SEDAR
Southeast Data, Assessment, and Review

SEDAR 43
Stock Assessment Report

Gulf of Mexico Gray Triggerfish

August 2015

SEDAR
4055 Faber Place Drive, Suite 201
North Charleston, SC 29405

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SEDAR

Southeast Data, Assessment, and Review

SEDAR 43

Gulf of Mexico Gray Triggerfish

SECTION I: Introduction

SEDAR
4055 Faber Place Drive, Suite 201
North Charleston, SC 29405

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; and Interstate Commission representatives: Executive Directors of the Atlantic States and Gulf States Marine Fisheries Commissions.

SEDAR is organized around two workshops and a series of webinars. First is the Data Workshop, during which fisheries, monitoring, and life history data are reviewed and compiled. The second stage is the Assessment Process, which is conducted via a series of webinars, during which assessment models are developed and population parameters are estimated using the information provided from the Data Workshop. Third and final is the Review Workshop, during which independent experts review the input data, assessment methods, and assessment products. The completed assessment, including the reports of all 3 workshops and all supporting documentation, is then forwarded to the Council SSC for certification as 'appropriate for management' and development of specific management recommendations.

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.

SEDAR Review Workshop Panels consist of a chair, 3 reviewers appointed by the Center for Independent Experts (CIE), and three reviewers appointed from the SSC of the Council having jurisdiction over the stocks being assessed. The Review Workshop Chair is appointed by the Council from their SSC. Participating councils may appoint additional representatives of their SSC, Advisory, and other panels as observers.

2. MANAGEMENT OVERVIEW

2.1. Reef Fish Fishery Management Plan and Amendments

Original 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; and, (2) data reporting requirements.

Description of Action	FMP/Amendment	Effective Date
Allowed 2-day charter-for-hire possession limit on trips that extend beyond 24 hours, provided the vessel has two licensed operators aboard, and each passenger can provide a receipt to verify the length of the trip. Limited other fishermen fishing under a bag limit to a single day possession limit. Established a longline and buoy gear boundary at approximately the 50 fathom depth contour west of Cape San Blas, Florida and the 20 fathom depth contour east of Cape San Blas, inshore of which the directed harvest of reef fish with longlines and buoy gear was prohibited and the retention of reef fish captured incidentally in other longline operations (e.g., sharks) was limited to the recreational bag limit. Limited trawl vessels to the recreational size and bag limits of reef fish. Established fish trap permits, allowing up to a maximum of 100 fish traps per permit holder. Prohibited the use of entangling nets for directed harvest of reef fish. Retention of reef fish caught in entangling nets for other fisheries was limited to the recreational bag limit. Established the fishing year to be January 1 through December 31.	Amendment 1	1990
Commercial reef fish permit moratorium established for three years	Amendment 4	1992

Fish trap endorsement and three year moratorium established	Amendment 5	1994
Extended commercial reef fish permit moratorium until January 1996.	Amendment 9	1994
Commercial reef fish permit moratorium extended until December 30, 2000. Reef fish permit requirement established for headboats and charter vessels.	Amendment 11	1996
10-year phase-out of fish traps in EEZ established (February 7, 1997 – February 7, 2007).	Amendment 14	1997
Established a 12" total length minimum size limit.	Amendment 16B	1999
Commercial reef fish permit moratorium extended until December 31, 2005.	Amendment 17	2000
(1) Prohibits vessels from retaining reef fish caught under recreational bag/possession limits when commercial quantities of Gulf reef fish are aboard, (2) adjusts the maximum crew size on charter vessels that also have a commercial reef fish permit and a USCG certificate of inspection (COI) to allow the minimum crew size specified by the COI when the vessel is fishing commercially for more than 12 hours, (3) prohibits the use of reef fish for bait except for sand perch or dwarf sand perch, and (4) requires electronic VMS aboard vessels with federal reef fish permits, including vessels with both commercial and charter vessel permits (implemented May 6, 2007).	Amendment 18A	2006
Also known as Generic Essential Fish Habitat (EFH) Amendment 2. Established two marine reserves off the Dry Tortugas where fishing for any species and anchoring by fishing vessels is prohibited.	Amendment 19	2002

3-year moratorium on reef fish charter/headboat permits established	Amendment 20	2002, but implementation deferred until June 16, 2003
Continued the Steamboat Lumps and Madison-Swanson reserves for an additional six years, until June 2010. In combination with the initial four-year period (June 2000-June 2004), this allowed a total of ten years in which to evaluate the effects of these reserves.	Amendment 21	2003
Permanent moratorium established for commercial reef fish permits.	Amendment 24	2005
Permanent moratorium established for charter and headboat reef fish permits, with periodic reviews at least every 10 years.	Amendment 25	2006
Addressed the use of non-stainless steel circle hooks when using natural baits to fish for Gulf reef fish effective June 1, 2008, and required the use of venting tools and dehooking devices when participating in the commercial or recreational reef fish fisheries effective June 1, 2008.	Amendment 27	2008
Reduced the harvest of gray triggerfish in order to end overfishing and rebuild the stock. Adjusted the allocation of gray triggerfish catches between recreational and commercial fisheries to 79% and 21%, respectively, and set management thresholds and targets to comply with the Sustainable Fisheries Act (SFA) ($F_{30\%SPR}$). Increased the minimum size limit for gray triggerfish to 14" fork length.	Amendment 30A	2008
Established additional restrictions on bottom longline gear in the eastern Gulf of Mexico to reduce bycatch of endangered sea turtles. (1) Prohibits the use of bottom longline gear shoreward of the 35-fathom contour from June through August; (2) reduces the number of longline vessels operating in the fishery through	Amendment 31	2010

an endorsement provided only to vessel permits with a demonstrated history of landings, on average, of at least 40,000 pounds of reef fish annually with fish traps or longline gear during 1999-2007; and (3) restricts the total number of hooks that may be possessed onboard each reef fish bottom longline vessel to 1,000, only 750 of which may be rigged for fishing. The boundary line was initially moved from 20 to 50 fathoms by emergency rule effective May 18, 2009. That rule was replaced on October 16, 2009 by a rule under the Endangered Species Act moving the boundary to 35 fathoms and implementing the maximum hook provisions.		
Modified the gray triggerfish rebuilding plan based on a 2011 gray triggerfish update assessment, which determined that the stock was not rebuilding on target. Reduced the commercial and recreational annual catch limits to 64,100 and 241,200 pounds whole weight respectively, and reduced the commercial and recreational annual catch targets to 60,900 and 217,100 pounds whole weight respectively. A fixed closed season from June 1 through July 31 was established for the commercial and recreational sectors. Established a commercial trip limit of 12 gray triggerfish, and a recreational bag limit of 2 gray triggerfish per angler bag limit within the 20 reef fish aggregate bag limit.	Amendment 37	2013

2.2. Generic Amendments

Generic Sustainable Fisheries Act Amendment: partially approved and implemented in **November 1999**, set the Maximum Fishing Mortality Threshold (MFMT) for most reef fish stocks at $F_{30\%}$ SPR. Estimates of maximum sustainable yield, Minimum Stock Size Threshold (MSST), and optimum yield were disapproved because they were based on SPR proxies rather than biomass based estimates.

Generic ACL/AM Amendment: Established in-season and post-season accountability measures for all stocks that did not already have such measures defined. This includes the “other shallow-water grouper species” complex. The accountability measure states that if an ACL is exceeded, in subsequent years an in-season accountability measure will be implemented that would close fishing when the ACL is reached or projected to be reached.

2.3. Emergency and Interim Rules

Emergency Rule - Implemented May 18, 2009 through October 28, 2009: Prohibited the use of bottom longline gear to harvest reef fish east of 85°30′ W longitude in the portion of the exclusive economic zone (EEZ) shoreward of the coordinates established to approximate a line following the 50–fathom (91.4–m) contour as long as the 2009 deepwater grouper and tilefish quotas are unfilled. After the quotas have been filled, the use of bottom longline gear to harvest reef fish in water of all depths east of 85°30′ W longitude are prohibited [74 FR 20229].

Emergency Rule - Implemented May 3, 2010 through November 15, 2010: NMFS issued an emergency rule to temporarily close a portion of the Gulf of Mexico EEZ to all fishing [75 FR 24822] in response to an uncontrolled oil spill resulting from the explosion on April 20, 2010 and subsequent sinking of the Deepwater Horizon oil rig approximately 36 nautical miles (41 statute miles) off the Louisiana coast. The initial closed area extended from approximately the mouth of the Mississippi River to south of Pensacola, Florida and covered an area of 6,817 square statute miles. The coordinates of the closed area were subsequently modified periodically in response to changes in the size and location of the area affected by the spill. At its largest size on June 1, 2010, the closed area covered 88,522 square statute miles, or approximately 37 percent of the Gulf of Mexico EEZ.

2.4. Management Parameters and Projection Specifications

Table 2.4.1. General Management Information

Species/Management Unit	Gray Triggerfish
Management Unit Definition	Gulf of Mexico
Management Entity	Gulf of Mexico Fishery Management Council
Management Contacts SERO / Council	Steven Atran, Dr. Carrie Simmons - GMFMC Peter Hood
Current stock exploitation status	Experiencing overfishing (2012)
Current stock biomass status	Overfished (2012)

Table 2.4.2. Specific Management Criteria

Note: mp = million pounds; gw = gutted weight.

Criteria	Current- 2011 Update Assessment (2012)		Proposed	
	Definition	Value	Definition	Value
MSST	(1-M)*SSB_{MSY} M=0.14	1.529 trillion eggs	Value from the most recent stock assessment based on MSST = [(1-M) or 0.5 whichever is greater]*BMSY	SEDAR 43
MFMT	F_{MSY}	0.269	F_{MSY} or proxy from the most recent stock assessment (median from probabilistic analysis)	SEDAR 43
MSY	F_{MSY}	0.269	Yield at F_{MSY} , landings and discards, pounds and numbers (median from probabilistic analysis)	SEDAR 43
F_{MSY}	F_{MSY}	0.269		
SSB_{MSY}	Equilibrium SSB @ F_{MSY}	2.094 trillion eggs	Spawning stock biomass (median from probabilistic analysis)	SEDAR 43
F Targets (i.e., F_{OY})	75% of F_{MSY}	0.202	75% F_{MSY}	SEDAR 43
Yield at F_{Target} (Equilibrium)	Equilibrium Yield @ FOY		landings and discards, pounds and numbers	SEDAR 43
M		0.27	Natural Mortality, average across ages	SEDAR 43
Terminal F	Geometric mean 2008-2010	0.435	Exploitation	SEDAR 43
Terminal Biomass[1]	SSB_{2010}	1.345 trillion eggs	Biomass	SEDAR 43
Exploitation Status	$F_{CURRENT}$/MFMT	1.62	F/MFMT	SEDAR 43
Biomass Status[1]	$SSB_{CURRENT}$/MSST	0.64	B/MSST B/B_{MSY}	SEDAR 43

Table 2.4.3. General projection information.

First Year of Management	2016 Fishing Year
Interim basis	- ACL, if ACL is met - Average exploitation, if ACL is not met
Projection Outputs	By stock and fishing year
Landings	pounds and numbers
Discards	pounds and numbers
Exploitation	F & Probability F>MFMT
Biomass (total or SSB, as appropriate)	SSB & Probability SSB>MSST (and Prob. SSB>B_{MSY} if under rebuilding plan)
Recruits	Number

Table 2.4.4. Base Run Projections Specifications. Long Term and Equilibrium conditions.

Criteria	Definition	If overfished	If overfishing	Not overfished, no overfishing
Projection Span	Years	$T_{Rebuild}$	10	10
Projection Values	$F_{Current}$	X	X	X
	F_{MSY} (proxy)	X	X	X
	75% F_{MSY}	X	X	X
	$F_{Rebuild}$	X		
	F=0	X		

NOTE: Exploitation rates for projections may be based on point estimates from the base run (current process) or the median of such values from the MCBS evaluation of uncertainty. The objective is for projections to be based on the same criteria as the management specifications.

Table 2.4.5. P-Star Projections. Short term specifications for OFL and ABC recommendations. Additional P-star projections may be requested by the SSC once the ABC control rule is applied.

Criteria		Overfished	Not overfished
Projection Span	Years	10	10
Probability Values	50%	Probability of stock rebuild	Probability of overfishing

The following should be provided regardless of whether the stock is healthy or overfished:

- OFL: yield at F_{MSY} (or $F_{30\%\ SPR}$ proxy)
- OY: yield at 75% for $F_{30\%\ SPR}$
- Equilibrium MSY and equilibrium OY

If the stock is overfished, the following should also be provided:

- $F_{REBUILD}$ and the yield at $F_{REBUILD}$ (where the rebuilding time frame is 10 years)
- A probability distribution function (PDF) that can be used along with the P* selected by the SSC to determine ABC. If multiple model runs are provided, this may need to wait until the SSC selects which model run to use for management.
-

The SSC typically recommends OFL and ABC yield streams for 3-5 years out. Yield streams provided by assessment scientists should go beyond five years. If a 10-year rebuilding plan is needed, yield streams should be provided for 10 years.

Table 2.4.6. Quota Calculation Details

Note: mp = million pounds; ww = whole weight. ACT = annual catch target.

Current Quota Value (2014)	278000 lbs ww (ACT)
Next Scheduled Quota Change	2015
Annual or averaged quota?	Annual
Does the quota include bycatch/discard?	No- Landed only

Quotas are conditioned upon exploitation. Bycatch/discard estimates are considered in setting the quota; however, quota values are for landed fish only.

2.5. Management and Regulatory Timeline

Table 2.5.1. Annual Recreational Regulatory Summary

Note: Quota is in pounds whole weight.

Year	Quota	Season Open	Seasonal Closure	Season Close	Bag Limit	Size Limit	Effective Date(s):
1990 - 1996	N/A	Jan 1	None	Dec 31	None	None	Jan 1
1997 - 1998	"	Jan 1	"	Dec 31	Part of 20 reef fish aggregate limit	"	Jan 1
1999 - 2007	"	Jan 1	"	Dec 31	"	12" TL	Nov 1
2008	306000	Jan 1	"	Dec 31	"	14" FL	July 3
2009	356000	Jan 1	"	Dec 31	"	"	
2010 - 2011	405000	Jan 1	"	Dec 31	"	"	
2012	217100	Jan 1	"	June 10	"	"	May 14
2013	"	Jan 1	June 1 - July 31	Oct 14	2/person/day	"	June 10
2014	"	Jan 1	June 1 - July 31	Apr 30	2/person/day	"	

Notes:

1 Dates listed in "Season Open" or "Season Close" indicate days when fishing is still permitted

2 "Part of 20 reef fish aggregate bag limit" means up to 20 triggerfish could be kept per person with no other "reef fish" kept by the same person

3 Managed species: http://www.gulfcouncil.org/fishery_management_plans/Beta/GMFMCWeb/downloads/species%20managed.pdf

Table 2.5.2. Annual Recreational Regulatory Summary

Note: Quota is in pounds whole weight.

Year	Quota	Season Open	Seasonal Closure	Season Close	Trip Limit	Size Limit	Effective Date(s):
1990 - 1998	N/A	Jan 1	None	Dec 31	None	None	Jan 1
1999 - 2007	"	Jan 1	"	Dec 31	"	12" TL	Nov 1
2008	80000	Jan 1	"	Dec 31	"	14" FL	July 3
2009	93000	Jan 1	"	Dec 31	"	"	
2010	106000	Jan 1	"	Dec 31	"	"	
2011	106000	Jan 1	"	Dec 31	"	"	
2012	60900	Jan 1	"	June 30	"	"	May 14
2013	"	Jan 1	June 1 - July 31	Dec 31	12 fish/boat/day	"	June 10
2014	"	Jan 1	June 1 - July 31	Apr 30	12 fish/boat/day	"	

Notes:

1 Commercial longlining restricted to waters deeper than 50 fathoms west and 20 fathoms east of Cape San Blas as of Jan 1, 1990

2 Commercial longlining restricted to waters deeper than 35 fathoms from June 1 to August 31 as of May 26, 2010

3 Commercial longlining limited to 750 hooks per set beginning in 2010, with an extra 250 hooks in reserve on the boat as of May 26, 2010

4 "Season Open" or "Season Close" dates indicate permitted fishing days. "Seasonal Closure" dates indicate days when fishing is prohibited.

5 Commercial fish traps were phased out over 10 years beginning in March 1997, with all traps banned on Jan 1, 2006

6 Commercial/Recreational allocation split effective as of August 1, 2008

3. ASSESSMENT HISTORY AND REVIEW

Management of Gray Triggerfish (*Balistes capriscus*) in the U.S. Gulf of Mexico began in 1984 with the implementation of the Gulf of Mexico Fishery Management Council Reef Fish Fishery Management Plan. At that time, no formal assessment of the population dynamics of Gulf of Mexico Gray Triggerfish had been conducted. Gray Triggerfish is the only Balistid of 40 species of reef fish in the management unit. Two assessments of Gray Triggerfish were conducted in 2001 using different versions of a generalized Aggregated Surplus Production Model (ASPIC; Porch 2001; Valle et al. 2002). Based on the definition of MFMT (F20%SPR), both assessments indicated that the stock was overfished and undergoing overfishing. Fishing mortality rates were 65-70 % above sustainable levels. Biomass estimates were highly sensitive to parameter input restrictions, and all but one model run indicated that the stock had been severely overfished from the beginning of the time series. This was considered unrealistic as Gray Triggerfish was not a desirable target species. Additionally, the effect the 12-inch minimum size limit implemented in 1999 was unknown. Therefore, no new regulations were implemented based on the results of these assessments.

A benchmark stock assessment was completed in 2006 using an age-structured production model (SS-ASPM). The stock was determined to be undergoing overfishing but it was uncertain whether the stock was also overfished. Based on the definition of MFMT ($F_{30\%SPR}$), the reference fishing mortality was estimated to be 62% to high (F2004/MFMT = 1.62). The review panel also examined a biomass based fishing mortality rate (F_{MSY}) but felt this measure was unacceptable because it was sensitive to the stock-recruitment relationship which was poorly estimated. The Review Panel stated that no conclusion could be made as to whether the stock was overfished, although it appeared to be approaching an overfished condition. Based on the definition of MSST ($SSB_{20\%SPR}$), the reference stock biomass was estimated to be slightly above MSST (SSB_{2004}/MSST = 1.0 to 1.2).

A SEDAR Update Assessment (UA) was conducted in 2011 to update the 2006 SEDAR-9 benchmark assessment of Gray Triggerfish within US waters of the Gulf of Mexico. Commercial and recreational fisheries statistical data, in addition to fishery independent data were updated through 2010. Any changes in data since the last benchmark assessment (SEDAR 9) were incorporated in the assessment. Fishery dependent and independent indices of abundance were constructed with updated data using the same methodology as in the benchmark assessment. The same age-structured production model used in SEDAR 9 (SS-ASPM) was applied to the update assessment. The final model used an average (rather than time varying) shrimp bycatch, incorporated an index of Gulf-wide shrimp effort, and used an updated age-length key and von Bertalanffy growth function. Results suggest that the stock was overfished and experiencing overfishing. As part of the 2011 update assessment, a statistical catch-at-age model (Stock Synthesis; SS) was evaluated was evaluated as an alternative to SSASPM in an effort to characterize some of the potential error associated with the model fit and to determine if

SS could be used for future assessments. Model results were similar, despite differences in recruitment and historic fishery assumptions. Although management advice from the 2011 update assessment was based on the SS-ASPM model results, the SSC approved of the use of SS in future assessments.

As a result of concern over the effects on catchability of Gray Triggerfish of recently implemented regulations mandating the use of circle hooks in the reef fish fishery in the Gulf of Mexico, an analysis of the stock status controlling for this effect was conducted in 2013. Analysis of unpublished data indicated the implementation of circle hook regulations resulted in a 47% decrease in catchability of Gray Triggerfish, suggesting the stock was above levels estimated in 2011. However, the stock status did not change; therefore, the results were not used to develop new management advice.

A chronological list of selected stock assessment documents pertaining to Gulf of Mexico Gray Triggerfish.

Valle, M., C.M. Legault, and M. Ortiz. 2001. A Stock Assessment for Gray Triggerfish, *Balistes capriscus*, in the Gulf of Mexico. 56pp.

Porch, C. 2001. Another Assessment of Gray Triggerfish (*Balistes capriscus*) in the Gulf of Mexico Using a State-Space Implementation of the Pella-Tomlinson Production Model

SEDAR. 2006. SEDAR 9 Stock Assessment Report Gulf of Mexico Gray Triggerfish. 358 pp.

SEDAR. 2009. Stock assessment of Gray Triggerfish in the Gulf of Mexico - SEDAR Update Assessment. 143pp.

SEDAR. 2011. SEDAR 9 Update Stock Assessment Report: Gulf of Mexico Gray Triggerfish. 270pp.

Methot Jr., R. D. 2013. User Manual for Stock Synthesis Model Version 3.24s NOAA Fisheries Seattle, WA. http://nft.nefsc.noaa.gov/Stock_Synthesis_3.htm

4. REGIONAL MAPS

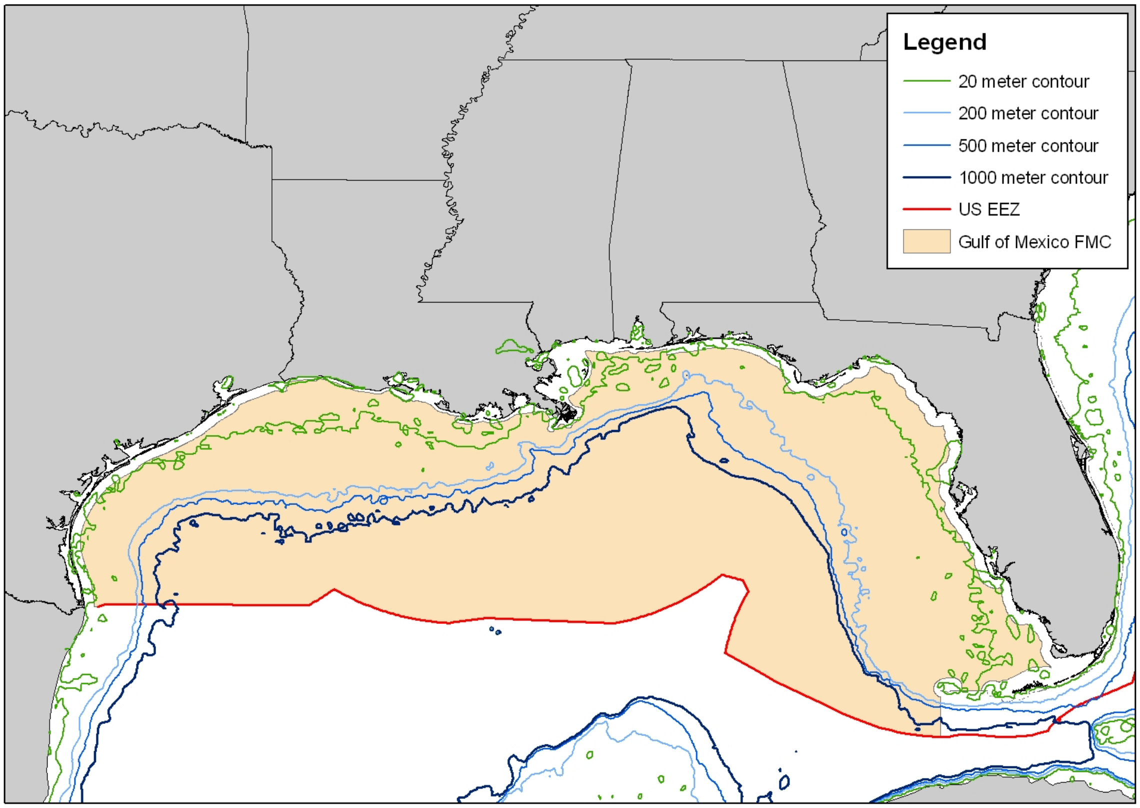

Figure 4.1 Southeast Region including Council and EEZ Boundaries.

5. SEDAR ABBREVIATIONS

ABC	Allowable 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
ASMFC	Atlantic States Marine Fisheries Commission
B	stock biomass level
BAM	Beaufort Assessment Model
BMSY	value of B capable of producing MSY on a continuing basis

CFMC	Caribbean Fishery Management Council
CIE	Center for Independent Experts
CPUE	catch per unit of effort
EEZ	exclusive economic zone
F	fishing mortality (instantaneous)
FMSY	fishing mortality to produce MSY under equilibrium conditions
FOY	fishing mortality rate to produce Optimum Yield under equilibrium
FXX% SPR	fishing mortality rate that will result in retaining XX% of the maximum spawning production under equilibrium conditions
FMAX	fishing mortality that maximizes the average weight yield per fish recruited to the fishery
F0	a fishing mortality close to, but slightly less than, Fmax
FL FWCC	Florida Fish and Wildlife Conservation Commission
FWRI	(State of) 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
LGL	LGL Ecological Research Associates
M	natural mortality (instantaneous)
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

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
OY	optimum yield
SAFMC	South Atlantic Fishery Management Council
SAS	Statistical Analysis Software, SAS Corporation
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
SERO	Fisheries Southeast Regional Office, National Marine Fisheries Service
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

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Gulf of Mexico Gray Triggerfish

SECTION II: Assessment Process Report

August 2015

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1 Workshop Proceedings

1.1 Introduction

1.1.1. Workshop Time and Place

The SEDAR 43 Assessment Process for Gulf of Mexico Gray Triggerfish was conducted via a series of webinars held between February and June 2015.

1.1.2. Terms of Reference

1. Using data through 2013, provide a model consistent with the previous assessment configuration to incorporate and evaluate any recommended changes for this assessment.
2. Evaluate and document the following specific changes in input data or deviations from the benchmark model previous assessment model.
   - Review updated life history information (age and growth, mortality, and reproductive parameters)
   - Evaluate the effect of circle hooks on fishery dependent catch rates of gray triggerfish.
   - If warranted, incorporate a change in catchability and or selectivity due to the implementation of circle-hooks.
   - Review the stock recruitment relationship related to males only, females only, and males and females combined.

- *Evaluate the fishery-independent video and trap surveys conducted by NMFS Panama City Lab and FWRI.*

3. Document any revisions or corrections made to the model and input datasets, and provide updated input data tables. Provide commercial and recreational landings and discards in numbers and weight (pounds).
4. Update model parameter estimates and their variances, model uncertainties, and estimates of stock status and management benchmarks. In addition to the base model, conduct sensitivity analysis to address uncertainty in data inputs and model configuration and consider runs that represent plausible, alternate states of nature.
5. Project future stock conditions regardless of the status of the stock. Develop rebuilding schedules, if warranted. Provide the estimated generation time for each unit stock. Stock projections shall be developed in accordance with the following:

   Scenarios to Evaluate (preliminary, to be modified as appropriate)

   1. Landings fixed at 2013 target.

   2. FOY= 75% FMSY (project when OY will be achieved)

   3. FREBUILD (if necessary)

   4. F=0 (if necessary)

6. Develop a stock assessment report to address these TORs and fully document the input data, methods, and results.

1.1.3. List of Participants

Workshop Panel

Jeff Isely, Lead Analyst	NMFS Miami
Clay Porch	NMFS Miami
Mary Christman	MCC
Gary Fitzhugh	NMFS Panama City
Bob Gill	SSC
Dan Gothel	NMFS Miami
Adam Pollack	NMFS Pascagoula
Brooke Shipley-Lozano	SSC
Matthew Smith	NMFS Miami
Jim Tolan	SSC

Appointed Observers

Scott Hickman	Industry Representative

Staff

Julie Neer	SEDAR
Ryan Rindone	GMFMC

Charlotte Schiaffo ....GMFMC

Additional Participants via Webinar

Robert Allman...NMFS Panama City
Neil Baertlein ....NMFS Miami
Ken Brennan ....NMFS Beaufort
Shannon Calay ....NMFS Miami
Ching-Ping Chih ....NMFS Miami
Michael Drexler .... Ocean Conservancy
Doug DeVries ....NMFS Panama City
Alisha Gray ....FWC
Michael Larkin..NOAA SERO
Rich Malinowski .... NMFS SERO
Vivian Matter ....NMFS Miami
Kevin McCarthy...NMFS Miami
Beverly Sauls ....FWC
Sonny Schindler .... Industry Representative
Ted Switzer ....FWC
Adyan Rios...NMFS Miami

1.1.4. List of Assessment Workshop Working Papers

Documents Prepared for the Assessment Process			
SEDAR43-WP-01	Validation of Annual Growth Zone Formation in Gray Triggerfish (Balistes capriscus) Dorsal Spines, Fin Rays, and Vertebrae	Robert J. Allman, Carrie L. Fioramonti, William F. Patterson III and Ashley E. Pacicco	10 March 2015
SEDAR43- WP -02	Oogenesis and fecundity type of Gray Triggerfish (Balistes capriscus) in the Gulf of Mexico	Erik T. Lang and Gary R. Fitzhugh	17 March 2015
SEDAR43- WP -03	Reproductive parameters of Gray Triggerfish (Balistes capriscus) from the Gulf of Mexico: sex ratio, maturity and spawning fraction	Gary R. Fitzhugh, Hope M. Lyon, and Beverley K. Barnett	17 March 2015
SEDAR43- WP -04	Length frequency distributions for gray triggerfish collected in the Gulf of Mexico from 1986 to 2013	Ching-Ping Chih	20 March 2015
SEDAR 43- WP -05	Standardized Catch Rate Indices for Gulf of Mexico Gray Triggerfish (Balistes capriscus) Landed During 1993-2013 by	Matthew W. Smith, Daniel Goethel, Adyan Rios, and Jeff	20 March 2015

	the Commercial Handline Fishery	Isely	
SEDAR 43- WP -06	Standardized Catch Rate Indices for Gulf of Mexico Gray Triggerfish (Balistes capriscus) Landed During 1986-2013 by the Headboat Fishery	Matthew W. Smith, Daniel Goethel, Adyan Rios, and Jeff Isely	20 March 2015
SEDAR 43- WP -07	Standardized Catch Rate Indices for Gulf of Mexico Gray Triggerfish (Balistes capriscus) Landed During 1981-2013 by the Recreational and Private Boat Fisheries	Matthew W. Smith, Daniel Goethel, Adyan Rios, and Jeff Isely	20 March 2015
SEDAR 43- WP -08	Indices of abundance for Gray Triggerfish (Balistes capriscus) from the Florida Fish and Wildlife Research Institute (FWRI) video survey on the West Florida Shelf	Kevin A. Thompson, Theodore S. Switzer, and Sean F. Keenan	24 March 2015
SEDAR 43- WP -09	Hook Selectivity in Gulf of Mexico Gray Triggerfish when using circle or 'J' Hooks	Alisha M. Gray and Beverly Sauls	25 March 2015
SEDAR 43- WP -10	Description of age data and estimated growth for Gray Triggerfish from the northern Gulf of Mexico: 2003-2013	Linda Lombardi, Robert Allman, and Ashley Pacicco	27 March 2015
SEDAR 43- WP -11	Gray Triggerfish Abundance Indices from SEAMAP Groundfish Surveys in the Northern Gulf of Mexico	Adam G. Pollack and G. Walter Ingram, Jr.	30 March 2015
SEDAR 43- WP -12	SEAMAP Reef Fish Video Survey: Relative Indices of Abundance of Gray Triggerfish	Matthew D. Campbell, Kevin R. Rademacher, Michael Hendon, Paul Felts, Brandi Noble, Michael Felts, Joseph Salisbury, and John Moser	30 March 2015
SEDAR 43- WP -13	Gray Triggerfish Ageing Error	Linda Lombardi	16 April 2015
SEDAR 43- WP -14	Gray triggerfish Balistes capriscus Findings from the NMFS Panama City Laboratory Trap & Camera Fishery-Independent Survey – 2004-2014	D.A. DeVries, C.L. Gardner, P. Raley, and W. Ingram	21 April 2015

1.1.5. Workshop Presentations

Presentations Prepared for the Assessment Process

SEDAR43- In-person Workshop Intro Presentation	SEDAR 43 Gulf of Mexico Gray Triggerfish Standard Assessment Data and Assessment Workshop	Jeff Isely	10 March 2015

1.1.6. List of Assessment Workshop Supplementary Papers

Workshop Supplementary Documents			
SEDAR43-RD-01	Recruitment of Age-0 Gray Triggerfish to Benthic Structured Habitat in the Northern Gulf of Mexico	Carrie M. Simmons and Stephen T. Szedlmayer	9 December 2014
SEDAR43- RD -02	Territoriality, reproductive behavior, and parental care in gray triggerfish, Balistes capriscus, from the northern Gulf of Mexico	Carrie M. Simmons and Stephen T. Szedlmayer	9 December 2014
SEDAR43- RD -03	Description of reared preflexion gray triggerfish, Balistes capriscus, larvae from the northern Gulf of Mexico	Carrie M. Simmons and Stephen T. Szedlmayer	17 March 2015

1.2 Panel Recommendations and Comments on Terms of Reference

Term of Reference 1: *Using data through 2013, provide a model consistent with the previous assessment configuration to incorporate and evaluate any recommended changes for this assessment.*

The Panel recommended the use of a fully integrated age and length based statistical-catch-at-age model (Stock Synthesis) as the modeling platform. The model configuration and data inputs are described in Section **Error! Reference source not found.**.

Term of Reference 2: *Evaluate and document the following specific changes in input data or deviations from the benchmark model previous assessment model.*

- *Review updated life history information (age and growth, mortality, and reproductive parameters)*
- *Evaluate the effect of circle hooks on fishery dependent catch rates of gray triggerfish.*
- *If warranted, incorporate a change in catchability and or selectivity due to the implementation of circle-hooks.*

- *Review the stock recruitment relationship related to males only, females only, and males and females combined.*
- *Evaluate the fishery-independent video and trap surveys conducted by NMFS Panama City Lab and FWRI.*

All changes to the data following the Data and Assessment Workshop are reviewed in Section **Error! Reference source not found.**.

Term of Reference 3: *Document any revisions or corrections made to the model and input datasets, and provide updated input data tables. Provide commercial and recreational landings and discards in numbers and weight (pounds).*

Section **Error! Reference source not found.** provides a complete description of all data inputs. Appendix A includes the input data file used in the SEDAR 43 Gray Triggerfish Stock Synthesis model.

Term of Reference 4: *Update model parameter estimates and their variances, model uncertainties, and estimates of stock status and management benchmarks. In addition to the base model, conduct sensitivity analyses to address uncertainty in data inputs and model configuration and consider runs that represent plausible, alternate states of nature.*

Estimates of assessment model parameters and their associated standard errors are reported in 3.1.4 and Table 3.1.1. Results of the sensitivity analyses are characterized in Section 3.1.7, Table 3.2.4 - Table 3.2. 6, and Figure 3.2. 67 - Figure 3.2. 76. Model convergence was tested by varying starting parameters and refitting the model (Table 3.1.3). Uncertainty in the assessment parameters and estimated values is characterized in Section 3.2.2 and Table 3.2.1. Sensitivity analyses are presented in Section 3.2.7. Estimates of stock biomass, spawning stock biomass, recruitment, and fishing mortality are presented in Table 3.2.2 - Table 3.2 3.

Term of Reference 5: *Project future stock conditions regardless of the status of the stock. Develop rebuilding schedules, if warranted. Provide the estimated generation time for each unit stock. Stock projections shall be developed in accordance with the following:*

Scenarios to Evaluate (preliminary, to be modified as appropriate)

1. *Landings fixed at 2013 target.*
2. *FOY= 75% FMSY (project when OY will be achieved)*
3. *FREBUILD (if necessary)*
4. *F=0 (if necessary)*

Projected stock status is presented in section 3.2.9.

Term of Reference 6: *Develop a stock assessment report to address these TORs and fully document the input data, methods, and results.*

This report satisfies this Term of Reference.

2 Data Review and Update

The following list summarizes the main data inputs used in the assessment model:

- Life history
  - Age and growth
  - Natural mortality
  - Maturity
  - Fecundity
- Landings
  - Commercial (combined vertical line, longline and trap): 1945-2013, East and West Gulf
  - Recreational (combined headboat, charterboat and private): 1945-2013, East and West Gulf
- Discards
  - Commercial (combined vertical line, longline and trap): 2000-2013, East and West Gulf
  - Recreational (combined headboat, charterboat and private): 1981-2013, East and West Gulf
  - Shrimp Bycatch: 1945-2013
- Length composition of landings (Converted to Age Comp with annual ALKs)
  - Commercial (combined vertical line, longline and trap): 1990-2013, East and West Gulf
  - Recreational (combined headboat, charterboat and private): 1981-2013, East and West Gulf
- Abundance indices
  - Fishery-independent
    - SEAMAP Groundfish (Trawl): 1987-2013
    - SEAMAP Larval Survey: 1986-2013
    - Combined video: 1993-1997, 2001-2002 & 2004-2013
  - Fishery-dependent
    - Commercial Handline: 1993-2007, East and West Gulf
    - Recreational Charterboat and private (MRFSS): 1981-2013, East Gulf
    - Recreational Headboat: 1986-2013, East and West Gulf
    - Shrimp Bycatch (as an effort series): 1945-2013
- Discard mortality
  - Commercial fleets, East and West Gulf
  - Recreational fleets, East and West Gulf

A brief summary of each input will be provided in the following sections.

2.1 Life history

2.1.1 Age and growth

SEDAR43-WP-01 described the validation of annual growth increments in Gray Triggerfish dorsal spines, fin rays and vertebrae. The aging structures were marked with oxytetracycline (OTC). After 262 days, the fish were sacrificed, and the hard parts were extracted and sectioned. One translucent zoned formed distal to the OTC mark on all aging structures during winter. Additional fin rays and vertebrae with corresponding dorsal spines were sampled during fishery-independent surveys to compare translucent zone counts between hard parts. There was a significant difference in translucent zone counts between fin ray and dorsal spine sections ($t_{1,25} = -3.15$, $P = 0.004$), with fin ray counts being on average 1 zone higher than dorsal spines. Translucent zone counts in vertebrae were similar to those counted in dorsal spines with no significant difference between structures ($t_{1,57} = 1.90$, $P = 0.062$). The combined results of this study validate annual translucent zone formation in Gray Triggerfish hard parts, with dorsal spines being considered the most reliable ageing structure.

The growth of Gray Triggerfish was summarized in SEDAR43-WP-10. Gray Triggerfish were sampled for age structure (using dorsal spines) from both the recreational and commercial fisheries in the Gulf of Mexico. According to this study, Gray Triggerfish were fully recruited to the commercial fishery by 4-6 years of age, while younger fish were landed by the recreational fishery. Fish became rare in both fisheries by age 10. Several size-modified von Bertalanffy growth models that accounted for non-random sampling due to minimum-size restrictions were examined. The data/assessment working group recommended a combined-sex growth model with a constant coefficient of variation at age (CV = 0.22) and the following von Bertalanffy parameters (**Figure 2.1.1**):

L_{inf} (cm FL) = 58.97
K (year^{-1}) = 0.14
t_0 (year) = -1.66

The CV as a function of length at age, the asymptotic length (L_{inf}), the von Bertalanffy growth coefficient *(k)* and the theoretical age at length zero *(t_0)*, were fixed within the SS model.

Meristic relationships were also provided to the Data/Assessment Workshop. The parameters describing these relationships are summarized in **Table 2.1.1**.

2.1.2 Natural mortality

The Data/Assessment Workshop developed an estimate of natural mortality-at-age using the Lorenzen (1996) estimator, and a target M estimated using Hoenig (1983) assuming a maximum age of 15 years. The resulting natural mortality vector (**Table 2.1.2** and **Figure 2.1.2**) was fixed within the assessment model. The previous assessment (SEDAR 9) used a fixed natural mortality rate equal to 0.27 which is also shown in **Figure 2.1.2**.

2.1.3 Maturity

The reproductive parameters of Gray Triggerfish, sex ration, maturity and spawning fraction were described in SEDAR43-WP-03. Based upon histological preparations of ovary sections, females displaying vitellogenic or more advanced oocytes (yolked oocytes) were defined as “mature” (consistent with prior SEDARs). Females with cortical alveoli (CA) or primary growth oocytes (PG) as the leading stage, but displaying atretic-yolked oocytes, were classified as "uncertain maturity”. Females with primary growth oocytes and with no indications of prior spawning were classified as “immature”. Female records used to determine maturity were taken only from the reproductive period (June, July and August).

In order to expand the number of maturity observations, especially among the smallest and youngest fish, macroscopic maturity records were added for consideration. Similar to the criteria above, only records from June, July and August from scientific surveys were retained. Macroscopic classes (Lang et al. 2013) include immature, maturing, running ripe, spent and inactive. Gray Triggerfish records listed as maturing, running ripe and spent were aggregated and considered “mature”, while females scored as inactive were considered to have “uncertain maturity”.

Specimens were assigned 50 mm fork length classes and the proportion mature was related to length classes (mid-point) using logistic regression weighted by the numbers in each length class. Females considered to be "uncertain" in histological or macroscopic staging were censored while immature and mature totals were retained. A logistic model, based upon the Gompertz function was fitted to the data using maximum likelihood (logistic regression). Age at 50% maturity (A_{50}) was 1.5 years for females (**Figure 2.1.3**). This maturity function was assumed fixed in the SS model.

2.1.4 Sex Ratio

The sex ratio for Gray Triggerfish in the GOM was slightly female dominated; 56% female based upon histology and 64% female based upon macroscopic observation (SEDAR43-WP-03). However, studies that sampled Gray Triggerfish from commercial sources in the Gulf tended to report higher ratios of males overall and at larger sizes. Therefore, for the purposes of the SS model, the sex ratio was fixed at 50% female for all ages.

2.1.5 Fecundity

The oogenesis and fecundity of Gray Triggerfish was described in SEDAR43-WP-02. The study objective was to verify the pattern of oogenesis and fecundity type. From 1999-2012, 1092 female Gray Triggerfish were collected from the eastern Gulf of Mexico with subsets used to calculate condition indices and assess ovarian histology. Gonadosomatic and hepatosomatic indices and Fulton's condition factor indicated liver and somatic energy stores increased prior to spawning and were depleted throughout the spawning period. This is characteristic of a capital pattern of energy storage and allocation to reproduction.

Typical of a capital pattern, the authors observed a hiatus in oocyte size distribution and group synchronous oogenesis, both traits of a deterministic fecundity type. However, evidence that fecundity was not set prior to spawning included the observation of "de novo" vitellogenesis during the spawning season; secondary oocytes increased in number and failed to increase in mean size over time. Thus Gray Triggerfish are thought to exhibit an indeterminate fecundity type with mixed reproductive traits that may characterize species exhibiting female parental care in warm water environments.

Using oocyte growth rate and the proportion of females bearing postovulatory follicles, the inter-spawning interval was estimated to range from 8-11 d. This indicated production of 8-11 batches per female may occur during an estimated 86-d reproductive period. Batch fecundity (BF) ranged from 0.34 to 2.0 million eggs and was significantly related to fork length (FL): The Data/Assessment Workshop recommended a power-function fit to batch fecundity at length to model female reproductive potential (**Figure 2.1.4**).

$$\text{Batch Fecundity} = 51.357 * \text{Fork Length(mm)}^{2.8538}$$

2.2 Landings

2.2.1 Commercial landings

Commercial landings statistics from 1963-2013 were obtained from the NMFS Accumulated Landings System (ALS). The eastern and western regions were separated at approximately the mouth of the

Mississippi River. The eastern region included NMFS statistical shrimp areas 1-12 and the western region included areas 13-21. Several gears were combined under the designation “Handline” (aka vertical line) including electric reel, bandit rig, manual reel and manual handline.

Commercial landings were reviewed at the Data/Assessment Workshop and are presented in **Table 2.2.1** and in **Figure 2.2.1**. A few significant updates to the commercial landings have taken place since the previous assessment (SEDAR 9 Update). These updates affected the landings estimates for 1989-1993, and 2008. The updated values are indicated by gray highlighting in **Table 2.2.1**.

Commercial landings (lbs whole weight) were reported by gear, and include handline, longline, trap, and ‘other’. As in the previous assessment (SEDAR 9 Update), landings by commercial gears were combined within each region (i.e. Eastern U.S. Gulf of Mexico and Western U.S. Gulf of Mexico). Landings were dominated by commercial handline. A trap fishery existed for a period, but has since been eliminated by regulation. Although Gray Triggerfish are caught on bottom longline, these catches are limited to the Eastern U.S. Gulf of Mexico and Gray Triggerfish are not the targeted species. Landings reported under ‘other’ made up less than 1% of overall commercial landings. The aggregated commercial landings were converted to metric tons whole weight for input into the SS model (**Table 2.2.1b**). Landings prior to 1963 were estimated. Commercial landings were assumed to have a standard error of 0.05.

2.2.2 Recreational landings

The recreational fishery statistics for gray triggerfish were obtained from three separate sampling programs: Marine Recreational Information Program (MRIP), Texas Parks and Wildlife Department (TPWD) and the Southeast Region Headboat Survey (SRHS). MRIP (formerly known as MRFSS) began in 1979 (data prior to 1981 are generally considered less reliable), and collects estimates of shore based, charter boat and private/rental boat fishing from Florida through Louisiana. MRIP also included information from headboat trips from 1981-1985. MRIP collects information on fish landed, discarded dead and released alive. However, it is important to note that estimates of discards and released fish are self-reported.

The SRHS focuses on monitoring and sampling the recreational headboat fisheries in the Atlantic and Gulf of Mexico, from Texas to Florida. SRHS data collection includes catch records from every trip and biological samples from dockside intercepts by port samplers.

Prior to 1986, TPWD was responsible for reporting landings from all recreational boat modes operating in Texas. However, since 1986 GOM headboat landings have been compiled by the SRHS. TPWD continued to sample charterboat and private boat fishing modes, but the emphasis was placed on sampling bay and inshore fishing effort. Therefore, it is likely that offshore fishing is under-represented in the TPWD estimates. TPWD also does not record information on discards.

Recreational landings (in numbers of fish) were reviewed by the Data/Assessment Workshop and are presented in **Table 2.2.2** and **Figures 2.2.2 - 2.2.3**. Recreational landings are available by mode and include headboat, charterboat, private boat, and shore. Prior to 1981, private and charterboat landings are only available as a single combined mode. Between 1946 and 1980, the combined private and charterboat mode landings are estimated from effort data using a constant catch per effort ratio.

Landings by headboat, charterboat and private modes were pooled within geographic area (East, West). Landings reported for the shore mode were excluded as they comprised <1% of overall recreational landings. Recreational landings were assumed to have a standard error of 0.05.

2.3 Discards

2.3.1 Commercial discards

Commercial discards are available by gear for handline (aka vertical line), longline and trap; however, only handline estimates were used. Handline discards reviewed at the Data/Assessment Workshop were re-estimated after evaluating the reliability of the logbook effort data used in the discard calculation. That alternative method of estimating discards was:

$$\left(\frac{observer\ reported\ Gray\ Triggerfish\ discard\ rate}{observer\ reported\ Gray\ Triggerfish\ kept\ rate}\right)\times Gray\ Triggerfish\ landings$$

Discards were calculated for each year/region/season. Calculated discards across strata within each year and region were summed to obtain yearly regional total discards (**Table 2.3.1**).

Strata were:
- Year
- Region (east = statistical zones 1-8, west = 9-21)
- Season (red snapper season – open or closed)

For the SS model, the annual proportion discarded was used rather than the absolute magnitude of discards. These proportions are illustrated in **Figure 2.3.1**. Discard estimates are available since 2005. Landings and discard estimates are derived from mandatory self-reported logbooks.

2.3.2 Recreational discards

Annual estimates of recreational discards were derived from MRIP for the years 1981-2013. Discards are based on dockside interviews (intercepts) of anglers and represent the self-reported number of fish discarded alive.

The recreational discards were reviewed at the Data and Assessment Workshop and are presented in **Table 2.3.2**. Estimated recreational discards are available by mode for headboat, charterboat, private boat, and shore. Discards by headboat, charterboat, and private modes were used in the assessment model. The discards from the shore mode were excluded. Recall that landings from this mode made up less than 1% of overall recreational landings.

For the SS model, the annual proportion discarded was used rather than the absolute magnitude of discards. These proportions are illustrated in **Figure 2.3.2**.

2.4 Age composition of landings

2.4.1 Age composition of commercial landings

Estimated commercial age composition was derived using the observed length frequency and annual age-length keys. The effective sample size for the derived age composition was assumed to be equal to the annual number of aged fish sampled from commercial trips (**Table 2.4.1**). The derived commercial age composition is summarized in **Figures 2.4.1**. Cohorts are not readily apparent in the commercial data (**Figure 2.4.1**). This may be due to the weak relationship between length and age, and the use of annual ALKs to derive age composition from length frequency data.

2.4.2 Age composition of recreational landings

Estimated recreational age composition was also derived using the observed length frequency and annual age-length keys. The effective sample size for the derived age composition was assumed to be equal to the annual number of aged fish sampled from recreational trips (**Table 2.4.1**). It should be noted that the number of aged fish was quite small in some years, particularly for the private fishery (**Table 2.4.1**). Data for the charterboat and private modes were aggregated into a single combined mode. The derived commercial age composition is summarized in **Figure 2.4.1**. Like the commercial age composition, cohorts are also not readily apparent in the recreational data (**Figure 2.4.1**). This may be due to the weak relationship between length and age, and the use of annual ALKs to derive age composition from length frequency data.

2.4.3 Age composition of shrimp bycatch

After initial attempts to estimate annual age composition using the length composition of the SEAMAP groundfish survey and shrimp observer program yielded unreliable results, characterized by anomalously old fish, the previous assessment (SEDAR 9 Update) assumption was retained. Because the SEDAR 9 panels found no basis for extracting separate age classes from the single peak in length frequency observed during the fall groundfish survey, that assessment assumed that the shrimp bycatch was dominated by age 0s with minor error due to contamination by older fish. Likewise, shrimp bycatch was assumed to be composed of age-0 Gray Triggerfish in this assessment **(Figure 2.4.2**).

2.5 Measures of population abundance

Indices of abundance were presented and considered during the Data/Assessment Workshop. The eight indices of abundance that were recommended for use in the assessment include:

- Fishery-independent (3)
    - SEAMAP Groundfish (Trawl): 1987-2013
    - SEAMAP Larval Survey: 1986-2007
    - Combined video: 1993-1997, 2001-2002 & 2004-2013
- Fishery-dependent (5)
    - Commercial Handline (vertical line): 1993-2013, East and West Gulf
    - Recreational Charterboat/Private (MRFSS): 1981-2013, East Gulf
    - Recreational Headboat: 1986-2013, East and West Gulf

Seven of eight recommended indices were also used in the previous assessment (SEDAR9 Update-AR). The combined video survey index (SEAMAP VIDEO, Panama City Video, and FWRI Video) is a new index that delivers a longer time series than the SEAMAP Video alone by standardizing the three similar fishery-independent video surveys across common habitat types. Development, review and incorporation of this index in the assessment satisfies the fifth element of Term of Reference 2.

Three of the eight indices were derived from fishery-independent data sources: the SEAMAP fall groundfish survey, SEAMAP Larval survey and the combined video survey (**Table 2.5.1** and **Figures 2.5.1 – 2.5.3**). The SEAMAP groundfish index was derived as the mean number of Gray Triggerfish caught per trawl hour. The combined video survey was derived as the minimum count of Gray Triggerfish (maximum number of individuals in the field of view at one instance) per 20 minute recording.

There were five recommended fishery-dependent indices: the Eastern Gulf Marine Recreational Fishery Statistic Survey (MRFSS-East) index, the Eastern and Western Gulf Southeast Regional Headboat Survey indices (SRHS-East, SRHS-West), and the Eastern and Western Gulf Commercial Vertical Line indices, (**Tables 2.5.2 - 2.5.3** and **Figures 2.5.4 – 2.5.8**). The SERHS index was derived using numbers of Gray Triggerfish landed per angler hour and the MRFSS index, which represents the charterboat and private modes, was derived using the numbers of Gray Triggerfish landed or discarded per angler hour. The commercial vertical line index was derived as pounds of Gray Triggerfish landed per hook hour.

For input into the Stock Synthesis assessment model, the coefficients of variation (CV) associated with the standardized indices were converted to log-scale standard errors as follows:

$$\log(SE) = \sqrt{log_e(1 + CV^2)}$$

The relative shrimp effort series 1945-2013 was also fit in the model in a manner similar to the fit of the CPUE series. The relative shrimp effort and associated log-scale variance are illustrated in **Figure 2.5.9**.

2.6 Discard Mortality

Discard mortality of gray triggerfish has not been extensively studied. This topic was discussed at the Data/Assessment Workshop. Based on a review of best available information, the panel recommended a 5% discard mortality rate for use in the SEDAR 43 assessment model. The panel further recommended the evaluation of a 10% mortality rate as a sensitivity analysis.

2.7 Tables

Table 2.1.1. Meristic regressions for gray triggerfish (2003-2013) from the Gulf of Mexico. Data combined from all data sources, both fishery independent and dependent. Length Type: Max TL – Maximum Total Length, FL – Fork Length, Nat TL – Natural Total Length, SL – Standard Length. Weight Type: G WT – Gutted Weight, W WT – Whole Weight. Units: length (mm) and weight (kg). Linear and non-linear regressions calculated using R (lm and nls functions, respectively).

Regression	Equation	statistic	N	Data Range
Max TL to FL	$\mathrm{FL} = \mathrm{Max\_TL} * 0.791 + 21.282$	$r^2=0.9754$	818	Max TL: 110 – 753; FL: 109 – 572
Nat TL to FL	$\mathrm{FL} = \mathrm{Nat\_TL} * 0.807 + 24.360$	$r^2=0.9539$	130	Nat TL: 65 – 712; FL: 65 – 617
SL to FL	$\mathrm{FL} = \mathrm{SL} * 1.153 + 10.311$	$r^2=0.9946$	391	SL: 87 – 440; FL: 109 – 515
SL to Max TL	$\mathrm{Max\_TL} = \mathrm{SL} * 1.425 - 5.687$	$r^2=0.9769$	388	SL: 87 – 440; Max TL: 110 – 622
Max TL to W WT	$\mathrm{W\ WT} = 3.679 \times 10^{-08} * (\mathrm{max\_TL}^{2.842})$	RSE = 0.1398	374	Max TL: 155 – 585 ; W WT: 0.067 – 3.380
Nat TL to W WT	$\mathrm{W\ WT} = 4.473 \times 10^{-08} * (\mathrm{nat\_TL}^{2.815})$	RSE = 0.1939	121	Nat TL: 65 – 712; W WT: 0.006 – 5.840
FL to W WT	$\mathrm{W\ WT} = 2.162 \times 10^{-08} * (\mathrm{FL}^{3.007})$	RSE = 0.1528	309	FL: 65 – 617; W WT: 0.006 – 5.840
SL to W WT	$\mathrm{W\ WT} = 7.591 \times 10^{-08} * (\mathrm{SL}^{2.884})$	RSE = 0.0996	158	SL: 123 – 432; W WT: 0.067 – 3.800
FL to G WT	$\mathrm{G\ WT} = 1.354 \times 10^{-08} * (\mathrm{FL}^{3.076})$	RSE = 0.1884	708	FL: 249 – 660; G WT: 0.232 – 6.259
Max TL to G WT			3	
Nat TL to G WT			11	

Table 2.1.2 Recommended values for age-specific natural mortality for Gray Triggerfish in the Gulf of Mexico.

Age	Age-specific natural mortality
0	0.790
1	0.571
2	0.461
3	0.395
4	0.351
5	0.321
6	0.298
7	0.281
8	0.267
9	0.257
10	0.248
11	0.241
12	0.235
13	0.231
14	0.227
15	0.223

Table 2.2.1 Annual Gray Triggerfish commercial landings by gear type from the U.S. Gulf of Mexico in pounds whole weight from 1963-2013. Shaded values are updated since SEDAR9 Update.

Year	East US Gulf handline	longline	trap	West US Gulf handline	longline	trap
1963	3100	0	0	4200	0	0
1964	15700	0	0	4300	0	0
1965	17400	0	0	4300	0	0
1966	8600	0	0	5200	0	0
1967	12200	0	0	5200	0	0
1968	8600	0	0	3900	0	0
1969	14600	0	0	7700	0	0
1970	16000	0	0	8200	0	0
1971	30500	0	0	9900	0	0
1972	47400	0	0	15200	0	0
1973	40000	0	0	13200	0	0
1974	40000	0	0	13100	0	0
1975	62000	0	0	16000	0	0
1976	69700	0	0	14800	0	0
1977	50096	0	0	9290	0	0
1978	48518	0	0	10197	0	0
1979	65670	0	0	31814	3919	0
1980	64015	1406	0	28707	2294	0
1981	61465	3033	0	20636	4726	0
1982	55317	7642	0	26316	7398	0
1983	40486	9102	0	19350	4481	0
1984	29050	8346	0	29392	3334	23
1985	43333	11507	0	32230	5556	0
1986	60397	12461	0	14919	7863	0
1987	65974	23339	0	33653	637	0
1988	124927	13051	0	54586	2498	0
1989	187798	30166	12397	77330	9941	0
1990	270238	12979	76469	99018	279	54
1991	341216	8	96	103179	32	0
1992	183096	151981	23101	112376	371	80
1993	287183	13566	80782	174369	452	2657
1994	200702	20207	30669	152702	439	0
1995	182072	6385	18755	130156	509	0
1996	112642	6722	22821	124950	381	0
1997	80972	10456	16352	75918	991	0
1998	87645	5520	13065	70482	92	0
1999	98692	10103	13946	102457	222	0
2000	48186	5457	9282	94796	283	0
2001	87792	6053	14742	67536	52	0
2002	127914	2989	17571	85850	59	0
2003	145074	7299	14093	85332	0	0
2004	116086	14317	12626	76382	754	0
2005	94515	6616	6848	41717	29	0

2006	49703	7637	3723	30794	62	0
2007	43420	7990	15	36896	15	0
2008	35496	15555	0	25222	219	0
2009	55327	9150	0	16738	3	0
2010	44590	2530	0	7936	14	0
2011	97570	1057	0	12943	20	0
2012	67061	705	0	7740	47	0
2013	59423	1050	0	3794	76	0

Table 2.2.1b Annual Gray Triggerfish commercial landings from the U.S. Gulf of Mexico in metric tons whole weight from 1945-2013. Landings from 1945-1962 are estimated.

Year	East	West
1945	0.01	0.05
1946	0.08	0.11
1947	0.16	0.21
1948	0.23	0.32
1949	0.31	0.42
1950	0.39	0.53
1951	0.47	0.64
1952	0.55	0.74
1953	0.63	0.85
1954	0.7	0.95
1955	0.78	1.06
1956	0.86	1.16
1957	0.94	1.27
1958	1.02	1.38
1959	1.09	1.48
1960	1.17	1.59
1961	1.25	1.69
1962	1.33	1.8
1963	1.41	1.91
1964	7.12	1.95
1965	7.89	1.95
1966	3.9	2.36
1967	5.54	2.36
1968	3.9	1.77
1969	6.62	3.49
1970	7.26	3.72
1971	13.84	4.49
1972	21.51	6.9
1973	18.15	5.99
1974	18.15	5.94
1975	28.13	7.26
1976	31.62	6.72
1977	22.73	4.22
1978	22.01	4.63
1979	29.8	16.21
1980	29.68	14.07
1981	29.26	11.51
1982	28.57	15.3
1983	22.5	10.81

1984	16.97	14.86
1985	24.88	17.14
1986	33.06	10.34
1987	40.52	15.56
1988	62.6	25.9
1989	104.52	39.6
1990	163.2	45.08
1991	154.86	46.83
1992	162.51	51.19
1993	173.11	80.53
1994	114.15	69.48
1995	94.02	59.28
1996	64.51	56.87
1997	48.9	34.9
1998	48.2	32.02
1999	55.69	46.59
2000	28.55	43.14
2001	49.27	30.67
2002	67.37	38.98
2003	75.53	38.72
2004	64.9	35
2005	48.99	18.94
2006	27.71	14
2007	23.33	16.75
2008	23.16	11.54
2009	29.25	7.6
2010	21.38	3.61
2011	44.75	5.88
2012	30.75	3.53
2013	27.44	1.76

Table 2.2.2. Annual Gray Triggerfish recreational landings from the U.S. Gulf of Mexico in numbers of fish from 1946-2013. Values prior to 1981 are estimated.

Year	Private Charter East	Private Charter West	Headboat East	Headboat West	Total East	Total West
1946	3254	389	293	164	3548	553
1947	18601	1141	586	327	19187	1468
1948	30492	2163	1173	655	31664	2818
1949	42383	3186	1759	982	44142	4168
1950	59457	3802	2344	1309	61801	5111
1951	71348	4824	3907	2182	75255	7006
1952	83239	5847	5470	3055	88709	8902
1953	95131	6869	7033	3927	102163	10797
1954	107022	7892	8596	4800	115618	12692
1955	118913	8915	10158	5673	129072	14588
1956	126456	10279	10627	5935	137084	16213
1957	133999	11642	11096	6197	145095	17839
1958	141542	13006	11565	6459	153107	19465
1959	149085	14370	12034	6720	161119	21091
1960	156628	15734	12503	6982	169131	22716
1961	157036	16567	12971	7244	170008	23811
1962	157444	17400	13440	7506	170885	24906
1963	157852	18233	13909	7768	171762	26001
1964	158261	19066	14378	8030	172639	27096
1965	158669	19899	14847	8291	173515	28191
1966	162489	20635	14330	8003	176819	28637
1967	166310	21370	13812	7714	180122	29084
1968	170130	22106	13295	7425	183425	29530
1969	173951	22841	12778	7136	186729	29977
1970	177771	23576	12261	6847	190032	30423
1971	184023	26556	9675	5403	193698	31959
1972	190275	29536	14512	8104	204787	37640
1973	196528	32516	20040	11192	216568	43707
1974	202780	35495	17967	10034	220747	45529
1975	209032	38475	18428	10291	227460	48766
1976	220923	37744	18889	10549	239812	48293
1977	232814	37014	27642	15437	260456	52450
1978	244705	36283	28333	15823	273038	52106
1979	256595	35552	28333	15823	284928	51375
1980	268486	34821	25914	14472	294401	49293
1981	271011	35238	27642	15437	298653	50675
1982	579294	94726	25914	14472	605208	109198

1983	128870	245044	24532	13700	153402	258744
1984	36510	115287	29370	16402	65880	131689
1985	102564	18028	29370	16209	131933	34237
1986	357592	13524	29024	16018	386616	29542
1987	213253	5480	22033	16697	235286	22177
1988	753384	12275	27123	41438	780507	53713
1989	813675	59923	55618	24891	869293	84814
1990	1148307	116203	105336	25565	1253643	141768
1991	761051	109778	58119	31128	819170	140906
1992	626207	43084	68924	41752	695131	84836
1993	583571	18703	58787	44184	642358	62887
1994	501372	47096	53467	56712	554839	103808
1995	550415	76658	45825	51841	596240	128499
1996	286600	5727	36195	40329	322795	46056
1997	265511	17250	34458	29227	299969	46477
1998	267111	7191	37085	16103	304196	23294
1999	198751	38832	34143	6836	232894	45668
2000	145072	63558	26245	5978	171317	69536
2001	229174	22530	32561	7494	261735	30024
2002	339421	6836	44858	8996	384279	15832
2003	418120	15295	46468	17013	464588	32308
2004	498106	34703	43101	18864	541207	53567
2005	358684	4499	36952	11318	395636	15817
2006	225855	1943	23087	10821	248942	12764
2007	205065	13749	20796	11953	225861	25702
2008	141799	35227	18852	3730	160651	38957
2009	115047	1058	11002	1102	126049	2160
2010	94502	1019	9038	414	103540	1433
2011	150598	980	15307	1084	165905	2064
2012	59574	10587	5444	478	65018	11065
2013	142886	4704	9296	532	152182	5236

Table 2.3.1 Annual Gray Triggerfish commercial discards from the U.S. Gulf of Mexico in numbers of fish from 2000-2013.

Year	East Gulf	West Gulf
2000	5082	24234
2001	4362	25480
2002	4848	26454
2003	5048	27557
2004	5967	24906
2005	5569	21585
2006	5987	21898
2007	8395	22969
2008	217	7128
2009	13143	12416
2010	15239	40890
2011	14516	86010
2012	41406	225974
2013	28507	84287

Table 2.3.2 Annual Gray Triggerfish recreational discards from the U.S. Gulf of Mexico in numbers of fish from 1981-2013.

YEAR	East	West	Total
1981	74869	1936	76805
1982	118316	35465	153781
1983	201318	506242	707560
1984	290390	31380	321770
1985	9182	170793	179975
1986	141128	2254	143383
1987	132603	0	132603
1988	147134	62864	209998
1989	304152	58832	362984
1990	263978	11429	275407
1991	131324	103510	234835
1992	325999	32168	358167
1993	198925	42041	240966
1994	114413	58135	172548
1995	103636	26235	129871
1996	206388	80	206468
1997	137119	14711	151830
1998	299342	13844	313186
1999	185633	35672	221305
2000	91209	51534	142743
2001	235962	38962	274925
2002	342724	22777	365501
2003	214062	1913	215975
2004	411968	17309	429278
2005	138736	13301	152037
2006	134051	574	134625
2007	575493	23071	598564
2008	173010	5454	178464
2009	189337	26280	215618
2010	201379	0	201379
2011	357340	2017	359357
2012	290513	7052	297565
2013	357632	10594	368226

Table 2.4.1 Number of Gray Triggerfish aged in the Gulf of Mexico by year and fleet.

