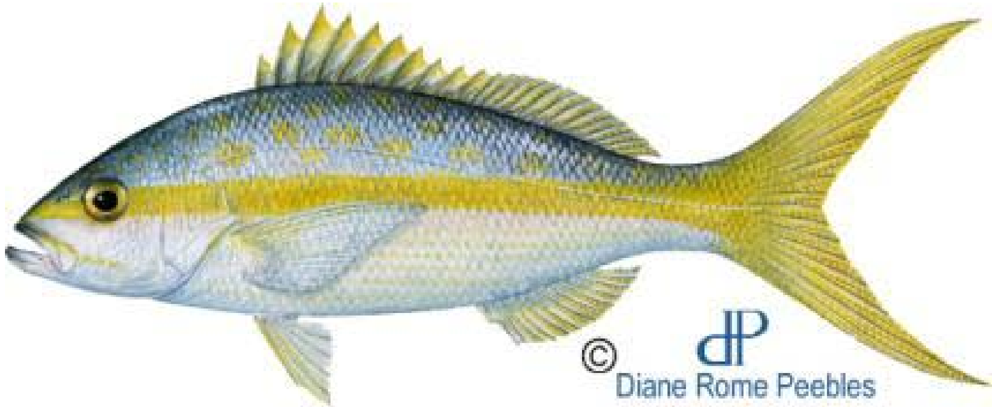

The 2012 Stock Assessment Report for Yellowtail Snapper in the South Atlantic and Gulf of Mexico

Joe O'Hop, Mike Murphy, and Dave Chagaris

May 29, 2012

Fish and Wildlife Conservation Commission
Fish and Wildlife Research Institute
100 Eighth Ave Southeast
St. Petersburg, Florida 33701-5020

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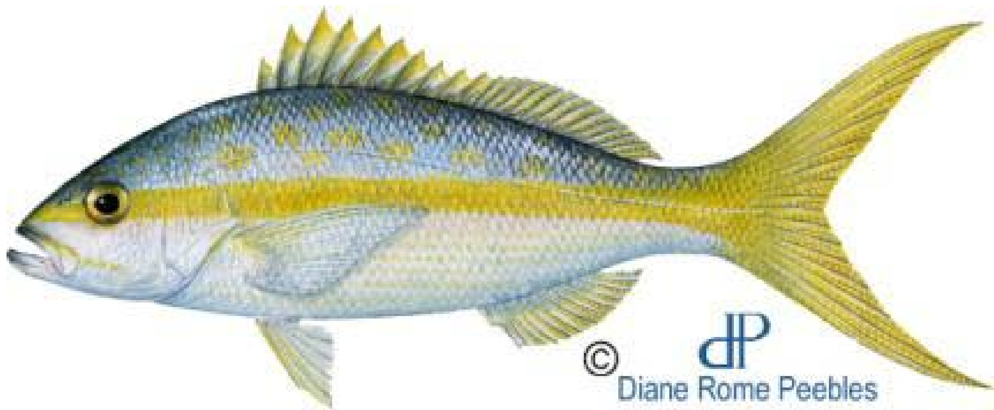

The 2012 Stock Assessment Report for Yellowtail Snapper in the South Atlantic and Gulf of Mexico

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Section I: Introduction

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1. PROCESS DESCRIPTION

The Florida Fish and Wildlife Conservation Commission (FWC) is responsible for managing fish and wildlife resources for the people of the State of Florida. There are multiple federal and state agencies which also management fish and wildlife resources with overlapping responsibilities and jurisdictions, and the FWC works cooperatively with the regional fishery management councils (South Atlantic Fishery Management Council and Gulf of Mexico Fishery Management Council) and the National Marine Fisheries Service to effectively manage saltwater fisheries in Florida. The FWC Fish and Wildlife Institute is responsible for providing information and research on fish and wildlife resources in the state, including assessments of the status of fish populations such as yellowtail snapper.

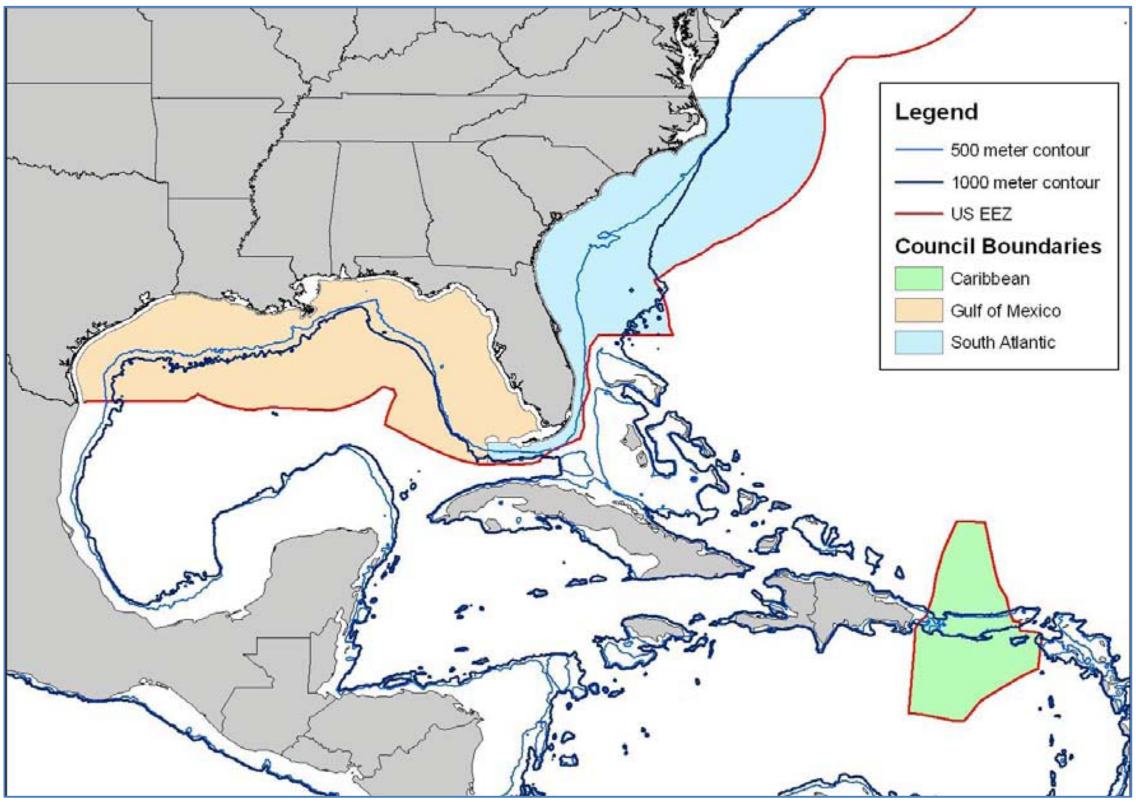
Information and data on yellowtail snapper in state and federal waters in Florida and in southeastern US waters was assembled and analyzed for this assessment. The results of this assessment may serve as advice to managers of fisheries in the region regarding the current status of the yellowtail snapper population in southeastern US waters.

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.

Southeast Region including Council and EEZ Boundaries



2.1.1. ORIGINAL SAFMC 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 conservation zone (FCZ) 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. In the case of the sea basses, the management regime applies only to south of Cape Hatteras, North Carolina. Regulations apply only to federal waters.

2.1.2. SAFMC FMP Amendments affecting yellowtail snapper

Description of Action	FMP/Amendment	Effective Date
4” trawl mesh, 12” (305mm) TL minimum size limit	Snapper Grouper FMP	08/31/1983
Trawls prohibited	Amendment 1 (1988)	01/12/1989
Fish traps prohibited, entanglement nets & longlines within 50 fathoms prohibited, aggregate bag limit of 10 snappers (including yellowtail snapper, and excluding lane, vermilion, and yelloweye snappers).	Amendment 4 (1991)	01/01/1992
Oculina Experimental Closed Area	Amendment 6 (1993)	06/27/1994
Limited entry program: transferable permits and 225-lb non-transferable permits	Amendment 8 (1997)	12/1998
MSY proxy for yellowtail snapper is 30% static SPR; OY proxy is 40% static SPR	Amendment 11B (1998)	12/02/1999
Establish eight deepwater Type II marine protected areas to protect a portion of the population and habitat of long-lived deepwater snapper grouper species	Amendment 15 (2007)	02/12/2009
Required use by commercial and recreational fishermen of dehooking devices for releasing reef fish	Amendment 16 (2009)	07/29/2009
Use of non-stainless steel circle hooks in the snapper - grouper fishery not required south of 28°N	Amendment 17A (2010)	03/02/2011

2.1.3. 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.

2.1.4. 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 harvestof reef fish using trawls or entangling nets wasprohibited. 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 fishing spiny lobster or stone crab traps except for vessels possessing a valid fish trap endorsement.	Amendment 16A	01/2000
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
Currently under development. Addresses Sustainable Fisheries Act (SFA) requirements such as setting the minimum stock size threshold (MSST), maximum fishing mortality rate (MFMT), and other associated parameters for reef fish species for which these have not been defined.	Amendment 18B	----------

2.1.5. 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).

2.1.6. 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

None.

2.3. MANAGEMENT PROGRAM SPECIFICATIONS

Table 2.3.1. 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	Jack McGovern/Myra Brouwer
Current stock exploitation status	Not overfished, not overfishing (SEDAR 3, 2003)

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/Carrie Simmons
Current stock exploitation status	Not overfished, not overfishing (SEDAR 3, 2003)

Table 2.3.2. Specific Management (SFA) Criteria

South Atlantic and Gulf of Mexico*				
	Current (SEDAR 3, 2003)		Results from SEDAR 27	
Criteria	Definition	Value**	Definition	Value
MSST (Minimum Stock Size Threshold)	[(1-M) or 0.5, whichever is greater] *B_{MSY} (The estimated population biomass at MSY)	7,975,500 pounds	[(1-M) or 0.5, whichever is greater] *B_{MSY} (The estimated stock biomass at MSY)	TBD
MFMT (Maximum Fishing Mortality Threshold)	F_{MSY}	0.33/year	F_{MSY}	TBD
MSY (Maximum Sustainable Yield)	Yield at F_{MSY}	2,572,500 pounds	Yield at F_{MSY}	TBD
F_{MSY} (Fishing Mortality Rate at MSY)	$F_{\text{at 30\% SPR}}$ (Spawning Potential Ratio)	0.25/year	$F_{\text{at 30\% SPR}}$ (Spawning Potential Ratio)	TBD
OY (Optimum Yield)	Yield at F_{OY}	2,434,500 pounds	Yield at F_{OY}	TBD
F_{OY} (Fishing Mortality Rate at OY)	$F_{\text{at 40\% SPR}}$ (Spawning Potential Ratio)	0.21/year	$F_{\text{at 40\% SPR}}$ (Spawning Potential Ratio)	TBD
M (Natural Mortality Rate)	Constant	0.2/year	Age-Specific	TBD

* The GMFMC Amendment 18B (which has not been accepted) would have set SFA criteria for reef fish which have not been assessed. However, since yellowtail snapper was assessed in SEDAR 3, it is likely that the GMFMC's management criteria for yellowtail snapper are the same as for the South Atlantic Fishery Management Council after SEDAR 3 was reviewed by the SSC (Statistical Standing Committee).

** The SAFMC's SSC accepted the SEDAR 3 results from both models (Integrated catch-at-age and fleet-specific catch-at-age) used in the assessment. Because the SSC felt that both models adequately represented the dynamics of the population and fisheries, and neither could be chosen as "better", the SSC chose to average the results of the two models.

2.4. STOCK REBUILDING INFORMATION

The SEDAR 3 assessment found no evidence that the stock of yellowtail snapper was overfished nor was overfishing occurring. Therefore, no stock rebuilding information was required.

2.5. STOCK PROJECTION INFORMATION

There was no requirement for SEDAR 3 to provide projections of the stock biomass or fishing mortality rate in future years.

2.6. QUOTA CALCULATION DETAILS

Not applicable. Yellowtail snapper are not currently under quota management.

2.7. Management and Regulatory Timelines

The following tables provide a timeline for federal and state management actions related to size and bag limits for the yellowtail snapper fishery.

Table 2.7.1 Annual Yellowtail Snapper Regulatory Summary (Size and Bag Limits)

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

2.8. REFERENCES

Florida Fish and Wildlife Conservation Commission, Division of Marine Fisheries Management. Evolution of each saltwater regulation (1985-2010). Prepared by Lee Schlesinger (revised February 24, 2010). http://www.myfwc.com/fishing/saltwater/regulations/history/

GMFMC (Gulf of Mexico Fishery Management Council). 1981. Fishery management plan for the reef fish fishery of the Gulf of Mexico and environmental impact statement. Gulf of Mexico Fishery Management Council, Tampa, Florida. 155 pp.

GMFMC (Gulf of Mexico Fishery Management Council). 1989. Amendment 1 to the reef fish fishery management plan. Gulf of Mexico Fishery Management Council, Tampa, Florida. 356 pp.

GMFMC (Gulf of Mexico Fishery Management Council). 1991. Amendment 4 to the reef fish fishery management plan. Gulf of Mexico Fishery Management Council, Tampa, Florida. 42 pp.

GMFMC (Gulf of Mexico Fishery Management Council). 1996. Amendment 14 to the reef fish fishery management plan for the reef fish fishery of the Gulf of Mexico. Gulf of Mexico Fishery Management Council, Tampa, Florida. 89 pp.

GMFMC (Gulf of Mexico Fishery Management Council). 1997. Amendment 15 to the reef fish fishery management plan for the reef fish fishery of the Gulf of Mexico. Gulf of Mexico Fishery Management Council, Tampa, Florida. 114 pp.

GMFMC (Gulf of Mexico Fishery Management Council). 1998. Amendment 16A to the reef fish fishery management plan for the reef fish fishery of the Gulf of Mexico. Gulf of Mexico Fishery Management Council, Tampa, Florida. 49 pp.

GMFMC (Gulf of Mexico Fishery Management Council). Under development. Amendment 18B to the Reef Fish FMP Gulf of Mexico Fishery Management Council, 2203 North Lois Avenue, Suite 1100, Tampa, Florida 33607.

GMFMC (Gulf of Mexico Fishery Management Council) 2001. Generic Amendment Addressing the Establishment of the Tortugas Marine Reserves in the Following Fishery Management Plans of the Gulf of Mexico: Coastal Migratory Pelagics Fishery Management Plan (Amendment 13), Coral and Coral Reefs Fishery Management Plan (Amendment 4), Red Drum Fishery Management Plan (Amendment 4), Reef Fish Fishery Management Plan (Amendment 19), Shrimp Fishery Management Plan (Amendment 12), Spiny Lobster Fishery Management Plan (Amendment 7), Stone Crag Fishery Management Plan (Amendment 8) (includes an IRFA, RIR and a FSEIS) (EFH Amendment 2). Gulf of Mexico Fishery Management Council, Tampa, Florida. 194 pp.

GMFMC (Gulf of Mexico Fishery Management Council). 2007. Amendment 27 to the Reef Fish FMP and Amendment 14 to the Shrimp FMP to end overfishing and rebuild the red snapper stock. Gulf of Mexico Fishery Management Council, 2203 North Lois Avenue, Suite 1100, Tampa, Florida 33607. 490 pp.

SAFMC (South Atlantic Fishery Management Council). 1983. Fishery Management Plan, Regulatory Impact Review and Final Environmental Impact Statement for the Snapper Grouper Fishery of the South Atlantic Region. South Atlantic Fishery Management Council, 1 Southpark Circle, Suite 306, Charleston, South Carolina, 29407-4699.

SAFMC (South Atlantic Fishery Management Council). 1988. Amendment Number 1 and Environmental Assessment and Regulatory Impact Review to the Fishery Management Plan for the Snapper Grouper Fishery of the South Atlantic Region. South Atlantic Fishery Management Council, 1 Southpark Cir., Suite 306, Charleston, S.C. 29407-4699. 63 pp.

SAFMC (South Atlantic Fishery Management Council). 1991. Amendment Number 4, Regulatory Impact Review, Initial Regulatory Flexibility Analysis and Environmental Assessment for the Fishery Management Plan for the Snapper Grouper Fishery of the South Atlantic Region. South Atlantic Fishery Management Council, 1 Southpark Cir., Suite 306, Charleston, S.C. 29407-4699. 200 pp.

SAFMC (South Atlantic Fishery Management Council). 1993. Amendment Number 6, Regulatory Impact Review, Initial Regulatory Flexibility Analysis and Environmental Assessment for the Fishery Management Plan for the Snapper Grouper Fishery of the South Atlantic Region. South Atlantic Fishery Management Council, 1 Southpark Cir., Suite 306, Charleston, S.C. 29407-4699. 155 pp.

SAFMC (South Atlantic Fishery Management Council). 1997. Amendment Number 8, Regulatory Impact Review, Social Impact Assessment, Initial Regulatory Flexibility Analysis and Supplemental Environmental Impact Statement for the Fishery Management Plan for the Snapper Grouper Fishery of the South Atlantic Region. South Atlantic Fishery Management Council, 1 Southpark Cir., Ste 306, Charleston, S.C. 29407-4699. 124 pp.

SAFMC (South Atlantic Fishery Management Council). 1998b. Comprehensive Amendment Addressing Sustainable Fishery Act Definitions and Other Required Provisions in Fishery Management Plans of the South Atlantic Region (Amendment 11 to the Snapper Grouper Fishery Management Plan). South Atlantic Fishery Management Council, 1 Southpark Cir., Suite 306, Charleston, S.C. 29407-4699. 151 pp.

SAFMC (South Atlantic Fishery Management Council). 2008. Final Amendment Number 15B, Final Environmental Impact Statement, Initial Regulatory Flexibility Analysis/Regulatory Impact Review, and Social Impact Assessment/Fishery Impact Statement for the Fishery Management Plan for the Snapper Grouper Fishery of the South Atlantic Region. South Atlantic Fishery Management Council, 4055 Faber Place, Ste 201, North Charleston, S.C. 29405.

SAFMC (South Atlantic Fishery Management Council). 2008. Amendment Number 16, Final Environmental Impact Statement, Initial Regulatory Flexibility Analysis/Regulatory Impact Review, and Social Impact Assessment/Fishery Impact Statement for the Fishery Management Plan for the Snapper Grouper Fishery of the South Atlantic Region. South Atlantic Fishery Management Council, 4055 Faber Place, Ste 201, North Charleston, S.C. 29405. 375 pp.

SAFMC (South Atlantic Fishery Management Council). 2010. Final Amendment Number 17A for the Snapper Grouper Fishery of the South Atlantic Region with Final Environmental Impact

Statement, Initial Regulatory Flexibility Act Analysis/Regulatory Impact Review, and Social Impact Assessment/Fishery Impact Statement . South Atlantic Fishery Management Council, 4055 Faber Place, Ste 201, North Charleston, S.C. 29405. 375 pp. + XXI + Summary (20 pp.)

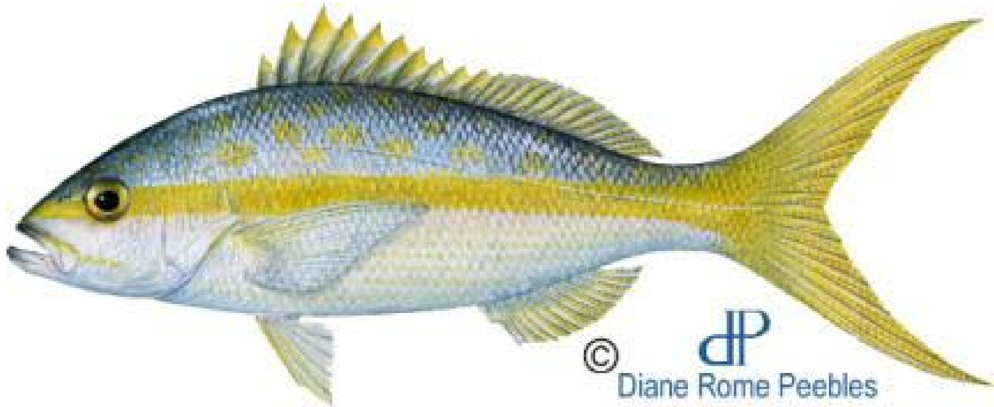
3. ASSESSMENT HISTORY AND REVIEW

Catches of yellowtail snapper and assessments were reviewed in Huntsman et al. (1992) and Muller et al. (2003) for SEDAR 3. The former used catch curves and yield per recruit analyses to examine stock status with data through 1990, while the latter used an age-structured assessment model (Integrated Catch-at-Age) for estimating stock status with data through 2001. Huntsman et al. (1992) estimated that the first fully recruited age to the fishery was age-3 fish, that fishing mortality in 1988 was 0.28 and in 1990 was 0.48, and spawning stock per recruit ratio to fishing mortality in 1988 was 0.38 and in 1990 was 0.19. Muller et al. (2003), in the SEDAR Stock Status Report for Yellowtail Snapper) estimated for 2001 that F was 0.17 and SSB was 4,481 metric tons, that SSB_{2001}/SSB_{MSST} was 1.78 (not overfished) and F2001/FOY was 0.92 (not overfishing). Model estimates for F during 1988 and 1990 were 0.24 and 0.28 (Muller et al. 2003).

3.1. LITERATURE CITED

Huntsman. O.R .. Potts, J.C., Mays, R., Dixon, R.L., Willis. P., Burton, M.L., Harvey, B.W., 1992. A stock assessrnent 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)



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Section II: Data Inputs

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4. INTRODUCTION TO DATA INPUTS

4.1 TERMS OF REFERENCE

(1) Evaluate precision and accuracy of fishery-dependent and fishery-independent data used in the assessment:

(a) Discuss data strengths and weaknesses (e.g., temporal and spatial scale, gear selectivities, aging accuracy, sampling intensity).

(b) Report metrics of precision for data inputs and use them to inform the model as appropriate.

(c) Describe and justify index standardization methods.

(d) Justify weighting or elimination of available data sources.

(2) Evaluate models used to estimate population parameters (e.g., F, biomass, abundance) and biological reference points.

(a) Did the model have difficulty finding a stable solution?

(b) Were sensitivity analyses for starting parameter values, priors, etc. and other model diagnostics performed?

(c) Have the model strengths and limitations been clearly and thoroughly explained?

(d) Have the models been used in other peer reviewed assessments? If not, has new model code been verified with simulated data?

(e) Compare and discuss differences among alternative models.

(3) State and evaluate assumptions made for all models and explain the likely effects of assumption violations on model outputs, including:

(a) Calculation of natural mortality (M).

(b) Choice of selectivity patterns.

(c) Error in the catch-at-age matrix.

(d) Choice of a plus group for age-structured species.

(e) Constant or variable ecosystem (e.g., abiotic) conditions.

(f) Choice of stock-recruitment function.

(g) Choice of reference points (e.g. equilibrium assumptions).

(4) *Evaluate uncertainty of model estimates and biological or empirical reference points.*

   (a) *Explain rationale for weighting of likelihood components.*

(5) *Perform retrospective analyses, assess magnitude and direction of retrospective patterns detected, and discuss implications of any observed retrospective pattern for uncertainty in population parameters (e.g., F, SSB), reference points, and/or management measures.*

(6) *Recommend stock status as related to reference points.*

(7) *Develop detailed short and long-term prioritized lists of recommendations for future research, data collection, and assessment methodology. Highlight improvements to be made by next benchmark review.*

4.2 LIST OF WORKING PAPERS AND DOCUMENTS

SEDAR27-RD01	McCarthy, K. 2011a. Commercial vertical line vessel standardized catch rates of yellowtail snapper in southern Florida, 1993-2010. National Marine Fisheries Service, Southeast Fisheries Division. Sustainable Fisheries Division Contribution SFD-2011-015.
SEDAR27-RD02	McCarthy, K. 2011b. Calculated discards of yellowtail snapper from commercial vertical line fishing vessels in southern Florida. National Marine Fisheries Service, Southeast Fisheries Division. Sustainable Fisheries Division Contribution SFD-2011-016.
YTS-RD03	Chagaris, D. 2011a. Standardized catch rates of yellowtail snapper (*Ocyurus chrysurus*) from the headboat fishery in southeast Florida and the Florida Keys.
YTS-RD04	Chagaris, D. 2011b. Standardized catch rates of yellowtail snapper (*Ocyurus chrysurus*) from the Marine Recreational Fisheries Statistics Survey in south Florida, 1981-2010.

5. LIFE HISTORY

5.1 OVERVIEW

5.1.1 ISSUES

5.2 REVIEW OF WORKING PAPERS

5.3 STOCK DEFINITION AND DESCRIPTION

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 (1993)], la rabirrubia [Mexico; Rincón-Sandoval et al. (2010)], and probably others.

Issues with identification: none. This species is readily recognizable, with a yellow lateral stripe and deeply forked yellow tail (Fig. 5.11.1). 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 chrysura*) 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).

5.3.1 STOCK STRUCTURE/DEFINITION

The yellowtail snapper (*Ocyurus chrysurus*) fishery is managed in the US by the South Atlantic Fishery Management Council (SAFMC) and the Gulf of Mexico Fishery Management Council (GMFMC) as separate stock units with the boundary essentially being U.S. Highway 1 in the Florida Keys west to the Dry Tortugas (Fig. 5.11.2). 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. Muller et al. (SEDAR 3; 2003), using data from genetic analyses available at the time (Hoffman et al. 2003), treated yellowtail snapper in the SAFMC and GMFMC jurisdictions as a single stock for assessment purposes. This assessment will continue SEDAR 3’s treatment of southeastern US yellowtail snapper as a single stock for assessment purposes (see also Section 5.3.3. Larval transport / connectivity).

5.3.2 Population genetics

Yellowtail snapper occur in the Western Atlantic Ocean from the Atlantic Coast of Brazil to the Atlantic Coast of the US (Fig. 5.11.3). Yellowtail snapper from southeastern US waters (Fig. 5.11.4) are believed to belong to a single stock. Mitochondrial DNA and microsatellite DNA from this species collected in seven locations in southern Florida and Puerto Rico analyzed by Hoffman et al. (2003) found little evidence of population structuring between the Florida Keys, southeast Florida, and Puerto Rico (Hoffman et al. 2003). However, there was evidence of isolation by distance between southern Florida and Puerto Rico specimens. Vasconcellos et al. (2008) compared mitochondrial DNA and morphometrics between specimens collected off of Brazil and Belize. They found that the Brazilian populations appear to be from a single stock but that there were significant genetic differences between the specimens collected in Brazil and Belize. Recently, Saillant et al. (2012) examined yellowtail snapper collected from the Florida Keys, Puerto Rico, and the US Virgin Islands (USVI). Their findings add further support for a single stock of yellowtail snapper off of southern Florida with restricted gene flow to or from eastern Caribbean populations in Puerto Rico and the USVI, and their findings also indicate that yellowtail snapper collected from locations around St. Croix may represent a separate stock. Unfortunately, there has been no comparison available regarding the genetics of yellowtail snapper specimens from the western Caribbean [e.g., Belize, Yucatan Peninsula and the Campeche Banks] with those in the Florida Keys.

5.3.3 Larval transport/connectivity

There are no empirical studies of the transport of yellowtail snapper larvae in US or Caribbean waters. High resolution ocean circulation modeling (see Cowen et al. 2000) by Paris et al. (2005) of the transport of larvae of four other snapper species with similar larval durations suggests a low probability (~1% connectivity) of larvae from the western Caribbean (particularly from south of Cuba) reaching US waters. The velocity and pattern of flow of the Caribbean Current, Florida Current, and Loop Current (Gyory et al. 2008a, b; Fig. 5.11.5) and the locations of source areas (e.g., shelf areas in the Caribbean and Gulf of Mexico, Fig. 5.11.6) which could supply larvae are possible but not favorable for providing larvae of those four species of snappers (and probably others such as yellowtail snapper) to the Florida Keys. Data on stock structure/population genetics (previous section) suggest that the movements of adults between areas in the eastern Caribbean Sea and South Florida are limited, and one could conclude that the majority of larvae in each of these areas probably came from adults occupying those areas (i.e., local production of recruits). Cowen et al. (2000, 2006) suggest that most ecologically relevant recruitment occurs over distances of 10-100 km in distance. Hydrodynamic models that incorporate larval behaviors suggest that propagule emigration from Cuba (particularly from northeast and north central regions) to southeastern Florida could occur, but that the contribution is low in terms of the total number of advected larvae over the planktonic larval duration of ca. 30 days (Lindeman et al. 2001; Paris et al. 2005). Based on drifter studies (Figure 5.11.7) and the duration of the larval stage of yellowtail snapper (approximately 3-4 weeks), some low level of recruitment from the western Caribbean (e.g., Yucatan Peninsula, Campeche Banks) to the Florida Keys via the Loop Current may also be possible. Because the possibility of recruitment from Cuba and the Western Caribbean appears low, the unit stock of yellowtail snapper for this assessment is considered at the functional population level, and is defined as the total number of individuals that use waters within the jurisdiction of the South Atlantic Fishery Management Council and the Gulf of Mexico Fishery Management Council.

5.3.4 DISTRIBUTION

Yellowtail snapper, *Ocyurus chrysurus*, are a tropical reef species endemic to waters of the tropical Western Atlantic Ocean (Fig. 5.11.3). This species ranges from Massachusetts to southeastern Brazil, including the Gulf of Mexico and Caribbean Sea (Fisher 1979; Kaschner et al. 2010). They are abundant in coral reef areas in waters off of south Florida, Bahamas, and the Caribbean (Manooch and Drennon 1987). In the western hemisphere, yellowtail snapper are harvested in relatively large quantities in Brazil, Mexico (chiefly off the Campeche Banks, Yucatan), and the United States (see Table 6.8.1). In continental US waters, this species is primarily found associated with reefs and is commonly caught in the Florida Keys and southeastern Florida [McClellan and Cummings 1998, Acosta and Beaver 1998; see Sections 6 (Commercial Statistics) and 7 (Recreational Statistics)].

5.4 MORTALITY

5.4.1 NATURAL MORTALITY

Yellowtail snapper natural mortality was estimated assuming that the instantaneous natural mortality (M) was inversely related to fish length (Lorenzen 2005). Yellowtail snapper appeared from analyses of ages in the catch to be fully vulnerable to fishing gears by age 3. This relation (Fig. 5.11.8) was scaled so that the cumulative instantaneous rate predicted during ages 3-20 agreed with the cumulative rate over these same ages calculated from a constant mortality-at-age estimate derived from maximum age (Hoenig 1983; known max. age = 23 years). Natural mortality-at-age (i.e., age-specific M) of yellowtail snapper was assumed constant over time.

Length-at-age required for this analysis was predicted using a von Bertalanffy growth model. Assuming a hatching date of June 1, this function was fit to observed age and length data (Fig. 5.11.9; Section 5.5.3 Age and Growth) using a truncated normal likelihood to account for size limit effects and included a changing variance of length data across ages (Diaz et al. 2004).

No attempt was made to include episodic types of natural mortality (red tides, cold kills, etc.) into this assessment because there were no data on which to base such modifications to M. 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. Species of fish in Florida waters differ in their ability to tolerate cold waters and the rapidity and duration of a temperature decline. 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 (1977)].

5.4.2 RELEASE MORTALITY

Data on the release mortality of yellowtail snapper are scarce. SEDAR 3 (2003) used a 30% release mortality rate based upon the MRFSS B1 fish (fish not measured by field samplers for various reasons including fish that were released dead during the fishing trip) and rough calculations from a small amount of discard data in commercial log books (Poffenberger 2003) for the all of the modeled fisheries (commercial, MRFSS, and Head Boat), and the review panel recommended that studies of discards should be conducted to resolve this lack of data. The NMFS' Marine Recreational Fishery Statistics Survey (MRFSS) has regularly collected angler-reported data on dead discards (included with their "Type B1" fish) and live released fish ("Type B2") since 1981, though there were scant few records of the B1 fish listed as discarded dead (i.e., nearly 100% of the yellowtail snapper were reported to have been released alive by intercepted recreational anglers). The NMFS Beaufort Head Boat Survey has collected reports of live and dead discards from head boat captains on their vessel catch logs beginning in 2004. The NMFS Coastal Log Books have required a sample of commercial fishermen to report the quantity of fish discarded by species beginning in 2002 (see McCarthy 2011b), but estimates of release mortality come from trips with at-sea observers on board. There are general concerns about self-reported data and bycatch reporting because of issues such as recall bias, prestige bias, rounding (i.e., digit bias, "dozens", tens, etc.), and perhaps a perception by some fishermen that the accurate reporting of bycatch or discards may lead to future management actions and reduced levels of allowable catch.

There have been no studies on the delayed mortality of yellowtail snapper after release from fishing gears, but there are programs which collect information on the observable condition of fish immediately after release. The NMFS at-sea observers gather information on released fish from commercial long line and bandit reel reef fish trips and note release condition of fish. However, released yellowtail snapper are uncommon on those few observed trips (Ms. Lori Hale, National Marine Fisheries Service (NMFS) Panama City Laboratory, personal communication). A new source of data collected by biologists on at-sea trips on head boat has accumulated recently, and it represents a more direct and unbiased source of several types of release data such as the size-at-release and the release mortality immediately observable after the release of fish off of Florida's Gulf Coast [funded during 2005-2007 by the Gulf States Marine Fisheries Commission's Fisheries Information Network (FIN) program] and off Florida's Atlantic Coast [funded during 2005-2010 by the Atlantic States Marine Fisheries Commission's Atlantic Coastal Cooperative Statistics Program (ACCSP)].

At-sea samplers were randomly assigned to ride head boats and observe (and interview) recreational anglers according to protocols established by the MRFSS. Samplers monitor a number of anglers fishing and identify and measure (if possible) fish caught by the angler that would be released. After measurement, the sampler returns the fish to the angler and observes and records information about the release of the fish such as the reason for release, release condition of the fish, and whether the fish was able to swim down from the surface after release. Notes regarding predation (by birds, marine mammals, or other fish) on released fish were also part of the scoring. Samplers attempted to observe all releases from anglers that they followed during the fishing trip. After the fishing trip, the samplers identified and measured as many of the landed fish as possible, and interviewed the anglers using the typical MRFSS survey forms. At-sea measurement forms and MRFSS survey forms were linked to each angler using a unique identification code. Only completed interviews (completed interview forms with all fish landed or released) are allowed by the MRFSS for at-sea sampling, so the data gathered by the samplers are a complete description of an angler's catch from the trip. Fish kept or released, even if undersized and/or used for bait or fed to birds or marine mammals, were scored on the forms by the samplers.

A total of 1,364 MRFSS at-sea sampling trips were completed under the FIN and ACCSP programs from 2005-2010, and yellowtail snapper were seen by samplers in all but the NW Florida region. Yellowtail snapper were more usually observed on head boat trips in the Florida Keys, SE FL, and the southern portion of SW FL region (Table 5.10.1). Most (97-100%) fish released alive and observed by the at-sea samplers were below the 12" TL minimum size limit. About 50% (36-83%; Type B2/Total Catch) of the yellowtail snapper caught were released alive on trips in the Florida Keys when an at-sea sampler was present, and 99% of the released fish observed were below the size limit based upon at-sea measurements by the samplers. Released yellowtail snapper from SW Florida and SE Florida were about 23% (19-26%) and 15% (11-27%) of the total catch, respectively, and 97% from both regions were observed to be undersized (Table 5.10.1). There were some measured undersized fish caught that were not released but rather were used for bait or fed to birds, and there were some measured legal-sized fish that were released by anglers stating that they thought the fish was undersized. Whether to release or keep a fish was a decision left up to an angler, and the coding of the reason for the release was determined by the angler's response.

The inferred release condition of a fish was scored by samplers after observing the fish for a short time after the fish was released back into the water by the angler. The releases recorded by the samplers were totaled by condition code to estimate the immediate release mortality for yellowtail snapper (Table 5.10.2). Fish that swam down immediately or during the time they were observed by the sampler (even if somewhat "disoriented" were assumed to have survived the encounter with the fishing gear. Those fish that were "very disoriented, remained at surface", were "dead/unresponsive", or that were "eaten by bird/fish/marine mammal" were an estimate of the immediate release mortality rate for yellowtail snapper fished from head boats. Yellowtail snapper released by head boat anglers in the Florida Keys/SW FL regions had an immediate release mortality rate of about 4.5%, and those fish released by head boat anglers in SE FL/NE FL regions had an immediate release mortality rate of 10.5% (Table 5.10.2) possibly as a result of deeper depths of capture in SE FL compared with the areas normally fished in the Keys and SW Florida (Fig. 5.11.10). A rate of 10% release mortality was chosen as an approximation for the lower bound on release mortality for yellowtail snapper, and sensitivity runs using release mortality rates of 20% and 30% should be considered to account for any delayed mortality after encounter with hook and line fishing gears. It is also necessary to consider that the extra handling for the measurement of released fish may also be contributing to the observed immediate release mortality.

5.4.3 SIZE OF KEPT AND RELEASED FISH FROM AT-SEA SAMPLING

The size frequencies of kept and released (alive and dead) yellowtail snapper observed during at-sea sampling of head boats in recent years show that nearly all of the fish kept by anglers on head boats are of legal size (Table 5.10.3; Fig. 5.11.11) and that most of the releases were undersized and were alive at the time of release (Table 5.10.4; Fig. 5.11.12). The proportions of released fish at size appear relatively similar for live and dead releases in that the most frequent size classes of live releases were also the most frequent in the dead releases. Small sample sizes for the dead releases by size class make rigorous comparisons of the size distributions more difficult especially on the Atlantic Coast.

5.5 AGE AND GROWTH

5.5.1 AVAILABLE AGE DATA AND ALTERNATIVE PROCEDURES

Sectioned otoliths are the preferred structures for aging yellowtail snapper (Johnson 1983, Manooch and Drennon 1987, Garcia et al. 2003). Data (Table 5.10.5) from 9,107 otoliths from 1980-2002 analyzed by Garcia et al. (2003), Barbieri and Colvocoresses (2003), and for SEDAR 3 (2003) were available for this assessment, as well as 12,129 otoliths collected from yellowtail snapper during 2001-2010 by various federal and state biologists involved in the southeastern region fishery dependent [Trip Interview Program (TIP), Head Boat Survey (HBS), and MRFSS] and fishery independent (FWRI’s Fisheries Independent Monitoring and Fish Biology) data collection programs. A few otoliths were collected from other sources such as the Louisiana Department of Fish and Wildlife. Otoliths were chiefly obtained from the NMFS’ Panama City and Beaufort Laboratories, and from the Florida Fish and Wildlife Conservation Commission’s (FWC) Fish and Wildlife Research Institute (FWRI). Additionally, the Panama City Laboratory sectioned 1,626 otoliths and supplied the age and other biological/field information from these samples. The FWRI Age and Growth Laboratory sectioned 10,503 otoliths and supplied the age information for this assessment. Ages determined from the otoliths and adjusted for collection date by year were used to develop an age-length key (Table 5.10.6) and were applied to the length samples of retained and estimated discards of yellowtail snapper for the separate fleets from each region to construct the proportions at age and estimate the numbers of fish in the catch by size (see section 5.5.5).

The FWRI and Panama City Laboratories use the same criteria for counting annuli, scoring the edge type, and adjusting the annuli counts for providing an age estimate in years. Marginal increment analyses (e.g., Garcia et al. 2003) have validated that yellowtail snapper form an opaque annulus in the spring (typically March-June). Annuli of most snappers (including yellowtail) are easily discerned and present no special challenges for laboratory analyses. The age of specimens was determined from the count of annuli and date of collection, with specimens showing edge types 2/3 or more complete before June 30 adjusted to an age of annuli count+1. Both laboratories use similar quality assurance techniques utilizing multiple readers and otolith metrics for developing consensus among the readers and consistency in the annuli counts and edge data.

Otolith ages were matched with any corresponding field data using one or more reference numbers (using a sample identification number and sometimes a specimen number) in the TIP, HBS, and FWRI data bases. In some instances field information from the envelopes in which the specimens were stored were consulted. Most data from the fishery dependent field surveys matched well, though roughly 30% of age data from one survey were unmatched with field data (a combination of sample identifiers and lengths). As a result of the data clean-up process, specimen mismatches fell below 2.5%. In most instances, labeling of the envelopes with the collection information and perhaps transcription errors in length measurements were the likely causes of the non-matching data. In a small number of cases, the process used for computerizing the information may also have been involved (e.g., a species code entered incorrectly at the time of measurement, minor differences in length measurement versus that written on the envelope, etc.). There may also have been some delay of time between otolith collection and final preparation of the envelopes in some cases which may have contributed to the number of mismatches. There were about 1,000 additional otoliths received in August 2011 collected mainly from recreational anglers during 2009-2010; however, time was not sufficient for processing and including the age and field data for those otoliths in this assessment.

5.5.2 MORPHOMETRICS

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 or with the tips of the tail compressed to its maximum length. Length of yellowtail snapper was largely measured in fork length in most of the data collection programs since this species has a deeply forked tail. In the TIP (samples largely from commercial trips) data bases, specimens may have multiple length measurements recorded such as standard, fork, and total length but FL is most usual for this species. The TIP samplers, when measuring total length, will typically compress the tail so that it produces a "maximum" TL measurement. The MRFSS protocols specify that field samplers measure a "midline" length which corresponds to fork length for yellowtail snapper. The HBS samplers using digital measuring boards mostly measured specimens in total length (measured with the tail in its natural position; Mike Burton and Ken Brennan, NMFS Beaufort Laboratory, personal communication) and over the last several years many are providing fork lengths for some species. The FWRI fishery dependent monitoring program, over the last 11 years, has measured SL, FL, and TL (natural and "max") measurements in order to provide a way of converting between the different measurement methods. SEDAR 3 (2003) treated the head boat TL measurements without correction for the $TL_{natural}$ measurement method. This assessment converts all fork length measurements and HB TL measurements (when a FL was not measured) to "maximum" TL (i.e., TL_{max} measured with the tail compressed). New length-length (simple linear regression; Table 5.10.7) and length-weight (log-log transformed and nonlinear power function; Table 5.10.8 and Fig. 5.11.13 a,b) equations were developed for this assessment using more recent length and weight data available for this species. The whole weight-FL relationships were developed from MRFSS data (with exclusion of outliers) from 1981-2010, and the nonlinear model was used for length-weight conversions in this assessment. The parameters for the FL-TL conversion equations used in this assessment were functionally similar to those used in SEDAR 3. The two TL measurement methods ("natural" and "maximum") can differ from 10-25 mm over the range of legal sizes typically encountered by anglers. Also, a comparison of conversion equations provided by Johnson (1983) and Garcia et al. (2003) are included in these tables.

5.5.3 Maximum age

The maximum observed age of yellowtail snapper based on the markings interpreted from thin sections of sagittal otoliths was 17 years prior to 2005. Seventeen-year-old fish were first collected out of only 299 fish sampled for age in 1980. After an accumulated age sample of nearly 12,000 fish from 1981 through 2004, only four additional 17 year olds had been sampled (Table 5.10.4). Since that time nine yellowtail snapper 20 years old or older have been collected, with a current maximum observed age of 23 years.

5.5.4 Growth

Length-at-age required for this analysis was predicted using a von Bertalanffy growth model fit to all available length and age data (Fig. 5.11.9a). Ages two through six accounted for about 88% of the otolith samples (Table 5.10.6) used in these analyses, and had a large effect on the parameters computed for the growth curve using all of the length and age data. This effect can be seen in the additional growth curves (Fig. 5.11.9a) were generated that used a random selection of lengths at age such that there were no more than 10, 20, or 30 length samples pre age depending upon the run. The parameters resulting from the “no more than 30 length samples per age” was selected to represent the growth curve, and these were used in conjunction with estimating age from length used in estimating the age-specific mortality values (see Section 5.4.1 Natural Mortality). Assuming a hatching date of June 1, this function (Fig. 5.11.9) was fit to the observed data using a truncated normal likelihood to account for size limit effects and included age-specific estimates of variance of lengths (Diaz et al. 2004).

5.5.5 Age composition of catches

The age composition of the fisheries catch were derived from estimated length composition of the landings and released fish (discards) using age-length keys. There were not sufficient length-age samples from each year, region, and fleet to develop annual fleet-specific age-length keys by coast. Age-length keys (ALK) were developed separately for each year during 1981-2010 and separately for the Gulf of Mexico and South Atlantic regions. The dimensions of the ALK were years 1981-2010 and ages 0 - 12^+ and length classes ≤ 5 inches total length, 6-23 inches, and ≥ 24 inches. The few predicted age-0, representing large young-of-the-year during the fall, were pooled with age-1 fish in a given year (modeled ages 1-12^+ in ASAP). Though the number of yellowtail snapper sampled for lengths and ages were fairly large in many years (Table 5.10.5), the age composition of certain length classes with less than six fish sampled for ages in that year and region required some pooling of age composition data across time (5-year periods, or all years) and space (both regions). The minimum of six age samples per length class per year per region accounted for 39% of the length-class cell observations, each cell being a unique combination of region (2; South Atlantic and gulf), year (30; 1981-2010), and total length inch classes (20 classes,<=5”,6”-23”,>=24” inches) for a total of 1,200 cells. The minimum sample limit of six ages per length class was chosen so that a minimum amount of pooling, which masks year-class-strengths, was needed. Pooling within region across 5-year periods accounted for data for 336 cells, pooling across all years within region accounted for data in 310 cells, and finally pooling across all years and regions provided age composition information for 90 cells.

For the released fish, the age composition (derived from the lengths of fish released observed by during at-sea sampling and the ALK) during 2005-2010 was applied over the entire 1985-2010 time period for all fleets. It appeared from the size information on the landed portion of the catches that fishermen were observing the 12” TL minimum size limit to a large extent during those years. The releases during the 1981-1984 time period, for which there was information other than sizes in the landed fish, was modified by assuming that fisherman may have retained fish of 10” TL and larger.

A second method for estimating the age composition of fishery catches was direct ageing of the fleet landings by year and region (when length-age samples were available) and ageing of the released portion of the catch with the ALK as described in the preceding paragraph as were the total length and age class groupings. The number of fish estimated for each age class was summed for a year across regions. If length-age samples were not available from the fleet landings for each coast by year, the age composition for that year was set to missing (i.e., no information on the age composition for a year from a fleet to inform the model). For released fish, the age composition was estimated only for the 2005-2010 period when there was some at-sea sampling data available (but not for each fleet), and set to missing for 1981-2004.

5.5.6 Additional considerations

It is worth noting that the reporting of landings and the sampling of retained catch from each of the fleets (commercial, recreational, and head boat) reside in different reporting systems and involve different intercept and sampling strategies. Commercial landings are reported in pounds (assumed to be gutted weight) by dealers in the southeastern U.S. either through monthly dealer surveys (NMFS General Canvass system) or trip tickets (in Florida, beginning in 1986). Sampling of landed catch from commercial vessels is conducted at seafood houses, and data are reported in the Trip Interview Program (TIP) since 1983. Biases (size, sex, and other types of bias) in the sampling of fish from the perspective of the samplers are recorded as part of the interview. There is no attempt to record information about discarded catch, though this information is, in later years (2002-2010), captured in a sample of vessels with log books that include the self-reporting of discards. Recreational landings (in terms of numbers of fish and whole weight) are collected through the NMFS’ Marine Recreational Fishery Statistics Survey (MRFSS; now called the Marine Recreational Information Program or “MRIP”), which also collects information on released catch, uses survey techniques to estimate catches based upon site-based intercepts of anglers in shore-based fishing, private or rental boat fishing, and from for-hire vessels (charter boats, fishing guides, and head boats in some states) and other sources of effort information. The NMFS Southeast Head Boat Survey uses a combination of vessel logs and dockside intercepts to collect information on vessel trips, fishing effort (number of anglers, hours fished, areas fished), and dockside samples of fish caught by head boat anglers to estimate the total landings (number of fish and whole weight by species) and recently estimates of discards and fishing effort in areas of the southeast region.

Each of the reporting systems noted in the previous paragraph required some additional processing to make landings data compatible for each of the fleets with each other and to the data inputs for the model. Commercial data in gutted weight were converted to landings in numbers of fish using the average number of fish per weight obtained from the TIP sampling. Most of the TIP data for yellowtail snapper was in fork length (FL) with few weight measurements, and if a different length type was measured a conversion to FL was made to enable whole weight estimates. Recreational data (MRFSS) is recorded in terms of numbers (and whole weight) of fish, and measurements for this survey are in “mid-line” length (= FL). The Southeast Head Boat Survey records the number of fish landed (from log books), and dockside sampling provides the data on sizes (typically in total length (TL) with the tail flat, but may also include a FL measurement) and whole weight (if measured). If whole weights were not reported for TIP, MRFSS, or HB samples, the whole weight was estimated from the FL of the specimen. Management regulations for yellowtail snapper specify the minimum size for retention in TL, though it is left up to the fishers’ discretion as to whether the tail should lay flat for the measurement or should be compressed for a maximum length. All of the yellowtail snapper data from the different reporting systems were made to conform to numbers (and whole weight) of fish landed by size (TL, with the tail compressed or “max”). The conventions used in this assessment have followed those used in SEDAR 3, with the exception of the relatively minor TL conversion from natural to “max” for the head boat measurements which was not realized to be needed at the time SEDAR 3 was conducted.

5.6 REPRODUCTION

5.6.1 REPRODUCTIVE CHARACTERISTICS

Yellowtail snapper are gonochoristic (individuals remain the same sex throughout their lifetime) and are multiple (batch) spawners with indeterminate fecundity (Barbieri and Colvocoresses 2003). Claro et al. (2001) classify reproduction in yellowtail snapper as having “discontinuous asynchronous development” of oocytes, where all oocytes that will be spawned by an individual within a reproductive cycle split from those still in the protoplasmic phase. Different batches of oocytes go through vitellogenesis at different times and mature asynchronously, and spawning occurs as each batch completes maturation. An individual spawns all oocytes from a batch in a single month.

5.6.2 SPAWNING SEASON

The months that spawning is known to occur in yellowtail snapper varies throughout the Caribbean Sea and continental US waters. In the Florida Keys, ripe fish have been observed year-round (Collins and Finucane 1989). Spawning may occur in most months of the year, but is most typical during April to August (McClellan and Cummings 1998). During these months, the large aggregations that form are believed to be spawning-related. Spawning probably occurs in open waters over high-relief hard bottom areas such as coral reefs, banks, and shelf areas, but has not been directly observed. In the Caribbean Sea, spawning may occur year-round in some areas (Grimes 1987, McClellan and Cummings 1998), although in Cuban waters peak spawning is during April with another less intensive peak in September (Claro et al. 2001). Barbieri and Colvocoresses (2003), using chevron traps and hook and line gear, studied several species of snappers including yellowtail off of Tequesta (southeast Florida) and the Florida Keys to examine reproductive characteristics in those species. The reproductive data resulting from that study were used in SEDAR 3 and were re-analyzed for this assessment.

5.6.3 AGE/SIZE AT MATURITY

Lowerre-Barbieri et al. (2011) discuss a myriad of considerations when estimating the size or age at maturity, and suggest that researchers make careful decisions on the intended use for the estimate. They note that there “is no standard level of gonadal development considered representative of ‘mature’”, and that the criteria upon which maturity is based should be explicitly stated. Individuals with only primary growth oocytes have been defined as immature (e.g., SEDAR 3 Yellowtail Snapper, SEDAR 15 Mutton Snapper, and SEDAR 19 Black Grouper), while those with cortical alveoli, yolked and/or hydrated oocytes, and minor to moderate atresia were used in this assessment to indicate female reproductive maturity (Table 5.10.9). Hunter and Macewisc (1985, 2003) recommended that, when examining maturity in a species, specimens should be examined from the early part of the spawning season in order to maximize the proportion of individuals that may be undergoing maturation while minimizing the number of individuals which may have already spawned and are difficult to distinguish from immature individuals.

Following the recommendations of Hunter and Macewicz (1985, 2003) the data (Barbieri and Colvocoresses 2003) on the reproductive stage of gonads (assessed histologically) from the peak spawning period (April-October) formerly used in SEDAR 3 were re-evaluated for the purposes of generating a size- and age- based maturation schedule for female *Ocyurus chrysurus*. Gonad maturity stages (GMS; Table 5.10.9) 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):

for length:

Equation 5.6.3.1

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

or, for age:

Equation 5.6.3.2

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

where y is the proportion mature, L_{50} or A_{50} is the point at which 50% of individuals are mature, and x is equal to either length or age depending upon the equation used. Analyses were restricted to fishes that were collected during the spawning season (i.e., if an individual were to mature were to occur, maturity would most likely be observed during the peak spawning months). Both models (for length-at-maturity and age-at-maturity) were significant and explained the majority of variance in the data (Tables 5.10.10.a, b). Alternatively, SEDAR 3 used a logistic model without the direct solution for L_{50} or A_{50} values, and L_{50} and A_{50} estimates were derived using the ratio of the intercept to the slope from the model (e.g., SAS Proc Logistic).

In Florida waters, fifty percent of females achieved sexual maturity at 232 mm TL_{max} (about 193 mm FL) and 1.7 years of age (Table 5.10.10(a) and (b) respectively). The age at 50% maturity from the logistic model used in this assessment is consistent with that used in SEDAR 3 (2003), but the length at 50% maturity estimated for SEDAR 3 from the same specimens and same histological criteria using another logistic model (SAS Proc Logistic) was 209 mm TL_{max} (about 180 mm FL). Because the assessment used the age at 50% maturity, the minor differences between these solutions for L_{50} (see previous paragraph) are unimportant for the assessment model. These values are somewhat smaller and younger compared with data (macroscopic determinations only, not histological) from Cuba, as Claro et al. (2001) report a mean size at maturity for this species to be 250 mm FL (ca. 308 mm TL_{max}) and 2 years of age. Using histological criteria and specimens of *O. chrysurus* from all or most months of the year, Figuerola et al. (1998), reported a L_{50} of 224 mm FL (ca. 275 mm TL_{max}) in waters off of Puerto Rico, and Trejo-Martínez et al. (2011) estimated a L_{50} of 213 mm FL (ca. 261 mm TL_{max}) for this species from the Yucatan's Campeche Banks.

Cummings (2004) provides a comprehensive summary of the biological information on yellowtail snapper, and references other works on estimates of size at maturity particularly in the Caribbean. Maturity estimates for specimens from SE FL and the FL Keys (Barbieri and Colvocoresses 2003) are smaller and a little younger than estimated elsewhere in the Caribbean and Gulf of Mexico. 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.].

5.6.4 Fecundity

Estimates of fecundity in yellowtail snapper were not used for this assessment, but there were estimates available (as cited in Cummings 2004) from Piedra (1969; 4 specimens), Collins and Finucane (1989), de Albornoz and Grillo (1993; 60 specimens). Rather than using fecundity estimates directly (which was an option if sufficient data were available), the ASAP model was configured to use female spawning stock biomass adjusted for total mortality for each age and year prior to the starting month defined for the spawning season, the maturity schedule, and average weight at age of individuals to calculate spawning stock biomass (SSB), the spawner-recruit relationship, and the estimated recruitment. Female SSB was used to calculate the spawning potential ratios and other management reference points dependent on SSB (NOAA Fisheries Toolbox, 2011).

5.6.5 SEX RATIO

Sex ratios in yellowtail snapper populations may be approximately equal in most months (see discussion in Cummings 2004). Grimes (1987) cites studies from Jamaica and Cuba showing male:female ratios of 1:1.3 and 1:1.4, and 1:1.04 in the Florida Keys. The sex ratio for yellowtail snapper specimens captured on the Campeche Banks was not significantly different from 1:1 (Trejo-Martínez et al. 2011).

5.6.6 DISTRIBUTION AND CHARACTERIZATION OF SPAWNING AGGREGATIONS

Large spawning aggregations are 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 of the Dry Tortugas (Lindeman et al. 2000). Spawning appears to take place from late afternoon through the evening hours over open waters, and the planktonic eggs are buoyant (i.e., they contain an oil droplet that allows them to float).

5.7 HABITATS AND MOVEMENTS

5.7.1 EFH, HABITAT QUALITY AND ONTOGENETIC SHIFTS

In Florida waters, yellowtail snapper are reported in spawning condition from April to August (Allen 1985). The pelagic eggs are buoyant and hatch within 24 hours (Bortone and Williams 1986), and the sparsely pigmented planktonic larvae are largely transparent (Clarke et al. 1997). Settlement of larvae into seagrass habitats occurs around 3-4 weeks after hatching (Bortone and Williams 1986) when the larvae reach about 20 mm SL (Bartels and Ferguson 2006). Larvae can reach this length around 24 days after hatching. Settlement is typically in habitats particularly with seagrasses, and juveniles smaller than 150 mm FL are found primarily in seagrasses, moving to shallow coral reef areas as they grow larger (Nagelkerken et al. 2000).

5.7.2 MOVEMENTS AND MIGRATIONS

Lindeholm et al. (2005) used acoustic tags to monitor movements of 9 yellowtail snapper (and 5 black grouper, also) in the Conch Reef Research Area in the northern Florida Keys during November 2001 in order to characterize site fidelity and other movement behaviors. The longest time at liberty for yellowtail snapper was 237 days, and shortest was two days. Six fish were tracked in the Conch Reef area for over five months. Five of the nine tagged yellowtail snapper were tracked to another reef (Davis reef), over 4 km away, immediately after release. All of those fish returned to Conch Reef within 24 hours of release. Only one fish re-visited Davis reef (on three occasions) during the seventh month (June, 2002) after tagging. For most of the study, the fish were monitored in the vicinity of Conch Reef. Although only a few fish were tagged in this study, the authors concluded that there were indications for site fidelity in yellowtail snapper. This finding was contrary to their expectations of low site fidelity because of their observations that yellowtail snapper form transient aggregations in the water column at Conch Reef and often move out of visual range. In a study of small no-take reserves four years after their designation in the Florida Keys (Bohnsack and Ault 2002), densities of yellowtail snapper increased 15-fold within the reserves. Their findings of such a large increase in densities over a short time span may also suggest some level of site fidelity for yellowtail snapper recruiting to the no-take reserves.

5.8 ADEQUACY OF DATA FOR ASSESSMENT ANALYSES (COMMENTS)

At present, genetic analyses were sufficient to support a single stock for yellowtail snapper in U.S. southeast region. The extent of linkage of the U.S. population with the Campeche Banks has not been studied, however. The known maximum age of yellowtail snapper in U.S. waters has been lengthened from 23 years from the 17 years through additional sampling of commercial and recreational catches after SEDAR 3(2003), and is sufficient to provide an estimate of natural mortality using a variety of methods. It may be likely that even older individuals may be found in the future. Studies on released fish including yellowtail snapper using at-sea sampling methods during 2005-2007 in the Florida Keys and southwest Florida and from 2005-2010 off the Atlantic Coast of Florida on head boats are sufficient to provide a rough estimation of immediate release mortality and the sizes released. The use of these data to provide estimates for commercial and other types of recreational fishing relies on the assumption that catches from the unstudied fleets are similar in size spectrum and that immediate release mortalities are similar at least in the other recreational fishing modes (shore-based, private/rental boats, and charter vessels). The estimate of release mortality (11.5%) from commercial vessels was based upon self-reported data from these vessels, which is not dissimilar from release mortality observed off southeastern Florida over the 2005-2010 period, but is about twice the estimate observed in the Florida Keys during 2005-2007. Curiously, there were practically no records of dead discards from the MRFSS data, and all releases were reported as “live”. There were no known studies of delayed mortality of released yellowtail snapper.

Age sampling was sufficient to generate a growth curve and annual age-length keys (ALK) by coast, though there was some filling required for some length classes for the ALK, but was not sufficient to generate fleet-specific age-length keys by coast. This may not be a particular issue with yellowtail snapper, as commercial and recreational (including head boats) vessels may be fishing in similar areas and depths throughout the reef habitats used by this species. There was a large overlap in lengths at age for the ages (1-12+) used in the model, and a large overlap in the length frequencies observed in the landings of each fleet. There were usually enough measured lengths from dockside sampling in most years to generate length compositions directly from the data. Gaps in the length sampling data and how they were filled are discussed in the appropriate sections (following) for each fleet modeled.

Age sampling for some fleets was a little sparse by coast, but was available for use in direct ageing of the landings by fleets particularly in the later years. No yellowtail snapper otoliths were sampled from the commercial fleets during 1981-1991 for the Atlantic coast, and 1982-1991 for the gulf coast. No yellowtail snapper otoliths from recreational fishing modes sampled by the MRFSS were collected from 1981-2001. (Note: The MRFSS does not allow otolith sampling in the regular MRFSS interviews for catch and effort. Separate add-on surveys, such as those funded under the MRFSS, GMFMC’s RecFIN and FIN programs and the ACCSP’s biological sampling, allow for otolith sampling.) No yellowtail snapper otoliths were collected by the Southeast Head Boat Survey in 1993 and 2002-2003 on the Atlantic Coast, and none on the gulf coast were collected from 1985, 1987, 1990, 1992-1993, 1996-1999, and 2001. No age composition information from a fleet's landings for a year were available to the model if there were no otoliths sampled on either coast. The ASAP2 model uses the fleet age compositions provided to assess the fit of the model to the data, and it for allows time periods where there were no data available.

Sex ratio and spawning season information was sufficient for use, as was the age and size at maturity. There were differences in size and age at maturity with published literature, but these differences were likely a function of the type of study (macroscopic versus histological), the histological stages used and the months/seasons (all year versus peak of the spawning season) included in the maturity model.

5.9 LITERATURE CITED

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5.10 TABLES

Table 5.10.1 Number of yellowtail snapper harvested and released alive by head boat anglers during at-sea sampling trips in Florida. Released fish partitioned by release code. Dead fish released are counted as harvested fish following the MRFSS survey protocols. Some released fish ("Type B2") were not seen by the at-sea samplers, and in most cases only a limited number of anglers were followed by the at-sea samplers on a trip.

Yellowtail snapper			Harvested		Released alive	Total Catch		Observed released fish			
	Year	Observed Trips	Type A	Type B1	Type B2	A+B1+B2	release not observed	Dead releases	Total Alive	Number < 12" TL minimum	Number >=12" TL limit
NW FL	2005	56	0	0	0	0	0	0	0	0	0
	2006	48	0	0	0	0	0	0	0	0	0
	2007	55	0	0	0	0	0	0	0	0	0
	Total	159	0	0	0	0	0	0	0	0	0
SW FL	2005	96	535	21	194	750	6	10	89	86	3
	2006	107	790	23	245	1,058	7	20	168	165	3
	2007	91	669	7	164	840	4	7	75	72	3
	Total	294	1,994	51	603	2,648	17	37	332	323	9
FL Keys	2005	39	653	72	543	1,268	4	25	451	450	1
	2006	58	1,097	45	650	1,792	25	40	615	608	7
	2007	55	2,109	316	750	3,175	37	72	591	579	12
	Total	152	3,859	433	1943	6,235	66	137	1,657	1,637	20
SE FL	2005	99	561	16	111	688	1	16	111	109	2
	2006	71	356	2	48	406	1	2	48	47	1
	2007	71	445	7	58	510	2	7	52	50	2
	2008	76	190	6	74	270	1	6	74	70	4
	2009	77	270	8	47	325	4	8	47	47	0
	2010	72	301	12	40	353	2	9	40	39	1
	Total	466	2,123	51	378	2,552	11	48	372	362	10
NE FL	2005	51	43	0	14	57	0	0	14	14	0
	2006	39	8	0	3	11	0	0	3	3	0
	2007	50	52	1	8	61	1	1	7	7	0
	2008	53	29	2	7	38	2	2	7	7	0
	2009	52	15	2	1	18	2	2	1	1	0
	2010	49	4	0	0	4	0	0	0	0	0
	Total	294	151	5	33	189	5	5	32	32	0

*FL Gulf of Mexcio Coast: NW FL = Escambia-Dixie, SW FL = Levy-Collier, FL Keys = Monroe
FL Atlantic Coast: NE FL = Nassau-Brevard, SE FL=Indian River – Miami-Dade

Table 5.10.2 Released fish observed by at-sea samplers (MRFSS) on head boats, 2005-2010, by release condition in southeast Florida (a) and the Florida Keys/SW FL regions (b), and average depth fished on at-sea sampled head boat trips with catches of yellowtail snapper (c).

a. SE FL (2005-2010)

	MRFSS Release Condition						
MRFSS Disposition	swam down	disoriented, swam down	very disoriented, remained at surface	dead / unresponsive	eaten by bird / fish / marine mammal	unable to observe	total
thrown back alive/legal	10	0	2	0	0	0	12
thrown back alive/not legal	311	77	25	17	3	11	444
used for bait/plan to use for bait	0	0	0	0	0	5	5
thrown back dead/plan to throw away	0	0	0	0	0	0	0
coding error?	0	0	0	0	0	0	0
Totals	321	77	27	17	3	16	461

SE FL	observed released alive	observed/ probable released dead	% released alive	% released dead
Fish released alive (those that swam down)	398	47	89.4%	10.6%

b. FL Keys and SW FL (2005-2007)

	MRFSS Release Condition						
MRFSS Disposition	swam down	disoriented, swam down	very disoriented, remained at surface	dead / unresponsive	eaten by bird / fish / marine mammal	unable to observe	total
thrown back alive/legal	26	1	3	0	0	0	30
thrown back alive/not legal	1,827	89	33	33	17	6	2,005
used for bait/plan to use for bait	2	0	0	0	1	66	69
thrown back dead/plan to throw away	0	0	0	5	0	2	7
coding error?	1	0	0	0	0	0	1
Totals	1,856	90	36	38	18	74	2,112

FL Keys and SW FL	observed released alive	observed/ probable released dead	% released alive	% released dead
Fish released alive (those that swam down)	1,946	86	95.8%	4.2%

c. Average depths fished on at-sea sampled head boat trips with catches of yellowtail snapper

		At-sea sampling		Average depth fished	
For-Hire Survey region	Years	Total Trips	Trips with yellowtail snapper	feet	meters
NW FL (Escambia – Dixie)	2005-2007	161	0	n.a.	n.a.
SW FL (Levy – Collier)	2005-2007	294	34	88.7	27.0
FL Keys (Monroe)	2005-2007	152	85	54.0	16.5
SE FL (Indian River – Miami-Dade)	2005-2010	466	38	95.9	29.2
NE FL (Nassau – Brevard)	2005-2010	294	63	96.5	29.4

Table 5.10.3 Number and sizes of yellowtail snapper kept by anglers on at-sea sampling trips in south Florida during 2005-2010 (Atlantic Coast) and 2005-2007 (Gulf Coast).

a.) Atlantic Coast, yellowtail snapper kept by anglers on at-sea sampling trips

TL (inch class, minimum)	2005	2006	2007	2008	2009	2010	Total
7	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0
9	0	0	0	0	1	0	1
10	1	1	3	4	0	0	9
11	18	16	27	5	16	8	90
12	76	64	94	54	55	51	394
13	84	117	124	49	69	72	515
14	97	81	80	29	55	62	404
15	118	48	69	28	46	52	361
16	99	15	57	29	20	28	248
17	49	10	23	11	15	10	118
18	25	3	12	3	4	8	55
19	16	2	1	3	0	8	30
20	4	1	2	0	0	2	9
21	0	0	0	0	0	0	0
22	0	0	0	2	0	2	4
23	0	0	0	0	0	2	2
24	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0
31	0	0	0	0	0	0	0
Total	587	358	492	217	281	305	2240

b.) Gulf Coast, yellowtail snapper kept by anglers on at-sea sampling trips

TL (inch class, minimum)	2005	2006	2007	2008	2009	2010	Total
7	0	1	0				1
8	0	0	0				0
9	4	0	4				8
10	4	4	2				10
11	21	40	40				101
12	99	262	275				636
13	105	339	441				885
14	128	204	408				740
15	111	133	364				608
16	97	87	229				413
17	63	65	144				272
18	32	25	61				118
19	20	17	36				73
20	17	13	17				47
21	16	10	8				34
22	10	6	3				19
23	2	1	3				6
24	3	2	0				5
25	0	1	0				1
31	0	1	0				1
Total	732	1211	2035				3978

Table 5.10.4 Number and sizes of yellowtail snapper released live or dead by anglers on at-sea sampling trips in south Florida during 2005-2010 (Atlantic Coast) and 2005-2007 (Gulf Coast).

a.) Atlantic Coast, yellowtail snapper released by anglers on at-sea sampling trips

TL (inch class, minimum)	Live Releases (numbers)	Dead Releases (numbers)	all releases (numbers)	Live Releases (proportions)	Dead Releases (proportions)	all Releases (proportions)
5	0	0	0	0.0000	0.0000	0.0000
6	0	1	1	0.0000	0.0213	0.0022
7	4	0	4	0.0101	0.0000	0.0090
8	27	1	28	0.0678	0.0213	0.0629
9	61	5	66	0.1533	0.1064	0.1483
10	117	18	135	0.2940	0.3830	0.3034
11	155	18	173	0.3894	0.3830	0.3888
12	27	3	30	0.0678	0.0638	0.0674
13	3	1	4	0.0075	0.0213	0.0090
14	2	0	2	0.0050	0.0000	0.0045
15	2	0	2	0.0050	0.0000	0.0045
16	0	0	0	0.0000	0.0000	0.0000
17	0	0	0	0.0000	0.0000	0.0000
18	0	0	0	0.0000	0.0000	0.0000
Total	398	47	445	1.0000	1.0000	1.0000

b.) Gulf Coast, yellowtail snapper released by anglers on at-sea sampling trips

TL (inch class, minimum)	Live Releases (numbers)	Dead Releases (numbers)	all releases (numbers)	Live Releases (proportions)	Dead Releases (proportions)	all Releases (proportions)
5	7	0	7	0.0036	0.0000	0.0034
6	8	2	10	0.0041	0.0220	0.0049
7	60	2	62	0.0309	0.0220	0.0305
8	216	9	225	0.1112	0.0989	0.1106
9	396	18	414	0.2038	0.1978	0.2035
10	534	24	558	0.2748	0.2637	0.2743
11	520	26	546	0.2676	0.2857	0.2684
12	157	8	165	0.0808	0.0879	0.0811
13	23	2	25	0.0118	0.0220	0.0123
14	12	0	12	0.0062	0.0000	0.0059
15	6	0	6	0.0031	0.0000	0.0029
16	3	0	3	0.0015	0.0000	0.0015
17	0	0	0	0.0000	0.0000	0.0000
18	1	0	1	0.0005	0.0000	0.0005
Total	1943	91	2034	1.0000	1.0000	1.0000

Table 5.10.5 Number of otoliths available by year, fishing sector, and mode of fishing. [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), Shore (SH), Other or Unknown (OT or UN), and Law Enforcement confiscations (LE)].

		Commercial	FI	Recreational					
Year	Total	CM	SS	HB	PC	PR	SH	OT or UN	LE
1980	299	0	0	299	0	0	0	0	0
1981	352	153	0	199	0	0	0	0	0
1982	235	0	0	235	0	0	0	0	0
1983	597	0	0	597	0	0	0	0	0
1984	217	0	0	217	0	0	0	0	0
1985	180	0	0	180	0	0	0	0	0
1986	74	0	0	74	0	0	0	0	0
1987	52	0	0	52	0	0	0	0	0
1988	10	0	0	10	0	0	0	0	0
1989	10	0	0	10	0	0	0	0	0
1990	120	0	0	120	0	0	0	0	0
1991	34	0	0	34	0	0	0	0	0
1992	122	107	0	15	0	0	0	0	0
1993	174	174	0	0	0	0	0	0	0
1994	342	262	0	80	0	0	0	0	0
1995	542	270	0	272	0	0	0	0	0
1996	465	400	0	65	0	0	0	0	0
1997	1,072	977	0	95	0	0	0	0	0
1998	861	512	6	343	0	0	0	0	0
1999	1,130	833	119	178	0	0	0	0	0
2000	1,150	541	540	68	0	0	0	1	0
2001	981	638	300	30	0	0	0	13	0
2002	760	454	90	4	137	75	0	0	0
2003	698	341	0	1	281	21	0	0	54
2004	1,352	444	0	395	482	31	0	0	0
2005	1,536	676	0	447	384	29	0	0	0
2006	1,415	707	0	390	290	28	0	0	0
2007	1,193	360	23	734	53	23	0	0	0
2008	1,673	834	25	617	164	32	1	0	0
2009	1,804	742	27	563	446	26	0	0	0
2010	1,761	493	91	702	420	40	0	15	0
Total	21,211	9,918	1,221	7,026	2,657	305	1	29	54

Table 5.10.6 Ages of yellowtail snapper sampled (all sources) by year and used in the development of age-length keys during 1980-2010. Ages for 1980 were combined with those of 1981 for the age-length keys.

	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	Total
1980	0	7	84	73	48	34	29	9	4	5	4	1	0	0	0	0	0	1	0	0	0	0	0	0	299
1981	0	7	103	89	53	35	18	19	13	7	1	4	2	0	0	0	1	0	0	0	0	0	0	0	352
1982	0	4	34	127	35	15	6	8	4	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	234
1983	0	17	266	203	88	6	6	4	2	0	2	1	0	0	1	0	0	0	0	0	0	0	0	0	596
1984	0	2	100	73	19	16	4	2	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	217
1985	0	31	51	69	28	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	180
1986	0	4	39	12	11	4	1	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	74
1987	0	4	29	15	3	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	52
1988	0	0	3	6	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10
1989	0	0	2	5	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10
1990	0	0	22	50	37	8	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	120
1991	0	0	7	5	13	5	0	0	0	1	0	2	1	0	0	0	0	0	0	0	0	0	0	0	34
1992	0	0	26	64	16	5	3	6	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	122
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	174
1994	0	2	48	146	69	20	11	11	13	4	5	4	3	2	2	0	2	0	0	0	0	0	0	0	342
1995	0	5	101	253	117	33	13	8	5	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	542
1996	0	18	187	95	74	44	21	5	9	6	2	2	2	0	0	0	0	0	0	0	0	0	0	0	465
1997	0	3	200	401	165	113	83	45	19	16	8	12	6	1	0	0	0	0	0	0	0	0	0	0	1,072
1998	0	27	235	320	130	57	33	28	13	6	5	5	0	1	1	0	0	0	0	0	0	0	0	0	861
1999	0	77	504	250	132	72	38	19	18	8	6	0	1	2	2	0	0	0	0	0	0	0	0	0	1,129
2000	1	170	393	206	134	95	59	33	19	20	8	7	1	2	1	0	0	0	0	0	0	0	0	0	1,149
2001	1	44	282	218	165	88	75	36	20	13	10	9	7	1	0	1	0	1	0	0	0	0	0	0	971
2002	0	0	74	166	148	160	98	40	30	16	12	4	6	3	1	1	1	0	0	0	0	0	0	0	760
2003	0	43	166	150	101	45	47	34	18	15	4	5	8	4	1	2	0	3	0	0	0	0	0	0	646
2004	0	34	637	346	183	88	40	33	16	7	3	5	3	2	2	3	0	0	0	0	0	0	0	0	1,402
2005	0	35	460	604	200	104	45	29	12	17	8	5	6	2	5	1	1	0	0	0	0	0	0	1	1,535
2006	0	21	759	249	158	72	47	25	30	15	19	1	8	2	6	1	0	1	0	0	0	1	0	0	1,415
2007	17	35	371	440	126	82	59	23	17	0	9	5	1	1	2	0	1	2	0	0	1	1	0	0	1,193
2008	0	51	344	421	356	180	110	63	56	28	13	18	10	6	3	5	4	0	2	0	1	1	1	0	1,673
2009	0	23	400	449	249	243	145	114	69	34	19	11	16	18	5	6	2	1	0	0	0	0	0	0	1,804
2010	0	27	474	525	318	153	117	48	35	21	8	13	5	5	3	1	2	0	0	1	0	0	0	2	1,758
Totals	19	691	6,455	6,087	3,198	1,788	1,123	651	433	249	149	116	87	52	37	21	14	9	2	1	2	3	1	3	21,191

Table 5.10.7 Length-Length conversion equations for yellowtail snapper.

Length-Length conversion equations for yellowtail snapper

Linear model: $FL_{(mm)} = a + b \cdot TL_{(max,\ mm)}$					independent var.		dependent var.	
Study	a (mm)	b	n	r^2	TL_{max} Min (mm)	TL_{max} Max (mm)	FL Min (mm)	FL Max (mm)
Johnson (1983)	17.7	0.78	100	0.97				
SEDAR 3	23.465	0.747	409	0.98	281	653	233	506
SEDAR 3* *minus 2 outliers*	21.355	0.752	407	0.99	281	653	233	506
This assessment	14.255	0.768	3,036	0.99	281	684	233	548

Linear model: $FL_{(mm)} = a + b \cdot TL_{(natural,\ mm)}$					independent var.		dependent var.	
Study	a (mm)	b	n	r^2	TL_{nat} Min (mm)	TL_{nat} Max (mm)	FL Min (mm)	FL Max (mm)
Garcia et al.(2003)	7.56	0.79	1,264	0.95	240	780	220	720
Garcia et al.(2003) *minus 18 outliers*	10.72	0.78	1,246	0.97	240	615	220	495
This assessment	25.845	0.750	6,118	0.97	253	697	212	548

Linear model: $TL_{(max,\ mm)} = a + b \cdot FL_{(mm)}$					independent var.		dependent var.	
Study	a (mm)	b	n	r^2	FL Min (mm)	FL Max (mm)	TL_{max} Min (mm)	TL_{max} Max (mm)
SEDAR 3	-23.117	1.313	409	0.98	233	506	281	653
SEDAR 3*	-24.518	1.318	407	0.99	233	506	281	653
This assessment	-14.947	1.290	3,036	0.99	233	548	281	684

Linear model: $TL_{(max,\ mm)} = a + b \cdot TL_{(natural,\ mm)}$					independent var.		dependent var.	
Study	a (mm)	b	n	r^2	TL_{nat} Min (mm)	TL_{nat} Max (mm)	TL_{max} Min (mm)	TL_{max} Max (mm)
This assessment	12.688	0.998	3,008	0.99	249	662	266	684

Linear model: $TL_{(natural,\ mm)} = a + b \cdot TL_{(max,\ mm)}$					independent var.		dependent var.	
Study	a (mm)	b	n	r^2	TL_{max} Min (mm)	TL_{max} Max (mm)	TL_{nat} Min (mm)	TL_{nat} Max (mm)
This assessment	-8.604	0.991	3,008	0.99	266	684	249	662

Linear model: $TL_{(max,\ mm)} = a + b \cdot SL_{(mm)}$					independent var.		dependent var.	
Study	a (mm)	b	n	r^2	SL Min (mm)	SL Max (mm)	TL_{max} Min (mm)	TL_{max} Max (mm)
This assessment	2.701	1.417	2,997	0.98	200	502	281	684

Linear model: $FL_{(\ mm)} = a + b \cdot SL_{(mm)}$					independent var.		dependent var.	
Study	a (mm)	b	n	r^2	SL Min (mm)	SL Max (mm)	FL Min (mm)	FL Max (mm)
This assessment	13.609	1.099	3,136	0.99	200	502	233	548

Table 5.10.8 Length-Weight conversion equations for yellowtail snapper.

a. Length-Weight conversion equations for yellowtail snapper.

Linearized model: ln (body weight$_{(kg)}$) = ln (a) + b*ln(FL$_{(mm)}$)

Study	ln (a$_{(kg)}$)	b	n	Mean Square Error (MSE)	r^2	FL Min (mm)	FL Max (mm)
Johnson (1983)	-7.2125[i]	2.76	517	----------	0.94	100	500
Garcia et al.(2003)	-17.0064[ii]	2.835	1,254	0.01522	0.89	220	561
This assessment	-17.0007[iii]	2.845	8,273	0.01371	0.94	146	792

Nonlinear model: body weight$_{(kg)}$ = a · FL$_{(mm)}^{\,b}$

Study	a$_{(kg)}$	b	n	Mean Square Error (MSE)	approx. r^2	FL Min (mm)	FL Max (mm)
This assessment	$6.135e^{-8}$	2.779	8,273	0.00820		146	792

Linearized model: ln (body weight$_{(kg)}$) = ln (a) + b*ln(TL$_{(max,\ mm)}$)

Study	ln (a$_{(kg)}$)	b	n	Mean Square Error (MSE)	r^2	TL_{max} Min (mm)	TL_{max} Max (mm)
SEDAR 3[iv] (2003)	-16.9735[iv]	2.739	1,421	0.03597	0.91	127	649
This assessment	-17.0144[v]	2.744	8,273	0.01371	0.94	173[vi]	1007 [vi]

Linearized model: ln (body weight$_{(kg)}$) = ln (a) + b*ln(TL$_{(natural,\ mm)}$)

Study	ln (a$_{(kg)}$)	b	n	Mean Square Error (MSE)	r^2	TL_{max} Min (mm)	TL_{max} Max (mm)
Garcia et al.(2003)	-17.1414[vii]	2.757	1,254	0.01735	0.87	240	615

[i] Johnson. (1983) FL: ln (a) back-transformed: $6.13e^{-8}$ kg
[ii] Garcia et al. (2003) FL: ln (a) back-transformed: $4.114e^{-8}$ kg
[iii] This assessment FL: ln (a) back-transformed: $4.137e^{-8}$ kg
[iv] SEDAR 3 (2003) TL_{max}: ln (a) back-transformed: $4.251e^{-8}$ kg
[v] This assessment TL_{max}(estimated): ln (a) back-transformed: $4.081e^{-8}$ kg
[vi] Total Length (max, mm) estimated from Fork Length (mm)
[vii] Garcia et al. (2003) $TL_{natural}$: ln (a) back-transformed: $3.594e^{-8}$ kg

Table 5.10.9 Histological staging criteria used in this study for determining the maturity stage of female specimens of *Ocyurus chrysurus*.

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

a) TOTAL LENGTH (TL_{MAX}, MM)

Parameter	Estimate	SE	
R	0.016	0.004	
$L_{50\ (TLmax,\ mm)}$	232.4	19.848	
Variance Source	DF	MS	P
Model	2	75.004	< 0.0001
Error	218	0.1342	

*SEDAR 3 L_{50} = 209 mm based on the same specimens using Proc Logistic

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	

*SEDAR 3 A_{50} = 1.70 years based on the same specimens using Proc Logistic

5.11 FIGURES

Figure 5.11.1 Yellowtail snapper over soft corals, Florida Keys, 2009. (photo credit: Ms. Janessa Cobb).

Figure 5.11.2 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.

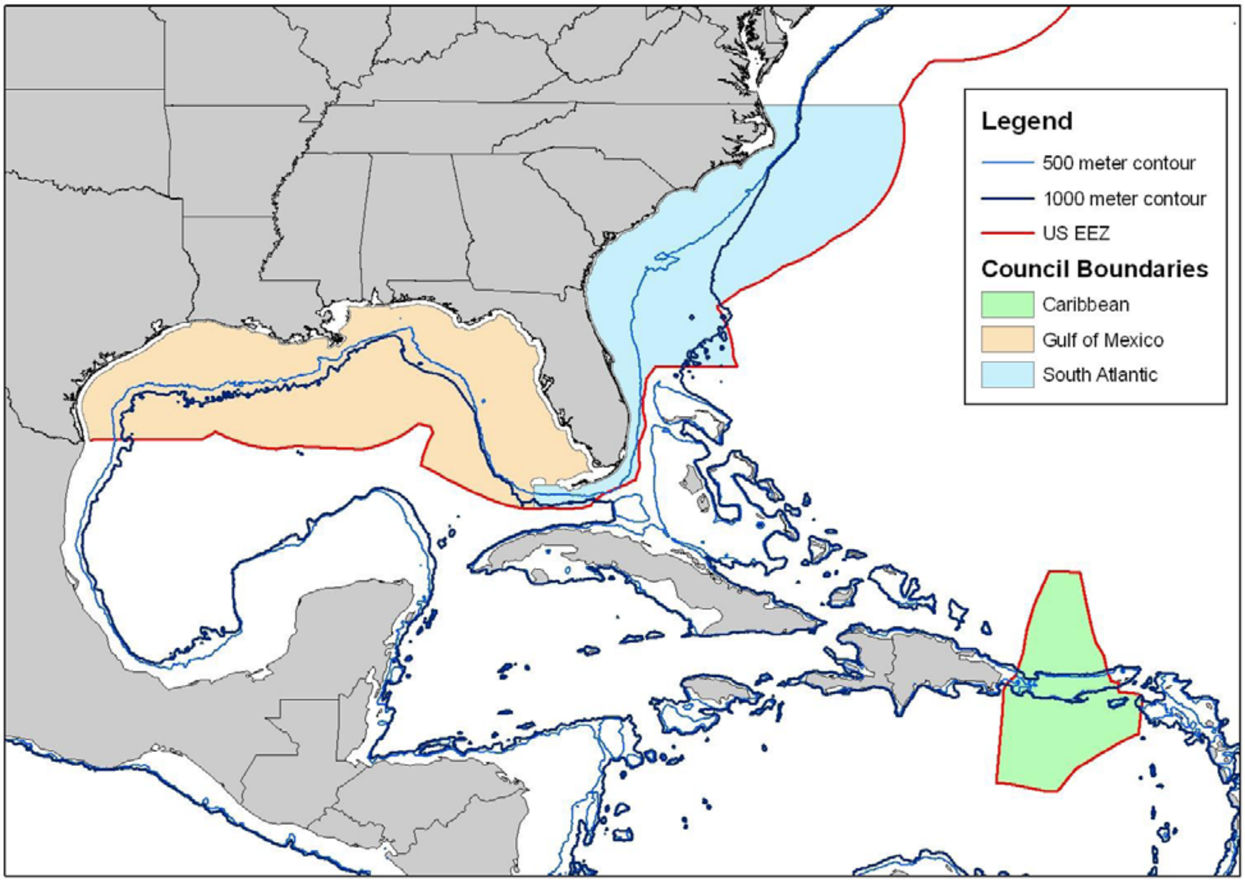


Figure 5.11.3 Estimated worldwide distribution for yellowtail snapper [Kaschner et al., 2010; Computer-generated map for *Ocyurus chrysurus* (un-reviewed). www.aquamaps.org, version of Aug. 2010.]

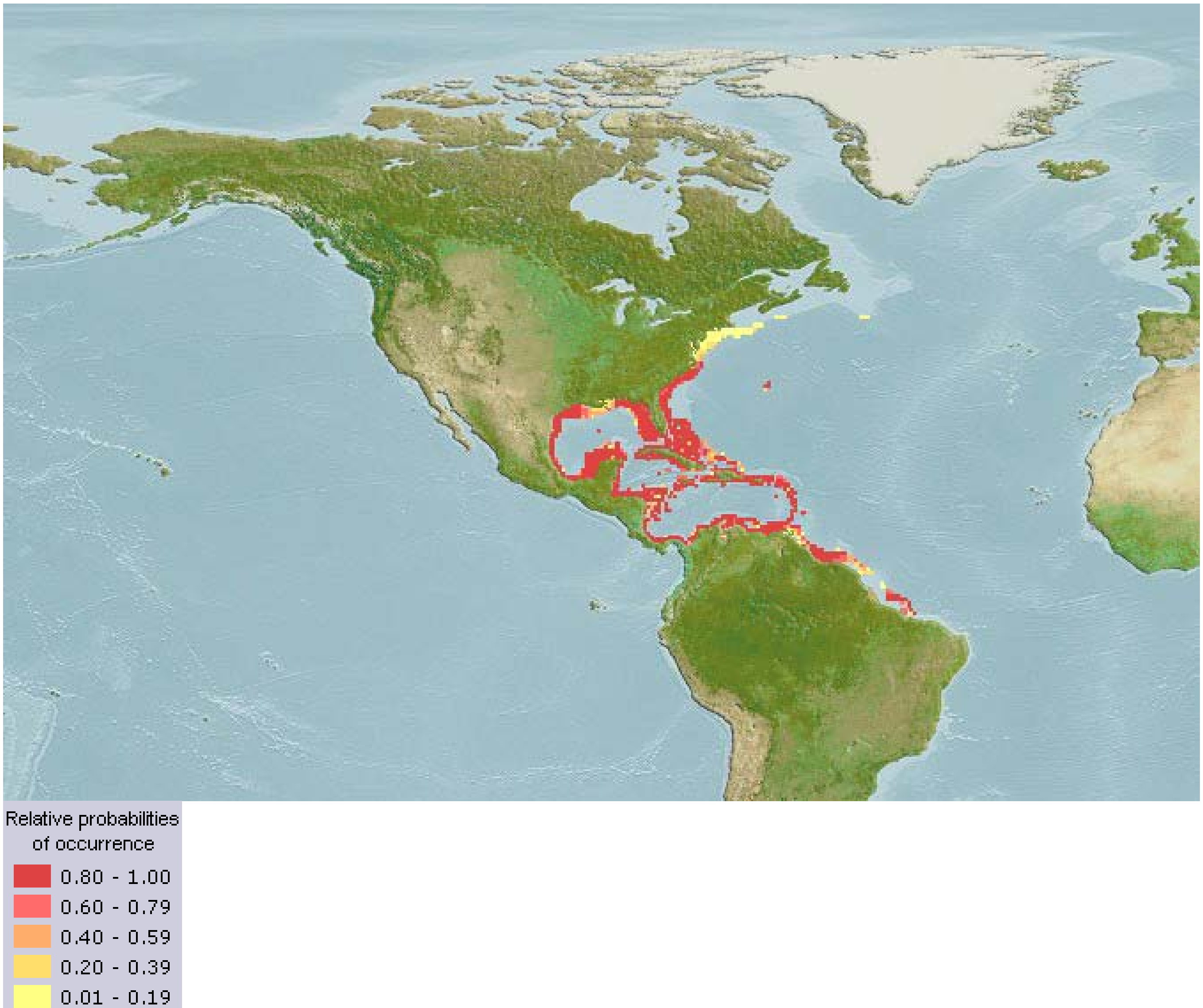


Figure 5.11.4 Map of the Southeastern United States (NC-TX), Bahamas, Cuba, and the Yucatan Peninsula, Mexico.

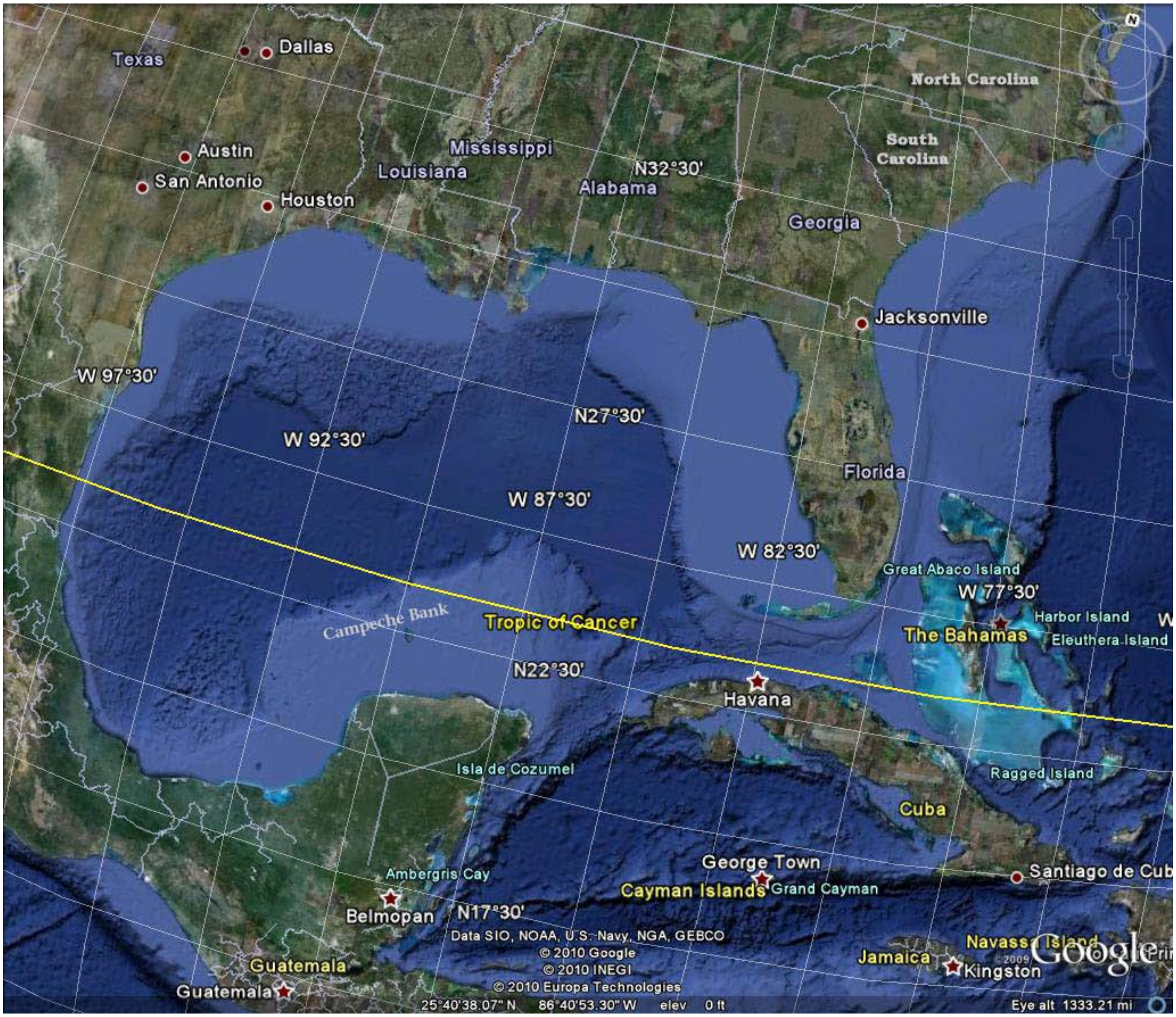
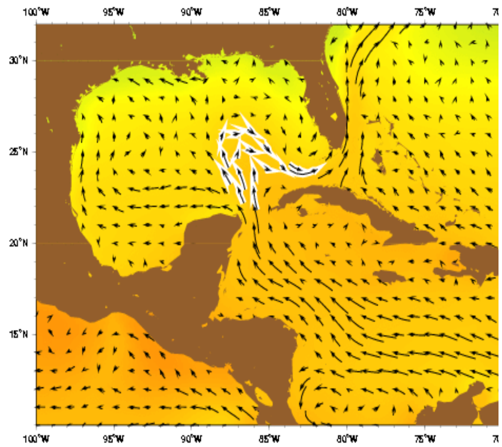
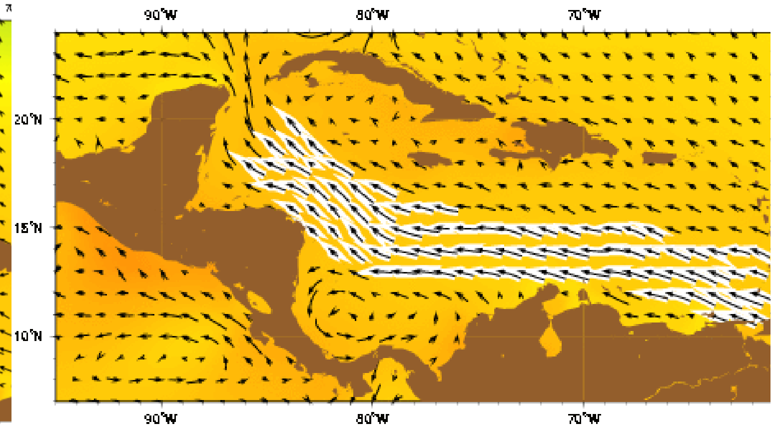


Figure 5.11.5 Major oceanographic currents (**a**) in the Gulf of Mexico and (**b**) the Caribbean Sea. (Courtesy of RSMAS/University of Miami)



a. The Loop Current and Florida Current (highlighted in white).



b. The Caribbean Current (highlighted in white)

Figure 5.11.6 Major oceanographic and shelf features in the Gulf of Mexico and the Caribbean Sea. (Courtesy of RSMAS/University of Miami)

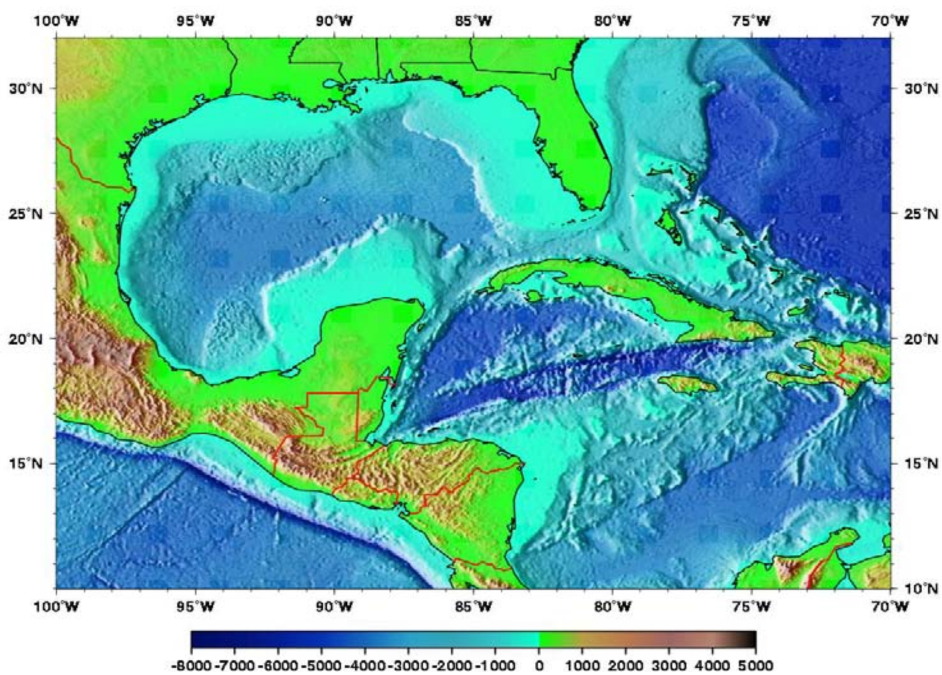


Figure 5.11.7 Drifter tracks from the Gulf of Mexico and the Caribbean Sea. (Courtesy of RSMAS/University of Miami)

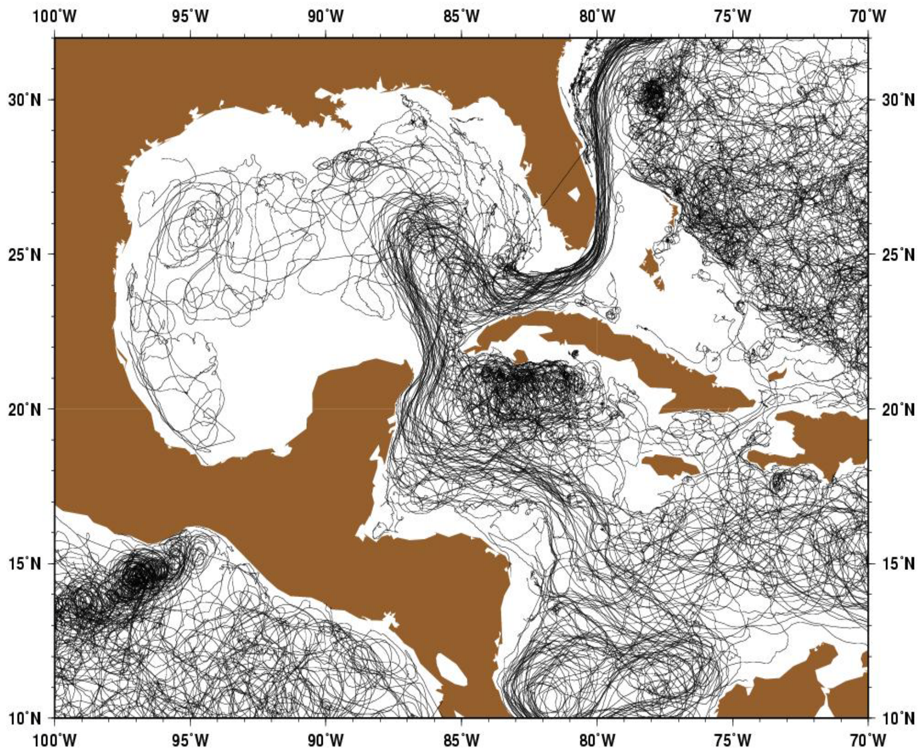


Figure 5.11.8 Estimated age-specific natural mortality based on length (solid line, Lorenzen 2005) and the constant rate (M=0.194) estimated using the relationship to maximum age (dashed line, Hoenig 1983). The former was scaled to have the same cumulative mortality as the latter for ages 3-20 years.

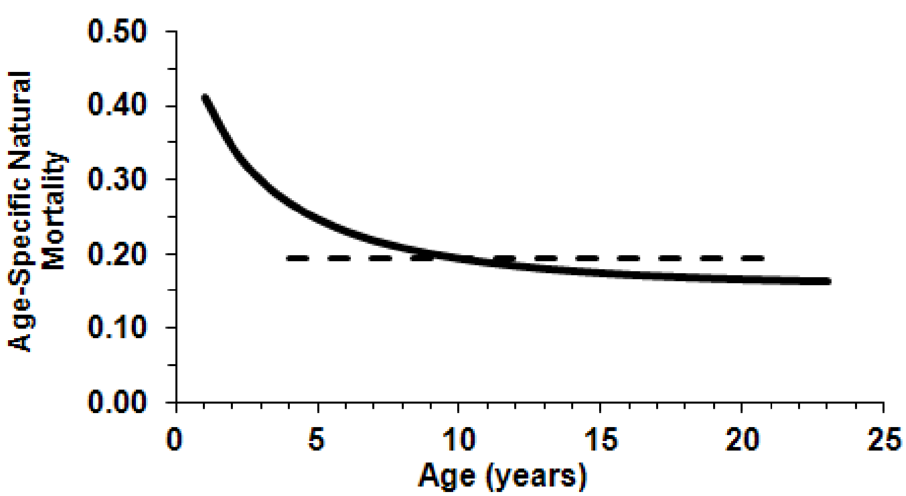
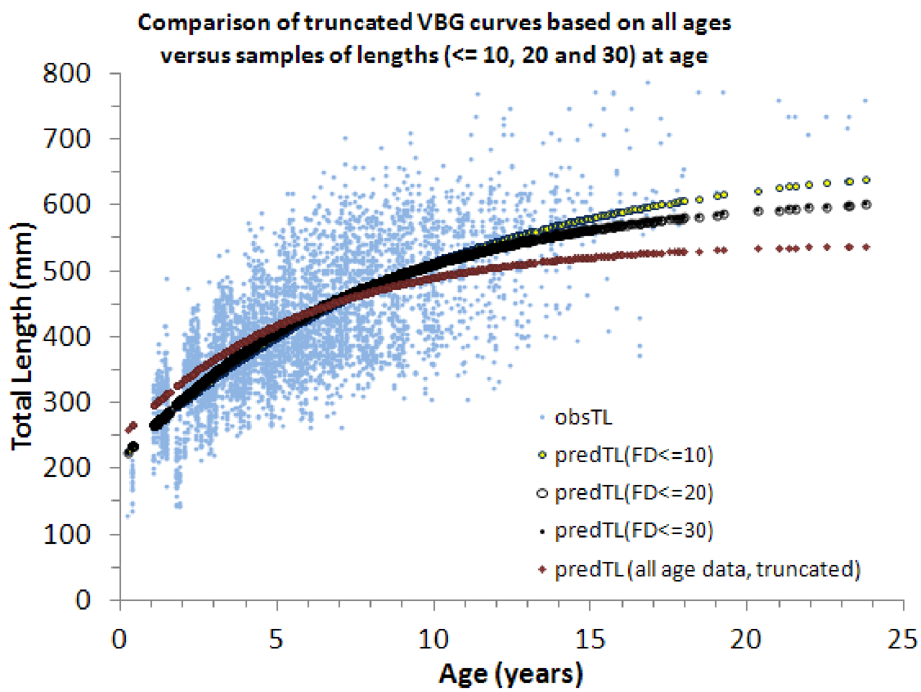


Figure 5.11.9 a.) Estimated von Bertalanffy growth function fit to all the available data on yellowtail snapper and to subsets of a maximum of 10, 20, and 30 lengths at age from fishery dependent (FD) sampling. The parameters for the equation using subsets of up to 30 lengths at age are L_∞ = 618.0 mm total length, K = 0.133, t_o =-3.132. The growth function was estimated using truncated likelihoods accounting for fish sampled during periods of minimum size limit. **b)**. The model fit assumed the standard deviation of length-at-age was modeled as stdev(TL_{age}) = -0.40Age^2 + 10.50Age + 16.4 (r^2=0.77).

a.)



b.) Modeled relationship of standard deviation of total length (mm) at age.

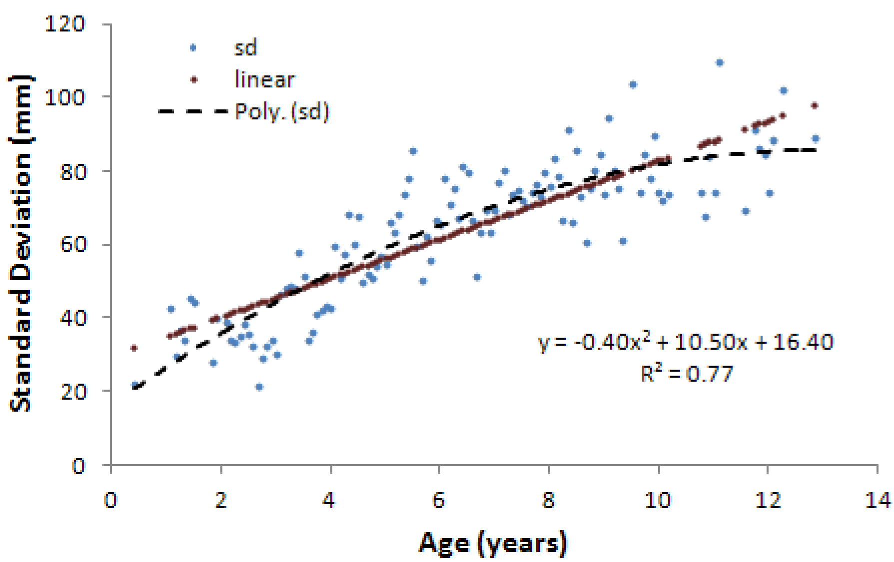


Figure 5.11.10 Satellite image and color enhancement of Florida bathymetry illustrating the preponderance of red and orange (depths less than 30 m) on the majority of the Florida shelf. Image courtesy of Google earth, while layer produced by USGS.

