SEDAR
Southeast Data, Assessment, and Review

SEDAR 64
Stock Assessment Report

Southeastern US Yellowtail Snapper

March 2020

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

Table of Contents

SEDAR

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SECTION I: Introduction

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Overview

SEDAR 64 addressed the stock assessment for Southeastern US Yellowtail Snapper. The assessment process consisted of two in-person workshops, as well as a series of webinars. The Data Workshop was held June 25-27, 2019 in Saint Petersburg, Florida the Assessment Process was conducted via webinars September - December 2019, and the Review Workshop took place February 24-26, 2020 in Saint Petersburg, Florida.

The Stock Assessment Report is organized into 6 sections. Section I – Introduction contains a brief description of the SEDAR Process, Assessment and Management Histories for the species of interest, and the management specifications requested by the Cooperator. The Data Workshop Report can be found in Section II. It documents the discussions and data recommendations from the Data Workshop Panel. Section III is the Assessment Process report. This section details the assessment model, as well as documents any changes to the data recommendations that may have occurred after the data workshop. Consolidated Research Recommendations from all three stages of the process (data, assessment, and review) can be found in Section IV for easy reference. Section V documents the discussions and findings of the Review Workshop (RW). Finally, Section VI – Addenda and Post-Review Workshop Documentation consists of any analyses conducted during or after the RW to address reviewer concerns or requests. It may also contain documentation of the final RW-recommended base model, should it differ from the model put forward in the Assessment Report for review.

The final Stock Assessment Reports (SAR) for Southeastern US yellowtail snapper was disseminated to the public in March 2020. The Gulf of Mexico and South Atlantic Council's Scientific and Statistical Committee (SSC) will review the SAR. The SSCs are tasked with recommending whether the assessments represent Best Available Science, whether the results presented in the SARs are useful for providing management advice and developing fishing level recommendations for the Council. An SSC may request additional analyses be conducted or may use the information provided in the SAR as the basis for their Fishing Level Recommendations (e.g., Overfishing Limit and Acceptable Biological Catch). A review of the assessment will be conducted by the Gulf of Mexico Fishery Management Council's SSC, including a subset of the South Atlantic Fishery Management Council's SSC at its July 2020 meeting, followed by the Councils receiving that information at their August and September 2020. Documentation on SSC recommendations is not part of the SEDAR process and is handled through each Council.

1 SEDAR PROCESS DESCRIPTION

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

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

SEDAR is normally 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 workshop and/or a series of webinars, during which assessment models are developed and population parameters are estimated using the information provided from the Data Workshop. The final step 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 stages 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.

2 MANAGEMENT OVERVIEW

2.1. Fishery Management Plans and Amendments

The following summary describes only those management actions in the southeastern U.S. in the jurisdictions of the South Atlantic Fishery Management Council (SAFMC), the Gulf of Mexico Fishery Management Council (GMFMC), and the Florida Fish and Wildlife Conservation Commission (FWC) that were likely to affect yellowtail snapper fisheries and harvest.

Original SAMFC FMP

The Fishery Management Plan (FMP), Regulatory Impact Review, and Final Environmental Impact Statement for the Snapper Grouper Fishery of the South Atlantic Region, approved in 1983 and implemented in August of 1983, establishes a management regime for the fishery for snappers, groupers, and related demersal species of the continental shelf of the southeastern United States in the fishery exclusive economic zone (EEZ) under the area of authority of the South Atlantic Fishery Management Council (SAFMC) and the territorial seas of the states, extending from the North Carolina/Virginia border through the Atlantic side of the Florida Keys to 83° W longitude. Regulations apply only to federal waters.

SAFMC FMP Amendments affecting yellowtail snapper

Description of Action	**FMP/Amendment**	**Effective Date**
4” trawl mesh; 12” (305mm) TL minimum size limit for yellowtail snapper; gear limitations (poisons, explosives, fish traps, trawls)	Snapper Grouper FMP	08/31/1983
Trawls prohibited south of Cape Hatteras, NC and north of Cape Canaveral, FL	Amendment 1 (1988)	01/12/1989
Fish traps prohibited, entanglement nets & longlines within 50 fathoms prohibited, 12” TL limit – red porgy, vermilion snapper (commercial only), gray, yellowtail, mutton, schoolmaster, queen, blackfin, cubera, dog, mahogany, and silk snappers; aggregate bag limit of 10 snappers (including yellowtail snapper, and excluding lane, vermilion, and allowing no more than 2 red snappers); spawning season closure – commercial harvest greater amberjack > 3 fish bag prohibited in April and commercial harvest mutton snapper > snapper aggregate prohibited during May and June.	Amendment 4 (1991)	01/01/1992
Limited entry program: transferable permits and 225-lb non-transferable permits	Amendment 8	12/14/1998

	(1997)	
Greater amberjack: 1 fish rec. bag limit; no harvest or possession > bag limit, and no purchase or sale, during April; began fishing year May 1. Black grouper: 24” TL (recreational and commercial); no harvest or possession > bag limit, and no purchase or sale, during March and April.	Amendment 9 (1998)	2/24/1999
MSY proxy for yellowtail snapper is 30% static SPR; OY proxy is 40% static SPR; MSST = [(1-M) or 0.5 whichever is greater]*B_{MSY}. MFMT = F_{MSY}.	Amendment 11 (1998)	12/02/1999
Commercial trip limit for greater amberjack	Amendment 9 (1998) resubmitted	10/13/2000
Established eight deepwater Type II marine protected areas to protect a portion of the population and habitat of long-lived deepwater snapper grouper species	Amendment 14 (2007)	02/12/2009
Prohibited the sale of snapper grouper species harvested or possessed in the EEZ under the bag limits and prohibited the sale of snapper-grouper harvested or possessed under the bag limits by vessels with a Federal charter vessel/headboat permit for South Atlantic snapper-grouper regardless of where harvested;	Amendment 15B (2008)	12/16/2009
Required commercial and recreational fishermen to use, as needed, dehooking devices when catching snapper grouper species to reduce recreational and commercial bycatch mortality.	Amendment 16 (2009)	07/29/2009
Required use of non-stainless-steel circle hooks when fishing for snapper grouper species with	Amendment 17A (2010)	03/03/2011

hook-and-line gear with natural baits north of 28 deg. N latitude in the South Atlantic EEZ;		
Reorganized FMU into 6 complexes (deepwater, jacks, snappers, grunts, shallow-water groupers, porgies) (see final rule for species list); established acceptable biological catch (ABC) control rules and established ABCs, ACLs, and AMs for species not undergoing overfishing, including yellowtail snapper; established jurisdictional ABC allocation between SAFMC and GMFC for yellowtail snapper, mutton snapper, and black grouper; removed some species from South Atlantic FMU and designated others as ecosystem component species; specified allocations between the commercial and, recreational sectors for species not undergoing overfishing, including yellowtail snapper.	Amendment 25 (included in the Comprehensive ACL Amendment) (2011)	4/16/2012
Modified AMs for snapper grouper species, including yellowtail snapper	Amendment 34 (included in the Generic AMs Amendment) (2015)	2/22/2016
Removed black snapper, dog snapper, mahogany snapper, and schoolmaster from the FMU	Amendment 35 (2015)	6/22/2016
Established SMZs to enhance protection for snapper grouper species in spawning condition	Amendment 36 (2016)	7/31/2017

SAFMC FMP Regulatory Amendments

Description of Action	**FMP/Amendment**	**Effective Date**
Established trip limits for vermilion snapper and gag; increased trip limit for greater amberjack	Regulatory Amendment 9 (2010)	7/15/2011
Modified ACLs and OY for yellowtail snapper: Comm ACL = 1,596,510 lbs ww	Regulatory Amendment 15	9/12/2013

Rec ACL = 1,440,990 lbs ww Rec ACT = 1,253,661 lbs ww	(2013)	
Modified the definition of the overfished threshold (MSST) for red snapper, blueline tilefish, gag, black grouper, yellowtail snapper, vermilion snapper, red porgy, and greater amberjack. MSST=75%SSB_{MSY}	Regulatory Amendment 21 (2014)	11/6/2014
Changed the commercial and recreational fishing year for yellowtail snapper from calendar year to August-July.	Regulatory Amendment 25 (2016)	8/12/2016
Modify in-season accountability measures to reduce possibility of in-season closures	Regulatory Amendment 32	TBD

ORIGINAL GMFMC FMP

The Fishery Management Plan (FMP) for the reef fish fishery of the Gulf of Mexico was implemented on November 8, 1984. This plan is for the management of reef fish resources under the authority of the Gulf of Mexico Fishery Management Council. The plan considers reef fish resources throughout its range from Florida through Texas. The areas which will be regulated by the federal government under this plan is confined to the waters of the fishery conservation zone (FCZ). The estimated area of the FCZ is 6.82 x 10^5 km^2 (263,525 square miles) and of that 12.4% of it is estimated as part of the continental shelf that is encompassed within the FCZ. Yellowtail snapper is one of the many species included in the fishery management unit. The four objectives of the FMP were: (1) to rebuild the declining reef fish stocks wherever they occur within the fishery; (2) establish a fishery reporting system for monitoring the reef fish fishery; (3) conserve reef fish habitats and increase reef fish habitats in appropriate areas and to provide protection for juveniles while protecting existing new habitats; (4) to minimize conflicts between user groups of the resource and conflicts for space.

Measures in the original FMP that would have affected the harvest of yellowtail snapper are maximum sustainable yield (MSY and optimum yield (OY) estimates for all grouper and snapper species in aggregate, permits and gear specifications for fish traps along with a limit on the number of fish traps allowed per vessel, establishment of a stressed area within which the use of fish traps, roller trawls, and powerheads for the taking of reef fish was prohibited, and a prohibition on the use of poison or explosives for taking reef fish.

GMFMC FMP AMENDMENTS AFFECTING YELLOWTAIL SNAPPER

Description of Action	FMP/Amendment	Effective Date
MSY and OY estimates for all groupers and snappers in aggregate, permits and gear specifications for fish traps and limits on the number of fish traps allowed per vessel, establishment of a stressed area within which the use of fish traps, roller trawls, and powerheads for reef fish harvest was prohibited, explosives and poisons for taking reef fish prohibited.	Reef Fish FMP	[Submitted 8/1981] 11/08/1984
The stressed area was expanded, and a longline/buoy gear boundary was established. The number of fish traps allowed per vessel was reduced from 200 to 100. Reef fish permits were required for commercial reef fish vessels. Commercial harvest of reef fish using trawls or entangling nets was prohibited. Reporting requirements established for commercial and for-hire recreational vessels, 12” TL minimum size limit for yellowtail snapper adopted, 10 fish aggregate recreational bag limit for snappers (including yellowtail snapper) implemented, prohibited use of entangling gear for direct harvest, reef fish vessel permit established with an income qualification.	Amendment 1 (1990)	[Submitted 8/1989] 02/21/1990
Moratorium on new reef fish permits which was extended at various times and was in effect through 2005.	Amendment 4	05/1992
Established a 10-year phase-out of fish traps.	Amendment 14	03-04/1997
Prohibited harvest of reef fish from traps other than permitted reef fish traps, stone crab traps, or spiny lobster traps.	Amendment 15	01/1998
Prohibited retention of reef fish exhibiting “trap rash” on vessels with a reef fish permit that is	Amendment 16A	01/2000

fishing spiny lobster or stone crab traps except for vessels possessing a valid fish trap endorsement.		
Generic amendment addressing the establishment of the Tortugas Marine Reserves – establishes two marine reserves and prohibits fishing for any species and anchoring by fishing vessels inside the two marine reserves.	Amendment 19	08/19/2002
Commercial and recreational fishermen fishing for reef fish required to use non-stainless steel circle hooks when using natural baits, and to use dehooking and venting tools for releasing reef fish.	Amendment 27	02/2008
Established ABCs, ACLs, and AMs for species not undergoing overfishing, including yellowtail snapper; established jurisdictional ABC allocation between SAFMC and GMFMC for yellowtail snapper	Generic ACL/AM Amendment	01/2012

GMFMC FMP Regulatory Amendments

Increased the Gulf yellowtail snapper ACL from 725,000 lbs round weight to 901,125 lbs round weight, and removes the requirement to have onboard and use venting tools when releasing reef fish.	Reef Fish Framework Action	09/2013
Changed the commercial and recreational yellowtail snapper fishing year so that it opens on August 1 and runs through July 31, each year. Modified the circle hook requirement so that the use of circle hooks is not required while commercial fishing with natural bait for yellowtail snapper south of Cape Sable (the line extending due west from 25°09’ N. latitude off the west coast of Monroe County, Florida, to the Gulf and South Atlantic Councils’ shared boundary).	Reef Fish Framework Action	03/2017

ORIGINAL FWC REGULATIONS

Florida's management of reef fish fisheries, prior to the establishment of the Marine Fisheries Commission (MFC) in 1983, began with the implementation of size limits in 1979 (Florida Statutes in chapter 370.11) for several groupers (red, Nassau, gag, black, and goliath). In July of 1985, the Florida MFC implemented rules in the Florida Administrative Code (F.A.C.) to establish minimum 12" TL size limits for red, mutton, and yellowtail snapper. Later rules sought to achieve a higher level of conformance between state and federal (Council) regulations to reduce potential conflicts between state and federal management. After the merger of the Florida Department of Environmental Protection and the Florida Game and Freshwater Fish Commission by the Florida Legislature on July 1, 1999, the management functions of the MFC became part of the Florida Fish and Wildlife Conservation Commission (FWC).

FWC REGULATIONS AFFECTING YELLOWTAIL SNAPPER

Description of Action	Rule chapter	Effective Date
Established 12" TL minimum size for yellowtail snapper from state waters	F.A.C. Chap. 68-14	07/1985
Established a 10 fish aggregate bag limit for snappers (included yellowtail snapper, excluded lane, vermilion, and yelloweye [= silk] snappers). Stab nets (anchored, bottom gill nets) for the harvest of reef fish prohibited.	F.A.C. Chap. 68-14	12/1986
Required the appropriate federal permit to exceed the recreational bag limit in state waters.	F.A.C. Chap. 68-14	12/1992
Temporarily allowed fishermen to land reef fish in the Florida Keys if they possessed either South Atlantic snapper grouper permits or Gulf reef fish permits, with subsequent extensions of these provisions in July 1995 and January 1996.	F.A.C. Chap. 68-14	10/1993
Prohibited commercial fishermen from harvesting or possessing the recreational bag limit of reef fish species on commercial trips.	F.A.C. Chap. 68-14	07/2007
Required commercial and recreational anglers fishing for any Gulf reef fish species to use circle hooks, de-hooking devices, and venting tools.	F.A.C. Chap. 68-14	06/2008

2.2. Emergency and Interim Rules

SAFMC:

- Increased the commercial ACL for yellowtail snapper from 1,142,589 lbs to 1,596,510 lbs – Effective 11/7/2012 through 5/6/2013.

GMFMC: None

2.3. Secretarial Amendments

SAFMC: None

GMFMC: None

2.4. Control Date Notices

SAFMC:

Notice of Control Date (07/30/91 56 FR 36052) - Anyone entering federal snapper grouper fishery (other than for wreckfish) in the EEZ off S. Atlantic states after 07/30/91 was not assured of future access if limited entry program developed.

Notice of Control Date (10/14/05 70 FR 60058) - Anyone entering federal snapper grouper fishery off S. Atlantic states after 10/14/05 was not assured of future access if limited entry program developed.

Notice of Control Date (3/8/07 72 FR 60794) - Considered measures to limit participation in the snapper grouper for-hire sector effective 3/8/07.

Notice of Control Date (01/31/11 76 FR 5325) - Anyone entering federal snapper grouper fishery off S. Atlantic states after 09/17/10 was not assured of future access if limited entry program developed.

Notice of Control Date (06/15/2016 81 FR 66244) - fishermen who enter the federal for-hire recreational sector for the Snapper Grouper fishery after June 15, 2016, will not be assured of future access should a management regime that limits participation in the sector be prepared and implemented.

GMFMC: None

2.5. Management Program Specifications

Table 2.5.1. General Management Information

South Atlantic

Species	Yellowtail Snapper (*Ocyurus chrysurus*)
Management Unit	Southeastern U.S.
Management Unit Definition	All waters within the South Atlantic Fishery Management Council boundaries. Defined as the economic zone (EEZ), 200 miles from state boundary line.
Management Entity	South Atlantic Fishery Management Council
Management Contacts SERO/Council	Rick DeVictor/Myra Brouwer
Stock exploitation status (as of SEDAR 27A, 2012)	Not undergoing overfishing
Stock biomass status as of SEDAR 27A, 2012)	Not overfished

Gulf of Mexico

Species	Yellowtail Snapper (*Ocyurus chrysurus*)
Management Unit	U. S. Gulf of Mexico
Management Unit Definition	All waters within the Gulf of Mexico Fishery Management Council boundaries. Defined as the economic zone (EEZ), 200 miles from state boundary line.
Management Entity	Gulf of Mexico Fishery Management Council
Management Contacts SERO/Council	Peter Hood/Ryan Rindone
Stock exploitation status (as of SEDAR 27A, 2012)	Not undergoing overfishing
Stock biomass status as of SEDAR 27A, 2012)	Not overfished

Table 2.5.2. Specific Management Criteria

South Atlantic and Gulf of Mexico*				
Criteria	Current (SEDAR 27A, 2012)		Results from SEDAR 64	
	Definition	Value**	Definition	Value
MSST	(1-M)*SSBMSY	583.6 mt (5.49 mp)	[(1-M) or 0.5, whichever is greater] *SSBMSY (The estimated spawning stock biomass at MSY)	TBD
MFMT	FMSY	0.24 per year	FMSY	TBD
MSY	Yield at FMSY at equilibrium	4.51 mp	Yield at FMSY	TBD
FMSY	F that produces MSY	0.24 per year	F that produces MSY	TBD
SSB30%SPR	Spawning stock biomass at equilibrium when F=F30%SPR	3,072 mt (6.77 mp)	Spawning stock biomass at equilibrium when F=FMSY	
BMSY	Total biomass at equilibrium when F=FMSY		Total biomass at equilibrium when F=FMSY	
OY	Yield at FOY at equilibrium		Yield at FOY	TBD
FTARGET (i.e. FOY)	F at 40% SPR	0.19	F at 40% SPR	TBD
Yield at FTARGET (equilibrium)	Landings and discards, pounds and numbers			
M	Natural mortality rate used to scale Age-Specific M	0.194	Natural mortality rate used to scale Age-Specific M	TBD
Current F	Exploitation in terminal year (F2010)	0.0454 per year	Exploitation in terminal year (F2017)	TBD
Terminal Biomass1	Biomass in terminal year (SSB2010)	10,311 mt (22,732 mp)	Biomass in terminal year (SSB2017)	TBD
Exploitation Status (F)	F2010/FMSY	0.189	F2017/FMSY	TBD
Biomass Status1 (SSB)	SSB2010/MSST	4.144	SSB2017/MSST	TBD
	SSB2010/SSB30%SPR	3.357	SSB2017/SSB30%SPR	TBD
Generation Time				
TREBUILD (if appropriate)				

Table 2.5.3. Stock Rebuilding Information

The yellowtail snapper is not under a rebuilding plan.

Table 2.5.4. Stock projection information.

First Year of Management	2021
Interim basis	Recent SEDAR assessments have asked for ACL, if ACL is met Average exploitation, if ACL is not met
Projection Outputs	
Landings	Pounds and numbers
Discards	Pounds and numbers
Exploitation	F & Probability F>MFMT
Biomass (total or SSB, as appropriate)	B & Probability B>MSST (and Prob. $B>B_{MSY}$ if under rebuilding plan)
Recruits	Number

Table 2.5.5. Base Run Projections Specifications. Long Term and Equilibrium conditions.

Criteria	Definition	If overfished	If overfishing	Neither overfished nor overfishing
Projection Span	Years	$T_{REBUILD}$	10	10
Projection Values	$F_{CURRENT}$	X	X	X
	F_{MSY}	X	X	X
	75% F_{MSY}	X	X	X
	$F_{REBUILD}$	X		
	F=0	X		

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

Table 2.5.6. 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.

Basis	Value	Years to project	P* applies to
P*	50%	Interim + 5	Probability of overfishing
P*	40%	Interim + 5	Probability of overfishing
Exploitation	Fmsy	Interim + 5	NA
Exploitation	75% Fmsy	Interim + 5	NA

Table 2.5.7. South Atlantic Quota Calculation Details (Values are in lbs. whole weight)

	Commercial	Recreational	Total Annual Catch Limit
Current ACL Value	1,596,510	1,440,990	3,037,500
Next Scheduled Quota Change			
Annual or averaged quota?	Annual	Annual	
If averaged, number of years to average			
Does the quota account for bycatch/discard?	No	No	No

How is the quota calculated - conditioned upon exploitation or average landings?

The ACL is set equal to the ABC, which comes directly from the assessment projections. The yellowtail snapper total ACL is allocated 52.56% and 47.44% to the commercial and recreational sectors, respectively. Sector allocation = (0.5 * catch history) + (0.5 * current trend), where *catch history* = average landings 1986-2008 and the *current trend* = average landings 2006-2008.

Does the quota include bycatch/discard estimates? If so, what is the source of the bycatch/discard values? What are the bycatch/discard allowances?

The quota does not explicitly include estimates of discards in it. However, the projections assume a certain number of dead discards will occur when the quota is met and that the total F associated with both the landings and discards will not result in overfishing.

Are there additional details of which the analysts should be aware to properly determine quotas for this stock?

The yellowtail snapper ABC is apportioned 75% to the South Atlantic and 25% to the Gulf of Mexico Fishery Management Council jurisdictions. The stock is managed separately in each region.

Table 2.5.8. Gulf of Mexico Quota Calculation Details (Values are in lbs. whole weight)

	Total Annual Catch Limit
Current ACL Value	901,125
Next Scheduled Quota Change	-
Annual or averaged quota?	Annual
If averaged, number of years to average	-
Does the quota account for bycatch/discard?	No

How is the quota calculated - conditioned upon exploitation or average landings?

Conditioned on exploitation.

Does the quota include bycatch/discard estimates? If so, what is the source of the bycatch/discard values? What are the bycatch/discard allowances?

No.

2.6. Management and Regulatory Timeline

Table 2.6.1. Pertinent Federal Management Regulations – South Atlantic Region

Harvest Restrictions – Trip Limits*

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

First Yr In Effect	Effective Date	End Date	Fishery	Bag Limit Per Person/Day	Bag Limit Per Boat/Day	Region Affected	Amendment Number or Rule Type
1983	8/31/83	Ongoing	Comm	None	None	South Atlantic	Snapper Grouper FMP
1983	8/31/83	12/31/91	Rec	None	None	South Atlantic	Snapper Grouper FMP
1992	1/1/92	Ongoing	Rec	Aggregate bag limit of 10 snappers (including yellowtail snapper, and excluding lane, vermilion, and allowing no more than 2 red snappers)		South Atlantic	Amendment 4

Harvest Restrictions (Size Limits*)

*Size limits do not apply during closures

First Yr In Effect	Effective Date	End Date	Fishery	Size Limit	Length Type	Region Affected	FR Reference	Amendment Number or Rule Type
1983	8/31/98	12/31/91	Commercial	12 inches	TL	South Atlantic		Sanpper Grouper FMP
1983	8/31/98	12/31/91	Rec	12 inches	TL	South Atlantic		Sanpper Grouper FMP
1992	1/1/92	Ongoing	Commercial	12 inches	TL	South Atlantic	56 FR 56016	Amendment 4
1992	1/1/92	Ongoing	Rec	12 inches	TL	South Atlantic	56 FR 56016	Amendment 4

Harvest Restrictions (Fishery Closures*)

*Area specific regulations are documented under spatial restrictions

First Yr In Effect	Effective Date	End Date	Fishery	Closure Type	First Day Closed	Last Day Closed	Region Affected	FR Reference	Amendment Number or Rule Type
2015	10/31/15	12/31/15	Commercial	ACL	10/31/15	12/31/15	SA	80 FR 65970	Temporary Rule
2017	6/3/17	8/1/17	Commercial	ACL	6/3/17	7/31/17	SA	82 FR 25205	Temporary Rule
2018	6/5/18	8/1/18	Commercial	ACL	6/5/18	7/31/18	SA	83 FR 24944	Temporary Rule

Harvest Restrictions (Spatial Restrictions)

There are no spatial restrictions for yellowtail snapper in the South Atlantic.

Harvest Restrictions (Gear Restrictions*)

*Area specific gear regulations are documented under Spatial Restrictions

Gear Type	First Yr In Effect	Effective Date	End Date	Gear/Harvesting Restrictions	Region Affected	FR Reference	Amendment Number or Rule Type
Poison	1983	8/31/83	ongoing	Prohibited	South Atlantic EEZ	48 FR 39463	SG FMP
Explosives	1983	8/31/83	ongoing	Prohibited	South Atlantic EEZ	48 FR 39463	SG FMP
Fish traps	1983	8/31/83	12/31/91	Prohibited shoreward of the 100 ft contour, south of Fowey Rocks Light (Miami). Restriction on pulling traps from one hour before sunset to one hour before sunrise south of Cape Canaveral. Gear specs (degradaable panel, degradable door fasteners, mesh size).	South Atlantic EEZ	48 FR 39463	SG FMP
Hand-held hook and line and spearfishing	1987	3/27/87	ongoing	Only gear allowed in Special Management Zones	SMZs within the South Atlantic EEZ	52 FR 9864	Regulatory Amendment 1
Trawl	1989	1/12/89	ongoing	Prohibited south of Cape Hatteras, NC and north of Cape Canaveral, FL	specified area within the South Atlantic EEZ	54 FR 1720	Amendment 1
Fish traps	1992	1/1/92	ongoing	Prohibited fish traps (except black sea bass pots) north of Cape Canaveral, FL	specified area within the South Atlantic EEZ	56 FR 56016	Amendment 4

Entanglement nets	1992	1/1/92	ongoing	Prohibited	South Atlantic EEZ	56 FR 56016	Amendment 4
Longline	1992	1/1/92	ongoing	Prohibited inside of 50 fathoms	specified area within the South Atlantic EEZ	56 FR 56016	Amendment 4
Powerheads and bangsticks	1992	1/1/92	ongoing	Prohibited in SMZs off South Carolina	specific areas off SC	56 FR 56016	Amendment 4
Allowable gear	1995	1/23/95	ongoing	Specified allowable gear in the SG fishery	South Atlantic EEZ	59 FR 66270	Amendment 7
Non-stainless steel circle hooks	2011	3/3/11	ongoing	Required to fish for SG species with natural baits north of 28 egrees N Lat.	specified area within the South Atlantic EEZ	75 FR 76874	Amendment 17A

Quota History – Recreational

First Yr In Effect	Effective Date	End Date	Quota or ACL	Region Affected	FR Reference	Amendment Number or Rule Type
2012	4/16/12	9/11/13	1,031,286 lbs ww	South Atlantic	77 FR 15916	Comp ACL Amendment (SG Am 25)
2013	9/12/13	current	1,440,990 lbs ww	South Atlantic	78 FR 49183	Regulatory Amendment 15

Quota History – Commercial

First Yr In Effect	Effective Date	End Date	Quota or ACL	Species Complex	Region Affected	FR Reference	Amendment Number or Rule Type
2012	4/16/12	11/6/12	1,142,589 lbs ww	SG	South Altantic	77 FR 15916	Comp ACL Amendment (SG Am 25)
2012/2013	11/7/12	5/5/13	1,596,510 lbs ww	SG	South Altantic	77 FR 66744	Temporary Rule
2013	5/6/13	11/28/13	1,596,510 lbs ww	SG	South Altantic	78 FR 25213	Temporary Rule Extension
2013	9/12/13	Ongoing	1,596,510 lbs ww	SG	South Altantic	78 FR 49183	Regulatory Amendment 15

Table 2.6.2. Pertinent Federal Management Regulations – Gulf of Mexico Region

Harvest Restrictions – Trip Limits*

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

First Yr In Effect	Effective Date	End Date	Fishery	Bag Limit Per Person/Day	Bag Limit Per Boat/Day	Region Affected	Amendment Number or Rule Type
1984	11/8/84	Present	Comm	-	-	Gulf of Mexico	Original Reef Fish FMP
1984	11/8/84	2/20/90	Rec	-	-	Gulf of Mexico	Original Reef Fish FMP
1990	2/21/90	Present	Rec	10 fish	-	Gulf of Mexico	Reef Fish Amendment 1

Harvest Restrictions (Size Limits*)

*Size limits do not apply during closures

First Yr In Effect	Effective Date	End Date	Fishery	Size Limit	Length Type	Region Affected	Amendment Number or Rule Type
1990	2/21/90	Present	Comm	12"	TL	Gulf of Mexico and South Atlantic	Reef Fish Amendment 1
1990	2/21/90	Present	Rec	12"	TL	Gulf of Mexico and South Atlantic	Reef Fish Amendment 1

Harvest Restrictions (Fishery Closures*)

There were no fishery closures for yellowtail snapper in the Gulf of Mexico.

Harvest Restrictions (Spatial Restrictions)

Area	First Yr In Effect	Last Yr In Effect	Effective Date	End Date	Fishery	First Day Closed	Last Day Closed	Restriction in Area	FR Reference	FR Section	Amendment Number or Rule Type
Gulf of Mexico Stressed Areas	1984	Ongoing	11/8/84	Ongoing	Both	Year round		Prohibited powerheads for Reef FMP	49 FR 39548	641.7	Original Reef Fish FMP
	1984	Ongoing	11/8/84	Ongoing	Both	Year round		Prohibited pots and traps for Reef FMP	49 FR 39548	641.7	Original Reef Fish FMP
Alabama Special Management Zones	1994	Ongoing	2/7/94	Ongoing	Both	Year round		Allow only hook-and line gear with three or less hooks per line and spearfishing gear for fish in Reef FMP	59 FR 966	641.23	Reef Fish Amendment 5
EEZ, inside 50 fathoms west of Cape San Blas, FL	1990	Ongoing	2/21/90	Ongoing	Both	Year round		Prohibited longline and buoy gear for Reef FMP	55 FR 2078	641.7	Reef Fish Amendment 1
EEZ, inside 20 fathoms east of Cape San Blas, FL	1990	Ongoing	2/21/90	Ongoing	Both	Year round		Prohibited longline and buoy gear for Reef FMP	55 FR 2078	NA	Reef Fish Amendment 1
EEZ, inside 50 fathoms east of Cape San Blas, FL	2009	2009	5/18/09	10/15/09	Both	18-May	28-Oct	Prohibited bottom longline for Reef FMP	74 FR 20229	622.34	Emergency Rule
EEZ, inside 35 fathoms east of	2009	2010	10/16/09	5/25/10	Both	Year round		Prohibited bottom	74 FR 53889	223.206	Sea Turtle ESA Rule

Cape San Blas, FL								longline for Reef FMP			
	2010	Ongoing	5/26/10	Ongoing	Rec	Year round		Prohibited bottom longline for Reef FMP	75 FR 21512	622.34	Reef Fish Amendment 31
	2010	Ongoing	5/26/10	Ongoing	Com	1-Jun	31-Aug	Prohibited bottom longline for Reef FMP	75 FR 21512	622.34	Reef Fish Amendment 31
Madison-Swanson	2000	2004	6/19/00	6/2/04	Both	Year round		Fishing prohibited except HMS[1]	65 FR 31827	622.34	Reef Fish Regulatory Amendment
	2004	Ongoing	6/3/04	Ongoing	Both	1-May	31-Oct	Fishing prohibited except surface trolling	70 FR 24532 74 FR 17603	622.34 NA	Reef Fish Amendment 21 Reef Fish Amendment 30B
	2004	Ongoing	6/3/04	Ongoing	Both	1-Nov	30-Apr	Fishing prohibited except HMS[1]	70 FR 24532 74 FR 17603	622.34 NA	Reef Fish Amendment 21 Reef Fish Amendment 30B
Steamboat Lumps	2000	2004	6/19/00	6/2/04	Both	Year round		Fishing prohibited except HMS[1]	65 FR 31827	622.34	Reef Fish Regulatory Amendment
	2004	Ongoing	6/3/04	Ongoing	Both	1-May	31-Oct	Fishing prohibited except surface trolling	70 FR 24532 74 FR 17603	622.34 NA	Reef Fish Amendment 21 Reef Fish Amendment 30B
	2004	Ongoing	6/3/04	Ongoing	Both	1-Nov	30-Apr	Fishing prohibited except HMS[1]	70 FR 24532 74 FR 17603	622.34 NA	Reef Fish Amendment 21 Reef Fish Amendment 30B
The Edges	2010	Ongoing	7/24/09	Ongoing	Both	1-Jan	30-Apr	Fishing prohibited	74 FR 30001	622.34	Reef Fish Amendment 30B Suppleme

20 Fathom Break	2014	Ongoing	7/5/13	Ongoing	Rec	1-Feb	31-Mar	Fishing for SWG prohibited[2]	78 FR 33259	622.34	Reef Fish Framework Action
Flower Garden	1992	Ongoing	1/17/92	Ongoing	Both	Year round		Fishing with bottom gears prohibited[3]	56 FR 63634 70 FR 76216	934 622.34	Sanctuary Designation Essential Fish Habitat Amendment 3
Riley's Hump	1994	2002	2/7/94	8/18/02	Both	1-May	30-Jun	Fishing prohibited	59 FR 966	641.23	Reef Fish Amendment 5
Tortugas Reserves	2002	Ongoing	8/19/02	Ongoing	Both	Year round		Fishing prohibited	67 FR 47467 70 FR 76216	635.71 622.34	Tortugas Amendment Essential Fish Habitat Amendment 3
Pulley Ridge	2006	Ongoing	1/23/06	Ongoing	Both	Year round		Fishing with bottom gears prohibited[3]	70 FR 76216	622.34	Essential Fish Habitat Amendment 3
McGrail Bank	2006	Ongoing	1/23/06	Ongoing	Both	Year round		Fishing with bottom gears prohibited[3]	70 FR 76216	622.34	Essential Fish Habitat Amendment 3
Stetson Bank	2006	Ongoing	1/23/06	Ongoing	Both	Year round		Fishing with bottom gears prohibited[3]	70 FR 76216	622.34	Essential Fish Habitat Amendment 3

[1] HMS: highly migratory species (tuna species, marlin, oceanic sharks, sailfishes, and swordfish)

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

[3] Bottom gears: Bottom longline, bottom trawl, buoy gear, pot, or trap

Harvest Restrictions (Gear Restrictions*)

*Area specific gear regulations are documented under Spatial Restrictions

Gear Type	First Yr In Effect	Last Yr In Effect	Effective Date	End Date	Gear/Harvesting Restrictions	Region Affected	FR Reference	FR Section	Amendment Number or Rule Type
Poison	1984	Ongoing	11/8/84	Ongoing	Prohibited for Reef FMP	Gulf of Mexico EEZ	49 FR 39548	641.24	Original Reef Fish FMP
Explosives	1984	Ongoing	11/8/84	Ongoing	Prohibited for Reef FMP	Gulf of Mexico EEZ	49 FR 39548	641.24	Original Reef Fish FMP
Pots and Traps	1984	1994	11/23/84	2/6/94	Established fish trap permit	Gulf of Mexico EEZ	49 FR 39548	641.4	Original Reef Fish FMP
	1984	1990	11/23/84	2/20/90	Set max number of traps fish by a vessel at 200	Gulf of Mexico EEZ	49 FR 39548	641.25	Original Reef Fish FMP
	1990	1994	2/21/90	2/6/94	Set max number of traps fish by a vessel at 100	Gulf of Mexico EEZ	55 FR 2078	641.22	Reef Fish Amendment 1
	1994	1997	2/7/94	2/7/97	Moratorium on additional commercial trap permits	Gulf of Mexico EEZ	59 FR 966	641.4	Reef Fish Amendment 5
	1997	2007	3/25/97	2/7/07	Phase out of fish traps begins	Gulf of Mexico EEZ	62 FR 13983	622.4	Reef Fish Amendment 14
	1997	2007	1/29/88	2/7/07	Prohibited harvest of reef fish from traps other than permited reef fish, stone crab, or spiny lobster traps.	Gulf of Mexico EEZ	62 FR 67714	622.39	Reef Fish Amendment 15
	2007	Ongoing	2/8/07	Ongoing	Traps prohibited	Gulf of Mexico EEZ	62 FR 13983	622.31	Reef Fish Amendment 14

All	1992	1995	5/8/92	12/31/95	Moratorium on commercial permits for Reef FMP	Gulf of Mexico EEZ	59 FR 11914 59 FR 39301	641.4 641.4	Reef Fish Amendment 4 Reef Fish Amendment 9
	1994	Ongoing	2/7/94	Ongoing	Finfish must have head and fins intact through landing, can be eviscerated, gilled, and scaled but must otherwise be whole (HMS and bait exceptions)	Gulf of Mexico EEZ	59 FR 966	641.21	Reef Fish Amendment 5
	1996	2005	7/1/96	12/31/05	Moratorium on commercial permits for Gulf reef fish	Gulf of Mexico EEZ	61 FR 34930 65 FR 41016	622.4 622.4	Interim Rule Reef Fish Amendment 17
	2006	Ongoing	9/8/06	Ongoing	Use of Gulf reef fish as bait prohibited[1]	Gulf of Mexico EEZ	71 FR 45428	622.31	Reef Fish Amendment 18A
Vertical Line	2008	Ongoing	6/1/08	Ongoing for Rec only: See Next	Requires non-stainless steel circle hooks and dehooking devices	Gulf of Mexico EEZ	74 FR 5117	322.41	Reef Fish Amendment 27
	2017	Ongoing	3/13/17	Ongoing: Comm only	Use of circle hooks is not required while commercial fishing with natural bait for yellowtail snapper south of Cape Sable (the line extending due west from 25°09’ N. latitude off the west coast of Monroe County, Florida, to the Gulf and South Atlantic Councils’ shared boundary	Gulf of Mexico EEZ	link	622	Reef Fish Framework Action

	2008	2013	6/1/08	9/3/13	Requires venting tools	Gulf of Mexico EEZ	74 FR 5117 78 FR 46820	322.41 NA	Reef Fish Amendment 27 Framework Action
Bottom Longline	2010	Ongoing	5/26/10	Ongoing	Limited to 1,000 hooks of which no more than 750 hooks are rigged for fishing or fished	Gulf of Mexico EEZ	75 FR 21512	622.34	Reef Fish Amendment 31

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

Gulf of Mexico Quota History

First Yr In Effect	Effective Date	End Date	Stock ACL	Stock ACT*	Region Affected	Amendment Number or Rule Type
2012	1/30/12	9/2/13	725,000 lbs ww	645,000 lbs ww	Gulf of Mexico	Generic ACL/AM Amendment
2013	9/3/13	12/31/13	901,125 lbs ww		Gulf of Mexico	Reef Fish Framework Action
2014	9/3/13	12/31/14	901,125 lbs ww		Gulf of Mexico	Reef Fish Framework Action
2015	9/3/13	12/31/15	901,125 lbs ww		Gulf of Mexico	Reef Fish Framework Action
2016	9/3/13	12/31/16	901,125 lbs ww		Gulf of Mexico	Reef Fish Framework Action
2017	9/3/13	12/31/17	901,125 lbs ww		Gulf of Mexico	Reef Fish Framework Action
2018	9/3/13	12/31/18	901,125 lbs ww		Gulf of Mexico	Reef Fish Framework Action

*Stock ACL removed in 2013

2.7. Closures Due to Meeting Commercial Quota or Commercial/Recreational ACL

South Atlantic:

Commercial: October 31, 2015; June 3, 2017; June 5, 2018

Recreational: None

Gulf of Mexico:

Commercial: None

Recreational: None

Table 7. State Regulatory History

Year	Florida	
	Minimum size (TL, inches)	Aggregate bag limit
1982	-----	-----
1983	-----	-----
1984	-----	-----
1985	12	-----
1986	12	10
1987	12	10
1988	12	10
1989	12	10
1990	12	10
1991	12	10
1992	12	10
1993	12	10
1994	12	10
1995	12	10
1996	12	10
1997	12	10
1998	12	10
1999	12	10
2000	12	10
2001	12	10
2002	12	10
2003	12	10
2004	12	10
2005	12	10
2006	12	10
2007	12	10
2008	12	10
2009	12	10
2010	12	10

3 ASSESSMENT HISTORY AND REVIEW

Prior to the first SEDAR for Southeastern U.S. Yellowtail Snapper (SEDAR 3 2003), Huntsman *et al.* (1992) reviewed catches of Yellowtail Snapper and performed catch curve and yield-per-recruit analyses to examine stock status using data through 1990. Huntsman *et al.* (1992) estimated that the first fully recruited age to the fishery was age-3 fish that the fishing mortality rate in 1988 was 0.28 yr^{-1} and in 1990 was 0.48 yr^{-1}, and the spawning stock-per-recruit ratio to fishing mortality in 1988 was 0.38 yr^{-1} and in 1990 was 0.19 yr^{-1}.

In SEDAR 3 (Muller *et al.* 2003), an age-structured assessment model (Integrated Catch-at-Age, ICA) was used to estimate stock status through 2001. ICA was a hybrid model (i.e., a combination of separable and classical virtual population analysis) which used a backward projection instead of the more familiar forward projection method; thus, ICA solved for the population numbers in the most recent year and the number of the fish in the oldest age bin which together with the selectivity and annual fishing mortality rates allowed the calculation of the numbers of fish by age and year and the corresponding predicted catch-at-age. Muller *et al.* (2003) estimated that the age-6 fishing mortality rate in 2001 was 0.21 yr_{-1} and SSB in 2001 was 5,198 metric tons, that SSB_{2001}/SSB_{MSST} was 1.06 (not overfished) and F_{2001}/F_{MFMT} was 0.65 (not overfishing). Model estimates for age-6 fishing mortality rates during 1988 and 1990 were 0.24 yr_{-1} and 0.28 yr_{-1}, respectively (Muller *et al.* 2003).

The second SEDAR assessment for Southeastern U.S. Yellowtail Snapper (SEDAR 27A, O'Hop *et al.* 2012) was completed in 2012 and applied a forward-projecting, statistical catch-at-age model (ASAP2) to data from 1981 – 2010. This type of model required catch-at-age and mean weight-at-age matrices, as well as age-based selectivities. O'Hop *et al.* (2012) estimated that the age-5 fishing mortality rate in 2010 was 0.05 yr_{-1} and SSB in 2010 was 10,311 metric tons, that SSB_{2010}/SSB_{MSST} was 3.36 (not overfished) and F_{2010}/F_{MFMT} was 0.15 (not overfishing). Model estimates for age-5 fishing mortality rates during 1988, 1990, and 2001 were 0.10 yr_{-1}, 0.11 yr_{-1}, 0.06 yr_{-1} respectively (O'Hop et al. 2012).

Huntsman. O.R, Potts, J.C., Mays, R., Dixon, R.L., Willis. P., Burton, M.L., Harvey, B.W., 1992. A stock assessment of the snapper-grouper complex in the US South Atlantic based on fish caught in 1990. Report Submitted to the South Atlantic Fishery Management Council, Charleston, SC. This report may be obtained from Michael L. Burton, NOANNOS/CCFHR. Beaufort, NC.

Muller, R. G., M. D. Murphy, J. deSilva, L. R. Barbieri. 2003. A stock assessment report of yellowtail snapper, *Ocyurus chrysurus*, in the southeast United States. SEDAR 3 Assessment Report 1. South Atlantic Fishery Management Council. Charleston, SC. 330p. (http://www.sefsc.noaa.gov/sedar/download/SEDAR3_SAR1_Final.pdf?id=DOCUMENT)

O'Hop, J., M.D. Murphy, and D. Chagaris. 2012. The 2012 stock assessment report for yellowtail snapper in the South Atlantic and Gulf of Mexico. South East Data, Assessment, and Review. SEDAR. 27A. Technical Report, Florida Fish and Wildlife Conservation Commission. St. Petersburg, FL. 341p.

4 REGIONAL MAPS

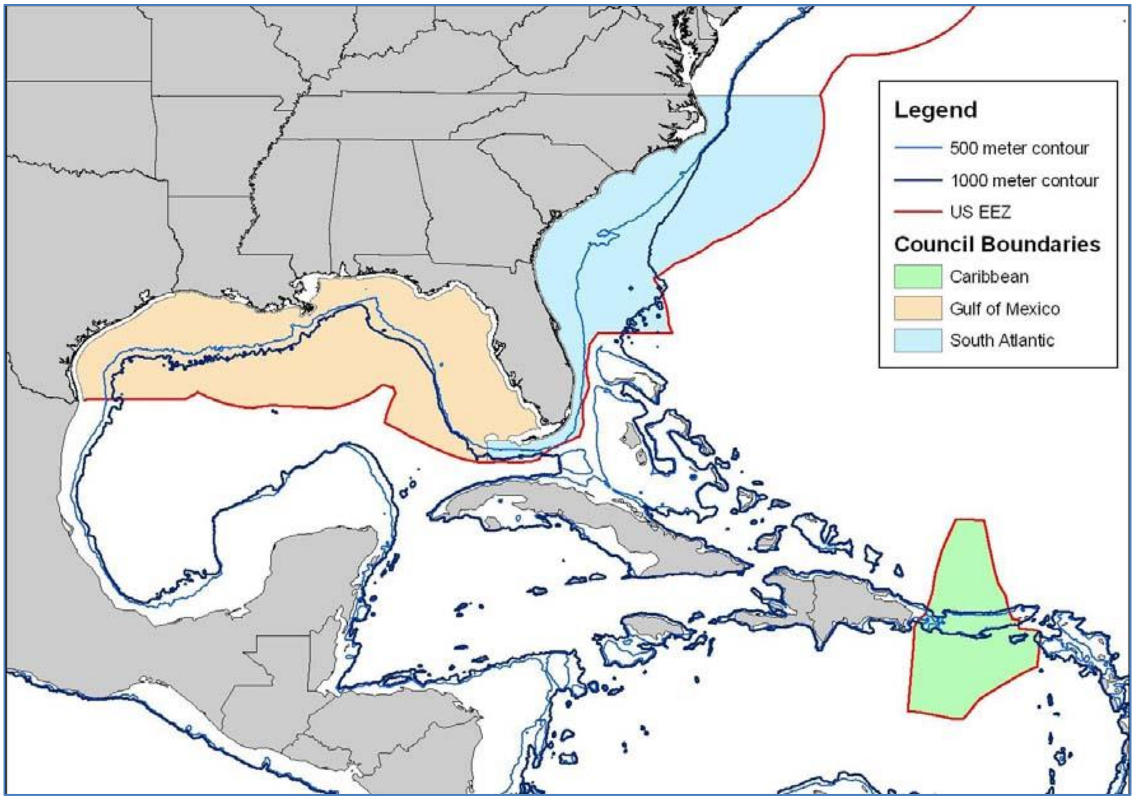

Figure 4.1 Southeast Region including Council and EEZ Boundaries.

5 SEDAR ABBREVIATIONS

ABC	Acceptable Biological Catch
ACCSP	Atlantic Coastal Cooperative Statistics Program
ADMB	AD Model Builder software program
ALS	Accumulated Landings System; SEFSC fisheries data collection program
AMRD	Alabama Marine Resources Division
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
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
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

SEDAR

Southeast Data, Assessment, and Review

SEDAR 64

Southeastern U.S. Yellowtail Snapper

SECTION II: Data Workshop Report

October 2019

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

Table of Contents

1 INTRODUCTION

1.1 WORKSHOP TIME AND PLACE

The SEDAR 64 Data Workshop was held June 25-27, 2019 in Saint Petersburg, Florida.

1.2 TERMS OF REFERNCE

1. Review stock structure and unit stock definitions and consider whether changes are required.
2. Review, discuss, and tabulate available life history information.
   - Evaluate age, growth, natural mortality, and reproductive characteristics
   - Provide appropriate models to describe population growth, maturation, and fecundity by age, sex, and/or length by appropriate strata as feasible.
   - Evaluate the adequacy of available life history information for conducting stock assessments and recommend life history information for use in population modeling.
   - Evaluate and discuss the sources of uncertainty and error, and data limitations (such as temporal and spatial coverage) for each data source. Provide estimates or ranges of uncertainty for all life history information.
3. Recommend discard mortality rates.
   - Review available research and published literature
   - Consider research directed at yellowtail snapper as well as similar species from the southeastern United States and other areas
   - Provide estimates of discard mortality rate by fishery, gear type, depth, and other feasible or appropriate strata.
   - Include thorough rationale for recommended discard mortality rates
   - Provide justification for any recommendations that deviate from the range of discard mortality provided in the last benchmark or other prior assessment
   - Provide estimates of uncertainty around recommended discard mortality rates
4. Provide measures of population abundance that are appropriate for stock assessment.
   - Consider and discuss all available and relevant fishery-dependent and -independent data sources
   - Consider species identification issues between yellowtail snapper and other species, and correct for these instances as appropriate
   - Document all programs evaluated; address program objectives, methods, coverage, sampling intensity, and other relevant characteristics
   - Provide maps of fishery and survey coverage
   - Develop fishery and survey CPUE indices by appropriate strata (e.g., age, size, area, and fishery) and include measures of precision and accuracy
   - Discuss the degree to which available indices adequately represent fishery and population conditions

- Recommend which data sources adequately and reliably represent population abundance for use in assessment modeling
- Provide appropriate measures of uncertainty for the abundance indices to be used in stock assessment models
- Rank the available indices with regard to their reliability and suitability for use in assessment modeling

5. Provide commercial catch statistics, including both landings and discards in both pounds and number.
    - Evaluate and discuss the adequacy of available data for accurately characterizing harvest and discard by fishery sector or gear
    - Provide length and age distributions for both landings and discards if feasible
    - Provide maps of fishery effort and harvest and fishery sector or gear
    - Provide estimates of uncertainty around each set of landings and discard estimates
6. Provide recreational catch statistics, including both landings and discards in both pounds and number.
    - Evaluate and discuss the adequacy of available data for accurately characterizing harvest and discard by species and fishery sector or gear
    - Provide length and age distributions for both landings and discards if feasible
    - Provide maps of fishery effort and harvest and fishery sector or gear
    - Provide estimates of uncertainty around each set of landings and discard estimates
7. Identify and describe ecosystem, climate, species interactions, habitat considerations, and/or episodic events that would be reasonably expected to affect population dynamics.
8. Incorporate socioeconomic information into considerations of environmental events that affect stock status and related fishing effort and catch levels as practicable.
9. Provide recommendations for future research in areas such as sampling, fishery monitoring, and stock assessment. Include specific guidance on sampling intensity (number of samples including age and length structures) and appropriate strata and coverage.
10. Review, evaluate, and report on the status and progress of all research recommendations listed in the last assessment, peer review reports, and SSC report concerning this stock.
11. Prepare the Data Workshop report providing complete documentation of workshop actions and decisions in accordance with project schedule deadlines (Section II of the SEDAR assessment report)

1.3 LIST OF PARTICIPANTS

Workshop Panel

Shanae Allen, Co-Lead Analyst	FWRI, St. Petersburg
Chris Swanson, Co-Lead Analyst	FWRI, St. Petersburg
Alejandro Acosta	FL FWC, Marathon
Dustin Addis	FL FWC, St. Petersburg

Brittany Barbara	FL FWC, St. Petersburg
Luiz Barbieri	FL FWC, St. Petersburg
Mike Birren	Fisherman, Hernando Beach, FL
Chris Bradshaw	FWRI, St. Petersburg
Steve Brown	FWRI, Cedar Key
Jessica Carroll	FL FWC, St. Petersburg
Bridget Cernel	FL FWC, St. Petersburg
Kerry Flaherty-Walia	FWRI St. Pete
Rachel Germeroth	FL FWC, St. Petersburg
Jennifer Herbig	FWC Marathon
Liz Herdter	FWRI, St. Petersburg
Manny Herrera	Commercial Fisherman, Key West, FL
Walter Ingram	NMFS, Pascagoula
Dominque Lazare	FWC St. Pete
Charlotte Marin	FL FWC, St. Petersburg
Vivian Matter	NMFS Miami
Robert Muller	FL FWC, St. Petersburg
Joseph Munyanderaro	FWRI, St. Petersburg
Kevin McCarthy	NMFS Miami
James Nance	GMFMC SSC, Galveston, TX
Jeff Renchen	FL FWC-DMFM, Tallahassee
Kristen Rynerson	FWRI, St. Petersburg
Beverly Sauls	FWC St. Pete
Eric Schmidt	Industry Rep, Ft. Myers, FL
Steven Scyphers	GMFMC SSC, Medford, MA
George Sedberry	SAFMC SSC, Savannah, GA
CJ Sweetman	FL FWC, Marathon
Jim Tolan	GMFMC SSC/TPWD
Kyle Williams	FL FWC, St. Petersburg
Beth Wrege	NMFS Miami

Attendees

Martha Guyas	FL FWC, GMFMC Rep, Tallahassee
Michael Larkin	NMFS SERO St. Pete
Jessica McCawley	FL FWC, SAFMC Rep, Tallahassee

Staff

Julie Neer	SEDAR
Mike Errigo	SAFMC
Lisa Hollensead	GMFMC
Natasha Mendez	GMFMC
Ryan Rindone	GMFMC
Camilla Shireman	GMFMC

Additional Participants via Webinar

Sarina Atkinson	NMFS Miami

Erika Burgess	FL FWC
Ben Duffin	FL FWC
Jim Eliason	GMFMC SSC
Adam Pollack	NMFS Pascagoula
Marcel Reichert	SCDNR
Allison Shideler	NMFS Miami

1.4 LIST OF DATA WORKSHOP WORKING PAPERS & REFERNCE DOCUMENTS

Document #	Title	Authors	Date Submitted
Documents Prepared for the Data Workshop			
SEDAR64-DW-01	SEAMAP Reef Fish Video Survey: Relative Indices of Abundance of Yellowtail Snapper	Matthew D. Campbell, Kevin R. Rademacher, Michael Hendon, Paul Felts, Brandi Noble, Ryan Caillouet, Joseph Salisbury, and John Moser	20 Dec 2018
SEDAR64-DW-02	A model-based index of Yellowtail Snapper, *Ocyurus chrysurus*, in the Dry Tortugas using Reef Fish Visual Census data from 1999-2016	Christopher E. Swanson	1 March 2019
SEDAR64-DW-03	Juvenile Yellowtail Snapper, *Ocyurus chrysurus*, collected from short-term fisheries-independent surveys in Florida Bay and the Florida Keys from 1994 – 2003	Christopher E. Swanson, Kerry Flaherty-Walia, and Alejandro Acosta	1 March 2019
SEDAR64-DW-04	A model-based index of Yellowtail Snapper, *Ocyurus chrysurus*, for the Florida Reef Tract from Card Sound through the Florida Keys using Reef Fish Visual Census data from 1997-2016	Christopher E. Swanson and Robert G. Muller	1 March 2019
SEDAR64-DW-05	Fisheries-independent data for Yellowtail Snapper (*Ocyurus chrysurus*) from reef-fish visual surveys in the Florida Keys and Dry Tortugas, 1999-2016	Jennifer Herbig, Jeffrey Renchen, Alejandro Acosta	1 March 2019 Updated: 1 July 2019

SEDAR64-DW-06	A model-based index of Yellowtail Snapper, *Ocyurus chrysurus*, for the Northern Florida Reef Tract from Government Cut through Martin County using Reef Fish Visual Census data from 2012-2016	Christopher E. Swanson	1 March 2019 Updated: 13 June 2019
SEDAR64-DW-07	Accuracy and precision of Yellowtail Snapper (*Ocyurus chrysurus*) age determination	Jessica Carroll, Kristen Rynerson, Brittany Barbara	9 April 2019
SEDAR64-DW-08	Abundance and Distribution of Juvenile Yellowtail Snapper in Nearshore Seagrass Habitat in the Middle Florida Keys	Jennifer Herbig, Alejandro Acosta, Ariel Wile	23 May 2019 Updated: 28 June 2019
SEDAR64-DW-09	Standardized Catch Rates of Yellowtail Snapper (*Ocyurus chrysurus*) from the Marine Recreational Information Program (MRIP) in Southeast Florida and the Florida Keys, 1981-2017	Liz Herdter	28 May 2019 Updated: 28 June 2019
SEDAR64-DW-10	Overview of the Southeast Region Headboat Survey and Data Related to Yellowtail Snapper (*Ocyurus chrysurus*)	Shanae Allen, Liz Herdter, and Kelly Fitzpatrick	28 May 2019 Updated: 5 June 2019 Updated: 19 August 2019
SEDAR64-DW-11	Standardized Catch Rates of Yellowtail Snapper (*Ocyurus chrysurus*) from the U.S. Headboat Fishery in Southeast Florida and the Florida Keys, 1981-2017	Liz Herdter and Shanae Allen	28 May 2019
SEDAR64-DW-12	Recreational Survey Data for Southeast Yellowtail Snapper	Vivian M. Matter and Richard C. Jones	26 June 2019 Updated: 15 August 2019 Updated: 28 August 2019
SEDAR64-DW-13	Historical Commercial Fishery Landings of Yellowtail Snapper in Florida and the Southeastern U.S.	Steve Brown and Chris Bradshaw	17 June 2019 Updated: 22 July 2019
SEDAR64-DW-14	Length frequency distributions for yellowtail snapper collected by	Chris Bradshaw and Steve Brown	17 June 2019

	TIPS in the Southeast from 1984 to 2017		
SEDAR64-DW-15	Length distribution and release discard mortality for southeastern yellowtail snapper	Sarina F. Atkinson, Kevin J. McCarthy, Allison C. Shideler	21 June 2019 Updated: 18 July 2019
SEDAR64-DW-16	A Summary of Observer Data Related to the Size Distribution and Release Condition of Yellowtail Snapper from Recreational Fishery Surveys in Florida	Dominique Lazarre	24 July 2019
SEDAR64-DW-17	Social Dimensions of the Recreational Fishery for Yellowtail Snapper (*Ocyurus chrysurus*) in Florida	Steven Scyphers and Kelsi Furman	7 July 2019
SEDAR64-DW-18	Calculated discards of yellowtail snapper from commercial vertical line fishing vessels in southern Florida	Kevin McCarthy and Jose Diaz	19 Sept 2019

Reference Documents

SEDAR64-RD01	Coral Reef Conservation Program (CRCP) Local Action Strategy (LAS) Project 3B “Southeast Florida Coral Reef Fishery-Independent Baseline Assessment” - 2012-2013 Interim Report	Florida Department of Environmental Protection - Coral Reef Conservation Program
SEDAR64-RD02	Implementing the Dry Tortugas National Park Research Natural Area Science Plan - The 10-Year Report	Florida Fish and Wildlife Conservation Commission
SEDAR64-RD03	Examining movement patterns of yellowtail snapper, *Ocyurus chrysurus*, in the Dry Tortugas, Florida	Jennifer L Herbig, Jessica A Keller, Danielle Morley, Kristen Walter, Paul Barbera, Alejandro Acosta
SEDAR64-RD04	Yellowtail Snapper Fishery Performance Report	SAFMC Snapper Grouper Advisory Panel
SEDAR64-RD05	Reflex impairment and physiology as predictors of delayed mortality in	Francesca C. Forrestal, M. Danielle McDonald, Georgianna Burress and David J. Die

	recreationally caught yellowtail snapper (*Ocyurus chrysurus*)	
SEDAR64-RD06	Preliminary Observations of Abundance and Distribution of Settlement-Stage Snappers in Shallow, Nearshore Seagrass Beds in the Middle Florida Keys	**Claudine T. Bartels and Karole L. Ferguson**
SEDAR64-RD07	*Lutjanus Ambiguus* (Poey), a Natural Intergeneric Hybrid of *Ocyurus Chrysurus* (Bloch) and *Lutjanus Synagris* (Linnaeus)	William F. Loftus
SEDAR64-RD08	A Laboratory Produced Hybrid Between *Lutjanus Synagris* and *Ocyurus Chrysurus* and a Probable Hybrid Between *L. Griseus* and *0. Chrysurus* (Perciformes: Lutjanidae)	M. L. Domeier and M. E. Clarke
SEDAR64-RD09	A Survey to Characterize Harvest and Regulatory Discards in the Offshore Recreational Charter Fishery off the Atlantic Coast of Florida	Beverly Sauls and Oscar Ayala
SEDAR64-RD10	Seagrass Habitats as Nurseries for Reef-Associated Fish: Evidence from Fish Assemblages in and Adjacent to a Recently Established No-Take Marine Reserve in Dry Tortugas National Park, Florida, USA	Kerry E. Flaherty-Walia, Brett Pittinger, Theodore S. Switzer, Sean F. Keenan
SEDAR64-RD11	Fish assemblages in seagrass habitats of the Florida Keys, Florida: spatial and temporal characteristics	A. Acosta, C. Bartels, J. Colvocoresses, and M. F. D. Greenwood
SEDAR64-RD12	Model-estimated conversion factors for calibrating Coastal Household Telephone Survey (CHTS) charterboat catch and effort estimates with For Hire Survey (FHS) estimates in the Atlantic and Gulf of Mexico with application to red grouper and greater amberjack	Kyle Dettloff and Vivian Matter

2 LIFE HISTORY

2.1 OVERVIEW

The Life History Workgroup (LHW) reviewed and discussed available data for Yellowtail Snapper and offered recommendations. Information was examined on natural mortality, release mortality, age, growth, reproduction, habitat, movements and migrations, size conversions, and episodic events. A summary of the data presented, discussed, and recommendations made is presented below.

2.1.1 Life History Workgroup members

Jessica Carroll (lead)	FWRI, St. Petersburg, FL
Alejandro Acosta (lead)	FWRI, Marathon, FL
Jim Tolan	TPWD, Corpus Christi, TX
George Sedberry	SSC, SAFMC (chair)
CJ Sweetman	FWC-DMFM, Marathon, FL
Joseph Munyandorero	FWRI, St. Petersburg, FL
Kerry Flaherty-Walia	FWRI, St. Petersburg, FL
Kristen Rynerson	FWRI, St. Petersburg, FL
Brittany Barbara	FWRI, St. Petersburg, FL
Kyle Williams	FWRI, St. Petersburg, FL

2.2 REVIEW OF WORKING PAPERS

Three working papers were submitted for review to the LHW:

SEDAR64-DW-03: Juvenile Yellowtail Snapper, *Ocyurus chrysurus*, collected from short-term fisheries-independent surveys in Florida Bay and the Florida Keys from 1994 – 2003.

SEDAR-DW-07: Accuracy and precision of Yellowtail Snapper (*Ocyurus chrysurus*) age determination.

SEDAR64-DW-08: Abundance and Distribution of Juvenile Yellowtail Snapper in Nearshore Seagrass Habitat in the Middle Florida Keys.

Discussion of working papers and other literature reviewed is listed below by topic.

2.3 STOCK DEFINITION AND DESCRIPTION

2.3.1 Classification and Identification Issues

Nelson et al. (2004) present the taxonomic classification of Yellowtail Snapper as follows:

Kingdom: Animalia (animals)
  Phylum: Chordata (organisms with a notochord)
    Subphylum: Vertebrata (animals with a backbone)
      Class: Actinopterygii (ray-finned fishes)
       Order: Perciformes
          Family: Lutjanidae
            Genus: *Ocyurus*
              Species: *chrysurus* (Bloch 1791)

Common names: Yellowtail Snapper (English), rubia (Spanish), la colirrubia [Puerto Rico; Figuerola et al. (1998)], pargo canane [Mexico; Mexicano-Cíntora (1999)], la rabirrubia [Mexico; Rincón-Sandoval et al. (2009)], and probably others.

This species is readily recognizable, with a yellow lateral stripe and deeply forked yellow tail (Fig. 2.15.1). Yellowtail Snapper may associate for feeding purposes (e.g., Sikkel and Hardison 1992) with schools of Yellow Goatfish ([*Mulloidichthys martinicus* (Cuvier 1829)] which are superficially similar in appearance but are easily distinguishable. Historically, “yellowtail” was used for reporting commercial landings of Silver Perch (*Bairdiella chrysoura*) only in 1923 on Florida’s east coast (U.S. Bureau of Fisheries, 1925), but for Florida’s west coast and for other states bordering the Gulf of Mexico the “yellowtail” reporting category referred to Yellowtail Snapper (e.g., U.S. Bureau of Fisheries, 1904, 1920, 1926, and later).

Historically, a natural hybrid between Yellowtail Snapper and Lane Snapper (*Lutjanus synagris*) was described by Poey (1860) as *Lutjanus ambiguus*. Subsequent research comparing meristic and morphometric characteristics (Loftus 1992) and laboratory experiments producing hybrid individuals (Domeier and Clark 1992) concluded that this description is indeed a hybrid between Yellowtail and Lane Snapper and that Yellowtail Snapper could potentially hybridize with Gray Snapper (*Lutjanus griseus*) as well. The incidence of this hybrid is relatively rare (only 30 records or museum specimens were reported from Loftus [1992]), however, it has been encountered recently by scientists on the panel and reported from the public for this assessment via the Gulf of Mexico Fishery Management Council's "Something's Fishy about Yellowtail Snapper" tool.

2.3.2 Stock Definition and Description

The Yellowtail Snapper fishery is managed in the U.S. by the South Atlantic Fishery Management Council (SAFMC) and the Gulf of Mexico Fishery Management Council (GMFMC) as separate stock units with the boundary being U.S. Highway 1 in the Florida Keys west to the Dry Tortugas (Fig. 2.15.2). Additionally, the State of Florida participates in the management of this species in state waters. Other states in the SAFMC and GMFMC jurisdictions defer to the federal management regulations for this species. Both SEDAR 3 (Muller et al. 2003) and SEDAR 27A (O'Hop et al. 2012) used data from genetic analyses available at the time (Hoffman et al. 2003) to treat Yellowtail Snapper in the SAFMC and GMFMC jurisdictions as a single stock for assessment purposes and the LHW continued to recommend this approach.

The species is found in the Western Central Atlantic region, from the U.S. Atlantic coast, Gulf of Mexico, Caribbean Sea, to Brazil. Yellowtail Snapper is an important part of the reef fish assemblage in the western, tropical Atlantic and is caught by both recreational and commercial fisheries in south Florida and the Bahamas (Johnson 1983; Manooch and Drennon 1987; Garcia et al. 2003; Saillant et al. 2012). While the biological stock extends along the southeastern U.S. beyond the coasts of Florida and is considered a single unit for management purposes, the LHW recommended that only data from Florida be considered for assessment modeling and management purposes. This recommendation came largely due to 1) the greater concentration of landings off south Florida and the Florida Keys and 2) the multiple growth patterns exhibited due to the presence of larger and older individuals caught off the Carolinas not subjected to the greater directed fishing pressures in Florida.

2.3.3 Population Genetics

The stock structure of Yellowtail Snapper is not clearly understood, however, populations from southeastern U.S. waters are believed to belong to a single stock. Mitochondrial and microsatellite DNA analyzed from seven locations in southern Florida and Puerto Rico found little evidence of population structuring between the Florida Keys, southeast Florida, and Puerto

Rico (Hoffman et al. 2003; O'Hop et al. 2012). Further support from another study in the Florida Keys and the eastern Caribbean revealed occurrences of up to four groupings (stocks) of Yellowtail Snapper: 1) in the Florida Keys, 2) along the west coast of Puerto Rico, 3) along the east coast of Puerto Rico and St. Thomas, and 4) offshore of St. Croix (Saillant et al. 2012). However, the genetic linkages between the Gulf of Mexico and western Caribbean remain unknown. Vasconcellos et al. (2008) and more recently da Silva et al. (2015) compared mitochondrial DNA and morphometrics of specimens collected off Brazil and Belize and found that Brazilian populations appear to be from a single stock but differed significantly from populations off Belize.

2.3.4 Larval Transport/Connectivity

Despite the ecological and economic importance of western Atlantic Ocean lutjanid species, little is known about their larval stage. Lutjanids, like most marine fishes, have a pelagic egg/larval stage that lasts for several weeks during which time they are highly vulnerable to starvation, predation, and advection away from suitable juvenile habitat, and survival rates may be near zero (Houde 1987; D'Alessandro et al. 2010).

Complete descriptions of larval ontogeny are available for only 6 of the 18 western Atlantic snapper species, and the few studies on lutjanid larvae have been descriptive in nature and/or used captive-bred larvae (Riley et al. 1995, Clarke et al. 1997, Drass et al. 2000, D'Alessandro et al. 2010, D'Alessandro and Sponaugle 2011), or have examined otolith-based traits of late-stage larvae and juveniles to make inferences about pelagic larval life (Tzeng et al. 2003, Denit and Sponaugle 2004). Studies directly examining the early life history of wild-caught larvae beyond coarse distributions at the genus level are largely lacking due in large part to the difficulties involved in adequately sampling diffuse populations of larvae in the open ocean, and in identifying them to the species level (Lindeman et al. 2006, D'Alessandro et al. 2010, D'Alessandro and Sponaugle 2011). D'Alessandro et al. (2010) reported that eight snapper species including Yellowtail Snapper had significant spatiotemporal larval distribution patterns with most snapper larvae occurring from July to September when water temperatures were warmest, and Yellowtail Snapper was most abundant from 0- 25 meters. Despite between-year variability and presence of snapper larvae in most months, temporal distributions of larval abundance, occurrence, and concentration all point to peaks in spawning activity in July to

September, consistent with existing literature and the subtropical area sampled (Thresher 1984, Grimes 1987, Leis 1987).

2.3.5 Distribution, Habitat, and Trophic Structure

Yellowtail Snapper range mainly from the Carolinas southward to southeastern Brazil (Druzhinin 1970, SEDAR8 DW-Figure 1). Occasional reports in Bermuda and off Massachusetts and in the Cape Verde Islands off the Atlantic coast of Africa exist, however these occurrences are not common (Druzhinin 1970). This species is observed most in the Bahamas, south Florida, the Netherlands Antilles, Campeche Bank and throughout the Caribbean (Randall 1967, Fischer 1978, Allen 1985, Hoese and Moore 1998). Yellowtail Snapper are also occasionally found in the eastern Atlantic along with the gray, queen, and lane snappers (Fischer 1978, Allen 1985).

Yellowtail Snapper are considered ubiquitous and utilize a variety of habitat types during their life, making ontogenetic migrations between settlement, sub-adult, and adult developmental stages. It is reported to exhibit a niche requirement close to that of Vermilion Snapper, *Rhomboplites aurorubens*, because unlike many other snapper species, Yellowtail Snapper are usually seen well above the substrate, swimming in large schools or in small groups (Grimes 1976). Juveniles are found in shallow coastal waters over back reefs and on seagrass beds (especially turtle grass, *Thallasia testudinum).* Juveniles have been reported in mangrove habitats off the southwest coast of Puerto Rico and Tortola British Virgin Islands (Kimmel 1985, Boulon 1992, Rooker and Dennis 1991) and off the Netherlands Antilles (Nagelkerken et al. 2001). The extent to which Yellowtail Snapper depend on mangrove prop root habitat as a larval and juvenile nursery area is not clear (Dennis 1998). For juveniles, the mangrove habitat may be important on a seasonal basis as Yellowtail Snapper were reported there only occasionally (Cummings 2004). Bartels and Ferguson (2006) and Herbig et al. (2019c) found individuals in the 16 – 30 mm SL range in nearshore seagrass habitats in the middle Florida Keys. In the Dry Tortugas, Yellowtail Snapper as small as 33 mm SL were collected in seagrass habitats (Flaherty-Walia et al. 2017, Swanson et al. 2019). Adults are associated with coral reefs and other hard bottom substrate and are generally found in schools above the substrate (Hoese and Moore, 1998, Herbig et al. 2019b) and at depths ranging from 32 to 230 feet (10-70 m; GMFMC 2013).

Yellowtail Snapper are carnivorous, with adults and juveniles feeding above the bottom. Detailed information on feeding habits is limited to just a few studies off Cuba, Virgin Islands, south Florida, and the Netherlands Antilles. Longley and Hildebrand (1941, reported in Thompson and Munro 1974) indicated that Yellowtail Snapper did not restrict feeding to nocturnal periods as commonly seen in other lutjanids, but ranged freely throughout the reef and fed both by day and night. Cummings (2004) suggested that Yellowtail Snapper feeds opportunistically throughout the day and Friedlander et al. (2013) suggested that Yellowtail Snapper feed primarily at night. Herbig et al (2019a) reported that tagged fish could be using the hardbottom/coral reef and seagrass habitats to forage from dusk throughout the night and then return at dawn to forage along the reef edge throughout the day. However, foraging in seagrass habitat has previously only been associated with juvenile or subadult individuals (Cummings 2004, Verweij et al. 2008) and the fish in this study were mature adults. Yellowtail Snapper have also been shown to eat the eggs of other spawning fish (Cummings 2004) and may leave the area to take advantage of the many species of fish that spawn in the evening. Other food items include cephalopods and worms (Barbieri and Colvocoresses 2003- south Florida). Several researchers have reported seasonal variability in feeding. de Albornoz and Ramiro (1988) found most stomachs of Yellowtail Snapper sampled off Cuba to be full from January to April, and, a reduction in stomach content from May on, correlating with the observed season of spawning in that region (Mar-August, peaking in June). Collins and Finucane (1989) reported similar observations for fish sampled off south Florida. The diversity of their diet as well as the size of the foraging area increases with the size of the juveniles, possibly reflecting ontogenetic changes in diet with growth.

2.4 NATURAL MORTALITY

Yellowtail Snapper natural mortality was estimated assuming that the instantaneous natural mortality was inversely related to fish length (Lorenzen 2005) and held constant over time. From analyses of ages in the catch, fish were found to be fully vulnerable to fishing gears by age 3. This relation was therefore scaled so that the cumulative instantaneous rate predicted during ages 3-28 agreed with the cumulative rate over these same ages calculated from a constant mortality-at-age estimate derived from maximum age. The LHW recommended using the $\text{Hoenig}_{\text{all taxa}}$ (1983) equation:

$$M = e^{(1.44-0.982*\ln(t_{max}))}$$

where M is the constant mortality-at-age (to be used as the target M) and t_{max} is the observed maximum age for the species. Accordingly, constant mortality-at-age was found to be equal to 0.160 using a maximum age of 28 years.

Length-at-age required for this analysis was predicted using a size-truncated von Bertalanffy growth model to account for size limit effects fit to observed age and length data assuming a hatching date of July 1 (see section 2.6 below). Using these growth parameters and the above constant mortality-at-age value, natural mortality-at-age ($M_{at\text{-}age}$) was found to range from 0.385 – 0.147 (Table 2.14.1, Fig 2.15.3).

2.4.1 Sensitivity Analyses

Sensitivity analyses recommended by SEDAR Best Practices (2016) included using the standard deviation around the average age of older fish or average age of multiple readers of the oldest fish age structure. However, otolith sample sizes for older Yellowtail Snapper are quite limited (e.g. fish >= age 20; n = 19) and only 1 individual has been observed with maximum age 28. Therefore, the LHW recommended varying maximum age to create upper and lower bounds for natural mortality-at-age. The upper bound was set to maximum age 20 years because it is the maximum age observed in Florida. The lower bound was set to maximum age 33 years because it represents a possible future maximum age seen in the next assessment based on the maximum age difference seen between this and the previous assessment (i.e. 5 years maximum age difference [28 – 23] from the previous assessment corresponds to 5 years maximum age difference [33-28] here). Natural mortality-at-age ($M_{at\text{-}age(tmax=20)}$) for the upper bound was found to range from 0.536 – 0.204 (M_{target} = 0.223) and the lower bound ($M_{at\text{-}age(tmax=33)}$) ranged from 0.328 – 0.125 (M_{target} = 0.136; Table 2.14.1, Fig 2.15.3).

The LHW also recommended a sensitivity analysis using the *M/k* ratio, a Beverton-Holt life history invariant (Beverton 1992; Charnov 1993; Jensen 1996; Hordyk et al. 2015). Using the von Bertalanffy *k* parameter (k = 0.200; see section 2.6 below) and the constant mortality-at-age values above (M = 0.160, 0.223, and 0.136 for maximum ages of 28, 20, and 33, respectively), *M/k* ratios were found to be 0.800, 1.115, and 0.680, respectively. The range of these ratio values were less than the invariant $M/k = 1.5$, however they are still within the variability which fish species reportedly exhibit (Hordyk et al. 2015). For the M/k ratio of Yellowtail Snapper to be equal to 1.5, following Jensen (1996) where $M = 1.5 * k$, M would equal 0.30 and corresponds to a similar constant mortality-at-age estimate using maximum age of 15 years (M=0.295).

2.4.2 Episodic Mortality Events

No attempt was made to investigate episodic types of natural mortality (red tides, cold kills, oil spills, etc.) because there were no data on which to base such modifications to the M parameter. Red tide blooms are more commonly seen on Florida's Gulf Coast and usually occur well north of the Florida Keys and away from the center of the distribution of Yellowtail Snapper. Cold stuns and kills from water temperatures of perhaps 15ºC or lower (see discussion in Gilmore et al. 1978), while infrequent, may occur once or twice a decade in Florida. There was an account of a cold kill during late January 1940 (Galloway 1941) noting that large numbers of many species including Yellowtail Snapper washed ashore in Key West after water temperature dropped below 14ºC. In other accounts of cold kill events in Florida (even in the Florida Keys; Miller 1940), either a listing of the species affected was not given (e.g., Packard 1871, Finch 1917) or Yellowtail Snapper were not mentioned explicitly [see discussions in Storey and Gudger (1936) and Snelson and Bradley (1978)]. An extreme cold event during the winter of 2010 caused massive mortality of patch reefs in the Florida Keys (Colella et al. 2012) which most likely impacted Yellowtail Snapper habitat. Although subtropical fish species in various regions of Florida were affected by this event (Stevens et al. 2016), no specific reports on Yellowtail Snapper mortalities were reported (Hallac et al. 2010).

2.5 RELEASE MORTALITY

An ad-hoc workgroup comprised of all workshop panelist was convened during the Data Workshop to discuss discard mortality. SEDAR 27A (O'Hop et al. 2012) used headboat observer data to choose a lower bound immediate release mortality rate (10%) and performed sensitivity runs on higher values (20% and 30%) in attempt to account for delayed mortality. Studies on fishing-induced mortality on released Yellowtail Snapper included at-sea sampling methods from the commercial and headboat sectors and were decided to be sufficient to provide an upper and lower bound of immediate release mortality, as well as the range of sizes released (Atkinson et al. 2019). The Workgroup decided on a 10% lower bound for both commercial and recreational fisheries. The upper bound of sensitivity runs for higher values were set at 15% for the commercial sector and 20% and 30% for the recreational sector. This assessment is based on a suitable sensitivity analysis based on different runs at different rates of release mortality. In the absence of any substantive empirical data the panel consider this approach to be a reasonable approximation for a release mortality rate for this species. However, attempts should be made to obtain a more accurate estimate of discard mortality such as the work conducted by Forrestal et al (2017) on the development of physiological parameters to evaluate post release mortality of under-sized Yellowtail Snapper.

2.6 AGE AND GROWTH

2.6.1 Available Age Data

The National Marine Fisheries Service Panama City laboratory (PCLAB), the National Marine Fisheries Service Beaufort laboratory (NCLAB), and the Florida Fish and Wildlife Research Institute (FWRI) age and growth laboratory supplied data from 58,539 otoliths from 1980 – 2017. These otoliths were collected by various federal and state biologists involved in fishery-dependent [Trip Interview Program (TIP), Head Boat Survey (HBS), and Marine Recreational Information Program (MRIP)] and fishery-independent (FWRI's Fisheries Independent Monitoring and Fish Biology) data collection programs on both Atlantic and Gulf of Mexico coasts. Sectioned otoliths are the preferred structures for ageing Yellowtail Snapper (Johnson 1983, Manooch and Drennon 1987, Garcia et al. 2003) and were used to count annuli, score the edge type, and adjust the annuli counts to provide age estimates in years.

Marginal increment analyses (e.g., Garcia et al. 2003; Carroll et al. 2019) have indirectly validated that Yellowtail Snapper form an opaque annulus in the spring (typically March-June) and deposition is assumed to be completed by July 1. Annuli of most snappers (including Yellowtail) are easily discerned and present no special challenges for laboratory analyses. FWRI's quality assurance techniques used multiple reads to develop consensus among the readers and consistency in the annuli counts and edge data. Campana (2001) suggests an average percent error (APE) of 5% or less as an acceptable benchmark for precision. Ageing precision was below this benchmark and can be reliably used for analyses in this assessment (Carroll et al. 2019).

Calendar ages were calculated using annulus count (number of opaque zones), degree of marginal completion, average date of otolith increment deposition, and date of capture. Using these criteria, age was advanced by one year if a large translucent zone was visible on the margin and the capture date was between January 1 and June 30. For all fish collected after June 30, age was assigned to be annulus count. Calendar ages were converted to fractional or monthly biological ages based on a July 1 hatch date and month of capture.

2.6.2 Maximum Age

The current maximum observed age of Yellowtail Snapper based on sectional otoliths (n = 1) is 28 years and represents the maximum age for the entire southeastern U.S. stock. This is an update to the previous assessment which observed maximum age for this species at age 23 years (O’Hop et al. 2012). However, the oldest fish collected from Florida waters is currently age 20. The LHW discussed that fish greater than age 20 (n = 15) were sampled along the northern range of the species (off North Carolina and South Carolina) and not subject to greater levels of fishing pressure which occur within core fishery areas of south Florida waters.

2.6.3 Growth

To model growth, data were filtered to eliminate records: 1) that were identified as outliers, 2) that included a known size or effort bias, and 3) where lengths were collected using a known non-random sampling method or were selected by quota sampling. Data were further restricted to records containing complete information on year, month, and state (or were assigned a state based on area fished or sample location if the area fished was unknown or unassigned). The filtered dataset contained 45,280 length-at-age observations coming from 5 defined regions within Florida waters (northwest, southwest, the Florida Keys, southeast, and northeast Florida) and from waters outside Florida along the southeastern US Atlantic and Gulf of Mexico (Table 2.14.2) For confidentiality purposes, data from areas outside of Florida are defined as either “west of Florida” or “north of Florida”. The majority of Yellowtail Snapper within the filtered age data were found to be age-2 and -3 (56.9%) with ages 2 – 6 comprising 89.9% of the age data (Table 2.14.3). Ages sampled from the recreational fishery constituted a total of 52.4%, predominantly from the headboat survey, while ages sampled from the commercial fishery made up 46.9% (Table 2.14.4). Age data from fishery-independent sources comprised <1% for Yellowtail Snapper (Table 2.14.4).

Length-at-age data for Yellowtail Snapper are almost exclusively (99.3%) from the state of Florida (n=44,953 otoliths). Within Florida, 62.4% (n = 28,250 otoliths) come from the Florida Keys region (Monroe County) and 33.2% (n = 15,031 otoliths) come from southeast Florida region (Indian River County south to Miami-Dade County; Table 2.14.2). The amount of length-at-age data collected and available for this assessment has more than doubled what was used since the terminal year (2010) of the previous assessment (O'Hop et al 2012) and the LHW noted the emergence of an additional growth pattern caused by the larger and older fish sampled outside Florida waters (n = 326 otoliths; Figure 2.15.4A). As noted above (Section 2.6.2), these additional fish were sampled in areas not subject to the elevated levels of fishing pressure common in the core fishery areas of south Florida waters and thus experienced longevity not observed in Florida. Since this assessment is focused on providing management advice for the fishery, which is predominantly based in Florida, the inclusion or exclusion of data from the larger and older fish from outside Florida was discussed extensively by the LHW. Ultimately, the non-Florida length-at-age data was deemed not adequately representative of the fishery and attempts at modeling growth yielded poor fits. The LHW therefore recommended the exclusive use of Florida data to model growth for this assessment (n = 44,953 otoliths).

Length-at-age data, based on fractional (monthly biological) ages and observed fork lengths at capture, were modeled using a size-truncated von Bertalanffy growth model (Diaz et al. 2004) executed in ADMB (Auto Differentiate Model Builder). This growth model accounts for minimum size restrictions (using a truncated normal distribution) which influence non-random sampling across ages (e.g. smaller fish not available to sample) and allows for the exploration of alternative variance structures. Model options for variance structures are: 1) constant standard deviation (SD) with age, 2) constant coefficient of variation (CV) with age, 3) variance proportion to the mean, 4) CV increases linearly with age, and 5) CV increases linearly with size at age. This growth model also accommodates data-weighting as a direct input and was explored here using inverse-weighting by $1/n$ of each calendar age or calendar age plus group (Burton et al. 2015). Size truncation was set using the minimum size limit of 12" TL (248 mm FL) first implemented by the SAFMC Snapper-Grouper FMP amendment on 8/31/1983. Model selection criteria was based on model convergence (maximum gradient < 0.0001), model objective function (minimized negative loglikelihood), Akaike Information Criteria (AIC), and model standardized-residual diagnostic plots.

Several models were considered to best fit the data: 1) an unweighted non-truncated model, 2) a size-truncated model using a random selection of no more than 30 length observations per age 3) a size-truncated model using inverse-weighting that includes an age 8+ group, and 4) a size-truncated model using inverse-weighting that includes an age 12+ group. The size-truncated model using inverse-weighting that included an age 12+ group (n = 42,985 otoliths) and estimated a constant CV at age (CV = 0.18) was selected as the final most parsimonious model (Fig 2.15.4B) with equation:

$$L_t = 426\left(1 - e^{-0.20(t+1.93)}\right)$$

Diagnostic plots for the final model are in Fig. 2.15.5. A comparison of the outputs between the four von Bertalanffy growth models can be found in Table 2.14.5 while Figure 2.15.6 compares them against the observed length-at-age data.

2.7 REPRODUCTION

Barbieri and Colvocoresses (2003) used chevron traps and hook and line gear to study several species of snappers (including Yellowtail Snapper) off the coast of Tequesta (southeast Florida) and the Florida Keys. Their reproductive data have been used to inform prior Yellowtail Snapper assessments (Muller et al. 2003; O’Hop et al. 2012) and were used again for this assessment as no new reproductive data have become available. Therefore, following SEDAR Best Practices (2016) a more complete summary and discussion on Yellowtail Snapper reproductive characteristics can be found in Section II, 5.6 of SEDAR 27A (O’Hop et al. 2012) and will not replicated in its entirety here.

2.7.1 Spawning Season

Yellowtail Snapper are gonochoristic (individuals remain the same sex throughout their lifetime) and are multiple (batch) spawners with indeterminate fecundity (Barbieri and Colvocoresses

2003). In the Florida Keys, spawning peaks during April to August but can occur year-round (McClellan and Cummings 1998; Collins and Finucane 1989). Gonadosomatic indices from studies in the Florida Keys (e.g. Collins and Finucane 1989; Pinkard and Shenker 2001; Barbieri and Colvocoresses 2003) reported increasing values beginning in April and remained high through July or August. In Cuban waters, peak spawning occurs in April with another less intensive peak in September (Claro et al. 2001). Large spawning aggregations have been reported to form seasonally off the coasts of Cuba, the Turks and Caicos Islands, U.S. Virgin Islands, and during May – July southwest of Key West, FL, at Riley's Hump off the Dry Tortugas (Lindeman et al. 2000).

2.7.2 Age/Size and Maturity

Maturity data from Barbieri and Colvocoresses (2003) on the reproductive stage of gonads (assessed histologically) from the peak spawning period (April-October) were used to create a size- and age- based maturation schedule for female Yellowtail Snapper following the recommendations of Hunter and Macewicz (1985, 2003). Gonad maturity stages (GMS; Table 2.14.6) were assigned a maturity value of 1 if greater than stage 1 and a value of zero if GMS=1 (immature, primary oocytes only present or sex undetermined due to lack of development). These data were fit to a logistic regression that explicitly provides estimates of both the slope (R) and proportion at 50% of the maximum value (Quinn and DeRiso 1999; PROC NLIN, SAS ver 9.2):

Equation 2.7.2.1 for length:

$$y = \frac{1}{\left(1 + \left(e^{-R* \, (x - L_{50})}\right)\right)}$$

Equation 2.7.2.2 for age:

$$y = \frac{1}{\left(1 + \left(e^{-R* \, (x - A_{50})}\right)\right)}$$

where y is the proportion mature, L50 or A50 is the point at which 50% of individuals are mature, and x is equal to either length or age depending upon the equation used. Both length-at-maturity and age-at-maturity models were significant and explained the majority of variance in the data (Table 2.14.7a, b).

In Florida waters, 50% of females achieved sexual maturity at 192 mm FL (232 mm TL_{max}) and 1.7 years of age (Table 2.14.7(a) and (b) respectively). The age at 50% maturity from the logistic model used in this assessment is consistent with prior assessments, but the length at 50% maturity estimated for SEDAR 3 (Muller et al. 2003) from the same specimens and same histological criteria using another logistic model (SAS Proc Logistic) was 180 mm FL (209 mm TL_{max}). These values are somewhat smaller and younger compared with macroscopic data from Cuba where mean size at maturity was reported to be 250 mm FL (ca. 308 mm TL_{max}) and 2 years of age (Claro et al. 2001). Using histological criteria and specimens of Yellowtail Snapper from all or most months of the year, Figuerola et al. (1998), reported an L_{50} of 224 mm FL (ca. 275 mm TL_{max}) in waters off Puerto Rico and Trejo-Martínez et al. (2011) estimated an L_{50} of 213 mm FL (ca. 261 mm TL_{max}) from the Yucatan's Campeche Banks. The differences between the estimates of size and age at maturity between studies may be due to the analytical methods employed [e.g., histological versus macroscopic determinations and which gonad maturity stages were classed as mature (Lowerre-Barbieri et al. 2011), whether all specimens from a year-round study were used versus only those collected from the peak spawning period (Hunter and Macewicz 1985, 2003), sample sizes available, etc.].

2.7.3 Fecundity

Estimates of fecundity in Yellowtail Snapper are limited. In the Florida Keys, Collins and Finucane (1989) estimated ovarian egg numbers between 11,000 and 1,391,000 from 44 fish ranging in size and weight between 200 – 480 mm FL and 168 – 1,784 g total weight. Egg number estimates from 4 fish off western Cuba reported by Piedra (1969; and corrected by Collins and Finucane 1989) ranged between 99,666 – 618,742 eggs from fish ranging in size and weight between 292 – 382 mm FL and 402 – 920 g total weight. Cummings (2004) cites and presents additional model results of fecundity at-age and at-weight estimates from Collins and Finucane (1989; 60 fish) and de Albornoz and Grillo (1993; 60 fish).

2.7.4 Sex Ratio

Sex ratios in Yellowtail Snapper populations may be approximately equal in most months (see discussion in Cummings [2004]). In the Florida Keys, male:female ratios were 1:1.04 and 1:1.3 and 1:1.4 in Jamaica and Cuba (Grimes 1987). Trejo-Martínez et al. (2011) reported ratios not significantly different from 1:1 on the Campeche Banks.

2.8 MOVEMENTS AND MIGRATIONS

Yellowtail Snapper is unique in the snapper family. It is a semi-pelagic transient species (Harborne et al. 2016, Farmer and Ault 2011), and although its life history and geographic distribution have been well documented, information regarding its movements and migration patterns is limited (Bohnsack and Ault 2002, Lindholm et al. 2005). Movement occurs on small and large scales and includes diel habitat shifts, foraging, seasonal migrations, and ontogenetic movement (Friedlander et al. 2013, Pittman et al. 2014). Herbig et al. (2019a) used acoustic telemetry to show that the movement of tagged Yellowtail Snapper was not completely random, but rather was methodical as fish visited the same sites during most of the year, and some fish demonstrated similar seasonal differences. Similar results were observed by Novak (2018). Yellowtail Snapper demonstrated movement patterns based on diel activity (fewer detections at night) and seasonal patterns (fewer detections and longer movements in summer). Although only a few fish were tagged in this study, the authors concluded that there were indications for site fidelity in Yellowtail Snapper. This analysis revealed that tagged Yellowtail Snapper also had relatively small 50% [x- = 0.42 (SE 0.14) km2] and 95% [x- = 5.45 (SE 1.79) km2] home ranges for a species considered highly mobile (Friedlander et al. 2013). The difference between the 50% and 95% home ranges indicates that the tagged Yellowtail Snapper remained within an area no larger than 1 km$_2$ for much of the time, but occasionally made larger movements. Feeley et al. (2012) also found that although most recaptured Yellowtail Snapper were caught in the same area in which they had been tagged, some (25%) were caught farther (18.5– 100 km) away.

2.9 MERISTICS AND CONVERSION FACTORS

The management regulations on minimum legal size for Yellowtail Snapper specifies a 12” total length (TL) and that the fish can be measured either with the tail flat in its normal shape (“relaxed”) or with the tips of the tail compressed to its maximum length (“maximum”). Multiple types of length measurements (standard, fork, and total length) are taken for Yellowtail Snapper by the various fishery dependent and independent data collection programs (e.g. TIP, MRIP, Headboat, FWRI-FDM), but fork length is largely measured since this species has a deeply forked tail. The FWRI fishery dependent monitoring program has measured SL, FL, and TL ("relaxed" and "max") measurements in order to provide a way of converting between the different measurement methods. SEDAR 3 (Muller et al. 2003) treated the headboat TL measurements without correction for the $TL_{relaxed}$ measurement method. SEDAR 27A (O'Hop et al. 2012) converted all fork length measurements and HB TL measurements (when a FL was not measured) to "maximum" TL. This assessment converted all total lengths to fork length measurements to match most data collection programs. New length-length (simple linear regression; Table 2.14.8) and length-weight (nonlinear power function; Table 2.14.9) equations were developed for this assessment using more recent length and weight data available for this species. A comparison of conversion equations provided by Johnson (1983) and Garcia et al. (2003) are also included in these tables.

2.10 COMMENTS ON ADEQUACY OF DATA FOR ASSESSMENT ANALYSES

2.10.1 Stock Definition

Genetic analyses available on Yellowtail Snapper supported a single stock for populations in southeastern U.S. and Gulf of Mexico regions, however no additional analyses have been conducted since the previous assessment.

2.10.2 Natural Mortality

The life history data were found sufficient to empirically derive estimates of natural mortality as no direct estimates were available. In addition to the recommended analyses outlined above (Section 2.4), the methods put forth by Then et al. (2015) and Munyandorero (2019) were evaluated by the LHW. Empirical estimates of natural mortality for Yellowtail Snapper derived from maximum age continue to get smaller as maximum age continues to lengthen with each assessment (max. age 17 in SEDAR 3 [Muller et al. 2003]; max. age 23 in SEDAR 27A [O'Hop et al. 2012]; max. age 28 here [see Section 2.6 above]).

2.10.3 Release Mortality

Data on fishing-induced mortality on released Yellowtail Snappers from commercial and headboat at-sea sampling were sufficient to provide rough estimation of immediate release mortality, upper and lower bounds, and the range of sizes released. No studies on delayed release mortality for Yellowtail Snapper were available for consideration. The size frequencies of kept and released (both alive and dead) Yellowtail Snapper observed for all sectors in recent years showed that nearly all legal size fish are kept, and that most of the release mortalities were associated with undersized fish (although these were generally alive and noted to be in ‘Good’ to ‘Fair’ condition at the time of release). An initial upper bound estimate of 20% for commercial release mortality was thought by sector-representative panelists to be too high, commenting that “even 10% fishing mortality seemed too high given the surface congregation-based method of fishing utilized by most commercial vessels” (i.e., power-chumming, cane poles, barb-less hooks, etc.). Therefore, a compromise on an upper bound release mortality estimate of 15% for the commercial fishery was reached.

2.10.4 Age and Growth

Through continued efforts of fishery-dependent and -independent sampling, the known maximum age of Yellowtail Snapper in southeastern U.S. and Gulf of Mexico jurisdictions has been lengthened to 28 years from 23 years in SEDAR 27A (O’Hop et al. 2012) and 17 years in SEDAR 3 (Muller et al. 2003). Age sampling data, though restricted to Florida for this assessment, were more than adequate to generate a growth curve; however, length-at-age data came primarily from fishery-dependent sources with active minimum size limits and necessitated the use of a size-truncated growth model. Large overlaps in length-at-age for this species (age 2+) and differences in growth patterns by region exist within the data and may be influenced more by the size-selective nature of the fishery than the biology of the species. Increased biological samples from fishery-independent efforts may address these and preclude the need for this type of growth model in the future.

The definition of edge types and the criteria used to advance ages differed among data providers, leading to some inconsistency in Yellowtail Snapper ages. NCLAB and FWRI use edge types 1-4 to identify an opaque zone on margin to a translucent zone that is 2/3 to fully complete, whereas PCLAB uses edge types 2PC, 4PC, and 6PC to identify an opaque zone on margin, translucent zone forming to ½ complete, and a translucent zone that is ½ to fully complete, respectively. FWRI and NCLAB advance calendar ages to the number of annuli plus one when the translucent zone is 1/3 to fully complete, whereas PCLAB advances calendar ages when the translucent zone is 1/2 to fully complete. Another inconsistency among data sources is the portion of the year when a calendar age can be advanced. FWRI and PCLAB sources use January to the end of June but NCLAB uses January to the end of May. However, since the vast majority of ages were provided by FWRI (51,353 records out of 58,539), these inconsistencies are expected to have little influence on the age distribution and length-at-age relationship of Yellowtail Snapper.

Length-at-age data of Yellowtail Snapper from two studies (Garcia et al. 2003; Vose and Shank 2003) were either currently unavailable or did not have adequate metadata to determine fishery type. However, length-at-age observations from these studies were minimal (n=2,984) compared to the final dataset used to model growth (n=45,280). Furthermore, within Vose and Shank (2003), age assignments were found inconsistent and caused primarily by only two edge types (opaque zone complete or translucent on edge) and ambiguity surrounding the months for which ages were advanced.

2.10.5 Reproduction

Information on size and age at maturity was sufficient for use, as was sex ratio and spawning season information. However, data from one study (Barbieri and Colvocoresses 2003) has been the primary informer of size and age at maturity for southeastern U.S. and Gulf of Mexico Yellowtail Snapper assessments (including here) and should to be expanded. Exploratory analyses may indicate some level of regional differences in size and age at maturity, however sample numbers and the size range of fish processed are limited. Although fecundity estimates were not used in the prior assessment, there were also no new estimates available for the LHW to review.

2.10.6 Movements and Migrations

New movement information continues to suggest Yellowtail Snapper exhibit a greater site fidelity than historically perceived. Currently, movement data is sufficient to suggest assessment modeling on the spatial scale as far as ‘areas-as-fleets’. For spatial modeling to move into a multiple area design, tagging studies need to be expanded at least into southeast and southwest Florida as movement rates between there and the Florida Keys remain unclear.

2.10.7 Meristics and Conversion Factors

Programs from both fishery-dependent and fishery-independent sources provided adequate quantities of differing length and weight measurement types to create length-length and length-weight conversion factors.

2.11 RESEARCH RECOMMENDATIONS

2.11.1 Stock Definition

- Investigate the genetic linkages of Yellowtail Snapper populations between Florida and the Carolinas and between the Gulf of Mexico and western Caribbean.
- Investigate the current occurrence of hybrids (e.g., with Lane Snapper) throughout the range of the stock.

2.11.2 Natural Mortality

- As the apparent maximum age of Yellowtail Snapper increased from assessment to assessment, the natural mortality estimates decreased. Estimates of natural mortality that are derived independently from life history parameters would help to validate these methods. Given adequate fishery independent age information, total mortality (fishing mortality plus natural mortality) can be estimated. In addition, telemetry and tag-recapture methods can offer independent estimation of fishing mortality and natural mortality, however these methods rely on high site fidelity of Yellowtail Snapper to reef sites or reliable tag return rates.
- Investigate estimates of natural mortality rates for different life stages of Yellowtail Snapper using ecosystem simulation models (e.g., Ecopath with Ecosim and OSMOSE).

2.11.3 Release Mortality

- On-board observers inform immediate release mortality, however information on delayed mortality is limited. Additional tagging of Yellowtail Snapper with passive and acoustic tags, as well as the continued development of tag-and-recapture models would help to inform delayed release mortality.

2.11.4 Age and Growth

- Expand and increase the amount of length-at-age data coming from fishery-independent biological sampling throughout the range of the stock (especially for fish smaller than the current minimum size limit).
- Continue to sample the population off the Carolinas undergoing reduced targeted fishing pressures and allowing for greater estimates of maximum age.

2.11.5 Reproduction

- Expand information on reproductive characteristics such as age- and size-at-maturity, fecundity, sex ratio, and distribution of spawning aggregations throughout the range of the stock.

2.11.6 Movements and Migrations

- Investigate juvenile ontogenetic shifting from nearshore areas to reef habitat.
- Investigate movement and migration rates between the Florida Keys, southeast Florida, and southwest Florida (e.g. acoustic tagging and stable isotope studies).

2.12 DATA BEST PRACTICES COMMENTS AND SUGGESTIONS

The methods outlined and implemented above for deriving constant and age-specific estimates of natural mortality followed the SEDAR Best Practices (2016) recommendations and the precedent set by other SEDAR assessments (e.g. SEDAR 51). When gathering the age information from the different data providers (e.g. NCLAB, PCLAB, and FWRI), the use of the Best Practices template allowed for easier merging between sources and helped reduce ambiguity within the data. The methods used for predicting length at age also followed Best Practices recommendations.

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2.14 TABLES

Table 2.14.1. Natural mortality-at-age ($M_{at\text{-}age}$) of Yellowtail Snapper with maximum age of 28 years. $M_{at\text{-}age}$ is derived following Lorenzen (2005) using the $Hoenig_{all\ taxa}$ (1983) constant mortality-at-age as the target M scaled between vulnerable ages 3 – 28 (M_{target} = 0.160) and the von Bertalanffy growth model parameters (Linf = 425.6; k = 0.1998; t0 = -1.9297). For the upper bound: M_{target} = 0.223; and for the lower bound: M_{target} = 0.136.

Age (yr)	Predicted FL (mm)	$M_{at\text{-}age.tmax=28.}$	$M_{at\text{-}age.tmax=20.}$ (upper bound)	$M_{at\text{-}age.tmax=33.}$ (lower bound)
0	164	0.385	0.536	0.328
1	189	0.297	0.413	0.253
2	232	0.25	0.348	0.213
3	267	0.222	0.308	0.189
4	295	0.203	0.282	0.172
5	319	0.189	0.264	0.161
6	338	0.18	0.250	0.153
7	354	0.173	0.240	0.147
8	367	0.167	0.233	0.142
9	378	0.163	0.227	0.139
10	386	0.16	0.222	0.136
11	393	0.157	0.219	0.134
12	399	0.155	0.216	0.132
13	404	0.153	0.214	0.131
14	408	0.152	0.212	0.129
15	411	0.151	0.210	0.129
16	414	0.15	0.209	0.128
17	416	0.15	0.208	0.127
18	418	0.149	0.207	0.127
19	419	0.148	0.207	0.126
20	420	0.148	0.206	0.126
21	421	0.148	0.206	0.126
22	422	0.148	0.205	0.126
23	423	0.147	0.205	0.125
24	423	0.147	0.205	0.125
25	424	0.147	0.205	0.125
26	424	0.147	0.204	0.125
27	424	0.147	0.204	0.125
28	425	0.147	0.204	0.125

Table 2.14.2. Number of Yellowtail Snapper otoliths by year and region within the filtered dataset. [Region: Northeast Florida (Nassau County south to Brevard County), Southeast Florida (Indian River County south to Miami-Dade County), Florida Keys (Monroe County), Southwest Florida (Levy County south to Collier County), Northwest Florida (Escambia County south to Dixie County), North of Florida (states north of Florida through North Carolina), West of Florida (states west of Florida through Texas)].

Year	Northeast Florida	Southeast Florida	Florida Keys	Southwest Florida	Northwest Florida	North of Florida	West of Florida	Unknown	Total
1980	1	32	153	0	0	0	0	102	288
1981	5	100	242	0	0	0	0	0	347
1982	15	114	60	0	0	0	0	0	189
1983	20	202	12	0	0	1	0	0	235
1984	18	141	0	0	0	2	0	0	161
1985	24	14	0	0	0	0	0	0	38
1986	33	22	0	9	0	0	0	0	64
1987	28	22	0	0	0	0	0	0	50
1988	4	6	0	1	0	0	0	0	11
1989	0	0	0	0	0	0	0	0	0
1990	0	0	0	0	0	0	0	0	0
1991	0	0	28	0	0	0	0	0	28
1992	0	73	1	6	0	0	0	25	105
1993	0	130	32	11	1	0	0	0	174
1994	0	200	96	1	0	4	0	18	319
1995	7	265	108	0	0	0	0	0	380
1996	0	312	85	1	0	10	0	0	408
1997	0	121	240	26	0	0	0	136	523
1998	0	0	187	6	0	0	0	0	193
1999	0	458	172	1	0	2	0	0	633
2000	1	289	191	11	0	0	0	0	492
2001	0	210	296	0	0	0	0	1	507
2002	0	3	447	3	0	0	0	0	453
2003	0	87	211	3	0	0	0	0	301
2004	0	627	262	9	0	2	0	0	900
2005	4	573	756	28	0	28	2	0	1,391
2006	3	781	769	20	0	43	4	0	1,620
2007	6	695	718	32	0	25	0	0	1,476
2008	8	479	1,085	171	0	59	4	25	1,831
2009	29	397	1,223	157	1	40	11	1	1,859
2010	10	342	953	64	0	25	0	0	1,394
2011	8	501	1,016	23	0	13	0	0	1,561
2012	11	696	1,814	20	0	13	0	0	2,554
2013	15	1,164	1,683	8	0	8	0	0	2,878

2014	12	2,025	3,739	30	1	9	0	0	5,816
2015	4	1,963	3,902	92	1	7	0	0	5,969
2016	20	1,273	4,353	170	1	8	0	4	5,829
2017	18	714	3,416	150	2	3	0	0	4,303
Total	304	15,031	28,250	1,053	7	302	21	312	45,280
Percent	0.7	33.2	62.4	2.3	<0.1	0.7	<0.1	0.7	100.0

Table 2.14.3. Number of ages of Yellowtail Snapper sampled by year during 1980 – 2017 within the filtered dataset. Sources of age data include Florida and along the southeastern US Atlantic (states north of Florida through North Carolina) and Gulf of Mexico (states west of Florida through Texas).

	Age (years)																					
Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1980	0	6	78	73	48	33	28	8	3	5	4	1	0	0	0	0	0	1	0	0	0	0
1981	0	7	101	89	51	34	18	19	13	7	1	4	2	0	0	0	1	0	0	0	0	0
1982	0	2	25	96	32	16	6	7	4	0	1	0	0	0	0	0	0	0	0	0	0	0
1983	0	5	105	69	37	4	6	3	2	0	2	1	0	0	1	0	0	0	0	0	0	0
1984	0	2	74	50	17	11	4	2	0	0	0	0	1	0	0	0	0	0	0	0	0	0
1985	0	3	16	12	6	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1986	0	4	33	11	9	4	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1987	0	4	28	14	3	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1988	0	0	4	6	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1989	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1990	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1991	0	0	5	3	11	5	0	0	0	1	0	2	1	0	0	0	0	0	0	0	0	0
1992	0	0	23	54	15	4	3	4	0	1	0	1	0	0	0	0	0	0	0	0	0	0
1993	0	0	54	57	21	10	10	6	9	2	2	1	0	0	2	0	0	0	0	0	0	0
1994	0	2	41	140	60	19	11	11	13	4	5	4	3	2	2	0	2	0	0	0	0	0
1995	0	2	86	163	72	26	12	7	5	7	0	0	0	0	0	0	0	0	0	0	0	0
1996	0	18	180	79	49	36	19	5	8	6	2	2	2	0	0	0	0	1	0	0	0	0
1997	0	3	50	126	81	85	75	43	19	16	7	12	5	1	0	0	0	0	0	0	0	0
1998	0	0	12	44	46	26	19	21	11	5	3	5	0	0	1	0	0	0	0	0	0	0
1999	0	55	299	96	66	47	25	17	15	6	4	0	0	1	2	0	0	0	0	0	0	0
2000	0	11	159	93	83	56	33	19	12	13	5	5	0	2	1	0	0	0	0	0	0	0
2001	0	6	125	80	102	61	57	28	13	12	8	6	6	1	0	1	0	1	0	0	0	0
2002	0	0	42	97	91	85	66	24	23	7	7	4	4	1	1	0	1	0	0	0	0	0
2003	0	11	53	69	46	22	33	28	9	12	3	3	7	4	0	1	0	0	0	0	0	0
2004	0	11	385	294	111	42	26	15	7	3	0	3	1	0	1	1	0	0	0	0	0	0
2005	0	15	301	568	231	130	70	29	14	12	7	4	2	2	4	1	1	0	0	0	0	0

2006	0	22	633	345	274	126	68	51	36	26	13	7	9	2	5	1	0	1	0	0	0	1
2007	17	30	399	569	207	101	67	31	19	5	13	4	2	3	3	0	2	2	0	0	1	1
2008	0	39	341	491	454	194	116	68	51	22	10	16	9	5	1	5	4	0	2	0	1	1
2009	0	30	399	444	315	300	135	102	55	26	17	5	11	10	4	4	2	0	0	0	0	0
2010	0	37	309	341	297	155	132	47	28	19	5	9	4	3	2	1	2	0	0	1	0	0
2011	0	78	351	542	255	150	63	64	22	12	7	5	2	2	1	0	1	2	1	1	0	0
2012	0	74	600	721	576	266	137	61	49	15	16	11	9	7	3	3	3	0	1	0	1	0
2013	0	111	1,142	721	362	290	97	72	32	24	12	6	2	1	3	0	0	1	1	0	0	1
2014	1	129	2,087	1,686	761	405	367	172	93	48	33	9	9	7	3	2	0	0	2	0	0	0
2015	4	180	1,495	2,058	1,060	468	264	215	97	57	32	8	12	4	6	4	2	0	2	0	0	0
2016	0	92	1,663	1,370	1,407	696	239	118	110	72	20	16	11	3	6	3	0	0	0	1	1	0
2017	0	69	1,008	1,406	748	553	244	109	59	54	25	14	8	3	1	2	0	0	0	0	0	0
Totals	22	1,058	12,706	13,077	8,005	4,460	2,453	1,408	831	499	264	168	122	64	53	29	21	9	9	3	4	4
Percent	<0.1	2.3	28.1	28.9	17.7	9.8	5.4	3.1	1.8	1.1	0.6	0.4	0.3	0.1	0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1

Table 2.14.4. Number of Yellowtail Snapper otoliths within the filtered dataset by year, fishing sector, and mode of fishing. Sources of age data include Florida and along the southeastern US Atlantic (states north of Florida through North Carolina) and Gulf of Mexico (states west of Florida through Texas). [Fishing sectors: Commercial, Recreational, and Fishery Independent (FI); Fishing modes: Commercial (CM, mainly hook and line), Scientific Survey (SS), Head Boat (HB), Party/Charter (PC), Private/Rental Boat (PR), and Other (OTH)].

		Commercial	FI	Recreational			
Year	Total	CM	SS	HB	PC	PR	OTH
1980	288	16	0	272	0	0	0
1981	347	153	0	194	0	0	0
1982	189	0	0	189	0	0	0
1983	235	0	0	235	0	0	0
1984	161	0	0	161	0	0	0
1985	38	0	0	38	0	0	0
1986	64	0	0	60	4	0	0
1987	50	0	0	50	0	0	0
1988	11	0	0	11	0	0	0
1989	0	0	0	0	0	0	0
1990	0	0	0	0	0	0	0
1991	28	0	0	28	0	0	0
1992	105	74	0	31	0	0	0
1993	174	158	0	5	4	7	0
1994	319	255	0	54	0	10	0
1995	380	267	1	112	0	0	0
1996	408	408	0	0	0	0	0

1997	523	502	0	0	5	16	0
1998	193	161	0	0	0	32	0
1999	633	571	0	2	9	51	0
2000	492	481	0	9	2	0	0
2001	507	450	0	0	18	39	0
2002	453	448	0	0	5	0	0
2003	301	213	0	36	51	1	0
2004	900	271	0	503	113	13	0
2005	1,391	566	0	749	70	6	0
2006	1,620	662	0	877	81	0	0
2007	1,476	304	23	1,148	0	1	0
2008	1,831	635	25	1,050	104	17	0
2009	1,859	714	27	1,042	50	26	0
2010	1,394	441	92	753	90	17	1
2011	1,561	492	9	1,049	11	0	0
2012	2,554	820	39	1,695	0	0	0
2013	2,878	984	16	1,847	31	0	0
2014	5,816	3,413	49	2,225	129	0	0
2015	5,969	3,304	32	2,202	431	0	0
2016	5,829	2,764	0	2,875	188	2	0
2017	4,303	1,700	0	1,993	507	103	0
Total	45,280	21,227	313	21,495	1,903	341	1
Percent	100.0	46.9	0.7	47.5	4.2	0.8	<0.1

Table 2.14.5. A comparison of the outputs between the four von Bertalanffy growth models used to predict length-at-age for Yellowtail Snapper from the Florida-exclusive filtered dataset (1980 – 2017). The four models are: 1) an unweighted non-truncated model (n = 44,953 otoliths), 2) a size-truncated model using a random selection of no more than 30 length observations per age (n = 4,803 otoliths) 3) a size-truncated model using inverse-weighting that includes an age 8+ group (n = 42,985 otoliths), and 4) a size-truncated model using inverse-weighting that includes an age 12+ group (n = 42,985 otoliths). The final model selected was the size-truncated model using inverse-weighting that included an age 12+ group and estimated a constant CV at age (model 4).

		Model variance structure				
Model	Parameter	Constant SD	Constant CV	Var/Mean ratio	Increase CV w/ Age	Increase CV w/ Size-at-Age
Unweighted non-truncated	Linf	446.8	422.3	432.4	355.9	405.0
	k	0.120	0.164	0.143	0.380	0.192
	t0	-6.111	-4.417	-5.080	-1.900	-3.913
	var. param. 1	39.691	0.126	4.973	0.073	0.067
	var. param. 2				0.361	0.184
	obj._function	229262.95	227391.07	228241.65	225864.57	226168.60
	max._gradient	5.3558E-03	1.0686E-03	1.2657E-02	5.1856E-05	1.3364E-03
	AIC	458534.00	454790.00	456491.00	451739.00	452347.00
Size-truncated using random selection of 30 lengths per age	Linf	460.5	422.0	441.0	422.2	419.6
	k	0.155	0.192	0.172	0.192	0.195
	t0	-1.987	-2.192	-2.110	-2.194	-2.189
	var. param. 1	61.988	0.189	11.694	0.189	0.183
	var. param. 2				0.189	0.192
	obj._function	24814.61	24694.21	24724.42	24694.20	24694.00
	max._gradient	2.7768E-04	1.0754E-05	6.3102E-09	1.5790E-04	1.5108E-05
	AIC	49637.20	49396.40	49456.80	49398.40	49398.00
Size-truncated using inverse weighting with age 8+ group	Linf	424.8	390.4	407.4	371.0	371.1
	k	0.198	0.266	0.231	0.324	0.305
	t0	-1.906	-1.542	-1.675	-1.329	-1.445
	var. param. 1	51.568	0.174	8.755	0.148	0.128
	var. param. 2				0.250	0.210
	obj._function	45.18	44.41	44.70	44.33	44.32
	max._gradient	1.9868E-08	2.4028E-08	4.6003E-08	4.1865E-07	5.6114E-06
	AIC	98.35	96.82	97.39	98.67	98.64

Size-truncated using inverse weighting with age 12+ group	L_{inf}	484.9	425.6	452.7	412.4	412.3
	k	0.131	0.200	0.163	0.224	0.223
	t0	-2.520	-1.930	-2.185	-1.781	-1.800
	var. param. 1	59.234	0.181	10.522	0.164	0.151
	var. param. 2				0.216	0.197
	obj._function	67.64	66.80	67.08	66.79	66.77
	max._gradient	8.6772E-07	6.8968E-09	4.9125E-06	9.1029E-07	2.8928E-06
	AIC	143.28	141.61	142.17	143.59	143.55

Table 2.14.6. Histological staging criteria used in this assessment for determining the maturity stage of female specimens of Yellowtail Snapper.

Gonadal Maturity Stage (GMS)	Maturity description	Description
1 - Immature	Immature	Only primary growth oocytes present; no atresia; ovarian membrane thin; ovarian membrane should be free of any large folds (indicative of stretching due to previous spawning)
2 - Developing	Mature	Only primary growth, cortical alveoli and a few partially yolked oocytes may be present; there may be minor atresia
3- Fully developed / Partially spent / Redeveloping	Mature	Primary growth to advanced yolked oocytes present; may have some left over hydrated oocytes and POFs from previous spawning; might have atresia of advanced yolked oocytes, but no major atresia (only minor/moderate) of other oocytes
4 – Final oocyte maturation (FOM) / Hydrated	Mature	Primary growth to FOM/hydrated oocytes present; may have minor/moderate atresia of advanced yolked oocytes; germinal vessel migration (beginning of FOM); hydrated oocytes unovulated.
5 – Running ripe	Mature	Primary growth to ovulated, hydrated oocytes present; often minor/moderate atresia of advanced yolked oocytes; occasionally only hydrated and primary growth oocytes present; most of the hydrated oocytes will be

		concentrated in the lumen, giving the ovary cross-section the appearance of a jelly donut.
6 - Regressing	Mature	Primary growth and cortical alveoli oocytes present; yolked oocytes being resorbed; major atresia; may be remnant hydrated oocytes or degenerating POFs.
7 – Resting or Regenerating	Mature	Most oocytes (>90%) are primary growth; may have other oocytes in late stages of atresia; more follicular tissues than immature fish; presence of large folds on the ovarian membrane (indicative of stretching due to previous spawning).

Table 2.14.7. Logistic model fits for maturity related to (a) size and (b) age for Yellowtail Snapper during the peak spawning months of April-October in Florida. SE=standard error, MS=mean squares for model F-tests.

a. Fork Length (mm)

Parameter	Estimate	SE	
R	0.021	0.00566	
L_{50} (FL, mm)	191.9	15.294	
Variance Source	DF	MS	P
Model	2	75.004	< 0.0001
Error	216	0.1342	

b. Age (years)

Parameter	Estimate	SE	
R	2.706	0.657	
A_{50} (years)	1.704	0.089	
Variance Source	DF	MS	P
Model	2	77.317	< 0.0001
Error	203	0.0856	

Table 2.14.8. Length-length .mm. relationships for Yellowtail Snapper. Length-length regressions are in the form Y = a + bX. SL: standard length (mm); FL: fork length (mm); TL: total length (mm); TW: total weight (kg), GW: gutted weight (kg).

Source	**Y (mm)**	**a (mm)**	**b**	**X (mm)**	**n**	**Min X (mm)**	**Max X (mm)**	**Avg. X* (mm)**	**MSE***	**Adj. r^2**	**Σx^2***	**Σxy***	**Σy^2***
SEDAR 64	SL [a]	-8.5525	0.8961	FL	5,873	230	548	309.8	24.19173	0.99	14972186	13416498	12164483
	$TL_{relaxed}$ [b]**	-14.7197	1.2727	FL	16,212	205	550	304.8	75.76723	0.98	32304485	41115136	53556972
	TL_{max} [c]	-16.4139	1.2969	FL	6,827	225	548	308.1	32.20539	0.99	16365228	21223575	27744022
SEDAR 27A	TL_{max}	-14.947	1.29	FL	3,036	233	548			0.99			
SEDAR 3	TL_{max}	-23.117	1.313	FL	409	233	506			0.98			
Johnson (1983)	FL	17.7	0.78	TL_{max}	100					0.97			
Garcia et al. (2003)	FL	7.56	0.79	$TL_{relaxed}$	1,264	240	780			0.95			
SEDAR 27A	$TL_{relaxed}$	-8.604	0.991	TL_{max}	3,008	266	684			0.99			

[a] reverse prediction: FL = 9.5441 + 1.1159 * SL

[b] reverse prediction: FL = 11.5657 + 0.7857 * $TL_{relaxed}$

[c] reverse prediction: FL = 12.6563 + 0.7711 * TL_{max}

Table 2.14.9. Length-weight relationships .nonlinear estimation. for Yellowtail Snapper in waters off Southern Florida. FL: fork length (mm); TL: total length (mm); TW: total weight (kg), GW: gutted weight (kg). Length-weight regressions were calculated with a nonlinear model: weight = a * Length$_b$.

Source	**Y (kg)**	**a**	**b**	**X(mm)**	**n**	**Min (mm)**	**Max (mm)**	**MSE**
SEDAR 64	TW	3.40E-08	2.8797	FL	16,540	202	550	0.002
	TW	4.04E-08	2.7487	TL$_{\text{relaxed}}$	10,792	247	697	0.00267
	TW	3.21E-08	2.7849	TL$_{\text{max}}$	1,763	284	654	0.00367
	GW	6.15E-08	2.7691	FL	4,052	232	548	0.00311
	GW	5.16E-08	2.7086	TL$_{\text{relaxed}}$	1,955	277	662	0.0043
	GW	5.27E-08	2.6935	TL$_{\text{max}}$	1,838	281	684	0.00403
SEDAR 27A	TW	6.14E-08	2.779	FL	8,273	146	792	0.0082

Source	**Y (kg)**	**a**	**b**	**X(cm)**	**n**	**Min (cm)**	**Max (cm)**	**MSE**
SEDAR 64	TW	2.07E-05	2.8797	FL	16,540	20.2	55	0.002
	TW	2.46E-05	2.7487	TL$_{\text{relaxed}}$	10,792	24.7	69.7	0.00267
	TW	1.96E-05	2.7849	TL$_{\text{max}}$	1,763	28.4	65.4	0.00367
	GW	3.75E-05	2.7691	FL	4,052	23.2	54.8	0.00311
	GW	3.14E-05	2.7086	TL$_{\text{relaxed}}$	1,955	27.7	66.2	0.0043
	GW	3.21E-05	2.6935	TL$_{\text{max}}$	1,838	28.1	68.4	0.00403
SEDAR 27A	TW	3.74E-05	2.779	FL	8,273	14.6	79.2	0.0082

2.15 FIGURES

Figure 2.15.1. A Yellowtail Snapper over natural live bottom in the Florida Keys

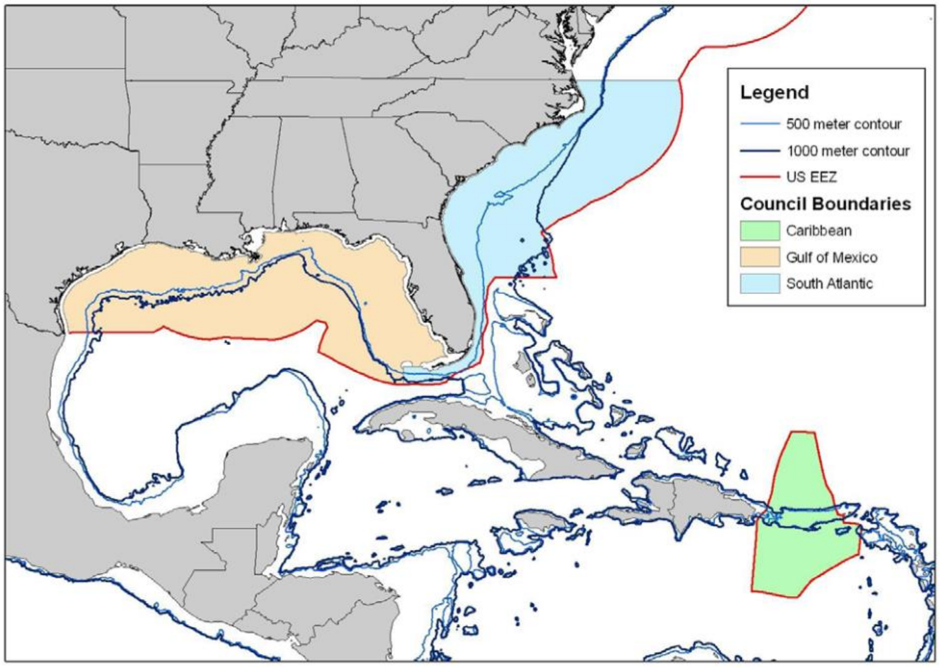

Figure 2.15.2. Jurisdictional boundaries in the Southeast Region for the South Atlantic Fishery Management Council, the Gulf of Mexico Fishery Management Council, and the Caribbean Fishery Management Council.

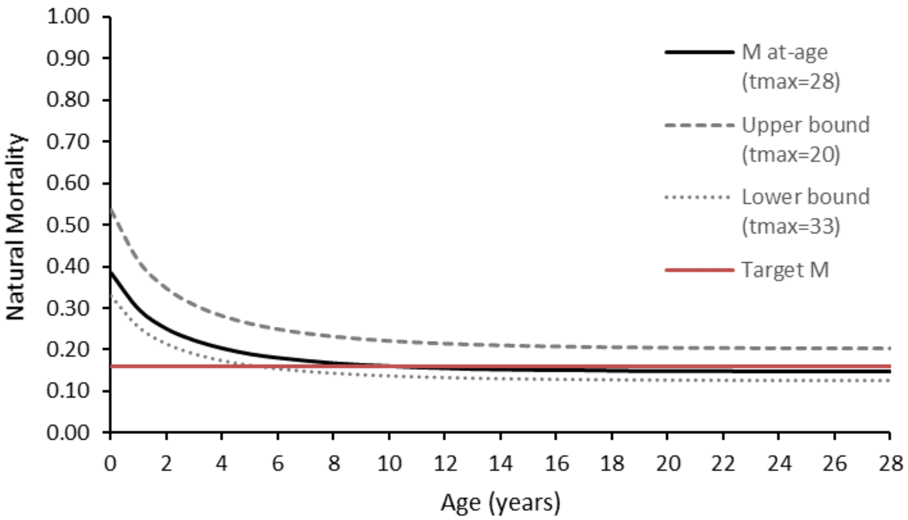

Figure 2.15.3. Natural mortality-at-age ($M_{at\text{-}age}$) of Yellowtail Snapper with maximum age of 28 years. $M_{at\text{-}age}$ is derived following Lorenzen (2005) using the $Hoenig_{all\ taxa}$ (1983) constant mortality-at-age as the target M scaled between vulnerable ages 3 – 28 ($M_{target} = 0.160$) and the von Bertalanffy growth model parameters (Linf = 425.6; k = 0.1998; t0 = -1.9297). For the upper bound: $M_{target} = 0.223$ for maximum age 20 years; and for the lower bound: $M_{target} = 0.136$ for maximum age 33 years.

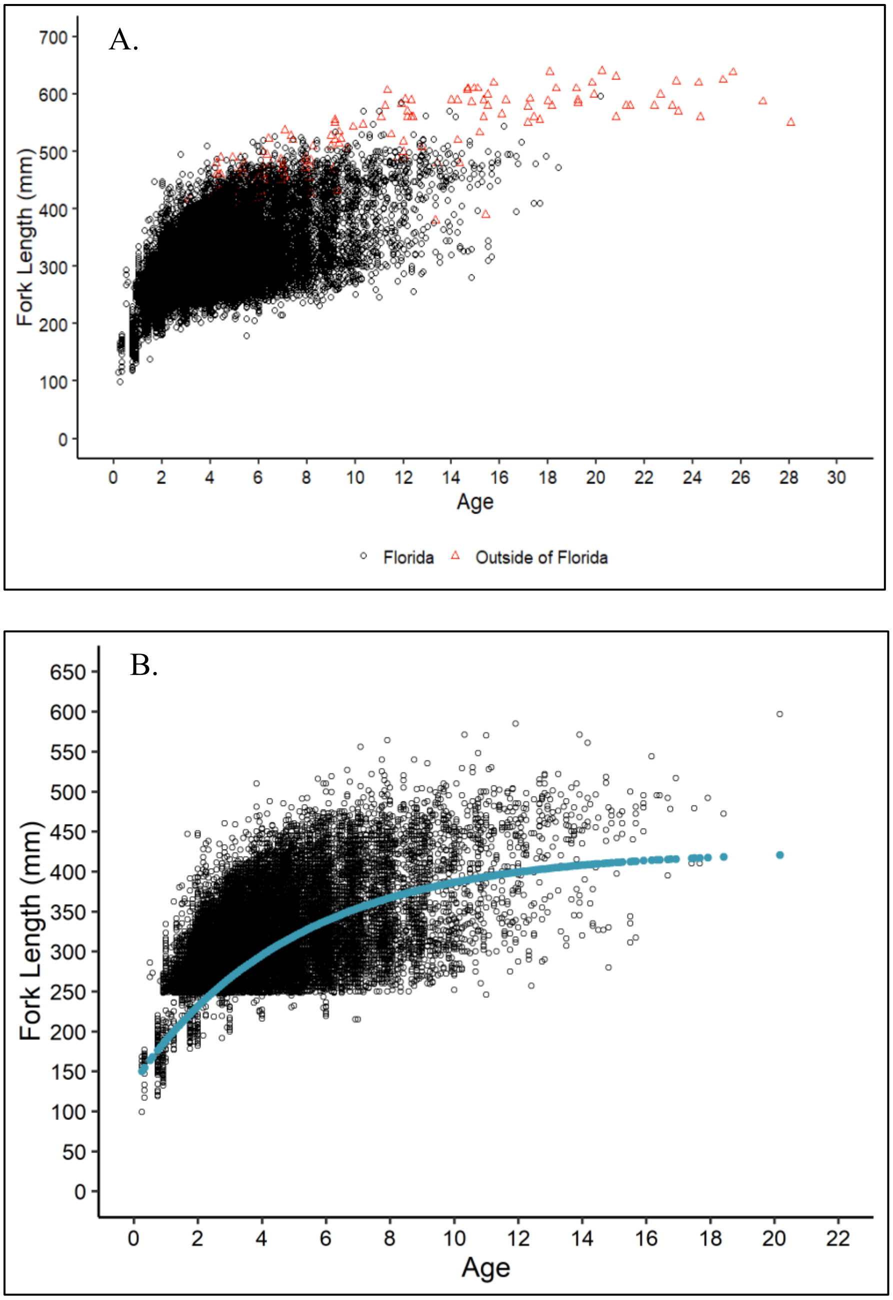

Figure 2.15.4. Yellowtail Snapper (1980 – 2017) observed ages (years) and fork lengths (mm). The upper panel (A) shows non-truncated length-at-age data collected from Florida and outside of Florida along the southeastern US Atlantic and Gulf of Mexico (n=45,280 otoliths). The lower panel (B) displays Florida-exclusive data (n = 42,985 otoliths) with a predicted growth curve (blue dots) using a size-truncated von Bertalanffy growth model. Data were inversely weighted by 1/*n* of each calendar age, included an age 12+ group, and size-truncated at 248 mm fork length. The model variance structure estimated a constant CV with age.

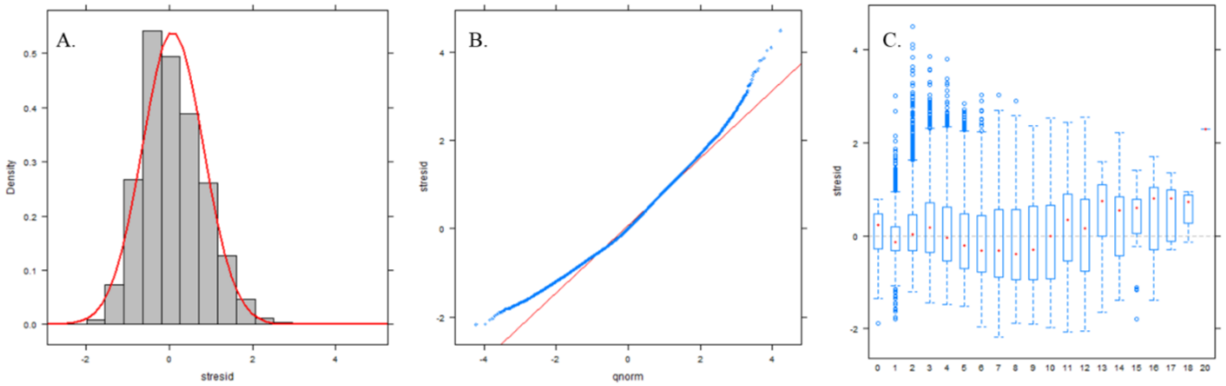

Figure 2.15.5. Standardized residual diagnostic plots: a) density distribution, b) normal probability plot (quantiles vs standardized residuals), and c) standardized residuals by age for the Yellowtail Snapper size-truncated von Bertalanffy growth model. The data were inversely weighted by 1/*n* of each calendar age and included an age 12+ group. The model variance structure estimated a constant CV with age. Boxplots include the median, upper and lower quartiles, and outliers (open circles).

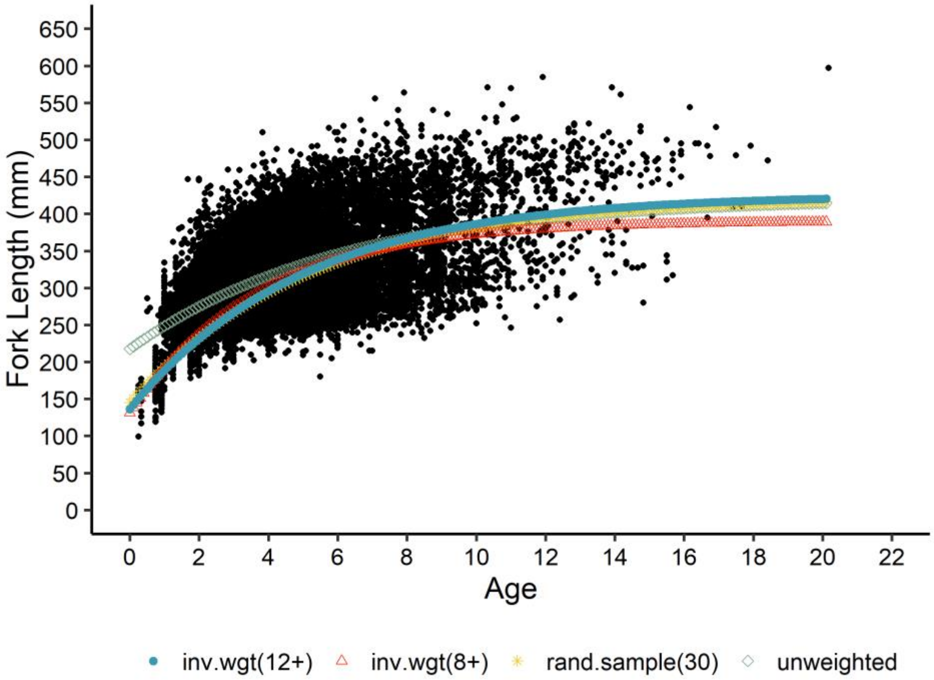

Figure 2.15.6. A comparison of the outputs between the four von Bertalanffy growth models used to predict length-at-age for Yellowtail Snapper (1980 – 2017) in Florida waters: 1) an unweighted non-truncated model (green diamond; n = 44,953 otoliths), 2) a size-truncated model using a random selection of no more than 30 length observations per age (yellow star; n = 4,803 otoliths) 3) a size-truncated model using inverse-weighting that includes an age 8+ group (red triangle; n = 42,985 otoliths), and 4) a size-truncated model using inverse-weighting that includes an age 12+ group (blue dots; n = 42,985 otoliths). All models shown included a variance structure which estimated a constant CV with age. All length-at-age observations (black dots; n = 44,953) were exclusively from Florida.

3 COMMERCIAL FISHERY STATISTICS

3.1 OVERVIEW

Commercial landings of Yellowtail Snapper for Florida and the Southeastern United States. were tallied by year, month, region, and gear (hook/line and other) in pounds whole weight for the period 1981−2017 based on federal and state databases. Corresponding landings in numbers were calculated by applying mean weights estimated from the Trip Interview Program (TIP) by year, month, region, and gear.

Commercial discards were calculated from federally permitted vessels fishing in the US South Atlantic and Gulf of Mexico using data from the Coastal Fisheries Logbook Program (CFLP) from 1993–2018.

Sampling for Yellowtail Snapper lengths and ages by year, region, and gear were extracted from the Trip Interview Program (TIP). Most sampling occurred in the Florida Keys which shows sufficient number of length samples for all years. Other regions show few samples prior to 1992 where Southeast Florida had the next largest number of samples outside the Florida Keys. Hard parts were collected for aging and sufficient age samples are available starting in 2002. Most age samples are from the Florida Keys and to a lesser extent, Southeast Florida.

3.1.1. Commercial Workgroup Participants

Steve Brown	Workgroup co-leader	FL FWC
Chris Bradshaw	Workgroup co-leader	FL FWC
Elizabeth Herdter	Stock Assess/rapporteur	FL FWC
Beth Wrege	Data provider	SEFSC Miami
Kevin McCarthy	Data provider	SEFSC Miami
Manny Hererra	Commercial	Miami, FL
Michael Birren	Commercial	Hudson, FL
Charlotte Marin	Biological Field Staff	FL FWC

3.1.2 Issues Discussed at the Data Workshop

Issues discussed by the commercial workgroup concerning Yellowtail Snapper landings included sources of data for historical landings, potential unreported or mis-reported catch, gear groupings, and regional definitions. The group also discussed available data for discards from NOAA Fisheries Coastal Logbook and observer programs, and available biological sampling data from TIP.

3.2 REVIEW OF WORKING PAPERS

SEDAR64-DW-13: This working paper provided summary landings by year, region, and gear from Florida and the Southeastern U.S. Data were provided from Florida's Marine Fisheries Trip Ticket, NOAA Fisheries Accumulated Landings System, and NOAA Fisheries Coastal Logbook program. Data were compared among all three data sources to establish historical landings of Yellowtail Snapper. Landings data indicate most of the harvest occurs in Florida, with the highest landings coming from the Florida Keys. Effort data were provided as number of trips and participation and were compared to historical landings by year and region. Additional analyses provided a comparison of landings by fishing zone (state or federal) and region.

SEDAR64-DW-14: This working paper provided summary data for length and weight from biological sampling of Yellowtail Snapper through the NOAA Fisheries Trip Interview Program. Data provided were collected by both state and federal samplers. Data were analyzed for length composition for both fork length (FL) and maximum total length (maxTL) by year, region and gear. Outliers were identified and flagged for potential removal from further analyses. A length weight conversion provided weights for samples missing weights. Gear types were identified, and length frequency histograms were generated by region for both FL and maxTL.

SEDAR64-DW-15: This working paper provided summary data on release discard mortality and discard length distribution for Yellowtail Snapper from the NOAA Fisheries Reef Fish Observer Program (RFOP) and Shark Observer Program (SOP). RFOP data were from bottom longline and vertical line gears in the Gulf of Mexico. The SOP includes data from both the Gulf and South Atlantic for bottom long line as well as some voluntary data from the Snapper-Grouper vertical line fishery in the South Atlantic. Data from both sources were analyzed by region and gear and length distributions were generated. Discard mortality was estimated by depth.

3.3 COMMERCIAL LANDINGS

Commercial landings of Yellowtail Snapper were compiled from 1950-2018 for the Southeast U.S. by Florida coast and other states combined (Table 3.1). Data sources for the landings include Florida's Marine Fisheries Trip Ticket, NOAA Fisheries Accumulated Landings System

(ALS), as well as NOAA Fisheries Coastal Logbook program. Florida accounts for nearly all Yellowtail Snapper harvest from Gulf of Mexico and South Atlantic waters, and nearly 90% of Yellowtail Snapper landings in Florida have occurred in Monroe county since 1962 (Table 3.2). Less than 1% of reported landings were from the other Gulf and South Atlantic states combined since 1982. No Yellowtail Snapper landings were reported from any state other than Florida prior to 1982.