Year	Commercial	Charter/ Private	Headboat	Scientific Survey
	East			
2003	84	48	2	13
2004	40	95	8	26
2005	126	55	6	82
2006	69	78	0	129
2007	69	85	15	115
2008	80	192	47	134
2009	37	201	63	303
2010	30	128	52	172
2011	178	206	22	136
2012	76	130	130	264
2013	168	233	264	59
	West			
2003	0	0	0	0
2004	0	0	0	0
2005	1	0	0	0
2006	0	0	0	0
2007	46	163	0	0
2008	29	89	0	6
2009	28	109	3	0
2010	2	4	0	52
2011	28	45	0	19
2012	234	42	4	29
2013	338	22	12	0

Table 2.5.1 Fishery-independent standardized indices of abundance and associated log-scale standard errors for the Gulf of Mexico Gray Triggerfish. The indices are scaled to a mean of one over each respective time series.

	Fishery-Independent Indices					
	Combined		SEAMAP		SEAMAP	
Year	Video		Neuston		Groundfish	
	Index	SE	Index	SE	Index	SE
1986			0.86712	0.38672		
1987			0.39618	0.68233	0.90083	0.23661
1988			0.41911	0.46366	0.78839	0.2472
1989			0.2209	0.44595	1.33977	0.19562
1990			0.37104	0.3954	0.32166	0.28505
1991			0.74063	0.26368	2.82945	0.15013
1992			1.99286	0.35724	0.30901	0.32752
1993	1.76176	0.32428	0.79233	0.28136	2.12938	0.18035
1994	2.95265	0.31817	0.98834	0.30689	1.64808	0.17844
1995	1.23425	0.43765	1.0421	0.30324	0.98248	0.22203
1996	1.79571	0.31403	0.75863	0.32677	1.05747	0.23525
1997	1.77735	0.28902	0.71963	0.3994	0.53606	0.26942
1998					0.06582	0.52936
1999			0.20762	0.42127	0.97472	0.21574
2000			2.24433	0.31159	1.98509	0.18532
2001	0.21365	0.77573	0.39802	0.42557	2.82822	0.18026
2002	1.458	0.32646	1.40706	0.51245	1.31209	0.2215
2003			0.69343	0.33678	0.79005	0.25597
2004	0.53401	0.35349	0.40493	0.39799	0.75063	0.21182
2005	0.46149	0.30487			1.02622	0.20513
2006	0.77863	0.26439	1.80179	0.31183	0.93541	0.24437
2007	1.4671	0.2721	1.65072	0.39532	0.98358	0.23508
2008	0.40024	0.28973			0.71584	0.19332
2009	0.77347	0.25879			0.17362	0.25527
2010	0.49615	0.27325			0.25218	0.28378
2011	0.36622	0.25866			0.31097	0.27853
2012	0.23366	0.27631			0.84401	0.24804
2013	0.29566	0.28521			0.20897	0.33624

Table 2.5.2. Recreational fishery-dependent standardized indices of abundance and associated log-scale standard errors for Gulf of Mexico Gray Triggerfish. The indices are scaled to a mean of one over each respective time series.

	MRFSS East		Headboat East		Headboat West	
Year	Index	SE	Index	SE	Index	SE
1981	1.298021	0.569294				
1982	0.780012	0.487633				
1983	0.55049	0.588171				
1984	0.13797	0.984959				
1985	0.109193	0.938285				
1986	1.848001	0.290083	0.727466	0.324151	0.846587	0.301862
1987	0.798006	0.320455	0.657518	0.318236	0.821708	0.268726
1988	1.683405	0.301367	0.727258	0.289118	1.20876	0.265427
1989	2.908827	0.27896	1.734481	0.287548	1.466504	0.275718
1990	3.346629	0.321719	2.313363	0.277994	1.751336	0.261235
1991	1.971824	0.311774	1.968438	0.28433	2.961779	0.247564
1992	1.82168	0.239697	2.307343	0.281281	2.22335	0.239747
1993	1.339601	0.2801	1.671302	0.279203	2.053309	0.234626
1994	1.502775	0.272434	1.250887	0.285734	2.035191	0.228237
1995	0.983844	0.322315	1.20616	0.291611	1.610886	0.237236
1996	1.140358	0.302654	1.044067	0.288752	1.844262	0.24272
1997	0.779723	0.272151	1.126757	0.283644	1.240153	0.306987
1998	0.856778	0.245336	1.088817	0.282752	0.834426	0.272912
1999	0.776129	0.226839	1.123037	0.281785	0.571995	0.321775
2000	0.486889	0.236623	0.709425	0.290562	0.32274	0.319448
2001	0.697511	0.235813	0.705757	0.292939	0.446103	0.298212
2002	0.722099	0.232871	1.167901	0.292417	0.588489	0.295458
2003	0.598154	0.237909	1.102974	0.293485	0.749297	0.275986
2004	1.128374	0.223985	1.079982	0.295145	0.96357	0.267059
2005	0.779251	0.23845	1.203324	0.2939	0.933825	0.251254
2006	0.581913	0.251191	0.677107	0.301656	0.751524	0.257855
2007	0.484566	0.249615	0.748747	0.305114	0.998079	0.264539
2008	0.390181	0.271416	0.79512	0.29593	0.807858	0.351328
2009	0.773183	0.274417	0.507822	0.305925	0.163459	0.412724
2010	1.090668	0.271406	0.4766	0.319044	0.072516	0.486452
2011	1.526968	0.249144	0.572047	0.315155	0.128387	0.427655
2012	1.284174	0.257899	0.491847	0.514961	0.152702	0.618538
2013	0.973436	0.287854	0.415773	0.468934	0.04269	0.630079

Table 2.5.3. Commercial fishery-dependent standardized indices of abundance and associated log-scale standard errors for Gulf of Mexico Gray Triggerfish. The indices are scaled to a mean of one over each respective time series.

	Handline East		Handline West	
Year	Index	SE	Index	SE
1993	1.89237	0.292882	1.5231	0.250226
1994	2.06973	0.270772	2.34967	0.309077
1995	1.40191	0.267266	2.22327	0.215352
1996	1.01441	0.28159	1.63229	0.167634
1997	0.83308	0.281663	1.25173	0.095168
1998	0.92855	0.28285	1.41771	0.106435
1999	0.83824	0.267451	1.3361	0.200919
2000	0.59704	0.2845	1.001309	0.083532
2001	1.01893	0.279695	0.80944	0.063781
2002	1.52396	0.261166	1.00291	0.071896
2003	1.76743	0.256165	1.02019	0.071661
2004	1.29024	0.26752	0.91255	0.06529
2005	1.31981	0.275833	0.50594	0.071198
2006	1.169674	0.286293	0.858431	0.075651
2007	1.715829	0.288393	1.836853	0.170725
2008	1.335688	0.288262	1.593043	0.176305
2009	1.112905	0.282623	1.11284	0.133168
2010	0.836587	0.288475	0.880855	0.124583
2011	1.416205	0.299952	1.128621	0.163375
2012	0.713069	0.240996	0.436063	0.076939
2013	0.957266	0.262108	0.469345	0.076671

Table 2.7.1 Number of Gray Triggerfish lengths measured in the Gulf of Mexico by commercial gear and year.

Year	East Hand Line	Long Line	Trap	East Total	West Hand Line	Long Line	Trap	West Total
1989	1			1	5			5
1990	50	52	3	105	332			332
1991	8	51		59	811	7		818
1992	96	23	12	131	1529	2		1531
1993	901	41	73	1015	648	2	51	701
1994	1626	27	15	1668	1048			1048
1995	1776	5	24	1805	403	14		417
1996	1330	37	203	1570	266			266
1997	1047	46	169	1262	260			260
1998	749	61	246	1056	122			122
1999	652	48	235	935	61			61
2000	270	29	192	491	36			36
2001	795	32	426	1253	103			103
2002	330	57	385	772	167			167
2003	278	48	213	539	213			213
2004	193	27	29	249	81			81
2005	295	66	32	393	148			148
2006	184	58	124	366	14			14
2007	64	49		113	142			142
2008	75	74		149	68			68
2009	144	25		169	64			64
2010	179	16		195	12			12
2011	271	54		325	31			31
2012	118	17		135	285			285
2013	186	36		222	555			555

Table 2.7.2 Number of Gray Triggerfish lengths measured in the Gulf of Mexico by recreational mode and year.

	East			West		
Year	Charter/ Private	Headboat	East Total	Charter/ Private	Headboat	West Total
1981	54	14	68	11	0	11
1982	78	96	174	0	14	14
1983	59	67	127	48	0	48
1984	11	22	35	72	0	72
1985	10	20	30	109	0	109
1986	86	263	349	85	276	361
1987	387	341	728	113	259	372
1988	383	433	816	144	232	376
1989	203	1037	1240	95	399	494
1990	281	1608	1889	140	510	650
1991	616	1359	1980	205	302	507
1992	1286	1167	2472	225	1197	1422
1993	372	700	1075	131	662	793
1994	329	930	1260	201	1209	1410
1995	288	872	1160	217	884	1101
1996	175	708	883	153	836	989
1997	476	882	1359	158	330	488
1998	1344	1119	2463	126	465	591
1999	2097	614	2711	102	187	289
2000	1961	746	2707	146	56	202
2001	2763	687	3451	106	219	325
2002	2353	1063	3416	128	149	277
2003	2053	968	3021	144	148	292
2004	2671	628	3299	190	102	292
2005	2043	389	2433	156	101	257
2006	998	336	1334	232	84	316
2007	841	448	1289	364	91	455
2008	845	357	1203	374	24	398
2009	567	224	791	214	13	227
2010	535	267	803	31	3	34
2011	1067	219	1286	128	11	139
2012	356	128	484	100	30	130
2013	504	321	825	89	34	123

2.8 Figures

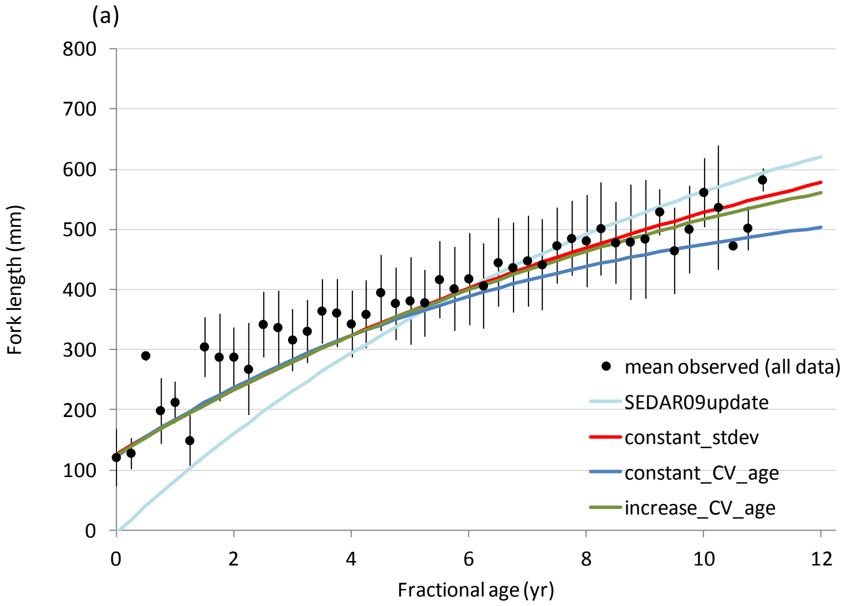


Figure 2.1.1 Von Bertalanffy growth relationship recommended by the Data Workshop (dark blue) compared to alternative models including the model used in SEDAR9 Update (light blue). The von Bertalanffy parameters assuming constant CV with length were: L_{inf} = 58.97cm FL, K = 0.14, and t_0 = -1.66.

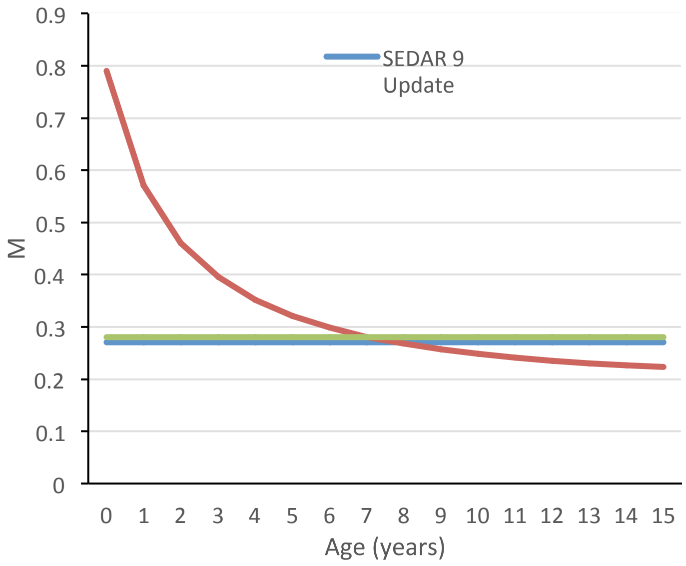


Figure 2.1.2 Recommended age-specific natural mortality vector recommended by the Data/Assessment Workshop (red line). The target mortality based on Hoenig et al. (1983) was 0.28 (green line). The previous assessment (SEDAR9 Update) assumed a fixed mortality rate of 0.27 (blue line).

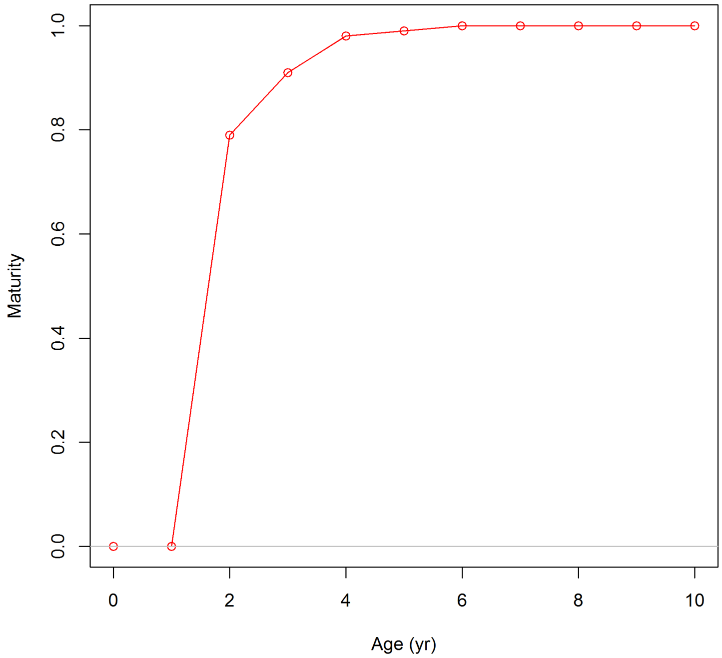


Figure 2.1.3 Proportion mature at age.

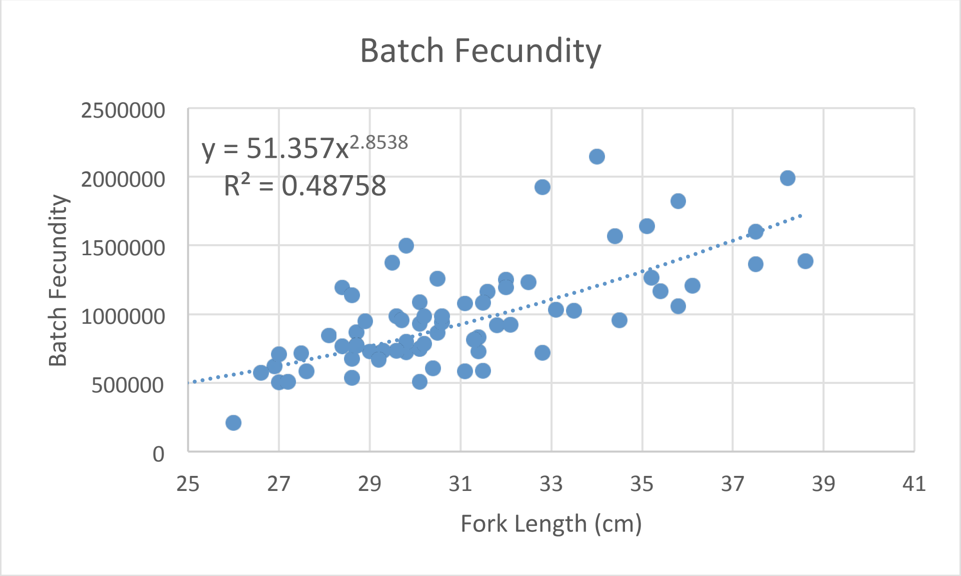
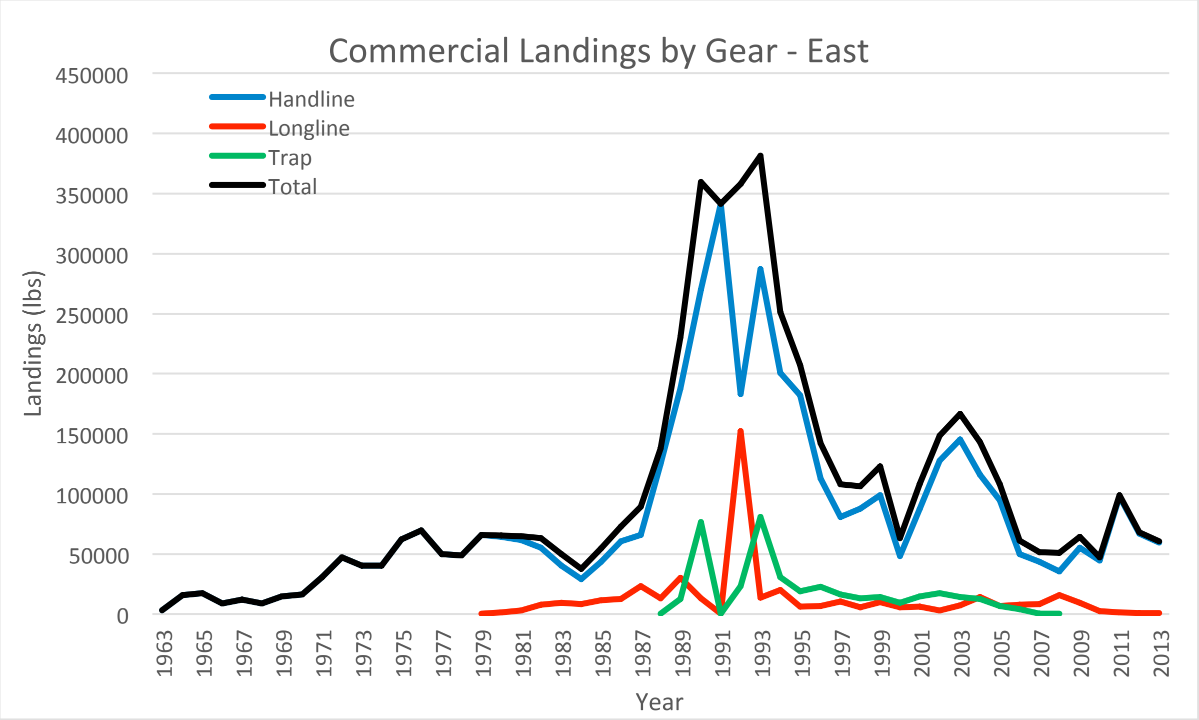


Figure 2.1.4 Batch fecundity at length.



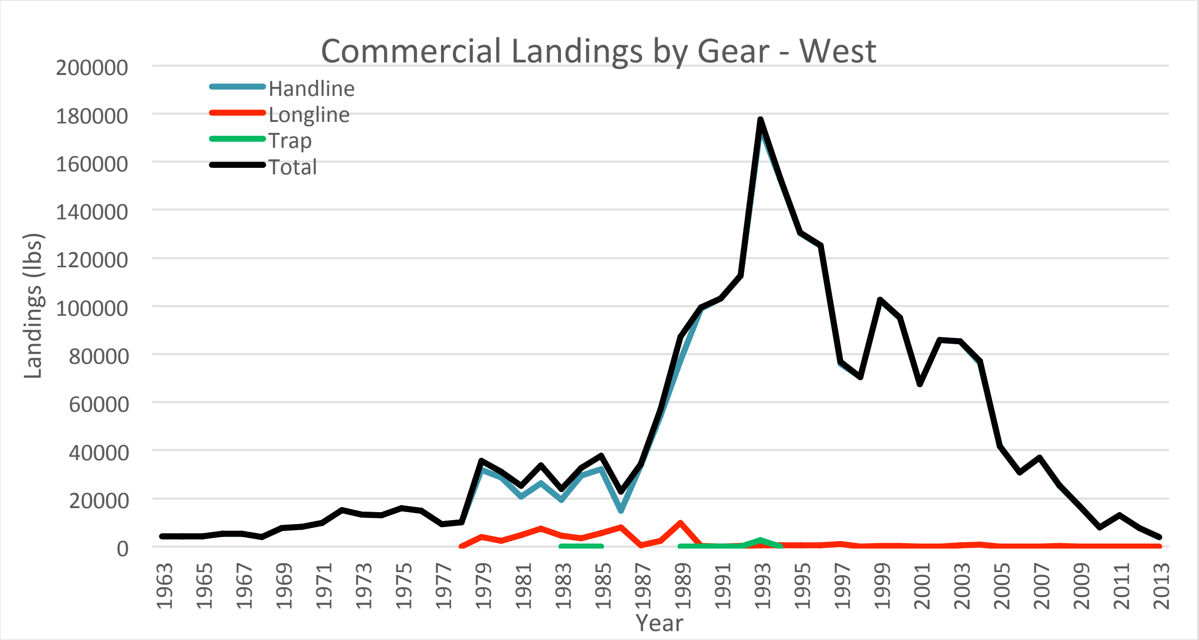


Figure 2.2.1 Gray Triggerfish commercial landings from the Eastern (top panel) and Western (bottom panel) U.S. Gulf of Mexico in pounds whole weight from 1963-2013.

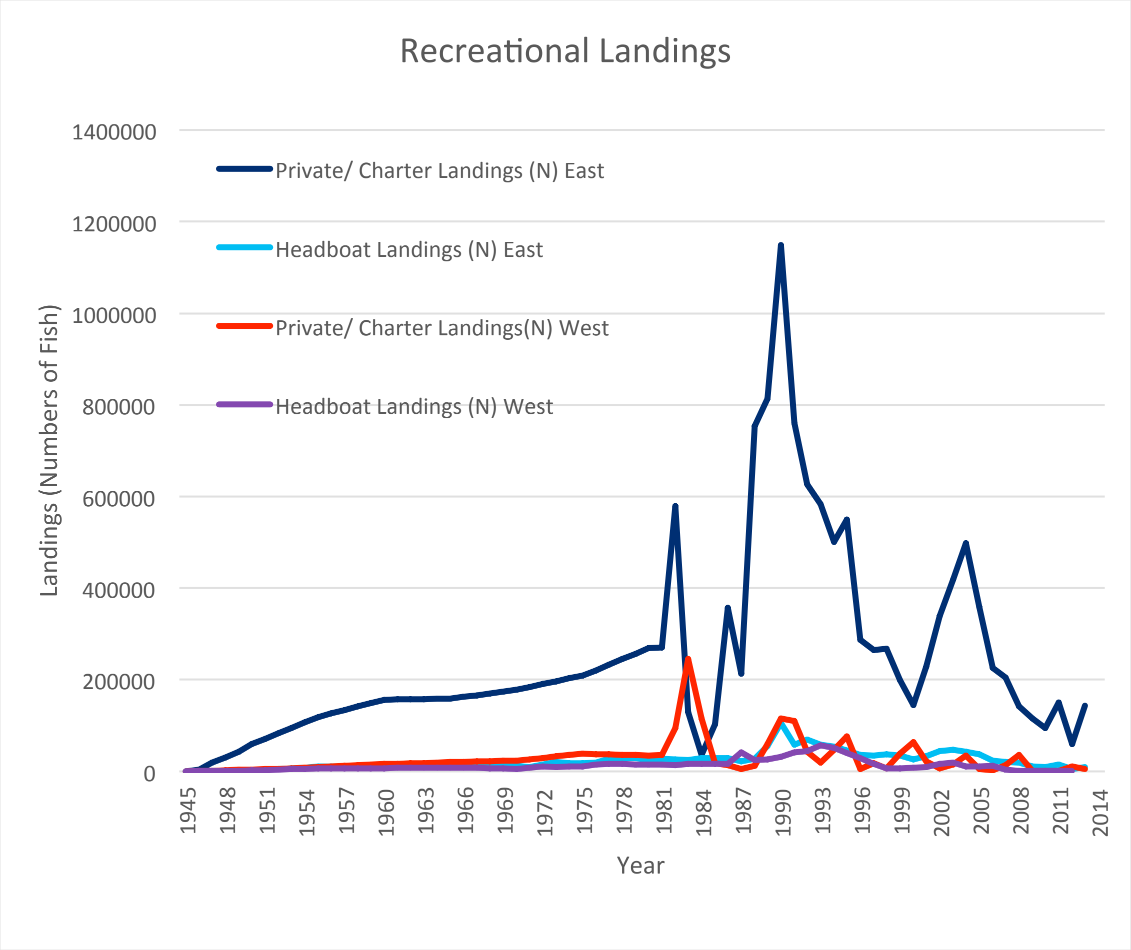


Figure 2.2.2 Gray Triggerfish recreational landings (numbers of fish) from the U.S. Gulf of Mexico from 1945-2013. Values prior to 1981 are estimated.

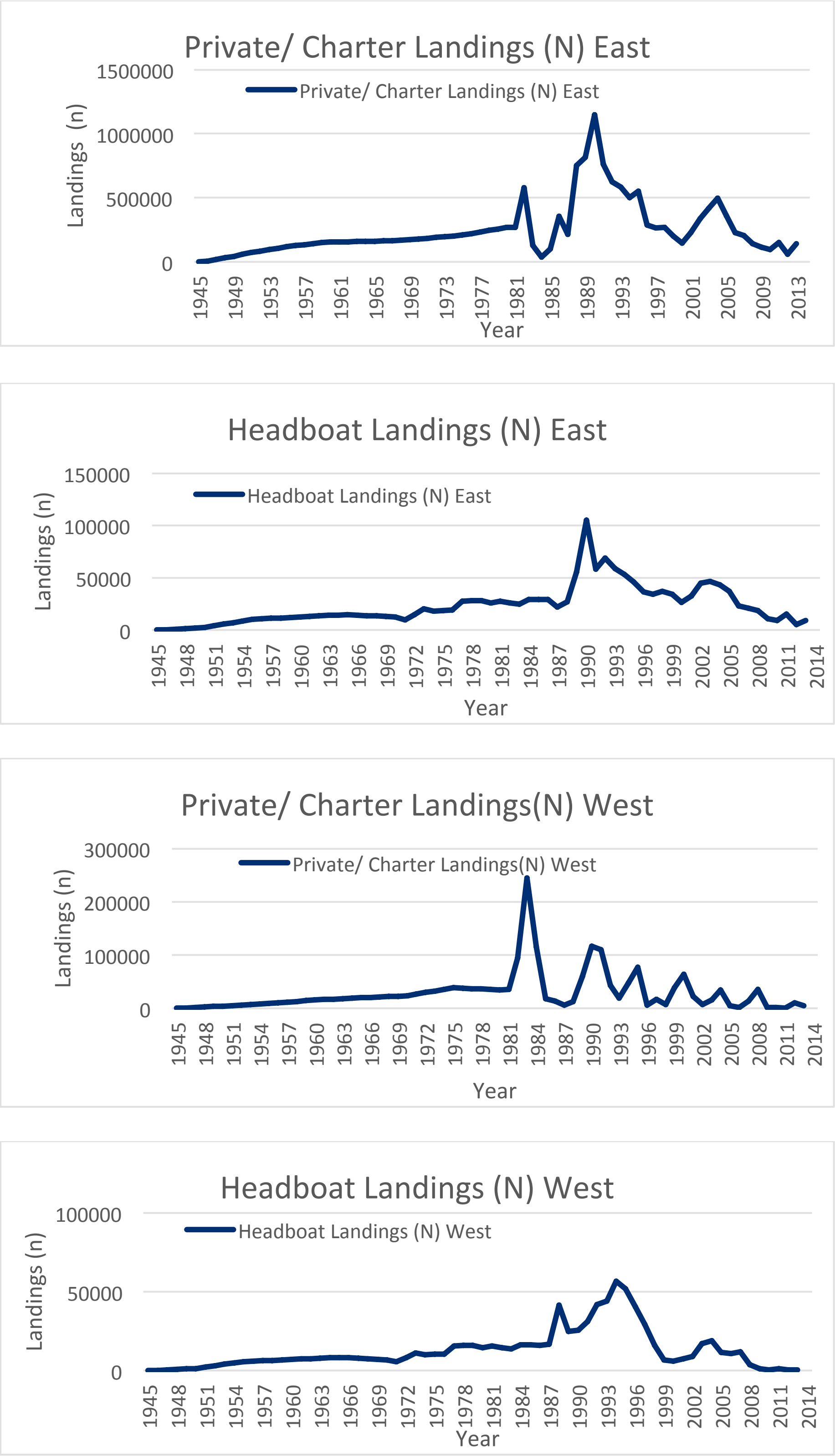


Figure 2.2.3 Detail of Gray Triggerfish recreational landings (numbers of fish) from the U.S. Gulf of Mexico from 1945-2013 by area and mode.

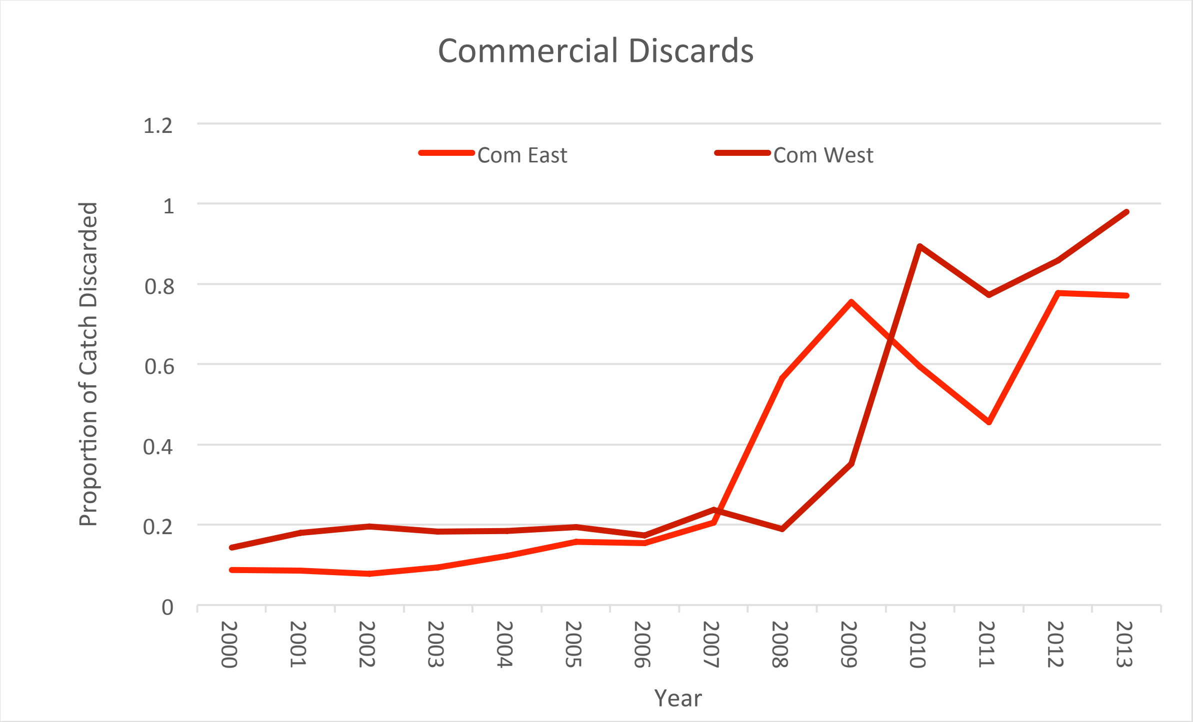


Figure 2.3.1 Gray Triggerfish commercial discards from the U.S. Gulf of Mexico as a proportion of total catch from 2000-2013.

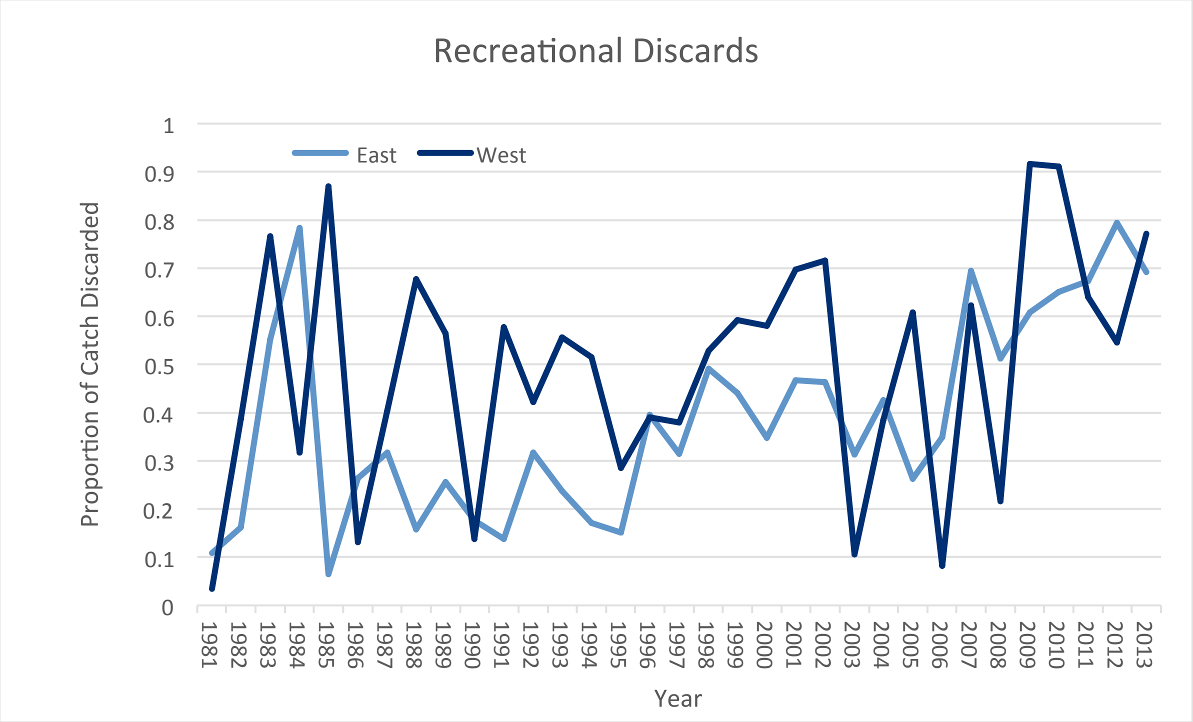


Figure 2.3.2 Gray Triggerfish recreational discards from the U.S. Gulf of Mexico as a proportion of total catch (ab1b2) from 1981-2013.

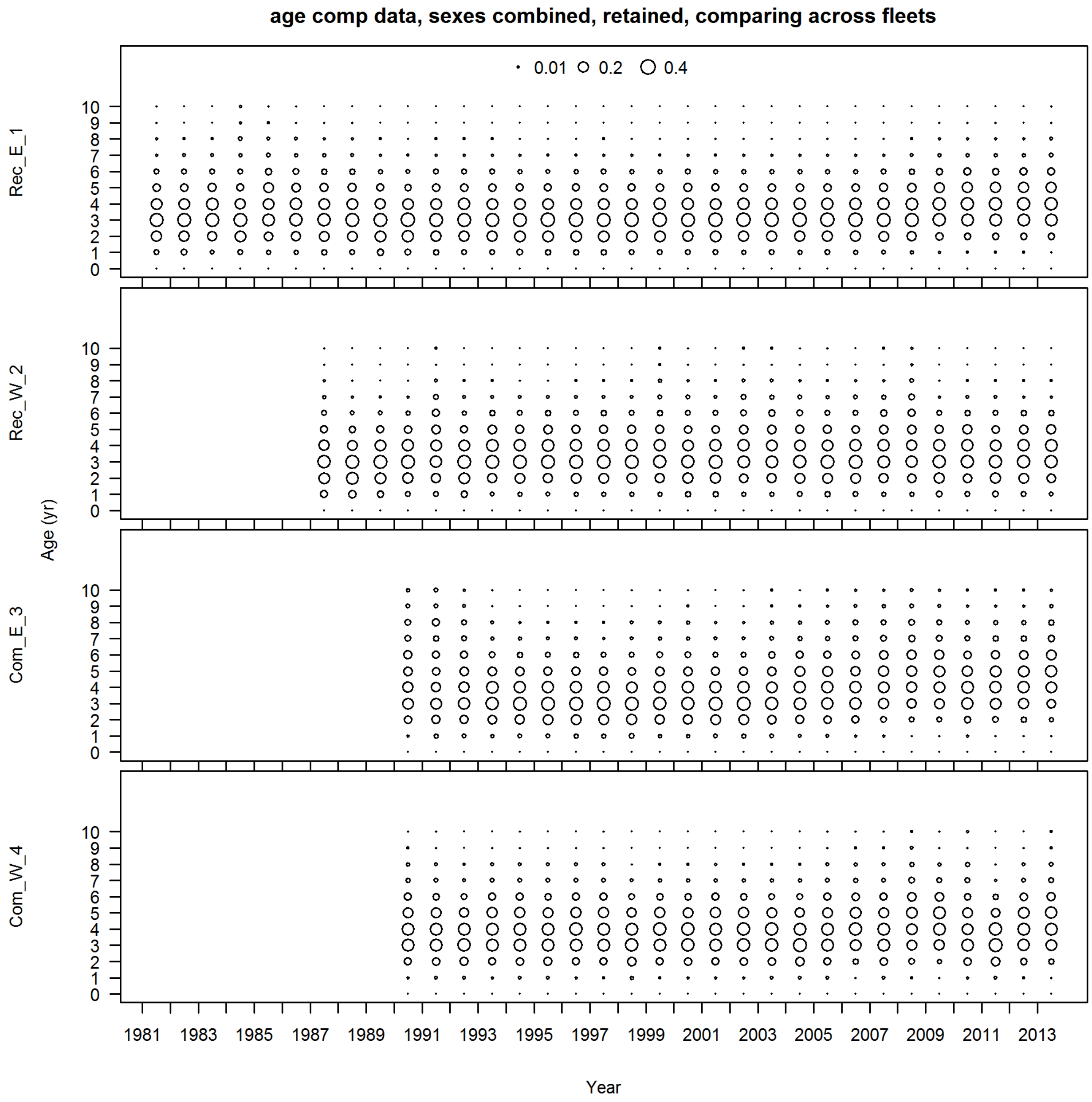


Figure 2.4.1 Annual derived age composition data of Gray Triggerfish landed by the commercial and recreational fisheries in the Eastern and Western U.S. Gulf of Mexico.

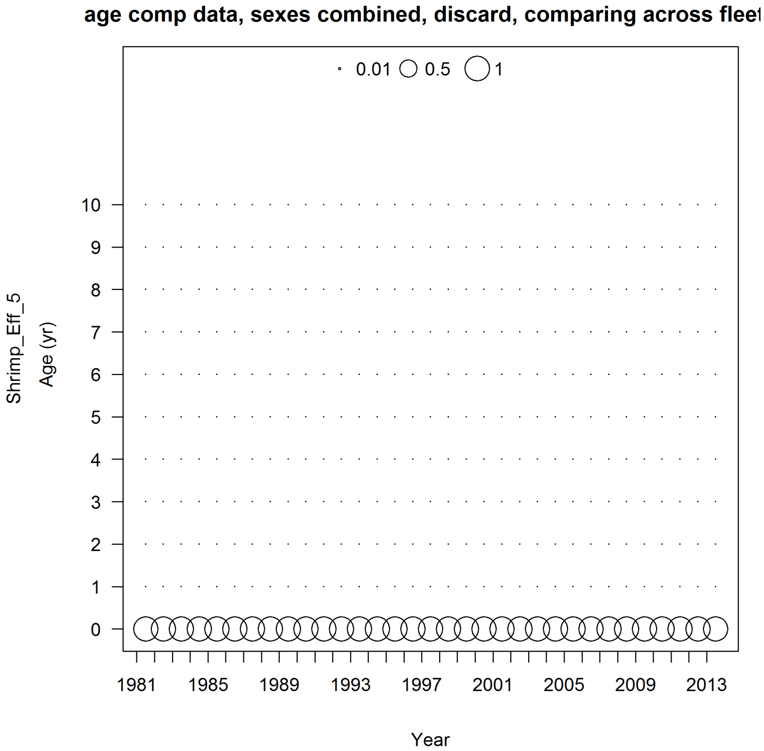


Figure 2.4.2 Annual age composition assigned to Gray Triggerfish discarded as bycatch in the shrimp fishery in the U.S. Gulf of Mexico.

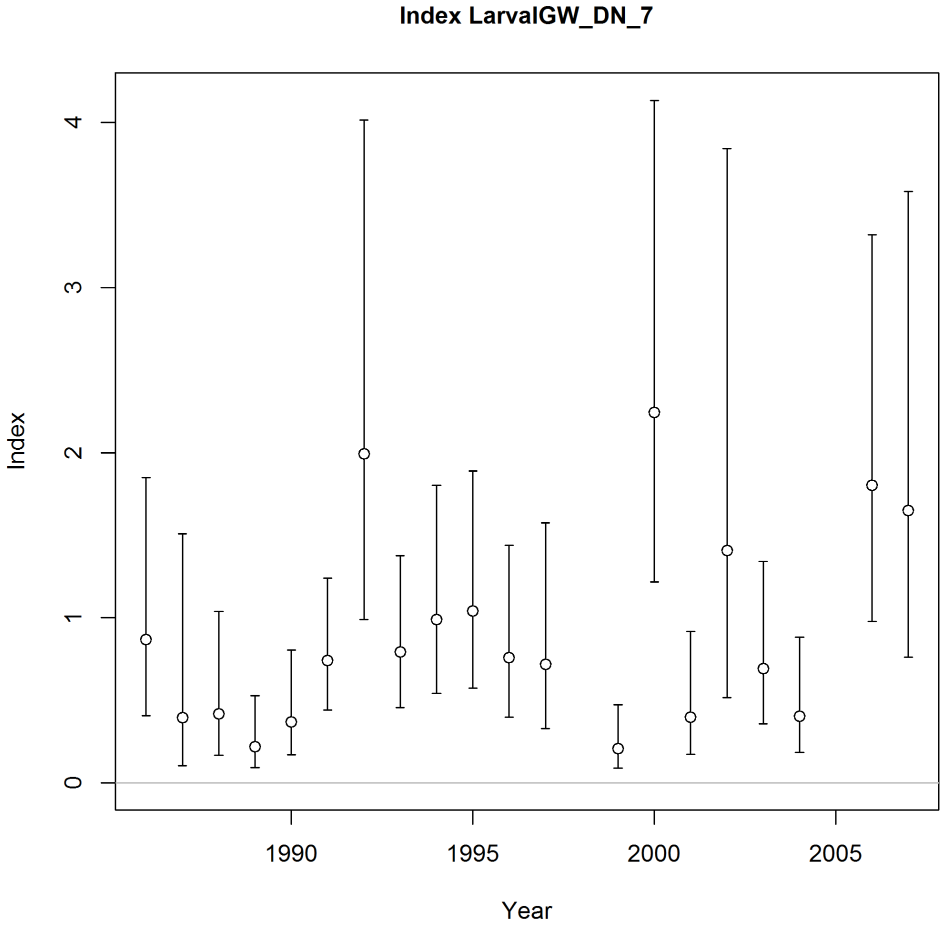


Figure 2.5.1. Standardized indices of abundance and the associated log-scale standard errors from the Gulf of Mexico fall plankton (larval) survey in the U.S. Gulf of Mexico. The index is scaled to a mean of one over the time series and was derived using the number of Gray Triggerfish per trawl hour.

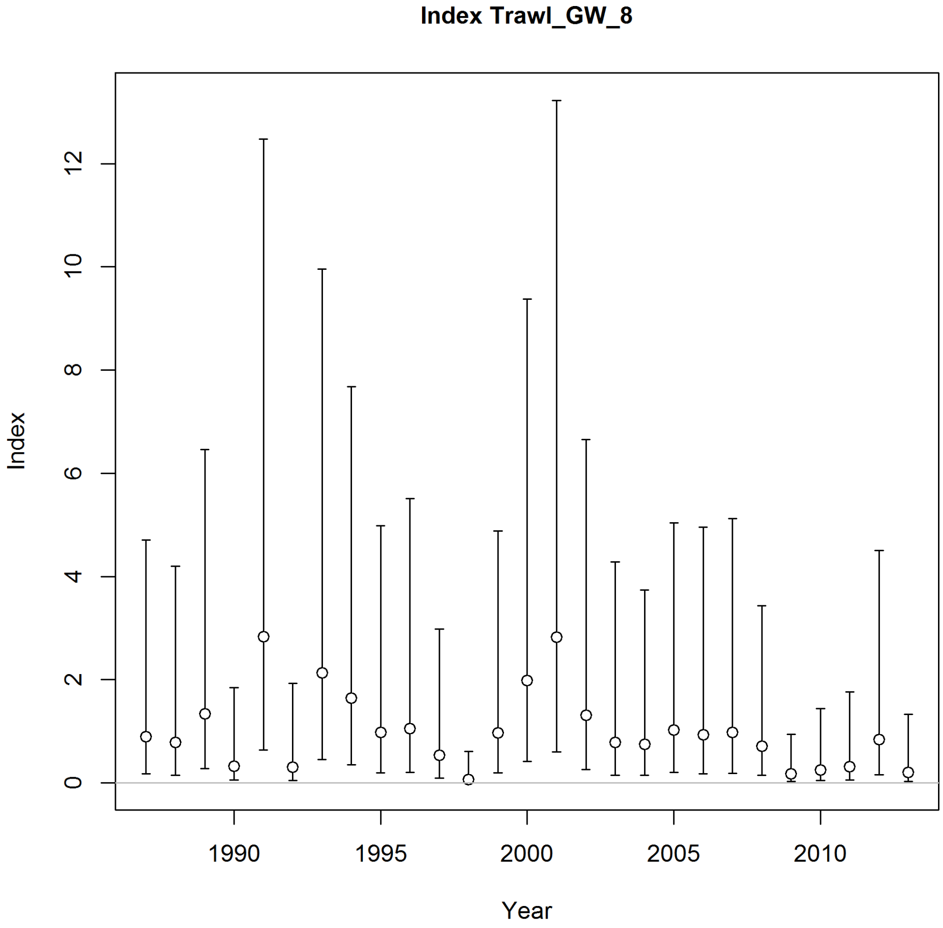


Figure 2.5.2 Standardized indices of abundance and the associated log-scale standard errors from the Gulf of Mexico fall SEAMAP groundfish trawl survey in the U.S. Gulf of Mexico. The index is scaled to a mean of one over the time series and was derived using the number of Gray Triggerfish per trawl hour.

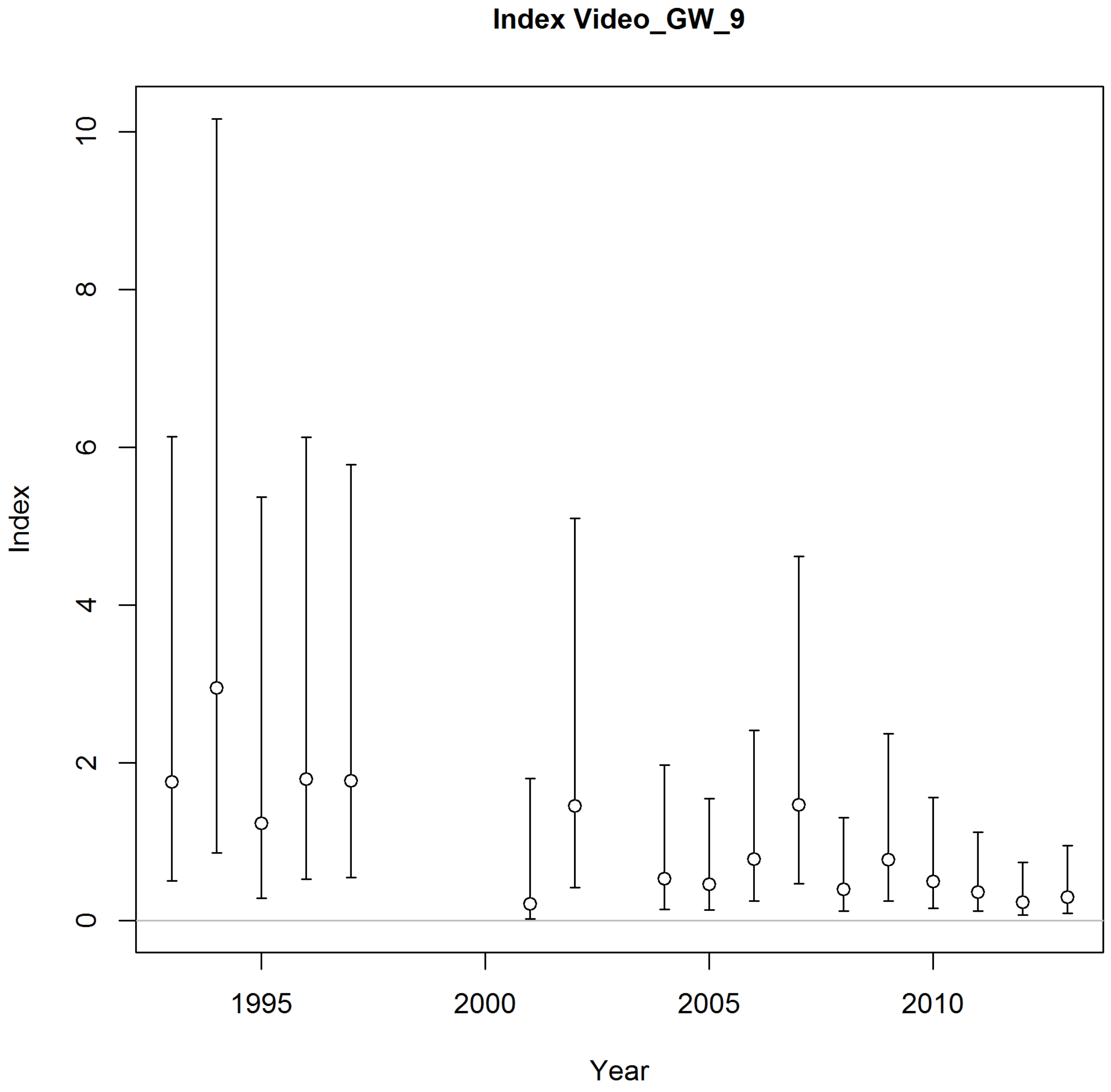


Figure 2.5.3 Standardized indices of abundance and the associated log-scale standard errors from the Gulf of Mexico combined SEAMAP, Panama City and FWRI video survey. The index is scaled to a mean of one over the time series and was derived using the minimum count (maximum number of individuals in the field of view at one instance) of Gray Triggerfish per 20 minute recording.

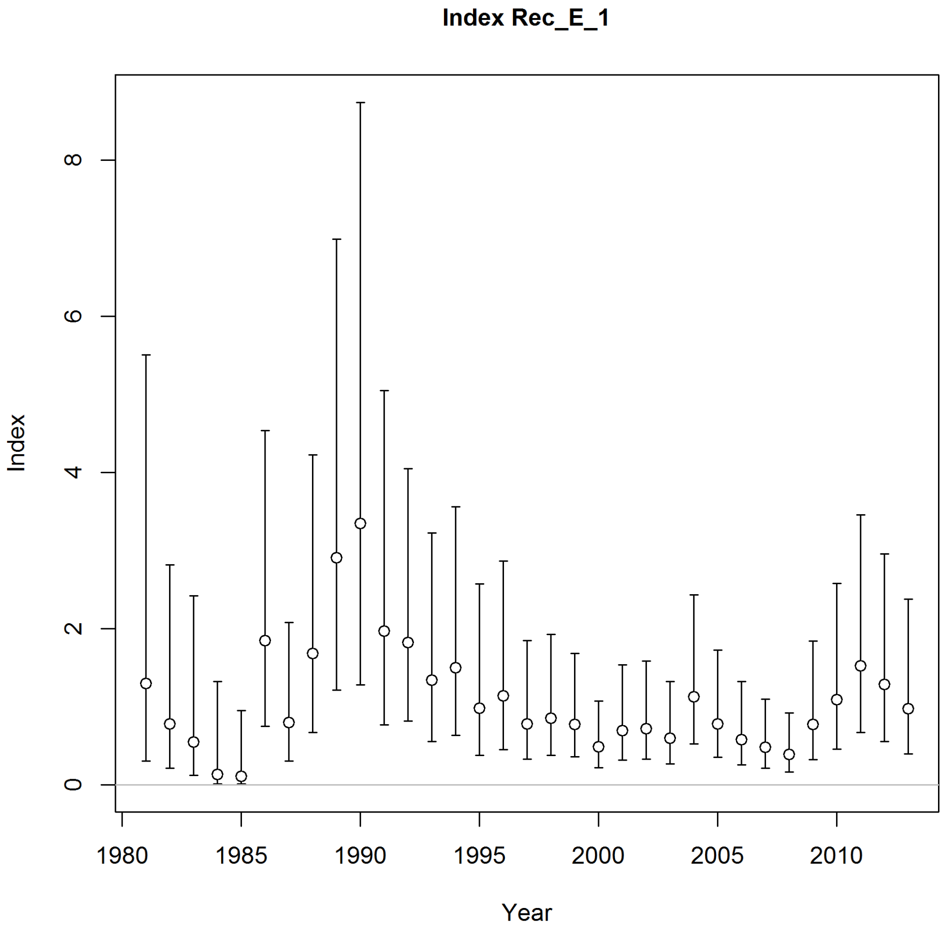


Figure 2.5.4 Standardized indices of abundance and the associated log-scale standard errors from the Gulf of Mexico MRFSS survey in the Eastern U.S. Gulf of Mexico. The index is scaled to a mean of one over the time series and was derived using the number of Gray Triggerfish per angler hour.

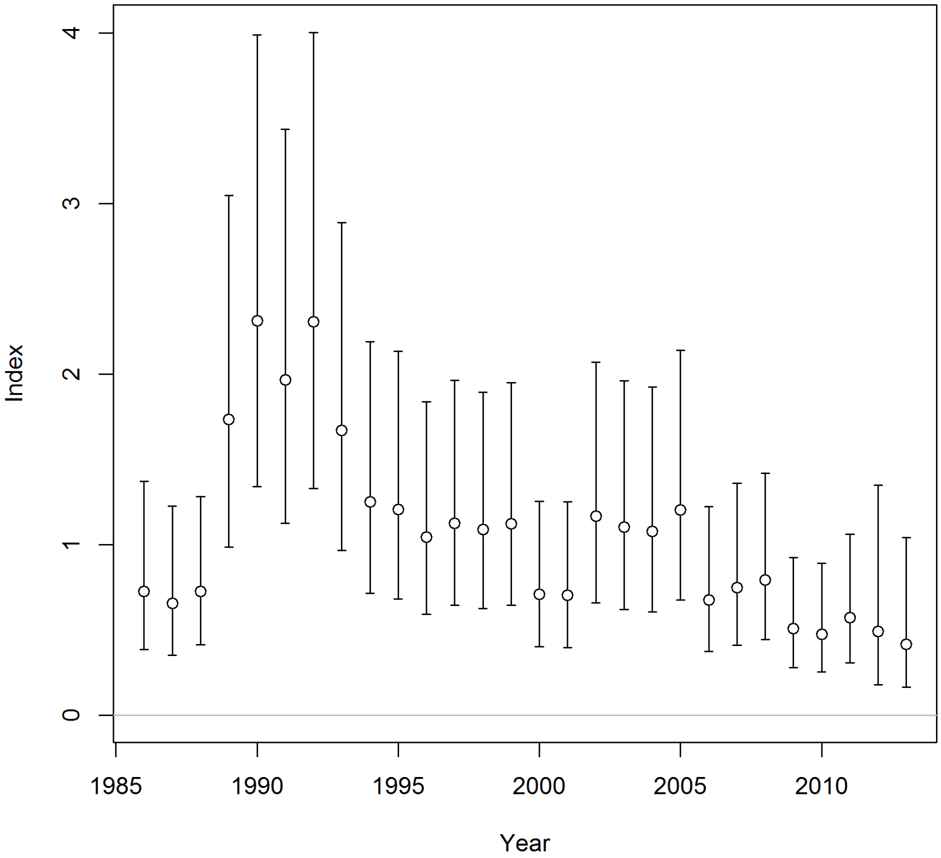


Figure 2.5.5 Standardized indices of abundance and the associated log-scale standard errors from the Eastern Gulf of Mexico headboat recreational fishery. The index is scaled to a mean of one over the time series and was derived using the number of Gray Triggerfish per angler hour.

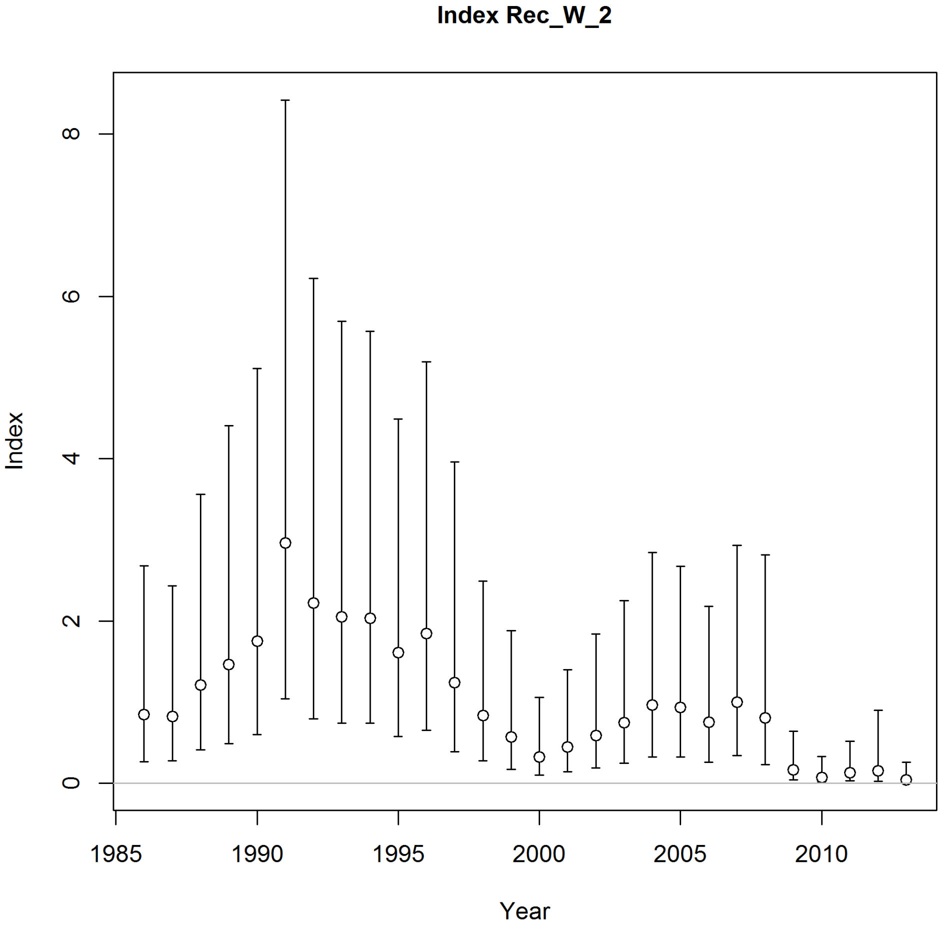


Figure 2.5.6 Standardized indices of abundance and the associated log-scale standard errors from the Western Gulf of Mexico headboat recreational fishery. The index is scaled to a mean of one over the time series and was derived using the number of Gray Triggerfish per angler hour.

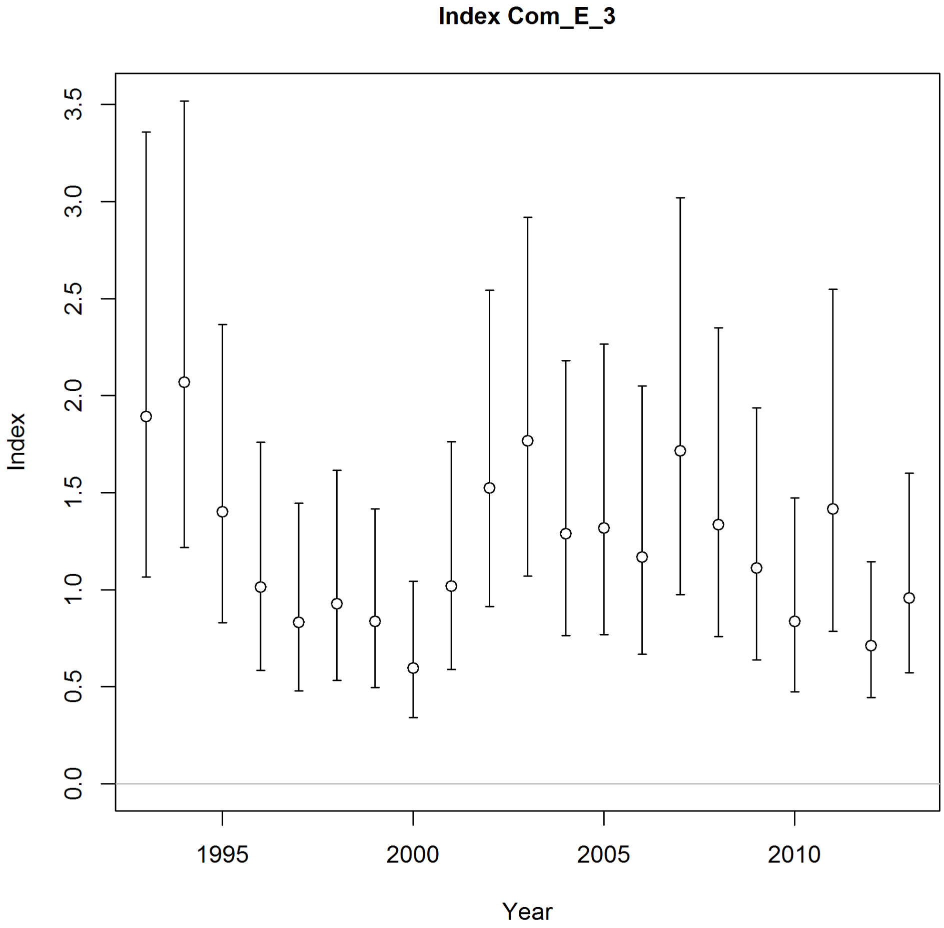


Figure 2.5.7 Standardized indices of abundance and the associated log-scale standard errors from the Eastern Gulf of Mexico vertical line commercial fishery. The index is scaled to a mean of one over the time series and was derived using the pounds of Gray Triggerfish per number of hook hours.

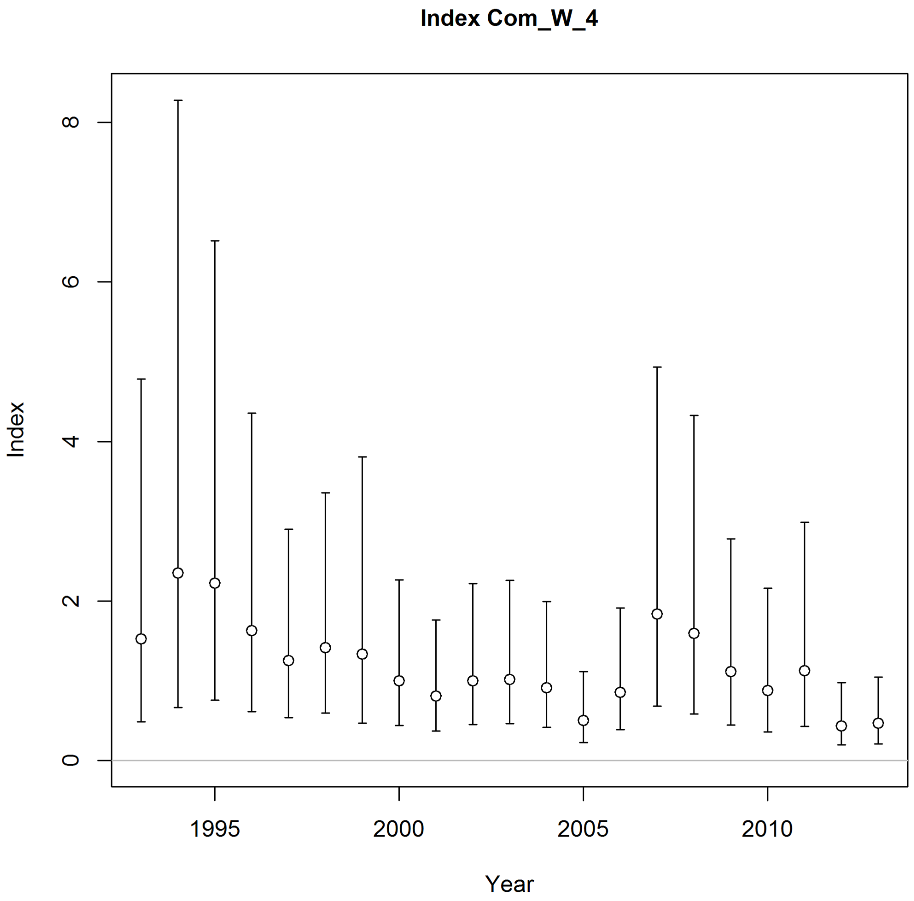


Figure 2.5.8 Standardized indices of abundance and the associated log-scale standard errors from the Western Gulf of Mexico vertical line commercial fishery. The index is scaled to a mean of one over the time series and was derived using the pounds of Gray Triggerfish per number of hook hours.