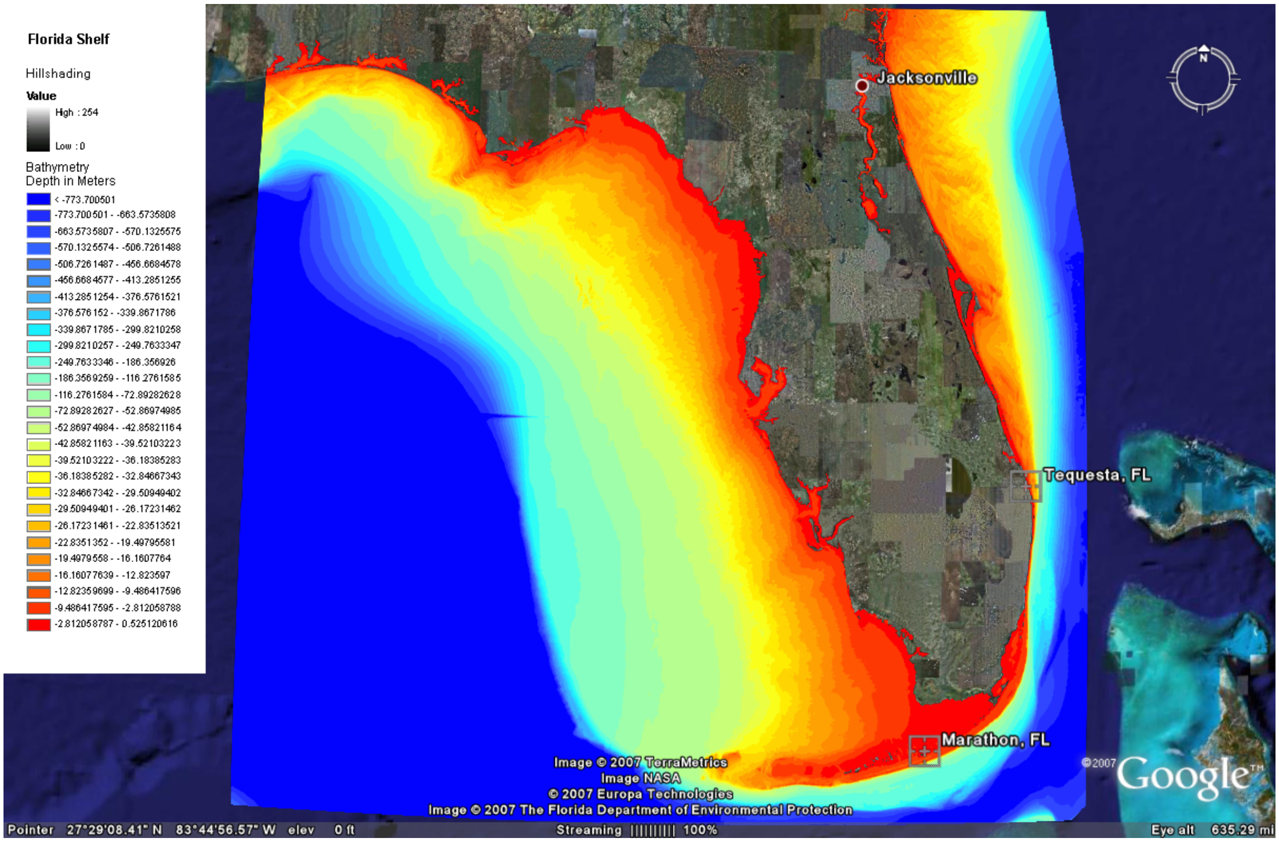
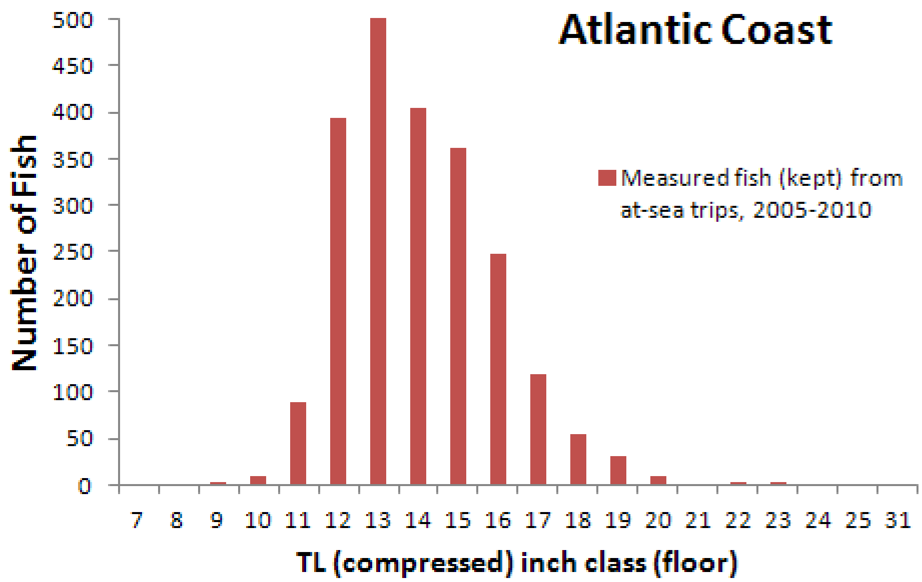


Figure 5.11.11 Number and sizes (TL) of yellowtail snapper kept by anglers measured on at-sea sampling trips on the Atlantic and Gulf Coast. The lower limit of the size class is shown on the horizontal axis.

a.) Atlantic Coast



b.) Gulf Coast

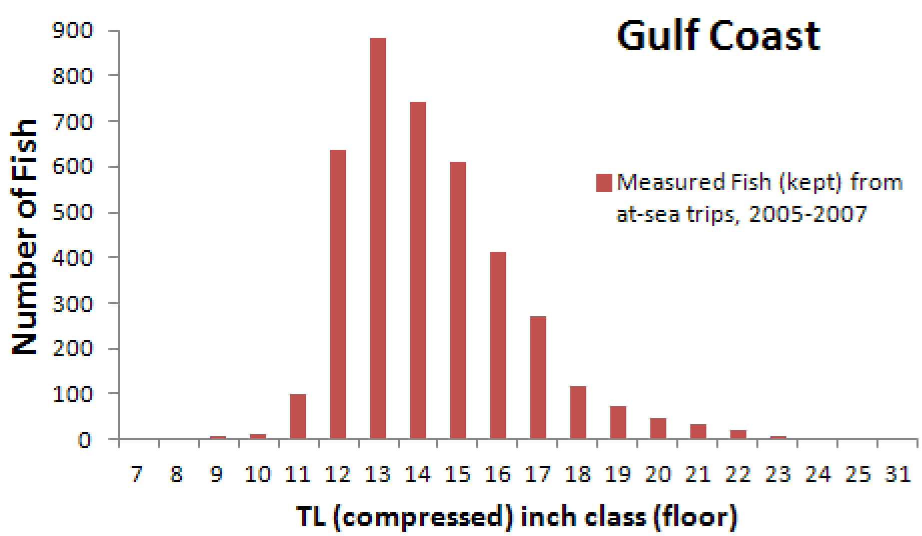
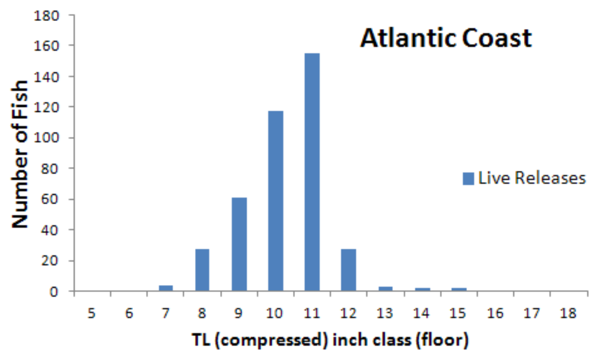
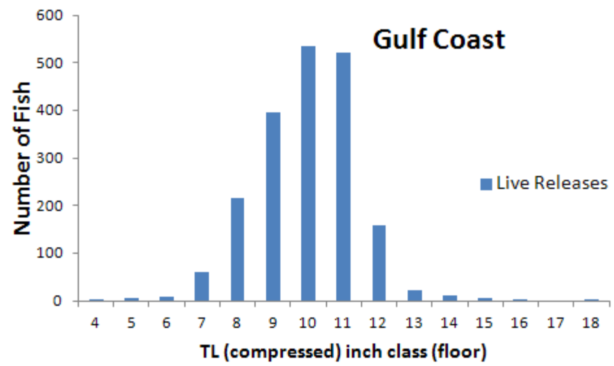


Figure 5.11.12 Number and sizes (TL) of yellowtail snapper released (live or dead) by anglers measured on at-sea sampling trips on the Atlantic (2005-2010) and Gulf Coast (2005-2007). The lower limit of the size class is shown on the horizontal axis.

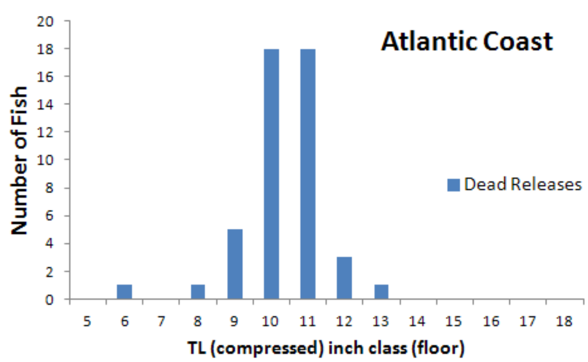
a.) Atlantic Coast, live releases



b.) Gulf Coast, live releases



c.) Atlantic Coast, dead releases



d.) Gulf Coast, dead releases

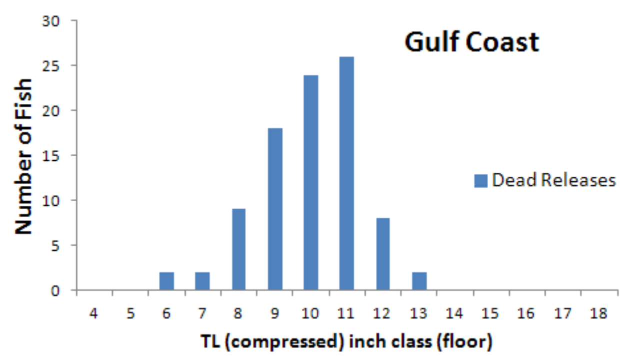
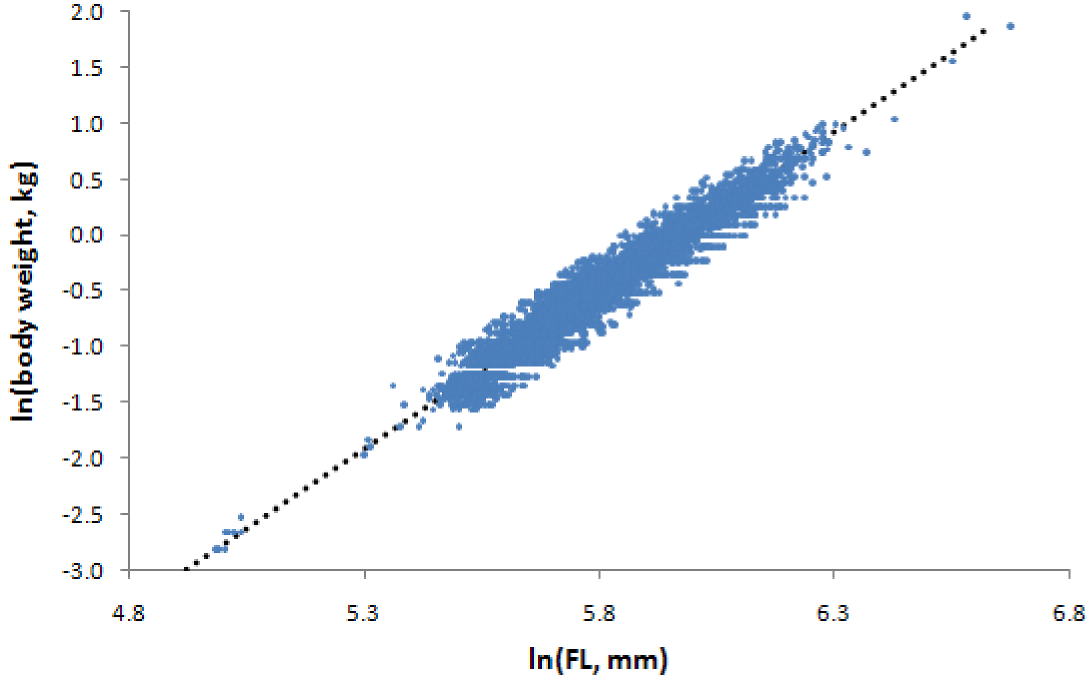
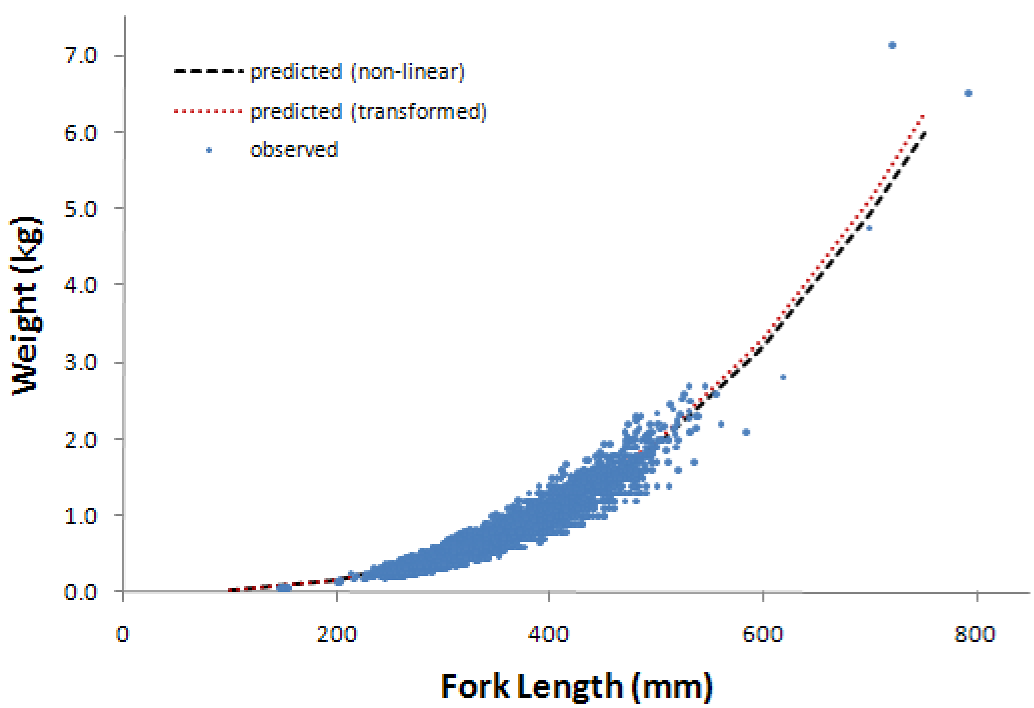


Figure 5.11.13 Length (FL in mm) – weight (kg) relationship for yellowtail snapper. a) log-log transformed relationship; b) comparison of non-linear and log-log transformed fits.

a) ln (body weight, kg) vs. ln (FL, mm)



b) comparison fits to non-linear (power function) and log-log transformed (linearized, adjusted for bias when log transformations are made) weight-length models



6. COMMERCIAL STATISTICS

6.1 OVERVIEW

6.1.1 ISSUES

Yellowtail snapper are distinctive in appearance and are not easily confused with other marine fish (despite the superficial resemblance of yellow goatfish underwater; see Section 5.3), the common name has been used consistently for *Ocyurus chrysurus*, and the reporting of commercial landings has regularly included yellowtail snapper since 1904 [with the exception of the use of "yellowtail" for silver perch (*Bairdiella chrysura*) in the commercial landings on the South Atlantic Coast in 1923 (see Section 5.3)]. Some discussion on possible unreported commercial landings in the Florida Keys occurred among participants during SEDAR 3 (2003), but there were no adjustments to the magnitude of the reported commercial landings that resulted from the discussions as they apparently could not agree on how to make such adjustments. There were no other significant issues with the commercial landings data other than the lack of length measurements and age samples for 1981-1991 (Atlantic region) and for the Gulf in 1982-1983 (lengths) and 1982-1991 (ages), and there was very little information about discarded fish and no information on the size of discards. These issues are not uncommon in assessments in the southeastern US.

6.2 REVIEW OF WORKING PAPERS

There were two working papers, both based upon fisherman-recorded data in Gulf of Mexico reef fish log books and South Atlantic grouper-snapper log books, developed on yellowtail snapper: commercial catch per unit effort (McCarthy 2011a) and commercial discards (McCarthy 2011b).

6.2.1 COMMERCIAL CATCH-PER-EFFORT (MCCARTHY, 2011A)

Commercial fishermen provide landings and effort data to NMFS through the Coastal Fisheries Log Book (CFLB) program. The CFLB began collecting data from vessels federally permitted to fish in a number of fisheries in waters of the Gulf of Mexico (from Texas to the southwest Florida and most of the Tortugas) in 1990, and in 1992 from the South Atlantic (from NC to Key West to southeast of the Tortugas). This program was intended to collect fishing effort and landings in a complete census of federally permitted vessels; however, through 1992 the program included only a subsample of 20% of Florida vessels. Beginning in 1993, all of the federally permitted vessels were required to report.

Landings data (because total catch is not reported from all of the CFLB log books) from vessels employing vertical lines were used to construct standardized landings per unit effort indices (see Section 8) for South Florida (99% of the yellowtail snapper landings) and for a "core" area (96.5% of the landings) with relatively higher catch rates of this species. The indices were model-based and applied a technique (Stephens and MacCall, 2004) to select from all the available commercial vessel trips whether yellowtail snapper were landed or not. The landings and effort from the trips selected by technique will not equal total landings and total effort expended by the commercial fleet for the year because some trips with yellowtail snapper (especially those with only this species) may be excluded and other trips without yellowtail snapper landings ("zero trips") may be included. But the selected trips will provide an estimate of average landings per unit effort for the index and the landings and associated fishing effort on those trips would be representative for the vertical line fishery.

Additional information on landings and effort used for the index were provided by Kevin McCarthy (NMFS, SEFSC, personal communication). These data were useful in examining residual patterns from the derived index from the model predictions.

6.2.2 Commercial Discards (McCarthy, 2011b)

Beginning in 2002, the NMFS' Commercial Fishery Log Book (CFLB) program began collecting discard information from a random subsample (20%) of federally permitted commercial vessels participating in reef fish and other Gulf of Mexico and South Atlantic fisheries. Over ninety-eight percent of the snapper discards are from vertical line vessels. There may be a negative bias in the self-reporting of discards (i.e., discards may be under-reported). Vessel trips with no self-reported discards have increased from 42 to 73 percent in southern Florida, whereas at-sea observers report that only about 10% of the observed trips have no discards. Admittedly, the number of observed trips is low (30 trips in South Florida to Central-West Florida waters). To adjust for potential bias, vessels reporting more than 30 percent of their trips having no discards were filtered out of the analyses. The choice of the 30 percent threshold was arbitrary, and there would have been too few trips left for the analyses if a lower threshold was chosen. In addition, because there were trips on which no discards were observed, vessels reporting six or fewer trips without discards were retained in the dataset for analyses.

Discard rates per unit effort (hook-hour) were calculated using a general linear model (GENMOD, version 8.02, SAS System for Windows © 2000, SAS Institute Inc., Cary, NC, USA) using the discard log reports, including those trips with zero discards, in a delta-lognormal (also called "hurdle models") design. These models use a binomial model to predict the proportion of trips on which discards occur (proportion positive trips, with adjustment for significant factors), and another general linear model (in this case, a lognormal model), to estimate the average level of discards after adjustment for significant factors in the design. The results for the two model are combined to produce an average discard rate on an annual basis for 2002-2010. The average discard rate for the 2002-2010 period was applied to the 1993-2001 period (when discards were not reported), and were weighted by the CFLB annual total effort (trips) to estimate the amount of discards for those years.

6.3 COMMERCIAL LANDINGS

6.3.1 Fishery Description

Yellowtail snapper have been harvested commercially in the southeastern United States for over a hundred years (Table 6.8.1). Historically, a variety of gears including hook and line gears (rod and reel, electric reels, long lines, etc.), trawls, nets (particularly anchored bottom gill nets [also called ”stab nets”] used in reef areas), and fish traps were used for harvest, though hook and line gears accounted for the majority of landings (Table 6.8.2). Acosta and Beaver (1998) and McClellan and Cummins (1998) report that a common method used by commercial (and recreational) fishers targeting yellowtail snapper employs chum bags to bring fish up from a reef where they are caught by hook and line.

Management regulations impacting the size and allowable gears for harvesting reef fish (including yellowtail snapper) were listed in Section 2.1. Briefly, a 12” TL minimum size limit was implemented in 1983 by the South Atlantic Fishery Management Council (SAFMC) for South Atlantic federal waters, in state water by the State of Florida in 1985, and in 1990 by the Gulf of Mexico Fishery Management Council (GMFMC) for Gulf of Mexico federal waters. Trawls for reef fish in the South Atlantic region were limited in 1983 to 4” minimum mesh and later eliminated in 1989 by the SAFMC and in 1990 by the GMFMC. Stab nets for reef fish harvest in state waters were prohibited by the State of Florida in 1986, by the GMFMC in 1990, and by the SAFMC in 1992. Fish traps were prohibited by the SAFMC in 1992, and a 10-year phase-out program was implemented by the GMFMC in 1997. Prohibition of retention of reef fish exhibiting “trap rash” was implemented in 2000 by the GMFMC. The SAFMC excluded bottom long lines for reef fish shoreward of the 50-fathom line in 1992, and the GMFMC excluded bottom long lines for reef fish shoreward of the 20-fathom line in 1990. There were also license and permit limitations that were implemented by the three management entities that restricted the commercial harvest and sale of reef fish by licensed commercial fishermen with federal permits to licensed seafood dealers with federal permits (see Section 2.1) and recreational harvests were limited to bag limits [a 10-fish aggregate for snappers including yellowtail and excluding lane, vermilion and silk (also called “yelloweye”) snappers].

6.3.2 Western Atlantic Landings

Landings from the western hemisphere were obtained from the United Nations Food and Agriculture Organization’s (FAO) Fisheries Department, Fishery Information, Data and Statistics Unit for 1950-2009 (latest available year; http://www.fao.org/fishery/statistics/software/fishstat/en) to provide a wider geographic perspective on the harvest of this species. After 1979, the FAO data were incomplete and was augmented with landings data from the National Marine Fisheries Service (http://www.st.nmfs.noaa.gov/st1/commercial/). Western Central Atlantic commercial landings have averaged 4,161 metric tons per year over the 2005-2009 period. U.S. commercial landings for the Gulf of Mexico and South Atlantic regions (i.e., excluding Puerto Rico and the Virgin Islands) averaged 625 metric tons (1.378 million pounds) over the same period – about 15% of the Western Atlantic commercial landings.

6.3.3 U.S. Commercial Landings

As in SEDAR 3, NMFS’ website (cited in the above paragraph) and their Southeast Fisheries Science Center’s General Canvass landings by gear along with landings data from Florida trip tickets were used to build a composite tabulation of annual regional (Gulf of Mexico and South Atlantic) commercial landings by state (Table 6.8.2), and gear (Table 6.8.3). Nearly all (in most years, 100%) of the reported annual commercial landings of yellowtail snapper from the

Gulf of Mexico and the South Atlantic are in Florida (Table 6.8.2). Nearly all (97% -100%) of the yellowtail snapper landed commercially in most years were reported from vertical hook-and-line gears (Table 6.8.3).

In Florida, commercial landings in Monroe County accounted for about ninety-two percent of the yellowtail snapper landed from 1985 to 2010 (Table 6.8.4). About six percent occurred in southeast Florida (chiefly the counties of Miami-Dade, Broward, and Palm Beach), and less than 2 percent occurred in southwest Florida (primarily Lee County). These five counties accounted for over 99% of the 1985-2010 commercial landings of yellowtail snapper, and over 98% of the fishing trips on which yellowtail snapper were caught. While some landings show up in other counties and even other states west and north of Florida in some years, it is clear from the landings data that this species is most often caught in South Florida waters and most often by vertical line gears.

From 1985-2010 in this five county area of south Florida, yellowtail snapper were landed on 319,572 commercial trips, and sometimes they were the only species landed from those trips. There were 22 other species or species groups that were landed on 1% or more of those trips with yellowtail snapper (Table 6.8.5). A cluster analysis of the presence/absence of these 22 other species on those trips, using average linkage and the Horn-Morisita index (in R-packages “vegan” and “hclust”) was used to examine the similarity in species associations (Krebs 1999) in the landed catch from commercial trips. A scree plot (Fig. 6.9.1) gave an indication of the optimum number of clusters (9) from the analysis. The cluster containing yellowtail snapper and the species more strongly associated on commercial trips than the others were: gray snapper, mutton snapper, black grouper, red grouper, hogfish, lane snapper, grunts, and jacks (Fig. 6.9.2).

Commercial landings of yellowtail snapper increased through the 1980’s and early 1990’s, reaching their highest observed values in 1993-1994 and declining in subsequent years (Fig. 6.9.3). Commercial landings have recently increased in 2008-2011, even though the numbers of fishing trips with landings of yellowtail snapper has declined (Fig. 6.9.4). As the number of fishing trips landing yellowtail snapper after 1993-1994 decreased, the average number of pounds per trip (Fig. 6.9.5) shows an increasing trend through the years, and abruptly increases in 2009-2010.

In Florida, commercial fishermen selling fish and other saltwater products must have a Saltwater Products License (SPL), fishermen are only allowed to sell to wholesale seafood dealers, and purchases of saltwater products from fishermen must be reported by wholesale dealers to the FWC. The distribution of the landings of yellowtail snapper by SPL has changed in recent years. Total annual landings of this species of 5,000 or more kg by licenses have been increasing increasing and amounts to 60% or more of the reported metric tons (Table 6.8.6), the percentage of SPLs landing 5,000 kg or more in a year is increasing and the total number of SPLs landing yellowtail snapper is decreasing (Table 6.8.7), and the number of commercial fishing trips with landings of yellowtail snapper is declining but the proportion of trips by SPLs landings 5,000 kg or more in a year is increasing (Table 6.8.8).

6.4 COMMERCIAL DISCARDS AND RELEASE MORTALITY

6.4.1 LOGBOOK DISCARDS

SEDAR 3 used ratios of discards to landings derived from 24 fishing vessels contributing discard data in their logbooks to the Coastal Fisheries Logbook Program (CFLP) from August 2001 to July 2002 (Poffenberger 2003) to estimate discards for the commercial catches. They estimated a discard rate (yellowtail snapper discarded per fish landed) of 16% (i.e., one discarded for every 6.25 fish kept), and 77.7% of the trips with yellowtail snapper reported discards of this species.

McCarthy (2011b) reviewed the available data on discards of yellowtail snapper from log books from commercial vertical line vessels in south Florida (section 6.2.2). A random sample (20%) of commercial vessels with Gulf of Mexico reef fish, South Atlantic snapper-grouper, king mackerel, Spanish mackerel, dolphin/wahoo, and shark permits are selected for the reporting of discards on log books. There is some skepticism on the accuracy of the self-reporting of discards (McCarthy, 2011b). The proportion of commercial trips on which discards are reported has decreased in recent years, and the proportion of commercial trips with discards when at-sea observers are aboard are higher (though the number of observed trips is relatively small).

A random sample of vessels stratified by region (Gulf of Mexico and South Atlantic) and fishing gear was selected for the analyses of discard rates. Analyses of the available data by McCarthy (2011b) attempted to adjust for the possible under-reporting of discards by filtering out commercial vessels taking more than 6 trips annually with less than 30% of trips with reported discards of any species. A delta-lognormal model was constructed of a binomial sub-model to examine the proportion of trips that had discards of yellowtail snapper, and a lognormal sub-model to estimate the average discard rates of yellowtail snapper on those trips which had discards of this species. Each of the sub-models is a general linear model comprised of main effects (i.e., year, region (based on area fished), days at sea, quarter of the year, crew size) and interaction terms were included as random effects. A forward selection process is used to identify significant terms and estimate adjusted average discard rates. The product of the total annual effort from the log books and the average annual discard rate (the rate of total live and dead discards of yellowtail snapper per hook-hour fished) is the estimate of annual total discards (Table 6.8.9). A weighted average discard rate (number of fish/ hook-hour fished) was calculated from the 2002-2010 annual discard rates to provide an estimate of annual total discards based on the number of hook hours fished reported in the log books for 1993-2001.

There were no estimates of the total annual hook-hours fished prior to 1993. To estimate the amount of discards for 1985-1992, it was necessary to find another ratio estimator for discard rates. The method used in SEDAR 3 used the ratio of discarded yellowtail snapper to the number of yellowtail snapper landed to calculate a discard rate. Because commercial landings are reported in weight, it was necessary to convert the weights of landed fish to numbers of fish. Measurements in the TIP database were used to examine the number of fish in size classes of landed fish (Tables 6.8.10, 6.8.11) and derive an approximation to use for estimating the number of fish landed annually by region (Tables 6.8.12, 6.8.13; see Section 6.6). The ratios of total discards in numbers of fish to total annual landings estimated in numbers of fish (Table 6.8.14; see

Section 6.6) for 1993-1999 (average = 0.127) in Florida was used to estimate the discard rates from landings.

Additional calculations were needed to extend the estimate of annual discards to the 1981-1984 period because of the implementation of the 12” TL minimum size limits by the South Atlantic Fishery Management Council in 1983 and by the Florida Department of Natural Resources (merged later into the new Florida Fish and Wildlife Conservation Commission) in 1985. There were no data available on the size of discarded yellowtail snapper (alive or dead) from commercial trips. The only data available on size frequencies of discarded fish were from the 2005-2010 (Atlantic) and 2005-2007 (Gulf) time periods derived from at-sea sampling on head boats (see Section 5.4.2). Inspection of the size frequencies measured from the commercial landings in 1981 and 1984 (samples from the Florida Keys) showed a little higher prevalence of yellowtail snapper in the 10-11” TL classes than in 1985 (Table 6.8.11), but there were no samples from the Atlantic Coast with which to compare. In order to provide an estimate of the discards for the 1981-1984 period prior to the implementation of the 12” TL minimum size limit in Florida waters in 1985, the assumption that commercial fleets may be releasing fish smaller than TL 10” was made. The weighted average proportion of fish less than 10” TL in released catches (combined Gulf and Atlantic) from the at-sea sampling (Table 5.10.4) in 2005-2010 was 0.334 (0.222 on the Atlantic Coast, 0.353 on the Gulf Coast). This factor was applied to the average discard rate used for the 1985-1992 period (i.e., 0.127 x 0.334 = 0.042) and multiplied by the annual estimated number of yellowtail snapper landed to estimate the annual total number of discards (live and dead; Table 6.8.14).

Once the total discards were estimated for the combined Atlantic and Gulf commercial fleet, the proportions of landings (in estimated numbers of yellowtail snapper) by region (Atlantic and Gulf) was used to split the estimated combined annual discards into estimated regional total discards in numbers and weight by year (Table 6.8.14). The proportions at length of discards (live and dead) from the at-sea sampling (Table 5.10.4) were used as proxies for the size of animals released in the 1981-1984 and 1985-2010 periods. Multiplying the annual regional (Atlantic and Gulf) discards by the proportions at length from the at-sea sampling produced estimates for the size classes in the discards. Weight of the estimated sizes of fish released was the product of the number of fish in a size class and the average weight for the mid-point of a size class using the length-weight regressions in Table 5.10.8. An estimate of release mortality (McCarthy, K., personal communication, NMFS, SEFSC) of 11.5% for commercial discards was applied to the annual estimate of yellowtail snapper total discards (Table 6.8.14).

SEDAR 3 estimated discards and discard rates for the commercial fleet in the assessment based upon 12 months of CFLP logbooks (Poffenberger 2003). The methodology used in SEDAR 3 for estimating discards was different from the current assessment and was based upon a small number (24) of vessels reporting landings of yellowtail snapper and trips (480) on which the discards of any species was reported. Of the 480 trips, there were 233 trips on which yellowtail snapper were landed (16,844 lbs; 15,313 fish), and of these 181 reported discards. The discard rate was calculated as (3178/15313) * (181/233) = 16% and is in terms of the number of yellowtail snapper discarded per fish landed. The mortality rate (28%) was based on Poffenberger (2003) using all of the disposition categories other than “released alive” for non-landed fish. The current assessment uses McCarthy’s (2011b) model-based estimates of the number of yellowtail snapper discarded per hook-hour fished, and the delta-lognormal model includes both trips catching yellowtail snapper (landed or discarded) and trips without catch of yellowtail snapper. The model estimates are scaled to the total effort (in hook-hours fished) to calculate (total live and dead) discards. The immediately observable release mortality estimate (11.5%) used in the current assessment is also from McCarthy (NMFS, SEFSC, personal communication) and was based on a small number of at-sea observations. The estimates of dead discards and release mortality rates for SEDAR 3 and the current assessment are different (Table 6.8.15; Fig. 6.9.5). The model-based approach used by McCarthy (2011b) should be an improvement of the discard rate estimate. Either of the release mortality estimates are probably not unreasonable for this species which inhabits relatively shallow habitats. The other source of release mortality estimates for this study came from at-sea sampling on head boats and were in the 4.5% (Florida Keys) to 10.5% (southeast Florida) range. Any unobserved release mortality is not estimated.

6.4.2 Recommendations on commercial discards and release mortality

There was so little information available on commercial discards it should be considered unknown until it is properly studied. There was also the concern expressed by McCarthy (2011b) about the reliability of the discard information provided by the vessel captains on the log books. The age-structured assessment model (ASAP2) used attempts to reconstruct the population dynamics of a species through the biological and fleet-specific parameters used as inputs to model, the catches (total landings and proportions at age) from the fleets, discards (total dead discards and proportions at age discarded), and proportions of fish released by age / total caught by age for each fleet. A reconstruction of the total weights and proportions at age in the catch and discards is essential to represent the dynamics of the total population studied. With this in mind, I considered it important to provide reasonable estimates for amounts and weights of discards for each of the fleets. Unfortunately, this meant stretching what little data existed to cover the wide gaps in information about discards for this fleet. The extent to which the effort succeeded rests on a lot of tenuous assumptions about the annual sizes of fish harvested, discarded, and released and the reliability of the release mortality estimate. The discard calculations and assumptions used should be viewed as very rough approximations to the reality existing over the 30 years covered by this assessment. Varying the level of release mortality may be appropriate for examining the model response to increasing levels of dead discards and the effect upon the benchmarks generated, but these sensitivity investigations are no substitute for data objectively obtained. An at-sea sampling study of sizes released and condition of released fish from commercial vertical line vessels would provide very helpful data for future assessments of the yellowtail snapper population in southeastern US waters. The at-sea observers are providing these types of data for reef fish and other species, but unfortunately the level of sampling and coverage was not sufficient for providing much data on yellowtail snapper. The estimate of immediate release mortality (11.5%) was based on 6 dead yellowtail snapper of the 52 discarded fish from commercial vessels with at-sea observers on-board (K. McCarthy, NMFS SEFSC, personal communication). On those trips, the observers had seen a total of 799 yellowtail snapper, and an additional 5 fish had an unknown disposition.

6.5 COMMERCIAL EFFORT

There are two main sources of commercial fishing effort information in Florida. Information about the number of trips taken (e.g., Tables 6.8.4, 6.8.8), duration of the trips, area fished, depths fished, and gear used (added in late-1991) is available from Florida trip tickets for 1985-present. Prior to the trip ticket system's implementation in October 1984, the only available measures of effort were the number of fishing vessels by port and the number of persons employed in the fishing sector. The trip ticket data collection system relies on the mandatory reporting of purchases of saltwater products from commercial fishermen by wholesale seafood dealers in Florida. More in-depth information about fishing trips (specific gears used, certain gear characteristics like hook-hours (number of lines, number of hooks/line, hours fished, detailed area fished information, etc.) is available from commercial vessel captains that are required to report landings of reef fish and other species to the NMFS' Coastal Fisheries Logbook Program (CFLP) which began collecting these data in 1990 for the Gulf of Mexico and in 1992 for the South Atlantic.

The number of commercial fishing trips in Florida with landings yellowtail snapper has been steadily declining from a broad peak over 1989-1993 of about 20,000 trips to the about 5,700 trips in 2010 (Table 6.8.4). Commercial landings peaked at a little over one thousand metric tons during 1993 and 1994, and steadily declined until 2008 and have risen thereafter (Table 6.8.4, Figs. 6.9.3, 6.9.4), and the majority of trips and landings occur in the Florida Keys. A simple cluster analysis (Horn-Morisita index using average linkage) was used to select fishing trips landing reef fish using the Florida trip ticket data based upon the similarity of the presence or absence in the landings from the trips. First, trip tickets with landings of yellowtail snapper were selected and analyzed for similarities in the presence or absence of other species on those trips. Clusters of species resulted (Fig. 6.9.2) from the analysis. Trips with species in the cluster with yellowtail snapper were selected, including trips on which no yellowtail snapper were reported landed. The annual number of selected commercial trips and the average pounds of yellowtail snapper landed show a declining trend in trips after 1994 with an increasing trend in the average pounds per trip and quite a sharp increase during 2008-2010 (Fig. 6.9.6). This is a result of fewer trips with small amounts of landings made by fewer fishermen (Florida Saltwater Products Licenses [SPL]) over 1995-2010. The number of SPLs landing small amounts (< 1,000 kg) of yellowtail snapper annually has declined (Table 6.8.6), the number of SPL licenses making commercial trips with small amounts (< 1,000 kg) of landings annually has been declining (Table 6.8.7), and the percentage of SPLs with annual landings of less than 1,000 kg of yellowtail snapper is declining (Table 6.8.8). The share of commercial landings in 2007-2010 (65-75%) for SPLs landing over 5,000 kg annually has shown strong increases (Table 6.8.8) and implies that there is increasing interest in harvesting this species.

McCarthy (2011a) reviewed the available logbook data for 1993-2010 from commercial vertical line fishing vessels which caught yellowtail snapper or were fishing in south Florida waters in order to develop an index of catch per effort based on hook-hours fished and other factors (see Section 9). Using a filtering process to select vertical line commercial trips which fished with only one type of gear in only one area (Fig. 6.9.7), and excluding outliers falling outside the 99.9th percentile for number of crew, hooks per line, number of lines, fishing more than 24 hours per day, trip durations greater than 15 days, and cpue values of more than 205 pounds/hook-hour (South Florida index) or more than 210 pounds/hook-hour in the core area index. The design included a logistic selection model (Stephens and MacCall 2004) for species on trips which was used to restrict the data to areas likely to contain yellowtail snapper habitat. This selection process will exclude those trips on which only yellowtail snapper were reported. After the selection of trips (including trips without landings of yellowtail snapper) was made, a delta-lognormal model (Lo et al., 1992) was used to produce estimates of catch-per-effort (see Section 8.3.1). From this analysis of cpue, the trends in the annual amount of fishing effort and landings for yellowtail snapper will also be represented in the sample of trips though it is more clearly seen in the index itself. The amount of fishing effort (hook-hours fished) from the logbooks and corresponding amount of yellowtail snapper landed (Fig. 6.9.8; K. McCarthy, personal communication, NMFS, SEFSC) was generally increasing over the 1993-1999 period, and has been generally on the decline from 2000-2010. Landings from the selected trips have generally followed the trends in effort, but the decline in amounts landed has not been as great as the decline in fishing effort (Fig. 6.9.8). The 2008-2010 period shows a large increase in landings and a more modest increase in fishing effort for 2008-2009, which may indicate either that yellowtail snapper have increased in availability (i.e., become more abundant) or that the catchability of yellowtail snapper has increased through the use or increasing adoption of new technology (fishing gear, fishing methods like “power chumming”, etc.), or both.

6.6 BIOLOGICAL SAMPLING

6.6.1 ADEQUACY FOR CHARACTERIZING CATCH AND FOR ASSESSMENT ANALYSES

Sampling for the sizes, weights, species composition, and other measures to characterize commercial catches is performed by state and federal biologists at dockside or in seafood houses that receive and purchase fish, crabs, lobsters, and other seafood from commercial fishermen. These data have been housed in the Trip Interview Program’s data base at the NMFS Southeast Fisheries Science Center in Miami since 1984. Some states may also have data from commercial sampling that they may share with the NMFS. Some dockside sampling of commercial catches was performed in the Keys in 1981 by state biologists, and those data for yellowtail snapper are included in this assessment. Sampling these fish for ages is more difficult because it takes more time and effort and dealers do not want the quality of their fish to be degraded, so consequently there are fewer opportunities to take otoliths or other hard parts used for ageing fish. For fish like yellowtail snapper and other reef fish, simply knowing the length of the fish does not provide much information about its age, so it is desirable to sample hard parts for ages.

Along with the information collected by the samplers are whether the sample was subject to any bias, such as sorting by size, sex, or some other way which might affect how size estimates must be adjusted to reflect the size composition of the landings. For this assessment, only length samples that were considered to be subject to no sample bias and between 4” and 36” TL were accepted for these analyses. The measurements of nearly all yellowtail snapper are in fork length, so the conversion equations in Table 5.10.7 were used to estimate TL. There were few measurements of weight for yellowtail snapper, so whole body weight was estimated using the conversion equations in Table 5.10.8. There were 118,486 length samples and 9,918 ages available for 1981-2010, but commercial fishery samples were not available for every region every year (Table 6.8.16). Yellowtail snapper are more frequently caught in the Florida Keys, and most of the "Gulf" region measurements came from catches made in the Keys.

One of the tasks was to estimate the number of fish landed from the landings in weight. Length measurements were grouped into two broad gear categories: hook-and-line gears and other, and the estimated weight of measured fish was divided by the number of fish in the sample for a year by gear to give a rough approximation of the number of fish per kg of landings (Table 6.8.17). There were relatively few measurements of fish landed from other gears, and the estimated numbers of fish per weight were not greatly to those from hook-and-line gears for a region and year. However, the larger differences in the number of fish per weight were between regions, with yellowtail snapper measured on the Atlantic region (chiefly southeast Florida) more often a little heavier (in the number of fish per weight calculations) than those from the Keys (Gulf region). The measurements were combined by year and region for the rough calculations of number of fish per weight (Table 6.8.18).

The number of fish measured by region in Tables 6.8.10 (Atlantic region) and 6.8.11 (Gulf region) show the distribution by size class for these areas. There were 11 years (1981-1991) in the Atlantic region that had fewer than 50 measurements from commercial catches with no sample bias noted, and two years (1982-1983) in the Gulf region which had no measurements. To fill these gaps in the size distributions for the Atlantic region, the numbers of measurements by size class were summed for the 1992-1996 period for the Atlantic region, and these were used for the length distributions for those years along with any actual measurements that were taken in those years. For the Gulf region, the length frequencies from adjacent years were used for the missing data.

The landings (kg) of yellowtail snapper were multiplied by the rough approximation of fish/kg to get a preliminary estimate of the number of fish landed. The length distributions are multinomial (comprised of many size classes), and computing a simple average weight from the sample totals will only be a crude approximation of the true average. Multiplying that rough estimate by the proportion at length for a size class and the average weight for a size class provided an estimated weight of landings resulting from the length distribution for a year. These preliminary estimates were typically within 6% of the actual landings for the Atlantic region, within 3% for the Gulf region, and were often closer. The fish/kg estimate was adjusted to bring the estimated landings to within 0.1% of the reported landings (Tables 6.8.12, 6.8.13). After the adjustments, the observed and estimated weight of the commercial landings were similar (Fig. 6.9.9). The model runs use the reported landings for the commercial fishery, and the estimated proportions of landed and discarded fish and the proportions by size of released fish in the catches, and the calculation of discards (proportions by size and total weight) and proportion of releases by size to the total catch by size are dependent upon the fish/kg factors used.

6.6.2 AGEING USING AGE-LENGTH KEYS (ALK)

Tables 6.8.10 and 6.8.11 were converted to proportions at length in the catch for the commercial fishery. Age-length keys (Section 5.5.5) were generated for lengths from 5" to 24" TL (lengths of fish 24" or greater summed into the last class) and for ages 0-12+. Though the number of yellowtail snapper sampled for lengths and ages were fairly large in many years, there were too few samples to develop the age-length keys by fleet and year (see Section 5.5.5), and an age-length key for all catches was constructed using varying degrees of pooling of 5-year periods, or pooled data from all years and space (both regions). There were no otoliths collected from commercial catches from 1981-1991 from the Atlantic region, and none were collected from the Gulf region from 1982-1991 (Table 6.8.16).

The estimated number of fish by length in the landings was the product of the proportion at length for a region, year, and size class and the estimated number of fish landed by region (Tables 6.8.12, 6.8.13). The estimated number of fish by size class was multiplied by the age-length key for a region, year, and size class to produce an estimate of the number of fish by age in the landings (Tables 6.8.19, 6.8.20). Examination of the relative changes in the age composition of the catches over time showed few indications of strong or weak year classes of yellowtail snapper (Fig. 6.9.10). Relative catches of yellowtail snapper estimated to be older than age 6 showed a vertical stacking in the bubble plot indicating that year-to-year changes across ages 7-12+ were more important than cohort-specific changes (Fig. 6.9.10). These ages showed a period of relatively high catches during 1985-1987. Variability in the age-class progressions made it difficult to discern any consistent patterns in recruitment. The 1994 and 2006 year-class appeared consistently weak over time through the first five ages, whereas the 2001 cohort appears in relatively high abundance through those ages.

A similar process was used to estimate the numbers of yellowtail snapper at length (Tables 6.8.21, 6.8.22) and age (Tables 6.8.23, 6.8.24) for total discards (live and dead), and the estimated weight of the discards (e.g., Table 6.8.14) was derived from the estimated number of animals in each size class in the discards (proportion at length x estimated total discards x estimated weight at length). The total number of fish discarded dead was the product of the proportion at length of the discards, estimated total discards, and the release mortality applied to released (discarded) fish (Table 6.8.14). The annual numbers of fish landed and the total discarded by region were summed by age, and these new matrices became the annual proportions by age used as inputs for the commercial fleet. The annual amounts of dead discards depended upon the release mortality rate used (Table 6.8.25), and is just the product of the release mortality rate and the weights by age of fish released. The proportions of the numbers of fish at age in the discards is the ratio of numbers of fish released by age divided by the total numbers of fish by age caught (landed or total discarded) by the fleet (Table 6.8.26).

6.6.3 Direct Ageing (DA)

The previous section described the construction of the proportions at age in the catch, landings, and discards using age-length keys. The direct ageing (DA) method modifies the construction of comparable matrices for landings and discards. The available age data is arrayed for a region by age and year (Tables 6.8.27, 6.8.28), and the DA proportions at age are calculated. Regions with no age samples for a year are set to missing values (-999 for ASAP2). Annual estimated numbers of yellowtail snapper landed (Table 6.8.14) by region are multiplied by the non-missing DA proportions at age for each region. For years in which samples were taken in both regions, the estimated numbers landed by age are summed, and the proportion at age in the combined catches are calculated (Table 6.8.29).

There were no age samples of fish in the commercial discards. The annual age compositions were estimated by the ALK method from the measurements of discarded fish from head boats (at-sea sampling), with the exception that only those years when size in the discards became available (2005-2010) were used in the DA-formulated model (Table 6.8.30).

6.6.4 EFFECTIVE SAMPLE SIZES (ESS)

Effective sample sizes (ESS) are weightings for the annual age composition data in the model. The higher the ESS, the more weight the model will give the age compositions during the fitting process. Various weighting schemes have been used as rules-of-thumb, and ASAP2 recommends capping the weighting at 200. Typically, the number of ages available (up to 200) will be used for the initial values for annual ESS. The initial ESS weights for landings in this assessment (for ALK and DA models) used the square root of the annual number of ages (rounded to the nearest integer) available for each fleet, effectively diminishing the effect on the model fitting process for years with larger age samples. The initial ESS weights for discards was the square root of the number of at-sea sampling trips on head boats when the sizes of discarded fish were measured.

6.7 LITERATURE CITED

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6.8 TABLES

Table 6.8.1 Western Atlantic commercial landings (in metric tons) of yellowtail snapper (Data from UN FAO Fisheries Department, NOAA Fisheries, and FWC.)

	SW Atlantic	Atlantic, Western Central								
Year	Brazil	British Virgin Is.	Colombia	Cuba	Dominican Republic	Mexico	Nicaragua	Puerto Rico[1]	United States[2]	Venezuela
1950	100	.	.	.	.	.	.	.	157	.
1951	100	.	.	.	.	.	.	.	199	.
1952	200	.	.	.	.	.	.	.	177	.
1953	100	.	.	.	.	.	.	.	158	.
1954	200	.	.	.	.	.	.	.	151	.
1955	400	.	.	.	.	.	.	.	107	.
1956	400	.	.	.	.	.	.	.	120	.
1957	400	.	.	.	.	.	.	.	201	100
1958	400	.	.	.	.	.	.	.	158	100
1959	500	.	.	1,000	.	.	.	.	224	100
1960	500	.	.	1,000	.	.	.	.	284	100
1961	500	.	.	1,000	.	.	.	.	333	100
1962	500	.	.	1,100	.	.	.	.	453	100
1963	1,000	.	.	1,100	.	.	.	.	377	100
1964	1,100	.	.	900	.	.	.	.	472	100
1965	800	.	.	1,200	.	.	.	.	483	100
1966	900	.	.	1,600	.	.	.	.	377	<0.5
1967	1,100	.	.	3,000	.	.	.	.	437	100
1968	1,300	.	.	1,200	.	.	.	.	539	100
1969	1,500	.	.	800	.	.	.	.	440	100
1970	2,100	.	.	700	-	300	.	.	543	100
1971	2,400	.	.	800	-	400	.	.	496	200
1972	3,300	.	.	900	-	300	.	.	463	200
1973	3,900	.	.	1,100	-	500	.	.	428	100
1974	2,952	.	.	700	285	446	.	.	473	130
1975	3,435	.	.	800	246	822	.	.	362	110
1976	2,344	.	.	1,100	.	655	.	.	444	124
1977	3,956	.	.	800	.	630	.	.	367	132
1978	4,181	.	.	600	182	723	.	.	395	172
1979	1,360	.	.	600	285	519	.	.	354	301
1980	1,711	.	.	590	321	1,261	.	.	295	820
1981	2,677	.	.	748	320	2,224	.	.	332	200
1982	1,870	.	.	959	202	1,803	.	.	622	211
1983	1,821	.	.	923	276	1,627	.	.	436	212
1984	2,300	.	.	898	254	1,173	.	.	430	262
1985	2,784	.	.	947	155	274	.	.	375	473
1986	3,099	.	.	904	210	1,752	.	.	507	351
1987	3,195	.	.	1,070	191	2,164	.	.	619	388
1988	2,792	.	.	851	194	1,520	.	.	641	464
1989	2,862	.	.	948	197	2,519	.	.	840	674
1990	2,800	.	.	740	180	3,226	.	.	796	715
1991	2,862	.	.	704	183	2,320	.	.	844	659
1992	2,810	.	.	745	267	1,132	.	.	842	659
1993	2,800	.	.	539	273	910	.	.	1,079	678
1994	2,800	.	36	592	671	1,184	.	.	1,001	684
1995	4,766	.	75	592	248	825	.	.	842	511
1996	4,167	.	54	1,176	793	858	.	.	662	338
1997	5,000	5	35	727	529	840	.	206	759	335
1998	3,317	9	<0.5	457	190	1,900	.	197	692	272
1999	4,541	9	1	409	234	1,554	.	209	837	220
2000	4,165	<0.5	1	408	249	1,357	.	246	722	291
2001	2,002	101	-	413	356	1,600	.	154	644	158
2002	2,106	131	-	370	134	1,702	.	132	640	213
2003	2,656	289	3	437	151	591	.	173	640	585
2004	2,667	318	.	438	126	537	.	68	671	928
2005	5,376	290	.	299	71	1,640	.	52	601	497
2006	5,371	290	20	295	181	1,713	864	43	561	299
2007	3,717	270	40	323	152	1,707	613	42	444	210
2008	4,745	250	60	295	177	2,057	519	36	622	407
2009	5,233	250	81	365	160	2,106	570	31	896	407
2010								28	768	
2011									858[3]	

[1] NOAA, Fisheries of the U.S. publications
[2] 1950-1977 (NOAA Fisheries Commercial Landings Web Site), 1978-1991 (NOAA Fisheries General Canvass), 1992-2011 (FWC Trip Tickets)
[3] Preliminary data for 2011 (Florida trip tickets only)

Table 6.8.2 REDACTED U.S commercial landings (in metric tons) of yellowtail snapper by state. (Data from NOAA Fisheries, and FWC.)

This table has been removed due to potential issues of confidentiality of data reporting at the state level.

Table 6.8.2 REVISED U.S commercial landings (in metric tons) of yellowtail snapper by state, when possible. (Data from NOAA Fisheries, and FWC.)

Year	FL West Coast	FL East Coast	U.S. GOM (TX-FL West Coast) Totals	U.S. SE Atlantic (NC-FL East Coast) Totals	U.S. SE Region Totals
1950	113.4	43.8	113.4	43.8	157.2
1951	95.3	103.2	95.3	103.2	198.5
1952	97.7	79.2	97.7	79.2	176.9
1953	96.7	61.0	96.7	61.0	157.7
1954	90.8	60.6	90.8	60.6	151.4
1955	65.2	42.0	65.2	42.0	107.2
1956	74.3	45.5	74.3	45.5	119.8
1957	134.5	66.6	134.5	66.6	201.1
1958	118.5	39.2	118.5	39.2	157.7
1959	184.3	39.2	184.3	39.2	223.5
1960	239.3	44.5	239.3	44.5	283.8
1961	290.3	43.1	290.3	43.1	333.4
1962	412.7	40.1	412.7	40.1	452.8
1963	330.7	46.6	330.7	46.6	377.3
1964	406.6	65.4	406.6	65.4	472.0
1965	427.2	55.8	427.2	55.8	483.0
1966	341.3	35.2	341.3	35.2	376.5
1967	385.5	51.1	385.5	51.1	436.6
1968	465.1	73.9	465.1	73.9	539.0
1969	366.4	73.6	366.4	73.6	440.0
1970	447.7	94.9	447.7	94.9	542.6
1971	430.4	65.5	430.4	65.5	495.9
1972	392.6	70.2	392.6	70.2	462.8
1973	379.0	48.6	379.0	48.6	427.6
1974	425.4	47.6	425.4	47.6	473.0
1975	306.4	55.5	306.4	55.5	361.9
1976	418.4	25.1	418.4	25.1	443.5
1977	345.8	21.0	345.8	21.0	366.8
1978	376.7	18.2	376.7	18.2	394.9
1979	331.9	21.9	331.9	21.9	353.8
1980	275.1	20.5	275.1	20.5	295.6
1981	314.9	17.0	314.9	17.0	331.9
1982	605.5	16.3	605.5	16.9	622.4
1983	405.7	30.5	405.7	30.5	436.2
1984	413.5	16.2	413.5	16.3	429.8
1985	355.7	18.7	356.0	18.7	374.7
1986	465.6	41.9	465.6	41.9	507.5
1987	574.0	40.2	578.4	40.3	618.8
1988	589.4	50.8	589.9	50.8	640.7
1989	776.2	62.2	777.7	62.2	839.9
1990	738.1	58.1	738.2	58.2	796.4
1991	776.3	67.5	776.9	67.5	844.4
1992	759.8	80.0	759.8	82.1	841.9
1993	994.8	84.2	994.8	84.4	1079.2
1994	924.2	76.4	924.2	76.5	1000.7
1995	784.2	58.0	784.2	58.0	842.2
1996	612.4	49.5	612.4	49.5	661.9
1997	693.6	65.7	693.6	65.7	759.3
1998	634.2	57.3	634.2	57.4	691.6
1999	787.1	50.3	787.2	50.3	837.5
2000	676.2	45.8	676.3	45.8	722.1
2001	600.8	43.5	600.8	43.6	644.5
2002	596.6	42.9	596.7	43.1	639.8
2003	591.7	47.8	592.7	47.9	640.7
2004	624.7	46.6	624.8	46.8	671.6
2005	550.0	50.8	550.0	51.1	601.1
2006	523.4	37.7	523.4	37.7	561.0
2007	399.6	44.0	399.7	44.2	443.9
2008	571.0	50.4	571.0	50.7	621.7
2009	823.2	72.6	823.2	73.1	896.4
2010	681.5	86.9	681.5	86.9	768.4
2011*	742.0	116.1			858.0

*Florida FWC trip ticket data preliminary and incomplete for 2011

Table 6.8.3 Florida commercial landings (in metric tons) of yellowtail snapper by gear. [Data from NOAA Fisheries (NMFS), and FWC (FL-TT). "HL"=hook and line gears.]

	Gulf Total			Southeast Atlantic			Southeastern US			Data
Year	HL	Other	Total	HL	Other	Total	HL	Other	Total	Source
1950	113.4	0	113.4	42.9	0.9	43.8	156.3	0.9	157.2	NMFS[1]
1951	95.2	0	95.2	103.3	0	103.3	198.5	0	198.5	NMFS[1]
1952	97.7	0	97.7	79.2	0	79.2	176.9	0	176.9	NMFS[1]
1953	92.2	4.5	96.7	60.9	0	60.9	153.1	4.5	157.6	NMFS[1]
1954	39.7	51.1	90.8	50.3	10.3	60.6	90	61.4	151.4	NMFS[1]
1955	65.2	0	65.2	42.0	0	42.0	107.2	0	107.2	NMFS[1]
1956	74.1	0.1	74.2	45.5	0	45.5	119.6	0.1	119.7	NMFS[1]
1957	134.5	0	134.5	66.6	0	66.6	201.1	0	201.1	NMFS[1]
1958	118.5	0	118.5	39.2	0	39.2	157.7	0	157.7	NMFS[1]
1959	184.3	0	184.3	39.2	0	39.2	223.5	0	223.5	NMFS[1]
1960	239.3	0	239.3	44.5	0	44.5	283.8	0	283.8	NMFS[1]
1961	290.3	0	290.3	43.1	0	43.1	333.4	0	333.4	NMFS[1]
1962	412.7	0	412.7	40.1	0	40.1	452.8	0	452.8	NMFS[1]
1963	330.7	0	330.7	46.6	0	46.6	377.3	0	377.3	NMFS[1]
1964	406.6	0	406.6	65.4	0	65.4	472	0	472.0	NMFS[1]
1965	427.2	0	427.2	55.8	0	55.8	483	0	483.0	NMFS[1]
1966	341.3	0	341.3	35.2	0	35.2	376.5	0	376.5	NMFS[1]
1967	385.5	0	385.5	51.1	0	51.1	436.6	0	436.6	NMFS[1]
1968	465.1	0	465.1	73.9	0	73.9	539	0	539.0	NMFS[1]
1969	366.4	0	366.4	73.6	0	73.6	440	0	440.0	NMFS[1]
1970	447.7	0	447.7	94.9	0	94.9	542.6	0	542.6	NMFS[1]
1971	430.4	0	430.4	65.5	0	65.5	495.9	0	495.9	NMFS[1]
1972	392.6	0	392.6	70.2	0	70.2	462.8	0	462.8	NMFS[1]
1973	379.0	0	379.0	48.6	0	48.6	427.6	0	427.6	NMFS[1]
1974	425.4	0	425.4	47.6	0	47.6	473	0	473.0	NMFS[1]
1975	306.4	0	306.4	55.5	0	55.5	361.9	0	361.9	NMFS[1]
1976	418.4	0	418.4	25.1	0	25.1	443.5	0	443.5	NMFS[1]
1977	345.8	0	345.8	21.0	0	21.0	366.8	0	366.8	NMFS GC[2]
1978	376.7	0	376.7	15.9	2.4	18.2	392.5	2.4	394.9	NMFS GC[2]
1979	297.8	34.1	331.9	19.2	2.7	21.9	317.0	36.8	353.8	NMFS GC[2]
1980	247.9	27.2	275.1	15.6	4.9	20.4	263.4	32.1	295.5	NMFS GC[2]
1981	303.8	11.0	314.9	13.1	3.9	17.0	316.9	14.9	331.9	NMFS GC[2]
1982	600.3	5.1	605.5	14.3	2.6	16.9	614.6	7.8	622.4	NMFS GC[2]
1983	398.9	6.7	405.7	15.7	14.8	30.6	414.7	21.6	436.2	NMFS GC[2]
1984	396.4	17.1	413.5	16.0	0.2	16.3	412.4	17.4	429.8	NMFS GC[2]
1985	337.9	18.1	356.0	18.6	0.1	18.7	356.5	18.1	374.7	NMFS GC[2]
1986	446.9	18.7	465.6	38.0	3.9	41.9	484.9	22.6	507.5	NMFS GC[2]
1987	574.1	4.3	578.4	34.0	6.3	40.3	608.2	10.5	618.7	NMFS GC[2]
1988	567.9	22.1	589.9	36.4	14.3	50.8	604.3	36.4	640.7	NMFS GC[2]
1989	753.3	24.3	777.7	42.0	20.2	62.2	795.3	44.5	839.8	NMFS GC[2]
1990	719.3	18.9	738.2	44.3	13.8	58.2	763.6	32.7	796.3	NMFS GC[2]
1991	760.5	16.4	776.9	59.4	8.1	67.5	819.9	24.5	844.4	NMFS GC[2]
1992	717.3	42.5	759.8	78.9	3.1	82.0	796.2	45.7	841.8	FL-TT[3]
1993	935.5	59.2	994.8	82.2	2.2	84.4	1017.7	61.5	1079.2	FL-TT[3]
1994	892.1	32.1	924.2	74.1	2.4	76.5	966.2	34.5	1000.7	FL-TT[3]
1995	756.2	28.0	784.2	54.3	3.7	58.0	810.5	31.7	842.2	FL-TT[3]
1996	596.2	16.2	612.4	48.5	1.0	49.5	644.7	17.2	661.9	FL-TT[3]
1997	678.6	15.0	693.6	64.8	0.9	65.7	743.5	15.8	759.3	FL-TT[3]
1998	615.3	18.9	634.2	56.6	0.8	57.4	671.9	19.7	691.6	FL-TT[3]
1999	763.5	23.7	787.2	49.4	0.8	50.3	812.9	24.6	837.5	FL-TT[3]
2000	668.6	7.6	676.3	44.9	0.9	45.8	713.6	8.5	722.1	FL-TT[3]
2001	596.9	3.9	600.8	43.1	0.5	43.6	640.0	4.5	644.5	FL-TT[3]
2002	593.5	3.2	596.7	42.9	0.3	43.1	636.4	3.5	639.8	FL-TT[3]
2003	587.0	4.7	591.7	47.6	0.3	47.9	634.7	5.0	639.7	FL-TT[3]
2004	620.3	4.4	624.7	46.0	0.8	46.8	666.2	5.2	671.5	FL-TT[3]
2005	548.1	1.9	550.0	50.5	0.6	51.1	598.6	2.5	601.1	FL-TT[3]
2006	518.8	4.6	523.4	37.0	0.7	37.7	555.8	5.3	561.0	FL-TT[3]
2007	393.2	6.6	399.7	44.0	0.2	44.2	437.2	6.7	443.9	FL-TT[3]
2008	567.4	3.6	571.0	50.6	0.1	50.7	618.0	3.7	621.7	FL-TT[3]
2009	822.4	0.8	823.2	72.8	0.3	73.1	895.2	1.2	896.4	FL-TT[3]
2010	679.0	2.5	681.5	86.1	0.8	86.8	765.1	3.2	768.4	FL-TT[3]

[1] NMFS = NMFS website (http://www.st.nmfs.noaa.gov/st1/commercial/landings/gear_landings.html)
[2] NMFS GC = NMFS General Canvass data (NMFS Southeast Fishery Science Center, Miami, FL)
[3] FL-TT = FL FWC trip tickets

Table 6.8.4 Florida reported commercial landings by coast and region, and percentage of landings and trips in the Florida Keys. Landings were modified by area fished (if reported on Florida trip tickets), and will not necessarily match regional totals shown in Tables 6.8.2 and 6.8.3.

	Atlantic Coast - Florida				Gulf of Mexico - Florida						Total		Total		Total			
	Nassau-Martin		Palm Beach - Miami-Dade		Florida Keys		Collier-Escambia		West of Florida*		Atlantic Coast - Florida		Gulf of Mexico - Florida		Florida		Percentage in Florida Keys	
Year	**mt**	**trips**	**mt**	**trips**	**mt**	**trips**	**mt**	**trips**	**mt**	**trips**	**mt**	**trips**	**mt**	**trips**	**mt**	**trips**	**mt**	**trips**
1985	0.1	17	13.7	768	358.7	10,806	15.2	238	0.0	0	13.7	785	373.9	11,044	387.6	11,829	92.5%	91.4%
1986	3.4	97	22.2	1,263	466.4	10,807	15.7	390	0.0	0	25.6	1,360	482.1	11,197	507.7	12,557	91.9%	86.1%
1987	1.2	98	33.4	1,499	564.4	15,518	15.5	532	0.0	0	34.5	1,597	579.9	16,050	614.4	17,647	91.9%	87.9%
1988	0.8	73	40.7	1,574	579.5	15,228	19.0	646	0.0	0	41.5	1,647	598.5	15,874	640.1	17,521	90.5%	86.9%
1989	1.8	102	50.2	1,884	757.4	18,023	30.3	699	0.0	0	52.0	1,986	787.7	18,722	839.7	20,708	90.2%	87.0%
1990	0.7	78	52.4	1,854	720.7	16,483	23.3	496	0.0	0	53.1	1,932	744.0	16,979	797.0	18,911	90.4%	87.2%
1991	2.5	170	56.7	2,125	767.7	15,823	17.6	505	0.0	0	59.2	2,295	785.3	16,328	844.5	18,623	90.9%	85.0%
1992	2.5	192	74.2	2,313	727.0	15,637	36.2	514	0.0	0	76.7	2,505	763.2	16,151	839.8	18,656	86.6%	83.8%
1993	1.4	124	80.0	2,428	971.5	16,416	26.0	571	0.0	0	81.4	2,552	997.5	16,987	1079.0	19,539	90.0%	84.0%
1994	2.1	94	73.1	2,257	911.0	15,036	14.2	550	0.2	1	75.2	2,351	925.4	15,587	1001.0	17,938	91.0%	83.8%
1995	1.1	91	53.9	1,887	769.8	13,411	17.4	387	0.0	0	55.0	1,978	787.2	13,798	842.2	15,776	91.4%	85.0%
1996	1.6	90	44.0	1,709	603.3	11,416	13.0	308	0.0	0	45.6	1,799	616.3	11,724	661.9	13,523	91.1%	84.4%
1997	1.2	87	59.4	2,184	690.6	12,027	8.0	238	0.0	0	60.6	2,271	698.6	12,265	759.3	14,536	91.0%	82.7%
1998	1.6	76	49.8	1,426	637.1	9,824	3.1	126	0.0	0	51.3	1,502	640.2	9,950	691.5	11,452	92.1%	85.8%
1999	0.6	78	38.5	1,190	789.2	9,481	9.1	193	0.0	0	39.1	1,268	798.3	9,674	837.4	10,942	94.2%	86.6%
2000	0.7	86	32.4	1,218	685.8	7,760	3.1	167	0.0	0	33.1	1,304	688.9	7,927	722.0	9,231	95.0%	84.1%
2001	1.8	143	36.5	1,024	603.1	7,947	3.0	152	0.0	0	38.2	1,167	606.1	8,099	644.4	9,266	93.6%	85.8%
2002	1.4	186	39.8	1,184	596.0	7,737	2.5	114	0.0	0	41.1	1,370	598.5	7,851	639.5	9,221	93.2%	83.9%
2003	0.6	60	44.2	1,142	589.9	7,774	4.9	115	0.0	0	44.8	1,202	594.8	7,889	639.6	9,091	92.2%	85.5%
2004	0.4	57	37.4	1,068	631.5	7,380	2.1	116	0.0	0	37.7	1,125	633.6	7,496	671.3	8,621	94.1%	85.6%
2005	0.3	43	33.1	1,004	565.3	6,606	2.1	145	0.0	0	33.4	1,047	567.4	6,751	600.8	7,798	94.1%	84.7%
2006	1.3	30	26.2	778	530.8	5,705	2.8	163	0.0	0	27.4	808	533.6	5,868	561.0	6,676	94.6%	85.5%
2007	0.9	72	22.2	745	419.1	5,353	1.4	67	0.0	0	23.1	817	420.5	5,420	443.6	6,237	94.5%	85.8%
2008	0.5	33	20.2	557	598.7	5,790	2.1	68	0.0	0	20.7	590	600.8	5,858	621.4	6,448	96.3%	89.8%
2009	0.4	63	24.7	655	869.4	6,168	1.3	93	0.0	0	25.1	718	870.7	6,261	895.9	6,979	97.0%	88.4%
2010	1.3	55	34.6	497	732.2	5,154	0.3	38	0.0	0	35.9	552	732.5	5,192	768.4	5,744	95.3%	89.7%
2011*	0.2	45	36.4	524	819.4	5,099	2.0	94	0.0	0.0	38.6	569	821.4	5,193	858.0	5,762	95.5%	88.5%

***2011 FWC trip ticket data are preliminary and incomplete**

Table 6.8.5 The number of commercial fishing trips from 1985-2010 on which yellowtail snapper were landed in a five county area of south Florida and the number and percentage of trips on which other species were also landed. Data from Florida trip tickets.

species	trips	% trips
yellowtail snapper	319,572	100.0%
gray snapper	105,883	33.1%
mutton snapper	67,953	21.3%
black grouper	51,078	16.0%
misc. food fish	45,415	14.2%
red grouper	45,092	14.1%
grunts	39,219	12.3%
king mackerel	28,132	8.8%
lane snapper	21,382	6.7%
blue runner	19,023	6.0%
hogfish	16,740	5.2%
jack, mixed	13,599	4.3%
Spanish mackerel	11,568	3.6%
cero mackerel	10,364	3.2%
greater amberjack	9,892	3.1%
dolphin	9,262	2.9%
cobia	7,330	2.3%
porgy, other	6,172	1.9%
jacks, other	6,166	1.9%
spiny lobster	6,109	1.9%
crevalle jack	5,714	1.8%
grouper, mixed	3,527	1.1%
gray triggerfish	3,364	1.1%

Table 6.8.6 Florida reported commercial landings (from trip tickets) of yellowtail snapper (in metric tons) by categories of kilograms landed per license in a year. [For example, in 1987, there were 23 metric tons of yellowtail snapper landed commercially by fishermen who landed less than 50 kg of this species that year. Of the total metric tons of yellowtail snapper landed in 1987, 38.6% were landed by fishermen with total landings of this species of less than 1,000 kg.] Florida Saltwater Products License numbers (commercial fishing licenses) were not allowed to be retained in the trip ticket database until October 1986.

Year	< 50 kg	50 - 99 kg	100 - 199 kg	200 - 499 kg	500 - 999 kg	1,000- 4,999 kg	5,000 - 9,999 kg	10,000+ kg	Total kg	Percentage < 1,000 kg	Percentage >5,000 kg
1985	.	0.1	.	.	.	.	.	387.5	387.6		
1986	5.2	3.5	6.1	13.5	15.5	34	8.9	421.1	507.7		
1987	23.0	21.3	36.0	73.3	83.5	205.3	102.4	69.7	614.4	38.6%	28.0%
1988	24.2	22.3	36.2	77.6	102.0	242.4	75.8	59.6	640.1	41.0%	21.2%
1989	26.5	24.4	36.8	81.1	118.7	301.2	124.1	127.0	839.7	34.2%	29.9%
1990	20.6	17.2	32.9	85.8	96.7	335.0	138.6	70.2	797.0	31.8%	26.2%
1991	16.4	15.1	29.0	65.7	100.8	372.5	200.5	44.5	844.5	26.9%	29.0%
1992	13.1	15.5	25.8	70.7	107.8	351.3	148.2	107.4	839.8	27.7%	30.4%
1993	13.5	13.1	22.1	66.8	122.2	430.5	257.4	153.3	1079.0	22.0%	38.1%
1994	13.0	13.3	25.7	68.2	93.1	413.3	261.3	112.7	1001.0	21.3%	37.4%
1995	12.5	12.5	23.3	58.4	96.9	340.5	169.3	128.9	842.2	24.2%	35.4%
1996	10.3	11.3	22.4	65.2	79.7	280.3	93.5	99.1	661.9	28.5%	29.1%
1997	10.5	10.8	21.2	64.7	95.3	293.0	160.4	103.2	759.3	26.7%	34.7%
1998	9.3	9.8	18.3	48.9	82.3	259.6	137.8	125.5	691.5	24.4%	38.1%
1999	6.9	7.5	14.3	41.1	76.7	261.6	134.7	294.7	837.4	17.5%	51.3%
2000	6.7	6.7	13.1	37.2	56.4	201.7	145.6	254.5	722.0	16.6%	55.4%
2001	6.1	7.9	14.3	42.3	58.1	195.5	135.0	185.0	644.4	20.0%	49.7%
2002	6.1	8.0	13.7	36.6	68.1	167.0	132.6	207.4	639.5	20.7%	53.2%
2003	5.4	6.0	11.3	30.5	62.3	218.0	116.2	189.9	639.6	18.1%	47.9%
2004	5.3	7.0	10.5	35.4	54.6	190.2	111.0	257.3	671.3	16.8%	54.9%
2005	4.5	6.0	10.1	27.7	42.9	191.3	70.9	247.4	600.8	15.2%	53.0%
2006	4.5	4.6	10.1	25.0	39.8	145.1	136.8	195.1	561.0	15.0%	59.2%
2007	3.4	3.9	7.8	25.4	34.4	140.8	103.9	123.9	443.6	16.9%	51.4%
2008	3.0	3.1	7.7	22.3	32.8	149.8	148.6	254.1	621.4	11.1%	64.8%
2009	3.0	4.6	7.4	22.5	32.3	155.1	207.2	463.8	895.9	7.8%	74.9%
2010	2.6	3.2	7.0	18.6	42.0	183.3	149.0	362.6	768.4	9.6%	66.6%
2011	2.2	3.3	5.1	20.2	29.0	203.7	238.1	356.4	858.0	7.0%	69.3%

* 2011 data are preliminary and incomplete

Table 6.8.7 Florida reported commercial landings (from trip tickets) of yellowtail snapper (in number of Saltwater Products Licenses) by categories of kilograms landed per license in a year. [For example, in 1987, there were 1,603 SPLs commercially landing yellowtail snapper who landed less than 50 kg of this species that year. Of the total number of licenses with landings of yellowtail snapper in 1987, 95.4% were landed by fishermen with total landings of this species of less than 1,000 kg.] Florida Saltwater Products License numbers (commercial fishing licenses) were not allowed to be retained in the trip ticket database until October 1986.

Year	< 50 kg	50 - 99 kg	100 - 199 kg	200 - 499 kg	500 - 999 kg	1,000- 4,999 kg	5,000 - 9,999 kg	10,000+ kg	Total licenses	Percentage < 1,000 kg	Percentage >5,000 kg
1985	.	1	.	.	.	.	.	3	4		
1986	416	51	41	42	23	20	1	3	597		
1987	1,603	298	256	231	120	106	14	2	2,630	95.4%	0.6%
1988	1,679	317	255	248	143	117	11	2	2,772	95.3%	0.5%
1989	1,816	344	260	251	173	150	17	6	3,017	94.3%	0.8%
1990	1,357	242	233	263	141	181	20	4	2,441	91.6%	1.0%
1991	1,032	214	202	205	138	183	28	4	2,006	89.3%	1.6%
1992	943	214	184	222	150	183	23	9	1,928	88.8%	1.7%
1993	911	187	159	205	168	201	37	12	1,880	86.7%	2.6%
1994	882	183	183	207	135	205	38	9	1,842	86.3%	2.6%
1995	837	173	164	182	130	161	24	10	1,681	88.4%	2.0%
1996	745	154	157	202	112	125	15	8	1,518	90.3%	1.5%
1997	751	149	148	201	132	132	22	8	1,543	89.5%	1.9%
1998	618	133	127	154	114	120	19	11	1,296	88.4%	2.3%
1999	491	102	101	123	107	124	19	23	1,090	84.8%	3.9%
2000	464	93	92	114	76	99	20	18	976	86.0%	3.9%
2001	408	108	103	128	81	92	19	13	952	87.0%	3.4%
2002	405	109	96	111	94	87	20	14	936	87.1%	3.6%
2003	366	86	78	96	84	104	16	13	843	84.2%	3.4%
2004	352	96	74	110	78	91	15	15	831	85.4%	3.6%
2005	348	83	72	91	62	92	10	17	775	84.6%	3.5%
2006	295	64	69	78	55	72	18	14	665	84.4%	4.8%
2007	263	56	56	78	47	72	15	9	596	83.9%	4.0%
2008	255	45	54	71	47	67	21	16	576	81.9%	6.4%
2009	233	63	53	67	45	75	28	24	588	78.4%	8.8%
2010	190	43	46	55	57	74	23	20	508	77.0%	8.5%
2011	186	45	35	64	40	75	33	18	496	74.6%	10.3%

* 2011 data are preliminary and incomplete

Table 6.8.8 Florida reported commercial landings (from trip tickets) of yellowtail snapper (in numbers of fishing trips) by categories of kilograms landed per license in a year. [For example, in 1987, there were 3,357 commercial fishing trips with landings yellowtail snapper by fishermen who landed less than 50 kg of this species that year. Of the total number of commercial fishing trips with landings of yellowtail snapper in 1987, 71.4% were landed by fishermen with total landings of this species of less than 1,000 kg.] Florida Saltwater Products License numbers (commercial fishing licenses) were not allowed to be retained in the trip ticket database until October 1986.

Year	< 50 kg	50 - 99 kg	100 - 199 kg	200 - 499 kg	500 - 999 kg	1,000- 4,999 kg	5,000 - 9,999 kg	10,000+ kg	Total kg	Percentage < 1,000 kg	Percentage >5,000 kg
1985	.	17	.	.	.	.	.	11,812	11,829		
1986	793	170	254	271	160	248	138	10,523	12,557		
1987	3,337	1,578	2,124	2,982	2,585	3,414	396	1,231	17,647	71.4%	9.2%
1988	3,443	1,598	1,947	3,169	2,452	3,672	366	874	17,521	72.0%	7.1%
1989	3,719	1,846	2,072	3,072	3,234	5,297	436	1,032	20,708	67.3%	7.1%
1990	2,651	1,076	1,529	3,426	2,919	6,255	558	497	18,911	61.3%	5.6%
1991	2,285	1,056	1,693	2,711	3,167	6,532	1,086	93	18,623	58.6%	6.3%
1992	2,073	1,116	1,489	2,954	2,995	6,410	1,255	364	18,656	57.0%	8.7%
1993	2,004	986	1,261	2,608	3,758	7,228	1,115	579	19,539	54.3%	8.7%
1994	1,943	949	1,299	2,687	2,795	6,776	1,107	382	17,938	53.9%	8.3%
1995	1,895	921	1,258	2,410	2,923	5,262	735	372	15,776	59.6%	7.0%
1996	1,800	828	1,108	2,579	2,425	4,029	259	495	13,523	64.6%	5.6%
1997	1,656	826	1,163	2,519	2,576	4,620	521	655	14,536	60.1%	8.1%
1998	1,330	605	855	1,763	2,086	3,514	667	632	11,452	58.0%	11.3%
1999	995	471	590	1,346	2,033	3,924	655	928	10,942	49.7%	14.5%
2000	955	390	613	1,463	1,533	2,871	650	756	9,231	53.7%	15.2%
2001	837	468	643	1,526	1,732	2,472	619	969	9,266	56.2%	17.1%
2002	851	444	566	1,218	1,987	2,564	714	877	9,221	54.9%	17.3%
2003	760	390	571	1,064	1,777	3,092	716	721	9,091	50.2%	15.8%
2004	760	489	506	1,389	1,476	2,553	488	960	8,621	53.6%	16.8%
2005	676	407	531	1,084	1,129	2,836	301	834	7,798	49.1%	14.6%
2006	639	265	569	902	984	2,105	592	620	6,676	50.3%	18.2%
2007	557	264	411	999	950	2,070	479	507	6,237	51.0%	15.8%
2008	469	189	341	878	958	2,195	563	855	6,448	44.0%	22.0%
2009	465	331	365	746	916	2,154	702	1,300	6,979	40.4%	28.7%
2010	355	208	356	590	876	1,492	571	1,296	5,744	41.5%	32.5%
2011	358	146	200	707	517	2,035	768	1,031	5,762	33.5%	31.2%

* 2011 data are preliminary and incomplete

Table 6.8.9 Yellowtail snapper annual discards (numbers of fish) and discard rates estimated from log books of commercial vertical line vessels, 2002-2010 (McCarthy, 2011b). Table values in red were estimated from the weighted average standardized catch rate of the 1984-2010 time period. The proportion of discarded yellowtail snapper that were dead were based upon at-sea observer monitored releases in southwest Florida and the Florida Keys. A total of 6 dead of 52 released fish (11.5%) were observed (K. McCarthy, personal communication, NMFS Southeast Fishery Science Center).

Year	proportion of trips with discards	trips (for discard rate)	standardized mean discard rate	cv (discard rate)	trips reporting hook hours (with filtering)	total hook hours reported (with filtering)	calculated total discards	dead discards (11.5% discard mortality)
1993			**0.219**	0.471	11,529	744,952	163,165	18,764
1994			**0.219**	0.471	13,360	1,313,018	287,587	33,072
1995			**0.219**	0.471	13,706	831,195	182,054	20,936
1996			**0.219**	0.471	14,328	868,133	190,144	21,867
1997			**0.219**	0.471	16,216	1,020,674	223,555	25,709
1998			**0.219**	0.471	14,989	768,831	168,395	19,365
1999			**0.219**	0.471	14,945	868,038	190,124	21,864
2000			**0.219**	0.471	13,534	943,095	206,563	23,755
2001			**0.219**	0.471	14,225	644,938	141,259	16,245
2002	0.410	585	0.237	0.455	14,282	696,486	165,154	18,993
2003	0.413	768	0.215	0.445	15,285	550,347	118,371	13,613
2004	0.389	540	0.105	0.469	14,109	487,564	51,337	5,904
2005	0.486	533	0.161	0.444	12,125	420,355	67,594	7,773
2006	0.629	313	0.438	0.483	12,734	448,889	196,619	22,611
2007	0.588	745	0.230	0.426	12,660	407,089	93,455	10,747
2008	0.581	874	0.299	0.408	12,861	396,876	118,560	13,634
2009	0.498	609	0.177	0.444	14,561	504,285	89,464	10,288
2010	0.485	676	0.166	0.482	13,084	442,946	73,545	8,458

weighted average discard rate 2002-2010: **0.219**

Table 6.8.10 Number of yellowtail snapper measured from commercial catches on the Atlantic Coast, 1981-2010. Table values shaded in grey were filled using the frequencies of measurements taken during 1992-1996, and were added to any measurements actually taken by size class for a year in this region.

Total Length (inch class)

Year	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	29	30	31	32	33	34	35	36
1981	0	0	1	1	1	2	5	148	558	532	644	349	252	121	86	34	11	10	6	2	1	0	1	0	0	0	0	0	0	0	0	0	0
1982	0	0	1	1	1	2	5	148	558	532	644	349	252	121	86	34	11	10	6	2	1	0	1	0	0	0	0	0	0	0	0	0	0
1983	0	0	1	1	1	2	5	148	558	532	644	349	252	121	86	34	11	10	6	2	1	0	1	0	0	0	0	0	0	0	0	0	0
1984	0	0	1	1	1	2	5	148	558	532	644	349	252	121	86	34	11	10	6	2	1	0	1	0	0	0	0	0	0	0	0	0	0
1985	0	0	1	1	1	2	5	148	558	532	644	349	252	121	86	34	11	10	6	2	1	0	1	0	0	0	0	0	0	0	0	0	0
1986	0	0	1	1	1	2	5	148	558	532	644	349	252	121	86	34	11	10	6	2	1	0	1	0	0	0	0	0	0	0	0	0	0
1987	0	0	1	1	1	2	5	148	558	532	644	349	252	121	86	34	11	10	6	2	1	0	1	0	0	0	0	0	0	0	0	0	0
1988	0	0	1	1	1	3	5	148	558	533	644	349	253	121	86	34	11	10	6	2	1	0	1	0	0	0	0	0	0	0	0	0	0
1989	0	0	1	1	1	3	5	148	558	533	644	349	253	121	86	34	11	10	6	2	1	0	1	0	0	0	0	0	0	0	0	0	0
1990	0	0	1	1	1	3	5	148	558	534	650	356	264	125	88	34	11	10	6	2	1	0	1	0	0	0	0	0	0	0	0	0	0
1991	0	0	1	1	1	3	5	148	558	538	651	356	264	125	88	34	11	10	6	2	1	0	1	0	0	0	0	0	0	0	0	0	0
1992	0	0	0	0	0	0	3	46	241	284	351	165	124	59	18	5	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
1993	0	0	0	0	0	0	0	9	60	57	42	25	10	5	4	2	0	3	3	1	0	0	1	0	0	0	0	0	0	0	0	0	0
1994	0	0	1	1	1	2	0	3	7	4	16	24	15	16	14	8	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1995	0	0	0	0	0	0	1	13	69	49	121	70	56	27	30	8	5	4	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1996	0	0	0	0	0	0	1	77	181	138	114	65	47	14	20	11	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1997	0	0	0	0	0	1	0	156	537	301	332	199	194	66	44	23	3	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
1998	0	0	0	0	0	0	17	120	285	292	337	158	142	60	49	22	13	3	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
1999	0	0	0	0	0	0	12	148	385	448	366	300	172	110	64	29	8	14	12	3	3	1	0	1	2	0	0	0	0	0	0	0	0
2000	0	0	0	0	0	0	4	172	380	310	334	259	192	127	73	32	24	7	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	0	0	0	0	0	1	7	90	421	474	654	692	376	272	115	68	29	11	10	2	2	3	0	0	0	0	1	0	0	0	0	0	0
2002	0	0	0	0	0	0	12	83	261	213	279	234	163	89	49	42	16	8	2	4	0	1	0	0	0	0	0	0	0	0	0	0	0
2003	0	0	0	0	0	0	0	12	98	114	126	72	81	62	20	7	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2004	0	0	0	0	0	0	0	28	132	159	131	136	118	47	21	10	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
2005	0	0	0	0	0	0	0	5	42	89	183	221	124	53	32	15	1	1	4	3	0	1	0	0	0	0	0	0	0	0	0	0	0
2006	0	0	0	0	0	0	1	16	102	115	126	126	120	70	40	28	9	4	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	0	0	0	0	0	0	1	4	116	162	197	183	81	31	8	6	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	0	0	0	0	0	0	0	7	79	84	118	136	97	41	11	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	0	0	0	0	0	0	2	12	82	140	126	85	63	27	8	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2010	0	0	0	0	0	0	2	5	58	94	89	45	23	8	9	3	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 6.8.11 Number of yellowtail snapper measured from commercial catches on the Gulf of Mexico Coast, 1981-2010. Table values shaded in grey were filled from adjacent years.

	Total Length (inch class)																																
Year	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	29	30	31	32	33	34	35	36
1981	0	0	0	0	0	0	2	9	7	26	32	22	10	13	7	6	10	5	7	0	1	0	0	0	0	0	0	0	0	0	0	0	0
1982	0	0	0	0	0	0	2	9	7	26	32	22	10	13	7	6	10	5	7	0	1	0	0	0	0	0	0	0	0	0	0	0	0
1983	0	0	0	0	0	0	13	115	135	101	149	128	165	107	65	53	42	26	27	21	23	3	2	3	1	0	1	0	0	0	0	0	0
1984	0	0	0	0	0	0	13	115	135	101	149	128	165	107	65	53	42	26	27	21	23	6	2	3	1	0	1	0	0	0	0	0	0
1985	0	0	0	0	0	0	0	0	3	8	19	36	74	173	375	434	407	206	219	161	127	80	55	40	22	6	7	2	0	0	0	0	0
1986	0	0	0	0	0	0	0	15	87	74	188	342	356	356	297	284	228	116	137	106	66	56	21	11	11	6	0	1	0	0	0	0	0
1987	0	0	0	0	0	0	0	50	204	280	256	203	186	180	169	150	117	68	83	66	37	24	18	14	18	17	3	1	0	0	0	0	0
1988	0	0	0	0	0	13	12	100	388	332	351	261	162	106	62	42	54	34	15	9	2	1	0	0	0	0	0	0	0	0	0	0	0
1989	0	0	0	0	0	0	1	73	459	428	519	445	343	219	125	95	87	52	40	19	1	0	0	0	0	0	0	0	0	0	0	0	0
1990	0	0	0	0	0	12	8	244	1129	879	733	636	326	235	135	87	95	66	51	26	5	4	2	0	0	0	0	0	0	0	0	0	0
1991	0	0	0	0	1	0	1	150	1045	881	944	806	526	288	188	154	115	75	59	34	10	7	1	1	0	0	0	0	0	0	0	0	0
1992	0	0	0	0	0	0	2	129	782	656	639	526	296	157	148	106	100	136	97	38	24	7	1	2	0	0	0	0	0	0	0	0	0
1993	0	0	0	0	0	0	2	80	640	802	900	851	559	307	190	126	106	86	46	33	7	5	0	0	0	0	0	0	0	0	0	0	0
1994	0	0	0	0	2	4	7	99	768	894	919	1000	650	384	207	147	112	82	63	38	16	0	2	1	0	3	0	0	0	0	0	0	0
1995	0	0	0	0	0	5	7	161	1292	1265	1233	934	542	306	164	100	60	48	29	20	7	3	0	0	0	0	0	0	0	0	0	0	0
1996	0	0	0	0	0	0	2	144	781	755	658	472	366	222	146	86	44	45	19	10	7	3	1	0	0	0	0	0	0	0	0	0	0
1997	0	0	0	0	0	0	2	180	953	1072	1142	838	607	382	231	171	121	85	49	35	14	8	0	0	1	1	2	1	0	1	0	0	2
1998	0	0	0	0	0	0	1	175	899	995	1101	922	550	382	252	141	68	38	17	8	5	1	1	0	0	0	0	0	0	0	0	0	0
1999	0	0	0	0	0	15	0	147	889	926	1283	1055	732	429	287	181	137	57	55	20	9	4	1	2	0	0	0	0	0	0	0	0	0
2000	0	0	0	0	0	0	3	46	286	492	590	510	288	179	128	100	71	55	29	20	6	1	1	0	0	0	0	0	0	0	0	0	0
2001	0	0	0	0	0	1	1	93	748	943	1083	883	537	298	180	103	64	39	26	14	5	2	0	0	0	0	0	0	0	0	0	0	0
2002	0	0	0	0	0	0	1	104	775	1143	1103	1058	661	419	283	189	139	96	56	32	13	0	0	0	0	0	0	0	0	0	0	0	0
2003	0	0	0	0	0	1	16	133	446	571	656	671	455	236	153	124	72	52	40	18	8	5	1	1	5	2	3	4	3	5	2	0	1
2004	0	0	0	0	0	0	0	57	315	487	636	573	357	253	190	118	79	41	28	8	3	2	1	1	0	0	0	0	0	0	0	0	0
2005	0	0	0	0	0	0	0	12	134	322	463	505	395	234	144	91	81	50	26	9	1	0	0	0	0	0	0	0	0	0	0	0	0
2006	0	0	0	0	0	0	1	13	72	148	268	258	237	126	74	39	38	18	19	7	10	2	0	0	0	0	0	0	0	0	0	0	0
2007	0	0	0	0	0	0	1	15	124	224	312	324	229	131	108	74	58	53	38	14	2	1	0	0	0	0	0	0	0	0	0	0	0
2008	0	0	0	0	0	0	0	21	200	307	495	541	315	216	142	137	85	53	36	10	5	1	2	0	0	0	0	0	0	0	0	0	0
2009	0	0	0	0	0	0	0	40	279	418	551	540	384	229	161	122	109	60	52	34	10	1	0	0	0	0	0	0	0	0	0	0	0
2010	0	0	0	0	0	0	0	7	111	202	311	306	167	129	82	73	77	45	28	25	7	0	0	1	0	0	0	0	0	0	0	0	0

Table 6.8.12 Number of yellowtail snapper measured from commercial catches from the Atlantic Coast from 1981-2010 in Trip Interview Program (TIP) samples, calculated whole wt. (kg) of fish in length samples, number of length samples used in calculations (including those used for hole filling shown in red), reported commercial landings, approximate number of fish from TIP, approx. number of fish landed, calculation of landings in kg. using the annual length samples, and adjustments to the TIP number of fish/kilogram in the length samples to adjust the estimated number of fish landed to the calculated landings in weight within ±0.1% of the reported landings in kg. Fish with lengths from 4” to 36” TL from samples with no sample bias noted were used for these calculations. Approximately 98% of the measured fish came from trips using vertical lines. Table values in red were estimated from the average of the 1992-2010 time period (Atlantic Coast).

	Atlantic Coast									
Year	**Actual number of fish measured (TIP)**	**Calculated whole wt. (kg) of measured fish**	**Number of fish measure-ments (with hole filling)**	**Reported Landings (kg, whole wt)**	**TIP approx. fish/kg**	**Approx. Landings (calculated number of fish)**	**Approx. Landings (calculated kg whole wt.)**	**adjusted TIP fish/kg**	**Adjusted Landings (calculated number of fish)**	**Adjusted Landings (calculated kg whole wt. after adjustment)***
1981	0	0.0	**2,765**	16,980	**2.04**	34,713	16,030	**2.16**	36,726	16,960
1982	0	0.0	**2,765**	16,277	**2.04**	33,275	15,366	**2.16**	35,205	16,258
1983	0	0.0	**2,765**	30,542	**2.04**	62,438	28,834	**2.16**	66,090	30,521
1984	0	0.0	**2,765**	16,192	**2.04**	33,102	15,286	**2.16**	35,022	16,173
1985	0	0.0	**2,765**	18,654	**2.04**	38,136	17,611	**2.16**	40,348	18,633
1986	0	0.0	**2,765**	41,875	**2.04**	85,606	39,533	**2.16**	90,614	41,846
1987	0	0.0	**2,765**	40,163	**2.04**	82,107	37,917	**2.16**	86,910	40,135
1988	3	1.2	**2,768**	50,773	**2.04**	103,798	47,925	**2.16**	109,922	50,753
1989	0	0.0	**2,768**	62,152	**2.04**	127,060	58,665	**2.16**	134,556	62,126
1990	31	18.8	**2,799**	58,114	**2.04**	118,806	55,029	**2.16**	125,459	58,110
1991	5	2.0	**2,804**	67,542	**2.04**	138,079	63,937	**2.16**	145,811	67,517
1992	1,301	599.1	1,301	79,237	2.17	172,059	77,441	**2.22**	176,016	79,223
1993	222	100.7	222	84,384	2.20	186,031	84,841	**2.19**	185,008	84,374
1994	115	69.1	115	76,475	1.66	127,201	77,181	**1.65**	125,992	76,448
1995	455	242.2	455	57,944	1.88	108,867	56,652	**1.92**	111,317	57,927
1996	672	291.7	672	49,500	2.30	114,027	48,108	**2.37**	117,277	49,479
1997	1,859	828.6	1,859	65,682	2.24	147,359	64,000	**2.30**	151,190	65,664
1998	1,499	688.1	1,499	57,402	2.18	125,052	56,872	**2.20**	126,177	57,384
1999	2,078	986.4	2,078	50,293	2.11	105,946	50,178	**2.11**	106,158	50,278
2000	1,918	924.0	1,918	45,839	2.08	95,150	45,265	**2.10**	96,292	45,809
2001	3,228	1,693.1	3,228	43,625	1.91	83,173	43,087	**1.93**	84,171	43,604
2002	1,456	733.5	1,456	43,177	1.99	85,710	42,558	**2.01**	86,910	43,154
2003	596	298.4	596	47,914	2.00	95,712	47,482	**2.02**	96,574	47,909
2004	784	385.2	784	46,860	2.04	95,380	45,940	**2.08**	97,287	46,859
2005	774	432.8	774	51,076	1.79	91,338	49,813	**1.83**	93,621	51,058
2006	760	418.5	760	37,672	1.82	68,420	36,988	**1.85**	69,651	37,653
2007	793	381.5	793	44,158	2.08	91,789	43,413	**2.11**	93,349	44,151
2008	578	293.4	578	50,747	1.97	99,968	49,912	**2.00**	101,617	50,736
2009	547	256.3	547	73,160	2.13	156,158	71,611	**2.18**	159,516	73,150
2010	341	157.0	341	87,330	2.17	189,726	86,228	**2.20**	192,098	87,306

*A check on the calculations, should be close to the reported commercial landings.

Table 6.8.13 Number of yellowtail snapper measured from commercial catches from the Gulf Coast from 1981-2010 in Trip Interview Program (TIP) samples, calculated whole wt. (kg) of fish in length samples, number of length samples used in calculations (including those used for hole filling shown in red), reported commercial landings, approximate number of fish from TIP, approx. number of fish landed, calculation of landings in kg. using the annual length samples, and adjustments to the TIP number of fish/kilogram in the length samples to adjust the estimated number of fish landed to the calculated landings in weight within ±0.1% of the reported landings in kg. Fish with lengths from 4” to 36” TL from samples with no sample bias noted were used for these calculations. Approximately 98% of the measured fish came from trips using vertical lines. Table values in red were estimated from years adjacent to 1982-1983 time period (Gulf Coast).

	Gulf Coast									
Year	**Actual number of fish measured (TIP)**	**Calculated whole wt. (kg) of measured fish**	**Number of fish measure-ments (with hole filling)**	**Reported Landings (kg, whole wt)**	**TIP approx. fish/kg**	**Approx. Landings (calculated number of fish)**	**Approx. Landings (calculated kg whole wt.)**	**adjusted TIP fish/kg**	**Adjusted Landings (calculated number of fish)**	**Adjusted Landings (calculated kg whole wt. after adjustment)***
1981	157	99.8	157	314,878	1.57	573,861	308,962	**1.60**	504,599	314,863
1982	0	0.0	**157**	605,469	**1.57**	1,103,459	594,093	**1.60**	970,315	605,464
1983	0	0.0	**1,183**	405,686	**1.52**	716,247	395,288	**1.56**	630,996	405,684
1984	1,183	780.6	1,183	413,498	1.52	626,665	403,472	**1.55**	642,206	413,478
1985	2,454	3,067.0	2,454	355,659	0.80	284,575	346,080	**0.82**	292,429	355,632
1986	2,758	2,552.7	2,758	465,593	1.08	503,040	453,219	**1.11**	516,773	465,592
1987	2,144	1,737.4	2,144	577,791	1.23	713,006	564,406	**1.26**	729,904	577,783
1988	1,944	1,013.8	1,944	589,411	1.92	1,130,252	574,628	**1.97**	1,159,300	589,396
1989	2,906	1,657.3	2,906	776,221	1.75	1,361,044	759,535	**1.79**	1,390,919	776,207
1990	4,673	2,353.9	4,673	738,067	1.99	1,465,203	724,692	**2.02**	1,492,236	738,063
1991	5,286	2,855.2	5,286	776,331	1.85	1,437,293	760,611	**1.89**	1,466,973	776,317
1992	3,846	2,213.0	3,846	726,991	1.74	1,263,475	712,743	**1.77**	1,288,681	726,962
1993	4,740	2,639.9	4,740	994,586	1.80	1,785,835	983,616	**1.82**	1,805,747	994,584
1994	5,398	3,010.4	5,398	923,803	1.79	1,656,503	915,926	**1.81**	1,670,749	923,803
1995	6,176	3,018.5	6,176	784,289	2.05	1,604,721	775,769	**2.07**	1,622,293	784,263
1996	3,761	1,898.5	3,761	612,202	1.98	1,212,782	605,460	**2.00**	1,226,244	612,181
1997	5,898	3,205.1	5,898	693,472	1.84	1,276,106	685,896	**1.86**	1,290,144	693,441
1998	5,556	2,862.0	5,556	634,115	1.94	1,230,999	627,693	**1.96**	1,243,555	634,096
1999	6,229	3,397.0	6,229	787,149	1.83	1,443,372	780,111	**1.85**	1,456,362	787,132
2000	2,805	1,598.9	2,805	676,374	1.75	1,186,576	669,012	**1.77**	1,199,628	676,371
2001	5,020	2,587.0	5,020	601,046	1.94	1,166,321	596,879	**1.95**	1,174,427	601,028
2002	6,072	3,363.9	6,072	596,804	1.81	1,077,269	592,290	**1.82**	1,085,457	596,791
2003	3,684	2,132.1	3,684	592,861	1.73	1,024,403	586,022	**1.75**	1,036,337	592,850
2004	3,149	1,803.1	3,149	627,287	1.75	1,095,535	620,363	**1.77**	1,107,750	627,280
2005	2,467	1,508.3	2,467	550,083	1.64	899,725	541,980	**1.66**	913,131	550,056
2006	1,330	821.1	1,330	523,457	1.62	847,885	516,495	**1.64**	859,289	523,442
2007	1,708	1,073.8	1,708	399,743	1.59	635,843	395,260	**1.61**	643,028	399,726
2008	2,566	1,574.0	2,566	571,109	1.63	931,045	564,020	**1.65**	942,729	571,098
2009	2,983	1,832.1	2,990	823,289	1.63	1,343,621	811,758	**1.66**	1,362,700	823,285
2010	1,570	1,013.6	1,571	681,522	1.55	1,056,337	670,840	**1.57**	1,073,132	681,506

*A check on the calculations, should be close to the reported commercial landings.

Table 6.8.14 Landings (metric tons) of yellowtail snapper reported and estimated numbers of fish landed or discarded from commercial catches from the Atlantic and Gulf of Mexico regions, 1981-2010.

	Commercial Landings (reported)						Commercial Discards (live and dead)								
Year	Atlantic (mt)	Gulf (mt)	Both Regions (mt)	Atlantic (estimated no. of fish)	Gulf (estimated no. of fish)	Both Regions (no. of fish)	Discard rate (fish / hook-hour)*	Total discards for Atlantic and Gulf (numbers of fish)*	Total discard rate (no. discards / total number landed)	Atlantic estimated total (numbers)	Gulf estimate total discards (numbers)	Atlantic (est. total discards, mt)	Gulf (est. total discards, mt)	Total, live or dead discards (mt)	Est. dead discards @ 11.5% release mortality (mt)
1981	16.980	314.878	331.858	36,726	504,599	541,325	---	22,915	0.042	1,555	21,360	0.201	2.762	2.963	0.341
1982	16.277	605.469	621.746	35,205	970,315	1,005,520	---	42,565	0.042	1,490	41,074	0.193	5.311	5.503	0.633
1983	30.542	405.686	436.228	66,090	630,996	697,086	---	29,508	0.042	2,798	26,711	0.362	3.453	3.815	0.439
1984	16.192	413.498	429.690	35,022	642,206	677,228	---	28,668	0.042	1,483	27,185	0.192	3.515	3.707	0.426
1985	18.654	355.659	374.314	40,348	292,429	332,777	---	42,229	0.127	5,120	37,109	1.026	7.433	8.459	0.973
1986	41.875	465.593	507.467	90,614	516,773	607,387	---	77,076	0.127	11,499	65,577	2.303	13.135	15.439	1.775
1987	40.163	574.002	614.165	86,910	729,904	816,814	---	103,652	0.127	11,029	92,623	2.209	18.553	20.762	2.388
1988	50.773	589.411	640.185	109,922	1,159,300	1,269,222	---	161,061	0.127	13,949	147,112	2.794	29.467	32.261	3.710
1989	62.152	776.221	838.373	134,556	1,390,919	1,525,475	---	193,579	0.127	17,075	176,504	3.420	35.355	38.775	4.459
1990	58.106	738.067	796.173	125,459	1,492,236	1,617,695	---	205,282	0.127	15,920	189,361	3.189	37.930	41.119	4.729
1991	67.509	776.331	843.840	145,811	1,466,973	1,612,784	---	204,658	0.127	18,503	186,155	3.706	37.288	40.994	4.714
1992	77.102	726.991	804.093	176,016	1,288,681	1,464,698	---	185,867	0.127	22,336	163,531	4.474	32.756	37.230	4.281
1993	84.198	994.586	1,078.784	185,008	1,805,747	1,990,756	0.219	163,165	0.082	15,163	148,001	3.037	29.645	32.683	3.759
1994	76.389	923.803	1,000.192	125,992	1,670,749	1,796,741	0.219	287,587	0.160	20,166	267,420	4.039	53.566	57.605	6.625
1995	57.944	784.289	842.233	111,317	1,622,293	1,733,609	0.219	182,054	0.105	11,690	170,364	2.342	34.125	36.466	4.194
1996	49.500	612.202	661.702	117,277	1,226,244	1,343,521	0.219	190,144	0.142	16,598	173,547	3.325	34.762	38.087	4.380
1997	65.682	693.451	759.133	151,190	1,290,144	1,441,333	0.219	223,555	0.155	23,450	200,105	4.697	40.082	44.779	5.150
1998	57.327	634.115	691.442	126,177	1,243,555	1,369,733	0.219	168,395	0.123	15,512	152,883	3.107	30.623	33.730	3.879
1999	50.293	787.093	837.386	106,158	1,456,362	1,562,521	0.219	190,124	0.122	12,917	177,207	2.587	35.496	38.083	4.380
2000	45.839	676.299	722.138	96,292	1,199,628	1,295,920	0.219	206,563	0.159	15,348	191,215	3.074	38.301	41.376	4.758
2001	43.543	601.037	644.581	84,171	1,174,427	1,258,598	0.219	141,259	0.112	9,447	131,812	1.892	26.403	28.295	3.254
2002	42.957	596.711	639.668	86,910	1,085,457	1,172,367	0.237	165,154	0.141	12,243	152,911	2.452	30.629	33.081	3.804
2003	47.848	591.901	639.749	96,574	1,036,337	1,132,910	0.215	118,371	0.104	10,090	108,280	2.021	21.689	23.710	2.727
2004	46.651	627.203	673.854	97,287	1,107,750	1,205,038	0.105	51,337	0.043	4,145	47,193	0.830	9.453	10.283	1.183
2005	50.775	550.044	600.819	93,621	913,131	1,006,752	0.161	67,594	0.067	6,286	61,308	1.259	12.280	13.539	1.557
2006	37.672	523.416	561.088	69,651	859,289	928,940	0.438	196,619	0.212	14,742	181,877	2.953	36.431	39.384	4.529
2007	43.954	399.690	443.643	93,349	643,028	736,377	0.230	93,455	0.127	11,847	81,608	2.373	16.346	18.720	2.153
2008	50.422	571.109	621.531	101,617	942,729	1,044,346	0.299	118,560	0.114	11,536	107,024	2.311	21.438	23.748	2.731
2009	72.640	823.289	895.929	159,516	1,362,700	1,522,216	0.177	89,464	0.059	9,375	80,089	1.878	16.042	17.920	2.061
2010	86.889	681.522	768.411	192,098	1,073,132	1,265,230	0.166	73,545	0.058	11,166	62,379	2.237	12.495	14.731	1.694

* values shaded in blue were from McCarthy (2011b)

Table 6.8.15 A comparison of estimated numbers of yellowtail landed and discarded for SEDAR 3 and this assessment.

Year	SEDAR 3 Total commercial landings (numbers)	This assessment Total commercial landings (numbers)	SEDAR 3 Total dead discards @ relM=28% (numbers)	This assessment Total dead discards @ relM=11.5% (numbers)	This assessment Total dead discards @ relM=28% (numbers)
1981	522,140	541,325	23,194	2,635	5,981
1982	1,165,536	1,005,520	43,694	4,895	11,501
1983	809,637	697,086	32,991	3,393	7,479
1984	766,498	677,228	32,573	3,297	7,612
1985	366,211	332,777	16,182	4,856	10,390
1986	1,131,332	607,387	50,509	8,864	18,362
1987	1,214,692	816,814	54,771	11,920	25,934
1988	1,582,930	1,269,222	72,131	18,522	41,191
1989	1,991,560	1,525,475	89,906	22,262	49,421
1990	1,964,255	1,617,695	89,777	23,607	53,021
1991	1,916,660	1,612,784	88,462	23,536	52,124
1992	1,397,400	1,464,698	63,079	21,375	45,789
1993	2,128,908	1,990,756	95,661	18,764	41,440
1994	2,002,509	1,796,741	90,111	33,072	74,878
1995	1,707,347	1,733,609	77,558	20,936	47,702
1996	1,248,209	1,343,521	56,419	21,867	48,593
1997	1,512,255	1,441,333	67,785	25,709	56,029
1998	1,399,210	1,369,733	62,546	19,365	42,807
1999	1,632,113	1,562,521	73,095	21,864	49,618
2000	1,413,465	1,295,920	63,495	23,755	53,540
2001	1,221,673	1,258,598	55,117	16,245	36,907

Table 6.8.16 Number of yellowtail snapper measured from commercial catches from 1981-2010 for the Atlantic and Gulf region, and number of age samples available. These data include only samples which were not subject to sampling biases, and were 4" to 36" TL.