3.3.1 Commercial Gears

The workgroup investigated reported gears landing Yellowtail Snapper from the data sources identified in Section 3.3 and determined the predominate gear to be hook and line gear types. Landings were then categorized into two gear groups: hook and line, and other. Hook and line include rod and reel, electric/hydraulic (a.k.a., bandit) reels, trolling, hand lines, and long line. A list of gears included in the hook and line category can be found in Table 3.3. On average, more than 98% of Yellowtail Snapper were reported landed by hook and line gears in the Southeastern U.S. from 1962 to 2018 (Figure 3.1).

3.3.2 Commercial Regions

Since most Yellowtail Snapper landings occur in Florida, the stock assessment group asked that the landings be separated by region using the Marine Recreational Information Program (MRIP) for-hire regions in Florida (Figure 3.2). Landings were separated into seven different for-hire survey (FHS) regions based first on area fished, and then county landed, if area fished was not present. Any landings reported west of Florida in the Gulf of Mexico were categorized as FHS region 0, and any landings reported north of Florida on the Atlantic coast were placed is FHS region 6. The five FHS regions within Florida were defined as: Northwest=1, Southwest=2, Florida Keys=3, Southeast=4, and Northeast=5.

3.3.3 Misidentification and Unclassified Yellowtail Snapper

The workgroup decided early on that there were no issues of misreporting with regard to Yellowtail Snapper. Industry representatives and scientists both agreed that because of its distinct appearance and dissimilarity to other snapper species, Yellowtail Snapper were unlikely to be classified as another snapper species. Industry representatives also confirmed that reporting Yellowtail Snapper as unclassified snapper was unlikely, especially in South Florida where most Yellowtail Snapper are landed, and that fishers would want to have Yellowtail Snapper reported separately from other snapper species. There was some concern about potential under reporting, particularly in the earlier years before the trip ticket program. The workgroup decided that establishing estimates of uncertainty in landings could address this issue.

3.3.4 Commercial Landings by Region and Gear

Comparisons were made between Florida's commercial trip ticket data (1986-2018) to both the NMFS ALS (1962-2018) and logbook data (1992-2018). The ALS data are of a longer time series than Florida trip ticket, but both datasets appear identical when comparing statewide landings from 1986-2018 (Figure 3.3). The NMFS logbook data are of a shorter time series, and do not capture much of Yellowtail Snapper that may be harvested in state waters (Kevin McCarthy, personal communication). Additional comparisons also show that Florida trip ticket and ALS show similar landings by FHS region, particularly for the Florida Keys and Southeast Florida where the majority of Yellowtail Snapper are landed (Figure 3.4). Though similar in trend after 1992, the logbook data show fewer landings by region. Because gear data were not available in Florida trip ticket until 1991, the workgroup decided combined landings from both Florida trip ticket (1992-2018) and NMFS ALS (1962-1991 for all states, 1962-2018 for non-Florida states) would be used to establish final commercial landings by FHS region and gear. Figure 3.5 presents Yellowtail Snapper landings in pounds by region averaged over the last three years (2015-2017). Table 3.4 shows annual Yellowtail Snapper landings in whole weight pounds by region and gear. Though landings will be provided by defined FHS region and gear for the assessment, Table 3.4 shows landings by more general regions to address confidentiality issues. Most landings of Yellowtail Snapper were reported in gutted weight and converted to whole weight using a conversion of 1.11 where:

$$\text{Whole weight} = 1.11*\text{gutted weight}$$

<u>Confidentiality Issues</u>

Landings of Yellowtail Snapper were aggregated among states (except for Florida) to meet the rule of 3 and ensure confidential landings were not presented in this report. Any cell of data still deemed confidential was masked by an '*'. These landings account for less than 0.1% of the annual totals. Landings by year, month, FHS region, and gear will be provided to assessment staff for use in the assessment.

Uncertainty

After consultation with assessment biologists, the commercial workgroup estimated uncertainty in commercial fishery landings by using a similar methodology and modifying the uncertainty estimates used in SEDAR 41 (Red Snapper) and SEDAR 50 (Blueline Tilefish). These estimates of uncertainty are not coefficients of variation but are estimates of possible reporting error such that they represent the range in actual commercial landings relative to the reported landings.

Because of its unique appearance and that misidentification would be unlikely, a single assumption was used in establishing uncertainty estimates for commercial landings of Yellowtail Snapper:

Landings may be underreported during all years; but underreporting was likely highest during early years of the time series and landings were more accurate in recent years. This assumption was based upon the following information and data workshop expert testimony: during the period of 1950 (beginning of landings time series) to 1961 landings were summarized annually by state and likely did not include landings from small scale dealers. In the years 1962 to 1977 landings data were collected annually, but under a more all-inclusive program (General Canvass). Monthly landings summaries were collected during the period 1978 to the beginning of trip ticket data collection (starting dates vary among states). The most recent landings data, collected through the Florida trip ticket program, were assumed to be most reliable and inclusive of all commercial landings. Based on this information Table 3.5 shows estimated uncertainties by multi-year blocks for Yellowtail Snapper.

3.3.5 Converting Landings in Weight to Landings in Numbers

Commercial landings in whole weight kilograms were converted to landings in numbers based on mean weight (in kilograms whole weight) from the TIP data for each year, FHS region, and gear. These data were generally available from 1984 to 2017 for hook and line gears, especially in the Florida Keys. Data for the other gear category and for FHS regions North and West of South Florida were more sparse (annual sample sizes by year, FHS region, and gear are summarized in Table 3.6). Because so few samples were available outside of South Florida, data from FHS regions west of FL and Northwest Florida were combined with Southwest Florida as West, and data from FHS regions north of FL and Northeast FL were combined with Southeast as East. Subsequent mean weights calculated for the East and West regions were then later applied to all three FHS regions within each larger region. For 1984-2017, annual estimates of mean weight by year and region for both hook and line and other gear were applied to the corresponding landings in weight when the TIP sample size (number of fish) was greater than or equal to 50. For years when samples size was less than 50, a mean weight calculated from adjacent 5-year blocks was applied by region for each gear category back through 1981. Calculated numbers of fish can be found in Table 3.7 and Figure 3.6. Like landings in pounds, Table 3.7 shows numbers of fish aggregated by general FHS region and gear to mask any potential confidential data. Summary data for the assessment will be provided by defined FHS region and gear. Mean weights by year, region, and gear are provided in Table 3.8.

3.4 COMMERCIAL DISCARDS

Three possible approaches were investigated for the calculation of Yellowtail Snapper discards from the commercial handline fishery. The first technique (continuity method) followed the methods used in SEDAR 27 (McCarthy, 2011) by modeling discard rates. The second technique followed the methods recommended in SEDAR 32 (standard method) where discard rates were directly calculated from discard logbook data. Finally, calculating discards using available observer data was investigated.

The SEDAR 64 Commercial Work Group recommended the standard method as the preferred method for commercial discard calculation because that method has been used for all SEDAR assessments since SEDAR 32 in cases where observer data is unavailable or insufficient for use.

Available observer data were not representative of Yellowtail Snapper trips and use of those data for providing discard estimates was not recommended. The Work Group did not recommend the continuity method because the standard method was judged to be more appropriate.

Yellowtail snapper discard calculation used data reported between January 1, 2002 and December 31, 2018 in southern Florida from vertical line trips. Yellowtail snapper discards were not reported on more than a few trips using other gears. Data filtering followed the methods recommended during SEDARs 32 and 41 (McCarthy, 2013 and 2014). Data were also filtered to exclude trips landing only mackerel because the SEDAR 32 and 41 panels (and accepted by the SEDAR 64 working group) noted that for trips targeting mackerel only, the likelihood of catching species other than mackerel was extremely low. To avoid removing mixed effort trips, however, only trips with 100% mackerel landings were excluded.

A final data filter designed to address possible underreporting of commercial discards was included following the recommendation of SEDARs 32 and 41. The percentage of discard reports returned with “no discards” from vertical line trips has increased from 49 to 79 percent in southern Florida over the period 2002-2018. The working group recommended that data be filtered to remove records from vessels that never reported discards of any species during a year. Following the SEDAR 32 and 41 commercial working groups’ recommendations, data from vessels that reported many more trips than the fleet average before a discard was reported (the mean number of trips prior to the first trip with reported discards plus two standard deviations above that mean) were excluded. Filtered logbook data were assigned to one of three regions by reported area fished. Each logbook region coincides with the FHS regions established in Figure 3.2 (West Florida – FHS 2, Florida Keys – FHS 3, and Southeast Florida – FHS 4).

Yearly discard rates of vertical line vessels were calculated as the mean rate (discards per hook hour fished) within each region during the years 2002-2018. Yearly total effort (hook hours) of all trips by vertical line vessels within each region was multiplied by the yearly mean discard rate from the appropriate region to calculate total discards of yellowtail snapper by vertical line vessels.

*Calculated discards per region = yearly mean yellowtail snapper discard rate per region*total effort per region*[1]

[1] total effort post data filtering

For years prior to 2002 (the first year of discard data), the mean discard rate, by region, for the years 2002-2006 was used to calculate discards for the years 1993-2001 when only effort data were available.

*Calculated discards per region = 02-06 mean yellowtail snapper discard rate per region*total effort per region*[1]

[1] total effort post data filtering

Total discards are provided in Table 3.9 by region in number of fish and pounds whole weight.

Immediate release mortality was assessed by depth for vertical line trips in the Florida Keys from the reef fish observer data (Table 3.10.). Based on the fishing depth distribution of all discards, depth was categorized into five-meter bins with the last bin representing fishing depth deeper than 20 meters. Percent release mortality was calculated based on the observer reported discard disposition of yellowtail snapper within each depth bin. Percent release mortality was the highest at the shallow (< 5m) and deep (> 20m) depth bins as 17% and 22%, respectively. Disposition was then compared to the initial condition of the fish when hauled on board the vessel (alive, dead, or barotrauma). This showed that most fish discarded dead were initially alive when brought on board. This suggests delayed release may have been due to extended observer handling times before fish were discarded resulting in high release mortality when caught less than five meters from the surface. Additionally, a single trip accounted for 35% of the fish released dead within the five-meter depth bin. Due to this presumed effect of handling time, the work group did not recommend using these results to inform commercial discard mortality. See working paper SEDAR64-DW-15 for a detailed description of methods.

Discard mortality estimates for commercial Yellowtail Snapper were set at a lower and upper bound of 10% and 15%, respectively. During the plenary session, an estimate of 20% upper bound was proposed but thought to be too high by industry. Commercial fishers would be more apt to release their fish quickly thereby reducing potential predation and interruption in fishing activity. These new estimates are similar to the calculated estimate of 11.5% from SEDAR 27A. Table 3.11 shows the amount of estimated discard mortality by year and region in both numbers of fish and pounds whole weight.

3.5 COMMERCIAL EFFORT

Figure 3.7 presents the number of commercial Yellowtail Snapper trips with Florida landings by region averaged over 2015-2017. The commercial workgroup looked at both number of licenses reporting Yellowtail Snapper landings as well as the number of trips on which Yellowtail Snapper were caught as potential measures of effort in the fishery. A comparison of number of trips and landings by year for the three regions of major harvest (FL Keys, Southeast Florida, and Southwest Florida) show that prior to 2008, both number of trips and landings in each region changed somewhat similarly from year to year (Figure 3.8). But starting in 2008, the FL Keys region showed a dramatic increase in landings while the number of trips decreased. Additionally, the number of state commercial fishing licenses harvesting Yellowtail Snapper has also declined in all three regions of South Florida, particularly in the FL Keys since about 1990 (Figure 3.9). The number of federal snapper-grouper permits active in the South Atlantic has decreased as well (Figure 3.10). This inverse relationship between effort and landings could be attributed to more efficient fishing methods, and possibly a more abundant population of Yellowtail Snapper during this time.

There was some concern as to where most of the Yellowtail Snapper harvest was taking place with respect to changes in state and federal regulations in the Gulf and South Atlantic. Figure 3.11 shows commercial Yellowtail Snapper landings by state and federal waters for each of the

South Florida subregions from Florida trip ticket data. While area fished was always a data element on the trip ticket, it was not required to be reported until 1995. Also, early area fished coding did not separate state and federal waters initially. We consider 1996 to be a good starting year for reporting landings by area fished. Yellowtail Snapper landings in the Southwest region are almost exclusively from federal waters while landings from Southeast Florida tend to be more from state waters. The Florida Keys show a mixture of landings from state and federal waters with most of the fish coming from federal waters. Commercial industry participants generally agreed with these observed fishing trends.

3.6 BIOLOGICAL SAMPLING

Biological samples from the commercial fishery primarily come from the Trip Interview Program System (TIPS). These data are collected by state and federal port agents who meet the vessel at the dock upon return from its fishing activities and sample their catch. Data collected from the catch include lengths, weights, and hard parts for aging whenever possible in addition to trip and effort information from the fishers. This information is then entered into the TIPS database housed at the NOAA Fisheries Southeast Fisheries Science Center. All data for Yellowtail Snapper were provided in Microsoft Access and converted into SAS data sets for processing and analysis using methods approved by the working group. A series of length/length and length/weight regressions were used to fill any missing data.

3.6.1 Sampling Intensity Length/Age/Weight

Sampling for Yellowtail Snapper lengths for TIPS occurred from 1984 to 2017 (terminal year of SEDAR 64) and from Louisiana to North Carolina. Lengths were compiled by region based on the FHS region definitions in Figure 3.2 using area fished when available and county landed when area fished was not available. The number of FL records for each region are shown in Table 3.12. Over 99% of samples came from Florida with the majority of those (~81%) coming from the Florida Keys. Flags were set up to mark data for exclusion as outliers in length frequency distributions based on extreme lengths, non-commercial data, size or effort bias, no region assigned, and non-random records. Other factors were examined but not found to alter the mean or SD of lengths (i.e. if the catch is landed sorted, complete/incomplete landings, interview type, etc.). The Florida Keys has adequate samples for all years, but other regions have few to no samples for early years until 1992 when sample size in Southeast Florida increased (Table 3.13). No other regions consistently have enough samples. TIPS records show gutted or whole weight for 14.3% of samples. The remaining weights were computed from FL or TL max length-weight equations. These computed weights were used to create mean weights for calculating the number of fish landed in section 3.3.5.

Hard parts for aging Yellowtail Snapper were collected from TIPS sampled fish. The ages from these samples were obtained from age and growth labs at NOAA Fisheries (Panama City and Beaufort) and from FWC's Fish and Wildlife Research Institute (FWRI) in St. Petersburg. Preliminary age data were lacking TIPS interview numbers for samples collected before 2002. We requested a complete download of yellowtail data from the age and growth labs and were able to match the TIP data from 1992 to 2017. Age data from the Florida Keys are sufficient starting in 2002 and from Southeast Florida starting in 2004. The ages were combined with the TIPS length data to create an age at length key.

3.6.2 Length/Age Distributions

Length and age distributions were reviewed by the workgroup. More details on length frequency distributions are shown in working paper S64_DW_14_TIPS_LFD.pdf. Data from the Florida Keys and Southeast Florida generated robust distributions (Figure 3.12) and mean length was very similar between the Florida Keys and southeast Florida (Table 3.12). Plots showing the proportion of age by year indicate Yellowtail Snapper were mostly 3-5 years old in the Florida Keys (Figure 3.13) and 2-3 years old in Southeast Florida (Figure 3.14). The Florida Keys also had a much broader age distribution than Southeast Florida. A box plot of mean age by FHS region (Figure 3.15) shows Yellowtail Snapper in the northern regions reach larger lengths and mean ages. The North of Florida region had the oldest (23 years) and largest fish (~840 mm TL max) in the dataset. The age and growth workgroup noted they will not be including the very old fish from outside Florida for their analyses.

3.6.3 Adequacy for Characterizing Catch

The workgroup had determined that these data are adequate for characterizing catch because the data corroborate the landings. We have identified items that could be improved and have included them in the research recommendations.

3.6.4 Alternatives for Characterizing Discard Length/Age

Discard data presently comes from the observer program and commercial logbooks. Size composition data from the Reef Fish and Shark Observer Programs were provided to the FWRI data compiler. Based on data availability and coverage, shark observer data were only sufficient for vertical line trips in the Florida Keys. It should be noted that the shark observer data were not representative because length data were only available for trips taken within a single year by a single vessel. Reef fish observer data were supplied for both longline and vertical line trips in the Florida Keys and along the western Florida coast. All lengths were converted to both fork length (cm) and total length (cm) and binned to one-centimeter increments. See working paper SEDAR64-DW-15 for a detailed description of methods.

Beginning a program of on-board sampling for discards in the South Atlantic commercial fleet would be an alternative for the present fisher reported data and would supplement the logbook program and the Gulf of Mexico observer programs greatly. This could be done with sampling predominantly day trips and some multiday trips to characterize yellowtail catch. Head boat discard data was suggested as a proxy, but the group determined that the fishing behavior differences and higher discard mortality would make it a poor fit.

3.7 COMMERCIAL CATCH-AT-AGE/LENGTH (DIRECTED AND DISCARD)

These data are currently still under review and will be provided in the assessment report.

3.8 COMMENTS ON ADEQUACY OF DATA FOR ASSESSMENT ANALYSES

The commercial workgroup considered the landings data from Florida to be adequate for assessment analyses. Misidentification or misclassification of Yellowtail Snapper were not significant issues. There is some concern that landings prior to 1986 (beginning of the trip ticket program) may have been underreported. However, uncertainty estimates for the landings were developed to address the issue of accuracy and completeness in the landings. Gear data missing from Florida trip ticket were supplemented by ALS landings by gear prior to 1991. Also, the workgroup recommended that landings be aggregated by gear as most of the Yellowtail Snapper harvest is by vertical line.

While the amount of discard data captured from the observer programs seems inadequate for the calculation of discards, these data may be useful for comparison and potential development of discard length composition. Although self-reported, the coastal logbook program was able to provide much more discard data and the workgroup agreed is the best data available for the calculation of discard rates of commercial Yellowtail Snapper. CVs were provided as an estimate of uncertainly in the mean discard rates.

The discard calculations rely on self-reported discard and effort data. Perhaps the most important source of error in the commercial discard calculations was misreporting and non-reporting of discards, both of yellowtail snapper and other species. An effort was made to minimize that potential error by removing data from vessels that never reported discards of any species during a year or reported many more trips than the fleet average before a discard was reported. Although such clear instances of discard non-reporting were identified and excluded, other cases of non-reporting and misreporting have not been quantified. The degree to which continued nonreporting or misreporting may have affected the discard calculations is unknown.

The discard totals provided may represent a minimum estimate of the number of yellowtail snapper discarded from the commercial vertical line fishery. The conclusion of the commercial working group was that given the very limited and non-representative nature of available observer data, fisher reported discard data represent the best available information on commercial yellowtail snapper discards. This decision was approved in plenary session of the Data Workshop.

The workgroup agreed that length samples from the TIP program appear to be adequate for assessment analyses as there were a relatively high number of samples for most years in the core areas (Florida Keys and Southeast Florida).

3.9 RESEARCH RECOMMENDATIONS

Improve or develop new methods for collecting discard data. Expand observer coverage to the entire range for Yellowtail Snapper (i.e. Atlantic) to document discard length and mortality. Find a better method to address false zeros in self-reported logbook data. Explore recall bias/rounding issue: discards 5,10, 15 – recall bias – 1-10, units of 5 after that.

Study smaller fish for possible correlation between sex and tail length. Industry has seen robust fish with short tails and skinny fish with longer tails and believe them to be evidence of a secondary sex characteristic.

Perform genetic analysis of commercial samples to determine if Yellowtail Snapper is a single stock in the Southeastern United States (very old and large fish North of Florida along the Atlantic coast possibly indicating different stocks).

So little data is available on YOY/juvenile Yellowtail Snapper. There may be an opportunity to increase these samples as commercial fishers who participated in the workgroup have offered to assist fisheries scientists to obtain samples of YOY/juvenile Yellowtail Snapper. Industry believes they can get fisheries independent scientists' access to these fish by taking scientists to areas where many YOY/juvenile fish have been observed, or by providing them with area and gear recommendations based on the results of commercial fishing activities for Yellowtail Snapper.

Survey fishers for when then encounter small sub-legal fish (on board observer or email/mail). When they see small fish, they often leave the site which is not captured by logbook or gulf observer program. Modifying API of e-logbook or putting more onboard observers in the keys could provide more data on behavior. Onboard observers could also obtain discard information. Could use VMS to account for target species switching.

Ensure consistent and adequate levels of funding for continued TIPS sampling. These data were critical in providing age, length, weight, and trip information which can help validate reported landings information.

3.10 DATA BEST PRACTICES COMMENTS AND SUGGESTIONS

While the topic of unclassified/misidentified fish did not seem to be an issue for Yellowtail Snapper, the workgroup recommends the continued practice of evaluating this potential issue on a species by species basis.

The availability of duplicate datasets allows for the comparison, validation, and potential synthesis of multiple datasets for development of best available data. The workgroup recommends continued use of this practice.

The Commercial Workgroup still supports the recommendation from the Best Practices Report to hold a workshop or meeting to determine specific methods for quantifying uncertainty in commercial landings in such a way that is appropriate and informative to the model.

3.11 LITERATURE CITED

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3.12 TABLES

Table 3.1. U.S. commercial landings (in pounds) of Yellowtail Snapper by Florida coast and other states combined. Data from NOAA Fisheries and FL FWC.

Year	FL West Coast	FL East Coast	Out-of-State
1950	249,900	96,500	0
1951	210,000	227,600	0
1952	215,400	174,600	0
1953	213,200	134,400	0
1954	200,100	133,700	0
1955	143,800	92,600	0
1956	163,700	100,400	0
1957	296,500	146,800	0
1958	261,300	86,500	0
1959	406,300	86,400	0
1960	527,600	98,200	0
1961	639,900	95,000	0
1962	909,800	88,300	0
1963	729,000	102,700	0
1964	896,500	144,100	0
1965	941,700	123,000	0
1966	752,500	77,700	0
1967	849,900	112,600	0
1968	1,025,300	162,900	0
1969	807,800	162,300	0
1970	986,900	209,300	0
1971	948,900	144,400	0
1972	865,500	154,700	0
1973	835,500	107,100	0
1974	937,900	104,900	0
1975	675,400	122,300	0
1976	922,300	55,400	0
1977	762,400	46,400	0
1978	830,400	40,200	0
1979	731,700	48,300	0
1980	606,438	45,017	0
1981	694,188	37,434	0
1982	1,334,831	35,884	1,358
1983	894,385	67,326	31
1984	911,608	35,697	160
1985	784,095	41,126	766
1986	1,026,456	92,318	46
1987	1,265,459	88,544	10,054
1988	1,299,430	111,936	1,210
1989	1,711,275	137,021	3,231
1990	1,627,159	128,102	352
1991	1,711,518	148,832	1,292

Year	FL West Coast	FL East Coast	Out-of-State
1992	1,675,050	176,462	4,830
1993	2,193,092	185,641	506
1994	2,037,469	168,384	434
1995	1,728,856	127,934	124
1996	1,350,073	109,127	136
1997	1,529,064	144,842	277
1998	1,398,046	126,385	177
1999	1,735,291	110,862	253
2000	1,490,704	101,016	226
2001	1,324,607	95,974	203
2002	1,315,257	94,687	755
2003	1,304,558	105,449	2,452
2004	1,377,250	102,689	706
2005	1,212,587	111,960	780
2006	1,153,822	83,061	423
2007	881,060	96,905	609
2008	1,258,882	111,120	799
2009	1,814,961	160,137	1,672
2010	1,502,395	191,557	1,449
2011	1,682,877	210,667	1,312
2012	1,937,097	170,213	1,084
2013	1,947,817	113,326	1,866
2014	1,984,270	59,010	824
2015	2,164,831	33,139	2,253
2016	2,259,559	55,347	748
2017	2,780,951	39,489	272
2018	1,955,100	24,822	743

Table 3.2. Monroe county (FL Keys) landings of Yellowtail Snapper as a percent of the Florida statewide total from 1962-2018.

Year	Monroe County	Statewide	% Monroe
1962	892,700	998,100	89.4%
1963	716,600	831,700	86.2%
1964	885,400	1,040,600	85.1%
1965	915,100	1,064,700	85.9%
1966	735,000	830,200	88.5%
1967	828,800	962,500	86.1%
1968	947,700	1,188,200	79.8%
1969	755,800	970,100	77.9%
1970	915,100	1,196,200	76.5%
1971	836,100	1,093,300	76.5%
1972	741,000	1,020,200	72.6%
1973	726,700	942,600	77.1%
1974	798,600	1,042,800	76.6%
1975	591,700	797,700	74.2%
1976	810,500	977,700	82.9%
1977	653,700	808,800	80.8%
1978	735,100	870,600	84.4%
1979	656,800	780,000	84.2%
1980	535,531	651,455	82.2%
1981	639,863	731,622	87.5%
1982	1,257,985	1,370,715	91.8%
1983	846,222	961,711	88.0%
1984	861,773	947,305	91.0%
1985	762,048	825,221	92.3%
1986	991,101	1,118,774	88.6%
1987	1,234,050	1,354,016	91.1%
1988	1,259,673	1,411,366	89.3%
1989	1,639,195	1,848,305	88.7%
1990	1,576,733	1,755,261	89.8%
1991	1,673,075	1,860,350	89.9%
1992	1,594,981	1,850,852	86.2%
1993	2,135,552	2,378,313	89.8%
1994	2,005,681	2,205,051	91.0%
1995	1,696,420	1,856,806	91.4%
1996	1,335,745	1,458,799	91.6%
1997	1,523,527	1,673,603	91.0%
1998	1,393,145	1,524,370	91.4%
1999	1,726,777	1,846,119	93.5%
2000	1,500,692	1,591,912	94.3%
2001	1,318,381	1,420,654	92.8%
2002	1,310,039	1,410,125	92.9%
2003	1,294,918	1,410,177	91.8%
2004	1,372,617	1,480,041	92.7%
2005	1,209,201	1,324,612	91.3%
2006	1,148,783	1,236,987	92.9%
2007	878,227	978,082	89.8%
2008	1,257,655	1,370,089	91.8%
2009	1,812,237	1,975,533	91.7%
2010	1,501,385	1,694,057	88.6%
2011	1,679,163	1,893,636	88.7%
2012	1,892,442	2,069,485	91.4%
2013	1,940,670	2,061,217	94.2%
2014	1,933,005	2,043,302	94.6%
2015	2,146,870	2,198,334	97.7%

Year	Monroe County	Statewide	% Monroe
2016	2,237,346	2,314,725	96.7%
2017	2,765,302	2,819,733	98.1%
2018	1,918,402	1,963,363	97.7%

Table 3.3. Specific gears by data source in the hook and line category for Yellowtail Snapper.

NOAA FISHERIES ALS	
GEAR CODE	**DESCRIPTION**
610	LINES HAND, OTHER
678	LINES LONG DRIFT WITH HOOKS
675	LINES LONG SET WITH HOOKS
676	LINES LONG, REEF FISH
677	LINES LONG, SHARK
614	LINES LONG, VERTICAL
660	LINES TROLL, OTHER
613	REEL, ELECTRIC OR HYDRAULIC
612	REEL, MANUAL
611	ROD AND REEL
616	ROD AND REEL, ELECTRIC (HAND)
600	TROLL & HAND LINES CMB
FLORIDA FWC	
GEAR CODE	**DESCRIPTION**
6770	BOUY DROP LINE
6130	ELECTRIC REEL
6120	HAND REEL
6100	HOOK & LINE, UNCL.
6760	LONG LINE, BOTTOM
6750	LONG LINE, SURFACE/MIDWATER
6740	LONG LINE, UNCL.
6110	ROD AND REEL
6200	TROLL LINES
6210	TROLL LINES, MANUAL

Table 3.4. U.S. Southeast commercial Yellowtail Snapper landings (whole pounds) by year, YS region, and gear. Data from NOAA Fisheries ALS (yellow) and FL Trip Ticket (green). Landings with an * are considered confidential and account for less than 0.1% of the annual total.

	Region by Gear							
	FL Gulf of Mexico		**FL Keys**		**FL South Atlantic**		**Out-of-State**	
Year	**H&L**	**Other**	**H&L**	**Other**	**H&L**	**Other**	**H&L**	**Other**
1962	17,100		892,700		88,300			
1963	12,400		716,600		102,700			
1964	10,400		885,400		144,100		700	
1965	17,000		915,900		123,000		8,800	
1966	1,700		745,700		77,700		5,100	
1967			849,300		112,600		600	
1968			1,025,000		162,900		300	
1969			807,500		162,300		300	
1970			986,900		209,300			
1971	100		948,600		144,400		200	
1972	589,800		275,600		154,700		100	
1973	21,800		813,500		107,100		200	
1974	28,200		909,200		104,900		500	
1975	17,500		657,700		122,300		200	
1976	29,300		893,000		55,400			
1977	11,600		750,800		46,400			
1978	15,200		833,200	2,600	17,000	2,600		
1979	58,900		609,300	81,100	30,700			
1980	35,979	2,014	525,097	62,648	25,717			
1981	27,396		652,540	29,694	21,992			
1982	51,701		1,287,777	5,809	25,428		1,358	
1983	26,929		865,519	16,618	28,113	24,532	31	
1984	37,254		857,119	17,235	35,296	401	12	148
1985	13,124	198	718,847	32,113	60,820	119	766	
1986	17,471	17,154	608,186	419,317	35,517	21,615	46	
1987	18,138	136	1,247,185	1,383	75,063	13,494	8,353	318
1988	25,231	173	1,218,183	39,063	98,267	31,633	26	
1989	59,980	1,439	1,585,008	55,448	117,492	30,290	1,879	
1990	41,493	795	1,536,655	40,992	114,174	21,152	134	218
1991	21,710	1,372	1,630,109	37,856	155,631	13,672	1,243	49
1992	78,875	693	1,495,350	39,758	235,469	1,368	4,827	12
1993	47,609	9,737	1,911,737	156,739	235,653	17,258	454	54
1994	30,304	1,077	1,811,735	91,646	260,762	9,981	414	20
1995	36,702	1,642	1,528,688	59,162	227,147	3,450	84	40
1996	26,507	2,028	1,158,819	36,599	231,681	3,463	145	20
1997	16,848	882	1,268,681	37,237	344,787	5,470	230	47
1998	6,447	354	1,177,292	46,546	287,381	6,411	166	
1999	18,363	1,668	1,494,992	43,251	282,623	5,245	141	123
2000	6,385	357	1,346,558	22,547	212,247	3,626	226	
2001	5,142	983	1,192,509	2,216	218,943	344	642	*
2002	2,457	537	1,159,472	4,158	240,493	418	3,157	*
2003	5,558	565	1,144,728	1,033	252,997	373	2,454	
2004	4,684	*	1,243,834	1,160	230,162	81	695	*

Year	Region by Gear							
	FL Gulf of Mexico		**FL Keys**		**FL South Atlantic**		**Out-of-State**	
	H&L	**Other**	**H&L**	**Other**	**H&L**	**Other**	**H&L**	**Other**
2005	4,533	122	1,131,715	1,017	186,745	415	772	*
2006	5,977	145	1,110,201	632	119,735	191	416	*
2007	3,098	*	853,443	4,620	116,756	45	567	*
2008	4,615	*	1,255,458	6,563	103,134	228	782	*
2009	2,830	107	1,822,814	947	148,232	168	1,353	319
2010	596	*	1,525,772	2,181	165,392	*	1,176	273
2011	4,413	*	1,766,022	915	121,568	616	572	733
2012	13,007	*	1,960,463	2,906	130,464	394	656	449
2013	10,731	*	1,973,924	5,559	70,772	151	1,725	141
2014	9,881	*	1,958,699	4,698	69,485	461	828	17
2015	12,399	467	2,078,140	3,224	103,267	457	546	*
2016	13,878	496	2,204,120	1,111	95,244	57	699	*
2017	13,322	861	2,739,383	1,779	64,809	272	282	*
2018	20,772	253	1,899,479	742	58,557	104	746	*

Table 3.5. Commercial landings uncertainty estimates for Yellowtail Snapper.

Year Range	TX-AL	NW FL	SW FL	FL Keys	SE FL	NE FL	GA-NC
1950-1961	0.25	0.25	0.25	0.25	0.25	0.25	0.25
1962-1977	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1978-1985	0.2	0.1	0.1	0.1	0.1	0.1	0.2
1986-2001	0.2	0.1	0.05	0.05	0.05	0.1	0.2
2002-2018	0.2	0.1	0.05	0.05	0.05	0.1	0.2

Table 3.6. Number of Yellowtail Snapper measured by FHS region and gear from the Trip Interview Program (TIP) database, 1984-2017.

	Hook and line							Other						
Year	W of FL	FL NW	FL SW	FL Keys	FL SE	FL NE	N of FL	W of FL	FL NW	FL SW	FL Keys	FL SE	FL NE	N of FL
1984	2			1126			6				153			
1985				2003							451			
1986			1	2560	25	2	7			60	199			
1987				1758			13				13			
1988			10	1867	3		11				74			
1989				2632			2				274			
1990	1		5	4734	31	11	9				169			
1991	11		150	5196	5	8	22			61	611			10
1992			117	3871	1301	21	1			6	13			3
1993	17		42	5103	214	5	9			16	157	150		
1994	1	1	36	5469	192	16	10			1	170	72		
1995	3	95	24	5998	455	82	25				246			12
1996	6		253	3565	672	2	7			68	132			4
1997	1		96	5658	1859	19	6			8	202		1	8
1998		7	23	5419	1496	14	9			2	108			8
1999		5	146	5973	2081	32	75		2	1	308			14
2000			105	2654	2021	97	18		1		38		1	12
2001			109	4972	3250	26				1	12	11	2	5
2002			38	5951	1447	8	14			4	17	39		22
2003	1		44	3649	621	11	29				1			1
2004			16	3136	834		43				2	180		
2005	1		85	2569	827	2	95	1		1	108	112		
2006	4		20	1324	758	23	56				27	352		1
2007			6	1656	809	19	33			44	56	60	1	
2008	4		85	2447	577		74	1		76	2	108	2	
2009			230	2906	547	10	72			35	265	23	2	
2010			31	1462	378		30				136	144	8	4
2011	6		22	2559	994		15				375	85		
2012	5		24	5790	408		16				1260	88	14	
2013	1		15	3365	593		8			1	1343	222	2	
2014	4	1	51	3985	1313	2	9			19	1036	10	1	1
2015		1	105	3450	936	3	7			45	496	5	7	
2016	2	6	52	2822	428		12			22	137	54	2	
2017	2	2	66	3344	355		1			52	247	4	1	1

Table 3.7. Yellowtail Snapper landings in numbers of fish by general FHS region and gear, 1981-2017. * denotes confidential data per table 3.4.

	Hook and Line				Other			
Year	FL Gulf	FL Keys	FL Atlantic	Out-of-State	FL Gulf	FL Keys	FL Atlantic	Out-of-State
1981	19,533	498,724	12,439			18,748		
1982	36,862	984,223	14,383	768		3,668		
1983	19,200	661,504	15,901	18		10,492	19,786	
1984	26,562	563,199	19,964	7		10,450	323	119
1985	9,357	488,037	34,401	545	267	18,766	96	
1986	15,088	780,075	58,618	28	140	21,442	6,859	
1987	12,932	979,856	42,457	5,955	183	873	10,883	256
1988	17,990	1,057,970	55,582	16	233	31,108	25,513	
1989	42,765	1,276,120	110,897	1,340	1,738	36,807	24,430	
1990	29,584	1,366,854	68,925	81	960	29,018	17,060	263
1991	16,685	1,355,624	146,895	966	1,625	39,714	11,027	55
1992	60,264	1,160,510	230,903	4,731	836	33,120	1,103	14
1993	25,886	1,560,957	221,173	425	11,757	123,514	15,471	65
1994	26,669	1,446,580	195,356	339	1,481	64,804	7,021	28
1995	45,114	1,429,761	178,926	66	2,258	60,063	1,662	55
1996	22,398	1,047,519	238,751	144	2,987	32,721	1,668	29
1997	14,277	1,064,500	352,112	200	1,214	26,322	2,635	65
1998	5,674	1,035,124	274,522	159	487	32,043	3,088	
1999	14,253	1,207,119	259,501	124	2,295	49,749	2,029	169
2000	4,008	1,048,065	188,622	158	491	24,584	1,402	
2001	3,099	1,034,973	188,319	434	1,352	2,416	133	*
2002	1,575	931,767	214,705	2,160	739	4,534	168	*
2003	3,563	886,073	202,820	1,627	2,864	1,126	144	
2004	2,796	965,207	200,198	541	*	815	70	*
2005	2,597	830,377	143,738	575	66	672	343	*
2006	3,568	793,471	90,851	301	78	444	211	*
2007	1,849	603,092	103,844	469	*	3,836	42	*
2008	2,881	904,548	79,700	591	*	4,608	217	*
2009	2,426	1,333,201	129,002	1,175	67	810	152	205
2010	424	1,052,728	144,060	990	*	1,901	4	151
2011	3,142	1,291,242	113,585	526	*	798	549	395
2012	9,262	1,596,768	102,825	503	*	2,540	317	332
2013	5,524	1,544,557	70,902	1,481	*	4,254	142	108
2014	5,561	1,602,780	69,927	705	*	3,973	299	11
2015	8,413	1,723,077	110,250	548	315	2,998	296	*
2016	8,511	1,837,862	87,156	609	367	925	39	*
2017	7,032	2,116,984	66,349	261	653	1,516	176	*

Table 3.8. Mean whole weight (kilograms) of Yellowtail Snapper by year, region, and gear derived from length compositions from the U.S. South Atlantic TIP database, 1981-2017.

	Hook and Line			Other		
Year	**West**	**FL Keys**	**East**	**West**	**FL Keys**	**East**
1981	0.636	0.593	0.802	0.337	0.718	0.562
1982	0.636	0.593	0.802	0.337	0.718	0.562
1983	0.636	0.593	0.802	0.337	0.718	0.562
1984	0.636	0.690	0.802	0.337	0.748	0.562
1985	0.636	0.668	0.802	0.337	0.776	0.562
1986	0.636	0.556	0.802	0.337	0.634	0.562
1987	0.636	0.577	0.802	0.337	0.718	0.562
1988	0.636	0.522	0.802	0.337	0.570	0.562
1989	0.636	0.563	0.481	0.376	0.683	0.562
1990	0.636	0.510	0.751	0.376	0.641	0.562
1991	0.590	0.545	0.481	0.383	0.432	0.562
1992	0.594	0.584	0.463	0.376	0.545	0.562
1993	0.834	0.556	0.483	0.376	0.576	0.506
1994	0.515	0.568	0.605	0.330	0.641	0.645
1995	0.369	0.485	0.576	0.330	0.447	0.942
1996	0.537	0.502	0.440	0.308	0.507	0.942
1997	0.535	0.541	0.444	0.330	0.642	0.942
1998	0.515	0.516	0.475	0.330	0.659	0.942
1999	0.584	0.562	0.494	0.330	0.394	1.173
2000	0.723	0.583	0.510	0.330	0.416	1.173
2001	0.753	0.523	0.527	0.330	0.416	1.173
2002	0.708	0.564	0.508	0.330	0.416	1.130
2003	0.708	0.586	0.566	0.842	0.416	1.173
2004	0.760	0.585	0.521	0.842	0.646	0.524
2005	0.792	0.618	0.589	0.842	0.686	0.548
2006	0.760	0.635	0.598	0.842	0.646	0.410
2007	0.760	0.642	0.510	0.871	0.546	0.490
2008	0.727	0.630	0.587	0.819	0.646	0.477
2009	0.529	0.620	0.521	0.723	0.530	0.502
2010	0.637	0.657	0.521	0.842	0.521	0.482
2011	0.637	0.620	0.485	0.842	0.520	0.509
2012	0.637	0.557	0.576	0.613	0.519	0.563
2013	0.881	0.580	0.453	0.613	0.593	0.481
2014	0.806	0.554	0.451	0.613	0.536	0.700
2015	0.668	0.547	0.425	0.674	0.488	0.700
2016	0.740	0.544	0.496	0.613	0.545	0.665
2017	0.859	0.587	0.443	0.599	0.532	0.700

Table 3.9. Amount of Yellowtail Snapper discards by year and region (a=Florida Keys, b=Southeast Florida, c=West Florida) from 1993-2018. Data are from NMFS Coastal Fisheries Logbook Program. Discards are in number of fish and pounds whole weight.

a) Florida Keys

Year	Total Effort (hook hours)	Trips Reporting Effort	Mean Discard Rate	Trips Reporting Discards	CV Discard Rate	Total Discards (number of fish)	Total Discards (pounds)
1993	317173.2	7835	0.275027	3906	2.254803	87,231	91,536
1994	357590	8696	0.275027	3906	2.254803	98,347	103,200
1995	414053.5	9206	0.275027	3906	2.254803	113,876	119,496
1996	403791.5	9253	0.275027	3906	2.254803	111,054	116,534
1997	478473.5	10603	0.275027	3906	2.254803	131,593	138,087
1998	330883.6	8737	0.275027	3906	2.254803	91,002	95,493
1999	362593.4	8983	0.275027	3906	2.254803	99,723	104,644
2000	354032.1	8168	0.275027	3906	2.254803	97,369	102,174
2001	296854.7	8457	0.275027	3906	2.254803	81,643	85,672
2002	282726.6	8009	0.261483	671	1.844513	73,928	77,576
2003	246587.5	7947	0.3152	1110	1.889972	77,724	81,560
2004	228999.5	7302	0.207186	655	2.500164	47,445	49,787
2005	195380.5	6359	0.222223	868	2.801261	43,418	45,561
2006	193964	5903	0.366002	602	2.307079	70,991	74,495
2007	154537.5	5562	0.51708	1041	2.043995	79,908	83,852
2008	148880	5785	0.313663	1306	2.331052	46,698	49,003
2009	184699	6073	0.319083	994	1.821567	58,934	61,843
2010	151427.5	5322	0.322927	1074	2.761632	48,900	51,313
2011	177147	5259	0.336128	1114	2.045451	59,544	62,483
2012	198969	5249	0.186444	1562	2.8973	37,096	38,927
2013	181474	4872	0.243113	1236	4.977136	44,119	46,296
2014	189570	5545	0.306127	1068	3.505844	58,033	60,896
2015	206618.5	5284	0.091896	1198	3.443187	18,987	19,924
2016	188053	5584	0.236573	1329	2.289697	44,488	46,684
2017	153585.5	5199	0.182811	794	2.212199	28,077	29,463
2018	144825	4614	0.146023	674	3.29938	21,148	22,191

b) Southeast Florida

Year	Total Effort (hook hours)	Trips Reporting Effort	Mean Discard Rate	Trips Reporting Discards	CV Discard Rate	Total Discards (number of fish)	Total Discards (pounds)
1993	70534.5	2678	0.066102	985	3.74769	4,662	4,893
1994	99934	3553	0.066102	985	3.74769	6,606	6,932
1995	105041	3352	0.066102	985	3.74769	6,943	7,286
1996	90202.5	3442	0.066102	985	3.74769	5,963	6,257
1997	118117	4037	0.066102	985	3.74769	7,808	8,193
1998	104920.3	3938	0.066102	985	3.74769	6,935	7,278
1999	85567	3415	0.066102	985	3.74769	5,656	5,935

Year	Total Effort (hook hours)	Trips Reporting Effort	Mean Discard Rate	Trips Reporting Discards	CV Discard Rate	Total Discards (number of fish)	Total Discards (pounds)
2000	93411.5	3156	0.066102	985	3.74769	6,175	6,479
2001	89288.7	3352	0.066102	985	3.74769	5,902	6,193
2002	84161.5	3941	0.151788	133	2.574713	12,775	13,405
2003	91458	4350	0.044748	280	4.214544	4,093	4,295
2004	88442.5	4054	0.045476	259	3.774309	4,022	4,220
2005	78377	3576	0.069464	206	3.951195	5,444	5,713
2006	80602.5	3635	0.05893	107	4.050197	4,750	4,984
2007	86746	4232	0.046903	595	5.182482	4,069	4,269
2008	87415	4064	0.021592	1053	6.249249	1,887	1,981
2009	101319	4810	0.01317	559	7.170827	1,334	1,400
2010	99997.5	4842	0.006395	1186	21.61366	639	671
2011	109208	5512	0.006097	1412	13.38943	666	699
2012	93296	4870	0.021111	1248	8.926608	1,970	2,067
2013	81319.4	4472	0.023177	1094	5.087743	1,885	1,978
2014	108249.5	5327	0.010382	1222	7.318741	1,124	1,179
2015	87411	4300	0.015109	717	8.807575	1,321	1,386
2016	93645	4567	0.002565	908	9.317938	240	252
2017	80801	4138	0.051743	560	4.942359	4,181	4,387
2018	79891	3861	0.099801	653	6.080124	7,973	8,367

c) West Florida

Year	Total Effort (hook hours)	Trips Reporting Effort	Mean Discard Rate	Trips Reporting Discards	CV Discard Rate	Total Discards (number of fish)	Total Discards (pounds)
1993	663958.8	2300	0	1370		0	0
1994	637970.2	2734	0	1370		0	0
1995	690881.6	2820	0	1370		0	0
1996	750681.5	2925	0	1370		0	0
1997	714304	3113	0	1370		0	0
1998	703378.6	3151	0	1370		0	0
1999	768056	3490	0	1370		0	0
2000	724358.9	3507	0	1370		0	0
2001	610663	3128	0	1370		0	0
2002	591682	2843	0	222		0	0
2003	621863.3	2835	0	428		0	0
2004	868284.2	2703	0	305		0	0
2005	540335.5	2329	0	233		0	0
2006	588116.5	2120	0	182		0	0
2007	437366	1623	0	215		0	0
2008	402756.4	1715	0.003428	389	15.58041	1,380	1,698
2009	617119	2102	0	330		0	0
2010	444616	1354	0	210		0	0
2011	408938	1349	0	312		0	0
2012	492644	1533	0.000808	259	11.35782	398	489

Year	Total Effort (hook hours)	Trips Reporting Effort	Mean Discard Rate	Trips Reporting Discards	CV Discard Rate	Total Discards (number of fish)	Total Discards (pounds)
2013	629909	1837	0.002012	495	9.688243	1,267	1,559
2014	678754	2087	0	402		0	0
2015	767123	2284	0.004196	610	17.04694	3,219	3,959
2016	817913	2180	1.35E-05	386	19.64688	11	14
2017	590473	2079	0.009532	597	7.701527	5,628	6,923
2018	541765	1697	0.001542	249	8.864824	836	1,028

Table 3.10**.** Release Discard Mortality for the Florida Keys.

Fishing Depth (m)	Number of Discarded Fish	% Total Discards	Number Released Alive (%)	Number Released Dead (%)
< 5 m	330	38%	274 (83%)	56 (17%)
6 – 10 m	219	25%	203 (92.7%)	16 (7.3%)
11 – 15 m	202	25%	192 (95%)	10 (5%)
16 – 20 m	110	13%	98 (89.1%)	12 (10.9%)
> 20 m	18	2%	14 (77.8%)	4 (22.2%)
Total	879		781 (88.9%)	98 (11.1%)

Table 3.11. Estimates of discard mortality based on lower (10%) and upper (15%) bound mortality rates of commercial Yellowtail Snapper by year and region (a=Florida Keys, b=Southeast Florida, c=West Florida) from 1993-2018. Discard mortality estimates are in numbers of fish and pounds whole weight.

a) Florida Keys

Year	Dead Discards (number of fish, mortality 10%)	Dead Discards (pounds, mortality 10%)	Dead Discards (number of fish, mortality 15%)	Dead Discards (pounds, mortality 15%)
1993	8,723	9,154	13,085	13,730
1994	9,835	10,320	14,752	15,480
1995	11,388	11,950	17,081	17,924
1996	11,105	11,653	16,658	17,480
1997	13,159	13,809	19,739	20,713
1998	9,100	9,549	13,650	14,324
1999	9,972	10,464	14,958	15,697
2000	9,737	10,217	14,605	15,326
2001	8,164	8,567	12,246	12,851
2002	7,393	7,758	11,089	11,636
2003	7,772	8,156	11,659	12,234
2004	4,745	4,979	7,117	7,468
2005	4,342	4,556	6,513	6,834
2006	7,099	7,449	10,649	11,174
2007	7,991	8,385	11,986	12,578
2008	4,670	4,900	7,005	7,350
2009	5,893	6,184	8,840	9,276
2010	4,890	5,131	7,335	7,697
2011	5,954	6,248	8,932	9,372
2012	3,710	3,893	5,564	5,839
2013	4,412	4,630	6,618	6,944
2014	5,803	6,090	8,705	9,134
2015	1,899	1,992	2,848	2,989
2016	4,449	4,668	6,673	7,003
2017	2,808	2,946	4,212	4,419
2018	2,115	2,219	3,172	3,329

Table 3.11 (continued). Estimates of discard mortality based on lower (10%) and upper (15%) bound mortality rates of commercial Yellowtail Snapper by year and region (a=Florida Keys, b=Southeast Florida, c=West Florida) from 1993-2018. Discard mortality estimates are in numbers of fish and pounds whole weight.

b) Southeast Florida

Year	Dead Discards (number of fish, mortality 10%)	Dead Discards (pounds, mortality 10%)	Dead Discards (number of fish, mortality 15%)	Dead Discards (pounds, mortality 15%)
1993	466	489	699	734
1994	661	693	991	1,040
1995	694	729	1,042	1,093
1996	596	626	894	939
1997	781	819	1,171	1,229
1998	694	728	1,040	1,092
1999	566	594	848	890
2000	617	648	926	972
2001	590	619	885	929
2002	1,277	1,341	1,916	2,011
2003	409	429	614	644
2004	402	422	603	633
2005	544	571	817	857
2006	475	498	712	748
2007	407	427	610	640
2008	189	198	283	297
2009	133	140	200	210
2010	64	67	96	101
2011	67	70	100	105
2012	197	207	295	310
2013	188	198	283	297
2014	112	118	169	177
2015	132	139	198	208
2016	24	25	36	38
2017	418	439	627	658
2018	797	837	1,196	1,255

Table 3.11 (continued).

c) West Florida

Year	Dead Discards (number of fish, mortality 10%)	Dead Discards (pounds, mortality 10%)	Dead Discards (number of fish, mortality 15%)	Dead Discards (pounds, mortality 15%)
1993	0	0	0	0
1994	0	0	0	0
1995	0	0	0	0
1996	0	0	0	0
1997	0	0	0	0
1998	0	0	0	0
1999	0	0	0	0
2000	0	0	0	0
2001	0	0	0	0
2002	0	0	0	0
2003	0	0	0	0
2004	0	0	0	0
2005	0	0	0	0
2006	0	0	0	0
2007	0	0	0	0
2008	138	170	207	255
2009	0	0	0	0
2010	0	0	0	0
2011	0	0	0	0
2012	40	49	60	73
2013	127	156	190	234
2014	0	0	0	0
2015	322	396	483	594
2016	1	1	2	2
2017	563	692	844	1,038
2018	84	103	125	154

Table 3.12. The number of commercial fork length (FL) samples in millimeters (applying the frequency column), mean FL, FL standard deviation, minimum FL, maximum FL, and percentage of total records by FHS region for Yellowtail Snapper.

FHS Region	N Obs	Mean	Std Dev	Minimum	Maximum	N	Percentage
FL Northeast	580	357	66.66	220.8	600	580	0.34%
FL Northwest	127	283	37.61	238.2	427.1	127	0.07%
FL Southeast	28414	299	37.74	146.8	605	28405	16.70%
FL Southwest	2541	325	54.96	180	637.5	2537	1.49%
Keys	137514	314	48.96	178	920	137452	80.84%
North of FL	857	397	103.22	217	910	854	0.50%
West of FL	74	403	85.67	266	608	74	0.04%

Table 3.13. Number of commercial fork length samples available in TIPS for Yellowtail Snapper by year and FHS region.

Year	FL Northeast	FL Northwest	FL Southeast	FL Southwest	Keys	North of FL	West of FL	Total
1984	.	.	.	.	1279	6	2	1287
1985	.	.	.	.	2454	.	.	2454
1986	2	.	25	61	2759	7	.	2854
1987	.	.	.	.	1771	13	.	1784
1988	.	.	3	10	1941	11	.	1965
1989	.	.	.	.	2906	2	.	2908
1990	11	.	31	5	4903	9	1	4960
1991	8	.	5	211	5807	32	11	6074
1992	21	.	1301	123	3884	4	.	5333
1993	5	.	364	58	5260	9	17	5713
1994	16	1	264	37	5639	10	1	5968
1995	82	95	455	24	6244	37	3	6940
1996	2	.	672	321	3697	11	6	4709
1997	20	.	1859	104	5860	14	1	7858
1998	14	7	1496	25	5527	17	.	7086
1999	32	7	2081	147	6281	89	.	8637
2000	98	1	2021	105	2692	30	.	4947
2001	28	.	3261	110	4984	5	.	8388
2002	8	.	1486	42	5968	36	.	7540
2003	11	.	621	44	3650	30	1	4357
2004	.	.	1014	16	3138	43	.	4211
2005	2	.	939	86	2677	95	2	3801
2006	23	.	1110	20	1351	57	4	2565
2007	20	.	869	50	1712	33	.	2684
2008	2	.	685	161	2449	74	5	3376
2009	12	.	570	265	3171	72	.	4090
2010	8	.	522	31	1598	34	.	2193
2011	.	.	1079	22	2934	15	6	4056
2012	14	.	496	24	7050	16	5	7605
2013	2	.	815	16	4708	8	1	5550
2014	3	1	1323	70	5022	10	4	6433
2015	10	1	941	150	3946	7	.	5055
2016	2	6	482	74	2959	12	2	3537
2017	1	2	359	118	3591	2	2	4075
Total	457	121	27149	2530	129812	850	74	160993

3.13 FIGURES

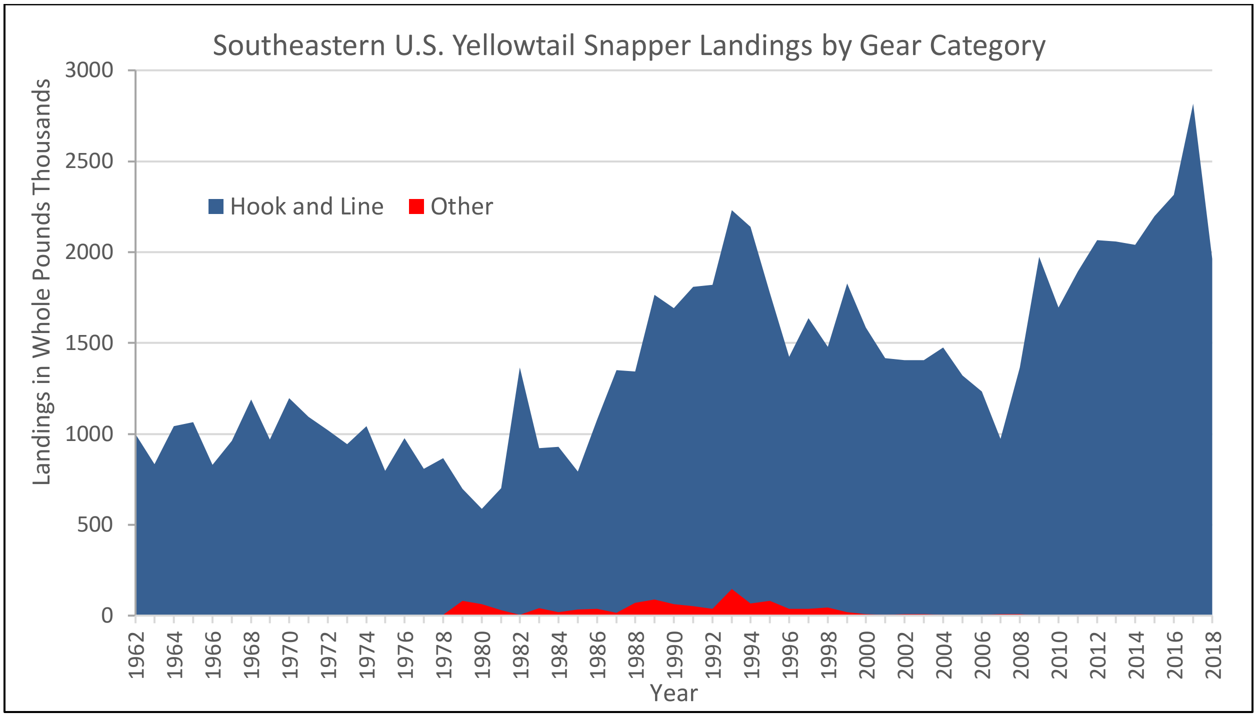


Figure 3.1. Yellowtail Snapper landings by gear category for the Southeastern. U.S. from 1962-2018.

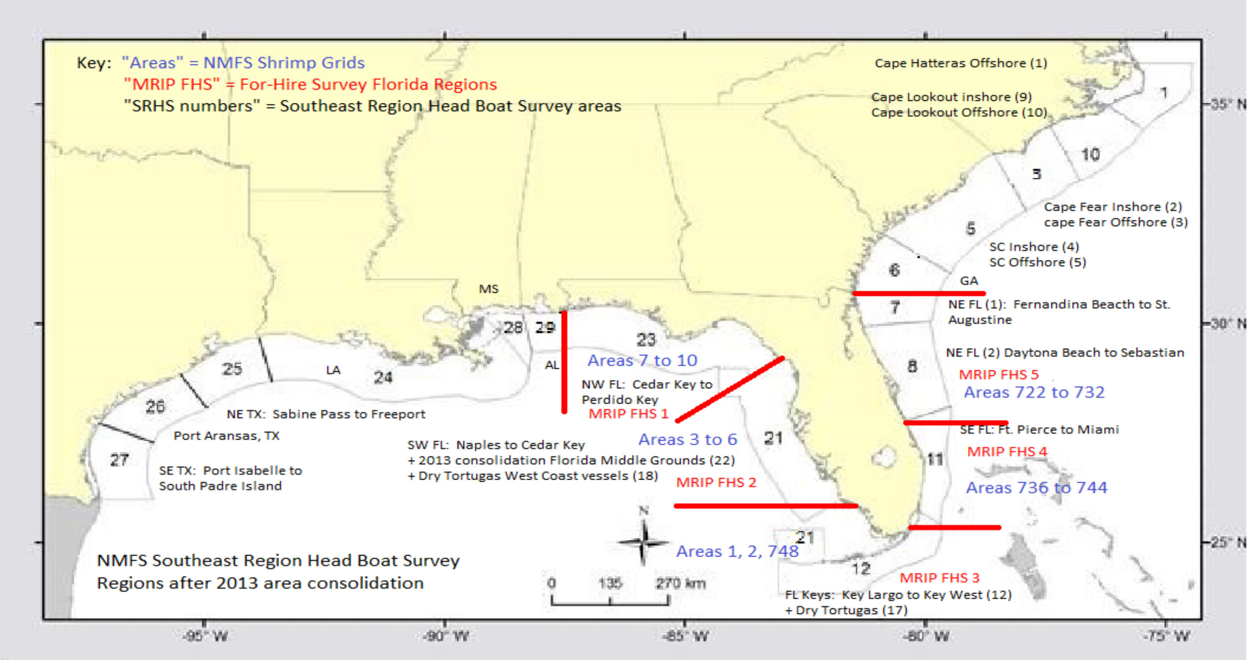


Figure 3.2. Region definitions for Yellowtail Snapper based on the for-hire survey regions in Florida from the Marine Recreational Information Program (MRIP).

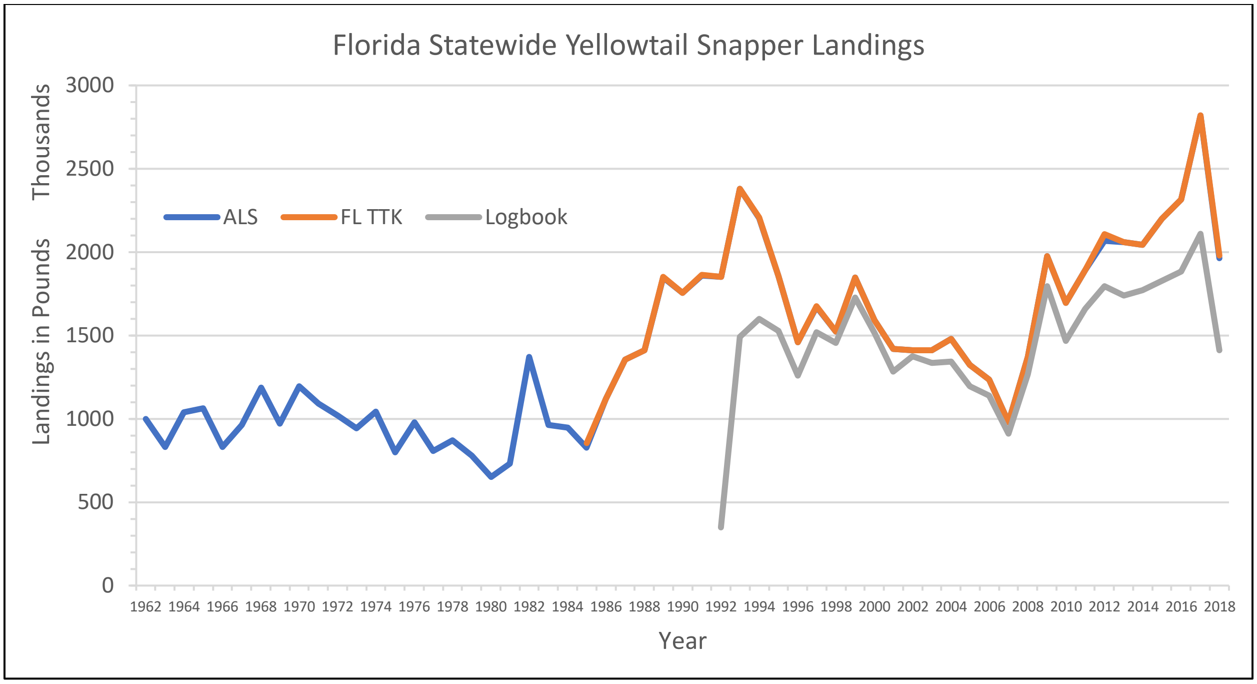


Figure 3.3. Commercial Yellowtail Snapper landings in Florida by data source, 1962-2018. (ALS=NMFS Accumulated Landings System, FL TTK=Florida Trip Ticket, Logbook=NMFS Coastal Logbook).

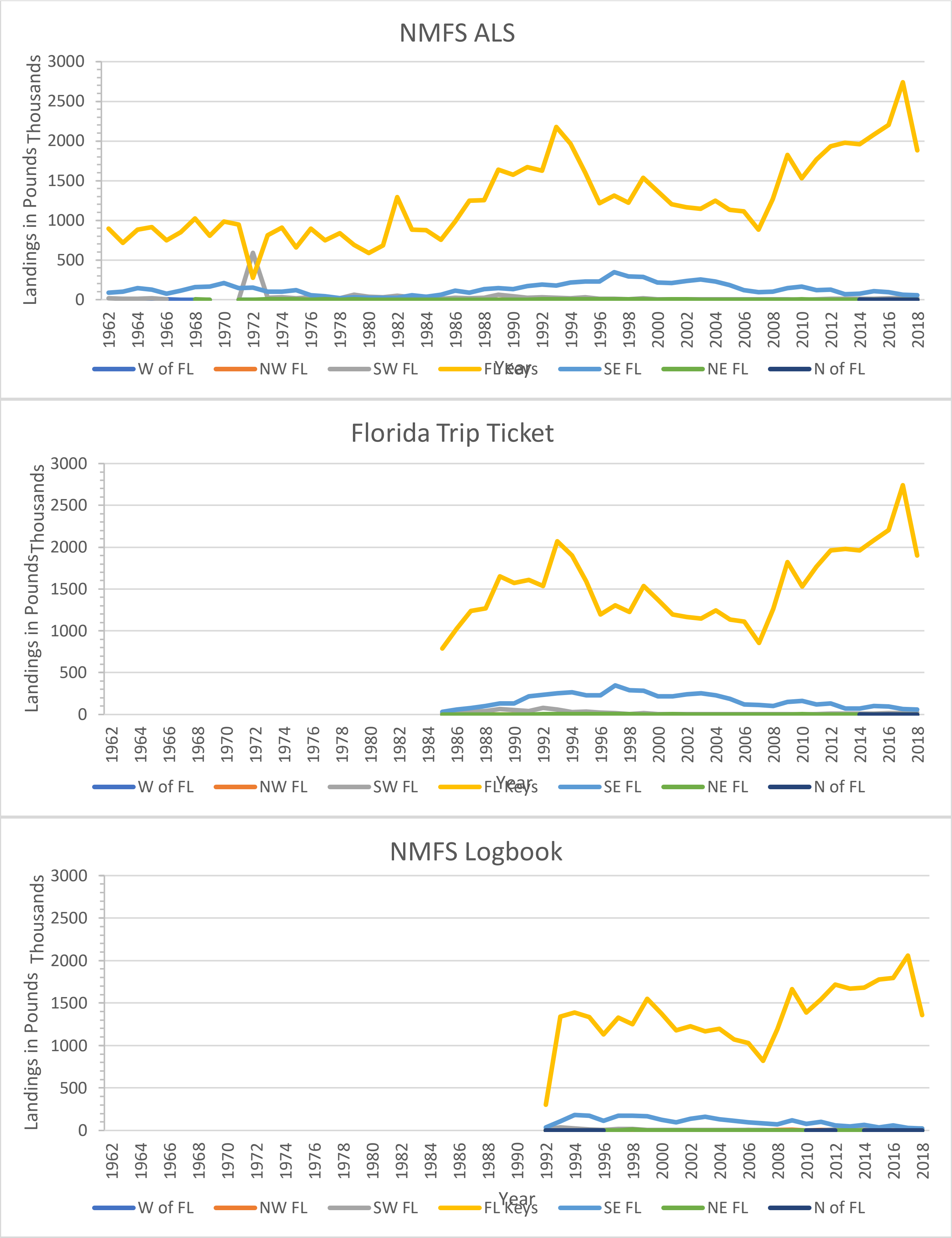


Figure 3.4. Comparison of Yellowtail Snapper landings by FHS region and data source, 1962-2018.

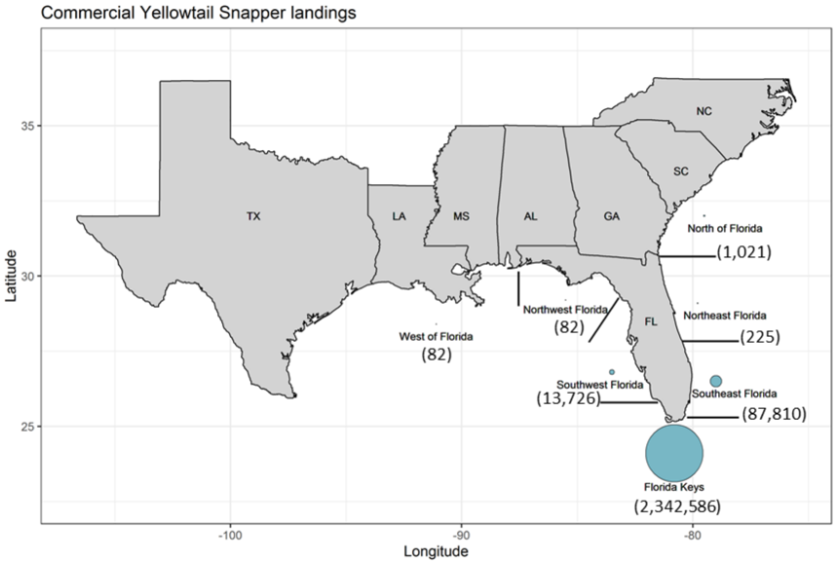


Figure 3.5. Commercial Yellowtail Snapper landings in pounds by region averaged over 2015-2017.

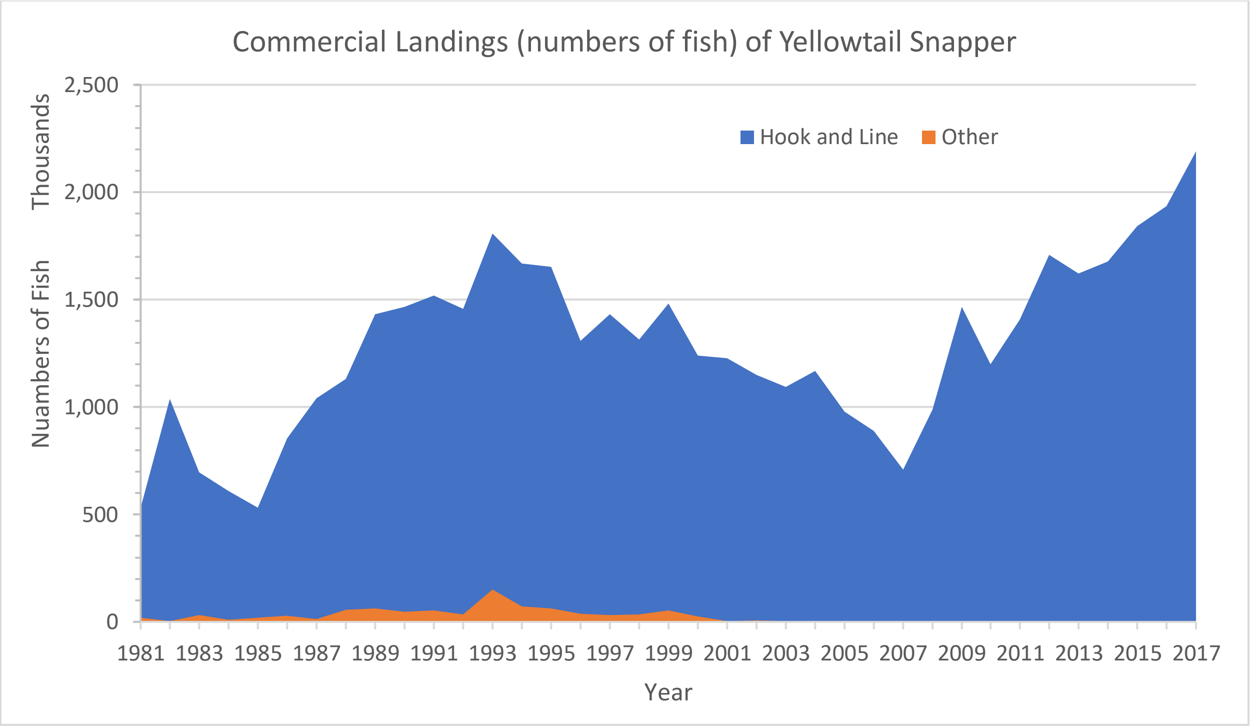


Figure 3.6. Commercial Yellowtail Snapper landings in numbers of fish by gear for all FHS regions combined, 1981-2017.

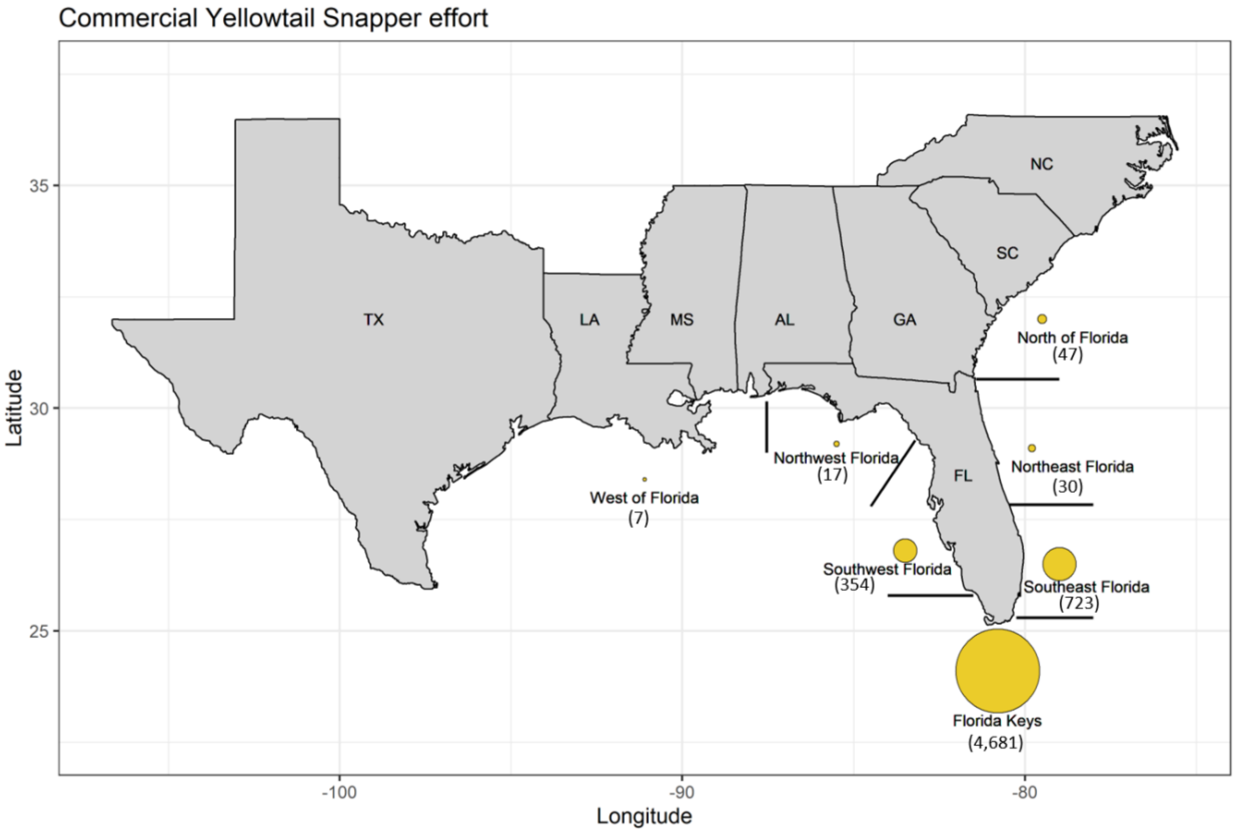


Figure 3.7. Number of commercial Yellowtail Snapper trips by region averaged over 2015-2017.

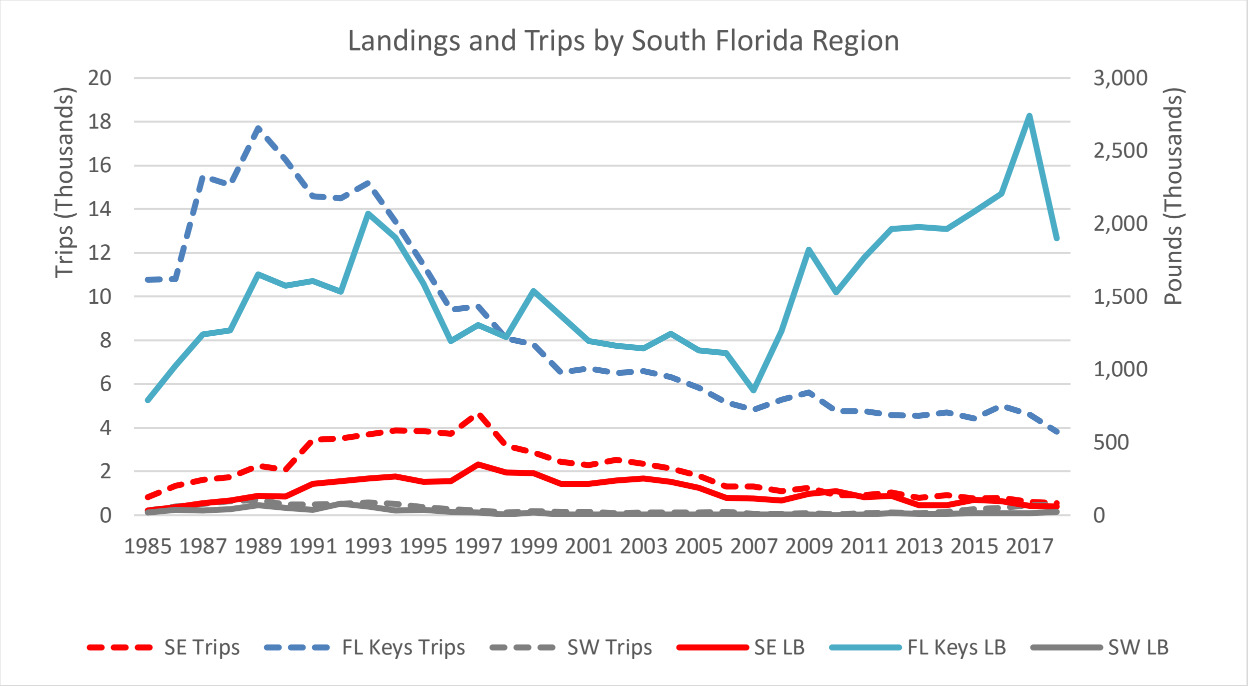


Figure 3.8. Number of commercial Yellowtail Snapper trips and landings by region in South Florida, 1985-2017.

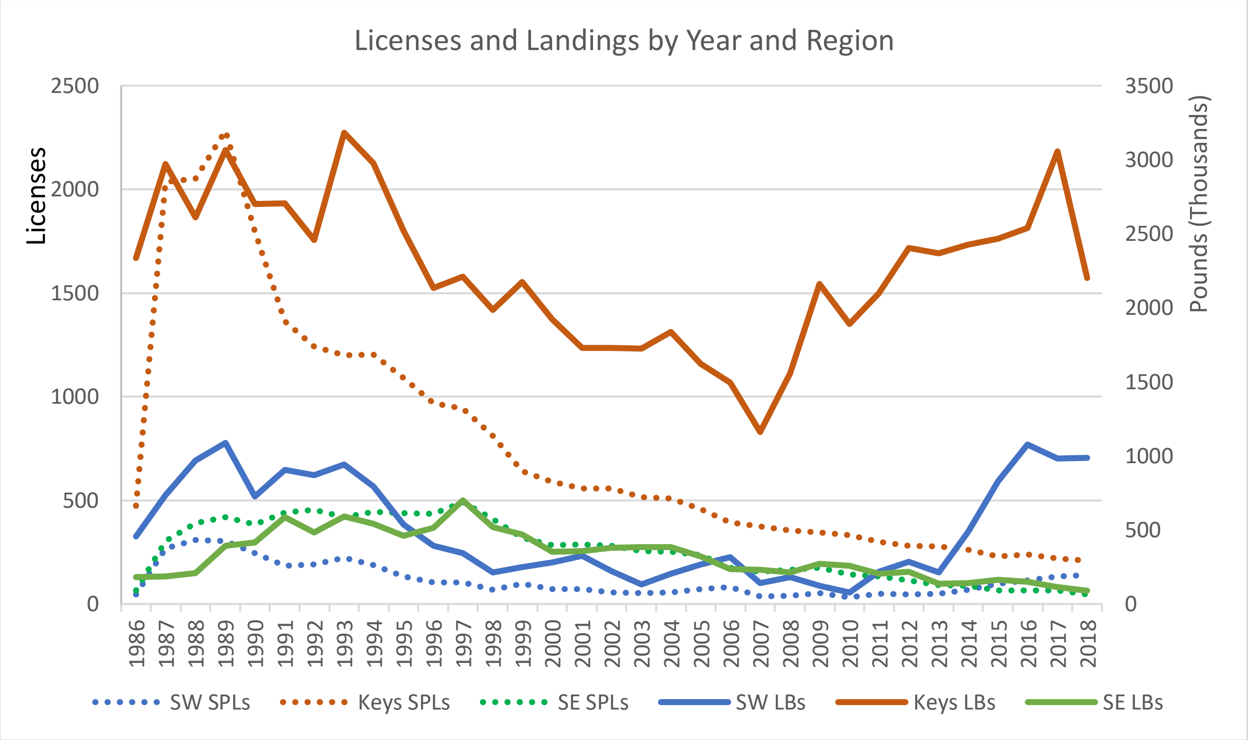


Figure 3.9. Number of state commercial fishing licenses (SPL) and landings by region in South Florida from commercial trips harvesting Yellowtail Snapper, 1986-2018.

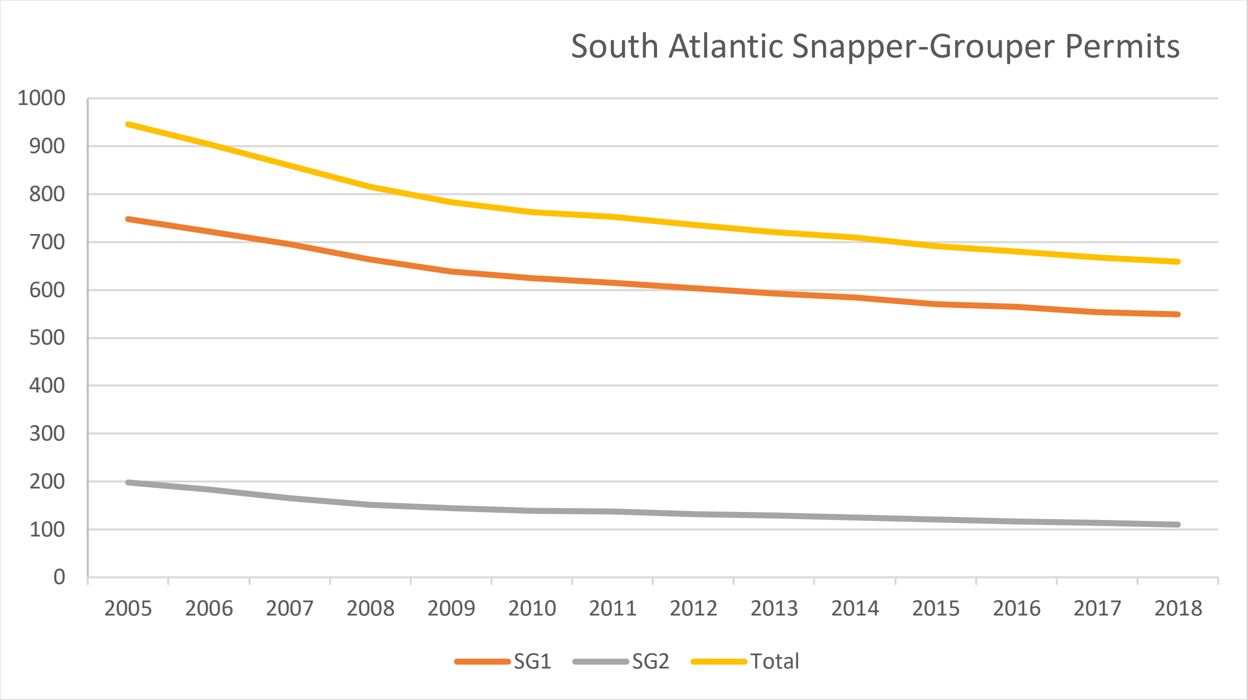


Figure 3.10. Active South Atlantic Snapper-Grouper permits by year, 2005-2018. Data from NOAA Fisheries.


Southwest Florida

FL Keys

Southeast Florida

Figure 3.11. Commercial Yellowtail Snapper landings by region and state-federal waters zone, 1985-2017.

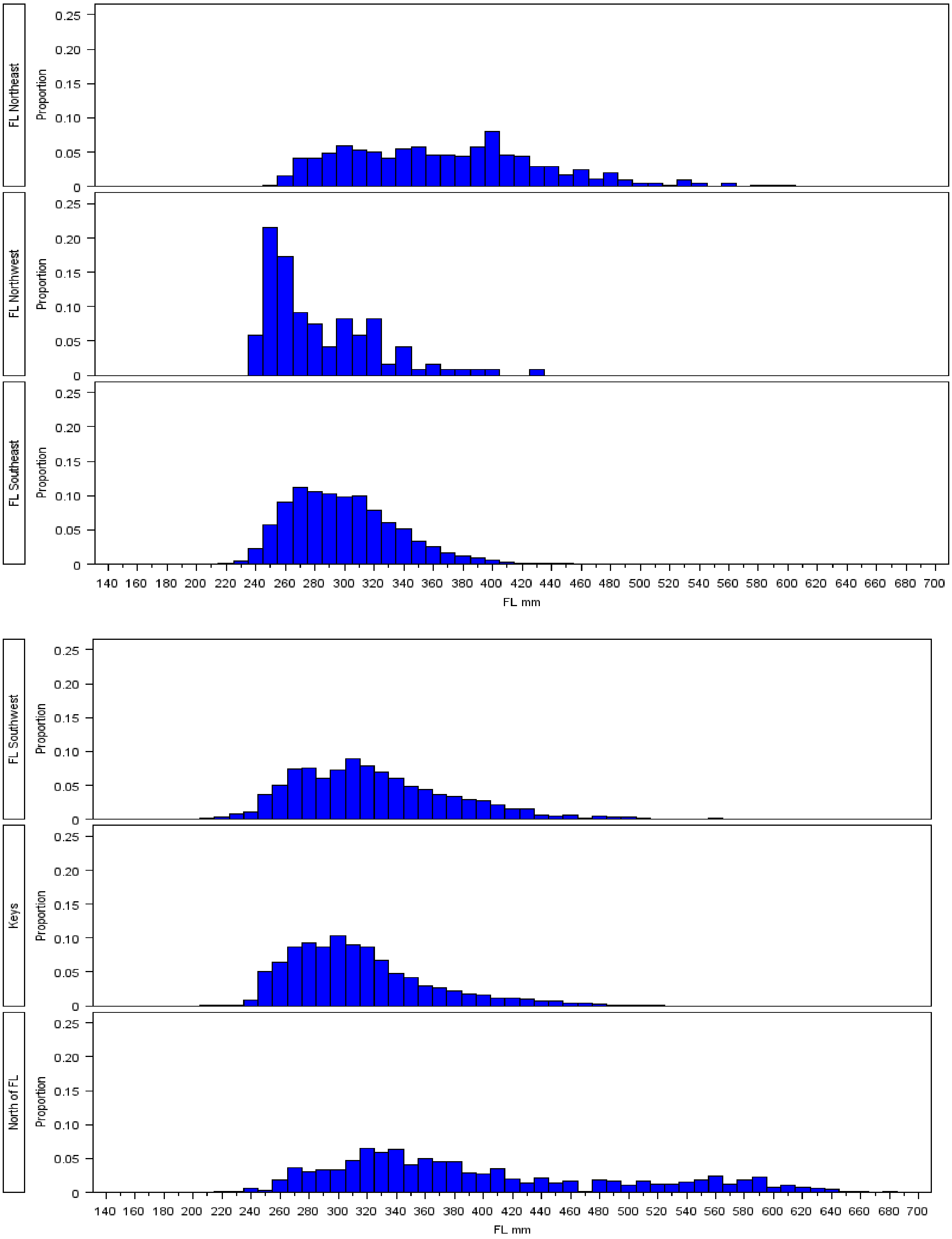


Figure 3.12. Length frequency distribution in fork length (mm) by FHS region for commercial Yellowtail Snapper. Data from TIPS.

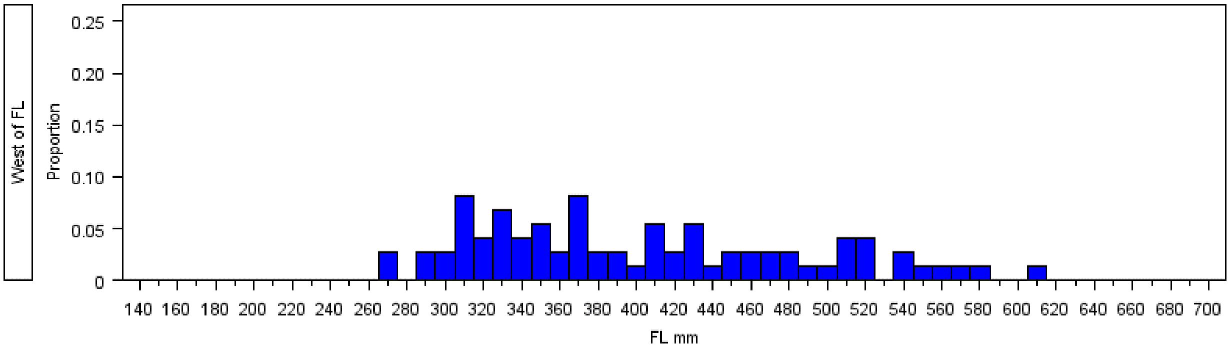


Figure 3.12 (cont). Length frequency distribution in fork length (mm) by FHS region for commercial Yellowtail Snapper. Data from TIPS.

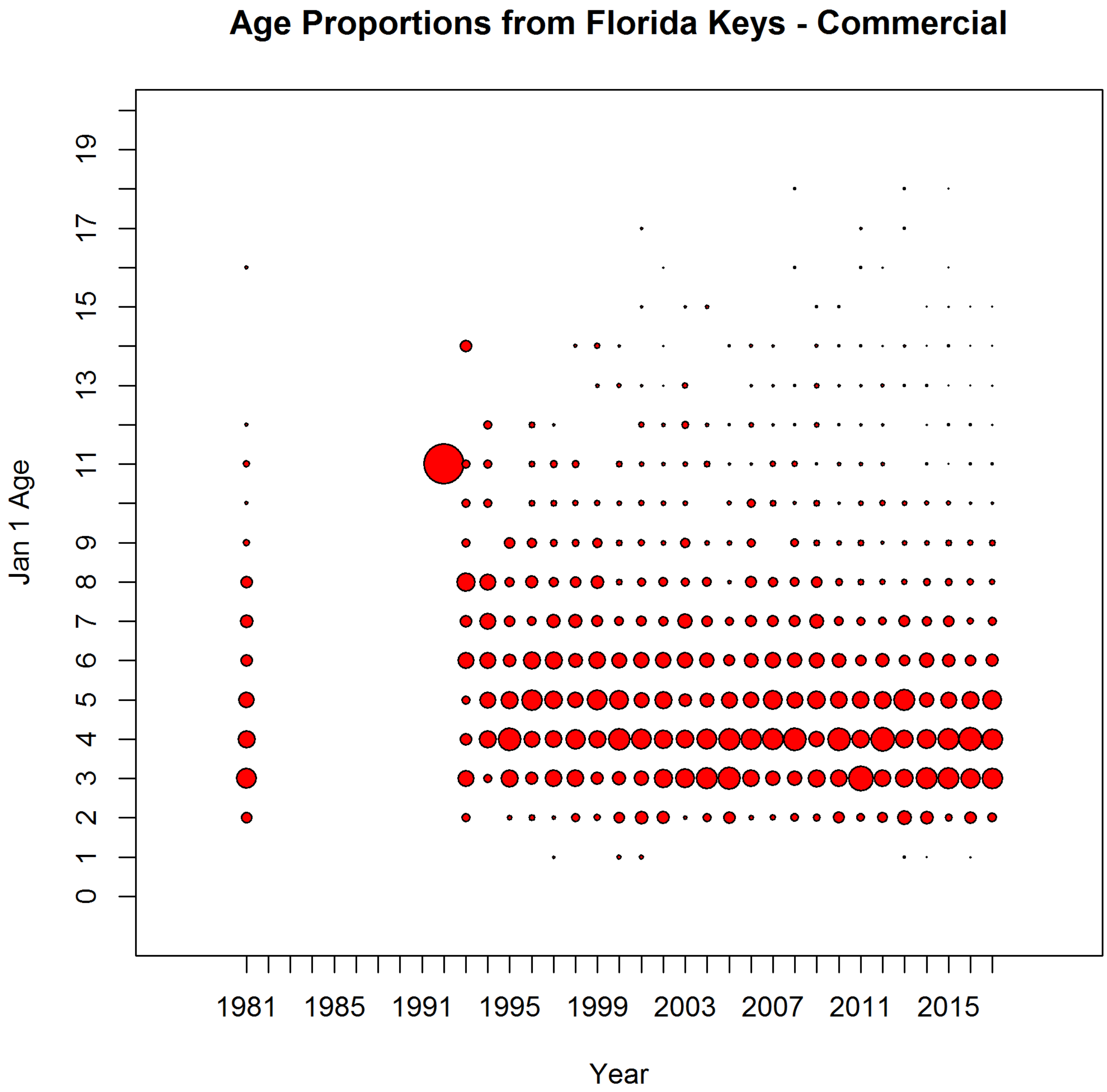


Figure 3.13. Plot showing the proportion of ages of Yellowtail Snapper by year for the Florida Keys.

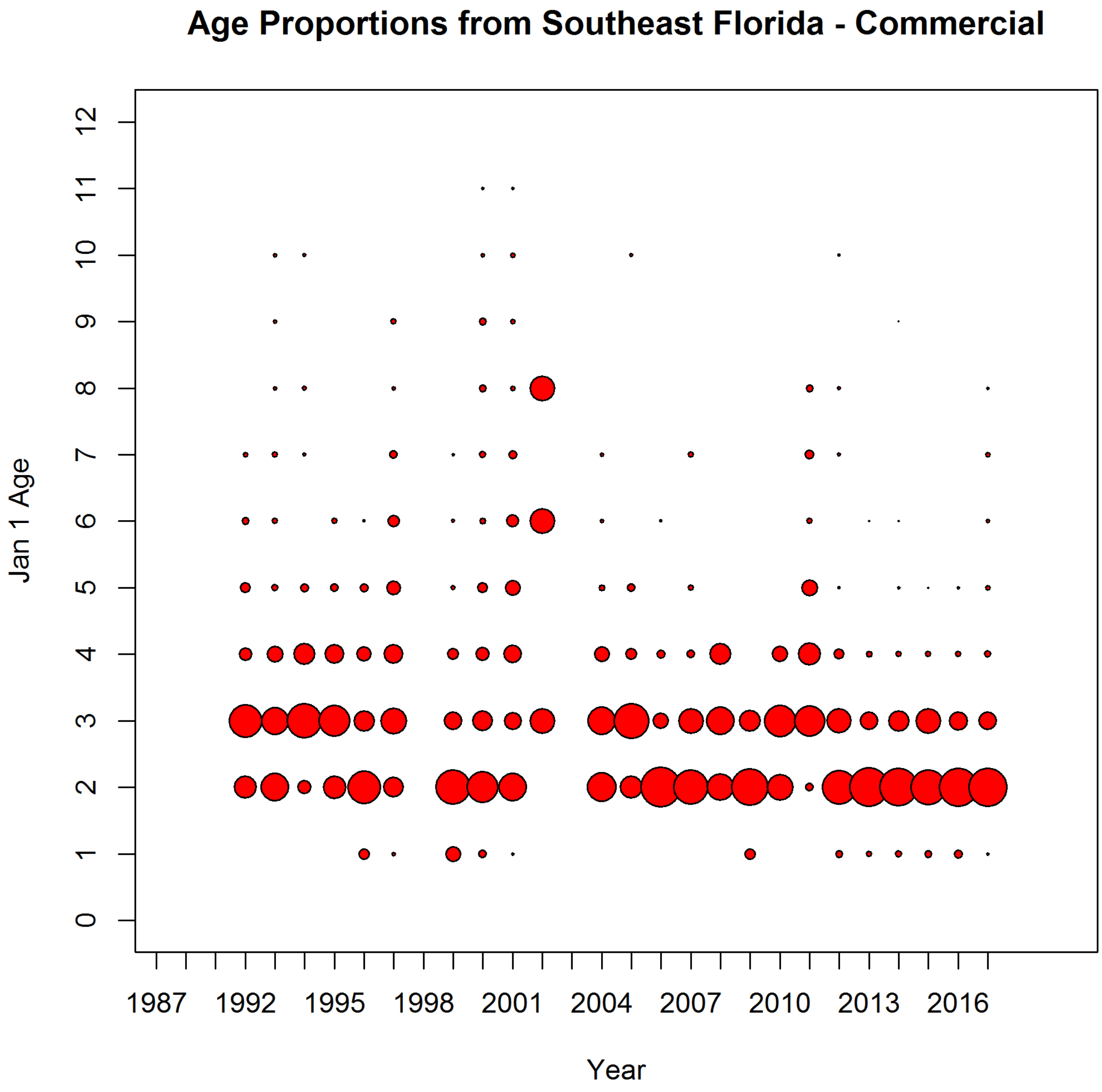


Figure 3.14. Plot showing the proportion of ages of Yellowtail Snapper by year from Southeast Florida.

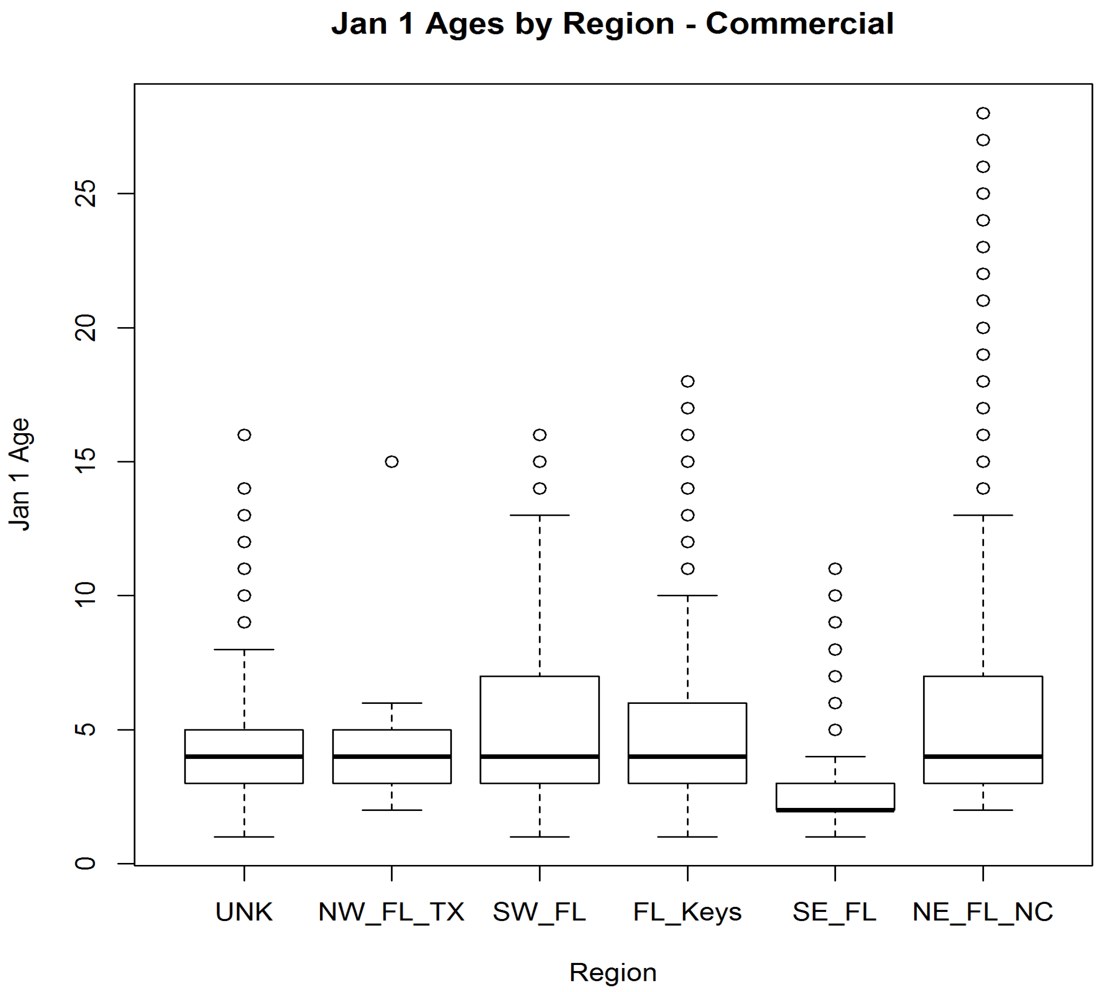


Figure 3.15. Box plot of mean age for Yellowtail Snapper by FHS region from TIPS records. Each box shows the range of ages with associated 95% confidence limits.

4 RECREATIONAL FISHERY STATISTICS

4.1 OVERVIEW

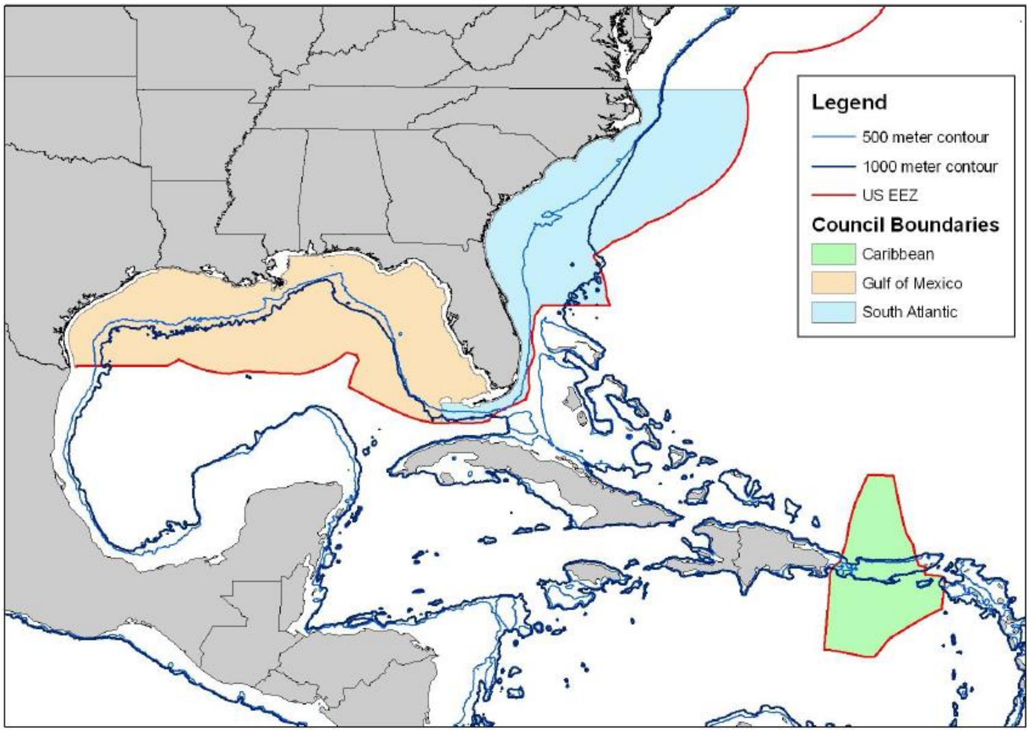
4.1.1 Recreational Workgroup (RWG) Members

Kelly Fitzpatrick (via phone; NMFS Beaufort, NC), Eric Schmidt (Headboat Industry Representative, FL), Dominique Lazarre (Co-leader, FWCC, FL), Shanae Allen (Co-leader, FWCC, FL), Vivian Matter (NMFS Miami, FL), Beverly Sauls (FWCC, FL), and Steven Scyphers (Northeastern University, MA)

4.1.2 Issues Discussed at the Data Workshop

1) Possible causes of reduced effort (angler days) in FL Keys and SE FL for the SRHS in 2016-2017.
2) Measures of uncertainty for headboat landings and discards.
3) Headboat discards from 2004-2017 and back-calculation prior to 2004.
4) Investigation of high MRIP discards in 1991 and high MRIP landings in some years prior to 1992.
5) Adequacy of adjusting sampling weights for at-sea observer discards using only daytime fishing trips versus using both night and daytime fishing trips.
6) Distributions of length and proportions of landings by strata. Use of imputed lengths and effective sample size.

4.1.3 Gulf of Mexico Fishery Management Council Jurisdictional Boundaries



4.2 REVIEW OF WORKING PAPERS

SEDAR 64-DW-10: Overview of the Southeast Region Headboat Survey and Data Related to Yellowtail Snapper (*Ocyurus chrysurus*). Shanae Allen, Elizabeth Herdter, and Kelly Fitzpatrick.

This report provides an overview of the Southeast Region Headboat Survey and presents Yellowtail Snapper landings, discards, effort, and sampled length data.

SEDAR 64-DW-12: Recreational Survey Data for Southeast Yellowtail Snapper. Vivian Matter and Richard Jones.

This report summarizes recreational landings, discards, effort, and sampled length data for Yellowtail Snapper from the following separate sampling programs: Marine Recreational Information Program (MRIP), Texas Parks and Wildlife Department (TPWD), and Louisiana Creel survey program (LA Creel).

SEDAR 64-DW-16: A Summary of Observer Data Related to the Size Distribution and Release Condition of Yellowtail Snapper from Recreational Fishery Surveys in Florida. Dominique Lazarre.

This report documents the size distribution, hook trauma, and release condition of Yellowtail snapper captured by for-hire vessels (Headboat and Charterboat) operating in Florida.

SEDAR 64-DW-17: Social Dimensions of the Recreational Fishery for Yellowtail Snapper (*Ocyurus chrysurus*) in Florida. Steven Scyphers and Kelsi Furman.

This report describes a series of survey results, which were conducted as part of a broader study on the social dimensions of saltwater recreational fisheries, comparing groups of fishers representing various levels of engagement with Yellowtail Snapper. The specific survey questions and results described here focus on:

1) Importance of Yellowtail Snapper as a Target Species

2) Recreational Fishery Demographics & Fishing Characteristics

3) Current Satisfaction with Availability of Catch, Size of Catch, and Fishing Regulation

4.3 RECREATIONAL LANDINGS

Recreational landings of Yellowtail Snapper were compiled from 1981 through 2017 for the U.S. South Atlantic and Gulf of Mexico from the Southeast Region Headboat Survey (SRHS), Marine Recreational Information Program (MRIP), Texas Parks and Wildlife Department (TPWD), and Louisiana Creel survey program (LA Creel, Figure 4.11.1). Total recreational Yellowtail Snapper landings by region and year are illustrated in Figure 4.11.2. Recreational landings outside of Florida comprise less than 0.1% of the overall landings. Table 4.10.1 summarizes Florida recreational landings by year and region. Figure 4.11.3 presents Florida landings by year and source (MRIP, headboat). Headboat landings comprise less than 10% of the overall recreational landings.

Further discussion of how landings were compiled from the SRHS can be found in the working paper (SEDAR 64-DW-10) in the Methods section and associated tables and figures are presented in the Results section. Tables 2 and 3 present landings in numbers and pounds, respectively. Figure 5 in the working paper presents overall SRHS landings by region and Figure 6 presents mean landings by month per region.

Landings from all other sources are summarized in the Catch Estimates and Weight Estimation sections in the working paper SEDAR 64-DW-12. A comparison of landings estimates from 1981 to 2017 under the MRIP base, Access Point Angler Intercept Survey (APAIS) calibrated, and fully calibrated APAIS and Fishing Effort Survey (FES) is shown in Figures 2 and 3. Fully calibrated landings were estimated to be much higher for Gulf of Mexico (including the FL Keys) in years 1981-1982, 1984, and 1989-1991.

Additionally, charterboat estimates were calibrated for the Gulf of Mexico prior to 2000 and on the Atlantic coast prior to 2004 in order to adjust for the change in effort estimation from the Coastal Household Telephone Survey (CHTS) to the For-Hire Survey (FHS) producing a consistent time series of charterboat estimates (Detloff and Matter, 2019). Figure 1 in the working paper illustrates charterboat landing and discard estimates of Yellowtail Snapper from the CHTS and the FHS from both the Gulf of Mexico (GOM) and the South Atlantic (SA) between years 1981 and 1999 (for GOM) and 1981 to 2003 (for SA). The greatest divergence of landings between the two methods estimates occurred in the GOM from 1983-1985.

Tables 1 and 2 in the working paper present landings by region and fishing mode, respectively. Table 3 presents coefficients of variance (CVs) associated with landings and landings in pounds by region are tabulated in Table 5. Figures 4 and 6 illustrate the number of fish landed and discarded by region, while Figure 5 shows the contribution by mode per year. These figures show that the vast majority of landings originate from the private mode in FL Keys and Southeast FL. The contribution of charterboat landings have increased slightly over time, while the contribution of the shore mode has decreased. Figure 7 in the working paper presents average fish weight, landings in pounds, and landings in numbers over time.

Issue:

Variance estimates are not currently available for the SRHS catch estimates because of the survey design. Further research is required to develop a suitable method to calculate variance.

Recommendation:

Without a suitable method to calculate the variance of the headboat estimates, the RWG recommended to assume zero variance. Headboat landings and discards are minimal compared to other sources such that they may be combined with other sources and their variances may be ignored.

Issue:

The working group investigated high landings in the MRIP APAIS in 1981-1982, 1984, and 1989-1991 and found that landings in all years except 1989 had the majority of landings originating in more than one stratum (i.e. year-wave-mode-area). The sources of high landings in 1989 were two interviews on the same day for private mode/Ocean>10mi that caught 35 and 40 Yellowtail Snapper. High landing years also had relatively low CVs (e.g., in the FL Keys, all years except 1991 had CV < 0.50).

Recommendation:

Most high landing years had catch originating from more than one stratum and the scale of landings in these exceptional years are comparable. The RWG recommends using these estimates without further manipulation, but whether to start the model after these high landings years in 1992 remains an AW Panel decision.

4.4 RECREATIONAL DISCARDS

Recreational discards of Yellowtail Snapper were compiled from 1981 through 2017 for the U.S. South Atlantic and Gulf of Mexico from the same sources as the landings. Total recreational Yellowtail Snapper discards by region and year are illustrated in Figure 4.11.4. Recreational discards outside of Florida comprise less than 0.1% of the overall landings. Table 4.10.2 summarizes Florida recreational discards by year and region. Figure 4.11.5 presents Florida discards by year and source (MRIP, headboat). Headboat discards comprise less than 5% of the overall recreational landings.

Headboat discards were estimated according to methods in the Estimating Discards section from the working paper (SEDAR 64-DW-10). The Results section presents annual discards in numbers by region in Table 4 and Figure 7. As shown, 1991 is an outlying high year because estimates are based on the adjusted MRIP charterboat discard:landings ratio from 1981-2003.

Discards from all other sources are summarized in the Catch Estimates section in the working paper SEDAR 64-DW-12. A comparison of landings and discards estimates from 1981 to 2017 under the MRIP base, APAIS calibrated, and fully calibrated APAIS and FES is shown in Figures 2 and 3. Fully calibrated discards were estimated to be much higher for Gulf of Mexico (including the FL Keys) in 1991. Figure 1 in the working paper illustrates charterboat landing and discard estimates of Yellowtail Snapper from the CHTS and the FHS from both the Gulf of Mexico (GOM) and the South Atlantic (SA) between years 1981 and 1999 (for GOM) and 1981 to 2003 (for SA). Discards are similar between the two surveys.

Tables 1 and 2 in the working paper present discards by region and fishing mode, respectively. CVs by year and region associated with discards are presented Table 4. Figures 4 and 6 illustrate the number of fish landed and discarded by region, while the contribution by mode per year is shown in Figure 5. The majority of discards originate from the private mode in the FL Keys and Southeast Florida regions.

Issue:

The working group investigated high discards in 1991 and found it is mainly originating from the private mode. The high estimates, however, do not come from a single wave or area fished. This suggests that the spike in discards is not the result of one or two unusual intercepts reporting many discards. In addition, effort estimates from the Florida Keys greatly increased in 1991. CVs for discards in 1991 are also relatively low (e.g., in 1991 the FL Keys had CV = 0.21).

Recommendation:

High discards in 1991 did not originate from a single wave or area fished. The RWG recommends using these estimates without further manipulation, but whether to start the model in 1992 remains an AW Panel decision.

Issue:

The working group discussed whether headboat discards should be estimated and alternative methods to do so.

Recommendation:

The RWG recommends using the method presented in the working paper (SEDAR 64-DW-10) to estimate discards prior to 2004 and to use self-reported discards from logbooks from 2004-2017.

4.5 BIOLOGICAL SAMPLING

4.5.1 Sampling Intensity Length/Age/Weight

Biological samples for length, weight, and age of Yellowtail Snapper were compiled from 1981 through 2017 for the U.S. South Atlantic and Gulf of Mexico. Recreational sources for biological samples include the SRHS Biological Sampling and other headboat-directed programs (e.g., MRFSS Headboat), MRFSS/MRIP Biological Sampling (including the Gulf Reef Fish Survey [GRFS] and the Marine Fisheries Initiative Program [MARFIN]), the Florida At-Sea Observer Sampling, in addition to other programs (FL Fish and Wildlife Research Institute [FWRI], and the Trip Interview Program [TIP]). The number of length, weight, and age samples by year for each data source is presented in Tables 4.10.3 and 4.10.4 and the associated number of trips those samples originated from are presented in Tables 4.10.5 and 4.10.6.

At-sea observers have collected length and discard information from reef fish species caught by the for-hire fleet in Florida from 2005-2017. Survey design and data related to Yellowtail Snapper are described in detail in the working paper (SEDAR 64-DW-16). At-sea observer spatial and temporal coverage is presented in Table 1 of the working paper and Table 2 presents the number of trips by region, year and trip duration for the headboat and charter recreational fleets. Tables 4 and 5 contain the number of discarded and harvested fish observed on headboat and charterboat trips, respectively, by region and year. The depth of capture, release condition and hook location for released fish are also summarized in Tables 6 and 7.

SRHS biological sampling effort by region is presented in Table 4 in the respective working paper (SEDAR 64-DW-10). This table presents Florida only data, as biological data outside of Florida are negligible (< 0.2%), and it includes all measurements, even those that were later removed due to data quality issues (see Figures 8 and 9). Tables 7 and 8 provides summary statistics of filtered and predicted fork lengths (mm) and whole weights (g), respectively.

Summary statistics for MRIP intercepted Yellowtail Snapper fork lengths (mm) by region and year are presented in Table 6 in the working paper (SEDAR 64-DW-12). Similarly, Table 7 presents summary statistics for weights. Sample sizes in these tables include imputed (i.e. predicted) lengths and weights.

Issue:

An investigation of the headboat logbook data and discussion with industry representatives revealed that a portion of headboat trips for Yellowtail occur at night. The catch rates for day and night trips could potentially vary greatly. Subsequently, the at-sea headboat data was evaluated to determine if the observer trips comprised both day/night trips, if an additional weighting factor was necessary to represent the ratio of day to night trips observed in headboat logbook data, or if the headboat weights should be re-calculated for day trips only. It was determined that only a small portion of trips in the headboat logbook/at-sea observer data represented night trips (Table 4.10.7).

Recommendation:

The group recommended not re-calculating the weight, and to proceed with the weighted length frequencies provided.

4.5.2 Length-Age Distribution

Summaries of length information (number, minimum, mean, and maximum lengths; fork length) were provided in working papers for each data source by year and region (Table 5 in SEDAR 64-DW-16 presents this information for both harvested and discarded fish observed by at-sea observers; Table 7 in SEDAR 64-DW-10 shows this information for the SRHS, all other recreational lengths are presented in Table 6 in SEDAR 64-DW-12). Length distributions sampled by SRHS are also illustrated in Figures 10-15 in the working paper (SEDAR 64-DW-10).

Figure 4.11.6 presents an overview of age data from all recreational sources and a summary table can be found in Table 4.10.8. The number of fish aged in each fork length bin (2 cm) for all recreational sources is provided in Table 4.10.9. Most ages originate from the SRHS after 2003. There does appear to be some differences in age distributions in the FL Keys and SE FL (Figure 4.11.7).

4.6 RECREATIONAL EFFORT

Total recreational effort is summarized below by survey. Effort by mode is summarized for all marine fishing, regardless of what was caught. A map summarizing MRIP effort in angler trips is included in Figure 4.11.9. A map summarizing SRHS effort in angler days is included in Figure 4.11.10.

4.6.1 MRFSS/MRIP Effort

Survey methods to estimate effort as well as MRIP effort estimates by region and mode are described in the working paper (SEDAR 64-DW-12) and in Tables 9 and 10, respectively. Effort estimates are shown in angler trips and are not specific to Yellowtail Snapper. An angler-trip is a single day of fishing in the specified mode, not to exceed 24 hours.

4.6.2 SRHS Effort

Details on effort estimation and tables and figures of non-directed effort (in angler days) are presented in the working paper (Table 5 and Figure 8). SRHS effort, particularly in SE FL has been highly variable since the mid-2000s and declined considerably in 2017. One contributing factor to the decline may be that in recent years, some federally permitted headboats surveyed by the SRHS have chosen not to renew their federal reef fish permits, relieving them of the requirement to provide logbooks or be sampled by federal headboat port samplers. These vessels, concentrated in southeast Florida (59% of headboats operating in southeast Florida), now target popular reef fish species solely in state waters. No federally administered surveys have absorbed these vessels into their sample frames, eliminating opportunities for these vessels to report landings or fishing effort; however, state surveys continue to collect biological data from these vessels through at-sea observer trips and a dockside intercept surveys utilized to collect biological samples.

4.6.3 Fishery Demographics and Fishing Characteristics

The working paper SEDAR 64-DW-17 summarizes Yellowtail Snapper recreational fishery demographics and fishing characteristics in accordance with TOR item #8 that aims to: "Incorporate socioeconomic information into considerations of environmental events that affect stock status and related fishing effort and catch levels as practicable”. This study indicated that Yellowtail Snapper is a commonly targeted sport fish and that they are targeted in both offshore waters (3 or more miles from shore) and nearshore waters, mostly by boat. Also, the majority of respondents indicated that they are currently satisfied with the availability of the catch, size of catch, and fishing regulations.

4.7 COMMENTS ON THE ADEQUACY OF DATA FOR ASSESSMENT

Regarding the adequacy of the available recreational data for assessment analyses, the RWG discussed the following:

- Recreational landings are very high for Yellowtail Snapper in some years, particularly for the private mode, while headboat landings and discards are low in comparison. Based on the available data sources, the landings and discards represented in this report appear to be adequate for the time period covered.
- Age and size data appear to adequately represent the landed catch for the headboat sector. These data are lacking for the private mode; however, there does not appear to be divergent size distributions among recreational modes.

4.8 ADDITIONAL RECOMMENDATIONS

4.8.1 Research

- Continue to collect discard length and age data from headboat and charterboat sectors.
- Increase research efforts to collect discard and retained length and age data from the private sector.
- Increase at-sea observer coverage for nighttime trips.
- Assess the impact of headboats that do not renew their federal reef fish permits and target popular reef fish species solely in state waters on the SRHS coverage.

4.8.2 SEDAR Data Best Practices

Recommend methods to estimate uncertainty in headboat landings and discards.

4.9 LITERATURE CITED

Dettloff, K. and V.M. Matter 2019. SEDAR61-WP19: Model-estimated conversion factors for calibrating Coastal Household Telephone Survey (CHTS) charterboat catch and effort estimates with For-Hire Survey estimates in the Atlantic and Gulf of Mexico with application to red grouper and greater amberjack. National Marine Fisheries Service Southeast Fisheries Science Center, Fisheries Statistics Division, Miami, FL., National Marine Fisheries Service Southeast Fisheries Science Center, Sustainable Fisheries Division, Miami, FL.

4.10 TABLES

Table 4.10.1. Recreational Florida landings in number of fish by region, 1981-2017.

Year	NW FL	SW FL	FL KEYS	SE FL	NE FL	Total
1981	0	0	4,235,300	1,384,827	616	5,620,743
1982	0	737	5,162,783	1,684,625	6,637	6,854,782
1983	0	44,072	1,625,732	427,252	16,477	2,113,533
1984	0	37,429	4,155,231	207,031	462	4,400,153
1985	77,869	3,127	1,137,671	820,044	793	2,039,504
1986	1,806	3,022	1,140,488	534,450	1,495	1,681,261
1987	18,926	26,680	1,230,244	119,760	2,304	1,397,914
1988	37	8,844	1,174,873	243,396	2,161	1,429,311
1989	0	13,872	4,660,690	176,300	1,248	4,852,110
1990	213	8,257	3,405,080	243,950	2,023	3,659,523
1991	4	28,038	4,156,078	236,731	2,146	4,422,997
1992	97	59,806	839,814	271,325	3,907	1,174,949
1993	266	50,530	1,571,989	559,275	1,590	2,183,650
1994	727	17,949	1,213,168	302,079	10,924	1,544,847
1995	3	3,058	1,832,567	181,373	441	2,017,442
1996	212	3,000	871,393	134,321	31	1,008,957
1997	216	1,645	815,435	104,141	4,375	925,812
1998	72	4,450	816,059	167,571	10,947	999,099
1999	97	55,170	552,702	147,309	13,489	768,767
2000	289	5,837	620,012	194,532	11,072	831,742
2001	37	13,233	507,580	93,105	9,517	623,472
2002	89	9,352	959,292	93,370	10,894	1,072,997
2003	0	9,691	1,454,034	130,721	5,975	1,600,421
2004	33	31,191	1,189,738	356,125	1,104	1,578,191
2005	59	38,341	360,557	344,532	15,233	758,722
2006	7	71,864	1,013,235	527,897	13,060	1,626,063
2007	14	21,875	1,005,743	614,439	42,878	1,684,949
2008	19	6,883	2,061,495	385,556	923	2,454,876
2009	14	31,880	619,539	361,202	1,229	1,013,864
2010	5	12,724	621,815	313,535	3,629	951,708
2011	14	32,189	475,592	210,310	178	718,283
2012	5	2,237	755,082	264,175	222	1,021,721
2013	1	5,534	1,349,747	480,648	642	1,836,572
2014	0	14,554	773,619	1,281,591	951	2,070,715
2015	3	52,879	753,688	688,463	625	1,495,658
2016	0	20,745	893,514	794,187	721	1,709,167
2017	39	312,384	915,442	427,345	5,767	1,660,977
Total	101,173	1,063,079	56,927,021	15,507,493	206,686	73,805,452

Table 4.10.2. Recreational Florida discards in number of fish by region, 1981-2017.

Year	NW FL	SW FL	FL KEYS	SE FL	NE FL	Total
1981	0	20,827	273,882	647,480	32	942,221
1982	0	0	964,997	77,679	83,509	1,126,185
1983	0	4,952	506,578	120,278	3,318	635,126
1984	0	766	3,752,994	92,897	121	3,846,778
1985	28,955	0	201,901	92,532	8	323,396
1986	3,445	0	539,912	523,218	118	1,066,693
1987	88,405	7,874	1,849,768	349,717	1,940	2,297,704
1988	0	0	1,332,785	61,565	2,114	1,396,464
1989	1,530	809	3,024,027	119,409	301	3,146,076
1990	0	3,817	1,716,402	444,301	1,790	2,166,310
1991	0	17,277	13,937,312	766,026	12,126	14,732,741
1992	14	94,241	2,518,141	864,001	395	3,476,792
1993	0	87,134	4,093,900	647,137	2,531	4,830,702
1994	0	45,390	2,434,270	409,498	196	2,889,354
1995	0	8,545	2,946,207	419,969	180	3,374,901
1996	0	27,104	2,965,469	346,865	13	3,339,451
1997	0	148,972	3,181,517	242,567	165	3,573,221
1998	23	64,371	2,171,754	283,765	92	2,520,005
1999	4	176,051	1,527,357	412,995	12,875	2,129,282
2000	27	14,114	1,379,248	421,177	14,597	1,829,163
2001	39	102,173	801,095	215,991	3,566	1,122,864
2002	3	72,864	981,064	244,114	5,635	1,303,680
2003	0	15,990	1,508,993	338,382	1,614	1,864,979
2004	0	11,045	2,027,040	489,096	54	2,527,235
2005	0	259,660	986,701	417,707	51	1,664,119
2006	0	121,022	1,963,097	596,770	2,710	2,683,599
2007	6,299	46,229	2,783,099	659,652	13,216	3,508,495
2008	2	22,838	2,699,771	552,011	256	3,274,878
2009	0	14,961	1,475,421	940,595	1,035	2,432,012
2010	0	6,411	1,249,387	303,442	3,595	1,562,835
2011	0	19,589	1,473,558	196,516	156	1,689,819
2012	0	8,166	1,447,555	250,346	130	1,706,197
2013	0	6,132	3,676,598	1,243,814	532	4,927,076
2014	0	35,391	3,061,836	1,056,882	2,657	4,156,766
2015	0	31,846	1,438,557	1,304,699	2,289	2,777,391
2016	0	15,773	1,026,027	565,720	638	1,608,158
2017	0	116,616	1,695,830	494,203	1,991	2,308,640
Total	128,746	1,628,950	81,614,050	17,213,016	176,546	100,761,308

Table 4.10.3. Number of biological samples of Yellowtail Snapper from headboat and MRIP data sources.

Year	Headboat*			MRIP**		
	Length Samples	Weight Samples	Age Samples	Length Samples	Weight Samples	Age Samples
1981	1737	1737	194	214	215	0
1982	2469	2471	189	223	219	0
1983	2787	2786	234	101	100	0
1984	2887	2891	159	95	88	0
1985	2746	2748	38	31	32	0
1986	3217	3219	64	80	74	0
1987	2947	2944	50	133	131	0
1988	1687	1689	11	158	32	0
1989	2374	2370	0	126	78	0
1990	1353	1356	0	74	78	0
1991	1727	1730	28	160	153	0
1992	1284	1281	31	205	151	0
1993	1891	1895	0	265	259	0
1994	2269	2270	53	296	259	0
1995	1669	1669	112	175	160	0
1996	1508	1508	0	133	122	0
1997	2421	2422	0	246	245	0
1998	2274	2276	0	513	511	0
1999	1659	1651	0	649	645	0
2000	1535	1534	9	588	594	1
2001	1416	1416	0	515	475	13
2002	1770	1765	0	622	587	5
2003	2648	2640	36	892	659	52
2004	2333	2189	504	881	632	123
2005	2438	2286	736	688	596	88
2006	2706	2517	874	952	785	81
2007	3238	3049	1147	942	684	0
2008	2125	2066	1048	700	666	7
2009	1743	1728	1030	431	358	0
2010	1378	1372	738	658	622	0
2011	2032	1900	1047	516	470	6
2012	3505	3399	1695	891	813	0
2013	3876	3713	1846	853	819	0
2014	3610	3299	2224	882	870	32
2015	4387	4101	2199	979	979	60
2016	4865	4073	2527	678	636	2
2017	3527	3150	1816	602	601	390

*Headboat: MRFSS-HEADBOAT, CRP HEADBOAT, SRHS. **MRIP: GRFS, MRFSS, MARFIN.

Table 4.10.4. Number of biological samples of Yellowtail Snapper from the at-sea observer program and other data sources.

Year	AT-SEA Observers		Other*
	Length Samples	Age Samples	Age Samples
1993	0	0	16
1994	0	0	10
1997	0	0	21
1998	0	0	32
1999	0	0	60
2000	0	0	1
2001	0	0	44
2005	2001	0	0
2006	2459	0	0
2007	3301	0	0
2008	307	0	114
2009	356	1	75
2010	748	28	92
2011	456	0	7
2012	1677	0	0
2013	2159	31	0
2014	1348	97	0
2015	1709	374	0
2016	2935	536	0
2017	2364	395	0

source*	Programs
Other	SEFL-CRP, TIP, FWRI

Table 4.10.5. Number of trips that collected biological samples of Yellowtail Snapper from headboat and MRIP data sources*. *Headboat: MRFSS-HEADBOAT, CRP HEADBOAT, SRHS. *MRIP: GRFS, MRFSS, MARFIN.

Year	Headboat*			MRIP*		
	Length Trips	Weight Trips	Age Trips	Length Trips	Weight Trips	Age Trips
1981	343	343	120	27	27	0
1982	385	386	63	34	34	0
1983	539	538	99	21	21	0
1984	558	558	97	32	32	0
1985	558	558	25	12	13	0
1986	585	586	42	21	25	0
1987	497	496	31	32	37	0
1988	361	361	9	38	6	0
1989	400	400	0	33	32	0
1990	253	253	0	22	20	0
1991	276	275	18	39	44	0
1992	240	240	8	48	41	0
1993	317	317	0	69	68	0
1994	291	291	14	69	63	0
1995	304	304	36	39	36	0
1996	255	255	0	44	42	0
1997	426	426	0	42	42	0
1998	434	435	0	90	86	0
1999	361	357	0	99	95	0
2000	343	343	5	107	107	1
2001	315	315	0	81	79	5
2002	361	360	0	122	117	1
2003	461	460	16	114	100	8
2004	431	416	192	113	100	18
2005	388	382	246	104	96	30
2006	365	358	266	119	109	11
2007	420	413	323	135	125	0
2008	328	326	264	97	94	2
2009	326	325	281	71	65	0
2010	270	269	222	76	79	0
2011	307	303	224	78	73	1
2012	404	398	334	129	124	0
2013	390	383	317	129	129	0
2014	399	378	328	154	152	4
2015	434	415	371	145	145	9
2016	467	443	414	145	140	1
2017	316	304	289	115	114	65

Table 4.10.6. Number of trips that collected biological samples of Yellowtail Snapper from the at-sea observer program and other data sources.

Year	AT-SEA Observers		Other*
	Length Trips	Age Trips	Age Trips
1993	0	0	6
1994	0	0	1
1997	0	0	4
1998	0	0	4
1999	0	0	10
2000	0	0	1
2001	0	0	15
2005	118	0	0
2006	111	0	0
2007	111	0	0
2008	48	0	23
2009	55	1	20
2010	74	15	27
2011	59	0	2
2012	92	0	0
2013	145	10	0
2014	83	31	0
2015	152	66	0
2016	150	64	0
2017	171	93	0

source*	Programs
Other	SEFL-CRP, TIP, FWRI

Table 4.10.7. The total number of night trips (starting after 6:00 pm) in the at-sea observer data conducted in each for-hire survey region and the total number of trips in each region of Florida. The gray highlighted portion of the table is used to identify the regions of Florida that have the highest proportion of trips where Yellowtail snapper were observed.

FHS Region	**Headboat**		**Charter**	
	Night Trips	*Total Trips*	*Night Trips*	*Total Trips*
NW FL	1	659	2	814
SW FL	7	819	9	681
FL Keys	8	257	7	473
SE FL	16	646	1	285
NE FL	18	413	1	197
Total	50	2794	20	2450

Table 4.10.8. Number of fish measured for length, average fork length in centimeters, coefficient of variation (CV), minimum fork length observed (Min), and maximum fork length observed (Max) by sex and age calculated from available Florida biological data for the recreational fleet.

Sex	Age	n	Average	CV	Min	Max
Female	1	230	25.9	0.06	21.7	33
	2	1992	28.36	0.09	19.5	44.7
	3	1289	31.58	0.11	22.7	45.9
	4	416	33.36	0.13	24.6	44.8
	5	166	32.93	0.18	23.8	47.5
	6	78	33.25	0.17	24.2	51.9
	7	44	34.7	0.17	25.3	47.5
	8	22	35.63	0.2	25.8	49.6
	9	16	40.91	0.16	26.9	50.2
	10	8	36.08	0.19	29.5	46.5
	11+	11	39.73	0.16	32.4	49.5
Male	1	232	25.81	0.07	21	38
	2	1933	28.08	0.09	20.8	43.5
	3	1240	31.5	0.1	22	43.7
	4	354	33.32	0.13	24.1	45.7
	5	143	32.68	0.16	23.8	48
	6	66	35.01	0.16	25.3	46.9
	7	41	33.86	0.18	25.5	50.1
	8	22	38.45	0.2	26.2	54
	9	18	37.04	0.19	26.5	50.3
	10	3	36	0.18	30	43
	11+	11	44.35	0.13	31.6	50
Unknown	1	255	25.6	0.06	17.8	31.6
	2	3447	26.97	0.09	20.3	44.5
	3	5165	28.58	0.11	21.6	41.5
	4	3137	29.86	0.14	22	47.2
	5	1593	30.26	0.15	20.9	48.5
	6	736	31.01	0.16	23.2	51
	7	432	31.67	0.17	24	55.6
	8	234	32.57	0.17	23.7	56.4
	9	126	33.38	0.18	23.2	53.5
	10	62	34.67	0.2	25.2	51
	11+	99	39.23	0.2	25.7	59.7

Table 4.10.9. Number of fish aged per length bin (2 cm fork length) for all recreational data sources. Dark grey indicates there were no ages sampled in a length bin and light grey indicates the number of fish aged was less than 10.

Year	17	19	21	23	25	27	29	31	33	35	37	39	41	43	45	47	49	51	53	55	57	59	Total
1980	1	4	11	16	28	38	37	33	24	25	13	13	6	5	10	4	3	1	0	0	0	0	272
1981	0	5	13	11	21	22	27	32	11	13	12	10	7	3	4	1	2	0	0	0	0	0	194
1982	0	1	1	11	6	17	20	34	33	24	13	6	9	4	5	2	1	2	0	0	0	0	189
1983	0	1	2	4	15	24	41	37	32	25	14	15	9	4	4	4	2	1	0	0	1	0	235
1984	0	1	0	2	12	28	21	24	24	19	8	8	5	5	3	0	0	1	0	0	0	0	161
1985	0	0	4	0	2	4	7	13	3	2	0	2	0	5	0	1	0	0	0	0	0	0	38
1986	0	0	5	6	5	9	12	7	4	4	1	3	3	3	1	0	1	0	0	0	0	0	64
1987	0	0	1	2	6	11	10	6	8	3	1	0	1	0	1	0	0	0	0	0	0	0	50
1988	0	0	0	0	1	3	1	3	1	0	1	1	0	0	0	0	0	0	0	0	0	0	11
1989	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1990	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1991	0	0	0	0	6	3	7	4	2	0	2	2	0	1	2	1	0	0	0	0	0	0	28
1992	0	0	0	1	1	6	5	7	3	2	1	2	2	1	3	1	0	0	0	0	0	0	31
1993	0	0	0	0	2	1	0	2	2	1	0	1	3	2	2	0	0	0	0	0	0	0	16
1994	2	2	5	4	17	17	16	12	3	3	3	1	1	0	0	1	0	0	0	0	0	0	64
1995	0	0	0	3	38	45	59	70	44	23	5	8	3	1	0	0	0	0	0	0	0	0	112
1996	0	0	0	4	10	17	14	6	4	3	0	1	0	0	0	0	0	0	0	0	0	0	59
1997	0	0	0	2	28	28	18	9	3	3	2	2	2	2	2	0	0	0	1	0	0	0	21
1998	0	0	0	10	30	37	23	15	4	4	1	2	2	1	0	0	0	0	0	0	0	0	32
1999	0	0	0	4	10	10	14	8	10	8	3	2	2	3	0	1	0	0	0	0	0	0	62
2000	0	0	0	1	2	2	2	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	11
2001	0	0	0	1	12	12	10	6	4	3	2	1	2	3	1	0	0	0	0	0	0	0	57
2002	0	0	0	0	4	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
2003	0	0	0	3	19	15	15	19	3	6	4	2	2	0	0	0	0	0	0	0	0	0	88
2004	0	0	0	20	149	162	119	84	50	28	5	6	3	2	0	0	0	0	1	0	0	0	629
2005	0	0	2	33	191	188	138	129	74	45	12	5	1	4	2	0	1	0	0	0	0	0	825
2006	0	0	2	40	239	242	186	112	68	32	16	5	6	6	0	2	0	0	1	0	0	0	958
2007	0	2	7	61	302	232	170	170	112	58	13	8	5	4	3	0	2	0	0	0	0	0	1149
2008	0	0	4	56	286	252	214	149	110	64	17	10	5	3	5	1	0	0	0	0	0	0	1171
2009	0	2	2	72	342	269	157	86	70	37	26	18	9	10	8	6	1	0	0	0	0	0	1118
2010	0	2	6	41	218	184	154	113	49	45	25	9	3	4	4	3	0	0	0	0	0	0	861
2011	0	0	2	72	275	270	186	102	80	31	19	9	0	3	1	1	1	0	0	0	0	0	1060
2012	0	0	2	87	399	362	245	173	139	117	66	43	30	19	5	4	2	2	0	0	0	0	1695
2013	0	0	2	130	463	385	311	194	145	110	63	41	15	8	5	4	1	1	0	0	0	0	1878
2014	0	0	3	207	556	504	384	284	170	116	59	31	15	13	3	3	0	0	0	1	0	0	2354
2015	0	1	2	210	626	546	452	300	213	144	69	31	21	7	3	1	3	1	0	0	0	0	2633
2016	0	0	7	253	794	676	493	361	217	122	61	35	25	11	4	1	1	0	1	1	1	1	3065
2017	0	1	19	325	554	535	403	282	173	125	79	46	21	13	16	8	1	1	0	0	0	0	2603

4.11 FIGURES

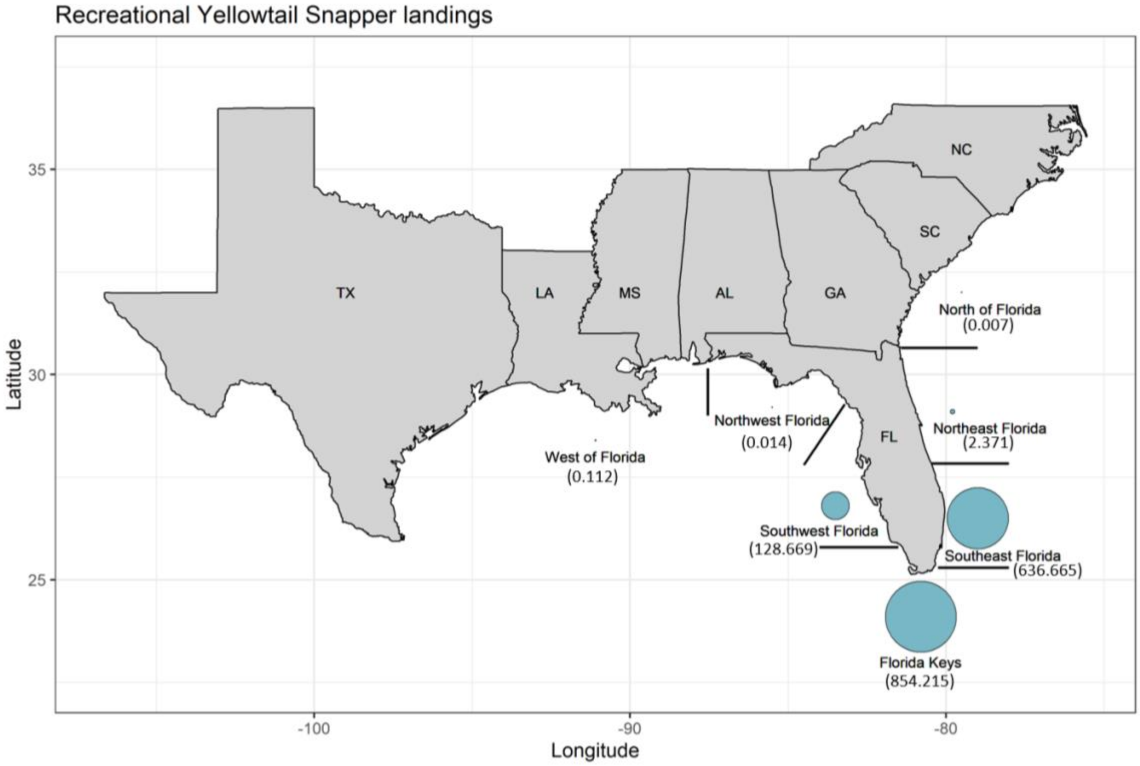


Figure 4.11.1. Average Yellowtail Snapper recreational landings (in thousands of fish) by region, 2015-2017.