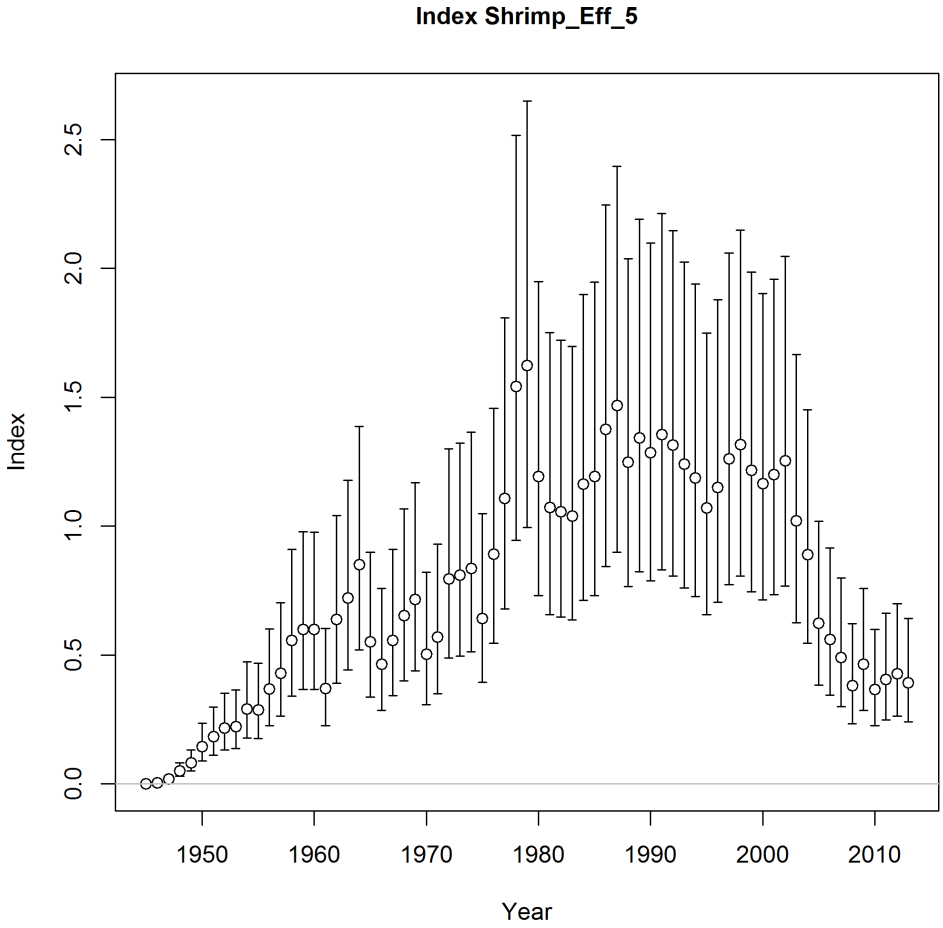


Figure 2.5.9 Relative Gulf of Mexico shrimp effort and the associated log-scale standard errors during 1945-2013. The effort index is scaled to a mean of one over the time series.

3 Stock assessment models and results

3.1 Stock Synthesis

3.1.1 Overview

The primary assessment model selected for the Gulf of Mexico Gray Triggerfish assessment was Stock Synthesis version 3.24S (Methot 2013). Stock Synthesis (SS) has been widely used and tested for assessment evaluations, particularly in the US west coast NMFS centers. Descriptions of SS algorithms and options are available in the SS user's manual (Methot 2013) and in Methot and Wetzel (2013).

Stock Synthesis is an integrated statistical catch-at-age model which is widely used for stock assessments in the United States and throughout the world (Methot and Wetzel 2013). SS takes relatively unprocessed input data and incorporates many important processes (mortality, selectivity, growth, etc.) that operate in conjunction to produce estimates of observed catch, size and age composition and CPUE indices. Because many inputs are correlated, the concept behind SS is that they should be modeled together. This helps to ensure that uncertainties in the input data are properly accounted for in the assessment. SS is comprised of three sub-models: 1) a population sub-model that recreates an estimate of the numbers/biomass at age using estimates for various natural processes such as natural mortality, growth, fecundity, etc.; 2) an observational sub-model that consists of observed (measured) quantities from the population such as relative abundance (i.e., CPUE) or the proportion of individuals at length/age; and 3) a statistical sub-model that employs a likelihood framework to quantify the fit of the observations to the recreated population.

3.1.2 Data sources

The data sources used in the assessment model are described in Section 2. **Figure 3.1.1** summarizes the data sources and their corresponding temporal scale. The Stock Synthesis data file is included as Appendix A.

3.1.3 Model configuration and equations

Life history

The growth parameters were estimated externally from the SS model assuming a single combined sex von Bertalanffy model (**Figure 2.1.1**, SEDAR43-WP-10). The parameterization of the von Bertalanffy model in SS included two additional parameters used to describe the variability in size-at-age. These parameters represent the coefficient of variability (CV) in size-at-age at the minimum (age 1) and at the maximum (age 10) observed ages. Models testing the variance structure were compared; these assumed either constant standard deviation at age, constant CV at age, linear increase in CV with age, or linear increase in CV with length. AIC results indicated that assuming a constant CV of 0.2039 with length best described the data.

Within SS, growth is modeled with a three parameter von Bertalanffy equation (Lmin, Lmax, and K). In SS, 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 (Lbin). Fish then grow linearly until they reach a real age equal to the input value of Amin

(0.5 years) and have a size equal to the Lmin (28.3 cm). As they age further, they grow according to the von Bertalanffy growth equation. Lmax was specified as equivalent to L_{inf} (58.97 cm). The three parameters of the von Bertalanffy equation (Lmin, Lmax, and K) were fixed in the SS model (**Table 3.1.1**). The CVs for length-at-age were input using a fixed parameter of 0.204 for all ages (**Table 3.1.1**). A fixed length-weight relationship was used to convert body length (cm) to body weight (kg) (**Table 3.1.1)**.

The natural mortality rate (M) was assumed to decrease as a function of age based on a Lorenzen (2005) function. The Data/Assessment Workshop life history working group initially recommended using M = 0.27 for scaling the Lorenzen curve (consistent with SEDAR9 UPDATE). However, when using the Hoenig (1983) function to estimate M based on a maximum age of 19, the estimated base mortality rate was 0.28. This revised base M value was then used to develop the age-specific natural mortality vector input into SS as a fixed vector (**Table 2.1.2**). **Figure 2.1.2** illustrates the base age-specific natural mortality M values and the two M at age sensitivity vectors considered during the SEDAR 43 Gray Triggerfish evaluation.

Gray Triggerfish fecundity was modeled as batch fecundity (Figure 2.1.4). The SEDAR 43 life history working group indicated that the relationship between batch fecundity and age was weak and recommended using the relationship between batch fecundity and length.

Stock-recruitment model

The Beverton-Holt stock-recruitment function was used in this assessment to characterize the stock-recruitment (S-R) relationship. Three parameters of the S-R relationship were estimated in the model; the log of unexploited equilibrium recruitment log(R0), an offset parameter for initial equilibrium recruitment relative to virgin recruitment log(R1), and the steepness (h) parameter. The steepness parameter describes the fraction of the unexploited (virgin) recruits produced at 20% of the equilibrium spawning biomass level. A fourth parameter representing the standard deviation in recruitment (σ_R) was also estimated.

Annual deviations from the stock-recruit function were estimated for an early period (prior to 1981) and a later data-rich period (1982-2012). The data-rich period is associated with the beginning of collection of annual composition data (e.g, length, age). The SS model has the ability to track cohorts through time, so it was assumed that the age composition data provided some indication of trends in recruitment between 1965 and 1981. Prior to 1965, recruitment was estimated directly from the S-R relationship. Stock Synthesis assumes a lognormal error structure for recruitment. Therefore, expected recruitments were bias adjusted. Methot and Taylor (2011) recommend that the full bias adjustment only be applied to data-rich years in the assessment (i.e., 1982-2013) when there is sufficient data to inform the model about the full range of recruitment variability. Full bias adjustment was used from 1982 to 2012. Bias adjustment was phased in linearly from no bias adjustment to full bias adjustment from 1965-1981. Bias adjustment was phased out over the last year, decreasing from full bias adjustment to no bias adjustment.

Initial Model Starting conditions

The beginning year of the SS assessment model was 1945. Minor removals of Gray Triggerfish are assumed to have occurred in the Gulf of Mexico prior to 1945; however, for this evaluation the stock was assumed to be at equilibrium at the start of the model. Model runs starting in 1881 were presented at the Data/Assessment Workshop. The assessment panel recommended the incorporation of data back only to 1945 for use in the base model, consistent with the previous assessment (SEDAR 9 Update).

Fleet structure and indices of abundance

The assessment model includes five fishing fleets. The fleets include the aggregated recreational headboat, charterboat and private modes in the Eastern and Western U.S. Gulf of Mexico (Recreational East, Recreational West), the aggregated commercial handline, longline and trap fisheries in the Eastern and Western U.S. Gulf of Mexico (Commercial East, Commercial West), and the bycatch of Gray Triggerfish in the shrimp fishery in the Gulf of Mexico (Shrimp Bycatch). Gray triggerfish as bycatch in the shrimp fishery was considered to be a 100% dead discard fishery; however, a negligible amount of landed catch was input to meet model requirements (i.e. 100 fish annually). The previous assessment used the same primary fleets, but shrimp fishery bycatch was modeled as if it were a directed harvest of age-1 equivalent fish.

The assessment model included eight indices of abundance, as described in Section 2. The commercial and headboat indices were modeled as retained landings indices. The MRFSS East index of abundance included discards in the estimation, and as such was treated as an index of total catch. The three fishery-independent indices were also assumed to model total catch. An index of shrimp effort was also fit as an effort series.

Selectivity and retention distributions

Fleet-specific age based selectivity and retention patterns, and the assumed discard mortality rates are illustrated in ***Figures 3.1.2 – 3.1.5****.*

Age-based selectivity functions were specified for all fleets and indices. Selectivity patterns characterize the probability of capture-at-age for a given gear and are used to model not only gear selectivity, but also fishery availability (due to spatial patterns of fish and fishers). Most of the age-based selectivity functions used in the Gray Triggerfish assessment were modeled using double normal functions. The double normal function is described by two adjacent normal distributions. Each has its own variance term and the two are joined by a horizontal line. This selectivity pattern is described by six parameters, all of which were estimated in the SS model. The selectivity of the shrimp fishery was fixed at 1.0 for age-0, and 0.0 for all other ages. This fishery was assumed to discard all Gray Triggerfish, and a 100% mortality rate was applied. Selectivity of the combined video index was modeled as a 2-parameter logistic function. The larval index was assumed to represent the adult spawning biomass, therefore the selectivity pattern was fixed to the assumed biomass at age of mature fish.

Selectivity patterns were assumed to be constant over time for each fishery and survey. However, the Gray Triggerfish fishery has experienced changes in management regulations over time. These were assumed to influence retention patterns more so than selectivity. As such, these changes were accounted for in the model by the incorporation of time-varying retention patterns and modeling discards explicitly.

Regulatory management changes include the implementation of a 12 inch fork length (30.48 cm FL) size limit from 1999 until 2007 across all fleets. The size limit was increased to 14 inches TL (35.56 cm FL) in 2008. Retention patterns were assumed to change with the changes in the size limit. Retention is modeled as a logistic function with size in SS. Four parameters describe this function; the inflection point, the slope, the asymptote and the male offset inflection (not applicable to this model). The retention patterns associated with the 1999-2007, and 2008-2013 time blocks were assumed to be knife-edge at the size limit. The retention pattern for the pre-1999 time block for all fleets was a fixed, knife-edge relationship at the 6 inch FL size limit (minimum size of retained fish in the landings). Retention above the size limit was freely estimated to account for discards due to factors unrelated to minimum size restrictions (e.g. bag limits).

3.1.4 Estimated parameters

A total of 478 parameters were used for the base case model, and of these 410 were estimated. (Table 3.1.1). The estimated parameters included three (3) parameters used to define the S-R Relationship (h, R0, sR), 345 fleet-specific fishing mortality rates, 28 used to estimate selectivity and retention, 33 used to estimate annual recruitment deviations, and one (1) used to estimate initial catchability coefficient for the shrimp fleet.

Table 3.1.1 includes SS predicted parameter values and their associated standard errors, initial parameter values, and minimum and maximum values a parameter could take. Parameters designated as fixed were held at their initial values. Parameter bounds were selected to be sufficiently wide to avoid truncating the searching procedure during maximum likelihood estimation. The soft bounds option in SS was utilized when fitting the assessment model. This option creates a weak symmetric-beta penalty on selectivity parameters to move parameters away from the bounds (Methot 2013).

3.1.5 Model Convergence

Model convergence was evaluated using a jitter analysis. The jitter analysis perturbs the initial values so that a broad range of parameter values along the likelihood surface are used as starting values. This exercise is typically used to confirm that the model converged to a global solution rather than a local minima. Starting values of all estimated parameters were randomly perturbed by 10% and the model was run for 100 trials. All 100 trials converged on a single solution (**Table 3.1.2**). While this test cannot prove convergence of the model, evidence suggests the base model configuration is stable.

3.1.6 Uncertainty and Measures of Precision

Uncertainty in parameter estimates and derived quantities was evaluated using multiple approaches. First, uncertainty in parameter estimates was quantified by computing asymptotic standard errors for each parameter (**Table 3.1.1**). Asymptotic standard errors are calculated by inverting the Hessian matrix (i.e., the matrix of second derivatives of the likelihood with respect to the parameters) after the model fitting process. Asymptotic standard errors are based upon the analytical estimate of the variance near the converged solution.

Likelihood profiles were also completed for three key model parameters of the stock – recruitment function: steepness of the stock-recruit relationship (h), the log of unexploited equilibrium recruitment (R0), and the variation in recruitment (σ_R). Likelihood profiles are commonly used to elucidate conflicting information among various data sources, to determine how asymmetric the likelihood surfaces surrounding point estimates may be, and to provide an additional evaluation of how precisely parameters are being estimated.

3.1.7 Sensitivity analysis

Uncertainty in data inputs and model configuration were also examined through sensitivity analyses. The sensitivity models reported in this section are not meant to be a comprehensive evaluation of all possible aspects of model uncertainty, nor do they reflect the full range of models considered in developing the base case. These scenarios are intended to provide information about sensitivity of model results (e.g., spawning stock biomass, recruitment, fishing mortality) to assumptions regarding key model parameters. The order in which they are presented is not intended to reflect their importance; each run included herein provided important information for developing or evaluating the base case model and alternate states of nature.

Discard Mortality

Discard mortality in the model was fixed at 5% based on recommendations by the SEDAR 43 Data Workshop panel. A discard mortality rate of 10% was evaluated as a sensitivity run.

Circle Hook Change in Catchability

Based on an evaluation of data provided by Shipp et al. (unpublished data), the effect of a regulation requiring the use of circle hooks in the reef fish fishery in the Gulf of Mexico was estimated to reduce catchability of Gray Triggerfish by a factor of 2.14 (i.e. CPUE on J hooks/CPUE on circle hooks = 2.14). The change in catchability was modeled by adjusting the CPUE series for all hook-and-line fisheries (recreational east, recreational west, commercial east, commercial west) accordingly. Sensitivities were evaluated assuming 1) no effect and 2) 2X the estimated effect (4.28).

Suspect headboat index values

Starting in 2009, a decrease in estimated CPUE of approximately 90% in the headboat fishery in the Western U.S. Gulf of Mexico was observed (**Figure 2.5.6**). Although this decrease coincides with the implementation of an increase in size limit, a decrease in bag limit and a mandatory gear change to circle hooks, a similar decrease in estimated CPUE was not observed for either the Eastern Gulf recreational index or the Western Gulf commercial index. Extensive investigation of headboat catch and effort data failed to find a correlation between the drop in CPUE and any other factor. To determine the sensitivity of the model results to these unusual estimates, a sensitivity run excluding index values from 2009-2012 in the Western Gulf Headboat Index was evaluated.

Retention

Anecdotal information suggests that Gray Triggerfish are not highly prized by some recreational and commercial fisherman and are sometimes discarded at sizes above the minimum size limit. Therefore, the proportion retained above the size limit was estimated within the base model and sensitivity runs fixing the proportion retained above the size limit at 80% were also evaluated.

Index Inclusion (Jack-knife analysis)

The final set of sensitivity runs was used to evaluate the model sensitivity to each of the indices of abundance. A jack-knife approach was used where each index of abundance was removed from the model and then the model was refit to the remaining data.

3.1.8 Retrospective analysis

A retrospective analysis was conducted to assess the consistency of stock assessment results by sequentially eliminating a year of data from the terminal year while retaining the same model configuration. The results of this exercise are useful in assessing potential biases in the estimates of key SS derived quantities (e.g., stock biomass, fishing mortality, recruitment) and uncertainty in terminal year estimates.

3.1.9 Projection Methods

For the purpose of projecting stock status and associated yields, the base assessment model was re-estimated allowing for correlated recruitment deviations. No other parameters were changed from the base configuration. Analysis of recruitment deviations indicated that strong correlation existed in recruitment and suggested that the inclusion of a correlation parameter in the model could improve the deviation estimates, particularly the terminal year estimate which was considered highly suspect (**Table 3.1.1**).

Using the model that allowed for correlated recruitment deviations, projections were run fora low recruitment scenario. Deterministic low recruitment projections were accomplished by calculating the average recruitment deviation over the last ten data years (1994 – 2013) and applying the result to the recruitment estimates for the first five projection years (2014 – 2018). After the first five years, all future recruitments were determined solely by the stock recruitment relationship and not bias corrected or adjusted via a recruitment deviation to account for recent trends.

Projections were done using 2015 as the terminal data year (i.e., 2016 was the first year for which caps and allocations could be set. The average of the 2011, 2012, and 2013 fleet specific exploitation rates fixed as the exploitation rates for 2014 and 2015, for which the actual data was not yet available. Annual and equilibrium OFL values were obtained from projections of F_{SPR30}. ABC values are preliminary and were calculated using a target of SPR30, a rebuilding year of 2025 and a p* value of 0.427. Uncertainty in forecasted yields and stock status was accounted for using model estimated standard errors.

3.2 Model Results

3.2.1 Measures of model fit

Landings

Landings were assumed to have a standard error of 0.05. The predicted landings fit the observed landings nearly identically (**Figures 3.2.1 - 3.2.4**).

Discards

The SS model was fit to the discard fractions estimated for the four directed fleets: Rec E, Rec W, Com E, Com W (**Figures 3.2.5 – 3.2.8**). The model was also fit to the estimated GOM Shrimp Bycatch in absolute numbers (**Figure 3.2.9**). As discards are considered to be known with low precision, they were modeled as the median of the time series with a CV=0.1. As the annual estimates were thought to be less reliable than the mean, the discard fractions and discards and were modeled using a "Super-Year" approach. This capability allows the user to introduce data that may best represent an amalgam across a number of contiguous years. The model will then estimate a single expected value for these observations over the same time period.

The fractions of Gray Triggerfish discarded by the recreational fisheries were modeled in three time blocks to account for various fishing regulations. The observed and predicted discard fractions from the recreational east fleet show an increasing trend roughly corresponding to regulatory changes (**Figure 3.2.5**). The model overestimated the recreational east fleet discard fractions in years prior to regulations (before 1999) and also underestimated discards following the most recent regulation change of 2008 (**Figure 3.2.5**). However, in general the fit to the discard fractions is acceptable. Similarly, the observed and predicted discard fractions from the recreational west fleet also show an increasing trend roughly corresponding to regulatory changes (**Figure 3.2.6)**. However the observed annual discards rates were more variable between years. The model fit to the observed recreational west discard fractions was generally acceptable (**Figure 3.2.6**).

The annual fractions of Gray Triggerfish discarded by the commercial fisheries were modeled in two time blocks. Observed commercial discard fractions increased following regulatory changes in 2008 in both the eastern and western commercial fleets. The model overestimated discard fractions in the 2000-2007 time period and underestimated discard fractions during 2008-2013 (**Figures 3.2.7** and **3.2.8**). However, given the substantial coefficient of variation, the fits were acceptable.

Discards of Gray Triggerfish from the shrimp fishery were modeled in two time blocks. The first time block incorporated years prior to 1972 when effort was estimated, and years following 1971 when effort was based on a survey. The use of time blocks for shrimp discards reduced the effect of imprecision in the model. Observed discards from the shrimp fishery showed large variation during the second time block. The SS fit to the discards was generally adequate (**Figure 3.2.9**).

Indices of abundance

The SS model was fit to five fishery-dependent indices, three fishery-independent indices and an effort series. The fits to the indices are summarized in **Figures 3.2.10** – Error! Reference source not found.**3.2.18**. The model fit to the recreational east standardized index (RMSE = 0.445) suggests a decrease in the abundance of relevant age-classes since a peak in 1989 (Figure 3.2.10). The standardized index also exhibits a general decrease during this time period; however, the model underestimates a recent increase in the standardized index between 2008 and 2013.

The SS model fit to the SRHS (Headboat) East standardized index (RMSE = 0.229) indicates a decrease in the indexed age-classes after 1989, slightly earlier than the observed peak in the index in 1990 (**Figure 3.2.11**). The standardized index also suggests a general decrease during this time period; however, the model failed to fit a recent decrease in the standardized index between 2008 and 2013. The contradictory trends in the MRFSS East and SRHS (Headboat) East indices since 2008 quite likely contributed to the poor SS model fit for both indices. MRFSS East contains discards, and consequently references somewhat younger fish. This could partially explain the discrepancy.

The model fit to the recreational west standardized index (RMSE = 0.914) also shows a decrease in the index since a peak in 1989 (**Figure 3.2.12**). However, the standardized index demonstrates a substantial decrease from 1991-2000, then an increase from 2000-2005 followed by a sharp decline in 2008. The model fitted trend was relatively flat compared to the observed series. The contradictory trends between the eastern and western recreational indices could have contributed to this lack of fit.

The model fit to the standardized commercial east index (RMSE = 0.282) and standardized commercial west index (RMSE = 0.458) are shown in **Figures 3.2.13** and **3.2.14**. The model fit to the commercial east index generally followed the trend in the index. The model fit to the commercial west index appears to be relatively flat, missing observed changes in the index. In addition, the model failed to fit the recent decline in CPUE between 2011 and 2013. However, given the estimated high variance in the index, the lack of fit in the SS estimated index is not unexpected.

The SS model fit to the Shrimp Fishery effort series was very close (RMSE = 0.066) (Figure 3.2.15). This is a common characteristic of SS models that fit to effort series, and likely results from the underlying model specifications.

The SS model fits to the standardized fishery-independent indices are shown in **Figures 3.2.16- 3.2.18**. The standardized SEAMAP Larval Survey was used as an index of spawning biomass, and varies annually an without overall trend. Although the model fit suggests recent declines in the spawning biomass, the fit to the observations was poor overall (Figure 3.2.16), in part due to the large coefficients of variation. The standardized SEAMAP Fall Groundfish (Trawl) Survey index is thought to reference young of the year Gray Triggerfish (**Figure 3.2.17**). Like the SEAMAP larval survey, it was also highly variable with large CVs. The index suggested higher than average recruitment in 1991 and 2001, and a generally declining trend since 2001. The fit to this index was relatively poor, with a generally flat trend and a substantial residual pattern. The standardized combined video index (**Figure 3.2.18**) suggests a declining trend since 1994. Like the SEAMAP Groundfish Index, the model fit to the combined video index was poor, with a generally flat trend and a substantial residual pattern.

Derived Age Composition

The model fits to the derived age composition associated with the landings series, and the corresponding Pearson residuals are presented in **Figures 3.2.19** – **3.2.28**. In general, the SS model fit the derived age comps well across all fleets, as reflected by Pearson residual values generally less than four units.

The fits to the recreational east derived age composition were quite good (**Figure 3.2.19** and **3.2.20**). In general, the predicted and observed distributions were nearly identical in most years. The slight degradation in the fits during the most recent years suggests that anglers may have responded to regulatory changes in length and bag limits in a manner that differed somewhat from model predictions. Pearson residuals indicate that there is little systematic noise in the model fit to the data.

The fits to the recreational west derived age composition were also quite good (**Figures 3.2. 21 - 3.2.22**). The predicted and observed distributions were nearly identical in most years. The model has routinely overestimated the abundance of older age classes somewhat since 2009, the year following a change in regulations. Pearson residuals indicate a slight temporal bias as younger age classes were overestimated from 1994-2003 and underestimated thereafter.

The fits to the commercial east derived age composition were somewhat less strong (**Figures 3.2.23 – 3.2.24**). The predicted and observed distributions were similar in most years, except the earliest which were characterized by relatively low effective sample sizes. The model frequently overestimated or underestimated the numbers of individuals in the most dominant age class. However, the Pearson residuals suggest that there was little systematic noise in the model fit to the data for this fleet.

The fits to the commercial west derived age composition were relatively good (**Figure 3.2 25 – 3.2.26**). The predicted and observed distributions were quite similar in all years except 2010 and 2011. The model overestimated the abundance of older age classes in these years. Because the model was constrained to discard sub-legal size fish, the lack of fit to these years could be a function of commercial landings that contained either sub-legal or faster growing fish. Regardless, Pearson residuals indicate that there as little systematic noise in the model fit to the data for this fleet.

All Gray Triggerfish discarded from the shrimp fishery were assumed to be age-0, and selectivity was fixed at 1.0 for age-0, and 0.0 for all other ages. Thus, as expected, the model fit exactly to the assumed age composition of the shrimp fishery (**Figures 3.2. 27 – 3.2.28**).

3.2.2 Parameter estimates and associated uncertainty

Table 3.1.1 summarizes the parameter estimates and the asymptotic standard errors from SS. The majority of parameters have relatively low standard errors. The parameters with larger standard errors are mainly the age selectivity parameters and some years of the recruitment deviations

Likelihood profiles were generated for several key parameters in this assessment. They include three parameters in the Beverton-Holt stock-recruitment function: steepness (h), recruitment at an unexploited state*, ln(R0)*, and the offset in recruitment from the unexploited equilibrium, *ln(R1_offset)*. Likelihood profiles were used to evaluate how estimable these parameters were, and to identify possible conflicts in the signal derived from various data inputs.

The likelihood profile of the steepness parameter shows that there were possible conflicts between data sources (**Figure 3.2.29**). The age, survey and recruitment components exhibited similar likelihood patterns. The discard component favored a lower steepness. Steepness was relatively insensitive to catch. The model run with steepness fixed at 0.6 reached an alternative solution, likely the result of the starting value, and should be excluded from consideration of steepness.

The total likelihood component from the ln(R0) likelihood profile indicates that the global solution for this parameter is approximately 9.5 (**Figure 3.2.30**) The recruitment likelihood component is the largest component of the total dictating this outcome. The data conflicts are seemingly minimal.

The likelihood profile on the parameter accounting for the variation in recruitment (σ_R) suggests that the dominant influence on the likelihood is the age component (**Figure 3.2.31**). Survey and discard components favored lower σ_R, and the model was insensitive to catch.

3.2.3 Selectivity and retention

Age-based selectivity functions were estimated for all fleets and indices. Selectivity patterns represent the probability of capture-at-age for a given gear and are used to model not only gear selectivity but also fishery availability (due to spatial patterns of fish and fishers). Selectivity patterns were assumed to be constant over time for each fishery and survey (**Figures 3.2.33 – 3.2.41**). The Gray Triggerfish fisheries have experienced changes in management regulations over time. These were assumed to influence the retention patterns more so than selectivity. As such, these changes were accounted for in the model using time-varying retention patterns and by modeling discards explicitly.

Changes in the management regulations for all fleets include the implementation of a 12 inch fork length (30.48 cm FL) size limit from 1999 until 2007. The size limit was increased to 14 inches TL (35.56 cm FL) in 2008. Retention patterns were assumed to vary with the changes in the size limit (**Figures 3.2.42 – 3.2.45)**. The asymptotic parameters for the retention functions (i.e., the proportion retained above the size limit) were estimated for all fleets, and are summarized in **Table 3.1.1**. The proportion retained above the size limit varied from 0.564 in the recreational west fleet to 0.698 in the commercial east fleet.

The fishery-independent surveys age selectivity patterns were fixed based on either observed or assumed age composition. All Gray Triggerfish in the SEAMAP larval survey were assumed to be age 0. The SEAMAP fall groundfish survey was used as a proxy of spawning stock biomass in the previous year; therefore, all ages were assumed to be captured. The video survey selectivity pattern was estimated externally based on the probability of detection at size and was then fixed in the model to be essentially asymptotic.

3.2.4 Recruitment

The three key parameters for defining the stock-recruitment relationship were steepness (*h*), virgin recruitment (*R0*), and sigma(R). All three parameters were estimated without priors and were estimated within the upper and lower bounds (**Table 3.1.1**). Steepness was estimated at 0.459 for the base model. The log of virgin recruitment is estimated at 9.76. The sigma (R) parameter was estimated at 0.358.

The plot of the stock-recruitment relationship shows unusually high recruitment associated with years 1986 and 1987 (Figure 3.2.26). The model is driven to estimate these high recruitments in order to account for the large increase in landings in the mid-1980s in the recreational east and west fishing fleets (**Figures 3.2.1 and 3.2.2**). In general, levels of recruitment are positively related to spawning biomass values, suggesting a relatively strong stock-recruit relationship. This is an unusual result for Gulf of Mexico assessments, and may be influenced by nest-guarding behavior in Gray Triggerfish. Recall that the likelihood profile on steepness supported estimates between 0.4 and 0.45, but also exhibited unusual behavior at steepness values greater than 0.45 (**Figure 3.2.29**).

Predicted age-0 recruits are presented in **Figure 3.2.47**, and in **Table 3.2.1**. Average recruitment was variable over time. Higher average recruitments are generally preceded and followed by relatively lower than average recruitments. The RMSE for recruitment deviations was 0.264. Recruitment in 1985 was predicted to be the highest recruitment over the time series with a secondary peak observed in 1999. Age 0 recruitments during the six most recent years were predicted to be relatively low.

3.2.5 Stock biomass

Predicted total biomass and spawning output in eggs are summarized in **Table 3.2.1** and **Figures 3.2.48 – 3.2.49**. Total biomass has generally decreased throughout the time series. The decreasing trend seen in total biomass is also evident in the predicted spawning output time-series.

The predicted numbers-at-age and mean age is presented **Figure 3.2.50**. The predicted numbers-at-age suggest two strong recruitment events in 1985 and 1999. Mean age has varied between one and two between 1945 and 2013. Mean age was relatively constant between 1945 and 1981, but declined rapidly through 1986. Mean age has shown a gradual increase since 2000, likely the result of regulations limiting harvest, and/or lower than average recruitment.

The trend in the numbers-at-length and mean length is obviously similar to the predicted numbers-at-age and mean age (**Figure 3.2.51**). Although mean age and mean size have not changed considerably over the time series, it is important to note that the relative proportion of larger and older fish has declined steadily.

3.2.6 Fishing mortality

The predicted fishing mortalities (overall and by fleet) are presented in **Table 3.2.2** and **Figure** 3.2. **3.2.52 – 3.2.54**. Predicted total fishing mortality declined, on average, between 1989 and 2013, although the 2013 fishing mortality increased somewhat over 2012.

The main source of directed fishing mortality is the recreational east fleet (**Figures 3.2.53 – 3.2.54**). The recreational west fleet accounts for the next highest fishing mortality. Although the commercial east and west fleets exhibited some significant fishing pressure in the early 1990s, fishing mortality due to commercial fishing has remained low in recent years. The trend in fishing mortality associated with shrimp fishery bycatch mirrors effort for that fleet. It appears to be quite significant because it takes a significant fraction of the age-0 fish (but no other age-classes are affected).

3.2.7 Sensitivity analyses

The results of the sensitivity analyses are summarized in **Table 3.2.3** and **Figures 3.2.55 – 3.2.60**).

Discard mortality

The primary assessment results were relatively insensitive to an increase in discard mortality (to 10%) as shown in Figures 3.2.55 - 3.2. 57.

Circle Hook Change in Catchability

Sensitivities were evaluated to explore the sensitivity of model results to assumptions regarding the circle-hook effect on catchability (base = 2.14 fold reduction in q, sensitivities at 2X assumed effect and no effect). The model was sensitive to the removal of the circle hook effect. The removal of the circle hook adjustment reduced SSB, recruitment and total biomass by over 40% (**Figures 3.2.55 - 3.2. 57**)

Suspect headboat index values

Starting in 2009, a decrease in CPUE of approximately 90% in the headboat fishery in the Western U.S. Gulf of Mexico was observed. Although this decrease coincided with the implementation of an increase in size limit, a decrease in bag limit and a mandatory gear change to circle hooks, a similar decrease in CPUE was not observed in either the Eastern Gulf recreational indices or the Western Gulf commercial index. Extensive investigation of headboat catch and effort data failed to find a correlation between the drop in CPUE and any other factor. A sensitivity run excluding index values from 2009-2012 in the Western Gulf Headboat Index was evaluated. The exclusion of SRHS West index values since 2008 caused an increase in estimates of SSB, recruitment and total biomass (**Figures 3.2.55 - 3.2. 57).**

Retention

Anecdotal information suggests that Gray Triggerfish are not highly prized by some fisherman and are sometimes discarded at sizes above the minimum size limit. The proportion retained above the size limit was estimated in the base model resulting in retention estimates that ranged from 50-65% by fleet. A sensitivity run with retention fixed at 90% was included for comparison. Using a fixed retention of 90% had very little effect on the outcome of the analysis (**Figures 3.2.55 - 3.2. 57**).

Jack-knife of indices

The results of the sensitivity exercise to evaluate index inclusion (i.e., jack-knife analysis) are summarized in **Figures 3.2.58-3.2.60** and **Table 3.2.4**. The model was most sensitive to exclusion of the SRHS West and SEAMAP Larval indices. The fit to these indices was similar when comparing the RMSEs.

3.2.8 Retrospective results

The results from the retrospective analysis are summarized in **Figures 3.2.61 and 3.2.62**. There were no major patterns or systematic biases in the spawning stock biomass. The scale of SSB did vary between years, but the direction was inconsistent. However, a retrospective pattern in age-0 recruits was evident

(**Figure 3.2.62**), suggesting that recruitment estimates were sensitive to the effective terminal year of the data.

3.2.9 Benchmark and reference points

Stock status measures for the base and sensitivity runs are presented in **Table 3.2.3**. The results indicate that Gray Triggerfish have been overfished since 1993, as spawning stock biomass has remained below MSST (SPR30) since that time.

3.2.10 Projections

SS estimated the stock recruitment correlation parameter to be 0.729 (**Table 3.2.5**). Documentation for the exact interpretation and implementation of this parameter in the estimation process is limited. However, this value is similar to a one year auto-correlation value estimated independently of SS and was assumed to have a similar interpretation in SS. Patterns in the estimated recruitment deviations were similar to those obtained in the base model (**Tables 3.1.1 and 3.2.5**) with the exception of the terminal year deviation which was estimated to be -0.52 with correlation instead of -0.12 without.

Near term overfishing limits for gray triggerfish were around one million pounds retained whole weight while the ABC values calculated with a 2025 rebuild timeline and a p* of 0.427 were approximately 200,000 pounds in the near term (**Table 3.2.6**). Optimum yield projections effectively reduced the harvest rates of the directed fleets by 75% however the retained yield estimates obtained by SS were uniformly higher than 75% because of the contribution of the shrimp fishery which did not experience harvest rate reductions in the optimum yield run (**Table 3.2.7**).

Stock Rebuilding times vary widely depending on the projection scenario used (**Table 3.2.8**). Under the low recruitment scenario, rebuilding is slow and doesn't begin to accelerate until several years after the negative recruitment deviations are removed and the larger cohorts reach sexual maturity. Rebuilding time estimates are based on the assumption that gray triggerfish will experience lower than average recruitment through 2018 and average recruitment from then on. Rebuilding times will increase or decrease if the future recruitment pattern differs greatly from the one assumed.

3.2.11 Discussion

The assessment model predicts that total biomass and the spawning potential (egg production) have generally decreased throughout the time series, and are currently estimated near (or at) the lowest annual value (**Figures 3.2.48 and 3.2.49**). Although spawning stock biomass recovered somewhat between 1995 and 2002, the stock biomass continued to decline thereafter. Despite a decline in fishing mortality in all fleets since 2003 (**Figure 3.2.52 – 3.2.54**), the stock has shown little sign of recovery.

The Gray Triggerfish fishery is dominated by recreational fishing in the Eastern U.S. Gulf of Mexico. Despite regulations to reduce bag limits and increase size limits, the species has not exhibited sustained recovery. Two standardized indices of abundance were associated with the recreational east fleet: the MRFSS East index and the SRHS East survey. Although the MRFSS East index shows a consistent increase in CPUE since 2008, the SRHS East survey shows a consistent decrease during the same period. Consequently, the model integrates the signals of both indices resulting in a low but relatively stable spawning stock estimates. The SRHS West survey also showed a substantial decrease in CPUE beginning in 2009. Since, the MRFSS West index was rejected by the DW Panel. The result is that the recent low CPUE estimates from the SRHS in the West are not buffered (or exacerbated) by other recreational indices in that region. However, the relatively low contribution of this fishery to total landings likely reduces the influence of this index on the stock trends.

3.2.12 Recommendations

1. Evaluate existing methods for deriving historical discard numbers and discard rates and improve methods as appropriate.

2. Develop/evaluate methods to maintain continuity of fishery-dependent indices in light of management regulations.

3. Develop a relationship between catchability of Gray Triggerfish on circle hooks when compared to J hooks.

4. Identify underlying factors resulting in discrepancies between recent estimates of cpue between the MRFSS Index and the SRHS Index.

5. Explore separating fisheries by gear, rather than by area.

6. Identify factors resulting in the release of fish in excess of size limits and improve estimates of asymptotic retention.

3.3 Acknowledgements

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3.4 References

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Tables

Table 3.1.1 List of SS parameters for Gulf of Mexico Gray Triggerfish. The list includes predicted parameter values from the base model run, initial parameter values, lower and upper bounds of the parameters, and an indicator of whether or not the parameter was fixed or estimated.

Num	Parameter	Parameter Estimate	Min	Max	Initial Value	Fixed/Est
1	L_at_Amin_Fem_GP_1	28.3000	10	40	28.3000	Fixed
2	L_at_Amax_Fem_GP_1	58.9700	20	70	58.9700	Fixed
3	VonBert_K_Fem_GP_1	0.1400	0.01	0.5	0.1400	Fixed
4	CV_young_Fem_GP_1	0.2039	0.1	0.5	0.2039	Fixed
5	CV_old_Fem_GP_1	0.2039	0.001	0.5	0.2039	Fixed
6	Wtlen_1_Fem	2.16E-05	0	1	2.16E-05	Fixed
7	Wtlen_2_Fem	3.0070	0	4	3.0070	Fixed
8	Mat50%_Fem	31.0000	25	100	31.0000	Fixed
9	Mat_slope_Fem	-0.0650	-1	0	-0.0650	Fixed
10	Eggs_scalar_Fem	51.3570	40	60	51.3570	Fixed
11	Eggs_exp_len_Fem	2.8538	1	4	2.8538	Fixed
12	RecrDist_GP_1	0.0000	0	0	0.0000	Fixed
13	RecrDist_Area_1	0.0000	-4	4	0.0000	Fixed
14	RecrDist_Seas_1	0.0000	0	0	0.0000	Fixed
15	CohortGrowDev	1.0000	0	0	1.0000	Fixed
16	SR_LN(R0)	9.7608	3	20	9.4466	Estimated
17	SR_BH_steep	0.4593	0.2	1	0.3943	Estimated
18	SR_sigmaR	0.3582	0.2	2	0.2881	Estimated
19	SR_envlink	0.0000	-5	5	0.0000	Fixed
20	SR_R1_offset	0.0000	-5	5	0.0000	Fixed
21	SR_autocorr	0.0000	0	0	0.0000	Fixed
22	Main_RecrDev_1981	-0.1141	_	_	_	Estimated
23	Main_RecrDev_1982	-0.0858	_	_	_	Estimated
24	Main_RecrDev_1983	0.0218	_	_	_	Estimated
25	Main_RecrDev_1984	0.1999	_	_	_	Estimated
26	Main_RecrDev_1985	0.3949	_	_	_	Estimated
27	Main_RecrDev_1986	0.5793	_	_	_	Estimated
28	Main_RecrDev_1987	0.5727	_	_	_	Estimated
29	Main_RecrDev_1988	0.3746	_	_	_	Estimated
30	Main_RecrDev_1989	0.2881	_	_	_	Estimated
31	Main_RecrDev_1990	0.2015	_	_	_	Estimated
32	Main_RecrDev_1991	0.2114	_	_	_	Estimated

33	Main_RecrDev_1992	0.1317	_	_	_	Estimated
34	Main_RecrDev_1993	0.0074	_	_	_	Estimated
35	Main_RecrDev_1994	-0.0613	_	_	_	Estimated
36	Main_RecrDev_1995	-0.0550	_	_	_	Estimated
37	Main_RecrDev_1996	0.0572	_	_	_	Estimated
38	Main_RecrDev_1997	0.1556	_	_	_	Estimated
39	Main_RecrDev_1998	0.2832	_	_	_	Estimated
40	Main_RecrDev_1999	0.3291	_	_	_	Estimated
41	Main_RecrDev_2000	0.3242	_	_	_	Estimated
42	Main_RecrDev_2001	0.2340	_	_	_	Estimated
43	Main_RecrDev_2002	0.1075	_	_	_	Estimated
44	Main_RecrDev_2003	-0.1107	_	_	_	Estimated
45	Main_RecrDev_2004	-0.2278	_	_	_	Estimated
46	Main_RecrDev_2005	-0.3295	_	_	_	Estimated
47	Main_RecrDev_2006	-0.3480	_	_	_	Estimated
48	Main_RecrDev_2007	-0.2890	_	_	_	Estimated
49	Main_RecrDev_2008	-0.3033	_	_	_	Estimated
50	Main_RecrDev_2009	-0.3878	_	_	_	Estimated
51	Main_RecrDev_2010	-0.5376	_	_	_	Estimated
52	Main_RecrDev_2011	-0.7321	_	_	_	Estimated
53	Main_RecrDev_2012	-0.7721	_	_	_	Estimated
54	Main_RecrDev_2013	-0.1203	_	_	_	Estimated
55	InitF_1Rec_E_1	0.0000	0	1	0.0000	Fixed
56	InitF_2Rec_W_2	0.0000	0	1	0.0000	Fixed
57	InitF_3Com_E_3	0.0000	0	1	0.0000	Fixed
58	InitF_4Com_W_4	0.0000	0	1	0.0000	Fixed
59	InitF_5Shrimp_Eff_5	0.0000	0	1	0.0000	Fixed
60	F_fleet_1_YR_1945_s_1	0.0002	0	8	_	Estimated
61	F_fleet_1_YR_1946_s_1	0.0007	0	8	_	Estimated
62	F_fleet_1_YR_1947_s_1	0.0040	0	8	_	Estimated
63	F_fleet_1_YR_1948_s_1	0.0066	0	8	_	Estimated
64	F_fleet_1_YR_1949_s_1	0.0093	0	8	_	Estimated
65	F_fleet_1_YR_1950_s_1	0.0130	0	8	_	Estimated
66	F_fleet_1_YR_1951_s_1	0.0160	0	8	_	Estimated
67	F_fleet_1_YR_1952_s_1	0.0190	0	8	_	Estimated
68	F_fleet_1_YR_1953_s_1	0.0222	0	8	_	Estimated
69	F_fleet_1_YR_1954_s_1	0.0255	0	8	_	Estimated
70	F_fleet_1_YR_1955_s_1	0.0290	0	8	_	Estimated
71	F_fleet_1_YR_1956_s_1	0.0313	0	8	_	Estimated

72	F_fleet_1_YR_1957_s_1	0.0337	0	8	_	Estimated
73	F_fleet_1_YR_1958_s_1	0.0363	0	8	_	Estimated
74	F_fleet_1_YR_1959_s_1	0.0391	0	8	_	Estimated
75	F_fleet_1_YR_1960_s_1	0.0422	0	8	_	Estimated
76	F_fleet_1_YR_1961_s_1	0.0438	0	8	_	Estimated
77	F_fleet_1_YR_1962_s_1	0.0452	0	8	_	Estimated
78	F_fleet_1_YR_1963_s_1	0.0460	0	8	_	Estimated
79	F_fleet_1_YR_1964_s_1	0.0467	0	8	_	Estimated
80	F_fleet_1_YR_1965_s_1	0.0482	0	8	_	Estimated
81	F_fleet_1_YR_1966_s_1	0.0505	0	8	_	Estimated
82	F_fleet_1_YR_1967_s_1	0.0524	0	8	_	Estimated
83	F_fleet_1_YR_1968_s_1	0.0532	0	8	_	Estimated
84	F_fleet_1_YR_1969_s_1	0.0540	0	8	_	Estimated
85	F_fleet_1_YR_1970_s_1	0.0553	0	8	_	Estimated
86	F_fleet_1_YR_1971_s_1	0.0571	0	8	_	Estimated
87	F_fleet_1_YR_1972_s_1	0.0611	0	8	_	Estimated
88	F_fleet_1_YR_1973_s_1	0.0654	0	8	_	Estimated
89	F_fleet_1_YR_1974_s_1	0.0688	0	8	_	Estimated
90	F_fleet_1_YR_1975_s_1	0.0742	0	8	_	Estimated
91	F_fleet_1_YR_1976_s_1	0.0812	0	8	_	Estimated
92	F_fleet_1_YR_1977_s_1	0.0915	0	8	_	Estimated
93	F_fleet_1_YR_1978_s_1	0.0996	0	8	_	Estimated
94	F_fleet_1_YR_1979_s_1	0.1094	0	8	_	Estimated
95	F_fleet_1_YR_1980_s_1	0.1197	0	8	_	Estimated
96	F_fleet_1_YR_1981_s_1	0.2743	0	8	_	Estimated
97	F_fleet_1_YR_1982_s_1	0.3079	0	8	_	Estimated
98	F_fleet_1_YR_1983_s_1	0.0889	0	8	_	Estimated
99	F_fleet_1_YR_1984_s_1	0.0438	0	8	_	Estimated
100	F_fleet_1_YR_1985_s_1	0.0689	0	8	_	Estimated
101	F_fleet_1_YR_1986_s_1	0.1955	0	8	_	Estimated
102	F_fleet_1_YR_1987_s_1	0.1091	0	8	_	Estimated
103	F_fleet_1_YR_1988_s_1	0.3219	0	8	_	Estimated
104	F_fleet_1_YR_1989_s_1	0.3536	0	8	_	Estimated
105	F_fleet_1_YR_1990_s_1	0.5509	0	8	_	Estimated
106	F_fleet_1_YR_1991_s_1	0.4124	0	8	_	Estimated
107	F_fleet_1_YR_1992_s_1	0.3848	0	8	_	Estimated
108	F_fleet_1_YR_1993_s_1	0.3835	0	8	_	Estimated
109	F_fleet_1_YR_1994_s_1	0.3619	0	8	_	Estimated
110	F_fleet_1_YR_1995_s_1	0.4439	0	8	_	Estimated

111	F_fleet_1_YR_1996_s_1	0.2699	0	8	_	Estimated
112	F_fleet_1_YR_1997_s_1	0.2540	0	8	_	Estimated
113	F_fleet_1_YR_1998_s_1	0.2642	0	8	_	Estimated
114	F_fleet_1_YR_1999_s_1	0.2302	0	8	_	Estimated
115	F_fleet_1_YR_2000_s_1	0.1546	0	8	_	Estimated
116	F_fleet_1_YR_2001_s_1	0.2185	0	8	_	Estimated
117	F_fleet_1_YR_2002_s_1	0.3034	0	8	_	Estimated
118	F_fleet_1_YR_2003_s_1	0.3607	0	8	_	Estimated
119	F_fleet_1_YR_2004_s_1	0.4582	0	8	_	Estimated
120	F_fleet_1_YR_2005_s_1	0.3625	0	8	_	Estimated
121	F_fleet_1_YR_2006_s_1	0.2463	0	8	_	Estimated
122	F_fleet_1_YR_2007_s_1	0.2614	0	8	_	Estimated
123	F_fleet_1_YR_2008_s_1	0.2294	0	8	_	Estimated
124	F_fleet_1_YR_2009_s_1	0.1859	0	8	_	Estimated
125	F_fleet_1_YR_2010_s_1	0.1507	0	8	_	Estimated
126	F_fleet_1_YR_2011_s_1	0.2454	0	8	_	Estimated
127	F_fleet_1_YR_2012_s_1	0.1111	0	8	_	Estimated
128	F_fleet_1_YR_2013_s_1	0.2565	0	8	_	Estimated
129	F_fleet_2_YR_1945_s_1	0.0001	0	8	_	Estimated
130	F_fleet_2_YR_1946_s_1	0.0001	0	8	_	Estimated
131	F_fleet_2_YR_1947_s_1	0.0004	0	8	_	Estimated
132	F_fleet_2_YR_1948_s_1	0.0007	0	8	_	Estimated
133	F_fleet_2_YR_1949_s_1	0.0010	0	8	_	Estimated
134	F_fleet_2_YR_1950_s_1	0.0013	0	8	_	Estimated
135	F_fleet_2_YR_1951_s_1	0.0017	0	8	_	Estimated
136	F_fleet_2_YR_1952_s_1	0.0022	0	8	_	Estimated
137	F_fleet_2_YR_1953_s_1	0.0027	0	8	_	Estimated
138	F_fleet_2_YR_1954_s_1	0.0033	0	8	_	Estimated
139	F_fleet_2_YR_1955_s_1	0.0038	0	8	_	Estimated
140	F_fleet_2_YR_1956_s_1	0.0043	0	8	_	Estimated
141	F_fleet_2_YR_1957_s_1	0.0048	0	8	_	Estimated
142	F_fleet_2_YR_1958_s_1	0.0054	0	8	_	Estimated
143	F_fleet_2_YR_1959_s_1	0.0059	0	8	_	Estimated
144	F_fleet_2_YR_1960_s_1	0.0066	0	8	_	Estimated
145	F_fleet_2_YR_1961_s_1	0.0071	0	8	_	Estimated
146	F_fleet_2_YR_1962_s_1	0.0076	0	8	_	Estimated
147	F_fleet_2_YR_1963_s_1	0.0081	0	8	_	Estimated
148	F_fleet_2_YR_1964_s_1	0.0085	0	8	_	Estimated
149	F_fleet_2_YR_1965_s_1	0.0091	0	8	_	Estimated

150	F_fleet_2_YR_1966_s_1	0.0095	0	8	_	Estimated
151	F_fleet_2_YR_1967_s_1	0.0098	0	8	_	Estimated
152	F_fleet_2_YR_1968_s_1	0.0099	0	8	_	Estimated
153	F_fleet_2_YR_1969_s_1	0.0101	0	8	_	Estimated
154	F_fleet_2_YR_1970_s_1	0.0103	0	8	_	Estimated
155	F_fleet_2_YR_1971_s_1	0.0110	0	8	_	Estimated
156	F_fleet_2_YR_1972_s_1	0.0130	0	8	_	Estimated
157	F_fleet_2_YR_1973_s_1	0.0153	0	8	_	Estimated
158	F_fleet_2_YR_1974_s_1	0.0165	0	8	_	Estimated
159	F_fleet_2_YR_1975_s_1	0.0185	0	8	_	Estimated
160	F_fleet_2_YR_1976_s_1	0.0190	0	8	_	Estimated
161	F_fleet_2_YR_1977_s_1	0.0214	0	8	_	Estimated
162	F_fleet_2_YR_1978_s_1	0.0220	0	8	_	Estimated
163	F_fleet_2_YR_1979_s_1	0.0228	0	8	_	Estimated
164	F_fleet_2_YR_1980_s_1	0.0232	0	8	_	Estimated
165	F_fleet_2_YR_1981_s_1	0.0568	0	8	_	Estimated
166	F_fleet_2_YR_1982_s_1	0.0659	0	8	_	Estimated
167	F_fleet_2_YR_1983_s_1	0.1953	0	8	_	Estimated
168	F_fleet_2_YR_1984_s_1	0.0854	0	8	_	Estimated
169	F_fleet_2_YR_1985_s_1	0.0310	0	8	_	Estimated
170	F_fleet_2_YR_1986_s_1	0.0171	0	8	_	Estimated
171	F_fleet_2_YR_1987_s_1	0.0120	0	8	_	Estimated
172	F_fleet_2_YR_1988_s_1	0.0290	0	8	_	Estimated
173	F_fleet_2_YR_1989_s_1	0.0435	0	8	_	Estimated
174	F_fleet_2_YR_1990_s_1	0.0745	0	8	_	Estimated
175	F_fleet_2_YR_1991_s_1	0.0887	0	8	_	Estimated
176	F_fleet_2_YR_1992_s_1	0.0558	0	8	_	Estimated
177	F_fleet_2_YR_1993_s_1	0.0459	0	8	_	Estimated
178	F_fleet_2_YR_1994_s_1	0.0821	0	8	_	Estimated
179	F_fleet_2_YR_1995_s_1	0.1116	0	8	_	Estimated
180	F_fleet_2_YR_1996_s_1	0.0443	0	8	_	Estimated
181	F_fleet_2_YR_1997_s_1	0.0455	0	8	_	Estimated
182	F_fleet_2_YR_1998_s_1	0.0234	0	8	_	Estimated
183	F_fleet_2_YR_1999_s_1	0.0541	0	8	_	Estimated
184	F_fleet_2_YR_2000_s_1	0.0765	0	8	_	Estimated
185	F_fleet_2_YR_2001_s_1	0.0317	0	8	_	Estimated
186	F_fleet_2_YR_2002_s_1	0.0161	0	8	_	Estimated
187	F_fleet_2_YR_2003_s_1	0.0291	0	8	_	Estimated
188	F_fleet_2_YR_2004_s_1	0.0536	0	8	_	Estimated

189	F_fleet_2_YR_2005_s_1	0.0183	0	8	_	Estimated
190	F_fleet_2_YR_2006_s_1	0.0144	0	8	_	Estimated
191	F_fleet_2_YR_2007_s_1	0.0333	0	8	_	Estimated
192	F_fleet_2_YR_2008_s_1	0.0623	0	8	_	Estimated
193	F_fleet_2_YR_2009_s_1	0.0076	0	8	_	Estimated
194	F_fleet_2_YR_2010_s_1	0.0045	0	8	_	Estimated
195	F_fleet_2_YR_2011_s_1	0.0035	0	8	_	Estimated
196	F_fleet_2_YR_2012_s_1	0.0191	0	8	_	Estimated
197	F_fleet_2_YR_2013_s_1	0.0111	0	8	_	Estimated
198	F_fleet_3_YR_1945_s_1	0.0000	0	8	_	Estimated
199	F_fleet_3_YR_1946_s_1	0.0000	0	8	_	Estimated
200	F_fleet_3_YR_1947_s_1	0.0000	0	8	_	Estimated
201	F_fleet_3_YR_1948_s_1	0.0000	0	8	_	Estimated
202	F_fleet_3_YR_1949_s_1	0.0000	0	8	_	Estimated
203	F_fleet_3_YR_1950_s_1	0.0000	0	8	_	Estimated
204	F_fleet_3_YR_1951_s_1	0.0001	0	8	_	Estimated
205	F_fleet_3_YR_1952_s_1	0.0001	0	8	_	Estimated
206	F_fleet_3_YR_1953_s_1	0.0001	0	8	_	Estimated
207	F_fleet_3_YR_1954_s_1	0.0001	0	8	_	Estimated
208	F_fleet_3_YR_1955_s_1	0.0001	0	8	_	Estimated
209	F_fleet_3_YR_1956_s_1	0.0001	0	8	_	Estimated
210	F_fleet_3_YR_1957_s_1	0.0001	0	8	_	Estimated
211	F_fleet_3_YR_1958_s_1	0.0001	0	8	_	Estimated
212	F_fleet_3_YR_1959_s_1	0.0001	0	8	_	Estimated
213	F_fleet_3_YR_1960_s_1	0.0002	0	8	_	Estimated
214	F_fleet_3_YR_1961_s_1	0.0002	0	8	_	Estimated
215	F_fleet_3_YR_1962_s_1	0.0002	0	8	_	Estimated
216	F_fleet_3_YR_1963_s_1	0.0002	0	8	_	Estimated
217	F_fleet_3_YR_1964_s_1	0.0010	0	8	_	Estimated
218	F_fleet_3_YR_1965_s_1	0.0012	0	8	_	Estimated
219	F_fleet_3_YR_1966_s_1	0.0006	0	8	_	Estimated
220	F_fleet_3_YR_1967_s_1	0.0009	0	8	_	Estimated
221	F_fleet_3_YR_1968_s_1	0.0006	0	8	_	Estimated
222	F_fleet_3_YR_1969_s_1	0.0011	0	8	_	Estimated
223	F_fleet_3_YR_1970_s_1	0.0012	0	8	_	Estimated
224	F_fleet_3_YR_1971_s_1	0.0023	0	8	_	Estimated
225	F_fleet_3_YR_1972_s_1	0.0036	0	8	_	Estimated
226	F_fleet_3_YR_1973_s_1	0.0030	0	8	_	Estimated
227	F_fleet_3_YR_1974_s_1	0.0031	0	8	_	Estimated

228	F_fleet_3_YR_1975_s_1	0.0050	0	8	_	Estimated
229	F_fleet_3_YR_1976_s_1	0.0058	0	8	_	Estimated
230	F_fleet_3_YR_1977_s_1	0.0044	0	8	_	Estimated
231	F_fleet_3_YR_1978_s_1	0.0044	0	8	_	Estimated
232	F_fleet_3_YR_1979_s_1	0.0062	0	8	_	Estimated
233	F_fleet_3_YR_1980_s_1	0.0066	0	8	_	Estimated
234	F_fleet_3_YR_1981_s_1	0.0072	0	8	_	Estimated
235	F_fleet_3_YR_1982_s_1	0.0081	0	8	_	Estimated
236	F_fleet_3_YR_1983_s_1	0.0071	0	8	_	Estimated
237	F_fleet_3_YR_1984_s_1	0.0055	0	8	_	Estimated
238	F_fleet_3_YR_1985_s_1	0.0079	0	8	_	Estimated
239	F_fleet_3_YR_1986_s_1	0.0102	0	8	_	Estimated
240	F_fleet_3_YR_1987_s_1	0.0120	0	8	_	Estimated
241	F_fleet_3_YR_1988_s_1	0.0176	0	8	_	Estimated
242	F_fleet_3_YR_1989_s_1	0.0295	0	8	_	Estimated
243	F_fleet_3_YR_1990_s_1	0.0499	0	8	_	Estimated
244	F_fleet_3_YR_1991_s_1	0.0536	0	8	_	Estimated
245	F_fleet_3_YR_1992_s_1	0.0608	0	8	_	Estimated
246	F_fleet_3_YR_1993_s_1	0.0695	0	8	_	Estimated
247	F_fleet_3_YR_1994_s_1	0.0495	0	8	_	Estimated
248	F_fleet_3_YR_1995_s_1	0.0455	0	8	_	Estimated
249	F_fleet_3_YR_1996_s_1	0.0341	0	8	_	Estimated
250	F_fleet_3_YR_1997_s_1	0.0263	0	8	_	Estimated
251	F_fleet_3_YR_1998_s_1	0.0260	0	8	_	Estimated
252	F_fleet_3_YR_1999_s_1	0.0307	0	8	_	Estimated
253	F_fleet_3_YR_2000_s_1	0.0149	0	8	_	Estimated
254	F_fleet_3_YR_2001_s_1	0.0238	0	8	_	Estimated
255	F_fleet_3_YR_2002_s_1	0.0308	0	8	_	Estimated
256	F_fleet_3_YR_2003_s_1	0.0342	0	8	_	Estimated
257	F_fleet_3_YR_2004_s_1	0.0310	0	8	_	Estimated
258	F_fleet_3_YR_2005_s_1	0.0252	0	8	_	Estimated
259	F_fleet_3_YR_2006_s_1	0.0147	0	8	_	Estimated
260	F_fleet_3_YR_2007_s_1	0.0127	0	8	_	Estimated
261	F_fleet_3_YR_2008_s_1	0.0142	0	8	_	Estimated
262	F_fleet_3_YR_2009_s_1	0.0181	0	8	_	Estimated
263	F_fleet_3_YR_2010_s_1	0.0130	0	8	_	Estimated
264	F_fleet_3_YR_2011_s_1	0.0270	0	8	_	Estimated
265	F_fleet_3_YR_2012_s_1	0.0188	0	8	_	Estimated
266	F_fleet_3_YR_2013_s_1	0.0175	0	8	_	Estimated

267	F_fleet_4_YR_1945_s_1	0.0000	0	8	_	Estimated
268	F_fleet_4_YR_1946_s_1	0.0000	0	8	_	Estimated
269	F_fleet_4_YR_1947_s_1	0.0000	0	8	_	Estimated
270	F_fleet_4_YR_1948_s_1	0.0000	0	8	_	Estimated
271	F_fleet_4_YR_1949_s_1	0.0001	0	8	_	Estimated
272	F_fleet_4_YR_1950_s_1	0.0001	0	8	_	Estimated
273	F_fleet_4_YR_1951_s_1	0.0001	0	8	_	Estimated
274	F_fleet_4_YR_1952_s_1	0.0001	0	8	_	Estimated
275	F_fleet_4_YR_1953_s_1	0.0001	0	8	_	Estimated
276	F_fleet_4_YR_1954_s_1	0.0001	0	8	_	Estimated
277	F_fleet_4_YR_1955_s_1	0.0002	0	8	_	Estimated
278	F_fleet_4_YR_1956_s_1	0.0002	0	8	_	Estimated
279	F_fleet_4_YR_1957_s_1	0.0002	0	8	_	Estimated
280	F_fleet_4_YR_1958_s_1	0.0002	0	8	_	Estimated
281	F_fleet_4_YR_1959_s_1	0.0002	0	8	_	Estimated
282	F_fleet_4_YR_1960_s_1	0.0003	0	8	_	Estimated
283	F_fleet_4_YR_1961_s_1	0.0003	0	8	_	Estimated
284	F_fleet_4_YR_1962_s_1	0.0003	0	8	_	Estimated
285	F_fleet_4_YR_1963_s_1	0.0003	0	8	_	Estimated
286	F_fleet_4_YR_1964_s_1	0.0004	0	8	_	Estimated
287	F_fleet_4_YR_1965_s_1	0.0004	0	8	_	Estimated
288	F_fleet_4_YR_1966_s_1	0.0004	0	8	_	Estimated
289	F_fleet_4_YR_1967_s_1	0.0005	0	8	_	Estimated
290	F_fleet_4_YR_1968_s_1	0.0004	0	8	_	Estimated
291	F_fleet_4_YR_1969_s_1	0.0007	0	8	_	Estimated
292	F_fleet_4_YR_1970_s_1	0.0007	0	8	_	Estimated
293	F_fleet_4_YR_1971_s_1	0.0009	0	8	_	Estimated
294	F_fleet_4_YR_1972_s_1	0.0014	0	8	_	Estimated
295	F_fleet_4_YR_1973_s_1	0.0012	0	8	_	Estimated
296	F_fleet_4_YR_1974_s_1	0.0012	0	8	_	Estimated
297	F_fleet_4_YR_1975_s_1	0.0016	0	8	_	Estimated
298	F_fleet_4_YR_1976_s_1	0.0015	0	8	_	Estimated
299	F_fleet_4_YR_1977_s_1	0.0010	0	8	_	Estimated
300	F_fleet_4_YR_1978_s_1	0.0011	0	8	_	Estimated
301	F_fleet_4_YR_1979_s_1	0.0042	0	8	_	Estimated
302	F_fleet_4_YR_1980_s_1	0.0039	0	8	_	Estimated
303	F_fleet_4_YR_1981_s_1	0.0035	0	8	_	Estimated
304	F_fleet_4_YR_1982_s_1	0.0054	0	8	_	Estimated
305	F_fleet_4_YR_1983_s_1	0.0043	0	8	_	Estimated

