SEDAR
Southeast Data, Assessment, and Review

SEDAR 68 OA
Stock Assessment Report

Gulf of Mexico Scamp Grouper

August 2022

SEDAR
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North Charleston, SC 29405

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Table of Contents

SEDAR

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SEDAR 68

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SECTION I: Introduction

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Overview

SEDAR 68OA addressed the stock assessment for Gulf of Mexico scamp grouper. The assessment process consisted of a series of webinars. There was one Topical Working Group (TWG) that met via webinar as part of this process. SEDAR organized 2 webinars for the Life History TWG, held in February and May 2022.

The Stock Assessment Report is organized into 2 sections. Section I – Introduction contains a brief description of the SEDAR Process, Assessment and Management Histories for the species of interest, and the management specifications requested by the Cooperator. Section II is the Assessment Process report. This section details the assessment model, as well as documents any data recommendations that arise for new data sets presented during this assessment process, or changes to data sets used previously.

The final Stock Assessment Report (SAR) for Gulf of Mexico scamp grouper was disseminated to the public in August 2022. The Council's Scientific and Statistical Committee (SSC) will review the SAR for its stock. The SSCs are tasked with recommending whether the assessments represent Best Available Science, whether the results presented in the SARs are useful for providing management advice and developing fishing level recommendations for the Council. An SSC may request additional analyses be conducted or may use the information provided in the SAR as the basis for their Fishing Level Recommendations (e.g., Overfishing Limit and Acceptable Biological Catch). The Gulf of Mexico Fishery Management Council's SSC will review the assessment at its September 2022 meeting, followed by the Council receiving that information at its October 2022 meeting. Documentation on SSC recommendations are not part of the SEDAR process and is handled through each Council.

1 SEDAR PROCESS DESCRIPTION

SouthEast Data, Assessment, and Review (**SEDAR**) is a cooperative Fishery Management Council process initiated in 2002 to improve the quality and reliability of fishery stock assessments in the South Atlantic, Gulf of Mexico, and US Caribbean. SEDAR seeks improvements in the scientific quality of stock assessments and the relevance of information available to address fishery management issues. SEDAR emphasizes constituent and stakeholder participation in assessment development, transparency in the assessment process, and a rigorous and independent scientific review of completed stock assessments.

SEDAR is managed by the Caribbean, Gulf of Mexico, and South Atlantic Regional Fishery Management Councils in coordination with NOAA Fisheries and the Atlantic and Gulf States Marine Fisheries Commissions. Oversight is provided by a Steering Committee composed of NOAA Fisheries representatives: Southeast Fisheries Science Center Director and the Southeast Regional Administrator; Regional Council representatives: Executive Directors and Chairs of the South Atlantic, Gulf of Mexico, and Caribbean Fishery Management Councils; a representative from the Highly Migratory Species Division of NOAA Fisheries, and Interstate Commission representatives: Executive Directors of the Atlantic States and Gulf States Marine Fisheries Commissions.

SEDAR workshops are public meetings organized by SEDAR staff and the lead Cooperator. Workshop participants are drawn from state and federal agencies, non-government organizations, Council members, Council advisors, and the fishing industry with a goal of including a broad range of disciplines and perspectives. All participants are expected to contribute to the process by preparing working papers, contributing, providing assessment analyses, and completing the workshop report.

2 SCAMP MANAGEMENT OVERVIEW

2.1 Fishery Management Plans and Amendments

The following summary describes only those management actions that likely affect Scamp and Yellowmouth Grouper fisheries and harvest.

Original GMFMC FMP

The Reef Fish Fishery Management Plan was implemented in November 1984. The regulations, designed to rebuild declining reef fish stocks, included: (1) prohibitions on the use of fish traps, roller trawls, and powerhead-equipped spear guns within an inshore stressed area; (2) a minimum size limit of 13 inches total length (TL) for red snapper with the exceptions that for- hire boats were exempted until 1987 and each angler could keep 5 undersize fish; and, (3) data reporting requirements.

GMFMC FMP Amendments affecting Scamp:

Description of Action	FMP/Amendment	Effective Date
Set an 11.0 million-pound commercial quota for groupers, with the commercial quota divided into a 9.2 million pound shallow-water grouper quota and a 1.8 million-pound deepwater grouper quota. Shallow-water grouper were defined as black grouper, gag, red grouper, Nassau grouper, yellowfin grouper, yellowmouth grouper, rock hind, red hind, speckled hind, and scamp (until the shallow-water grouper quota is filled). Goliath grouper (jewfish) are not included in the quotas. Established a longline and buoy gear boundary and expanded the stressed area to the entire Gulf coast. Established a commercial reef fish permit.	Amendment 1	1990
Established a moratorium on the issuance of new reef fish permits for a maximum period of three years; established an allowance for permit transfers	Amendment 4	1992
Created an Alabama special management zone (SMZ) with fishing gear restricted to no more than three hooks within the SMZ, and a framework procedure for future specification of SMZs. Established restrictions on the use of fish traps in the Gulf of Mexico EEZ, and implemented a three-year moratorium on the use of fish traps by creating a fish trap endorsement. Required that finfish be landed head and tails intact	Amendment 5	1994
Established reef fish dealer permitting and record keeping.	Amendment 7	1994
Extended the reef fish permit moratorium through December 31, 1995 and allowed collections of commercial landings data for initial allocation of individual transferable quota (ITQ) shares. Established historical captain status for purposes of ITQ allocation.	Amendment 9	1994
Attempted to establish an ITQ system, which was then repealed by Congress	Amendment 8	1995

Implemented a new commercial reef fish permit moratorium for no more than five years or until December 31, 2000, permitted dealers can only buy reef fish from permitted vessels and permitted vessels can only sell to permitted dealers, established a charter and headboat reef fish permit.	Amendment 11	1996
Initiated a 10-year phase-out on the use of fish traps in the EEZ from February 7, 1997 to February 7, 2007, after which fish traps would be prohibited, and prohibited the use of fish traps west of Cape San Blas, Florida.	Amendment 14	1997
Prohibited harvest of reef fish from traps other than permitted reef fish traps, stone crab traps, or spiny lobster traps. Established 2-tier red snapper license system (Class 1 & 2).	Amendment 15	1998
(1) The possession of reef fish exhibiting the condition of trap rash on board any vessel with a reef fish permit that is fishing spiny lobster or stone crab traps is prima facie evidence of illegal trap use and is prohibited except for vessels possessing a valid fish trap endorsement; (2) that NOAA Fisheries establish a system design, implementation schedule, and protocol to require implementation of a vessel monitoring system (VMS) for vessels engaged in the fish trap fishery, with the cost of the vessel equipment, installation, and maintenance to be paid or arranged by the owners as appropriate; and, (3) that fish trap vessels submit trip initiation and trip termination reports. Prior to implementing this additional reporting requirement, there will be a one-month fish trap inspection/compliance/education period, at a time determined by the NOAA Fisheries Regional Administrator and published in the *Federal Register*. During this window of opportunity, fish trap fishermen will be required to have an appointment with NMFS enforcement for the purpose of having their trap gear, permits, and vessels available for inspection. The disapproved measure was a proposal to prohibit fish traps south of 25.05 degrees north latitude beginning February 7, 2001. The status quo 10-year phase-out of fish traps in areas in the Gulf EEZ is therefore maintained.	Amendment 16A	1998
Extended the commercial reef fish permit moratorium for another five years, from its previous expiration date of December 31, 2000 to December 31, 2005	Amendment 17	2000
Prohibited vessels with commercial harvests of reef fish aboard from also retaining fish caught under recreational bag and possession limits. Vessels with both for-hire and commercial permits were limited to the minimum crew size outlined in its Certificate of Inspection when fishing commercially. Prohibited the use of reef fish other than sand perches for bait. Required commercially permitted reef fish vessels to be equipped with VMS.	Amendment 18A	2006

Established two marine reserve areas off the Tortugas area and prohibits fishing for any species and anchoring by fishing vessels inside the two marine reserves.	Amendment 19	2002
Established a 3-year moratorium on the issuance of new charter and headboat vessel permits in the recreational for hire fisheries in the Gulf EEZ. Allowed transfer of permits. Required vessel captains/owners to participate in data collection efforts.	Amendment 20	2002
Continues the Madison-Swanson and Steamboat Lumps marine reserves for an additional 6 years, until July 2010. Modified the fishing restrictions within the reserves to allow surface trolling during May – October.	Amendment 21	2004
Established bycatch reporting methodologies for the reef fish fishery.	Amendment 22	2005
Extended the commercial reef fish permit moratorium indefinitely. Established a permanent limited access system for the commercial fishery for Gulf reef fish. Permits issued under the limited access system are renewable and transferable.	Amendment 24	2005
Extended the recreational for-hire reef fish permit moratorium indefinitely. Established a limited access system on for-hire reef fish and CMP permits. Permits are renewable and transferable in the same manner as currently prescribed for such permits.	Amendment 25	2006
Requires all commercial and recreational reef fish fisheries to use non-stainless steel circle hooks when using natural baits, as well as venting tools and dehooking devices.	Amendment 27	2008
Established an individual fishing quota (IFQ) system for the commercial grouper and tilefish fishery, which began January 1, 2010.	Amendment 29	2009
Established annual catch limits (ACLs) and accountability measures (AMs) for the commercial and recreational gag fisheries, and commercial aggregate shallow-water grouper fishery. For the commercial sector, the amendment for 2009 reduces the aggregate shallow-water grouper quota from 8.80 mp to 7.8 mp. The Steamboat Lumps and Madison-Swanson fishing area restrictions were continued indefinitely. For the recreational sector, the amendment reduces the aggregate grouper bag limit from five fish to four. A recreational closed season on shallow-water grouper was established from February 1 through March 31. Finally, the amendment requires that all vessels with federal commercial or charter reef fish permits must comply with the more restrictive of state or federal reef fish regulations when fishing in state waters.	Amendment 30B	2009
Longline endorsement requirement - Vessels must have average annual reef fish landings of 40,000 pounds gutted weight or more from 1999	Amendment 31	2010

through 2007. The longline boundary in the eastern Gulf is extended from the 20-fathom depth contour to the 35-fathom depth contour from June - August. Vessels are limited to 1000 hooks of which no more than 750 of which can be rigged for fishing or fished.		

GMFMC Regulatory Amendments:

July 1991:

The 1991 quota for shallow-water groupers was increased to 9.9 million pounds whole weight (using a revised gutted to whole weight conversion factor of 1.05 rather than 1.18, this corresponded to 8.8 million pounds whole weight). This action was taken to provide the commercial sector an opportunity to harvest 0.7 million pounds that went unharvested in 1990 due to an early closure of the fishery in 1990. NMFS had projected that the 9.2 million pound whole weight quota would be reached on November 7, but subsequent data showed that the actual harvest was 8.5 million pounds whole weight (or 7.6 million pounds whole weight using the revised gutted to whole weight conversion factor).

November 1991:

Set the 1992 commercial quota for shallow-water groupers at 9.8 million pounds in adjusted whole weights. This reflected an increase of 1.6 million pounds plus an adjustment in the gutted to whole weight conversion factor from 1.18 to 1.05.

August 1999:

Implemented June 19, 2000- Established two marine reserves (Madison-Swanson and Steamboat Lumps) on areas suitable for gag and other reef fish spawning aggregations sites that are closed year-round to fishing for all species under the Council's jurisdiction. The two sites cover 219 square nautical miles near the 40-fathom contour, off west central Florida.

October 2005:

Implemented January 2006 – Established an aggregate commercial trip limit of 6,000 pounds gutted weight for both deep-water grouper and shallow-water grouper combined.

March 2006:

Implemented July 2006 - Prohibits captain and crew of for-hire vessels from retaining grouper when under charter.

August 2010:

Effective January 2011- Provides a more specific definition of buoy gear by limiting the number of hooks, limiting the terminal end weight, restricting materials used for the line, restricting the length of the drop line, and where the hooks may be attached. In addition, the Council requested that each buoy must display the official number of the vessel (USCG documentation number or state registration number) to assist law enforcement in monitoring the use of the gear, which requires rulemaking.

July 2013:

Effective July 5, 2013 - Eliminated the February 1 through March 31 shallow-water grouper closure shoreward of 20 fathoms.

2.2 Emergency and Interim Rules

December 17, 2002- The National Marine Fisheries Service published an emergency rule that extended certain permit-related deadlines contained in the final rule implementing the for-hire (charter vessel/headboat) permit moratorium for reef fish and coastal migratory pelagic fish in the Gulf of Mexico (Gulf). This emergency rule was implemented because the final rule implementing the for-hire permit moratorium contained an error regarding eligibility that needed to be resolved as soon as possible. In addition, the regulations that implemented the moratorium required all for-hire vessels operating in the Gulf reef fish or coastal migratory pelagic fisheries in federal waters to have a valid "moratorium permit," as opposed to the prior open access charter permit, beginning December 26, 2002.

March 3, 2005 – An emergency rule established a commercial trip limit of 10,000 pounds for all grouper combined; reduce the trip limit to 7,500 pounds when 50 percent of either the shallow-water grouper or red grouper quota was reached; and reduce the trip limit to 5,500 pounds when 75 percent of either the shallow-water grouper or red grouper quota was reached. Fifty percent of the quota was reached on June 9 and trip limits were reduced to 7,500 pounds. The deep- water grouper quota was reached on June 23 and that component was closed. Seventy-five percent of the shallow-water grouper quota was reached on August 4 and trip limits were reduced to 5,500 pounds. The shallow-water grouper component closed on October 10.

April 1, 2005 - The National Marine Fisheries Service published an emergency rule to reopen the application process for obtaining Gulf charter vessel/headboat permits under moratorium. Permit owners who received their Gulf charter vessel/headboat permits under the moratorium, or a letter of eligibility for such a permit, need not reapply. This reopening is extended to historical participants in the fishery who, for whatever reason, failed to apply during the moratorium application period.

August 9, 2005 - NOAA's National Marine Fisheries Service (NMFS) published a temporary rule in the Federal Register implementing management measures for the recreational grouper fishery in the exclusive economic zone of the Gulf of Mexico, as requested by the Gulf of Mexico Fishery Management Council, to reduce overfishing of red grouper. This rule establishes a seasonal closure of the recreational fishery for all Gulf grouper species from November 1 through December 31, 2005 and reduces both the recreational bag limit for red grouper and the aggregate grouper bag limit. The intended effects are to reduce overfishing of red grouper in the Gulf of Mexico and to minimize potential adverse impacts on other grouper stocks that could result from a shift in fishing effort from red grouper to other grouper species. (A legal challenge resulted in a ruling that the November 1 through December 31 seasonal closure could, under an interim rule, only be applied to the stock that was undergoing overfishing, i.e., red grouper.)

January 1, 2009 - NOAA's National Marine Fisheries Service (NOAA Fisheries Service) has published a final rule implementing interim measures in the Gulf of Mexico reef fish fishery. The rule published in the Federal Register on December 2, 2008, and the measures are effective January 1, 2009. The Gulf of Mexico Fishery Management Council (Council) requested a temporary rule be effective at the beginning of 2009 to address overfishing of gag, as well as red snapper, greater amberjack, and gray triggerfish until more permanent measures can be implemented through Amendment 30B to the Fishery Management Plan for the Reef Fish Resources of the Gulf of Mexico. The Council developed Amendment 30B to end overfishing of gag, revise shallow-water grouper management measures in light of new information on gag and red grouper stocks, and improve the effectiveness of federal management measures. NOAA Fisheries Service is presently reviewing Amendment 30B with subsequent rulemaking occurring later in 2009. New Management Measures The interim rule will: 1) Establish a two-fish gag recreational bag limit (recreational grouper aggregate bag limit will remain at 5 fish); 2) Adjust the recreational closed season for gag to February 1 through March 31 (the recreational closed season for red and black groupers will remain February 15 to March 15); 3) Establish a 1.32 million pound commercial quota for gag; and 4) Require operators of federally permitted Gulf of

Mexico commercial and for-hire reef fish vessels to comply with the more restrictive of federal or state reef fish regulations when fishing in state waters for red snapper, greater amberjack, gray triggerfish, and gag.

May 18, 2009 - NOAA Fisheries Service implemented an emergency rule, effective May 18, 2009, through October 28, 2009, to reduce the sea turtle bycatch in the Gulf of Mexico bottom longline reef fish fishery. The emergency rule prohibits bottom longlining for Gulf reef fish east of 85^{o} 30'W longitude (near Cape San Blas, Florida) in a portion of the Exclusive Economic Zone shoreward of the 50-fathom depth contour. Once the deepwater grouper and tilefish quotas have been filled, the use of bottom longline gear to harvest reef fish in water of all depths east of 85^{o} 30'W longitude will be prohibited. During transit no reef fish may be possessed unless bottom longline gear is appropriately stowed meaning that a longline may be left on the drum if all gangions and hooks are disconnected and stowed below deck; hooks cannot be baited, and all buoys must be disconnected from the gear, but may remain on deck.

May 2, 2010 - NOAA Fisheries Service is enacting emergency regulations to close a portion of the Gulf of Mexico (Gulf) exclusive economic zone (EEZ) to all fishing, in response to the Deepwater Horizon oil spill. The closure will be in effect for 10 days, from May 2, 2010, through 12:01 a.m. local time May 12, 2010, unless conditions allow NOAA Fisheries Service to terminate it sooner. NOAA Fisheries Service will continue to monitor and evaluate the oil spill and its impacts on Gulf fisheries and will take immediate and appropriate action to extend or reduce this closed area. This closure is implemented for public safety (subsequent frequent adjustments were made to the closed area during the summer of 2010).

2.3 Secretarial Amendments

Secretarial Amendment 1 (2004)

Implemented July 15, 2004- Changed the quota for deep-water grouper from 1.6 million pounds whole weight (equal to 1.35 million pounds landed weight) to a gutted weight quota of 1.02 million pounds (equal to the average annual harvest 1996-2000.

2.4 Control Date Notices

Control date notices are used to inform fishermen that a license limitation system or other method of limiting access to a particular fishery or fishing method is under consideration. If a program to limit access is established, anyone not participating in the fishery or using the fishing method by the published control date may be ineligible for initial access to participate in the fishery or to use that fishing method. However, a person who does not receive an initial eligibility may be able to enter the fishery or fishing method after the limited access system is established by transfer of the eligibility from a current participant, provided the limited access system allows such transfer. Publication of a control date does not obligate the Council to use that date as an initial eligibility criteria. A different date could be used, and additional qualification criteria could be established. The announcement of a control date is primarily intended to discourage entry into the fishery or use of a particular gear based on economic speculation during the Council's deliberation on the issues. The following summarizes control dates that have been established for the Reef Fish FMP. A reference to the full *Federal Register* notice is included with each summary.

November 1, 1989:

Anyone entering the commercial reef fish fishery in the Gulf and South Atlantic after November 1, 1989, may not be assured of future access to the reef fish resource if a management regime is developed and implemented that limits the number of participants in the fishery [54 FR 46755].

November 18, 1998:

The Council is considering whether there is a need to impose additional management measures limiting entry into the recreational-for-hire (i.e., charter vessel and headboat) fisheries for reef fish and coastal migratory pelagic fish in the EEZ of the Gulf and, if there is a need, what management measures should be imposed. Possible measures include the establishment of a limited entry program to control participation or effort in the recreational-for-hire fisheries for reef fish and coastal migratory pelagic [63 FR 64031] (In Amendment 20 to the Reef Fish FMP, a qualifying date of March 29, 2001, was adopted).

July 12, 2000:

The Council is considering whether there is a need to limit participation by gear type in the commercial reef fish fisheries in the exclusive economic zone of the Gulf and, if there is a need, what management measures should be imposed to accomplish this. Possible measures include modifications to the existing limited entry program to control fishery participation, or effort, based on gear type, such as a requirement for a gear endorsement on the commercial reef fish vessel permit for the appropriate gear. Gear types which may be included are longlines, buoy gear, handlines, rod-and-reel, bandit gear, spear fishing gear, and powerheads used with spears [65 FR 42978].

October 15, 2004:

The Council is considering the establishment of an individual fishing quota program to control participation or effort in the commercial grouper fisheries of the Gulf. If an individual fishing quota program is established, the Council is considering October 15, 2004, as a possible control date regarding the eligibility of catch histories in the commercial grouper fishery [69 FR 67106].

December 31, 2008:

The Council voted to establish a control date for all Gulf commercial reef fish vessel permits. The control date will allow the Council to evaluate fishery participation and address any level of overcapacity. The establishment of this control date does not commit the Council or NOAA Fisheries Service to any particular management regime or criteria for entry into this fishery.

Fishermen would not be guaranteed future participation in the fishery regardless of their entry date or intensity of participation in the fishery before or after the control date under consideration. Comments were requested by close of business April 17, 2009 [74 FR 11517].

2.5 Management Program Specifications

Table 2.5.1. General Management Information Gulf of Mexico

Species	Scamp
Management Unit	Gulf of Mexico
Management Unit Definition	Gulf of Mexico EEZ
Management Entity	Gulf of Mexico Fishery management Council
Management Contacts SERO/Council	Peter Hood/ Ryan Rindone
Current stock exploitation status	Unknown
Current spawning stock biomass status	Unknown

Table 2.5.2. Specific Management Criteria

Criteria	Gulf of Mexico - Proposed	
	Definition	Value
MSST	$1\text{-}M*SSB_{MSY}$	SEDAR OA
SSB_{MSY}		SEDAR OA
$SSB_{Current}$	SSB_{2021}	SEDAR OA
MFMT	F_{MSY}	SEDAR OA
MSY	F_{MSY}	SEDAR OA
FMSY		SEDAR OA
$F_{Current}$	Geom mean of last 3 fishing years	SEDAR OA
OY	Equilibrium yield at F_{MSY}	SEDAR OA
FOY	75% of F_{MSY}	SEDAR OA
M	-	SEDAR OA

NOTE: "Proposed" columns are for indicating any definitions that may exist in FMPs or amendments that are currently under development and should therefore be evaluated in the current assessment. "Current" is those definitions in place now. Please clarify whether landings parameters are 'landings' or 'catch' (Landings + Discard). If 'landings', please indicate how discards are addressed.

Stock Rebuilding Information

Gulf of Mexico scamp is not currently under a rebuilding plan.

Table 2.5.4. Stock projection information

(This provides the basic information necessary to bridge the gap between the terminal year of the assessment and the year in which any changes may take place or specific alternative exploitation rates should be evaluated)

Gulf of Mexico

Requested Information	Value
First Year of Management	2023
Projection Criteria during interim years should be based on (e.g., exploitation or harvest)	Fixed Exploitation
Projection criteria values for interim years should be determined from (e.g., terminal year, average of X years)	Actual or preliminary landings; else, average of previous 3 years

*Fixed Exploitation would be $F=F_{MSY}$ (or $F<F_{MSY}$) that would rebuild overfished stock to B_{MSY} in the allowable timeframe. Modified Exploitation would be allow for adjustment in $F<=F_{MSY}$, which would allow for the largest landings that would rebuild the stock to B_{MSY} in the allowable timeframe. Fixed harvest would be maximum fixed harvest with $F<=F_{MSY}$ that would allow the stock to rebuild to B_{MSY} in the allowable timeframe.

Project future stock conditions and develop rebuilding schedules if warranted, including estimated generation time. Develop stock projections in accordance with the following:

A) If stock is overfished:
   $F=0$, $F_{Current}$, F_{MSY}, F_{OY}
   $F=F_{Rebuild}$ (max that permits rebuild in allowed time)
B) If stock is undergoing overfishing:
   $F= F_{Current}$, F_{MSY}, F_{OY}
C) If stock is neither overfished nor undergoing overfishing:
   $F= F_{Current}$, F_{MSY}, F_{OY}
D) If data limitations preclude classic projections (i.e. A, B, C above), explore alternate models to provide management advice

Table 2.5.5. Quota Calculation Details

If the stock is managed by quota, please provide the following information

Current Quota Value	1.35 mp gw
Next Scheduled Quota Change	2022
Annual or averaged quota?	Annual
If averaged, number of years to average	-
Does the quota include bycatch/discard?	No

2.6 Federal Management and Regulatory Timelines for Scamp and Yellowmouth Groupers

Harvest Restrictions (Trip Limits*)

*Trip limits do not apply during closures (if season is closed, then trip limit is 0)

First Yr In Effect	Last Yr In Effect	Effective Date	End Date	Fishery	Bag Limit Per Person/Day	Trip Limit Per Boat/Day	Region Affected	FR Reference	FR Section	Amendment Number or Rule Type
2005	2005	3/3/05	6/8/05	Com	NA	10,000 lbs gw; DWG[1] & SWG[2]	Gulf of Mexico EEZ	70 FR 8037	622.44	Emergency Rule
2005	2005	6/9/05	8/3/05	Com	NA	7,500 lbs gw; DWG[1] & SWG[2]	Gulf of Mexico EEZ	70 FR 33033	622.44	Temporary Rule
2005	2005	8/4/05	12/31/05	Com	NA	5,500 lbs gw; SWG[2]	Gulf of Mexico EEZ	70 FR 42279	622.44	Temporary Rule
2006	2009	1/1/06	12/31/09	Com	NA	6,000 lbs gw; DWG[1] & SWG[2]	Gulf of Mexico EEZ	70 FR 77057	622.44	Reef Fish Regulatory Amendment
2010	Ongoing	1/1/10	Ongoing	Com	NA	IFQ	Gulf of Mexico EEZ	74 FR 44732	622.2	Reef Fish Amendment 29
1990	2004	4/23/90	7/14/04	Rec	5 grouper aggregate	NA	Gulf of Mexico EEZ	55 FR 2078	641.24	Reef Fish Amendment 1
2004	2005	7/15/04	8/8/05	Rec	5 grouper aggregate	NA	Gulf of Mexico EEZ	69 FR 33315	622.39	Secretarial Amendment 1
2005	2006	8/9/05	1/23/06	Rec	3 grouper aggregate	NA	Gulf of Mexico EEZ	70 FR 42510	622.39	Temporary Rule
2006	2009	1/24/06	5/17/09	Rec	5 grouper aggregate	NA	Gulf of Mexico EEZ	71 FR 3018 71 FR 34534	622.39	Temporary Rule Reef Fish Regulatory Amendment
2009	Ongoing	5/18/09	Ongoing	Rec	4 grouper aggregate	NA	Gulf of Mexico EEZ	74 FR 17603	622.39	Reef Fish Amendment 30B

[1]DWG: deep-water grouper (misty grouper, snowy grouper, yellowedge grouper, warsaw grouper, and speckled hind)

[2]SWG: shallow-water grouper (black, gag, red, red hind, rock hind, scamp, yellowfin, and yellowmouth)

Note: Once all of an IFQ account holder's other SWG allocation has been landed and sold, or transferred, or if an IFQ account holder has no SWG allocation, then DWG allocation may be used to land and sell scamp.

Harvest Restrictions (Size Limits*)

*Size limits do not apply during closures

First Yr In Effect	Last Yr In Effect	Effective Date	End Date	Fishery	Size Limit	Length Type	Region Affected	FR Reference	FR Section	Amendment Number or Rule Type
1999	Ongoing	11/24/99	Ongoing	Com	16"	Minimum TL	Gulf of Mexico EEZ	64 FR 57403	622.37	Reef Fish Amendment 16B
1999	Ongoing	11/24/99	Ongoing	Rec	16"	Minimum TL	Gulf of Mexico EEZ	64 FR 57403	622.37	Reef Fish Amendment 16B

No size limits for Yellowmouth Grouper

Harvest Restrictions (Fishery Closures*)

*Area specific regulations are documented under spatial restrictions

First Yr In Effect	Last Year in Effect	Effective Date	End Date	Fishery	Closure Type	First Day Closed	Last Day Closed	Region Affected	FR Reference	FR Section	Amendment Number or Rule Type	Species Associated with Closure
2004	2004	11/15/04	12/31/04	Com	Quota	15-Nov	31-Dec	Gulf of Mexico EEZ	69 FR 65092	622.43	Notice of Closure	SWG: Black, Red, Gag, Scamp, Yellowfin, Rock Hind, Red Hind, and Yellowmouth
2005	2005	10/10/05	12/31/05	Com	Quota	10-Oct	31-Dec	Gulf of Mexico EEZ	70 FR 57802	622.43	Temporary Rule	SWG: Black, Red, Gag, Scamp, Yellowfin, Rock Hind, Red Hind, and Yellowmouth
2005	2005	8/9/05	1/23/06	Rec	Seasonal	1-Nov	31-Dec	Gulf of Mexico EEZ	70 FR 42510	622.34	Temporary Rule	Groupers
2010	2013	5/18/09	7/4/13	Rec	Seasonal	1-Feb	31-Mar	Gulf of Mexico EEZ	74 FR 17603	622.34	Reef Fish Amendment 30B	SWG: Black, Red, Gag, Scamp, Yellowfin, Rock Hind, Red Hind, and Yellowmouth
2014	Ongong	7/5/13	Ongoing	Rec	Seasonal	1-Feb	31-Mar	Gulf of Mexico EEZ seaward of 20 fathoms	78 FR 33259	622.34	Reef Fish Framework Action	SWG: Black, Red, Gag, Yellowfin and Yellowmouth

[1]According to Fishery Bulletins, the 15-Feb to 15-Mar closures ended at 12:01 am 14-Mar, as such the last day closed is effectively 14-Mar (FB02-001, FB03-005, FB04-005, FB05-001, FB06-002, FB07-06, FB08-004, FB09-005)

Harvest Restrictions (Spatial Restrictions)

Area	First Yr In Effect	Last Yr In Effect	Effective Date	End Date	Fishery	First Day Closed	Last Day Closed	Restriction in Area	FR Reference	FR Section	Amendment Number or Rule Type
Gulf of Mexico Stressed Areas	1984	Ongoing	11/8/84	Ongoing	Both	Year round		Prohibited powerheads for Reef FMP	49 FR 39548	641.7	Original Reef Fish FMP
	1984	Ongoing	11/8/84	Ongoing	Both	Year round		Prohibited pots and traps for Reef FMP	49 FR 39548	641.7	Original Reef Fish FMP
Alabama Special Management Zones	1994	Ongoing	2/7/94	Ongoing	Both	Year round		Allow only hook-and line gear with three or less hooks per line and spearfishing gear for fish in Reef FMP	59 FR 966	641.23	Reef Fish Amendment 5
EEZ, inside 50 fathoms west of Cape San Blas, FL	1990	Ongoing	2/21/90	Ongoing	Both	Year round		Prohibited longline and buoy gear for Reef FMP	55 FR 2078	641.7	Reef Fish Amendment 1
EEZ, inside 20 fathoms east of Cape San Blas, FL	1990	Ongoing	2/21/90	Ongoing	Both	Year round		Prohibited longline and buoy gear for Reef FMP	55 FR 2078	NA	Reef Fish Amendment 1
EEZ, inside 50 fathoms east of Cape San Blas, FL	2009	2009	5/18/09	10/15/09	Both	18-May	28-Oct	Prohibited bottom longline for Reef FMP	74 FR 20229	622.34	Emergency Rule
EEZ, inside 35 fathoms east of Cape San Blas, FL	2009	2010	10/16/09	4/25/10	Both	Year round		Prohibited bottom longline for Reef FMP	74 FR 53889	223.206	Sea Turtle ESA Rule
	2010	Ongoing	4/26/10	Ongoing	Rec	Year round		Prohibited bottom longline for Reef FMP	75 FR 21512	622.34	Reef Fish Amendment 31
	2010	Ongoing	4/26/10	Ongoing	Com	1-Jun	31-Aug	Prohibited bottom longline for Reef FMP	75 FR 21512	622.34	Reef Fish Amendment 31
Madison-Swanson	2000	2004	6/19/00	6/2/04	Both	Year round		Fishing prohibited except HMS[1]	65 FR 31827	622.34	Reef Fish Regulatory Amendment
	2004	Ongoing	6/3/04	Ongoing	Both	1-May	31-Oct	Fishing prohibited except surface trolling	70 FR 24532 74 FR 17603	622.34 NA	Reef Fish Amendment 21 Reef Fish Amendment 30B
	2004	Ongoing	6/3/04	Ongoing	Both	1-Nov	30-Apr	Fishing prohibited except HMS[1]	70 FR 24532 74 FR 17603	622.34 NA	Reef Fish Amendment 21 Reef Fish Amendment 30B
	2021	Ongoing	8/20/21	Ongoing	Both	Year round		Fishing prohibited	86 FR 38416	622.34	Reef Fish Regulatory Amendment
Steamboat Lumps	2000	2004	6/19/00	6/2/04	Both	Year round		Fishing prohibited except HMS[1]	65 FR 31827	622.34	Reef Fish Regulatory Amendment
	2004	Ongoing	6/3/04	Ongoing	Both	1-May	31-Oct	Fishing prohibited except surface trolling	70 FR 24532 74 FR 17603	622.34 NA	Reef Fish Amendment 21 Reef Fish Amendment 30B
	2004	Ongoing	6/3/04	Ongoing	Both	1-Nov	30-Apr	Fishing prohibited except HMS[1]	70 FR 24532 74 FR 17603	622.34 NA	Reef Fish Amendment 21 Reef Fish Amendment 30B
	2021	Ongoing	8/20/21	Ongoing	Both	Year round		Fishing prohibited	86 FR 38416	622.34	Reef Fish Regulatory Amendment
The Edges	2010	Ongoing	7/24/09	Ongoing	Both	1-Jan	30-Apr	Fishing prohibited	74 FR 30001	622.34	Reef Fish Amendment 30B Supplement
20 Fathom Break	2014	Ongoing	7/5/13	Ongoing	Rec	1-Feb	31-Mar	Fishing for SWG prohibited[2]	78 FR 33259	622.34	Reef Fish Framework Action
Flower Garden	1992	Ongoing	1/17/92	Ongoing	Both	Year round		Fishing with bottom gears prohibited[3]	56 FR 63634 70 FR 76216	934 622.34	Sanctuary Designation Essential Fish Habitat Amendment 3
Riley's Hump	1994	2002	2/7/94	8/18/02	Both	1-May	30-Jun	Fishing prohibited	59 FR 966	641.23	Reef Fish Amendment 5
Tortugas Reserves	2002	Ongoing	8/19/02	Ongoing	Both	Year round		Fishing prohibited	67 FR 47467 70 FR 76216	635.71 622.34	Tortugas Amendment Essential Fish Habitat Amendment 3
Pulley Ridge	2006	Ongoing	1/23/06	Ongoing	Both	Year round		Fishing with bottom gears prohibited[3]	70 FR 76216	622.34	Essential Fish Habitat Amendment 3
McGrail Bank	2006	Ongoing	1/23/06	Ongoing	Both	Year round		Fishing with bottom gears prohibited[3]	70 FR 76216	622.34	Essential Fish Habitat Amendment 3
Stetson Bank	2006	Ongoing	1/23/06	Ongoing	Both	Year round		Fishing with bottom gears prohibited[3]	70 FR 76216	622.34	Essential Fish Habitat Amendment 3

[1]HMS: highly migratory species (tuna species, marlin, oceanic sharks, sailfishes, and swordfish)
[2]SWG: shallow-water grouper (black, gag, red, red hind, rock hind, scamp, yellowfin, and yellowmouth)
[3]Bottom gears: Bottom longline, bottom trawl, buoy gear, pot, or trap

Harvest Restrictions (Gear Restrictions*)

*Area specific gear regulations are documented under spatial restrictions

Gear Type	First Yr In Effect	Last Yr In Effect	Effective Date	End Date	Gear/Harvesting Restrictions	Region Affected	FR Reference	FR Section	Amendment Number or Rule Type
Poison	1984	Ongoing	11/8/84	Ongoing	Prohibited for Reef FMP	Gulf of Mexico EEZ	49 FR 39548	641.24	Original Reef Fish FMP
Explosives	1984	Ongoing	11/8/84	Ongoing	Prohibited for Reef FMP	Gulf of Mexico EEZ	49 FR 39548	641.24	Original Reef Fish FMP
Pots and Traps	1984	1994	11/23/84	2/6/94	Established fish trap permit	Gulf of Mexico EEZ	49 FR 39548	641.4	Original Reef Fish FMP
	1984	1990	11/23/84	2/20/90	Set max number of traps fish by a vessel at 200	Gulf of Mexico EEZ	49 FR 39548	641.25	Original Reef Fish FMP
	1990	1994	2/21/90	2/6/94	Set max number of traps fish by a vessel at 100	Gulf of Mexico EEZ	55 FR 2078	641.22	Reef Fish Amendment 1
	1994	1997	2/7/94	2/7/97	Moratorium on additional commercial trap permits	Gulf of Mexico EEZ	59 FR 966	641.4	Reef Fish Amendment 5
	1997	2007	3/25/97	2/7/07	Phase out of fish traps begins	Gulf of Mexico EEZ	62 FR 13983	622.4	Reef Fish Amendment 14
	1997	2007	1/29/88	2/7/07	Prohibited harvest of reef fish from traps other than permitted reef fish, stone crab, or spiny lobster traps.	Gulf of Mexico EEZ	62 FR 67714	622.39	Reef Fish Amendment 15
	2007	Ongoing	2/8/07	Ongoing	Traps prohibited	Gulf of Mexico EEZ	62 FR 13983	622.31	Reef Fish Amendment 14
All	1992	1995	5/8/92	12/31/95	Moratorium on commercial permits for Reef FMP	Gulf of Mexico EEZ	59 FR 11914 59 FR 39301	641.4 641.4	Reef Fish Amendment 4 Reef Fish Amendment 9
	1994	Ongoing	2/7/94	Ongoing	Finfish must have head and fins intact through landing, can be eviscerated, gilled, and scaled but must otherwise be whole (HMS and bait exceptions)	Gulf of Mexico EEZ	59 FR 966	641.21	Reef Fish Amendment 5
	1996	2005	7/1/96	12/31/05	Moratorium on commercial permits for Gulf reef fish	Gulf of Mexico EEZ	61 FR 34930 65 FR 41016	622.4 622.4	Interim Rule Reef Fish Amendment 17
	2006	Ongoing	9/8/06	Ongoing	Use of Gulf reef fish as bait prohibited[1]	Gulf of Mexico EEZ	71 FR 45428	622.31	Reef Fish Amendment 18A
Vertical Line	2008	Ongoing	6/1/08	Ongoing	Requires non-stainless steel circle hooks and dehooking devices	Gulf of Mexico EEZ	74 FR 5117	322.41	Reef Fish Amendment 27
	2008	2013	6/1/08	9/3/13	Requires venting tools	Gulf of Mexico EEZ	74 FR 5117 78 FR 46820	322.41 NA	Reef Fish Amendment 27 Framework Action
Bottom Longline	2010	Ongoing	5/26/10	Ongoing	Limited to 1,000 hooks of which no more than 750 hooks are rigged for fishing or fished	Gulf of Mexico EEZ	75 FR 21512	622.34	Reef Fish Amendment 31

[1]Except when, purchased from a fish processor, filleted carcasses may be used as bait crab and lobster traps.

Quota History

First Yr In Effect	Last YR In Effect	Effective Date	End Date	Fishery	Species Affected	Quota	ACL	ACT	Units	Region Affected	FR Reference	FR Section	Amendment Number or Rule Type
1990	1991	2/21/90	12/31/91	Com	All Groupers Excluding DWG[1] and Goliath	9.2			mp ww	Gulf of Mexico EEZ	55FR 2078	641.25	Reef Fish Amendment 1
1992	2003	6/22/92	12/31/03	Com	All Groupers Including Scamp Excluding DWG[1] and Goliath	9.8			mp ww	Gulf of Mexico EEZ	57 FR 21752	641.25	Reef Fish Regulatory Amendment
2004	2008	7/15/04	12/31/08	Com	All Groupers Including Scamp Excluding DWG[1], Goliath, and Nassau	8.8			mp gw	Gulf of Mexico EEZ	69 FR 33315	622.42	Secretarial Amendment 1
2009	2009	5/18/09	12/31/09	Com	SWG[2]	7.48			mp gw	Gulf of Mexico EEZ	74 FR 17603	622.42	Reef Fish Amendment 30B
2010	2010	5/18/09	12/31/10	Com	SWG[2]	0.41			mp gw	Gulf of Mexico EEZ	74 FR 17603	622.42	Reef Fish Amendment 30B
2011	2011	11/2/11	12/31/11	Com	SWG[2]	0.41			mp gw	Gulf of Mexico EEZ	76 FR 67618	622.42	Reef Fish Regulatory Amendment
2012	2012	3/12/12	12/31/12	Com	SWG[2]	0.509			mp gw	Gulf of Mexico EEZ	77 FR 6988	622.49	Reef Fish Amendment 32
2013	2013	3/12/12	12/31/13	Com	SWG[2]	0.518			mp gw	Gulf of Mexico EEZ	77 FR 6988	622.49	Reef Fish Amendment 32
2014	2014	1/7/15	12/31/14	Com	Other SWG[3]	0.523			mp gw	Gulf of Mexico EEZ	79 FR 72556	622.39	Reef Fish Framework Action
2015	Ongoing	1/7/15	Ongoing	Com	Other SWG[3]	0.525			mp gw	Gulf of Mexico EEZ	79 FR 72556	622.39	Reef Fish Framework Action

[1]DWG: deep-water grouper (misty grouper, snowy grouper, yellowedge grouper, warsaw grouper)

[2]SWG: shallow-water grouper (black, gag, red, red hind, rock hind, scamp, yellowfin, and yellowmouth)

[3]Other SWG: other shallow-water grouper (black grouper, scamp, yellowmouth grouper, yellowfin grouper)

Scamp would be applied to the DWG quota once the SWG quota was filled. DWG were defined as misty grouper, snowy grouper, yellowedge grouper, warsaw grouper, and scamp once the SWG quota was filled.

2.7 Closures in the Gulf of Mexico Due to Meeting Commercial Quota or Commercial/Recreational ACL

None

2.8 State Regulatory Information

Florida West Coast:

Gulf of Mexico Scamp Regulation History

Year	Minimum Size Limit	Recreational Daily Harvest Limits	Commercial Daily Harvest Limits	Regulation Changes	Rule Change Effective Date
1980	None	None	None		
1981	None	None	None		
1982	None	None	None		
1983	None	None	None		
1984	None	None	None		
1985	None	None	None		
1986	None	5 per person per day within the 5-fish grouper aggregate bag limit	None	Established a recreational bag limit. Prohibited use of longline gear by commercial fishermen. Longline harvesters targeting other species have a bycatch allowance of 5%. Prohibited use of stab nets (or sink nets) to take grouper in Atlantic waters of Monroe County. Required fish to be landed in whole condition.	Dec. 11, 1986
1987	None	5 per person per day within the 5-fish grouper aggregate bag limit	None		
1988	None	5 per person per day within the 5-fish grouper aggregate bag limit	None		

1989	None	5 per person per day within the 5-fish grouper aggregate bag limit	None		
1990	20 inches	5 per person per day within the 5-fish grouper aggregate bag limit	None	Established a minimum size limit. Designated all grouper as "restricted species." Designated allowable gear as hook and line, black sea bass trap, spear, gig, or lance (except powerheads, bangsticks, or explosive devices). Prohibited all commercial harvest in state waters when harvest for that species is prohibited in adjacent federal waters.	Feb. 1, 1990
1991	20 inches	5 per person per day within the 5-fish grouper aggregate bag limit	None		
1992	20 inches	5 per person per day within the 5-fish grouper aggregate bag limit	None	Required harvesters possess the appropriate federal permit to exceed the recreational bag limit and to purchase or sell grouper on the Gulf coast.	Dec. 31, 1992
1993	20 inches	5 per person per day within the 5-fish grouper aggregate bag limit	None	Allowed persons who possess either a Gulf of Mexico or South Atlantic federal reef fish permit to commercially harvest snappers and groupers (except red snapper) in all state waters until July 1, 1995	Oct. 18, 1993
1994	20 inches	5 per person per day within the 5-fish grouper aggregate bag limit	None	Allowed a two-day possession limit for reef fish statewide for persons aboard charter and headboats on trips exceeding 24 hours provided the vessel is equipped with a permanent berth for each passenger aboard,	March 1, 1994

				and each passenger has a receipt verifying the trip length. Modified rule language to provide the same definitions of Gulf of Mexico and Atlantic Ocean regions.	
1995	20 inches	5 per person per day within the 5-fish grouper aggregate bag limit	None	Continued the allowance for persons to possess either the proper South Atlantic or Gulf permit to harvest reef fish for commercial purposes through Dec. 31, 1995.	July 1, 1995
1996	20 inches	5 per person per day within the 5-fish grouper aggregate bag limit	None	(1) Continued the allowance for persons to possess either the proper South Atlantic or Gulf permit to harvest reef fish for commercial purposes through Dec. 31, 1996. (2) Continued the allowance for persons to possess either the proper South Atlantic or Gulf permit to harvest reef fish for commercial purposes through Dec. 31, 1997.	(1) Jan. 1, 1996 (2) Nov. 27, 1996
1997	20 inches	5 per person per day within the 5-fish grouper aggregate bag limit	None		
1998	20 inches	5 per person per day within the 5-fish grouper aggregate bag limit	None		
1999	20 inches	5 per person per day within the 5-fish grouper aggregate bag limit	None		
2000	20 inches	5 per person per day within the 5-fish grouper	None	Eliminated the 5-day commercial closure extension.	Jan. 1, 2000

		aggregate bag limit			
2001	20 inches	5 per person per day within the 5-fish grouper aggregate bag limit	None		
2002	20 inches	5 per person per day within the 5-fish grouper aggregate bag limit	None		
2003	16 inches TL	5 per person per day within the 5-fish grouper aggregate bag limit	None	Reduced the minimum size limit.	Jan. 1, 2003
2004	16 inches TL	5 per person per day within the 5-fish grouper aggregate bag limit	None	Establishes a Sept. 20 through Oct. 4 closure to use of black sea bass traps in all Gulf of Mexico state waters between three and nine miles from shore.	July 15, 2004
2005	16 inches TL	5 per person per day within the 5-fish grouper aggregate bag limit	None		May 20, 2005
2006	16 inches TL	5 per person per day within the 5-fish grouper aggregate bag limit	None	Provided that, for purposes of determining the legal size of reef fish species, “total length” means the straight-line distance from the most forward point of the head with the mouth closed, to the farthest tip of the tail with the tail compressed or squeezed, while the fish is lying on its side.	July 1, 2006
2007	16 inches TL	5 per person per day within the 5-fish grouper	None	Prohibited commercial fishermen from harvesting or possessing the recreational bag	July 1, 2007

		aggregate bag limit		limit of reef fish species on commercial trips.	
2008	16 inches TL	5 per person per day within the 5-fish grouper aggregate bag limit	None	Required all commercial and recreational anglers fishing for Gulf reef species are required to use circle hooks, dehooking devices, and venting tools.	June 1, 2008
2009	16 inches TL	4 fish per person within the 4-fish grouper aggregate bag limit	None	Reduced the recreational bag limit. Established a Feb. 1 – March 31 closed spawning season for all recreational harvest of shallow-water groupers in Gulf state waters, except Monroe County.	Aug. 27, 2009
2010	16 inches TL	4 fish per person within the 4-fish grouper aggregate bag limit	None	Prohibited the captain and crew of for-hire vessels from retaining any species in the aggregate grouper bag limit.	Jan. 19, 2010
2011	16 inches TL	4 fish per person within the 4-fish grouper aggregate bag limit	None		
2012	16 inches TL	4 fish per person within the 4-fish grouper aggregate bag limit	None		
2013	16 inches TL	4 fish per person within the 4-fish grouper aggregate bag limit	None	Eliminated the Feb. 1 – March 31 closed spawning season for all recreational harvest of shallow-water groupers in Gulf state waters, except Monroe County.	Oct. 31, 2013
2014	16 inches TL	4 fish per person within the 4-fish grouper aggregate bag limit	None	Eliminated the requirement to possess and use venting tools when fishing for reef fish in the Gulf of Mexico.	Jan. 24, 2014

2015	16 inches TL	4 fish per person within the 4-fish grouper aggregate bag limit	None		
2016	16 inches TL	4 fish per person within the 4-fish grouper aggregate bag limit	None		
2017	16 inches TL	4 fish per person within the 4-fish grouper aggregate bag limit	None		
2018	16 inches TL	4 fish per person within the 4-fish grouper aggregate bag limit	None		
2019	16 inches TL	4 fish per person within the 4-fish grouper aggregate bag limit	None		

Texas:

Texas does not have state regulations on Scamp. Those fish captured in federal waters will be adhere to federal regulations.

Mississippi:

Mississippi has continually remained compliant with federal regulations for Scamp. These regulations are listed in Title 22 Part 7 of the Mississippi State Code which can be found at: http://www.dmr.state.ms.us/index.php/dmr-information/regulations.

Louisiana:

Scamp are currently regulated in Louisiana with as part of the 4 fish grouper aggregate bag limit with a 16 inch minimum total length. There is currently a regulated closed season for scamp from February 1 through March 31 of each year in waters seaward of the 20 fathom boundary.

Brief regulatory history is below.

- 1990 (June) - All groupers have a 5 fish per day (in aggregate) bag limit.
- 2000 (July) – 16 inch total length minimum size established.
- 2007 (July) – Zero bag limit of groupers for captain and crew.
- 2012 (September) – Grouper aggregate reduced to 4 fish per day. Closed season of February 1 through March 31 of each year established for scamp.
- 2014 (June) – Closed season of February 1 through March 31 of each year seaward of the 20 fathom boundary established for scamp.

Alabama:

Scamp are currently regulated in Alabama as part of the 4 fish grouper aggregate bag limit with a 16-inch minimum total length.

Alabama Regulatory history:

- 2002 – December 22 Scamp possession limit regulation begins. Scamp must be minimum 16" total length and a possession limit as part of the 5 fish Grouper Aggregate limit.
- 2009 – July 23 Grouper aggregate limit moved from 5 fish to 4 fish.

3 ASSESSMENT HISTORY AND REVIEW

The first assessment for Gulf of Mexico Scamp Grouper was the SEDAR 68 Research Track Assessment (SEDAR 2021). Both Scamp Grouper and Yellowmouth Grouper were assessed together as a complex due to concerns over species mis-identification issues detailed during both SEDAR 68 and the SEDAR 49 Gulf of Mexico Data-Limited Stock Assessment (SEDAR 2016). For the SEDAR 68 Research Track Assessment, Stock Synthesis (Methot and Wetzel 2013) was used to develop the base model for Scamp Grouper using data from 1986 through 2017. Given the research nature of the assessment, a number of topics received considerable attention, such as modeling recreational landings, quantifying uncertainty in both commercial and recreational landings, and life history. Stock status was not provided by the SEDAR 68 Research Track Assessment. Prior to the SEDAR 68 stock assessment, fisheries statistics for both species in the Gulf of Mexico were summarized by Goodyear (1988).

References:

Goodyear, C. P. 1988. The Gulf of Mexico Fishery for Reef Fish Species - A Descriptive Profile. Coastal Resources Division CRD 87/88-19, Southeast Fisheries Center, Miami Laboratory, Coastal Resources Division, Miami, FL. 262 pp.

Methot, R. D. and C. R. Wetzel. 2013. Stock synthesis: a biological and statistical framework for fish stock assessment and fishery management. Fisheries Research 142:86−99.

SEDAR (Southeast Data Assessment and Review). 2016. SEDAR 49 Gulf of Mexico Data-limited Species Stock Assessment Report. SEDAR, North Charleston, SC. 618 pp.

SEDAR (Southeast Data Assessment and Review). 2021. SEDAR 68 Gulf of Mexico Scamp Grouper Stock Assessment Report. SEDAR, North Charleston, SC. 601 pp.

4 REGIONAL MAPS

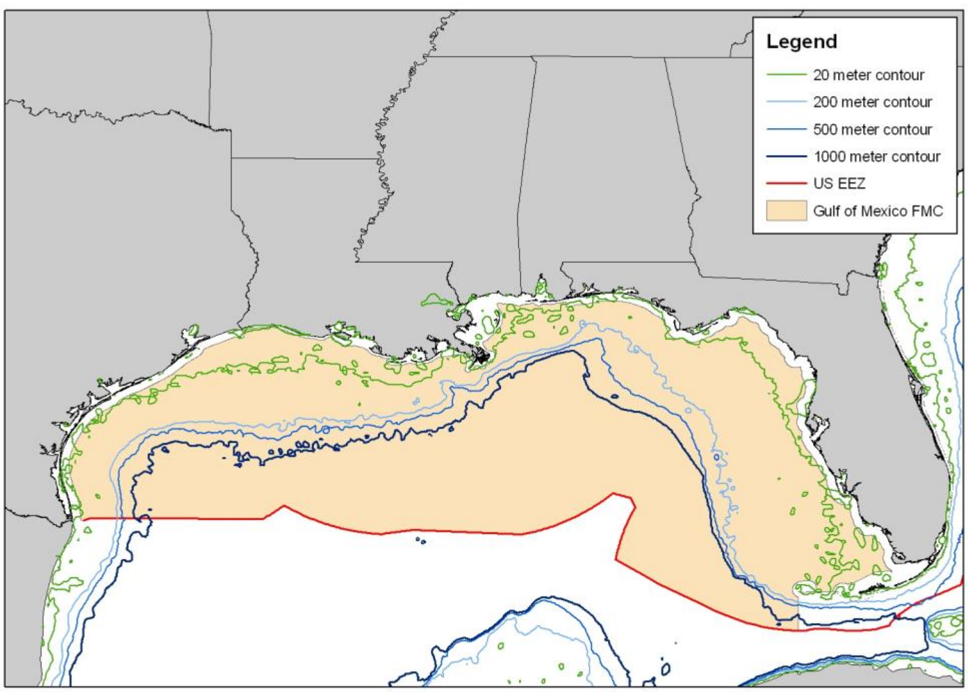

Figure 4.1 Gulf of Mexico Region including Council and EEZ Boundaries.

5 SEDAR ABBREVIATIONS

ABC	Acceptable Biological Catch
ACCSP	Atlantic Coastal Cooperative Statistics Program
ADMB	AD Model Builder software program
ALS	Accumulated Landings System; SEFSC fisheries data collection program
AMRD	Alabama Marine Resources Division
APAIS	Access Point Angler Intercept Survey
ASMFC	Atlantic States Marine Fisheries Commission
B	stock biomass level
BAM	Beaufort Assessment Model
B_{msy}	value of B capable of producing MSY on a continuing basis
BSIA	Best Scientific Information Available
CHTS	Coastal Household Telephone Survey
CFMC	Caribbean Fishery Management Council
CIE	Center for Independent Experts
CPUE	catch per unit of effort
EEZ	exclusive economic zone
F	fishing mortality (instantaneous)
FES	Fishing Effort Survey
FIN	Fisheries Information Network
F_{MSY}	fishing mortality to produce MSY under equilibrium conditions
F_{OY}	fishing mortality rate to produce Optimum Yield under equilibrium
$F_{XX\%\ SPR}$	fishing mortality rate that will result in retaining XX% of the maximum spawning production under equilibrium conditions
F_{max}	fishing mortality that maximizes the average weight yield per fish recruited to the fishery

F_o	a fishing mortality close to, but slightly less than, Fmax
FL FWCC	Florida Fish and Wildlife Conservation Commission
FWRI	Florida Fish and Wildlife Research Institute
GA DNR	Georgia Department of Natural Resources
GLM	general linear model
GMFMC	Gulf of Mexico Fishery Management Council
GSMFC	Gulf States Marine Fisheries Commission
GULF FIN	GSMFC Fisheries Information Network
HMS	Highly Migratory Species
LDWF	Louisiana Department of Wildlife and Fisheries
M	natural mortality (instantaneous)
MARFIN	Marine Fisheries Initiative
MARMAP	Marine Resources Monitoring, Assessment, and Prediction
MDMR	Mississippi Department of Marine Resources
MFMT	maximum fishing mortality threshold, a value of F above which overfishing is deemed to be occurring
MRFSS	Marine Recreational Fisheries Statistics Survey; combines a telephone survey of households to estimate number of trips with creel surveys to estimate catch and effort per trip
MRIP	Marine Recreational Information Program
MSA	Magnuson Stevens Act
MSST	minimum stock size threshold, a value of B below which the stock is deemed to be overfished
MSY	maximum sustainable yield
NC DMF	North Carolina Division of Marine Fisheries
NMFS	National Marine Fisheries Service

NOAA	National Oceanographic and Atmospheric Administration
OST NOAA	Fisheries Office of Science and Technology
OY	optimum yield
SAFMC	South Atlantic Fishery Management Council
SC DNR	South Carolina Department of Natural Resources
SEAMAP	Southeast Area Monitoring and Assessment Program
SEDAR	Southeast Data, Assessment and Review
SEFIS	Southeast Fishery-Independent Survey
SEFSC	Fisheries Southeast Fisheries Science Center, National Marine Fisheries Service
SERFS	Southeast Reef Fish Survey
SERO	Fisheries Southeast Regional Office, National Marine Fisheries Service
SRFS	State Reef Fish Survey (Florida)
SRHS	Southeast Region Headboat Survey
SPR	spawning potential ratio, stock biomass relative to an unfished state of the stock
SSB	Spawning Stock Biomass
SS	Stock Synthesis
SSC	Science and Statistics Committee
TIP	Trip Incident Program; biological data collection program of the SEFSC and Southeast States.
TPWD	Texas Parks and Wildlife Department
Z	total mortality, the sum of M and F

SEDAR 68 Gulf of Mexico Scamp Grouper Operational Assessment

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

Table of Contents

1. Operational Assessment Proceedings

1.1. Introduction

SEDAR 68 addressed the stock assessment for Gulf of Mexico Scamp using data inputs through 2020 as implemented in the Stock Synthesis 3 modeling framework (Methot and Wetzel 2013). The first assessment for Gulf of Mexico Scamp Grouper was the SEDAR 68 Research Track Assessment (SEDAR 2021). Both Scamp Grouper and Yellowmouth Grouper were assessed together as a complex due to concerns over species mis-identification issues detailed during both SEDAR 68 and the SEDAR 49 Gulf of Mexico Data-Limited Stock Assessment (SEDAR 2016). For the SEDAR 68 Research Track Assessment, Stock Synthesis (Methot and Wetzel 2013) was used to develop the base model for Scamp Grouper using data from 1986 through 2017. Given the research nature of the assessment, a number of topics received considerable attention, such as modeling recreational landings, quantifying uncertainty in both commercial and recreational landings, and life history. Stock status was not provided by the SEDAR 68 Research Track Assessment. Prior to the SEDAR 68 stock assessment, fisheries statistics for both species in the Gulf of Mexico were summarized by Goodyear (1988).

This assessment investigated outstanding issues identified during the Research Track Assessment, most noticeably life history issues raised during the Review Workshop. Status determination criteria and projections are provided.

1.1.1. Workshop Time and Place

The SEDAR 68 Operational Assessment (OA) process for Gulf of Mexico Scamp consisted of a series of webinars. There was one Topical Working Group (TWG) focusing on Life History. SEDAR organized two webinars for the Life History TWG which were held between February 2022 and May 2022.

1.1.2. Terms of Reference

The terms of reference (TORs) approved by the Gulf of Mexico Fishery Management Council (GMFMC) are listed below.

1. Update the approved SEDAR 68 Gulf of Mexico Scamp MRIP base model with data through 2020.
    a. Document any changes or corrections made to model and input datasets and provide updated input data tables.
    b. Document any changes in MRIP data, both pre- and post-recalibration, in terms of the magnitude of changes to catch and effort. Compare to values from SEDAR 68.
    c. Update life history data (e.g., growth, reproduction, mortality) if warranted.
        i. Re-evaluate maximum size and asymptotic size in light of modeling issues noted during the SEDAR 68 Research Track Review Workshop.
        ii. Re-estimate age data using the updated growth curve, and update the aging error matrix as necessary.

iii. Re-evaluate the representativeness of length and age composition data.

d. Consider the treatment of recreational and commercial harvest:

i. Consider inputting recreational catch in weight (i.e., pounds) instead of in numbers of fish.

ii. Re-evaluate error estimates for recreational landings.

iii. Re-evaluate fleet-specific gear selectivity and retention.

e. Investigate retrospective bias.

2. Update model parameter estimates and their variances, model uncertainties, estimates of stock status and management benchmarks, and provide the probability of overfishing occurring at specified future harvest and exploitation levels. Provide commercial and recreational landings and discards in pounds and numbers.

a. Use the following status determination criteria (SDC):

i. MSY or MSY proxy = yield at F_{MSY}

ii. MSST = 0.75*B_{MSY}

iii. MFMT = F_{MSY} (or proxy) and $F_{Rebuild}$ (if overfished)

iv. OY = 75% of F_{MSY}

v. If different SDC are recommended, provide outputs for both the current and recommended SDC.

b. Unless otherwise recommended, use the geometric mean of the previous three years' fishing mortality to determine $F_{Current}$. If an alternative approach is recommended, provide justification and outputs for the current and alternative approach.

c. Provide yield and spawning stock biomass streams for the overfishing limit and acceptable biological catch in pounds:

i. Annually for five years

ii. Under a "constant catch" scenario for both three and five years

iii. For the equilibrium yield at F_{MSY}, when estimable

3. Develop a stock assessment report to address these TORs and fully document the input data and results of the stock assessment model.

1.1.3. List of Participants

<u>Life History Topical Working Group Members</u>

Skyler Sagarese (Lead analyst) .... NMFS Miami
Robert Allman .... NMFS Panama City
Luiz Barbieri .... FWC/SSC
Beverly Barnett .... NMFS Panama City
Steve Garner .... NMFS Panama City
Scott Hickman .... Industry - Commercial
Ron Hill .... NMFS Panama City
Will Patterson .... UFL/SSC
Katie Siegfried .... NMFS Beaufort

Molly Stevens .... NMFS Miami
Ted Switzer .... FWC
Kevin Thompson.. FWC, St. Petersburg
Laura Thornton .... NMFS Panama City
Jim Tolan .... TPWD/ SSC

Attendees

Carole Neidig .... Mote Marine Lab
Julie Vecchio... FWC

Staff

Julie Neer .... SEDAR
Alisha Gray .... NOAA SERO
Ryan Rindone.. GMFMC Staff

1.1.4. List of Working Papers and Reference Documents

Document #	Title	Authors	Date Submitted
Documents Prepared for the Operational Assessment			
SEDAR68OA-WP-01	Standardized Catch Rate Indices for Scamp (Mycteroperca phenax) and Yellowmouth Grouper (Mycteroperca interstitialis) during 1986-2020 by the U.S. Gulf of Mexico Headboat Recreational Fishery	Gulf Fisheries Branch; NOAA Fisheries - SEFSC	21 March 2022
SEDAR68OA-WP-02	Indices of abundance for Scamp (Mycteroperca phenax) using combined data from three independent video surveys	Kevin A. Thompson, Theodore S. Switzer, Mary C. Christman, Sean F. Keenan, Christopher Gardner, Katherine E. Overly, Matt Campbell	28 March 2022
SEDAR68OA-WP-03	General Recreational Survey Data for Scamp and Yellowmouth Grouper in the Gulf of Mexico	Matthew A. Nuttall	24 June 2022
SEDAR68OA-WP-04	Age and ageing error of Scamp from the northern Gulf of Mexico	Steven B. Garner, Laura A. Thornton, Robert J. Allman	1 July, 2022; Updated: 8 July 2022

Document #	Title	Authors	Date Submitted
SEDAR68OA-WP-05	Gulf of Mexico Scamp (Mycteroperca phenax) and Yellowmouth Grouper (Mycteroperca interstitialis) Commercial and Recreational Length and Age Compositions	Molly H. Stevens	29 June 2022
SEDAR68OA-WP-06	Estimating Natural Mortality for Gulf of Mexico Scamp Grouper	Gulf Fisheries Branch; NOAA Fisheries - SEFSC	1 July 2022
SEDAR68OA-WP-07	Headboat landings and discard corrections for SEDAR 68 scamp/yellowmouth grouper	Rob Cheshire	24 Aug 2022
Final Stock Assessment Reports			
SEDAR68OA-SAR1	Gulf of Mexico Scamp		

2. Data Review and Update

A variety of data sources were used in the SEDAR 68 Operational Assessment (OA) following the SEDAR 68 Research Track Assessment. Where practicable, the SEDAR 68 OA Base Model used the same data sets as the SEDAR 68 RW Base Model with an updated time series. However, there were a few new or revised datasets provided for consideration including:

1. New age data between 2003-2012 to replace placeholder ages used during the Research Track Assessment
2. An ageing error matrix accompanying the new age data (2003-2012 and 2018-2020)
3. Age-specific natural mortality estimates
4. Mean weight of Scamp landed by each recreational fleet (with corresponding error estimates)
5. Mean length-at-age of Scamp landed by each fleet (for checking model predictions only, the model is not fitting to these data inputs)
6. Corrected headboat landings estimates (1986-2020), mean weight of landed Scamp (1986-2020), discard estimates (2000-2003), and discard length composition bin specifications

These new data series were considered because they had not previously been available for the SEDAR 68 Research Track Assessment or represented improved data inputs for use in the assessment. The data utilized in the SEDAR 68 OA Base Model are summarized below and illustrated in **Figure 1** along with their corresponding temporal scale. Some data streams were not updated through 2020 for the OA due to sampling issues arising from COVID-19. Descriptions of individual data components are provided within each subsection below, with additional details provided in the SEDAR 68 Research Track Assessment Report (SEDAR 2021a).

1. Life history
    a. Meristics
    b. Age and growth
    c. Natural mortality
    d. Maturity
    e. Sex transition
    f. Fecundity
2. Discard mortality rates (based on numbers of fish)
    a. Commercial Vertical Line
    b. Commercial Longline
    c. Recreational Charter Private
    d. Recreational Headboat
3. Landings
    a. Commercial Vertical Line: 1986-2020 (metric tons gutted weight)
    b. Commercial Longline: 1986-2020 (metric tons gutted weight)
    c. Recreational Charter Private: 1986-2020 (1,000s of fish)
    d. Recreational Headboat: 1986-2020 (1,000s of fish)
4. Mean weight (kg, gutted weight) of landings
    a. Recreational Charter Private: 1986-2020
    b. Recreational Headboat: 1986-2020
5. Discards
    a. Commercial Vertical Line: 2000-2020 (1,000s of fish)
    b. Commercial Longline: 2000-2020 (1,000s of fish)
    c. Recreational Charter Private: 1986-2020 (1,000s of fish)
    d. Recreational Headboat: 2000-2020 (1,000s of fish)
6. Length composition of landings (3:84 cm Fork Length (cm FL), 3 cm FL bins)
    a. Commercial Vertical Line: 1986-2020
    b. Commercial Longline: 1986-2020
    c. Recreational Charter Private: 1992-2020
    d. Recreational Headboat: 1986-2019
7. Length composition of discards (3:84 cm FL, 3 cm FL bins)
    a. Commercial Vertical Line: 2007-2017 (Reef Fish Observer Program)
    b. Commercial Longline: 2010-2016 (Reef Fish Observer Program)
    c. Recreational Charter Private: 2010-2019 (FWRI At-Sea Observer Program)
    d. Recreational Headboat: 2005-2019 (FWRI At-Sea Observer Program)
8. Age composition of landings (1-year age bins, plus group ages 20 and older)
    a. Commercial Vertical Line: 1991-2020
    b. Commercial Longline: 1992-2020
    c. Recreational Charter Private: 1994-2020

   d. Recreational Headboat: 1986-2019
9. Mean length-at-age of landings
   a. Commercial Vertical Line: 1991-2020
   b. Commercial Longline: 1992-2020
   c. Recreational Charter Private: 1994-2019
   d. Recreational Headboat: 1986-2019
10. Abundance indices
    a. Fishery-independent:
       i. Combined Video Survey: 1993-2019
    b. Fishery-dependent:
       i. pre-IFQ Vertical Line CPUE: 1993-2009
       ii. Headboat CPUE: 1986-2020
       iii. RFOP Vertical Line Survey: 2007-2019
11. Length composition of surveys (3:84 cm FL, 3 cm FL bins)
    a. Combined Video Survey: 1996-2019
    b. RFOP Vertical Line Survey: 2007-2019

A summary listing of all data sets included in the assessment, along with any revisions to the contact information for who provided the analysis, has been compiled below. This will be the source of data information for the next assessment.

Data Updates	**Data Type**	**Contributing Organizations**	**Data Providers**	**Contact Information**
Landings, Discards	Headboat Landings	SEFSC	Ken Brennan	kenneth.brennan@noaa.gov
	Headboat Discards	SEFSC	Ken Brennan	kenneth.brennan@noaa.gov
	General Recreational (MRIP, TPWD, LACreel) Landings	SEFSC	Matt Nuttall	matthew.nuttall@noaa.gov
	General Recreational (MRIP) Discards	SEFSC	Matt Nuttall	matthew.nuttall@noaa.gov
	Commercial Landings - ALS	SEFSC	Refik Orhun	refik.orhun@noaa.gov
	Commercial Landings - IFQ	SERO	Alisha Gray Jessica Stephen	alisha.gray@noaa.gov jessica.stephen@noaa.gov
	Commercial Landings - Florida	FWRI ACCSP	Steve Brown Mike Rinaldi	steve.brown@myfwc.com mike.rinaldi@accsp.org
	Commercial Discards	SEFSC	Kevin McCarthy Steve Smith Stephanie Martinez	kevin.j.mccarthy@noaa.gov steven.smith@noaa.gov stephanie.martinez@noaa.gov

Indices	Commercial Vertical Line (pre-IFQ) Logbook Index	SEFSC	Skyler Sagarese	skyler.sagarese@noaa.gov
	Headboat Index	SEFSC	Skyler Sagarese	skyler.sagarese@noaa.gov
	Combined Video Index	SEFSC FWRI	Matt Campbell Chris Gardner Kate Overly Kevin Thompson	matthew.campbell@noaa.gov chris.gardner@noaa.gov katherine.overly@noaa.gov kevin.thompson@myfwc.com
	Reef Fish Observer Program Vertical Line Index	SEFSC	Kevin McCarthy Steve Smith Stephanie Martinez	kevin.j.mccarthy@noaa.gov steven.smith@noaa.gov stephanie.martinez@noaa.gov
Life History	Fishery Independent & Fishery Dependent biological data	SEFSC	Beverly Barnett Robert Allman Laura Thornton	beverly.barnett@noaa.gov robert.allman@noaa.gov laura.thornton@noaa.gov
	Fishery Independent biological data	FWRI	Meagan Schrandt	meagan.schrandt@myfwc.co m
	Fishery Dependent biological data	GulfFIN	Gregg Bray	gbray@gsmfc.org
	Natural mortality estimate	SEFSC	Skyler Sagarese Katie Siegfried	skyler.sagarese@noaa.gov kate.siegfried@noaa.gov
	Ageing error matrix	SEFSC	Steve Garner Eric Fitzpatrick	steven.garner@noaa.gov eric.fitzpatrick@noaa.gov
Length Comps	Commercial length raw data	SEFSC	Larry Beerkircher	lawrence.beerkircher@noaa.g ov
	Commercial length comp development	SEFSC	Molly Stevens	molly.stevens@noaa.gov
	Headboat length raw data	SEFSC	Ken Brennan	kenneth.brennan@noaa.gov
	Headboat length comp development	SEFSC	Molly Stevens	molly.stevens@noaa.gov
	MRIP length raw data	SEFSC	Matt Nuttall	matthew.nuttall@noaa.gov
	MRIP length comp development	SEFSC	Molly Stevens	molly.stevens@noaa.gov
	Combined Video length comps	SEFSC, FWRI	Matt Campbell Chris Gardner Kate Overly Kevin Thompson	matthew.campbell@noaa.gov chris.gardner@noaa.gov katherine.overly@noaa.gov kevin.thompson@myfwc.com

	Commercial discard length comps from reef fish observer data	SEFSC	Kevin McCarthy Sarina Atkinson	kevin.j.mccarthy@noaa.gov sarina.atkinson@noaa.gov
	Reef Fish Observer Program Vertical Line Index length comps	SEFSC	Kevin McCarthy Steve Smith	kevin.j.mccarthy@noaa.gov steven.smith@noaa.gov
	Recreational discard length comps	FWRI	Dominique Lazarre Beverly Sauls	dominique.lazarre@myfwc.com beverly.sauls@myfwc.com
Age Comps	Commercial age raw data	SEFSC	Beverly Barnett Robert Allman Laura Thornton	beverly.barnett@noaa.gov robert.allman@noaa.gov laura.thornton@noaa.gov
	Commercial age comp development	SEFSC	Molly Stevens	molly.stevens@noaa.gov
	Headboat age raw data	SEFSC	Beverly Barnett Robert Allman Laura Thornton	beverly.barnett@noaa.gov robert.allman@noaa.gov laura.thornton@noaa.gov
	Headboat age comp development	SEFSC	Molly Stevens	molly.stevens@noaa.gov
	General recreational age raw data	SEFSC	Beverly Barnett Robert Allman Laura Thornton	beverly.barnett@noaa.gov robert.allman@noaa.gov laura.thornton@noaa.gov
	Recreational age comp development	SEFSC	Molly Stevens	molly.stevens@noaa.gov
	Commercial mean length at age	SEFSC	Molly Stevens	molly.stevens@noaa.gov
	Recreational mean length at age	SEFSC	Molly Stevens	molly.stevens@noaa.gov

2.1. Stock Structure and Management Unit

Two regions (Atlantic and Gulf of Mexico) are currently used by the South Atlantic Fishery Management Council (SAFMC) and Gulf of Mexico Fishery Management Council (GMFMC) for Scamp management. The SEDAR 68 Research Track Assessment Stock ID Workshop recommended that the Gulf of Mexico and South Atlantic stocks be assessed separately using the default boundary of U.S. Highway 1 in the Florida Keys, as defined by the Councils' jurisdictions. Species misidentification issues with Yellowmouth Grouper (*Mycteroperca interstitialis*) led to the recommendation that both species be assessed jointly as a complex. For the purpose of brevity, all reference to Scamp in this report refers to the Scamp and Yellowmouth Grouper complex.

2.2. Life History Parameters

A Life History Topical Working Group (TWG) was formed to address the following TOR:

1. Update life history data (e.g., growth, reproduction, mortality [see **Section 2.2.3** for updates]) if warranted.
    i. Re-evaluate maximum size and asymptotic size in light of modeling issues noted during the SEDAR 68 Research Track Assessment Review Workshop (see discussion in **Section 2.3.5**).
    ii. Re-estimate age data using the updated growth curve, and update the aging error matrix as necessary (see **Section 2.2.2**).
    iii. Re-evaluate the representativeness of length and age composition data (see **Sections 2.3.5-2.3.8, 2.3.11** and **2.4.2**).

2.2.1. Morphometric and Conversion Factors

Morphometric and conversion factors developed during the SEDAR 68 Research Track Assessment were not updated during the SEDAR 68 OA. The relationship between gutted weight (in kilograms) and fork length (FL in centimeters; $gw = aFL^b$) for both sexes combined was used as a fixed model input (**Table 1**, **Figure 2A**). Although not a direct input into the model, the whole weight to gutted weight conversion (**Table 1**) was used to convert the recreational landings and mean weight of Scamp landed by each recreational fleet from whole weight to gutted weight for input into the model (**Section 2.3.2**). Similarly, the total length (TL) to fork length conversion was used to convert the minimum size limits for input into the model retention functions (see **Section 3.1.8**).

2.2.2. Age and Growth

Growth was modeled using a single size-modified von Bertalanffy growth curve for both sexes combined (**Table 2**, **Figure 2B**). The SEDAR 68 Research Track Assessment recommended use of the population model with the constant coefficient of variation (CV)-at-age (CV = 0.13) because this model exhibited the lowest Akaike's Information Criterion (AIC), and examination of the variance structure for observed size-at-age data supported a constant CV for most ages, with the exception of the older age classes where sample sizes were small.

During the SEDAR 68 Research Track Assessment, processing errors unique to Scamp in the Gulf of Mexico led to the exclusion of all age data between 2003 and 2012 and the use of placeholder calendar age estimates developed using otolith weight. No concerning bias in ageing of Scamp was evident across laboratories or readers for ages provided for the SEDAR 68 Research Track Assessment for the years 1991-2002 and 2013-2017 (SEDAR68-DW-15). Overall, the average percent error (APE) for Gulf of Mexico Scamp was 5.14%.

For the SEDAR 68 OA, remaining otoliths between 2003 and 2012 were subsampled, subsectioned, and aged along with otoliths from 2018 to 2020 (SEDAR68OA-WP-04). Due to time limitations, four agers (three primary and one expert) were required to read these otoliths within the project schedule. Multiple training sessions were held to train the primary readers, some of whom were new to ageing Scamp, and their accuracy and precision were compared to the expert ager. For these new data, the APE for Gulf of Mexico Scamp was 8.2% (SEDAR68OA-WP-04).

To account for uncertainty in the ageing process and for the differences between time periods (e.g., number of readers and expertise level of readers), standard deviation (SD)-at-age were calculated and used as a measure of ageing error in the assessment model for ages associated with each time period: (1) 1991-2002 and 2013-2017 (Research Track Assessment) and (2) 2003-2012 and 2018-2020 (Operational Assessment). The Life History TWG reviewed several ageing error models differing in bias and precision for the OA (SEDAR68OA-WP-04; **Table 3**). The best fit model based on AIC assumed curvilinear bias, curvilinear SD, and error within expert reader ages (SEDAR68OA-WP-04). Uncertainty in age estimates increased with age, with wider distributions of observed ages noted for older Scamp (**Figure 3**). Larger ageing error was evident for the OA (**Figure 3**), primarily due to more readers with varying expertise levels. As a result, the growth parameters were not updated using the new OA age data.

Life History TWG Recommendations:

1. *OA age data*: use when developing age compositions
2. *Growth parameters (including asymptotic size)*: use parameters provided during Research Track Assessment as best available and do not update growth parameters using newly aged OA data; consider estimating growth parameters if model diagnostics support their estimation
3. *Ageing error matrix*: include a matrix corresponding to the Research Track Assessment years of age data (1991-2002 and 2013-2017) and another corresponding to the newly aged OA data (2003-2012 and 2018-2020). Evaluate how different ageing error matrices affect model results with sensitivity runs (see **Section 3.4.8**)

2.2.3. Natural Mortality

The age-specific vector of natural mortality (*M*) recommended for use during the OA accounted for a shift in peak spawning and was based on the Lorenzen (2000) approach for scaling *M* (SEDAR68OA-WP-06). This shift in peak spawning is required because Stock Synthesis expects a vector based on lengths corresponding to mid-calendar-year. This *M* vector assumes a size-dependent mortality schedule (Lorenzen 2000) in which the instantaneous mortality rate-at-age is inversely proportional to length-at-age and requires: (1) von Bertalanffy growth parameters (**Section 2.2.2**); (2) the age at full recruitment to the fishery (6 years); and (3) an estimate of peak spawning (i.e., birth date of April 15th for Scamp). The age-specific *M* vector was then scaled to the Then et al. (2015) point estimate of 0.155 yr^{-1}, which was obtained by recalculating the t_{max} regression using Serranid-only data and a maximum age of 34 years (**Table 4**, **Figure 2C**).

Life History TWG Recommendations:

1. *Natural mortality*: use the fixed vector that adjusts for peak spawning as a starting point; consider implementing the Lorenzen option within Stock Synthesis using a reference age of 10 years and the estimated *M* from the externally calculated age-specific *M* vector as the input point estimate for Stock Synthesis

2.2.4. Maturity

Maturity parameters developed during the SEDAR 68 Research Track Assessment were not updated during the SEDAR 68 OA because no new data were provided. Scamp are protogynous hermaphrodites (i.e., transition from female to male), and all male or transitioning fish were considered mature in this assessment. A logistic relationship with a logit link function based on fish collected during the period when actively spawning individuals were observed was recommended by the SEDAR 68 Data Workshop Life History Working Group to model maturity as a function of age (SEDAR68-DW-28). The slope was estimated at -1.335 and the age at 50% maturity predicted around 3.407 years (**Figure 2D**).

2.2.5. Sexual Transition

Sexual transition parameters developed during the SEDAR 68 Research Track Assessment were not updated during the SEDAR 68 OA because no new data were provided. Hermaphroditism in Stock Synthesis (SS) is modeled as the proportion of individuals transitioning at a given age using a scaled cumulative normal distribution based on three parameters. The inflection age represents the age at which 50% of individuals transition to male, and differs from the traditional 50% probability of being male, which was predicted around 10.8 years (SEDAR68-DW-28; **Figure 2E**). The SD controls how quickly the asymptote is reached. Lastly, the maximum value represents the asymptotic proportion of transition, and can be less than 1 if females still occur in the plus group (i.e., not 100% transition by the maximum age). For this analysis, all individuals sampled from the reproductive study were used and resulted in the following hermaphroditism transition function parameters for input in Stock Synthesis: inflection age = 21.525, SD in age = 10.141 and asymptote = 0.891 (**Figure 2E**). The sex ratio at birth was 100% females and females were assumed to first transition at age-3 (new option introduced in SS version 3.30.17).

2.2.6. Fecundity

Fecundity parameters proposed during the SEDAR 68 Research Track Assessment ((i.e., $eggs = aW^b$ where a = 1 and b = 1) were not updated during the SEDAR 68 OA because no new data were provided. The SEDAR 68 Research Track Assessment recommended using combined male and female spawning stock biomass (SSB) as a measure of reproductive potential (i.e., SSB equivalent to body weight, **Figure 2F**). This implies that 1 kg of male biomass is equally important to the likelihood of spawning success as 1 kg of female biomass and is recommended in situations where the potential for decreased fertility is moderate or unknown (Brooks et al. 2008). Estimated sex ratios for Scamp from field collections have ranged from 18-24% in the 1990s to 41% between 2003 and 2017 (SEDAR68-DW-28). However, there is a paucity of reproduction data and limited understanding of the reproductive behavior of Scamp in the Gulf of Mexico.

2.2.7. Discard Mortality

Discard mortality estimates were unchanged from those recommended by the SEDAR 68 Research Track Assessment. The total discard mortality rate for each commercial fleet was estimated by conditionally combining the immediate unvented and delayed mortality estimates (**Table 5**; SEDAR68-AW-03). Data from the Southeast Regional Headboat Survey (SRHS) were used to determine the mean discard depth (29 m) for Scamp in the Gulf of Mexico and the Pulver

(2017) model was used to predict the immediate discard mortality of 9-10% at this depth. Combined with a bootstrapped delayed mortality prediction of 18% (7-33%) at 30 m, the total discard mortality estimate was 26% (16-40%). For the Gulf of Mexico, discard mortality was assumed similar between the Recreational Charter Private and Recreational Headboat fleets due to similarities between fishing practices, targeting, and depths where Scamp were discarded.

2.3. Fishery-Dependent Data

2.3.1. Commercial Landings

Commercial landings of Scamp were constructed using data from the Florida Trip Ticket program for West Florida since 1986 and data housed in the NOAA's Southeast Fisheries Science Center's (SEFSC) Accumulated Landings System for the remaining Gulf States. Landings from the Grouper-Tilefish Individual Fishing Quota (IFQ) program were used for 2010 to 2020. Commercial landings since 1986 were used in the assessment (**Table 6**) because historical landings (i.e., pre-1986) were not recommended for use during the SEDAR 68 Research Track Assessment.