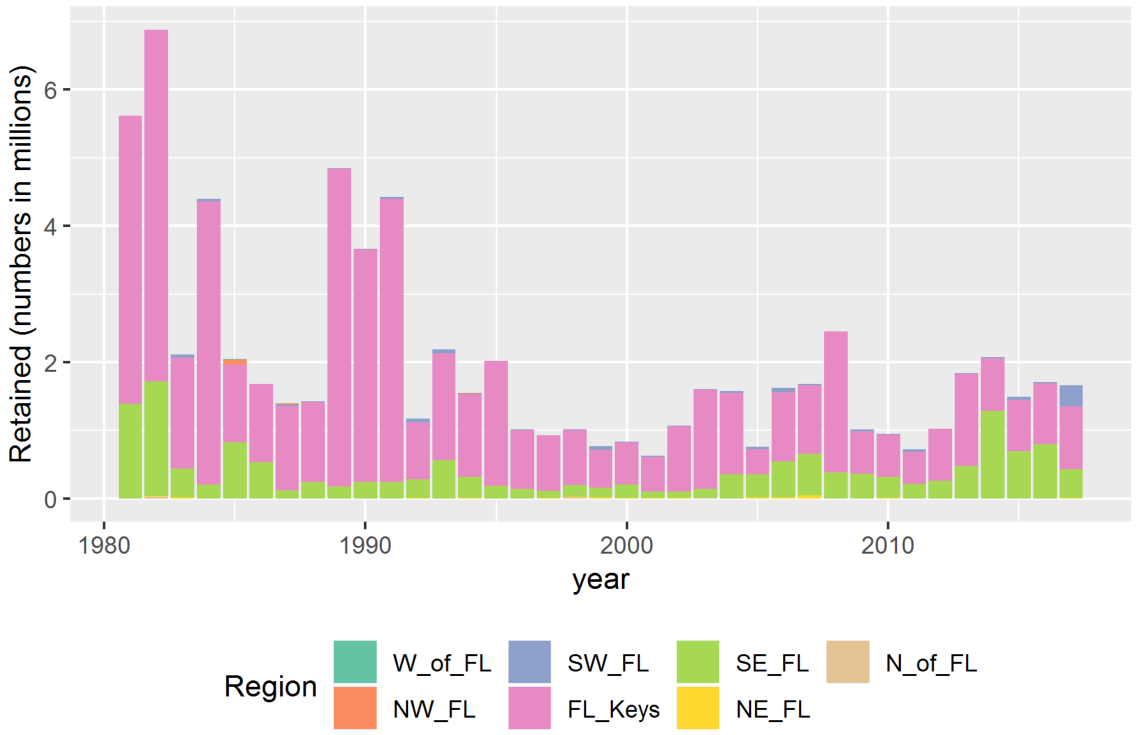


Figure 4.11.2. Yellowtail Snapper landings by region and year, 1981-2017.

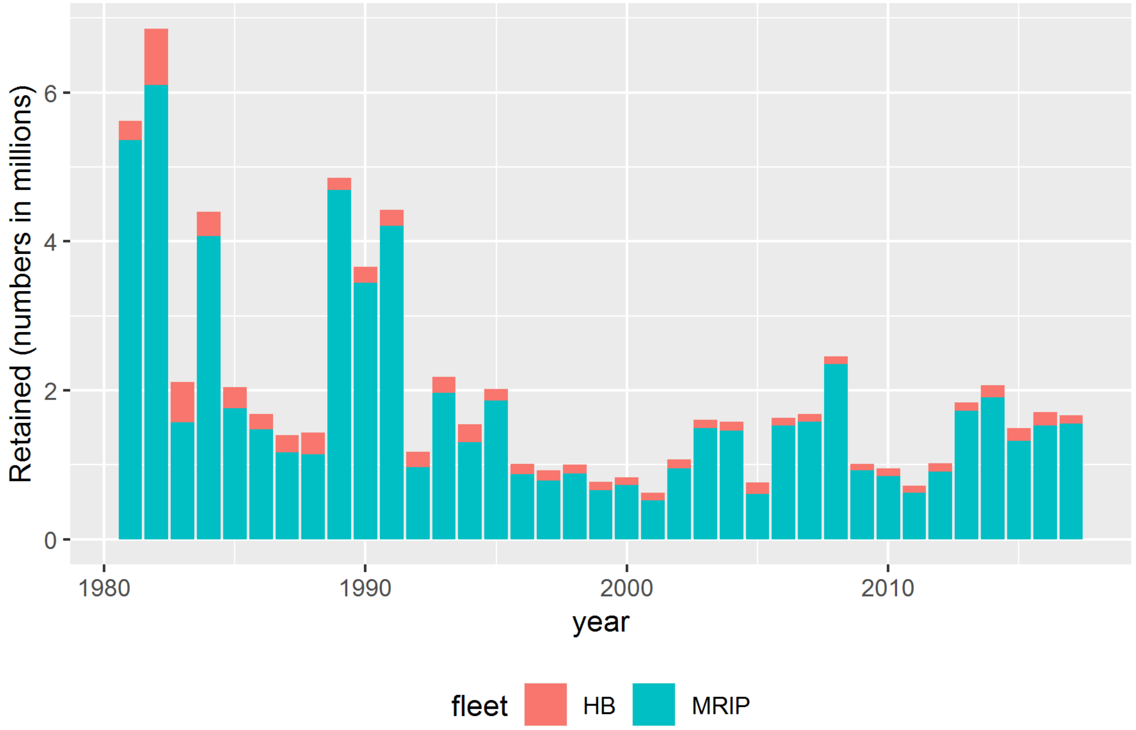


Figure 4.11.3. Yellowtail Snapper landings in Florida by data source 1981-2017. Note that from 1981-1985 headboat landings in the Gulf of Mexico originated from MRIP.

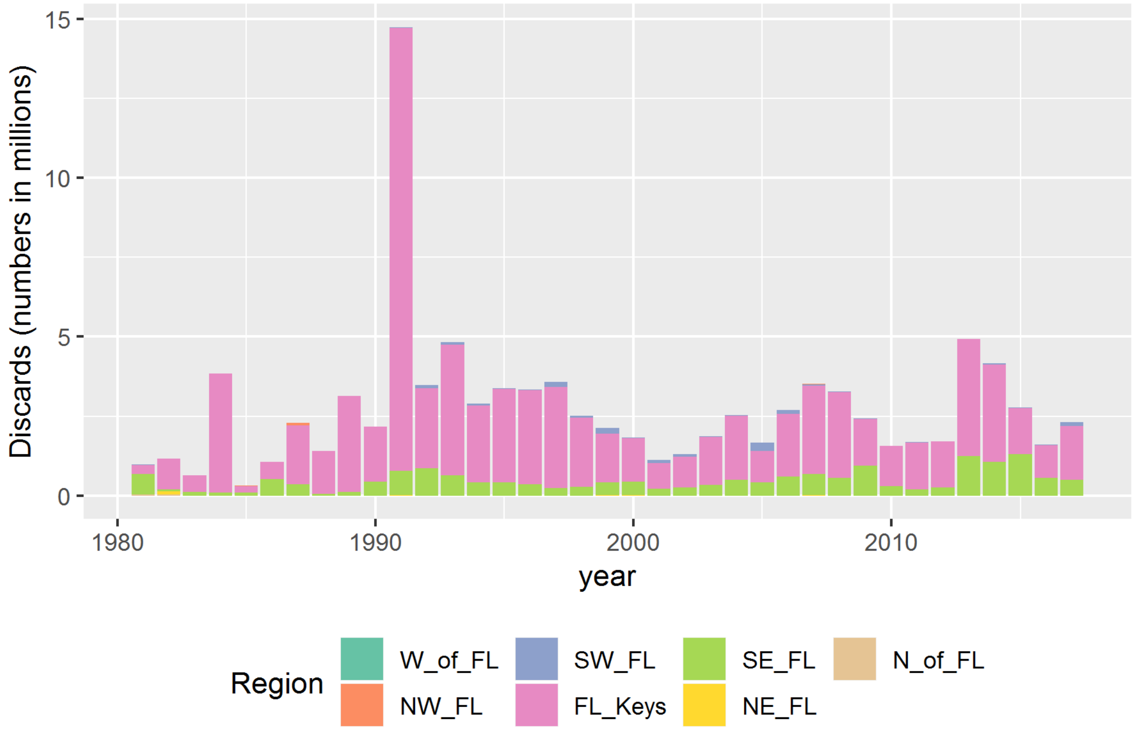


Figure 4.11.4. Yellowtail Snapper discards by region and year, 1981-2017.

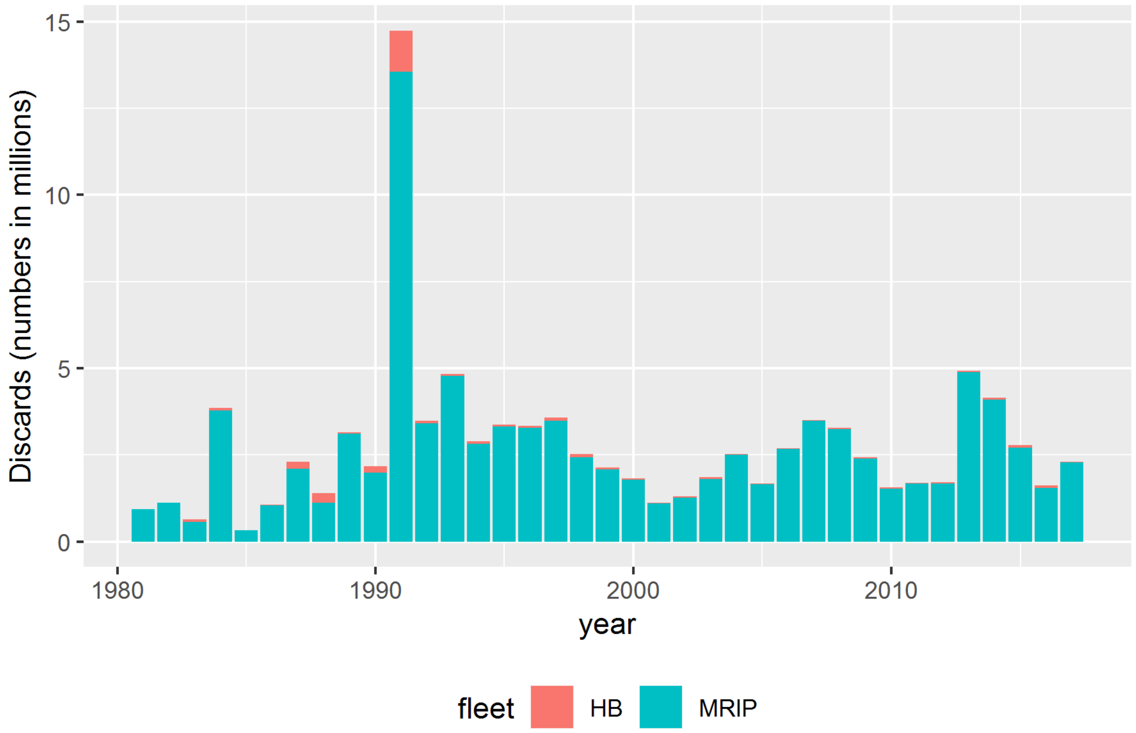


Figure 4.11.5. Yellowtail Snapper discards in Florida by data source 1981-2017. Note that from 1981-1985 headboat discards in the Gulf of Mexico originated from MRIP.

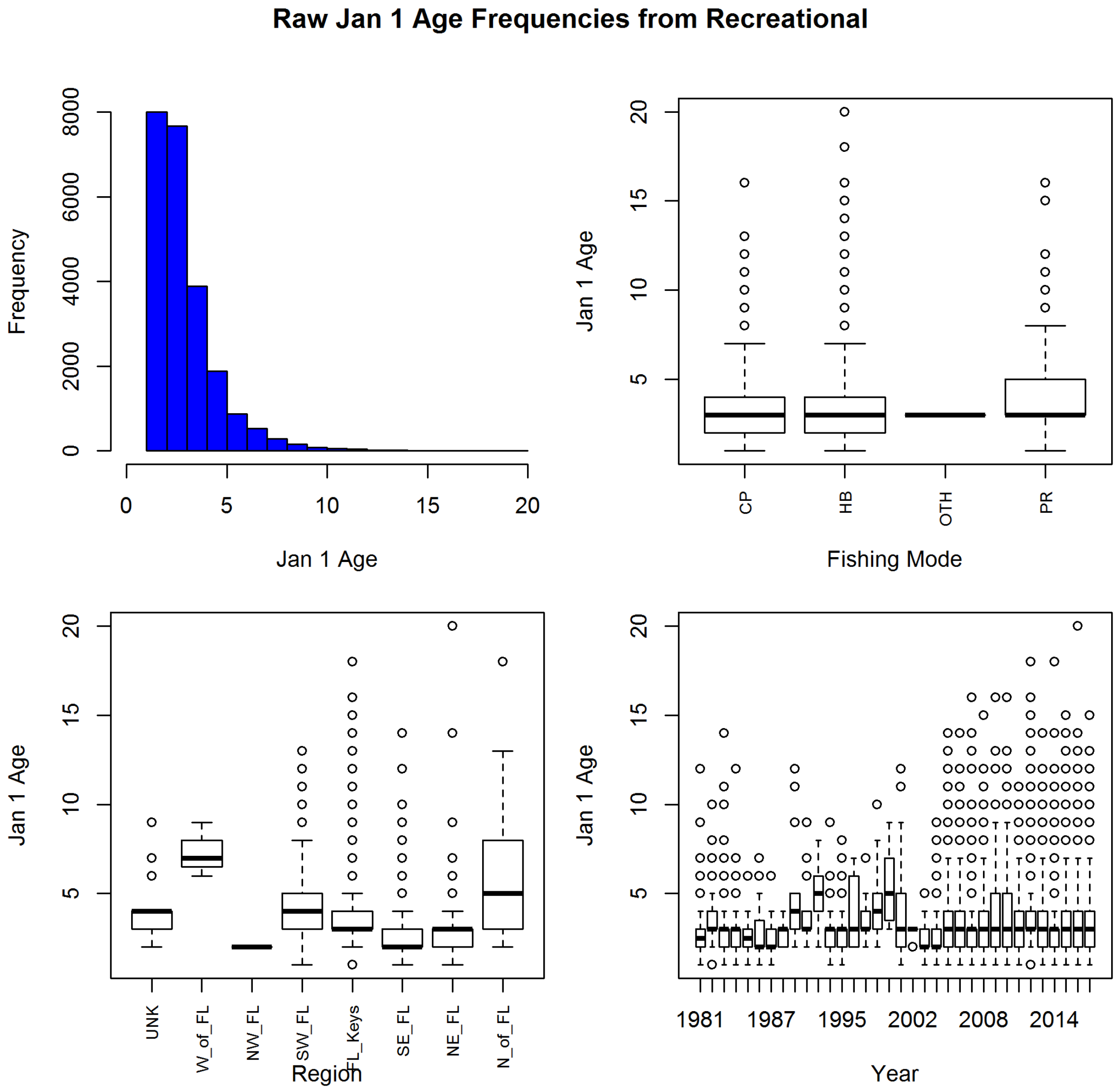


Figure 4.11.6. An overview of Yellowtail Snapper age data from recreational sources, 1981-2017.

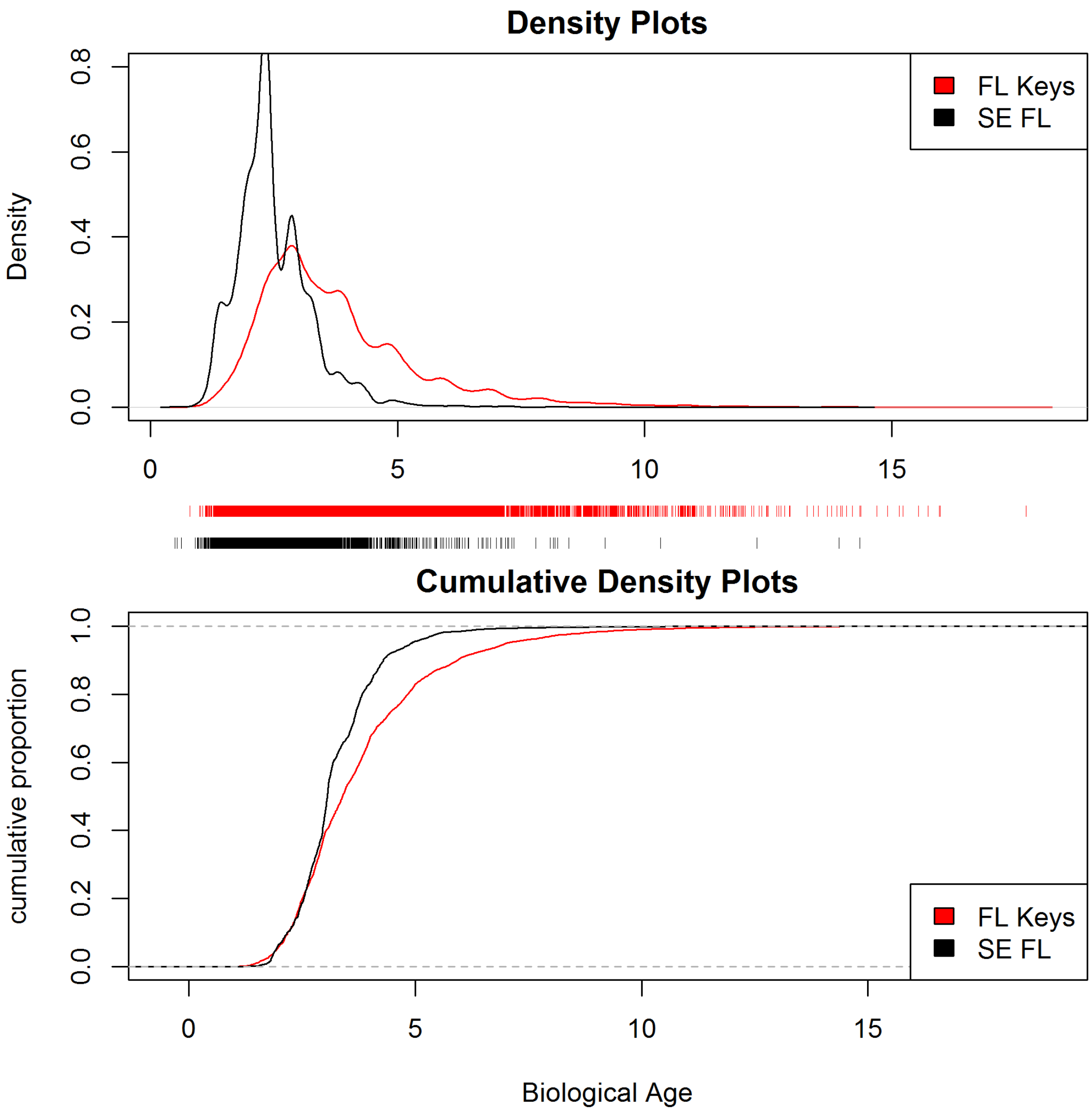


Figure 4.11.7. A comparison of Yellowtail Snapper age distributions from recreational sources in the FL Keys and SE FL.

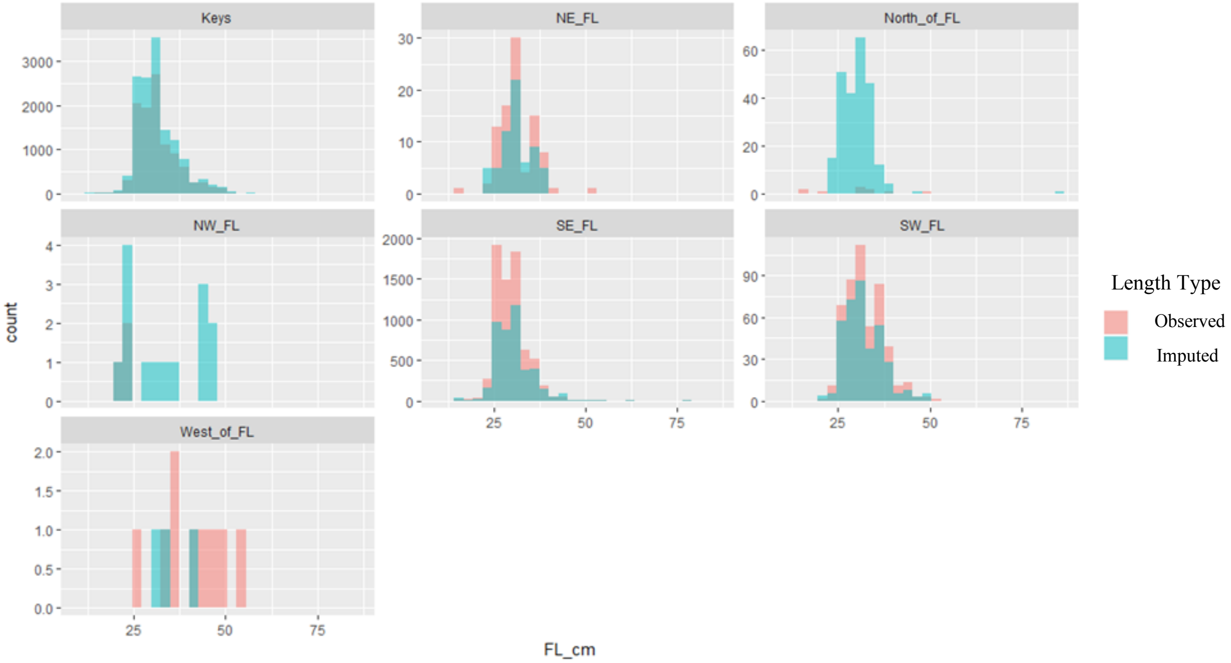


Figure 4.11.8. Comparison of MRIP length distributions for Yellowtail Snapper derived from observed and imputed fork lengths (cm).

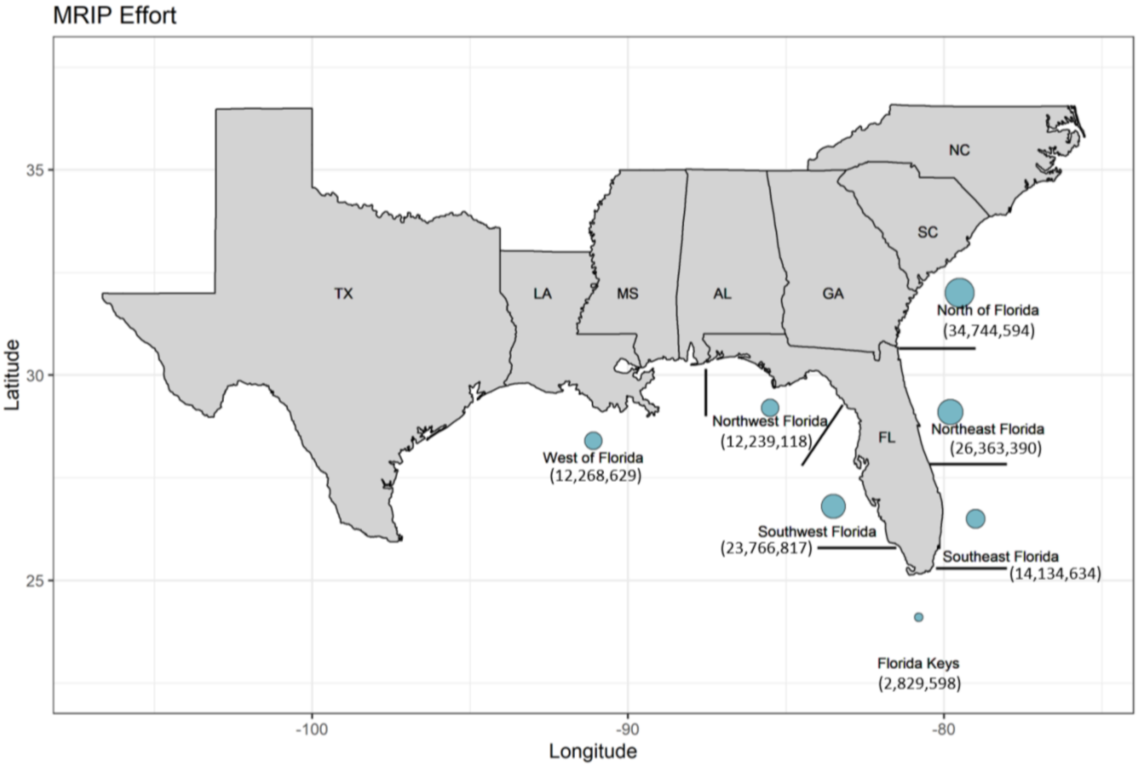


Figure 4.11.9. Average Yellowtail Snapper MRIP angler-days by region, 2015-2017.

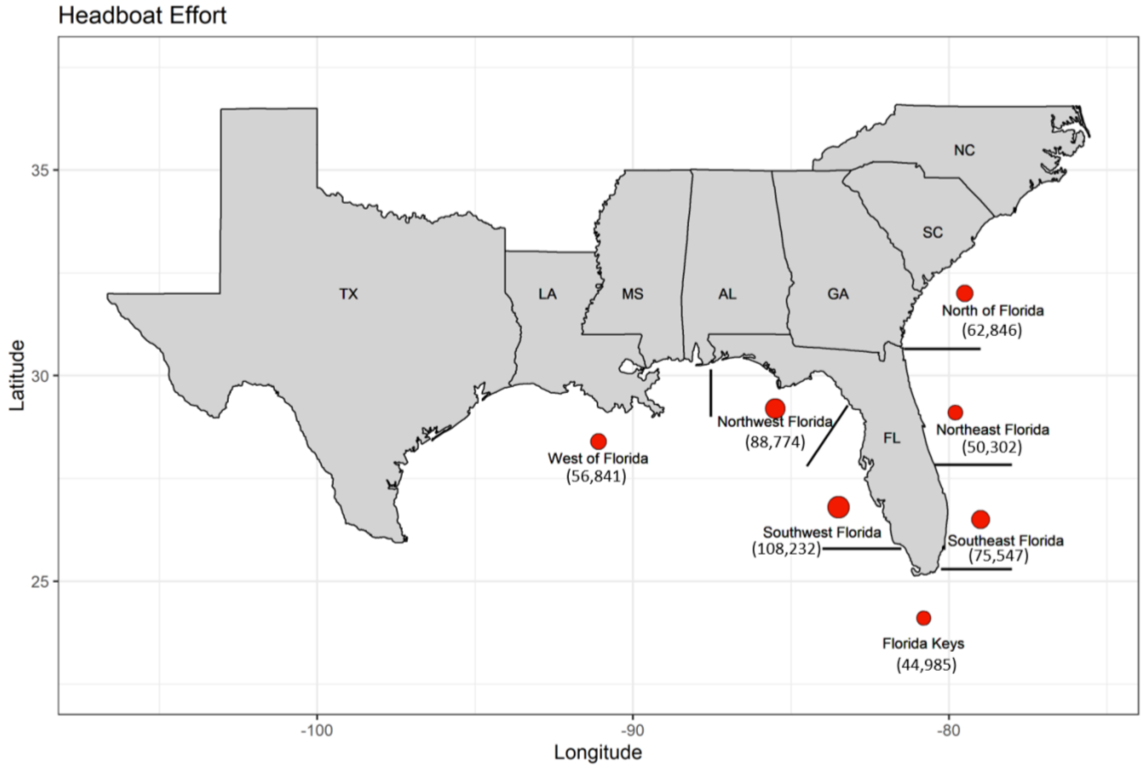


Figure 4.11.10. Average Yellowtail Snapper Headboat angler-days by region, 2015-2017.

5 MEASURES OF POPULATION ABUNDANCE

The Population Abundance Workgroup (PAW) was tasked to review indices of relative abundance for Yellowtail Snapper from fishery-independent and fishery-dependent surveys for inclusion in the stock assessment model. Each survey index was individually evaluated according to SEDAR Best Practices (SEDAR 2016) with considerations to factors such as survey design, sampling gear, spatial coverage, temporal coverage, analytical methodology, data limitations, and size/age classes sampled. Discussions for each index focused on whether they adequately represented fishery and population conditions and whether modifications to analytical methods could be made to improve the quality of the index.

5.1.1 Group Membership

Christopher Swanson (lead)	FWRI, St. Petersburg, FL
Jeff Renchen	FWC-DMFM, Tallahassee, FL
Walt Ingram	NOAA SEFSC, Pascagoula, Mississippi
Jim Nance	GMFMC SSC, Tampa, FL
Kerry Flaherty-Walia	FWRI, St. Petersburg, FL
Jennifer Herbig	FWRI, Marathon, FL
Mike Errigo	SAFMC, Charleston, SC
Elizabeth Herdter Smith	FWRI, St. Petersburg, FL
Eric Schmidt	Headboat captain, Ft. Myers, FL
Robert Muller	FWRI, St. Petersburg, FL
Kevin McCarthy	NOAA SEFCS, Miami, FL

5.2 REVIEW OF WORKING PAPERS

Eight working papers were submitted for review to the PAW. Five papers covered fishery-independent surveys, while the other three covered fishery-dependent surveys. Each working paper described the source data, information on quality control, and subsetting methodology used to produce final datasets for the index. The papers also contained diagnostic plots and, where appropriate, more detailed information about the survey design. Indices were prepared for this assessment from the following five programs: the Reef Fish Visual Census (RVC; a multi-agency collaborative underwater survey), the NMFS’ Southeast Area Monitoring and Assessment Program’s (SEAMAP) reef fish video survey, the NMFS’ Coastal Fisheries Log Book Program (CFLP), the NMFS’ Marine Recreational Information Program (MRIP), and the NMFS’ Southeast Region Headboat Survey (SRHS).

SEDAR 64-DW-01: SEAMAP Reef Fish Video Survey: Relative Indices of Abundance of Yellowtail Snapper

SEDAR 64-DW-02: A model-based index of Yellowtail Snapper, *Ocyurus chrysurus*, in the Dry Tortugas using Reef Fish Visual Census data from 1999-2016

SEDAR 64-DW-04: A model-based index of Yellowtail Snapper, *Ocyurus chrysurus*, for the Florida Reef Tract from Card Sound through the Florida Keys using Reef Fish Visual Census data from 1997-2016

SEDAR 64-DW-05: Fisheries-independent data for Yellowtail Snapper (*Ocyurus chrysurus*) from reef-fish visual surveys in the Florida Keys and Dry Tortugas, 1999-2016

SEDAR 64-DW-06: A model-based index of Yellowtail Snapper, *Ocyurus chrysurus*, for the Northern Florida Reef Tract from Government Cut through Martin County using Reef Fish Visual Census data from 2012-2016

SEDAR 64-DW-09: Standardized Catch Rates of Yellowtail Snapper (*Ocyurus chrysurus*) from the Marine Recreational Information Program (MRIP) in Southeast Florida and the Florida Keys, 1981-2017

SEDAR 64-DW-11: Standardized Catch Rates of Yellowtail Snapper (*Ocyurus chrysurus*) from the U.S. Headboat Fishery in Southeast Florida and the Florida Keys, 1981-2017

5.3 FISHERY INDEPENDENT SURVEYS

5.3.1 Reef Fish Visual Census (RVC)

Personnel from the National Marine Fisheries Service began the Reef Fish Visual Census (RVC) in 1979 to provide long term monitoring data for reef fish populations along the Florida Reef Tract (Bohnsack and Bannerot 1986; Bohnsack et al. 1999; Ault et al. 2001; and Smith et al. 2011). The survey is now conducted by several agencies in three regions of the south Florida coral reef ecosystem domain: (1) the Florida Keys (Key Biscayne to west of Key West; domain size = 559 km_2); (2) the Dry Tortugas (domain size = 339 km_2); and (3) the southeast Florida region (Key Biscayne to Martin County; domain size = 365 km_2). They employed a two-stage stratified random survey design (Cochran 1977; Brandt et al. 2009; Smith et al. 2011) in shallow water (<30 m) with sampling frames by hard-bottom habitat that were created by dividing the Florida Reef Tract into 200-m x 200-m grid cells, or primary sampling units (PSUs), and listing the habitat strata in each PSU. The PSU size was later reduced to 100-m x 100-m in 2014 to improve spatial resolution. This change, however, does not affect the index because the measuring unit for Yellowtail Snapper is the average abundance within a secondary sampling unit (SSU). The number of PSUs sampled in each stratum was based on the area of each strata within the sampling region and the variance in abundance (Smith et al. 2011). Strata with higher variance were allocated more samples to increase survey accuracy. Once the estimated number of PSUs needed to achieve a 20% coefficient of variation (CV) were allocated to each stratum, PSUs were randomly chosen from the habitat sampling domain.

The RVC data were first assessed on a regional basis. Based on the results, the PAW determined that the Florida Keys and Dry Tortugas regions should be combined into a single index reflecting the core spatial areas for Yellowtail Snapper while the southeast Florida region (the northern extent of the core area) would be removed due to limited sampling years. Two approaches were discussed: a design-based modeling approach (Smith et al. 2011; Herbig et al. 2019) and a model-based approach (Swanson and Muller 2019, Swanson 2019a, Swanson 2019b). While both approaches have been used in assessments, the PAW ultimately recommended the design-based approach that weights the abundance of fish by habitat strata to account for the increased sampling effort over strata with higher variances. Yellowtail Snapper abundance was therefore assessed for the combined Florida Keys and Dry Tortugas regions between April and December using only the years that contained sampling information from both regions (1999, 2000, 2004, 2006, 2008, 2010, 2012, 2014, 2016). Based on Yellowtail Snapper life history and length compositions collected for each region, the PAW further partitioned the RVC data into two indices. Data from Yellowtail Snapper less than 19 cm fork length (FL; age 0 juveniles; range: 1 – 18 cm) were used to develop a recruitment index while data from fish 19 cm FL or greater (range: 19 – 66 cm) were used for development of an adult (age 1+) index. From 1999 to 2016, the abundance for both juvenile and adult Yellowtail Snapper showed a slightly increasing trend (Table 5.9.1, Fig 5.10.1).

5.3.2 SEAMAP Reef Fish Video Survey

The primary objective of the annual Southeast Area Monitoring and Assessment Program (SEAMAP) reef fish video survey is to provide an index of the relative abundances of fish species associated with topographic features (e.g. reefs, banks, and ledges) located on the continental shelf of the Gulf of Mexico (GOM) from Brownsville, TX to the Dry Tortugas, FL. The survey has been executed from 1992-1997, 2001-2002, and 2004-present and historically takes place from April - May, however in limited years the survey was conducted through the end of August. In 2001, the survey was abbreviated due to ship scheduling, during which, the only sites that were completed were located in the western Gulf of Mexico. The survey collects data on diversity, abundance (min-count), fish length, habitat type, habitat coverage, bottom topography and water quality.

A delta (hurdle) model with three different error distributions (lognormal, Poisson and negative binomial) was used to standardize relative abundance indices for Yellowtail Snapper (Lo et al. 1992). Because there were very few observations of Yellowtail Snapper from sites outside of the Dry Tortugas region, the data were spatially restricted to that area. The delta-lognormal model was selected as the best fitting model by evaluating the conditional likelihood, over-dispersion parameter (Pearson chi-square/DF), and visual interpretation of the Q/Q plots. The size of fish sampled with the baited video gear is species specific and Yellowtail Snapper sampled over the history of the survey ranged in size from 8 – 73 cm FL with mean annual fork lengths ranging from 19 – 31 cm. A review and discussion about the survey design, specific data caveats, index, and diagnostic plots can be found in Campbell et al. (2018).

5.4 FISHERY-DEPENDENT MEASURES

5.4.1 Coastal Fisheries Logbook Program (CFLP) Commercial Index

The Coastal Fisheries Logbook Program (CFLP) available catch per unit effort (CPUE) data were used to construct standardized abundance indices for Yellowtail snapper. The index was constructed using data reported from commercial vertical line (handline and bandit rig) trips in southern Florida. Yellowtail Snapper data were sufficient to construct indices of abundance including the years 1993-2018.

Several data filters were used in constructing the final data set. Trips reporting multiple gears or areas fished were excluded. Data were restricted to include only those trips with landings and effort data reported within 45 days of the completion of the trip due to the assumption that longer reporting delays likely resulted in less reliable effort data. Clear outliers in the data, e.g., values falling outside the 99.9 percentile of the data, and logical inconsistencies (e.g., reports of fishing more than 24 hours/day) were also excluded from the analyses. Yellowtail Snapper trips were identified using a data subsetting technique (modified from Stephens and MacCall 2004) intended to restrict the data set to trips with fishing effort in presumptive Yellowtail snapper habitat. Three commercial closures (2015, 2017, and 2018) were implemented that affected construction of indices of abundance using the logbook dataset. In each case, data reported during the closure were excluded from the analyses.

Two indices were constructed using coastal logbook commercial vertical line data following the methods of McCarthy (2011). The first index (south Florida index) included effort and landings data reported from statistical areas 1, 2, 3, 4, 2482, 2481, 2480, 2479, 2579, 2580, 2679, 2680, 2779, and 2780 (see Figure 5.10.2). The second index (core area index) included data reported from areas 1, 2, 2482, 2481, 2480, 2579, 2580, 2679, and 2680. Vertical line catch rate was calculated as weight of landed Yellowtail snapper per hook hour fished.

Five factors were considered as possible influences on the proportion of trips that landed Yellowtail Snapper and on the catch rate of Yellowtail Snapper. An additional factor, number of hooks fished, was examined for its effect on the proportion of positive trips.

Factor	**Levels**	**Value**
Year	26	1993-2018
Season	4	Jan-Mar, Apr-Jun, Jul-Sep, Oct-Dec
Subregion	7/5	Areas as defined above: 7 in south Florida; 5 in core area
Days at sea	2	1, 2+ days
Crew	3	1, 2, 3+ crew members
Hooks hours fished[1]	4	South Florida index: <8, 8-15, >15-23, >23 hook hours Core area index: 0.1-8, >8-15, >15-24, >24 hook hours

[1] Hooks fished was examined only for the proportion positive analyses.

The delta lognormal model approach (Lo et al. 1992) was used to construct standardized indices of abundance. Parameterization of each model was accomplished using a GLM analysis (GENMOD; Version 8.02 of the SAS System for Windows © 2000. SAS Institute Inc., Cary, NC, USA). For each GLM analysis of proportion positive trips, a type-3 model was fit, a binomial error distribution was assumed, and the logit link was selected. The response variable was proportion successful trips. During the analysis of catch rates on successful trips, a type-3 model assuming lognormal error distribution was examined. The linking function selected was "normal", and the response variable was log(CPUE) where log(CPUE)=ln(pounds of yellowtail snapper/hook hours fished). All 2-way interactions among significant main effects were examined. Higher order interaction terms were not examined.

A forward stepwise regression procedure was used to determine the set of fixed factors and interaction terms that explained a significant portion of the observed variability. Once a set of fixed factors was identified, the influence of the YEAR*FACTOR interactions were examined. YEAR*FACTOR interaction terms were included in the model as random effects. Selection of the final mixed model was based on the Akaike's Information Criterion (AIC), Schwarz's Bayesian Criterion (BIC), and a chi-square test of the difference between the –2 log likelihood statistics between successive model formulations (Littell et al. 1996).

The final delta-lognormal models were fit using a SAS macro, GLIMMIX (Russ Wolfinger, SAS Institute). The PAW recommended using the south Florida area index over the similarly trending core area index due to the greater spatial representation and smaller CVs (Table 5.9.1, Fig 5.10.1). This index was also chosen for use in the prior assessment (O'Hop et al. 2012).

5.4.2 Marine Recreational Informational Program (MRIP) Index

yellowtail Snapper are caught by recreational anglers primarily in south Florida from Palm Beach County to Monroe County. Since the Marine Recreational Information Program (MRIP) collects data on both harvested (observed landings=A; dead discards not observed=B1) and live released fish (B2), a total catch (A + B1 + B2) by species for an angler-trip can be calculated. Therefore, trip level data using only hook and line gear were used to construct total catch rate indices of Yellowtail Snapper for the Florida Keys (including the Dry Tortugas; Monroe County) and Southeast Florida (Palm Beach, Broward, and Miami-Dade Counties) from 1981 – 2017. A combined area index was also produced using the selected trip data from the Florida Keys and southeast Florida. Species clustering (Shertzer and Williams 2008) was used to identify trips that were either directly or indirectly targeting Yellowtail Snapper.

Generalized linear models and a delta-lognormal approach were used to generate the indices (Lo et al. 1992; Dick 2004; Maunder and Punt 2004). Due to inconsistencies in the methods used to collapse catch by trip between the earlier (up to 1990) and later portions of the MRIP data set, and considering the research recommendations made by SEDAR 27A (O'Hop et al. 2012), the PAW recommended the index start year be set at 1991 for this assessment. Model residuals indicated good overall fit to both the positive and binomial sub-models for both regions and the combined area model. Observed (non-imputed) measurements taken for Yellowtail Snapper in southeast Florida and the Florida Keys ranged in size from 11 – 79 cm FL. Since there was no indication that recreational fishers were targeting different portions of the population between the two areas, the PAW recommended the use of the combined area index as it better represents the core population area. The combined area index decreased in trend from 1991 – 1998 then variably increased through 2017 (Table 5.9.1, Fig 5.10.1). A further review and discussion about the MRIP survey design, specific data caveats, index, and diagnostic plots can be found in Herdter (2019).

5.4.3 Southeast Region Headboat Survey (SRHS) Index

Headboats are vessels with a capacity for carrying six or more recreational anglers. The Southeast Region Headboat Survey (SRHS), administered by the NOAA Southeast Fishery Science Center laboratory in Beaufort, NC, has operated along the east coast since 1972 and in the Gulf of Mexico since 1986. Catch and effort records from every trip are provided using self-reported logbooks and biological samples are collected from dockside intercepts by port agents. Catch and effort information from the SRHS were used to construct indices of Yellowtail Snapper catch rates in the Florida Keys (including the Dry Tortugas; areas 12 and 17) and southeast Florida (area 11) from 1981 – 2017. A combined area index was also produced using the selected trip data from the Florida Keys and southeast Florida. Only retained catch estimates were available beginning in 1981, however, total catch estimates became available beginning in 2008 when mandatory logbook reporting was implemented and required for permit renewal.

Species clustering (Shertzer and Williams 2008) was used to identify trips that were either directly or indirectly targeting Yellowtail Snapper.

Generalized linear mixed effects models and a delta-lognormal approach were used to generate the indices (Lo et al. 1992; Dick 2004; Maunder and Punt 2004); 'Vessel ID' was included as a random effect in both positive and binomial sub-models. Reporting issues during the middle portion of the time series caused poor model fit for all models. Two types of SRHS indices were considered where catch rates were defined as 1) retained catch per trip from 1981 – 2017 or 2) as total catch per trip from 2008 – 2017. A further review and discussion about the SRHS design, specific data caveats, index, and diagnostic plots can be found in Herdter and Allen (2019).

5.5 CONSENSUS RECOMMENDATIONS AND SURVEY EVALUATIONS

During the Data Workshop and webinar, the PAW evaluated several indices from five survey programs for use in the Yellowtail Snapper stock assessment model. Ultimately, the PAW recommended the following four relative abundance indices for use: RVC – Juvenile index, RVC – Adult index, MRIP index, and the CFLP Commercial index. The values for each individual index and their respective CVs are presented in Table 5.9.1 and index values normalized to their means are presented in Table 5.9.2 and Figure 5.10.1. Below are the evaluations for each of the surveys and their respective indices.

5.5.1 Reef Fish Visual Census – Juvenile

The Reef Fish Visual Census juvenile index was recommended for use in the assessment. This fishery-independent survey collects information on juvenile sizes not yet recruited to the fishery, spatially operates in core Yellowtail Snapper habitat along the Florida Reef Tract, and contains sufficient temporal coverage.

5.5.2 Reef Fish Visual Census – Adult

The Reef Fish Visual Census adult index was recommended for use in the assessment. This survey spatially operates in core Yellowtail Snapper habitat along the Florida Reef Tract, adequately targets population size ranges vulnerable to the fishery, and contains sufficient temporal coverage.

5.5.3 SEAMAP Reef Fish Video Survey

The SEAMAP Reef Fish Video Survey index was not recommended for use in the assessment. The survey overlaps in spatial and temporal coverage with the RVC index, targets similarly sized fish, but is limited to the Dry Tortugas and therefore not representative of total population abundance.

5.5.4 Marine Recreational Information Program

The MRIP index was recommended for use in the assessment because it contains adequate spatial and temporal coverage in the core Yellowtail Snapper habitat, includes the larger sized fish in the estimate, and is similar in trend to the fishery-independent indices.

5.5.5 Coastal Fisheries Logbook Program

The Commercial index was recommended for use in the assessment after confirming proper calculation of index variance estimates. Temporal and spatial coverage were adequate in the Yellowtail Snapper south Florida area in the opinion of the PAW. TIP data inform the size composition of the fish included in this CPUE series.

5.5.6 Southeast Region Headboat Survey

The Headboat survey index was not recommended for use in the assessment due to poor reporting compliance and model fit through 2008, numerous data uncertainties, and survey overlap in spatial and temporal coverage with other fishery-dependent indices. In addition, annual headboat landings averaged only 5% of the total annual Yellowtail Snapper landings.

5.6 RESEARCH RECOMMENDATIONS

During the review and evaluation of the various program datasets and indices presented during the Data Workshop, the PAW identified the following research recommendations to further improve the indices of relative abundance:

- Develop fishery-independent surveys throughout the Florida Keys which successfully target settlement sized Yellowtail Snapper in seagrass/mangroves habitats before ontogenetically shifting to reef habitats. This habitat shift is observed throughout the Caribbean but not well documented for Florida.
  - Develop or extend fishery-independent reef fish surveys into deeper waters (>30 m) along the Florida Keys for greater overlap with exploited portions of the population.

5.7 DATA BEST PRACTICES COMMENTS AND SUGGESTIONS

By familiarizing ourselves with the SEDAR Best Practices Living Document (SEDAR 2016), several potential issues described therein were avoided by the PAW during the Data Workshop. The recommendations within SEDAR 2016 streamlined the DW process and allowed each member to follow similar protocols. There was more time for discussion on the particulars of each index because we were not required to complete the index report cards. Additionally, having evaluation criteria promoted constructive discussion regarding index inclusion, rejection, or modification. Finally, re-organization of the Data Workshop Report section limited redundancy and allowed for clearer communication regarding final recommendations.

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5.9 TABLES

Table 5.9.1. Recommended relative abundance index values and CVs for Yellowtail Snapper from 1991 – 2017.

Year	RVC Index Juvenile		RVC Index Adult		MRIP Index		Commercial Index	
	Index	CV	Index	CV	Index	CV	Index	CV
1991					3.84	0.09		
1992					2.96	0.09		
1993					2.99	0.10	2.34	0.18
1994					2.27	0.13	2.53	0.18
1995					2.33	0.12	1.93	0.18
1996					1.71	0.13	1.69	0.18
1997					1.58	0.12	1.94	0.18
1998					1.30	0.09	2.27	0.18
1999	1.59	0.13	1.35	0.19	1.72	0.09	3.02	0.17
2000	2.67	0.08	1.33	0.12	1.91	0.09	2.73	0.18
2001					1.98	0.08	2.71	0.18
2002					1.82	0.09	3.05	0.18
2003					1.74	0.09	2.21	0.18
2004	2.38	0.12	2.40	0.18	2.25	0.09	3.02	0.18
2005					2.40	0.08	3.78	0.18
2006	2.96	0.11	1.82	0.25	2.27	0.08	3.59	0.18
2007					2.72	0.08	4.84	0.18
2008	3.45	0.07	3.38	0.13	2.25	0.09	6.12	0.18
2009					2.09	0.09	5.62	0.18
2010	2.94	0.11	2.51	0.12	2.29	0.11	5.36	0.18
2011					2.09	0.09	5.98	0.18
2012	3.26	0.07	2.75	0.09	2.15	0.09	5.23	0.18
2013					3.02	0.08	5.04	0.18
2014	3.85	0.10	4.44	0.17	2.76	0.08	4.72	0.18
2015					2.95	0.09	4.82	0.19
2016	3.55	0.10	3.01	0.12	2.56	0.09	5.98	0.18
2017					2.93	0.11	6.77	0.19

Table 5.9.2. Recommended relative abundance index values (normalized to their means) and CVs for Yellowtail Snapper from 1991 – 2017.

Year	RVC Index Juvenile		RVC Index Adult		MRIP Index		Commercial Index	
	Index	CV	Index	CV	Index	CV	Index	CV
1991					1.65	0.09		
1992					1.27	0.09		
1993					1.28	0.10	0.60	0.18
1994					0.97	0.13	0.65	0.18
1995					1.00	0.12	0.50	0.18
1996					0.73	0.13	0.43	0.18
1997					0.68	0.12	0.50	0.18
1998					0.56	0.09	0.58	0.18
1999	0.54	0.13	0.53	0.19	0.74	0.09	0.78	0.17
2000	0.90	0.08	0.52	0.12	0.82	0.09	0.70	0.18
2001					0.85	0.08	0.70	0.18
2002					0.78	0.09	0.78	0.18
2003					0.75	0.09	0.57	0.18
2004	0.80	0.12	0.94	0.18	0.97	0.09	0.78	0.18
2005					1.03	0.08	0.97	0.18
2006	1.00	0.11	0.71	0.25	0.97	0.08	0.92	0.18
2007					1.17	0.08	1.24	0.18
2008	1.17	0.07	1.32	0.13	0.97	0.09	1.57	0.18
2009					0.90	0.09	1.44	0.18
2010	0.99	0.11	0.98	0.12	0.98	0.11	1.38	0.18
2011					0.90	0.09	1.54	0.18
2012	1.10	0.07	1.08	0.09	0.92	0.09	1.34	0.18
2013					1.30	0.08	1.30	0.18
2014	1.30	0.10	1.74	0.17	1.19	0.08	1.21	0.18
2015					1.27	0.09	1.24	0.19
2016	1.20	0.10	1.18	0.12	1.10	0.09	1.54	0.18
2017					1.26	0.11	1.74	0.19

5.10 FIGURES

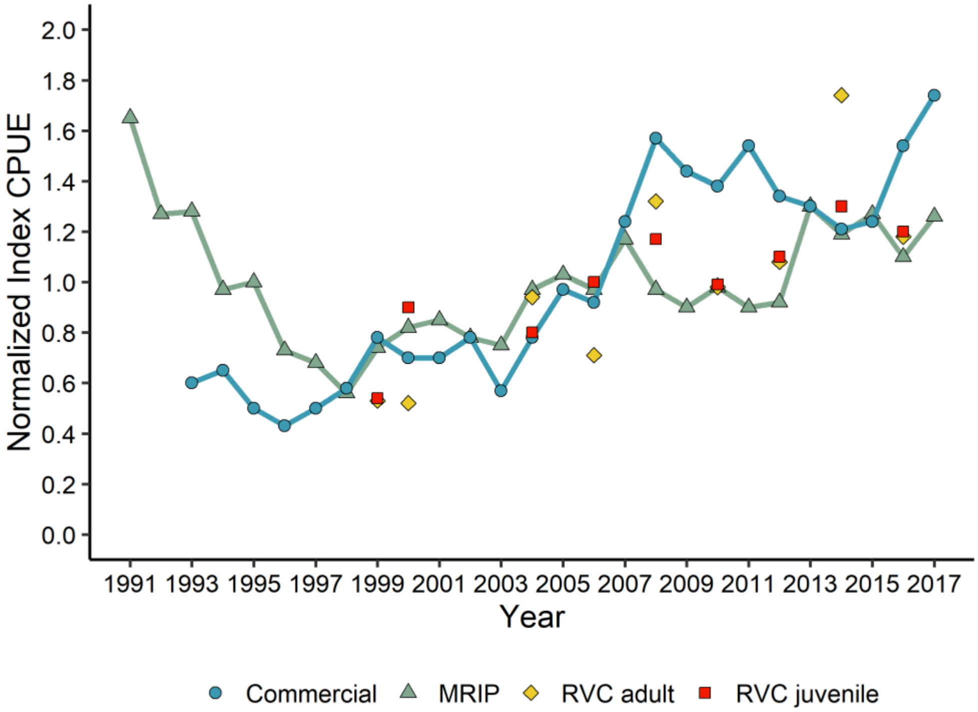

Figure 5.10.1. Recommended normalized indices of relative abundance for Yellowtail Snapper from 1991 – 2017. MRIP surveys were conducted from 1991-2017, the commercial CFLP index was from 1993 – 2017, and RVC surveys were conducted in 1999, 2000 and biennially from 2004 -2016.

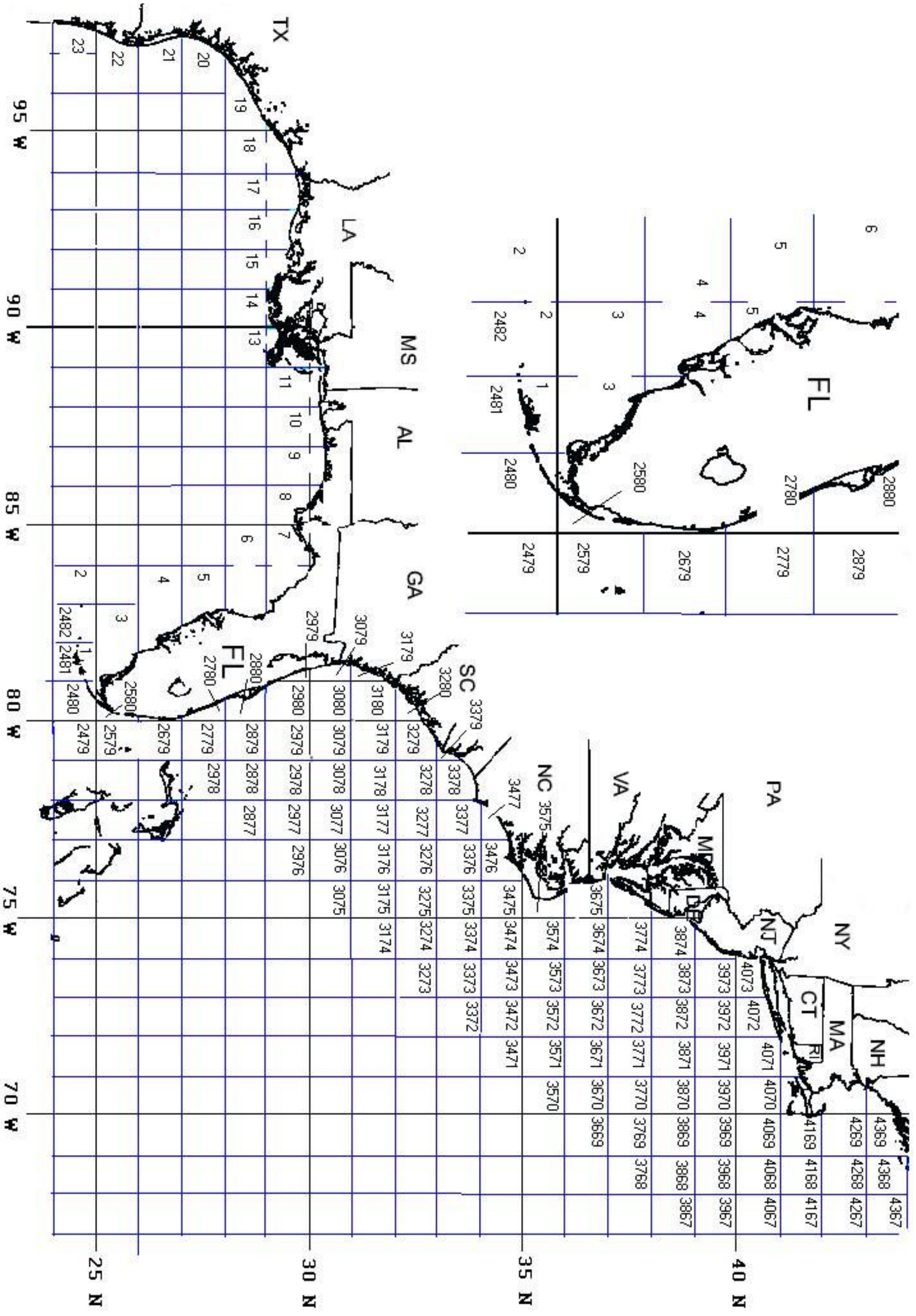

Figure 5.10.2. Grid system currently used in the reporting data to the NMFS Coastal Fisheries Logbook Program.

SEDAR

Southeast Data, Assessment, and Review

SEDAR 64

Southeastern US Yellowtail Snapper

SECTION III: Assessment Process Report

February 2020

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

Table of Contents

1 Introduction

1.1 Workshop Time and Place

The SEDAR 64 southeastern U.S. Yellowtail Snapper assessment workshop process was conducted through a series of four webinars between September and December 2019. No in-person workshops were conducted.

1.1.1. Terms of Reference

1. Review any changes in data following the data workshop and any analyses suggested by the data workshop. Summarize data as used in each assessment model. Provide justification for any deviations from Data Workshop recommendations.
2. Develop population assessment models that are compatible with available data and document input data, model assumptions and configuration, and equations for each model considered.
    - Fully document and describe the impacts (on population parameters and management benchmarks) of any changes to the model structure, methods, application or fitting procedures made between this assessment and the prior assessment (SEDAR 27A).
    - Provide a continuity model consistent with the prior assessment configuration, if one exists, updated to include the most recent observations. Alternative approaches to a strict continuity run that distinguish between model, population, and input data influences on findings, may be considered.
3. Provide estimates of stock population parameters, if feasible:
    - Include fishing mortality, abundance, biomass, selectivity, stock-recruitment relationship (if applicable), and other parameters as necessary to describe the population
    - Include appropriate and representative measures of precision for parameter estimates
    - Compare and contrast population parameters and time series estimated in this assessment with values from the previous (SEDAR 27A) assessment, and comment on the impacts of changes in data, assumptions or assessment methods on estimated population conditions
4. Characterize uncertainty in the assessment and estimated values.
    - Consider uncertainty in input data, modeling approach, and model configuration
    - Consider and include other sources as appropriate for this assessment
    - Provide appropriate measures of model performance, reliability, and ‘goodness of fit’
    - Provide measures of uncertainty for estimated parameters
5. Provide estimates of yield and productivity.
    - Include yield-per-recruit, spawner-per-recruit, and stock-recruitment models

6. Provide estimates of population benchmarks or management criteria consistent with available data, applicable FMPs, proposed FMPs and Amendments, other ongoing or proposed management programs, and National Standards. Include values for fishing mortality (including assumed discard mortality if appropriate), spawning stock biomass, fishery yield, SPR and recruitment for potential population benchmarks.
   - Evaluate existing or proposed management criteria as specified in the management summary
   - Recommend proxy values when necessary, and provide appropriate justification
   - Compare and contrast reference values estimated in this assessment with values from the previous (SEDAR 27A) assessment, and comment on the impacts of changes in data, assumptions or assessment methods on reference point differences.
7. Incorporate known applicable environmental covariates into the selected model, and provide justification for why any of those covariates cannot be included at the time of the assessment
8. Provide declarations of stock status relative to management benchmarks or alternative data poor approaches if necessary.
9. Provide uncertainty distributions of proposed reference points, stock status, and yield.
   - Provide the probability of overfishing at various harvest or exploitation levels.
   - Provide a probability density function for biological reference point estimates.
   - If the stock is overfished, provide the probability of rebuilding within mandated time periods as described in the management summary or applicable federal regulations.
10. Project future stock conditions (biomass, abundance, and exploitation) and develop rebuilding schedules if warranted; include estimated generation time. Stock projections shall be developed in accordance with the following:

    A) If stock is overfished:
        $F=0$, $F_{Current}$, $F=F_{MSY}$, F at 75% of F_{MSY}
        $F=F_{Rebuild}$ (max exploitation that rebuild in greatest allowed time)
    B) If overfishing is occurring:
        $F=F_{Current}$, $F=F_{MSY}$, F at 75% of F_{MSY}
    C) If stock is neither overfished nor undergoing overfishing:
        $F=F_{Current}$, $F=F_{MSY}$, F at 75% of F_{MSY}, equilibrium yield
    D) If data limitations preclude classic projections (i.e. A, B, C above), explore alternative models to provide management advice

11. Provide recommendations for future research and data collection.
    - Be as specific as practicable in describing sampling design and sampling intensity
    - Emphasize items that will improve future assessment capabilities and reliability
    - Consider data, monitoring, and assessment needs
12. Review, evaluate, and report on the status and progress of all research recommendations listed in the last assessment, peer review reports, and SSC report concerning this stock.

13. Complete the Assessment Workshop Report in accordance with project schedule deadlines (Section III of the SEDAR Stock Assessment Report).

1.1.2. Participants

Workshop Panel

Shanae Allen, Co-Lead Analyst	FWRI, St. Petersburg
Chris Swanson, Co-Lead Analyst	FWRI, St. Petersburg
Beth Babcock	RSMAS, U. Miami
Bob Gill	GMFMC SSC
Anne Lange	SAFMC SSC
Robert Muller	FL FWC, St. Petersburg
Joseph Munyanderaro	FWRI, St. Petersburg
Joe O'hop	FWRI, St. Petersburg
Skyler Sagarese	NMFS Miami
Steven Scyphers	GMFMC SSC, Medford, MA
Fred Serchuk	SAFMC SSC

Appointed Observers

Ed Walker	GMFMC AP

Attendees

Dustin Addis	FL FWC, St. Petersburg
Luiz Barbieri	FL FWC, St. Petersburg
Martha Guyas	FL FWC, GMFMC Rep, Tallahassee
Michael Larkin	NMFS SERO St. Pete
Jessica McCawley	FL FWC, SAFMC Rep, Tallahassee
Katie Siegfried	NMFS Beaufort

Staff

Julie Neer	SEDAR
Mike Errigo	SAFMC
Ryan Rindone	GMFMC

1.1.3. List of Assessment Workshop Working Papers

Documents Prepared for the Assessment Process

SEDAR64-AP-01	Weighted Length Compositions for U.S. Yellowtail Snapper (*Ocyurus chrysurus*) from 1981-2017	Shanae D. Allen	20 December 2019

1.2 Panel Recommendations and Comments on Terms of Reference

Term of Reference 1: The Data Workshop recommended using only data concerning the Yellowtail Snapper population within Florida waters. Since the Data Workshop, the Assessment Panel recommended only using Florida data to inform natural mortality in order to make the data sources consistent. All changes to the data following the Data Workshop are reviewed in Section 2.

Term of Reference 2: The Assessment Panel recommended the use of a fully integrated age and length based statistical-catch-at-age model (Stock Synthesis) as the modeling platform. The data inputs and base model configuration are described in Sections 2 and 3.2, respectively. Continuity model methods and results are presented in Section 3.1. Comparisons of the base model and SEDAR 27A configurations, as well as results, are presented in Sections 3.1, 3.4, and 3.5.

Term of Reference 3: Section 3.3 of this report contains estimates of stock population parameters (e.g. fishing mortality, abundance, biomass, selectivity, stock-recruitment relationship), as well as their associated standard errors. Section 3.3.10.4 presents the results of MCMC analysis to further assess parameter uncertainty. Sections 3.4 and 3.5 highlight differences in model results between the base model and SEDAR 27A.

Term of Reference 4: Uncertainty of base model parameters and derived quantities is evaluated by multiple model diagnostics, including profile likelihood analysis, jitter analysis, bootstrap analysis, MCMC, jack-knife analysis on indices of abundance, retrospective analysis, and several sensitivity runs (Section 3.3.10).

Term of Reference 5: Yield-per-recruit and spawner-per-recruit models are presented in Section 3.3.11 and the estimated stock-recruitment model is discussed in Section 3.3.6.

Term of Reference 6: Estimates of population benchmarks are presented in Section 3.3.13 and projections of fishing mortality, spawning stock biomass, fishery yield, SPR, and recruitment under these population benchmarks are discussed in Section 3.3.14. A comparison of population benchmarks between the current assessment and SEDAR 27A is presented Section 3.5.

Term of Reference 7: Environmental covariates were not available for this species.

Term of Reference 8: Declarations of stock status relative to management benchmarks are presented in Section 3.3.13.

Term of Reference 9: Uncertainty distributions of proposed reference points, stock status, and yield are presented in Section 3.3.13.

Term of Reference 10: Future stock conditions in terms of biomass, abundance, and exploitation are projected under multiple scenarios in Section 3.3.14.

Term of Reference 11: Recommendations for future research and data collection are provided in the Assessment Working paper SEDAR64-AP-01, as well as Section 3.6 of this report.

Term of Reference 12: Research recommendations listed in SEDAR27A are reviewed and evaluated in Section 3.6.

Term of Reference 13: This report satisfies this Term of Reference

2 Data Review and Update

Following the recommendations from the Data Workshop, only data concerning the Yellowtail Snapper population within Florida waters were used in this benchmark assessment. The following list summarizes the main data inputs used in the SEDAR 64 assessment model:

- Stock structure and management unit
- Life history
    - Age and growth
    - Natural mortality

    - Release mortality
    - Maturity
    - Fecundity
- Landings
    - Commercial (metric tons): 1981 – 2017
    - Headboat (thousands of fish): 1981 – 2017
    - MRIP (thousands of fish): 1981 – 2017
- Discards (thousands of fish)
    - Commercial: 1993 – 2017
    - Headboat: 1981 – 2017
    - MRIP: 1981 – 2017
- Length composition of landings (2-cm fork length bins)
    - Commercial: 1984 – 2017
    - Headboat: 1981 – 2017
    - MRIP: 1981 – 2017
- Conditional age-at-length (1-year age bins, plus group for ages 12 and older)
    - Commercial landings: 1981, 1992 – 2017
    - Headboat landings: 1981 – 1988, 1991 – 2000, 2003 – 2017
    - MRIP landings: 1993 – 1994, 1997 – 2011, 2013 – 2017
    - Fishery-independent survey: 1995, 1998 – 2002, 2007 – 2015
- Length composition of discards (2-cm fork length bins)
    - Commercial: 2009 – 2017
    - Headboat: 2005 – 2017
    - MRIP: 2005 – 2017
- Abundance indices
    - Fishery-independent
        - RVC Adult: 1999 – 2000, 2004, 2006, 2008, 2010, 2012, 2014, 2016
        - RVC Juvenile: 1999 – 2000, 2004, 2006, 2008, 2010, 2012, 2014, 2016
    - Fishery-dependent
        - Commercial vertical line: 1993 – 2017
        - MRIP: 1991 – 2017
- Length composition from abundance indices (2-cm fork length bins)
    - Fishery-independent
        - RVC Adult: 1999 – 2000, 2004, 2006, 2008, 2010, 2012, 2014, 2016
        - RVC Juvenile: 1999 – 2000, 2004, 2006, 2008, 2010, 2012, 2014, 2016
    - Fishery-dependent
        - MRIP: 2005 – 2017

2.1 Stock Structure

The Yellowtail Snapper fishery is managed in the U.S. by the South Atlantic Fishery Management Council (SAFMC) and the Gulf of Mexico Fishery Management Council (GMFMC) as separate stock units with the boundary being U.S. Highway 1 in the Florida Keys west to the Dry Tortugas (**Fig. 2.10.1**). The State of Florida also participates in the management of this species in state waters. Other states in the SAFMC and GMFMC jurisdictions defer to the federal management regulations for this species. Both SEDAR 3 (Muller et al. 2003) and SEDAR 27A (O'Hop et al. 2012) used data from genetic analyses available at the time (Hoffman et al. 2003) to treat Yellowtail Snapper in the SAFMC and GMFMC jurisdictions as a single stock for assessment purposes. No additional genetic analyses have been conducted since the previous assessment, therefore, this approach continues to be recommended here.

2.2 Life History

2.2.1 Age and Growth

Following the Data Workshop, additional fishery-independent and fishery-dependent length-at-age data from Vose and Shank (2003) and Garcia et al. (2003), that were used in the prior assessment (SEDAR 27A; O'Hop et al. 2012), became available to the analytical team. These data increased the filtered dataset from 45,280 length-at-age observations to 48,212 originating from five defined regions within Florida waters (northwest, southwest, the Florida Keys, southeast, and northeast Florida), from Florida but with the region of origin unknown, and from waters outside Florida along the southeastern US Atlantic and Gulf of Mexico (**Table 2.9.1**). As stated in the Data Workshop Report, for confidentiality purposes, data from areas outside of Florida were defined as being either "west of Florida" or "north of Florida". The updated length-at-age data for Yellowtail Snapper remained almost exclusively (99%) from the state of Florida (n=47,886 otoliths originating from one of the five defined Florida regions or regionally 'unknown'). For otoliths which come from known regions within Florida, 61% (n = 29,253 otoliths) came from the Florida Keys region (Monroe County) and 35% (n = 16,939 otoliths) came from southeast Florida region (Indian River County south to Miami-Dade County; **Table 2.9.1**). More than half (58%) of the Yellowtail Snapper age data were age-2 and -3 fish and ages 2 – 6 comprised 90% of the age data (**Tables 2.9.2**). Age data for Yellowtail Snapper remain predominantly from fishery-dependent age sources (46% commercial and 50% recreational), but the number of otolith ages from fishery-independent sources increased from <1% to 4% (**Table 2.9.3**). **Table 2.9.4** displays the updated number of ages of Yellowtail Snapper sampled only in the state of Florida (n = 47,886 otoliths) by year within the filtered dataset.

As outlined in the Data Workshop Report (see Data Workshop Report Section 2.6.1), calendar ages of individuals were converted to monthly biological ages based on an assumed hatch date of July 1. The analytical team revisited the assumed hatch date because the mid-year hatching date underestimated fish ages, especially at smaller sizes (e.g. fish with mean observed lengths of 150 mm FL were estimated to be 3 months old). The assumed hatch date was changed to April 1 to align biologically with peaks in spawning season and gonadosomatic indices detailed in empirical studies listed in the Data Workshop Report Section 2.7. Updated length-at-age data, based on fractional (monthly biological) ages and observed fork lengths at capture, were modeled using a size-truncated von Bertalanffy growth model (Diaz et al. 2004) executed in AD Model Builder version 11.6 (Fournier et al. 2012, admb-project.org) following the methods described in the Data Workshop Report Section 2.6.3. The Assessment Panel (AP) selected the size-truncated model using inverse-weighting that included an age 12+ group (n = 45,833 otoliths with lengths above the minimum size limit, if applicable) and estimated a constant coefficient of variation (CV) for length-at-age (CV = 0.179) as the final, most parsimonious model (**Table 2.9.5; Figure 2.10.2**). Updated von Bertalanffy growth parameters: L_{inf} (the asymptotic length), k (the von Bertalanffy growth coefficient), and t_0 (the theoretical age at length zero) were estimated at:

L_{inf} = 42.29 cm FL

k = 0.207 year^{-1}

t_0 = -1.636 year

Diagnostic plots for the updated final model are in **Figure 2.10.3**. The updated growth curve predicted a slightly smaller L_{inf} (42.6 cm FL updated to 42.3 cm FL) and fit the length-at-age for smaller individuals better by reducing t_0 (from -1.93 yr to -1.64 yr).

2.2.2 Natural Mortality

The Data Workshop recommended Yellowtail Snapper natural mortality be estimated with the assumption that the instantaneous natural mortality, which followed the $\text{Hoenig}_{\text{all taxa}}$ (1983) equation, should be inversely related to fish length (Lorenzen 2005) and held constant over time (see Data Workshop Report Section 2.4). For this analysis, lengths-at-age were predicted using the size-truncated von Bertalanffy growth model to develop an estimate of natural mortality-at-age. However, the lengths-at-age used to develop the natural mortality-at-age estimates for this assessment came exclusively from Florida data which did not include the larger and older individuals that are generally unsusceptible to the fishing pressure occurring within the core fishery areas of south Florida waters (see Data Workshop Report Sections 2.6.2 and 2.6.3). The AP decided that the maximum age used in the $\text{Hoenig}_{\text{all taxa}}$ (1983) equation should be the maximum age observed in Florida (20 yr) in accordance with this assessment's exclusive usage of all other Yellowtail Snapper life history data from Florida waters and to focus on providing management advice for this predominantly Florida-based fishery.

The instantaneous natural mortality estimate was updated to 0.223 yr^{-1} using the $\text{Hoenig}_{\text{all taxa}}$ (1983) equation and t_{max} = 20 yr. Following Lorenzen (2005), age-specific natural mortality rates were derived using this estimate as the target-M (scaled between ages 3 – 20) and with the updated size-truncated von Bertalanffy growth model results (Section 2.2.1 above). Estimated age-specific natural mortality rates were found to range from 0.558 yr^{-1} to 0.198 yr^{-1} for ages 0 to 20 years (**Table 2.9.6**).

During the Assessment Workshop process, panel members requested natural mortality estimates based on Beverton-Holt life history invariant values derived from the von Bertalanffy growth coefficient (k) or the M/k ratio to determine if the natural mortality estimates were reasonable given what is known about the biology of Yellowtail Snapper. Natural mortality was estimated using the formula $M = 1.5k$ (Jensen 1996) and the k value (0.207 yr^{-1}) from the updated von Bertalanffy growth model (Section 2.2.1 above). This produced an estimate of constant natural mortality equal to 0.311 yr^{-1}. Using the methods described above which use this estimate as target-M to derive natural mortality-at-age following Lorenzen (2005), the estimates of natural mortality-at-age were found to be too high and unrealistic by the assessment panel, particularly for the younger ages. The surviving proportion of fish in an unfished cohort were found to be only 45% by age-1, 25% by age-2, 15% by age-3, and 1.6% by age-9. Charnov et al. (2013) developed an alternate method that utilizes both $Linf$ and k to estimate natural mortality-at-age. However, the Charnov et al. (2013) method produced even higher estimates of natural mortality-at-age for younger ages with the proportion of fish in an unfished cohort surviving to age-1 being 26%, 12% by age-2, 7% by age-3, and 1.3% by age-8. The M/k value for Yellowtail Snapper using M = 0.223 yr^{-1} and k = 0.207 yr^{-1} was found to be 1.076 as opposed to the value M/k = 1.5

as suggested to be optimal by Jensen (1996); yet the variability of the Beverton-Holt life history invariants has been acknowledged and shown for several species ranging from 0.12 – 3.52 (Hordyk et al. 2015). Based on the growth estimates produced in this assessment, if *M/k* were to equal 1.5, it would correspond to t_{max} = 14 yr in the $\text{Hoenig}_{\text{all taxa}}$ (1983) equation.

2.2.3 Discard Mortality Rates

Discard mortality rates were treated as fixed model inputs equal to the values recommended by the Data Workshop panel: 10% discard mortality rate for the commercial, headboat, and MRIP fleets. Sensitivity runs were also performed using a 15% discard mortality rate for the commercial fleet and then a 20% and 30% discard mortality rate for the recreational (headboat and MRIP) fleets.

2.2.4 Maturity

An age-based maturity schedule was developed using a logistic regression on available female Yellowtail Snapper histological data (see Data Workshop Report Section 2.7.2). The data included 205 individuals up to age-12 that were collected during spawning season between April and October. The analysis was performed using PROC NLIN (SAS version 9.2) and showed that 50% of the females were mature at 1.7 years old and 100% by age-4 (**Table 2.9.7**). For the assessment model, the predicted maturity proportions were extended to age-20 and used as fixed inputs.

2.2.5 Fecundity

The assessment model was configured to use spawning biomass as a proxy of fecundity.

2.3 Landings

No changes to the landings data were made after the Data Workshop. The results are briefly summarized below and in greater detail in the Data Workshop Report Sections 3 and 4.

2.3.1 Commercial Landings

Commercial landings of U.S. South Atlantic and Gulf of Mexico Yellowtail Snapper from 1950 – 2018 were obtained from Florida's Marine Fisheries Trip Ticket, NOAA Fisheries' Accumulated Landings System (ALS), as well as NOAA's Coastal Fisheries Logbook Program

(CFLP). They were reviewed at the Data Workshop and finalized for years 1962 – 2018. Commercial landings were predominantly from hook and line gear types and categorized into two gear groups: hook and line, and other. While landings in pounds (lb) were presented earlier in the Data Workshop Report Section 3, they were converted here to metric tons (mt) and restricted to Florida-only landings for use in the assessment model (**Table 2.9.8**). The Data Workshop initially used multi-year blocks per region to characterize uncertainty in the commercial landings. For the assessment model, annual Florida-wide standard errors (in log space) were calculated by averaging regional standard errors weighted by the corresponding reported landings. The uncertainty estimates closely aligned with those reported for the Florida Keys because nearly 90% of Yellowtail Snapper landings in Florida occurred in the Florida Keys since 1962 (see Data Workshop Report Section 3.3).

2.3.2 Recreational Landings

Recreational landings include four fishing modes: headboats, charterboats, private and rental boats, and fishing from shore. However, there is minimal landings of Yellowtail Snapper from shore.

2.3.2.1 Headboat Landings

Estimates of headboat landings of Yellowtail Snapper from 1981 – 2017 from the U.S. South Atlantic and from 1986 – 2017 from the Gulf of Mexico were obtained from the Southeast Region Headboat Survey (SRHS) and those data were reviewed at the Data Workshop. Vessel trip reports typically include catch by species, the number of anglers, and number of vessel trips. Dockside intercepts with returning anglers allow for biological sampling (e.g. length and weight measurements, otoliths) of landed fish. From 1981 – 1985, headboat landings for the Gulf of Mexico were initially reported by the Marine Recreational Fishery Statistics Survey (MRFSS, which later developed into MRIP, see below) and were therefore added here after separating headboat from the other modes. Headboat landings for Yellowtail Snapper comprise a small portion (<10%) of the total recreational landings. The motivation for isolating the headboat fishery was to avoid combining length and age information across all recreational modes. For the assessment model, Florida-exclusive headboat landings (in thousands of fish) are presented in **Table 2.9.9**. The SRHS design prevents variance estimates from being developed, so the standard errors (in log space) of the observations were assumed to be equal to 0.25 and constant through time.

2.3.2.2 MRIP Landings

Estimates of recreational landings of Yellowtail Snapper from 1981 – 2017 from the U.S. South Atlantic and Gulf of Mexico by anglers using private, rental boats, or charterboats came from the Marine Recreational Information Program (MRIP) and those data also were reviewed at the Data Workshop. Catch data were collected through dockside angler interviews in the Access Point Angler Intercept Survey (APAIS). Catch rates from dockside intercept surveys were then combined with estimates of effort initially from telephone interviews (Coastal Household Telephone Survey [CHTS]) and later from a mail survey (Fishing Effort Survey, [FES]) to estimate landings and discards by coast (Atlantic or Gulf of Mexico), year, two-month wave, fishing mode, and area fished (inland, state, and federal waters).

On the Atlantic coast, charterboat effort data collection changed in 2004 from the CHTS to the For-Hire Survey (FHS) and in 2000 on the Gulf of Mexico coast. The FHS is a telephone survey of a proportion of the charterboat captains from Louisiana to Florida to obtain the number of trips for that week. Charterboat effort estimates were calibrated for prior years. In 2013, MRIP implemented a new APAIS to help remove sampling bias and in 2015, a new household Fishing Effort Survey (FES) was launched to improve private boat and shore effort estimates. Calibrated APAIS and FES catch estimates (A + B1; in thousands of fish) and associated standard errors (in log space) for Yellowtail Snapper in Florida waters were compiled for the assessment model and are presented in **Table 2.9.10.** Headboats are treated as a separate fleet in the assessment model thus headboat landings and discards from the Gulf of Mexico were removed for years 1981 – 1985. Florida-wide CVs were provided by the SEFSC after the Data Workshop and were transformed to standard errors (in log space) using the formula in Section 3.2.1.5.

2.3.3 Western Atlantic Landings

Yellowtail Snapper landings for 1950-2017 from the western Atlantic were obtained from the Food and Agriculture Organization United Nations (FAO) Fisheries and Aquaculture Department, Statistics and Information Service using their program *FishStatJ* (FAO 2019; http://www.fao.org/fishery/statistics/software/fishstat/en). The FAO data were not included as input for the assessment models but are presented here to provide a geographic perspective on the harvest of this species in southern Florida. Between 1979 and 1995, the FAO data for the United States were incomplete and were supplemented with annual landings data from the National Marine Fisheries Service (https://foss.nmfs.noaa.gov).

Yellowtail Snapper commercial landings in the Western Central Atlantic have averaged 4,329 metric tons per year in recent years (2010-2017). U.S. commercial landings for the Gulf of Mexico and South Atlantic regions (i.e., excluding Puerto Rico and the U.S. Virgin Islands) averaged 998 metric tons (2.200 million pounds) over the same period – about 23% of the Western Atlantic commercial landings (**Table 2.9.11**). Reported Yellowtail Snapper landings in the Western Atlantic have been increasing since 2004 and U.S. landings have been increasing since 2007.

2.4 **Discards**

2.4.1 Commercial Discards

Commercial discards were calculated from discard data reported in the SEFSC coastal fisheries discard logbook program (CFLP) for vertical line trips in southern Florida beginning in 2002. Yearly discard rates of vertical line vessels were calculated as the mean rate (number of discarded fish per hook hour fished) within each region. Yearly total effort (hook hours) of all trips by vertical line vessels within each region was multiplied by the yearly mean discard rate from the appropriate region to calculate total discards of Yellowtail Snapper by vertical line vessels. To estimate the commercial discards for years 1993 – 2001, when only effort data were available, the mean discard rate by region for the years 2002 – 2006 was multiplied by the annual effort. Estimated discards and CVs of discards rates by region and year are presented in Table 4 of SEDAR64-DW-18. For the assessment model, discards were aggregated over regions and annual CVs were produced by summing the standard errors and estimated discards among regions. Total commercial discards (in thousands of fish) and CVs are presented here for Florida waters in **Table 2.9.12**.

2.4.2 Headboat Discards

Headboat discards were obtained from the SRHS logbook data from 2004 – 2017. Self-reported logbook data were then compared and validated using trip data from the Florida At-Sea Observer Program. Since there was general agreement in most years between the two data sources on the east coast and the paucity of at-sea observer data on the west coast of Florida, The Data Workshop recommended using the discard rates from the self-reported logbooks. Adjusted annual MRIP charterboat discard:landings ratios were then used to hindcast SRHS discards from 1981 – 2003. Total headboat discards were reviewed at the Data Workshop and are presented here for Florida waters (in thousands of fish) in **Table 2.9.13**. As with the landings, variance estimates for the headboat discard data were unavailable and therefore standard errors (in log space) were assumed equal to 0.5 and constant through time.

2.4.3 MRIP Discards

Discarded live fish, compiled from MRIP for years 1981 – 2017, were reviewed and accepted by the Data Workshop. Mode-specific discards are based on dockside interviews (intercepts) of anglers and represent the self-reported number of fish discarded alive. Total discards (in thousands of fish) for shore, private, and charter modes and associated measures of uncertainty in Florida waters are presented in **Table 2.9.14.** Florida-wide CVs were provided by the SEFSC after the Data Workshop and were transformed to standard errors (in log space) using the formula in Section 3.2.1.5.

2.5 Length and Age Composition

2.5.1 Landings

Weighted length compositions of the landings are presented in SEDAR64-AP-01. In brief, length compositions of landings and discards were catch-weighted according to scales that generally satisfied a minimum level of sampling. Effective sample sizes for length were initially equal to the square root of the number of trips with at least one measured Yellowtail Snapper. Effective sample sizes were then re-weighted using the Francis (2011) procedure (for additional details refer to Section 3.2.1.5). Length compositions of landed Yellowtail Snapper used in the assessment model are summarized by fleet in **Figure 2.10.4**. Length samples were assigned to have occurred mid-year (July) and were not separated by sex.

Conditional age-at-length inputs by fleet are summarized as mean age by year in **Figures 2.10.5**, **2.10.6**, and **2.10.7**. Effective sample sizes for the number of ages sampled in a given length bin by year were initially equal to the square root of the number of aged fish, but were later re-weighted according to Francis (2011). Age samples were assigned to have occurred mid-year (July) and were not separated by sex.

2.5.2 Discards

Weighted length compositions of live discards by fleet are presented in SEDAR64-AP-01. Effective sample sizes for length were initially equal to the square root of the number of trips with at least one measured Yellowtail Snapper. Effective sample sizes were then re-weighted using the Francis (2011) procedure. Length compositions of live discards used in the assessment model are summarized by fleet in **Figure 2.10.8**. Length samples were assigned to have occurred mid-year (July) and were not separated by sex.

2.5.3 Additional Fishery-independent Sources

Conditional age-at-length data from fishery independent sources (Vose and Shank [2003], FWRI Fisheries-Independent Monitoring, SEAMAP) were used within the model to estimate growth but were not linked to any existing fleet or survey. These samples are summarized as mean age by year in **Figure 2.10.9**. Effective sample sizes for the number of ages sampled in a given length bin by year were initially equal to the square root of the number of aged fish, but were later re-weighted according to Francis (2011). These samples were assigned to have occurred mid-year (July) and were not separated by sex.

2.6 Indices of Abundance

The Assessment Workshop recommended two fishery-dependent and two fishery-independent indices of abundance or biomass for use in the assessment model. They are briefly summarized below and outlined in greater detail in the Data Workshop Report Section 5. No changes to the indices were made after the Data Workshop.

2.6.1 Coastal Fisheries Logbook Program Commercial Index

Coastal Fisheries Logbook Program (CFLP) data were used to construct a standardized index of biomass for Yellowtail Snapper (see Data Workshop Report Section 5.4.1). The index was constructed using data from commercial vertical line (handline and bandit rig) trips in southern Florida between 1993 – 2017. Data from all months were used to construct the index and the timing of the index was assigned to mid-year (July) in the assessment model. Index units were in fish weight per hook hour fished and uncertainty in the index observations was estimated through the standardization techniques used to determine the final observed index values. Index values and their CVs are presented in **Table 2.9.14**.

2.6.2 Reef Fish Visual Census (RVC) – Adult Index

Reef Fish Visual Census (RVC) data were used to construct a standardized index of abundance for adult (fish ≥ 19 cm fork length, ages 1+) Yellowtail Snapper for the combined Florida Keys and Dry Tortugas regions during overlapping years 1999, 2000, 2004, 2006, 2008, 2010, 2012, 2014, and 2016 (SEDAR 64-DW-05). Data from April through December were used to construct the index and the timing of the index was assigned to mid-year (July) in the assessment model. Uncertainty in the index observations was estimated through the standardization techniques used to determine the final observed index values. Index values and their CVs are presented in **Table 2.9.15.**

2.6.3 Reef Fish Visual Census (RVC) – Juvenile Index

Reef Fish Visual Census (RVC) data were used to construct a standardized index of abundance for juvenile (fish < 19 cm fork length, ages 0-1) Yellowtail Snapper for the combined Florida Keys and Dry Tortugas regions during overlapping years 1999, 2000, 2004, 2006, 2008, 2010, 2012, 2014, and 2016 (SEDAR 64-DW-05). Data from April through December were used to construct the index and the timing of the index was assigned to July (mid-year) in the assessment model. Uncertainty in the juvenile index observations was estimated through the standardization techniques used to determine the final observed index values. Index values and their CVs are presented in **Table 2.9.15.**

2.6.4 Marine Recreational Information Program Index

Marine Recreational Information Program (MRIP) data were used to construct a standardized index of abundance for Yellowtail Snapper (SEDAR 64-DW-09). Trips reporting the use of hook and line gear from the Florida Keys and southeast Florida between 1991 – 2017 were used to create a total number of fish (A + B1 + B2) caught per angler-trip index. Data from all months were used to construct the index and the timing of the index was assigned to July (mid-year) in the assessment model. Uncertainty in the index observations was estimated through the standardization techniques used to determine the final observed index values. Index values and their CVs are presented in **Table 2.9.15**.

2.7 Length Composition of Indices

2.7.1 Coastal Fisheries Logbook Program Commercial Index

Lengths of Yellowtail Snapper characterizing the commercial index were assumed to match those of commercial landings.

2.7.2 Marine Recreational Information Program Index

The MRIP index is based on total catch. Lengths of Yellowtail Snapper characterizing the MRIP index were therefore assumed to match the lengths associated with the MRIP landings and the MRIP discards which were constructed using information from the Florida At-Sea Observer data.

2.7.3 RVC – Adult Index

Weighted length compositions of the RVC Adult Index are presented in SEDAR64-AP-01. Effective sample sizes for length were initially equal to the square root of the number of observations of adult and juvenile Yellowtail Snapper per secondary sampling unit. Effective sample sizes were then re-weighted using the Francis (2011) procedure. Length compositions of Yellowtail Snapper used in the assessment model are summarized by survey in **Figure 2.10.10**. Length samples were assigned to have occurred mid-year (July) and were not separated by sex.

2.7.4 RVC – Juvenile Index

Weighted length compositions of the RVC Juvenile Index are presented in SEDAR64-AP-01. Effective sample sizes for length were initially equal to the square root of the number of observations of adult and juvenile Yellowtail Snapper per secondary sampling unit. Effective sample sizes were then re-weighted using the Francis (2011) procedure. Length compositions of Yellowtail Snapper used in the assessment model are summarized by survey in **Figure 2.10.10**. Length samples were assigned to have occurred mid-year (July) and were not separated by sex.

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2.9 Tables

Table 2.9.1. Number of Yellowtail Snapper otoliths by year and region within the updated filtered dataset (n=48,212). Regions: Northeast Florida (Nassau County to Brevard County), Southeast Florida (Indian River County to Miami-Dade County), Florida Keys (Monroe County), Southwest Florida (Levy County to Collier County), Northwest Florida (Escambia County to Dixie County), North of Florida (states Georgia through North Carolina), West of Florida (states Alabama through Texas), and Unknown (regionally unknown but from Florida).

Year	Northeast Florida	Southeast Florida	Florida Keys	Southwest Florida	Northwest Florida	Unknown (FL)	North of Florida	West of Florida	Total
1980	1	32	153	0	0	102	0	0	288
1981	5	100	242	0	0	0	0	0	347
1982	15	114	60	0	0	0	0	0	189
1983	20	202	12	0	0	0	1	0	235
1984	18	141	0	0	0	0	2	0	161
1985	24	18	0	0	0	0	1	0	43
1986	33	22	0	9	0	0	0	0	64
1987	28	22	0	0	0	0	0	0	50
1988	4	6	0	1	0	0	0	0	11
1991	2	0	28	0	0	0	0	0	30
1992	4	73	1	6	0	25	0	0	109
1993	0	130	32	11	1	0	0	0	174
1994	0	200	119	1	0	18	4	0	342
1995	7	437	123	0	0	0	0	0	567
1996	0	313	143	1	0	0	10	0	467
1997	6	519	363	26	0	136	0	0	1,050
1998	0	518	332	6	0	0	1	0	857
1999	13	796	290	1	0	0	2	0	1,102
2000	1	634	459	11	0	0	0	0	1,105
2001	0	318	496	0	0	1	0	0	815
2002	0	19	521	3	0	0	0	0	543
2003	0	87	211	3	0	0	0	0	301
2004	0	627	262	9	0	0	2	0	900
2005	4	573	756	28	0	0	27	2	1,390
2006	3	782	767	20	0	0	43	4	1,619
2007	6	695	718	32	0	0	25	0	1,476
2008	8	485	1,084	171	0	25	59	4	1,836
2009	29	397	1,223	154	1	1	40	11	1,856
2010	10	342	953	63	0	0	25	0	1,393
2011	8	502	1,007	23	0	0	13	0	1,553
2012	11	696	1,814	20	0	0	12	0	2,553
2013	15	1,164	1,683	8	0	0	8	0	2,878
2014	12	2,025	3,734	30	1	0	9	0	5,811
2015	4	1,963	3,899	92	1	0	7	0	5,966
2016	20	1,273	4,353	170	1	4	8	0	5,829
2017	18	714	3,415	150	2	0	3	0	4,302
Total	329	16,939	29,253	1,049	7	312	302	21	48,212
Percent	0.7	35.1	60.7	2.2	<0.1	0.6	0.6	<0.1	100.0

Table 2.9.2. Number of ages of Yellowtail Snapper sampled by year during 1980 – 2017 within the updated filtered dataset. Sources of age data include the southeastern US Atlantic (Florida through North Carolina) and Gulf of Mexico (Florida through Texas).

	Age (years)																													
Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	Total
1980	0	6	78	73	48	33	28	8	3	5	4	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	288
1981	0	7	101	89	51	34	18	19	13	7	1	4	2	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	347
1982	0	2	25	96	32	16	6	7	4	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	189
1983	0	5	105	69	37	4	6	3	2	0	2	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	235
1984	0	2	74	50	17	11	4	2	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	161
1985	0	3	17	14	6	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	43
1986	0	4	33	11	9	4	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	64
1987	0	4	28	14	3	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	50
1988	0	0	4	6	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11
1991	0	0	6	4	11	5	0	0	0	1	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30
1992	0	0	23	58	15	4	3	4	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	109
1993	0	0	54	57	21	10	10	6	9	2	2	1	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	174
1994	0	2	46	148	69	20	11	11	13	4	5	4	3	2	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	342
1995	0	2	112	251	133	36	14	7	5	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	567
1996	0	18	186	98	73	43	22	5	8	6	2	2	2	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	467
1997	0	3	264	325	155	108	85	47	20	16	8	12	6	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,050
1998	0	27	233	320	125	51	40	28	15	5	6	5	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	857
1999	0	75	505	227	127	74	38	20	18	8	5	0	1	1	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,102
2000	1	175	372	196	128	90	57	31	19	20	6	7	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,105
2001	1	35	231	168	139	83	70	33	16	13	9	8	6	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	815
2002	0	0	47	118	107	109	78	32	25	7	7	4	5	2	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	543
2003	0	11	53	69	46	22	33	28	9	12	3	3	7	4	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	301
2004	0	11	385	294	111	42	26	15	7	3	0	3	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	900
2005	0	15	301	567	231	130	70	29	14	12	7	4	2	2	4	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1,390
2006	0	22	634	345	274	125	68	51	35	26	13	7	9	2	5	1	0	1	0	0	0	1	0	0	0	0	0	0	0	1,619
2007	17	30	399	569	207	101	67	31	19	5	13	4	2	3	3	0	2	2	0	0	1	1	0	0	0	0	0	0	0	1,476
2008	0	40	344	492	454	194	116	69	50	22	10	16	9	5	1	5	4	0	2	0	1	1	1	0	0	0	0	0	0	1,836
2009	0	30	399	442	315	300	135	101	55	26	17	5	11	10	4	4	2	0	0	0	0	0	0	0	0	0	0	0	0	1,856
2010	0	37	309	341	297	155	131	47	28	19	5	9	4	3	2	1	2	0	0	1	0	0	0	2	0	0	0	0	0	1,393
2011	0	77	347	539	255	150	63	64	22	12	7	5	2	2	1	0	1	2	1	1	0	0	0	1	1	0	0	0	0	1,553
2012	0	74	599	721	576	266	137	61	49	15	16	11	9	7	3	3	3	0	1	0	1	0	0	0	1	0	0	0	0	2,553
2013	0	111	1,142	721	362	290	97	72	32	24	12	6	2	1	3	0	0	1	1	0	0	1	0	0	0	0	0	0	0	2,878
2014	1	129	2,083	1,685	761	405	367	172	93	48	33	9	9	7	3	2	0	0	2	0	0	0	0	1	0	0	0	0	1	5,811
2015	4	180	1,494	2,056	1,060	468	264	215	97	57	32	8	12	4	6	4	2	0	2	0	0	0	0	0	0	0	1	0	0	5,966
2016	0	92	1,663	1,370	1,407	696	239	118	110	72	20	16	11	3	6	3	0	0	0	1	1	0	0	0	0	0	0	1	0	5,829
2017	0	69	1,008	1,406	748	553	244	109	58	54	25	14	8	3	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	4,302
Total	24	1,298	13,704	14,009	8,411	4,632	2,551	1,448	848	509	271	172	125	66	54	29	21	9	9	3	4	4	1	4	2	1	1	1	1	48,212
Percent	<0.1	2.7	28.4	29.1	17.4	9.6	5.3	3.0	1.8	1.1	0.6	0.4	0.3	0.1	0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	100.0

Table 2.9.3. Number of Yellowtail Snapper otoliths within the updated filtered dataset by year, fishing sector, and mode of fishing. Sources of age data include the southeastern US Atlantic (Florida through North Carolina) and Gulf of Mexico (Florida through Texas). [Fishing sectors: Commercial, Recreational, and Fishery Independent (FI); Fishing modes: Commercial (CM, mainly hook and line), Scientific Survey (SS), Head Boat (HB), Party/Charter (PC), Private/Rental Boat (PR), and Other (OTH)].

		Commercial	FI	Recreational			
Year	Total	CM	SS	HB	PC	PR	OTH
1980	288	16	0	272	0	0	0
1981	347	153	0	194	0	0	0
1982	189	0	0	189	0	0	0
1983	235	0	0	235	0	0	0
1984	161	0	0	161	0	0	0
1985	43	0	0	43	0	0	0
1986	64	0	0	60	4	0	0
1987	50	0	0	50	0	0	0
1988	11	0	0	11	0	0	0
1991	30	0	0	30	0	0	0
1992	109	74	0	35	0	0	0
1993	174	158	0	5	4	7	0
1994	342	255	0	77	0	10	0
1995	567	267	1	299	0	0	0
1996	467	408	0	59	0	0	0
1997	1,050	948	0	81	5	16	0
1998	857	457	271	97	0	32	0
1999	1,102	735	292	15	9	51	0
2000	1,105	481	613	9	2	0	0
2001	815	449	309	0	18	39	0
2002	543	448	90	0	5	0	0
2003	301	213	0	36	51	1	0
2004	900	271	0	503	113	13	0
2005	1,390	565	0	749	70	6	0
2006	1,619	662	0	876	81	0	0
2007	1,476	304	23	1,148	0	1	0
2008	1,836	635	25	1,056	103	17	0
2009	1,856	714	27	1,039	50	26	0
2010	1,393	441	92	752	90	17	1
2011	1,553	492	9	1,041	11	0	0
2012	2,553	819	39	1,695	0	0	0
2013	2,878	984	16	1,847	31	0	0
2014	5,811	3,413	49	2,225	124	0	0
2015	5,966	3,304	32	2,199	431	0	0
2016	5,829	2,764	0	2,875	188	2	0
2017	4,302	1,700	0	1,992	507	103	0
Total	48,212	22,130	1,888	21,955	1,897	341	1
Percent	100.0	45.9	3.9	45.5	3.9	0.7	<0.1

Table 2.9.4. Number of ages of Yellowtail Snapper sampled in Florida by year during 1980 – 2017 within the updated filtered dataset. Regions of Florida include: Northeast Florida (Nassau County to Brevard County), Southeast Florida (Indian River County to Miami-Dade County), Florida Keys (Monroe County), Southwest Florida (Levy County to Collier County), Northwest Florida (Escambia County to Dixie County), and Unknown (regionally unknown but from Florida).

	Age (years)																					
Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Total
1980	0	6	78	73	48	33	28	8	3	5	4	1	0	0	0	0	0	1	0	0	0	288
1981	0	7	101	89	51	34	18	19	13	7	1	4	2	0	0	0	1	0	0	0	0	347
1982	0	2	25	96	32	16	6	7	4	0	1	0	0	0	0	0	0	0	0	0	0	189
1983	0	5	105	69	36	4	6	3	2	0	2	1	0	0	1	0	0	0	0	0	0	234
1984	0	2	73	50	17	10	4	2	0	0	0	0	1	0	0	0	0	0	0	0	0	159
1985	0	3	17	14	6	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	42
1986	0	4	33	11	9	4	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	64
1987	0	4	28	14	3	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	50
1988	0	0	4	6	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11
1989	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1990	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1991	0	0	6	4	11	5	0	0	0	1	0	2	1	0	0	0	0	0	0	0	0	30
1992	0	0	23	58	15	4	3	3	0	0	0	1	0	0	0	0	0	0	0	0	0	107
1993	0	0	54	57	21	10	10	6	9	2	2	1	0	0	2	0	0	0	0	0	0	174
1994	0	2	46	148	68	20	9	11	13	3	5	4	3	2	2	0	2	0	0	0	0	338
1995	0	2	112	251	133	36	14	7	5	7	0	0	0	0	0	0	0	0	0	0	0	567
1996	0	18	185	97	73	41	20	4	8	5	2	2	2	0	0	0	0	0	0	0	0	457
1997	0	3	264	325	155	108	85	47	20	16	8	12	6	1	0	0	0	0	0	0	0	1,050
1998	0	27	233	320	125	51	40	28	14	5	6	5	0	1	1	0	0	0	0	0	0	856
1999	0	75	505	227	127	73	38	20	17	8	5	0	1	1	3	0	0	0	0	0	0	1,100
2000	1	175	372	196	128	90	57	31	19	20	6	7	0	2	1	0	0	0	0	0	0	1,105
2001	1	35	231	168	139	83	70	33	16	13	9	8	6	1	0	1	0	1	0	0	0	815
2002	0	0	47	118	107	109	78	32	25	7	7	4	5	2	1	0	1	0	0	0	0	543
2003	0	11	53	69	46	22	33	28	9	12	3	3	7	4	0	1	0	0	0	0	0	301
2004	0	11	385	293	110	42	26	15	7	3	0	3	1	0	1	1	0	0	0	0	0	898
2005	0	15	296	555	229	126	69	29	14	12	7	4	2	1	2	0	0	0	0	0	0	1,361
2006	0	22	634	329	254	120	68	51	35	26	12	7	7	2	5	0	0	0	0	0	0	1,572
2007	17	30	396	565	201	96	66	31	19	5	13	4	2	2	3	0	1	0	0	0	0	1,451
2008	0	40	339	465	449	184	113	69	50	22	9	15	6	4	1	3	3	0	1	0	0	1,773
2009	0	30	397	431	297	297	132	94	52	25	17	4	11	10	4	2	1	0	0	0	0	1,804
2010	0	37	309	333	291	152	130	47	28	18	5	8	3	3	1	1	2	0	0	0	0	1,368
2011	0	77	347	539	251	147	61	64	22	12	7	5	2	2	1	0	1	2	0	0	0	1,540
2012	0	74	598	720	576	266	136	61	49	13	16	11	8	7	2	1	2	0	1	0	0	2,541
2013	0	111	1,142	721	361	290	94	71	30	24	12	6	2	1	3	0	0	1	1	0	0	2,870
2014	1	129	2,083	1,685	761	404	367	172	93	46	33	9	7	7	3	2	0	0	0	0	0	5,802
2015	4	180	1,494	2,056	1,060	466	264	215	96	57	31	8	11	4	6	4	2	0	1	0	0	5,959
2016	0	92	1,663	1,370	1,407	696	239	117	110	70	20	16	10	3	6	1	0	0	0	0	1	5,821
2017	0	69	1,008	1,405	747	553	244	109	58	54	25	14	7	3	1	2	0	0	0	0	0	4,299
Total	24	1,298	13,686	13,927	8,345	4,592	2,532	1,436	840	498	268	169	113	63	50	19	16	5	4	0	1	47,886
Percent	<0.1	2.7	28.6	29.1	17.4	9.6	5.3	3.0	1.8	1.0	0.6	0.4	0.2	0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	100.0

Table 2.9.5. An updated comparison among model variance structure outputs of the size-truncated von Bertalanffy growth model which used inverse-weighting and included an age 12+ group (total n = 45,833 otoliths). The final model selected had the variance structured which estimated a constant CV at age.

	Model variance structure				
	Constant SD	Constant CV	Var/Mean ratio	Increase CV w/ Age	Increase CV w/ Size-at-Age
Parameters					
L_{inf}	479.9	422.9	448.0	406.2	410.6
k	0.134	0.207	0.169	0.240	0.230
t_0	-2.345	-1.636	-1.916	-1.434	-1.506
Var. param 1	58.815	0.179	10.312	0.157	0.150
Var. param 2				0.226	0.194
Convergence Criteria					
Obj. function	67.95	67.09	67.38	67.06	67.05
Max. gradient	5.9100E-09	9.5921E-07	4.4887E-07	2.4169E-06	1.4789E-09
AIC	143.89	142.18	142.77	144.13	144.11

Table 2.9.6. Updated natural mortality-at-age ($M_{at\text{-}age}$) of Yellowtail Snapper with Florida observed maximum age of 20 years. $M_{at\text{-}age}$ is derived following Lorenzen (2005) using the $\text{Hoenig}_{all\ taxa}$ (1983) constant mortality-at-age as the target M scaled between vulnerable ages 3 – 20 years (M_{target} = 0.223 yr^{-1}) and the von Bertalanffy growth model parameters: L_{inf} = 42.3 cm FL, k = 0.207 yr^{-1}, and t_0 = -1.636 yr.

Age (yr)	Predicted FL (cm)	$M_{at\text{-}age(tmax=20)}(yr^{-1})$
0	12.2	0.558
1	17.8	0.414
2	22.4	0.343
3	26.1	0.301
4	29.1	0.273
5	31.6	0.255
6	33.6	0.241
7	35.2	0.231
8	36.5	0.224
9	37.6	0.218
10	38.5	0.214
11	39.2	0.210
12	39.8	0.208
13	40.3	0.205
14	40.6	0.204
15	40.9	0.202
16	41.2	0.201
17	41.4	0.200
18	41.6	0.200
19	41.7	0.199
20	41.8	0.198

Table 2.9.7. Proportion mature at age developed using logistic regression (PROC NLIN, SAS version 9.2) on female Yellowtail Snapper maturity-at-age data from southeast Florida and the Florida Keys.

Age	Proportion Mature
0	0.01
1	0.13
2	0.69
3	0.97
4	1.00
5	1.00
6	1.00
7	1.00
8	1.00
9	1.00
10	1.00
11	1.00
12	1.00
13	1.00
14	1.00
15	1.00
16	1.00
17	1.00
18	1.00
19	1.00
20	1.00

Table 2.9.8. Annual commercial landings of Yellowtail Snapper for the state of Florida from 1962 – 2017. Landings are in whole weight metric tons (mt).

Year	Commercial landings (mt)	Standard Error (Log Scale)
1962	452.730	0.20
1963	377.252	0.20
1964	471.690	0.20
1965	478.948	0.20
1966	374.259	0.20
1967	436.310	0.20
1968	538.822	0.20
1969	439.894	0.20
1970	542.587	0.20
1971	495.821	0.20
1972	462.709	0.20
1973	427.465	0.20
1974	472.779	0.20
1975	361.740	0.20
1976	443.477	0.20
1977	366.865	0.20
1978	394.897	0.10
1979	353.802	0.10
1980	295.495	0.10
1981	331.858	0.10
1982	621.746	0.10
1983	436.228	0.10
1984	429.690	0.10
1985	374.314	0.10
1986	507.467	0.05
1987	614.799	0.05
1988	640.722	0.05
1989	838.990	0.05
1990	796.173	0.05
1991	843.840	0.05
1992	839.832	0.05
1993	1,078.975	0.05
1994	1,000.400	0.05
1995	842.226	0.05
1996	661.835	0.05
1997	759.271	0.05
1998	691.470	0.05
1999	837.396	0.05
2000	721.992	0.05
2001	644.163	0.05
2002	638.447	0.05
2003	639.567	0.05
2004	671.289	0.05
2005	600.804	0.05
2006	561.040	0.05
2007	443.598	0.05
2008	621.421	0.05
2009	895.889	0.05
2010	768.364	0.05
2011	858.897	0.05
2012	955.851	0.05
2013	934.919	0.05
2014	926.807	0.05
2015	996.975	0.05
2016	1,050.023	0.05
2017	1,279.324	0.05

Table 2.9.9. Annual headboat landings of Yellowtail Snapper for the state of Florida from 1981 – 2017. Landings are in thousands of fish.

Year	Headboat landings (thousands of fish)	Standard Error (Log Scale)
1981	177.311	0.25
1982	293.743	0.25
1983	262.303	0.25
1984	185.632	0.25
1985	162.158	0.25
1986	206.149	0.25
1987	235.527	0.25
1988	291.372	0.25
1989	166.437	0.25
1990	218.763	0.25
1991	212.789	0.25
1992	205.367	0.25
1993	218.701	0.25
1994	243.158	0.25
1995	157.496	0.25
1996	137.599	0.25
1997	139.838	0.25
1998	120.526	0.25
1999	109.223	0.25
2000	109.300	0.25
2001	101.869	0.25
2002	121.012	0.25
2003	108.854	0.25
2004	118.422	0.25
2005	149.087	0.25
2006	98.974	0.25
2007	104.598	0.25
2008	103.362	0.25
2009	88.380	0.25
2010	102.174	0.25
2011	98.768	0.25
2012	110.815	0.25
2013	112.942	0.25
2014	163.990	0.25
2015	173.617	0.25
2016	184.576	0.25
2017	110.680	0.25

Table 2.9.10. Annual MRIP landings of Yellowtail Snapper for the state of Florida from 1981 – 2017. Landings are in thousands of fish.

Year	MRIP landings (thousands of fish)	Standard Error (Log Scale)
1981	5,356.740	0.23
1982	6,098.713	0.22
1983	1,566.289	0.17
1984	4,067.863	0.41
1985	1,754.715	0.39
1986	1,475.112	0.39
1987	1,162.387	0.23
1988	1,137.940	0.15
1989	4,685.673	0.25
1990	3,440.760	0.41
1991	4,210.209	0.46
1992	969.581	0.20
1993	1,964.950	0.15
1994	1,301.688	0.14
1995	1,859.946	0.18
1996	871.358	0.17
1997	785.974	0.20
1998	878.573	0.24
1999	659.544	0.15
2000	722.441	0.30
2001	521.603	0.36
2002	951.985	0.14
2003	1,491.566	0.13
2004	1,459.769	0.34
2005	609.636	0.17
2006	1,527.089	0.21
2007	1,580.351	0.24
2008	2,351.513	0.26
2009	925.484	0.16
2010	849.533	0.13
2011	619.515	0.17
2012	910.906	0.28
2013	1,723.631	0.09
2014	1,906.725	0.09
2015	1,322.040	0.10
2016	1,524.592	0.10
2017	1,550.296	0.11

Table 2.9.11. Western Atlantic commercial landings (in metric tons) of Yellowtail Snapper (Data from UN FAO, Fisheries Department; NOAA Fisheries and FWC.

	Southwest Atlantic	Western Central Atlantic							
Year	Brazil	British Virgin Is	Columbia	Cuba	Dominican Republic	Mexico	Nicaragua	Puerto Rico[1]	United States[2]	Venezuela
1981	2677	-	...	748	320	2224	...	...	332	200
1982	1870	-	...	959	202	1803	...	...	622	211
1983	1821	-	...	923	276	1627	...	...	436	212
1984	2300	-	...	898	254	1173	...	...	430	262
1985	2784	-	...	947	155	274	...	...	374	473
1986	3099	-	...	904	210	1752	...	57	507	351
1987	3195	-	...	1070	191	2164	...	56	615	388
1988	2792	-	...	851	194	1520	...	63	641	464
1989	2862	-	...	948	197	2519	...	81	839	674
1990	2800	-	...	740	180	3226	...	95	796	715
1991	2862	-	...	704	183	2320	...	132	844	659
1992	2810	-	...	745	267	1132	...	113	840	659
1993	2800	-	...	539	273	910	...	138	1079	678
1994	2800	-	36	592	671	1184	...	132	1000	684
1995	4766	-	75	592	248	825	...	186	842	511
1996	4167	-	54	1176	793	858	...	174	662	338
1997	5000	-	35	727	529	840	...	159	759	335
1998	3317	-	< 0.5	457	190	1900	...	146	691	272
1999	4541	-	1	409	234	1554	...	162	837	220
2000	4165	-	1	408	249	1357	...	287	722	291
2001	2002	-	-	413	356	1600	...	211	644	158
2002	2106	-	-	370	134	1702	...	153	638	213
2003	2656	-	3	437	151	591	...	128	640	585
2004	2667	-	...	438	126	537	...	156	671	650
2005	5376	10	...	299	71	1640	...	304	601	550
2006	5371	9	20	295	181	1713	864	125	561	328
2007	3717	9	40	323	152	1707	613	94	444	370
2008	4745	11	60	295	177	2057	519	169	621	395
2009	5233	12	81	365	160	2106	570	101	896	400
2010	4945	8	16	293	172	1227	808	97	768	240
2011	4602	7	36	302	151	819	644	68	859	422
2012	5008	12	24	257	147	1780	577	94	956	219
2013	4322	14	16	248	174	1516	596	60	935	195
2014	5217	13	8	223	168	1466	770	87	927	173
2015	4700	14	0 0	174	166	1777	705	81	997	168
2016	4900	20	3	158	166	2433	908	85	1050	124
2017	4800	16	50	170	178	1972	734	57	1279	130

[1] NOAA Southeast Regional Office, Caribbean Branch

[2] 1981-1985 NOAA Annual Landings System, 1986-2017 FWC trip tickets

Table 2.9.12. Annual commercial discards of Yellowtail Snapper for the state of Florida from 1993 – 2017. Discards are in thousands of fish.

Year	Commercial discards (thousands of fish)	Coefficient of Variation (CV)
1993	91.894	2.33
1994	104.953	2.35
1995	120.819	2.34
1996	117.016	2.33
1997	139.401	2.34
1998	97.937	2.36
1999	105.379	2.33
2000	103.543	2.34
2001	87.545	2.36
2002	86.703	1.95
2003	81.817	2.01
2004	51.467	2.60
2005	48.862	2.93
2006	75.741	2.42
2007	83.977	2.20
2008	49.966	2.85
2009	60.269	1.94
2010	49.540	3.00
2011	60.210	2.17
2012	39.464	3.28
2013	47.271	5.11
2014	59.156	3.58
2015	23.527	5.61
2016	44.739	2.33
2017	37.886	3.33

Table 2.9.13. Annual headboat discards of Yellowtail Snapper for the state of Florida from 1981 – 2017. Discards are in thousands of fish.

Year	Headboat discards (thousands of fish)	Standard Error (Log Scale)
1981	9.865	0.50
1982	5.884	0.50
1983	71.705	0.50
1984	58.883	0.50
1985	1.785	0.50
1986	16.039	0.50
1987	194.371	0.50
1988	279.661	0.50
1989	38.546	0.50
1990	186.058	0.50
1991	1,171.961	0.50
1992	70.613	0.50
1993	50.914	0.50
1994	73.847	0.50
1995	63.104	0.50
1996	57.175	0.50
1997	88.120	0.50
1998	84.235	0.50
1999	48.342	0.50
2000	47.851	0.50
2001	22.699	0.50
2002	44.506	0.50
2003	65.429	0.50
2004	21.535	0.50
2005	15.812	0.50
2006	19.154	0.50
2007	26.965	0.50
2008	39.757	0.50
2009	37.637	0.50
2010	36.335	0.50
2011	24.211	0.50
2012	30.564	0.50
2013	39.777	0.50
2014	64.492	0.50
2015	65.844	0.50
2016	68.637	0.50
2017	33.818	0.50

Table 2.9.14. Annual MRIP discards of Yellowtail Snapper for the state of Florida from 1981 – 2017. Discards are in thousands of fish.

Year	MRIP discards (thousands of fish)	Standard Error (Log Scale)
1981	932.356	0.17
1982	1,120.300	0.23
1983	563.421	0.53
1984	3,787.895	0.37
1985	321.611	0.08
1986	1,050.654	0.28
1987	2,103.332	0.21
1988	1,116.803	0.27
1989	3,107.529	0.28
1990	1,980.252	0.14
1991	13,560.780	0.20
1992	3,406.179	0.12
1993	4,779.787	0.10
1994	2,815.507	0.17
1995	3,311.798	0.15
1996	3,282.277	0.07
1997	3,485.100	0.15
1998	2,435.771	0.14
1999	2,080.940	0.19
2000	1,781.311	0.16
2001	1,100.164	0.13
2002	1,259.174	0.14
2003	1,799.551	0.06
2004	2,505.699	0.09
2005	1,648.308	0.14
2006	2,664.445	0.10
2007	3,481.530	0.13
2008	3,235.121	0.14
2009	2,394.375	0.11
2010	1,526.499	0.20
2011	1,665.608	0.13
2012	1,675.632	0.16
2013	4,887.298	0.16
2014	4,092.275	0.12
2015	2,711.547	0.10
2016	1,539.521	0.15
2017	2,274.822	0.08

Table 2.9.15. Relative biomass or abundance index values and associated CVs for Yellowtail Snapper from 1991 – 2017 used in the assessment model.

Year	RVC Index Juvenile		RVC Index Adult		MRIP Index		Commercial Index	
	Index	CV	Index	CV	Index	CV	Index	CV
1991					3.84	0.09		
1992					2.96	0.09		
1993					2.99	0.10	2.34	0.18
1994					2.27	0.13	2.53	0.18
1995					2.33	0.12	1.93	0.18
1996					1.71	0.13	1.69	0.18
1997					1.58	0.12	1.94	0.18
1998					1.30	0.09	2.27	0.18
1999	1.59	0.13	1.35	0.19	1.72	0.09	3.02	0.17
2000	2.67	0.08	1.33	0.12	1.91	0.09	2.73	0.18
2001					1.98	0.08	2.71	0.18
2002					1.82	0.09	3.05	0.18
2003					1.74	0.09	2.21	0.18
2004	2.38	0.12	2.40	0.18	2.25	0.09	3.02	0.18
2005					2.40	0.08	3.78	0.18
2006	2.96	0.11	1.82	0.25	2.27	0.08	3.59	0.18
2007					2.72	0.08	4.84	0.18
2008	3.45	0.07	3.38	0.13	2.25	0.09	6.12	0.18
2009					2.09	0.09	5.62	0.18
2010	2.94	0.11	2.51	0.12	2.29	0.11	5.36	0.18
2011					2.09	0.09	5.98	0.18
2012	3.26	0.07	2.75	0.09	2.15	0.09	5.23	0.18
2013					3.02	0.08	5.04	0.18
2014	3.85	0.10	4.44	0.17	2.76	0.08	4.72	0.18
2015					2.95	0.09	4.82	0.19
2016	3.55	0.10	3.01	0.12	2.56	0.09	5.98	0.18
2017					2.93	0.11	6.77	0.19

2.10 Figures

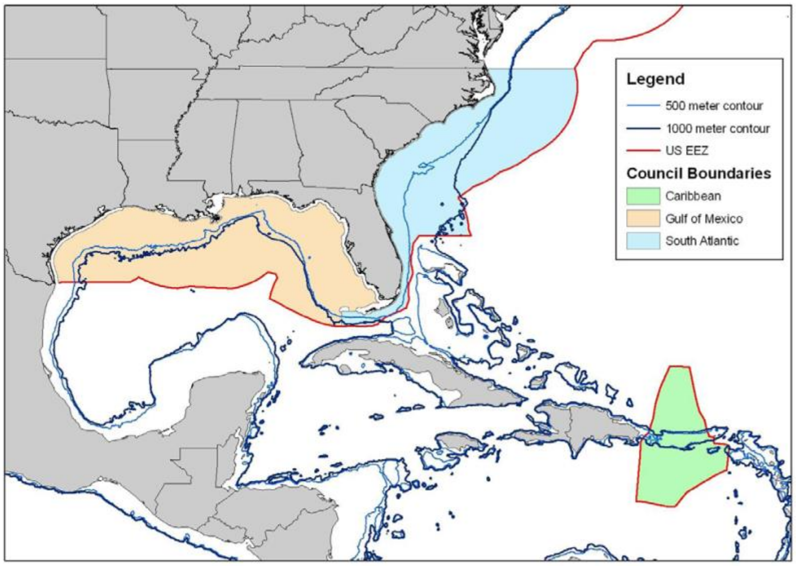

Figure 2.10.1 Jurisdictional boundaries in the Southeast Region for the South Atlantic Fishery Management Council, the Gulf of Mexico Fishery Management Council, and the Caribbean Fishery Management Council

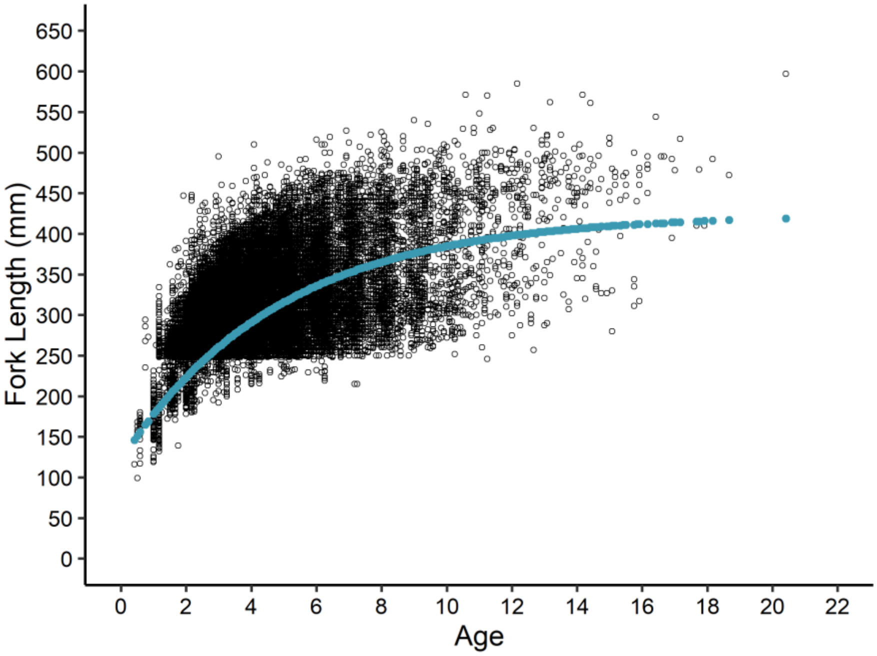

Figure 2.10.2. Yellowtail Snapper (1980 – 2017) observed ages (years) and fork lengths (mm) from updated Florida-exclusive data (n = 45,833 otoliths; black circles) and a predicted growth curve (blue dots) using a size-truncated von Bertalanffy growth model. Data were inversely weighted by the number of ages in each calendar age, included an age 12+ group, and fishery-dependent fish were size-truncated at 248 mm fork length. The model variance structure estimated a constant CV with age.

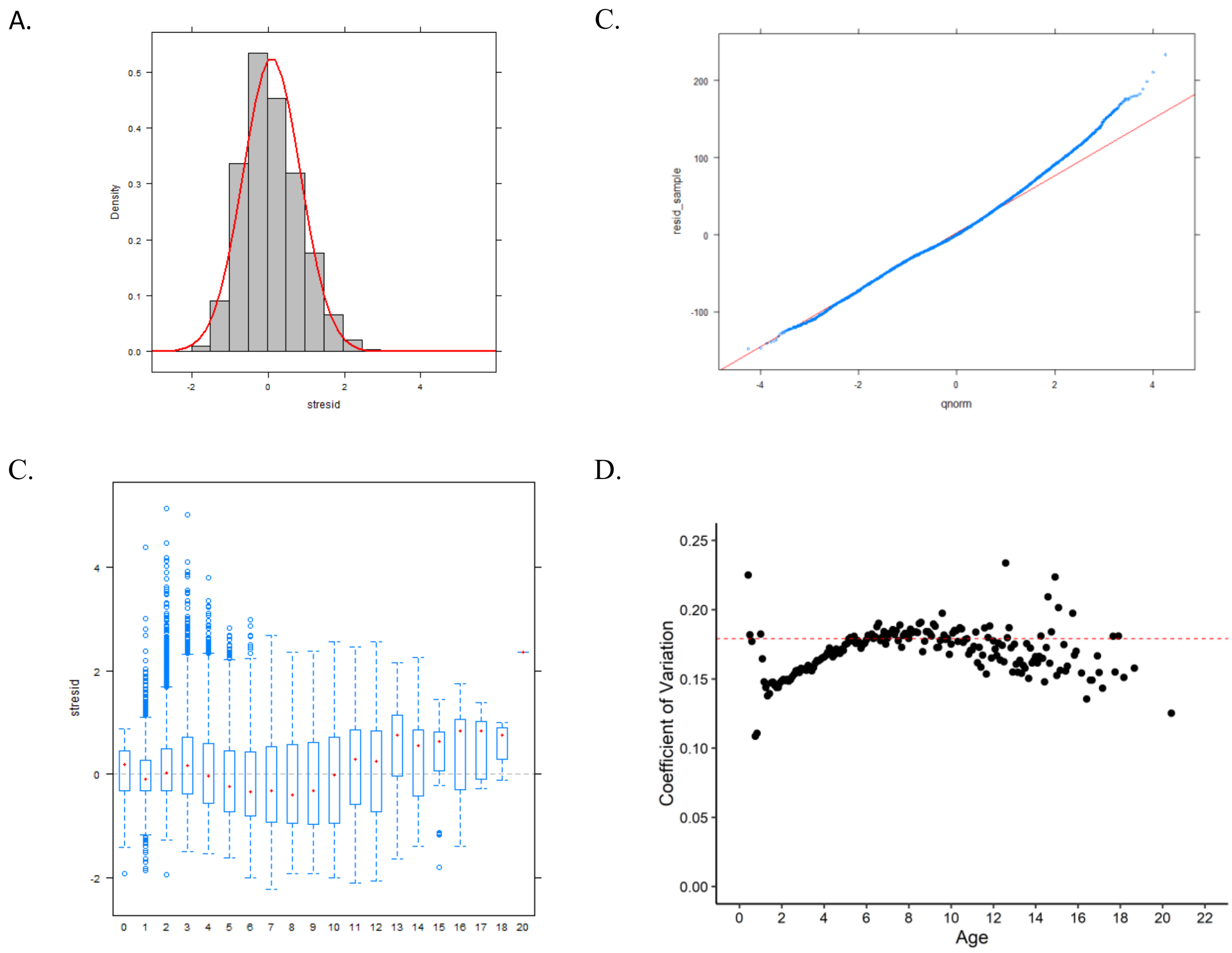

Figure 2.10.3. Updated diagnostic results from the size-truncated von Bertalanffy growth model on Florida-exclusive Yellowtail Snapper (1980 – 2017). Data (n = 45,833 otoliths) were inversely weighted by the number of ages in each calendar age, included an age 12+ group, fishery-dependent fish were size-truncated at the minimum size (248 mm fork length), and estimated a constant CV with age. Diagnostic plots include: a) standardized residual density distribution, b) normal probability plot (quantiles vs standardized residuals), c) standardized residuals by age, and d) coefficient of variation for each monthly biological age group.

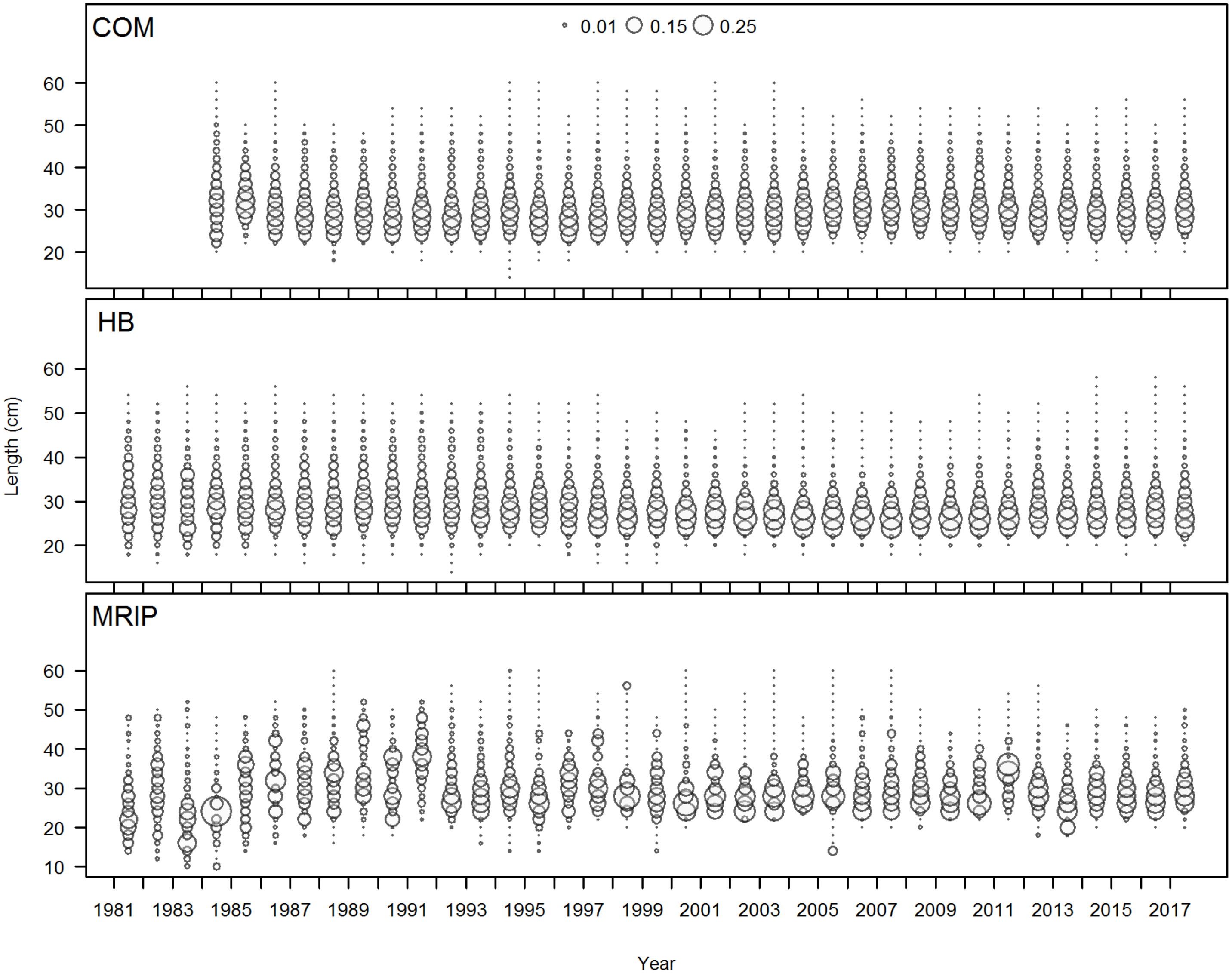

Figure 2.10.4. Length composition data of Yellowtail Snapper landings by fleet in Florida waters, 1981-2017.

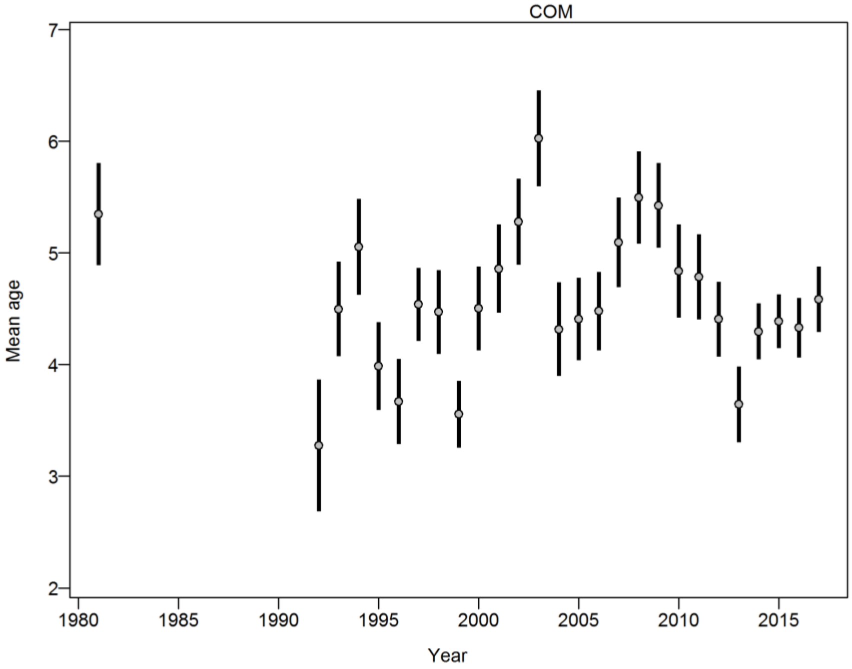

Figure 2.10.5. Mean age of Yellowtail Snapper commercial landings in Florida waters, 1981-2017.

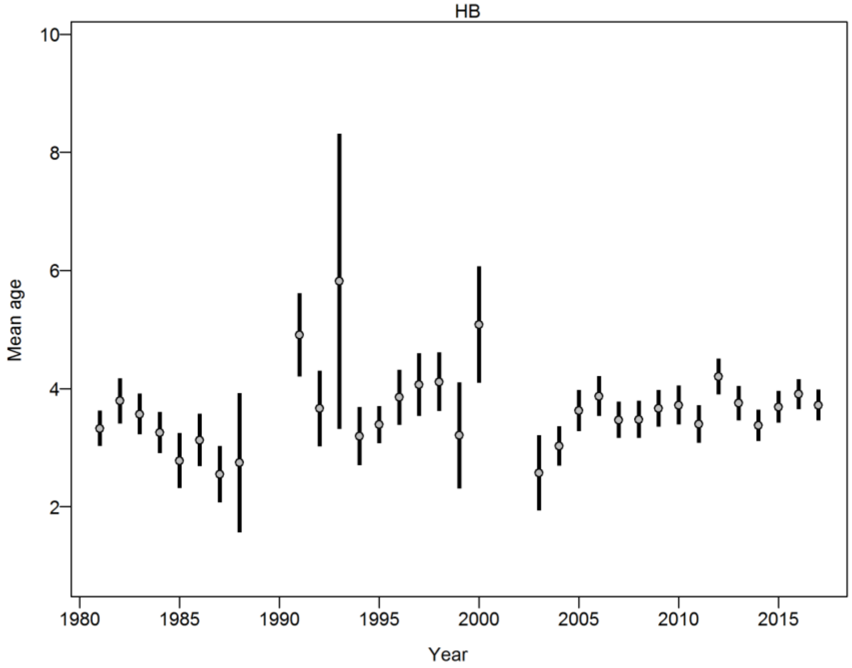

Figure 2.10.6. Mean age of Yellowtail Snapper headboat landings in Florida waters, 1981-2017.

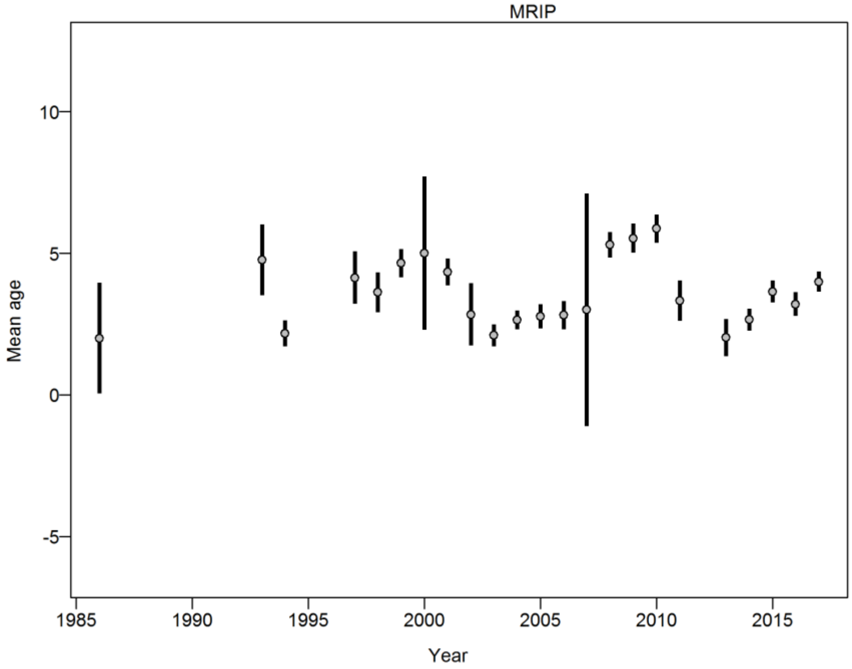

Figure 2.10.7. Mean age of Yellowtail Snapper charter, private, and shore (i.e. MRIP) landings in Florida waters, 1981-2017.

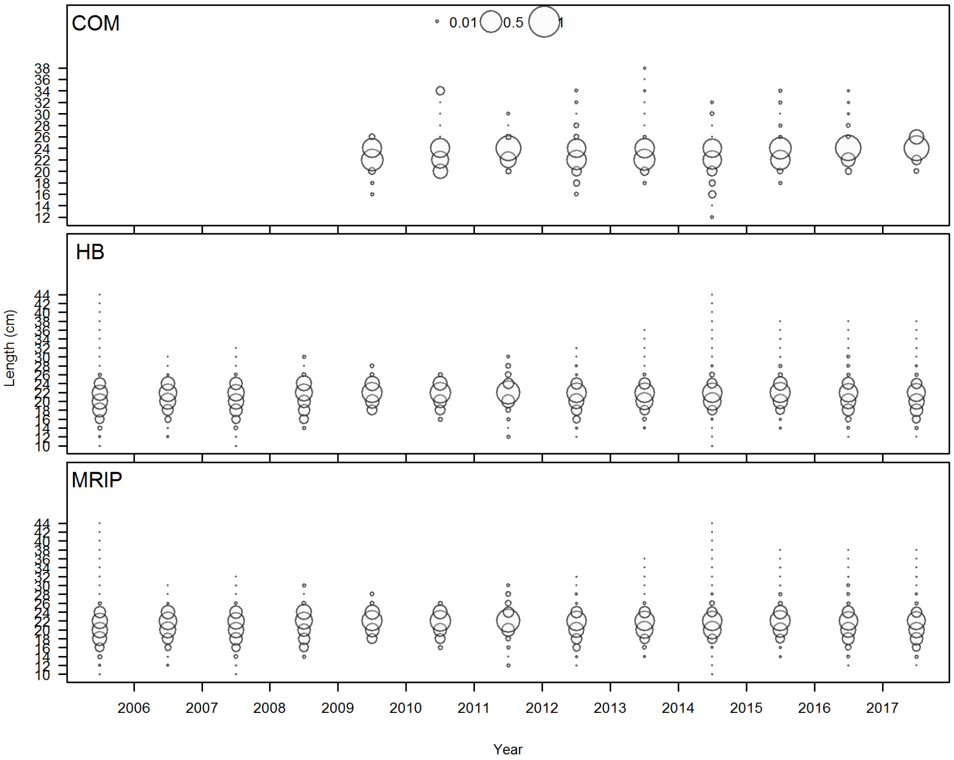

Figure 2.10.8. Length composition data of Yellowtail Snapper live discards by fleet in Florida waters, 2005-2017.

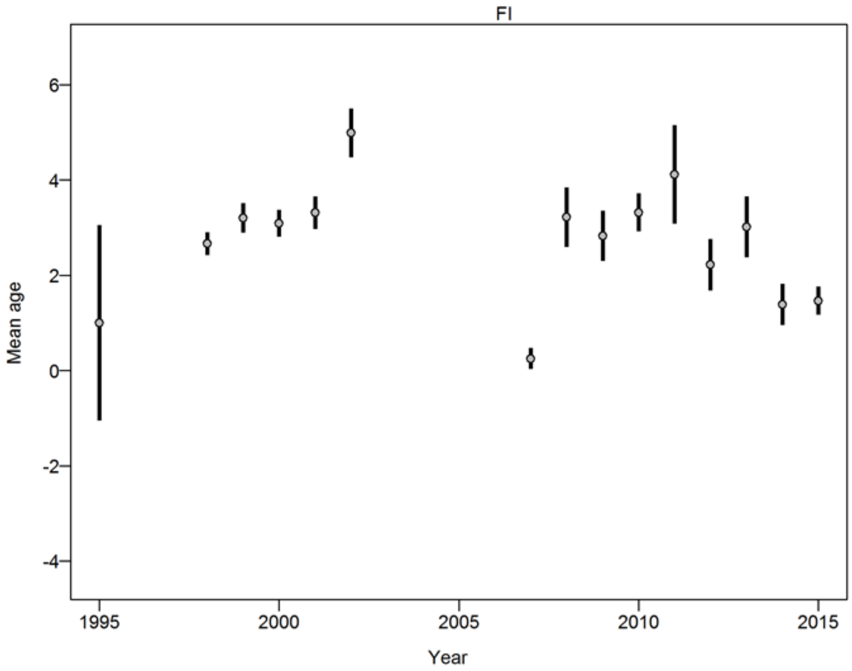

Figure 2.10.9. Mean age of Yellowtail Snapper from fishery independent data sources in Florida waters, 1995-2017.