306	F_fleet_4_YR_1984_s_1	0.0059	0	8	_	Estimated
307	F_fleet_4_YR_1985_s_1	0.0066	0	8	_	Estimated
308	F_fleet_4_YR_1986_s_1	0.0039	0	8	_	Estimated
309	F_fleet_4_YR_1987_s_1	0.0056	0	8	_	Estimated
310	F_fleet_4_YR_1988_s_1	0.0088	0	8	_	Estimated
311	F_fleet_4_YR_1989_s_1	0.0134	0	8	_	Estimated
312	F_fleet_4_YR_1990_s_1	0.0164	0	8	_	Estimated
313	F_fleet_4_YR_1991_s_1	0.0192	0	8	_	Estimated
314	F_fleet_4_YR_1992_s_1	0.0226	0	8	_	Estimated
315	F_fleet_4_YR_1993_s_1	0.0381	0	8	_	Estimated
316	F_fleet_4_YR_1994_s_1	0.0355	0	8	_	Estimated
317	F_fleet_4_YR_1995_s_1	0.0339	0	8	_	Estimated
318	F_fleet_4_YR_1996_s_1	0.0356	0	8	_	Estimated
319	F_fleet_4_YR_1997_s_1	0.0222	0	8	_	Estimated
320	F_fleet_4_YR_1998_s_1	0.0205	0	8	_	Estimated
321	F_fleet_4_YR_1999_s_1	0.0305	0	8	_	Estimated
322	F_fleet_4_YR_2000_s_1	0.0267	0	8	_	Estimated
323	F_fleet_4_YR_2001_s_1	0.0175	0	8	_	Estimated
324	F_fleet_4_YR_2002_s_1	0.0209	0	8	_	Estimated
325	F_fleet_4_YR_2003_s_1	0.0206	0	8	_	Estimated
326	F_fleet_4_YR_2004_s_1	0.0197	0	8	_	Estimated
327	F_fleet_4_YR_2005_s_1	0.0115	0	8	_	Estimated
328	F_fleet_4_YR_2006_s_1	0.0088	0	8	_	Estimated
329	F_fleet_4_YR_2007_s_1	0.0109	0	8	_	Estimated
330	F_fleet_4_YR_2008_s_1	0.0085	0	8	_	Estimated
331	F_fleet_4_YR_2009_s_1	0.0057	0	8	_	Estimated
332	F_fleet_4_YR_2010_s_1	0.0026	0	8	_	Estimated
333	F_fleet_4_YR_2011_s_1	0.0043	0	8	_	Estimated
334	F_fleet_4_YR_2012_s_1	0.0026	0	8	_	Estimated
335	F_fleet_4_YR_2013_s_1	0.0014	0	8	_	Estimated
336	F_fleet_5_YR_1945_s_1	0.0011	0	8	_	Estimated
337	F_fleet_5_YR_1946_s_1	0.0000	0	8	_	Estimated
338	F_fleet_5_YR_1947_s_1	0.0000	0	8	_	Estimated
339	F_fleet_5_YR_1948_s_1	0.0000	0	8	_	Estimated
340	F_fleet_5_YR_1949_s_1	0.0049	0	8	_	Estimated
341	F_fleet_5_YR_1950_s_1	0.0260	0	8	_	Estimated
342	F_fleet_5_YR_1951_s_1	0.0389	0	8	_	Estimated
343	F_fleet_5_YR_1952_s_1	0.0500	0	8	_	Estimated
344	F_fleet_5_YR_1953_s_1	0.0525	0	8	_	Estimated

345	F_fleet_5_YR_1954_s_1	0.0749	0	8	_	Estimated
346	F_fleet_5_YR_1955_s_1	0.0740	0	8	_	Estimated
347	F_fleet_5_YR_1956_s_1	0.1011	0	8	_	Estimated
348	F_fleet_5_YR_1957_s_1	0.1215	0	8	_	Estimated
349	F_fleet_5_YR_1958_s_1	0.1635	0	8	_	Estimated
350	F_fleet_5_YR_1959_s_1	0.1775	0	8	_	Estimated
351	F_fleet_5_YR_1960_s_1	0.1775	0	8	_	Estimated
352	F_fleet_5_YR_1961_s_1	0.1022	0	8	_	Estimated
353	F_fleet_5_YR_1962_s_1	0.1905	0	8	_	Estimated
354	F_fleet_5_YR_1963_s_1	0.2182	0	8	_	Estimated
355	F_fleet_5_YR_1964_s_1	0.2607	0	8	_	Estimated
356	F_fleet_5_YR_1965_s_1	0.1622	0	8	_	Estimated
357	F_fleet_5_YR_1966_s_1	0.1338	0	8	_	Estimated
358	F_fleet_5_YR_1967_s_1	0.1642	0	8	_	Estimated
359	F_fleet_5_YR_1968_s_1	0.1956	0	8	_	Estimated
360	F_fleet_5_YR_1969_s_1	0.2162	0	8	_	Estimated
361	F_fleet_5_YR_1970_s_1	0.1467	0	8	_	Estimated
362	F_fleet_5_YR_1971_s_1	0.1713	0	8	_	Estimated
363	F_fleet_5_YR_1972_s_1	0.3388	0	8	_	Estimated
364	F_fleet_5_YR_1973_s_1	0.2699	0	8	_	Estimated
365	F_fleet_5_YR_1974_s_1	0.3076	0	8	_	Estimated
366	F_fleet_5_YR_1975_s_1	0.2783	0	8	_	Estimated
367	F_fleet_5_YR_1976_s_1	0.3439	0	8	_	Estimated
368	F_fleet_5_YR_1977_s_1	0.3895	0	8	_	Estimated
369	F_fleet_5_YR_1978_s_1	0.4371	0	8	_	Estimated
370	F_fleet_5_YR_1979_s_1	0.4456	0	8	_	Estimated
371	F_fleet_5_YR_1980_s_1	0.4205	0	8	_	Estimated
372	F_fleet_5_YR_1981_s_1	0.3597	0	8	_	Estimated
373	F_fleet_5_YR_1982_s_1	0.3525	0	8	_	Estimated
374	F_fleet_5_YR_1983_s_1	0.3424	0	8	_	Estimated
375	F_fleet_5_YR_1984_s_1	0.3748	0	8	_	Estimated
376	F_fleet_5_YR_1985_s_1	0.3765	0	8	_	Estimated
377	F_fleet_5_YR_1986_s_1	0.4291	0	8	_	Estimated
378	F_fleet_5_YR_1987_s_1	0.4580	0	8	_	Estimated
379	F_fleet_5_YR_1988_s_1	0.3948	0	8	_	Estimated
380	F_fleet_5_YR_1989_s_1	0.4298	0	8	_	Estimated
381	F_fleet_5_YR_1990_s_1	0.4122	0	8	_	Estimated
382	F_fleet_5_YR_1991_s_1	0.4390	0	8	_	Estimated
383	F_fleet_5_YR_1992_s_1	0.4241	0	8	_	Estimated

384	F_fleet_5_YR_1993_s_1	0.4093	0	8	_	Estimated
385	F_fleet_5_YR_1994_s_1	0.3945	0	8	_	Estimated
386	F_fleet_5_YR_1995_s_1	0.3550	0	8	_	Estimated
387	F_fleet_5_YR_1996_s_1	0.3754	0	8	_	Estimated
388	F_fleet_5_YR_1997_s_1	0.4053	0	8	_	Estimated
389	F_fleet_5_YR_1998_s_1	0.4148	0	8	_	Estimated
390	F_fleet_5_YR_1999_s_1	0.3839	0	8	_	Estimated
391	F_fleet_5_YR_2000_s_1	0.3696	0	8	_	Estimated
392	F_fleet_5_YR_2001_s_1	0.3856	0	8	_	Estimated
393	F_fleet_5_YR_2002_s_1	0.4072	0	8	_	Estimated
394	F_fleet_5_YR_2003_s_1	0.3403	0	8	_	Estimated
395	F_fleet_5_YR_2004_s_1	0.3032	0	8	_	Estimated
396	F_fleet_5_YR_2005_s_1	0.2223	0	8	_	Estimated
397	F_fleet_5_YR_2006_s_1	0.2022	0	8	_	Estimated
398	F_fleet_5_YR_2007_s_1	0.1766	0	8	_	Estimated
399	F_fleet_5_YR_2008_s_1	0.1411	0	8	_	Estimated
400	F_fleet_5_YR_2009_s_1	0.1695	0	8	_	Estimated
401	F_fleet_5_YR_2010_s_1	0.1462	0	8	_	Estimated
402	F_fleet_5_YR_2011_s_1	0.1687	0	8	_	Estimated
403	F_fleet_5_YR_2012_s_1	0.1797	0	8	_	Estimated
404	F_fleet_5_YR_2013_s_1	0.1338	0	8	_	Estimated
405	LnQ_base_5_Shrimp_Eff_5	1.1244	-10	40	2.0000	Estimated
406	Retain_1P_1_Rec_E_1	15.2400	1	100	15.2400	Fixed
407	Retain_1P_2_Rec_E_1	1.0000	-1	30	1.0000	Fixed
408	Retain_1P_3_Rec_E_1	0.6894	-1	2	0.9000	Estimated
409	Retain_1P_4_Rec_E_1	0.0000	-1	2	0.0000	Fixed
410	DiscMort_1P_1_Rec_E_1	-5.0000	-10	10	-5.0000	Fixed
411	DiscMort_1P_2_Rec_E_1	1.0000	-1	2	1.0000	Fixed
412	DiscMort_1P_3_Rec_E_1	0.0500	0	2	0.0500	Fixed
413	DiscMort_1P_4_Rec_E_1	0.0000	-1	2	0.0000	Fixed
414	Retain_2P_1_Rec_W_2	15.2400	1	100	15.2400	Fixed
415	Retain_2P_2_Rec_W_2	1.0000	-1	50	1.0000	Fixed
416	Retain_2P_3_Rec_W_2	0.5634	-1	1	0.9000	Estimated
417	Retain_2P_4_Rec_W_2	0.0000	-1	2	0.0000	Fixed
418	DiscMort_2P_1_Rec_W_2	-5.0000	-10	10	-5.0000	Fixed
419	DiscMort_2P_2_Rec_W_2	1.0000	-1	2	1.0000	Fixed
420	DiscMort_2P_3_Rec_W_2	0.0500	0	2	0.0500	Fixed
421	DiscMort_2P_4_Rec_W_2	0.0000	-1	2	0.0000	Fixed
422	Retain_3P_1_Com_E_3	15.2400	1	100	15.2400	Fixed

423	Retain_3P_2_Com_E_3	1.0000	-1	30	1.0000	Fixed
424	Retain_3P_3_Com_E_3	0.6984	-1	1	0.9000	Estimated
425	Retain_3P_4_Com_E_3	0.0000	-1	2	0.0000	Fixed
426	DiscMort_3P_1_Com_E_3	-5.0000	-10	10	-5.0000	Fixed
427	DiscMort_3P_2_Com_E_3	1.0000	-1	2	1.0000	Fixed
428	DiscMort_3P_3_Com_E_3	0.0500	0	2	0.0500	Fixed
429	DiscMort_3P_4_Com_E_3	0.0000	-1	2	0.0000	Fixed
430	Retain_4P_1_Com_W_4	15.2400	1	100	15.2400	Fixed
431	Retain_4P_2_Com_W_4	1.0000	-1	30	1.0000	Fixed
432	Retain_4P_3_Com_W_4	0.6506	-1	1	0.9000	Estimated
433	Retain_4P_4_Com_W_4	0.0000	-1	2	0.0000	Fixed
434	DiscMort_4P_1_Com_W_4	-5.0000	-10	10	-5.0000	Fixed
435	DiscMort_4P_2_Com_W_4	1.0000	-1	2	1.0000	Fixed
436	DiscMort_4P_3_Com_W_4	0.0500	0	2	0.0500	Fixed
437	DiscMort_4P_4_Com_W_4	0.0000	-1	2	0.0000	Fixed
438	AgeSel_1P_1_Rec_E_1	3.6585	0	40	3.4921	Estimated
439	AgeSel_1P_2_Rec_E_1	-12.6830	-15	3	-12.8986	Estimated
440	AgeSel_1P_3_Rec_E_1	0.8555	0	10	0.7525	Estimated
441	AgeSel_1P_4_Rec_E_1	1.6995	0	10	1.6343	Estimated
442	AgeSel_1P_5_Rec_E_1	-17.2719	-20	7	-17.1498	Estimated
443	AgeSel_1P_6_Rec_E_1	-3.8494	-15	17	-3.8670	Estimated
444	AgeSel_2P_1_Rec_W_2	3.7367	0	40	3.5245	Estimated
445	AgeSel_2P_2_Rec_W_2	-12.3087	-15	3	-12.6225	Estimated
446	AgeSel_2P_3_Rec_W_2	1.0306	0	10	0.9566	Estimated
447	AgeSel_2P_4_Rec_W_2	1.9087	0	10	1.8278	Estimated
448	AgeSel_2P_5_Rec_W_2	-17.1316	-20	7	-17.0056	Estimated
449	AgeSel_2P_6_Rec_W_2	-3.3915	-15	17	-3.4957	Estimated
450	AgeSel_3P_1_Com_E_3	4.3923	0	40	4.0420	Estimated
451	AgeSel_3P_2_Com_E_3	-10.7902	-15	3	-11.3812	Estimated
452	AgeSel_3P_3_Com_E_3	1.1582	0	10	0.9483	Estimated
453	AgeSel_3P_4_Com_E_3	9.2341	0	10	3.6821	Estimated
454	AgeSel_3P_5_Com_E_3	-16.7366	-20	7	-16.5465	Estimated
455	AgeSel_3P_6_Com_E_3	-3.0737	-15	17	-3.1179	Estimated
456	AgeSel_4P_1_Com_W_4	4.1937	0	40	3.9849	Estimated
457	AgeSel_4P_2_Com_W_4	-12.0008	-15	3	-12.2733	Estimated
458	AgeSel_4P_3_Com_W_4	0.8718	0	10	0.7495	Estimated
459	AgeSel_4P_4_Com_W_4	1.8894	0	10	1.8189	Estimated
460	AgeSel_4P_5_Com_W_4	-17.0507	-20	7	-16.9019	Estimated
461	AgeSel_4P_6_Com_W_4	-4.0182	-15	17	-4.0479	Estimated

462	AgeSel_5P_1_Shrimp_Eff_5	0.0000	0	10	0.0000	Fixed
463	AgeSel_5P_2_Shrimp_Eff_5	0.0000	0	10	0.0000	Fixed
464	AgeSel_7P_1_LarvalGW_DN_7	0.0000	0	10	0.0000	Fixed
465	AgeSel_7P_2_LarvalGW_DN_7	0.0000	0	10	0.0000	Fixed
466	AgeSel_8P_1_Trawl_GW_8	0.0000	0	10	0.0000	Fixed
467	AgeSel_8P_2_Trawl_GW_8	10.0000	0	10	10.0000	Fixed
468	AgeSel_9P_1_Video_GW_9	-5.0000	-90	35	-5.0000	Fixed
469	AgeSel_9P_2_Video_GW_9	0.0000	-90	35	0.0000	Fixed
470	AgeSel_9P_3_Video_GW_9	2.0000	-90	35	2.0000	Fixed
471	AgeSel_9P_4_Video_GW_9	3.9998	-90	35	3.9998	Fixed
472	AgeSel_9P_5_Video_GW_9	6.0011	-90	35	6.0011	Fixed
473	AgeSel_9P_6_Video_GW_9	7.9862	-90	35	7.9862	Fixed
474	AgeSel_9P_7_Video_GW_9	9.0000	-90	35	9.0000	Fixed
475	AgeSel_9P_8_Video_GW_9	9.0000	-90	35	9.0000	Fixed
476	AgeSel_9P_9_Video_GW_9	9.0000	-90	35	9.0000	Fixed
477	AgeSel_9P_10_Video_GW_9	9.0000	-90	35	9.0000	Fixed
478	AgeSel_9P_11_Video_GW_9	9.0000	-90	35	9.0000	Fixed

Table 3.1.2 Model total likelihood and selected model component likelihoods from 100 model runs from the jitter analysis of the SS base model.

Trial	TOTAL	Catch	Survey	Discard	Age_comp	Recruitment
1	224.663	0.78787	-94.3029	-95.8171	426.927	-12.9511
2	224.663	0.78787	-94.3029	-95.8171	426.927	-12.9511
3	224.663	0.78787	-94.3029	-95.8171	426.927	-12.9511
4	224.663	0.78787	-94.3029	-95.8171	426.927	-12.9511
5	224.663	0.78787	-94.3029	-95.8171	426.927	-12.9511
6	224.663	0.78787	-94.3029	-95.8171	426.927	-12.9511
7	224.663	0.78787	-94.3029	-95.8171	426.927	-12.9511
8	224.663	0.78787	-94.3029	-95.8171	426.927	-12.9511
9	224.663	0.78787	-94.3029	-95.8171	426.927	-12.9511
10	224.663	0.78787	-94.3029	-95.8171	426.927	-12.9511
11	224.663	0.78787	-94.3029	-95.8171	426.927	-12.9511
12	224.663	0.78787	-94.3029	-95.8171	426.927	-12.9511
13	224.663	0.78787	-94.3029	-95.8171	426.927	-12.9511
14	224.663	0.78787	-94.3029	-95.8171	426.927	-12.9511
15	224.663	0.78787	-94.3029	-95.8171	426.927	-12.9511
16	224.663	0.78787	-94.3029	-95.8171	426.927	-12.9511

17	224.663	0.78787	-94.3029	-95.8171	426.927	-12.9511
18	224.663	0.78787	-94.3029	-95.8171	426.927	-12.9511
19	224.663	0.78787	-94.3029	-95.8171	426.927	-12.9511
20	224.663	0.78787	-94.3029	-95.8171	426.927	-12.9511
21	224.663	0.78787	-94.3029	-95.8171	426.927	-12.9511
22	224.663	0.78787	-94.3029	-95.8171	426.927	-12.9511
23	224.663	0.78787	-94.3029	-95.8171	426.927	-12.9511
24	224.663	0.78787	-94.3029	-95.8171	426.927	-12.9511
25	224.663	0.78787	-94.3029	-95.8171	426.927	-12.9511
26	224.663	0.78787	-94.3029	-95.8171	426.927	-12.9511
27	224.663	0.78787	-94.3029	-95.8171	426.927	-12.9511
28	224.663	0.78787	-94.3029	-95.8171	426.927	-12.9511
29	224.663	0.78787	-94.3029	-95.8171	426.927	-12.9511
30	224.663	0.78787	-94.3029	-95.8171	426.927	-12.9511
31	224.663	0.78787	-94.3029	-95.8171	426.927	-12.9511
32	224.663	0.78787	-94.3029	-95.8171	426.927	-12.9511
33	224.663	0.78787	-94.3029	-95.8171	426.927	-12.9511
34	224.663	0.78787	-94.3029	-95.8171	426.927	-12.9511
35	224.663	0.78787	-94.3029	-95.8171	426.927	-12.9511
36	224.663	0.78787	-94.3029	-95.8171	426.927	-12.9511
37	224.663	0.78787	-94.3029	-95.8171	426.927	-12.9511
38	224.663	0.78787	-94.3029	-95.8171	426.927	-12.9511
39	224.663	0.78787	-94.3029	-95.8171	426.927	-12.9511
40	224.663	0.78787	-94.3029	-95.8171	426.927	-12.9511
41	224.663	0.78787	-94.3029	-95.8171	426.927	-12.9511
42	224.663	0.78787	-94.3029	-95.8171	426.927	-12.9511
43	224.663	0.78787	-94.3029	-95.8171	426.927	-12.9511
44	224.663	0.78787	-94.3029	-95.8171	426.927	-12.9511
45	224.663	0.78787	-94.3029	-95.8171	426.927	-12.9511
46	224.663	0.78787	-94.3029	-95.8171	426.927	-12.9511
47	224.663	0.78787	-94.3029	-95.8171	426.927	-12.9511
48	224.663	0.78787	-94.3029	-95.8171	426.927	-12.9511
49	224.663	0.78787	-94.3029	-95.8171	426.927	-12.9511
50	224.663	0.78787	-94.3029	-95.8171	426.927	-12.9511
51	224.663	0.78787	-94.3029	-95.8171	426.927	-12.9511
52	224.663	0.78787	-94.3029	-95.8171	426.927	-12.9511
53	224.663	0.78787	-94.3029	-95.8171	426.927	-12.9511
54	224.663	0.78787	-94.3029	-95.8171	426.927	-12.9511
55	224.663	0.78787	-94.3029	-95.8171	426.927	-12.9511
56	224.663	0.78787	-94.3029	-95.8171	426.927	-12.9511
57	224.663	0.78787	-94.3029	-95.8171	426.927	-12.9511
58	224.663	0.78787	-94.3029	-95.8171	426.927	-12.9511
59	224.663	0.78787	-94.3029	-95.8171	426.927	-12.9511

60	224.663	0.78787	-94.3029	-95.8171	426.927	-12.9511
61	224.663	0.78787	-94.3029	-95.8171	426.927	-12.9511
62	224.663	0.78787	-94.3029	-95.8171	426.927	-12.9511
63	224.663	0.78787	-94.3029	-95.8171	426.927	-12.9511
64	224.663	0.78787	-94.3029	-95.8171	426.927	-12.9511
65	224.663	0.78787	-94.3029	-95.8171	426.927	-12.9511
66	224.663	0.78787	-94.3029	-95.8171	426.927	-12.9511
67	224.663	0.78787	-94.3029	-95.8171	426.927	-12.9511
68	224.663	0.78787	-94.3029	-95.8171	426.927	-12.9511
69	224.663	0.78787	-94.3029	-95.8171	426.927	-12.9511
70	224.663	0.78787	-94.3029	-95.8171	426.927	-12.9511
71	224.663	0.78787	-94.3029	-95.8171	426.927	-12.9511
72	224.663	0.78787	-94.3029	-95.8171	426.927	-12.9511
73	224.663	0.78787	-94.3029	-95.8171	426.927	-12.9511
74	224.663	0.78787	-94.3029	-95.8171	426.927	-12.9511
75	224.663	0.78787	-94.3029	-95.8171	426.927	-12.9511
76	224.663	0.78787	-94.3029	-95.8171	426.927	-12.9511
77	224.663	0.78787	-94.3029	-95.8171	426.927	-12.9511
78	224.663	0.78787	-94.3029	-95.8171	426.927	-12.9511
79	224.663	0.78787	-94.3029	-95.8171	426.927	-12.9511
80	224.663	0.78787	-94.3029	-95.8171	426.927	-12.9511
81	224.663	0.78787	-94.3029	-95.8171	426.927	-12.9511
82	224.663	0.78787	-94.3029	-95.8171	426.927	-12.9511
83	224.663	0.78787	-94.3029	-95.8171	426.927	-12.9511
84	224.663	0.78787	-94.3029	-95.8171	426.927	-12.9511
85	224.663	0.78787	-94.3029	-95.8171	426.927	-12.9511
86	224.663	0.78787	-94.3029	-95.8171	426.927	-12.9511
87	224.663	0.78787	-94.3029	-95.8171	426.927	-12.9511
88	224.663	0.78787	-94.3029	-95.8171	426.927	-12.9511
89	224.663	0.78787	-94.3029	-95.8171	426.927	-12.9511
90	224.663	0.78787	-94.3029	-95.8171	426.927	-12.9511
91	224.663	0.78787	-94.3029	-95.8171	426.927	-12.9511
92	224.663	0.78787	-94.3029	-95.8171	426.927	-12.9511
93	224.663	0.78787	-94.3029	-95.8171	426.927	-12.9511
94	224.663	0.78787	-94.3029	-95.8171	426.927	-12.9511
95	224.663	0.78787	-94.3029	-95.8171	426.927	-12.9511
96	224.663	0.78787	-94.3029	-95.8171	426.927	-12.9511
97	224.663	0.78787	-94.3029	-95.8171	426.927	-12.9511
98	224.663	0.78787	-94.3029	-95.8171	426.927	-12.9511
99	224.663	0.78787	-94.3029	-95.8171	426.927	-12.9511
100	224.663	0.78787	-94.3029	-95.8171	426.927	-12.9511

Table 3.2.1 Predicted total biomass (mt), mature biomass (SSB, eggs), and age-0 recruits (thousand fish for Gulf of Mexico Gray Triggerfish from the base model run.

Year	Total Biomass	Spawning Stock Bio	Recruitment (Age-0)
1943	39391.2	4.05E+10	21684.3
1944	39391.2	4.05E+10	21684.3
1945	39391.2	4.05E+10	21684.3
1946	39383.5	4.05E+10	21683.8
1947	39378.2	4.05E+10	21681.1
1948	39346.9	4.05E+10	21672.9
1949	39296.4	4.04E+10	21660.2
1950	39198.5	4.03E+10	21643.2
1951	38970.6	4.02E+10	21615.1
1952	38683.2	3.99E+10	21563.1
1953	38348	3.96E+10	21496.2
1954	38013	3.93E+10	21416.9
1955	37571.5	3.89E+10	21334.7
1956	37163.2	3.84E+10	21231
1957	36643.2	3.79E+10	21131.9
1958	36071.4	3.74E+10	21010
1959	35351	3.68E+10	20872.9
1960	34638	3.60E+10	20699.5
1961	33983.6	3.53E+10	20519
1962	33734	3.46E+10	20348.7
1963	33063.4	3.43E+10	20265.7
1964	32372.5	3.36E+10	20102.4
1965	31577.5	3.29E+10	19922.6
1966	31287.3	3.21E+10	19707.7
1967	31096.4	3.17E+10	19603.6
1968	30763.1	3.15E+10	19535.2
1969	30340.2	3.11E+10	19445.7
1970	29880.7	3.07E+10	19328.8
1971	29770.6	3.03E+10	19199.3
1972	29506.2	3.01E+10	19141.2
1973	28585.2	2.98E+10	19050.7
1974	28056.8	2.89E+10	18792
1975	27447.7	2.83E+10	18614.5
1976	27026.8	2.76E+10	18405.4
1977	26319.7	2.71E+10	18244.8
1978	25474.5	2.64E+10	18003.6
1979	24461.6	2.55E+10	17710.4
1980	23489.7	2.45E+10	17340.2

1981	22756.8	2.35E+10	14675.8
1982	21085.4	2.19E+10	14041.7
1983	19587.9	2.02E+10	14498.1
1984	18865.9	1.91E+10	15884.8
1985	18892.3	1.88E+10	18478.3
1986	19547.2	1.89E+10	21801.6
1987	20295.3	1.90E+10	21633.3
1988	20989.6	1.99E+10	19138.3
1989	20397.1	1.96E+10	17820.6
1990	19294	1.88E+10	16446
1991	17447.4	1.68E+10	15831.2
1992	16307.7	1.57E+10	14467.4
1993	15342.2	1.48E+10	12793.1
1994	14278.2	1.40E+10	11694.5
1995	13315.4	1.31E+10	11390.8
1996	12468.9	1.20E+10	11827.6
1997	12372.8	1.18E+10	12745.6
1998	12514.6	1.18E+10	14215.4
1999	12966.2	1.20E+10	14858
2000	13622	1.24E+10	15237.3
2001	14388.9	1.32E+10	14903.5
2002	14817	1.39E+10	14117.9
2003	14749.6	1.41E+10	12056.2
2004	14234.9	1.39E+10	10789.2
2005	13429.9	1.33E+10	9496.48
2006	12923	1.29E+10	9014.25
2007	12662.6	1.27E+10	9366.87
2008	12569.9	1.24E+10	8980.23
2009	12555.9	1.24E+10	8158.06
2010	12369.2	1.25E+10	6921.82
2011	11962.1	1.25E+10	5823.55
2012	11156.7	1.19E+10	6052.83
2013	10715.3	1.13E+10	10269.4

Table 3.2 2. Annual fishing mortality by fleet.

Year	Recreational East	Recreational West	Commercial East	Commercial West	Shrimp Bycatch
1945	0.000	0.000	0.000	0.000	0.001
1946	0.001	0.000	0.000	0.000	0.000
1947	0.003	0.000	0.000	0.000	0.000
1948	0.005	0.001	0.000	0.000	0.000
1949	0.007	0.001	0.000	0.000	0.004
1950	0.010	0.001	0.000	0.000	0.021
1951	0.012	0.001	0.000	0.000	0.031
1952	0.015	0.002	0.000	0.000	0.040
1953	0.017	0.002	0.000	0.000	0.042
1954	0.020	0.003	0.000	0.000	0.059
1955	0.022	0.003	0.000	0.000	0.059
1956	0.024	0.003	0.000	0.000	0.080
1957	0.026	0.004	0.000	0.000	0.096
1958	0.028	0.004	0.000	0.000	0.129
1959	0.030	0.005	0.000	0.000	0.140
1960	0.032	0.005	0.000	0.000	0.140
1961	0.033	0.005	0.000	0.000	0.080
1962	0.034	0.006	0.000	0.000	0.150
1963	0.035	0.006	0.000	0.000	0.172
1964	0.035	0.006	0.001	0.000	0.205
1965	0.036	0.007	0.001	0.000	0.127
1966	0.038	0.007	0.000	0.000	0.105
1967	0.039	0.007	0.001	0.000	0.129
1968	0.040	0.007	0.000	0.000	0.154
1969	0.040	0.007	0.001	0.001	0.170
1970	0.041	0.008	0.001	0.001	0.115
1971	0.043	0.008	0.002	0.001	0.133
1972	0.045	0.010	0.003	0.001	0.265
1973	0.048	0.011	0.002	0.001	0.210
1974	0.051	0.012	0.002	0.001	0.231
1975	0.054	0.013	0.004	0.001	0.199
1976	0.059	0.014	0.004	0.001	0.258
1977	0.066	0.015	0.003	0.001	0.303
1978	0.070	0.016	0.003	0.001	0.362
1979	0.077	0.016	0.004	0.003	0.373
1980	0.083	0.016	0.005	0.003	0.329
1981	0.188	0.039	0.005	0.002	0.287
1982	0.206	0.044	0.005	0.004	0.282
1983	0.058	0.128	0.004	0.003	0.275

1984	0.029	0.057	0.003	0.004	0.301
1985	0.047	0.021	0.005	0.004	0.302
1986	0.139	0.012	0.007	0.003	0.343
1987	0.081	0.009	0.008	0.004	0.366
1988	0.248	0.022	0.012	0.006	0.316
1989	0.277	0.033	0.021	0.010	0.343
1990	0.427	0.057	0.035	0.012	0.329
1991	0.309	0.066	0.037	0.014	0.349
1992	0.281	0.041	0.041	0.016	0.337
1993	0.272	0.032	0.046	0.026	0.325
1994	0.249	0.056	0.032	0.024	0.313
1995	0.291	0.073	0.028	0.022	0.281
1996	0.170	0.028	0.020	0.022	0.297
1997	0.158	0.028	0.015	0.013	0.321
1998	0.162	0.014	0.015	0.012	0.329
1999	0.141	0.033	0.017	0.018	0.304
2000	0.095	0.047	0.009	0.016	0.292
2001	0.137	0.020	0.014	0.010	0.304
2002	0.190	0.010	0.018	0.013	0.321
2003	0.222	0.018	0.019	0.012	0.267
2004	0.272	0.031	0.017	0.011	0.238
2005	0.205	0.010	0.013	0.006	0.175
2006	0.135	0.008	0.008	0.005	0.160
2007	0.141	0.018	0.006	0.006	0.139
2008	0.122	0.033	0.007	0.004	0.112
2009	0.099	0.004	0.009	0.003	0.136
2010	0.082	0.002	0.007	0.001	0.120
2011	0.134	0.002	0.014	0.002	0.139
2012	0.062	0.011	0.010	0.001	0.143
2013	0.144	0.006	0.009	0.001	0.106

Table 3.2.3. Summary of sensitivity runs. The results include estimated virgin recruitment (thousand fish; R0), virgin total biomass (mt; B0), total biomass in final year (mt; B2013), virgin spawning biomass (eggs; SSB0), spawning biomass in final year (eggs; SSB-2013), spawning biomass achieved at MSY (SSB_MSY), fishing mortality in 2013 (F2013), fishing mortality achieved at MSY (FMSY), the ratio of F2013 and FMSY, and the ratio of SSB and MSST.

Run	SSC Base Model	Discard_Mortalty_10	No_Circle_Hook	No_Recent HB_W	Retention_Fixed_90
R0	17339.6	17339.6	17121.9	17284.9	17218.5
B0	31546.6	31546.6	31150.7	31447.1	31326.4
Bcurrent	5800.25	6084.46	2941.11	6769.41	6017.25
SSB0	32,411,700,000	32,411,700,000	32,004,900,000	32,309,400,000	32,185,400,000
SSBcurrent	6,043,700,000	6,296,020,000	3,082,450,000	6,991,660,000	6,227,170,000
Fcurr	0.0952	0.0952	0.14664	0.09034	0.0953
SSBcurr	6,043,700,000	6,600,460,000	3,507,470,000	7,264,990,000	6,524,300,000
Fref_spr	0.3846	0.3846	0.3549	0.3897	0.3866
SSBref_spr	259,626,000	259,628,000	1.13E-17	669,276,000	193,499,000
Fratio_spr	0.247690589	0.247690589	0.413182015	0.231809898	0.246748818
SSBratio_spr	23.2784	25.4227	-	10.8549	33.7174
Fref_msy	0.1534	0.1534	0.1341	0.1599	0.1532
SSBref_msy	1.11E+10	1.11E+10	11.3 E+10	1.10E+10	11.1E+10
Fratio_msy	0.6210	0.6210	1.0932	0.5649	0.6224
SSBratio_msy	0.5430	0.5930	0.3102	0.6622	0.5892

Table 3.2.4 Estimates of key population parameters from the jack-knife analysis of indices of abundance.

Run	SSC Base Model	no_Com_E	no_Com_W	no_Larval	no_Rec_E	no_Rec_W	no_Shrimp	no_SF
R0	17339.6	1.77E+04	16747.5	16980.4	21518.7	17295.7	13789.5	
B0	31546.6	32159.6	30469.4	30893.2	39149.9	31466.7	25087.9	
Bcurrent	5800.25	6137.91	6177.68	5984.17	6783.04	6719.15	4155.22	
SSB0	3.24E+10	3.30E+10	3.13E+10	3.17E+10	4.02E+10	3.23E+10	2.58E+10	3
SSBcurrent	6.04E+09	6.37E+09	6.35E+09	6.17E+09	7.24E+09	6.94E+09	4.18E+09	7
Fcurr	0.0953	0.0936	0.0969	0.0984	0.0780	0.0908	0.9291	
SSBcurr	6.04E+09	6.69E+09	6.61E+09	6.45E+09	7.75E+09	7.21E+09	4.41E+09	7
Fref_spr	0.3847	0.3842	0.3871	0.3843	0.3794	0.3894	0.5232	
SSBref_spr	2.60E+08	3.46E-17	1.20E+09	8.39E+08	1.16E-18	6.41E+08	6.26E+09	6
Fratio_spr	0.2477	0.2437	0.2504	0.2561	0.2055	0.2333	1.7758	
SSBratio_spr	23.2785	-	5.5147	7.6900	-	11.2467	0.7037	
Fref_msy	0.1534	0.1471	0.1670	0.1609	0.0986	0.1594	0.6423	
SSBref_msy	1.11E+10	1.15E+10	1.05E+10	1.07E+10	1.56E+10	1.10E+10	5.15E+09	1
Fratio_msy	0.6211	0.6368	0.5805	0.6118	0.7909	0.5697	1.4465	
SSBratio_msy	0.5431	0.5812	0.6322	0.6020	0.4958	0.6560	0.8566	

Table 3.2.5 List of SS parameter estimates obtained when correlation in recruitment was included in the base model for Gulf of Mexico Gray Triggerfish. The list includes predicted parameter values, initial parameter values, lower and upper bounds of the parameter and an indicator as to whether the parameter was fixed or estimated.

Num	Parameter	Parameter Estimate	Min	Max	Initial Value	Fixed/Est
21	SR_autocorr	0.729	0	1	0.5	Estimated
22	Main_RecrDev_1981	-0.083	-	-	-	Estimated
23	Main_RecrDev_1982	-0.040	-	-	-	Estimated
24	Main_RecrDev_1983	0.074	-	-	-	Estimated
25	Main_RecrDev_1984	0.249	-	-	-	Estimated
26	Main_RecrDev_1985	0.437	-	-	-	Estimated
27	Main_RecrDev_1986	0.592	-	-	-	Estimated
28	Main_RecrDev_1987	0.586	-	-	-	Estimated
29	Main_RecrDev_1988	0.429	-	-	-	Estimated
30	Main_RecrDev_1989	0.328	-	-	-	Estimated
31	Main_RecrDev_1990	0.244	-	-	-	Estimated
32	Main_RecrDev_1991	0.222	-	-	-	Estimated
33	Main_RecrDev_1992	0.142	-	-	-	Estimated
34	Main_RecrDev_1993	0.030	-	-	-	Estimated
35	Main_RecrDev_1994	-0.035	-	-	-	Estimated
36	Main_RecrDev_1995	-0.028	-	-	-	Estimated
37	Main_RecrDev_1996	0.070	-	-	-	Estimated
38	Main_RecrDev_1997	0.174	-	-	-	Estimated
39	Main_RecrDev_1998	0.288	-	-	-	Estimated
40	Main_RecrDev_1999	0.335	-	-	-	Estimated
41	Main_RecrDev_2000	0.324	-	-	-	Estimated
42	Main_RecrDev_2001	0.234	-	-	-	Estimated
43	Main_RecrDev_2002	0.095	-	-	-	Estimated
44	Main_RecrDev_2003	-0.106	-	-	-	Estimated
45	Main_RecrDev_2004	-0.240	-	-	-	Estimated
46	Main_RecrDev_2005	-0.340	-	-	-	Estimated
47	Main_RecrDev_2006	-0.365	-	-	-	Estimated
48	Main_RecrDev_2007	-0.333	-	-	-	Estimated
49	Main_RecrDev_2008	-0.351	-	-	-	Estimated
50	Main_RecrDev_2009	-0.432	-	-	-	Estimated
51	Main_RecrDev_2010	-0.569	-	-	-	Estimated
52	Main_RecrDev_2011	-0.710	-	-	-	Estimated
53	Main_RecrDev_2012	-0.698	-	-	-	Estimated
54	Main_RecrDev_2013	-0.523	-	-	-	Estimated

Table 3.2.6 Overfishing limits (OFL; retained yield in millions of pounds whole weight) for long-term equilibrium runs and acceptable biological catch (ABC; retained yield in millions of pounds whole weight) for a 2025 target rebuilding date. OFL was calculated as the median (50th percentile) of the probability density function of retained yield (millions of pounds). Target spawning potential ratio (SPR) values were achieved over the last ten years of the model (i.e., assumed equilibrium; 2065-2074) where the average SPR over that time frame equaled the target value. Equilibrium yield was the average OFL over the last ten years. Equilibrium optimal yield (OY) was the average retained yield over the last ten years with $F_{Direct}=0.75*F_{Direct\ at\ SPRtarget}$ for the directed fisheries. ABC was calculated using a P* of 0.427 (the 42.7th percentile) of the probability density function of retained yield obtained from the projection of $F_{Rebuild}$ (the harvest rate that achieves the specified gulfwide SPR in 2025). A P* of 0.427 implies a 42.7% probability of overfishing in any given year **Projections assume 2014 and 2015 catch was fixed at the average of the 2011, 2012, and 2013 catch.**

	OFL (Million Pounds)	**ABC (Million Pounds)**
Year	**SPR 30%**	**SPR 30%**
2016	1.05	0.21
2017	0.99	0.21
2018	0.96	0.22
2019	0.94	0.22
2020	0.93	0.23
2021	0.96	0.24
2022	1.08	0.28
2023	1.19	0.32
2024	1.29	0.36
2025	1.37	0.40
Equil	2.23	0.77
Equil OY	2.10	NA

Table 3.2.7 Retained yield and relative fishing mortality for optimal yield (OY) runs where the directed fishing mortality was equivalent to 0.75 multiplied by the F at SPR 30% (from equilibrium OFL calculations). Proportions are given as the OY run value divided by the SPR 30% run value. Harvest rate is total removals (in weight) divided by total biomass. Retained yield is in millions of pounds. Equilibrium values are averages over the last ten years (2065-2074) of the projection. **Projections assume 2014 and 2015 catch was fixed at the average of the 2011, 2012, and 2013 catch.**

Optimal Yield (OY) Run Results				
Year	**OFL/Retained Yield (mp)**	**Yield Proportion**	**Harvest Rate**	**Harvest Rate Proportion**
2016	0.81	0.77	0.13	0.85
2017	0.79	0.79	0.13	0.86
2018	0.78	0.81	0.13	0.86
2019	0.77	0.82	0.16	0.88
2020	0.77	0.83	0.14	0.88
2021	0.80	0.84	0.14	0.87
2022	0.91	0.84	0.14	0.87
2023	1.02	0.85	0.15	0.86
2024	1.11	0.86	0.15	0.86
2025	1.20	0.87	0.15	0.86

Table 3.2.8 The time required to rebuild based on the projection year that SSB_{Proxy} is achieved for SPR 30%. F=0 runs indicate the time to rebuild in the absence of any fishing mortality. **Projections assume 2014 and 2015 catch was fixed at the average of the 2011, 2012, and 2013 catch.**

SPR	**F=0**		**OFL (Reach SPR by 2074)**		**ABC 2025 (Reach SPR by 2025)**	
	SSB	**MSST**	**SSB**	**MSST**	**SSB**	**MSST**
0.3	2023	2021	2070	2031	2025	2022

Figures

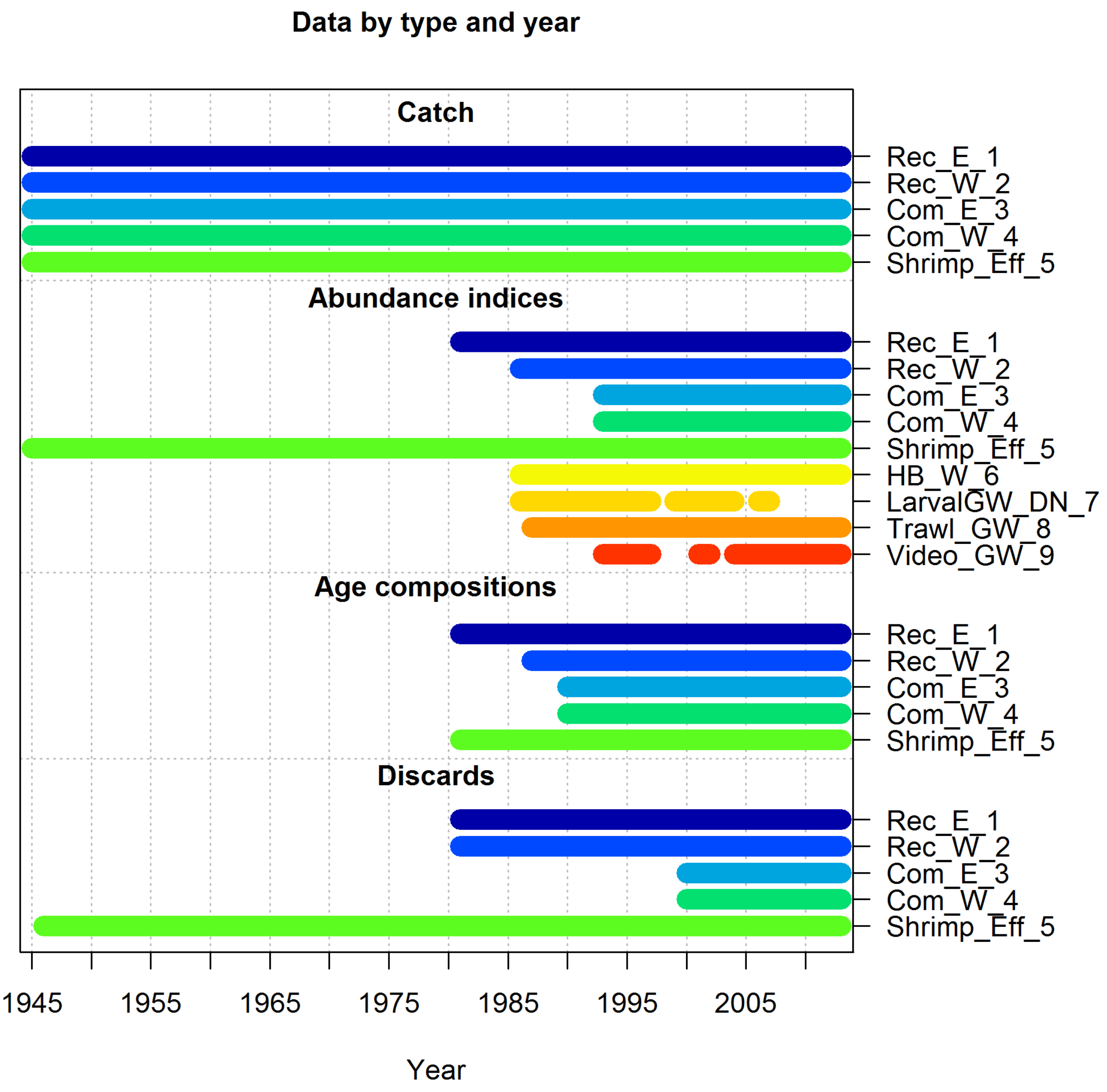


Figure 3.1.1 Data inputs for SEDAR 43 Gray Triggerfish SS base model.

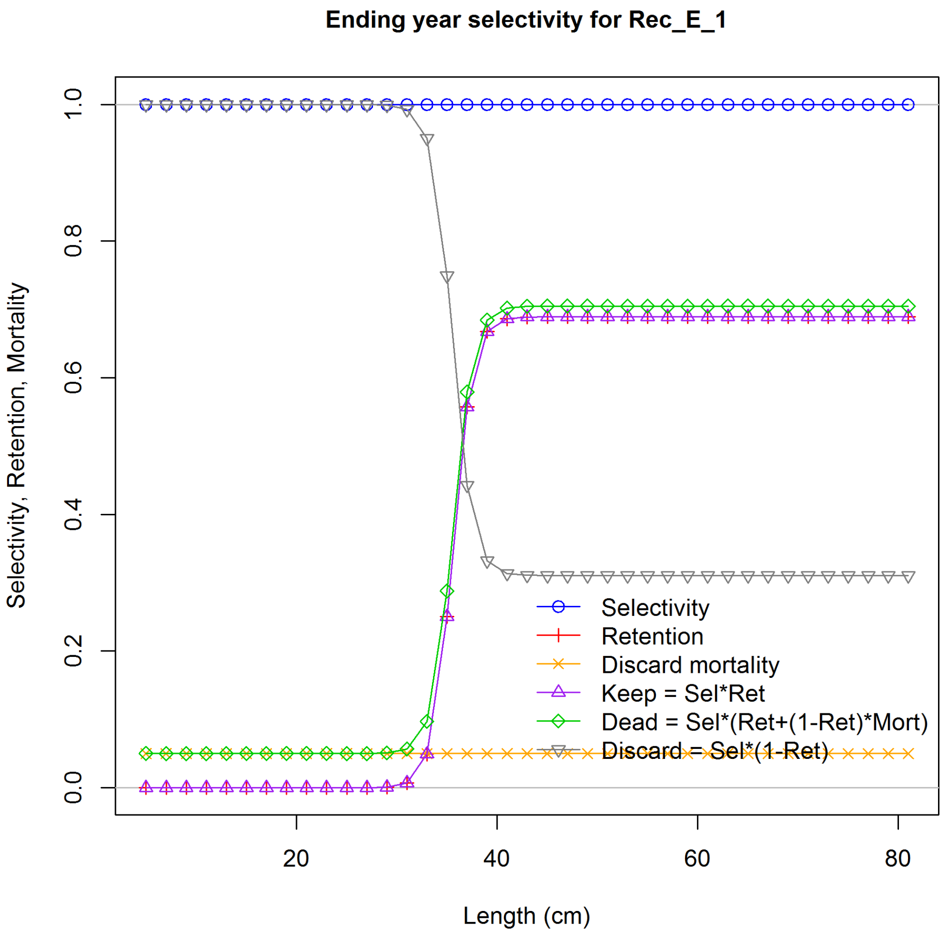


Figure 3.1.2. Terminal-year recreational East selectivity, retention and discard mortality pattern estimated from the SS model. Discard mortality was fixed at 5%. Selectivity was age-based, therefore all sizes were vulnerable. Retention was estimated.

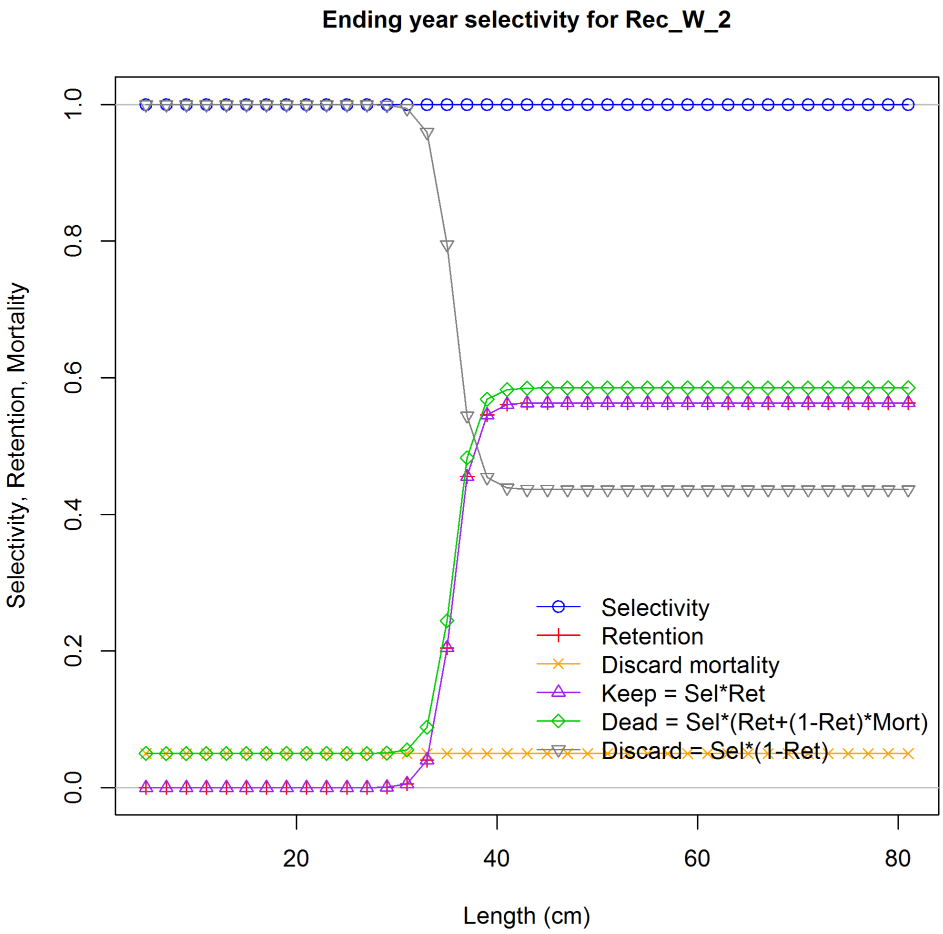


Figure 3.1.3. Terminal-year recreational West selectivity, retention and discard mortality pattern from the SS model. Discard mortality was fixed at 5%. Selectivity was age-based, therefore all sizes were vulnerable. Retention was estimated.

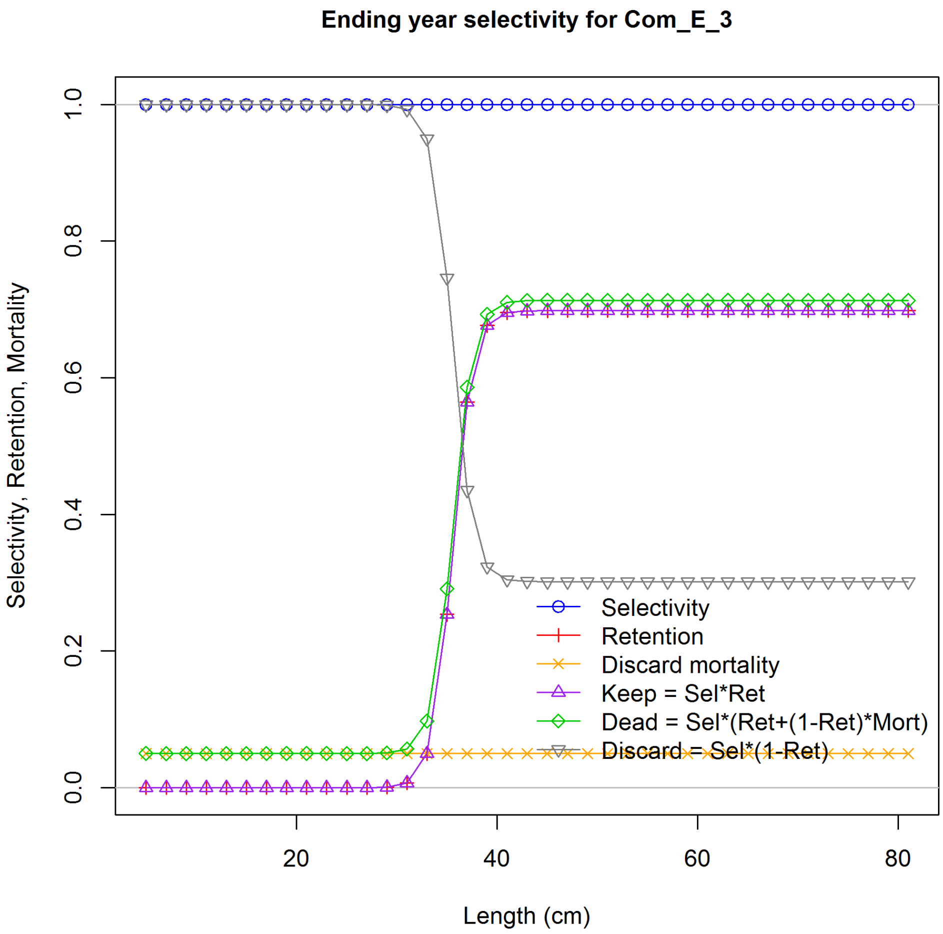


Figure 3.1.4. Terminal-year commercial East selectivity, retention and discard mortality pattern from the SS model. Discard mortality was fixed at 5%. Selectivity was age-based, therefore all sizes were vulnerable. Retention was estimated.

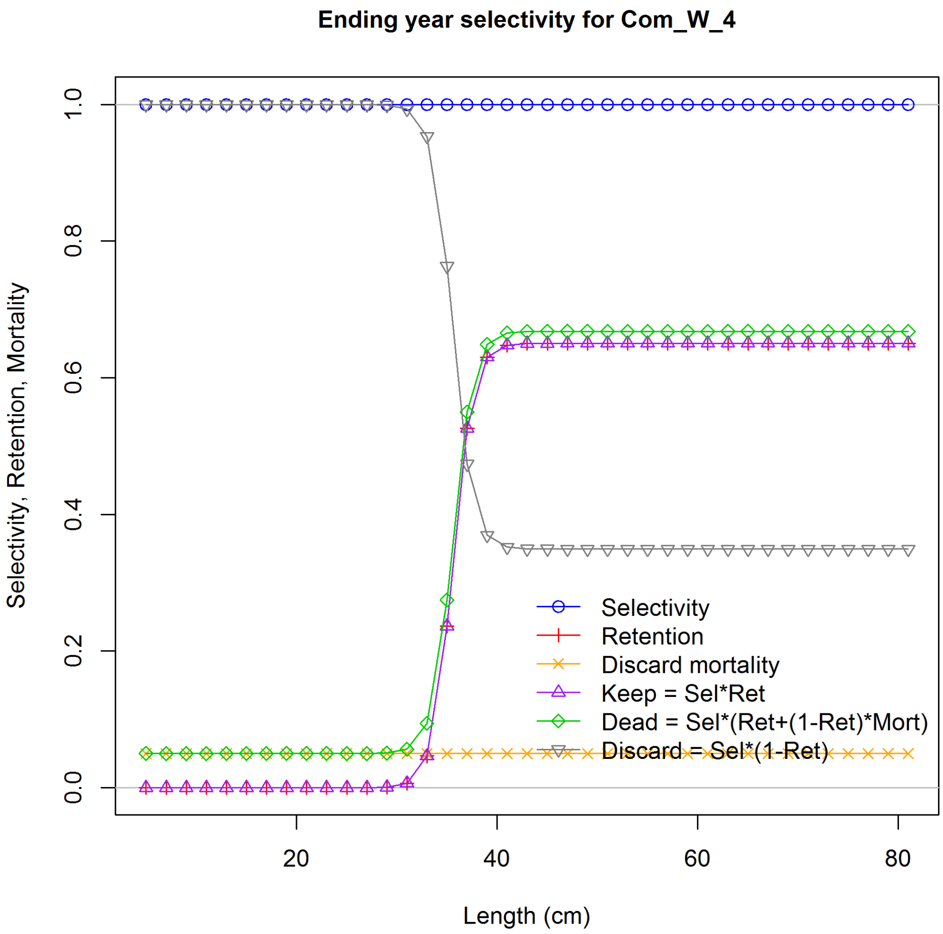


Figure 3.1.5. Terminal-year commercial West selectivity, retention and discard mortality pattern from the SS model. Discard mortality was fixed at 5%. Selectivity was age-based, therefore all sizes were vulnerable. Retention was estimated.

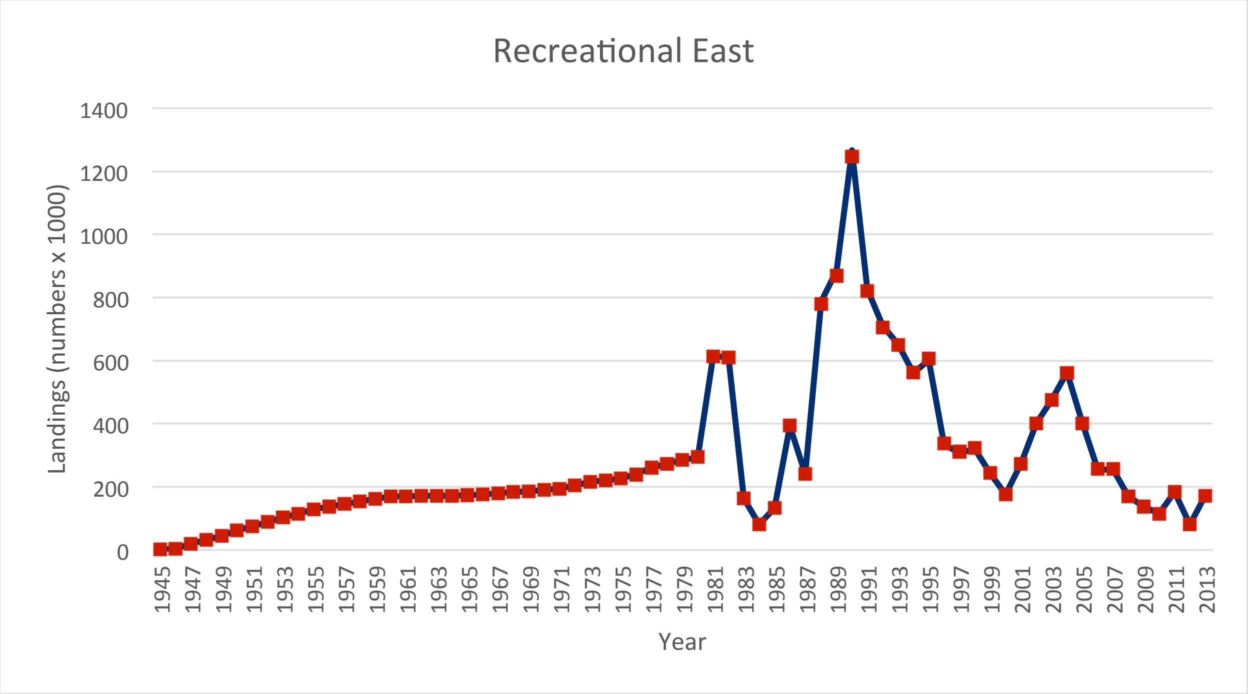


Figure 3.2.1 Observed (blue line) and predicted landings (red markers) numbers x 1000) of Gulf of Mexico Gray Triggerfish from the Recreational East fishing fleet, 1945-2013.

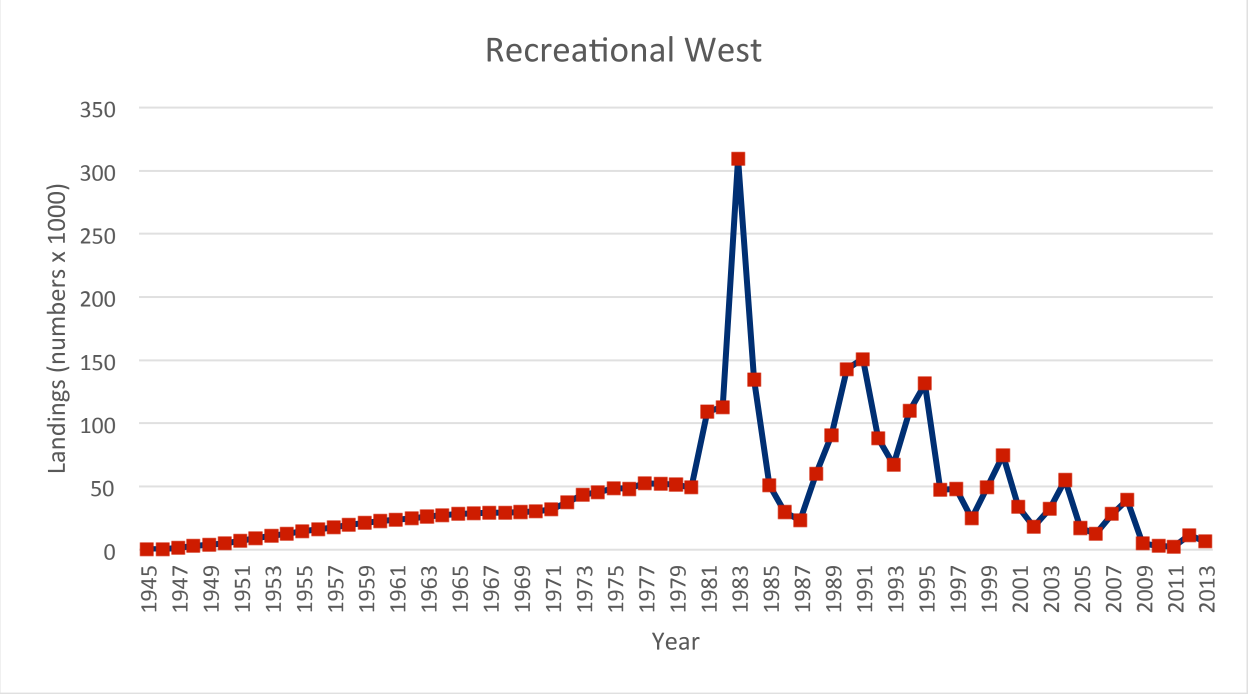


Figure 3.2.2 Observed (blue line) and predicted landings (red markers) numbers x 1000) of Gulf of Mexico Gray Triggerfish from the Recreational West fishing fleet, 1945-2013.

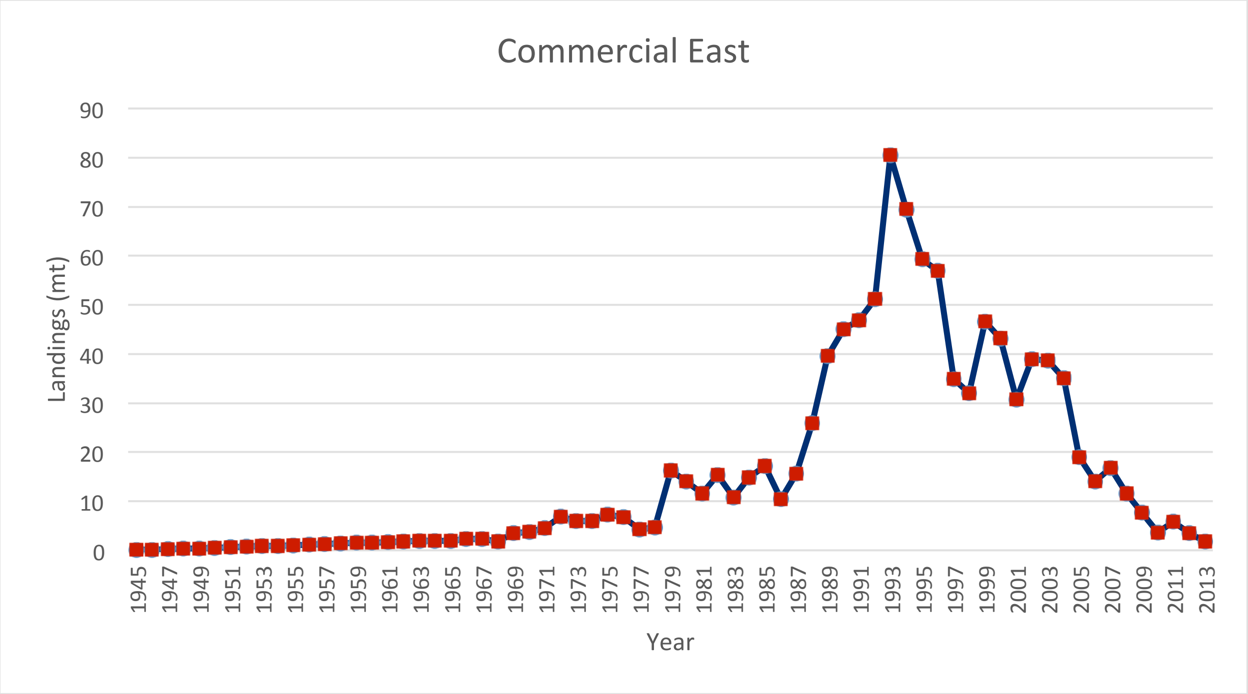


Figure 3.2.3 Observed (blue line) and predicted landings (red markers) (mt) of Gulf of Mexico Gray Triggerfish from the Commercial East fishing fleet, 1945-2013.