For the assessment, commercial landings were partitioned into two fleets that represent the two main commercial harvesting gears: (1) vertical line or handline and (2) longline (**Section 3.1.6**). Commercial Vertical Line landings have declined since the early 1990s, whereas Commercial Longline landings have remained variable across years (**Figure 4**). Both fleets exhibited the lowest landings of the time series in the most recent years. The proportion of commercial landings has varied over time, but has decreased considerably in recent years (**Figure 4**).

Commercial landings were reported in pounds gutted weight and converted to metric tons for input into the assessment model. Uncertainty estimates for landings from the Gulf of Mexico were not provided during the SEDAR 68 Research Track Assessment. Therefore, uncertainty estimates of 0.05 were borrowed for Florida from 1986 through 2009 (Table 3.4 in SEDAR 2021b), and an error of 0.01 was implemented since 2010, which corresponds to the implementation of the IFQ program in the Gulf of Mexico.

2.3.2. Recreational Landings

Recreational landings data reviewed during the SEDAR 68 Research Track Assessment included both whole weight (converted to gutted weight in **Table 7A**) and numbers (**Table 7B**). Weight estimates were developed by the SEFSC and used the Marine Recreational Information Program (MRIP; SEDAR68-DW-13) sample data to obtain a mean weight of landed Scamp by strata using the following hierarchy (from coarsest to finest): species, region, year, state, mode, wave, and area (Matter and Rios 2013). Mean weight of landed Scamp was then multiplied by the landings estimates in numbers to obtain estimates of landings in weight (SEDAR68OA-WP-03).

For the assessment, recreational landings were partitioned into two fleets that represent the two main recreational harvesting modes of fishing: (1) Charter Private and (2) Headboat (**Section 3.1.6**). Recreational landings of Scamp for the Recreational Charter Private fleet were estimated using data from MRIP (see SEDAR68OA-WP-03 for comparison between landings provided for SEDAR 68), Texas Parks and Wildlife Department (TPWD), and Louisiana Creel. Recreational Charter Private landings have varied considerably over the time series, with relatively high landings in the 1980s and in many years since 2005 (**Figure 4**). Recreational landings of Scamp for the Recreational Headboat fleet were estimated using data from SRHS. For the OA, Recreational Headboat landings were corrected (SEDAR68OA-WP-07) Recreational Headboat landings have remained consistently low throughout the time series, with the exception of slightly higher landings in the late 1980s (**Figure 4**). The proportion of recreational landings has varied over time, but has increased in recent years (**Figure 4**).

Recreational landings in 1,000s of fish were input into the assessment model (**Table 7B**; **Figure 4**). While inputting recreational landings in gutted weight was considered during the SEDAR 68 Research Track Assessment, numbers were ultimately preferred because they are the native units of data collection by the MRIP program (and other state sampling programs). Uncertainty estimates (CV) were provided for both the Recreational Charter Private and Recreational Headboat fleets, and were much larger for the Recreational Charter Private fleet, averaging 0.44 and ranging from 0.21 in 1998 and 2001 to 0.89 in 1990 (SEDAR68OA-WP-03). In comparison, uncertainty estimates (CV) for the Recreational Headboat fleet were much smaller and averaged about 0.02 (range: 0-0.1), primarily a function of the SRHS being a census of headboats. Attempts to input these CVs directly in Stock Synthesis were unsuccessful during the Research Track Assessment, and ultimately a CV of 0.3 was applied to recreational landings across the entire time series for both fleets.

Along with recreational landings in numbers, the mean weight (in kilograms) of Scamp landed by each recreational fleet was also included in the model (**Table 7C**). The mean weight was obtained by dividing the estimates of recreational landings in weights by the recreational landings in numbers to get an average size for each recreational fleet. Mean weight of Scamp landed by the Recreational Charter Private fleet was generally larger than the Recreational Headboat fleet (**Table 7C**). For the Recreational Charter Private fleet, the standard error (SE) was calculated from trip-level summaries of raw weight data (mean weight by vessel) to account for any correlation in fish sizes sampled from the same intercept (SEDAR68OA-WP-03). For the Recreational Headboat fleet, the SE was calculated from the annual weight summaries. Accompanying uncertainty estimates (CV) for mean weight of Scamp landed by the Recreational Charter Private and Recreational Headboat fleets averaged 0.14 (range: 0.04-0.5) and 0.11 (range: 0.05-0.19), respectively (**Table 7C**). Inclusion of this data source allows a comparison between the assessment model expected mean weight and the mean weight of Scamp landed by each recreational fleet.

2.3.3. Commercial Discards

Commercial discards were estimated using catch per unit effort (CPUE) from the coastal observer program and total fishing effort from the commercial reef logbook program (SEDAR68-DW-30). Compared to recreational discards, commercial discards have remained minor throughout the time series (**Figure 5**).

Discard data for each commercial fleet were provided starting in 2000, which is the first full year after the implementation of the federal size limit of 20 inches TL, under the assumption that discards were negligible prior to this regulation. The discard estimates reported in numbers were input into the assessment as 1,000s of fish with relatively large corresponding log-scale standard errors (SE, **Table 8**). Discard mortality rates of 0.47 and 0.68 were used for the Commercial Vertical Line and Commercial Longline fleets, respectively (**Table 5**).

2.3.4. Recreational Discards

For the Recreational Charter Private fleet, discard estimates starting in 1986 were provided solely by MRIP because discards from the LA Creel Survey and TPWD Survey were assumed negligible. Discard estimates for the Recreational Headboat fleet began in 2000 because discards prior to the implementation of the federal size limit in 1999 were assumed negligible. Between 2000 and 2003, discards from the Recreational Headboat fleet were estimated using a proxy method that used the mean SRHS discard:landings ratio (2004-2020) to estimated headboat landings. For the OA, Recreational Headboat proxy discards were corrected (SEDAR68OA-WP-07). From 2004 through 2020, Recreational Headboat fleet discards were provided by SRHS. Of all the fleets, the Recreational Charter Private fishery discards the large majority of Scamp (**Figure 5**).

The discard estimates reported in numbers were input into the assessment as 1,000s of fish with corresponding log-scale SEs (**Table 9**). For the Recreational Charter Private fleet, SEs averaged 0.52 (range: 0.31-0.83). A SE of 0.47 was used for the Recreational Headboat fleet in the absence of a value recommended during the SEDAR 68 Research Track Assessment, and was similar to estimates used for other Gulf stocks (e.g., Greater Amberjack, *Seriola dumerili*). A discard mortality rate of 0.26 was used for both recreational fleets (**Table 5**; **Section 2.2.7**).

2.3.5. Commercial Size Composition

Annual length compositions were combined into 3-cm fork length interval bins (3:84 cm FL) following the SEDAR 68 Research Track Assessment. For each fleet, length data of landed Scamp from the commercial trip intercept program (TIP) and GulfFIN were aggregated into three major sub-regions and weighted based on the distribution of landings estimates among sub-regions (SEDAR68-AW-01; SEDAR68OA-WP-05). Data from the Reef Fish Observer Program (RFOP) were used to characterize the length compositions from commercial discards (SEDAR68-DW-17).

For the OA, the length plus group was reduced from 129 cm FL used during the Research Track Assessment to 84 cm FL. This length plus bin was based on review of length data, as no Scamp larger than 84 cm FL were observed in either the Combined Video Survey or the RFOP Vertical Line Survey, whereas <0.5% of Scamp landed were larger than 84 cm FL (0.2% Commercial Vertical Line, 0.07% Commercial Longline, 0.5% Recreational Charter Private, and 0.5% Recreational Headboat). This reduction was recommended by the SEDAR 68 Research Track Assessment Review Panel because it led to a more appropriate ratio of $L\infty$ to L_{max} (0.84%) and would help obtain a better fit to the length compositions and improve estimates of selectivity.

Annual length compositions were input into the model along with input sample sizes reflective of the number of trips (≥ 10).

Life History TWG Recommendations:

1. *Length composition & length plus bin (maximum size)*: use the same methodology as the Research Track Assessment, with the exception of the length plus bin of 84 cm FL

2.3.6. Recreational Size Composition

Annual length compositions were combined into 3-cm fork length interval bins (3:84 cm FL) following the SEDAR 68 Research Track Assessment. For each fleet, length data of landed Scamp were obtained from MRIP (formerly MRFSS), TPWD, SRHS and GulfFIN. Nominal length compositions of landed Scamp were used in the assessment for each recreational fleet due to insufficient sample sizes (SEDAR68-AW-01; SEDAR68OA-WP-05). Length composition samples provided by Florida Fish and Wildlife Conservation Commission's (FWC) Fish and Wildlife Research Institute's (FWRI) At-Sea Observer Program (2006-2020) were used for characterizing the discards for both recreational fleets (SEDAR68-DW-24). Nominal length compositions of discarded Scamp were used for Recreational Charter Private. Recreational Headboat discard length compositions were weighted by trip length to correct for the fact that Headboat trips were not sampled proportional to fishing effort (SEDAR68-DW-24). For the OA, discard length compositions for the Recreational Headboat fleet were updated so that data were binned from the start of the length bin (e.g., 15 cm FL) as opposed to the mid-point (e.g., 15 cm FL being the mid-point).

Annual length compositions were input into the model along with input sample sizes reflective of the number of trips (≥ 10).

Life History TWG Recommendations:

1. *Length composition & length plus bin (maximum size)*: use the same methodology as the Research Track Assessment, with the exception of the length plus bin of 84 cm FL

2.3.7. Commercial Age Composition

Nominal age compositions of landed Scamp were provided for both commercial fleets due to data limitations preventing weighting of compositions (SEDAR68-AW-01; SEDAR68OA-WP-05). Annual age compositions were input into the model along with input sample sizes reflective of the number of trips (≥ 10). A few cohorts are apparent in the Commercial Vertical Line data (e.g., 1990 and 1999; **Figure 6**) and the Commercial Longline data (e.g., 1987; **Figure 7**), although data gaps exist for both fleets. The main age classes captured were 5-12 year olds and 7-14 year olds for the Commercial Vertical Line and Commercial Longline fleets, respectively.

A mean length-at-age vector for each year and fleet was included in the model for comparison between the model expected length-at-age and the observed length-at-age. These data were solely used as a check on model predictions and were not fit to within the model.

Life History TWG Recommendations:

1. *Age composition*: use the same methodology as the Research Track Assessment for the continuity, but consider using conditional age-at-length if time allows and model diagnostics support its use

2.3.8. Recreational Age Composition

Nominal age compositions of landed Scamp were provided for both recreational fleets due to data limitations preventing weighting of compositions (SEDAR68-AW-01; SEDAR68OA-WP-

05). Annual age compositions were input into the model along with input sample sizes reflective of the number of trips (≥ 10). Compared to the commercial fleets, recreational age compositions for both fleets exhibited lower sample sizes and consisted of younger Scamp. Data gaps were prevalent for both fleets, however, a few cohorts were apparent in the Recreational Charter Private data (e.g., 2007; **Figure 8**) and in the Recreational Headboat data (e.g., 1990; **Figure 9**). The main age classes captured were 3-9 year olds and 2-7 year olds for the Recreational Charter Private and Recreational Headboat fleets, respectively.

A mean length-at-age vector for each year and fleet was included in the model for comparison between the model expected length-at-age and the observed length-at-age. These data were solely used as a check on model predictions and were not fit to within the model.

Life History TWG Recommendations:

1. *Age composition*: use the same methodology as the Research Track Assessment, as nominal age compositions are best available

2.3.9. Commercial Catch Per Unit of Effort Indices of Abundance

Two commercial catch-per-unit-effort (CPUE) indices of relative abundance were recommended during the SEDAR 68 Research Track Assessment for use in the assessment (**Figure 10**). The pre-IFQ index for the Commercial Vertical Line fleet was recommended for use (SEDAR68-DW-29) because of its long and fairly consistent time series before the frequent implementation of regulations (i.e., 2010+). A novel CPUE index was developed for the Commercial Vertical Line fleet using data from the RFOP (SEDAR68-AW-04). Observer observations of catch include both kept and discarded fish, and are thus not directly impacted by changes in management regulations such as size limits or catch quotas. Since Scamp are often not a primary targeted species, the SEDAR 68 Data Workshop Index Working Group considered this index to be potentially more representative of population abundance rather than effort or response to management.

Annual CVs associated with each of the standardized indices were converted to log-scale SEs (**Section 3.2**). The input SEs as well as all index values by source are presented in **Table 10**. The RFOP Vertical Line Survey index ends in 2019 because of sampling limitations in 2020 due to COVID-19.

2.3.10. Recreational Catch Per Unit of Effort Indices of Abundance

The Recreational Headboat CPUE index was recommended during the SEDAR 68 Research Track Assessment for use (SEDAR68-DW-18; SEDAR68OA-WP-01) because of its long and consistent time series and large spatial coverage (**Figure 10**). Given the lack of targeting of Scamp by anglers, the SEDAR 68 Data Workshop Index Working Group recommended that this index should be reflective of relative abundance of the population. Annual CVs were converted to log-scale SEs (**Section 3.2**) and are presented in **Table 10**.

2.3.11. Size Composition for RFOP Vertical Line Survey

Annual length compositions of total catch (landed + discarded) for the RFOP Vertical Line Survey were combined into 3-cm fork length interval bins (3:84) following the SEDAR 68

Research Track Assessment. Annual length compositions were input into the model along with input sample sizes reflective of the number of sampling units, or the number of valid Scamp sample units that were sampled by observers (SEDAR68-AW-04).

Life History TWG Recommendations:

1. *Length composition & length plus bin (maximum size)*: use the same methodology as the Research Track Assessment, with the exception of the length plus bin of 84 cm FL

2.4. Fishery-Independent Surveys

2.4.1. Combined Video Survey Index

Three different stationary video surveys for reef fish are conducted in the Gulf of Mexico. The NMFS SEAMAP Reef Fish Video Survey, carried out by NMFS Mississippi Laboratories, has the longest running time series (1992-1997, 2002, and 2004-2020), followed by the NMFS Panama City Laboratory Survey (2005-2020), with the most recent survey being the FWC FWRI Survey (2008-2020). While the surveys use standardized deployment, camera field of view, and fish abundance methods to assess fish abundances on reef or structured habitat, there are variations in survey design and habitat characteristics collected in addition to the time period and area sampled. An index combining the three individual surveys using a habitat-based approach was recommended for use during the SEDAR 68 Research Track Assessment because it has a statistically sound survey design, has good coverage of Scamp habitat and, therefore, should reflect relative abundance (**Figure 10**, SEDAR68-DW-07, SEDAR68OA-WP-02). Annual CVs were converted to log-scale SEs (**Section 3.2**) and are presented in **Table 10**. This index ends in 2019 for the OA because of substantial modifications to the survey implementation starting in 2020 under the G-FISHER project (SEDAR74-DW-23). Modeling solutions to account for these changes are currently under evaluation by the SEDAR Procedural Workshop 08 (*http://sedarweb.org/pw-08*).

2.4.2. Survey Length Composition

A model-based approach was used to develop size composition of Scamp from the Combined Video Survey (SEDAR68OA-WP-02). These composition values are model estimated probabilities from a multinomial regression model using length bins (in 3-cm Fork Length) as the response variable, and are based on the approach applied for Vermilion Snapper (*Rhomboplites aurorubens*, Walter et al. 2020) and Red Snapper (*Lutjanus campechanus*, Walter et al. 2017). Model factors included year, habitat type, and survey (i.e., Lab) as categorical factors. The final model selected was based on AIC and included year and survey. Annual length compositions were input into the model along with input sample sizes reflective of the number of stations ($\geq$ 10).

Life History TWG Recommendations:

1. *Length composition & length plus bin (maximum size)*: use the same methodology as the Research Track Assessment, with the exception of the length plus bin of 84 cm FL

2.5. Environmental Considerations & Contributions from Stakeholders

A conceptual model focused on Gulf of Mexico Scamp was built during the SEDAR 68 Research Track Assessment by the SEFSC using responses from an online survey (with follow-up telephone interviews) and the Something's Fishy Survey from the GMFMC (SEDAR68-RD-41). Additional details are summarized in SEDAR68-AW-02. A key take home of this exercise was that regulations on other species (e.g., seasonal closures of Gag Grouper) were thought to be more influential than regulations on Scamp. While the relationships identified by the model reflect working hypotheses and not necessarily known truths, these hypotheses can direct further research to help identify factors that should be considered either in the assessment model or by management. For example, red tide blooms caused by the dinoflagellate *Karenia brevis* have been hypothesized to cause severe mortality for shallow-water grouper species. However, little evidence of red tide mortality was presented during the SEDAR 68 Research Track Assessment and therefore it was not considered a major source of mortality for Gulf of Mexico Scamp, which tends to inhabit deeper areas less affected by red tides.

3. Stock Assessment Model Configuration and Methods

3.1. Stock Synthesis Model Configuration

The assessment model used was Stock Synthesis, version 3.30.19.01. Descriptions of algorithms and options are available in the User's Manual (Methot et al. 2022), the NOAA Fisheries Toolbox website (*http://nft.nefsc.noaa.gov/*), and Methot and Wetzel (2013). Stock Synthesis is a widely used integrated statistical catch-at-age model (SCAA) that has been tested for stock assessments in the United States (US), particularly on the West Coast and Southeast, and also throughout the world (see Dichmont et al. 2016 for review). SCAA models consist of three closely linked modules: the population dynamics module, an observation module, and a likelihood function. Input biological parameters (**Section 2.2**) are used to propagate abundance and biomass forward from initial conditions (population dynamics model) and Stock Synthesis develops expected data sets based on estimates of fishing mortality (*F*), selectivity, and catchability (the observation model). The observed and expected data are compared (the likelihood module) to determine best fit parameter estimates using a statistical maximum likelihood framework (detailed in Methot and Wetzel [2013]). Because many inputs are correlated, the concept behind Stock Synthesis is that processes should be modeled together, which helps to ensure that uncertainties in the input data are properly accounted for in the assessment.

The SEDAR 68 OA Base Model was similar in configuration to the SEDAR 68 RW Base Model, the assessment model resulting from the SEDAR 68 Research Track Assessment (see **Section 4.8.6** for a discussion on differences). The fully configured model included observations of catch and discards for four fishing fleets (Commercial Vertical Line, Commercial Longline, Recreational Charter Private, and Recreational Headboat). The model included three fishery dependent CPUE indices of abundance (pre-IFQ Vertical Line CPUE, Headboat CPUE, and RFOP Vertical Line Survey) and one fishery independent time series (Combined Video Survey).

The Stock Synthesis modeling framework provides estimates for key derived quantities including: time series of recruitment (units: 1,000s of age-0 recruits), abundance (units: 1,000s of fish), biomass (units: metric tons), SSB (units for Scamp: male and female combined SSB in metric tons), and exploitation or harvest rate (units for Scamp: total biomass killed all ages / total biomass age 3+). The r4ss software (Taylor et al. 2021) was utilized extensively to develop various graphics for model outputs and was also used to summarize various output files and perform diagnostic runs. The ss3diags software (Carvahlo et al. 2021) was also used to perform additional diagnostics requested and reviewed during the Research Track Assessment Review Workshop.

Projections are implemented within Stock Synthesis starting from the year succeeding the terminal year of the assessment model utilizing the same population dynamics equations and modeling assumptions.

3.1.1. Initial Conditions

The Gulf of Mexico Scamp assessment begins in 1986 and has a terminal year of 2020. Since removals of Scamp are known to have occurred in the Gulf of Mexico prior to 1986 for both commercial and recreational fisheries, the stock was not assumed to be at equilibrium and initial conditions were estimated from initial equilibrium catches (specified as the mean landings over the first five years, 1986-1990). Following the SEDAR 68 RW Base Model, an initial *F* for the Recreational Headboat fleet was not estimated in the SEDAR 68 OA Base Model. This parameter bounded out near zero due to very minimal catches by this fleet (**Figure 4**), even after correcting the landings as discussed in **Section 2.3.2**.

3.1.2. Temporal Structure

The Scamp population was modeled from age-0 (Stock Synthesis starts at age-0; Methot et al. 2022) through age-34 (the maximum age), with data bins spanning age-0 through age-20+, with the last age representing a plus group (encompassing only 3% of otoliths). Data collection and fishing activities were assumed relatively continuous throughout the year; therefore, inclusion of a seasonal component to the removals was not deemed necessary. The fishing season was assumed to be continuous and homogeneously distributed throughout the year.

3.1.3. Spatial Structure

A single area model was implemented where recruits are assumed to homogeneously settle across the entire Gulf of Mexico region.

3.1.4. Life History

A fixed length-weight relationship was used to convert body length (cm Fork Length, cm FL) to body weight (kg gutted weight; **Table 1, Figure 2A**). Stock Synthesis moves fish among age classes and length bins on January 1st of each modeled year starting from birth at age-0. Because the ‘true’ birth date often does not occur on January 1st, with peak spawning occurring around April 15th for Scamp in the Gulf of Mexico, some slight alterations in growth (t_0, or the age at length 0) and *M* parameters are required to account for the difference between true age and modeled age when parameters are input as fixed parameters instead of estimated within Stock Synthesis.

Growth within Stock Synthesis was modeled with a three parameter von Bertalanffy equation: (1) L_{Amin} (cm FL), the mean size at age-1 Scamp; (2) L_{Amax} (cm FL), the mean size at maximum aged Scamp (34 years); and (3) K (year^{-1}), the growth coefficient. In Stock Synthesis, when fish recruit at the real age of 0.0 they have a body size equal to the lower limit of the first population bin (fixed at 3 cm FL for Scamp). Fish then grow linearly until they reach a real age equal to the input value of A_{min} (growth age for L_{Amin}; age-1 for Scamp) and have a size equal to L_{Amin}. As they age further, they grow according to the von Bertalanffy growth equation (**Figure 2B**). L_{Amax} was specified as equivalent to $L\infty$. Two additional parameters are used to describe the variability in size-at-age and represent the CV in length-at-age at A_{min} (age-1) and A_{max} (age-34). For intermediate ages, a linear interpolation of the CV on mean size-at-age is used if the CV varies with age or size.

Following the Life History TWG recommendations (**Section 2.2.2**), the three von Bertalanffy parameters (L_{Amin}, L_{Amax} [i.e., $L\infty$], and K) were estimated within the SEDAR 68 OA Base Model using normal priors based on the input values (and SD) recommended by the SEDAR 68 Research Track Assessment Data Workshop (**Table 2**). Attempts to also estimate CV_{Amin} and CV_{Amax} led to less variability for older Scamp compared to younger Scamp, a result which was considered unrealistic and likely due to lower sample sizes for older Scamp.

Also following the Life History TWG recommendations (**Section 2.2.3**), age-specific M was specified in the SEDAR 68 OA Base Model using the Lorenzen option in Stock Synthesis and a reference age of 10 years (**Table 4, Figure 2C**). The M point estimate for a 10-year old Scamp was obtained from the externally estimated age-specific vector of M (**Section 2.2.3**). This approach to modeling M was recommended by the Life History TWG because it uses the growth curve estimated within Stock Synthesis (as opposed to the fixed external growth curve which may be inconsistent with the growth curve estimated within Stock Synthesis).

The assessment model was set-up with two sexes to account for the reproductive biology of Scamp. As protogynous hermaphrodites, Scamp are born female (i.e., 100% female at birth), and starting at age-3, a portion of the population transitions to male. The two-sex model treated males and females identically, and data were input as combined due to the lack of sex-specific fisheries data. Immature females transitioned to mature females based on a fixed logistic function of age (**Section 2.2.4**; **Figure 2D**). The three required parameters to define the hermaphroditism transition rate (inflection age = 21.525, SD in age = 10.141, and asymptote = 0.891) were estimated externally to Stock Synthesis (**Section 2.2.5**) and fixed in the assessment model (**Figure 2E**). Reproductive potential was defined in terms of male and female combined SSB (i.e., SSB equivalent to body weight, **Section 2.2.6**; **Figure 2F**).

3.1.5. Recruitment Dynamics

A Beverton-Holt stock-recruit function was used to parametrize the relationship between spawning output and resulting recruitment of age-0 fish. The stock-recruit function (representing the arithmetic mean spawner-recruit levels) requires three parameters: (1) steepness (h) characterizes the initial slope of the ascending limb (i.e., the fraction of virgin recruits produced at 20% of the equilibrium spawning biomass); (2) the virgin recruitment (R_0, estimated in log space; $\ln(R_0)$) represents the asymptote or virgin recruitment levels; and (3) the variance or recruitment variability term (*sigmaR*) is the SD of the log of recruitment (it both penalizes deviations from the spawner-recruit curve and defines the offset between the arithmetic mean spawner-recruit curve and the expected geometric mean from which the deviations are calculated). Similar to the SEDAR 68 RW Base Model, steepness was fixed at 0.694 in the SEDAR 68 OA Base Model, while ln(R_0) and *sigmaR* were estimated.

Annual deviations from the stock-recruit function were estimated in Stock Synthesis as a vector of deviations forced to sum to zero and assuming a lognormal error structure. A lognormal bias adjustment factor was applied to recruitment estimates as recommended by Methot et al. (2022), but only to the data-rich years in the assessment. This was done so that Stock Synthesis will apply the full bias-correction only to those recruitment deviations that have enough data to inform the model about the full range of recruitment variability (Methot et al. 2022). For the SEDAR 68 OA Base Model, no recruitment deviations were estimated in the early period (i.e., pre-1986) or in the last three terminal years (2018-2020) because recent composition data contains little information on recruitment. Full bias adjustment was used from 1987 to 2016 when length or age composition data are available. Bias adjustment was phased in linearly, from no bias adjustment prior to 1972 (note that the model starts in 1986) to full bias adjustment in 1987. Bias adjustment was phased out in 2016, decreasing from full bias adjustment to no bias adjustment in 2025. The years selected for full bias adjustment were estimated following the methods of Methot and Taylor (2011).

3.1.6. Fleet Structure and Surveys

Four fishing fleets were modeled and had associated length and age compositions. The fleets were: Commercial Vertical Line (ComVL), Commercial Longline (ComLL), Recreational Charter Private (Charter_Private), and Recreational Headboat (Headboat). Fleet structure was determined during the Research Track Assessment, and was based on comparisons of length distributions between gears (commercial) or modes (recreational) and resulting sample sizes of available length and age composition data.

Three fishery-dependent CPUE indices were included in the SEDAR 68 OA Base Model: pre-IFQ Vertical Line CPUE (units: biomass kept per hook hour), SRHS Headboat CPUE (units: number kept per angler hour), and RFOP Vertical Line Survey (units: number kept or discarded per line hour). CPUE was treated as an index of biomass or abundance where the observed standardized CPUE time series was assumed to reflect annual variation in population trajectories. Both the pre-IFQ Vertical Line CPUE and SRHS Headboat CPUE indices were of landings only, and the selectivity of each was assumed identical to the associated fleet. The RFOP Vertical Line Survey was input as a survey into the model because it sampled both discarded and retained Scamp and was based on a statistically sound sampling approach. The length composition for this survey was fit directly based on the estimated length-based selectivity function.

A single fishery-independent survey, the Combined Video Survey, was included in the SEDAR 68 OA Base Model. This survey was treated in the same way as CPUE indices, except that it had its own unique selectivity function estimated from length composition data. The Combined Video Survey index was believed to reflect abundance of juveniles and adults. Because no age information was available for the survey, the length composition was fit directly based on the estimated length-based selectivity function.

3.1.7. Selectivity

Selectivity represents the probability of capture by age or length for a given fleet and represents the net result of multiple interrelated factors (e.g., gear type, targeting, and availability of fish due to spatial and temporal constraints). Stock Synthesis allows users to specify length-based selectivity, age-based selectivity, or both. The final selectivity curve governing each fleet/survey reflects the additive effect of both age- and length- based processes.

Selectivity patterns were assumed to be constant over time for each fleet and survey. The Gulf of Mexico Scamp fishery has experienced changes in management regulations over time (**Figure 11**), which were assumed to influence the discard patterns more so than selectivity. As such, these changes were accounted for in the assessment model using time-varying retention patterns (**Section 3.1.8**) and modeling discards explicitly (**Section 3.1.10**).

3.1.7.1. Length-based Selectivity

Length-based selectivity patterns were specified for each fleet and survey and were characterized as one of two functional forms:

1. a two-parameter logistic function - a logistic curve implies that fish below a certain size range are not vulnerable, but then gradually increase in vulnerability with increasing size until all fish are fully vulnerable (asymptotic selectivity curve). Two parameters describe logistic selectivity: (1) the length at 50% selectivity, and (2) the difference between the length at 95% selectivity and the length at 50% selectivity.

2. the six-parameter double normal function - the double normal has the feature that it allows for domed or logistic selectivity and is a combination of two normal distributions; the first describes the ascending limb, while the second describes the descending limb. A line segment joins the maximum selectivity of the two functions. However, the double normal functional form can be more unstable than other selectivity functions due to the increased number of parameters. When robust length or age compositions are available with sufficient numbers of larger or older fish, it may be appropriate to freely estimate all parameters (especially the descending limb). If that is not the case, certain parameters can be fixed to improve model stability as long as fixing the parameter does not largely influence the point estimates of the remaining selectivity parameters. Unless strong evidence exists for domed selectivity, it is generally advisable to use the logistic function.

In the SEDAR 68 OA Base Model, length-based selectivity patterns were defined for each fleet/survey: 1) Commercial Vertical Line (logistic), 2) Commercial Longline (logistic), 3) Recreational Charter Private (double normal), 4) Recreational Headboat (double normal), 5) Combined Video Survey (logistic), and 6) RFOP Vertical Line Survey (logistic). Selectivity patterns for the commercial fleets were based on catch curve analysis conducted during the Research Track Assessment. Double normal selectivity was implemented for both recreational fleets because dome-shaped selectivity was considered highly likely due to areas fished (e.g., closer to shore, shallower) and targeting behavior. Logistic selectivity was assumed for both the Combined Video Survey and the RFOP Vertical Line Survey, since both surveys encountered Scamp throughout their size range. All selectivity parameters were freely estimated, although exploratory runs were conducted which either used priors or fixed unstable parameters to reduce correlation and remove highly uncertain parameters. While these sensitivity runs displayed less variability in the jitter analysis (as one would expect), ultimately freely estimating all parameters was retained in the SEDAR 68 OA Base Model because it better highlights the uncertainty in the assessment model.

3.1.7.2. Age-based Selectivity

Age-based selectivity was specified for the Commercial Vertical Line, Commercial Longline, Combined Video Survey, and the RFOP Vertical Line Survey. Given that the spatial extent of these fleets/surveys did not overlap with age-0 Scamp habitat, age selectivity was restricted to ages 1+. The recreational fleets specified full selection across all ages since small Scamp (potentially age-0) were discarded according to the FWRI At-Sea Observer data.

3.1.7.3. Mirroring

The age and length-based selectivity patterns of the pre-IFQ Vertical Line CPUE and Headboat CPUE indices were assumed to mirror the selectivity pattern of their respective fleets.

3.1.8. Retention

Each of the directed fleets was assumed to have regulatory discards based on selection (catch) of fish below the minimum size limit (**Figure 11**). Time-varying retention functions are commonly used in Gulf stock assessments to allow for varying discards at size due to the impacts of fishery minimum size limits and bag limits. For Scamp, time blocks were based on changes in the minimum size limits (federal and the state of Florida) and the implementation of the Grouper-Tilefish Individual Fishing Quota (IFQ) program in 2010.

For each fleet, the retention function was specified as a logistic function consisting of four parameters: (1) the inflection point, (2) the slope, (3) the asymptote, and (4) the male offset inflection (not applicable to this model and assumed to be zero). Before the implementation of the size limit (i.e., pre-1990), all fish caught were assumed to be retained (i.e., landed) for the Commercial Vertical Line, Commercial Longline and Recreational Headboat fleets. Recreational Charter Private discard estimates were provided starting in 1982, which shows that some discarding did occur prior to the implementation of management regulations. Prior to the implementation of the commercial IFQ (pre-2010), all fish above the size limit were assumed to be retained. However, after the implementation of the commercial IFQ, the asymptote parameter was estimated because of potential discarding of fish above the size limit (e.g., due to lack of quota). The asymptotes of the retention function for each time block for both recreational fleets were estimated which allowed for less than 100% retention due to bag limits and other restrictions.

The parameters for the time varying retention blocks for the commercial fleets were treated as:

Time Block	Inflection	Slope	Asymptote
pre-1990	0	Fixed at 1 (knife-edge)	Fixed at Maximum
1990-1998	Estimated; started at Florida size limit of 20 inches TL	Estimated	Fixed at Maximum

Time Block	Inflection	Slope	Asymptote
1999-2002	Estimated (inconsistent federal and Florida size limits of 16 and 20 inches TL, respectively)	Estimated	Fixed at Maximum
2003-2009	Estimated; started at federal and Florida size limit of 16 inches TL	Estimated	Fixed at Maximum
2010-2020	Estimated; started at federal and Florida size limit of 16 inches TL	Estimated	Estimated (due to IFQ)

The parameters for the time varying retention blocks for the recreational fleets were treated as:

Time Block	Inflection	Slope	Asymptote
Charter Private pre-1990	Fixed at 35 (peak of retained)	Fixed at 0.5 (knife-edge)	Fixed at Maximum
Headboat pre-1990	0	Fixed at 1 (knife-edge)	Fixed at Maximum
1990-1998	Estimated; started at Florida size limit of 20 inches TL	Estimated	Estimated
1999-2002	Estimated (inconsistent federal and Florida size limits of 16 and 20 inches TL, respectively)	Estimated	Estimated
2003-2020	Estimated; started at federal and Florida size limit of 16 inches TL	Estimated	Estimated

3.1.9. Landings and Age Compositions

Landings by fleet and associated length and age compositions were estimated using fleet-specific continuous fishing mortality rates and length-specific selectivity curves following Baranov’s catch equation.

The commercial landings were assumed the most representative and reliable data source in the model, especially over the most recent time period, because this information was collected in the form of a census as opposed to being collected as part of a survey. The commercial landings were assumed to have a lognormal error structure, with a log-scale SE of 0.05 assumed for the pre-IFQ period and a log-scale SE of 0.01 assumed for the post-IFQ period (**Section 2.3.1**). The recreational landings were assumed to be less precise than the commercial landings. For each recreational fleet, the input log-scale SEs were set at 0.3 to reflect greater uncertainty. While annual CV estimates were provided for recreational landings (**Tables 7A-7B**), sensitivity runs incorporating such large uncertainty estimates during the Research Track Assessment revealed poor diagnostics, which precluded their use in the SEDAR 68 RW Base Model.

A new feature available for fitting composition data in Stock Synthesis is the Dirichlet Multinomial (DM) which differs from the standard multinomial in that it includes an estimable parameter (theta) which scales the input sample size (Thorson et al. 2017a; Methot et al. 2022). The DM is self-weighting, which avoids the potential for subjectivity as when the Francis re-weighting procedure is applied (Francis 2011). The DM approach also allows for observed zeros in the data, and the effective sample sizes calculated are directly interpretable. The DM uses the input sample sizes directly, adjusted by an estimated variance inflation factor. The more positive the inflation factor, the more weight the data carry in the likelihood. The DM is considered an improved practice and recommended for use by the Stock Synthesis model developers, and was first used in a Gulf stock assessment in 2020 for SEDAR 70 Gulf of Mexico Greater Amberjack. A normal prior was used on the DM parameters of 0 (SD = 1.813), which is recommended to counteract the effect of the logistic transformation between the DM parameter and the data weighting (Methot et al. 2022). While the SEDAR 68 RW Base Model included a DM for each fleet/data type combination, this decision was revisited during the OA after input from the Stock Synthesis developers that similar fleets with similar data collection programs should share DM parameters.

Because Stock Synthesis models the growth internally and tracks individual fish from birth, it actually grows fish by length bins before eventually converting to age (based on the growth curve). As such, it is possible to fit both age and length compositions. For SEDAR 68, the age and length composition data for each fleet/survey were assumed to follow a Dirichlet Multinomial error structure where sample size represented the number of trips, adjusted by an estimated variance inflation factor. Input sample sizes were related to the number of trips/sets rather than the number of measurements taken because using the number of lengths can overestimate sample sizes in fisheries data, as samples are rarely truly random or independent (Hulson et al. 2012). In addition, using higher effective sample sizes can lead to the composition data dominating the likelihood and reduce fit to other data sources. The final effective sample sizes for each year are provided on the figures illustrating the length and age compositions (given by N adj in each panel) in **Sections 4.7.4-4.7.5**.

3.1.10. Discards

Discard data for each fleet were directly fit in the model using size-based retention functions, and a log-normal error structure was assumed. The model estimated total discards based on the selectivity and retention functions, then calculated dead discards based on the discard mortality rate (**Sections 2.2.7, 2.3.3-2.3.4**).

3.1.11. Indices

The indices are assumed to have a lognormal error structure. The CVs provided by the index standardization were converted to log-scale SEs required for input to Stock Synthesis for lognormal error structures (**Section 3.2**). The interannual variation in the Combined Video Survey (mean SE = 0.14) and RFOP Vertical Line Survey (mean SE = 0.13) indices was estimated through the index standardization techniques and was used to inform the error around the final observed index values. For the pre-IFQ Commercial Vertical Line and Recreational

Headboat CPUE indices (both landings only), the SEs were scaled to a mean SE of 0.2 (sensu Francis et al. 2003) across the entire time series, but the relative annual variation was maintained in the scaling. This is a more appropriate approach than using the output SE from the standardization routine directly in Stock Synthesis because CPUE indices can often have artificially low error estimates. An extra SD parameter was estimated for each index and added to the input SD.

3.2. Goodness of Fit and Assumed Error Structure

A maximum likelihood approach was used to assess goodness of model fit to each of the data sources (e.g., catches, discards, indices, and length/age compositions). For each separate data set, an assumed error distribution and an associated likelihood component was specified, the value of which was determined by the difference in observed and expected values along with the assumed variance of the error distribution. The total likelihood was the sum of each individual component. A nonlinear iterative search algorithm was used to minimize the total negative log-likelihood across the multidimensional parameter space to determine the parameter values that provide the best fit to the data. With this type of integrated modeling approach, data weighting (i.e., the variance associated with each data set) can affect model results, particularly if the various data sets indicate differing population trends.

Where lognormal error structures were used, annual CVs associated with each of the data sources were converted to log-scale SEs where necessary using the approximation: $log_e(SE) = \sqrt{(log_e(1 + CV^2))}$ provided in Methot et al. (2022).

Weak penalty functions were implemented to keep parameter estimates from hitting their bounds, which includes a symmetric-beta penalty on selectivity parameters (Methot et al. 2022). Parameter bounds were set to be relatively wide and were unlikely to truncate the search algorithm.

Uncertainty in parameter estimates was quantified by computing asymptotic SEs for each parameter. Asymptotic SEs are calculated by inverting the Hessian matrix (i.e., the matrix of second derivatives) after the model fitting process (Methot and Wetzel, 2013). Asymptotic SEs provide a minimum estimate of uncertainty in parameter values.

3.3. Estimated Parameters

In all, 321 parameters were estimated for the SEDAR 68 OA Base Model, of which 244 were active parameters (**Table 11**). These parameters include: the three von Bertalanffy growth parameters (L_{Amin}, L_{Amax} [i.e., $L\infty$], and K), two stock-recruit relationship parameters (ln(R_0) and *sigmaR*), the stock-recruit deviations for the data-rich time period (1986-2017), initial *F* for the Commercial Vertical Line, the Commercial Longline, and the Recreational Charter Private fleets, year specific (1986-2020) *F* for each fleet, an extra SD parameter for each index of abundance (added to the input SE), two parameters informing logistic selectivity for each commercial fleet, the Combined Video Survey, and the RFOP Vertical Line Survey, six parameters informing selectivity for each recreational fleet, logistic retention parameters for each fleet, and 4 parameters informing the Dirichlet Multinomial length and age composition weightings (Combined Video Survey length, RFOP Vertical Line Survey length, commercial age, and recreational age).

3.4. Model Diagnostics

3.4.1. Residual Analysis

The main approach used to address model fit and performance was residual analysis of model fit to each of the data sets. Any temporal trends in model residuals (or trends with age or length for composition data) can be indicative of model misspecification and poor performance. It is not expected that any model will perfectly fit any of the observed data sets, but ideally, residuals will be randomly distributed and conform to the assumed error structure for that data source. Any extreme patterns of positive or negative residuals are indicative of poor model performance and potential unaccounted for process or observation error.

3.4.2. Correlation Analysis

High correlation among parameters can lead to flat likelihood response surfaces and poor model stability. By performing a correlation analysis, modeling assumptions that lead to inadequate model parameterizations can be highlighted. Because of the highly parameterized nature of stock assessment models, it is expected that some parameters will always be correlated (e.g., stock recruit parameters or growth parameters). However, a large number of extremely correlated parameters warrant reconsideration of modeling assumptions and parametrization. A correlation analysis was carried out and correlations with an absolute value greater than 0.7 were reported.

3.4.3. Likelihood Profiles

Likelihood profiles are used to examine the change in log-likelihood for each data source in order to address the stability of a given parameter estimate, and to see how each individual data source influences the estimate. The analysis is performed by holding the given parameter at a constant value and rerunning the model. This is repeated for a range of reasonable parameter values. Ideally, the graph of negative log-likelihood values against parameter values will give a well-defined minimum, indicating that data sources are in agreement. When a given parameter is not well estimated, the profile plot may show conflicting signals across the data sources. The resulting total likelihood surface will often be flat, indicating that multiple parameter values are equally likely given the data. In such instances, the model assumptions need to be reconsidered.

Typically, profiling is carried out for a few key parameters, particularly those defining the stock-recruit relationship. Profiles were carried out for ln(R_0), *sigmaR*, the initial F for each fishing fleet where estimated, and the von Bertalanffy growth parameters (L_{Amin}, L_{Amax} [i.e., $L\infty$], and K).

3.4.4. Jitter Analysis

Jitter analysis is a relatively simple method that can be used to assess model stability and to determine whether a global as opposed to a local minimum has been found by the search algorithm. All of the starting values are randomly altered (or 'jittered') by an input constant value and the model is rerun from the new starting values. If the resulting population trajectories across a number of runs converge to the same final solution, it can be reasonably assumed that a global minimum has been obtained. This process is not fault-proof and no guarantee can ever be made that the 'true' solution has been found or that the model does not contain misspecification. However, if the jitter analysis results are consistent, it provides additional support that the model is performing well and has come to a stable solution. For this assessment, a jitter value of 0.1 (10%) was applied to the starting values and 100 runs were completed.

3.4.5. Retrospective Analysis

Retrospective analysis evaluates the consistency of terminal year model estimates as it sequentially removes a year of data at a time and reruns the model. Mohn's Rho can be used to determine retrospective bias, with values between -0.15 to 0.2 considered acceptable for longer-lived species and values outside that range indicate an undesirable retrospective pattern (Hurtado-Ferro et al. 2015; Carvahlo et al. 2021). If the resulting estimates of derived quantities such as SSB or recruitment differ significantly, particularly if there is serial over- (+ Mohn's Rho) or underestimation (- Mohn's Rho) of any important quantities, it can indicate that the model has some unidentified process error, and requires reassessing model assumptions. Ideally, the difference in estimates will be slight and more or less randomly distributed above and below the estimates from the model with the complete data sets. In reality, small differences may exist between the new terminal year estimates and the updated estimates for that year in the model with the full data. Additional data, especially composition data, will improve estimates in years prior to the new terminal year because the information on cohort strength becomes more reliable. A five-year retrospective analysis was carried out. Retrospective forecasts were also evaluated to determine consistency between forward projections and subsequent updates with newly available data added one year at a time (Carvahlo et al. 2021).

3.4.6. Additional Diagnostics

Additional diagnostics using the R package 'SS3Diags' are presented following the recommendations of Carvahlo et al. (2021). Joint residual plots were used to assess goodness of model fit by identifying conflicting time series and auto-correlation of residual patterns via a Loess smoother (Winker et al. 2018; Carvahlo et al. 2021). Undesirably high root mean squared error (RMSE) were values which exceeded 30%. Model misspecification was evaluated by exploring patterns in residuals of indices and compositions using a runs test, which indicates the presence of nonrandom variation (Carvahlo et al. 2021). In addition, outlier data points were identified via the 3-sigma limit, where any points beyond this limit would be unlikely given random process error in the observed residual distribution (Carvahlo et al. 2021).

Prediction skill of the model was tested using the hindcasting cross-validation approach of Kell et al. (2021). The mean absolute scaled error (MASE; Hyndman and Koehler 2006) was calculated for a 5-year period for each data input where available. The MASE scales the mean absolute error (MAE) of forecasts (i.e., prediction residuals) to the MAE of a naïve in-sample prediction (Carvahlo et al. 2021). A skilled model would improve the model forecast compared to the baseline (i.e., random walk), with a MASE value of 0.5 indicative of a forecast being twice as accurate as the baseline and values >1 indicative of average model forecasts worse than the baseline (Carvahlo et al. 2021; Kell et al. 2021).

3.4.7. SEDAR 68 RW Base Model Sensitivity Runs

Sensitivity runs were first conducted with the SEDAR 68 RW Base Model to understand how changes in data inputs provided for the OA, either due to improvements in methodology or corrections, would have influenced model results. The following data inputs were included in this analysis:

1. *Updated mean weight of Scamp landed by each recreational fleet and error estimates, 1986-2017*. This run used the estimated average weights and updated error estimates derived for the OA (**Section 2.3.2**).
2. *2003-2012 age data with accompanying ageing error matrix*. This run replaced the placeholder age data used during the Research Track Assessment with the 2003-2012 age data and used the corresponding ageing error matrix recommended during the OA (**Section 2.2.2**).
3. *Updated headboat discard length compositions, 2005-2017*. This run used the discard length compositions provided for the OA, which used the lower edge of each bin (**Section 2.3.6**).
4. *Updated headboat landings (1986-2017), mean weight of landings (1986-2017), and discards (2000-2003)*. This run used the updated headboat data after including area 23 (NW Florida and Alabama), which was erroneously left out of data provision for the Research Track Assessment (**Sections 2.3.2 and 2.3.4**).

3.4.8. SEDAR 68 OA Base Model Sensitivity Runs

Sensitivity runs were conducted with the SEDAR 68 OA Base Model to investigate critical uncertainty in data and reactivity to modeling assumptions. An exhaustive evaluation of model uncertainty was not carried out, but the aspects of model uncertainty judged to be the most important for model performance and accuracy were investigated. Only the most important sensitivity runs are presented below, but many additional exploratory runs were also implemented. The order in which they are presented is not intended to reflect their importance; each run included here provided important information for developing or evaluating the base case model and alternate states of nature. Focus of the sensitivity runs was on population trajectories and important parameter estimates (e.g., recruitment).

Ageing error matrix - Methodology for developing the ageing error matrix, including model selection and assumptions of whether error was present in the expert reader ages, was a key discussion point by the Life History TWG. Additional details on the development of ageing error matrices for the OA are provided in SEDAR68OA-WP-04. Two sensitivity runs were conducted at the request of the Life History TWG:

1. *Ageing error matrix developed assuming linear bias, constant CV, and error in expert reader ages*. This run used the derived ageing error matrix when expert reader ages were assumed to have error (**Table 3**). This model exhibited the lowest Bayesian Information Criterion (BIC) of the scenarios tested (SEDAR68OA-WP-04).
2. *Ageing error matrix developed assuming curvilinear bias, curvilinear SD, and no error in expert reader ages*. This run used the derived ageing error matrix when expert reader ages were assumed to be without error (**Table 3**). This model exhibited the lowest AIC and BIC of the scenarios tested (SEDAR68OA-WP-04).

Jackknife of indices of abundance - The goal of these sensitivity runs was to determine if any single index of abundance was having undue influence on the model and causing tension with other data in terms of estimating parameters. The approach can be especially useful for identifying indices that may be giving conflicting abundance trend signals compared to the other indices. If removing a dataset leads to dramatically different results, it suggests that the dataset should be reexamined to determine if the sampling procedures are consistent and appropriate (e.g., an index may only be sampling a sub-unit of the stock and resulting abundance signals may only reflect a local sub-population and not the trend in the entire stock). Each index was removed and the model rerun. Additionally, all of the fishery-dependent indices were removed simultaneously. Other datasets (i.e., landings and compositional data) were deemed fundamentally necessary to stabilize the assessment and therefore their exclusion was not included in the jack-knife analysis (i.e., a full jackknife was not conducted).

4. Stock Assessment Model - Results

4.1. Estimated Parameters and Derived Quantities

Table 11 contains a summary of model parameters for the SEDAR 68 OA Base Model. Results included are expected parameter values and their associated CVs from Stock Synthesis, minimum and maximum bounds on parameters, and the prior type and densities assigned to each parameter (if a prior was used). Most parameter estimates and variances were reasonably well estimated (i.e., CV < 1). Of the 244 active parameters, 13 exhibited CVs above 1 and were poorly estimated, including 8 recruitment deviations, the asymptote of the Recreational Charter Private retention curve for the 1990-1998 and 1999-2002 time blocks, and the parameters defining the top, descending limb, and selectivity at the first bin for the Recreational Headboat fleet. No parameters were estimated near bounds.

4.2. Fishing Mortality

The exploitation rate (total biomass killed all ages / total biomass age 3+) for the entire stock and by fleet are provided in **Table 12** and **Figures 12-13**. Since 1986, the exploitation rate for the stock has averaged around 0.083, and ranged between 0.048 in 2000 to 0.129 in 2016 (**Figure 12**). The exploitation rate remained above the time series mean in the 1980s and early 1990s but dropped below for most years between 1994 and 2011. Since 2012, the exploitation rate has generally increased, peaking in 2016, and then hovered around the time series mean. The terminal year (2020) exploitation rate for the entire stock was 0.096, which is slightly above the time series mean.

Given the relatively recent start for this assessment (1986), all four fishing fleets have been exploiting this stock at varying levels throughout the time series (**Figure 13**). The exploitation rate for the Commercial Vertical Line fleet was largest on average (0.031) and ranged between 0.015 in 2011 (first year after implementation of the IFQ) to 0.058 in 1992. From 1992, the exploitation rate declined steadily until 2016, when the exploitation rate exceeded the time series mean (**Figure 13**). The Recreational Charter Private fleet also exhibited high exploitation on average (0.03), and increased considerably from 0.004 in 1995 to 0.082 in 2015 (**Figure 13**). The Commercial Longline fleet exhibited relatively low (average of 0.02) but variable levels of exploitation throughout the time series, ranging from 0.01 in 2011 (first year after implementation of the IFQ) to 0.036 in 1986. The Recreational Headboat fleet exhibited consistently low levels of exploitation (averaged 0.002) and peaked at 0.007 in 1989 (**Figure**

13). The terminal year (2020) exploitation rates for the Commercial Vertical Line, Commercial Longline, Recreational Charter Private, and Recreational Headboat fleets were 0.02, 0.02, 0.054, and 0.003, respectively (**Table 12**).

The exploitation rate for the stock (**Figure 12**) was driven largely by the commercial fleets in the 1980s and early 1990s, with the exception of 1986 which also revealed high exploitation by the Recreational Charter Private fleet (**Figure 13**). Starting in 2003, the Recreational Charter Private fleet was responsible for the highest exploitation rates for almost all years, particularly 2014 and 2015. High exploitation in 2016 was a function of increased exploitation by both commercial fleets along with the high exploitation by the Recreational Charter Private fleet.

4.3. Selectivity

Selectivity parameter estimates and associated uncertainty are listed in **Table 11** with the Label prefix "Size_". Most selectivity parameters for all fleets appeared well estimated (CV < 1; **Table 11**), with the exception of the parameters defining the width of the peak, the descending limb of the selectivity curve, and the selectivity at the first bin for the Recreational Headboat fleet.

Scamp were fully selected (> 95%) for at larger sizes for the commercial fleets compared to the recreational fleets (**Figure 14**). The Commercial Vertical Line fleet reached 50% selectivity around 49 cm FL (**Table 11**), with full selection by 66 cm FL (**Figure 14**). The Commercial Longline fleet reached 50% selectivity around 53 cm FL (**Table 11**), with full selection by 63 cm FL (**Figure 14**). The Recreational Charter Private fleet tended to select for smaller Scamp (30 cm FL), with selectivity leveling off at 76.2% for Scamp around 50 cm FL or larger (**Figure 14**). The Recreational Headboat fleet also selected for smaller Scamp (33 cm FL), with selectivity leveling off at 59% for Scamp around 44 cm FL or larger (**Figure 14**).

The derived age-based selectivity patterns illustrate that the recreational fleets select younger fish, with the Recreational Charter Private and Recreational Headboat fleets generally selecting Scamp 2+ years and 3+ years, respectively (**Figure 15**). In contrast, the Commercial Vertical Line and Commercial Longline fleets generally select for Scamp 10+ years and 11+ years, respectively. These results are in agreement with the observed age compositions from the four directed fleets given the increased proportion of younger fish in the recreational fishery. The Commercial Vertical Line and Commercial Longline fleets reached full selectivity (i.e., 95%) around ages 31 and 33, respectively. Selectivity for the Recreational Charter Private and Recreational Headboat fleets peaked at 94.9% for age-6 and 76.8% for age-6, respectively, and then declined slightly for older ages (**Figure 15**).

Selectivity for the RFOP Vertical Line Survey reached 50% selectivity around 44 cm FL (**Table 11**), with full selection above 57 cm FL (**Figure 14**). This translated into 50% selection by 7 years, and full selection by 18 years (**Figure 15**). Compared to the fleet, where selectivity was estimated based solely on retained Scamp, this survey selected for slightly smaller and younger Scamp, as expected, since it included discarded Scamp.

Selectivity of the Combined Video Survey reached 50% selection around 32 cm FL (**Table 11**), with full selection above 45 cm FL (**Figure 14**). This translated into general selection by age-3, and full selection by age-9 (**Figure 15**).

4.4. Retention

Retention parameter estimates and associated uncertainty are listed in **Table 11** with the Label prefix "Retain_". Most retention parameters for all fleets appeared well estimated (CV < 1; **Table 11**), except for the asymptotes for the 1990-1998 and 1999-2002 time blocks for the Recreational Charter Private fleet.

Fleet-specific terminal year (2020) selectivity, retention, discard mortality (constant at 0.47) and fraction of fish kept, dead and discarded for the Commercial Vertical Line fleet are shown in **Figure 16**. All Scamp caught prior to the implementation of regulations (1986-1989) were assumed to be retained and landed (**Figure 17**). An inflection point smaller than the Florida state size limit (20 inches TL, ~47 cm FL) of 35.6 cm FL was estimated starting in 1990 (**Table 11**) because no size limit existed in federal waters. The model estimated an inflection point of 33.4 cm FL, which was smaller than both the Florida state (20 inches TL) and federal (16 inches TL; ~38 cm FL) size limits between 1999 and 2002 (**Table 11**). After the size limits matched, the retention curve shifted toward larger Scamp around 35.9 cm FL starting in 2003 and 37.8 cm FL starting in 2010 (**Table 11**; **Figure 17**).The post-IFQ period retention curve reached an asymptote of 98.2% retention.

Fleet-specific terminal year (2020) selectivity, retention, discard mortality (constant at 0.68) and fraction of fish kept, dead and discarded for the Commercial Longline fleet are shown in **Figure 18**. All Scamp caught prior to the implementation of regulations (1986-1989) were assumed to be retained and landed (**Figure 19**). The inflection points were estimated around 36 cm FL between 1990 and 2009 (**Table 11**), and fell just below the federal size limit starting in 1999 (**Figure 19**). The retention curve for the post-IFQ period shifted to the largest Scamp, with an inflection point of 38.6 cm FL (**Table 11**), and reached an asymptote of 99.7% retention (**Figure 19**).

Fleet-specific terminal year (2020) selectivity, retention, discard mortality (constant at 0.26) and fraction of fish kept, dead and discarded for the Recreational Charter Private fleet are shown in **Figure 20**. All Scamp caught above 35 cm FL, which corresponds to the selectivity peak for this fleet (**Table 11**), were assumed to be retained and landed prior to the implementation of regulations in 1990 (**Figure 21**). An inflection point smaller than the Florida state size limit (20 inches TL, ~47 cm FL) of 41.2 cm FL was estimated starting in 1990 (**Table 11**) because no size limit existed in federal waters. The model estimated an inflection point of 43.1 cm FL between 1999 and 2002 (**Table 11**), which fell between the Florida state (20 inches TL) and federal (16 inches TL; ~38 cm FL) size limits. After the Florida state and federal size limit matched in 2003, the retention curve shifted to the smallest Scamp (38.7 cm FL; **Table 11**) at a very steep slope, and reached a maximum retention of 98.4% (**Figure 21**).

Fleet-specific terminal year (2020) selectivity, retention, discard mortality (constant at 0.26) and fraction of fish kept, dead and discarded for the Recreational Headboat fleet are shown in **Figure 22**. All Scamp caught prior to the implementation of regulations (1986-1989) were assumed to be retained and landed (**Figure 23**). An inflection point much smaller than the Florida state size limit (20 inches TL, ~47 cm FL) of 33.5 cm FL was estimated starting in 1990 (**Table 11**) because no size limit existed in federal waters. Between 1999 and 2002, the model estimated an inflection point of 36.6 cm FL (**Table 11**), which was just below the federal size limit, and a relatively low maximum retention of 67% (**Figure 23**). After the size limits matched, the inflection point increased slightly to 38 cm FL and the curve increased sharply to maximum retention of 99.2% (**Figure 23**).

4.5. Recruitment

As noted in **Section 3.1.5**, steepness was fixed at 0.694 as agreed upon during the SEDAR 68 Research Track Assessment Review Workshop. The corresponding Beverton-Holt stock recruit relationship is shown in **Figure 24**. The SEDAR 68 OA Base Model estimated a *sigmaR* (CV) of 0.562 (0.126) and ln(R_0) at 7.33 (0.004) (**Table 11**), which equates to 1.53 million age-0 Scamp.

The highest recruitments estimated by the SEDAR 68 OA Base Model occurred during 2000 (3.4 million age-0s), 2002 (3.31 million age-0s), 1999 (2.84 million age-0s), 2007 (2.61 million age-0s), and 1994 (2.39 million age-0s; **Table 13**; **Figures 24-25**). Between 1986 and 2017 (when recruitment deviations were estimated), estimated recruitment averaged 1.47 million Scamp and was lowest in 1986 at 0.4 million Scamp (**Figure 25**). Estimated recruits generally increased throughout the 1980s and 1990s, peaked in 2000, and then declined to below mean levels for most years between 2008 and 2017 (**Figure 25**). Recruitment deviations were characterized by a period of higher than average recruitment between 1989 and 2007 followed by a period of below average recruitment from 2009 to 2017, although the confidence intervals for some years overlapped with 0 (**Figure 26**). The asymptotic SEs for recruitment deviations averaged 0.292 between 1986 and 2017, and ranged from 0.137 in 2015 to 0.659 in 2001 (**Figure 27**). The estimated (and applied) recruitment bias adjustment ramp is shown in **Figure 28**.

4.6. Biomass and Abundance Trajectories

The estimated annual total biomass (metric tons), exploitable biomass (ages 3+, metric tons), SSB (metric tons), SSB ratio (SSB/virgin SSB) and exploitable abundance (ages 3+, 1,000s of fish) from 1986 to 2020 are provided in **Table 13**. Total biomass averaged 2,653 metric tons, and ranged from 1,719 metric tons in 2020 to 3,517 metric tons in 2003 (**Figure 29**). Exploitable (ages 3+) biomass and numbers averaged 2,272 metric tons and 2,069,754 Scamp, respectively. Exploitable biomass and numbers were lowest in 2020 at 1,383 metric tons and 1,035,711 Scamp, respectively, and peaked in 2005 at 2,999 metric tons and 3,130,016 Scamp, respectively (**Table 13**). SSB averaged 2,039 metric tons and ranged from 1,301 metric tons in 2020 to 2,653 metric tons in 2007 (**Figure 30**). Both total biomass and SSB declined early on in the time series, increased gradually from 1990 to a peak in 2003, and have since declined (**Figures 29-30**).

The SSB ratio averaged 0.54, and ranged from 0.34 in 2020 to 0.7 in 2007 (**Table 13**). The estimated SSB ratio remained above 0.4 for all years until 2018, where it declined to its lowest level at 34% of the corresponding virgin spawning stock biomass in 2020 (**Table 13**).

Estimated SSB (metric tons), exploitable biomass (ages 3+, metric tons), and exploitable abundance (1,000s of fish) by sex are provided in **Table 14**. Also included is the expected sex ratio of exploitable male to female Scamp, which averaged 17.1% and ranged from 11.3% in 2003 to 27.5% in 2017 (**Table 14**). The sex ratios expected by the model were lower than those observed in the field (**Section 2.2.6**), however the trends were similar, with lower sex ratios expected during the 1990s and higher sex ratios expected in the 2010s. The mean age of female Scamp approached 3 years in the late 1980s and the mid-2000s to 2014, but dropped to around 2 years during the remainder of the time series (**Figure 31**). The most abundant age class of female

Scamp was age-0 in most years, with the exceptions of 1986, 1995, 1998, 2001, 2003, 2008, and 2016 where age-1 abundance was larger and 2004, 2009, and 2017 where age-2 abundance was larger (**Table 15A**, **Figure 32**). In contrast, the age classes with the greatest biomass of female Scamp varied between age-1 in 1990-91, 2000-01 and 2016 to age-8 in 2015 (**Table 15B**; **Figure 33**). Age-2 through age-4 female Scamp dominated the biomass in many years (**Figure 33**).

The mean age of male Scamp ranged between 11 years in the mid-1990s to 2000s to nearly 14 years in recent years (**Figure 31**). The most abundant age class of male Scamp was between ages 9-10 but varied between age-6 in 2006 to age-13 in 2015, with the plus group (ages-20+) dominating in 2020 (**Table 16A**, **Figure 34**). The age classes with the greatest biomass of male Scamp varied between age-9 in 2009 to age-14 in 2008, with the plus group dominating male Scamp biomass in most years (**Table 16B**; **Figure 35**).

The expected numbers-at-age and biomass-at-age of female and male Scamp at virgin conditions are shown in **Figure 36**. The sex ratio expected by the model at virgin conditions was 32.2%. At virgin conditions, age-0 and age-4 female Scamp dominated in numbers and biomass, respectively, whereas age 20+ male Scamp were most abundant and dominated biomass (**Figure 36**).

4.7. Model Fit and Residual Analysis

4.7.1. Landings

The landings for the Commercial Vertical Line and Commercial Longline fleets were fit almost exactly given their relatively small SEs (**Tables 17-18**, **Figure 37**). The mean weight of Scamp landed over time by the Commercial Vertical Line fleet averaged 4.7 gutted pounds and ranged from 4.2 in 1986-87 (before implementation of size limits; **Figure 11**) and 1999 to 5.4 since 2017 (**Table 17**). The Commercial Longline fleet tended to retain larger Scamp, with the mean weight of landed Scamp over time averaging 5.7 gutted pounds and ranging from 5.3 in 1999-2000 to 6.4 since 2019 (**Table 18**). Given the large SEs assigned to the Recreational Charter Private landings, there were considerable differences between input and expected landings in numbers for this fleet (**Table 19**, **Figure 37**). The model expected lower Recreational Charter Private landings in 1987, the mid- to late-1990s, the mid-2000s, and since 2015, but higher landings around 2004, the late 2000s, and around 2014 (**Figure 37**). The mean weight of Scamp landed over time by the Recreational Charter Private fleet averaged 3.6 gutted pounds and ranged from 2.9 in 1986-88 (before implementation of size limits; **Figure 11**) to 4 in the early 1990s and 2017-18 (**Table 19**). These expected estimates remained within the confidence intervals of the input mean weight for the majority of years (**Figure 38**). Even though landings for the Recreational Headboat fleet had relatively large SEs, the expected landings were generally similar to the input landings (**Table 20**, **Figure 37**). The mean weight of Scamp landed over time by the Recreational Headboat fleet was the smallest of the fleets, averaging 3 gutted pounds, and ranged from 2.3 in 1986 (before implementation of size limits; **Figure 11**) to 3.7 between 2016-18 (**Table 20**). These expected estimates remained within the confidence intervals of the input mean weight for the majority of years (**Figure 39**).

4.7.2. Discards

Commercial Vertical Line discards were estimated with a large assumed uncertainty (**Table 21**), and therefore were characterized by large confidence intervals (**Figure 40**). The model fit fairly well to the total discards in many years, although higher total discards were expected between 2003 and 2005 (**Figure 40**). Dead discards were very minor (mean: 2% of biomass, 5% of numbers) compared to landings (**Figure 41**). Total discards expected by the model averaged 3,752 Scamp (1,763 dead) and peaked at 8,314 Scamp (3,908 dead) in 1993 (**Table 21**). Expected total discard biomass averaged 4,802 gutted pounds (2,257 gutted pounds dead) and peaked at 10,408 gutted pounds (4,892 gutted pounds dead) in 1997 (**Table 21**). The mean weight of Scamp discarded over time by the Commercial Vertical Line fleet averaged 1.7 gutted pounds (**Table 21**).

Commercial Longline discards were also estimated with a large assumed uncertainty (**Table 22**) and were characterized by large confidence intervals (**Figure 42**). The model fit fairly well to the total discards in many years, although the model expected higher total discards between 2003 and 2005 and underestimated discards from 2014 to 2019 (**Figure 42**). Dead discards were very minor (mean: 1% of biomass, 2% of numbers) compared to landings (**Figure 43**). Total discards expected by the model averaged 555 Scamp (377 dead) and peaked at 1,093 Scamp (743 dead) in 2004 following the implementation of a consistent size limit between Florida state and federal waters (**Table 22**). Expected total discard biomass averaged 898 gutted pounds (611 gutted pounds dead) and peaked at 1,631 gutted pounds (1,109 gutted pounds dead) in 2016 (**Table 22**). The mean weight of Scamp discarded over time by the Commercial Longline fleet averaged 2.1 gutted pounds (**Table 22**).

The total discards for the Recreational Charter Private fleet were highly variable and uncertain, and as a result the model had difficulty fitting in some years (**Figure 44**). Compared to landings, dead discards in terms of biomass and numbers accounted for far less removals (mean: 11% of biomass, 27% of numbers; **Figure 45**). Expected total discards averaged 45,424 Scamp (11,810 dead) and 53,443 gutted pounds (13,895 gutted pounds dead), and peaked at 112,144 Scamp (29,157 dead) and 129,402 gutted pounds (33,645 gutted pounds dead) in 2004 following the implementation of a consistent size limit between Florida state and federal waters (**Table 23**). The mean weight of Scamp discarded over time by the Recreational Charter Private fleet averaged 1.2 gutted pounds (**Table 23**).

For the Recreational Headboat, the model fit pretty well to total discards throughout much of the time series (**Figure 46**). Compared to landings, dead discards in terms of biomass and numbers accounted for far less removals (mean: 7% of biomass, 14% of numbers; **Figure 47**). Expected total discards averaged 1,582 Scamp (411 dead) and 2,098 pounds (545 pounds dead) and peaked at 3,796 Scamp (987 dead) and 4,277 pounds (1,112 pounds dead) in 2003 (**Table 24**). The mean weight of Scamp discarded over time by the Recreational Headboat fleet averaged 1.4 gutted pounds (**Table 24**).

4.7.3. Indices

Observed and expected CPUE are provided in **Tables 25-26** and **Figures 48-51**. The model fit best to the Recreational Headboat index (RMSE = 0.231, extra SD parameter = 0.029; **Table 11**). Expected relative abundance fit fairly well to observed abundance, as both peaked in 1986, declined to below average values for some of the 1990s and 2000s, and remained below the time series mean since 2013 (**Figure 50**). This index exhibited a relatively moderate correlation of 0.42 with the expected SSB. The model also fit the Combined Video Survey index fairly well (RMSE = 0.285, extra SD parameter = 0.11; **Table 11**). This index exhibited the highest correlation of 0.68 with the expected SSB. Expected relative abundance from this survey increased until 2004 and then declined until 2019 (**Figure 51**). Poor fits were evident for the RFOP Vertical Line Survey index (RMSE = 0.382, extra SD parameter = 0.254; **Table 11**), and to a lesser extent to the pre-IFQ Commercial Vertical Line index (RMSE = 0.26, extra SD parameter = 0.06; **Table 11**). Both of these indices were relatively flat throughout the time series and exhibited little contrast (**Figures 48, 49**) and were poorly correlated with the expected SSB (pre-IFQ ComVL = -0.1; RFOP VL = -0.12).

4.7.4. Length Compositions

Overall, the quality of the model fit to observed length composition varied among the fleets and surveys, as well as between retained and discarded length compositions within fleets (**Figures 52-61**). Aggregated across years, the expected length compositions were similar to the observed compositions for most fleets and surveys (**Figure 62**). Fits to retained length compositions were often better than to discarded length compositions for each fleet, although sample sizes were notably smaller for discard length compositions (discussed below).

Annual fits to retained length compositions for the Commercial Vertical Line fleet were generally good, with expected and observed peaks corresponding in many years (**Figure 52**). Some early years exhibited small sample sizes and therefore jagged compositions differing from the expected compositions. Although the Pearson residuals were generally small (min = -2.47, max = 4.3), some patterns were evident such as observing more smaller Scamp (large positive residuals) in the late 1990s and early 2000s, larger Scamp in the mid-2000s, and more Scamp just below the size limits from 2005 to 2013. While sample sizes were relatively low for the discard compositions, resulting in poor fits in some years, Pearson residuals did not show any concerning magnitudes (min = -1.78, max = 3.9) or patterns (**Figure 53**).

Annual fits to retained length compositions for the Commercial Longline fleet were also generally good, with both expected and observed peaks around 50 cm FL in many years (**Figure 54**). Although the Pearson residuals were relatively small (min = -1.57, max = 6.04) with the exception of 1986 where more smaller Scamp were observed, some patterns were evident. Clusters of more observed Scamp were identified around 60 cm FL in the late-2000s and around 40 cm FL near the end of the time series. Given limited sample sizes in most years, only a few years of discard length compositions were fit by the model and showed good agreement between expected and observed peaks just below 40 cm FL but poor correspondence for smaller Scamp (**Figure 55**). Residuals did not reveal any concerning magnitudes (min = -1.49, max = 2.28) or strong patterns. When estimated, the Dirichlet parameter for commercial length compositions bounded out near 5 and did not result in very different sample sizes from the inputs, suggested that input sample sizes were appropriate for each commercial fleet (**Table 11**).

Annual fits to retained length compositions for the Recreational Charter Private fleet showed more variability in quality, with some years exhibiting good fits (e.g., 1999-2007), but others showing poor correspondence and jagged compositions (e.g., 2008-2019; **Figure 56**). The Pearson residuals were relatively large (min = -3.15, max = 5.7) and showed some patterning.

For example, more observed Scamp (larger positive residuals) were evident around 40 cm in 2011 and then increased in size over time. For the annual discard length compositions, the model generally expected peak composition in agreement with the data of Scamp for some years (**Figure 57**). Residuals did not reveal any concerning magnitudes (min = -1.8, max = 3) or patterns.

Annual fits to retained length compositions for the Recreational Headboat fleet also showed more variability in quality and very variable sample sizes between years (**Figure 58**). Many years exhibited good agreement between expected and observed peaks in composition while the most recent years showed poor correspondence. The Pearson residuals were also very large (min = -2.87, max = 10.76) and showed some patterns, with more observed Scamp (larger positive residuals) below the size limit during the 2000s and more larger Scamp observed in the most recent years. For the annual discard length compositions, the model generally expected peak composition close to the peak observed (**Figure 59**). Residuals did not reveal any concerning magnitudes (min = -2.76, max = 3.95) or patterns. When estimated, the Dirichlet parameter for recreational length compositions bounded out near 5 and did not result in very different sample sizes from the inputs, suggested that input sample sizes were appropriate for each recreational fleet (**Table 11**).

Annual fits to length compositions for the Combined Video Survey showed more variability in quality and very variable sample sizes between years (**Figure 60**). Some early years exhibited good agreement between expected and observed peaks in composition whereas years such as 2017 through 2019 showed poor correspondence. The Pearson residuals were relatively large in some years (min = -1.9, max = 6.59) and showed some patterns, such as observing more Scamp around 20 cm FL for much of the time series. The estimated Dirichlet parameter of 4.44 did not result in very different sample sizes from the inputs, suggested that input sample sizes were appropriate (**Table 11**).

Annual fits to length compositions for the RFOP Vertical Line Survey showed considerable variability in terms of agreement between observed and expected compositions (**Figure 61**). While some years showed good agreement of peak composition (e.g., 2012-2013), the model expected smaller compositions in 2008 and 2017 but larger composition in 2010. The Pearson residuals were relatively large (min = -2.89, max = 4.55) but did not show any strong patterns. The estimated Dirichlet parameter of -1.88 resulted in very different sample sizes, suggested that input sample sizes were too large (**Table 11**).

4.7.5. Age Compositions

Annual fits to nominal age compositions for the Commercial Vertical Line fleet showed considerable variability and sometimes poor agreement between observed and expected compositions (**Figure 63**). While more recent years (2012+) showed good agreement of peak composition, poor fits were more prevalent in the 1990s and 2000s. The Pearson residuals did not reveal any strong patterns or concerning magnitudes (min = -2.38, max = 3.44; **Figure 63**). Differences in observed (range: 6 to 12 years) and expected (range: 9 to 11 years) mean age were variable for the Commercial Vertical Line fleet, although the expected mean age remained within the 95% confidence intervals for most of the years, with the exception of 1992, 2011, 2013, 2015 and 2018. Good agreement between observed and expected mean length-at-age was common, although a few years displayed fairly variable observed mean length-at-age due to lower sample sizes (**Figure 65**).

Annual fits to nominal age compositions for the Commercial Longline fleet also showed considerable variability and sometimes poor agreement between observed and expected compositions (**Figure 66**). The estimated Dirichlet parameter of 3.55 for commercial age compositions resulted in slightly lower sample sizes, suggesting that input sample sizes were too large for each commercial fleet (**Table 11**). The model tended to expect younger Scamp in many years (**Figure 66**). The Pearson residuals showed some underestimation of older Scamp throughout much of the time series (min = -2.28, max = 4.24). Differences in observed (range: 8 to 13 years) and expected (range: 10 to 12 years) mean age were evident in many years for the Commercial Longline fleet (**Figure 67**). Most years revealed good agreement between observed and expected mean length-at-age, with some years displaying fairly variable observed mean length-at-age due to lower sample sizes (**Figure 68**).

Annual fits to nominal age compositions for the Recreational Charter Private fleet showed considerable variability and often poor agreement between observed and expected compositions due to low sample sizes (**Figure 69**). While some years showed good agreement of peak composition around 5 years (e.g., 1994-1997), the model tended to expect more older Scamp. The Pearson residuals showed underestimation of younger Scamp in the last 10 years (min = -1.93, max = 9.02). While differences in observed (range: 6 to 8 years) and expected (range: 8 to 9 years) mean age were evident, the expected mean age remained within the 95% confidence intervals for the earlier years but not in many recent years (**Figure 70**). There was a clear disconnect in more recent years (potentially due to regulations for other species that co-occur with Scamp), where the observed mean age ranged between 5 and 8 years while the mean age of expected Scamp averaged about 9 years. Agreement between observed and expected mean length-at-age was variable over the time series, although many years displayed variable observed mean length-at-age due to lower sample sizes (**Figure 71**).

Annual fits to nominal age compositions for the Recreational Headboat fleet also showed considerable variability and often poor agreement between observed and expected compositions due to low sample sizes (**Figure 72**). Only a few years showed good agreement of peak composition around 5 years (e.g., 1993), with the model consistently expecting more older Scamp, as observed above for the Recreational Charter Private fleet. The Pearson residuals showed an underestimation of younger Scamp in many years, particularly the most recent years (min = -2.15, max = 4.83). The estimated Dirichlet parameter of 1.82 for recreational age compositions resulted in lower sample sizes, suggesting that input sample sizes were too large for each recreational fleet (**Table 11**). Differences in observed (range: 4 to 9 years) and expected (range: 5 to 8 years) mean age were more evident and variable for the Recreational Headboat fleet, but the expected mean age remained within the 95% confidence intervals for most years except 2015 and 2018 (**Figure 73**). Agreement between observed and expected mean length-at-age was very variable over the time series, although many years displayed variable observed mean length-at-age due to lower sample sizes (**Figure 74**).

Aggregated across years, the model expected slightly younger and slightly older Scamp for the commercial and recreational fleets, respectively, when compared to the observed age compositions (**Figure 75**). While there was still a trade-off in fitting either the length compositions (weighted for commercial and nominal for recreational) or the nominal age compositions, these fits were much improved over those exhibited by the SEDAR 68 RW Base Model. Overall, the model fit more closely to the length compositions due to the larger sample sizes and larger contribution to the total likelihood. The residuals for the recreational fleets in particular were reduced in magnitude for the SEDAR 68 OA Base Model compared to the SEDAR 68 RW Base Model.

4.8. Model Diagnostics

4.8.1. Correlation Analysis

Given the highly parametrized nature of this model, some parameters were mildly correlated (correlation coefficient > 70%) and two combinations displayed a strong correlation (> 95%; **Table 27**). High correlation occurred between the parameters defining the peak and the width of the ascending limb of the double normal selectivity function for the Recreational Charter Private fleet and the von Bertalanffy growth parameters K and L_{Amax} [i.e., $L\infty$]. Moderate correlations occurred between the parameters defining the size at inflection and the width for 95% selection for the Commercial Vertical Line fleet and RFOP Vertical Line Survey and the von Bertalanffy growth parameters K and L_{Amin}. The parameters defining the inflection point and width of the retention curve in the 1990-1998, 1999-2002, and 2003-2017 time blocks were moderately correlated for the Recreational Charter Private fleet. Lastly, a few recruitment deviations demonstrated moderate correlations.

4.8.2. Likelihood Profiles

The total likelihood component from the ln(R_0) likelihood profile indicates that the global solution for this parameter is approximately 7.35 (**Figure 76**), with the SEDAR 68 OA Base Model estimating ln(R_0) at 7.33 (**Table 11**). Other ln(R_0) values which remained within 2 negative log-likelihood units included: 7.3. Conflicts were evident, particularly between the age data which favored lower values and the length data which supported higher values.

The total likelihood component from the *sigmaR* likelihood profile indicates that the global solution for this parameter is approximately 0.58 (**Figure 77**), with the SEDAR 68 OA Base Model estimating *sigmaR* at 0.562 (**Table 11**). However, values between 0.44 and 0.68 remained within 2 negative log-likelihood units. Data sources including indices and discards supported values lower than the total minimum, whereas mean weight of recreational landings and length composition supported higher values.

The total likelihood components from the initial F likelihood profiles for each commercial fleet corresponded well with the SEDAR 68 OA Base Model estimates (Commercial Vertical Line = 0.075; Commercial Longline = 0.078; **Table 11**). The global solution for this parameter is approximately 0.08 for each fleet (**Figures 78-79**). For each fleet, values between 0.07 and 0.09 remained within 2 negative log-likelihood units. Many data sources supported minima at lower values, whereas mean weight of recreational landings and age composition supported higher values around 0.1.

The total likelihood component from the initial F likelihood profile for the Recreational Charter Private fleet indicates that the global solution for this parameter is approximately 0.02 (**Figure 80**), with the SEDAR 68 OA Base Model estimate at 0.024 (**Table 11**). No other values remained within 2 negative log-likelihood units, and most of the data sources showed minima close to the model estimate.

The total likelihood component from the *K* growth parameter indicates that the global solution for this parameter is approximately 0.075 (**Figure 81**), with the SEDAR 68 OA Base Model estimate of 0.073 (**Table 11**). No other values remained within 2 negative log-likelihood units. While the length composition supported higher values around 0.095, the age composition supported lower values around 0.06.

The total likelihood component from the L_{Amin} growth parameter indicates that the global solution for this parameter is approximately 24 cm FL (**Figure 82**), with the SEDAR 68 OA Base Model estimate of 24.695 cm FL (**Table 11**). Other values which remained within 2 negative log-likelihood units included 25 cm FL. Conflicts were evident, as the length composition supported a minimum around 20 cm FL.

The total likelihood component from the L_{inf} growth parameter indicates that the global solution for this parameter is approximately 77 cm FL (**Figure 83**), with the SEDAR 68 OA Base Model estimate of 77.289 cm FL (**Table 11**). Other values which remained within 2 negative log-likelihood units included 75 and 80 cm FL. Conflicts were evident, as the age composition supported higher values around 84 cm FL.

4.8.3. Jitter Analysis

No jitter runs demonstrated a lower negative log-likelihood solution than the SEDAR 68 OA Base Model, although only 5% and 59% of runs converged to the same likelihood solution or within 50 negative log-likelihood units, respectively (**Figure 84**). These results are due to the large number of selectivity and retention parameters estimated freely (**Table 11**). In instances where the base solution was not reached or approached, the length data were often disproportionately dominating the total negative log-likelihood, most likely due to difficulties estimating selectivity or retention for the recreational fleets. Total negative log-likelihood values greatly exceeded the base for some runs (red bars in **Figure 86**), although it is probable that non-optimal solutions were found (i.e., the model search was stuck in local minima). Given the similarity in recruitment parameter estimates (**Figure 85**) and the relative agreement in estimated trajectories for SSB, recruitment, and exploitation rate (**Figure 86**), the model results are relatively consistent. When problematic parameters (i.e., CV > 1) were fixed and priors were used to reduce correlations in selectivity parameters for a sensitivity run (results not shown), a much higher percentage of jitter runs converged to the base solution for that run (64% same negative log-likelihood and 85% within 50 negative log-likelihood units). However, the SEDAR 68 Research Track Assessment supported the approach taken because fixing parameters (with high uncertainty) can give a false sense of model stability. Further, Scamp are not as data-rich as primary targeted groupers, so greater uncertainty in model parameters can be expected given data quantity and quality.

4.8.4. Retrospective Analysis

Results of the retrospectives illustrate acceptable levels of retrospective bias and forecasting bias in SSB (Mohn's Rho of -0.1; Forecasting Bias of -0.1) and *F* (Mohn's Rho of 0.14; **Table 28**; **Figure 87**), all of which are much improved over the SEDAR 68 RW Base Model. The forecasting bias in *F* remained high (0.3), which suggests poor forecasting ability of the model in predicting *F*. While a trend of underestimation in SSB and an overestimation of *F* is evident, trends for most runs remain within the confidence intervals of the base run (terminal year of 2020). Recruitment estimates are more variable as more years of data are peeled off because the model is missing key composition data inputs that capture those cohorts moving through the fishery (**Figure 88**).