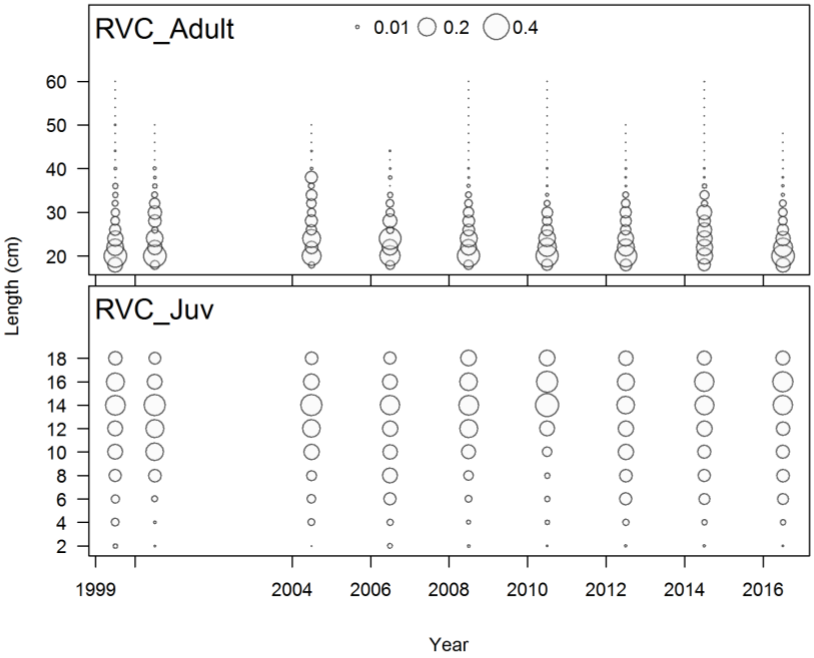

Figure 2.10.10. Length composition data of Yellowtail Snapper for the RVC surveys in Florida waters, 1999-2016.

3 Stock assessment models and results

3.1 Continuity Model

3.1.1 Methods

Continuity models are useful for comparing model performance and assessing the impact of additional years of data because typically only data from recent years are added to the prior model. Development of a true continuity model for SEDAR 64, however, was unattainable due to the NMFS redesign and implementation of the recreational data collection and estimation procedures (i.e. APAIS and FES calibrated MRIP data) which produced catch estimates that are now 2 – 5 times higher than those used in the previous assessment (O'Hop et al. 2012). To that end, the SEDAR 64 Continuity Model was developed to replicate the configuration of the SEDAR 27A Final Model in ASAP (Legault and Restrepo 1998) with the updated data in accordance with Section 2 for all years: 1981 – 2017. In addition, a model bridging exercise presented in Section 3.4 was undertaken to provide a comprehensive bridge between the SEDAR 27A Final Model and the SEDAR 64 Base Model.

The initial step was to run the SEDAR 27A Final Model in the current version of ASAP, version 3.0.16 to ensure that the updated version produced the same results as the version used in 2012 (version 2.0). The configuration of SEDAR 27A is described in detail by O'Hop et al. (2012) and is summarized in Table 3.8.1. The SEDAR 64 Continuity Model followed these configuration settings, as well as the SEDAR 27A Final Model phases and parameter starting values (e.g. initial guesses, starting selectivity and CVs). Stock assessment models have advanced in both design and computing power and, therefore, some model structure limitations which existed in the prior assessment model are no longer as limiting. For example, the SEDAR 27A Final Model was run in ASAP 2.0 which limited the number of weight-at-age matrices to three; one for the catch and discards, one for January 1 biomass, and one for spawning stock biomass. The effects of these model limitations will be illustrated and discussed in Section 3.4.

Data for the SEDAR 64 Continuity Model, such as landings, discards (fish released alive), indices, length frequencies, conditional age-at-length, and release morality rates, came from the Data Workshop Report and are summarized in Section 2. Catch and discard at age matrices, weight at age matrices, as well as release proportion at age matrices were created by applying an age-length-key to annual length frequencies. Annual length frequencies by fleet, coast, and year from 1981 – 2017 were converted to annual age frequencies by fleet, coast, and year using updated age-length keys that were developed following the procedure described in SEDAR 27A

Data Inputs, Section 5.5.5 (O'Hop et al. 2012). As mentioned above, the recreational MRIP catch estimates are substantially higher than what were available in 2012. The SEDAR 64 Continuity Model followed the SEDAR 27A configuration as closely as possible, thereby providing a means of evaluating the effect of the revised data on the results.

3.1.2 Continuity Model Results

When the data inputs for SEDAR 27A model were updated and extended to 2017, the average annual fishing mortality rates increased and the spawning stock biomass decreased; showing that updated data influenced the results (**Figure 3.9.1**). The trends, however, are very similar between the two models; fishing mortality rates decreased and spawning stock biomass increased throughout the time series. Although fishing mortality rates increased in the continuity model, the magnitude was still relatively low (average estimated fishing mortality rates were less than 0.20 yr^{-1}).

3.2 Base Model

3.2.1 Base Model Methods

Overview

The base model for the SEDAR 64 southeastern U.S. Yellowtail Snapper stock assessment was developed in Stock Synthesis (SS) version 3.30.14. Stock Synthesis is an age- and size-structured assessment model in the integrated analysis class of models. It has 1) a population sub-model that simulates growth, maturity, fecundity, recruitment, movement, and mortality processes, 2) an observation sub-model which predicts values for the input data, 3) a statistical sub-model which characterizes goodness of fit and obtains best-fitting parameters and their associated variance, and 4) a forecast sub-model which projects various user-determined management quantities (Methot et al. 2019). Further descriptions of SS options, equations, and algorithms can be found in the SS user's manual (Methot et al. 2019), the NOAA Fisheries Toolbox website (http://nft.nefsc.noaa.gov/), and Methot and Wetzel (2013).

The SEDAR 64 base model was of moderate complexity comprising three fishing fleets (including landings, discards, landings-at-length and -age compositions, and discards-at-length compositions where available), two fishery-independent indices of relative abundance (including length compositions), two fishery-dependent indices of relative abundance or biomass (including length compositions) and fishery-independent age composition data that were not associated with any fleet or survey. The model estimated 85 out of the 117 parameters including, but not limited to, growth parameters (asymptotic length [L_{inf}], von Bertalanffy growth coefficient [k], and the reference length for the start of von Bertalanffy growth [L_{min}]) , virgin recruitment (*ln(R0)*), *steepness* (*h*), variability in recruitment (*sigmaR*), time-varying stock-recruit deviations, fishing mortality for each fleet and year that it was operational, length-based selectivity parameters for fleets, landings, discards, retention and indices with length composition data. The model derived estimates included a full time series of recruitment, population abundance, and biomass (total, spawning stock, and exploitable). Projections in Stock Synthesis start from the year subsequent to the terminal year of the assessment model utilizing the same population dynamics equations and modeling assumptions.

The r4ss software (www.cran.r-project.org/web/packages/r4ss/index.html) was utilized extensively to develop various graphics for model outputs and summaries and was used to perform several diagnostic runs.

3.2.2 Data Sources

The data sources used in the base model of the SEDAR 64 assessment are described in greater detail in Section 2 and include any changes following the Data Workshop. The following list summarizes the main data inputs used in the SEDAR 64 stock assessment base model:

- Stock structure and management unit
- Life history
    - Age and growth
    - Natural mortality
    - Release mortality
    - Maturity
    - Fecundity
- Landings
    - Commercial (metric tons): 1981 – 2017
    - Headboat (thousands of fish): 1981 – 2017
    - MRIP (thousands of fish): 1981 – 2017
- Discards (thousands of fish)
    - Commercial: 1993 – 2017
    - Headboat: 1981 – 2017
    - MRIP: 1981 – 2017

- Length composition of landings (2-cm fork length bins)
    - Commercial: 1984 – 2017
    - Headboat: 1981 – 2017
    - MRIP: 1981 – 2017
- Age composition of landings (1-year age bins, plus group for ages 12 and older)
    - Commercial: 1981, 1992 – 2017
    - Headboat: 1981 – 1988, 1991 – 2000, 2003 – 2017
    - MRIP: 1993 – 1994, 1997 – 2011, 2013 – 2017
    - Fishery-independent survey: 1995, 1998 – 2002, 2007 – 2015
- Length composition of discards (2-cm fork length bins)
    - Commercial: 2009 – 2017
    - Headboat: 2005 – 2017
    - MRIP: 2005 – 2017
- Abundance indices
    - Fishery-independent
        - RVC Adult: 1999 – 2000, 2004, 2006, 2008, 2010, 2012, 2014, 2016
        - RVC Juvenile: 1999 – 2000, 2004, 2006, 2008, 2010, 2012, 2014, 2016
    - Fishery-dependent
        - Commercial vertical line: 1993 – 2017
        - MRIP: 1991 – 2017
- Length composition from abundance indices (2-cm fork length bins)
    - Fishery-independent
        - RVC Adult: 1999 – 2000, 2004, 2006, 2008, 2010, 2012, 2014, 2016
        - RVC Juvenile: 1999 – 2000, 2004, 2006, 2008, 2010, 2012, 2014, 2016
    - Fishery-dependent
        - MRIP: 2005 – 2017

The data sources and their corresponding temporal scale are presented in **Figure 3.8.2.**

3.2.3 Base Model Configuration

3.2.3.1 Stock Structure and Management Unit

The southeastern U.S. Yellowtail Snapper stock is treated as one stock for assessment purposes despite being managed under two jurisdictions of the SAFMC and the GMFMC. The stock is predominantly concentrated in south Florida, especially in the Florida Keys, but extends west to Texas in the Gulf of Mexico and north to North Carolina on the Atlantic coast. Following the recommendation of the Data Workshop, the base model was spatially configured to be a one area model and was restricted solely to Florida waters.

3.2.3.2 Life History

Growth was estimated within Stock Synthesis according to the von Bertalanffy growth function where initial values for the asymptotic length L_{inf}), the von Bertalanffy growth coefficient (k), and the CV as a function of length-at-age were based on the external size-truncated model results (Section 2.2.1). Initial values were:

L_{inf} = 42.29 cm FL
k = 0.207 yr^{-1}
L_{min} = 2 cm FL
CV = 0.179

L_{max} was specified as equivalent to L_{inf}. The CV parameter was used in SS to describe the variability in length-at-age for the minimum (CV_{young}) and the maximum (CV_{old}) observed ages. In the base model, growth was initially configured such that fish grew according to the von Bertalanffy growth model immediately upon ‘settlement’ at age-0 ($Amin = 0$) beginning at a length of 2 cm (L_{min}), but L_{min} was freely estimated (**Figure 3.9.3)**. Differences between the external growth model and SS estimated growth are discussed in Section 3.3.4.4.

The timing of spawning and settlement in the base model deviated from the timing defined for the external growth model. Because the base model is a one season model, spawning must occur on January 1. When settlement timing was defined as April 1, the base model estimated a bimodal length distribution of the population which was thought to be unreasonable and perhaps an issue within SS. A settlement timing of January 1 resulted in more realistic length structure of the population. A fixed length-weight relationship ($w = a*L^b$) was used to convert body length (cm) to body weight (kg) with parameters $a = 2.574\text{e} - 5; \text{b} = 2.8797$ (**Figure 3.9.4**).

Natural mortality was assumed to be constant over time and inversely related to fish length following Lorenzen (2005). The updated natural mortality-at-age vector (Section 2.2.2) was a fixed input within the SS base model.

The SS base model was configured as a single gender model where the spawning biomass would be multiplied by a user-defined fraction female, here defined as *frac_female* = 0.50. Maturity-at-age followed the vector described in Section 2.2.4 and was a fixed input within the SS base model (**Figure 3.9.5**). Fecundity was configured as linear eggs/kg on body weight ($eggs = a +$

$b * wt$) and parameterized such that the number of eggs was equivalent to spawning biomass by fixing $a = 0$ and $b = 1$.

3.2.3.3 Recruitment Dynamics

The SS base model used the Beverton-Holt stock-recruitment model. In SS, this stock-recruitment function uses three parameters which can be simultaneously estimated: 1) *steepness* (*BH_steep*; the recruitment obtained at 20% of the virgin biomass), 2) the virgin recruitment estimated in log-space (*ln(R0)*), and 3) the standard deviation of natural log of recruitment (*sigmaR*). *SigmaR* penalizes deviations from the spawner-recruitment curve (calculated from *ln(R0)* and *steepness*) and it defines the difference between the arithmetic mean spawner-recruitment curve and the expected geometric mean (Methot et al 2019). All three stock-recruitment parameters were estimated within the base model.

Simple annual deviations from the stock-recruitment function, which were not constrained to sum to zero, were estimated assuming a lognormal error structure. The main recruitment deviations were estimated for the time period of greatest data-richness (1991 – 2017) and corresponds to when the age composition data for the three fleets largely became available. However, early recruitment deviations were estimated for 1981 – 1990 with the assumption that length composition data and a small amount of age composition data along with information on removals from natural mortality and fishing could provide some indication of recruitment level trends. In SS, expected recruitments need to be bias adjusted because of its assumed lognormal error structure. The adjustment is accomplished by applying a full-bias correction to the recruitment deviations which have enough data to inform the model about the range of recruitment variability (Methot et al. 2019). Following the recommendation from Methot and Taylor (2011) to use the full bias adjustment on data-rich years, the SS base model used full bias adjustment between 1993 – 2015 after which it phased out to no bias adjustment from 2016 – 2017. After performing the Francis (2011) re-weighting procedure, however, the input bias adjustments were not updated and thus, differed slightly from the new recommended values (**Figure 3.9.6**). The effect of this was further explored and discussed below in Section 3.3.10.7

3.2.3.4 Initial Conditions

Stock Synthesis requires estimates of initial fishing mortality rates. This is done using the initial equilibrium catches which represent catches from a stock exhibiting a balance of removals and natural mortality by stable recruitment and growth. However, the Yellowtail Snapper stock in Florida waters was not assumed to be in equilibrium in the assessment's start year given the reported fishing history. Initial equilibrium catches for each fleet were therefore estimated within the developing base model using starting values of 25% of the total landings and discards reported. Due to the high uncertainty associated with these starting values coupled with the inability of knowing initial equilibrium catches, the AP supported setting the lambdas associated with these initial equilibrium catch values to 0, thereby removing matching the equilibrium catches from the objective function. Initial results showed that initial fishing mortality rates for the commercial and headboat fleets were <0.0001 while the initial fishing mortality rate for MRIP was 0.80. The AP did not deem the commercial and headboat initial fishing mortality estimates realistic. Therefore, in an effort to have the model estimates remain in a more plausible space, symmetric beta prior types with wide ranges were applied to the initial fishing mortality estimates of the three fleets of the base model.

The base model was initially developed with a proposed starting year of 1981 based on available data and following the precedent set in SEDAR 3 and SEDAR 27A. However, the reliability and accuracy of the recreational data for the 1980s (especially years 1981-1982, 1984, and 1989-1991), as discussed by the Data Workshop panel (see Data Workshop Report Section 4.3), continued to be questioned in detail by the AP. Therefore, the AP requested a run to see how sensitive the model would be if the model started later during a more data-rich period. The panel chose the start year 1992 because that was after the years of data with questionable reliability, and it coincided with when the available age composition data for the different fleets became more consistent, as well as when some indices of abundance first became available. After the sensitivity analysis was completed (see below Sections 3.2.6.9 and 3.3.10.7), the panel chose to have the SEDAR 64 base model configured with a start year of 1992.

3.2.3.5 Selectivity

Selectivity patterns describe the probability of fish's capture-at-length or -age by a given fishery or gear. Selectivity can be used to model different gear types, targeting, and fish availability according to the spatial utilization of fish and/or fishery. The SEDAR 64 base model was configured using length-based selectivity for all fleets and indices.

The AP discussed, during the Data Workshop and Assessment Workshop processes, whether the commercial fishery exhibited flat-topped or dome-shaped patterns based upon commercial length and age composition data along with input from commercial fishermen. It was determined that the commercial fleet operates in areas and depths where Yellowtail Snapper at the minimum size limit are both available and vulnerable to the gear and become fully selected with increasing in size/age; therefore, the AP chose the two-parameter single logistic function as being appropriate to model selectivity for the commercial fleet. The commercial index of retained pounds per hook hour was based on logbook data and linked to the commercial fleet in Stock Synthesis. Selectivity parameters for the commercial fleet and index were freely estimated.

Selectivity patterns for the MRIP and headboat fisheries were estimated to be dome-shaped based on their life history and headboat fishermen input in additional to the length and age composition data. Therefore, the six-parameter double normal function was selected for use, and all parameters were freely estimated. The MRIP index, which is based on total catch, was configured to mirror the MRIP fleet's selectivity. Following the Data Workshop recommendation, the headboat index was not included in the assessment.

The RVC survey, which was partitioned into juvenile and adult data for the subsequent indices using a 19 cm length cutoff (see Data Workshop Report Section 5.3.1), also exhibited a dome-shaped patterns based on the survey area and length composition data. Consideration of the locations where the RVC survey operates was an important factor in deciding to assume dome-shaped patterns for the selectivity of the juvenile and adult surveys. The RVC survey is constrained to depths less than 30 meters, which is suspected to limit observing older, and therefore larger, Yellowtail Snapper. The RVC juvenile survey is not representative of young-of-the-year (<10 cm FL), mostly likely because these fish prefer seagrass habitat which is not surveyed in the RVC, and by design in this assessment the juvenile index portion does not include Yellowtail Snapper above 19 cm FL. Conversely, the RVC adult survey index does not include fish less than 19 cm FL by design in this assessment. The double normal function was used again to estimate selectivity for the juvenile and adult indices with all parameters freely estimated save one in the RVC juvenile index. This parameter controls the selectivity for the final length bin and was fixed to help truncate the descending limb.

Selectivity patterns across fleets and indices were configured to be constant over time as no major changes in the regulation of the Yellowtail Snapper fishery have occurred which would alter these patterns since the model's start year.

3.2.3.6 Retention

In Stock Synthesis, retention is defined as a logistic function of size or age (Methot et al 2019). Since size regulations for southeastern U.S. Yellowtail Snapper are in the form of a minimum size limit, as opposed to a slot limit, retention was modeled as an asymptotic function with size and used the following formula:

$$\text{Retention} = \left(\frac{P3}{1+e^{\frac{-(L-(P1+P4*male))}{P2}}}\right).$$

The four parameters describe 1) the inflection point, 2) the slope, 3) the asymptote, and 4) the male offset inflection. Asymptotic retention was utilized for each of the three fleets with the first three retention parameters freely estimated and assumed to be constant through time. The fourth parameter was not applicable to this single gender model and was fixed at zero.

3.2.3.7 Discards

Live and dead discards for each fleet were calculated and fit within the base model. Live discards were estimated by applying the converse of the retention function to the total catch, while dead discards were the result of assumed discard mortality rates (Methot and Wetzel 2013). The total mortality can then be expressed as:

# of dead fish = selectivity*(retention + (1 – retention)*discard mortality rate).

Fleet specific discard mortality rates were treated as fixed model inputs (see above Section 2.2.3) and configured in SS using the following formula:

$$\text{Discard Mortality Rate} = \left(1 - \frac{1-P3}{1+e^{\frac{-(L-(P1+P4*male))}{P2}}}\right).$$

The four parameters describe 1) the descending inflection point, 2) the descending slope, 3) the maximum discard mortality, and 4) the male offset inflection. The fourth parameter was not applicable to this model and fixed at zero. Therefore, discard mortality rates are a logistic function of size such that mortality declines from 1.0 to an asymptotic level as fish get larger. For all fleets, the discard mortality rates were treated as constant across sizes by setting a very large positive value for the descending slope (i.e. 1E+06), resulting in a denominator approximately equal to 2, and a negative value for P3 that produces a specified discard mortality rate. Discard mortality rates were assumed constant through time.

3.2.3.8 Catchability

Constant catchability was assumed for all surveys except for the commercial index. Catchability for the commercial index was allowed to change for years 2009 – 2017 compared to the base period of 1992 – 2008. Increasing commercial CPUE from 2007-2017 was thought to be attributed to improved fishing efficiency in the commercial fleet rather than an increase in the underlying population. Input from several commercial fishermen during the Data and Assessment Workshops indicated that the power chumming technique, which had already been in somewhat use for a few decades, had become increasingly prolific starting around 2005 and was considered standard practice by 2009/2010. Power chumming involves hanging multiple frozen chum bags (usually sardine or menhaden chum and possibly oats) overboard to thaw and disperse in a short period of time (less than 4-5 hours).

3.2.4 Estimated Parameters

A total of 85 out of 117 parameters were estimated within the SS base model for southeastern U.S. Yellowtail Snapper (**Table 3.8.2**). Of the 117 total parameters, eighteen were used to describe life history components, 39 estimated annual recruitment dynamics, 3 estimated initial fishing mortality rates, 5 estimated index catchabilities, and 52 described selectivity, retention and discard mortality for the three fleets and four indices. Included in **Table 3.8.2** are estimated parameter values from Stock Synthesis, the range of values a parameter could take, their initial starting values, their associated standard deviations and CVs, the prior type and its standard deviation (where applicable), and the phase the parameter was either estimated (positive phase) or fixed (negative phase). Parameter bounds were selected to be sufficiently wide to avoid truncating the searching procedure during maximum likelihood estimation and avoid finding a local minimum. The SS base model also used the soft bounds option which moves parameters away from the bounds with a weak penalty (Methot et al. 2019).

3.2.5 Maximum Likelihood and Uncertainty

In SS, a maximum likelihood approach was used to evaluate the overall goodness of fit to each kind of data source. Datasets contained an assumed error distribution (e.g. lognormal) and an associated likelihood determined by the difference between observed and predicted values and the variance of the error distribution. The total likelihood is the sum of the individual component's likelihoods. The global best fit to all the data was determined using a nonlinear iterative search algorithm to minimize the total negative loglikelihood across the multidimensional parameter space.

Several approaches were used to assess model convergence. First, the Hessian matrix must be invertible (i.e., there are valid solutions for all the parameters in the model). Next, the maximum gradient component (a measure of the degree to which the model converged to a solution) was compared to the final convergence criteria (0.0001, common default value). Ideally, the maximum gradient component will be less than the criterion.

Several model components were not given any weight in the loglikelihood function, that is, the likelihood component multiplied by the weight (lambda) value was set to zero. These zero weight components included initial equilibrium catch values for each fleet. Setting the weight in the loglikelihood function to zero reflects a lack of confidence in values for these components and they were not used for fitting the model to the data and parameters.

The error structure for landings, indices, and discards was assumed to be log-normal, except where noted. Within the landings data, commercial landings contained the least amount of uncertainty because the programs which collect those data consider it a census (assumed to be complete or nearly so) rather than a survey (which is from a sample). Limitations of the SRHS design prevented any variance estimates from being developed for the headboat landings and discard estimates. Estimates of variability for headboat landings and discards were thus assumed to be constant through time. Estimates of uncertainty for MRIP landings and discards varied by year and were provided by the SEFSC after the Data Workshop. Estimates of variability for commercial discards were quite large with CVs mostly > 2 (i.e. >200%). Commercial discards were assumed to have a normal error structure with specified CVs since CVs and standard deviations provided by SEFSC applied to discard rates on the arithmetic scale, as opposed to discards on the logarithmic scale. Uncertainty in the index observations was estimated through the standardization techniques used to determine the final observed index values. For most data sources, the variance of the observations was available only as a coefficient of variation (CV). In SS, if lognormal error structures were required, CVs were converted to a standard error (SE) in log-space using the following formula:

$$SE = \sqrt{ln\,(1 + CV^2)}.$$

Multinomial distributions were assumed for the length composition data of the landings, discards, and indices as well as the conditional age-at-length composition data of the landings and fishery-independent dataset, which have the variances estimated by the input effective sample sizes. The variance of the multinomial distribution is a function of true probability and sample size; thus, an increase in sample size represents lower variance and vice versa. The effective sample size is meant to represent the number of fish independently and randomly sampled each year to determine the length or age composition. The assumption of independent and random sampling is typically violated because fish caught in the same tow or set tend to be more similar to each other in length or age than are fish from different catches, and this can extend to fish caught by the same vessel. In addition, the assumption of random sampling can be violated (e.g. by sampling vessels non-randomly or by under-sampling nighttime trips or fishing areas).

Because true effective sample sizes are unknown, effective sample sizes for length compositions were initially set to the square root of the number of trips from which samples of Yellowtail Snapper were obtained to avoid over-weighting observations of lengths in the likelihoods. The effective sample sizes for conditional age-at-length were set to the square root of the number of Yellowtail Snapper sampled because there are fewer fish aged at a given length. Francis (2011) and Punt (2017) have developed re-weighting procedures to adjust the effective sample sizes of length and conditional age-at-length data iteratively until the multipliers reached a stable value.

Multipliers are calculated so that variability of model inputs is consistent with the model fits to mean length or mean age (Francis 2011).

Uncertainty estimates for estimated and derived quantities were calculated after the model fitting based on the asymptotic standard errors from the covariance matrix determined by inverting the Hessian matrix (i.e., the matrix of second derivatives was used to determine the level of curvature in the parameter phase space and to calculate parameter correlations; Methot and Wetzel 2013). Asymptotic standard errors provided a minimum estimate of uncertainty in parameter values. In addition, bootstrap (see Section 3.2.6.5) and MCMC (see Section 3.2.6.6) analyses provided posterior distributions of model parameters and selected derived quantities.

3.2.6 Model Diagnostics

3.2.6.1 Residual Analysis

Fits to landings, discards, indices, and length and age compositions were evaluated via visual inspection of residuals and a comparison of root mean squared standardized errors (RMSSE). Pervasive patterns in residuals indicate poor model performance and potentially model misspecification. RMSSEs are calculated as

$$RMSSE = \sqrt{\frac{\sum_{i=1}^{n}\left(\frac{\ln(x_i) - \ln\,(\hat{x}_i)}{\sigma_x}\right)^2}{n}}\ ,$$

such that x and $\hat{x}$ are the observed and predicted values, respectively, and σ_x is the input standard error in log space of the observations. To further evaluate the fits to the indices, the criteria set forth in Francis (2011) was used. That is, the RMSSE (which is closely related to the standard deviation of the normalized residuals, SDNR) were calculated and compared to

$RMSSE_{MAX} = \sqrt{\chi^2_{0.95,m-1}/(m\ -1)}$, where $\chi^2_{0.95,m-1}$ is the 95th percentile of a χ^2 distribution with m – 1 degrees of freedom, and m is the number of years in the data set. Francis (2011) suggests that the SDNR, and by extension RMSSE, be less than this value for a particular index.

3.2.6.2 Correlation Analysis

High correlation among parameters exists within a model and can lead to poor model stability along with flat likelihood response surfaces. Examining these correlations can help prevent erroneous model parameterizations caused by inadequate modeling assumptions. While some parameters will always be correlated due to their structural nature (e.g., growth and stock-recruitment parameters), many highly correlated parameters will warrant reconsideration of modeling assumptions and parameterization. Therefore, correlation among parameters was examined and correlations with an absolute value greater than 0.7 were reported.

3.2.6.3 Profile Likelihood

Likelihood profiles were used to examine the change in log-likelihood for selected model across a range of values in order to gauge the stability of a given parameter estimate and to identify conflicts among log-likelihood values of different data components. Typically, profiling is carried out for a handful of problematic (and often correlated) parameters, particularly those defining the stock-recruitment relationship. The analysis is performed by holding the given parameter at a fixed value in each run and rerunning the model across a range of reasonable parameter values. Ideally, the graph of likelihood values against parameter values yields a well-defined minimum indicating that the parameter is in agreement with the maximum likelihood solution. If a given parameter is not well estimated, the profile plot will show conflicting signals across the data sources. The resulting total likelihood surface will often be flat, indicating that multiple parameter values are equally likely given the data. In such instances, the component is not influential in the model or the model assumptions may need to be reconsidered if the model shows instability and model solutions may be unreliable. Likelihood profiles were done for each of the stock-recruitment parameters (*steepness*, recruitment variability [*sigmaR*], virgin recruitment [*R0*]) and the initial fishing mortality estimates for each fishing fleet.

3.2.6.4 Jitter Analysis

Jitter analysis is a relatively simple method that can be used to assess model stability given different parameter starting values and to suggest whether a global as opposed to a local minimum has been found by the search algorithm. The premise is that all starting values are randomly altered (or ‘jittered’) by an input constant proportion of the parameter’s range and the model is rerun with the new starting values. Provided that loglikelihood values associated with each model run are equal to or above the base model loglikelihood value and parameter estimates corresponding to the lowest loglikelihood values match the parameter estimates of the base model, it can be reasonably assured that a global minimum has been obtained. Jitter analysis is not fault-proof and contains no guarantee that a ‘true’ solution has been found or that the model does not contain misspecification. However, if the jitter analysis results are consistent, it provides additional support that the model is performing well and has come to a stable solution. For this assessment, a jitter value of 20% was applied to the starting values and 200 runs were performed.

3.2.6.5 Parametric Bootstrap

Parametric bootstrap resampling methods were used to analyze the uncertainty associated with the data and to detect possible model misspecification. Five hundred bootstrapped datasets were produced by randomly drawing datasets according to assumed error distributions centered on fitted values. Effective sample sizes (i.e. sample sizes after applying the Francis re-weighting procedure) for some conditional age-at-length data were less than one, leading to failed bootstraps. This was addressed by adding one to all conditional age-at-length effective sample sizes. By fitting the model to each of the bootstrapped datasets, base model parameter estimates and derived quantities were compared to the distribution of parameter estimates and derived quantities from the bootstraps. Discrepancies between base model estimates and the median of the distribution produced by bootstrap analysis may indicate model misspecification of error distributions, data conflicts, or considerable autocorrelation within datasets (Methot and Wetzel 2013).

3.2.6.6 MCMC Analysis

Monte Carlo Markov Chain (MCMC) is a method of generating posterior distributions of model parameters and was used in this analysis to estimate uncertainty in fishing mortality and spawning stock biomass. MCMC allows a probabilistic reporting of the uncertainty associated with the estimated values. Estimates of population values in the terminal year of the stock assessment are often the most uncertain. Assuming the MCMC posterior distributions provide reliable estimates of model uncertainty, the probability that the estimated terminal year value is above or below the overfished/overfishing reference points can be calculated. In this way, a level of risk associated with failing to reach the reference points can be quantitatively specified.

Two MCMC chains were produced. For the first chain, a total of 5,000,000 MCMC iterations were performed but only one out of every 2,000 iterations were saved, resulting in 2,500 iterations used to generate uncertainty estimates in estimates of fishing mortality and spawning stock biomass. Using the convergence performance of the first chain as a guide, a second chain was produced by running a total of 10,000,000 MCMC iterations but only saving one out of every 2,000 iterations, resulting in 5,000 iterations. Two-chain convergence was assessed using Gelman and Rubin's (1992) potential reduction scale factor implemented in the boa package in R (Smith 2007). Trace plots were also visually inspected.

3.2.6.7 Jack-knife Analysis on Indices of Abundance

A jack-knife approach to data exclusion analysis was performed where individual data sets were removed and the model rerun with the remaining data. The goal was to determine if any single data set was having undue influence on the model and causing tension with other data in terms of estimating parameters. The approach can be especially useful for identifying indices that may be giving conflicting abundance trend signals compared to the other indices. If removing a data set leads to dramatically different results, it suggests that the data set should be reexamined to determine if the sampling procedures are consistent and appropriate (e.g., an index may only be sampling a sub-unit of the stock and resulting abundance signals may only reflect a local sub-population and not the trend in the entire stock). Therefore, a full index jack-knife was done for the survey data where each survey index was removed (including associated length or age composition data) and the model rerun. When an index was removed, any associated estimated parameters (e.g., selectivity parameters) were no longer estimated. Other data sets (i.e., landings and compositional data) were deemed fundamentally necessary to stabilize the model and were not included in this data exclusion analysis.

3.2.6.8 Retrospective Analysis

The base model was subject to a retrospective analysis that removed successive years of data from the model for seven years (i.e. seven peels). Iteratively removing data associated with the final model year elucidates the effect of the final year on model results. If results of this analysis show a retrospective bias (consistent patterns of increasing or decreasing model estimates and related derived quantities with each retrospective peel), it can be an indication of model misspecification of temporal dynamics. It is preferable for estimates associated with each retrospective peel to be randomly distributed around base model results. Model performance was evaluated by visual inspection of retrospective patterns and the Mohn's Rho (ρ) metric (Mohn 1999, Hurtado-Ferro et al. 2015).

3.2.6.9 Sensitivity Runs

Start Year

Between 1991 – 1992, programs which collect commercial and recreational data underwent refinements which led to an increase in data quality and reliability. Commercial gear became available by trip and the MRFSS increased the number of intercepts, as well as added a link so that ancillary angler interviews on the trip could be identified and grouped. Therefore, commercial and MRIP/MRFSS landings data prior to 1992 were of less utility. The data quality related to the headboat fleet (SRHS) did not change. In addition, the age data for Yellowtail Snapper were sparse and the earliest index in SEDAR 64 began in 1992. A previous iteration of the base model with lower natural mortality demonstrated a moderate level of sensitivity when changing the start year from 1981 to 1992. This sensitivity run was reconsidered by changing the start year from 1992 to 1981with the revised natural mortality rates to assess the sensitivity of the current base model.

Discard Mortality Rates

In accordance with Data Workshop recommendations (see Data Workshop Report Section 2.5), model runs examining sensitivity to discard mortality rates for each fleet were performed. This was completed by configuring the fixed parameter inputs in the discard mortality equation (Section 3.2.3.7 above) to produce the respective discard mortality rates for each fleet. For the commercial fleet, the upper bound sensitivity was set at 15%. In the sensitivity runs for the recreational fleets, both headboat and MRIP discard mortality rates were set at 20% and then at 30%. Thus, there were a total of three discard mortality sensitivity run scenarios.

Bias Adjustments to the Recruitment Deviations

After implementing the Francis (2011) re-weighting procedure, the recommended bias adjustment values no longer agreed with the model input values (see Section 3.2.3.3; **Figure 3.9.6**). A sensitivity run was performed to further tune the base model where the model input values for the bias adjustments matched the recommended values produced by the r4SS outputs following Methot and Taylor (2011).

3.2.7 Per-recruit Analyses

The expected results of a yield-per-recruit (YPR) analysis are to obtain targets of fishing mortality and age at first capture in effort to evaluate regulations regarding gear types (e.g. hook/mesh sizes and minimum sizes), fishing seasons, or fishing effort (e.g. harvest strategies; Haddon 2001). Overall, the assumed goal is to identify the maximum yield from the fishery and then to adjust that target based on risk aversion and uncertainty. Inherent in YPR analyses is the inconsideration of whether the target fishing effort is sustainable, and it assumes that the fishery has reached an equilibrium with the fishing mortality it exerts. It also assumes characteristics of natural mortality, growth, and recruitment are constant with stock size (Haddon 2001).

3.2.8 Catch Curve Analysis

A catch curve analysis using the Chapman-Robson estimator (Chapman and Robson 1960; Robson and Chapman 1961) was performed to provide a simple method of estimating total mortality (Z). The estimate of Z from the catch curve analysis can be used to help understand the fishing mortality rates estimated by the SEDAR 64 base model, and to serve as a diagnostic when comparing fishing mortality rates between this and the previous assessment. For the catch curve analysis, the number of observed Yellowtail Snapper-at-age within the filtered age data (see Section 2.2.1) were aggregated across time and examined to identify the appropriate starting age, typically the modal age plus one. The age composition data peaked at age-3 and then declined through age-20. Therefore, data for ages 4 – 20 (n = 18,316 otoliths) were assumed fully recruited and were used to estimate Z.

3.2.9 Benchmark/Reference Points Methods

In 1998, the South Atlantic Fishery Management Council (SAFMC) passed Amendment 11 which adopted spawning potential ratio (SPR)-based benchmark reference points for snappers and groupers using a target of 30% as the proxy for MSY. The amendment also established the proxy for optimum yield (OY) at 40% SPR. In 2011, the SAFMC set the acceptable catch limit (ACL) and acceptable biological catch (ABC) of Yellowtail Snapper equal to the OY (Regulatory Amendment 15). The Maximum Fishing Mortality Threshold (MFMT; also referred to as the overfishing limit, OFL) was defined as the fishing mortality rate that produces an SPR of 30% ($F_{30\%SPR}$) and is used to determine if overfishing is occurring. In 2014, the minimum stock size threshold (MSST) for Yellowtail Snapper was redefined by the SAFMC as 75 percent of spawning stock biomass at maximum sustainable yield (SSB_{MSY}; re-defined here as $SSB_{F30\%SPR}$) and is used to determine if a stock is overfished (Regulatory Amendment 21).

The jurisdictional allocation of Yellowtail Snapper ABC is 75% to the south Atlantic and 25% to the Gulf of Mexico; therefore, the overfishing and overfished criterion for Yellowtail Snapper is according to the SAFMC.

3.2.10 Projection Methods

Deterministic projections for a five-year time horizon, 2018 – 2022, were run under several fishing mortality scenarios with the selectivity for each fleet was taken from the terminal year of the assessment and relative fishing mortality rates for the directed fisheries were assumed to stay in proportion to their terminal three-year geometric mean (2015 – 2017) values. In addition, stock recruit parameters are assumed to be constant and recruitment for first year of projection is equal to the terminal three-year average. Fishing mortality scenarios include those listed in the Terms of Reference #10.

3.3 Base Model Results

3.3.1 Landings

Landings data for the commercial, headboat, and MRIP fleets were fit well within the SS base model (total negative log-likelihood = 5.388e-12). Standard errors for the log of the commercial data were quite low (0.05 – 0.1) and the predicted landings fit the observed landings exactly for all years (**Figure 3.9.7**). For the observed headboat and MRIP landings data, where standard errors in log-space could be larger than 0.25, predicted landings for both fleets also fit the observed landings exactly for all years (**Figure 3.9.7**). Since the predicted landings for each fleet was fit exactly, the RMSSE values for each fleet equaled zero.

3.3.2 Discards

The SS base model fits to the discard data and standardized residuals are presented in **Figures 3.9.8 – 3.9.11**. Discard data for the commercial, headboat, and MRIP fleets were fit fairly well within the SS base model (total negative log-likelihood = 140.735). Observed commercial discards tended to decline across the time series. The base model consistently underestimated observed commercial discard data through 2003 while maintaining the overall trend and consistently overestimated them beginning in 2009 while increasing in trend (**Figures 3.9.8 and 3.9.11**). The RMSSE values for the commercial discard fits were the lowest at 0.349 and was likely attributed to the data containing the highest CVs amongst the fleets. Predicted and observed discards for the headboat fleet exhibited similar trends except for a few years where consistent underestimation occurred (1997 – 2000) and consistent overestimation occurred (2004 – 2007; **Figures 3.9.9 and 3.9.11**). Uncertainty intervals were moderately large and thus the RMSSE associated with the headboat discards was 0.849. Observed MRIP discard data declined in trend through 2001 then varied without trend through 2017. Model predicted discards fit the observed data moderately well with under- and overestimation occurring in some years beyond the uncertainty intervals creating the highest RMSSE value at 2.363 (**Figures 3.9.10 and 3.9.11**).

3.3.3 Indices

The SS base model fits to two fishery-independent indices (RVC Adult, RVC Juvenile) and two fishery-dependent indices (Commercial, MRIP) along with the standardized residuals are presented in **Figures 3.9.12 – 3.9.16.** Model fits to the indices were generally adequate (total negative log-likelihood = -63.815). The two fishery-dependent indices, which were the longest time series, exhibited a declining trend until about the mid-1990s and then increased in trend through 2017. The two fishery-independent indices, which began in 1999, also exhibited this increasing trend. Model fits to the commercial index were adequate but underestimated the data in 2008 (**Figures 3.9.12 and 3.9.16)**. Allowing for a change in catchability beginning in 2009 following commercial fishermen input (see above Section 3.2.3.8) produced an improved fit to the commercial index for those years when compared to previous model versions (RMSSE = 1.013, $\text{RMSSE}_{\text{MAX}}$ = 1.23). Model fits to the beginning years of the MRIP index underestimated the initial decline and then began increasing in trend three years prior to the observed values. The model was then able to fit the increasing trends (RMSSE = 1.723, RMSSE$_{MAX}$= 1.23; **Figures 3.9.13 and 3.9.16**). The model fit to the RVC Adult index was relatively flat, overestimating the first two years and underestimating years 2008 and 2014 (RMSSE = 1.706, RMSSE$_{MAX}$=1.39; **Figures 3.9.14 and 3.9.16**). Fits to the RVC Juvenile index were similar but showed more of an increasing trend and a higher RMSSE (1.810, RMSSE$_{MAX}$=1.39; **Figures 3.9.15 and 3.9.16**).

3.3.4 Length and Age Composition

3.3.4.1 Data Weighting

Iterative reweighting of length and conditional length-at-age composition data was performed according to Francis composition weighting method TA1.8 (Francis 2011). Francis weights were calculated iteratively until they stabilized to the values presented in **Table 3.8.3**, which occurred on the 6th iteration. As shown, length compositions from commercial fleet and MRIP CPUE index were up-weighted the most, while length compositions for RVC indices as well as conditional age-at-length data were all down-weighted. Input and Francis estimated effective sample sizes for length compositions are presented in **Table 3.8.4** and the annual input and effective sample sizes for the conditional-age-at-length data are in **Table 3.8.5**.

3.3.4.2 Length Composition

The SS base model fits to the length composition data along with the Pearson residuals associated with the landings series, discard series and indices are presented in **Figures 3.9.17 – 3.9.27**. The quality of the fit varied among fleets and indices and fits aggregated across time were acceptable (total negative log-likelihood = 367.901; **Figure 3.9.17**). The model's predicted distributions were able to match the observed distributions but slightly underestimated the peak for the commercial and MRIP discards, MRIP retained, and the RVC Adult index.

The fits to the retained length composition data of the commercial fleet for each year were greatly improved after the Francis reweighting increased the effective sample size more than four times (**Figures 3.9.18 and 3.9.27**). Prior base model versions consistently underestimated length distribution peaks to a large degree and tended to overestimate the proportion of larger sizes for each year. Model fits are now generally in line with observed distributions for most years which contain higher effective sample sizes and exhibit some overestimation of smaller sizes for years of data with fewer samples (e.g. 2005, 2006, 2008). Fits to the commercial discard length composition data were reasonable but contained some degree of peak underestimation for half of the series probably due to the reduction catches of fish less than 20 cm in 2015 and later years (**Figures 3.9.19 and 3.9.27**).

For the retained length composition data of the headboat fleet, model fits were reasonable for most years and poor for the few years (e.g. 1992, 1993, 1996, 2004, or 2009) containing much lower effective sample sizes (**Figures 3.9.20 and 3.9.27**). Headboat retained length compositions tended to be consistently weighted higher for the last ten years of the timeseries. Fits to the discard length composition data were quite reasonable but overestimated distribution peaks for years 2005, 2007, and 2008 (**Figures 3.9.21 and 3.9.27**).

Unlike both the commercial and headboat retained length compositions, which exhibited smoother unimodal dome-shaped distributions for each year, the MRIP retained length compositions by year were jagged and occasionally bimodal due to the low observed sample sizes. Model fits to this data therefore were moderate and often underestimated peaks at smaller sizes while overestimating the proportion of fish at larger sizes (**Figures 3.9.22 and 3.9.27**). Fits to the MRIP discard length composition data were similar to the observed discard distributions, which showed more uniform distributions (**Figures 3.9.23 and 3.9.27**). Underestimation of peaks or overestimation of smaller sizes continued to occur for most years.

The shape of the distribution of the observed length compositions by year for the RVC Adult index tended to become jagged with increasing fish size. The model typically underestimated the initial peak then attempted to fit the descending slope by smoothing through the peaks (**Figures 3.9.24 and 3.9.27**). Observed length compositions by year for the RVC Juvenile index were comparatively smoother. However, the fluctuating proportions of smaller fish observed in each length bin by year, likely due in part to diver observation error and varying annual recruitment levels to the reefs, led to fits which consistently under- or overestimated the abundance at smaller length classes (**Figures 3.9.25 and 3.9.27**).

The fits to the length composition data for the MRIP index were reasonable for most years (**Figures 3.9.26 and 3.9.27**). For years (e.g. 2011, 2012, and 2016) when the composition data were more variable at larger sizes, the model tended to underestimate those abundances at length.

3.3.4.3 Age Composition

The SS base model fits to the conditional age-at-length composition data associated with the landings series and fishery-independent data are presented in **Figures 3.9.28 – 3.9.32.** The quality of the fit varied among data sources and fits to their respective mean ages aggregated across time were generally acceptable (total negative log-likelihood = 321.183; **Figure 3.9.28**).

The fits to the mean ages aggregated across time for the commercial fleet followed the trends of the observations with underestimation occurring in years 1997, 2002, 2003, 2008, and 2009 (**Figure 3.9.28**). The annual fits to the observed ages at smaller sizes was generally adequate for most years but the model also tended to underestimate the ages observed for larger size classes (**Figure 3.9.29**). This may be due to unrepresentative sampling of commercial ages coupled with differential growth patterns among regions (e.g. fish beyond the Florida Keys may grow faster and have larger asymptotic sizes). The sampling of commercial ages by region is not in proportion to the commercial landings. For example, over 85% of the Florida-only landings come from the Florida Keys, but sampled otoliths from the Florida Keys only comprise approximately 50% of the total number of otoliths sampled in Florida waters.

For the headboat landings, the trend of the observed mean ages aggregated across time was mostly flat and the model fit this trend quite reasonably (**Figure 3.9.28**). However, in the years when there were slight increasing trends, the model either slightly underestimated (e.g. 1997 and 1998) or overestimated the mean age (e.g. 2003 and 2004). The annual fits to the conditional age-at-length compositions were mostly well but exhibited underestimation of age at the smallest size for some years (e.g. 2006, 2010, 2011; **Figure 3.9.30**).

The trend of the mean ages aggregated across time for the MRIP landings was relatively flat and model fits were acceptable with underestimation occurring primarily in 2010 (**Figure 3.9.28**). The annual fits to the conditional age-at-length compositions were adequate for years where sample sizes were sufficient **(Figure 3.9.31**). Sample sizes were quite small for 1994, 2000, 2002, 2007, and 2011 and the model tended to consistently underestimate the ages-at-length for years 2008 – 2010.

The fits to the mean ages aggregated across time for the fishery-independent data source that was not linked to any fleet or index followed the variable trends of the observations quite well

(**Figure 3.9.28**). The annual fits to the conditional age-at-length compositions were also reasonable (**Figure 3.9.32**). Beginning in 2008, the number of observed ages per length bin decreased markedly but the model was largely able to match those observed values.

3.3.4.4 Growth

The von Bertalanffy growth curve estimated by the base model differs from the external size-truncated model, however, there is substantial overlap in the approximate confidence intervals (**Figure 3.9.3**). The external size-truncated model estimated L_{inf} to be approximately 42 cm and k to be 0.21 yr^{-1}, whereas the base model estimated L_{inf} to be approximately 36 cm and k to be 0.34 yr^{-1}. The difference occurring between these estimates of L_{inf} was primarily in response to the re-weighting of the length and conditional age-at-length data according to the Francis (2011) methodology. Earlier iterations of the base model, which did not have the length and conditional age-at-length data re-weighted by Francis (2011), estimated L_{inf} to be approximately 44 cm and k to be 0.25 yr^{-1}.

For the commercial fleet, there may be some conflict between the length and conditional age-at-length data. After re-weighting the length and conditional age-at-length data using the Francis (2011) methodology, the fits to the commercial length composition data improved substantially but the mean ages observed for larger size classes were underestimated (**Figure 3.9.29**). Within the data, the sampling proportions of ages by region were unrepresentative in relation to the proportion of landings by region. For example, 89% of the commercial landings in Florida between 1981 – 2017 came from the Florida Keys, but only 45% of commercial age data was from the Florida Keys. The result of implementing the Francis (2011) methodology, which heavily up-weighted the commercial length composition and down-weighted the conditional age-at-length data (**Table 3.8.3**), may have been that the growth parameters estimated by the SS base model align closer to the length-at-age observations from the Florida Keys.

3.3.5 Fishery Selectivity and Retention

Selectivities for all fleets and indices were estimated using length-based selectivity functions. Fleet-specific length-based selectivity and retention patterns, as well as assumed discard mortality rates, are illustrated in **Figures 3.9.33 – 3.9.35**.

The commercial fleet generally retained Yellowtail Snapper at the minimum size limit of 24 cm and full retention occurred by 29 cm (**Figure 3.9.33**). The amount of fish discarded by the commercial fleet was the lowest compared to the other fleets and fish length ranged primarily between 23 – 25 cm.

For the headboat fleet, selectivity of Yellowtail Snapper was generally between 24 – 35 cm (**Figure 3.9.34**). The probability that fish greater than 39 cm would be selected by this fishery was estimated to reach an asymptote of 40%. Retention of Yellowtail Snapper for the headboat fleet primarily started at the minimum size limit of 24 cm and full retention occurred at 29 cm. Discards mostly ranged between 19 – 26 cm.

Selectivity of Yellowtail Snapper within the MRIP fleet was generally between 20 – 26 cm and reached an asymptote of 45% by 27 cm (**Figure 3.9.35**). Retention of Yellowtail Snapper generally occurred at 25 cm and full retention occurred by 31 cm. The quantity of fish discarded by the MRIP fleet was the highest of the fleets and largely ranged between 17 – 27 cm.

Selectivity (vulnerability to observations by divers) of Yellowtail Snapper by the RVC Juvenile index occurred mostly between 2 cm (the lowest size bin) and 21 cm and peaked at 14 cm (**Figure 3.9.36**). Juvenile fish through 11 cm were consistently selected at 20%. For the RVC Adult index, fish were primarily selected between 19 – 39 cm and then reached an asymptote of 25% by 49 cm **(Figure 3.9.37**). The increasing slope of the RVC Adult index and the decreasing slope of the RVC Juvenile index was characteristically knife-edge due to the recommended 19 cm delineation.

3.3.6 Recruitment

The three parameters for defining the stock-recruitment relationship of Yellowtail Snapper within the SS base model were *steepness*, virgin recruitment estimated in log-space (*ln(R0)*), and the standard deviation of natural log recruitment (*sigmaR*). These parameters were estimated without priors (**Table 3.8.2**). The estimated value for *steepness* was 0.808 (*sd* = 0.13), the virgin recruitment in log-space was 9.897 (*sd* = 0.12) and equates to 19.5 million age-0 recruits, and the standard deviation of the natural log recruitment was 0.25 (*sd* = 0.05).

The plot of the stock-recruitment relationship estimated by the base model shows that for the time series modeled in this assessment, the stock has occupied a narrow range of spawning stock biomass relative to the origin and the theoretical virgin level (**Figure 3.9.39**). Recruitment estimates increased in trend between 1992 – 2014 and exhibited nearly cyclic patterns with stronger year classes in 1991, 1996, 2000, 2004, 2008, and 2011 – 2014. From 2015 – 2017 recruitment decreased back to levels estimated prior to 2011 and flattened in trend (**Figure 3.9.40**). No clear patterns were evident within the main recruitment deviation estimates and early recruitment deviations hovered around 0 between 1981 – 1985 before negatively deviating through 1989 (**Figure 3.9.40**).

3.3.7 Stock Biomass (total and spawning stock)

The predicted total biomass and spawning stock biomass are summarized in **Table 3.8.6** and **Figures 3.9.41** and **3.9.42**. The total biomass initially decreased between 1992 – 1996 from 5,949 mt to 3,877 mt and then began to increase in trend to around 7,000 mt through the terminal year (**Figure 3.9.41**). The total biomass in 2016 was estimated at the highest for the time series at 7,740 mt. This trend is also evident for the predicted spawning stock biomass (**Figure 3.9.42**).

3.3.8 Fishing Mortality

The annual instantaneous fishing mortality rates on age-4 Yellowtail Snapper are presented in **Table 3.8.7** and **Figure 3.9.43**. Fleet-specific fishing mortality rates (i.e. instantaneous apical rates representing the fishing mortality level on the most vulnerable age class) are presented in **Table 3.8.8** and **Figure 3.9.44**. The annual fishing mortality rate on Yellowtail Snapper was the highest from 1993 – 1995 (0.46 yr$_{-1}$ – 0.59 yr$_{-1}$), but declined steadily through 2001 (0.22 yr$_{-1}$) then became stable but variable through 2017 (**Figure 3.9.43**). The largest source of fishing mortality on Yellowtail Snapper came from the MRIP fleet where fishing mortality peaked in 1995 at 0.88 yr$_{-1}$, declined through 2001 and then varied between 0.17 yr$_{-1}$ and 0.69 yr$_{-1}$ around a mean of 0.37 yr$_{-1}$ (**Figure 3.9.44**). Fishing mortality rates from the commercial fleet declined in trend between 1993 – 2007 but increased slightly through 2017 (**Figure 3.9.44**). The headboat fleet exerted the least amount of fishing mortality and remained flat in trend varying between 0.01 – 0.05 yr$_{-1}$ (**Figure 3.9.44**).

3.3.9 Estimated Parameters

The estimated parameters are provided in **Table 3.8.2**. Most parameter estimates appeared reasonable and coefficients of variation (CV; standard error divided by parameter estimate) were low indicating relatively well estimated parameters. The parameters with the larger CVs were mainly from a few size selectivity parameters from the headboat and MRIP fleets along with both RVC indices.

Given the highly parametrized nature of the SS base model, some of the parameters were mildly correlated (correlation coefficient > 0.70) and only one pair of parameters showed strong correlations (> 0.95; **Table 3.8.9**). The estimated von Bertalanffy growth coefficient (*k*) was moderately correlated with the length at the minimum age (L_{min}) and the length at maximum age (L_{max}). The estimate of virgin recruitment in log-space (*ln(R0)*) was also moderately correlated with *steepness*. Moderate or strong correlations occurred between some of the parameters defining the peak of the double normal selectivity function and the parameter defining the width of the ascending limb of the double normal function or between the parameters defining the inflection point and ascending limb width of the logistic function. Correlation among these parameters is not at all surprising, especially for the selectivity parameters, because the parameters of selectivity functions are inherently correlated (i.e., as the value of one parameter changes the other value will compensate).

3.3.10 Model Diagnostics

3.3.10.1 Profile Likelihood

Steepness

The effect of varying fixed *steepness* values on the total and component-specific log-likelihood (LL) values are presented in **Figures 3.9.45 – 3.9.46.** For this exercise, *steepness* varied from 0.5 to 0.99 in increments of 0.01. The base run estimated *steepness* (=0.808) resulted in the lowest LL value, however the change in LL values is less than two for values of *steepness* ranging from approximately 0.65 to 0.99 (**Figure 3.9.47)**. In this case, LL values associated with each profiled run did not reach the base run LL value because the exact value estimated by the base run was not reproduced by the profiled values.

There is some conflict among model components (**Figure 3.9.46**). Fits to recruitment favor *steepness* values between 0.70 and 0.80, whereas fits to discards and length data are improved with high *steepness* values (> 0.90) and fits to index data are improved with low *steepness* values (< 0.70). However, there is little model sensitivity to changes in *steepness* values as characterized by model estimates of spawning stock biomass and fishing mortality rates (**Figure 3.9.47**).

Unfished Recruitment

Profiled values of unfished recruitment (*ln(R0)*) ranged from 9.8 to 10 in increments of 0.01. The total LL value is the lowest for the base run estimated unfished recruitment *ln(R0)* = 9.897; **Figure 3.9.48**), however all profiled LL values are within one unit of the base model LL suggesting a wide range of plausible values for *ln(R0)*. This is consistent with the stock-recruitment model (**Figure. 3.9.39**) in that there is a lot of variation in recruitment for a given stock size; the model estimates a general level for recruitment but mostly depends on other parameters. There are discrepancies among some model components. Fits to recruitment and index data are improved with higher unfished recruitment values while fits to length and discard data benefit from lower values (**Figure 3.9.49**). Derived model quantities such as spawning stock biomass and fishing mortality rates are not sensitive to profiled unfished recruitment values (**Figure 3.9.50**).

Recruitment Variability

Recruitment variability (*sigmaR*) was estimated in the base model to be 0.25 and corresponded to the lowest total LL value found (**Figure 3.9.51**); however, values of recruitment variability consistent with less than two LL units from the base run ranged from approximately 0.16 to 0.38 (**Figure 3.9.52**). Discard and length LL components are the lowest for high values of *sigmaR*, while recruitment and, to a lesser degree, index LL components improved with lower values of *sigmaR*. Estimates of spawning stock biomass and fishing mortality rates illustrate a modest level of sensitivity to recruitment variability in the most recent years (**Figure 3.9.53**).

Initial Fishing Mortality Rates

Initial fishing mortality (F) rates are profiled on a range of values depending on the fleet. For commercial, profiled values ranged from 0.05 yr$_{-1}$ to 0.20 yr$_{-1}$ by 0.002 yr$_{-1}$, headboat initial F values ranged from 0.01 yr$_{-1}$ to 0.10 yr$_{-1}$ by 0.002 yr$_{-1}$, while MRIP initial F values ranged from 0.05 yr$_{-1}$ to 1.00 yr$_{-1}$ by 0.01 yr$_{-1}$. As shown in **Figures 3.9.54, 3.9.56, and 3.9.58**, log-likelihoods associated with profiled values are at or above (i.e. worse than) the base run estimates, however the differences are minimal. In addition, there is no effect on estimates of spawning stock biomass and fishing mortality rates (**Figures 3.9.55, 3.9.57, and 3.9.59**). This is due to the model structure. There is no emphasis on fitting the initial equilibrium catch because the component is given a weight of zero in the LL function. Thus, there is no model sensitivity to these values. For that reason, plots of component-specific LL values are not included.

3.3.10.2 Jitter Analysis

A jitter analysis was performed to serve as an additional test of model convergence by varying the initial starting points by 20%. The base run LL value (744.447) corresponded to the minimum LL value found by performing 200 jitter runs, and the maximum LL found by the jitter analysis was much higher (3737.58). A bar plot of LL values for each model component associated with each jitter run is presented in **Figure 3.9.60**. Estimates of selected parameters associated with each jitter run are illustrated in **Figure 3.9.61**. While some parameters varied widely among jitter runs, the base run estimated value corresponded to the jitter run with the lowest LL value. The stability of the jitter analysis was adequate, however 140 runs had parameters on or near the bounds and 118 had gradients higher than the threshold (0.0001). **Table 3.8.10** identifies parameters that were estimated to be on or near defined bounds. Recruitment variability (*sigmaR*) was found to be on or near the bounds the most (62 runs). For these runs, recruitment variability was estimated to be at or near the lower bound of 0.005.

3.3.10.3 Parametric Bootstrap

A parametric bootstrap analysis produced 500 bootstrapped datasets. Fits to these datasets were concerning as most base run estimated parameters and derived quantities were outside of the central range of the estimates produced by the bootstrap analysis (**Figure 3.9.62**). Several avenues were explored to identify the source of these discrepancies. The main contributor of differences found between the data used to fit the base model and the bootstrapped datasets was how the effective sample sizes of conditional ages-at-length were being treated. Sample sizes for a bootstrapped dataset must be an integer and adding one to the effective sample size for each conditional age-at-length bin allowed for each bin to be rounded to at least one sample; thereby increasing the weight of the conditional age-at-length data within the bootstrap datasets relative to how its weighted in the base model. By not adding one to the effective sample size, the bootstrapping method forced the effective sample size of some conditional age-at-length bins to be rounded down to zero and failed.

Therefore, another bootstrap analysis was explored that assigned effective sample sizes of conditional-age-at-length bins to the nearest integer of the Francis re-weighted values and removed any conditional age-at-length bins with effective sample sizes rounded down to zero. Preliminary results from this analysis were more reasonable as the estimated parameters and derived quantities from the base model generally occurred within the interquartile range of the bootstrapped results. This suggests that the original bootstrap method of adding one to all effective sample sizes led to substantial differences in data weighting compared to the base model.

An important caveat to this analysis is that nearly all bootstrapped runs using both methods had gradients higher than 0.0001 and therefore, may not have all converged. Additionally, 391 of the original runs had parameters estimated to be on or near bounds. The parameter most commonly estimated near the bounds was the width of the descending limb for the selectivity of the RVC adult survey (**Table 3.8.11**).

3.3.10.4 MCMC Analysis

Convergence of two MCMC chains was assessed by visual inspection of trace plots (Figures **3.9.63 – 3.9.64**) and Gelman and Rubin's (1992) potential scale reduction factor which was implemented in the boa package in R (Smith 2007). Burn-in values for each chain were defined so that at least half the chain was removed and chains were of equal length. This resulted in a burn-in of 1,250 iterations for the first chain and 3,750 for the second. Then, the potential scale reduction factor was calculated for each of the selected model parameters (*steepness*, *ln(R0)*, and unfished SSB) and derived quantities (SSB in 2017 and the age-4 fishing mortality rate in 2017). Since upper confidence intervals for potential scale reduction factors did not exceed 1.01 for any of the model parameters and derived quantities, it was concluded that the MCMC converged.

Chains were combined and posterior distributions for the aforementioned quantities were produced, as well as the geometric mean of SSB from 2015-2017 [$SSB_{current}$] and geometric mean of age-4 fishing mortality rates from 2015-2017 [$F_{current}$] (**Figure 3.9.65**). Base model results fall within the interquartile range of posterior distributions for all considered parameters, however trace plots for the second chain indicate some inter-chain correlation issues between the 1000th and 1500th iterations. Additionally, the posterior distribution of *steepness* is quite flat for values greater than 0.75, indicating the data are not particularly informative for this parameter.

3.3.10.5 Jack-knife Analysis on Indices of Abundance

The effect of each index of abundance on base run estimates was evaluated by removing indices one at a time and refitting the base model. This analysis identified the fishery dependent MRIP CPUE index as having an effect on the magnitude of spawning stock biomass and fishing mortality rates, however the trends in these derived quantities were not affected (**Figure 3.9.66**). Selected parameters and derived quantities were compared among 'jack-knife' runs (**Table 3.8.12**).

3.3.10.6 Retrospective Analysis

A retrospective analysis showed no discernable patterns in estimates of spawning stock biomass, fishing mortality rates, or recruitment when removing successive terminal years (**Figure 3.9.67**). Two retrospective runs resulted in *sigmaR* on the lower bound (0.005), and thus nearly constant recruitment. The calculated values for Mohn's ρ for SSB (ρ = -0.04), F (ρ = 0.06), and recruitment (ρ = -0.10) were well within the "acceptable" range for longer-lived species according to Hurtado-Ferro et al. (2015).

3.3.10.7 Sensitivity Runs

Start Year

There was very little model sensitivity to the start year as demonstrated by a sensitivity analysis that changed the start year from 1992 to 1981 (i.e. the start year in SEDAR 27A), although estimated *steepness* decreased from 0.81 to 0.62 and unfished SSB and recruitment increased after adding additional years. These results are summarized in **Figure 3.9.68** and **Table 3.8.13**.

Discard Mortality

Per the Data Workshop recommendations, three discard mortality sensitivity run scenarios were performed. For the commercial fleet, the upper bound sensitivity was set at 15%. In the sensitivity runs for the recreational fleets, both headboat and MRIP discard mortality rates were set at 20% and then at 30%. Both runs altering the recreational discard mortality rate resulted in gradients slightly higher than the threshold (0.001 > 0.0001).

Model results were insensitive to an increase in commercial discard mortality rates from 10% to 15% due to the low magnitude of live discards. Therefore, only comparisons of the base model and two models varying recreational discard mortality rates are shown in **Figure 3.9.69** and **Table 3.8.14**. Note that the total LL value when the recreational discard mortality rate was equal to 20% was much higher than the base total LL and alternative discard rate scenario (discard mortality = 30%), suggesting the model did not converge to a global solution. As shown in **Figure 3.9.69**, increasing the discard mortality rate for recreational fleets led to minimal changes in model results. Recruitment increased slightly as discard mortality rates increased. MSST increased and MFMT decreased slightly for the highest discard rate scenario.

Bias Adjustments to the Recruitment Deviations

After implementing the Francis (2011) re-weighting procedure, the recommended bias adjustment values no longer agreed with the model input values (see Section 3.2.3.3; **Figure 3.9.6**). A sensitivity run was performed to further tune the base model where the model input values for the bias adjustments matched the recommended values produced by the r4SS outputs following Methot and Taylor (2011). The results indicated very little sensitivity as changes to the recruitment deviations, virgin recruitment (*ln[R0]*), *steepness*, and *sigmaR* differed insignificantly. The bias adjustment values in the base model inputs were therefore not updated to the newly recommended values as time and resources prohibited full model diagnostics and projections from being rerun on this model iteration. Thus, the base model reflects the bias adjustment values recommended before the Francis (2011) re-weighting procedure.

3.3.11 Per-recruit Analyses

The yield-per-recruit (YPR), spawner-per-recruit (SSB/R), static spawning potential ratio (SPR), and total equilibrium yield analyses were computed as a function of the instantaneous fishing mortality rate on age-4 Yellowtail Snapper and are presented in **Table 3.8.15** and **Figure 3.9.70**.

Presented with these values is also their relation to the Maximum Fishing Mortality Threshold (MFMT) defined as $F_{30\%SPR}$. The SPR values by year were also calculated and are presented in **Figure 3.9.71**. The amount of retained yield of Yellowtail Snapper at equilibrium associated with $F_{30\%SPR}$ was estimated by the SEDAR 64 base model to be at 1,607 metric tons (3,542,829 pounds).

3.3.12 Catch Curve Analysis

The results of the catch curve analysis showed Z to be estimated at 0.57 yr^{-1}. Using the constant natural mortality rate of 0.22 yr^{-1} from the $Hoenig_{alltaxa}$ equation (Hoenig 1983; see Section 2.2.2), the corresponding fishing mortality rate for Yellowtail Snapper was 0.35 yr^{-1}. This rough approximation of the fishing mortality rate provided by the catch curve analysis was found to align with the annual fishing mortality rates estimated by the SEDAR 64 base model which ranged from 0.22 – 0.59 yr^{-1} with a mean of 0.33 yr^{-1}. This suggests that the level of fishing mortality rates estimated by the SEDAR 64 base model were reasonable despite being higher than what was estimated by SEDAR 27A.

3.3.13 Benchmark and Reference Points

A summary of the stock status determination criterion and their values according to the SAFMC and the GMFMC are presented in **Table 3.8.16**.

The Maximum Fishing Mortality Threshold (MFMT; also referred to as the overfishing limit, OFL) for SEDAR 64 Yellowtail Snapper is defined as $F_{30\%SPR}$ and overfishing is occurring if the recent average of fishing mortality rates ($F_{current}$) exceeds the MFMT. $F_{current}$ is calculated as the geometric mean of age-4 Yellowtail Snapper fishing mortality rates for 2015 – 2017. The MFMT for SEDAR 64 was estimated to be 0.438 yr^{-1} and $F_{current}$ was estimated to be 0.298 yr^{-1} and F_{2017} was estimated to be 0.343 yr^{-1}. Based on the results of the SEDAR 64 base model, the southeastern U.S. Yellowtail Snapper stock is not experiencing overfishing ($F_{current}$/MFMT = 0.68). Annual estimates of fishing mortality rates on age-4 fish relative to the MFMT are presented in **Figure 3.9.72** and **Table 3.8.17.** Throughout the assessment time period, annual estimates of fishing mortality rates were above the MFMT between 1993 and 1995 but then fell below the MFMT and have been variable but stable. Optimum yield (OY) is defined as the retained yield at $F_{40\%SPR}$ where $F_{40\%SPR}$ was estimated to be 0.271 yr^{-1}. OY was therefore estimated to be 1,497 metric tons (3,300,320 pounds).

The minimum stock size threshold (MSST) for SEDAR 64 Yellowtail Snapper is defined as 75 percent of the spawning stock biomass associated with $F_{30\%SPR}$ (0.75* $SSB_{F30\%SPR}$). The stock is overfished if the recent average spawning stock biomass ($SSB_{current}$) is less than MSST. $SSB_{current}$ is calculated as the geometric mean of the spawning stock biomass for 2015 – 2017. The $SSB_{F30\%SPR}$ for SEDAR 64 was estimated at 1,904 metric tons (4,197,601 pounds) and MSST was therefore defined as 1,428 metric tons (3,148,201 pounds). $SSB_{current}$ was estimated to be 3,223 metric tons (7,105,499 pounds) and SSB_{2017} was estimated to be 3,207 metric tons (7,070,225 pounds). Based on the results of the SEDAR 64 base model, the southeastern U.S. Yellowtail Snapper stock is not overfished ($SSB_{current}$/MSST = 2.26). Annual estimates of spawning stock biomass relative to $SSB_{F30\%SPR}$ and MSST are presented in **Figure 3.9.73** and **Table 3.8.17**. The spawning stock biomass of Yellowtail Snapper has never declined below the MSST, however the MSST was within the uncertainty range of the spawning stock biomass estimates for 1996 and 1997.

The posterior distributions produced by the MCMC analysis were developed for management criteria and benchmark reference points $F_{30\%SPR}$, $F_{current}$/MFMT, $SSB_{F30\%SPR}$, $SSB_{current}$/MSST, and the retained yield associated with $F_{30\%SPR}$ and are presented in **Figure 3.9.74**. The estimates for these reference points produced by the SEDAR 64 base model are near the median values and are within the interquartile ranges of the posterior distributions. The distribution of $F_{current}$/MFMT is entirely below one, indicating a high probability that overfishing is not occurring, and the distribution for $SSB_{current}$/MSST is entirely above one, indicating a high probability that the stock is not overfished.

The estimates of spawning stock biomass and fishing mortality rates from the SEDAR 64 base model were rather different than the estimates reported in the previous assessment (SEDAR 27A). The SEDAR 64 base model estimated spawning stock biomass much lower and estimated fishing mortality rates much higher over the same assessment period. The MFMT estimated by the SEDAR 64 base model was 0.438 yr^{-1} compared to what was reported in the previous assessment (0.295 yr^{-1}; SEDAR 27A). The $SSB_{F30\%SPR}$ estimated by the SEDAR 64 base model

(1,904 mt) was a little over half of the $SSB_{F30\%SPR}$ reported in SEDAR27A (3,072 mt). Despite these differences, the status of the stock has not changed between assessments. Even under the previous definition of MSST ($MSST_{old}$ = [1-M]*$SSB_{F30\%SPR}$) which was used in SEDAR 27A, the results of the SEDAR 64 base model would not have been very different, as MSST would have equaled 1,485 mt ($MSST_{old}$ = [1 – 0.22] * 1,904) and the stock would still be considered not overfished. The causes that affected the changes in the scale of these estimates were primarily due to model configuration and model framework differences. This was further explored through an extensive model bridging exercise and the results are discussed below in Section 3.4.

3.3.14 Projections

As per term of reference number 10, deterministic projections for a five-year time horizon, 2018 – 2022, were run under several fishing mortality scenarios. The first scenario was to assume the overall fishing mortality rate was equal to the terminal three-year geometric mean (2015 – 2017) values. For reference, the average fishing mortality for age-4 fish ($F_{current}$) is 0.30 yr^{-1}. SSB is projected to decrease marginally and recruitment is projected to stay nearly constant and equal to the last year's values (**Figure 3.9.75**).

The second scenario was to assume fishing mortality rates were equal to MFMT (i.e. $F_{30\%SPR}$; 0.44 yr^{-1}). Because this scenario resulted in a higher fishing mortality than current values, SSB is projected to decrease, as is recruitment albeit to a lesser degree (**Figure 3.9.76**).

The population was projected under a third scenario; fishing mortality rates equal to 75% of MFMT (0.33 yr^{-1}), which is very close to $F_{current}$. **Figure 3.9.77** illustrates the results of this projection run closely align with the first scenario.

The final projection scenario was to assume fishing mortality rates from 2018 – 2022 were held constant at a rate that would produce equilibrium yield (F_{MSY}=0.55 yr^{-1}). Fishing mortality was the highest in this scenario leading to sharp declines in spawning stock biomass and moderate declines in recruitment (**Figure 3.9.78**).

3.4 **Model Bridging**

3.4.1 Methods

A model building exercise was undertaken to provide a comprehensive bridge between the SEDAR 27A Final Model and the SEDAR 64 Base Model. This exercise consisted of three stages: the first stage transferred the SEDAR 27A Final Model (originally conducted in ASAP version 2) to ASAP version 3.0.16 and ensured that both model versions produced the same results. The version 3 SEDAR27A Final Model was extended with SEDAR 64 data as closely as possible. This is referred to as the SEDAR 64 Continuity Model and is presented in Section 3.1. The second stage of model building was to develop and finalize the SEDAR64 ASAP Model in parallel with a Stock Synthesis 3.3 model. The third stage was the complement of the first and used the original SEDAR 27A data with the SEDAR 64 ASAP configuration. **Table 3.8.1** highlights the major differences in model configurations between the SEDAR 27A Final Model/SEDAR 64 Continuity Model, SEDAR 64 Base Model (SS3), and SEDAR 64 ASAP Model (ASAP).

The data requirements for the SEDAR 64 Base Model (in SS) and the SEDAR 64 ASAP Model overlap extensively, however major differences exist between the two modeling frameworks. The ASAP3 model is a forward-projecting, statistical catch-at-age model and requires catch-at-age matrices and age-based selectivities. Stock Synthesis is also at statistical catch-at-age model but allows the use of either age or length-based selectivities and explicitly models length-based retention to align with fishery regulations. The ASAP model cannot use length composition data directly and requires external assignment of ages to length frequencies, while the SS relies heavily on the growth curve to assign ages to lengths. In SS, the growth parameters are refined with conditional age-at-length data. The ASAP model does not require any assumptions on growth if an empirical age-length key is used to derive catch and weight-at-age matrices. Another difference between the two modeling frameworks is the treatment of age-0 fish. Growth and mortality of age-0 fish can be handled explicitly in SS, while in ASAP, recruitment occurs at age-1 and therefore does not incorporate catch and indices of age-0 fish.

The configuration of the SEDAR 64 ASAP Model aligns as closely as possible to the SEDAR 64 Base Model in SS. **Table 3.8.1** presents an overview of the similarities and differences between the configurations of these two models. In addition to the differences between model frameworks as described above, configuration differences include the treatment of the RVC juvenile survey, the timing of spawning, time varying catchability, model start year and composition data weighting. The selectivity of the RVC juvenile survey is length based in SS3 and can include any corresponding age in theory, while the selectivity of the RVC juvenile survey is only on age 1 fish in ASAP. In a one season SS model, spawning must occur on January 1. Alternatively, ASAP allows for greater flexibility in the specification of the timing of spawning (e.g. April). Time varying catchability for indices in ASAP can only be implemented as annual deviations as opposed to blocks of years. Lastly, due to time constraints and model stability issues, the SEDAR 64 ASAP Model used a start year of 1981 and did not apply the reweighting of composition data according to Francis (2011).

In the final stage of model bridging, an ASAP model was developed which utilized the SEDAR 27A data but with the SEDAR 64 ASAP configuration. An example of a configuration change in SEDAR 64 was to use dome-shaped selectivities (double logistic) for headboat and recreational fisheries. Another would be the shifting the mid-year spawning season to the beginning of April based on the RVC length data. Additionally, ASAP3 allows the use of fleet-specific average weight-at-age matrices for catch and discards, while ASAP2 allowed only one average weight-at-age matrix that was applied to both catch and discards. The effect of this limitation was explored with the SEDAR 27A Final Model in version 3 and entering fleet-specific average weight-at-age matrices for catch and discards from SEDAR 27A data.

3.4.2 Results

Model bridging results are presented in **Figures 3.9.79** and **3.9.80**. As shown in **Figure 3.9.79**, the results of SEDAR 64 ASAP Model align closely with the SEDAR 64 Base Model. Estimated spawning stock biomasses are very similar from 1999 – 2017, as are abundances of age-1 fish. Estimated fishing mortality rates for the SEDAR 64 ASAP Model are estimated to be slightly higher than the Base Model estimated fishing mortality rates, and much higher than the continuity model.

When the configuration of the SEDAR 64 ASAP Model was applied to the SEDAR 27A data, the results closely resembled that of the SEDAR 64 ASAP Model (and by extension the SEDAR 64 Base Model) as illustrated in **Figure 3.9.80**. This exercise suggested that the major differences in model results between the SEDAR 27A Final Model and the SEDAR 64 Base

Model could be attributed more to differences in configuration settings and less so to differences in data and model frameworks (i.e. ASAP vs SS).

To further understand which part of the configuration made a difference, the SEDAR 27A Final Model was run with SEDAR 27A data except with fleet-specific average weight-at-age for landings and discards. This model also produced results that resembled the SEDAR 64 ASAP Model results (**Figure 3.9.81**), suggesting that this configuration difference may be driving the notable differences in model results between the SEDAR 27A Final Model and the SEDAR 64 Base Model. The SEDAR 27A Final Model was developed using ASAP version 2 which only allowed a single catch weight-at-age matrix, while ASAP version 3 allows the user to specify the needed number of weight-at-age matrices. This issue does not arise in the SS model because the fleet selectivities of landings and discard create distinct average weight-at-age matrices. The discussion and research recommendations of the SEDAR 27A assessment report (O'Hop *et al.* 2012) noted that the fishing mortality rates for Yellowtail Snapper were too low and corresponding spawning biomasses were too high. However, these issues were not resolved in that assessment.

3.5 Discussion

The SEDAR 64 Base Model performed fairly well, and the Stock Synthesis framework improved upon some of the deficiencies encountered with the ASAP version 2 model framework of the SEDAR 27A Final Model. Significant changes to data inputs since SEDAR 27A included the use of revised MRIP data, lengths of commercial discards from observer data, and the use of Florida-only data. In addition to transferring model frameworks from ASAP to SS, significant changes to model configuration included changing the selectivity patterns of recreational fleets to dome-shaped, removing the headboat index of abundance, and partitioning the RVC index into separate juvenile and adult indices (see **Table 3.8.1** for additional configuration details). Other major changes to the assessment model included starting the model in 1992 to take advantage of the period with greater data richness and reliability, using size-based selectivity for fishing fleets and indices of abundance rather than age-based selectivity, and implementing the Francis (2011) method for iterative re-weighting of the length and conditional age-at-length data.

Model fits and diagnostics overall for the SEDAR 64 Base model were acceptable and suggests that the model may be suitable for use in the management of Yellowtail Snapper. The Stock

Synthesis model framework and the r4ss package supported additional diagnostics not available to or performed on the SEDAR 27A Final Model (e.g. a catchability block applied to the commercial index, likelihood profiling, jitter analysis, and jack-knife analysis), thereby bolstering stability and confidence in the model having found a global solution. However, several sources of uncertainty within the data remain. The bootstrap analyses demonstrated sensitivity to effective sample sizes of conditional age-at-length data that may be due in part to the conflict between some of the length composition data and the conditional age-at-length data for certain fleets (e.g. the commercial fleet). In contrast, the results from the MCMC analysis, which explored uncertainty beyond the estimated standard deviations of the parameters, showed that parameter and derived quantity estimates from the SEDAR 64 Base Model aligned with interquartile ranges of the posterior distributions.

Another source of uncertainty within this assessment was the stock-recruitment relationship. For this assessment and SEDAR 27A, the *steepness* parameter was estimated to be 0.808 and 0.69, respectively, while it was fixed in SEDAR 3 (Muller *et al.* 2003) at 0.80. While a value of 0.808 resulted in the lowest log-likelihood value, the change in log-likelihood was less than two for *steepness* values ranging from approximately 0.68 – 0.99 and the SEDAR 64 Base Model was mostly insensitive to these changes. This can also be seen in the stock-recruitment relationship estimated for Yellowtail Snapper that showed the stock occupying a narrow range of spawning stock biomass relative to the origin and the theoretical virgin level.

According to the SEDAR 64 Base Model, the southeastern U.S. Yellowtail Snapper population is not overfished or experiencing overfishing and the population is estimated at over two times the minimum stock size threshold (MSST). Status designation of this stock has not changed since the first assessment (SEDAR 3). The magnitude of estimated spawning stock biomass and fishing mortality rates has substantially changed since the last assessment (SEDAR 27A) but are comparable to the results from SEDAR 3 (**Figure 3.9.82**). The source of this disparity may stem, in large part, from a limitation of the modeling framework that was used for SEDAR 27A (ASAP 2) as discussed above in Section 3.4.

3.6 Research Recommendations

Age and Growth

Age data for southeastern U.S Yellowtail Snapper suggest there may be multiple growth patterns, such that fish beyond the Florida Keys may grow faster and have larger asymptotic sizes. Data are sparse however outside of South Florida, limiting these speculations. Therefore, a recommendation is to increase otolith sampling outside of South Florida and to explore alternative model configurations that allow for multiple growth patterns (e.g. multiple areas, areas-as-fleets). It is also recommended to increase otolith sampling for private and charterboat modes which are highly under represented. Lastly, it is recommended to explore methods to weight the age data sampled from landings accordingly to account for regional differences and uneven sampling of the landings.

Length Composition

For length samples to be a better representation of the length composition of landings and discards, it is recommended to increase sampling of lengths in regions outside of the Florida Keys as presented in S64-AW-01. Length compositions of discards are valuable model inputs, therefore it is recommended to continue data collection from at-sea observer programs and to expand the coverage of these programs. This was also a research recommendation discussed in SEDAR 27A. Additionally, it is recommended to increase length sampling for private and charter recreational modes which are highly under represented.

Commercial Discards

Commercial discards are currently highly uncertain. It is recommended to explore data collection and data analysis methods to increase precision on these estimates.

Headboat Landings and Discards

Uncertainty of headboat landings and discards are unknown and should be evaluated. Additionally, some headboats in South Florida are exempt from participating in the SRHS and no federally administered surveys have absorbed these vessels into their sample frames, eliminating opportunities for these vessels to report landings or fishing effort.

Fishery Independent Data

Age samples for Yellowtail Snapper from fishery independent sources are lacking and would be highly useful in determining growth. In addition, an index of abundance of young-of-the-year

(<10 cm FL) Yellowtail Snapper targeted in seagrass habitat would aid in refining the recruitment signal over time of this species.

3.7 References

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3.8 Tables

Table 3.8.1. An overview of configuration settings for SEDAR 27A Final Model (S27A), SEDAR 64 Base Model (SS3), and SEDAR 64 ASAP Model (ASAP 3). *note: the reweighting procedure in S27A only decreased effective sample sizes according to Francis (2011).

Assessment		**S27A**	**S64**	
Framework		ASAP 2	ASAP 3	SS3
Natural mortality		Fixed at age	Fixed at age	Fixed at age
Maturity		Fixed at age	Fixed at age	Fixed at age
Growth		-	-	Estimated
Steepness		Estimated	Estimated	Estimated
Sexes		Combined	Combined	Combined
SSB		Female	Female	Female
Fraction of year before spawning		0.5	0.25	0
Number of weight-at-age matrices		3	10	-
# of Selectivity blocks		9	3	3
Fleet Selectivity	Commercial	Flat-topped	Flat-topped	Flat-topped
	Recreational MRIP	Flat-topped	Dome-shaped	Dome-shaped
	Headboat	Flat-topped	Dome-shaped	Dome-shaped
Indices		RVC age 1+ Com CPUE HB CPUE MRIP CPUE	RVC Juv RVC Adult Com CPUE MRIP CPUE	RVC Juv RVC Adult Com CPUE MRIP CPUE
Index selectivity	RVC age 1+	Age-specific	-	-
	RVC Juv	-	Age-1	Dome-shaped
	RVC Adult	-	Dome-shaped	Dome-shaped
	Com CPUE	linked	linked	linked
	HB CPUE	linked	-	-
	MRIP CPUE	linked	linked	mirrored to MRIP selectivity
Catchability	RVC age 1+	constant	-	-
	RVC Juv	-	constant	constant
	RVC Adult	-	constant	constant
	Com CPUE	constant	annual devs	block: 2009-2017
	HB CPUE	constant	-	-
	MRIP CPUE	constant	constant	constant
Weighting Factors (λ)	Indices	< 1	1	1
	Deviation from initial steepness	1	1	-
	Deviation from initial N	1	0	-
	Deviation from initial SSB0	1	-	-
	Deviation from initial R1	-	0	-
	Deviation from initial F-Mult	1	0	-
	Deviation from Equilibrium Catch	-	-	0
Iterative Reweighting of ESS (N)		yes*	no	yes
Calculate Likelihood Constants		yes	no	no

Table 3.8.2. List of Stock Synthesis parameters used in the base model for southeastern U.S. Yellowtail Snapper. The list includes estimated parameter values and their associated standard deviations (SD) and coefficients of variation (CV = SD/value), lower and upper bounds of the parameters (Min, Max), initial starting points (Init), prior types (Prior Type) and prior standard deviations (Prior SD) assigned where applicable, and estimation phases (negative parameters identify fixed inputs). Fixed parameters were held at their initial values and have no associated range or SD.

Number	Label	Value	Min	Max	Init	SD	CV	Prior type	Prior SD	Phase
1	L_at_Amin_Fem_GP_1	5.352	2	20	2	0.701	0.131			3
2	L_at_Amax_Fem_GP_1	36.229	25	60	42.3	0.965	0.027			4
3	VonBert_K_Fem_GP_1	0.342	0.1	0.5	0.207	0.027	0.078			4
4	CV_young_Fem_GP_1	0.233	0.1	0.5	0.179	0.018	0.077			6
5	CV_old_Fem_GP_1	0.188	0.005	0.4	0.179	0.012	0.063			6
6	Wtlen_1_Fem_GP_1	2.574E-05	0	3	2.57E-05					-3
7	Wtlen_2_Fem_GP_1	2.880	1	4	2.8797					-3
8	Mat50%_Fem_GP_1	1.700	0	5	1.7					-3
9	Mat_slope_Fem_GP_1	-2.706	-4	-1	-2.706					-3
10	Eggs_intercept_Fem_GP_1	0.000	-3	3	0					-3
11	Eggs_slope_Wt_Fem_GP_1	1.000	-3	3	1					-3
12	CohortGrowDev	1.000	0	1	1					-4
13	FracFemale_GP_1	0.500	0.5	0.5	0.5					-4
14	SR_LN(R0)	9.897	5	20	13	0.120	0.012			5
15	SR_BH_steep	0.808	0.3	0.99	0.75	0.130	0.161			5
16	SR_sigmaR	0.250	0.005	0.8	0.2	0.048	0.194			7
17	SR_regime	0.000	-5	5	0					-4
18	SR_autocorr	0.000	0	0	0					-99
19	Early_InitAge_11	0.016	-4	4	0	0.252	15.598			6
20	Early_InitAge_10	0.020	-4	4	0	0.252	12.304			6
21	Early_InitAge_9	0.012	-4	4	0	0.250	21.606			6
22	Early_InitAge_8	0.015	-4	4	0	0.248	16.726			6
23	Early_InitAge_7	0.045	-4	4	0	0.245	5.463			6
24	Early_InitAge_6	-0.029	-4	4	0	0.237	8.050			6
25	Early_InitAge_5	-0.166	-4	4	0	0.230	1.387			6
26	Early_InitAge_4	-0.309	-4	4	0	0.219	0.708			6
27	Early_InitAge_3	-0.314	-4	4	0	0.198	0.632			6
28	Early_InitAge_2	-0.103	-4	4	0	0.187	1.811			6
29	Main_InitAge_1	0.263	-4	4	0	0.166	0.632			3

Table 3.8.2. Continued List of Stock Synthesis parameters for southeastern U.S. Yellowtail Snapper.

Number	Label	Value	Min	Max	Init	SD	CV	Prior type	Prior SD	Phase
30	Main_RecrDev_1992	-0.164	-4	4	0	0.137	0.834			3
31	Main_RecrDev_1993	-0.457	-4	4	0	0.146	0.321			3
32	Main_RecrDev_1994	-0.272	-4	4	0	0.137	0.503			3
33	Main_RecrDev_1995	0.223	-4	4	0	0.112	0.501			3
34	Main_RecrDev_1996	-0.163	-4	4	0	0.155	0.950			3
35	Main_RecrDev_1997	-0.056	-4	4	0	0.141	2.502			3
36	Main_RecrDev_1998	-0.102	-4	4	0	0.140	1.379			3
37	Main_RecrDev_1999	-0.025	-4	4	0	0.132	5.189			3
38	Main_RecrDev_2000	0.209	-4	4	0	0.119	0.568			3
39	Main_RecrDev_2001	-0.175	-4	4	0	0.132	0.754			3
40	Main_RecrDev_2002	-0.229	-4	4	0	0.112	0.491			3
41	Main_RecrDev_2003	-0.057	-4	4	0	0.112	1.975			3
42	Main_RecrDev_2004	0.334	-4	4	0	0.097	0.290			3
43	Main_RecrDev_2005	-0.025	-4	4	0	0.113	4.467			3
44	Main_RecrDev_2006	0.134	-4	4	0	0.103	0.769			3
45	Main_RecrDev_2007	-0.009	-4	4	0	0.108	12.410			3
46	Main_RecrDev_2008	0.196	-4	4	0	0.098	0.499			3
47	Main_RecrDev_2009	-0.112	-4	4	0	0.110	0.988			3
48	Main_RecrDev_2010	-0.044	-4	4	0	0.107	2.430			3
49	Main_RecrDev_2011	0.232	-4	4	0	0.097	0.419			3
50	Main_RecrDev_2012	0.529	-4	4	0	0.093	0.175			3
51	Main_RecrDev_2013	0.295	-4	4	0	0.106	0.360			3
52	Main_RecrDev_2014	0.317	-4	4	0	0.109	0.344			3
53	Main_RecrDev_2015	-0.110	-4	4	0	0.140	1.276			3
54	Main_RecrDev_2016	0.082	-4	4	0	0.138	1.676			3
55	Main_RecrDev_2017	-0.009	-4	4	0	0.248	26.740			3
56	ForeRecr_2018	0.000	-4	4	0	0.250	0.000			8
57	Impl_err_2018	0.000								
58	InitF_seas_1_flt_1COM	0.134	0	0.5	0.25	0.161	1.196	Sym_Beta	0.5	1
59	InitF_seas_1_flt_2HB	0.062	0	0.1	0.05	0.072	1.162	Sym_Beta	0.2	1
60	InitF_seas_1_flt_3MRIP	0.667	0	1	0.5	0.350	0.525	Sym_Beta	0.2	1
61	LnQ_base_COM(1)	-6.954	-18	5	-7	0.089	0.013			2
62	LnQ_base_RVC_Adult(4)	-8.407	-18	5	-8					-1

Table 3.8.2. Continued List of Stock Synthesis parameters for southeastern U.S. Yellowtail Snapper.

Number	Label	Value	Min	Max	Init	SD	CV	Prior type	Prior SD	Phase
63	LnQ_base_RVC_Juv(5)	-8.058	-18	5	-8					-1
64	LnQ_base_MRIP_CPUE(6)	-8.342	-18	5	-8					-1
65	LnQ_base_COM(1)_BLK1repl_2009	-6.658	-12	5	-6	0.102	0.015			2
66	Size_inflection_COM(1)	25.994	10	35	27	0.212	0.008			2
67	Size_95%width_COM(1)	3.579	1	20	7.4	0.290	0.081			3
68	Retain_L_infl_COM(1)	24.212	5	35	29	0.217	0.009			3
69	Retain_L_width_COM(1)	0.697	0.6	5	2.4	0.081	0.117			4
70	Retain_L_asymptote_logit_COM(1)	6.035	1	30	1.5	0.668	0.111			4
71	Retain_L_maleoffset_COM(1)	0.000	-1	1	0					-3
72	DiscMort_L_infl_COM(1)	1.000	0.5	1.5	1					-3
73	DiscMort_L_width_COM(1)	1.00E+06	1.00E+04	1.00E+08	1.00E+06					-3
74	DiscMort_L_level_old_COM(1)	-0.800	-1.5	0	-0.8					-3
75	DiscMort_L_male_offset_COM(1)	0.000	-1	2	0					-3
76	Size_DblN_peak_HB(2)	27.984	11.1	40	23	0.557	0.020			2
77	Size_DblN_top_logit_HB(2)	-12.632	-18	-1	-10	83.801	6.634			3
78	Size_DblN_ascend_se_HB(2)	3.532	-4	12	3.5	0.149	0.042			4
79	Size_DblN_descend_se_HB(2)	2.642	-2	6	3.5	0.697	0.264			4
80	Size_DblN_start_logit_HB(2)	-8.421	-15	5	-10	4.082	0.485			3
81	Size_DblN_end_logit_HB(2)	-0.379	-10	5	-5	0.353	0.931			3
82	Retain_L_infl_HB(2)	24.235	15	35	27	0.136	0.006			3
83	Retain_L_width_HB(2)	0.708	0.1	12	2.4	0.081	0.114			4
84	Retain_L_asymptote_logit_HB(2)	5.298	1	10	4	1.009	0.190			4
85	Retain_L_maleoffset_HB(2)	0.000	-1	1	0					-3
86	DiscMort_L_infl_HB(2)	1.000	0.5	1.5	1					-3
87	DiscMort_L_width_HB(2)	1.00E+06	1.00E+04	1.00E+08	1.00E+06					-3
88	DiscMort_L_level_old_HB(2)	-0.800	-1.5	0	-0.8					-3
89	DiscMort_L_male_offset_HB(2)	0.000	-1	2	0					-3
90	Size_DblN_peak_MRIP(3)	23.019	11.1	30	23	0.021	0.001			2
91	Size_DblN_top_logit_MRIP(3)	-14.638	-18	1	-7	55.384	3.784			3
92	Size_DblN_ascend_se_MRIP(3)	2.763	0	5	2	0.064	0.023			4
93	Size_DblN_descend_se_MRIP(3)	-10.573	-25	6	2	88.965	8.414			4
94	Size_DblN_start_logit_MRIP(3)	-6.565	-20	7	-7	0.713	0.109			3

Table 3.8.2. Continued List of Stock Synthesis parameters for southeastern U.S. Yellowtail Snapper.

Number	Label	Value	Min	Max	Init	SD	CV	Prior type	Prior SD	Phase
95	Size_DblN_end_logit_MRIP(3)	-0.188	-10	5	-5	0.116	0.616			3
96	Retain_L_infl_MRIP(3)	25.825	11.1	33	27	0.158	0.006			3
97	Retain_L_width_MRIP(3)	0.845	0.1	10	2.4	0.093	0.111			4
98	Retain_L_asymptote_logit_MRIP(3)	4.268	1	10	6	1.139	0.267			4
99	Retain_L_maleoffset_MRIP(3)	0.000	-1	1	0					-3
100	DiscMort_L_infl_MRIP(3)	1.000	0.5	1.5	1					-3
101	DiscMort_L_width_MRIP(3)	1.00E+06	1.00E+04	1.00E+08	1.00E+06					-3
102	DiscMort_L_level_old_MRIP(3)	-0.800	-1.5	0	-0.8					-3
103	DiscMort_L_male_offset_MRIP(3)	0.000	-1	2	0					-3
104	Size_DblN_peak_RVC_Adult(4)	19.032	16	25	19	0.026	0.001			2
105	Size_DblN_top_logit_RVC_Adult(4)	-12.550	-20	-1	-10	116.918	9.316			3
106	Size_DblN_ascend_se_RVC_Adult(4)	-14.100	-28	-0.2	-7	310.810	22.043			4
107	Size_DblN_descend_se_RVC_Adult(4)	4.770	1	6	3.5	1.294	0.271			4
108	Size_DblN_start_logit_RVC_Adult(4)	-11.054	-15	0	-10	65.183	5.897			3
109	Size_DblN_end_logit_RVC_Adult(4)	-1.056	-15	10	-5	1.769	1.675			3
110	Size_DblN_peak_RVC_Juv(5)	13.476	8	18	18	0.576	0.043			3
111	Size_DblN_top_logit_RVC_Juv(5)	-8.585	-10	-1	-4	29.471	3.433			4
112	Size_DblN_ascend_se_RVC_Juv(5)	-1.815	-1.9	5	3	2.415	1.331			5
113	Size_DblN_descend_se_RVC_Juv(5)	2.531	-22	4	-9	0.317	0.125			5
114	Size_DblN_start_logit_RVC_Juv(5)	-1.372	-30	10	8	0.330	0.241			2
115	Size_DblN_end_logit_RVC_Juv(5)	-15.000	-15	5	-15					-3
116	SizeSel_P1_MRIP_CPUE(6)	-1.000	-1	-1	-1					-1
117	SizeSel_P2_MRIP_CPUE(6)	-1.000	-1	-1	-1					-1

Table 3.8.3. Francis weights applied to length and conditional age-at-length data.

Data Type	Fleet/Index	Francis Weight
Length Composition	Commercial	4.35
	Headboat	1.13
	MRIP	1.49
	RVC Adult	0.48
	RVC Juvenile	0.84
	MRIP CPUE	6.63
Conditional Age-at-Length	Commercial	0.17
	Headboat	0.28
	MRIP	0.14
	FI Ages	0.14

Table 3.8.4. A comparison of input and estimated effective sample sizes for length composition data.

Year	Commercial				Headboat				MRIP				Indices					
	Landings		Discards		Landings		Discards		Landings		Discards		RVC Adult		RVC Juvenile		MRIP CPUE	
	Input N	Francis N	Input N	Francis N	Input N	Francis N	Input N	Francis N	Input N	Francis N	Input N	Francis N	Input N	Francis N	Input N	Francis N	Input N	Francis N
1981					18.52	20.89			6.00	8.91								
1982					19.62	22.13			6.78	10.07								
1983					23.22	26.19			5.29	7.86								
1984	4.00	17.40			23.62	26.64			6.63	9.85								
1985	4.80	20.88			23.62	26.64			4.58	6.80								
1986	7.28	31.67			24.19	27.28			6.00	8.91								
1987	5.92	25.75			22.29	25.14			7.75	11.51								
1988	6.00	26.10			19.00	21.43			7.35	10.92								
1989	7.55	32.84			20.00	22.56			7.07	10.50								
1990	11.58	50.37			15.91	17.94			7.48	11.11								
1991	12.12	52.72			16.61	18.73			8.89	13.20								
1992	12.49	54.33			15.49	17.47			11.00	16.34								
1993	13.19	57.37			17.80	20.08			11.66	17.32								
1994	13.82	60.11			17.06	19.24			10.91	16.20								
1995	14.42	62.72			17.44	19.67			8.31	12.34								
1996	12.92	56.20			15.97	18.01			9.22	13.69								
1997	16.55	71.99			20.64	23.28			9.27	13.77								
1998	15.33	66.68			20.83	23.49			11.27	16.74								
1999	17.09	74.33			19.00	21.43			12.85	19.08			27.69	13.23	27.69	23.16		
2000	15.97	69.46			18.52	20.89			12.92	19.19			29.90	14.28	29.90	25.01		
2001	16.76	72.90			17.75	20.02			12.08	17.94								
2002	16.34	71.07			19.00	21.43			15.13	22.47								
2003	14.21	61.81			21.47	24.21			13.75	20.42								
2004	11.87	51.63			20.76	23.41			14.42	21.42			28.83	13.77	28.83	24.11		
2005	11.92	51.85			19.70	22.22	8.49	9.58	14.35	21.31	8.49	12.61					16.67	110.51
2006	10.25	44.58			19.10	21.54	8.94	10.08	14.00	20.79	8.94	13.28	32.40	15.48	32.40	27.10	16.61	110.11
2007	11.92	51.85			20.49	23.11	8.06	9.09	14.76	21.92	8.06	11.97					16.82	111.50
2008	13.23	57.55			18.11	20.43	4.12	4.65	14.76	21.92	4.12	6.12	37.23	17.79	37.23	31.14	15.33	101.62
2009	14.90	64.81	1.41	6.13	18.06	20.37	4.00	4.51	12.21	18.13	4.00	5.94					12.85	85.18
2010	11.83	51.46	1.73	7.52	16.43	18.53	6.00	6.77	13.34	19.81	6.00	8.91	37.96	18.14	37.96	31.75	14.63	96.98
2011	12.45	54.15	1.73	7.52	17.52	19.76	4.90	5.53	12.12	18.00	4.90	7.28					13.08	86.71
2012	15.43	67.11	3.32	14.44	20.10	22.67	7.42	8.37	13.45	19.97	7.42	11.02	40.17	19.19	40.17	33.60	15.36	101.82
2013	15.59	67.81	2.65	11.53	19.75	22.27	8.72	9.83	13.34	19.81	8.72	12.95					15.94	105.67
2014	15.84	68.90	3.00	13.05	19.97	22.52	7.21	8.13	15.20	22.57	7.21	10.71	39.46	18.85	39.46	33.01	16.82	111.50
2015	14.76	64.20	2.83	12.31	20.83	23.49	9.64	10.87	14.97	22.23	9.64	14.32					17.80	118.00
2016	13.30	57.85	3.00	13.05	21.61	24.37	10.20	11.50	14.35	21.31	10.20	15.15	36.62	17.50	36.62	30.63	17.61	116.74
2017	12.77	55.54	2.65	11.53	17.78	20.05	11.00	12.41	12.88	19.13	11.00	16.34					16.94	112.30

Table 3.8.5. A comparison of input and estimated annual effective sample sizes for conditional age-at-length data.

Year	Comm Landings		HB Landings		MRIP Landings		FI Ages	
	Input N	Francis N	Input N	Francis N	Input N	Francis N	Input N	Francis N
1981	42.76	7.31	51.33	14.57				
1982			50.38	14.30				
1983			56.84	16.14				
1984			42.63	12.10				
1985			20.04	5.69				
1986			28.2	8.01	2.73	0.37		
1987			21.66	6.15				
1988			7.73	2.19				
1989								
1990								
1991			15.79	4.48				
1992	24.08	4.12	18.9	5.37				
1993	40.14	6.86	3.82	1.08	9.23	1.27		
1994	54.10	9.25	24.56	6.97	6.00	0.82		
1995	55.05	9.41	49.23	13.98			1	0.14
1996	61.83	10.57	20.76	5.89				
1997	101.78	17.41	23.66	6.72	14.60	2.00		
1998	70.96	12.14	27.56	7.82	14.87	2.04	55.78	7.79
1999	86.12	14.73	9.06	2.57	23.42	3.21	64.24	8.97
2000	70.88	12.12	7.14	2.03	2.00	0.27	85.42	11.92
2001	74.35	12.72			22.61	3.10	60.31	8.42
2002	70.56	12.07			3.00	0.41	32.68	4.56
2003	52.12	8.91	18.32	5.20	17.21	2.36		
2004	55.97	9.57	63.24	17.95	28.24	3.87		
2005	74.30	12.71	79.8	22.65	23.78	3.26		
2006	83.55	14.29	85.88	24.38	26.06	3.57		
2007	56.59	9.68	101.87	28.92	1.00	0.14	8.89	1.24
2008	81.24	13.89	94.03	26.69	32.79	4.50	15.14	2.11
2009	89.48	15.30	93.22	26.46	28.80	3.95	17.16	2.40
2010	69.62	11.91	81.43	23.12	33.01	4.53	30.7	4.29
2011	75.97	12.99	92.98	26.40	4.65	0.64	7.82	1.09
2012	97.37	16.65	132.66	37.66			19.04	2.66
2013	97.20	16.62	133.5	37.90	15.15	2.08	10.19	1.42
2014	185.93	31.80	142.43	40.43	31.75	4.35	20.95	2.92
2015	179.66	30.73	140.82	39.98	63.67	8.73	14.43	2.01
2016	164.24	28.09	164.35	46.66	36.60	5.02		
2017	132.68	22.69	140.43	39.87	78.92	10.82		

Table 3.8.6. Predicted biomass (metric tons), spawning stock biomass (SSB; metric tons), abundance (1000s of fish), age-0 recruits (1000s of fish), and depletion (SSB/SSB0) for southeastern U.S. Yellowtail Snapper from the SEDAR 64 Base Model run.

Year	Biomass	SSB	Abundance	Recruits	SSB/SSB_0
1990	16,044	7,446	62,821	19,864	1.000
1991	5,949	2,412	47,584	19,864	0.324
1992	5,211	1,999	42,117	14,168	0.268
1993	5,439	2,207	35,820	10,735	0.296
1994	4,792	2,041	32,714	12,721	0.274
1995	4,307	1,796	38,829	20,357	0.241
1996	3,878	1,464	34,667	13,211	0.197
1997	4,120	1,610	35,432	15,033	0.216
1998	4,335	1,753	35,437	14,633	0.235
1999	4,510	1,832	36,873	15,941	0.246
2000	4,692	1,897	42,121	20,293	0.255
2001	5,059	2,012	39,034	13,978	0.270
2002	5,513	2,290	37,522	13,564	0.307
2003	5,616	2,403	38,968	16,238	0.323
2004	5,440	2,272	46,750	23,786	0.305
2005	5,486	2,167	43,790	16,463	0.291
2006	6,051	2,473	46,628	19,744	0.332
2007	6,252	2,597	45,094	17,249	0.349
2008	6,441	2,696	48,495	21,293	0.362
2009	6,158	2,528	43,616	15,499	0.340
2010	6,262	2,625	43,015	16,680	0.352
2011	6,427	2,732	48,282	22,104	0.367
2012	6,759	2,793	59,155	29,844	0.375
2013	7,227	2,864	59,098	23,719	0.385
2014	7,488	3,007	59,467	24,392	0.404
2015	7,662	3,154	51,190	16,026	0.424
2016	7,740	3,311	50,650	19,667	0.445
2017	7,468	3,207	48,385	18,246	0.431

Table 3.8.7. Estimates of annual instantaneous fishing mortality rates on age-4 southeastern U.S. Yellowtail Snapper combined across all fleets for SEDAR 64.

Year	Age-4 F
1992	0.362
1993	0.528
1994	0.461
1995	0.593
1996	0.411
1997	0.379
1998	0.342
1999	0.333
2000	0.298
2001	0.228
2002	0.253
2003	0.313
2004	0.341
2005	0.219
2006	0.282
2007	0.254
2008	0.370
2009	0.277
2010	0.232
2011	0.216
2012	0.262
2013	0.336
2014	0.333
2015	0.275
2016	0.291
2017	0.343

Table 3.8.8. Annual estimates of instantaneous apical fishing mortality rates by fleet for southeastern U.S. Yellowtail Snapper. This represents the instantaneous fishing mortality level on the most vulnerable age class for each fleet.

Year	Commercial	Headboat	MRIP
1992	0.295	0.038	0.367
1993	0.366	0.037	0.693
1994	0.359	0.046	0.504
1995	0.361	0.038	0.886
1996	0.324	0.035	0.454
1997	0.334	0.030	0.353
1998	0.276	0.025	0.371
1999	0.317	0.022	0.269
2000	0.261	0.021	0.284
2001	0.213	0.018	0.188
2002	0.188	0.019	0.306
2003	0.183	0.018	0.485
2004	0.205	0.021	0.514
2005	0.183	0.026	0.209
2006	0.154	0.015	0.460
2007	0.115	0.015	0.458
2008	0.162	0.015	0.692
2009	0.240	0.013	0.279
2010	0.195	0.015	0.242
2011	0.208	0.014	0.172
2012	0.230	0.016	0.254
2013	0.227	0.015	0.468
2014	0.214	0.020	0.475
2015	0.215	0.020	0.311
2016	0.216	0.021	0.351
2017	0.278	0.014	0.389

Table 3.8.9. Summary of moderately correlated (correlation coefficient > 0.7) parameters for the southeastern U.S. Yellowtail Snapper SS Base Model.

Parameter$_i$	**Parameter$_j$**	**Correlation**
Size_DblN_ascend_se_RVC_Juv(5)	Size_DblN_peak_RVC_Juv(5)	0.992
Size_DblN_ascend_se_HB(2)	Size_DblN_peak_HB(2)	0.858
Size_DblN_start_logit_RVC_Juv(5)	L_at_Amin_Fem_GP_1	0.769
Retain_L_width_MRIP(3)	Retain_L_infl_MRIP(3)	0.735
CV_old_Fem_GP_1	L_at_Amax_Fem_GP_1	-0.710
Main_InitAge_1	SR_LN(R0)	-0.716
VonBert_K_Fem_GP_1	L_at_Amin_Fem_GP_1	-0.761
InitF_seas_1_flt_3MRIP	InitF_seas_1_flt_1COM	-0.776
VonBert_K_Fem_GP_1	L_at_Amax_Fem_GP_1	-0.852
SR_BH_steep	SR_LN(R0)	-0.864
Size_DblN_end_logit_RVC_Adult(4)	Size_DblN_descend_se_RVC_Adult(4)	-0.917

Table 3.8.10. List of parameters that were estimated to be on or near the bounds for at least one jitter run.

Number	Parameter	# of jitter runs near bounds
16	SR_sigmaR	62
4	CV_young_Fem_GP_1	11
107	Size_DblN_descend_se_RVC_Adult(4)	10
112	Size_DblN_ascend_se_RVC_Juv(5)	9
1	L_at_Amin_Fem_GP_1	7
5	CV_old_Fem_GP_1	6
68	Retain_L_infl_COM(1)	6
92	Size_DblN_ascend_se_MRIP(3)	5
95	Size_DblN_end_logit_MRIP(3)	4
15	SR_BH_steep	3
110	Size_DblN_peak_RVC_Juv(5)	3
3	VonBert_K_Fem_GP_1	2
60	InitF_seas_1_flt_3MRIP	1
70	Retain_L_asymptote_logit_COM(1)	1
77	Size_DblN_top_logit_HB(2)	1
78	Size_DblN_ascend_se_HB(2)	1
79	Size_DblN_descend_se_HB(2)	1
81	Size_DblN_end_logit_HB(2)	1
90	Size_DblN_peak_MRIP(3)	1
91	Size_DblN_top_logit_MRIP(3)	1
93	Size_DblN_descend_se_MRIP(3)	1
105	Size_DblN_top_logit_RVC_Adult(4)	1
106	Size_DblN_ascend_se_RVC_Adult(4)	1
113	Size_DblN_descend_se_RVC_Juv(5)	1

Table 3.8.11. List of parameters that were estimated to be on or near the bounds for at least one bootstrap run.

Parameter	# of bootstrap runs near bounds
Size_DblN_descend_se_RVC_Adult(4)	145
CV_old_Fem_GP_1	71
CV_young_Fem_GP_1	54
Size_DblN_ascend_se_RVC_Juv(5)	45
L_at_Amin_Fem_GP_1	41
Retain_L_infl_COM(1)	41
Size_DblN_ascend_se_HB(2)	37
Size_DblN_descend_se_HB(2)	37
Size_DblN_end_logit_HB(2)	29
Size_DblN_peak_RVC_Juv(5)	27
VonBert_K_Fem_GP_1	21
Size_DblN_end_logit_MRIP(3)	14
Size_DblN_top_logit_HB(2)	14
Size_DblN_start_logit_RVC_Juv(5)	12
Size_DblN_start_logit_RVC_Adult(4)	11
Size_DblN_top_logit_MRIP(3)	10
Size_DblN_top_logit_RVC_Juv(5)	10
InitF_seas_1_flt_3MRIP	8
Size_DblN_ascend_se_MRIP(3)	8
Size_DblN_peak_MRIP(3)	7
Size_DblN_descend_se_RVC_Juv(5)	6
InitF_seas_1_flt_2HB	5
Retain_L_asymptote_logit_COM(1)	5
Size_DblN_descend_se_MRIP(3)	5
Size_DblN_start_logit_MRIP(3)	5
SR_BH_steep	5
Size_DblN_ascend_se_RVC_Adult(4)	4
Size_DblN_peak_HB(2)	4
Size_DblN_peak_RVC_Adult(4)	4
InitF_seas_1_flt_1COM	3
Retain_L_asymptote_logit_MRIP(3)	3
Size_DblN_start_logit_HB(2)	3
Retain_L_infl_HB(2)	2
Size_DblN_end_logit_RVC_Adult(4)	2
Size_DblN_top_logit_RVC_Adult(4)	2
Retain_L_asymptote_logit_HB(2)	1
Retain_L_infl_MRIP(3)	1
Retain_L_width_COM(1)	1
Retain_L_width_HB(2)	1
Size_95%width_COM(1)	1

Table 3.8.12. Comparison of log-likelihood values and estimated and derived parameters for the 'jack-knife' analysis (i.e. removing indices one at a time and refitting the base model).

Model Component	Base Run	Com CPUE Removed	MRIP CPUE Removed	RVC Juvenile Index Removed	RVC Adult Index Removed
TOTAL LL	744.447	920.738	790.918	720.722	881.745
Survey LL	-63.816	-36.583	-50.084	-55.812	-58.486
Length comp LL	367.901	373.124	271.647	338.048	360.329
Age comp LL	321.183	464.127	465.539	323.954	463.739
Prior LL	0.154	0.136	0.262	0.128	0.145
Recr_Virgin_millions	19.864	20.130	21.155	18.712	19.815
SR_LN(R0)	9.897	9.910	9.960	9.837	9.894
Steepness	0.808	0.796	0.821	0.867	0.819
L_at_Amax_Fem_GP_1	36.229	35.383	36.201	35.181	35.503
VonBert_K_Fem_GP_1	0.342	0.394	0.388	0.343	0.390
SSB_Virgin_thousand_mt	7.446	7.433	8.218	6.836	7.339
Bratio_2017	1.436	1.460	1.766	1.524	1.455
SPRratio_2017	0.349	0.356	0.416	0.352	0.351

Table 3.8.13. Comparison of log-likelihood values and estimated and derived parameters for a sensitivity run changing the start year to 1981.

Model Component	Base Run	Start Year = 1981
TOTAL LL	744.447	1025.910
Survey LL	-63.816	-54.014
Length comp LL	367.901	487.849
Age comp LL	321.183	393.961
Priors LL	0.154	0.690
Recr_Virgin_millions	19.864	27.935
SR_LN(R0)	9.897	10.238
SR_BH_steep	0.808	0.624
L_at_Amax_Fem_GP_1	36.229	37.230
VonBert_K_Fem_GP_1	0.342	0.341
SSB_Virgin_thousand_mt	7.446	11.157
Bratio_2017	1.436	0.919
SPRratio_2017	0.349	0.326

Table 3.8.14. Comparison of log-likelihood values and estimated and derived parameters for sensitivity runs varying recreational discard mortality rates and the base run.

Model Component	Base Run (Discard Mort = 10%)	Rec Discard Mort = 20%	Rec Discard Mort = 30%
TOTAL LL	744.447	990.819	741.007
Survey LL	-63.816	-64.096	-64.222
Length comp LL	367.901	608.407	367.494
Age comp LL	321.183	328.545	321.214
Priors LL	0.154	0.247	0.359
Recr_Virgin_millions	19.864	21.235	22.556
SR_LN(R0)	9.897	9.963	10.024
SR_BH_steep	0.808	0.789	0.787
L_at_Amax_Fem_GP_1	36.229	35.479	36.670
VonBert_K_Fem_GP_1	0.342	0.346	0.326
SSB_Virgin_thousand_mt	7.446	7.826	8.510
Bratio_2017	1.436	1.396	1.292
SPRratio_2017	0.651	0.652	0.672

Table 3.8.15. The yield-per-recruit (YPR), spawner-per-recruit (SSB/R), static spawning potential ratio (SPR), and total equilibrium yield in metric tons computed over a range of instantaneous fishing mortality rates (F) on age-4 Yellowtail Snapper.

Age-4 F	YPR	SSB/R	SPR	Yield (mt)
0.000	0.000	0.375	1.000	0.878
0.082	0.047	0.253	0.676	898.434
0.165	0.070	0.193	0.516	1,278.095
0.247	0.083	0.158	0.421	1,462.907
0.329	0.091	0.134	0.358	1,556.070
0.411	0.097	0.117	0.312	1,600.110
0.438	0.098	0.112	0.300	1,607.678
0.494	0.101	0.104	0.278	1,615.457
0.576	0.104	0.094	0.252	1,613.008
0.658	0.107	0.086	0.230	1,599.030
0.740	0.109	0.080	0.213	1,577.344
0.822	0.110	0.074	0.198	1,550.387
0.905	0.112	0.070	0.185	1,519.769
0.987	0.113	0.065	0.175	1,486.589
1.069	0.114	0.062	0.165	1,451.618
1.151	0.115	0.059	0.157	1,415.403
1.234	0.116	0.056	0.150	1,378.340
1.316	0.116	0.054	0.143	1,340.725
1.398	0.117	0.051	0.137	1,302.776
1.480	0.118	0.049	0.132	1,264.658
1.563	0.118	0.048	0.127	1,226.497
1.645	0.119	0.046	0.122	1,188.390
1.727	0.119	0.044	0.118	1,150.411
1.809	0.119	0.043	0.114	1,112.615
1.892	0.120	0.042	0.111	1,075.048
1.974	0.120	0.040	0.108	1,037.745
2.056	0.120	0.039	0.105	1,000.730

Table 3.8.16. The stock status determination criterion for southeastern U.S. Yellowtail Snapper according to the South Atlantic Fishery Management Council (SAFMC) and the Gulf of Mexico Fishery Management Council (GMFMC). Note: values of MSST and OY are currently undefined for the GMFMC and they default to the definition provided below by the SAFMC.

	South Atlantic and Gulf of Mexico Fishery Management Councils	
Criteria	Definition	Value
MSST (Minimum Stock Size Threshold)	$0.75*SSB_{F30\%SPR}$	1,428 mt
$SSB_{F30\%SPR}$	The estimated spawning stock biomass associated with F at 30% SPR	1,904 mt
$SSB_{current}$ (recent average of SSB)	The geometric mean of SSB for 2015 - 2017	3,223 mt
MFMT (Maximum Fishing Mortality Threshold)	$F_{30\% SPR}$	0.438 yr^{-1}
$F_{30\%SPR}$	The fishing mortality rate associated with 30% SPR	0.438 yr^{-1}
$F_{current}$ (recent average fishing mortality rate on age-4 fish)	The geometric mean of F on age-4 fish for 2015 - 2017	0.295 yr^{-1}
OY (Optimum Yield)	Yield at F_{OY}	1,497 mt
F_{OY} (Fishing Mortality Rate at OY)	$F_{at\ 40\%\ SPR}$	0.271 yr^{-1}

Table 3.8.17. Summary of annual stock status estimates for U.S. Yellowtail Snapper (MFMT = $F_{SPR30\%}$, MSST=0.75*$SSB_{F30\%SPR}$). SSB is in metric tons while F is the age-4 fishing mortality rate. Red text identifies years exceeding the thresholds.

Year	Age-4 F	F std error	F/MFMT	SSB	SSB std error	SSB/MSST	$SSB/SSB_{FSPR30\%}$	SSB/SSB_0
1992	0.36	0.03	0.82	1999	138	1.40	1.05	0.27
1993	0.53	0.03	1.20	2207	126	1.55	1.16	0.30
1994	0.46	0.03	1.05	2041	120	1.43	1.07	0.27
1995	0.59	0.04	1.34	1796	111	1.26	0.94	0.24
1996	0.41	0.03	0.93	1464	106	1.03	0.77	0.20
1997	0.38	0.03	0.86	1610	117	1.13	0.85	0.22
1998	0.34	0.03	0.77	1753	127	1.23	0.92	0.24
1999	0.33	0.03	0.75	1832	131	1.28	0.96	0.25
2000	0.3	0.02	0.68	1896	132	1.33	1.00	0.25
2001	0.23	0.02	0.52	2012	135	1.41	1.06	0.27
2002	0.25	0.02	0.57	2290	139	1.60	1.20	0.31
2003	0.31	0.02	0.70	2403	142	1.68	1.26	0.32
2004	0.34	0.02	0.77	2272	140	1.59	1.19	0.31
2005	0.22	0.01	0.50	2167	138	1.52	1.14	0.29
2006	0.28	0.02	0.64	2473	146	1.73	1.30	0.33
2007	0.25	0.02	0.57	2597	153	1.82	1.36	0.35
2008	0.37	0.02	0.84	2696	157	1.89	1.42	0.36
2009	0.28	0.02	0.64	2528	163	1.77	1.33	0.34
2010	0.23	0.02	0.52	2625	170	1.84	1.38	0.35
2011	0.22	0.01	0.50	2732	177	1.91	1.43	0.37
2012	0.26	0.02	0.59	2793	180	1.96	1.47	0.38
2013	0.34	0.02	0.77	2864	185	2.01	1.50	0.38
2014	0.33	0.02	0.75	3007	198	2.11	1.58	0.40
2015	0.27	0.02	0.61	3154	215	2.21	1.66	0.42
2016	0.29	0.02	0.66	3311	230	2.32	1.74	0.44
2017	0.34	0.03	0.77	3207	238	2.25	1.68	0.43

3.9 Figures

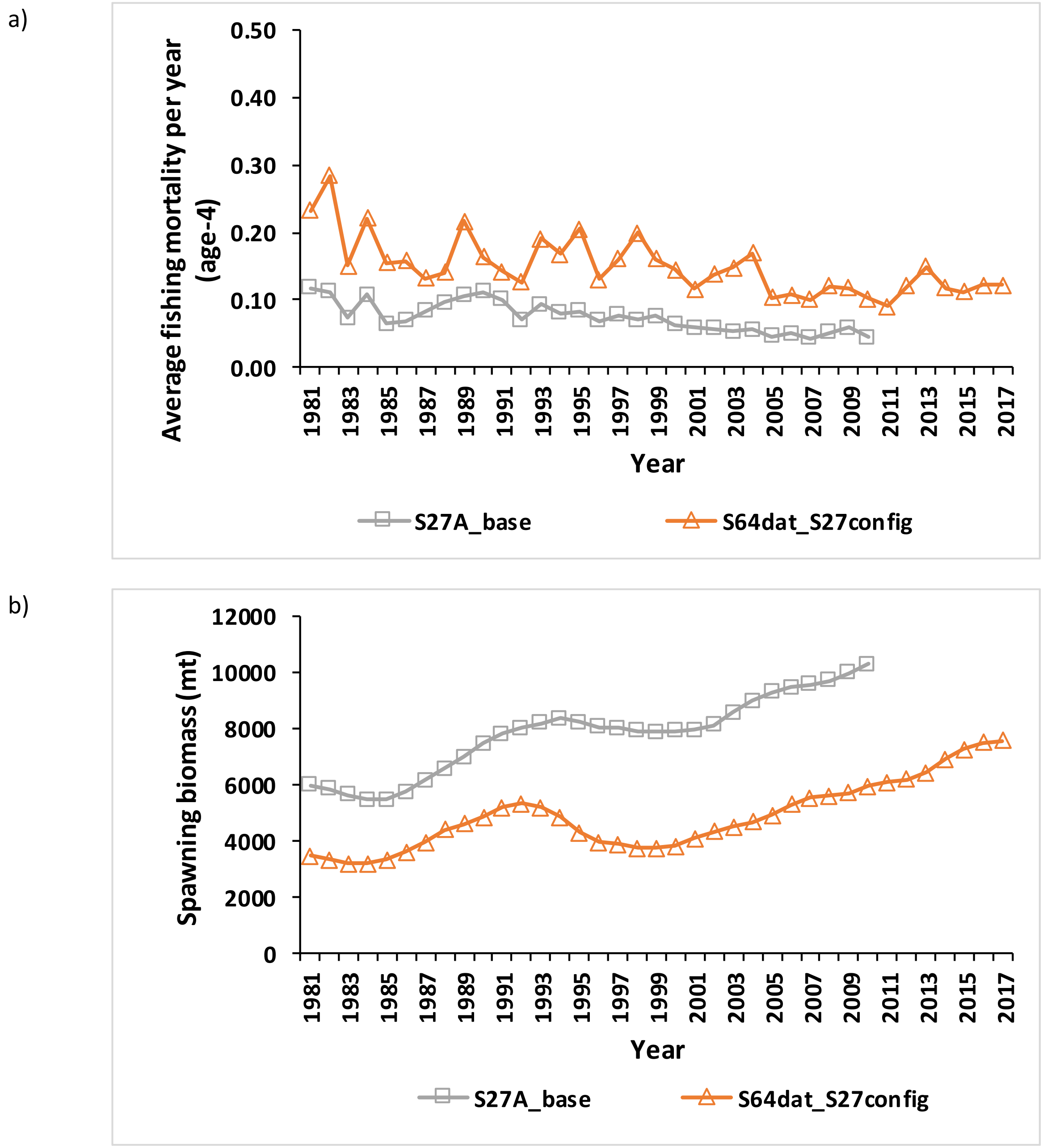


Figure 3.9.1. Average fishing mortality rates per year of age-4 fish (a) and spawning biomass estimates (b) from the SEDAR 27A Final Model (S27A_base) and the SEDAR 64 Continuity Model (S64dat_S27config).

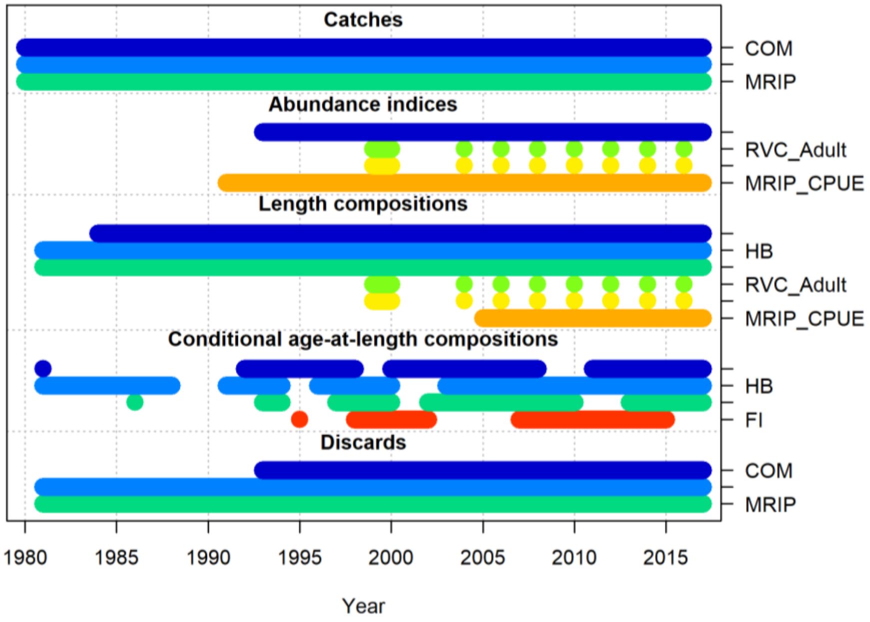


Figure 3.9.2. Data streams available by year for the SEDAR 64 southeastern U.S. Yellowtail Snapper stock assessment. For the base model, the assessment panel determined to have the model start in year 1992.

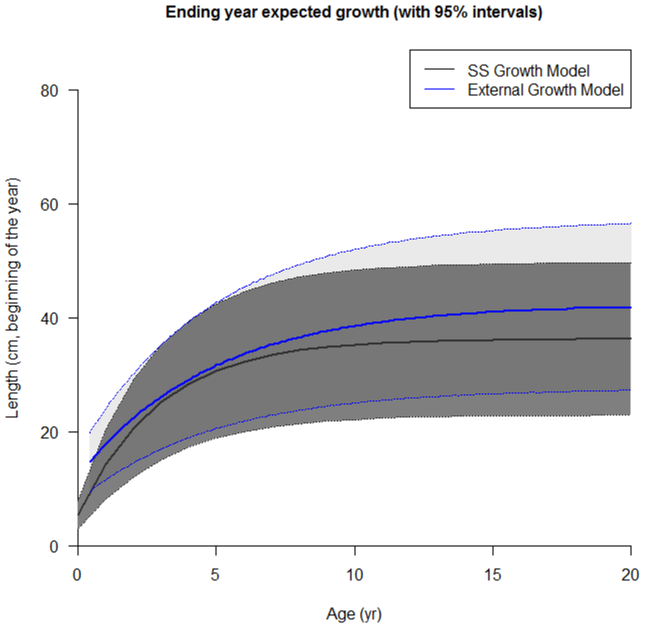


Figure 3.9.3. A comparison of estimated length-at-age for southeastern U.S. Yellowtail Snapper using the von Bertalanffy growth curve (black line) in the SS base model and the von Bertalanffy growth curve of the external model (blue line). Shaded area indicates 95% confidence intervals.

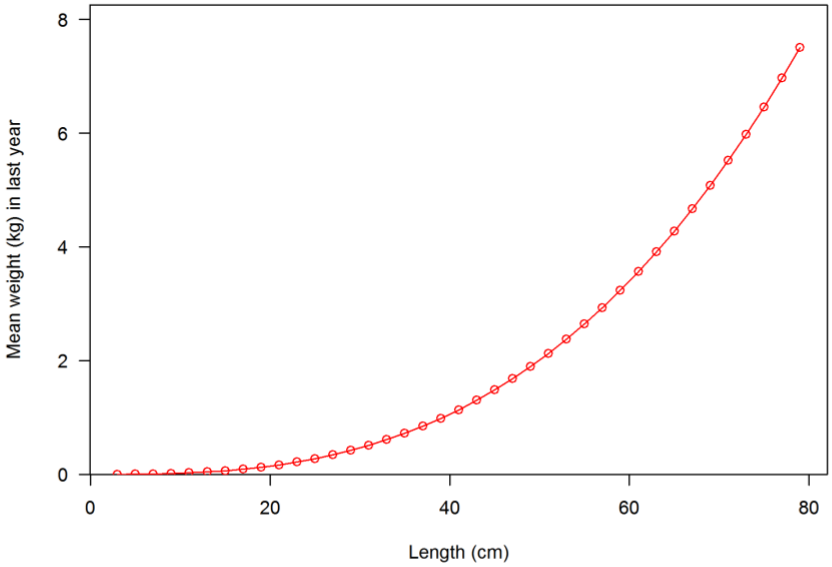


Figure 3.9.4. Mean weight-at-length within the SS base model for southeastern U.S. Yellowtail Snapper.

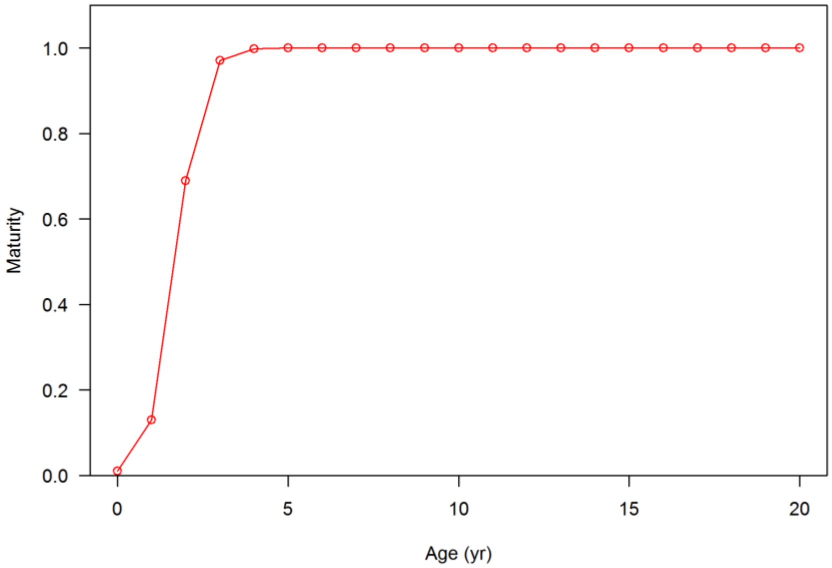


Figure 3.9.5. Maturity-at-age within the SS base model for southeastern U.S. Yellowtail Snapper.

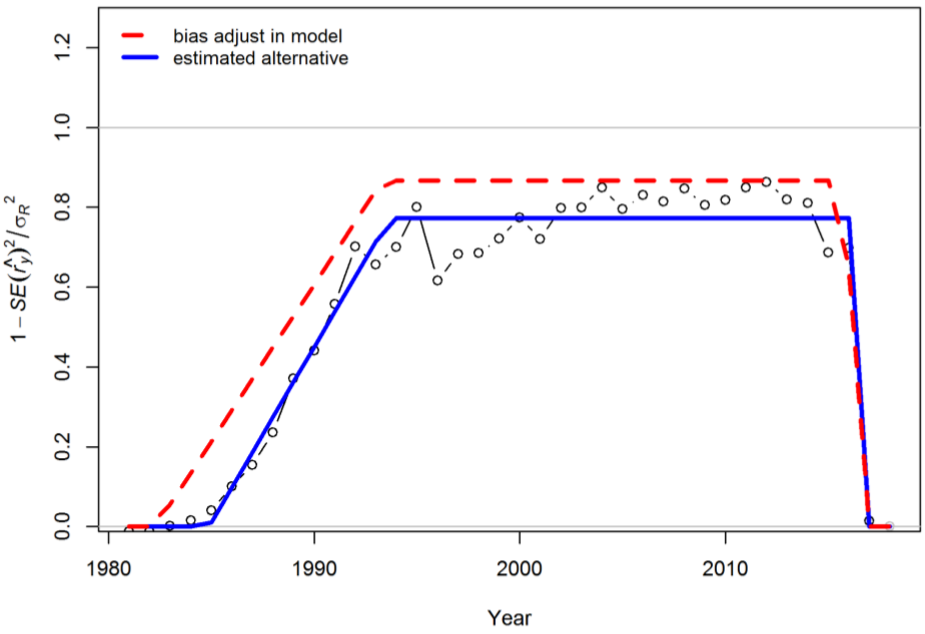


Figure 3.9.6. Bias adjustment to estimated Yellowtail Snapper recruitment deviations used in the SS base model following Methot and Taylor (2011). The blue line shows the recommended least squares estimate of the alternative bias adjustment relationship provided by the model output. The red line shows the user-defined bias adjustment. Points are transformed variances.

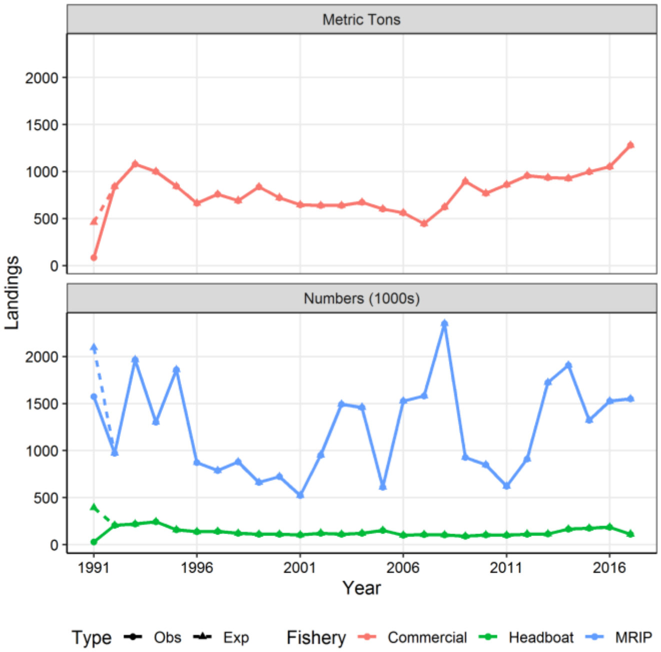


Figure 3.9.7. Southeastern U.S. Yellowtail Snapper observed and expected landings by fleet for the SEDAR 64 base model. The red line is the commercial fleet in metric tons, the green line is the headboat fleet landings in thousands of fish, and the blue line is the MRIP fleet landings in thousands of fish. Solid lines are the observed landings and dashed lines are the expected (predicted) landings.

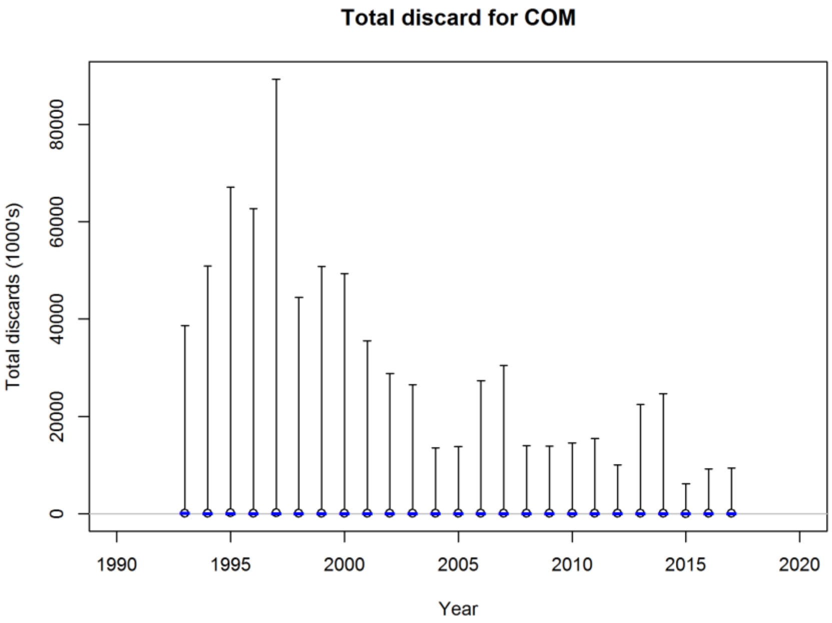


Figure 3.9.8. Southeastern U.S. Yellowtail Snapper observed (dots with 95% confidence intervals) and expected (blue dashes) discards (i.e., before applying the discard mortality rate for each fleet) by the commercial fleet in thousands of fish for the SEDAR 64 base model.

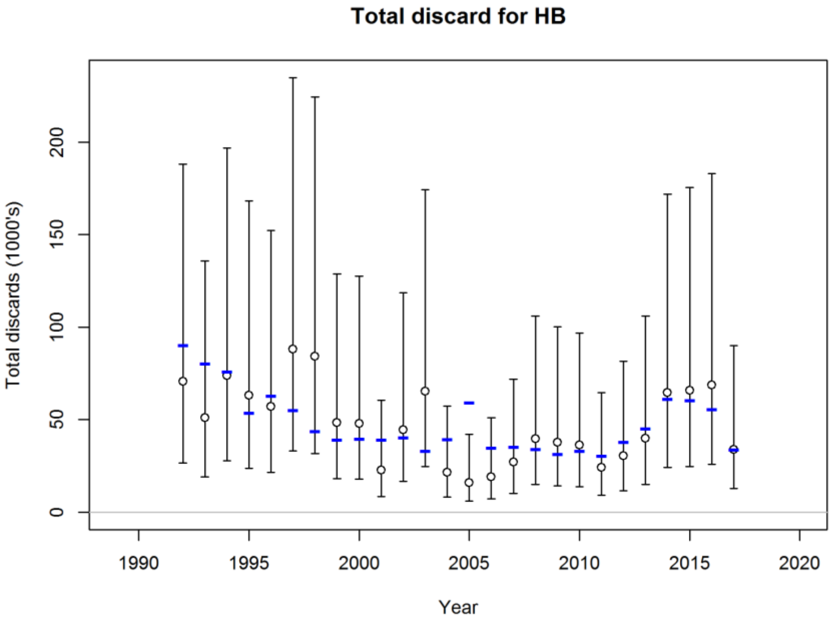


Figure 3.9.9. Southeastern U.S. Yellowtail Snapper observed (dots with 95% confidence intervals) and expected (blue dashes) discards (i.e., before applying the discard mortality rate for each fleet) by the headboat fleet in thousands of fish for the SEDAR 64 base model.

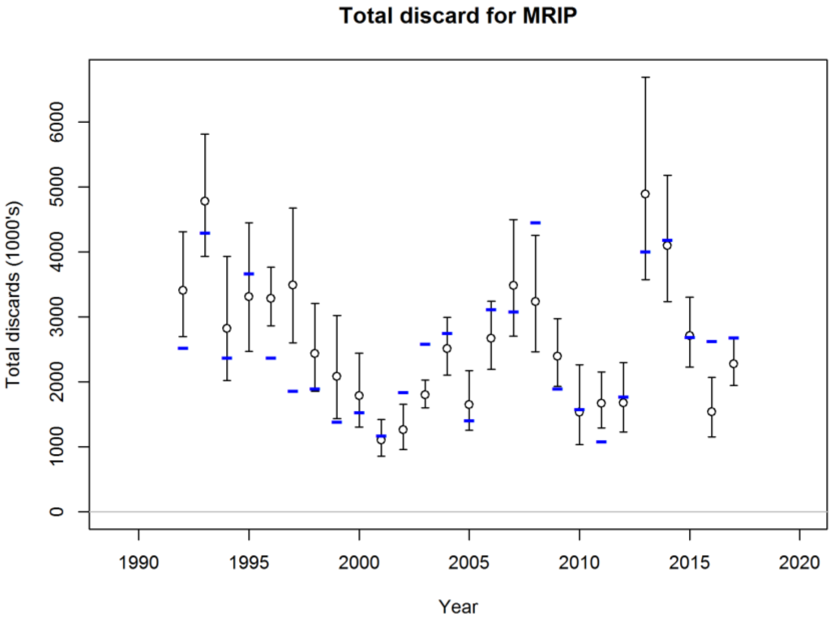


Figure 3.9.10. Southeastern U.S. Yellowtail Snapper observed (dots with 95% confidence intervals) and expected (blue dashes) discards (i.e., before applying the discard mortality rate for each fleet) by the MRIP fleet in thousands of fish for the SEDAR 64 base model.