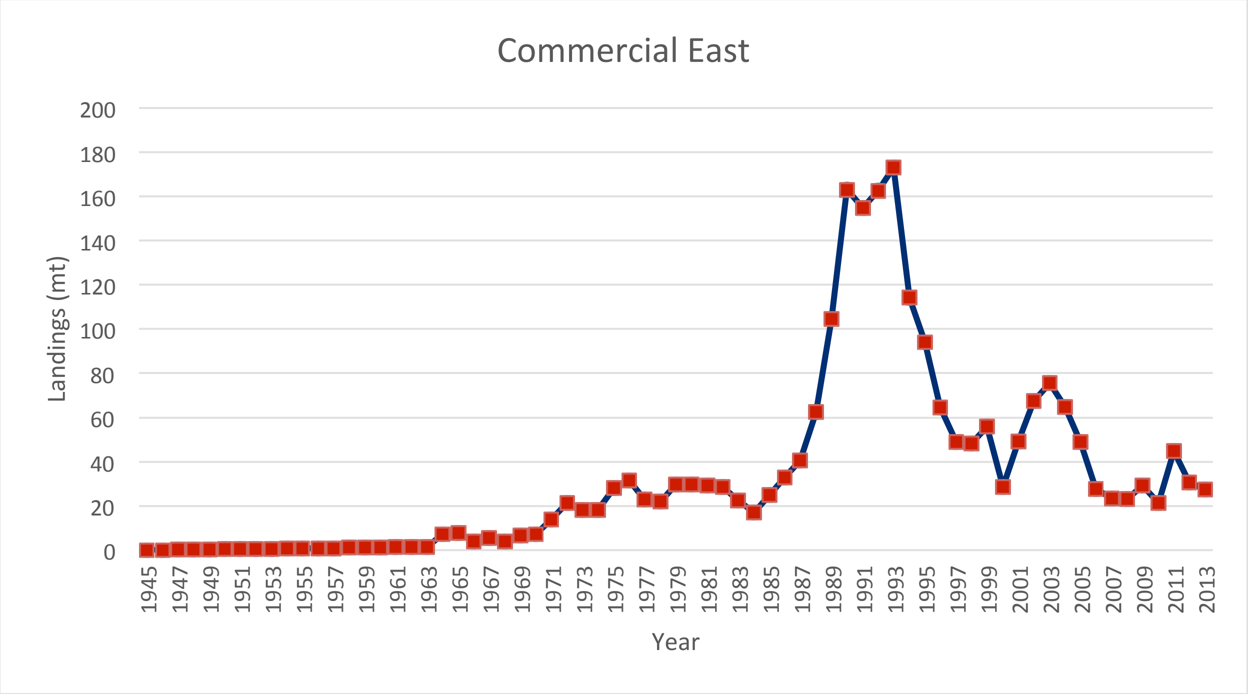


Figure 3.2.4 Observed (blue line) and predicted landings (red markers) (mt) of Gulf of Mexico Gray Triggerfish from the Commercial West fishing fleet, 1945-2013.

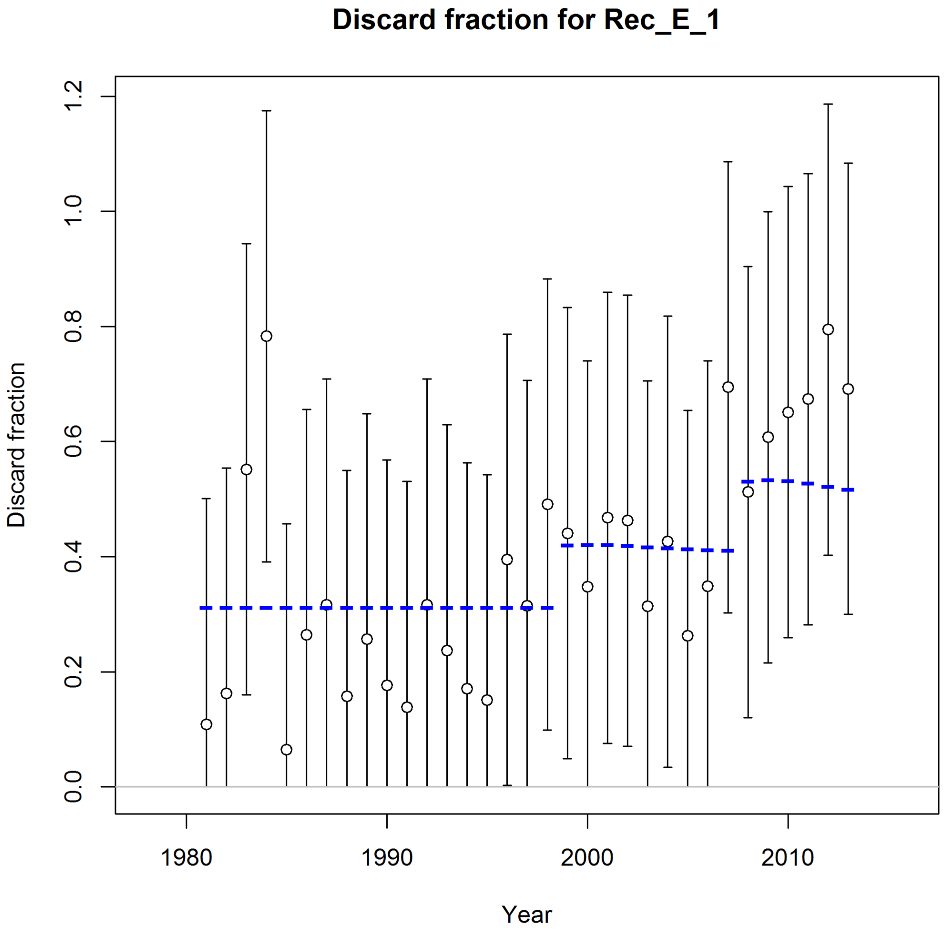


Figure 3.2.5 Observed (open circles) and SS predicted discard fractions (blue dashes) for Gulf of Mexico Gray Triggerfish from the Recreational East fishing fleet, 1981-2013.

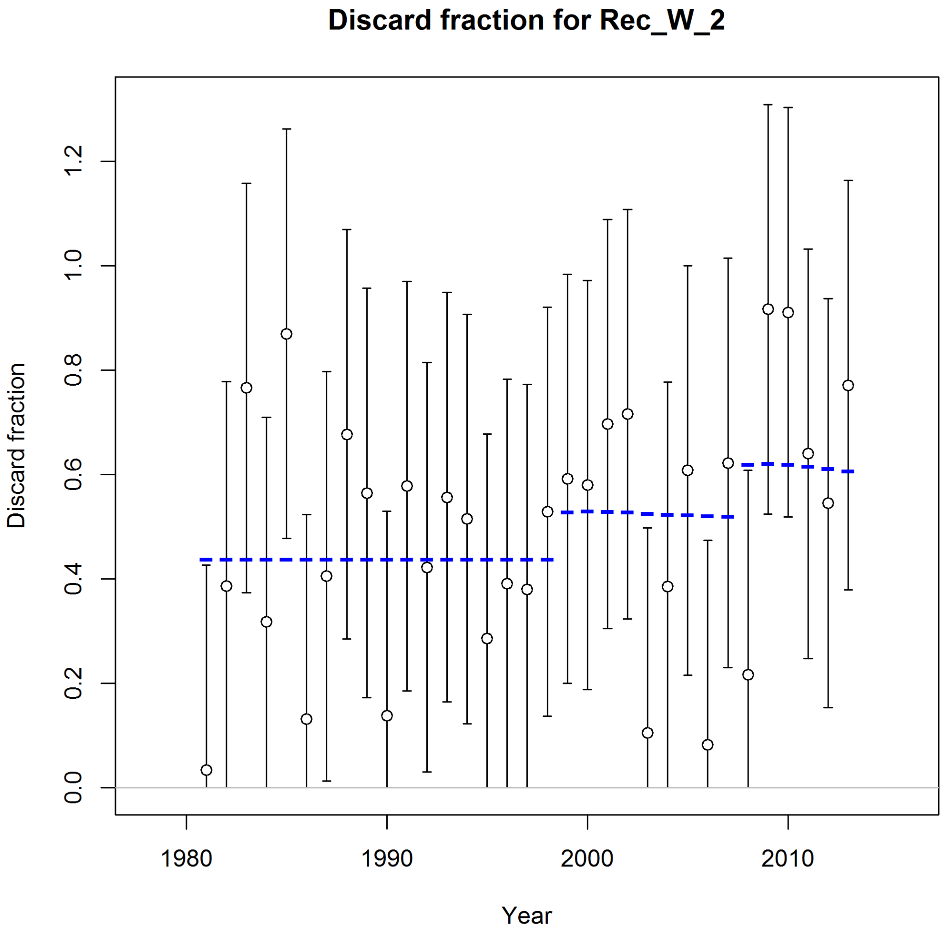


Figure 3.2.6 Observed (open circles) and SS predicted discard fractions (blue dashes) for Gulf of Mexico Gray Triggerfish from the Recreational West fishing fleet, 1981-2013.

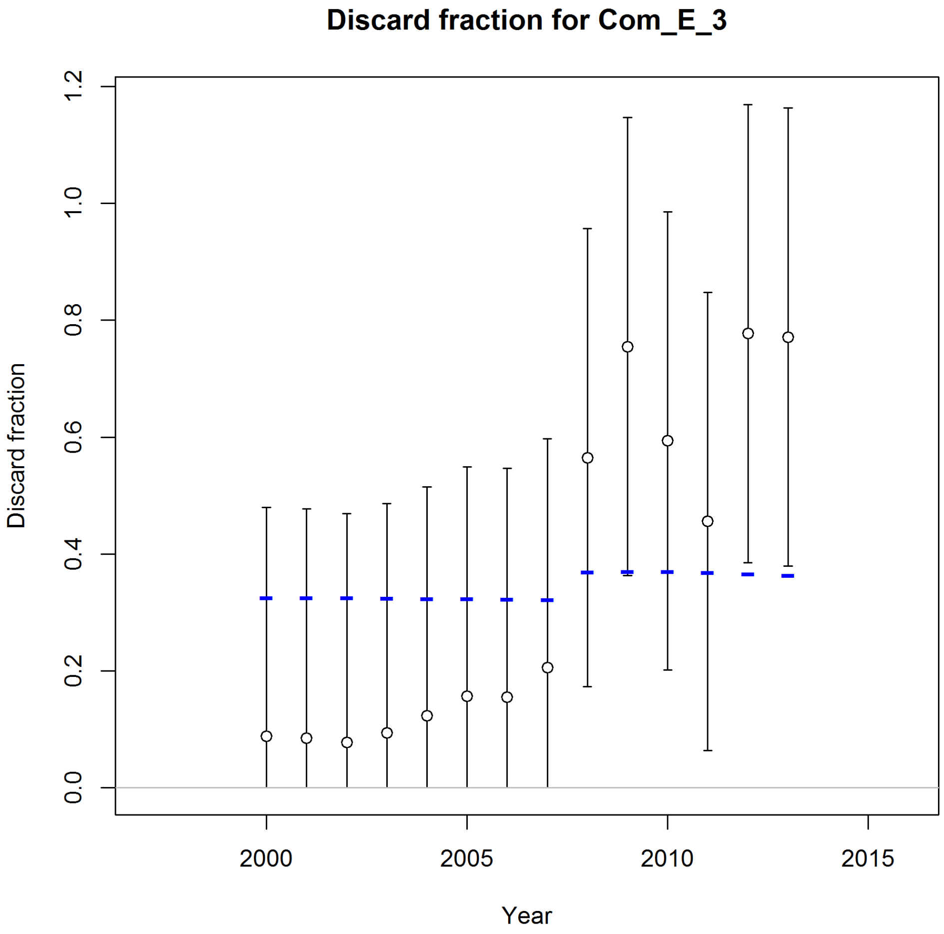


Figure 3.2.7 Observed (open circles) and SS predicted discard fractions (blue dashes) for Gulf of Mexico Gray Triggerfish from the Commercial East fishing fleet, 2000-2013.

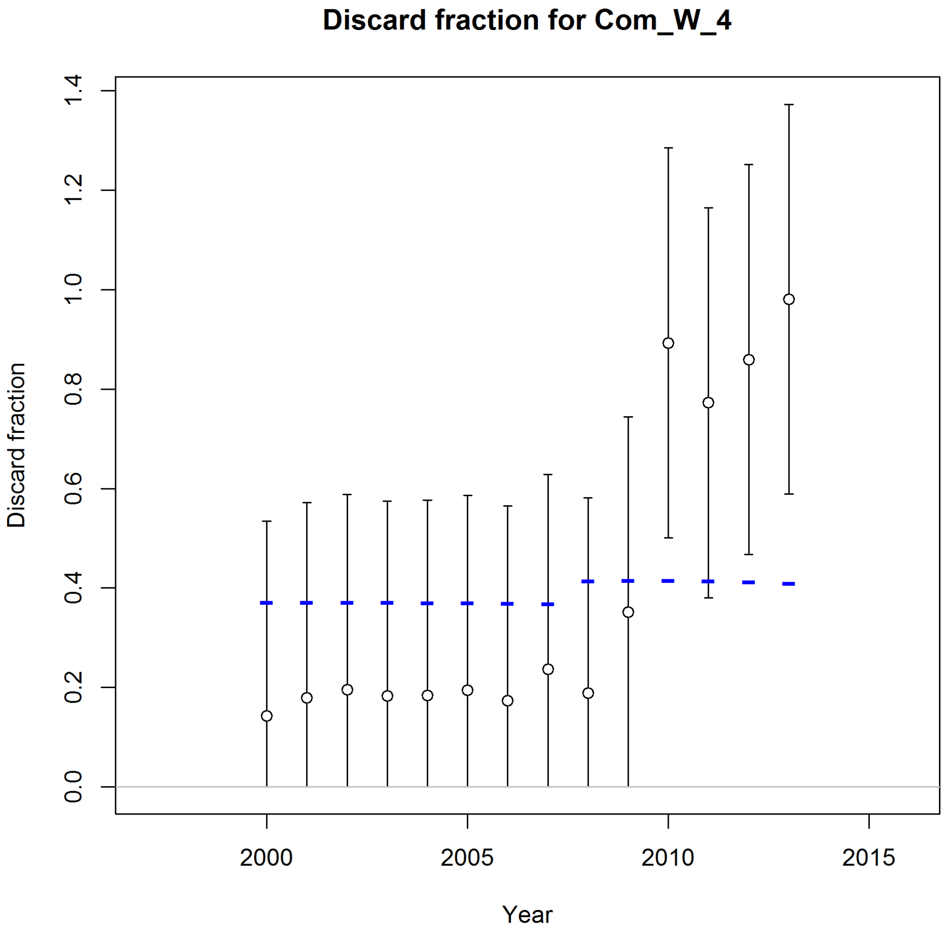


Figure 3.2.8 Observed (open circles) and SS predicted discard fractions (blue dashes) for Gulf of Mexico Gray Triggerfish from the Commercial West fishing fleet, 2000-2013.

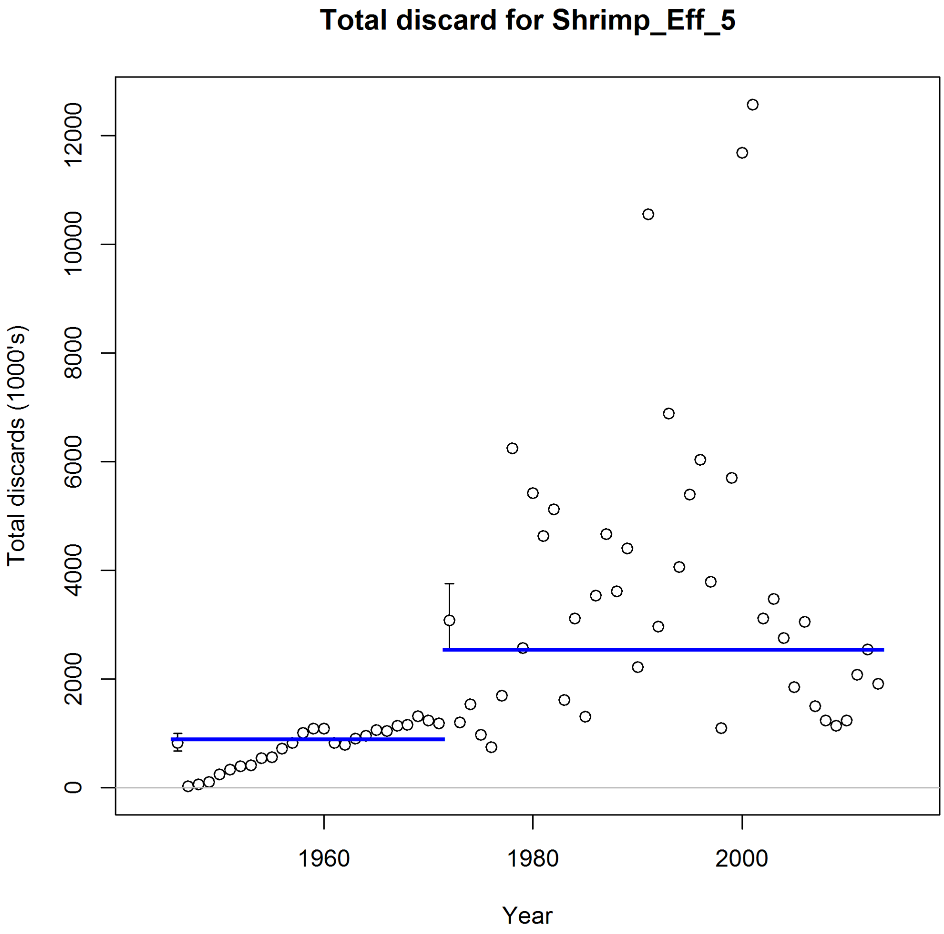


Figure 3.2.9 Observed (open circles) and SS predicted discards (blue dashes) (thousands of fish) of Gulf of Mexico Gray Triggerfish from the Shrimp Bycatch fishing fleet, 1945-2013.

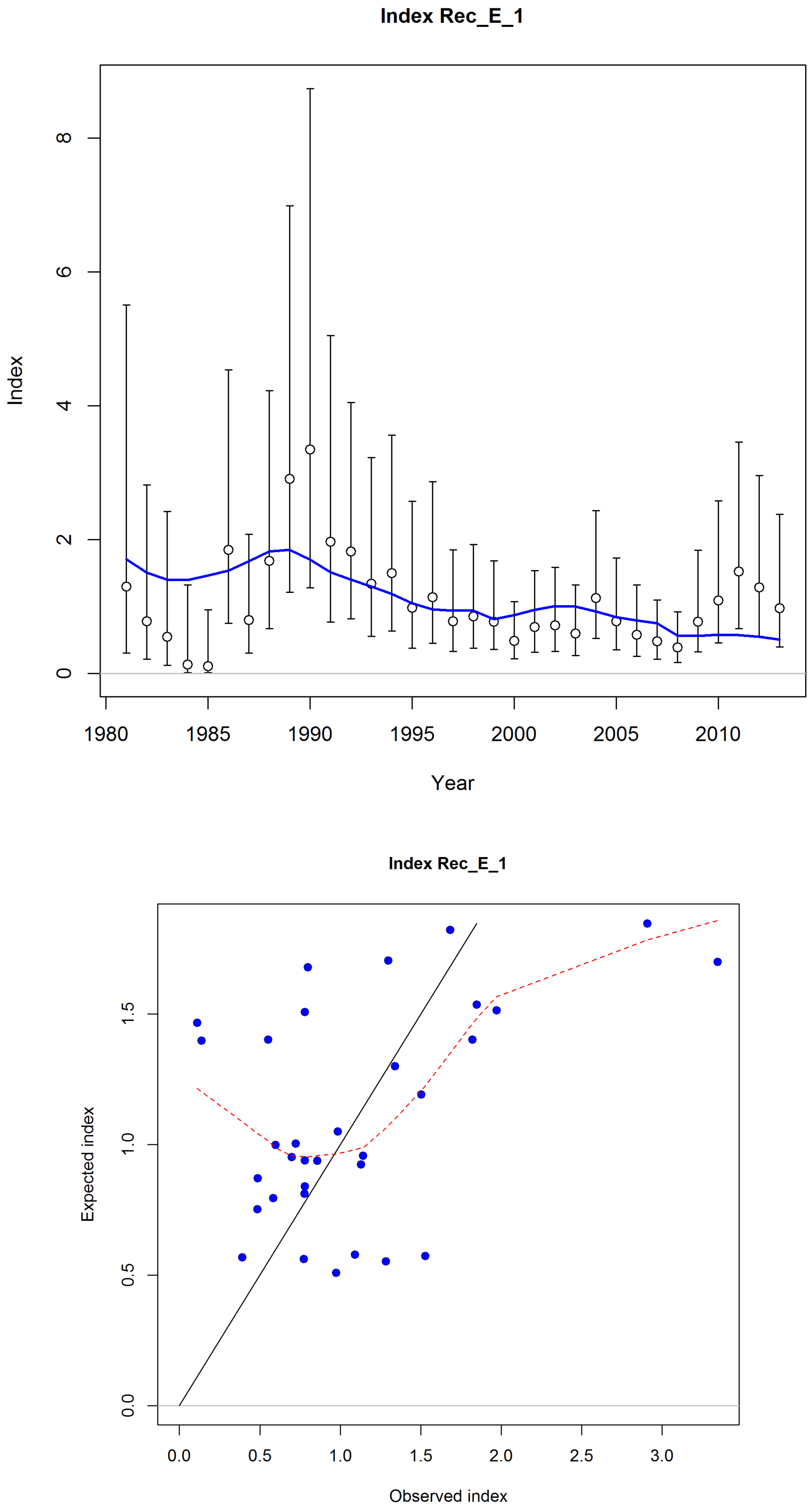


Figure 3.2.5 Model fit (blue line) to the standardized MRFSS East CPUE index (open circles) (top panel). The bottom panel also shows a QQ-plot comparison of the observed and predicted indices, where the black line is the expected 1:1 line.

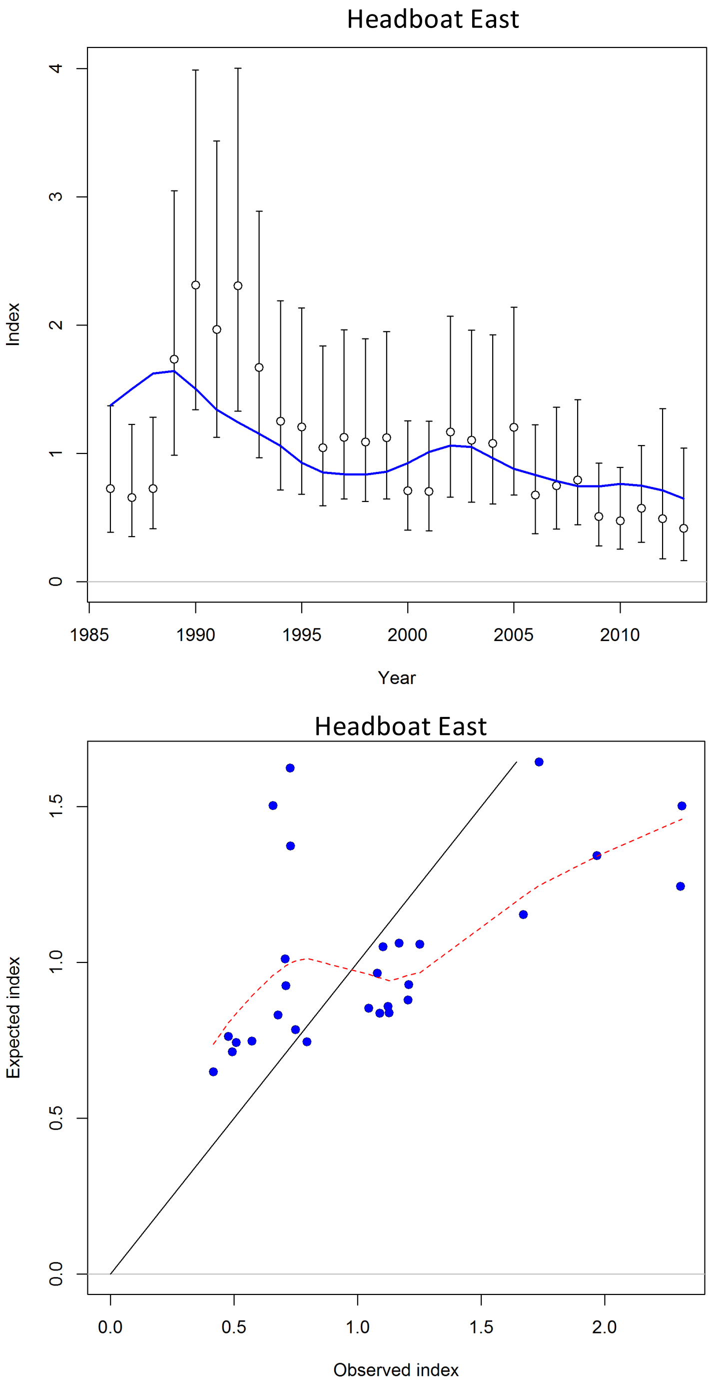
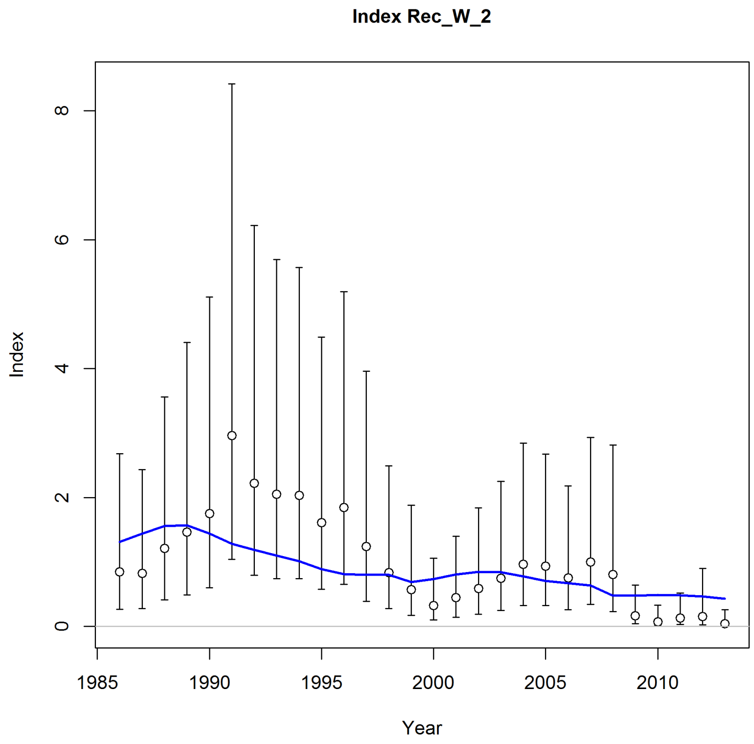


Figure 3.2.11 Model fit (blue line) to the SRHS East CPUE index (open circles) (top panel). The bottom panel also shows a QQ-plot comparison of the observed and predicted indices, where the black line is the expected 1:1 line.



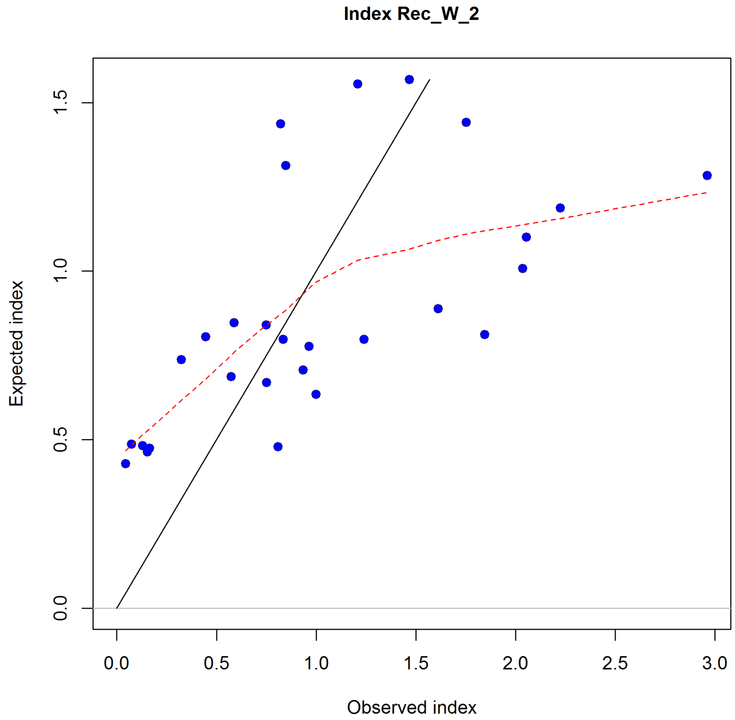


Figure 3.2.12 Model fit (blue line) to the standardized SRHS West CPUE index (open circles) (top panel). The bottom panel also shows a QQ-plot comparison of the observed and predicted indices, where the black line is the expected 1:1 line.

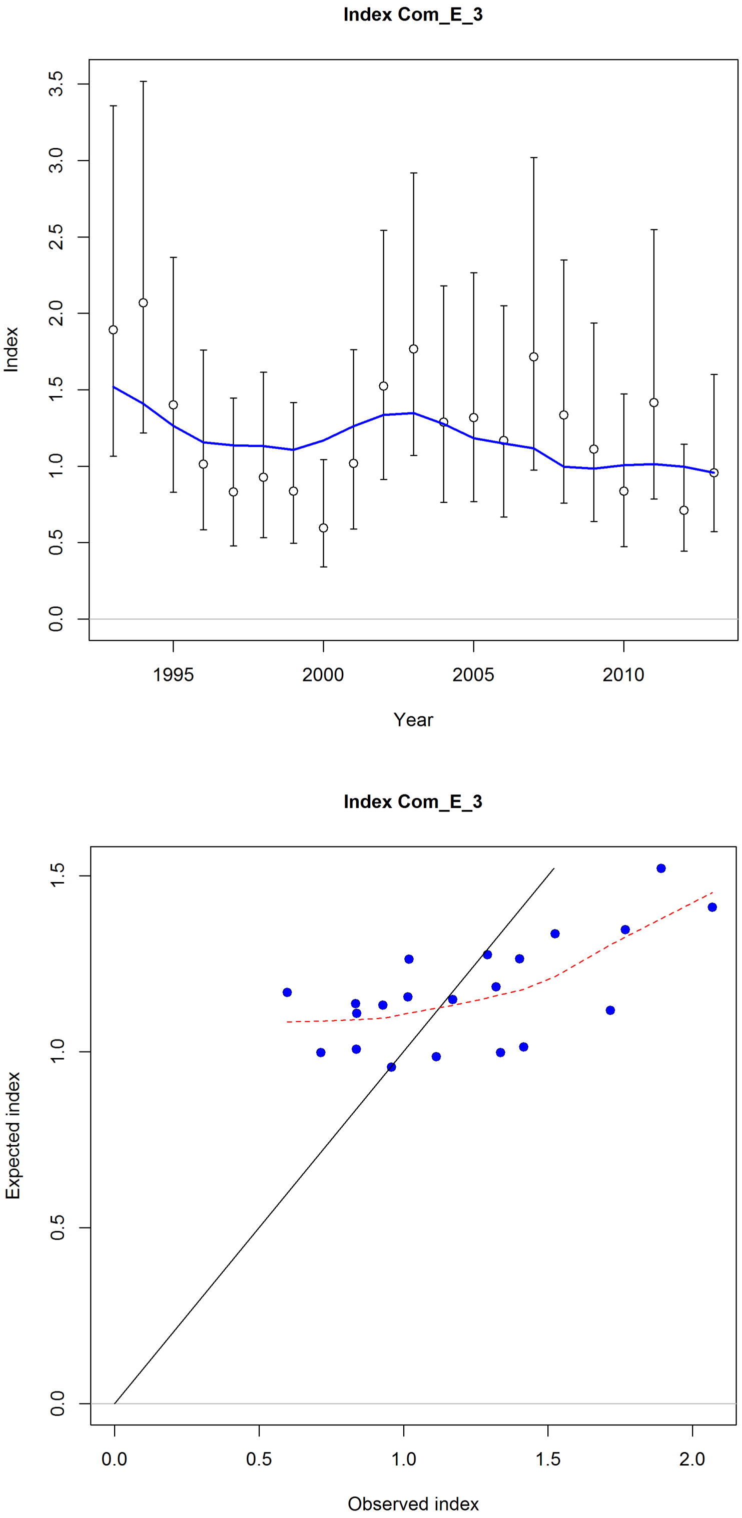


Figure 3.2.6 Model fit (blue line) to the standardized Commercial Handline East CPUE index (open circles) (top panel). The bottom panel also shows a QQ-plot comparison of the observed and predicted indices, where the black line is the expected 1:1 line.

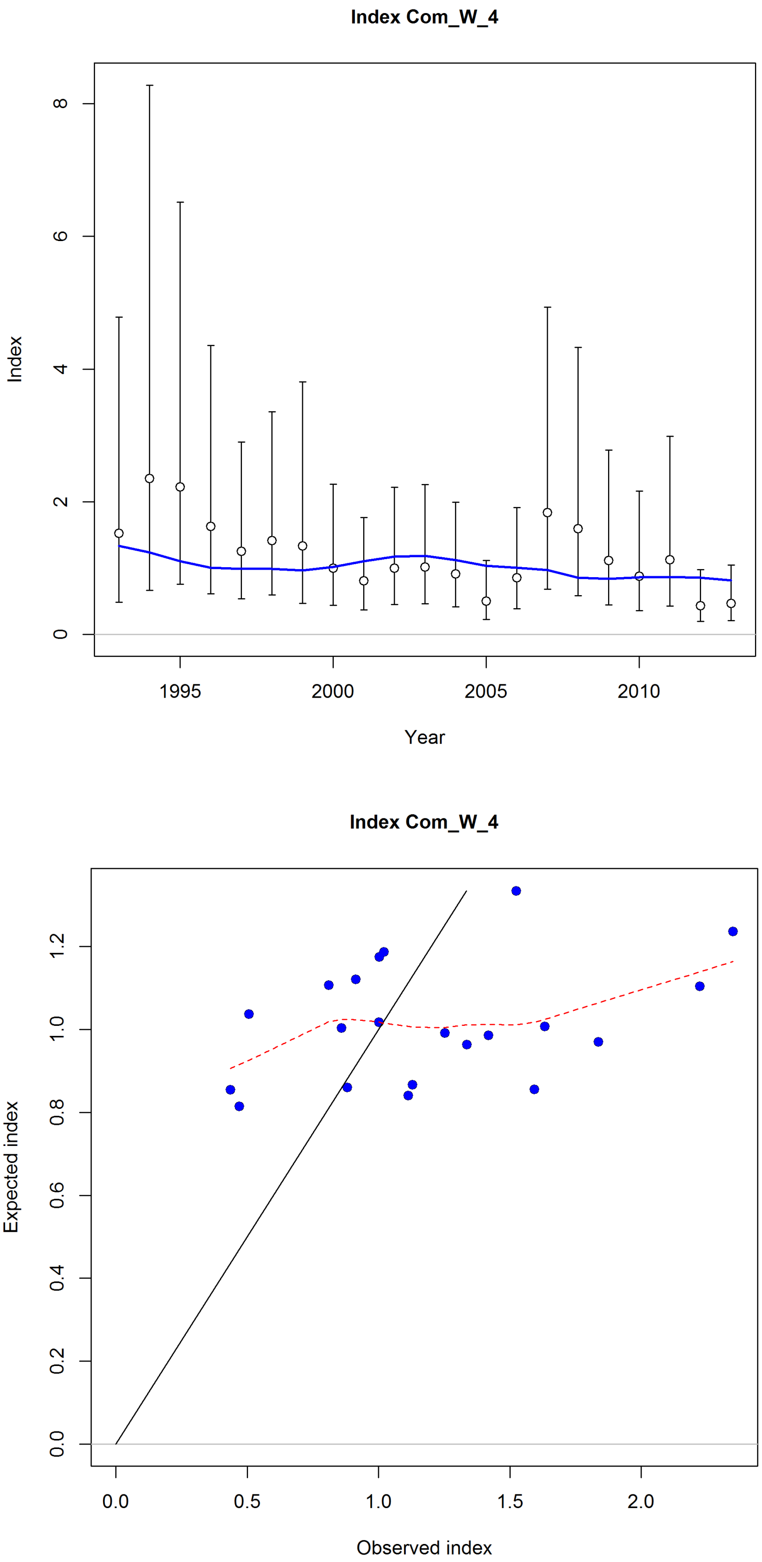
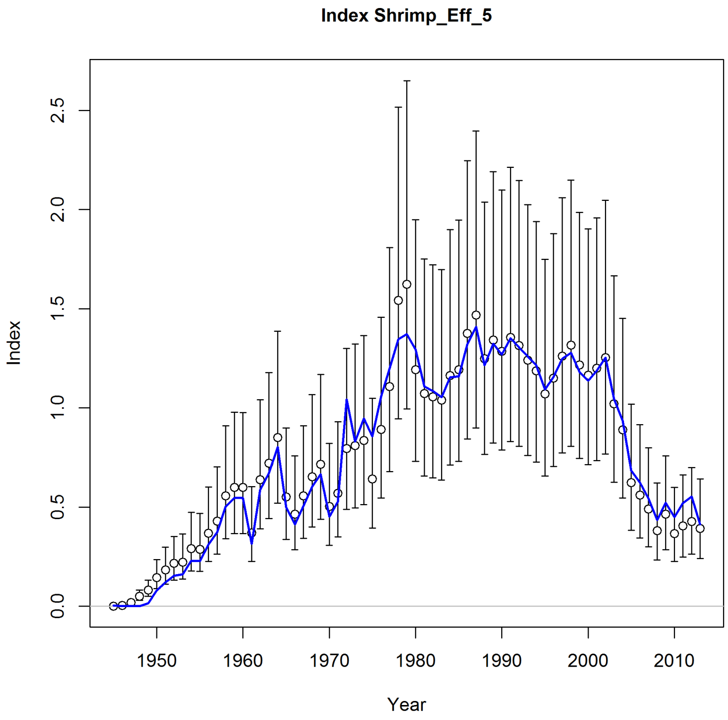


Figure 3.2.7 Model fit (blue line) to the standardized Commercial Handline West CPUE index (open circles) (top panel). The bottom panel also shows a QQ-plot comparison of the observed and predicted indices, where the black line is the expected 1:1 line.



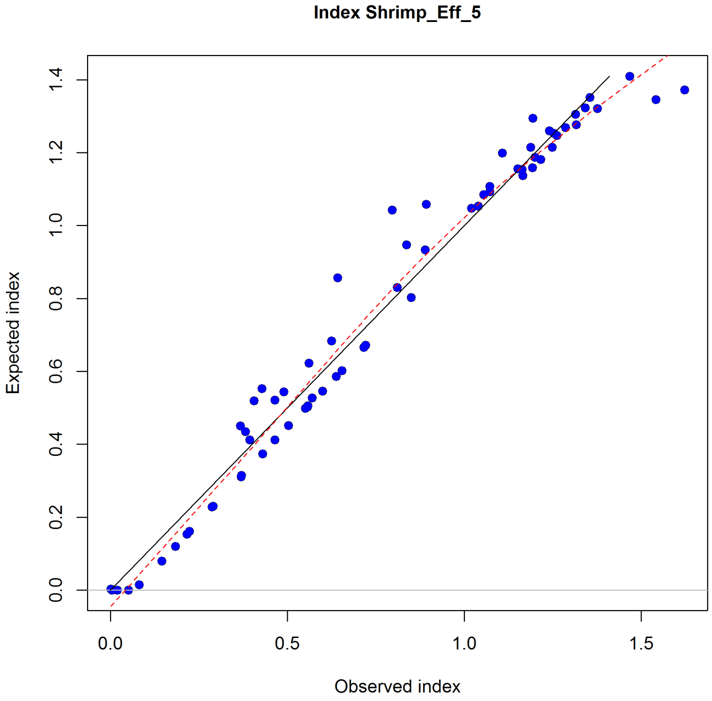


Figure 3.2.8 Model fit (blue line) to the Shrimp Fishery Effort index (open circles) (top panel). The bottom panel also shows a comparison of the observed and predicted indices, where the black line is the 1:1 line.

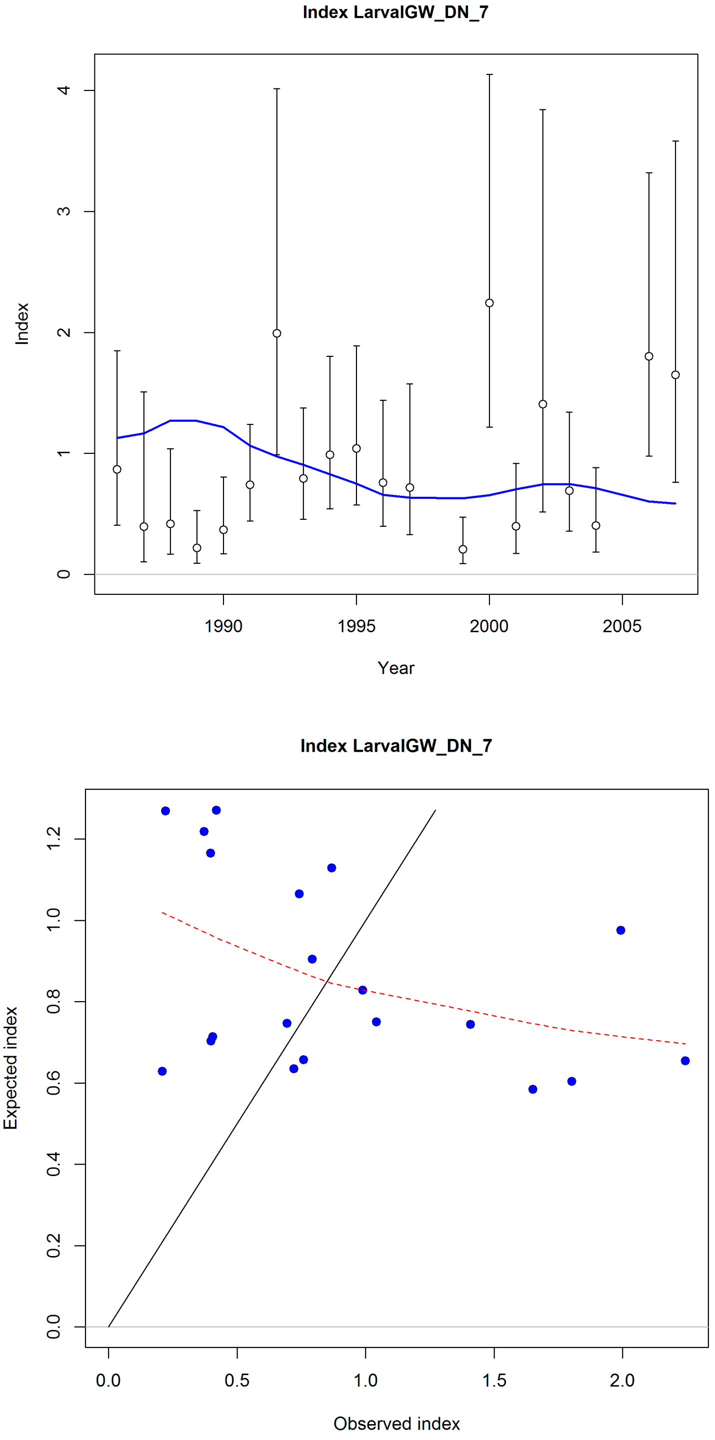


Figure 3.2.16 Model fit (blue line) to the SEAMAP Neuston CPUE index (open circles) (top panel). The bottom panel also shows a comparison of the observed and predicted indices, where the black line is the 1:1 line.

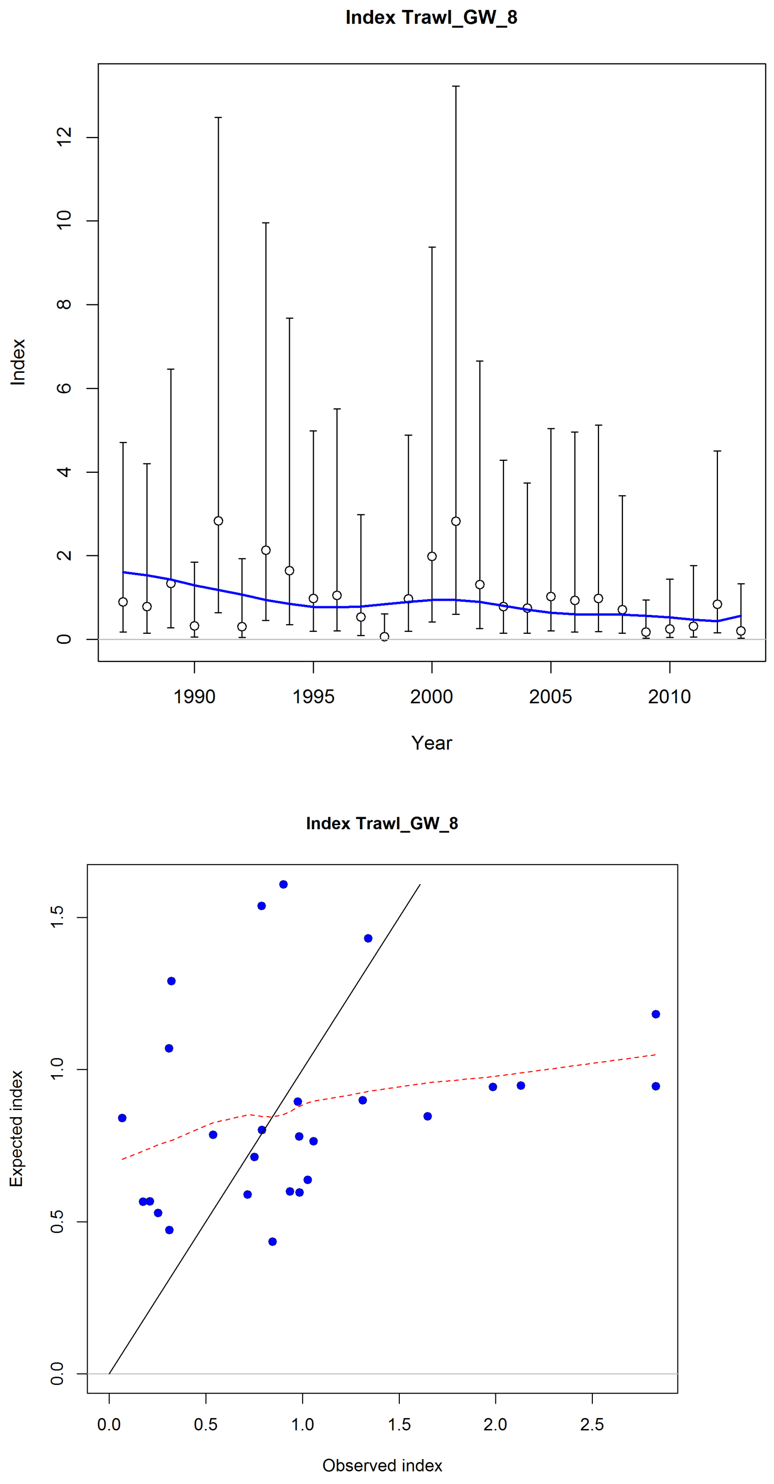


Figure 3.2.17 Model fit (blue line) to the SEAMAP Fall Trawl Survey CPUE index (open circles) (top panel). The bottom panel also shows a comparison of the observed and predicted indices, where the black line is the 1:1 line.

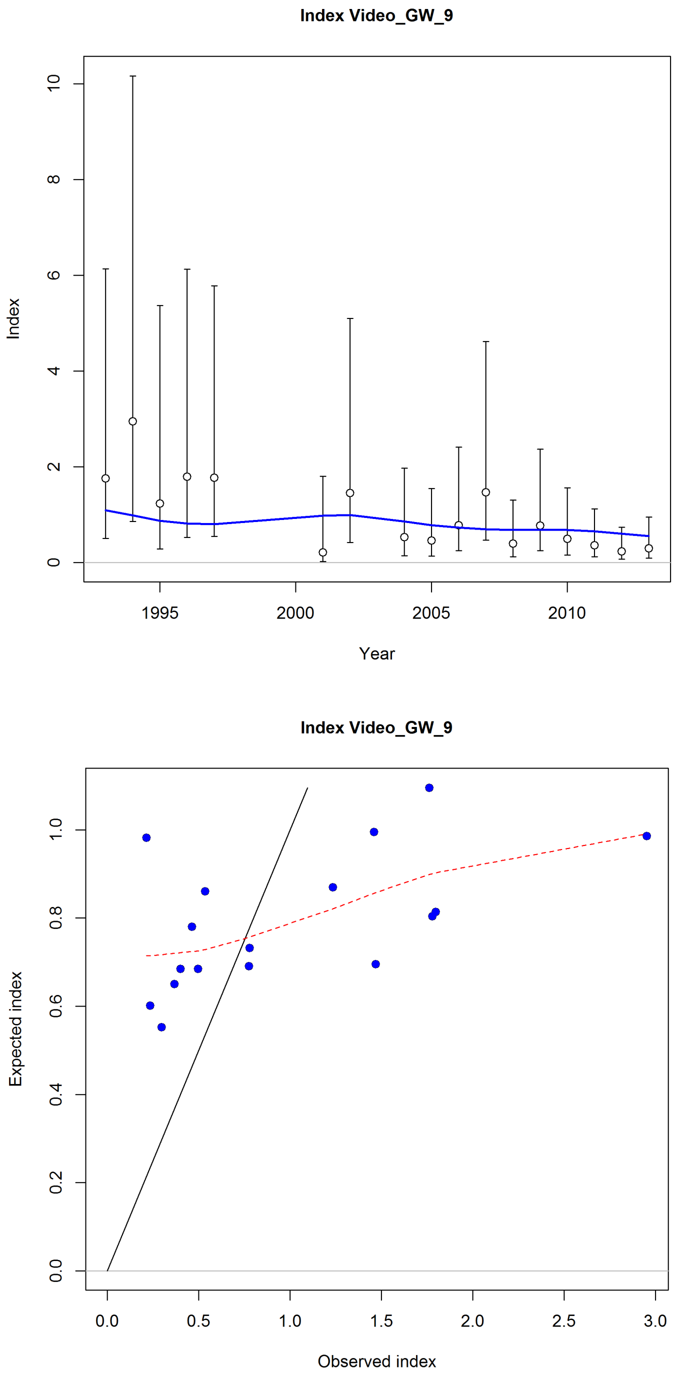


Figure 3.2.18 Model fit (blue line) to the standardized combined video survey index (open circles) (top panel). The bottom panel also shows a comparison of the observed and predicted indices, where the black line is the 1:1 line.

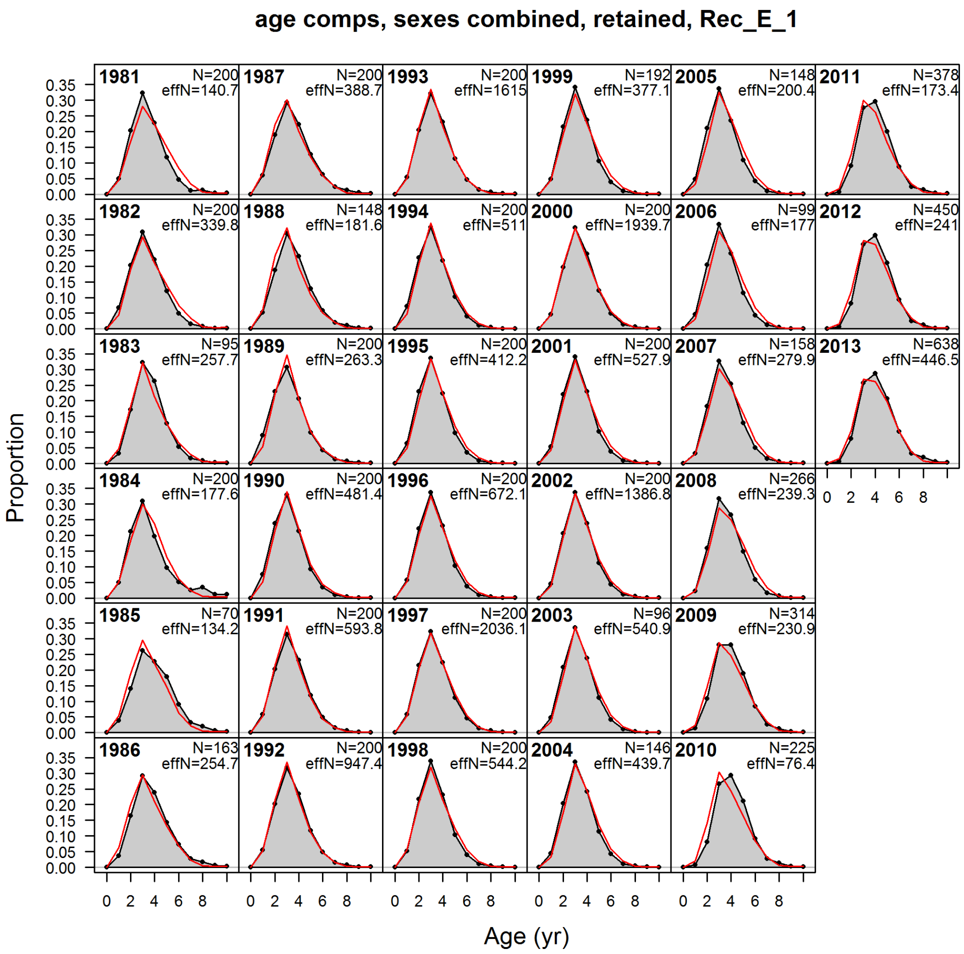


Figure 3.2.19 Observed and predicted age compositions of landed Gray Triggerfish in the Recreational East fleet. Observed (N) sample sizes and effective sample sizes (effN) estimated by SS are also reported. Observed sample sizes were capped at a maximum of 200 fish.

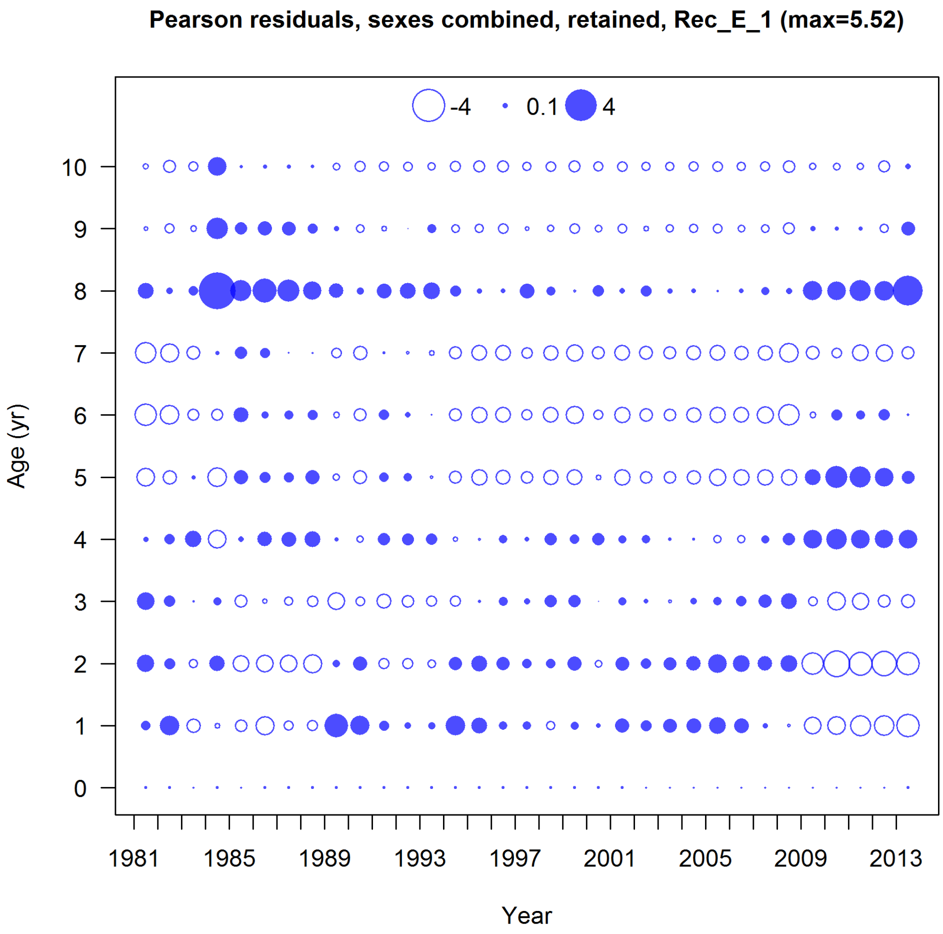


Figure 3.2.20 Pearson residuals for the age composition fit to Recreational East landings. Solid circles are positive residuals (i.e. observed greater than predicted) and open circles are negative residuals (i.e. predicted greater than observed).

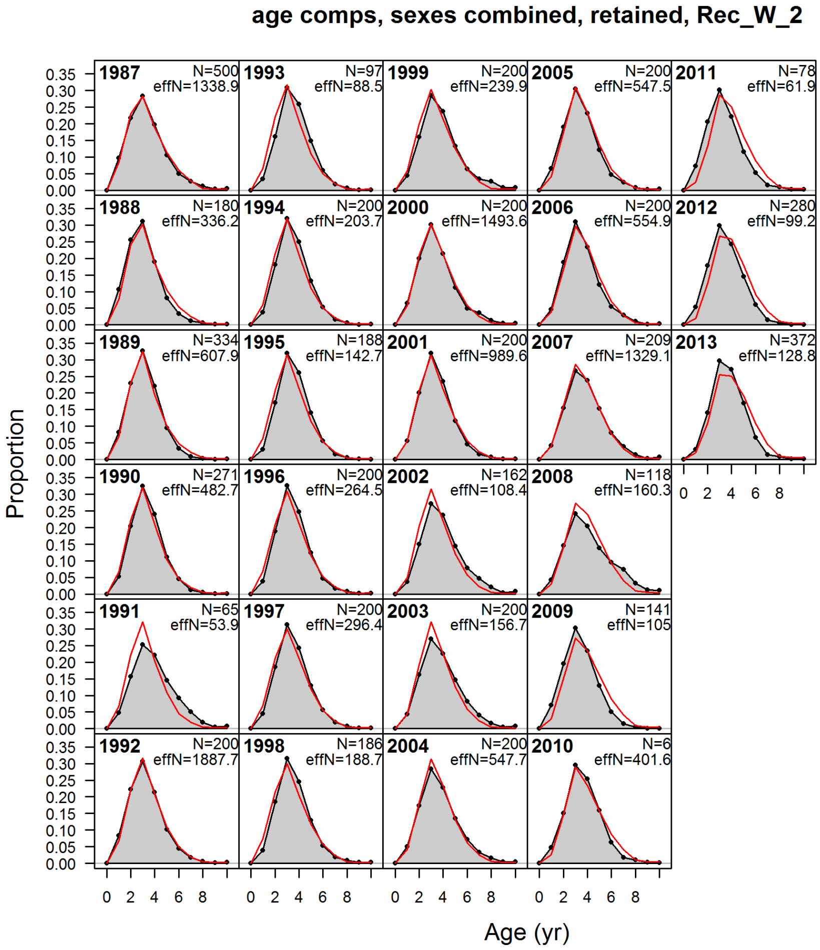


Figure 3.2.21 Observed and predicted age compositions of landed Gray Triggerfish in the Recreational West fleet. Observed (N) sample sizes and effective sample sizes (effN) estimated by SS are also reported. Observed sample sizes were capped at a maximum of 200 fish.

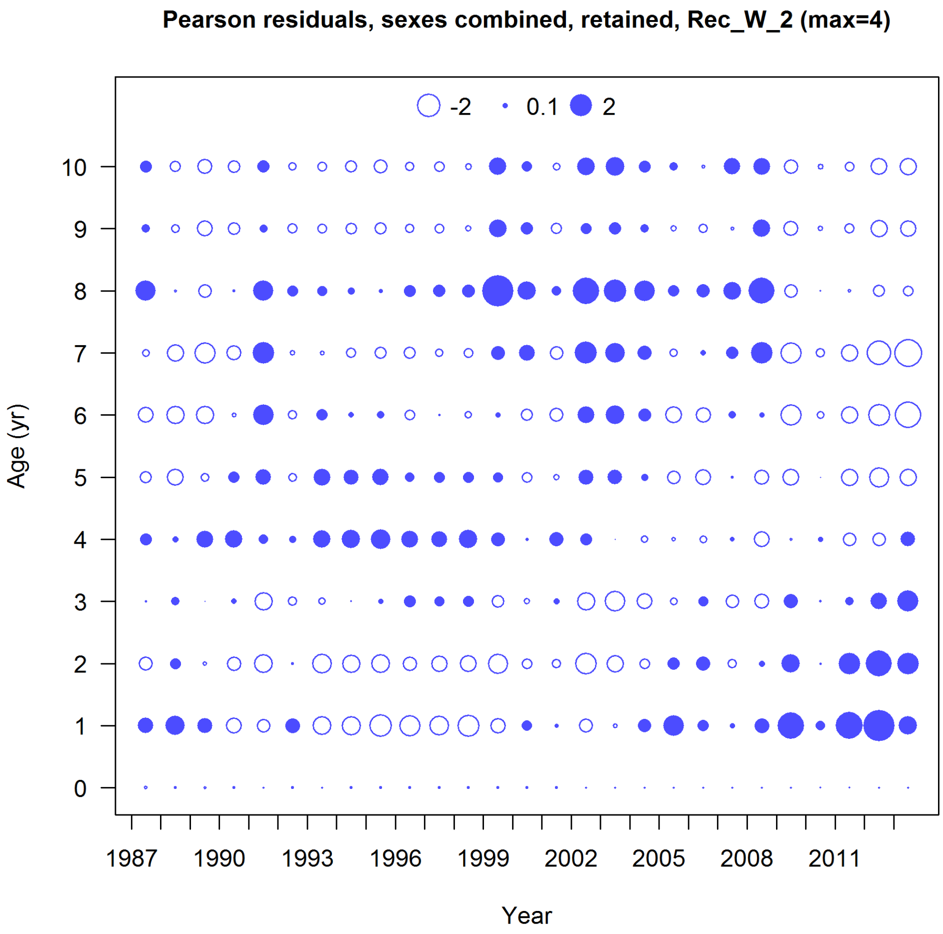


Figure 3.2.22 Pearson residuals for the length composition fit to Recreational West landings. Solid circles are positive residuals (i.e., observed greater than predicted) and open circles are negative residuals (i.e., predicted greater than observed).

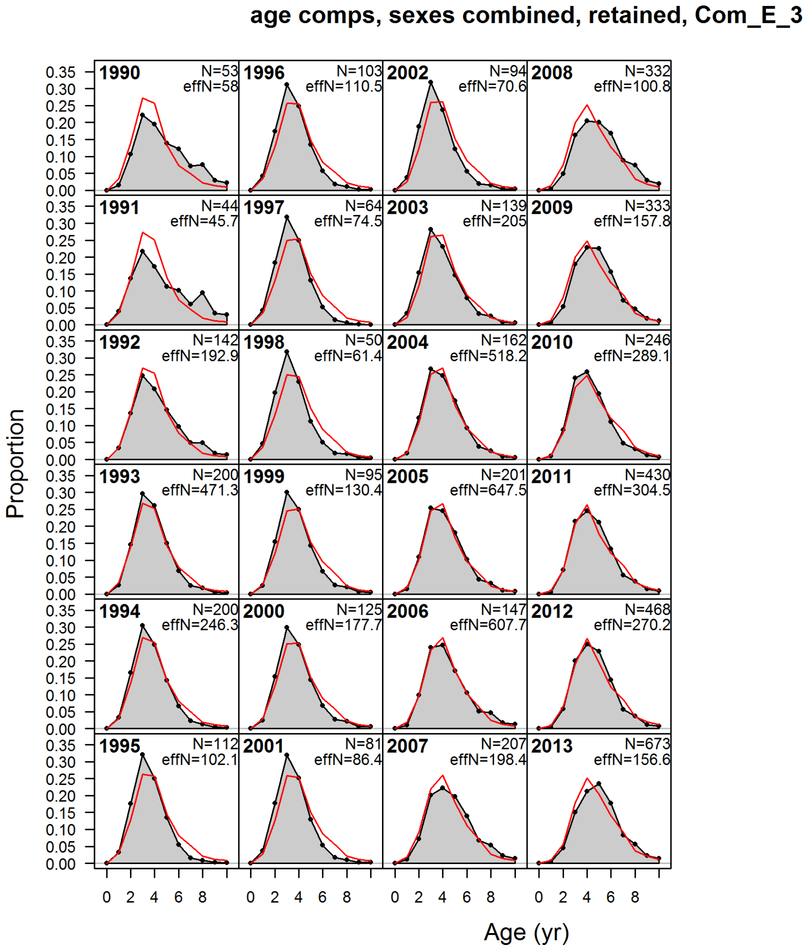


Figure 3.2.23 Observed and predicted age compositions of landed Gray Triggerfish in the Commercial East fleet. Observed (N) sample sizes and effective sample sizes (effN) estimated by SS are also reported. Observed sample sizes were capped at a maximum of 200 fish.