4.8.5. Additional Diagnostics

The SEDAR 68 OA Base Model displayed acceptable RMSE (<30%) for the joint residuals for all indices, mean age and mean length data sources (**Table 29**). Residuals revealed some conflict in indices of abundance and mean age (evident by colored vertical lines in opposite directions) and trends in the residuals (evident by Loess smoothed line; **Figure 89**). The lowest RMSE was exhibited for the length composition, which exhibited the smallest residuals but did reveal some conflicts (**Table 29**; **Figure 89**). Runs test results revealed evidence of non-randomly distributed residuals for the pre-IFQ Commercial Vertical Line index of abundance, Recreational Charter Private age compositions, Commercial Vertical Line length compositions, and Recreational Headboat length compositions (**Table 30**; **Figure 90**). A few outliers (evident by red points) were identified in residuals for mean age for all fleets except Recreational Headboat and in residuals for length compositions for the commercial fleets, the Recreational Headboat fleet, and the Combined Video Survey (**Figure 90**). Superior prediction skill (<1) was evident over the naive baseline forecast for the Recreational Headboat index (**Figure 91**), mean age for all fleets (**Figure 92**), and mean length for the commercial fleets (**Figure 93**; **Table 31**).

4.8.6. Bridging Analysis

The general flow of model building runs that led to the SEDAR 68 OA Base Model is shown in **Table 32**. Changes in estimated quantities starting from the SEDAR 68 RW Base Model are shown in **Table 33** and **Figures 94-95**.

Model building occurred in phases, with the first phase focused on implementing the changes recommended by the Life History TWG. Step 2 involved updating all data streams and maintaining the model structure of the SEDAR 68 RW Base Model (“Continuity” model). Considerable differences in key derived quantities were evident, with SSB shifting to higher estimates since the mid-2000s due to lower *F* (**Figure 94**). Estimated annual recruitments also showed some deviation, but remained within the confidence intervals of the SEDAR 68 RW Base Model estimates (**Figure 94**). These changes were largely due to improvements in data streams made for the OA (see **Section 4.8.7**). Step 3 implemented a fixed *M* vector accounting for peak spawning whereas Step 4 implemented the Lorenzen *M* option in Stock Synthesis using a reference age of 10 years with *M* obtained from the fixed *M* vector from Step 3. Trends in derived quantities remained similar to those for the Step 2 model (**Figure 94**), with the exception of a higher ln(R_0) estimate for the Step 4 model (**Table 32**). This result was primarily due to Stock Synthesis estimating a higher *M* for age-0 compared to the fixed *M* vector run (Step 4; **Figure 2C**). Step 5 estimated the growth parameters L_{Amin}, L_{Amax} [i.e., $L\infty$], and *K* using normal priors, which led to a larger L_{Amin} estimate, a higher *sigmaR*, and changes in derived quantities, particularly recruitment estimates (**Tables 32-33**; **Figure 94**). Step 6 applied the recruitment deviations bias adjustment ramp as recommended by Stock Synthesis developers. Most changes affecting the trajectory of the stock occurred during Step 2 and Step 5.

The second phase of model building occurred after receiving data corrections to the commercial landings and headboat data streams, but overall the models resulted in nearly identical derived quantities (**Table 33**; **Figure 95**). Step 7 incorporated data corrections identified near the end of the assessment process for the commercial landings (2019-2020) and the headboat landings (1986-2020), discards (2000-2003), and mean weight of landings (1986-2020). Step 8 updated the inflection point of the earliest retention time block (1986-1989) for the Recreational Charter Private fleet to correspond with the peak of the estimated selectivity curve (35 cm FL; **Table 11**). Step 9 re-applied the recruitment deviations bias adjustment ramp. Step 10 reduced the total number of estimated Dirichlet parameters from 10 to 6, with similar fleets (e.g., commercial or recreational) sharing a parameter as recommended by the Stock Synthesis developers. Step 11 fixed those Dirichlet parameters being estimated at the upper bound, and finally Step 12 re-applied the recruitment deviations bias adjustment ramp, leading to the SEDAR 68 OA Base Model. Additional runs were conducted during the development of the SEDAR 68 OA Base Model, but the above mentioned 12 steps show the most important stepping stones that govern the changes observed between the SEDAR 68 RW Base Model and the SEDAR 68 OA Base Model.

4.8.7. SEDAR 68 RW Base Model Sensitivity Runs

Results for the sensitivity runs summarized in **Section 3.4.7** for the SEDAR 68 RW Base Model are presented in **Tables 34-35**. Even given the differences discussed below, the derived quantities for each sensitivity run remained within the confidence intervals of estimates from the SEDAR 68 RW Base Model (**Figure 96**). Inclusion of the 2003-2012 age data and accompanying ageing error matrix and the updated mean weight and error estimates of recreationally landed Scamp led to the largest differences in model results. Throughout the time series and under virgin conditions, incorporating the 2003-2012 age data led to consistently higher SSB (and SSB ratios) and lower F, as well as a higher *sigmaR* and more extreme recruitment estimates in years such as 1999 and 2001 (**Table 35**; **Figure 96**). The OA age data likely contain different information concerning cohorts moving through the population than the placeholder data used during the Research Track Assessment. The updated mean weight and error estimates of recreationally landed Scamp led to consistently lower SSB (and SSB ratios) and higher *F* throughout the time series, along with a lower *sigmaR* and reduced recruitment estimates in the early 1990s, 1999, and 2001 (**Table 35**; **Figure 96**). This was likely a result of the tighter error estimates provided during the OA, which were deemed more appropriate for quantifying uncertainty than the placeholder error estimates used during the Research Track Assessment (see SEDAR68-RW-01 for details). Results for the model run updating headboat landings (1986-2017), mean weight of landings (1986-2017), and discards (2000-2003) led to slightly lower SSB (and SSB ratios) and higher *F* in some years along with changes in a few recruitment estimates (**Figure 96**). Updates to the headboat discard length compositions revealed no major changes in key trajectories when compared to the SEDAR 68 RW Base Model, with the exception of a few recruitment estimates between 2000 and 2006 (**Figure 96**).

4.8.8. SEDAR 68 OA Base Model Sensitivity Runs

Results for the sensitivity runs summarized in **Section 3.4.8** for the SEDAR 68 OA Base Model are presented in **Tables 36-37** and discussed below.

Ageing error matrix

Different input ageing error matrices accompanying the 2003-2012 and 2018-2020 age data led to very similar estimates of SSB (and SSB ratio), recruitment and *F* throughout much of the time series (**Figure 97**). Some minor differences were observed for the model assuming no error in the expert reader ages, most notably a lower *sigmaR* estimate, higher ln(R_0), and four more uncertain recruitment estimates (i.e., CVs > 1; **Tables 36-37**). However, all derived quantities for each sensitivity run remained within the confidence intervals of the SEDAR 68 OA Base Model (**Figure 97**).

Jack-knife Analysis on Indices of Abundance

The removal of one index at a time and all fishery-dependent indices at one time indicated that no one index or group of indices appeared to be having undue influence on estimates of key derived quantities (**Table 37**), although some earlier years revealed some sensitivity to index removal (**Figure 98**). The removal of the Headboat CPUE index and all fishery-dependent indices led to higher virgin SSB and recruitment (**Table 37**) and higher SSB and recruitment in the first decade and in more recent years (**Figure 98**). The removal of these indices resulted in more variable *F* in the earlier years, with the exclusion of the Headboat CPUE index resulting in lower *F* in more recent years. Although these small differences were noted, the resulting trends in the most recent years remained within the confidence intervals of the SEDAR 68 OA Base Model.

5. Discussion

The SEDAR 68 OA Base Model includes several important changes to data inputs and model parameterization that affected the assessment results including the following:

1. Inclusion of age data from 2003-2012 along with the accompanying ageing error matrix
2. Incorporation of mean weight (with error estimates) of recreationally landed Scamp
3. Updated headboat landings, mean weight of landings, discards and discard length composition bin specifications
4. Using the Lorenzen option for parameterizing *M* in Stock Synthesis to ensure consistency with the growth curve estimated within Stock Synthesis
5. Estimation of the growth curve using normal priors derived from Data Workshop recommendations

Data inputs were updated to reflect the new terminal year of 2020 where possible, although some data streams ended in 2019 due to sampling issues stemming from COVID-19 (Combined Video Survey, RFOP Vertical Line Survey, and recreational length and age compositions). The most significant changes concerning data inputs were the updates to the age data from 2003-2012 and the updates to the mean weight and error estimates of Scamp landed by each recreational fleet, which both led to relatively large changes in SSB and recruitment trajectories (**Figure 96**). The most significant change concerning model configuration was the estimation of the growth parameters which scaled down SSB estimates in many years (**Figure 94**). This specific configuration change led to much improved model diagnostics such as less of a retrospective pattern compared to the concerning pattern exhibited by the SEDAR 68 RW Base Model (TOR

1e). The remaining changes did not have as large an impact on the overall assessment results and estimates of parameters (ln(R_0), etc.) or key derived quantities. However, the remaining changes did lead to significant improvements in model fits and diagnostics.

The SEDAR 68 OA Base Model fit most of the data sources well with no major residual patterns, and the fits were improved compared to the SEDAR 68 RW Base Model. The trade-offs between fitting to the recreational length and age compositions were still evident but were reduced compared to the trends exhibited by the SEDAR 68 RW Base Model. The dominant data inputs were the length and age compositions as these produced the greatest impact on the model fit (as measured in the total likelihood). While many of the commercial and recreational data streams did not reveal very large residuals in terms of magnitude, some patterns in residuals noted likely relate to regulations for species other than Scamp since Scamp are generally not targeted (SEDAR68-AW-02). This assessment, as well as other Gulf of Mexico assessments, would greatly benefit from a better understanding of changes in management regulations for other species (e.g., groupers, Red snapper) that fall within the multi-species fisheries in the Gulf of Mexico, and how these regulations may affect the species under assessment (e.g., selectivity, catchability, etc.).

Overall, the SEDAR 68 OA Base Model appears to perform fairly well and exhibited some noticeable improvements in performance over SEDAR 68 RW Base Model, including fewer correlated parameters, fewer non-random residuals in data sources, less retrospective bias, and acceptable joint residuals in all data sources. Although the jitter analysis revealed many runs with higher negative log-likelihood estimates than the SEDAR 68 OA Base Model, due to freely estimating many of the retention and selectivity parameters, the trends and estimates of key derived quantities were similar and did not suggest an alternative model solution. Many jitter runs came to different negative log-likelihood solutions due to differences in fits to either length or age compositions for the recreational fleets, as both fleets exhibited either selectivity or retention parameters with CVs exceeding 1 or moderate correlations (>0.7). Rather than fix these parameters or give them priors to force them to remain stable, we maintained the current configuration to better illustrate these uncertainties and the impact on model results. Profile likelihood analyses provided support for the SEDAR 68 OA Base Model estimates of key recruitment parameters, initial fishing mortality parameters and growth parameters, although conflicts between data sources were identified in some cases. Sensitivity analyses focused on uncertainty in the ageing error matrix for the newly aged OA data and the removal of indices of abundance (separately or all fishery-dependent indices simultaneously) revealed no major differences in key estimated quantities of SSB or recruitment.

The SEDAR 68 Research Track Assessment included sensitivity runs to explore how recreational landings are incorporated into Gulf stock assessments by exploring two key questions: (1) whether to input recreational landings in numbers of fish (i.e., native units of collection by recreational surveys) or in weight (used for ACL monitoring) and (2) whether to fit to the mean weight of Scamp landed by each recreational fleet or use it as a check (i.e., include but do not fit to it and exclude from the likelihood; SEDAR68-RW-01). This analysis was motivated by the mismatch in terms of how recreational landings have traditionally been incorporated into assessments (i.e., numbers) versus what recreational landings have been used for ACL monitoring (i.e., weights), specifically for Red Grouper (*Epinephelus morio*) following SEDAR 61. Solely switching to inputting recreational landings in weight for Red Grouper would not have corrected the issue identified after SEDAR61 because the model still would have expected smaller Red Grouper in the absence of data on mean weight of Red Grouper landed by the recreational fleet. Ultimately, the SEDAR 68 Research Track Assessment Review Workshop Panel supported inputting and fitting to recreational landings of Scamp in numbers because this approach is in line with the native units of the recreational surveys. Further, they supported fitting to the mean weight of Scamp landed by each recreational fleet because this would ensure model results adequately characterize the size of landed fish. Given the thorough investigation undertaken during the SEDAR 68 Research Track Assessment and reviewed during the SEDAR 68 Review Workshop, no additional sensitivity runs were conducted on this topic during the OA.

The SEDAR 68 Research Track Assessment also included sensitivity runs to evaluate how uncertainty surrounding recreational landings would affect model results. While annual CVs for recreational landings by mode were provided, and were variable (**Tables 7A-7B**), these estimates were not incorporated into the SEDAR 68 RW Base Model because of poor model behavior and instability based on model diagnostics. Another sensitivity run scaled the error estimates as provided for each recreational fleet to a mean of 0.3, which maintained the interannual variability in uncertainty estimates for recreational landings in numbers of fish but reduced the overall uncertainty. Ultimately, a CV of 0.3 was supported by the SEDAR 68 Research Track Assessment's Assessment Development Team (ADT) and applied to recreational landings for each fleet across the entire time series. This decision was thought to better reflect the uncertainty around catch estimates and allow for better overall fits to the model. Given the thorough investigation undertaken during the SEDAR 68 Research Track Assessment and reviewed during the SEDAR 68 Review Workshop, no additional sensitivity runs were conducted on this topic during the OA.

A key uncertainty for the Gulf of Mexico Scamp stock assessment and most assessment models in general, is the stock-recruitment relationship. Ultimately, the SEDAR 68 Research Track Assessment Review Workshop Panel supported fixing steepness at a biologically plausible value of 0.694. This value was the average value (weighted by CV) based on the estimate for Scamp of 0.78 (CV = 0.27) from FishLife (Thorson et al. 2017b) and the estimated value for South Atlantic Scamp (0.57, CV = 0.19; SEDAR 2021b). While some discussion centered around the stock-recruitment relationship for the Scamp-Yellowmouth Grouper complex, the SEDAR 68 Research Track Assessment's ADT and SEDAR 68 Research Track Assessment Review Workshop Panel supported this application because of the overwhelming dominance of Scamp throughout each data stream (see SEDAR 2016 for a thorough review of data available for Yellowmouth Grouper). For this assessment, benchmarks were determined through projections (see **Section 6**) using the spawner-recruit curve. As shown in **Figure 25**, recruitment estimates in the late years of the assessment (2018-2020) are much higher than subsequent years because they are derived from the spawner-recruit curve. These values may have important implications for determination of benchmarks and short-term catch advice.

Overall, the SEDAR 68 OA Base Model is improved since the SEDAR 68 Research Track Assessment Review Workshop, and it incorporates the best available data and addressed modeling issues evident in the Research Track Assessment. According to the SEDAR 68 OA Base Model, the Gulf of Mexico Scamp resource is not overfished nor undergoing overfishing in 2020. Spawning stock biomass started out at relatively low values in the 1990s when the commercial fisheries were responsible for much of the mortality on Gulf of Mexico Scamp. As SSB gradually increased until peaking in 2007, landings began to shift more towards the Recreational Charter and Private fleets. Composition data in combination with large recruitment events (1994, 1999, and 2000) largely drove the increase in SSB. SSB has declined steadily since 2007 to the lowest value in 2020. The recent decline in Scamp SSB, as well as observed declines in both the Combined Video Survey and Recreational Headboat indices, may be tied to changes in more desirable and targeted species such as Gag and Red Grouper. Between 2015 and 2016, the stock experienced relatively high *F* due to spikes in *F* for all four fleets, potentially due to increased targeting or pressure stemming from an inability to reach quotas for more desirable Gag and Red Grouper. Overall, dead discards for all four fleets have remained only a minor contribution to total removals throughout the time series.

6. Projections

6.1. Introduction

The SEDAR 68 projections were run for two key fishing mortality scenarios: $F_{MSYproxy}$ and F_{OY}. Both an MSY proxy of $SPR_{30\%}$ and the OY (0.9 $F_{MSYproxy}$) were specified for shallow-water grouper in Amendment 48 (GMFMC 2021), which was finalized and published after the development of the SEDAR 68 TORs.

6.2. Projection methods

The simulated dynamics used for projections assumed nearly identical parameter values and population dynamics as the SEDAR 68 OA Base Model. **Table 38** provides a summary of projection settings. Projections were run assuming that relative F, selectivity, discarding and retention associated with the last three years (which fall within the most recent time period, 2010-2020) would remain the same into the future. Forecast recruitment values were derived from the model-estimated Beverton-Holt stock-recruitment relationship.

The terminal year of the SEDAR 68 OA was 2020 and the first year of management advice was 2023. Retained catch for the interim years (2021-2022) used preliminary landings estimates for 2021 and the average of the last three years of retained catches (2019-2021) for 2022 (**Table 38**).

$F_{30\%SPR}$ was determined using a long-term 100-year projection assuming that equilibrium was obtained over the last 10 years (2111-2120). For the OFL projection, the $F_{30\%SPR}$ was applied to the stock starting in 2023. No fleet allocations exist for the other shallow-water grouper complex, which includes Scamp and Yellowmouth Grouper.

The current status determination criteria (SDCs) for Gulf of Mexico Scamp were confirmed by GMFMC staff following the finalization of Amendment 48 (GMFMC 2021), which was approved by NOAA Fisheries on June 8, 2022. The minimum stock size threshold (MSST) was determined by multiplying the reference spawning stock biomass, $SSB_{30\%SPR}$, by 0.75 (per Amendment 48 and the SEDAR 68 TORs) and was used to determine stock status (**Table 39**). The maximum fishing mortality threshold (MFMT) was equivalent to the harvest rate ($F_{30\%SPR}$; total biomass killed all ages / total biomass age 3+) that achieved $SSB_{30\%SPR}$, and was used to assess whether overfishing was occurring in a given year (**Table 39**). A stock is considered overfished when $SSB_{Current}$ < MSST and undergoing overfishing if $F_{Current}$ > MFMT, where $F_{Current}$ is defined as the geometric mean of the fishing mortality over the most recent three years (2018-2020).

Once the proxy values were calculated, 2020 stock status was used to determine whether a rebuilding plan was required (i.e., if SSB < MSST then Gulf of Mexico Scamp would be considered overfished and a rebuilding plan would be required).

6.3. Projection results

Benchmarks and reference points were calculated assuming an SSB defined in terms of male and female combined SSB.

6.3.1. Biological Reference Points

The status determination criteria (SDCs) for the shallow-water complex specified in Amendment 48 were adopted for Gulf of Mexico Scamp (**Table 39**; **Figure 99**) and are summarized below (note differences from the SEDAR 68 TORs which were finalized before Amendment 48 was finalized and published):

- MSY proxy = yield at $F_{30\%SPR}$ = 319,487 pounds gutted weight
- MSST = 0.75*$SSB_{30\%SPR}$ = 604 metric tons
- MFMT = $F_{MSYproxy}$ ($F_{30\%SPR}$) = 0.171
- OY = 0.9*$F_{MSYproxy}$ ($F_{30\%SPR}$) = 0.154

6.3.2. Stock Status

Benchmarks and reference points are shown in **Table 39**. Detailed time series of derived quantities and benchmarks with SSB defined as male and female combined SSB are presented in **Table 40**. As of 2020, the Gulf of Mexico Scamp stock is not undergoing overfishing ($F_{Current}$ > MFMT) and is not overfished (SSB_{2020} > MSST) according to the SEDAR 68 OA Base Model (**Table 39**). The terminal year SSB (2020) is above $SSB_{30\%SPR}$ (**Figure 99**) at 162% of the biomass level needed to support MSY (**Table 40**). From 2018 to 2020 the estimated stock harvest rate, using the geometric mean, was 0.092, which was equivalent to 54% of $F_{30\%SPR}$ (**Table 39**).

The Kobe plot (**Figure 100**) indicates that over the time horizon of the assessment (i.e., 1986-2020), the stock has not experienced overfishing nor been overfished in any year since 1986.

6.3.3. Overfishing Limits and OY projections

OFL and OY projection results assuming predicted recruitment follows the spawner-recruitment curve are provided in **Tables 41-42** and **Figure 101**. After a relatively large landings estimate in the interim years of 2021 and 2022, forecasts indicate that yields will decline in the near-term for the OY projection scenario presented. Compared to the 2022 landings estimate, the forecasted yield for the OFL scenario increases slightly in 2023 and declines gradually thereafter.

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8. Research Recommendations

Recommendations for considerations of future research are provided below and do not indicate any particular order of priority.

Age and Growth
- Investigate methods to better collect age structure samples randomly and systematically from all fishing sectors, especially the recreational sector
- Continue collaboration with ageing facilities throughout the Gulf of Mexico and South Atlantic. These efforts will include the annual reading of references sets for Scamp and other reef fish, and annual meetings to review the interpretation of ageing structures and the timing of annual band deposition.

Natural Mortality
- Explore more direct approaches to estimating natural mortality (e.g., Mark-recapture approaches (conventional, telemetry, or close-kin))

Reproduction
- Continue data collection for maturity, sex transition, and fecundity as detailed in the SEDAR 68 Research Track Assessment DW Report Recommendations

Discard Mortality
- Continue data collection from observer programs or electronic monitoring programs (e.g., SEDAR68-DW-22)
- Develop discard mortality rates for recreational fishery by mode

Landings
- Explore approaches for assigning uncertainty estimates to commercial landings and revisit estimation of historic landings

Discards
- Explore approaches for assigning uncertainty estimates to recreational headboat discards

CPUE indices
- Additional research is needed to investigate if assumptions are appropriate across full time series for recreational CPUE indices (e.g., targeting, trip length, effects of various regulations, Red Snapper)
- Re-evaluate the appropriateness of the RFOP Vertical Line Survey for tracking trends in population abundance over time

Age and length composition
- Quantify and evaluate appropriate modeling and weighting procedures of length and age compositions to ensure age and length composition inputs are representative of the segment of the population being modeled

- Obtain consistent funding source to ensure continuation of sampling of discard length composition for Scamp and other reef fish

Selectivity and catchability
- Further investigate and quantify changes in selectivity/catchability through time to improve fit to the discards and length compositions

Surveys
- Determine how best to continue the Combined Video Survey index given changes in survey design and sampling over time

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10. Tables

Table 1. Conversion factors used to convert fork length in centimeters (cm FL) to gutted weight (gw) in kilograms, whole weight (ww) in kilograms to gw in kilograms, and total length (TL) in centimeters to fork length for Gulf of Mexico Scamp males and females combined. Model fit criteria: linear regression models R2 and non-linear regression models mean squared error (MSE).

Model	N	R2	Range	MSE
gw = 1.186 E-05 x (FL^3.04)	30,798	0.940	FL (cm): 22.0–117.0	0.016
gw = 0.95 x ww	396	0.999	ww (kg): 0.136–7.8	-
FL = 1.77 + 0.89 TL	3,205	0.990	FL (cm): 16.7–97.6	-

Table 2. Growth parameters (and associated standard deviation, SD) recommended for Gulf of Mexico Scamp during the Research Track Assessment. The von Bertalanffy parameters (Linf, K, and t0) and CV estimate were not updated during the Operational Assessment.

Parameter	Value	SD
Linf (cm FL)	70.222	2.610
K (per year)	0.134	0.024
t0 (year)	-1.762	0.575
CV at age (constant)	0.130	0.016

Table 3. Ageing error matrices (standard deviations associated with mean age) recommended for Gulf of Mexico Scamp during the Research Track Assessment (1991-2002 and 2013-2017 age data) and for the Operational Assessment (2003-2012 and 2018-2020 age data) to incorporate uncertainty at age. Expert error refers to whether error was assumed in the expert reader ages or not. See **Section 3.4.8** for details on sensitivity runs conducted.

Age	Research	Operational (curvilinear bias and SD model with expert error)	Linear bias and constant CV model with expert error	Curvilinear bias and SD model with no expert error
0	0.28	0.10	0.16	1.43
1	0.28	0.10	0.16	1.43
2	0.34	0.29	0.31	1.50
3	0.40	0.48	0.47	1.57
4	0.46	0.66	0.63	1.65
5	0.53	0.83	0.78	1.73
6	0.60	1.00	0.94	1.82
7	0.67	1.16	1.10	1.91
8	0.75	1.31	1.25	2.00
9	0.83	1.45	1.41	2.10
10	0.92	1.60	1.56	2.21
11	1.01	1.73	1.72	2.32
12	1.10	1.86	1.88	2.44
13	1.20	1.98	2.03	2.57
14	1.31	2.10	2.19	2.70
15	1.42	2.22	2.35	2.85
16	1.53	2.33	2.50	3.00
17	1.66	2.44	2.66	3.16
18	1.78	2.54	2.82	3.32
19	1.92	2.64	2.97	3.50
20	2.06	2.73	3.13	3.69
21	2.21	2.82	3.29	3.89
22	2.37	2.91	3.44	4.10

Table 3 Continued. Ageing error matrices (standard deviations associated with mean age) recommended for Gulf of Mexico Scamp during the Research Track Assessment (1991-2002 and 2013-2017 age data) and for the Operational Assessment (2003-2012 and 2018-2020 age data) to incorporate uncertainty at age. Expert error refers to whether error was assumed in the expert reader ages or not. See **Section 3.4.8** for details on sensitivity runs conducted.

Age	Research	Operational (curvilinear bias and SD model with expert error)	Linear bias and constant CV model with expert error	Curvilinear bias and SD model with no expert error
23	2.53	2.99	3.60	4.33
24	2.70	3.07	3.76	4.57
25	2.88	3.15	3.91	4.82
26	3.07	3.22	4.07	5.09
27	3.28	3.29	4.22	5.37
28	3.49	3.36	4.38	5.67
29	3.71	3.42	4.54	5.98
30	3.94	3.49	4.69	6.32
31	4.19	3.55	4.85	6.67
32	4.44	3.60	5.01	7.05
33	4.72	3.66	5.16	7.44
34	5.00	3.71	5.32	7.87

Table 4. Age-specific natural mortality (M, per year) for Gulf of Mexico Scamp. Female and male M were assumed equivalent. For implementing Lorenzen scaling in Stock Synthesis, the reference age used was 10 years (in bold) and its corresponding M was obtained by externally estimating the Lorenzen (2000) curve (see SEDAR68OA-WP-06 for details).

Age	SS Lorenzen M (per year)	External Lorenzen M (per year)
0	0.5562	0.4995
1	0.3140	0.3764
2	0.2800	0.3099
3	0.2545	0.2685
4	0.2345	0.2405
5	0.2186	0.2204
6	0.2057	0.2054

Table 4 Continued. Age-specific natural mortality (M, per year) for Gulf of Mexico Scamp. Female and male M were assumed equivalent. For implementing Lorenzen scaling in Stock Synthesis, the reference age used was 10 years (in bold) and its corresponding M was obtained by externally estimating the Lorenzen (2000) curve (see SEDAR68OA-WP-06 for details).

Age	SS Lorenzen M (per year)	External Lorenzen M (per year)
7	0.1949	0.1939
8	0.1859	0.1848
9	0.1782	0.1775
10	**0.1716**	**0.1716**
11	0.1659	0.1668
12	0.1609	0.1627
13	0.1566	0.1594
14	0.1527	0.1565
15	0.1493	0.1542
16	0.1462	0.1521
17	0.1435	0.1504
18	0.1411	0.1489
19	0.1389	0.1476
20	0.1369	0.1465
21	0.1351	0.1456
22	0.1335	0.1448
23	0.1320	0.1441
24	0.1307	0.1435
25	0.1294	0.1429
26	0.1283	0.1425
27	0.1273	0.1421
28	0.1264	0.1417
29	0.1255	0.1414
30	0.1247	0.1411
31	0.1240	0.1409
32	0.1233	0.1407
33	0.1227	0.1405
34	0.1212	0.1405

Table 5. Discard mortality rates used as recommended during the SEDAR 68 Research Track Assessment for Gulf of Mexico Scamp. Point estimates were input into the SEDAR 68 OA Base Model.

Fleet	Discard Mortality (range)
Commercial Vertical Line	47% (40-51%)
Commercial Longline	68% (57-75%)
Recreational Charter Private	26% (16-40%)
Recreational Headboat	26% (16-40%)

Table 6. Gulf of Mexico Scamp commercial landings in pounds gutted weight. Landings by "Other" gears were lumped into the Commercial Vertical Line fleet for input into the stock assessment model. In the absence of uncertainty estimates provided during the SEDAR 68 Research Track Assessment for the Gulf of Mexico, commercial landings were assigned a log-scale SE of 0.05 for 1986-2009 (borrowed from the South Atlantic) and 0.01 for 2010-2020 (after implementation of the IFQ program).

Year	Vertical line	Longline	Other
1986	178,419	174,428	5,427
1987	180,055	154,071	5,340
1988	155,529	110,414	3,919
1989	160,144	127,059	4,220
1990	98,192	109,171	57,821
1991	126,139	129,427	59,509
1992	166,389	76,227	59,245
1993	157,538	102,138	60,858
1994	107,612	57,454	50,830
1995	130,757	60,779	44,332
1996	127,484	66,711	38,874
1997	136,524	79,514	76,299
1998	98,858	85,243	36,720
1999	103,403	85,405	71,820
2000	114,610	73,528	11,721
2001	133,561	112,002	22,235
2002	149,583	118,036	37,010

Table 6 Continued. Gulf of Mexico Scamp commercial landings in pounds gutted weight. Landings by "Other" gears were lumped into the Commercial Vertical Line fleet for input into the stock assessment model. In the absence of uncertainty estimates provided during the SEDAR 68 Research Track Assessment for the Gulf of Mexico, commercial landings were assigned a log-scale SE of 0.05 for 1986-2009 (borrowed from the South Atlantic) and 0.01 for 2010-2020 (after implementation of the IFQ program).

Year	Vertical line	Longline	Other
2003	164,034	136,708	11,874
2004	151,845	151,716	15,581
2005	154,666	141,964	12,184
2006	115,796	86,283	16,040
2007	134,089	120,265	20,565
2008	122,179	138,725	17,138
2009	141,611	89,656	19,705
2010	75,921	64,936	15,197
2011	75,374	60,415	10,095
2012	141,093	93,246	16,090
2013	125,540	103,610	16,077
2014	96,973	62,095	9,394
2015	91,383	80,820	6,310
2016	141,099	143,307	1,629
2017	84,706	77,086	1,185
2018	71,279	68,711	2,616
2019	59,690	52,695	1,687
2020	57,742	59,594	1,707

Table 7A. Gulf of Mexico Scamp recreational landings in pounds gutted weight (converted from pounds whole weight; **Table 1**) and associated log-scaled standard errors (SE). Log-scale SEs were converted from CVs provided for landings in weights (**Section 3.2**).

Year	Headboat	Headboat SE	Charter	Private	Charter Private	Charter Private SE
1986	23,203	0.294	98,885	92,402	191,287	0.327
1987	14,964	0.294	42,820	217,794	260,614	0.597
1988	11,401	0.294	39,684	97,832	137,515	0.318
1989	26,206	0.294	56,343	24,854	81,198	0.377
1990	9,276	0.294	22,261	238	22,499	0.772
1991	9,095	0.294	15,979	29,751	45,730	0.653
1992	6,731	0.294	42,132	14,948	57,080	0.405
1993	5,865	0.294	75,137	43,338	118,476	0.454
1994	5,450	0.294	50,061	352	50,413	0.551
1995	6,775	0.294	14,826	129	14,956	0.666
1996	4,878	0.294	42,387	117	42,504	0.580
1997	4,223	0.294	69,547	29,679	99,226	0.365
1998	6,251	0.294	124,453	3,680	128,134	0.224
1999	3,842	0.294	103,422	47,306	150,728	0.288
2000	5,777	0.294	20,956	20,593	41,549	0.374
2001	2,527	0.294	46,777	15,263	62,040	0.226
2002	3,874	0.294	40,112	48,004	88,116	0.307
2003	6,823	0.294	38,773	111,257	150,031	0.484
2004	7,852	0.294	92,077	38,462	130,539	0.259
2005	5,111	0.294	49,469	112,444	161,912	0.459
2006	6,147	0.294	52,880	255,237	308,117	0.684
2007	9,874	0.294	35,368	62,128	97,496	0.336
2008	13,530	0.294	33,362	202,898	236,260	0.442
2009	4,962	0.294	44,686	147,408	192,094	0.528
2010	7,118	0.294	18,967	66,006	84,973	0.454
2011	18,438	0.294	34,415	70,597	105,012	0.258

Table 7A Continued. Gulf of Mexico Scamp recreational landings in pounds gutted weight (converted from pounds whole weight; **Table 1**) and associated log-scaled standard errors (SE). Log-scale SEs were converted from CVs provided for landings in weights (**Section 3.2**).

Year	Headboat	Headboat SE	Charter	Private	Charter Private	Charter Private SE
2012	14,584	0.294	42,030	178,615	220,645	0.335
2013	6,139	0.294	47,473	205,498	252,971	0.264
2014	8,865	0.294	68,357	185,158	253,515	0.306
2015	11,373	0.294	47,593	281,372	328,965	0.501
2016	6,751	0.294	104,574	132,339	236,913	0.329
2017	5,570	0.294	69,319	116,148	185,467	0.418
2018	11,508	0.294	29,672	190,114	219,785	0.348
2019	8,378	0.294	72,821	321,008	393,829	0.619
2020	6,281	0.294	23,925	344,551	368,475	0.502

Table 7B. Gulf of Mexico Scamp recreational landings in numbers (1,000s of fish) and associated log-scaled standard errors (SE). Log-scale SEs were converted from CVs provided for landings in numbers (**Section 3.2**) but were not used in the stock assessment model for reasons discussed during the SEDAR 68 Research Track Assessment. Landings input into the stock assessment model include Headboat and Charter Private and their associated log-scale SEs, which were assigned a value of 0.30.

Year	Headboat	Headboat SE	Charter	Private	Charter Private	Charter Private SE
1986	9.479	0.058	22.873	24.575	47.448	0.312
1987	5.616	0.046	10.150	58.366	68.516	0.586
1988	4.396	0.049	11.175	28.345	39.520	0.275
1989	10.544	0.030	12.590	6.021	18.611	0.358
1990	3.212	0.033	6.450	0.069	6.519	0.764
1991	2.611	0.019	5.170	9.703	14.873	0.646
1992	2.526	0.011	10.118	3.532	13.649	0.358
1993	2.648	0.006	14.397	9.036	23.434	0.412
1994	2.504	0.040	12.769	0.098	12.867	0.538
1995	2.602	0.102	4.296	0.032	4.328	0.586

Table 7B Continued. Gulf of Mexico Scamp recreational landings in numbers (1,000s of fish) and associated log-scaled standard errors (SE). Log-scale SEs were converted from CVs provided for landings in numbers (**Section 3.2**) but were not used in the stock assessment model for reasons discussed during the SEDAR 68 Research Track Assessment. Landings input into the stock assessment model include Headboat and Charter Private and their associated log-scale SEs, which were assigned a value of 0.30.

Year	Headboat	Headboat SE	Charter	Private	Charter Private	Charter Private SE
1996	2.045	0.069	12.281	0.034	12.315	0.547
1997	1.984	0.041	10.200	4.518	14.719	0.349
1998	1.755	0.026	20.104	0.629	20.733	0.208
1999	1.673	0.021	26.794	12.935	39.730	0.275
2000	1.371	0.030	5.298	5.266	10.565	0.358
2001	0.976	0.032	10.311	3.448	13.759	0.208
2002	1.418	0.046	10.835	13.630	24.465	0.275
2003	2.990	0.026	11.725	33.669	45.394	0.481
2004	3.832	0.063	31.445	20.665	52.110	0.256
2005	2.823	0.018	17.903	43.380	61.283	0.455
2006	2.292	0.040	17.974	87.416	105.390	0.682
2007	3.281	0.042	11.912	28.548	40.460	0.303
2008	2.604	0.016	9.168	50.678	59.846	0.438
2009	2.447	0.005	12.582	36.664	49.246	0.522
2010	1.642	0.005	6.260	21.147	27.407	0.447
2011	3.551	0.000	14.872	29.077	43.949	0.256
2012	2.742	0.000	11.210	64.982	76.192	0.331
2013	2.299	0.001	14.262	62.888	77.150	0.246
2014	3.099	0.000	18.497	57.838	76.336	0.284
2015	3.765	0.000	13.668	92.327	105.995	0.498
2016	2.448	0.000	24.430	44.122	68.552	0.322
2017	2.239	0.000	14.922	31.590	46.512	0.403
2018	2.865	0.000	7.131	47.117	54.248	0.331
2019	2.383	0.000	15.013	49.754	64.767	0.617
2020	1.873	0.000	7.062	57.827	64.889	0.489

Table 7C. Mean weight (kg, gutted weight) of Scamp landed by each recreational fleet in the Gulf of Mexico and associated coefficient of variation (CV) input into the stock assessment model. Mean weight was obtained by dividing the estimated weights by the estimated numbers for each fleet.

Year	Headboat	Headboat CV	Charter Private	Charter Private CV
1986	1.110	0.075	1.829	0.107
1987	1.209	0.116	1.725	0.177
1988	1.176	0.096	1.578	0.174
1989	1.127	0.081	1.979	0.136
1990	1.310	0.072	1.566	0.335
1991	1.580	0.106	1.395	0.163
1992	1.209	0.116	1.897	0.218
1993	1.005	0.115	2.293	0.233
1994	0.987	0.091	1.777	0.167
1995	1.181	0.101	1.568	0.500
1996	1.082	0.170	1.566	0.281
1997	0.965	0.194	3.058	0.120
1998	1.616	0.178	2.803	0.089
1999	1.042	0.123	1.721	0.094
2000	1.911	0.185	1.784	0.122
2001	1.174	0.121	2.045	0.093
2002	1.239	0.181	1.634	0.149
2003	1.035	0.076	1.499	0.073
2004	0.929	0.148	1.136	0.043
2005	0.821	0.150	1.198	0.068
2006	1.217	0.107	1.326	0.088
2007	1.365	0.055	1.093	0.160
2008	2.357	0.143	1.791	0.076
2009	0.920	0.064	1.769	0.110
2010	1.966	0.122	1.406	0.102
2011	2.355	0.062	1.084	0.037
2012	2.412	0.102	1.314	0.059

Table 7C Continued. Mean weight (kg, gutted weight) of Scamp landed by each recreational fleet in the Gulf of Mexico and associated coefficient of variation (CV) input into the stock assessment model. Mean weight was obtained by dividing the estimated weights by the estimated numbers for each fleet.

Year	Headboat	Headboat CV	Charter Private	Charter Private CV
2013	1.211	0.072	1.487	0.103
2014	1.298	0.116	1.506	0.125
2015	1.370	0.079	1.408	0.079
2016	1.251	0.069	1.568	0.076
2017	1.128	0.104	1.809	0.131
2018	1.822	0.073	1.838	0.122
2019	1.595	0.071	2.758	0.090
2020	1.521	0.148	2.576	0.149

Table 8. Gulf of Mexico Scamp commercial discards in numbers (1,000s of fish) with associated log-scale standard errors (SE) input into the stock assessment model. Discards refer to the total number of fish discarded before applying the discard mortality rate (**Table 5**).

Year	Vertical Line	Vertical Line SE	Longline	Longline SE
2000	2.946	0.390	0.462	0.497
2001	3.470	0.390	0.564	0.497
2002	3.842	0.390	0.533	0.497
2003	4.236	0.390	0.643	0.497
2004	4.083	0.390	0.688	0.497
2005	3.611	0.390	0.692	0.497
2006	3.231	0.390	0.510	0.497
2007	3.080	0.390	0.537	0.497
2008	2.748	0.405	0.667	0.497
2009	3.356	0.412	0.430	0.497
2010	2.421	0.421	0.251	0.333
2011	2.736	0.421	0.403	0.333
2012	3.423	0.421	0.379	0.333
2013	2.822	0.421	0.458	0.333
2014	2.657	0.421	0.524	0.333
2015	2.302	0.421	0.618	0.333
2016	2.790	0.421	0.664	0.333
2017	2.112	0.421	0.644	0.333
2018	1.823	0.421	0.565	0.333
2019	1.781	0.462	0.466	0.349
2020	1.491	0.462	0.376	0.349

Table 9. Gulf of Mexico Scamp recreational discards in numbers (1,000s of fish) with associated log-scale standard errors (SE) input into the stock assessment model. Discards refer to the total number of fish discarded before applying the discard mortality rate (**Table 5**). Discards input into the stock assessment model include Headboat and Charter Private and their associated log-scale SEs.

Year	Headboat	Headboat SE	Charter	Private	Charter Private	Charter Private SE
1986	0.000	0.000	30.041	24.077	54.118	0.609
1987	0.000	0.000	0.605	0.823	1.428	0.646
1988	0.000	0.000	0.323	3.378	3.701	0.783
1989	0.000	0.000	1.858	0.000	1.858	0.617
1990	0.000	0.000	4.395	36.301	40.696	0.601
1991	0.000	0.000	0.000	3.128	3.128	0.833
1992	0.000	0.000	4.443	27.406	31.849	0.506
1993	0.000	0.000	2.723	37.345	40.068	0.489
1994	0.000	0.000	2.007	10.786	12.792	0.639
1995	0.000	0.000	1.922	2.859	4.780	0.578
1996	0.000	0.000	0.114	0.816	0.930	0.757
1997	0.000	0.000	3.554	3.471	7.025	0.578
1998	0.000	0.000	1.661	2.884	4.545	0.481
1999	0.000	0.000	0.661	8.983	9.645	0.530
2000	2.642	0.472	2.153	61.616	63.768	0.751
2001	1.549	0.472	3.792	51.082	54.874	0.661
2002	2.497	0.472	8.637	11.268	19.904	0.349
2003	6.651	0.472	5.886	164.133	170.019	0.403
2004	1.610	0.472	20.433	156.051	176.484	0.322
2005	0.685	0.472	6.051	20.881	26.932	0.322
2006	0.469	0.472	1.650	17.476	19.127	0.455
2007	0.671	0.472	6.408	82.688	89.096	0.322
2008	2.799	0.472	9.896	104.783	114.679	0.358
2009	2.682	0.472	5.081	138.261	143.342	0.472
2010	1.760	0.472	7.153	224.917	232.070	0.385
2011	1.936	0.472	1.698	29.744	31.442	0.438
2012	1.909	0.472	1.370	183.013	184.383	0.617

Table 9 Continued. Gulf of Mexico Scamp recreational discards in numbers (1,000s of fish) with associated log-scale standard errors (SE) input into the stock assessment model. Discards refer to the total number of fish discarded before applying the discard mortality rate (**Table 5**). Discards input into the stock assessment model include Headboat and Charter Private and their associated log-scale SEs.

Year	Headboat	Headboat SE	Charter	Private	Charter Private	Charter Private SE
2013	1.895	0.472	3.009	25.356	28.365	0.498
2014	2.970	0.472	5.941	119.954	125.895	0.312
2015	3.500	0.472	5.988	178.674	184.662	0.498
2016	1.880	0.472	17.399	41.688	59.087	0.349
2017	1.689	0.472	5.222	71.872	77.094	0.609
2018	2.176	0.472	2.181	8.669	10.850	0.675
2019	1.441	0.472	7.097	26.502	33.599	0.385
2020	1.911	0.472	6.539	23.593	30.132	0.358

Table 10. Standardized indices of relative abundance and associated log-scale standard errors (SE) for Gulf of Mexico Scamp. The SE were scaled to a common mean of 0.2 for the fishery-dependent Commercial Vertical Line (ComVL) and Recreational Headboat indices. Note: the SE values represent the input estimates of uncertainty and do not include the additional standard error estimated within the stock assessment model.

Year	ComVL CPUE	ComVL SE	Headboat CPUE	Headboat SE	Combined Video	Combined Video SE	RFOP VL CPUE	RFOP VL SE
1986			2.185	0.190				
1987			1.457	0.196				
1988			1.559	0.181				
1989			0.869	0.190				
1990			1.197	0.186				
1991			1.007	0.190				
1992			0.734	0.188				
1993	0.986	0.202	0.736	0.186	0.888	0.173		
1994	0.849	0.200	0.950	0.181	0.508	0.233		
1995	1.254	0.200	1.288	0.186	0.577	0.253		
1996	1.048	0.200	0.882	0.192	0.794	0.175		

Table 10 Continued. Standardized indices of relative abundance and associated log-scale standard errors (SE) for Gulf of Mexico Scamp. The SE were scaled to a common mean of 0.2 for the fishery-dependent Commercial Vertical Line (ComVL) and Recreational Headboat indices. Note: the SE values represent the input estimates of uncertainty and do not include the additional standard error estimated within the stock assessment model.

Year	ComVL CPUE	ComVL SE	Headboat CPUE	Headboat SE	Combined Video	Combined Video SE	RFOP VL CPUE	RFOP VL SE
1997	1.314	0.200	0.770	0.215	0.659	0.134		
1998	0.991	0.200	1.000	0.200				
1999	0.954	0.199	0.718	0.222				
2000	0.634	0.200	0.824	0.206				
2001	1.005	0.200	0.724	0.217				
2002	0.991	0.200	1.039	0.196	1.795	0.142		
2003	0.948	0.200	0.847	0.212				
2004	1.081	0.200	1.370	0.191	2.031	0.176		
2005	1.302	0.200	1.309	0.193	1.530	0.134		
2006	0.847	0.200	0.947	0.221	0.961	0.169		
2007	1.001	0.200	1.584	0.217	1.563	0.122	0.923	0.103
2008	0.966	0.200	1.464	0.199	1.155	0.148	0.998	0.176
2009	0.829	0.200	0.953	0.196	1.254	0.128	0.979	0.185
2010			0.722	0.233	1.094	0.125	0.682	0.198
2011			1.848	0.204	1.206	0.098	0.602	0.130
2012			1.112	0.184	0.687	0.121	1.206	0.059
2013			0.707	0.223	0.744	0.119	1.072	0.217
2014			0.741	0.198	0.894	0.119	0.864	0.094
2015			0.831	0.197	0.958	0.132	1.142	0.074
2016			0.494	0.192	0.806	0.103	1.251	0.098
2017			0.488	0.215	0.766	0.117	1.066	0.125
2018			0.602	0.206	0.566	0.109	1.215	0.122
2019			0.598	0.194	0.564	0.102	0.511	0.170
2020			0.446	0.202				

Table 11. List of Stock Synthesis parameters for Gulf of Mexico Scamp. The list includes expected parameter values, lower and upper bounds of the parameters, associated standard deviations (SD) and coefficients of variation (CV), the prior type and densities (value,SD) assigned to the parameters as applicable, and phases (negative identifies parameters that were fixed). Parameters designated as fixed were held at their initial values and have no associated range or SD.

Label	Value	Range	SD	CV	Prior	Phase
NatM_Lorenzen_Fem_GP_1	0.1716	(0,1)				-2
L_at_Amin_Fem_GP_1	24.6953	(1,40)	0.3902	0.016	Normal(19.816,3.33)	2
L_at_Amax_Fem_GP_1	77.2886	(60,84)	1.4061	0.018	Normal(70.222,2.61)	4
VonBert_K_Fem_GP_1	0.0727	(0.05,0.3)	0.0037	0.052	Normal(0.134,0.02)	4
CV_young_Fem_GP_1	0.1298	(0.01,0.5)				-3
CV_old_Fem_GP_1	0.1298	(0.01,0.5)				-3
Wtlen_1_Fem_GP_1	1.19e-05	(0,1)				-2
Wtlen_2_Fem_GP_1	3.04	(0,4)				-3
Mat50%_Fem_GP_1	3.4068	(1,10)				-3
Mat_slope_Fem_GP_1	-1.3346	(-10,0)				-3
Eggs_scalar_Fem_GP_1	1	(-1,1)				-3
Eggs_exp_wt_Fem_GP_1	1	(0,4)				-3
NatM_Lorenzen_Mal_GP_1	0	(0,1)				-2
L_at_Amin_Mal_GP_1	0	(-1,1)				-3
L_at_Amax_Mal_GP_1	0	(-1,1)				-4
VonBert_K_Mal_GP_1	0	(-1,1)				-4
CV_young_Mal_GP_1	0	(-1,1)				-3
CV_old_Mal_GP_1	0	(-1,1)				-3
Wtlen_1_Mal_GP_1	1.19e-05	(0,1)				-2
Wtlen_2_Mal_GP_1	3.04	(0,4)				-3
Herm_Infl_age	21.5253	(10,34)				-4
Herm_stdev	10.1407	(1,20)				-4
Herm_asymptote	0.8907	(0,1)				-4
CohortGrowDev	1	(0.1,10)				-1
FracFemale_GP_1	1	(1e-06,1)				-99
SR_LN(R0)	7.3301	(1,40)	0.0307	0.004		1
SR_BH_steep	0.6935	(0.2,0.99)				-3
SR_sigmaR	0.5623	(0,2)	0.0707	0.126		4

Table 11 Continued. List of Stock Synthesis parameters for Gulf of Mexico Scamp.

Label	Value	Range	SD	CV	Prior	Phase
SR_regime	0	(-5,5)				-4
SR_autocorr	0	(0,0.5)				-99
Main_RecrDev_1986	-1.1431	(-5,5)	0.3496	-0.306		2
Main_RecrDev_1987	-0.278	(-5,5)	0.2231	-0.802		2
Main_RecrDev_1988	-0.7248	(-5,5)	0.3255	-0.449		2
Main_RecrDev_1989	0.4501	(-5,5)	0.174	0.387		2
Main_RecrDev_1990	0.6128	(-5,5)	0.1814	0.296		2
Main_RecrDev_1991	0.2973	(-5,5)	0.2625	0.883		2
Main_RecrDev_1992	0.3251	(-5,5)	0.2675	0.823		2
Main_RecrDev_1993	0.0942	(-5,5)	0.3476	3.689		2
Main_RecrDev_1994	0.69	(-5,5)	0.2362	0.342		2
Main_RecrDev_1995	0.1186	(-5,5)	0.3977	3.353		2
Main_RecrDev_1996	0.37	(-5,5)	0.3455	0.934		2
Main_RecrDev_1997	0.6109	(-5,5)	0.2709	0.444		2
Main_RecrDev_1998	-0.3822	(-5,5)	0.5091	-1.332		2
Main_RecrDev_1999	0.8171	(-5,5)	0.2918	0.357		2
Main_RecrDev_2000	0.9926	(-5,5)	0.3136	0.316		2
Main_RecrDev_2001	0.0621	(-5,5)	0.6487	10.452		2
Main_RecrDev_2002	0.9529	(-5,5)	0.2885	0.303		2
Main_RecrDev_2003	0.0488	(-5,5)	0.5118	10.487		2
Main_RecrDev_2004	-0.0296	(-5,5)	0.376	-12.700		2
Main_RecrDev_2005	-0.1797	(-5,5)	0.3344	-1.861		2
Main_RecrDev_2006	0.3143	(-5,5)	0.2106	0.670		2
Main_RecrDev_2007	0.6931	(-5,5)	0.1551	0.224		2
Main_RecrDev_2008	0.0659	(-5,5)	0.2249	3.411		2
Main_RecrDev_2009	-0.3093	(-5,5)	0.2264	-0.732		2
Main_RecrDev_2010	-0.263	(-5,5)	0.1747	-0.664		2
Main_RecrDev_2011	-0.3703	(-5,5)	0.171	-0.462		2
Main_RecrDev_2012	-0.3835	(-5,5)	0.173	-0.451		2
Main_RecrDev_2013	-0.8985	(-5,5)	0.2481	-0.276		2
Main_RecrDev_2014	-0.7336	(-5,5)	0.2306	-0.314		2
Main_RecrDev_2015	0.2609	(-5,5)	0.1352	0.518		2
Main_RecrDev_2016	-1.0004	(-5,5)	0.3208	-0.321		2

Table 11 Continued. List of Stock Synthesis parameters for Gulf of Mexico Scamp.

Label	Value	Range	SD	CV	Prior	Phase
Main_RecrDev_2017	-1.0809	(-5,5)	0.3458	-0.320		2
Late_RecrDev_2018	0					
Late_RecrDev_2019	0					
Late_RecrDev_2020	0					
InitF_seas_1_flt_1ComVL	0.075	(0,1)	0.007	0.093		1
InitF_seas_1_flt_2ComLL	0.0782	(0,1)	0.0074	0.094		1
InitF_seas_1_flt_3Charter_Private	0.0236	(0,1)	0.0016	0.070		1
F_fleet_1_YR_1986_s_1	0.0847	(0,4)	0.0077	0.091		1
F_fleet_1_YR_1987_s_1	0.0882	(0,4)	0.0081	0.092		1
F_fleet_1_YR_1988_s_1	0.0773	(0,4)	0.0071	0.092		1
F_fleet_1_YR_1989_s_1	0.0807	(0,4)	0.0074	0.092		1
F_fleet_1_YR_1990_s_1	0.0799	(0,4)	0.0074	0.093		1
F_fleet_1_YR_1991_s_1	0.0976	(0,4)	0.0091	0.093		1
F_fleet_1_YR_1992_s_1	0.1234	(0,4)	0.0115	0.094		1
F_fleet_1_YR_1993_s_1	0.124	(0,4)	0.0117	0.094		1
F_fleet_1_YR_1994_s_1	0.0905	(0,4)	0.0086	0.095		1
F_fleet_1_YR_1995_s_1	0.0973	(0,4)	0.0092	0.095		1
F_fleet_1_YR_1996_s_1	0.0887	(0,4)	0.0084	0.094		1
F_fleet_1_YR_1997_s_1	0.1094	(0,4)	0.0103	0.094		1
F_fleet_1_YR_1998_s_1	0.0666	(0,4)	0.0063	0.094		1
F_fleet_1_YR_1999_s_1	0.08	(0,4)	0.0074	0.093		1
F_fleet_1_YR_2000_s_1	0.0551	(0,4)	0.005	0.091		1
F_fleet_1_YR_2001_s_1	0.0645	(0,4)	0.0058	0.091		1
F_fleet_1_YR_2002_s_1	0.0745	(0,4)	0.0067	0.090		1
F_fleet_1_YR_2003_s_1	0.069	(0,4)	0.0062	0.090		1
F_fleet_1_YR_2004_s_1	0.0652	(0,4)	0.0059	0.091		1
F_fleet_1_YR_2005_s_1	0.0635	(0,4)	0.0058	0.092		1
F_fleet_1_YR_2006_s_1	0.0485	(0,4)	0.0045	0.092		1
F_fleet_1_YR_2007_s_1	0.0551	(0,4)	0.0051	0.093		1
F_fleet_1_YR_2008_s_1	0.0493	(0,4)	0.0046	0.093		1
F_fleet_1_YR_2009_s_1	0.0576	(0,4)	0.0054	0.093		1
F_fleet_1_YR_2010_s_1	0.0336	(0,4)	0.0026	0.078		1
F_fleet_1_YR_2011_s_1	0.031	(0,4)	0.0024	0.077		1

Table 11 Continued. List of Stock Synthesis parameters for Gulf of Mexico Scamp.

Label	Value	Range	SD	CV	Prior	Phase
F_fleet_1_YR_2012_s_1	0.0576	(0,4)	0.0045	0.078		1
F_fleet_1_YR_2013_s_1	0.054	(0,4)	0.0043	0.080		1
F_fleet_1_YR_2014_s_1	0.0428	(0,4)	0.0035	0.081		1
F_fleet_1_YR_2015_s_1	0.0426	(0,4)	0.0036	0.084		1
F_fleet_1_YR_2016_s_1	0.0686	(0,4)	0.0061	0.088		1
F_fleet_1_YR_2017_s_1	0.0451	(0,4)	0.0042	0.093		1
F_fleet_1_YR_2018_s_1	0.0413	(0,4)	0.004	0.097		1
F_fleet_1_YR_2019_s_1	0.0366	(0,4)	0.0037	0.101		1
F_fleet_1_YR_2020_s_1	0.0378	(0,4)	0.0041	0.107		1
F_fleet_2_YR_1986_s_1	0.1048	(0,4)	0.0095	0.091		1
F_fleet_2_YR_1987_s_1	0.0955	(0,4)	0.0087	0.092		1
F_fleet_2_YR_1988_s_1	0.0694	(0,4)	0.0064	0.092		1
F_fleet_2_YR_1989_s_1	0.0803	(0,4)	0.0073	0.091		1
F_fleet_2_YR_1990_s_1	0.07	(0,4)	0.0065	0.092		1
F_fleet_2_YR_1991_s_1	0.0844	(0,4)	0.0078	0.093		1
F_fleet_2_YR_1992_s_1	0.0511	(0,4)	0.0048	0.093		1
F_fleet_2_YR_1993_s_1	0.072	(0,4)	0.0068	0.094		1
F_fleet_2_YR_1994_s_1	0.0415	(0,4)	0.0039	0.095		1
F_fleet_2_YR_1995_s_1	0.0434	(0,4)	0.0041	0.095		1
F_fleet_2_YR_1996_s_1	0.0463	(0,4)	0.0044	0.095		1
F_fleet_2_YR_1997_s_1	0.0536	(0,4)	0.0051	0.095		1
F_fleet_2_YR_1998_s_1	0.0552	(0,4)	0.0052	0.094		1
F_fleet_2_YR_1999_s_1	0.0521	(0,4)	0.0048	0.092		1
F_fleet_2_YR_2000_s_1	0.0426	(0,4)	0.0039	0.091		1
F_fleet_2_YR_2001_s_1	0.0613	(0,4)	0.0055	0.090		1
F_fleet_2_YR_2002_s_1	0.0621	(0,4)	0.0056	0.089		1
F_fleet_2_YR_2003_s_1	0.0704	(0,4)	0.0063	0.089		1
F_fleet_2_YR_2004_s_1	0.0778	(0,4)	0.0069	0.089		1
F_fleet_2_YR_2005_s_1	0.0716	(0,4)	0.0064	0.090		1
F_fleet_2_YR_2006_s_1	0.0419	(0,4)	0.0038	0.090		1
F_fleet_2_YR_2007_s_1	0.056	(0,4)	0.005	0.090		1
F_fleet_2_YR_2008_s_1	0.0634	(0,4)	0.0057	0.090		1
F_fleet_2_YR_2009_s_1	0.0407	(0,4)	0.0037	0.090		1

Table 11 Continued. List of Stock Synthesis parameters for Gulf of Mexico Scamp.

Label	Value	Range	SD	CV	Prior	Phase
F_fleet_2_YR_2010_s_1	0.0294	(0,4)	0.0022	0.073		1
F_fleet_2_YR_2011_s_1	0.0267	(0,4)	0.0019	0.073		1
F_fleet_2_YR_2012_s_1	0.0414	(0,4)	0.003	0.073		1
F_fleet_2_YR_2013_s_1	0.0477	(0,4)	0.0036	0.075		1
F_fleet_2_YR_2014_s_1	0.0298	(0,4)	0.0023	0.077		1
F_fleet_2_YR_2015_s_1	0.0417	(0,4)	0.0033	0.080		1
F_fleet_2_YR_2016_s_1	0.0808	(0,4)	0.0069	0.085		1
F_fleet_2_YR_2017_s_1	0.0471	(0,4)	0.0042	0.090		1
F_fleet_2_YR_2018_s_1	0.0446	(0,4)	0.0042	0.094		1
F_fleet_2_YR_2019_s_1	0.0365	(0,4)	0.0036	0.099		1
F_fleet_2_YR_2020_s_1	0.0441	(0,4)	0.0047	0.106		1
F_fleet_3_YR_1986_s_1	0.0374	(0,4)	0.0026	0.070		1
F_fleet_3_YR_1987_s_1	0.0299	(0,4)	0.0104	0.349		1
F_fleet_3_YR_1988_s_1	0.0302	(0,4)	0.0101	0.335		1
F_fleet_3_YR_1989_s_1	0.0128	(0,4)	0.004	0.315		1
F_fleet_3_YR_1990_s_1	0.0145	(0,4)	0.0043	0.297		1
F_fleet_3_YR_1991_s_1	0.0195	(0,4)	0.0067	0.342		1
F_fleet_3_YR_1992_s_1	0.0254	(0,4)	0.0075	0.295		1
F_fleet_3_YR_1993_s_1	0.0397	(0,4)	0.0118	0.297		1
F_fleet_3_YR_1994_s_1	0.0182	(0,4)	0.0058	0.316		1
F_fleet_3_YR_1995_s_1	0.0054	(0,4)	0.0017	0.305		1
F_fleet_3_YR_1996_s_1	0.0098	(0,4)	0.0034	0.346		1
F_fleet_3_YR_1997_s_1	0.0136	(0,4)	0.0042	0.311		1
F_fleet_3_YR_1998_s_1	0.0118	(0,4)	0.0037	0.314		1
F_fleet_3_YR_1999_s_1	0.0277	(0,4)	0.0088	0.317		1
F_fleet_3_YR_2000_s_1	0.0164	(0,4)	0.005	0.308		1
F_fleet_3_YR_2001_s_1	0.0192	(0,4)	0.0058	0.303		1
F_fleet_3_YR_2002_s_1	0.017	(0,4)	0.0045	0.263		1
F_fleet_3_YR_2003_s_1	0.0517	(0,4)	0.0129	0.249		1
F_fleet_3_YR_2004_s_1	0.0613	(0,4)	0.0137	0.224		1
F_fleet_3_YR_2005_s_1	0.0267	(0,4)	0.0066	0.246		1
F_fleet_3_YR_2006_s_1	0.0397	(0,4)	0.0114	0.287		1
F_fleet_3_YR_2007_s_1	0.045	(0,4)	0.0101	0.225		1

Table 11 Continued. List of Stock Synthesis parameters for Gulf of Mexico Scamp.

Label	Value	Range	SD	CV	Prior	Phase
F_fleet_3_YR_2008_s_1	0.0594	(0,4)	0.0141	0.237		1
F_fleet_3_YR_2009_s_1	0.053	(0,4)	0.0137	0.258		1
F_fleet_3_YR_2010_s_1	0.0504	(0,4)	0.0119	0.235		1
F_fleet_3_YR_2011_s_1	0.0324	(0,4)	0.0086	0.264		1
F_fleet_3_YR_2012_s_1	0.0784	(0,4)	0.0212	0.271		1
F_fleet_3_YR_2013_s_1	0.0567	(0,4)	0.0159	0.280		1
F_fleet_3_YR_2014_s_1	0.1064	(0,4)	0.0226	0.212		1
F_fleet_3_YR_2015_s_1	0.1171	(0,4)	0.0274	0.234		1
F_fleet_3_YR_2016_s_1	0.0764	(0,4)	0.0179	0.234		1
F_fleet_3_YR_2017_s_1	0.0682	(0,4)	0.0188	0.276		1
F_fleet_3_YR_2018_s_1	0.061	(0,4)	0.019	0.311		1
F_fleet_3_YR_2019_s_1	0.0817	(0,4)	0.0225	0.276		1
F_fleet_3_YR_2020_s_1	0.0729	(0,4)	0.0201	0.275		1
F_fleet_4_YR_1986_s_1	0.0065	(0,4)	4.62e-04	0.072		1
F_fleet_4_YR_1987_s_1	0.0042	(0,4)	0.0014	0.335		1
F_fleet_4_YR_1988_s_1	0.0035	(0,4)	0.0012	0.335		1
F_fleet_4_YR_1989_s_1	0.0096	(0,4)	0.0032	0.339		1
F_fleet_4_YR_1990_s_1	0.0044	(0,4)	0.0015	0.347		1
F_fleet_4_YR_1991_s_1	0.0037	(0,4)	0.0013	0.347		1
F_fleet_4_YR_1992_s_1	0.0033	(0,4)	0.0012	0.347		1
F_fleet_4_YR_1993_s_1	0.0032	(0,4)	0.0011	0.346		1
F_fleet_4_YR_1994_s_1	0.0028	(0,4)	9.75e-04	0.346		1
F_fleet_4_YR_1995_s_1	0.0028	(0,4)	9.59e-04	0.346		1
F_fleet_4_YR_1996_s_1	0.0021	(0,4)	7.19e-04	0.346		1
F_fleet_4_YR_1997_s_1	0.0019	(0,4)	6.72e-04	0.346		1
F_fleet_4_YR_1998_s_1	0.0017	(0,4)	5.76e-04	0.346		1
F_fleet_4_YR_1999_s_1	0.0023	(0,4)	8.22e-04	0.350		1
F_fleet_4_YR_2000_s_1	0.0021	(0,4)	5.75e-04	0.277		1
F_fleet_4_YR_2001_s_1	0.0013	(0,4)	3.66e-04	0.280		1
F_fleet_4_YR_2002_s_1	0.0019	(0,4)	5.26e-04	0.278		1
F_fleet_4_YR_2003_s_1	0.0036	(0,4)	9.74e-04	0.269		1
F_fleet_4_YR_2004_s_1	0.0027	(0,4)	7.50e-04	0.282		1
F_fleet_4_YR_2005_s_1	0.0017	(0,4)	4.74e-04	0.287		1

Table 11 Continued. List of Stock Synthesis parameters for Gulf of Mexico Scamp.

Label	Value	Range	SD	CV	Prior	Phase
F_fleet_4_YR_2006_s_1	0.0013	(0,4)	3.80e-04	0.287		1
F_fleet_4_YR_2007_s_1	0.002	(0,4)	5.71e-04	0.286		1
F_fleet_4_YR_2008_s_1	0.0028	(0,4)	7.70e-04	0.272		1
F_fleet_4_YR_2009_s_1	0.0028	(0,4)	7.55e-04	0.273		1
F_fleet_4_YR_2010_s_1	0.0019	(0,4)	5.19e-04	0.273		1
F_fleet_4_YR_2011_s_1	0.0034	(0,4)	9.45e-04	0.277		1
F_fleet_4_YR_2012_s_1	0.0031	(0,4)	8.51e-04	0.274		1
F_fleet_4_YR_2013_s_1	0.003	(0,4)	8.33e-04	0.274		1
F_fleet_4_YR_2014_s_1	0.0049	(0,4)	0.0013	0.272		1
F_fleet_4_YR_2015_s_1	0.0067	(0,4)	0.0018	0.272		1
F_fleet_4_YR_2016_s_1	0.0044	(0,4)	0.0012	0.278		1
F_fleet_4_YR_2017_s_1	0.0043	(0,4)	0.0012	0.280		1
F_fleet_4_YR_2018_s_1	0.0059	(0,4)	0.0017	0.281		1
F_fleet_4_YR_2019_s_1	0.0046	(0,4)	0.0013	0.284		1
F_fleet_4_YR_2020_s_1	0.0043	(0,4)	0.0012	0.282		1
LnQ_base_ComVL(1)	-6.9604	(-25,25)				-4
Q_extraSD_ComVL(1)	0.0595	(0,0.5)	0.046	0.773		4
LnQ_base_Headboat(4)	-6.8344	(-25,25)				-4
Q_extraSD_Headboat(4)	0.0285	(0,0.5)	0.0275	0.965		4
LnQ_base_Combined_Video(5)	-7.5483	(-25,25)				-1
Q_extraSD_Combined_Video(5)	0.1101	(0,0.5)	0.0398	0.361		4
LnQ_base_RFOP_Index(6)	-6.6953	(-25,25)				-1
Q_extraSD_RFOP_Index(6)	0.2535	(0,0.5)	0.0763	0.301		4
Size_inflection_ComVL(1)	49.2366	(10,84)	0.6241	0.013		2
Size_95%width_ComVL(1)	16.1302	(0,50)	0.549	0.034		2
Retain_L_infl_ComVL(1)	0	(0,84)				-3
Retain_L_width_ComVL(1)	1	(0,20)				-3
Retain_L_asymptote_logit_ComVL(1)	10	(-10,10)				-2
Retain_L_maleoffset_ComVL(1)	0	(-1,2)				-4
DiscMort_L_infl_ComVL(1)	-5	(-10,10)				-2
DiscMort_L_width_ComVL(1)	1	(-1,2)				-4
DiscMort_L_level_old_ComVL(1)	0.47	(-1,2)				-2
DiscMort_L_male_offset_ComVL(1)	0	(-1,2)				-4

Table 11 Continued. List of Stock Synthesis parameters for Gulf of Mexico Scamp.

Label	Value	Range	SD	CV	Prior	Phase
Size_inflection_ComLL(2)	52.6986	(10,84)	0.3709	0.007		2
Size_95%width_ComLL(2)	11.5835	(0,50)	0.2674	0.023		2
Retain_L_infl_ComLL(2)	0	(0,84)				-3
Retain_L_width_ComLL(2)	1	(0,20)				-3
Retain_L_asymptote_logit_ComLL(2)	10	(-10,10)				-2
Retain_L_maleoffset_ComLL(2)	0	(-1,2)				-4
DiscMort_L_infl_ComLL(2)	-5	(-10,10)				-2
DiscMort_L_width_ComLL(2)	1	(-1,2)				-4
DiscMort_L_level_old_ComLL(2)	0.68	(-1,2)				-2
DiscMort_L_male_offset_ComLL(2)	0	(-1,2)				-4
Size_DblN_peak_Charter_Private(3)	35.4483	(10,81)	2.0431	0.058		2
Size_DblN_top_logit_Charter_Private(3)	-1.7881	(-15,15)	0.5544	-0.310		3
Size_DblN_ascend_se_Charter_Private(3)	3.9937	(-15,15)	0.4956	0.124		3
Size_DblN_descend_se_Charter_Private(3)	2.6454	(-15,15)	1.3666	0.517		3
Size_DblN_start_logit_Charter_Private(3)	-6.5232	(-15,15)	3.1807	-0.488		2
Size_DblN_end_logit_Charter_Private(3)	1.1631	(-15,15)	0.3031	0.261		4
Retain_L_infl_Charter_Private(3)	35	(0,84)				-3
Retain_L_width_Charter_Private(3)	0.5	(0,20)				-3
Retain_L_asymptote_logit_Charter_Private(3)	10	(-10,10)				-2
Retain_L_maleoffset_Charter_Private(3)	0	(-1,2)				-4
DiscMort_L_infl_Charter_Private(3)	-5	(-10,10)				-2
DiscMort_L_width_Charter_Private(3)	1	(-1,2)				-4
DiscMort_L_level_old_Charter_Private(3)	0.26	(-1,2)				-2
DiscMort_L_male_offset_Charter_Private(3)	0	(-1,2)				-4
Size_DblN_peak_Headboat(4)	43.3751	(10,81)	0.0801	0.002		2
Size_DblN_top_logit_Headboat(4)	-12.5868	(-15,15)	42.595	-3.384		3
Size_DblN_ascend_se_Headboat(4)	4.9245	(-15,15)	0.0593	0.012		3
Size_DblN_descend_se_Headboat(4)	-6.701	(-15,15)	33.6471	-5.021		3
Size_DblN_start_logit_Headboat(4)	-13.2737	(-15,15)	33.6899	-2.538		2
Size_DblN_end_logit_Headboat(4)	0.3632	(-15,15)	0.1468	0.404		4
Retain_L_infl_Headboat(4)	0	(0,84)				-3
Retain_L_width_Headboat(4)	1	(0,20)				-3
Retain_L_asymptote_logit_Headboat(4)	10	(-10,10)				-2

Table 11 Continued. List of Stock Synthesis parameters for Gulf of Mexico Scamp.

Label	Value	Range	SD	CV	Prior	Phase
Retain_L_maleoffset_Headboat(4)	0	(-1,2)				-4
DiscMort_L_infl_Headboat(4)	-5	(-10,10)				-2
DiscMort_L_width_Headboat(4)	1	(-1,2)				-4
DiscMort_L_level_old_Headboat(4)	0.26	(-1,2)				-2
DiscMort_L_male_offset_Headboat(4)	0	(-1,2)				-4
Size_inflection_Combined_Video(5)	31.5797	(10,84)	0.6059	0.019		2
Size_95%width_Combined_Video(5)	12.11	(0,50)	1.4438	0.119		2
Size_inflection_RFOP_Index(6)	43.5125	(10,84)	0.7471	0.017		2
Size_95%width_RFOP_Index(6)	12.8377	(0,50)	0.7004	0.055		2
ln(DM_theta)_1	4.9997	(-5,5)			Normal(0,1.81)	-6
ln(DM_theta)_2	4.9994	(-5,5)			Normal(0,1.81)	-6
ln(DM_theta)_3	4.4437	(-5,5)	0.7571	0.170	Normal(0,1.81)	6
ln(DM_theta)_4	-1.8757	(-5,5)	0.0808	-0.043	Normal(0,1.81)	6
ln(DM_theta)_5	3.5457	(-5,5)	0.7847	0.221	Normal(0,1.81)	6
ln(DM_theta)_6	1.8238	(-5,5)	0.3829	0.210	Normal(0,1.81)	6
Retain_L_infl_ComVL(1)_BLK1repl_1990	35.5621	(10,84)	0.7273	0.020		3
Retain_L_infl_ComVL(1)_BLK1repl_1999	33.3786	(10,84)	0.6545	0.020		3
Retain_L_infl_ComVL(1)_BLK1repl_2003	35.8875	(10,84)	0.363	0.010		3
Retain_L_infl_ComVL(1)_BLK1repl_2010	37.7934	(10,84)	0.1986	0.005		3
Retain_L_width_ComVL(1)_BLK1repl_1990	2.9872	(0,20)	0.4899	0.164		3
Retain_L_width_ComVL(1)_BLK1repl_1999	1.8475	(0,20)	0.4661	0.252		3
Retain_L_width_ComVL(1)_BLK1repl_2003	1.3278	(0,20)	0.2216	0.167		3
Retain_L_width_ComVL(1)_BLK1repl_2010	1.259	(0,20)	0.1695	0.135		3
Retain_L_asymptote_logit_ComVL(1)_BLK1repl_1990	10	(-10,10)				-3
Retain_L_asymptote_logit_ComVL(1)_BLK1repl_1999	10	(-10,10)				-3
Retain_L_asymptote_logit_ComVL(1)_BLK1repl_2003	10	(-10,10)				-3
Retain_L_asymptote_logit_ComVL(1)_BLK1repl_2010	4.0135	(-10,10)	0.2703	0.067		3
Retain_L_infl_ComLL(2)_BLK1repl_1990	36.5408	(10,84)	1.5321	0.042		3
Retain_L_infl_ComLL(2)_BLK1repl_1999	36.1525	(10,84)	0.766	0.021		3
Retain_L_infl_ComLL(2)_BLK1repl_2003	36.7902	(10,84)	0.5239	0.014		3
Retain_L_infl_ComLL(2)_BLK1repl_2010	38.6153	(10,84)	0.4968	0.013		3
Retain_L_width_ComLL(2)_BLK1repl_1990	2.9604	(0,20)	1.4419	0.487		3
Retain_L_width_ComLL(2)_BLK1repl_1999	1.1608	(0,20)	0.4809	0.414		3

Table 11 Continued. List of Stock Synthesis parameters for Gulf of Mexico Scamp.

Label	Value	Range	SD	CV	Prior	Phase
Retain_L_width_ComLL(2)_BLK1repl_2003	1.3213	(0,20)	0.4365	0.330		3
Retain_L_width_ComLL(2)_BLK1repl_2010	2.0266	(0,20)	0.284	0.140		3
Retain_L_asymptote_logit_ComLL(2)_BLK1repl_1990	10	(-10,10)				-3
Retain_L_asymptote_logit_ComLL(2)_BLK1repl_1999	10	(-10,10)				-3
Retain_L_asymptote_logit_ComLL(2)_BLK1repl_2003	10	(-10,10)				-3
Retain_L_asymptote_logit_ComLL(2)_BLK1repl_2010	5.6957	(-10,10)	0.5318	0.093		3
Retain_L_infl_Charter_Private(3)_BLK2repl_1990	41.2134	(10,84)	0.7968	0.019		3
Retain_L_infl_Charter_Private(3)_BLK2repl_1999	43.0797	(10,84)	0.8783	0.020		3
Retain_L_infl_Charter_Private(3)_BLK2repl_2003	38.7247	(10,84)	0.2063	0.005		3
Retain_L_width_Charter_Private(3)_BLK2repl_1990	1.3813	(0,20)	0.4178	0.302		3
Retain_L_width_Charter_Private(3)_BLK2repl_1999	2.6681	(0,20)	0.3572	0.134		3
Retain_L_width_Charter_Private(3)_BLK2repl_2003	0.7231	(0,20)	0.1165	0.161		3
Retain_L_asymptote_logit_Charter_Private(3)_BLK2repl_1990	9.5198	(-10,10)	12.5314	1.316		3
Retain_L_asymptote_logit_Charter_Private(3)_BLK2repl_1999	9.2124	(-10,10)	18.792	2.040		3
Retain_L_asymptote_logit_Charter_Private(3)_BLK2repl_2003	4.1324	(-10,10)	0.8222	0.199		3
Retain_L_infl_Headboat(4)_BLK2repl_1990	33.4505	(10,84)	0.5368	0.016		3
Retain_L_infl_Headboat(4)_BLK2repl_1999	36.5632	(10,84)	0.8397	0.023		3
Retain_L_infl_Headboat(4)_BLK2repl_2003	37.9625	(10,84)	0.1853	0.005		3
Retain_L_width_Headboat(4)_BLK2repl_1990	1.2852	(0,20)	0.3412	0.265		3
Retain_L_width_Headboat(4)_BLK2repl_1999	1.5393	(0,20)	0.4684	0.304		3
Retain_L_width_Headboat(4)_BLK2repl_2003	0.8572	(0,20)	0.1021	0.119		3
Retain_L_asymptote_logit_Headboat(4)_BLK2repl_1990	1.533	(-10,10)	0.554	0.361		3
Retain_L_asymptote_logit_Headboat(4)_BLK2repl_1999	0.7101	(-10,10)	0.3947	0.556		3
Retain_L_asymptote_logit_Headboat(4)_BLK2repl_2003	4.7897	(-10,10)	0.6526	0.136		3

Table 12. Estimates of annual exploitation rate (total biomass killed all ages / total biomass age 3+) by fleet and combined across all fleets (Total) for Gulf of Mexico Scamp, which was used as the proxy for annual fishing mortality rate.

Year	Commercial Vertical Line	Commercial Longline	Recreational Charter Private	Recreational Headboat	Total
1986	0.038	0.036	0.030	0.004	0.108
1987	0.039	0.032	0.024	0.003	0.098
1988	0.034	0.024	0.024	0.002	0.084
1989	0.038	0.029	0.010	0.007	0.085
1990	0.038	0.027	0.010	0.002	0.078
1991	0.049	0.034	0.014	0.002	0.099
1992	0.058	0.019	0.017	0.002	0.096
1993	0.053	0.024	0.025	0.002	0.104
1994	0.038	0.014	0.012	0.002	0.065
1995	0.040	0.014	0.004	0.002	0.059
1996	0.037	0.015	0.007	0.001	0.060
1997	0.044	0.016	0.009	0.001	0.070
1998	0.028	0.017	0.008	0.001	0.054
1999	0.034	0.017	0.017	0.001	0.069
2000	0.023	0.013	0.010	0.001	0.048
2001	0.029	0.021	0.013	0.001	0.063
2002	0.032	0.020	0.011	0.001	0.064
2003	0.028	0.021	0.036	0.002	0.086
2004	0.027	0.024	0.044	0.002	0.097
2005	0.025	0.021	0.019	0.001	0.066
2006	0.020	0.013	0.029	0.001	0.063
2007	0.024	0.019	0.033	0.001	0.077
2008	0.023	0.023	0.044	0.002	0.092
2009	0.027	0.015	0.039	0.002	0.083
2010	0.015	0.011	0.035	0.001	0.062
2011	0.015	0.010	0.023	0.002	0.050
2012	0.027	0.016	0.056	0.002	0.101

Table 12 Continued. Estimates of annual exploitation rate (total biomass killed all ages / total biomass age 3+) by fleet and combined across all fleets (Total) for Gulf of Mexico Scamp, which was used as the proxy for annual fishing mortality rate.

Year	Commercial Vertical Line	Commercial Longline	Recreational Charter Private	Recreational Headboat	Total
2013	0.027	0.019	0.041	0.002	0.089
2014	0.021	0.012	0.076	0.003	0.113
2015	0.022	0.018	0.082	0.004	0.125
2016	0.036	0.036	0.055	0.002	0.129
2017	0.024	0.022	0.050	0.003	0.099
2018	0.021	0.019	0.042	0.003	0.085
2019	0.019	0.016	0.058	0.003	0.095
2020	0.020	0.020	0.054	0.003	0.096

Table 13. Expected biomass (metric tons) for all Scamp and exploited Scamp (3+ years), spawning stock biomass (male and female combined SSB, metric tons), exploited numbers (3+ years, 1,000s of fish), age-0 recruits (1,000s of fish), and SSB ratio (SSB/SSB_0) where SSB_0 = 3,779 metric tons for Gulf of Mexico Scamp.

Year	Biomass (all)	Biomass (exploited)	SSB	Abundance (exploited)	Recruits	SSB ratio
1986	2,606	2,210	1,972	2,057.33	398.42	0.52
1987	2,415	2,157	1,920	2,021.23	934.56	0.51
1988	2,298	2,128	1,892	2,005.68	596.10	0.50
1989	2,168	1,965	1,831	1,655.21	1,917.38	0.48
1990	2,207	1,887	1,754	1,564.88	2,236.01	0.46
1991	2,317	1,778	1,668	1,399.76	1,613.40	0.44
1992	2,343	1,838	1,617	1,673.73	1,647.58	0.43
1993	2,374	1,950	1,645	1,976.24	1,312.94	0.44
1994	2,347	1,958	1,678	1,998.11	2,392.55	0.44
1995	2,512	2,037	1,771	2,063.93	1,366.98	0.47
1996	2,570	2,072	1,841	2,020.37	1,771.81	0.49

Table 13 Continued. Expected biomass (metric tons) for all Scamp and exploited Scamp (3+ years), spawning stock biomass (male and female combined SSB, metric tons), exploited numbers (3+ years, 1,000s of fish), age-0 recruits (1,000s of fish), and SSB ratio (SSB/SSB_0) where SSB_0 = 3,779 metric tons for Gulf of Mexico Scamp.

Year	Biomass (all)	Biomass (exploited)	SSB	Abundance (exploited)	Recruits	SSB ratio
1997	2,664	2,257	1,942	2,327.76	2,278.55	0.51
1998	2,789	2,265	2,002	2,227.38	848.94	0.53
1999	2,777	2,357	2,088	2,298.85	2,838.93	0.55
2000	2,953	2,484	2,163	2,492.71	3,404.80	0.57
2001	3,248	2,440	2,223	2,217.84	1,349.24	0.59
2002	3,281	2,646	2,302	2,622.09	3,308.17	0.61
2003	3,517	2,925	2,458	3,104.49	1,354.04	0.65
2004	3,453	2,835	2,509	2,779.11	1,256.06	0.66
2005	3,339	2,999	2,576	3,130.02	1,085.43	0.68
2006	3,259	2,952	2,643	2,839.34	1,785.80	0.70
2007	3,258	2,887	2,653	2,590.24	2,609.80	0.70
2008	3,322	2,756	2,565	2,328.97	1,386.74	0.68
2009	3,222	2,695	2,456	2,328.24	946.34	0.65
2010	3,086	2,780	2,439	2,594.01	990.15	0.64
2011	2,988	2,736	2,460	2,436.52	890.63	0.65
2012	2,903	2,657	2,461	2,202.72	878.96	0.65
2013	2,689	2,460	2,295	1,967.16	519.17	0.61
2014	2,480	2,296	2,149	1,778.83	605.26	0.57
2015	2,238	2,091	1,953	1,595.08	1,607.30	0.52
2016	2,117	1,837	1,735	1,334.17	446.04	0.46
2017	1,906	1,632	1,538	1,178.18	405.24	0.41
2018	1,756	1,644	1,460	1,393.68	1,297.81	0.39
2019	1,735	1,518	1,395	1,201.81	1,283.14	0.37
2020	1,719	1,383	1,301	1,035.71	1,260.23	0.34

Table 14. Expected spawning stock biomass (male and female combined SSB, metric tons), exploitable biomass (3+ years, metric tons), and exploitable abundance (3+ years, 1,000s of fish) by sex and associated sex ratio (exploitable male:female) for Gulf of Mexico Scamp.