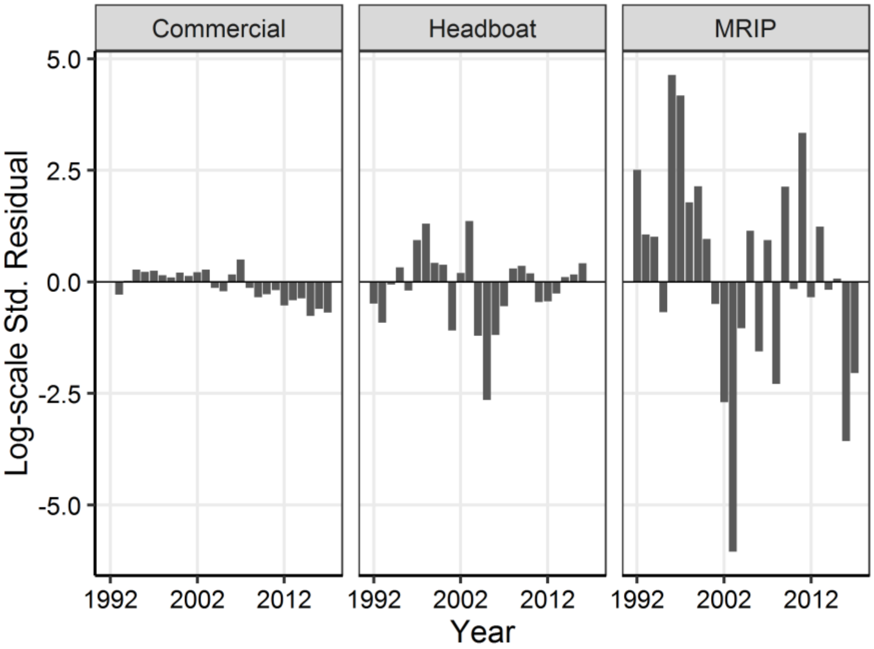


Figure 3.9.11. Standardized residuals for the discards by year across fleets for southeastern U.S. Yellowtail Snapper.

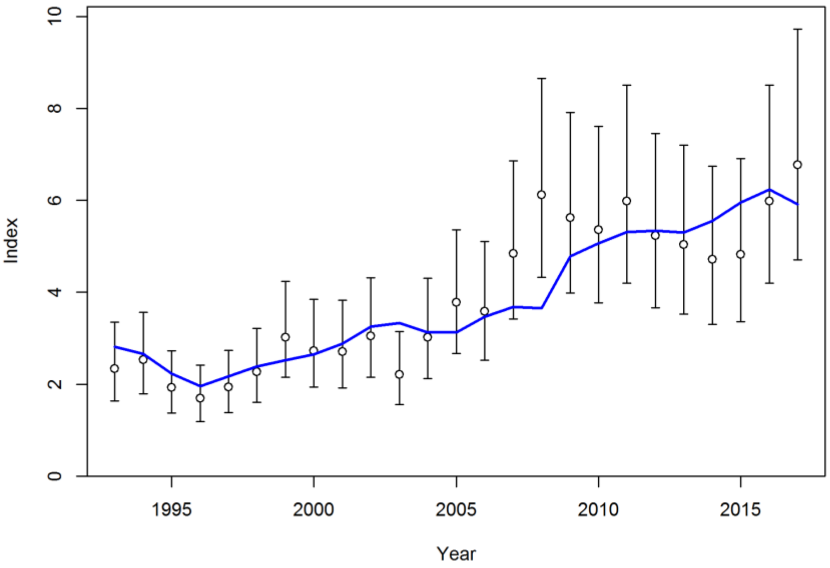


Figure 3.9.12. The southeastern U.S. Yellowtail Snapper observed (dots with 95% confidence intervals) and predicted (blue line) commercial CPUE index of relative biomass for SEDAR 64.

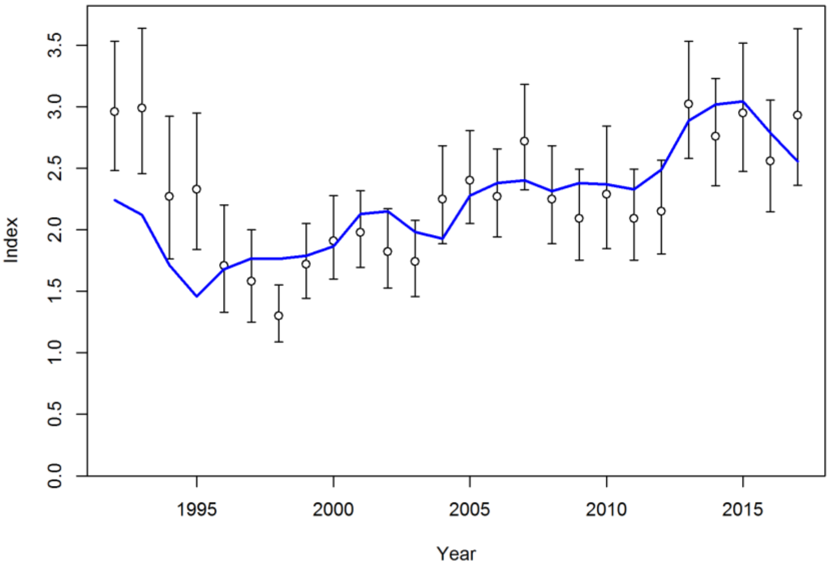


Figure 3.9.13. The southeastern U.S. Yellowtail Snapper observed (dots with 95% confidence intervals) and predicted (blue line) MRIP CPUE index of relative abundance for SEDAR 64.

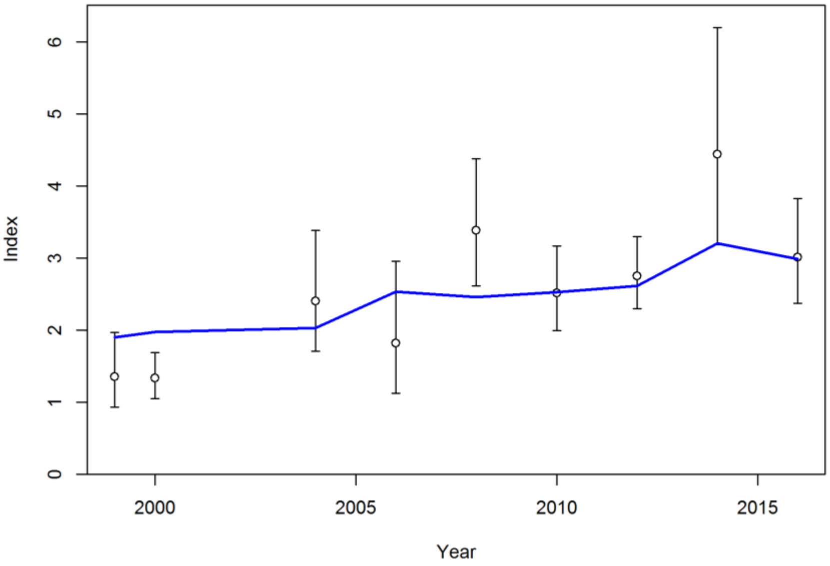


Figure 3.9.14. The southeastern U.S. Yellowtail Snapper observed (dots with 95% confidence intervals) and predicted (blue line) RVC Adult CPUE index of relative abundance for SEDAR 64.

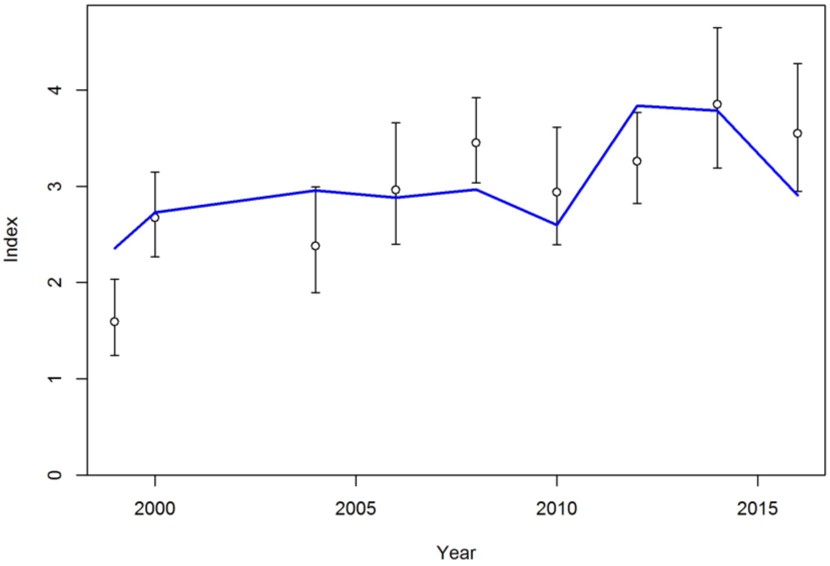


Figure 3.9.15. The southeastern U.S. Yellowtail Snapper observed (dots with 95% confidence intervals) and predicted (blue line) RVC Juvenile CPUE index of relative abundance for SEDAR 64.

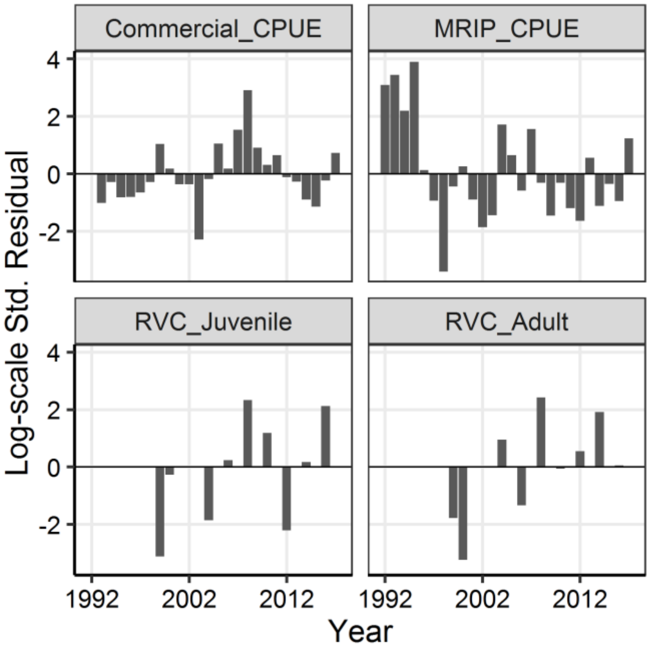


Figure 3.9.16. Standardized residuals for the indices by year for southeastern U.S. Yellowtail Snapper.

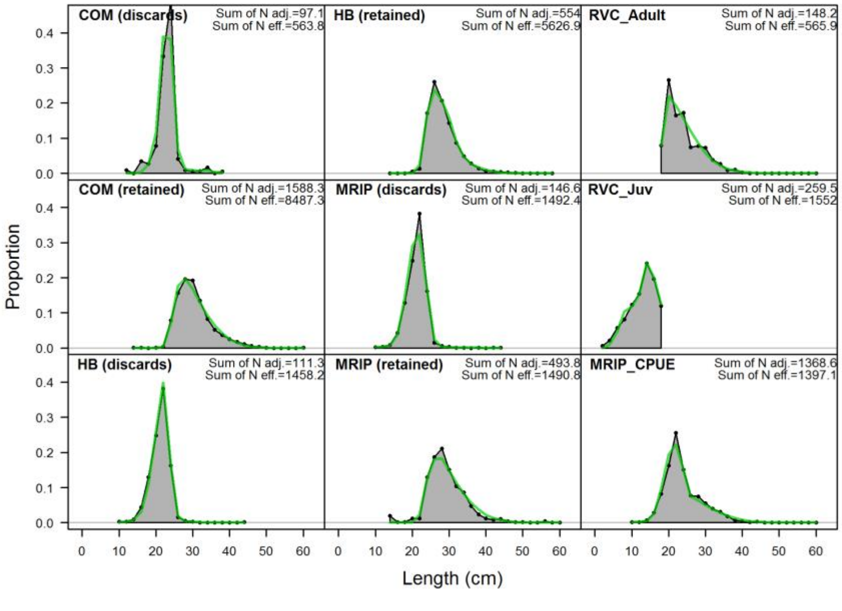


Figure 3.9.17. Model fits to the length composition of retained and discarded catch aggregated across years within a given fleet or survey for southeastern U.S. Yellowtail Snapper. Green lines represent predicted length compositions, while grey shaded regions represent observed length compositions. The input effective sample size after the Francis data re-weighting adjustment to the yearly length composition data, N adj., and the calculated effective sample size used in the McAllister-Iannelli tuning method, N eff., are provided in the upper right corner of each panel.

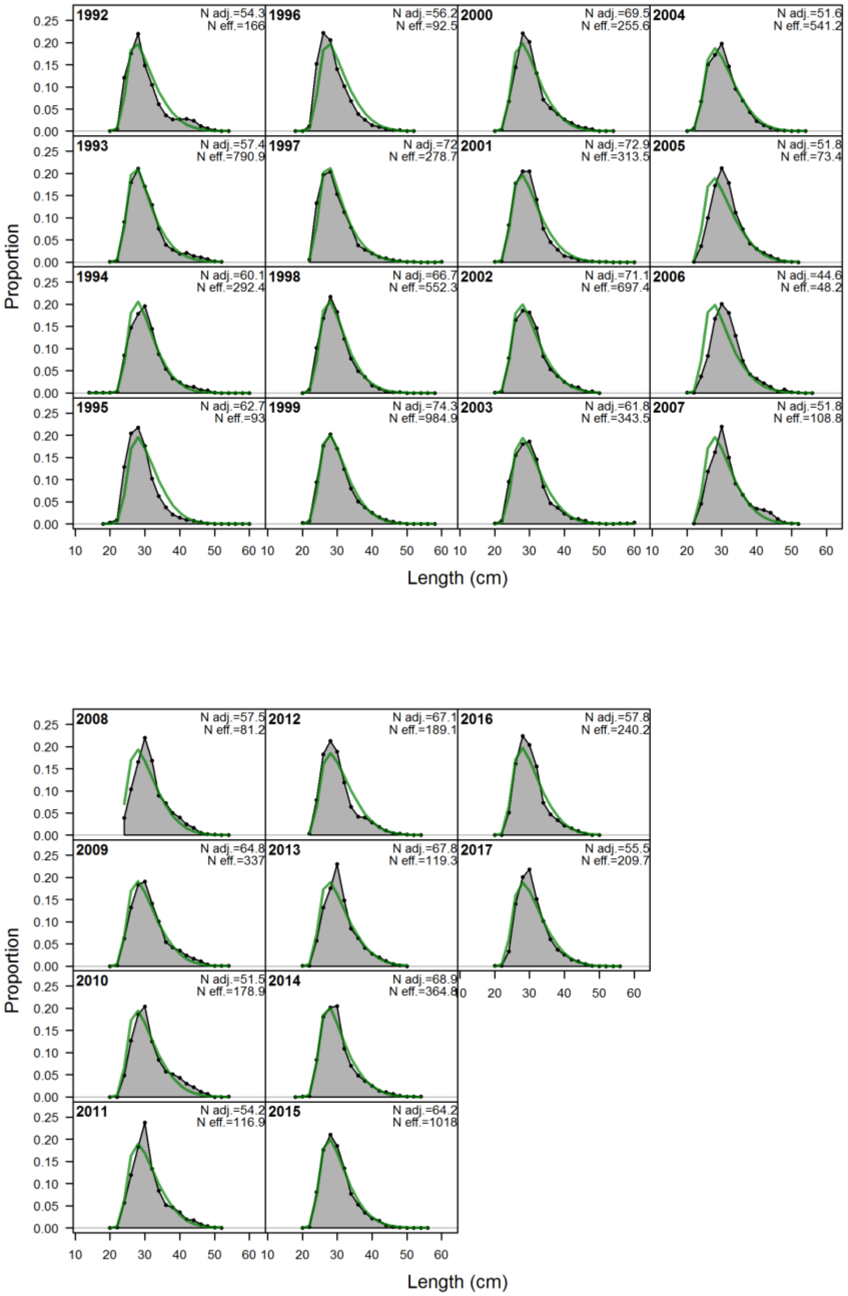


Figure 3.9.18. Model fits to the length composition of retained catch by the commercial fleet for southeastern U.S. Yellowtail Snapper. Green lines represent predicted length compositions, while grey shaded regions represent observed length compositions. The input effective sample size after the Francis data re-weighting adjustment to the yearly length composition data, N adj., and the calculated effective sample size used in the McAllister-Iannelli tuning method, N eff., are provided in the upper right corner of each panel.

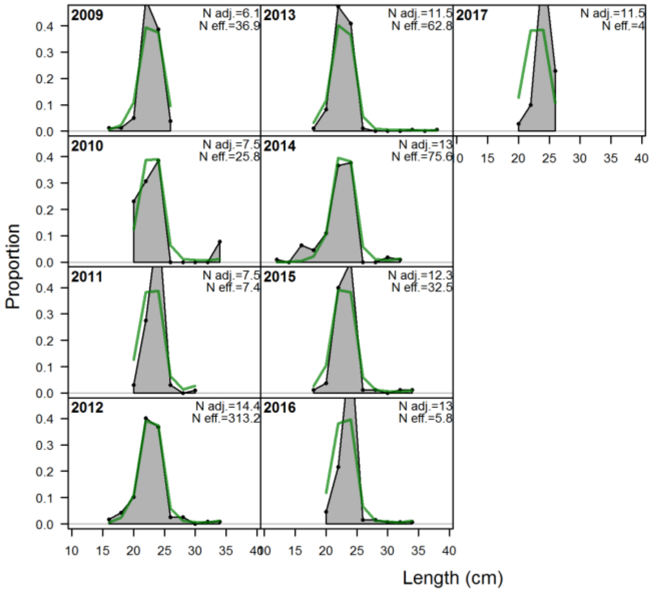


Figure 3.9.19. Model fits to the discard length composition data by the commercial fleet for southeastern U.S. Yellowtail Snapper. Green lines represent predicted length compositions, while grey shaded regions represent observed length compositions. The input effective sample size after the Francis data re-weighting adjustment to the yearly length composition data, N adj., and the calculated effective sample size used in the McAllister-Iannelli tuning method, N eff., are provided in the upper right corner of each panel.

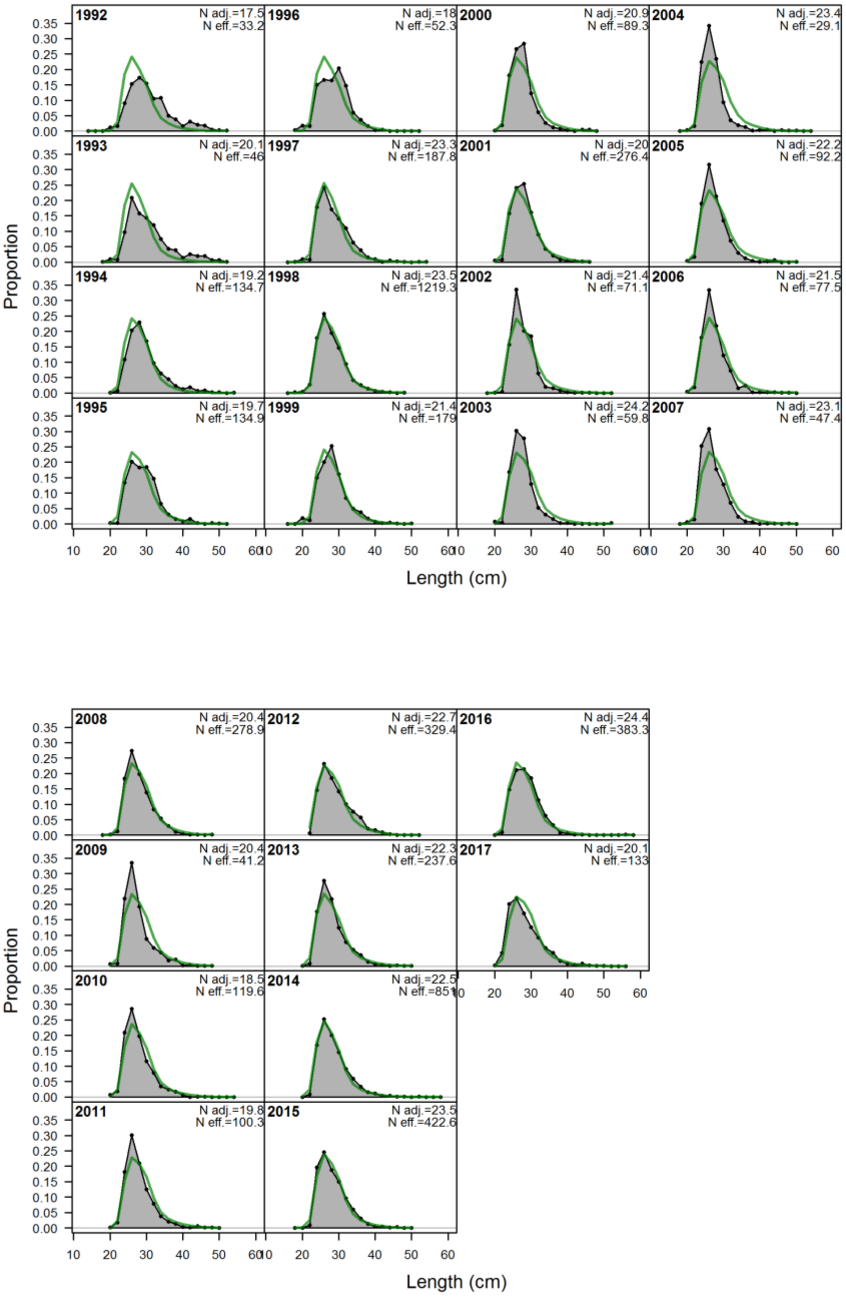


Figure 3.9.20. Model fits to the length composition of retained catch by the headboat fleet for southeastern U.S. Yellowtail Snapper. Green lines represent predicted length compositions, while grey shaded regions represent observed length compositions. The input effective sample size after the Francis data re-weighting adjustment to the yearly length composition data, N adj., and the calculated effective sample size used in the McAllister-Iannelli tuning method, N eff., are provided in the upper right corner of each panel.

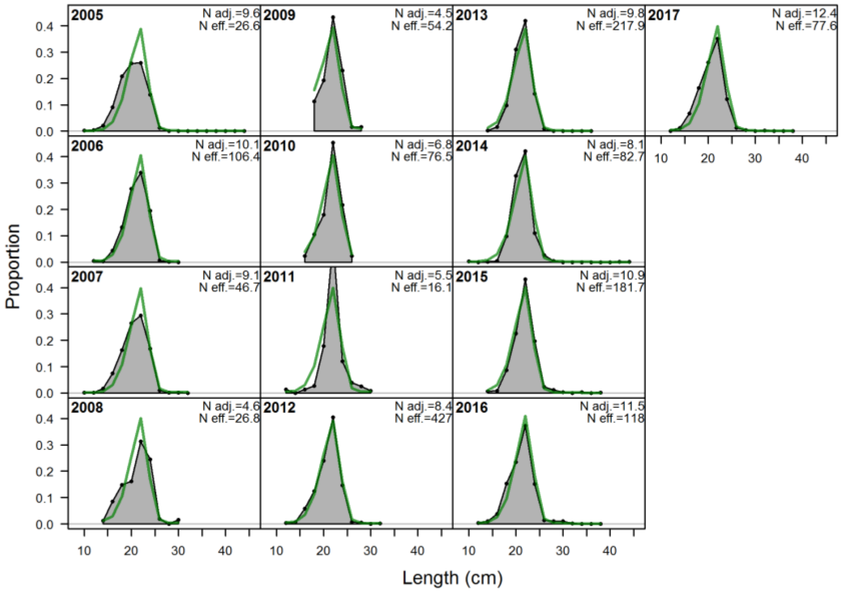


Figure 3.9.21. Model fits to the discard length composition data by the headboat fleet for southeastern U.S. Yellowtail Snapper. Green lines represent predicted length compositions, while grey shaded regions represent observed length compositions. The input effective sample size after the Francis data re-weighting adjustment to the yearly length composition data, N adj., and the calculated effective sample size used in the McAllister-Iannelli tuning method, N eff., are provided in the upper right corner of each panel.

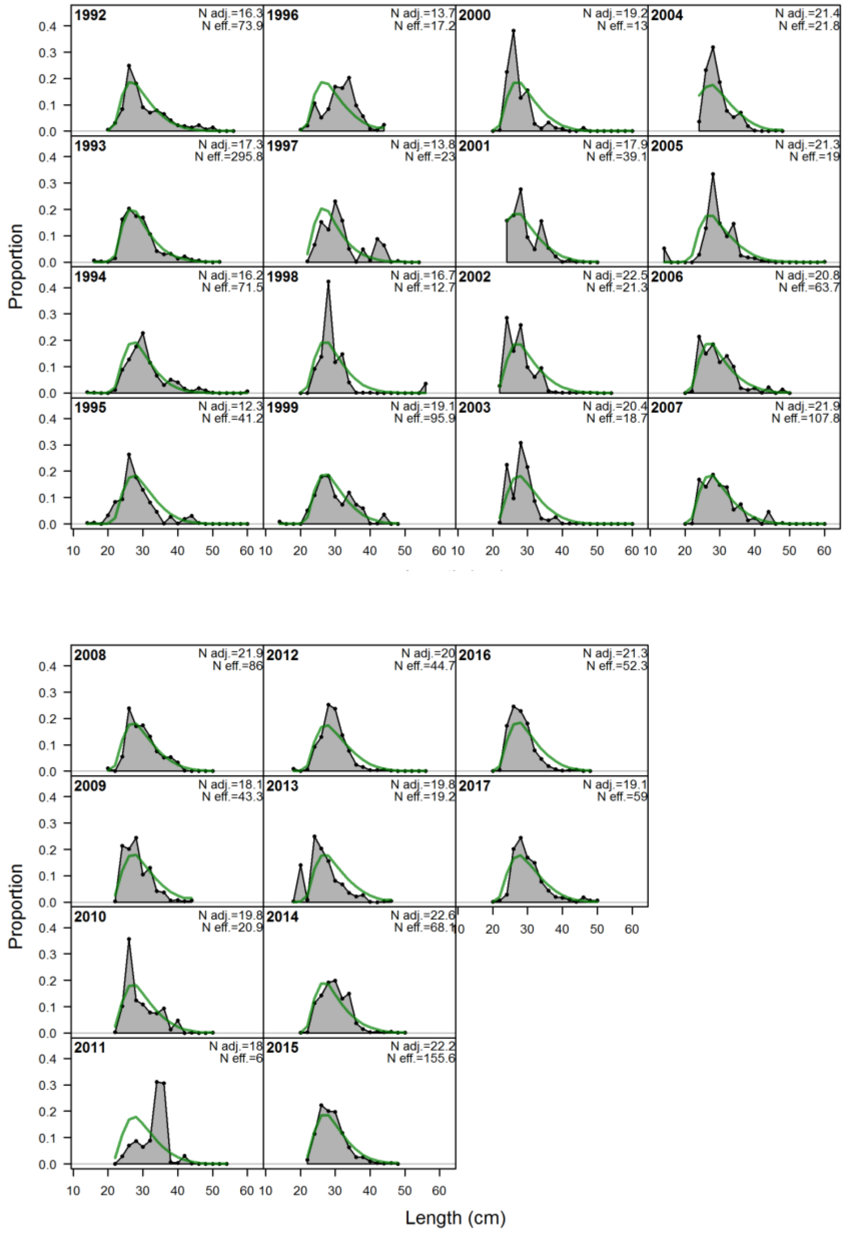


Figure 3.9.22. Model fits to the length composition of retained catch by the MRIP fleet for southeastern U.S. Yellowtail Snapper. Green lines represent predicted length compositions, while grey shaded regions represent observed length compositions. The input effective sample size after the Francis data re-weighting adjustment to the yearly length composition data, N adj., and the calculated effective sample size used in the McAllister-Iannelli tuning method, N eff., are provided in the upper right corner of each panel.

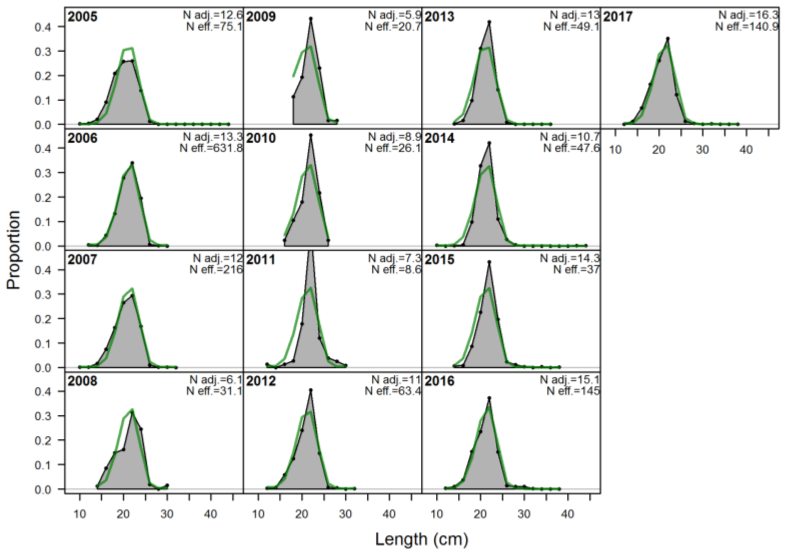


Figure 3.9.23. Model fits to the discard length composition data by the MRIP fleet for southeastern U.S. Yellowtail Snapper. Green lines represent predicted length compositions, while grey shaded regions represent observed length compositions. The input effective sample size after the Francis data re-weighting adjustment to the yearly length composition data, N adj., and the calculated effective sample size used in the McAllister-Iannelli tuning method, N eff., are provided in the upper right corner of each panel.

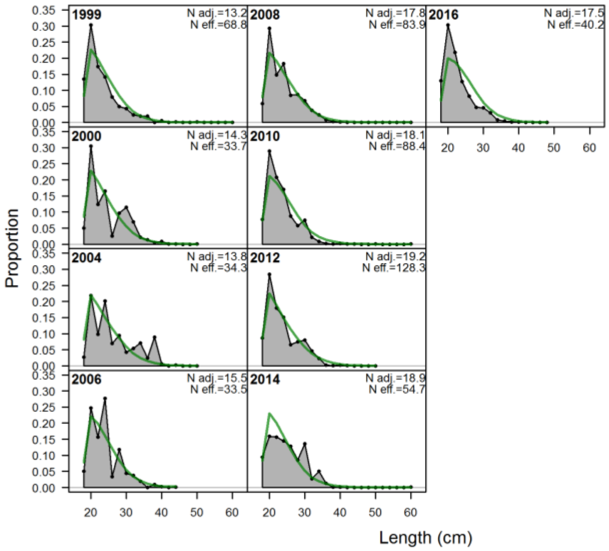


Figure 3.9.24. Model fits to the length composition of the RVC Adult index for southeastern U.S. Yellowtail Snapper. Green lines represent predicted length compositions, while grey shaded regions represent observed length compositions. The input effective sample size after the Francis data re-weighting adjustment to the yearly length composition data, N adj., and the calculated effective sample size used in the McAllister-Iannelli tuning method, N eff., are provided in the upper right corner of each panel.

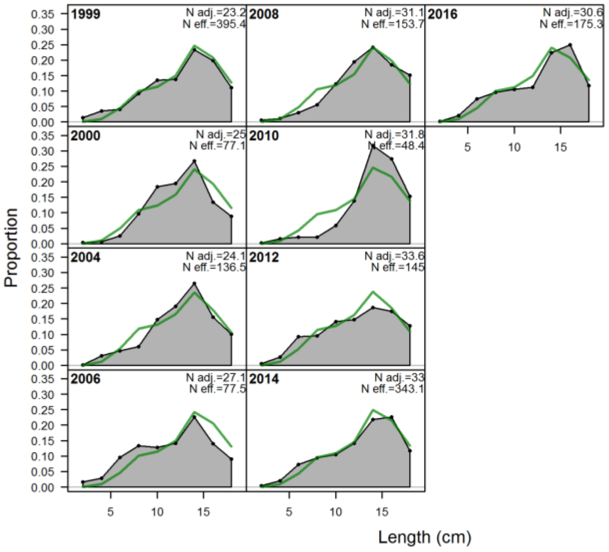


Figure 3.9.25. Model fits to the length composition of the RVC Juvenile index for southeastern U.S. Yellowtail Snapper. Green lines represent predicted length compositions, while grey shaded regions represent observed length compositions. The input effective sample size after the Francis data re-weighting adjustment to the yearly length composition data, N adj., and the calculated effective sample size used in the McAllister-Iannelli tuning method, N eff., are provided in the upper right corner of each panel.

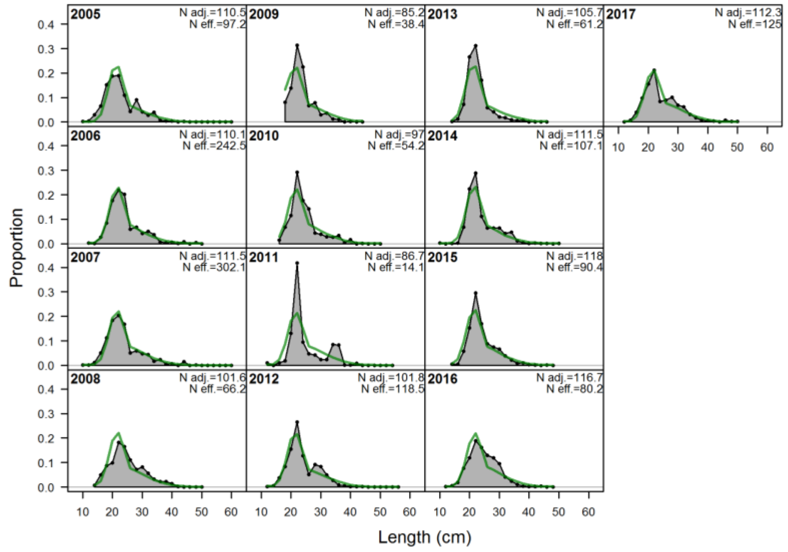


Figure 3.9.26. Model fits to the length composition of the MRIP CPUE index for southeastern U.S. Yellowtail Snapper. Green lines represent predicted length compositions, while grey shaded regions represent observed length compositions. The input effective sample size after the Francis data re-weighting adjustment to the yearly length composition data, N adj., and the calculated effective sample size used in the McAllister-Iannelli tuning method, N eff., are provided in the upper right corner of each panel.

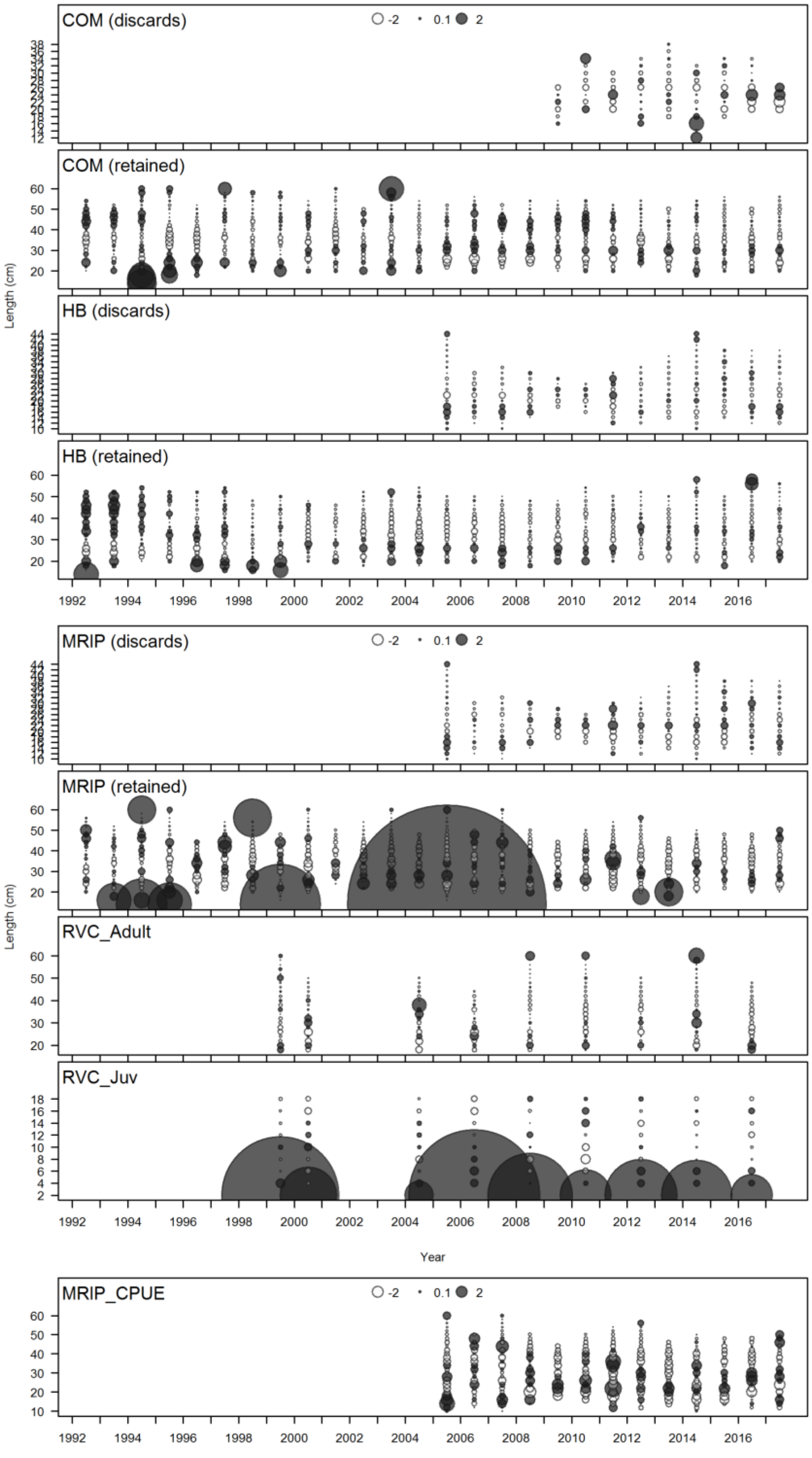


Figure 3.9.27. Pearson residuals for length composition data by year compared across a given fleet or survey for southeastern U.S. Yellowtail Snapper. Closed bubbles are positive residuals (observed > expected) and open bubbles are negative residuals (observed < expected).

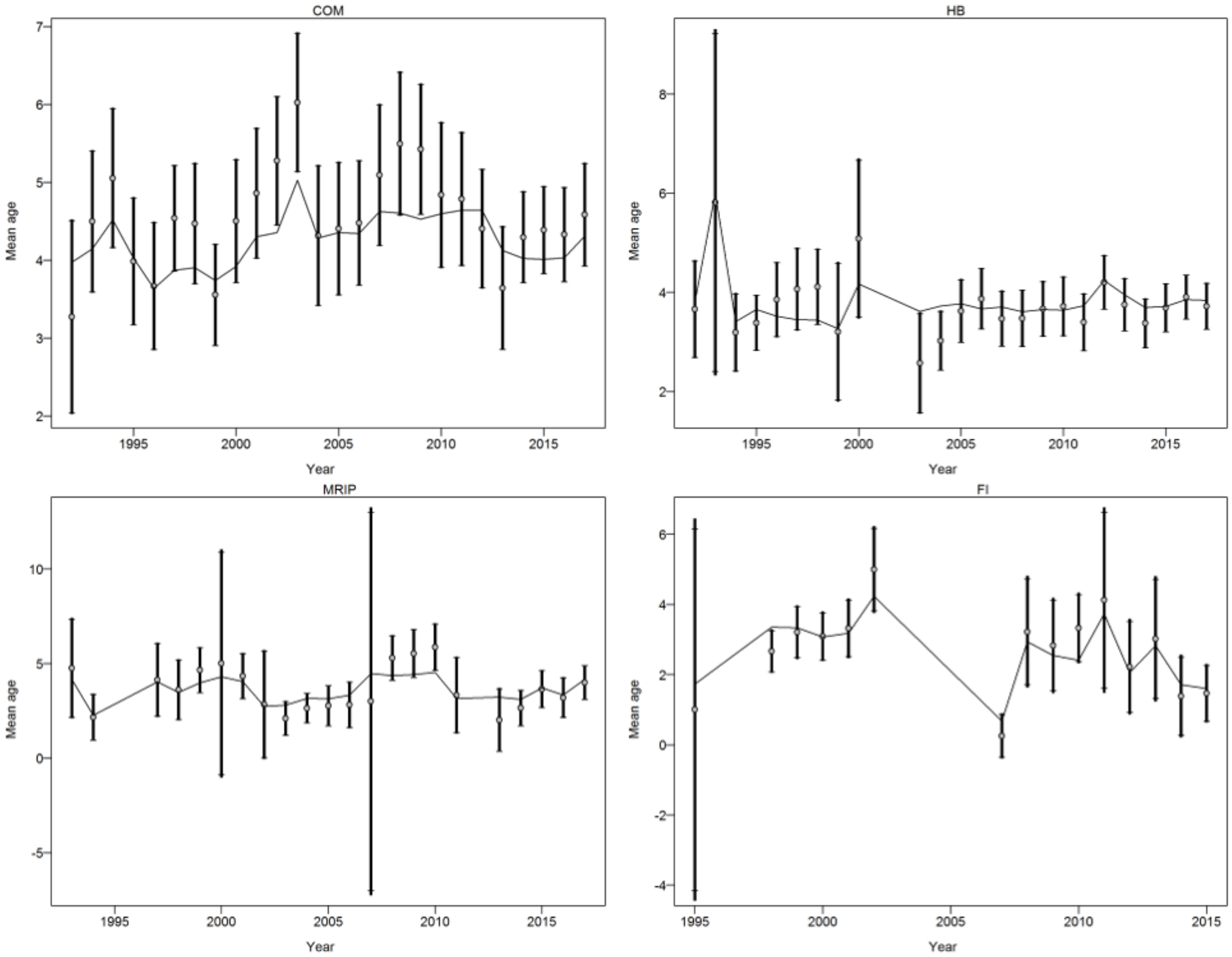


Figure 3.9.28. Mean ages of southeastern U.S. Yellowtail Snapper from conditional age-at-length data aggregated across length bins for each fleet and the fishery-independent data source (observed -- dots with 95% confidence intervals and predicted --black line).

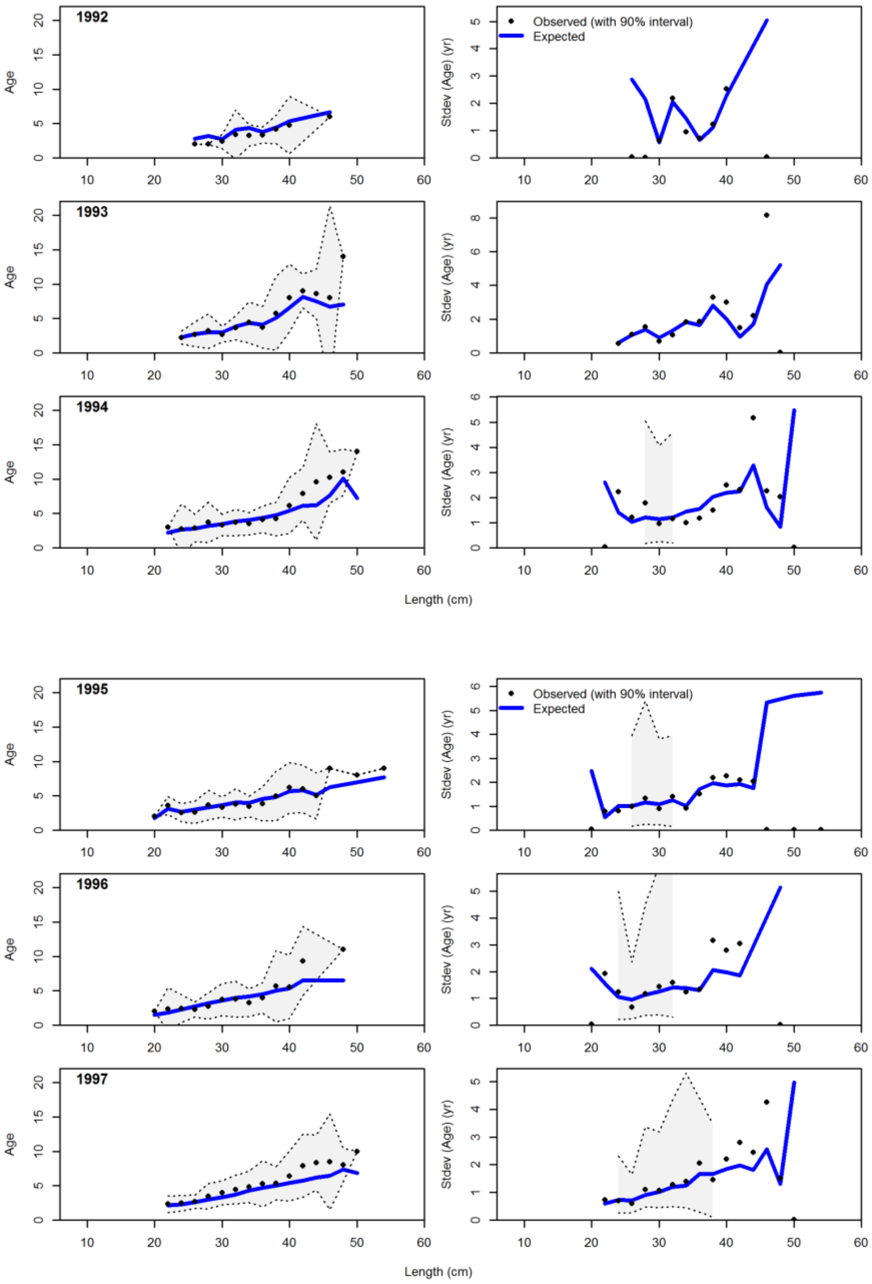


Figure 3.9.29. Model fits to the annual conditional age-at-length data from retained catch by the commercial fleet for southeastern U.S. Yellowtail Snapper. In the left plots, the blue lines represent predicted mean age-at-length by size class while the black dots and grey shaded regions represent the observed mean age-at-length by size class with 90% confidence intervals. In the right plots, the blue lines represent predicted standard error of mean age-at-length by size class while the black dots and grey shaded regions represent the observed standard error of mean age-at-length by size class with 90% confidence intervals.

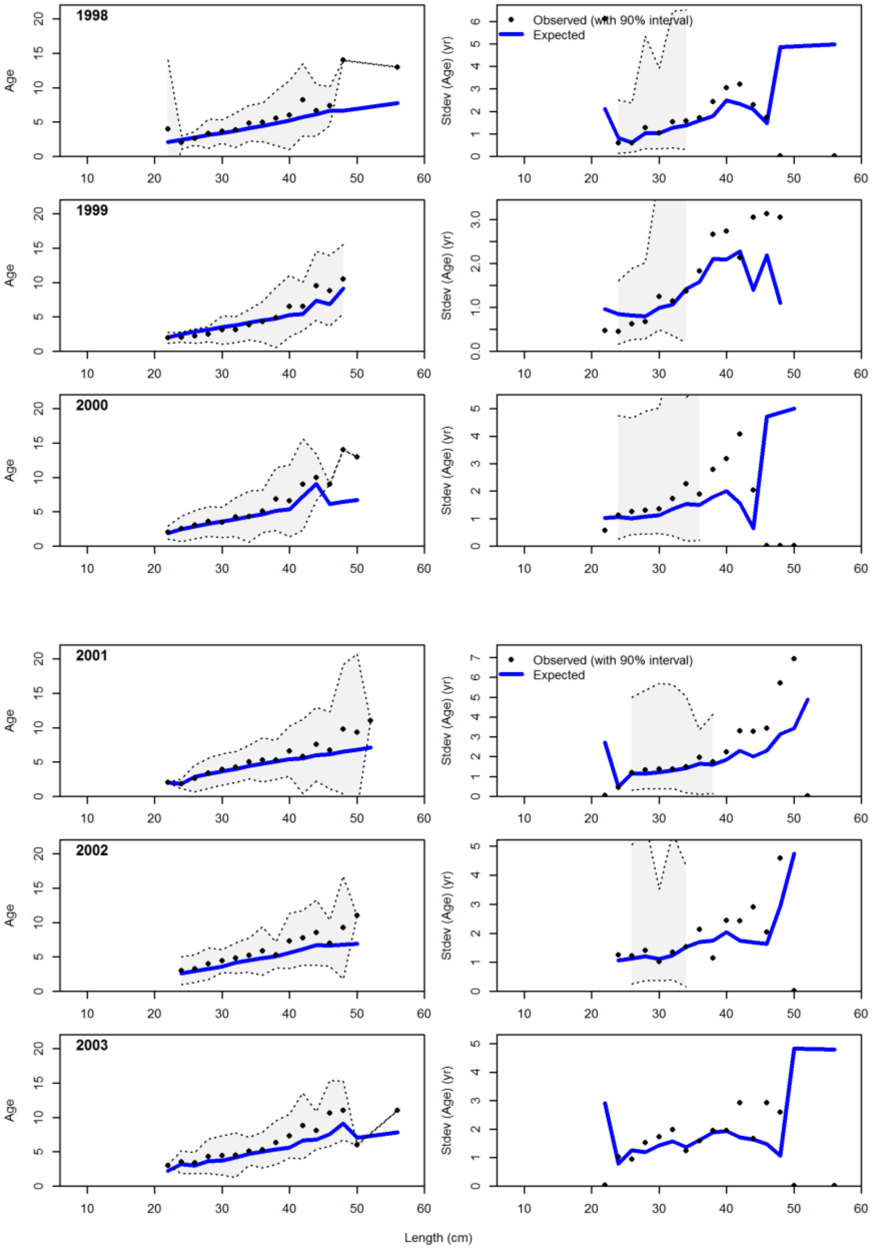


Figure 3.9.29. Continued Model fits to the annual conditional age-at-length data from retained catch by the commercial fleet for southeastern U.S. Yellowtail Snapper. In the left plots, the blue lines represent predicted mean age-at-length by size class while the black dots and grey shaded regions represent the observed mean age-at-length by size class with 90% confidence intervals. In the right plots, the blue lines represent predicted standard error of mean age-at-length by size class while the black dots and grey shaded regions represent the observed standard error of mean age-at-length by size class with 90% confidence intervals.

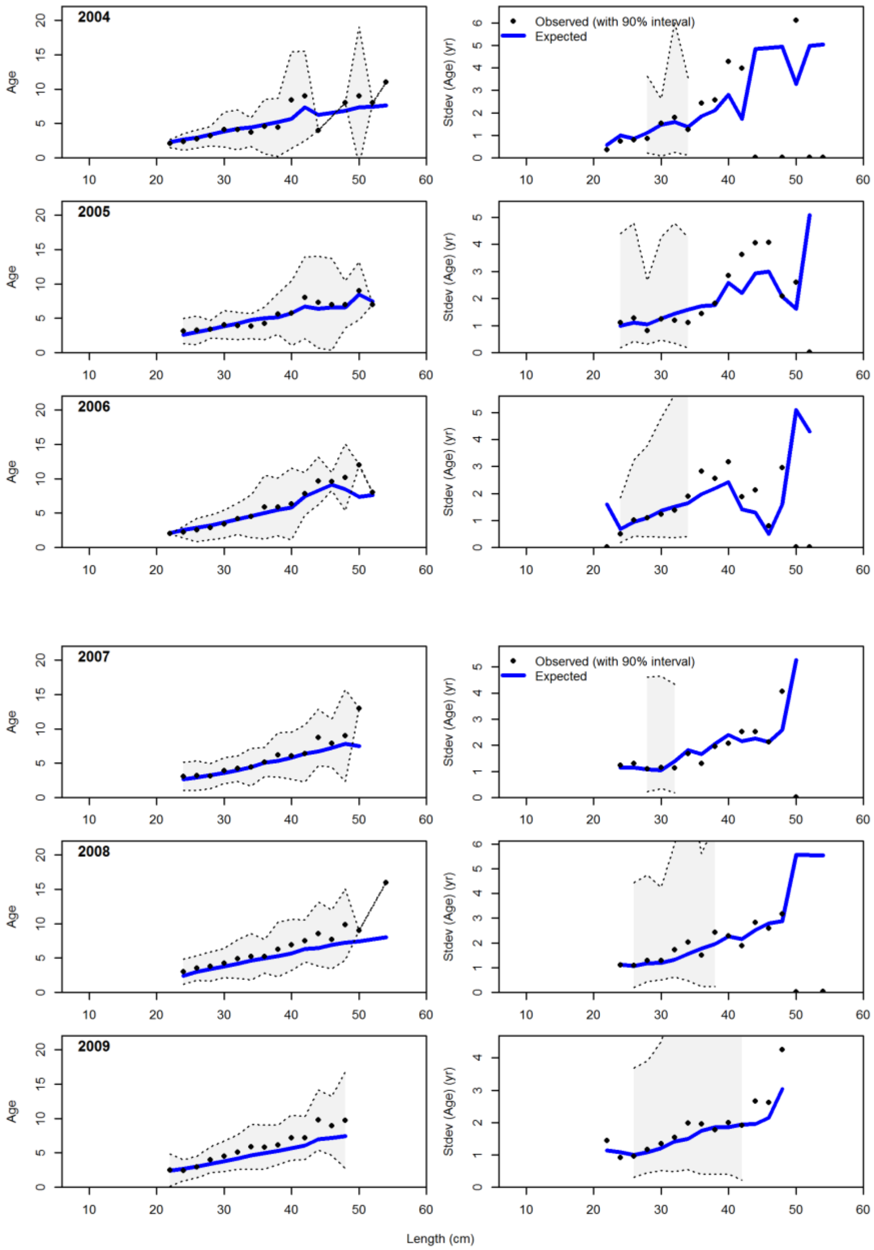


Figure 3.9.29. Continued Model fits to the annual conditional age-at-length data from retained catch by the commercial fleet for southeastern U.S. Yellowtail Snapper. In the left plots, the blue lines represent predicted mean age-at-length by size class while the black dots and grey shaded regions represent the observed mean age-at-length by size class with 90% confidence intervals. In the right plots, the blue lines represent predicted standard error of mean age-at-length by size class while the black dots and grey shaded regions represent the observed standard error of mean age-at-length by size class with 90% confidence intervals.

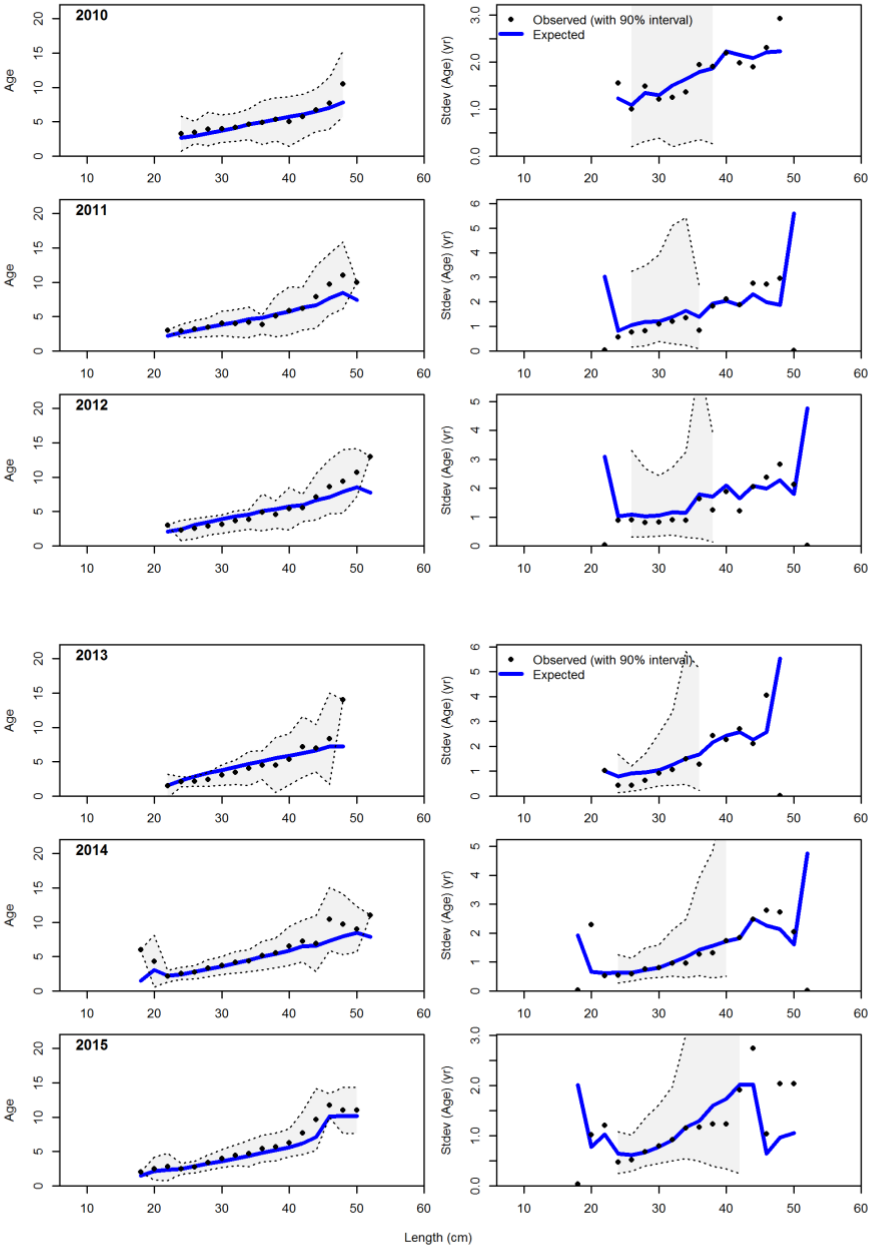


Figure 3.9.29. Continued Model fits to the annual conditional age-at-length data from retained catch by the commercial fleet for southeastern U.S. Yellowtail Snapper. In the left plots, the blue lines represent predicted mean age-at-length by size class while the black dots and grey shaded regions represent the observed mean age-at-length by size class with 90% confidence intervals. In the right plots, the blue lines represent predicted standard error of mean age-at-length by size class while the black dots and grey shaded regions represent the observed standard error of mean age-at-length by size class with 90% confidence intervals.

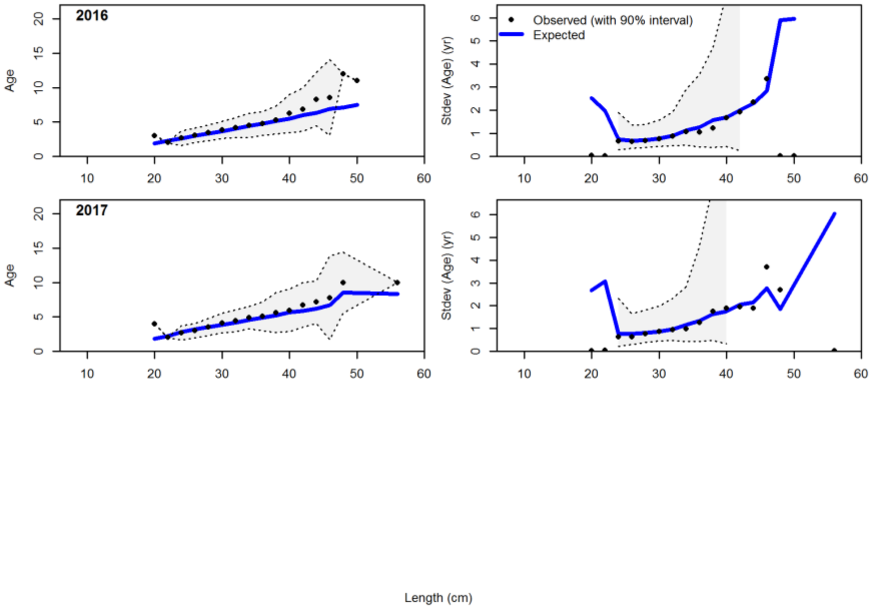


Figure 3.9.29. Continued Model fits to the annual conditional age-at-length data from retained catch by the commercial fleet for southeastern U.S. Yellowtail Snapper. In the left plots, the blue lines represent predicted mean age-at-length by size class while the black dots and grey shaded regions represent the observed mean age-at-length by size class with 90% confidence intervals. In the right plots, the blue lines represent predicted standard error of mean age-at-length by size class while the black dots and grey shaded regions represent the observed standard error of mean age-at-length by size class with 90% confidence intervals.

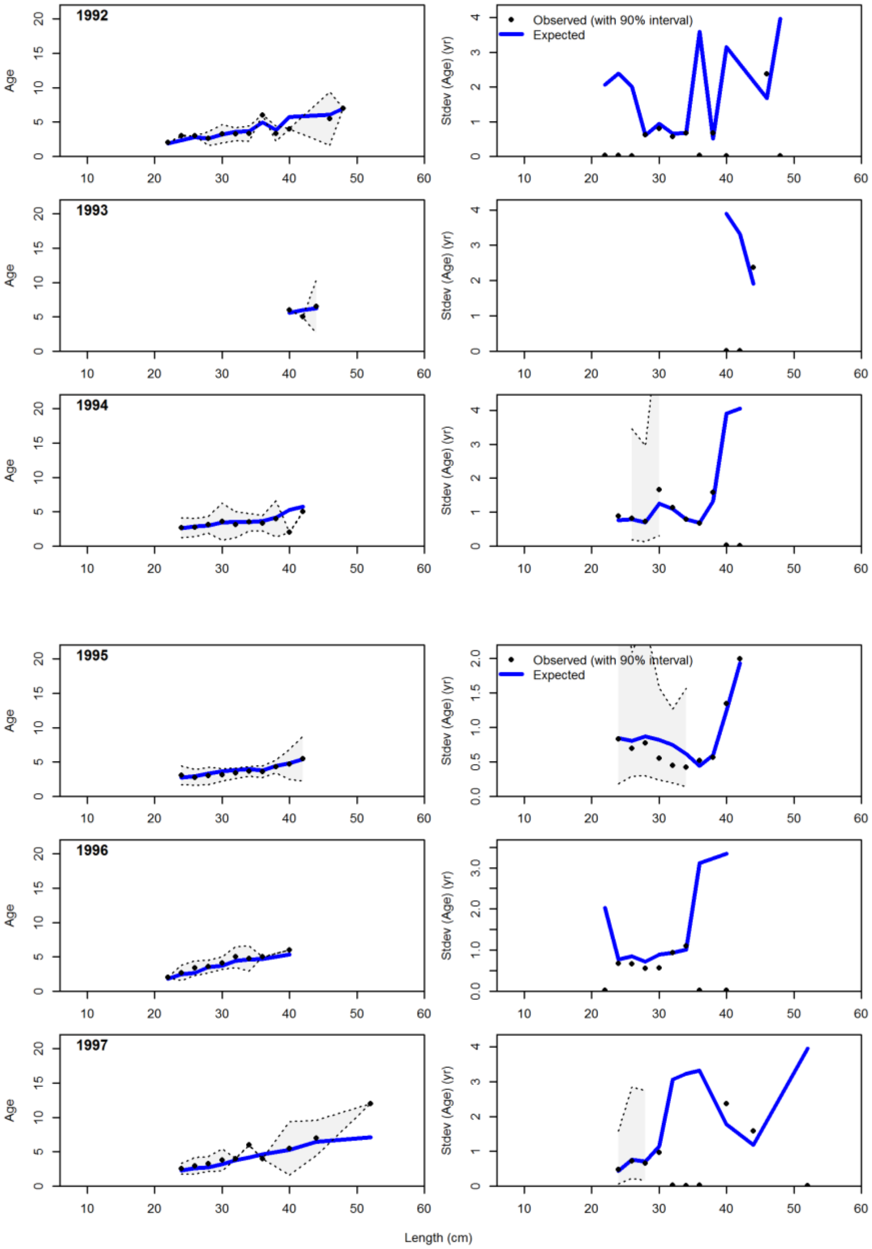


Figure 3.9.30. Model fits to the annual conditional age-at-length data from retained catch by the headboat fleet for southeastern U.S. Yellowtail Snapper. In the left plots, the blue lines represent predicted mean age-at-length by size class while the black dots and grey shaded regions represent the observed mean age-at-length by size class with 90% confidence intervals. In the right plots, the blue lines represent predicted standard error of mean age-at-length by size class while the black dots and grey shaded regions represent the observed standard error of mean age-at-length by size class with 90% confidence intervals.

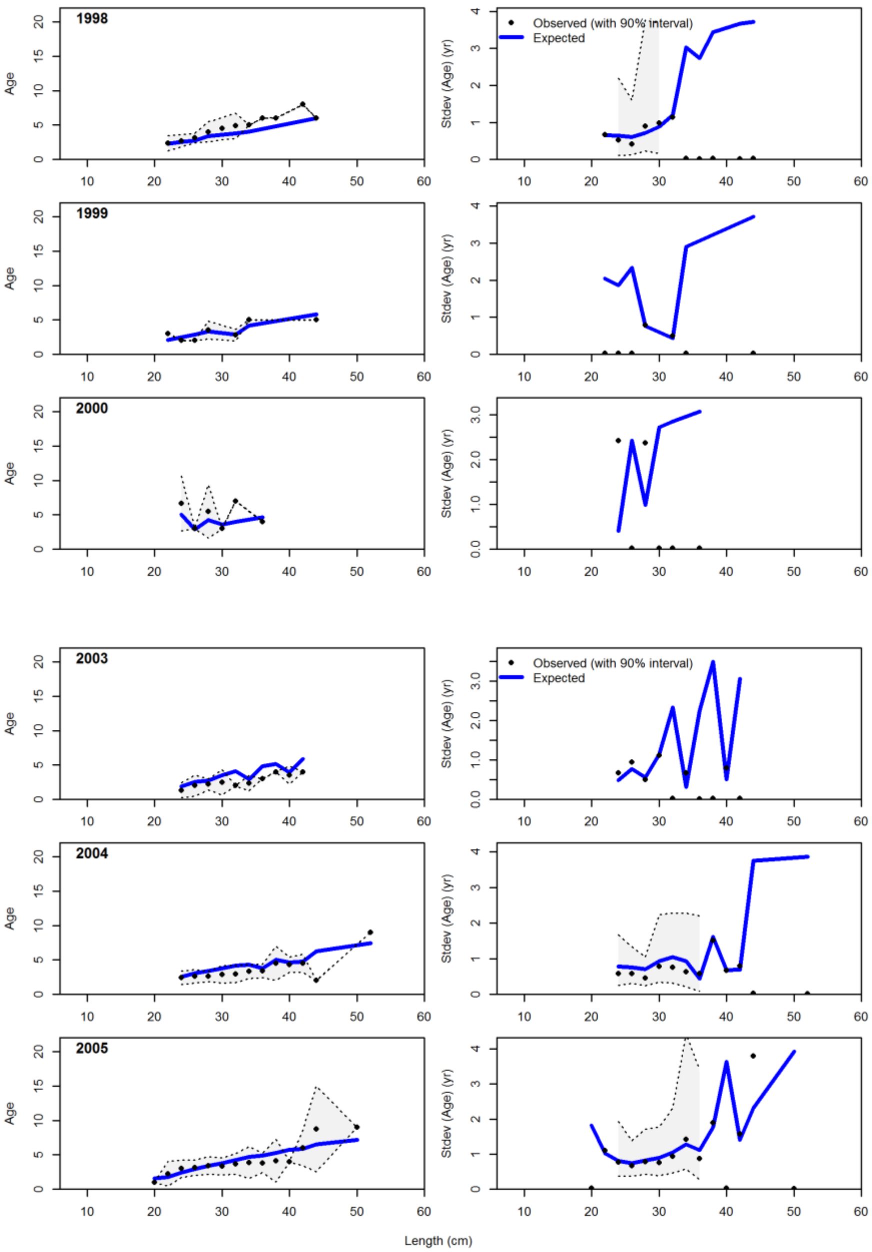


Figure 3.9.30. Continued Model fits to the annual conditional age-at-length data from retained catch by the headboat fleet for southeastern U.S. Yellowtail Snapper. In the left plots, the blue lines represent predicted mean age-at-length by size class while the black dots and grey shaded regions represent the observed mean age-at-length by size class with 90% confidence intervals. In the right plots, the blue lines represent predicted standard error of mean age-at-length by size class while the black dots and grey shaded regions represent the observed standard error of mean age-at-length by size class with 90% confidence intervals.

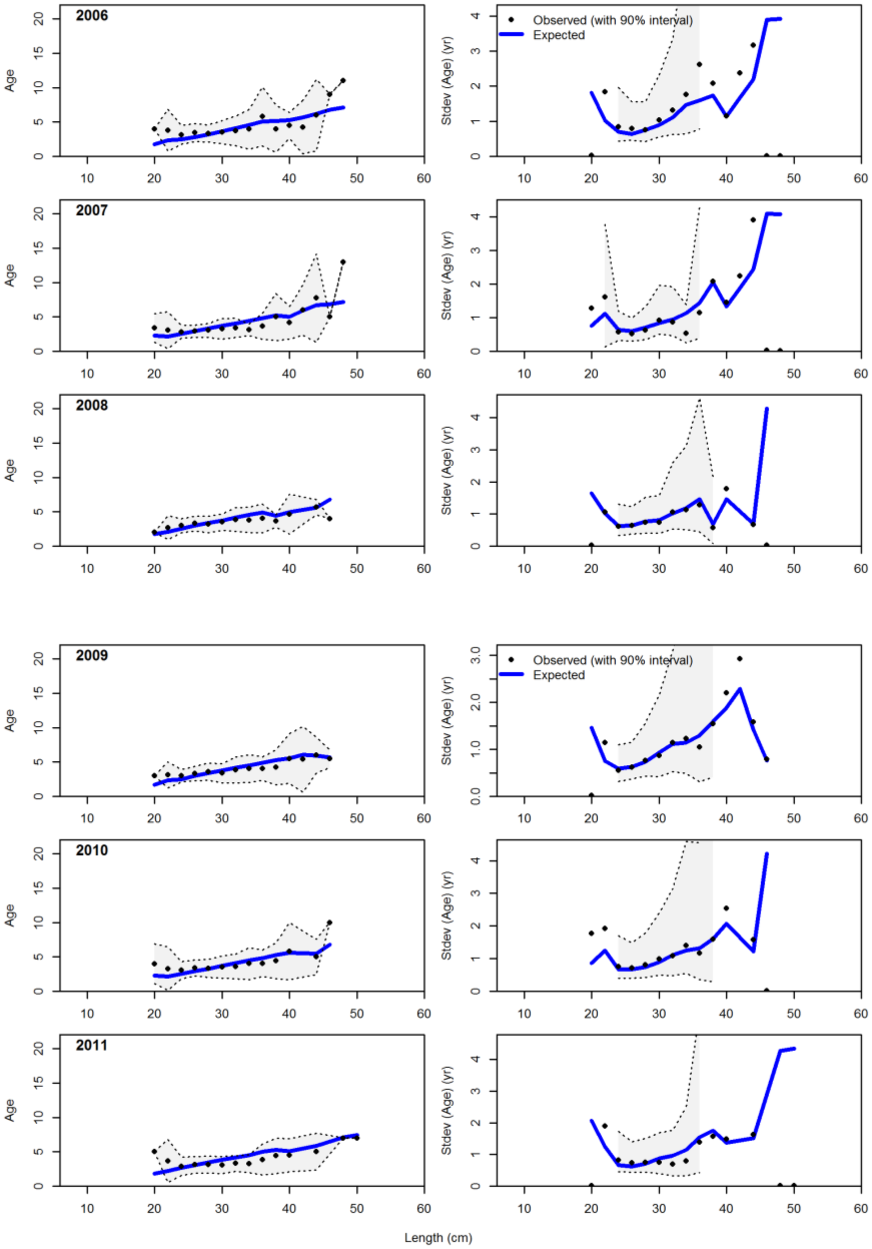


Figure 3.9.30. Continued Model fits to the annual conditional age-at-length data from retained catch by the headboat fleet for southeastern U.S. Yellowtail Snapper. In the left plots, the blue lines represent predicted mean age-at-length by size class while the black dots and grey shaded regions represent the observed mean age-at-length by size class with 90% confidence intervals. In the right plots, the blue lines represent predicted standard error of mean age-at-length by size class while the black dots and grey shaded regions represent the observed standard error of mean age-at-length by size class with 90% confidence intervals.

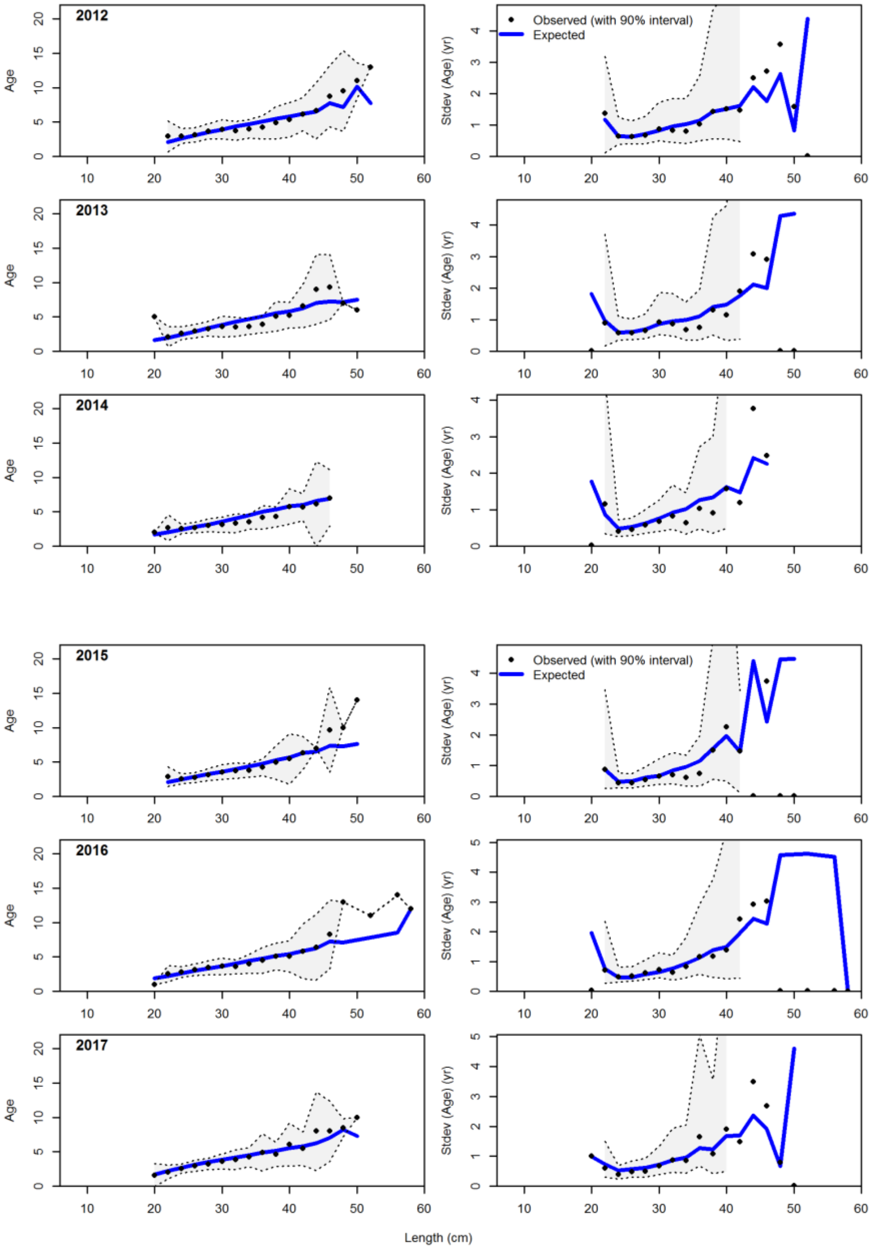


Figure 3.9.30. Continued Model fits to the annual conditional age-at-length data from retained catch by the headboat fleet for southeastern U.S. Yellowtail Snapper. In the left plots, the blue lines represent predicted mean age-at-length by size class while the black dots and grey shaded regions represent the observed mean age-at-length by size class with 90% confidence intervals. In the right plots, the blue lines represent predicted standard error of mean age-at-length by size class while the black dots and grey shaded regions represent the observed standard error of mean age-at-length by size class with 90% confidence intervals.

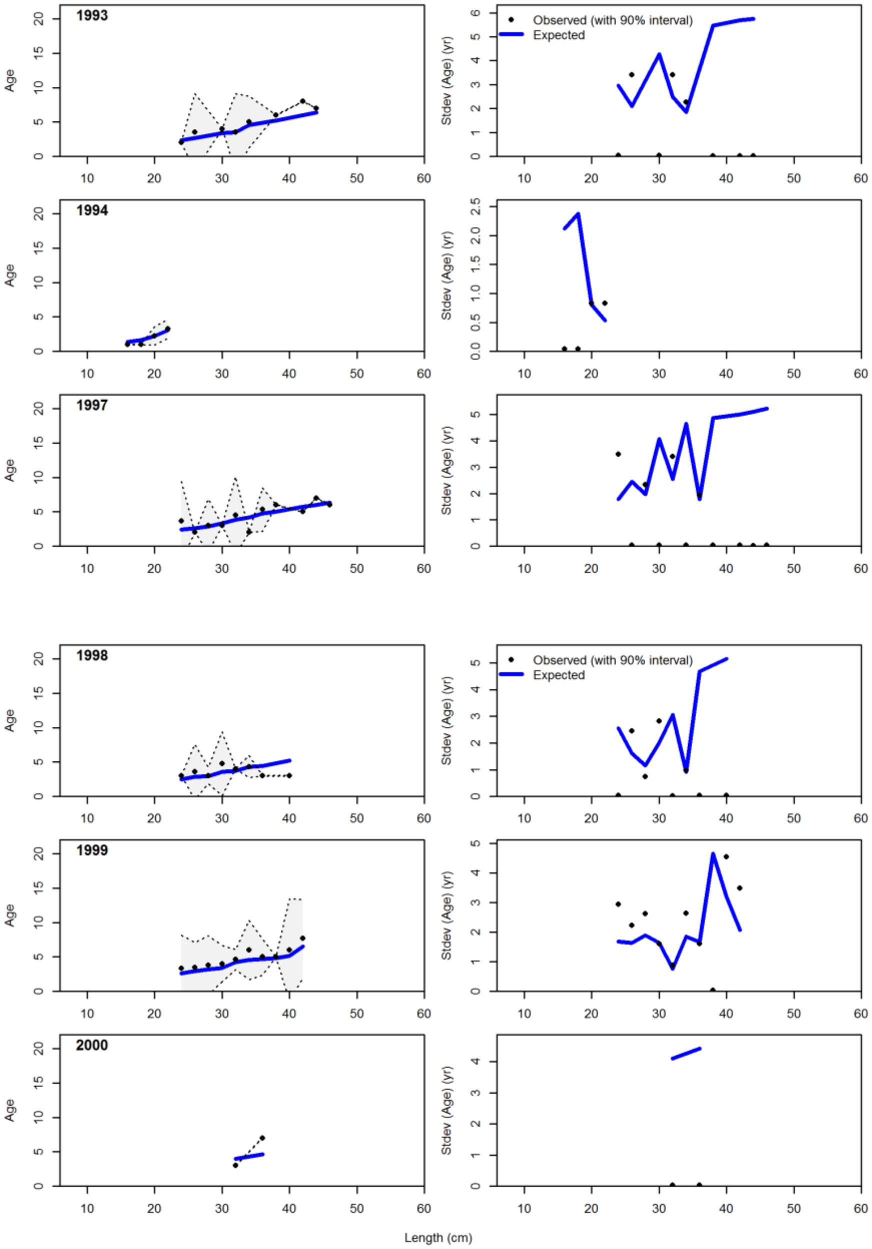


Figure 3.9.31. Model fits to the annual conditional age-at-length data from retained catch by the MRIP fleet for southeastern U.S. Yellowtail Snapper. In the left plots, the blue lines represent predicted mean age-at-length by size class while the black dots and grey shaded regions represent the observed mean age-at-length by size class with 90% confidence intervals. In the right plots, the blue lines represent predicted standard error of mean age-at-length by size class while the black dots and grey shaded regions represent the observed standard error of mean age-at-length by size class with 90% confidence intervals.

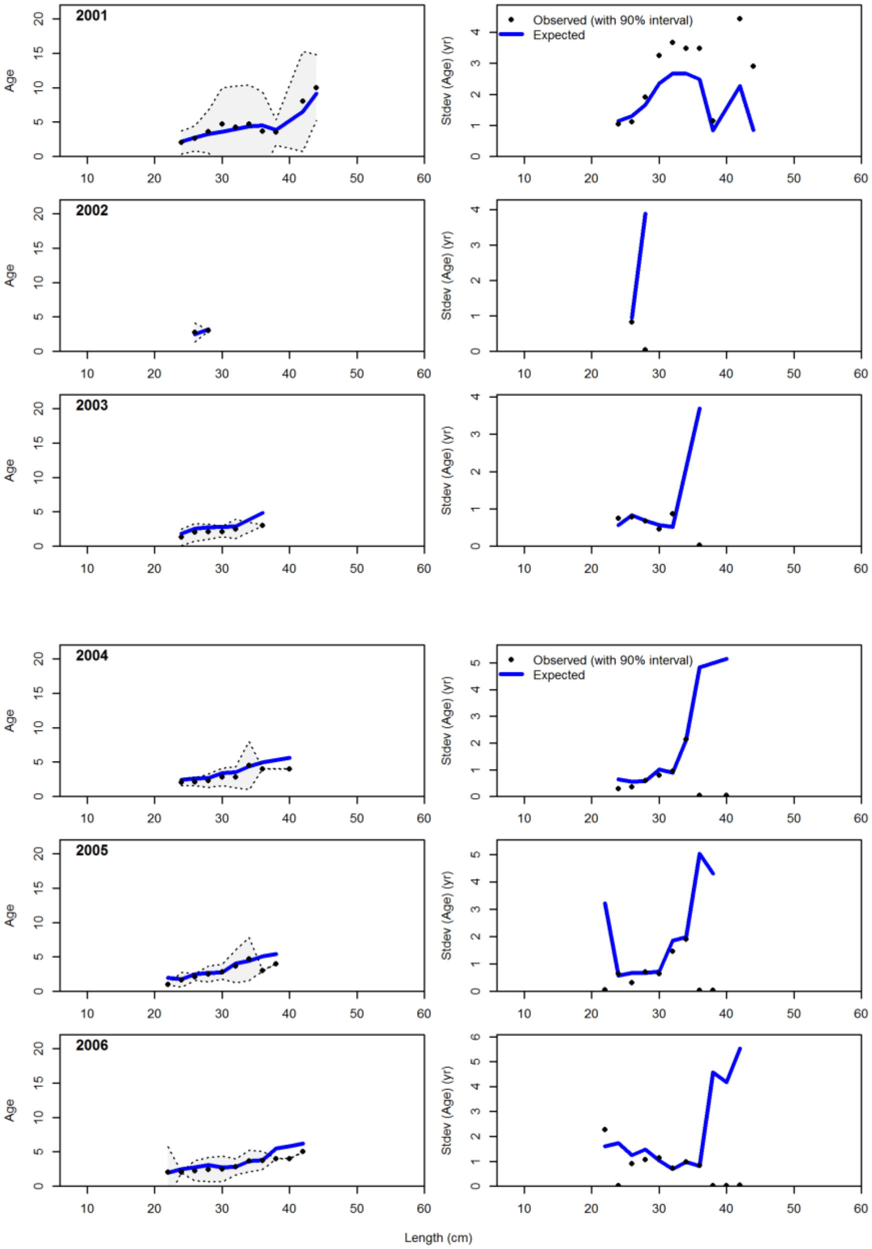


Figure 3.9.31. Continued Model fits to the annual conditional age-at-length data from retained catch by the MRIP fleet for southeastern U.S. Yellowtail Snapper. In the left plots, the blue lines represent predicted mean age-at-length by size class while the black dots and grey shaded regions represent the observed mean age-at-length by size class with 90% confidence intervals. In the right plots, the blue lines represent predicted standard error of mean age-at-length by size class while the black dots and grey shaded regions represent the observed standard error of mean age-at-length by size class with 90% confidence intervals.

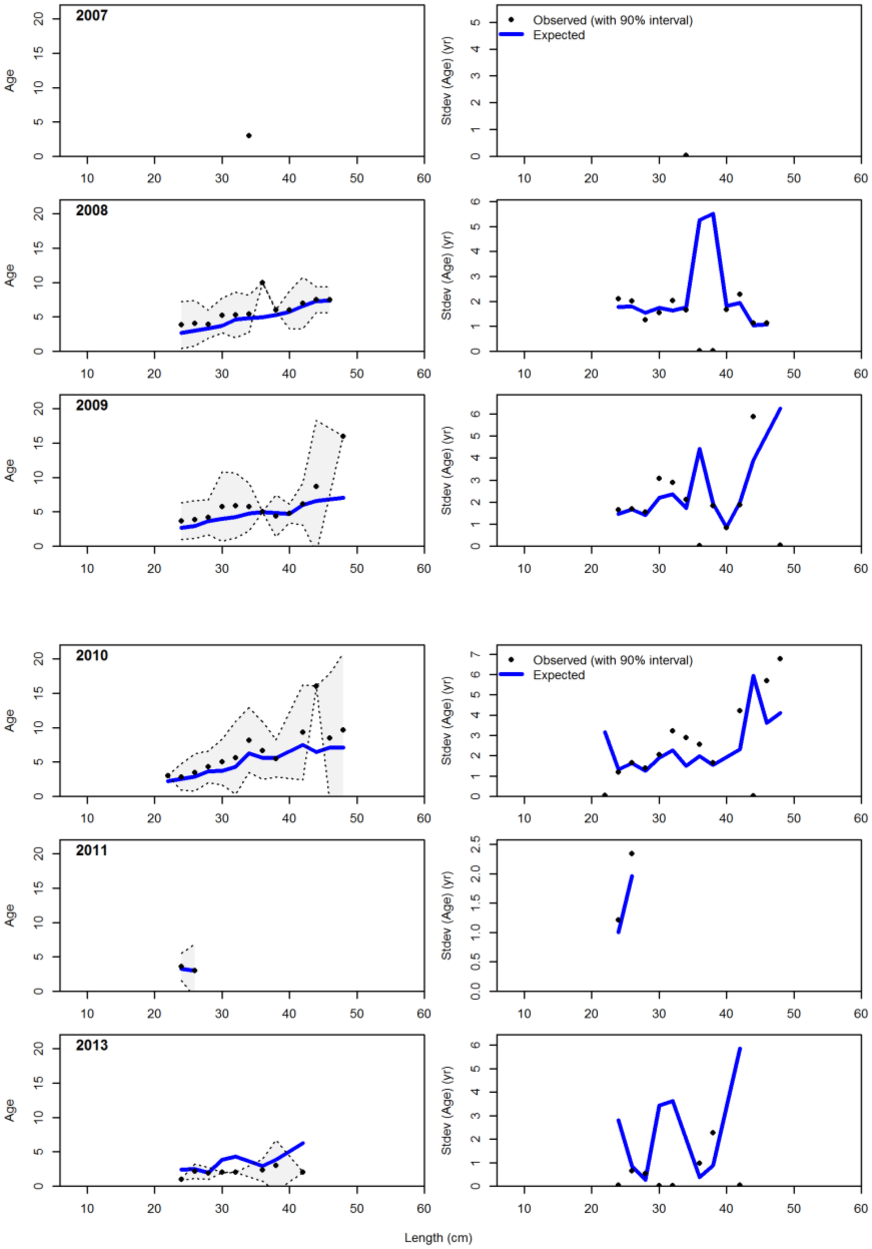


Figure 3.9.31. Continued Model fits to the annual conditional age-at-length data from retained catch by the MRIP fleet for southeastern U.S. Yellowtail Snapper. In the left plots, the blue lines represent predicted mean age-at-length by size class while the black dots and grey shaded regions represent the observed mean age-at-length by size class with 90% confidence intervals. In the right plots, the blue lines represent predicted standard error of mean age-at-length by size class while the black dots and grey shaded regions represent the observed standard error of mean age-at-length by size class with 90% confidence intervals.

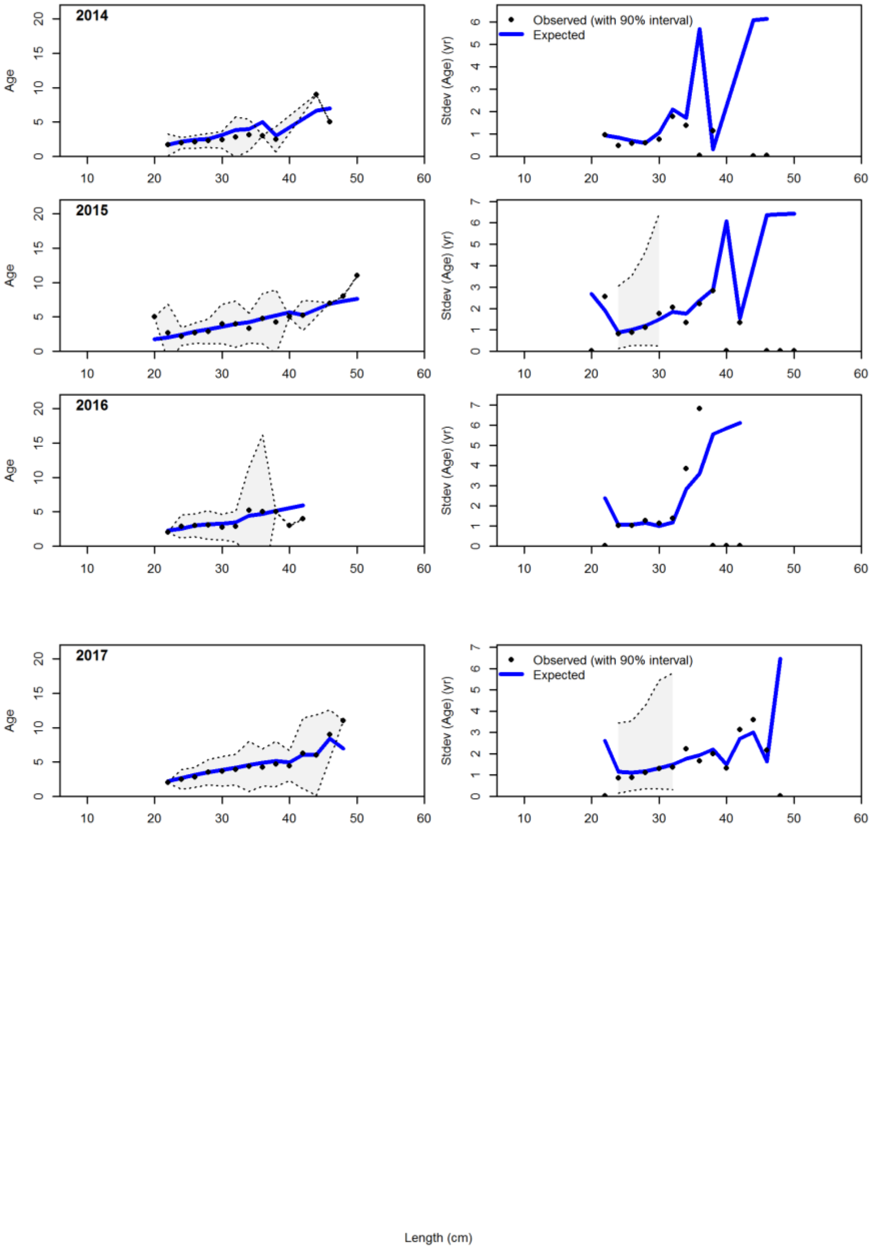


Figure 3.9.31. Continued Model fits to the annual conditional age-at-length data from retained catch by the MRIP fleet for southeastern U.S. Yellowtail Snapper. In the left plots, the blue lines represent predicted mean age-at-length by size class while the black dots and grey shaded regions represent the observed mean age-at-length by size class with 90% confidence intervals. In the right plots, the blue lines represent predicted standard error of mean age-at-length by size class while the black dots and grey shaded regions represent the observed standard error of mean age-at-length by size class with 90% confidence intervals.

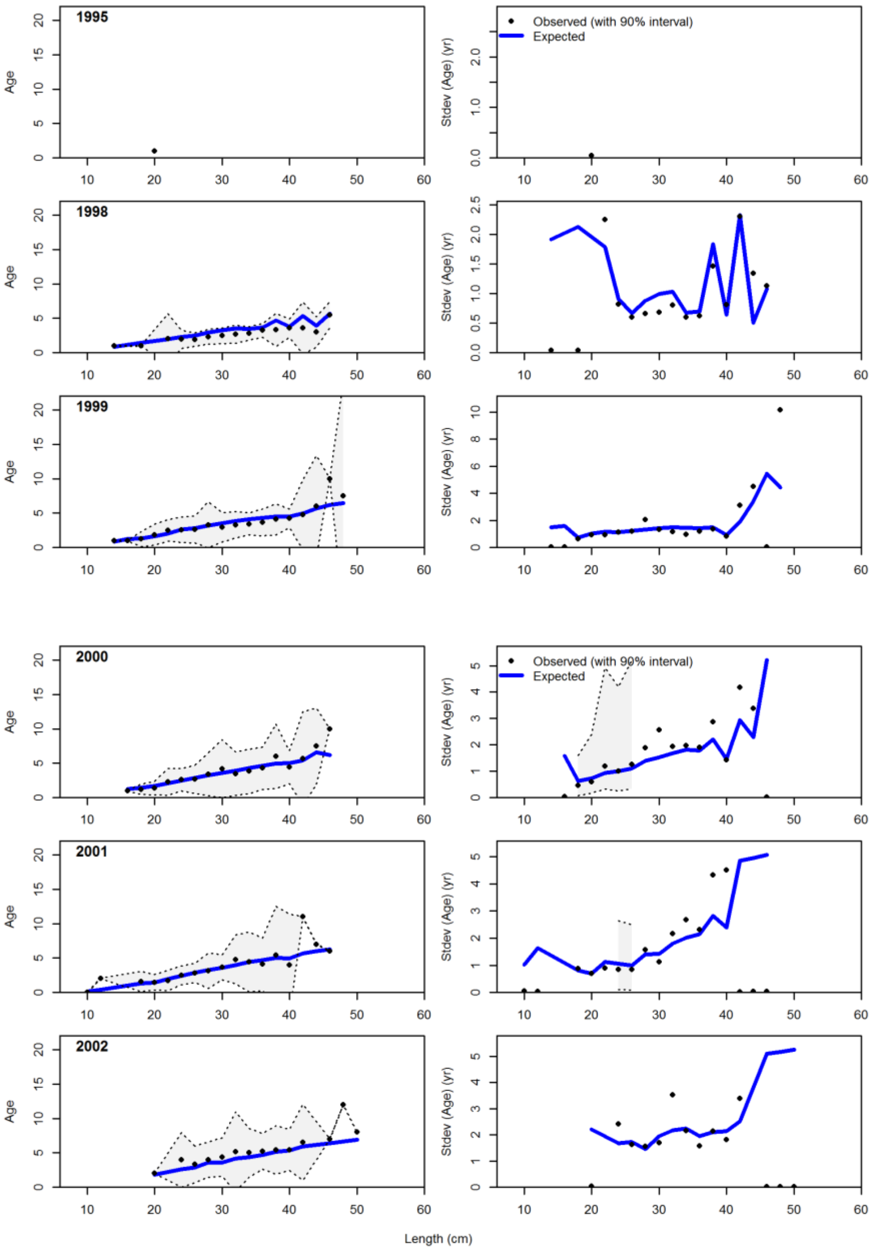


Figure 3.9.32. Model fits to the annual conditional age-at-length data from fishery-independent data sources for southeastern U.S. Yellowtail Snapper. In the left plots, the blue lines represent predicted mean age-at-length by size class while the black dots and grey shaded regions represent the observed mean age-at-length by size class with 90% confidence intervals. In the right plots, the blue lines represent predicted standard error of mean age-at-length by size class while the black dots and grey shaded regions represent the observed standard error of mean age-at-length by size class with 90% confidence intervals.

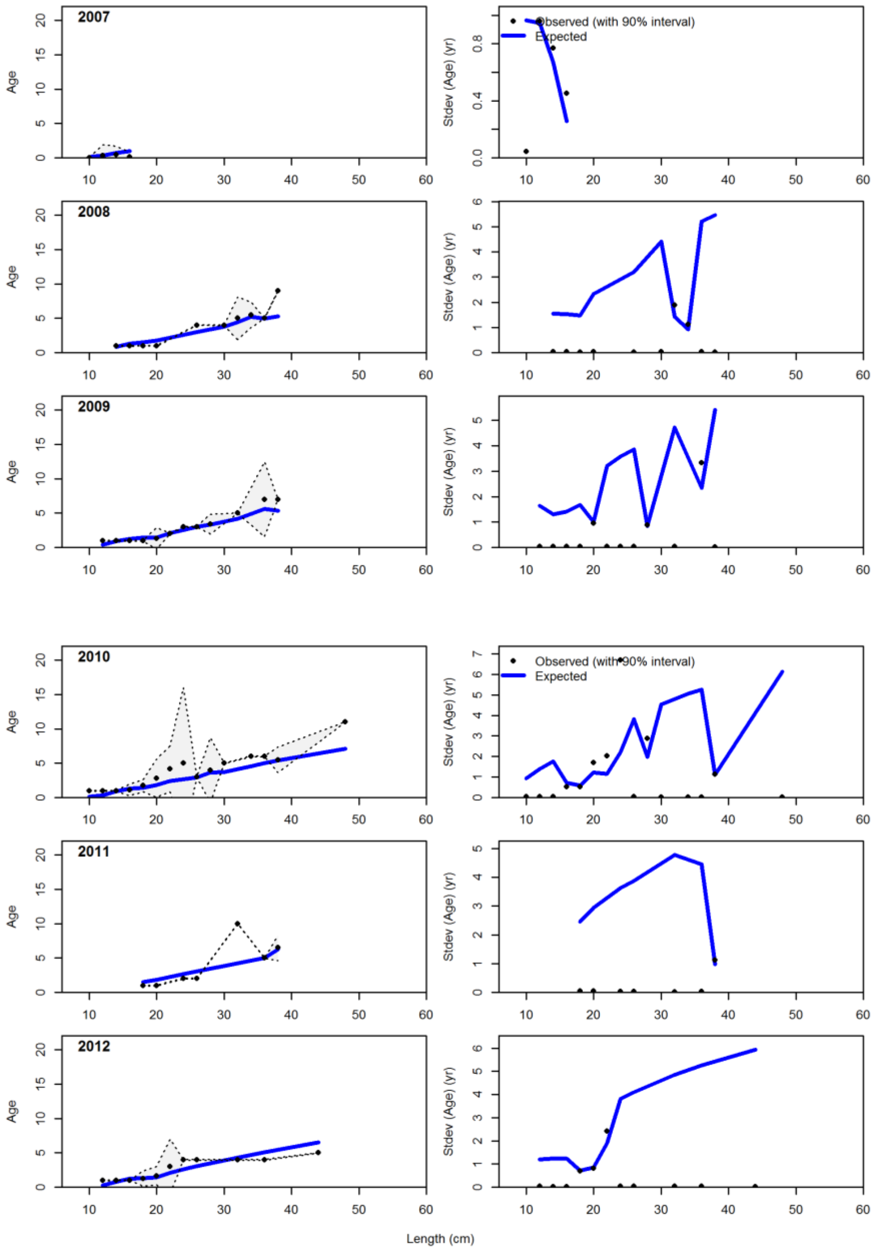


Figure 3.9.32. Continued Model fits to the annual conditional age-at-length data from fishery-independent data sources for southeastern U.S. Yellowtail Snapper. In the left plots, the blue lines represent predicted mean age-at-length by size class while the black dots and grey shaded regions represent the observed mean age-at-length by size class with 90% confidence intervals. In the right plots, the blue lines represent predicted standard error of mean age-at-length by size class while the black dots and grey shaded regions represent the observed standard error of mean age-at-length by size class with 90% confidence intervals.

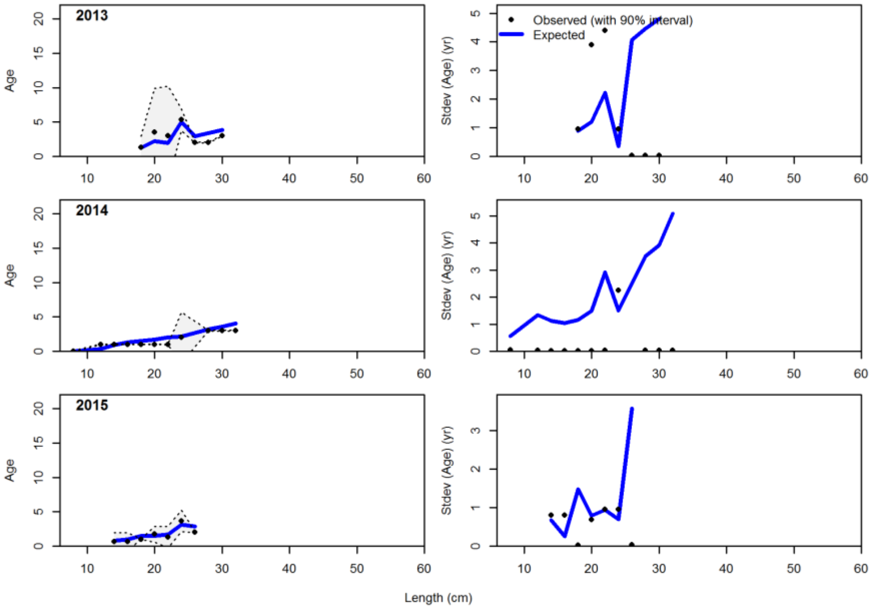


Figure 3.9.32. Continued Model fits to the annual conditional age-at-length data from fishery-independent data sources for southeastern U.S. Yellowtail Snapper. In the left plots, the blue lines represent predicted mean age-at-length by size class while the black dots and grey shaded regions represent the observed mean age-at-length by size class with 90% confidence intervals. In the right plots, the blue lines represent predicted standard error of mean age-at-length by size class while the black dots and grey shaded regions represent the observed standard error of mean age-at-length by size class with 90% confidence intervals.

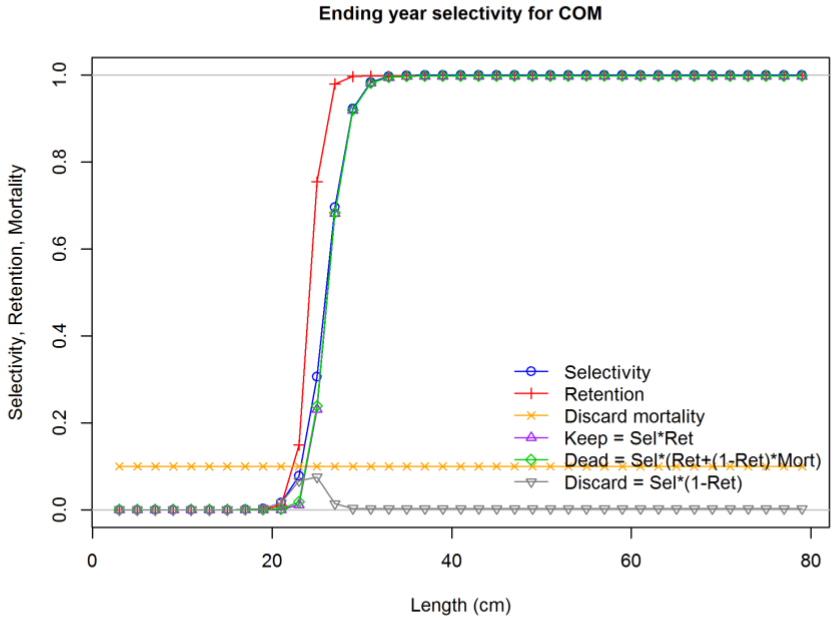


Figure 3.9.33. Terminal year (2017) length-based selectivity, retention, and discard mortality pattern for the commercial fleet for southeastern U.S. Yellowtail Snapper.

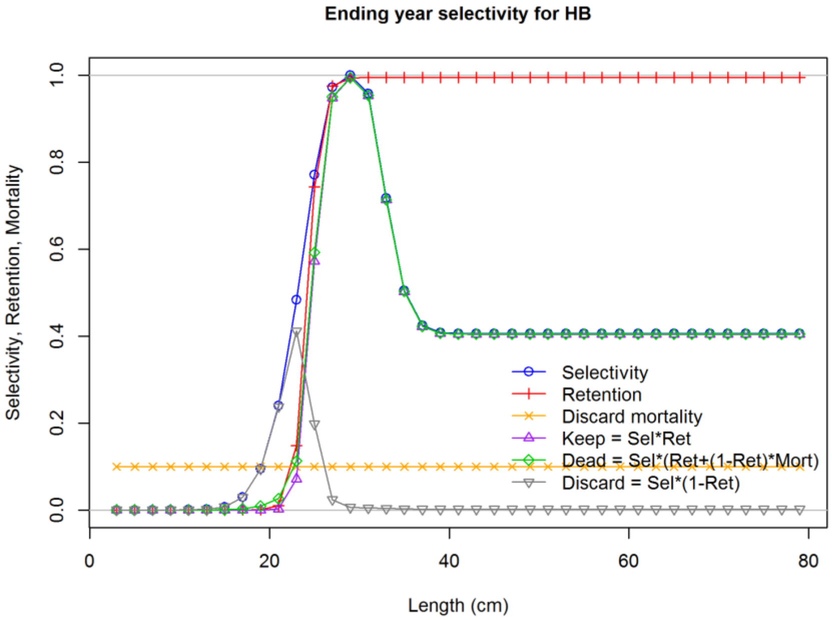


Figure 3.9.34. Terminal year (2017) length-based selectivity, retention, and discard mortality pattern for the headboat fleet for southeastern U.S. Yellowtail Snapper.

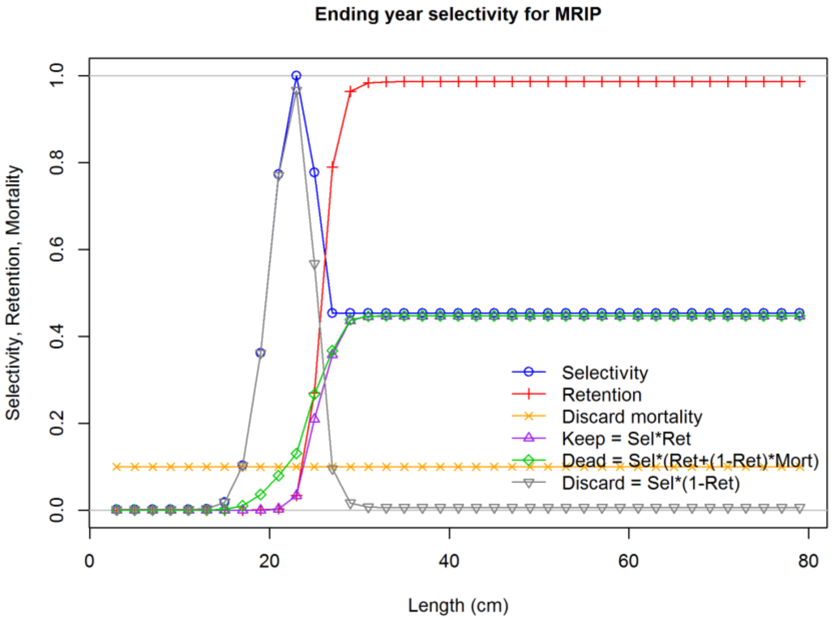


Figure 3.9.35. Terminal year (2017) length-based selectivity, retention, and discard mortality pattern for the MRIP fleet for southeastern U.S. Yellowtail Snapper.

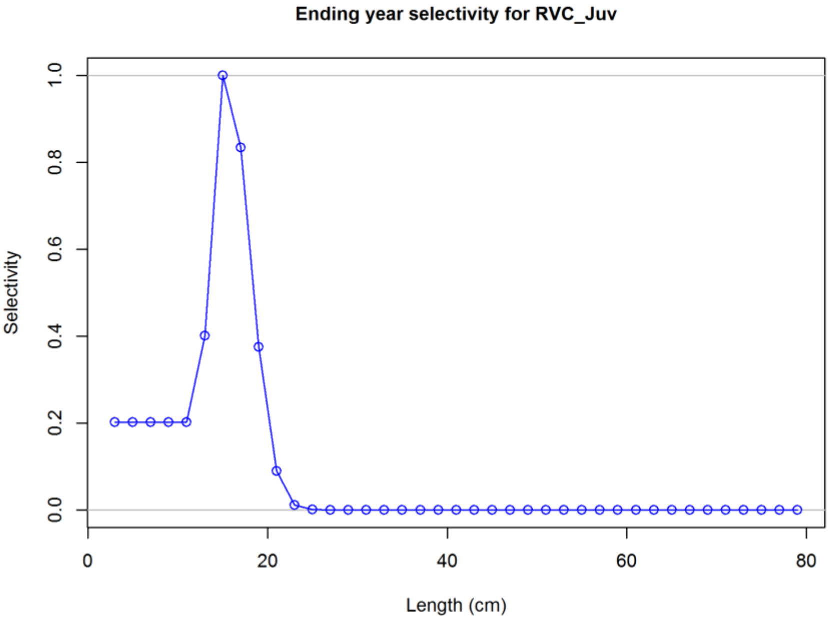


Figure 3.9.36. Terminal year (2017) length-based selectivity, retention, and discard mortality pattern for the RVC Juvenile index for southeastern U.S. Yellowtail Snapper. Juvenile Yellowtail Snapper were defined as being less than 19 cm FL.

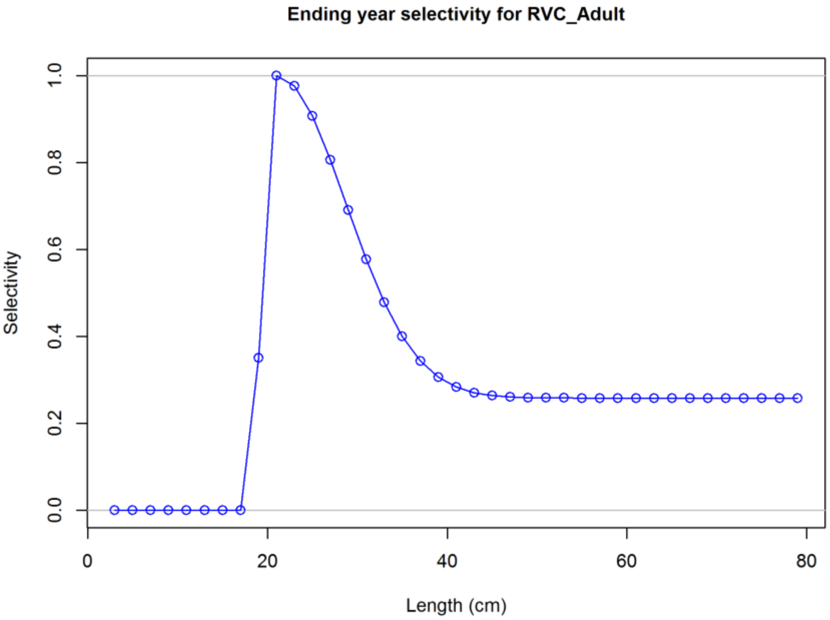


Figure 3.9.37. Terminal year (2017) length-based selectivity, retention, and discard mortality pattern for the RVC Adult index for southeastern U.S. Yellowtail Snapper. Adult Yellowtail Snapper were defined as being at least 19 cm FL.

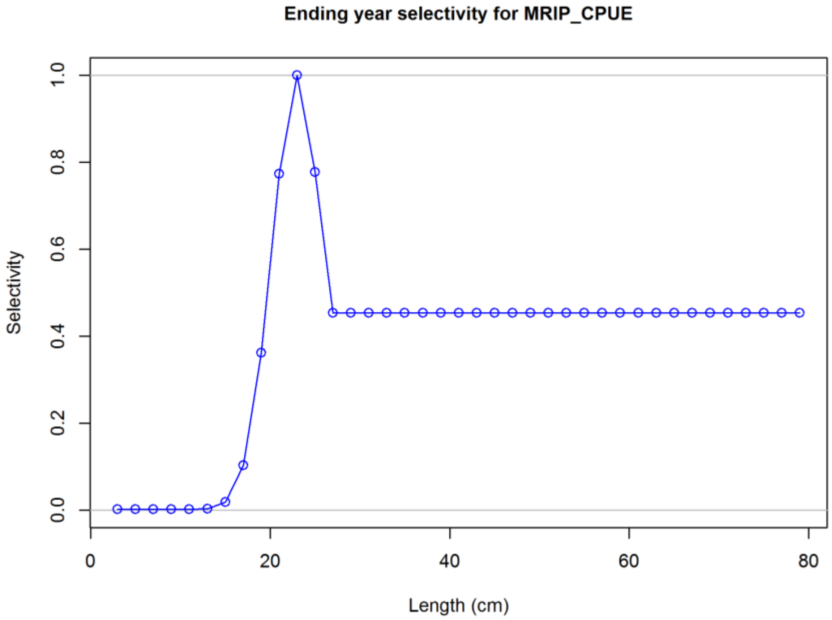


Figure 3.9.38. Terminal year (2017) length-based selectivity, retention, and discard mortality pattern for the MRIP CPUE index for southeastern U.S. Yellowtail Snapper.

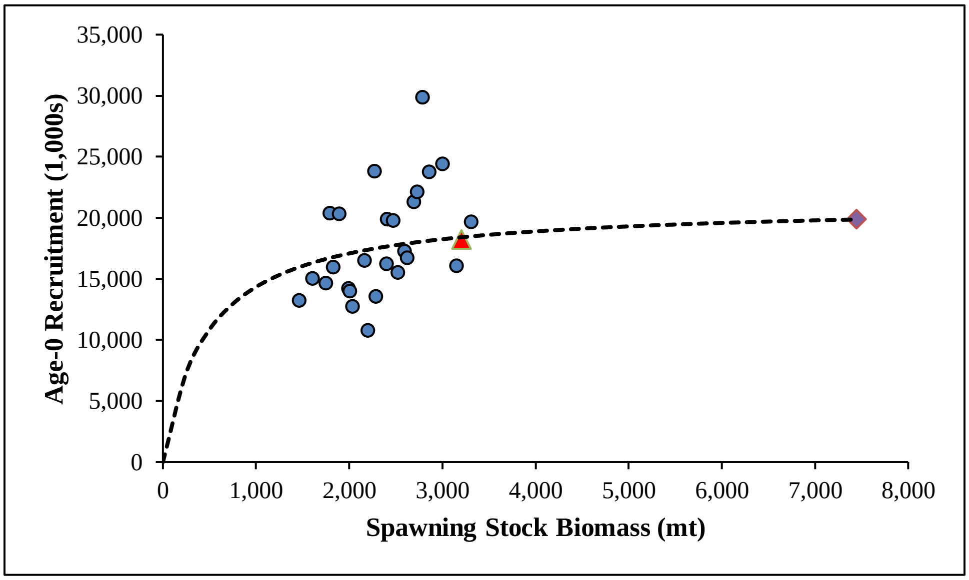
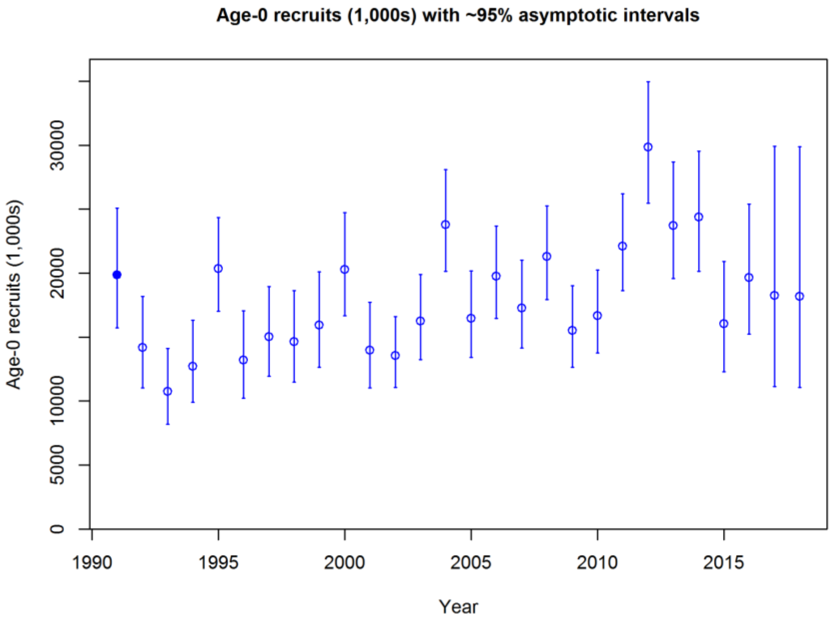


Figure 3.9.39. Predicted stock-recruitment relationship for southeastern U.S. Yellowtail Snapper (*steepness* estimated at 0.808, *sigmaR* estimated at 0.25). Plotted is the expected recruitment from the stock-recruitment relationship (black dashed line), the predicted annual recruitments from Stock Synthesis (blue circles), the terminal year (2017) predicted annual recruitment (red triangle), and the predicted virgin recruitment (yellow diamond).

a)



b)

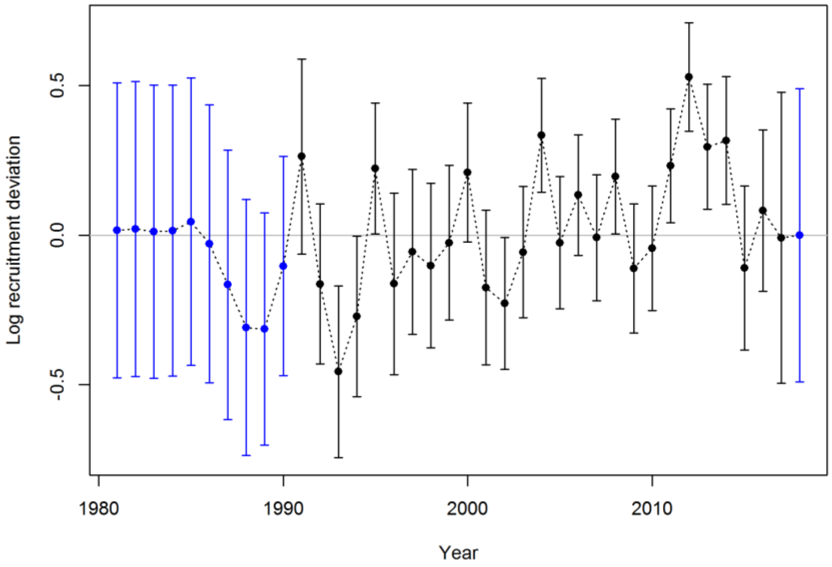


Figure 3.9.40. Estimated age-0 recruitment (blue/black dots) with 95% confidence intervals (blue/black lines, a) and log recruitment deviations (1981 – 2017, b) for southeastern U.S. Yellowtail Snapper (*steepness* estimated at 0.808, *sigmaR* estimated at 0.25). The blue dots and lines indicate when early recruitment deviations were estimated (1981 – 1990) while the black dots and lines indicate when the main recruitment deviations were estiamated (1991 – 2017).

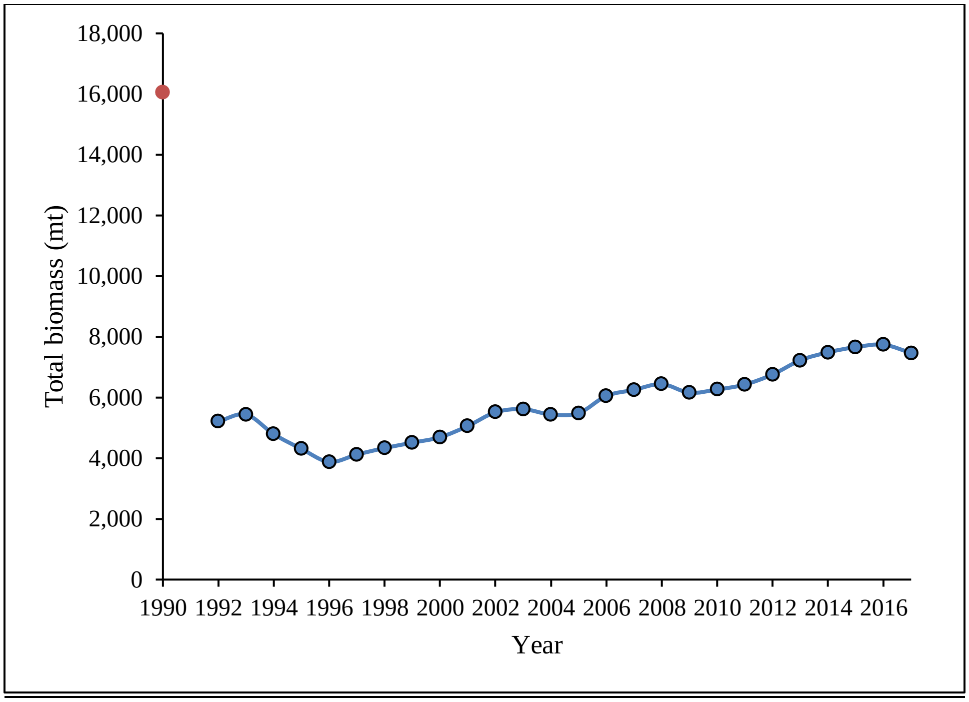


Figure 3.9.41. Estimates of total biomass (in metric tons) of southeastern U.S. Yellowtail Snapper (blue circles). The solid orange circle is the estimated unfished equilibrium biomass.

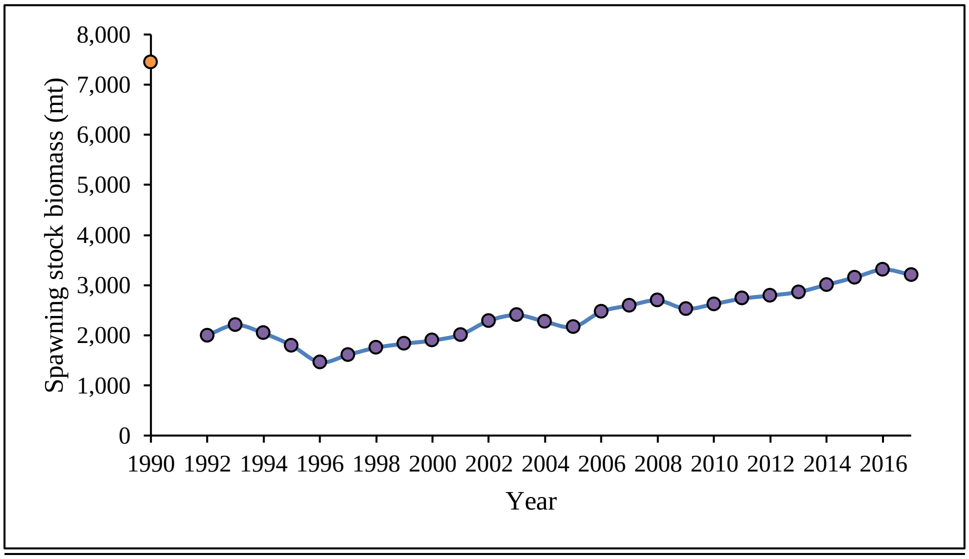


Figure 3.9.42. Estimates of spawning stock biomass (in metric tons) of southeastern U.S. Yellowtail Snapper (yellow circles). The solid green circle is the estimated unfished spawning stock biomass.

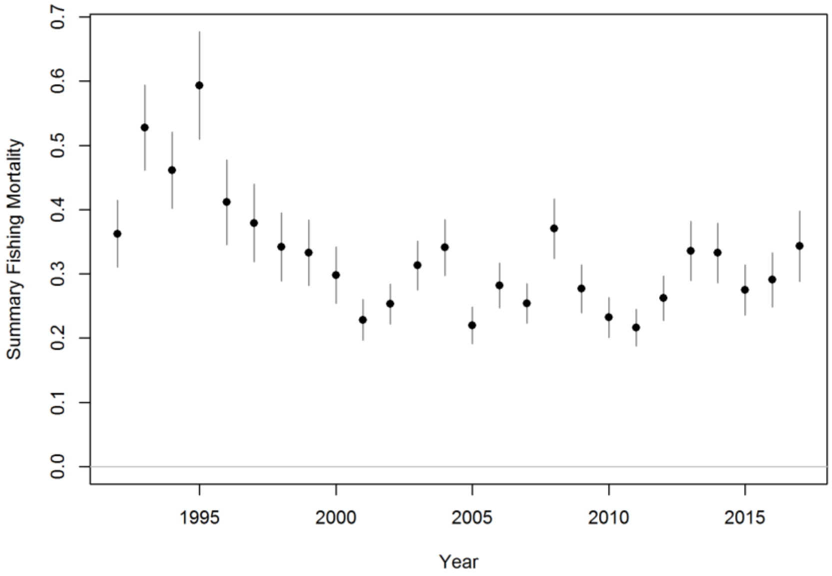


Figure 3.9.43. Annual instantaneous fishing mortality rates for age-4 southeastern U.S. Yellowtail Snapper with 95% confidence intervals for SEDAR 64.

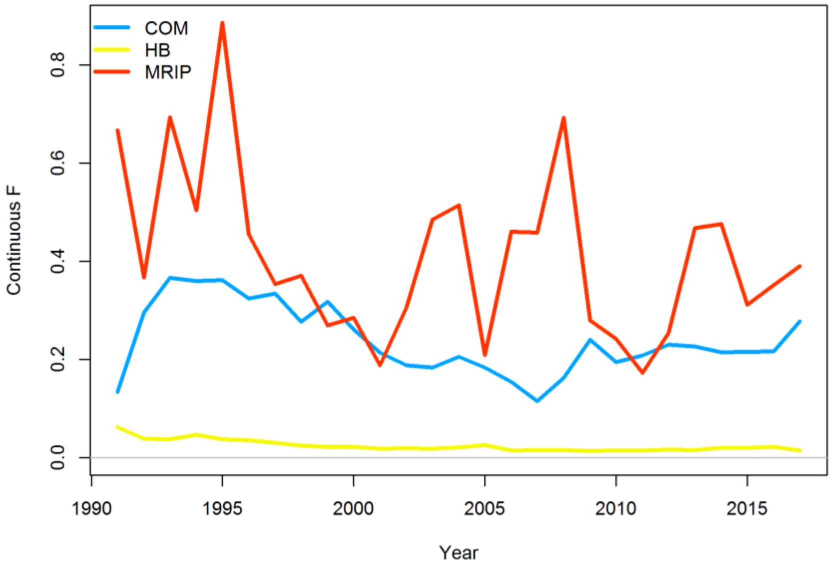


Figure 3.9.44. Annual fleet-specific instantaneous apical fishing mortality rates for southeastern U.S. Yellowtail Snapper for SEDAR 64. This represents the instantaneous fishing mortality level on the most vulnerable age class for each fleet.

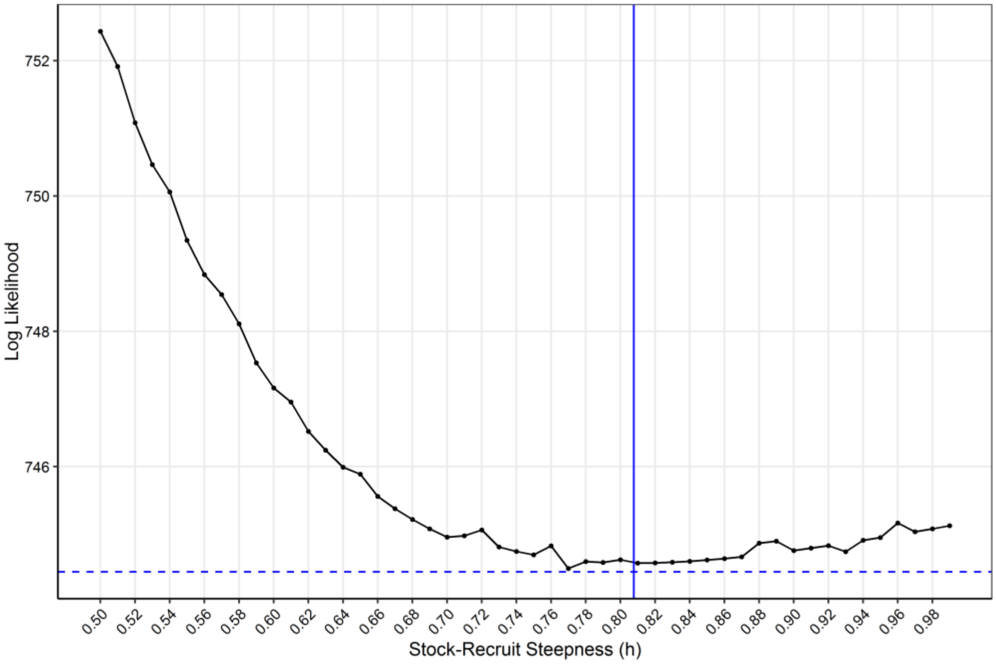


Figure 3.9.45. Overall log-likelihood profile when varying fixed values for steepness (*h*). The vertical solid blue line indices the base run estimated value and the dotted blue line indicates the base run log-likelihood value.

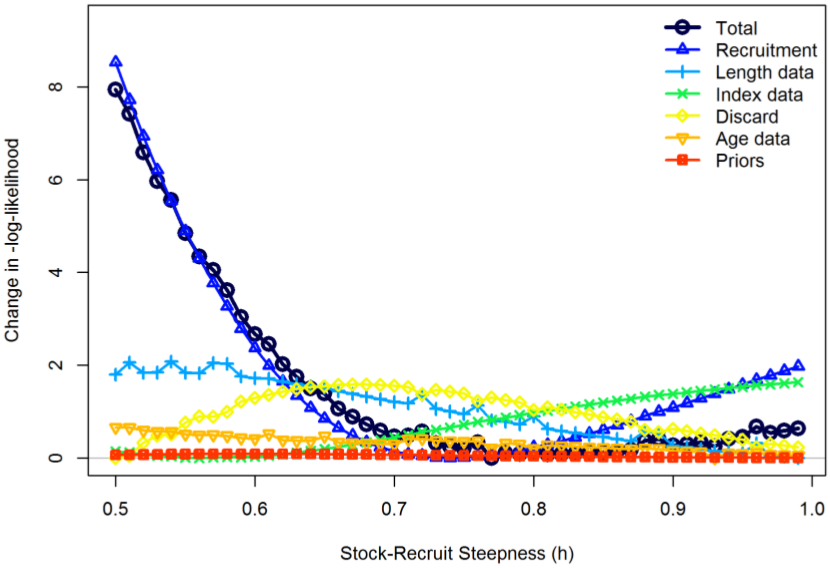
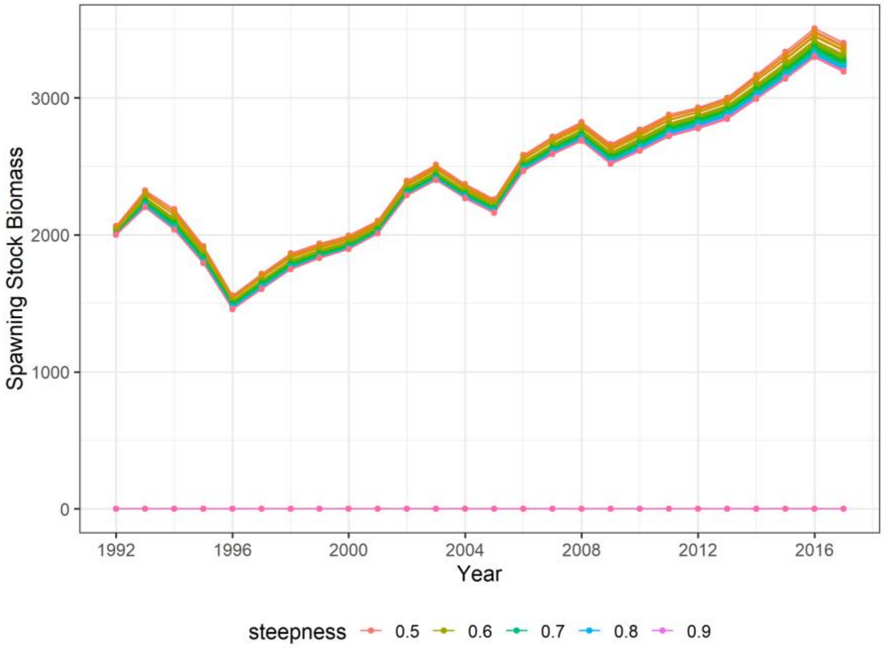


Figure 3.9.46. Change in log-likelihood by model component when varying fixed values for steepness (*h*).

a)



b)

Figure 3.9.47. Trends in a) spawning stock biomass (SSB) and b) fishing mortality rates (F) when varying fixed values for steepness (*h*). SSB values equal to zero indicate failed runs.

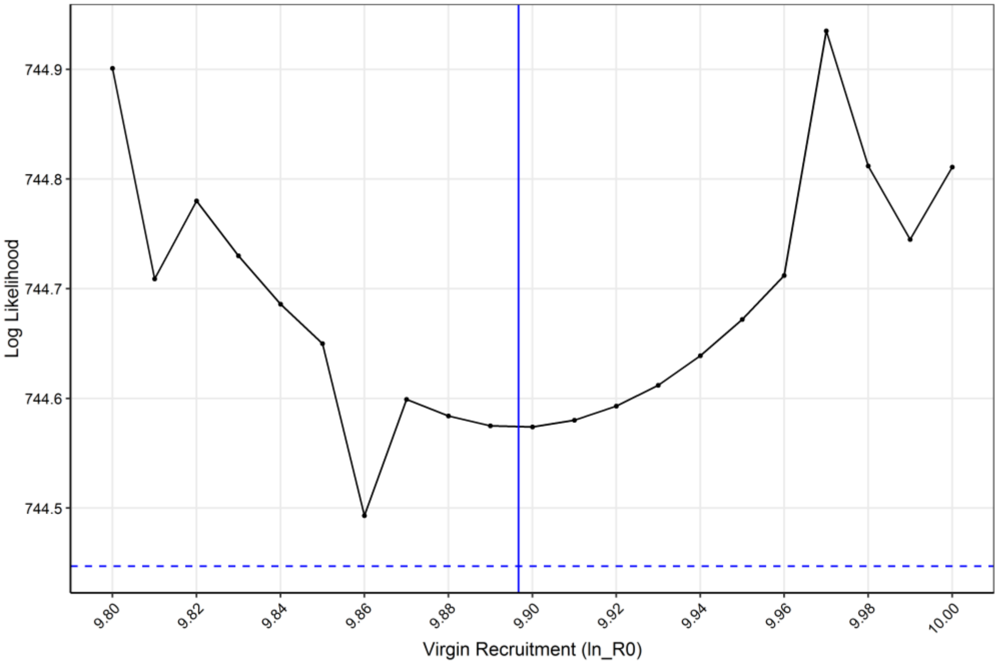


Figure 3.9.48. Overall log-likelihood profile when varying fixed values for unfished recruitment (*ln(R0)*). The vertical solid blue line indices the base run estimated value and the dotted blue line indicates the base run log-likelihood value.

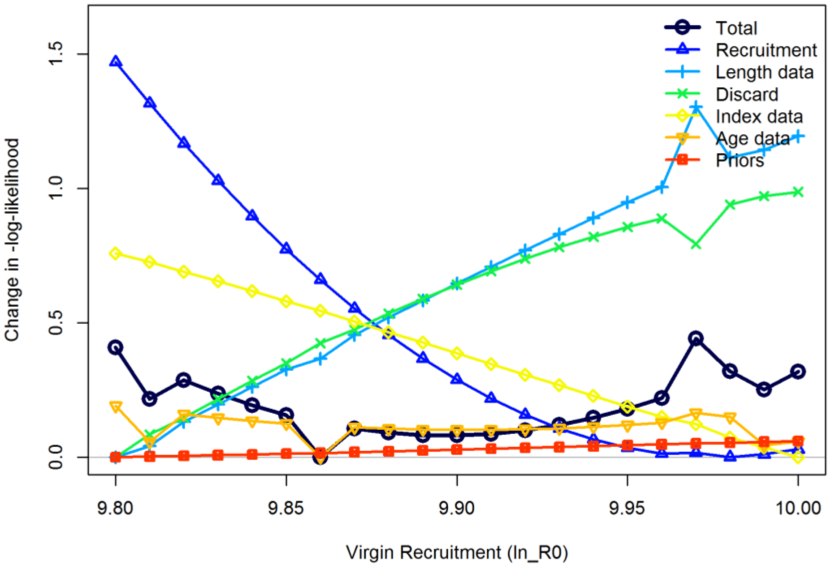
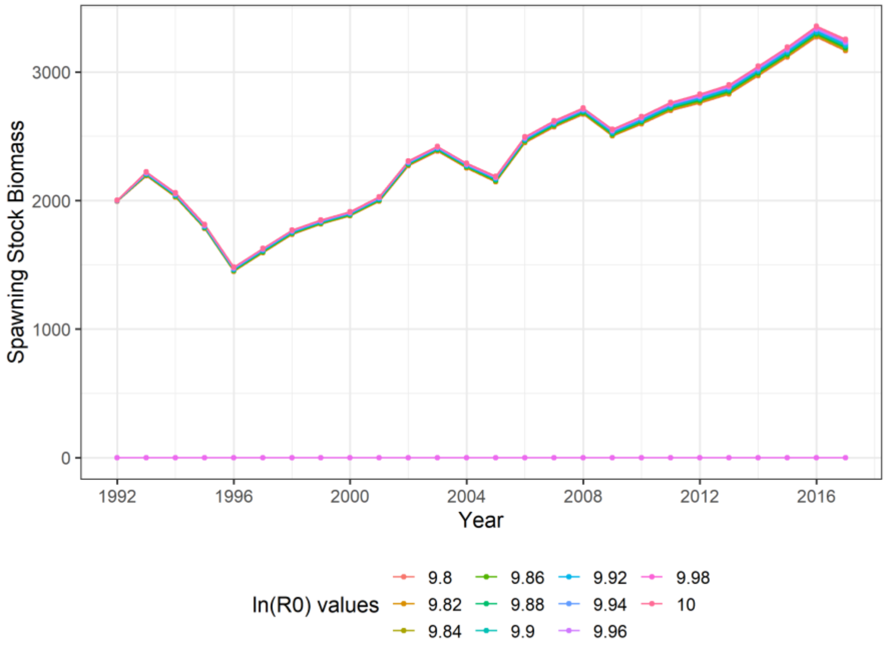


Figure 3.9.49. Change in log-likelihood by model component when varying fixed values for unfished recruitment (*ln(R0)*).

a)



b)

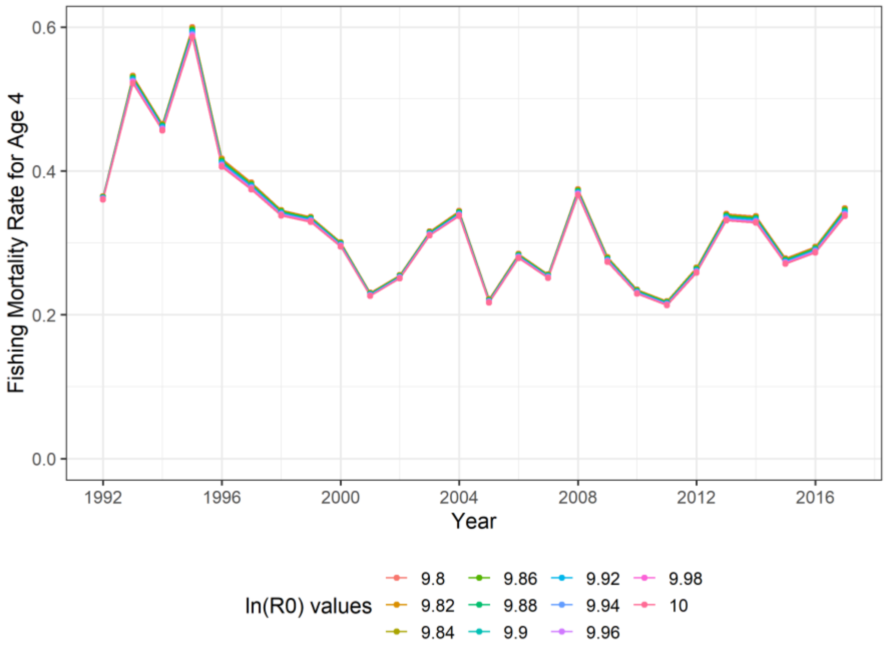


Figure 3.9.50. Trends in scaled a) spawning stock biomass (SSB) and b) fishing mortality rates (F) when varying fixed values for unfished recruitment (*ln(R0)*). SSB values equal to zero indicate failed runs.