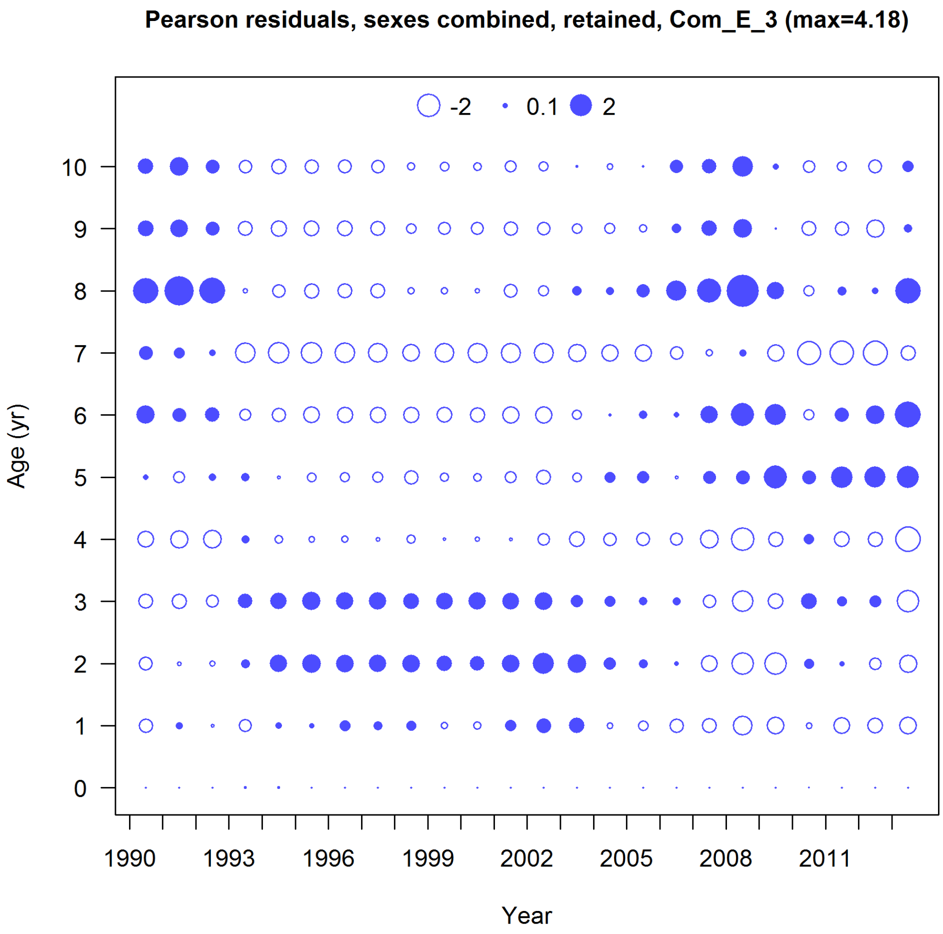


Figure 3.2.24 Pearson residuals for the age composition fit to Commercial East landings. Solid circles are positive residuals (i.e., observed greater than predicted) and open circles are negative residuals (i.e., predicted greater than observed).

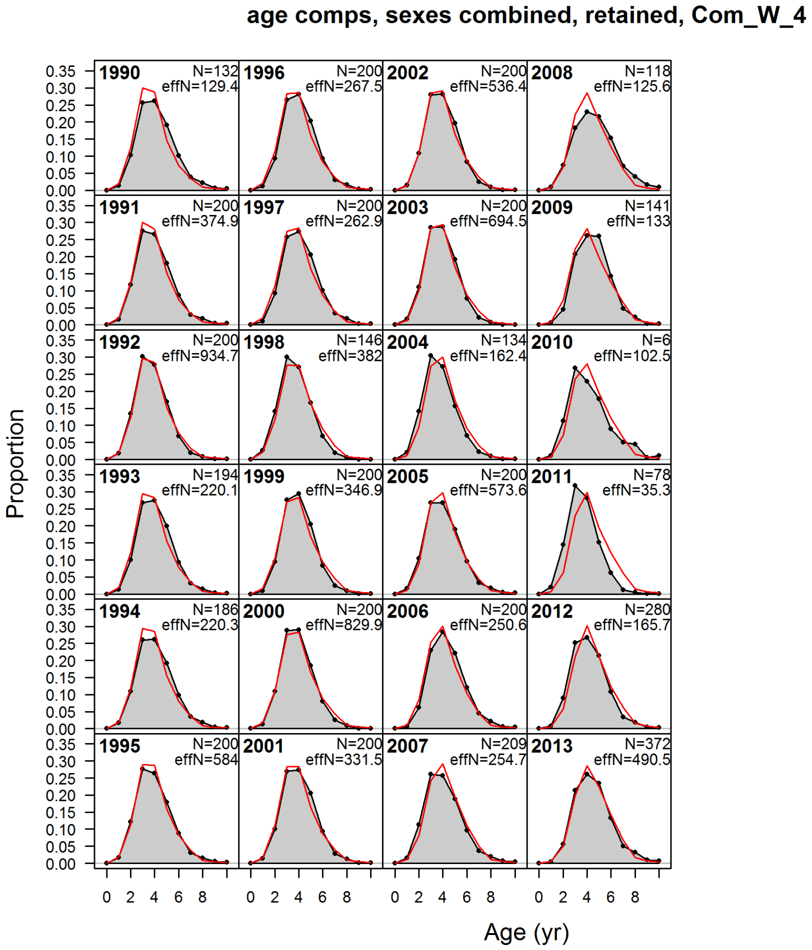


Figure 3.2.25 Observed and predicted age compositions of landed Gray Triggerfish in the Commercial West fleet. Observed (N) sample sizes and effective sample sizes (effN) estimated by SS are also reported. Observed sample sizes were capped at a maximum of 200 fish.

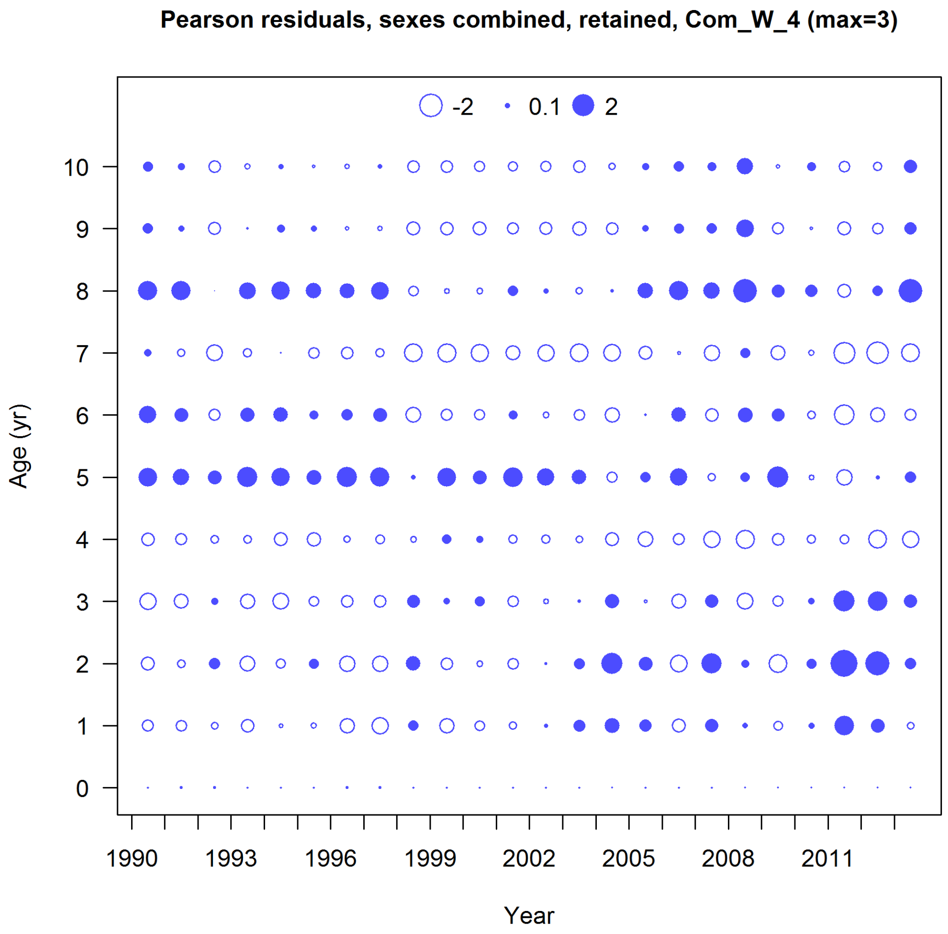


Figure 3.2.26 Pearson residuals for the age composition fit to Commercial West landings. Solid circles are positive residuals (i.e., observed greater than predicted) and open circles are negative residuals (i.e., predicted greater than observed).

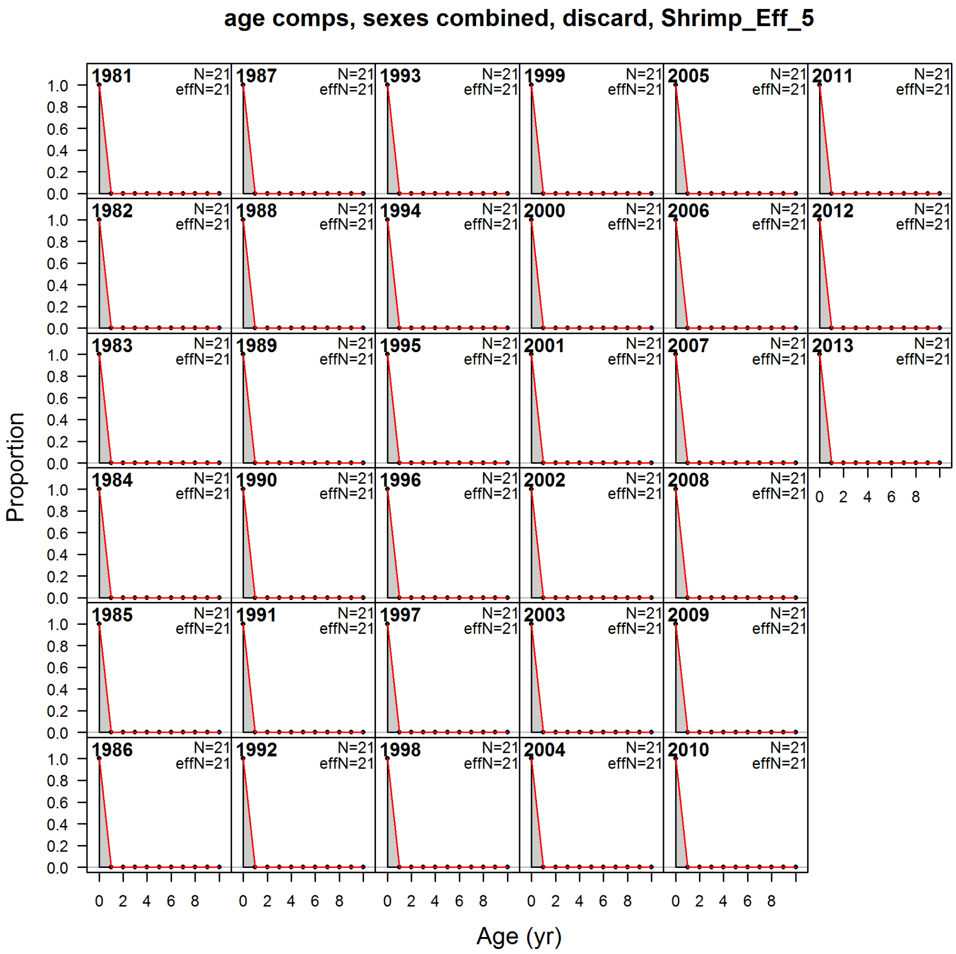


Figure 3.2.27 Observed and predicted age compositions of discards from the Shrimp Bycatch fleet. Observed (N) sample sizes and effective sample sizes (effN) estimated by SS are also reported.

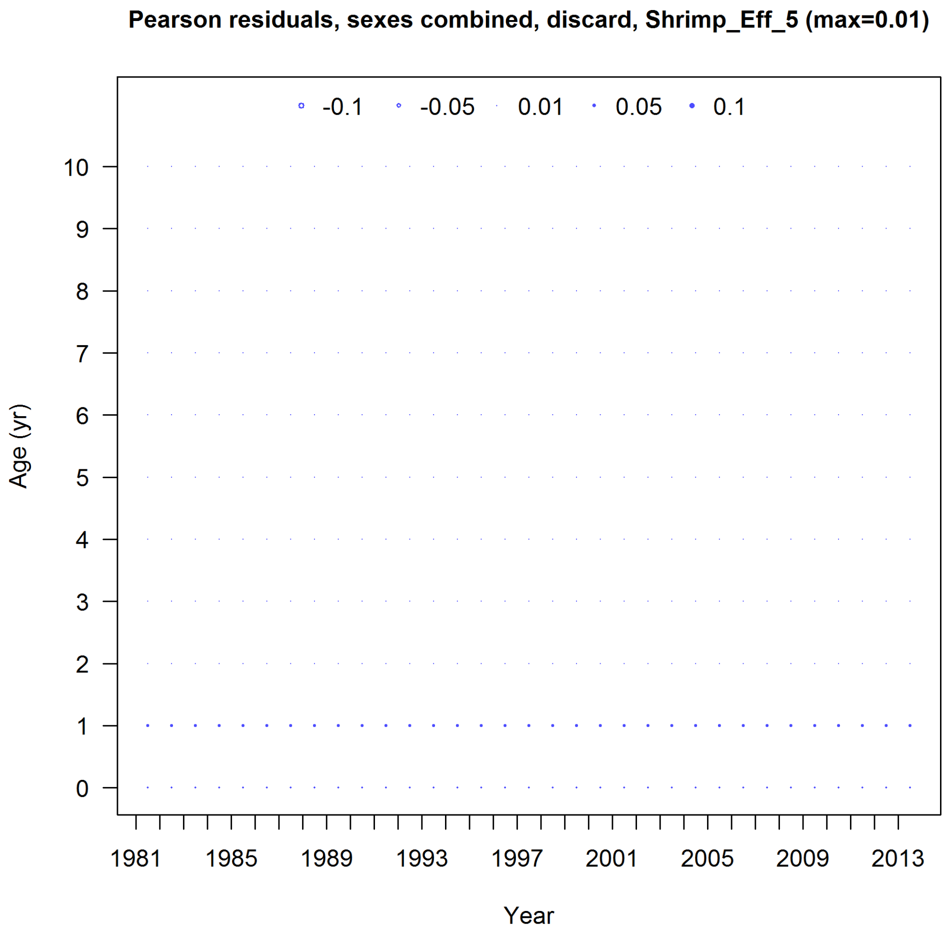


Figure 3.2.28 Pearson residuals for the age composition fit to the Shrimp Bycatch fleet discard observations. Solid circles are positive residuals (i.e., observed greater than predicted) and open circles are negative residuals (i.e., predicted greater than observed).

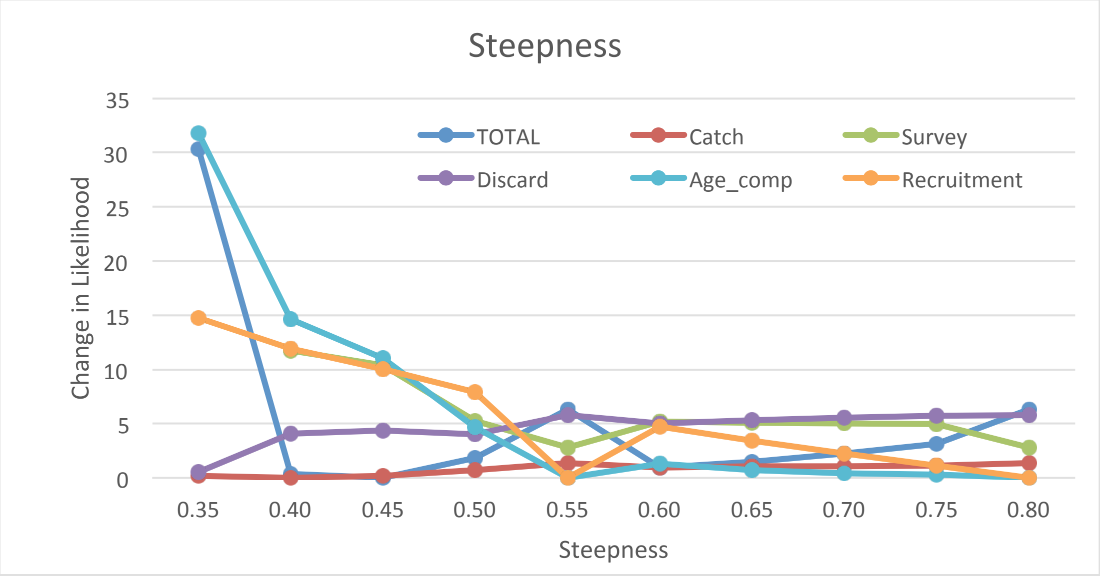


Figure 3.2.29. Likelihood profile on steepness. Model runs with values below 0.35 did not converge.

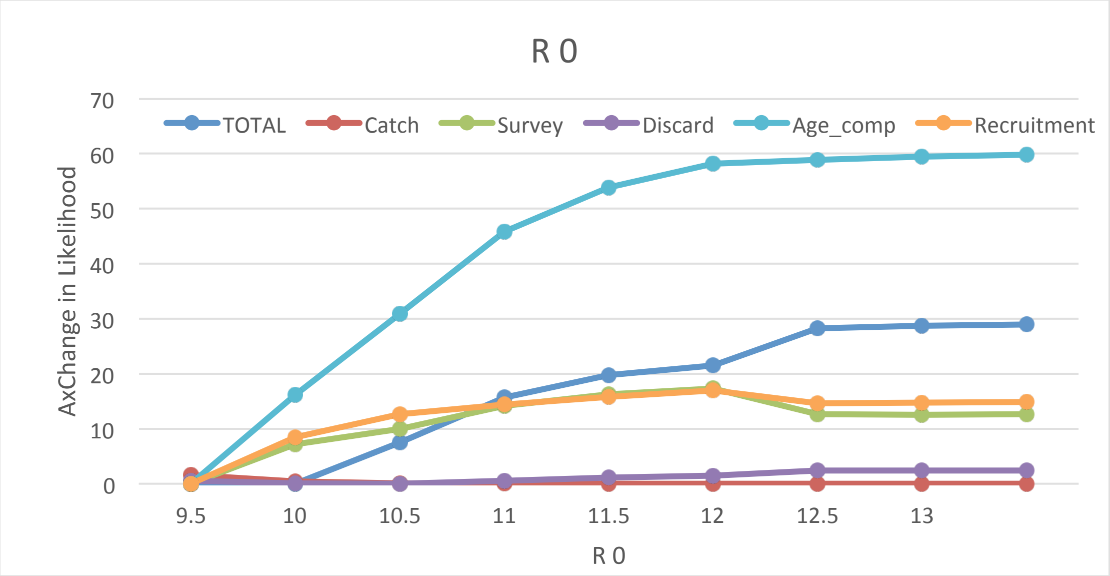


Figure 3.2.30 Likelihood profile on recruitment at an unexploited state, ln(R0). Model runs with values of R0 below 9.5 did not converge.

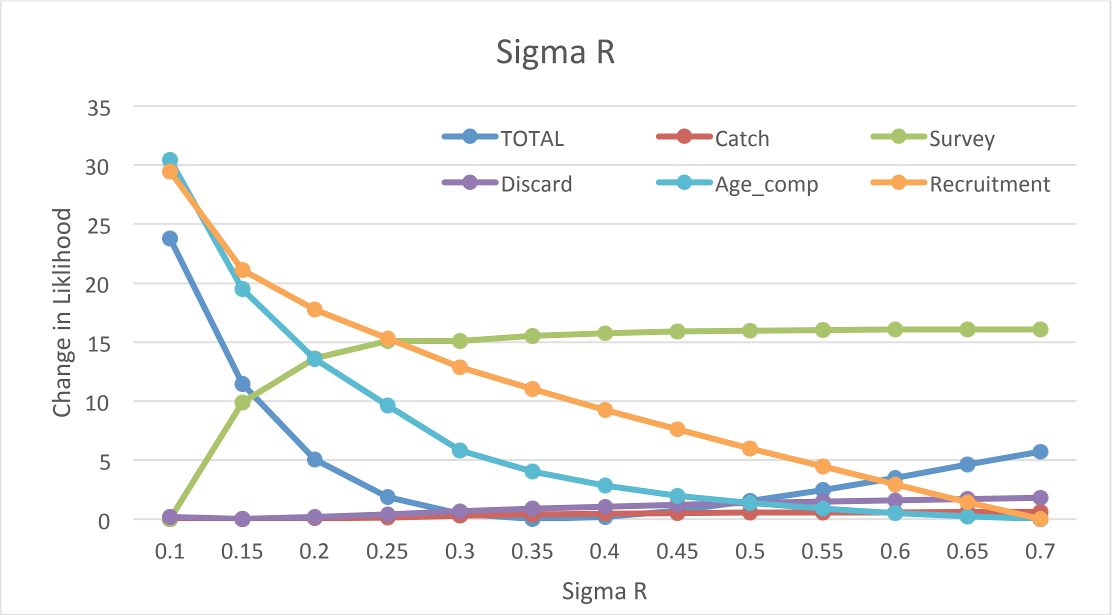


Figure 3.2.31 Likelihood profile on σ_R at intervals of 0.05

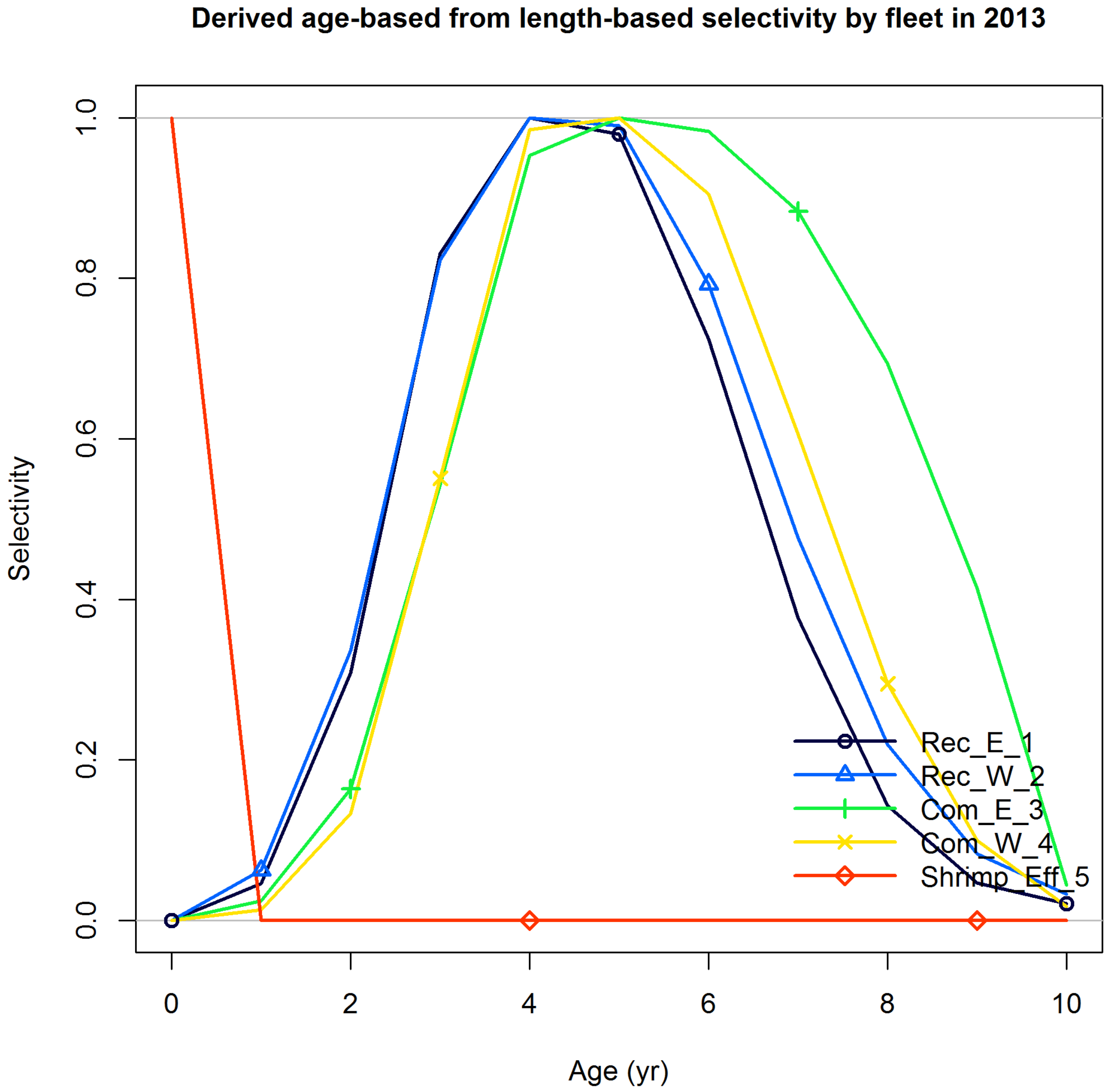


Figure 3.2.32 The estimated age-based selectivity patterns for the five fishing fleets.

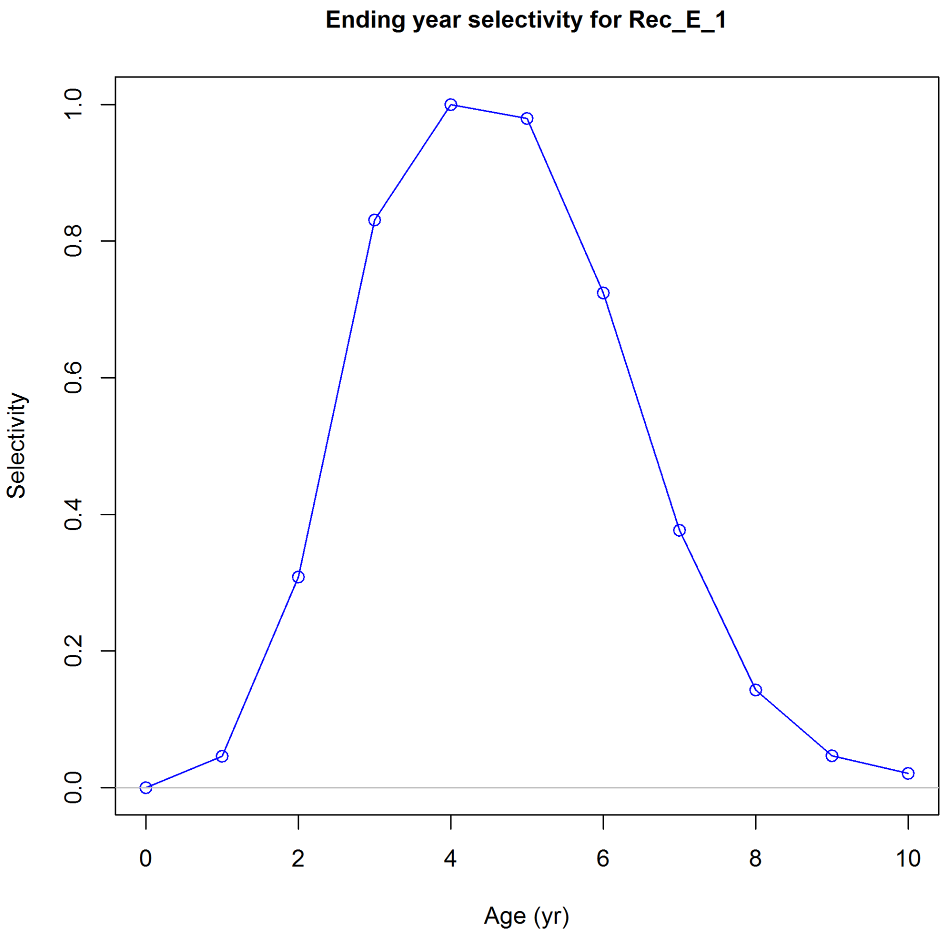


Figure 3.2.33 The estimated Recreational East (MRFSS) selectivity pattern using a double normal fit.

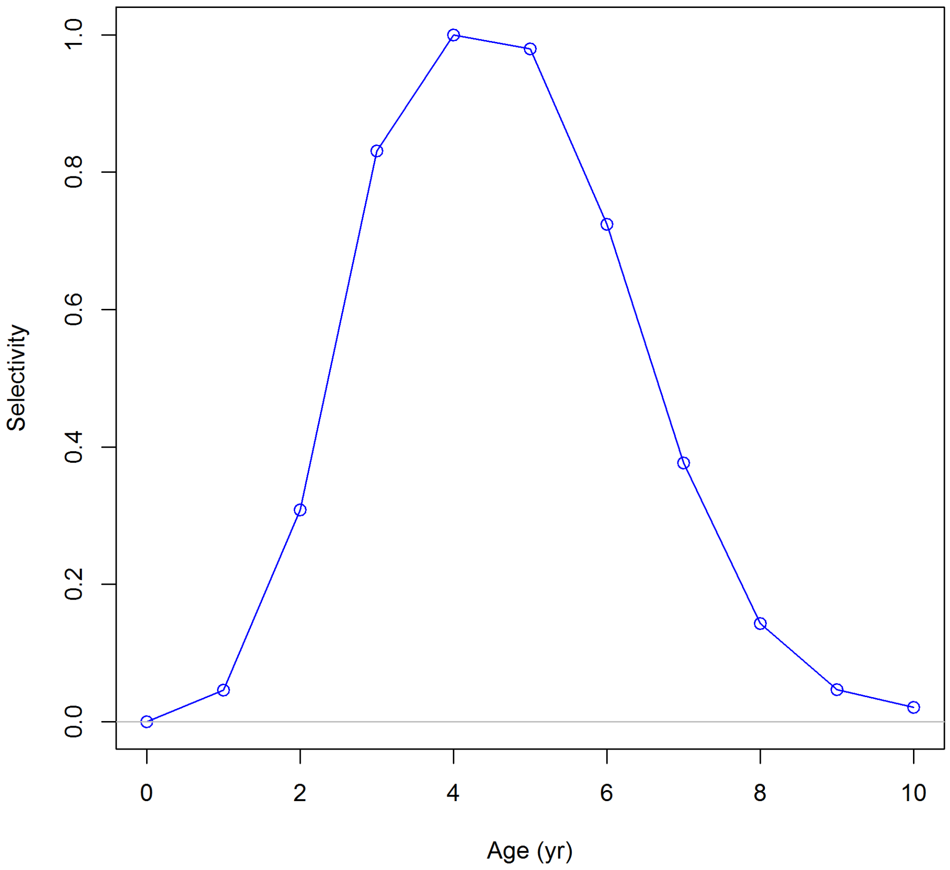


Figure 3.2.34 The fixed SRHS East selectivity pattern using a double normal fit. This survey was set to mirror the Recreational East Fleet selectivity pattern.

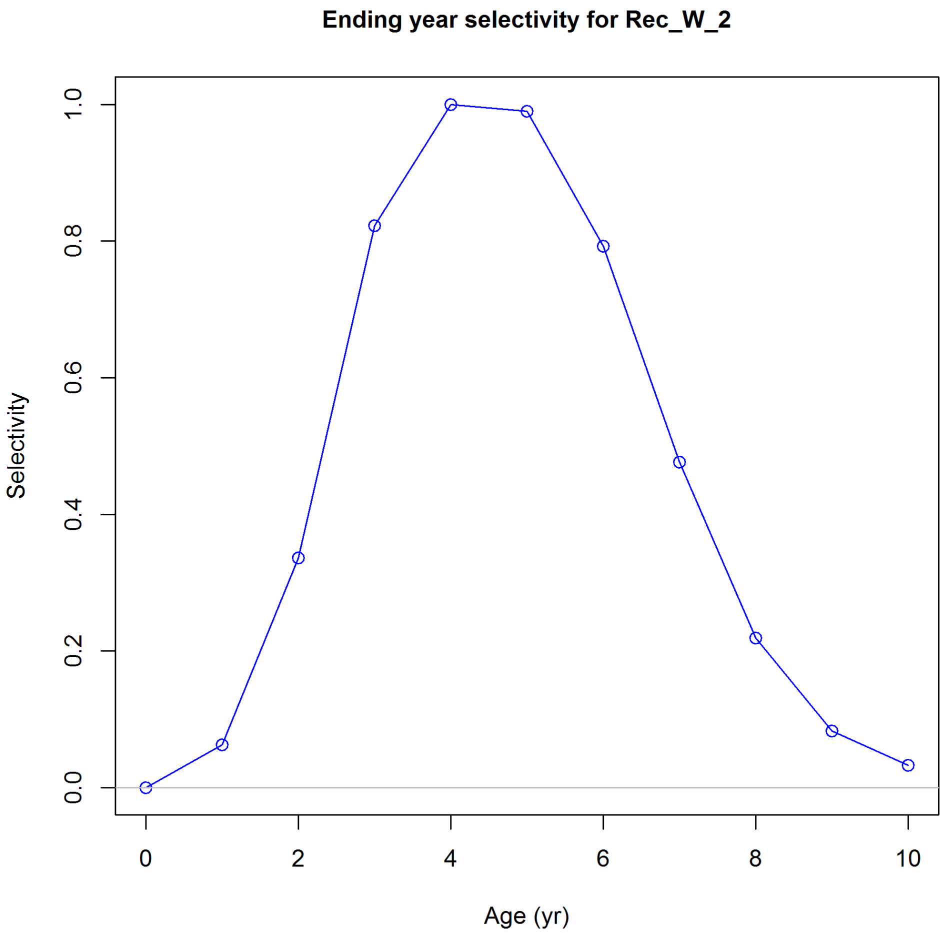


Figure 3.2.35 The estimated Recreational West SRHS (HB) Fleet selectivity pattern using a double normal fit.

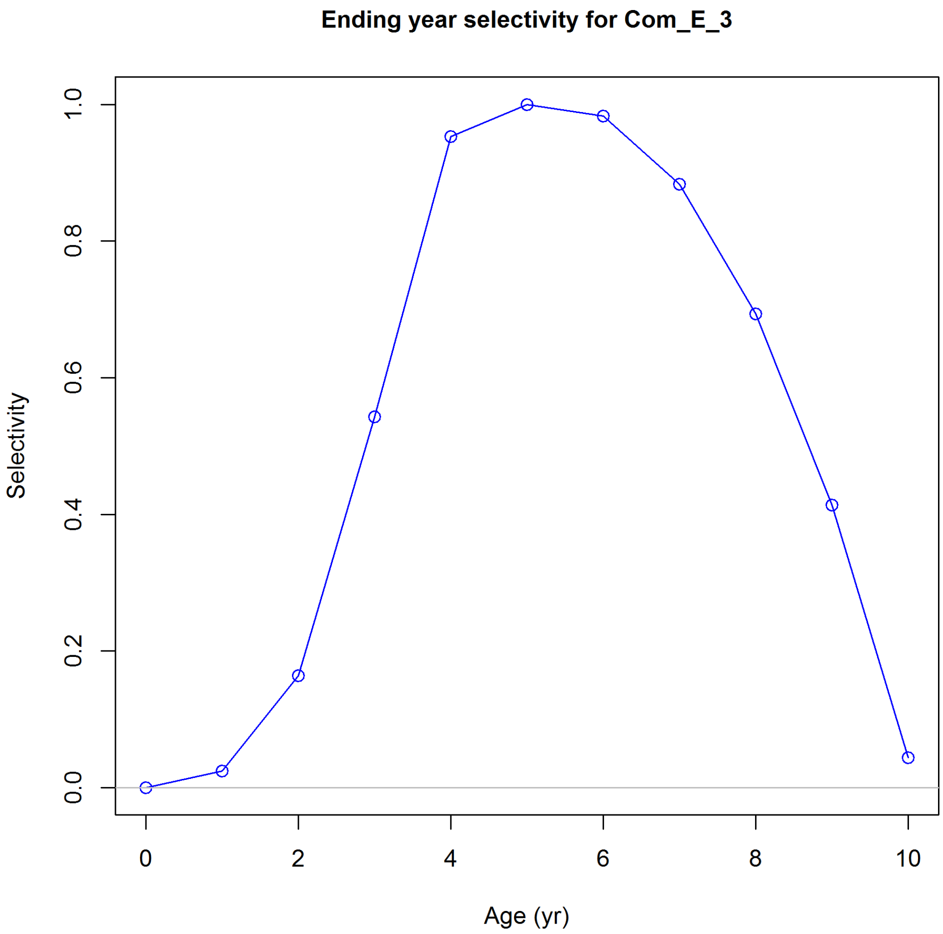


Figure 3.2.36 The estimated Commercial East Fleet selectivity pattern using a double normal fit.

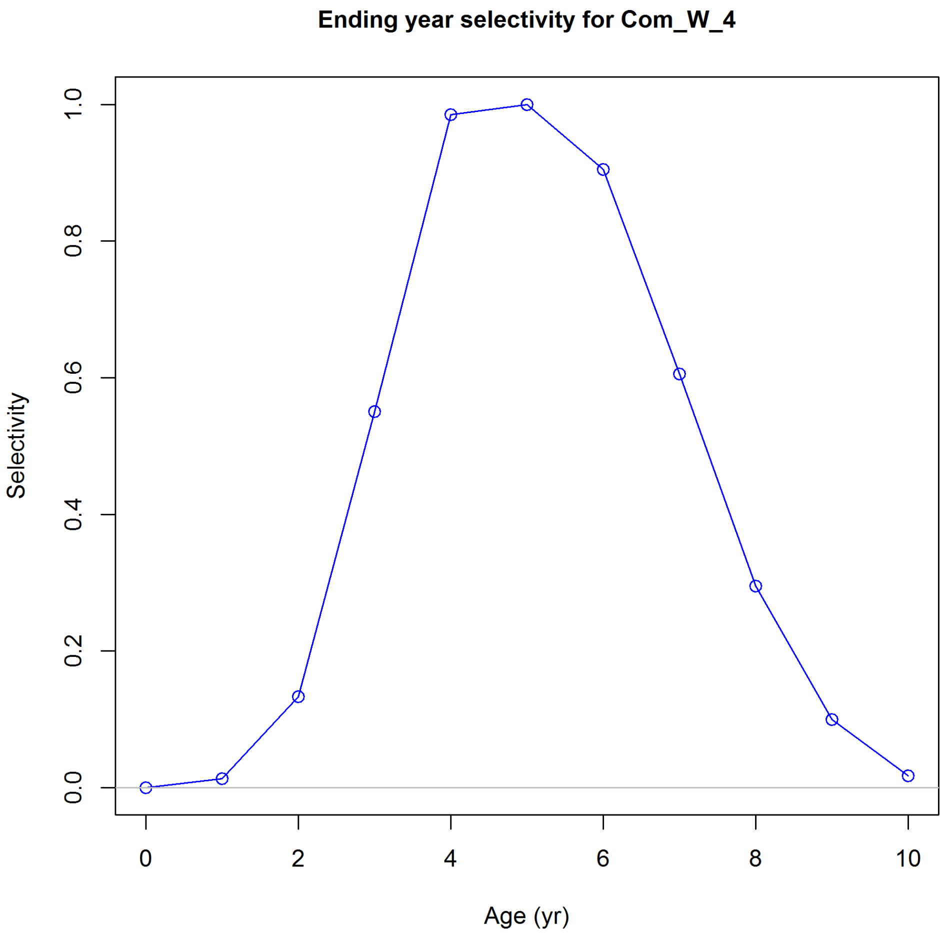


Figure 3.2.37 The estimated Commercial West Fleet selectivity pattern using a double normal fit.

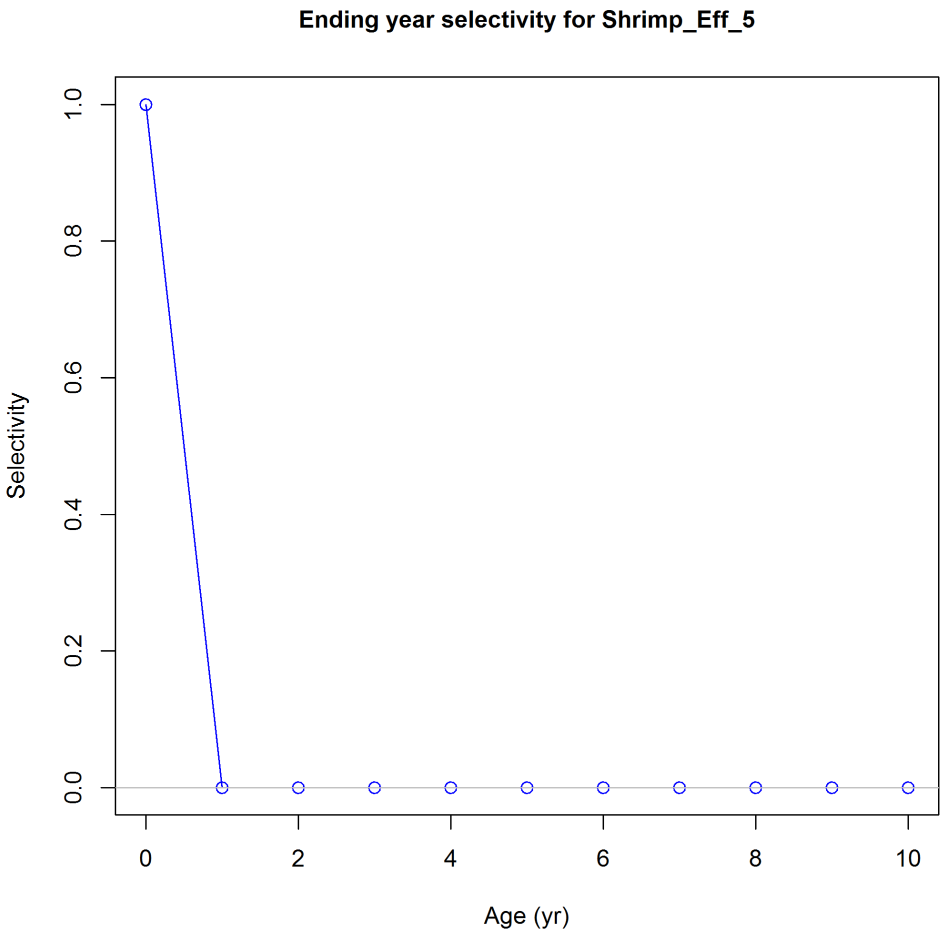


Figure 3.2.38 The fixed Shrimp Bycatch Fleet selectivity pattern.

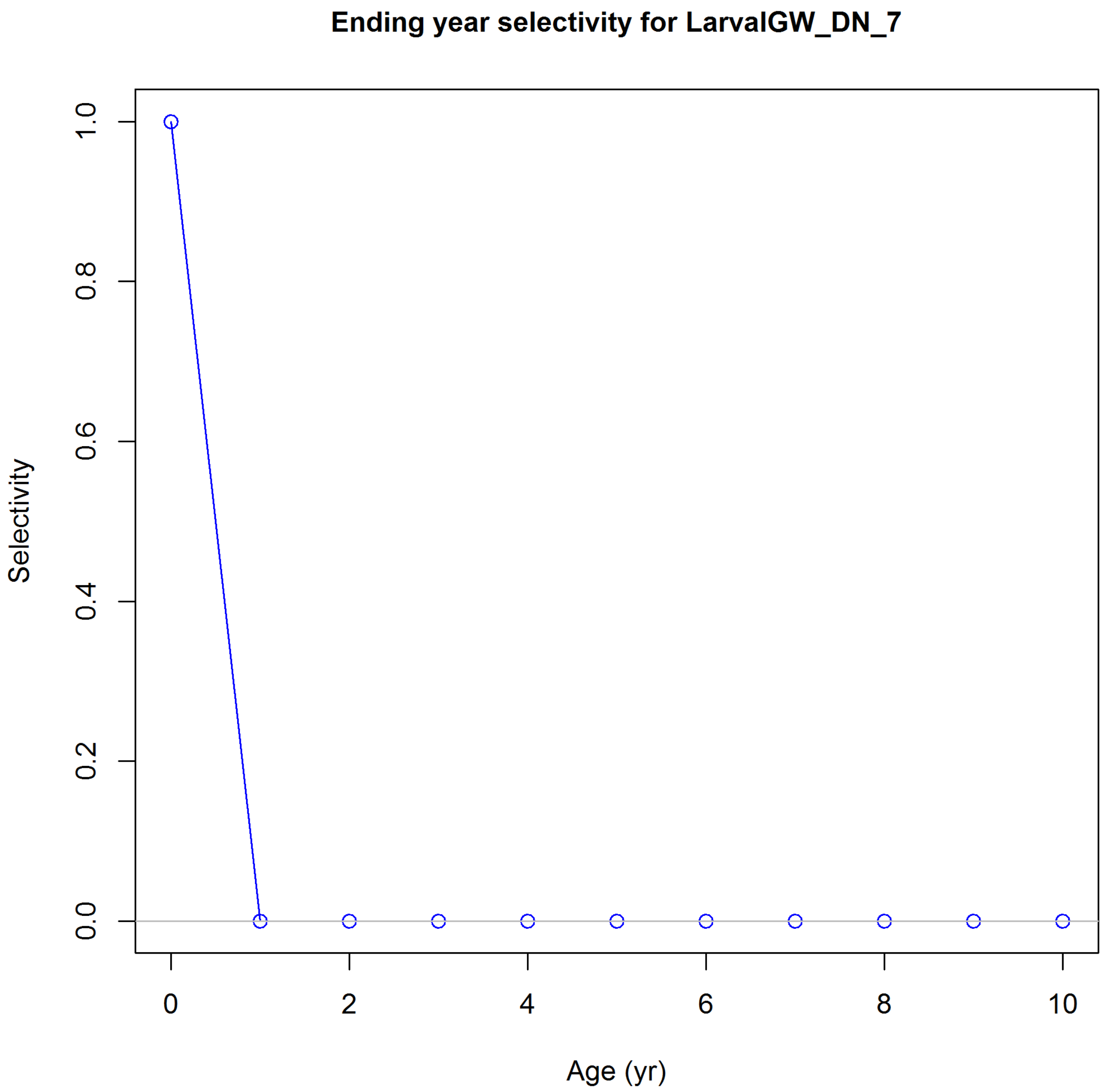


Figure 3.2.39 The fixed SEAMAP Larval Survey index selectivity pattern

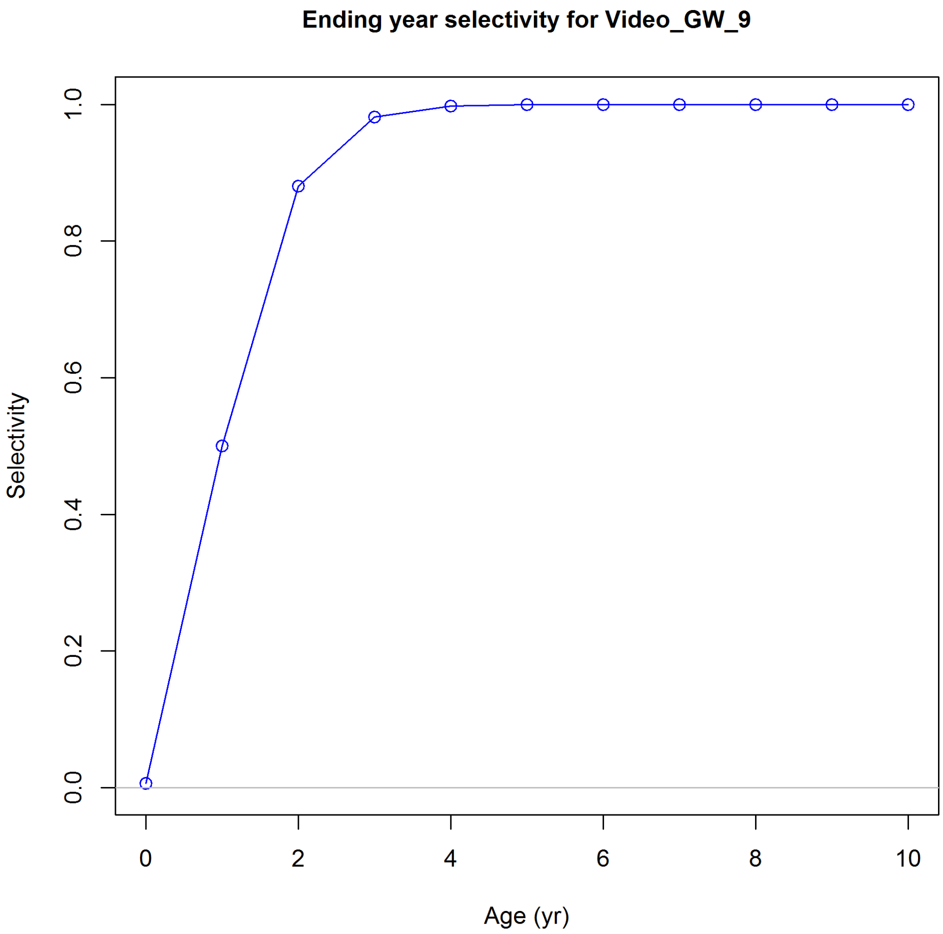


Figure 3.2.40 The estimated Combined Video Survey selectivity pattern using a logistic fit.

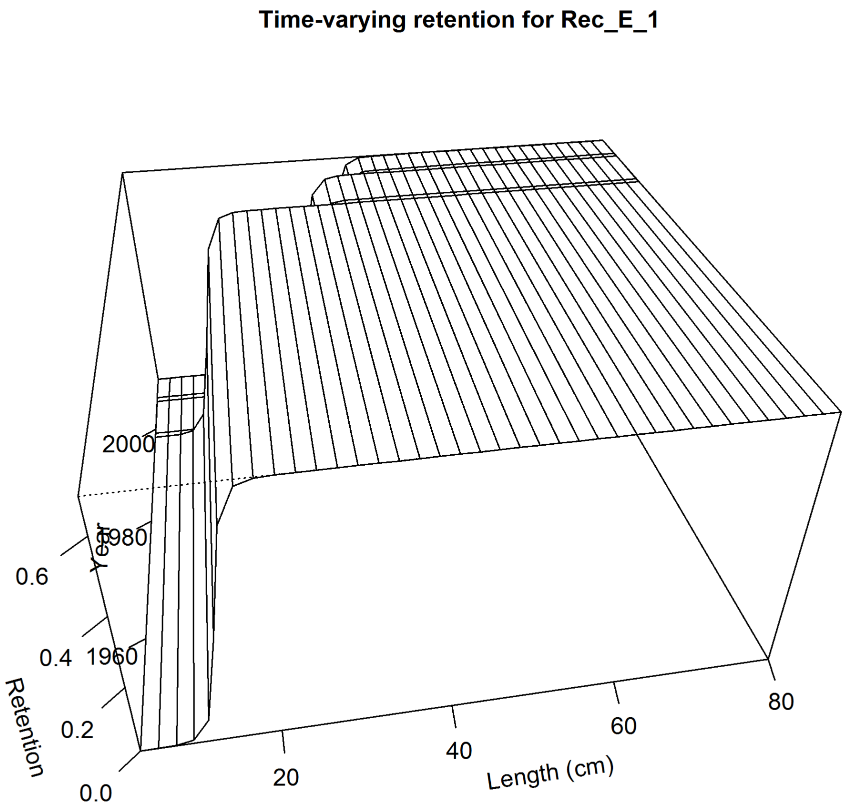


Figure 3.2.41. Time-varying retention for the Recreational East fleet. A near knife-edge retention function was modeled using a logistic fit. Initial minimum retained size was set at 6 inches, the minimum size observed in the landings. Minimum retained size was advanced to 12 inches and 14 inches corresponding to changes in regulations. Asymptotic retention was estimated by the model.

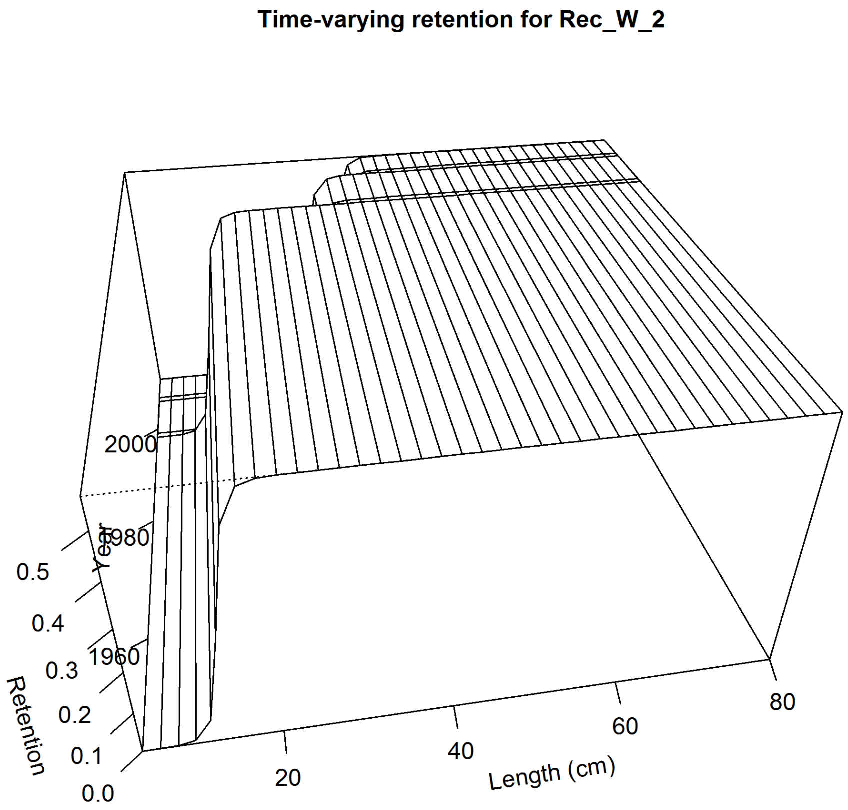


Figure 3.2.42. Time-varying retention for the Recreational West fleet. A near knife-edge retention function was modeled using a logistic fit. Initial minimum retained size was set at 6 inches, the minimum size observed in the landings. Minimum retained size was advanced to 12 inches and 14 inches corresponding to changes in regulations. Asymptotic retention was estimated by the model.

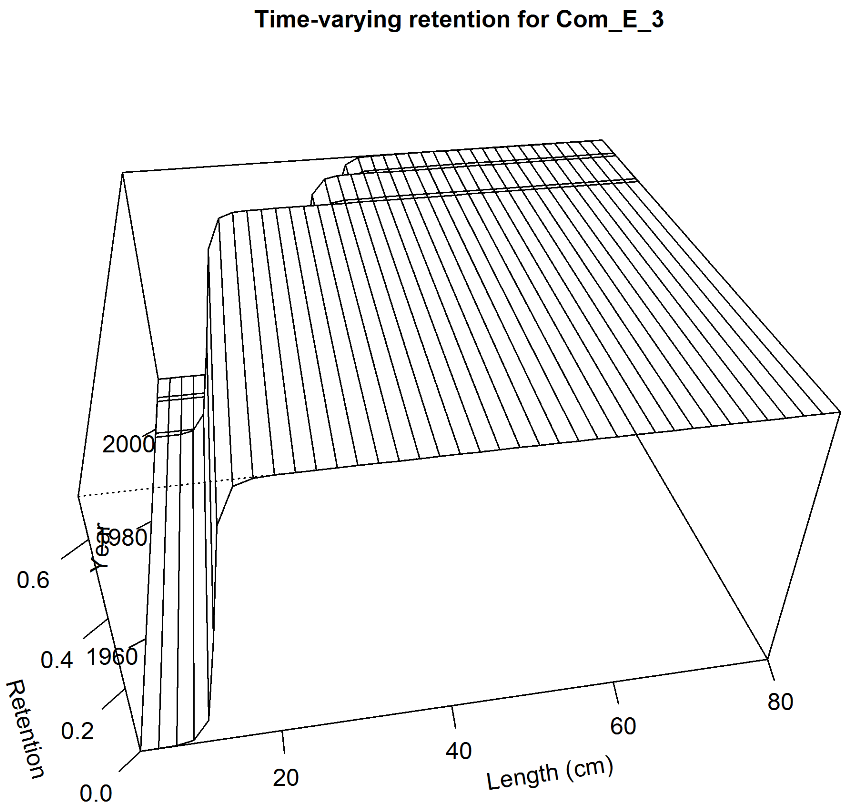


Figure 3.2.43. Time-varying retention for the Commercial East fleet. A near knife-edge retention function was modeled using a logistic fit. Initial minimum retained size was set at 6 inches, the minimum size observed in the landings. Minimum retained size was advanced to 12 inches and 14 inches corresponding to changes in regulations. Asymptotic retention was estimated by the model.

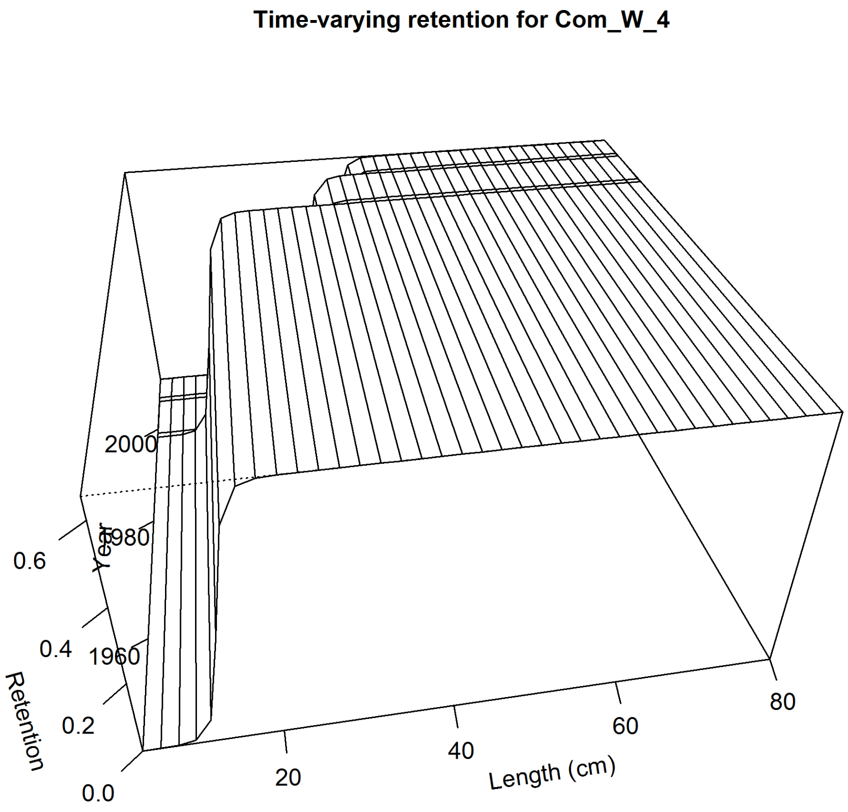


Figure 3.2.44. Time-varying retention for the Commercial West fleet. A near knife-edge retention function was modeled using a logistic fit. Initial minimum retained size was set at 6 inches, the minimum size observed in the landings. Minimum retained size was advanced to 12 inches and 14 inches corresponding to changes in regulations. Asymptotic retention was estimated by the model. Asymptotic retention was estimated by the model.

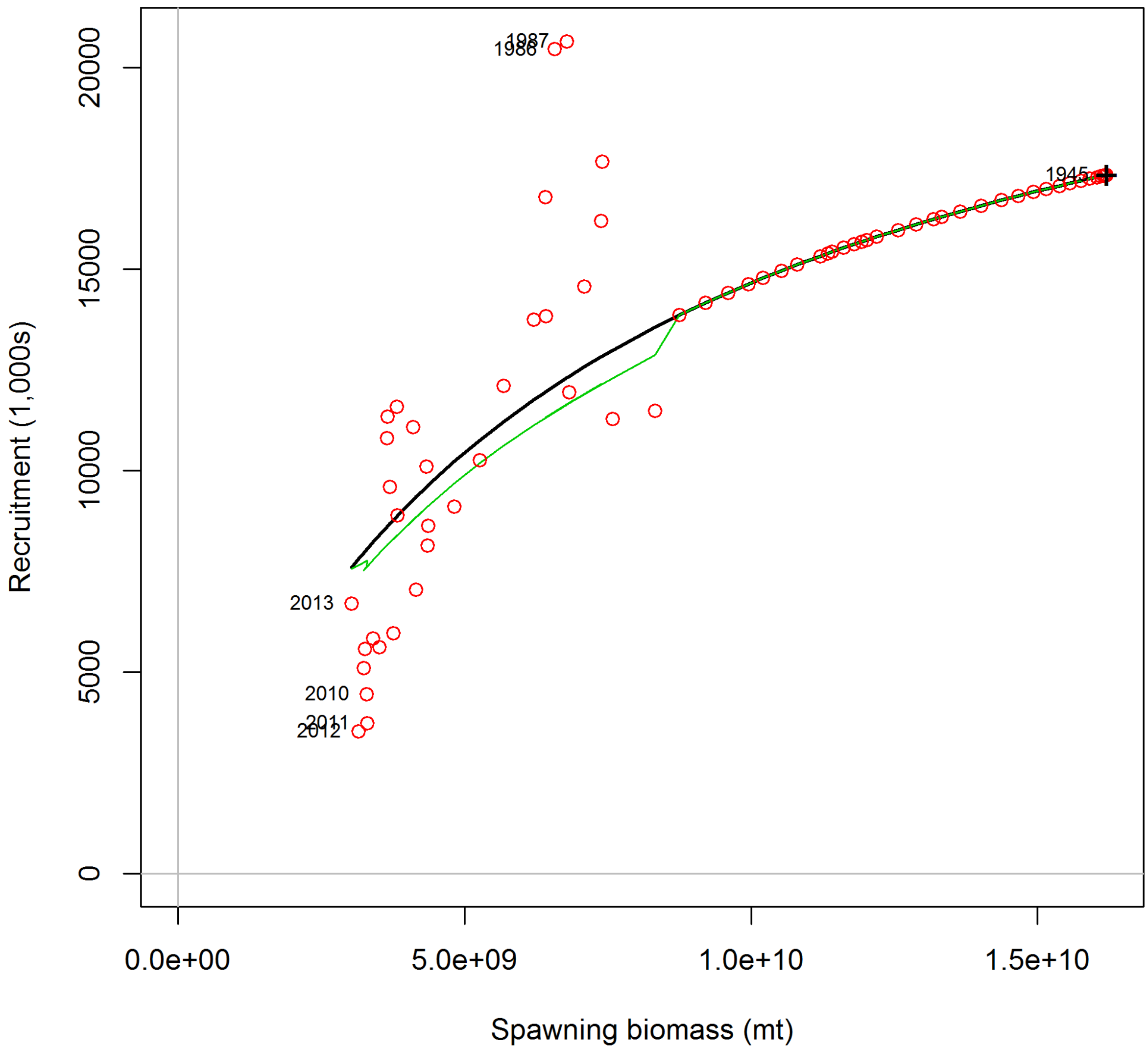


Figure 3.2.45. Predicted stock-recruitment relationship for Gulf of Mexico Gray Triggerfish. Plotted are predicted annual recruitments from SS (circles), expected recruitment from the stock-recruit relationship (black line), and bias adjusted recruitment from the stock-recruit relationship (green line).

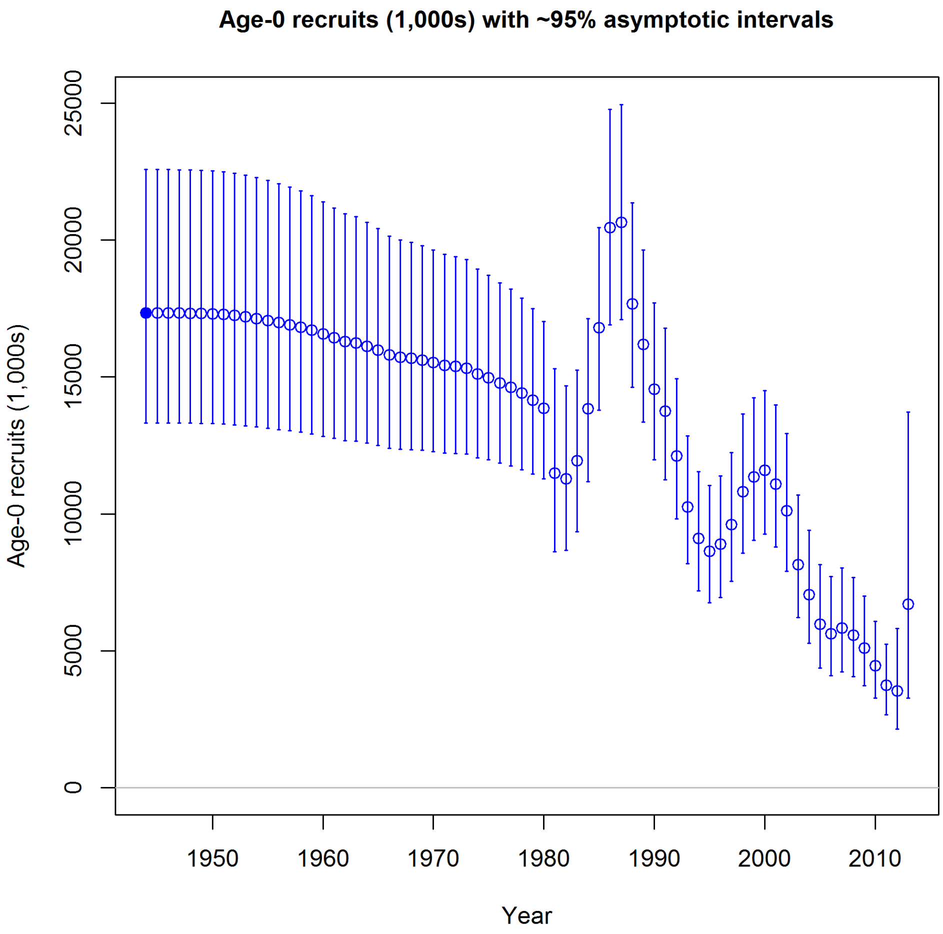


Figure 3.2.46. Predicted age-0 recruits with associated 95% asymptotic intervals.