Year	SSB (female)	SSB (male)	Biomass (female)	Biomass (male)	Abundance (female)	Abundance (male)	Sex ratio
1986	1,385	587	1,624	587	1,786.32	271.01	15.2
1987	1,354	566	1,591	566	1,758.75	262.48	14.9
1988	1,339	553	1,576	553	1,748.36	257.32	14.7
1989	1,279	552	1,413	552	1,398.08	257.13	18.4
1990	1,203	550	1,337	550	1,311.58	253.30	19.3
1991	1,116	551	1,227	551	1,149.73	250.03	21.7
1992	1,081	536	1,301	536	1,434.66	239.07	16.7
1993	1,125	520	1,430	520	1,745.21	231.03	13.2
1994	1,183	495	1,463	495	1,774.43	223.68	12.6
1995	1,271	500	1,537	500	1,834.32	229.61	12.5
1996	1,331	510	1,563	510	1,782.28	238.09	13.4
1997	1,420	522	1,735	522	2,081.28	246.48	11.8
1998	1,473	529	1,737	529	1,972.61	254.77	12.9
1999	1,535	553	1,804	553	2,030.82	268.03	13.2
2000	1,593	570	1,915	570	2,215.64	277.08	12.5
2001	1,617	606	1,834	606	1,922.99	294.85	15.3
2002	1,671	631	2,015	631	2,318.41	303.68	13.1
2003	1,804	654	2,270	654	2,789.69	314.80	11.3
2004	1,848	661	2,173	661	2,457.09	322.02	13.1
2005	1,913	662	2,337	662	2,806.97	323.05	11.5
2006	1,956	687	2,265	687	2,501.03	338.31	13.5
2007	1,931	722	2,165	722	2,237.57	352.67	15.8
2008	1,823	742	2,014	742	1,971.95	357.02	18.1
2009	1,708	748	1,947	748	1,976.36	351.88	17.8
2010	1,682	758	2,022	758	2,245.19	348.82	15.5
2011	1,677	783	1,953	783	2,081.18	355.34	17.1
2012	1,644	817	1,840	817	1,838.55	364.17	19.8

Table 14 Continued. Expected spawning stock biomass (male and female combined SSB, metric tons), exploitable biomass (3+ years, metric tons), and exploitable abundance (3+ years, 1,000s of fish) by sex and associated sex ratio (exploitable male:female) for Gulf of Mexico Scamp.

Year	SSB (female)	SSB (male)	Biomass (female)	Biomass (male)	Abundance (female)	Abundance (male)	Sex ratio
2013	1,501	794	1,666	794	1,619.19	347.97	21.5
2014	1,371	778	1,518	778	1,444.21	334.62	23.2
2015	1,213	740	1,351	740	1,283.73	311.35	24.3
2016	1,048	687	1,150	687	1,050.89	283.28	27.0
2017	911	626	1,005	626	923.70	254.48	27.6
2018	867	594	1,051	594	1,157.36	236.32	20.4
2019	829	566	952	566	977.53	224.28	22.9
2020	767	534	850	534	825.82	209.89	25.4

Table 15A. Expected numbers-at-age (1,000s of fish) at the beginning of the year (January 1st) for female Scamp in the Gulf of Mexico.

Year	0	1	2	3	4	5	6	7
1986	398.421	874.670	636.622	476.959	357.269	268.023	200.146	147.979
1987	934.563	228.432	635.033	474.212	353.493	263.891	196.288	144.686
1988	596.100	535.828	166.010	474.159	353.038	262.798	194.774	143.110
1989	1,917.380	341.773	389.540	124.040	353.455	263.060	194.707	142.849
1990	2,236.010	1,099.320	248.578	291.618	92.890	265.244	196.548	144.030
1991	1,613.400	1,282.030	801.188	186.880	219.950	70.347	200.077	146.710
1992	1,647.580	925.050	933.819	601.629	140.656	165.963	52.753	148.077
1993	1,312.940	944.646	673.340	700.262	451.758	105.745	123.832	38.808
1994	2,392.550	752.775	686.794	503.750	523.816	337.620	78.224	90.065
1995	1,366.980	1,371.780	548.471	516.086	379.711	396.365	254.427	58.345
1996	1,771.810	783.768	1,000.440	412.911	390.120	288.501	300.308	190.967
1997	2,278.550	1,015.880	571.469	752.878	311.986	296.251	218.449	225.267
1998	848.939	1,306.420	740.324	429.584	567.684	236.070	223.056	162.552
1999	2,838.930	486.745	952.626	557.270	324.808	431.688	179.156	167.873
2000	3,404.800	1,627.710	354.396	714.792	419.161	245.196	324.531	133.287
2001	1,349.240	1,952.160	1,186.580	266.611	540.078	318.660	186.215	244.751
2002	3,308.170	773.593	1,422.640	892.023	201.179	409.650	241.111	139.653
2003	1,354.040	1,896.760	563.782	1,069.510	672.984	152.512	309.635	180.523
2004	1,256.060	776.332	1,378.590	421.512	798.361	500.940	112.379	224.987
2005	1,085.430	720.150	563.856	1,029.240	313.875	591.958	367.168	81.139
2006	1,785.800	622.332	524.543	423.449	774.537	236.704	444.026	272.489
2007	2,609.800	1,023.890	452.911	393.280	317.835	582.046	176.899	328.722
2008	1,386.740	1,496.320	744.744	339.179	294.529	237.923	432.497	129.969
2009	946.335	795.076	1,087.130	556.409	252.944	218.998	175.190	314.373
2010	990.146	542.576	577.921	812.998	415.664	188.615	161.919	128.024
2011	890.628	567.696	394.584	432.711	608.916	311.400	140.461	119.509
2012	878.961	510.642	413.435	296.292	325.740	459.888	234.487	105.061
2013	519.172	503.941	370.416	307.921	219.760	240.109	334.693	168.171
2014	605.259	297.664	366.205	276.887	229.871	163.674	177.205	244.003
2015	1,607.300	347.012	215.453	271.530	203.768	167.398	117.263	124.918
2016	446.037	921.504	250.932	159.432	199.087	147.487	118.914	81.804
2017	405.240	255.730	668.421	186.857	118.173	146.499	106.956	84.751
2018	1,297.810	232.340	185.667	498.724	139.040	87.569	107.413	77.414
2019	1,283.140	744.091	168.779	138.686	371.826	103.357	64.490	78.176
2020	1,260.230	735.672	539.690	125.674	102.835	274.069	75.275	46.351

Table 15A Continued. Expected numbers-at-age (1,000s of fish) at the beginning of the year (January 1st) for female Scamp in the Gulf of Mexico.

Year	8	9	10	11	12	13	14	15
1986	107.785	76.993	53.726	36.498	24.063	15.350	9.445	5.585
1987	105.112	74.896	52.132	35.329	23.239	14.794	9.085	5.364
1988	103.691	73.712	51.194	34.618	22.723	14.437	8.850	5.217
1989	103.439	73.553	51.119	34.591	22.718	14.437	8.852	5.218
1990	104.071	73.874	51.288	34.683	22.765	14.459	8.859	5.219
1991	105.820	74.931	51.933	35.092	23.028	14.625	8.959	5.277
1992	106.570	75.113	51.790	34.847	22.799	14.448	8.835	5.196
1993	106.874	75.177	51.628	34.590	22.557	14.264	8.712	5.118
1994	27.621	74.173	50.730	33.789	21.904	13.786	8.392	4.918
1995	66.169	19.909	52.278	34.854	22.562	14.171	8.614	5.046
1996	43.149	48.004	14.117	36.114	23.388	14.661	8.889	5.197
1997	141.166	31.298	34.043	9.757	24.252	15.213	9.208	5.371
1998	164.777	101.072	21.858	23.121	6.427	15.449	9.344	5.435
1999	120.691	120.172	72.136	15.216	15.650	4.216	9.789	5.699
2000	122.976	86.703	84.371	49.345	10.112	10.073	2.620	5.852
2001	99.326	90.172	62.324	59.254	33.748	6.712	6.466	1.620
2002	180.968	72.090	64.004	43.122	39.842	21.983	4.222	3.913
2003	103.013	130.930	50.968	44.079	28.841	25.800	13.739	2.538
2004	128.983	72.167	89.666	34.018	28.584	18.115	15.644	8.014
2005	159.623	89.686	49.037	59.362	21.876	17.800	10.888	9.043
2006	59.320	114.515	62.913	33.526	39.430	14.074	11.055	6.504
2007	199.228	42.702	80.903	43.477	22.585	25.804	8.914	6.750
2008	238.090	141.825	29.783	55.108	28.828	14.529	16.048	5.339
2009	93.053	167.478	97.729	20.042	36.097	18.319	8.925	9.494
2010	226.557	65.967	116.456	66.446	13.280	23.228	11.407	5.356
2011	93.453	163.157	46.728	80.869	45.072	8.766	14.863	7.045
2012	88.529	68.350	117.424	32.977	55.760	30.248	5.703	9.336
2013	74.192	61.465	46.545	78.200	21.407	35.161	18.460	3.355
2014	120.854	52.430	42.591	31.526	51.606	13.717	21.795	11.027
2015	169.437	82.645	35.244	28.063	20.291	32.325	8.329	12.774
2016	85.721	114.374	54.786	22.881	17.784	12.506	19.300	4.798
2017	57.208	58.703	76.504	35.693	14.477	10.893	7.392	10.970
2018	60.474	40.165	40.445	51.564	23.456	9.243	6.732	4.404
2019	55.592	42.757	27.882	27.478	34.169	15.106	5.763	4.048
2020	55.429	38.834	29.356	18.758	18.051	21.837	9.355	3.444

Table 15A Continued. Expected numbers-at-age (1,000s of fish) at the beginning of the year (January 1st) for female Scamp in the Gulf of Mexico.

Year	16	17	18	19	20+
1986	3.163	1.708	0.876	0.424	0.326
1987	3.034	1.637	0.838	0.406	0.311
1988	2.947	1.588	0.813	0.393	0.301
1989	2.947	1.588	0.812	0.393	0.301
1990	2.945	1.586	0.811	0.392	0.300
1991	2.977	1.602	0.819	0.396	0.303
1992	2.927	1.573	0.803	0.388	0.296
1993	2.881	1.547	0.789	0.381	0.291
1994	2.763	1.481	0.755	0.364	0.277
1995	2.834	1.520	0.774	0.373	0.284
1996	2.917	1.564	0.797	0.384	0.292
1997	3.010	1.612	0.821	0.395	0.301
1998	3.035	1.622	0.825	0.397	0.302
1999	3.178	1.694	0.860	0.414	0.314
2000	3.265	1.737	0.880	0.422	0.321
2001	3.473	1.851	0.937	0.449	0.340
2002	0.940	1.923	0.974	0.466	0.352
2003	2.254	0.516	1.004	0.480	0.362
2004	1.418	1.202	0.262	0.481	0.362
2005	4.438	0.749	0.603	0.124	0.359
2006	5.176	2.424	0.389	0.296	0.205
2007	3.812	2.900	1.291	0.196	0.224
2008	3.878	2.092	1.512	0.637	0.183
2009	3.030	2.101	1.077	0.737	0.366
2010	5.469	1.668	1.100	0.534	0.499
2011	3.180	3.105	0.901	0.563	0.476
2012	4.253	1.836	1.707	0.469	0.485
2013	5.272	2.295	0.942	0.829	0.412
2014	1.923	2.887	1.195	0.464	0.553
2015	6.211	1.036	1.481	0.580	0.441
2016	7.068	3.286	0.522	0.705	0.436
2017	2.612	3.671	1.621	0.243	0.479
2018	6.275	1.428	1.909	0.797	0.312
2019	2.543	3.463	0.750	0.948	0.500
2020	2.324	1.396	1.810	0.371	0.653

Table 15B. Expected biomass-at-age (metric tons) at the beginning of the year (January 1st) for female Scamp in the Gulf of Mexico.

Year	0	1	2	3	4	5	6	7
1986	0.457	187.565	208.198	220.478	220.696	211.928	195.804	174.264
1987	1.073	48.985	207.678	219.208	218.364	208.661	192.028	170.386
1988	0.684	114.904	54.291	219.184	218.082	207.797	190.548	168.529
1989	2.201	73.290	127.393	57.338	218.340	208.004	190.483	168.222
1990	2.566	235.739	81.294	134.803	57.381	209.731	192.284	169.613
1991	1.852	274.919	262.017	86.386	135.870	55.624	195.736	172.769
1992	1.891	198.369	305.392	278.107	86.887	131.229	51.609	174.379
1993	1.507	202.571	220.206	323.701	279.065	83.614	121.145	45.701
1994	2.746	161.426	224.606	232.862	323.577	266.959	76.527	106.062
1995	1.569	294.166	179.370	238.564	234.559	313.410	248.907	68.708
1996	2.034	168.072	327.178	190.871	240.989	228.120	293.792	224.886
1997	2.615	217.846	186.891	348.023	192.723	234.248	213.709	265.279
1998	0.974	280.150	242.112	198.578	350.676	186.663	218.216	191.425
1999	3.258	104.378	311.543	257.602	200.644	341.340	175.269	197.691
2000	3.908	349.048	115.900	330.418	258.928	193.879	317.490	156.961
2001	1.549	418.623	388.054	123.243	333.623	251.967	182.174	288.224
2002	3.797	165.890	465.253	412.344	124.274	323.914	235.880	164.459
2003	1.554	406.742	184.377	494.388	415.722	120.592	302.917	212.587
2004	1.442	166.477	450.849	194.847	493.172	396.098	109.941	264.949
2005	1.246	154.430	184.401	475.776	193.890	468.067	359.201	95.550
2006	2.050	133.453	171.544	195.742	478.455	187.164	434.392	320.889
2007	2.995	219.563	148.118	181.797	196.336	460.229	173.061	387.111
2008	1.592	320.873	243.558	156.788	181.939	188.128	423.113	153.055
2009	1.086	170.497	355.529	257.204	156.251	173.164	171.388	370.212
2010	1.136	116.351	189.001	375.815	256.769	149.140	158.406	150.763
2011	1.022	121.737	129.043	200.024	376.146	246.227	137.413	140.736
2012	1.009	109.503	135.208	136.963	201.219	363.638	229.399	123.723
2013	0.596	108.066	121.139	142.339	135.752	189.856	327.430	198.042
2014	0.695	63.831	119.762	127.993	141.998	129.419	173.360	287.344
2015	1.845	74.414	70.461	125.517	125.874	132.363	114.718	147.107
2016	0.512	197.608	82.064	73.699	122.982	116.619	116.333	96.334
2017	0.465	54.839	218.597	86.376	72.999	115.838	104.635	99.805
2018	1.490	49.823	60.720	230.539	85.889	69.242	105.082	91.164
2019	1.473	159.564	55.197	64.108	229.688	81.725	63.091	92.061
2020	1.446	157.758	176.498	58.094	63.524	216.709	73.642	54.584

Table 15B Continued. Expected biomass-at-age (metric tons) at the beginning of the year (January 1st) for female Scamp in the Gulf of Mexico.

Year	8	9	10	11	12	13	14	15
1986	149.378	123.230	97.737	74.446	54.390	38.057	25.455	16.237
1987	145.674	119.873	94.837	72.061	52.527	36.678	24.487	15.594
1988	143.705	117.979	93.131	70.610	51.361	35.792	23.854	15.167
1989	143.356	117.725	92.996	70.557	51.348	35.794	23.857	15.169
1990	144.232	118.238	93.302	70.743	51.456	35.847	23.877	15.171
1991	146.655	119.930	94.475	71.577	52.050	36.259	24.148	15.340
1992	147.695	120.222	94.215	71.079	51.532	35.819	23.813	15.104
1993	148.117	120.324	93.921	70.553	50.984	35.365	23.480	14.877
1994	38.279	118.716	92.287	68.921	49.508	34.179	22.617	14.296
1995	91.703	31.865	95.103	71.092	50.997	35.134	23.216	14.667
1996	59.800	76.832	25.681	73.663	52.863	36.349	23.958	15.109
1997	195.642	50.094	61.930	19.901	54.815	37.717	24.817	15.614
1998	228.363	161.769	39.764	47.161	14.526	38.300	25.183	15.799
1999	167.265	192.341	131.229	31.037	35.373	10.452	26.385	16.567
2000	170.432	138.771	153.486	100.650	22.855	24.972	7.061	17.012
2001	137.655	144.324	113.379	120.862	76.279	16.640	17.428	4.710
2002	250.803	115.382	116.435	87.957	90.053	54.501	11.378	11.376
2003	142.765	209.559	92.721	89.909	65.189	63.965	37.030	7.377
2004	178.758	115.507	163.118	69.386	64.608	44.912	42.164	23.296
2005	221.220	143.546	89.208	121.082	49.446	44.131	29.346	26.289
2006	82.211	183.285	114.451	68.383	89.124	34.892	29.794	18.908
2007	276.109	68.346	147.177	88.680	51.049	63.974	24.025	19.622
2008	329.968	226.996	54.181	112.405	65.160	36.022	43.254	15.521
2009	128.961	268.055	177.788	40.880	81.589	45.417	24.055	27.600
2010	313.984	105.582	211.855	135.531	30.016	57.588	30.743	15.571
2011	129.516	261.139	85.007	164.950	101.875	21.734	40.059	20.481
2012	122.692	109.397	213.617	67.264	126.033	74.993	15.372	27.139
2013	102.823	98.377	84.673	159.506	48.387	87.173	49.753	9.754
2014	167.491	83.917	77.481	64.305	116.643	34.007	58.742	32.055
2015	234.822	132.276	64.115	57.240	45.864	80.142	22.448	37.135
2016	118.800	183.060	99.666	46.671	40.196	31.005	52.018	13.947
2017	79.285	93.957	139.176	72.804	32.721	27.007	19.924	31.890
2018	83.811	64.286	73.576	105.176	53.017	22.915	18.144	12.803
2019	77.045	68.434	50.722	56.047	77.232	37.451	15.533	11.767
2020	76.819	62.155	53.405	38.260	40.800	54.139	25.214	10.012

Table 15B Continued. Expected biomass-at-age (metric tons) at the beginning of the year (January 1st) for female Scamp in the Gulf of Mexico.

Year	16	17	18	19	20+
1986	9.849	5.662	3.073	1.568	1.297
1987	9.446	5.424	2.941	1.500	1.239
1988	9.175	5.262	2.850	1.452	1.198
1989	9.175	5.262	2.850	1.452	1.198
1990	9.170	5.256	2.845	1.449	1.194
1991	9.269	5.311	2.874	1.463	1.206
1992	9.114	5.215	2.819	1.433	1.180
1993	8.969	5.127	2.769	1.407	1.157
1994	8.602	4.910	2.647	1.343	1.102
1995	8.825	5.037	2.716	1.378	1.130
1996	9.083	5.183	2.794	1.417	1.162
1997	9.371	5.343	2.880	1.461	1.197
1998	9.451	5.375	2.893	1.466	1.201
1999	9.894	5.615	3.018	1.528	1.251
2000	10.166	5.758	3.087	1.561	1.276
2001	10.814	6.135	3.286	1.658	1.354
2002	2.926	6.373	3.415	1.721	1.401
2003	7.017	1.712	3.521	1.775	1.441
2004	4.416	3.984	0.918	1.775	1.440
2005	13.819	2.484	2.116	0.458	1.426
2006	16.118	8.034	1.364	1.093	0.833
2007	11.871	9.610	4.531	0.724	0.897
2008	12.075	6.933	5.306	2.354	0.735
2009	9.433	6.965	3.780	2.722	1.439
2010	17.028	5.527	3.859	1.972	1.967
2011	9.900	10.291	3.162	2.080	1.894
2012	13.243	6.086	5.989	1.733	1.934
2013	16.415	7.607	3.306	3.063	1.649
2014	5.989	9.569	4.193	1.715	2.191
2015	19.338	3.434	5.194	2.144	1.762
2016	22.008	10.890	1.830	2.606	1.736
2017	8.133	12.167	5.686	0.898	1.901
2018	19.537	4.732	6.696	2.946	1.258
2019	7.918	11.477	2.630	3.504	1.978
2020	7.237	4.628	6.348	1.370	2.578

Table 16A. Expected numbers-at-age (1,000s of fish) at the beginning of the year (January 1st) for male Scamp in the Gulf of Mexico.

Year	0	1	2	3	4	5	6	7	8	9	10	11
1986	0	0	0	0	6.290	11.875	16.532	20.104	22.495	23.689	23.756	22.852
1987	0	0	0	0	6.223	11.692	16.214	19.656	21.937	23.044	23.052	22.120
1988	0	0	0	0	6.215	11.644	16.088	19.442	21.641	22.679	22.637	21.675
1989	0	0	0	0	6.222	11.655	16.083	19.407	21.588	22.630	22.604	21.659
1990	0	0	0	0	1.635	11.752	16.235	19.567	21.720	22.729	22.678	21.716
1991	0	0	0	0	3.872	3.117	16.526	19.931	22.085	23.054	22.964	21.972
1992	0	0	0	0	2.476	7.353	4.357	20.117	22.241	23.110	22.900	21.819
1993	0	0	0	0	7.953	4.685	10.229	5.272	22.305	23.130	22.829	21.657
1994	0	0	0	0	9.222	14.959	6.461	12.236	5.765	22.821	22.432	21.156
1995	0	0	0	0	6.685	17.561	21.016	7.926	13.810	6.126	23.116	21.823
1996	0	0	0	0	6.868	12.782	24.806	25.944	9.005	14.770	6.242	22.612
1997	0	0	0	0	5.492	13.126	18.044	30.604	29.462	9.630	15.053	6.109
1998	0	0	0	0	9.994	10.459	18.425	22.083	34.389	31.097	9.665	14.477
1999	0	0	0	0	5.718	19.126	14.799	22.806	25.189	36.974	31.897	9.527
2000	0	0	0	0	7.379	10.864	26.806	18.108	25.666	26.676	37.307	30.896
2001	0	0	0	0	9.508	14.119	15.382	33.251	20.730	27.744	27.558	37.101
2002	0	0	0	0	3.542	18.150	19.916	18.972	37.769	22.180	28.301	27.000
2003	0	0	0	0	11.848	6.757	25.576	24.525	21.499	40.284	22.537	27.599
2004	0	0	0	0	14.055	22.195	9.283	30.565	26.919	22.204	39.648	21.299
2005	0	0	0	0	5.526	26.227	30.328	11.023	33.314	27.594	21.683	37.168
2006	0	0	0	0	13.635	10.488	36.677	37.019	12.380	35.233	27.819	20.991
2007	0	0	0	0	5.595	25.788	14.612	44.658	41.580	13.138	35.773	27.222
2008	0	0	0	0	5.185	10.541	35.725	17.657	49.690	43.636	13.170	34.504
2009	0	0	0	0	4.453	9.703	14.471	42.709	19.420	51.529	43.214	12.549
2010	0	0	0	0	7.318	8.357	13.375	17.393	47.283	20.296	51.494	41.604
2011	0	0	0	0	10.720	13.797	11.602	16.236	19.504	50.199	20.662	50.634
2012	0	0	0	0	5.734	20.376	19.369	14.273	18.476	21.029	51.923	20.648
2013	0	0	0	0	3.869	10.638	27.646	22.847	15.484	18.911	20.581	48.963
2014	0	0	0	0	4.047	7.252	14.637	33.149	25.223	16.131	18.833	19.740
2015	0	0	0	0	3.587	7.417	9.686	16.971	35.362	25.428	15.584	17.571
2016	0	0	0	0	3.505	6.535	9.822	11.113	17.890	35.190	24.225	14.326
2017	0	0	0	0	2.080	6.491	8.835	11.514	11.940	18.061	33.829	22.348
2018	0	0	0	0	2.448	3.880	8.872	10.517	12.621	12.358	17.884	32.286
2019	0	0	0	0	6.546	4.579	5.327	10.620	11.602	13.155	12.329	17.205
2020	0	0	0	0	1.810	12.143	6.218	6.297	11.568	11.948	12.981	11.745

Table 16A Continued. Expected numbers-at-age (1,000s of fish) at the beginning of the year (January 1st) for male Scamp in the Gulf of Mexico.

Year	12	13	14	15	16	17	18	19	20+
1986	21.191	19.014	16.559	14.035	11.608	9.392	7.456	5.824	18.343
1987	20.465	18.324	15.929	13.480	11.133	8.998	7.136	5.569	17.508
1988	20.011	17.882	15.517	13.110	10.814	8.730	6.916	5.393	16.923
1989	20.006	17.883	15.519	13.112	10.814	8.729	6.915	5.392	16.914
1990	20.048	17.910	15.532	13.114	10.808	8.719	6.903	5.380	16.858
1991	20.279	18.115	15.708	13.260	10.925	8.810	6.973	5.432	17.010
1992	20.077	17.896	15.491	13.056	10.742	8.651	6.839	5.322	16.624
1993	19.864	17.669	15.274	12.860	10.571	8.506	6.719	5.225	16.285
1994	19.289	17.076	14.713	12.358	10.139	8.145	6.424	4.988	15.493
1995	19.869	17.553	15.102	12.678	10.402	8.357	6.590	5.117	15.879
1996	20.596	18.160	15.585	13.060	10.706	8.598	6.780	5.263	16.313
1997	21.357	18.844	16.144	13.497	11.045	8.864	6.988	5.425	16.798
1998	5.659	19.135	16.382	13.657	11.139	8.917	7.020	5.446	16.827
1999	13.781	5.222	17.163	14.320	11.662	9.315	7.322	5.676	17.529
2000	8.905	12.476	4.593	14.706	11.982	9.553	7.490	5.796	17.873
2001	29.719	8.314	11.337	4.072	12.746	10.178	7.972	6.158	18.966
2002	35.086	27.229	7.402	9.833	3.449	10.572	8.287	6.391	19.600
2003	25.398	31.957	24.088	6.377	8.271	2.840	8.542	6.591	20.107
2004	25.172	22.438	27.428	20.137	5.205	6.609	2.227	6.594	20.047
2005	19.265	22.048	19.090	22.724	16.287	4.120	5.134	1.703	19.811
2006	34.724	17.432	19.381	16.344	18.997	13.328	3.309	4.059	16.492
2007	19.889	31.962	15.628	16.961	13.991	15.943	10.993	2.690	16.249
2008	25.387	17.997	28.137	13.417	14.232	11.502	12.874	8.742	14.625
2009	31.788	22.691	15.648	23.857	11.118	11.554	9.171	10.109	17.893
2010	11.694	28.772	19.999	13.460	20.070	9.169	9.363	7.322	21.854
2011	39.692	10.858	26.059	17.704	11.668	17.073	7.671	7.724	23.534
2012	49.104	37.467	10.000	23.459	15.609	10.096	14.530	6.437	25.636
2013	18.852	43.552	32.365	8.431	19.347	12.620	8.022	11.375	24.467
2014	45.446	16.990	38.212	27.708	7.059	15.875	10.174	6.371	27.775
2015	17.869	40.040	14.602	32.100	22.793	5.697	12.602	7.963	26.079
2016	15.661	15.491	33.839	12.055	25.939	18.066	4.440	9.679	25.500
2017	12.748	13.493	12.960	27.566	9.586	20.185	13.795	3.336	25.711
2018	20.656	11.448	11.803	11.067	23.027	7.851	16.247	10.941	22.417
2019	30.090	18.711	10.104	10.171	9.332	19.039	6.380	13.012	26.073
2020	15.896	27.048	16.402	8.655	8.530	7.677	15.403	5.088	30.481

Table 16B. Expected biomass-at-age (metric tons) at the beginning of the year (January 1st) for male Scamp in the Gulf of Mexico.

Year	0	1	2	3	4	5	6	7	8	9	10	11
1986	0	0	0	0	3.885	9.390	16.174	23.674	31.176	37.915	43.217	46.612
1987	0	0	0	0	3.844	9.245	15.862	23.148	30.403	36.882	41.935	45.119
1988	0	0	0	0	3.839	9.207	15.739	22.895	29.992	36.299	41.181	44.211
1989	0	0	0	0	3.844	9.216	15.734	22.854	29.919	36.221	41.121	44.178
1990	0	0	0	0	1.010	9.292	15.883	23.043	30.102	36.379	41.256	44.294
1991	0	0	0	0	2.392	2.464	16.168	23.471	30.607	36.899	41.775	44.816
1992	0	0	0	0	1.530	5.814	4.263	23.690	30.824	36.989	41.660	44.504
1993	0	0	0	0	4.913	3.705	10.007	6.209	30.912	37.021	41.530	44.175
1994	0	0	0	0	5.696	11.828	6.321	14.409	7.989	36.526	40.807	43.153
1995	0	0	0	0	4.129	13.886	20.560	9.334	19.139	9.804	42.052	44.513
1996	0	0	0	0	4.242	10.107	24.267	30.552	12.480	23.639	11.356	46.122
1997	0	0	0	0	3.393	10.379	17.652	36.039	40.831	15.413	27.384	12.460
1998	0	0	0	0	6.173	8.270	18.025	26.006	47.660	49.772	17.583	29.529
1999	0	0	0	0	3.532	15.124	14.477	26.857	34.909	59.178	58.026	19.433
2000	0	0	0	0	4.558	8.590	26.225	21.324	35.570	42.696	67.868	63.019
2001	0	0	0	0	5.873	11.164	15.048	39.157	28.729	44.405	50.134	75.675
2002	0	0	0	0	2.188	14.351	19.484	22.342	52.343	35.500	51.485	55.072
2003	0	0	0	0	7.319	5.343	25.021	28.881	29.796	64.476	40.999	56.294
2004	0	0	0	0	8.682	17.550	9.081	35.995	37.307	35.538	72.128	43.445
2005	0	0	0	0	3.413	20.738	29.670	12.981	46.169	44.165	39.446	75.813
2006	0	0	0	0	8.423	8.293	35.881	43.594	17.158	56.392	50.608	42.816
2007	0	0	0	0	3.456	20.391	14.295	52.591	57.625	21.028	65.079	55.525
2008	0	0	0	0	3.203	8.335	34.949	20.793	68.865	69.841	23.958	70.379
2009	0	0	0	0	2.751	7.672	14.157	50.295	26.915	82.474	78.614	25.596
2010	0	0	0	0	4.520	6.608	13.084	20.482	65.529	32.485	93.678	84.860
2011	0	0	0	0	6.622	10.909	11.350	19.120	27.030	80.346	37.588	103.280
2012	0	0	0	0	3.542	16.111	18.948	16.808	25.606	33.658	94.457	42.116
2013	0	0	0	0	2.390	8.412	27.046	26.905	21.459	30.268	37.441	99.871
2014	0	0	0	0	2.500	5.734	14.320	39.037	34.956	25.819	34.261	40.263
2015	0	0	0	0	2.216	5.865	9.476	19.985	49.008	40.698	28.350	35.839
2016	0	0	0	0	2.165	5.167	9.609	13.087	24.794	56.323	44.070	29.222
2017	0	0	0	0	1.285	5.132	8.643	13.559	16.547	28.908	61.541	45.584
2018	0	0	0	0	1.512	3.068	8.680	12.385	17.492	19.779	32.534	65.854
2019	0	0	0	0	4.044	3.621	5.211	12.507	16.080	21.055	22.428	35.093
2020	0	0	0	0	1.118	9.602	6.083	7.415	16.032	19.124	23.614	23.956

Table 16B Continued. Expected biomass-at-age (metric tons) at the beginning of the year (January 1st) for male Scamp in the Gulf of Mexico.

Year	12	13	14	15	16	17	18	19	20+
1986	47.897	47.140	44.630	40.800	36.143	31.129	26.156	21.516	79.148
1987	46.257	45.431	42.932	39.186	34.665	29.822	25.034	20.576	75.538
1988	45.230	44.334	41.822	38.112	33.670	28.932	24.263	19.926	73.006
1989	45.219	44.336	41.827	38.117	33.671	28.930	24.259	19.920	72.967
1990	45.313	44.402	41.862	38.122	33.653	28.897	24.217	19.876	72.719
1991	45.837	44.912	42.337	38.546	34.017	29.199	24.462	20.071	73.372
1992	45.380	44.367	41.751	37.953	33.446	28.671	23.991	19.664	71.697
1993	44.898	43.804	41.166	37.384	32.915	28.191	23.570	19.303	70.226
1994	43.598	42.336	39.654	35.925	31.570	26.994	22.535	18.430	66.798
1995	44.910	43.518	40.704	36.857	32.388	27.696	23.120	18.907	68.461
1996	46.552	45.024	42.005	37.967	33.334	28.496	23.785	19.446	70.324
1997	48.272	46.718	43.511	39.235	34.391	29.379	24.516	20.043	72.410
1998	12.792	47.441	44.153	39.700	34.683	29.555	24.629	20.119	72.525
1999	31.150	12.947	46.259	41.629	36.311	30.873	25.687	20.970	75.546
2000	20.127	30.932	12.379	42.749	37.307	31.660	26.277	21.414	77.023
2001	67.173	20.612	30.556	11.836	39.687	33.731	27.968	22.752	81.733
2002	79.303	67.507	19.949	28.586	10.739	35.038	29.072	23.611	84.454
2003	57.407	79.230	64.923	18.537	25.753	9.411	29.967	24.351	86.622
2004	56.896	55.630	73.924	58.538	16.206	21.902	7.812	24.361	86.337
2005	43.544	54.663	51.450	66.059	50.713	13.656	18.011	6.291	85.296
2006	78.485	43.218	52.237	47.512	59.149	44.173	11.610	14.996	72.613
2007	44.955	79.242	42.121	49.306	43.564	52.840	38.564	9.937	71.627
2008	57.382	44.618	75.835	39.003	44.314	38.121	45.163	32.300	65.065
2009	71.850	56.256	42.176	69.353	34.619	38.294	32.174	37.350	77.212
2010	26.433	71.332	53.901	39.128	62.492	30.388	32.846	27.053	92.759
2011	89.714	26.920	70.234	51.465	36.331	56.585	26.911	28.535	100.264
2012	110.988	92.890	26.951	68.196	48.601	33.461	50.974	23.784	109.570
2013	42.611	107.976	87.230	24.510	60.241	41.826	28.141	42.026	105.428
2014	102.719	42.123	102.990	80.548	21.978	52.615	35.693	23.539	118.513
2015	40.389	99.268	39.356	93.314	70.969	18.883	44.209	29.419	112.438
2016	35.398	38.404	91.202	35.045	80.765	59.875	15.575	35.761	110.100
2017	28.815	33.452	34.931	80.135	29.848	66.899	48.394	12.326	110.476
2018	46.688	28.384	31.811	32.172	71.699	26.020	56.995	40.422	98.080
2019	68.012	46.388	27.233	29.568	29.056	63.102	22.383	48.074	112.182
2020	35.929	67.059	44.206	25.160	26.558	25.445	54.034	18.800	129.647

Table 17. Input (with log-scale standard errors, SE) and expected (Exp) landings for the Commercial Vertical Line fleet in biomass (B, million pounds gutted weight) and number (N, 1,000s of fish) for Gulf of Mexico Scamp. The expected mean weight (gutted pounds per fish) was determined by dividing the expected landings in weights by expected landings in numbers of fish.

Year	Input B SE	Input B	Exp B	Exp N	Exp Mean Weight
1986	0.05	0.184	0.184	43.845	4.2
1987	0.05	0.185	0.186	43.824	4.2
1988	0.05	0.159	0.160	37.309	4.3
1989	0.05	0.164	0.166	37.683	4.4
1990	0.05	0.156	0.157	33.120	4.8
1991	0.05	0.186	0.188	39.245	4.8
1992	0.05	0.226	0.230	48.076	4.8
1993	0.05	0.218	0.222	47.319	4.7
1994	0.05	0.158	0.160	34.962	4.6
1995	0.05	0.175	0.177	39.378	4.5
1996	0.05	0.166	0.167	37.845	4.4
1997	0.05	0.213	0.214	48.836	4.4
1998	0.05	0.136	0.136	31.122	4.4
1999	0.05	0.175	0.175	41.346	4.2
2000	0.05	0.126	0.126	29.558	4.3
2001	0.05	0.156	0.155	36.142	4.3
2002	0.05	0.187	0.186	43.521	4.3
2003	0.05	0.176	0.174	39.675	4.4
2004	0.05	0.167	0.166	38.126	4.4
2005	0.05	0.167	0.166	38.184	4.3
2006	0.05	0.132	0.132	30.130	4.4
2007	0.05	0.155	0.154	34.529	4.5
2008	0.05	0.139	0.139	30.344	4.6
2009	0.05	0.161	0.161	34.475	4.7
2010	0.01	0.091	0.091	18.814	4.8
2011	0.01	0.085	0.085	17.429	4.9
2012	0.01	0.157	0.157	31.643	5.0

Table 17 Continued. Input (with log-scale standard errors, SE) and expected (Exp) landings for the Commercial Vertical Line fleet in biomass (B, million pounds gutted weight) and number (N, 1,000s of fish) for Gulf of Mexico Scamp. The expected mean weight (gutted pounds per fish) was determined by dividing the expected landings in weights by expected landings in numbers of fish.

Year	Input B SE	Input B	Exp B	Exp N	Exp Mean Weight
2013	0.01	0.142	0.142	28.117	5.0
2014	0.01	0.106	0.106	20.738	5.1
2015	0.01	0.098	0.098	18.665	5.2
2016	0.01	0.143	0.143	26.804	5.3
2017	0.01	0.086	0.086	15.926	5.4
2018	0.01	0.074	0.074	13.608	5.4
2019	0.01	0.061	0.061	11.294	5.4
2020	0.01	0.059	0.059	10.951	5.4

Table 18. Input (with log-scale standard errors, SE) and expected (Exp) landings for the Commercial Longline fleet in biomass (B, million pounds gutted weight) and number (N, 1,000s of fish) for Gulf of Mexico Scamp. The expected mean weight (gutted pounds per fish) was determined by dividing the expected landings in weights by expected landings in numbers of fish.

Year	Input B SE	Input B	Exp B	Exp N	Exp Mean Weight
1986	0.05	0.174	0.174	32.049	5.4
1987	0.05	0.154	0.154	28.392	5.4
1988	0.05	0.110	0.111	20.319	5.5
1989	0.05	0.127	0.128	23.251	5.5
1990	0.05	0.109	0.110	19.407	5.7
1991	0.05	0.129	0.131	22.892	5.7
1992	0.05	0.076	0.077	13.342	5.8
1993	0.05	0.102	0.103	17.926	5.7
1994	0.05	0.057	0.058	10.138	5.7
1995	0.05	0.061	0.061	10.873	5.6
1996	0.05	0.067	0.067	12.114	5.5
1997	0.05	0.080	0.080	14.636	5.4
1998	0.05	0.085	0.085	15.821	5.4
1999	0.05	0.085	0.086	16.024	5.3
2000	0.05	0.074	0.074	13.764	5.3
2001	0.05	0.112	0.112	20.783	5.4
2002	0.05	0.118	0.118	21.843	5.4
2003	0.05	0.137	0.136	25.151	5.4
2004	0.05	0.152	0.151	27.992	5.4
2005	0.05	0.142	0.141	26.377	5.4
2006	0.05	0.086	0.086	16.121	5.4
2007	0.05	0.120	0.120	22.246	5.4
2008	0.05	0.139	0.138	25.368	5.5
2009	0.05	0.090	0.090	16.149	5.5
2010	0.01	0.065	0.065	11.385	5.7
2011	0.01	0.060	0.060	10.437	5.8
2012	0.01	0.093	0.093	15.907	5.9

Table 18 Continued. Input (with log-scale standard errors, SE) and expected (Exp) landings for the Commercial Longline fleet in biomass (B, million pounds gutted weight) and number (N, 1,000s of fish) for Gulf of Mexico Scamp. The expected mean weight (gutted pounds per fish) was determined by dividing the expected landings in weights by expected landings in numbers of fish.

Year	Input B SE	Input B	Exp B	Exp N	Exp Mean Weight
2013	0.01	0.104	0.104	17.504	5.9
2014	0.01	0.062	0.062	10.371	6.0
2015	0.01	0.081	0.081	13.301	6.1
2016	0.01	0.143	0.143	23.260	6.2
2017	0.01	0.077	0.077	12.368	6.2
2018	0.01	0.069	0.069	10.896	6.3
2019	0.01	0.053	0.053	8.293	6.4
2020	0.01	0.060	0.060	9.344	6.4

Table 19. Input (with log-scale standard errors, SE) and expected (Exp) landings for the Recreational Charter Private fleet in number (N, 1,000s of fish) and biomass (B, million pounds gutted weight) for Gulf of Mexico Scamp. The expected mean weight (gutted pounds per fish) was determined by dividing the expected landings in weights by expected landings in numbers of fish.

Year	Input N SE	Input N	Exp N	Exp B	Exp Mean Weight
1986	0.05	47.448	47.794	0.139	2.9
1987	0.30	68.516	37.418	0.108	2.9
1988	0.30	39.520	36.360	0.107	2.9
1989	0.30	18.611	14.312	0.043	3.0
1990	0.30	6.519	9.535	0.037	3.9
1991	0.30	14.873	12.054	0.048	4.0
1992	0.30	13.649	14.891	0.059	4.0
1993	0.30	23.433	23.083	0.090	3.9
1994	0.30	12.867	11.181	0.042	3.8
1995	0.30	4.328	3.618	0.013	3.7
1996	0.30	12.315	7.003	0.026	3.6
1997	0.30	14.719	10.156	0.037	3.6
1998	0.30	20.733	9.268	0.034	3.6
1999	0.30	39.730	19.549	0.073	3.7
2000	0.30	10.565	11.953	0.045	3.8
2001	0.30	13.759	14.558	0.055	3.8
2002	0.30	24.465	13.328	0.050	3.8
2003	0.30	45.394	60.309	0.200	3.3
2004	0.30	52.110	74.312	0.243	3.3
2005	0.30	61.283	33.695	0.110	3.3
2006	0.30	105.390	51.291	0.169	3.3
2007	0.30	40.460	57.072	0.192	3.4
2008	0.30	59.846	70.719	0.246	3.5
2009	0.30	49.246	59.174	0.210	3.6
2010	0.30	27.407	55.119	0.197	3.6
2011	0.30	43.949	35.752	0.128	3.6
2012	0.30	76.192	83.914	0.304	3.6

Table 19 Continued. Input (with log-scale standard errors, SE) and expected (Exp) landings for the Recreational Charter Private fleet in numbers (N, 1,000s of fish) and biomass (B, million pounds gutted weight) for Gulf of Mexico Scamp. The expected mean weight (gutted pounds per fish) was determined by dividing the expected landings in weights by expected landings in numbers of fish.

Year	Input N SE	Input N	Exp N	Exp B	Exp Mean Weight
2013	0.3	77.150	56.233	0.208	3.7
2014	0.3	76.336	95.338	0.360	3.8
2015	0.3	105.995	92.217	0.357	3.9
2016	0.3	68.552	52.466	0.207	3.9
2017	0.3	46.512	41.890	0.167	4.0
2018	0.3	54.248	35.307	0.140	4.0
2019	0.3	64.767	45.522	0.178	3.9
2020	0.3	64.889	38.578	0.150	3.9

Table 20. Input (with log-scale standard errors, SE) and expected (Exp) landings for the Recreational Headboat fleet in numbers (N, 1,000s of fish) and biomass (B, million pounds gutted weight) for Gulf of Mexico Scamp. The expected mean weight (gutted pounds per fish) was determined by dividing the expected landings in weights by expected landings in numbers of fish.

Year	Input N SE	Input N	Exp N	Exp B	Exp Mean Weight
1986	0.05	9.479	9.484	0.022	2.3
1987	0.30	5.616	5.726	0.014	2.4
1988	0.30	4.396	4.480	0.011	2.5
1989	0.30	10.544	11.086	0.028	2.6
1990	0.30	3.212	3.272	0.010	2.9
1991	0.30	2.611	2.648	0.008	2.9
1992	0.30	2.526	2.552	0.007	2.7
1993	0.30	2.648	2.667	0.007	2.6
1994	0.30	2.504	2.516	0.006	2.6
1995	0.30	2.602	2.612	0.007	2.6
1996	0.30	2.045	2.050	0.005	2.6
1997	0.30	1.984	1.985	0.005	2.6
1998	0.30	1.755	1.754	0.005	2.6
1999	0.30	1.673	1.670	0.005	2.9
2000	0.30	1.371	1.513	0.004	2.9
2001	0.30	0.976	0.976	0.003	2.9
2002	0.30	1.418	1.483	0.004	2.9
2003	0.30	2.990	3.885	0.012	3.1
2004	0.30	3.832	2.983	0.009	3.0
2005	0.30	2.823	1.916	0.006	3.0
2006	0.30	2.292	1.561	0.005	3.1
2007	0.30	3.281	2.268	0.007	3.2
2008	0.30	2.604	2.980	0.010	3.3
2009	0.30	2.447	2.740	0.009	3.3
2010	0.30	1.642	1.864	0.006	3.3
2011	0.30	3.551	3.384	0.011	3.3
2012	0.30	2.742	2.958	0.010	3.4

Table 20 Continued. Input (with log-scale standard errors, SE) and expected (Exp) landings for the Recreational Headboat fleet in numbers (N, 1,000s of fish) and biomass (B, million pounds gutted weight) for Gulf of Mexico Scamp. The expected mean weight (gutted pounds per fish) was determined by dividing the expected landings in weights by expected landings in numbers of fish.

Year	Input N SE	Input N	Exp N	Exp B	Exp Mean Weight
2013	0.3	2.299	2.664	0.009	3.5
2014	0.3	3.099	3.810	0.014	3.6
2015	0.3	3.765	4.575	0.017	3.6
2016	0.3	2.448	2.599	0.010	3.7
2017	0.3	2.239	2.300	0.009	3.7
2018	0.3	2.865	3.010	0.011	3.7
2019	0.3	2.383	2.275	0.008	3.6
2020	0.3	1.873	2.002	0.007	3.6

Table 21. Input (with log-scale standard errors, SE) and expected (Exp) discards for the Commercial Vertical Line fleet in numbers (N, 1,000s of fish) and biomass (B, thousand pounds gutted weight) for Gulf of Mexico Scamp. Dead discards in numbers (discard mortality rate = 0.47), dead discards in biomass, and mean weight (MW, gutted pounds per fish) are included. Mean weight was determined by dividing the expected discards in weights by the expected discards in numbers.

Year	Input N SE	Input N	Exp N	Exp Dead N	Exp B	Exp Dead B	Exp MW
1986			0.002	0.001	0.008	0.004	4.2
1987			0.002	0.001	0.008	0.004	4.2
1988			0.002	0.001	0.007	0.004	4.3
1989			0.002	0.001	0.007	0.004	4.4
1990			3.769	1.772	4.916	2.310	1.3
1991			5.634	2.648	6.718	3.158	1.2
1992			7.836	3.683	9.429	4.431	1.2
1993			8.314	3.908	10.258	4.822	1.2
1994			5.991	2.816	7.709	3.623	1.3
1995			7.101	3.337	8.886	4.176	1.3
1996			6.408	3.012	8.279	3.891	1.3
1997			8.002	3.761	10.408	4.892	1.3
1998			5.191	2.440	6.611	3.107	1.3
1999			3.389	1.593	3.362	1.580	1.0
2000	0.390	2.946	2.771	1.302	2.555	1.201	0.9
2001	0.390	3.470	4.109	1.931	3.657	1.719	0.9
2002	0.390	3.842	4.372	2.055	4.194	1.971	1.0
2003	0.390	4.236	6.459	3.036	6.585	3.095	1.0
2004	0.390	4.083	5.545	2.606	5.905	2.775	1.1
2005	0.390	3.611	4.666	2.193	5.125	2.409	1.1
2006	0.390	3.231	2.971	1.396	3.310	1.556	1.1
2007	0.390	3.080	3.213	1.510	3.421	1.608	1.1
2008	0.405	2.748	3.308	1.555	3.305	1.553	1.0
2009	0.412	3.356	3.862	1.815	3.996	1.878	1.0
2010	0.421	2.421	3.060	1.438	4.948	2.325	1.6
2011	0.421	2.736	2.536	1.192	4.304	2.023	1.7
2012	0.421	3.423	4.104	1.929	7.244	3.405	1.8

Table 21 Continued. Input (with log-scale standard errors, SE) and expected (Exp) discards for the Commercial Vertical Line fleet in numbers (N, 1,000s of fish) and biomass (B, thousand pounds gutted weight) for Gulf of Mexico Scamp. Dead discards in numbers (discard mortality rate = 0.47), dead discards in biomass, and mean weight (MW, gutted pounds per fish) are included. Mean weight was determined by dividing the expected discards in weights by the expected discards in numbers.

Year	Input N SE	Input N	Exp N	Exp Dead N	Exp B	Exp Dead B	Exp MW
2013	0.421	2.822	3.400	1.598	6.125	2.879	1.8
2014	0.421	2.657	2.302	1.082	4.327	2.034	1.9
2015	0.421	2.302	1.974	0.928	3.797	1.785	1.9
2016	0.421	2.790	3.452	1.623	5.895	2.771	1.7
2017	0.421	2.112	2.173	1.021	3.749	1.762	1.7
2018	0.421	1.823	1.815	0.853	3.262	1.533	1.8
2019	0.462	1.781	1.676	0.788	2.806	1.319	1.7
2020	0.462	1.491	1.907	0.896	2.967	1.395	1.6

Table 22. Input (with log-scale standard errors, SE) and expected (Exp) discards for the Commercial Longline fleet in numbers (N, 1,000s of fish) and biomass (B, thousand pounds gutted weight) for Gulf of Mexico Scamp. Dead discards in numbers (discard mortality rate = 0.68), dead discards in biomass, and mean weight (MW, gutted pounds per fish) are included. Mean weight was determined by dividing the expected discards in weights by the expected discards in numbers.

Year	Input N SE	Input N	Exp N	Exp Dead N	Exp B	Exp Dead B	Exp MW
1986			0.001	0.001	0.008	0.005	5.7
1987			0.001	0.001	0.007	0.005	5.4
1988			0.001	0.001	0.005	0.004	5.6
1989			0.001	0.001	0.006	0.004	5.7
1990			0.684	0.465	1.269	0.863	1.9
1991			0.905	0.615	1.547	1.052	1.7
1992			0.600	0.408	0.990	0.673	1.6
1993			0.913	0.621	1.498	1.019	1.6
1994			0.544	0.370	0.917	0.624	1.7
1995			0.612	0.416	1.028	0.699	1.7
1996			0.670	0.455	1.149	0.781	1.7
1997			0.793	0.539	1.375	0.935	1.7
1998			0.852	0.579	1.468	0.998	1.7
1999			0.465	0.316	0.549	0.373	1.2
2000	0.497	0.462	0.407	0.277	0.463	0.315	1.1
2001	0.497	0.564	0.699	0.475	0.765	0.521	1.1
2002	0.497	0.533	0.733	0.498	0.840	0.571	1.1
2003	0.497	0.643	1.035	0.704	1.258	0.855	1.2
2004	0.497	0.688	1.093	0.743	1.369	0.931	1.3
2005	0.497	0.692	0.910	0.619	1.173	0.798	1.3
2006	0.497	0.510	0.456	0.310	0.600	0.408	1.3
2007	0.497	0.537	0.552	0.375	0.709	0.482	1.3
2008	0.497	0.667	0.658	0.447	0.799	0.543	1.2
2009	0.497	0.430	0.434	0.295	0.533	0.362	1.2
2010	0.333	0.251	0.537	0.365	1.030	0.701	1.9
2011	0.333	0.403	0.461	0.313	0.916	0.623	2.0
2012	0.333	0.379	0.641	0.436	1.319	0.897	2.1

Table 22 Continued. Input (with log-scale standard errors, SE) and expected (Exp) discards for the Commercial Longline fleet in numbers (N, 1,000s of fish) and biomass (B, thousand pounds gutted weight) for Gulf of Mexico Scamp. Dead discards in numbers (discard mortality rate = 0.68), dead discards in biomass, and mean weight (MW, gutted pounds per fish) are included. Mean weight was determined by dividing the expected discards in weights by the expected discards in numbers.

Year	Input N SE	Input N	Exp N	Exp Dead N	Exp B	Exp Dead B	Exp MW
2013	0.333	0.458	0.650	0.442	1.367	0.929	2.1
2014	0.333	0.524	0.352	0.239	0.760	0.517	2.2
2015	0.333	0.618	0.421	0.286	0.927	0.630	2.2
2016	0.333	0.664	0.784	0.533	1.631	1.109	2.1
2017	0.333	0.644	0.439	0.298	0.899	0.611	2.0
2018	0.333	0.565	0.397	0.270	0.824	0.560	2.1
2019	0.349	0.466	0.324	0.220	0.653	0.444	2.0
2020	0.349	0.376	0.406	0.276	0.780	0.530	1.9

Table 23. Input (with log-scale standard errors, SE) and expected (Exp) discards for the Recreational Charter Private fleet in numbers (N, 1,000s of fish) and biomass (B, thousand pounds gutted weight) for Gulf of Mexico Scamp. Dead discards in numbers (discard mortality rate = 0.26), dead discards in biomass, and mean weight (MW, gutted pounds per fish) are included. Mean weight was determined by dividing the expected discards in weights by the expected discards in numbers.

Year	Input N SE	Input N	Exp N	Exp Dead N	Exp B	Exp Dead B	Exp MW
1986	0.609	54.118	31.305	8.139	29.396	7.643	0.9
1987	0.646	1.428	20.033	5.208	19.643	5.107	1.0
1988	0.783	3.701	16.805	4.369	16.281	4.233	1.0
1989	0.617	1.858	5.945	1.546	5.724	1.488	1.0
1990	0.601	40.696	14.075	3.660	17.219	4.477	1.2
1991	0.833	3.128	23.493	6.108	26.876	6.988	1.1
1992	0.506	31.849	35.137	9.136	40.902	10.634	1.2
1993	0.489	40.068	58.777	15.282	70.650	18.369	1.2
1994	0.639	12.792	26.764	6.959	33.266	8.649	1.2
1995	0.578	4.780	8.554	2.224	10.427	2.711	1.2
1996	0.757	0.930	15.533	4.039	19.225	4.999	1.2
1997	0.578	7.025	21.631	5.624	26.916	6.998	1.2
1998	0.481	4.545	19.867	5.165	24.352	6.331	1.2
1999	0.530	9.645	46.640	12.126	64.525	16.777	1.4
2000	0.751	63.768	29.538	7.680	39.457	10.259	1.3
2001	0.661	54.874	40.387	10.501	51.399	13.364	1.3
2002	0.349	19.904	36.485	9.486	48.006	12.482	1.3
2003	0.403	170.019	101.075	26.280	113.049	29.392	1.1
2004	0.322	176.484	112.144	29.157	129.402	33.645	1.2
2005	0.322	26.932	43.101	11.206	51.302	13.338	1.2
2006	0.455	19.127	53.875	14.008	65.272	16.971	1.2
2007	0.322	89.096	56.569	14.708	66.411	17.267	1.2
2008	0.358	114.679	82.223	21.378	91.210	23.715	1.1
2009	0.472	143.342	75.139	19.536	85.067	22.116	1.1
2010	0.385	232.070	65.678	17.076	77.622	20.182	1.2
2011	0.438	31.442	36.717	9.547	44.371	11.536	1.2
2012	0.617	184.383	75.521	19.635	91.622	23.821	1.2

Table 23 Continued. Input (with log-scale standard errors, SE) and expected (Exp) discards for the Recreational Charter Private fleet in numbers (N, 1,000s of fish) and biomass (B, thousand pounds gutted weight) for Gulf of Mexico Scamp. Dead discards in numbers (discard mortality rate = 0.26), dead discards in biomass, and mean weight (MW, gutted pounds per fish) are included. Mean weight was determined by dividing the expected discards in weights by the expected discards in numbers.

Year	Input N SE	Input N	Exp N	Exp Dead N	Exp B	Exp Dead B	Exp MW
2013	0.498	28.365	47.742	12.413	57.485	14.946	1.2
2014	0.312	125.895	75.776	19.702	92.451	24.037	1.2
2015	0.498	184.662	71.198	18.511	86.631	22.522	1.2
2016	0.349	59.087	52.623	13.682	58.460	15.199	1.1
2017	0.609	77.094	46.596	12.115	53.448	13.896	1.1
2018	0.675	10.850	37.251	9.685	44.780	11.643	1.2
2019	0.385	33.600	52.242	13.583	59.339	15.428	1.1
2020	0.358	30.132	53.412	13.887	58.316	15.162	1.1

Table 24. Input (with log-scale standard errors, SE) and expected (Exp) discards for the Recreational Headboat fleet in numbers (N, 1,000s of fish) and biomass (B, thousand pounds gutted weight) for Gulf of Mexico Scamp. Dead discards in numbers (discard mortality rate = 0.26), dead discards in biomass, and mean weight (MW, gutted pounds per fish) are included. Mean weight was determined by dividing the expected discards in weights by the expected discards in numbers.

Year	Input N SE	Input N	Exp N	Exp Dead N	Exp B	Exp Dead B	Exp MW
1986			0.000	0.000	0.001	0.000	2.3
1987			0.000	0.000	0.001	0.000	2.4
1988			0.000	0.000	0.001	0.000	2.5
1989			0.001	0.000	0.001	0.000	2.2
1990			1.813	0.471	2.990	0.777	1.6
1991			1.837	0.478	2.702	0.703	1.5
1992			1.801	0.468	2.594	0.675	1.4
1993			1.777	0.462	2.565	0.667	1.4
1994			1.525	0.397	2.267	0.589	1.5
1995			1.660	0.432	2.388	0.621	1.4
1996			1.238	0.322	1.837	0.478	1.5
1997			1.170	0.304	1.753	0.456	1.5
1998			1.073	0.279	1.581	0.411	1.5
1999			2.255	0.586	3.954	1.028	1.8
2000	0.472	2.642	2.145	0.558	3.640	0.946	1.7
2001	0.472	1.549	1.546	0.402	2.492	0.648	1.6
2002	0.472	2.497	2.272	0.591	3.770	0.980	1.7
2003	0.472	6.651	3.796	0.987	4.277	1.112	1.1
2004	0.472	1.610	2.618	0.681	3.050	0.793	1.2
2005	0.472	0.685	1.439	0.374	1.728	0.449	1.2
2006	0.472	0.469	0.978	0.254	1.193	0.310	1.2
2007	0.472	0.671	1.359	0.353	1.600	0.416	1.2
2008	0.472	2.799	2.096	0.545	2.333	0.607	1.1
2009	0.472	2.682	2.097	0.545	2.390	0.621	1.1
2010	0.472	1.760	1.337	0.348	1.591	0.414	1.2
2011	0.472	1.936	2.098	0.545	2.550	0.663	1.2
2012	0.472	1.909	1.619	0.421	1.973	0.513	1.2

Table 24 Continued. Input (with log-scale standard errors, SE) and expected (Exp) discards for the Recreational Headboat fleet in numbers (N, 1,000s of fish) and biomass (B, thousand pounds gutted weight) for Gulf of Mexico Scamp. Dead discards in numbers (discard mortality rate = 0.26), dead discards in biomass, and mean weight (MW, gutted pounds per fish) are included. Mean weight was determined by dividing the expected discards in weights by the expected discards in numbers.

Year	Input N SE	Input N	Exp N	Exp Dead N	Exp B	Exp Dead B	Exp MW
2013	0.472	1.895	1.385	0.360	1.675	0.435	1.2
2014	0.472	2.970	1.870	0.486	2.289	0.595	1.2
2015	0.472	3.500	2.201	0.572	2.675	0.696	1.2
2016	0.472	1.880	1.609	0.418	1.787	0.465	1.1
2017	0.472	1.689	1.563	0.406	1.803	0.469	1.2
2018	0.472	2.176	1.942	0.505	2.341	0.609	1.2
2019	0.472	1.441	1.586	0.412	1.802	0.468	1.1
2020	0.472	1.911	1.667	0.433	1.823	0.474	1.1

Table 25. Observed (Obs) versus expected (Exp) standardized fishery-dependent catch-per-unit-effort (CPUE) indices for Gulf of Mexico Scamp. SEs shown below include extra SD estimated (**Table 11**) and added to the input SE values for each year (**Table 10**).

Year	ComVL (Obs)	ComVL (Exp)	ComVL (SE)	Headboat (Obs)	Headboat (Exp)	Headboat (SE)
1986				2.185	1.581	0.219
1987				1.457	1.467	0.224
1988				1.559	1.367	0.210
1989				0.869	1.244	0.219
1990				1.197	0.798	0.215
1991				1.007	0.780	0.218
1992				0.734	0.825	0.216
1993	0.986	0.770	0.261	0.736	0.896	0.215
1994	0.849	0.760	0.260	0.950	0.960	0.210
1995	1.254	0.781	0.260	1.288	1.013	0.215
1996	1.048	0.812	0.260	0.882	1.061	0.221
1997	1.314	0.842	0.259	0.770	1.099	0.244
1998	0.991	0.879	0.259	1.000	1.132	0.228
1999	0.954	0.943	0.259	0.718	0.765	0.250
2000	0.634	0.988	0.259	0.824	0.783	0.234
2001	1.005	1.036	0.259	0.724	0.804	0.246
2002	0.991	1.076	0.259	1.039	0.845	0.225
2003	0.948	1.087	0.259	0.847	1.157	0.241
2004	1.081	1.097	0.259	1.370	1.207	0.220
2005	1.302	1.122	0.260	1.309	1.249	0.221
2006	0.847	1.169	0.259	0.947	1.267	0.250
2007	1.001	1.203	0.260	1.584	1.223	0.246
2008	0.966	1.208	0.260	1.464	1.135	0.228
2009	0.829	1.200	0.260	0.953	1.066	0.224
2010				0.722	1.054	0.262
2011				1.848	1.065	0.233
2012				1.112	1.026	0.213

Table 25 Continued. Observed (Obs) versus expected (Exp) standardized fishery-dependent catch-per-unit-effort (CPUE) indices for Gulf of Mexico Scamp. SEs shown below include extra SD estimated (**Table 11**) and added to the input SE values for each year (**Table 10**).

Year	ComVL (Obs)	ComVL (Exp)	ComVL (SE)	Headboat (Obs)	Headboat (Exp)	Headboat (SE)
2013				0.707	0.941	0.251
2014				0.741	0.844	0.226
2015				0.831	0.738	0.226
2016				0.494	0.642	0.220
2017				0.488	0.577	0.244
2018				0.602	0.551	0.234
2019				0.598	0.534	0.222
2020				0.446	0.507	0.231

Table 26. Observed (Obs) versus expected (Exp) standardized survey indices for Gulf of Mexico Scamp. SEs shown below include extra SD estimated (**Table 11**) and added to the input SE values for each year (**Table 10**).

Year	Combined Video (Obs)	Combined Video (Exp)	Combined Video (SE)	RFOP VL (Obs)	RFOP VL (Exp)	RFOP VL (SE)
1993	0.888	0.929	0.283			
1994	0.508	0.940	0.343			
1995	0.577	1.019	0.363			
1996	0.794	1.039	0.285			
1997	0.659	1.067	0.244			
2002	1.795	1.321	0.252			
2004	2.031	1.378	0.286			
2005	1.530	1.317	0.244			
2006	0.961	1.241	0.279			
2007	1.563	1.200	0.232	0.923	1.290	0.356
2008	1.155	1.220	0.258	0.998	1.266	0.430
2009	1.254	1.185	0.239	0.979	1.227	0.439
2010	1.094	1.124	0.235	0.682	1.197	0.452
2011	1.206	1.064	0.208	0.602	1.179	0.383

Table 26 Continued. Observed (Obs) versus expected (Exp) standardized survey indices for Gulf of Mexico Scamp. SEs shown below include extra SD estimated (**Table 11**) and added to the input SE values for each year (**Table 10**).

Year	Combined Video (Obs)	Combined Video (Exp)	Combined Video (SE)	RFOP VL (Obs)	RFOP VL (Exp)	RFOP VL (SE)
2012	0.687	0.981	0.231	1.206	1.129	0.312
2013	0.744	0.893	0.229	1.072	1.054	0.471
2014	0.894	0.790	0.229	0.864	0.965	0.348
2015	0.958	0.690	0.243	1.142	0.860	0.327
2016	0.806	0.675	0.213	1.251	0.775	0.352
2017	0.766	0.621	0.227	1.066	0.707	0.379
2018	0.566	0.570	0.219	1.215	0.658	0.376
2019	0.564	0.575	0.212	0.511	0.626	0.424

Table 27. Summary of correlated parameters with correlation coefficients exceeding 0.7 for the Gulf of Mexico Scamp SEDAR 68 OA Base Model.

Parameter 1	Parameter 2	Correlation
Main_RecrDev_2000	Main_RecrDev_1999	-0.743
Main_RecrDev_2001	Main_RecrDev_2000	-0.739
Main_RecrDev_2003	Main_RecrDev_2002	-0.766
Main_RecrDev_2004	Main_RecrDev_2003	-0.724
Retain_L_width_Charter_Private(3)_BLK2repl_1990	Retain_L_infl_Charter_Private(3)_BLK2repl_1990	0.756
Retain_L_width_Charter_Private(3)_BLK2repl_1999	Retain_L_infl_Charter_Private(3)_BLK2repl_1999	0.798
Retain_L_width_Charter_Private(3)_BLK2repl_2003	Retain_L_infl_Charter_Private(3)_BLK2repl_2003	0.732
Size_95%width_ComVL(1)	Size_inflection_ComVL(1)	0.731
Size_95%width_RFOP_Index(6)	Size_inflection_RFOP_Index(6)	0.822
Size_DblN_ascend_se_Charter_Private(3)	Size_DblN_peak_Charter_Private(3)	0.958
VonBert_K_Fem_GP_1	L_at_Amin_Fem_GP_1	-0.711
VonBert_K_Fem_GP_1	L_at_Amax_Fem_GP_1	-0.960

Table 28. Retrospective analysis and retrospective forecast spawning stock biomass (male and female combined SSB, metric tons) and fishing mortality (F, total biomass killed all ages / total biomass age 3+) for the last five terminal years and combined (grey rows) for the Gulf of Mexico Scamp SEDAR 68 OA Base Model. N = number of observations to compute each statistic. Values within -0.15 to 0.2 are highlighted in green and are considered acceptable levels of retrospective bias. Values outside the acceptable range of -0.15 to 0.2 for longer-lived species (Hurtado-Ferro et al. 2015) are highlighted in red and indicate an undesirable retrospective pattern. See Carvalho et al. (2021) for additional details.

Quantity	Statistic	SEDAR68 OT	OT N
SSB (-2019)	Mohn's Rho	0.007	1
SSB (-2018)	Mohn's Rho	-0.053	1
SSB (-2017)	Mohn's Rho	-0.131	1
SSB (-2016)	Mohn's Rho	-0.170	1
SSB (-2015)	Mohn's Rho	-0.155	1
SSB (-Combined)	Mohn's Rho	-0.101	5
SSB (-2019)	Forecast bias	0.004	1
SSB (-2018)	Forecast bias	-0.036	1
SSB (-2017)	Forecast bias	-0.128	1
SSB (-2016)	Forecast bias	-0.163	1
SSB (-2015)	Forecast bias	-0.158	1
SSB (-Combined)	Forecast bias	-0.096	5
F (-2019)	Mohn's Rho	-0.008	1
F (-2018)	Mohn's Rho	0.041	1
F (-2017)	Mohn's Rho	0.165	1
F (-2016)	Mohn's Rho	0.175	1
F (-2015)	Mohn's Rho	0.305	1
F (-Combined)	Mohn's Rho	0.135	5
F (-2019)	Forecast bias	0.388	1
F (-2018)	Forecast bias	0.257	1
F (-2017)	Forecast bias	0.410	1
F (-2016)	Forecast bias	0.202	1
F (-2015)	Forecast bias	0.259	1
F (-Combined)	Forecast bias	0.303	5

Table 29. Joint residual summary statistics for the Gulf of Mexico Scamp SEDAR 68 OA Base Model. N = number of observations to compute each statistic. RMSE = root mean squared error (as a percentage), with values above 30% for joint residuals (grey rows) highlighted in red if present and acceptable values below 30% highlighted in green. See Carvalho et al. (2021) for additional details.

Quantity	Statistic	SEDAR68 OT	OT N
Index of Abundance			
ComVL	RMSE(%)	26	17
Headboat	RMSE(%)	18.1	35
Combined_Video	RMSE(%)	22.8	22
RFOP_Index	RMSE(%)	29.7	13
Combined	RMSE(%)	27.8	87
Age			
ComVL	RMSE(%)	14.2	21
ComLL	RMSE(%)	13.6	23
Charter_Private	RMSE(%)	16.8	15
Headboat	RMSE(%)	16.3	16
Combined	RMSE(%)	16.6	75
Length			
ComVL	RMSE(%)	3.5	35
ComLL	RMSE(%)	3.5	34
Charter_Private	RMSE(%)	4.1	25
Headboat	RMSE(%)	3.5	34
Combined_Video	RMSE(%)	4.7	19
RFOP_Index	RMSE(%)	5.7	13
Combined	RMSE(%)	4.7	160

Table 30. Runs tests summary statistics for the Gulf of Mexico Scamp SEDAR 68 OA Base Model. N = number of observations to compute each statistic. P-values greater than 0.05% (in green) provide support for randomly distributed residuals whereas p-values less than 0.05% (in red) indicate non-randomly distributed residuals. See Carvalho et al. (2021) for additional details.

Quantity	Statistic	SEDAR68 OT	OT N
Index of Abundance			
ComVL	p-value	0.003	17
Headboat	p-value	0.895	35
Combined_Video	p-value	0.344	22
RFOP_Index	p-value	0.076	13
Age			
ComVL	p-value	0.448	21
ComLL	p-value	0.052	23
Charter_Private	p-value	0.001	15
Headboat	p-value	0.76	16
Length			
ComVL	p-value	0.002	35
ComLL	p-value	0.067	34
Charter_Private	p-value	0.744	25
Headboat	p-value	0.024	34
Combined_Video	p-value	0.05	19
RFOP_Index	p-value	0.623	13

Table 31. Hindcast cross-validation summary statistics for the Gulf of Mexico Scamp SEDAR 68 OA Base Model. N = number of observations to compute each statistic. MASE = mean absolute scaled error, with values < 1 (in green) indicative of superior prediction skill over a naïve baseline forecast (random walk) and values > 1 (in red) indicative of poor prediction skill. See Carvalho et al. (2021) for additional details.

Quantity	Statistic	SEDAR68 OT	OT N
Index of Abundance			
ComVL	MASE		0
Headboat	MASE	0.623	5
Combined_Video	MASE	1.181	4
RFOP_Index	MASE	1.697	4
joint	MASE	1.203	13
Age			
ComVL	MASE	0.678	5
ComLL	MASE	0.928	5
Charter_Private	MASE	0.625	5
Headboat	MASE	0.476	4
joint	MASE	0.615	19
Length			
ComVL	MASE	0.36	5
ComLL	MASE	0.317	5
Charter_Private	MASE	1.214	5
Headboat	MASE	1.517	4
Combined_Video	MASE	2.022	4
RFOP_Index	MASE	1.243	4
joint	MASE	0.93	27

Table 32. Summary of key model building steps towards the SEDAR 68 OA Base Model for Gulf of Mexico Scamp and associated convergence diagnostics (NLL = negative log-likelihood; CV = coefficient of variation).

Model Name	Description	NLL	Gradient	Estimated Parameters (Bounded)	Parameters with CV>1
1_RW Base	SEDAR 68 RW Base Model	7,827.0	0.0262	230 (0)	13
2_Continuity	Step 1 + update all data	9,088.0	0.0022	245 (0)	14
3_2 + AP M vector	Step 2 + input natural mortality (M) vector from Assessment Process	9,088.6	0.0025	245 (0)	16
4_3 + SSLorenzen M	Step 3 + use Lorenzen M option in SS	9,087.7	0.0235	245 (0)	14
5_4 + Estimate Growth	Step 4 + estimate growth parameters (Linf, K and LAmin) using normal priors	8,833.3	0.0024	247 (0)	13
6_5 + RecBias	Step 5 + apply recruitment deviations bias adjustment ramp	8,832.5	0.0038	247 (0)	13
7_6 + Late data updates	Step 6 + update headboat landings (1986-2020), mean weight of landings (1986-2020), discards (2000-03) and commercial landings (2019-20)	8,870.8	0.0047	247 (0)	13
8_7 + Charter Private early retention	Step 7 + update inflection point for Charter Private retention for 1986-1989	8,872.2	0.0020	247 (0)	13
9_8 + RecBias	Step 8 + apply recruitment deviations bias adjustment ramp	8,871.9	0.0031	247 (0)	13
10_9 + Estimate Fewer DM	Step 9 + estimate fewer Dirichlet Multinomial (DM) parameters	8,862.7	0.0118	246 (0)	13
11_10 + Fix DM at bounds	Step 10 + fix DM at bounds	8,862.6	0.0172	244 (0)	13
12_11 + RecBias	Step 11 + apply recruitment deviations bias adjustment ramp	8,862.7	0.0003	244 (0)	13

Table 33. Summary of key model building steps towards the SEDAR 68 OA Base Model for Gulf of Mexico Scamp and associated key estimates and derived quantities (note that steepness was fixed at 0.694 across all runs). SSB defined as male and female combined SSB in metric tons (mt), Recr = recruitment, LAmin = length at the minimum age (1 year), and Linf and K = von Bertalanffy asymptotic length and growth rate, respectively.

Model Name	sigmaR	ln(R0)	Virgin SSB (mt)	Virgin Recr (1,000s)	LAmin	Linf	K
1_RW Base	0.445	7.417	3,816.56	1,663.89	15.237	70.222	0.134
2_Continuity	0.518	7.370	3,695.55	1,587.55	16.136	70.222	0.134
3_2 + AP M vector	0.518	7.272	3,691.12	1,439.50	16.155	70.222	0.134
4_3 + SSLorenzen M	0.517	7.616	3,693.74	2,030.04	16.086	70.222	0.134
5_4 + Estimate Growth	0.609	7.308	3,745.28	1,492.58	24.970	78.162	0.070
6_5 + RecBias	0.559	7.310	3,750.44	1,495.59	24.957	78.118	0.070
7_6 + Late data updates	0.569	7.323	3,748.69	1,514.55	24.687	77.293	0.073
8_7 + Charter Private early retention	0.572	7.331	3,784.74	1,527.42	24.703	77.284	0.073
9_8 + RecBias	0.559	7.332	3,786.22	1,528.35	24.699	77.272	0.073
10_9 + Estimate Fewer DM	0.559	7.330	3,779.73	1,525.76	24.694	77.286	0.073
11_10 + Fix DM at bounds	0.559	7.330	3,779.73	1,525.76	24.694	77.286	0.073
12_11 + RecBias	0.562	7.330	3,779.37	1,525.53	24.695	77.289	0.073

Table 34. Summary of sensitivity runs for the SEDAR 68 RW Base Model with new data inputs provided during the SEDAR 68 OA for Gulf of Mexico Scamp and associated convergence diagnostics (NLL = negative log-likelihood; CV = coefficient of variation).

Model Name	Description	NLL	Gradient	Estimated Parameters (Bounded)	Parameters with CV>1
RW Base	SEDAR 68 Research Track RW Base	7,827	0.0262	230 (0)	13
Recreational mean weight (with error)	+ updated error estimates for mean weight of recreationally landed Scamp	7,916	0.0032	230 (0)	15
2003-2012 age data with ageing error	+ 2003-2012 age data with ageing error matrix (error in expert)	7,784	0.0036	230 (0)	13
Update headboat discard length composition	+ updated headboat discard length composition bins	7,850	0.0162	230 (0)	15
Update headboat landings, mean weight and discards	+ updated headboat landings, mean weight of landings, and discards	7,891	0.0216	230 (0)	16

Table 35. Summary of sensitivity runs for the SEDAR 68 RW Base Model with new data inputs provided during the SEDAR 68 OA for Gulf of Mexico Scamp and associated key estimates and derived quantities (note that steepness was fixed at 0.694 across all runs). SSB defined as male and female combined SSB in metric tons (mt) and Recr = recruitment.

Model Name	sigmaR	ln(R0)	Virgin SSB (mt)	Virgin Recr (1,000s)
RW Base	0.445	7.417	3,816.56	1,663.89
Recreational mean weight (with error)	0.430	7.390	3,710.99	1,620.23
2003-2012 age data with ageing error	0.471	7.415	3,867.75	1,661.05
Update headboat discard length composition	0.447	7.420	3,827.34	1,668.29
Update headboat landings, mean weight and discards	0.441	7.407	3,761.52	1,647.38

Table 36. Summary of sensitivity runs conducted for the SEDAR 68 OA Base Model for Gulf of Mexico Scamp and associated convergence diagnostics (NLL = negative log-likelihood; CV = coefficient of variation).

Description	NLL	Gradient	Estimated Parameters (Bounded)	Parameters with CV>1
SEDAR 68 OA Base	8,862.7	0.0003	244 (0)	13
Ageing error matrix				
Linear bias and constant CV model with expert error	8,864.6	0.0141	244 (0)	13
Curvilinear bias and SD model with no expert error	8,911.0	0.0356	245 (0)	17
Indices of Abundance				
No preIFQ Commercial Vertical Line	8,876.9	0.0037	244 (0)	14
No Headboat	8,891.1	0.0033	245 (0)	17
No Video	8,881.1	0.0080	246 (0)	14
No RFOP	8,868.5	0.0199	247 (0)	14
No Fishery-dependent	8,912.1	0.0018	248 (0)	19

Table 37. Summary of sensitivity runs conducted for the SEDAR 68 OA Base Model for Gulf of Mexico Scamp and associated key estimates and derived quantities (note that steepness was fixed at 0.694 across all runs). SSB defined as male and female combined SSB in metric tons (mt), Recr = recruitment, LAmin = length at the minimum age (1 year), and Linf and K = von Bertalanffy asymptotic length and growth rate, respectively.

Description	sigmaR	ln(R0)	Virgin SSB (mt)	Virgin Recr (1,000s)	LAmin	Linf	K
SEDAR 68 OA Base	0.562	7.330	3,779	1,526	24.695	77.289	0.073
Ageing error matrix							
Linear bias and constant CV model with expert error	0.561	7.330	3,786	1,525	24.758	77.294	0.072
Curvilinear bias and SD model with no expert error	0.524	7.374	3,777	1,594	23.671	76.472	0.077
Indices of Abundance							
No pre-IFQ Commercial Vertical Line	0.560	7.325	3,763	1,518	24.700	77.326	0.073
No Headboat	0.518	7.456	4,247	1,730	24.581	77.135	0.073
No Video	0.584	7.325	3,762	1,518	24.697	77.242	0.073
No RFOP	0.572	7.329	3,771	1,523	24.677	77.251	0.073
No Fishery-dependent	0.530	7.434	4,160	1,693	24.570	77.132	0.073

Table 38. Settings used for Gulf of Mexico Scamp projections.

Parameter	Value	Comment
Relative F	Average from 2018-2020	Average relative fishing mortality (apical F) over terminal three years of model
Selectivity	Average from 2018-2020	Fleet specific selectivity estimated over terminal three years of model
Retention	Average from 2018-2020	Fleet specific retention estimated over terminal three years of model
Recruitment	Beverton-Holt stock-recruitment relationship	Derived from the model estimated Beverton-Holt stock-recruitment relationship
Interim Landings (2021-2022)	29.14/27.98 metric tons (Commercial Vertical Line); 30.13/27.02 metric tons (Commercial Longline); 96.07/75.24 thousands of fish (Recreational Charter Private); 3.13/2.46 thousands of fish (Recreational Headboat)	Landings provided for 2021; For 2022, used 3-year average of landings (2019-2021)
Allocation Ratio	None	

Table 39. Summary of Magnuson-Stevens Reauthorization Act benchmarks and reference points for the SEDAR 68 Gulf of Mexico Scamp Operational Assessment. Spawning Stock Biomass (SSB) is in metric tons (male and female combined SSB), whereas F is a harvest rate (total biomass killed all ages / total biomass age 3+).

Criteria	Definition	Value
Base M	Target M for fully selected ages in the Lorenzen (2000) scaling	0.155
Steepness	Steepness of the Beverton-Holt stock-recruit relationship (fixed)	0.694
R0	Virgin recruitment (1,000s)	1,526
Generation Time	Fecundity-weighted mean age	8.34
SSB0	Virgin spawning stock biomass (mt)	3,779
	Mortality Rate Criteria	
FMSYproxy	Equilibrium F that achieves 30%SPR	0.171
MFMT	FMSYproxy	0.171
FOY	0.9 * Directed F at F30%SPR	0.154
Fcurrent	Geometric mean of the last 3 years of the assessment (F2018-2020)	0.092
Fcurrent/MFMT	Current stock status based on MFMT	0.538
	Biomass Criteria	
SSBMSYproxy	Equilibrium SSB at F30%SPR	805
MSST	0.75 * SSB30%SPR	604
SSB at Optimum Yield	Equilibrium SSB when Directed F = 0.9 * Directed F at F30%SPR	919
SSBcurrent	SSB in 2020	1,301
SSBcurrent/SSBFMSYproxy	Current stock status based on SSB30%SPR (Equil)	1.62
SSBcurrent/MSST	Current stock status based on MSST	2.15
SSBcurrent/SSB0	SSB ratio in 2020	0.34

Table 40. Time series of fishing mortality (F) and SSB relative to associated biological reference points. SSB is in metric tons (male and female combined SSB), whereas F is a harvest rate (total biomass killed all ages / total biomass age 3+). Reference points include $F_{30\%SPR}$ = 0.171, $SSB_{F30\%SPR}$ = 805 metric tons, and $MSST_{F30\%SPR}$ = 604 metric tons which was calculated as (0.75) * $SSB_{F30\%SPR}$. SSB ratio was calculated as annual SSB divided by SSB_0 where SSB_0 = 3,779 metric tons. Red indicates overfishing and/or overfished states if present.