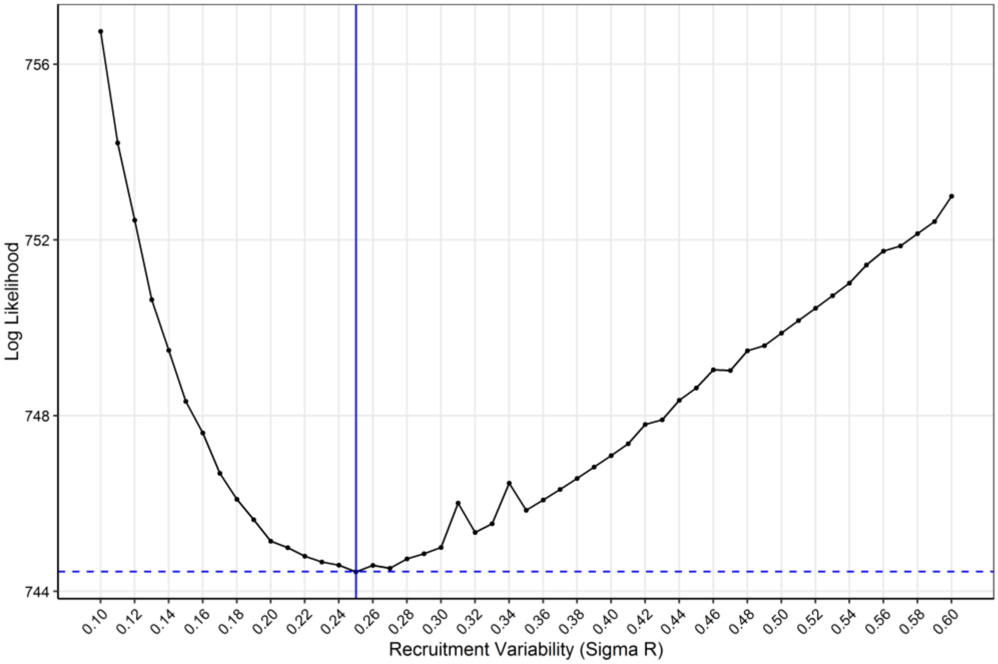


Figure 3.9.51. Overall log-likelihood profile when varying fixed values for recruitment variability (*sigmaR*). The vertical solid blue line indices the base run estimated value and the dotted blue line indicates the base run log-likelihood value.

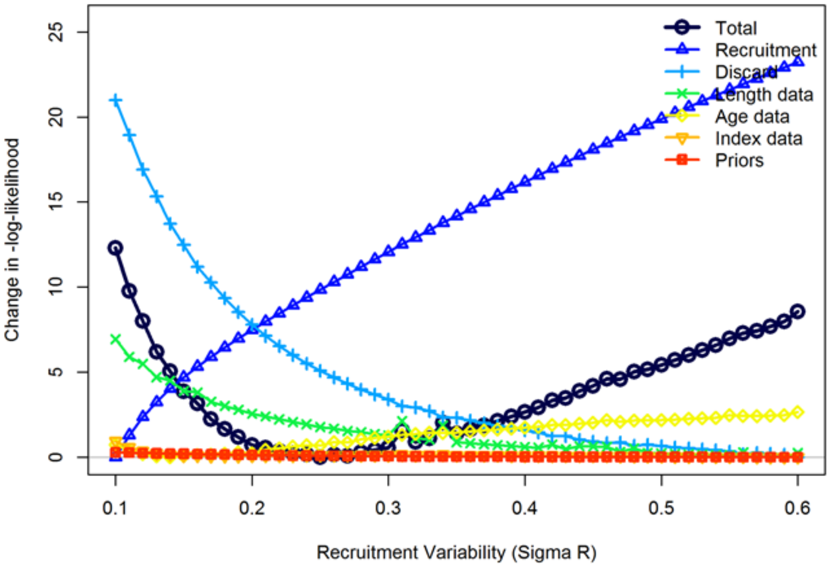


Figure 3.9.52. Change in log-likelihood by model component when varying fixed values for recruitment variability (*sigmaR*).

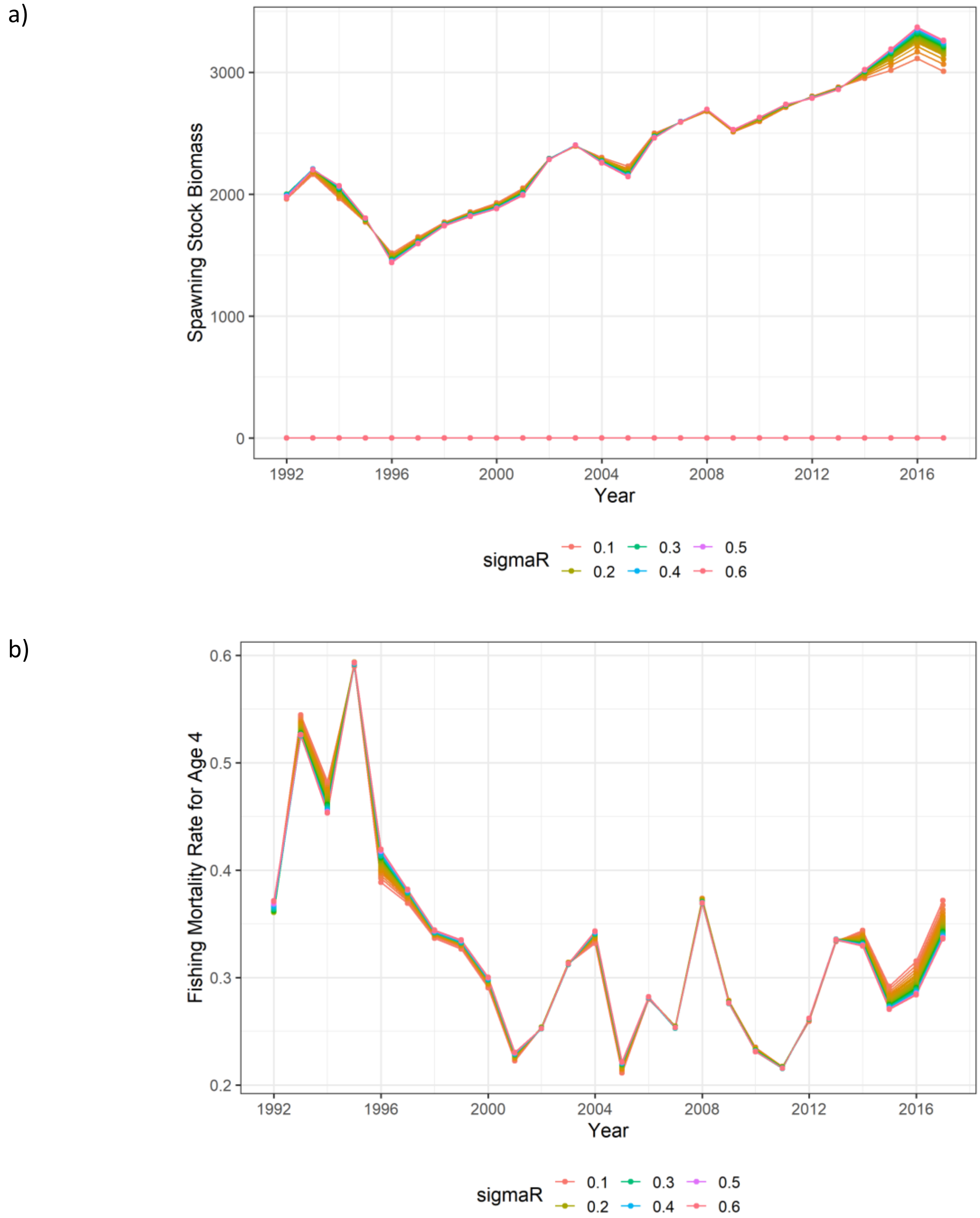


Figure 3.9.53. Trends in scaled a) spawning stock biomass (SSB) and b) fishing mortality rates (F) when varying fixed values for recruitment variability (*sigmaR*). SSB values equal to zero indicate failed runs.

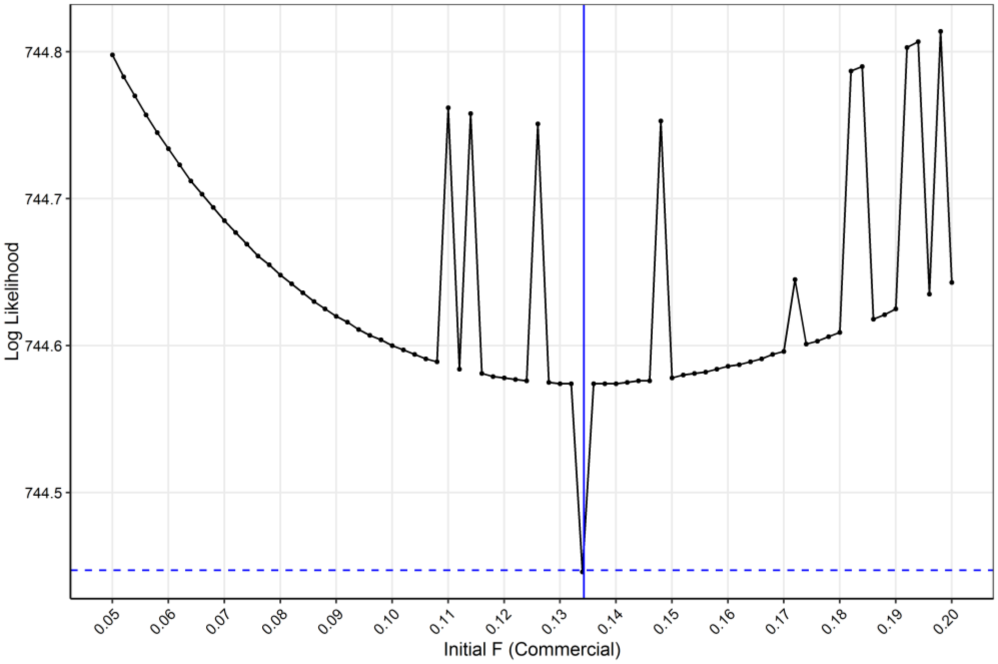


Figure 3.9.54. Overall log-likelihood profile when varying fixed values for the initial fishing mortality rate of the commercial fleet. The vertical solid blue line indices the base run estimated value and the dotted blue line indicates the base run log-likelihood value.

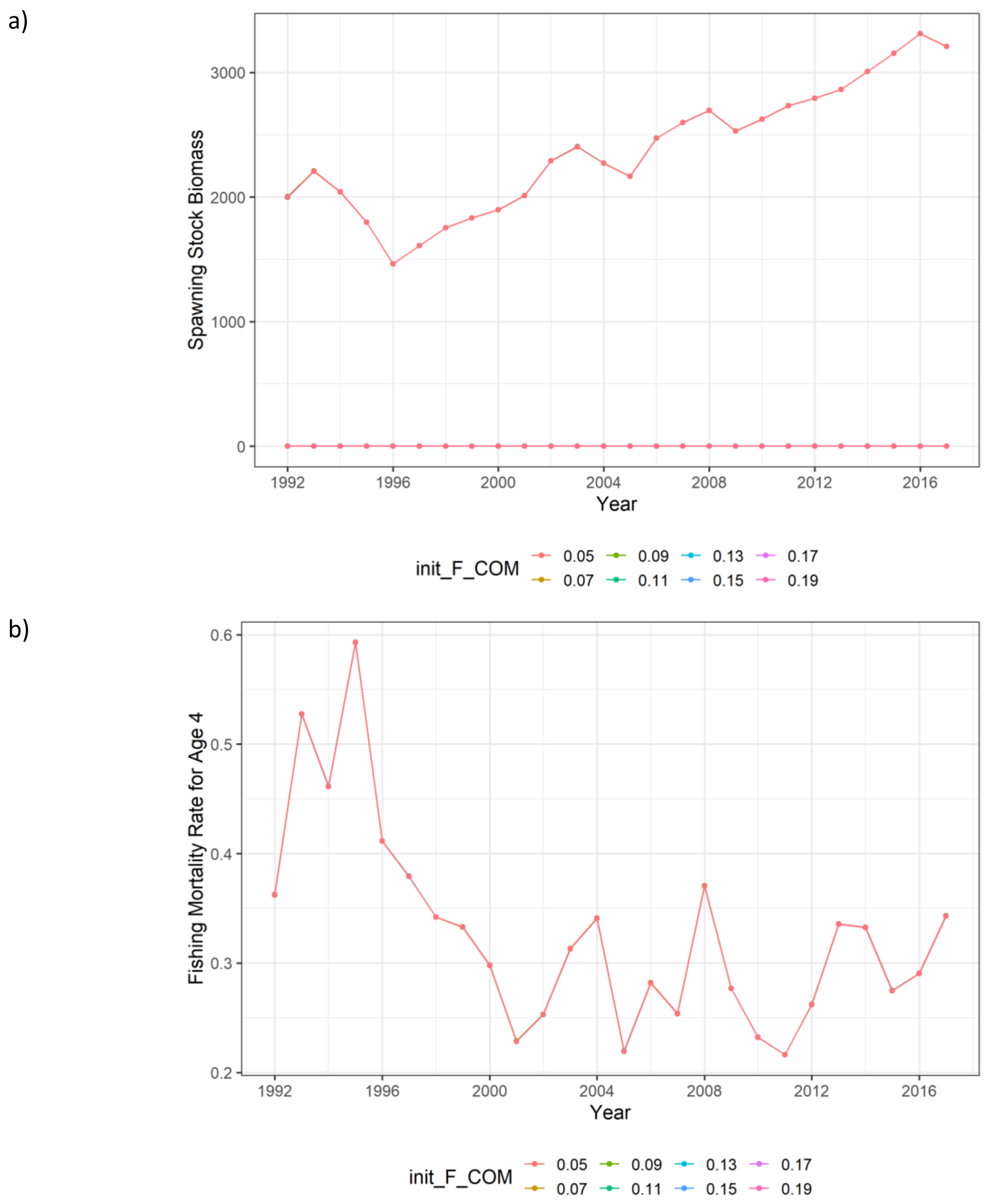


Figure 3.9.55. Trends in scaled a) spawning stock biomass (SSB) and b) fishing mortality rates (F) when varying fixed values for the initial fishing mortality rate of the commercial fleet. SSB values equal to zero indicate failed runs.

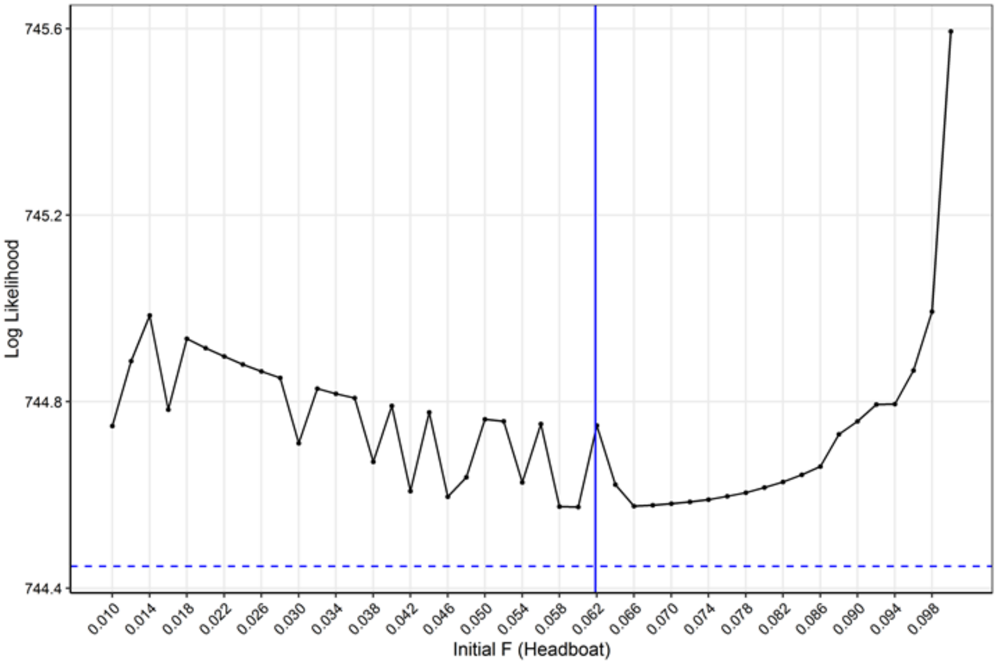
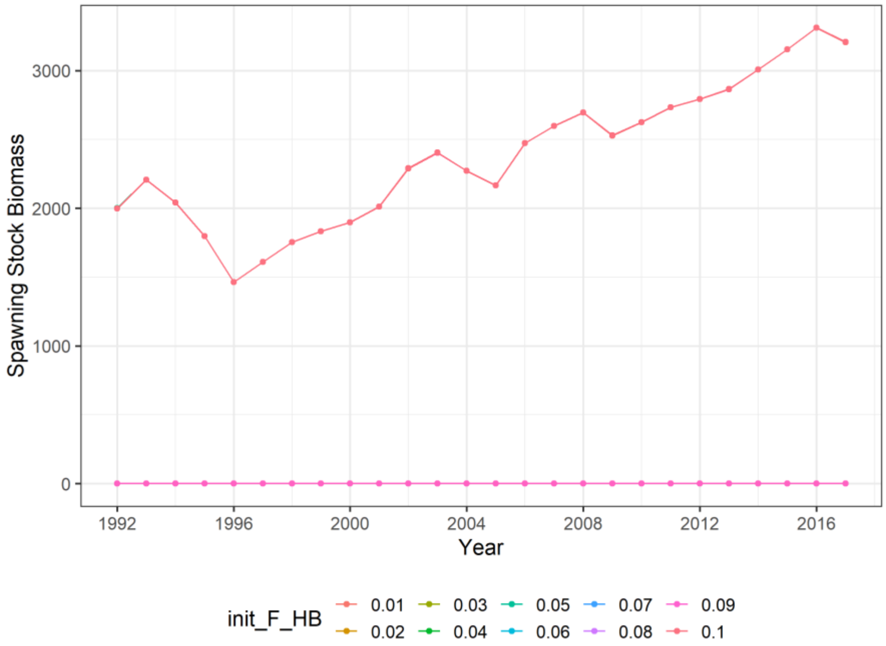


Figure 3.9.56. Overall log-likelihood profile when varying fixed values for the initial fishing mortality rate of the headboat fleet. The vertical solid blue line indices the base run estimated value and the dotted blue line indicates the base run log-likelihood value.

a)



b)

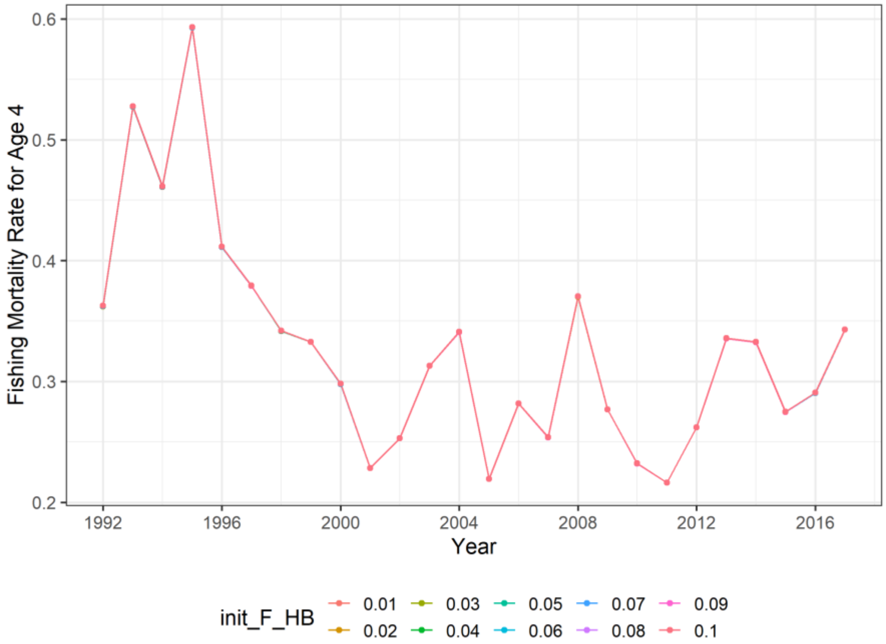


Figure 3.9.57. Trends in scaled a) spawning stock biomass (SSB) and b) fishing mortality rates (F) when varying fixed values for the initial fishing mortality rate of the headboat fleet. SSB values equal to zero indicate failed runs.

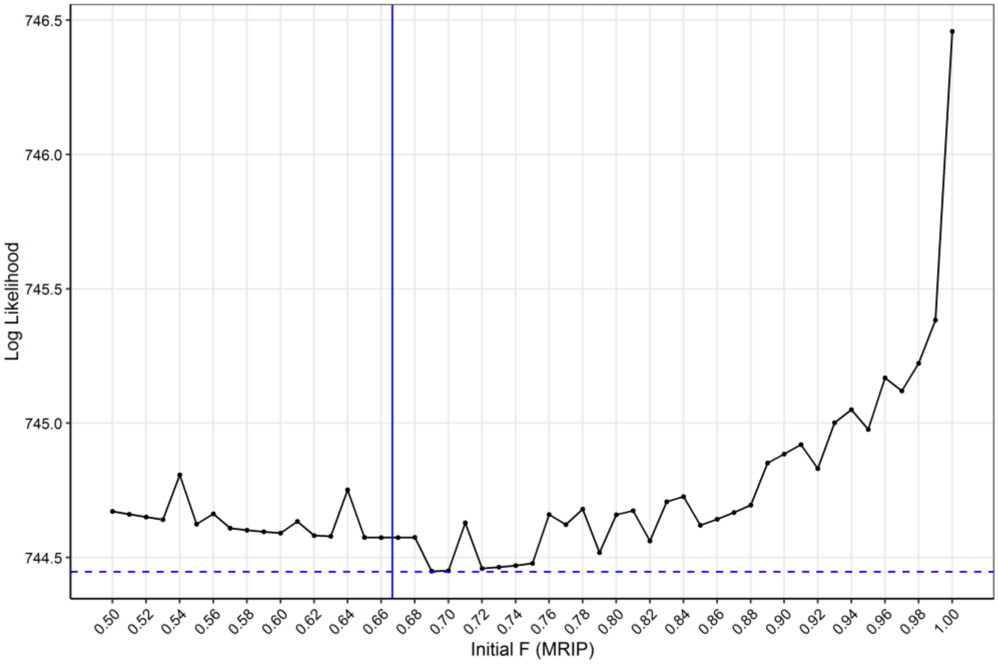


Figure 3.9.58. Overall log-likelihood profile when varying fixed values for the initial fishing mortality rate of the MRIP fleet. The vertical solid blue line indices the base run estimated value and the dotted blue line indicates the base run log-likelihood value.

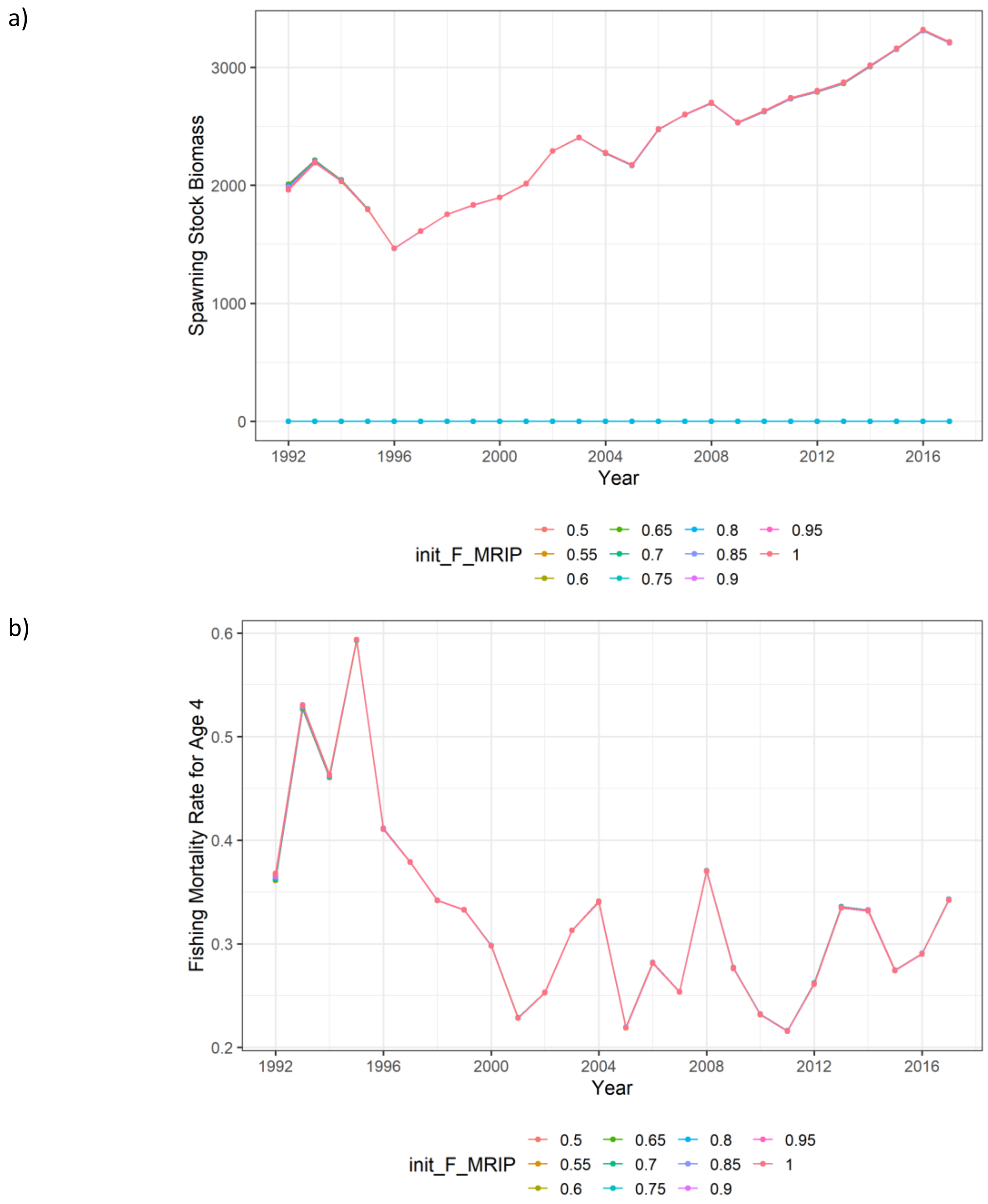


Figure 3.9.59. Trends in scaled a) spawning stock biomass (SSB) and b) fishing mortality rates (F) when varying fixed values for the initial fishing mortality rate of the MRIP fleet. SSB values equal to zero indicate failed runs.

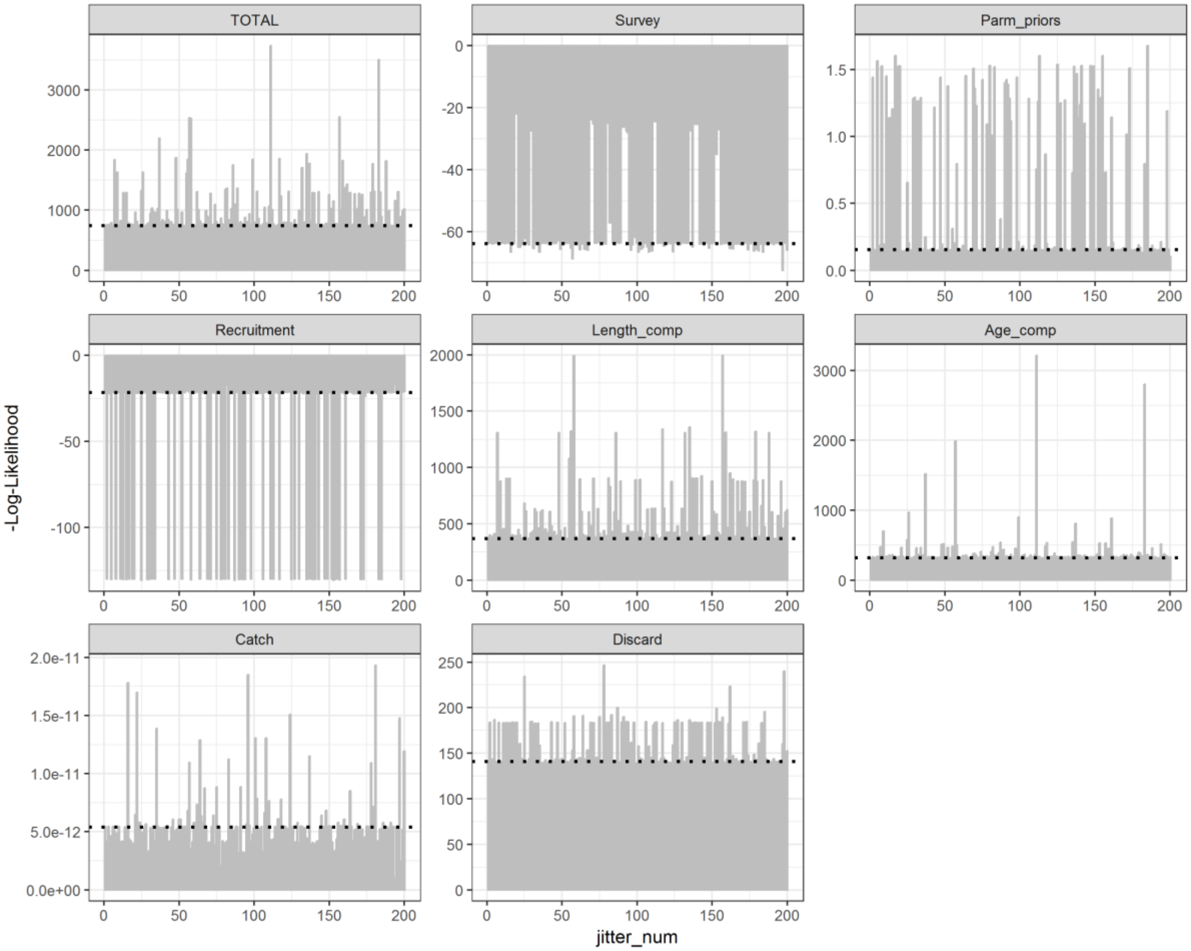


Figure 3.9.60. Total and component-specific log-likelihood values found by the jitter analysis (grey bars) and the base run (black dotted line).

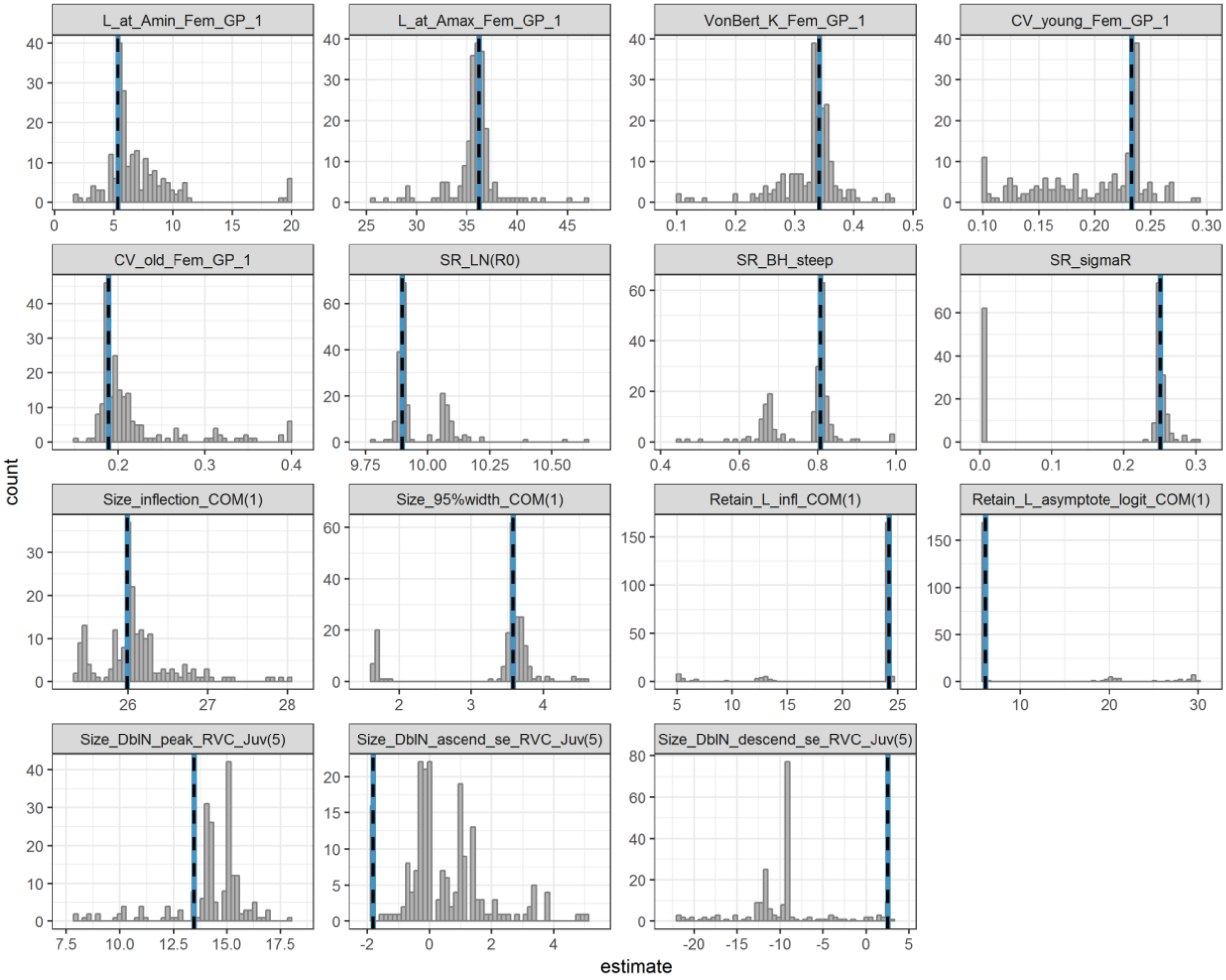


Figure 3.9.61. Histograms of parameter estimates associated with 200 jitter runs (grey bars) and the base run (black dashed line). Parameter estimates associated with the lowest LL value found by the jitter analysis are identified by the blue line.

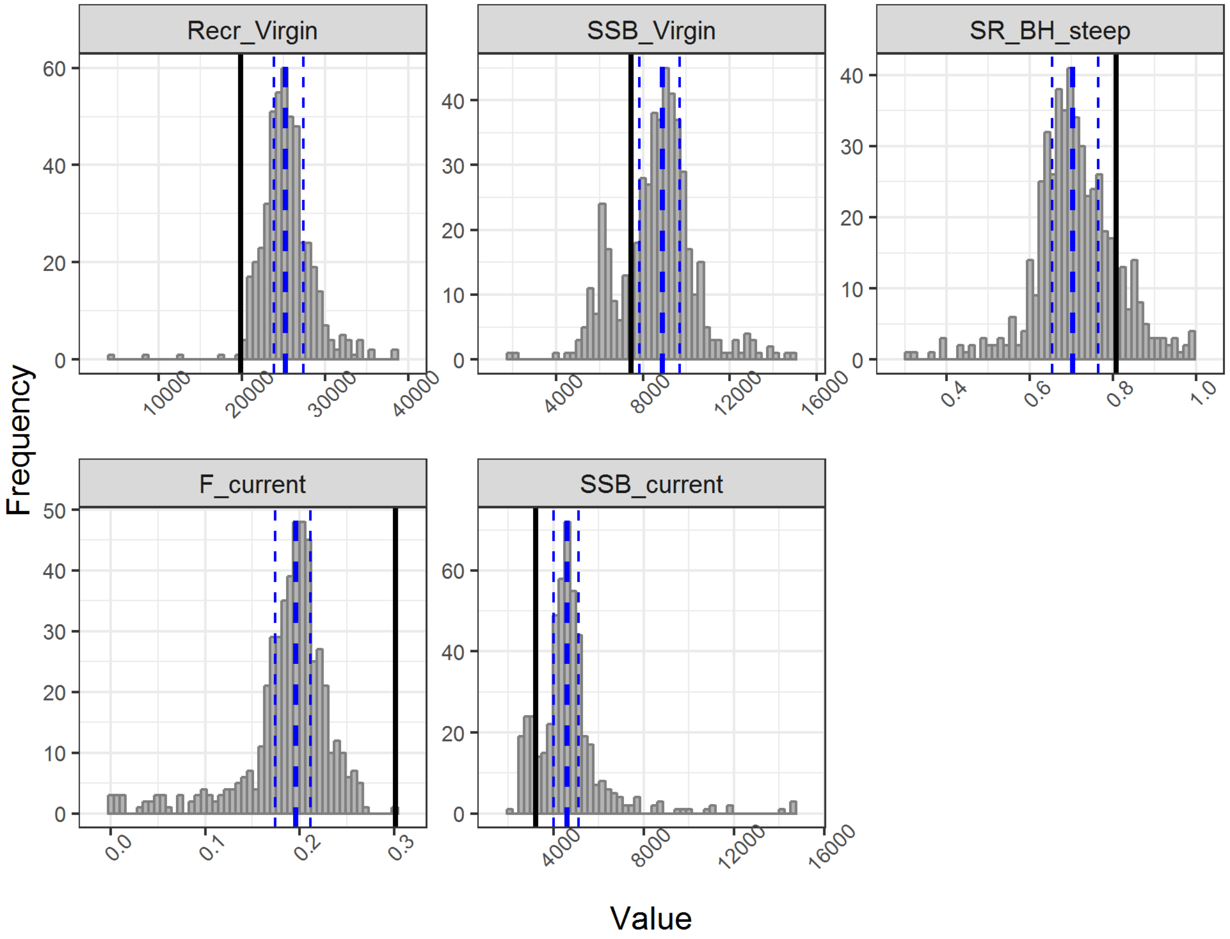


Figure 3.9.62. Histograms of parameter estimates associated with 500 bootstrap runs (grey bars) and the base run (black line). Thin dashed lines represent the 25th and 75th percentiles and thick dashed lines represent the median of parameter distributions.

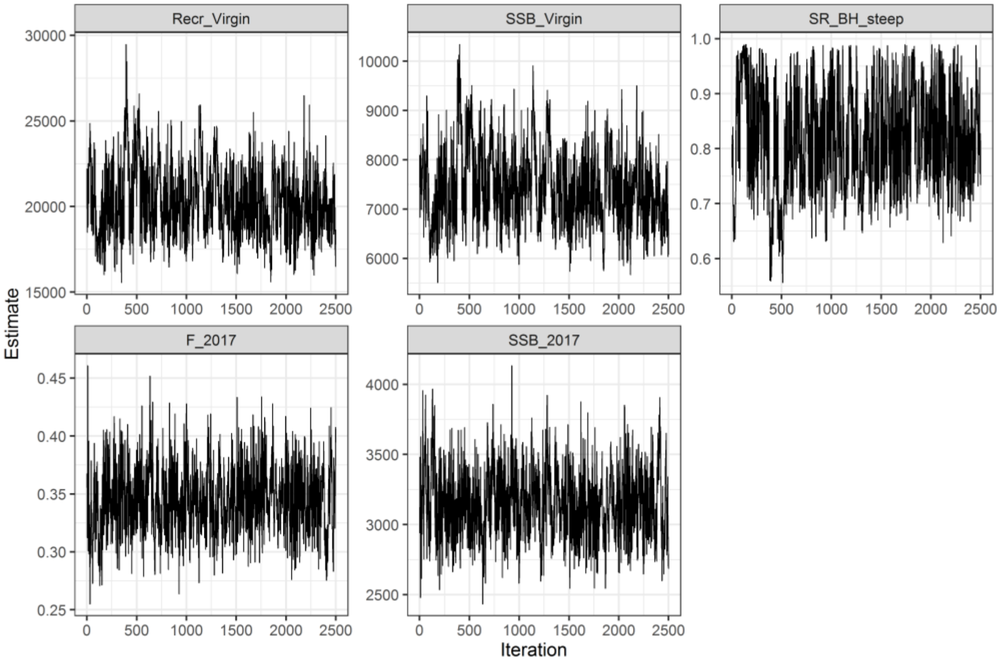


Figure 3.9.63. Traceplot of the first MCMC chain for selected parameters and derived quantities.

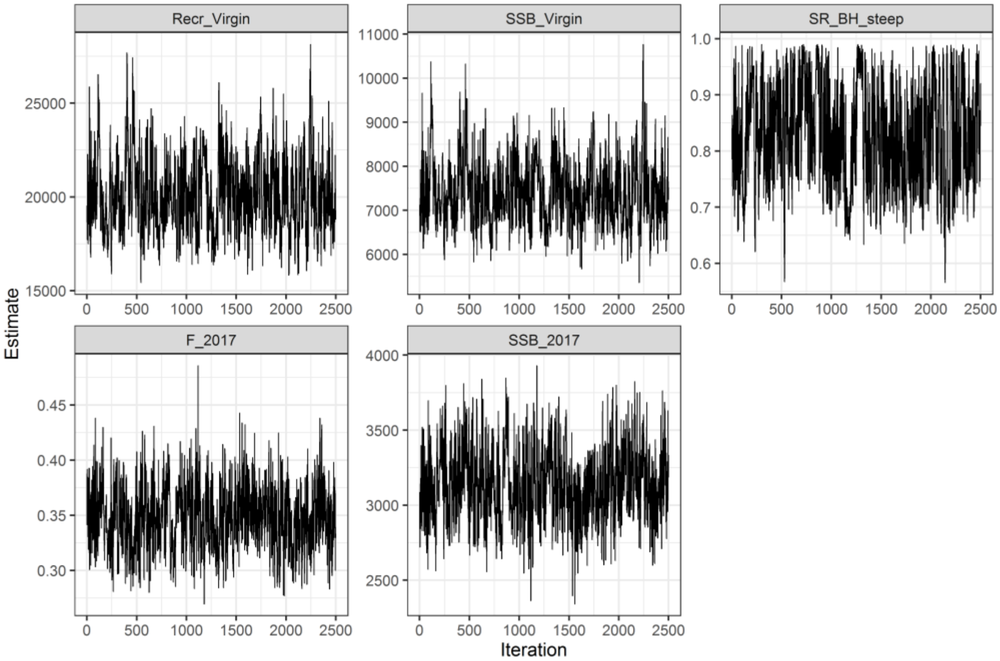


Figure 3.9.64. Traceplot of the second MCMC chain for selected parameters and derived quantities.

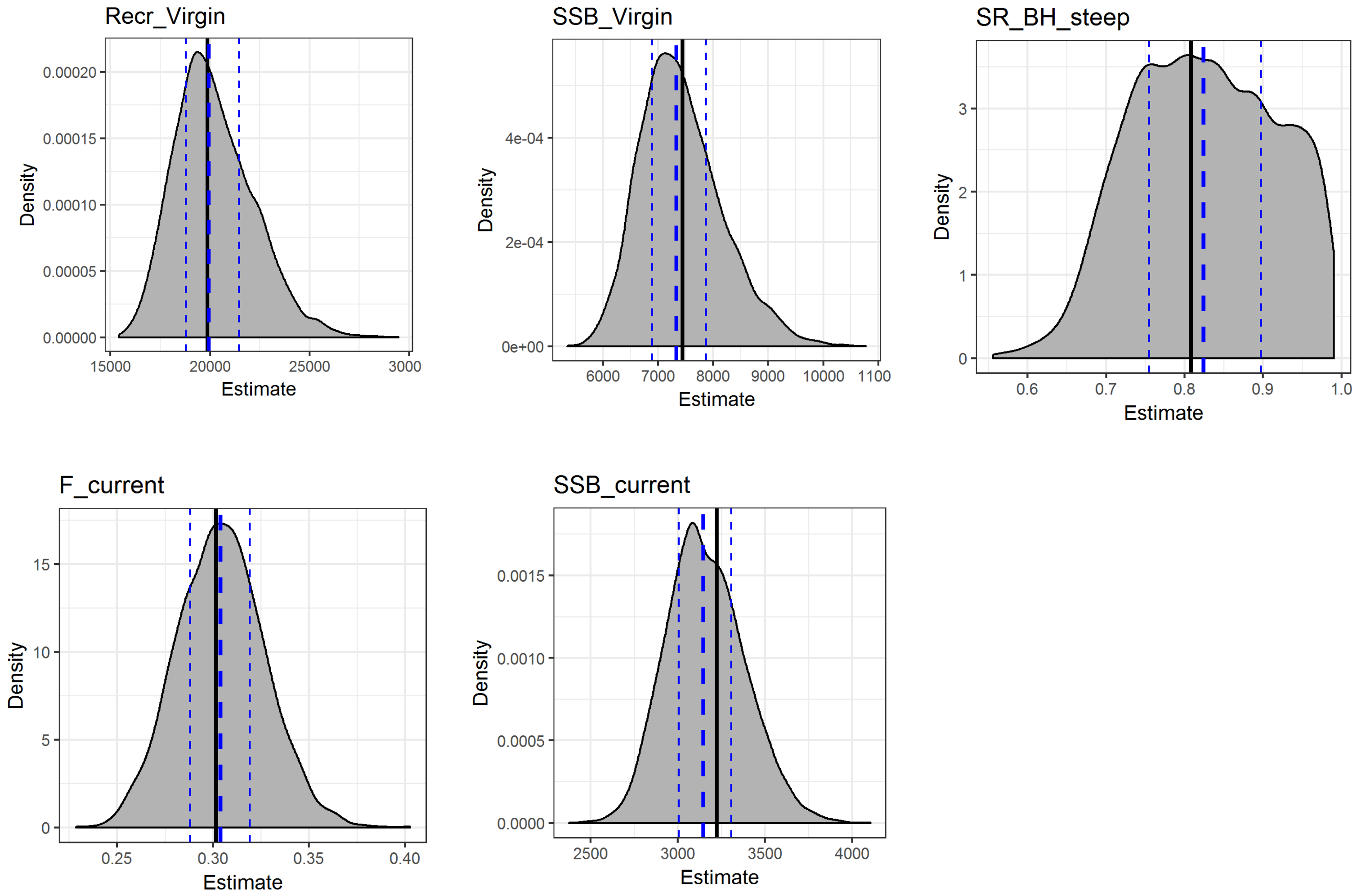
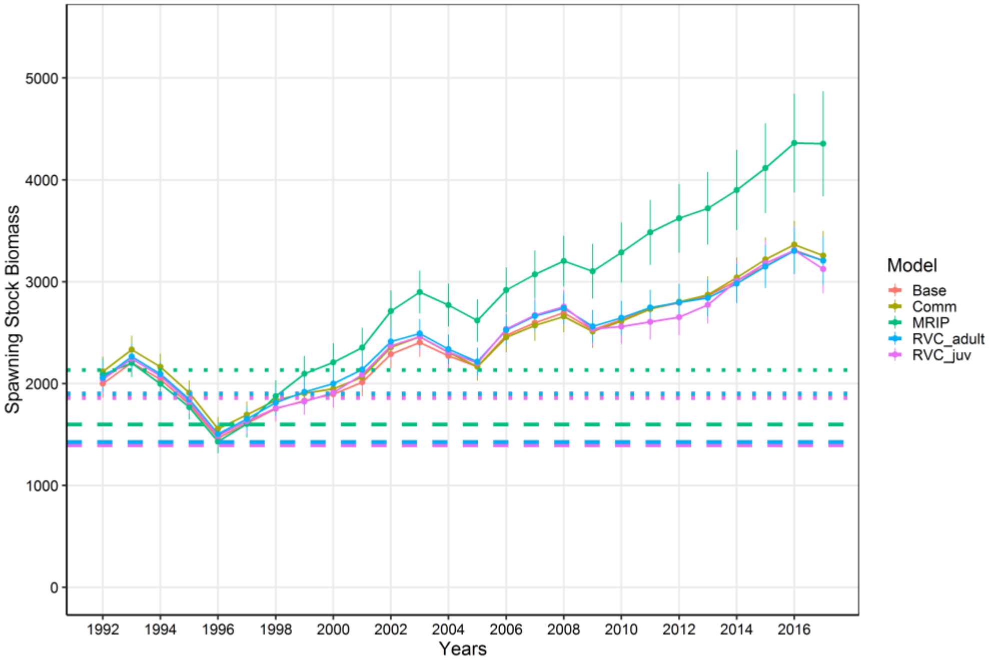


Figure 3.9.65. Posterior distribution of selected parameters and derived quantities. Blue dotted lines indicate the median and interquartile range. Base model run estimates are shown in black.

a)



b)

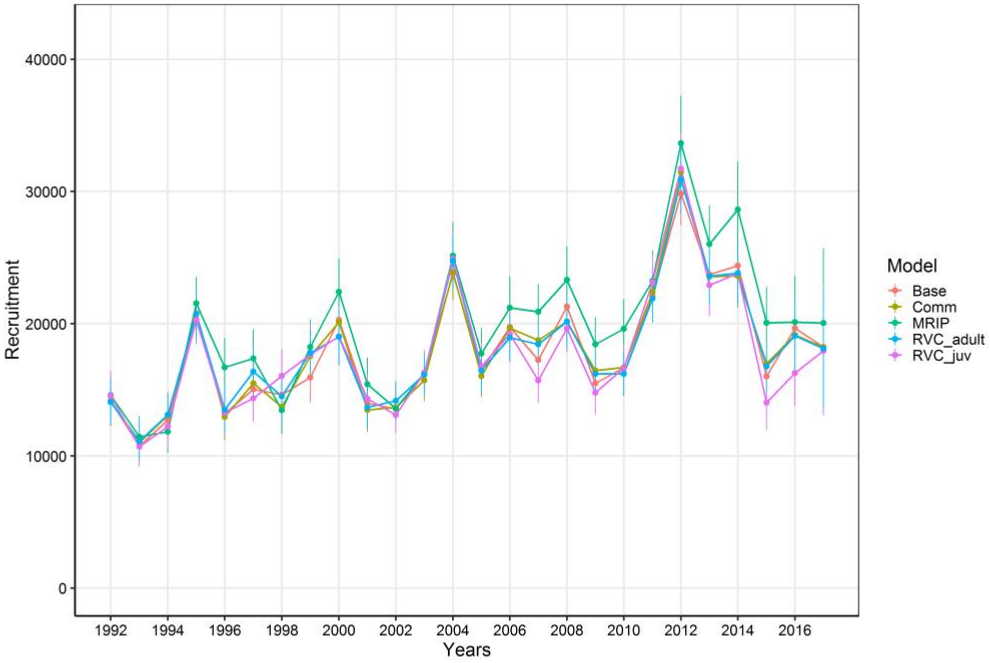


Figure 3.9.66. Results of a 'jack-knife' analysis by removing indices one at a time and refitting the base model. Spawning stock biomass (a), recruitment (b), and age-4 fishing mortality (c) are shown relative to MSST (short dashed line), $SSB_{F30\%SPR}$ (long dashed line), and MFMT (long dashed line).

c)

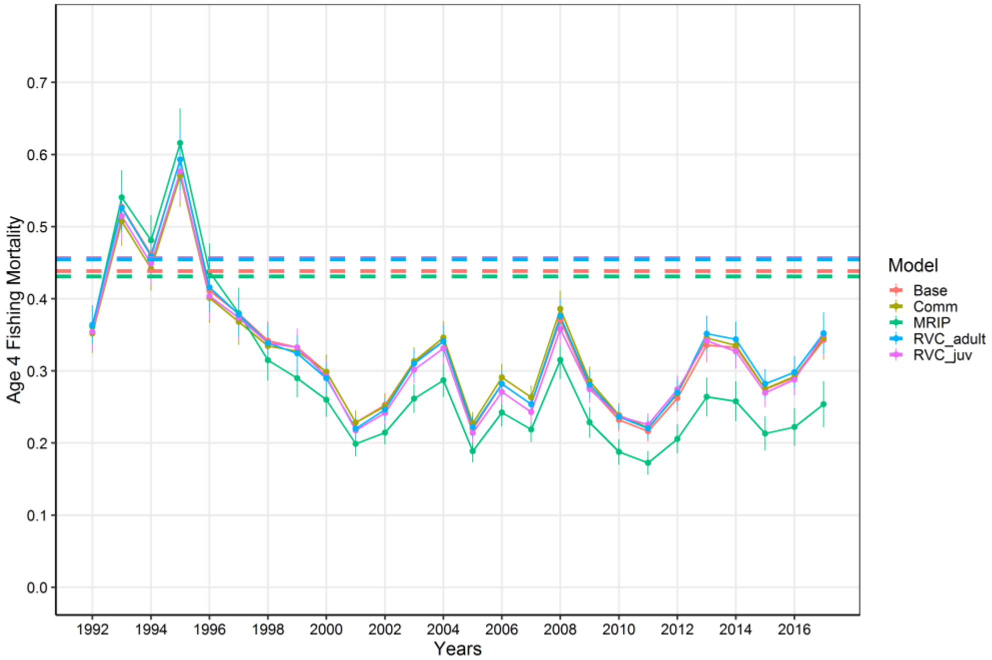


Figure 3.9.66. Continued Results of a ‘jack-knife’ analysis by removing indices one at a time and refitting the base model.

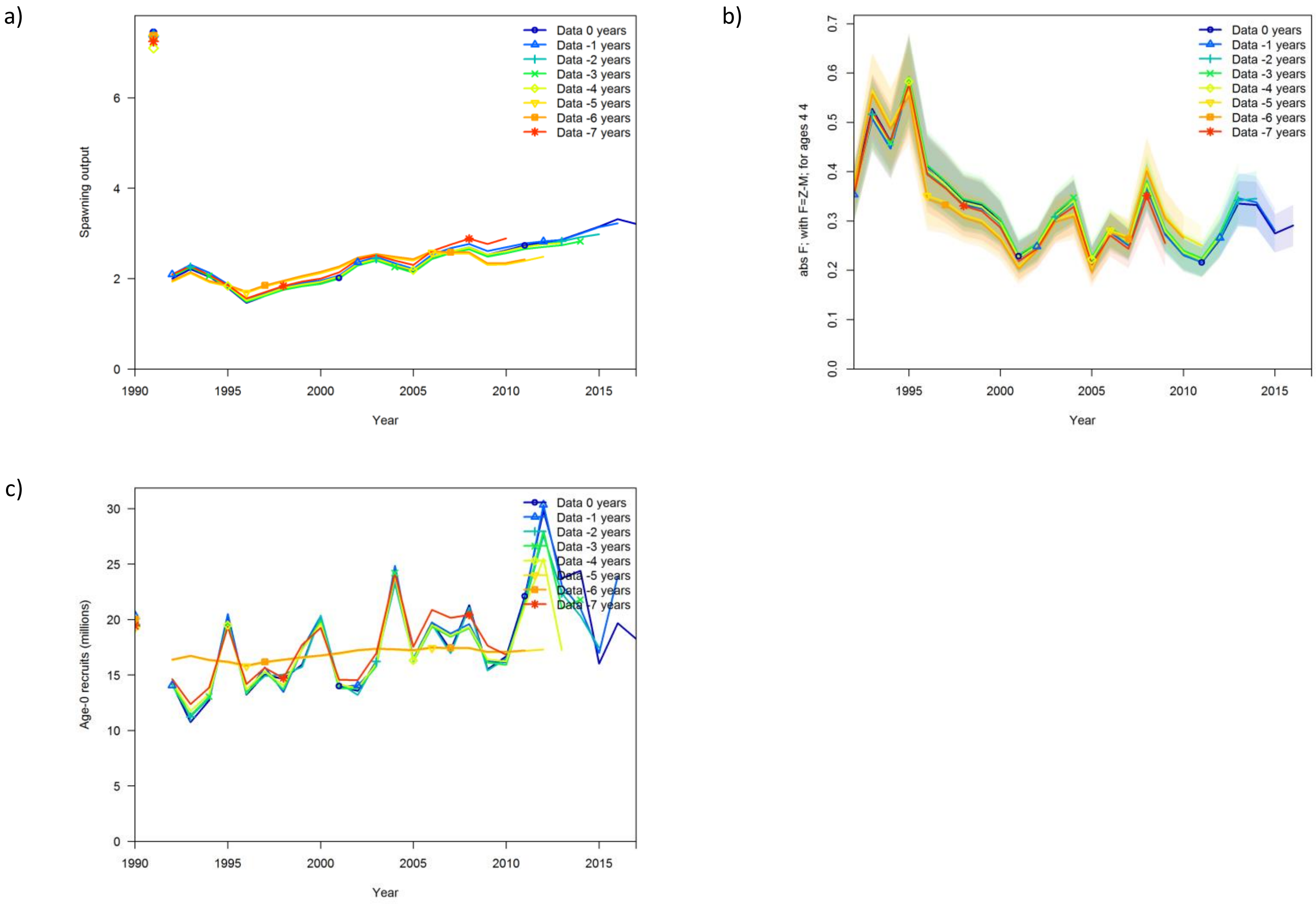


Figure 3.9.67. Results of a seven-year retrospective analysis for spawning biomass (a), age-4 fishing mortality (b), and recruitment (c).

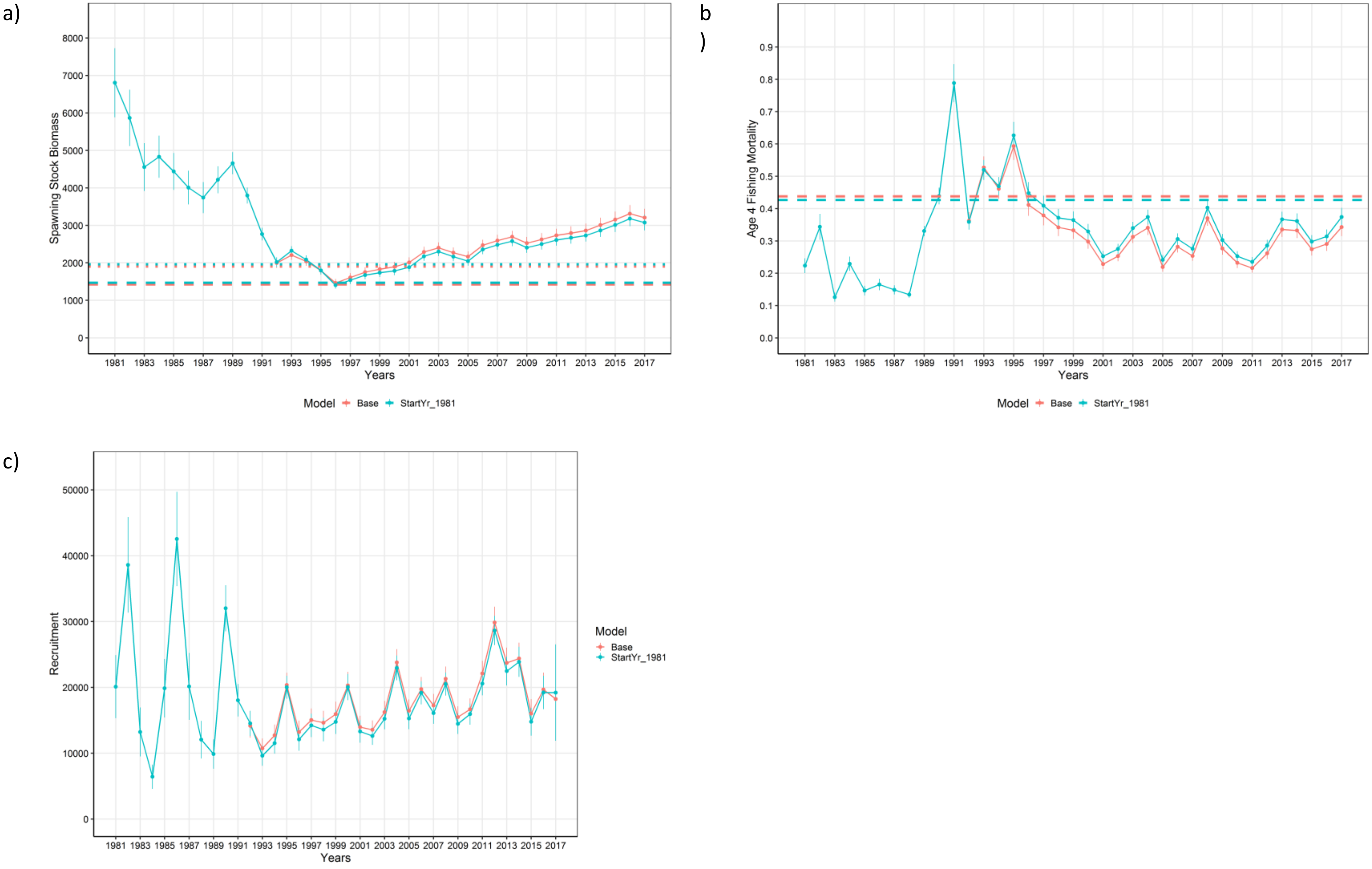
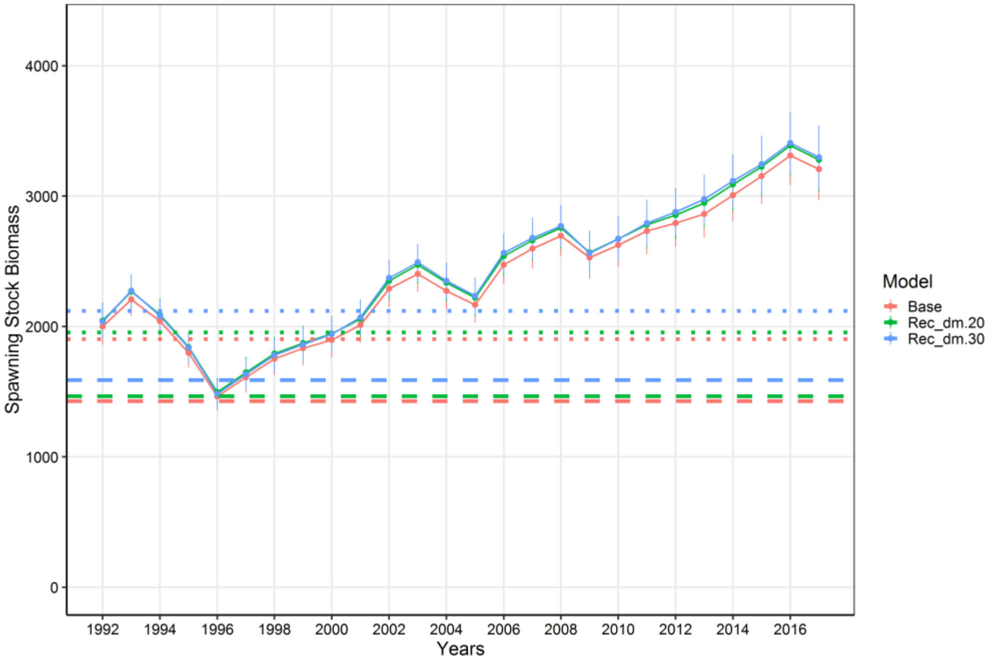


Figure 3.9.68. A comparison of the base run to a sensitivity analysis with a start year of 1981 for spawning biomass (a), age-4 fishing mortality (b), and recruitment (c) is shown relative to MSST (short dashed line), SSB$_{F30\%SPR}$ (long dashed line), and MFMT (long dashed line).

a)



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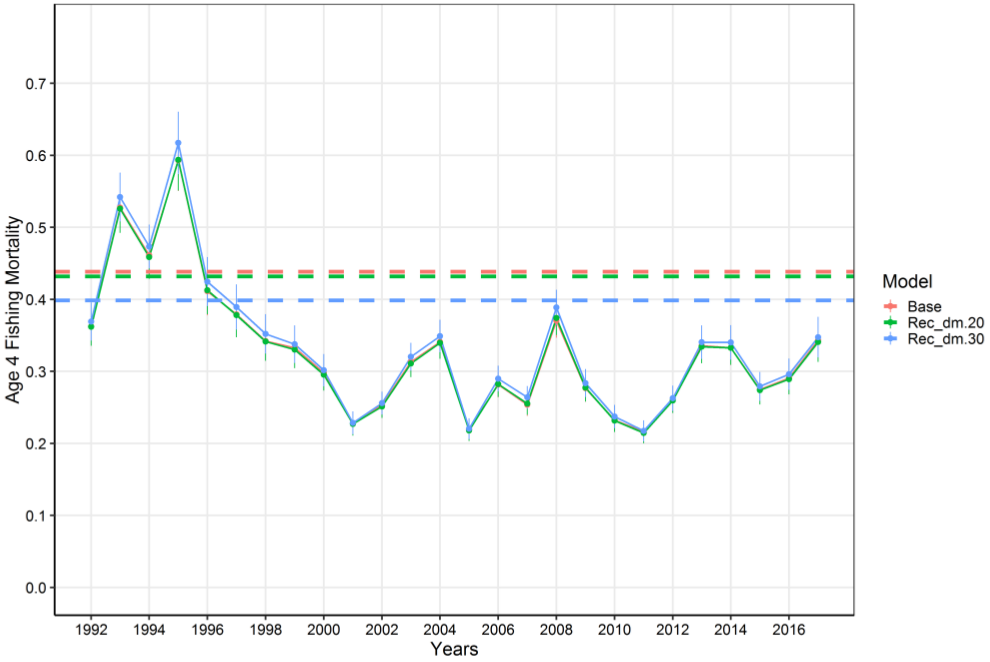


Figure 3.9.69. A comparison of the base run to a sensitivity analysis with varying levels of discard mortality for recreational fisheries (Base = 10% discard mortality rate; Rec_dm.20 = 20% discard mortality rate; Rec_dm.30=30% discard mortality rate). Spawning biomass (a), age-4 fishing mortality (b), and recruitment (c) is shown relative to MSST (short dashed line), $SSB_{F30\%SPR}$ (long dashed line), and MFMT (long dashed line).

c)

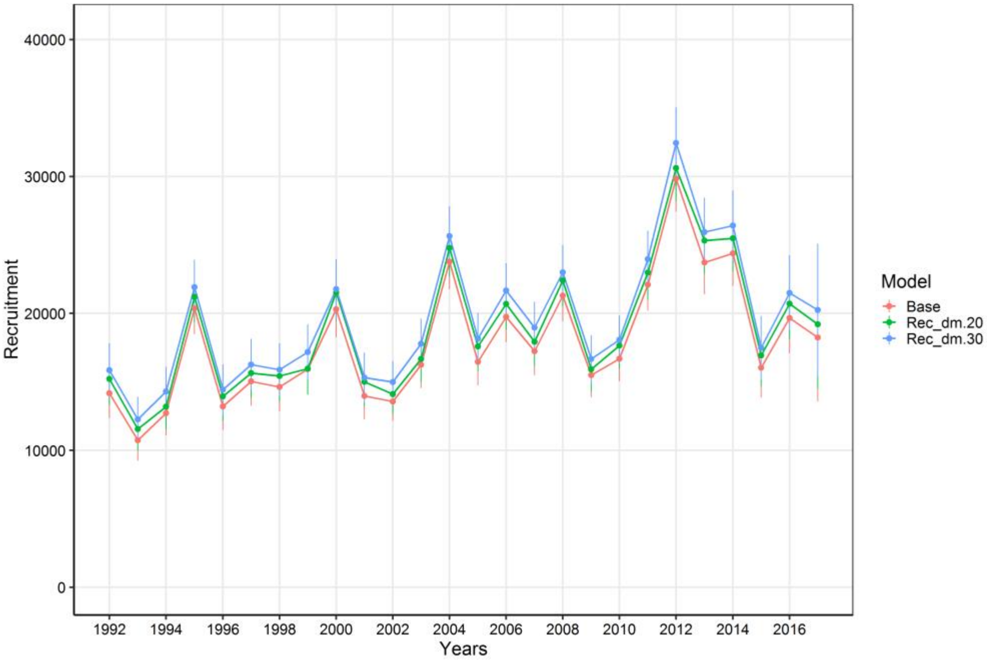


Figure 3.9.69. Continued A comparison of the base run to a sensitivity analysis with varying levels of discard mortality for recreational fisheries (Base = 10% discard mortality rate; Rec_dm.20 = 20% discard mortality rate; Rec_dm.30=30% discard mortality rate). .

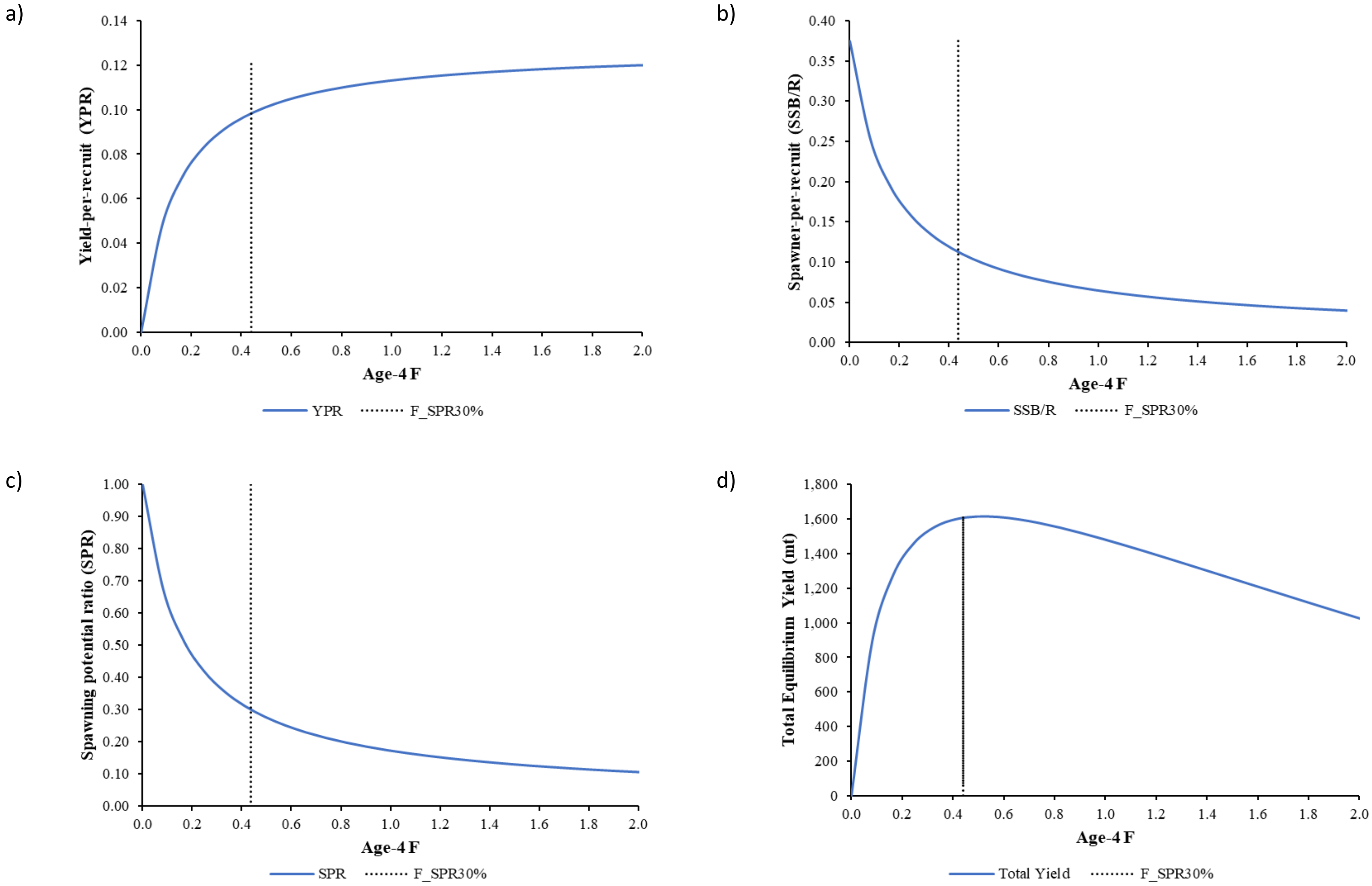


Figure 3.9.70. The a) yield-per-recruit, b) spawner-per-recruit, c) spawning potential ratio, and d) total equilibrium yield computed as a function of the instantaneous fishing mortality rate on age-4 Yellowtail Snapper.

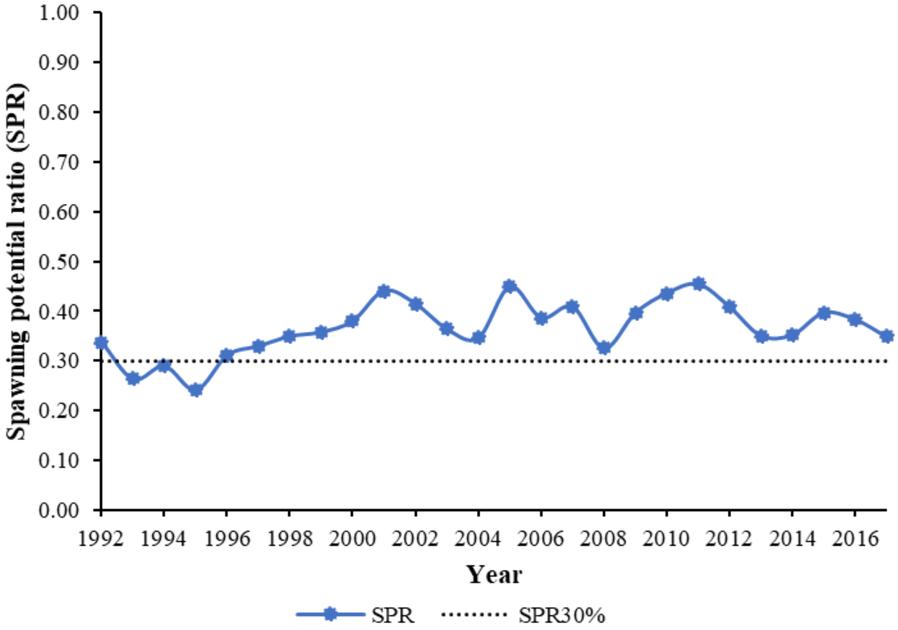


Figure 3.9.71. The static spawning potential ratio (SPR) by year for Yellowtail Snapper as estimated by the SEDAR 64 base model.

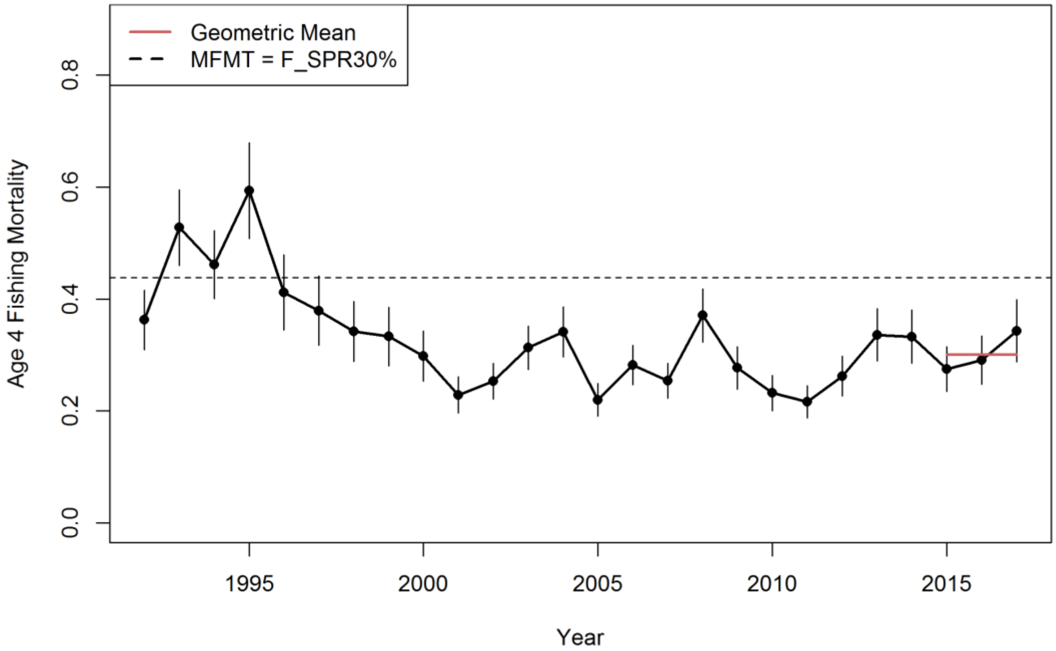


Figure 3.9.72. Annual estimates of age-4 fishing mortality relative MFMT (black dashed line). The geometric mean of fishing mortality in the last three years ($F_{current}$) is shown in red. Vertical lines represent approximate symmetric 95% confidence intervals.

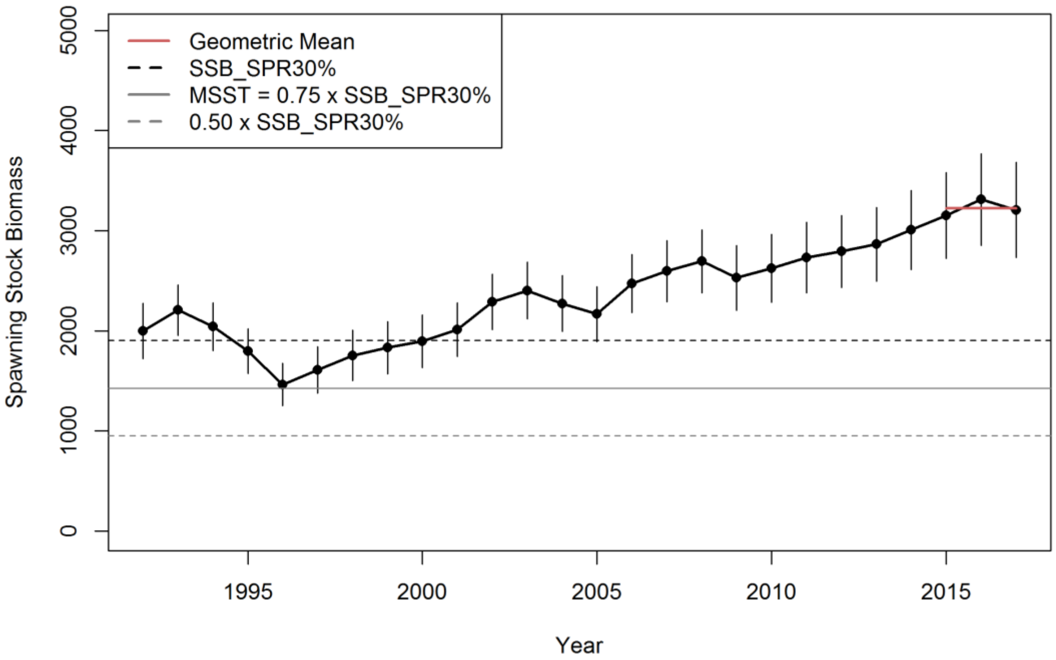


Figure 3.9.73. Annual estimates of spawning stock biomass (SSB) relative to MSST (black dashed line), $SSB_{F30\%SPR}$ (solid grey line), and GMFMC MSST (grey dashed line). The geometric mean of SSB in the last three years (SSBcurrent) is shown in red. Vertical lines represent approximate symmetric 95% confidence intervals.

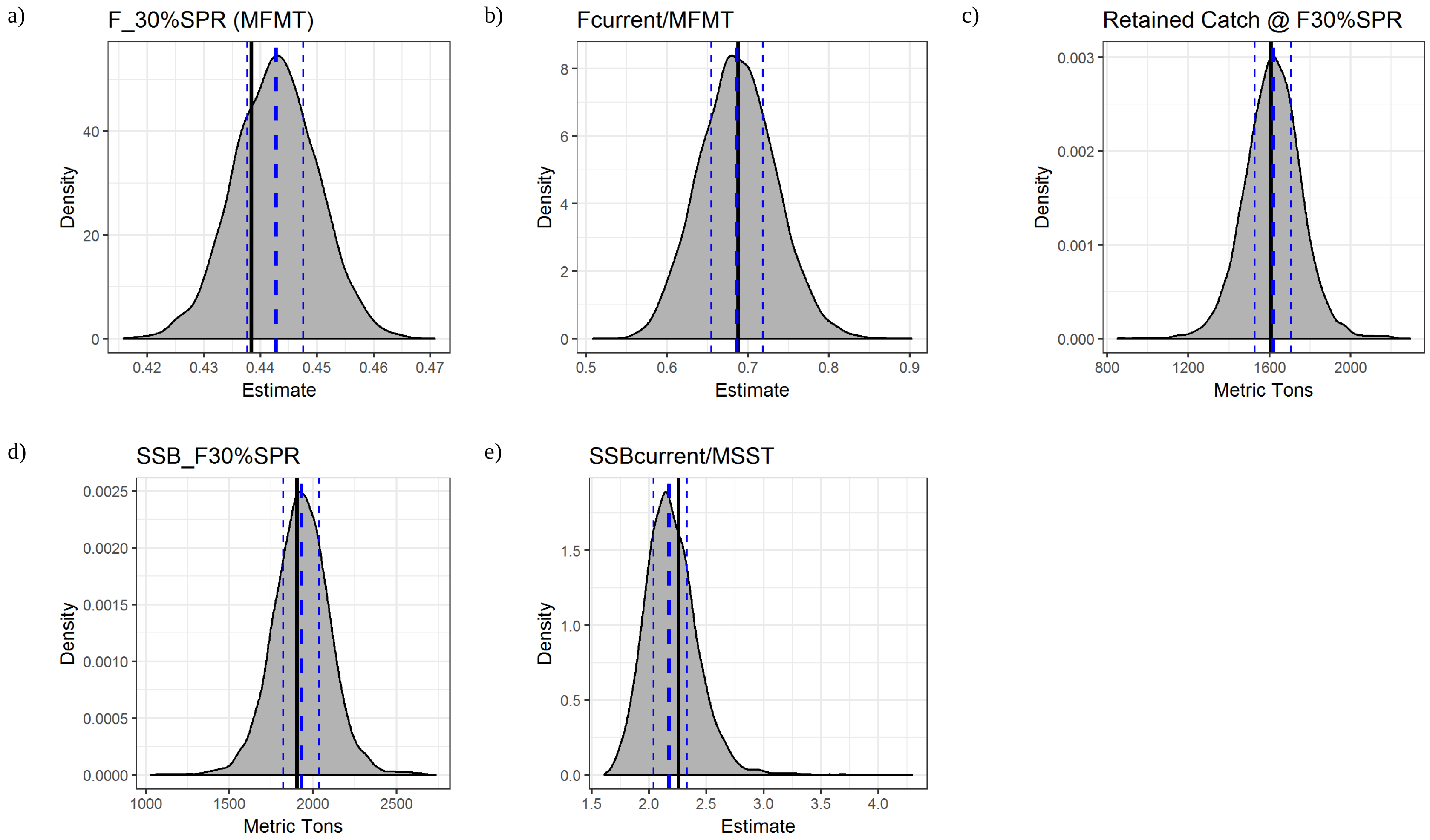
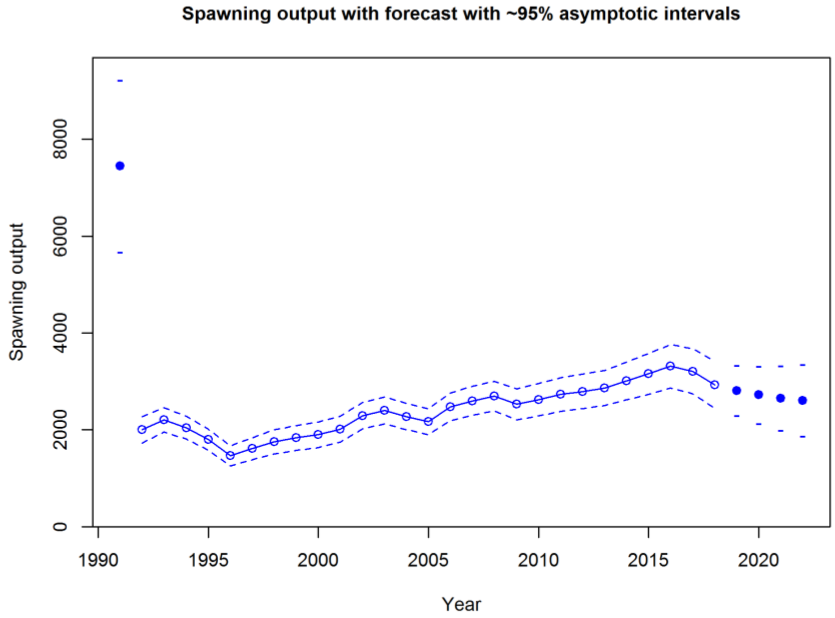


Figure 3.9.74. Posterior distributions of benchmark reference points and management criteria a) fishing mortality associated with 30% SPR ($F_{30\%SPR}$, the Maximum Fishing Mortality Threshold [MFMT]), b) the ratio of the geometric mean of fishing mortality from 2015 – 2017 over the MFMT, c) the equilibrium retained yield associated with F at 30% SPR, d) spawning stock biomass associated with F at 30% SPR ($SSB_{F30\%SPR}$), and e) the ratio of the geometric mean of spawning stock biomass from 2015 – 2017 over 75% of $SSB_{F30\%SPR}$ (the Minimum Stock Size Threshold [MSST]). Blue dotted lines indicate the median and 50th percentiles and the black solid lines show the SEDAR 64 base model run estimates.

a)



b)

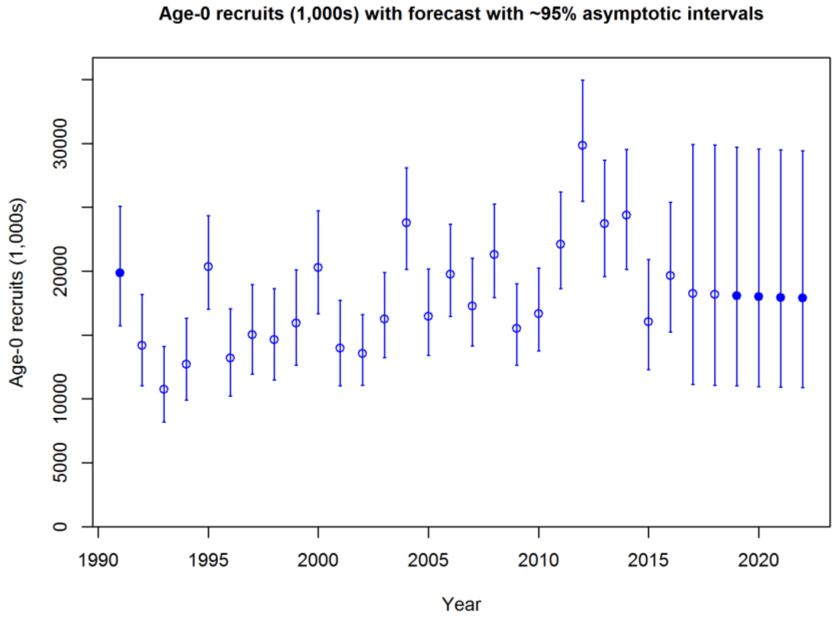
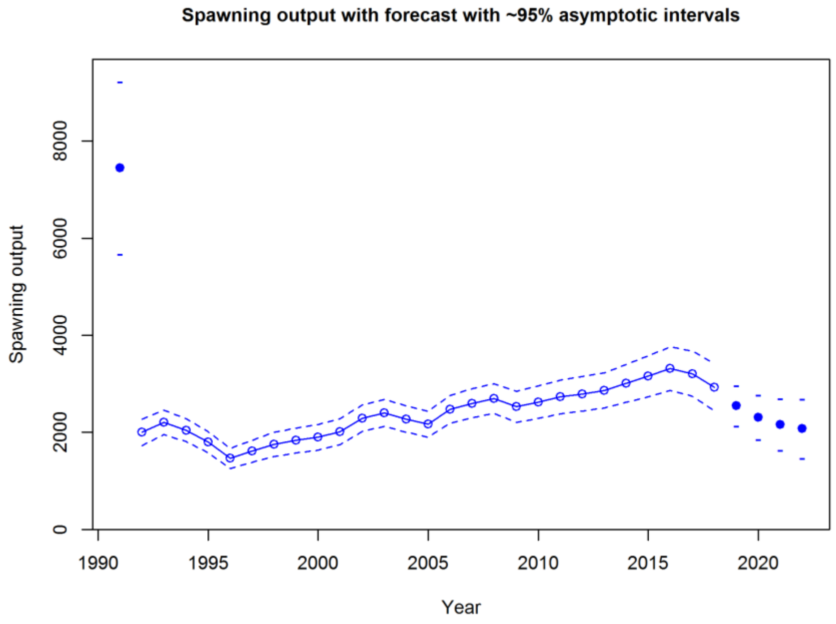


Figure 3.9.75. Projected SSB in metric tons (a) and recruitment in thousands (b) when fishing mortality rates equal $F_{current}$.

a)



b)

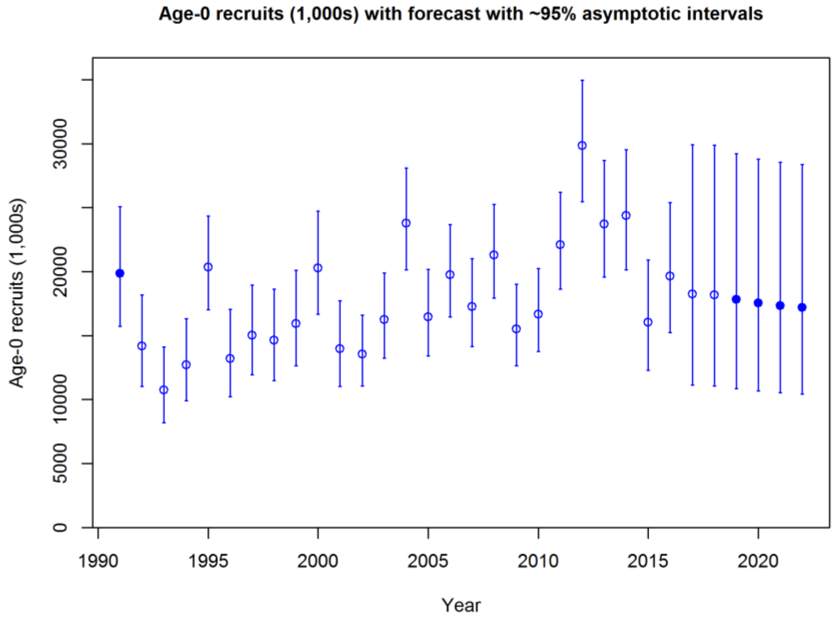
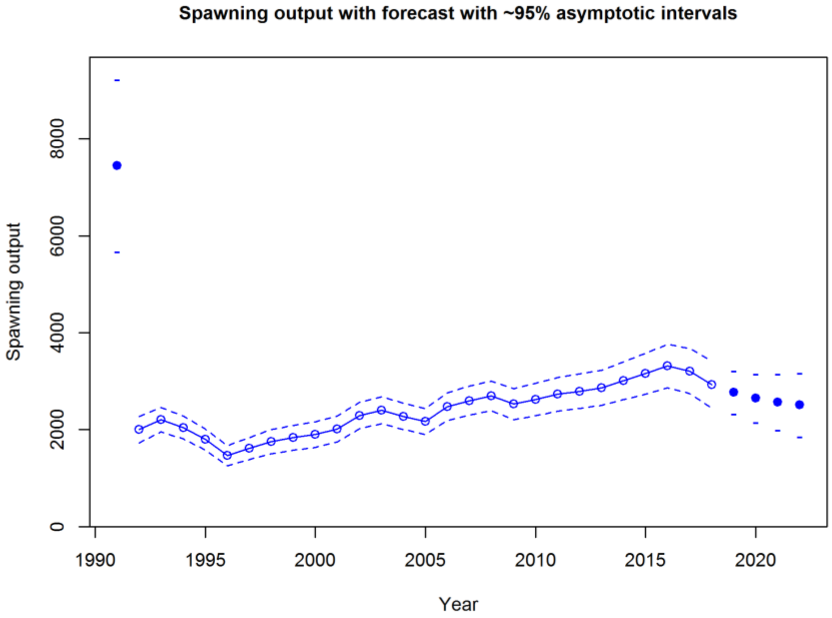


Figure 3.9.76. Projected SSB in metric tons (a) and recruitment in thousands (b) when fishing mortality rates equal MFMT ($F_{30\%SPR}$).

a)



b)

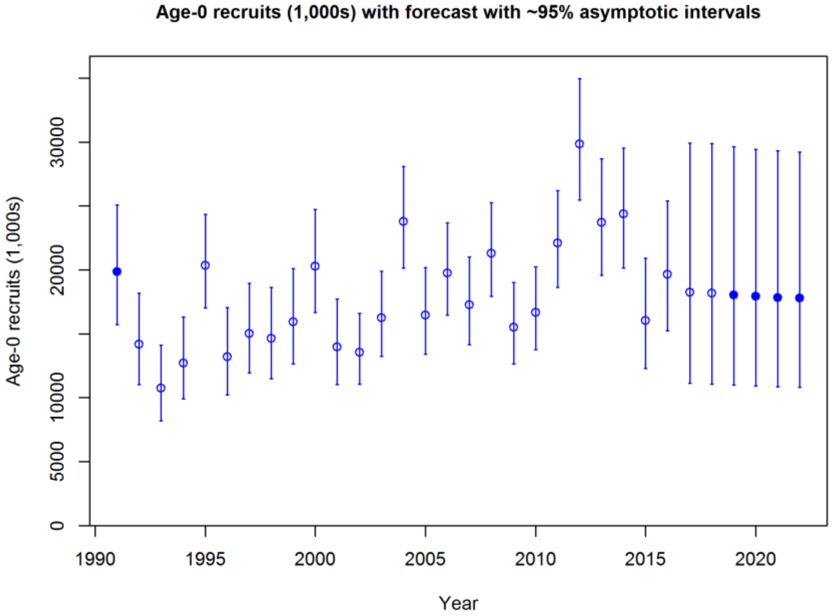
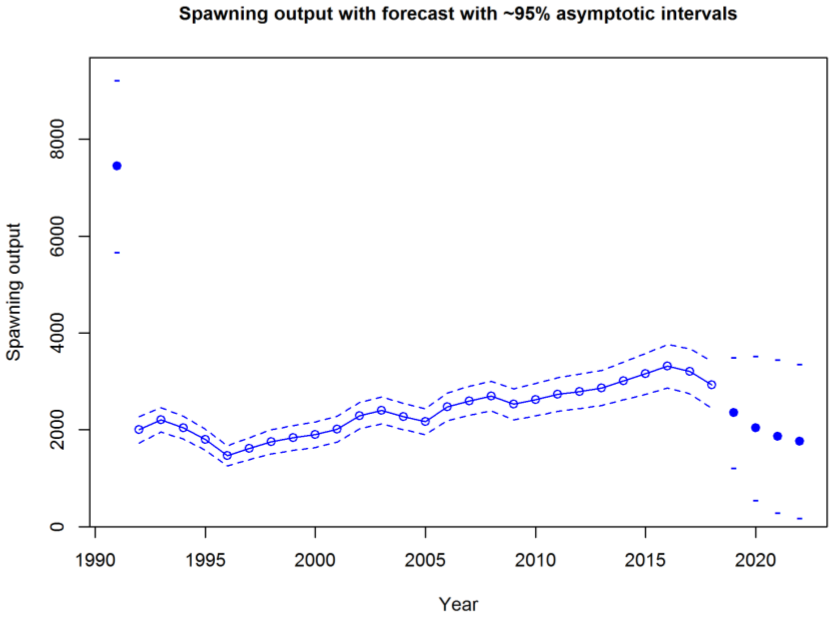


Figure 3.9.77. Projected SSB in metric tons (a) and recruitment in thousands (b) when fishing mortality rates equal 75% of MFMT (i.e. 75% of $F_{30\%SPR}$).

a)



b)

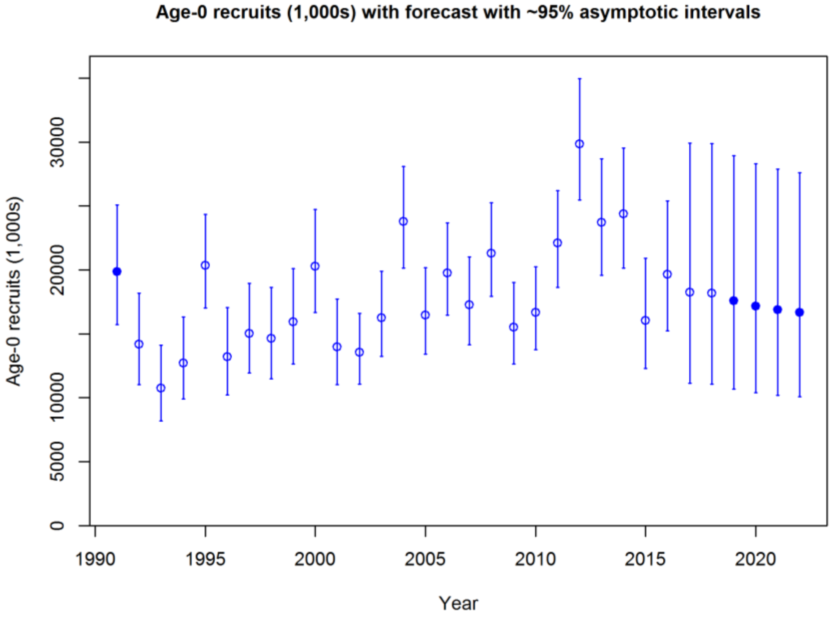


Figure 3.9.78. Projected SSB in metric tons (a) and recruitment in thousands (b) when fishing mortality rates produce equilibrium yield (FMSY).

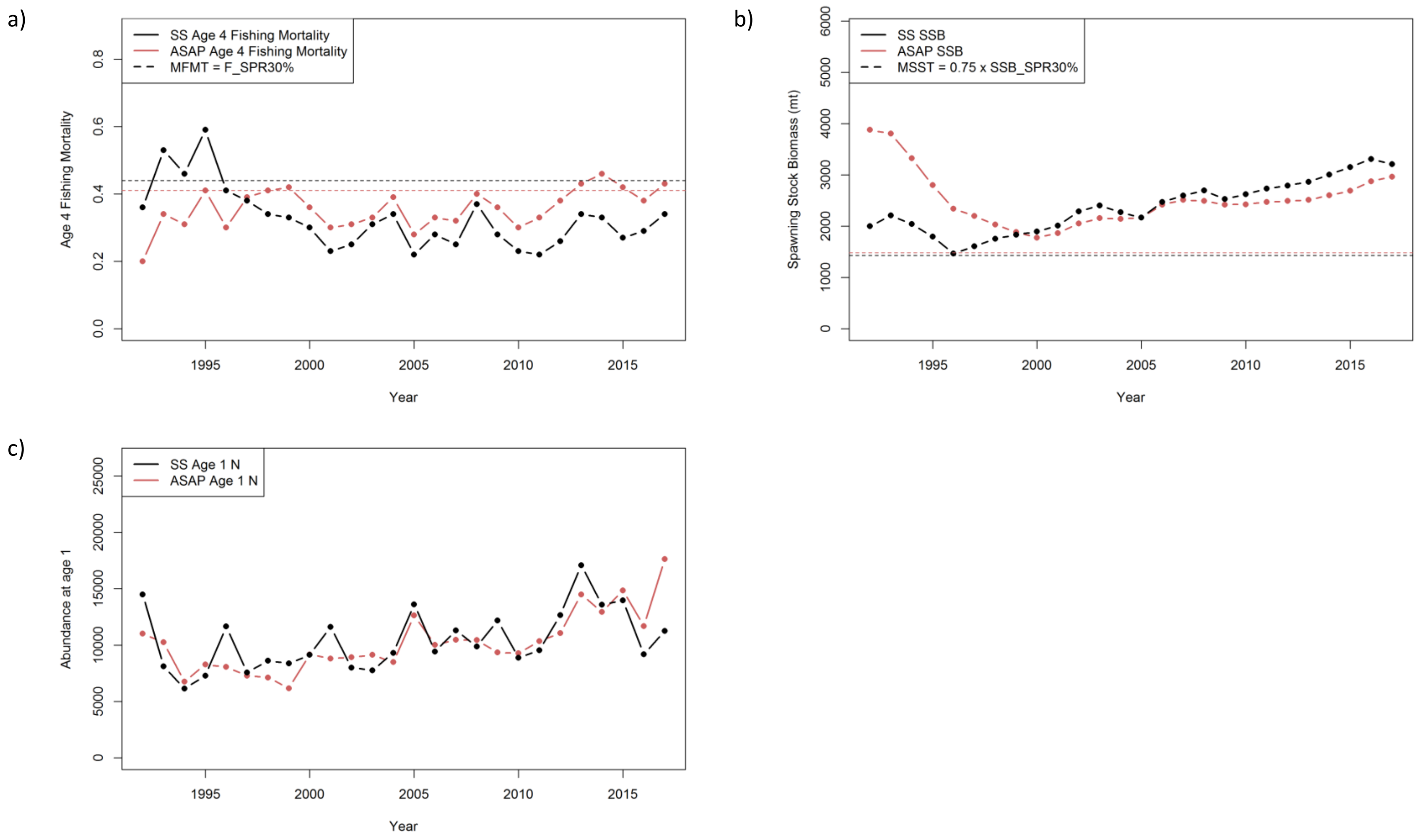


Figure 3.9.79. Average fishing mortality rates per year of age-4 fish (a), spawning biomass estimates (metric tons; b), and numbers of Age-1 fish (in thousands; c) from the SEDAR 64 ASAP Model (ASAP) and the SEDAR 64 Base Model (SS).

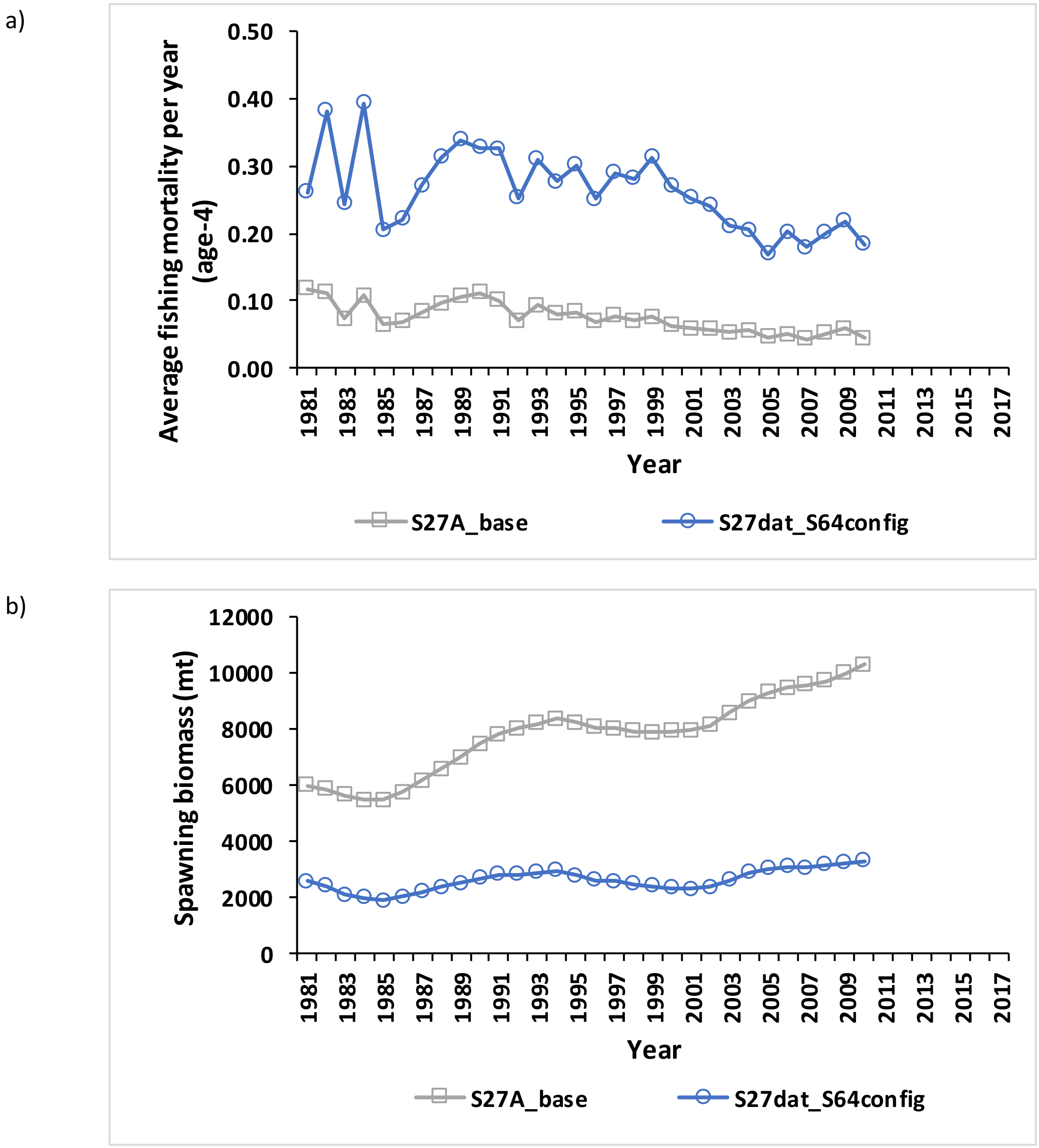
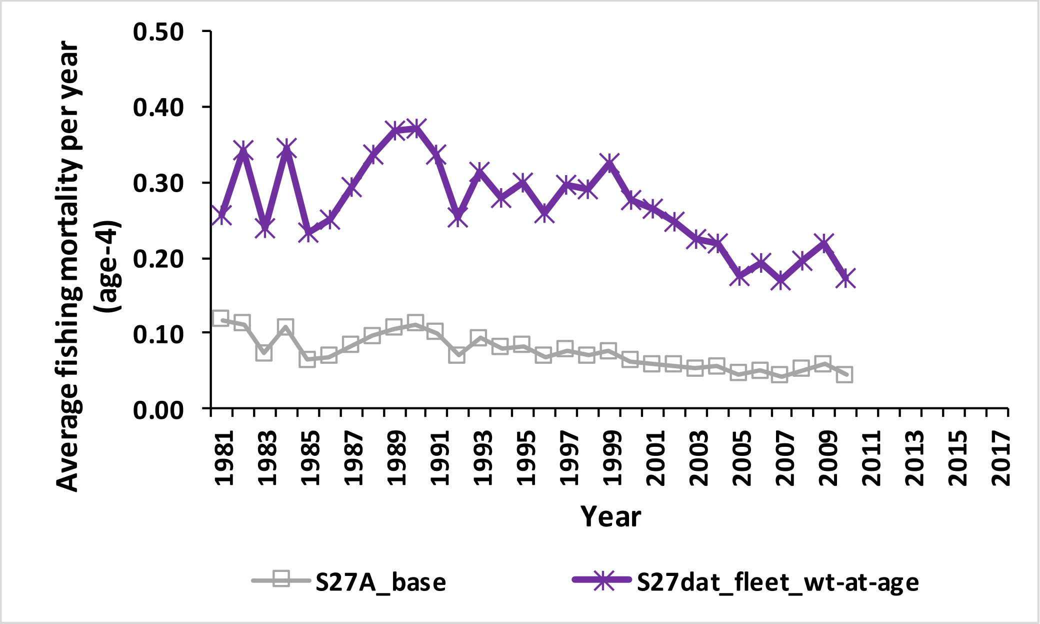


Figure 3.9.80. Average fishing mortality rates per year on age-4 fish (a) and spawning biomass estimates (b) from the SEDAR 27A Final Model (S27A_base) and a model with SEDAR 27A data and SEDAR 64 configuration (S27dat_S64config).

a)



b)

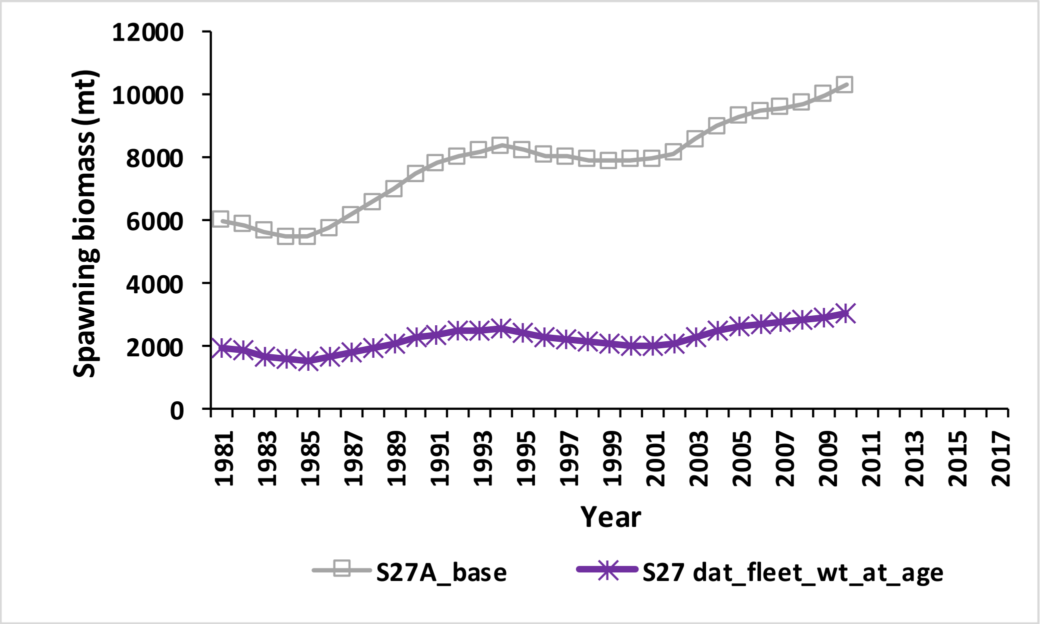


Figure 3.9.81. Average fishing mortality rates per year on age-4 fish (a) and spawning biomass estimates (b) from the SEDAR 27A Final Model (S27A_base) and SEDAR 27A base model with fleet-specific average weight-at-age matrices for landings and discards (S27 dat_fleet_wt_at_age).

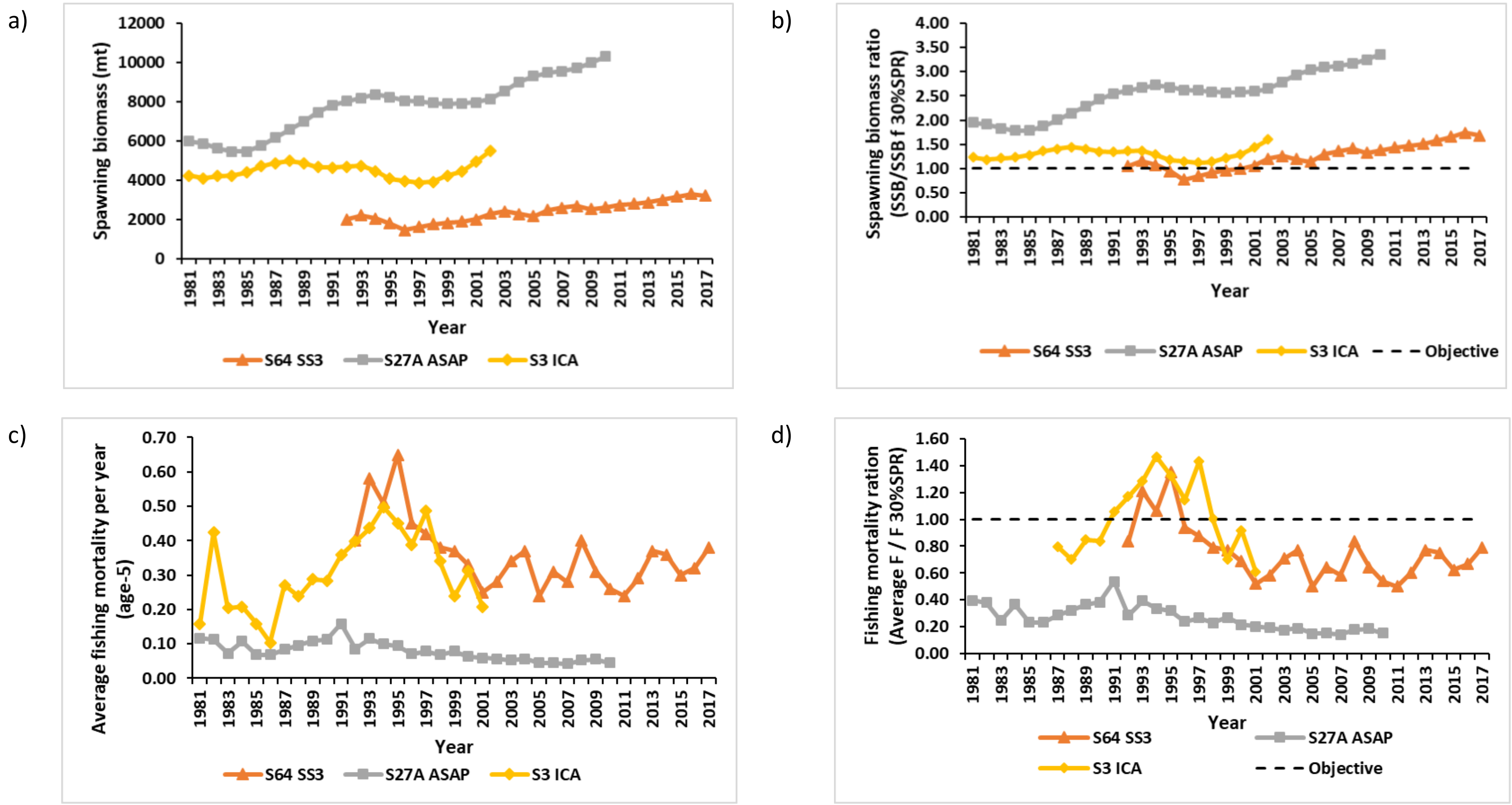


Figure 3.9.82. A comparison of estimates of a) spawning stock biomass, b) spawning stock biomass relative to SSB$_{F30\%SPR}$, c) average fishing mortality rates per year on age-5 fish, d) average fishing mortality rates relative to F30%SPR, and e) number of age 1 fish in thousands for the SEDAR 3 assessment model (S3 ICA), SEDAR 27A assessment model (S27A ASAP), and SEDAR 64 base model (S64 SS3).

e)

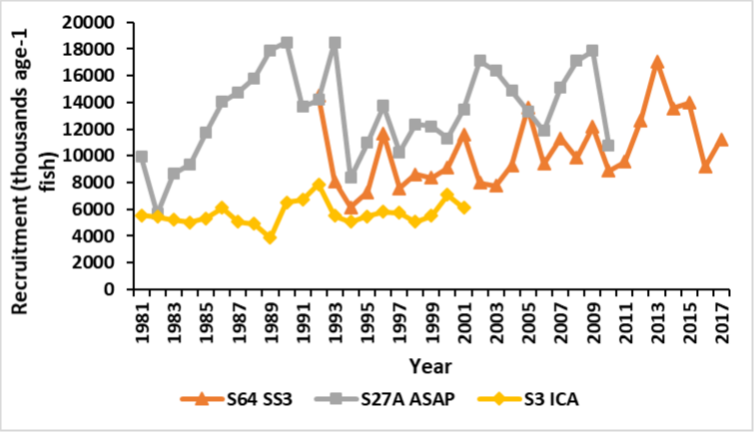


Figure 3.9.82. Continued A comparison of estimates of a) spawning stock biomass, b) spawning stock biomass relative to $SSB_{F30\%SPR}$, c) average fishing mortality rates per year on age-5 fish, d) average fishing mortality rates relative to F30%SPR, and e) number of age 1 fish in thousands for the SEDAR 3 assessment model (S3 ICA), SEDAR 27A assessment model (S27A ASAP), and SEDAR 64 base model (S64 SS3).

SEDAR

Southeast Data, Assessment, and Review

SEDAR 64

Southeastern U.S. Yellowtail Snapper

SECTION IV: Research Recommendations

SEDAR
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Table of Contents

1. DATA WORKSHOP RESEARCH RECOMMENDATIONS

1.1 LIFE HISTORY RESEARCH RECOMMENDATIONS

1.1.1. Stock Definition

- Investigate the genetic linkages of Yellowtail Snapper populations between Florida and the Carolinas and between the Gulf of Mexico and western Caribbean.
- Investigate the current occurrence of hybrids (e.g., with Lane Snapper) throughout the range of the stock.

1.1.2. Natural Mortality

- As the apparent maximum age of Yellowtail Snapper increased from assessment to assessment, the natural mortality estimates decreased. Estimates of natural mortality that are derived independently from life history parameters would help to validate these methods. Given adequate fishery independent age information, total mortality (fishing mortality plus natural mortality) can be estimated. In addition, telemetry and tag-recapture methods can offer independent estimation of fishing mortality and natural mortality, however these methods rely on high site fidelity of Yellowtail Snapper to reef sites or reliable tag return rates.

- Investigate estimates of natural mortality rates for different life stages of Yellowtail Snapper using ecosystem simulation models (e.g., Ecopath with Ecosim and OSMOSE).

1.1.3. Release Mortality

- On-board observers inform immediate release mortality, however information on delayed mortality is limited. Additional tagging of Yellowtail Snapper with passive and acoustic tags, as well as the continued development of tag-and-recapture models would help to inform delayed release mortality.

1.1.4. Age and Growth

- Expand and increase the amount of length-at-age data coming from fishery-independent biological sampling throughout the range of the stock (especially for fish smaller than the current minimum size limit).
- Continue to sample the population off the Carolinas undergoing reduced targeted fishing pressures and allowing for greater estimates of maximum age.

1.1.5. Reproduction

- Expand information on reproductive characteristics such as age- and size-at-maturity, fecundity, sex ratio, and distribution of spawning aggregations throughout the range of the stock.

1.1.6. Movements and Migrations

- Investigate juvenile ontogenetic shifting from nearshore areas to reef habitat.
- Investigate movement and migration rates between the Florida Keys, southeast Florida, and southwest Florida (e.g. acoustic tagging and stable isotope studies).

1.2 COMMERCIAL FISHERY STATISTICS RESEARCH RECOMMENDATIONS

Improve or develop new methods for collecting discard data. Expand observer coverage to the entire range for Yellowtail Snapper (i.e. Atlantic) to document discard length and mortality. Find a better method to address false zeros in self-reported logbook data. Explore recall bias/rounding issue: discards 5,10, 15 – recall bias – 1-10, units of 5 after that.

Study smaller fish for possible correlation between sex and tail length. Industry has seen robust fish with short tails and skinny fish with longer tails and believe them to be evidence of a secondary sex characteristic.

Perform genetic analysis of commercial samples to determine if Yellowtail Snapper is a single stock in the Southeastern United States (very old and large fish North of Florida along the Atlantic coast possibly indicating different stocks).

So little data is available on YOY/juvenile Yellowtail Snapper. There may be an opportunity to increase these samples as commercial fishers who participated in the workgroup have offered to assist fisheries scientists to obtain samples of YOY/juvenile Yellowtail Snapper. Industry believes they can get fisheries independent scientists' access to these fish by taking scientists to areas where many YOY/juvenile fish have been observed, or by providing them with area and gear recommendations based on the results of commercial fishing activities for Yellowtail Snapper.

Survey fishers for when then encounter small sub-legal fish (on board observer or email/mail). When they see small fish, they often leave the site which is not captured by logbook or gulf observer program. Modifying API of e-logbook or putting more onboard observers in the keys could provide more data on behavior. Onboard observers could also obtain discard information. Could use VMS to account for target species switching.

Ensure consistent and adequate levels of funding for continued TIPS sampling. These data were critical in providing age, length, weight, and trip information which can help validate reported landings information.

1.3 RECREATIONAL FISHERY STATISTICS RESEARCH RECOMMENDATIONS

- Continue to collect discard length and age data from headboat and charterboat sectors.
- Increase research efforts to collect discard and retained length and age data from the private sector.
- Increase at-sea observer coverage for nighttime trips.
- Assess the impact of headboats that do not renew their federal reef fish permits and target popular reef fish species solely in state waters on the SRHS coverage.
- Recommend methods to estimate uncertainty in headboat landings and discards.

1.4 MEASURES OF POPULTAION ABUNDANCE RESEARCH RECOMMENDATIONS

During the review and evaluation of the various program datasets and indices presented during the Data Workshop, the PAW identified the following research recommendations to further improve the indices of relative abundance:

- Develop fishery-independent surveys throughout the Florida Keys which successfully target settlement sized Yellowtail Snapper in seagrass/mangroves habitats before ontogenetically shifting to reef habitats. This habitat shift is observed throughout the Caribbean but not well documented for Florida.
- Develop or extend fishery-independent reef fish surveys into deeper waters (>30 m) along the Florida Keys for greater overlap with exploited portions of the population.

2. ASSESSMENT WORKSHOP RESEARCH RECOMMENDATIONS

2.1 Age and Growth

Age data for southeastern U.S Yellowtail Snapper suggest there may be multiple growth patterns, such that fish beyond the Florida Keys may grow faster and have larger asymptotic sizes. Data are sparse however outside of South Florida, limiting these speculations. Therefore, a recommendation is to increase otolith sampling outside of South Florida and to explore alternative model configurations that allow for multiple growth patterns (e.g. multiple areas, areas-as-fleets). It is also recommended to increase otolith sampling for private and charterboat modes which are highly under represented. Lastly, it is recommended to explore methods to weight the age data sampled from landings accordingly to account for regional differences and uneven sampling of the landings.

2.2 Length Composition

For length samples to be a better representation of the length composition of landings and discards, it is recommended to increase sampling of lengths in regions outside of the Florida Keys as presented in S64-AW-01. Length compositions of discards are valuable model inputs, therefore it is recommended to continue data collection from at-sea observer programs and to expand the coverage of these programs. This was also a research recommendation discussed in SEDAR 27A. Additionally, it is recommended to increase length sampling for private and charter recreational modes which are highly under represented.

2.3 Commercial Discards

Commercial discards are currently highly uncertain. It is recommended to explore data collection and data analysis methods to increase precision on these estimates.

2.4 Headboat Landings and Discards

Uncertainty of headboat landings and discards are unknown and should be evaluated. Additionally, some headboats in South Florida are exempt from participating in the SRHS and no federally administered surveys have absorbed these vessels into their sample frames, eliminating opportunities for these vessels to report landings or fishing effort.

2.5 Fishery Independent Data

Age samples for Yellowtail Snapper from fishery independent sources are lacking and would be highly useful in determining growth. In addition, an index of abundance of young-of-the-year (<10 cm FL) Yellowtail Snapper targeted in seagrass habitat would aid in refining the recruitment signal over time of this species.

3. REVIEW PANEL RESEARCH RECOMMENDATIONS

ToR #6: Consider the research recommendations provided by the Data and Assessment workshops and make any additional recommendations or prioritizations warranted.

- ***Clearly denote research and monitoring that could improve the reliability of, and information provided by, future assessments***

More analysis and synthesizing of existing biological information pertaining to spatial stock structure and dynamics is needed. The stock occurs at the edge of the species' range and cursory analysis suggests that movement, migration, and life history plasticity are important factors in stock dynamics. Additionally, further investigation of stock structure, spawning areas, larval transport and juvenile/adult movement using methods such as otolith microchemistry or stable isotopes would be useful.

Age validation studies are needed to test whether growth checks are laid down consistently throughout the area of distribution and sampling (which includes tropical and temperate habitats) and reflect annual increments.

Age-length sampling among areas of the stock distribution is needed. Altered age-length sampling may require re-allocating sampling effort from the FL Keys and Southeast FL to other areas. These samples would improve growth information representing data throughout the range of the stock. This may be informed by outcomes of the analyses suggested above.

Improve sampling of discards, particularly in the commercial and headboat sectors.

Consider options for improving fisheries independent sampling of the yellowtail snapper stock.

- ***Provide recommendations on possible ways to improve the SEDAR process***

There is a need to consistently outline reasoning behind decisions made in the assessment process and reference relevant information sources such as data workshop reports.

Provide presentation files (PowerPoints) in advance of workshop sessions and include file name and page number on every slide to facilitate referencing of slides in discussions. This can also include past assessment reports (https://www.nefsc.noaa.gov/saw/reviews_report_options.php).

SEDAR

Southeast Data, Assessment, and Review

SEDAR 64

Southeastern U.S. Yellowtail Snapper

SECTION V: Review Workshop Report

March 2020

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

Table of Contents

1. INTRODUCTION

1.1 WORKSHOP TIME AND PLACE

The SEDAR 64 Review Workshop was held February 24-26, 2018 in St. Petersburg, Florida.

1.2 TERMS OF REFERENCE

1. Evaluate the data used in the assessment, including discussion of the strengths and weaknesses of data sources and decisions, and consider the following:
    a) Are data decisions made by the DW and AW sound and robust?
    b) Are data uncertainties acknowledged, reported, and within normal or expected levels?
    c) Are data applied properly within the assessment model?
    d) Are input data series reliable and sufficient to support the assessment approach and findings?
2. Evaluate and discuss the strengths and weaknesses of the methods used to assess the stock, taking into account the available data, and considering the following:
    a) Are methods scientifically sound and robust?
    b) Are assessment models configured properly and consistent with standard practices?
    c) Are the methods appropriate for the available data?
3. Evaluate the assessment findings and consider the following:
    a) Are population estimates (model output – e.g. abundance, exploitation, biomass) reliable, consistent with input data and population biological characteristics, and useful to support status inferences?
    b) Is the stock overfished? What information helps you reach this conclusion?

   c) Is the stock undergoing overfishing? What information helps you reach this conclusion?

   d) Is there an informative stock recruitment relationship? Is the stock recruitment curve reliable and useful for evaluation of productivity and future stock conditions?

   e) Are the quantitative estimates of the status determination criteria for this stock reliable? If not, are there other indicators that may be used to inform managers about stock trends and conditions?

4. Evaluate the stock projections, including discussing strengths and weaknesses, and consider the following:

   a) Are the methods consistent with accepted practices and available data?

   b) Are the methods appropriate for the assessment model and outputs?

   c) Are the results informative and robust, and useful to support inferences of probable future conditions?

   d) Are key uncertainties acknowledged, discussed, and reflected in the projection results?

5. Consider how uncertainties in the assessment, and their potential consequences, are addressed.

   - Comment on the degree to which methods used to evaluate uncertainty reflect and capture the significant sources of uncertainty in the population, data sources, and assessment methods
   - Ensure that the implications of uncertainty in technical conclusions are clearly stated

6. Consider the research recommendations provided by the Data and Assessment workshops and make any additional recommendations or prioritizations warranted.

   - Clearly denote research and monitoring that could improve the reliability of, and information provided by, future assessments
   - Provide recommendations on possible ways to improve the SEDAR process

7. Consider whether the stock assessment constitutes the best scientific information available using the following criteria as appropriate: relevance, inclusiveness, objectivity, transparency, timeliness, verification, validation, and peer review of fishery management information.

8. Provide suggestions on key improvements in data or modeling approaches that should be considered when scheduling the next assessment.

9. Prepare a Peer Review Summary summarizing the Panel's evaluation of the stock assessment and addressing each Term of Reference. Develop a list of tasks to be completed following the workshop. Complete and submit the Peer Review Summary Report in accordance with the project guidelines.

1.3 LIST OF PARTICIPANTS

Workshop Panel

Joseph Powers (Chair)	GMFMC SSC
Kai Lorenzen	GMFMC SSC
J.J. Maguire	CIE
Amy Schueller	SAFMC SSC
Alexei Sharov	SAFMC SSC
Peter Stephenson	CIE
Kevin Stokes	CIE

Analytic Team

Shanae Allen, Co-Lead Analyst	FWRI, St. Petersburg
Chris Swanson, Co-Lead Analyst	FWRI, St. Petersburg

Appointed Observers

Ed Walker	GMFMC AP

Attendees

Dustin Addis	FL FWC, St. Petersburg
Luiz Barbieri	FL FWC, St. Petersburg
Martha Guyas	FL FWC, GMFMC Rep, Tallahassee
Jessica McCawley	FL FWC, SAFMC Rep, Tallahassee
Bob Muller	FWRI, St. Petersburg
Joseph Munyanderaro	FWRI, St. Petersburg
Joe O'hop	FWRI, St. Petersburg

Staff

Julie Neer	SEDAR
Mike Errigo	SAFMC Staff
Ryan Rindone	GMFMC Staff
Charlotte Schiaffo	GMFMC Staff

1.4 LIST OF REVIEW WORKSHOP WORKING PAPERS AND DOCUMENTS

No working papers or reference documents were submitted for the Review portion of the assessment.

2. REVIEW PANEL REPORT

Summary Report
Southeast Data Assessment Review (SEDAR) 64 Review Panel
of the
Southeastern US Yellowtail Snapper Assessment

Prepared
for the

Gulf of Mexico Fishery Management Council
and the
South Atlantic Fishery Management Council

by

Joseph Powers (Chair), Kai Lorenzen, Jean-Jacques Maguire, Amy Schueller,
Alexei Sharov, Peter Stephenson, and Kevin Stokes

Background

This document is a summary of the SEDAR Review Panel findings addressing the stock assessment of the Southeastern United States Yellowtail Snapper fishery resource. The review was conducted from Feb 24-26, 2020 in St. Petersburg, FL. This summary addresses the Terms of Reference of the review and provides findings, comments, and guidance relative to each Term.

Terms of Reference

1. Evaluate the data used in the assessment, including discussion of the strengths and weaknesses of data sources and decisions, and consider the following:

a) ***Are data decisions made by the DW and AW sound and robust?***

Yes, the data and modeling framework selected by the DW and AW were appropriate given the life history of this species (and typical species in the region) and the history of data collection within the region.

However, some of the decision processes were reported in the DW/AW Reports at a high level such that it was difficult to follow the detailed arguments for the decisions. In particular, more information regarding decisions when standardizing data to create CPUEs would have been beneficial.

Pragmatically (and appropriately), for this assessment, the decision was made to focus on data from Florida (specifically, the Keys) where the bulk of the fishery occurs. However, the area of distribution of the species extends outside of the assessment area in the Gulf of Mexico, on the US Atlantic coast and in international waters. This affects the understanding of the how representative the CPUE's and size distributions used in the assessment might be of the entire population.

b) ***Are data uncertainties acknowledged, reported, and within normal or expected levels?***

Yes, data uncertainties are within normal or expected levels. Note that "normal" in this region is acknowledged to encompass the nature of the life histories of reef fish species (e.g., protracted spawning, smearing of year-class signals), which lead to uncertainties in growth estimations and inferences on natural mortality. These uncertainties are not unique to YT snapper. But overall understanding of the dynamics and potential productivity are limited by these uncertainties.

c) ***Are data applied properly within the assessment model?***

Yes, the data are used and appropriately implemented in the SS model. However, there are some conflicting signals from the data. The typical SS approach (as was used here) was to explore this through weighting likelihood components and by inclusion/rejection of individual components in sensitivity analyses. That being said, letting the model "decide" is not the best approach. Ultimately there needs to be a better understanding of the underlying data processes that would allow informed choices to be made by experts outside the confines of the model.

d) ***Are input data series reliable and sufficient to support the assessment approach and findings?***

Yes, the data are sufficient to support the assessment approaches, status determinations, and subsequent ACL determinations.

2. ***Evaluate and discuss the strengths and weaknesses of the methods used to assess the stock, taking into account the available data, and considering the following:***

a) ***Are methods scientifically sound and robust?***

The main method is SS3, a widely available software used worldwide. SS3 is sound, but small changes in data, parameters, or constraints can result in unexpected changes in results: the method is therefore not necessarily robust and requires skilled users. The assessment team also used ASAP, another widely used software, which was used as the main assessment tool in the previous assessment. ASAP is less sensitive to small changes in data, parameters, and constraints; it produced results broadly similar to those from SS3 for fishing mortality, biomass, and recruitment.

b) ***Are assessment models configured properly and consistent with standard practices?***

Yes, the assessment models are properly configured, consistent with standard practices. There appears to be tension between the length compositions and the age compositions. When both are included in modelling, the model may average the results, which may not be the most appropriate thing to do. Generally speaking, if there is confidence in the stock size indices, those should be given more weight than age or length compositions. Similarly, more weight should be given to either length or weight compositions, whichever is considered more reliable.

c) ***Are the methods appropriate for the available data?***

Yes, the methods are appropriate for the available data. SS3 is a very flexible method that can be run with very limited data or with considerable amounts of data, as is the case here. The differences are then dependent on assumptions in implementing those data.

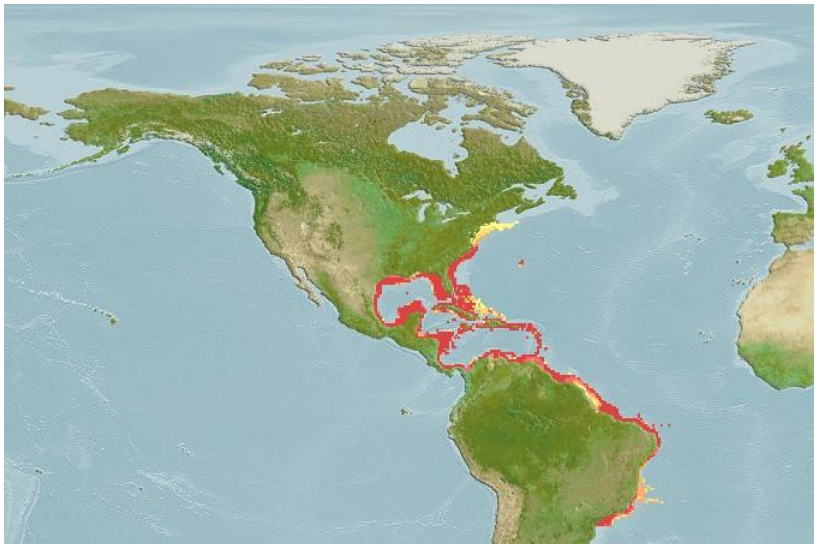
The assessment analyses also included a simpler approach (ASAP), which is also used widely and was used historically for this stock. ASAP is less flexible but can provide a basic check of the consistency of results with SS3. In the next assessment, ASAP results should be analyzed and compared more extensively with those from SS3. As ASAP does not use length composition information this would be one way of analyzing the apparent tension in SS3 between the length and age compositions. With better understanding of these tensions, there might be a possibility of using ASAP as the main assessment in the future.

The jitter analysis produced bi-modal distributions for R0, steepness, and sigma R with the left-hand side mode suggesting constant recruitment, i.e. sigma R = 0. This suggests that the stock-recruitment parameters are not well defined. See TOR 3.

3. *Evaluate the assessment findings and consider the following:*

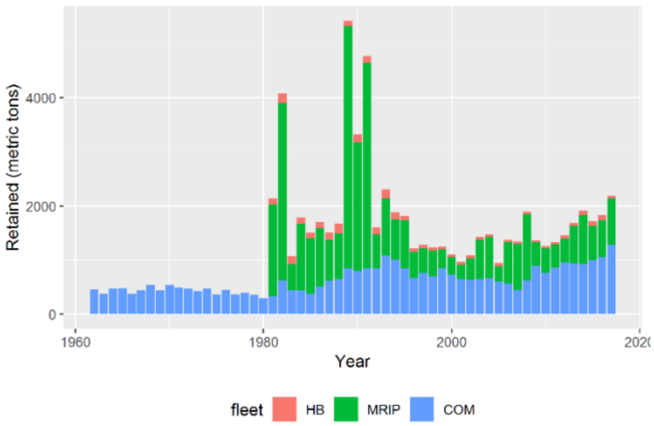
a) *Are population estimates (model output – e.g. abundance, exploitation, biomass) reliable, consistent with input data and population biological characteristics, and useful to support status inferences?*

Yellowtail snapper is distributed across a wide geographic range from Brazil through the Caribbean and Gulf of Mexico and along the US SE Atlantic coastline. But little is known through the documents about large scale information. The USA stock is treated as a single, closed stock found along the entire USA GoM coastline, around Florida, and along the Atlantic coastline. However, the fishery is largely centered around southern and southeastern Florida.



Yellowtail snapper in USA waters are fast growing and long-lived but with plastic life history depending on environmental conditions - growth rates and longevity are highly variable across regions even within Florida. This plastic life history creates problems in defining appropriate parameters in stock assessment, or appropriate data to present to model.

Exploitation of yellowtail snapper in commercial and recreational fisheries has a long history (note recreational fisheries existed before 1980, but landings data were not collected).