	Atlantic		Gulf	
Year	lengths	ages	lengths	ages
1981	0	0	157	153
1982	0	0	0	0
1983	0	0	0	0
1984	0	0	1,183	0
1985	0	0	2,454	0
1986	0	0	2,758	0
1987	0	0	2,144	0
1988	3	0	1,944	0
1989	0	0	2,906	0
1990	31	0	4,673	0
1991	5	0	5,286	0
1992	1,301	74	3,846	33
1993	222	123	4,740	51
1994	115	183	5,398	79
1995	455	198	6,176	72
1996	672	313	3,761	87
1997	1,859	606	5,898	371
1998	1,499	319	5,556	193
1999	2,078	649	6,229	184
2000	1,918	326	2,805	215
2001	3,228	304	5,020	334
2002	1,456	0	6,072	454
2003	596	2	3,684	339
2004	784	150	3,149	294
2005	774	225	2,467	451
2006	760	389	1,330	318
2007	793	117	1,708	243
2008	578	222	2,566	612
2009	547	76	2,990	666
2010	341	91	1,571	402
Total	20,015	4,367	98,471	5,551

Table 6.8.17 Number of yellowtail snapper measured, estimated weight (kg), and rough approximations of the number of fish/kg landed from commercial gears from 1981-2010 for the Atlantic and Gulf region. These data include only samples which were not subject to sampling biases, and were 4” to 36” TL.

	Hook and Line Gears						Other Gears					
	Atlantic Coast			Gulf Coast			Atlantic Coast			Gulf Coast		
Year	Number of fish	Calculated kg	# fish/kg	Number of fish	Calculated kg	# fish/kg	Number of fish	Calculated kg	# fish/kg	Number of fish	Calculated kg	# fish/kg
1984	.	.	.	1,126	758.9	1.48	.	.	.	57	21.7	2.63
1985	.	.	.	2,003	2426.1	0.83	.	.	.	451	640.9	0.70
1986	.	.	.	2,559	2407.1	1.06	.	.	.	199	145.6	1.37
1987	.	.	.	2,131	1725.5	1.24	.	.	.	13	12.0	1.09
1988	3	1.2	2.48	1,870	971.9	1.92	.	.	.	74	41.9	1.77
1989	.	.	.	2,632	1472.4	1.79	.	.	.	274	184.9	1.48
1990	31	18.8	1.65	4,504	2247.2	2.00	.	.	.	169	106.7	1.58
1991	5	2.0	2.54	5,247	2836.0	1.85	.	.	.	39	19.2	2.03
1992	1299	598.0	2.17	3,846	2213.0	1.74	2	1.1	1.77	.	.	.
1993	204	93.8	2.17	4,586	2555.0	1.79	18	6.9	2.61	154	84.9	1.81
1994	113	68.1	1.66	5,248	2934.9	1.79	2	1.0	1.94	150	75.5	1.99
1995	455	242.2	1.88	5,991	2941.7	2.04	.	.	.	185	76.8	2.41
1996	672	291.7	2.30	3,568	1801.5	1.98	.	.	.	193	97.0	1.99
1997	1859	828.6	2.24	5,694	3067.9	1.86	.	.	.	204	137.3	1.49
1998	1491	681.1	2.19	5,417	2779.2	1.95	8	7.0	1.15	139	82.9	1.68
1999	2072	983.5	2.11	5,915	3275.6	1.81	6	2.9	2.05	314	121.4	2.59
2000	1918	924.0	2.08	2,767	1580.5	1.75	.	.	.	38	18.4	2.07
2001	3213	1683.5	1.91	5,008	2580.9	1.94	15	9.7	1.55	12	6.1	1.98
2002	1436	724.5	1.98	6,055	3354.6	1.80	20	9.0	2.23	17	9.3	1.84
2003	596	298.4	2.00	3,683	2131.6	1.73	.	.	.	1	0.5	2.00
2004	782	384.3	2.03	3,147	1801.2	1.75	2	0.9	2.35	2	1.8	1.09
2005	771	431.4	1.79	2,466	1507.9	1.64	3	1.4	2.14	1	0.4	2.33
2006	758	417.0	1.82	1,330	821.1	1.62	2	1.5	1.32	.	.	.
2007	793	381.5	2.08	1,708	1073.8	1.59	.	.	.	.	.	.
2008	578	293.4	1.97	2,564	1572.7	1.63	.	.	.	2	1.3	1.55
2009	547	256.3	2.13	2,981	1826.5	1.63	.	.	.	9	5.6	1.60
2010	341	157.0	2.17	1,570	1013.1	1.55	.	.	.	1	0.4	2.33

Table 6.8.18 Number of yellowtail snapper measured, estimated weight (kg), and rough approximations (values shaded in green) of the number of fish/kg landed from combined commercial data from 1981-2010 for the Atlantic and Gulf region. These data include only samples which were not subject to sampling biases, and were 4” to 36” TL.

	Total			Atlantic Coast			Gulf Coast		
Year	Number of fish	Calculated kg	# fish/kg	Number of fish	Calculated kg	# fish/kg	Number of fish	Calculated kg	# fish/kg
1984	1,183	781	1.52	0	0	2.04	1,183	781	1.52
1985	2,454	3,067	0.80	0	0	2.04	2,454	3,067	0.80
1986	2,758	2,553	1.08	0	0	2.04	2,758	2,553	1.08
1987	2,144	1,737	1.23	0	0	2.04	2,144	1,737	1.23
1988	1,947	1,015	1.92	3	1	2.04	1,944	1,014	1.92
1989	2,906	1,657	1.75	0	0	2.04	2,906	1,657	1.75
1990	4,704	2,373	1.98	31	19	2.04	4,673	2,354	1.99
1991	5,291	2,857	1.85	5	2	2.04	5,286	2,855	1.85
1992	5,147	2,812	1.83	1,301	599	2.17	3,846	2,213	1.74
1993	4,962	2,741	1.81	222	101	2.20	4,740	2,640	1.80
1994	5,513	3,080	1.79	115	69	1.66	5,398	3,010	1.79
1995	6,631	3,261	2.03	455	242	1.88	6,176	3,018	2.05
1996	4,433	2,190	2.02	672	292	2.30	3,761	1,899	1.98
1997	7,757	4,034	1.92	1,859	829	2.24	5,898	3,205	1.84
1998	7,055	3,550	1.99	1,499	688	2.18	5,556	2,862	1.94
1999	8,307	4,383	1.90	2,078	986	2.11	6,229	3,397	1.83
2000	4,723	2,523	1.87	1,918	924	2.08	2,805	1,599	1.75
2001	8,248	4,280	1.93	3,228	1,693	1.91	5,020	2,587	1.94
2002	7,528	4,097	1.84	1,456	733	1.99	6,072	3,364	1.81
2003	4,280	2,430	1.76	596	298	2.00	3,684	2,132	1.73
2004	3,933	2,188	1.80	784	385	2.04	3,149	1,803	1.75
2005	3,241	1,941	1.67	774	433	1.79	2,467	1,508	1.64
2006	2,090	1,240	1.69	760	418	1.82	1,330	821	1.62
2007	2,501	1,455	1.72	793	382	2.08	1,708	1,074	1.59
2008	3,144	1,867	1.68	578	293	1.97	2,566	1,574	1.63
2009	3,537	2,088	1.69	547	256	2.13	2,990	1,832	1.63
2010	1,912	1,171	1.63	341	157	2.17	1,571	1,014	1.55

Table 6.8.19 Estimated number of yellowtail snapper at age (years) from commercial landings from 1981-2010 for the Atlantic region using age-length keys. The estimated numbers of fish older than 11 years were combined into the age 12-plus group.

Year	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12+	total
1981	8	1,583	25,432	7,828	1,520	84	235	17	12	0	3	0	3	36,726
1982	8	3,138	13,679	13,504	3,350	350	527	632	12	0	3	0	3	35,205
1983	15	3,118	36,561	22,361	3,346	426	200	30	22	0	6	0	6	66,091
1984	8	766	23,572	8,226	1,364	804	194	71	11	0	3	0	3	35,022
1985	9	1,838	20,608	15,823	1,542	360	110	36	13	0	4	0	4	40,348
1986	20	4,419	54,339	18,910	10,743	919	935	108	65	58	31	13	54	90,614
1987	20	6,743	50,116	22,106	5,863	812	934	104	62	56	30	12	51	86,910
1988	25	3,637	39,485	40,323	20,328	4,181	1,544	131	79	71	38	16	65	109,922
1989	30	4,452	48,334	49,359	24,883	5,118	1,890	161	96	87	47	19	79	134,555
1990	28	2,509	23,272	51,801	36,802	8,618	1,975	149	89	80	43	18	73	125,459
1991	32	2,820	53,477	65,611	17,171	2,545	1,100	2,048	575	32	325	6	68	145,811
1992	0	2,563	87,287	77,199	4,068	979	1,193	2,526	36	31	37	8	88	176,017
1993	0	1,250	92,850	60,484	16,986	4,247	3,746	3,405	642	260	540	51	545	185,008
1994	681	4,901	15,979	63,818	32,141	4,639	1,129	946	994	0	764	0	0	125,993
1995	0	1,855	29,833	55,274	19,410	2,945	1,029	572	205	21	174	0	0	111,317
1996	0	8,741	64,157	25,545	14,176	3,993	665	0	0	0	0	0	0	117,277
1997	0	565	41,768	70,302	24,758	7,924	2,741	1,448	1,103	249	174	144	14	151,190
1998	0	8,025	46,317	49,554	14,645	4,534	1,898	660	113	197	213	0	21	126,177
1999	0	7,894	57,427	26,662	9,344	2,510	1,257	427	295	159	69	0	115	106,159
2000	0	2,773	53,609	20,226	7,182	4,411	2,333	1,952	1,545	1,228	650	201	182	96,292
2001	0	2,227	35,082	22,083	11,969	5,804	4,206	958	1,007	100	450	13	271	84,170
2002	0	5,029	42,030	27,022	7,773	2,535	1,221	729	175	129	145	5	118	86,910
2003	0	12,454	59,815	19,150	3,197	680	1,015	177	27	32	27	0	0	96,573
2004	0	2,780	53,382	27,683	9,888	2,064	728	614	0	56	10	10	72	97,287
2005	0	1,256	32,611	48,769	6,891	2,345	903	428	7	76	101	12	221	93,621
2006	0	1,058	42,417	17,211	8,035	629	231	23	24	7	4	0	11	69,651
2007	0	4,368	52,361	33,602	2,215	389	118	85	16	9	5	0	182	93,349
2008	0	6,579	48,109	37,183	7,841	1,007	762	54	83	0	0	0	0	101,617
2009	0	3,688	89,689	53,190	10,609	1,869	447	0	0	0	0	0	24	159,516
2010	0	1,446	117,962	64,057	6,158	1,502	684	167	121	0	0	0	0	192,098

Table 6.8.20 Estimated number of yellowtail snapper at age (years) from commercial catches from 1981-2010 for the Gulf region using age-length keys. The estimated number of fish older than 11 years were combined into the age 12-plus group.

Year	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12+	total
1981	0	1,190	71,105	144,216	89,674	75,379	44,626	33,326	20,194	8,985	4,752	7,187	3,964	504,598
1982	0	2,207	129,657	333,334	164,992	120,828	65,654	55,027	59,449	13,175	10,420	9,587	5,982	970,313
1983	0	1,238	68,574	99,615	224,906	76,039	53,874	40,337	27,427	11,692	11,109	6,605	9,577	630,992
1984	0	1,260	99,352	145,132	142,392	86,747	54,801	43,323	28,876	11,968	11,235	6,782	10,333	642,202
1985	0	0	863	12,344	19,240	59,254	49,198	53,202	37,030	16,614	17,957	9,062	17,663	292,428
1986	0	432	16,698	62,875	98,392	93,023	71,889	51,240	39,531	24,508	15,038	13,431	29,716	516,772
1987	0	1,547	56,855	131,878	144,506	115,548	83,313	56,916	44,007	27,391	16,693	15,414	35,833	729,901
1988	0	7,723	163,532	300,661	267,236	174,218	106,484	56,741	35,302	18,429	9,854	8,205	10,909	1,159,295
1989	0	4,269	150,996	333,212	330,338	226,910	145,095	79,484	50,764	27,143	14,625	11,749	16,328	1,390,914
1990	0	8,180	223,178	402,202	343,589	217,378	129,244	67,696	41,853	22,471	11,957	10,116	14,363	1,492,229
1991	7	187	220,309	265,342	465,759	170,608	130,533	68,219	71,539	35,597	6,772	16,065	16,035	1,466,972
1992	0	0	173,506	410,684	350,161	111,159	58,525	51,434	57,037	25,563	10,329	18,612	21,669	1,288,680
1993	0	0	146,170	469,804	390,133	238,869	204,933	119,723	140,248	49,512	6,435	19,814	20,107	1,805,749
1994	15	791	246,923	388,439	305,814	251,951	141,950	89,363	132,857	60,998	12,543	22,482	16,625	1,670,752
1995	0	396	45,459	430,375	481,105	266,163	179,756	88,615	61,293	42,446	3,466	12,020	11,202	1,622,296
1996	0	53	56,244	187,566	257,909	339,493	160,888	86,075	70,326	44,541	7,604	9,597	5,954	1,226,251
1997	0	6,167	107,333	312,609	224,885	235,809	202,349	89,626	34,323	33,277	9,874	20,299	13,592	1,290,142
1998	0	18	97,560	353,181	332,642	165,711	96,655	92,912	42,806	30,417	16,943	12,682	2,027	1,243,556
1999	0	2,338	182,646	224,113	347,814	326,225	165,822	89,500	65,675	28,956	12,389	2,845	8,040	1,456,363
2000	0	12,023	124,899	239,008	276,221	200,135	150,706	79,736	42,155	32,394	13,662	18,240	10,450	1,199,628
2001	0	13,002	196,054	306,699	269,162	148,403	116,550	55,835	34,284	7,492	9,971	13,070	3,911	1,174,431
2002	0	17	136,004	260,088	223,074	222,303	125,201	45,006	30,756	17,600	12,189	3,037	10,181	1,085,455
2003	0	14,186	69,054	325,416	266,172	111,682	97,404	59,518	35,858	21,914	4,633	9,460	21,041	1,036,337
2004	0	1,308	63,708	260,306	318,444	212,783	104,666	70,255	42,108	9,692	2,484	8,384	13,616	1,107,753
2005	0	0	66,870	228,730	263,533	165,806	69,411	50,830	15,471	27,728	15,331	4,189	5,227	913,126
2006	0	20	30,884	186,272	211,933	151,938	96,259	48,781	54,321	27,102	30,523	495	20,764	859,291
2007	0	186	19,700	100,901	199,760	137,627	115,044	30,038	22,214	149	9,966	3,515	3,929	643,029
2008	0	855	47,916	157,137	294,595	170,307	105,390	58,864	48,570	20,558	9,146	13,718	15,670	942,726
2009	0	701	168,069	321,611	213,712	248,642	148,073	110,286	62,274	30,841	15,130	8,593	34,774	1,362,705
2010	0	2,883	72,133	250,653	310,531	159,258	120,904	53,240	39,490	25,223	10,265	13,216	15,334	1,073,131

Table 6.8.21 Estimated number of yellowtail snapper by size class (TL, inches) of commercial discards (live or dead) from 1981-2010 for the Atlantic region using age-length keys. The estimated numbers of fish in the total discards with TL > 23" were summed into the " >=24" size class.

	TL (inch class)																			
Year	<=5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	>=24
1981	14	21	127	482	910	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1982	13	20	122	462	873	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1983	25	38	229	868	1,638	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1984	13	20	121	460	868	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1985	15	23	140	530	1,000	1,427	1,466	405	60	29	16	6	0	2	0	0	0	0	0	0
1986	34	52	314	1,190	2,246	3,204	3,292	909	136	65	37	14	0	5	0	0	0	0	0	0
1987	32	50	301	1,142	2,154	3,073	3,158	872	130	63	35	14	0	5	0	0	0	0	0	0
1988	41	63	381	1,444	2,725	3,887	3,994	1,103	165	79	44	18	0	6	0	0	0	0	0	0
1989	50	77	466	1,768	3,335	4,758	4,889	1,350	201	97	54	21	0	7	0	0	0	0	0	0
1990	47	72	434	1,648	3,110	4,436	4,559	1,259	188	91	51	20	0	7	0	0	0	0	0	0
1991	54	84	505	1,916	3,614	5,156	5,298	1,463	218	105	59	23	0	8	0	0	0	0	0	0
1992	65	101	609	2,312	4,363	6,224	6,396	1,766	264	127	71	28	0	9	0	0	0	0	0	0
1993	44	69	414	1,570	2,962	4,225	4,342	1,199	179	86	48	19	0	6	0	0	0	0	0	0
1994	59	91	550	2,088	3,939	5,619	5,774	1,595	238	115	64	25	0	8	0	0	0	0	0	0
1995	34	53	319	1,210	2,283	3,257	3,347	924	138	67	37	15	0	5	0	0	0	0	0	0
1996	49	75	453	1,718	3,242	4,625	4,753	1,313	196	94	53	21	0	7	0	0	0	0	0	0
1997	69	106	640	2,428	4,580	6,534	6,715	1,854	277	133	75	29	0	10	0	0	0	0	0	0
1998	45	70	423	1,606	3,030	4,323	4,442	1,227	183	88	49	19	0	6	0	0	0	0	0	0
1999	38	58	352	1,337	2,523	3,599	3,699	1,022	152	74	41	16	0	5	0	0	0	0	0	0
2000	45	69	419	1,589	2,998	4,277	4,395	1,214	181	87	49	19	0	6	0	0	0	0	0	0
2001	28	43	258	978	1,845	2,632	2,705	747	111	54	30	12	0	4	0	0	0	0	0	0
2002	36	55	334	1,267	2,391	3,412	3,506	968	144	70	39	15	0	5	0	0	0	0	0	0
2003	30	46	275	1,045	1,971	2,812	2,889	798	119	57	32	13	0	4	0	0	0	0	0	0
2004	12	19	113	429	810	1,155	1,187	328	49	24	13	5	0	2	0	0	0	0	0	0
2005	18	28	172	651	1,228	1,752	1,800	497	74	36	20	8	0	3	0	0	0	0	0	0
2006	43	67	402	1,526	2,880	4,108	4,221	1,166	174	84	47	19	0	6	0	0	0	0	0	0
2007	35	54	323	1,226	2,314	3,301	3,392	937	140	67	38	15	0	5	0	0	0	0	0	0
2008	34	52	315	1,194	2,253	3,215	3,303	912	136	66	37	14	0	5	0	0	0	0	0	0
2009	27	42	256	971	1,831	2,612	2,684	741	111	53	30	12	0	4	0	0	0	0	0	0
2010	33	50	305	1,156	2,181	3,112	3,197	883	132	64	36	14	0	5	0	0	0	0	0	0

Table 6.8.22 Estimated number of yellowtail snapper by size class (TL, inches) of commercial discards (live or dead) from 1981-2010 for the Gulf region using age-length keys. The estimated numbers of fish in the total discards with TL > 23" were summed into the " >=24" size class.

	TL (inch class)																			
Year	<=5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	>=24
1981	188	289	1,747	6,629	12,507	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1982	361	556	3,360	12,747	24,051	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1983	235	362	2,185	8,289	15,640	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1984	239	368	2,224	8,437	15,918	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1985	109	168	1,013	3,842	7,248	10,340	10,625	2,935	438	211	118	47	0	16	0	0	0	0	0	0
1986	192	296	1,789	6,789	12,809	18,273	18,777	5,186	774	373	209	82	0	27	0	0	0	0	0	0
1987	271	419	2,527	9,589	18,092	25,810	26,521	7,325	1,093	527	295	116	0	39	0	0	0	0	0	0
1988	431	665	4,014	15,230	28,735	40,994	42,123	11,634	1,736	837	468	185	0	62	0	0	0	0	0	0
1989	517	798	4,816	18,273	34,476	49,184	50,539	13,958	2,083	1,004	561	222	0	74	0	0	0	0	0	0
1990	555	856	5,167	19,604	36,987	52,766	54,221	14,975	2,234	1,078	602	238	0	79	0	0	0	0	0	0
1991	545	841	5,079	19,272	36,361	51,873	53,303	14,722	2,197	1,059	592	234	0	78	0	0	0	0	0	0
1992	479	739	4,462	16,929	31,942	45,569	46,824	12,932	1,930	931	520	205	0	68	0	0	0	0	0	0
1993	434	669	4,038	15,322	28,908	41,241	42,378	11,704	1,746	842	471	186	0	62	0	0	0	0	0	0
1994	783	1,209	7,297	27,685	52,234	74,518	76,572	21,148	3,156	1,522	850	336	0	112	0	0	0	0	0	0
1995	499	770	4,648	17,637	33,276	47,473	48,781	13,473	2,010	969	542	214	0	71	0	0	0	0	0	0
1996	508	784	4,735	17,966	33,898	48,360	49,692	13,724	2,048	988	552	218	0	73	0	0	0	0	0	0
1997	586	904	5,460	20,716	39,086	55,760	57,297	15,825	2,361	1,139	636	251	0	84	0	0	0	0	0	0
1998	448	691	4,171	15,827	29,862	42,602	43,776	12,090	1,804	870	486	192	0	64	0	0	0	0	0	0
1999	519	801	4,835	18,345	34,613	49,380	50,740	14,014	2,091	1,008	563	222	0	74	0	0	0	0	0	0
2000	560	864	5,217	19,795	37,349	53,283	54,751	15,122	2,256	1,088	608	240	0	80	0	0	0	0	0	0
2001	386	596	3,596	13,646	25,746	36,730	37,742	10,424	1,555	750	419	165	0	55	0	0	0	0	0	0
2002	448	691	4,172	15,830	29,867	42,609	43,784	12,093	1,804	870	486	192	0	64	0	0	0	0	0	0
2003	317	489	2,954	11,210	21,150	30,173	31,004	8,563	1,278	616	344	136	0	45	0	0	0	0	0	0
2004	138	213	1,288	4,886	9,218	13,151	13,513	3,732	557	269	150	59	0	20	0	0	0	0	0	0
2005	180	277	1,673	6,347	11,975	17,084	17,555	4,848	723	349	195	77	0	26	0	0	0	0	0	0
2006	533	822	4,962	18,829	35,525	50,681	52,078	14,383	2,146	1,035	578	228	0	76	0	0	0	0	0	0
2007	239	369	2,227	8,448	15,940	22,740	23,367	6,454	963	464	259	102	0	34	0	0	0	0	0	0
2008	314	484	2,920	11,080	20,904	29,823	30,645	8,464	1,263	609	340	134	0	45	0	0	0	0	0	0
2009	235	362	2,185	8,291	15,643	22,317	22,932	6,334	945	456	255	101	0	34	0	0	0	0	0	0
2010	183	282	1,702	6,458	12,184	17,382	17,861	4,933	736	355	198	78	0	26	0	0	0	0	0	0

Table 6.8.23 Estimated number of yellowtail snapper at age (years) of commercial discards (live or dead) from 1981-2010 for the Atlantic region using age-length keys. The estimated numbers of fish older than 11 years were combined into the age 12-plus group.

Year	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12+	total
1981	72	1,295	176	11	0	0	0	0	0	0	0	0	0	1,555
1982	69	1,241	169	11	0	0	0	0	0	0	0	0	0	1,490
1983	130	2,331	317	20	0	0	0	0	0	0	0	0	0	2,798
1984	69	1,235	168	10	0	0	0	0	0	0	0	0	0	1,482
1985	79	3,369	1,439	145	87	0	0	0	0	0	0	0	0	5,120
1986	178	5,491	5,353	459	16	1	0	0	0	0	0	0	0	11,499
1987	171	5,391	4,894	566	6	0	0	0	0	0	0	0	0	11,029
1988	216	6,574	6,086	930	130	12	1	0	0	0	0	0	0	13,949
1989	265	8,047	7,450	1,138	159	15	2	0	0	0	0	0	0	17,075
1990	247	7,422	6,765	1,202	254	27	3	0	0	0	0	0	0	15,920
1991	287	9,738	5,980	1,493	108	5	3	886	3	0	1	0	0	18,503
1992	346	11,756	7,316	1,756	90	2	2	1,069	0	0	0	0	0	22,336
1993	235	7,935	5,067	1,064	119	7	6	730	0	0	0	0	0	15,164
1994	313	10,553	6,484	1,700	126	5	3	965	15	0	3	0	0	20,166
1995	181	6,180	3,718	989	62	1	0	558	0	0	0	0	0	11,690
1996	263	9,896	4,997	1,255	172	14	2	0	0	0	0	0	0	16,598
1997	371	12,749	6,929	3,033	295	40	25	5	3	0	1	0	0	23,450
1998	246	10,331	3,066	1,682	174	10	3	0	0	0	0	0	0	15,512
1999	205	7,501	4,417	715	72	5	2	0	0	0	0	0	0	12,917
2000	243	9,321	5,009	512	167	35	6	25	17	11	1	0	0	15,348
2001	147	4,112	4,988	92	41	41	21	2	2	0	0	0	2	9,447
2002	190	4,562	7,054	393	24	13	6	1	0	0	0	0	0	12,243
2003	156	4,123	5,553	251	5	1	1	0	0	0	0	0	0	10,090
2004	64	769	3,034	262	8	5	2	1	0	0	0	0	0	4,145
2005	97	2,754	3,186	236	10	1	1	0	0	0	0	0	0	6,286
2006	229	7,139	7,143	195	36	0	1	0	0	0	0	0	0	14,742
2007	184	8,358	3,053	223	27	1	0	0	0	0	0	0	0	11,847
2008	179	7,655	3,026	640	34	1	1	0	0	0	0	0	0	11,536
2009	145	4,863	4,115	222	27	2	0	0	0	0	0	0	0	9,375
2010	173	5,328	5,332	308	25	0	0	0	0	0	0	0	0	11,166

Table 6.8.24 Estimated number of yellowtail snapper at age (years) of commercial discards (live or dead) from 1981-2010 for the Gulf region using age-length keys. The estimated numbers of fish older than 11 years were combined into the age 12-plus group.

Year	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12+	total
1981	905	12,908	7,547	0	0	0	0	0	0	0	0	0	0	21,360
1982	1,741	24,820	14,513	0	0	0	0	0	0	0	0	0	0	41,074
1983	1,132	16,141	9,438	0	0	0	0	0	0	0	0	0	0	26,711
1984	1,152	16,428	9,606	0	0	0	0	0	0	0	0	0	0	27,185
1985	525	9,327	19,499	5,442	2,104	102	28	63	8	1	1	8	2	37,109
1986	927	12,187	28,338	12,690	5,678	3,522	1,662	406	40	30	6	88	3	65,577
1987	1,309	17,214	40,025	17,924	8,019	4,975	2,348	574	56	42	8	124	4	92,623
1988	2,080	27,341	63,571	28,468	12,737	7,902	3,729	911	90	66	13	196	7	147,112
1989	2,495	32,803	76,272	34,156	15,282	9,481	4,475	1,094	107	80	15	236	8	176,504
1990	2,677	35,193	81,828	36,644	16,395	10,171	4,801	1,173	115	86	16	253	9	189,361
1991	2,632	28,290	61,139	48,377	43,855	1,183	376	78	158	53	0	13	0	186,155
1992	2,312	24,852	50,771	47,385	35,012	2,693	164	240	74	17	0	11	0	163,531
1993	2,092	22,492	46,931	44,314	28,836	976	442	1,525	340	42	0	10	0	148,001
1994	3,781	40,640	87,631	72,712	57,494	4,292	360	90	269	134	0	19	0	267,420
1995	2,409	25,891	49,496	51,024	36,358	4,379	475	134	120	67	0	12	0	170,364
1996	2,004	29,254	66,408	31,465	20,406	19,138	3,426	1,000	298	137	6	4	0	173,546
1997	2,311	34,196	78,060	41,215	21,077	17,550	4,461	974	62	145	16	19	19	200,105
1998	1,766	25,770	60,169	34,112	16,094	11,480	2,027	1,306	63	72	19	4	0	152,882
1999	2,047	49,205	68,221	37,415	13,365	4,849	1,059	877	110	46	13	0	0	177,206
2000	2,208	17,239	87,813	40,303	21,449	15,446	5,242	885	115	470	23	23	0	191,215
2001	1,863	28,203	66,032	19,815	9,037	4,304	2,095	344	63	0	39	18	0	131,812
2002	2,162	27,372	59,003	36,242	11,088	9,342	6,893	547	202	40	13	3	5	152,911
2003	1,531	21,981	47,132	20,532	8,994	4,880	2,847	296	55	15	0	10	7	108,280
2004	667	9,329	19,786	8,920	4,798	2,267	1,268	140	12	0	0	0	5	47,193
2005	867	10,974	18,840	9,632	9,228	7,351	4,134	155	10	16	6	93	2	61,308
2006	3,065	26,006	68,965	33,683	12,810	19,557	14,938	1,696	559	483	108	0	6	181,876
2007	2,610	11,153	32,561	15,832	7,915	5,072	4,999	1,090	11	0	5	359	0	81,608
2008	1,360	18,947	31,402	22,603	18,652	7,269	5,424	1,243	83	16	5	8	11	107,024
2009	540	14,925	45,153	12,027	942	6,015	344	92	27	15	1	3	5	80,089
2010	162	7,707	24,095	13,248	6,369	2,167	5,920	1,769	26	15	2	896	2	62,379

Table 6.8.25 Annual estimated weight (metric tons) of total discards (live or dead) from commercial gears from 1981-2010 for the Atlantic and Gulf region at various rates of release mortality. Levels of release mortality (as a proportion) applied to the total discards results in an estimate of dead discards by year. The column shaded in blue is the estimate of release mortality (11.5%) from at-sea observations of dead discards from commercial vessels using vertical lines (see Section 6.4.1).

	Release Mortality rate									
Year	1.0	0.9	0.8	0.7	0.6	0.5	0.4	0.3	0.2	0.1	0.115
1981	2.963	2.666	2.370	2.074	1.778	1.481	1.185	0.889	0.593	0.296	0.341
1982	5.503	4.953	4.403	3.852	3.302	2.752	2.201	1.651	1.101	0.550	0.633
1983	3.815	3.434	3.052	2.671	2.289	1.908	1.526	1.145	0.763	0.382	0.439
1984	3.707	3.336	2.965	2.595	2.224	1.853	1.483	1.112	0.741	0.371	0.426
1985	8.459	7.613	6.767	5.921	5.075	4.229	3.383	2.538	1.692	0.846	0.973
1986	15.439	13.895	12.351	10.807	9.263	7.719	6.175	4.632	3.088	1.544	1.775
1987	20.762	18.686	16.610	14.533	12.457	10.381	8.305	6.229	4.152	2.076	2.388
1988	32.261	29.035	25.809	22.583	19.357	16.131	12.905	9.678	6.452	3.226	3.710
1989	38.775	34.897	31.020	27.142	23.265	19.387	15.510	11.632	7.755	3.877	4.459
1990	41.119	37.007	32.895	28.783	24.671	20.560	16.448	12.336	8.224	4.112	4.729
1991	40.994	36.895	32.795	28.696	24.597	20.497	16.398	12.298	8.199	4.099	4.714
1992	37.230	33.507	29.784	26.061	22.338	18.615	14.892	11.169	7.446	3.723	4.281
1993	32.683	29.415	26.146	22.878	19.610	16.341	13.073	9.805	6.537	3.268	3.759
1994	57.605	51.845	46.084	40.324	34.563	28.803	23.042	17.282	11.521	5.761	6.625
1995	36.467	32.820	29.173	25.527	21.880	18.233	14.587	10.940	7.293	3.647	4.194
1996	38.087	34.278	30.470	26.661	22.852	19.044	15.235	11.426	7.617	3.809	4.380
1997	44.779	40.301	35.823	31.346	26.868	22.390	17.912	13.434	8.956	4.478	5.150
1998	33.730	30.357	26.984	23.611	20.238	16.865	13.492	10.119	6.746	3.373	3.879
1999	38.083	34.274	30.466	26.658	22.850	19.041	15.233	11.425	7.617	3.808	4.380
2000	41.376	37.238	33.101	28.963	24.825	20.688	16.550	12.413	8.275	4.138	4.758
2001	28.295	25.465	22.636	19.806	16.977	14.147	11.318	8.488	5.659	2.829	3.254
2002	33.081	29.773	26.465	23.157	19.849	16.541	13.233	9.924	6.616	3.308	3.804
2003	23.710	21.339	18.968	16.597	14.226	11.855	9.484	7.113	4.742	2.371	2.727
2004	10.283	9.255	8.227	7.198	6.170	5.142	4.113	3.085	2.057	1.028	1.183
2005	13.539	12.185	10.832	9.478	8.124	6.770	5.416	4.062	2.708	1.354	1.557
2006	39.384	35.445	31.507	27.569	23.630	19.692	15.754	11.815	7.877	3.938	4.529
2007	18.720	16.848	14.976	13.104	11.232	9.360	7.488	5.616	3.744	1.872	2.153
2008	23.748	21.373	18.999	16.624	14.249	11.874	9.499	7.124	4.750	2.375	2.731
2009	17.920	16.128	14.336	12.544	10.752	8.960	7.168	5.376	3.584	1.792	2.061
2010	12.495	11.245	9.996	8.746	7.497	6.247	4.998	3.748	2.499	1.249	1.437

Table 6.8.26 Proportions of the numbers of fish at age in the total discards (live or dead) to the total numbers at age estimated to be caught by the commercial fleet from 1981-2010 for the Atlantic and Gulf region. [For example, the interpretation for Age 1 fish released during 2010 is that 75.5% of all the age 1 fish caught by this fleet are released (live or dead). Because of the calculation of the proportion by age, the rows in this matrix will not sum to 1.]

Proportions of Released Fish by Age for Fleet to the Total Caught by Age for Fleet

Year	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12+
1981	0.84514	0.07408	0.00007	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
1982	0.83889	0.09291	0.00003	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
1983	0.81867	0.08491	0.00016	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
1984	0.90278	0.07365	0.00007	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
1985	0.87808	0.49372	0.16552	0.09537	0.00171	0.00056	0.00118	0.00022	0.00006	0.00006	0.00090	0.00010
1986	0.79408	0.32170	0.13851	0.04959	0.03615	0.02232	0.00785	0.00101	0.00121	0.00038	0.00647	0.00010
1987	0.74347	0.29573	0.10720	0.05067	0.04101	0.02712	0.00997	0.00128	0.00152	0.00048	0.00795	0.00012
1988	0.76080	0.25546	0.07937	0.04283	0.04248	0.03338	0.01578	0.00253	0.00358	0.00129	0.02333	0.00064
1989	0.83286	0.29578	0.08446	0.04166	0.03931	0.02955	0.01355	0.00211	0.00292	0.00104	0.01962	0.00051
1990	0.80951	0.26442	0.07695	0.04193	0.04318	0.03531	0.01700	0.00274	0.00378	0.00137	0.02433	0.00062
1991	0.93075	0.19688	0.13095	0.08344	0.00681	0.00287	0.01353	0.00223	0.00149	0.00010	0.00081	0.00000
1992	0.93872	0.18216	0.09150	0.09016	0.02347	0.00276	0.02367	0.00129	0.00067	0.00000	0.00061	0.00000
1993	0.96324	0.17868	0.07883	0.06640	0.00403	0.00214	0.01799	0.00241	0.00085	0.00000	0.00052	0.00000
1994	0.89641	0.26361	0.14129	0.14566	0.01647	0.00253	0.01154	0.00211	0.00220	0.00020	0.00083	0.00000
1995	0.93902	0.41410	0.09674	0.06783	0.01602	0.00262	0.00769	0.00195	0.00158	0.00000	0.00099	0.00000
1996	0.82485	0.37228	0.13310	0.07031	0.05281	0.02078	0.01149	0.00422	0.00306	0.00082	0.00040	0.00000
1997	0.88055	0.36306	0.10359	0.07886	0.06731	0.02141	0.01064	0.00182	0.00430	0.00165	0.00091	0.00137
1998	0.82573	0.30532	0.08162	0.04475	0.06323	0.02018	0.01377	0.00147	0.00235	0.00112	0.00032	0.00000
1999	0.85211	0.23229	0.13198	0.03626	0.01455	0.00631	0.00966	0.00167	0.00157	0.00108	0.00000	0.00000
2000	0.66226	0.34210	0.13603	0.07087	0.07036	0.03315	0.01102	0.00300	0.01411	0.00169	0.00124	0.00000
2001	0.69267	0.23504	0.05709	0.03128	0.02741	0.01722	0.00605	0.00184	0.00000	0.00372	0.00134	0.00038
2002	0.87170	0.27063	0.11316	0.04592	0.03995	0.05174	0.01185	0.00649	0.00223	0.00105	0.00109	0.00048
2003	0.51058	0.29019	0.05689	0.03233	0.04163	0.02813	0.00493	0.00153	0.00066	0.00000	0.00110	0.00035
2004	0.72595	0.16310	0.03090	0.01443	0.01046	0.01190	0.00199	0.00030	0.00000	0.00000	0.00000	0.00037
2005	0.92125	0.18127	0.03434	0.03303	0.04189	0.05554	0.00302	0.00065	0.00056	0.00037	0.02171	0.00042
2006	0.97125	0.50939	0.14273	0.05518	0.11362	0.13406	0.03358	0.01019	0.01751	0.00354	0.00000	0.00029
2007	0.83046	0.33075	0.10664	0.03783	0.03546	0.04161	0.03492	0.00051	0.00000	0.00048	0.09276	0.00012
2008	0.79105	0.26391	0.10683	0.05819	0.04071	0.04863	0.02067	0.00171	0.00078	0.00053	0.00058	0.00070
2009	0.82348	0.16047	0.03165	0.00430	0.02345	0.00231	0.00083	0.00044	0.00048	0.00008	0.00037	0.00014
2010	0.75539	0.13405	0.04130	0.01979	0.01331	0.04643	0.03205	0.00067	0.00058	0.00024	0.06346	0.00011

Table 6.8.27 Number of yellowtail snapper by age from age samples (otoliths) from commercial landings for the Atlantic region for 1981-2010.

	Age																							
Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	total
1981	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1982	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1983	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1984	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1985	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1986	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1987	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1988	0	0	0	0	0	0	0	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	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	0
1991	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1992	0	19	41	6	4	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	74
1993	0	50	48	17	2	2	2	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	123
1994	0	17	113	42	7	0	1	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	183
1995	1	51	97	36	6	4	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	198
1996	18	176	70	35	13	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	313
1997	2	164	292	83	33	16	7	4	2	2	1	0	0	0	0	0	0	0	0	0	0	0	0	606
1998	10	102	129	48	15	6	4	1	1	2	0	0	1	0	0	0	0	0	0	0	0	0	0	319
1999	57	390	136	49	10	4	2	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	649
2000	8	154	72	32	20	9	9	8	8	4	1	1	0	0	0	0	0	0	0	0	0	0	0	326
2001	10	121	59	51	25	20	6	4	3	4	0	1	0	0	0	0	0	0	0	0	0	0	0	304
2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
2004	0	65	60	19	3	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	150
2005	0	51	131	20	9	1	1	0	2	1	1	1	2	3	0	1	0	0	0	0	0	0	1	225
2006	0	291	60	29	3	1	0	0	0	0	0	2	0	0	1	0	1	0	0	0	1	0	0	389
2007	1	57	36	10	6	1	1	0	0	0	0	0	0	0	0	1	2	0	0	1	1	0	0	117
2008	12	83	77	23	10	5	0	0	0	0	1	3	1	0	2	1	0	1	0	1	1	1	0	222
2009	1	14	22	28	4	1	2	0	0	0	1	0	0	0	2	1	0	0	0	0	0	0	0	76
2010	0	29	41	10	3	1	0	0	1	0	1	1	0	1	0	0	0	0	1	0	0	0	2	91

Table 6.8.28 Number of yellowtail snapper by age from age samples (otoliths) from commercial landings for the Gulf region for 1981-2010.

	Age																							
Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	total
1981	0	11	39	28	23	13	15	13	4	1	4	1	0	0	0	1	0	0	0	0	0	0	0	153
1982	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1983	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1984	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1985	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1986	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1987	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1988	0	0	0	0	0	0	0	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	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	0
1991	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1992	0	4	13	10	0	1	3	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	33
1993	0	4	9	4	8	8	4	9	1	1	1	0	0	2	0	0	0	0	0	0	0	0	0	51
1994	2	3	8	10	8	8	10	11	2	4	4	3	2	2	0	2	0	0	0	0	0	0	0	79
1995	1	1	13	23	13	7	5	4	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	72
1996	0	3	8	14	23	16	4	8	5	2	2	2	0	0	0	0	0	0	0	0	0	0	0	87
1997	1	20	71	55	70	65	37	15	14	6	11	5	1	0	0	0	0	0	0	0	0	0	0	371
1998	0	12	44	46	26	19	21	11	5	3	5	0	0	1	0	0	0	0	0	0	0	0	0	193
1999	0	12	20	41	43	24	15	15	6	5	0	0	1	2	0	0	0	0	0	0	0	0	0	184
2000	4	26	34	56	41	26	10	4	4	3	4	0	2	1	0	0	0	0	0	0	0	0	0	215
2001	5	48	54	75	42	43	25	12	9	5	7	6	1	0	1	0	1	0	0	0	0	0	0	334
2002	0	42	93	92	88	66	24	23	7	7	4	5	1	1	0	1	0	0	0	0	0	0	0	454
2003	0	4	93	79	35	43	32	16	14	4	4	8	4	1	1	0	1	0	0	0	0	0	0	339
2004	0	8	55	80	63	32	24	14	4	2	4	2	2	2	2	0	0	0	0	0	0	0	0	294
2005	0	38	125	125	75	32	24	10	7	5	4	4	0	1	1	0	0	0	0	0	0	0	0	451
2006	0	7	63	75	50	37	23	25	14	13	1	4	2	4	0	0	0	0	0	0	0	0	0	318
2007	0	5	35	70	50	35	20	13	0	7	4	1	1	2	0	0	0	0	0	0	0	0	0	243
2008	1	29	95	173	101	59	45	38	24	12	15	7	4	3	2	3	0	1	0	0	0	0	0	612
2009	0	77	121	85	121	85	71	43	18	15	4	9	11	4	2	0	0	0	0	0	0	0	0	666
2010	0	32	75	131	62	47	21	13	8	4	3	2	2	1	1	0	0	0	0	0	0	0	0	402

Table 6.8.29 Proportion of yellowtail snapper by age from age samples (otoliths) from commercial landings for the Atlantic and Gulf region for 1981-2010. Years when samples were not available from one or both coasts are set to missing (“-999”). The annual “effective sample size” (ESS) for the proportion at age was set as the square root of the number of ages available to derive the proportions.

Proportion at Age (DA) of Landed Fish

Year	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12+	No. of ages	initial ESS
1981	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	0	0
1982	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	0	0
1983	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	0	0
1984	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	0	0
1985	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	0	0
1986	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	0	0
1987	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	0	0
1988	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	0	0
1989	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	0	0
1990	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	0	0
1991	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	0	0
1992	0.0000	0.1375	0.4132	0.2764	0.0065	0.0299	0.0832	0.0000	0.0267	0.0000	0.0267	0.0000	107	10
1993	0.0000	0.1089	0.1963	0.0840	0.1438	0.1438	0.0727	0.1601	0.0185	0.0185	0.0178	0.0356	174	13
1994	0.0235	0.0418	0.1375	0.1338	0.0968	0.0942	0.1181	0.1302	0.0235	0.0475	0.0471	0.1059	262	16
1995	0.0133	0.0295	0.2004	0.3106	0.1709	0.0923	0.0653	0.0520	0.0656	0.0000	0.0000	0.0000	270	16
1996	0.0050	0.0806	0.1034	0.1566	0.2449	0.1681	0.0420	0.0839	0.0525	0.0210	0.0210	0.0210	400	20
1997	0.0028	0.0766	0.2218	0.1471	0.1746	0.1596	0.0905	0.0369	0.0341	0.0148	0.0267	0.0145	977	31
1998	0.0029	0.0859	0.2442	0.2302	0.1266	0.0911	0.0999	0.0520	0.0238	0.0147	0.0235	0.0050	512	23
1999	0.0060	0.1016	0.1155	0.2128	0.2189	0.1220	0.0762	0.0760	0.0304	0.0253	0.0000	0.0153	833	29
2000	0.0190	0.1470	0.1628	0.2484	0.1811	0.1140	0.0451	0.0190	0.0190	0.0138	0.0175	0.0131	541	23
2001	0.0162	0.1607	0.1638	0.2208	0.1228	0.1245	0.0712	0.0344	0.0258	0.0148	0.0196	0.0254	638	25
2002	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	0	0
2003	0.0000	0.0108	0.2510	0.2132	0.1371	0.1587	0.0863	0.0432	0.0378	0.0108	0.0108	0.0405	341	18
2004	0.0000	0.0600	0.2043	0.2604	0.1986	0.1006	0.0756	0.0438	0.0125	0.0068	0.0125	0.0250	444	21
2005	0.0000	0.0975	0.3055	0.2597	0.1546	0.0648	0.0487	0.0201	0.0149	0.0105	0.0085	0.0154	676	26
2006	0.0000	0.0765	0.1948	0.2238	0.1460	0.1078	0.0669	0.0727	0.0407	0.0378	0.0029	0.0301	707	27
2007	0.0011	0.0797	0.1648	0.2624	0.1862	0.1269	0.0730	0.0467	0.0000	0.0252	0.0144	0.0198	360	19
2008	0.0067	0.0792	0.1739	0.2653	0.1534	0.0892	0.0664	0.0560	0.0354	0.0177	0.0226	0.0343	834	29
2009	0.0014	0.1228	0.1930	0.1529	0.1682	0.1156	0.0982	0.0578	0.0242	0.0202	0.0068	0.0391	742	27
2010	0.0000	0.1159	0.2266	0.2931	0.1358	0.1008	0.0443	0.0274	0.0185	0.0084	0.0080	0.0210	493	22

Table 6.8.30 Proportion of yellowtail snapper estimated by age from at-sea sampling on head boats (measurements of length used ALK to estimate ages) and applied to commercial discards for the Atlantic and Gulf region for 1981-2010. Years when samples were not available from one or both coasts are set to missing (“-999”). The annual “effective sample size” (ESS) for the proportion at age was set as the square root of the number of trips on which at-sea sampling occurred.

Discard Proportion at Age for DA-formulated model, Commercial Fleet

Year	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12+	No. of ages	initial ESS
1981	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	0	0
1982	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	0	0
1983	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	0	0
1984	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	0	0
1985	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	0	0
1986	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	0	0
1987	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	0	0
1988	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	0	0
1989	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	0	0
1990	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	0	0
1991	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	0	0
1992	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	0	0
1993	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	0	0
1994	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	0	0
1995	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	0	0
1996	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	0	0
1997	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	0	0
1998	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	0	0
1999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	0	0
2000	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	0	0
2001	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	0	0
2002	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	0	0
2003	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	0	0
2004	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	0	0
2005	0.2174	0.3259	0.1460	0.1367	0.1088	0.0612	0.0023	0.0001	0.0002	0.0001	0.0014	0.0000	341	18
2006	0.1853	0.3871	0.1723	0.0653	0.0995	0.0760	0.0086	0.0028	0.0025	0.0006	0.0000	0.0000	324	18
2007	0.2387	0.3811	0.1718	0.0850	0.0543	0.0535	0.0117	0.0001	0.0000	0.0001	0.0038	0.0000	323	18
2008	0.2374	0.2904	0.1960	0.1576	0.0613	0.0458	0.0105	0.0007	0.0001	0.0000	0.0001	0.0001	129	11
2009	0.2289	0.5507	0.1369	0.0108	0.0672	0.0038	0.0010	0.0003	0.0002	0.0000	0.0000	0.0001	129	11
2010	0.1818	0.4001	0.1843	0.0869	0.0295	0.0805	0.0240	0.0004	0.0002	0.0000	0.0122	0.0000	121	11

6.9 FIGURES

Figure 6.9.1 Scree plot of cluster height versus cluster number, with a piecewise regression to estimate an optimum number of clusters from the commercial trips on which yellowtail snapper were landed and the presence/absence of other species on those trips. [Data from FWC trip tickets (FL-TT).]

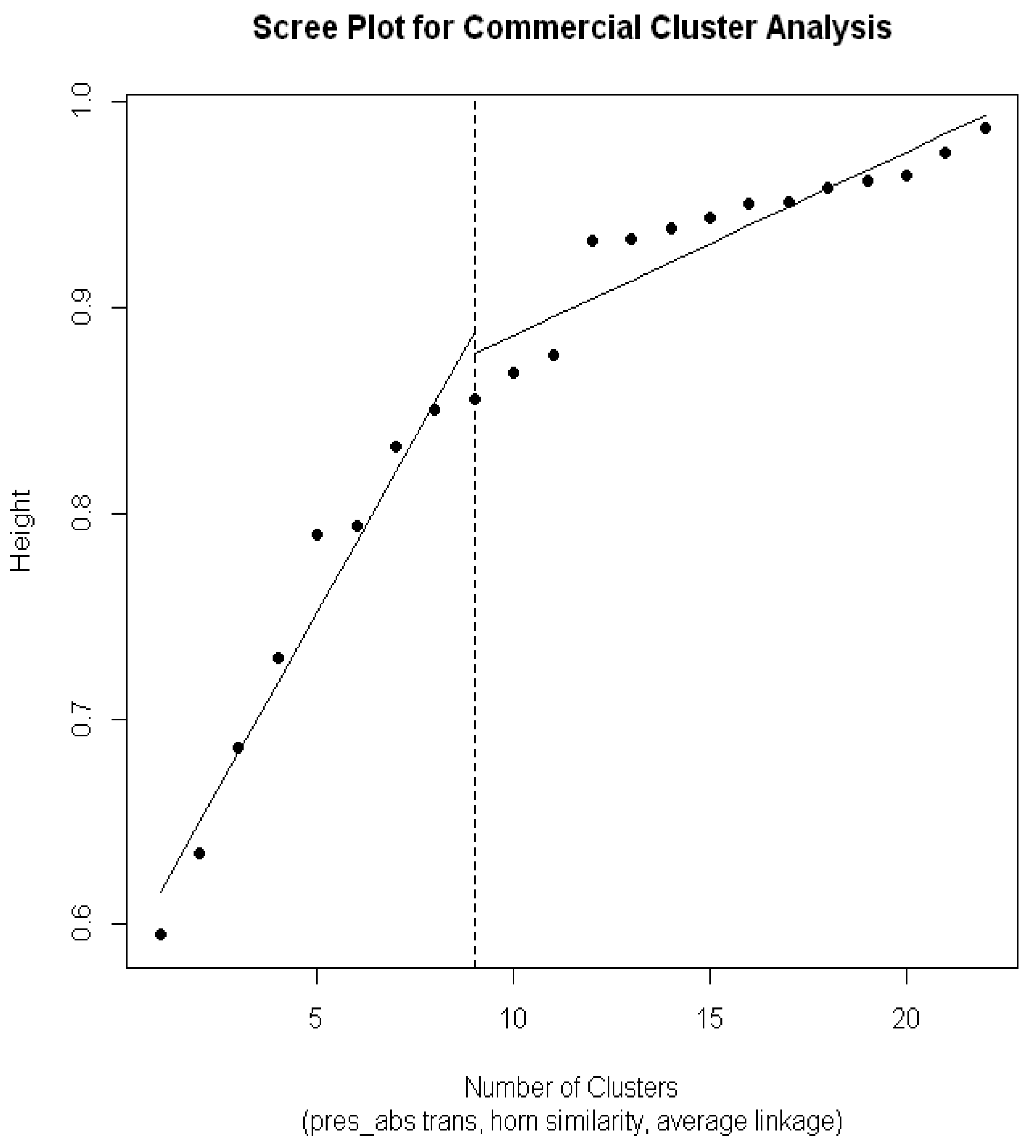


Figure 6.9.2 Cluster analysis of commercial fishing trips landings yellowtail snapper and other species. The rectangles (in red) outline the clusters of species selected by the analyses. [Data from FWC trip tickets (FL-TT).]

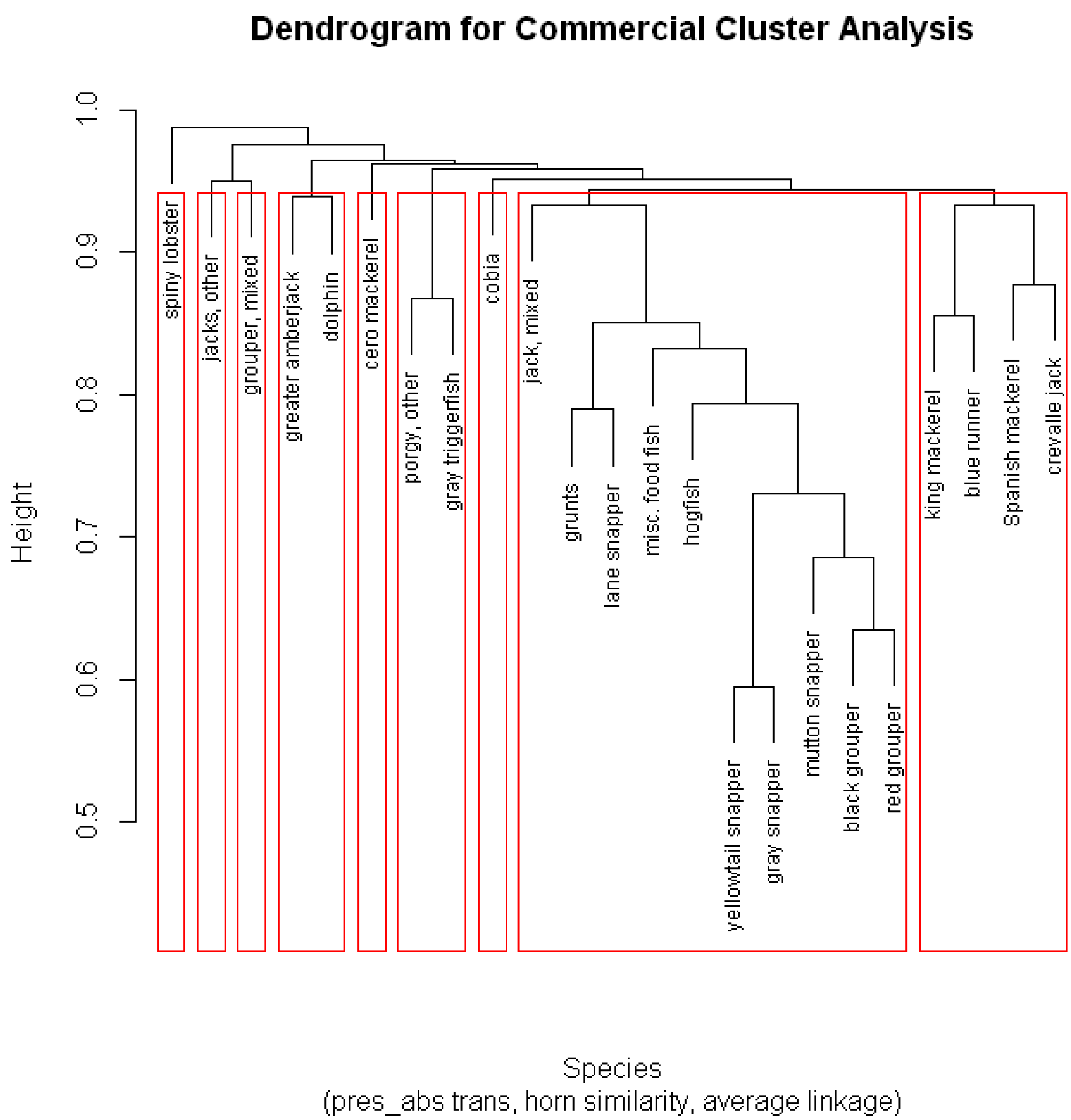


Figure 6.9.3 Florida commercial landings (in metric tons) of yellowtail snapper by region. [Data from FWC trip tickets (FL-TT).]

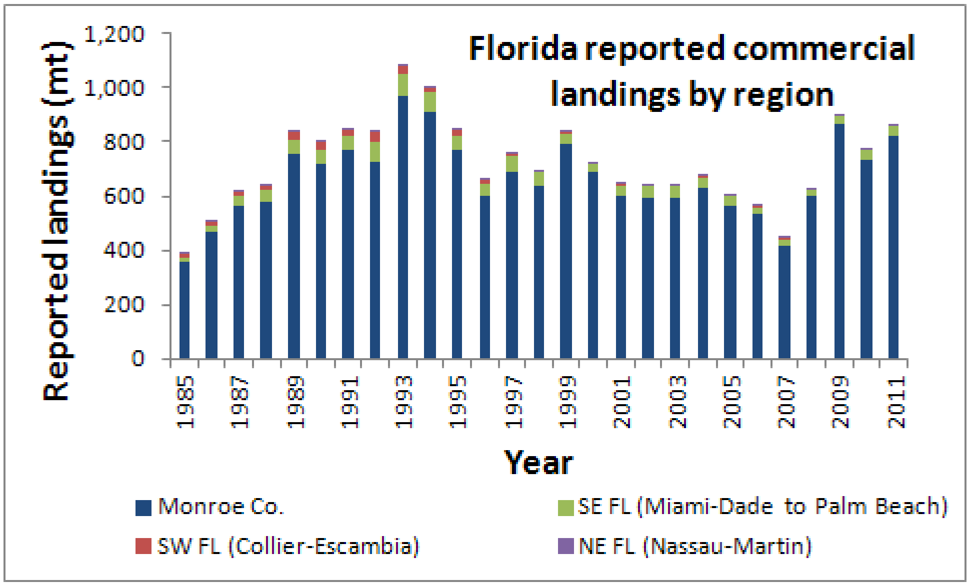


Figure 6.9.4 Number of commercial fishing trips landing yellowtail snapper by region. [Data from FWC trip tickets (FL-TT).]

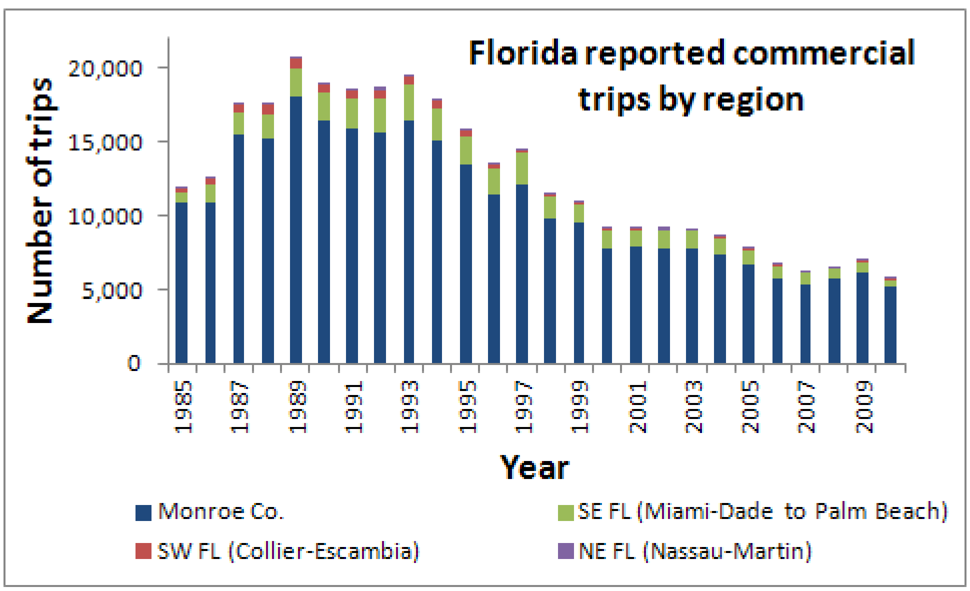


Figure 6.9.5 Estimated number of yellowtail snapper landed and discarded dead. A comparison of estimates from SEDAR 3 and this assessment.

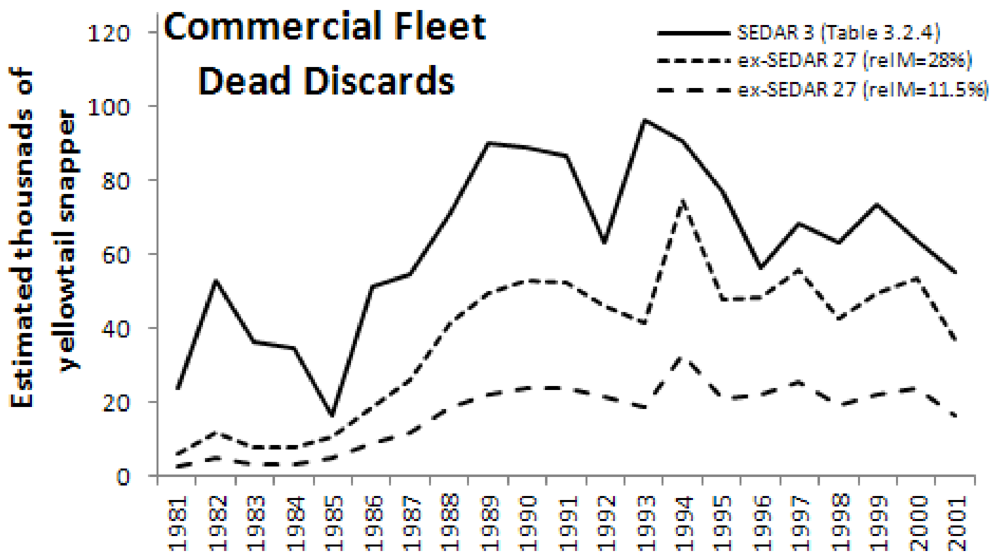


Figure 6.9.6 Number of commercial fishing trips and nominal average pounds per trip landing yellowtail snapper from a selection of trips (including trips on which no yellowtail snapper were caught) using a cluster analysis. [Data from FWC trip tickets (FL-TT).]

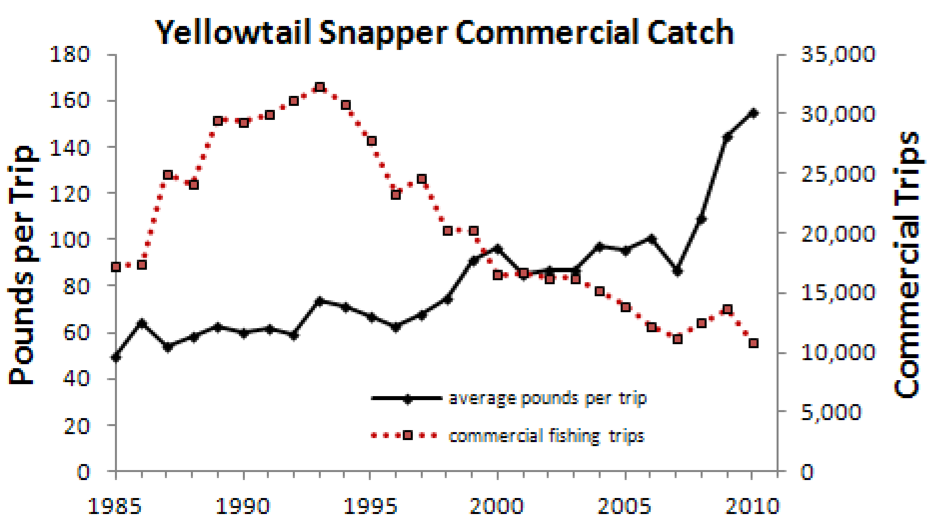


Figure 6.9.7 Grid system currently used in the reporting data to the NMFS Coastal Fisheries Logbook Program.

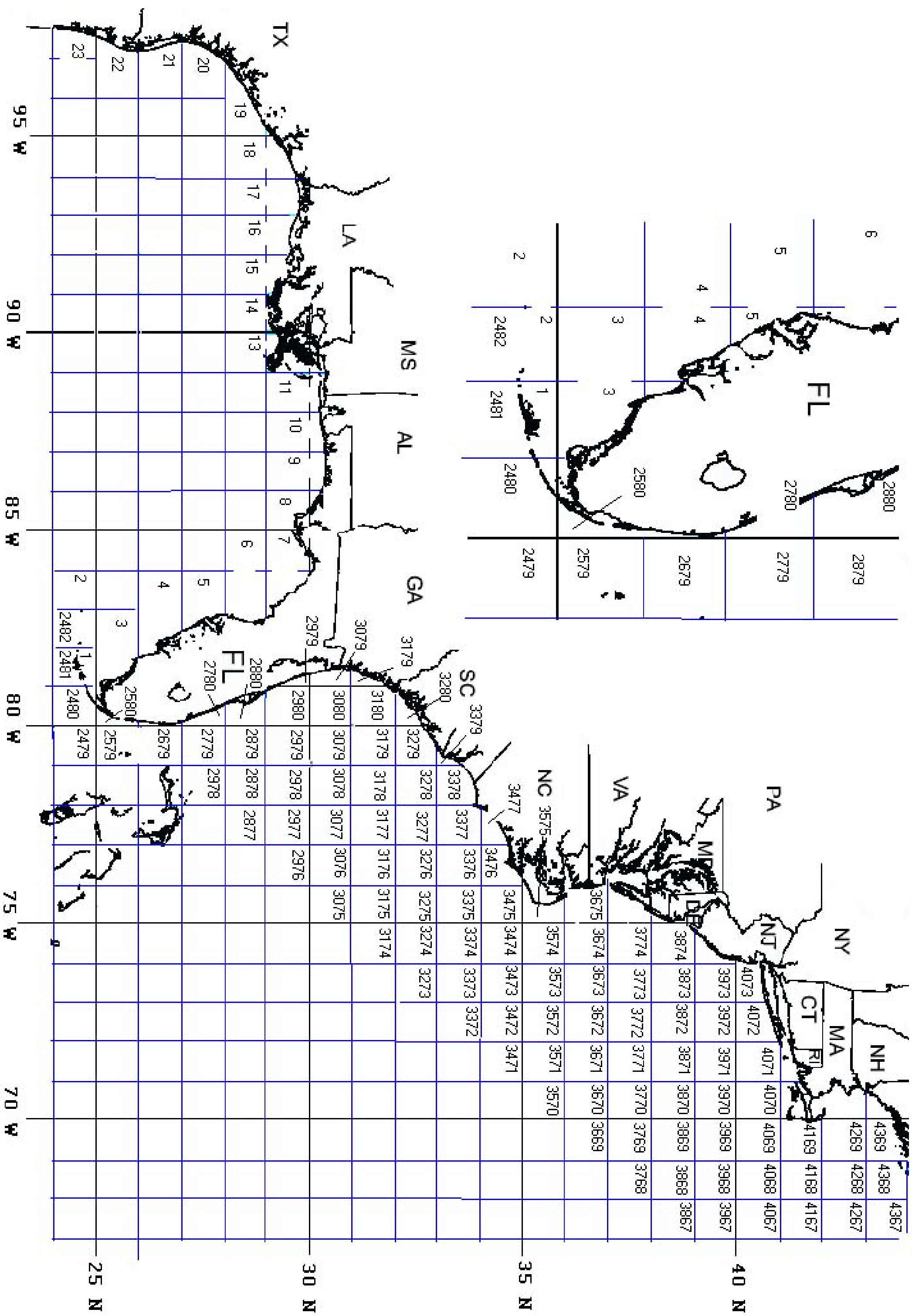


Figure 6.9.8 Fishing effort (in thousand hook-hours) and landings (metric tons) reported from the sample of log books used by McCarthy (2011a) for an analysis of catch-per-effort of yellowtail snapper in the south Florida area. Because these data are a subset of trips for reef fish and other species in south Florida, the amounts of landings and fishing effort do not represent total landings or fishing effort for yellowtail snapper.

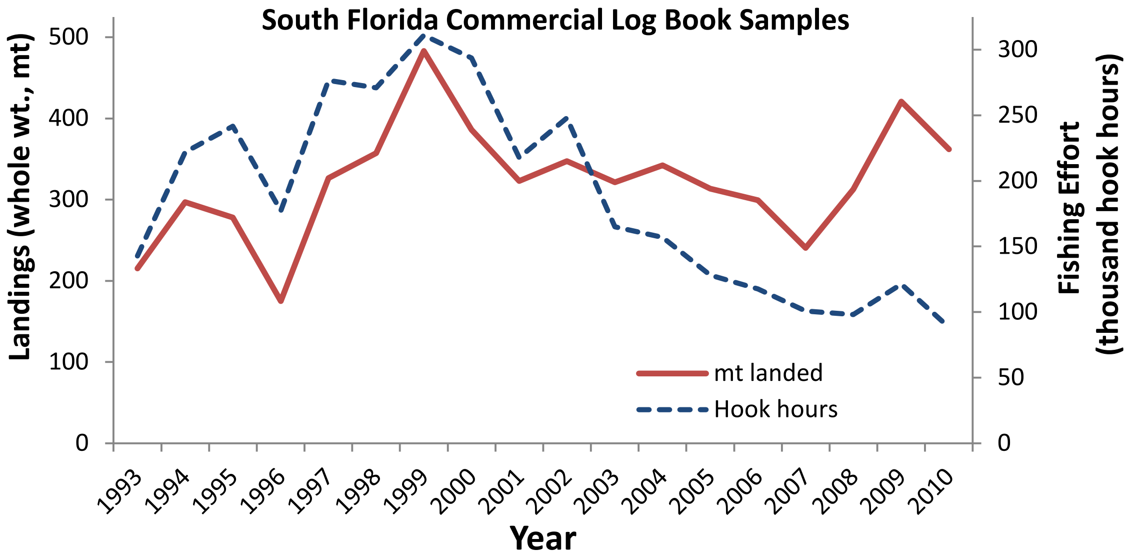
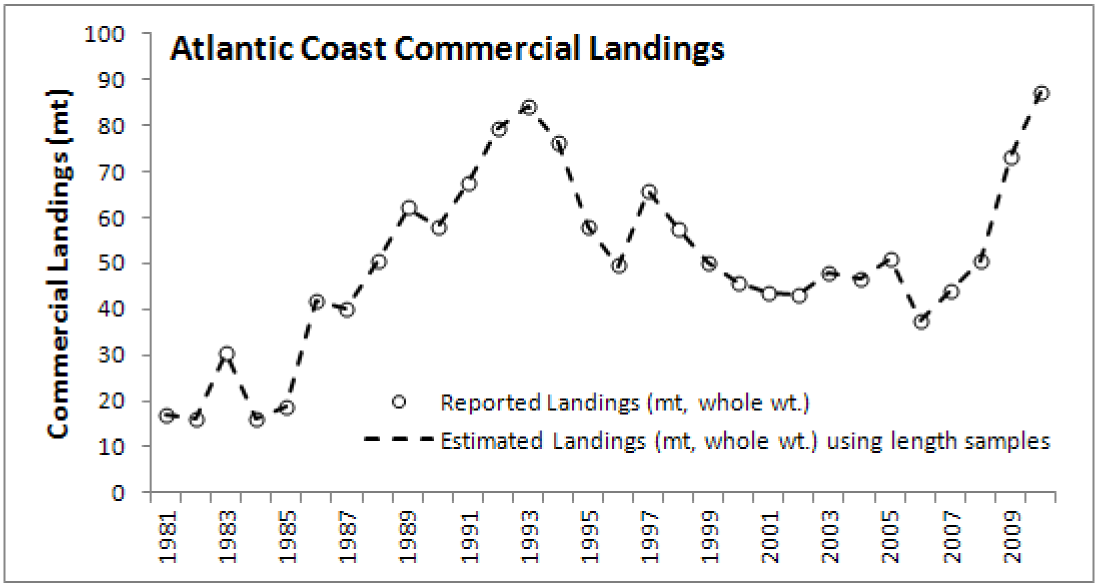


Figure 6.9.9 A comparison of reported commercial landings (kg) of yellowtail snapper with estimates of landings (kg) computed from length samples and adjusted numbers of fish at length for the a) Atlantic Coast and b) Gulf Coast.

a.) Atlantic Coast



b.) Gulf Coast

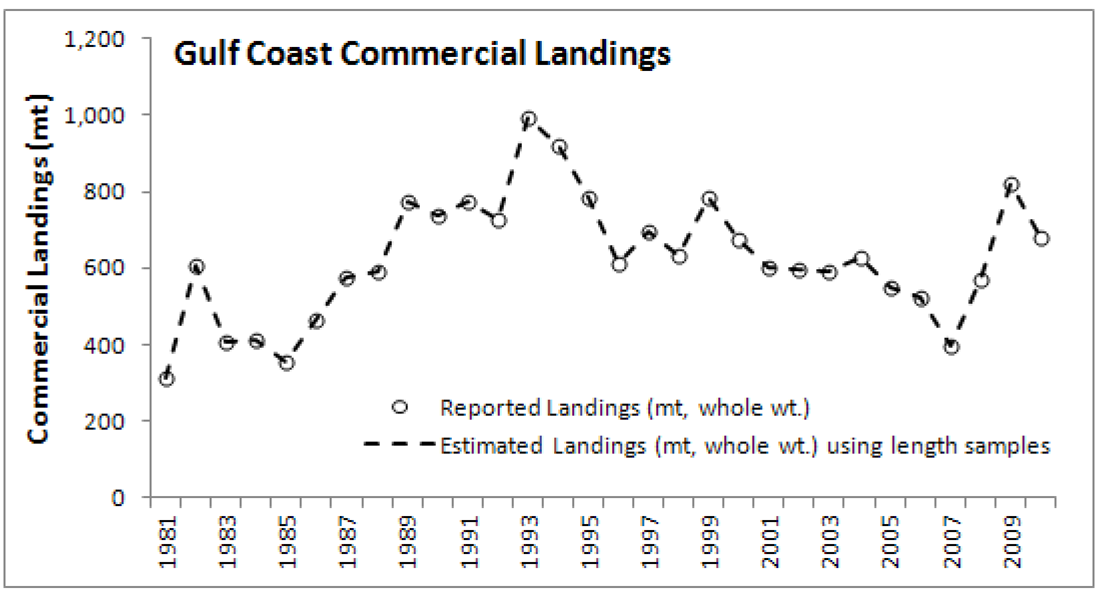
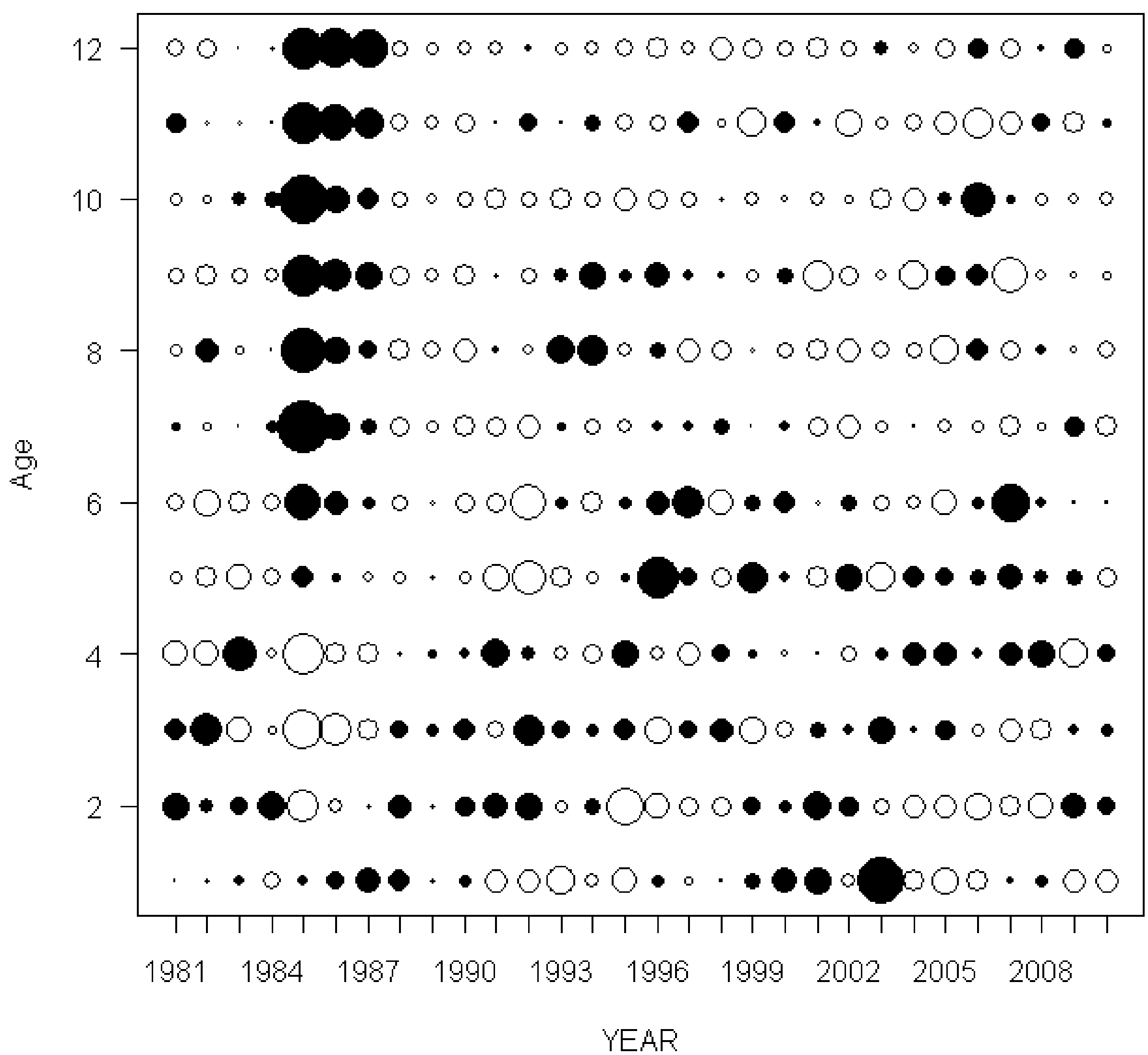


Figure 6.9.10 Age composition (Atlantic and Gulf combined) using age-length keys to estimate ages from length samples measured from commercial landings during 1981-2010. Values are in Z-score units within each age group. Positive scores (higher relative abundance) are represented as filled circles, and negative scores (lower relative abundance) as open circles. Circle diameters are proportional to the square-root of the absolute value of the Z-score.



7. RECREATIONAL STATISTICS

7.1 OVERVIEW

7.1.1 ISSUES

7.2 REVIEW OF WORKING PAPERS

There were no working papers for this section.

7.3 RECREATIONAL LANDINGS

7.3.1 SOUTHEAST HEAD BOAT SURVEY (HBS)

The NMFS Southeast Headboat Survey collects catch, effort, and biological measurements from head boats operating from North Carolina to Texas. The survey began operation in 1972 on the Atlantic Coast, expanded into Florida in the mid-1970’s and to the Florida Keys by 1979, and in 1986 began operating in states bordering the Gulf of Mexico. Catch by species and effort (numbers of anglers and vessel trips) are collected on vessel trip reports sent by the vessel operators. Biological samples (measurements of length and weight, otoliths, etc.) are collected from anglers’ landings during dockside intercepts of vessels returning from fishing. Catch and effort records record the general area fished, date, duration of trip, number of anglers fishing, and other information. Data are routinely analyzed for quality, and reporting rates are ground-truthed through dockside visits. The goal of this survey is to be a census of data for the entire head boat fleet, but because of non-compliance with reporting rules by some vessel operators the survey makes estimates for the non-compliant vessels based on vessel characteristics and similar fishing patterns of compliant vessels.

Landings and effort (angler-hours) data from the vessel trip reports are summarized into estimates of monthly and annual landings (in numbers and weight) by species in each of the head boat areas (Fig. 7.9.1). Annual landings by HBS area numbers of fish show that most yellowtail snapper are caught in areas 11, 12 and 17 by numbers (Table 7.8.1) and weight (Table 7.8.2). The landings can be grouped by area into Atlantic and Gulf regions to conform to those used by this assessment (Table 7.8.3). There were no Gulf of Mexico data until 1986 when the survey expanded into those areas, and the only data available were from areas 12 (Florida Keys) and 17 (Dry Tortugas). The average ratio of yellowtail snapper landings from areas 12 and 17 in relation to the landings for areas 12-27 from 1986-1990 was about 0.973, so the sum of areas 12 and 17 (in numbers) was raised by this factor to produce an estimate of yellowtail snapper landings in numbers for 1981. Landings for 1982 were estimated using the average of ratios from 1987-1991, and etc. for succeeding years through 1985. The adjustments were on the order of 4,100 fish (2,000 to 5,700) for those years because the landings in areas in the Gulf of Mexico were small relative to the Florida Keys and the Dry Tortugas (Tables 7.8.1, 7.8.2).

The number of length measurements of yellowtail snapper (Tables 7.8.4, 7.8.5) is relatively large particularly in the Gulf region (primarily the Florida Keys and Dry Tortugas). The age composition of the landings by Atlantic and Gulf regions were estimated using region-specific age-length keys (ALK) (Tables 7.8.6, 7.8.7). The number and ages of otoliths sampled annually from the Atlantic and Gulf regions are in Tables 7.8.9 and 7.8.10. Otolith samples were reasonably large (over 100) during most years in the Atlantic region particularly after 2003. Otolith collections from the Gulf region were relatively lacking until 2008. For direct aging model formulations, the annual number of yellowtail snapper by age in a region was the product of the proportions at age in the otolith samples and the total number of fish estimated in the landings. The total number of landings from both regions were summed, and became the weighted proportions at age (PAA) for the fleet in the DA-formulated model runs (Table 7.8.10). If one or both of the regions had no otolith samples for a year, the PAA values were set to missing ("-999").

7.3.2 Marine Recreational Fishery Statistics Survey (MRFSS)

The NMFS Marine Recreational Fishery Statistics Survey began collecting information from saltwater anglers on the Atlantic Coast in 1979. The first two years of the survey data are rarely used. Data from this survey are generally available from March of 1981 to the present. Texas participated in the MRFSS from 1981-1985, but has run their own saltwater fishing surveys using different methodology since that time. However, yellowtail snapper rarely shows up in landings from that state. The survey in most states is comprised of one telephone survey of households that collects fishing effort information and three separate intercept surveys – shore mode intercepts, private or rental boat intercepts, and charter vessel intercepts (in some states, both head boats or "party" boats are combined for intercepts). In mid-1997, a pilot survey for collecting charter vessel effort began collecting effort for that mode of fishing because of the difficulty of contacting the relatively small number of anglers who had taken a charter fishing trip in the previous sixty days (which caused estimation problems). In 2000, charter vessel fishing effort was collected using the telephone survey of charter vessel captains for Louisiana to Florida, and beginning in 2002 on Florida's Atlantic Coast. In this voluntary survey, the MRFSS collects catch information on harvested (landings, dead discards) and fish released alive through angler interviews, and field samplers measure and weigh fish if the anglers allow them access.

The MRFSS estimates the number and weight of fish in the harvest (landings and dead discards) and the numbers of fish released alive by coast, state, year, wave, and area fished (in terms of distance from shore). Intact fish from anglers' landings are measured as samples of the sizes and weights landed by species. The MRFSS makes separate estimates for harvest and releases for West Florida (bordering eastern Gulf of Mexico waters) and East Florida (counties along the Atlantic coast of Florida). The MRFSS treats Monroe County as part of the Gulf of Mexico for summaries of harvests and releases rather using the jurisdictional boundaries of the Fishery Management Councils (South Atlantic and Gulf of Mexico). Thus, Florida is essentially treated as two 'states' – East Florida and West Florida.

The harvest of yellowtail snapper by recreational anglers was greatest in West Florida and to a lesser extent in East Florida compared to all other states in the southeastern region of the US (Tables 7.8.11, 7.8.12, Fig. 7.9.3). The number of fish released alive by reported by saltwater anglers (Fig. 7.9.4) was similar in magnitude in most years to the harvested amounts. The number of released fish in 1991 is anomalous and should be more closely. Yellowtail snapper are more often caught from vessels, but there is some catch from shore (Fig. 7.9.5). The amount of harvested yellowtail snapper by recreational anglers has sometimes been above 500 metric tons (Fig. 7.9.6), but mostly that was during the early years of the survey when sample sizes for the survey were lower. In more recent years, MRFSS harvest estimates have been more in the range of 100-300 metric tons. Often, more of the harvests and releases occur in the Florida Keys, though SE Florida can account for a large share of harvests and releases in some of the more recent years (Fig. 7.9.7).

The number of lengths measured from saltwater anglers interviewed by samplers (Tables 7.8.13, 7.8.14) was usually over a hundred measurements in the Gulf region and in the Atlantic region after 2000. Using the annual size frequencies and the average weight of fish in a size class, the harvested weight can be calculated for comparison with the MRFSS estimates (Fig. 7.9.8). The calculated harvest amounts were very similar to the MRFSS harvest estimates from 1987-2010. There were some rather large deviations in harvest amounts in the early years of the MRFSS, and this may be function of their estimation procedures for weights or sample biases in the lengths of fish measured from anglers. Lengths of yellowtail snapper in the Gulf region (Table 7.8.14) showed more larger fish than seen in the Atlantic region (Table 7.8.13). The ages estimated from the length measurements and the age-length key (ALK) for the Atlantic and Gulf regions are in Tables 7.8.15 and 7.8.16. Ages 2 through 6 were the more frequent age classes estimated by the ALK for recreational angler landings. Otoliths sampled from recreational saltwater anglers' landings (Tables 7.8.17, 7.8.18) showed some older ages in the Gulf region (chiefly the Florida Keys) than seen in the Atlantic region (chiefly southeast Florida). Yellowtail snapper otoliths from saltwater angler's landings were not sampled until 2002 and the numbers of otoliths taken were low in some years from 2002-2010. For direct aging model formulations, the annual number of yellowtail snapper by age in a region was the product of the proportions at age in the otolith samples and the total number of fish estimated in the landings. The total number of landings from both regions were summed, and became the weighted proportions at age (PAA) for the fleet in the DA-formulated model runs (Table 7.8.19). If one or both of the regions had no otolith samples for a year, the PAA values were set to missing ("-999").

7.4 RECREATIONAL DISCARDS AND RELEASE MORTALITY

7.4.1 DISCARDS

There are several sources of information on the discards of fish (some prefer "releases" as in "catch and release" fishing) by recreational anglers. The MRFSS has included sampling protocols for collecting discard data for species in both the Type B1 fish (fish harvested but not available to the field sampler at the time of the dockside interview, including fish that were dead and released by the angler) and the Type B2 fish (fish released alive). In 2004, the HBS began collecting the number of fish released dead and released alive in their vessel trip reports submitted by vessel operators which are records of landings (and now, catch) by species for a head boat trip. Neither of these recreational data collection programs collects measurements of the size of released fish, though the MRFSS asks about the reasons for releasing fish such as whether the fish was below legal size (if there were size limits), of legal size to keep, or not legal to keep (i.e., fish not legal to harvest during closures, or bag limit exceeded, etc.). A more recent source of discard data has come from at-sea sampling on head boats. The amounts of landed fish and sizes by species as well as the numbers and sizes of released fish by species and their immediate disposition within a short time after release by anglers (see discussion in Sections 5.4.2 and 5.4.3) are recorded by the at-sea samplers.

The HBS estimates discards by species from vessel trip reports supplied by vessel operators. The annual discards for yellowtail snapper from head boat trips in southeast Florida and the Florida Keys and those derived from at-sea sampling using the ratio of released fish to those landed by head boat anglers (Table 7.8.20). The at-sea sampling estimates for releases are higher than reported in the vessel trip reports for the southeast Atlantic area in the Florida Keys during the 2005-2007. The at-sea sampling program did not sample in the Keys during 2008-2010, but the estimates for releases based on the number of landed fish are similar to discard estimates made by the HBS from vessel trip reports for 2008-2010. The at-sea sampling ratios for the proportions of released to landed yellowtail snapper were used as an approximations for releases for 1985-2010 by region (Table 7.8.21). An additional factor was used to adjust this rate for the proportion of fish below 10” TL for 1981-1984 which was prior to the implementation of minimum size limits by Florida at the beginning of 1985.

Using the at-sea sampling measurements (Table 5.10.4), the number of released fish (total discards, live or dead) by size class can be estimated for each region (Tables 7.8.22, 7.8.23). The ages in the discards (Tables 7.8.24, 7.8.25) were estimated through conversion with the age-length key for each region. The resulting proportions at age for the total discards for the combined regions (which weights the proportions by the amount of discards in each region) are shown in Table 7.8.26. The estimated weight (in metric tons) of the total discards multiplied by various release mortality rates are in Table 7.8.27. The proportion of the number of fish of a particular age released to the total number of that age class caught by head boat anglers is calculated in Table 7.8.28.

The annual discard data by region (Atlantic or Gulf) from the MRFSS was used as the estimate of the total number of yellowtail snapper released alive by anglers. There were so few records (about a dozen) of fish released dead in the B1 data that practically 100% of yellowtail snapper were released alive. The at-sea sampling observable release mortality rates for yellowtail snapper immediately after release by head boat anglers ranged from 4.5% to 10.5%, and based on those data a rate of 10% release mortality was used in this assessment for releases from modes of fishing surveyed by the MRFSS. Similarly, the size at release data measured during the at-sea sampling of head boats was adopted as a proxy for the sizes of yellowtail snapper released by recreational anglers surveyed by the MRFSS. Estimated discards by length (Tables 7.8.29,7.8.30) of yellowtail snapper were calculated using the MRFSS B2 estimates by region and the proportions at length from the at-sea sampling by region. Estimated ages in the total discards were calculated by converting the lengths in the discards using the age-length key by region (Tables 7.8.31, 7.8.32). The estimated numbers of yellowtail snapper by age by region were combined and the n-weighted proportions at age matrix was calculated (Table 7.8.33). The weight of annual total discards (live and dead) were the product of the number of yellowtail snapper in length classes estimated in the discards and the average weight of fish in a length class. The weight (in metric tons) of annual dead discards is the product of the weight of total discards and a release mortality rate to be applied (Table 7.8.34). The proportion of the number of fish of a particular age released to the total number of that age class caught by recreational(MRFSS) anglers is calculated in Table 7.8.28.

7.4.2 Recommendations on recreational discards and release mortality

The estimated release mortality rates from at-sea sampling (see Section 5.4.2) for yellowtail snapper released by head boat anglers was between 4.5% (Florida Keys) - 10.5% (southeast Atlantic) in the short period over which the samplers were able to see the fish after release. A release mortality rate of 10% is probably not unreasonable for a first approximation for a release mortality rate for this species by head boat anglers. Because there are no release mortality estimates for yellowtail snapper released by other recreational anglers, it is also reasonable to adopt the same 10% release mortality rate as a first approximation for this parameter.

7.5 RECREATIONAL EFFORT

7.5.1 Southeast Head Boat Survey (HBS)

Fishing effort (number of angler-days) information is collected by the HBS from vessel trip reports. Head boat fishing effort has declined roughly three-fold in southeast FL and 2.7-fold in the Florida Keys area from 1981 to 2010 (Table 7.8.36).

7.5.2 Marine Recreational Fishery Statistics Survey (MRFSS)

Fishing effort (number of one-day angler trips) by coast, state, year, wave (two-month estimation period), mode of fishing (shore, private/rental boats, charter vessels) data is collected by the MRFSS. Total effort for the south Atlantic and Gulf of Mexico regions is estimated to be on the order of 8-25 million angler trips annually with a majority of those trips taken in Florida (Fig. 7.9.9). A cluster analysis of the MRFSS data identified fishing trips taken in southeast Florida and the Florida Keys areas presumed to have been in habitats where yellowtail snapper occurs (Chagaris 2011b) even if none were caught. The angler-trips identified by the cluster analsyis were used to develop a total catch index for yellowtail snapper. The vessel trips associated with the angler trips identified by the cluster analysis were identified using the MRFSS Type 6 records (linking all angler interviews to unique vessel trips) from 1991 (when the Type 6 records were first introduced) to 2010. Vessel trips in presumptive yellowtail snapper habitats show a general declining trend through 2001, increased over 2002-2007, and declined over 2008-2010 (Fig. 7.9.10).

7.6 BIOLOGICAL SAMPLING

The age composition of the fisheries landings were derived from length samples taken from the landings and discards. These lengths were converted to ages using age-length keys developed separately for each year during 1981-2010 and separately for the Gulf of Mexico and South Atlantic regions. The dimensions of the ALK were years 1981-2010 and ages 0 - 12+. The few age-0 were pooled with age-1 (modeled 1-12+ in ASAP). Though the number of yellowtail snapper sampled for lengths and ages were fairly large in many years (Table X), the age composition of certain length classes with less than five fish sampled for ages in that year and region required some pooling of age composition data across time (5-year periods, or all years) and space (both regions). The minimum of five ages samples per length class per year per region accounted for 39% of the age x length-class cell observations, each cell being a unique combination of region (2; South Atlantic and gulf), year (30; 1981-2010), and total length inch classes (20,<=5,6-23,>=24 inches) for a total of 1,200 cells. The minimum sample limit of five ages was chosen so that a minimum amount of pooling, which masks year-class-strengths, was needed. Pooling within region across 5-year periods accounted for data for 336 cells, pooling across all years within region accounted for data in 310 cells, and finally pooling across all years and regions provided age composition information for 90 cells.

Examination of the relative changes in the age composition of the catches over time showed few indications of strong or weak year classes of yellowtail snapper. Relative catches of yellowtail estimated to be older than age 6 showed a vertical stacking in the bubble plot indicating that year-to-year changes across ages 7-12+ were more important than age class changes (Figs. 7.9.11, 7.9.12). These ages showed a period of high catches during 1985-1992. Variability between fisheries and in year-class progressions made it difficult to discern any consistent patterns in recruitment. The 2007 year-class appeared strong in the head boat landings data (Fig. 7.9.11) but not in the other fisheries (Figs. 6.9.10, 7.9.12). The 1995 year-class appeared weak in all three fisheries landings.

7.6.1 SOUTHEAST HEAD BOAT SURVEY (HBS)

The number of yellowtail snapper length measurements taken by head boat samplers by region are in Tables 7.8.4 and 7.8.5, and the number of age samples of this species taken by those samplers are in Tables 7.8.8 and 7.8.9.

7.6.2 MARINE RECREATIONAL FISHERY STATISTICS SURVEY (MRFSS)

The number of yellowtail snapper length measurements taken by MRFSS samplers by region are in Tables 7.8.13 and 7.8.14, and the number of age samples from this species landed by recreational anglers are in Tables 7.8.17 and 7.8.18.

7.6.3 ADEQUACY FOR CHARACTERIZING CATCH AND FOR ASSESSMENT ANALYSES

The number of length measurements and age samples from head boats (HBS) was sufficient in most years to use for length composition of the landings and for combining with other age samples to form a general age-length key for this species to estimate age compositions. Length measurements from the MRFSS were reasonably sufficient in most years for estimating length compositions, but the ages from the recreational anglers intercepted by this survey was very low in many years. The MRFSS protocols do not allow the sampling of otoliths from recreational anglers during the conduct of the regular MRFSS intercepts because age sampling may interfere with the opportunity to interview other recreational anglers. Instead, the MRFSS allows add-on surveys to be conducted specifically for other purposes (such as the collection of age samples). The number of age samples available from anglers in fishing modes that would be intercepted by the MRFSS was low or non-existent in many years, but recently has improved after 2001. These age samples were incorporated into the general age-length keys used for conversion of lengths to ages for landings and estimated discards in this assessment.

7.7 LITERATURE CITED

Chagaris, D. 2011b. Standardized catch rates of yellowtail snapper (*Ocyurus chrysurus*) from the Marine Recreational Fisheries Statistics Survey in south Florida, 1981-2010. SEDAR27-RD04.

7.8 TABLES

Table 7.8.1 Head Boat Survey (HBS) annual landings (numbers of fish) of yellowtail snapper by survey area*, 1981-2010.

	Head Boat Survey Area																		
Year	10	3	4	5	6	7	8	11	12	17	18	21	22	23	24	25	26	27	Total
1981	1	0	0	0	0	0	616	84,928	61,575	12,853									159,973
1982	0	0	15	0	0	154	296	60,071	80,762	59,995									201,293
1983	1	0	0	9	0	44	763	34,177	94,957	75,374									205,325
1984	0	0	0	14	0	99	291	33,557	50,943	71,411									156,315
1985	0	0	0	1	0	87	503	25,179	54,966	56,897									137,633
1986	0	0	0	0	0	167	1,328	29,035	58,122	114,422	120	2,448	454	53	0	2	43	0	206,194
1987	0	0	0	3	0	162	2,142	34,736	67,607	126,149	0	4,112	0	619	0	0	0	0	235,530
1988	0	0	0	5	0	184	1,977	53,087	80,878	149,687	0	5,522	0	37	0	0	0	0	291,377
1989	0	0	0	2	0	419	829	43,794	91,605	23,372	689	5,727	2	0	6	0	0	0	166,445
1990	0	0	0	5	0	46	1,977	47,198	118,812	42,260	4,905	3,244	108	213	31	0	0	0	218,799
1991	0	2	20	94	0	34	2,112	51,289	131,177	22,762	1,243	4,106	62	4	4	0	637	0	213,546
1992	16	0	1	116	0	44	1,082	54,365	118,173	24,560	1,110	5,893	43	97	0	0	3	0	205,503
1993	1	10	0	75	0	23	669	45,274	123,137	35,049	6,409	7,210	664	266	0	0	0	0	218,787
1994	0	0	0	28	0	6	619	76,348	136,844	21,757	1,485	3,448	1,924	727	0	0	5	0	243,191
1995	7	2	4	36	0	13	428	35,954	92,857	25,183	1,485	501	1,072	3	0	0	0	0	157,545
1996	0	0	0	36	0	5	26	23,378	93,021	17,957	0	3,000	0	212	0	0	0	0	137,635
1997	0	0	0	25	0	50	210	26,729	95,757	16,353	0	517	6	216	1	0	0	0	139,864
1998	0	0	0	19	3	8	122	16,007	81,770	19,542	0	2,977	28	72	0	0	5	0	120,553
1999	0	18	12	17	3	7	217	24,512	70,126	7,117	0	5,913	1,234	97	3	0	1	0	109,277
2000	1	15	0	3	0	55	133	12,027	88,607	6,422	0	671	1,096	289	0	0	0	0	109,319
2001	0	0	0	26	0	28	215	4,770	75,004	18,939	2,369	123	384	37	2	0	0	0	101,897
2002	0	0	0	30	2	36	384	2,382	87,490	30,184	0	401	46	89	2	0	0	0	121,046
2003	0	3	0	10	0	10	165	10,267	82,737	15,001	0	238	436	0	4	1	4	0	108,876
2004	3	0	10	2	12	42	426	8,118	94,614	14,749	0	402	64	7	0	55	23	20	118,547
2005	1	45	0	93	21	222	527	16,160	107,184	23,303	0	1,508	149	34	0	22	5	0	149,274
2006	0	0	3	184	1	111	347	2,157	80,189	14,010	0	1,850	303	7	0	15	35	12	99,224
2007	0	7	53	628	4	121	2,050	16,679	73,050	10,823	0	1,837	24	14	0	35	22	22	105,369
2008	0	1	24	104	0	62	662	31,857	59,148	8,973	1,510	1,104	27	19	107	3	1	0	103,602
2009	1	0	7	2	0	123	826	19,329	51,570	12,123	3,161	1,149	85	14	58	0	9	0	88,457
2010	0	0	5	0	0	13	188	38,577	51,117	9,998	1,987	253	36	5	1	0	14	0	102,194

HBS area*	Description
10	NC (Morehead City - Sneads Ferry)
3	NC offshore (Topsail Island - Ocean Isle Beach)
4	SC inshore (Calabash - Hilton Head Island)
5	SC offshore (Calabash - Hilton Head Island)
6	Georgia (Savannah - Brunswick)
7	NE FL (Fernandina Beach - St. Augustine)
8	NE FL (Daytona Beach-Sebastian)
11	SE FL (Ft. Pierce-Miami)

HBS area*	Description
12	Florida Keys (Key Largo-Key West)
17	Dry Tortugas (vessels docked in Key West)
18	Dry Tortugas (vessels docked in west coast of Florida)
21	SW FL (Naples - Cedar Key)
22	FL Middle Grounds
23	NW FL and AL
24	LA (Empire - Grand Isle)
25	NE TX (Sabine Pass - Freeport)
26	TX (Port Aransas)
27	SE TX (Port Isabelle - South Padre Island)

Table 7.8.2 Head Boat Survey (HBS) annual landings (weight, kilograms) of yellowtail snapper by survey area*, 1981-2010.

	Head Boat Survey Area																		
Year	10	3	4	5	6	7	8	11	12	17	18	21	22	23	24	25	26	27	Total
1981	0.5	0.0	0.0	0.0	0.0	0.0	239.0	60,962.7	34,709.6	8,071.7									103,983.6
1982	0.0	0.0	7.5	0.0	0.0	77.0	133.2	44,929.3	50,901.1	36,766.9									132,815.0
1983	0.5	0.0	0.0	4.6	0.0	21.7	367.8	22,183.2	45,012.3	46,241.2									113,831.2
1984	0.0	0.0	0.0	12.5	0.0	63.1	131.0	22,064.3	23,054.9	48,564.8									93,890.6
1985	0.0	0.0	0.0	0.2	0.0	34.5	204.1	15,346.8	26,728.5	32,739.3									75,053.3
1986	0.0	0.0	0.0	0.0	0.0	77.8	450.7	19,287.9	31,360.2	66,659.8	71.9	1,295.4	453.1	24.9	0.0	1.2	28.4	0.0	119,711.3
1987	0.0	0.0	0.0	1.3	0.0	72.4	842.3	17,837.4	40,683.2	66,608.7	0.0	1,662.2	0.0	247.0	0.0	0.0	0.0	0.0	127,954.6
1988	0.0	0.0	0.0	2.7	0.0	97.7	1,196.3	31,097.8	45,076.2	104,458.8	0.0	1,953.1	0.0	13.1	0.0	0.0	0.0	0.0	183,895.7
1989	0.0	0.0	0.0	1.0	0.0	189.8	373.1	27,549.4	59,333.0	12,118.2	269.6	2,941.9	1.0	0.0	3.1	0.0	0.0	0.0	102,780.0
1990	0.0	0.0	0.0	1.8	0.0	14.8	704.6	23,936.7	87,403.8	31,352.0	3,056.5	1,904.2	73.9	150.6	21.9	0.0	0.0	0.0	148,620.8
1991	0.0	0.8	7.4	36.7	0.0	12.4	781.0	22,408.8	111,354.1	19,048.9	960.6	3,280.8	49.5	3.3	1.8	0.0	723.6	0.0	158,669.6
1992	6.2	0.0	0.4	65.9	0.0	25.0	449.7	25,187.8	69,321.3	18,215.2	913.1	3,264.6	25.4	55.9	0.0	0.0	1.7	0.0	117,532.2
1993	1.0	10.2	0.0	75.5	0.0	13.3	364.2	23,729.4	111,193.0	25,890.6	4,822.9	5,147.9	474.1	189.4	0.0	0.0	0.0	0.0	171,911.4
1994	0.0	0.0	0.0	18.0	0.0	2.0	199.6	38,410.4	69,941.0	10,327.4	799.9	1,655.0	923.5	152.7	0.0	0.0	1.1	0.0	122,430.5
1995	10.1	2.9	5.8	52.2	0.0	8.0	220.6	19,742.7	40,601.3	12,229.8	774.8	257.2	524.2	1.6	0.0	0.0	0.0	0.0	74,431.1
1996	0.0	0.0	0.0	71.9	0.0	1.8	9.1	11,729.2	43,063.6	7,829.1	0.0	1,185.1	0.0	109.5	0.0	0.0	0.0	0.0	63,999.3
1997	0.0	0.0	0.0	16.1	0.0	22.5	91.9	16,590.8	41,790.2	8,932.1	0.0	377.0	3.2	191.1	0.5	0.0	0.0	0.0	68,015.5
1998	0.0	0.0	0.0	9.7	1.5	3.4	49.8	9,398.4	35,128.3	9,753.5	0.0	1,364.3	13.1	33.8	0.0	0.0	2.4	0.0	55,758.1
1999	0.0	13.9	9.3	13.1	2.4	4.7	136.8	13,040.1	28,651.8	2,991.1	0.0	2,598.7	580.7	45.1	1.4	0.0	0.3	0.0	48,089.2
2000	0.5	10.1	0.0	1.8	0.0	28.0	59.3	5,739.5	33,210.4	3,904.6	0.0	422.1	689.4	181.8	0.0	0.0	0.0	0.0	44,247.3
2001	0.0	0.0	0.0	12.5	0.0	13.2	80.0	2,368.4	30,848.9	10,317.0	1,197.9	80.9	226.9	21.0	1.1	0.0	0.0	0.0	45,167.7
2002	0.0	0.0	0.0	31.9	2.7	26.8	235.0	1,241.3	33,171.2	15,356.4	0.0	216.4	24.8	47.8	1.1	0.0	0.0	0.0	50,355.3
2003	0.0	1.9	0.0	6.4	0.0	5.2	83.9	5,479.6	30,816.9	7,335.6	0.0	133.2	234.6	0.0	2.4	0.6	2.1	0.0	44,102.3
2004	1.4	0.0	4.7	0.9	5.6	18.6	183.9	3,531.8	33,659.3	9,549.1	0.0	223.5	34.0	5.8	0.0	26.0	11.0	9.4	47,264.8
2005	0.5	22.3	0.0	46.0	8.6	90.8	215.6	7,815.1	38,037.6	20,655.6	0.0	642.6	80.7	18.5	0.0	11.7	2.7	0.0	67,648.2
2006	0.0	0.0	1.8	85.8	0.4	61.0	160.9	956.8	28,654.5	7,876.4	0.0	864.1	159.2	3.7	0.0	7.7	17.7	6.1	38,856.1
2007	0.0	12.7	96.8	1,165.3	7.5	36.7	622.6	7,267.7	25,345.9	4,084.4	0.0	1,064.5	13.9	8.0	0.0	20.5	12.7	12.7	39,771.7
2008	0.0	0.9	20.5	84.9	0.0	48.3	299.7	15,168.7	21,571.4	4,147.6	868.3	541.0	15.1	9.3	52.4	1.5	0.5	0.0	42,830.0
2009	1.6	0.0	10.4	2.9	0.0	173.5	382.4	8,736.6	19,247.6	5,498.0	1,720.3	506.6	60.6	15.7	64.0	0.0	9.3	0.0	36,429.4
2010	0.0	0.0	6.6	0.0	0.0	17.8	82.1	16,610.8	17,973.5	4,115.2	1,668.6	199.9	33.0	3.9	0.9	0.0	12.5	0.0	40,724.9

Table 7.8.3 Head Boat Survey (HBS) annual landings (numbers and kilograms) of yellowtail snapper by Atlantic (NC-SE FL) and Gulf (FL Keys-TX) regions, 1981-2010. Data for the Gulf of Mexico was not collected prior to 1986, so the "Gulf region" includes estimates for areas 18-27 (shaded in blue) for 1981-1985. Total weight is shown in metric tons (mt).

	numbers of fish			kilograms of fish		
	Atlantic Region	Gulf Region		Atlantic Region	Gulf Region	
Year	NC - SE FL	FL Keys - TX	Total	NC - SE FL	FL Keys - TX	Total (mt)
1981	85,545	76,460	162,005	59,927	47,179	107.106
1982	60,536	144,988	205,524	41,896	93,631	135.527
1983	34,994	176,046	211,040	24,149	103,069	127.218
1984	33,961	127,079	161,039	21,570	72,880	94.450
1985	25,770	115,929	141,699	15,099	67,907	83.006
1986	30,530	172,664	203,194	18,575	104,725	123.299
1987	37,043	193,755	230,798	17,791	111,922	129.713
1988	55,253	230,564	285,817	29,260	130,517	159.776
1989	45,044	115,666	160,710	26,679	72,048	98.728
1990	49,226	165,976	215,203	24,412	112,088	136.500
1991	53,551	155,182	208,733	25,787	100,707	126.494
1992	55,624	143,843	199,467	28,036	88,846	116.882
1993	46,052	164,595	210,647	25,810	100,512	126.323
1994	77,001	160,086	237,088	38,578	89,613	128.191
1995	36,444	119,525	155,969	21,816	63,010	84.826
1996	23,445	110,979	134,424	13,050	57,128	70.178
1997	27,014	112,110	139,124	15,230	58,759	73.989
1998	16,159	101,312	117,471	9,108	50,315	59.423
1999	24,786	77,243	102,029	14,055	38,803	52.858
2000	12,234	95,029	107,263	6,355	45,160	51.515
2001	5,039	96,312	101,351	2,662	47,704	50.366
2002	2,834	117,674	120,508	1,630	59,024	60.654
2003	10,455	97,738	108,193	5,810	48,572	54.382
2004	8,613	109,363	117,976	4,125	50,530	54.656
2005	17,069	130,486	147,555	8,883	64,131	73.013
2006	2,803	94,199	97,002	1,413	45,874	47.288
2007	19,542	83,873	103,415	10,037	40,916	50.953
2008	32,710	69,631	102,341	16,862	33,572	50.434
2009	20,288	66,854	87,142	10,249	31,052	41.300
2010	38,783	63,102	101,885	19,139	28,887	48.026

Table 7.8.4 Head Boat Survey (HBS) annual number of yellowtail snapper measured by TL size class (inches) from the Atlantic region (NC-SE FL), 1981-2010. Some measurements with lengths less than 6” or 31” or greater were excluded.