Year	F	F/F30%SPR	SSB	SSB/SSB30%SPR	SSB/MSST	SSB ratio
1986	0.108	0.632	1,972	2.448	3.264	0.522
1987	0.098	0.575	1,920	2.384	3.179	0.508
1988	0.084	0.490	1,892	2.349	3.133	0.501
1989	0.085	0.494	1,831	2.274	3.032	0.485
1990	0.078	0.453	1,754	2.178	2.904	0.464
1991	0.099	0.577	1,668	2.071	2.761	0.441
1992	0.096	0.562	1,617	2.008	2.678	0.428
1993	0.104	0.608	1,645	2.043	2.724	0.435
1994	0.065	0.379	1,678	2.084	2.778	0.444
1995	0.059	0.346	1,771	2.199	2.933	0.469
1996	0.060	0.352	1,841	2.286	3.048	0.487
1997	0.070	0.410	1,942	2.412	3.216	0.514
1998	0.054	0.317	2,002	2.486	3.314	0.530
1999	0.069	0.403	2,088	2.593	3.457	0.552
2000	0.048	0.280	2,163	2.686	3.581	0.572
2001	0.063	0.371	2,223	2.760	3.680	0.588
2002	0.064	0.376	2,302	2.859	3.812	0.609
2003	0.086	0.505	2,458	3.052	4.070	0.650
2004	0.097	0.568	2,509	3.116	4.155	0.664
2005	0.066	0.389	2,576	3.198	4.264	0.681
2006	0.063	0.369	2,643	3.282	4.376	0.699
2007	0.077	0.453	2,653	3.294	4.393	0.702
2008	0.092	0.538	2,565	3.185	4.247	0.679

Table 40 Continued. Time series of fishing mortality (F) and SSB relative to associated biological reference points. SSB is in metric tons (male and female combined SSB), whereas F is a harvest rate (total biomass killed all ages / total biomass age 3+). Reference points include $F_{30\%SPR}$ = 0.171, $SSB_{F30\%SPR}$ = 805 metric tons, and $MSST_{F30\%SPR}$ = 604 metric tons which was calculated as (0.75) * $SSB_{F30\%SPR}$. SSB ratio was calculated as annual SSB divided by SSB_0 where SSB_0 = 3,779 metric tons. Red indicates overfishing and/or overfished states if present.

Year	F	F/F30%SPR	SSB	SSB/SSB30%SPR	SSB/MSST	SSB ratio
2009	0.083	0.487	2,456	3.050	4.067	0.650
2010	0.062	0.366	2,439	3.029	4.039	0.645
2011	0.050	0.291	2,460	3.055	4.073	0.651
2012	0.101	0.592	2,461	3.056	4.074	0.651
2013	0.089	0.519	2,295	2.850	3.800	0.607
2014	0.113	0.658	2,149	2.669	3.558	0.569
2015	0.125	0.733	1,953	2.425	3.234	0.517
2016	0.129	0.753	1,735	2.154	2.872	0.459
2017	0.099	0.577	1,538	1.910	2.546	0.407
2018	0.085	0.497	1,460	1.813	2.418	0.386
2019	0.095	0.555	1,395	1.732	2.309	0.369
2020	0.096	0.563	1,301	1.615	2.154	0.344

Table 41. Results of the OFL projections (fishing set at $F_{30\%SPR}$) for Gulf of Mexico Scamp **assuming predicted recruitment from the spawner-recruit curve**. Recruitment (Recr) is in 1,000s of age-0 fish, F is a harvest rate (total biomass killed all ages / total biomass age 3+), SSB is in metric tons (male and female combined SSB), and OFL is the overfishing limit in millions of pounds gutted weight. Reference points include $F_{30\%SPR}$ = 0.171, $SSB_{F30\%SPR}$ = 805 metric tons, and $MSST_{F30\%SPR}$ = 604 metric tons which was calculated as (0.75) * $SSB_{F30\%SPR}$. SSB ratio was calculated as annual SSB divided by SSB_0 where SSB_0 = 3,779 metric tons.

Year	Recr	F	F/F30%SPR	SSB	SSB/SSB30%SPR	SSB/MSST	SSB ratio	OFL
2023	1,191	0.171	1	1,069	1.328	1.770	0.283	0.427
2024	1,176	0.171	1	1,026	1.274	1.698	0.271	0.409
2025	1,165	0.171	1	994	1.235	1.647	0.263	0.395
2026	1,155	0.171	1	970	1.205	1.606	0.257	0.385
2027	1,147	0.171	1	950	1.180	1.573	0.251	0.377
2028	1,140	0.171	1	933	1.158	1.545	0.247	0.370

Table 42. Results of projections at optimum yield (OY; directed F = 0.9 * Directed F at $F_{30\%SPR}$ (0.171)) for Gulf of Mexico Scamp **assuming predicted recruitment from the spawner-recruit curve**. Recruitment (Recr) is in 1,000s of age-0 fish, F is a harvest rate (total biomass killed all ages / total biomass age 3+), SSB is in metric tons (male and female combined SSB), and optimum yield (OY) in millions of pounds gutted weight. Reference points include $F_{30\%SPR}$ = 0.171, $SSB_{F30\%SPR}$ = 805 metric tons, and $MSST_{F30\%SPR}$ = 604 metric tons which was calculated as (0.75) * $SSB_{F30\%SPR}$. SSB ratio was calculated as annual SSB divided by SSB_0 where SSB_0 = 3,779 metric tons.

Year	Recr	F	F/F30%SPR	SSB	SSB/SSB30%SPR	SSB/MSST	SSB ratio	OY
2023	1,191	0.154	0.9	1,069	1.328	1.770	0.283	0.384
2024	1,182	0.154	0.9	1,043	1.296	1.727	0.276	0.375
2025	1,176	0.154	0.9	1,026	1.274	1.699	0.271	0.367
2026	1,171	0.154	0.9	1,013	1.257	1.677	0.268	0.361
2027	1,167	0.154	0.9	1,001	1.244	1.658	0.265	0.357
2028	1,164	0.154	0.9	992	1.232	1.642	0.262	0.353

11. Figures

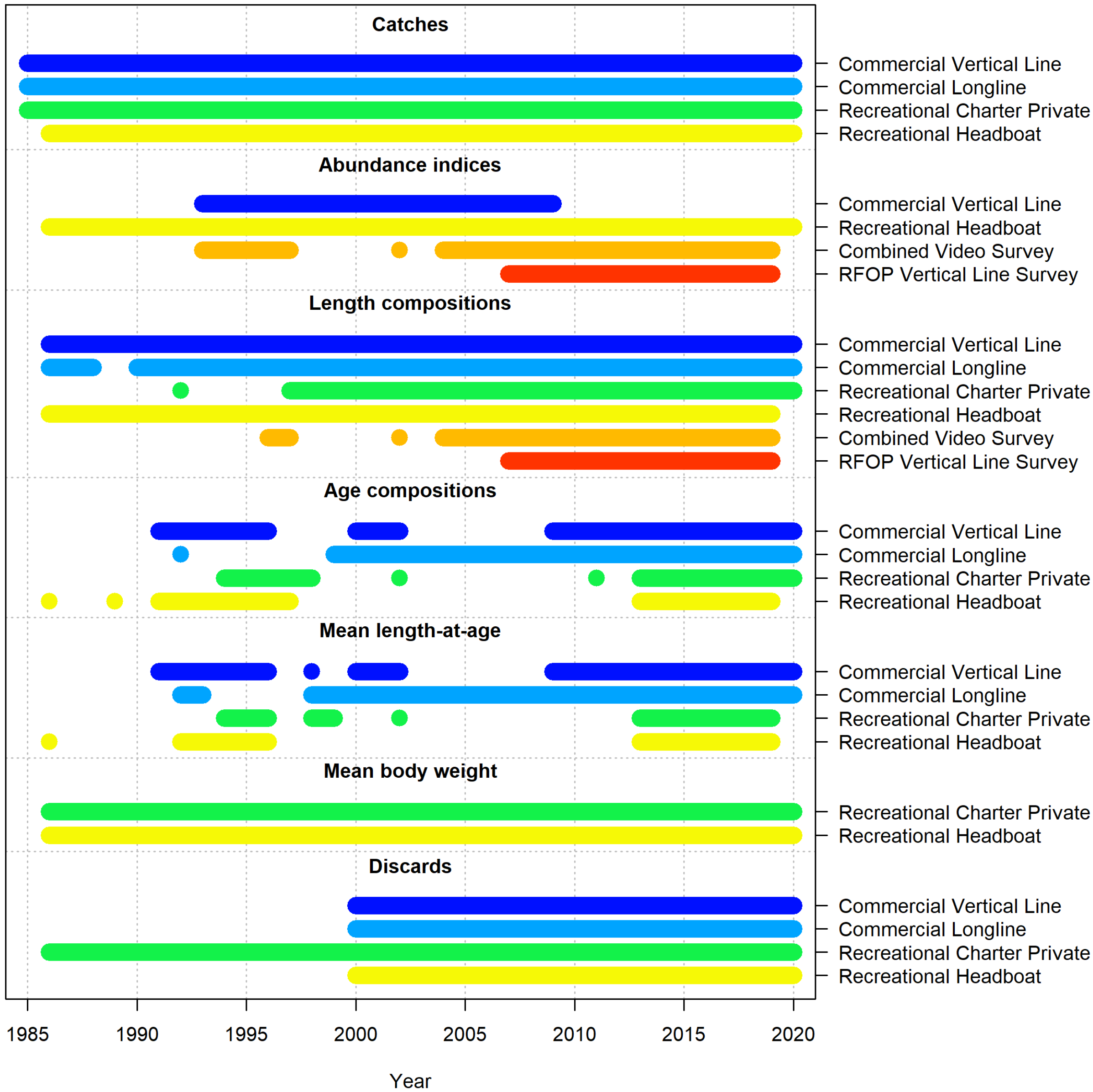


Figure 1. Data sources used in the Gulf of Mexico Scamp Stock Synthesis assessment model.

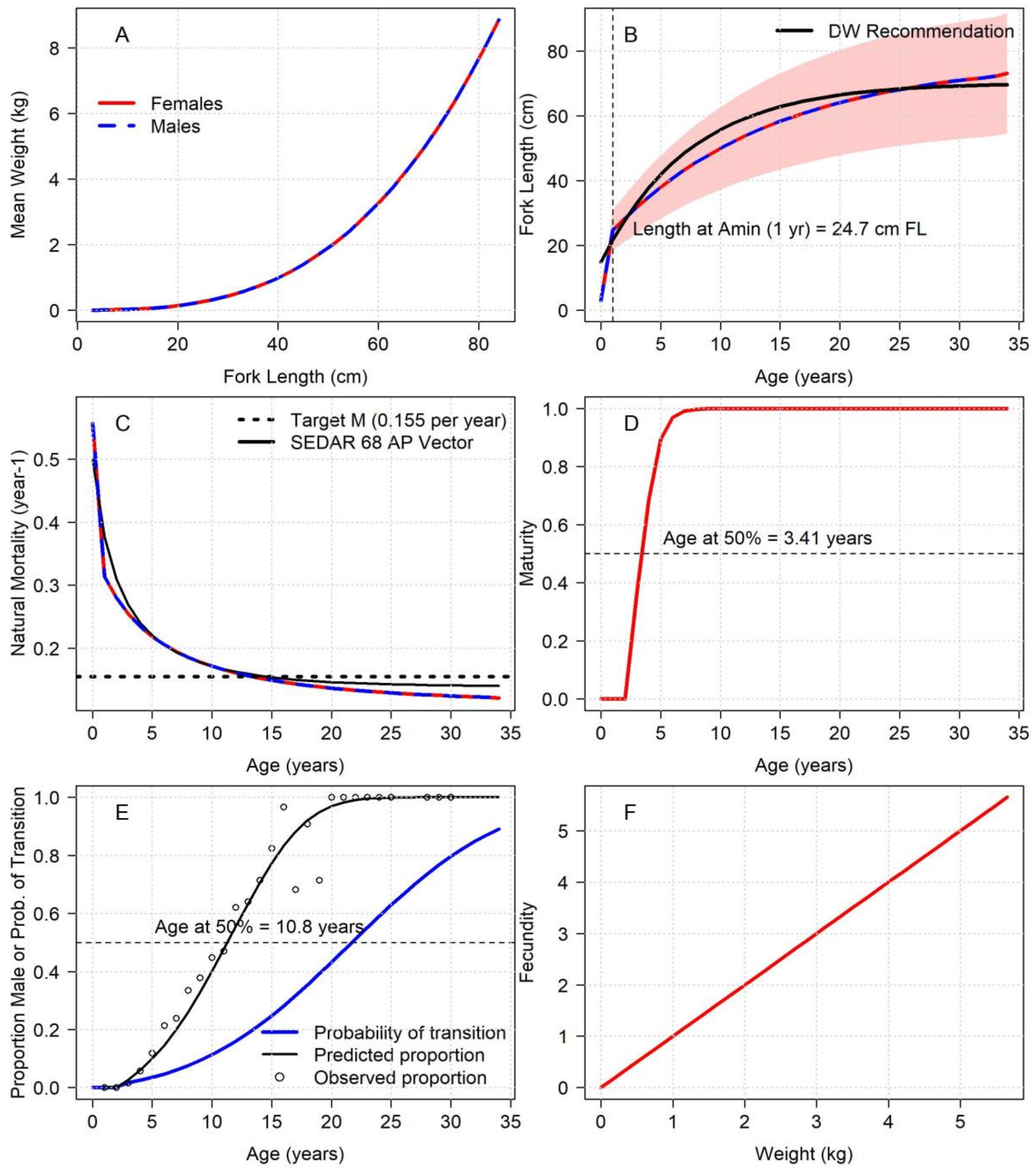


Figure 2. Life history relationships for Gulf of Mexico Scamp including (A) mean weight-at-length, (B) recommended and estimated growth curves (shaded area indicates the 95% distribution of length-at-age), (C) natural mortality-at-age, (D) maturity-at-age, (E) the hermaphroditism transition rate (probability of transition, proportion male also shown but not required by Stock Synthesis as an input), and (F) fecundity at weight.

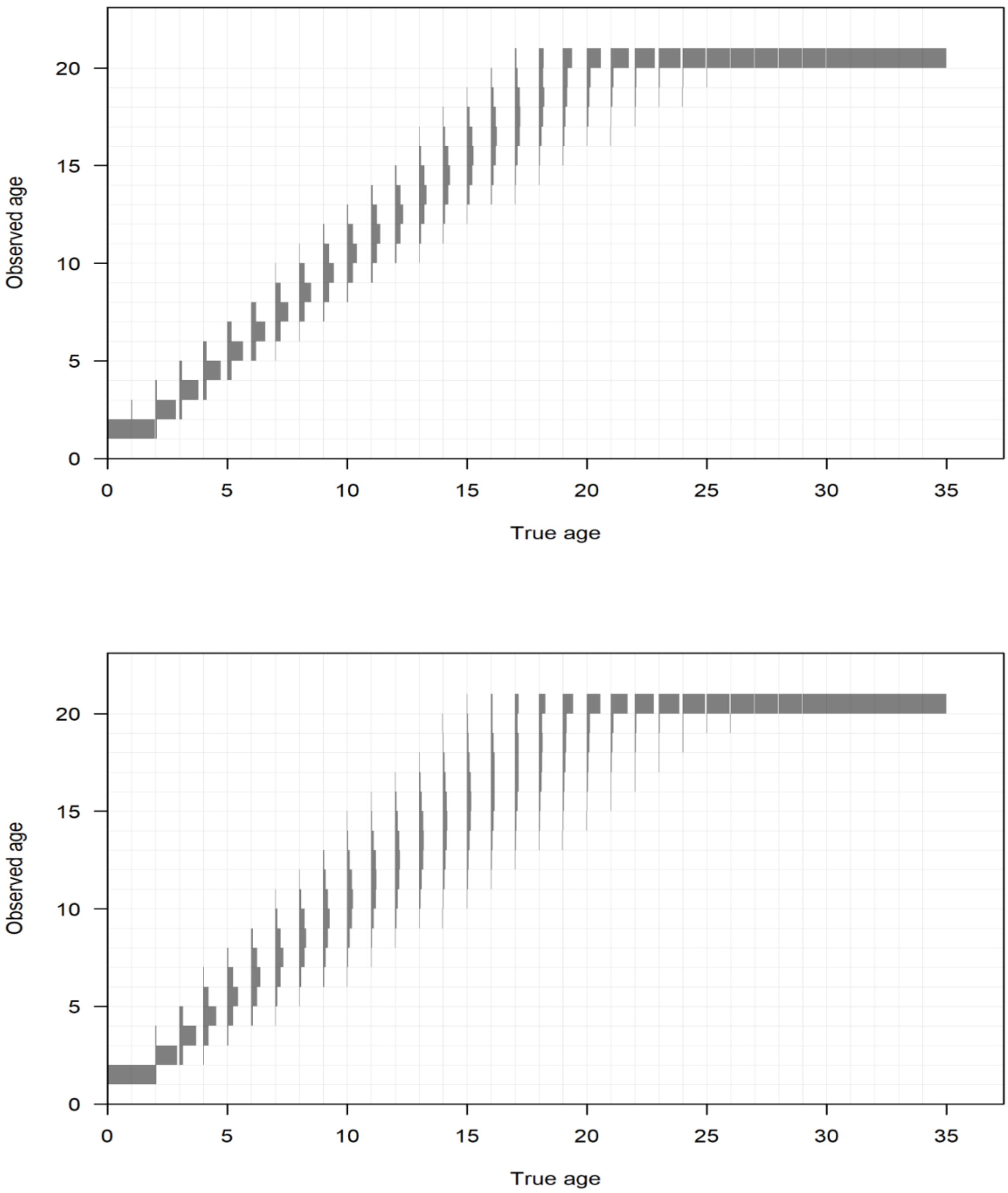


Figure 3. Distribution of observed age at true age based on ageing error matrices developed for the Research Track Assessment (top; used for years 1991-2002, 2013-2017) and the Operational Assessment (bottom; used for years 2003-2012, 2018-2020) for Gulf of Mexico Scamp.

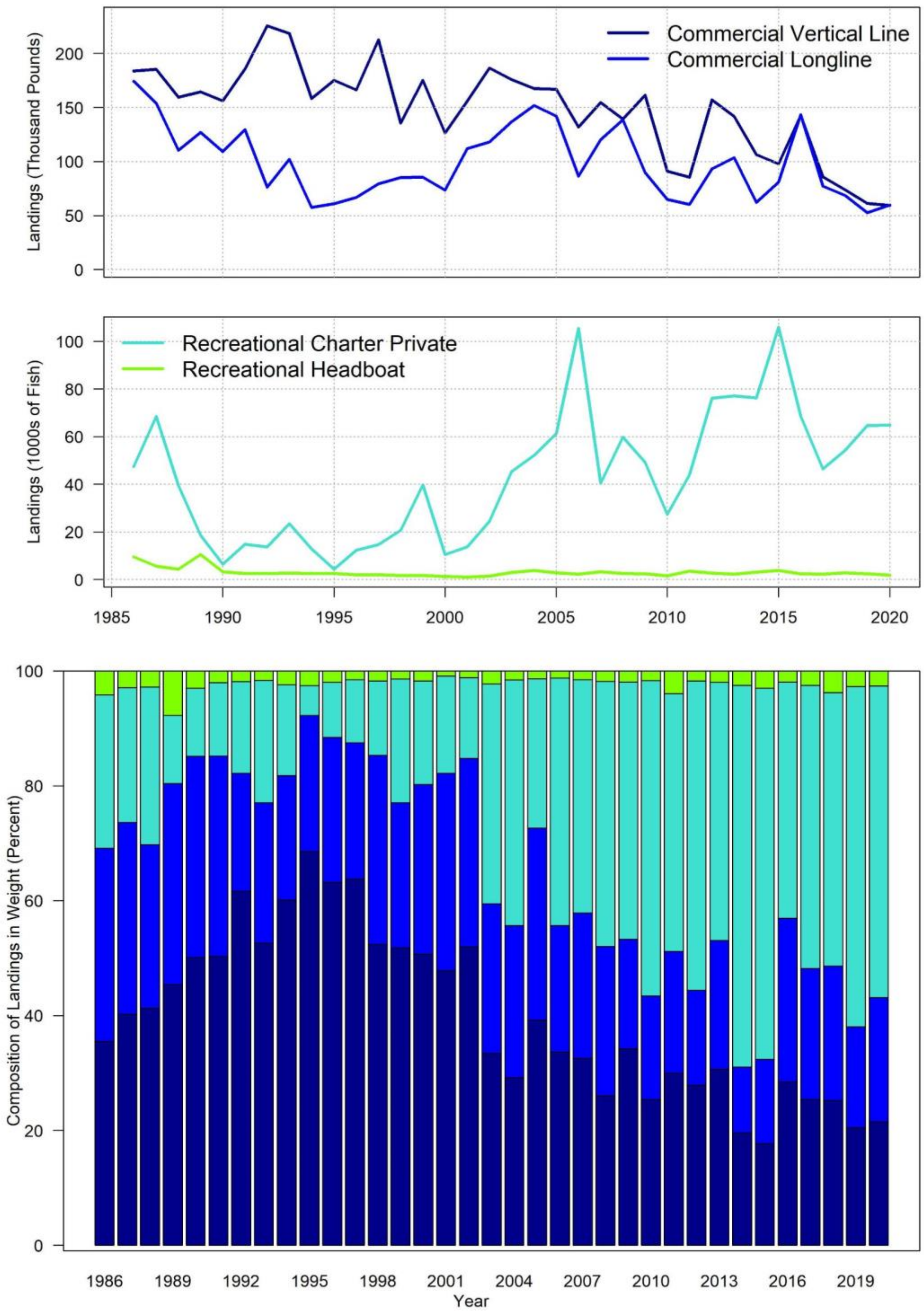


Figure 4. Observed landings by fleet and by percent (by weight based on landings expected by Stock Synthesis) for Gulf of Mexico Scamp. Commercial landings are shown in thousands of pounds but input into the stock assessment model in units of metric tons. Recreational landings are shown and input in numbers (1,000s of fish).

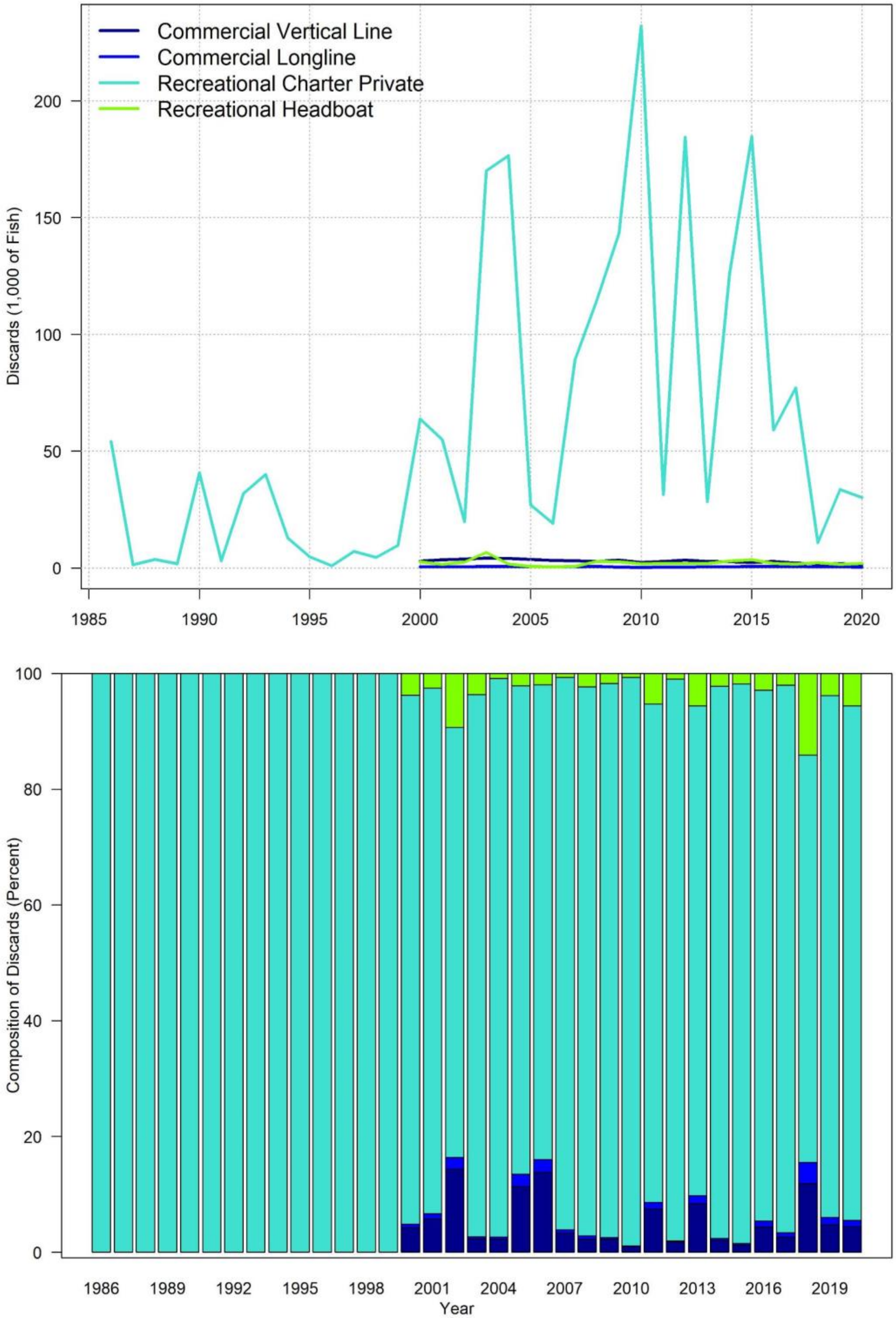


Figure 5. Observed discards by fleet and by percent for Gulf of Mexico Scamp. Commercial and recreational discards are both in numbers of fish (1,000s of fish).

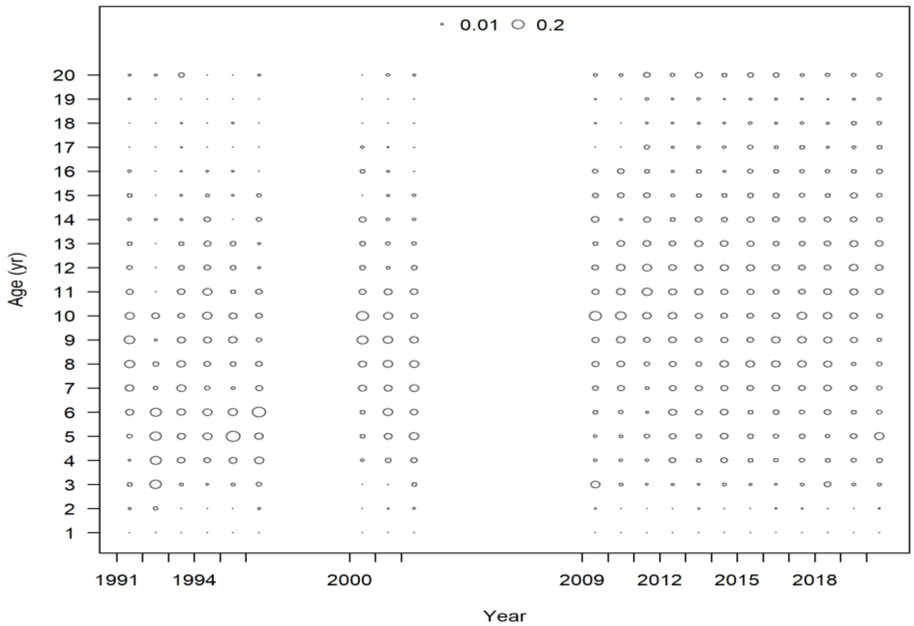


Figure 6. Observed relative age proportions in each year for Gulf of Mexico Scamp in the Commercial Vertical Line fishery.

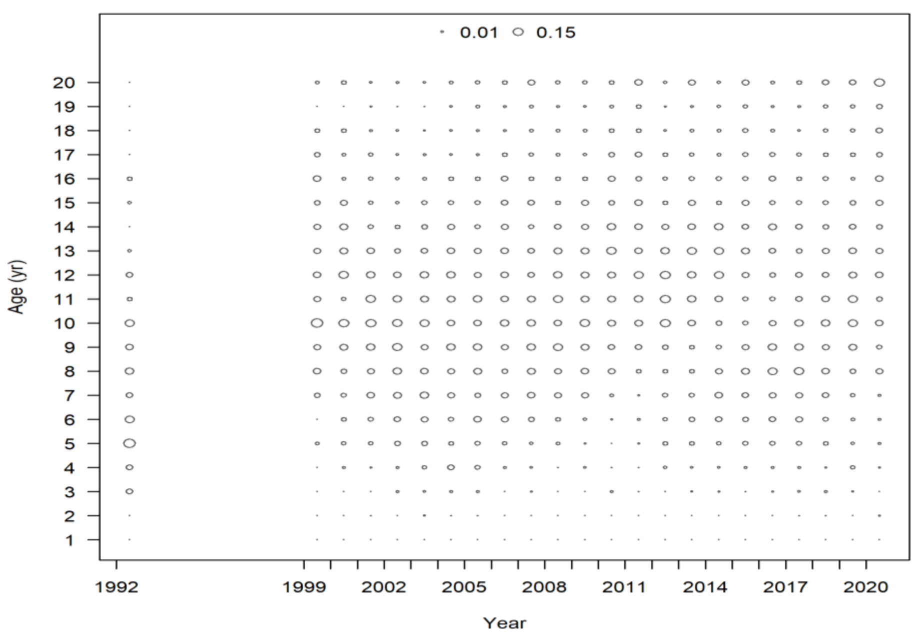


Figure 7. Observed relative age proportions in each year for Gulf of Mexico Scamp in the Commercial Longline fishery.

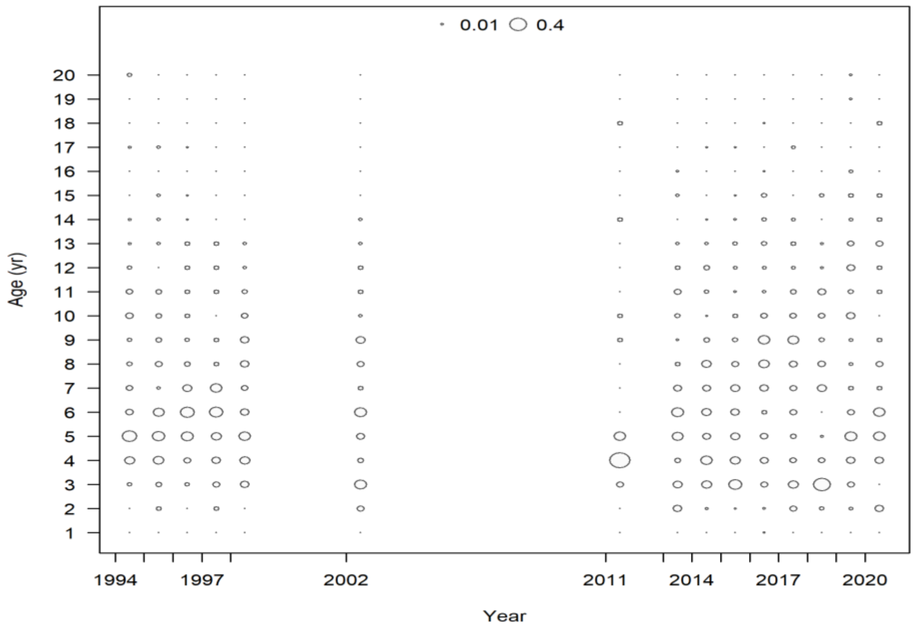


Figure 8. Observed relative age proportions in each year for Gulf of Mexico Scamp in the Recreational Charter Private fishery.

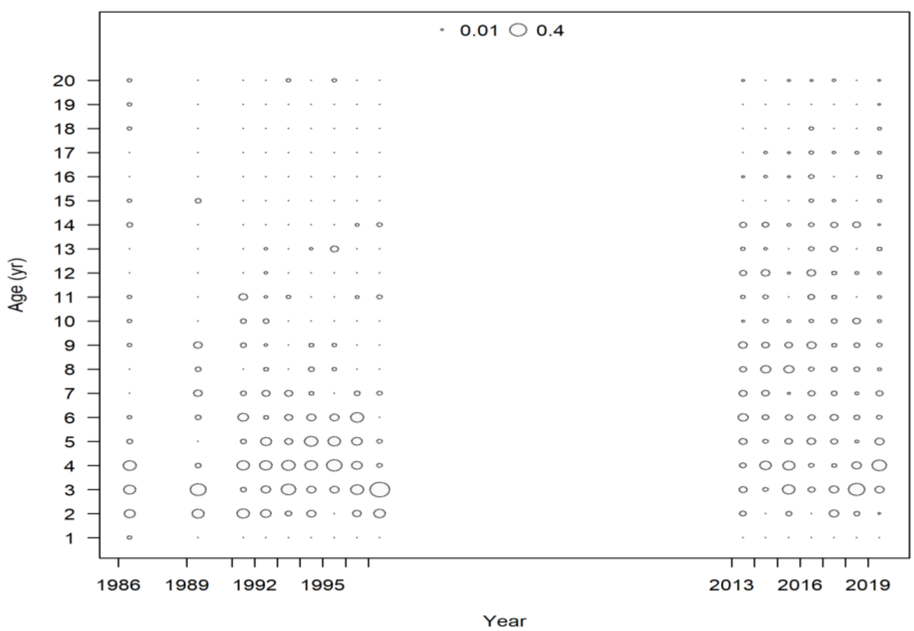


Figure 9. Observed relative age proportions in each year for Gulf of Mexico Scamp in the Recreational Headboat fishery.

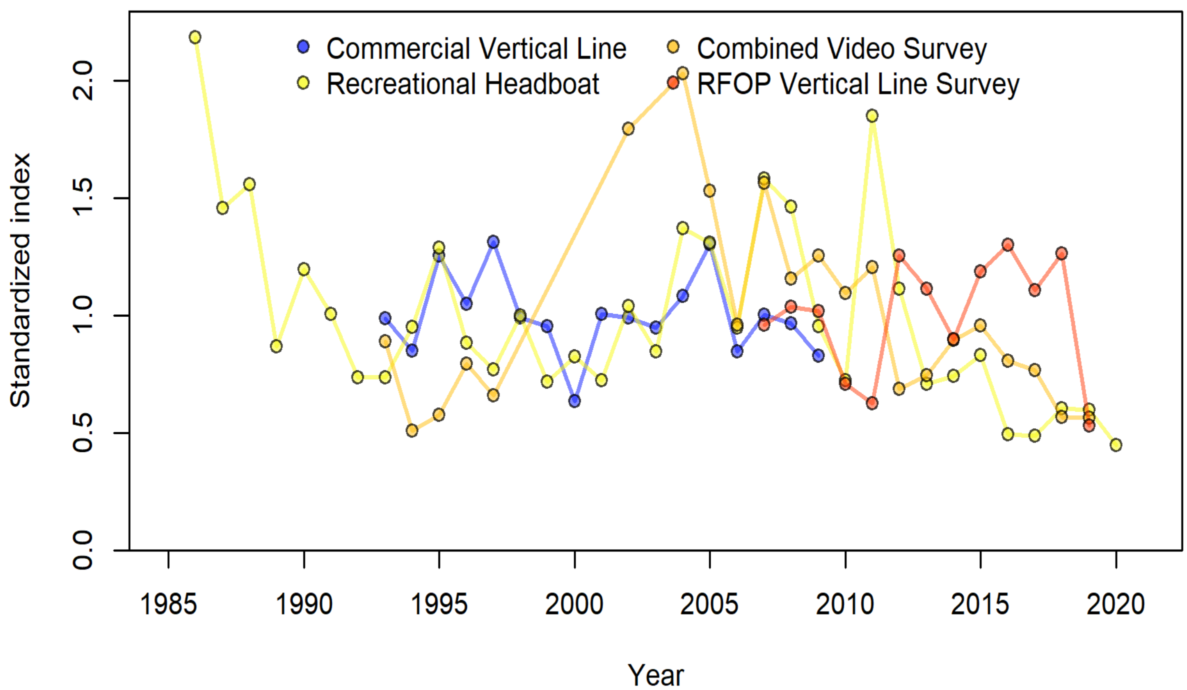


Figure 10. Standardized indices of relative abundance recommended for use during the SEDAR 68 Research Track Assessment for Gulf of Mexico Scamp. Each index has been rescaled to have a mean observation = 1.0. The RFOP Vertical Line Survey was treated as a survey in Stock Synthesis because it sampled both discarded and retained Scamp and was based on a statistically sound sampling approach.

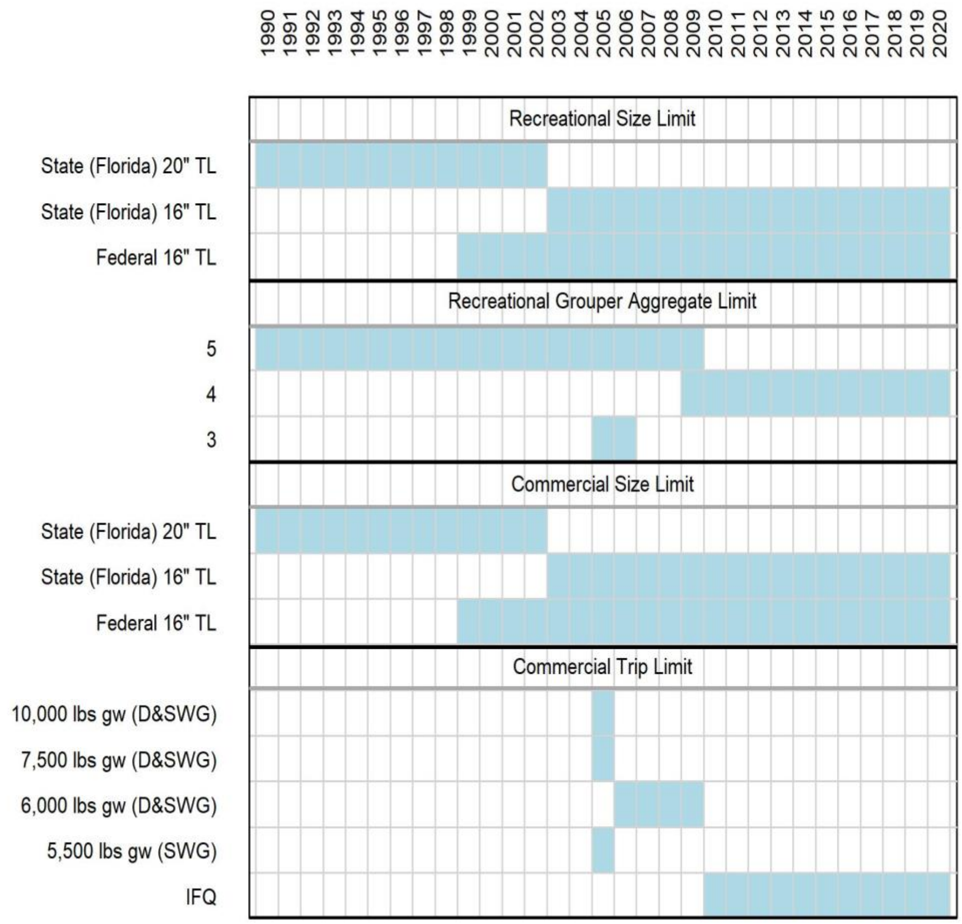


Figure 11. Summary of federal and relevant State (Florida) management regulations for Gulf of Mexico Scamp. Size limits shown are for inches total length (TL) and trip limits in pounds gutted weight (lbs gw) are shown for either shallow-water grouper (SWG) or deep and shallow-water grouper (D&SWG). IFQ refers to the implementation of the Grouper-Tilefish Individual Fishing Quota program. Not included are time or area closures.

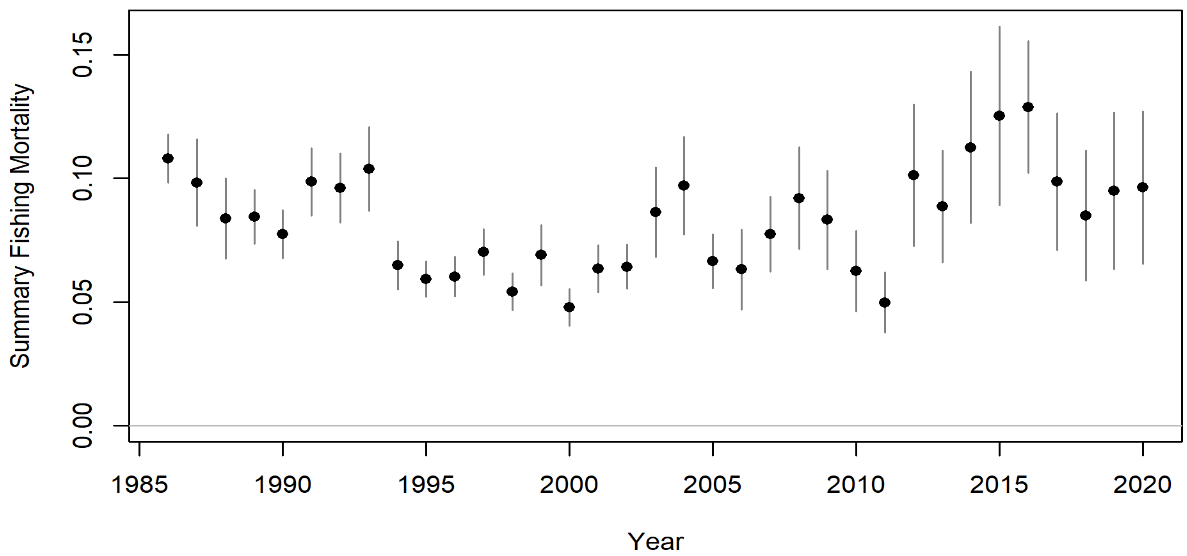


Figure 12. Annual exploitation rate estimates (total biomass killed all ages / total biomass age 3+) for Gulf of Mexico Scamp.

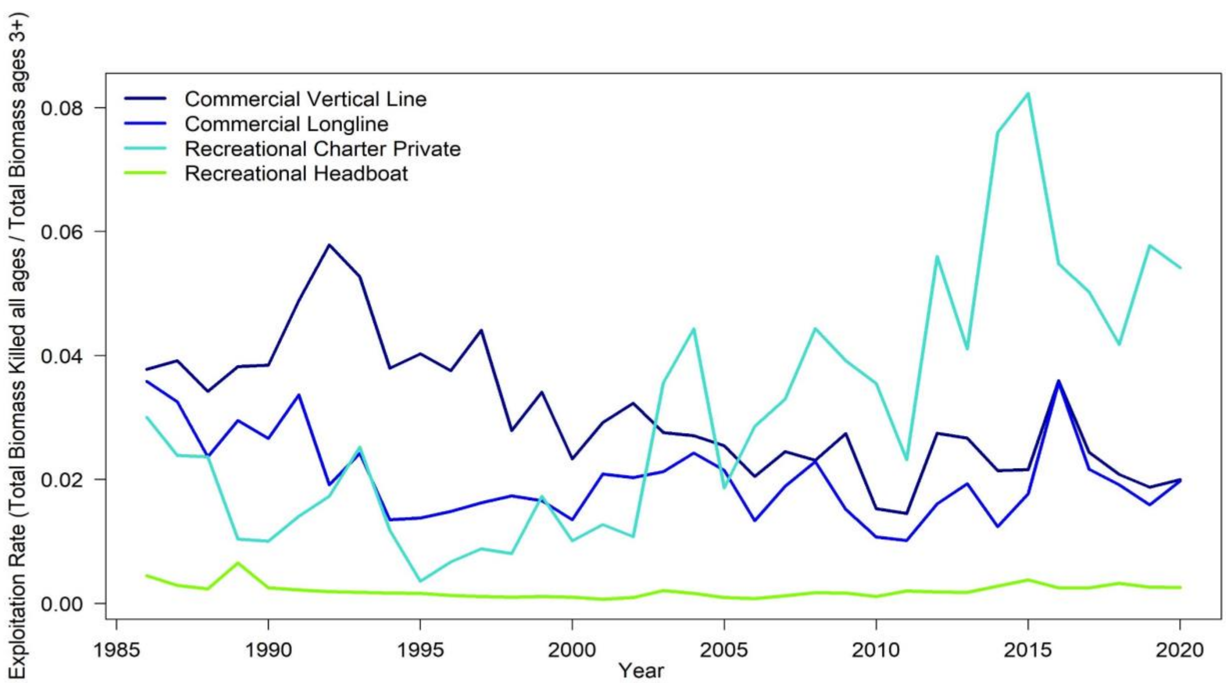


Figure 13. Annual exploitation rate estimates (total biomass killed all ages / total biomass age 3+) by fleet for Gulf of Mexico Scamp.

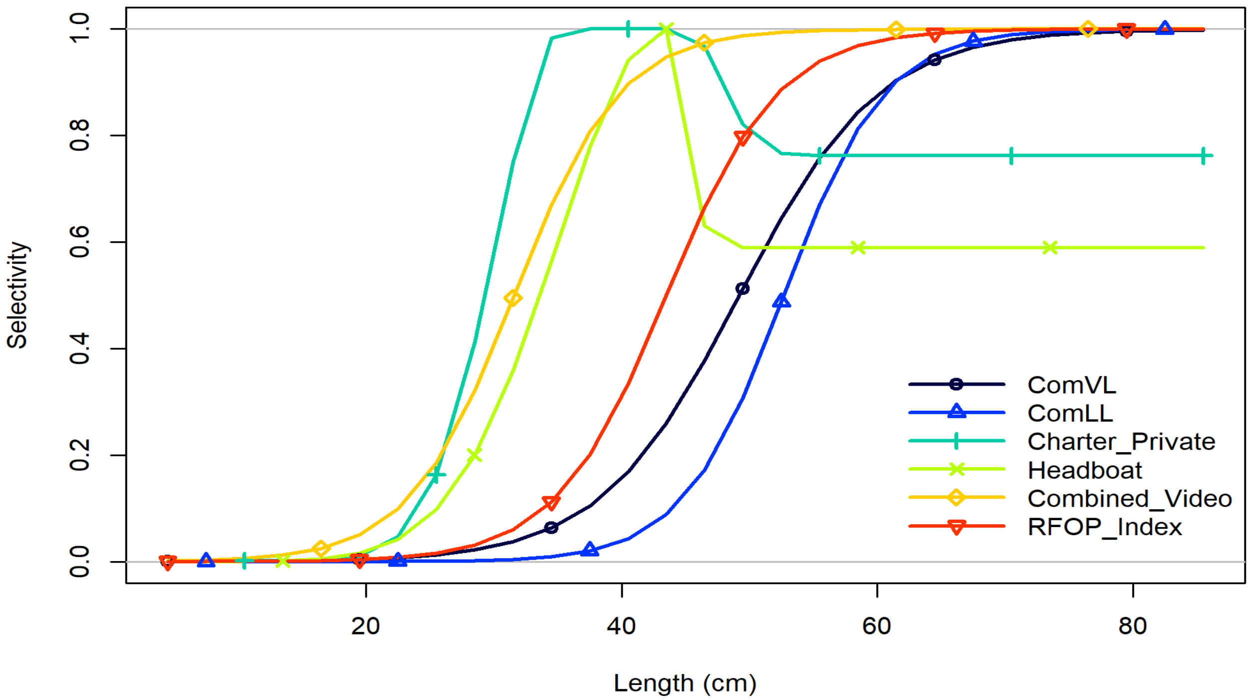


Figure 14. Length-based selectivity for each fleet and survey for Gulf of Mexico Scamp in the terminal year of the assessment, 2020.

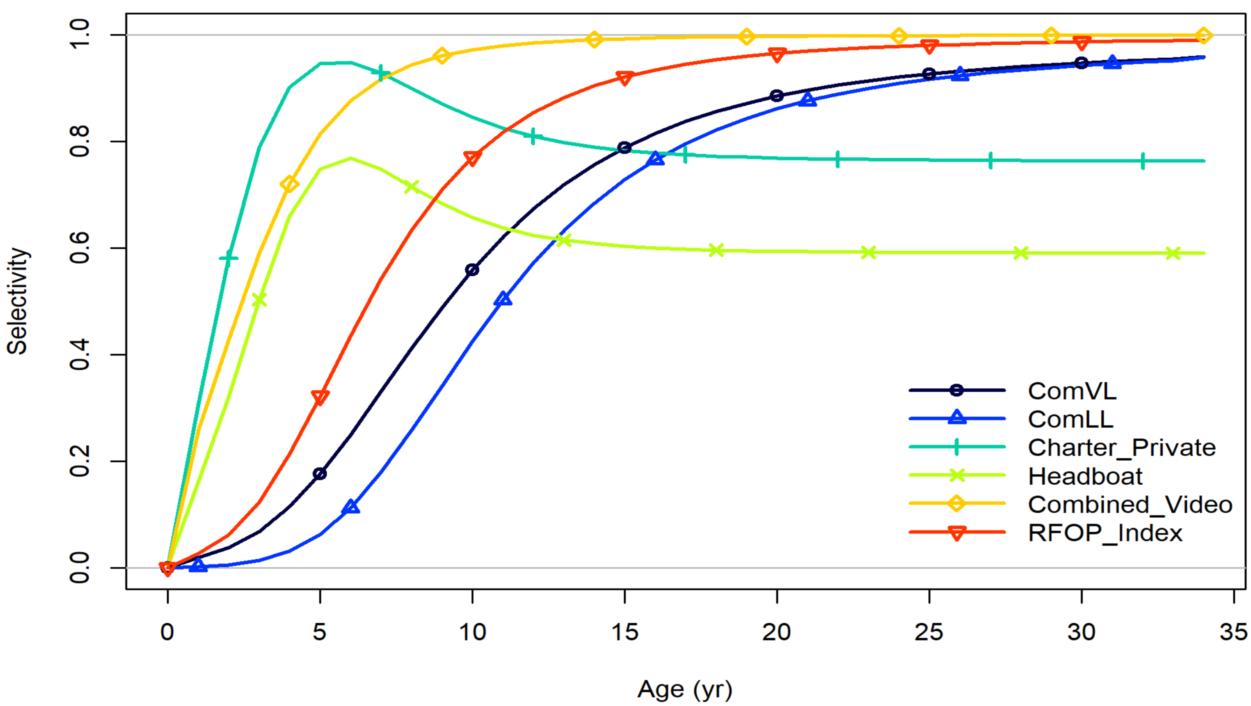


Figure 15. Derived age-based selectivity for each fleet and survey for Gulf of Mexico Scamp in the terminal year of the assessment, 2020.

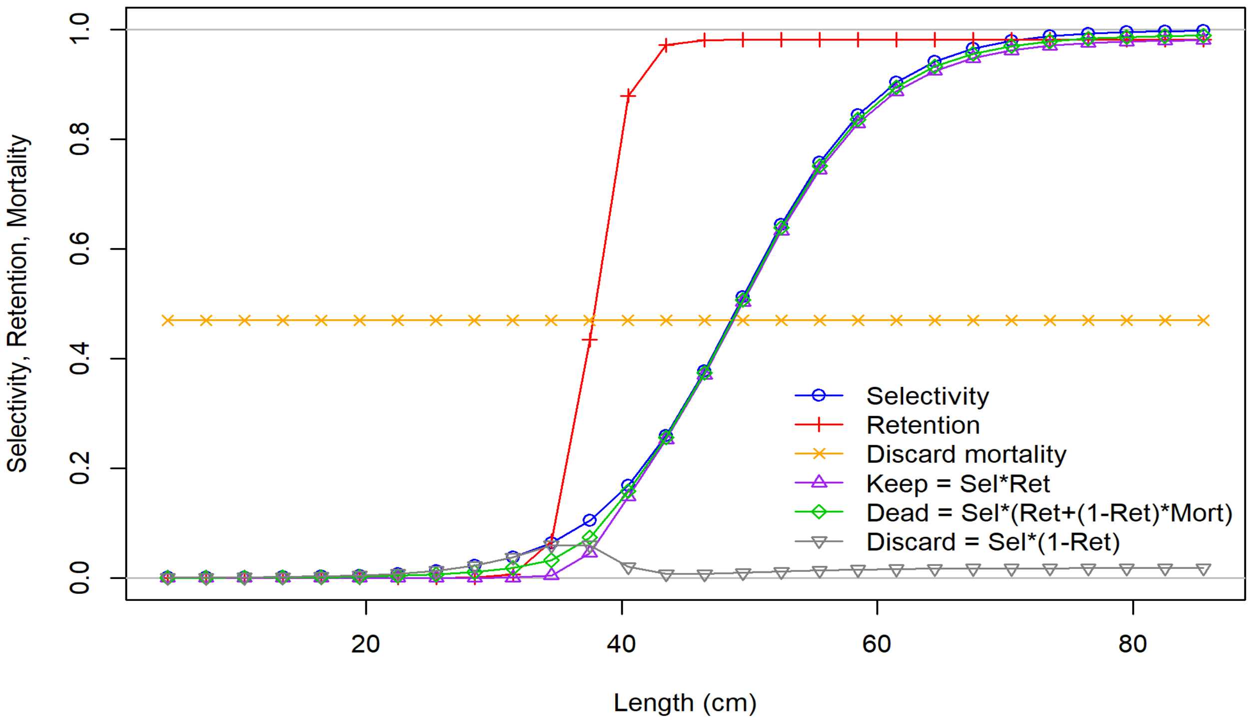
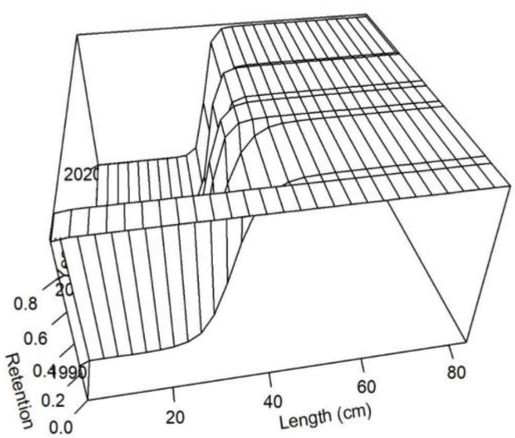


Figure 16. Length-based selectivity and retention for the Commercial Vertical Line fleet in the terminal year of the assessment, 2020. Selectivity (blue line) is constant over the entire assessment time period (1986-2020). Retention (red line) is shown for the most recent time period (2010-2020). Discard mortality (orange line) is constant at 0.47.



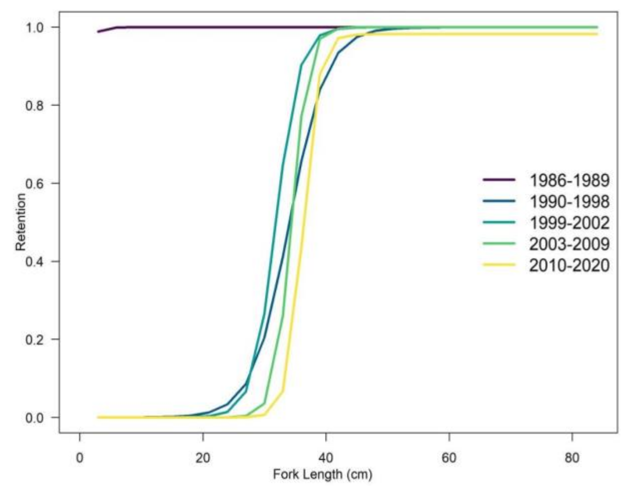


Figure 17. Time-varying retention at length for the Commercial Vertical Line fleet for Gulf of Mexico Scamp.

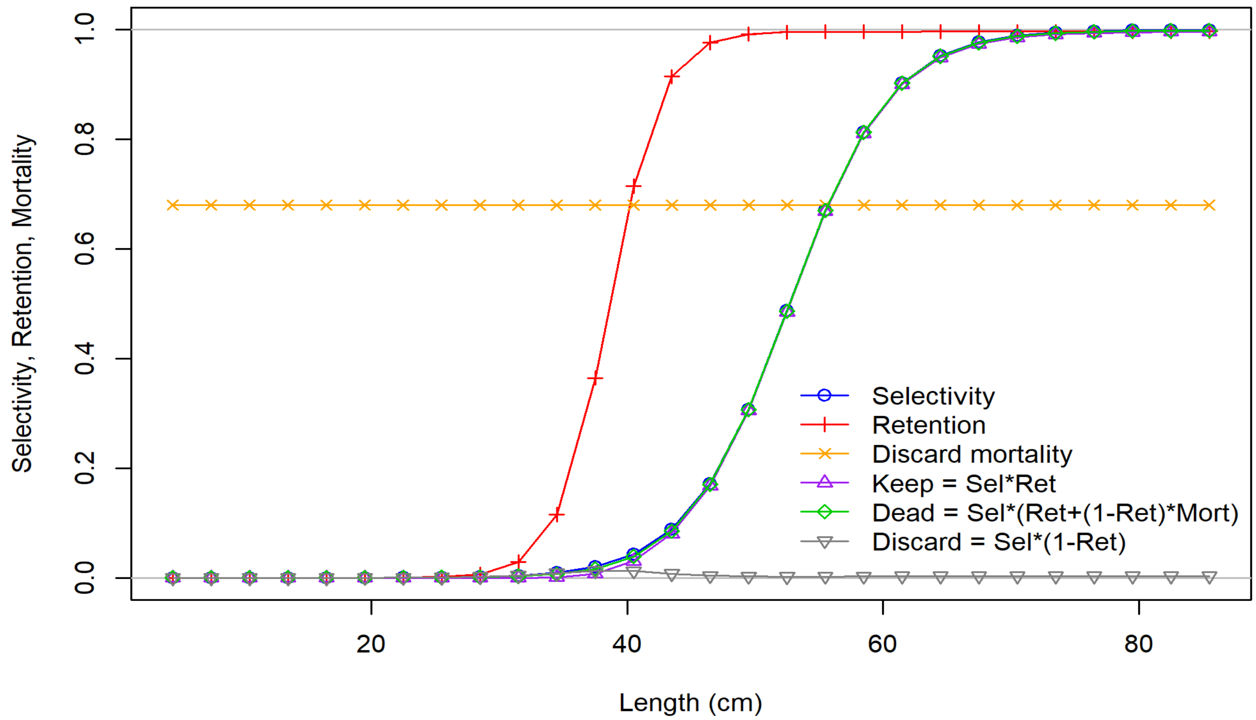


Figure 18. Length-based selectivity and retention for the Commercial Longline fleet in the terminal year of the assessment, 2020. Selectivity (blue line) is constant over the entire assessment time period (1986-2020). Retention (red line) is shown for the most recent time period (2010-2020). Discard mortality (orange line) is constant at 0.68.

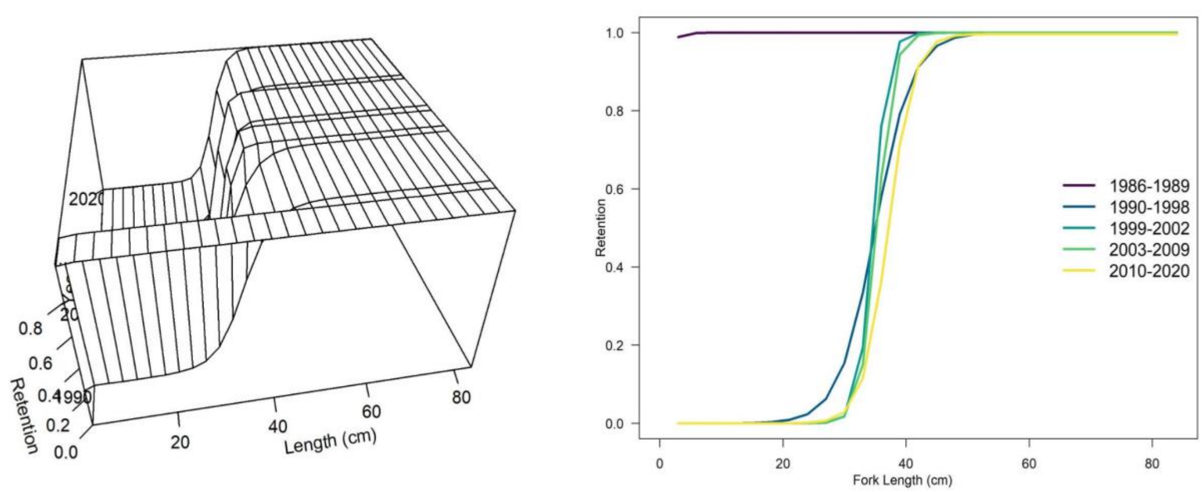


Figure 19. Time-varying retention at length for the Commercial Longline fleet for Gulf of Mexico Scamp.

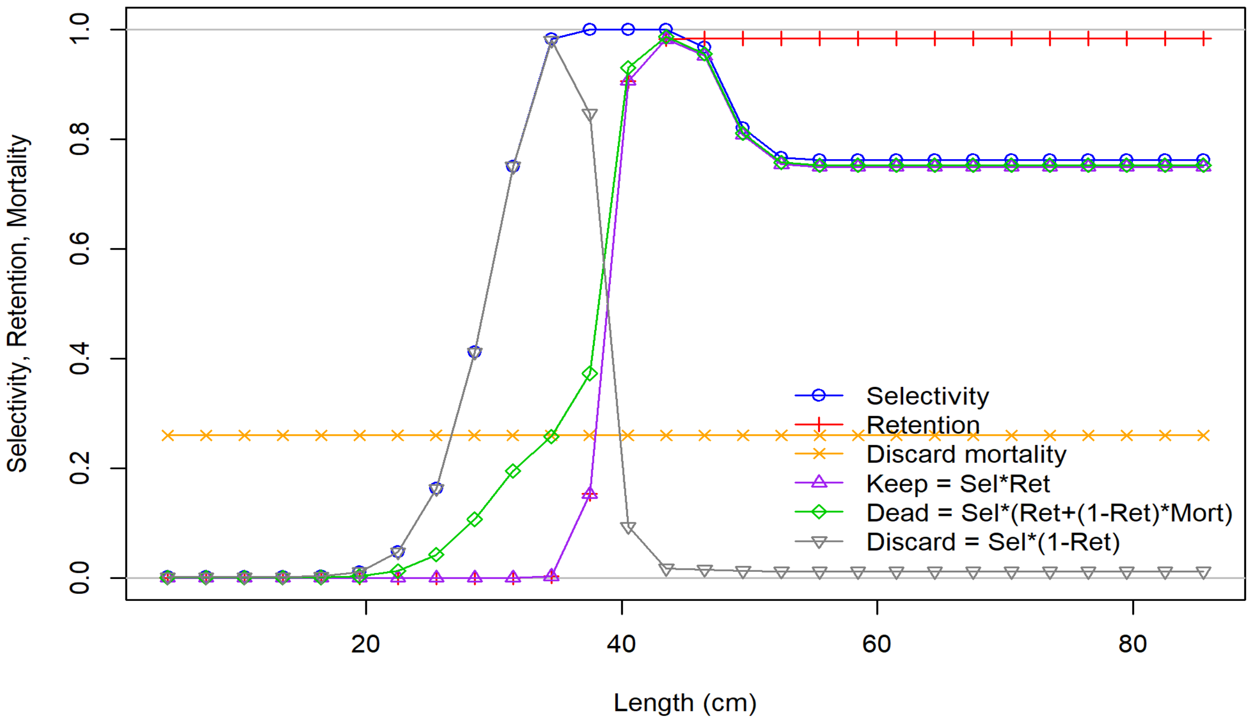


Figure 20. Length-based selectivity and retention for the Recreational Charter Private fleet in the terminal year of the assessment, 2020. Selectivity (blue line) is constant over the entire assessment time period (1986-2020). Retention (red line) is shown for the most recent time period (2003-2020). Discard mortality (orange line) is constant at 0.26.

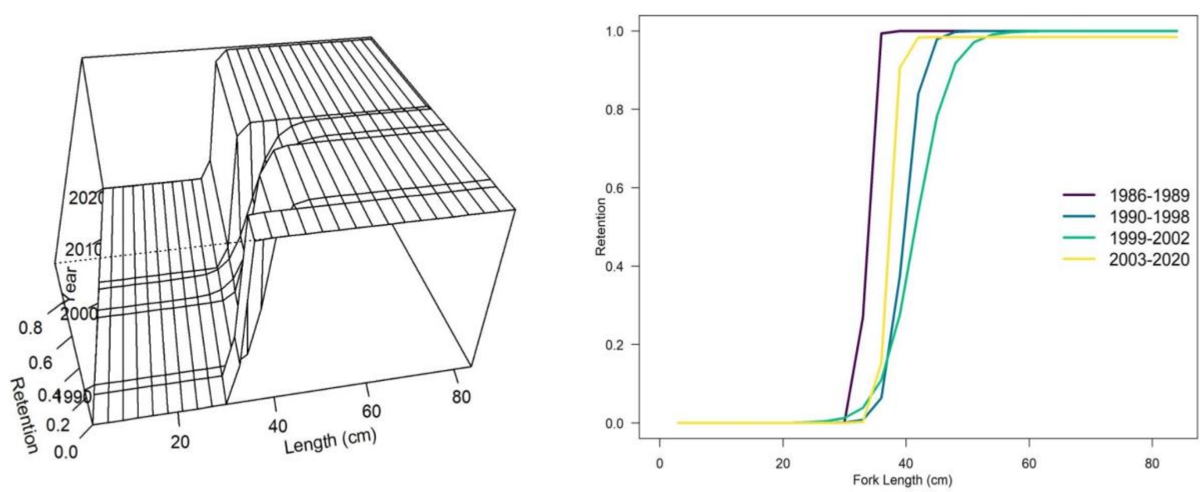


Figure 21. Time-varying retention at length for the Recreational Charter Private fleet for Gulf of Mexico Scamp.

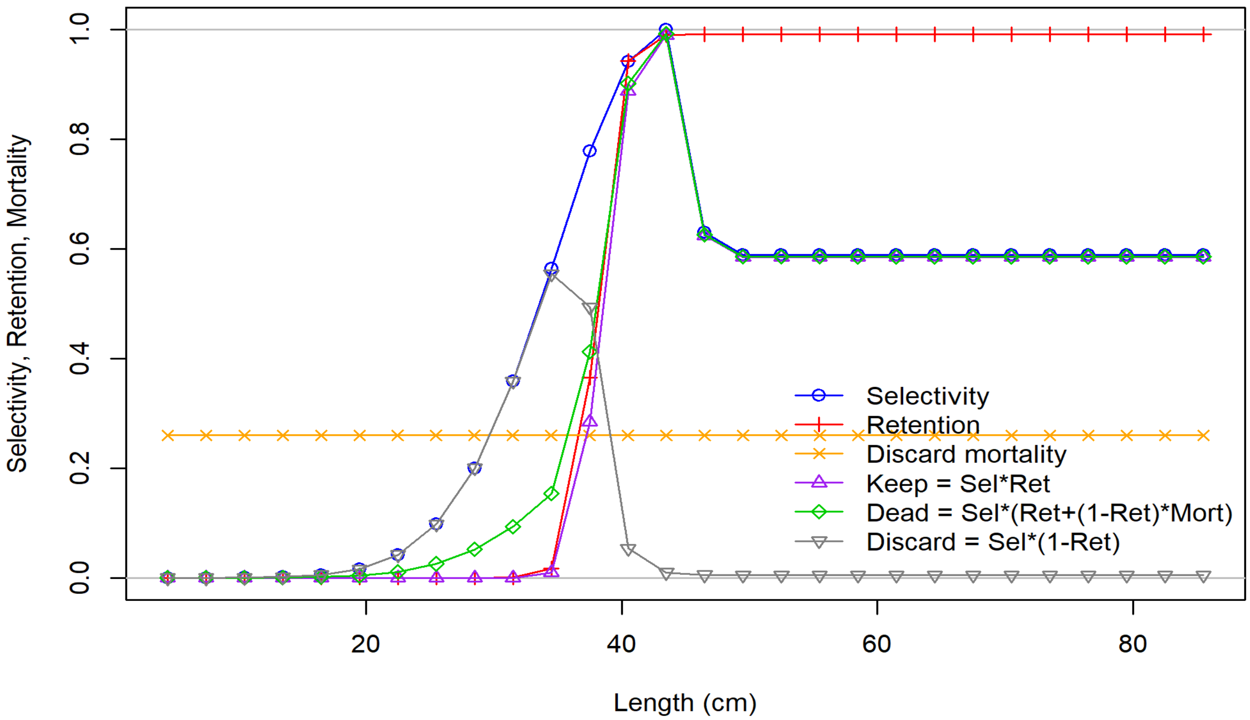


Figure 22. Length-based selectivity and retention for the Recreational Headboat fleet in the terminal year of the assessment, 2020. Selectivity (blue line) is constant over the entire assessment time period (1986-2020). Retention (red line) is shown for the most recent time period (2003-2020). Discard mortality (orange line) is constant at 0.26.

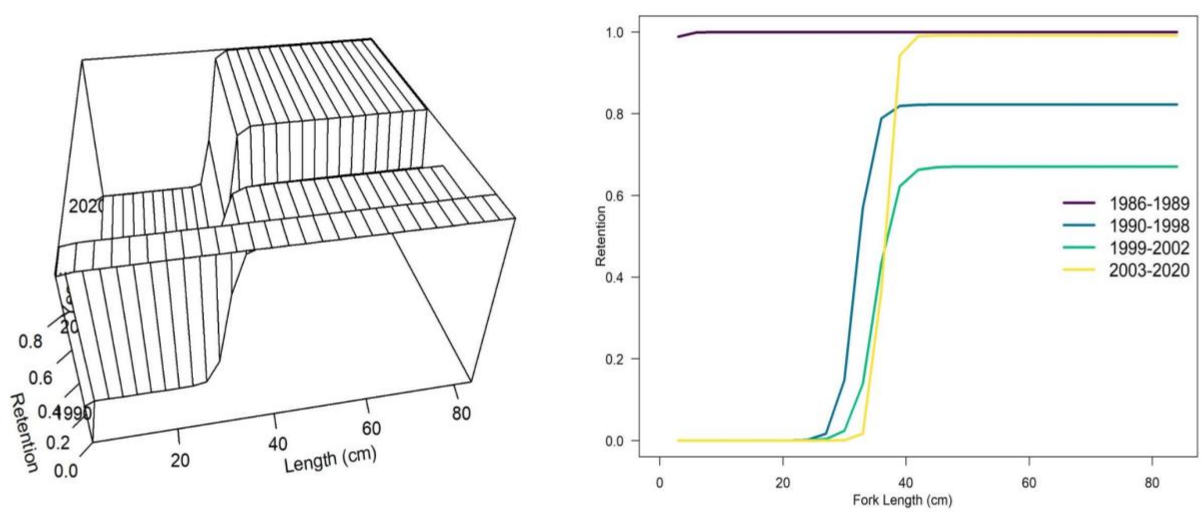


Figure 23. Time-varying retention at length for the Recreational Headboat fleet for Gulf of Mexico Scamp.

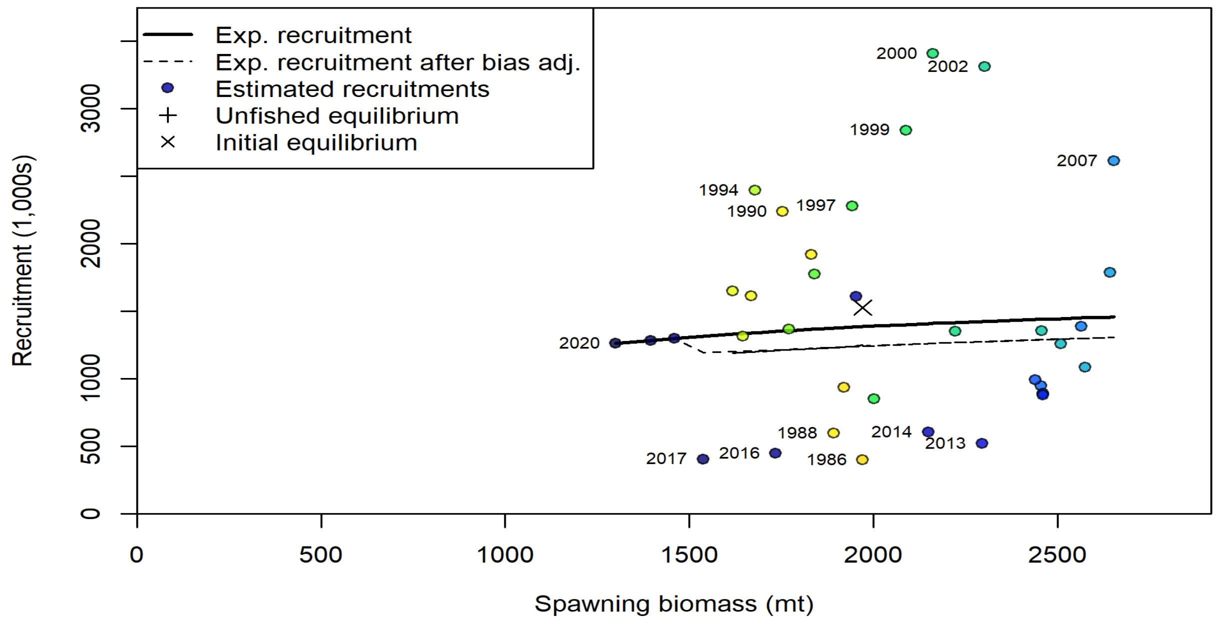


Figure 24. Expected stock-recruitment relationship for Gulf of Mexico Scamp. Steepness was fixed at 0.694 and sigmaR was estimated at 0.562. Plotted are expected annual recruitments from Stock Synthesis (circles), expected recruitment from the stock-recruit relationship (black line), and bias adjusted recruitment from the stock-recruit relationship (dashed line).

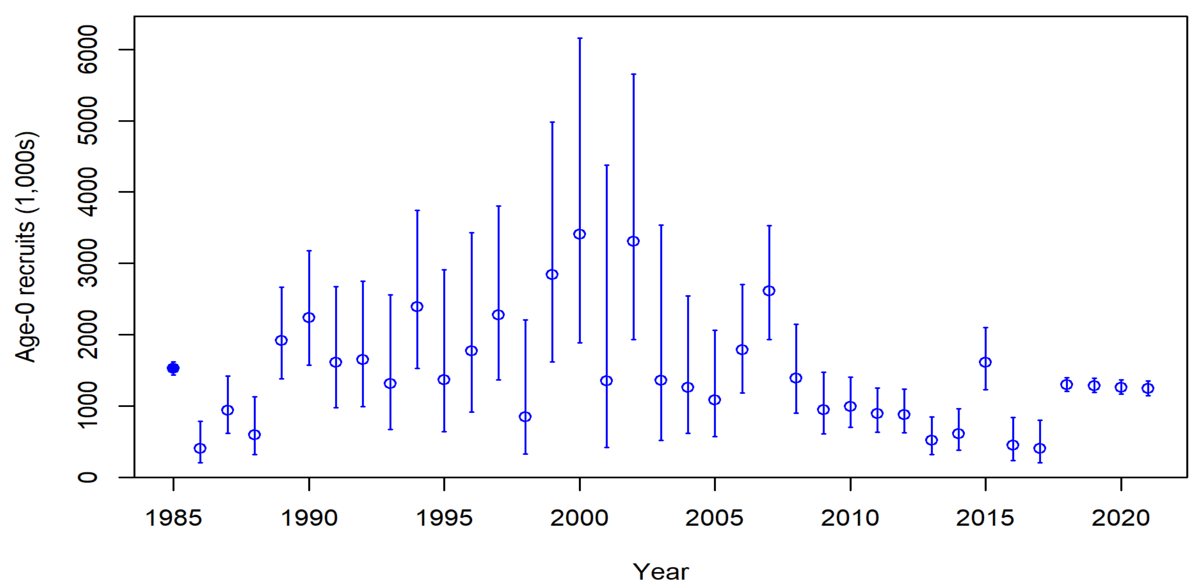


Figure 25. Estimated Age-0 recruitment with 95% confidence intervals for Gulf of Mexico Scamp. Steepness was fixed at 0.694 and sigmaR was estimated at 0.562.

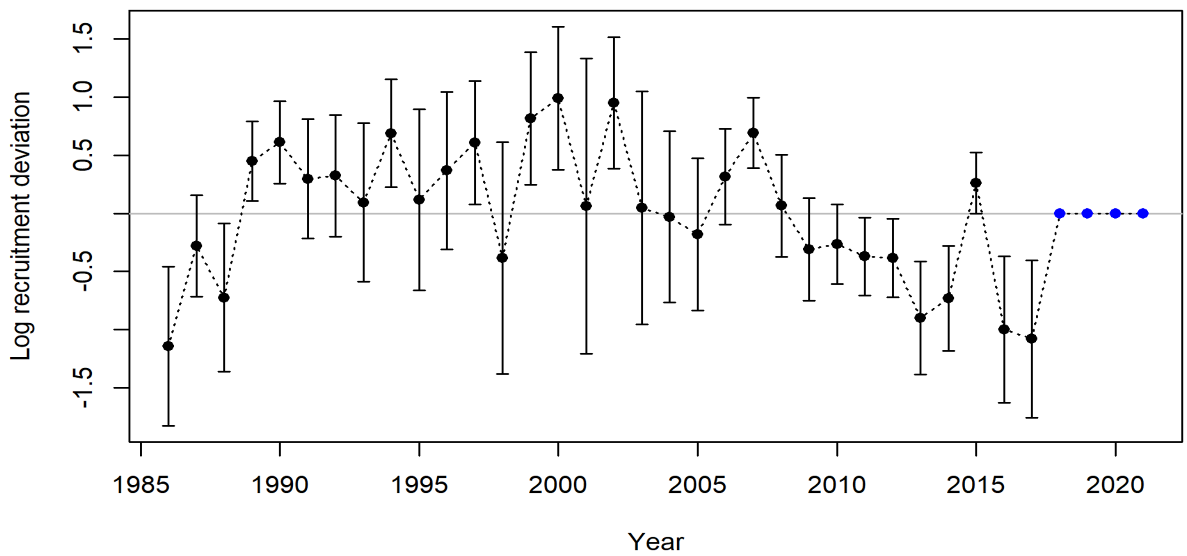


Figure 26. Estimated log-scale recruitment deviations with 95% confidence intervals for Gulf of Mexico Scamp. Steepness was fixed at 0.694 and sigmaR was estimated at 0.562.

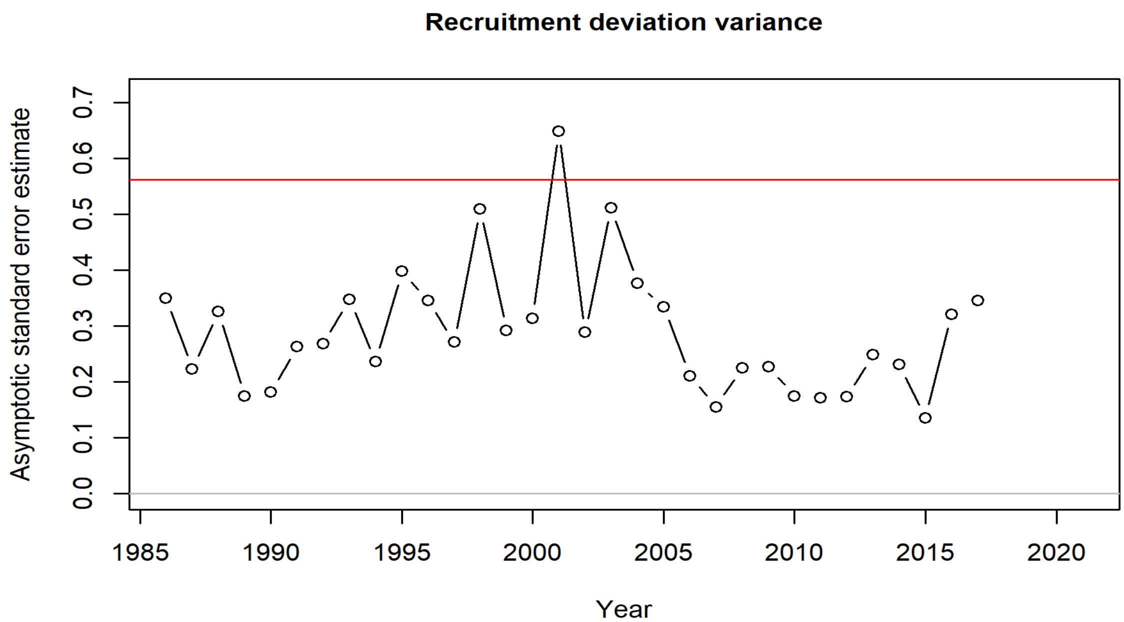


Figure 27. Asymptotic standard errors for recruitment deviations for Gulf of Mexico Scamp. Steepness was fixed at 0.694 and sigmaR was estimated at 0.562 (red line).

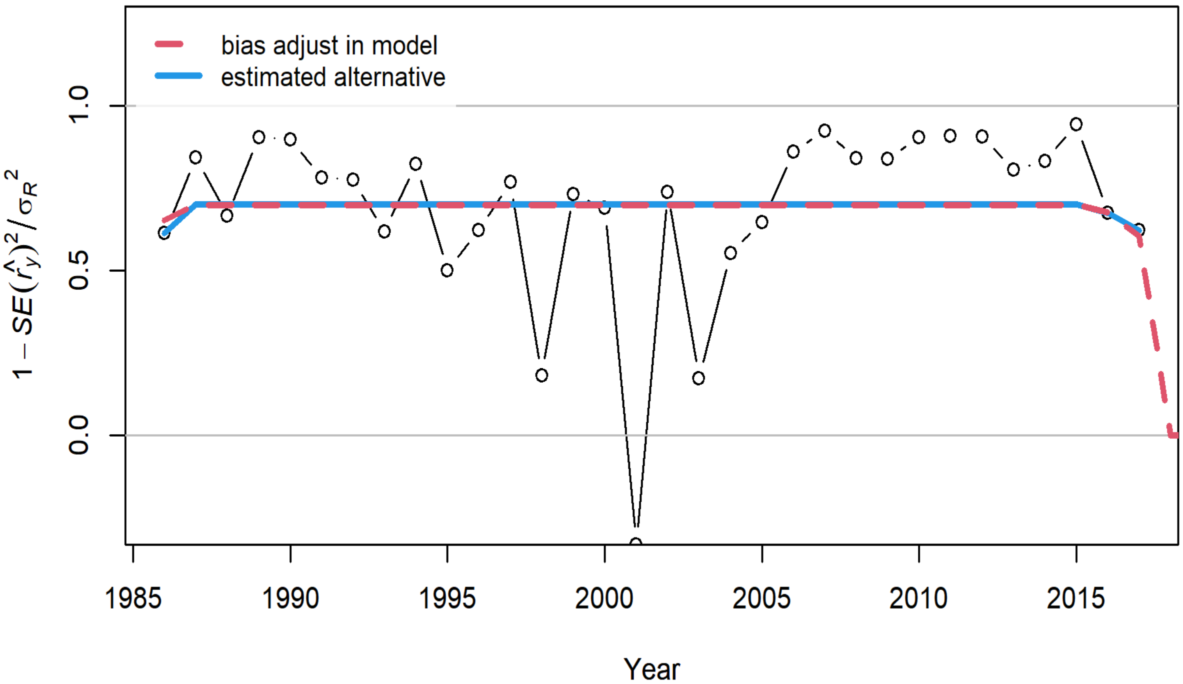


Figure 28. Points are transformed variances. Red line shows current settings for bias adjustment specified for the Base Run, which coincides with the least squares estimate of alternative bias adjustment relationship for recruitment deviations (dashed red line). For more information, see Methot and Taylor (2011).