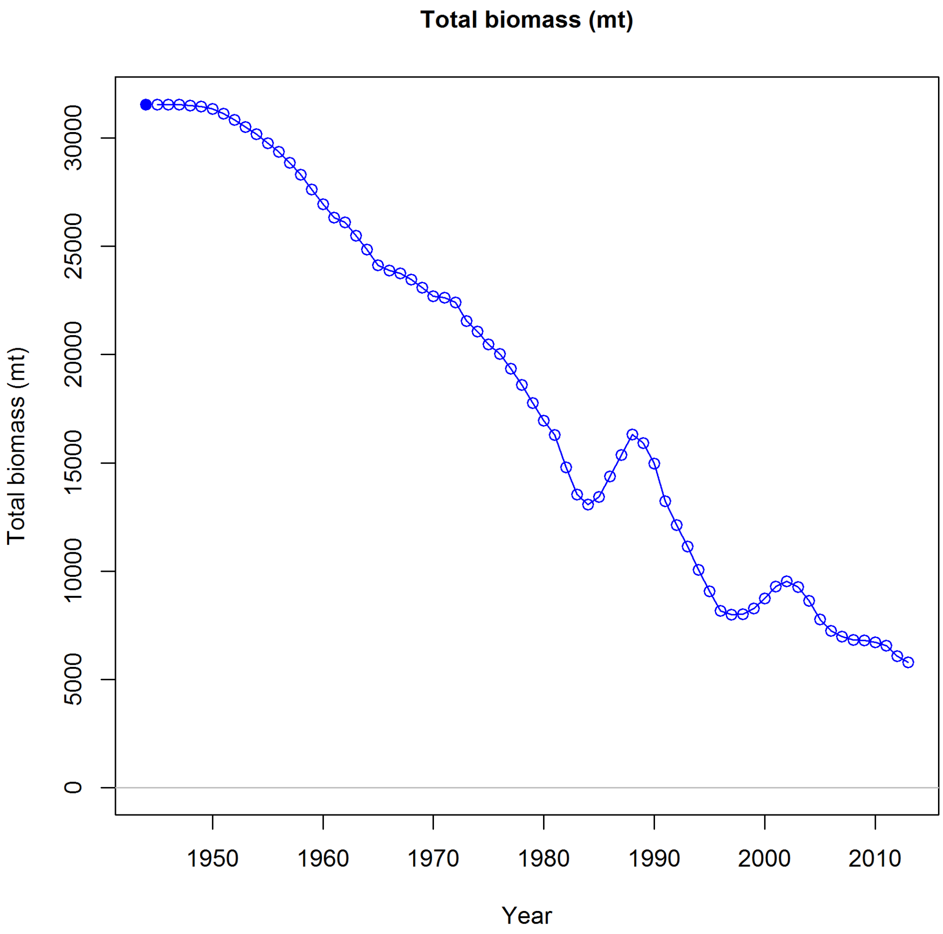


Figure 3.2.47. Predicted total biomass (mt) of Gulf of Mexico Gray Triggerfish from 1945-2013.

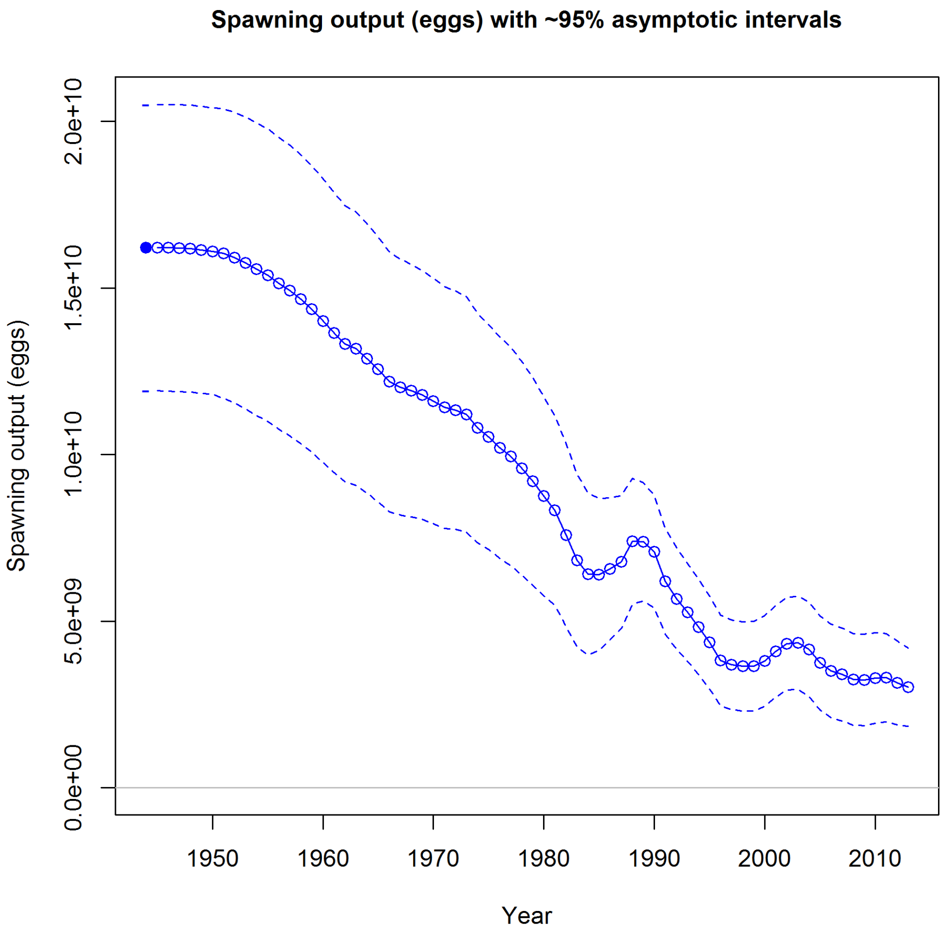


Figure 3.2.48. Predicted spawning output (eggs) with the associated 95% asymptotic intervals of Gulf of Mexico Gray Triggerfish from 1945-2013.

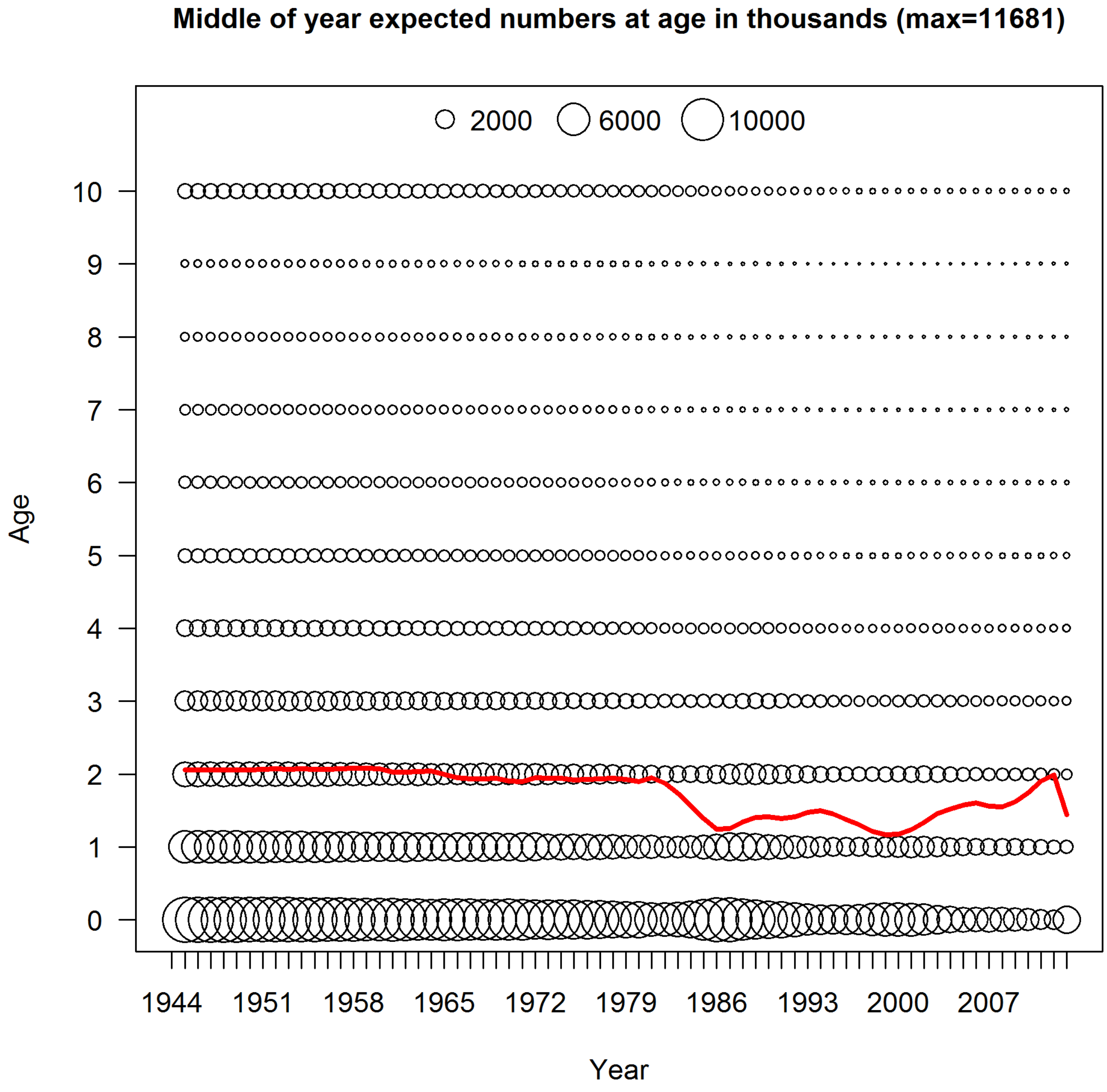


Figure 3.2.49 Predicted numbers-at-age (bubbles) and mean age (red line) of Gulf of Mexico Gray Triggerfish.

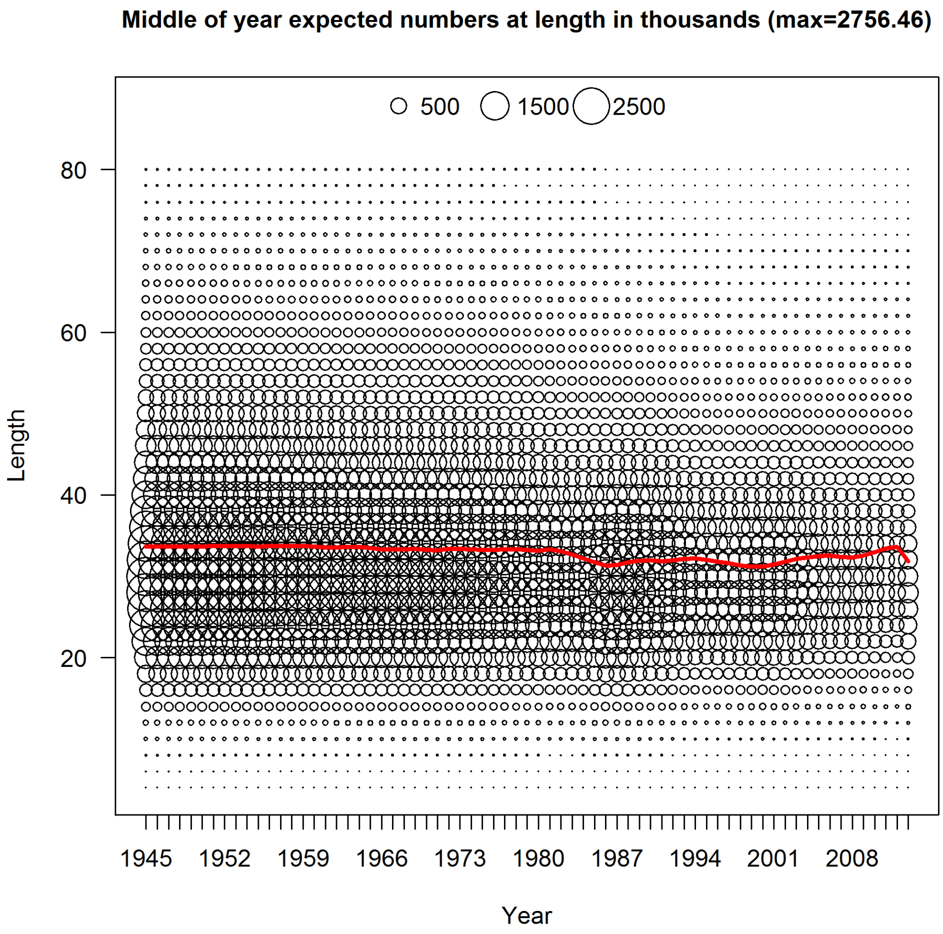


Figure 3.2.50 Predicted numbers-at-length (bubbles) and mean length (red line) of Gulf of Mexico Gray Triggerfish.

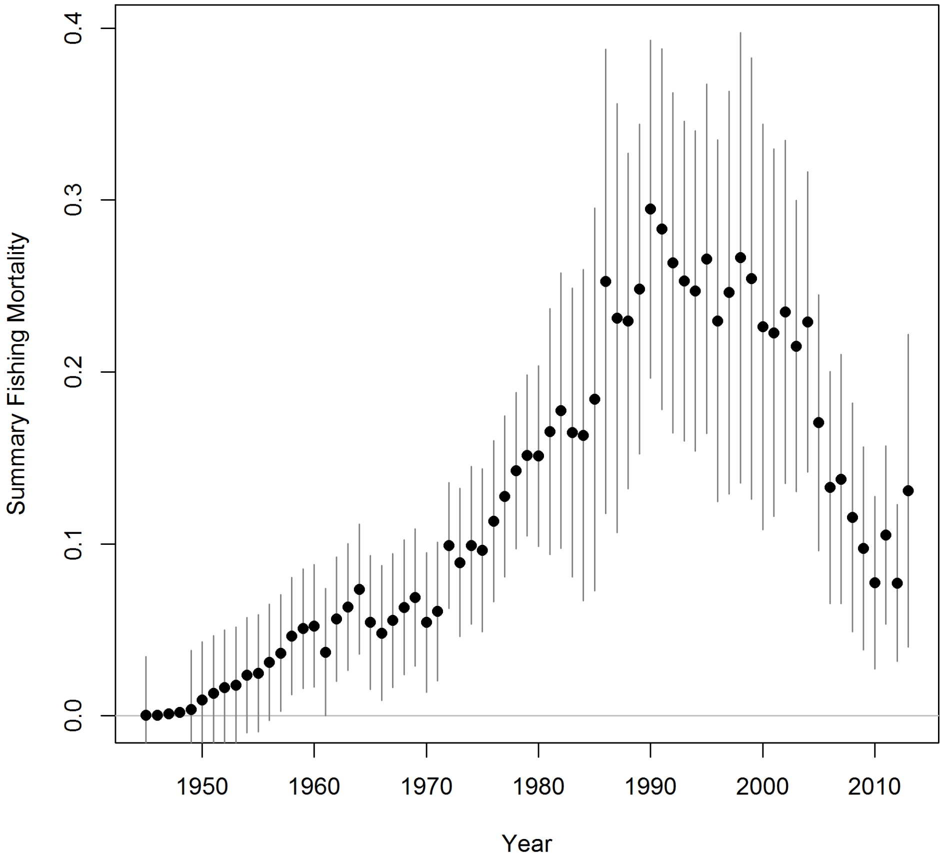


Figure 3.2.51 Predicted annual exploitation rate calculated as the ratio of total annual catch in weight to total biomass in weight.

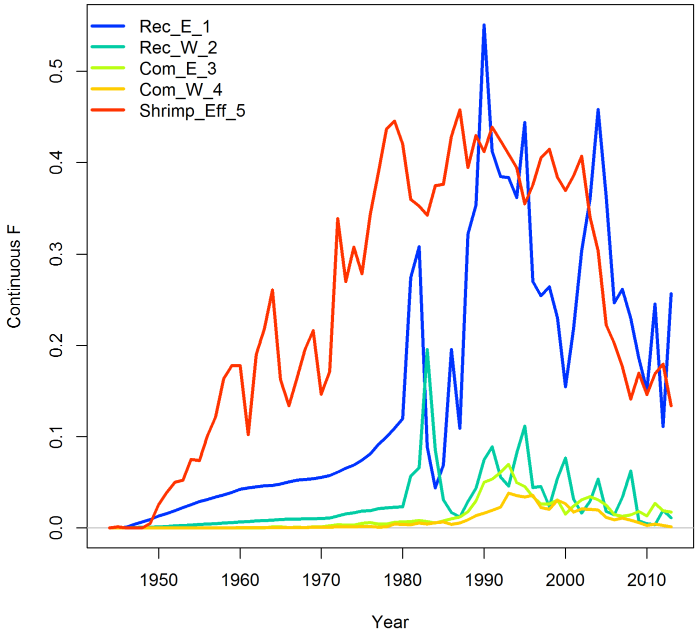


Figure 3.2.52 Predicted fleet specific fishing mortality.

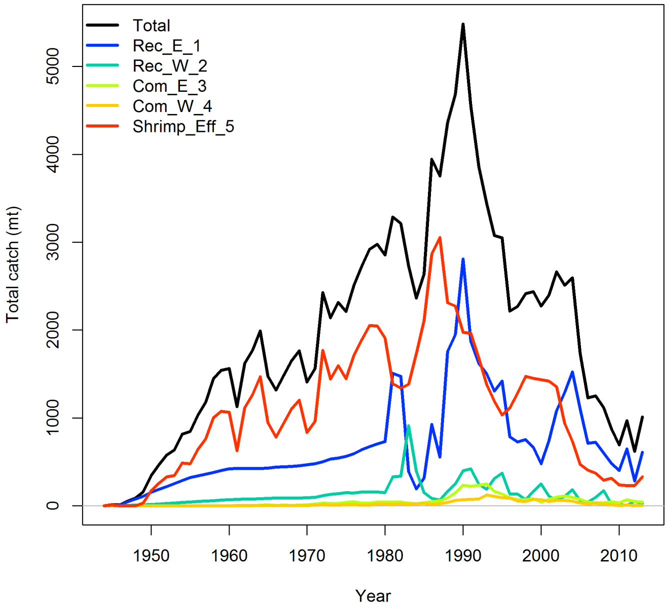


Figure 3.2.93 Fleet-specific total catch (landings + discards).

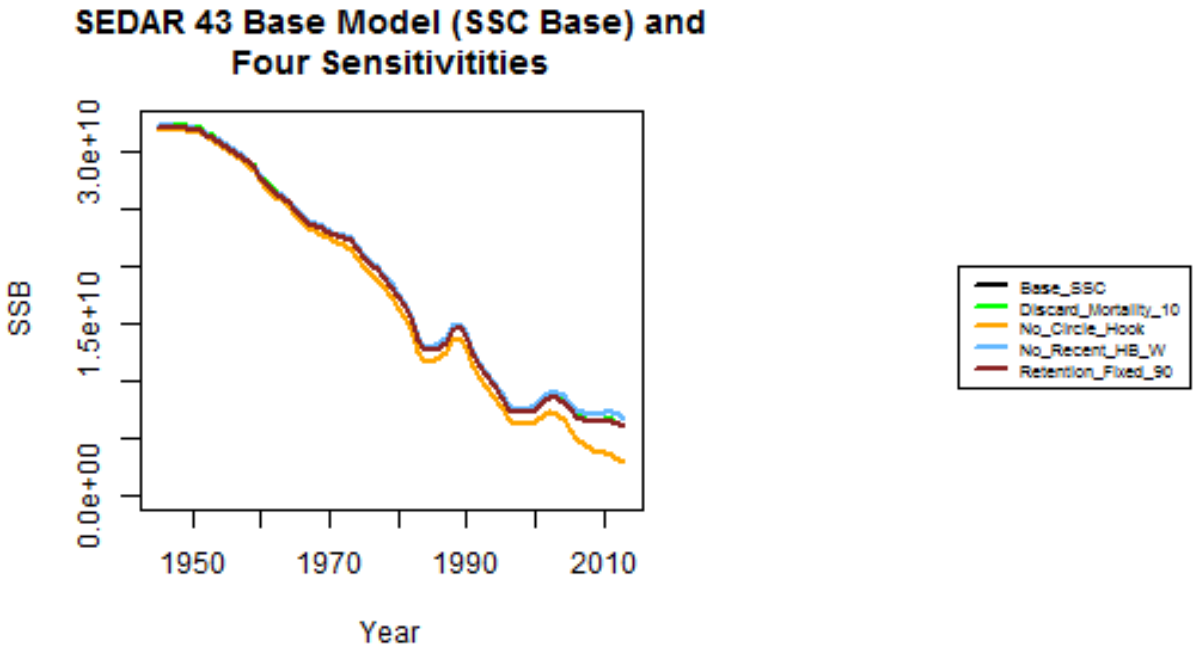


Figure 3.2.54 Estimates of spawning stock biomass (SSB) in eggs from all sensitivity runs.

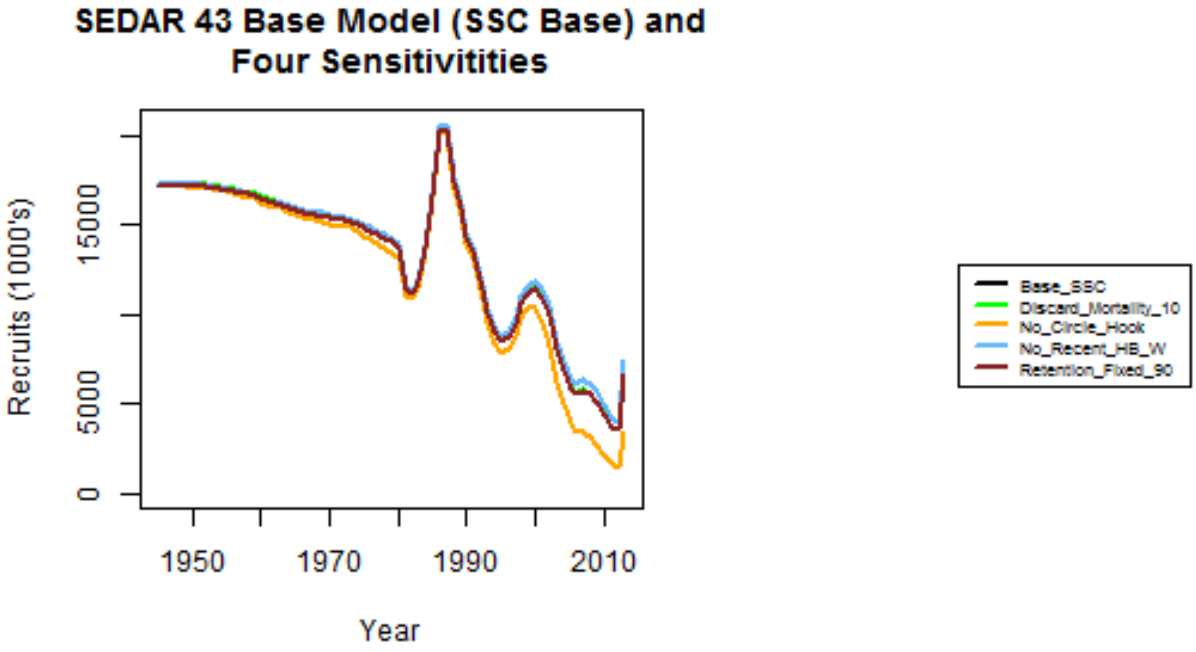


Figure 3.2.55 Estimates of age-0 recruits from all sensitivity runs.

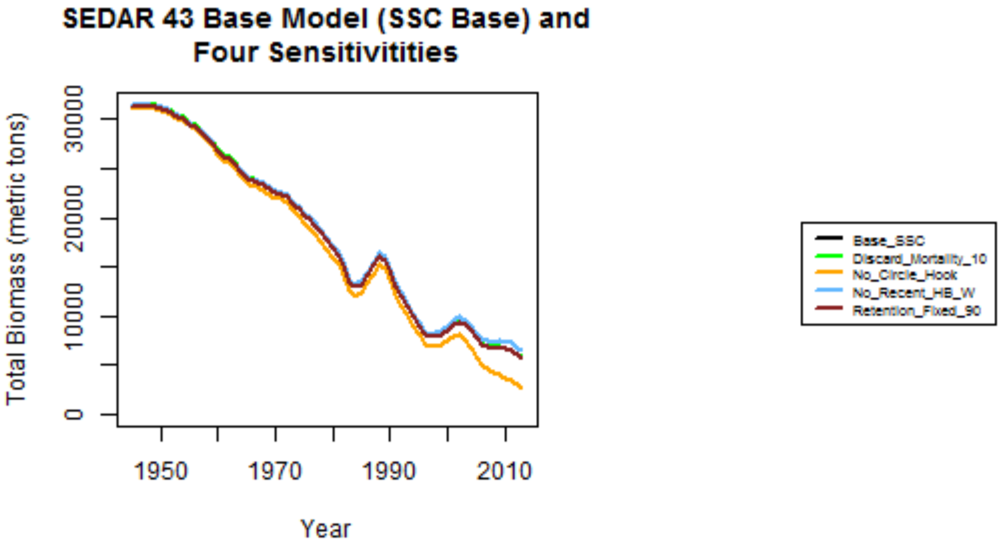


Figure 3.2.56 Estimates total biomass from sensitivity runs.

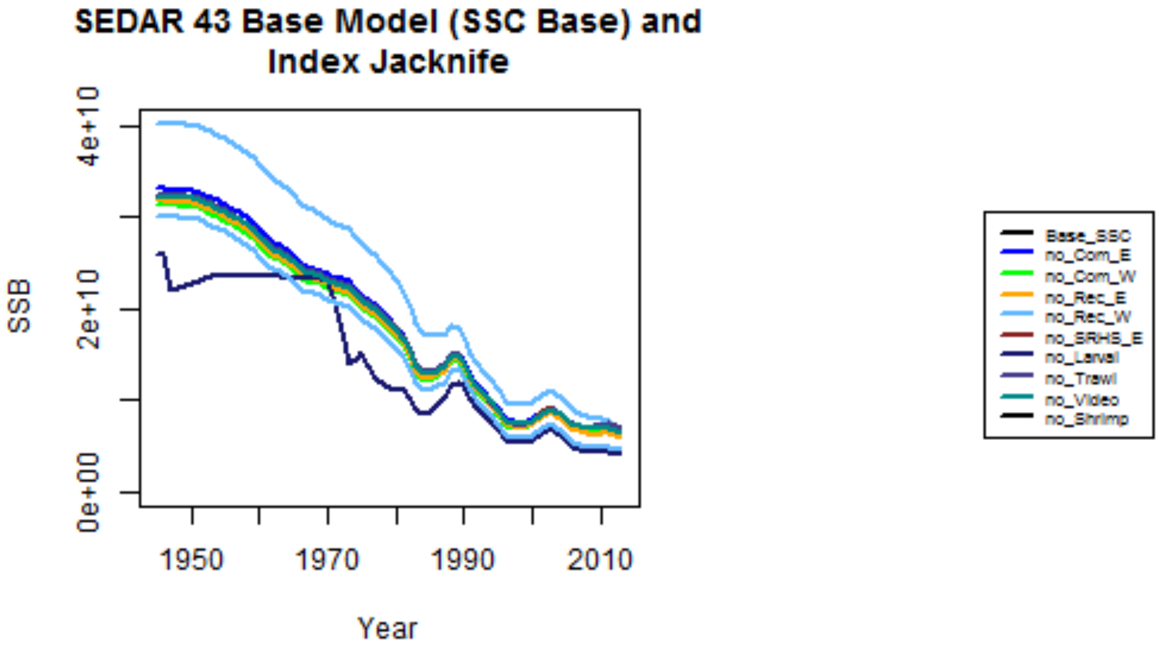


Figure 3.2.57 Estimates of spawning stock biomass (SSB, eggs) from the jack-knife analysis.

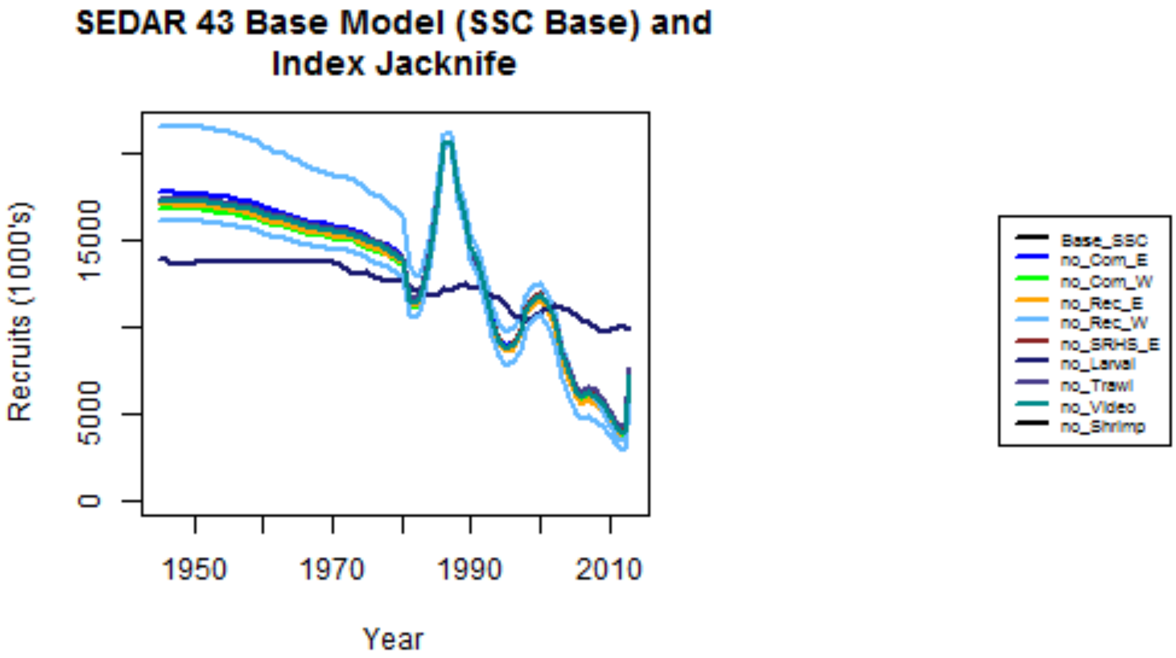


Figure 3.2.58 Estimates of age-0 recruits from the jack-knife analysis.

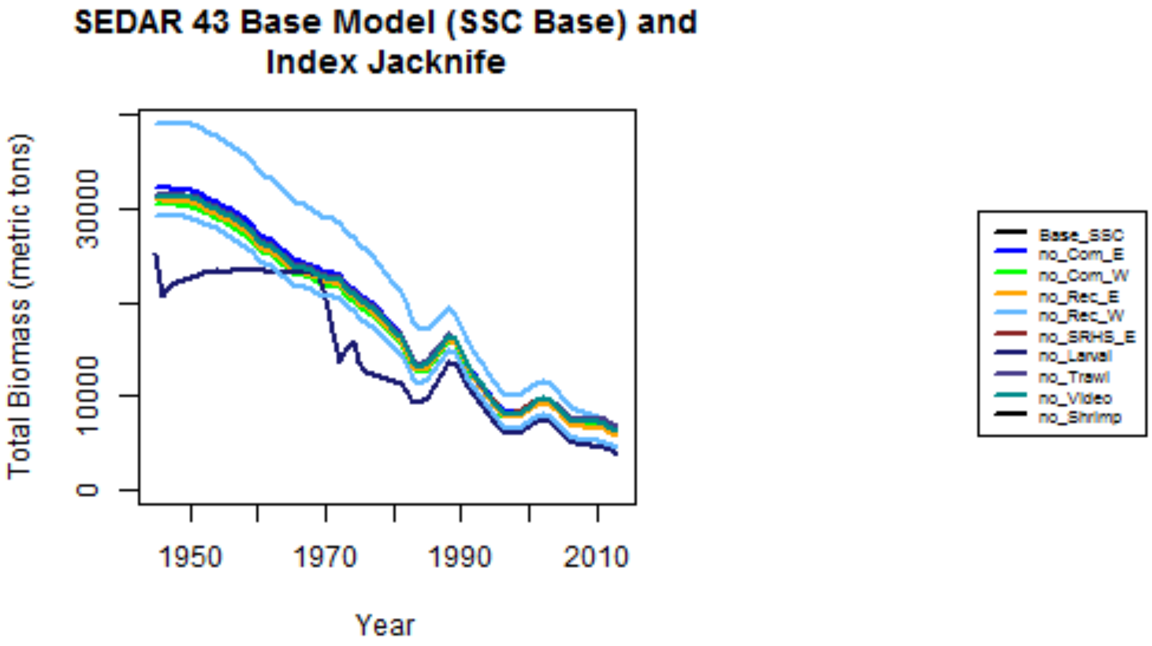


Figure 3.2.59 Estimates of total biomass from the jack-knife analysis.

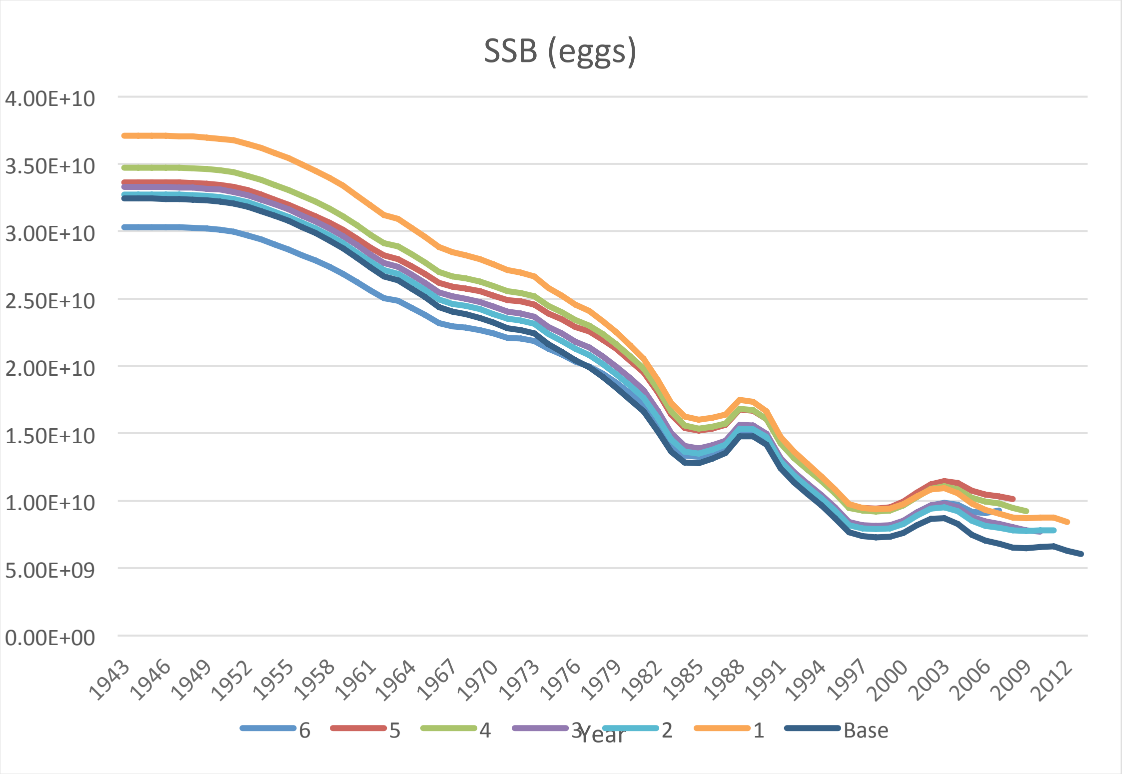


Figure 3.2.60 Estimates of spawning stock biomass (SSB, eggs) from the retrospective analysis.

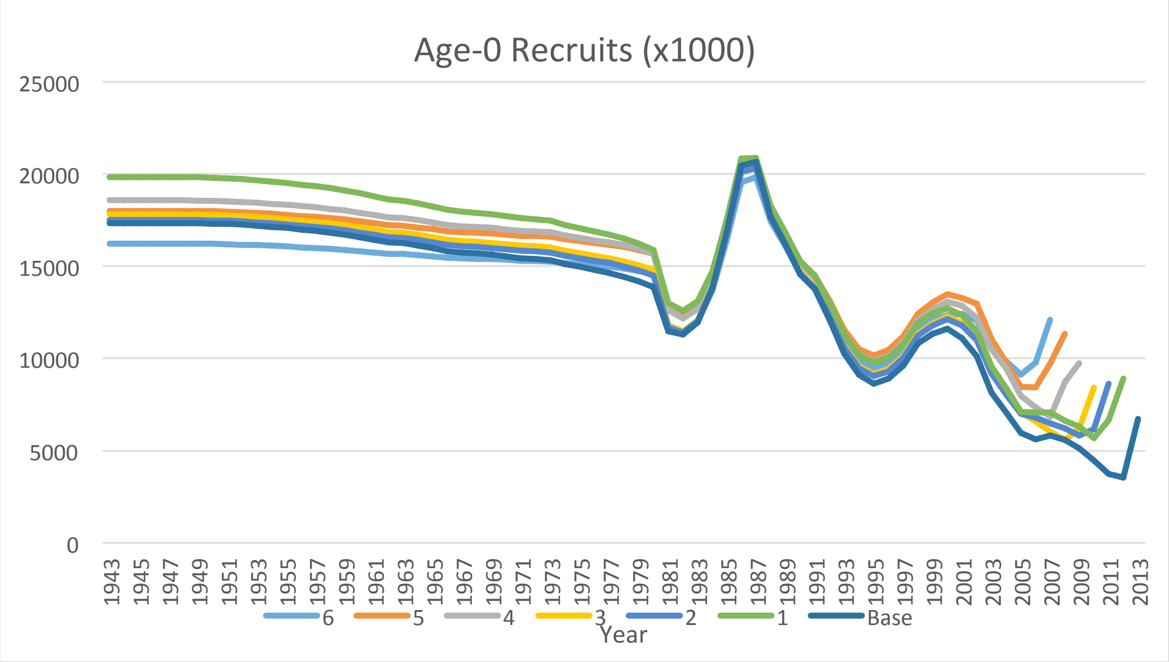


Figure 3.2.61 Estimates of age-0 recruits from the retrospective analysis.

3.6. Appendix A: Stock Synthesis Model for Gulf of Mexico Gray Triggerfish

3.6.1. Starter File:

```
#
# Stock Synthesis Version 3.24p
#
Trigger_dat.SS
Trigger_ctl.SS
0 # 0=use init values in control file; 1=use ss3.par
1 # run display detail (0,1,2)
1 # detailed age-structured reports in REPORT.SSO (0,1)
0 # write detailed checkup.sso file (0,1)
0 # write parm values to ParmTrace.sso (0=no,1=good,active; 2=good,all; 3=every_iter,all_parms; 4=every,active)
1 # write to cumreport.sso (0=no,1=like&timeseries; 2=add survey fits)
1 # Include prior_like for non-estimated parameters (0,1)
1 # Use Soft Boundaries to aid convergence (0,1) (recommended)
1 # Number of datafiles to produce: 1st is input, 2nd is estimates, 3rd and higher are bootstrap
10 # Turn off estimation for parameters entering after this phase
10 # MCeval burn interval
2 # MCeval thin interval
0 # jitter initial parm value by this fraction
-1 # min yr for sdreport outputs (-1 for styr)
-1 # max yr for sdreport outputs (-1 for endyr; -2 for endyr+Nforecastyrs
0 # N individual STD years
0.0001 # final convergence criteria
0 # retrospective year relative to end year
1 # min age for calc of summary biomass
1 # Depletion basis:  denom is: 0=skip; 1=rel X*B0; 2=rel X*Bmsy; 3=rel X*B_styr
1.00 # Fraction (X) for Depletion denominator
4 # (1-SPR)_reporting:  0=skip; 1=rel(1-SPR); 2=rel(1-SPR_MSY); 3=rel(1-SPR_Btarget); 4=notrel
1 # F_std reporting: 0=skip; 1=exploit(Bio); 2=exploit(Num); 3=sum(frates)
0 # F_report_basis: 0=raw; 1=rel Fspr; 2=rel Fmsy ; 3=rel Fbtgt
999
```

3.6.2. Control File:

```
#
#           Base Model:  Retention estimated
#           Isely
#           7/26/2015
#
#C estimate either M or h
#_data_and_control_files: sra.dat // sra.ctl
#_SS-V3.1-test_biasadj;_12/07/09;_Stock_Synthesis_by_Richard_Methot_(NOAA)
1  #_N_Growth_Patterns
1  #_N_Morphs_Within_GrowthPattern
#_Cond  1 #_Morph_between/within_stdev_ratio (no read if N_morphs=1)
#_Cond  1 #vector_Morphdist_(-1_in_first_val_gives_normal_approx)
#
#_Cond 0  #  N recruitment designs goes here if N_GP*nseas*area>1
#_Cond 0  #  placeholder for recruitment interaction request
#_Cond 1 1 1  # example recruitment design element for GP=1, seas=1, area=1
#
#_Cond 0  # N_movement_definitions goes here if N_areas > 1
#_Cond 1.0 # first age that moves (real age at begin of season, not integer) also cond on do_migration>0
#_Cond 1 1 1 2 4 10 # example move definition for seas=1, morph=1, source=1 dest=2, age1=4, age2=10
#
1           #_Nblock_Patterns__Block_pattern_was_the_same_for_recretional_and_commercial
3           #_blocks_per_pattern__Blocks_correspond_to_no_length_limit,_12_inch_length_limit_and_14_inch_length_limit.
#Begin and End Years of Blocks
1945 1998           1999 2007           2008 2013           #recreational and commercial size limit @12;  @ 14 and Circle hooks
#
0.5 #_fracfemale
3   #_natM_type:_0=1Parm; 1=N_breakpoints;_2=Lorenzen;_3=agespecific;_4=agespec_withseasinterpolate
   #_no additional input for selected M option; read 1P per morph
0.790     0.571     0.461     0.395     0.351     0.321     0.298     0.281     0.267     0.257     0.248
1   # GrowthModel: 1=vonBert with L1&L2; 2=Richards with L1&L2; 3=not implemented; 4=not implemented
0.5   #_Growth_Age_for_L1
999 #_Growth_Age_for_L2 (999 to use as Linf)
0   #_SD_add_to_LAA (set to 0.1 for SS2 V1.x compatibility)
0   #_CV_Growth_Pattern:  0 CV=f(LAA); 1 CV=F(A); 2 SD=F(LAA); 3 SD=F(A)
3 #4   #_maturity_option:  1=length logistic; 2=age logistic; 3=read age-maturity matrix by growth_pattern; 4=read age-
fecundity; 5=read fec and wt from wtatage.ss
#  0    1      2       3       4      5      6       7       8       9      10
#   0  0.2335502 0.320312 0.439306 0.602506 0.826332 1.133309 1.5543255 2.131747 2.923676 4.009801
0          0          0.79       0.91       0.98       0.99       1          1          1          1          1
2   #_First_Mature_Age
2   #_fecundity option:(1)eggs=Wt*(a+b*Wt);(2)eggs=a*L^b;(3)eggs=a*Wt^b
0   #_hermaphroditism option:  0=none; 1=age-specific fxn
1  #2   #_parameter_offset_approach (1=none, 2= M, G, CV_G as offset from female-GP1, 3=like SS2 V1.x)
2   #_env/block/dev_adjust_method (1=standard; 2=logistic transform keeps in base parm bounds; 3=standard w/ no bound
check)
#
#_growth_parms
```

```
#_LO#       HI     INIT      PRIOR   PR_type   SD      PHASE  env-var use_dev dev_minyr dev_maxyr dev_stddev  Block Block_Fxn
#0.01       0.6      0.27       0.15     -1    1.0      -3      0      0      0       0       0        0      0 # NatM_p_1_Fem_GP_1
10          40      28.3       30.39     -1    1.0      -3      0      0      0       0       0        0      0 # L at A min
20          70      58.97       58.97    -1    8.5992   -3      0      0      0       0       0.5      0      0 # L infinity
0.01        0.5     0.14        0.14     -1    0.18771  -3      0      0      0       0       0.5      0      0 # k
0.10        0.5     0.2039      0.252    -1    0.003    -3      0      0      0       0       0.5      0      0 # CV L at A min
0.001       0.5     0.2039      0.252    -1    0.2      -6      0      0      0       0       0.5      0      0 # CV L infinity
#===================================================================================================
========================
0          1       0.00002162  0.00002162 -1    0.8      -2      0      0      0       0       0.5      0      0 # FL to WWt Constant
0          4       3.007       3.007    -1    0.8      -2      0      0      0       0       0.5      0      0 # FL to WWt exponent
25         100       31          31    -1    0.8      -3      0      0      0       0       0        0      0 # Mat50%_Fem
-1         0       -0.065      -0.065   -1    0.8      -3      0      0      0       0       0        0      0 # Mat_slope_Fem
40         60       51.357      51.357   -1    0        -3      0      0      0       0       0        0      0 # Eggs_scalar_Fem
1          4        2.8538     2.8538   -1    0        -3      0      0      0       0       0        0      0 # Eggs_exp_len_Fem
0          0         0           0          -1          0          -4          0          0          0          0          0          0
           0         #           RecrDist_GP_1
-4         4         0           0          -1          0          -4          0          0          0          0          0          0
           0         #           RecrDist_Area_1
0          0         0           0          -1          0          -4          0          0          0          0          0          0
           0         #           RecrDist_Seas_1
0          0         1           1          -1          0          -4          0          0          0          0          0          0
           0         #           CohortGrowDev
#_Cond 0  #custom_MG-env_setup (0/1)
#_Cond -2 2 0 0 -1 99 -2 #_placeholder when no MG-environ parameters
#_Cond 0  #custom_MG-block_setup (0/1)
#_Cond -2 2 0 0 -1 99 -2 #_placeholder when no MG-block parameters
#_Cond No MG parm trends
#_seasonal_effects_on_biology_parms
 0 0 0 0 0 0 0 0 0 0 #_femwtlen1,femwtlen2,mat1,mat2,fec1,fec2,Malewtlen1,malewtlen2,L1,K
#_Cond -2 2 0 0 -1 99 -2 #_placeholder when no seasonal MG parameters
#
#_Cond -4 #_MGparm_Dev_Phase
#_Spawner-Recruitment
3 #_SR_function
#_LO    HI     INIT    PRIOR   PR_type SD     PHASE
3      20    9.4466   9.80476      -1      99      1      # SR_R0
0.2    1     0.394293   0.45679           -1      99      2      # SR_steep
0.2    2     0.288092   0.279282          -1      99      4      # SR_sigmaR
-5     5      0     0      -1     1      -3     # SR_envlink
-5     5      0     0      -1     1      -4     # SR_R1_offset
0      0      0     0      -1     0      -99    # SR_autocorr
0   #_SR_env_link
0   #_SR_env_target_0=none;1=devs;_2=R0;_3=steepness
1   #do_recdev:  0=none; 1=devvector; 2=simple deviations
1981 # first year of main recr_devs; early devs can preceed this era
2013 # last year of main recr_devs; forecast devs start in following year
2   #_recdev phase
1   # (0/1) to read 13 advanced options
#=====================================================================
 0  #_recdev_early_start (0=none; neg value makes relative to recdev_start)
```

```
-4    #_recdev_early_phase
 0    #_forecast_recruitment phase (incl. late recr) (0 value resets to maxphase+1)
 1    #_lambda for fore_recr_like occurring before endyr+1

1964.4    #_last_early_yr_nobias_adj_in_MPD
1981.9  #_first_yr_fullbias_adj_in_MPD
2009.9  #_last_yr_fullbias_adj_in_MPD
2013.2    #_first_recent_yr_nobias_adj_in_MPD
0.8543  #_max_bias_adj_in_MPD (1.0 to mimic pre-2009 models)
0    #_period of cycles in recruitment (N parms read below)
 -5 #min rec_dev
  5 #max rec_dev
 0   #_read_recdevs
##_end of advanced SR options
##=====================================================================
#
#Fishing Mortality info
0.2 # F ballpark for tuning early phases
-2001 # F ballpark year (neg value to disable)
2 # F_Method:  1=Pope; 2=instan. F; 3=hybrid (hybrid is recommended)
1.5 # max F or harvest rate, depends on F_Method
# no additional F input needed for Fmethod 1
# if Fmethod=2; read overall start F value; overall phase; N detailed inputs to read
# if Fmethod=3; read N iterations for tuning for Fmethod 3
#4  # N iterations for tuning F in hybrid method (recommend 3 to 7)
0.005     2         5         #         overall   start     F         value;    overall   phase;    N         detailed  inputs
          to        read
#_initial_F_parms
#Fleet    Year      Seas      F_value   se        phase     (for      detailed  setup     of        F_Method=2)
1         1945      1         0.05      0.05      1
2         1945      1         0.05      0.05      1
3         1945      1         0.05      0.05      1
4         1945      1         0.05      0.05      1
5         1945      1         0.05      0.05      1
#_LO HI INIT PRIOR PR_type SD PHASE
 0 1 0 0.1 0 99  1 # InitF_1FISHERY1
 0 1 0 0.1 0 99  1 # InitF_1FISHERY2
 0 1 0 0.1 0 99  1 # InitF_1FISHERY3
 0 1 0 0.1 0 99  1 # InitF_1FISHERY4
 0 1 0 0.1 0 99  -1 # InitF_1FISHERY5                    was 0.0

#_Q_setup
 # A=do power, B=env-var, C=extra SD, D= Q type(<0=mirror, 0/1=none, 2=cons, 3=rand, 4=randwalk); E:0=num/1=bio/2=F, F:-
1=norm/0=lognorm/>0=T
 #_A  B  C  D
 0 0 0 0   # FISHERY1
 0 0 0 0   # FISHERY2
 0 0 0 0   # FISHERY3
 0 0 0 0   # FISHERY4
 0 0 0 2   # FISHERY5
 0 0 0 0   # SURVEY1
```

```
 0 0 0 0   # SURVEY2
 0 0 0 0   # SURVEY3
 0 0 0 0   # SURVEY4

#
#_Cond 0 #_If q has random component, then 0=read one parm for each fleet with random q; 1=read a parm for each year of
index
#_Q_parms(if_any)
# LO HI INIT PRIOR PR_type SD PHASE
-10         40        2             1          -1            1        1          #_Shrimp bycatch
#
#_size_selex_types
#_Pattern Discard Male Special
 0  2 0 0  #  FISHERY1_Rec_east
 0  2 0 0  #  FISHERY2_Rec_west
 0  2 0 0  #  FISHERY3_Commercial_east
 0  2 0 0  #  FISHERY4_Commercial_west
 0  3 0 0  #  FISHERY5_Shrimp (all dead)
 0  0 0 0  #  SURVEY6 Headboat_East
 30  0 0 0 #  SURVEY7 LarvalGW_DN
 0  0 0 0 #  SURVEY8 Trawl_GW
 0  0 0 0 #  SURVEY9 Video_GW
#
#_age_selex_types
#_Pattern ___ Male Special
20  0 0 0 #  FISHERY1_Rec_east
20  0 0 0 #  FISHERY2_Rec_west
20  0 0 0 #  FISHERY3_Commercial_east
20  0 0 0 #  FISHERY4_Commercial_west
11   0 0 0 #  FISHERY5_Shrimp               17

15  0 0 1 #  SURVEY2 Headboat_east
11  0 0 0 #  SURVEY6 LarvalGW_DN
11  0 0 0 #  SURVEY7 Trawl_GW
14  0 0 0 #  SURVEY8 Video_GW

#LO    HI    INIT    PRIOR  PR_type SD  PHASE env-var  use_dev dev_minyr dev_maxyr dev_stddev  Block_Pattern Block_Type
#Size Selex
#Rec_E
1          100        15.24      15.24      -1          1          -3         0          0          0          0          0          1
           2          #Retain_1P_1_MRIP_E
-1         30         1          1          -1          1          -3         0          0          0          0          0          0
           0          #Retain_1P_2_MRIP_E
-1         2          0.9    0.9 -1         1          2          0          0          0          0          0          0
           #Retain_1P_3_MRIP_E
-1         2          0          0          -1          1          -4         0          0          0          0          0          0
           0          #Retain_1P_4_MRIP_E
-10        10         -5         -5         -1          1          -2         0          0          0          0          0          0
           0          #DiscMort_1P_1_MRIP_E
-1         2          1          1          -1          1          -4         0          0          0          0          0          0
           0          #DiscMort_1P_2_MRIP_E
```

```
0     2     0.05   0.05   -1    1    -2    0    0    0    0    0    0
      0     #DiscMort_1P_3_MRIP_E
-1    2     0      0      -1    1    -4    0    0    0    0    0    0
      0     #DiscMort_1P_4_MRIP_E
#Rec_W
1     100   15.24  15.24  -1    1    -3    0    0    0    0    0    1
      2     #Retain_2P_1_MRIP_W
-1    50    1      1      -1    1    -3    0    0    0    0    0    0
      0     #Retain_2P_2_MRIP_W
-1    1     0.9    0.9  -1  1    2    0    0    0    0    0    0    0
      #Retain_2P_3_MRIP_W
-1    2     0      0      -1    1    -4    0    0    0    0    0    0
      0     #Retain_2P_4_MRIP_W
-10   10    -5     -5     -1    1    -2    0    0    0    0    0    0
      0     #DiscMort_2P_1_MRIP_W
-1    2     1      1      -1    1    -4    0    0    0    0    0    0
      0     #DiscMort_2P_2_MRIP_W
0     2     0.05   0.05   -1    1    -2    0    0    0    0    0    0
      0     #DiscMort_2P_3_MRIP_W
-1    2     0      0      -1    1    -4    0    0    0    0    0    0
      0     #DiscMort_2P_4_MRIP_W
#COM_E
1     100   15.24  15.24  -1    1    -3    0    0    0    0    0    1
      2     #Retain_3_1P_COM_E
-1    30    1      1      -1    1    -3    0    0    0    0    0    0
      0     #Retain_3_2P_COM_E
-1    1     0.9  0.9  -1    1     2    0    0    0    0    0    0    0
      #Retain_3_3P_COM_E
-1    2     0      0      -1    1    -4    0    0    0    0    0    0
      0     #Retain_3_4P_COM_E
-10   10    -5     -5     -1    1    -2    0    0    0    0    0    0
      0     #DiscMort_3P_1_COM_E
-1    2     1      1      -1    1    -4    0    0    0    0    0    0
      0     #DiscMort_3P_2_COM_E
0     2     0.05   0.05   -1    1    -2    0    0    0    0    0    0
      0     #DiscMort_3P_3_COM_E
-1    2     0      0      -1    1    -4    0    0    0    0    0    0
      0     #DiscMort_3P_4_COM_E
#COM_W
1     100   15.24  15.24  -1    1    -3    0    0    0    0    0    1
      2     #Retain_4P_1_COM_W
-1    30    1      1      -1    1    -3    0    0    0    0    0    0
      0     #Retain_4P_2_COM_W
-1    1     0.9  0.9  -1    1     2    0    0    0    0    0    0    0
      #Retain_4P_3_COM_W
-1    2     0      0      -1    1    -4    0    0    0    0    0    0
      0     #Retain_4P_4_COM_W
-10   10    -5     -5     -1    1    -2    0    0    0    0    0    0
      0     #DiscMort_4P_1_COM_W
-1    2     1      1      -1    1    -4    0    0    0    0    0    0
      0     #DiscMort_4P_2_COM_W
```

```
0       2       0.05    0.05    -1      1       -2      0       0       0       0       0       0
        0       #DiscMort_4P_3_COM_W
-1      2       0       0       -1      1       -4      0       0       0       0       0       0
        0       #DiscMort_4P_4_COM_W
#Shrimp

#LO   HI   INIT   PRIOR    PR_type  SD  PHASE env-var  use_dev dev_minyr dev_maxyr dev_stddev  Block_Pattern Block_Type
#Age Selex
#Rec_east
 0      40      3.49212  10       -1 1 2 0 0 0 0 0.5 0 0 # AgeSel_1P_1_Rec_E_1
-15     3       -12.8986 3        -1 1 3 0 0 0 0 0.5 0 0 # AgeSel_1P_2_Rec_E_1
 0      10       0.752451         3        -1 1 3 0 0 0 0 0.5 0 0 # AgeSel_1P_3_Rec_E_1
 0      10       1.63431 3        -1 1 3 0 0 0 0 0.5 0 0 # AgeSel_1P_4_Rec_E_1
-20     7       -17.1498 3        -1 1 2 0 0 0 0 0.5 0 0 # AgeSel_1P_5_Rec_E_1
-15     17       -3.86698         3        -1 1 2 0 0 0 0 0.5 0 0 # AgeSel_1P_6_Rec_E_1
#Rec_west
0       40      3.52446           10      -1    1      2       0       0       0       0       0.5     0
        0       #       AgeSel_2P_1_Rec_W_2
-15     3       -12.6225 3      -1    1      3       0       0       0       0       0.5     0       0
        #       AgeSel_2P_2_Rec_W_2
0       10      0.956643 3      -1    1      3       0       0       0       0       0.5     0       0
        #       AgeSel_2P_3_Rec_W_2
0       10      1.8278   3      -1    1      3       0       0       0       0       0.5     0       0
        #       AgeSel_2P_4_Rec_W_2
-20     7       -17.0056 3      -1    1      2       0       0       0       0       0.5     0       0
        #       AgeSel_2P_5_Rec_W_2
-15     17      -3.49572 3      -1    1      2       0       0       0       0       0.5     0       0
        #       AgeSel_2P_6_Rec_W_2
#Commercial_east
0       40      4.042             10      -1    1      2       0       0       0       0       0.5     0
        0       #       AgeSel_3P_1_Com_E_3
-15     3       -11.3812 3      -1    1      3       0       0       0       0       0.5     0       0
        #       AgeSel_3P_2_Com_E_3
0       10      0.948269          3       -1    1      3       0       0       0       0       0.5     0
        0       #       AgeSel_3P_3_Com_E_3
0       10      3.68211  3      -1    1      3       0       0       0       0       0.5     0       0
        #       AgeSel_3P_4_Com_E_3
-20     7       -16.5465 3      -1    1      2       0       0       0       0       0.5     0       0
        #       AgeSel_3P_5_Com_E_3
-15     17      -3.11791 3      -1    1      2       0       0       0       0       0.5     0       0
        #       AgeSel_3P_6_Com_E_3
#Commercial_west
0       40      3.98492  10     -1    1      2       0       0       0       0       0.5     0       0
        #       AgeSel_4P_1_Com_W_4
-15     3       -12.2733 3      -1    1      3       0       0       0       0       0.5     0       0
        #       AgeSel_4P_2_Com_W_4
0       10      0.749515          3       -1    1      3       0       0       0       0       0.5     0
        0       #       AgeSel_4P_3_Com_W_4
0       10      1.81886  3      -1    1      3       0       0       0       0       0.5     0       0
        #       AgeSel_4P_4_Com_W_4
```

```
-20      7      -16.9019 3      -1   1    2      0      0      0      0      0.5    0      0
         #      AgeSel_4P_5_Com_W_4
-15      17  -4.04785    3      -1   1    2      0      0      0      0      0.5    0      0
         #      AgeSel_4P_6_Com_W_4
#Shrimp
 0       10     0        5      -1        1      -1     0      0      0      0      0      0
         0      #
 0       10     0        6      -1        1      -1     0      0      0      0      0      0
         0      #
#
##########################################
#Larval
0        10     0        5      -1        1      -1     0      0      0      0      0      0
         0      #
0        10     0        6      -1        1      -1     0      0      0      0      0      0
         0      #
#Trawl
0        10     0        5      -1        1      -1     0      0      0      0      0      0
         0      #
0        10     10       6      -1        1      -1     0      0      0      0      0      0
         0      #
#Video
-90   35    -5          -5          -1    99   -3    0     0     0     0     0.5     0      0
-90   35    0           0           -1    99   -3    0     0     0     0     0.5     0      0
-90   35    2.000027831   2.000027831    -1   99   -3    0     0     0     0     0.5     0      0
-90   35    3.999785444   3.999785444    -1   99   -3    0     0     0     0     0.5     0      0
-90   35    6.001064073   6.001064073    -1   99   -3    0     0     0     0     0.5     0      0
-90   35    7.986224883   7.986224883    -1   99   -3    0     0     0     0     0.5     0      0
-90   35    9           9           -1    99   -3    0     0     0     0     0.5     0      0
-90   35    9           9           -1    99   -3    0     0     0     0     0.5     0      0
-90   35    9           9           -1    99   -3    0     0     0     0     0.5     0      0
-90   35    9           9           -1    99   -3    0     0     0     0     0.5     0      0
-90   35    9           9           -1    99   -3    0     0     0     0     0.5     0      0
##########################################
 #_custom_sel-env_setup
 #_custom_sel-block_setup
1 #_Cond 0 #_custom_sel-blk_setup (0/1)
##########################################################################################################
####################
#LO      HI     INIT     PRIOR    PR_type  SD     PHASE
1        100    15.24    15.24    -1       1      -6     #      Rec E Retain_1P_Rec_1945-1998      6
1        100    30.48    30.48    -1       1      -6     #      Rec E Retain_1P_Rec_1999-2007      12
1        100    35.56  35.56  -1  1        -6     #      Rec E Retain_1P_Rec_2007-2013      14

1        100    15.24    15.24    -1       1      -6     #      Rec W Retain_1P_Rec_1945-1998      6
1        100    30.48    30.48    -1       1      -6     #      Rec W Retain_1P_Rec_1999-2007      12
1        100    35.56  35.56  -1  1        -6     #      Rec W Retain_1P_Rec_2007-2013      14

1        100    15.24    15.24    -1       1      -6     #      cOM E Retain_1P_Rec_1945-1998      6
1        100    30.48    30.48    -1       1      -6     #      cOM E Retain_1P_Rec_1999-2007      12
1        100    35.56  35.56  -1  1        -6     #      cOM E Retain_1P_Rec_2007-2013      14
```

```
1	100	15.24	15.24	-1	1	-6	#	cOM w Retain_1P_Rec_1945-1998	6
1	100	30.48	30.48	-1	1	-6	#	cOM w Retain_1P_Rec_1999-2007	12
1	100	35.56  35.56  -1	1	-6	#	cOM w Retain_1P_Rec_2007-2013	14
3 #_Cond No selex parm trends
#
#_Cond No selex parm trends
#_Cond -4 # placeholder for selparm_Dev_Phase
#_env/block/dev_adjust_method    NEW_XXXX  (where 1=use previous method; 2=use new logistic method)
############################################
# Tag loss and Tag reporting parameters go next
0  # TG_custom:  0=no read; 1=read if tags exist
#_Cond -6 6 1 1 2 0.01 -4 0 0 0 0 0 0 0  #_placeholder if no parameters
#
1	#_Variance_adjustments_to_input_values
#0.227794 0.497845   0.0336436  0.285536 -0.183005 -0.013969 0.418154 0.606697 0.312689	#_add_to_Index_stddev
#0.139515  0.590156 -0.0033801  0.320487 -0.241631 -0.049827 0.41149  0.598602 0.418677
#0	0.285536  0		0.333414  0		0	-0.049827 0.606697 0.312689
 0.1678	0.285536  0		0.333414  0		0	0	0.606697 0.312689
0	0	0	0	0	0	0	0	0	#_add_to_discard_stddev
0	0	0	0	0	0	0	0	0	#_add_to_bodywt_CV
1	1	1	1	1	1	1	1	1	#_mult_by_lencomp_N
1	1	1	1	1	1	1	1	1	#_mult_by_agecomp_N
1	1	1	1	1	1	1	1	1	#_mult_by_size-at-age
#30 #_discard_like:  >0 for DF of T-dist(read CV in data file); 0 for normal with CV; -1 for normal with se; -2 for lognormal
#30 #_DF_for_meanbodywt_like
#
4 #_maxlambdaphase
1 #_sd_offset
#
0 # number of changes to make to default Lambdas (default value is 1.0)
# Like_comp codes:  1=surv; 2=disc; 3=mnwt; 4=length; 5=age; 6=SizeFreq; 7=sizeage; 8=catch;
# 9=init_equ_catch; 10=recrdev; 11=parm_prior; 12=parm_dev; 13=CrashPen; 14=Morphcomp; 15=Tag-comp; 16=Tag-negbin
#_comp  fleet phase val sizefreq_method
0 # (0/1) read specs for more stddev reporting
  # 0 1 -1 5 1 5 1 -1 5 # placeholder for selex type, len/age, year, N selex bins, Growth pattern, N growth ages, NatAge_area(-1 for all), NatAge_yr, N Natages
  # placeholder for vector of selex bins to be reported
  # placeholder for vector of growth ages to be reported
  # placeholder for vector of NatAges ages to be reported
999
```

3.6.3. Data File

```
#V3.20b
#           With dead discards added to landings
#_SS-V3.20b-safe;_01/23/2011;_Stock_Synthesis_by_Richard_Methot_(NOAA)_using_ADMB
#_Start_time:       Wed      Aug      31       16:05:04  2011
#_Number_of_datafiles:       1
#C          This     data     file     is       built    to       mimic    the      2011     asapm    model
#C          All      assumptions       are      as       in       the      asapm    model
#_observed           data:
1945        #_styr
2013        #_endyr
1           #_nseas
12          #_months/season
1           #_spawn_seas
5           #_Nfleet
4           #_Nsurveys
1           #_N_areas
Rec_E_1%Rec_W_2%Com_E_3%Com_W_4%Shrimp_Eff_5%HB_W_6%LarvalGW_DN_7%Trawl_GW_8%Video_GW_9

-1          #_surveytiming_in_season    1**************Changed from 0.5
-1          #_surveytiming_in_season    2
-1          #_surveytiming_in_season    3
-1          #_surveytiming_in_season    4
-1          #_surveytiming_in_season    5
0.5         #_surveytiming_in_season    6
0.5         #_surveytiming_in_season    7
0.5         #_surveytiming_in_season    8
0.5         #_surveytiming_in_season    9
1           1        1        1        1        1        1        1        1
#_area_assignments_for_each_fishery_and_survey
2           2        1        1        2        #_units  of       catch:   1=bio;   2=num
0.05        0.05     0.05     0.05     -1       #_se     of       log(catch)        only     used     for
            init_eq_catch     and      for      Fmethod
1   #_Ngenders
10   #_Nages
0 0 0 0  0   #_init_equil_catch_for_each_fishery
69   # Number of Catch Observations
#Rec- E     Rec-W             Comm-E            Comm-W      Shrimp_Age    Year  Season
1           0.25     0.01     0.05     0.1      1945     1
3.55        0.55     0.08     0.11     0.1      1946     1
19.19       1.47     0.16     0.21     0.1      1947     1
31.66       2.82     0.23     0.32     0.1      1948     1
44.14       4.17     0.31     0.42     0.1      1949     1
61.80       5.11     0.39     0.53     0.1      1950     1
75.26       7.01     0.47     0.64     0.1      1951     1
88.71       8.90     0.55     0.74     0.1      1952     1
102.16      10.80    0.63     0.85     0.1      1953     1
115.62      12.69    0.70     0.95     0.1      1954     1
129.07      14.59    0.78     1.06     0.1      1955     1
137.08      16.21    0.86     1.16     0.1      1956     1
145.10      17.84    0.94     1.27     0.1      1957     1
153.11      19.47    1.02     1.38     0.1      1958     1
161.12      21.09    1.09     1.48     0.1      1959     1
169.13      22.72    1.17     1.59     0.1      1960     1
170.01      23.81    1.25     1.69     0.1      1961     1
170.89      24.91    1.33     1.80     0.1      1962     1
171.76      26.00    1.41     1.91     0.1      1963     1
```