	TL inch class																									
Year	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	Total
1981	0	0	0	1	0	6	32	65	121	108	79	47	51	65	43	23	17	8	2	0	0	0	0	0	0	668
1982	0	0	0	0	1	6	27	27	54	79	88	90	31	31	17	6	9	8	0	1	1	0	0	0	1	477
1983	0	0	0	0	8	13	54	89	150	144	150	127	78	68	49	33	13	8	6	2	2	0	2	1	1	998
1984	0	0	0	1	12	18	62	110	166	144	138	109	75	53	29	25	15	3	0	1	1	0	1	0	1	964
1985	0	0	0	0	16	25	78	147	156	157	131	87	47	45	20	17	11	4	1	0	0	0	0	0	0	942
1986	0	0	0	0	3	15	107	144	252	142	90	97	64	38	39	30	11	9	6	1	0	0	0	0	0	1048
1987	0	0	2	1	10	35	209	281	183	107	74	56	40	12	9	9	2	3	1	2	1	0	0	0	0	1037
1988	0	0	0	1	5	6	64	101	134	76	42	35	23	11	5	9	5	1	0	0	0	0	0	0	0	518
1989	0	0	1	4	6	15	57	140	152	135	101	97	43	33	33	10	7	2	1	1	0	0	0	0	0	838
1990	0	0	0	0	2	4	36	75	64	49	25	27	10	3	2	0	0	0	0	0	0	0	0	0	0	297
1991	0	0	0	2	0	13	54	107	90	74	28	26	8	8	1	1	0	1	0	0	0	0	0	0	0	413
1992	0	0	0	0	1	9	77	99	83	51	40	31	16	13	5	2	0	0	0	0	1	0	0	0	0	428
1993	0	0	0	1	2	1	47	94	83	75	54	53	17	11	7	5	1	0	2	1	2	0	0	0	0	456
1994	0	0	0	0	0	3	77	138	119	78	48	35	24	8	2	4	0	1	0	0	0	0	0	0	0	537
1995	0	1	2	8	1	0	15	53	58	96	106	49	21	12	6	5	0	0	0	1	2	1	0	0	0	437
1996	0	0	0	0	2	2	3	1	2	11	8	3	0	0	0	0	0	0	0	0	0	1	0	0	0	33
1997	0	0	0	2	3	9	62	111	167	171	134	87	59	11	5	3	2	1	0	0	1	1	0	1	0	830
1998	0	0	1	5	1	21	90	137	135	160	122	113	45	33	13	7	3	0	0	0	0	0	0	0	0	886
1999	0	0	1	1	2	8	47	85	123	108	74	88	40	17	4	1	1	0	1	1	0	0	0	0	0	602
2000	0	0	0	0	1	8	74	133	114	82	62	61	31	9	3	2	0	1	0	0	0	0	0	0	0	581
2001	0	0	0	0	1	9	73	84	90	113	70	47	27	13	3	0	0	0	0	0	0	0	0	0	0	530
2002	0	0	0	1	3	8	42	118	154	140	113	90	38	16	12	3	4	0	1	1	2	1	0	0	0	747
2003	0	0	0	0	0	22	111	205	275	268	182	138	87	26	9	7	1	0	0	0	1	0	1	2	1	1336
2004	0	0	0	1	2	30	221	347	350	237	156	71	37	9	4	3	0	0	0	0	0	2	0	0	0	1470
2005	0	0	0	1	3	13	198	300	292	272	229	156	59	15	10	3	0	0	0	0	0	0	0	0	0	1551
2006	0	0	0	2	28	41	242	363	360	289	208	151	57	24	14	4	5	0	0	1	0	0	0	0	0	1789
2007	0	0	0	0	2	13	295	477	456	432	340	210	62	16	11	5	2	1	1	0	1	0	0	0	0	2324
2008	0	0	0	2	1	21	132	181	209	147	131	102	30	21	4	1	0	0	0	0	0	0	0	0	1	983
2009	0	0	0	0	0	6	105	176	148	101	70	44	26	14	4	4	2	0	1	0	1	0	0	0	0	702
2010	0	0	0	0	0	5	93	126	117	87	51	33	16	10	6	0	0	0	0	1	0	0	0	0	0	545

Table 7.8.5 Head Boat Survey (HBS) annual number of yellowtail snapper measured by TL size class (inches) from the Gulf region (FL Keys-TX), 1981-2010. Some measurements with lengths less than 6" or 31" or greater were excluded.

	TL Inch Class																									
Year	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	Total
1981	0	0	1	16	91	107	163	199	267	221	173	108	88	100	72	45	42	24	14	7	2	2	0	0	0	1742
1982	0	0	2	17	59	126	161	230	324	367	336	256	176	119	96	62	49	25	14	10	4	0	1	0	0	2434
1983	0	0	2	23	130	172	261	296	390	398	337	273	154	127	75	57	28	21	9	2	5	0	2	1	1	2764
1984	0	0	1	6	110	216	293	332	396	398	387	289	176	136	71	44	30	9	5	2	1	1	1	0	1	2905
1985	0	0	0	3	58	98	289	376	419	435	346	254	131	115	58	47	37	16	14	2	1	0	0	0	0	2699
1986	0	0	0	1	8	56	290	436	701	514	325	285	144	142	100	59	52	18	25	1	3	0	0	1	0	3161
1987	0	0	0	0	10	64	373	527	490	435	299	226	119	116	79	30	36	20	24	4	2	0	0	0	0	2854
1988	0	0	0	2	12	50	261	274	295	227	160	127	81	74	39	22	15	9	11	2	1	1	0	0	1	1664
1989	0	0	1	6	11	29	152	325	436	419	307	243	126	117	80	37	35	12	17	3	0	1	0	1	0	2358
1990	0	0	0	1	6	7	100	205	205	200	147	147	82	74	55	45	30	16	22	4	2	0	0	0	0	1348
1991	0	0	0	0	9	29	187	260	242	254	173	159	73	88	63	61	39	26	12	8	2	1	0	0	1	1687
1992	0	1	0	2	17	20	144	208	180	186	129	136	52	42	25	38	24	23	8	3	2	0	0	1	0	1241
1993	0	0	0	4	15	18	232	354	309	303	193	160	67	81	33	42	36	31	15	15	4	0	2	0	0	1914
1994	0	0	0	1	4	23	268	464	444	380	216	160	95	66	27	42	19	20	7	4	0	2	0	0	0	2242
1995	0	0	0	1	3	12	222	332	295	308	255	109	51	23	16	12	4	1	5	2	1	0	0	0	0	1652
1996	0	0	0	4	6	14	247	292	275	253	201	92	61	28	6	10	2	2	3	1	1	0	0	0	0	1498
1997	0	0	0	5	10	20	353	532	425	376	297	191	106	40	21	11	7	8	2	0	3	2	1	1	0	2411
1998	0	0	1	8	7	74	373	509	385	364	226	157	66	55	17	11	4	0	1	0	0	0	0	0	0	2258
1999	0	0	1	2	12	14	260	327	342	267	141	116	61	26	8	3	6	1	2	1	0	0	0	0	0	1590
2000	0	0	0	0	3	23	294	386	367	207	123	85	41	13	3	6	4	4	1	0	0	0	0	0	0	1560
2001	0	0	0	0	7	15	231	308	294	245	157	81	42	20	9	3	3	1	1	0	0	0	0	0	0	1417
2002	0	0	0	1	5	10	219	472	268	305	208	93	53	18	15	4	4	2	1	0	1	0	0	0	0	1679
2003	0	0	0	0	8	30	367	590	611	469	244	149	100	28	13	8	2	0	0	0	2	0	1	2	1	2625
2004	0	0	0	2	16	52	393	581	544	341	185	84	46	9	6	5	1	1	3	0	0	2	0	0	0	2271
2005	0	0	0	2	27	38	355	554	475	391	294	172	66	18	10	6	4	0	0	1	0	0	0	0	0	2413
2006	0	0	0	2	39	51	380	650	595	413	267	167	70	30	18	6	7	1	2	0	0	0	0	0	0	2698
2007	0	0	0	3	10	21	495	802	615	525	400	215	68	19	11	6	3	1	1	1	0	0	0	0	0	3196
2008	0	0	0	4	14	29	342	528	428	289	203	125	47	26	12	6	2	1	3	0	0	0	0	0	0	2059
2009	0	0	0	2	13	18	342	538	348	184	119	62	34	25	10	7	7	4	2	1	0	0	0	0	0	1716
2010	0	0	0	2	14	23	300	372	252	175	98	61	29	17	9	2	0	0	0	0	0	1	1	0	0	1356

Table 7.8.6 Head Boat Survey (HBS) annual number of yellowtail snapper in the landings estimated at age (with age-length keys) from the Atlantic region (NC-SE FL), 1981-2010.

	Age Class (years)													
Year	0	1	2	3	4	5	6	7	8	9	10	11	12+	totals
1981	0	812	40,234	23,429	15,454	2,284	2,620	352	296	0	32	0	32	85,545
1982	0	1,518	9,311	35,208	9,145	2,802	1,629	708	118	0	48	0	48	60,536
1983	0	644	12,690	12,580	6,506	970	1,140	254	88	0	61	0	61	34,994
1984	0	612	15,462	11,438	3,073	2,421	625	216	80	0	18	0	18	33,961
1985	0	914	10,667	10,747	2,414	635	281	62	44	0	3	0	3	25,770
1986	0	625	14,298	6,799	6,182	994	975	189	120	118	62	21	149	30,530
1987	3	2,762	21,493	8,713	2,726	482	557	78	43	52	27	12	94	37,043
1988	0	923	17,344	20,578	11,737	2,861	1,355	150	131	96	47	9	22	55,253
1989	2	808	11,790	15,882	11,728	2,679	1,565	211	123	95	57	21	83	45,044
1990	0	333	6,917	20,429	16,365	3,953	1,129	47	18	13	11	4	6	49,226
1991	0	769	18,697	25,191	6,650	928	393	578	216	10	103	0	15	53,551
1992	0	667	25,219	24,268	2,362	1,372	516	1,033	45	14	49	8	70	55,624
1993	0	247	15,433	18,722	8,073	1,271	1,257	477	101	59	110	31	272	46,052
1994	0	72	20,143	37,588	14,502	1,556	623	476	1,525	11	489	0	17	77,001
1995	34	912	6,018	19,044	8,234	1,308	467	31	75	36	85	21	180	36,444
1996	0	1,813	8,018	5,862	4,695	2,034	490	89	89	89	89	0	178	23,445
1997	0	168	3,313	12,215	6,622	2,500	1,073	431	416	145	73	28	30	27,014
1998	1	492	4,623	7,008	2,270	936	487	162	32	66	84	0	0	16,159
1999	2	1,312	10,372	7,934	3,708	818	374	150	60	20	16	0	21	24,786
2000	0	145	6,439	2,894	1,004	605	327	268	207	179	103	24	40	12,234
2001	0	112	2,063	1,360	734	352	263	52	62	0	29	0	11	5,039
2002	0	62	1,134	1,105	311	104	51	27	8	7	10	2	13	2,834
2003	0	788	6,292	2,557	473	140	119	28	4	21	8	3	23	10,455
2004	0	237	4,905	2,357	791	180	60	65	1	6	2	1	7	8,613
2005	0	456	7,090	7,857	1,051	383	126	72	6	7	6	0	16	17,069
2006	0	75	1,873	621	208	17	6	1	1	0	0	0	1	2,803
2007	0	836	9,800	8,056	597	152	33	22	2	1	0	2	42	19,542
2008	0	2,455	15,321	11,367	2,925	326	219	28	39	0	0	3	28	32,710
2009	0	390	10,769	6,499	1,982	433	118	6	8	2	0	5	78	20,288
2010	0	131	21,319	14,909	1,653	359	204	87	51	12	0	12	47	38,783

Table 7.8.7 Head Boat Survey (HBS) annual number of yellowtail snapper in the landings estimated at age (with age-length keys) from the Gulf region (FL Keys-TX), 1981-2010.

	Age Class (years)													
Year	0	1	2	3	4	5	6	7	8	9	10	11	12+	totals
1981	1	1,159	13,860	19,508	13,132	10,367	6,598	4,638	3,112	1,323	937	844	979	76,460
1982	3	1,271	17,766	44,305	25,563	22,083	11,417	7,861	9,410	1,710	1,387	1,017	1,194	144,988
1983	3	2,378	20,521	30,716	64,605	21,796	13,937	9,736	5,948	1,914	1,611	1,503	1,377	176,046
1984	1	1,035	20,406	31,607	30,269	17,918	10,480	7,391	4,204	1,190	938	951	688	127,079
1985	0	516	15,543	30,652	29,476	15,913	9,223	6,575	3,864	1,260	1,018	1,031	857	115,929
1986	0	440	15,461	39,090	41,222	29,089	19,163	10,761	7,090	3,724	2,093	1,711	2,820	172,664
1987	0	604	20,575	46,557	45,969	31,270	20,135	10,989	7,100	3,845	2,072	1,719	2,920	193,755
1988	0	967	26,697	55,755	54,108	36,745	23,555	12,768	8,167	4,376	2,305	1,953	3,168	230,564
1989	1	384	9,245	24,882	27,829	20,198	13,519	7,546	4,947	2,610	1,442	1,160	1,902	115,666
1990	0	393	12,685	33,676	37,744	28,253	19,455	11,779	8,196	4,580	2,686	2,283	4,247	165,976
1991	0	0	15,837	26,746	43,124	19,370	15,378	11,284	10,197	5,128	1,559	2,687	3,872	155,182
1992	39	147	15,483	43,298	39,365	11,609	9,426	7,929	6,542	3,064	1,012	2,301	3,629	143,843
1993	0	104	12,254	41,048	33,655	21,034	18,231	12,750	13,668	4,544	958	2,169	4,180	164,595
1994	0	22	23,814	40,357	29,247	23,059	13,048	8,909	11,854	5,393	1,033	1,737	1,613	160,086
1995	0	22	2,918	28,398	35,933	18,261	15,400	6,974	5,275	3,891	290	1,213	952	119,525
1996	0	131	4,370	16,375	22,741	30,017	16,127	8,075	7,037	4,366	612	715	413	110,979
1997	0	595	9,309	27,782	20,264	20,908	17,629	7,071	2,877	2,924	691	1,269	790	112,110
1998	0	166	8,592	30,468	27,910	12,833	7,234	6,729	3,218	2,016	1,324	760	62	101,312
1999	0	185	10,926	13,333	18,578	16,766	8,310	4,570	2,766	1,145	420	49	195	77,243
2000	0	1,171	13,352	21,865	22,791	13,904	10,495	5,437	2,513	1,850	754	730	167	95,029
2001	0	1,033	16,764	26,459	22,342	11,969	9,069	4,004	2,540	369	826	800	137	96,312
2002	0	55	17,217	30,373	25,669	23,226	12,115	3,620	2,225	1,648	843	195	487	117,674
2003	0	1,277	6,373	34,938	27,678	10,142	7,767	4,255	2,851	1,098	103	591	665	97,738
2004	0	267	8,562	34,249	33,239	16,987	8,595	4,351	2,132	111	25	113	732	109,363
2005	0	174	15,049	41,267	36,712	20,292	8,218	3,499	1,287	1,974	1,283	423	309	130,486
2006	0	58	5,749	25,548	24,199	16,835	9,202	3,362	3,927	2,197	2,168	4	952	94,199
2007	0	42	4,511	17,853	28,709	15,841	13,777	1,729	983	7	332	30	58	83,873
2008	0	178	6,229	14,797	23,581	10,871	6,299	3,254	2,432	724	283	392	591	69,631
2009	0	100	13,795	20,723	10,518	9,889	5,471	3,332	1,349	704	236	204	531	66,854
2010	0	495	8,245	19,873	17,514	7,720	4,735	2,063	1,151	681	134	288	204	63,102

Table 7.8.8 Number of yellowtail snapper otoliths sampled annually from head boats in the Atlantic region (NC-SE FL), 1981-2010.

	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	total
1981	0	3	91	39	19	4	7	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	164
1982	0	4	24	104	26	10	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	173
1983	0	17	264	201	46	5	6	3	2	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	546
1984	0	2	100	73	18	16	3	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	214
1985	0	31	51	69	28	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	180
1986	0	4	31	11	11	4	1	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	65
1987	0	4	29	15	3	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	52
1988	0	0	2	6	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9
1989	0	0	2	5	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9
1990	0	0	22	50	37	8	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	120
1991	0	0	2	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
1992	0	0	3	10	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15
1993	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
1994	0	0	14	14	10	1	3	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	43
1995	0	3	46	126	49	7	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	233
1996	0	0	8	17	25	8	4	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	65
1997	0	0	16	38	27	10	2	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	95
1998	0	15	118	146	36	16	8	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	343
1999	0	2	70	75	23	5	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	178
2000	0	0	38	17	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	59
2001	0	0	6	19	4	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30
2002	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
2003	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	0	10	236	100	29	4	0	3	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	383
2005	0	9	168	218	24	10	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	431
2006	0	19	253	76	27	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	377
2007	0	28	306	354	29	9	3	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	730
2008	0	23	212	192	53	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	484
2009	0	7	180	94	18	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	304
2010	0	2	237	155	13	4	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	413

Table 7.8.9 Number of yellowtail snapper otoliths sampled annually from head boats in the Gulf region (FL Keys-TX), 1981-2010.

	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	total
1981	0	11	85	84	54	42	27	12	4	8	4	1	1	0	0	0	0	1	0	0	0	0	0	0	334
1982	0	0	10	24	9	5	2	7	4	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	62
1983	0	0	2	3	42	1	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	51
1984	0	0	0	0	1	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	3
1985	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
1986	0	0	8	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9
1987	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
1988	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
1989	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
1990	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
1991	0	0	5	3	12	5	0	0	0	1	0	2	1	0	0	0	0	0	0	0	0	0	0	0	29
1992	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
1993	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
1994	0	0	14	11	7	4	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	37
1995	0	0	3	17	9	7	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	39
1996	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
1997	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
1998	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
1999	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	0	0	1	1	2	1	1	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9
2001	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
2002	0	0	0	0	1	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
2003	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
2004	0	0	2	9	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12
2005	0	0	4	6	2	1	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16
2006	0	0	0	3	0	3	2	1	0	0	1	0	1	0	2	0	0	0	0	0	0	0	0	0	13
2007	0	0	1	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
2008	0	0	9	29	44	25	13	6	3	1	0	2	0	0	0	1	0	0	0	0	0	0	0	0	133
2009	0	0	48	85	39	29	22	15	7	6	0	2	3	1	0	2	0	0	0	0	0	0	0	0	259
2010	0	0	24	104	77	37	23	7	8	3	1	2	1	2	0	0	0	0	0	0	0	0	0	0	289

Table 7.8.10 Proportion of yellowtail snapper by age from age samples (otoliths) from head boats in the Atlantic (NC-SE FL) and Gulf regions (FL Keys-TX), 1981-2010 used in direct ageing model runs. When samples were not available on one or both coasts in a year, the age compositions were set as missing values (“-999”). The annual “effective sample size” (ESS) for the proportion at age was set as the square root of the number of ages available to derive the proportions.

Proportion at Age (DA) of Landed Fish

Year	1	2	3	4	5	6	7	8	9	10	11	12+	No. of ages	initial ESS
1981	0.0252	0.4123	0.2443	0.1376	0.0725	0.0608	0.0203	0.0057	0.0114	0.0057	0.0014	0.0028	498	22
1982	0.0068	0.1547	0.4497	0.1467	0.0740	0.0296	0.0816	0.0457	0.0000	0.0114	0.0000	0.0000	235	15
1983	0.0051	0.1123	0.1097	0.7020	0.0179	0.0018	0.0173	0.0006	0.0000	0.0167	0.0164	0.0003	597	24
1984	0.0020	0.0977	0.0713	0.2812	0.0156	0.2666	0.0020	0.0000	0.0000	0.0000	0.0000	0.2636	217	15
1985	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	0	0
1986	0.0090	0.8289	0.1196	0.0246	0.0090	0.0022	0.0045	0.0022	0.0000	0.0000	0.0000	0.0000	74	9
1987	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	0	0
1988	0.0000	0.8548	0.1244	0.0207	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	10	3
1989	0.0000	0.0593	0.1482	0.0000	0.7332	0.0296	0.0296	0.0000	0.0000	0.0000	0.0000	0.0000	10	3
1990	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	0	0
1991	0.0000	0.2287	0.1767	0.3610	0.1298	0.0000	0.0000	0.0000	0.0260	0.0000	0.0519	0.0260	34	6
1992	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	0	0
1993	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	0	0
1994	0.0000	0.3619	0.3061	0.2027	0.0816	0.0218	0.0000	0.0000	0.0258	0.0000	0.0000	0.0000	80	9
1995	0.0029	0.1044	0.4598	0.2261	0.1454	0.0208	0.0396	0.0010	0.0000	0.0000	0.0000	0.0000	272	16
1996	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	0	0
1997	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	0	0
1998	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	0	0
1999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	0	0
2000	0.0000	0.1697	0.1306	0.2052	0.0989	0.0989	0.1978	0.0000	0.0989	0.0000	0.0000	0.0000	68	8
2001	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	0	0
2002	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	0	0
2003	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	0	0
2004	0.0019	0.1987	0.7151	0.0828	0.0007	0.0000	0.0006	0.0000	0.0002	0.0000	0.0000	0.0000	395	20
2005	0.0023	0.2657	0.3897	0.1172	0.0581	0.1112	0.0003	0.0000	0.0555	0.0000	0.0000	0.0000	447	21
2006	0.0014	0.0186	0.2300	0.0020	0.2245	0.1496	0.0748	0.0000	0.0000	0.0748	0.0000	0.2244	390	20
2007	0.0070	0.2809	0.0885	0.0073	0.4110	0.2051	0.0000	0.0003	0.0000	0.0000	0.0000	0.0000	734	27
2008	0.0148	0.1830	0.2737	0.2619	0.1301	0.0679	0.0317	0.0162	0.0052	0.0000	0.0104	0.0052	617	25
2009	0.0052	0.2772	0.3239	0.1299	0.0896	0.0665	0.0448	0.0209	0.0179	0.0000	0.0060	0.0179	563	24
2010	0.0018	0.2671	0.3657	0.1783	0.0837	0.0516	0.0151	0.0173	0.0065	0.0022	0.0043	0.0065	702	26

Table 7.8.11 Annual harvest (landings and dead discards in numbers of fish) of yellowtail snapper for states in the southeastern US by recreational saltwater anglers, 1981-2010.

Year	TX*	LA	AL	West FL	East FL	GA	SC	NC	SE Region	% harvested in Florida
1981	0	0	814	1,333,706	344,503	0	0	0	1,679,023	100.0%
1982	0	0	0	1,173,319	417,678	877	3,697	0	1,595,571	99.7%
1983	31,756	0	0	558,546	196,781	0	0	0	787,083	96.0%
1984	0	0	0	1,475,698	110,238	0	0	0	1,585,936	100.0%
1985	0	1,088	0	427,545	343,164	0	0	0	771,797	99.9%
1986	---	0	0	237,692	103,226	0	0	0	340,919	100.0%
1987	---	0	0	408,474	55,668	0	0	0	464,142	100.0%
1988	---	0	0	290,569	198,257	0	0	0	488,826	100.0%
1989	---	0	0	621,863	72,352	0	129	0	694,344	100.0%
1990	---	0	0	714,397	116,204	0	0	265	830,866	100.0%
1991	---	0	0	862,702	138,428	0	0	0	1,001,130	100.0%
1992	---	0	0	371,381	153,936	0	0	325	525,642	99.9%
1993	---	0	0	428,593	229,134	411	0	0	658,138	99.9%
1994	---	0	0	355,405	112,988	0	0	0	468,393	100.0%
1995	---	0	0	351,082	74,061	0	0	0	425,143	100.0%
1996	---	0	0	239,218	73,596	0	0	0	312,815	100.0%
1997	---	0	60	326,698	56,070	0	0	0	382,829	100.0%
1998	---	0	0	245,232	92,559	14,467	0	0	352,259	95.9%
1999	---	0	0	202,296	65,408	0	0	0	267,704	100.0%
2000	---	0	0	131,867	113,362	17	0	0	245,245	100.0%
2001	---	0	0	102,883	85,637	0	0	0	188,520	100.0%
2002	---	0	0	210,382	61,027	0	0	99	271,507	100.0%
2003	---	37	0	271,303	90,020	0	2,382	0	363,742	99.3%
2004	---	0	0	280,087	216,676	0	16	0	496,780	100.0%
2005	---	110	0	127,439	325,819	0	0	75	453,443	100.0%
2006	---	215	116	192,219	321,735	0	0	0	514,285	99.9%
2007	---	0	0	269,880	395,988	0	40	125	666,033	100.0%
2008	---	296	0	337,007	248,449	0	59	62	585,873	99.9%
2009	---	0	0	118,700	148,430	0	1,130	0	268,260	99.6%
2010	---	0	0	172,613	150,938	0	0	58	323,609	100.0%

*Texas participated in the MRFSS only during 1981-1985.

Table 7.8.12 Annual harvest (landings and dead discards in kilograms whole weight) of yellowtail snapper for states in the southeastern US by recreational saltwater anglers, 1981-2010.

Year	TX*	LA	AL	West FL	East FL	GA	SC	NC	SE Region	% harvested in Florida
1981	0	0	289	489,858	138,531	0	0	0	628,678	100.0%
1982	0	0	0	490,066	152,224	88	1,602	0	643,980	99.7%
1983	13,276	0	0	198,028	117,068	0	0	0	328,373	96.0%
1984	0	0	0	453,237	60,725	0	0	0	513,962	100.0%
1985	0	653	0	213,083	273,658	0	0	0	487,394	99.9%
1986	---	0	0	130,089	71,361	0	0	0	201,451	100.0%
1987	---	0	0	275,753	25,864	0	0	0	301,617	100.0%
1988	---	0	0	201,349	134,121	0	0	0	335,470	100.0%
1989	---	0	0	567,506	42,414	0	77	0	609,998	100.0%
1990	---	0	0	477,122	50,782	0	0	159	528,063	100.0%
1991	---	0	0	804,680	75,955	0	0	0	880,635	100.0%
1992	---	0	0	321,549	77,926	0	0	154	399,630	100.0%
1993	---	0	0	241,813	140,009	215	0	0	382,037	99.9%
1994	---	0	0	216,825	56,995	0	0	0	273,820	100.0%
1995	---	0	0	184,801	41,296	0	0	0	226,097	100.0%
1996	---	0	0	157,746	34,478	0	0	0	192,224	100.0%
1997	---	0	31	242,897	11,848	0	0	0	254,775	100.0%
1998	---	0	0	150,858	40,949	6,534	0	0	198,342	96.7%
1999	---	0	0	118,341	29,502	0	0	0	147,843	100.0%
2000	---	0	0	68,043	75,259	13	0	0	143,315	100.0%
2001	---	0	0	71,214	42,857	0	0	0	114,071	100.0%
2002	---	0	0	114,736	26,103	0	0	47	140,886	100.0%
2003	---	26	0	154,984	40,340	0	1,187	0	196,537	99.4%
2004	---	0	0	175,871	101,601	0	12	0	277,484	100.0%
2005	---	53	0	67,461	139,975	0	0	110	207,600	99.9%
2006	---	195	60	93,341	131,559	0	0	0	225,156	99.9%
2007	---	0	0	159,158	168,910	0	22	244	328,335	99.9%
2008	---	150	0	186,948	118,704	0	47	42	305,891	99.9%
2009	---	0	0	54,143	76,121	0	667	0	130,931	99.5%
2010	---	0	0	96,475	66,879	0	0	30	163,383	100.0%

*TX participated in the MRFSS only during 1981-1985.

Table 7.8.13 Number of yellowtail snapper length measurements (converted to total length classes) from the MRFSS, 1981-2010 on the Atlantic region.

	TL inch class																											
Year	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	29	30	Total
1981	0	0	0	4	3	5	7	7	9	15	20	6	2	3	1	0	0	0	0	1	0	0	0	0	0	0	0	83
1982	0	0	0	2	0	5	6	7	1	1	6	2	3	2	2	5	0	1	1	2	0	0	0	0	0	0	0	46
1983	0	0	0	3	1	3	2	3	4	6	14	11	10	12	8	8	3	3	3	1	1	0	1	0	0	0	0	97
1984	0	0	0	1	0	4	5	4	6	7	6	16	21	21	21	2	3	0	8	0	0	0	0	0	0	0	0	125
1985	0	0	0	0	1	0	0	0	0	2	1	0	1	4	5	1	0	1	1	0	0	0	0	0	0	0	0	17
1986	0	0	0	0	1	0	1	1	8	0	1	0	0	10	6	0	8	0	0	0	0	0	0	0	0	0	0	36
1987	0	0	0	0	0	0	0	0	0	1	2	1	1	4	3	2	1	1	0	0	0	0	0	0	0	0	0	16
1988	0	0	0	0	1	0	1	2	2	1	3	6	7	15	9	5	9	5	1	2	2	0	0	2	0	0	0	73
1989	0	0	0	0	0	0	2	2	0	0	0	0	1	3	3	2	3	4	0	0	0	0	0	0	0	0	0	20
1990	0	0	0	0	0	2	0	0	0	0	2	1	0	1	2	0	2	4	0	0	0	0	0	0	0	0	0	14
1991	0	0	0	0	0	0	0	0	1	1	1	2	0	1	2	0	0	0	1	0	0	0	0	0	0	0	0	9
1992	0	0	0	0	0	0	0	4	6	15	7	2	2	6	0	0	0	2	1	0	0	0	0	0	0	0	0	45
1993	0	0	0	0	1	0	1	0	1	8	9	14	6	4	5	5	1	1	1	1	0	0	0	0	0	0	0	58
1994	0	0	0	0	0	0	0	1	3	4	7	8	1	3	0	3	2	0	0	0	0	0	0	0	0	0	0	32
1995	0	0	0	0	0	0	0	1	0	1	3	3	0	1	1	0	0	8	3	0	0	0	0	0	0	0	0	21
1996	0	0	0	0	0	1	0	2	9	8	16	5	2	4	2	2	0	0	0	0	0	0	0	0	0	0	0	51
1997	0	0	0	0	0	0	0	3	6	3	3	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18
1998	0	0	0	0	0	0	0	5	8	14	11	15	15	1	0	1	0	0	0	0	0	0	0	0	0	0	0	70
1999	0	0	0	0	0	0	1	4	9	14	12	3	6	5	3	1	0	0	1	0	0	0	0	0	0	0	0	59
2000	0	0	0	0	0	0	1	1	6	8	18	9	2	8	6	4	0	0	0	2	0	0	0	0	0	0	0	65
2001	0	0	0	0	0	0	0	11	46	47	54	25	24	18	4	3	0	0	0	0	0	0	0	0	0	0	0	232
2002	0	0	0	0	0	0	0	6	47	52	41	24	30	15	3	2	0	1	0	0	0	0	0	0	0	0	0	221
2003	0	0	0	0	0	1	0	8	70	100	80	64	28	12	10	1	1	2	0	0	1	0	0	0	0	0	0	378
2004	0	0	0	0	0	0	0	11	120	128	127	73	21	12	9	3	3	0	0	0	1	0	0	0	0	0	0	508
2005	0	0	5	4	0	0	0	23	112	104	106	81	36	28	8	8	0	0	1	0	0	0	0	0	0	0	0	516
2006	0	0	0	0	0	0	3	50	162	164	183	77	23	19	12	6	4	3	0	0	0	1	0	0	0	0	0	707
2007	0	0	0	0	0	1	0	16	130	147	180	97	72	18	14	1	1	0	1	0	1	0	0	0	0	0	0	679
2008	0	0	0	0	0	2	1	8	110	94	67	53	37	15	10	4	4	1	0	0	0	0	0	0	0	0	0	406
2009	0	0	0	0	0	0	1	6	30	50	48	59	51	18	14	6	1	1	0	0	0	0	0	0	0	0	0	285
2010	0	0	0	0	0	0	1	7	51	41	52	44	26	18	4	3	0	0	0	0	0	0	0	0	0	0	0	247

Table 7.8.14 Number of yellowtail snapper length measurements (converted to total length classes) from the MRFSS, 1981-2010 on the Gulf region.

	TL inch class																											
Year	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	29	30	Total
1981	0	0	0	4	8	9	26	20	20	8	10	18	12	7	2	4	4	1	3	3	2	0	1	0	0	0	0	162
1982	0	1	4	5	4	8	3	10	16	19	17	12	22	16	24	13	11	7	7	4	2	0	0	0	0	0	0	205
1983	1	0	3	0	1	4	10	22	32	48	32	29	23	13	15	5	2	0	0	1	1	0	0	0	0	0	0	242
1984	0	0	0	3	4	2	4	7	7	2	11	4	4	1	2	2	6	1	2	2	0	0	0	0	0	0	0	64
1985	0	0	0	1	2	1	2	1	2	3	5	7	3	6	6	3	5	1	3	4	0	0	0	0	0	0	0	55
1986	0	0	0	0	1	0	2	1	1	1	0	5	12	0	0	0	2	4	5	6	1	3	0	0	0	0	0	44
1987	0	0	0	0	1	1	4	5	6	17	18	13	12	11	10	3	2	3	5	2	2	2	0	0	0	0	0	117
1988	0	0	0	0	0	0	0	4	8	8	3	4	7	16	5	11	1	5	2	5	3	0	0	0	0	1	0	83
1989	0	0	0	0	1	0	2	3	7	9	13	15	7	7	5	9	9	5	4	5	4	0	2	0	0	0	0	107
1990	0	0	0	0	0	1	0	1	4	11	9	6	9	11	5	2	0	0	1	0	1	0	0	0	0	0	0	61
1991	0	0	0	0	0	0	1	3	5	10	16	15	15	12	14	12	8	9	15	10	5	1	0	0	0	0	0	151
1992	0	0	0	0	0	0	1	3	4	8	9	12	14	31	19	15	14	8	6	9	3	3	0	0	1	0	0	160
1993	0	0	0	0	1	1	4	9	38	41	44	24	21	2	5	4	3	4	3	1	0	1	1	0	0	0	0	207
1994	0	0	0	1	1	0	1	7	26	40	38	49	29	23	10	10	6	7	6	3	4	1	1	0	0	0	0	263
1995	0	0	0	1	0	0	0	6	18	23	38	27	16	5	4	5	2	4	3	1	0	0	0	0	0	0	0	153
1996	0	0	0	0	0	0	2	7	0	7	6	22	15	13	6	0	1	0	3	0	0	0	0	0	0	0	0	82
1997	0	0	0	0	0	0	0	8	39	36	33	34	31	12	8	13	5	3	1	3	2	0	0	1	0	0	0	229
1998	0	0	0	0	0	1	2	8	52	94	88	68	49	25	18	15	4	4	6	3	3	1	1	1	0	0	0	443
1999	0	0	0	1	0	0	1	7	62	105	123	93	73	39	24	27	18	10	3	2	2	0	0	0	0	0	0	590
2000	0	0	0	0	0	0	1	13	44	106	101	89	50	33	24	17	13	10	6	10	1	3	2	0	0	0	0	523
2001	0	0	0	0	0	0	0	1	23	35	43	52	38	31	23	11	12	5	4	4	0	1	0	0	0	0	0	283
2002	0	0	0	0	0	0	1	12	52	82	62	74	31	26	16	7	6	5	9	10	6	1	2	1	0	0	0	403
2003	0	0	0	0	0	0	0	6	38	101	117	82	52	32	21	23	16	8	12	2	3	1	1	0	0	0	0	515
2004	0	0	0	0	0	0	0	2	46	101	102	82	72	37	22	22	11	2	6	5	2	0	0	0	0	0	0	512
2005	0	0	0	0	0	0	0	3	35	65	66	43	27	17	10	18	4	6	4	1	0	0	0	0	0	0	0	299
2006	0	0	0	0	0	0	0	3	67	83	46	45	38	17	7	2	2	4	5	2	0	1	0	0	0	0	0	322
2007	0	0	0	0	0	0	0	6	58	60	57	68	42	21	14	10	7	5	6	1	2	1	0	0	0	0	0	358
2008	0	0	0	0	0	0	1	3	29	72	81	75	29	22	8	3	3	7	3	4	2	1	0	0	0	0	0	343
2009	0	0	0	0	0	0	0	10	34	43	23	9	9	8	6	0	2	2	0	0	0	0	0	0	0	0	0	146
2010	0	0	0	0	0	0	0	15	73	80	97	64	41	34	17	7	4	2	4	0	2	0	0	0	0	0	0	440

Table 7.8.15 Annual number of yellowtail snapper landed by recreational anglers estimated at age (with age-length keys and MRFSS length data) from the Atlantic region (NC – SE FL), 1981-2010.

	Age (years)													
Year	0	1	2	3	4	5	6	7	8	9	10	11	12+	totals
1981	4,873	77,510	179,882	40,205	6,833	0	4,090	1,396	0	0	0	0	0	314,789
1982	3,970	107,708	81,731	102,280	27,612	11,147	17,223	5,067	1,021	0	0	0	0	357,759
1983	697	12,643	57,881	51,101	25,625	5,932	5,812	2,492	575	0	755	0	755	164,268
1984	7	8,639	31,875	29,252	7,527	6,453	1,330	387	188	0	0	0	0	85,656
1985	2,447	40,962	85,966	130,626	45,046	17,591	8,909	2,236	1,374	0	294	0	294	335,745
1986	110	7,614	31,079	11,599	38,043	5,644	6,614	1,388	511	221	366	0	38	103,227
1987	20	2,689	18,724	12,548	12,275	3,782	3,342	631	494	427	219	66	453	55,669
1988	167	7,479	28,155	49,635	69,044	17,477	14,931	2,999	1,519	1,747	988	484	3,632	198,257
1989	26	2,459	14,959	20,561	20,674	6,253	4,569	821	643	556	286	86	589	72,482
1990	41	3,469	11,488	35,297	40,844	13,463	7,077	1,320	1,033	893	459	138	948	116,469
1991	49	4,455	24,436	49,654	31,146	13,742	6,867	2,155	2,272	410	2,070	105	1,068	138,428
1992	0	3,066	77,711	55,067	5,719	3,525	3,370	3,006	1,434	146	1,216	0	0	154,261
1993	61	5,182	57,024	93,734	50,192	12,098	6,214	3,025	402	483	508	0	623	229,546
1994	0	588	22,969	55,593	26,295	3,963	562	1,150	1,305	0	562	0	0	112,988
1995	26	2,529	12,635	25,053	17,878	7,668	4,548	719	1,103	219	1,055	56	571	74,061
1996	0	4,511	39,233	15,790	10,364	3,310	389	0	0	0	0	0	0	73,597
1997	32	355	12,935	27,541	9,563	3,302	1,071	604	392	120	93	44	17	56,070
1998	0	3,059	36,005	45,979	14,841	4,269	2,059	593	0	202	19	0	0	107,027
1999	0	5,207	33,611	16,795	6,491	1,916	836	297	183	47	24	0	0	65,408
2000	0	2,344	52,319	26,654	9,909	7,301	3,789	2,525	2,277	3,116	1,186	869	1,091	113,379
2001	0	3,880	45,558	17,752	9,143	4,415	3,075	690	663	0	209	0	252	85,636
2002	0	3,483	34,165	17,397	3,724	1,343	613	237	58	46	24	0	37	61,127
2003	0	14,593	58,557	14,994	2,717	649	572	45	2	163	14	12	85	92,403
2004	0	7,464	135,884	49,674	15,266	4,019	1,148	1,886	69	304	170	101	709	216,693
2005	4,311	25,178	151,948	121,691	15,430	4,493	1,650	918	0	0	6	0	195	325,819
2006	0	7,913	253,269	45,414	12,572	1,187	1,000	0	0	0	0	0	381	321,736
2007	0	26,934	215,219	141,870	8,632	1,921	111	385	10	7	0	21	878	395,988
2008	0	28,535	133,129	66,682	16,064	2,330	1,509	166	95	0	0	0	0	248,511
2009	0	2,702	64,937	58,088	19,106	3,393	1,070	0	0	0	0	0	263	149,559
2010	0	870	84,670	57,937	5,154	910	864	376	157	0	0	0	0	150,938

Table 7.8.16 Annual number of yellowtail snapper landed by recreational anglers estimated at age (with age-length keys and MRFSS length data) from the Gulf region (FL Keys-TX), 1981-2010.

Year	0	1	2	3	4	5	6	7	8	9	10	11	12+	totals
1981	12,467	147,067	417,112	276,339	174,972	102,177	66,028	41,751	31,378	19,360	14,693	11,235	17,750	1,332,329
1982	18,124	78,511	148,394	231,062	149,579	174,749	105,664	83,898	73,479	18,141	13,887	12,055	12,531	1,120,073
1983	2,411	13,737	71,400	92,709	172,215	38,889	24,978	15,916	8,668	2,087	1,527	2,513	1,713	448,762
1984	23,566	139,937	299,285	267,437	224,625	129,440	90,006	90,416	47,295	21,386	12,479	19,134	14,886	1,379,892
1985	2,888	22,069	39,058	66,281	68,274	69,009	46,297	40,634	22,567	12,750	6,008	9,184	9,327	414,345
1986	117	4,338	13,175	25,461	32,628	31,622	24,857	21,947	22,018	17,037	10,305	10,251	23,936	237,692
1987	76	5,175	42,206	83,368	87,002	64,143	43,398	26,252	19,173	11,500	6,869	6,091	13,223	408,474
1988	0	735	22,264	44,177	55,756	47,610	35,506	24,318	19,019	12,938	6,840	7,078	14,327	290,569
1989	89	4,112	40,613	97,655	111,507	94,545	70,498	52,553	44,380	29,234	17,983	17,373	41,321	621,862
1990	0	5,152	67,531	157,328	177,143	124,963	81,111	41,321	25,278	13,637	6,362	5,344	9,227	714,397
1991	0	0	41,891	104,072	178,996	106,565	80,531	94,350	91,429	43,919	19,404	37,838	63,710	862,703
1992	0	0	20,530	65,340	90,401	34,774	36,994	40,156	30,056	14,277	7,055	10,163	21,634	371,381
1993	43	1,802	49,004	128,272	83,130	49,125	39,947	24,576	33,000	8,975	1,767	4,379	4,573	428,593
1994	404	1,512	44,428	77,610	60,709	51,511	29,583	24,303	32,602	13,943	4,673	5,572	8,554	355,404
1995	581	1,162	8,152	70,125	100,931	53,361	42,909	27,490	20,715	14,263	1,894	5,317	4,181	351,083
1996	0	304	11,699	32,034	41,709	54,210	42,846	18,323	20,443	10,561	3,577	2,462	1,049	239,218
1997	0	1,670	26,341	77,390	56,037	59,824	51,324	22,305	9,846	9,157	2,115	5,403	5,346	326,758
1998	0	301	17,890	67,032	65,080	32,197	18,959	16,993	9,330	7,116	4,383	3,522	2,431	245,233
1999	44	128	23,336	29,679	48,904	45,037	23,996	12,784	10,252	4,550	1,706	661	1,221	202,297
2000	0	1,399	14,550	26,096	29,898	21,341	16,069	8,638	4,646	3,814	1,523	2,133	1,759	131,866
2001	0	720	11,540	21,260	24,492	14,513	12,891	7,825	3,783	1,735	1,020	2,082	1,022	102,884
2002	0	33	30,756	53,059	40,069	39,864	20,910	7,863	6,326	3,787	2,138	1,379	4,198	210,382
2003	0	2,004	9,854	86,359	72,397	29,190	27,060	18,321	10,177	6,446	1,399	2,393	5,740	271,340
2004	0	57	15,021	67,390	79,838	52,752	27,367	16,999	10,886	2,584	731	2,776	3,687	280,087
2005	0	0	12,774	37,386	33,726	19,828	10,070	6,225	1,783	2,924	1,781	456	596	127,549
2006	0	0	10,772	52,882	49,065	32,498	18,854	7,073	8,322	5,428	5,425	73	2,158	192,549
2007	0	171	17,698	54,667	86,570	48,746	38,476	10,217	7,169	130	3,251	1,576	1,206	269,879
2008	0	435	22,845	66,127	112,031	53,698	31,555	16,898	15,548	6,061	2,806	4,207	5,092	337,303
2009	0	396	28,547	35,872	16,456	17,417	8,974	5,628	2,363	1,242	537	359	912	118,701
2010	0	1,066	17,926	49,313	49,814	23,097	15,221	6,528	4,317	2,340	774	1,250	968	172,613

Table 7.8.17 Number of yellowtail snapper otoliths sampled annually from recreational saltwater anglers in the Atlantic Region (NC-SE FL), 1981-2010.

	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	Total
1981	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
1982	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
1983	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
1984	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
1985	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
1986	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
1987	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
1988	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
1989	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
1990	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
1991	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
1992	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
1993	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
1994	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
1995	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
1996	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
1997	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
1998	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
1999	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	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
2001	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
2002	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
2003	0	40	150	37	5	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	235
2004	0	24	316	96	40	8	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	488
2005	0	26	197	120	23	6	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	378
2006	0	2	201	37	14	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	255
2007	0	0	2	9	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12
2008	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
2009	0	2	33	31	9	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	77
2010	0	0	86	76	8	3	3	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	179

Table 7.8.18 Number of yellowtail snapper otoliths sampled annually from recreational saltwater anglers in the Gulf region (FL Keys-TX), 1981-2010.

	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	Total
1981	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
1982	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
1983	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
1984	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
1985	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
1986	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
1987	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
1988	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
1989	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
1990	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
1991	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
1992	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
1993	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
1994	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
1995	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
1996	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
1997	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
1998	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
1999	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	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
2001	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
2002	0	0	27	51	39	47	18	8	5	9	5	0	0	1	0	1	0	0	0	0	0	0	0	0	211
2003	0	2	11	20	15	7	3	2	2	1	0	1	0	0	0	1	0	2	0	0	0	0	0	0	67
2004	0	0	4	3	7	2	1	1	2	2	0	1	1	0	0	1	0	0	0	0	0	0	0	0	25
2005	0	0	2	5	6	3	4	2	2	7	2	0	1	0	1	0	0	0	0	0	0	0	0	0	35
2006	0	0	7	10	13	13	7	1	5	1	5	0	1	0	0	0	0	0	0	0	0	0	0	0	63
2007	0	0	0	6	17	14	19	2	3	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	64
2008	0	0	11	28	57	41	29	11	14	2	1	0	0	1	0	0	0	0	0	0	0	0	0	0	195
2009	0	1	46	91	68	80	36	24	19	9	4	4	4	6	1	0	1	1	0	0	0	0	0	0	395
2010	0	5	23	59	71	41	30	18	12	9	3	5	1	1	1	0	2	0	0	0	0	0	0	0	281

Table 7.8.19 Proportion of yellowtail snapper by age from age samples (otoliths) from recreational saltwater anglers in the Atlantic (NC-SE FL) and Gulf regions (FL Keys-TX), 1981-2010 used in direct ageing model runs. When samples were not available on one or both coasts in a year, the age compositions were set as missing values (“-999”). The annual “effective sample size” (ESS) for the proportion at age was set as the square root of the number of ages available in a year for the fleet.

Proportion at Age (DA) for Landed Fish

Year	1	2	3	4	5	6	7	8	9	10	11	12+	No. of ages	initial ESS
1981	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	0	0
1982	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	0	0
1983	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	0	0
1984	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	0	0
1985	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	0	0
1986	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	0	0
1987	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	0	0
1988	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	0	0
1989	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	0	0
1990	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	0	0
1991	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	0	0
1992	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	0	0
1993	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	0	0
1994	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	0	0
1995	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	0	0
1996	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	0	0
1997	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	0	0
1998	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	0	0
1999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	0	0
2000	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	0	0
2001	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	0	0
2002	0.0000	0.0992	0.4124	0.1432	0.1726	0.0661	0.0294	0.0184	0.0331	0.0184	0.0000	0.0073	212	15
2003	0.0655	0.2846	0.2627	0.1724	0.0801	0.0345	0.0223	0.0223	0.0111	0.0000	0.0111	0.0334	302	17
2004	0.0215	0.3727	0.1535	0.1936	0.0523	0.0252	0.0234	0.0451	0.0451	0.0000	0.0226	0.0451	513	23
2005	0.0494	0.3906	0.2683	0.0920	0.0355	0.0417	0.0180	0.0161	0.0563	0.0161	0.0000	0.0161	413	20
2006	0.0049	0.5347	0.1502	0.1116	0.0797	0.0416	0.0059	0.0297	0.0059	0.0297	0.0000	0.0059	318	18
2007	0.0000	0.0991	0.4840	0.1077	0.1382	0.1203	0.0127	0.0190	0.0000	0.0127	0.0063	0.0000	76	9
2008	0.2121	0.0325	0.0827	0.3804	0.1211	0.0856	0.0325	0.0413	0.0059	0.0030	0.0000	0.0030	197	14
2009	0.0156	0.2905	0.3264	0.1413	0.1041	0.0403	0.0269	0.0213	0.0101	0.0045	0.0045	0.0146	472	22
2010	0.0095	0.2678	0.3101	0.1556	0.0857	0.0648	0.0368	0.0280	0.0171	0.0057	0.0095	0.0095	460	21

Table 7.8.20 Comparison of discard estimates for yellowtail snapper from the NMFS HBS (vessel trip reports) and at-sea sampling ratio estimates of releases to landed fish by head boat anglers. a) southeast Atlantic area, b) Florida Keys. Values in bold italics are estimates for years when there were no at-sea samples taken in the Florida Keys.

a) southeast Atlantic

	live releases (numbers of fish)		all releases		
Year	at-sea sampling [live/kept=0.18]	HBS vessel trip reports	at-sea sampling [all/kept=0.20]	HBS vessel trip reports	HBS landings
2005	3,072	202	3,414	202	17,069
2006	505	106	561	109	2,803
2007	3,518	708	3,908	708	19,542
2008	5,888	2,173	6,542	2,249	32,710
2009	3,652	1,960	4,058	2,004	20,288
2010	6,981	3,087	7,757	3,094	38,783

b) Florida Keys

	live releases (numbers of fish)		all releases		
Year	at-sea sampling [live/kept=0.50]	HBS vessel trip reports	at-sea sampling [all/kept=0.54]	HBS vessel trip reports	HBS landings
2005	66,103	15,619	71,391	16,404	132,205
2006	48,211	19,052	52,067	19,142	96,421
2007	42,914	26,357	46,347	26,593	85,827
2008	***35,446***	37,631	***38,282***	39,680	70,892
2009	***34,085***	35,677	***36,811***	36,736	68,169
2010	***31,706***	33,248	***34,242***	33,837	63,411

Table 7.8.21 Yellowtail snapper landings (in numbers) from the NMFS HBS (vessel trip reports) and discard estimates (in numbers) using at-sea sampling ratio estimates of releases to landed fish by head boat anglers. Values in shaded in gray are estimates for landings for years before the HBS expanded coverage into the Gulf of Mexico. Values shaded in blue are estimates derived from the at-sea sampling ratio estimates of the number of released fish to fish landed by head boat anglers in each region (see table 7.8.20).

Year	Atlantic landings	Atlantic total discards (estimated)	Atlantic live discards	Gulf landings	Gulf total discards (estimated)	Gulf live discards
1981	85,545	3,806	3,559	76,460	14,575	13,517
1982	60,536	2,694	2,519	144,988	27,638	25,632
1983	34,994	1,557	1,456	176,047	33,558	31,123
1984	33,961	1,511	1,413	127,079	24,224	22,466
1985	25,770	5,154	4,639	115,930	60,406	55,931
1986	30,530	6,106	5,495	175,664	94,858	87,832
1987	37,043	7,409	6,668	198,487	107,183	99,243
1988	55,253	11,051	9,946	236,124	127,507	118,062
1989	45,044	9,009	8,108	121,401	65,556	60,700
1990	49,226	9,845	8,861	169,573	91,569	84,786
1991	53,551	10,710	9,639	159,995	86,397	79,997
1992	55,624	11,125	10,012	149,879	80,935	74,939
1993	46,052	9,210	8,289	172,735	93,277	86,368
1994	77,001	15,400	13,860	166,190	89,743	83,095
1995	36,444	7,289	6,560	121,101	65,395	60,551
1996	23,445	4,689	4,220	114,190	61,663	57,095
1997	27,014	5,403	4,863	112,850	60,939	56,425
1998	16,159	3,232	2,909	104,394	56,373	52,197
1999	24,786	4,957	4,461	84,491	45,625	42,245
2000	12,234	2,447	2,202	97,085	52,426	48,543
2001	5,039	1,008	907	96,858	52,303	48,429
2002	2,834	567	510	118,212	63,834	59,106
2003	10,455	2,091	1,882	98,421	53,147	49,211
2004	8,613	1,723	1,550	109,934	59,364	54,967
2005	17,069	3,414	3,072	132,205	71,391	66,102
2006	2,803	561	505	96,421	52,067	48,210
2007	19,542	3,908	3,518	85,827	46,347	42,914
2008	32,710	6,542	5,888	70,892	38,282	35,446
2009	20,288	4,058	3,652	68,169	36,811	34,084
2010	38,783	7,757	6,981	63,411	34,242	31,705

Table 7.8.22 Yellowtail snapper head boat total discard (live or dead) estimates (numbers of fish) by size class from at-sea sampling measurements of released fish for the Atlantic region.

	TL inch class																				
Year	<=5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	>=24	Total
1981	0	35	155	1,080	2,536	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3,806
1982	0	25	110	764	1,795	0	0	**0**	**0**	**0**	0	0	0	0	0	0	0	0	0	0	2,694
1983	0	14	63	442	1,038	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,557
1984	0	14	61	429	1,007	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,511
1985	0	11	47	326	766	1,561	2,004	348	46	23	23	0	0	0	0	0	0	0	0	0	5,154
1986	0	13	55	386	907	1,849	2,374	412	54	28	28	0	0	0	0	0	0	0	0	0	6,106
1987	0	16	67	468	1,101	2,244	2,880	500	66	34	34	0	0	0	0	0	0	0	0	0	7,409
1988	0	24	100	698	1,642	3,347	4,296	745	98	50	50	0	0	0	0	0	0	0	0	0	11,051
1989	0	19	81	569	1,339	2,729	3,503	608	80	41	41	0	0	0	0	0	0	0	0	0	9,009
1990	0	21	89	622	1,463	2,982	3,828	664	88	45	45	0	0	0	0	0	0	0	0	0	9,845
1991	0	23	97	677	1,591	3,244	4,164	722	95	48	48	0	0	0	0	0	0	0	0	0	10,710
1992	0	24	101	703	1,653	3,369	4,325	750	99	50	50	0	0	0	0	0	0	0	0	0	11,125
1993	0	20	83	582	1,368	2,790	3,581	621	82	42	42	0	0	0	0	0	0	0	0	0	9,210
1994	0	33	139	973	2,288	4,664	5,988	1,039	137	70	70	0	0	0	0	0	0	0	0	0	15,400
1995	0	16	66	461	1,083	2,208	2,834	492	65	33	33	0	0	0	0	0	0	0	0	0	7,289
1996	0	10	42	296	697	1,420	1,823	316	42	21	21	0	0	0	0	0	0	0	0	0	4,689
1997	0	11	49	341	803	1,636	2,101	364	48	24	24	0	0	0	0	0	0	0	0	0	5,403
1998	0	7	29	204	480	979	1,257	218	29	15	15	0	0	0	0	0	0	0	0	0	3,232
1999	0	11	45	313	737	1,501	1,927	334	44	22	22	0	0	0	0	0	0	0	0	0	4,957
2000	0	5	22	155	364	741	951	165	22	11	11	0	0	0	0	0	0	0	0	0	2,447
2001	0	2	9	64	150	305	392	68	9	5	5	0	0	0	0	0	0	0	0	0	1,008
2002	0	1	5	36	84	172	220	38	5	3	3	0	0	0	0	0	0	0	0	0	567
2003	0	4	19	132	311	633	813	141	19	9	9	0	0	0	0	0	0	0	0	0	2,091
2004	0	4	16	109	256	522	670	116	15	8	8	0	0	0	0	0	0	0	0	0	1,723
2005	0	7	31	216	507	1,034	1,327	230	30	15	15	0	0	0	0	0	0	0	0	0	3,414
2006	0	1	5	35	83	170	218	38	5	3	3	0	0	0	0	0	0	0	0	0	561
2007	0	8	35	247	581	1,184	1,520	264	35	18	18	0	0	0	0	0	0	0	0	0	3,908
2008	0	14	59	413	972	1,981	2,544	441	58	30	30	0	0	0	0	0	0	0	0	0	6,542
2009	0	9	37	256	603	1,229	1,578	274	36	18	18	0	0	0	0	0	0	0	0	0	4,058
2010	0	17	70	490	1,152	2,349	3,016	523	69	35	35	0	0	0	0	0	0	0	0	0	7,757

Table 7.8.23 Yellowtail snapper head boat total discard (live or dead) estimates (numbers of fish) by size class from at-sea sampling measurements of released fish for the Gulf region.

	TL inch class																				
Year	<=5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	>=24	Total
1981	138	226	1,249	4,557	8,406	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14,575
1982	261	428	2,368	8,641	15,939	0	0	**0**	**0**	**0**	0	0	0	0	0	0	0	0	0	0	27,638
1983	317	520	2,875	10,492	19,354	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	33,558
1984	229	375	2,076	7,574	13,971	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	24,224
1985	202	329	1,826	6,660	12,284	16,552	16,247	4,913	760	345	173	86	0	29	0	0	0	0	0	0	60,406
1986	316	516	2,867	10,459	19,291	25,992	25,514	7,715	1,194	542	271	136	0	45	0	0	0	0	0	0	94,859
1987	358	583	3,239	11,818	21,797	29,369	28,829	8,717	1,349	613	306	153	0	51	0	0	0	0	0	0	107,183
1988	425	694	3,853	14,059	25,930	34,938	34,295	10,370	1,605	729	365	182	0	61	0	0	0	0	0	0	127,507
1989	219	357	1,981	7,228	13,332	17,963	17,633	5,332	825	375	187	94	0	31	0	0	0	0	0	0	65,557
1990	305	498	2,767	10,096	18,622	25,091	24,629	7,447	1,153	524	262	131	0	44	0	0	0	0	0	0	91,569
1991	288	470	2,611	9,526	17,570	23,674	23,238	7,027	1,088	494	247	124	0	41	0	0	0	0	0	0	86,397
1992	270	440	2,446	8,924	16,459	22,177	21,769	6,582	1,019	463	231	116	0	39	0	0	0	0	0	0	80,935
1993	311	507	2,819	10,285	18,969	25,559	25,088	7,586	1,174	533	267	133	0	44	0	0	0	0	0	0	93,277
1994	299	488	2,712	9,895	18,250	24,590	24,138	7,299	1,130	513	257	128	0	43	0	0	0	0	0	0	89,743
1995	218	356	1,976	7,210	13,299	17,919	17,589	5,319	823	374	187	93	0	31	0	0	0	0	0	0	65,395
1996	206	335	1,863	6,799	12,540	16,896	16,585	5,015	776	353	176	88	0	29	0	0	0	0	0	0	61,663
1997	203	332	1,842	6,719	12,393	16,698	16,391	4,956	767	348	174	87	0	29	0	0	0	0	0	0	60,939
1998	188	307	1,704	6,216	11,464	15,447	15,162	4,585	710	322	161	81	0	27	0	0	0	0	0	0	56,373
1999	152	248	1,379	5,031	9,278	12,502	12,272	3,711	574	261	130	65	0	22	0	0	0	0	0	0	45,625
2000	175	285	1,584	5,780	10,662	14,365	14,101	4,264	660	300	150	75	0	25	0	0	0	0	0	0	52,426
2001	174	285	1,581	5,767	10,637	14,332	14,068	4,254	658	299	150	75	0	25	0	0	0	0	0	0	52,303
2002	213	347	1,929	7,038	12,982	17,491	17,169	5,192	804	365	183	91	0	30	0	0	0	0	0	0	63,834
2003	177	289	1,606	5,860	10,808	14,563	14,295	4,322	669	304	152	76	0	25	0	0	0	0	0	0	53,147
2004	198	323	1,794	6,545	12,073	16,266	15,967	4,828	747	339	170	85	0	28	0	0	0	0	0	0	59,364
2005	238	388	2,157	7,872	14,518	19,562	19,202	5,806	899	408	204	102	0	34	0	0	0	0	0	0	71,391
2006	174	283	1,574	5,741	10,589	14,267	14,004	4,235	655	298	149	74	0	25	0	0	0	0	0	0	52,067
2007	155	252	1,401	5,110	9,425	12,699	12,466	3,769	583	265	133	66	0	22	0	0	0	0	0	0	46,347
2008	128	208	1,157	4,221	7,785	10,490	10,297	3,113	482	219	109	55	0	18	0	0	0	0	0	0	38,282
2009	123	200	1,112	4,059	7,486	10,087	9,901	2,994	463	211	105	53	0	18	0	0	0	0	0	0	36,811
2010	114	186	1,035	3,776	6,964	9,383	9,210	2,785	431	196	98	49	0	16	0	0	0	0	0	0	34,242

Table 7.8.24 Yellowtail snapper head boat total discard (live or dead) estimates (numbers of fish) by age class from at-sea sampling measurements of released fish for the Atlantic region. Age-length keys were used to estimate the ages of fish from lengths measured.

						Age (years)								
Year	0	1	2	3	4	5	6	7	8	9	10	11	12+	totals
1981	102	3,213	461	31	0	0	0	0	0	0	0	0	0	3,806
1982	72	2,274	326	22	0	0	0	0	0	0	0	0	0	2,694
1983	42	1,314	188	13	0	0	0	0	0	0	0	0	0	1,557
1984	40	1,276	183	12	0	0	0	0	0	0	0	0	0	1,511
1985	31	3,230	1,656	119	118	0	0	0	0	0	0	0	0	5,154
1986	36	2,616	3,145	303	6	0	0	0	0	0	0	0	0	6,106
1987	44	3,245	3,679	440	0	0	0	0	0	0	0	0	0	7,409
1988	66	4,675	5,419	800	81	8	1	0	0	0	0	0	0	11,051
1989	54	3,811	4,417	652	66	7	1	0	0	0	0	0	0	9,009
1990	59	4,123	4,733	791	123	15	2	0	0	0	0	0	0	9,845
1991	64	5,038	3,858	996	55	2	1	695	1	0	0	0	0	10,710
1992	66	5,233	4,045	1,017	42	0	0	721	0	0	0	0	0	11,125
1993	55	4,309	3,408	773	60	3	3	600	0	0	0	0	0	9,210
1994	92	7,205	5,529	1,480	79	3	2	1,000	9	0	2	0	0	15,400
1995	44	3,444	2,592	702	35	1	0	472	0	0	0	0	0	7,289
1996	29	2,481	1,694	434	47	4	0	0	0	0	0	0	0	4,689
1997	33	2,513	1,974	808	61	8	5	1	0	0	0	0	0	5,403
1998	20	2,031	728	417	33	2	1	0	0	0	0	0	0	3,232
1999	31	2,524	2,052	321	28	1	0	0	0	0	0	0	0	4,957
2000	15	1,342	959	90	28	4	1	3	2	1	0	0	0	2,447
2001	6	436	548	8	4	4	2	0	0	0	0	0	0	1,008
2002	3	203	339	20	1	1	0	0	0	0	0	0	0	567
2003	12	813	1,203	61	1	0	0	0	0	0	0	0	0	2,091
2004	10	237	1,346	124	3	2	1	0	0	0	0	0	0	1,723
2005	20	1,531	1,713	144	4	0	0	0	0	0	0	0	0	3,414
2006	3	231	317	8	1	0	0	0	0	0	0	0	0	561
2007	23	2,765	1,049	62	9	0	0	0	0	0	0	0	0	3,908
2008	39	4,225	1,814	445	18	0	1	0	0	0	0	0	0	6,542
2009	24	1,855	2,066	101	11	0	0	0	0	0	0	0	0	4,058
2010	46	3,137	4,310	248	16	0	0	0	0	0	0	0	0	7,757

Table 7.8.25 Yellowtail snapper head boat total discard (live or dead) estimates (numbers of fish) by age class from at-sea sampling measurements of released fish for the Gulf region. Age-length keys were used to estimate the ages of fish from lengths measured.

	Age (years)													
Year	0	1	2	3	4	5	6	7	8	9	10	11	12+	Total
1981	650	8,822	5,103	0	0	0	0	0	0	0	0	0	0	14,575
1982	1,232	16,729	9,676	0	0	0	0	0	0	0	0	0	0	27,638
1983	1,495	20,313	11,749	0	0	0	0	0	0	0	0	0	0	33,558
1984	1,080	14,663	8,481	0	0	0	0	0	0	0	0	0	0	24,224
1985	949	15,849	31,246	8,584	3,422	169	47	105	14	2	2	14	3	60,406
1986	1,491	18,487	40,897	17,836	8,031	4,957	2,349	575	59	44	8	120	4	94,858
1987	1,684	20,889	46,210	20,153	9,075	5,601	2,654	650	67	50	10	136	5	107,183
1988	2,004	24,850	54,972	23,975	10,795	6,663	3,157	773	79	60	11	161	6	127,507
1989	1,030	12,776	28,264	12,326	5,550	3,426	1,623	398	41	31	6	83	3	65,556
1990	1,439	17,846	39,478	17,217	7,753	4,785	2,267	555	57	43	8	116	4	91,569
1991	1,358	13,979	28,697	21,892	19,585	565	179	36	76	24	0	7	0	86,397
1992	1,272	13,095	25,386	22,982	16,553	1,380	88	122	40	10	0	6	0	80,935
1993	1,466	15,092	29,890	27,428	17,232	634	289	987	226	26	0	7	0	93,277
1994	1,410	14,520	29,746	23,855	18,454	1,471	121	30	86	43	0	7	0	89,743
1995	1,028	10,581	19,170	19,236	13,334	1,733	186	50	48	25	0	5	0	65,395
1996	799	10,947	23,676	10,744	7,106	6,695	1,190	346	108	48	3	2	0	61,663
1997	790	10,964	23,863	12,161	6,255	5,197	1,344	284	19	47	5	6	6	60,939
1998	730	10,008	22,275	12,252	5,779	4,074	718	475	24	28	8	2	0	56,373
1999	591	13,271	17,299	9,302	3,351	1,254	279	233	29	12	3	0	0	45,625
2000	679	5,019	24,436	10,709	5,689	4,064	1,403	249	32	133	6	6	0	52,426
2001	822	11,579	25,971	7,735	3,512	1,677	825	134	25	0	16	7	0	52,303
2002	1,003	12,025	24,818	14,564	4,510	3,814	2,760	228	86	18	6	1	2	63,834
2003	835	11,235	23,071	9,833	4,325	2,316	1,347	144	27	8	0	5	4	53,147
2004	933	12,224	24,793	10,949	5,960	2,766	1,541	174	17	0	0	0	6	59,364
2005	1,122	13,449	22,353	11,031	10,340	8,160	4,606	179	11	19	7	112	2	71,391
2006	972	7,907	19,789	9,358	3,670	5,401	4,149	479	164	143	32	0	2	52,067
2007	1,644	6,643	18,499	8,726	4,458	2,799	2,776	601	7	0	2	192	0	46,347
2008	546	7,200	11,350	7,796	6,461	2,521	1,920	443	31	6	2	3	4	38,282
2009	275	7,188	20,603	5,387	445	2,682	162	44	13	7	1	2	2	36,811
2010	105	4,487	13,375	7,057	3,454	1,184	3,157	935	15	8	1	462	1	34,242

Table 7.8.26 Yellowtail snapper head boat total discard (live or dead) proportion at age from at-sea sampling measurements of released fish for the Atlantic and Gulf regions. Age-length keys were used to estimate the ages of fish from lengths measured. In 2010, for example, 18.4 % of all the fish released by recreational anglers were age-1 fish.

Proportion at Age for Total Discards, Head Boat Fleet

Year	1	2	3	4	5	6	7	8	9	10	11	12+
1981	0.6955	0.3028	0.0017	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1982	0.6692	0.3300	0.0007	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1983	0.6594	0.3403	0.0004	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1984	0.6626	0.3370	0.0005	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1985	0.3057	0.5021	0.1326	0.0540	0.0027	0.0008	0.0016	0.0002	0.0000	0.0000	0.0002	0.0000
1986	0.2244	0.4360	0.1794	0.0796	0.0491	0.0233	0.0057	0.0006	0.0004	0.0001	0.0012	0.0000
1987	0.2260	0.4351	0.1795	0.0792	0.0489	0.0232	0.0057	0.0006	0.0004	0.0001	0.0012	0.0000
1988	0.2283	0.4355	0.1786	0.0785	0.0482	0.0229	0.0056	0.0006	0.0004	0.0001	0.0012	0.0000
1989	0.2372	0.4377	0.1740	0.0754	0.0461	0.0219	0.0054	0.0006	0.0004	0.0001	0.0011	0.0000
1990	0.2316	0.4356	0.1774	0.0777	0.0474	0.0225	0.0055	0.0006	0.0004	0.0001	0.0011	0.0000
1991	0.2101	0.3352	0.2363	0.2021	0.0059	0.0019	0.0074	0.0008	0.0003	0.0000	0.0001	0.0000
1992	0.2132	0.3197	0.2614	0.1803	0.0149	0.0009	0.0090	0.0004	0.0001	0.0000	0.0001	0.0000
1993	0.2039	0.3250	0.2755	0.1687	0.0063	0.0029	0.0153	0.0022	0.0003	0.0000	0.0001	0.0000
1994	0.2203	0.3353	0.2416	0.1762	0.0142	0.0013	0.0096	0.0010	0.0004	0.0000	0.0001	0.0000
1995	0.2073	0.2995	0.2747	0.1837	0.0238	0.0026	0.0071	0.0007	0.0004	0.0000	0.0001	0.0000
1996	0.2146	0.3829	0.1684	0.1077	0.1007	0.0181	0.0052	0.0016	0.0008	0.0000	0.0000	0.0000
1997	0.2153	0.3900	0.1951	0.0952	0.0784	0.0204	0.0044	0.0003	0.0007	0.0001	0.0001	0.0001
1998	0.2143	0.3867	0.2120	0.0974	0.0684	0.0121	0.0080	0.0004	0.0005	0.0001	0.0000	0.0000
1999	0.3248	0.3823	0.1900	0.0669	0.0250	0.0056	0.0046	0.0006	0.0003	0.0001	0.0000	0.0000
2000	0.1280	0.4637	0.1966	0.1041	0.0740	0.0256	0.0046	0.0006	0.0025	0.0001	0.0001	0.0000
2001	0.2411	0.4973	0.1450	0.0659	0.0316	0.0156	0.0026	0.0005	0.0000	0.0003	0.0002	0.0000
2002	0.2059	0.3909	0.2259	0.0700	0.0591	0.0428	0.0036	0.0014	0.0003	0.0001	0.0000	0.0000
2003	0.2336	0.4395	0.1788	0.0782	0.0419	0.0245	0.0027	0.0005	0.0002	0.0000	0.0001	0.0001
2004	0.2200	0.4278	0.1808	0.0974	0.0454	0.0253	0.0029	0.0003	0.0000	0.0000	0.0000	0.0001
2005	0.2157	0.3222	0.1492	0.1381	0.1089	0.0615	0.0024	0.0002	0.0003	0.0001	0.0015	0.0000
2006	0.1735	0.3823	0.1775	0.0698	0.1024	0.0788	0.0091	0.0031	0.0027	0.0006	0.0000	0.0000
2007	0.2197	0.3893	0.1747	0.0890	0.0558	0.0554	0.0120	0.0001	0.0000	0.0001	0.0038	0.0000
2008	0.2671	0.2938	0.1839	0.1447	0.0564	0.0431	0.0099	0.0007	0.0001	0.0000	0.0001	0.0001
2009	0.2284	0.5547	0.1342	0.0112	0.0658	0.0040	0.0011	0.0003	0.0002	0.0000	0.0000	0.0001
2010	0.1841	0.4205	0.1742	0.0831	0.0284	0.0756	0.0224	0.0004	0.0002	0.0000	0.0110	0.0000

Table 7.8.27 Amount (in metric tons) of yellowtail snapper released by head boat anglers estimated from at-sea sampling measurements of released fish for the Atlantic and Gulf regions at various rates of release mortality.

	Metric Tons Discarded Dead at Various Release Mortality Rates									
Year	1	0.9	0.8	0.7	0.6	0.5	0.4	0.3	0.2	0.1
1981	2.431	2.188	1.945	1.702	1.459	1.215	0.972	0.729	0.486	0.243
1982	3.991	3.591	3.192	2.793	2.394	1.995	1.596	1.197	0.798	0.399
1983	4.611	4.150	3.689	3.228	2.766	2.305	1.844	1.383	0.922	0.461
1984	3.381	3.043	2.705	2.367	2.029	1.691	1.353	1.014	0.676	0.338
1985	13.316	11.984	10.652	9.321	7.989	6.658	5.326	3.995	2.663	1.332
1986	20.482	18.434	16.386	14.338	12.289	10.241	8.193	6.145	4.096	2.048
1987	23.253	20.928	18.603	16.277	13.952	11.627	9.301	6.976	4.651	2.325
1988	28.144	25.329	22.515	19.701	16.886	14.072	11.257	8.443	5.629	2.814
1989	15.186	13.667	12.149	10.630	9.111	7.593	6.074	4.556	3.037	1.519
1990	20.622	18.560	16.498	14.436	12.373	10.311	8.249	6.187	4.124	2.062
1991	19.763	17.787	15.811	13.834	11.858	9.882	7.905	5.929	3.953	1.976
1992	18.748	16.874	14.999	13.124	11.249	9.374	7.499	5.625	3.750	1.875
1993	20.831	18.748	16.665	14.582	12.498	10.415	8.332	6.249	4.166	2.083
1994	21.448	19.303	17.159	15.014	12.869	10.724	8.579	6.434	4.290	2.145
1995	14.783	13.305	11.826	10.348	8.870	7.391	5.913	4.435	2.957	1.478
1996	13.469	12.123	10.776	9.429	8.082	6.735	5.388	4.041	2.694	1.347
1997	13.477	12.129	10.781	9.434	8.086	6.738	5.391	4.043	2.695	1.348
1998	12.087	10.878	9.670	8.461	7.252	6.043	4.835	3.626	2.417	1.209
1999	10.286	9.258	8.229	7.200	6.172	5.143	4.115	3.086	2.057	1.029
2000	11.121	10.008	8.896	7.784	6.672	5.560	4.448	3.336	2.224	1.112
2001	10.786	9.708	8.629	7.550	6.472	5.393	4.314	3.236	2.157	1.079
2002	13.022	11.719	10.417	9.115	7.813	6.511	5.209	3.906	2.604	1.302
2003	11.190	10.071	8.952	7.833	6.714	5.595	4.476	3.357	2.238	1.119
2004	12.367	11.130	9.894	8.657	7.420	6.183	4.947	3.710	2.473	1.237
2005	15.161	13.645	12.129	10.613	9.097	7.580	6.064	4.548	3.032	1.516
2006	10.642	9.578	8.514	7.450	6.385	5.321	4.257	3.193	2.128	1.064
2007	10.206	9.186	8.165	7.145	6.124	5.103	4.083	3.062	2.041	1.021
2008	9.143	8.229	7.315	6.400	5.486	4.572	3.657	2.743	1.829	0.914
2009	8.312	7.480	6.649	5.818	4.987	4.156	3.325	2.493	1.662	0.831
2010	8.588	7.729	6.871	6.012	5.153	4.294	3.435	2.576	1.718	0.859

Table 7.8.28 Proportions at age of released fish for head boat catches (Atlantic and Gulf regions combined). Values are the proportions of released fish (by number) of age-X to the total of fish of age-X caught by head boat anglers each year. For example, in 2010, 91.9% of all the age-1 fish caught by head boat anglers were released (alive or dead) in South Florida waters.

	Proportions at Age (years) of Total Discards											
Year	1	2	3	4	5	6	7	8	9	10	11	12+
1981	0.8576	0.0873	0.0007	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1982	0.8709	0.2555	0.0003	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1983	0.8765	0.2503	0.0003	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1984	0.9057	0.1832	0.0003	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1985	0.9283	0.5371	0.1625	0.0930	0.0096	0.0048	0.0146	0.0035	0.0015	0.0018	0.0117	0.0031
1986	0.9516	0.5776	0.2674	0.1355	0.1322	0.0976	0.0465	0.0078	0.0107	0.0037	0.0602	0.0015
1987	0.8766	0.5228	0.2559	0.1470	0.1403	0.1063	0.0517	0.0088	0.0119	0.0043	0.0675	0.0017
1988	0.9392	0.5587	0.2305	0.1325	0.1348	0.1052	0.0526	0.0090	0.0123	0.0046	0.0706	0.0019
1989	0.9318	0.5888	0.2270	0.1160	0.1219	0.0908	0.0454	0.0076	0.0105	0.0037	0.0609	0.0016
1990	0.9676	0.6754	0.2350	0.1185	0.1211	0.0927	0.0418	0.0066	0.0087	0.0029	0.0447	0.0010
1991	0.9608	0.4652	0.2897	0.2668	0.0254	0.0108	0.0529	0.0071	0.0047	0.0002	0.0025	0.0000
1992	0.9550	0.4002	0.2474	0.2685	0.0890	0.0080	0.0784	0.0056	0.0031	0.0000	0.0028	0.0000
1993	0.9822	0.5263	0.3038	0.2767	0.0259	0.0137	0.0989	0.0146	0.0057	0.0000	0.0034	0.0000
1994	0.9957	0.4251	0.2311	0.2809	0.0529	0.0089	0.0903	0.0069	0.0079	0.0010	0.0041	0.0000
1995	0.9350	0.6922	0.2798	0.2183	0.0755	0.0110	0.0635	0.0089	0.0063	0.0000	0.0042	0.0000
1996	0.8713	0.6546	0.3171	0.1940	0.1615	0.0626	0.0377	0.0136	0.0107	0.0036	0.0022	0.0000
1997	0.9454	0.6544	0.2302	0.1782	0.1704	0.0626	0.0344	0.0058	0.0134	0.0063	0.0044	0.0069
1998	0.9472	0.6172	0.2376	0.1510	0.2150	0.0797	0.0601	0.0072	0.0131	0.0057	0.0022	0.0000
1999	0.9101	0.4560	0.2944	0.1229	0.0623	0.0291	0.0434	0.0101	0.0100	0.0071	0.0000	0.0000
2000	0.8316	0.5432	0.2872	0.1817	0.2056	0.1072	0.0393	0.0119	0.0578	0.0077	0.0083	0.0000
2001	0.9122	0.5658	0.2046	0.1235	0.1123	0.0763	0.0302	0.0095	0.0000	0.0167	0.0092	0.0006
2002	0.9906	0.5594	0.2996	0.1384	0.1313	0.1734	0.0553	0.0348	0.0098	0.0067	0.0063	0.0038
2003	0.8525	0.6394	0.1959	0.1242	0.1724	0.1368	0.0308	0.0092	0.0068	0.0000	0.0077	0.0051
2004	0.9610	0.6423	0.2182	0.1393	0.1300	0.1417	0.0357	0.0080	0.0000	0.0000	0.0000	0.0077
2005	0.9595	0.5016	0.1736	0.2019	0.2670	0.3375	0.0449	0.0084	0.0090	0.0053	0.1953	0.0071
2006	0.9846	0.7096	0.2484	0.1223	0.2285	0.2942	0.1170	0.0374	0.0564	0.0137	0.0000	0.0021
2007	0.9207	0.5581	0.2384	0.1236	0.1394	0.1571	0.2415	0.0067	0.0000	0.0073	0.8487	0.0013
2008	0.8074	0.3604	0.2251	0.1841	0.1724	0.2148	0.1112	0.0115	0.0080	0.0057	0.0072	0.0061
2009	0.9462	0.4601	0.1568	0.0326	0.1939	0.0264	0.0122	0.0091	0.0099	0.0026	0.0072	0.0039
2010	0.9192	0.3549	0.1623	0.1437	0.1197	0.3720	0.2870	0.0119	0.0109	0.0090	0.5870	0.0042

Table 7.8.29 Yellowtail snapper total discards (live or dead) by size class using MRFSS B2 estimates (numbers of fish) and size class measurements from at-sea sampling of released fish by head boat anglers for the Atlantic region.

	TL inch class																
Year	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	totals
1981	0	0	752	3008	21056	49631	0	0	0	0	0	0	0	0	0	0	0	74447
1982	0	0	803	3213	22491	53015	0	0	0	0	0	0	0	0	0	0	0	79522
1983	0	0	450	1798	12589	29673	0	0	0	0	0	0	0	0	0	0	0	44510
1984	0	0	450	1801	12609	29722	0	0	0	0	0	0	0	0	0	0	0	44583
1985	0	0	108	433	3029	7139	14603	18714	3245	433	216	216	0	0	0	0	0	48136
1986	0	0	341	1365	9554	22519	46062	59028	10236	1365	682	682	0	0	0	0	0	151835
1987	0	0	340	1360	9519	22438	45897	58816	10199	1360	680	680	0	0	0	0	0	151289
1988	0	0	27	109	764	1802	3686	4723	819	109	55	55	0	0	0	0	0	12150
1989	0	0	139	557	3898	9187	18792	24082	4176	557	278	278	0	0	0	0	0	61944
1990	0	0	340	1359	9513	22424	45867	58778	10193	1359	680	680	0	0	0	0	0	151192
1991	0	0	402	1608	11256	26532	54270	69546	12060	1608	804	804	0	0	0	0	0	178890
1992	0	0	918	3670	25691	60557	123866	158732	27526	3670	1835	1835	0	0	0	0	0	408298
1993	0	0	573	2293	16053	37840	77401	99187	17200	2293	1147	1147	0	0	0	0	0	255135
1994	0	0	358	1432	10021	23620	48315	61914	10737	1432	716	716	0	0	0	0	0	159259
1995	0	0	552	2207	15449	36414	74484	95450	16552	2207	1103	1103	0	0	0	0	0	245521
1996	0	0	388	1553	10872	25626	52417	67171	11648	1553	777	777	0	0	0	0	0	172782
1997	0	0	261	1046	7319	17253	35290	45223	7842	1046	523	523	0	0	0	0	0	116325
1998	0	0	293	1173	8209	19350	39579	50720	8795	1173	586	586	0	0	0	0	0	130464
1999	0	0	435	1741	12190	28733	58773	75316	13061	1741	871	871	0	0	0	0	0	193733
2000	0	0	449	1796	12570	29630	60606	77665	13468	1796	898	898	0	0	0	0	0	199775
2001	0	0	308	1232	8624	20328	41579	53283	9240	1232	616	616	0	0	0	0	0	137057
2002	0	0	296	1185	8292	19546	39981	51235	8885	1185	592	592	0	0	0	0	0	131790
2003	0	0	369	1478	10344	24383	49874	63912	11083	1478	739	739	0	0	0	0	0	164398
2004	0	0	572	2286	16002	37719	77153	98870	17145	2286	1143	1143	0	0	0	0	0	254320
2005	0	0	581	2325	16272	38355	78454	100537	17434	2325	1162	1162	0	0	0	0	0	258606
2006	0	0	775	3101	21707	51166	104657	134117	23257	3101	1550	1550	0	0	0	0	0	344982
2007	0	0	904	3615	25307	59652	122016	156361	27115	3615	1808	1808	0	0	0	0	0	402201
2008	0	0	717	2870	20087	47348	96848	124109	21522	2870	1435	1435	0	0	0	0	0	319239
2009	0	0	499	1994	13958	32902	67299	86242	14955	1994	997	997	0	0	0	0	0	221836
2010	0	0	265	1060	7423	17497	35788	45862	7953	1060	530	530	0	0	0	0	0	117969

Table 7.8.30 Yellowtail snapper total discards (live or dead) by size class using MRFSS B2 estimates (numbers of fish) and size class measurements from at-sea sampling of released fish by head boat anglers for the Gulf region.

Gulf	inchTL														
Year	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	Total
1981	0	1088	1555	9638	34978	64359	0	0	0	0	0	0	0	0	0	111618
1982	0	2333	3333	20663	74985	137973	0	0	0	0	0	0	0	0	0	239287
1983	0	1663	2376	14734	53469	98383	0	0	0	0	0	0	0	0	0	170626
1984	0	8669	12384	76780	278636	512689	0	0	0	0	0	0	0	0	0	889157
1985	0	314	449	2782	10095	18574	25035	24497	7403	1122	538	269	135	0	45	91257
1986	0	433	619	3839	13931	25633	34548	33805	10216	1548	743	371	186	0	62	125934
1987	0	2045	2921	18112	65729	120941	163008	159502	48201	7303	3506	1753	876	0	292	594189
1988	0	1449	2070	12836	46582	85711	115524	113040	34160	5176	2484	1242	621	0	207	421104
1989	0	2299	3285	20365	73906	135986	183286	179344	54197	8212	3942	1971	985	0	328	668107
1990	0	1471	2102	13031	47290	87014	117280	114757	34679	5254	2522	1261	631	0	210	427503
1991	0	10413	14876	92232	334715	615875	830092	812241	245457	37191	17851	8926	4463	0	1488	3025821
1992	0	2462	3517	21803	79124	145589	196228	192008	58024	8792	4220	2110	1055	0	352	715283
1993	0	3951	5645	34999	127012	233702	314989	308215	93142	14112	6774	3387	1693	0	564	1148186
1994	0	2131	3045	18876	68502	126043	169884	166231	50235	7611	3653	1827	913	0	304	619256
1995	0	2330	3329	20638	74897	137811	185745	181750	54924	8322	3995	1997	999	0	333	677069
1996	0	2045	2922	18114	65735	120953	163024	159518	48206	7304	3506	1753	876	0	292	594248
1997	0	3409	4870	30191	109565	201600	271722	265879	80348	12174	5843	2922	1461	0	487	990471
1998	0	1863	2661	16500	59879	110178	148500	145307	43911	6653	3194	1597	798	0	266	541308
1999	0	1122	1602	9934	36052	66336	89409	87486	26438	4006	1923	961	481	0	160	325911
2000	0	800	1142	7082	25701	47290	63739	62368	18847	2856	1371	685	343	0	114	232338
2001	0	763	1090	6760	24533	45140	60841	59532	17991	2726	1308	654	327	0	109	221774
2002	0	695	992	6153	22330	41088	55379	54188	16375	2481	1191	595	298	0	99	201865
2003	0	1069	1528	9472	34376	63251	85252	83419	25209	3820	1833	917	458	0	153	310757
2004	0	904	1292	8009	29066	53481	72084	70533	21315	3230	1550	775	388	0	129	262756
2005	0	666	952	5900	21412	39399	53102	51960	15702	2379	1142	571	285	0	95	193567
2006	0	1168	1669	10349	37558	69107	93144	91141	27543	4173	2003	1002	501	0	167	339526
2007	0	1378	1969	12207	44301	81514	109867	107505	32488	4922	2363	1181	591	0	197	400484
2008	0	1509	2155	13361	48488	89218	120250	117664	35558	5388	2586	1293	647	0	216	438332
2009	0	606	865	5365	19472	35828	48289	47251	14279	2164	1038	519	260	0	87	176023
2010	0	644	919	5701	20688	38067	51307	50204	15172	2299	1103	552	276	0	92	187024

Table 7.8.31 Yellowtail snapper total discards (live or dead) by age class using MRFSS B2 estimates (numbers of fish), size class measurements from at-sea sampling of released fish by head boat anglers, and age-length key conversions for the Atlantic region.

	Age (years)													
Year	0	1	2	3	4	5	6	7	8	9	10	11	12+	Total
1981	2000	62841	9007	598	0	0	0	0	0	0	0	0	0	74447
1982	2137	67125	9621	639	0	0	0	0	0	0	0	0	0	79522
1983	1196	37571	5385	358	0	0	0	0	0	0	0	0	0	44510
1984	1198	37633	5394	358	0	0	0	0	0	0	0	0	0	44583
1985	288	30168	15467	1112	1101	0	0	0	0	0	0	0	0	48136
1986	908	65005	78245	7525	152	0	0	0	0	0	0	0	0	151835
1987	904	66228	75168	8988	0	0	0	0	0	0	0	0	0	151289
1988	73	5137	5961	879	89	9	1	0	0	0	0	0	0	12150
1989	370	26190	30390	4484	456	47	7	0	0	0	0	0	0	61944
1990	904	63274	72723	12140	1889	228	34	0	0	0	0	0	0	151192
1991	1069	84145	64446	16629	917	31	19	11610	19	0	5	0	0	178891
1992	2441	192053	148497	37320	1534	0	0	26456	0	0	0	0	0	408301
1993	1525	119356	94415	21405	1667	79	79	16611	0	0	0	0	0	255137
1994	952	74504	57191	15301	823	30	16	10336	92	0	16	0	0	159260
1995	1468	115987	87328	23635	1175	21	0	15909	0	0	0	0	0	245523
1996	1068	91420	62415	15994	1715	157	13	0	0	0	0	0	0	172782
1997	719	54096	42499	17400	1312	163	104	19	6	0	6	0	0	116325
1998	806	81966	29391	16850	1349	80	21	0	0	0	0	0	0	130464
1999	1197	98641	80196	12529	1100	52	13	0	6	0	0	0	0	193733
2000	1235	109561	78334	7387	2282	358	42	272	174	111	19	0	0	199775
2001	819	59231	74572	1130	486	515	248	19	19	0	0	0	17	137057
2002	788	47220	78750	4637	213	118	50	12	2	0	0	0	2	131791
2003	983	63945	94615	4779	77	0	0	0	0	0	0	0	0	164399
2004	1520	34914	198706	18346	440	253	102	38	0	0	0	0	0	254320
2005	1546	115976	129808	10883	340	34	14	7	0	0	0	0	0	258607
2006	2062	142354	195025	4736	794	0	10	0	0	0	0	0	0	344981
2007	2404	284537	107936	6355	932	24	0	0	0	0	0	0	13	402202
2008	1908	206176	88522	21699	881	22	32	0	0	0	0	0	0	319240
2009	1326	101415	112971	5519	591	14	0	0	0	0	0	0	0	221837
2010	705	47701	65551	3762	250	0	0	0	0	0	0	0	0	117969

Table 7.8.32 Yellowtail snapper total discards (live or dead) by age class using MRFSS B2 estimates (numbers of fish), size class measurements from at-sea sampling of released fish by head boat anglers, and age-length key conversions for the Gulf region.

	Age (years)													
Year	0	1	2	3	4	5	6	7	8	9	10	11	12+	Totals
1981	4962	67559	39097	0	0	0	0	0	0	0	0	0	0	111618
1982	10637	144834	83816	0	0	0	0	0	0	0	0	0	0	239287
1983	7585	103275	59766	0	0	0	0	0	0	0	0	0	0	170626
1984	39525	538182	311450	0	0	0	0	0	0	0	0	0	0	889157
1985	1432	23969	47196	12952	5166	259	72	160	22	3	3	20	4	91257
1986	1976	24567	54303	23655	10656	6578	3120	765	79	59	11	159	6	125934
1987	9324	115912	256216	111610	50278	31036	14719	3607	374	279	54	751	29	594188
1988	6608	82147	181581	79098	35632	21995	10431	2557	265	198	38	532	21	421104
1989	10484	130332	288089	125494	56532	34897	16550	4056	421	314	60	845	33	668106
1990	6708	83395	184340	80300	36174	22329	10590	2595	269	201	39	541	21	427503
1991	47480	490085	1005206	766839	684890	19858	6348	1285	2699	882	0	248	0	3025821
1992	11224	115853	224455	203138	146105	12159	773	1075	355	88	0	59	0	715283
1993	18017	185969	368067	337558	211879	7824	3561	12130	2752	335	0	94	0	1148186
1994	9717	100299	205271	164603	127146	10180	861	215	609	304	0	51	0	619256
1995	10624	109663	198593	199116	137847	17917	1945	529	514	265	0	55	0	677069
1996	7681	105593	228309	103481	68398	64402	11501	3331	1032	480	25	16	0	594247
1997	12803	178361	388086	197441	101568	84390	21847	4637	319	749	77	96	96	990469
1998	6997	96186	214014	117480	55441	39109	6912	4565	235	273	80	17	0	541307
1999	4213	94905	123552	66359	23926	8974	1999	1661	212	86	23	0	0	325910
2000	3003	22245	108376	47416	25198	17987	6217	1102	145	589	29	29	0	232338
2001	3480	49127	110108	32769	14888	7113	3508	571	108	0	68	32	0	221773
2002	3168	38068	78508	46006	14258	12052	8723	725	273	56	19	4	6	201865
2003	4876	65738	134927	57437	25258	13535	7882	849	161	47	0	28	21	310758
2004	4123	54151	109771	48408	26352	12249	6825	774	78	0	0	0	26	262757
2005	3037	36503	60664	29884	28009	22097	12472	488	31	53	19	302	6	193567
2006	6330	51619	129092	60955	23935	35190	27048	3130	1073	930	210	0	13	339525
2007	14230	57430	159885	75311	38514	24184	24000	5195	59	0	22	1653	0	400484
2008	6233	82570	130014	89156	73898	28858	22009	5073	353	69	19	34	45	438332
2009	1294	34422	98522	25724	2126	12825	778	211	62	36	3	8	12	176022
2010	548	24536	73081	38499	18874	6471	17249	5107	83	44	7	2518	6	187024

Table 7.8.33 Yellowtail snapper MRFSS total discard (live or dead) proportion at age from at-sea sampling measurements of released fish for the Atlantic and Gulf regions. Age-length keys were used to estimate the ages of fish from lengths measured. In 2010, for example, 24.1 % of all the fish released by recreational anglers were age-1 fish.

Proportion at Age for Total Discards

Year	1	2	3	4	5	6	7	8	9	10	11	12+
1981	0.7383	0.2585	0.0032	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1982	0.7049	0.2931	0.0020	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1983	0.6955	0.3028	0.0017	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1984	0.6603	0.3393	0.0004	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1985	0.4007	0.4495	0.1009	0.0450	0.0019	0.0005	0.0011	0.0002	0.0000	0.0000	0.0001	0.0000
1986	0.3329	0.4772	0.1123	0.0389	0.0237	0.0112	0.0028	0.0003	0.0002	0.0000	0.0006	0.0000
1987	0.2580	0.4445	0.1618	0.0674	0.0416	0.0197	0.0048	0.0005	0.0004	0.0001	0.0010	0.0000
1988	0.2169	0.4329	0.1846	0.0824	0.0508	0.0241	0.0059	0.0006	0.0005	0.0001	0.0012	0.0000
1989	0.2293	0.4362	0.1780	0.0781	0.0479	0.0227	0.0056	0.0006	0.0004	0.0001	0.0012	0.0000
1990	0.2666	0.4442	0.1597	0.0658	0.0390	0.0184	0.0045	0.0005	0.0003	0.0001	0.0009	0.0000
1991	0.1943	0.3338	0.2445	0.2140	0.0062	0.0020	0.0040	0.0008	0.0003	0.0000	0.0001	0.0000
1992	0.2862	0.3319	0.2140	0.1314	0.0108	0.0007	0.0245	0.0003	0.0001	0.0000	0.0001	0.0000
1993	0.2315	0.3296	0.2558	0.1522	0.0056	0.0026	0.0205	0.0020	0.0002	0.0000	0.0001	0.0000
1994	0.2382	0.3371	0.2311	0.1644	0.0131	0.0011	0.0136	0.0009	0.0004	0.0000	0.0001	0.0000
1995	0.2577	0.3099	0.2414	0.1507	0.0194	0.0021	0.0178	0.0006	0.0003	0.0000	0.0001	0.0000
1996	0.2683	0.3790	0.1558	0.0914	0.0842	0.0150	0.0043	0.0013	0.0006	0.0000	0.0000	0.0000
1997	0.2222	0.3890	0.1941	0.0930	0.0764	0.0198	0.0042	0.0003	0.0007	0.0001	0.0001	0.0001
1998	0.2768	0.3623	0.2000	0.0845	0.0583	0.0103	0.0068	0.0003	0.0004	0.0001	0.0000	0.0000
1999	0.3829	0.3921	0.1518	0.0482	0.0174	0.0039	0.0032	0.0004	0.0002	0.0000	0.0000	0.0000
2000	0.3148	0.4321	0.1268	0.0636	0.0425	0.0145	0.0032	0.0007	0.0016	0.0001	0.0001	0.0000
2001	0.3140	0.5147	0.0945	0.0428	0.0213	0.0105	0.0016	0.0004	0.0000	0.0002	0.0001	0.0000
2002	0.2675	0.4713	0.1518	0.0434	0.0365	0.0263	0.0022	0.0008	0.0002	0.0001	0.0000	0.0000
2003	0.2853	0.4831	0.1309	0.0533	0.0285	0.0166	0.0018	0.0003	0.0001	0.0000	0.0001	0.0000
2004	0.1832	0.5966	0.1291	0.0518	0.0242	0.0134	0.0016	0.0002	0.0000	0.0000	0.0000	0.0001
2005	0.3473	0.4212	0.0902	0.0627	0.0489	0.0276	0.0011	0.0001	0.0001	0.0000	0.0007	0.0000
2006	0.2956	0.4735	0.0960	0.0361	0.0514	0.0395	0.0046	0.0016	0.0014	0.0003	0.0000	0.0000
2007	0.4468	0.3337	0.1017	0.0491	0.0302	0.0299	0.0065	0.0001	0.0000	0.0000	0.0021	0.0000
2008	0.3919	0.2885	0.1463	0.0987	0.0381	0.0291	0.0067	0.0005	0.0001	0.0000	0.0000	0.0001
2009	0.3480	0.5316	0.0785	0.0068	0.0323	0.0020	0.0005	0.0002	0.0001	0.0000	0.0000	0.0000
2010	0.2410	0.4545	0.1386	0.0627	0.0212	0.0566	0.0167	0.0003	0.0001	0.0000	0.0083	0.0000

Table 7.8.34 Amount (in metric tons) of yellowtail snapper released by saltwater anglers using the MRFSS data and estimated from at-sea sampling measurements of released fish for the Atlantic and Gulf regions at various rates of release mortality.

	Metric Tons Discarded Dead at Various Release Mortality Rates									
Year	1	0.9	0.8	0.7	0.6	0.5	0.4	0.3	0.2	0.1
1981	24.373	21.936	19.499	17.061	14.624	12.187	9.749	7.312	4.875	2.437
1982	41.490	37.341	33.192	29.043	24.894	20.745	16.596	12.447	8.298	4.149
1983	27.946	25.152	22.357	19.563	16.768	13.973	11.179	8.384	5.589	2.795
1984	120.454	108.409	96.363	84.318	72.272	60.227	48.182	36.136	24.091	12.045
1985	28.273	25.446	22.618	19.791	16.964	14.136	11.309	8.482	5.655	2.827
1986	57.057	51.351	45.646	39.940	34.234	28.529	22.823	17.117	11.411	5.706
1987	149.842	134.858	119.874	104.889	89.905	74.921	59.937	44.953	29.968	14.984
1988	86.112	77.501	68.890	60.278	51.667	43.056	34.445	25.834	17.222	8.611
1989	145.634	131.071	116.508	101.944	87.381	72.817	58.254	43.690	29.127	14.563
1990	116.752	105.076	93.401	81.726	70.051	58.376	46.701	35.025	23.350	11.675
1991	638.100	574.290	510.480	446.670	382.860	319.050	255.240	191.430	127.620	63.810
1992	228.156	205.340	182.525	159.709	136.893	114.078	91.262	68.447	45.631	22.816
1993	281.689	253.520	225.351	197.182	169.014	140.845	112.676	84.507	56.338	28.169
1994	156.499	140.849	125.199	109.549	93.899	78.250	62.600	46.950	31.300	15.650
1995	186.190	167.571	148.952	130.333	111.714	93.095	74.476	55.857	37.238	18.619
1996	154.394	138.954	123.515	108.076	92.636	77.197	61.758	46.318	30.879	15.439
1997	221.077	198.970	176.862	154.754	132.646	110.539	88.431	66.323	44.215	22.108
1998	134.952	121.456	107.961	94.466	80.971	67.476	53.981	40.485	26.990	13.495
1999	105.582	95.024	84.466	73.907	63.349	52.791	42.233	31.675	21.116	10.558
2000	88.294	79.464	70.635	61.806	52.976	44.147	35.318	26.488	17.659	8.829
2001	72.950	65.655	58.360	51.065	43.770	36.475	29.180	21.885	14.590	7.295
2002	67.888	61.099	54.310	47.521	40.733	33.944	27.155	20.366	13.578	6.789
2003	96.380	86.742	77.104	67.466	57.828	48.190	38.552	28.914	19.276	9.638
2004	105.850	95.265	84.680	74.095	63.510	52.925	42.340	31.755	21.170	10.585
2005	93.029	83.726	74.423	65.120	55.817	46.514	37.212	27.909	18.606	9.303
2006	140.232	126.208	112.185	98.162	84.139	70.116	56.093	42.069	28.046	14.023
2007	164.413	147.971	131.530	115.089	98.648	82.206	65.765	49.324	32.883	16.441
2008	154.397	138.957	123.518	108.078	92.638	77.199	61.759	46.319	30.879	15.440
2009	81.781	73.603	65.425	57.247	49.069	40.891	32.712	24.534	16.356	8.178
2010	62.024	55.821	49.619	43.417	37.214	31.012	24.809	18.607	12.405	6.202

Table 7.8.35 Proportions at age of released fish for catches by recreational (MRFSS) anglers (Atlantic and Gulf regions combined). Values are the proportions of released fish (by number) of age-X to the total of fish of age-X caught by head boat anglers each year. For example, in 2010, 97.4% of all the age-1 fish caught by recreational (MRFSS) anglers were released (alive or dead) in South Florida waters.

	Proportions at Age (years) of Total Discards											
Year	1	2	3	4	5	6	7	8	9	10	11	12+
1981	0.3622	0.0746	0.0019	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1982	0.5190	0.2888	0.0019	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1983	0.8354	0.3351	0.0025	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1984	0.7817	0.4890	0.0012	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1985	0.4496	0.3339	0.0667	0.0524	0.0030	0.0013	0.0037	0.0009	0.0002	0.0005	0.0022	0.0004
1986	0.8836	0.7497	0.4569	0.1326	0.1500	0.0902	0.0317	0.0035	0.0034	0.0011	0.0153	0.0003
1987	0.9603	0.8447	0.5570	0.3362	0.3136	0.2395	0.1183	0.0187	0.0229	0.0075	0.1088	0.0021
1988	0.9181	0.7881	0.4602	0.2225	0.2527	0.1714	0.0856	0.0127	0.0133	0.0048	0.0658	0.0011
1989	0.9616	0.8514	0.5237	0.3013	0.2574	0.1807	0.0706	0.0093	0.0104	0.0033	0.0462	0.0008
1990	0.9468	0.7649	0.3243	0.1487	0.1401	0.1075	0.0574	0.0101	0.0136	0.0056	0.0898	0.0020
1991	0.9928	0.9416	0.8360	0.7655	0.1419	0.0679	0.1179	0.0282	0.0195	0.0002	0.0065	0.0000
1992	0.9906	0.7915	0.6663	0.6057	0.2410	0.0188	0.3894	0.0112	0.0061	0.0000	0.0057	0.0000
1993	0.9786	0.8135	0.6179	0.6156	0.1143	0.0731	0.5101	0.0761	0.0342	0.0000	0.0210	0.0000
1994	0.9867	0.7957	0.5746	0.5953	0.1554	0.0283	0.2930	0.0202	0.0214	0.0031	0.0090	0.0000
1995	0.9822	0.9322	0.7006	0.5392	0.2272	0.0394	0.3682	0.0230	0.0180	0.0000	0.0102	0.0000
1996	0.9771	0.8509	0.7141	0.5738	0.5288	0.2103	0.1538	0.0481	0.0434	0.0070	0.0063	0.0000
1997	0.9917	0.9164	0.6719	0.6106	0.5725	0.2953	0.1689	0.0307	0.0747	0.0362	0.0173	0.0175
1998	0.9823	0.8187	0.5431	0.4154	0.5180	0.2480	0.2061	0.0245	0.0359	0.0178	0.0047	0.0000
1999	0.9737	0.7816	0.6293	0.3112	0.1612	0.0750	0.1126	0.0205	0.0185	0.0131	0.0000	0.0000
2000	0.9732	0.7363	0.5095	0.4084	0.3904	0.2397	0.1096	0.0440	0.0918	0.0175	0.0095	0.0000
2001	0.9608	0.7638	0.4649	0.3137	0.2872	0.1905	0.0648	0.0278	0.0000	0.0527	0.0154	0.0134
2002	0.9621	0.7078	0.4182	0.2484	0.2280	0.2896	0.0833	0.0414	0.0144	0.0086	0.0029	0.0020
2003	0.8909	0.7704	0.3804	0.2522	0.3121	0.2219	0.0442	0.0155	0.0070	0.0000	0.0114	0.0036
2004	0.9264	0.6715	0.3632	0.2198	0.1805	0.1954	0.0412	0.0071	0.0000	0.0000	0.0000	0.0059
2005	0.8419	0.5362	0.2040	0.3658	0.4764	0.5158	0.0648	0.0170	0.0177	0.0106	0.3983	0.0081
2006	0.9624	0.5511	0.4006	0.2863	0.5109	0.5768	0.3068	0.1142	0.1463	0.0372	0.0000	0.0052
2007	0.9297	0.5349	0.2935	0.2930	0.3233	0.3835	0.3289	0.0082	0.0000	0.0067	0.5087	0.0063
2008	0.9111	0.5835	0.4550	0.3686	0.3401	0.4000	0.2292	0.0221	0.0113	0.0068	0.0080	0.0087
2009	0.9781	0.6935	0.2495	0.0710	0.3815	0.0719	0.0362	0.0257	0.0280	0.0056	0.0206	0.0099
2010	0.9743	0.5747	0.2827	0.2581	0.2123	0.5175	0.4252	0.0182	0.0185	0.0088	0.6683	0.0062

Table 7.8.36 Head boat fishing effort in angler days for southeast Florida (area 11), and the Florida Keys including the Dry Tortugas (areas 12, 17, and 18).

Year	FL Keys	SE FL
1981	71,709	154,747
1982	71,614	154,558
1983	64,721	129,643
1984	71,314	122,446
1985	67,227	119,169
1986	76,218	128,513
1987	82,174	136,723
1988	76,641	115,978
1989	81,586	132,944
1990	81,182	147,006
1991	68,468	127,765
1992	68,002	107,043
1993	74,698	91,020
1994	64,656	113,326
1995	57,613	94,293
1996	58,821	93,797
1997	56,059	64,450
1998	49,605	53,946
1999	41,781	65,261
2000	46,228	76,250
2001	45,888	62,271
2002	47,904	54,731
2003	42,544	49,672
2004	48,319	74,838
2005	50,785	72,515
2006	52,678	73,936
2007	36,431	69,981
2008	31,345	40,949
2009	32,241	38,881
2010	28,835	42,462

7.9 FIGURES

Figure 7.9.1 Survey areas defined by the NMFS Southeast Head Boat Survey.