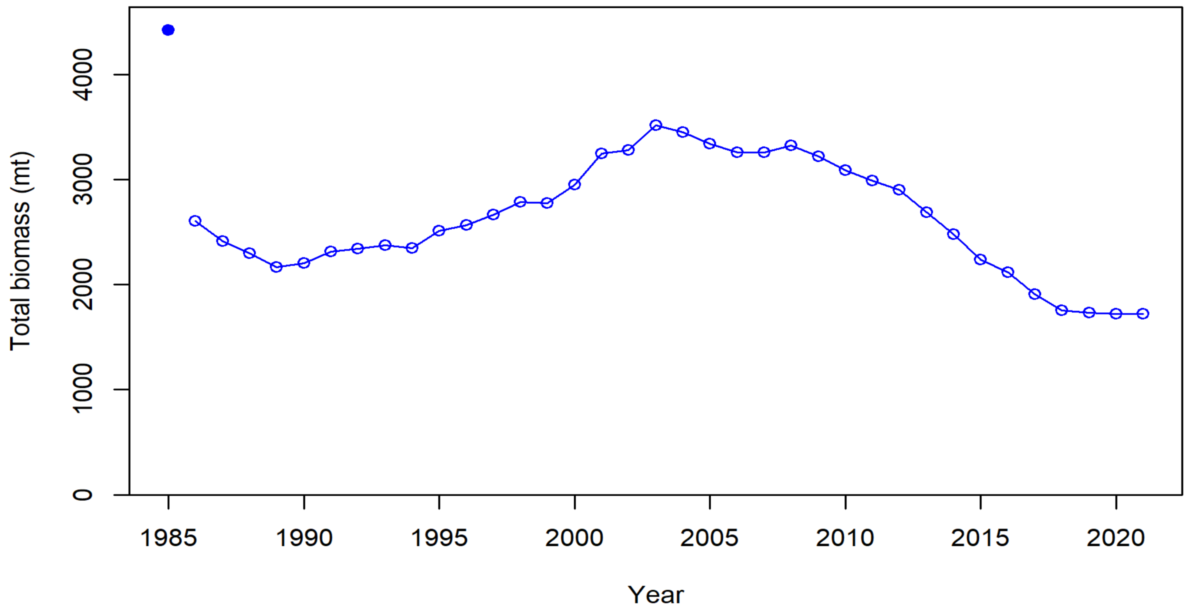


Figure 29. Estimate of total biomass (metric tons) for Gulf of Mexico Scamp.

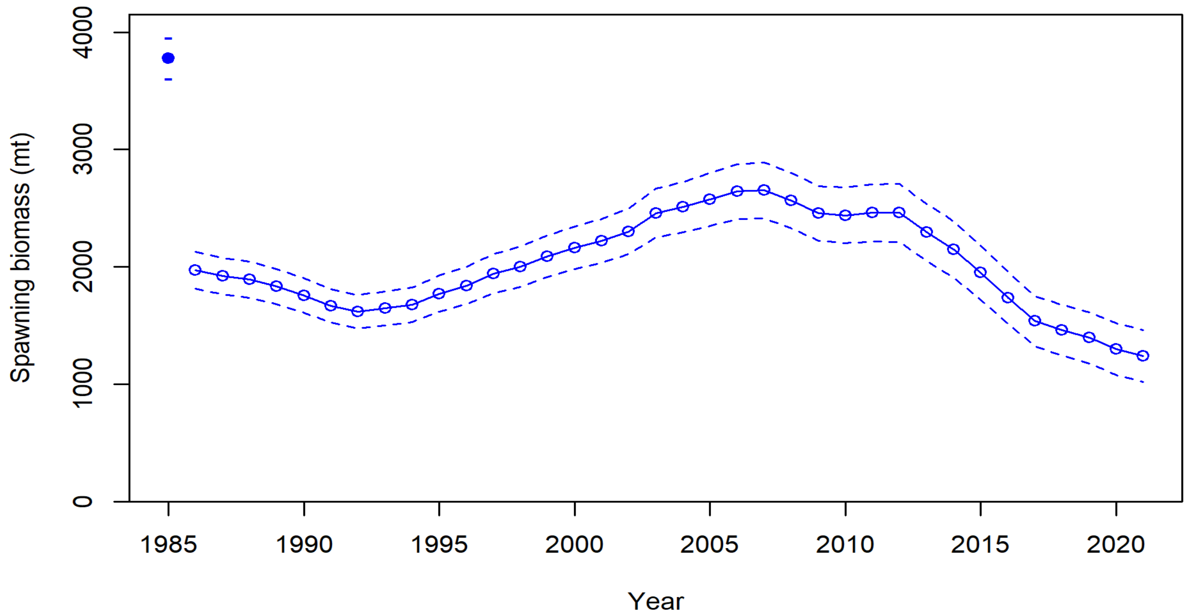
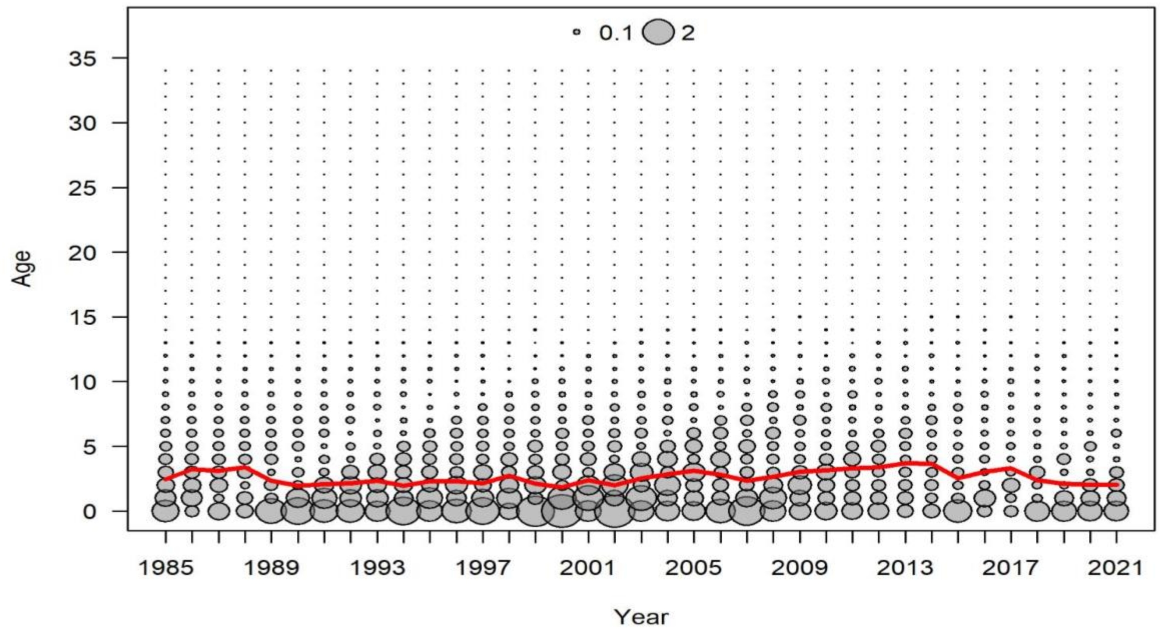


Figure 30. Estimate of spawning stock biomass (metric tons) with 95% confidence intervals for Gulf of Mexico Scamp. SSB defined as male and female combined SSB.



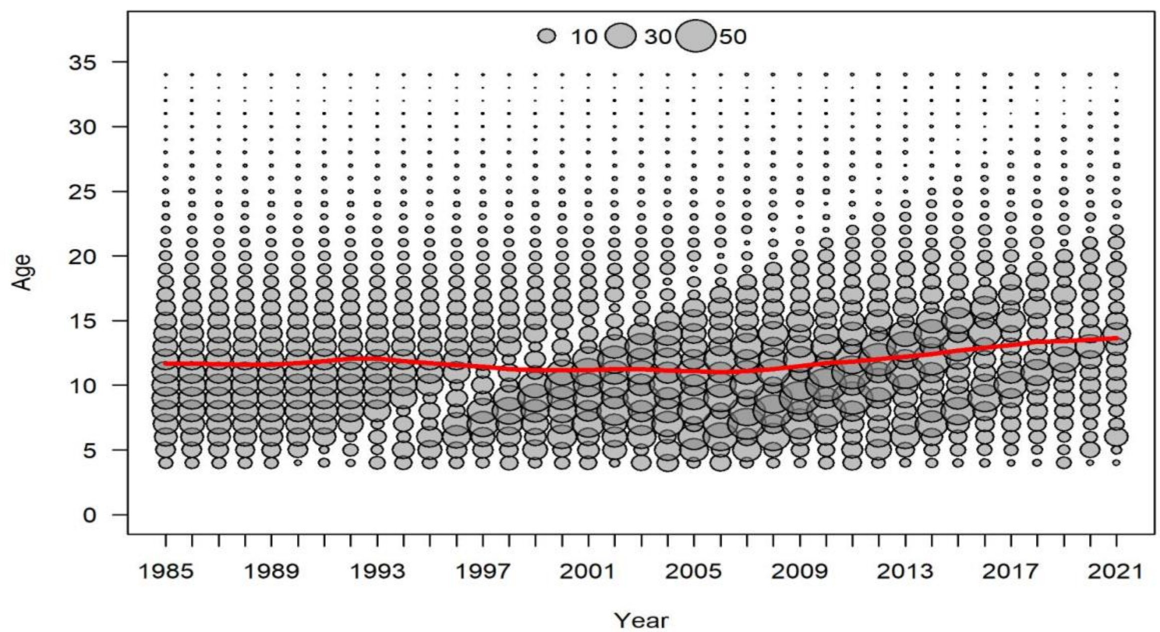


Figure 31. Expected numbers-at-age (bubbles) and mean age (red line) of female (top; millions of fish) and male (bottom; thousands of fish) Gulf of Mexico Scamp.

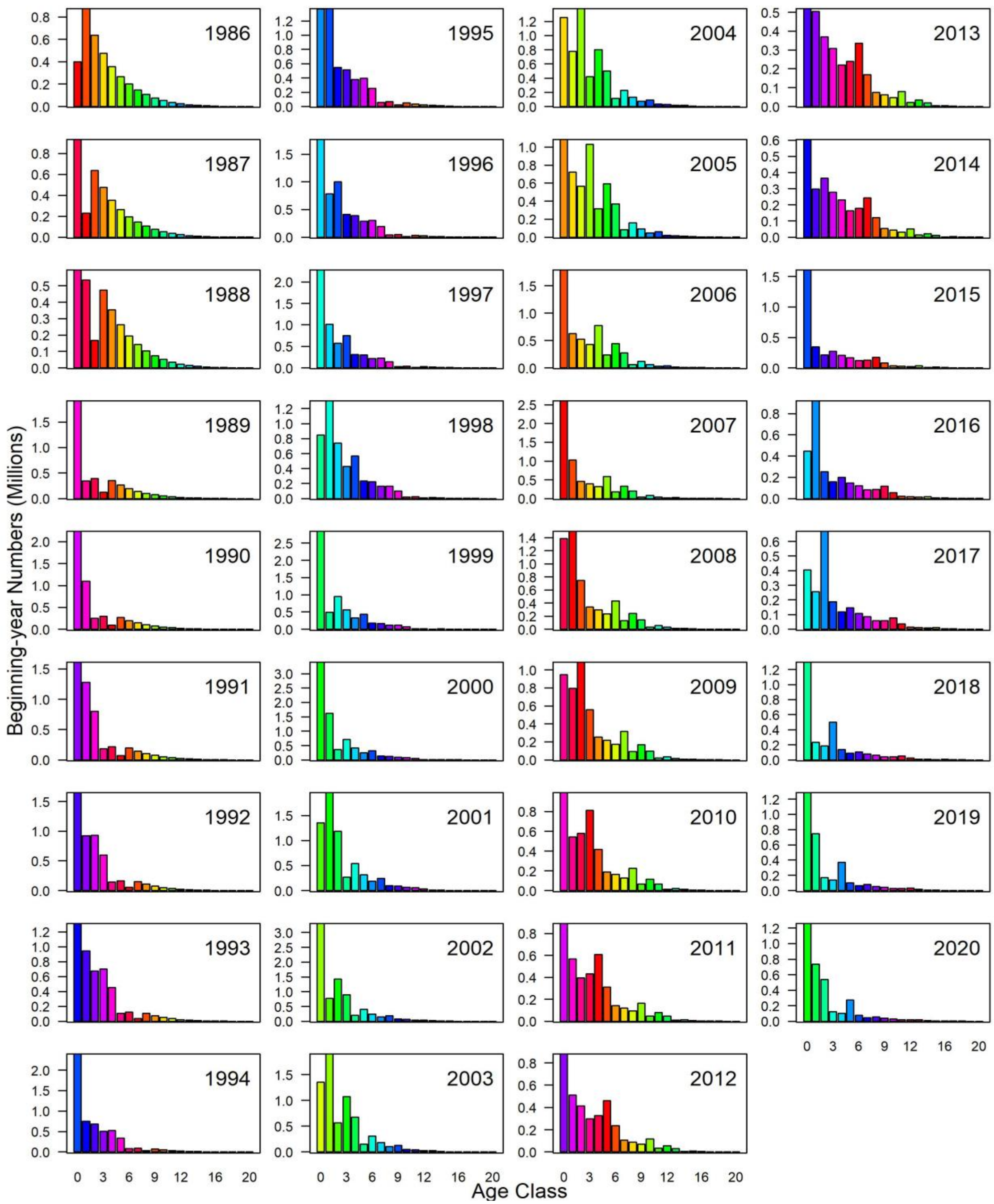


Figure 32. Expected numbers-at-age (millions) at the beginning of each year (January 1st) for female Scamp in the Gulf of Mexico. Note that y-axes differ between panels and colors track cohorts across years.

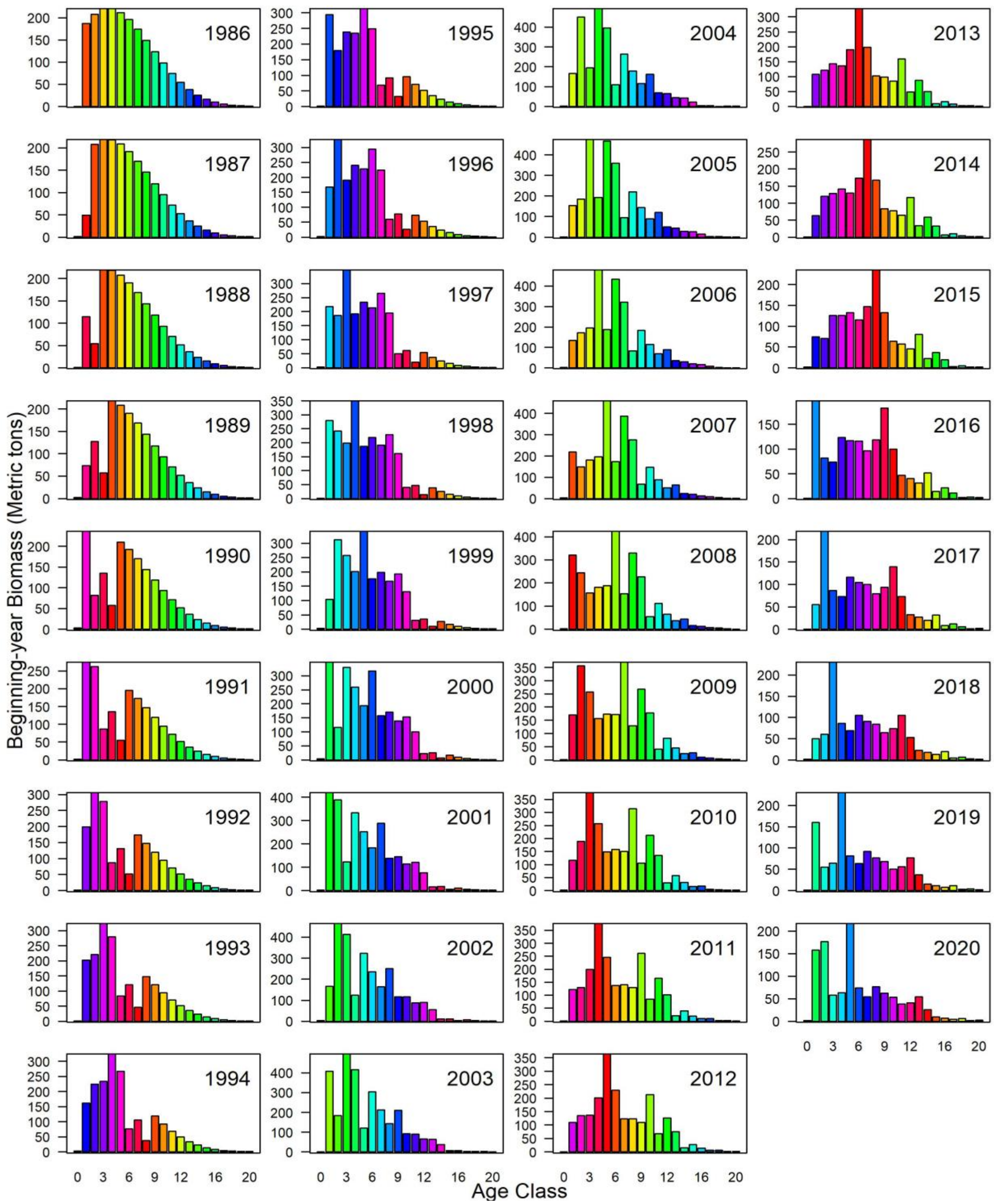


Figure 33. Expected biomass-at-age (metric tons) at the beginning of each year (January 1st) for female Scamp in the Gulf of Mexico. Note that y-axes differ between panels and colors track cohorts across years.

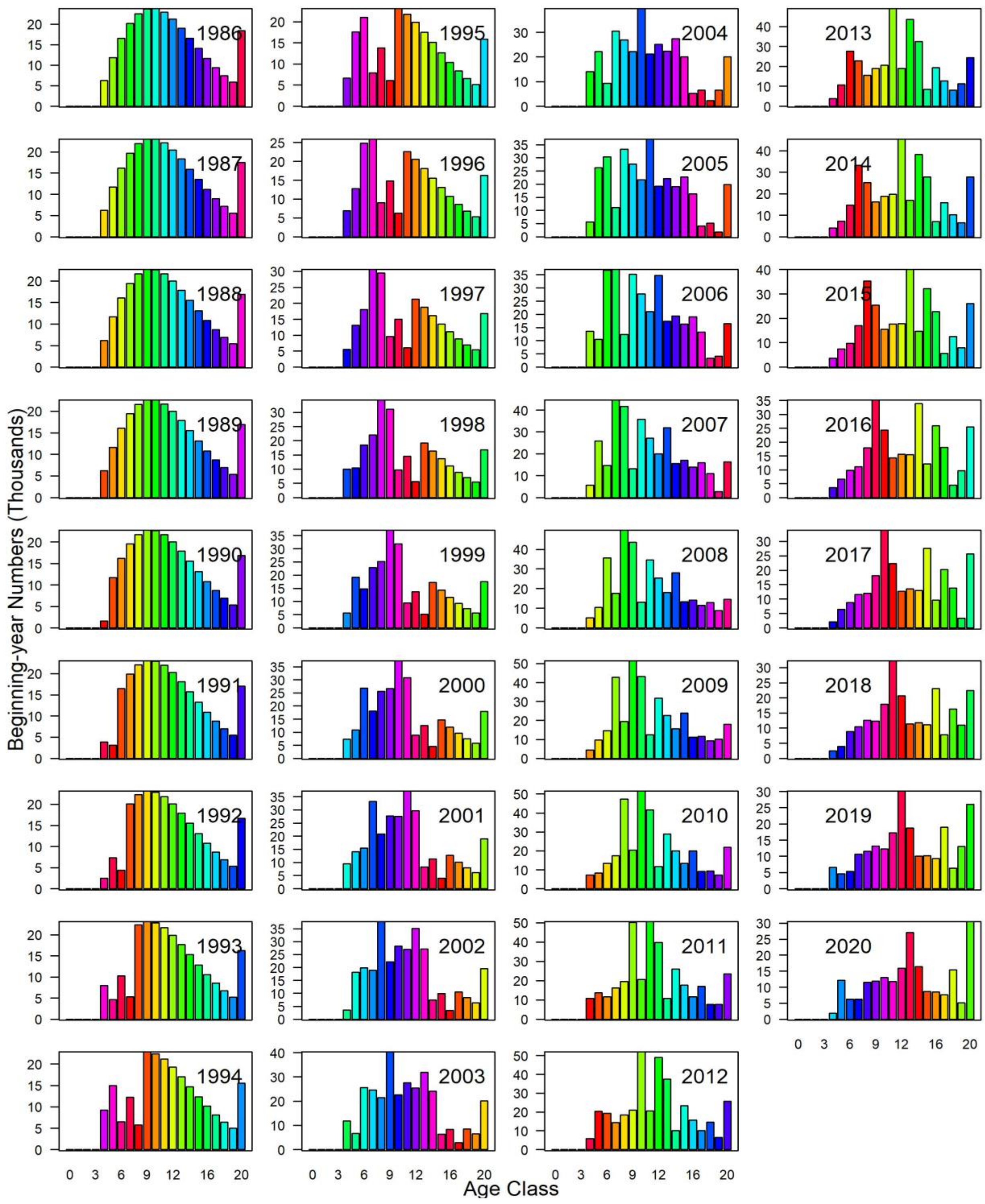


Figure 34. Expected numbers-at-age (thousands) at the beginning of each year (January 1st) for male Scamp in the Gulf of Mexico. Note that y-axes differ between panels and colors track cohorts across years.

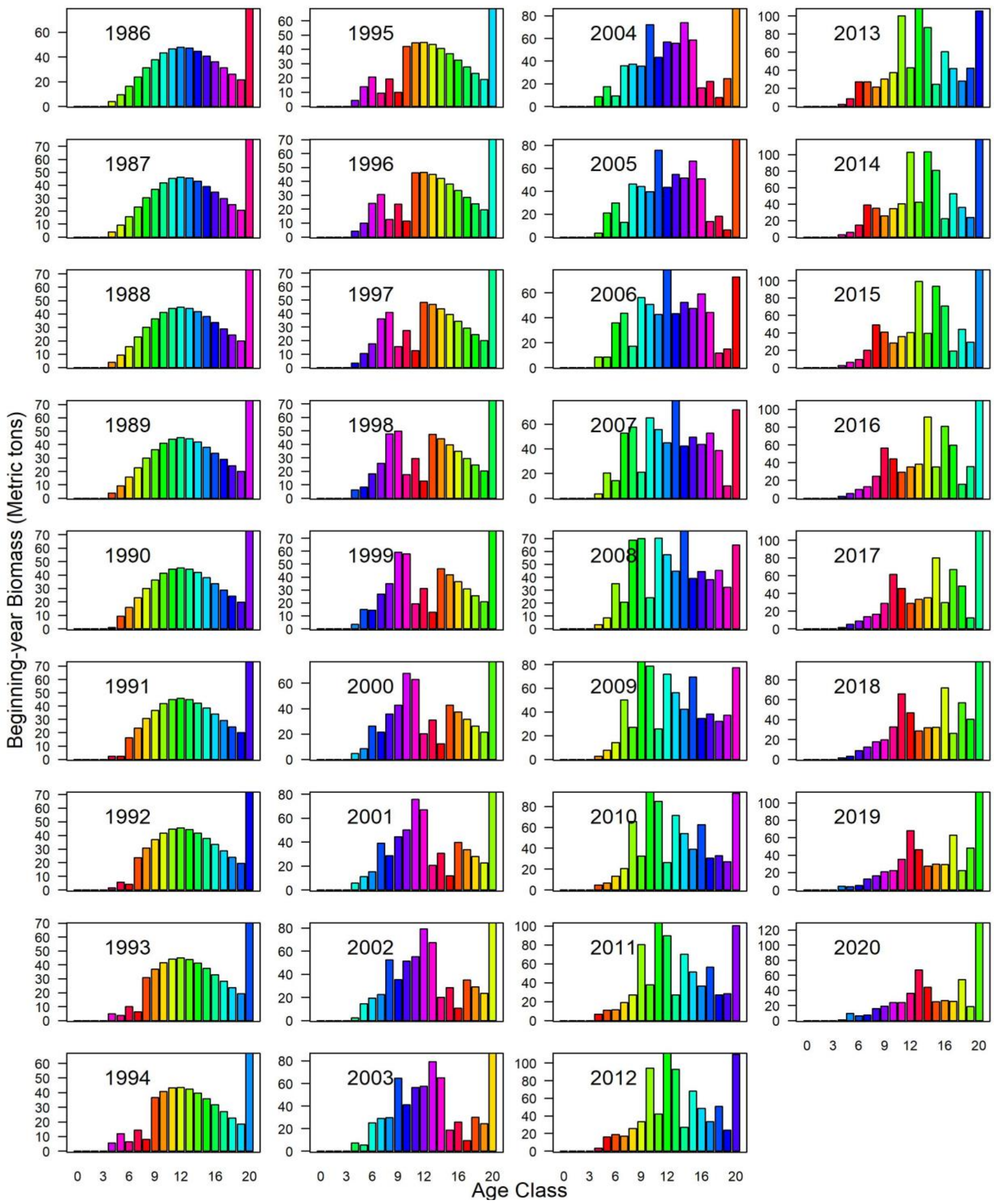


Figure 35. Expected biomass-at-age (metric tons) at the beginning of each year (January 1st) for male Scamp in the Gulf of Mexico. Note that y-axes differ between panels and colors track cohorts across years.

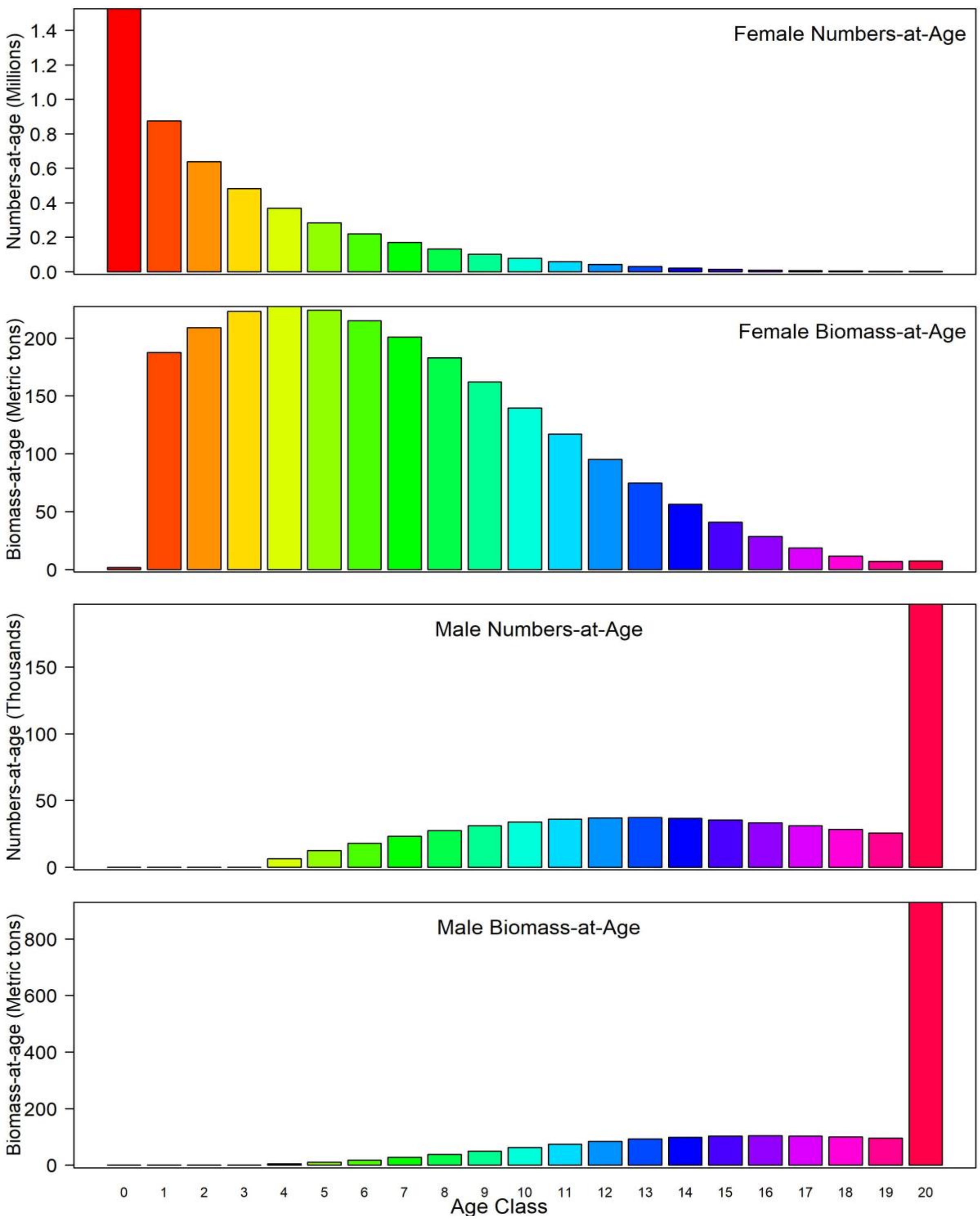


Figure 36. Expected numbers-at-age and biomass-at-age for female and male Scamp in the Gulf of Mexico at virgin stock conditions.

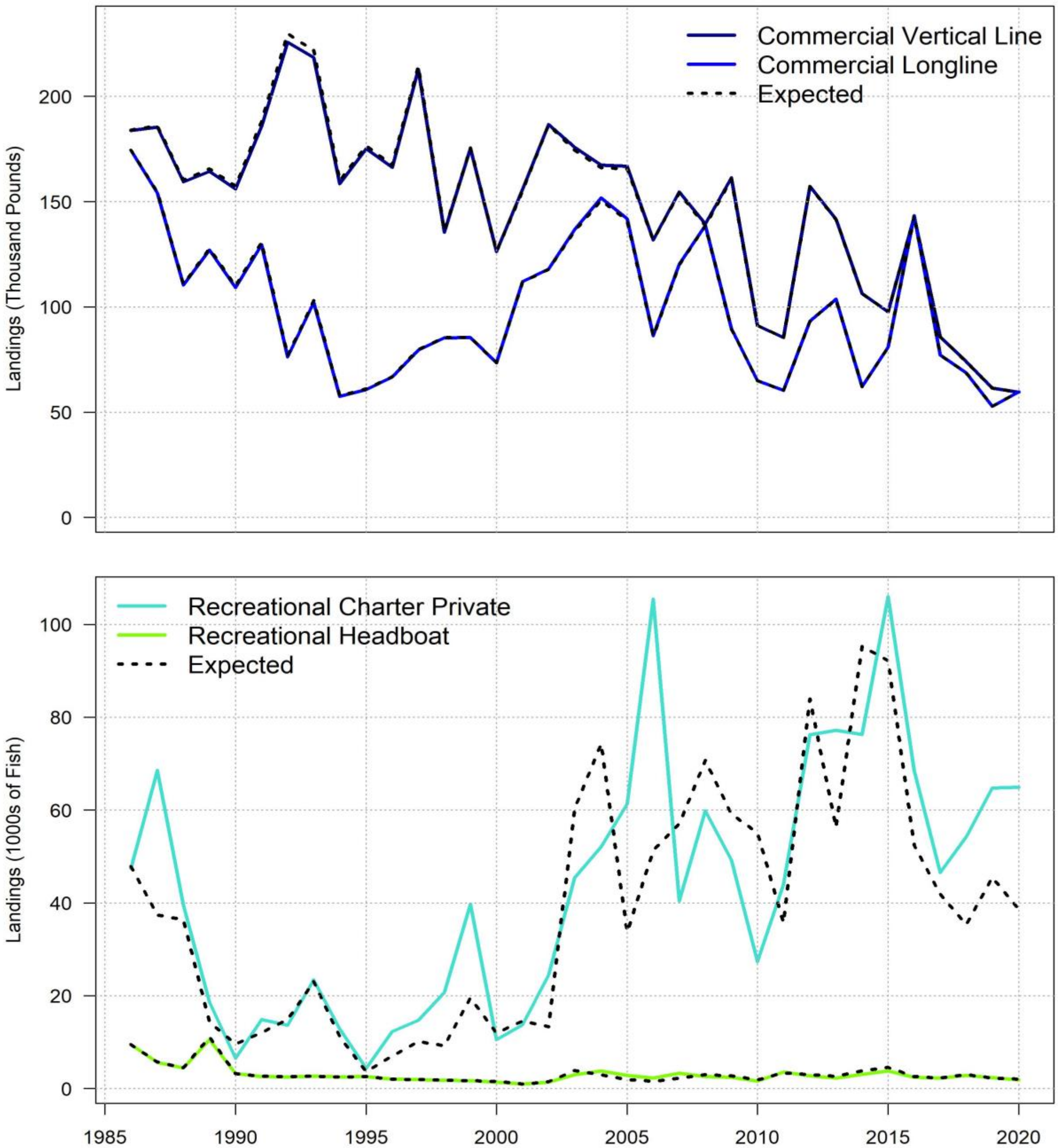


Figure 37. Gulf of Mexico Scamp observed (thick colored lines) and expected (dashed lines) landings by fleet. Commercial landings were input into the stock assessment model as metric tons in gutted weight, and are shown in thousands of pounds. Recreational landings were input into the stock assessment model as numbers (1,000 of fish). Associated log-scale standard errors are provided in ***Tables 17-20****.*

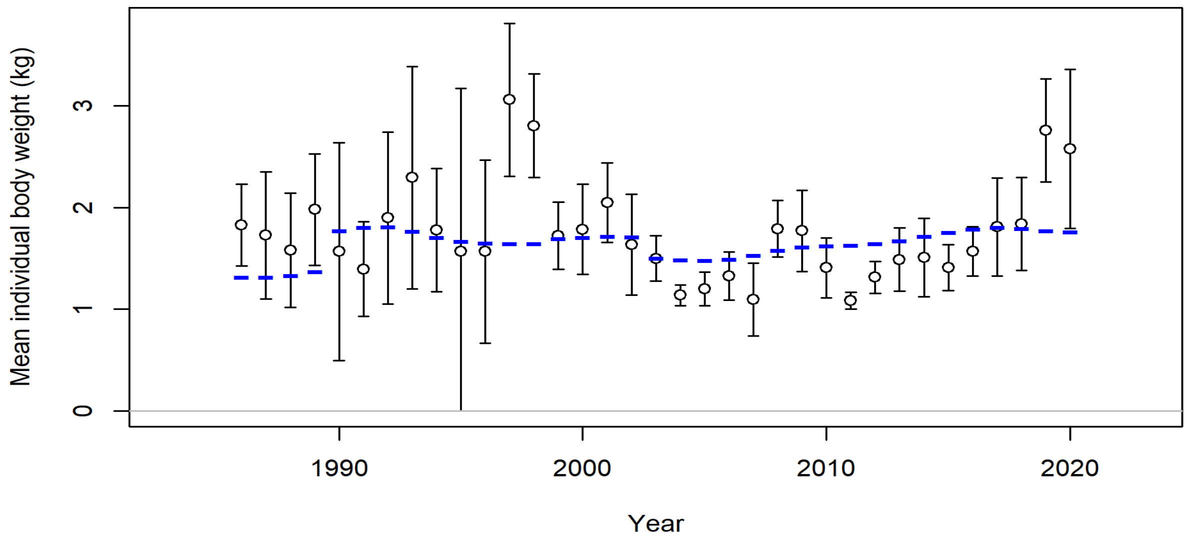


Figure 38. Input (dots with 95% confidence intervals) and expected (blue dashes) mean weight (kg, gutted weight) of Scamp landed by the Recreational Charter Private fleet in the Gulf of Mexico.

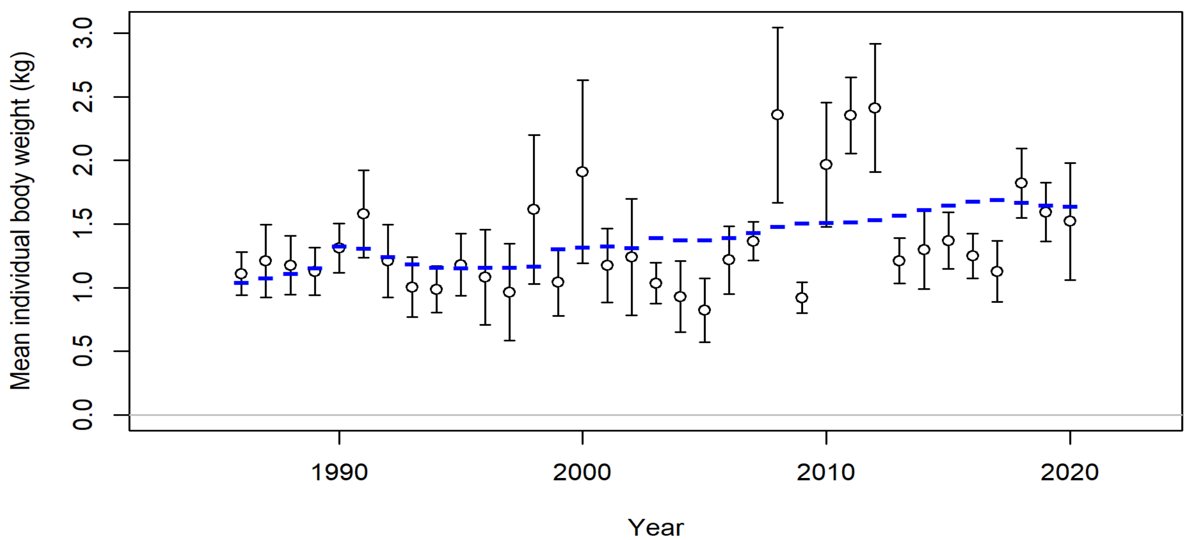


Figure 39. Input (dots with 95% confidence intervals) and expected (blue dashes) mean weight (kg, gutted weight) of Scamp landed by the Recreational Headboat fleet in the Gulf of Mexico.

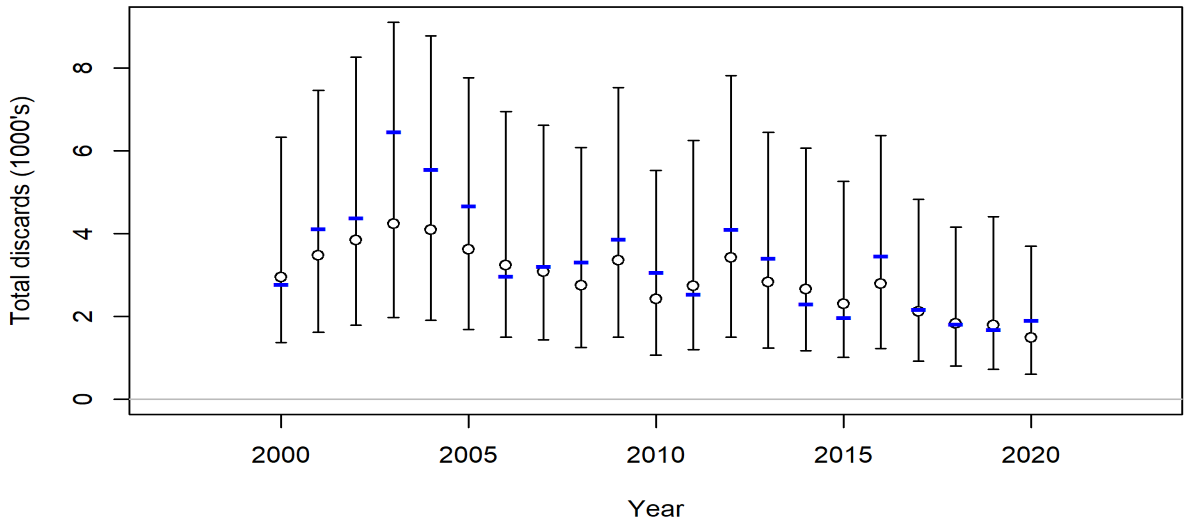


Figure 40. Observed (dots with 95% confidence intervals) and expected (blue lines) discards by the Commercial Vertical Line fleet for Gulf of Mexico Scamp. Discards are in numbers of fish (1,000s) and reflect released fish (i.e., before discard mortality has been applied).

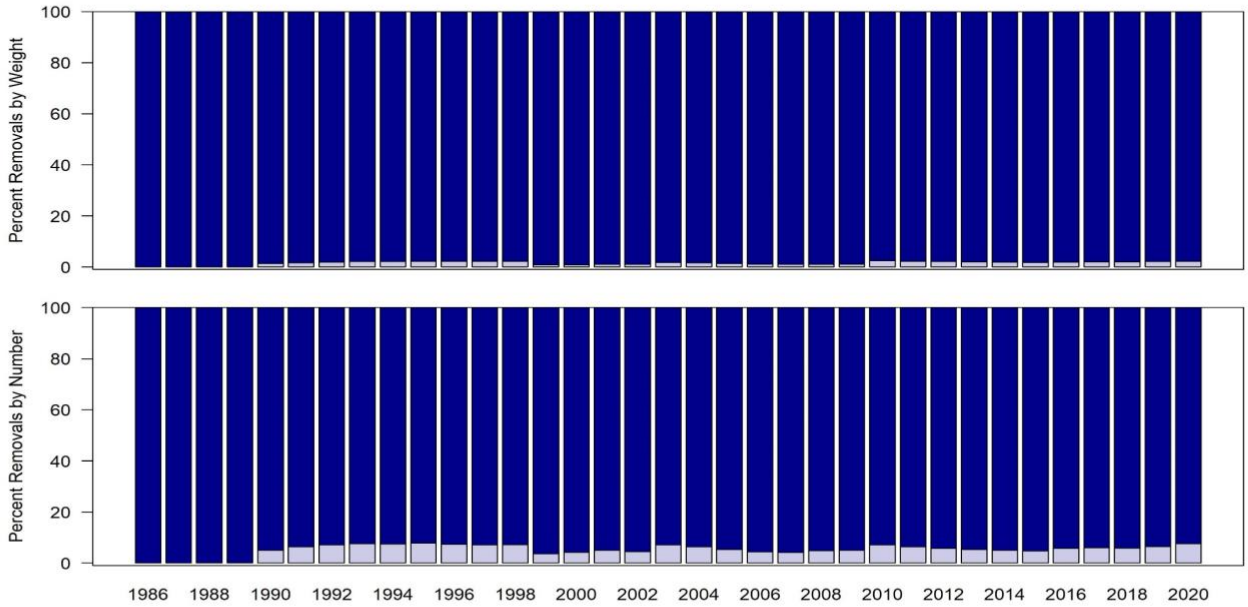


*Figure 41. Comparison of landings (dark bars) and dead discards (light bars) for weights (top panel) and numbers of fish (bottom panel) for the Commercial Vertical Line fleet for Gulf of Mexico Scamp. Estimates of dead discards in both numbers and weights are provided in **Table 21**.*

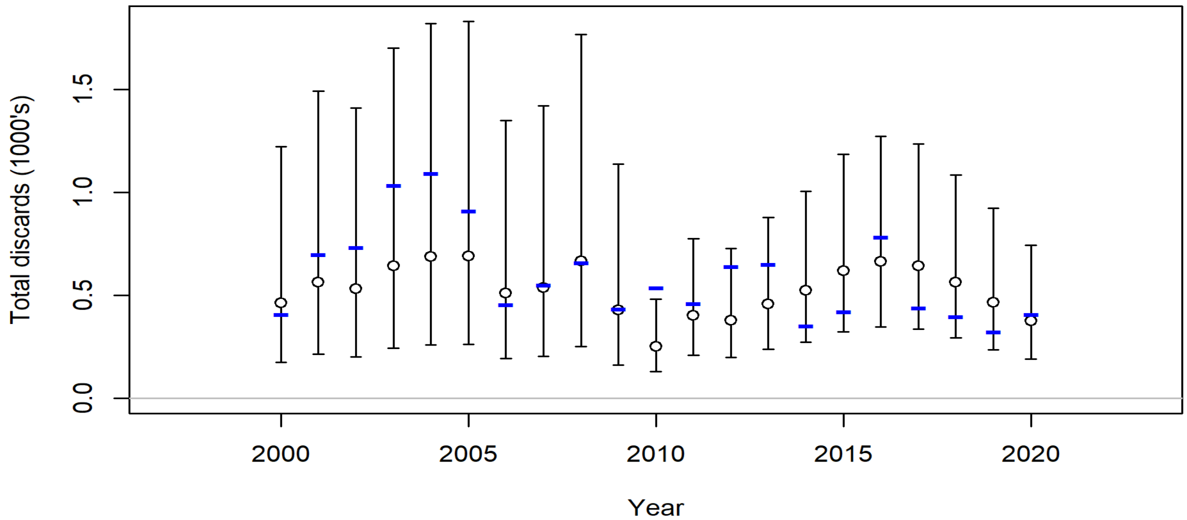


Figure 42. Observed (dots with 95% confidence intervals) and expected (blue lines) discards by the Commercial Longline fleet for Gulf of Mexico Scamp. Discards are in numbers of fish (1,000s) and reflect released fish (i.e., before discard mortality has been applied).

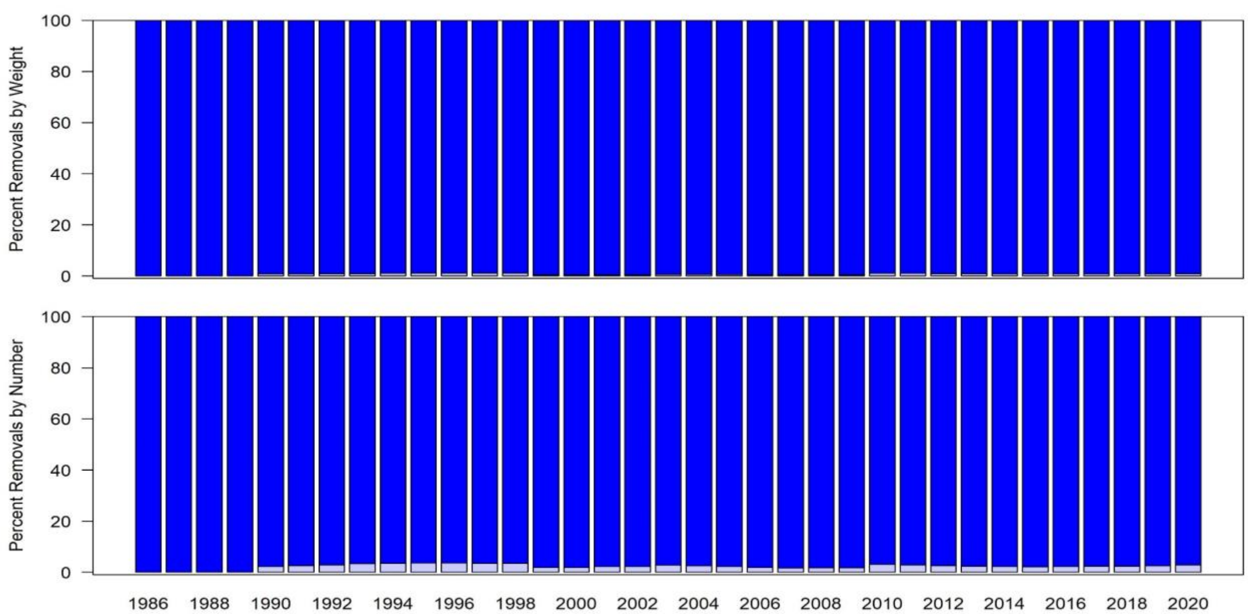


Figure 43. Comparison of landings (dark bars) and dead discards (light bars) for weights (top panel) and numbers of fish (bottom panel) for the Commercial Longline fleet for Gulf of Mexico Scamp. Estimates of dead discards in both numbers and weights are provided in ***Table 22****.*

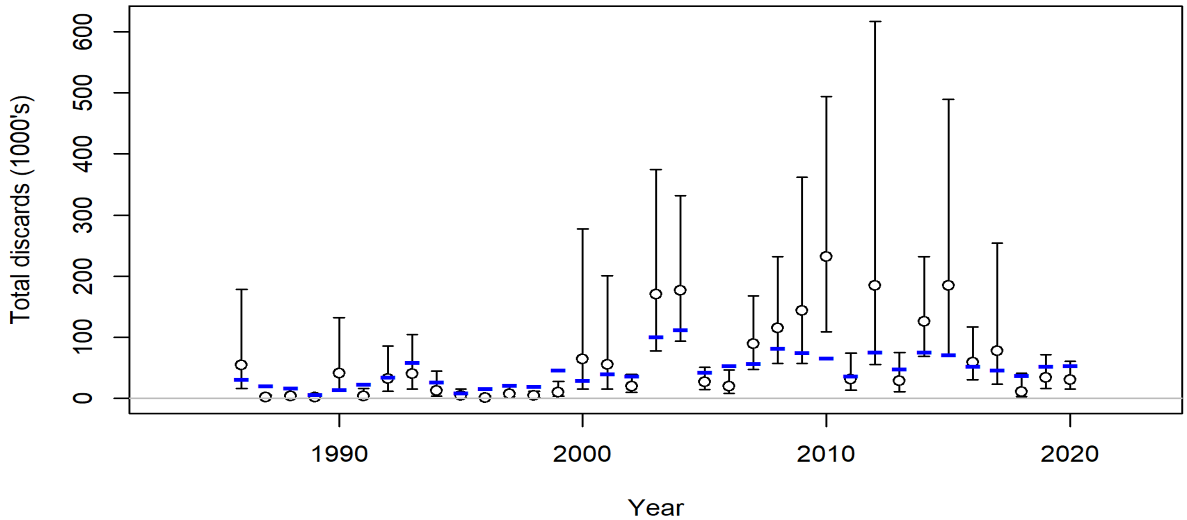


Figure 44. Observed (dots with 95% confidence intervals) and expected (blue lines) discards by the Recreational Charter Private fleet for Gulf of Mexico Scamp. Discards are in numbers of fish (1,000s) and reflect released fish (i.e., before discard mortality has been applied).

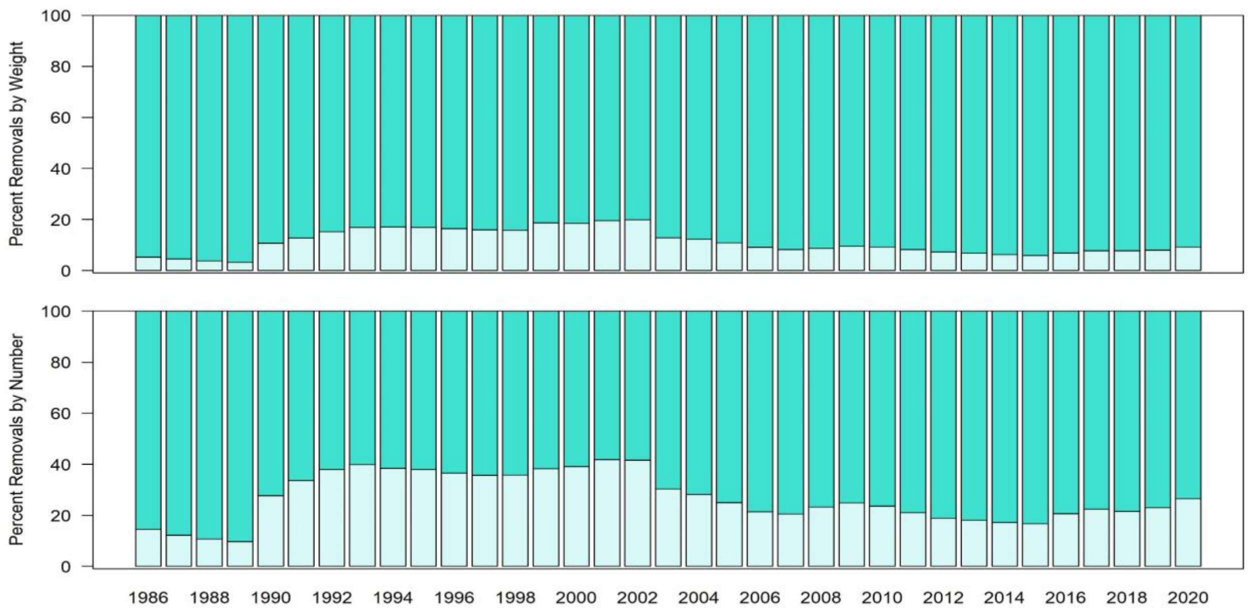


Figure 45. Comparison of landings (dark bars) and dead discards (light bars) for weights (top panel) and numbers of fish (bottom panel) for the Recreational Charter Private fleet for Gulf of Mexico Scamp. Estimates of dead discards in both numbers and weights are provided in ***Table 23****.*

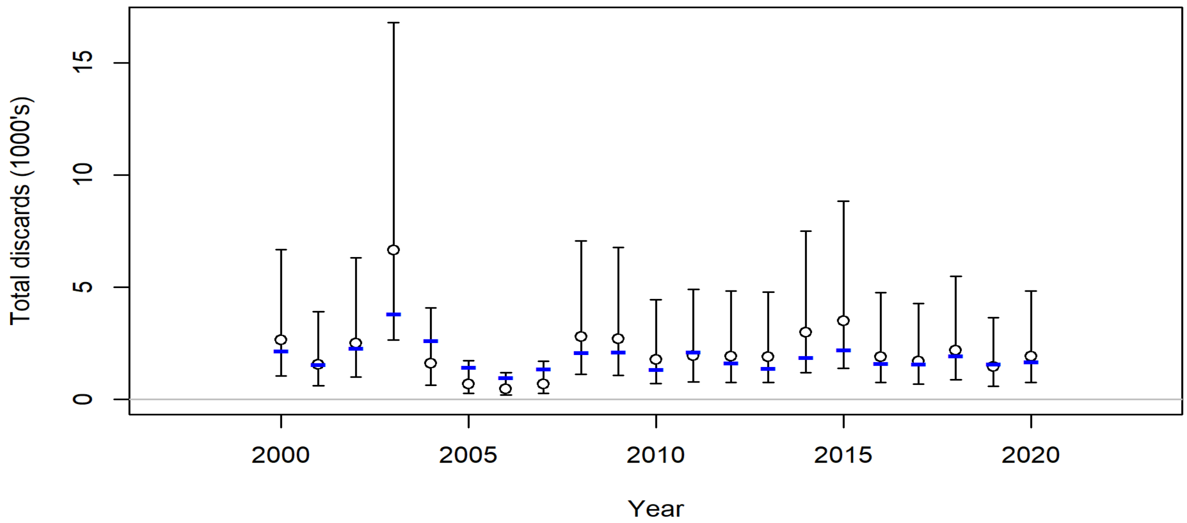


Figure 46. Observed (dots with 95% confidence intervals) and expected (blue lines) discards by the Recreational Headboat fleet for Gulf of Mexico Scamp. Discards are in numbers of fish (1,000s) and reflect released fish (i.e., before discard mortality has been applied).

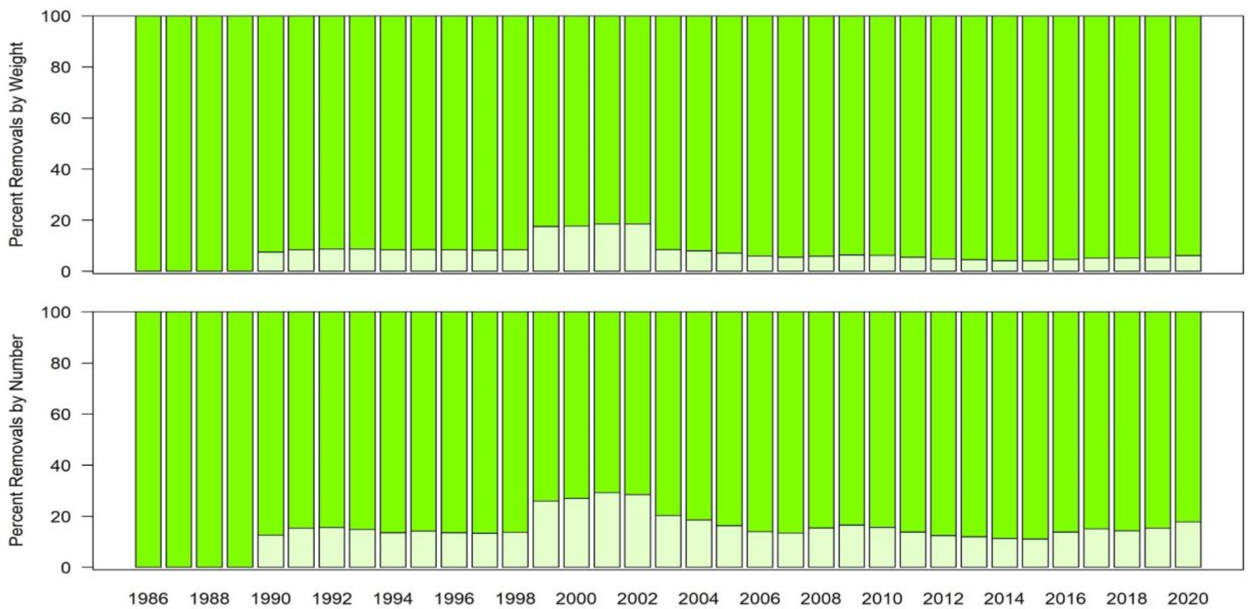


*Figure 47. Comparison of landings (dark bars) and dead discards (light bars) for weights (top panel) and numbers of fish (bottom panel) for the Recreational Headboat fleet for Gulf of Mexico Scamp. Estimates of dead discards in both numbers and weights are provided in **Table 24**.*

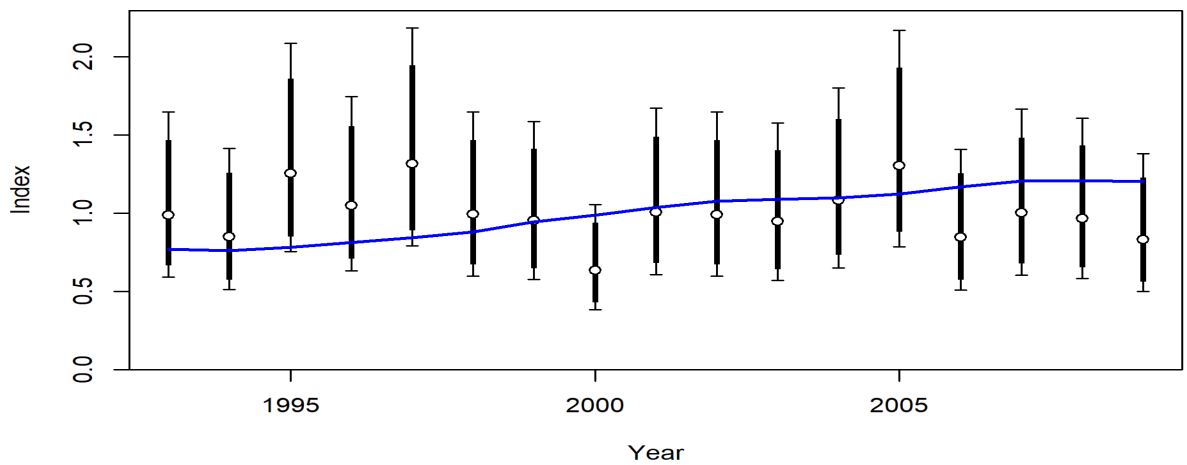


Figure 48. Observed (dots with 95% confidence intervals) and expected (blue lines) indices of relative abundance for Gulf of Mexico Scamp retained by the Commercial Vertical Line fleet prior to the implementation of the Grouper-Tilefish Individual Fishing Quota. The stock assessment model assumes lognormal error around the standardized index. Thicker lines indicate input uncertainty before addition of the estimated additional uncertainty parameter (0.06).

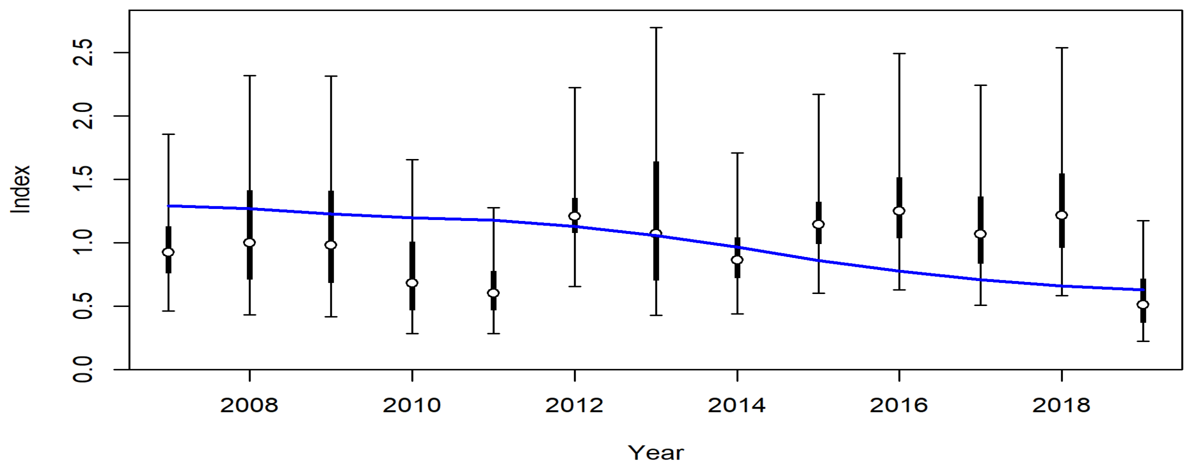


Figure 49. Observed (dots with 95% confidence intervals) and expected (blue lines) indices of relative abundance for Gulf of Mexico Scamp from the RFOP Vertical Line Survey. The stock assessment model assumes lognormal error around the standardized index. Thicker lines indicate input uncertainty before addition of the estimated additional uncertainty parameter (0.254).

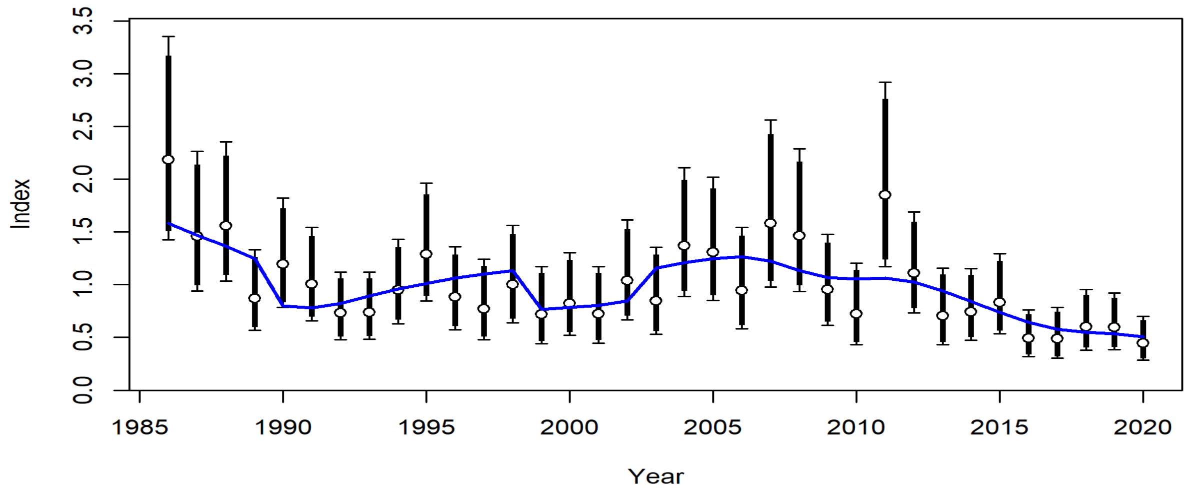


Figure 50. Observed (dots with 95% confidence intervals) and expected (blue lines) indices of relative abundance for Gulf of Mexico Scamp retained by the Recreational Headboat fleet. The stock assessment model assumes lognormal error around the standardized index. Thicker lines indicate input uncertainty before addition of the estimated additional uncertainty parameter (0.029).

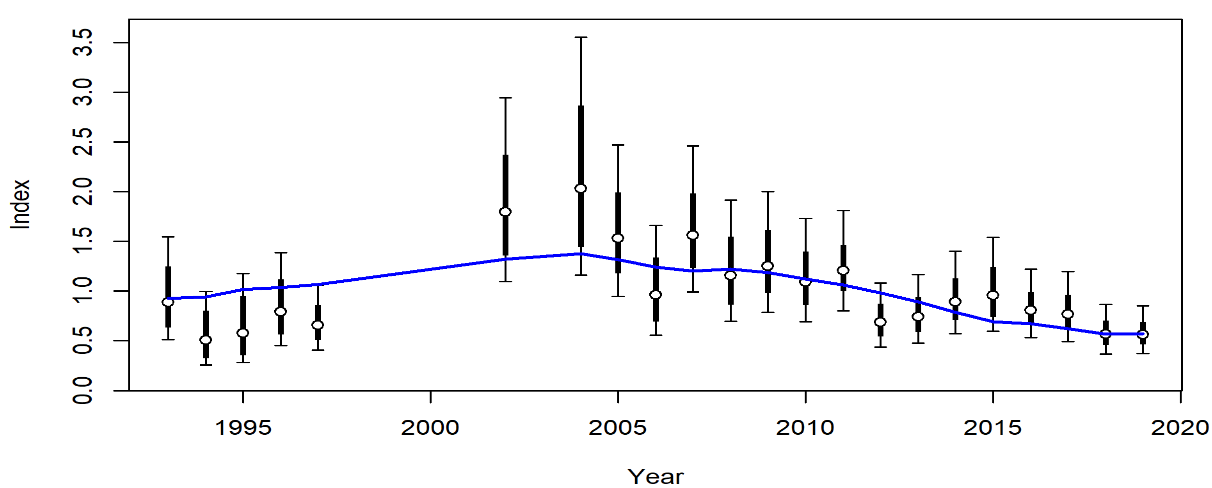
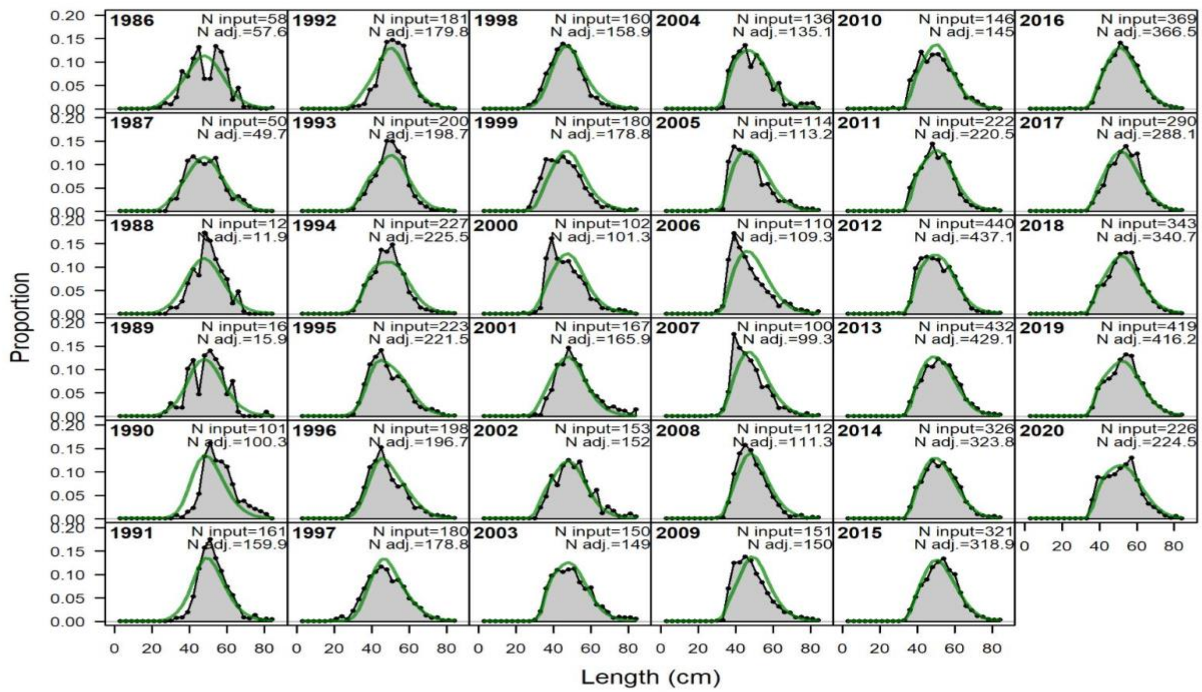


Figure 51. Observed (dots with 95% confidence intervals) and expected (blue lines) indices of relative abundance for Gulf of Mexico Scamp from the Combined Video Survey. The stock assessment model assumes lognormal error around the standardized index. Thicker lines indicate input uncertainty before addition of the estimated additional uncertainty parameter (0.11).



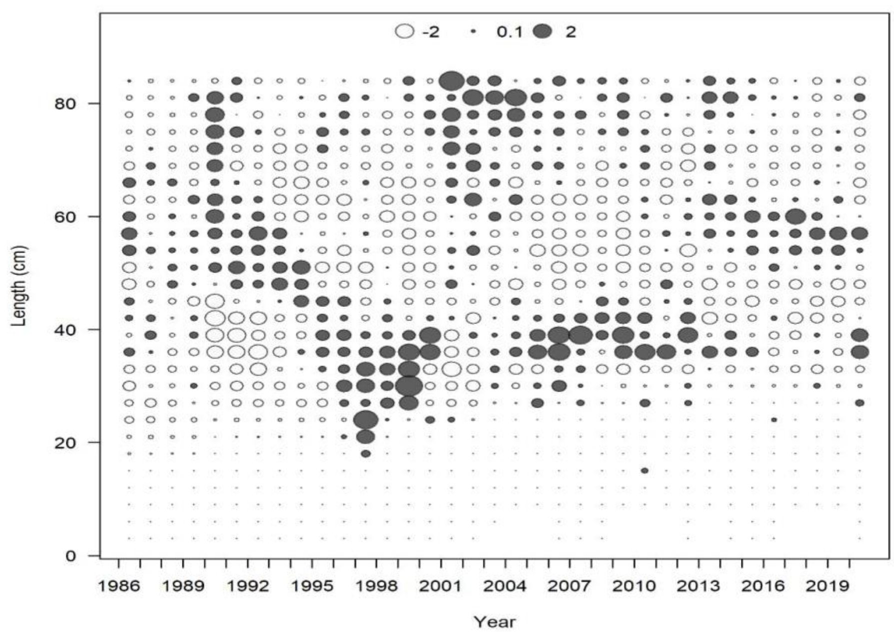
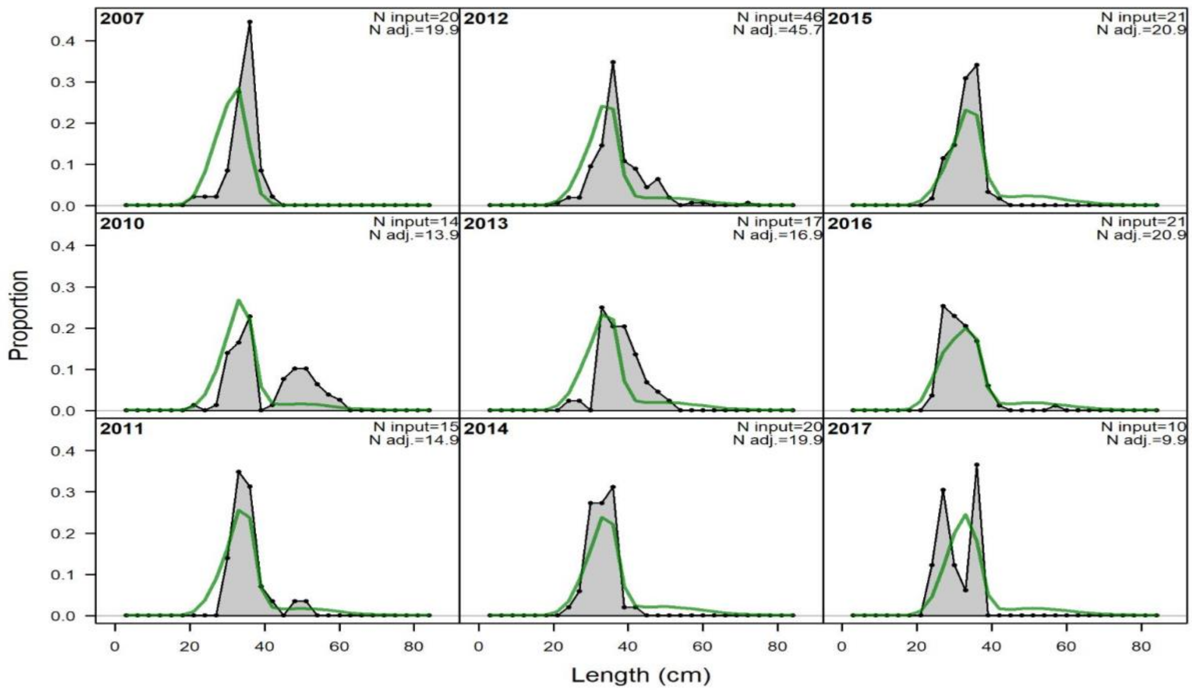


Figure 52. Observed and expected length compositions (top) and Pearson residuals (bottom) for Gulf of Mexico Scamp landed by the Commercial Vertical Line fleet. Green lines represent expected length compositions, while grey shaded regions represent observed length compositions. Input sample sizes (N input) and adjusted sample sizes (N adj) estimated by Stock Synthesis are also reported. Closed bubbles are positive residuals (Obs > Exp) and open bubbles are negative residuals (Obs < Exp).



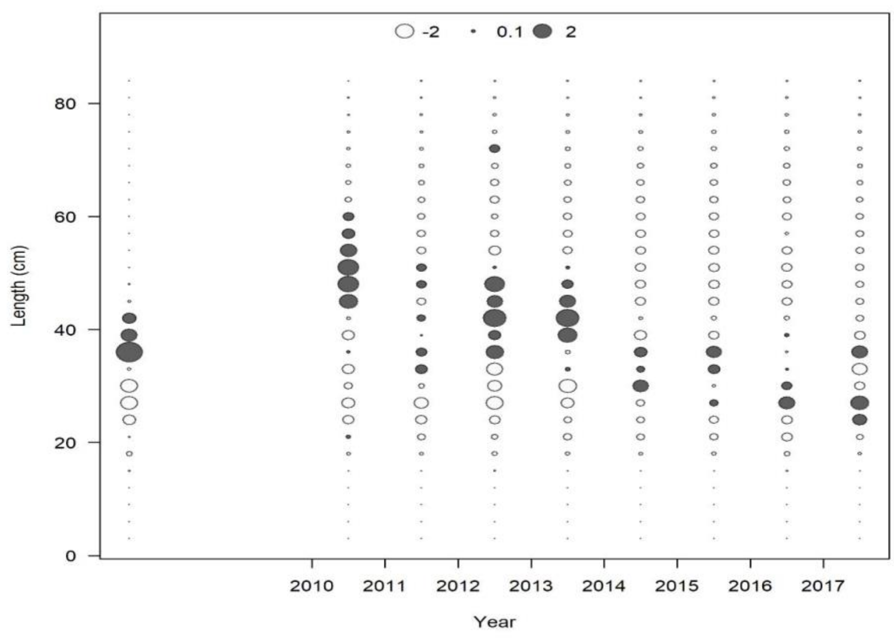


Figure 53. Observed and expected length compositions (top) and Pearson residuals (bottom) for Gulf of Mexico Scamp discarded by the Commercial Vertical Line fleet. Green lines represent expected length compositions, while grey shaded regions represent observed length compositions. Input sample sizes (N input) and adjusted sample sizes (N adj) estimated by Stock Synthesis are also reported. Closed bubbles are positive residuals (Obs > Exp) and open bubbles are negative residuals (Obs < Exp).

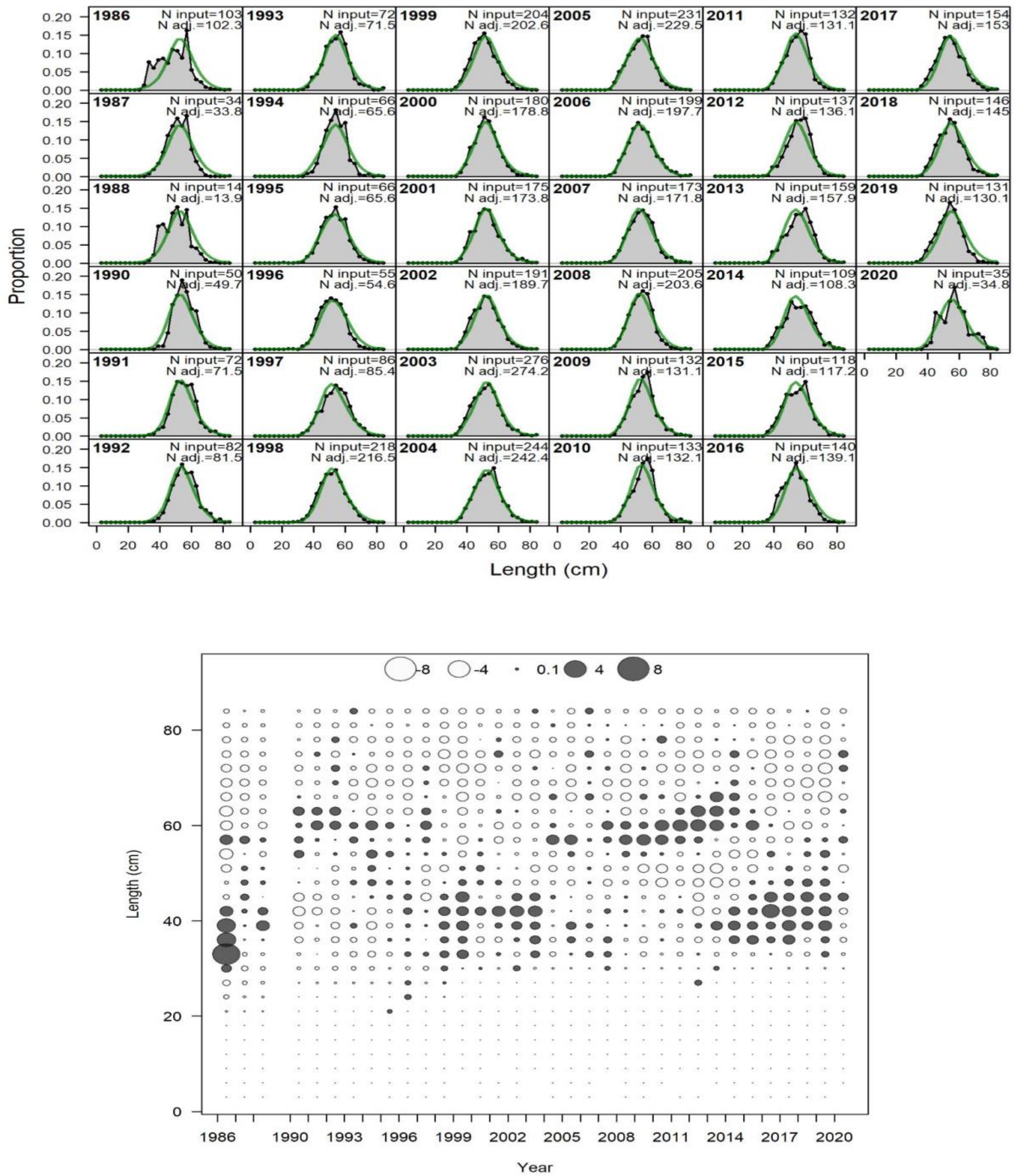
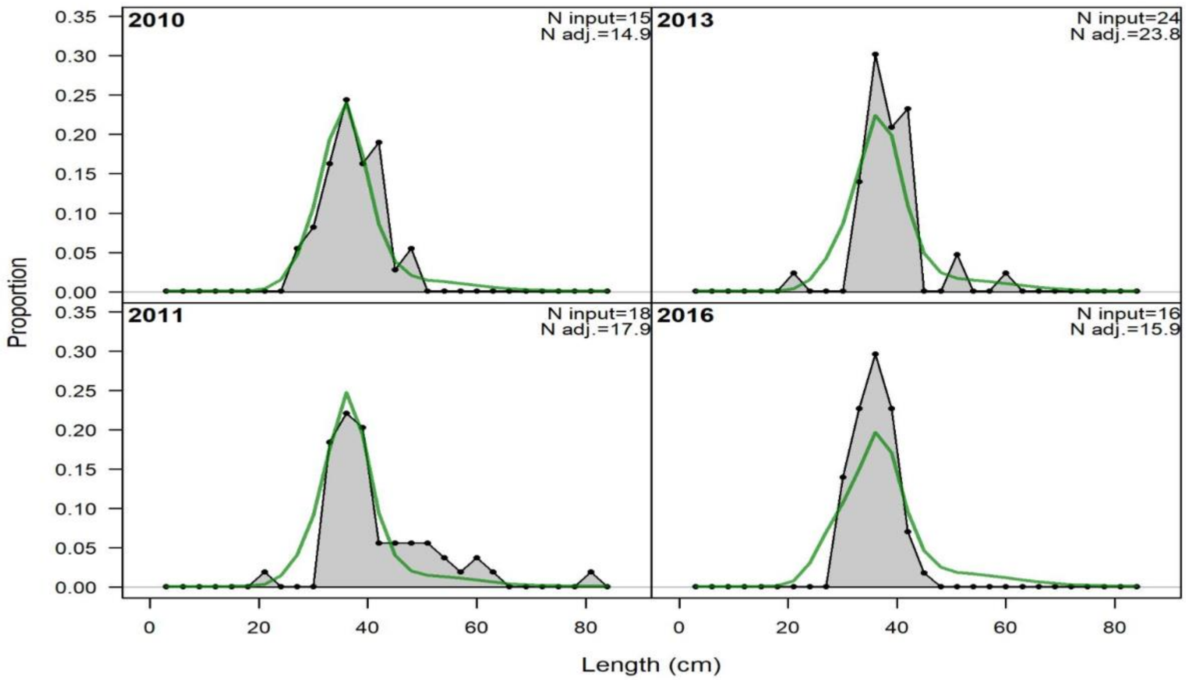


Figure 54. Observed and expected length compositions (top) and Pearson residuals (bottom) for Gulf of Mexico Scamp landed by the Commercial Longline fleet. Green lines represent expected length compositions, while grey shaded regions represent observed length compositions. Input sample sizes (N input) and adjusted sample sizes (N adj) estimated by Stock Synthesis are also reported. Closed bubbles are positive residuals (Obs > Exp) and open bubbles are negative residuals (Obs < Exp).