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172.64   27.10    7.12     1.95     0.1      1964     1
173.52   28.19    7.89     1.95     0.1      1965     1
176.82   28.64    3.90     2.36     0.1      1966     1
180.12   29.08    5.54     2.36     0.1      1967     1
183.43   29.53    3.90     1.77     0.1      1968     1
186.73   29.98    6.62     3.49     0.1      1969     1
190.03   30.42    7.26     3.72     0.1      1970     1
193.70   31.96    13.84    4.49     0.1      1971     1
204.79   37.64    21.51    6.90     0.1      1972     1
216.57   43.71    18.15    5.99     0.1      1973     1
220.75   45.53    18.15    5.94     0.1      1974     1
227.46   48.77    28.13    7.26     0.1      1975     1
239.81   48.29    31.62    6.72     0.1      1976     1
260.46   52.45    22.73    4.22     0.1      1977     1
273.04   52.11    22.01    4.63     0.1      1978     1
284.93   51.38    29.80    16.21    0.1      1979     1
294.40   49.29    29.68    14.07    0.1      1980     1
612.70   109.59   29.26    11.51    0.1      1981     1
611.12   112.75   28.57    15.30    0.1      1982     1
163.47   309.37   22.50    10.81    0.1      1983     1
80.40    134.83   16.97    14.86    0.1      1984     1
132.39   51.32    24.88    17.14    0.1      1985     1
393.68   29.77    33.06    10.34    0.1      1986     1
240.87   22.96    40.52    15.56    0.1      1987     1
787.89   60.00    62.60    25.90    0.1      1988     1
884.54   90.70    104.52   39.60    0.1      1989     1
1267.19  142.91   163.20   45.08    0.1      1990     1
825.81   151.26   154.86   46.83    0.1      1991     1
711.61   88.05    162.51   51.19    0.1      1992     1
652.50   67.09    173.11   80.53    0.1      1993     1
560.61   109.62   114.15   69.48    0.1      1994     1
601.58   131.12   94.02    59.28    0.1      1995     1
333.68   47.58    64.51    56.87    0.1      1996     1
307.01   47.95    48.90    34.90    0.1      1997     1
319.60   24.68    48.20    32.02    0.1      1998     1
242.45   49.24    55.69    46.59    0.1      1999     1
176.02   74.69    28.55    43.14    0.1      2000     1
273.75   33.92    49.27    30.67    0.1      2001     1
401.57   18.11    67.37    38.98    0.1      2002     1
475.46   32.50    75.53    38.72    0.1      2003     1
562.08   55.30    64.90    35.00    0.1      2004     1
402.80   17.15    48.99    18.94    0.1      2005     1
255.79   12.82    27.71    14.00    0.1      2006     1
254.85   28.01    23.33    16.75    0.1      2007     1
169.55   39.50    23.16    11.54    0.1      2008     1
136.63   4.79     29.25    7.60     0.1      2009     1
114.20   2.93     21.38    3.61     0.1      2010     1
185.00   2.27     44.75    5.88     0.1      2011     1
80.61    11.77    30.75    3.53     0.1      2012     1
171.41   6.30     27.44    1.76     0.1      2013     1
#
264      #_N_cpue_and_surveyabundance_observations
#_Units: 0=numbers;         1=biomass;         2=F
#_Errtype:        -2= lognormal, -1=normal with CV,  0= normal with SE,  >=1 = df Student's T and CV
#_Fleet  Units    Errtype
1        0        0        #        MRFSS_E_1                  (w/
2        0        0        #        HB_W_2          (w/
3        1        0        #        CmHL_E_3                   (w/
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4         1         0         #         CmHL_W_4                      (w/
5         2         -1        #         Shrimp_effort_5
          *****************Changed from -1
6         0         0         #         HB_E_6
7         0         0         #         LarvalGW_DN_7
8         0         0         #         Trawl_GW_8
9         0         0         #         Video_GW_9
#_year    seas      index     obs       err
1981      1         1         1.298021072         0.569293835         #         MRFSS_E_6
1982      1         1         0.780011908         0.487632907         #         MRFSS_E_6
1983      1         1         0.550489923         0.588171306         #         MRFSS_E_6
1984      1         1         0.137970056         0.984959293         #         MRFSS_E_6 -
1985      1         1         0.109192976         0.938285199         #         MRFSS_E_6
1986      1         1         1.84800093          0.290082761         #         MRFSS_E_6
1987      1         1         0.798005743         0.320455332         #         MRFSS_E_6
1988      1         1         1.683405352         0.301367351         #         MRFSS_E_6
1989      1         1         2.908827193         0.278959608         #         MRFSS_E_6
1990      1         1         3.346629309         0.321718654         #         MRFSS_E_6
1991      1         1         1.971824441         0.311774334         #         MRFSS_E_6
1992      1         1         1.821679537         0.23969746          #         MRFSS_E_6
1993      1         1         1.339601412         0.280099844         #         MRFSS_E_6
1994      1         1         1.502774749         0.272433831         #         MRFSS_E_6
1995      1         1         0.983844157         0.322315083         #         MRFSS_E_6
1996      1         1         1.140358243         0.30265368          #         MRFSS_E_6
1997      1         1         0.77972283          0.272151169         #         MRFSS_E_6
1998      1         1         0.856778407         0.245335895         #         MRFSS_E_6
1999      1         1         0.776129158         0.226838538         #         MRFSS_E_6
2000      1         1         0.486888817         0.236622849         #         MRFSS_E_6
2001      1         1         0.697511194         0.235813248         #         MRFSS_E_6
2002      1         1         0.722099482         0.232871319         #         MRFSS_E_6
2003      1         1         0.598154175         0.237908957         #         MRFSS_E_6
2004      1         1         1.128373624         0.223985125         #         MRFSS_E_6
2005      1         1         0.779250992         0.238450482         #         MRFSS_E_6
2006      1         1         0.581912771         0.251191299         #         MRFSS_E_6
2007      1         1         0.484565618         0.249614883         #         MRFSS_E_6
2008      1         1         0.390180889         0.271416143         #         MRFSS_E_6
2009      1         1         0.773182941         0.274417384         #         MRFSS_E_6
2010      1         1         1.090668443         0.271405504         #         MRFSS_E_6
2011      1         1         1.526967568         0.249143511         #         MRFSS_E_6
2012      1         1         1.284174269         0.257899481         #         MRFSS_E_6
2013      1         1         0.973436354         0.287854137         #         MRFSS_E_6
1986      1         2         0.846586557         0.301862034         #         HB_W_8
1987      1         2         0.821708137         0.268726369         #         HB_W_8
1988      1         2         1.208759521         0.265426749         #         HB_W_8
1989      1         2         1.466503638         0.275717505         #         HB_W_8
1990      1         2         1.751335774         0.261234553         #         HB_W_8
1991      1         2         2.961779437         0.247564056         #         HB_W_8 =
1992      1         2         2.223350363         0.239746565         #         HB_W_8 =
1993      1         2         2.05330852          0.234626144         #         HB_W_8
1994      1         2         2.035191231         0.228237122         #         HB_W_8
1995      1         2         1.610886462         0.237235916         #         HB_W_8
1996      1         2         1.844262075         0.242719556         #         HB_W_8
1997      1         2         1.240153246         0.306986767         #         HB_W_8
1998      1         2         0.834425951         0.272912357         #         HB_W_8
1999      1         2         0.571994622         0.321775409         #         HB_W_8
2000      1         2         0.322740438         0.319448274         #         HB_W_8
2001      1         2         0.446103212         0.298211768         #         HB_W_8
2002      1         2         0.5884893           0.295457545         #         HB_W_8
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2003    1    2    0.749297425    0.275986244    #    HB_W_8
2004    1    2    0.963570426    0.267058944    #    HB_W_8
2005    1    2    0.93382507     0.251253656    #    HB_W_8
2006    1    2    0.751523547    0.257855496    #    HB_W_8
2007    1    2    0.998079046    0.264538888    #    HB_W_8
2008    1    2    0.807857625    0.351327812    #    HB_W_8
2009    1    2    0.163458687    0.412723867    #    HB_W_8
2010    1    2    0.072515727    0.486451653    #    HB_W_8 =
2011    1    2    0.128386924    0.427655387    #    HB_W_8 =
2012    1    2    0.152701864    0.618538114    #    HB_W_8
2013    1    2    0.042690196    0.630078935    #    HB_W_8 =
1993    1    3    1.892370 0.292882148    #    CmHL_E_9
1994    1    3    2.069730 0.270772153    #    CmHL_E_9
1995    1    3    1.401910 0.267265762    #    CmHL_E_9
1996    1    3    1.014410 0.281590022    #    CmHL_E_9
1997    1    3    0.833080 0.281663189    #    CmHL_E_9
1998    1    3    0.928550 0.282849932    #    CmHL_E_9
1999    1    3    0.838240 0.267450785    #    CmHL_E_9
2000    1    3    0.597040 0.284500029    #    CmHL_E_9
2001    1    3    1.018930 0.279694717    #    CmHL_E_9
2002    1    3    1.523960 0.261165748    #    CmHL_E_9
2003    1    3    1.767430 0.256164919    #    CmHL_E_9
2004    1    3    1.290240 0.267519959    #    CmHL_E_9
2005    1    3    1.319810 0.275832862    #    CmHL_E_9
2006    1    3    1.16967375     0.286293447    #    CmHL_E_9
2007    1    3    1.715829 0.288393126    #    CmHL_E_9
2008    1    3    1.3356875      0.28826223     #    CmHL_E_9
2009    1    3    1.1129045      0.282622889    #    CmHL_E_9
2010    1    3    0.8365865      0.288475144    #    CmHL_E_9
2011    1    3    1.416205 0.299952 #    CmHL_E_9
2012    1    3    0.713069 0.240996 #    CmHL_E_9
2013    1    3    0.957266 0.262108 #    CmHL_E_9
1993    1    4    1.523100 0.250226351    #    CmHL_W_10
1994    1    4    2.349670 0.309077496    #    CmHL_W_10
1995    1    4    2.223270 0.215351598    #    CmHL_W_10
1996    1    4    1.632290 0.167633547    #    CmHL_W_10
1997    1    4    1.251730 0.095167835    #    CmHL_W_10
1998    1    4    1.417710 0.106435063    #    CmHL_W_10
1999    1    4    1.336100 0.20091948627  #    CmHL_W_10
2000    1    4    1.001309 0.083531739    #    CmHL_W_10
2001    1    4    0.809440 0.063780557    #    CmHL_W_10
2002    1    4    1.002910 0.071895644    #    CmHL_W_10
2003    1    4    1.020190 0.07166091     #    CmHL_W_10
2004    1    4    0.912550 0.065289561    #    CmHL_W_10
2005    1    4    0.505940 0.071198149    #    CmHL_W_10
2006    1    4    0.8584308      0.075651387    #    CmHL_W_10
2007    1    4    1.8368525      0.170725328    #    CmHL_W_10
2008    1    4    1.5930425      0.176305288    #    CmHL_W_10
2009    1    4    1.112840 0.133167902    #    CmHL_W_10
2010    1    4    0.880855 0.124583347    #    CmHL_W_10
2011    1    4    1.128621 0.163374803    #    CmHL_W_10
2012    1    4    0.436063 0.07693907     #    CmHL_W_10
2013    1    4    0.469345 0.076670803    #    CmHL_W_10

1945    1    5    0.001          0.25    #    Shrimp_effort_5
1946    1    5    0.003735214    0.25    #    Shrimp_effort_5
1947    1    5    0.019049594    0.25    #    Shrimp_effort_5
1948    1    5    0.050051876    0.25    #    Shrimp_effort_5
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1949	1	5	0.080867396	0.25	#	Shrimp_effort_5
1950	1	5	0.144179284	0.25	#	Shrimp_effort_5
1951	1	5	0.182838755	0.25	#	Shrimp_effort_5
1952	1	5	0.215895405	0.25	#	Shrimp_effort_5
1953	1	5	0.222805551	0.25	#	Shrimp_effort_5
1954	1	5	0.290039414	0.25	#	Shrimp_effort_5
1955	1	5	0.287051242	0.25	#	Shrimp_effort_5
1956	1	5	0.368478922	0.25	#	Shrimp_effort_5
1957	1	5	0.430109962	0.25	#	Shrimp_effort_5
1958	1	5	0.556920498	0.25	#	Shrimp_effort_5
1959	1	5	0.598941662	0.25	#	Shrimp_effort_5
1960	1	5	0.598598996	0.25	#	Shrimp_effort_5
1961	1	5	0.369572371	0.25	#	Shrimp_effort_5
1962	1	5	0.637351169	0.25	#	Shrimp_effort_5
1963	1	5	0.721176836	0.25	#	Shrimp_effort_5
1964	1	5	0.849906282	0.25	#	Shrimp_effort_5
1965	1	5	0.550408519	0.25	#	Shrimp_effort_5
1966	1	5	0.464479823	0.25	#	Shrimp_effort_5
1967	1	5	0.55738805	0.25	#	Shrimp_effort_5
1968	1	5	0.653507851	0.25	#	Shrimp_effort_5
1969	1	5	0.715427549	0.25	#	Shrimp_effort_5
1970	1	5	0.50256971	0.25	#	Shrimp_effort_5
1971	1	5	0.569340516	0.25	#	Shrimp_effort_5
1972	1	5	0.796040061	0.25	#	Shrimp_effort_5
1973	1	5	0.810056878	0.25	#	Shrimp_effort_5
1974	1	5	0.83603208	0.25	#	Shrimp_effort_5
1975	1	5	0.641797986	0.25	#	Shrimp_effort_5
1976	1	5	0.89210658	0.25	#	Shrimp_effort_5
1977	1	5	1.107641719	0.25	#	Shrimp_effort_5
1978	1	5	1.542041848	0.25	#	Shrimp_effort_5
1979	1	5	1.623310726	0.25	#	Shrimp_effort_5
1980	1	5	1.193499503	0.25	#	Shrimp_effort_5
1981	1	5	1.07233	0.25	#	Shrimp_effort_5
1982	1	5	1.05514	0.25	#	Shrimp_effort_5
1983	1	5	1.03946	0.25	#	Shrimp_effort_5
1984	1	5	1.16342	0.25	#	Shrimp_effort_5
1985	1	5	1.19308	0.25	#	Shrimp_effort_5
1986	1	5	1.37614	0.25	#	Shrimp_effort_5
1987	1	5	1.46779	0.25	#	Shrimp_effort_5
1988	1	5	1.2488	0.25	#	Shrimp_effort_5
1989	1	5	1.34196	0.25	#	Shrimp_effort_5
1990	1	5	1.2855	0.25	#	Shrimp_effort_5
1991	1	5	1.35545	0.25	#	Shrimp_effort_5
1992	1	5	1.31468	0.25	#	Shrimp_effort_5
1993	1	5	1.24074	0.25	#	Shrimp_effort_5
1994	1	5	1.1877	0.25	#	Shrimp_effort_5
1995	1	5	1.07149	0.25	#	Shrimp_effort_5
1996	1	5	1.15076	0.25	#	Shrimp_effort_5
1997	1	5	1.26155	0.25	#	Shrimp_effort_5
1998	1	5	1.31668	0.25	#	Shrimp_effort_5
1999	1	5	1.21642	0.25	#	Shrimp_effort_5
2000	1	5	1.16544	0.25	#	Shrimp_effort_5
2001	1	5	1.19925	0.25	#	Shrimp_effort_5
2002	1	5	1.25371	0.25	#	Shrimp_effort_5
2003	1	5	1.0202	0.25	#	Shrimp_effort_5
2004	1	5	0.88967	0.25	#	Shrimp_effort_5
2005	1	5	0.624	0.25	#	Shrimp_effort_5
2006	1	5	0.56049	0.25	#	Shrimp_effort_5

2007	1	5	0.48986	0.25	#	Shrimp_effort_5
2008	1	5	0.38104	0.25	#	Shrimp_effort_5
2009	1	5	0.46423	0.25	#	Shrimp_effort_5
2010	1	5	0.36721	0.25	#	Shrimp_effort_5
2011	1	5	0.40519	0.25	#	Shrimp_effort_5
2012	1	5	0.4278	0.25	#	Shrimp_effort_5
2013	1	5	0.39297	0.25	#	Shrimp_effort_5
1986	1	6	0.727465918	0.324151387	#	HB_E_7
1987	1	6	0.657517705	0.318236108	#	HB_E_7
1988	1	6	0.727258024	0.289118356	#	HB_E_7
1989	1	6	1.734480502	0.287547767	#	HB_E_7
1990	1	6	2.313362678	0.277993942	#	HB_E_7
1991	1	6	1.968438051	0.284330244	#	HB_E_7
1992	1	6	2.307342602	0.281281455	#	HB_E_7
1993	1	6	1.671301997	0.279202901	#	HB_E_7
1994	1	6	1.250887335	0.28573377	#	HB_E_7
1995	1	6	1.206159805	0.291610868	#	HB_E_7
1996	1	6	1.044067018	0.288751866	#	HB_E_7
1997	1	6	1.126757008	0.283644203	#	HB_E_7
1998	1	6	1.088817265	0.282752462	#	HB_E_7
1999	1	6	1.123037197	0.281785172	#	HB_E_7
2000	1	6	0.709425082	0.290561904	#	HB_E_7
2001	1	6	0.705757168	0.292939028	#	HB_E_7
2002	1	6	1.167901449	0.292417211	#	HB_E_7
2003	1	6	1.102973602	0.293485151	#	HB_E_7
2004	1	6	1.079981787	0.295145088	#	HB_E_7
2005	1	6	1.203323823	0.293900461	#	HB_E_7
2006	1	6	0.677106889	0.30165638	#	HB_E_7
2007	1	6	0.748747205	0.305113631	#	HB_E_7
2008	1	6	0.795120411	0.295929991	#	HB_E_7
2009	1	6	0.507821763	0.305925043	#	HB_E_7
2010	1	6	0.476600415	0.319043774	#	HB_E_7
2011	1	6	0.57204659	0.315155264	#	HB_E_7
2012	1	6	0.491847422	0.514961194	#	HB_E_7
2013	1	6	0.415773476	0.468933692	#	HB_E_7
1986	1	7	0.86712	0.38672	#	LarvalGW_DN_11
1987	1	7	0.39618	0.68233	#	LarvalGW_DN_11
1988	1	7	0.41911	0.46366	#	LarvalGW_DN_11
1989	1	7	0.2209	0.44595	#	LarvalGW_DN_11
1990	1	7	0.37104	0.3954	#	LarvalGW_DN_11
1991	1	7	0.74063	0.26368	#	LarvalGW_DN_11
1992	1	7	1.99286	0.35724	#	LarvalGW_DN_11 = 2.9
1993	1	7	0.79233	0.28136	#	LarvalGW_DN_11
1994	1	7	0.98834	0.30689	#	LarvalGW_DN_11
1995	1	7	1.0421	0.30324	#	LarvalGW_DN_11
1996	1	7	0.75863	0.32677	#	LarvalGW_DN_11
1997	1	7	0.71963	0.3994	#	LarvalGW_DN_11
1999	1	7	0.20762	0.42127	#	LarvalGW_DN_11
2000	1	7	2.24433	0.31159	#	LarvalGW_DN_11
2001	1	7	0.39802	0.42557	#	LarvalGW_DN_11
2002	1	7	1.40706	0.51245	#	LarvalGW_DN_11
2003	1	7	0.69343	0.33678	#	LarvalGW_DN_11
2004	1	7	0.40493	0.39799	#	LarvalGW_DN_11
2006	1	7	1.80179	0.31183	#	LarvalGW_DN_11
2007	1	7	1.65072	0.39532	#	LarvalGW_DN_11
1987	1	8	0.90083	0.23661	#	Trawl_GW_12
1988	1	8	0.78839	0.24720	#	Trawl_GW_12

```
1989	1	8	1.33977		0.19562	#	Trawl_GW_12
1990	1	8	0.32166		0.28505	#	Trawl_GW_12 -
1991	1	8	2.82945		0.15013	#	Trawl_GW_12
1992	1	8	0.30901		0.32752	#	Trawl_GW_12
1993	1	8	2.12938		0.18035	#	Trawl_GW_12 -
1994	1	8	1.64808		0.17844	#	Trawl_GW_12
1995	1	8	0.98248		0.22203	#	Trawl_GW_12
1996	1	8	1.05747		0.23525	#	Trawl_GW_12
1997	1	8	0.53606		0.26942	#	Trawl_GW_12
1998	1	8	0.06582		0.52936	#	Trawl_GW_12 -
1999	1	8	0.97472		0.21574	#	Trawl_GW_12
2000	1	8	1.98509		0.18532	#	Trawl_GW_12
2001	1	8	2.82822		0.18026	#	Trawl_GW_12
2002	1	8	1.31209		0.22150	#	Trawl_GW_12
2003	1	8	0.79005		0.25597	#	Trawl_GW_12
2004	1	8	0.75063		0.21182	#	Trawl_GW_12
2005	1	8	1.02622		0.20513	#	Trawl_GW_12
2006	1	8	0.93541		0.24437	#	Trawl_GW_12
2007	1	8	0.98358		0.23508	#	Trawl_GW_12
2008	1	8	0.71584		0.19332	#	Trawl_GW_12
2009	1	8	0.17362		0.25527	#	Trawl_GW_12
2010	1	8	0.25218		0.28378	#	Trawl_GW_12
2011	1	8	0.31097		0.27853	#	Trawl_GW_12
2012	1	8	0.84401		0.24804	#	Trawl_GW_12
2013	1	8	0.20897		0.33624	#	Trawl_GW_12
1993	1	9	1.76176		0.32428	#	Video_GW_13
1994	1	9	2.95265		0.31817	#	Video_GW_13
1995	1	9	1.23425		0.43765	#	Video_GW_13
1996	1	9	1.79571		0.31403	#	Video_GW_13
1997	1	9	1.77735		0.28902	#	Video_GW_13
2001	1	9	0.21365		0.77573	#	Video_GW_13
2002	1	9	1.458		0.32646	#	Video_GW_13
2004	1	9	0.53401		0.35349	#	Video_GW_13
2005	1	9	0.46149		0.30487	#	Video_GW_13
2006	1	9	0.77863		0.26439	#	Video_GW_13
2007	1	9	1.4671		0.2721	#	Video_GW_13
2008	1	9	0.40024		0.28973	#	Video_GW_13
2009	1	9	0.77347		0.25879	#	Video_GW_13
2010	1	9	0.49615		0.27325	#	Video_GW_13
2011	1	9	0.36622		0.25866	#	Video_GW_13
2012	1	9	0.23366		0.27631	#	Video_GW_13
2013	1	9	0.29566		0.28521	#	Video_GW_13
#
5  #N fleets with discards
# Fleet number, _discard_type (1=bio or num; 2=fraction),
#_discard_errtype:  >0 for DF of T-dist(read CV below); 0 for normal with CV; -1 for normal with se; -2 for lognormal
1	2	-1
2	2	-1
3	2	-1
4	2	-1
5	3	-2
162 #_N_discard_obs
#	REC_E
1981	1	1	0.108889435	0.2	#
1982	1	1	0.16220203	0.2
1983	1	1	0.551876706	0.2
1984	1	1	0.783165673	0.2
1985	1	1	0.064857458	0.2
```

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1986    1       1       0.264111019     0.2
1987    1       1       0.316725434     0.2
1988    1       1       0.157829591     0.2
1989    1       1       0.256369752     0.2
1990    1       1       0.176182703     0.2
1991    1       1       0.138477299     0.2
1992    1       1       0.316563311     0.2
1993    1       1       0.237165083     0.2
1994    1       1       0.17067441      0.2
1995    1       1       0.150732969     0.2
1996    1       1       0.394902149     0.2
1997    1       1       0.314500193     0.2
1998    1       1       0.490806314     0.2

1999    1       1       0.440854412     0.2     #       0.418300855
2000    1       1       0.348221328     0.2
2001    1       1       0.467484973     0.2
2002    1       1       0.462653933     0.2
2003    1       1       0.313735254     0.2
2004    1       1       0.426187251     0.2
2005    1       1       0.262316999     0.2
2006    1       1       0.348581237     0.2
2007    1       1       0.69467231      0.2

2008    1       1       0.512162139     0.2     #               0.655123597
2009    1       1       0.607584648     0.2
2010    1       1       0.651173091     0.2
2011    1       1       0.673603907     0.2
2012    1       1       0.794572389     0.2
2013    1       1       0.691645409     0.2
#       REC_W
1981    1       2       0.034125963     0.2     #               0.441419928
1982    1       2       0.386160714     0.2
1983    1       2       0.765942638     0.2
1984    1       2       0.31762741      0.2
1985    1       2       0.869381522     0.2
1986    1       2       0.13153826      0.2
1987    1       2       0.405042627     0.2
1988    1       2       0.676933017     0.2
1989    1       2       0.564695719     0.2
1990    1       2       0.137896712     0.2
1991    1       2       0.577816233     0.2
1992    1       2       0.422194807     0.2
1993    1       2       0.556195012     0.2
1994    1       2       0.51469807      0.2
1995    1       2       0.28579988      0.2
1996    1       2       0.390523525     0.2
1997    1       2       0.380266763     0.2
1998    1       2       0.528719829     0.2

1999    1       2       0.591657337     0.2     #               0.487390324
2000    1       2       0.579803094     0.2
2001    1       2       0.696720432     0.2
2002    1       2       0.715537824     0.2
2003    1       2       0.10532401      0.2
2004    1       2       0.385002057     0.2
2005    1       2       0.608017919     0.2
2006    1       2       0.082187858     0.2
```

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2007    1       2       0.62226238      0.2

2008    1       2       0.216394223     0.2     #       0.666551758
2009    1       2       0.916479224     0.2
2010    1       2       0.910605321     0.2
2011    1       2       0.639911168     0.2
2012    1       2       0.545103192     0.2
2013    1       2       0.770817418     0.2
#       COM_E
2000    1       3       0.0880925       0.2     #       0.123204004
2001    1       3       0.085254911     0.2
2002    1       3       0.077489764     0.2
2003    1       3       0.094190732     0.2
2004    1       3       0.123150713     0.2
2005    1       3       0.157030766     0.2
2006    1       3       0.15477062      0.2
2007    1       3       0.205652026     0.2

2008    1       3       0.564863985     0.2     #       0.564863985
2009    1       3       0.754834167     0.2
2010    1       3       0.593736936     0.2
2011    1       3       0.456039481     0.2
2012    1       3       0.777254618     0.2
2013    1       3       0.771154071     0.2
#       COM_W
2000    1       4       0.142482309     0.2     #       0.186157096
2001    1       4       0.179595549     0.2
2002    1       4       0.195724838     0.2
2003    1       4       0.182743045     0.2
2004    1       4       0.184301296     0.2
2005    1       4       0.1943511       0.2
2006    1       4       0.173260895     0.2
2007    1       4       0.23679774      0.2

2008    1       4       0.188980252     0.2     #       0.674481396
2009    1       4       0.352088662     0.2
2010    1       4       0.893132031     0.2
2011    1       4       0.772533849     0.2
2012    1       4       0.859530442     0.2
2013    1       4       0.980623142     0.2

#       Shrimp
1946    -1       5      826     0.1     #SHRIMP BYCATCH #( = median of 1946-1972, 1946=5)
1947    1       -5      26      0.1     #SHRIMP BYCATCH
1948    1       -5      67      0.1     #SHRIMP BYCATCH
1949    1       -5      110     0.1     #SHRIMP BYCATCH
1950    1       -5      247     0.1     #SHRIMP BYCATCH
1951    1       -5      336     0.1     #SHRIMP BYCATCH
1952    1       -5      397     0.1     #SHRIMP BYCATCH
1953    1       -5      418     0.1     #SHRIMP BYCATCH
1954    1       -5      542     0.1     #SHRIMP BYCATCH
1955    1       -5      565     0.1     #SHRIMP BYCATCH
1956    1       -5      722     0.1     #SHRIMP BYCATCH
1957    1       -5      827     0.1     #SHRIMP BYCATCH
1958    1       -5      1012    0.1     #SHRIMP BYCATCH
1959    1       -5      1091    0.1     #SHRIMP BYCATCH
1960    1       -5      1091    0.1     #SHRIMP BYCATCH
1961    1       -5      826     0.1     #SHRIMP BYCATCH
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1962    1       -5      795     0.1     #SHRIMP BYCATCH
1963    1       -5      907     0.1     #SHRIMP BYCATCH
1964    1       -5      958     0.1     #SHRIMP BYCATCH
1965    1       -5      1063    0.1     #SHRIMP BYCATCH
1966    1       -5      1046    0.1     #SHRIMP BYCATCH
1967    1       -5      1140    0.1     #SHRIMP BYCATCH
1968    1       -5      1158    0.1     #SHRIMP BYCATCH
1969    1       -5      1316    0.1     #SHRIMP BYCATCH
1970    1       -5      1240    0.1     #SHRIMP BYCATCH
1971    -1      -5      1182    0.1     #SHRIMP BYCATCH

1972    -1      5       3083    0.1     #SHRIMP BYCATCH (3083 = median of 1972-2013, 1972 = 3501)
1973    1       -5      1206    0.1     #SHRIMP BYCATCH
1974    1       -5      1535    0.1     #SHRIMP BYCATCH
1975    1       -5      972     0.1     #SHRIMP BYCATCH
1976    1       -5      744     0.1     #SHRIMP BYCATCH
1977    1       -5      1697    0.1     #SHRIMP BYCATCH
1978    1       -5      6248    0.1     #SHRIMP BYCATCH
1979    1       -5      2569    0.1     #SHRIMP BYCATCH
1980    1       -5      5423    0.1     #SHRIMP BYCATCH
1981    1       -5      4628    0.1     #SHRIMP BYCATCH
1982    1       -5      5120    0.1     #SHRIMP BYCATCH
1983    1       -5      1618    0.1     #SHRIMP BYCATCH
1984    1       -5      3116    0.1     #SHRIMP BYCATCH
1985    1       -5      1305    0.1     #SHRIMP BYCATCH
1986    1       -5      3537    0.1     #SHRIMP BYCATCH
1987    1       -5      4665    0.1     #SHRIMP BYCATCH
1988    1       -5      3615    0.1     #SHRIMP BYCATCH
1989    1       -5      4402    0.1     #SHRIMP BYCATCH
1990    1       -5      2219    0.1     #SHRIMP BYCATCH
1991    1       -5      10550   0.1     #SHRIMP BYCATCH
1992    1       -5      2967    0.1     #SHRIMP BYCATCH
1993    1       -5      6889    0.1     #SHRIMP BYCATCH
1994    1       -5      4059    0.1     #SHRIMP BYCATCH
1995    1       -5      5395    0.1     #SHRIMP BYCATCH
1996    1       -5      6037    0.1     #SHRIMP BYCATCH
1997    1       -5      3790    0.1     #SHRIMP BYCATCH
1998    1       -5      1096    0.1     #SHRIMP BYCATCH
1999    1       -5      5704    0.1     #SHRIMP BYCATCH
2000    1       -5      11680   0.1     #SHRIMP BYCATCH
2001    1       -5      12570   0.1     #SHRIMP BYCATCH
2002    1       -5      3113    0.1     #SHRIMP BYCATCH
2003    1       -5      3478    0.1     #SHRIMP BYCATCH
2004    1       -5      2755    0.1     #SHRIMP BYCATCH
2005    1       -5      1853    0.1     #SHRIMP BYCATCH
2006    1       -5      3054    0.1     #SHRIMP BYCATCH
2007    1       -5      1505    0.1     #SHRIMP BYCATCH
2008    1       -5      1239    0.1     #SHRIMP BYCATCH
2009    1       -5      1143    0.1     #SHRIMP BYCATCH
2010    1       -5      1239    0.1     #SHRIMP BYCATCH
2011    1       -5      2078    0.1     #SHRIMP BYCATCH
2012    1       -5      2545    0.1     #SHRIMP BYCATCH
2013    -1      -5      1917    0.1     #SHRIMP BYCATCH

0 #_N_meanbodywt_obs
30 #degrees of freedom (necessary to have this value)

1 # length bin method: 1=use databins; 2=generate from binwidth,min,max below; 3=read vector
```

```
-0.001 #_comp_tail_compression. If you are using sex ratio data only you want this turned on (i.e. = 0.0001)
1e-007 #_add_to_comp
1 #_combine males into females at or below this bin number

39 #_N_LengthBins
4 6 8   10      12      14      16      18      20      22      24      26      28      30      32
        34      36      38      40
        42      44      46      48      50      52      54      56      58      60      62      64
        66      68      70
        72      74      76      78      80
0       #27 #number of Length Obs
#

11  # Number of Age Bins
0 1 2 3 4 5 6 7 8 9 10
1 # Number of Ageing Error Sets  CV= 0.10
 0.5   1.5    2.5    3.5    4.5    5.5    6.5    7.5    8.5    9.5    10.5
0.116583173     0.117800351     0.050899592     0.035505388     0.031268275     0.042083964
        0.123381818     0.173561797     0.525247604     0.780147043 0.780147043
#

147 # Number Age Observations
2   #_Lbin_method: 1=poplenbins; 2=datalenbins; 3=lengths
-1  # Combine Males & Females Below this Bin
# Year  Season  Fleet   Gender  Partition ageerr Lbin   Lbin    Nsamp   0       1       2       3
        4       5       6       7       8       9       10
1981    1       1       0       2       1       -1      -1      200     0       0.049577267
        0.203092561     0.322012378     0.226305102     0.117898799     0.046903635     0.011656126
        0.0135199       0.003569867     0.003569867     #
1982    1       1       0       2       1       -1      -1      200     0       0.067221453
        0.201982634     0.307838669     0.220194436     0.120036913     0.048457467     0.016050707
        0.008093515     0.002468968     0.001639025     #
1983    1       1       0       2       1       -1      -1      95      0       0.031219963
        0.171048665     0.322481991     0.261988707     0.12787056      0.052689679     0.016739085
        0.009690169     0.00304266      0.002027268     #
1984    1       1       0       2       1       -1      -1      200     0       0.048904221
        0.212248014     0.308919232     0.197526053     0.097387608     0.051226168     0.025239472
        0.03463865      0.011503902     0.01098029      #
1985    1       1       0       2       1       -1      -1      70      0       0.038981797
        0.140017467     0.260654869     0.226192087     0.177496258     0.090038633     0.032634442
        0.020015733     0.006667022     0.004000013     #
1986    1       1       0       2       1       -1      -1      163     0       0.036605754
        0.163913055     0.291486775     0.238324881     0.143212637     0.072223798     0.02733284
        0.016302959     0.005605027     0.003583618     #
1987    1       1       0       2       1       -1      -1      200     0       0.060183711
        0.188364112     0.292119485     0.222242368     0.126742875     0.06294552      0.023234137
        0.01316218      0.004854822     0.002962385     #
1988    1       1       0       2       1       -1      -1      148     0       0.051609349
        0.186658734     0.303363874     0.231752131     0.128568542     0.05826285      0.019824979
        0.011512462     0.003673934     0.002539883     #
1989    1       1       0       2       1       -1      -1      200     0       0.089437173
        0.228206087     0.305294883     0.20507904      0.098147662     0.042879442     0.013975667
        0.007520334     0.002433592     0.001553502     #
1990    1       1       0       2       1       -1      -1      200     0       0.075782593
        0.236732435     0.328491 0.213792558    0.091206967     0.034718414     0.009608415
        0.004283673     0.001233697     0.000776233     #
```

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1991    1       1       0       2       1       -1      -1      200     0       0.058610228
        0.201430246     0.31307944      0.231095739     0.118932468     0.049505989     0.015002924
        0.006607058     0.001638956     0.00112515      #
1992    1       1       0       2       1       -1      -1      200     0       0.055286671
        0.201223095     0.316658132     0.233866571     0.117063306     0.048341224     0.014829811
        0.007045135     0.001852279     0.001285597     #
1993    1       1       0       2       1       -1      -1      200     0       0.053763736
        0.204760769     0.3212022       0.23075864      0.113506151     0.047020347     0.015089107
        0.00761213      0.002675048     0.001510244     #
1994    1       1       0       2       1       -1      -1      200     0       0.071730909
        0.226727402     0.322658714     0.216929603     0.101371168     0.039387515     0.011067416
        0.005048503     0.001101143     0.000858383     #
1995    1       1       0       2       1       -1      -1      200     0       0.064401303
        0.229013349     0.334511026     0.222544142     0.096778121     0.035197546     0.009493092
        0.003768685     0.001062823     0.0006386       #
1996    1       1       0       2       1       -1      -1      200     0       0.056777925
        0.220700823     0.336516984     0.230056305     0.101939512     0.037107626     0.009438982
        0.003889987     0.000799311     0.000605562     #
1997    1       1       0       2       1       -1      -1      200     0       0.058457391
        0.214191191     0.321607585     0.223519147     0.110644589     0.046180246     0.013549555
        0.006875396     0.001708125     0.001261971     #
1998    1       1       0       2       1       -1      -1      200     0       0.051878984
        0.21698186      0.337812191     0.230638073     0.103465211     0.039844663     0.010789825
        0.004732477     0.001331526     0.000797628     #
1999    1       1       0       2       1       -1      -1      192     0       0.048365121
        0.214499872     0.340421981     0.235466863     0.106080504     0.038587403     0.009732611
        0.003811153     0.000826447     0.000541523     #
2000    1       1       0       2       1       -1      -1      200     0       0.046406181
        0.196292402     0.322393072     0.239240687     0.122452851     0.0494863       0.014027526
        0.005962663     0.001333396     0.000887241     #
2001    1       1       0       2       1       -1      -1      200     0       0.053901624
        0.219965798     0.339684454     0.229325473     0.101355825     0.038597535     0.009762925
        0.004015723     0.000909558     0.00064844      #
2002    1       1       0       2       1       -1      -1      200     0       0.044577128
        0.206281956     0.335918359     0.237726129     0.111318405     0.04334779      0.011777481
        0.005197077     0.001406686     0.000876803     #
2003    1       1       0       2       1       -1      -1      96      0       0.0478175       0.209053
        0.335173 0.237014 0.110935 0.0419837    0.0109889       0.00410534      0.000842752
        0.000526638     #
2004    1       1       0       2       1       -1      -1      146     0       0.0440096       0.203543
        0.336012 0.242082 0.113813 0.0422192    0.011035 0.00426464     0.000937024     0.000583465
        #
2005    1       1       0       2       1       -1      -1      148     0       0.0481642       0.210991
        0.336815 0.235207 0.109266 0.0416061    0.0107438       0.00419226      0.000843224
        0.00055177      #
2006    1       1       0       2       1       -1      -1      99      0       0.0453253       0.203903
        0.33274  0.239951 0.11405  0.0437554    0.0119225       0.00489309      0.00121863
        0.000711553     #
2007    1       1       0       2       1       -1      -1      158     0       0.032475 0.182403 0.326815
        0.253502 0.129765 0.0506442     0.0149545       0.00599818      0.00140815      0.000907426
        #
2008    1       1       0       2       1       -1      -1      266     0       0.0226939       0.159057
        0.317368 0.265997 0.1486        0.0591832       0.0169941       0.0068645       0.00139497
        0.000967278     #
2009    1       1       0       2       1       -1      -1      314     0       0.013619 0.108064 0.279412
        0.280256 0.188724 0.0835533     0.0266835       0.0134359       0.00354556      0.00230453
        #
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2010    1           1           0           2           1           -1          -1          225         0           0.00825823
        0.0803895               0.266502 0.293467 0.211491 0.0918328            0.027914 0.0144044              0.00355343
        0.0021094               #
2011    1           1           0           2           1           -1          -1          378         0           0.006796267
        0.089914463             0.273771384             0.294027994             0.198390358             0.087472784             0.023164852
        0.01407465              0.003530327             0.00248056              #
2012    1           1           0           2           1           -1          -1          450         0           0.00642562
        0.080764463             0.267293388             0.296942149             0.208801653             0.092727273             0.024214876
        0.012747934             0.002603306             0.001735537             #
2013    1           1           0           2           1           -1          -1          638         0           0.005393939
        0.078981818             0.255975758             0.285854545             0.205418182             0.101733333             0.032193939
        0.01929697              0.005454545             0.00369697              #

-1981   1           2           0           2           1           -1          -1          100         0           0.000001 0.002217259
        0.02229804              0.145559983             0.239887564             0.239548476             0.191531508             0.082694019
        0.035889772             0.040373379             #
-1982   1           2           0           2           1           -1          -1          100         0           0.007142862
        0.074863625             0.086258633             0.168056549             0.298488785             0.192135137             0.156047254
        0.006802862             0.001700716             0.008503578             #
-1983   1           2           0           2           1           -1          -1          100         0           0.108314263
        0.22484604              0.24728403              0.123315878             0.043557115             0.065378968             0.116700186
        0.055881907             0.001251366             0.006493647             #
-1984   1           2           0           2           1           -1          -1          100         0           0.181891023
        0.165437179             0.135406707             0.07439896              0.069498974             0.086012956             0.156068733
        0.05942039              0.019494946             0.023522435             #
-1985   1           2           0           2           1           -1          -1          100         0           0.281233621
        0.260625198             0.192200392             0.084378738             0.061676646             0.022511633             0.04285657
        0.008986506             0.011056138             0.003590089             #
-1986   1           2           0           2           1           -1          -1          100         0           0.098256977
        0.222570837             0.281685107             0.188040819             0.099869582             0.046121022             0.032366056
        0.013578234             0.00615582              0.005363576             #
1987    1           2           0           2           1           -1          -1          500         0           0.096991681
        0.216014076             0.281624202             0.196284976             0.104723272             0.050072911             0.026565691
        0.011802804             0.004193874             0.005646106             #
1988    1           2           0           2           1           -1          -1          180         0           0.10608009
        0.254396887             0.309871574             0.188873838             0.079916896             0.032713669             0.012031027
        0.005935229             0.002265947             0.001600778             #
1989    1           2           0           2           1           -1          -1          334         0           0.081953317
        0.228466669             0.324458233             0.220082108             0.094039298             0.03329812              0.008306742
        0.002915601             0.000486829             0.000931577             #
1990    1           2           0           2           1           -1          -1          271         0           0.052260201
        0.20458261              0.3240743               0.239766667             0.111466483             0.044644136             0.013128841
        0.005068427             0.001285379             0.001529849             #
1991    1           2           0           2           1           -1          -1          65          0           0.047850499
        0.156905075             0.252214689             0.22045431              0.145194105             0.091606531             0.051226883
        0.018961405             0.004666977             0.008063341             #
1992    1           2           0           2           1           -1          -1          200         0           0.082375778
        0.221087072             0.30571825              0.212844163             0.101101527             0.043876748             0.017437704
        0.006447833             0.001550079             0.002614401             #
1993    1           2           0           2           1           -1          -1          97          0           0.033295603
        0.161435123             0.308622521             0.25872786              0.148207148             0.05959288              0.018696045
        0.006915333             0.000968702             0.001476241             #
1994    1           2           0           2           1           -1          -1          200         0           0.038136051
        0.180786043             0.319340568             0.250127263             0.132646082             0.052947965             0.016560598
        0.005640842             0.001038153             0.001244974             #
1995    1           2           0           2           1           -1          -1          188         0           0.030158913
        0.169704614             0.318889865             0.260912745             0.140201058             0.055999061             0.016121918
        0.005380703             0.000900602             0.00049171              #
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1996    1       2       0       2       1       -1      -1      200     0       0.038842122
        0.187732039     0.32528192      0.247309223     0.123553651     0.04695759      0.016407186
        0.007956692     0.00194684      0.002325112     #
1997    1       2       0       2       1       -1      -1      200     0       0.044408467
        0.184860616     0.311834438     0.241849094     0.128996728     0.055653599     0.019393959
        0.008029403     0.001670272     0.001733338     #
1998    1       2       0       2       1       -1      -1      186     0       0.039134003
        0.184652677     0.315153481     0.244981705     0.128665351     0.053592261     0.019019098
        0.008398362     0.00236476      0.002533492     #
1999    1       2       0       2       1       -1      -1      200     0       0.043877209
        0.159361177     0.284080122     0.236288394     0.132066871     0.063709978     0.034012474
        0.026854965     0.00846574      0.008482719     #
2000    1       2       0       2       1       -1      -1      200     0       0.065243479
        0.198944949     0.299729876     0.212728339     0.111445936     0.049170778     0.03611135
        0.012832745     0.005275059     0.004712681     #
2001    1       2       0       2       1       -1      -1      200     0       0.056285998
        0.199847497     0.318316632     0.234915871     0.116042633     0.045385793     0.015886114
        0.006963339     0.001275662     0.001961531     #
2002    1       2       0       2       1       -1      -1      162     0       0.037241317
        0.150045991     0.271162438     0.237540617     0.144530645     0.078277076     0.046089697
        0.020770732     0.004504226     0.007810148     #
2003    1       2       0       2       1       -1      -1      200     0       0.043281 0.162478 0.268924
        0.225533 0.146845 0.0818647     0.0405327       0.0159201       0.00483963      0.00772131
        #
2004    1       2       0       2       1       -1      -1      200     0       0.0507738       0.172384
        0.283169 0.227429 0.134392 0.0717266    0.0332791       0.0151894       0.00405107
        0.00470086      #
2005    1       2       0       2       1       -1      -1      200     0       0.0652894       0.189791
        0.302999 0.230879 0.120709 0.0469138    0.0236213       0.008669 0.00270805     0.00403606
        #
2006    1       2       0       2       1       -1      -1      200     0       0.0464079       0.188106
        0.309583 0.233196 0.120588 0.0551252    0.0294424       0.0102088       0.00220912
        0.00297649      #
2007    1       2       0       2       1       -1      -1      209     0       0.0414973       0.155149
        0.2662  0.237383 0.152308 0.0806352     0.0388104       0.0145355       0.00345911
        0.00785097      #
2008    1       2       0       2       1       -1      -1      118     0       0.0426781       0.145036
        0.240752 0.204241 0.138874 0.0952295    0.0741394       0.0330717       0.0126579
        0.0114349       #
2009    1       2       0       2       1       -1      -1      141     0       0.0701338       0.194664
        0.301069 0.232831 0.128707 0.0499996    0.0141308       0.00418667      0.000276768
        0.000276768     #
2010    1       2       0       2       1       -1      -1      6       0       0.047345 0.15062  0.294349
        0.252407 0.158238 0.0629468     0.0176015       0.00946797      0.00229898      0.00137932
        #
2011    1       2       0       2       1       -1      -1      78      0       0.07294964
        0.205611511     0.300143885     0.220719424     0.115611511     0.052158273     0.015467626
        0.009280576     0.002374101     0.002086331     #
2012    1       2       0       2       1       -1      -1      280     0       0.053   0.177538462
        0.297153846     0.241230769     0.144307692     0.060846154     0.014461538     0.006846154
        0.000769231     0.000615385     #
2013    1       2       0       2       1       -1      -1      372     0       0.029918699
        0.139349593     0.29601626      0.269430894     0.16804878      0.066341463     0.014715447
        0.008536585     0.00203252      0.001219512     #

1990    1       3       0       2       1       -1      -1      53      0       0.014728775
        0.106903996     0.22185 0.195383596     0.139271834     0.122517915     0.071812919
        0.075590731     0.029561263     0.021805257     #
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1991	1	3	0	2	1	-1	-1	44	0	0.039694478
	0.136405311	0.216834864	0.171414245	0.112774434	0.102155605	0.060349516
	0.094553151	0.034704231	0.029843686	#
1992	1	3	0	2	1	-1	-1	142	0	0.033625728
	0.135549328	0.247536082	0.207656293	0.146008132	0.097413131	0.048883245
	0.049782942	0.017756149	0.014211789	#
1993	1	3	0	2	1	-1	-1	200	0	0.025664305
	0.145967426	0.296600545	0.260741299	0.149807726	0.068674257	0.024883669
	0.01748304	0.004996992	0.004129422	#
1994	1	3	0	2	1	-1	-1	200	0	0.032725427
	0.164748826	0.303330294	0.247136596	0.141706473	0.066133686	0.022886601
	0.013067176	0.00422986	0.002759701	#
1995	1	3	0	2	1	-1	-1	112	0	0.032806203
	0.175331868	0.319695733	0.250824827	0.135181032	0.055266109	0.016221475
	0.009144111	0.002451948	0.001868694	#
1996	1	3	0	2	1	-1	-1	103	0	0.042084629
	0.173209445	0.310648312	0.24760266	0.134478698	0.056542661	0.018061627
	0.010177473	0.00271904	0.002093997	#
1997	1	3	0	2	1	-1	-1	64	0	0.041948417
	0.183040051	0.317605913	0.248651011	0.13157517	0.05209127	0.014522618
	0.006605408	0.001296714	0.001044387	#
1998	1	3	0	2	1	-1	-1	50	0	0.046568558
	0.197166166	0.317100426	0.228312257	0.112308269	0.050841667	0.018411757
	0.017166511	0.005516293	0.004790069	#
1999	1	3	0	2	1	-1	-1	95	0	0.025163073
	0.154635354	0.299918552	0.250335819	0.14321635	0.067579882	0.026114935
	0.020609641	0.00607097	0.005292307	#
2000	1	3	0	2	1	-1	-1	125	0	0.025047852
	0.154289458	0.298582384	0.248332789	0.143654175	0.068182453	0.027207594
	0.0216222	0.006361 0.005658499	#
2001	1	3	0	2	1	-1	-1	81	0	0.036111662
	0.17706747	0.31835904	0.251084384	0.129833311	0.053535306	0.016543422
	0.010576905	0.003067893	0.002369165	#
2002	1	3	0	2	1	-1	-1	94	0	0.03742333
	0.187393255	0.318450713	0.236934511	0.121831666	0.055413035	0.019009545
	0.014293751	0.00425736	0.003523727	#
2003	1	3	0	2	1	-1	-1	139	0	0.0338557	0.153975
	0.282008 0.23129	0.146398 0.0792984	0.0323844	0.025224 0.00774112	0.00639245
	#
2004	1	3	0	2	1	-1	-1	162	0	0.0179823	0.122869
	0.266827 0.247245 0.173235 0.0933804	0.0378169	0.0253215	0.00856193
	0.00599286	#
2005	1	3	0	2	1	-1	-1	201	0	0.015378 0.108796 0.254497
	0.245502 0.180735 0.101526 0.0426266	0.0313941	0.011345 0.00769525	#
2006	1	3	0	2	1	-1	-1	147	0	0.0103712
	0.0989024	0.240171 0.247088 0.16998	0.106047 0.0506627	0.0466611	0.0167829
	0.0129158	#
2007	1	3	0	2	1	-1	-1	207	0	0.0109843
	0.0719976	0.201118 0.222431 0.196759 0.138868 0.0676706	0.0531294	0.0227654
	0.0136065	#
2008	1	3	0	2	1	-1	-1	332	0	0.00410212	0.048822
	0.162665 0.205302 0.200726 0.167878 0.0884156	0.0742076	0.0283751	0.0194498
	#
2009	1	3	0	2	1	-1	-1	333	0	0.00597214
	0.0538424	0.179656 0.228161 0.225597 0.156878 0.072051 0.0475408	0.01897	0.0112442
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2010    1       3       0       2       1       -1      -1      246     0       0.0103612
        0.0867886       0.240181 0.258816 0.194455 0.111699 0.0477174       0.0305068       0.0121634
        0.00708642      #
2011    1       3       0       2       1       -1      -1      430     0       0.005292308
        0.071661538     0.213723077     0.244061538     0.211569231     0.132061538     0.055815385
        0.037907692     0.014369231     0.009076923     #
2012    1       3       0       2       1       -1      -1      468     0       0.004632353
        0.058602941     0.2     0.248382353     0.228088235     0.143823529     0.056323529
        0.036764706     0.012058824     0.007867647     #
2013    1       3       0       2       1       -1      -1      673     0       0.00443038
        0.045316456     0.150590717     0.211603376     0.234894515     0.176666667     0.08257384
        0.056455696     0.022109705     0.013966245     #

1990    1       4       0       2       1       -1      -1      132     0       0.013853411
        0.10327671      0.255949129     0.262137155     0.190072167     0.100844425     0.038827738
        0.02247123      0.007213283     0.004988054     #
1991    1       4       0       2       1       -1      -1      200     0       0.01591431
        0.117477486     0.275291743     0.265627875     0.180699987     0.086534545     0.030084672
        0.018784817     0.005080476     0.004036078     #
1992    1       4       0       2       1       -1      -1      200     0       0.01834031
        0.134583984     0.301855214     0.277496061     0.168871611     0.068124029     0.019801694
        0.008010735     0.001400107     0.000922691     #
1993    1       4       0       2       1       -1      -1      194     0       0.013053699
        0.100198468     0.267016659     0.274409615     0.198677543     0.093128362     0.031098637
        0.015558849     0.004010311     0.002541432     #
1994    1       4       0       2       1       -1      -1      186     0       0.01740529
        0.109048028     0.260291933     0.261419827     0.191724301     0.097925009     0.035251644
        0.017996989     0.005158799     0.003381248     #
1995    1       4       0       2       1       -1      -1      200     0       0.017112329
        0.121433767     0.275701017     0.264040828     0.178595453     0.087790738     0.031344484
        0.015543307     0.004992593     0.002940556     #
1996    1       4       0       2       1       -1      -1      200     0       0.011637222
        0.092514332     0.264859478     0.281029147     0.203768227     0.093012049     0.030228284
        0.015743301     0.004141996     0.00279791      #
1997    1       4       0       2       1       -1      -1      200     0       0.009561624
        0.093217191     0.257019119     0.273703354     0.205654577     0.100992094     0.034373091
        0.018077597     0.003868749     0.003313481     #
1998    1       4       0       2       1       -1      -1      146     0       0.026735879
        0.140771951     0.300105172     0.270184041     0.16661791      0.067820068     0.019550699
        0.006112555     0.000497788     0.00036123      #
1999    1       4       0       2       1       -1      -1      200     0       0.008958719
        0.094573768     0.276575214     0.293735929     0.204991525     0.083990945     0.02506648
        0.009509213     0.001639186     0.000819839     #
2000    1       4       0       2       1       -1      -1      200     0       0.013346126
        0.108885399     0.287361986     0.288783099     0.184139927     0.080787868     0.025144195
        0.008931121     0.001141668     0.001141668     #
2001    1       4       0       2       1       -1      -1      200     0       0.013889268
        0.100882362     0.269028629     0.274068548     0.205135803     0.093497581     0.027863779
        0.012100913     0.001912142     0.001275538     #
2002    1       4       0       2       1       -1      -1      200     0       0.014798488
        0.107808413     0.280112951     0.281356248     0.196126647     0.083392231     0.024272769
        0.009541945     0.001326112     0.000867128     #
2003    1       4       0       2       1       -1      -1      200     0       0.0167924       0.110205
        0.285692 0.287619 0.191057 0.0773035       0.0215447       0.00791467      0.000634556
        0.000478124     #
2004    1       4       0       2       1       -1      -1      134     0       0.0204182       0.140646
        0.303483 0.2727 0.156948 0.0702011       0.0217294       0.010182 0.00125586      0.00167647
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2005      1         4         0         2         1         -1        -1        200       0         0.0157002           0.104672
          0.26684   0.267984  0.189299  0.0951875           0.0335328           0.0175681           0.00545089
          0.00331109          #
2006      1         4         0         2         1         -1        -1        200       0         0.00574858
          0.0619694           0.22906   0.284041  0.220513  0.120988  0.0448394           0.0217829           0.00671858
          0.00433858          #
2007      1         4         0         2         1         -1        -1        209       0         0.0156377           0.112626
          0.261714  0.257139  0.188301  0.0967527           0.0360257           0.0200483           0.00721548
          0.00400345          #
2008      1         4         0         2         1         -1        -1        118       0         0.00871777          0.073511
          0.181722  0.230495  0.215533  0.153449  0.0705399           0.03971   0.0163366           0.0096711           #
2009      1         4         0         2         1         -1        -1        141       0         0.00543626
          0.0451014           0.207506  0.261284  0.260529  0.142878  0.0481939           0.0222213           0.00342501
          0.00342501          #
2010      1         4         0         2         1         -1        -1        6         0         0.0113417           0.113052
          0.267895  0.229393  0.177038  0.0888771           0.0497652           0.0449252           0.00574669
          0.0114951           #
2011      1         4         0         2         1         -1        -1        78        0         0.020322581
          0.144516129         0.315806452         0.280322581         0.150967742         0.062258065         0.012580645
          0.005806452         0.000645161         0.000645161         #
2012      1         4         0         2         1         -1        -1        280       0         0.008175439
          0.089824561         0.250140351         0.265929825         0.213403509         0.107578947         0.034561404
          0.018491228         0.004631579         0.002842105         #
2013      1         4         0         2         1         -1        -1        372       0         0.00427027
          0.05563964          0.212540541         0.26009009          0.234162162         0.132378378         0.04990991
          0.031441441         0.010036036         0.006486486         #

1981      1         5         0         1         1         -1        -1        21        1         0         0         0
          0         0         0         0         0         0         0         #
1982      1         5         0         1         1         -1        -1        21        1         0         0         0
          0         0         0         0         0         0         0         #
1983      1         5         0         1         1         -1        -1        21        1         0         0         0
          0         0         0         0         0         0         0         #
1984      1         5         0         1         1         -1        -1        21        1         0         0         0
          0         0         0         0         0         0         0         #
1985      1         5         0         1         1         -1        -1        21        1         0         0         0
          0         0         0         0         0         0         0         #
1986      1         5         0         1         1         -1        -1        21        1         0         0         0
          0         0         0         0         0         0         0         #
1987      1         5         0         1         1         -1        -1        21        1         0         0         0
          0         0         0         0         0         0         0         #
1988      1         5         0         1         1         -1        -1        21        1         0         0         0
          0         0         0         0         0         0         0         #
1989      1         5         0         1         1         -1        -1        21        1         0         0         0
          0         0         0         0         0         0         0         #
1990      1         5         0         1         1         -1        -1        21        1         0         0         0
          0         0         0         0         0         0         0         #
1991      1         5         0         1         1         -1        -1        21        1         0         0         0
          0         0         0         0         0         0         0         #
1992      1         5         0         1         1         -1        -1        21        1         0         0         0
          0         0         0         0         0         0         0         #
1993      1         5         0         1         1         -1        -1        21        1         0         0         0
          0         0         0         0         0         0         0         #
1994      1         5         0         1         1         -1        -1        21        1         0         0         0
          0         0         0         0         0         0         0         #
1995      1         5         0         1         1         -1        -1        21        1         0         0         0
          0         0         0         0         0         0         0         #
```

```
1996    1       5       0       1       1       -1      -1      21      1       0       0       0
        0       0       0       0       0       0       0       #
1997    1       5       0       1       1       -1      -1      21      1       0       0       0
        0       0       0       0       0       0       0       #
1998    1       5       0       1       1       -1      -1      21      1       0       0       0
        0       0       0       0       0       0       0       #
1999    1       5       0       1       1       -1      -1      21      1       0       0       0
        0       0       0       0       0       0       0       #
2000    1       5       0       1       1       -1      -1      21      1       0       0       0
        0       0       0       0       0       0       0       #
2001    1       5       0       1       1       -1      -1      21      1       0       0       0
        0       0       0       0       0       0       0       #
2002    1       5       0       1       1       -1      -1      21      1       0       0       0
        0       0       0       0       0       0       0       #
2003    1       5       0       1       1       -1      -1      21      1       0       0       0
        0       0       0       0       0       0       0       #
2004    1       5       0       1       1       -1      -1      21      1       0       0       0
        0       0       0       0       0       0       0       #
2005    1       5       0       1       1       -1      -1      21      1       0       0       0
        0       0       0       0       0       0       0       #
2006    1       5       0       1       1       -1      -1      21      1       0       0       0
        0       0       0       0       0       0       0       #
2007    1       5       0       1       1       -1      -1      21      1       0       0       0
        0       0       0       0       0       0       0       #
2008    1       5       0       1       1       -1      -1      21      1       0       0       0
        0       0       0       0       0       0       0       #
2009    1       5       0       1       1       -1      -1      21      1       0       0       0
        0       0       0       0       0       0       0       #
2010    1       5       0       1       1       -1      -1      21      1       0       0       0
        0       0       0       0       0       0       0       #
2011    1       5       0       1       1       -1      -1      21      1       0       0       0
        0       0       0       0       0       0       0       #
2012    1       5       0       1       1       -1      -1      21      1       0       0       0
        0       0       0       0       0       0       0       #
2013    1       5       0       1       1       -1      -1      21      1       0       0       0
        0       0       0       0       0       0       0       #

0 #_N_MeanSize-at-Age_obs
0 #_N_environ_variables
0 #_N_environ_obs
0 # N sizds to read
0 # no tag data
0 # no morphcomp data
999
ENDDATA
```

3.6.4 Forecast File:

```
#V3.20b
#C  generic forecast file
# for all year entries except rebuilder; enter either: actual year, -999 for styr, 0 for endyr, neg number for rel. endyr
1 # Benchmarks: 0=skip; 1=calc F_spr,F_btgt,F_msy
2 # MSY: 1= set to F(SPR); 2=calc F(MSY); 3=set to F(Btgt); 4=set to F(endyr)
0.3 # SPR target (e.g. 0.40)
0.3 # Biomass target (e.g. 0.40)
#_Bmark_years: beg_bio, end_bio, beg_selex, end_selex, beg_relF, end_relF (enter actual year, or values of 0 or -integer to be rel. endyr)
 0 0 0 0 0 0
#  2010 2010 2010 2010 2010 2010 # after processing
1 #Bmark_relF_Basis: 1 = use year range; 2 = set relF same as forecast below
#
0 # Forecast: 0=none; 1=F(SPR); 2=F(MSY) 3=F(Btgt); 4=Ave F (uses first-last relF yrs); 5=input annual F scalar
0 # N forecast years
0 # F scalar (only used for Do_Forecast==5)
#_Fcast_years:  beg_selex, end_selex, beg_relF, end_relF  (enter actual year, or values of 0 or -integer to be rel. endyr)
 1.20327e-306 1.20323e-306 1.2032e-306 1.20317e-306
#  0 1667592815 7631713 0 # after processing
0 # Control rule method (1=catch=f(SSB) west coast; 2=F=f(SSB) )
0 # Control rule Biomass level for constant F (as frac of Bzero, e.g. 0.40); (Must be > the no F level below)
0 # Control rule Biomass level for no F (as frac of Bzero, e.g. 0.10)
0 # Control rule target as fraction of Flimit (e.g. 0.75)
0 #_N forecast loops (1=OFL only; 2=ABC; 3=get F from forecast ABC catch with allocations applied)
0 #_First forecast loop with stochastic recruitment
0 #_Forecast loop control #3 (reserved for future bells&whistles)
0 #_Forecast loop control #4 (reserved for future bells&whistles)
0 #_Forecast loop control #5 (reserved for future bells&whistles)
0  #FirstYear for caps and allocations (should be after years with fixed inputs)
0 # stddev of log(realized catch/target catch) in forecast (set value>0.0 to cause active impl_error)
0 # Do West Coast gfish rebuilder output (0/1)
0 # Rebuilder:  first year catch could have been set to zero (Ydecl)(-1 to set to 1999)
0 # Rebuilder:  year for current age structure (Yinit) (-1 to set to endyear+1)
1 # fleet relative F:  1=use first-last alloc year; 2=read seas(row) x fleet(col) below
# Note that fleet allocation is used directly as average F if Do_Forecast=4
0 # basis for fcast catch tuning and for fcast catch caps and allocation  (2=deadbio; 3=retainbio; 5=deadnum; 6=retainnum)
# Conditional input if relative F choice = 2
# Fleet relative F:  rows are seasons, columns are fleets
#_Fleet:  CM_E CM_W REC SMP_BYC
#  0 0 0 0
# max totalcatch by fleet (-1 to have no max) must enter value for each fleet
# max totalcatch by area (-1 to have no max); must enter value for each fleet
# fleet assignment to allocation group (enter group ID# for each fleet, 0 for not included in an alloc group)
#_Conditional on >1 allocation group
# allocation fraction for each of: 0 allocation groups
# no allocation groups
0 # Number of forecast catch levels to input (else calc catch from forecast F)
0 # basis for input Fcast catch:  2=dead catch; 3=retained catch; 99=input Hrate(F) (units are from fleetunits; note new codes in SSV3.20)
# Input fixed catch values
#Year Seas Fleet Catch(or_F)
#
999 # verify end of input
```