Management measures have been implemented in the GoM and SE Atlantic through various amendments to the Fishery Management Plans:

SAFMC FMP Amendments:

- Snapper-Grouper FMP (8/31/1983)
- 12” (305mm) TL minimum size limit for commercial and recreational fisheries
- Florida state waters regulation enacted 7/1/1985
- Amendment 4 (1/1/1992)
- Aggregate daily bag limit of 10 snappers for recreational fishery
- Florida state waters regulation enacted 12/1/1986
- Amendment 11B (12/2/1999)
- MSY-proxy set as 30% static SPR; OY-proxy is 40% static SPR
- Regulatory Amendment 15 (9/12/13)
- OY = ACL = ABC
- Regulatory Amendment 21 (11/6/2014)
- Modified MSST to be 75% of the SSBMSY

GMFMC FMP Amendments:

- Reef Fish FMP (11/8/1984)
- Reef Fish Amendment 1 (2/21/1990)
- 12” (305mm) TL minimum size limit for commercial and recreational fisheries
- Aggregate daily bag limit of 10 snappers for recreational fishery

Quota History

Gulf	**South Atlantic**
Commercial and Recreational Combined • ACL • 725,000 lbs (1/30/2012 - 9/2/2013) • 901,125 lbs (9/3/2013 - present)	Commercial • ACL 1,142,589 lbs (4/2012 – 11/2012) 1,596,510 lbs (11/2012 – present) • Closures 10/31/2015 – 12/31/2015 6/3/2017 – 8/1/2017 Recreational • ACL 1,031,286 lbs (4/2012 – 9/2013) 1,440,990 lbs (9/2013 – present)

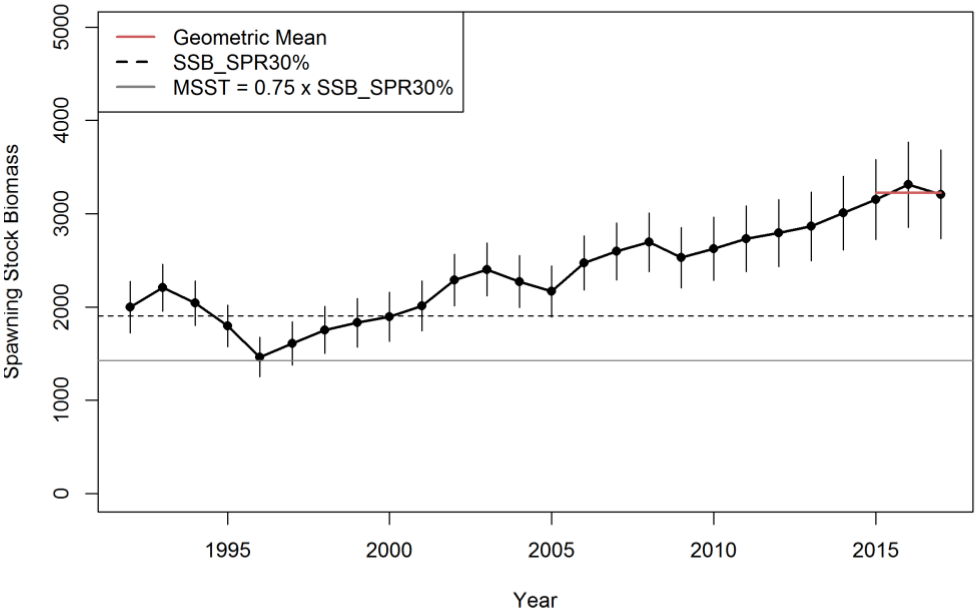
The assessment area accounts for approximately 96% of the catch of yellowtail snapper from the GoM and SE Atlantic, with the majority of the catch coming from the Florida Keys.

The base case stock assessment model includes landings and discards split by fleet (commercial, Head boat, and recreational), fishery-dependent and -independent indices, and age and length compositions.

The base case stock assessment is implemented using SS3 and is tuned using standard procedures. The assessment provides reliable estimates of abundance, biomass, and exploitation, consistent with input data and population biological parameters, which can be used to infer status and inform management based on proxy reference points.

b) *Is the stock overfished? What information helps you reach this conclusion?*

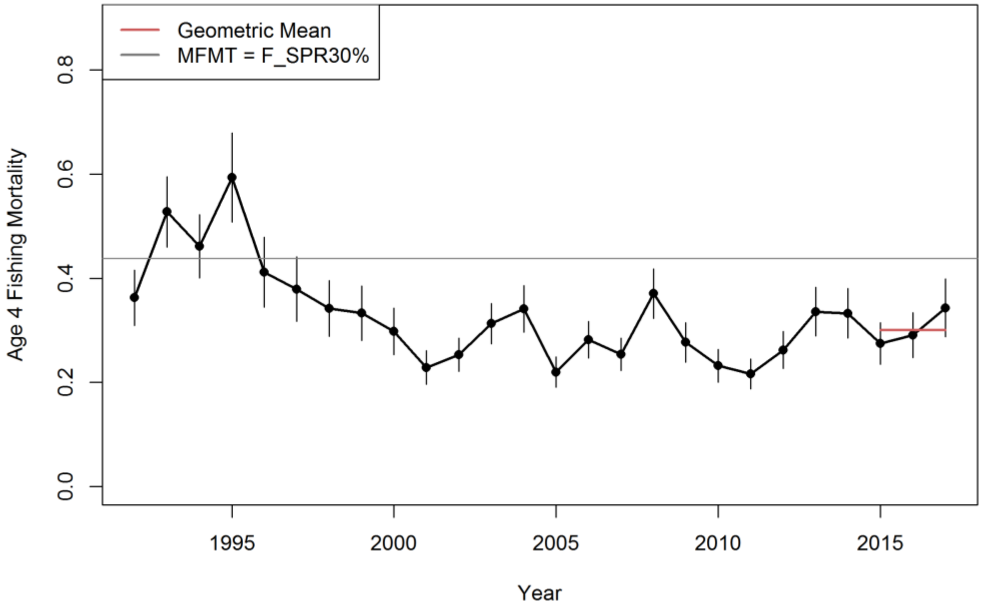
The stock is not overfished. The base case assessment estimates SSB$_{F30\%SPR}$ as 1,904 mt and SSB$_{current}$ as 3,223 mt.



Sensitivity tests considering alternative selectivity, natural mortality, and steepness indicate the status determination (not overfished) is robust.

c) *Is the stock undergoing overfishing? What information helps you reach this conclusion?*

The stock is not undergoing overfishing. The base case assessment estimates F$_{30\%SPR}$ as 0.44 and F$_{current}$ as 0.30.



Sensitivity tests considering alternative selectivity, natural mortality, and steepness indicate the status determination (not undergoing overfishing) is robust.

d) Is there an informative stock recruitment relationship? Is the stock recruitment curve reliable and useful for evaluation of productivity and future stock conditions?

A Beverton-Holt stock recruitment model was implemented within the SS3 framework and a solution (estimate) of steepness was obtained. However, the likelihood profile, the jitter analysis, the fact that the stock has not been reduced to levels where strong density dependence might occur, and the fact that steepness is confounded with natural mortality all suggest that the stock-recruitment relationship is not informative for defining future productivity. Therefore, it is recommended that the current 30% SPR continue to be used as a MSY proxy.

Note that even though the base case estimates the Beverton-Holt model in the assessment, alternative recruitment approaches may be equally appropriate given the data. Therefore, the determination of stock biomass, fishing mortality, and trends are expected to be robust to the S-R choice.

e) Are the quantitative estimates of the status determination criteria for this stock reliable? If not, are there other indicators that may be used to inform managers about stock trends and conditions?

See also ToR 5

All indices and composition data (from 1992-2017) have been put into the model with no forced weighting to give preference to a particular data set. The tuning of process and observation errors given the data presented has followed standard (Francis, 2011) approaches. Assessment sensitivity to maximum age (affecting growth function determination), and other inputs/assumptions was tested.

Resulting quantitative, management-related estimates are reliable to the extent that the stock definition is appropriate, and data from the Florida Keys and SE Florida are representative of the USA stock as a whole.

One concern of the Panel was the determination of a maximum age (T_{max}) estimate for the stock within the assessment area, and its use in the estimation of the natural mortality rate, M. The use of T_{max} based on Florida data sources is justified, but only given the overall approach to the data treatment (i.e., exclusion of data from outside the assessment area, which included some older fish). There is some uncertainty in the estimate of natural mortality due to the choice of specific method of estimating M from T_{max}. The method used is consistent with current practice in other assessments, but alternative methods suggest higher M values. However, using a higher M value in the assessment would be unlikely to change conclusions about overfishing or overfished conditions.

4. ***Evaluate the stock projections, including discussing strengths and weaknesses, and consider the following:***

   a) ***Are the methods consistent with accepted practices and available data?***

   The projection methods are included in the SS3 software, and they are consistent with accepted practice and available data.

   b) ***Are the methods appropriate for the assessment model and outputs?***

   The projection method is entirely consistent with the assessment model and outputs and forms an integral part of the SS3 software used. Projections were done for a 5-year period from the last year in the assessment (2018 – 2022) extracting recruitment from the stock-recruitment relationship under three fishing mortality scenarios: average fishing mortality of the last 3 years, $F_{30\%SPR}$, $0.75F_{30\%SPR}$.

   c) ***Are the results informative and robust, and useful to support inferences of probable future conditions?***

   The projection results are informative and useful to support inferences of possible future conditions in the fisheries. Past estimates of recruitment have showed fluctuations, and recruitment can be expected to continue to fluctuate more than what is predicted from the stock-recruitment relationship. Strong year-classes are estimated to have been produced in 2011 - 2014, but recruitment is estimated to have been about average for the 2015-2017 year-classes. This implies that spawning stock biomass is projected to decline and recruitment in the projection years, based on the stock-recruitment relationship, is also expected to decline slowly.

   d) ***Are key uncertainties acknowledged, discussed, and reflected in the projection results?***

   The projections are deterministic and assume constant recruitment, weights at ages, selectivity, and fishing mortality. Uncertainties are acknowledged and discussed but not explicitly taken into account in the projections other than by providing confidence intervals on projected quantities. Future stock size will depend on realized recruitment since the 2017 year-class whose sizes are unknown at this stage. Alternative approaches could involve re-sampling from a given period of past recruitment estimates.

5. ***Consider how uncertainties in the assessment, and their potential consequences, are addressed*.**

   Comment on the degree to which methods used to evaluate uncertainty reflect and capture the significant sources of uncertainty in the population, data sources, and assessment methods.

   Ensure that the implications of uncertainty in technical conclusions are clearly stated

   Uncertainties were addressed through a variety of methods including sensitivity runs, retrospective runs, parametric bootstrap runs, and MCMC. These methods are all appropriate for exploration of uncertainties related to data inputs, model assumptions, and observation error. Note that the jackknife analyses indicates the sensitivities of the results to the inclusion (or not) of specific indices.

   Several sensitivity runs were completed by the analytical team but were not included in the report. In the future, including a suite of those additional runs, in addition to the runs that were already included, would be useful for the review workshop panelists. For example, runs related to weighting of the data components, selectivity, growth options, natural mortality, and stock-recruitment configuration would all have been useful and are typically included in the report or made available on a web site.

   Parametric bootstrap runs are informative for looking at uncertainty related to data input components, and are thus worthwhile for exploring uncertainty. However, the runs that were provided in the workshop report needed more work to improve convergence and to decrease the number of runs with parameters hitting bounds. Given these two problems, it is difficult to discern the uncertainty characterized by the parametric bootstrap runs.

   MCMC is likely a minimum level of uncertainty for this assessment and is a good first step towards acknowledgement of uncertainty. However, MCMC does not account for uncertainties outside of the base run model framework; thus, the uncertainty estimates should be viewed as a minimum versus an indication of the true level of uncertainty in the stock assessment.

   The work provided for this assessment only speaks to the uncertainties as set up and as compared to the base run, but doesn't address data or structural uncertainties such as stock structure and maximum age.

6. ***Consider the research recommendations provided by the Data and Assessment workshops and make any additional recommendations or prioritizations warranted*.**

   Clearly denote research and monitoring that could improve the reliability of, and information provided by, future assessments

More analysis and synthesizing of existing biological information pertaining to spatial stock structure and dynamics is needed. The stock occurs at the edge of the species' range and cursory analysis suggests that movement, migration, and life history plasticity are important factors in stock dynamics. Additionally, further investigation of stock structure, spawning areas, larval transport and juvenile/adult movement using methods such as otolith microchemistry or stable isotopes would be useful.

Age validation studies are needed to test whether growth checks are laid down consistently throughout the area of distribution and sampling (which includes tropical and temperate habitats) and reflect annual increments.

Age-length sampling among areas of the stock distribution is needed. Altered age-length sampling may require re-allocating sampling effort from the FL Keys and Southeast FL to other areas. These samples would improve growth information representing data throughout the range of the stock. This may be informed by outcomes of the analyses suggested above.

Improve sampling of discards, particularly in the commercial and headboat sectors.

Consider options for improving fisheries independent sampling of the yellowtail snapper stock.

Provide recommendations on possible ways to improve the SEDAR process

There is a need to consistently outline reasoning behind decisions made in the assessment process and reference relevant information sources such as data workshop reports.

Provide presentation files (PowerPoints) in advance of workshop sessions and include file name and page number on every slide to facilitate referencing of slides in discussions. This can also include past assessment reports (https://www.nefsc.noaa.gov/saw/reviews_report_options.php).

7. ***Consider whether the stock assessment constitutes the best scientific information available using the following criteria as appropriate: relevance, inclusiveness, objectivity, transparency, timeliness, verification, validation, and peer review of fishery management information.***

Appropriate: The Assessment model SS3 is an appropriate tool to provide the outputs necessary to determine catch levels.

Relevance: The SS3 assessment tool is highly relevant for analysis of the available data in this fishery.

Inclusiveness: At the review meeting, all stakeholders were invited and all participants were invited to comment.

Objectivity: The model outputs are based on the best available data inputs, and the shortcomings of these inputs are recognized and acknowledged.

Transparency: The assessment model was subjected to various adjustments and the differences in the outputs were candidly explained.

Timeliness. The data inputs and SS3 input files were supplied about two weeks before the meeting. The Assessment model outputs were supplied two days before, which is satisfactory.

Verification: The current data was analyzed in SS3 and also ASAP, the model used in the previous SEDAR 27a assessment.

Validation: The assessment outputs were compared for the chosen model, SS3, and ASAP. Although each model had its strengths, the continued use of SS3 is considered satisfactory provided ASAP continues to be used for comparison of outputs.

Peer Review: the data sources used were reviewed at a Data Workshop and the outputs of the assessment model were reviewed at an Assessment Workshop.

8. ***Provide suggestions on key improvements in data or modeling approaches that should be considered when scheduling the next assessment.***

Recommendations for future assessment process improvements (note similar comments made in other TORs):

Additional information is needed on stock structure and movements within the unit of the assessment (Florida Keys and Southeast Florida) and outside of the assessment area – North of Florida (Georgia – North Carolina waters) and west of Florida (Mississippi to Texas). Otolith microchemistry (stable isotope analysis) analysis could be used to inform on the origin of the fish and their potential movements.

Explore potential sources of data on spawning areas, larval distribution, and transport to justify current definition of assessment unit.

Complete age validation of otolith based age readings to increase confidence in the age information.

Complete more detailed exploration of various data components weighting, including fitting the model separately to size and age composition data and compare the quality of fit and model outcomes. This should shed light on the tension between the age and length data.

For the likelihood profiling graph only the results that are converged. When the likelihood profile shows no change across a broad parameter space, that parameter should not be estimated [or they need a prior on it]. Make sure that the likelihood profile is evaluated with sufficient precision.

Continue using ASAP as an alternative assessment model to contrast and compare with SS3. Identify strength and weaknesses of each model performance and check for the consistency or lack thereof between two models.

9. ***Prepare a Peer Review Summary summarizing the Panel's evaluation of the stock assessment and addressing each Term of Reference. Develop a list of tasks to be completed following the workshop. Complete and submit the Peer Review Summary accordance with the project guidelines***.

   This report constitutes the Peer Review Summary. No further tasks are required.

SEDAR

Southeast Data, Assessment, and Review

SEDAR 64

Southeastern US Yellowtail Snapper

Addendum

March 2020

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Table of Contents

1 Introduction

The SEDAR 64 Yellowtail Snapper Assessment Review Workshop (RW) took place February 24 – 26, 2020 in St. Petersburg, Florida. During the RW, the SEDAR 64 Review Panel (RP) revisited prior discussions and decisions made during the Data Workshop and Assessment Webinars and requested additional analyses from the analytical team. Below is a summary of those requests as they pertain to the various portions of the assessment process.

2 Data Review Sensitivities

Yellowtail Snapper are distributed widely across a geographic range spanning from Brazil, throughout the Caribbean and Gulf of Mexico, and along the southeastern Atlantic U.S. coastline. In U.S. waters (i.e. the northern extent of its total range), the stock is predominantly centered around the Florida Keys and southeastern Florida. For management purposes, this stock is treated as a single, closed stock and the focus of this assessment was on providing management advice solely for the population residing in Florida.

2.1 Growth

Yellowtail Snapper in southeastern U.S. waters are fast growing, long-lived, and can display flexible life-history depending on environmental conditions. Their plasticity in life-history can be problematic when identifying appropriate data for model use or when informing life-history parameters. During the assessment process, both growth rates and longevity were found to be highly variable across regions inside and outside of Florida. The tension between the length composition and conditional length-at-age data, as exhibited within the assessment model, became a point of interest to the RP and was further explored.

2.1.1 Regional growth

The RP was interested in the regional effects on Yellowtail Snapper growth and requested to have a size-truncated von-Bertalanffy growth model run on the age-at-length data solely from the Florida Keys. They wanted to compare these results with those produced by the external size-truncated growth model as reported in the Data Workshop Report and updated in the Assessment Workshop Report and with the growth estimated from the SS Base Model.

Results

Length-at-age data from 27,883 fish collected in the Florida Keys between 1980 – 2017, ranging in size from 12 – 59 cm fork length, and fractional ages 0.83 – 18.7 years were used to estimate growth. The estimated von-Bertalanffy growth parameters were:

Parameter	Florida Keys Data	All Florida Data	SS Base Model
L_{inf}	46.3 cm fork length	42.3 cm fork length	36.2 cm fork length
k	0.13 yr^{-1}	0.21 yr^{-1}	0.34 yr^{-1}
$t0$	-3.10 yr	-1.64 yr	-
CV	0.18	0.18	0.23; 0.19*

*SS estimates two CVs: one for fish <= the reference age for first size-at-age (*CVyoung*) and another for fish >= the reference age for L_{inf} (*CVold*)

The growth model for the Florida Keys population (**Figure 5.1**) estimated fish that grow slower (i.e. a lower k parameter) and get larger (i.e. a larger L_{inf}) when compared to the estimated growth of the population of Yellowtail Snapper within Florida waters as a whole (**Figure 5.1**). Diagnostic plots for the Florida Keys growth model are presented in **Figure 5.2**. The tension within the data was further exhibited when comparing these results to the growth parameters estimated by the SEDAR 64 Base Model, which up-weighted the length composition data and down-weighted the age data via the Francis re-weighting procedure. The SEDAR 64 Base Model estimated that Yellowtail Snapper in Florida waters grow faster ($k = 0.34$ yr^{-1}) and reach smaller asymptotic sizes ($L_{inf} = 36.2$ cm fork length). These differences were noted by the RP as contributing to the uncertainties which limit the overall understanding of Yellowtail Snapper dynamics and their potential productivity.

2.1.2 Fishery-independent growth

As discussed in Section 2.2.1 of the Assessment Process Report, length-at-age data used to model growth of Yellowtail Snapper come primarily from fishery-dependent sources (96% total: 46% commercial sources; 50% recreational sources) and were collected before and after minimum size limits were established by managers. Length-at-age data can be biased when primarily originating from fishery-dependent sources and the analytical team sought to correct for this by using a size-truncated von Bertalanffy growth model. The RP requested to see an additional growth analysis to help address this bias by using the fishery-independent length-at-age data along with the fishery-dependent length-at-age data collected when no minimum size regulation was in effect.

Results

Length-at-age data from 2,807 fish collected throughout Florida between 1980 – 2015, ranging in size from 10 – 57 cm fork length, and fractional ages 0.42 – 17.2 years were used to estimate growth. These fish were comprised of 1,888 fish collected from fishery-independent sources and 919 fish collected from fishery-dependent sources not subjugated to a minimum size regulation (**Figure 5.3**). Forty-six percent of the data were collected in the Florida Keys while 44% of the data were collected from southeast Florida. The estimated von-Bertalanffy growth parameters were:

Parameter	FI Data	All Florida Data	SS Base Model
L_{inf}	39.5 cm fork length	42.3 cm fork length	36.2 cm fork length
k	0.40 yr^{-1}	0.21 yr^{-1}	0.34 yr^{-1}
$t0$	-0.51 yr	-1.64 yr	-
CV	0.16	0.18	0.23; 0.19*

*SS estimates two CVs: one for fish <= the reference age for first size-at-age (*CVyoung*) and another for fish >= the reference age for L_{inf} (*CVold*)

The growth model which used data primarily from fishery-independent sources estimated growth of Yellowtail Snapper to be much faster with fish reaching a smaller asymptotic size compared to the external growth model using all Florida data (**Figure 5.4**). These results were also closer to the growth parameters estimated by the SS Base Model. Diagnostic plots for the growth model primarily using fishery-independent data are presented in **Figure 5.5**.

Based on these results and those from the above subsection, it appears fish from the Florida Keys grow slower and reach larger asymptotic sizes. However, when additional data from other areas of Florida are introduced (most prominently from southeast Florida), fish are modeled to grow faster and reach smaller asymptotic sizes. These differences continued to cast uncertainty in understanding Yellowtail Snapper life history dynamics.

2.2 Maximum Age

The RP requested a sensitivity run assuming the maximum age of Yellowtail Snapper used in the $\text{Hoenig}_{\text{all taxa}}$ (1983) equation was 28 years (i.e. the maximum age observed outside of Florida). The motivation was to ascertain the sensitivity of model results to assumptions of natural mortality.

Results

The instantaneous natural mortality estimate using the $\text{Hoenig}_{\text{all taxa}}$ (1983) equation and t_{max} = 28 yr was 0.160 yr^{-1}. Following Lorenzen (2005), age-specific natural mortality rates were derived using this estimate as the target-M (scaled between ages 3 – 20) and with growth parameters estimated from the external size-truncated von Bertalanffy growth model using Florida-only data. Estimated age-specific natural mortality rates ranged from 0.385 yr^{-1} to 0.147 yr^{-1} for ages 0 to 20 years.

The overall log-likelihood value for this sensitivity run was slightly higher than the Base Model and the log-likelihood component for the length composition increased the most; visually, however, the fits to the length composition data for this sensitivity run were nearly identical to the fits for the Base Model. The model was sensitive to lower estimates of natural mortality as illustrated by differing magnitudes of spawning stock biomass, fishing mortality rates, and recruitment; however, the trends in these quantities were similar to the Base Model (**Figure 5.6**). Unfished recruitment (**Table 4.1**) and recruitment by year (**Figure 5.6**) were estimated lower than the Base Model. Since estimates of natural mortality were lower compared to the Base Model, the model estimated an increased fishing mortality rate by year (**Figure 5.6**) which decreased the annual spawning stock biomass estimates (**Figure 5.6**). The estimated *steepness* parameter and the growth parameters were similar to those in the Base Model (**Table 4.1**).

Reference points were sensitive to the influence of natural mortality. Estimates of spawning stock biomass as a function of age-4 fishing mortality rates were similar between this run and the Base Model (**Figure 5.7**); however, the estimated unfished recruitment and recruitment were much lower (**Table 4.1**; **Figure 5.7**). Therefore, the spawning potential ratio (SPR) was significantly different between the two model runs and affected the values associated with the 30% reference point (**Table 4.1; Figure 5.7**). $F_{30\%SPR}$ of this sensitivity run was estimated lower at 0.29 (compared to 0.44 in the Base Model) and SSB $_{F30\%SPR}$ was estimated higher at 2,519 mt (compared to 1,904 mt in the Base Model). According to this sensitivity run, the stock would have been undergoing overfishing for most of the timeseries and would have been considered overfished in 2005 and prior to 2002 (**Figure 5.6**).

3 Base Model Configuration Sensitivities

3.1 Francis Re-weighting

3.1.1 No Francis re-weighting

The RP requested a sensitivity run that did not include weighting the composition data according to Francis (2011). This run thus used the original effective sample sizes that were defined as the square root of the number of trips with measured fish for the length composition data or the square root of the number of fish sampled for the conditional-age-at-length data. The goal of this analysis was to determine the sensitivity of model results to data weighting techniques.

Results

The log-likelihood component pertaining to conditional age at length data comprised most of the overall log-likelihood value for this sensitivity run (**Table 4.2**). The fits to the length data for this sensitivity run were inferior to the Base Model, as many of the peaks were underestimated and tails were overestimated (**Figure 5.8**), while fits to the age data were very similar overall. Unfished recruitment (**Table 4.2**) and recruits per year (**Figure 5.9**) aligned closely to that estimated by the Base Model. Unfished spawning stock biomass (**Table 4.2**) and spawning stock biomass estimates per year (**Figure 5.9**) were estimated to be higher than the Base Model. The estimates of steepness and the von Bertalanffy growth parameter k were slightly lower, while L_{inf} was higher compared to the Base Model (**Table 4.2**). For this sensitivity run, estimated growth parameters aligned closely with estimates produced by the external size-truncated growth model.

Fishing mortality rates and the MFMT were less than those estimated by the Base Model (**Table 4.2; Figure 5.9**), and spawning stock biomass and MSST estimates were higher (**Table 4.2; Figure 5.9**). This sensitivity run did not result in a change in stock status designation.

3.1.2 Francis weights for each Jack-knife run

The RP requested a comparison of Francis (2011) weights for each length and conditional-age-at-length component among sensitivity runs that iteratively removed one index at a time. There was concern that since the reweighting procedure was not done for each of these sensitivity runs, the results of the jack-knife analysis may reflect this difference more so than the removal of an index.

Results

Table 4.3 presents calculated Francis (2011) weights for each length and conditional age-at-length component. As shown, weights did not differ substantially among jack-knife sensitivity runs, suggesting that the results of the jack-knife analysis are reflecting the removal of an index, rather than differences in data weighting.

3.2 Ages 3 – 8 Fishing Mortality Rates

The SEDAR 64 Base Model, much like the Base Models of the previous assessments, reported the fishing mortality rate for a single age across time. This age is meant to represent the maximum fishing mortality rate for a given fleet or year. Reporting on a single age, as opposed to multiple ages, allows for a comparison of fishing mortality rates across time and reduces the variability around this estimate caused by varying levels of fishing mortality on different ages over different years. The MRIP fleet exerted the highest amount of fishing mortality on age-2 fish, the headboat fleet exerted the highest amount of fishing mortality on age-4 fish, while fishing mortality rates produced by the commercial fleet begin to reach their highest level by age-6 (**Figure 5.10**). The MRIP and commercial fleets exerted the greatest amount of fishing mortality on Yellowtail Snapper; therefore, based on their respective estimated selectivities, this assessment used the midpoint of the relative maximum selectivities, i.e., age-4, as the reference fishing mortality age. But since the age that experiences the highest degree of fishing mortality varies for each fleet, the RP requested a comparison between age-4 fishing mortality rates and fishing mortality rates reported across ages 3 – 8.

Results

Fishing mortality rates reported for ages 3 – 8 were overall slightly lower compared to the Base Model that reported fishing mortality rates for age-4 fish, however, they maintained similar trends (**Figure 5.11**). This was also accompanied by a decrease in $F_{30\%SPR}$ (the MFMT). Since the level of fishing mortality rate varied across ages and years for a given fleet, the differences between the fishing mortality rates estimated by the two model runs were not directly proportional. Some years experienced greater differences in the fishing mortality rate than others when compared to the SEDAR 64 Base Model. This sensitivity run did not result in any change to the status of the stock.

3.3 MRIP Fleet Selectivity: Flat-topped

The RP requested a sensitivity run assuming flat top (single logistic) selectivity for the MRIP fleet. The motivation was to simplify the model by reducing the number of highly uncertain parameters. In addition, there were similar ranges of lengths and ages observed from aged

Yellowtail Snapper collected from the MRIP and commercial fleet prior to the implementation of minimum size limits.

Results

The results of this run indicated a higher log-likelihood, even with fewer parameters (**Table 4.4**). Components of the log-likelihood were slightly lower (i.e. improved) for the indices but higher for the length and age compositions. Estimates of steepness, unfished recruitment, and the von Bertalanffy growth parameter *k* were similar to the Base Model. However, the estimates of spawning stock biomass and L_{inf} were lower (5,021 metric tons and 30 cm fork length, respectively) compared to the Base Model (7,446 metric tons and 36 cm; **Table 4.4**). The overall fits to the length compositions were very similar, but the peak of the MRIP discarded lengths and lengths associated with the MRIP CPUE index were underestimated (**Figure 5.12**). Estimates of fishing mortality rates and MFMT were slightly higher, while estimates of spawning stock biomass and MSST were notably lower compared the Base Model (**Figure 5.13**). This sensitivity run did not result in a change in stock status.

3.4 Fixed Steepness

The stock-recruitment relationship estimated by the SEDAR 64 Base Model exhibited a wide range of age-0 recruitment for a limited range of spawning stock biomass (Figure 3.9.39 in Section III of the Assessment Report). When the *steepness* parameter was profiled (Figure 3.9.46 in Section III of the Assessment Report), there were minor differences in the total log-likelihood for values >=0.7. The RP discussed whether the stock-recruitment relationship estimated by the Base Model was truly informative and whether *steepness* should be estimated. Additional sensitivity runs were requested which fixed the *steepness* parameter at 0.7, 0.9, and 0.99, given that the Base Model estimated *steepness* at 0.808. The RP was further interested in how these differences would affect optimum yield (OY) and other stock status determination criteria.

Results

Differences in the total log-likelihood between the SEDAR 64 Base Model and the model sensitivity runs with fixed *steepness* values stemmed primarily from poorer fits to the discard, length composition, or age composition data components (**Table 4.5**). However, model estimates of fishing mortality, recruitment, and spawning stock biomass over time were largely unaffected when compared to the SEDAR 64 Base Model, except for when *steepness* was fixed at 0.99 (**Figure 5.14**). When fixed at 0.99, the model run estimated similar numbers of age-0 recruitment but with a much smaller fish (L_{inf} was approximately 7 cm fork length smaller) resulting in decreased spawning stock biomass. In addition, the MFMT increased, though the trend and magnitude of fishing mortality remained similar. The status of the stock remained unchanged with similar amounts of OY estimated between the Base Model and the fixed *steepness* sensitivity runs (**Table 4.6**).

4 Tables

Table 4.1. A comparison of log-likelihood values and estimated and derived parameters for a sensitivity run assuming lower natural mortality using a maximum age of 28 yr.

Parameter	**Base**	**Max Age = 28**
TOTAL_like	744.447	805.53
Survey_like	-63.816	-65.19
Length_comp_like	367.901	428.27
Age_comp_like	321.183	330.50
Unfished Recruits (millions)	19.86	12.42
SR_LN(R0)	9.90	9.43
Unfished SSB (metric tons)	7,446	9,263
SR_BH_steep	0.81	0.87
L_at_Amax_Fem_GP_1 (cm)	36.23	35.85
VonBert_K_Fem_GP_1 (yr^{-1})	0.34	0.36
MFMT (yr^{-1})	0.44	0.29
MSST (metric tons)	1,428	1,889

Table 4.2. A comparison of log-likelihood values and estimated and derived parameters for a sensitivity run that did not weight composition data according to Francis (2011).

Parameter	**Base**	**No Francis Weighting**
TOTAL_like	744.447	1813.32
Survey_like	-63.816	-64.65
Length_comp_like	367.901	235.09
Age_comp_like	321.183	1490.33
Unfished Recruits (millions)	19.86	21.21
SR_LN(R0)	9.90	9.96
Unfished SSB (metric tons)	7,446	10,467
SR_BH_steep	0.81	0.77
L_at_Amax_Fem_GP_1 (cm)	36.23	43.94
VonBert_K_Fem_GP_1 (yr^{-1})	0.34	0.25
MFMT (yr^{-1})	0.44	0.34
MSST (metric tons)	1,428	1,921

Table 4.3. A comparison of Francis (2011) weights calculated for each jack-knife analysis run.

Weighting Type	Fleet/Survey	Base Run	Remove MRIP CPUE	Remove Comm CPUE	Remove RVC Adult	Remove RVC Juvenile
Length Composition	**Comm**	4.36	5.56	4.02	4.27	4.41
	HB	1.03	1.00	1.05	1.01	1.05
	MRIP	1.50	1.32	1.51	1.45	1.53
	RVC Adult	0.48	0.52	0.49	-	0.44
	RVC Juvenile	0.92	1.00	1.05	0.98	-
	MRIP CPUE	6.73	-	6.67	6.74	7.89
Conditional age-at-length	**Comm**	0.18	0.17	0.17	0.17	0.17
	HB	0.30	0.24	0.29	0.27	0.30
	MRIP	0.14	0.14	0.13	0.14	0.15
	FI	0.16	0.11	0.10	0.10	0.17

Table 4.4. A comparison of log-likelihood values and estimated and derived parameters for a sensitivity run assuming flat top (single logistic) selectivity for the MRIP fleet.

Parameter	Base	MRIP Flat Top
TOTAL_like	744.447	904.366
Survey_like	-63.816	-67.488
Length_comp_like	367.901	380.105
Age_comp_like	321.183	458.76
Unfished Recruits (millions)	19.86	19.37
SR_LN(R0)	9.90	9.87
Unfished SSB (metric tons)	7,446	5,021
SR_BH_steep	0.81	0.83
L_at_Amax_Fem_GP_1 (cm)	36.23	30.14
VonBert_K_Fem_GP_1(yr^{-1})	0.34	0.33
MFMT (yr^{-1})	0.44	0.51
MSST (metric tons)	1,428	990

Table 4.5. A comparison of log-likelihood values and estimated and derived parameters for sensitivity runs when the *steepness* parameter was fixed at 0.7, 0.9, and 0.99.

		Steepness values		
Parameter	**Base (0.81)**	**0.70**	**0.90**	**0.99**
TOTAL	744.447	815.62	750.564	801.632
Survey	-63.8155	-64.2411	-63.7359	-65.5878
Discard	140.735	139.986	143.33	160.518
Length_comp	367.901	430.278	370.08	381.517
Age_comp	321.183	331.126	321.757	345.357
Recruitment	-21.7264	-21.7317	-21.0066	-20.2096
Unfished Recruits (millions)	19.86	22.028	18.553	17.857
SR_LN(R0)	9.90	10.00	9.83	9.79
Unfished SSB (metric tons)	7,446	8,294	6,904	4,359
L_at_Amax_Fem_GP_1 (cm)	36.23	36.2	36.2	28.9
VonBert_K_Fem_GP_1 (yr^{-1})	0.34	0.34	0.33	0.32

Table 4.6. The stock status determination criteria for southeastern U.S. Yellowtail Snapper based on model results when the *steepness* parameter is fixed at values 0.7, 0.9, and 0.99.

South Atlantic and Gulf of Mexico Fishery Management Councils					
Criteria	**Definition**	**h = 0.70**	**Base (h = 0.81)**	**h = 0.90**	**h = 0.99**
MSST (Minimum Stock Size Threshold)	$0.75*SSB_{F30\%SPR}$	1,344 mt	1,428 mt	1,450 mt	975 mt
$SSB_{F30\%SPR}$	The estimated spawning stock biomass associated with F at 30% SPR	1,792 mt	1,904 mt	1,933 mt	1,300 mt
$SSB_{current}$	The geometric mean of SSB for 2015 - 2017	3,286 mt	3,223 mt	3,113 mt	2,141 mt
MFMT (Maximum Fishing Mortality Threshold)	$F_{30\% SPR}$	0.439 yr^{-1}	0.438 yr^{-1}	0.437 yr^{-1}	0.512 yr^{-1}
$F_{30\%SPR}$	The fishing mortality rate associated with 30% SPR	0.439 yr^{-1}	0.438 yr^{-1}	0.437 yr^{-1}	0.512yr^{-1}
$F_{current}$	The geometric mean of F on age-4 fish for 2015 - 2017	0.296 yr^{-1}	0.295 yr^{-1}	0.310 yr^{-1}	0.326 yr^{-1}
OY (Optimum Yield)	Yield at F_{OY}	1,505 mt	1,497 mt	1,473 mt	1,472 mt
F_{OY} (Fishing Mortality Rate at OY)	$F_{40\% SPR}$	0.271 yr^{-1}	0.271 yr^{-1}	0.269 yr^{-1}	0.297 yr^{-1}

5 Figures

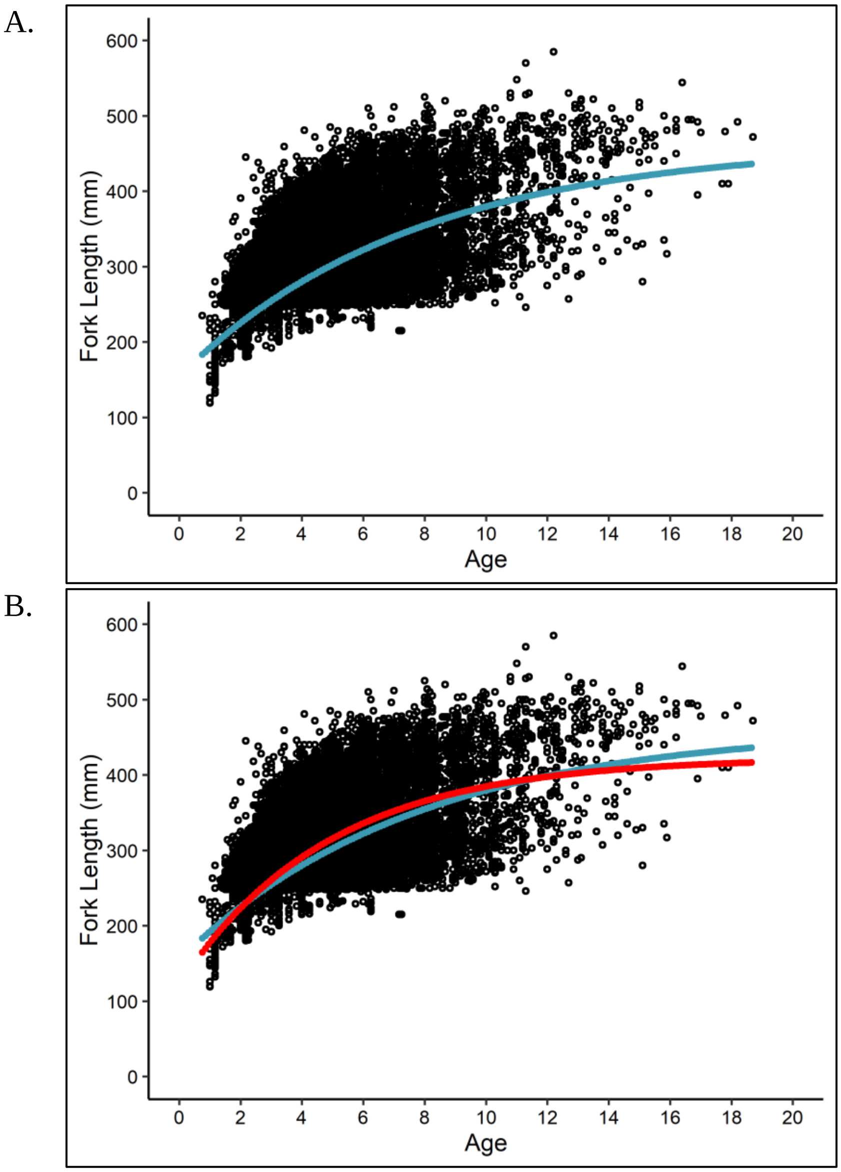

Figure 5.1. Yellowtail Snapper (1980 – 2017) observed ages (years) and fork lengths (mm). The upper panel (A) shows size-truncated length-at-age data collected from the Florida Keys (n=27,883 otoliths) with a predicted growth curve (blue line) using a size-truncated von Bertalanffy growth model. The lower panel (B) includes the external predicted growth curve (red line) which used a size-truncated growth model fit to all of Florida length-at-age data as reported in the Assessment Workshop Report.

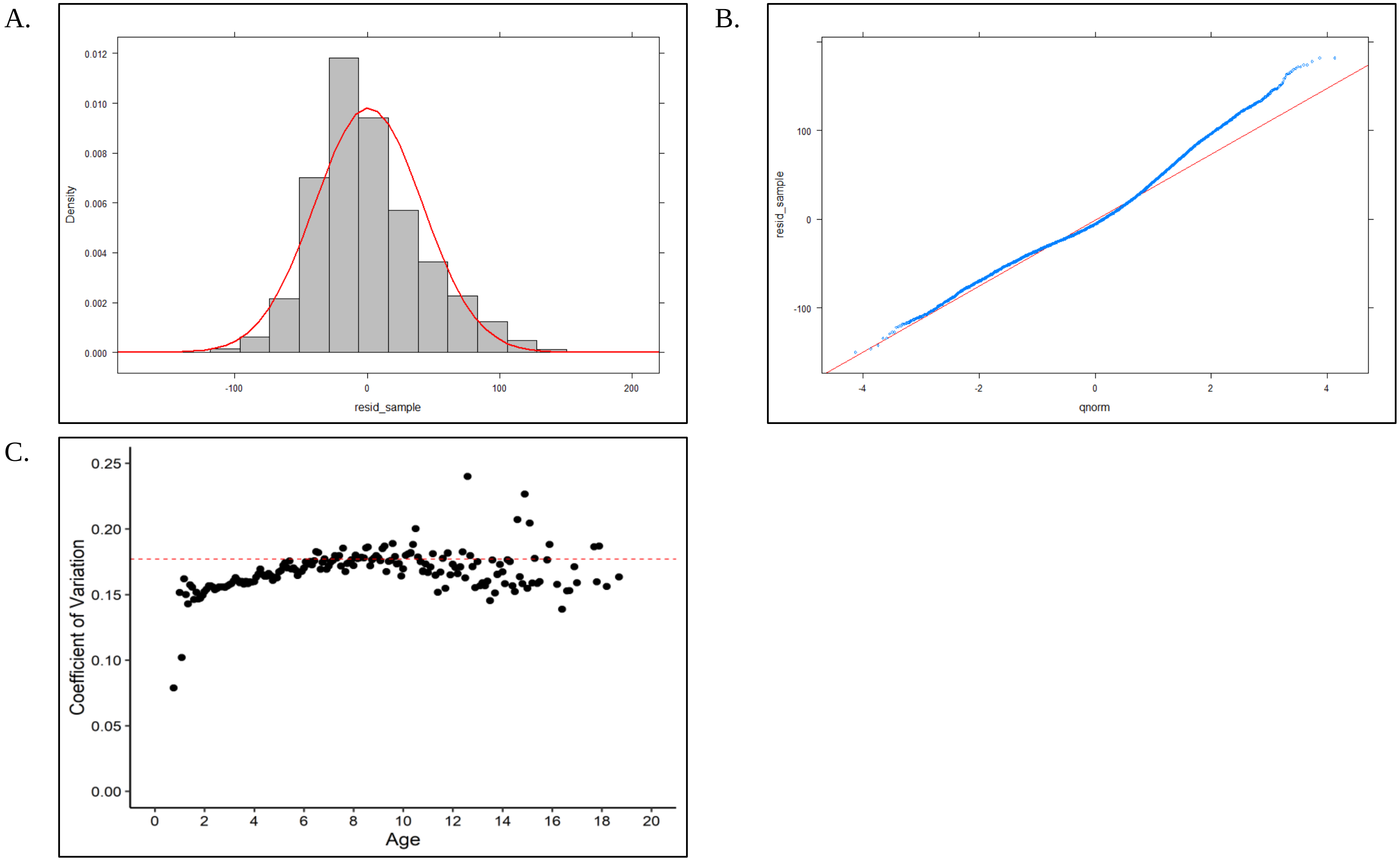

Figure 5.2. Diagnostic plots for the Yellowtail Snapper size-truncated von Bertalanffy growth model using length-at-age data only from the Florida Keys. Diagnostic plots are (a) standardized residual density distribution and (b) standardized residual normal probability plot (quantiles vs standardized residuals). Panel (c) is the coefficient of variation by monthly age.

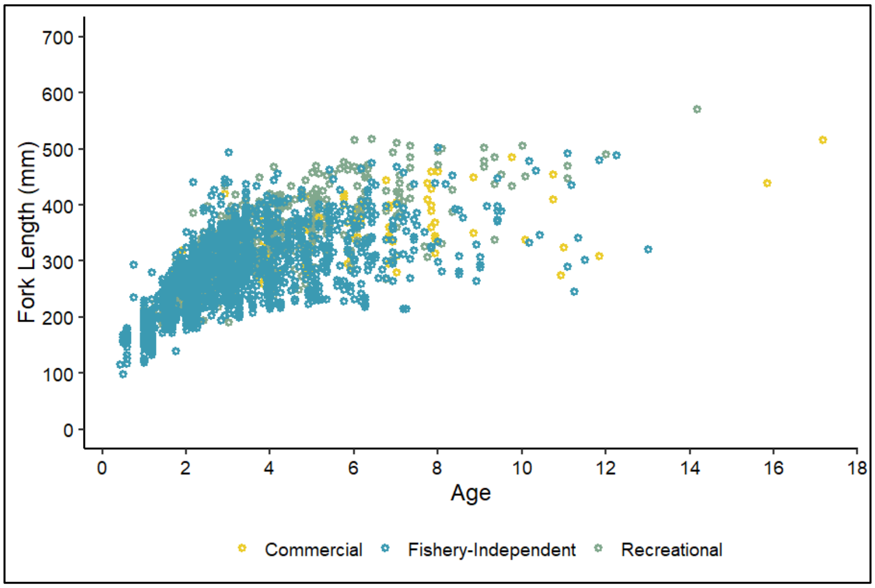

Figure 5.3. Yellowtail Snapper (1980 – 2015) observed ages (years) and fork lengths (mm) by fishery sector. Length-at-age data were collected in Florida from fishery-independent sources as well as from fishery-dependent sources not subjugated to a minimum size regulation (n=2,807 otoliths)

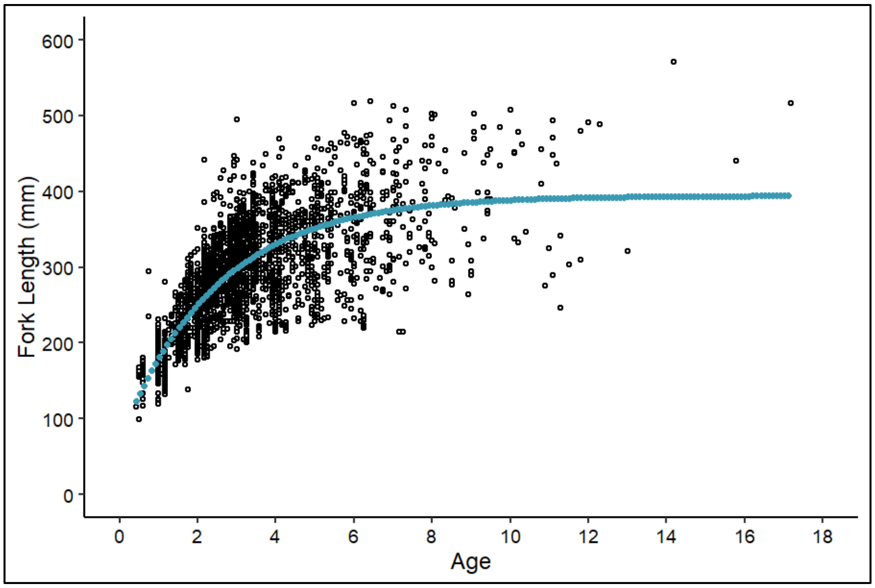

Figure 5.4. Yellowtail Snapper (1980 – 2015) observed ages (years) and fork lengths (mm) from length-at-age data collected in Florida from fishery-independent sources and fishery-dependent sources not subjugated to a minimum size regulation (n=2,807 otoliths; black dots). The blue dots are the predicted growth curve using a von Bertalanffy growth model.

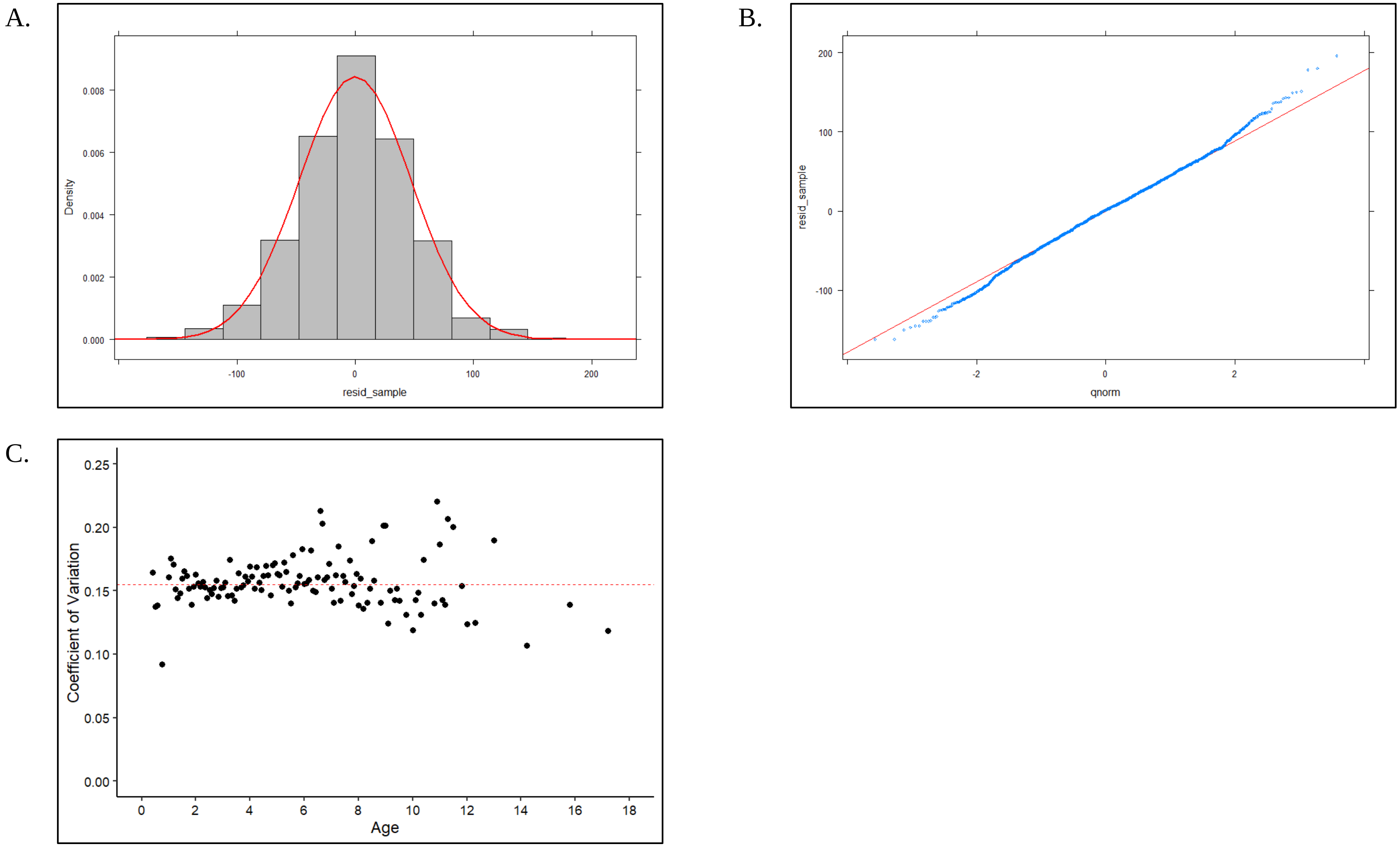

Figure 5.5. Diagnostic plots for the Yellowtail Snapper von Bertalanffy growth model using length-at-age data collected in Florida from fishery-independent sources and fishery-dependent sources not subjugated to a minimum size regulation. Diagnostic plots are (a) standardized residual density distribution and (b) standardized residual normal probability plot (quantiles vs standardized residuals). Panel (c) is the coefficient of variation by monthly age.

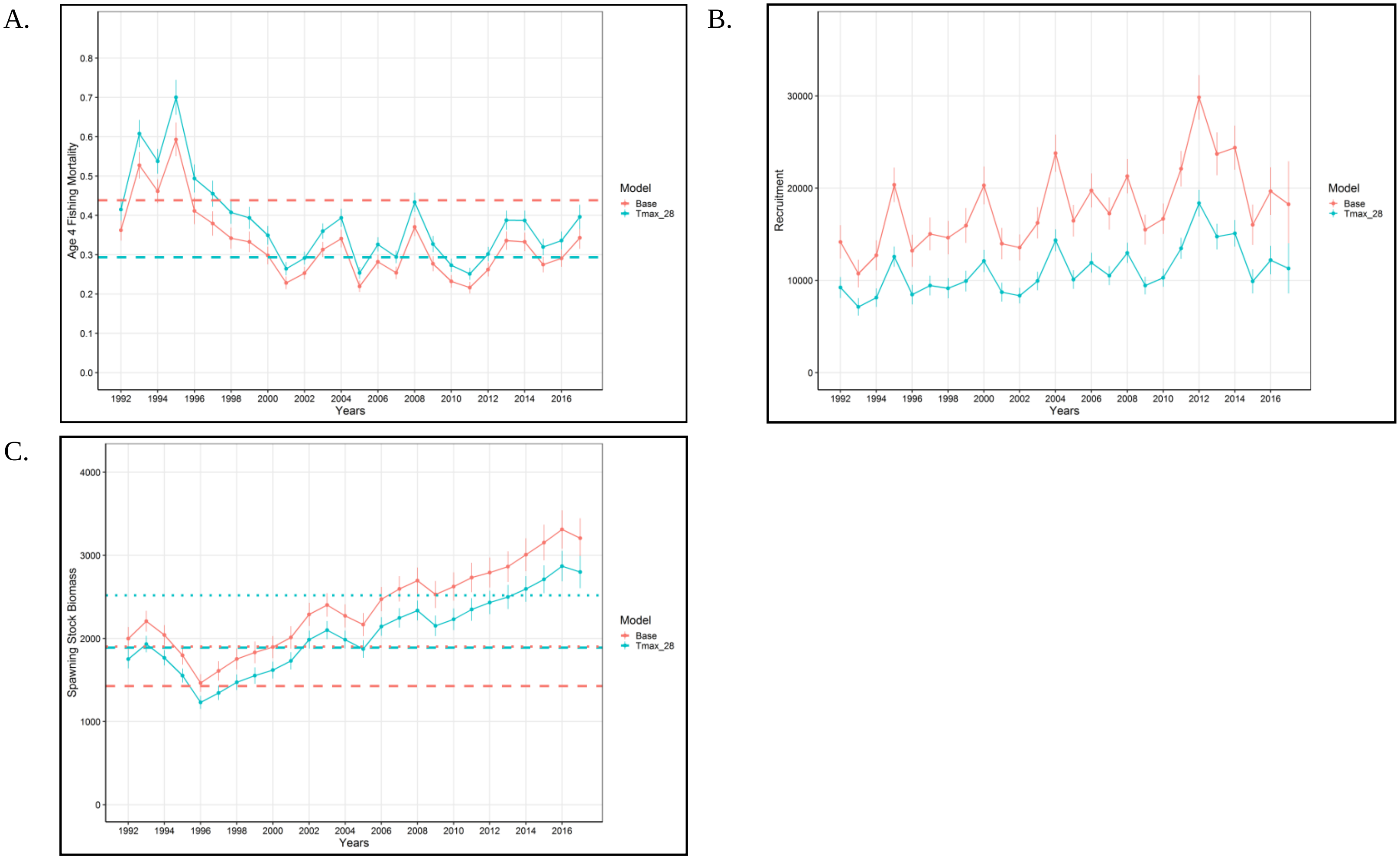

Figure 5.6. Results of a sensitivity run that assumed lower natural mortality and a maximum age (t_{max}) of 28 years. Age-4 fishing mortality (a), recruitment (b), and spawning stock biomass (c) are shown relative to MSST (long dashed line), $SSB_{F30\%SPR}$ (short dashed line), and MFMT (long dashed line).

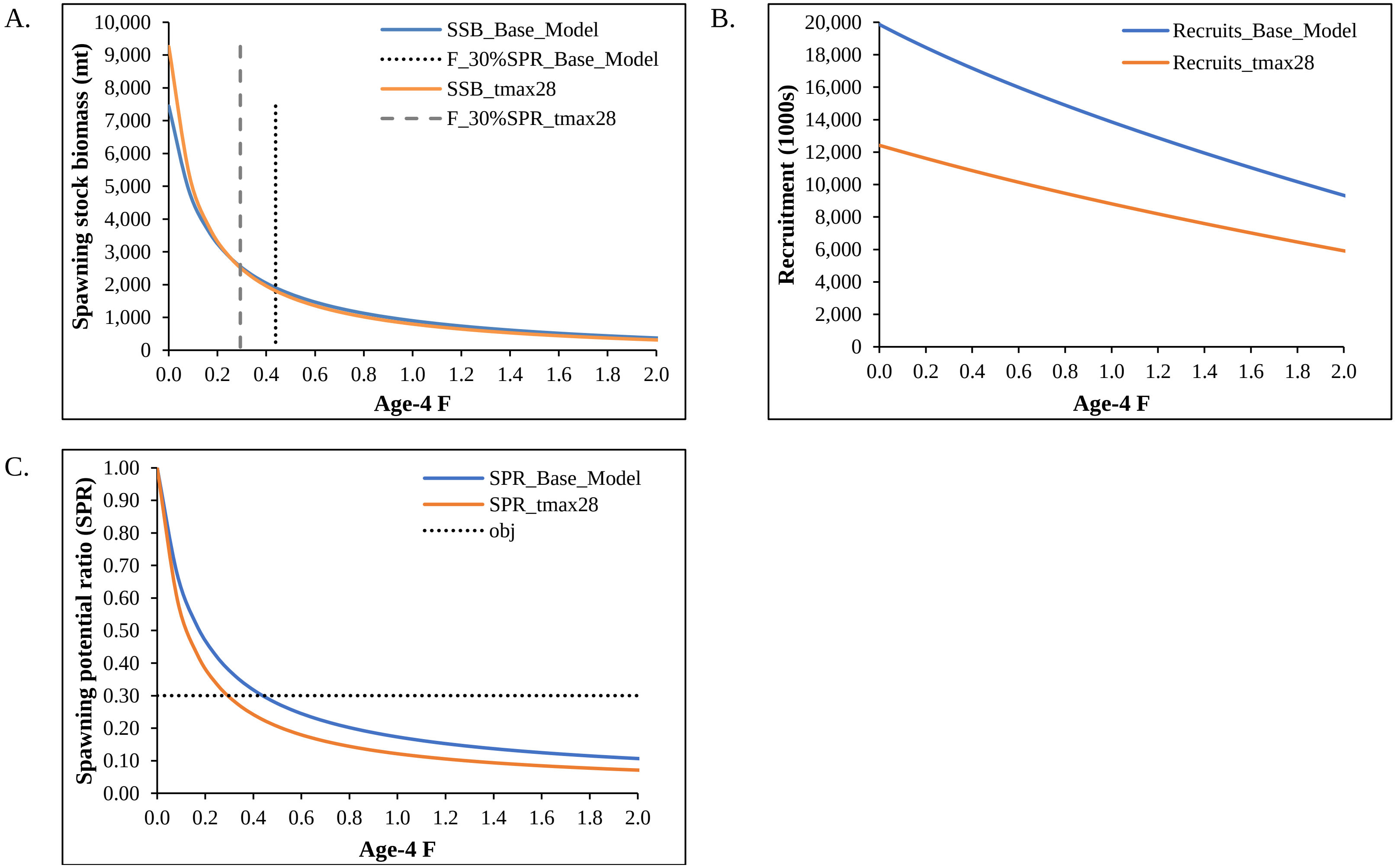

Figure 5.7. Comparative results of the SEDAR 64 Base Model and a sensitivity run that assumed lower natural mortality and a maximum age (t_{max}) of 28 years. The spawning stock biomass and respective $F_{30\%SPR}$ reference points (a), recruitment (b), and spawning potential ratio with the 30% target objective (c) are shown as a function of age-4 fishing mortality.

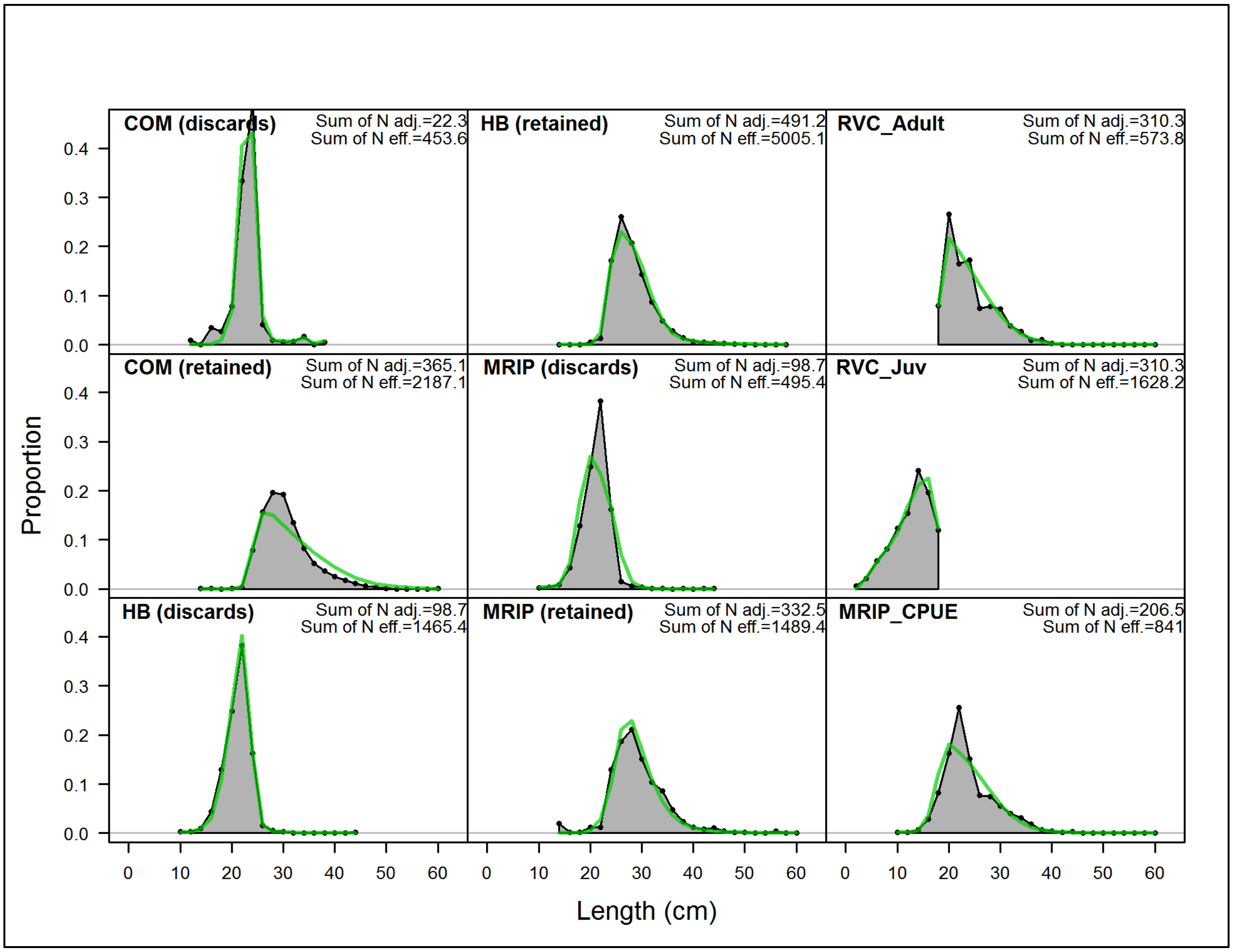

Figure 5.8. Results of a sensitivity run that did not apply Francis (2011) weights to composition data. Model fits to the length composition of retained and discarded catch aggregated across years within a given fleet or survey for southeastern U.S. Yellowtail Snapper. Green lines represent predicted length compositions, while grey shaded regions represent observed length compositions. The input effective sample size, N adj., and the calculated effective sample size used in the McAllister-Iannelli tuning method, N eff., are provided in the upper right corner of each panel.

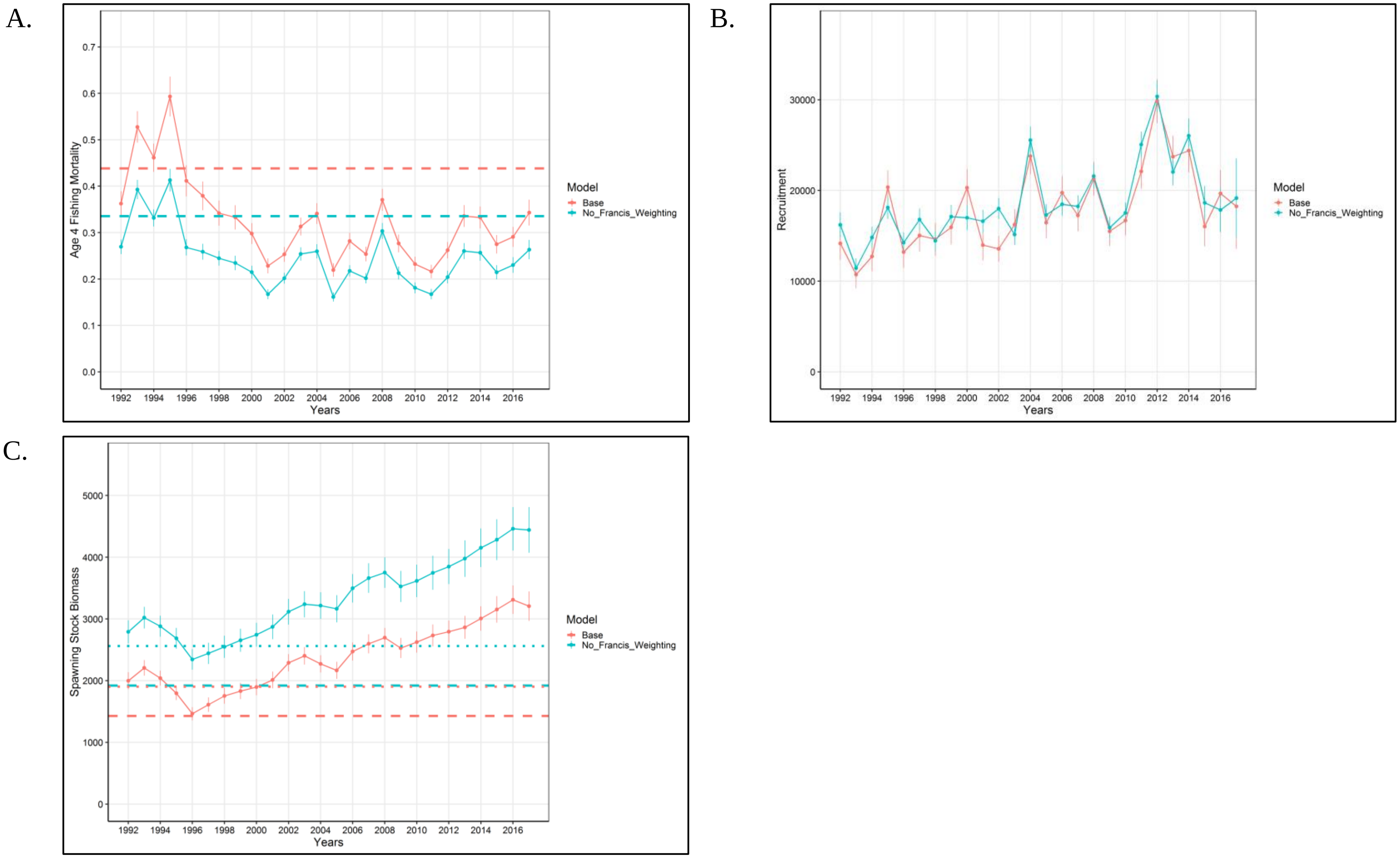

Figure 5.9. Results of a sensitivity run that did not apply Francis (2011) weights to composition data. Age-4 fishing mortality (a), recruitment (b), and spawning stock biomass (c) are shown relative to MSST (long dashed line), $SSB_{F30\%SPR}$ (short dashed line), and MFMT (long dashed line).

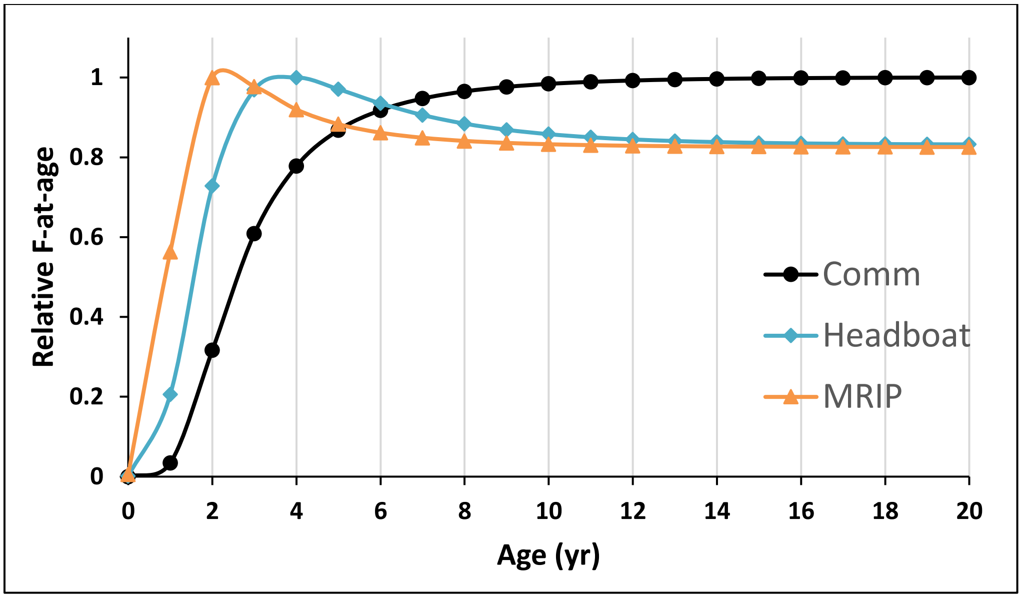

Figure 5.10. Relative fishing mortality rates per fleet and by age for Yellowtail Snapper. Fishing mortality rates for each fleet were scaled so that the age experiencing the highest rate was equal to 1.

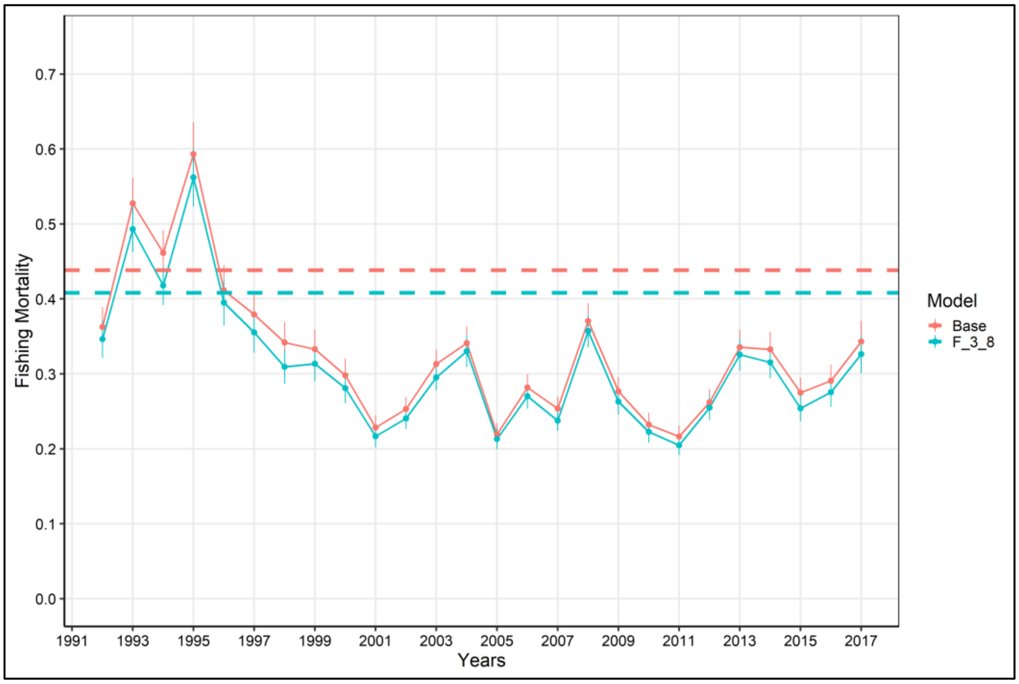

Figure 5.11. A comparison of fishing mortality rates by year between the SEDAR 64 Base Model, which reported fishing mortality rates on age-4 fish (red line), and a sensitivity run which reported fishing mortality rates on fish ages 3 – 8 (blue line). Fishing mortality rates by year are shown relative to their respectively calculated MFMT (long dashed line).

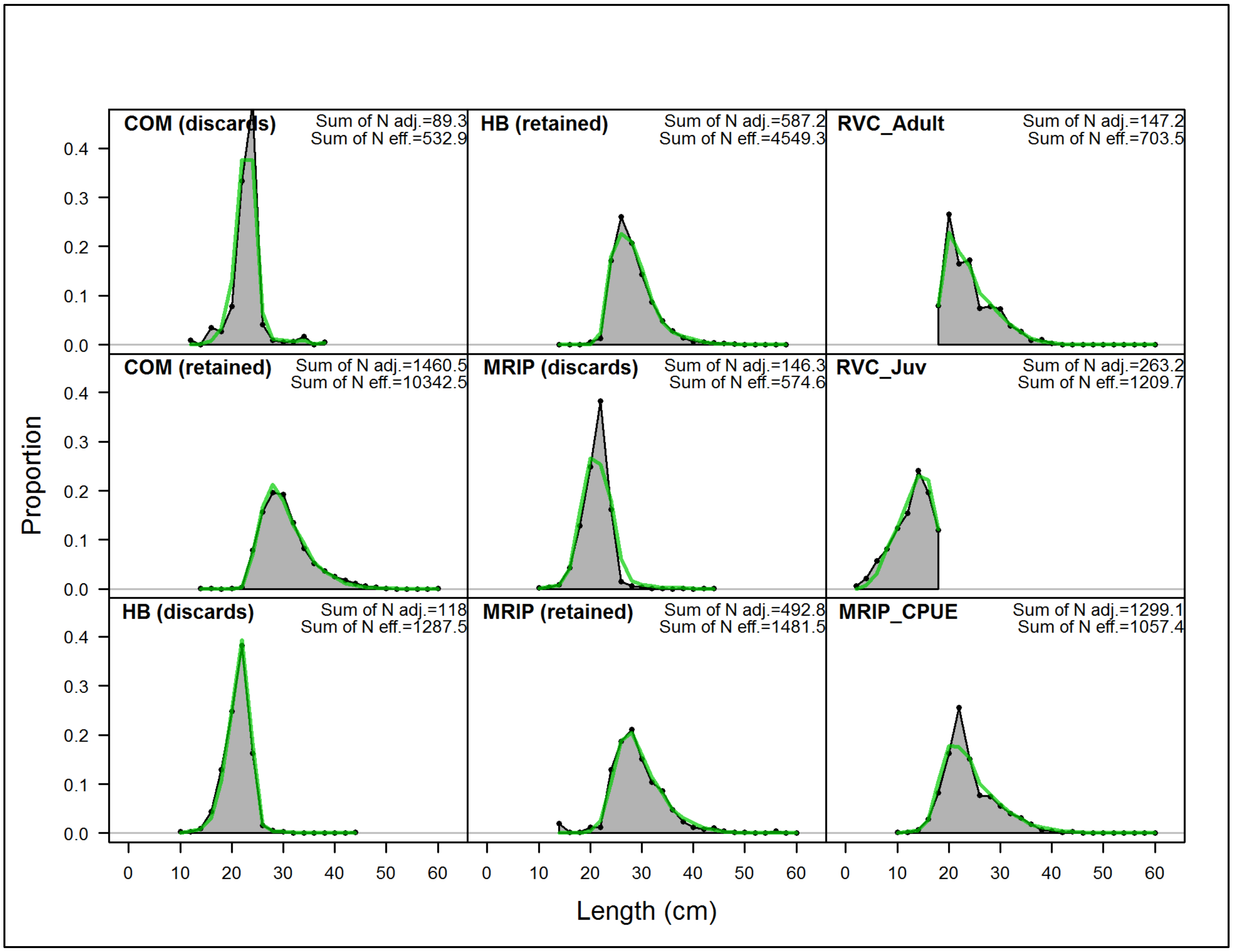

Figure 5.12. Results of a sensitivity run that assumed flat top (single logistic) selectivity for the MRIP fleet. Model fits to the length composition of retained and discarded catch aggregated across years within a given fleet or survey for southeastern U.S. Yellowtail Snapper. Green lines represent predicted length compositions, while grey shaded regions represent observed length compositions. The input effective sample size after the Francis data re-weighting adjustment to the yearly length composition data, N adj., and the calculated effective sample size used in the McAllister-Iannelli tuning method, N eff., are provided in the upper right corner of each panel.

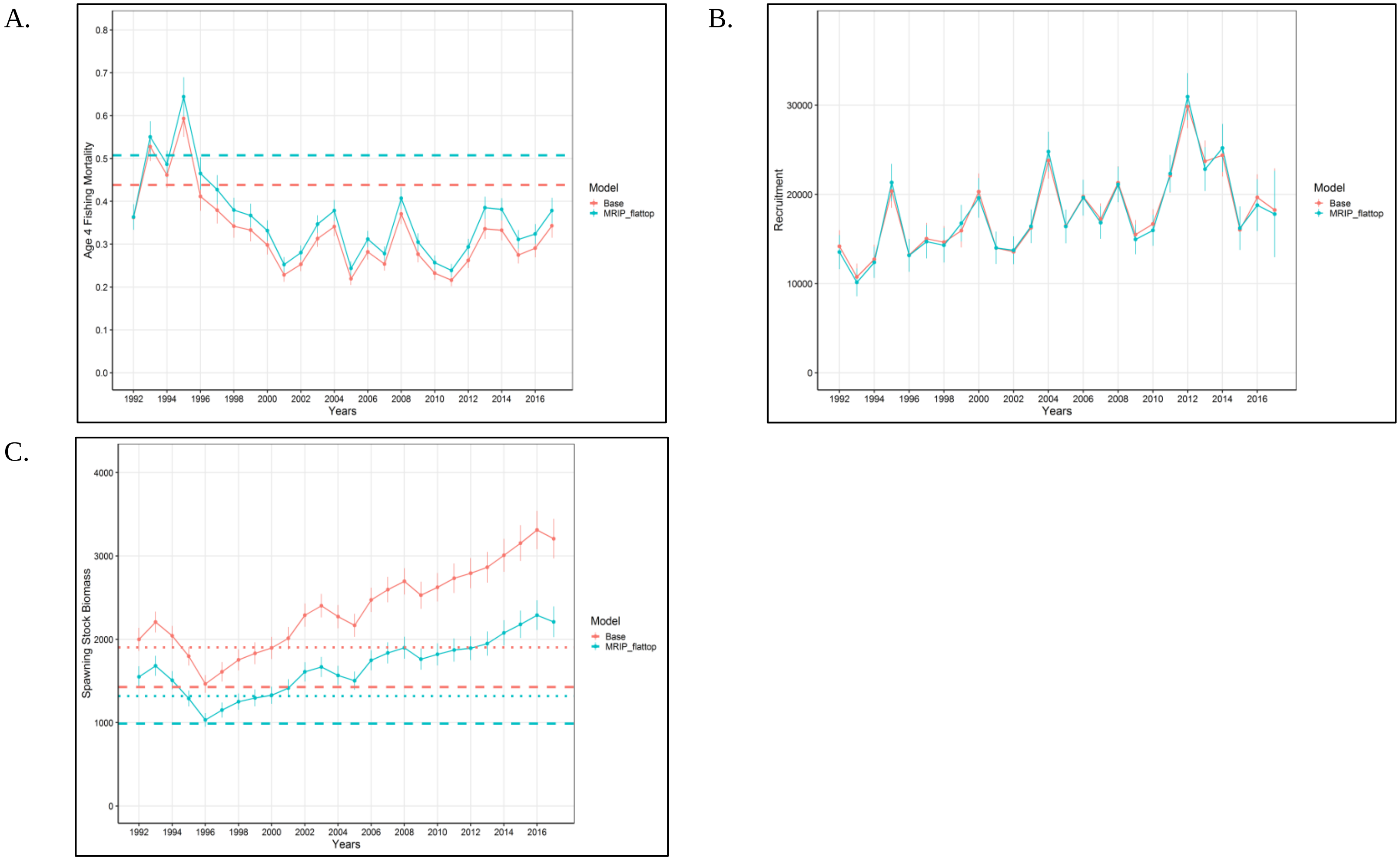

Figure 5.13. Results of a sensitivity run that assumed flat top (single logistic) selectivity for the MRIP fleet. Age-4 fishing mortality (a), recruitment (b), and spawning stock biomass (c) are shown relative to MSST (long dashed line), $SSB_{F30\%SPR}$ (short dashed line), and MFMT (long dashed line).

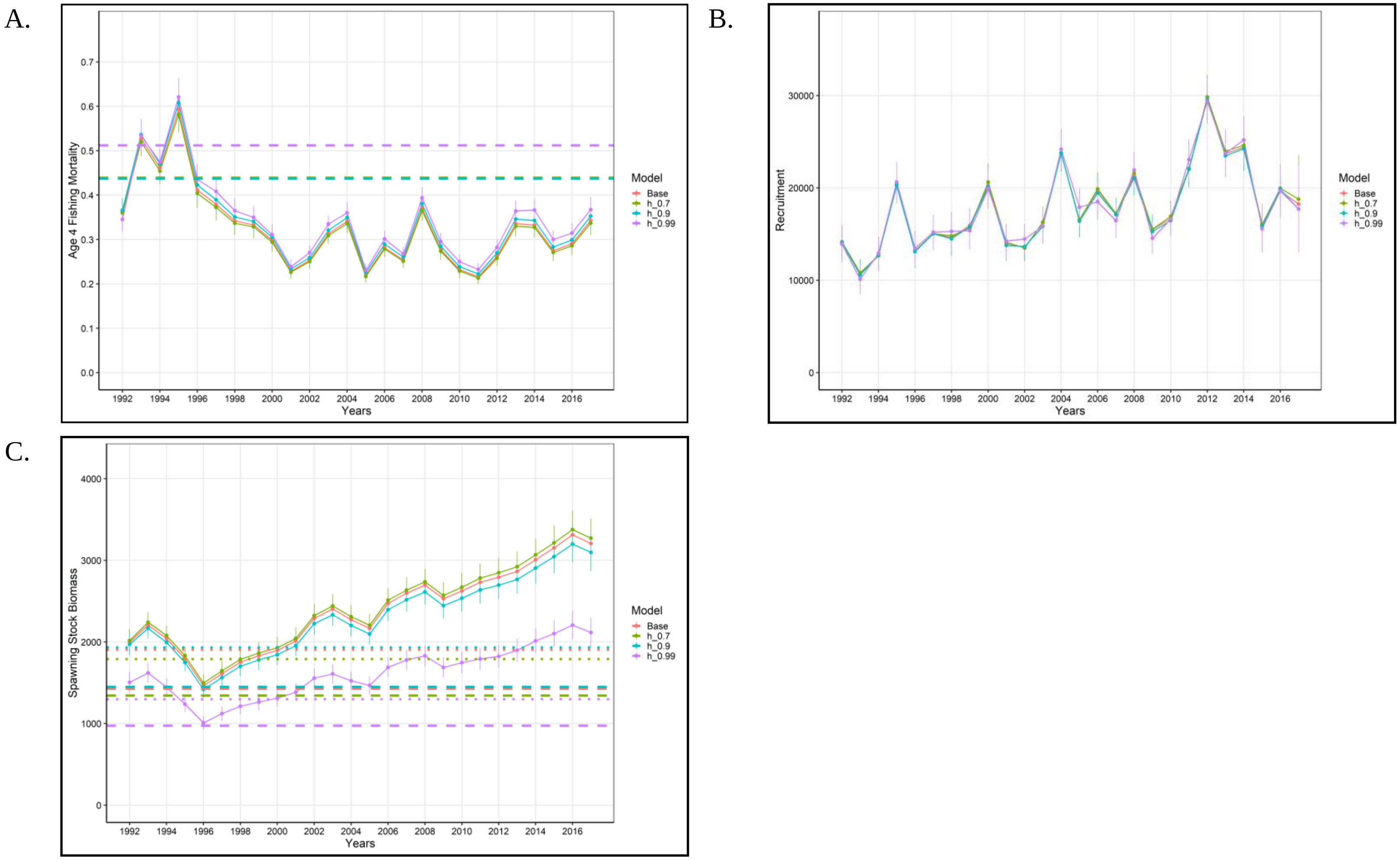

Figure 5.14. Results of a sensitivity run that fixed the *steepness* parameter at 0.7, 0.9, and 0.99. Age-4 fishing mortality (a), recruitment (b), and spawning stock biomass (c) are shown relative to MSST (long dashed line), $SSB_{F30\%SPR}$ (short dashed line), and MFMT (long dashed line).

```
#V3.30.13
#C SEDAR64 SS Control File
# Beginning of Control File Inputs
0           # 0 means do not read wtatage.ss;
1           #_N_Growth_Patterns
1           #_N_platoons_Within_GrowthPattern
#_Cond      #_Morph_between/within_stdev_ratio (no read if N_morphs=1)
#_Cond      #vector_Morphdist_(-1_in_first_val_gives_normal_approx)
# RECRUITMENT DISTRIBUTION AND TIMING------------------------------------------------------------------------------
4           # recr_dist_method for parameters:
1           # not yet implemented; Future usage: Spawner-Recruitment: 1=global; 2=by area
1           #  number of recruitment settlement assignments
0           # unused option
#Gpat       month     area       age (for each settlement assignment)
1           1         1          0
# MOVEMENT--------------------------------------------------------------------------------------------------------------------
#_Cond 1 # N_movement_definitions goes here if Nareas > 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
#
# BLOCK SETUP---------------------------------------------------------------------------------------------------------------------------
1           #_Nblock_Patterns
1           #_blocks_per_pattern
# begin and end years of blocks
2009        2018        #COM CPUE TV Q
# Controls for all timevarying parameters
1           #_env/block/dev_adjust_method for all time-vary parms
# AUTOGEN
1 1 1 1 1  # autogen: 1st element for biology, 2nd for SR, 3rd for Q, 4th reserved, 5th for selex
#_Available timevary codes
# NATURAL MORTALITY OPTIONS-------------------------------------------------------------------------
3           #_natM_type:
#Age 0      1       2       3       4       5       6       7       8       9       10      11      12##
            #13     14      15      16      17      18      19      20
0.558       0.414   0.343   0.301   0.273   0.255   0.241   0.231   0.224   0.218   0.214   0.210   0.208
            0.205   0.204   0.202   0.201   0.200   0.200   0.199   0.198
#_no additional input for selected M option; read 1P per morph
# GROWTH OPTIONS-------------------------------------------------------------------------------------
1           # GrowthModel:
0           #_Age(post-settlement)_for_L1;linear growth below this
999         #_Growth Age for L2 (enter 999 to use as Linf)
-998        #decay for growth above maxage
0           #_placeholder for future growth feature
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); 4 logSD=F(A)
#MATURITY OPTIONS-------------------------------------------------------------------------------------
3           #_maturity_option:
#Age0       1       2       3       4       5       6       7       8       9       10      11      12
            #13     14      15      16      17      18      19      20
0.010       0.130   0.690   0.971   0.998   1.0     1.0     1.0     1.0     1.0     1.0     1.0     1.0
            1.0     1.0     1.0     1.0     1.0     1.0     1.0     1.0
0           #_First_Mature_Age
5           #_fecundity option:
0           #_hermaphroditism option; 0=none; 1=age-specific fxn
1           #_parameter_offset_approach
# MG parameter initialization
# BIOLOGICAL (MG) PARAMETERS----------------------------------------------------------------------------------------------
  #_LO HI   INIT PRIOR PR_SD PR_type PHASE env-var use_dev      dev_minyr dev_maxyr dev_PH BlockBlk_Fxn #parm_name
```

```
# Sex: 1  BioPattern: 1  Growth
  2        20     2        2        10     0   3   0   0   0   0   0     0   0   #_L_at_Amin_Fem_GP_1
  25       60     42.3     42.3     10     0   4   0   0   0   0   0     0   0   #_L_at_Amax_Fem_GP_1
  0.1      0.5    0.207    0.207    0.8    0   4   0   0   0   0   0     0   0   #_VonBert_K_Fem_GP_1
  0.1      0.5    0.179    0.179    0.8    0   6   0   0   0   0   0     0   0   #_CV_young_Fem_GP_1
  0.005    0.4    0.179    0.179    0.8    0   6   0   0   0   0   0     0   0   #_CV_old_Fem_GP_1
# Sex: 1  BioPattern: 1  WtLen
  0        3       2.574E-05    2.574E-05      0.8     0    -3   0   0   0   0   0     0   0   #_Wtlen_1_Fem
  1        4       2.8797       2.8797         0.8     0    -3   0   0   0   0   0     0   0   #_Wtlen_2_Fem
# Sex: 1  BioPattern: 1  Maturity&Fecundity
  0      5     1.7        1.7        0.8    0    -3     0   0   0   0   0     0   0   #_Mat50%_Fem
  -4     -1    -2.706     -2.706     0.8    0    -3     0   0   0   0   0     0   0   #_Mat_slope_Fem
  -3     3     0          0          0.8    0    -3     0   0   0   0   0     0   0   #_Eggs/kg_inter_Fem
  -3     3     1          1          0.8    0    -3     0   0   0   0   0     0   0   #_Eggs/kg_slope_wt_Fem
# Hermaphoditisim
# Recruitment distribution
# Cohort growth dev base
  #_LO HI   INIT PRIOR PR_SD PR_type PHASE env-var use_dev     dev_minyr dev_maxyr dev_PH BlockBlk_Fxn #parm_name
  0      1    1     0    0      0      -4      0       0       0     0       0      0       0     #_CohortGrowDev
#  Movement
#  Age Error from parameters
# catch multiplier
#COND
# fraction female, by GP
#_LO HI   INIT PRIOR PR_SD   PR_type   PHASE env-var&link dev_link dev_minyr dev_maxyr dev_PH Block Block_Fxn    Label
  0.5      0.5            0.5      0.5     0        0      -4     0     0       0    0    0      0     0    # FracFemale_GP_1
#_no timevary MG parameters
#_seasonal_effects_on_biology_parms
#_femwtlen1,femwtlen2,mat1,mat2,fec1,fec2,Malewtlen1,malewtlen2,L1,K
0        0        0        0        0        0        0        0        0        0
  # SPAWNER-RECRUITMENT SETUP---------------------------------------------------------------------------------
  3         #_SpawnerRecruitment
  0         # 0/1 to use steepness in initial equ recruitment calculation
  0         #  future feature:  0/1 to make realized sigmaR a function of SR curvature
  #_LO HI   INIT PRIOR PR_SD PR_type PHASE env-var use_dev     dev_minyr dev_maxyr dev_PH BlockBlk_Fxn #parm_name
  5          20            13       13       10      0   5     0   0   0   0   0     0   0   #_SR_LN(R0)
  0.3        0.99          0.75     0.75     0.09    0   5     0   0   0   0   0     0   0   #_SR_BH_steep
  0.005      0.8           0.2      0.2      0.2     0   7     0   0   0   0   0     0   0   #_SR_sigmaR
  -5         5             0        0        0       0   -4    0   0   0   0   0     0   0   #_SR_regime
  0          0             0        0        0       0   -99   0   0   0   0   0     0   0   #_SR_autocorr
  # RECRUITMENT DEVIATIONS-----------------------------------------------------------------------------------
  2                    #do_recdev
  1991                 #_first year of the main recr_devs; early devs can preceed this era
  2017                 #_last year of the main recr_devs; forecast devs start in following year
  3                    #_recdev phase
  1                    #_(0/1) to read 13 advanced options.
  1981                 #_recdev_early_start (0=none; negative value makes relative to the recdev_start)
  6                    #_recdev_early_phase
  0                    #_forecast_recruitment phase (include late recruitment) (0 value rests to maxphase +1)
  1                    #_lambda for Fcast_recr_like occuring before endyr +1
  1982.3               #_last_early_yr_nobias_adj_in_MPD
  1993.3               #_first_yr_fullbias_adj_in_MPD
```

```
 2015.8                  #_last_yr_fullbias_adj_in_MPD
 2016.6                  #_first_recent_yr_nobias_adj_in_MPD
 0.867                   #_max_bias_adj_in_MPD (-1 to override ramp and set biasadj=1.0 for all estimated recdevs)
 0                       #_period of cycles in recruitment (N parms read below)
 -4                      #min rec_dev
 4                       #max rec_dev
 0                       #_read_recdevs
 #_end of advanced SR options
 # Placeholders for options SR inputs:
 #_placeholder for full parameter lines for recuitment cycles
 #_read specified_recr_devs
 #_Yr Input_value
 # FISHING MORTALITY INFO------------------------------------------------------------------------------------
 0.3                                       #_F ballpark for tuning early phases
 -2001                                     #_F ballpark year (negative value to disable)
 3                                         #_F method: 1= Pope; 2= Instantanous F; 3= Hybrid Method (recommended)
 4                                         #_max F or harvest rate depending on the F method
 #_No additional F input need for Fmethod = 1
 #_if F method =2 read overal start F value; overall phase; N detailed inputs to read
 #COND 0.10 1 0
 #_if F method = 3 N iteration for tuning for F method 3
 7                                         # N iterations for tuning F in hybrid method (recommend 3 to 7)
#_initial_F_parms;  count      =          3
 LO        HI        INIT      PRIOR     PR_SD    PR_type   PHASE
 0         0.5       0.25      0.25      0.5      1         1         #InitF_flt_1_Comm
 0         0.1       0.05      0.05      0.2      1         1         #InitF_flt_1_HB
 0         1         0.5       0.5       0.2      1         1         #InitF_flt_1_Rec
 #_Q_setup for fleets with CPUE or survey data
 #_1: fleet number
 #_2:  link type:
 #_3:  extra input for link, i.e. mirror fleet or dev index number
 #_4:  0/1 to select extra sd parameter
 #_5:  0/1 for biasadj or not
 #_6:  0/1 to float
 #Fleet   link    link info   extra se   bias adj   float   # fleetname
 1        1       0           0          1          0       #COM_CPUE
 4        1       0           0          0          1       #RVC Adult
 5        1       0           0          0          1       #RVC Juvenile
 6        1       0           0          0          1       #MRIP_CPUE
 -9999    0       0           0          0          0
#_Cond    0
#_Q_parms(if_any)
#_LO HI   INIT PRIOR PR_SD   PR_TYPE  PHASE    env-var   use_dev   dev_minyr dev_maxyr dev_PH Block Block_Fxn Label
 -18       5    -7    -7     1        0       2        0        0       0          0          0        1      2      #LnQ_Com CPUE
 -18       5    -8    -8     1        0      -1        0        0       0          0          0        0      0      #LnQ_RVC Adult CPUE
 -18       5    -8    -8     1        0      -1        0        0       0          0          0        0      0      #LnQ_RVC Juv CPUE
 -18       5    -8    -8     1        0      -1        0        0       0          0          0        0      0      #LnQ_MRIP CPUE
#_timevary Q parameters
#_LO      HI        INIT      PRIOR     PR_SD     PR_type   PHASE     #Parm name
-12       5         -6        -6        1         0         2         # COM_CPUE_2009-2017
```

```
 #_size_selex_types
 #_discard_options
 #_Pattern   Discard   Male   Special          Label
         1         2      0         0  #COM          #1
        24         2      0         0  #HB           #2
        24         2      0         0  #MRIP         #3
        24         0      0         0  #RVC_Adult    #4
        24         0      0         0  #RVC_Juv      #5
         5         0      0         3  #MRIP CPUE    #6
         0         0      0         0  #FI           #7
 #
 #_age_selex_types
 #_Pattern   Discard   Male   Special          Label
         0         0      0         0  #COM          #1
         0         0      0         0  #HB           #2
         0         0      0         0  #MRIP         #3
         0         0      0         0  #RVC_Adult    #4
         0         0      0         0  #RVC_Juv      #5
         0         0      0         0  #MRIP CPUE    #6
         0         0      0         0  #FI           #7
#_LO HI   INIT  PRIOR SD PR_TYPE PHASE env-var use_dev   dev_minyr dev_maxyr dev_stddev Block Block_Fxn  parm_name
#Commercial simple logistic
 10.0     35.0     27.0     27.0     1    0   2    0   0   0   0   0   0   0   #_SizeSel_1_P1_Com
 1.0      20.0     7.4      7.4      1    0   3    0   0   0   0   0   0   0   #_SizeSel_1_P2_Com
 #followed immediately by retention parameters for this fleet
 5        35       29       29       1    0   3    0   0   0   0   0   0   0   #_inflection_for_retention
 0.6      5        2.4      2.4      1    0   4    0   0   0   0   0   0   0   #_slope_for_logistic function
 1        30       1.5      1.5      1    0   4    0   0   0   0   0   0   0   #_asymptotic_retention
 -1       1        0        0        99   0   -3   0   0   0   0   0   0   0   #_male_offset_on_inflection
 #followed immediately by discard parameters for this fleet
 0.5      1.5      1        1        1    0   -3   0   0   0   0   0   0   0   #_inflection_for_discard_mortality
 1.E+04   1.E+08   1.E+06   1.E+06   1    0   -3   0   0   0   0   0   0   0   #_slope_for_logistic function
 -1.5     0        -0.8     -0.8     1    0   -3   0   0   0   0   0   0   0   #maximum discard mortality
 -1       2        0        0        99   0   -3   0   0   0   0   0   0   0   #_male_offset_on_inflection
 #Headboat double normal
 11.1     40.0     23.0     23.0     1    0   2    0   0   0   0   0   0   0   #PEAK: beginning size for the plateau
 -18.0    -1.0     -10.0    -10.0    1    0   3    0   0   0   0   0   0   0   #TOP: width of plateau
 -4.0     12.0     3.5      3.5      1    0   4    0   0   0   0   0   0   0   #ASC-WIDTH
 -2.0     6.0      3.5      3.5      1    0   4    0   0   0   0   0   0   0   #DESC-WIDTH
 -15      5        -10      -10      1    0   3    0   0   0   0   0   0   0   #INIT: selectivity at first bin
 -10      5        -5       -5       1    0   3    0   0   0   0   0   0   0   #FINAL: selectivity at last bin
 #followed immediately by retention parameters for this fleet
 15       35       27       27       1    0   3    0   0   0   0   0   0   0   #_inflection_for_retention
 0.1      12       2.4      2.4      1    0   4    0   0   0   0   0   0   0   #_slope_for_logistic function
 1        10       4        4        1    0   4    0   0   0   0   0   0   0   #_asymptotic_retention
 -1       1        0        0        99   0   -3   0   0   0   0   0   0   0   #_male_offset_on_inflection
 #followed immediately by discard parameters for this fleet
 0.5      1.5      1        1        1    0   -3   0   0   0   0   0   0   0   #_inflection_for_discard_mortality
 1.E+04   1.E+08   1.E+06   1.E+06   1    0   -3   0   0   0   0   0   0   0   #_slope_for_logistic function
 -1.5     0        -0.8     -0.8     1    0   -3   0   0   0   0   0   0   0   #maximum discard mortality
```

```
 -1      2       0       0       99  0  -3  0  0  0  0  0  0  0  #_male_offset_on_inflection
 #MRIP double normal
 11.1    30.0    23.0    23.0    1   0  2   0  0  0  0  0  0  0  #PEAK: beginning size for the plateau
 -18.0   1.0     -7.0    -7.0    1   0  3   0  0  0  0  0  0  0  #TOP: width of plateau
 0.0     5.0     2.0     2.0     1   0  4   0  0  0  0  0  0  0  #ASC-WIDTH
 -25.0   6.0     2.0     2.0     1   0  4   0  0  0  0  0  0  0  #DESC-WIDTH
 -20     7       -7      -7      1   0  3   0  0  0  0  0  0  0  #INIT: selectivity at first bin
 -10     5       -5      -5      1   0  3   0  0  0  0  0  0  0  #FINAL: selectivity at last bin
 #followed immediately by retention parameters for this fleet
 11.1    33.0    27      27      1   0  3   0  0  0  0  0  0  0  #_inflection_for_retention
 0.1     10      2.4     2.4     1   0  4   0  0  0  0  0  0  0  #_slope_for_logistic function
 1       10      6       6       1   0  4   0  0  0  0  0  0  0  #_asymptotic_retention
 -1      1       0       0       99  0  -3  0  0  0  0  0  0  0  #_male_offset_on_inflection
 #followed immediately by discard parameters for this fleet
 0.5     1.5     1       1       1   0  -3  0  0  0  0  0  0  0  #_inflection_for_discard_mortality
 1.E+04  1.E+08  1.E+06  1.E+06  1   0  -3  0  0  0  0  0  0  0  #_slope_for_logistic function
 -1.5    0       -0.8    -0.8    1   0  -3  0  0  0  0  0  0  0  #maximum discard mortality
 -1      2       0       0       99  0  -3  0  0  0  0  0  0  0  #_male_offset_on_inflection
 #RVC Adult double normal
 16.00   25.00   19.00   19.00   1   0  2   0  0  0  0  0  0  0  #PEAK: beginning size for the plateau
 -20.00  -1.00   -10.00  -10.00  1   0  3   0  0  0  0  0  0  0  #TOP: width of plateau
 -28.00  -0.20   -7.00   -7.00   1   0  4   0  0  0  0  0  0  0  #ASC-WIDTH
 1.00    6.00    3.50    3.50    1   0  4   0  0  0  0  0  0  0  #DESC-WIDTH
 -15.00  0.00    -10.00  -10.00  1   0  3   0  0  0  0  0  0  0  #INIT: selectivity at first bin
 -15.00  10.00   -5.00   -5.00   1   0  3   0  0  0  0  0  0  0  #FINAL: selectivity at last bin
 #Juvenile RVC double normal
 8.00    18.00   18.00   18.00   1   0  3   0  0  0  0  0  0  0  #PEAK: beginning size for the plateau
 -10.00  -1.00   -4.00   -4.00   1   0  4   0  0  0  0  0  0  0  #TOP: width of plateau
 -1.90   5.00    3.00    3.00    1   0  5   0  0  0  0  0  0  0  #ASC-WIDTH
 -22.00  4.00    -9.00   -9.00   1   0  5   0  0  0  0  0  0  0  #DESC-WIDTH
 -30.00  10.00   8.00    8.00    1   0  2   0  0  0  0  0  0  0  #INIT: selectivity at first bin
 -15.00  5.00    -15.00  -15.00  1   0  -3  0  0  0  0  0  0  0  #FINAL: selectivity at last bin
 #MRIP CPUE mirrored length bins
 -1      -1      -1      -1      1   0  -1  0  0  0  0  0  0  0  #_min_bin_num_MRIP CPUE
 -1      -1      -1      -1      1   0  -1  0  0  0  0  0  0  0  #_max_bin_num_MRIP CPUE
#_timevarying parameters    HI       INIT     PRIOR    PR_SD    PR_type  PHASE    #Parm name
0        #  use 2D_AR1 selectivity(0/1)
#_Tag loss and Tag reporting parameters go next
0        #_TG_custom; 0=no read, 1=read if tags exist
#_Cond   #_placeholder if no parameters
# no timevarying parameters
# Input variance adjustments factors:
#_1=add_to_survey_CV
#_2=add_to_discard_stddev
#_3=add_to_bodywt_CV
 #_4=mult_by_lencomp_N
 #_5=mult_by_agecomp_N
 #_6=mult_by_size-at-age_N
 #_7=mult_by_generalized_sizecomp
#Factor  Fleet    New_Var_adj
4        1        4.349588
4        2        1.12783
```

```
4         3         1.485104
4         4         0.477745
4         5         0.83643
4         6         6.629057
5         1         0.171021
5         2         0.28389
5         3         0.137154
5         7         0.139593
-9999     1         0         # terminator
#
1         #_maxlambdaphase
1         #_sd_offset; must be 1 if any growthCV, sigmaR, or survey extraSD is an estimated parameter
#_Like_comp codes:
#Like_Comp          fleet/survey        phase     value     sizefreq_method
9         1         1         0         1
9         2         1         0         1
9         3         1         0         1
-9999     1         1         1         1
0         # (0/1) read specs for more stddev reporting
# Placeholder for selex_fleet
#_Placeholder for vector of selex bins to be reported
#_Placeholder vector of growth ages to be reported
#_Placeholder for vector of NatAges ages to be reported
999       # End of control file input
```

```
#V3.30.13
#C SEDAR64 Data Input File
1992      #_styr
2017      #_endyr
1         #_nseas
12        #_months/season
2         #_N_subseasons
1         #_spawn_seas
-1        #_Ngenders
20        #_Nages
1         #_N_areas
7         #_Nfleets (including surveys)
# FLEET SETUP------------------------------------------------------------------------------------------------------------------------
# Type    Timing    Area      Units     Multiplier          Name
1         -1        1         1         0         COM
1         -1        1         2         0         HB
1         -1        1         2         0         MRIP
3         1         1         2         0         RVC_Adult
3         1         1         2         0         RVC_Juv
3         1         1         2         0         MRIP_CPUE
3         1         1         2         0         FI
# CATCH DATA--------------------------------------------------------------------------------------------------------------------------
#Year     #Season   #Fleet    #Catch    #Catch_SE
#Commercial
-999      1         1         82.536              0.1
1981      1         1         331.8581            0.1
1982      1         1         621.7457588         0.1
1983      1         1         436.227872          0.1
1984      1         1         429.6902464         0.1
1985      1         1         374.3138849         0.1
1986      1         1         507.4672631         0.05
1987      1         1         614.7985393         0.05
1988      1         1         640.7217923         0.05
1989      1         1         838.9901584         0.05
1990      1         1         796.1728603         0.05
1991      1         1         843.8404207         0.05
1992      1         1         839.8316583         0.05
1993      1         1         1078.975104         0.05
1994      1         1         1000.40035          0.05
1995      1         1         842.225741          0.05
1996      1         1         661.8352526         0.05
1997      1         1         759.2706463         0.05
1998      1         1         691.4700201         0.05
1999      1         1         837.3958867         0.05
2000      1         1         721.9918972         0.05
2001      1         1         644.1634928         0.05
2002      1         1         638.4472941         0.05
2003      1         1         639.5672365         0.05
2004      1         1         671.2890148         0.05
2005      1         1         600.8040301         0.05
2006      1         1         561.0399411         0.05
2007      1         1         443.5975273         0.05
2008      1         1         621.4210505         0.05
2009      1         1         895.8889483         0.05
2010      1         1         768.3639367         0.05
2011      1         1         858.897177          0.05
2012      1         1         955.8508189         0.05
2013      1         1         934.9185751         0.05
2014      1         1         926.8067982         0.05
2015      1         1         996.9749333         0.05
2016      1         1         1050.02309          0.05
2017      1         1         1279.323683         0.05
2018      1         1         898.0704387         0.05
# Headboat
-999      1         2         26.124              0.25
```

```
1981        1           2           177.3105024         0.25
1982        1           2           293.7431689         0.25
1983        1           2           262.3032633         0.25
1984        1           2           185.6324711         0.25
1985        1           2           162.1580849         0.25
1986        1           2           206.149   0.25
1987        1           2           235.527   0.25
1988        1           2           291.372   0.25
1989        1           2           166.437   0.25
1990        1           2           218.763   0.25
1991        1           2           212.789   0.25
1992        1           2           205.367   0.25
1993        1           2           218.701   0.25
1994        1           2           243.158   0.25
1995        1           2           157.496   0.25
1996        1           2           137.599   0.25
1997        1           2           139.838   0.25
1998        1           2           120.526   0.25
1999        1           2           109.223   0.25
2000        1           2           109.3     0.25
2001        1           2           101.869   0.25
2002        1           2           121.012   0.25
2003        1           2           108.854   0.25
2004        1           2           118.422   0.25
2005        1           2           149.087   0.25
2006        1           2           98.974    0.25
2007        1           2           104.598   0.25
2008        1           2           103.362   0.25
2009        1           2           88.38     0.25
2010        1           2           102.174   0.25
2011        1           2           98.768    0.25
2012        1           2           110.815   0.25
2013        1           2           112.942   0.25
2014        1           2           163.99    0.25
2015        1           2           173.617   0.25
2016        1           2           184.576   0.25
2017        1           2           110.68    0.25
# MRIP
-999        1           3           1572.274            0.25
1981        1           3           5356.739937         0.23
1982        1           3           6098.712696         0.22
1983        1           3           1566.288792         0.17
1984        1           3           4067.863109         0.41
1985        1           3           1754.714902         0.39
1986        1           3           1475.11219          0.39
1987        1           3           1162.386505         0.23
1988        1           3           1137.939791         0.15
1989        1           3           4685.672675         0.25
1990        1           3           3440.760197         0.41
1991        1           3           4210.208715         0.46
1992        1           3           969.5812339         0.2
1993        1           3           1964.950033         0.15
1994        1           3           1301.688287         0.14
1995        1           3           1859.945715         0.18
1996        1           3           871.3579596         0.17
1997        1           3           785.9740058         0.2
1998        1           3           878.5729437         0.24
1999        1           3           659.5444529         0.15
2000        1           3           722.4407513         0.3
2001        1           3           521.6030158         0.36
2002        1           3           951.985207          0.14
2003        1           3           1491.566091         0.13
2004        1           3           1459.768722         0.34
2005        1           3           609.6363401         0.17
2006        1           3           1527.088874         0.21
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2007        1           3           1580.350801 0.24
2008        1           3           2351.513229 0.26
2009        1           3           925.48432   0.16
2010        1           3           849.5330562 0.13
2011        1           3           619.5145204 0.17
2012        1           3           910.906141  0.28
2013        1           3           1723.630685 0.09
2014        1           3           1906.725282 0.09
2015        1           3           1322.040492 0.1
2016        1           3           1524.591652 0.1
2017        1           3           1550.29595  0.11
2018        1           3           1696.550856 0.13
-9999       0           0           0           0
# -9999 indicates the end of catch records to be read
# SURVEY DATA-----------------------------------------------------------------------------------------------------------
#_Fleet/ Survey         Units       Errtype     Sd_Report
1           1           0           0           #COM_SURV
2           0           0           0           #Headboat
3           0           0           0           #MRIP
4           0           0           0           #RVC_Adult
5           0           0           0           #RVC_Juv
6           0           0           0           #MRIP_SURV
7           0           0           0           #FI
#_year      month       Fleet/ Survey           obs         err         # comment
#Com CPUE
1993        7           1           2.34        0.183       #COM_CPUE
1994        7           1           2.53        0.175       #COM_CPUE
1995        7           1           1.93        0.176       #COM_CPUE
1996        7           1           1.69        0.182       #COM_CPUE
1997        7           1           1.94        0.175       #COM_CPUE
1998        7           1           2.27        0.177       #COM_CPUE
1999        7           1           3.02        0.173       #COM_CPUE
2000        7           1           2.73        0.175       #COM_CPUE
2001        7           1           2.71        0.177       #COM_CPUE
2002        7           1           3.05        0.177       #COM_CPUE
2003        7           1           2.21        0.18        #COM_CPUE
2004        7           1           3.02        0.181       #COM_CPUE
2005        7           1           3.78        0.178       #COM_CPUE
2006        7           1           3.59        0.18        #COM_CPUE
2007        7           1           4.84        0.178       #COM_CPUE
2008        7           1           6.12        0.177       #COM_CPUE
2009        7           1           5.62        0.175       #COM_CPUE
2010        7           1           5.36        0.179       #COM_CPUE
2011        7           1           5.98        0.18        #COM_CPUE
2012        7           1           5.23        0.181       #COM_CPUE
2013        7           1           5.04        0.182       #COM_CPUE
2014        7           1           4.72        0.182       #COM_CPUE
2015        7           1           4.82        0.184       #COM_CPUE
2016        7           1           5.98        0.18        #COM_CPUE
2017        7           1           6.77        0.185       #COM_CPUE
#RVC Adult
1999        7           4           1.35        0.192       #RVC Adult
2000        7           4           1.33        0.122       #RVC Adult
2004        7           4           2.4         0.175       #RVC Adult
2006        7           4           1.82        0.247       #RVC Adult
2008        7           4           3.38        0.132       #RVC Adult
2010        7           4           2.51        0.118       #RVC Adult
2012        7           4           2.75        0.092       #RVC Adult
2014        7           4           4.44        0.17        #RVC Adult
2016        7           4           3.01        0.122       #RVC Adult
# RVC Juvenile
1999        7           5           1.59        0.126       #RVC Juvenile
2000        7           5           2.67        0.084       #RVC Juvenile
2004        7           5           2.38        0.117       #RVC Juvenile
2006        7           5           2.96        0.108       #RVC Juvenile
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2008    7       5       3.45    0.065   #RVC Juvenile
2010    7       5       2.94    0.105   #RVC Juvenile
2012    7       5       3.26    0.074   #RVC Juvenile
2014    7       5       3.85    0.096   #RVC Juvenile
2016    7       5       3.55    0.095   #RVC Juvenile
#MRIP total catch
1991    7       6       3.84    0.09    #MRIP_totcatch
1992    7       6       2.96    0.09    #MRIP_totcatch
1993    7       6       2.99    0.1     #MRIP_totcatch
1994    7       6       2.27    0.129   #MRIP_totcatch
1995    7       6       2.33    0.12    #MRIP_totcatch
1996    7       6       1.71    0.129   #MRIP_totcatch
1997    7       6       1.58    0.12    #MRIP_totcatch
1998    7       6       1.3     0.09    #MRIP_totcatch
1999    7       6       1.72    0.09    #MRIP_totcatch
2000    7       6       1.91    0.09    #MRIP_totcatch
2001    7       6       1.98    0.08    #MRIP_totcatch
2002    7       6       1.82    0.09    #MRIP_totcatch
2003    7       6       1.74    0.09    #MRIP_totcatch
2004    7       6       2.25    0.09    #MRIP_totcatch
2005    7       6       2.4     0.08    #MRIP_totcatch
2006    7       6       2.27    0.08    #MRIP_totcatch
2007    7       6       2.72    0.08    #MRIP_totcatch
2008    7       6       2.25    0.09    #MRIP_totcatch
2009    7       6       2.09    0.09    #MRIP_totcatch
2010    7       6       2.29    0.11    #MRIP_totcatch
2011    7       6       2.09    0.09    #MRIP_totcatch
2012    7       6       2.15    0.09    #MRIP_totcatch
2013    7       6       3.02    0.08    #MRIP_totcatch
2014    7       6       2.76    0.08    #MRIP_totcatch
2015    7       6       2.95    0.09    #MRIP_totcatch
2016    7       6       2.56    0.09    #MRIP_totcatch
2017    7       6       2.93    0.11    #MRIP_totcatch
-9999   1       1       1.00    1       #Terminator Line
#
3       #_N_fleets_with_discard
#_Fleet units   errtype
2       3       -2      #HB
3       3       -2      #MRIP
1       3       0       #COM
#_year  season  Fleet   obs     err     # comment
1981    1       2       9.864664259     0.5     #HB
1982    1       2       5.884115917     0.5     #HB
1983    1       2       71.70478859     0.5     #HB
1984    1       2       58.88338576     0.5     #HB
1985    1       2       1.785057166     0.5     #HB
1986    1       2       16.03907352     0.5     #HB
1987    1       2       194.3714114     0.5     #HB
1988    1       2       279.6610097     0.5     #HB
1989    1       2       38.54597836     0.5     #HB
1990    1       2       186.0582264     0.5     #HB
1991    1       2       1171.961065     0.5     #HB
1992    1       2       70.61295325     0.5     #HB
1993    1       2       50.91445666     0.5     #HB
1994    1       2       73.84659745     0.5     #HB
1995    1       2       63.10353407     0.5     #HB
1996    1       2       57.1749185      0.5     #HB
1997    1       2       88.12044768     0.5     #HB
1998    1       2       84.23481694     0.5     #HB
1999    1       2       48.3423336      0.5     #HB
2000    1       2       47.85098597     0.5     #HB
2001    1       2       22.6990784      0.5     #HB
2002    1       2       44.50563137     0.5     #HB
2003    1       2       65.42851887     0.5     #HB
2004    1       2       21.535  0.5     #HB
```

2005	1	2	15.812	0.5	#HB	
2006	1	2	19.154	0.5	#HB	
2007	1	2	26.965	0.5	#HB	
2008	1	2	39.757	0.5	#HB	
2009	1	2	37.637	0.5	#HB	
2010	1	2	36.335	0.5	#HB	
2011	1	2	24.211	0.5	#HB	
2012	1	2	30.564	0.5	#HB	
2013	1	2	39.777	0.5	#HB	
2014	1	2	64.492	0.5	#HB	
2015	1	2	65.844	0.5	#HB	
2016	1	2	68.637	0.5	#HB	
2017	1	2	33.818	0.5	#HB	
1981	1	3	932.3556297		0.17	#MRIP
1982	1	3	1120.300015		0.23	#MRIP
1983	1	3	563.4208705		0.53	#MRIP
1984	1	3	3787.89467		0.37	#MRIP
1985	1	3	321.6105676		0.08	#MRIP
1986	1	3	1050.653893		0.28	#MRIP
1987	1	3	2103.332362		0.21	#MRIP
1988	1	3	1116.803123		0.27	#MRIP
1989	1	3	3107.52863		0.28	#MRIP
1990	1	3	1980.2515		0.14	#MRIP
1991	1	3	13560.77984		0.2	#MRIP
1992	1	3	3406.179081		0.12	#MRIP
1993	1	3	4779.78686		0.1	#MRIP
1994	1	3	2815.507003		0.17	#MRIP
1995	1	3	3311.798065		0.15	#MRIP
1996	1	3	3282.277092		0.07	#MRIP
1997	1	3	3485.099919		0.15	#MRIP
1998	1	3	2435.770771		0.14	#MRIP
1999	1	3	2080.939602		0.19	#MRIP
2000	1	3	1781.310535		0.16	#MRIP
2001	1	3	1100.164438		0.13	#MRIP
2002	1	3	1259.173922		0.14	#MRIP
2003	1	3	1799.550637		0.06	#MRIP
2004	1	3	2505.699147		0.09	#MRIP
2005	1	3	1648.307921		0.14	#MRIP
2006	1	3	2664.444644		0.1	#MRIP
2007	1	3	3481.530326		0.13	#MRIP
2008	1	3	3235.12069		0.14	#MRIP
2009	1	3	2394.37473		0.11	#MRIP
2010	1	3	1526.499075		0.2	#MRIP
2011	1	3	1665.608224		0.13	#MRIP
2012	1	3	1675.631829		0.16	#MRIP
2013	1	3	4887.298049		0.16	#MRIP
2014	1	3	4092.275103		0.12	#MRIP
2015	1	3	2711.546879		0.1	#MRIP
2016	1	3	1539.52053		0.15	#MRIP
2017	1	3	2274.822268		0.08	#MRIP
1993	1	1	91.89378327		2.33	#COM
1994	1	1	104.9528774		2.35	#COM
1995	1	1	120.8194675		2.34	#COM
1996	1	1	117.0162809		2.33	#COM
1997	1	1	139.4010805		2.34	#COM
1998	1	1	97.93749188		2.36	#COM
1999	1	1	105.3792603		2.33	#COM
2000	1	1	103.5432066		2.34	#COM
2001	1	1	87.54533209		2.36	#COM
2002	1	1	86.70276592		1.95	#COM
2003	1	1	81.81697234		2.01	#COM
2004	1	1	51.46749686		2.60	#COM
2005	1	1	48.86248772		2.93	#COM
2006	1	1	75.74111867		2.42	#COM
2007	1	1	83.97690848		2.20	#COM

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2008    1       1       49.9661355      2.85    #COM
2009    1       1       60.26864348     1.94    #COM
2010    1       1       49.53957853     3.00    #COM
2011    1       1       60.20993034     2.17    #COM
2012    1       1       39.46393501     3.28    #COM
2013    1       1       47.27060143     5.11    #COM
2014    1       1       59.15634765     3.58    #COM
2015    1       1       23.52696131     5.61    #COM
2016    1       1       44.73938979     2.33    #COM
2017    1       1       37.88629469     3.33    #COM
-9999   0       0       0       0.00    #terminator
#
0       #_Use mean body size data (0/1)
#
# LENGTH DATA-------------------------------------------------------------------------------------------------------------------
2       # length bin method
2       # binwidth for population size comp
2       # minimum size in the population (lower edge of first bin and size at age 0.00)
78      # maximum size in the population (lower edge of last bin)
1       # use length composition data (0/1)
#_mintailcomp   _addtocomp      _combM+F        _CompressBins   _CompError      _ParmSelect     minsamplesize
0       1.00E-07 0      9       0       0       0.01    #1-COM
0       1.00E-07 0      9       0       0       0.01    #2-HB
0       1.00E-07 0      9       0       0       0.01    #3-MRIP
0       1.00E-07 0      9       0       0       0.01    #4-RVC Adult
0       1.00E-07 0      9       0       0       0.01    #5-RVC Juv
0       1.00E-07 0      9       0       0       0.01    #6-MRIPCPUE
0       1.00E-07 0      9       0       0       0.01    #7-FI
39      #_Nbins for length composition data
#lower edge of each length data bin (in cm)                                                     2       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
#Yr     Month   Flt/Svy Sex     Part    Nsamp   datavector(female first)
#Commercial landings length comps
1984    7       1       0       2       4       0       0       0       0       0       0       0       0       0
        0.485143532     31.04918606     65.49437685     49.48464029     63.55380272     74.71210396     84.41497461
        74.71210396     42.2074873      33.96004726     27.1680378      20.86117189     16.4948801      12.61373184
        13.5840189      5.336578854     1.940574129     0.970287064     0.970287064     0       0.485143532     0
        0       0       0       0       0       0       0       0
1985    7       1       0       2       4.8     0       0       0       0       0       0       0       0       0
        0       0.898000562     6.510504078     15.04150942     61.28853839     117.8625738     119.4340748
        76.77904809     57.69653614     40.41002531     28.51151786     13.47000844     8.980005624     2.020501265
        1.796001125     0.224500141     0       0       0       0       0       0       0       0       0       0
        0       0       0       0
1986    7       1       0       2       7.28    0       0       0       0       0       0       0       0       0
        0       8.056836449     95.44252409     134.487193      165.7849039     136.346463      113.1055886
        73.44116301     55.46822017     44.00272214     32.53722412     9.916106399     9.606228074     3.09878325
        0.309878325     0.309878325     0       0       0       0       0       0.309878325     0       0       0
        0       0       0       0       0
1987    7       1       0       2       5.92    0       0       0       0       0       0       0       0       0
        0       7.468461912     99.75731269     157.9046233     218.7192417     162.1723158     108.2926977
        80.01923477     65.08231095     43.74384834     33.60807861     21.87192417     21.87192417     21.33846261
        3.734230956     1.600384695     0       0       0       0       0       0       0       0       0       0
        0       0       0       0
1988    7       1       0       2       6       0       0       0       0       0       0       0       0
        5.462490112     7.283320149     15.78052699     158.4122132     208.1815676     242.170395      198.4704741
        124.4233859     68.58459807     50.98324105     30.34716729     32.16799733     29.1332806      9.711093533
        3.641660075     3.034716729     0.606943346     0       0       0       0       0       0       0       0
        0       0       0       0       0       0
1989    7       1       0       2       7.55    0       0       0       0       0       0       0       0       0
        0       6.164171857     154.6179774     204.9587142     285.6066294     238.8616594     208.0408002
        135.6117808     89.89417291     48.28601288     56.50490869     31.84822126     19.00619656     12.32834371
        1.027361976     0       0       0       0       0       0       0       0       0       0       0       0
        0       0       0
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1990	7	1	0	2	11.58	0	0	0	0	0	0	0	0	0
	3.682197449	13.01043099	235.4151569	285.2475624	286.7204414	232.2239191	151.9520147
	99.91029079	62.84283647	40.01321228	40.50417194	23.07510401	21.11126538	11.04659235
	2.945757959	1.96383864	0.49095966	0.24547983	0	0	0	0	0	0
	0	0	0	0	0	0
1991	7	1	0	2	12.12	0	0	0	0	0	0	0	0
	0.170111516	0	2.705476405	164.4487485	263.730091	326.2845979	328.381911
	166.485469	115.0969561	56.27901661	50.40979798	40.92215108	21.54075063	16.77293357
	9.583447567	5.98793815	2.184223954	0.358401843	0.228750104	0	0	0	0
	0	0	0	0	0	0	0	0
1992	7	1	0	2	12.49	0	0	0	0	0	0	0	0	0
	0.139964066	8.97581072	179.1974348	261.157537	326.5609413	220.4595499	155.9941001
	90.24219991	53.43767536	39.46312921	40.25242652	41.14799226	35.38162095	17.95788447
	10.1335673	4.233319901	0.977556009	1.022531359	0	0	0	0	0	0
	0	0	0	0	0	0
1993	7	1	0	2	13.19	0	0	0	0	0	0	0	0	0
	1.387906534	8.23290068	177.3764076	351.2277515	412.6273772	333.1694185	252.9627275
	147.1941243	76.58113608	54.48122271	37.73006246	40.50500351	27.16712278	21.44547596
	12.2671705	3.990662166	0.410987687	0	0	0	0	0	0	0
	0	0	0	0	0
1994	7	1	0	2	13.82	0	0	0	0	0	0	0.942131122
	0.942131122	1.884262244	1.824232062	4.497764354	148.0877758	256.03874	310.5025573
	340.6746993	250.7050872	152.2725965	95.13499603	57.46514771	42.44365411	27.04628625
	24.16294657	12.90464706	10.50274889	1.853928162	0.289158576	0.578317152	0.289158576
	0.578317152	0.289158576	0	0	0	0	0	0	0	0	0
1995	7	1	0	2	14.42	0	0	0	0	0	0	0	0
	0.838158832	4.948602582	15.44988778	220.6783891	351.0011963	373.6128693	302.9945054
	175.9803698	108.4898209	64.22901113	36.419502	24.64045716	16.14059964	11.54961644
	6.213158049	2.651574416	0.927547264	0	0.330208769	0	0.344407518	0.344407518
	0	0	0	0	0	0	0	0	0
1996	7	1	0	2	12.92	0	0	0	0	0	0	0	0
	0.090852022	0.505757171	15.93336472	204.2982354	298.4076819	276.2686134	187.9594501
	136.8746817	91.54562318	52.63747001	34.14356943	18.42000925	13.26385034	7.407383167
	3.746875308	2.790540027	1.175984883	0.574642691	0	0	0	0	0	0
	0	0	0	0	0	0	0
1997	7	1	0	2	16.55	0	0	0	0	0	0	0	0	0
	0	8.87417776	194.2107791	286.7458731	297.5584456	223.9619704	164.611942
	115.1274299	55.08604561	40.39841392	28.63787632	17.76433557	13.09395085	7.527685493
	4.204653779	1.639848683	0.381322811	0	0.205882199	0	0.205882199	0.617646598
	0	0.205882199	0	0	0	0	0	0
1998	7	1	0	2	15.33	0	0	0	0	0	0	0	0	0
	0.288241111	10.88578857	137.4251754	228.225939	293.5432747	247.3063483	165.1489914
	104.9860149	67.27029909	49.35941806	22.94362772	13.5764072	3.463927716	3.006983105
	2.200200422	0.497537287	0.284817594	0.262441249	0	0.262441249	0	0	0
	0	0	0	0	0	0	0
1999	7	1	0	2	17.09	0	0	0	0	0	0	0	0	0
	3.524951651	9.917934393	144.1529537	270.7157536	310.9234178	260.6570501	189.9099304
	122.4603908	77.03494221	58.19244597	38.47827473	22.79890644	13.51671402	7.383634072
	3.216131865	0.780097832	0.642441248	0.145982391	0.33633623	0.157692165	0	0
	0	0	0	0	0	0	0	0
2000	7	1	0	2	15.97	0	0	0	0	0	0	0	0	0
	0.517958957	5.060344404	85.77067143	181.836357	279.8379658	254.9484203	166.1795211
	90.56294383	66.12913206	48.89895084	33.96187935	23.63117838	13.97728628	9.384741701
	5.309561351	0.861801772	0.151869038	0.151869038	0	0	0	0	0	0
	0	0	0	0	0	0
2001	7	1	0	2	16.76	0	0	0	0	0	0	0	0	0
	0.384827278	2.51733927	103.0806869	219.0159777	252.3875969	251.8443352	173.9604251
	92.70101358	55.86332111	34.69667728	17.19372961	12.78889049	6.752009259	3.7655372
	1.640229603	1.267727216	0.378892759	0	0	0	0.054428843	0	0	0
	0	0	0	0	0	0
2002	7	1	0	2	16.34	0	0	0	0	0	0	0	0	0
	1.095341899	4.563679692	90.85248914	189.9012668	213.7650819	209.3176361	168.9042395
	95.96366226	61.72376844	44.49247641	29.09355678	18.35099793	15.45767788	4.636317634
	5.082817923	0.286179665	0	0	0	0	0	0	0	0	0	0
	0	0	0	0
```