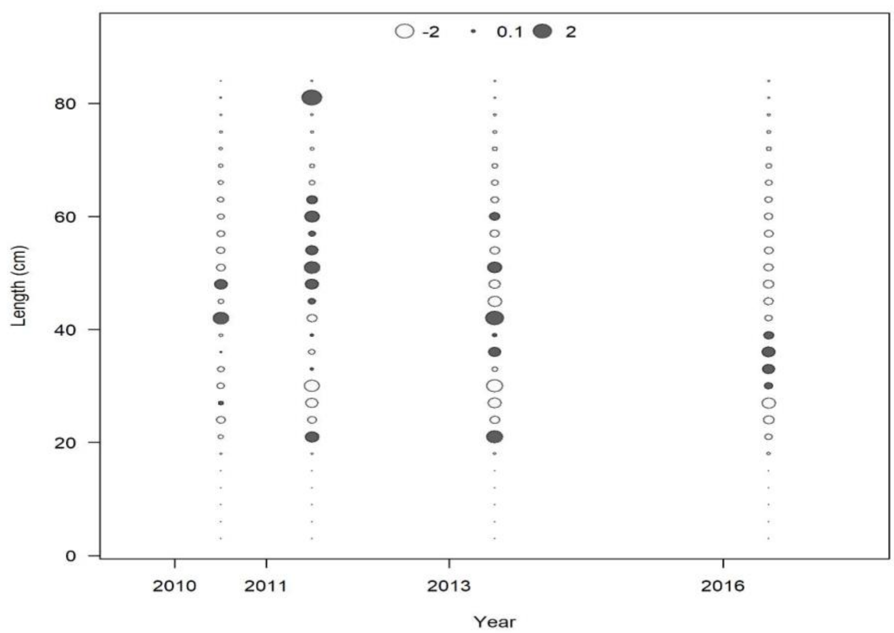


Figure 55. Observed and expected length compositions (top) and Pearson residuals (bottom) for Gulf of Mexico Scamp discarded by the Commercial Longline fleet. Green lines represent expected length compositions, while grey shaded regions represent observed length compositions. Input sample sizes (N input) and adjusted sample sizes (N adj) estimated by Stock Synthesis are also reported. Closed bubbles are positive residuals (Obs > Exp) and open bubbles are negative residuals (Obs < Exp).

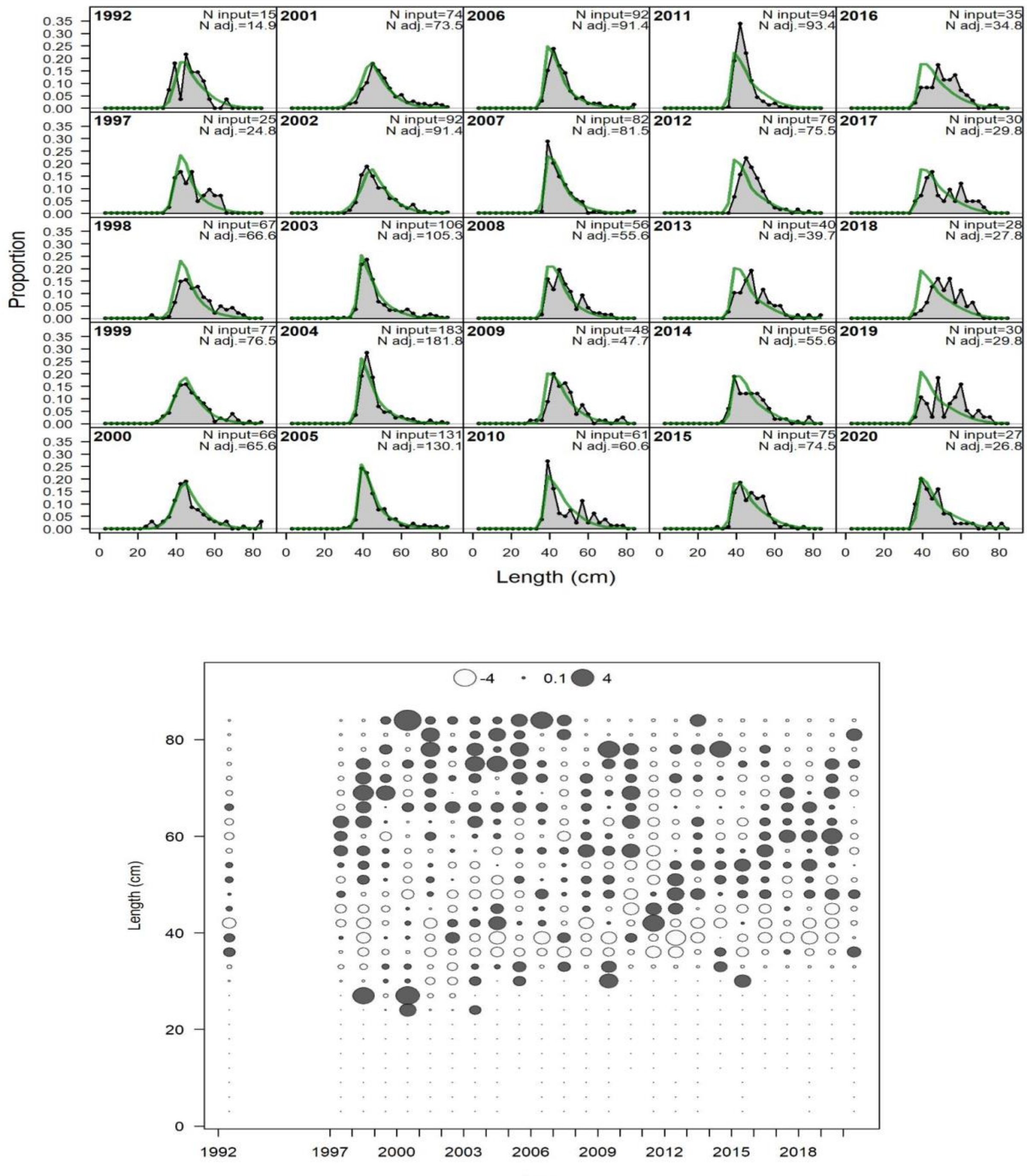


Figure 56. Observed and expected length compositions (top) and Pearson residuals (bottom) for Gulf of Mexico Scamp landed by the Recreational Charter Private fleet. Green lines represent expected length compositions, while grey shaded regions represent observed length compositions. Input sample sizes (N input) and adjusted sample sizes (N adj) estimated by Stock Synthesis are also reported. Closed bubbles are positive residuals (Obs > Exp) and open bubbles are negative residuals (Obs < Exp).

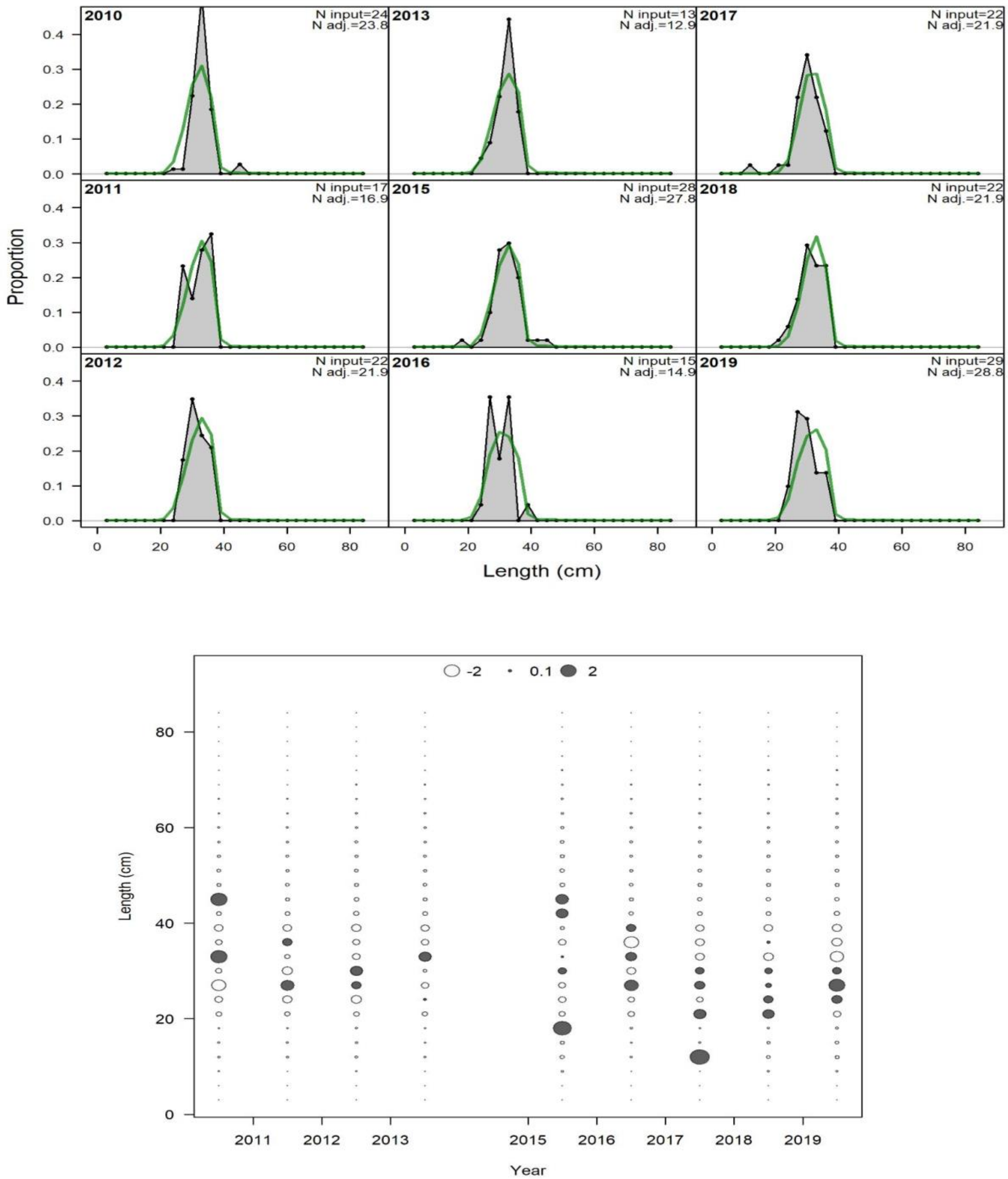


Figure 57. Observed and expected length compositions (top) and Pearson residuals (bottom) for Gulf of Mexico Scamp discarded by the Recreational Charter Private fleet. Green lines represent expected length compositions, while grey shaded regions represent observed length compositions. Input sample sizes (N input) and adjusted sample sizes (N adj) estimated by Stock Synthesis are also reported. Closed bubbles are positive residuals (Obs > Exp) and open bubbles are negative residuals (Obs < Exp).

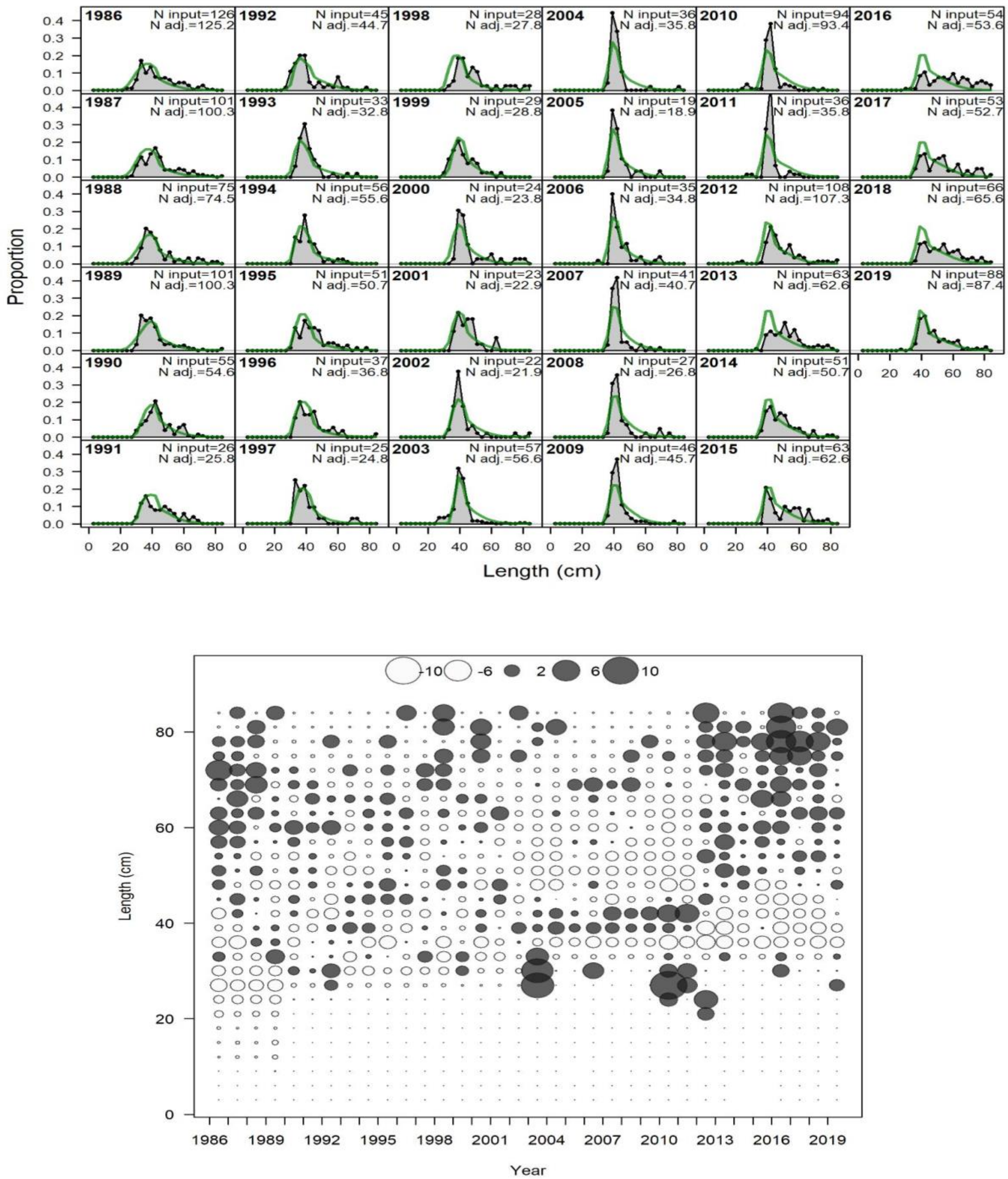


Figure 58. Observed and expected length compositions (top) and Pearson residuals (bottom) for Gulf of Mexico Scamp landed by the Recreational Headboat fleet. Green lines represent expected length compositions, while grey shaded regions represent observed length compositions. Input sample sizes (N input) and adjusted sample sizes (N adj) estimated by Stock Synthesis are also reported. Closed bubbles are positive residuals (Obs > Exp) and open bubbles are negative residuals (Obs < Exp).

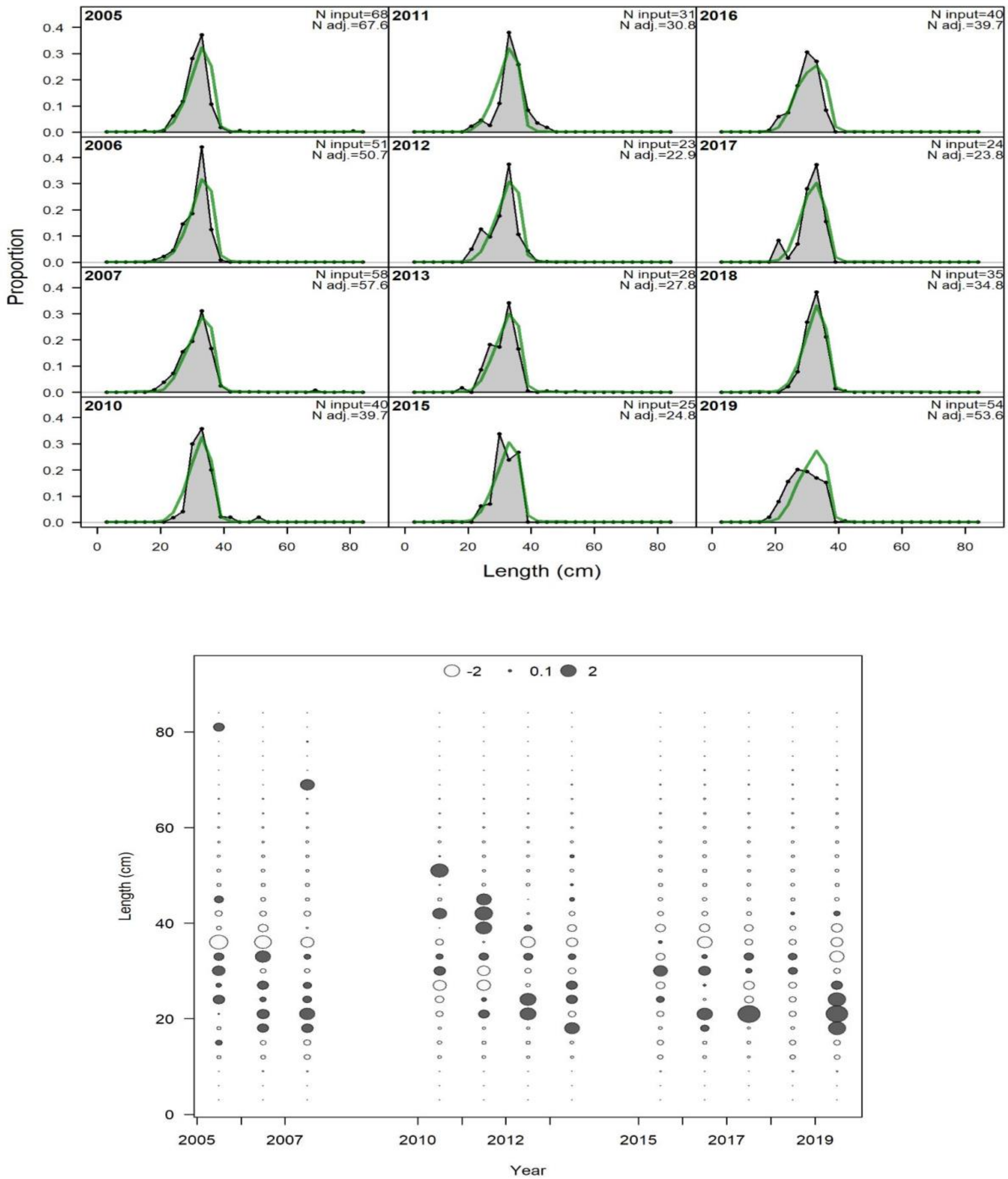


Figure 59. Observed and expected length compositions (top) and Pearson residuals (bottom) for Gulf of Mexico Scamp discarded by the Recreational Headboat fleet. Green lines represent expected length compositions, while grey shaded regions represent observed length compositions. Input sample sizes (N input) and adjusted sample sizes (N adj) estimated by Stock Synthesis are also reported. Closed bubbles are positive residuals (Obs > Exp) and open bubbles are negative residuals (Obs < Exp).

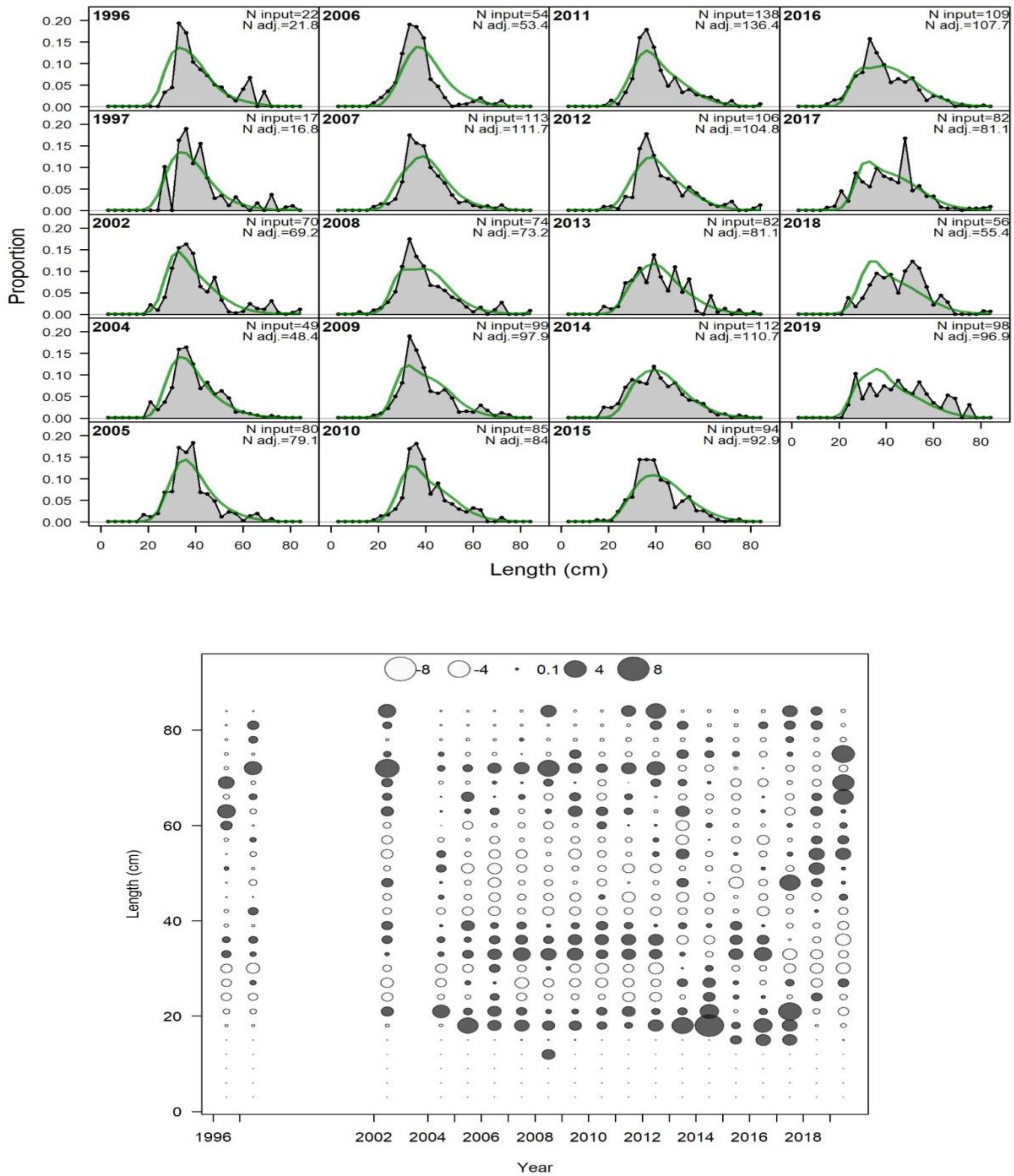


Figure 60. Observed and expected length compositions (top) and Pearson residuals (bottom) for Gulf of Mexico Scamp in the Combined Video Survey. Green lines represent expected length compositions, while grey shaded regions represent observed length compositions. Input sample sizes (N input) and adjusted sample sizes (N adj) estimated by Stock Synthesis are also reported. Closed bubbles are positive residuals (Obs > Exp) and open bubbles are negative residuals (Obs < Exp).

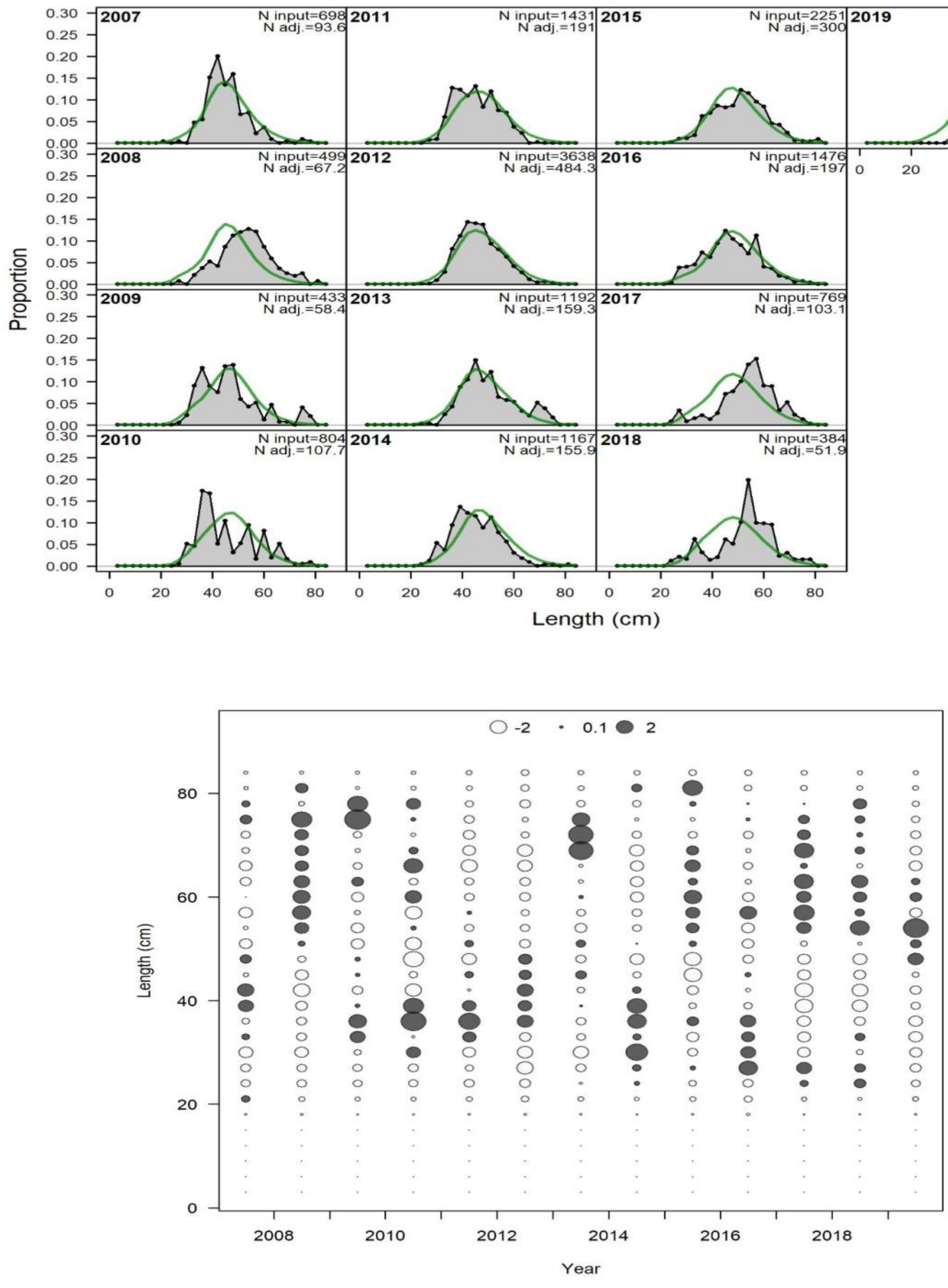


Figure 61. Observed and expected length compositions (top) and Pearson residuals (bottom) for Gulf of Mexico Scamp in the RFOP Vertical Line Survey. Green lines represent expected length compositions, while grey shaded regions represent observed length compositions. Input sample sizes (N input) and adjusted sample sizes (N adj) estimated by Stock Synthesis are also reported. Closed bubbles are positive residuals (Obs > Exp) and open bubbles are negative residuals (Obs < Exp).

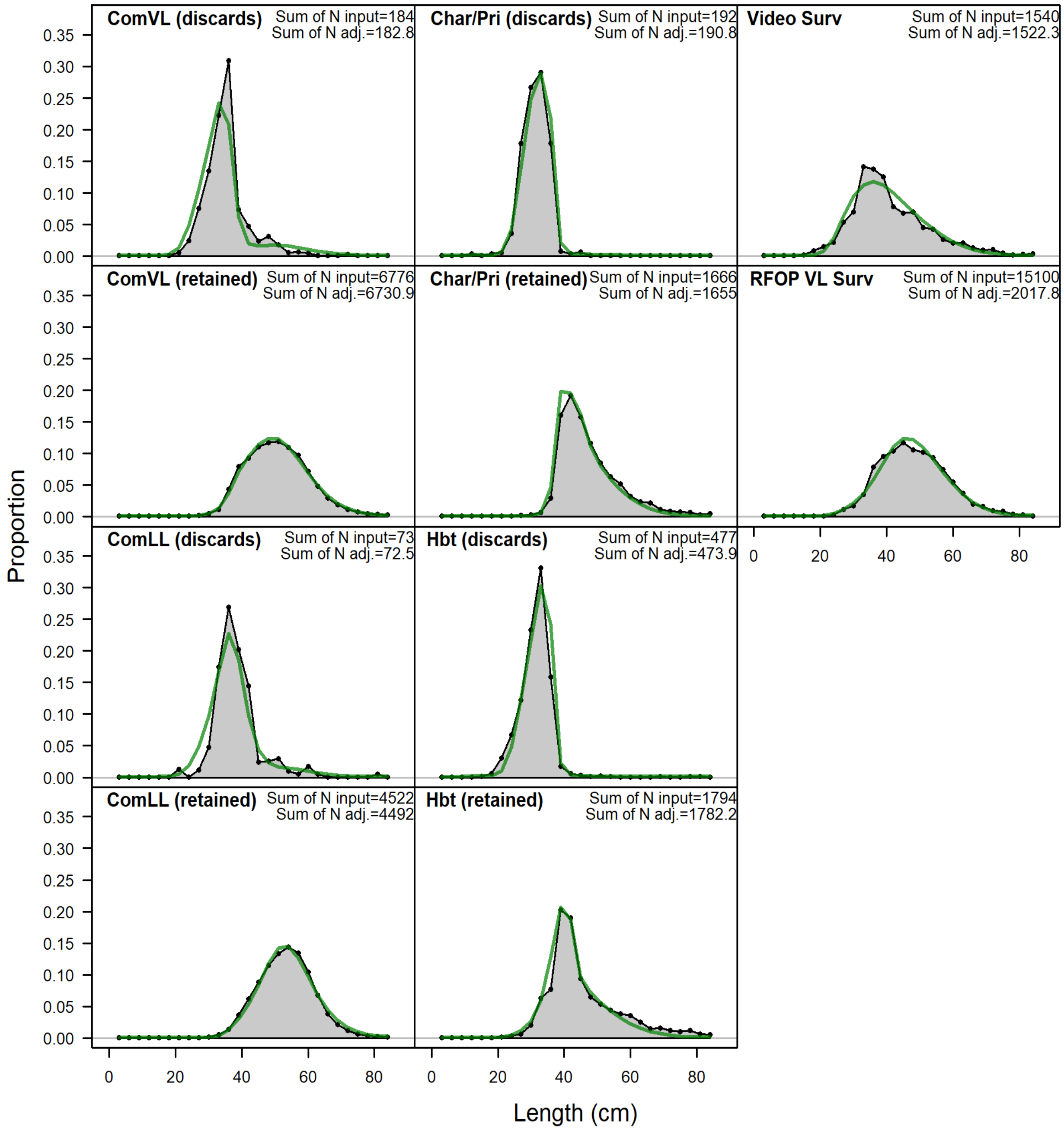


Figure 62. Model fits to the length composition of discarded or landed (i.e., retained) catch aggregated across years within a given fleet or survey for Gulf of Mexico Scamp. Green lines represent expected length compositions, while grey shaded regions represent observed length compositions. The input (N input) and adjusted (N adj) sample sizes are provided in the upper right corner of each panel. Abbreviations include: Commercial Vertical Line (ComVL), Commercial Longline (ComLL), Recreational Charter Private (Char/Pri), Recreational Headboat (Hbt), and Reef Fish Observer Program Vertical Line (RFOP VL).

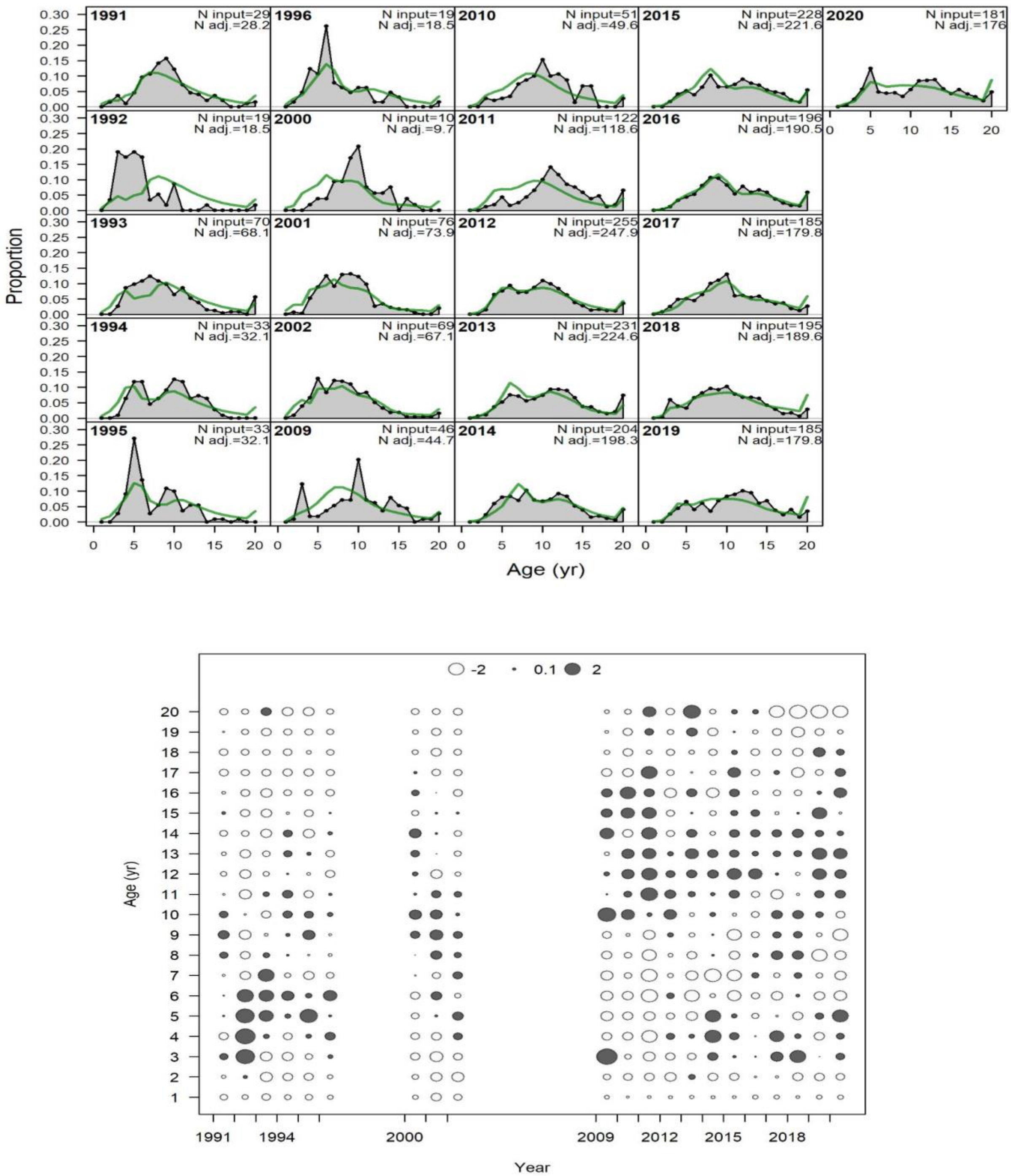


Figure 63. Observed and expected age compositions (top) and Pearson residuals (bottom) for Gulf of Mexico Scamp landed by the Commercial Vertical Line fleet. Green lines represent expected age compositions, while grey shaded regions represent observed age compositions. Input sample sizes (N input) and adjusted sample sizes (N adj) estimated by Stock Synthesis are also reported. Closed bubbles are positive residuals (Obs > Exp) and open bubbles are negative residuals (Obs < Exp).

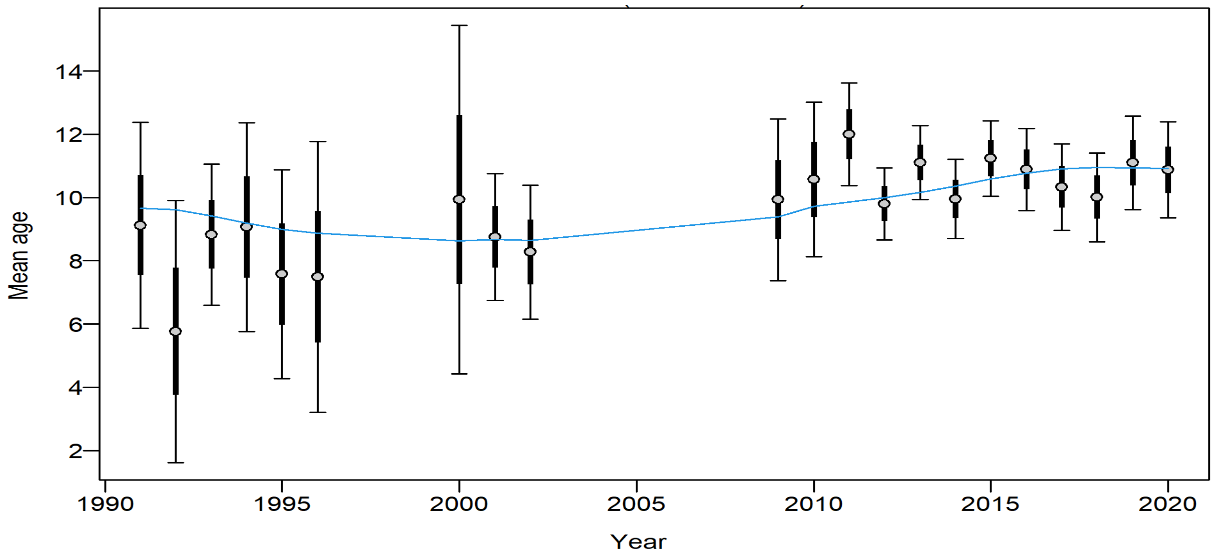


Figure 64. Mean age of landed Gulf of Mexico Scamp from data (aggregated across length bins) by the Commercial Vertical Line fleet with 95% confidence intervals (thick bars). Thinner intervals (with capped ends) show the result of further adjusting sample sizes based on the Francis data weighting method, which was not used here.

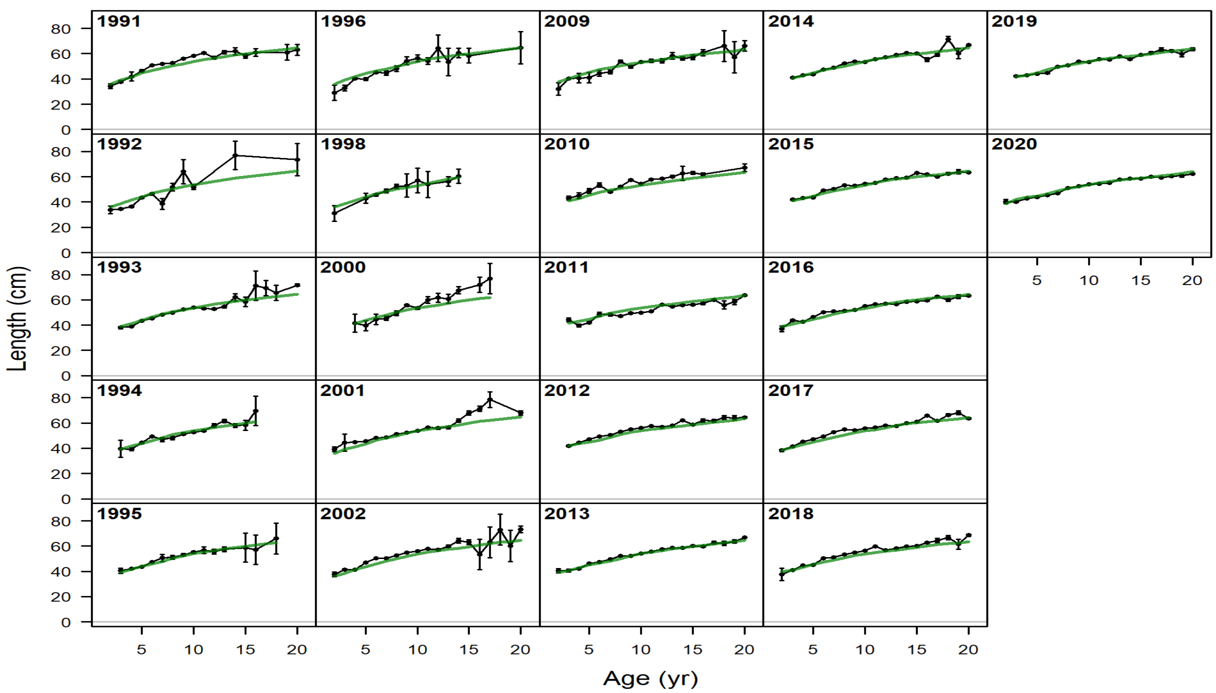


Figure 65. Observed (black line with error bars) and expected (green line) mean length-at-age (retained) for Gulf of Mexico Scamp landed by the Commercial Vertical Line fishery. Mean length-at-age is provided for comparison of trends and was not included in the likelihood.

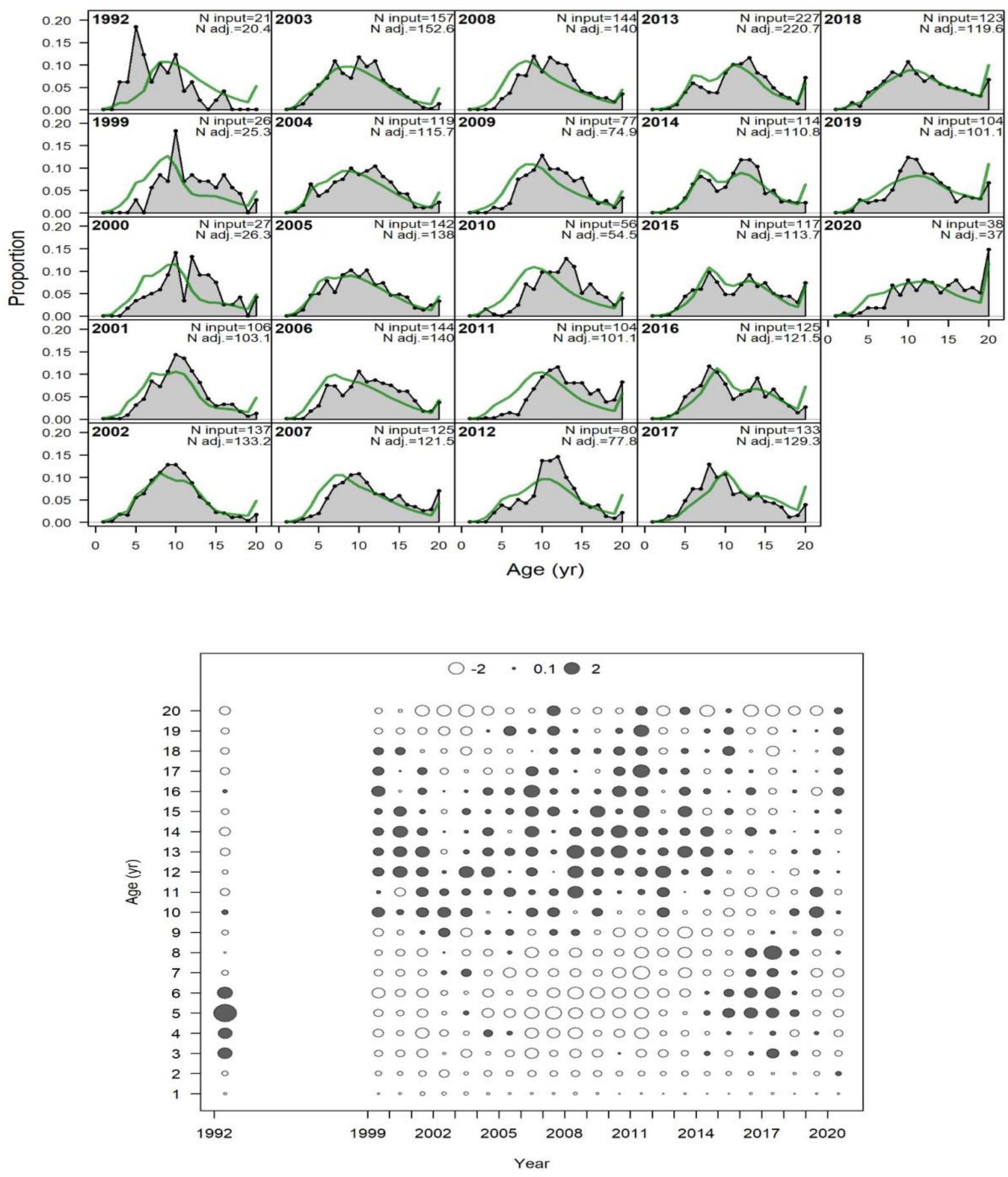


Figure 66. Observed and expected age compositions (top) and Pearson residuals (bottom) for Gulf of Mexico Scamp landed by the Commercial Longline fleet. Green lines represent expected age compositions, while grey shaded regions represent observed age compositions. Input sample sizes (N input) and adjusted sample sizes (N adj) estimated by Stock Synthesis are also reported. Closed bubbles are positive residuals (Obs > Exp) and open bubbles are negative residuals (Obs < Exp).

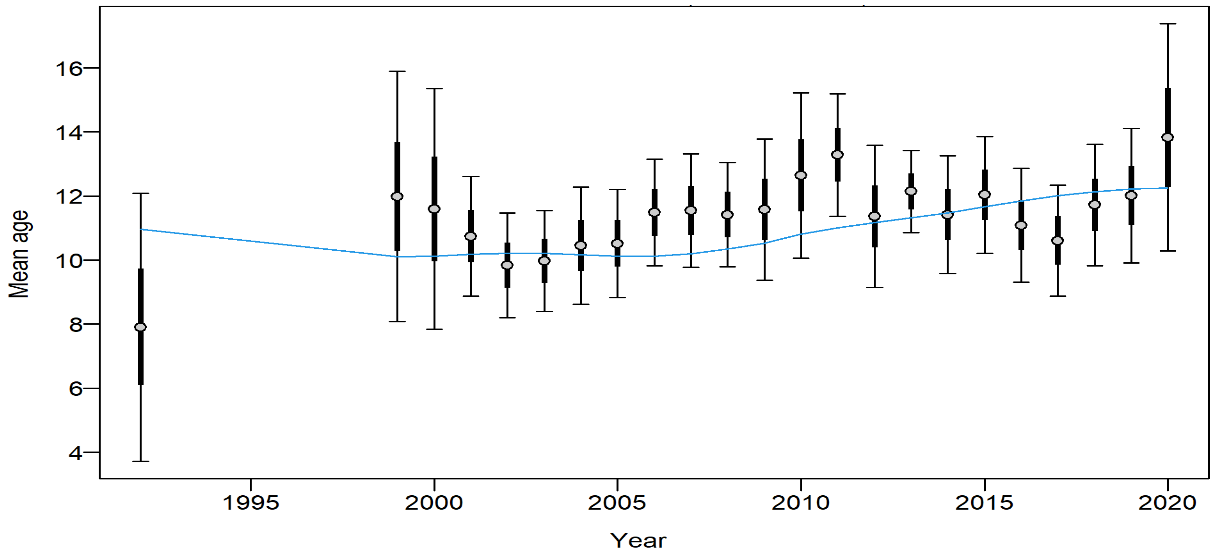


Figure 67. Mean age of landed Gulf of Mexico Scamp from data (aggregated across length bins) by the Commercial Longline fleet with 95% confidence intervals (thick bars). Thinner intervals (with capped ends) show the result of further adjusting sample sizes based on the Francis data weighting method, which was not used here.

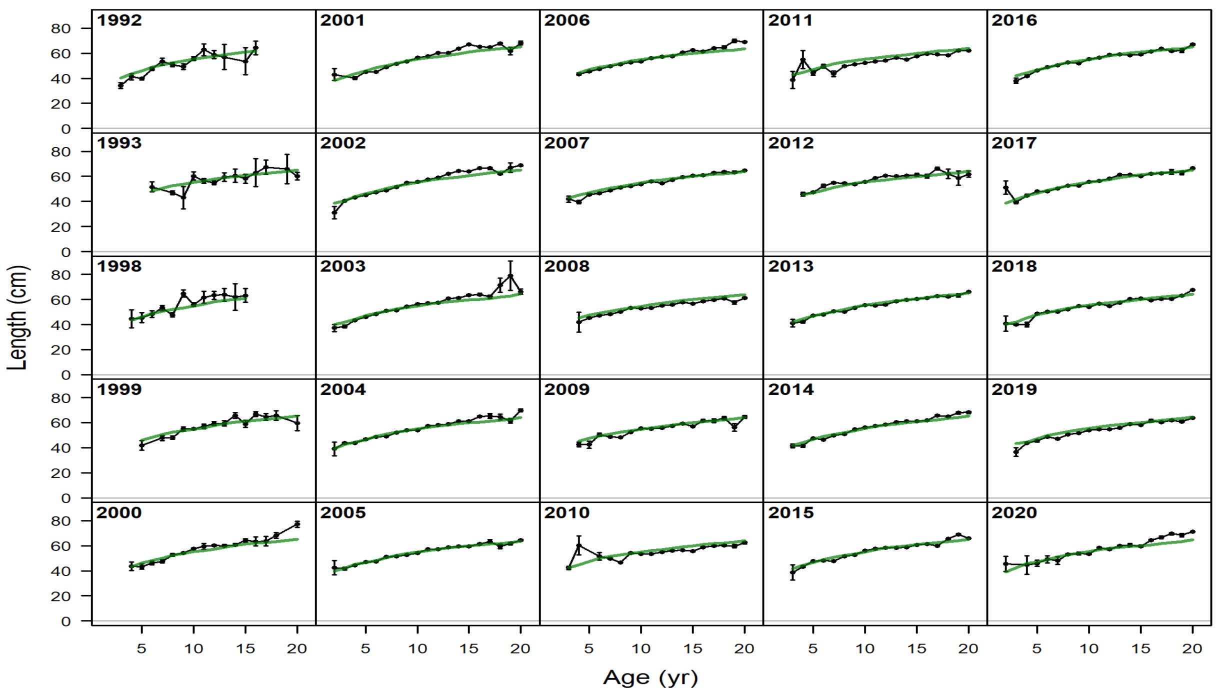


Figure 68. Observed (black line with error bars) and expected (green line) mean length-at-age (retained) for Gulf of Mexico Scamp landed by the Commercial Longline fishery. Mean length-at-age is provided for comparison of trends and was not included in the likelihood.

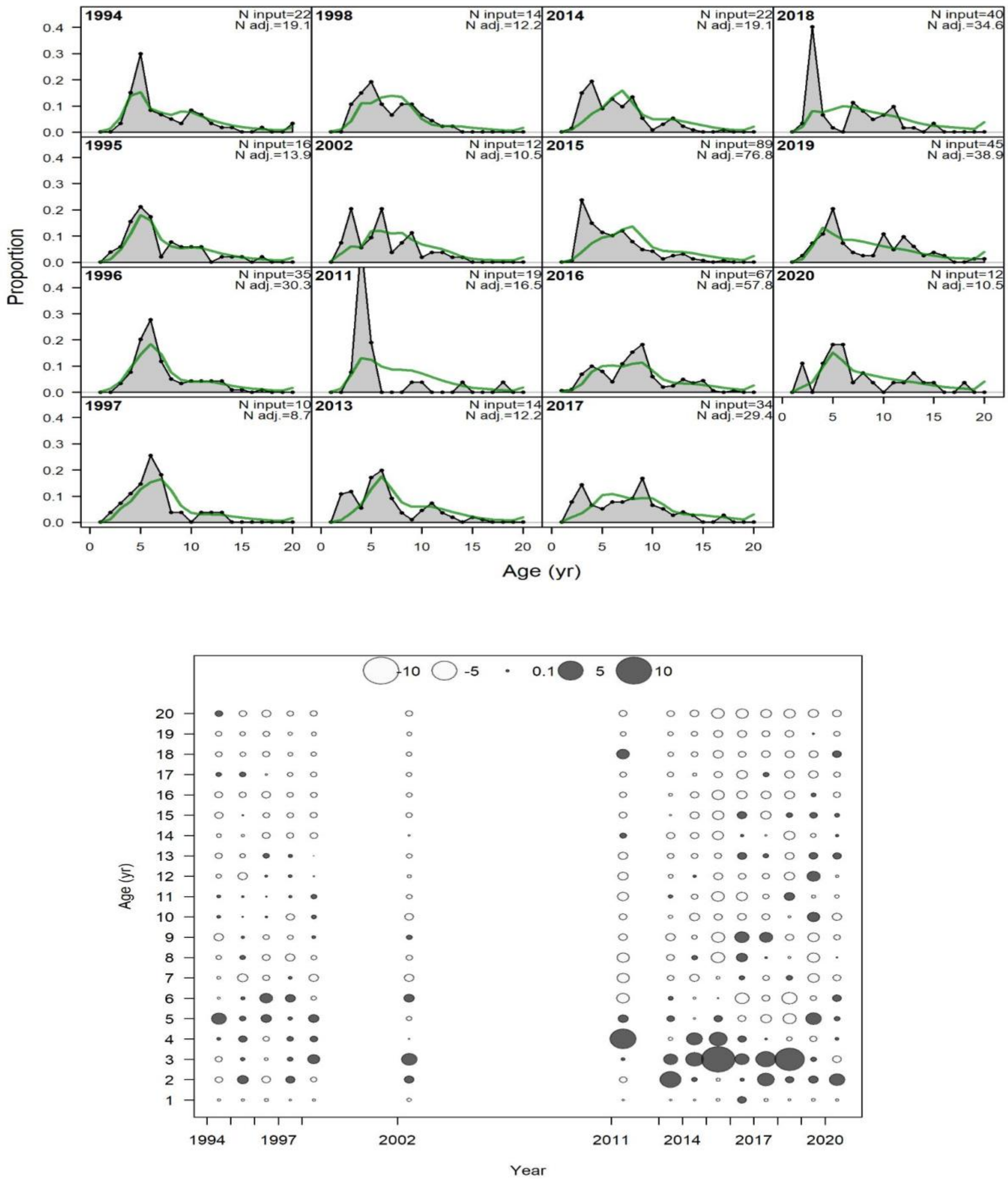


Figure 69. Observed and expected age compositions (top) and Pearson residuals (bottom) for Gulf of Mexico Scamp landed by the Recreational Charter Private fleet. Green lines represent expected age compositions, while grey shaded regions represent observed age compositions. Input sample sizes (N input) and adjusted sample sizes (N adj) estimated by Stock Synthesis are also reported. Closed bubbles are positive residuals (Obs > Exp) and open bubbles are negative residuals (Obs < Exp).

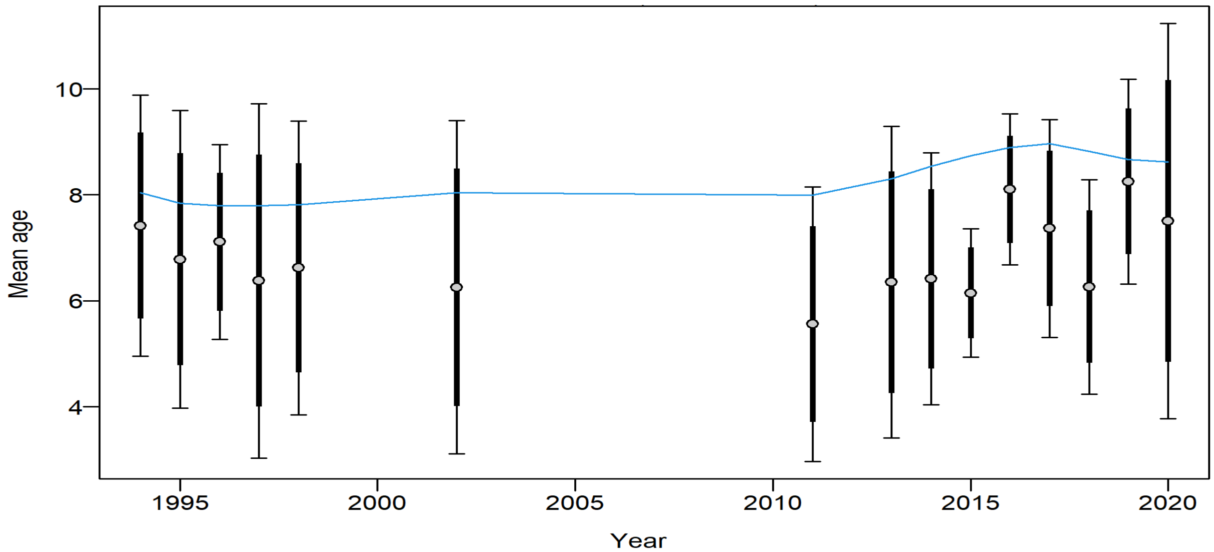


Figure 70. Mean age of landed Gulf of Mexico Scamp from data (aggregated across length bins) by the Recreational Charter Private fleet with 95% confidence intervals (thick bars). Thinner intervals (with capped ends) show the result of further adjusting sample sizes based on the Francis data weighting method, which was not used here.

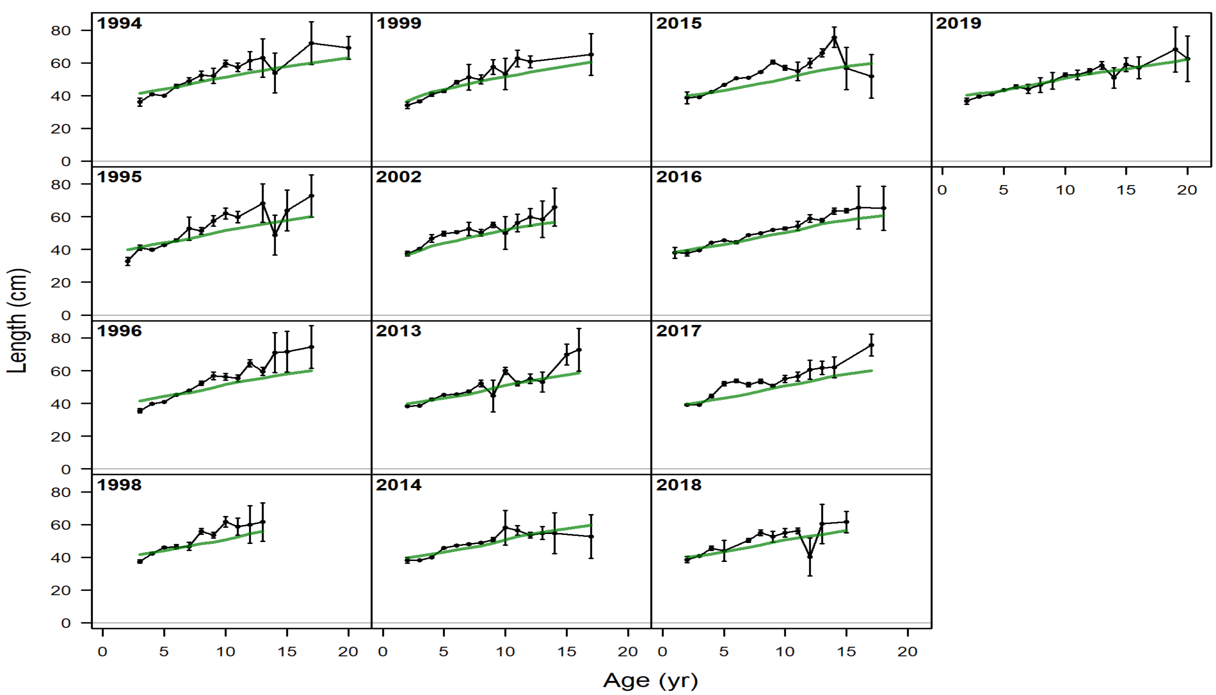


Figure 71. Observed (black line with error bars) and expected (green line) mean length-at-age (retained) for Gulf of Mexico Scamp landed by the Recreational Charter Private fishery. Mean length-at-age is provided for comparison of trends and was not included in the likelihood.

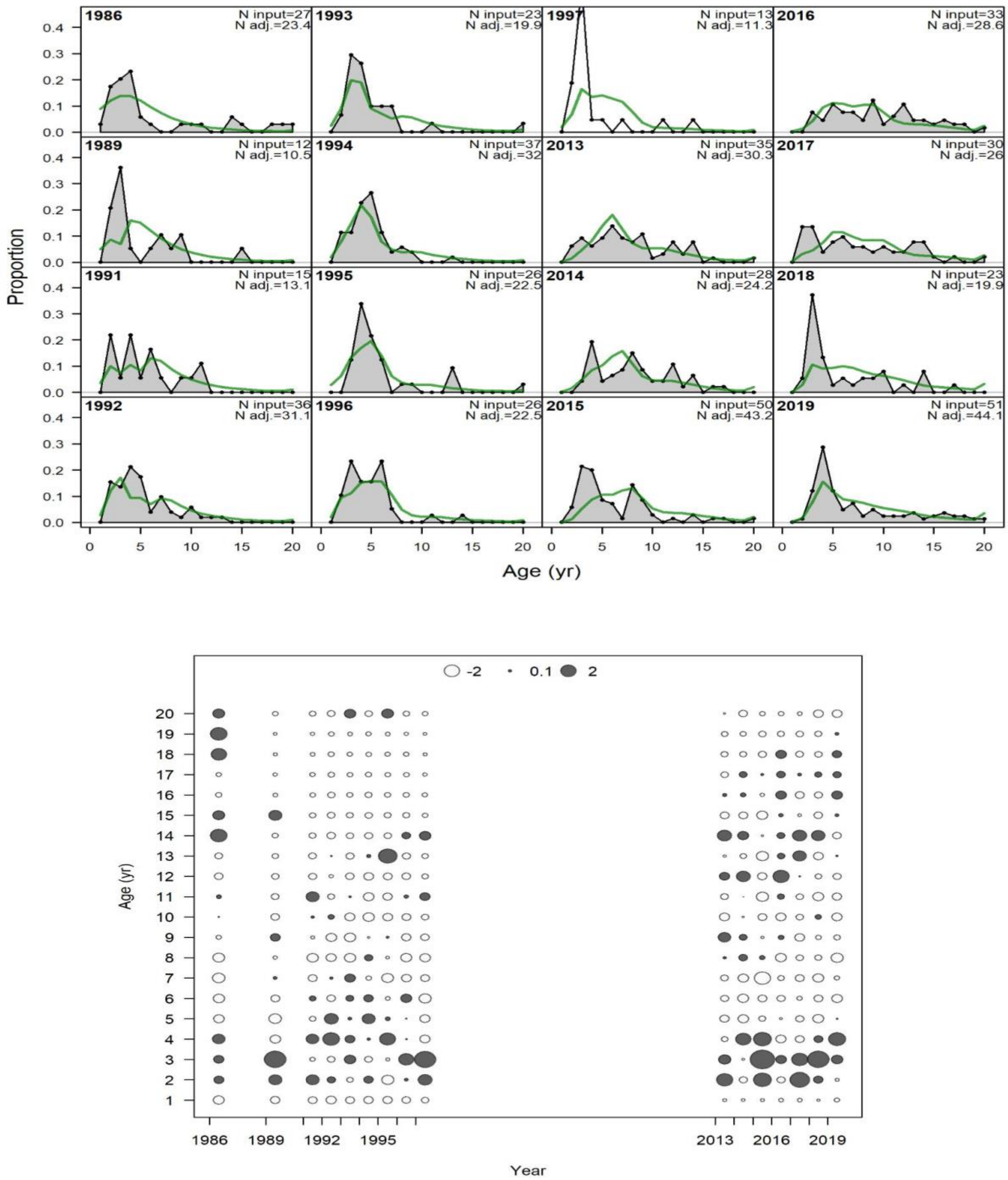


Figure 72. Observed and expected age compositions (top) and Pearson residuals (bottom) for Gulf of Mexico Scamp landed by the Recreational Headboat fleet. Green lines represent expected age compositions, while grey shaded regions represent observed age compositions. Input sample sizes (N input) and adjusted sample sizes (N adj) estimated by Stock Synthesis are also reported. Closed bubbles are positive residuals (Obs > Exp) and open bubbles are negative residuals (Obs < Exp).

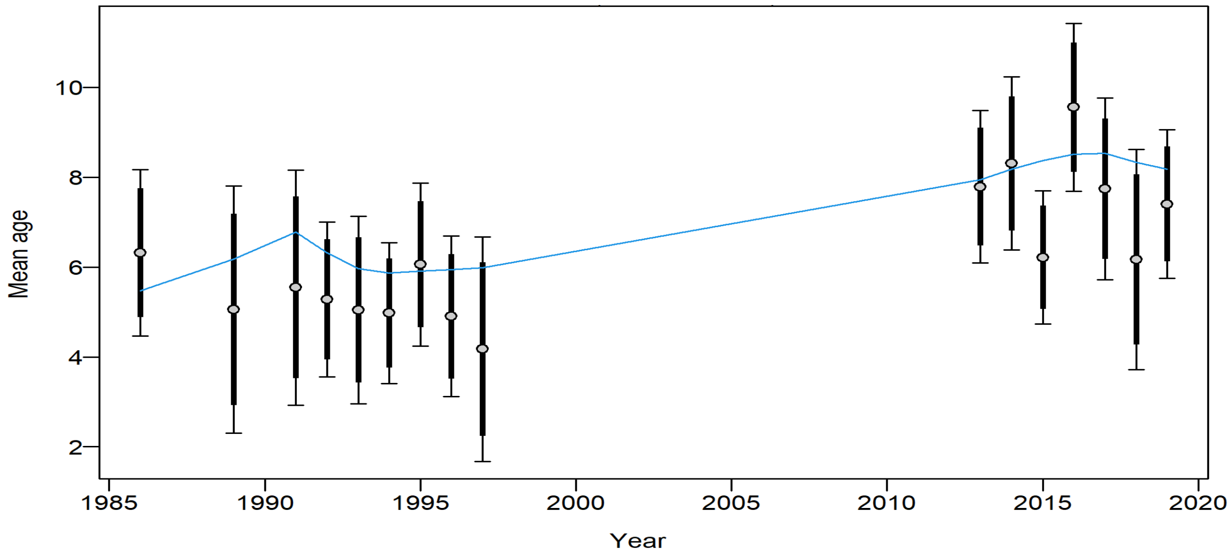


Figure 73. Mean age of landed Gulf of Mexico Scamp from data (aggregated across length bins) by the Recreational Headboat fleet with 95% confidence intervals (thick bars). Thinner intervals (with capped ends) show the result of further adjusting sample sizes based on the Francis data weighting method, which was not used here.

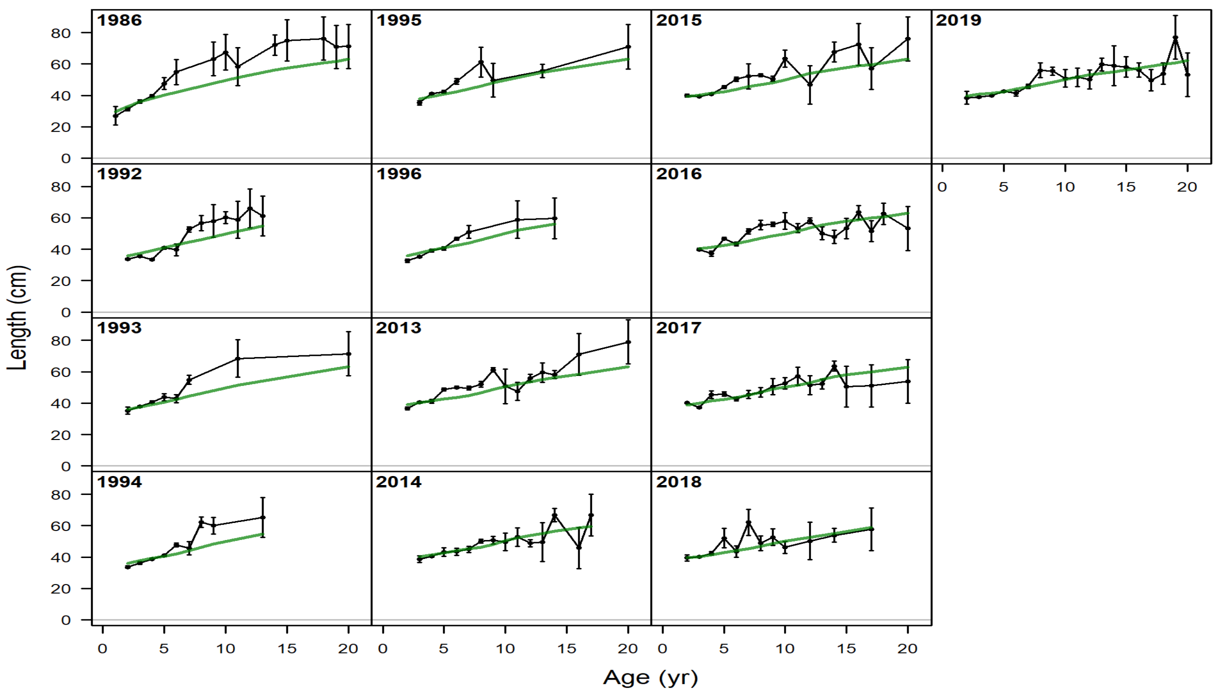


Figure 74. Observed (black line with error bars) and expected (green line) mean length-at-age (retained) for Gulf of Mexico Scamp landed by the Recreational Headboat fishery. Mean length-at-age is provided for comparison of trends and was not included in the likelihood.

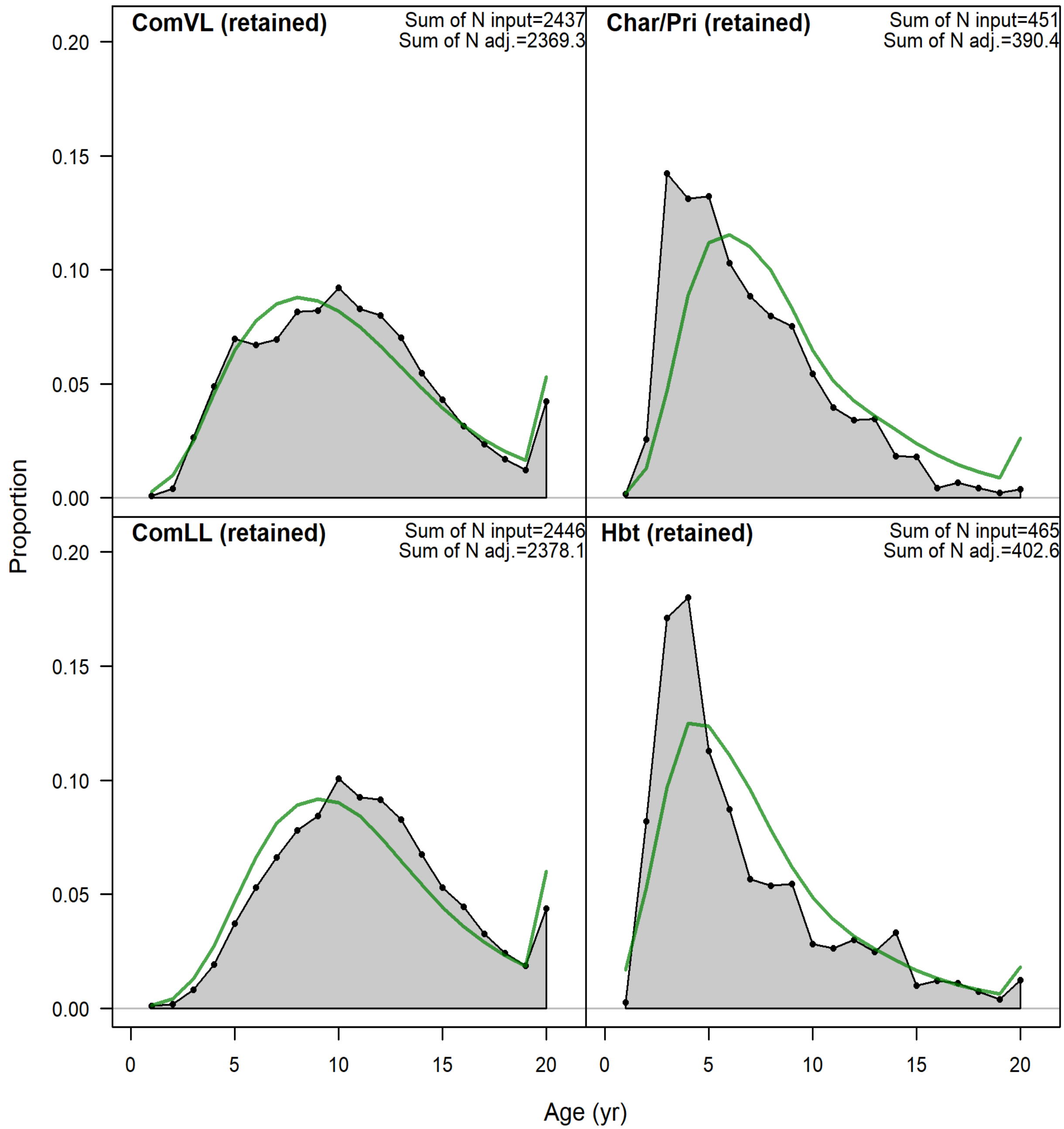


Figure 75. Model fits to the age composition of landed Scamp aggregated across years within a given fleet for the Gulf of Mexico. Green lines represent expected age compositions, while grey shaded regions represent observed age compositions. The input (N input) and adjusted (N adj) sample sizes are provided in the upper right corner of each panel. Abbreviations include: Commercial Vertical Line (ComVL), Commercial Longline (ComLL), Recreational Charter Private (Char/Pri), and Recreational Headboat (Hbt).

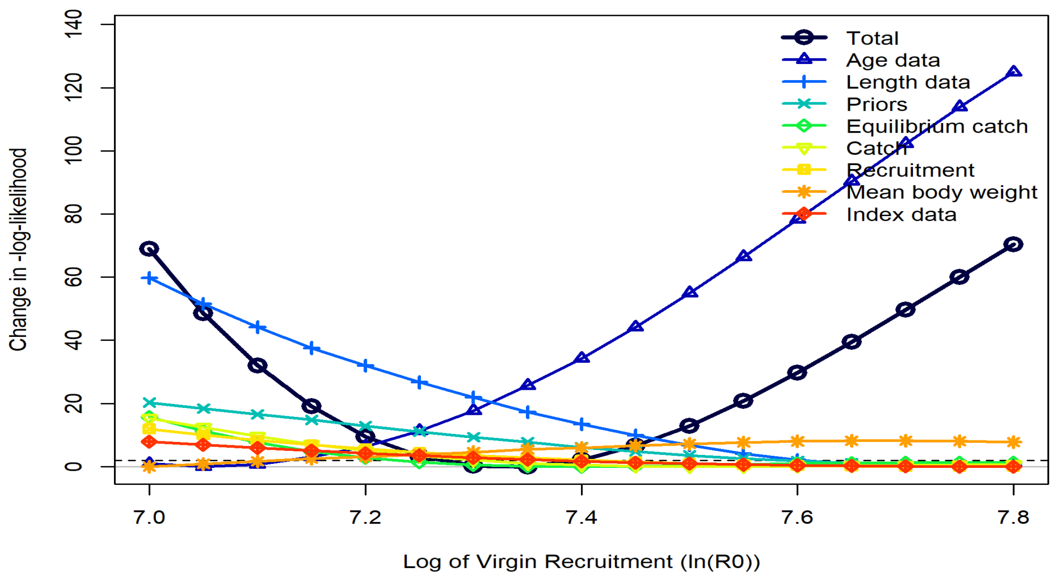


Figure 76. The likelihood profile for the natural log of the virgin recruitment parameter (ln(R_0)) of the Beverton – Holt stock-recruit function for Gulf of Mexico Scamp. Each line represents the change in negative log-likelihood value for each of the data sources fit in the model across the range of fixed values tested. The MLE (CV) for the SEDAR 68 OA Base Model was 7.33 (0.004). The dashed horizontal line at ~1.92 indicates the 95% confidence interval.

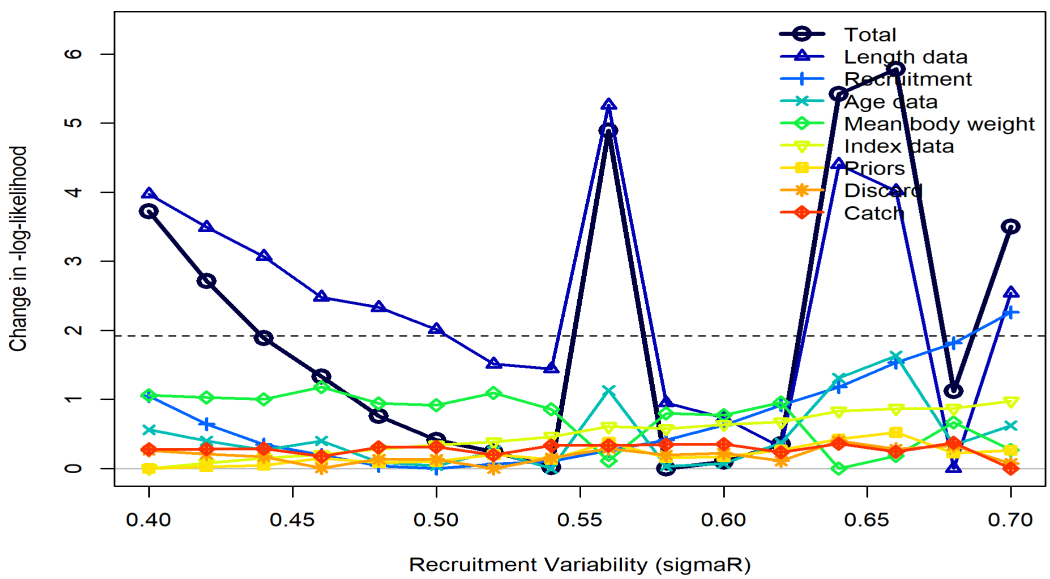


Figure 77. The likelihood profile for the recruitment variability (sigmaR) parameter of the Beverton – Holt stock-recruit function for Gulf of Mexico Scamp. Each line represents the change in negative log-likelihood value for each of the data sources fit in the model across the range of fixed values tested. The MLE (CV) for the SEDAR 68 OA Base Model was 0.562 (0.126). The dashed horizontal line at ~1.92 indicates the 95% confidence interval.

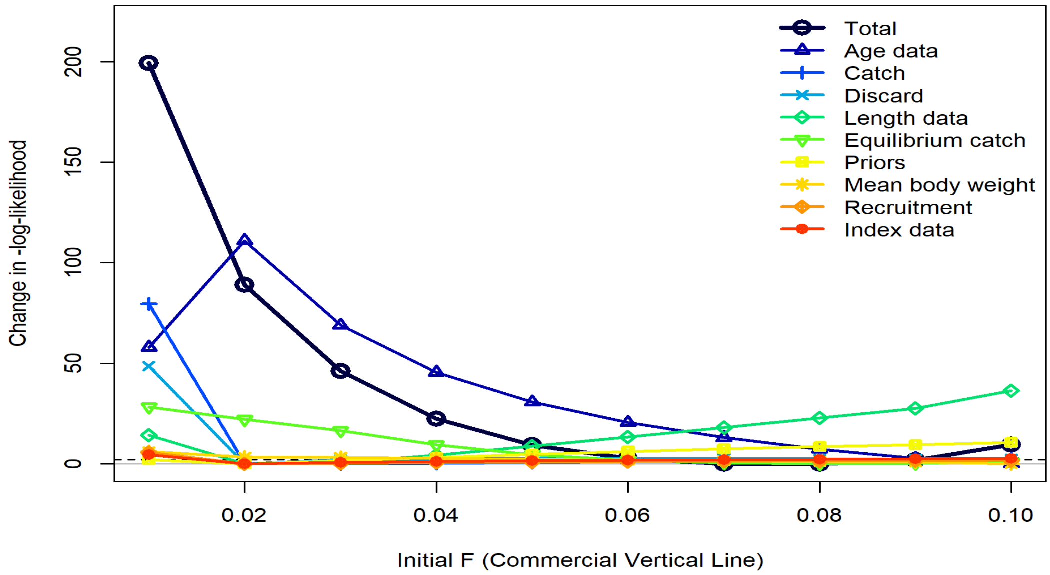


Figure 78. The likelihood profile for the initial fishing mortality rate (F) for the Commercial Vertical Line fleet. Each line represents the change in negative log-likelihood value for each of the data sources fit in the model across the range of fixed values tested. The MLE (CV) for the SEDAR 68 OA Base Model was 0.075 (0.093). The dashed horizontal line at ~1.92 indicates the 95% confidence interval.

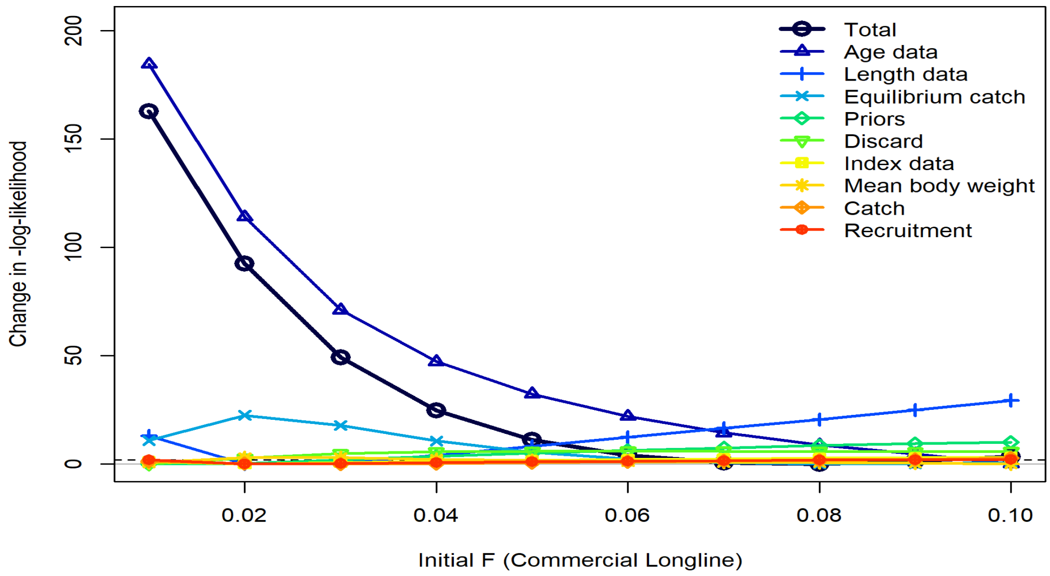


Figure 79. The likelihood profile for the initial fishing mortality rate (F) for the Commercial Longline fleet. Each line represents the change in negative log-likelihood value for each of the data sources fit in the model across the range of fixed values tested. The MLE (CV) for the SEDAR 68 OA Base Model was 0.078 (0.094). The dashed horizontal line at ~1.92 indicates the 95% confidence interval.