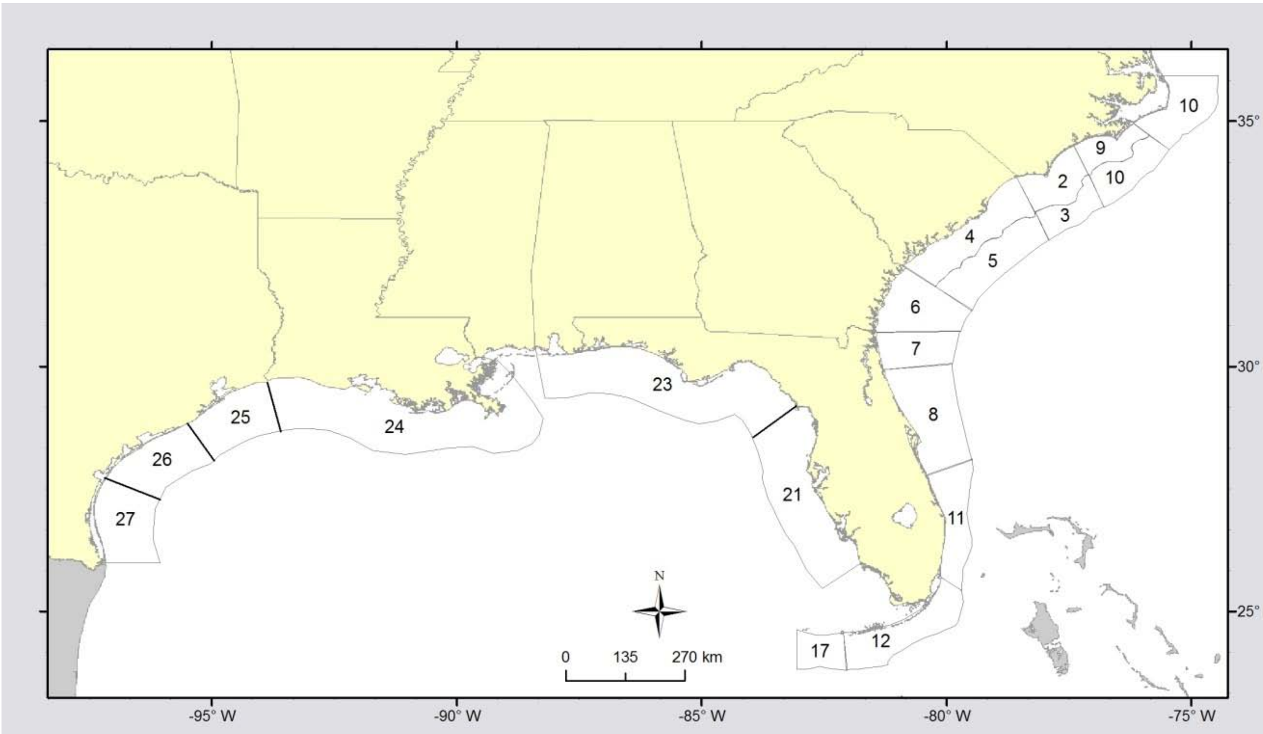


Figure 7.9.2 A comparison of landings in whole weight (mt) between the HBS estimates and estimates from length-frequency composition in the landings and the estimated weight at length.

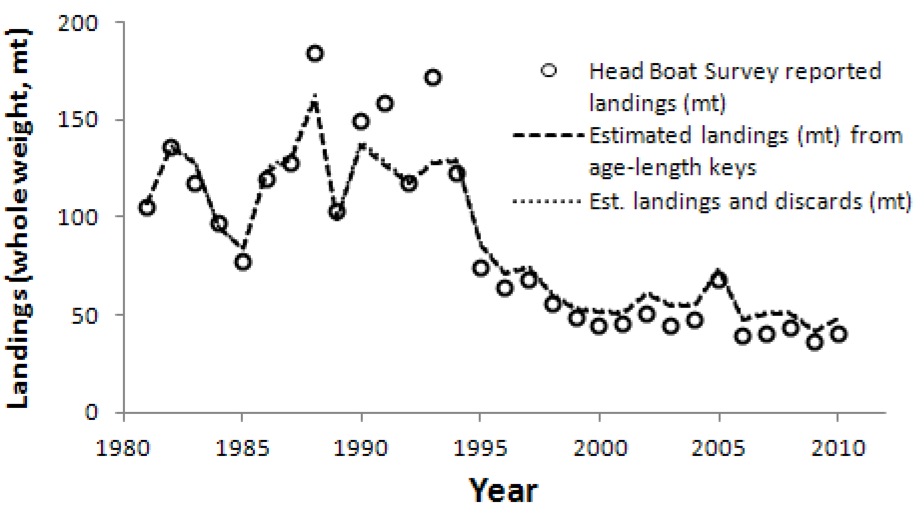


Figure 7.9.3 Annual recreational saltwater harvest (in numbers of fish) estimates by the MRFSS for yellowtail snapper in West Florida (Monroe County and Gulf Coast of Florida), East Florida (Miami-Dade to Nassau County), and other states in the southeastern US.

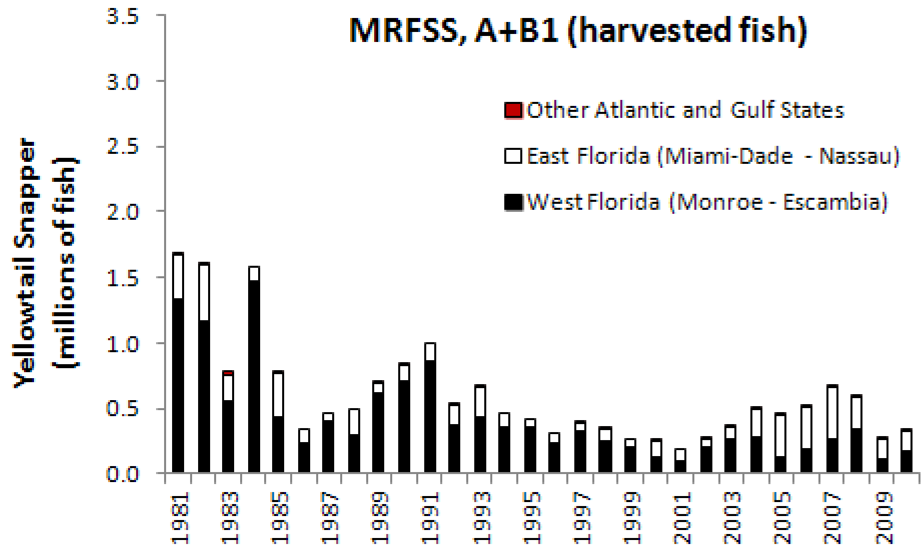


Figure 7.9.4 Annual numbers of yellowtail snapper released alive by recreational saltwater anglers estimated by the MRFSS in West Florida (Monroe County and Gulf Coast of Florida) and East Florida (Miami-Dade to Nassau County).

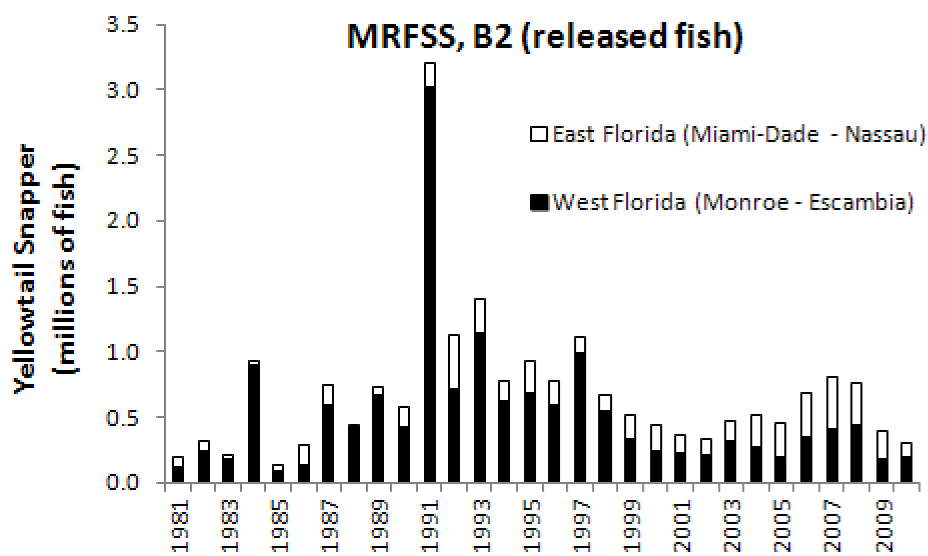
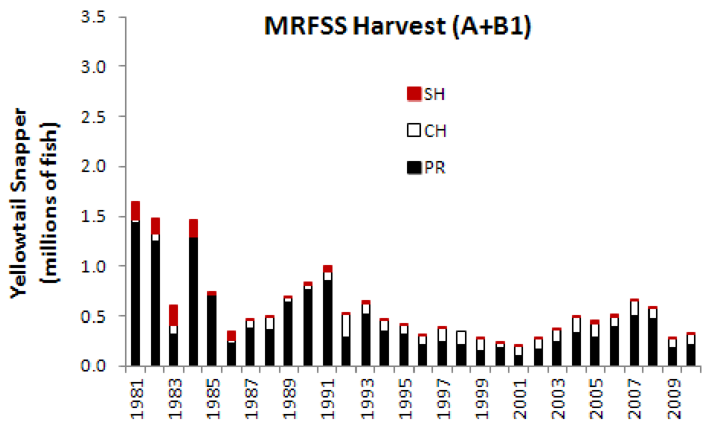
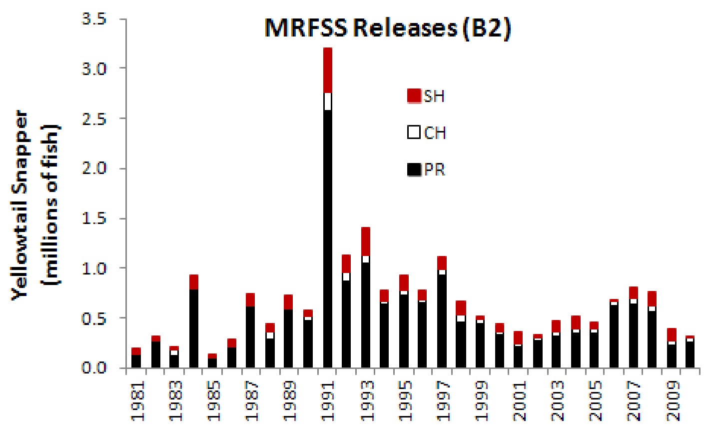


Figure 7.9.5 Annual numbers of yellowtail snapper a) harvested, b) released alive, and c) total catch by fishing mode (shore, private/rental boat, or charter vessel) by recreational saltwater anglers estimated by the MRFSS in Florida.

a) Harvested yellowtail snapper



b) Yellowtail snapper released alive



c) Total catch of yellowtail snapper

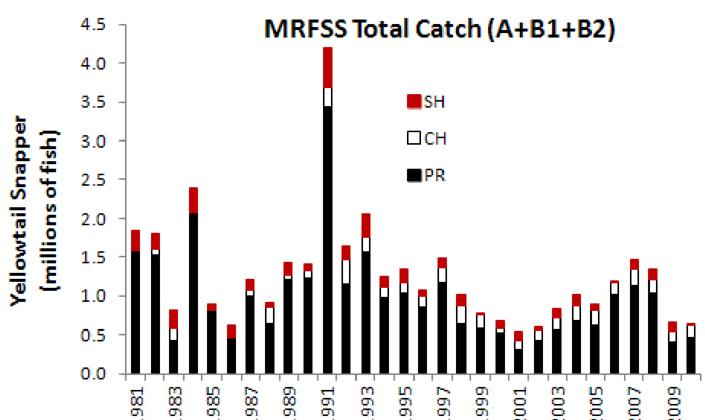


Figure 7.9.6 Annual metric tons of yellowtail snapper harvested by recreational saltwater anglers estimated by the MRFSS in West Florida (Monroe County and Gulf Coast of Florida) and East Florida (Miami-Dade to Nassau County).

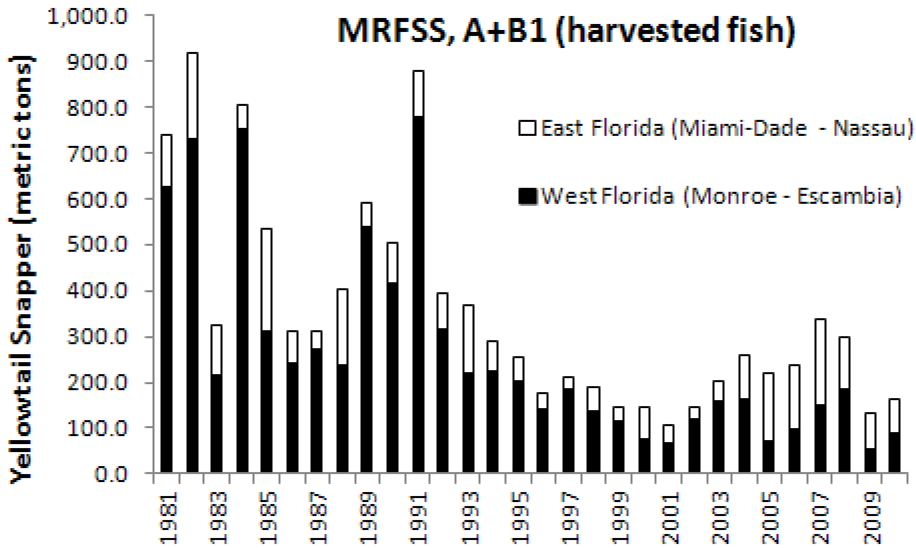
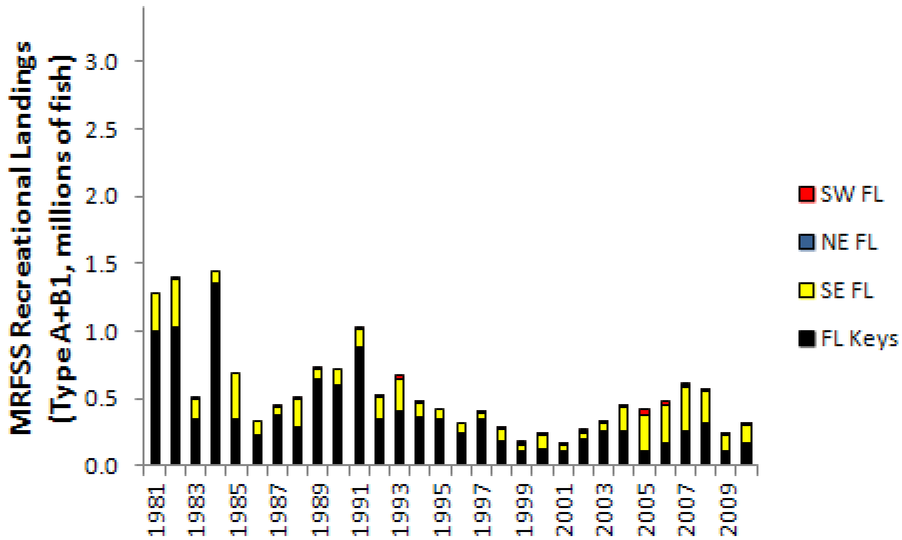


Figure 7.9.7 Annual numbers of yellowtail snapper a) harvested and b) released alive by recreational saltwater anglers estimated by post-stratifying the MRFSS data into regions of the Florida Keys (Monroe County), Southeast Florida (Indian River to Miami-Dade), Southwest Florida (Collier to Levy), and Northeast Florida (Nassau to Brevard).

a) Harvested yellowtail snapper



b) Yellowtail snapper released alive

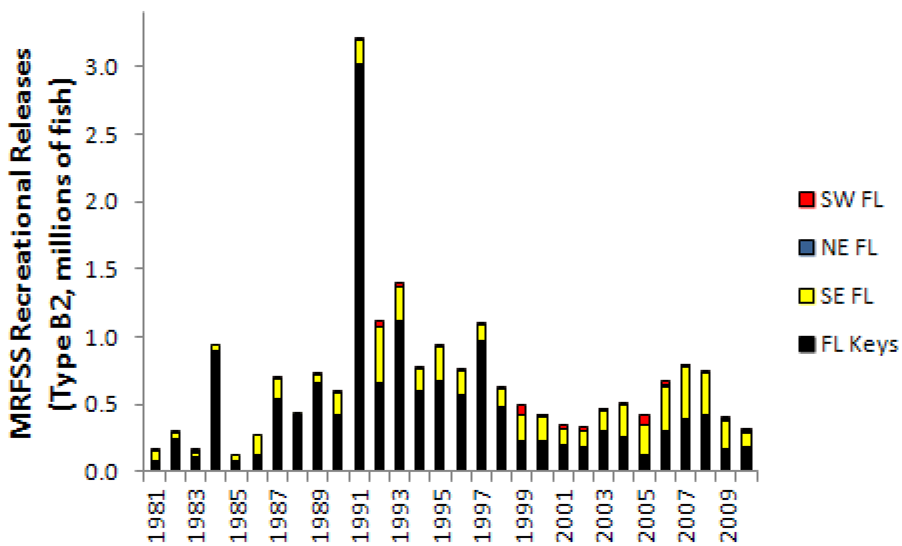


Figure 7.9.8 A comparison of the MRFSS A+B1 yellowtail snapper harvest estimates (in metric tons) with calculations of harvest from the annual size frequencies and average weights of yellowtail snapper.

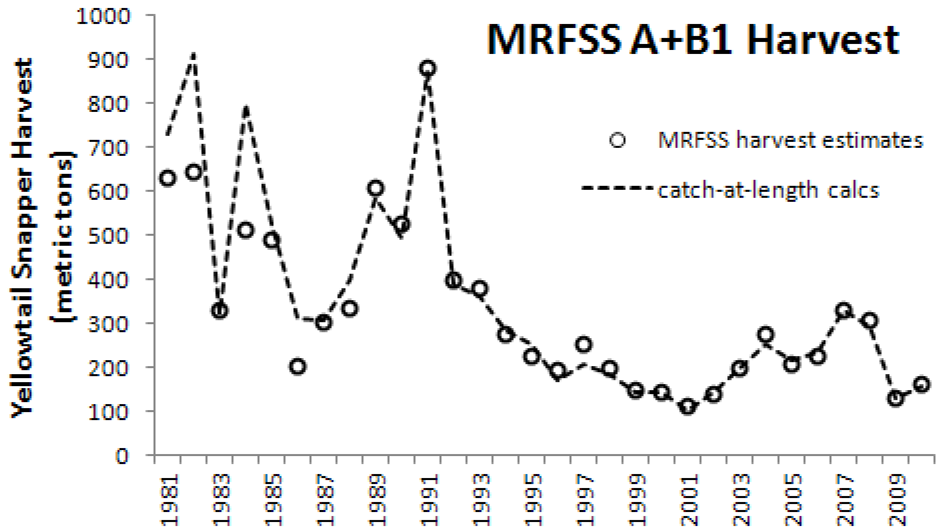
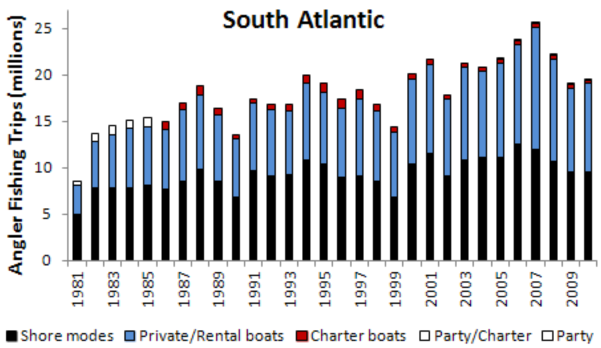
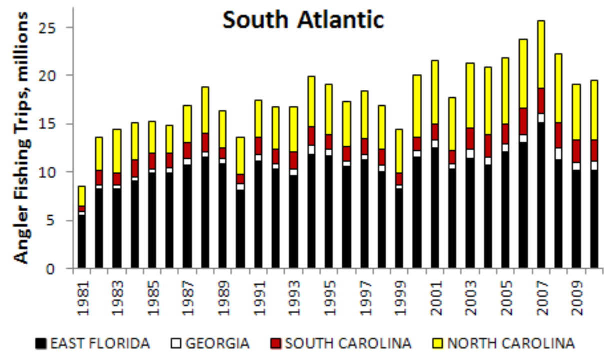


Figure 7.9.9 MRFSS fishing effort estimates (number of one-day angler trips) by region and mode of fishing: a) South Atlantic region by mode, b) South Atlantic region by state, c) Gulf of Mexico by mode, d) Gulf of Mexico by state.

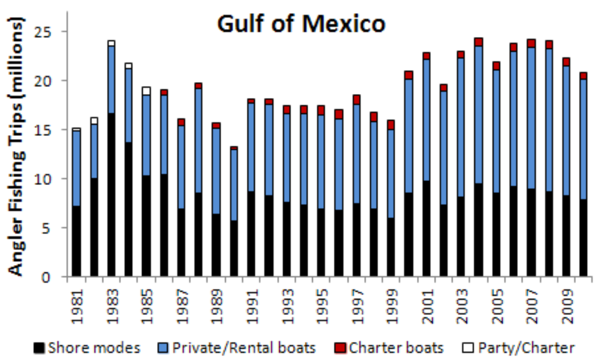
a) South Atlantic, by mode



b) South Atlantic, by state



c) Gulf of Mexico, by mode



d) Gulf of Mexico, by state

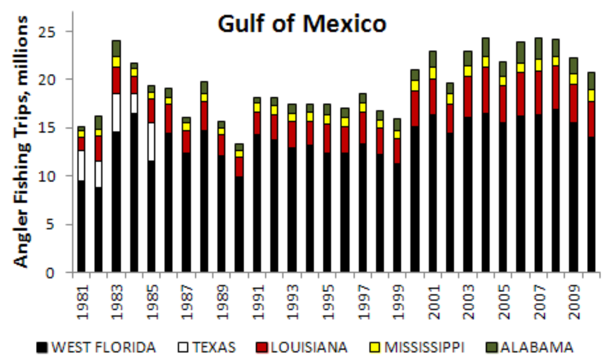


Figure 7.9.10 Estimated number of vessel fishing trips using MRFSS intercept data and trips identified from a cluster analyses (see Section 8.4.3).

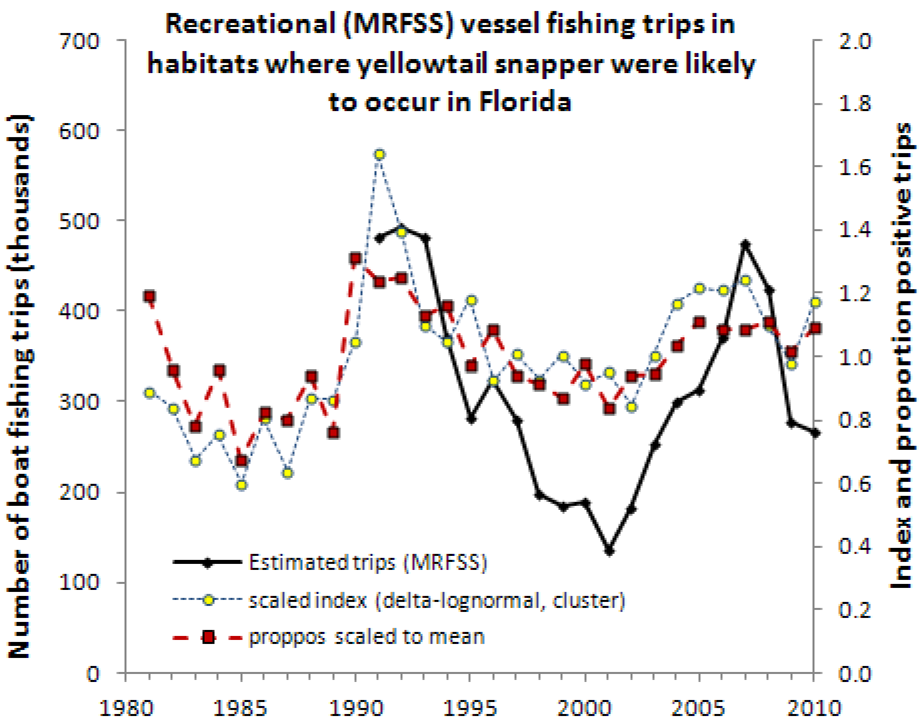


Figure 7.9.11 Age composition (Atlantic and Gulf combined) using age-length keys to estimate ages from length samples measured from the Southeast Head Boat Survey landings during 1981-2010. Values are in Z-score units within each age group. Positive scores (higher relative abundance) are represented as filled circles, and negative scores (lower relative abundance) as open circles. Circle diameters are proportional to the square-root of the absolute value of the Z-score.

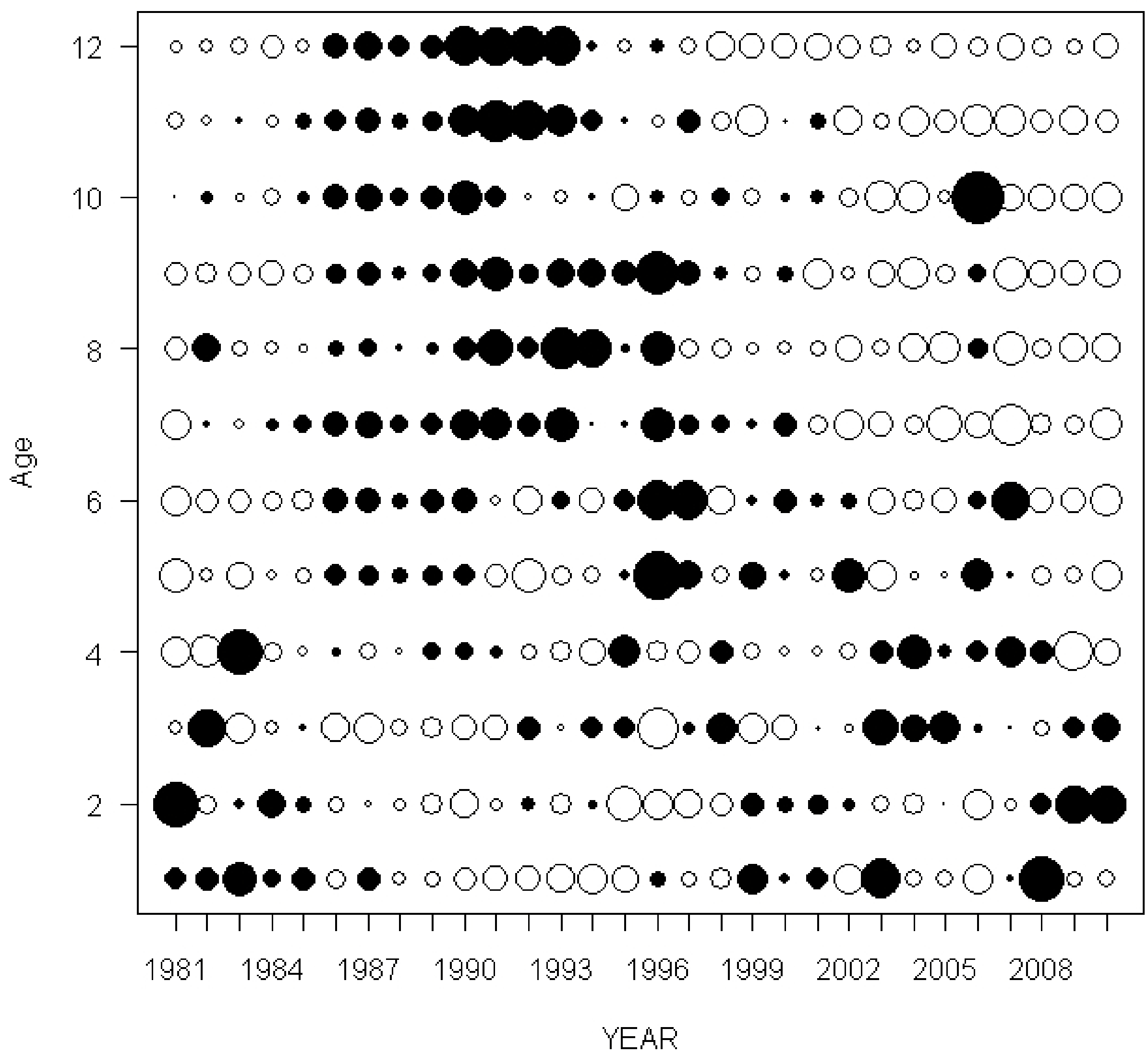
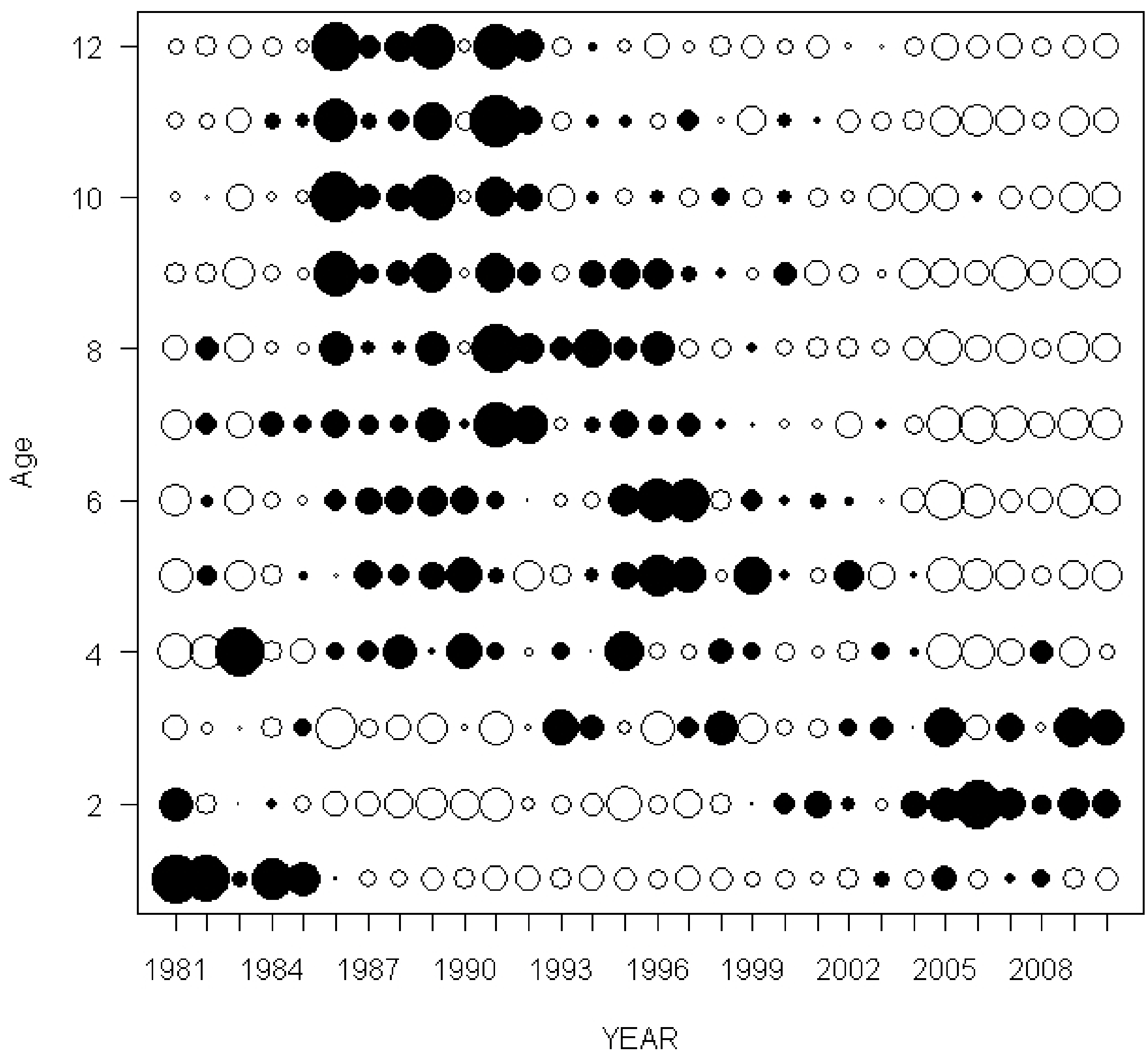


Figure 7.9.12 Age composition (Atlantic and Gulf combined) using age-length keys to estimate ages from length samples measured from the Marine Recreational Fishery Statistics Survey (MRFSS) landings during 1981-2010. Values are in Z-score units within each age group. Positive scores (higher relative abundance) are represented as filled circles, and negative scores (lower relative abundance) as open circles. Circle diameters are proportional to the square-root of the absolute value of the Z-score.



8. MEASURES OF POPULATION ABUNDANCE

8.1 OVERVIEW

8.1.1 ISSUES

Indices of population abundances should have good spatial coverage (area, depth, habitat, etc.) throughout the distribution and range of ages of a species, the temporal coverage should be as long as possible, trends in the indices should track trends in population abundance without bias, and variability in the estimates because of sampling issues should be as small as possible. These goals are likely never achieved in practice. Changes in population abundance in areas may be caused by a host of reasons such as shifts in oceanographic currents dispersing species to different areas than where the species is normally pursued (i.e., the species does not "show up" in the usual places in the usual amounts), and there are mortality events driven by red tides or winter kills that may locally drive down population abundance. Fishery independent surveys may have some biases arising from the types of gears employed, months surveyed, and access to habitats (survey coverage and design) from which information is collected. Fishery dependent surveys also have biases from how data are collected from fisheries, access to specimens and reporting compliance issues, sizes of fish pursued by fleets (e.g., economic or regulatory reasons), changes in areas fished (e.g., economic reasons like fuel costs, regulatory reasons such as closed areas) or due to changes in oceanographic conditions. Often, fishery dependent surveys are derived not from total catch data but only have landings information on which to be based and this is a disadvantage especially when discard amounts are large. These biases can be reduced somewhat by restricting the index coverage to the fully selected range of sizes or ages specific for the gears or fishing methods used. It may also be difficult to define which fishing trips may have been fishing in such a way that they could have caught the species in question, but did not (i.e., there was a probability of encounter but no catch of the species was made or none were legal to retain).

The indices developed for this assessment all have some drawbacks. There were compliance issues noted by McCarthy (2011a) for the NMFS CFLP and compliance rates for reporting in southeast Florida for the NMFS Southeast Head Boat Survey have been low in some years for some vessels (Ken Brennan, NMFS, SEFSC, personal communication). In addition, the MRFSS has been undergoing modifications to its survey protocols and estimation procedures (the NMFS Marine Recreational Improvement Program or "MRIP") over the last several years, and has recently released estimates for 2004-2010 made from the new procedures. MRFSS estimates of yellowtail snapper landed in the Florida Keys were lower than the MRIP estimates. However, estimation procedures for the previous years (1981-2003) were still under development at the time of this assessment and the choice was made to use the MRFSS estimates for 1981-2010.

8.1.2 REVIEW OF WORKING PAPERS

There were three working papers for fishery dependent indices: a commercial landings index developed from the NMFS Coastal Fisheries Log Book Program, a head boat landings index based on the NMFS Southeast Head Boat Survey, and a recreational angler catch index based on the NMFS Marine Recreational Fishery Statistics Survey. The fishery independent index was developed from abundance data received from the NMFS-University of Miami Reef-fish Visual Census.

8.1.3 Review of Indices

There were four indices prepared for this assessment: the Reef Visual Census (RVC) index from NMFS and University of Miami's underwater surveys, the commercial landings index from the NMFS' Coastal Log Book Program (CFLP), and index from total catches by anglers on boats (private/rental boats and charter vessels) from the NMFS' Marine Recreational Fishery Statistics Survey (MRFSS), and an index of trip landings from the catch records of the NMFS' Southeast Head Boat Survey (HBS). The RVC is a fishery independent index from a stratified random survey design, and consists of both abundance and size estimates for yellowtail snapper in reef areas of the Florida Keys for 1998-2010. The CFLP is a fishery dependent index from mandatory log books submitted by vessel captains with federal permits from 1993-2010. The MRFSS and HBS indices are also fishery dependent, but differ in that the MRFSS index was constructed to represent total catch (fish harvested or released alive) on angler trips from 1981-2010 whereas the HBS index was based upon log book catch records for vessel trips for 1981-2010. The three fishery dependent indices were constructed from delta-lognormal models used to examine both the probability of catching (MRFSS) or landing (CFLP and HBS) yellowtail snapper on trips and the amount of landings of yellowtail snapper from trips which caught yellowtail snapper.

8.2 REVIEW OF WORKING PAPERS

8.2.1 Commercial catch-per-effort (McCarthy, 2011a)

Commercial fishermen provide landings and effort data to NMFS through the Coastal Fisheries Log Book (CFLB) program. The CFLB began collecting data from vessels federally permitted to fish in a number of fisheries in waters of the Gulf of Mexico (from Texas to the southwest Florida and most of the Tortugas) in 1990, and in 1992 from the South Atlantic (from NC to Key West to southeast of the Tortugas). This program was intended to collect fishing effort and landings in a complete census of federally permitted vessels; however, through 1992 the program included only a subsample of 20% of Florida vessels. Beginning in 1993, all of the federally permitted vessels were required to report.

Landings data (because total catch is not reported from all of the CFLB log books) from vessels employing vertical lines were used to construct standardized landings per unit effort indices (see Section 8) for South Florida (99% of the yellowtail snapper landings) and for a "core" area (96.5% of the landings) with relatively higher catch rates of this species. The indices were model-based and applied a technique (Stephens and MacCall, 2004) to select from all the available commercial vessel trips whether yellowtail snapper were landed or not. The landings and effort from the trips selected by technique will not equal total landings and total effort expended by the commercial fleet for the year because some trips with yellowtail snapper (especially those with only this species) may be excluded and other trips without yellowtail snapper landings ("zero trips") may be included. But the selected trips will provide an estimate of average landings per unit effort for the index and the landings and associated fishing effort on those trips would be representative for the vertical line fishery.

Additional information on landings and effort used for the index were provided by Kevin McCarthy (NMFS, SEFSC, personal communication). These data were useful in examining residual patterns from the derived index from the model predictions.

8.2.2 HEADBOAT CATCH-PER-EFFORT (CHAGARIS, 2011A)

The NMFS Southeast Headboat Survey collects catch, effort, and biological measurements from headboats operating from North Carolina to Texas. The survey began operation in 1972 on the Atlantic Coast, expanded into Florida in the mid-1970's and to the Florida Keys by 1979, and in 1986 began operating in states bordering the Gulf of Mexico. Catch by species and effort (numbers of anglers and vessel trips) are collected on vessel trip reports sent by the vessel operators. Biological samples (measurements of length and weight, otoliths, etc.) are collected from anglers' landings during dockside intercepts of vessels returning from fishing. Catch and effort records record the general area fished, date, duration of trip, number of anglers fishing, and other information.

A standardized index of landed yellowtail snapper from the catch records was prepared through a subsetting process for trips (Stephens and MacCall 2004) that identified species positively or negatively associated with the target species (yellowtail snapper) from headboat survey regions 11, 12, and 17 (Southeast Florida, Florida Keys, and the Tortugas, respectively). This process attempts to identify fishing trips which, through the species landed, may be caught in the same habitats where the target species may occur even if the target species was not caught or landed on a particular trip. Once the trips were identified, a delta-glm model (Lo et al. 1992) was used to examine the probability of a yellowtail snapper being caught on a trip (the proportion positive trips) and the mean landings per trip from the trips on which yellowtail snapper were caught.

8.2.3 MRFSS TOTAL CATCH-PER-EFFORT (CHAGARIS, 2011B)

The NMFS Marine Recreational Fishery Statistics Survey began collecting information from saltwater anglers on the Atlantic Coast in 1979. The first two years of the survey data are rarely used. Data from this survey are generally available from March of 1981 to the present. The survey in most states is comprised of one telephone survey of households that collects fishing effort information and three separate intercept surveys – shore mode intercepts, private or rental boat intercepts, and charter vessel intercepts (in some states, both head boats or "party" boats are combined for intercepts). In mid-1997, a pilot survey for collecting charter vessel effort began collecting effort for that mode of fishing because of the difficulty of contacting the relatively small number of anglers who had taken a charter fishing trip in the previous sixty days (which caused estimation problems). In 2000, charter vessel fishing effort was collected using the telephone survey of charter vessel captains for Louisiana to Florida, and beginning in 2002 on Florida's Atlantic Coast. In this voluntary survey, the MRFSS collects catch information on harvested (landings, dead discards) and fish released alive through angler interviews, and field samplers measure and weigh fish if the anglers allow them access.

A standardized index of landed yellowtail snapper from the total catch (landed and released fish) was developed using a clustering technique to identify species associations on trips on which yellowtail snapper were caught. Once the species assemblage (cluster) in which yellowtail snapper was grouped was determined, all trips with catches of any of the species in the cluster were drawn from the data (including trips without yellowtail snapper). A delta-glm approach was used to examine the probability of a yellowtail snapper being caught on a trip (the proportion positive trips) and the mean landings per trip from the trips on which yellowtail snapper were caught.

8.3 FISHERY INDEPENDENT INDEX

8.3.1 NMFS-UM Reef Visual Census (RVC)

The yellowtail snapper total annual abundances and abundances by size class used for this index were prepared by Dr. S. G. Smith (Univ. of Miami, personal communication). The following description for this survey, provided from notes by Drs. J. S. Ault and S. G. Smith for the black grouper data workshop report in SEDAR 19 (SEDAR 2009), is appropriate for yellowtail snapper also and is excerpted in part below:

"The reef-fish visual census (RVC) has been conducted in the Florida reef tract since 1979 to the present in a collaboration between NOAA Fisheries SEFSC and the University of Miami. The RVC uses standard, non-destructive, in-situ visual monitoring methods by highly trained and experienced divers using open circuit SCUBA. The general statistical approach and sampling survey design methodologies incorporating habitat covariates are fully described in Ault et al. (2002, 2005, 2006). Field methods and sampling protocols are detailed in Brandt et al. (2009). In the 2008 survey year, the Florida Fish & Wildlife Conservation Commission and the National Park Service joined on as survey collaborators. The RVC survey is conducted in two principal regions of the south Florida coral reef ecosystem domain: (1) the Florida Keys (Key Biscayne to west of Key West) with a domain size of 559 km^2; and, (2) the Dry Tortugas region with a domain size of 339 km^2."

"Notable milestones for the Florida Keys surveys: (1) 1979-1993: sampling conducted along the Keys reef tract in various reef habitats, but limited in any particular year with respect to geographical coverage and habitats; (2) 1994-2000: sampling coverage expanded to include all geographic regions of the Keys (Biscayne National Park, upper Keys, middle Keys, lower Keys), the full range of reef habitats less than 18 m in depth, and all no-take marine reserves (implemented prior to 1998 survey); (3) 2001-2008: sampling coverage expanded to include fore-reef habitats ranging from 18-33 m in depth. The survey domain and habitat strata for the Florida Keys surveys are described in Table 5.7. Sample sizes by strata and year are given in Table 5.8. Notable milestones for the Dry Tortugas surveys: (1) 1999-2000, 2004, 2006, 2008: sampling conducted in all reef habitats less than 33 m in depth in two principal areas, Tortugas Bank and Dry Tortugas National Park, including no-take marine reserves."

The RVC design was simple random sampling from 1979-1993, and changed for the 1994-1997 period to use stratified random sampling (SRS) but did not include strata specifically for MPAs (Management Protected Areas), and from 1998-2010 included MPAs into the stratified design (Dr. J.S. Ault, University of Miami, personal communication). The RVC sampling domain (885 km^2) was stratified by reef habitat features (e.g. depth, rugosity) into areas where fish density were of low to high variability. Spatial management zones (added in 1998) were used as secondary stratification, and survey effort was allocated according to the spatial extent of each strata (Table 8.7.1) and variance in fish abundance. The adoption of the stratified random sampling design has allowed improvements in the estimation by general linear models of fish abundance and variability, and weights the sample means by the proportion of strata (e.g. habitats) represented on the reef tract to estimate population abundance. More complete details of this survey are documented in Smith et al. (2011).

The number of strata in the survey design, the number of primary units sampled (200m x 200m areas), the second-stage units (dives) sampled, and the estimated population abundance of yellowtail snapper from the survey is contained in Table 8.7.1. There are quite large fluctuations in population estimates (Fig. 8.8.2a) during 1980-1997 which become somewhat less so during the 1998-2010 period (Fig. 8.8.2b). Stratified random sampling, and the increased level of stratification in the survey design especially after 1997, appears to have greatly reduced the variability (as represented by the cv) of yellowtail snapper population estimates for this survey (Table 8.7.1). Dr. Ault (Univ. of Miami, personal communication) recommended the use of the 1994-2010 time period because of incorporation of stratified random sampling into survey design and estimation procedures which better accounted for variability. Instead, because of the improved performance (lower cv values) and increased level of stratification (inclusion of the MPAs as strata) during the 1998-2010 period (Table 8.7.1), this period was selected for use from the RVC estimates.

The survey also provided abundances by size classes (in centimeters fork length) from the counts and size estimates observed by the survey divers (Table 8.7.2). The abundance at size estimates were converted from fork length to total length using FL to TL conversions in Table 5.10.7. Approximately 95% of observed yellowtail snapper were between 3" – 16" TL (or, 7 cm – 34 cm FL; Fig. 8.8.3). The estimated abundances for these TL classes (in inches) were restricted to the sizes used in the age-length keys (< = 5", 5 - 23", and >=24" TL; Ages 1 to 12+; see Section 5.5.5) to estimate the age composition of the population (Table 8.7.3) observed in the RVC during 1998-2010. In contrast, the RVC survey estimates for juveniles [<197 mm TL (~7.76")] and adults (>=197 mm TL) were used for 1981-2001 in the SEDAR 3 assessment.

8.4 FISHERY DEPENDENT INDICES

8.4.1 COMMERCIAL SNAPPER-GROUPER AND REEF FISH LOG BOOKS

McCarthy (2011a) explained the methodology for developing this index. Commercial fishing vessels with federal permits that are required to submit log books in the southeast region from 1993-2010 were selected based upon the area that they fished, gear (vertical lines: bandit rigs, rod and reel, etc.) used, and number of hooks per line, duration of trips, and timeliness of report submission criteria. More than 99% of the yellowtail snapper were caught in south Florida. Outlier analyses excluded trips that fell in the 99.9th percentile for number of lines fished, number of hooks per line, trip duration, and amount of landings. Seventy percent of the vertical line trips were retained after all of the data filtering.

Commercial trips were selected by analyzing the species composition of trips on which yellowtail snapper were caught to identify those species which had the potential to identify areas ("presumptive habitat") where yellowtail snapper were likely to be caught even if they were not on a particular trip. The subsetting technique uses a logistic model to identify species with positive and negative associations (Fig. 8.8.4) with the target species (in this case, yellowtail snapper).

McCarthy (2011a) produced two different indices – a south Florida index and a "core area" index. Spatially, the area fished over which the south Florida index applies was limited to south Florida from Area 4 (Sarasota, approximately) to the Keys to grid cells 2779 and 2780 (Palm Bay, approximately) (Fig. 6.9.7). The "core area" index was more restricted spatially to the region from Jupiter Inlet (approximately; grid 2679) to the Dry Tortugas (grid area 2) where catch rates were slightly higher in some years. Some areas were grouped to produce a more balanced population of cells ("fewer holes" by strata) in the analyses for each index.

Catch rate for the indices was defined as the pounds of yellowtail snapper per hook-hour fished (the number of lines fished x the number of hooks per line x the hours fished). A delta-glm model (Lo et al. 1992) was used to examine the proportion of trips on which yellowtail snapper was caught and the average catch rate for trips on which yellowtail snapper were caught. The results from the two submodels are combined to produce an adjusted catch rate for all of the fishing effort in the area over which the index is developed. The catch rates for the south Florida and "core area" indices were similar (Table 8.7.6, Figs. 8.8.5, 8.8.6), and both show a generally increasing trend from 1993-2010. The trend from 2004 – 2010 has been for landings rates to be at higher rates and have increased at a faster rate than over much of the 1993-2003 time period. The index used in SEDAR 3 was also developed from the CFLP and also used the delta-glm approach and produced similar patterns to that of McCarthy (2011a), though the subsetting approach for selecting trips was different.

8.4.2 SOUTHEAST HEAD BOAT SURVEY (HBS)

Trips (represented by vessel trip reports or "catch records") from the NMFS Southeast Head Boat Survey in the south Florida area (HBS areas 11, 12, and 17; Fig. 7.9.1) were selected for catch rate analyses because 97% of the catch of yellowtail snapper occurs in these areas (Chagaris 2011a). Trips on which yellowtail snapper were landed were analyzed using a subsetting technique (Stephens and MacCall 2004) to identify species from the catch records that were positively or negatively associated with catches of yellowtail snapper (Fig. 8.8.8). Species occurring on fewer than 1% of the trips with yellowtail snapper were excluded from the analyses, as were vessels making less than 10 trips in areas 11, 12, and 17 and those carrying fewer than 5 anglers, and any with landings of yellowtail snapper in the 99.5th percentile. The logistic analyses scores trips based upon the suite of species landed and assigns a probability value to each trip, and the technique minimizes the difference between the number of observed and predicted positive trips (Stephens and MacCall 2004). There were 93,443 trips identified from the procedure which, from the suite of species caught, may have been fishing in areas where yellowtail snapper could have been caught. This subset of trips was analyzed with a delta-glm model to identify important strata (year, area, season, trip type, and number of anglers) available from the vessel trip reports which may have had an effect on catch rates. Catch rates were defined as the number of fish landed per angler-hour (number of anglers x hours fished). The effect of the 10-fish aggregate bag limit on yellowtail snapper catches appears negligible (Chagaris, 2011a).

The proportions of trips with catches (landings) of yellowtail snapper were highest in the Florida Keys (87%) and Dry Tortugas (97%) and lowest (68%) in southeast Florida (Table 8.7.7). The proportion of positive trips observed in the subset and from the delta-glm were very similar (Fig. 8.8.9). The observed ("nominal") catch rates, number of trips in the HBS in the selected subset, proportion of trips with landings of yellowtail snapper, delta-glm modeled index, and the index cv are in Table 8.7.8. The modeled catch rates were generally above the observed catch rates for the early portion of the time period, but were more similar after 1995 (Fig. 8.8.10). Scaling the observed and adjusted catch rates to their respective means removes the effect of the scale of the numbers and allows a little clearer inspection of trends in the indices (Fig. 8.8.11). The annual values scaled to the means show an increasing trend in landings rate after 1985 (the year Florida implemented the 12" TL size limit until 1994. A declining trend in landings was noted from 1995 to 2002. Landings rates increased to a maximum in 2005 and declined again through 2007. The annual landings rate is up slightly in 2008 and 2010 for head boats in south Florida (Fig. 8.8.11).

8.4.3 Marine Recreational Fishery Statistics Survey (MRFSS)

Yellowtail snapper are caught by recreational anglers primarily in south Florida from Palm Beach County to Monroe County (Chagaris, 2011b). Because the MRFSS collects data on both harvested (landings and dead discards) and released fish, a total catch by species for an angler-trip can be calculated. Anglers on the same trip may share the same receptacle for fish landed from a trip, and they may not be able to separate the landings for each angler. These group catches were recorded in the MRFSS data and can be used to examine data on an angler-trip base by adjusting for the number of anglers in the group contributing to the landings for a trip. A change to the survey protocols in 1991 began collecting information for anglers on the same vessel so that trip-level information on landings and catch can be analyzed. Most of the catch of yellowtail snapper is recorded by anglers fishing from vessels, so shore-mode intercepts were excluded though there are occasional catches and landings from anglers fishing in the shore mode. Most of the vessel landings are from trips that are made offshore, so trips from inland trips were also excluded. Additionally, intercepts of anglers fishing on head boats (when the MRFSS had allowed sampling of both charter vessels and head boat vessels in the "Party/Charter" mode) for 1981-1986 were excluded. Data from wave 2 (March-April) of 1981 through wave 6 (November-December) of 2010 were used for the analyses. There were 124,998 recreational angler-trips from the MRFSS data that met these criteria, and yellowtail snapper were caught on 7,159 of those trips (Chagaris, 2011b).

A subsetting procedure using clustering techniques (Shertzer and Williams 2008) was used for preparing a data set of trips to used in the delta-glm analyses (Lo et al. 1992) of catch rates. The clustering method chosen was Bray-Curtis using average linkage (see Krebs 1999). The total catch (harvested and released fish) data for angler-trips in numbers was square-root transformed to reduce the effect of large catches on the analyses. The cluster analysis identified a suite of seven species most often associated with catches of yellowtail snapper and similar to the "southern assemblage" of species found by Shertzer and Williams 2008). A total of 29,485 angler-trips resulted from the subsetting. Some of those angler-trips were not in Monroe, Miami-Dade, Broward, or Palm Beach counties where 98% of the yellowtail snapper catches are made, and were excluded from the analyses. The assumption made was that these resulting trips were made in areas and habitats where yellowtail snapper were likely to occur, even if they were not caught on a particular angler-trip. Additional filtering involved the exclusion of records where the number of hours fished, number of contributors to the catch, or days fished in the previous wave (avidity) was missing and of outliers with high leverage (relatively large impact on results). After subsetting and filtering, there were 15,026 trips of which 6,574 had catches of yellowtail snapper.

Catch rates (cpue) were defined as the total number of yellowtail snapper caught [MRFSS Type A – fish observed by the field sampler in the harvest, B1 – harvested fish unavailable for measurement, and B2 – fish released alive by the angler). The delta-glm included factor levels for area (distance from shore), hours fished (grouped into 6 levels), number of contributors (with more than 7 grouped into the 7+ group), avidity (number of days fished in the last 20 days, 7 levels), county (Monroe, Miami-Dade, Broward, and Palm Beach), mode of fishing (charter vessel or private/rental boats), and wave (two-month periods corresponding the MRFSS estimation periods). Catch rates were analyzed with a forward stepwise selection process for both the proportion of positive trips (binomial submodel) and the catch rates on trips which caught yellowtail snapper (“positive” trips) using a lognormal submodel. The adjust means for each of submodels were multiplied together with a bias correction (to adjust for log transformation of catch rates) to form the adjusted catch rate for the index (Table 8.7.9).

The modeled catch rates were generally above the observed catch rates for the many of the years and are a result of the standardization process adjusting catch rates for the various significant factors in the model. Both the observed and adjust average catch rates show a large increase in 1991 (Fig. 8.8.14) when live releases (MRFSS Type B2 fish) of yellowtail snapper were particularly high (Fig. 7.9.7). Scaling the observed and adjusted catch rates to their respective means removes the effect of the scale of the numbers and allows a little clearer inspection of trends in the indices (Fig. 8.8.15). The annual standardized catch rates values scaled to the means show a declining trend in landings rate from 1981 - 1985, a noisy but increasing trend to 1991, generally declining from 1991 to 2002, and increasing through 2007. Catch rates declined for 2008-2009 but increased a bit in 2010.

8.5 RECOMMENDATIONS ON INDICES

The NMFS-UM RVC index is the only fisheries independent index in the assessment. It should not be linked to any fleet (i.e., it is a population index), and the units are in numbers. A selectivity pattern should be derived from the proportions at age data (Table 8.7.5). The selectivity age range should be ages 1 to 5 (i.e., these ages comprise about 95% of the age composition of this index).

The commercial landings indices (south Florida and “core area”) developed for this assessment were similar in trend and in variability (as represented by the cv), and there was no clear reason to choose one over the other. The south Florida index, because of its larger spatial coverage than the “core area” index and slightly lower cv values, was selected to represent commercial catch rates for the assessment. The index should be linked to the commercial fleet (i.e., use the selectivity blocks associated with this fleet) and the units are in weight rather than numbers. No recommendation was included on the age range applicable to this index, so setting the age range to cover 95% of the age composition (e.g., age 2 to age 10) in the commercial landings would be a reasonable place to start.

The head boat index for South Florida developed for this assessment is consistent with other indices constructed from landings data which was all that was available over the 1981-2010 time period (except the 2004-2010 time period which also has estimates for fish discarded from head boats). As an index built on landings, it should be linked to the head boat fleet selectivity blocks, and the units for the index are in numbers of fish. No recommendation was included on the age range applicable to this index, so setting the age range to cover 95% of the age composition (e.g., age 2 to age 8) in the head boat landings would be a reasonable place to start.

The MRFSS index for South Florida developed for this assessment uses total catch data over 1981-2010. As an index built on recreational catches, it should be linked to the MRFSS fleet selectivity blocks, and the units for the index are in numbers of fish. No recommendation was included on the age range applicable to this index, so setting the age range to cover 95% of the age composition (e.g., age 2 to age 8) in the MRFSS landings would be a reasonable place to start. Since the index is comprised of both harvested (landings, other claimed but unobserved harvested fish) and live releases, it is possible that the age range might be modified to include Age 1.

8.6 LITERATURE CITED

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8.7 TABLES

Table 8.7.1 Estimated abundance of yellowtail snapper from the NMFS-UM Reef Visual Census (RVC) in the Florida Keys, 1979-2010. (n is number of primary 200m x 200m sampling units, nm is the number of second-stage (dives, 15m visual "cylinder") units sampled, and cv is the coefficient of variation as a percentage of the mean).

				Juveniles (5 - 17 cm FL)		Adults (> = 18 cm FL)		Total (> = 5cm FL)	
year	**No. strata**	**n**	**nm**	**abundance**	**cv (%)**	**abundance**	**cv (%)**	**abundance**	**cv (%)**
1979	1	4	13	0	0.0	25,192,180	42.7	25,192,180	42.7
1980	1	9	145	7,837,211	34.5	19,031,469	33.3	26,868,680	23.3
1981	1	25	213	1,369,843	23.6	13,981,749	25.9	15,351,592	23.3
1982	1	19	189	819,617	38.6	15,071,058	20.5	15,890,675	18.9
1983	1	16	505	1,701,521	42.9	11,544,769	16.3	13,246,289	14.7
1984	1	15	228	1,861,368	25.2	8,426,729	34.2	10,288,097	30.0
1985	1	8	124	8,348,913	31.0	6,895,143	29.3	15,244,056	26.7
1986	1	8	32	2,053,944	40.5	13,940,161	49.0	15,994,105	45.1
1987	1	6	70	3,698,052	33.5	15,834,129	42.4	19,532,181	39.8
1988	1	22	263	4,363,761	18.5	9,924,596	34.3	14,288,358	25.4
1989	1	29	318	3,217,006	31.8	8,551,794	50.6	11,768,800	44.3
1990	1	27	282	7,553,092	24.8	6,132,109	50.8	13,685,201	29.8
1991	1	21	280	9,192,250	27.4	10,658,351	38.0	19,850,601	22.9
1992	1	21	256	11,502,386	34.0	2,372,797	65.3	13,875,183	38.0
1993	1	23	196	16,314,552	27.6	7,703,135	32.5	24,017,687	24.9
1994	6	32	153	6,602,129	25.4	5,034,016	57.0	11,636,146	33.5
1995	6	61	291	4,643,868	26.3	3,303,840	40.2	7,947,708	25.4
1996	6	32	171	6,900,852	48.4	11,204,087	69.0	18,104,938	61.1
1997	6	66	408	16,834,619	57.9	9,627,058	62.4	26,461,676	59.4
1998	12	75	461	2,797,383	23.6	2,035,966	42.6	4,833,349	29.8
1999	12	161	440	5,294,945	16.9	5,870,703	29.5	11,165,649	18.6
2000	12	228	527	7,038,468	12.6	5,524,892	15.0	12,563,360	11.3
2001	13	305	742	5,359,530	14.1	6,854,652	14.3	12,214,182	11.5
2002	13	336	628	9,859,699	18.8	6,855,091	17.3	16,714,789	14.2
2003	13	237	448	5,266,501	11.9	4,681,955	14.0	9,948,455	10.6
2004	13	137	261	4,232,194	18.1	4,783,645	23.0	9,015,838	15.3
2005	13	256	498	11,247,458	14.8	5,913,034	15.1	17,160,492	11.6
2006	13	334	608	7,623,857	14.0	6,185,816	28.2	13,809,673	16.7
2007	13	320	619	6,838,219	14.4	6,452,952	9.0	13,291,170	9.5
2008	13	373	729	8,635,101	8.7	9,449,276	10.6	18,084,377	7.7
2009	13	516	1004	9,455,104	9.3	5,219,505	9.6	14,674,609	7.5
2010	13	379	739	6,172,668	13.9	5,706,019	19.7	11,878,687	13.3

Table 8.7.2 Estimated abundance of yellowtail snapper by size class (FL) from the NMFS-UM Reef Visual Census (RVC) in the Florida Keys, 1979-1994.

Fork Length (cm)	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2459
2	0	29847	0	19910	26323	24916	0	0	48916	0	0	0	0	0	0	0
3	0	29847	0	0	72387	12510	0	0	0	0	0	0	0	0	0	23278
4	0	0	20364	10034	13161	40553	23804	97546	0	0	24985	12326	0	0	35859	87269
5	0	0	0	59729	6581	62341	23804	195091	48916	0	49970	110521	0	29970	215394	124550
6	0	0	0	10034	6581	0	59511	0	48916	34721	49970	159688	18263	457049	112630	180547
7	0	0	40728	39819	19742	24916	71413	97546	0	451941	84383	423733	18263	280972	246680	212607
8	0	29847	101661	0	13161	62341	83315	0	48916	278051	343659	856780	73050	921451	198066	879843
9	0	59426	40728	0	19742	6255	11902	292637	48916	304199	103121	657102	27394	1783100	744371	741827
10	0	29847	172934	0	65807	43681	47609	97546	342411	199894	175012	1219021	351356	1123751	2172707	918818
11	0	118852	61092	0	13161	65469	119022	0	48916	156458	281197	807613	317213	958914	2111338	361554
12	0	81744	5091	79638	174321	296173	642719	0	342411	451941	318674	810626	1284532	1202423	4966806	658171
13	0	446097	81456	39819	93741	124683	601062	0	440243	373783	224981	386893	819036	224778	776139	253930
14	0	208125	40728	24847	282835	224449	535600	195091	391327	725706	156273	994966	1289098	1063810	2054782	333783
15	0	1018844	239117	89673	728441	308683	1690114	268331	391327	595396	966748	420720	1451079	1873011	1231955	459978
16	0	2335085	356051	84576	792502	380302	1964017	243864	941729	1464414	887315	654089	1918958	988884	1507514	1079796
17	0	4060316	767944	418102	587024	346004	993835	390182	586991	903882	643595	939636	613781	408347	668562	380584
18	775163	3747860	1078176	746690	1624488	632899	868861	1536423	990645	1381970	487440	411408	994714	636871	1347473	246808
19	96990	2996836	712102	637107	1019468	679603	975981	268331	574860	977752	804818	724620	771196	329674	233203	113738
20	3294381	3532206	1286747	1294124	1627711	1627336	1452070	1317026	1614224	1733892	1643460	1093161	2007888	580676	1319075	168596
21	775163	1792186	1312202	1752044	1300558	726411	595111	1170708	1320729	786574	421796	110521	390263	71180	1134486	65270
22	0	929570	1352930	1209548	1106495	953988	1529434	1609663	684822	1177646	1152956	236381	1305177	82419	870479	34648
23	5522882	855086	2019213	1468373	785921	826178	446333	975617	1443019	682269	715485	288697	1058633	554452	484455	632383
24	0	914781	1185086	1289186	996369	420856	553453	1634130	2274589	113021	334349	279385	828167	29970	489028	186692
25	12014654	1115377	1398749	2777468	1104883	707646	279702	1170708	1247355	286767	1335981	491251	1843525	29970	457982	2828884
26	387456	237972	625555	1279152	322319	286791	464186	1853527	819439	547530	156273	190365	335475	14985	255825	53212
27	0	200865	1042698	681864	103545	392812	267800	48773	904944	226042	6246	558906	317213	74926	35859	337352
28	775163	758553	478076	890994	182513	514367	249946	1780448	244579	165173	316789	270209	463115	0	89767	29549
29	0	304927	294959	159277	77222	187024	59511	0	758196	17432	0	12326	178060	116135	80863	9661
30	775163	416519	472985	298644	128256	143447	166631	487728	966187	60868	37477	147362	449418	22478	153062	196559
31	0	29847	50910	49854	0	0	23804	0	134617	0	0	236381	79799	0	0	44628
32	0	0	152571	79638	9804	0	0	97546	220122	34721	49970	18489	111759	0	18050	6869
33	0	89273	172934	79638	0	152726	71413	97546	440243	34721	0	18489	54788	0	0	31480
34	0	59426	0	4938	6581	12510	101169	0	0	52153	0	0	155232	0	0	0
35	0	0	203480	84576	39484	37426	119022	0	513617	17432	0	110521	166547	0	0	2576
36	387456	0	0	49854	0	0	0	0	146748	0	0	12326	18263	0	18050	82641
37	0	252761	20364	19910	13161	12510	0	0	146748	0	0	0	18263	0	0	0
38	0	118852	20364	79638	6581	24916	47609	0	0	0	0	18489	0	14985	0	642
39	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
>=40	387456	89541	101820	119458	59226	62342	119022	170786	391328	52153	12492	12326	120890	0	35859	41562
TOTAL	25191927	26890315	15909815	15928156	13430095	10425064	15258785	16096794	19566946	14288502	11785415	13695327	19850408	13875181	24066319	11812744

Table 8.7.3 Estimated abundance of yellowtail snapper by size class (FL) from the NMFS-UM Reef Visual Census (RVC) in the Florida Keys, 1995-2010.

Fork Length (cm)	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
1	2459	2459	0	0	0	0	0	0	0	0	0	47485	0	10052	2348	0
2	0	0	4948	0	242	9454	1814	0	0	0	24801	424	656	7383	5667	13473
3	41543	8973	0	0	1382	9685	17958	0	19409	5429	0	13009	53412	45768	55603	11815
4	44072	16349	25714	0	77807	4745	92455	8747	21784	103329	21258	16475	7974	45127	126028	49892
5	270136	79916	29727	5852	228658	32799	139783	21318	55401	206458	113935	68064	180338	106648	350473	114125
6	147751	120821	172624	113908	142268	89118	202790	144004	194858	342213	379179	610016	77525	186369	347900	112042
7	147987	113228	222063	52360	85246	150317	172601	401032	104087	94689	463364	256094	75153	289103	351770	81200
8	262379	157345	171668	156250	308837	473315	203322	964752	287316	340063	791429	775051	115364	362528	750137	131342
9	177064	24301	357958	66022	392428	327720	316920	837647	302719	274143	610549	418651	148514	281155	582329	58232
10	900684	877796	882634	349051	308067	944419	791741	835556	705423	346547	1066259	1017086	383126	750930	1069834	374982
11	245539	142870	123360	164476	315286	489657	255204	502798	201974	454212	349374	124244	478258	565045	369840	161508
12	874895	1143193	1057229	397085	549780	818109	475581	1544646	499322	649242	1217679	650918	858118	1020869	993574	518260
13	310765	887871	2912137	235367	374054	824380	466540	1109920	429888	95490	1375290	573927	557061	893535	666422	559175
14	342113	398097	1625450	139335	697894	772543	771254	643653	527961	237749	967675	486411	954125	918722	908320	675733
15	785935	2751757	7446511	636788	944353	1392235	794102	1425514	968439	740981	1986995	1434238	1447758	1635871	1714641	1374659
16	263813	327219	1452970	342648	794840	593925	793741	676332	558122	272824	920468	418238	880929	790082	706192	1008139
17	82194	110005	460377	174162	605486	386157	328165	795840	414729	293213	917399	692096	695892	803399	671024	968319
18	495309	940658	1956951	393103	888930	672175	636992	942953	591043	220431	800425	739722	717050	1615105	657771	1149819
19	98652	24313	161702	69274	577130	176076	236514	209789	227706	39329	271148	310441	275609	570261	374788	485571
20	818726	2127153	3614678	435254	1331733	1212756	1235369	1929498	1136043	488309	1729939	1265563	1034790	1637838	955597	1398364
21	154613	27482	749972	199730	504437	139078	35518	176934	167269	65422	198227	109970	130150	380357	197379	97724
22	119562	92118	268159	403388	342163	212258	119576	363181	209067	88912	407971	276355	400440	753131	415647	386709
23	287308	42139	113139	70125	518974	262051	275981	388317	370241	344827	602947	570948	279277	510576	424140	513824
24	129024	8169	179959	201326	196915	191234	132882	186522	215504	222450	271522	125013	313999	572444	301214	277401
25	708748	4281777	1400588	201859	555692	678824	664968	659498	699940	594773	667109	1602722	929755	864729	416814	564234
26	130462	2848794	340286	14047	113848	65728	214071	193618	32211	70319	160388	54461	168504	321539	144351	56957
27	62109	5192	505587	17647	30755	46467	69391	382710	253462	97101	123959	72936	299118	380325	234313	93330
28	121308	648741	83083	14983	79971	448423	510469	117453	123993	433711	352116	750666	439985	504015	339200	131649
29	0	473	234012	3836	88370	36811	58108	201070	39718	149550	127190	65562	204759	246050	107948	1712
30	68786	89484	78312	22384	91633	612864	526262	252871	231805	397854	203226	154241	396190	477524	263750	398823
31	2823	114	7270	1039	9287	71379	150235	27462	19984	7266	10595	1414	69519	110806	132460	4191
32	6311	2364	12538	2086	9187	243956	170829	131322	95560	22254	14128	76688	152791	236095	75484	13880
33	483	0	16785	289	98051	93313	311808	251767	100127	331012	14469	51036	115482	62655	54025	115339
34	0	0	305	2656	9115	8191	192774	118263	21888	14877	782	11216	106047	42107	26410	402
35	825	6024	1909	2467	37902	106846	179018	168739	112800	390792	29894	38522	241768	87434	35953	34329
36	275	0	234	586	1282	16485	354762	17204	12811	8105	0	3748	104981	5222	8493	0
37	0	0	0	141	1832	0	190179	1151	6230	135041	0	155	17440	36553	2310	2447
38	275	0	0	141	5926	2697	174395	62835	29152	280339	1298	5475	25691	19452	3417	0
39	0	0	0	0	0	15708	65311	0	2742	217257	0	155	4499	17566	332	0
>=40	0	1892	234	869	24522	52146	68399	39219	4125	43193	10595	1468	6799	30048	16577	17464
TOTAL	8104928	18309087	26671073	4890534	11344283	12684044	12397782	16734135	9994853	9119706	17203582	13890904	13348846	18194418	14860475	11957065

Table 8.7.4 Estimated abundance of yellowtail snapper re-grouped into approximate total length (TL) size classes in inches from FL size classes from the NMFS-UM Reef Visual Census (RVC) in the Florida Keys, 1998-2010.

TL inch class	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
< = 5	1,305,004	2,410,001	3,349,338	2,670,169	5,260,500	2,392,293	2,816,325	5,037,827	3,997,517	2,378,438	3,670,977	5,005,503	1,626,871
6	374,702	1,071,948	1,596,923	1,237,794	1,753,573	957,849	333,239	2,342,965	1,060,338	1,511,186	1,812,257	1,574,742	1,234,908
7	979,436	1,739,193	1,986,160	1,587,843	2,101,846	1,526,561	1,013,805	2,907,463	1,852,476	2,328,687	2,425,953	2,420,833	2,382,798
8	567,265	1,494,416	1,058,332	965,157	1,738,793	1,005,772	513,644	1,717,824	1,431,818	1,412,942	2,418,504	1,328,795	2,118,138
9	504,528	1,908,863	1,388,832	1,471,883	2,139,287	1,363,749	527,638	2,001,087	1,576,004	1,310,399	2,208,099	1,330,385	1,883,935
10	603,118	846,600	351,336	155,094	540,115	376,336	154,334	606,198	386,325	530,590	1,133,488	613,026	484,433
11	271,451	715,889	453,285	408,863	574,839	585,745	567,277	874,469	695,961	593,276	1,083,020	725,354	791,225
12	215,906	669,540	744,552	879,039	853,116	732,151	665,092	827,497	1,657,183	1,098,259	1,186,268	561,165	621,191
13	32,630	110,726	494,890	579,860	500,163	377,455	530,812	476,075	823,602	739,103	884,340	573,513	224,979
14	26,220	180,003	649,675	584,370	453,941	271,523	547,404	330,416	219,803	600,949	723,574	371,698	400,535
15	3,125	18,474	315,335	321,064	158,784	115,544	29,520	24,723	78,102	222,310	346,901	207,944	18,071
16	2,945	107,166	101,504	504,582	370,030	122,015	345,889	15,251	62,252	221,529	104,762	80,435	115,741
17	3,053	39,184	123,331	533,780	185,943	125,611	398,897	29,894	42,270	346,749	92,656	44,446	34,329
18	282	7,758	2,697	364,574	63,986	35,382	415,380	1,298	5,630	43,131	56,005	5,727	2,447
19	869	10,057	63,207	117,529	39,219	6,226	246,434	684	1,623	9,632	25,890	14,736	3,151
20	0	671	0	15,293	0	0	0	0	0	1,121	0	0	0
21	0	490	1,653	161	0	0	0	0	0	0	0	0	846
22	0	242	586	566	0	641	14,016	0	0	545	633	0	3,367
23	0	0	0	161	0	0	0	0	0	0	16,410	0	0
>=24	0	13,062	2,408	0	0	0	0	9,911	0	0	4,681	2,173	10,100
Total	4,890,534	11,344,283	12,684,044	12,397,782	16,734,135	9,994,853	9,119,706	17,203,582	13,890,904	13,348,846	18,194,418	14,860,475	11,957,065

Table 8.7.5 Proportion at age of yellowtail snapper using age-length keys estimated from the survey abundances from the NMFS-UM Reef Visual Census (RVC) in the Florida Keys, 1998-2010.

Year	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12+	ESS
1998	0.6897	0.1399	0.0774	0.0482	0.0264	0.0071	0.0063	0.0022	0.0019	0.0006	0.0001	0.0001	9
1999	0.6968	0.1594	0.0632	0.0366	0.0233	0.0096	0.0050	0.0039	0.0014	0.0001	0.0002	0.0006	13
2000	0.5983	0.2534	0.0717	0.0381	0.0236	0.0103	0.0026	0.0004	0.0014	0.0001	0.0001	0	15
2001	0.5796	0.2311	0.0883	0.0503	0.0248	0.0150	0.0047	0.0032	0.0004	0.0014	0.0011	0.0003	17
2002	0.5734	0.1771	0.0974	0.0557	0.0546	0.0259	0.0066	0.0050	0.0027	0.0012	0.0001	0.0002	18
2003	0.6178	0.1817	0.1086	0.0611	0.0188	0.0078	0.0022	0.0014	0.0003	0	0.0002	0.0001	15
2004	0.7097	0.1539	0.0642	0.0449	0.0161	0.0082	0.0022	0.0004	0	0	0.0001	0.0003	12
2005	0.5150	0.0989	0.1113	0.1133	0.0862	0.0365	0.0229	0.0018	0.008	0.0046	0.0014	0.0002	16
2006	0.5908	0.1773	0.0813	0.0532	0.0485	0.0276	0.0058	0.0064	0.005	0.0025	0	0.0016	18
2007	0.6490	0.1623	0.0595	0.0607	0.0331	0.0280	0.0048	0.0017	0	0.0003	0.0005	0.0001	18
2008	0.5478	0.1223	0.0770	0.1181	0.0586	0.0369	0.0162	0.0120	0.0035	0.0019	0.0024	0.0031	19
2009	0.6345	0.1873	0.0782	0.0321	0.0367	0.0159	0.0085	0.0035	0.0015	0.0005	0.0006	0.0008	23
2010	0.5535	0.2577	0.0812	0.0469	0.0176	0.0280	0.0088	0.0014	0.0006	0.0001	0.0035	0.0006	19

Table 8.7.6 Commercial vessel vertical line nominal catch rates, number of trips, proportion positive trips, and standardized abundance index for yellowtail snapper.

a) South Florida

YEAR	Normalized Nominal CPUE	Trips	Proportion Successful Trips	Standardized Index	Lower 95% CI (Index)	Upper 95% CI (Index)	CV (Index)
1993	0.78004	3,780	0.88	0.801506	0.554481	1.158583	0.185805
1994	0.721586	6,171	0.86	0.83499	0.579682	1.202741	0.183999
1995	0.689659	5,780	0.86	0.75149	0.521496	1.082918	0.184213
1996	0.614289	4,725	0.79	0.662653	0.458824	0.957032	0.185355
1997	0.693064	7,152	0.83	0.731318	0.508115	1.05257	0.18359
1998	0.838275	6,638	0.81	0.810017	0.562418	1.166619	0.183933
1999	0.932592	6,973	0.83	1.017357	0.706144	1.465727	0.184104
2000	0.82082	6,120	0.80	0.873469	0.606149	1.258682	0.184208
2001	0.952677	6,203	0.79	0.895314	0.621194	1.290398	0.184303
2002	0.947988	6,171	0.77	0.891586	0.618601	1.285038	0.184308
2003	0.875649	6,055	0.78	0.837022	0.580649	1.206592	0.184391
2004	1.068132	5,543	0.78	0.936827	0.649844	1.350547	0.184423
2005	1.068558	4,786	0.82	1.189224	0.824956	1.714337	0.184402
2006	1.2605	4,321	0.83	1.17046	0.811609	1.687977	0.184611
2007	1.223093	4,178	0.83	1.100732	0.762956	1.588048	0.184815
2008	1.523669	4,122	0.82	1.412812	0.977997	2.040945	0.185482
2009	1.444767	4,339	0.82	1.573268	1.090714	2.269314	0.184708
2010	1.544642	3,504	0.81	1.509954	1.045587	2.180556	0.185312

b) “core area”

YEAR	Normalized Nominal CPUE	Trips	Proportion Successful Trips	Standardized Index	Lower 95% CI (Index)	Upper 95% CI (Index)	CV (Index)
1993	0.771994	3,698	0.90	0.729073	0.501479	1.05996	0.188756
1994	0.704873	6,074	0.87	0.770778	0.531056	1.118712	0.187894
1995	0.676602	5,727	0.87	0.713097	0.491283	1.035061	0.187927
1996	0.593239	4,796	0.80	0.601174	0.41349	0.874047	0.188775
1997	0.685205	7,093	0.84	0.679875	0.468671	0.986259	0.187625
1998	0.826899	6,605	0.82	0.816866	0.562802	1.185622	0.187901
1999	0.921771	6,861	0.84	0.969	0.667721	1.406217	0.187823
2000	0.807324	6,047	0.82	0.852114	0.586781	1.237426	0.188169
2001	0.946559	6,076	0.81	0.922809	0.635416	1.340188	0.188207
2002	0.947674	5,990	0.80	0.935277	0.643989	1.358321	0.188216
2003	0.881349	5,896	0.80	0.895922	0.616869	1.301211	0.188234
2004	1.078191	5,354	0.81	0.987629	0.679831	1.434783	0.188371
2005	1.088574	4,640	0.85	1.19448	0.822284	1.735147	0.188329
2006	1.266215	4,175	0.86	1.176984	0.80988	1.710488	0.188556
2007	1.231023	4,047	0.86	1.10827	0.762354	1.611145	0.188721
2008	1.532369	3,997	0.85	1.552947	1.067806	2.258503	0.188928
2009	1.471643	4,081	0.85	1.560095	1.073328	2.267618	0.188638
2010	1.568497	3,341	0.83	1.533609	1.053652	2.232195	0.189346

Table 8.7.7 Annual number of trips in the selected subset and number of trips on which yellowtail snapper were caught ("positive" trips) from the Southeast Head Boat Survey vessel trip reports.

	Total Trips				**Positive Trips**			
year	**11**	**12**	**17**	**total**	**11**	**12**	**17**	**total**
1981	3101	1495	9	4605	2086	1160	9	3255
1982	3340	1502	16	4858	2375	1214	13	3602
1983	2605	1146	10	3761	1639	855	9	2503
1984	2071	1201	28	3300	1328	844	27	2199
1985	2142	980	24	3146	1162	752	22	1936
1986	2722	1111	39	3872	1743	984	38	2765
1987	2369	1342	39	3750	1600	1209	39	2848
1988	2410	1115	14	3539	1778	1027	12	2817
1989	2339	1073	57	3469	1844	976	55	2875
1990	2426	1356	6	3788	1746	1237	6	2989
1991	2303	1187	28	3518	1622	1099	25	2746
1992	2875	2189	46	5110	2129	1943	46	4118
1993	2612	2306	39	4957	1870	2037	39	3946
1994	2452	2293	57	4802	1950	2084	57	4091
1995	2041	2365	30	4436	1413	2175	30	3618
1996	641	2394	28	3063	362	2171	28	2561
1997	473	1784	27	2284	334	1659	26	2019
1998	554	2157	15	2726	279	1923	15	2217
1999	216	1881	3	2100	105	1689	3	1797
2000	189	1837	16	2042	84	1596	14	1694
2001	235	1445	27	1707	65	1283	27	1375
2002	168	1081	31	1280	52	978	31	1061
2003	93	1045	29	1167	43	925	28	996
2004	102	1077	21	1200	34	942	21	997
2005	152	1253	21	1426	57	1136	21	1214
2006	105	1313	44	1462	27	1104	42	1173
2007	216	1404	41	1661	92	1144	38	1274
2008	1319	1650	51	3020	941	1504	50	2495
2009	1673	1814	51	3538	1186	1559	48	2793
2010	2060	1759	37	3856	1532	1514	36	3082

Table 8.7.8 Observed ("nominal") catch rates, number of trips in the selected subset modeled with the delta-glm, proportion of positive trips in the subset from the Southeast Head Boat Survey vessel trip reports, adjusted ("standardized") catch rates for the index and the index coefficient of variation (cv).

Year	Nominal CPUE	N	Prop N Positive	Index	CV (index)
1981	0.141	4605	0.707	0.204	0.028
1982	0.114	4858	0.741	0.173	0.030
1983	0.101	3761	0.666	0.136	0.035
1984	0.097	3300	0.666	0.137	0.037
1985	0.083	3146	0.615	0.134	0.036
1986	0.103	3872	0.714	0.158	0.031
1987	0.138	3750	0.759	0.188	0.029
1988	0.133	3539	0.796	0.201	0.028
1989	0.142	3469	0.829	0.221	0.026
1990	0.172	3788	0.789	0.259	0.027
1991	0.181	3518	0.781	0.261	0.024
1992	0.190	5110	0.806	0.261	0.025
1993	0.193	4957	0.796	0.253	0.025
1994	0.237	4802	0.852	0.307	0.025
1995	0.194	4436	0.816	0.227	0.030
1996	0.215	3063	0.836	0.211	0.034
1997	0.199	2284	0.884	0.233	0.030
1998	0.192	2726	0.813	0.197	0.037
1999	0.228	2100	0.856	0.203	0.036
2000	0.214	2042	0.830	0.198	0.041
2001	0.205	1707	0.806	0.177	0.047
2002	0.215	1280	0.829	0.175	0.047
2003	0.258	1167	0.853	0.234	0.044
2004	0.279	1200	0.831	0.284	0.042
2005	0.281	1426	0.851	0.326	0.040
2006	0.204	1462	0.802	0.226	0.043
2007	0.170	1661	0.767	0.201	0.036
2008	0.204	3020	0.826	0.259	0.028
2009	0.161	3538	0.789	0.234	0.029
2010	0.201	3856	0.799	0.270	0.026

Table 8.7.9 Observed ("nominal") catch rates, number of trips in the selected subset modeled with the delta-glm, proportion of positive trips in the subset from the Marine Recreational Fishery Statistics Survey data, adjusted ("standardized") catch rates for the index and the index coefficient of variation (cv).

Year	Nominal CPUE	N	Proportion Positive	Index	Index CV
1981	4.109	92	0.500	3.901	0.150
1982	2.722	194	0.402	3.675	0.196
1983	1.771	131	0.328	2.960	0.161
1984	1.910	189	0.402	3.307	0.199
1985	1.422	135	0.281	2.627	0.159
1986	1.788	231	0.346	3.525	0.132
1987	2.067	372	0.336	2.786	0.142
1988	2.328	293	0.392	3.809	0.145
1989	2.154	267	0.318	3.787	0.131
1990	2.227	256	0.551	4.587	0.112
1991	4.892	278	0.518	7.183	0.094
1992	3.264	550	0.522	6.113	0.097
1993	3.210	499	0.473	4.819	0.106
1994	3.265	423	0.487	4.578	0.121
1995	3.572	339	0.407	5.179	0.117
1996	3.332	404	0.455	4.048	0.120
1997	4.085	424	0.394	4.408	0.118
1998	4.203	536	0.384	4.066	0.105
1999	3.477	792	0.365	4.397	0.106
2000	3.308	672	0.408	4.016	0.108
2001	3.977	665	0.350	4.168	0.104
2002	3.568	911	0.393	3.710	0.100
2003	3.956	895	0.397	4.407	0.099
2004	4.048	831	0.432	5.125	0.096
2005	4.392	738	0.466	5.325	0.094
2006	4.010	762	0.454	5.296	0.090
2007	4.386	888	0.453	5.436	0.090
2008	4.296	948	0.465	4.797	0.100
2009	3.164	623	0.424	4.284	0.099
2010	4.792	688	0.458	5.140	0.195

8.8 FIGURES

Figure 8.8.1 NMFS-UM Reef Visual Census (RVC) survey domain (Smith et al. 2011). The managed areas of the Florida Keys Marine Sanctuary are shaded in blue, tan areas are Biscayne National Park, Everglades National Park, and the Dry Tortugas National Park, and the areas in green are no-take marine preserves.

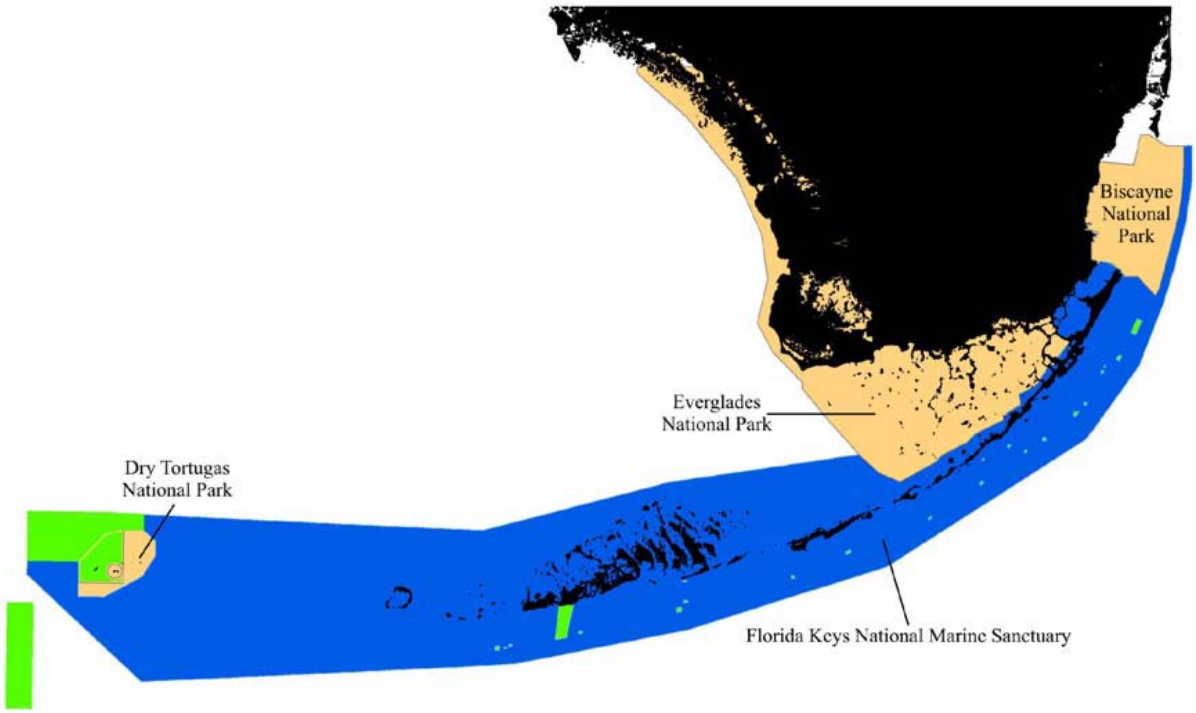
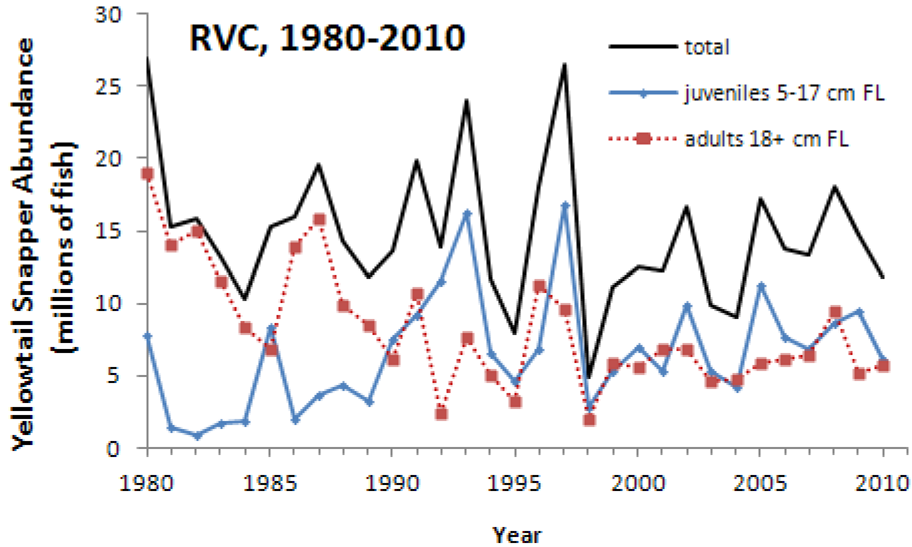


Figure 8.8.2 NMFS-UM Reef Visual Census (RVC) total population abundance estimates for yellowtail snapper in the Florida Keys reef tract, **a**) 1980-2010 and **b**) 1998-2010.

a) Yellowtail snapper, 1980-2010



b) Yellowtail snapper, 1998-2010

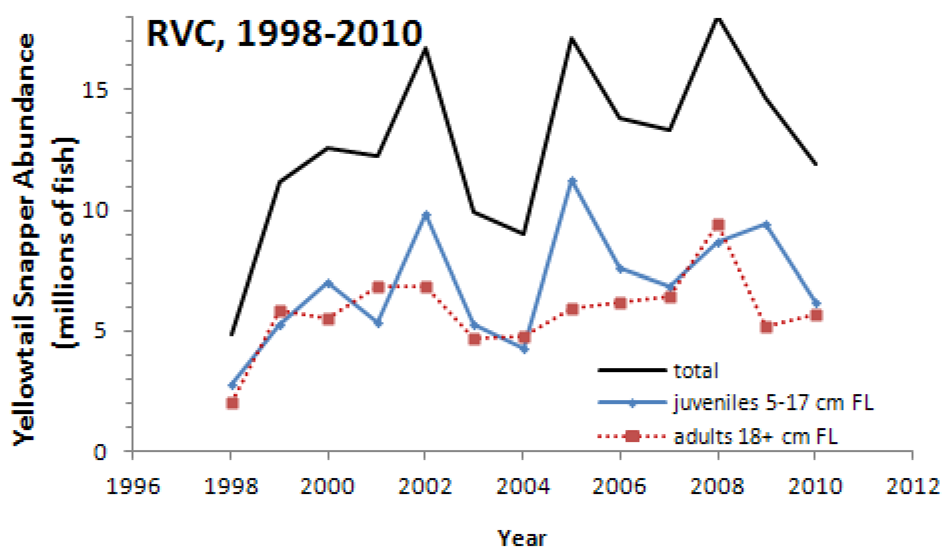


Figure 8.8.3 Proportion of yellowtail snapper in length classes observed by divers in the NMFS-UM Reef Visual Census (RVC), 1998-2010.

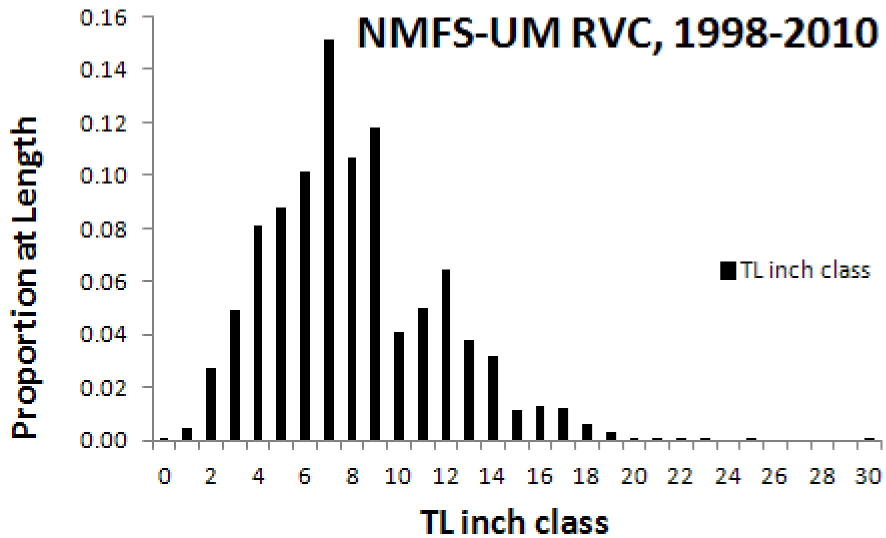
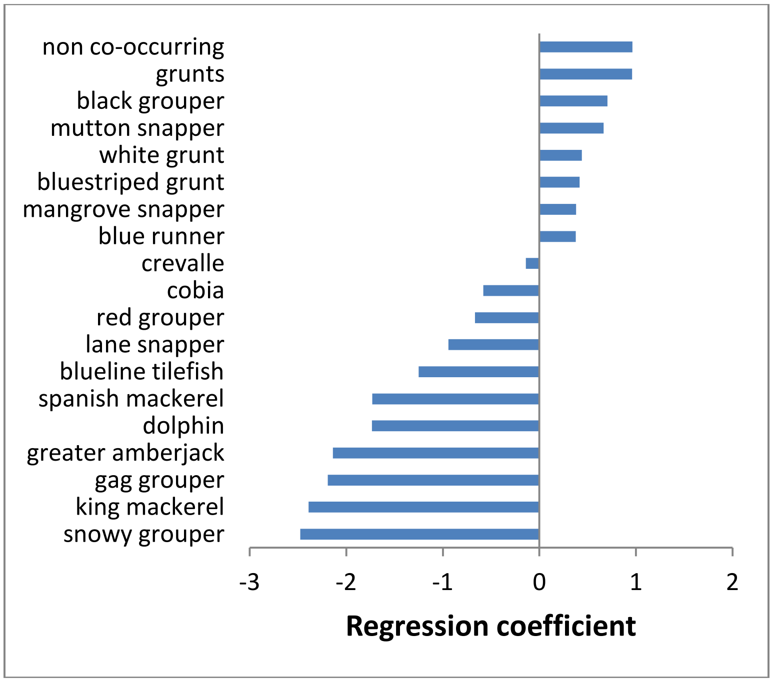


Figure 8.8.4 Logistic regression coefficients (Stephens and MacCall 2004) from the south Florida and "core area" analyses. Positive coefficients mean that a species was more likely to occur in the landings on trips with yellowtail snapper, and negative coefficients mean that the species was less likely to occur. The "non co-occurring" is the intercept for the regression.

a) South Florida subset



b) "core area" subset

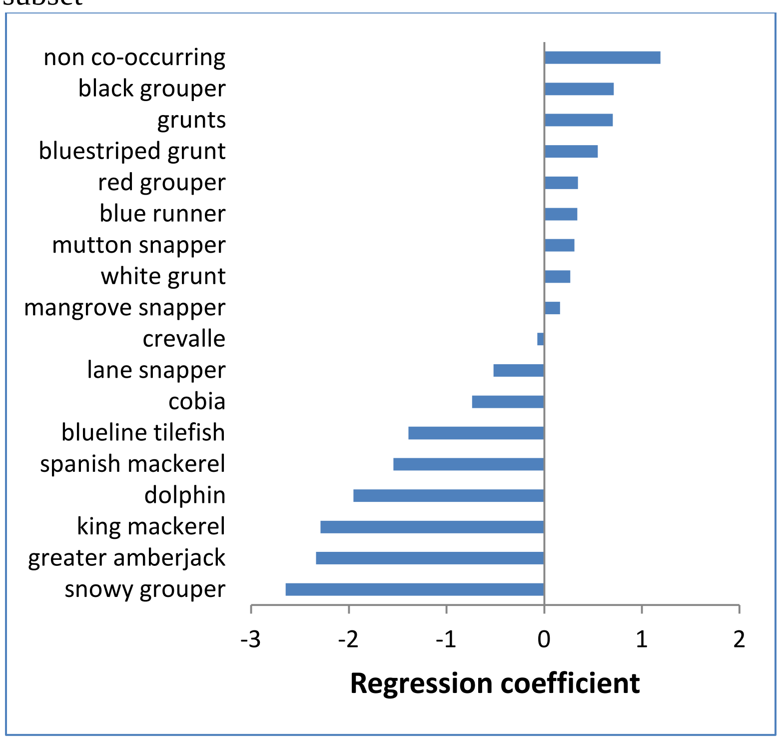
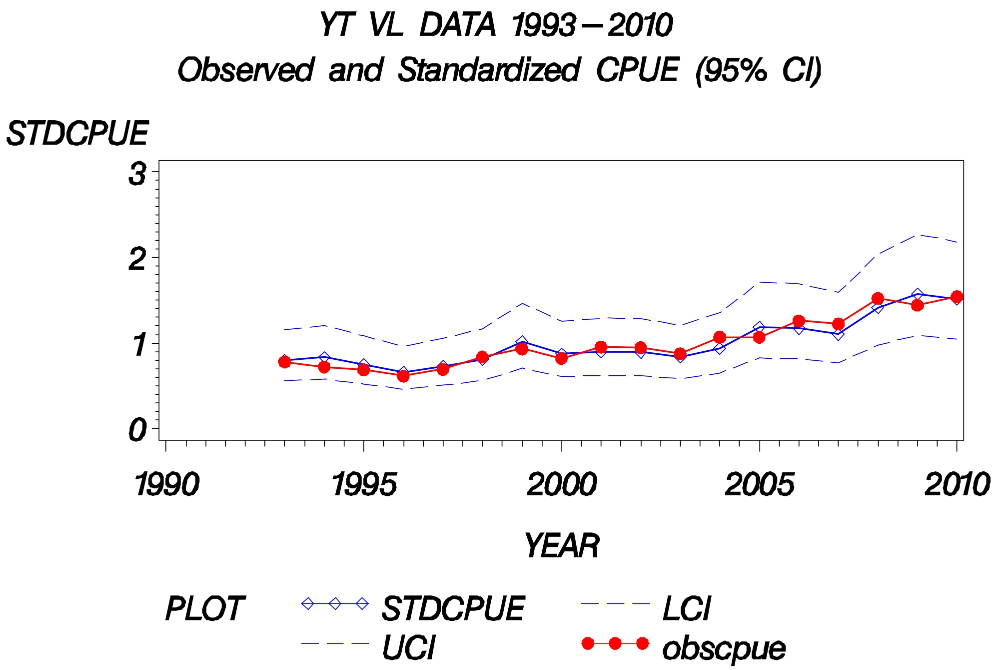


Figure 8.8.5 Observed and standardized catch rates (pounds of yellowtail snapper per hook-hour fished) in south Florida and in the “core area”. Nominal catch rates (solid circles), standardized catch rates (open diamonds), and dashed lines are the upper and lower 95% confidence bounds of the standardized catch rates for commercial vessels fishing vertical line gear.

a) South Florida



b) “core area”

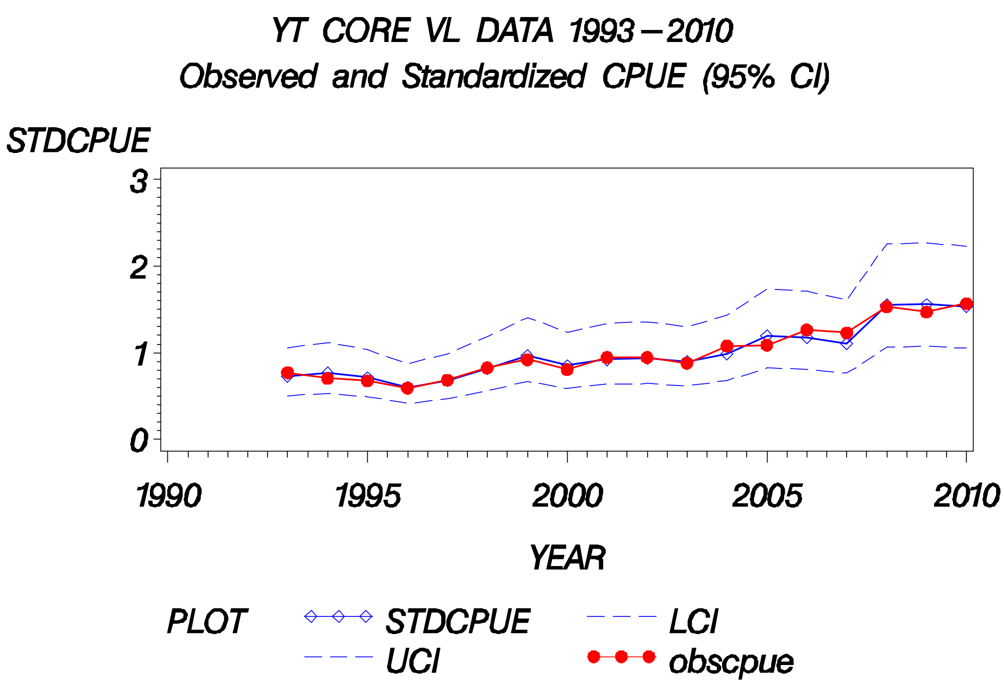


Figure 8.8.6 A comparison of the standardized catch rates (pounds of yellowtail snapper per hook-hour fished) for the south Florida index with the "core area" index. The dashed lines are the upper and lower 95% confidence bounds of the standardized catch rates for the south Florida index.

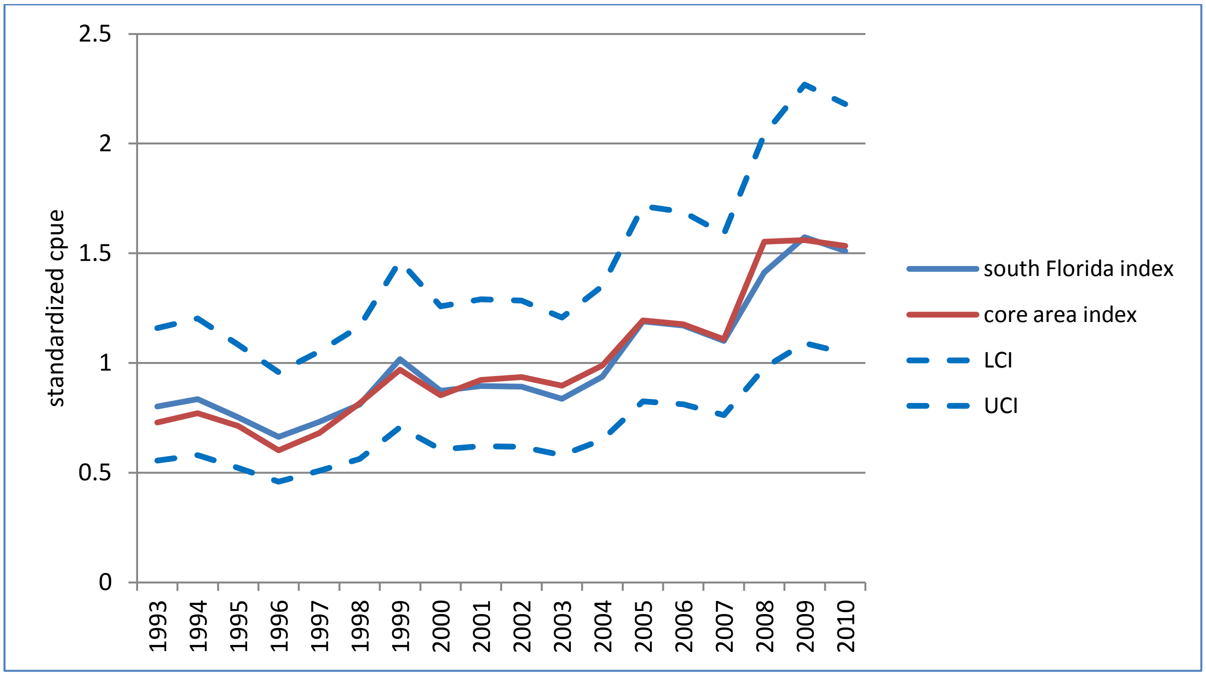


Figure 8.8.7 A comparison of the standardized catch rates (pounds of yellowtail snapper per hook-hour fished) for the south Florida index with the "core area" index with the commercial log book index developed for SEDAR 3.

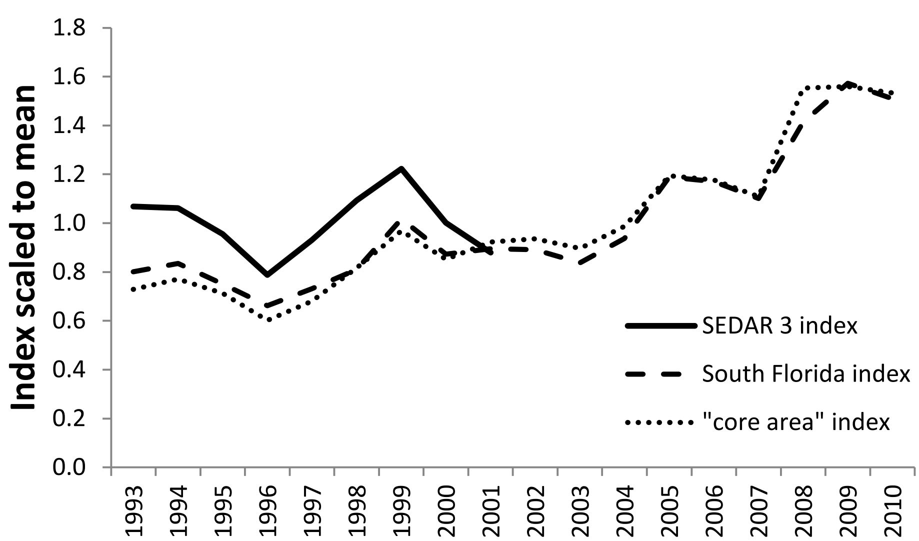


Figure 8.8.8 Logistic regression coefficients (Stephens and MacCall 2004) from an examination of trip-level catch records from head boats in south Florida..