```
2003    7    1    0    2    14.21    0    0    0    0    0    0    0    0    0
        1.546954925    7.558710268    104.1668711    169.7529751    197.5850801    204.2175465    159.4354936
        91.96381854    51.31474757    39.51402475    25.27494788    14.26513286    12.4363644    8.134897047
        2.772082952    1.285578631    0.200925691    0.200925691    0.743252161    0.803702764    0.200925691
        1.205554146    0.200925691    1.004628455    0.803702764    0    0    0    0    0
2004    7    1    0    2    11.87    0    0    0    0    0    0    0    0    0
        0.811506195    8.158068933    77.97942067    175.5441458    201.8030378    231.2604395    171.0089762
        111.8745605    81.28473196    50.53602071    27.14931311    16.15305867    9.35229547    3.45034879
        1.350572127    0.941780095    0.218564291    0.218564291    0    0    0    0    0    0
        0    0    0    0    0    0
2005    7    1    0    2    11.92    0    0    0    0    0    0    0    0    0
        0    0.257827306    35.67966254    97.06420024    168.4183449    206.9056593    174.6680116
        109.7862492    72.72232262    41.17857403    28.94006053    20.09590321    13.02722193    6.794466577
        1.563512919    0.617192708    0.073819605    0    0    0    0    0    0    0    0
        0    0    0    0    0
2006    7    1    0    2    10.25    0    0    0    0    0    0    0    0    0
        0.58473421    0.683561888    33.42415749    74.48423504    149.2137415    178.920259    160.3970234
        114.7899515    64.52729493    37.68747138    28.69649626    19.54810861    12.11708681    3.710198364
        7.211208317    1.531159369    1.008170616    0    0.088779862    0    0    0    0    0
        0    0    0    0    0    0
2007    7    1    0    2    11.92    0    0    0    0    0    0    0    0    0
        0    0.817386295    32.10564001    84.087885    115.0846102    156.0485297    106.6469346
        64.88228755    46.59812829    30.95920213    24.84395266    22.24216175    17.84850619    7.816574766
        2.084702907    0.584961896    0.014235087    0    0    0    0    0    0    0    0
        0    0    0    0    0
2008    7    1    0    2    13.23    0    0    0    0    0    0    0    0    0
        0    0    38.83045086    102.658862    164.0661383    218.0662097    167.3674901    89.19019984
        71.92812632    50.07928785    39.10290971    24.27854251    16.65045589    5.282519968    2.598551359
        1.10672818    0.359053293    0.388621595    0    0    0    0    0    0    0    0
        0    0    0    0
2009    7    1    0    2    14.9    0    0    0    0    0    0    0    0    0
        0.134449253    2.466592464    91.67877216    193.9151841    269.1649418    279.5127557    207.3700226
        147.4796803    79.73348899    61.26036126    51.18203497    34.40632528    24.86444684    15.40869482
        5.437134569    0.79509059    0.451354442    0.397545295    0    0    0    0    0    0
        0    0    0    0    0    0
2010    7    1    0    2    11.83    0    0    0    0    0    0    0    0    0
        0.42780491    0    57.69048654    152.5632859    223.9691725    244.8389062    149.9340616
        100.9917281    69.14236914    61.56803072    52.22815471    36.25937342    26.38051532    14.56980992
        7.862932723    0    0    0.693852708    0    0    0    0    0    0    0    0
        0    0    0    0
2011    7    1    0    2    12.45    0    0    0    0    0    0    0    0    0
        0.382858394    1.757071169    79.76129983    168.2982998    257.8306043    335.0552073    187.652497
        117.884117    73.28904564    66.15610821    50.14796199    27.40507624    23.65784498    11.28031456
        6.30001258    1.697183115    0.765716788    0    0    0    0    0    0    0    0
        0    0    0    0    0
2012    7    1    0    2    15.43    0    0    0    0    0    0    0    0    0
        0    6.424364814    136.0617645    312.6503226    364.7449173    322.81882    203.9854692
        109.5993566    70.89961326    68.03591156    49.21081204    32.46323887    18.50768745    7.561798896
        5.202472384    2.687395633    0.590600513    0.308579413    0    0    0    0    0    0
        0    0    0    0    0    0
2013    7    1    0    2    15.59    0    0    0    0    0    0    0    0    0
        0.45187025    1.763086218    93.65508142    214.536561    285.2873868    373.4311704    240.9153775
        137.3246203    102.4537968    67.11167068    45.14386393    32.33184096    19.73710898    8.120339205
        2.868603661    0.250963827    0    0    0    0    0    0    0    0    0    0
        0    0    0    0
2014    7    1    0    2    15.84    0    0    0    0    0    0    0    0
        0.055119262    1.428874176    2.653010399    140.4556176    304.0057863    339.6346313    345.3253415
        184.1244309    118.6525657    81.97776177    61.8115181    42.12861636    22.89775283    17.90755823
        11.29306259    4.933372192    1.346332411    1.25758783    0.677509991    0    0    0    0
        0    0    0    0    0    0    0    0
2015    7    1    0    2    14.76    0    0    0    0    0    0    0    0    0
        0.3613279    3.021327606    149.6496044    324.6834054    388.7992287    340.6556505    247.9685891
        141.4241292    97.4967899    62.92395445    39.94203351    29.87309928    11.27190018    4.647195051
        1.77949745    0.6196959    0    0.154342563    0.077171281    0    0    0    0    0
        0    0    0    0    0    0
```

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2016	7	1	0	2	13.3	0	0	0	0	0	0	0	0	0
	0.699286529	1.208395431	99.6180242	311.3326126	432.1316707	393.8891347	299.4163696
	140.7569365	91.34956607	66.07352712	42.42658892	30.46616723	17.6467136	7.338472082
	0.436746317	0.068433167	0	0	0	0	0	0	0	0	0	0
	0	0	0	0
2017	7	1	0	2	12.77	0	0	0	0	0	0	0	0	0
	0.478064799	0.902410462	73.41694629	306.7726631	439.8847327	478.8989049	332.1198584
	222.0727557	131.3884413	81.19840734	56.61193114	32.68525718	22.87378405	11.10215852
	2.247413445	0	0	0	0.056226559	0	0	0	0	0	0	0
	0	0	0	0
#Headboat landings length frequency	Month	Flt/Svy	Sex	Part	Nsamp
1981	7	2	0	2	18.52	0	0	0	0	0	0	0	0
	1.283869638	5.522249568	7.73756631	15.57657877	19.20253007	29.28166421	23.43877184
	18.4558402	11.43037297	10.73949842	11.96257202	8.680815982	5.162875116	4.68382418
	2.219821172	1.271483174	0.453043606	0.079104617	0.12802049	0	0	0	0
	0	0	0	0	0	0	0	0
1982	7	2	0	2	19.62	0	0	0	0	0	0	0	0.121482713
	1.090194166	5.695087963	14.09750052	22.96243101	28.44453315	42.27945666	43.19170906
	39.2438613	31.71501639	17.12060909	15.85082048	9.273999137	9.397422282	5.615348786
	4.194817524	1.756040583	1.022565185	0.670272936	0	0	0	0	0	0
	0	0	0	0	0	0	0
1983	7	2	0	2	23.22	0	0	0	0	0	0	0	0
	2.043037169	11.98903816	16.96586418	42.89347953	25.0364563	32.27042035	31.37659692
	28.11398358	19.5660003	29.90325526	8.599267928	5.236670974	3.702944638	1.798049469
	1.547108242	0.59444763	0.208657011	0.39582302	0	0.062162602	0	0	0
	0	0	0	0	0	0	0	0
1984	7	2	0	2	23.62	0	0	0	0	0	0	0	0
	0.275448731	5.445654404	10.13755443	15.33278111	15.65619485	39.95806826	33.91697089
	23.61769561	16.43707094	9.399319238	6.629638918	4.180691942	2.609127866	1.304617396
	0.438260646	0.161410552	0.065982641	0.037663875	0.028318766	0	0	0	0
	0	0	0	0	0	0	0	0
1985	7	2	0	2	23.62	0	0	0	0	0	0	0	0
	0.115556373	4.338773064	6.679223566	19.89702007	22.06205243	27.29822943	22.65030772
	19.18849324	13.65713083	8.696183777	4.953815133	3.708089207	4.664989574	2.29025137
	0.786362168	0.915282133	0.228612977	0.02771184	0	0	0	0	0	0
	0	0	0	0	0	0	0
1986	7	2	0	2	24.19	0	0	0	0	0	0	0	0
	0.173086957	0.555559627	3.121833174	18.1243986	29.20831844	49.61370053	33.39097125
	23.03923995	16.64264357	8.544956923	8.534827728	6.06799375	3.270013225	3.235341752
	1.07404444	1.283389647	0.080902299	0.133843265	0.026967433	0.026967433	0	0
	0	0	0	0	0	0	0	0	0
1987	7	2	0	2	22.29	0	0	0	0	0	0	0	0.025467593
	0.050935185	0.907281442	4.051798997	24.36769906	33.38076947	43.33497709	37.81059357
	29.05867572	19.74711408	10.08273602	12.13430756	8.985547359	2.656134613	4.380406132
	1.861896705	2.294855787	0.211785937	0.184017674	0	0	0	0	0	0
	0	0	0	0	0	0	0
1988	7	2	0	2	19	0	0	0	0	0	0	0	0
	0.535982335	1.413109426	7.176104567	44.47577866	44.17844125	51.76071812	41.54931339
	29.50573645	20.17080277	14.64356075	15.0295319	8.932486024	4.072981238	3.133129664
	1.421702734	2.314735233	0.389465607	0.334209945	0.334209945	0	0	0	0
	0	0	0	0	0	0	0	0
1989	7	2	0	2	20	0	0	0	0	0	0	0	0.069845794
	0.326546756	0.401115677	2.486254036	8.501957487	20.80398639	32.74184381	31.02969938
	21.33559013	16.58484755	9.190239993	8.858716563	5.71273403	2.828060531	3.055101514
	0.76572591	1.462580971	0.184518946	0	0.097634538	0	0	0	0	0
	0	0	0	0	0	0	0
1990	7	2	0	2	15.91	0	0	0	0	0	0	0	0
	0.127445175	0.814939052	2.052328139	14.65215268	34.00775946	37.01897747	32.03403216
	24.36603839	22.669489	13.33562333	11.8015815	7.771897017	7.345294332	4.315697641
	2.298783533	3.30208445	0.650247123	0.198629545	0	0	0	0	0	0
	0	0	0	0	0	0	0
1991	7	2	0	2	16.61	0	0	0	0	0	0	0	0
	0.192679537	0.739009 3.779702589	19.6834877	36.8780297	35.91879215	32.77312235
	22.74253733	16.67699573	10.25521885	9.924499121	6.217899122	6.756998344	5.405568092
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	2.20836416	1.723078096	0.766765379	0.097501832	0.048750916	0	0	0	0
	0	0	0	0	0	0	0	0
1992	7	2	0	2	15.49	0	0	0	0	0	0	0.155472622	0
	0.164110906	2.600748736	3.4854385	18.53846307	31.3219919	35.54684914	31.86284717
	21.76123443	22.08691508	10.14120901	7.794704768	3.406510007	6.525515949	4.353249905
	3.601012553	1.066326342	0.64780534	0.306594574	0	0	0	0	0	0
	0	0	0	0	0	0	0
1993	7	2	0	2	17.8	0	0	0	0	0	0	0	0
	0.086255906	2.205709676	1.913010108	21.32705153	45.64625065	34.66434963	31.48191745
	26.25203481	16.28634732	9.507216952	8.518128032	3.196240692	5.766334784	4.45210033
	4.239459028	1.479298545	1.421632465	0.2576621	0	0	0	0	0	0
	0	0	0	0	0	0	0
1994	7	2	0	2	17.06	0	0	0	0	0	0	0	0	0
	0.199644267	1.803199832	26.47279381	49.35370872	55.82230829	40.88843823	23.78516887
	15.58274712	10.82014062	5.71977487	3.270475806	4.406391613	1.800045435	2.01346869
	0.552545004	0.489413722	0	0.177735099	0	0	0	0	0	0	0
	0	0	0	0	0
1995	7	2	0	2	17.44	0	0	0	0	0	0	0	0	0
	0.401349171	0.517340781	20.97647928	31.88607049	28.83332033	28.96750823	23.06204777
	10.2569109	4.794654777	2.625987616	1.373286963	2.512313195	0.432657807	0.084682975
	0.401349171	0.254048924	0.115991611	0	0	0	0	0	0	0	0
	0	0	0	0	0
1996	7	2	0	2	15.97	0	0	0	0	0	0	0	0
	0.531496693	2.43057672	2.290833992	20.65613681	22.95599603	22.67532251	27.99077153
	20.31223895	8.354148837	5.077864969	2.359570517	0.575739067	0.794414923	0.134332643
	0.13619575	0.187164304	0.045229814	0.090965937	0	0	0	0	0	0
	0	0	0	0	0	0	0
1997	7	2	0	2	20.64	0	0	0	0	0	0	0	0.010475138
	0.206283767	1.412267241	1.2236942	24.91540501	33.89825095	23.851305	19.62302921
	15.36599558	8.805717323	5.33624973	2.165456012	1.369063956	0.225254321	0.751546855
	0.393363853	0.109707071	0	0.134420161	0.04051462	0	0	0	0	0
	0	0	0	0	0	0	0
1998	7	2	0	2	20.83	0	0	0	0	0	0	0	0.015142066
	0.310422446	0.508991616	3.261485646	21.48757299	30.88852186	23.42966634	17.73959576
	11.28062953	5.096150866	3.152201236	1.740297626	0.830561886	0.422620384	0.282355163
	0	0.07978458	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0
1999	7	2	0	2	19	0	0	0	0	0	0	0	0.060904762
	0	2.000777292	1.22276947	16.33467911	21.94807611	27.58043441	17.57589571
	9.159955015	5.411037806	4.114871972	1.973214251	0.789249275	0.252362389	0.523356657
	0.095728814	0.059083916	0.120603047	0	0	0	0	0	0	0	0
	0	0	0	0	0	0
2000	7	2	0	2	18.52	0	0	0	0	0	0	0	0	0
	0.187184834	2.212477418	19.6872576	29.16241074	30.99035098	13.4708503	6.806953731
	2.901119472	1.325357869	0.909975435	0.439790269	0.034959732	0.592277251	0.485441951
	0.093592417	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0
2001	7	2	0	2	17.75	0	0	0	0	0	0	0	0	0
	0.523198326	0.861111156	16.06013303	24.51613756	25.8251389	16.4018233	9.125411006
	4.343880997	2.207656366	0.83453253	0.454555972	0.407540366	0.185125329	0.122755166
	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0
2002	7	2	0	2	19	0	0	0	0	0	0	0	0
	0.009325843	0.224867792	0.436471212	18.97181986	40.65926875	24.47753364	22.36266327
	7.679568583	2.458331128	1.852824886	0.981334626	0.272533895	0.158324901	0.208530104
	0.192344828	0.004679245	0.05689818	0.004679245	0	0	0	0	0	0
	0	0	0	0	0	0	0
2003	7	2	0	2	21.47	0	0	0	0	0	0	0	0	0
	0.739408961	0.535850629	18.28298995	32.8268398	30.20780484	14.1517689	5.715622013
	3.383302136	1.679322576	0.38400729	0.377651515	0.049805363	0.07848064	0.07947953
	0	0.07848064	0.283185217	0	0	0	0	0	0	0	0	0
	0	0	0	0
2004	7	2	0	2	20.76	0	0	0	0	0	0	0	0
	0.003495091	0.459804289	1.924363554	26.55118783	40.47252238	27.76761638	11.07100989
	4.23619836	2.327158906	1.668539275	0.338873855	0.379259851	0.530214623	0
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	0.344730064	0.172365032	0.172365032	0.00114779	0.00114779	0	0	0	0
	0	0	0	0	0	0	0	0
2005	7	2	0	2	19.7	0	0	0	0	0	0	0	0	0
	0.531663924	2.571768085	28.32231485	47.04061957	31.78894623	20.05153839	10.36845856
	4.404963837	1.933206599	0.615261895	0.181935095	0.284114924	0.937325689	0	0
	0.054882353	0	0	0	0	0	0	0	0	0	0	0	0
	0	0
2006	7	2	0	2	19.1	0	0	0	0	0	0	0	0	0
	0.390376045	1.79646265	17.85141372	33.06098687	21.52899767	12.03005736	7.212327695
	1.499240133	2.359762965	0.302460834	0.212194736	0.226490279	0.19831738	0.142132209
	0.142132209	0.020647254	0	0	0	0	0	0	0	0	0	0
	0	0	0	0
2007	7	2	0	2	20.49	0	0	0	0	0	0	0	0
	0.065677419	0.601893749	1.576761088	26.51162711	32.20383865	18.51150006	13.31513648
	7.20857954	2.463003202	0.923976845	0.596079513	0.059977671	0.157739046	0.21027727
	0.004490099	0.12176484	0.065677419	0	0	0	0	0	0	0	0
	0	0	0	0	0	0
2008	7	2	0	2	18.11	0	0	0	0	0	0	0	0
	0.042202366	0.162179756	1.275393297	18.93981055	28.33879083	20.48978477	14.28995493
	8.693305688	5.634948437	3.016498163	1.132474544	0.584491379	0.266959571	0.230718012
	0.048713514	0.215774195	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0
2009	7	2	0	2	18.06	0	0	0	0	0	0	0	0	0
	0.573346667	0.740205411	19.36745875	29.58890337	17.03189031	7.762135329	5.161124151
	3.955652069	1.566220135	1.829586196	0.250307655	0.281190218	0.058688442	0.080364423
	0.132926869	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0
2010	7	2	0	2	16.43	0	0	0	0	0	0	0	0	0
	0.780262626	1.918081622	21.37939051	29.18331856	20.18693699	11.81281401	7.985178687
	3.573940481	2.553237031	1.741224873	0.758312524	0.023520833	0.109685928	0.121053662
	0	0.023520833	0	0.023520833	0	0	0	0	0	0	0	0
	0	0	0	0
2011	7	2	0	2	17.52	0	0	0	0	0	0	0	0	0
	0.139804 1.778574369	17.93375023	29.70362343	20.69596185	12.38229905	7.771412399
	3.744126044	1.978326526	1.275684729	0.325620141	0.208802396	0.601317737	0.098565217
	0.121950985	0.008180905	0	0	0	0	0	0	0	0	0	0
	0	0	0	0
2012	7	2	0	2	20.1	0	0	0	0	0	0	0	0	0
	0	0.777562351	16.24180889	25.64343777	20.45611161	15.71031393	11.19657048
	8.368341495	6.370633625	2.375643434	1.851627116	1.032568233	0.436232475	0.152838009
	0.117310233	0.065343195	0.018657143	0	0	0	0	0	0	0	0
	0	0	0	0	0
2013	7	2	0	2	19.75	0	0	0	0	0	0	0	0	0
	0.043738659	1.013475727	19.89000369	31.25520465	24.58819495	14.03261908	8.763205043
	6.021920463	4.078920069	1.554055918	0.685950735	0.401555473	0.155614012	0.21081167
	0.127054955	0.119674913	0	0	0	0	0	0	0	0	0	0
	0	0	0	0
2014	7	2	0	2	19.97	0	0	0	0	0	0	0	0	0
	0.020313889	1.391133295	27.70341729	41.48498178	32.95670333	23.69545768	15.01483812
	9.654907021	5.533122402	2.633133897	1.802818793	0.803809087	0.609823054	0.323801236
	0.144695652	0	0.144695652	0	0	0.072347826	0	0	0	0	0
	0	0	0	0	0
2015	7	2	0	2	20.83	0	0	0	0	0	0	0	0
	0.122444444	0	1.460588418	33.96235043	42.71570412	32.44556442	25.97246771
	16.63511004	10.42333796	5.431404909	2.205791684	0.718220577	0.760842681	0.291882049
	0.420924604	0.029429487	0.020936475	0	0	0	0	0	0	0	0
	0	0	0	0	0	0
2016	7	2	0	2	21.61	0	0	0	0	0	0	0	0	0
	0.073339244	1.617351673	27.15703569	38.90364824	39.52701245	34.2089535	21.06672813
	11.58973301	5.968933089	1.590244646	1.285201009	0.460594682	0.271977407	0.102353188
	0.021812766	0	0.009033408	0	0.464195652	0.257852212	0	0	0	0
	0	0	0	0	0	0
2017	7	2	0	2	17.78	0	0	0	0	0	0	0	0	0
	0.229750461	4.691390535	22.34643282	24.35644314	18.93664506	13.93697973	10.30024123
	6.511647285	4.836651165	1.957618563	0.959710494	0.376555836	0.897085269	0.195178346
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        0.098949465     0.032460758     0       0       0.016259843     0       0       0       0       0       0
        0       0       0       0       0
#MRIP landings length frequency         Month   Flt/Svy Sex     Part    Nsamp
1981    7       3       0       2       6       0       0       0       0       0       0       154.35316
        378.7756915     376.8335896     833.1776397     1035.824275     488.9472682     414.164396      598.2259713
        296.613053      291.3146997     123.6177044     75.1431655      60.06335488     0.249454403     37.7316444
        62.9097144      0.397919056     128.3968368     0       0       0       0       0       0       0       0
        0       0       0       0       0       0       0
1982    7       3       0       2       6.78    0       0       0       0       0       56.55698 54.65072 95.03653
        346.7697574     185.8905194     242.1252355     489.586207      677.8526899     762.2497132     498.8168504
        619.1011647     408.833189      648.1561479     358.9086376     172.5939471     121.2440608     99.47770954
        45.68667543     212.3867579     2.790094605     0       0       0       0       0       0       0       0
        0       0       0       0       0       0
1983    7       3       0       2       5.29    0       0       0       0       25.8226495      41.84909 77.17338
        325.0345394     80.01041305     107.6961962     272.1151025     266.4006849     153.5203015     33.22730823
        38.76524094     36.23608907     18.14483056     19.48628824     14.41370596     10.06658055     0       0
        19.14463551     0       17.29143 9.889639288    0       0       0       0       0       0       0       0
        0       0       0       0       0
1984    7       3       0       2       6.63    0       0       0       0       134.0655679     0       0
        132.511913      153.8434901     293.5052981     229.6041995     2277.236453     406.7221271     28.81605854
        228.1900835     36.6740197      54.90828249     13.23476426     61.68656647     9.309769111     0.141221778
        3.696052586     1.888831111     1.836859111     0       0       0       0       0       0       0       0
        0       0       0       0       0       0       0
1985    7       3       0       2       4.58    0       0       0       0       0       0       6.98599 42.63791643
        52.1877658      133.3647574     88.9098316      99.39416731     93.93484806     163.3154582     167.2847686
        186.6279232     125.9440491     291.1035079     197.0289863     35.80771489     28.8811658      21.90391719
        0       19.40244141     0       0       0       0       0       0       0       0       0       0       0
        0       0       0       0
1986    7       3       0       2       6       0       0       0       0       0       0       0       7.50215 29.95021
        12.85822 21.103 177.07827       35.37572041     199.40951       68.01384909     388.01961       61.50309 119.6655
        77.51634041     15.44448687     166.0506006     48.2386071      26.46169042     19.42399151     1.065990919
        0.429677786     0       0       0       0       0       0       0       0       0       0       0       0
        0
1987    7       3       0       2       7.75    0       0       0       0       0       0       0       0       6.47422
        13.11617 119.76915      24.94889 105.96304      170.6508772     139.44002       127.5285943     142.9101262
        169.011431      70.37756115     2.756916908     33.1372114      10.54182232     10.24303359     10.08800033
        5.429840334     0       0       0       0       0       0       0       0       0       0       0       0
        0       0
1988    7       3       0       2       7.35    0       0       0       0       0       0       0.404047593
        0       0       19.67390285     135.9240022     92.5465028      108.8276738     127.3735069     121.4248348
        251.3588265     107.9087999     80.05466811     19.76962 49.06919836    4.862300421     4.830027162
        5.494142932     0       0       3.38362 0       1.649966119     0       3.38363 0       0       0       0
        0       0       0       0
1989    7       3       0       2       7.07    0       0       0       0       0       0       0       0       4.38313
        3.40882 68.1158 151.7521284     75.20163672     733.47988       729.7360221     636.0903443     567.3966168
        43.45732518     156.0437561     190.4888597     300.7854042     185.2737486     527.7452003     185.9611361
        28.13075 98.22052 0     0       0       0       0       0       0       0       0       0       0
        0
1990    7       3       0       2       7.48    0       0       0       0       0       0       0       0       5.51808
        15.173  454.0826686     154.2820907     359.3242026     603.9278885     228.9278 91.98927917    253.4866849
        368.5116257     655.4287161     103.0715143     78.7569199      0.862890742     31.60836148     34.94569
        0.862890742     0       0       0       0       0       0       0       0       0       0       0       0
        0       0
1991    7       3       0       2       8.89    0       0       0       0       0       0       0       0       0
        0       31.33073324     58.31208111     151.4691075     83.04404466     163.7308955     214.4141 397.0152095
        423.1417706     927.0901392     389.1992893     363.671093      392.3784403     163.1810045     315.4770245
        75.09504555     61.66001 0      0       0       0       0       0       0       0       0       0       0
        0       0
1992    7       3       0       2       11      0       0       0       0       0       0       0       0       0
        4.99417 30.66859509     81.87706164     242.0305687     175.6882276     88.13886879     68.90022547
        75.88688374     62.73144713     39.58917214     22.52698463     18.53296212     14.67008739     22.14522977
        6.788357839     14.19961007     0       0       0.210711107     0       0       0       0       0       0
        0       0       0       0       0
1993    7       3       0       2       11.66   0       0       0       0       0       0       0       13.04268 5.25688
        3.26799 28.56886 320.5804968    399.8571672     343.5284953     333.1804966     208.6235307     83.21042447
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        60.13552356     63.79668731     26.44682 43.47512303    17.58168595     11.83796359     1.296131505
        0.214648467     1.048080196     0       0       0       0       0       0       0       0       0       0
        0       0       0
1994    7       3       0       2       10.91   0       0       0       0       0       0       4.87716 1.82631 0
        0       14.10935 115.5500007    164.6239938     229.2390767     296.7369735     150.0658793     86.81644403
        38.58802265     66.44591936     52.36417669     22.85237688     9.644347452     23.46002688     12.72983066
        3.026295263     0.21163849      0       0       0       0       0       0       0       0       0       0
        8.52168 0       0
1995    7       3       0       2       8.31    0       0       0       0       0       0       6.1505  8.54879 0
        60.95791 155.23579      173.24419       490.3377733     328.5050737     241.139971      151.8261006
        85.11275119     4.89691 51.68387707     2.511173641     36.0377238      57.88396481     5.3125  0       0
        0       0       0       0       0       0       0       0       0       0       0       0       0
        0.559378969
1996    7       3       0       2       9.22    0       0       0       0       0       0       0       0       0
        5.80308 18.05347 91.82908724    45.77167344     73.43377387     148.0639482     143.4366487     177.2423688
        85.17619847     50.26540208     7.542364784     3.28009 21.46132447     0       0       0       0       0
        0       0       0       0       0       0       0       0       0       0       0       0
1997    7       3       0       2       9.27    0       0       0       0       0       0       0       0       0
        0       2.068498265     51.69417149     119.8682954     97.01250585     181.1232331     124.5030953
        40.30784046     0.302948179     38.78902984     5.103744427     69.70197 50.67695 1.226869612   3.578552038
        0       0       0.016956001     0       0       0       0       0       0       0       0       0
        0       0
1998    7       3       0       2       11.27   0       0       0       0       0       0       0       0       0
        0.34466631      0.142067446     79.74643982     120.6970878     372.1824417     103.5068133     130.245349
        35.17332868     1.53251457      0.996890035     0.865809779     0.226006437     0.209000055     0.148134983
        0.536055266     0.029227634     0.122059259     0       31.86807 0      0       0       0       0       0
        0       0       0       0       0
1999    7       3       0       2       12.85   0       0       0       0       0       0       5.81042 0       0
        0       34.27541136     72.14127949     117.448446      119.9384611     68.61547631     47.79532942
        79.06739862     48.3118358      39.66690647     1.709003393     0.798704989     23.75464568     0.120840842
        0.090657729     0       0       0       0       0       0       0       0       0       0       0       0
        0       0       0
2000    7       3       0       2       12.92   0       0       0       0       0       0       0       0       0
        0.0151  2.54281 162.11558       275.29561       91.79847 112.1301 20.49838 7.4638       24.13107 8.74622 6.19478 0.95179
        0.30251 9.71803 0.12834 0.04709 0.30371 0       0       0       0       0       0       0       0       0
        0       0       0       0.05739
2001    7       3       0       2       12.08   0       0       0       0       0       0       0       0       0
        0       0       82.40381 92.42975 143.85955     49.0595 25.11323 81.60126 28.19542 11.66414 1.03515 5.01506 0.71242
        0.35368 0.09445 0.0656  0       0       0       0       0       0       0       0       0       0       0
        0       0       0
2002    7       3       0       2       15.13   0       0       0       0       0       0       0       0       0
        0       25.01756 271.0914 151.61581     245.7548 93.70762 58.06842 90.9833 7.20816 3.01728 0.67599 0.66809 0.99959
        1.41971 1.22493 0.30931 0.15444 0.06879 0       0       0       0       0       0       0       0       0
        0       0       0
2003    7       3       0       2       13.75   0       0       0       0       0       0       0       0       0
        0       6.544550889     334.2368909     143.6797627     458.3704106     322.7250338     129.2645389
        30.2884807      20.44636653     37.8494 2.65895 1.81250912      1.91569912      0.73816 0.189056641     0.1318
        0.53258 0       0       0       0       0       0       0       0.03033 0       0.15062 0       0       0
2004    7       3       0       2       14.42   0       0       0       0       0       0       0       0       0
        0       0       53.66974 339.41529      465.69861       271.12613       112.63568       77.66019 101.9546 28.78519
        3.50951 0.51554 1.28879 3.37038 0.139   0       0       0       0       0       0       0       0       0
        0       0       0       0       0       0
2005    7       3       0       2       14.35   0       0       0       0       0       0       31.67517 0      0
        0       0.12911 16.98459408     77.93997798     203.9222905     89.82939513     59.75158578     88.50633345
        15.7250668      10.63914626     9.39817 2.71449 1.79585 0.14401 0.17528 0       0       0       0       0
        0.30683 0       0       0       0       0       0       0       0       0
2006    7       3       0       2       14      0       0       0       0       0       0       0       0       0
        0.01662 11.25911 326.323299     228.7722358     282.2204551     177.6476 214.30082      154.11942       27.92383
        18.21314 28.29911 1.67646 34.64127 0    21.35046 0.32596 0      0       0       0       0       0       0
        0       0       0       0       0       0       0
2007    7       3       0       2       14.76   0       0       0       0       0       0       0       0       0
        0.06975 3.32498 265.06964       222.11088       296.37854       234.77871       220.0159 85.13937 117.17935
        21.17885 34.3905 1.02171 72.82999 0.32703 6.24532 0.13942 0      0       0       0       0       0       0
        0       0       0       0       0       0.15088 0
```

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2008	7	3	0	2	14.76	0	0	0	0	0	0	0	0	0
	26.66135	0.93864	127.98418	560.52707	403.28335	408.79059	310.53667	176.78194
	123.72544	125.6009	78.63233	6.1937	0.73027	0.75269	0.13949	0.23467	0	0	0	0	0
	0	0	0	0	0	0	0	0	0
2009	7	3	0	2	12.21	0	0	0	0	0	0	0	0	0
	0	3.09596	197.6418	186.60944	225.90447	96.81756	120.00323	39.43443	34.55305	5.13311	7.93452
	3.00963	5.34714	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0
2010	7	3	0	2	13.34	0	0	0	0	0	0	0	0	0
	0	2.57904	86.59377	302.51161	104.54753	91.75634	66.32363	63.13442	78.70525	10.77421	40.52949	0.17058
	0.9301	0.32282	0	0.65428	0	0	0	0	0	0	0	0	0	0
	0	0	0	0
2011	7	3	0	2	12.12	0	0	0	0	0	0	0	0	0
	0	0.43679	17.76667913	42.91223512	53.77285612	39.74806662	55.03427714	192.8889861
	189.2817879	4.317461865	2.61415	19.18084	0.98359	0.37651	0	0	0	0.19937	0	0
	0	0	0	0	0	0	0	0	0	0
2012	7	3	0	2	13.45	0	0	0	0	0	0	0	0	8.93148
	0.15085	4.98398	84.60605	118.58045	230.58695	215.7275	124.45141	71.04983	22.14021	15.27814	3.08628
	3.25747	5.15801	1.61784	0.31683	0.09581	0	0	0.8871	0	0	0	0	0	0
	0	0	0	0	0
2013	7	3	0	2	13.34	0	0	0	0	0	0	0	0	6.26297
	241.99504	14.80001	429.14421	349.62146	268.82558	140.13822	116.52554	61.80128
	36.43763	46.19313	1.14235	0.45812	3.81577	6.46947	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0
2014	7	3	0	2	15.2	0	0	0	0	0	0	0	0	0
	2.8648	5.7921	215.55249	271.27215	364.7414	379.40663	249.00075	283.27649	69.94912
	28.42244	6.12675	9.81241	5.10814	10.8517	1.63278	2.91513	0	0	0	0	0	0	0
	0	0	0	0	0	0	0
2015	7	3	0	2	14.97	0	0	0	0	0	0	0	0	0
	0	21.38233	151.38932	293.79527	266.32966	259.84001	154.92774	82.7977	32.90206
	33.14003	12.98112	4.33179	1.88544	5.28915	1.04898	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0
2016	7	3	0	2	14.35	0	0	0	0	0	0	0	0	0
	0.9797	5.96777	262.91787	374.7786	348.83538	276.12293	119.91396	72.08861	30.15117	12.66397
	4.33481	5.42763	9.34402	0.86737	0.19782	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0
2017	7	3	0	2	12.88	0	0	0	0	0	0	0	0	0
	2.85002	8.56101	43.82306	312.56779	379.24181	261.9634	232.0925	121.21155	67.46708	30.33524	25.42941
	14.52826	2.41294	28.24029	8.73942	10.83217	0	0	0	0	0	0	0	0	0
	0	0	0	0	0
#RVC Adult length frequency	Month	Flt/Svy	Sex	Part	Nsamp
1999	7	4	0	0	27.69	0	0	0	0	0	0	0	0
	1014.03876	2284.98692	1307.381014	1068.243436	596.5224799	371.1076843	329.1637583
	177.2129784	153.6620926	151.5921838	8.807620598	45.53095729	0.323844082	12.00852417
	0	0	12.15368972	0	1.700812135	0	0	0.425203034	0	0	0
	0	0	0	0	0	0
2000	7	4	0	0	29.9	0	0	0	0	0	0	0	0
	373.3003844	2263.808312	924.125449	1230.336836	188.8046391	718.7719478	850.6806057
	519.1942707	159.8065293	99.47523091	38.46750277	62.82506577	4.74670767	2.173839329
	0	0	2.005120787	0	0	0	0	0	0	0	0	0	0
	0	0	0	0
2004	7	4	0	0	28.83	0	0	0	0	0	0	0	0
	363.9696419	2911.599191	1314.081959	2696.818523	931.5869677	1253.771822	558.62623
	727.8360538	945.4213048	325.1988723	1192.992935	75.8085922	0.98082273	37.1204934
	0	0	0.150895805	0	0	0	0	0	0	0	0	0	0
	0	0	0	0
2006	7	4	0	0	32.4	0	0	0	0	0	0	0	0
	518.3986412	2510.956335	1586.821358	2805.040146	343.0579015	1197.293182	440.7571353
	383.361356	203.9868849	6.452137863	97.25758709	29.55698612	1.273926382	20.45981293
	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0
2008	7	4	0	0	37.23	0	0	0	0	0	0	0	0
	1105.376025	5531.466054	2803.568487	3442.497369	1600.56706	1638.228958	1290.019672
	708.4160388	456.2188576	150.9027485	60.30746893	28.91348438	0.706801968	1.916386294
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        23.11758229     0       2.204768731     0       0       0       0       6.60502351      0       0       0
        0       0       0       0       0       0
2010    7       4       0       0       37.96   0       0       0       0       0       0       0       0
        1072.4276       4057.763107     2906.538736     2391.195039     1220.300545     816.6276487     1036.520366
        310.1894371     114.8472886     21.40610836     7.386538198     28.49802841     4.238936568     6.200512712
        0       0       7.709532542     0       0       0       0       3.736699281     0       0       0       0
        0       0       0       0       0
2012    7       4       0       0       40.17   0       0       0       0       0       0       0       0
        1330.249131     4346.806255     2752.951323     2306.167483     1007.874686     1149.251983     1223.204344
        711.5465225     362.5209996     40.82185077     26.04434521     39.0988484      12.41533747     5.33581596
        0       0       1.298051915     0       0       0       0       0       0       0       0       0       0
        0       0       0       0
2014    7       4       0       0       39.46   0       0       0       0       0       0       0       0
        2364.723527     3960.602858     3905.681178     3616.830823     3203.698212     2116.583221     3386.545191
        676.973507      1253.855509     325.8161032     43.0914899      42.8102913      5.774566358     3.011093426
        2.663399214     1.421190379     0.494137291     0       1.649205419     0       6.596821676     16.49205419
        6.596821676     1.649205419     0       0       0       0       0       0       0
2016    7       4       0       0       36.62   0       0       0       0       0       0       0       0
        2196.75161      5135.886356     3693.774683     2155.910162     1384.768439     809.3308368     777.0887176
        518.6118427     137.8887402     71.2435963      27.38774426     22.35659015     16.19366752     4.944866169
        0.568290155     3.140570616     0       0       0       0       0       0       0       0       0       0
        0       0       0       0       0
#RVC Juvenile length frequency          Month   Flt/Svy Sex     Part    Nsamp
1999    7       5       0       0       27.69   127.3498504     320.2138852     366.4351929     814.1633636
        1196.124306     1220.314446     2067.561428     1756.207599     983.4063087     0       0       0       0
        0       0       0       0       0       0       0       0       0       0       0       0       0       0
        0       0       0       0       0       0       0       0       0       0       0       0
2000    7       5       0       0       29.9    48.18290285     85.96397214     365.3456283     1443.125286
        2738.129553     2898.640296     3987.659317     1996.001599     1316.81213      0       0       0       0
        0       0       0       0       0       0       0       0       0       0       0       0       0       0
        0       0       0       0       0       0       0       0       0       0       0       0
2004    7       5       0       0       28.83   11.0471033      410.010586      616.1994532     798.1794587
        1950.170452     2528.767239     3504.222417     2060.751487     1323.444134     0       0       0       0
        0       0       0       0       0       0       0       0       0       0       0       0       0       0
        0       0       0       0       0       0       0       0       0       0       0       0
2006    7       5       0       0       32.4    275.1277512     462.9605006     1575.131923     2210.545203
        2116.401928     2342.709889     3744.889148     2307.012353     1487.17956      0       0       0       0
        0       0       0       0       0       0       0       0       0       0       0       0       0       0
        0       0       0       0       0       0       0       0       0       0       0       0
2008    7       5       0       0       37.23   124.0920126     225.7584238     588.0726027     1072.893588
        2360.002742     3736.046211     4630.924491     3566.701678     2913.831331     0       0       0       0
        0       0       0       0       0       0       0       0       0       0       0       0       0       0
        0       0       0       0       0       0       0       0       0       0       0       0
2010    7       5       0       0       37.96   38.46793209     251.5810598     338.8456271     338.1189914
        962.1738394     2268.162684     5184.676703     4492.779903     2503.380218     0       0       0       0
        0       0       0       0       0       0       0       0       0       0       0       0       0       0
        0       0       0       0       0       0       0       0       0       0       0       0
2012    7       5       0       0       40.17   83.29699948     489.721119      1684.144883     1745.267188
        2573.822378     2693.341268     3399.089054     3188.190798     2334.015929     0       0       0       0
        0       0       0       0       0       0       0       0       0       0       0       0       0       0
        0       0       0       0       0       0       0       0       0       0       0       0
2014    7       5       0       0       39.46   94.3350644      444.5578125     1582.280704     2036.781949
        2273.776013     3055.224196     4717.166195     4899.527127     2525.576779     0       0       0       0
        0       0       0       0       0       0       0       0       0       0       0       0       0       0
        0       0       0       0       0       0       0       0       0       0       0       0
2016    7       5       0       0       36.62   31.48651832     410.004195      1483.75708      1914.598568
        2102.39783      2238.65171      4472.362789     4993.827555     2340.915397     0       0       0       0
        0       0       0       0       0       0       0       0       0       0       0       0       0       0
        0       0       0       0       0       0       0       0       0       0       0       0
#MRIP CPUE length frequency             Month   Flt/Svy Sex     Part    Nsamp
2005    7       6       0       0       16.67   0       0       0       0       5.349397005     8.024095507
        66.21302685     149.0572186     342.8143874     423.6099017     428.3496904     245.7040986     97.95058834
        203.9401644     92.46305919     62.43522123     88.50633345     15.72953527     10.63914626     9.39817 2.71449
        4.420577115     0.14401 0.17528 0       0       0       0       0       0.30683 0       0       0       0
        0       0       0       0       0
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2006	7	6	0	0	16.61	0	0	0	0	0	12.01166867	6.701012131
	114.7004475	352.3348598	739.4839265	913.8094294	844.1633504	243.8837546	285.9082359
	177.6872794	214.30082	154.11942	27.92383	18.21314	28.29911	1.67646	34.64127	0	21.35046	0.32596
	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	7	6	0	0	16.82	0	0	0	0	7.455327652	6.01836719
	60.79742993	260.5171693	566.2821297	924.9472673	1029.411345	847.4371009	258.8482983
	300.6971579	240.8280233	220.0391096	85.13937	117.17935	21.17885	34.3905	1.02171	72.82999	0.32703
	6.24532	0.13942	0	0	0	0	0	0	0	0	0	0	0	0
	0.15088	0
2008	7	6	0	0	15.33	0	0	0	0	0	0	39.33677232
	275.3574062	480.8167298	552.0945269	1012.468222	922.3423071	620.7037314	403.28335
	456.9028243	310.53667	176.78194	123.72544	125.6009	78.63233	6.1937	0.73027	0.75269	0.13949
	0.23467	0	0	0	0	0	0	0	0	0	0	0	0	0
	0
2009	7	6	0	0	12.85	0	0	0	0	0	0	0	0
	268.9010061	460.9731533	1040.285555	748.1239172	225.0238694	264.3188994	96.81756
	120.00323	39.43443	34.55305	5.13311	7.93452	3.00963	5.34714	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
2010	7	6	0	0	14.63	0	0	0	0	0	0	0	34.75407026
	159.5401234	273.764208	694.482557	416.8467894	338.7957466	104.54753	91.75634	66.32363
	63.13442	78.70525	10.77421	40.52949	0.17058	0.9301	0.32282	0	0.65428	0	0	0	0	0
	0	0	0	0	0	0	0	0	0
2011	7	6	0	0	13.08	0	0	0	0	0	21.90835843	0
	21.90835843	43.81671687	297.75402	957.0828862	219.0035031	108.6373104	96.77475498
	53.3589429	55.03427714	192.8889861	189.2817879	4.317461865	2.61415	19.18084	0.98359	0.37651
	0	0	0	0.19937	0	0	0	0	0	0	0	0	0	0
	0	0
2012	7	6	0	0	15.36	0	0	0	0	0	4.955782588	12.59025319
	96.05646288	217.4675051	402.5092423	684.4108347	330.3033842	130.3531941	239.4413829
	216.9727734	128.5896835	71.04983	22.14021	15.27814	3.08628	3.25747	5.15801	1.61784	0.31683	0.09581	0
	0	0.8871	0	0	0	0	0	0	0	0	0	0	0
2013	7	6	0	0	15.94	0	0	0	0	0	0	16.30095809
	81.58828631	481.0995481	1759.395458	2060.526225	1126.330185	392.9368664	274.1823251
	140.13822	116.52554	61.80128	42.02509784	46.19313	1.14235	0.45812	3.81577	6.46947	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2014	7	6	0	0	16.82	0	0	0	0	12.70892889	0	6.354464446
	19.06339334	400.3312601	1343.656798	1727.851965	666.7194657	379.2980456	383.8047933
	379.40663	249.00075	283.27649	69.94912	28.42244	6.12675	16.16687445	11.46260445	10.8517
	1.63278	2.91513	0	0	0	0	0	0	0	0	0	0	0	0
	0	0
2015	7	6	0	0	17.8	0	0	0	0	0	0	17.7724014
	22.06985591	234.3191519	612.9963477	1193.545159	686.6467385	355.6856587	299.4436996
	268.6425255	154.92774	91.6002155	32.90206	37.49944515	12.98112	4.33179	1.88544	5.28915	1.04898
	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0
2016	7	6	0	0	17.61	0	0	0	0	0	5.064410837	15.28406344
	58.07756223	235.8798191	363.2260186	578.9812823	496.0722128	396.2600767	364.7796216
	291.0000091	123.2211839	72.08861	30.74640992	13.25920992	4.33481	5.42763	9.34402	0.86737	0.19782
	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0
2017	7	6	0	0	16.94	0	0	0	0	0	1.722111464	29.50897749
	153.6964906	371.4373914	596.1550302	806.5993146	321.6224062	342.2726341	389.9127706
	262.9747539	238.1903885	121.21155	67.46708	32.16482942	25.42941	14.52826	2.41294	28.24029	8.73942
	10.83217	0	0	0	0	0	0	0	0	0	0	0	0	0
	0
#Headboat discards length frequency	Month	Flt/Svy	Sex	Part	Nsamp

2005	7	2	0	1	8.49	0	0	0	0	0.051316058	0.076974087
	0.331317095	1.429886195	3.288573101	4.06363379	4.107863422	2.194075973	0.19195914
	0.000171462	0.025264391	0.02574376	0	4.28655E-05	0	0	0	0.02517866
	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0
2006	7	2	0	1	8.94	0	0	0	0	0	0.086348764	0.048171834
	0.824551704	2.532843727	5.315838262	6.488199654	3.722617532	0.108632781	0.026510497
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	0.000285245	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
2007	7	2	0	1	8.06	0	0	0	0	0.057742685	0.046613201
	0.470885658	2.017746454	4.385944168	7.16332185	7.947200292	4.510527589	0.284537083
	0.033448375	0.046852883	0.000179762	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0
2008	7	2	0	1	4.12	0	0	0	0	0	0	0.483416913
	3.383918391	5.908846241	6.45714606	12.43087521	9.762014802	0.739522187	0
	0.591260198	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
2009	7	2	0	1	4	0	0	0	0	0	0	0	0
	4.226835106	7.246003038	16.30350684	8.652987848	0.603833587	0.603833587	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0
2010	7	2	0	1	6	0	0	0	0	0	0	0	0.827245272
	3.797506647	6.516363267	16.46926271	7.860956918	0.863665183	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0
2011	7	2	0	1	4.9	0	0	0	0	0	0.3184562	0
	0.3184562	0.6369124	4.328102174	13.90564618	2.925144506	0.9553686	0.625068343
	0.1978454	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
2012	7	2	0	1	7.42	0	0	0	0	0	0.090394881	0.22964979
	1.752097138	3.803756267	7.339131241	12.39293861	4.48158909	0.214738193	0.161507369
	0.022714141	0.075483283	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0
2013	7	2	0	1	8.72	0	0	0	0	0	0	0.1326711
	0.664035062	3.86462507	12.34989882	16.64986478	5.674294105	0.352537722	0.043597761
	0	0	0	0.045475579	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
2014	7	2	0	1	7.21	0	0	0	0	0.200285714	0	0.100142857
	0.300428571	6.309	21.13014286	27.13871429	7.110142857	1.702428571	0.300428571	0
	0	0	0	0	0	0.100142857	0.100142857	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
2015	7	2	0	1	9.64	0	0	0	0	0	0	0.431563993
	0.5359183	5.689929374	14.88527889	28.46341693	12.9975586	1.502873059	0.804102205
	0.213749884	0	0.213749884	0	0.105858886	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2016	7	2	0	1	10.2	0	0	0	0	0	0.225788458	0.681414922
	2.589292939	10.51631519	16.15015849	25.54686843	10.3948043	0.957716436	0.710847884
	0.663270194	0.147447157	0	0.026537797	0.026537797	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0
2017	7	2	0	1	11	0	0	0	0	0	0.025601282	0.438686844
	2.284885282	5.521868621	8.820200643	11.86381009	4.129825182	0.441598639	0.158636809
	0.015035006	0.09065253	0	0	0.027199072	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0
#MRIP discards length frequency	month	flt_svy	sex	part	nsamp

2005	7	3	0	1	8.49	0	0	0	0	5.349397005	8.024095507
	34.53785685	149.0572186	342.8143874	423.6099017	428.2205804	228.7195045	20.01061036
	0.017873893	2.633664061	2.683635449	0	0.004468473	0	0	0	2.624727115
	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0
2006	7	3	0	1	8.94	0	0	0	0	0	12.01166867	6.701012131
	114.7004475	352.3348598	739.4673065	902.5503194	517.8400514	15.11151876	3.687780749
	0.039679375	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
2007	7	3	0	1	8.06	0	0	0	0	7.455327652	6.01836719
	60.79742993	260.5171693	566.2821297	924.8775173	1026.086365	582.3674609	36.73741831
	4.318617908	6.049313276	0.023209564	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0
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2008	7	3	0	1	4.12	0	0	0	0	0	0	39.33677232
	275.3574062	480.8167298	525.4331769	1011.529582	794.3581271	60.17666143	0
	48.11223428	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
2009	7	3	0	1	4	0	0	0	0	0	0	0	0
	268.9010061	460.9731533	1037.189595	550.4821172	38.41442944	38.41442944	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0
2010	7	3	0	1	6	0	0	0	0	0	0	0	34.75407026
	159.5401234	273.764208	691.903517	330.2530194	36.28413659	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0
2011	7	3	0	1	4.9	0	0	0	0	0	21.90835843	0
	21.90835843	43.81671687	297.75402	956.6460962	201.236824	65.7250753	43.00189886
	13.61087628	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
2012	7	3	0	1	7.42	0	0	0	0	0	4.955782588	12.59025319
	96.05646288	208.5360251	402.3583923	679.4268547	245.6973342	11.77274411	8.854432924
	1.245273421	4.138273505	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0
2013	7	3	0	1	8.72	0	0	0	0	0	0	16.30095809
	81.58828631	474.8365781	1517.400418	2045.726215	697.1859746	43.31540643	5.356745126
	0	0	0	5.587467836	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
2014	7	3	0	1	7.21	0	0	0	0	12.70892889	0	6.354464446
	19.06339334	400.3312601	1340.791998	1722.059865	451.1669757	108.0258956	19.06339334
	0	0	0	0	0	0	6.354464446	6.354464446	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0
2015	7	3	0	1	9.64	0	0	0	0	0	0	17.7724014
	22.06985591	234.3191519	612.9963477	1172.162829	535.2574185	61.89038867	33.11403963
	8.802515503	0	8.802515503	0	4.359415151	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2016	7	3	0	1	10.2	0	0	0	0	0	5.064410837	15.28406344
	58.07756223	235.8798191	362.2463186	573.0135123	233.1543428	21.4814767	15.9442416
	14.87707914	3.307223878	0	0.595239924	0.595239924	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0
2017	7	3	0	1	11	0	0	0	0	0	1.722111464	29.50897749
	153.6964906	371.4373914	593.3050102	798.0383046	277.7993462	29.7048441	10.67096062
	1.011353886	6.097888514	0	0	1.829589417	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0
#Commercial discards length frequency		Month	Flt/Svy	Sex	Part	Nsamp
2009	7	1	0	1	1.41	0	0	0	0	0	0	0	0.753358044
	0.753358044	3.013432174	30.13432174	23.35409935	2.260074131	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0
2010	7	1	0	1	1.73	0	0	0	0	0	0	0	0	0
	11.43221043	15.24294724	19.05368405	0	0	0	0	3.81073681	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0
2011	7	1	0	1	1.73	0	0	0	0	0	0	0	0	0
	1.843161133	16.58845019	39.32077083	1.843161133	0	0.614387044	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0
2012	7	1	0	1	3.32	0	0	0	0	0	0	0	0.67459718
	1.686492949	4.047583078	15.85303372	14.50383936	1.011895769	1.011895769	0
	0.33729859	0.33729859	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
2013	7	1	0	1	2.65	0	0	0	0	0	0	0	0
	0.552872531	3.870107719	22.39133752	19.3505386	0.552872531	0	0	0
	0.276436266	0	0.276436266	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
2014	7	1	0	1	3	0	0	0	0	0	0.542718786	0
	3.7990315	2.713593929	6.512625429	21.70875143	22.25147022	0	0	1.085437572
```

```
	0.542718786	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
2015	7	1	0	1	2.83	0	0	0	0	0	0	0	0
	0.294087016	0.882261049	9.410784522	11.76348065	0.294087016	0.294087016	0
	0.294087016	0.294087016	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
2016	7	1	0	1	3	0	0	0	0	0	0	0	0	0
	2.064894913	9.636176263	30.62927455	0.688298304	0.688298304	0.344149152	0.344149152
	0.344149152	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0
2017	7	1	0	1	2.65	0	0	0	0	0	0	0	0	0
	1.082465563	3.788629469	24.35547516	8.659724501	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0
-9999	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0
#
#AGE DATA-------------------------------------------------------------------------------------------------------------------------
21	#_N_age'_bins;  these are in terms of age', not true age.
# following vector is the lower edge of the integer age' for each age' bin;
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
	15	16	17	18	19	20
1	#_N_ageerror_definitions;
#Age error 1: No age error
-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
	-1	-1	-1	-1	-1	-1
0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
	0.001	0.001	0.001	0.001	0.001	0.001
#_mintailcomp	#_addtocomp:	#combM+F	#_compressbins:	Comp_Error	#_Comp_Error2: parameter number for the
dirichlet error distribution	#_minsamplesize:
0	1.00E-07 0	8	0	0	0.01	# 1 COM
0	1.00E-07 0	8	0	0	0.01	# 2 HB
0	1.00E-07 0	8	0	0	0.01	# 3 MRIP
0	1.00E-07 0	8	0	0	0.01	# 4 RVC Adult
0	1.00E-07 0	8	0	0	0.01	# 5 RVC Juv
0	1.00E-07 0	8	0	0	0.01	#6 MRIP_CPUE
0	1.00E-07 0	8	0	0	0.01	#7 FI
3	 #_Lbin_method_for_Age_Data: 1=poplenbins; 2=datalenbins; 3=lengths
# the age composition data vectors below are by age' bins, not by true age
#Yr	Month	Flt/Svy	Sex	Part	Ageerr	Lbin_lo	Lbin_hi	Nsamp	datavector
1981	7	1	0	2	1	22	22	2	0	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1981	7	1	0	2	1	24	24	3	0	0	4	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1981	7	1	0	2	1	26	26	3.74	0	0	2	6	5	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
1981	7	1	0	2	1	28	28	6	0	0	2	17	7	6	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0
1981	7	1	0	2	1	30	30	4.24	0	0	0	6	6	2	1	1	1	0	0	0	1	0	0	0	0	0	0	0	0
1981	7	1	0	2	1	32	32	4.24	0	0	1	2	7	4	2	1	0	0	0	1	0	0	0	0	0	0	0	0	0
1981	7	1	0	2	1	34	34	3.16	0	0	0	0	1	3	1	2	2	1	0	0	0	0	0	0	0	0	0	0	0
1981	7	1	0	2	1	36	36	3.74	0	0	0	0	2	6	3	1	2	0	0	0	0	0	0	0	0	0	0	0	0
1981	7	1	0	2	1	38	38	2.24	0	0	0	0	0	0	0	4	1	0	0	0	0	0	0	0	0	0	0	0	0
1981	7	1	0	2	1	40	40	3.16	0	0	0	0	0	2	3	2	2	0	0	1	0	0	0	0	0	0	0	0	0
1981	7	1	0	2	1	42	42	2	0	0	0	1	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
1981	7	1	0	2	1	44	44	2.83	0	0	0	0	0	0	0	1	2	3	0	1	0	0	0	0	1	0	0	0	0
1981	7	1	0	2	1	46	46	1.41	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0
1981	7	1	0	2	1	48	48	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
1992	7	1	0	2	1	26	26	1.41	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1992	7	1	0	2	1	28	28	3	0	0	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1992	7	1	0	2	1	30	30	3.46	0	0	7	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
```

1992	7	1	0	2	1	32	32	4.24	0	0	1	16	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
1992	7	1	0	2	1	34	34	3.87	0	0	0	13	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1992	7	1	0	2	1	36	36	2.45	0	0	0	4	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1992	7	1	0	2	1	38	38	2.65	0	0	0	2	2	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1992	7	1	0	2	1	40	40	2	0	0	0	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
1992	7	1	0	2	1	46	46	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1993	7	1	0	2	1	24	24	3.46	0	0	9	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1993	7	1	0	2	1	26	26	6.24	0	0	21	15	1	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
1993	7	1	0	2	1	28	28	5.29	0	0	11	10	3	1	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0
1993	7	1	0	2	1	30	30	4.8	0	0	9	12	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1993	7	1	0	2	1	32	32	4.12	0	0	0	10	4	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1993	7	1	0	2	1	34	34	4.12	0	0	0	6	6	0	3	1	1	0	0	0	0	0	0	0	0	0	0	0	0
1993	7	1	0	2	1	36	36	2	0	0	1	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1993	7	1	0	2	1	38	38	2	0	0	0	1	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0
1993	7	1	0	2	1	40	40	1.73	0	0	0	0	0	0	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0
1993	7	1	0	2	1	42	42	1.73	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0
1993	7	1	0	2	1	44	44	2.24	0	0	0	0	0	0	0	1	2	1	0	1	0	0	0	0	0	0	0	0	0
1993	7	1	0	2	1	46	46	1.41	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
1993	7	1	0	2	1	48	48	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
1994	7	1	0	2	1	22	22	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1994	7	1	0	2	1	24	24	2	0	0	3	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1994	7	1	0	2	1	26	26	3	0	0	4	2	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1994	7	1	0	2	1	28	28	6.08	0	0	4	24	2	1	2	1	2	0	1	0	0	0	0	0	0	0	0	0	0
1994	7	1	0	2	1	30	30	7.62	0	0	6	40	5	4	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
1994	7	1	0	2	1	32	32	6.56	0	0	0	27	10	2	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0
1994	7	1	0	2	1	34	34	4.69	0	0	0	14	7	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
1994	7	1	0	2	1	36	36	4.69	0	0	0	6	11	2	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0
1994	7	1	0	2	1	38	38	3.74	0	0	0	3	8	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
1994	7	1	0	2	1	40	40	3.61	0	0	0	0	4	2	1	3	1	1	1	0	0	0	0	0	0	0	0	0	0
1994	7	1	0	2	1	42	42	3	0	0	0	0	0	1	0	3	3	0	1	1	0	0	0	0	0	0	0	0	0
1994	7	1	0	2	1	44	44	2.24	0	0	0	0	1	0	0	0	1	0	0	0	2	1	0	0	0	0	0	0	0
1994	7	1	0	2	1	46	46	3.46	0	0	0	0	0	0	0	1	2	1	1	3	1	0	1	0	2	0	0	0	0
1994	7	1	0	2	1	48	48	1.41	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0
1994	7	1	0	2	1	50	50	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
1995	7	1	0	2	1	20	20	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1995	7	1	0	2	1	22	22	2.24	0	0	0	2	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1995	7	1	0	2	1	24	24	3.61	0	0	7	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1995	7	1	0	2	1	26	26	6.56	0	0	30	5	4	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1995	7	1	0	2	1	28	28	6.71	0	0	8	17	12	3	3	0	2	0	0	0	0	0	0	0	0	0	0	0	0
1995	7	1	0	2	1	30	30	7.42	0	0	4	40	4	3	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0
1995	7	1	0	2	1	32	32	6.08	0	0	0	22	10	2	1	0	0	2	0	0	0	0	0	0	0	0	0	0	0
1995	7	1	0	2	1	34	34	4.47	0	0	2	9	7	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1995	7	1	0	2	1	36	36	4.36	0	0	0	8	10	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
1995	7	1	0	2	1	38	38	3.74	0	0	0	2	7	1	0	3	0	1	0	0	0	0	0	0	0	0	0	0	0
1995	7	1	0	2	1	40	40	2.45	0	0	0	0	0	3	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0
1995	7	1	0	2	1	42	42	2	0	0	0	0	0	2	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
1995	7	1	0	2	1	44	44	1.41	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1995	7	1	0	2	1	46	46	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
1995	7	1	0	2	1	50	50	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0

1995	7	1	0	2	1	54	54	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
1996	7	1	0	2	1	20	20	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1996	7	1	0	2	1	22	22	2.45	0	1	4	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1996	7	1	0	2	1	24	24	6.63	0	11	20	3	4	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1996	7	1	0	2	1	26	26	9.85	0	5	72	12	3	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1996	7	1	0	2	1	28	28	8.89	0	1	48	19	3	3	1	2	1	1	0	0	0	0	0	0	0	0	0	0	0
1996	7	1	0	2	1	30	30	7.81	0	0	21	8	15	8	6	1	1	1	0	0	0	0	0	0	0	0	0	0	0
1996	7	1	0	2	1	32	32	6.78	0	0	9	17	8	7	2	0	2	0	1	0	0	0	0	0	0	0	0	0	0
1996	7	1	0	2	1	34	34	4.36	0	0	4	10	2	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1996	7	1	0	2	1	36	36	3.87	0	0	0	6	6	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1996	7	1	0	2	1	38	38	3.74	0	0	0	3	3	2	2	1	1	1	0	0	1	0	0	0	0	0	0	0	0
1996	7	1	0	2	1	40	40	3	0	0	0	0	5	1	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0
1996	7	1	0	2	1	42	42	2.45	0	0	0	0	0	0	1	0	1	1	1	1	1	0	0	0	0	0	0	0	0
1996	7	1	0	2	1	48	48	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
1997	7	1	0	2	1	22	22	2.45	0	0	4	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1997	7	1	0	2	1	24	24	10.77	0	1	81	21	6	4	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1997	7	1	0	2	1	26	26	13.78	0	2	101	59	17	9	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1997	7	1	0	2	1	28	28	12.17	0	0	39	63	20	9	9	5	0	2	0	0	1	0	0	0	0	0	0	0	0
1997	7	1	0	2	1	30	30	12.49	0	0	11	71	28	21	13	7	3	0	1	1	0	0	0	0	0	0	0	0	0
1997	7	1	0	2	1	32	32	10.44	0	0	1	43	23	19	7	8	4	3	1	0	0	0	0	0	0	0	0	0	0
1997	7	1	0	2	1	34	34	8.94	0	0	0	19	24	13	13	3	5	2	0	1	0	0	0	0	0	0	0	0	0
1997	7	1	0	2	1	36	36	5.66	0	0	0	7	5	7	7	2	1	1	1	1	0	0	0	0	0	0	0	0	0
1997	7	1	0	2	1	38	38	6	0	0	0	2	8	11	10	3	1	0	0	1	0	0	0	0	0	0	0	0	0
1997	7	1	0	2	1	40	40	5.1	0	0	0	2	2	3	8	7	1	0	0	3	0	0	0	0	0	0	0	0	0
1997	7	1	0	2	1	42	42	4.8	0	0	0	1	1	2	3	4	3	3	1	2	2	1	0	0	0	0	0	0	0
1997	7	1	0	2	1	44	44	4	0	0	0	0	0	2	1	4	0	3	3	3	0	0	0	0	0	0	0	0	0
1997	7	1	0	2	1	46	46	2.45	0	0	0	0	0	1	1	1	0	1	0	0	2	0	0	0	0	0	0	0	0
1997	7	1	0	2	1	48	48	1.73	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0
1997	7	1	0	2	1	50	50	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
1998	7	1	0	2	1	22	22	1.41	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
1998	7	1	0	2	1	24	24	7.14	0	9	32	9	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1998	7	1	0	2	1	26	26	8.31	0	0	35	25	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1998	7	1	0	2	1	28	28	7.75	0	0	16	27	11	3	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0
1998	7	1	0	2	1	30	30	9	0	0	11	36	17	9	5	2	1	0	0	0	0	0	0	0	0	0	0	0	0
1998	7	1	0	2	1	32	32	7.48	0	0	6	26	13	5	2	1	0	1	2	0	0	0	0	0	0	0	0	0	0
1998	7	1	0	2	1	34	34	6.78	0	0	0	11	15	5	7	4	3	0	1	0	0	0	0	0	0	0	0	0	0
1998	7	1	0	2	1	36	36	5.74	0	0	0	10	5	5	5	7	0	1	0	0	0	0	0	0	0	0	0	0	0
1998	7	1	0	2	1	38	38	5.57	0	0	0	8	7	1	4	5	2	1	2	1	0	0	0	0	0	0	0	0	0
1998	7	1	0	2	1	40	40	3.16	0	0	0	1	2	2	1	2	1	0	0	1	0	0	0	0	0	0	0	0	0
1998	7	1	0	2	1	42	42	3.16	0	0	0	0	1	0	2	1	2	0	1	3	0	0	0	0	0	0	0	0	0
1998	7	1	0	2	1	44	44	1.73	0	0	0	0	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0
1998	7	1	0	2	1	46	46	1.73	0	0	0	0	0	0	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0
1998	7	1	0	2	1	48	48	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
1998	7	1	0	2	1	56	56	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
1999	7	1	0	2	1	22	22	5.66	0	3	28	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1999	7	1	0	2	1	24	24	9.9	0	9	79	9	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1999	7	1	0	2	1	26	26	12.29	0	23	90	29	5	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
1999	7	1	0	2	1	28	28	12.33	0	7	100	25	11	6	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1999	7	1	0	2	1	30	30	11.09	0	7	60	16	18	8	8	2	3	0	1	0	0	0	0	0	0	0	0	0	0

1999	7	1	0	2	1	32	32	8.66	0	5	27	16	14	9	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0
1999	7	1	0	2	1	34	34	6.32	0	1	2	17	10	6	2	1	0	1	0	0	0	0	0	0	0	0	0	0	0
1999	7	1	0	2	1	36	36	5	0	0	5	3	7	4	3	2	1	0	0	0	0	0	0	0	0	0	0	0	0
1999	7	1	0	2	1	38	38	3	0	0	1	2	1	1	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0
1999	7	1	0	2	1	40	40	3.32	0	0	0	0	2	3	1	1	1	2	1	0	0	0	0	0	0	0	0	0	0
1999	7	1	0	2	1	42	42	2.45	0	0	0	0	1	0	2	1	2	0	0	0	0	0	0	0	0	0	0	0	0
1999	7	1	0	2	1	44	44	2.45	0	0	0	0	0	0	0	1	2	0	1	0	0	0	2	0	0	0	0	0	0
1999	7	1	0	2	1	46	46	2.24	0	0	0	0	0	0	1	0	1	2	0	0	0	1	0	0	0	0	0	0	0
1999	7	1	0	2	1	48	48	1.41	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0
2000	7	1	0	2	1	22	22	3.32	0	1	9	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2000	7	1	0	2	1	24	24	7.35	0	5	33	6	7	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
2000	7	1	0	2	1	26	26	9.33	0	4	36	22	11	9	1	1	1	2	0	0	0	0	0	0	0	0	0	0	0
2000	7	1	0	2	1	28	28	9.22	0	1	27	15	24	7	5	3	2	1	0	0	0	0	0	0	0	0	0	0	0
2000	7	1	0	2	1	30	30	9.33	0	0	37	14	12	15	4	2	2	0	1	0	0	0	0	0	0	0	0	0	0
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2000	7	1	0	2	1	34	34	6	0	0	6	13	5	2	5	1	1	1	1	1	0	0	0	0	0	0	0	0	0
2000	7	1	0	2	1	36	36	6.16	0	0	2	8	6	7	8	1	3	3	0	0	0	0	0	0	0	0	0	0	0
2000	7	1	0	2	1	38	38	3.74	0	0	0	0	2	3	2	3	0	1	2	1	0	0	0	0	0	0	0	0	0
2000	7	1	0	2	1	40	40	3.61	0	0	0	0	1	7	0	1	1	1	0	1	0	1	0	0	0	0	0	0	0
2000	7	1	0	2	1	42	42	1.41	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0
2000	7	1	0	2	1	44	44	1.41	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0
2000	7	1	0	2	1	46	46	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
2000	7	1	0	2	1	48	48	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
2000	7	1	0	2	1	50	50	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
2001	7	1	0	2	1	22	22	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	7	1	0	2	1	24	24	4.12	0	3	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	7	1	0	2	1	26	26	7.68	0	1	41	8	4	3	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0
2001	7	1	0	2	1	28	28	8.31	0	0	28	13	16	5	5	0	1	0	1	0	0	0	0	0	0	0	0	0	0
2001	7	1	0	2	1	30	30	7.94	0	0	15	13	16	8	6	3	2	0	0	0	0	0	0	0	0	0	0	0	0
2001	7	1	0	2	1	32	32	8.06	0	0	9	12	19	13	7	2	2	0	1	0	0	0	0	0	0	0	0	0	0
2001	7	1	0	2	1	34	34	6.24	0	0	0	7	10	8	8	3	2	1	0	0	0	0	0	0	0	0	0	0	0
2001	7	1	0	2	1	36	36	5.92	0	0	1	1	12	11	5	1	1	0	1	2	0	0	0	0	0	0	0	0	0
2001	7	1	0	2	1	38	38	6	0	0	0	7	7	4	10	5	1	1	1	0	0	0	0	0	0	0	0	0	0
2001	7	1	0	2	1	40	40	5.1	0	0	0	1	4	3	4	8	2	1	2	0	1	0	0	0	0	0	0	0	0
2001	7	1	0	2	1	42	42	2.24	0	0	0	1	1	0	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0
2001	7	1	0	2	1	44	44	4.36	0	0	0	0	3	3	4	0	0	4	1	1	3	0	0	0	0	0	0	0	0
2001	7	1	0	2	1	46	46	2.65	0	0	0	1	1	0	1	1	0	3	0	0	0	0	0	0	0	0	0	0	0
2001	7	1	0	2	1	48	48	2	0	0	0	0	1	0	0	0	0	0	0	1	1	0	0	0	0	1	0	0	0
2001	7	1	0	2	1	50	50	1.73	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0
2001	7	1	0	2	1	52	52	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
2002	7	1	0	2	1	24	24	5.57	0	0	14	9	4	3	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2002	7	1	0	2	1	26	26	6.86	0	0	15	17	7	5	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0
2002	7	1	0	2	1	28	28	7.68	0	0	8	19	15	9	2	3	2	1	0	0	0	0	0	0	0	0	0	0	0
2002	7	1	0	2	1	30	30	10.2	0	0	4	26	29	23	16	3	3	0	0	0	0	0	0	0	0	0	0	0	0
2002	7	1	0	2	1	32	32	8.12	0	0	0	12	22	13	11	4	2	1	0	1	0	0	0	0	0	0	0	0	0
2002	7	1	0	2	1	34	34	6.08	0	0	0	5	6	12	9	2	1	1	1	0	0	0	0	0	0	0	0	0	0
2002	7	1	0	2	1	36	36	5.74	0	0	0	4	5	7	8	2	4	0	2	0	1	0	0	0	0	0	0	0	0
2002	7	1	0	2	1	38	38	4.47	0	0	0	1	2	9	7	0	1	0	0	0	0	0	0	0	0	0	0	0	0
2002	7	1	0	2	1	40	40	3.87	0	0	0	0	1	1	4	3	2	2	1	0	1	0	0	0	0	0	0	0	0

2002	7	1	0	2	1	42	42	4.24	0	0	0	0	0	2	4	3	4	1	2	0	1	0	1	0	0	0	0	0	0
2002	7	1	0	2	1	44	44	3.32	0	0	0	0	0	0	2	3	2	0	1	1	1	1	0	0	0	0	0	0	0
2002	7	1	0	2	1	46	46	1.41	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
2002	7	1	0	2	1	48	48	2	0	0	0	0	0	1	0	0	0	1	0	1	0	0	0	0	1	0	0	0	0
2002	7	1	0	2	1	50	50	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
2003	7	1	0	2	1	22	22	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	7	1	0	2	1	24	24	1.41	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	7	1	0	2	1	26	26	3.61	0	0	1	7	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	7	1	0	2	1	28	28	5.57	0	0	0	11	11	2	4	2	0	1	0	0	0	0	0	0	0	0	0	0	0
2003	7	1	0	2	1	30	30	6.48	0	0	1	16	10	4	6	2	2	0	0	1	0	0	0	0	0	0	0	0	0
2003	7	1	0	2	1	32	32	5	0	0	0	12	2	5	2	1	2	1	0	0	0	0	0	0	0	0	0	0	0
2003	7	1	0	2	1	34	34	3.46	0	0	0	0	4	4	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	7	1	0	2	1	36	36	3.87	0	0	0	0	6	3	3	2	1	0	0	0	0	0	0	0	0	0	0	0	0
2003	7	1	0	2	1	38	38	4.36	0	0	0	0	3	1	7	7	0	0	0	0	1	0	0	0	0	0	0	0	0
2003	7	1	0	2	1	40	40	4.47	0	0	0	0	1	1	5	6	1	4	1	1	0	0	0	0	0	0	0	0	0
2003	7	1	0	2	1	42	42	3	0	0	0	0	0	0	1	3	0	2	1	0	2	0	0	0	0	0	0	0	0
2003	7	1	0	2	1	44	44	3	0	0	0	0	0	0	1	2	2	3	1	0	0	0	0	0	0	0	0	0	0
2003	7	1	0	2	1	46	46	3.16	0	0	0	0	0	0	0	2	1	0	0	0	4	2	0	1	0	0	0	0	0
2003	7	1	0	2	1	48	48	1.73	0	0	0	0	0	0	0	0	0	1	0	0	0	2	0	0	0	0	0	0	0
2003	7	1	0	2	1	50	50	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	7	1	0	2	1	56	56	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
2004	7	1	0	2	1	22	22	3.46	0	0	11	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2004	7	1	0	2	1	24	24	3.87	0	0	11	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2004	7	1	0	2	1	26	26	5.74	0	0	15	11	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2004	7	1	0	2	1	28	28	7.42	0	0	11	32	7	2	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2004	7	1	0	2	1	30	30	5.92	0	0	4	11	9	3	5	2	1	0	0	0	0	0	0	0	0	0	0	0	0
2004	7	1	0	2	1	32	32	6.24	0	0	6	10	12	5	3	2	0	0	0	0	1	0	0	0	0	0	0	0	0
2004	7	1	0	2	1	34	34	6.08	0	0	6	14	5	9	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2004	7	1	0	2	1	36	36	4.12	0	0	3	4	3	0	2	4	1	0	0	0	0	0	0	0	0	0	0	0	0
2004	7	1	0	2	1	38	38	3.74	0	0	2	4	3	1	2	0	1	1	0	0	0	0	0	0	0	0	0	0	0
2004	7	1	0	2	1	40	40	2.24	0	0	0	0	1	0	0	1	0	1	0	2	0	0	0	0	0	0	0	0	0
2004	7	1	0	2	1	42	42	1.73	0	0	0	0	0	0	0	1	1	0	0	0	0	0	1	0	0	0	0	0	0
2004	7	1	0	2	1	44	44	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2004	7	1	0	2	1	48	48	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
2004	7	1	0	2	1	50	50	1.41	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0
2004	7	1	0	2	1	52	52	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
2004	7	1	0	2	1	54	54	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
2005	7	1	0	2	1	24	24	6.56	0	0	17	10	10	4	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	7	1	0	2	1	26	26	9.11	0	0	30	30	9	8	3	1	0	1	0	1	0	0	0	0	0	0	0	0	0
2005	7	1	0	2	1	28	28	10.91	0	0	23	53	24	12	6	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	7	1	0	2	1	30	30	10.39	0	0	3	51	26	13	6	3	3	1	1	0	1	0	0	0	0	0	0	0	0
2005	7	1	0	2	1	32	32	8.37	0	0	2	35	16	12	2	1	0	0	2	0	0	0	0	0	0	0	0	0	0
2005	7	1	0	2	1	34	34	6.48	0	0	0	17	19	5	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
2005	7	1	0	2	1	36	36	5.74	0	0	1	10	10	8	1	2	0	1	0	0	0	0	0	0	0	0	0	0	0
2005	7	1	0	2	1	38	38	3.32	0	0	0	1	2	1	3	4	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	7	1	0	2	1	40	40	2.83	0	0	0	1	1	2	2	1	0	0	1	0	0	0	0	0	0	0	0	0	0
2005	7	1	0	2	1	42	42	2	0	0	0	0	0	0	2	0	0	1	0	1	0	0	0	0	0	0	0	0	0
2005	7	1	0	2	1	44	44	2.45	0	0	0	0	1	1	0	2	0	1	0	0	0	0	1	0	0	0	0	0	0
2005	7	1	0	2	1	46	46	1.41	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0

2005	7	1	0	2	1	48	48	2	0	0	0	0	0	1	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0
2005	7	1	0	2	1	50	50	1.73	0	0	0	0	0	0	0	0	2	0	0	1	0	0	0	0	0	0	0	0	0
2005	7	1	0	2	1	52	52	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	7	1	0	2	1	22	22	2.83	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	7	1	0	2	1	24	24	9.59	0	0	78	9	2	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	7	1	0	2	1	26	26	11.49	0	0	107	9	4	3	6	0	0	2	1	0	0	0	0	0	0	0	0	0	0
2006	7	1	0	2	1	28	28	10.3	0	0	64	16	13	6	2	2	3	0	0	0	0	0	0	0	0	0	0	0	0
2006	7	1	0	2	1	30	30	8.77	0	0	25	24	14	8	3	1	1	0	1	0	0	0	0	0	0	0	0	0	0
2006	7	1	0	2	1	32	32	7.87	0	0	7	16	19	9	6	1	3	1	0	0	0	0	0	0	0	0	0	0	0
2006	7	1	0	2	1	34	34	6.93	0	0	5	17	8	3	4	6	2	3	0	0	0	0	0	0	0	0	0	0	0
2006	7	1	0	2	1	36	36	5.74	0	0	2	1	10	7	5	2	0	1	1	0	0	2	2	0	0	0	0	0	0
2006	7	1	0	2	1	38	38	4.58	0	0	0	2	6	2	4	2	2	2	0	0	1	0	0	0	0	0	0	0	0
2006	7	1	0	2	1	40	40	3.87	0	0	0	2	4	0	1	3	3	0	1	0	1	0	0	0	0	0	0	0	0
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2006	7	1	0	2	1	44	44	2.45	0	0	0	0	0	0	0	0	2	0	3	0	0	0	1	0	0	0	0	0	0
2006	7	1	0	2	1	46	46	2.24	0	0	0	0	0	0	0	0	0	2	3	0	0	0	0	0	0	0	0	0	0
2006	7	1	0	2	1	48	48	2.24	0	0	0	0	0	0	0	0	2	0	0	1	1	0	1	0	0	0	0	0	0
2006	7	1	0	2	1	50	50	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
2006	7	1	0	2	1	52	52	1.41	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0
2007	7	1	0	2	1	24	24	3.46	0	0	4	4	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	7	1	0	2	1	26	26	4.12	0	0	6	5	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	7	1	0	2	1	28	28	6.93	0	0	20	11	11	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	7	1	0	2	1	30	30	8.25	0	0	14	14	18	10	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	7	1	0	2	1	32	32	6.48	0	0	1	11	17	7	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	7	1	0	2	1	34	34	4.47	0	0	0	7	4	6	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0
2007	7	1	0	2	1	36	36	4.12	0	0	0	0	5	7	3	1	1	0	0	0	0	0	0	0	0	0	0	0	0
2007	7	1	0	2	1	38	38	3	0	0	0	0	1	2	3	0	3	0	0	0	0	0	0	0	0	0	0	0	0
2007	7	1	0	2	1	40	40	3.32	0	0	0	0	1	4	2	3	0	0	1	0	0	0	0	0	0	0	0	0	0
2007	7	1	0	2	1	42	42	3.16	0	0	0	0	0	4	4	0	0	0	2	0	0	0	0	0	0	0	0	0	0
2007	7	1	0	2	1	44	44	3.87	0	0	0	0	0	1	0	4	4	0	2	2	1	0	1	0	0	0	0	0	0
2007	7	1	0	2	1	46	46	3	0	0	0	0	0	0	1	4	2	0	1	1	0	0	0	0	0	0	0	0	0
2007	7	1	0	2	1	48	48	1.41	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0
2007	7	1	0	2	1	50	50	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
2008	7	1	0	2	1	24	24	4.24	0	1	5	5	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	7	1	0	2	1	26	26	6.71	0	0	10	12	16	3	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	7	1	0	2	1	28	28	9.43	0	0	17	28	29	3	5	3	3	0	0	1	0	0	0	0	0	0	0	0	0
2008	7	1	0	2	1	30	30	10.91	0	0	8	36	39	17	9	4	2	1	1	0	0	0	1	0	1	0	0	0	0
2008	7	1	0	2	1	32	32	10.05	0	0	7	19	36	11	8	6	5	4	2	0	1	1	0	1	0	0	0	0	0
2008	7	1	0	2	1	34	34	7.28	0	0	0	13	14	7	9	1	5	1	0	1	1	0	0	0	1	0	0	0	0
2008	7	1	0	2	1	36	36	6.4	0	0	0	2	12	13	9	2	2	0	0	0	0	1	0	0	0	0	0	0	0
2008	7	1	0	2	1	38	38	6.08	0	0	1	2	7	7	5	6	2	2	1	3	0	1	0	0	0	0	0	0	0
2008	7	1	0	2	1	40	40	4.8	0	0	0	1	2	2	5	6	1	4	1	0	1	0	0	0	0	0	0	0	0
2008	7	1	0	2	1	42	42	3.74	0	0	0	0	0	2	1	3	6	1	0	1	0	0	0	0	0	0	0	0	0
2008	7	1	0	2	1	44	44	4.12	0	0	0	0	1	2	0	3	2	3	0	5	0	0	0	1	0	0	0	0	0
2008	7	1	0	2	1	46	46	2.65	0	0	0	0	0	1	0	3	1	1	0	1	0	0	0	0	0	0	0	0	0
2008	7	1	0	2	1	48	48	2.83	0	0	0	0	0	1	0	0	1	0	2	2	0	1	0	0	0	0	1	0	0
2008	7	1	0	2	1	50	50	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
2008	7	1	0	2	1	54	54	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
2009	7	1	0	2	1	22	22	2.83	0	0	6	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

2009	7	1	0	2	1	24	24	4.47	0	0	14	4	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	7	1	0	2	1	26	26	8.89	0	0	35	29	6	5	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	7	1	0	2	1	28	28	10.63	0	0	16	42	17	18	11	6	2	1	0	0	0	0	0	0	0	0	0	0	0
2009	7	1	0	2	1	30	30	10.72	0	0	12	26	25	26	10	9	5	0	0	1	1	0	0	0	0	0	0	0	0
2009	7	1	0	2	1	32	32	8.83	0	0	4	11	15	19	15	9	2	1	0	0	2	0	0	0	0	0	0	0	0
2009	7	1	0	2	1	34	34	7.94	0	0	0	7	14	12	11	5	7	1	2	1	1	2	0	0	0	0	0	0	0
2009	7	1	0	2	1	36	36	6.93	0	1	0	3	7	15	6	9	2	2	1	0	2	0	0	0	0	0	0	0	0
2009	7	1	0	2	1	38	38	5.74	0	0	0	2	2	10	8	3	3	4	1	0	0	0	0	0	0	0	0	0	0
2009	7	1	0	2	1	40	40	6.86	0	0	0	1	2	6	11	12	5	1	5	0	2	2	0	0	0	0	0	0	0
2009	7	1	0	2	1	42	42	6.16	0	0	0	0	1	9	5	7	8	3	3	0	1	1	0	0	0	0	0	0	0
2009	7	1	0	2	1	44	44	3.87	0	0	0	0	0	0	1	2	3	0	2	1	1	1	3	1	0	0	0	0	0
2009	7	1	0	2	1	46	46	3.61	0	0	0	0	0	0	1	3	3	2	0	1	0	2	0	1	0	0	0	0	0
2009	7	1	0	2	1	48	48	2	0	0	0	0	0	0	1	0	0	1	0	0	0	1	1	0	0	0	0	0	0
2010	7	1	0	2	1	24	24	4.58	0	0	8	6	4	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2010	7	1	0	2	1	26	26	6.86	0	0	9	18	11	7	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2010	7	1	0	2	1	28	28	7	0	0	10	10	17	4	4	2	1	1	0	0	0	0	0	0	0	0	0	0	0
2010	7	1	0	2	1	30	30	8.77	0	0	11	20	23	12	6	3	1	1	0	0	0	0	0	0	0	0	0	0	0
2010	7	1	0	2	1	32	32	6.48	0	0	1	15	11	9	3	2	1	0	0	0	0	0	0	0	0	0	0	0	0
2010	7	1	0	2	1	34	34	5.66	0	0	0	4	16	6	2	3	0	1	0	0	0	0	0	0	0	0	0	0	0
2010	7	1	0	2	1	36	36	6.63	0	0	1	11	13	4	8	3	2	0	0	1	1	0	0	0	0	0	0	0	0
2010	7	1	0	2	1	38	38	6.32	0	0	0	1	19	7	6	1	3	1	0	1	1	0	0	0	0	0	0	0	0
2010	7	1	0	2	1	40	40	4.69	0	0	0	3	8	5	3	1	1	0	0	0	0	0	1	0	0	0	0	0	0
2010	7	1	0	2	1	42	42	4.12	0	0	0	0	4	5	4	2	0	1	1	0	0	0	0	0	0	0	0	0	0
2010	7	1	0	2	1	44	44	3.61	0	0	0	0	0	2	7	0	2	1	1	0	0	0	0	0	0	0	0	0	0
2010	7	1	0	2	1	46	46	2.45	0	0	0	0	0	0	2	1	1	1	1	0	0	0	0	0	0	0	0	0	0
2010	7	1	0	2	1	48	48	2.45	0	0	0	0	0	0	0	1	0	1	0	1	0	2	0	1	0	0	0	0	0
2011	7	1	0	2	1	22	22	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2011	7	1	0	2	1	24	24	5.2	0	0	5	19	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2011	7	1	0	2	1	26	26	7.07	0	0	8	29	9	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2011	7	1	0	2	1	28	28	7.55	0	0	3	34	15	3	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
2011	7	1	0	2	1	30	30	9.8	0	0	1	50	16	17	3	6	2	1	0	0	0	0	0	0	0	0	0	0	0
2011	7	1	0	2	1	32	32	7.48	0	0	1	30	8	8	5	3	1	0	0	0	0	0	0	0	0	0	0	0	0
2011	7	1	0	2	1	34	34	6.63	0	0	0	13	20	7	2	0	1	0	0	1	0	0	0	0	0	0	0	0	0
2011	7	1	0	2	1	36	36	6.16	0	0	0	13	20	3	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2011	7	1	0	2	1	38	38	5.83	0	0	0	6	7	13	4	0	1	2	0	1	0	0	0	0	0	0	0	0	0
2011	7	1	0	2	1	40	40	5.74	0	0	0	2	4	14	5	3	2	0	1	0	0	0	1	0	0	1	0	0	0
2011	7	1	0	2	1	42	42	4.12	0	0	0	0	0	9	3	1	2	1	1	0	0	0	0	0	0	0	0	0	0
2011	7	1	0	2	1	44	44	3.74	0	0	0	0	0	2	3	3	0	2	2	1	0	1	0	0	0	0	0	0	0
2011	7	1	0	2	1	46	46	2.65	0	0	0	0	0	0	0	1	1	2	0	1	0	1	0	0	0	1	0	0	0
2011	7	1	0	2	1	48	48	2	0	0	0	0	0	0	0	0	1	0	0	0	2	0	0	0	1	0	0	0	0
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2012	7	1	0	2	1	24	24	5.83	0	5	20	4	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2012	7	1	0	2	1	26	26	9.49	0	4	59	15	6	2	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0
2012	7	1	0	2	1	28	28	10.86	0	0	56	34	18	5	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2012	7	1	0	2	1	30	30	12.53	0	0	56	50	34	7	8	1	1	0	0	0	0	0	0	0	0	0	0	0	0
2012	7	1	0	2	1	32	32	12.17	0	0	28	46	43	22	5	1	2	1	0	0	0	0	0	0	0	0	0	0	0
2012	7	1	0	2	1	34	34	9.33	0	0	6	28	36	7	8	2	0	0	0	0	0	0	0	0	0	0	0	0	0
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2012	7	1	0	2	1	38	38	6.16	0	0	1	3	17	13	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0
2012	7	1	0	2	1	40	40	5.1	0	0	1	0	5	11	6	1	0	0	1	1	0	0	0	0	0	0	0	0	0
2012	7	1	0	2	1	42	42	4.8	0	0	0	0	5	6	8	3	1	0	0	0	0	0	0	0	0	0	0	0	0
2012	7	1	0	2	1	44	44	4.69	0	0	0	0	0	4	5	6	4	0	1	1	1	0	0	0	0	0	0	0	0
2012	7	1	0	2	1	46	46	2.83	0	0	0	0	0	0	2	0	1	1	4	0	0	0	0	0	0	0	0	0	0
2012	7	1	0	2	1	48	48	2.24	0	0	0	0	0	0	0	1	1	0	2	0	0	0	0	0	1	0	0	0	0
2012	7	1	0	2	1	50	50	2.45	0	0	0	0	0	0	0	0	1	0	1	2	1	1	0	0	0	0	0	0	0
2012	7	1	0	2	1	52	52	1.41	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0
2013	7	1	0	2	1	22	22	1.41	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2013	7	1	0	2	1	24	24	8.72	0	6	60	8	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2013	7	1	0	2	1	26	26	13.45	0	3	158	15	1	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2013	7	1	0	2	1	28	28	14.56	0	0	166	21	9	13	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
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2013	7	1	0	2	1	34	34	8.72	0	0	3	42	11	10	1	4	1	1	3	0	0	0	0	0	0	0	0	0	0
2013	7	1	0	2	1	36	36	6.63	0	0	1	10	13	13	3	3	0	1	0	0	0	0	0	0	0	0	0	0	0
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2013	7	1	0	2	1	42	42	3.46	0	0	0	0	1	2	1	4	1	2	0	0	0	0	1	0	0	0	0	0	0
2013	7	1	0	2	1	44	44	3.16	0	0	0	0	0	2	2	3	1	1	1	0	0	0	0	0	0	0	0	0	0
2013	7	1	0	2	1	46	46	2.45	0	0	0	0	0	0	2	2	0	0	0	0	0	1	0	0	0	0	1	0	0
2013	7	1	0	2	1	48	48	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
2014	7	1	0	2	1	18	18	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2014	7	1	0	2	1	20	20	1.73	0	0	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2014	7	1	0	2	1	22	22	2.65	0	0	6	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2014	7	1	0	2	1	24	24	18.71	0	9	202	95	26	11	4	3	0	0	0	0	0	0	0	0	0	0	0	0	0
2014	7	1	0	2	1	26	26	27.02	0	10	413	177	69	29	17	7	5	1	1	0	1	0	0	0	0	0	0	0	0
2014	7	1	0	2	1	28	28	25.57	0	4	267	161	97	51	44	15	11	1	2	1	0	0	0	0	0	0	0	0	0
2014	7	1	0	2	1	30	30	25.18	0	7	149	192	127	61	57	20	9	8	4	0	0	0	0	0	0	0	0	0	0
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2014	7	1	0	2	1	38	38	9.33	0	0	1	9	17	16	18	17	7	0	2	0	0	0	0	0	0	0	0	0	0
2014	7	1	0	2	1	40	40	8.31	0	0	1	2	10	9	14	10	14	1	5	3	0	0	0	0	0	0	0	0	0
2014	7	1	0	2	1	42	42	5.66	0	0	0	0	0	3	13	4	4	5	1	0	2	0	0	0	0	0	0	0	0
2014	7	1	0	2	1	44	44	4.12	0	0	0	1	0	2	6	4	1	0	2	0	0	0	0	1	0	0	0	0	0
2014	7	1	0	2	1	46	46	3.32	0	0	0	0	0	0	1	1	0	1	1	1	1	3	1	1	0	0	0	0	0
2014	7	1	0	2	1	48	48	2.65	0	0	0	0	0	0	0	1	1	2	0	1	0	2	0	0	0	0	0	0	0
2014	7	1	0	2	1	50	50	1.41	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0
2014	7	1	0	2	1	52	52	1.41	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0
2015	7	1	0	2	1	18	18	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2015	7	1	0	2	1	20	20	1.41	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2015	7	1	0	2	1	22	22	2.24	0	0	2	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2015	7	1	0	2	1	24	24	18.97	0	22	201	95	36	4	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2015	7	1	0	2	1	26	26	26.1	0	10	361	184	93	20	4	0	8	0	1	0	0	0	0	0	0	0	0	0	0
2015	7	1	0	2	1	28	28	25.44	0	0	186	223	130	54	24	20	4	4	2	0	0	0	0	0	0	0	0	0	0
2015	7	1	0	2	1	30	30	24.02	0	0	67	209	154	64	34	24	11	8	5	1	0	0	0	0	0	0	0	0	0
2015	7	1	0	2	1	32	32	21.1	0	0	7	171	96	67	53	23	14	7	3	0	4	0	0	0	0	0	0	0	0
2015	7	1	0	2	1	34	34	15.1	0	0	2	72	49	44	24	17	9	7	1	1	1	0	1	0	0	0	0	0	0

2015	7	1	0	2	1	36	36	12.12	0	0	0	17	30	42	16	24	10	6	2	0	0	0	0	0	0	0	0	0	0
2015	7	1	0	2	1	38	38	8.77	0	0	0	4	13	21	18	14	2	4	1	0	0	0	0	0	0	0	0	0	0
2015	7	1	0	2	1	40	40	7.94	0	0	1	1	3	13	18	18	6	1	2	0	0	0	0	0	0	0	0	0	0
2015	7	1	0	2	1	42	42	6.24	0	0	0	0	2	2	8	7	7	7	3	0	1	1	0	1	0	0	0	0	0
2015	7	1	0	2	1	44	44	3.74	0	0	0	0	0	0	2	1	1	3	1	1	2	0	3	0	0	0	0	0	0
2015	7	1	0	2	1	46	46	2.65	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	2	0	0	1	0	0
2015	7	1	0	2	1	48	48	1.41	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0
2015	7	1	0	2	1	50	50	1.41	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0
2016	7	1	0	2	1	20	20	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2016	7	1	0	2	1	22	22	2	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2016	7	1	0	2	1	24	24	13.27	0	12	82	48	24	9	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2016	7	1	0	2	1	26	26	22.05	0	11	199	117	98	48	5	3	4	1	0	0	0	0	0	0	0	0	0	0	0
2016	7	1	0	2	1	28	28	24.49	0	1	182	155	155	68	21	7	4	5	1	1	0	0	0	0	0	0	0	0	0
2016	7	1	0	2	1	30	30	23.32	0	0	104	145	154	85	26	8	14	6	1	1	0	0	0	0	0	0	0	0	0
2016	7	1	0	2	1	32	32	20.47	0	0	55	86	150	67	31	10	8	7	2	1	1	0	0	1	0	0	0	0	0
2016	7	1	0	2	1	34	34	14.18	0	0	10	41	74	39	14	9	5	7	0	2	0	0	0	0	0	0	0	0	0
2016	7	1	0	2	1	36	36	10.58	0	0	1	18	33	34	13	7	3	3	0	0	0	0	0	0	0	0	0	0	0
2016	7	1	0	2	1	38	38	8.89	0	0	1	4	21	25	13	8	5	1	0	1	0	0	0	0	0	0	0	0	0
2016	7	1	0	2	1	40	40	7.55	0	0	0	2	10	10	14	6	7	3	5	0	0	0	0	0	0	0	0	0	0
2016	7	1	0	2	1	42	42	6.24	0	0	0	0	4	8	9	2	8	5	1	1	1	0	0	0	0	0	0	0	0
2016	7	1	0	2	1	44	44	5.2	0	0	0	0	1	1	5	3	5	6	0	2	2	1	1	0	0	0	0	0	0
2016	7	1	0	2	1	46	46	3	0	0	0	0	0	1	1	2	1	0	2	0	1	0	1	0	0	0	0	0	0
2016	7	1	0	2	1	48	48	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
2016	7	1	0	2	1	50	50	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
2017	7	1	0	2	1	20	20	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2017	7	1	0	2	1	22	22	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2017	7	1	0	2	1	24	24	9.38	0	0	43	35	6	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2017	7	1	0	2	1	26	26	15.1	0	0	85	87	36	14	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2017	7	1	0	2	1	28	28	17.69	0	0	59	131	71	25	13	10	1	3	0	0	0	0	0	0	0	0	0	0	0
2017	7	1	0	2	1	30	30	19.03	0	1	47	83	107	72	29	8	8	3	3	1	0	0	0	0	0	0	0	0	0
2017	7	1	0	2	1	32	32	16.58	0	0	19	55	85	68	24	9	7	4	3	1	0	0	0	0	0	0	0	0	0
2017	7	1	0	2	1	34	34	13.19	0	0	2	25	46	61	18	13	3	5	0	0	1	0	0	0	0	0	0	0	0
2017	7	1	0	2	1	36	36	9.43	0	0	0	13	18	31	17	3	0	5	2	0	0	0	0	0	0	0	0	0	0
2017	7	1	0	2	1	38	38	7.81	0	0	1	7	7	21	9	6	5	2	1	0	1	0	1	0	0	0	0	0	0
2017	7	1	0	2	1	40	40	6.63	0	0	0	0	7	20	6	4	1	3	0	1	1	1	0	0	0	0	0	0	0
2017	7	1	0	2	1	42	42	5.48	0	0	0	1	3	3	8	6	2	5	1	1	0	0	0	0	0	0	0	0	0
2017	7	1	0	2	1	44	44	4.36	0	0	0	0	1	3	2	5	3	4	1	0	0	0	0	0	0	0	0	0	0
2017	7	1	0	2	1	46	46	3	0	0	0	0	0	2	2	2	0	0	1	0	1	0	0	1	0	0	0	0	0
2017	7	1	0	2	1	48	48	2	0	0	0	0	0	0	0	0	1	1	0	1	0	1	0	0	0	0	0	0	0
2017	7	1	0	2	1	56	56	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
1995	7	7	0	0	1	20	20	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1998	7	7	0	0	1	14	14	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1998	7	7	0	0	1	18	18	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1998	7	7	0	0	1	22	22	1.41	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1998	7	7	0	0	1	24	24	4.58	0	5	12	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1998	7	7	0	0	1	26	26	6.16	0	8	26	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1998	7	7	0	0	1	28	28	5.66	0	1	21	9	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1998	7	7	0	0	1	30	30	6.63	0	0	27	15	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1998	7	7	0	0	1	32	32	6.32	0	0	19	16	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

1998	7	7	0	0	1	34	34	6.16	0	0	10	25	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1998	7	7	0	0	1	36	36	3.46	0	0	0	9	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1998	7	7	0	0	1	38	38	4.69	0	0	3	15	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
1998	7	7	0	0	1	40	40	2.65	0	0	0	3	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1998	7	7	0	0	1	42	42	2.65	0	0	0	6	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
1998	7	7	0	0	1	44	44	2	0	0	1	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1998	7	7	0	0	1	46	46	1.41	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1999	7	7	0	0	1	14	14	1.73	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1999	7	7	0	0	1	16	16	1.41	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1999	7	7	0	0	1	18	18	3	0	7	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1999	7	7	0	0	1	20	20	3.61	0	4	7	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1999	7	7	0	0	1	22	22	4.8	0	1	13	6	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1999	7	7	0	0	1	24	24	4.36	0	0	12	4	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1999	7	7	0	0	1	26	26	6.16	0	2	22	6	5	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1999	7	7	0	0	1	28	28	6.71	0	1	25	5	2	6	3	0	1	2	0	0	0	0	0	0	0	0	0	0	0
1999	7	7	0	0	1	30	30	5.48	0	0	12	13	3	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
1999	7	7	0	0	1	32	32	6	0	0	5	22	6	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
1999	7	7	0	0	1	34	34	5.83	0	0	1	23	7	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
1999	7	7	0	0	1	36	36	3.87	0	0	0	8	5	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1999	7	7	0	0	1	38	38	3.46	0	0	0	4	4	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1999	7	7	0	0	1	40	40	2	0	0	0	0	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1999	7	7	0	0	1	42	42	2	0	0	1	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1999	7	7	0	0	1	44	44	1.41	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
1999	7	7	0	0	1	46	46	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
1999	7	7	0	0	1	48	48	1.41	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
2000	7	7	0	0	1	16	16	1.41	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2000	7	7	0	0	1	18	18	7.68	1	46	11	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2000	7	7	0	0	1	20	20	10	0	75	18	4	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2000	7	7	0	0	1	22	22	9.59	0	35	23	16	9	7	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2000	7	7	0	0	1	24	24	9.27	0	5	49	20	4	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2000	7	7	0	0	1	26	26	9.64	0	1	69	9	4	4	1	3	1	1	0	0	0	0	0	0	0	0	0	0	0
2000	7	7	0	0	1	28	28	6.16	0	0	18	6	5	4	2	1	2	0	0	0	0	0	0	0	0	0	0	0	0
2000	7	7	0	0	1	30	30	6.24	0	0	16	5	2	2	7	4	1	1	0	1	0	0	0	0	0	0	0	0	0
2000	7	7	0	0	1	32	32	5.39	0	0	7	14	4	0	1	2	0	1	0	0	0	0	0	0	0	0	0	0	0
2000	7	7	0	0	1	34	34	5.2	0	0	2	14	4	6	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
2000	7	7	0	0	1	36	36	5	0	0	0	11	6	3	2	2	0	1	0	0	0	0	0	0	0	0	0	0	0
2000	7	7	0	0	1	38	38	3.46	0	0	0	2	0	4	2	0	2	2	0	0	0	0	0	0	0	0	0	0	0
2000	7	7	0	0	1	40	40	2.24	0	0	0	0	4	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2000	7	7	0	0	1	42	42	1.73	0	0	0	1	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
2000	7	7	0	0	1	44	44	1.41	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
2000	7	7	0	0	1	46	46	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
2001	7	7	0	0	1	10	10	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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2001	7	7	0	0	1	18	18	2.24	0	2	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	7	7	0	0	1	20	20	3.61	0	7	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	7	7	0	0	1	22	22	5.92	0	15	17	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	7	7	0	0	1	24	24	7.55	0	5	29	16	6	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	7	7	0	0	1	26	26	7.48	0	0	24	21	8	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	7	7	0	0	1	28	28	6.86	0	0	18	16	8	3	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0

2001	7	7	0	0	1	30	30	5.74	0	0	3	14	8	7	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	7	7	0	0	1	32	32	4.8	0	0	2	6	2	3	7	1	2	0	0	0	0	0	0	0	0	0	0	0	0
2001	7	7	0	0	1	34	34	4	0	0	0	8	3	1	1	2	0	0	1	0	0	0	0	0	0	0	0	0	0
2001	7	7	0	0	1	36	36	3.46	0	0	1	5	2	2	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
2001	7	7	0	0	1	38	38	2.24	0	0	1	0	1	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0
2001	7	7	0	0	1	40	40	1.41	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	7	7	0	0	1	42	42	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
2001	7	7	0	0	1	44	44	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	7	7	0	0	1	46	46	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2002	7	7	0	0	1	20	20	1.41	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2002	7	7	0	0	1	24	24	2.45	0	0	1	2	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2002	7	7	0	0	1	26	26	3	0	0	1	6	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2002	7	7	0	0	1	28	28	3.61	0	0	0	5	5	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2002	7	7	0	0	1	30	30	3.74	0	0	1	3	2	7	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2002	7	7	0	0	1	32	32	3.32	0	0	0	3	1	4	2	0	0	0	0	0	0	1	0	0	0	0	0	0	0
2002	7	7	0	0	1	34	34	2.65	0	0	0	1	2	1	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2002	7	7	0	0	1	36	36	3.61	0	0	0	1	2	5	3	2	0	0	0	0	0	0	0	0	0	0	0	0	0
2002	7	7	0	0	1	38	38	2.24	0	0	0	0	2	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2002	7	7	0	0	1	40	40	2.24	0	0	0	0	1	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2002	7	7	0	0	1	42	42	1.41	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
2002	7	7	0	0	1	46	46	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2002	7	7	0	0	1	48	48	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
2002	7	7	0	0	1	50	50	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
2007	7	7	0	0	1	10	10	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	7	7	0	0	1	12	12	1.73	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	7	7	0	0	1	14	14	3	5	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	7	7	0	0	1	16	16	3.16	9	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	7	7	0	0	1	14	14	1.73	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	7	7	0	0	1	16	16	1.73	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	7	7	0	0	1	18	18	2.45	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	7	7	0	0	1	20	20	1.41	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	7	7	0	0	1	26	26	1.41	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	7	7	0	0	1	30	30	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	7	7	0	0	1	32	32	2	0	0	0	0	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	7	7	0	0	1	34	34	1.41	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	7	7	0	0	1	36	36	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	7	7	0	0	1	38	38	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
2009	7	7	0	0	1	12	12	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	7	7	0	0	1	14	14	2	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	7	7	0	0	1	16	16	1.73	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	7	7	0	0	1	18	18	1.73	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	7	7	0	0	1	20	20	1.73	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	7	7	0	0	1	22	22	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	7	7	0	0	1	24	24	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	7	7	0	0	1	26	26	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	7	7	0	0	1	28	28	2.24	0	0	0	3	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	7	7	0	0	1	32	32	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	7	7	0	0	1	36	36	1.73	0	0	0	0	0	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0
2009	7	7	0	0	1	38	38	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0

2010	7	7	0	0	1	10	10	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2010	7	7	0	0	1	12	12	1.41	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2010	7	7	0	0	1	14	14	1.41	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2010	7	7	0	0	1	16	16	2.83	0	7	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2010	7	7	0	0	1	18	18	5.1	0	7	19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2010	7	7	0	0	1	20	20	4.69	0	1	11	6	2	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2010	7	7	0	0	1	22	22	4.12	0	0	3	4	3	1	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2010	7	7	0	0	1	24	24	2	0	0	1	1	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
2010	7	7	0	0	1	26	26	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2010	7	7	0	0	1	28	28	1.73	0	0	0	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2010	7	7	0	0	1	30	30	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2010	7	7	0	0	1	34	34	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2010	7	7	0	0	1	36	36	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2010	7	7	0	0	1	38	38	1.41	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2010	7	7	0	0	1	48	48	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
2011	7	7	0	0	1	18	18	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2011	7	7	0	0	1	20	20	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2011	7	7	0	0	1	24	24	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2011	7	7	0	0	1	26	26	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2011	7	7	0	0	1	32	32	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
2011	7	7	0	0	1	36	36	1.41	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2011	7	7	0	0	1	38	38	1.41	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2012	7	7	0	0	1	12	12	1.41	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2012	7	7	0	0	1	14	14	2.45	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2012	7	7	0	0	1	16	16	2.45	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2012	7	7	0	0	1	18	18	2.83	0	6	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2012	7	7	0	0	1	20	20	2.45	0	2	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2012	7	7	0	0	1	22	22	2.45	0	1	2	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2012	7	7	0	0	1	24	24	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2012	7	7	0	0	1	26	26	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2012	7	7	0	0	1	32	32	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2012	7	7	0	0	1	36	36	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2012	7	7	0	0	1	44	44	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2013	7	7	0	0	1	18	18	1.73	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2013	7	7	0	0	1	20	20	2	0	0	2	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2013	7	7	0	0	1	22	22	1.73	0	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2013	7	7	0	0	1	24	24	1.73	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2013	7	7	0	0	1	26	26	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2013	7	7	0	0	1	28	28	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2013	7	7	0	0	1	30	30	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2014	7	7	0	0	1	8	8	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2014	7	7	0	0	1	12	12	1.41	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2014	7	7	0	0	1	14	14	3	0	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2014	7	7	0	0	1	16	16	3.16	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2014	7	7	0	0	1	18	18	3.32	0	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2014	7	7	0	0	1	20	20	2.83	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2014	7	7	0	0	1	22	22	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2014	7	7	0	0	1	24	24	1.41	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2014	7	7	0	0	1	28	28	1.41	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

2014	7	7	0	0	1	30	30	1.41	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2014	7	7	0	0	1	32	32	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2015	7	7	0	0	1	14	14	2.45	2	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2015	7	7	0	0	1	16	16	2.45	2	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2015	7	7	0	0	1	18	18	2.24	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2015	7	7	0	0	1	20	20	2.83	0	2	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2015	7	7	0	0	1	22	22	1.73	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2015	7	7	0	0	1	24	24	1.73	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2015	7	7	0	0	1	26	26	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1981	7	2	0	2	1	18	18	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1981	7	2	0	2	1	20	20	3.46	0	5	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1981	7	2	0	2	1	22	22	2.83	0	0	7	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1981	7	2	0	2	1	24	24	4.12	0	1	14	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1981	7	2	0	2	1	26	26	4.58	0	0	18	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1981	7	2	0	2	1	28	28	5.57	0	0	21	9	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1981	7	2	0	2	1	30	30	5.29	0	0	14	12	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1981	7	2	0	2	1	32	32	4.24	0	0	8	7	1	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0
1981	7	2	0	2	1	34	34	3.32	0	0	1	6	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1981	7	2	0	2	1	36	36	3.61	0	0	0	4	6	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1981	7	2	0	2	1	38	38	3.87	0	0	0	6	6	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
1981	7	2	0	2	1	40	40	2.65	0	0	0	1	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1981	7	2	0	2	1	42	42	2.24	0	0	0	0	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0
1981	7	2	0	2	1	44	44	1.41	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
1981	7	2	0	2	1	46	46	1.73	0	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1981	7	2	0	2	1	48	48	1.41	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0
1982	7	2	0	2	1	18	18	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1982	7	2	0	2	1	20	20	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1982	7	2	0	2	1	22	22	2.24	0	0	4	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1982	7	2	0	2	1	24	24	2.83	0	1	4	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1982	7	2	0	2	1	26	26	4.12	0	1	6	7	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
1982	7	2	0	2	1	28	28	3.87	0	0	5	7	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1982	7	2	0	2	1	30	30	5.2	0	0	6	15	5	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
1982	7	2	0	2	1	32	32	5.29	0	0	0	21	4	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
1982	7	2	0	2	1	34	34	6.08	0	0	0	27	6	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1982	7	2	0	2	1	36	36	3.74	0	0	0	9	4	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
1982	7	2	0	2	1	38	38	3.32	0	0	0	5	2	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
1982	7	2	0	2	1	40	40	2.45	0	0	0	0	3	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
1982	7	2	0	2	1	42	42	2.65	0	0	0	1	1	3	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0
1982	7	2	0	2	1	44	44	1.73	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1982	7	2	0	2	1	46	46	2.45	0	0	0	0	1	1	3	0	1	0	0	0	0	0	0	0	0	0	0	0	0
1982	7	2	0	2	1	48	48	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
1982	7	2	0	2	1	50	50	1.41	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
1983	7	2	0	2	1	20	20	1.73	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1983	7	2	0	2	1	22	22	1.73	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1983	7	2	0	2	1	24	24	3.16	0	0	5	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1983	7	2	0	2	1	26	26	4.58	0	3	14	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1983	7	2	0	2	1	28	28	6	0	0	26	8	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1983	7	2	0	2	1	30	30	5.39	0	0	23	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1983	7	2	0	2	1	32	32	6	0	0	18	16	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

1983	7	2	0	2	1	34	34	5.74	0	0	12	17	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1983	7	2	0	2	1	36	36	4.12	0	0	1	11	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1983	7	2	0	2	1	38	38	3.87	0	0	1	2	11	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1983	7	2	0	2	1	40	40	3.16	0	0	0	2	6	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1983	7	2	0	2	1	42	42	2.45	0	0	1	0	3	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
1983	7	2	0	2	1	44	44	2.45	0	0	0	0	1	1	0	0	2	0	1	1	0	0	0	0	0	0	0	0	0
1983	7	2	0	2	1	46	46	1.73	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1983	7	2	0	2	1	48	48	1.73	0	0	0	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
1983	7	2	0	2	1	50	50	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
1983	7	2	0	2	1	52	52	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
1983	7	2	0	2	1	56	56	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
1984	7	2	0	2	1	20	20	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1984	7	2	0	2	1	24	24	3.32	0	2	8	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1984	7	2	0	2	1	26	26	3.87	0	0	14	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1984	7	2	0	2	1	28	28	5.39	0	0	22	6	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1984	7	2	0	2	1	30	30	4.36	0	0	12	6	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1984	7	2	0	2	1	32	32	5.29	0	0	11	11	3	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1984	7	2	0	2	1	34	34	4.69	0	0	4	14	3	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
1984	7	2	0	2	1	36	36	3.16	0	0	0	6	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1984	7	2	0	2	1	38	38	2.45	0	0	0	4	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1984	7	2	0	2	1	40	40	2.24	0	0	1	0	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1984	7	2	0	2	1	42	42	2.45	0	0	0	1	2	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1984	7	2	0	2	1	44	44	2	0	0	0	0	1	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1984	7	2	0	2	1	46	46	1.41	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0
1984	7	2	0	2	1	52	52	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
1985	7	2	0	2	1	20	20	1.41	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1985	7	2	0	2	1	22	22	1.41	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1985	7	2	0	2	1	24	24	1.41	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1985	7	2	0	2	1	26	26	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1985	7	2	0	2	1	28	28	2.24	0	0	3	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1985	7	2	0	2	1	30	30	3.46	0	0	7	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1985	7	2	0	2	1	32	32	2.83	0	0	3	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1985	7	2	0	2	1	34	34	1.73	0	0	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1985	7	2	0	2	1	38	38	1.41	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1985	7	2	0	2	1	42	42	1.73	0	0	0	0	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1985	7	2	0	2	1	44	44	1.41	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1986	7	2	0	2	1	20	20	1.41	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1986	7	2	0	2	1	22	22	2	0	1	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1986	7	2	0	2	1	24	24	2.65	0	1	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1986	7	2	0	2	1	26	26	2.24	0	1	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1986	7	2	0	2	1	28	28	3.46	0	0	9	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1986	7	2	0	2	1	30	30	2.83	0	0	3	3	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1986	7	2	0	2	1	32	32	2	0	0	1	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1986	7	2	0	2	1	34	34	1.41	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1986	7	2	0	2	1	36	36	2.24	0	0	1	0	3	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1986	7	2	0	2	1	38	38	1.41	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1986	7	2	0	2	1	40	40	1.41	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1986	7	2	0	2	1	42	42	1.73	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1986	7	2	0	2	1	44	44	1.41	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

1986	7	2	0	2	1	46	46	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
1986	7	2	0	2	1	48	48	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
1987	7	2	0	2	1	22	22	1.41	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1987	7	2	0	2	1	24	24	2	0	1	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1987	7	2	0	2	1	26	26	3.16	0	1	8	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1987	7	2	0	2	1	28	28	3.16	0	0	9	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1987	7	2	0	2	1	30	30	2.83	0	0	3	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1987	7	2	0	2	1	32	32	2.45	0	0	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1987	7	2	0	2	1	34	34	2.24	0	0	2	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1987	7	2	0	2	1	36	36	1.41	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1987	7	2	0	2	1	38	38	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1987	7	2	0	2	1	42	42	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1987	7	2	0	2	1	46	46	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1988	7	2	0	2	1	26	26	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1988	7	2	0	2	1	28	28	2	0	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1988	7	2	0	2	1	30	30	1.73	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1988	7	2	0	2	1	34	34	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1988	7	2	0	2	1	36	36	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1988	7	2	0	2	1	38	38	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1991	7	2	0	2	1	24	24	1.41	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1991	7	2	0	2	1	26	26	2.45	0	0	3	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1991	7	2	0	2	1	28	28	2.65	0	0	2	2	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1991	7	2	0	2	1	30	30	2	0	0	0	0	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1991	7	2	0	2	1	32	32	1.73	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1991	7	2	0	2	1	36	36	1.41	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
1991	7	2	0	2	1	38	38	1.41	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1991	7	2	0	2	1	44	44	1.73	0	0	0	0	0	1	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0
1991	7	2	0	2	1	46	46	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
1992	7	2	0	2	1	22	22	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1992	7	2	0	2	1	24	24	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1992	7	2	0	2	1	26	26	1.73	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1992	7	2	0	2	1	28	28	2.24	0	0	2	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1992	7	2	0	2	1	30	30	2.65	0	0	1	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1992	7	2	0	2	1	32	32	2	0	0	0	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1992	7	2	0	2	1	34	34	1.73	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1992	7	2	0	2	1	36	36	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1992	7	2	0	2	1	38	38	1.73	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1992	7	2	0	2	1	40	40	1.41	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1992	7	2	0	2	1	46	46	1.41	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
1992	7	2	0	2	1	48	48	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
1993	7	2	0	2	1	40	40	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1993	7	2	0	2	1	42	42	1.41	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1993	7	2	0	2	1	44	44	1.41	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
1994	7	2	0	2	1	24	24	3	0	0	5	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1994	7	2	0	2	1	26	26	4.36	0	0	10	5	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1994	7	2	0	2	1	28	28	4	0	0	4	6	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1994	7	2	0	2	1	30	30	4	0	0	4	7	2	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
1994	7	2	0	2	1	32	32	2.65	0	0	2	3	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1994	7	2	0	2	1	34	34	1.41	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

1994	7	2	0	2	1	36	36	1.73	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1994	7	2	0	2	1	38	38	1.41	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1994	7	2	0	2	1	40	40	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1994	7	2	0	2	1	42	42	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1995	7	2	0	2	1	24	24	4.24	0	0	5	9	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1995	7	2	0	2	1	26	26	7.42	0	1	26	19	4	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1995	7	2	0	2	1	28	28	6.63	0	0	17	16	8	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
1995	7	2	0	2	1	30	30	7.94	0	0	11	37	13	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
1995	7	2	0	2	1	32	32	8	0	0	1	44	15	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1995	7	2	0	2	1	34	34	5.66	0	0	0	12	19	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1995	7	2	0	2	1	36	36	3.16	0	0	0	4	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1995	7	2	0	2	1	38	38	2.45	0	0	0	0	4	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1995	7	2	0	2	1	40	40	1.73	0	0	0	0	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1995	7	2	0	2	1	42	42	2	0	0	0	0	1	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
1996	7	2	0	2	1	22	22	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1996	7	2	0	2	1	24	24	3.16	0	0	4	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1996	7	2	0	2	1	26	26	3.32	0	0	1	5	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1996	7	2	0	2	1	28	28	4.12	0	0	0	8	8	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1996	7	2	0	2	1	30	30	3.16	0	0	0	1	7	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1996	7	2	0	2	1	32	32	2	0	0	0	0	1	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1996	7	2	0	2	1	34	34	2	0	0	0	0	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1996	7	2	0	2	1	36	36	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1996	7	2	0	2	1	40	40	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1997	7	2	0	2	1	24	24	3.74	0	0	6	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1997	7	2	0	2	1	26	26	5.2	0	0	9	12	4	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1997	7	2	0	2	1	28	28	4.58	0	0	4	8	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1997	7	2	0	2	1	30	30	3.32	0	0	1	3	4	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1997	7	2	0	2	1	32	32	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1997	7	2	0	2	1	34	34	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1997	7	2	0	2	1	36	36	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1997	7	2	0	2	1	40	40	1.41	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
1997	7	2	0	2	1	44	44	1.41	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
1997	7	2	0	2	1	52	52	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
1998	7	2	0	2	1	22	22	1.73	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1998	7	2	0	2	1	24	24	4.12	0	0	6	10	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1998	7	2	0	2	1	26	26	5.2	0	0	2	20	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1998	7	2	0	2	1	28	28	4.58	0	0	0	8	8	2	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1998	7	2	0	2	1	30	30	3.87	0	0	0	4	2	7	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1998	7	2	0	2	1	32	32	2.65	0	0	0	1	1	3	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1998	7	2	0	2	1	34	34	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1998	7	2	0	2	1	36	36	1.41	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1998	7	2	0	2	1	38	38	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1998	7	2	0	2	1	42	42	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
1998	7	2	0	2	1	44	44	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1999	7	2	0	2	1	22	22	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1999	7	2	0	2	1	24	24	1.41	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1999	7	2	0	2	1	26	26	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1999	7	2	0	2	1	28	28	1.41	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1999	7	2	0	2	1	32	32	2.24	0	0	1	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

1999	7	2	0	2	1	34	34	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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2000	7	2	0	2	1	24	24	1.73	0	0	0	0	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
2000	7	2	0	2	1	26	26	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2000	7	2	0	2	1	28	28	1.41	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2000	7	2	0	2	1	30	30	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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2000	7	2	0	2	1	36	36	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	7	2	0	2	1	24	24	1.73	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	7	2	0	2	1	26	26	2	0	1	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	7	2	0	2	1	28	28	2.24	0	0	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	7	2	0	2	1	30	30	2.83	0	0	6	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	7	2	0	2	1	32	32	1.73	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	7	2	0	2	1	34	34	1.73	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	7	2	0	2	1	36	36	2.24	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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2003	7	2	0	2	1	40	40	1.41	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	7	2	0	2	1	42	42	1.41	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2004	7	2	0	2	1	24	24	7.87	0	4	39	9	9	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2004	7	2	0	2	1	26	26	11.36	0	4	71	40	5	5	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0
2004	7	2	0	2	1	28	28	11.45	0	2	69	47	9	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2004	7	2	0	2	1	30	30	7.94	0	0	31	18	7	4	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2004	7	2	0	2	1	32	32	7.42	0	0	21	24	5	4	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
2004	7	2	0	2	1	34	34	5.74	0	0	2	23	5	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2004	7	2	0	2	1	36	36	3.87	0	0	1	7	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2004	7	2	0	2	1	38	38	2.45	0	0	0	1	3	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2004	7	2	0	2	1	40	40	1.73	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2004	7	2	0	2	1	42	42	1.41	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2004	7	2	0	2	1	44	44	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2004	7	2	0	2	1	52	52	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
2005	7	2	0	2	1	20	20	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	7	2	0	2	1	22	22	2	0	1	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	7	2	0	2	1	24	24	9.64	0	5	31	34	15	3	4	0	0	1	0	0	0	0	0	0	0	0	0	0	0
2005	7	2	0	2	1	26	26	13.82	0	1	75	61	27	14	9	2	1	1	0	0	0	0	0	0	0	0	0	0	0
2005	7	2	0	2	1	28	28	12.37	0	0	45	56	20	16	10	4	1	0	1	0	0	0	0	0	0	0	0	0	0
2005	7	2	0	2	1	30	30	10.91	0	1	28	56	13	9	9	1	2	0	0	0	0	0	0	0	0	0	0	0	0
2005	7	2	0	2	1	32	32	9.8	0	0	3	69	7	7	4	2	2	1	0	0	1	0	0	0	0	0	0	0	0
2005	7	2	0	2	1	34	34	7	0	0	2	31	8	3	1	0	0	2	1	0	0	1	0	0	0	0	0	0	0
2005	7	2	0	2	1	36	36	5.2	0	0	0	13	10	1	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	7	2	0	2	1	38	38	2.65	0	0	0	3	3	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
2005	7	2	0	2	1	40	40	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	7	2	0	2	1	42	42	1.41	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	7	2	0	2	1	44	44	2	0	0	0	0	0	1	0	1	0	0	0	1	0	0	1	0	0	0	0	0	0
2005	7	2	0	2	1	50	50	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
2006	7	2	0	2	1	20	20	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	7	2	0	2	1	22	22	2.24	0	0	1	2	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	7	2	0	2	1	24	24	10.91	0	8	34	40	20	11	4	1	0	0	0	0	1	0	0	0	0	0	0	0	0
2006	7	2	0	2	1	26	26	15.72	0	11	67	74	50	25	2	6	6	6	0	0	0	0	0	0	0	0	0	0	0
2006	7	2	0	2	1	28	28	13.93	0	0	81	33	42	20	10	5	2	1	0	0	0	0	0	0	0	0	0	0	0

2006	7	2	0	2	1	30	30	11.79	0	0	65	21	17	10	10	11	3	2	0	0	0	0	0	0	0	0	0	0	0
2006	7	2	0	2	1	32	32	9.43	0	0	34	23	10	4	7	5	2	2	0	2	0	0	0	0	0	0	0	0	0
2006	7	2	0	2	1	34	34	6	0	0	4	21	4	2	1	1	0	1	0	1	0	0	1	0	0	0	0	0	0
2006	7	2	0	2	1	36	36	5	0	0	0	6	8	3	1	0	0	2	1	2	2	0	0	0	0	0	0	0	0
2006	7	2	0	2	1	38	38	2.45	0	1	0	0	4	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	7	2	0	2	1	40	40	2	0	0	0	0	3	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	7	2	0	2	1	42	42	2	0	0	1	0	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	7	2	0	2	1	44	44	1.41	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
2006	7	2	0	2	1	46	46	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
2006	7	2	0	2	1	48	48	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
2007	7	2	0	2	1	20	20	2.24	0	0	1	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	7	2	0	2	1	22	22	3.61	0	2	4	2	3	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
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2007	7	2	0	2	1	26	26	17.06	0	9	114	104	38	15	7	3	1	0	0	0	0	0	0	0	0	0	0	0	0
2007	7	2	0	2	1	28	28	13.67	0	1	77	62	25	10	8	3	1	0	0	0	0	0	0	0	0	0	0	0	0
2007	7	2	0	2	1	30	30	13.15	0	1	64	70	14	7	7	3	1	1	4	0	0	0	1	0	0	0	0	0	0
2007	7	2	0	2	1	32	32	12.17	0	0	17	107	7	3	7	1	2	1	1	0	1	0	0	0	1	0	0	0	0
2007	7	2	0	2	1	34	34	9.06	0	0	4	69	8	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
2007	7	2	0	2	1	36	36	5.57	0	0	2	18	7	2	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0
2007	7	2	0	2	1	38	38	2.83	0	0	0	1	4	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0
2007	7	2	0	2	1	40	40	2.45	0	0	1	0	3	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	7	2	0	2	1	42	42	2.24	0	0	0	0	2	0	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0
2007	7	2	0	2	1	44	44	2	0	0	0	0	0	2	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0
2007	7	2	0	2	1	46	46	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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2008	7	2	0	2	1	20	20	1.41	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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2008	7	2	0	2	1	26	26	16.43	0	6	88	68	63	31	6	4	3	0	1	0	0	0	0	0	0	0	0	0	0
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2008	7	2	0	2	1	34	34	8.43	0	0	6	36	16	5	5	1	0	0	0	0	2	0	0	0	0	0	0	0	0
2008	7	2	0	2	1	36	36	5.83	0	0	1	12	16	2	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0
2008	7	2	0	2	1	38	38	3.87	0	0	0	6	8	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	7	2	0	2	1	40	40	1.73	0	0	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	7	2	0	2	1	44	44	1.73	0	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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2009	7	2	0	2	1	26	26	17.94	0	6	119	64	59	57	11	4	1	0	1	0	0	0	0	0	0	0	0	0	0
2009	7	2	0	2	1	28	28	14	0	0	59	49	35	32	14	3	2	2	0	0	0	0	0	0	0	0	0	0	0
2009	7	2	0	2	1	30	30	9.8	0	0	33	26	19	11	5	0	0	2	0	0	0	0	0	0	0	0	0	0	0
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2009	7	2	0	2	1	42	42	2.24	0	0	0	0	3	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
2009	7	2	0	2	1	44	44	1.41	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	7	2	0	2	1	46	46	1.41	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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2010	7	2	0	2	1	44	44	1.41	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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2011	7	2	0	2	1	30	30	11.87	0	0	56	53	15	6	6	3	1	0	1	0	0	0	0	0	0	0	0	0	0
2011	7	2	0	2	1	32	32	9.43	0	0	17	44	21	3	0	3	1	0	0	0	0	0	0	0	0	0	0	0	0
2011	7	2	0	2	1	34	34	7	0	0	7	31	6	3	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0
2011	7	2	0	2	1	36	36	5.1	0	0	0	15	7	1	2	0	0	0	0	1	0	0	0	0	0	0	0	0	0
2011	7	2	0	2	1	38	38	3.46	0	0	0	2	8	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
2011	7	2	0	2	1	40	40	2	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2011	7	2	0	2	1	44	44	2	0	0	0	0	2	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2011	7	2	0	2	1	48	48	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2011	7	2	0	2	1	50	50	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2012	7	2	0	2	1	22	22	3.61	0	2	4	2	4	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2012	7	2	0	2	1	24	24	16.37	0	22	99	76	34	22	10	1	3	1	0	0	0	0	0	0	0	0	0	0	0
2012	7	2	0	2	1	26	26	20.1	0	15	153	108	73	25	12	9	6	0	3	0	0	0	0	0	0	0	0	0	0
2012	7	2	0	2	1	28	28	16.94	0	1	58	107	52	35	19	7	7	1	0	0	0	0	0	0	0	0	0	0	0
2012	7	2	0	2	1	30	30	14.93	0	2	31	85	45	25	15	10	5	2	0	1	1	0	0	0	1	0	0	0	0
2012	7	2	0	2	1	32	32	12.08	0	0	13	73	36	12	6	2	1	0	0	2	0	0	0	1	0	0	0	0	0
2012	7	2	0	2	1	34	34	11.36	0	0	2	48	57	11	4	2	2	1	0	1	0	1	0	0	0	0	0	0	0
2012	7	2	0	2	1	36	36	9.75	0	0	3	26	51	2	4	3	3	1	0	0	1	0	1	0	0	0	0	0	0
2012	7	2	0	2	1	38	38	6.56	0	0	0	7	17	11	2	1	3	0	0	1	0	1	0	0	0	0	0	0	0
2012	7	2	0	2	1	40	40	6.16	0	0	0	2	11	18	2	0	1	1	1	1	0	0	0	0	0	0	1	0	0
2012	7	2	0	2	1	42	42	5.39	0	0	0	0	3	12	5	2	4	2	0	0	1	0	0	0	0	0	0	0	0
2012	7	2	0	2	1	44	44	3	0	0	0	0	1	3	1	1	2	0	0	0	0	1	0	0	0	0	0	0	0
2012	7	2	0	2	1	46	46	2	0	0	0	0	0	0	0	2	0	1	0	0	1	0	0	0	0	0	0	0	0
2012	7	2	0	2	1	48	48	2	0	0	0	0	0	1	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0
2012	7	2	0	2	1	50	50	1.41	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0
2012	7	2	0	2	1	52	52	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
2013	7	2	0	2	1	20	20	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2013	7	2	0	2	1	22	22	4.12	0	4	9	3	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2013	7	2	0	2	1	24	24	17.8	0	46	137	73	28	21	8	3	0	1	0	0	0	0	0	0	0	0	0	0	0

2013	7	2	0	2	1	26	26	21.35	0	37	179	132	44	36	16	8	0	3	1	0	0	0	0	0	0	0	0	0	0
2013	7	2	0	2	1	28	28	18.81	0	5	130	100	53	40	9	10	4	2	1	0	0	0	0	0	0	0	0	0	0
2013	7	2	0	2	1	30	30	14.53	0	2	69	58	28	27	9	7	4	4	2	1	0	0	0	0	0	0	0	0	0
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2013	7	2	0	2	1	34	34	11.4	0	0	9	71	30	11	3	3	2	1	0	0	0	0	0	0	0	0	0	0	0
2013	7	2	0	2	1	36	36	9.22	0	0	3	29	38	8	3	1	2	1	0	0	0	0	0	0	0	0	0	0	0
2013	7	2	0	2	1	38	38	6.63	0	0	0	5	18	9	3	3	4	1	0	1	0	0	0	0	0	0	0	0	0
2013	7	2	0	2	1	40	40	5	0	0	0	1	6	12	1	3	1	1	0	0	0	0	0	0	0	0	0	0	0
2013	7	2	0	2	1	42	42	4.12	0	0	0	0	3	2	5	3	1	0	2	1	0	0	0	0	0	0	0	0	0
2013	7	2	0	2	1	44	44	1.73	0	0	0	0	0	0	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0
2013	7	2	0	2	1	46	46	2.45	0	0	0	0	0	0	1	1	1	0	0	1	1	0	1	0	0	0	0	0	0
2013	7	2	0	2	1	48	48	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
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2014	7	2	0	2	1	22	22	5.1	0	2	14	6	2	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
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2014	7	2	0	2	1	26	26	22.61	0	10	275	151	46	14	7	3	1	2	2	0	0	0	0	0	0	0	0	0	0
2014	7	2	0	2	1	28	28	20.93	0	3	212	118	47	18	25	12	2	0	1	0	0	0	0	0	0	0	0	0	0
2014	7	2	0	2	1	30	30	17.64	0	0	113	135	22	13	16	3	3	4	1	0	1	0	0	0	0	0	0	0	0
2014	7	2	0	2	1	32	32	14.28	0	1	57	96	21	9	7	7	2	1	1	0	0	0	2	0	0	0	0	0	0
2014	7	2	0	2	1	34	34	11.45	0	0	7	80	24	12	4	1	2	1	0	0	0	0	0	0	0	0	0	0	0
2014	7	2	0	2	1	36	36	8.89	0	0	2	33	22	8	7	4	1	0	1	1	0	0	0	0	0	0	0	0	0
2014	7	2	0	2	1	38	38	6.56	0	0	0	11	19	8	2	2	0	1	0	0	0	0	0	0	0	0	0	0	0
2014	7	2	0	2	1	40	40	5.1	0	0	0	1	6	8	4	3	0	2	2	0	0	0	0	0	0	0	0	0	0
2014	7	2	0	2	1	42	42	3.46	0	0	0	0	1	7	0	3	1	0	0	0	0	0	0	0	0	0	0	0	0
2014	7	2	0	2	1	44	44	2.65	0	0	1	1	1	0	1	1	0	1	0	0	1	0	0	0	0	0	0	0	0
2014	7	2	0	2	1	46	46	2	0	0	0	0	0	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0
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2015	7	2	0	2	1	32	32	14.66	0	1	14	111	53	12	8	10	4	0	1	1	0	0	0	0	0	0	0	0	0
2015	7	2	0	2	1	34	34	12.61	0	0	4	76	55	9	8	6	0	0	1	0	0	0	0	0	0	0	0	0	0
2015	7	2	0	2	1	36	36	8.77	0	0	1	18	35	14	5	3	0	1	0	0	0	0	0	0	0	0	0	0	0
2015	7	2	0	2	1	38	38	6.24	0	0	0	6	18	6	2	3	1	1	1	0	0	0	0	1	0	0	0	0	0
2015	7	2	0	2	1	40	40	4.24	0	0	0	3	6	2	3	2	0	0	0	1	1	0	0	0	0	0	0	0	0
2015	7	2	0	2	1	42	42	3.61	0	0	0	0	0	6	2	2	1	2	0	0	0	0	0	0	0	0	0	0	0
2015	7	2	0	2	1	44	44	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2015	7	2	0	2	1	46	46	1.73	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0
2015	7	2	0	2	1	48	48	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
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2016	7	2	0	2	1	20	20	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2016	7	2	0	2	1	22	22	6.48	0	1	28	4	7	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2016	7	2	0	2	1	24	24	23.32	0	30	270	103	86	44	4	3	3	1	0	0	0	0	0	0	0	0	0	0	0
2016	7	2	0	2	1	26	26	26.7	0	25	288	168	116	78	19	10	4	5	0	0	0	0	0	0	0	0	0	0	0
2016	7	2	0	2	1	28	28	23.07	0	5	179	132	103	69	17	15	6	2	2	0	1	1	0	0	0	0	0	0	0
2016	7	2	0	2	1	30	30	20.35	0	2	111	133	90	27	15	10	14	10	1	1	0	0	0	0	0	0	0	0	0
2016	7	2	0	2	1	32	32	16.64	0	0	51	95	96	19	7	1	5	0	2	0	0	0	1	0	0	0	0	0	0

2016	7	2	0	2	1	34	34	12.41	0	0	17	43	61	19	4	3	3	1	1	2	0	0	0	0	0	0	0	0	0
2016	7	2	0	2	1	36	36	9.75	0	0	3	21	46	10	3	4	3	2	0	0	1	0	2	0	0	0	0	0	0
2016	7	2	0	2	1	38	38	6.78	0	0	0	4	19	7	8	4	3	0	0	1	0	0	0	0	0	0	0	0	0
2016	7	2	0	2	1	40	40	5.2	0	0	1	0	13	5	4	0	2	2	0	0	0	0	0	0	0	0	0	0	0
2016	7	2	0	2	1	42	42	4	0	0	1	2	2	5	1	1	0	2	1	1	0	0	0	0	0	0	0	0	0
2016	7	2	0	2	1	44	44	2.24	0	0	0	0	2	0	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0
2016	7	2	0	2	1	46	46	2	0	0	0	0	0	0	1	1	1	0	0	0	1	0	0	0	0	0	0	0	0
2016	7	2	0	2	1	48	48	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
2016	7	2	0	2	1	52	52	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
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2016	7	2	0	2	1	58	58	1.41	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
2017	7	2	0	2	1	20	20	2.24	0	3	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2017	7	2	0	2	1	22	22	9.95	0	25	55	14	3	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
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2017	7	2	0	2	1	30	30	15.65	0	0	42	118	34	25	16	4	3	2	1	0	0	0	0	0	0	0	0	0	0
2017	7	2	0	2	1	32	32	12	0	0	15	67	26	14	12	5	1	2	2	0	0	0	0	0	0	0	0	0	0
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2017	7	2	0	2	1	36	36	7.14	0	0	1	17	11	5	8	4	1	0	1	1	1	1	0	0	0	0	0	0	0
2017	7	2	0	2	1	38	38	6.56	0	0	0	9	15	11	2	3	2	1	0	0	0	0	0	0	0	0	0	0	0
2017	7	2	0	2	1	40	40	4.58	0	0	0	1	5	6	1	2	3	1	1	1	0	0	0	0	0	0	0	0	0
2017	7	2	0	2	1	42	42	3.32	0	0	0	0	3	4	2	1	0	1	0	0	0	0	0	0	0	0	0	0	0
2017	7	2	0	2	1	44	44	2.65	0	0	0	0	1	1	1	1	0	0	0	2	1	0	0	0	0	0	0	0	0
2017	7	2	0	2	1	46	46	2.45	0	0	0	0	0	0	3	0	1	0	0	2	0	0	0	0	0	0	0	0	0
2017	7	2	0	2	1	48	48	1.41	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0
2017	7	2	0	2	1	50	50	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
1986	7	3	0	2	1	28	28	1.73	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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1993	7	3	0	2	1	32	32	1.41	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1993	7	3	0	2	1	34	34	1.41	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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1994	7	3	0	2	1	16	16	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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1997	7	3	0	2	1	24	24	1.73	0	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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1997	7	3	0	2	1	42	42	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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1998	7	3	0	2	1	28	28	3	0	0	1	7	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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1998	7	3	0	2	1	32	32	1.73	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1998	7	3	0	2	1	34	34	1.73	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1998	7	3	0	2	1	36	36	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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1999	7	3	0	2	1	24	24	2.45	0	0	2	3	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
1999	7	3	0	2	1	26	26	3.32	0	0	4	2	3	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
1999	7	3	0	2	1	28	28	3.16	0	0	2	4	1	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
1999	7	3	0	2	1	30	30	2.83	0	0	1	1	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1999	7	3	0	2	1	32	32	2.24	0	0	0	0	2	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1999	7	3	0	2	1	34	34	2.45	0	0	0	0	2	0	1	2	1	0	0	0	0	0	0	0	0	0	0	0	0
1999	7	3	0	2	1	36	36	2.83	0	0	0	0	3	3	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
1999	7	3	0	2	1	38	38	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1999	7	3	0	2	1	40	40	1.41	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
1999	7	3	0	2	1	42	42	1.73	0	0	0	0	0	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0
2000	7	3	0	2	1	32	32	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2000	7	3	0	2	1	36	36	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	7	3	0	2	1	24	24	3	0	2	5	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	7	3	0	2	1	26	26	2.83	0	0	4	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	7	3	0	2	1	28	28	4	0	0	4	6	2	1	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	7	3	0	2	1	30	30	2.45	0	0	1	1	1	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	7	3	0	2	1	32	32	2	0	0	1	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	7	3	0	2	1	34	34	1.73	0	0	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	7	3	0	2	1	36	36	1.73	0	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	7	3	0	2	1	38	38	1.41	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	7	3	0	2	1	42	42	1.73	0	0	0	0	0	0	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0
2001	7	3	0	2	1	44	44	1.73	0	0	0	0	0	0	0	0	0	2	0	0	1	0	0	0	0	0	0	0	0
2002	7	3	0	2	1	26	26	2	0	0	1	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2002	7	3	0	2	1	28	28	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	7	3	0	2	1	24	24	2.65	0	5	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	7	3	0	2	1	26	26	3.61	0	2	9	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	7	3	0	2	1	28	28	3.61	0	1	10	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	7	3	0	2	1	30	30	3.16	0	0	9	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	7	3	0	2	1	32	32	2.45	0	0	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	7	3	0	2	1	36	36	1.73	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2004	7	3	0	2	1	24	24	4.36	0	0	18	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2004	7	3	0	2	1	26	26	5.92	0	0	31	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2004	7	3	0	2	1	28	28	5.48	0	1	20	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2004	7	3	0	2	1	30	30	4.24	0	0	5	11	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2004	7	3	0	2	1	32	32	4.24	0	0	7	8	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2004	7	3	0	2	1	34	34	2	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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2005	7	3	0	2	1	22	22	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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2005	7	3	0	2	1	26	26	4.12	0	0	16	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	7	3	0	2	1	28	28	3.74	0	0	7	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	7	3	0	2	1	30	30	2.45	0	0	1	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	7	3	0	2	1	32	32	3.74	0	0	1	7	3	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	7	3	0	2	1	34	34	2.45	0	0	0	1	2	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	7	3	0	2	1	36	36	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	7	3	0	2	1	38	38	1.41	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	7	3	0	2	1	22	22	1.41	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	7	3	0	2	1	24	24	3.74	0	0	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	7	3	0	2	1	26	26	5.39	0	1	24	1	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	7	3	0	2	1	28	28	4	0	0	11	4	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	7	3	0	2	1	30	30	1.41	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	7	3	0	2	1	32	32	2.24	0	0	1	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	7	3	0	2	1	34	34	1.73	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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2006	7	3	0	2	1	38	38	1.41	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	7	3	0	2	1	40	40	1.73	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	7	3	0	2	1	42	42	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	7	3	0	2	1	34	34	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	7	3	0	2	1	24	24	2.45	0	0	1	1	3	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	7	3	0	2	1	26	26	3.74	0	0	1	4	6	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
2008	7	3	0	2	1	28	28	5.39	0	0	2	8	12	5	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	7	3	0	2	1	30	30	5.39	0	0	1	0	9	6	9	2	2	0	0	0	0	0	0	0	0	0	0	0	0
2008	7	3	0	2	1	32	32	4.12	0	0	0	0	7	5	1	2	1	1	0	0	0	0	0	0	0	0	0	0	0
2008	7	3	0	2	1	34	34	3.74	0	0	0	0	4	3	5	1	1	0	0	0	0	0	0	0	0	0	0	0	0
2008	7	3	0	2	1	36	36	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
2008	7	3	0	2	1	38	38	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	7	3	0	2	1	40	40	1.73	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	7	3	0	2	1	42	42	1.41	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
2008	7	3	0	2	1	44	44	1.41	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0
2008	7	3	0	2	1	46	46	1.41	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0
2009	7	3	0	2	1	24	24	3	0	0	1	4	1	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	7	3	0	2	1	26	26	2.83	0	0	1	2	2	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	7	3	0	2	1	28	28	3.46	0	0	0	4	4	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	7	3	0	2	1	30	30	2.83	0	0	0	1	2	1	0	3	0	1	0	0	0	0	0	0	0	0	0	0	0
2009	7	3	0	2	1	32	32	3	0	0	0	1	1	3	0	2	1	1	0	0	0	0	0	0	0	0	0	0	0
2009	7	3	0	2	1	34	34	2.65	0	0	0	0	2	1	1	3	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	7	3	0	2	1	36	36	1.41	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	7	3	0	2	1	38	38	2.24	0	0	0	1	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	7	3	0	2	1	40	40	2	0	0	0	0	1	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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2009	7	3	0	2	1	44	44	1.73	0	0	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0
2009	7	3	0	2	1	48	48	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
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2010	7	3	0	2	1	24	24	2.45	0	0	2	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2010	7	3	0	2	1	26	26	4.12	0	1	1	9	3	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2010	7	3	0	2	1	28	28	4.36	0	0	0	5	7	3	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0

2010	7	3	0	2	1	30	30	5.57	0	0	1	4	10	6	4	4	1	0	0	1	0	0	0	0	0	0	0	0	0
2010	7	3	0	2	1	32	32	3.46	0	0	0	2	3	2	2	0	1	1	1	0	0	0	0	0	0	0	0	0	0
2010	7	3	0	2	1	34	34	2.45	0	0	0	0	0	0	1	2	0	2	0	1	0	0	0	0	0	0	0	0	0
2010	7	3	0	2	1	36	36	1.73	0	0	0	0	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0
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2010	7	3	0	2	1	42	42	1.73	0	0	0	0	0	0	0	1	0	1	0	0	0	1	0	0	0	0	0	0	0
2010	7	3	0	2	1	44	44	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
2010	7	3	0	2	1	46	46	1.41	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0
2010	7	3	0	2	1	48	48	1.73	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0
2011	7	3	0	2	1	24	24	2.65	0	0	0	4	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2011	7	3	0	2	1	26	26	2	0	0	2	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2013	7	3	0	2	1	24	24	1.73	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2013	7	3	0	2	1	26	26	2.45	0	0	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2013	7	3	0	2	1	28	28	2.83	0	1	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2013	7	3	0	2	1	30	30	2	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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2013	7	3	0	2	1	36	36	1.73	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2013	7	3	0	2	1	38	38	1.41	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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2014	7	3	0	2	1	22	22	1.73	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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2014	7	3	0	2	1	26	26	5.2	0	2	20	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2014	7	3	0	2	1	28	28	5.66	0	1	20	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2014	7	3	0	2	1	30	30	4.36	0	0	12	6	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2014	7	3	0	2	1	32	32	3.16	0	0	5	4	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2014	7	3	0	2	1	34	34	2.65	0	0	1	5	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2014	7	3	0	2	1	36	36	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2014	7	3	0	2	1	38	38	1.41	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2014	7	3	0	2	1	44	44	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
2014	7	3	0	2	1	46	46	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2015	7	3	0	2	1	20	20	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2015	7	3	0	2	1	22	22	1.73	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2015	7	3	0	2	1	24	24	8	0	15	28	17	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2015	7	3	0	2	1	26	26	10.54	0	14	37	42	12	5	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2015	7	3	0	2	1	28	28	9.17	0	4	30	35	8	4	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0
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2015	7	3	0	2	1	32	32	6.32	0	0	7	15	7	5	2	1	2	0	0	1	0	0	0	0	0	0	0	0	0
2015	7	3	0	2	1	34	34	5.29	0	0	3	18	5	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
2015	7	3	0	2	1	36	36	4.12	0	0	0	4	6	2	2	2	0	1	0	0	0	0	0	0	0	0	0	0	0
2015	7	3	0	2	1	38	38	3.32	0	0	0	4	5	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
2015	7	3	0	2	1	40	40	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2015	7	3	0	2	1	42	42	2.24	0	0	0	0	1	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2015	7	3	0	2	1	46	46	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2015	7	3	0	2	1	48	48	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
2015	7	3	0	2	1	50	50	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
2016	7	3	0	2	1	22	22	1.73	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2016	7	3	0	2	1	24	24	7.07	0	1	22	13	10	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2016	7	3	0	2	1	26	26	7.87	0	0	26	15	15	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2016	7	3	0	2	1	28	28	6.16	0	2	13	10	7	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

```
2016  7  3  0  2  1  30  30  4.47   0  1  8   6   5   0   0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
2016  7  3  0  2  1  32  32  2.65   0  0  3   2   2   0   0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
2016  7  3  0  2  1  34  34  2.24   0  0  0   1   2   0   1  0  0  1  0  0  0  0  0  0  0  0  0  0  0
2016  7  3  0  2  1  36  36  1.41   0  0  1   0   0   0   0  0  1  0  0  0  0  0  0  0  0  0  0  0  0
2016  7  3  0  2  1  38  38  1      0  0  0   0   0   1   0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
2016  7  3  0  2  1  40  40  1      0  0  0   1   0   0   0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
2016  7  3  0  2  1  42  42  1      0  0  0   0   1   0   0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
2017  7  3  0  2  1  22  22  1.73   0  0  3   0   0   0   0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
2017  7  3  0  2  1  24  24  8.25   0  5  37  18  6   1   1  0  0  0  0  0  0  0  0  0  0  0  0  0  0
2017  7  3  0  2  1  26  26  10.49  0  3  44  51  5   2   4  0  1  0  0  0  0  0  0  0  0  0  0  0  0
2017  7  3  0  2  1  28  28  11.05  0  1  22  52  21  16  6  3  0  0  1  0  0  0  0  0  0  0  0  0  0
2017  7  3  0  2  1  30  30  9.7    0  0  15  43  16  12  4  1  0  2  1  0  0  0  0  0  0  0  0  0  0
2017  7  3  0  2  1  32  32  8.94   0  0  7   37  10  18  5  2  0  0  0  0  1  0  0  0  0  0  0  0  0
2017  7  3  0  2  1  34  34  6.86   0  0  3   19  11  6   2  1  0  2  2  1  0  0  0  0  0  0  0  0  0
2017  7  3  0  2  1  36  36  6.24   0  0  1   11  17  6   2  0  1  0  0  1  0  0  0  0  0  0  0  0  0
2017  7  3  0  2  1  38  38  4.24   0  0  1   1   8   4   2  1  0  1  0  0  0  0  0  0  0  0  0  0  0
2017  7  3  0  2  1  40  40  3.32   0  0  0   2   3   5   1  0  0  0  0  0  0  0  0  0  0  0  0  0  0
2017  7  3  0  2  1  42  42  2      0  0  0   0   0   2   1  0  0  1  0  0  0  0  0  0  0  0  0  0  0
2017  7  3  0  2  1  44  44  2.45   0  0  0   1   1   0   2  0  1  1  0  0  0  0  0  0  0  0  0  0  0
2017  7  3  0  2  1  46  46  2.65   0  0  0   0   0   0   0  0  3  3  0  0  0  0  0  1  0  0  0  0  0
2017  7  3  0  2  1  48  48  1      0  0  0   0   0   0   0  0  0  0  0  1  0  0  0  0  0  0  0  0  0
-9999 0  0  0  0  0  0   0   0      0  0  0   0   0   0   0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
0        #_N_MeanSize-at-Age_obs
#
0        #_N_environ_variables
#
0        # N sizefreq methods to read
#
0        # no tag data
#
0        # no morph composition data
#
0        #  Do dataread for selectivity priors(0/1)
#
999      # end of file marker
```