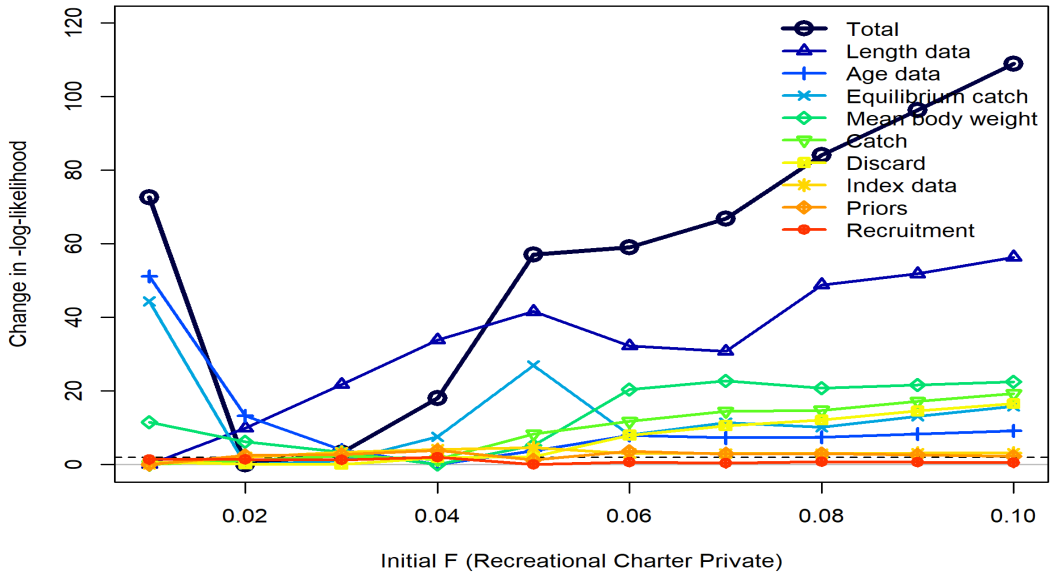


Figure 80. The likelihood profile for the initial fishing mortality rate (F) for the Recreational Charter Private fleet. Each line represents the change in negative log-likelihood value for each of the data sources fit in the model across the range of fixed values tested in the profile diagnostic run. The MLE (CV) for the SEDAR 68 OA Base Model was 0.024 (0.07). The dashed horizontal line at ~1.92 indicates the 95% confidence interval.

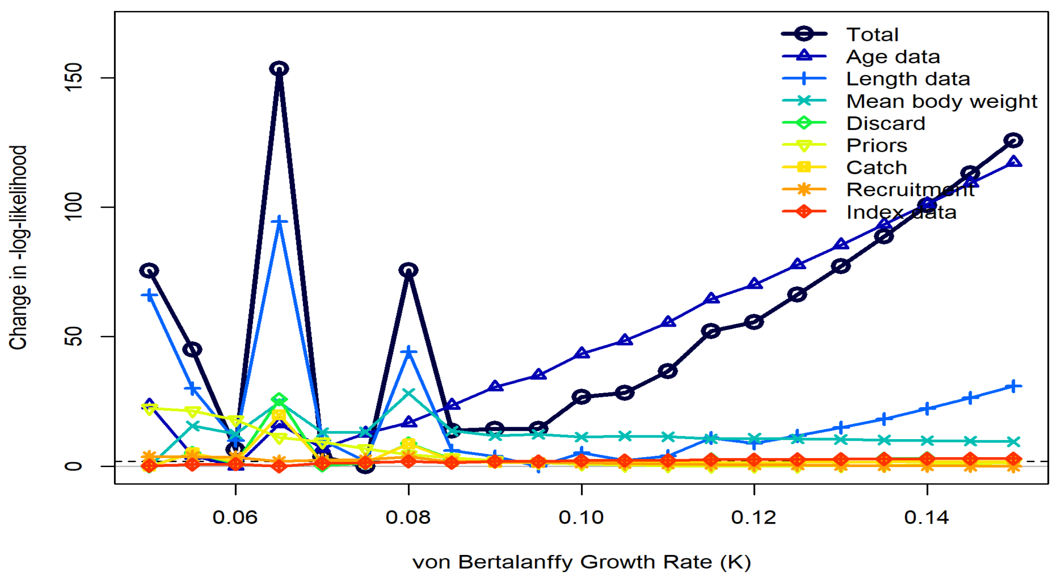


Figure 81. The likelihood profile for the von Bertalanffy growth rate parameter (K). Each line represents the change in negative log-likelihood value for each of the data sources fit in the model across the range of fixed values tested in the profile diagnostic run. The MLE (CV) for the SEDAR 68 OA Base Model was 0.073 (0.052). The dashed horizontal line at ~1.92 indicates the 95% confidence interval.

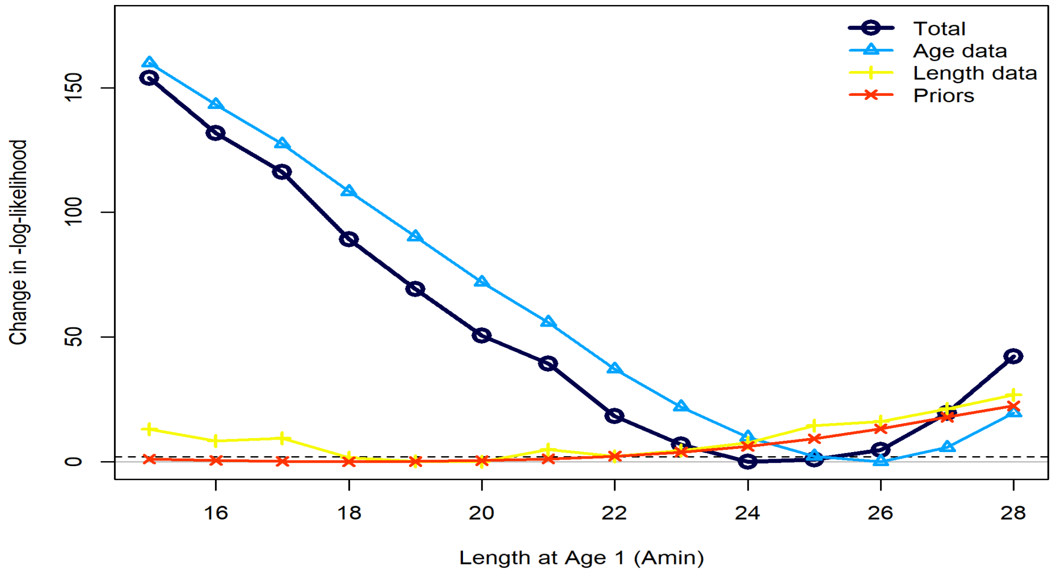


Figure 82. The likelihood profile for the length at the minimum age (1 year) parameter (L_{Amin}). Each line represents the change in negative log-likelihood value for each of the data sources fit in the model across the range of fixed values tested in the profile diagnostic run. The MLE (CV) for the SEDAR 68 OA Base Model was 24.695 (0.016). The dashed horizontal line at ~1.92 indicates the 95% confidence interval.

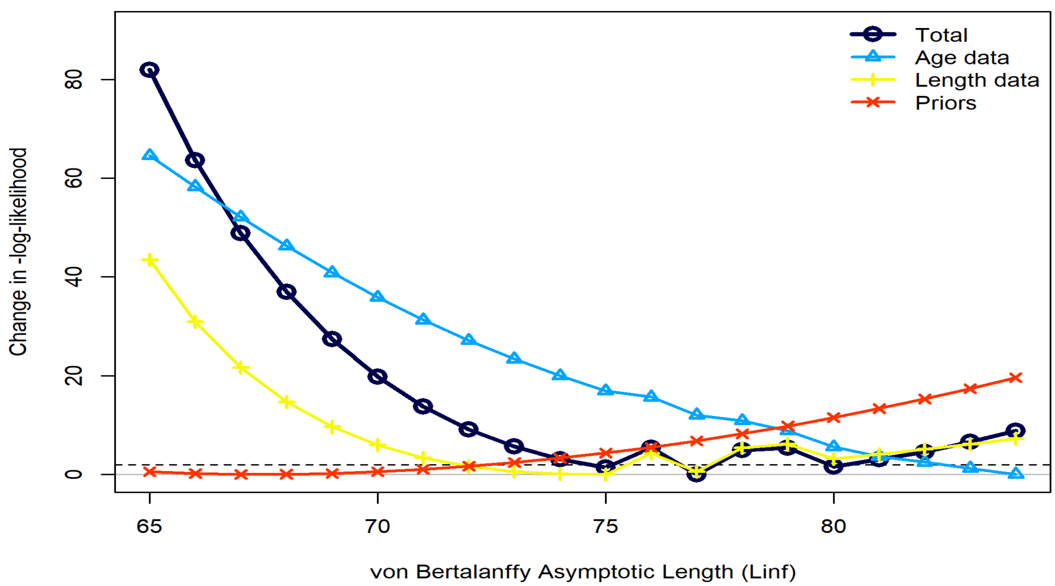


Figure 83. The likelihood profile for the von Bertalanffy asymptotic length parameter (L_{Amax} [i.e., $L\infty$]). Each line represents the change in negative log-likelihood value for each of the data sources fit in the model across the range of fixed values tested in the profile diagnostic run. The MLE (CV) for the SEDAR 68 OA Base Model was 77.289 (0.018). The dashed horizontal line at ~1.92 indicates the 95% confidence interval.

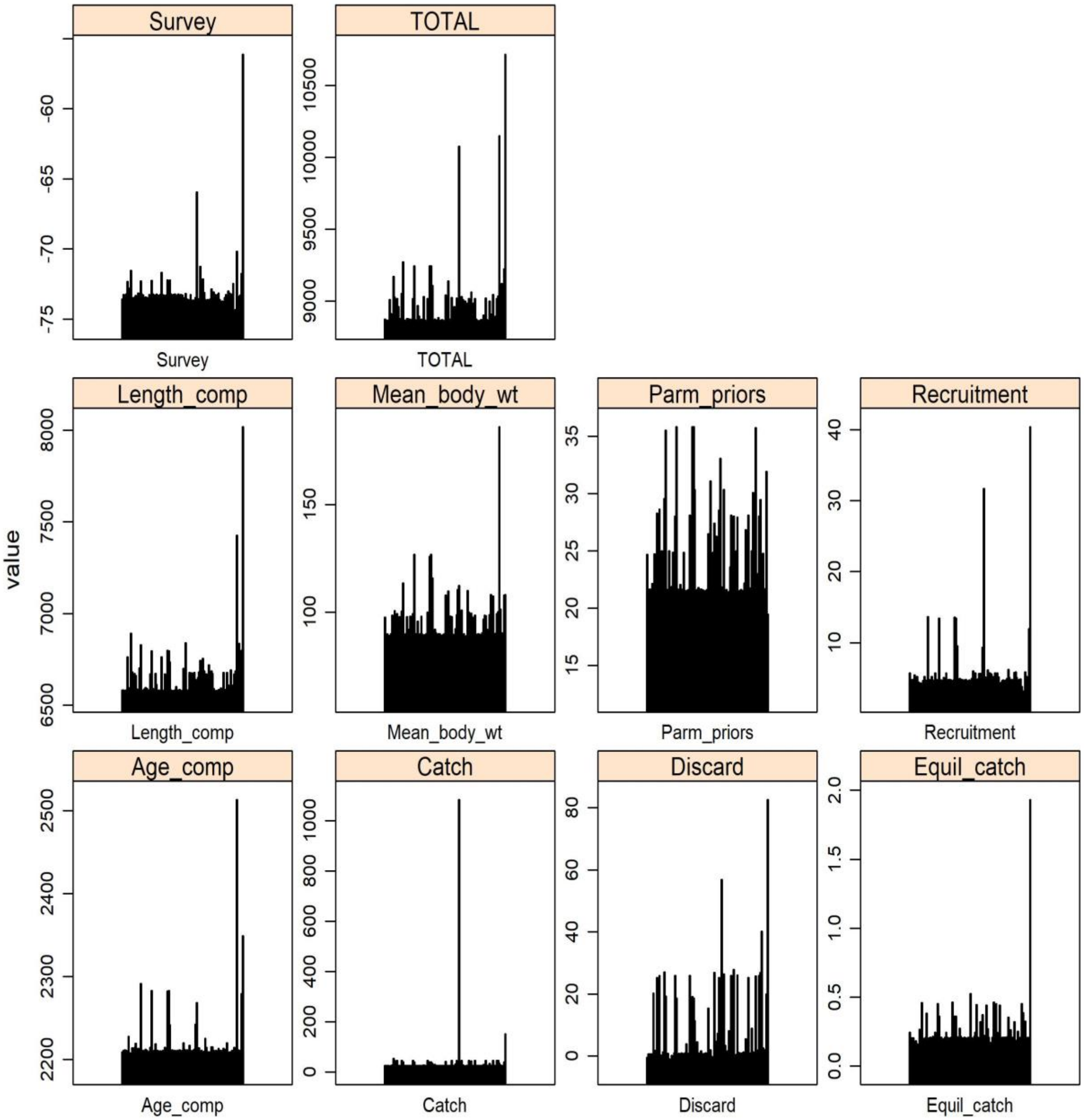


Figure 84. Results of the jitter analysis for various likelihood components for the SEDAR 68 OA Base Model for Gulf of Mexico Scamp. Each panel gives the results of 100 model runs where the starting parameter values for each run were randomly changed ('jittered') by 10% from the SEDAR 68 OA Base Model best fit values. Note that the y-axes differ between panels. Negative log-likelihood components shown from top left through bottom right include: survey, total, length composition (length_comp), mean weight (Mean_body_wt), parameter priors (Parm_priors), recruitment, age composition (Age_comp), catch, discards, and equilibrium catch (Equil_catch).

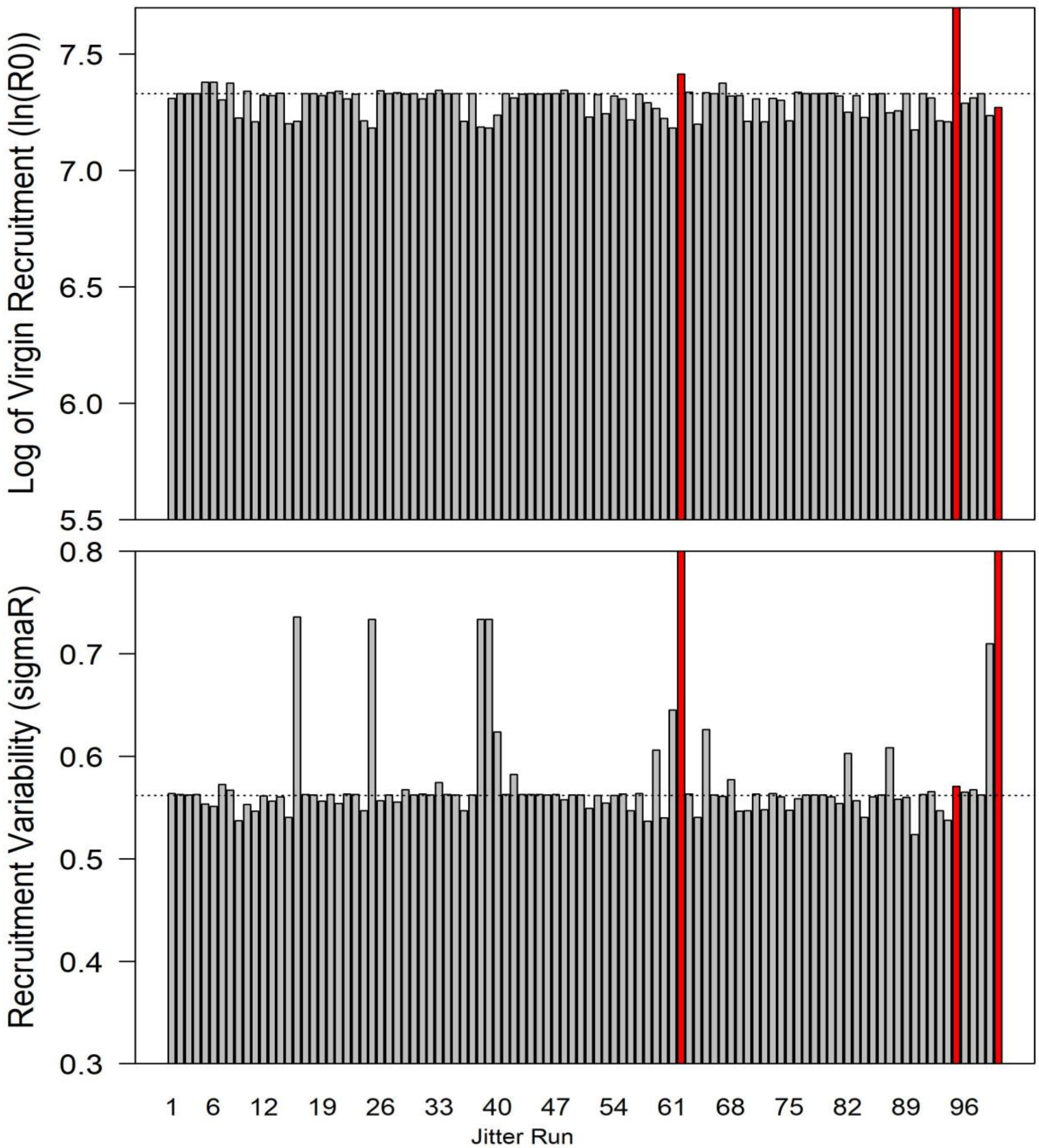


Figure 85. Results of the jitter analysis for the two key recruitment parameters for the SEDAR 68 OA Base Model for Gulf of Mexico Scamp. Each panel gives the model estimates for each parameter from 100 model runs where the starting parameter values for each run were randomly changed ('jittered') by 10% from the SEDAR 68 OA Base Model best fit values (shown in each panel by dashed horizontal lines). Red bars indicate jitter runs which displayed very poor gradients and large negative log-likelihoods and likely reflect models that would not converge.

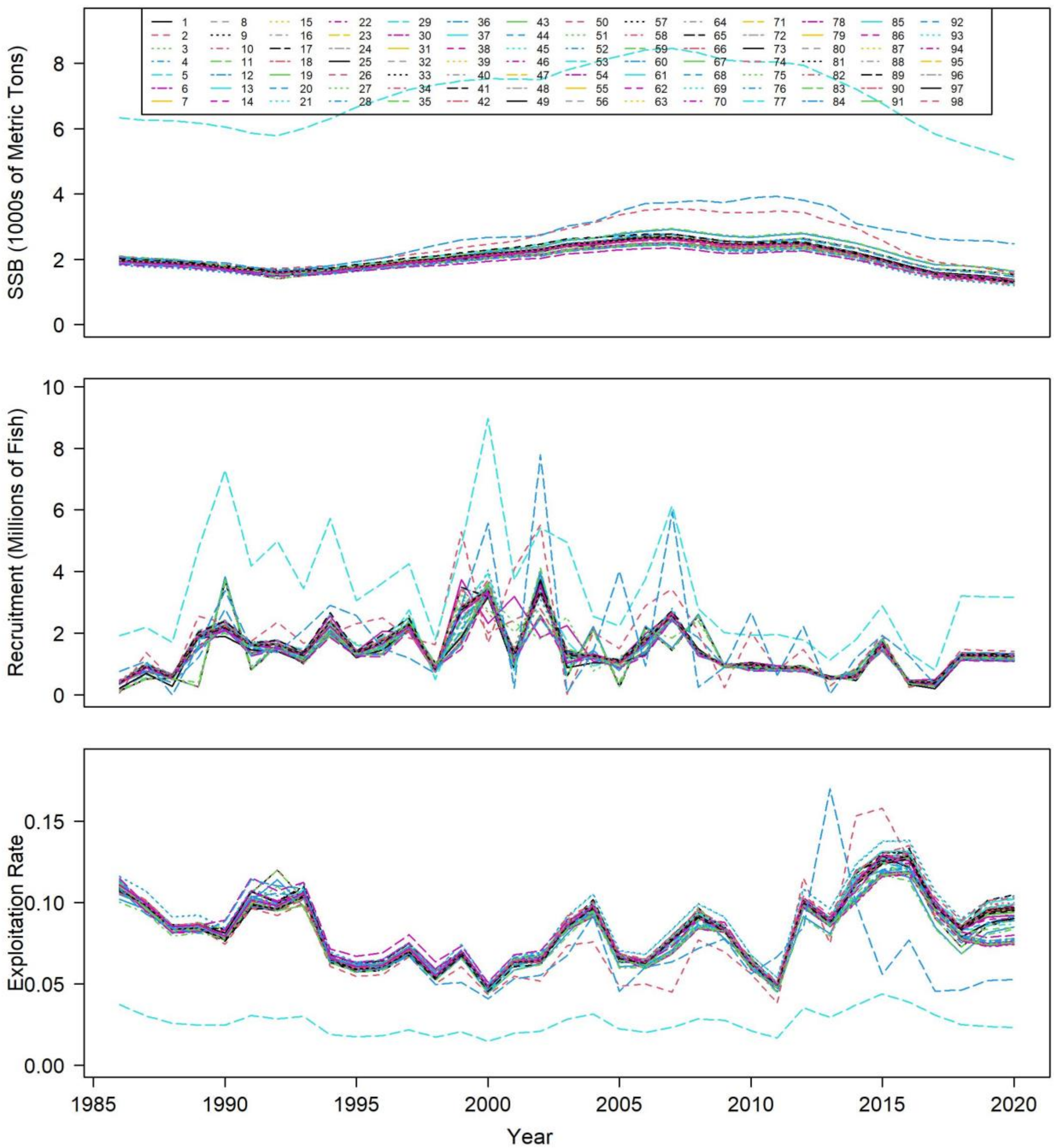


Figure 86. Estimated trajectories in spawning stock biomass (male and female combined SSB in 1,000s of metric tons; top panel), recruitment (millions of fish; middle panel), and fishing mortality (total biomass killed all ages / total biomass age 3+; bottom panel) for the SEDAR 68 OA Base Model for Gulf of Mexico Scamp.

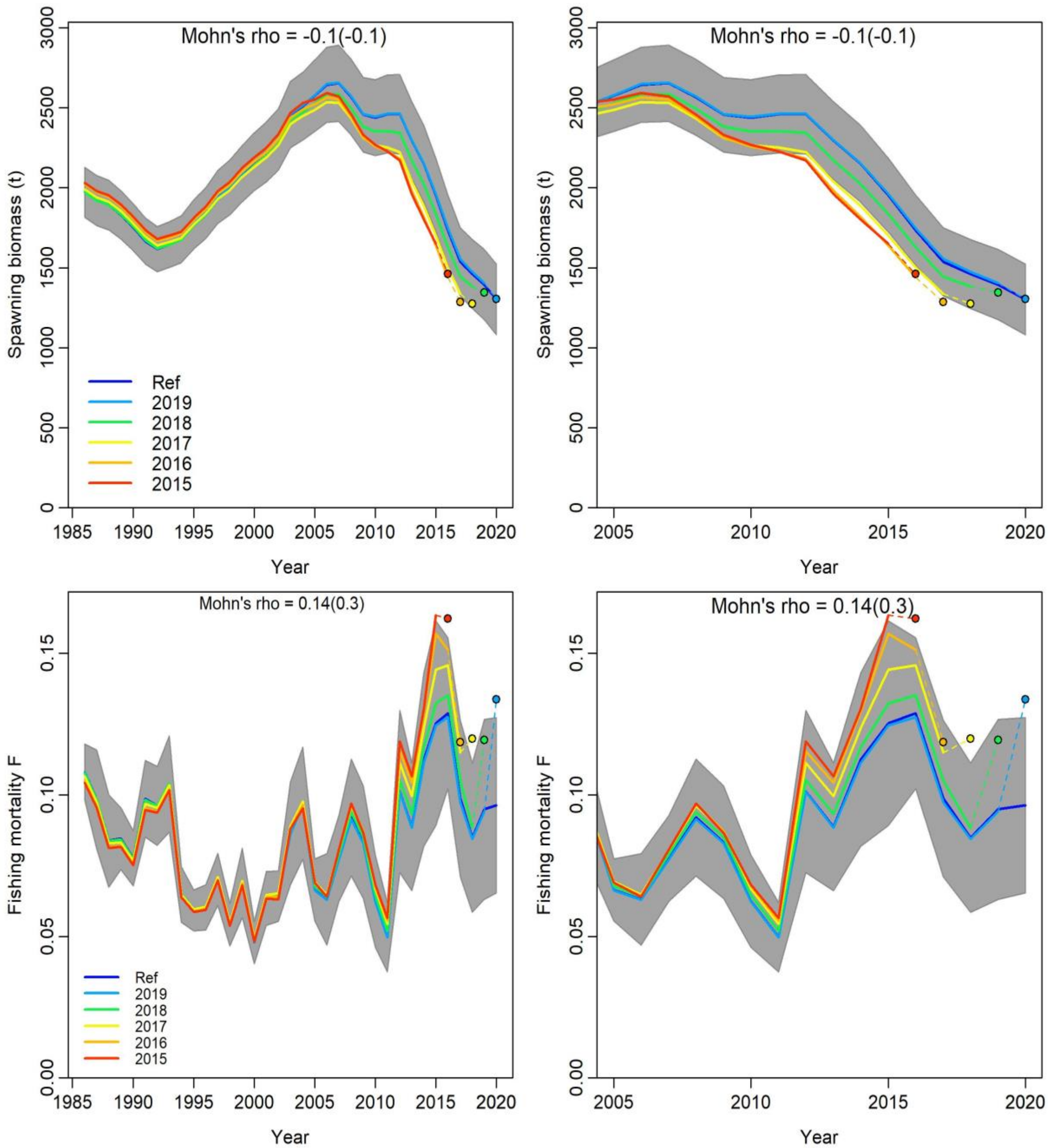


Figure 87. Retrospective analysis of spawning stock biomass (male and female combined SSB, top panels) and fishing mortality (F, bottom panels) estimates for Gulf of Mexico Scamp conducted by re-fitting each reference model (Ref) after removing five years of observations, one year at a time sequentially. The retrospective results are shown for the entire time series and for the most recent years only. Mohn's rho statistic and the corresponding 'hindcast rho' values (in brackets) are printed at the top of each panel. One-year-ahead projections denoted by color-coded dashed lines with terminal points shown for each model. Grey shaded areas are the 95% confidence intervals from the reference model. See Carvalho et al. (2021) for additional details.

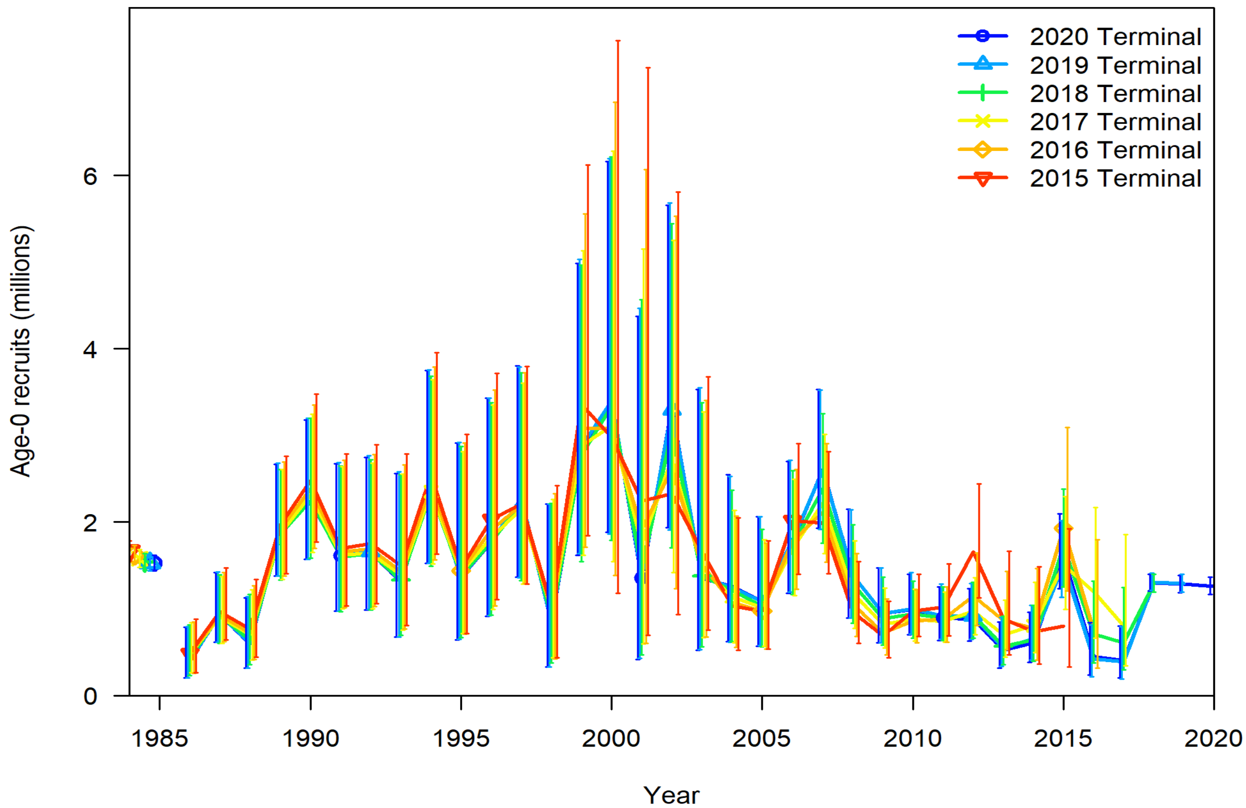


Figure 88. Results of a five year retrospective analysis for recruitment (millions of fish) for the SEDAR 68 OA Base Model for Gulf of Mexico Scamp.

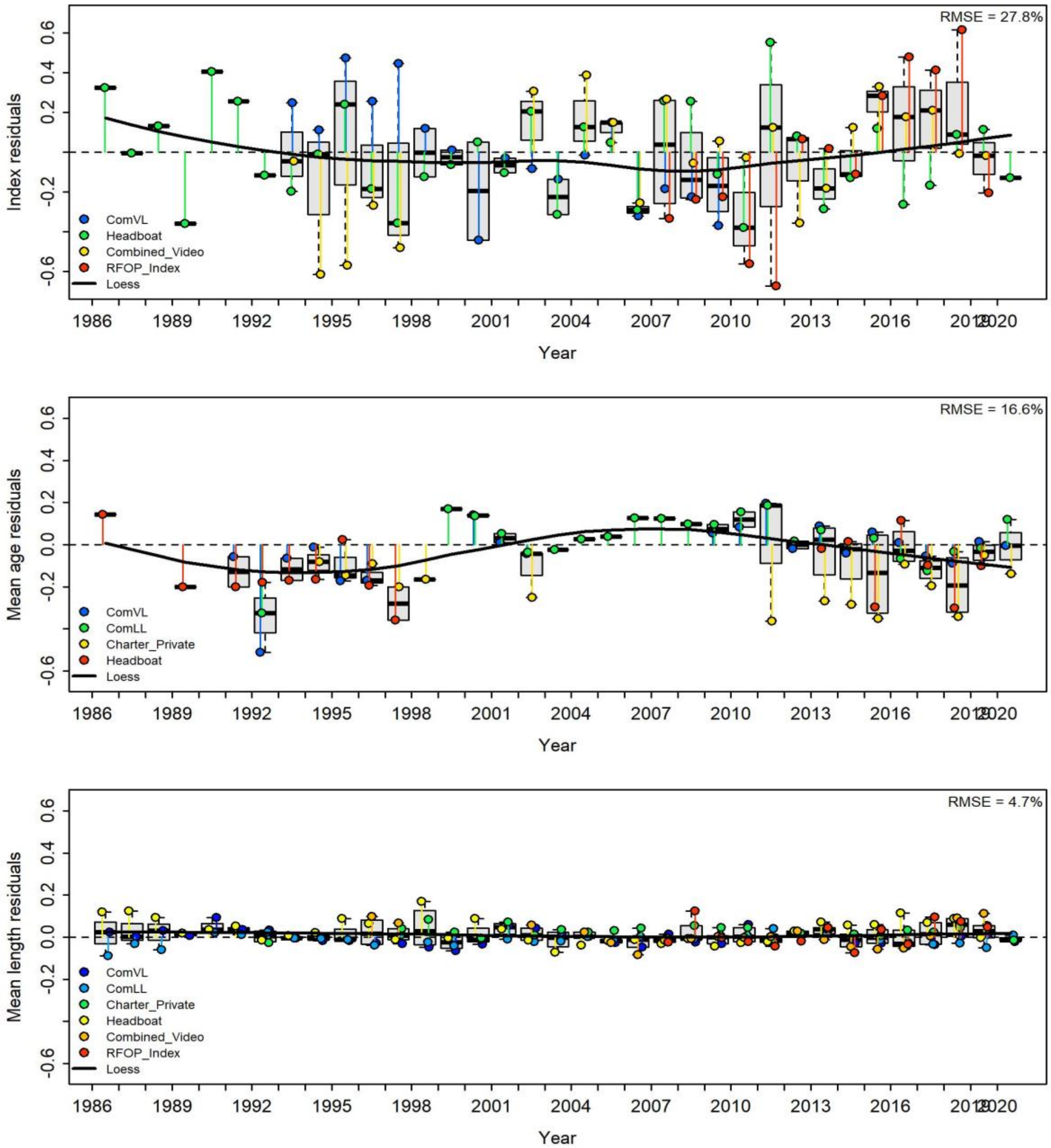


Figure 89. Joint residual plots for indices of abundance fits (top panel), annual mean age estimates (middle panel), and annual mean length estimates (bottom panel) for Gulf of Mexico Scamp. Vertical lines with points show the residuals (in colors by index), and solid black line reflects the loess smoother through all the residuals. Boxplots indicate the median and quantiles in cases where residuals from the multiple indices are available for any given year. Root-mean squared errors (RMSE) are included in the upper right-hand corner of each plot. See Carvalho et al. (2021) for additional details.

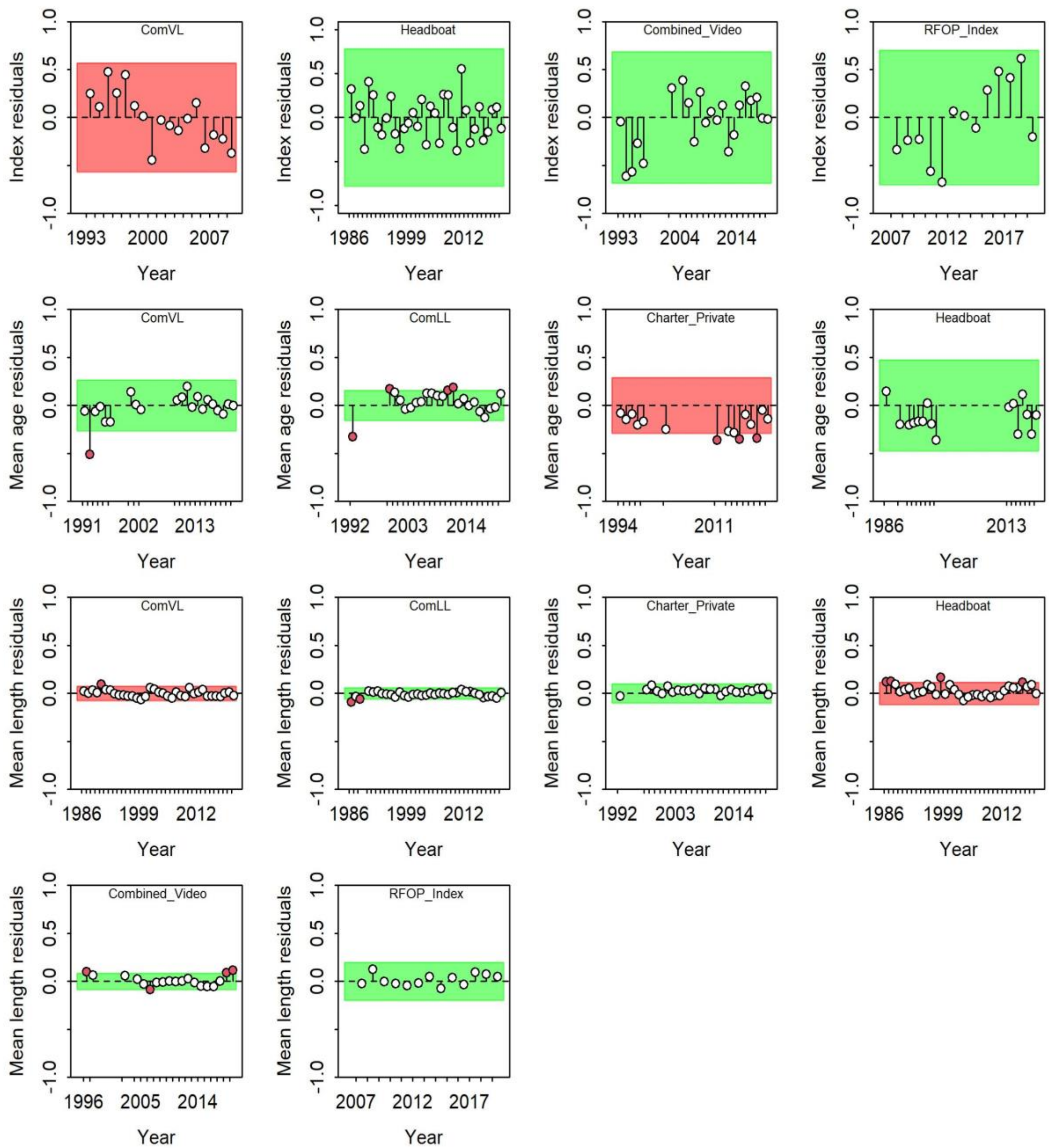


Figure 90. Runs tests results for indices of abundance, mean age, and mean length for Gulf of Mexico Scamp. Green shading indicates no evidence (p >= 0.05) and red shading evidence (p < 0.05) to reject the hypothesis of a randomly distributed time-series of residuals, respectively. The shaded (green/red) area spans three residual standard deviations to either side from zero, and the red points outside of the shading violate the 'three-sigma limit' for that series. See Carvalho et al. (2021) for additional details.

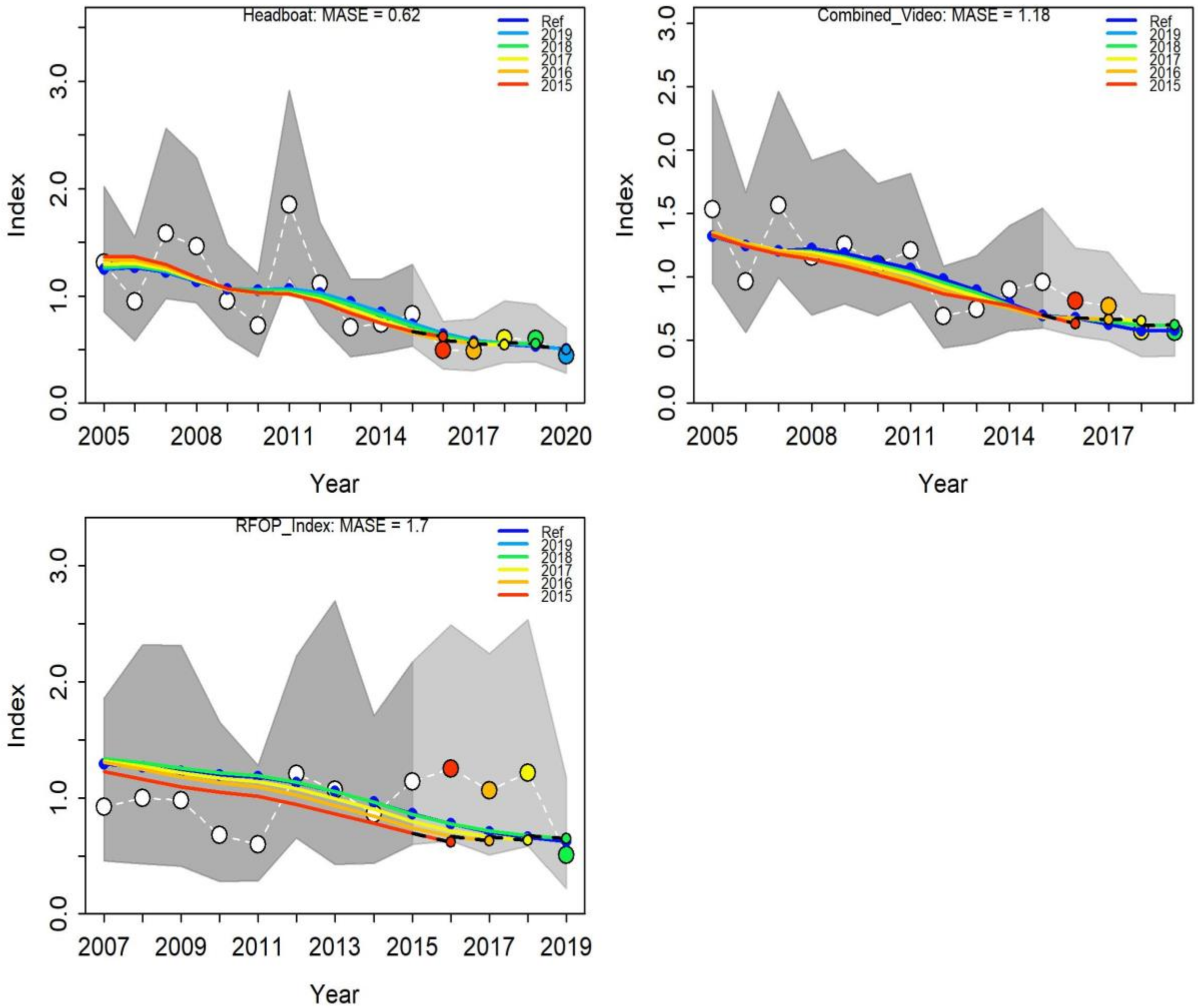


Figure 91. Hindcasting cross-validation (HCxval) results for indices of abundance fits for Gulf of Mexico Scamp. Shown are observed (large points connected with dashed line), fitted (solid lines) and one-year ahead forecast values (small terminal points). HCxval was performed using one reference model (Ref) and five hindcast model runs (solid lines) relative to the expected index. The observations used for cross validation are highlighted as color-coded solid circles with associated 95% confidence intervals (light-grey shading). The model reference year refers to the endpoints of each one-year-ahead forecast and the corresponding observation (i.e., year of peel + 1). The mean absolute scaled error (MASE) score associated with each index time series is denoted in each panel. See Carvalho et al. (2021) for additional details.

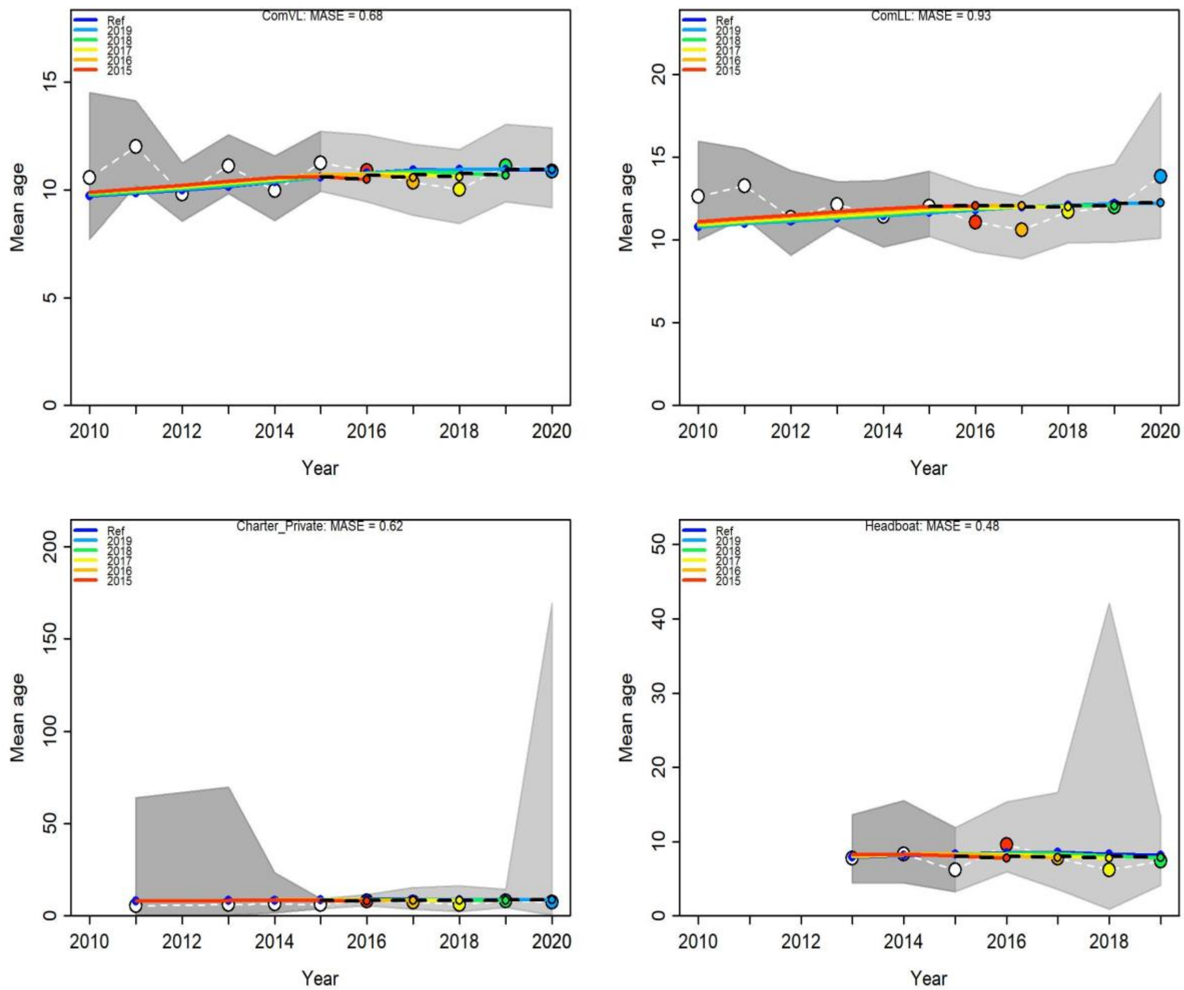


Figure 92. Hindcasting cross-validation (HCxval) results for fits to annual mean age estimates for Gulf of Mexico Scamp. Shown are observed (large points connected with dashed line), fitted (solid lines) and one-year ahead forecast values (small terminal points). HCxval was performed using one reference model (Ref) and five hindcast model runs (solid lines) relative to the expected mean age. The observations used for cross-validation are highlighted as color-coded solid circles with associated 95% confidence intervals (light-grey shading). The model reference year refers to the endpoints of each one-year-ahead forecast and the corresponding observation (i.e., year of peel + 1). The mean absolute scaled error (MASE) score associated with each age composition time series is denoted in each panel. See Carvalho et al. (2021) for additional details.

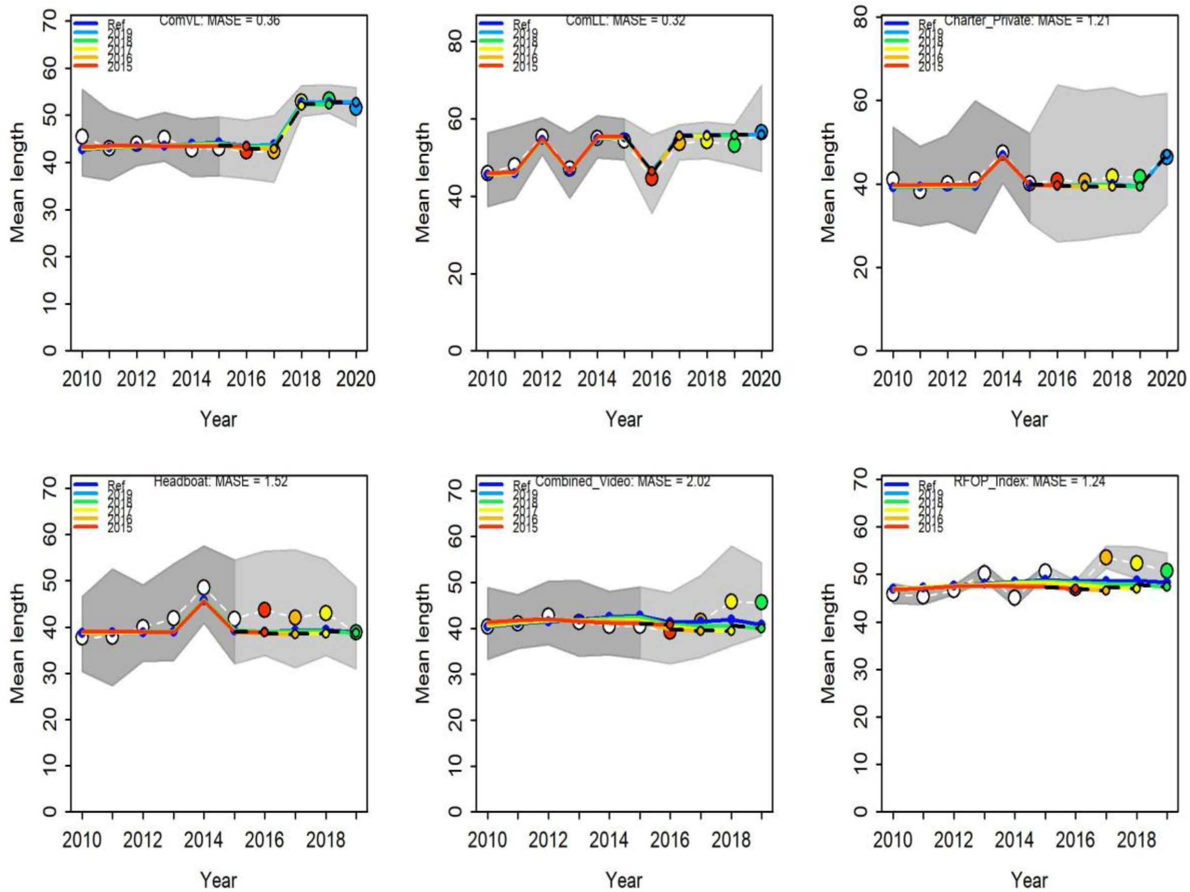


Figure 93. Hindcasting cross-validation (HCxval) results for fits to annual mean length estimates for Gulf of Mexico Scamp. Shown are observed (large points connected with dashed line), fitted (solid lines) and one-year ahead forecast values (small terminal points). HCxval was performed using one reference model (Ref) and five hindcast model runs (solid lines) relative to the expected mean length. The observations used for cross-validation are highlighted as color-coded solid circles with associated 95% confidence intervals (light-grey shading). The model reference year refers to the endpoints of each one-year-ahead forecast and the corresponding observation (i.e., year of peel + 1). The mean absolute scaled error (MASE) score associated with each size composition time series is denoted in each panel. See Carvalho et al. (2021) for additional details.

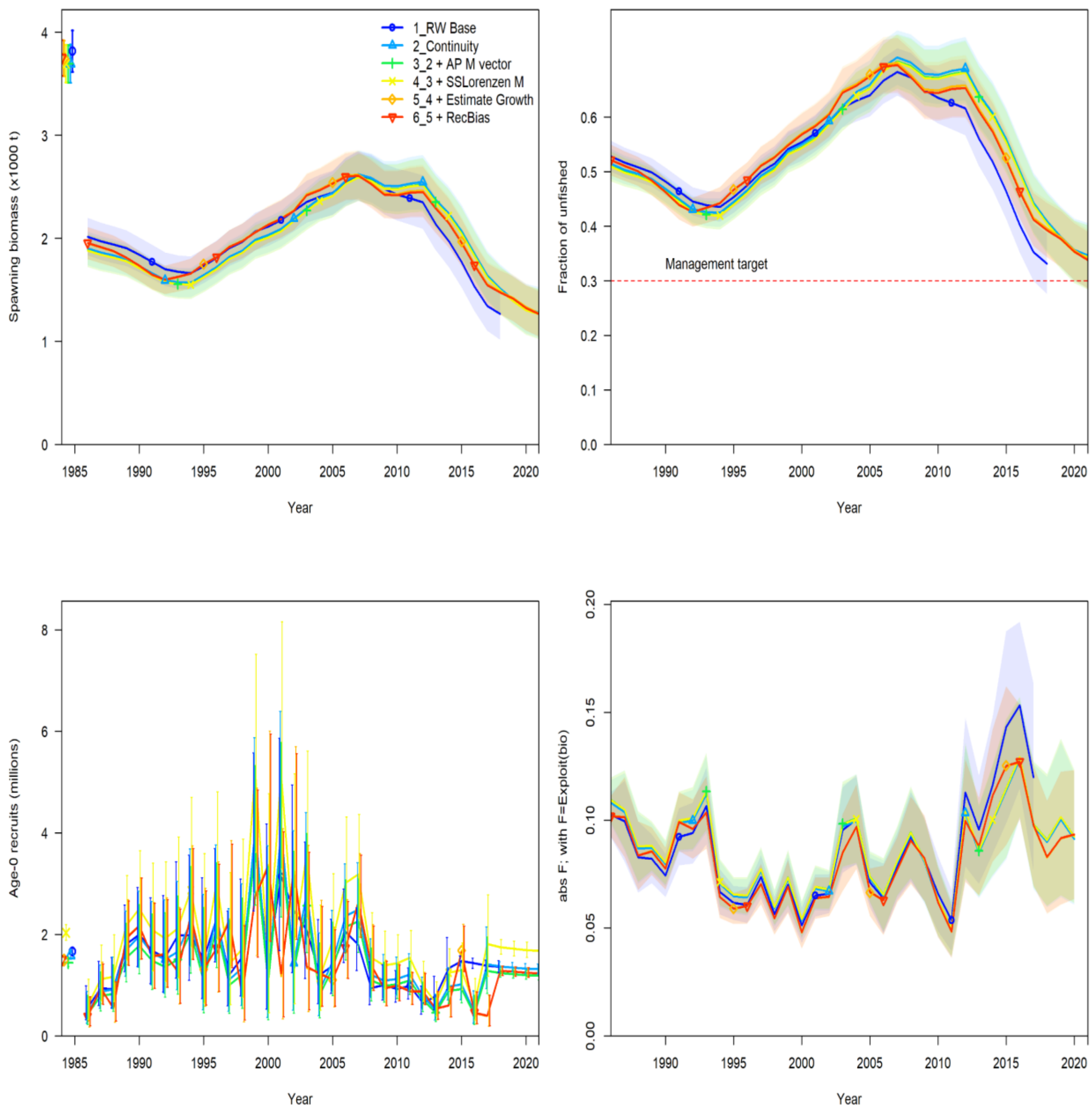


Figure 94. Bridging analysis showing phase 1 changes in estimates of spawning stock biomass (male and female combined SSB in 1,000s of metric tons; top left panel), the ratio of SSB to virgin SSB (top right panel), recruitment (millions of fish; bottom left panel), and fishing mortality (total biomass killed all ages / total biomass age 3+; bottom right panel) and associated uncertainty through each major step of model building between the SEDAR 68 RW Base Model (Step 1) and the SEDAR 68 OA Base Model (Step 12).

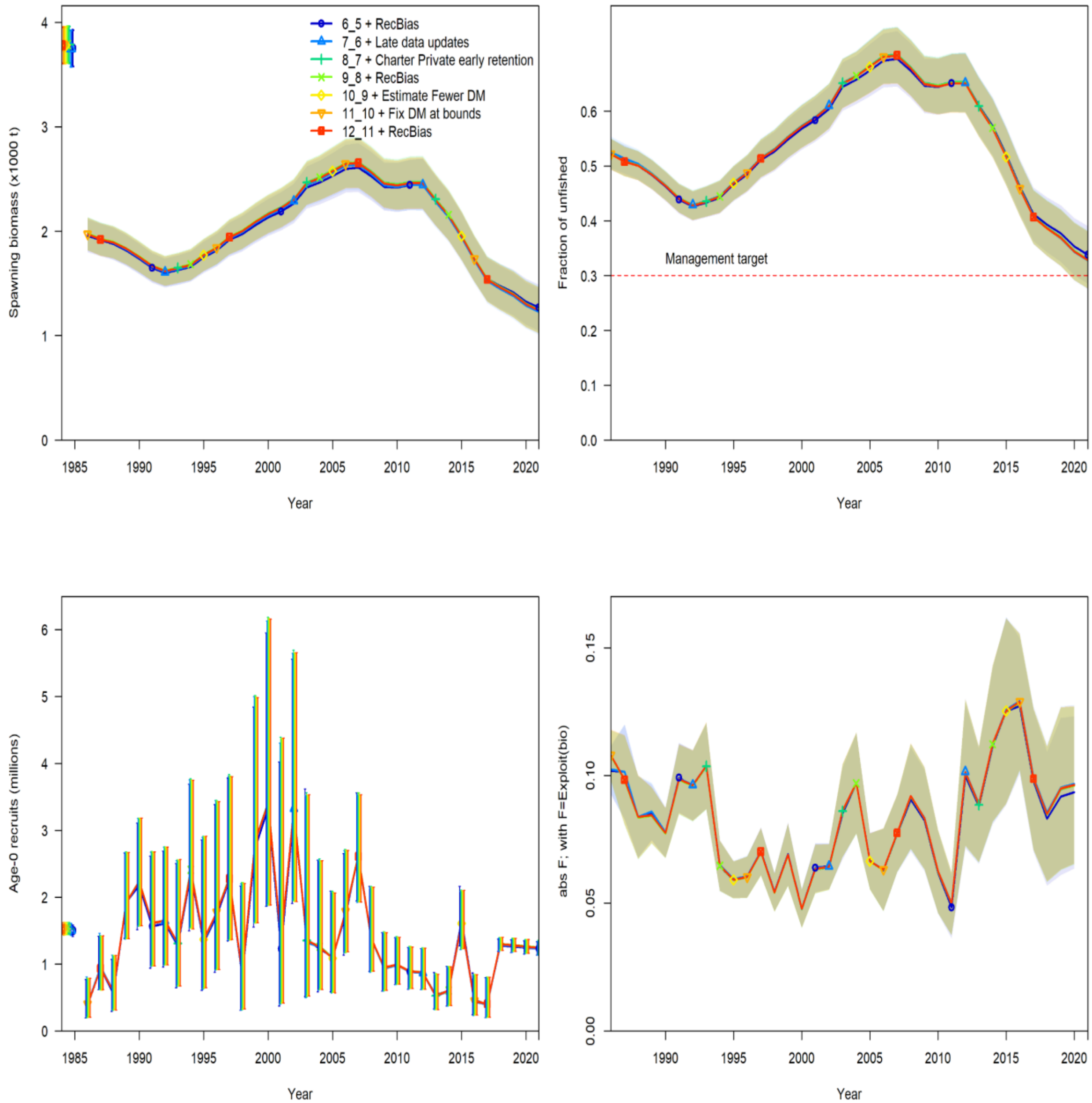


Figure 95. Bridging analysis showing phase 2 changes in estimates of spawning stock biomass (male and female combined SSB in 1,000s of metric tons; top left panel), the ratio of SSB to virgin SSB (top right panel), recruitment (millions of fish; bottom left panel), and fishing mortality (total biomass killed all ages / total biomass age 3+; bottom right panel) and associated uncertainty through each major step of model building between the SEDAR 68 RW Base Model (Step 1) and the SEDAR 68 OA Base Model (Step 12).

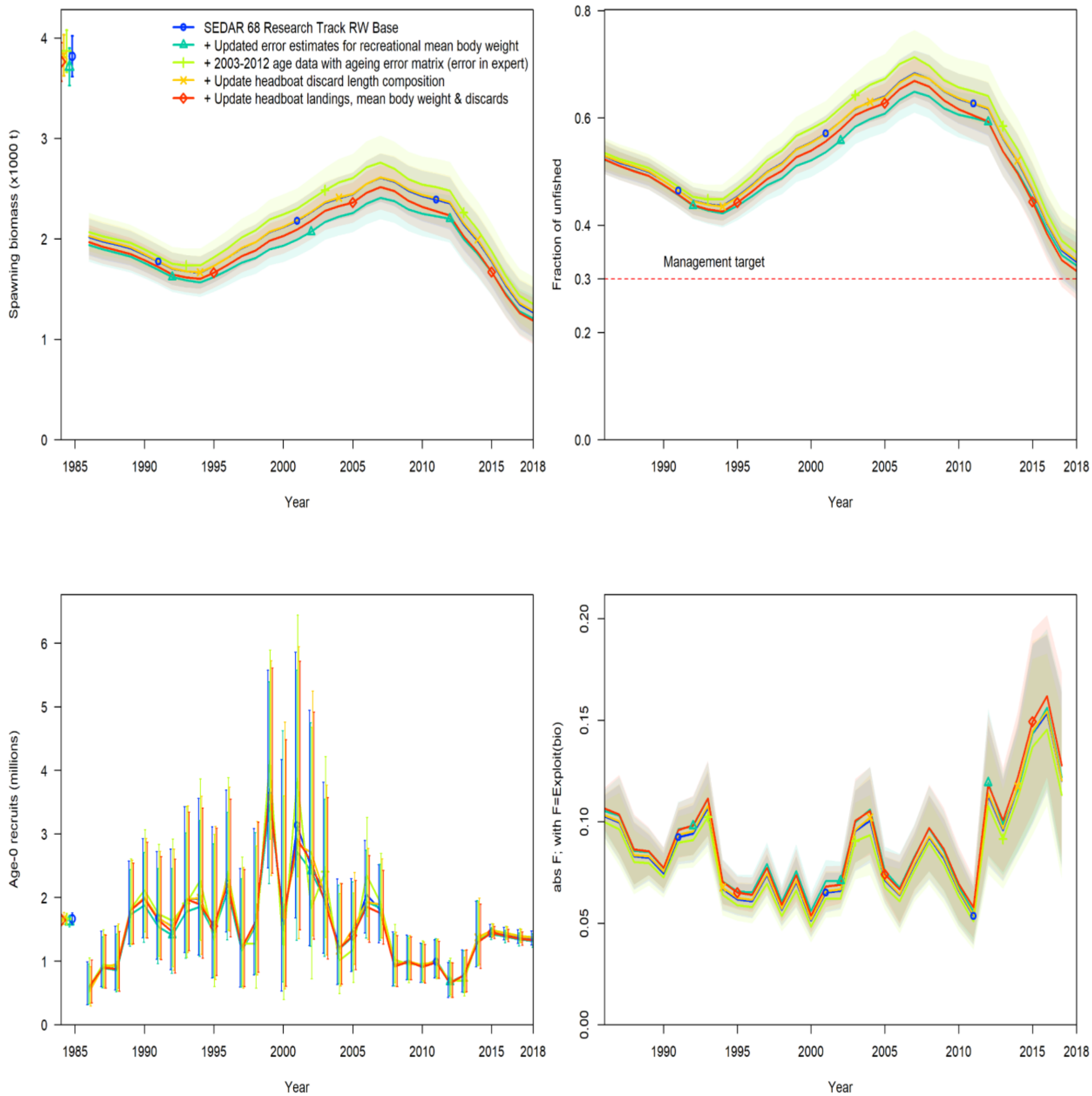


Figure 96. Comparison showing changes in estimates of spawning stock biomass (male and female combined SSB in 1,000s of metric tons; top left panel), the ratio of SSB to virgin SSB (top right panel), recruitment (millions of fish; bottom left panel), and fishing mortality (total biomass killed all ages / total biomass age 3+; bottom right panel), and associated uncertainty with major data changes for the SEDAR 68 RW Base Model for Gulf of Mexico Scamp.

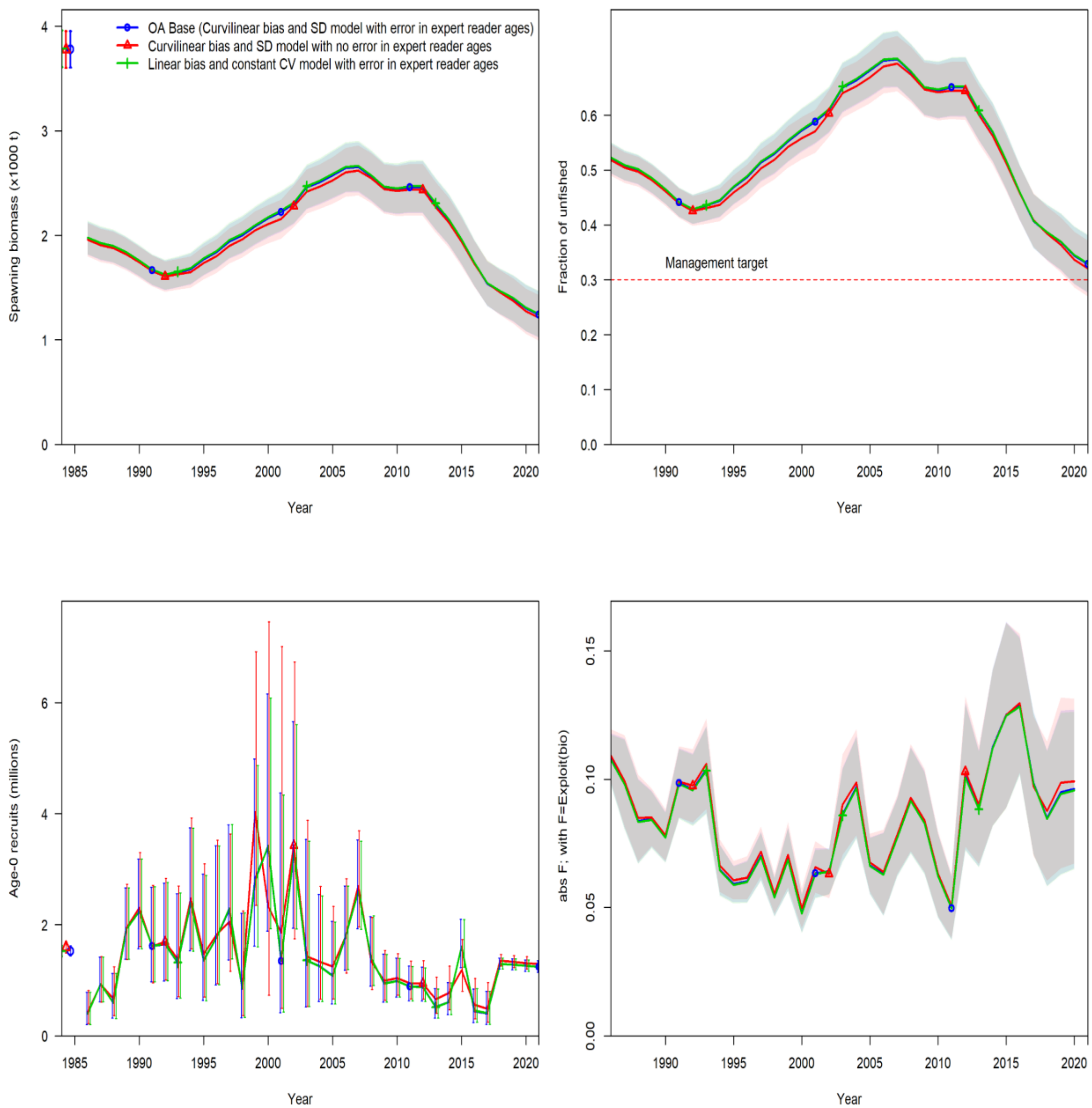


Figure 97. Estimates of spawning stock biomass (male and female combined SSB in 1,000s of metric tons; top left panel), the ratio of SSB to virgin SSB (top right panel), recruitment (millions of fish; bottom left panel), and fishing mortality (total biomass killed all ages / total biomass age 3+; bottom right panel) for the sensitivity runs evaluating the ageing error matrix conducted for the SEDAR 68 OA Base Model for Gulf of Mexico Scamp.

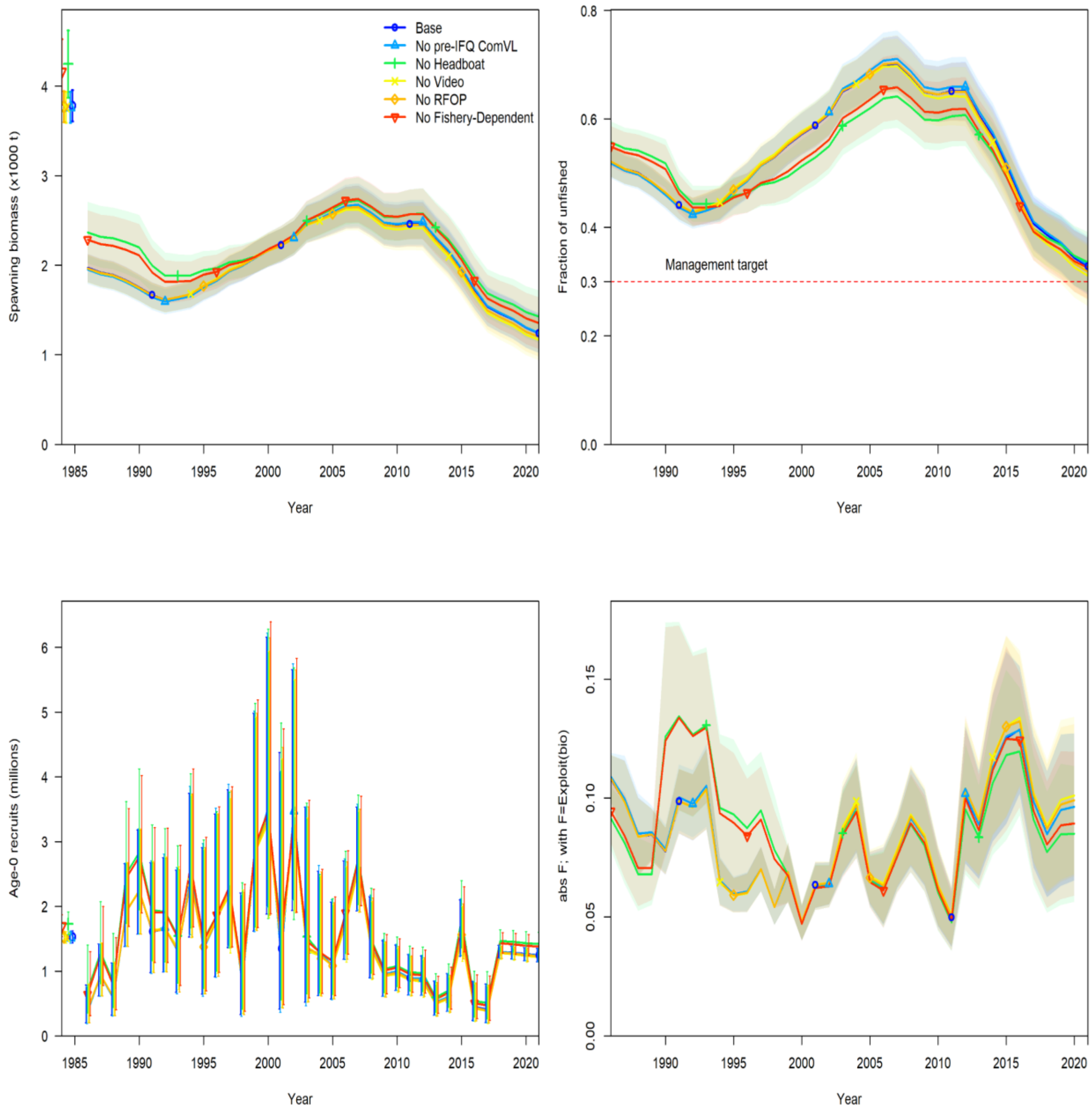


Figure 98. Estimates of spawning stock biomass (male and female combined SSB in 1,000s of metric tons; top left panel), the ratio of SSB to virgin SSB (top right panel), recruitment (millions of fish; bottom left panel), and fishing mortality (total biomass killed all ages / total biomass age 3+; bottom right panel) for the sensitivity runs removing each index of abundance conducted for the SEDAR 68 OA Base Model for Gulf of Mexico Scamp.

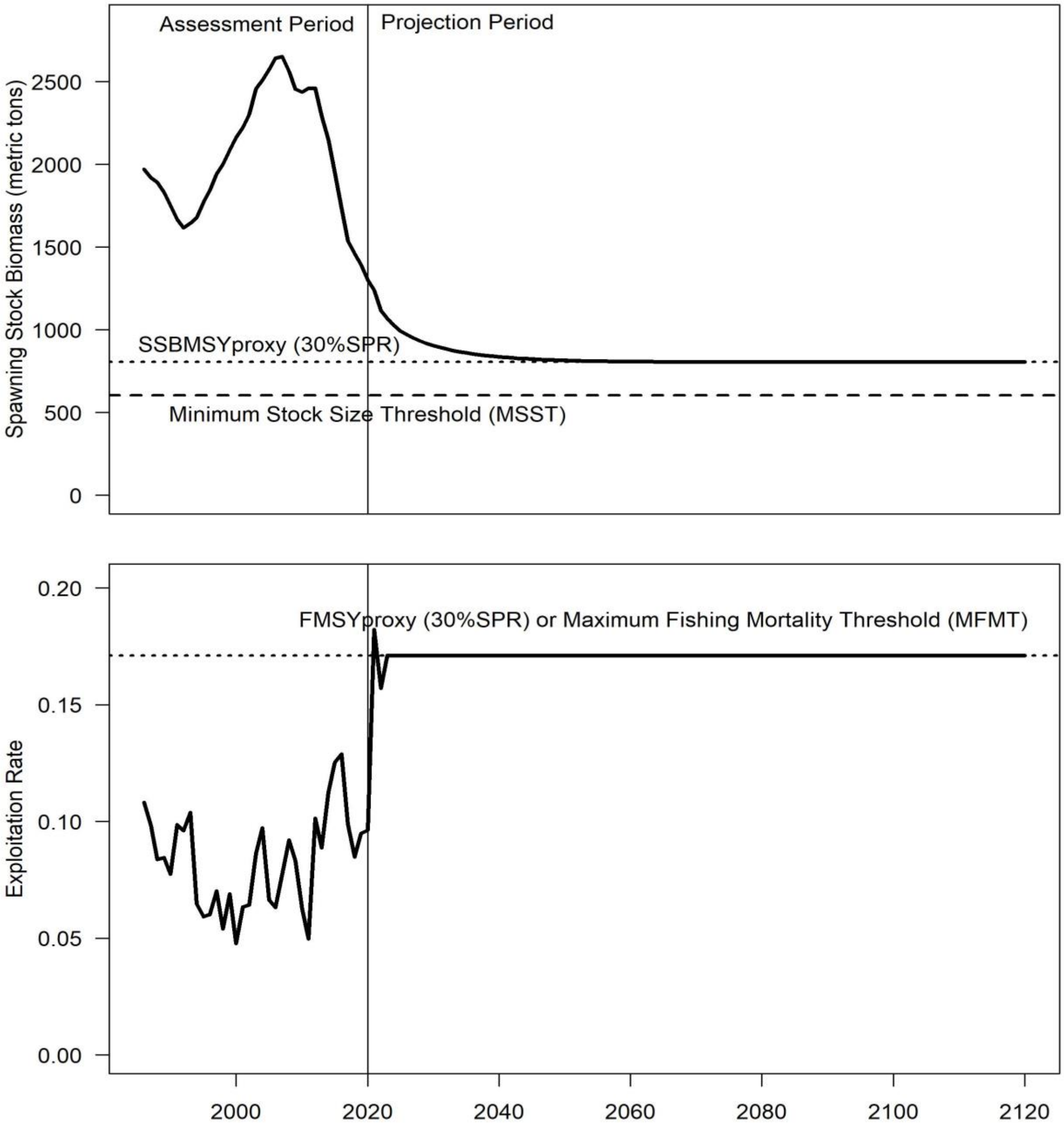


Figure 99. Time series of SSB (male and female combined SSB) and exploitation rate (total biomass killed all ages / total biomass age 3+) with respect to status determination criteria for the SEDAR 68 Gulf of Mexico Scamp Operational Assessment.

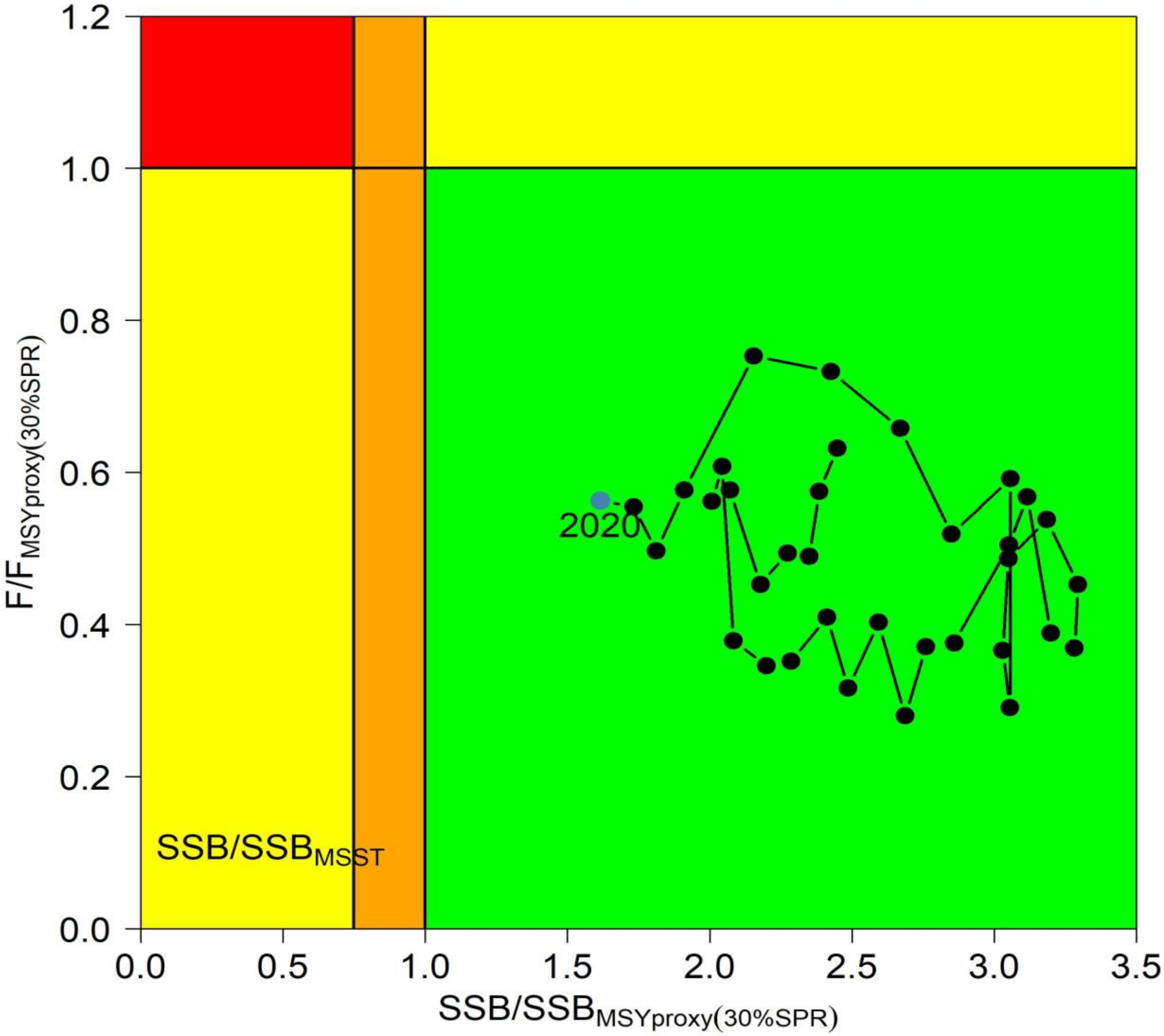


*Figure 100. Kobe plot illustrating the trajectory of stock status for Gulf of Mexico Scamp. The orange coloring indicates regions where the stock is below the biomass target but above the biomass threshold (MSST = 0.75 x $SSB_{30\%SPR}$). The 2020 terminal year stock status is indicated by the gray dot. See **Table 40** for values. SSB defined as male and female combined SSB.*

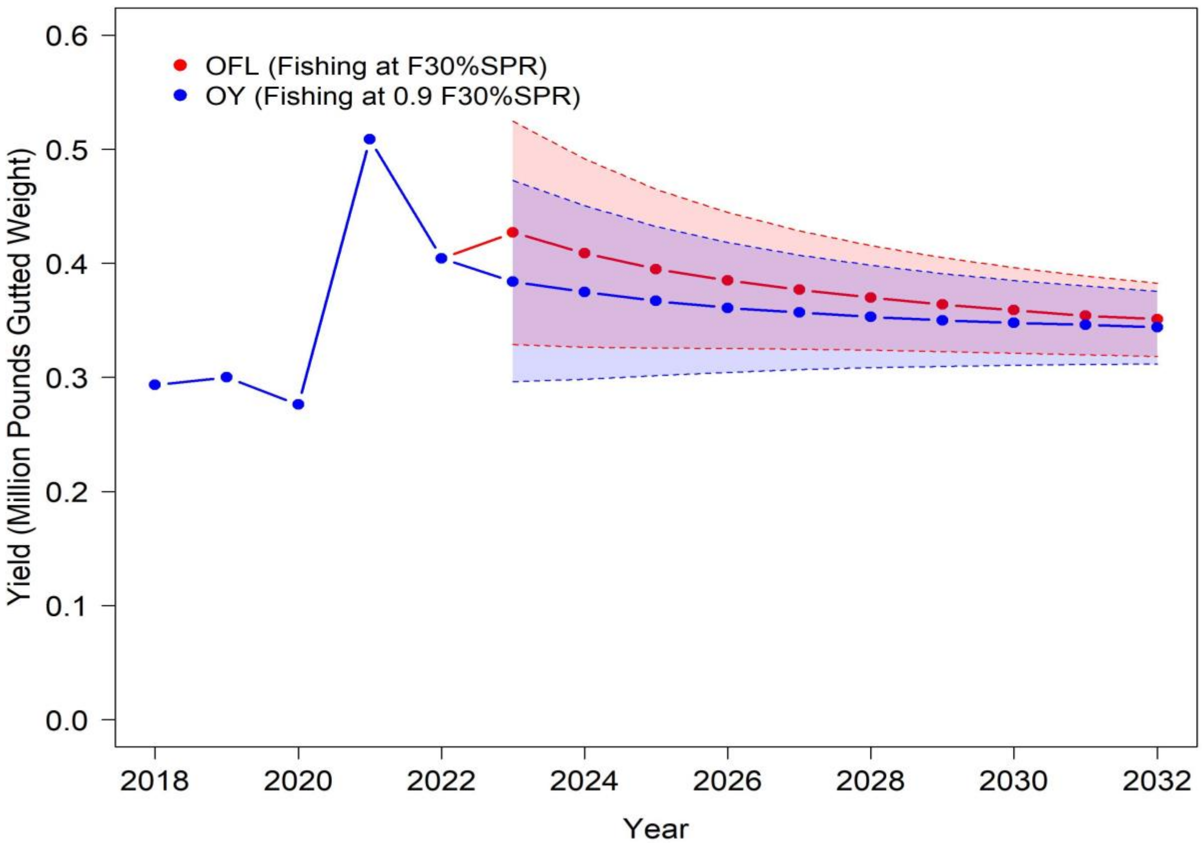


Figure 101. Historic (2018-2020), interim (2021-2022) and forecasted yields (2023+) for the OFL and OY projections for Gulf of Mexico Scamp with recruitment predicted by the spawner-recruit curve.