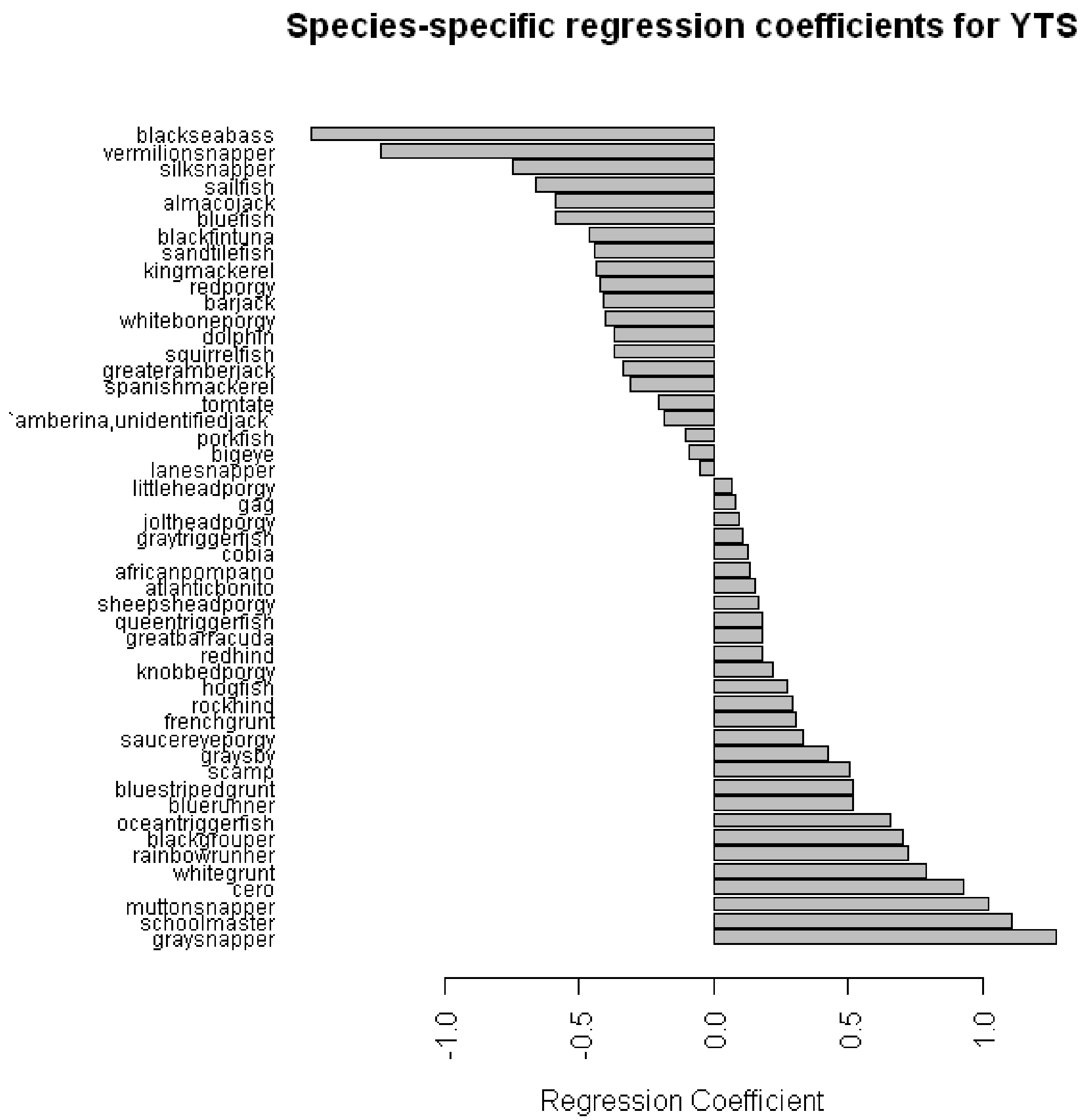


Figure 8.8.9 Observed and modeled proportion of positive trips with yellowtail snapper from a subset of trip-level catch records from head boats in south Florida.

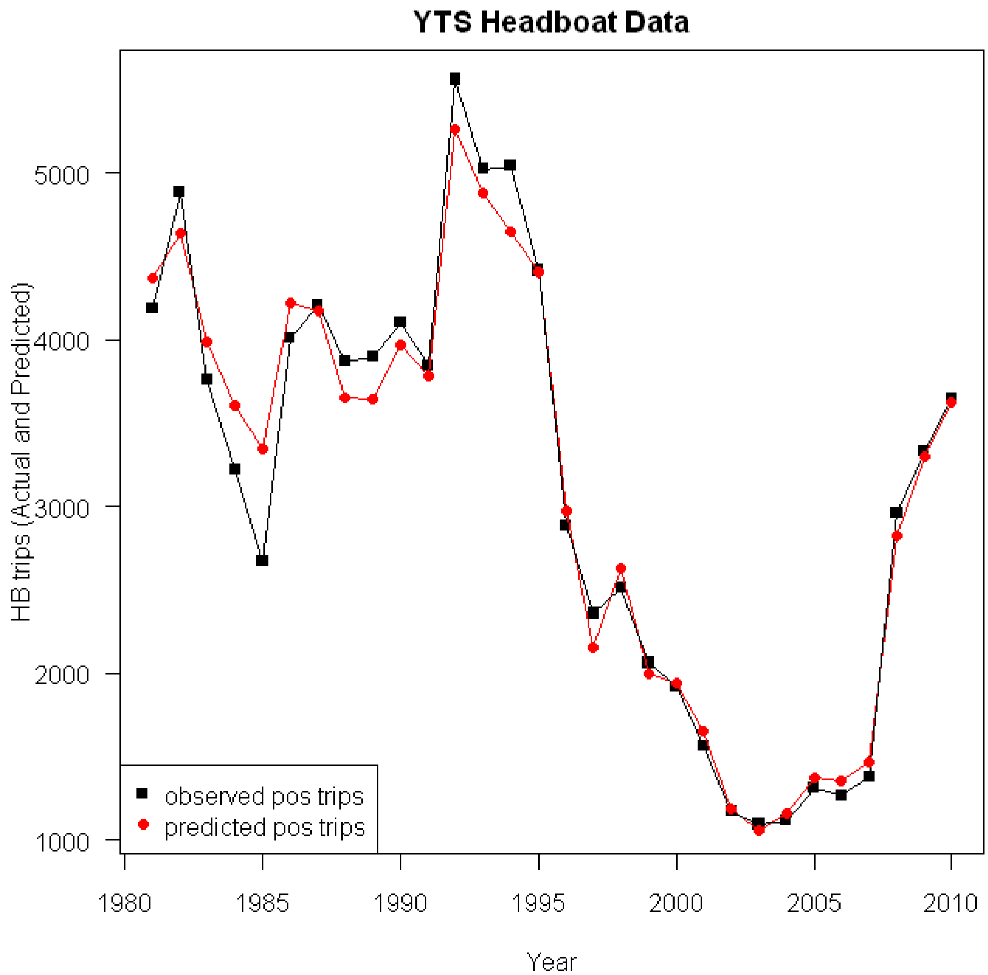


Figure 8.8.10 Observed (blue dots) and delta-glm modeled standardized catch rates from a subset of vessel trip reports from head boats in south Florida. The dashed lines are the 95% confidence limits for the standardized catch rates.

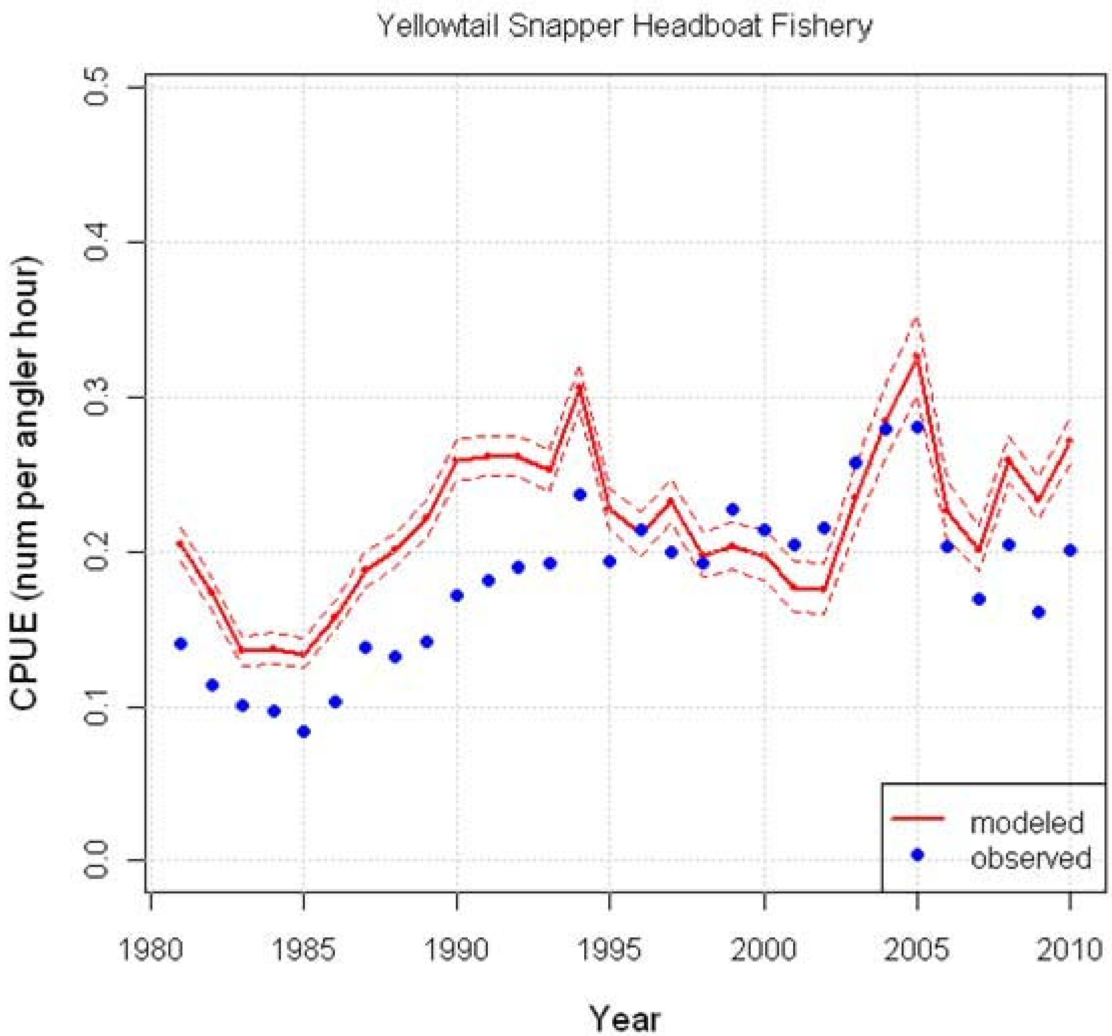


Figure 8.8.11 Observed (blue dots) and delta-glm modeled standardized catch rates scaled to their respective means from a subset of vessel trip reports from head boats in south Florida. The dashed lines are the 95% confidence limits for the standardized catch rates re-scaled to its mean.

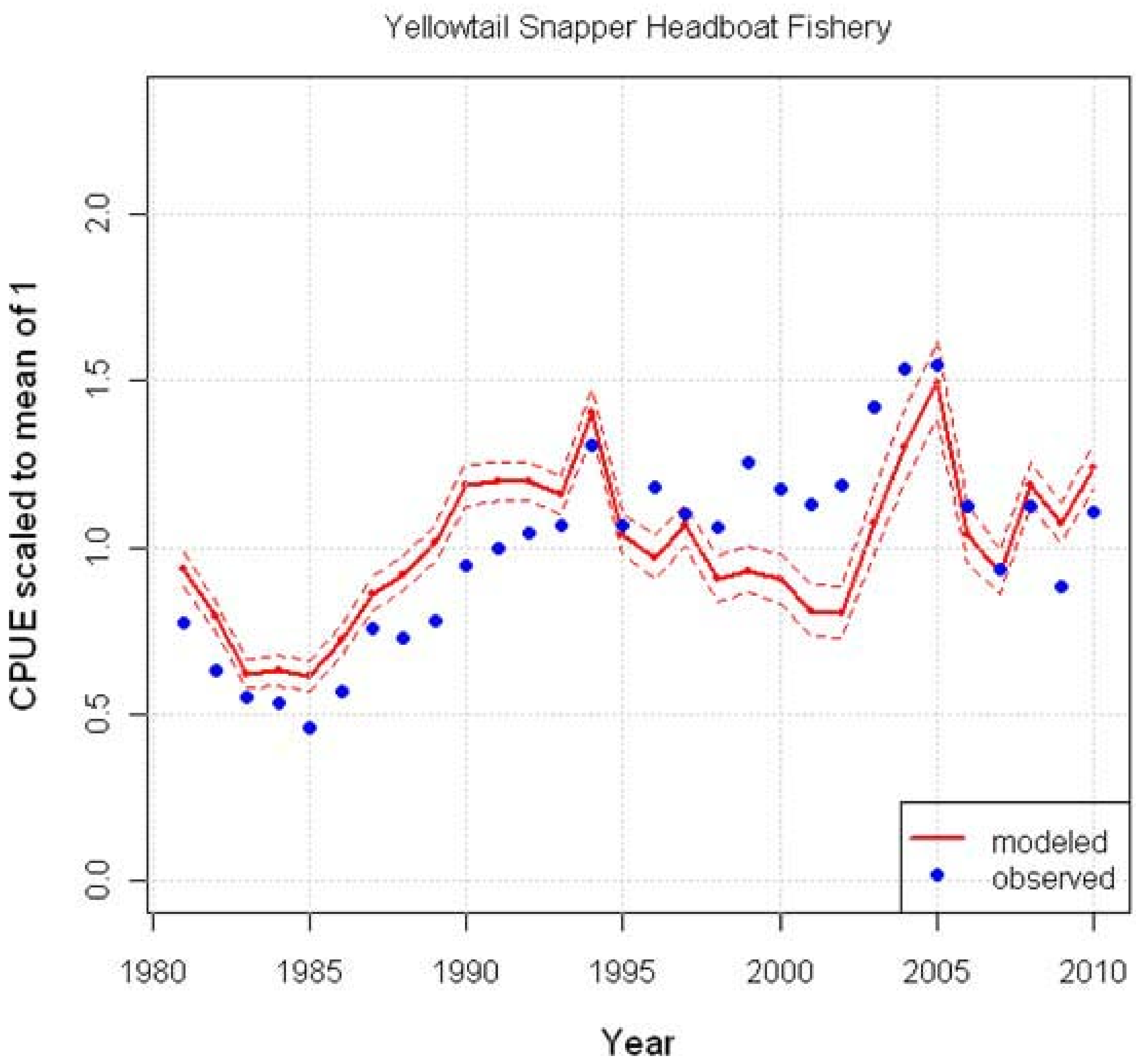


Figure 8.8.12 Scree plot for assessing the optimum number of clusters chosen from the cluster analyses. The optimum number of clusters is estimated from a plot of cluster height (average distance between clusters, a measure of the degree of similarity) versus number of clusters. Piece-wise regression was used to find the number of clusters that for the plot which minimized the residual mean square errors for both regressions.

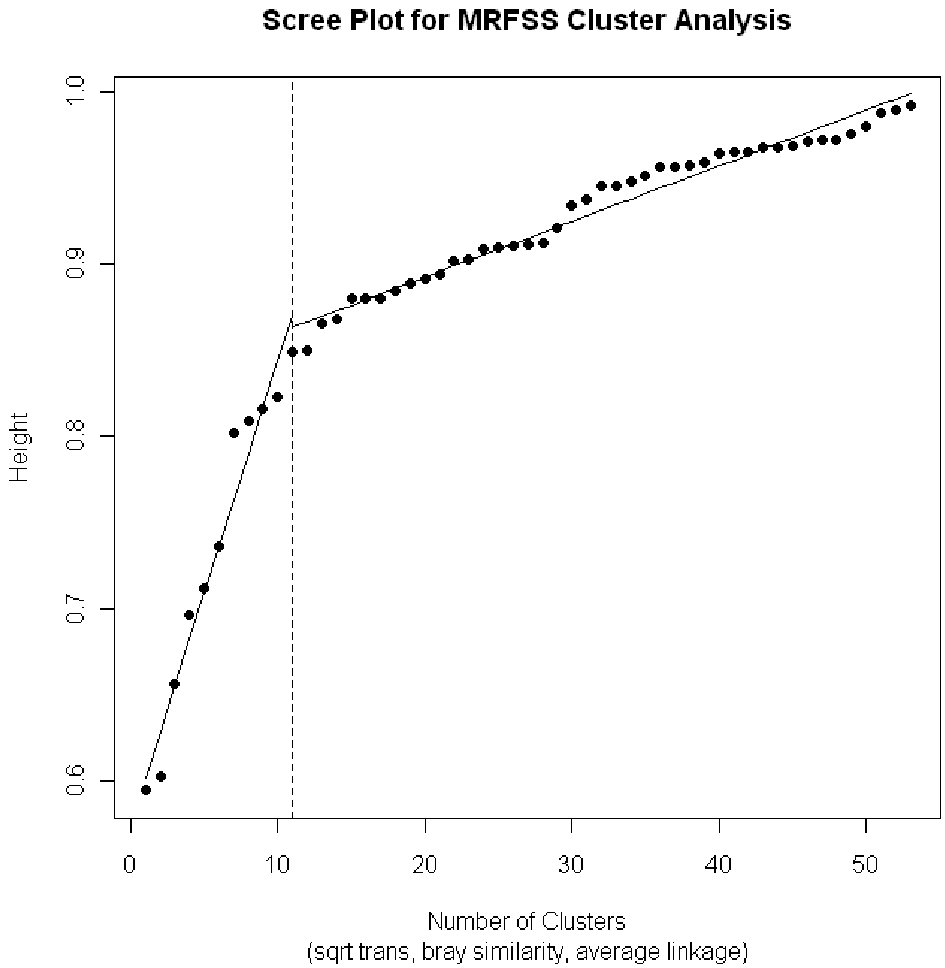


Figure 8.8.13 Dendogram resulting from the cluster analyses using eleven clusters. The species most closely associated with yellowtail snapper in angler catches (called “target”, in the third box from the right in the plot) are often associated with reef and hard-bottom habitats: mutton snapper, blue runner, lane snapper, gray snapper, cero mackerel, black grouper, and grunts.

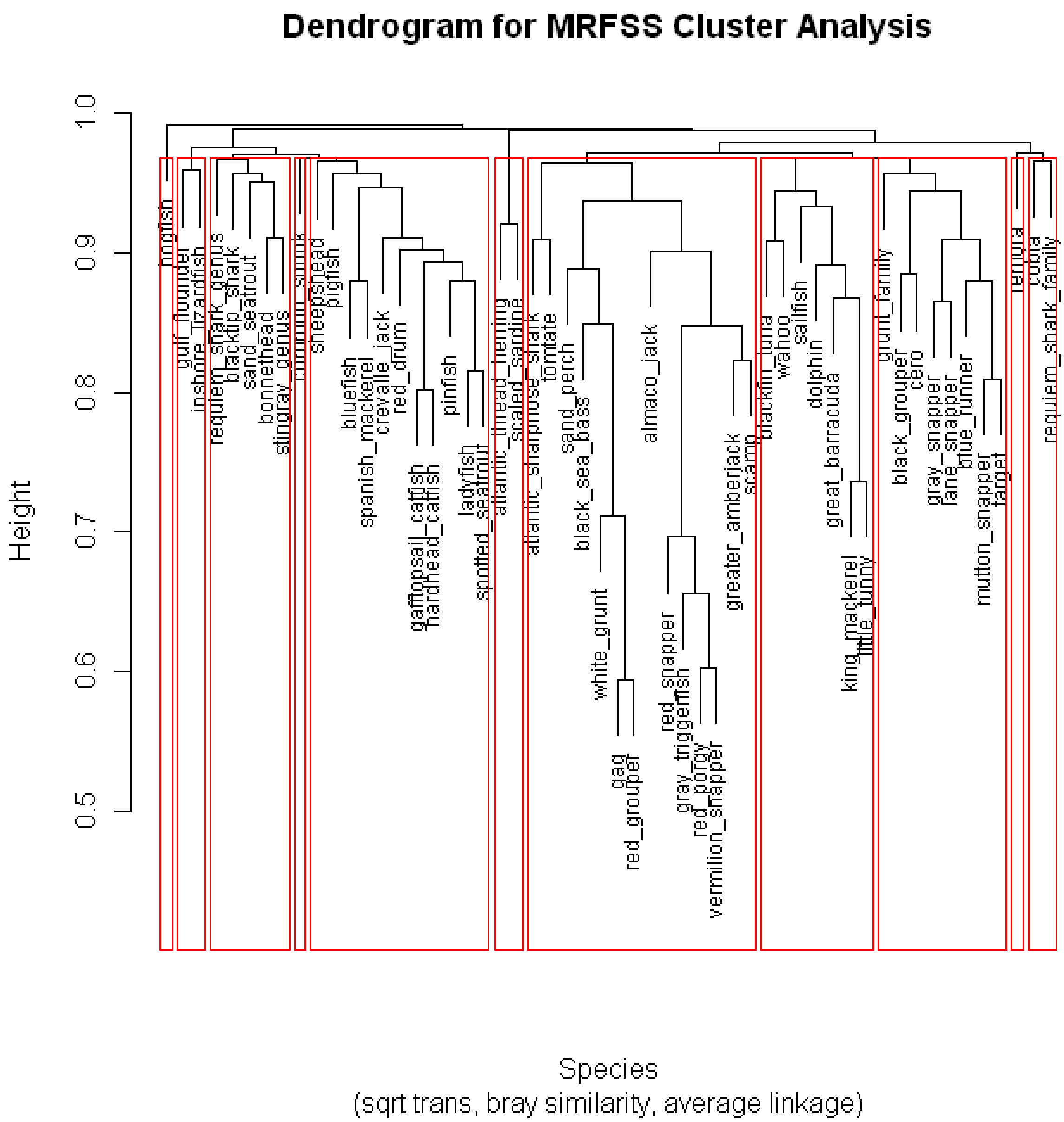


Figure 8.8.14 Observed (blue dots) and delta-glm modeled standardized catch rates from a subset of MRFSS data from angler intercepts in south Florida. The dashed lines are the 95% confidence limits for the standardized catch rates.

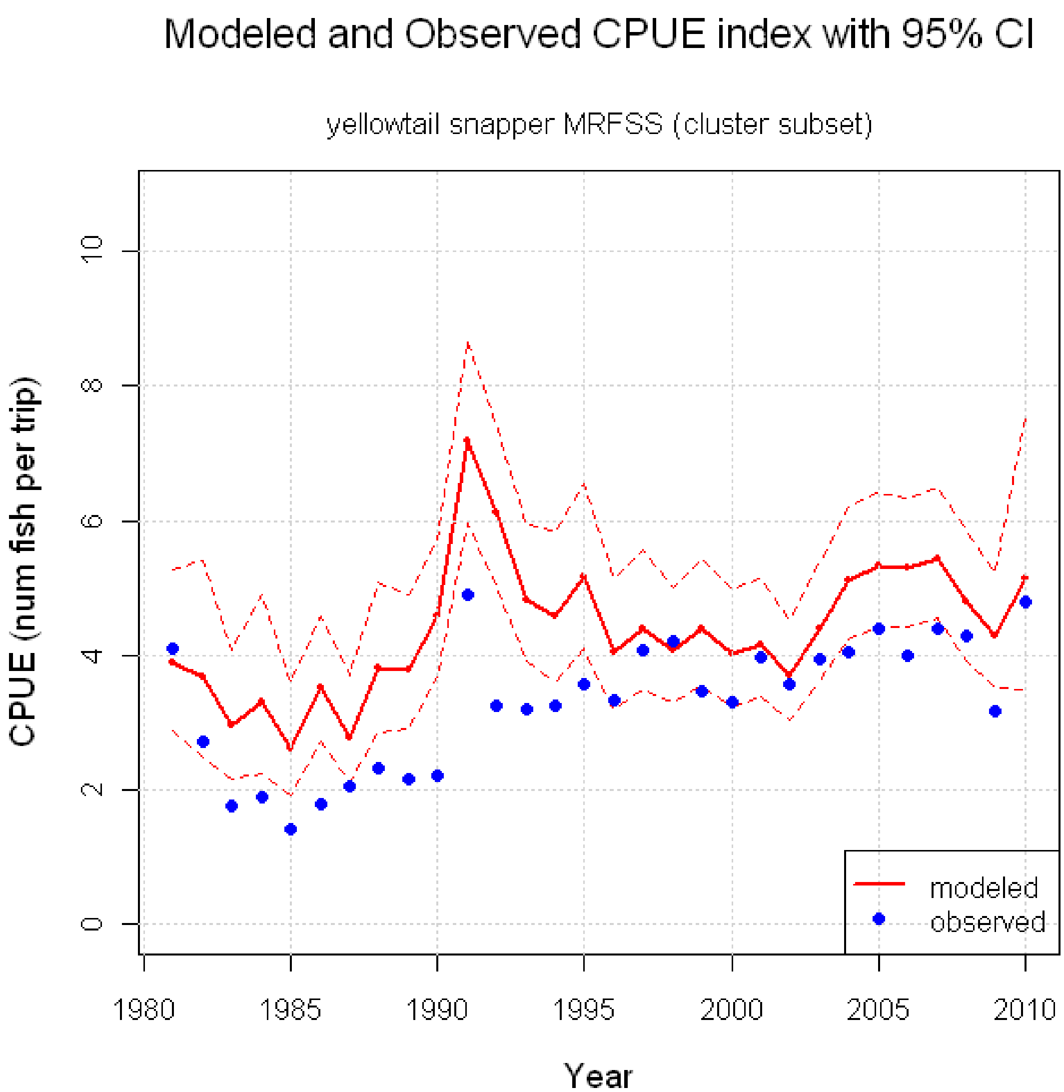
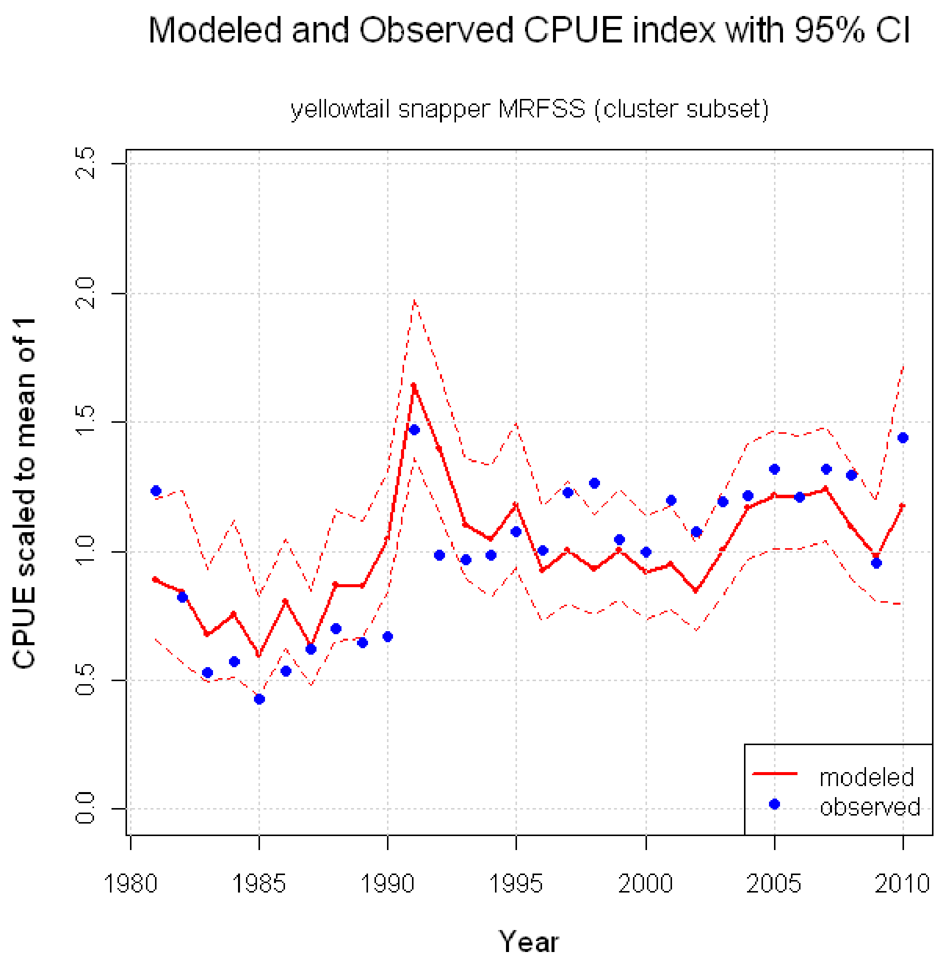
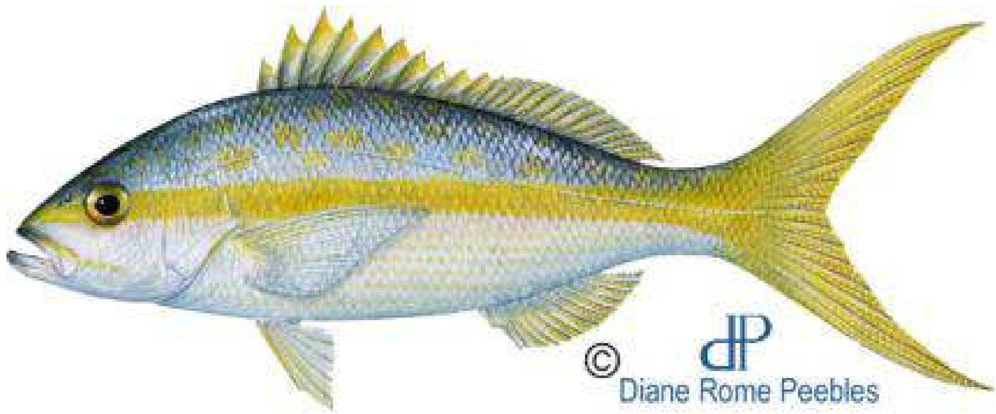


Figure 8.8.15 Observed (blue dots) and delta-glm modeled standardized catch rates scaled to their respective means from a subset of vessel trip reports from head boats in south Florida. The dashed lines are the 95% confidence limits for the standardized catch rates re-scaled to its mean.





The 2012 Stock Assessment Report for Yellowtail Snapper in the South Atlantic and Gulf of Mexico

Joe O'Hop, Mike Murphy, and Dave Chagaris

Section III: Assessment Report

May 29, 2012

Fish and Wildlife Conservation Commission
Fish and Wildlife Research Institute
100 Eighth Ave Southeast
St. Petersburg, Florida 33701-5020

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9 DATA REVIEW AND UPDATES

The previous sections described the data used for inputs to the model, and reflect all of the revisions available and used in the model configurations. There were no updates that were not included in the previous sections.

10 STOCK ASSESSMENT MODELS AND RESULTS

10.1 MODEL 1: STATISTICAL CATCH-AT-AGE (ASAP2)

The main assessment model chosen for yellowtail snapper was Legault and Restrepo's (1998) Age-Structured Assessment Program (ASAP2, version 2.0.21) which is available from the NOAA Fisheries Toolbox (http://nft.nefsc.noaa.gov/). ASAP2 is a forward-projecting, statistical catch-at-age model written in ADModelbuilder (Copyright (c) 2008 Regents of the University of California) that uses the Toolbox's graphical interface to facilitate data entry and presentation of model results. The model allows for age- and year-specific values for natural mortality rates, average spawning weights, average catch weight, and average stock weight at the beginning of the year. It accommodates multiple fleets with one or more selectivity blocks within the fleets, incomplete age-composition to accommodate fisheries that are not sampled every year, and indices of abundance in either numbers or biomass that are offset by month. Discards by fleet can be linked to their fishery as can fishery-dependent indices. The original version of ASAP only solved for selectivity by specific ages while this second version allows for modeling selectivity with logistic or double logistic curves as well as age-specific selectivities. The model estimates population numbers, fishing mortality rates, stock-recruit parameters, and management benchmarks such as maximum sustainable yield (MSY), the fishing mortality rate at MSY, the spawning biomass at MSY, and the fishing mortality rate corresponding to spawning potential ratios (e.g., 30%, 40%, or 45%). Precisions of parameters can be evaluated by their standard deviations from the variance-covariance matrix or through Markov Chain Monte Carlo (MCMC) simulations.

10.2 STATISTICAL CATCH-AT-AGE METHODS

10.2.1 OVERVIEW AND DATA SOURCES

ASAP2 is an age-structured model and integrates information on life history aspects such as age, reproduction, and natural mortality with fishery information like landings, discards, and selectivity to estimate past exploitation patterns and management benchmarks to determine whether management objectives are being met. The model only addresses a single stock but this limitation of the program does not present a problem for yellowtail snapper because the stock in U.S. waters is a single unit (Sections 5.3.2 – 5.3.3). If the stock in the South Atlantic and the Gulf of Mexico were separate units, separate assessments could be developed for each unit using the ASAP2 model.

Yellowtail snapper landings from the Headboat Survey, Marine Recreational Fisheries Statistics Survey (MRFSS), and NMFS's Accumulated Landings System were tallied annually by fleet from the Atlantic region (southeast Florida from Miami-Dade County to Nassau County, primarily) and the Gulf Region (primarily the Florida Keys, but also included data for southwest Florida) for the period of 1981 through 2010 (Sections 6.3.3, 7.3.1, 7.3.2). Fishery dependent indices of abundance were generated from the NMFS Coastal Fisheries Logbook Program (CFLP; Section 8.2.1), the NMFS Southeast Head Boat Survey (HBS; Section 8.2.2), and the NMFS Marine Recreational Fishery Statistics Survey data (MRFSS; Section 8.2.3). Length information was retrieved from the Trip Information Program Headboat Survey, and MRFSS and age information was obtained from Florida Fish and Wildlife Research Institute's Age Database. Data on the abundance of yellowtail snapper by length class for yellowtail snapper provided from the NMFS-UM Reef Visual Census (RVC) for 1998-2010 (J. Ault and S. Smith, University of Miami, personal communication, Section 8.3.1**)** were used to develop a fishery independent index**,** and the estimated abundances by length class and year from the survey data were used to estimate ages and selectivities by age for this index.

Additional refinements to the life history data used in SEDAR 3 were the estimate of natural mortality (Hoenig 1983, Hewitt and Hoenig 2005) based on the most recent maximum observed age (23 years), adjustment of natural mortality for age-specific estimates (Section 5.4.1; an average of $M=0.13 \cdot y^{-1}$) compared to a constant M (base run used 0.20) for all ages (SEDAR 3, 2003), and an offset to mid-year (mid-point of the April1-October 1 spawning season) for the estimated spawning date based on field observations of spawning in the Florida Keys (Barbieri and Colvocoresses 2003, SEDAR 3 (2003)], and other normal tuning adjustments.

10.2.2 MODEL CONFIGURATION AND EQUATIONS.

Two different model configurations were created for this assessment. The ALK ("age-length key") configuration used the data for fleet catch-at-age and fleet discards-at-age (Sections 6.6.2, 7.3.1, 7.3.2) from age-length keys for each region (see Section 5.5.5) to represent the age compositions in the catches and discards for 1981-2010. The DA ("direct ageing") configuration derived the fleet catch at age composition from the age samples taken annually from the fleets by region, and treated the age composition for years for which no samples were taken as "missing". The age composition for discards, however, were unknown and estimated using the discards measured from at-sea sampling on head boats and converted to ages by age-length keys (Section 5.5.5) as proxies for the age composition of discards for all fleets. However, the difference in treatment for the DA configuration was that these proxy values only applied to 2005-2010 when samples were actually acquired. The DA configuration was not used in this assessment, and will not be discussed further.

The models were configured with three fleets (commercial, general recreational (MRFSS), and head boat) and four indices of abundance (three fishery dependent indices and one fishery-independent index). The MRFSS and Head Boat Survey Indices covered the entire landings series period of 1981 through 2010, the commercial hook-and-line index developed from the reef fish log books spanned the 1993-2010 period, and the NMFS-UM RVC index covered 1998-2010. The fishery dependent indices for yellowtail snapper were linked to their respective fleets, and the fishery dependent index was linked to the population estimates.

Because of regulatory changes that potentially affected yellowtail snapper harvests, separate selectivity blocks for each "major" regulatory period (1981-1984, 1985-1991, and 1992-

2010) were used to estimate the age composition for catches for each fleet. The first selectivity block (1981-1984) corresponded to the period before Florida implemented a minimum size limit (12" TL) for retention of yellowtail snapper in July of 1985, and a 10-fish bag limit which included yellowtail snapper. The second block (1985-1991) corresponded to the period before fish traps were prohibited by the SAFMC (which were already prohibited in state waters) and entanglement (gill) nets and long lines were prohibited within 50 fathoms (federal waters, SAFMC) in January of 1992. [Florida's limitations on entangling nets in state waters beginning July 1, 1995 probably had no impact on yellowtail snapper harvest since "stab nets" (anchored bottom gill nets) for the harvest of reef fish had previously been banned in December of 1986, and the SAFMC prohibitions on entangling nets went into effect in 1992.] The last selectivity block (1992-2010) corresponded to a period of time when only relatively minor regulatory actions (prohibition of fish exhibiting "trap rash" in January of 2000, restricted commercial fishermen from retaining reef fish caught under recreational bag-limits on commercial fishing trips, and use of circle hooks, venting tools, and de-hooking devises for Gulf of Mexico reef fish in 2008) with regards to yellowtail snapper occurred. Time-varying catchability coefficients were held constant over the 30 years in the model. The use of different selectivity blocks by fleet tends to mitigate some departures from the constant catchability assumption.

The following equations for ASAP2 were based on those in the Technical Documentation for ASAP Version 2.0 which is supplied with the program from the NOAA Fisheries Toolbox (http://nft.nefsc.noaa.gov/ASAP.html).

(1) Proportions at age in catches, discards, and released fish

ASAP2 reconstructs virtual populations using calculations from the total catch and other parameters in the model. The annual proportion of the number of yellowtail snapper at age (PAA_{catch}) in the catch for a fleet is the ratio of the sum by age across regions of the number of fish landed (Tables 6.8.19, 6.8.20, 7.8.6, 7.8.7, 7.8.15, 7.8.16) or discarded (released alive or dead; Tables 6.8.23, 6.8.24, 7.8.24, 7.8.25, 7.8.31, 7.8.32) to the total number of yellowtail snapper by year caught:

Equation 10.2.2.1 Proportions at Age in the Catch (fleet, year, and age) - PAA_{catch}

$$Prop_{catch_{f,t,a}} = \frac{(Landings_{f,t,a} + Tot_{discards_{f,t,a}})}{(Number\_landed_{f,t} + Tot\_discards_{f,t})}$$

The annual proportion of the number of fish at age ($PAA_{discards}$)in the discards for a fleet is the ratio of the number of fish at a particular age that are discarded (released) to the total number of fish caught (landed or discarded) for a year:

Equation 10.2.2.2 Proportions at Age in the Discards (fleet, year, and age) - PAA$_{discards}$

$$Prop_{discards_{f,t,a}} = \frac{Tot_{discards_{f,t,a}}}{Tot\_discards_{f,t}}$$

Another matrix regarding the proportion at each age released by a fleet in a year is required by ASAP2 for its computations. This matrix (PAA$_{releases}$) is calculated from the number of fish discarded (released) by age relative to the total number at age caught (landed or discarded) by each fleet in a given year. The entries in this matrix represent the proportion of released fish of age-X by a fleet to all the age-X fish that are caught by a fleet in a year (Tables 6.8.26, 7.8.28, 7.8.35):

Equation 10.2.2.3 Proportions at Age of Released Fish(fleet, year, and age) - PAA$_{releases}$

$$Prop_{released_{f,t,a}} = \frac{Tot\_discards_{f,t,a}}{(Number\_landed_{f,t,a} + Tot\_discards_{f,t,a})}$$

(2) Selectivity

Most of the selectivity patterns used in the yellowtail snapper model were single logistic curves because the commercial vertical line vessels and recreational (MRFSS, Head Boats) fleets probably encounter the full range of ages of yellowtail snapper in the population. The ages sampled from the fleets shows that while the ages sampled from the recreational fleets (Tables 6.8.8,6.8.9, 6.8.17, 6.8.18) were typically 8 years or younger and the ages sampled from commercial hook-and-line fleet were typically 10 years or younger (Tables 6.8.27,6.8.28), fish 11 years and older were occasionally landed by all fleets. The equation for the logistic curve (Quinn and Deriso 1999) for the selectivity of fleet, *f* and age, *a*, (two parameters: α_f, β_f) was:

Equation 10.2.2.4 Selectivities(fleet and age)

$$Sel_{f,a} = \frac{1}{1 + e^{-(\alpha - \alpha_f)/\beta_f}}$$

The α_f parameter corresponds to the age at 50% of the maximum value, and β_f is a shape parameter for the curve. Parameters were estimated using the MS-Excel Solver add-in. The fleet selectivities were divided by the selectivity for the age with the maximum value ensuring that the final selectivity pattern for the fleet had a maximum value of 1.0.

(3) Mortality

Natural mortality is incorporated into the model as a year and age matrix. There was no basis on which to develop different natural mortality vectors by year for yellowtail snapper, therefore every year used the same Lorenzen-based age-specific values adjusted to the beginning of the year.

Fishing mortality is treated as separable, i.e., it is the product of a year effect, the fishing mortality multiplier, and the age-specific selectivity. The fishing mortality multiplier, *Fmult*, is estimated by fleet in the first year (1981) and by an annual fleet-specific fishing mortality multiplier deviation, *Fmultdev*. Both *Fmult* and *Fmultdev* are estimated in log space and then exponentiated as:

EQUATION 10.2.2.5 FISHING MORTALITY MULTIPLIERS IN YEAR 1 (FLEET)

$$\boldsymbol{Fmult_{f,1} = e^{log\_Fmult_{f,1}}}$$

and,

EQUATION 10.2.2.6 FISHING MORTALITY MULTIPLIERS (FLEET, YEAR)

$$Fmult_{f,t} = Fmult_{f,t-1}e^{\log\_Fmultdev_{f,t}}$$

Directed fishing mortality per year for a fleet, year, and age, $Fdir_{f,t,a}$, is calculated from the fishing mortality multiplier for the fleet and year, $Fmult_{f,t}$, selectivity for the fleet and age, $Sel_{f,a}$, and the proportion of the catch of the fleet for that year and age that was released, $prop\_release_{f,t,a}$ or:

EQUATION 10.2.2.7 DIRECTED FISHING MORTALITY (FLEET, YEAR, AND AGE)

$$Fdir_{f,t,a} = Fmult_{f,t}Sel_{f,a}(1 - prop_{release_{f,t,a}})$$

The dead discards, $Fby\_catch_{f,t,a}$, are similar but with the addition of the fleet's release mortality rate:

EQUATION 10.2.2.8 BY-CATCH FISHING MORTALITY (FLEET, YEAR, AND AGE)

$$Fby\_catch_{f,t,a} = Fmult_{f,t}Sel_{f,a}(prop_{release_{f,t,a}} * release\_mort_f)$$

The fishing mortality for the fleet, year, and age is the sum of the directed and discarded fishing mortality components:

EQUATION 10.2.2.9 FLEET TOTAL FISHING MORTALITY (FLEET, YEAR, AGE)

$$F_{f,t,a} = Fdir_{f,t} + Fby\_catch_{f,t,a}$$

Total mortality, *Z,* is the sum of the fishing mortalities by fleet and natural mortality

EQUATION 10.2.2.10 TOTAL MORTALITY (YEAR AND AGE)

$$Z_{t,a} = M_{t,a} + \sum_{f} F_{f,t,a}$$

(4) Population Abundance

The population abundances in the first year, 1981, for ages 1 to 12+ are calculated from the initial guesses, $N1ini_a$, and deviations. The equation for age, a, is:

EQUATION 10.2.2.11 POPULATION ABUNDANCE IN YEAR 1 (AGE)

$$N_{1,a} = N1ini_a * e^{\log\_Nyear1dev_a}$$

The population abundances for remainder of the ages less than the plus group are calculated from:

EQUATION 10.2.2.12 POPULATION ABUNDANCE (YEAR, AGE)

$$N_{t,a} = N_{t-1,a-1} * e^{-Z_{t-1,a-1}}$$

and the population abundance in the plus group, A, is calculated from:

EQUATION 10.2.2.13 POPULATION ABUNDANCE IN PLUS GROUP (YEAR)

$$N_{t,A} = N_{t-1,A-1} * e^{-Z_{t-1,A-1}} + N_{t-1,A} * e^{-Z_{t-1,A}}$$

The spawning biomass, SSB_t, is calculated from population abundances by year and age; average weight offset to the beginning of the spawning season by year and age, $\overline{w}ssb_{t,a}$, maturity by year and age, $m_{t,a}$; and total mortality offset for the spawning season, p_{SSB}, which was 0.5 years or July 1 [Barbieri and Colvocoresses 2003, SEDAR 3 (2003)]. The sex ratio for male and female yellowtail snapper is approximately 1:1 (Section 5.6.5), and the length-weight relationship for males and females were not different, so male and female biomass was not differentiated in the inputs for the model. But, female SSB was calculated as 0.5 of the mature fraction of the total population biomass for a year by the model. The equation for spawning biomass of the population is:

EQUATION 10.2.2.14 SPAWNING STOCK BIOMASS (YEAR)

$$SSB_t = \sum_{a} (N_{t,a} * \overline{w}ssb_{t,a} * M_{t,a} * e^{-\mathrm{p\ SSB} * Z_{t,a}})$$

The spawning biomass per recruit at for any F, $(SSB/R)_F$, where the number of recruits starts with $N_1 = 1$ is

EQUATION 10.2.2.15 SPAWNING STOCK PER RECRUIT

$$SSB/R_{F_{tot}} = \sum_a (N_a * e^{-(F_{tot} + M_a)*p\ SSB} * \overline{w}_{SSB,a} * M_a)$$

Recruitment in this model, the number of age-1 fish, is assumed to follow the Beverton-Holt stock recruitment relationship:

EQUATION 10.2.2.16 PREDICTED RECRUITMENT OF AGE-1 FISH (YEAR+1)

$$\hat{R}_{t+1} = \frac{\alpha SSB_t}{\beta + SSB_t}$$

However, equation *11.2.2.13* was re-parameterized to steepness, h, which is only defined over the range of 0.20-1.00 (Mace and Doonan 1988); the spawning biomass without fishing SSB_o; and $(SSB/R)_{F=0}$, the product of relative numbers-at-age calculated from natural mortality, average weight at age, and the maturity at age (Equation *10.2.2.15* with F = 0).

EQUATION 10.2.2.17 STOCK-RECRUITMENT PARAMETER ALPHA

$$\alpha = \frac{4hSSB_0 / (SSB/R)_{F=0}}{5h - 1}$$

and,

EQUATION 10.2.2.18 STOCK-RECRUITMENT PARAMETER BETA

$$\beta = \frac{SSB_0(1 - h)}{5h - 1}$$

With the Beverton-Holt stock recruitment relationship, the spawning biomass at any F is:

EQUATION 10.2.2.19 BEVERTON-HOLT STOCK-RECRUITMENT RELATIONSHIP

$$SSB_F = \alpha(SSB/R)_F - \beta$$

and recruitment at any F is:

Equation 10.2.2.20 Recruitment at any F from Stock-Recruitment Relationship

$$R_F = \frac{SSB_F}{(SSB/R)_F}$$

Annual predicted recruitment (age 1), $N_{t,1}$, is a product of the predicted value from the Beverton-Holt stock recruitment, $\hat{R}_t$, and an annual recruitment deviation:

Equation 10.2.2.21 Annual Predicted Recruitment Age 1 fish

$$N_{t,1} = \hat{R}_t * \ e^{log(Rdev_t)}$$

The predicted catch in biomass is the sum of the directed catch and the by-catch and these terms are calculated from the Baranov equation (Ricker 1975) and the average catch weight by year and age:

Equation 10.2.2.22 Predicted Fleet Directed Catch Biomass (fleet, year, age)

$$\hat{L}dir_{f,t,a} = \ N_{t,a} * Fdir_{f,t,a} * \ (1 - e^{-Z_{t,a}}) * \left({\bar{w}catch_{t,a}}/{Z_{t,a}} \right)$$

and,

Equation 10.2.2.23 Predicted Fleet Discard Biomass (fleet, year, age)

$$\hat{L}disc_{f,t,a} = \ N_{t,a} * Fby\_catch_{f,t,a} * \ (1 - e^{-Z_{t,a}}) * \left({\bar{w}catch_{t,a}}/{Z_{t,a}} \right)$$

The calculation of catchability for each index is similar to the fishing mortality calculation with a value for the first year (log_$q1_{ind}$) and annual deviations (log_$q_dev_{ind,t}$) which can be turned on or off. For the yellowtail snapper assessment, the catchability deviations were turned off so that use time-varying catchabilities were not estimated. The equation for catchability is:

Equation 10.2.2.24 Catchabilities for Indices (index, year)

$$q_{ind,t} \ = \ e^{log\ (q1_{ind}) + \log\ (qdev_{ind,t})}$$

and the predicted index value is:

Equation 10.2.2.25 Predicted Index Value (index, year)

$$I_{ind,t} = q_{ind,t} * \sum_{a=start_{age}}^{end_{age}} N_{t,a} * Sel_{ind,t,a} * e^{-(Z_{t,a}) * t_{offset_{ind}}}$$

where t_offset_{ind} is an offset within the year for the index's sampling period.

(5) Parameters Estimated

As ASAP2 was configured for yellowtail snapper, the model estimated values for 166 parameters. A breakdown of those parameters is: 18 selectivity coefficients for the 9 selectivity blocks for the fleets, 3 fleet fishing mortality multipliers in 1981, 87 fishing mortality multiplier deviations (3 fleets*29 years), 29 recruitment deviations, 12 age deviations in 1981, 4 index catchability coefficients, 11(1 fixed) index selectivity by age coefficients for the NMFS-UM RVC index (all the fishery dependent indices were linked to the selectivities estimated for their respective fleets), spawning biomass without fishing, and steepness (stock-recruitment parameter).

(6) Uncertainty and Measures of Precision

When ASAP2 achieves valid convergence, the model generates a variance-covariance matrix and, thus, the diagonal of that matrix estimates the variance for each of the 166 parameters. To explore the precision beyond the standard deviations of the parameters, Markov Chain Monte Carlo simulations (MCMC) were used with the variance-covariance matrix to start the Metropolis-Hastings method algorithm. The initial runs were made using 2,001,000 outcomes with no thinning to examine acceptance rates of the samples, potential burn-in periods (to eliminate effects of alternate starting values) for the chains, and autocorrelation in the outcomes (Gelman et al. 2003) using the diagnostics in the R package 'boa' (http://www.public-health.uiowa.edu/boa)). After burn-in and autocorrelation were assessed, five runs (chains) were made with 10,001,000 simulations each at a thinning rate of 8,000 (one of every 8,000 samples was kept). Each of the variables (model parameters) of interest from the five runs were compared for convergence using the methods suggested by Gelman et al. (2003) which monitors the "between" and "within" variances of the estimands from the chains.

Equation 10.2.2.26 Between sequence variances (MCMC)

$$\boldsymbol{B_m = \frac{n}{m-1} \sum_{j=1}^{m} \left(\bar{\varphi}_{.j} - \bar{\varphi}_{..}\right)^2}$$

where $\bar{\varphi}_{.j} = \frac{1}{n}\sum_{i=1}^{n} \varphi_{ij}$, $\bar{\varphi}_{..} = \frac{1}{m}\sum_{j=1}^{m} \bar{\varphi}_{.j}$,

from *m* parallel sequences (MCMC chains) each of length *n* (after discarding burn-in samples).

EQUATION 10.2.2.27 WITHIN SEQUENCE VARIANCES (MCMC)

$$\boldsymbol{W} = \frac{\boldsymbol{1}}{\boldsymbol{m}} \sum_{\boldsymbol{j=1}}^{\boldsymbol{m}} \boldsymbol{s_j^2}$$

where $s_j^2 = \frac{1}{n-1} \sum_{j=1}^{m} \left(\varphi_{ij} - \overline{\varphi}_{.j}\right)^2$

EQUATION 10.2.2.28 MARGINAL POSTERIOR VARIANCES (MCMC)

$$\widehat{var}^{\,+}(\varphi|y) = \frac{n-1}{n} W + \frac{1}{n} B$$

The quantity $\widehat{var}^{\,+}(\varphi|y)$ is a weighted average of the variance of the chains (B) divided by the within-variance of the separate chains (W), which overestimates the marginal posterior variance but is unbiased under stationarity (if the starting distribution equals the target distribution) and underestimates the "within" variance (W) because the sequences have not had time to range over all of the target distribution (Gelman et al. 2003). Convergence is monitored by estimating a factor by which the scale of the distribution of samples for φ might be reduced if additional simulations were performed.

The potential of reducing the scale for the ratio of the marginal posterior variance of the estimand and the "within" variance of the estimand is:

EQUATION 10.2.2.29 POTENTIAL SCALE REDUCTION FACTOR (MCMC)

$$\hat{R} = \sqrt{\frac{\widehat{var}^{\,+}(\varphi|y)}{\mathrm{W}}}$$

If the potential scale reduction factor ($\widehat{R}$) is high, then additional simulations may improve inferences about the distribution of the parameter estimated by the simulations. If $\widehat{R}$ is close to 1, additional simulations will not improve the inferences about the target distribution for the parameter estimated by the simulations (Gelman et al. 2003), and the samples from the separate chains produced by the MCMC simulations can be combined as samples from the target distribution for a parameter.

Another potential source of uncertainty in estimating fishing mortality rates, spawning biomass, or recruitment is from retrospective bias (Mohn 1999). The option to run analyses for retrospective bias is built into ASAP2, and six years (2005-2010) were examined.

Additionally, sensitivity runs were made for alternative values of release mortality because the estimates used for the immediately observable release mortality was based on relatively few observations from one study (at-sea sampling on head boats; Section 5.4.2), from commercial vertical line vessels log books (Section 6.4.1), and there may be unmeasured delayed mortality from the interaction with the fishing gear.

10.2.3 BENCHMARKS / REFERENCE POINTS / ABC METHODS

The South Atlantic Fishery Management Council (SAFMC) adopted benchmark proxies for the snappers and groupers in 1998 (Amendment 11) of F30%SPR as their Maximum Fishing Mortality Threshold (MFMT, now called the overfishing limit, OFL) and the Minimum Stock Size Threshold (MSST) is (1 – M) SSB30%SPR or 0.86 SSB30%SPR. In the same amendment, the SAFMC chose the yield corresponding to F40%SPR as their optimum yield (OY) goal. The Gulf of Mexico Fishery Management Council (GMFMC) also has adopted F30%SPR as their OFL for reef fish and they chose 0.8 SSB30%SPR as their MSST. The GMFMC's amendment that contained their optimum yield definition (Amendment 18B) was not accepted and the council is considering OY alternatives at this time.

ASAP2 has the ability to estimate commonly used reference points such as FMSY, F30%SPR, or F40%SPR. The program uses the bisection method to identify a particular fishing mortality rate with a given spawning potential ratio (SPR) and then using that fishing mortality rate, the program determines the spawning biomass, recruitment, and yield-per-recruit to estimate the equilibrium yield associated with at that fishing mortality rate. The senior author of ASAP2, Dr. Chris Legault, supplied the ASAP2's ADMB template and slight modifications were made to have ASAP2 estimate the biomass at F30%SPR and to estimate F45%SPR together with its biomass to provide additional estimates for probabilistic evaluation of the SAFMC's management objectives.

10.2.4 PROJECTION METHODS

Deterministic projections can be run in ASAP2. The projections could use the current level of fishing mortality or a specified level of F such as a geometric mean of the fishing mortality rates of the last three years to estimate the current fishing mortality rate (Fcurrent) and assumed no change in current management. The model used the current (2010) directed and discard fishing mortality rates by fleet to run the projections. Recruitment was calculated from the spawning biomass (Equation 10.2.2.20) and a log recruitment deviation (Equation 10.2.2.21). The duration of the projections was 10 years (2020). The projection model assumed that the selectivities would not change over the projection interval. This assumption is equivalent to implying that effort may vary but not sizes of yellowtail snapper affected by fishing gear or methods. The current fishing mortality rate (Fcurrent) was applied in 2011-2020.

10.2.5 SPECIFIC CONFIGURATIONS

(1) Proportions at age for catch and for discarded fish

The annual PAA_{catch} by fleet are in Tables 10.6.1 (commercial), 10.6.2 (recreational [MRFSS]), and 10.6.3 (head boats) and $PAA_{discards}$ for the total discards (live or dead) by fleet are in Tables 10.6.4 (commercial), 10.6.5 (recreational [MRFSS]), and 10.6.6 (head boats) for the age-length key (ALK) model configurations. The age compositions for the fleet catches and discards are weighted by the total number caught or discarded in the two regions, and the catch PAA and discard PAA matrices were fully populated (no missing values) over the 1981-2010 period. The proportions of yellowtail snapper in the fleet discards by age to the fleet catch (landings and discards) by age, $PAA_{releases,}$ are in Tables 10.6.7, 10.6.8, and 10.6.9).

The process was similar for the direct ageing (DA) model configurations. For calculating the annual numbers of fish landed by age for the DA runs, the observed proportions of ages in the age samples by year and region for each fleet was multiplied by the annual estimated numbers of fish landed by each fleet in a region. The number of yellowtail in the annual discards by each fleet were the same as used in the ALK configurations since there were no age samples from discarded fish. The catch at age for each fleet was the annual sum of the landed and discarded fish at age. The catch proportion-at-age ($PAA_{catch\ [DA]}$) was the catch-at-age for a fleet divided by the total number caught (Tables 10.6.10, 10.6.11, 10.6.12) and used the annual estimated numbers of yellowtail snapper in the total discards by fleet and age (using the age-length keys). $PAA_{catch\ [DA]}$ annual values were treated as missing values if there were no age samples from a fleet for one or both regions. The discard proportion-at-age ($PAA_{discards}$) for a fleet was the same as calculated for the ALK model for computing the $PAA_{catch\ [DA]}$. For the DA model configuration, though, the annual values for $PAA_{discards}$ were treated as missing values until 2005-2010 when at-sea sampling occurred. The $PAA_{releases}$ for each fleet were the same as used in the ALK configuration.

(2) Weights of Landings and Discards by Fleet

The total weight (in metric tons[1]) of yellowtail snapper harvested by the three fleets was a combination of the reported landings and the product of the estimated weight of total discards (live and dead) by fleet at a specified release mortality rate to estimate the total weight of dead discards by fleet. The vectors of weights by fleet for landings and dead discards (Table 10.6.13) were used as inputs to the ALK and DA model configurations used in this assessment. Landings and discards from all fleets were highest in the Gulf region (Fig. 10.7.1), and landings far exceed dead discards. The commercial fleet in the last 20 years has dominated the landings, and in this assessment the recreational (MRFSS) fleet is estimated to be the largest in terms of dead discards. There is one anomalously high year (1991) of released fish (Type B2 fish) in the MRFSS data. The inputs may also be structured to include the weight of dead discards (if known) with the landings for the total harvested weight by fleet, and include weights for fish that were released alive that subsequently die as a result of the encounter with the fishing gear using a specified release mortality rate as dead discards. Because of the uncertainty around the quantification of discard rates and sizes in the discards, this assessment examined the issue of

[1] One metric ton = 1,000 kilograms or 2,204.623 pounds

delayed mortality of yellowtail snapper released alive by examining runs at different rates of release mortality as sensitivity runs. The matrices of estimated weights of dead discards at different release mortalities are in Tables 6.8.25 (commercial discards), 7.8.27 (head boat discards), and 7.8.35 (MRFSS discards).

(3) Weighting input values in the model

ASAP2 allows for landings, discards, and index values to be weighted in terms of the variability associated with estimates of landings or discards in a year, or for indices of abundance the variability associated with the index in a year may be estimated as part of a survey design or a modeled in some way. The weightings are in terms of the coefficient of variation (cv; the ratio of the standard deviation to the mean) for a year and are used as inputs to the model. Low cv values indicate high precision of the estimates, whereas high cv values indicate that there is large variability. ASAP2 uses these estimates of variability in solving for parameters. For landings estimated by surveys (the MRFSS, for example), the cv values are the survey proportional standard errors (PSE). The head boat survey and commercial data collection programs attempt a census of the landings, and the annual cv values for these programs are unknown. Values for these two programs were assumed to be lower than those from surveys (e.g., MRFSS) and were assumed to be relatively constant across years.

Weighting of the age compositions for fleets (catches and total discards) is accomplished through the use of "effective sample sizes" (ESS) for each year that an age composition is estimated for a fleet or index. Typically, the number of samples taken is often used for the initial ESS values whether it is the number of otoliths sampled or some other measurement such as the number of dives for underwater surveys. The ASAP2 user manual suggests capping the ESS at 200 so that years with very large sample sizes do not exert too strong an influence in the fitting process. In practice, large weights such as 200 exert a very strong influence and predicted values tend to fit very closely to the observed values. In this assessment, the choice was made to de-emphasize large numbers of samples by using the square root of the sample sizes rather than using a cap on sample sizes.

Weightings are also possible at the fleet level for landings and dead discards, and index values also have an index level weighting factor. For initial runs of the model, these weightings were set equal to 1 so that all would be contributing the same amount to the model's objective function (a relative measure of the fit of the model to the data and parameters).

A series of runs of a model is typically made to assess whether the model converges successfully (no negative roots when inverting matrices so that the variance-covariance matrix is positive-definite, for example). During these initial runs, the analyst assesses the impact of the ESS values used for the age compositions. The model may suggest that some initial ESS values are larger than the model predicted ESS and the initial values should be reduced. Tuning the model runs with the ESS calculations is an iterative process, and it leads generally to better residual patterns in the fits to landings, discards, and indices.

Another tuning strategy is to examine the weighting of indices in models to estimate how much influence each index has on the overall fit of the model. Francis (2010) suggested using the standard deviation of "naturalized residuals" as a more objective approach to weightings for indexes. This process is iterative, with adjustments to the weightings occurring with each run until some tolerance level (e.g., ± 0.001) is reached. This assessment used his method for the weighting of indexes in the model runs.

Appendix B contains the ASAP2 input file yts_ALK_base.DAT (base run), including all adjusted ESS values and weightings for indices. An alternate configuration (yts_DA_alt.dat) is not included in Appendix B, and will not be discussed.

10.3 STATISTICAL CATCH-AT-AGE RESULTS

10.3.1 MEASURES OF OVERALL MODEL FIT

Fits of the ASAP2 model to the age composition in directed landings (Fig. 10.7.2) and dead discards (Fig. 10.7.3) in metric tons by fleet and the indices of abundance (Fig. 10.7.4) are presented together with their standardized residuals. Overall, the fits were reasonable considering the lack of measurements and age samples in some of the years, and inadequate information on discard rates, sizes in the discards, and release mortality rates for the fleets. The best fit for directed landings was with the commercial landings (lowest root mean square error, rmse = 0.52, Table 10.6.14). Head boat landings were the second best fit (rmse = 0.57), and the MRFSS landings were less well fit (rmse = 0.99). The best fit of the fleets for dead discards was the MRFSS (rmse = 0.98), and head boat and commercial dead discards were less well fit (Table 10.6.14). The indices of abundance fit less well than landings and dead discards, in general, with the fit to the head boat index being the worst. There was also a noticeable lack of fit to the commercial log book index particularly over 2003-2010. Data regarding landings and hook hours (Fig. 6.9.8) used in the calculation of the index was examined for potential changes in catchability over the 1993-2010 period. The ASAP2 model-generated directed F vector for the commercial fleet for age-5 (fully recruited age class) divided by the number of hook-hours that represented effort in the index was used to calculate catchabilities by year. Averaging the eight-year periods for 2003-2010 and 1995-2002, the change in catchability for the 2003-2010 was about 37.5% for South Florida index used in the model. The greatest change in catchability appears to have occurred in 2008-2010. The ASAP2 model in this assessment was configured for constant catchability, and ASAP2 does not offer a method for changing catchabilities in only a subset of years (i.e., the option to use catchability blocks are not currently included in the ASAP2 code).

Because of the number of fleets and years, the ASAP2 model fits to the fleet age composition and their standardized residuals are in Appendix A, Figure 11.1.1. The fits to the commercial data were not very good in the early portion of the time series. Low (or 0) numbers of length measurements in some years (for example, 1981-1991 on the Atlantic Coast) may have contributed to this lack of fit. Some age classes estimated to be in MRFSS catches also showed some relatively poor fits throughout the time series. The fits to the head boat age composition tended to be a little better than for the commercial or MRFSS fleets.

The fits to the discard data were good probably owing to the fact that fewer ages were common in the discards. However, there were very little data on which to base size (and age via the age-length keys) of discards from 2005-2010, and no data on sizes discarded prior to those years. Fits to the estimated age composition in the NMFS-UM RVC index were very good (Figure 11.1.3).

10.3.2 PARAMETER ESTIMATES AND ASSOCIATED MEASURES OF UNCERTAINTY

The age-specific selectivity of the directed fleets were modeled with single logistic curves (Table 10.6.15, Fig. 10.7.5). The age-specific selectivities of the NMFS-UM RVC index of abundance was modeled with a single logistic curve but entered in ASAP2 as age-specific selectivities (Table 10.6.16, Fig. 10.7.5). The fleet selectivities and the index selectivities together accounted for 30 parameters. All of the fishery dependent indices were linked to their respective fleets, and thus use the selectivity blocks assigned to each fleet.

The model estimated fishing mortality by first estimating the fishing mortality in 1981 by fleet for the fully selected ages and then estimating multiplicative deviations for the later years (Table 10.6.17). These calculations were conducted on the logarithms of the fishing mortality multiplier and the deviations. This rate, when multiplied by the selectivity by year and age, can be considered the total catch rate because this rate was split using the proportion released by fleet into the portion kept (directed fishery) and the portion discarded. The discarded portion was then multiplied by the fleet's release mortality rate to estimate the discards that died after being released. The proportion of fish by fleet, year, and age that were released was an input to ASAP2 and was the ratio of the total number of discards (alive and dead) divided by the sum of the number of fish landed and the total number of discards (see equation 10.2.2.3).

There were three, fleet-specific, 1981 log fishing mortality multiplier parameters and 87 log fishing mortality deviation parameters.

Logarithms of the number of fish at-age in the population at the beginning of 1981 (ages two through 12+) were estimated by applying deviations to the initial guesses (11 parameters, Table 10.6.18).

Annual recruitment was the predicted number of age-1 fish from the Beverton-Holt stock recruitment relationship (Equation 10.2.2.16) calculated from the spawning biomass in the previous year and adjusted by a log recruitment deviation (Equation 10.2.2.21). The model fit steepness (h = 0.697, sd = 0.0987) and the log spawning biomass without fishing (log SSB0 = 9.57, sd = 0.075) in the re-parameterized stock-recruit relationship. There were 29 log recruitment deviation parameters (Table 10.6.19). Recruitment in the initial year (1981) was calculated with the predicted spawning biomass in the first year less any contribution from age-1 fish and then the model estimated a recruitment deviation for 1981.

There were four log catchability coefficients, one for each index of abundance, and these coefficients are used to relate the number or biomass of fish at age to the index values (Table 10.6.20).

The ASAP2 model for yellowtail snapper in this configuration fit 166 parameters. A feature of ADMB is that parameters can be estimated in phases instead of trying to fit all of them at once and the order of estimation is shown in Table 10.6.21. Proper convergence of the model runs was confirmed by checking that the eigenvalues were positive which yielded a valid variance-covariance matrix.

10.3.3 STOCK ABUNDANCE AND RECRUITMENT

The number of yellowtail snapper in the population was estimated below 40 million from 1981 to 1986, increasing to over 50 million fish in 1989-1993, decreasing to approximately 45 million fish from 1994-2001, and has increased over this decade to about 54 million fish in 2010 (Table 10.6.22 and Fig. 10.7.6). Recruitment (the number of age-1 fish) has been variable but has increased overall since the early-1980s and a relatively large recruitment (17.8 million age-1 fish) was observed in 2009 (Table 10.6.22 and Fig. 10.7.7). In numbers of fish, the plus group of age-12 and older fish was below 4% of the annual total number in the early part of the time series (1981-1999) but has grown to over 4% during 2000-2010.

10.3.4 **STOCK BIOMASS (TOTAL AND SPAWNING STOCK)**

The total biomass was relatively stable at 19-20 thousand metric tons until 2001 when it began to increase and has continued to increase such that the highest total biomass was in 2009 (26.8 thousand metric tons, Table 10.6.22 and Fig. 10.7.8). The female spawning biomass has trended upward after 1985, reached a plateau around 8,000 metric tons from 1995-2001, and has increased to a little over 10,000 metric tons in 2010 (Figure 10.7.9).

10.3.5 FISHERY SELECTIVITY

The fishery selectivities by fleet and regulatory period are show in Fig. 10.7.5a-c. Selectivity with ASAP2 is for total catch, including discards, and it was no surprise that the two recreational fleets had somewhat more similar selectivity patterns compared to the commercial selectivity. The MRFSS selectivity pattern was more skewed to younger fish than the head boat selectivity, but both MRFSS and head boats showed age-2 was fully selected. Selectivity for the commercial fleet was moved to the right some, showing full selectivity at age 3 or 4.

The only discard size information came from the at-sea sampling from the head boat fleet and those data were only from 2005-2010. Discards for earlier years and from the other fleets were approximated by using the size distribution of fish measured by at-sea sampling and applying the rate of fish discarded to fish kept for 1985-2010 over which the 12” TL size limit was in effect for yellowtail snapper. For 1981-1984, even though the SAFMC implemented a size limit of 12” FL in federal waters, there were still some fish below the size limit in catches from the fleets. The proportion of fish here were no size limits for yellowtail snapper and assuming that the fleets caught similar sized fish under the larger minimum sizes and that the smaller fish were discarded (Sections 6.4.1, 7.4.1). The lack of size information for discards is a major data gap in conducting stock assessments in the southeast U.S.

10.3.6 FISHING MORTALITY

The instantaneous total catch rates (F-multipliers) for the commercial fleet reached about 0.07 per year, and MRFSS reached approximately 0.09 per year (Fig. 10.7.10a) in 1991, but these rates have since declined. In the beginning of the time series (1981-1985), the MRFSS fleet accounted for much of the directed fishing mortality with the commercial fleet being usually the next highest (Figure 10.7.10b). After 1985, the commercial fleet has accounted for more of the fishing mortality on yellowtail snapper (Fig. 10.7.10a,b). Only in 1991 was the commercial fleet Fmult exceeded by the MRFSS, and in that year the MRFSS B2 estimate for yellowtail snapper was anomalously high (and, coupled with release mortality, shows up in the model by generating a larger Fmult). However, the fishing mortality from the commercial fleet has declined since 1993 to a low of 0.03 per year in 2007, rising again in 2008-2009 to about 0.05 (Fig. 10.7.10b). The fishing mortality rate for head boats has trended downwards over the 1992-2010 period, and the trend in fishing mortality rate for the MRFSS over has also been a decline after 1991, though there was a small increase over 2002-2008 (Fig. 10.7.10a). The directed fishing mortality on age-5 (fully selected) fish for MRFSS was 0.007 per year in 2010, while for the commercial fleet the fishing mortality rate on age-5 was 0.036. The head boat fleet only accounted for 0.002 per year of the fishing mortality.

The combined (directed and discards) fishing mortality rate on age-5 fish, the fully selected age, has declined from values near 0.16 per year in 1991 to about 0.055-0.045 in recent years even with the upturn in 2008-2009 (Fig. 10.7.11).

10.3.7 STOCK-RECRUITMENT PARAMETERS

The model estimates recruitment with a Beverton-Holt stock-recruitment relationship (Equation 10.2.2.16). Based on life history considerations of longevity and age of maturity, the initial value for steepness was set at 0.75 (CV = 0.15). The model converged with a steepness value of 0.69 but the MCMC results showed a range of 0.50 to 0.99 with half of the outcomes between 0.650 and 0.775 (Fig. 10.8.). ASAP2 estimated that the spawning biomass at F = 0 was 14,316 metric tons . The final term necessary to predict the number of recruits from the previous year's spawning biomass is the spawning biomass per recruit at F=0 which was 1.009 kg. This term is used to estimate the recruitment at F= 0, R0 , and is fixed for a given input configuration being determined by natural mortality, the offset to the beginning of the spawning season (July 1), maturity at age, and the average weight-at-age of a fish in the spawning season. The pattern of spawning biomass and recruitment one year later was quite variable with the spawning biomass increasing from 1984 on and recruitment varied from a low in 1993 of 8.3 million age-1 fish to a recent high of 17.8 million fish in 2009 (Fig. 10.7.13).

10.3.8 EVALUATION OF UNCERTAINTY

ASAP2 estimates uncertainty with the variance-covariance matrix of the estimated parameters and through Markov Chain Monte Carlo (MCMC) simulations. The uncertainty in the model's 166 parameters is presented in Tables 10.6.15–10.6.20. MCMC simulations were used to explore uncertainty beyond the estimated standard deviations of the parameters. As was mentioned in the section 10.2.2 (6) above, preliminary MCMC runs of 2 million samples allowed an analysis of multiple MCMC runs of 10 million simulations each provided enough samples to evaluate the number of simulations spent in a step before making a successful jump and yield enough samples to investigate potential burn-in rates and autocorrelation among samples. A thinning rate of 8,000 was found to remove significant autocorrelation in most of the variables of interest. Subsequently, five runs of 10 million samples at a thinning rate of 8,000 were performed, and a burn-in period of 3.2 million samples was used (400 of the thinned samples) to obtain 850 samples from 5 separate MCMC chains. The method suggested by Gelman et al. (2003) was used to evaluate whether sufficient simulations had been performed to yield samples which had likely converged to the target distributions for the estimands (variables of interest from the model runs).

The distribution of MCMC outcomes for the fishing mortality per year in 2010 on fully selected ages and the spawning biomass in 2010 are shown in Fig. 10.7.14.

The two, main parameters of interest to the councils were their overfishing measure -- the ratio of fishing mortality in 2010 compared to the fishing mortality at 30% SPR, and overfished measure --the spawning biomass in 2010 compared to the spawning biomass at 30% SPR. Both of these measures indicated that the yellowtail snapper stock was in compliance with the councils' objectives. The F-ratio was less than 1.00 (0.154) and the spawning biomass ratio was greater than 1.00 (3.357). The distributions of the MCMC outcomes for these two measures showed that none of the MCMC outcomes failed to meet the councils' objectives (Fig. 10.7.15).

10.3.9 Restrospective Analysis

A retrospective analysis covering the period of 2005 to 2010 found that fishing mortality rates decreased each year at from 2- 12% with the addition of more years of data in the analysis while spawning biomass consistently declined for 2005 to 2010 the addition of new data (Fig.10.7.16). Recruitment was more variable and did not show a consistent pattern, and appeared to be tracking the NMFS-UM RVC index generally since that index is largely comprised (usually over half) of age-1 fish. This index may be exerting an influence on the recruitment portion of the retrospective analysis.

10.3.10 Sensitivity Runs

Sensitivity runs were conducted by varying the levels of release mortality from the "base" levels of 11.5% for the commercial fleet and 10% for the MRFSS and head boat anglers. Configuration for the runs consisted of changing the input values for release mortality in ASAP2, and changing the estimate of dead discards in metric tons to match the level or release mortality input for each fleets (tables 6.8.25, 7.8.27, and 7.8.34). Levels of release mortality were increased to 20% and 30% for the sensitivities. The range of release mortalities had little impact on the model outputs (Table 10.6.23). The model adjusted the stock-recruitment relationship (represented by the steepness parameter) which generated more spawning stock biomass to keep up with the increased level of release mortalities. The 30% SPR benchmarks adjust slightly as a result and are similar to the base run results.

10.3.11 BENCHMARKS / REFERENCE POINTS / ABC VALUES

Both the SAFMC and the GMFMC have chosen F30%SPR as their overfishing limit (OFL, the former Maximum Fishing Mortality Threshold). Using F30%SPR in lieu of FMSY has the advantage of being a per-recruit measure and does not depend upon the stock-recruit relationship. By not depending upon the stock-recruitment relationship, F30%SPR is more consistent than FMSY across different model configurations, which, in turn, aids managers. The point estimate for F30%SPR in the base run was 0.295 per year (fully recruited age, age-5) and 3,072 metric tons for the spawning biomass associated with F30%SPR. The Minimum Spawning Stock Threshold (MSST= (1-M)*SSB30%SPR was 583.6 metric tons.

The fishing mortality rate in 2010 on the fully recruited age (age-5) was 0.0454 per year, the F-ratio (F2010/F30%SPR) was 0.154 and none of the MCMC outcomes exceeded 1.0 indicating that the fleets were not overfishing the stock in 2010. The spawning biomass in 2010 was 10,311 metric tons and the SSB-ratio was 3.357 and none of the MCMC outcomes was less than 1.0 indicating the yellowtail snapper were not overfished. The distributions of these two ratios are shown in Fig.10.7.15.

10.3.12 PROJECTIONS

Yellowtail snapper were not deemed in this assessment to be either undergoing overfishing nor were they overfished in 2010 and no rebuilding plan needs to be developed. A projection of potential future values by age for the projected population structure (numbers), catch, discards, yield, and spawning stock biomass was run using the current rate of fishing mortality (Table 10.7.17). The population numbers slightly decreased and the number of fish in the Age 12+ group increased slightly. The projected catch decreases slightly as well over 2011-2020, and the Age 12+ group in the catch is increased. Dead discards are projected to increase modestly followed by a slight decrease. The projected yield (in metric tons) decreases slightly, and the number of age 12+ fish in the yield increases slightly. In short, no large changes to the population are anticipated.

10.4 DISCUSSION AND RESEARCH RECOMMENDATIONS

This assessment produced much lower fishing mortality rates than those of SEDAR 3 for the period covered by that assessment (1981-2001). The management benchmarks were lower for spawning stock biomass and higher for MSY, and the $F_{30\%SPR}$ (F_{MSY} proxy) was intermediate between the ICA and fleet-specific models used in SEDAR 3 (Table 10.6.24). There was a longer time series of data available for this assessment as well as more age information, and there were some discard rate, size-at-release, and estimates of release mortality not available at the time of SEDAR 3. SEDAR 3 used a constant natural mortality rate for its base run of 0.20, and this assessment used a value of 0.194 for M and age-specific natural mortality rates.

Discards from the fleets are a large unknown both in quantity and length composition for all of the fleets. There was some data from at-sea sampling on head boats, and there were more limited data from at-sea observers on commercial vertical line vessels that were used by McCarthy (2011b) to estimate the proportion released dead. The gathering of data on released fish (sizes, quantities, disposition at release) is important for all assessments and should be encouraged.

Future assessments on yellowtail snapper may want to re-examine the 1992 MRFSS B2 estimates to look for outliers because the number of estimated discards was anomalously high and had an impact on fishing mortality because of release mortality. Also, the quality and quantity of data gathered after 1991 appears to improve in terms of cv (or PSE) for the MRFSS, and the log book data series provided begins in 1993. Future assessments could restrict the data to 1993 to present, for example, to investigate the impact this restrict data set would have on estimates.

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10.6 TABLES

Table 10.6.1 Yellowtail snapper weighted annual proportions at age in the catch for commercial vessels fishing with vertical lines (Atlantic and Gulf regions combined). Values are the proportions of landed + discarded yellowtail snapper (in numbers) of age to the total of number of yellowtail snapper landed or discarded by the commercial fleet each year. For example, in 2010, 1.3% of yellowtail snapper caught by commercial vessels using vertical line gear were estimated (using age-length keys) to be age 1.

Catch Proportions at Age (by numbers of fish), $PAA_{commercial\ catch}$

Year	1	2	3	4	5	6	7	8	9	10	11	12+
1981	0.0318	0.1848	0.2695	0.1616	0.1337	0.0795	0.0591	0.0358	0.0159	0.0084	0.0127	0.0070
1982	0.0317	0.1508	0.3309	0.1606	0.1156	0.0631	0.0531	0.0567	0.0126	0.0099	0.0091	0.0057
1983	0.0332	0.1581	0.1679	0.3141	0.1052	0.0744	0.0556	0.0378	0.0161	0.0153	0.0091	0.0132
1984	0.0296	0.1880	0.2173	0.2037	0.1240	0.0779	0.0615	0.0409	0.0170	0.0159	0.0096	0.0146
1985	0.0404	0.1131	0.0900	0.0613	0.1592	0.1316	0.1421	0.0988	0.0443	0.0479	0.0242	0.0471
1986	0.0346	0.1530	0.1387	0.1678	0.1424	0.1088	0.0756	0.0579	0.0359	0.0220	0.0198	0.0435
1987	0.0352	0.1650	0.1874	0.1721	0.1318	0.0941	0.0626	0.0479	0.0299	0.0182	0.0169	0.0390
1988	0.0333	0.1906	0.2590	0.2101	0.1303	0.0781	0.0404	0.0248	0.0130	0.0069	0.0059	0.0077
1989	0.0305	0.1647	0.2431	0.2156	0.1405	0.0881	0.0470	0.0296	0.0159	0.0085	0.0070	0.0095
1990	0.0309	0.1838	0.2698	0.2178	0.1296	0.0746	0.0379	0.0231	0.0124	0.0066	0.0057	0.0079
1991	0.0242	0.1876	0.2095	0.2899	0.0959	0.0726	0.0392	0.0398	0.0196	0.0039	0.0089	0.0089
1992	0.0253	0.1932	0.3254	0.2359	0.0696	0.0363	0.0335	0.0346	0.0155	0.0063	0.0113	0.0132
1993	0.0158	0.1351	0.2673	0.2025	0.1133	0.0971	0.0582	0.0656	0.0231	0.0032	0.0092	0.0096
1994	0.0296	0.1713	0.2527	0.1898	0.1252	0.0688	0.0438	0.0644	0.0293	0.0064	0.0108	0.0080
1995	0.0193	0.0671	0.2807	0.2803	0.1428	0.0946	0.0469	0.0322	0.0222	0.0019	0.0063	0.0058
1996	0.0327	0.1251	0.1603	0.1908	0.2365	0.1076	0.0568	0.0460	0.0291	0.0050	0.0063	0.0039
1997	0.0339	0.1406	0.2566	0.1628	0.1570	0.1259	0.0553	0.0213	0.0202	0.0060	0.0123	0.0082
1998	0.0300	0.1347	0.2851	0.2364	0.1182	0.0654	0.0617	0.0279	0.0200	0.0112	0.0082	0.0013
1999	0.0395	0.1784	0.1648	0.2114	0.1903	0.0959	0.0518	0.0377	0.0166	0.0071	0.0016	0.0047
2000	0.0292	0.1806	0.1997	0.2030	0.1464	0.1054	0.0550	0.0292	0.0227	0.0095	0.0123	0.0071
2001	0.0354	0.2158	0.2491	0.2073	0.1133	0.0878	0.0408	0.0253	0.0054	0.0075	0.0094	0.0030
2002	0.0294	0.1825	0.2420	0.1809	0.1751	0.0997	0.0346	0.0233	0.0133	0.0092	0.0023	0.0077
2003	0.0435	0.1451	0.2920	0.2225	0.0937	0.0809	0.0479	0.0287	0.0176	0.0037	0.0076	0.0168
2004	0.0119	0.1114	0.2365	0.2652	0.1728	0.0849	0.0565	0.0335	0.0078	0.0020	0.0067	0.0109
2005	0.0148	0.1131	0.2675	0.2603	0.1634	0.0693	0.0479	0.0144	0.0259	0.0144	0.0040	0.0051
2006	0.0333	0.1327	0.2109	0.2068	0.1529	0.0990	0.0449	0.0488	0.0245	0.0272	0.0004	0.0185
2007	0.0324	0.1298	0.1814	0.2530	0.1724	0.1448	0.0376	0.0268	0.0002	0.0120	0.0047	0.0050
2008	0.0306	0.1122	0.1871	0.2761	0.1536	0.0959	0.0517	0.0419	0.0177	0.0079	0.0118	0.0135
2009	0.0154	0.1905	0.2402	0.1398	0.1592	0.0924	0.0685	0.0387	0.0191	0.0094	0.0053	0.0216
2010	0.0132	0.1640	0.2452	0.2413	0.1217	0.0952	0.0412	0.0296	0.0189	0.0077	0.0105	0.0115

Table 10.6.2 Yellowtail snapper weighted annual proportions at age in the catch for recreational anglers (MRFSS data, Atlantic and Gulf regions combined). Values are the proportions of landed + discarded yellowtail snapper (in numbers) of age to the total of number of yellowtail snapper landed or discarded by recreational anglers each year. For example, in 2010, 12.0% of yellowtail snapper caught by recreational anglers were estimated (using age-length keys) to be age-1.

Catch Proportions at Age (by numbers of fish), $PAA_{MRFSS\ catch}$

Year	1	2	3	4	5	6	7	8	9	10	11	12+
1981	0.2069	0.3519	0.1730	0.0992	0.0557	0.0382	0.0235	0.0171	0.0106	0.0080	0.0061	0.0097
1982	0.2410	0.1801	0.1859	0.0986	0.1035	0.0684	0.0495	0.0415	0.0101	0.0077	0.0067	0.0070
1983	0.2163	0.2348	0.1741	0.2389	0.0541	0.0372	0.0222	0.0112	0.0025	0.0028	0.0030	0.0030
1984	0.3287	0.2701	0.1238	0.0968	0.0566	0.0381	0.0378	0.0198	0.0089	0.0052	0.0080	0.0062
1985	0.1397	0.2110	0.2372	0.1344	0.0976	0.0621	0.0484	0.0269	0.0143	0.0071	0.0103	0.0108
1986	0.1691	0.2858	0.1103	0.1317	0.0709	0.0559	0.0390	0.0365	0.0280	0.0173	0.0168	0.0388
1987	0.1656	0.3243	0.1790	0.1236	0.0818	0.0508	0.0252	0.0166	0.0101	0.0059	0.0057	0.0113
1988	0.1110	0.2581	0.1885	0.1741	0.0945	0.0660	0.0324	0.0226	0.0161	0.0085	0.0088	0.0195
1989	0.1222	0.2626	0.1742	0.1328	0.0953	0.0643	0.0403	0.0319	0.0211	0.0129	0.0128	0.0294
1990	0.1156	0.2384	0.2022	0.1817	0.1142	0.0701	0.0321	0.0189	0.0105	0.0049	0.0043	0.0072
1991	0.1491	0.2701	0.2228	0.2130	0.0333	0.0223	0.0260	0.0229	0.0107	0.0051	0.0091	0.0154
1992	0.1968	0.2857	0.2188	0.1478	0.0306	0.0249	0.0429	0.0193	0.0088	0.0050	0.0062	0.0131
1993	0.1610	0.2758	0.2818	0.1683	0.0335	0.0242	0.0273	0.0175	0.0048	0.0011	0.0022	0.0025
1994	0.1508	0.2645	0.2511	0.1724	0.0527	0.0249	0.0289	0.0278	0.0114	0.0042	0.0045	0.0069
1995	0.1796	0.2276	0.2359	0.1913	0.0586	0.0367	0.0331	0.0166	0.0109	0.0022	0.0040	0.0035
1996	0.1950	0.3164	0.1549	0.1132	0.1131	0.0507	0.0201	0.0199	0.0102	0.0033	0.0023	0.0010
1997	0.1665	0.3154	0.2147	0.1131	0.0991	0.0499	0.0185	0.0071	0.0067	0.0015	0.0037	0.0037
1998	0.1849	0.2903	0.2415	0.1335	0.0739	0.0273	0.0216	0.0093	0.0074	0.0044	0.0035	0.0024
1999	0.2595	0.3311	0.1592	0.1021	0.0711	0.0341	0.0187	0.0135	0.0059	0.0022	0.0008	0.0016
2000	0.2064	0.3744	0.1588	0.0993	0.0694	0.0386	0.0185	0.0107	0.0113	0.0041	0.0045	0.0042
2001	0.2142	0.4417	0.1332	0.0895	0.0485	0.0360	0.0166	0.0084	0.0032	0.0024	0.0039	0.0024
2002	0.1533	0.3671	0.2001	0.0963	0.0882	0.0501	0.0146	0.0110	0.0064	0.0036	0.0023	0.0070
2003	0.1814	0.3552	0.1950	0.1197	0.0517	0.0423	0.0229	0.0123	0.0079	0.0017	0.0029	0.0070
2004	0.1008	0.4531	0.1813	0.1202	0.0683	0.0350	0.0194	0.0109	0.0028	0.0009	0.0028	0.0044
2005	0.2060	0.3922	0.2207	0.0856	0.0513	0.0267	0.0084	0.0020	0.0033	0.0020	0.0008	0.0009
2006	0.1754	0.4906	0.1368	0.0720	0.0575	0.0391	0.0085	0.0078	0.0053	0.0047	0.0001	0.0021
2007	0.2626	0.3410	0.1894	0.0917	0.0510	0.0426	0.0108	0.0049	0.0001	0.0022	0.0022	0.0014
2008	0.2426	0.2788	0.1814	0.1510	0.0632	0.0410	0.0165	0.0119	0.0046	0.0021	0.0032	0.0038
2009	0.2125	0.4578	0.1880	0.0575	0.0505	0.0162	0.0088	0.0036	0.0019	0.0008	0.0005	0.0018
2010	0.1200	0.3838	0.2379	0.1179	0.0485	0.0530	0.0191	0.0072	0.0038	0.0012	0.0060	0.0015

Table 10.6.3 Yellowtail snapper weighted annual proportions at age in the catch for head boat anglers (HBS data, Atlantic and Gulf regions combined). Values are the proportions of landed + discarded yellowtail snapper (in numbers) of age to the total of number of yellowtail snapper landed or discarded by recreational anglers each year. For example, in 2010, 5.5% of yellowtail snapper caught by head boat anglers were estimated (using age-length keys) to be age-1.

Catch Proportions at Age (by numbers of fish), $PAA_{\text{head boat catch}}$

Year	1	2	3	4	5	6	7	8	9	10	11	12+
1981	0.0773	0.3309	0.2399	0.1596	0.0706	0.0515	0.0279	0.0190	0.0074	0.0054	0.0047	0.0056
1982	0.0926	0.1556	0.3404	0.1485	0.1065	0.0558	0.0367	0.0408	0.0073	0.0061	0.0044	0.0053
1983	0.1006	0.1818	0.1778	0.2919	0.0934	0.0619	0.0410	0.0248	0.0079	0.0069	0.0062	0.0059
1984	0.0945	0.2375	0.2328	0.1803	0.1100	0.0600	0.0411	0.0232	0.0064	0.0052	0.0051	0.0038
1985	0.0986	0.2799	0.2444	0.1738	0.0826	0.0472	0.0333	0.0194	0.0062	0.0051	0.0052	0.0043
1986	0.0742	0.2376	0.2112	0.1849	0.1169	0.0753	0.0387	0.0245	0.0131	0.0073	0.0062	0.0100
1987	0.0811	0.2618	0.2206	0.1695	0.1097	0.0688	0.0347	0.0214	0.0117	0.0063	0.0055	0.0090
1988	0.0752	0.2411	0.2397	0.1834	0.1106	0.0673	0.0330	0.0202	0.0109	0.0057	0.0051	0.0077
1989	0.0763	0.2229	0.2298	0.1950	0.1135	0.0723	0.0354	0.0223	0.0119	0.0066	0.0055	0.0087
1990	0.0726	0.1955	0.2290	0.1988	0.1187	0.0735	0.0400	0.0268	0.0150	0.0088	0.0078	0.0138
1991	0.0657	0.2164	0.2451	0.2275	0.0698	0.0534	0.0420	0.0351	0.0173	0.0056	0.0090	0.0130
1992	0.0667	0.2386	0.3156	0.2006	0.0501	0.0352	0.0342	0.0233	0.0109	0.0037	0.0081	0.0130
1993	0.0644	0.1914	0.2812	0.1890	0.0750	0.0647	0.0481	0.0458	0.0152	0.0035	0.0072	0.0146
1994	0.0642	0.2289	0.3035	0.1821	0.0778	0.0413	0.0309	0.0403	0.0163	0.0046	0.0052	0.0049
1995	0.0667	0.1302	0.2953	0.2533	0.0949	0.0719	0.0335	0.0242	0.0177	0.0017	0.0056	0.0051
1996	0.0771	0.1832	0.1664	0.1739	0.1953	0.0906	0.0433	0.0369	0.0230	0.0036	0.0037	0.0030
1997	0.0696	0.1822	0.2592	0.1633	0.1408	0.0996	0.0388	0.0165	0.0155	0.0038	0.0065	0.0041
1998	0.0722	0.2000	0.2848	0.2060	0.1016	0.0486	0.0425	0.0190	0.0122	0.0082	0.0044	0.0004
1999	0.1121	0.2632	0.2026	0.1708	0.1261	0.0601	0.0332	0.0192	0.0079	0.0030	0.0003	0.0014
2000	0.0494	0.2742	0.2198	0.1840	0.1156	0.0767	0.0376	0.0174	0.0136	0.0055	0.0048	0.0013
2001	0.0865	0.2878	0.2321	0.1747	0.0921	0.0670	0.0278	0.0174	0.0024	0.0058	0.0054	0.0010
2002	0.0688	0.2313	0.2495	0.1674	0.1491	0.0817	0.0214	0.0128	0.0093	0.0048	0.0011	0.0028
2003	0.0879	0.2205	0.2928	0.2018	0.0780	0.0574	0.0277	0.0181	0.0071	0.0007	0.0038	0.0043
2004	0.0741	0.2157	0.2684	0.2266	0.1131	0.0578	0.0262	0.0123	0.0007	0.0002	0.0007	0.0043
2005	0.0717	0.2050	0.2743	0.2183	0.1301	0.0581	0.0172	0.0060	0.0092	0.0060	0.0024	0.0015
2006	0.0589	0.1801	0.2389	0.1908	0.1499	0.0895	0.0261	0.0280	0.0160	0.0151	0.0000	0.0066
2007	0.0739	0.2161	0.2270	0.2232	0.1240	0.1093	0.0154	0.0066	0.0001	0.0022	0.0014	0.0007
2008	0.0952	0.2345	0.2350	0.2261	0.0942	0.0578	0.0257	0.0174	0.0051	0.0020	0.0028	0.0043
2009	0.0729	0.3643	0.2585	0.1035	0.1025	0.0460	0.0271	0.0110	0.0057	0.0019	0.0017	0.0049
2010	0.0551	0.3260	0.2954	0.1592	0.0653	0.0559	0.0214	0.0087	0.0050	0.0010	0.0052	0.0018

Table 10.6.4 Yellowtail snapper weighted annual proportions at age in the total discards for commercial vertical line vessels (using at-sea sampling length measurements from head boats, age-length keys, and commercial log book estimates of total discards, Atlantic and Gulf regions combined). Values are the proportions of total discards of yellowtail snapper (in numbers) at age to the total of number of yellowtail snapper landed or discarded by commercial fishermen each year. For example, in 2010, 18.1% of yellowtail snapper discarded by commercial fishermen were estimated (using age-length keys) to be age-1.

Proportions at age discarded by commercial fleet total discards, $PAA_{commercial\ discards}$

Year	1	2	3	4	5	6	7	8	9	10	11	12+
1981	0.6625	0.3371	0.0005	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1982	0.6548	0.3449	0.0002	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1983	0.6687	0.3306	0.0007	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1984	0.6587	0.3409	0.0004	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1985	0.3150	0.4958	0.1323	0.0519	0.0024	0.0007	0.0015	0.0002	0.0000	0.0000	0.0002	0.0000
1986	0.2437	0.4371	0.1706	0.0739	0.0457	0.0216	0.0053	0.0005	0.0004	0.0001	0.0011	0.0000
1987	0.2324	0.4334	0.1784	0.0774	0.0480	0.0227	0.0055	0.0005	0.0004	0.0001	0.0012	0.0000
1988	0.2248	0.4325	0.1825	0.0799	0.0491	0.0232	0.0057	0.0006	0.0004	0.0001	0.0012	0.0000
1989	0.2253	0.4325	0.1823	0.0798	0.0491	0.0231	0.0056	0.0006	0.0004	0.0001	0.0012	0.0000
1990	0.2218	0.4316	0.1844	0.0811	0.0497	0.0234	0.0057	0.0006	0.0004	0.0001	0.0012	0.0000
1991	0.2001	0.3280	0.2437	0.2148	0.0058	0.0019	0.0047	0.0008	0.0003	0.0000	0.0001	0.0000
1992	0.2113	0.3125	0.2644	0.1889	0.0145	0.0009	0.0070	0.0004	0.0001	0.0000	0.0001	0.0000
1993	0.2007	0.3187	0.2781	0.1775	0.0060	0.0027	0.0138	0.0021	0.0003	0.0000	0.0001	0.0000
1994	0.1922	0.3273	0.2587	0.2004	0.0149	0.0013	0.0037	0.0010	0.0005	0.0000	0.0001	0.0000
1995	0.1904	0.2923	0.2857	0.2001	0.0241	0.0026	0.0038	0.0007	0.0004	0.0000	0.0001	0.0000
1996	0.2178	0.3755	0.1721	0.1082	0.1007	0.0180	0.0053	0.0016	0.0007	0.0000	0.0000	0.0000
1997	0.2220	0.3802	0.1979	0.0956	0.0787	0.0201	0.0044	0.0003	0.0006	0.0001	0.0001	0.0001
1998	0.2263	0.3755	0.2126	0.0966	0.0682	0.0121	0.0078	0.0004	0.0004	0.0001	0.0000	0.0000
1999	0.3101	0.3821	0.2006	0.0707	0.0255	0.0056	0.0046	0.0006	0.0002	0.0001	0.0000	0.0000
2000	0.1404	0.4494	0.1976	0.1046	0.0749	0.0254	0.0044	0.0006	0.0023	0.0001	0.0001	0.0000
2001	0.2430	0.5028	0.1409	0.0643	0.0308	0.0150	0.0024	0.0005	0.0000	0.0003	0.0001	0.0000
2002	0.2076	0.4000	0.2218	0.0673	0.0566	0.0418	0.0033	0.0012	0.0002	0.0001	0.0000	0.0000
2003	0.2348	0.4451	0.1756	0.0760	0.0412	0.0241	0.0025	0.0005	0.0001	0.0000	0.0001	0.0001
2004	0.2109	0.4445	0.1789	0.0936	0.0443	0.0247	0.0027	0.0002	0.0000	0.0000	0.0000	0.0001
2005	0.2174	0.3259	0.1460	0.1367	0.1088	0.0612	0.0023	0.0001	0.0002	0.0001	0.0014	0.0000
2006	0.1853	0.3871	0.1723	0.0653	0.0995	0.0760	0.0086	0.0028	0.0025	0.0006	0.0000	0.0000
2007	0.2387	0.3811	0.1718	0.0850	0.0543	0.0535	0.0117	0.0001	0.0000	0.0001	0.0038	0.0000
2008	0.2374	0.2904	0.1960	0.1576	0.0613	0.0458	0.0105	0.0007	0.0001	0.0000	0.0001	0.0001
2009	0.2289	0.5507	0.1369	0.0108	0.0672	0.0038	0.0010	0.0003	0.0002	0.0000	0.0000	0.0001
2010	0.1818	0.4001	0.1843	0.0869	0.0295	0.0805	0.0240	0.0004	0.0002	0.0000	0.0122	0.0000

Table 10.6.5 Yellowtail snapper weighted annual proportions at age in the total discards for recreational (MRFSS) anglers (using at-sea sampling length measurements and discard rates from head boats, and age-length keys). Values are the proportions of total discards of yellowtail snapper (in numbers) at age to the total of number of yellowtail snapper landed or discarded by recreational anglers each year. For example, in 2010, 24.1% of yellowtail snapper discards by recreational anglers were estimated (using age-length keys) to be age-1.

Proportions at age discarded by recreational (MRFSS) anglers, $PAA_{\text{recreational discards}}$

Year	1	2	3	4	5	6	7	8	9	10	11	12+
1981	0.7383	0.2585	0.0032	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1982	0.7049	0.2931	0.0020	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1983	0.6955	0.3028	0.0017	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1984	0.6603	0.3393	0.0004	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1985	0.4007	0.4495	0.1009	0.0450	0.0019	0.0005	0.0011	0.0002	0.0000	0.0000	0.0001	0.0000
1986	0.3329	0.4772	0.1123	0.0389	0.0237	0.0112	0.0028	0.0003	0.0002	0.0000	0.0006	0.0000
1987	0.2580	0.4445	0.1618	0.0674	0.0416	0.0197	0.0048	0.0005	0.0004	0.0001	0.0010	0.0000
1988	0.2169	0.4329	0.1846	0.0824	0.0508	0.0241	0.0059	0.0006	0.0005	0.0001	0.0012	0.0000
1989	0.2293	0.4362	0.1780	0.0781	0.0479	0.0227	0.0056	0.0006	0.0004	0.0001	0.0012	0.0000
1990	0.2666	0.4442	0.1597	0.0658	0.0390	0.0184	0.0045	0.0005	0.0003	0.0001	0.0009	0.0000
1991	0.1943	0.3338	0.2445	0.2140	0.0062	0.0020	0.0040	0.0008	0.0003	0.0000	0.0001	0.0000
1992	0.2862	0.3319	0.2140	0.1314	0.0108	0.0007	0.0245	0.0003	0.0001	0.0000	0.0001	0.0000
1993	0.2315	0.3296	0.2558	0.1522	0.0056	0.0026	0.0205	0.0020	0.0002	0.0000	0.0001	0.0000
1994	0.2382	0.3371	0.2311	0.1644	0.0131	0.0011	0.0136	0.0009	0.0004	0.0000	0.0001	0.0000
1995	0.2577	0.3099	0.2414	0.1507	0.0194	0.0021	0.0178	0.0006	0.0003	0.0000	0.0001	0.0000
1996	0.2683	0.3790	0.1558	0.0914	0.0842	0.0150	0.0043	0.0013	0.0006	0.0000	0.0000	0.0000
1997	0.2222	0.3890	0.1941	0.0930	0.0764	0.0198	0.0042	0.0003	0.0007	0.0001	0.0001	0.0001
1998	0.2768	0.3623	0.2000	0.0845	0.0583	0.0103	0.0068	0.0003	0.0004	0.0001	0.0000	0.0000
1999	0.3829	0.3921	0.1518	0.0482	0.0174	0.0039	0.0032	0.0004	0.0002	0.0000	0.0000	0.0000
2000	0.3148	0.4321	0.1268	0.0636	0.0425	0.0145	0.0032	0.0007	0.0016	0.0001	0.0001	0.0000
2001	0.3140	0.5147	0.0945	0.0428	0.0213	0.0105	0.0016	0.0004	0.0000	0.0002	0.0001	0.0000
2002	0.2675	0.4713	0.1518	0.0434	0.0365	0.0263	0.0022	0.0008	0.0002	0.0001	0.0000	0.0000
2003	0.2853	0.4831	0.1309	0.0533	0.0285	0.0166	0.0018	0.0003	0.0001	0.0000	0.0001	0.0000
2004	0.1832	0.5966	0.1291	0.0518	0.0242	0.0134	0.0016	0.0002	0.0000	0.0000	0.0000	0.0001
2005	0.3473	0.4212	0.0902	0.0627	0.0489	0.0276	0.0011	0.0001	0.0001	0.0000	0.0007	0.0000
2006	0.2956	0.4735	0.0960	0.0361	0.0514	0.0395	0.0046	0.0016	0.0014	0.0003	0.0000	0.0000
2007	0.4468	0.3337	0.1017	0.0491	0.0302	0.0299	0.0065	0.0001	0.0000	0.0000	0.0021	0.0000
2008	0.3919	0.2885	0.1463	0.0987	0.0381	0.0291	0.0067	0.0005	0.0001	0.0000	0.0000	0.0001
2009	0.3480	0.5316	0.0785	0.0068	0.0323	0.0020	0.0005	0.0002	0.0001	0.0000	0.0000	0.0000
2010	0.2410	0.4545	0.1386	0.0627	0.0212	0.0566	0.0167	0.0003	0.0001	0.0000	0.0083	0.0000

Table 10.6.6 Yellowtail snapper weighted annual proportions at age in the total discards for head boat anglers (using at-sea sampling length measurements and discard rates from head boats, and age-length keys). Values are the proportions of total discards of yellowtail snapper (in numbers) at age to the total of number of yellowtail snapper landed or discarded by head boat anglers each year. For example, in 2010, 18.4% of yellowtail snapper discarded by head boat anglers were estimated (using age-length keys) to be age-1.

Proportions at age discarded by head boat anglers, $PAA_{\text{head boat discards}}$

Year	1	2	3	4	5	6	7	8	9	10	11	12+
1981	0.6955	0.3028	0.0017	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1982	0.6692	0.3300	0.0007	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1983	0.6594	0.3403	0.0004	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1984	0.6626	0.3370	0.0005	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1985	0.3057	0.5021	0.1326	0.0540	0.0027	0.0008	0.0016	0.0002	0.0000	0.0000	0.0002	0.0000
1986	0.2244	0.4360	0.1794	0.0796	0.0491	0.0233	0.0057	0.0006	0.0004	0.0001	0.0012	0.0000
1987	0.2260	0.4351	0.1795	0.0792	0.0489	0.0232	0.0057	0.0006	0.0004	0.0001	0.0012	0.0000
1988	0.2283	0.4355	0.1786	0.0785	0.0482	0.0229	0.0056	0.0006	0.0004	0.0001	0.0012	0.0000
1989	0.2372	0.4377	0.1740	0.0754	0.0461	0.0219	0.0054	0.0006	0.0004	0.0001	0.0011	0.0000
1990	0.2316	0.4356	0.1774	0.0777	0.0474	0.0225	0.0055	0.0006	0.0004	0.0001	0.0011	0.0000
1991	0.2101	0.3352	0.2363	0.2021	0.0059	0.0019	0.0074	0.0008	0.0003	0.0000	0.0001	0.0000
1992	0.2132	0.3197	0.2614	0.1803	0.0149	0.0009	0.0090	0.0004	0.0001	0.0000	0.0001	0.0000
1993	0.2039	0.3250	0.2755	0.1687	0.0063	0.0029	0.0153	0.0022	0.0003	0.0000	0.0001	0.0000
1994	0.2203	0.3353	0.2416	0.1762	0.0142	0.0013	0.0096	0.0010	0.0004	0.0000	0.0001	0.0000
1995	0.2073	0.2995	0.2747	0.1837	0.0238	0.0026	0.0071	0.0007	0.0004	0.0000	0.0001	0.0000
1996	0.2146	0.3829	0.1684	0.1077	0.1007	0.0181	0.0052	0.0016	0.0008	0.0000	0.0000	0.0000
1997	0.2153	0.3900	0.1951	0.0952	0.0784	0.0204	0.0044	0.0003	0.0007	0.0001	0.0001	0.0001
1998	0.2143	0.3867	0.2120	0.0974	0.0684	0.0121	0.0080	0.0004	0.0005	0.0001	0.0000	0.0000
1999	0.3248	0.3823	0.1900	0.0669	0.0250	0.0056	0.0046	0.0006	0.0003	0.0001	0.0000	0.0000
2000	0.1280	0.4637	0.1966	0.1041	0.0740	0.0256	0.0046	0.0006	0.0025	0.0001	0.0001	0.0000
2001	0.2411	0.4973	0.1450	0.0659	0.0316	0.0156	0.0026	0.0005	0.0000	0.0003	0.0002	0.0000
2002	0.2059	0.3909	0.2259	0.0700	0.0591	0.0428	0.0036	0.0014	0.0003	0.0001	0.0000	0.0000
2003	0.2336	0.4395	0.1788	0.0782	0.0419	0.0245	0.0027	0.0005	0.0002	0.0000	0.0001	0.0001
2004	0.2200	0.4278	0.1808	0.0974	0.0454	0.0253	0.0029	0.0003	0.0000	0.0000	0.0000	0.0001
2005	0.2157	0.3222	0.1492	0.1381	0.1089	0.0615	0.0024	0.0002	0.0003	0.0001	0.0015	0.0000
2006	0.1735	0.3823	0.1775	0.0698	0.1024	0.0788	0.0091	0.0031	0.0027	0.0006	0.0000	0.0000
2007	0.2197	0.3893	0.1747	0.0890	0.0558	0.0554	0.0120	0.0001	0.0000	0.0001	0.0038	0.0000
2008	0.2671	0.2938	0.1839	0.1447	0.0564	0.0431	0.0099	0.0007	0.0001	0.0000	0.0001	0.0001
2009	0.2284	0.5547	0.1342	0.0112	0.0658	0.0040	0.0011	0.0003	0.0002	0.0000	0.0000	0.0001
2010	0.1841	0.4205	0.1742	0.0831	0.0284	0.0756	0.0224	0.0004	0.0002	0.0000	0.0110	0.0000

Table 10.6.7 Yellowtail snapper weighted annual proportions by age released by commercial fishermen. Values are the annual proportions of total discards of yellowtail snapper (in numbers) at an age to the total of number of yellowtail snapper caught (landed or discarded) at an age by commercial fishermen. For example, in 2010, 75.5% of all age-1 yellowtail snapper caught by commercial fishermen were discarded (alive or dead).

	Proportions at age released by commercial fishermen ($PAA_{commercial\ releases}$)											
Year	1	2	3	4	5	6	7	8	9	10	11	12+
1981	0.8451	0.0741	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1982	0.8389	0.0929	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1983	0.8187	0.0849	0.0002	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1984	0.9028	0.0737	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1985	0.8781	0.4937	0.1655	0.0954	0.0017	0.0006	0.0012	0.0002	0.0001	0.0001	0.0009	0.0001
1986	0.7941	0.3217	0.1385	0.0496	0.0361	0.0223	0.0079	0.0010	0.0012	0.0004	0.0065	0.0001
1987	0.7435	0.2957	0.1072	0.0507	0.0410	0.0271	0.0100	0.0013	0.0015	0.0005	0.0079	0.0001
1988	0.7608	0.2555	0.0794	0.0428	0.0425	0.0334	0.0158	0.0025	0.0036	0.0013	0.0233	0.0006
1989	0.8329	0.2958	0.0845	0.0417	0.0393	0.0296	0.0135	0.0021	0.0029	0.0010	0.0196	0.0005
1990	0.8095	0.2644	0.0769	0.0419	0.0432	0.0353	0.0170	0.0027	0.0038	0.0014	0.0243	0.0006
1991	0.9307	0.1969	0.1310	0.0834	0.0068	0.0029	0.0135	0.0022	0.0015	0.0001	0.0008	0.0000
1992	0.9387	0.1822	0.0915	0.0902	0.0235	0.0028	0.0237	0.0013	0.0007	0.0000	0.0006	0.0000
1993	0.9632	0.1787	0.0788	0.0664	0.0040	0.0021	0.0180	0.0024	0.0009	0.0000	0.0005	0.0000
1994	0.8964	0.2636	0.1413	0.1457	0.0165	0.0025	0.0115	0.0021	0.0022	0.0002	0.0008	0.0000
1995	0.9390	0.4141	0.0967	0.0678	0.0160	0.0026	0.0077	0.0019	0.0016	0.0000	0.0010	0.0000
1996	0.8249	0.3723	0.1331	0.0703	0.0528	0.0208	0.0115	0.0042	0.0031	0.0008	0.0004	0.0000
1997	0.8806	0.3631	0.1036	0.0789	0.0673	0.0214	0.0106	0.0018	0.0043	0.0016	0.0009	0.0014
1998	0.8257	0.3053	0.0816	0.0447	0.0632	0.0202	0.0138	0.0015	0.0023	0.0011	0.0003	0.0000
1999	0.8521	0.2323	0.1320	0.0363	0.0146	0.0063	0.0097	0.0017	0.0016	0.0011	0.0000	0.0000
2000	0.6623	0.3421	0.1360	0.0709	0.0704	0.0332	0.0110	0.0030	0.0141	0.0017	0.0012	0.0000
2001	0.6927	0.2350	0.0571	0.0313	0.0274	0.0172	0.0061	0.0018	0.0000	0.0037	0.0013	0.0004
2002	0.8717	0.2706	0.1132	0.0459	0.0399	0.0517	0.0118	0.0065	0.0022	0.0011	0.0011	0.0005
2003	0.5106	0.2902	0.0569	0.0323	0.0416	0.0281	0.0049	0.0015	0.0007	0.0000	0.0011	0.0004
2004	0.7259	0.1631	0.0309	0.0144	0.0105	0.0119	0.0020	0.0003	0.0000	0.0000	0.0000	0.0004
2005	0.9213	0.1813	0.0343	0.0330	0.0419	0.0555	0.0030	0.0007	0.0006	0.0004	0.0217	0.0004
2006	0.9712	0.5094	0.1427	0.0552	0.1136	0.1341	0.0336	0.0102	0.0175	0.0035	0.0000	0.0003
2007	0.8305	0.3308	0.1066	0.0378	0.0355	0.0416	0.0349	0.0005	0.0000	0.0005	0.0928	0.0001
2008	0.7911	0.2639	0.1068	0.0582	0.0407	0.0486	0.0207	0.0017	0.0008	0.0005	0.0006	0.0007
2009	0.8235	0.1605	0.0316	0.0043	0.0235	0.0023	0.0008	0.0004	0.0005	0.0001	0.0004	0.0001
2010	0.7554	0.1340	0.0413	0.0198	0.0133	0.0464	0.0321	0.0007	0.0006	0.0002	0.0635	0.0001

Table 10.6.8 Yellowtail snapper weighted annual proportions by age released by recreational MRFSS) anglers. Values are the annual proportions of total discards of yellowtail snapper (in numbers) at an age to the total of number of yellowtail snapper caught (landed or discarded) at an age by recreational anglers. For example, in 2010, 97.4% of all age-1 yellowtail snapper caught by recreational anglers were discarded (alive or dead).

Proportions at age released by recreational (MRFSS) anglers ($PAA_{MRFSS\ releases}$)

Year	1	2	3	4	5	6	7	8	9	10	11	12+
1981	0.3622	0.0746	0.0019	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1982	0.5190	0.2888	0.0019	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1983	0.8354	0.3351	0.0025	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1984	0.7817	0.4890	0.0012	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1985	0.4496	0.3339	0.0667	0.0524	0.0030	0.0013	0.0037	0.0009	0.0002	0.0005	0.0022	0.0004
1986	0.8836	0.7497	0.4569	0.1326	0.1500	0.0902	0.0317	0.0035	0.0034	0.0011	0.0153	0.0003
1987	0.9603	0.8447	0.5570	0.3362	0.3136	0.2395	0.1183	0.0187	0.0229	0.0075	0.1088	0.0021
1988	0.9181	0.7881	0.4602	0.2225	0.2527	0.1714	0.0856	0.0127	0.0133	0.0048	0.0658	0.0011
1989	0.9616	0.8514	0.5237	0.3013	0.2574	0.1807	0.0706	0.0093	0.0104	0.0033	0.0462	0.0008
1990	0.9468	0.7649	0.3243	0.1487	0.1401	0.1075	0.0574	0.0101	0.0136	0.0056	0.0898	0.0020
1991	0.9928	0.9416	0.8360	0.7655	0.1419	0.0679	0.1179	0.0282	0.0195	0.0002	0.0065	0.0000
1992	0.9906	0.7915	0.6663	0.6057	0.2410	0.0188	0.3894	0.0112	0.0061	0.0000	0.0057	0.0000
1993	0.9786	0.8135	0.6179	0.6156	0.1143	0.0731	0.5101	0.0761	0.0342	0.0000	0.0210	0.0000
1994	0.9867	0.7957	0.5746	0.5953	0.1554	0.0283	0.2930	0.0202	0.0214	0.0031	0.0090	0.0000
1995	0.9822	0.9322	0.7006	0.5392	0.2272	0.0394	0.3682	0.0230	0.0180	0.0000	0.0102	0.0000
1996	0.9771	0.8509	0.7141	0.5738	0.5288	0.2103	0.1538	0.0481	0.0434	0.0070	0.0063	0.0000
1997	0.9917	0.9164	0.6719	0.6106	0.5725	0.2953	0.1689	0.0307	0.0747	0.0362	0.0173	0.0175
1998	0.9823	0.8187	0.5431	0.4154	0.5180	0.2480	0.2061	0.0245	0.0359	0.0178	0.0047	0.0000
1999	0.9737	0.7816	0.6293	0.3112	0.1612	0.0750	0.1126	0.0205	0.0185	0.0131	0.0000	0.0000
2000	0.9732	0.7363	0.5095	0.4084	0.3904	0.2397	0.1096	0.0440	0.0918	0.0175	0.0095	0.0000
2001	0.9608	0.7638	0.4649	0.3137	0.2872	0.1905	0.0648	0.0278	0.0000	0.0527	0.0154	0.0134
2002	0.9621	0.7078	0.4182	0.2484	0.2280	0.2896	0.0833	0.0414	0.0144	0.0086	0.0029	0.0020
2003	0.8909	0.7704	0.3804	0.2522	0.3121	0.2219	0.0442	0.0155	0.0070	0.0000	0.0114	0.0036
2004	0.9264	0.6715	0.3632	0.2198	0.1805	0.1954	0.0412	0.0071	0.0000	0.0000	0.0000	0.0059
2005	0.8419	0.5362	0.2040	0.3658	0.4764	0.5158	0.0648	0.0170	0.0177	0.0106	0.3983	0.0081
2006	0.9624	0.5511	0.4006	0.2863	0.5109	0.5768	0.3068	0.1142	0.1463	0.0372	0.0000	0.0052
2007	0.9297	0.5349	0.2935	0.2930	0.3233	0.3835	0.3289	0.0082	0.0000	0.0067	0.5087	0.0063
2008	0.9111	0.5835	0.4550	0.3686	0.3401	0.4000	0.2292	0.0221	0.0113	0.0068	0.0080	0.0087
2009	0.9781	0.6935	0.2495	0.0710	0.3815	0.0719	0.0362	0.0257	0.0280	0.0056	0.0206	0.0099
2010	0.9743	0.5747	0.2827	0.2581	0.2123	0.5175	0.4252	0.0182	0.0185	0.0088	0.6683	0.0062

Table 10.6.9 Yellowtail snapper weighted annual proportions by age released by head boat anglers. Values are the annual proportions of total discards of yellowtail snapper (in numbers) at an age to the total of number of yellowtail snapper caught (landed or discarded) at an age by head boat anglers. For example, in 2010, 91.9% of all age-1 yellowtail snapper caught by head boat anglers were discarded (alive or dead).

Proportions at age released by head boat anglers ($PAA_{head\ boat\ releases}$)

Year	1	2	3	4	5	6	7	8	9	10	11	12+
1981	0.8576	0.0873	0.0007	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1982	0.8709	0.2555	0.0003	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1983	0.8765	0.2503	0.0003	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1984	0.9057	0.1832	0.0003	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1985	0.9283	0.5371	0.1625	0.0930	0.0096	0.0048	0.0146	0.0035	0.0015	0.0018	0.0117	0.0031
1986	0.9516	0.5776	0.2674	0.1355	0.1322	0.0976	0.0465	0.0078	0.0107	0.0037	0.0602	0.0015
1987	0.8766	0.5228	0.2559	0.1470	0.1403	0.1063	0.0517	0.0088	0.0119	0.0043	0.0675	0.0017
1988	0.9392	0.5587	0.2305	0.1325	0.1348	0.1052	0.0526	0.0090	0.0123	0.0046	0.0706	0.0019
1989	0.9318	0.5888	0.2270	0.1160	0.1219	0.0908	0.0454	0.0076	0.0105	0.0037	0.0609	0.0016
1990	0.9676	0.6754	0.2350	0.1185	0.1211	0.0927	0.0418	0.0066	0.0087	0.0029	0.0447	0.0010
1991	0.9608	0.4652	0.2897	0.2668	0.0254	0.0108	0.0529	0.0071	0.0047	0.0002	0.0025	0.0000
1992	0.9550	0.4002	0.2474	0.2685	0.0890	0.0080	0.0784	0.0056	0.0031	0.0000	0.0028	0.0000
1993	0.9822	0.5263	0.3038	0.2767	0.0259	0.0137	0.0989	0.0146	0.0057	0.0000	0.0034	0.0000
1994	0.9957	0.4251	0.2311	0.2809	0.0529	0.0089	0.0903	0.0069	0.0079	0.0010	0.0041	0.0000
1995	0.9350	0.6922	0.2798	0.2183	0.0755	0.0110	0.0635	0.0089	0.0063	0.0000	0.0042	0.0000
1996	0.8713	0.6546	0.3171	0.1940	0.1615	0.0626	0.0377	0.0136	0.0107	0.0036	0.0022	0.0000
1997	0.9454	0.6544	0.2302	0.1782	0.1704	0.0626	0.0344	0.0058	0.0134	0.0063	0.0044	0.0069
1998	0.9472	0.6172	0.2376	0.1510	0.2150	0.0797	0.0601	0.0072	0.0131	0.0057	0.0022	0.0000
1999	0.9101	0.4560	0.2944	0.1229	0.0623	0.0291	0.0434	0.0101	0.0100	0.0071	0.0000	0.0000
2000	0.8316	0.5432	0.2872	0.1817	0.2056	0.1072	0.0393	0.0119	0.0578	0.0077	0.0083	0.0000
2001	0.9122	0.5658	0.2046	0.1235	0.1123	0.0763	0.0302	0.0095	0.0000	0.0167	0.0092	0.0006
2002	0.9906	0.5594	0.2996	0.1384	0.1313	0.1734	0.0553	0.0348	0.0098	0.0067	0.0063	0.0038
2003	0.8525	0.6394	0.1959	0.1242	0.1724	0.1368	0.0308	0.0092	0.0068	0.0000	0.0077	0.0051
2004	0.9610	0.6423	0.2182	0.1393	0.1300	0.1417	0.0357	0.0080	0.0000	0.0000	0.0000	0.0077
2005	0.9595	0.5016	0.1736	0.2019	0.2670	0.3375	0.0449	0.0084	0.0090	0.0053	0.1953	0.0071
2006	0.9846	0.7096	0.2484	0.1223	0.2285	0.2942	0.1170	0.0374	0.0564	0.0137	0.0000	0.0021
2007	0.9207	0.5581	0.2384	0.1236	0.1394	0.1571	0.2415	0.0067	0.0000	0.0073	0.8487	0.0013
2008	0.8074	0.3604	0.2251	0.1841	0.1724	0.2148	0.1112	0.0115	0.0080	0.0057	0.0072	0.0061
2009	0.9462	0.4601	0.1568	0.0326	0.1939	0.0264	0.0122	0.0091	0.0099	0.0026	0.0072	0.0039
2010	0.9192	0.3549	0.1623	0.1437	0.1197	0.3720	0.2870	0.0119	0.0109	0.0090	0.5870	0.0042

Table 10.6.10 Direct ageing (DA) configuration for yellowtail snapper weighted annual proportions at age in the catch for commercial vessels fishing with vertical lines (Atlantic and Gulf regions combined). Values are the proportions of catch (landed + discarded) of yellowtail snapper (in numbers) of age to the total of number of yellowtail snapper caught (landed or discarded) by the commercial fleet each year. For example, in 2010, 1.0% of yellowtail snapper caught by commercial vessels using vertical line gear were estimated (using age-length keys) to be age 1.

Proportions at age caught by commercial fishermen, $PAA_{commercial\ catches\ [DA]}$

Year	1	2	3	4	5	6	7	8	9	10	11	12+
1981	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999
1982	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999
1983	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999
1984	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999
1985	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999
1986	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999
1987	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999
1988	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999
1989	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999
1990	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999
1991	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999
1992	0.0238	0.1572	0.3964	0.2665	0.0074	0.0266	0.0747	0.0000	0.0237	0.0000	0.0237	0.0000
1993	0.0152	0.1248	0.2025	0.0911	0.1334	0.1331	0.0682	0.1481	0.0172	0.0171	0.0164	0.0329
1994	0.0468	0.0812	0.1542	0.1430	0.0855	0.0813	0.1023	0.1124	0.0204	0.0409	0.0406	0.0913
1995	0.0301	0.0545	0.2085	0.3001	0.1570	0.0838	0.0595	0.0471	0.0594	0.0000	0.0000	0.0000
1996	0.0314	0.1171	0.1120	0.1506	0.2270	0.1495	0.0374	0.0737	0.0460	0.0184	0.0184	0.0184
1997	0.0322	0.1174	0.2186	0.1402	0.1617	0.1409	0.0789	0.0320	0.0296	0.0128	0.0231	0.0125
1998	0.0274	0.1176	0.2408	0.2156	0.1202	0.0825	0.0898	0.0464	0.0212	0.0131	0.0209	0.0044
1999	0.0390	0.1320	0.1248	0.1974	0.1979	0.1094	0.0684	0.0678	0.0271	0.0226	0.0000	0.0136
2000	0.0357	0.1886	0.1676	0.2286	0.1665	0.1018	0.0395	0.0165	0.0167	0.0119	0.0151	0.0113
2001	0.0391	0.1952	0.1615	0.2050	0.1135	0.1135	0.0642	0.0310	0.0232	0.0134	0.0176	0.0228
2002	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999
2003	0.0222	0.0519	0.2438	0.2002	0.1280	0.1459	0.0784	0.0391	0.0342	0.0098	0.0098	0.0367
2004	0.0086	0.0757	0.2032	0.2536	0.1923	0.0975	0.0726	0.0420	0.0120	0.0065	0.0120	0.0240
2005	0.0137	0.1119	0.2955	0.2519	0.1517	0.0645	0.0458	0.0189	0.0140	0.0098	0.0080	0.0144
2006	0.0324	0.1307	0.1909	0.1961	0.1379	0.1023	0.0567	0.0605	0.0340	0.0313	0.0024	0.0248
2007	0.0278	0.1137	0.1656	0.2424	0.1713	0.1186	0.0661	0.0415	0.0000	0.0223	0.0132	0.0176
2008	0.0302	0.1007	0.1761	0.2543	0.1440	0.0848	0.0607	0.0504	0.0318	0.0159	0.0203	0.0308
2009	0.0140	0.1466	0.1899	0.1450	0.1626	0.1094	0.0928	0.0546	0.0229	0.0190	0.0064	0.0369
2010	0.0100	0.1315	0.2243	0.2818	0.1300	0.0997	0.0432	0.0259	0.0175	0.0080	0.0082	0.0198

Table 10.6.11 Direct ageing (DA) configuration for yellowtail snapper weighted annual proportions at age in the catch for recreational [MRFSS] anglers (Atlantic and Gulf regions combined). Values are the proportions of the catch (landed + discarded) of yellowtail snapper (in numbers) by age to the total of number of yellowtail snapper caught (landed or discarded) by recreational anglers each year. For example, in 2010, 12.2% of yellowtail snapper caught by recreational anglers were estimated (using age-length keys) to be age 1.

Proportions at age caught by recreational anglers, $PAA_{\text{recreational (MRFSS) catches [DA]}}$

Year	1	2	3	4	5	6	7	8	9	10	11	12+
1981	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999
1982	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999
1983	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999
1984	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999
1985	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999
1986	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999
1987	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999
1988	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999
1989	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999
1990	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999
1991	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999
1992	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999
1993	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999
1994	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999
1995	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999
1996	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999
1997	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999
1998	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999
1999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999
2000	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999
2001	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999
2002	0.1475	0.3043	0.2687	0.0882	0.0975	0.0442	0.0144	0.0087	0.0149	0.0083	0.0000	0.0033
2003	0.1900	0.3970	0.1881	0.1050	0.0509	0.0243	0.0107	0.0098	0.0049	0.0000	0.0049	0.0145
2004	0.1039	0.4869	0.1410	0.1213	0.0379	0.0192	0.0123	0.0222	0.0221	0.0000	0.0111	0.0221
2005	0.1982	0.4059	0.1794	0.0773	0.0422	0.0346	0.0095	0.0081	0.0282	0.0081	0.0003	0.0081
2006	0.1709	0.4998	0.1192	0.0685	0.0636	0.0404	0.0052	0.0136	0.0033	0.0129	0.0000	0.0026
2007	0.2442	0.2273	0.2751	0.0757	0.0792	0.0709	0.0093	0.0087	0.0000	0.0058	0.0040	0.0000
2008	0.3135	0.1768	0.1186	0.2216	0.0743	0.0537	0.0179	0.0183	0.0026	0.0013	0.0000	0.0013
2009	0.2141	0.4345	0.1783	0.0610	0.0612	0.0174	0.0111	0.0087	0.0041	0.0018	0.0018	0.0059
2010	0.1218	0.3584	0.2269	0.1105	0.0544	0.0608	0.0271	0.0145	0.0089	0.0029	0.0089	0.0049

Table 10.6.12 Direct ageing (DA) configuration for yellowtail snapper weighted annual proportions at age in the catch for head boat anglers (Atlantic and Gulf regions combined). Values are the proportions of catch (landed + discarded) of yellowtail snapper (in numbers) of age to the total of number of yellowtail snapper caught (landed or discarded) by head boat anglers each year. For example, in 2010, 5.1% of yellowtail snapper caught by head boat anglers were estimated (using age-length keys) to be age 1.

Proportions at age caught by head boat anglers, $PAA_{\text{head boat catches [DA]}}$

Year	1	2	3	4	5	6	7	8	9	10	11	12+
1981	0.0887	0.4020	0.2213	0.1246	0.0656	0.0550	0.0183	0.0051	0.0103	0.0051	0.0013	0.0026
1982	0.0859	0.1756	0.3961	0.1292	0.0651	0.0261	0.0718	0.0402	0.0000	0.0101	0.0000	0.0000
1983	0.0917	0.1424	0.0952	0.6091	0.0155	0.0016	0.0150	0.0005	0.0000	0.0145	0.0142	0.0003
1984	0.0864	0.1283	0.0623	0.2452	0.0136	0.2325	0.0017	0.0000	0.0000	0.0000	0.0000	0.2299
1985	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999
1986	0.0744	0.7095	0.1378	0.0414	0.0212	0.0086	0.0049	0.0017	0.0001	0.0000	0.0004	0.0000
1987	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999
1988	0.0680	0.7300	0.1406	0.0379	0.0144	0.0068	0.0017	0.0002	0.0001	0.0000	0.0003	0.0000
1989	0.0677	0.1673	0.1556	0.0215	0.5370	0.0274	0.0227	0.0002	0.0001	0.0000	0.0003	0.0000
1990	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999
1991	0.0606	0.2594	0.1939	0.3151	0.0941	0.0006	0.0021	0.0002	0.0185	0.0000	0.0370	0.0185
1992	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999
1993	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999
1994	0.0613	0.3545	0.2882	0.1954	0.0628	0.0161	0.0027	0.0003	0.0188	0.0000	0.0000	0.0000
1995	0.0625	0.1613	0.4058	0.2138	0.1100	0.0155	0.0301	0.0009	0.0001	0.0000	0.0000	0.0000
1996	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999
1997	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999
1998	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999
1999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999
2000	0.0396	0.2606	0.1510	0.1740	0.0912	0.0762	0.1381	0.0002	0.0691	0.0000	0.0000	0.0000
2001	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999
2002	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999
2003	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999	-999
2004	0.0705	0.2708	0.5470	0.0874	0.0148	0.0080	0.0013	0.0001	0.0001	0.0000	0.0000	0.0000
2005	0.0682	0.2831	0.3155	0.1237	0.0738	0.0959	0.0009	0.0000	0.0384	0.0000	0.0005	0.0000
2006	0.0566	0.1353	0.2131	0.0237	0.1854	0.1269	0.0537	0.0010	0.0009	0.0510	0.0000	0.1524
2007	0.0705	0.3132	0.1142	0.0317	0.3050	0.1605	0.0036	0.0002	0.0000	0.0000	0.0011	0.0000
2008	0.0851	0.2139	0.2487	0.2293	0.1096	0.0610	0.0256	0.0119	0.0038	0.0000	0.0075	0.0038
2009	0.0703	0.3582	0.2685	0.0953	0.0827	0.0483	0.0321	0.0149	0.0128	0.0000	0.0042	0.0127
2010	0.0507	0.3082	0.3143	0.1528	0.0688	0.0580	0.0171	0.0128	0.0048	0.0016	0.0061	0.0048

Table 10.6.13 Total annual metric tons of yellowtail snapper harvested by fleets [commercial, recreational (MRFSS), and head boat (HB)] estimated using numbers of landed fish and total discards with specified release mortality rate, length samples from the fleets, average weight-at-length, and age-length keys for age compositions.

	Landings				Dead discards			
Year	Commercial	MRFSS	HB	total	Commercial Release M=0.115	MRFSS Release M=0.10	HB Release M=0.10	total
1981	331.8	729.8	107.1	1,168.7	0.3	2.4	0.2	3.0
1982	621.7	911.3	135.5	1,668.5	0.6	4.1	0.4	5.2
1983	436.2	319.0	127.2	882.4	0.4	2.8	0.5	3.7
1984	429.6	797.3	94.4	1,321.4	0.4	12.0	0.3	12.8
1985	374.3	525.4	83.0	982.7	1.0	2.8	1.3	5.1
1986	507.4	310.4	123.3	941.2	1.8	5.7	2.0	9.5
1987	617.9	306.7	129.7	1,054.3	2.4	15.0	2.3	19.7
1988	640.1	396.8	159.8	1,196.7	3.7	8.6	2.8	15.1
1989	838.3	584.8	98.7	1,521.9	4.5	14.6	1.5	20.5
1990	796.2	494.7	136.5	1,427.4	4.7	11.7	2.1	18.5
1991	843.8	870.6	126.5	1,840.9	4.7	63.8	2.0	70.5
1992	806.2	387.8	116.9	1,310.9	4.3	22.8	1.9	29.0
1993	1,079.0	362.7	126.3	1,568.0	3.8	28.2	2.1	34.0
1994	1,000.3	283.3	128.2	1,411.7	6.6	15.6	2.1	24.4
1995	842.2	251.5	84.8	1,178.5	4.2	18.6	1.5	24.3
1996	661.7	171.7	70.2	903.5	4.4	15.4	1.3	21.2
1997	759.1	209.1	74.0	1,042.2	5.1	22.1	1.3	28.6
1998	691.5	186.0	59.4	936.9	3.9	13.5	1.2	18.6
1999	837.4	145.4	52.9	1,035.7	4.4	10.6	1.0	16.0
2000	722.2	142.8	51.5	916.5	4.8	8.8	1.1	14.7
2001	644.6	102.6	50.4	797.6	3.3	7.3	1.1	11.6
2002	639.9	144.0	60.7	844.6	3.8	6.8	1.3	11.9
2003	640.8	198.8	54.4	893.9	2.7	9.6	1.1	13.5
2004	674.1	254.9	54.7	983.7	1.2	10.6	1.2	13.0
2005	601.1	215.3	73.0	889.4	1.6	9.3	1.5	12.4
2006	561.1	233.1	47.3	841.5	4.5	14.0	1.1	19.6
2007	443.9	331.7	51.0	826.5	2.2	16.4	1.0	19.6
2008	621.8	294.8	50.4	967.0	2.7	15.4	0.9	19.1
2009	896.4	131.8	41.3	1,069.6	2.1	8.2	0.8	11.1
2010	768.8	158.3	48.0	975.2	1.4	6.2	0.9	8.5

Table 10.6.14 ASAP2 model fits to landings, discards, and indices of abundance. The column labeled 'SS' is the sum of the squared standardized residuals, n is the number of years, 'MSE' is the sum of squares divided by n-1 which is equivalent to a variance, and observations, and 'RMSE' is the square root of MSE which is equivalent to the standard deviation.

Type	Fleet or Index	SS	n	MSE	RMSE
Landings	Commercial	7.85	30	0.27	0.52
	MRFSS	28.57	30	0.99	0.99
	Head Boat	9.43	30	0.33	0.57
Discards	Commercial	40.50	30	1.40	1.18
	MRFSS	28.02	30	0.97	0.98
	Head Boat	33.84	30	1.17	1.08
Indices	NMFS-UM RVC	51.93	13	4.33	2.08
	Head Boat	176.46	30	6.08	2.47
	MRFSS	34.27	30	1.18	1.09
	Commercial Log Books	22.03	18	1.30	1.14

Table 10.6.15 Selectivity coefficients and their standard deviations by fleet, period, and logistic curve type. The fleets were modeled with single logistic curves.

Fleet	Period	Type of logistic	model estimated α50	α sd	model estimated β	β sd	Initial α50	Initial α50 cv	initial β (slope)	Initial β (slope) cv
Commercial	1981-1984	Single	1.9095	0.1467	0.3303	0.0750	1.8841	0.25	0.3089	0.25
	1985-1991		2.6775	0.1631	0.3128	0.0764	1.8683	0.25	0.3038	0.25
	1992-2010		2.1867	0.0703	0.3720	0.0311	2.0071	0.25	0.2697	0.25
MRFSS	1981-1984	Single	0.8951	0.1176	0.0474	0.0116	0.955	0.25	0.0478	0.25
	1985-1991		1.2285	0.1368	0.0507	0.0122	1.0204	0.25	0.0525	0.25
	1992-2010		0.8126	0.0948	0.0488	0.0116	0.9949	0.25	0.0511	0.25
HB	1981-1984	Single	1.0422	0.0172	0.0409	0.0101	1.0333	0.25	0.0409	0.25
	1985-1991		1.1037	0.0410	0.0408	0.0100	1.0454	0.25	0.0410	0.25
	1992-2010		1.0447	0.0148	0.0410	0.0101	1.0499	0.25	0.0410	0.25

Table 10.6.16 Selectivity coefficients and their standard deviations (sd) for the NMFS-UM RVC index of abundance. [The fishery dependent indices were linked to their fleets, using the same selectivity blocks as for fleet catches.]

Index	Ages	model estimated selectivity proportion	sd	initial estimated proportion	cv
NMFS-UM RVC	Age 1	1	fixed	1	fixed
	Age 2	0.5478	0.0800	0.5883	0.25
	Age 3	0.3313	0.0587	0.3196	0.25
	Age 4	0.2249	0.0458	0.1653	0.25
	Age 5	0.1155	0.0263	0.0833	0.25
	Age 6	0.0413	0.0102	0.0413	0.25
	Age 7	0.0204	0.0050	0.0204	0.25
	Age 8	0.0100	0.0025	0.0100	0.25
	Age 9	0.0049	0.0012	0.0049	0.25
	Age 10	0.0024	0.0006	0.0024	0.25
	Age 11	0.0012	0.0003	0.0012	0.25
	Age 12	0.0006	0.0001	0.0006	0.25

Table 10.6.17 Fishing mortality parameters and their standard deviations by fleet and year. The fishing multiplier deviations are applied to the previous year's fishing multiplier in a sequential manner. The standard deviations of the log_Fmult_devs come from the variance-covariance matrix.

		Commercial		MRFSS		Head Boat	
Year	Parameter	Estimate	sd	Estimate	sd	Estimate	sd
1981	log_Fmult	1.9095	0.1274	-2.4928	0.1462	-4.8378	0.1182
1982	log_Fmult_devs	0.5138	0.1223	-0.3356	0.1662	0.1205	0.1217
1983	log_Fmult_devs	-0.2281	0.1225	-0.7519	0.1644	0.0656	0.1214
1984	log_Fmult_devs	-0.0232	0.1210	0.8589	0.2005	-0.2539	0.1214
1985	log_Fmult_devs	-0.2426	0.1304	-0.6124	0.2351	-0.1354	0.1233
1986	log_Fmult_devs	0.4266	0.1215	-0.4114	0.2215	0.4044	0.1213
1987	log_Fmult_devs	0.2642	0.1213	0.2945	0.1796	0.1042	0.1211
1988	log_Fmult_devs	0.1372	0.1212	0.0108	0.1731	0.1663	0.1212
1989	log_Fmult_devs	0.1580	0.1209	0.2586	0.1867	-0.5231	0.1210
1990	log_Fmult_devs	0.0086	0.1209	-0.0813	0.1777	0.2912	0.1209
1991	log_Fmult_devs	-0.0199	0.1211	0.8465	0.1442	-0.0915	0.1210
1992	log_Fmult_devs	-0.2722	0.1297	-1.0563	0.1085	-0.1784	0.1210
1993	log_Fmult_devs	0.3165	0.1217	0.1553	0.0858	0.1557	0.1205
1994	log_Fmult_devs	-0.0491	0.1220	-0.3965	0.0882	-0.0472	0.1209
1995	log_Fmult_devs	-0.0670	0.1229	0.1561	0.0990	-0.2333	0.1206
1996	log_Fmult_devs	-0.1581	0.1224	-0.2448	0.1015	-0.1392	0.1206
1997	log_Fmult_devs	0.1049	0.1223	0.2976	0.0989	0.0019	0.1206
1998	log_Fmult_devs	-0.1231	0.1221	-0.3531	0.1021	-0.2267	0.1205
1999	log_Fmult_devs	0.1242	0.1223	-0.3111	0.1024	-0.1767	0.1207
2000	log_Fmult_devs	-0.1420	0.1219	-0.1190	0.1232	-0.0012	0.1205
2001	log_Fmult_devs	-0.0995	0.1219	-0.2973	0.1519	-0.0400	0.1206
2002	log_Fmult_devs	-0.0760	0.1211	0.1076	0.1435	0.1340	0.1204
2003	log_Fmult_devs	-0.1251	0.1209	0.2139	0.1109	-0.2016	0.1203
2004	log_Fmult_devs	-0.0490	0.1207	0.2179	0.1044	0.0170	0.1204
2005	log_Fmult_devs	-0.1380	0.1205	-0.1698	0.1034	0.2109	0.1204
2006	log_Fmult_devs	0.0495	0.1211	0.2620	0.0927	-0.3339	0.1202
2007	log_Fmult_devs	-0.3640	0.1210	0.1498	0.0884	-0.0825	0.1203
2008	log_Fmult_devs	0.4131	0.1211	-0.0758	0.0882	0.0563	0.1204
2009	log_Fmult_devs	0.2481	0.1215	-0.8035	0.0942	-0.2710	0.1203
2010	log_Fmult_devs	-0.2768	0.1215	-0.0111	0.1045	0.0631	0.1214

Table 10.6.18 Initial stock size parameters and their standard deviations to estimate the age-structure in 1981 for ages 2-12+ years. These deviations are applied to the age-specific initial guesses of population size.

		Initial stock size parameters	
Age	Description	Estimate	sd
2	log_N_year1_devs	-5.5002	0.1001
3	log_N_year1_devs	-5.7159	0.1104
4	log_N_year1_devs	-5.7844	0.1152
5	log_N_year1_devs	-5.5388	0.1219
6	log_N_year1_devs	-5.4324	0.1291
7	log_N_year1_devs	-5.4283	0.1387
8	log_N_year1_devs	-5.4968	0.1478
9	log_N_year1_devs	-4.7020	0.1564
10	log_N_year1_devs	-4.8297	0.1664
11	log_N_year1_devs	-4.8965	0.1773
12+	log_N_year1_devs	-3.8660	0.2119

Table 10.6.19 Recruitment deviation parameters and their standard deviations by year.

		Recruitment parameters	
Year	Description	Estimate	sd
1981	log_recruit_devs	-0.2132	0.0787
1982	log_recruit_devs	-0.7801	0.1596
1983	log_recruit_devs	-0.3504	0.1524
1984	log_recruit_devs	-0.2601	0.1400
1985	log_recruit_devs	-0.0256	0.1326
1986	log_recruit_devs	0.1506	0.1231
1987	log_recruit_devs	0.1892	0.1217
1988	log_recruit_devs	0.2415	0.1172
1989	log_recruit_devs	0.3516	0.1064
1990	log_recruit_devs	0.3723	0.1019
1991	log_recruit_devs	0.0579	0.1208
1992	log_recruit_devs	0.0858	0.1115
1993	log_recruit_devs	0.3469	0.0931
1994	log_recruit_devs	-0.4528	0.1489
1995	log_recruit_devs	-0.1833	0.1268
1996	log_recruit_devs	0.0444	0.1098
1997	log_recruit_devs	-0.2429	0.1291
1998	log_recruit_devs	-0.0553	0.1131
1999	log_recruit_devs	-0.0675	0.1111
2000	log_recruit_devs	-0.1402	0.1058
2001	log_recruit_devs	0.0334	0.0959
2002	log_recruit_devs	0.2714	0.0847
2003	log_recruit_devs	0.2219	0.0849
2004	log_recruit_devs	0.1174	0.0864
2005	log_recruit_devs	0.0006	0.0826
2006	log_recruit_devs	-0.1213	0.0918
2007	log_recruit_devs	0.1172	0.0831
2008	log_recruit_devs	0.2406	0.0795
2009	log_recruit_devs	0.2796	0.0886
2010	log_recruit_devs	-0.2295	0.1949

Table 10.6.20 Index catchability parameters and their standard deviations.

Index	Description	Catchability parameters Estimate	sd
NMFS-UM RVC	log_q_year1	-9.9662	0.0826
HB	log_q_year2	-10.1550	0.0596
MRFSS	log_q_year3	-10.1690	0.0636
Comm Log Books	log_q_year4	-9.4735	0.0853

Table 10.6.21 The order of estimation of the parameters in the model configuration by phase.

Phase	Parameter	Description
1	q_{ind}	Catchabilities in year 1 by index
2	$Fmult_{f,1}$	Fishing multiplier in year 1 by fleet
3	SSB_0	Unexploited stock size
4	$N_{1,a}$	Numbers-at-age in year 1
6	$Sel_{f,a}$	Selectivity blocks by fleet
	Sel_{ind}	Selectivity of fishery-independent indices
7	Log_Rdev_t	Recruitment deviations
7	$Log\_Fmultdev_{f,t}$	Fishing multiplier deviations by fleet and year
8	h	Steepness

Table 10.6.22 Annual population numbers-at-age (a) and stock (b) at the beginning of the year.

a. Population abundance (in thousands of fish).

	Age (years)												
Year	1	2	3	4	5	6	7	8	9	10	11	12+	Total
1981	9,924	9,112	5,994	3,967	2,693	1,880	1,348	963	688	506	376	1,049	38,500
1982	5,651	6,699	6,129	4,082	2,759	1,903	1,346	975	702	505	373	1,059	32,182
1983	8,640	3,897	4,619	4,197	2,853	1,959	1,369	978	714	518	374	1,068	31,186
1984	9,370	6,093	2,764	3,290	3,052	2,108	1,466	1,035	745	547	399	1,120	31,989
1985	11,764	6,535	4,253	1,901	2,310	2,177	1,523	1,071	762	552	407	1,139	34,394
1986	14,030	8,354	4,708	3,076	1,394	1,713	1,636	1,156	819	586	427	1,205	39,103
1987	14,756	9,964	6,106	3,432	2,246	1,034	1,284	1,236	879	627	451	1,265	43,280
1988	15,790	10,479	7,269	4,398	2,472	1,641	762	952	920	659	472	1,303	47,116
1989	17,882	11,213	7,620	5,178	3,126	1,785	1,197	559	702	682	491	1,334	51,767
1990	18,488	12,699	8,169	5,394	3,642	2,228	1,284	865	406	513	501	1,351	55,539
1991	13,672	13,129	9,225	5,737	3,773	2,585	1,599	928	628	297	376	1,371	53,320
1992	14,182	9,709	9,505	6,542	4,058	2,559	1,765	1,108	643	437	207	1,232	51,949
1993	18,501	10,035	6,986	6,823	4,770	2,962	1,878	1,324	828	483	330	1,095	56,015
1994	8,344	13,078	7,169	4,907	4,861	3,375	2,120	1,379	965	606	355	1,056	48,215
1995	10,967	5,906	9,394	5,089	3,544	3,497	2,450	1,565	1,019	717	452	1,062	45,663
1996	13,730	7,760	4,284	6,696	3,665	2,561	2,545	1,817	1,159	759	537	1,142	46,655
1997	10,262	9,718	5,634	3,094	4,888	2,712	1,904	1,907	1,369	879	578	1,287	44,233
1998	12,372	7,261	7,043	4,026	2,240	3,589	1,996	1,409	1,417	1,025	660	1,411	44,448
1999	12,197	8,761	5,267	5,068	2,933	1,663	2,678	1,502	1,065	1,077	783	1,594	44,588
2000	11,330	8,641	6,337	3,794	3,674	2,152	1,234	2,009	1,134	808	822	1,827	43,764
2001	13,485	8,026	6,280	4,593	2,785	2,739	1,619	935	1,532	871	623	2,057	45,546
2002	17,130	9,557	5,840	4,563	3,387	2,085	2,075	1,236	719	1,185	678	2,101	50,556
2003	16,368	12,144	6,957	4,260	3,372	2,541	1,587	1,588	953	558	923	2,182	53,432
2004	14,871	11,582	8,860	5,078	3,158	2,542	1,938	1,218	1,228	742	436	2,447	54,099
2005	13,344	10,526	8,419	6,456	3,757	2,372	1,935	1,485	940	954	579	2,269	53,037
2006	11,875	9,442	7,653	6,155	4,821	2,856	1,829	1,494	1,155	736	750	2,260	51,024
2007	15,116	8,412	6,882	5,610	4,576	3,663	2,202	1,413	1,158	901	576	2,373	52,881
2008	17,125	10,695	6,123	5,064	4,203	3,485	2,830	1,717	1,102	908	711	2,350	56,314
2009	17,849	12,112	7,761	4,477	3,761	3,168	2,665	2,176	1,325	855	708	2,406	59,263
2010	10,772	12,657	8,810	5,642	3,303	2,829	2,405	2,042	1,681	1,030	667	2,452	54,291

b. Stock biomass (in metric tons).

	Age (years)												
Year	1	2	3	4	5	6	7	8	9	10	11	12+	Total
1981	1,373	2,657	2,614	2,162	1,956	1,674	1,298	1,093	962	783	400	1,607	18,579
1982	766	1,782	3,215	2,247	2,218	1,911	1,461	864	975	736	499	1,633	18,308
1983	1,135	1,166	2,249	2,051	2,252	1,712	1,363	1,049	919	766	363	1,676	16,702
1984	1,153	1,404	1,268	1,626	2,431	1,953	1,486	1,144	1,039	773	488	1,714	16,480
1985	1,853	2,126	2,412	1,257	2,085	2,253	1,716	1,389	1,178	935	536	1,966	19,705
1986	2,373	2,390	2,220	1,987	1,039	1,417	1,692	1,389	1,062	788	606	1,954	18,917
1987	2,314	2,608	2,391	1,796	1,409	745	1,184	1,400	1,079	833	623	2,168	18,550
1988	2,348	2,914	2,999	2,351	1,451	1,096	615	892	959	740	533	1,919	18,817
1989	2,629	2,985	3,101	2,674	1,890	1,230	1,033	570	791	822	610	2,019	20,351
1990	2,888	3,397	3,300	2,708	2,040	1,385	930	712	359	510	485	1,695	20,411
1991	1,725	3,091	2,966	2,242	2,515	1,702	1,466	920	605	407	472	2,048	20,158
1992	2,151	2,784	3,709	2,936	2,566	1,895	1,459	1,233	689	611	250	1,827	22,109
1993	2,559	2,718	2,593	3,198	2,820	1,719	1,152	917	666	654	320	1,490	20,806
1994	1,147	3,772	2,898	2,202	2,692	2,085	1,690	1,010	643	771	358	1,724	20,993
1995	1,583	1,375	3,375	2,221	1,676	1,952	1,572	1,138	747	929	426	1,295	18,289
1996	2,123	1,931	1,605	2,830	1,589	1,463	1,511	1,088	762	774	565	1,775	18,016
1997	1,455	2,304	2,095	1,282	2,304	1,550	1,301	1,414	1,045	800	580	1,917	18,049
1998	1,931	1,942	2,632	1,834	1,110	2,252	1,301	1,024	949	798	743	2,506	19,022
1999	1,959	2,633	1,976	2,659	1,642	1,004	1,673	1,125	837	1,031	1,116	2,555	20,208
2000	2,060	2,565	2,733	1,786	2,056	1,299	774	1,467	978	703	742	2,634	19,797
2001	2,537	2,422	2,632	2,341	1,519	1,668	1,177	600	1,774	531	550	2,872	20,623
2002	2,782	2,754	2,417	2,309	1,846	1,269	1,608	1,056	592	1,100	827	2,776	21,336
2003	3,259	3,405	2,973	2,091	1,867	1,641	1,264	1,251	975	669	1,001	3,360	23,756
2004	2,409	3,402	3,648	2,595	1,827	1,519	1,413	960	1,522	919	487	2,601	23,302
2005	2,387	3,289	3,978	3,448	2,152	1,412	1,682	1,213	836	763	504	2,381	24,046
2006	1,830	2,778	3,243	3,169	2,329	1,471	1,341	1,205	843	644	1,221	2,355	22,427
2007	2,878	2,562	3,047	2,723	2,652	2,086	1,906	1,412	2,169	1,027	654	2,852	25,968
2008	3,144	3,252	2,584	2,419	2,389	2,002	1,918	1,347	1,053	913	729	2,242	23,994
2009	2,977	3,814	3,586	2,466	2,201	2,102	2,041	1,969	1,227	911	653	2,824	26,771
2010	1,618	3,988	4,129	3,198	2,087	1,872	1,716	1,694	1,514	1,176	579	3,027	26,599

Table 10.6.23 Sensitivity runs and comparison of several key parameters with the "base" run.

Description	commercial	MRFSS	HB	steepness	SSB2010 (metric tons)	SSB_30%SPR (metric tons)	SSB 2010 / SSB30%spr	F2010 (per year)	F2010 / F30%SPR
"base run"	11.5	10	10	0.697	10311	3072	3.357	0.0454	0.154
Release mortality at 20%	20	20	20	0.696	10390	3107	3.345	0.0453	0.156
Release mortality at 30%	30	30	30	0.684	10471	3142	3.332	0.0453	0.158

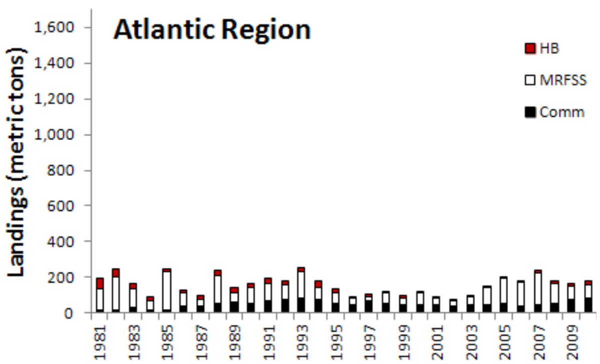
Table 10.6.24 Comparison of some of the management benchmarks calculated by SEDAR 3 and this assessment.

		SEDAR 3		This assessment
notes	reference pt.	ICA	Fleet-specific	ASAP2
	$SSB_{F30\%SPR}$ (mt)	3,684	5,360	3,072
	SSB_{MSST} (mt)	2,947	4,288	2,488
F_{MSY} proxy	$F_{30\%SPR}$	0.33	0.21	0.29
F_{OY} proxy	$F_{40\%SPR}$	0.21	0.21	0.19
	MSY (mt)	946	1,388	1,700

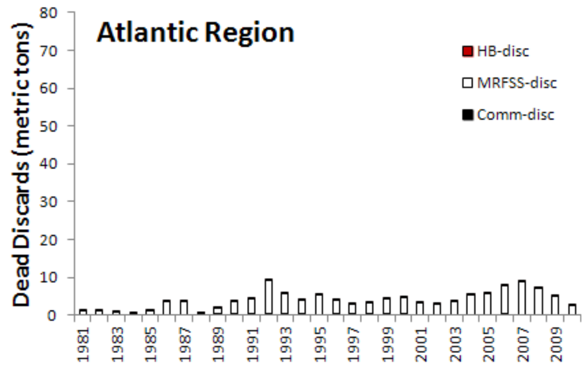
10.7 FIGURES

Figure 10.7.1 Landings and estimated dead discards for the ALK-base run by region and fleet.

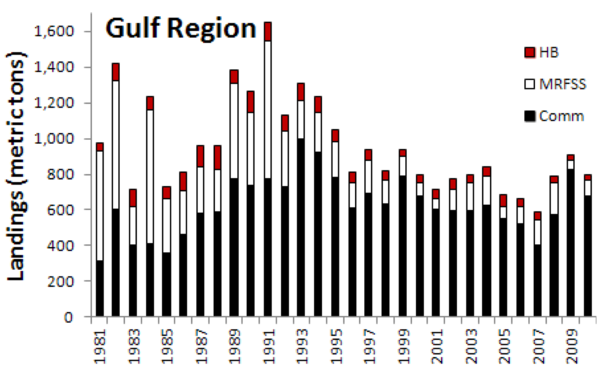
a) Atlantic Region Landings



b) Atlantic Region Dead Discards



c) Gulf Region Landings



d) Gulf Region Dead Discards

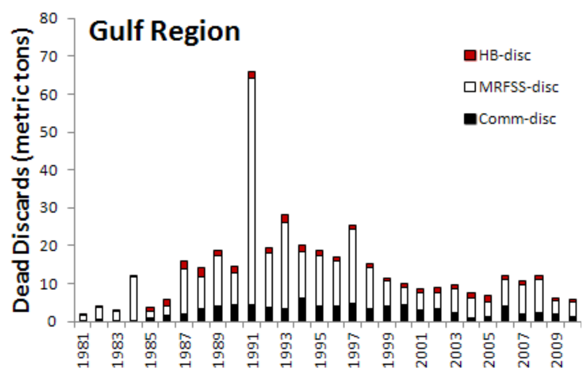


Figure 10.7.2 Observed and predicted landings by fleet (in metric tons) and standardized residuals by fleet for the ALK base run.

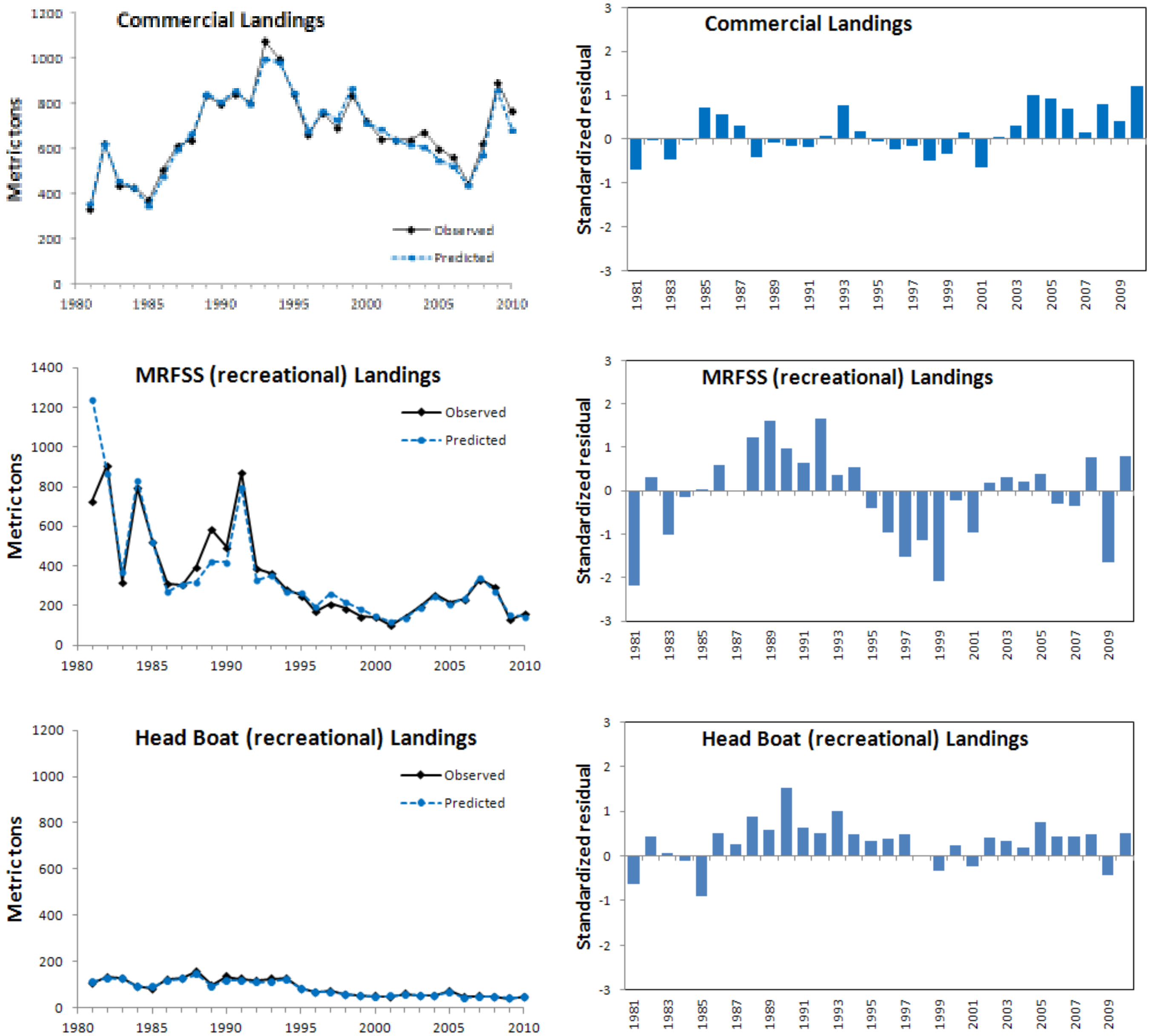


Figure 10.7.3 Observed and predicted dead discards by fleet (in metric tons) and standardized residuals by fleet for the ALK base run.

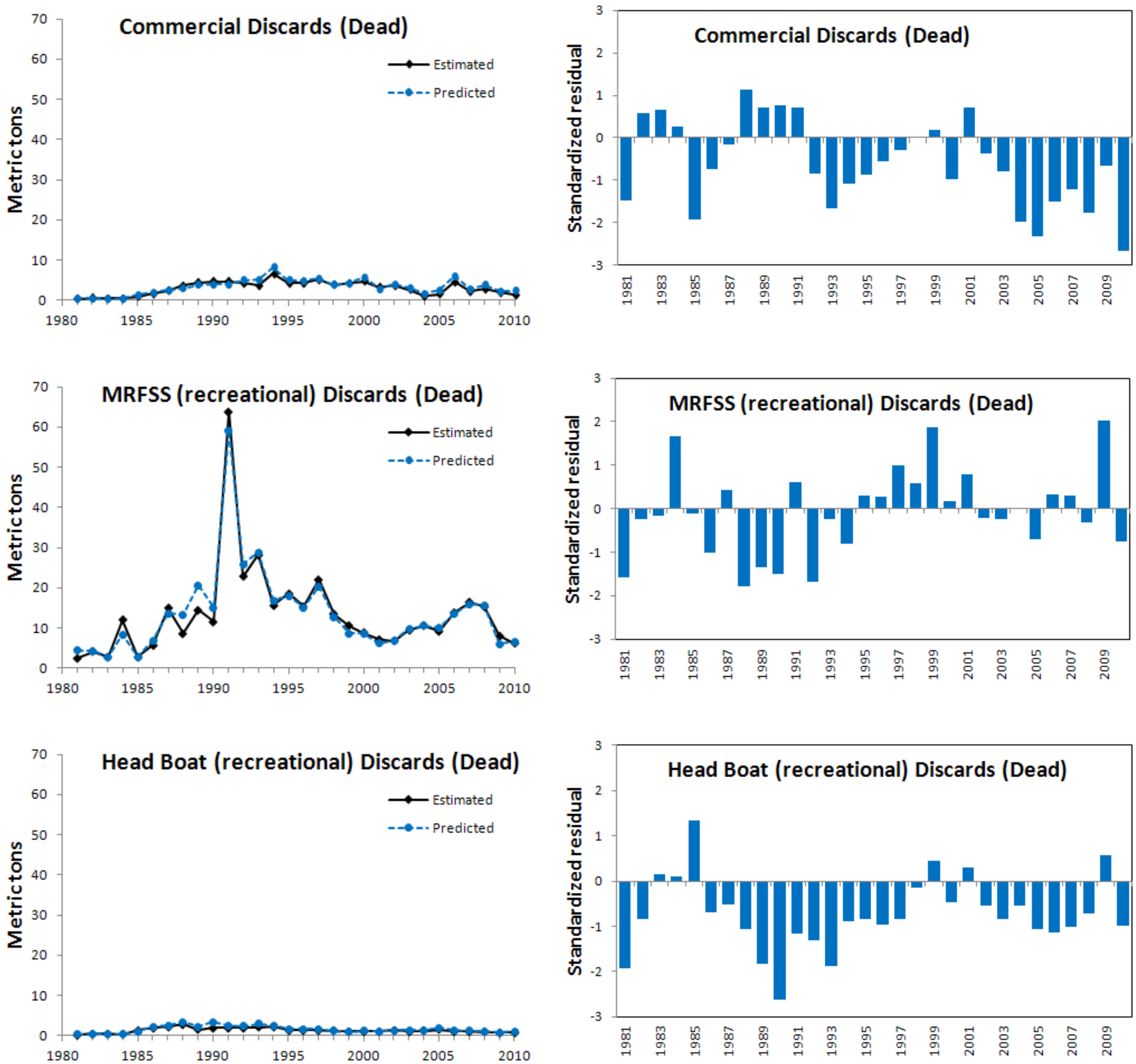


Figure 10.7.4 Observed index values and predicted fits by index and standardized residuals by index for the ALK base run.

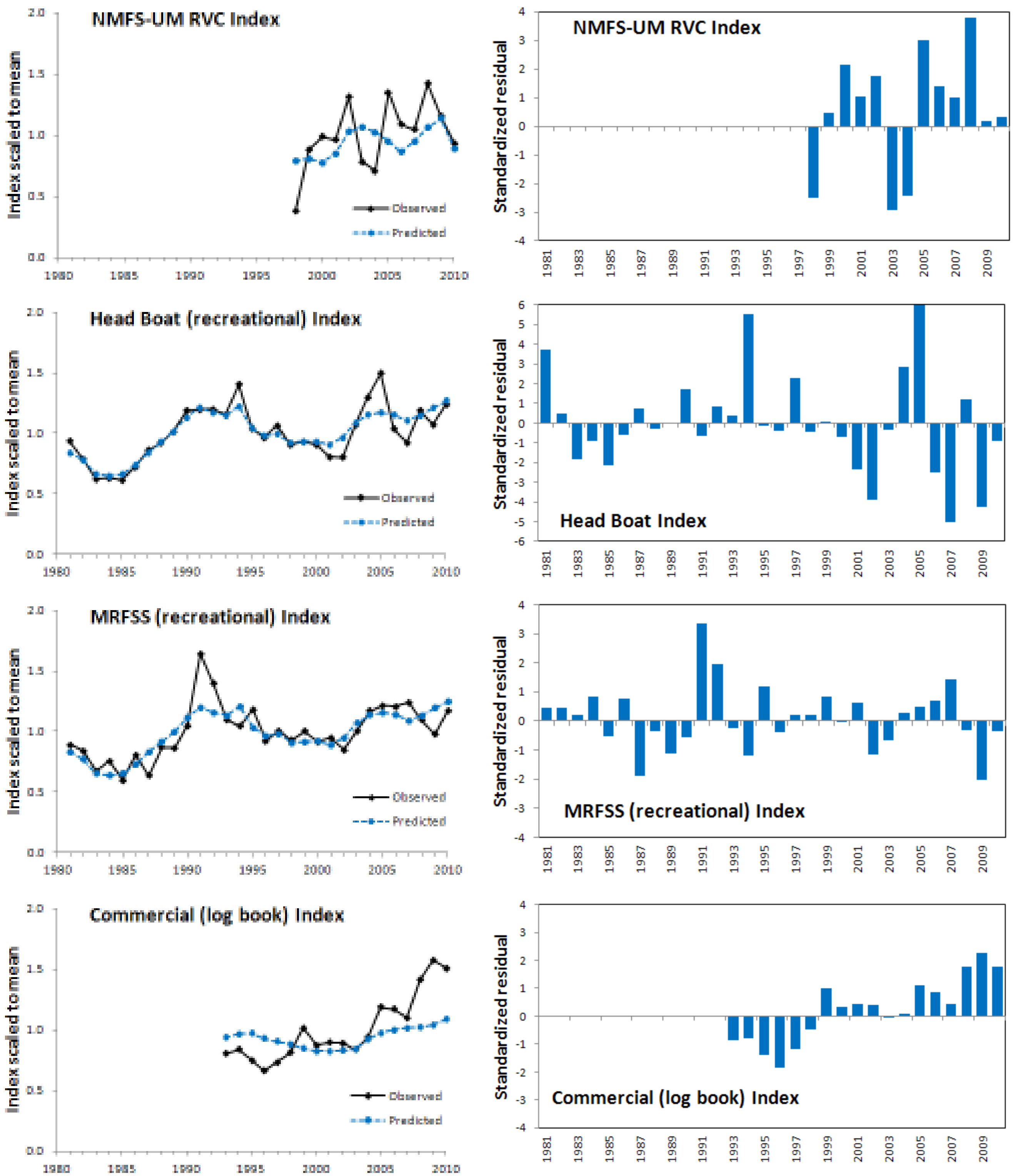
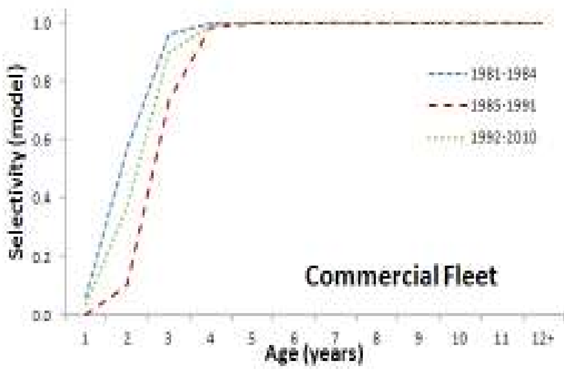
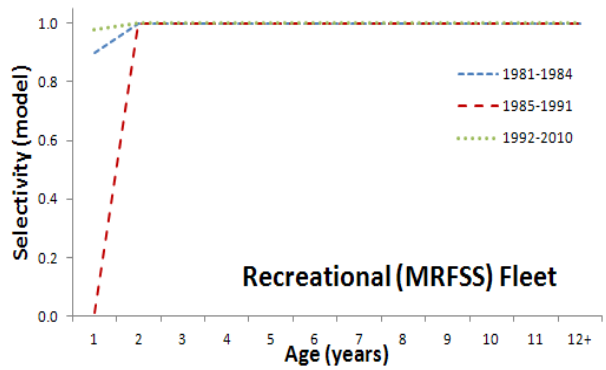


Figure 10.7.5 Selectivities for the catches by fleet for the three regulatory periods and for NMFS-UM RVC index.

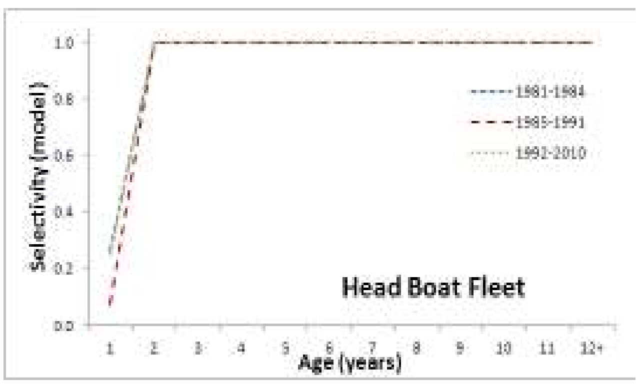
a) Commercial catch selectivities



b) MRFSS catch selectivities



c) Head boat catch selectivities



d) Index selectivities

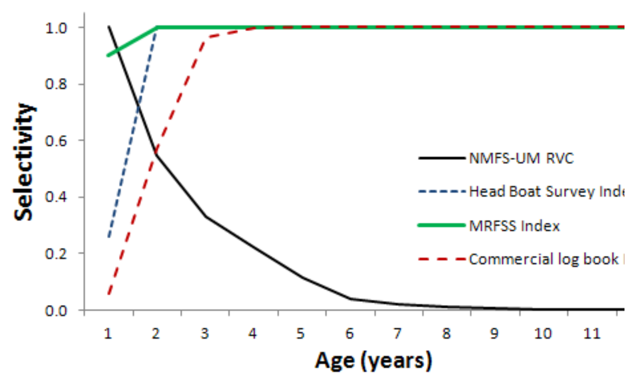


Figure 10.7.6 Population size in numbers (millions) of yellowtail snapper by year and age.

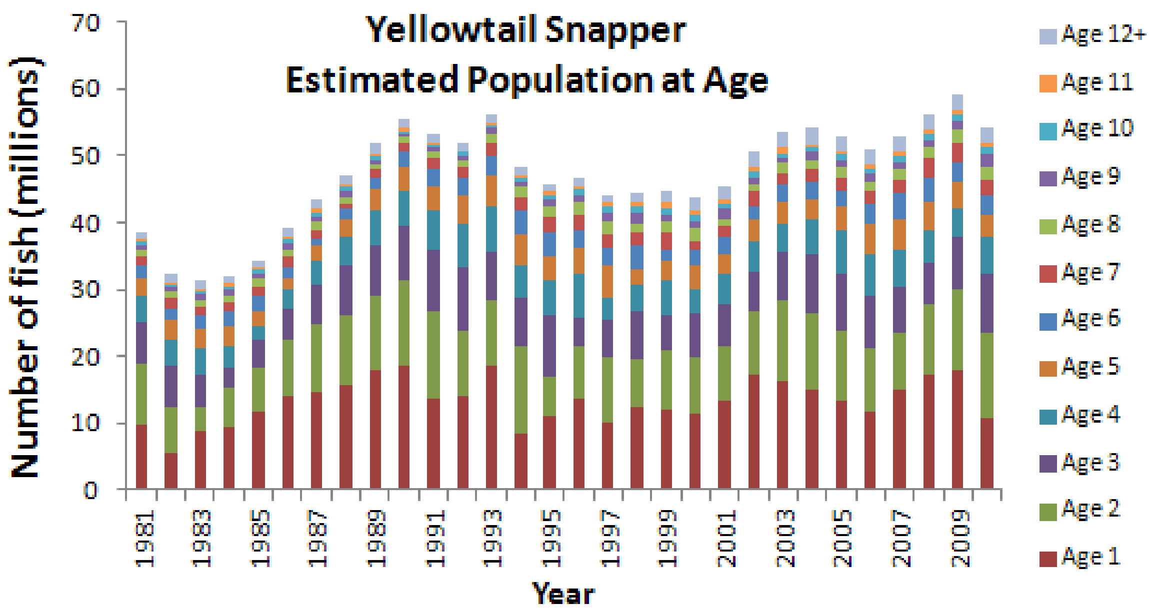


Figure 10.7.7 Recruitment expressed as the number of age-1 fish by year. Observed recruitment (blue diamonds) and predicted recruitment (red dashed line) for 1981-2010. Also shown is the NMFS-UM RVC index which is comprised of age-1 fish.

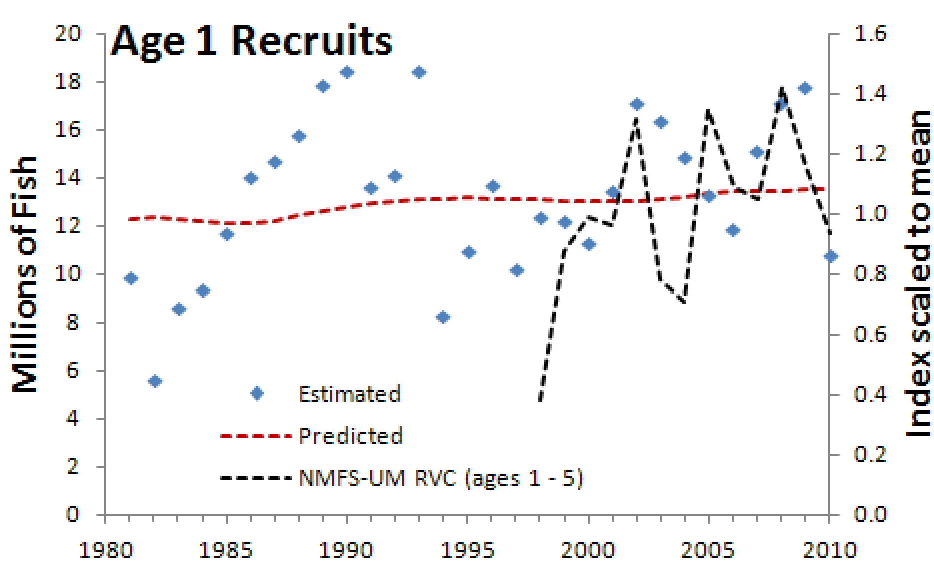


Figure 10.7.8 Yellowtail snapper stock biomass (in metric tons) by year and age.

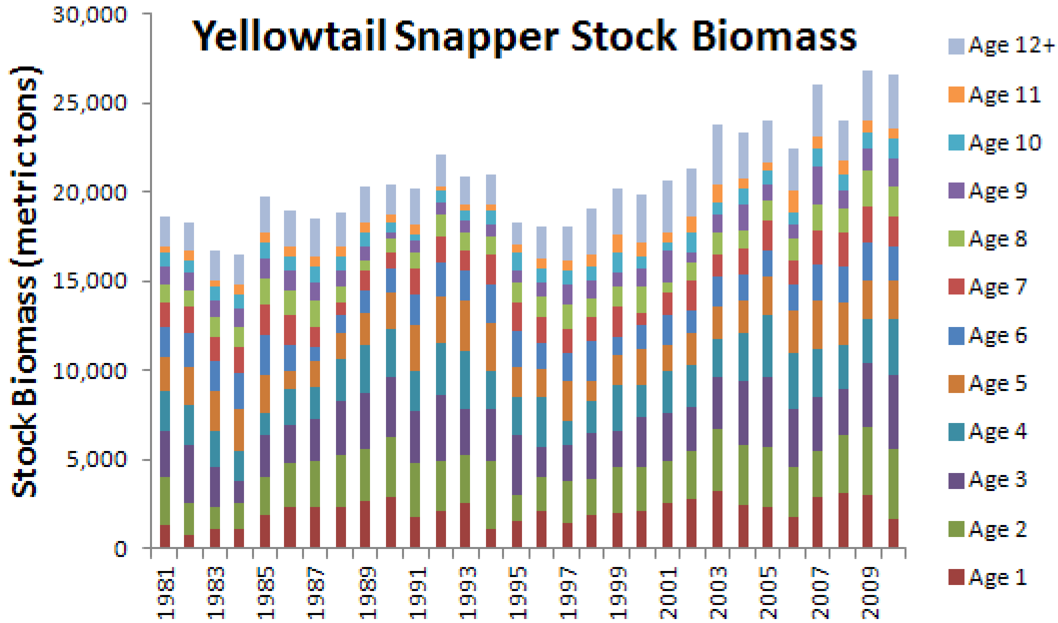


Figure 10.7.9 Female spawning biomass (in metric tons) by year.

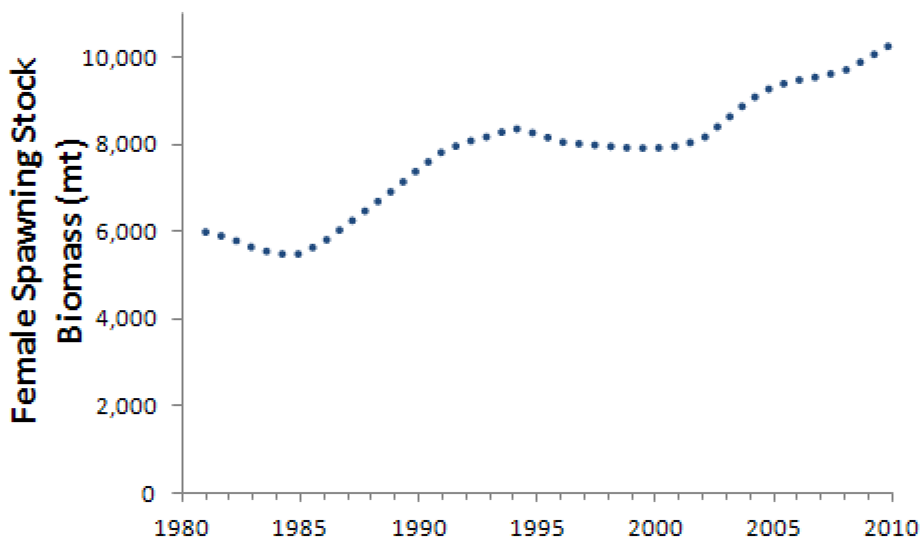
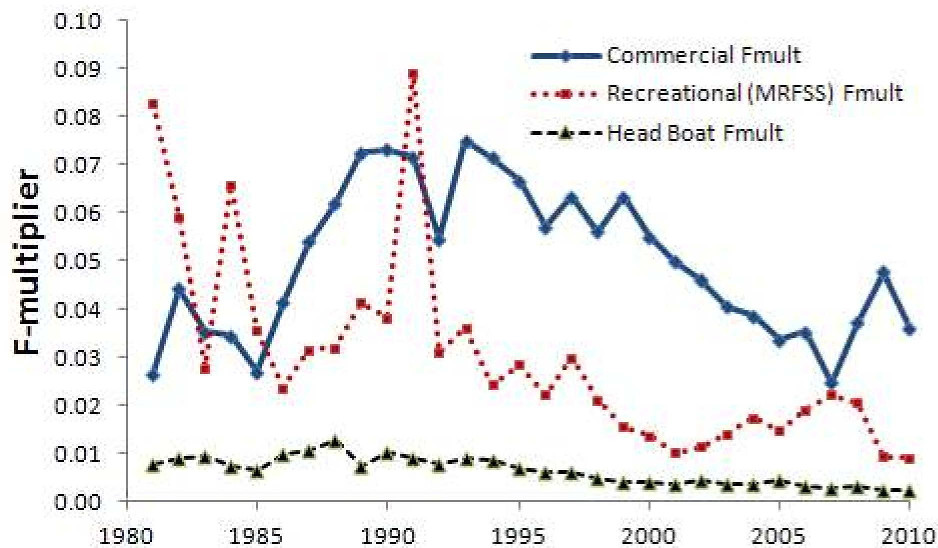


Figure 10.7.10 Fishing mortality multiplier (directed and discards, a) and the directed fishing mortality rate (b) by fleet and year.

a) Fishing mortality multiplier (Fmult, directed and discards)



b) Fishing mortality rate (directed)

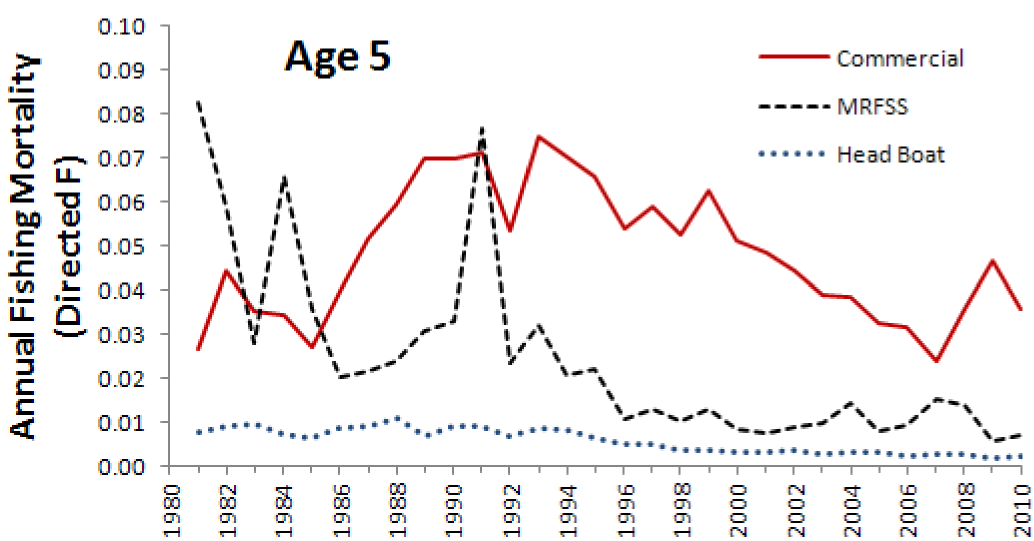


Figure 10.7.11 Total fishing mortality rate on age-5 fish (fully selected age) by year.

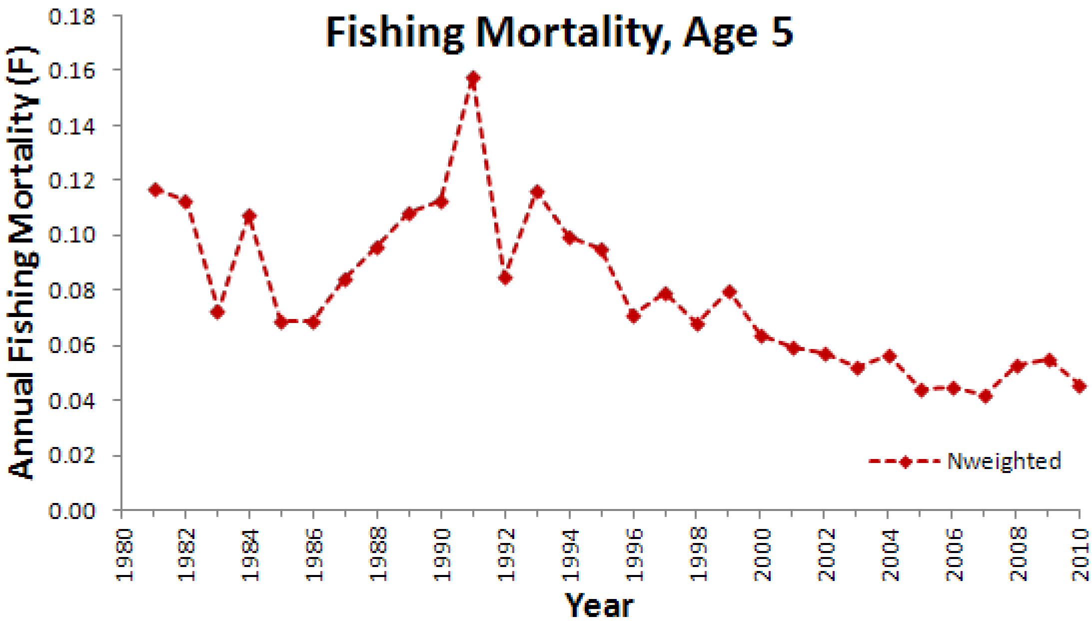


Figure 10.7.12 The distribution of steepness samples from the Markov Chain Monte Carlo (MCMC) simulation.

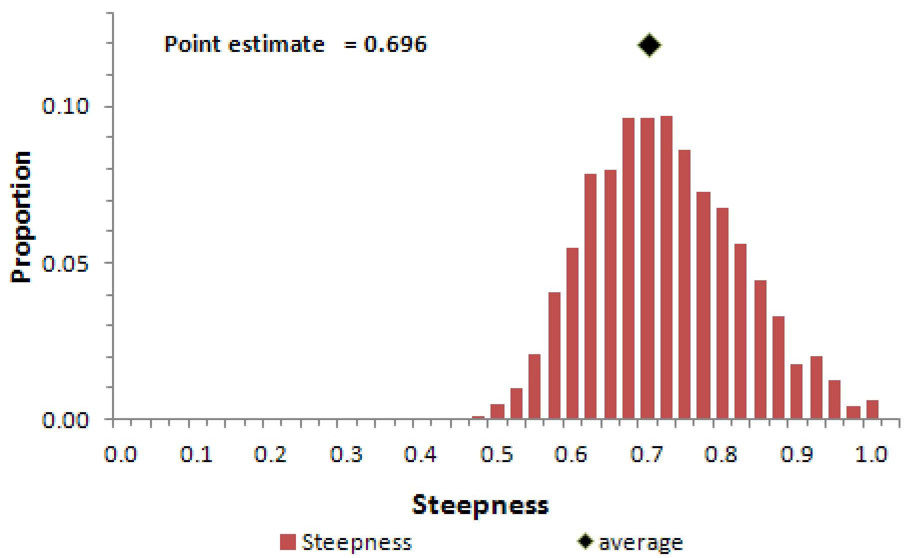


Figure 10.7.13 The estimated Beverton-Holt stock-recruit relationship for yellowtail snapper. The point estimate for steepness was 0.696 and 14,316 metric tons for the female spawning biomass at F=0.

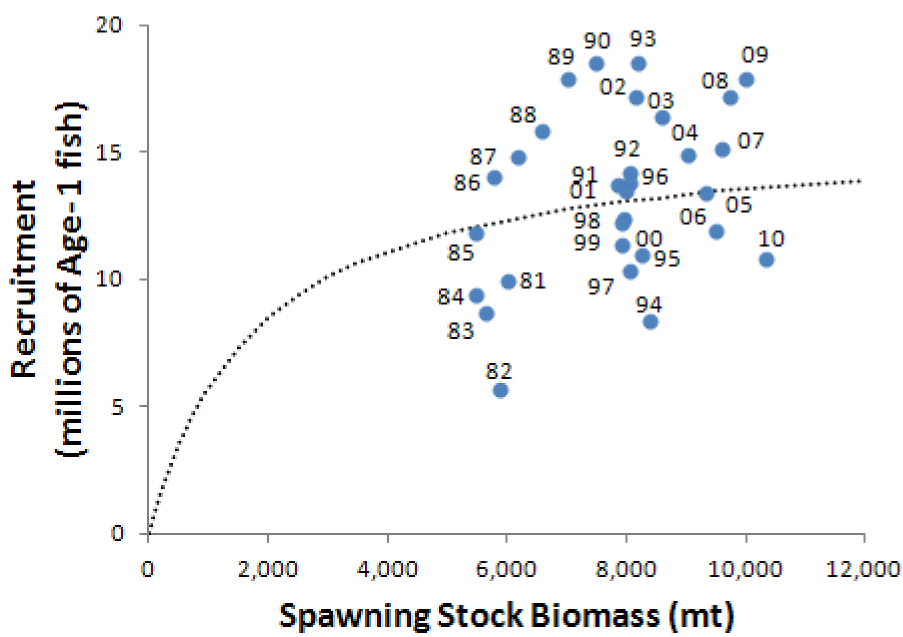
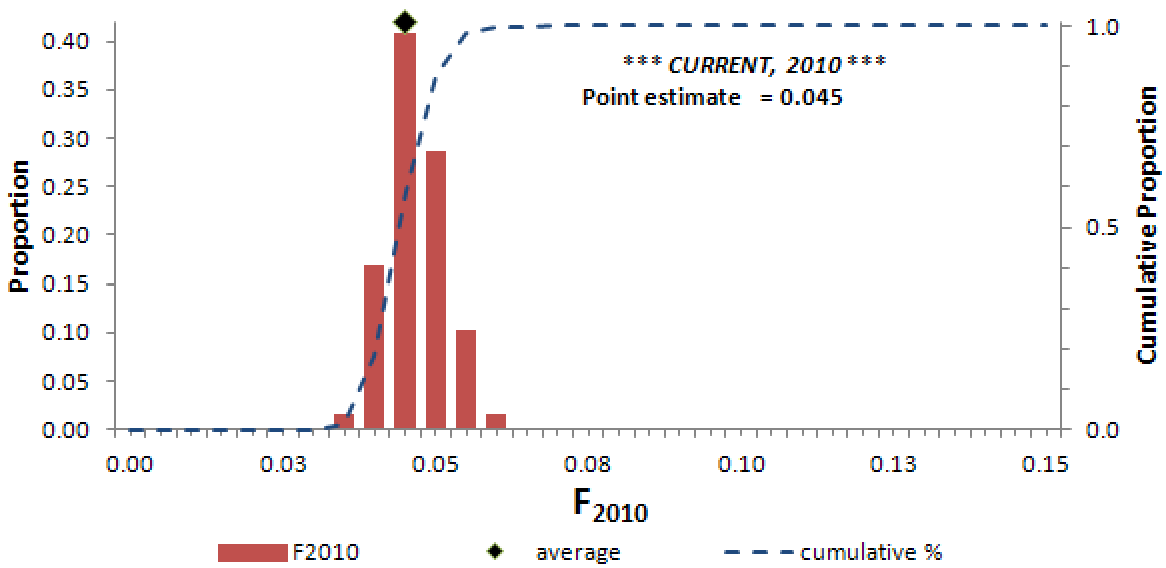


Figure 10.7.14 Distribution of Markov Chain Monte Carlo simulations, the cumulative proportion, and the point estimate for the fishing mortality per year for age-5 yellowtail snapper in 2010 (a) and for the spawning biomass in 2010 (b).

a)



b)

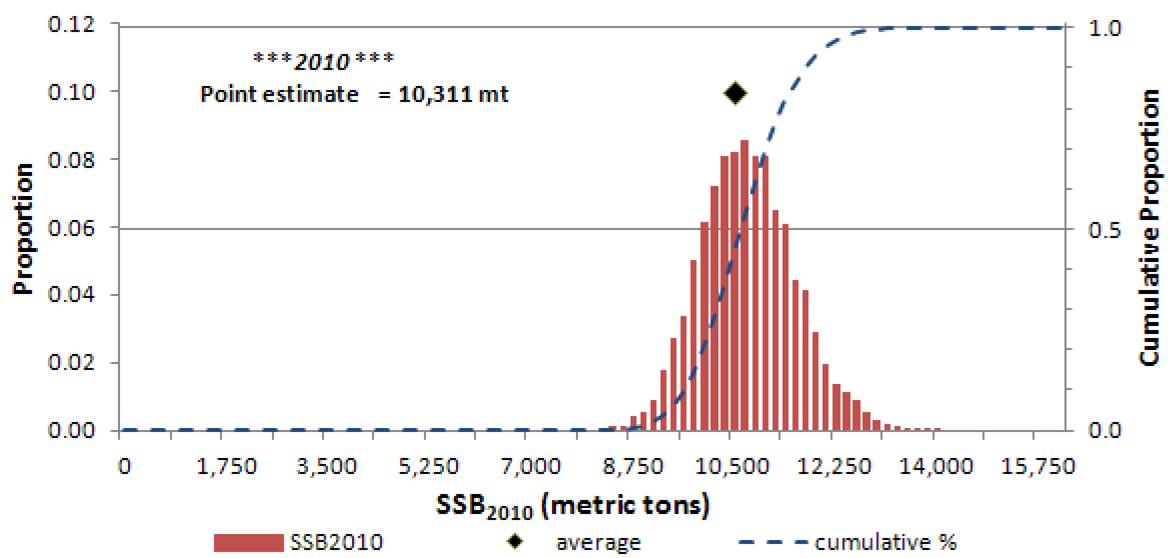
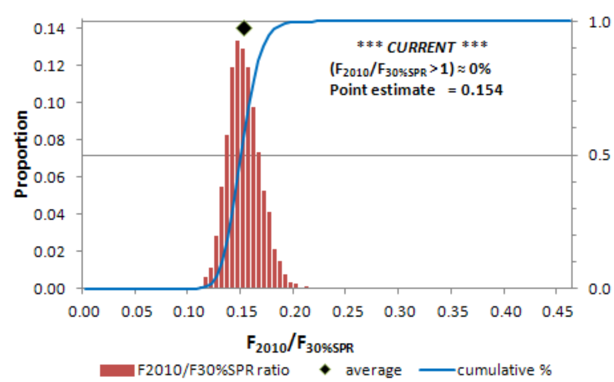
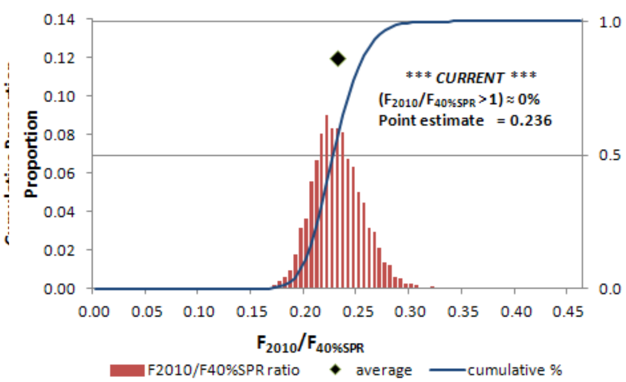


Figure 10.7.15 The distributions from the MCMC simulations (10 million runs with a 3.2 million sample run burn-in and 8000 thinning rate) of the ratio of fishing mortality in 2010 (F 2010) to the fishing mortality rate at 30% SPR (F30% SPR) (a), the distribution of the ratio of the spawning biomass in 2010 to the spawning biomass at 30% SPR (b), the ratio of fishing mortality in 2010 (F 2010) to the fishing mortality rate at 40% SPR (F40% SPR) (c), the distribution of the ratio of the spawning biomass in 2010 to the spawning biomass at 40% SPR (d), and the fishing mortality ratio plotted on the spawning biomass ratio at 30% SPR (e) and 40% SPR (f).

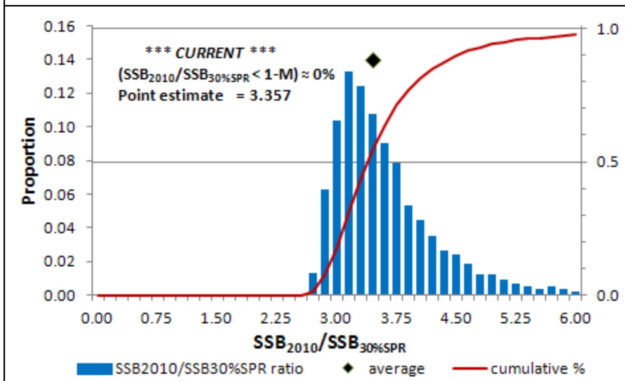
a)



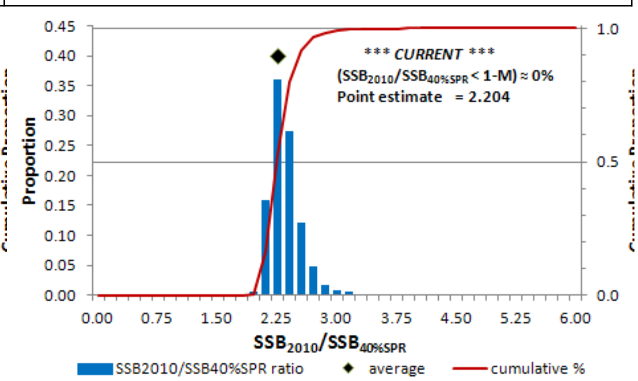
c)



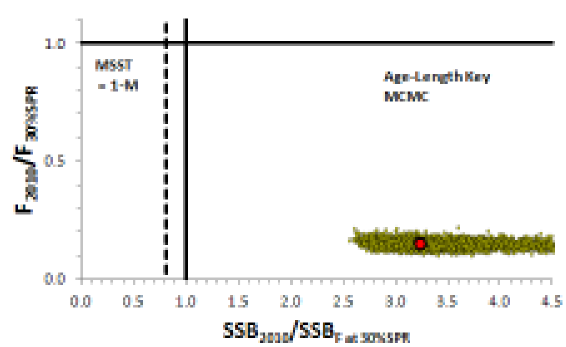
b)



d)



e)



f)

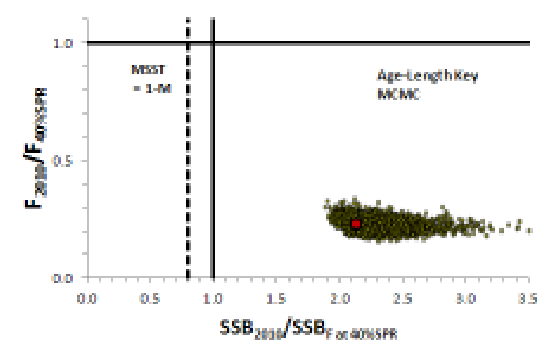
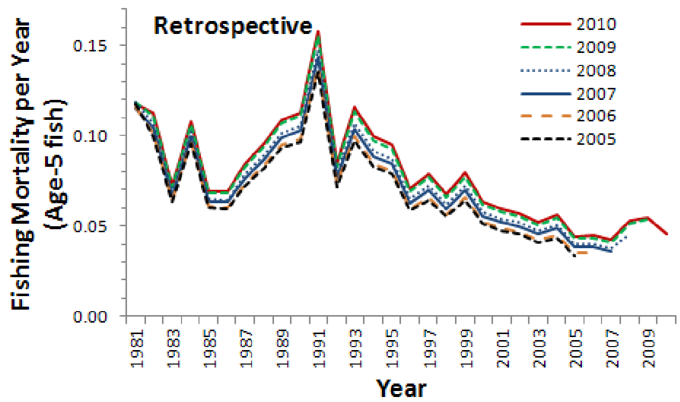
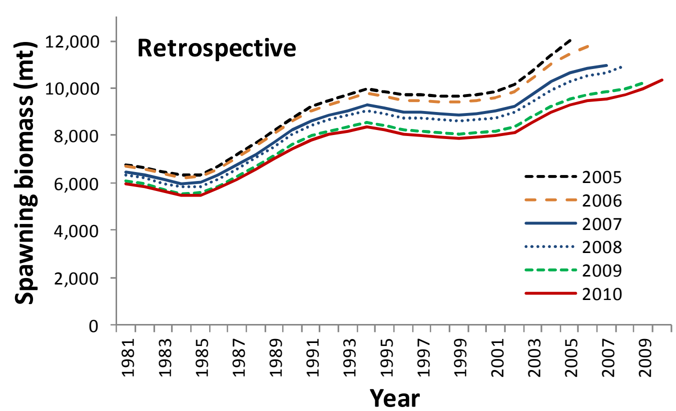


Figure 10.7.16 Retrospective analyses for fishing mortality rates (a), spawning biomass (b), and recruitment (c) for the years 2005-2010.

a)



b)



c)

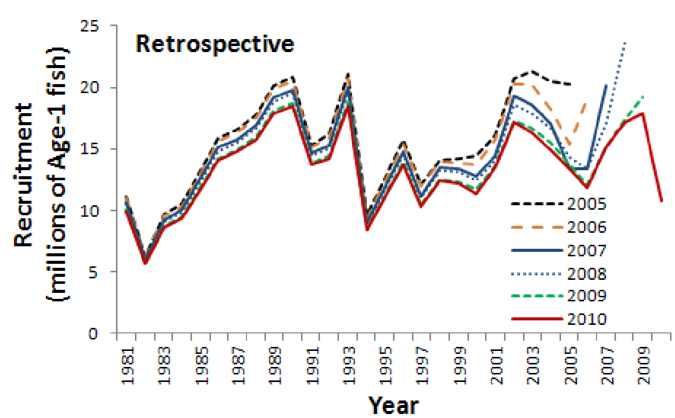
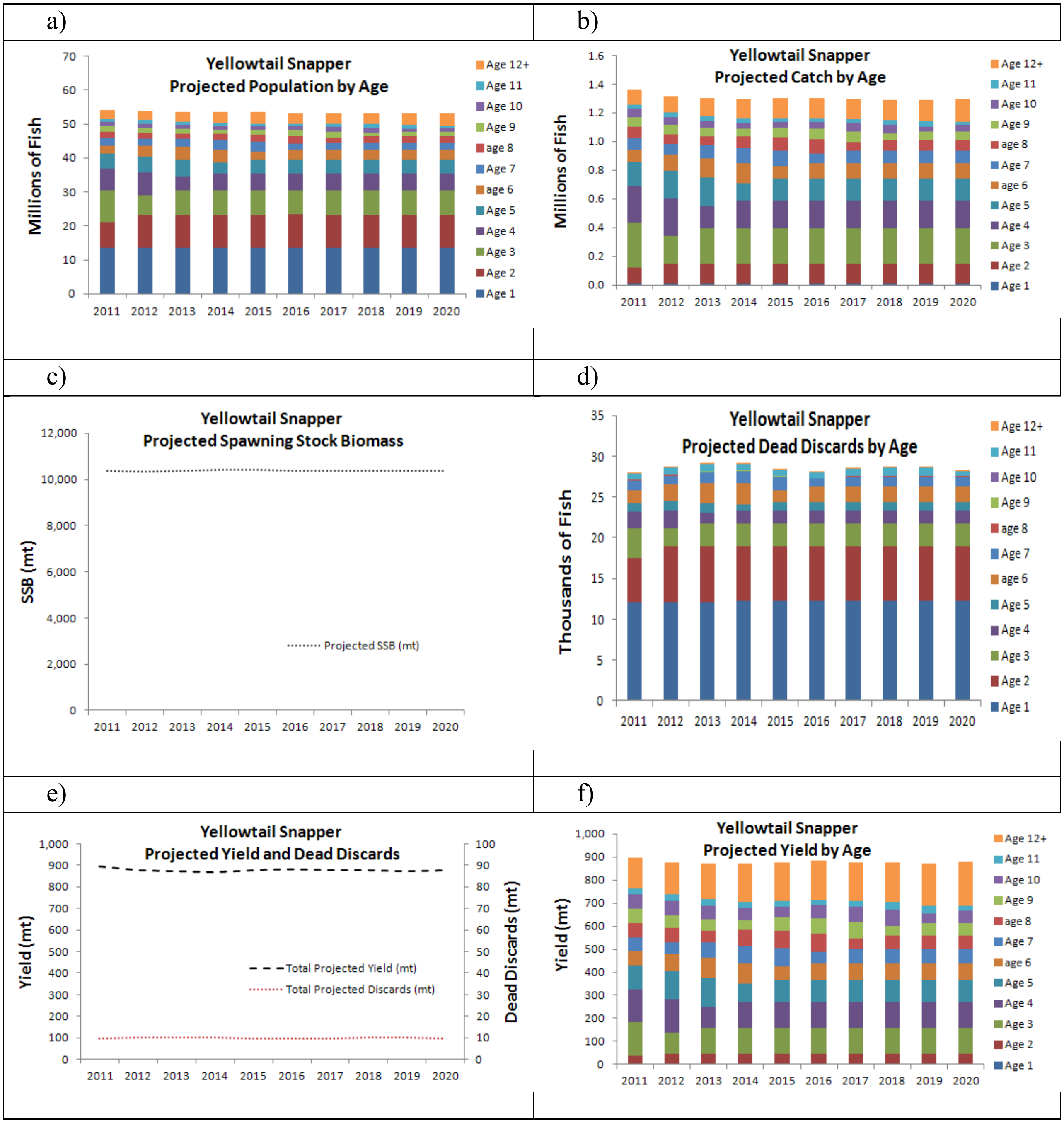


Figure 10.7.17 Projections by age of population numbers, catch, discards, and yield, and projected spawning stock biomass.



11 *Appendix A*

11.1 ALK-CONFIGURED AGE COMPOSITION AND RESIDUAL PLOTS

Age-length-key (ALK) configured annual age compositions and standardized residuals by the directed fleet (Figure 11-1), discards by fleet (Figure 11-2), and fishery independent index of abundance (NMFS-UM RVC; Figure 11-3). The standardized residuals allow for comparisons of the fits across years and fleets but they amplify the residuals. Also, if a plot for a year is missing, then there was no age information from that fleet or index for that year.

Figure 11.1.1 ASAP2 model fits and standardized residuals of age-length-key configured fleet catch age composition.

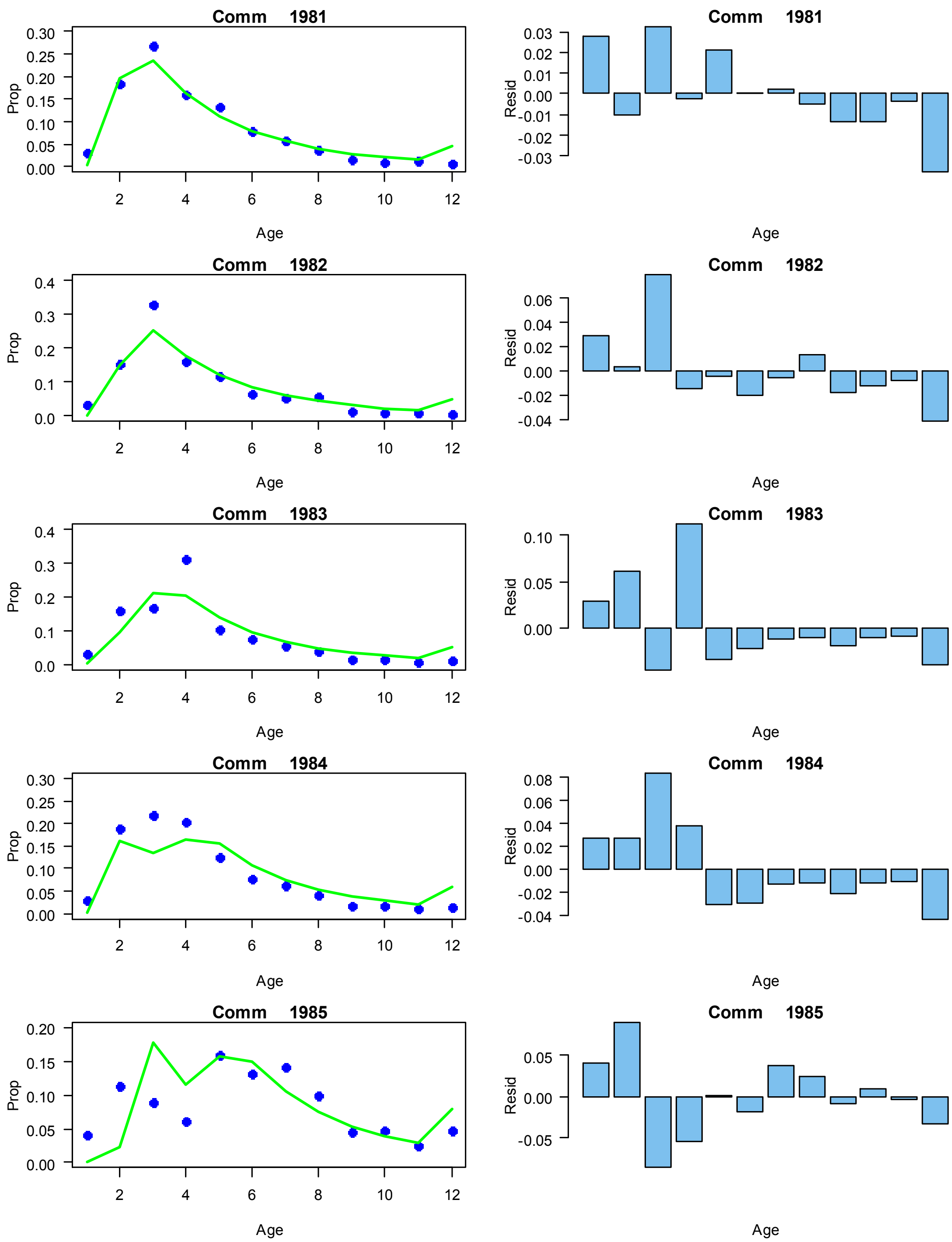


Figure 11.1.1 (continued). ASAP2 model fits and standardized residuals of age-length-key configured fleet catch age composition.

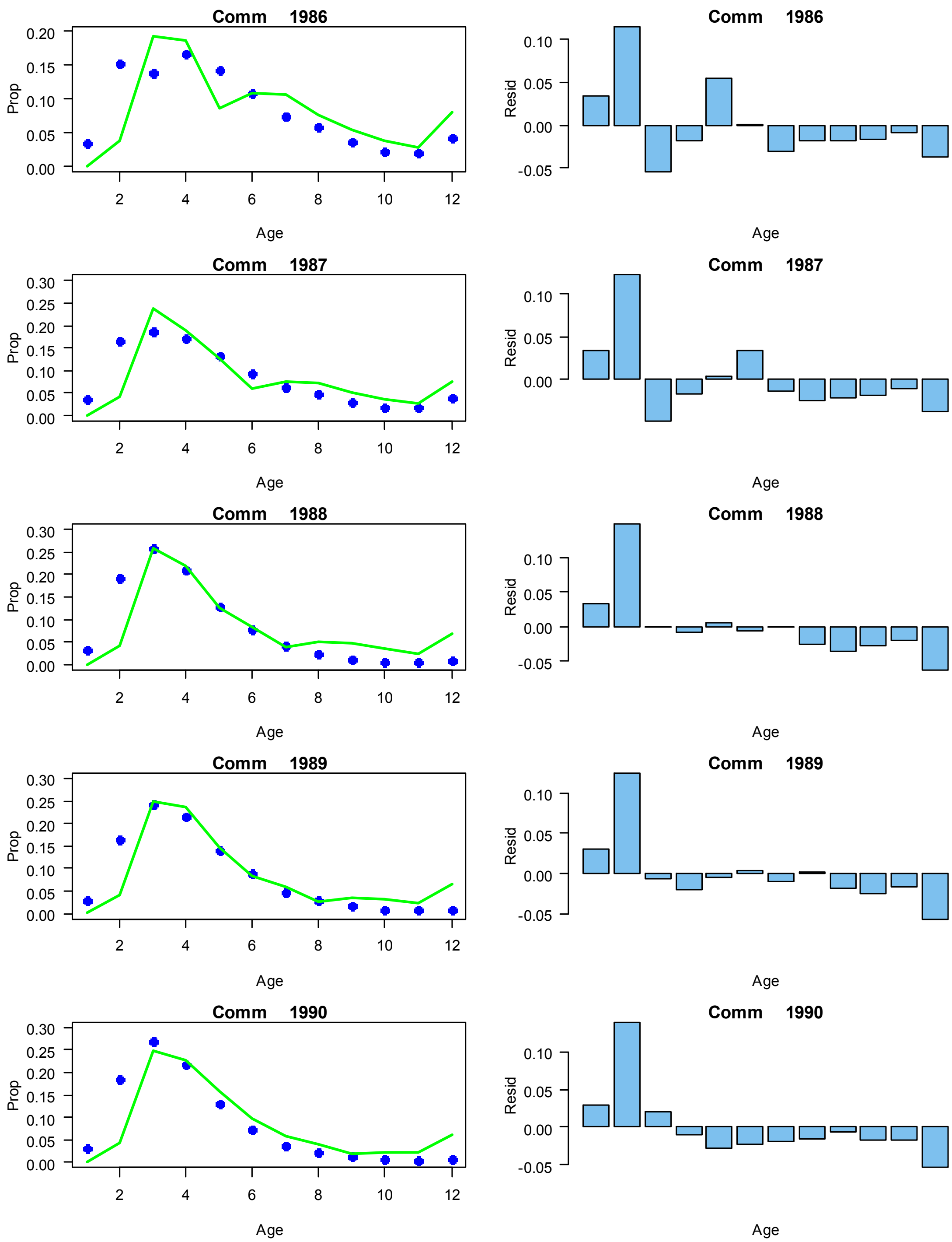


Figure 11.1.1 (continued). ASAP2 model fits and standardized residuals of age-length-key configured fleet catch age composition.

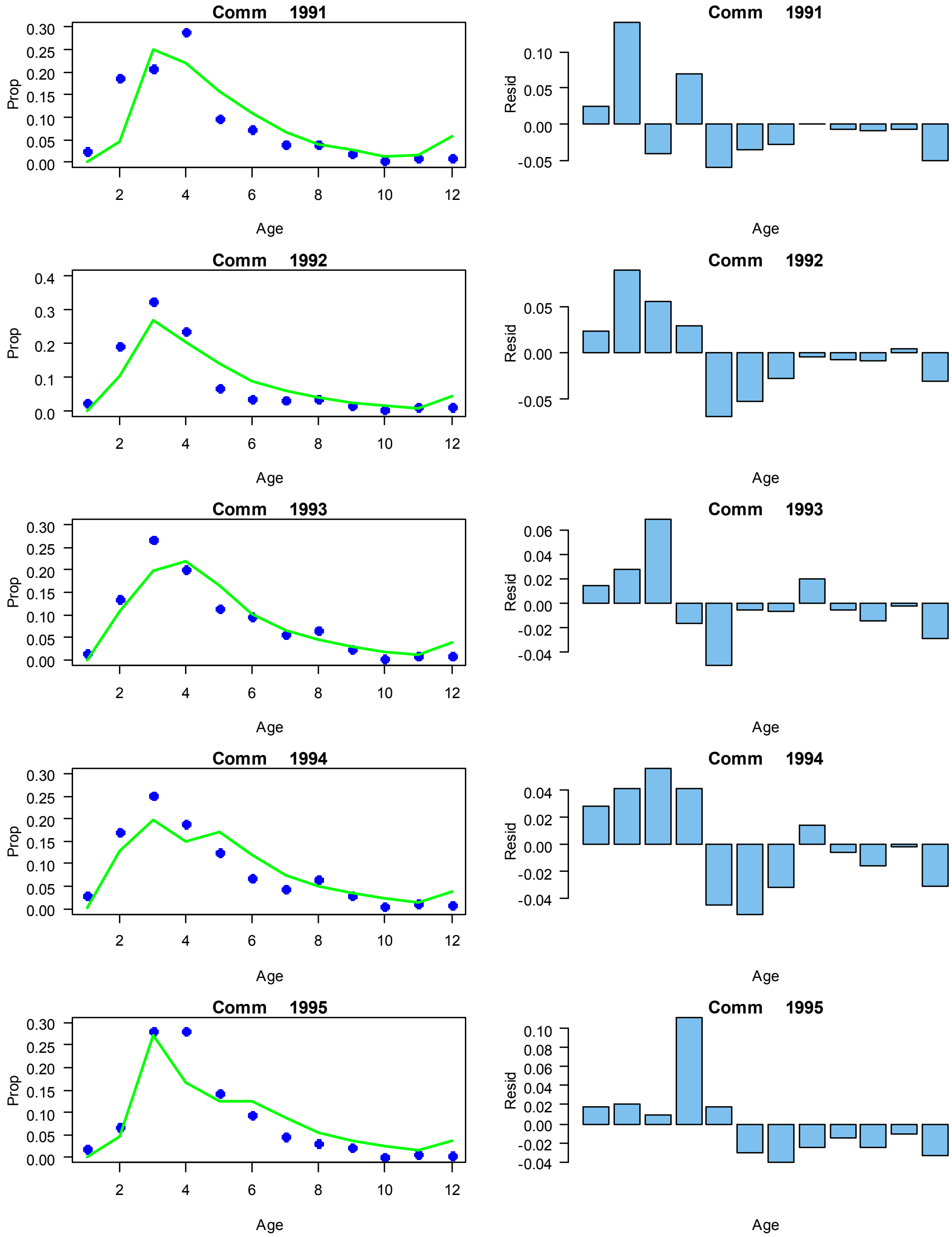


Figure 11.1.1 (continued). ASAP2 model fits and standardized residuals of age-length-key configured fleet catch age composition.

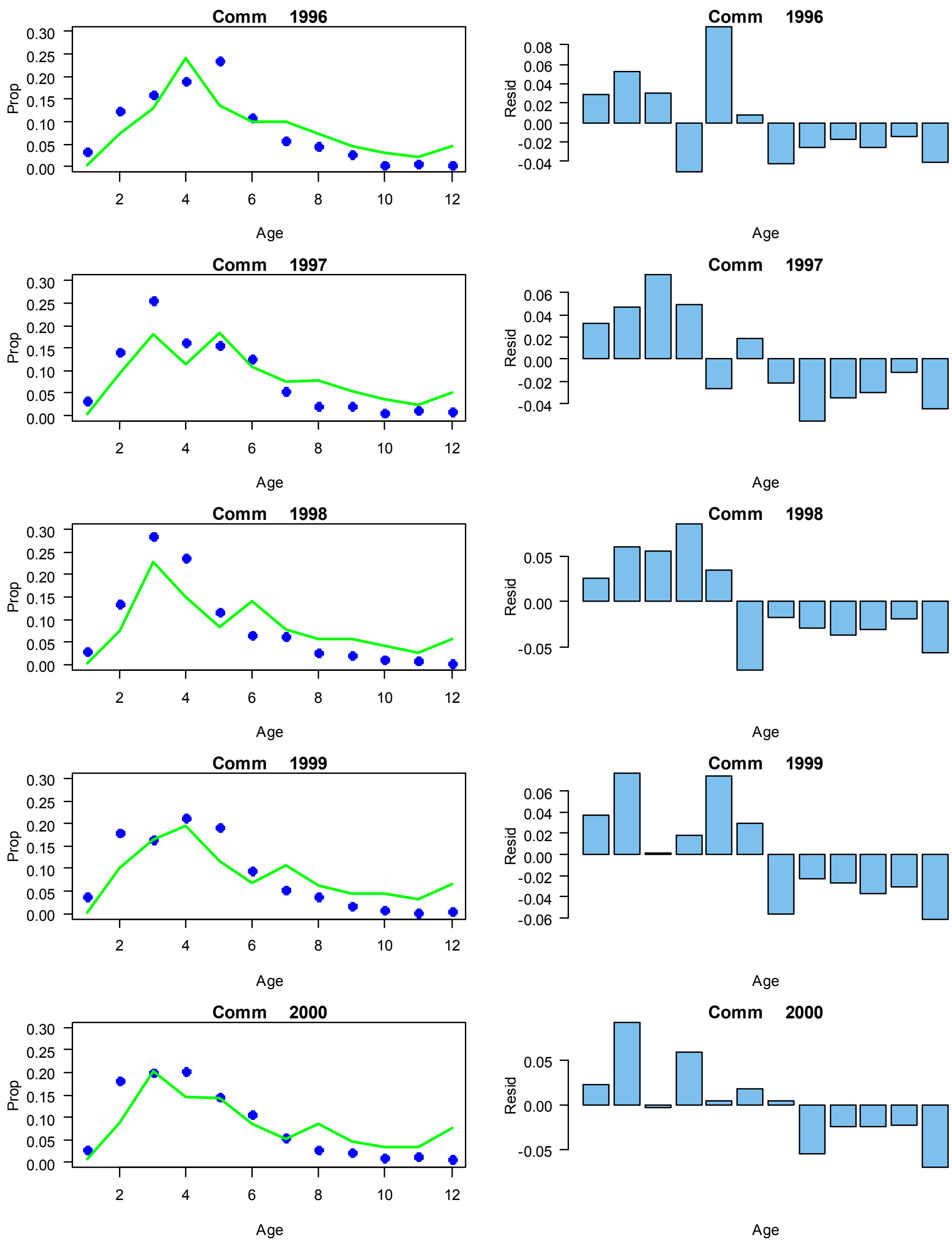


Figure 11.1.1 (continued). ASAP2 model fits and standardized residuals of age-length-key configured fleet catch age composition.

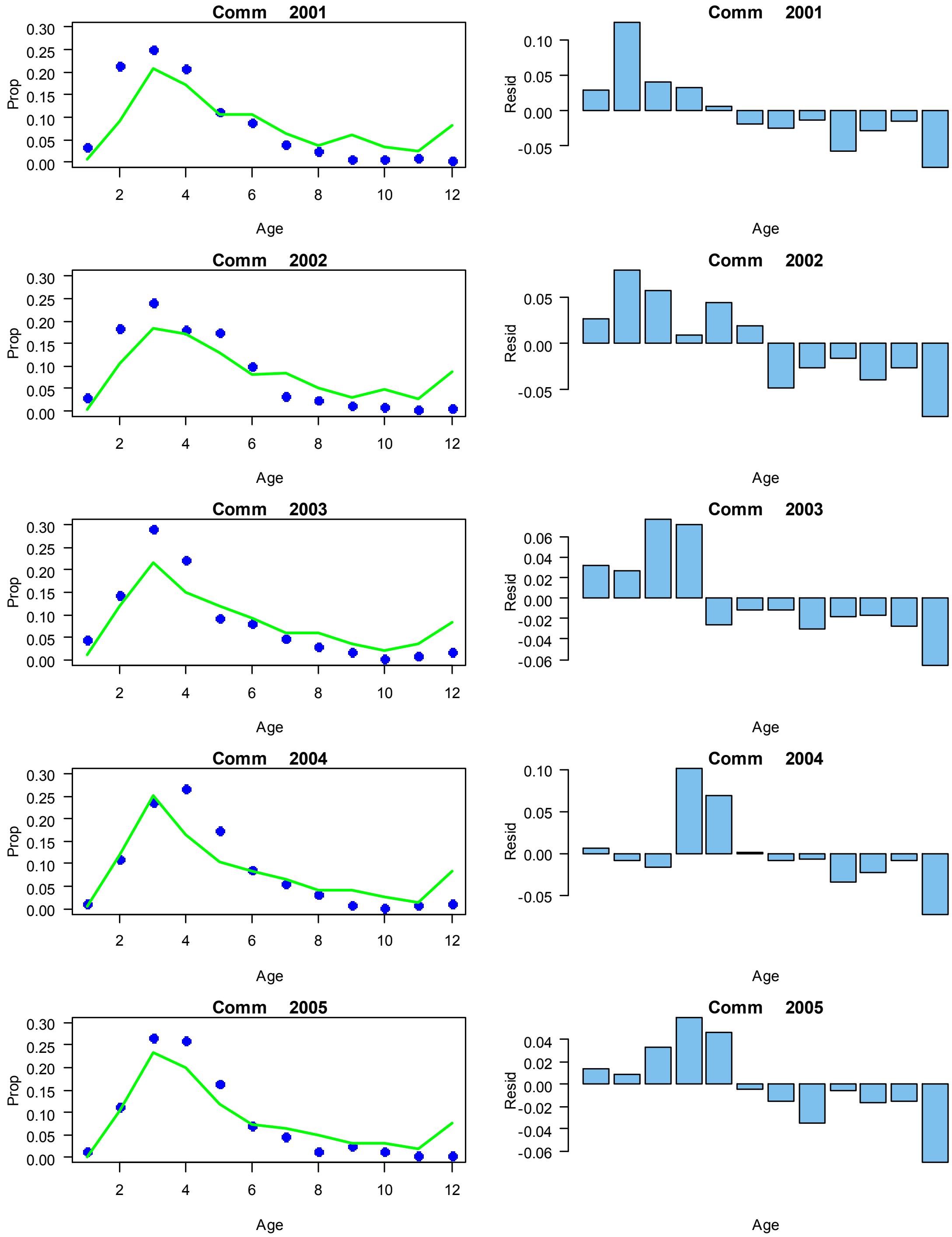


Figure 11.1.1 (continued). ASAP2 model fits and standardized residuals of age-length-key configured fleet catch age composition.

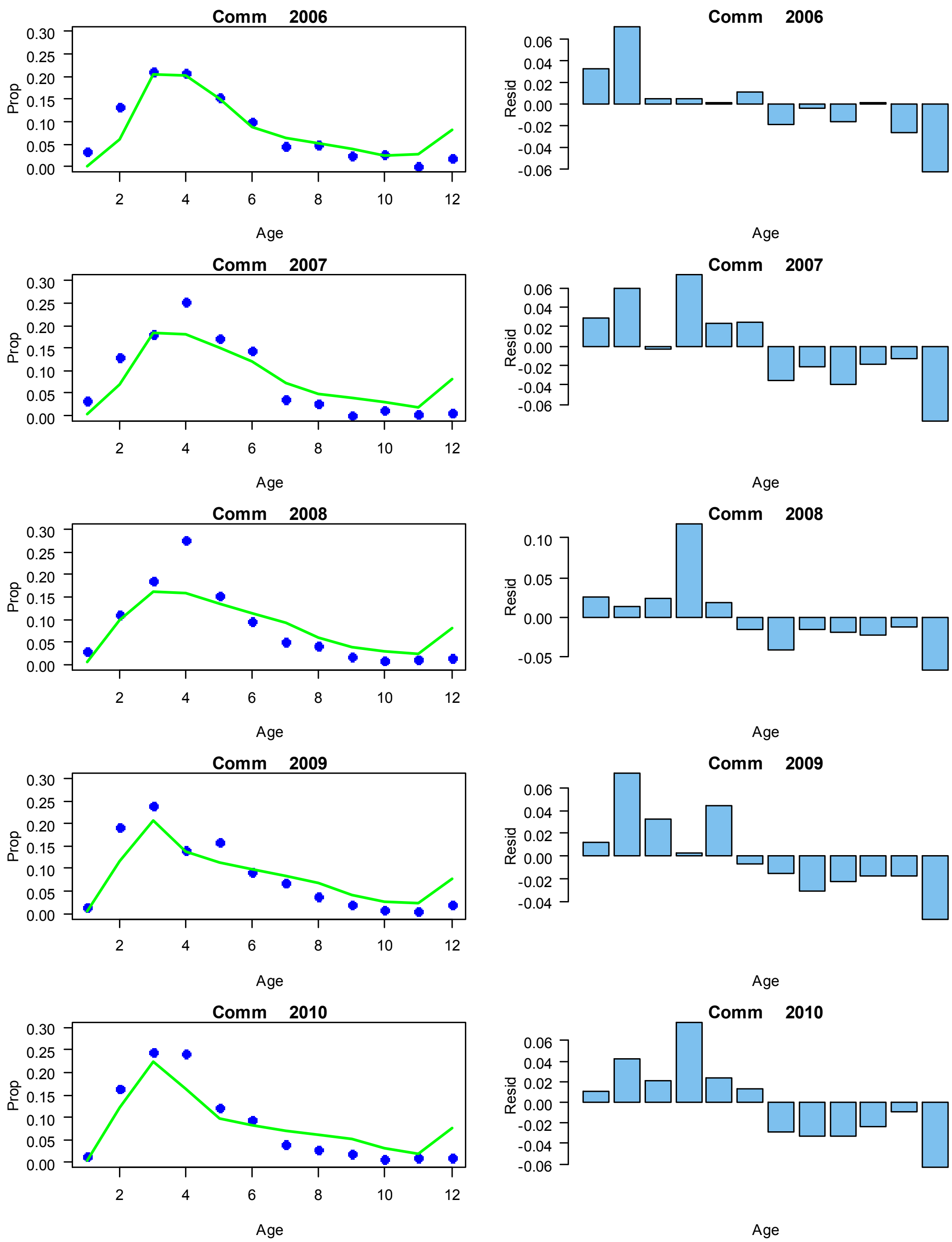


Figure 11.1.1 (continued). ASAP2 model fits and standardized residuals of age-length-key configured fleet catch age composition.

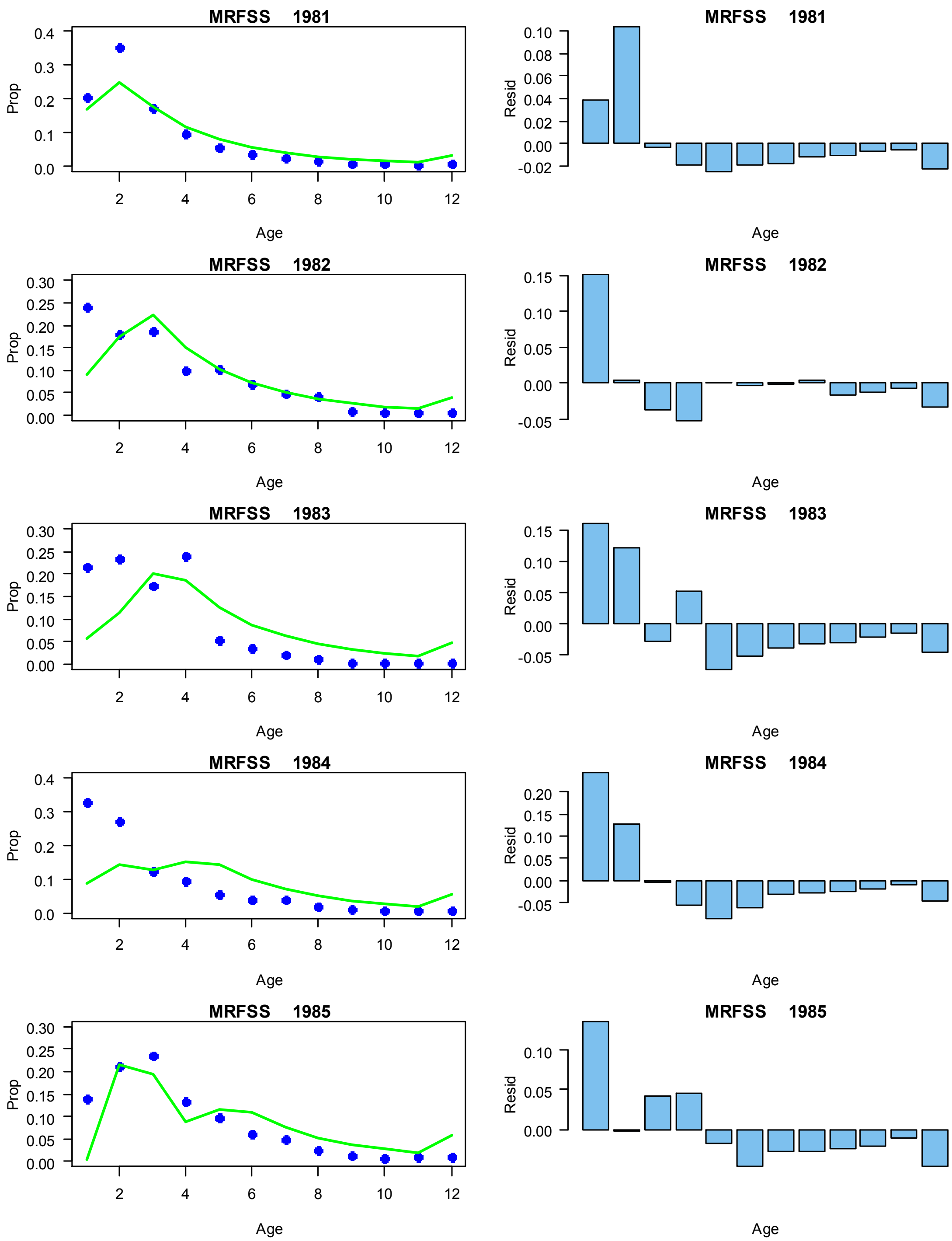


Figure 11.1.1 (continued). ASAP2 model fits and standardized residuals of age-length-key configured fleet catch age composition.

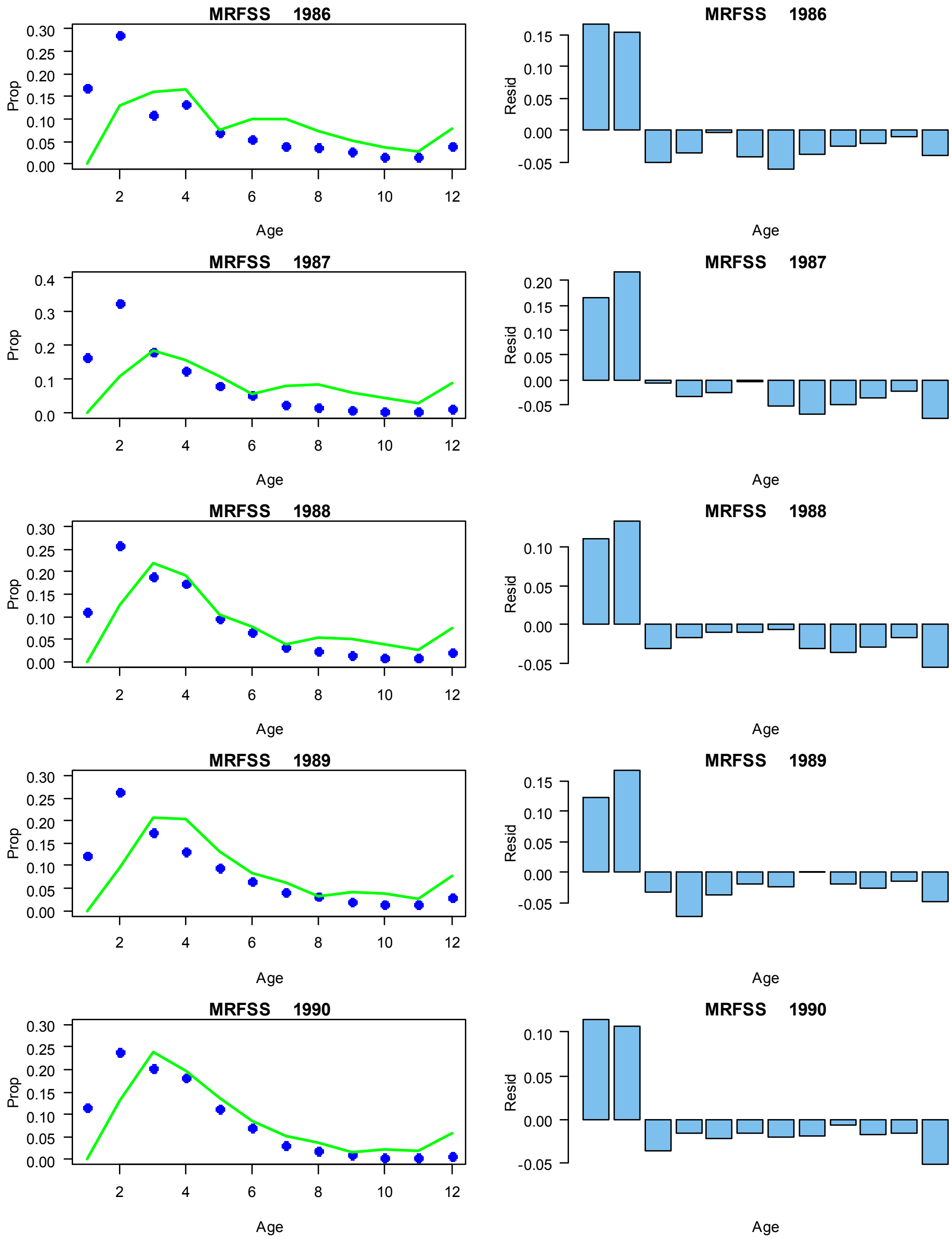


Figure 11.1.1 (continued). ASAP2 model fits and standardized residuals of age-length-key configured fleet catch age composition.

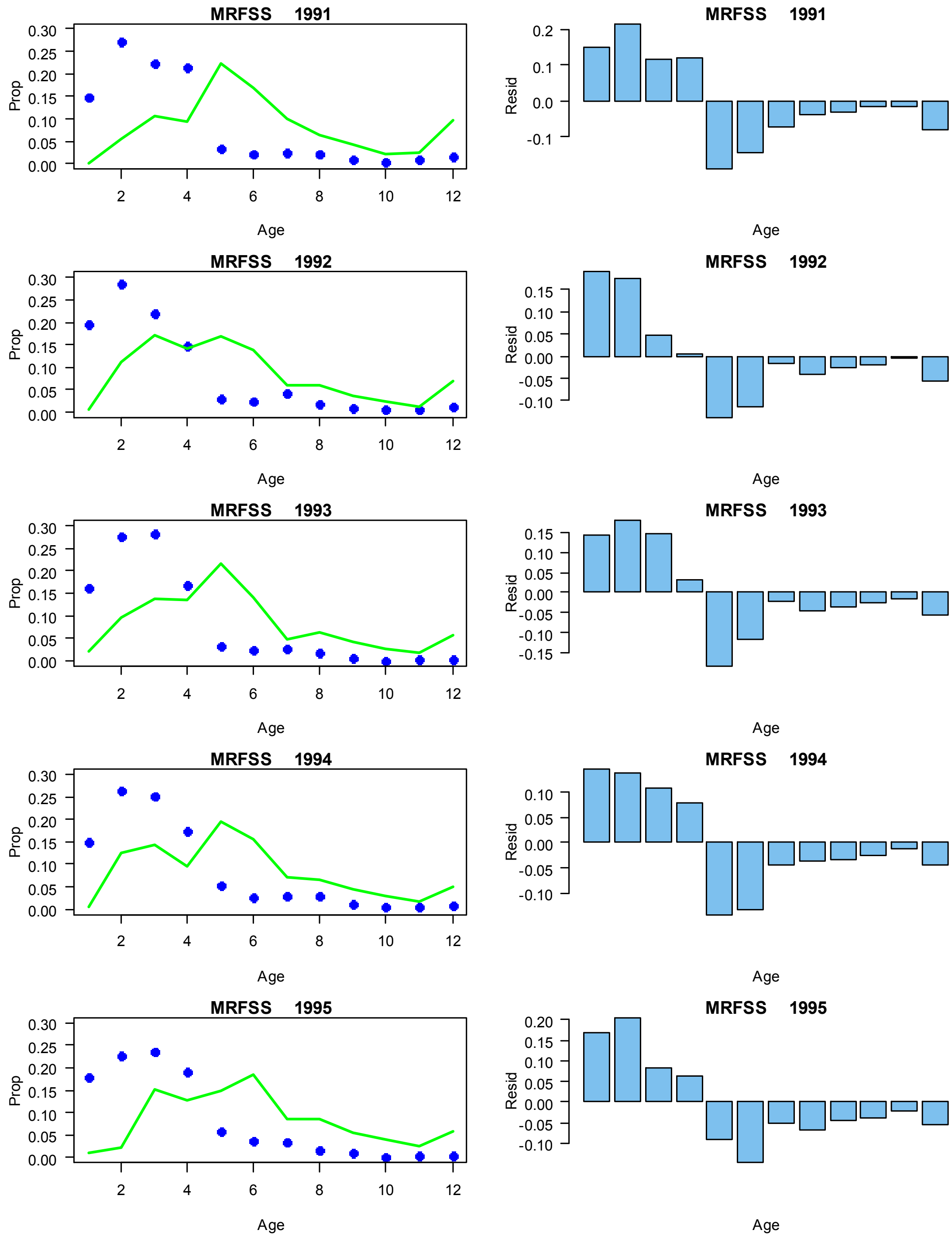


Figure 11.1.1 (continued). ASAP2 model fits and standardized residuals of age-length-key configured fleet catch age composition.

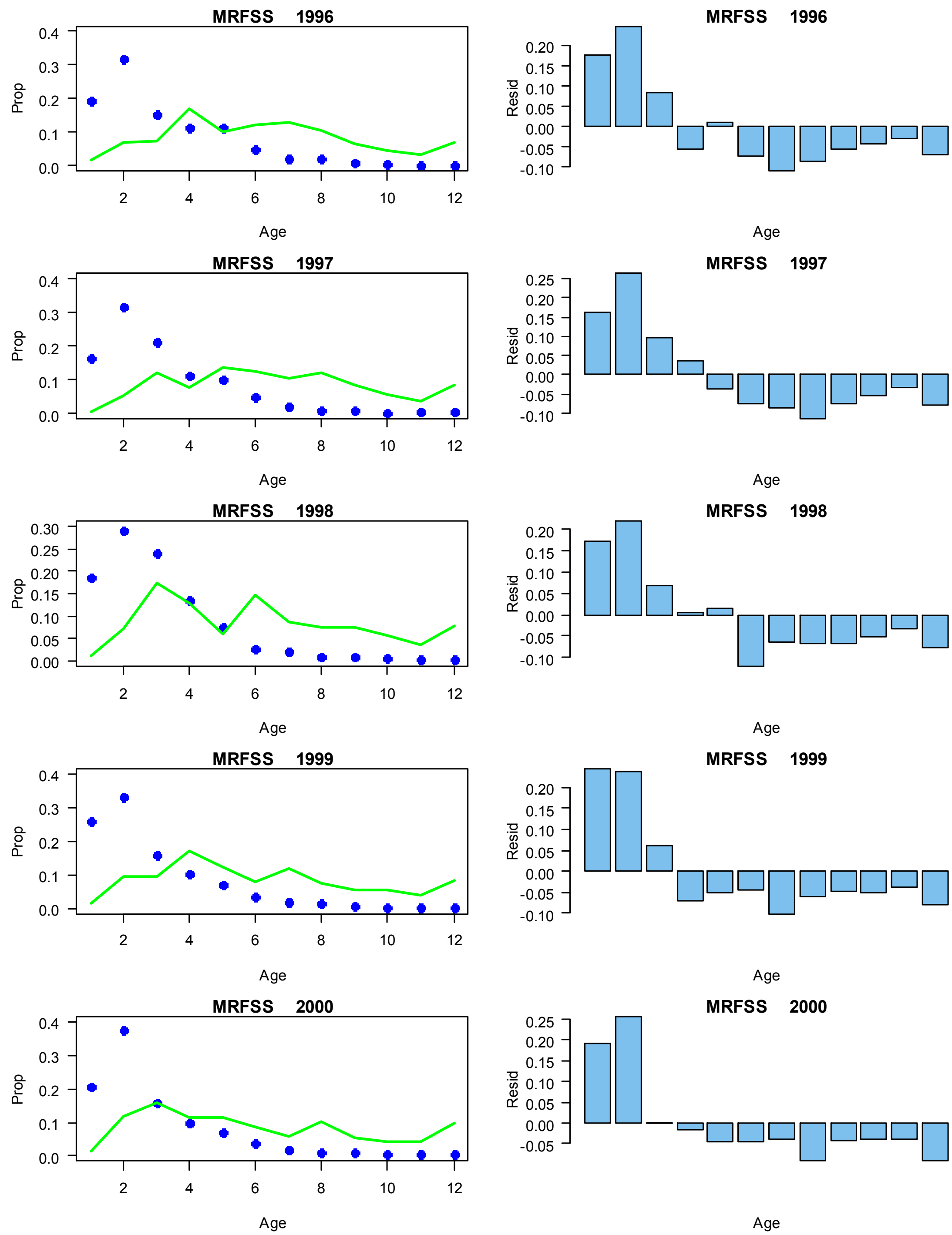


Figure 11.1.1 (continued). ASAP2 model fits and standardized residuals of age-length-key configured fleet catch age composition.

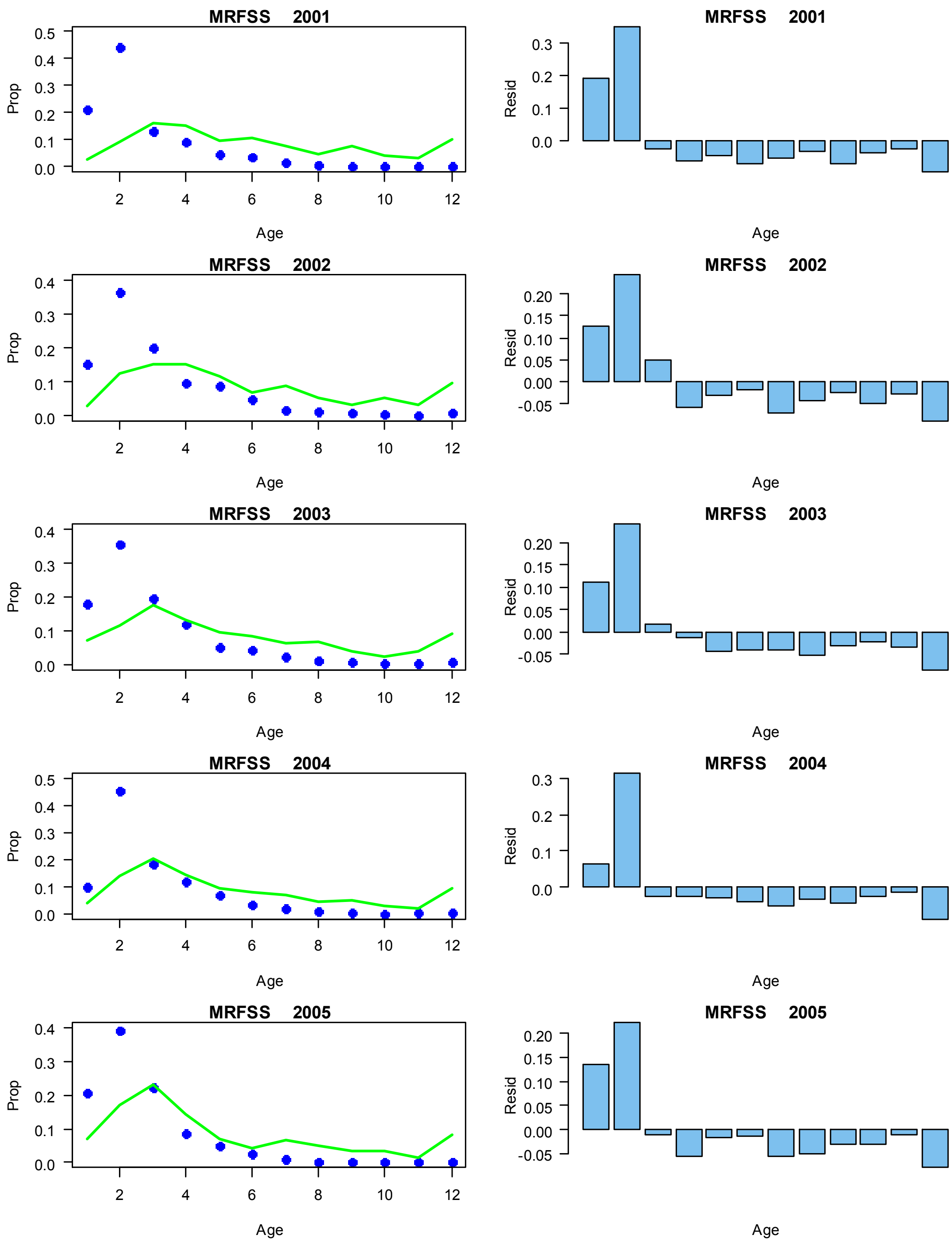


Figure 11.1.1 (continued). ASAP2 model fits and standardized residuals of age-length-key configured fleet catch age composition.

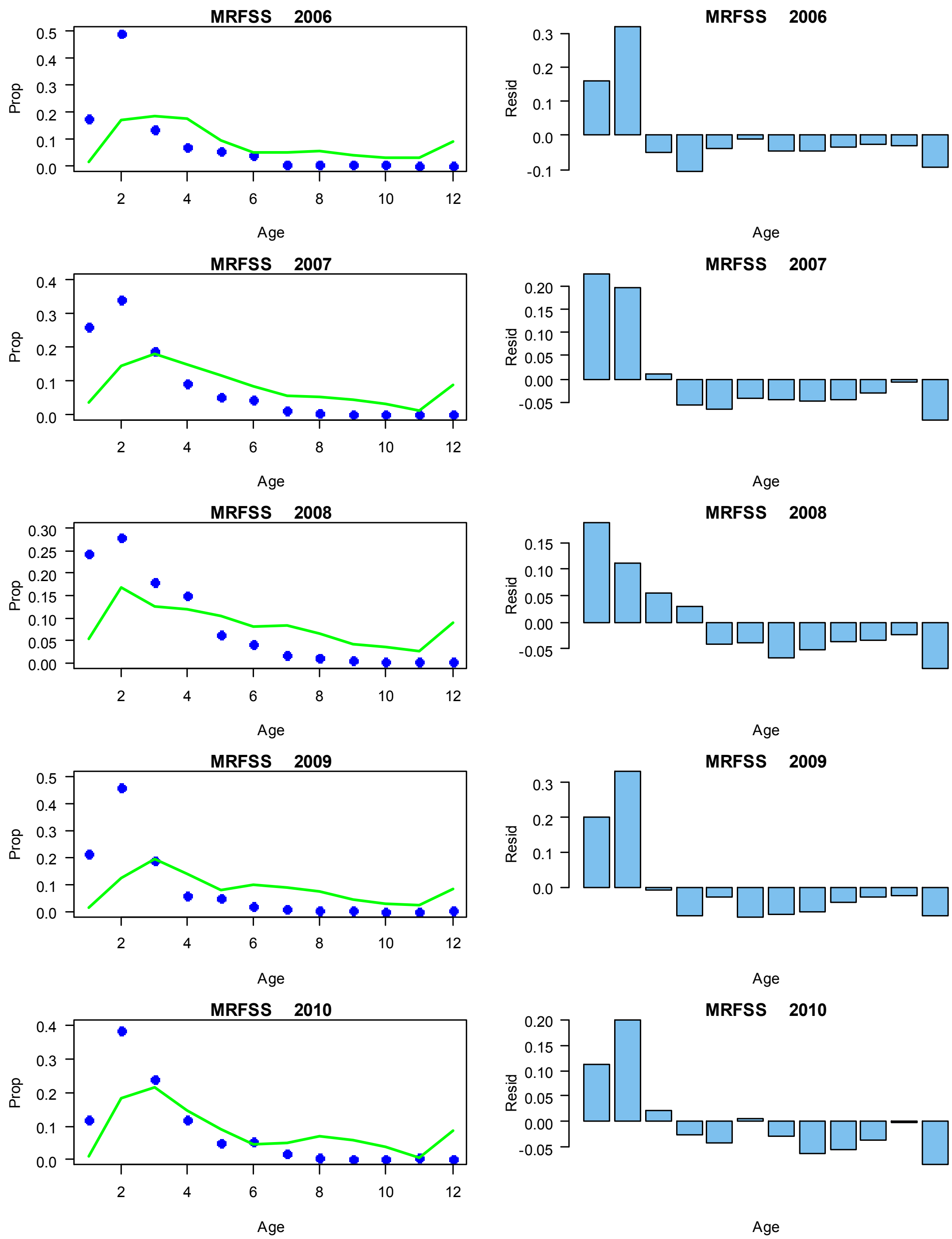


Figure 11.1.1 (continued). ASAP2 model fits and standardized residuals of age-length-key configured fleet catch age composition.

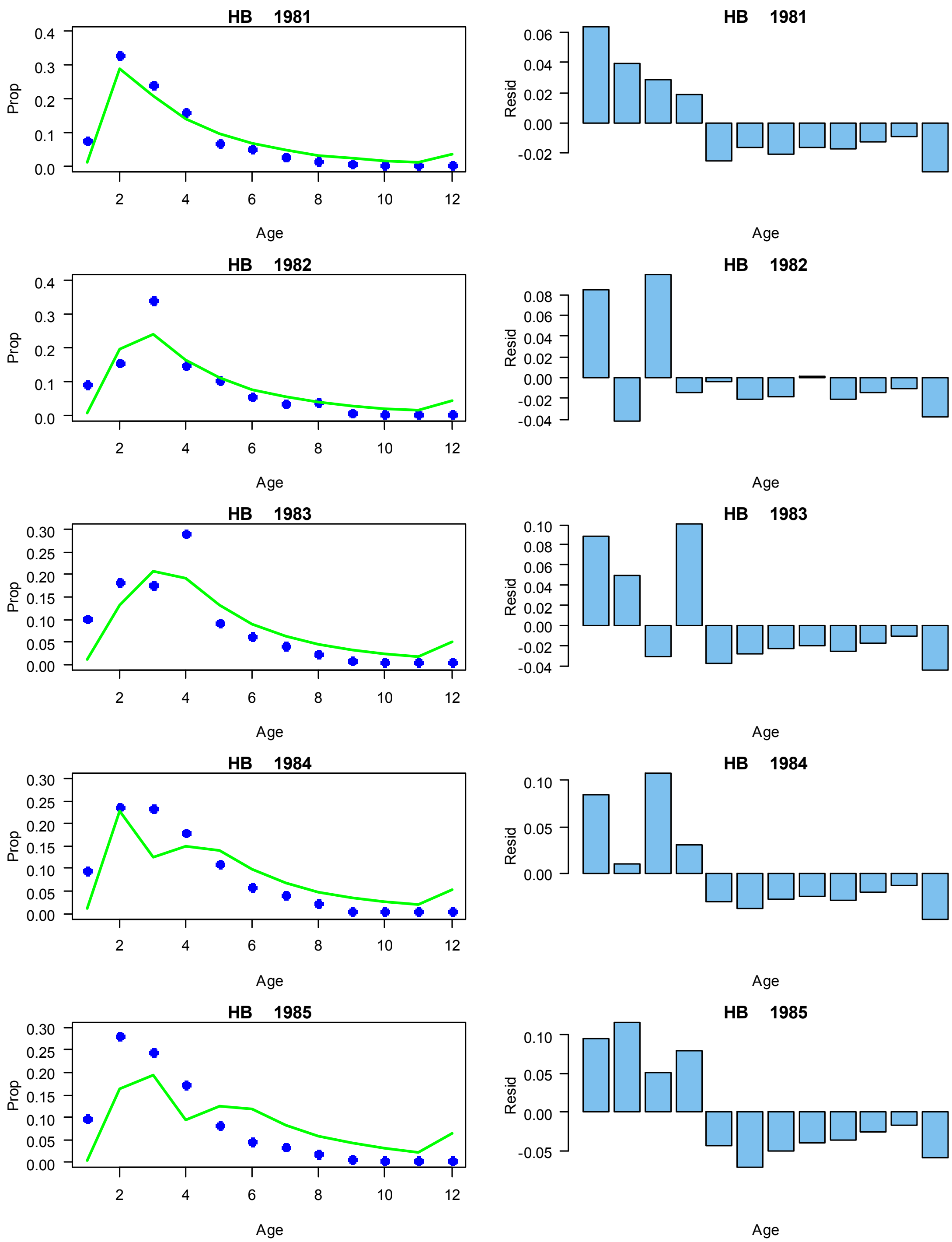


Figure 11.1.1 (continued). ASAP2 model fits and standardized residuals of age-length-key configured fleet catch age composition.

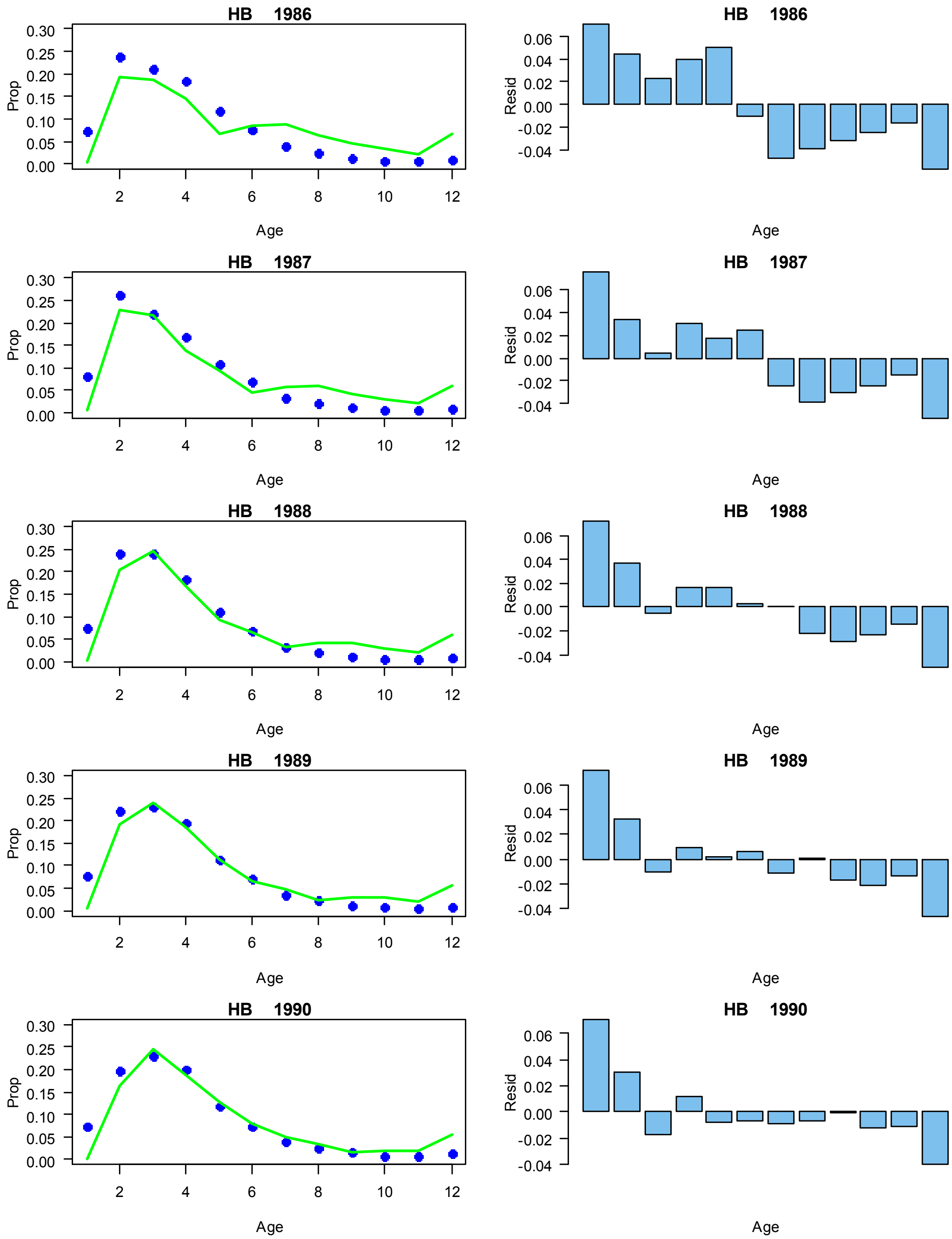


Figure 11.1.1 (continued). ASAP2 model fits and standardized residuals of age-length-key configured fleet catch age composition.

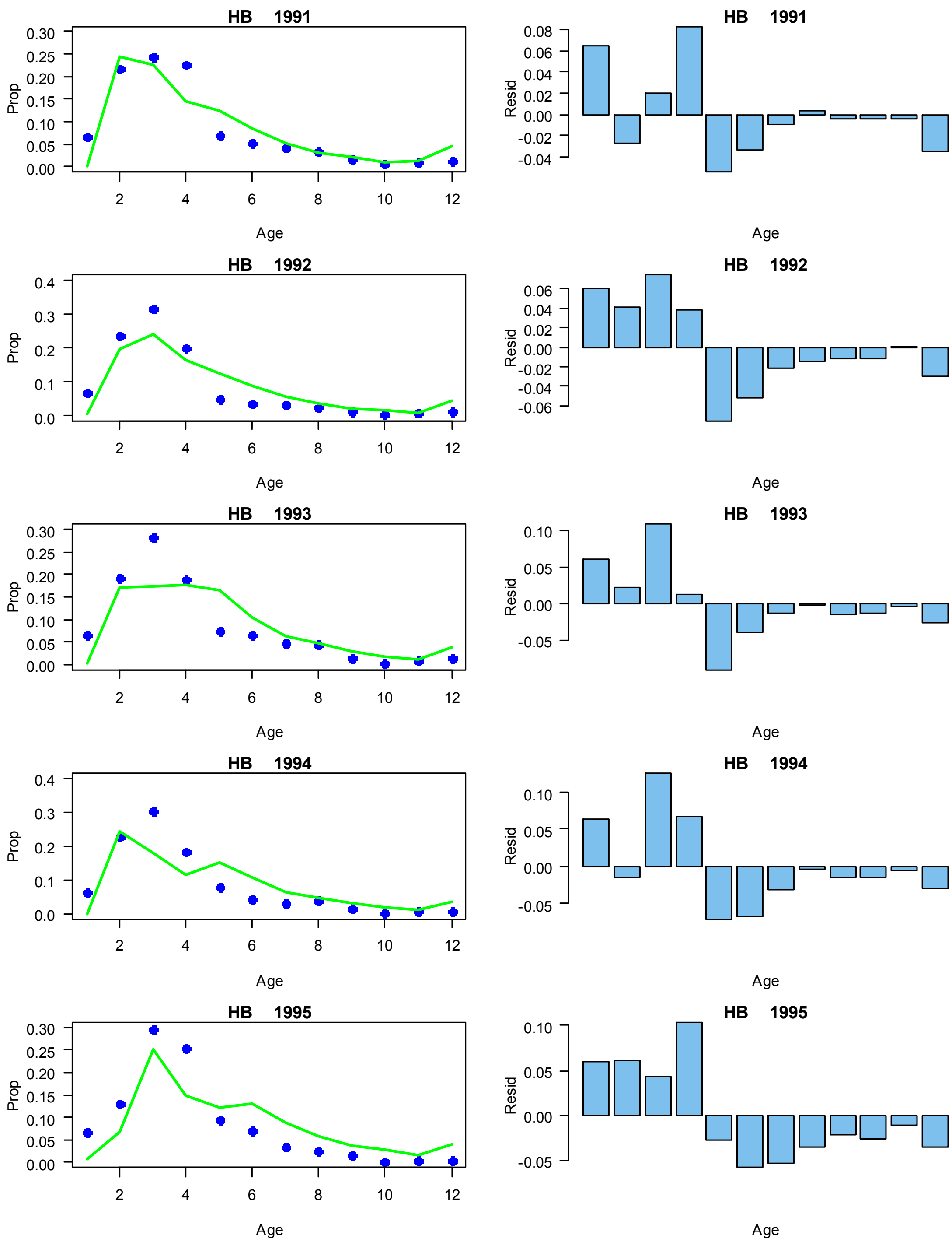


Figure 11.1.1 (continued). ASAP2 model fits and standardized residuals of age-length-key configured fleet catch age composition.

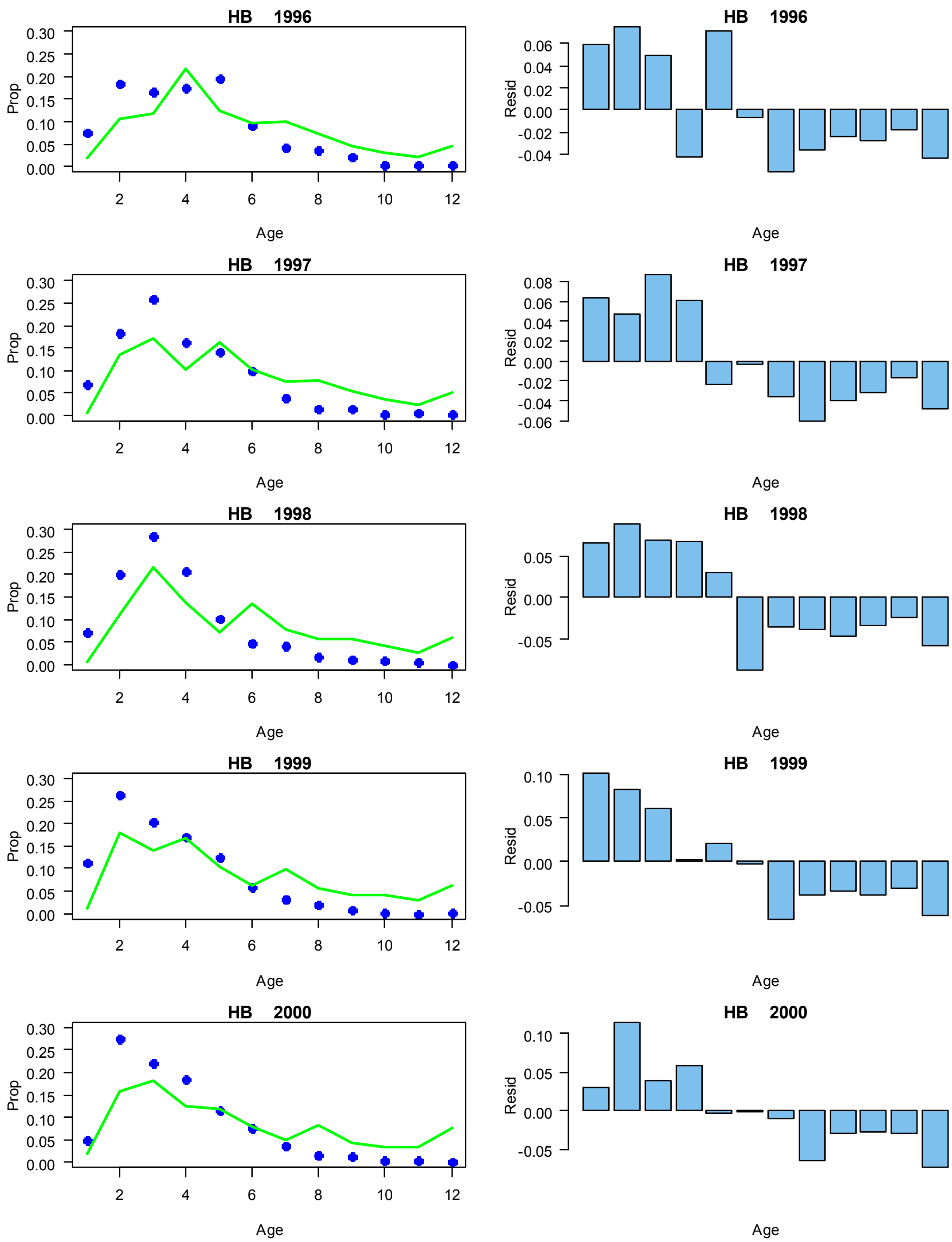


Figure 11.1.1 (continued). ASAP2 model fits and standardized residuals of age-length-key configured fleet catch age composition.

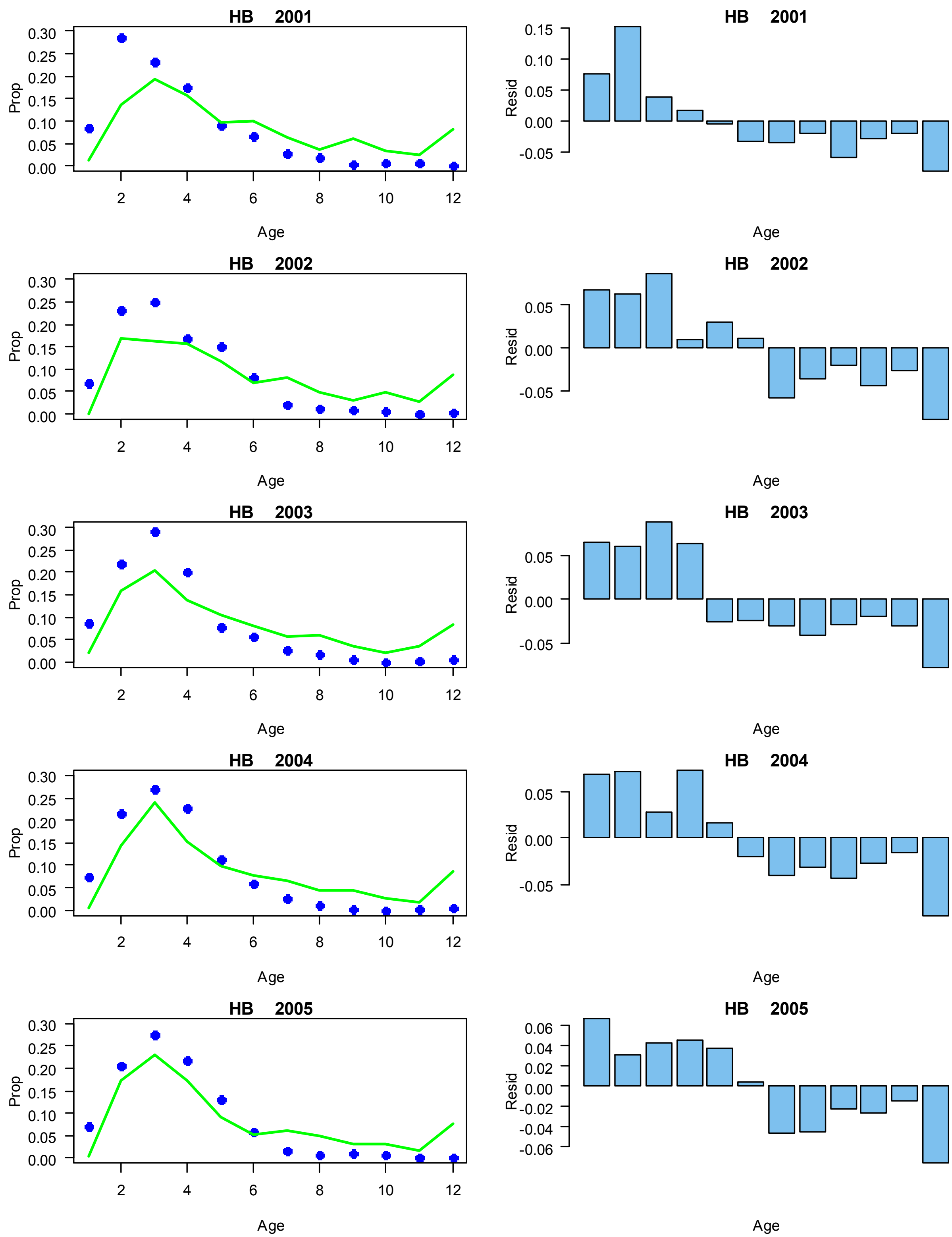


Figure 11.1.1 (continued). ASAP2 model fits and standardized residuals of age-length-key configured fleet catch age composition.

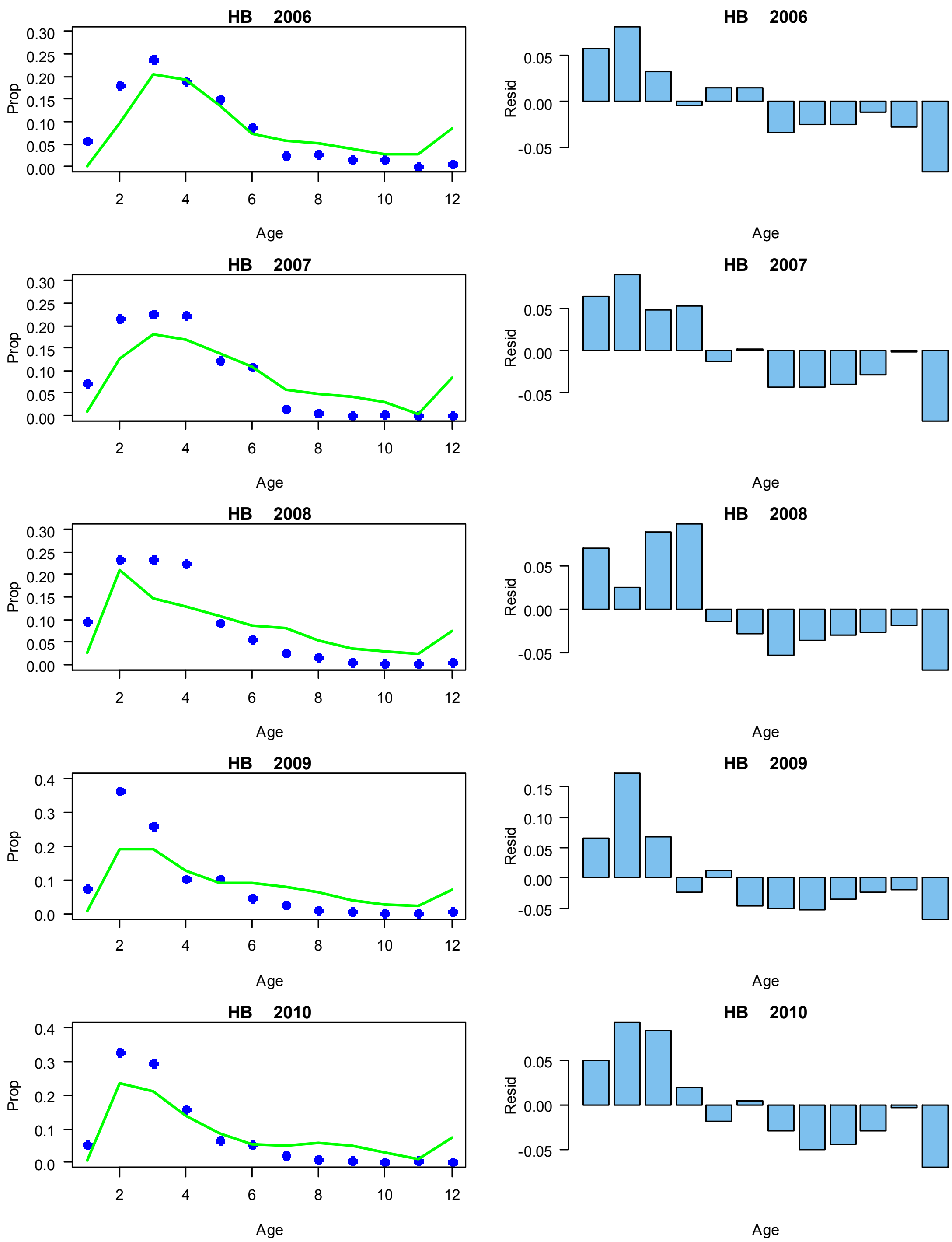


Figure 11.1.2 ASAP2 model fits and standardized residuals of age-length-key configured fleet discard age composition.

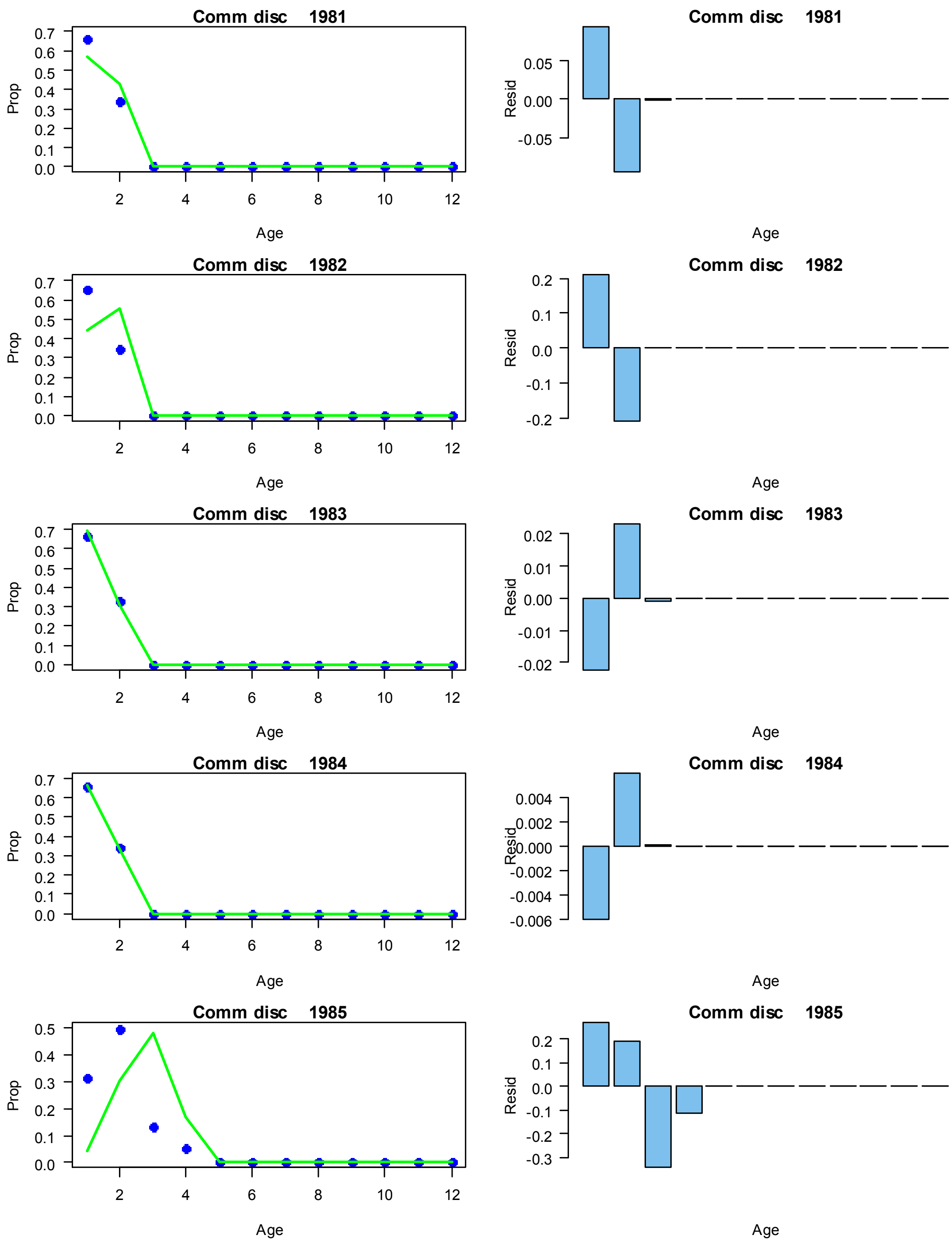


Figure 11.1.2 (continued). ASAP2 model fits and standardized residuals of age-length-key configured fleet discard age composition.

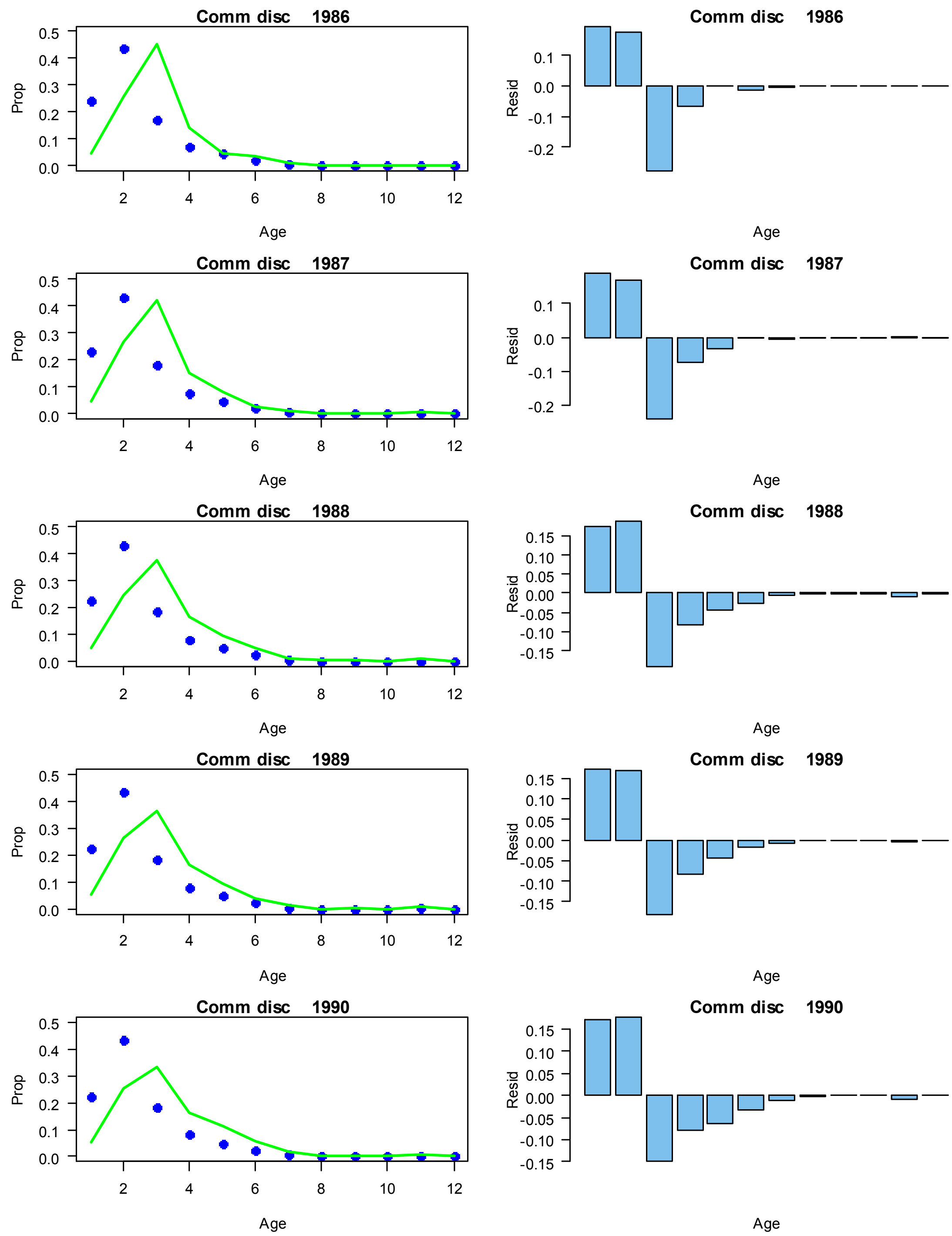


Figure 11.1.2 (continued). ASAP2 model fits and standardized residuals of age-length-key configured fleet discard age composition.

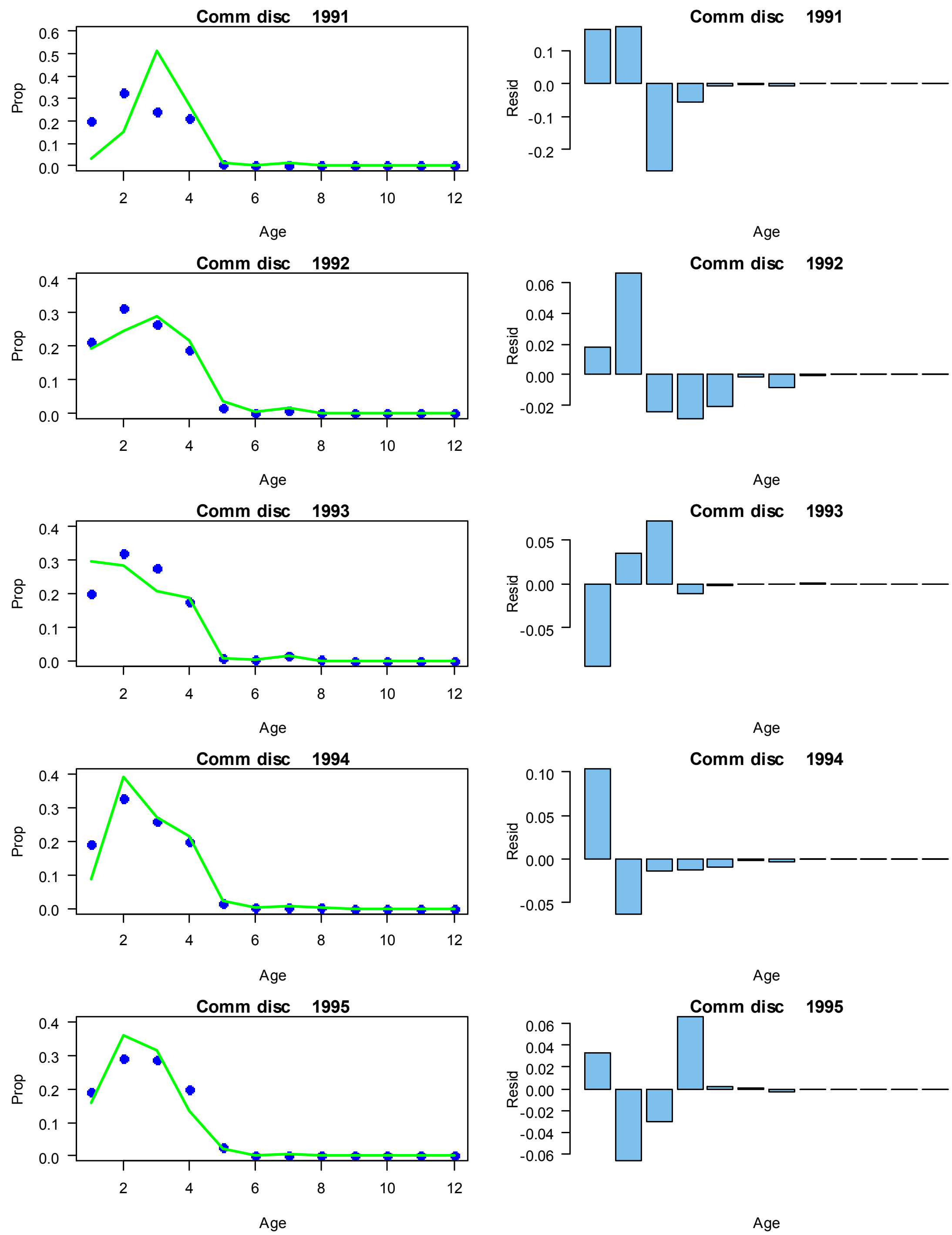


Figure 11.1.2 (continued). ASAP2 model fits and standardized residuals of age-length-key configured fleet discard age composition.

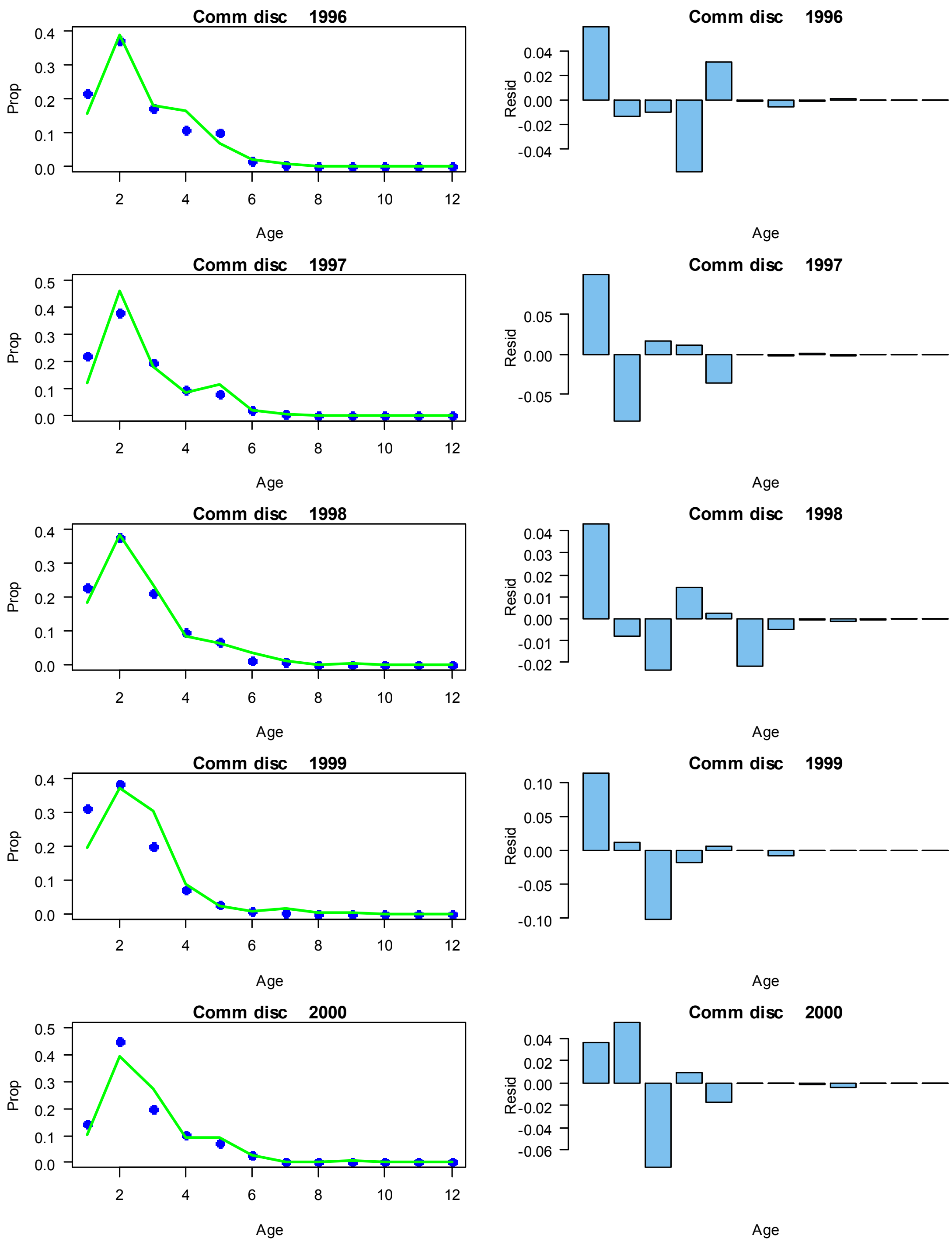


Figure 11.1.2 (continued). ASAP2 model fits and standardized residuals of age-length-key configured fleet discard age composition.

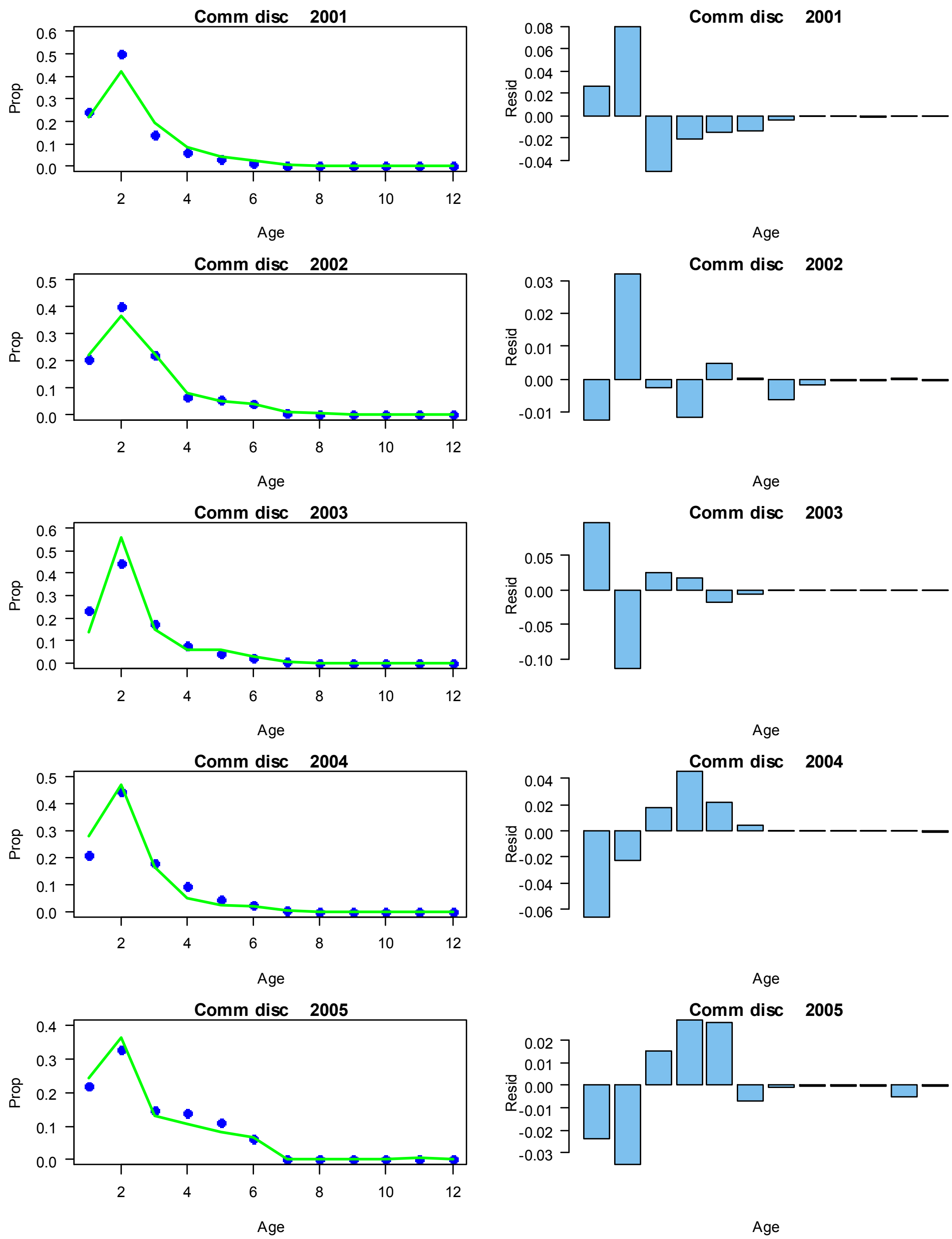


Figure 11.1.2 (continued). ASAP2 model fits and standardized residuals of age-length-key configured fleet discard age composition.

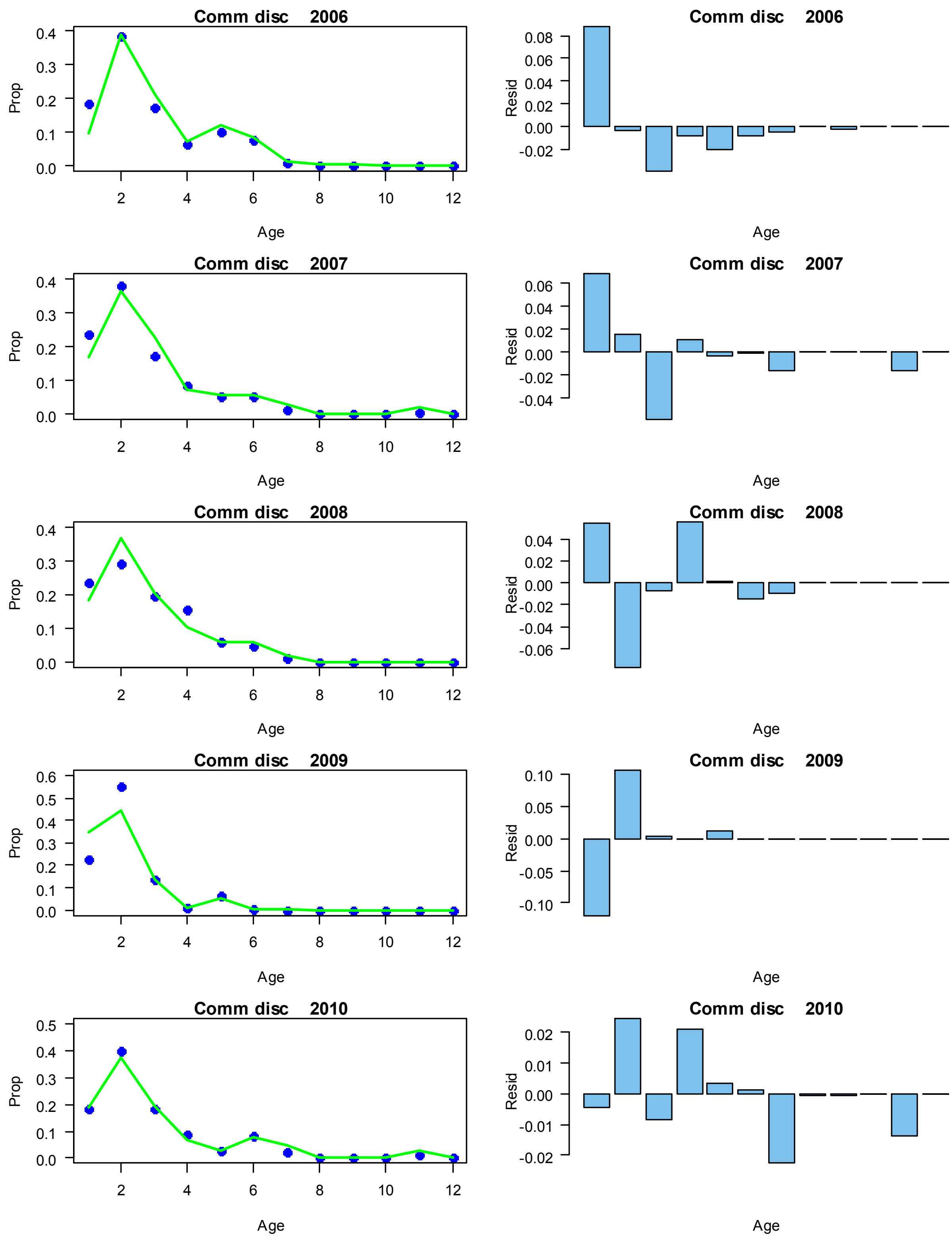


Figure 11.1.2 (continued). ASAP2 model fits and standardized residuals of age-length-key configured fleet discard age composition.

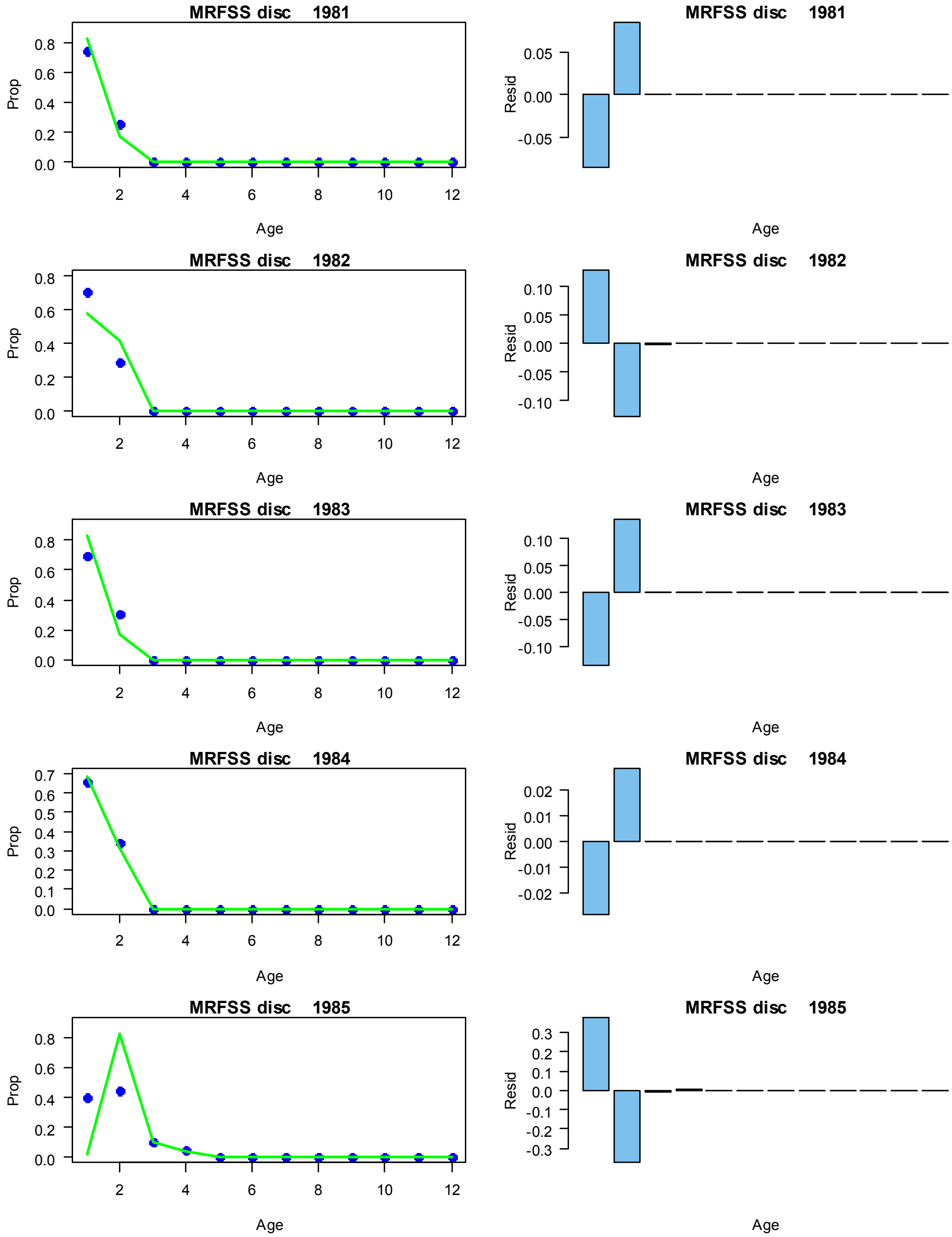


Figure 11.1.2 (continued). ASAP2 model fits and standardized residuals of age-length-key configured fleet discard age composition.

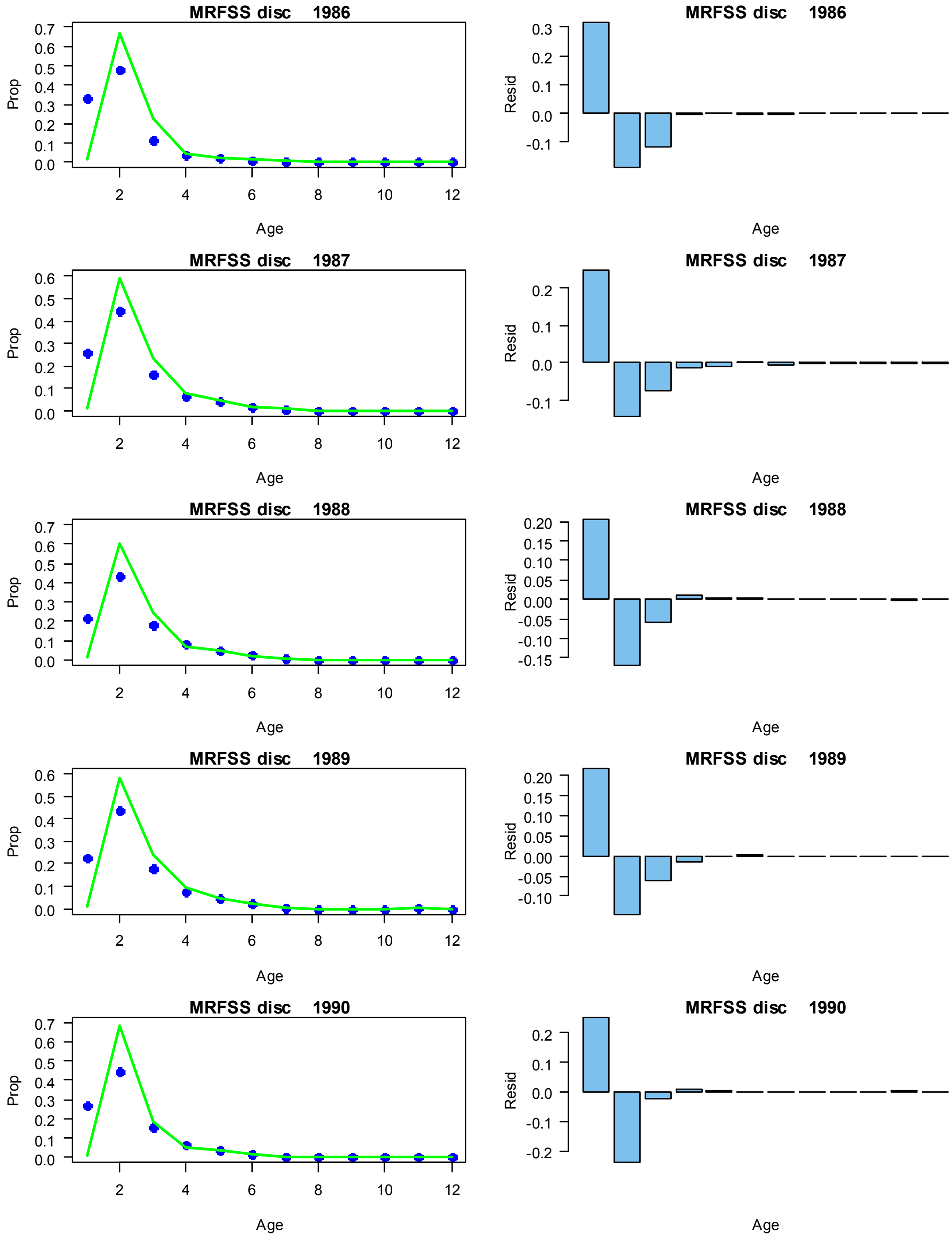


Figure 11.1.2 (continued). ASAP2 model fits and standardized residuals of age-length-key configured fleet discard age composition.

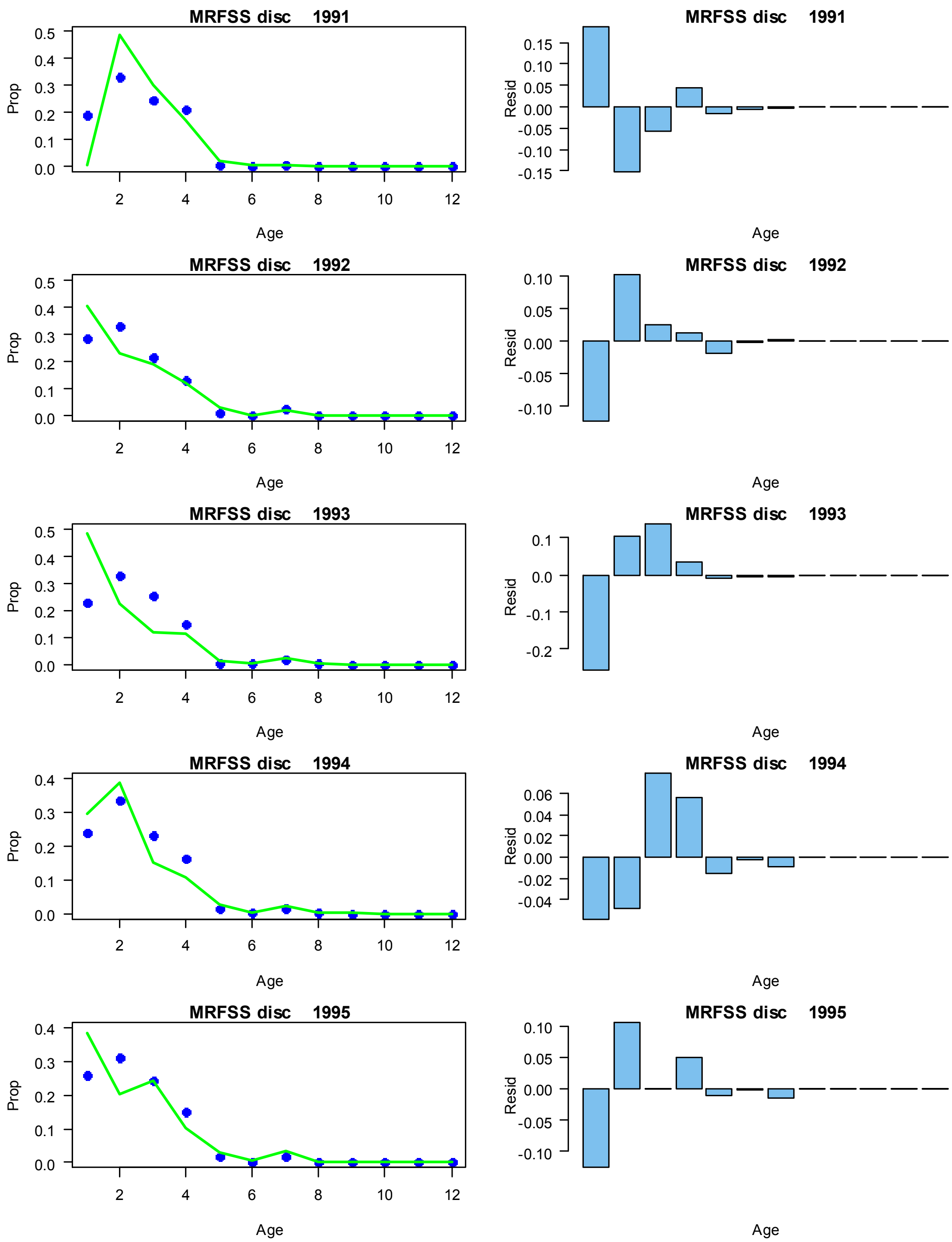


Figure 11.1.2 (continued). ASAP2 model fits and standardized residuals of age-length-key configured fleet discard age composition.

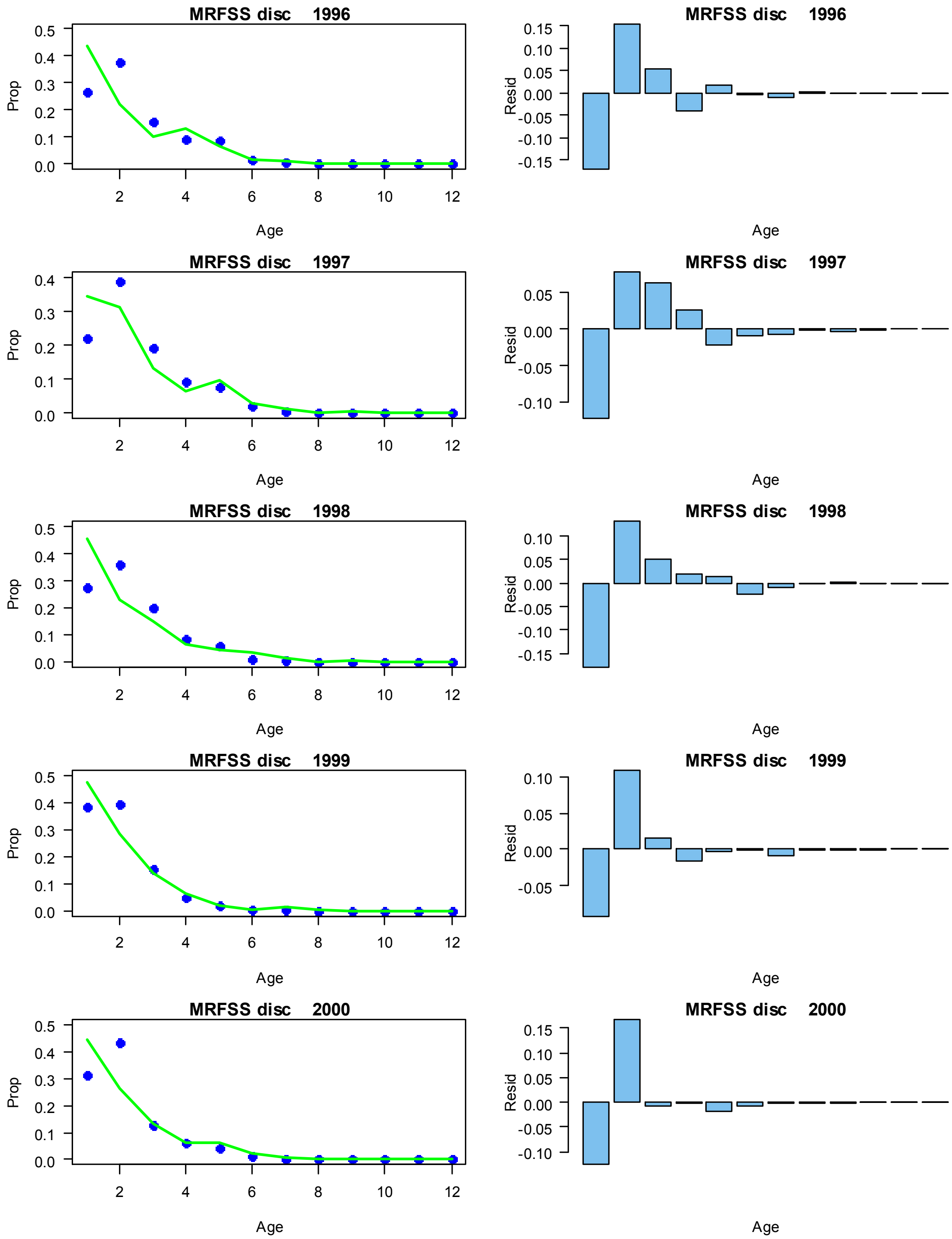


Figure 11.1.2 (continued). ASAP2 model fits and standardized residuals of age-length-key configured fleet discard age composition.

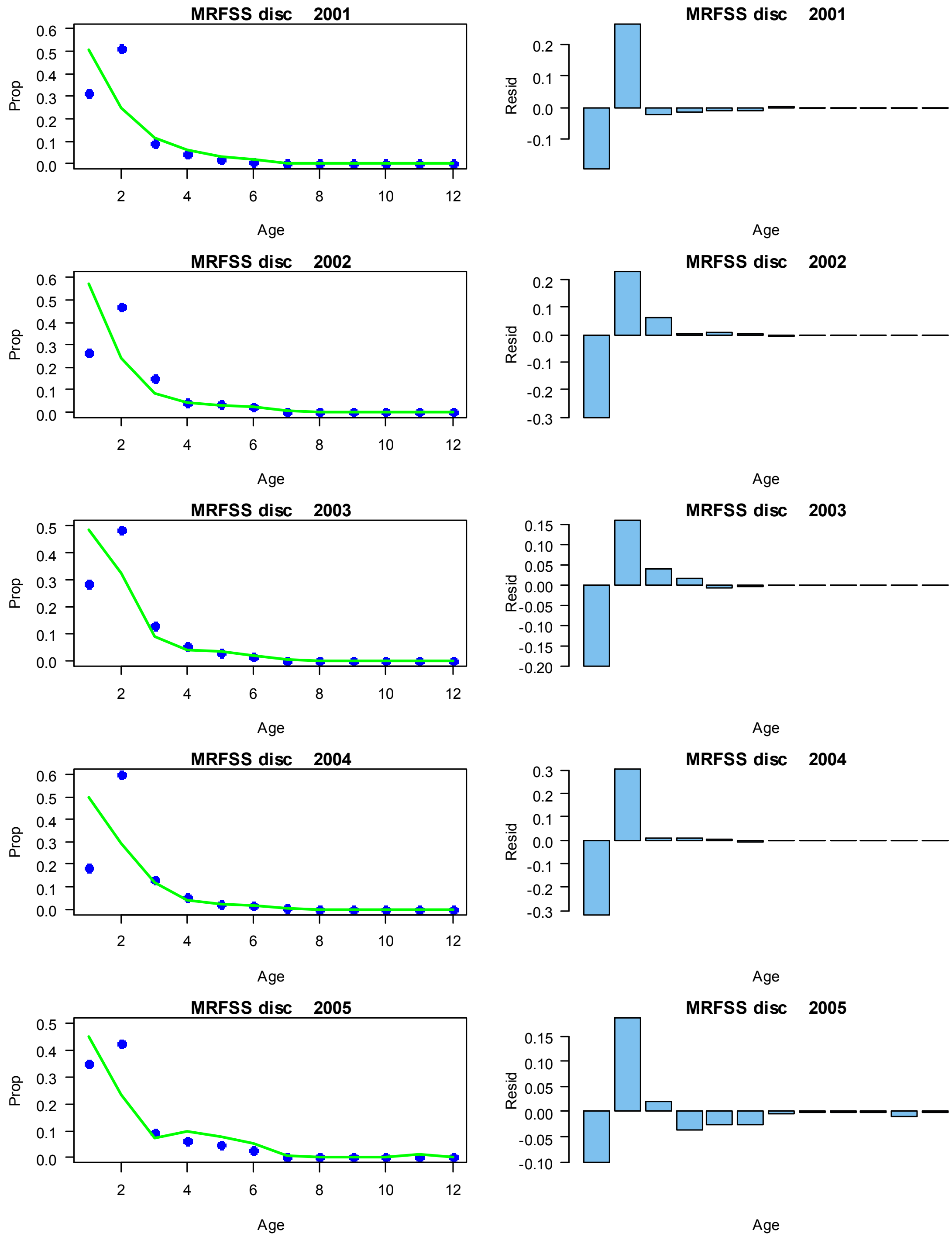


Figure 11.1.2 (continued). ASAP2 model fits and standardized residuals of age-length-key configured fleet discard age composition.

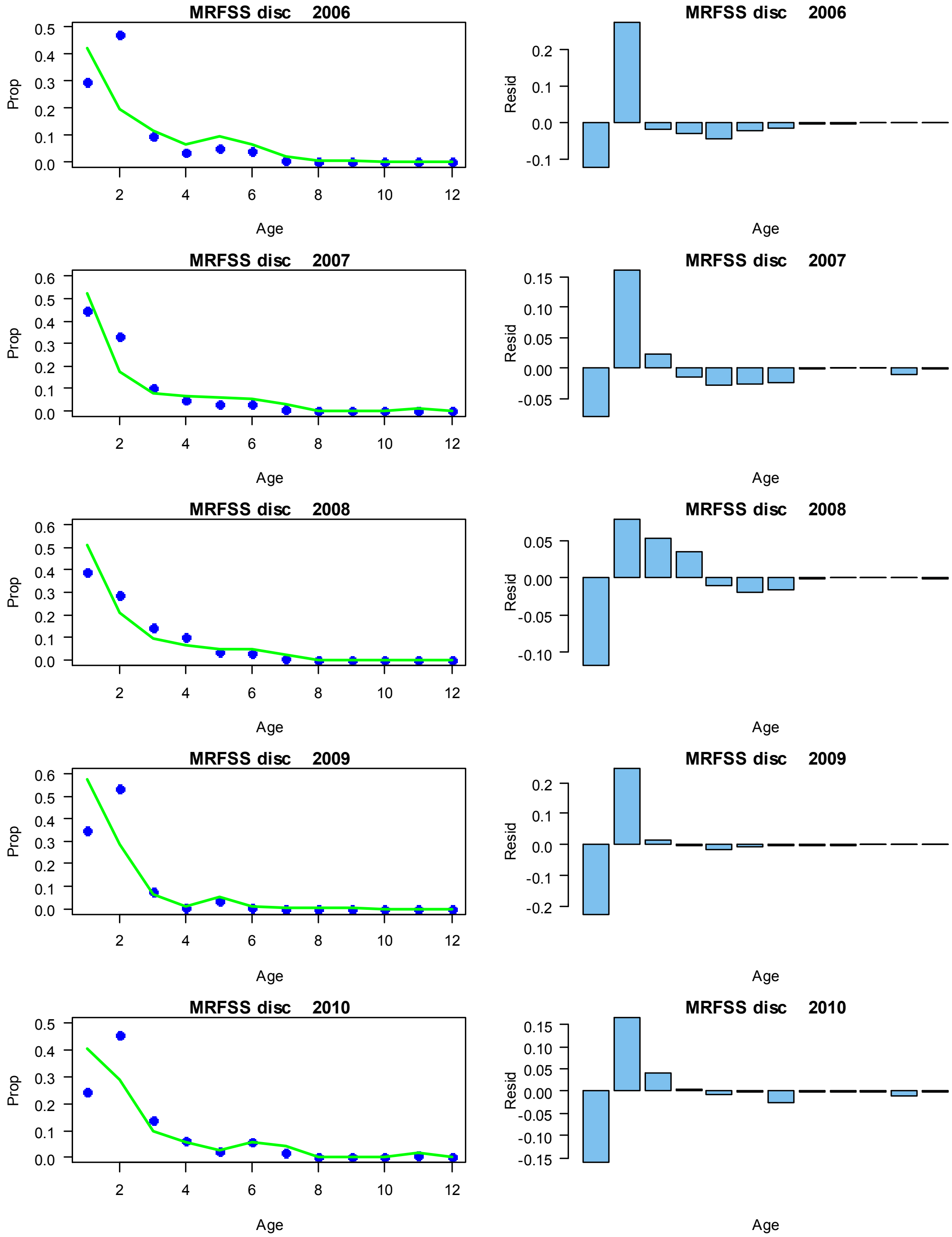


Figure 11.1.2 (continued). ASAP2 model fits and standardized residuals of age-length-key configured fleet discard age composition.

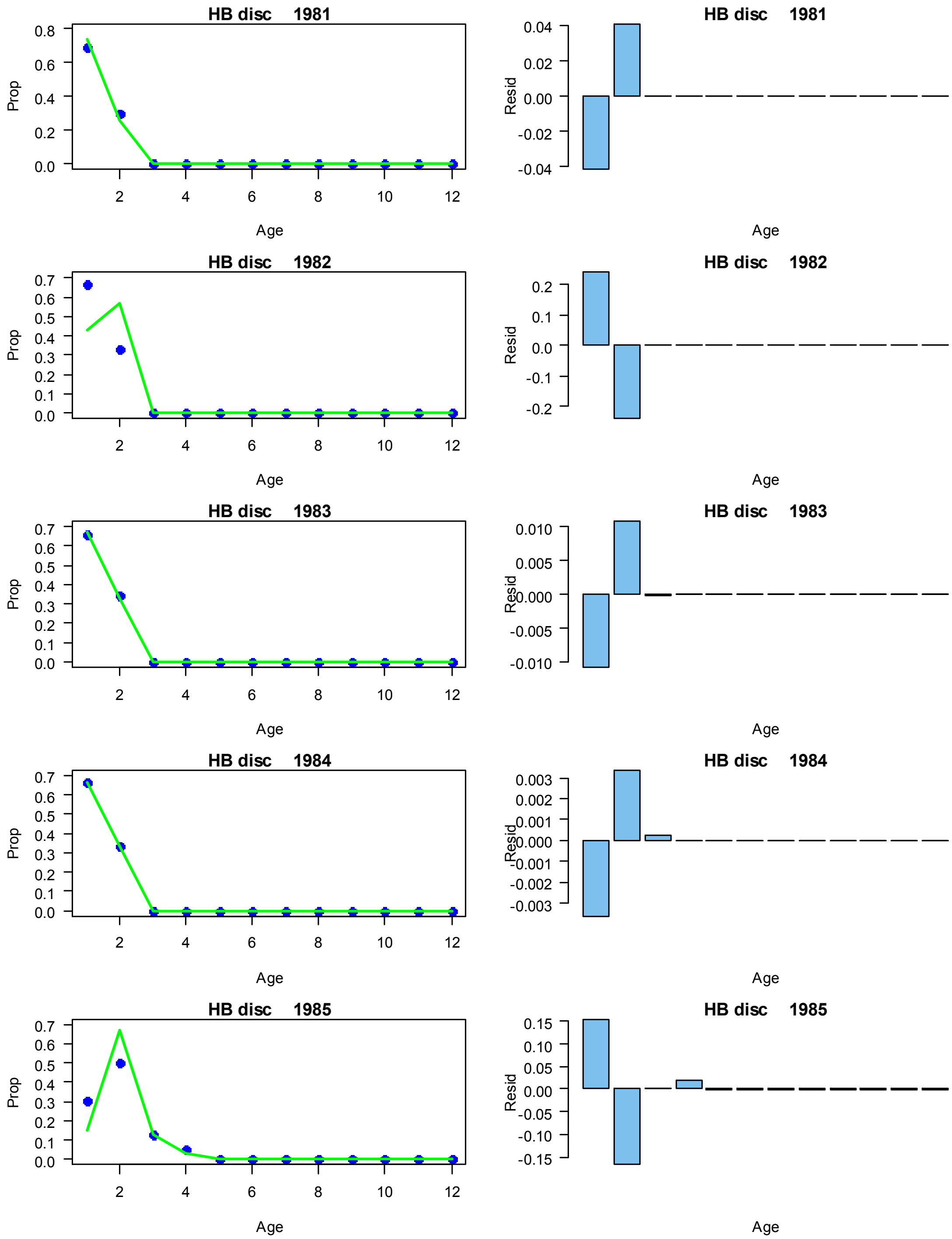


Figure 11.1.2 (continued). ASAP2 model fits and standardized residuals of age-length-key configured fleet discard age composition.

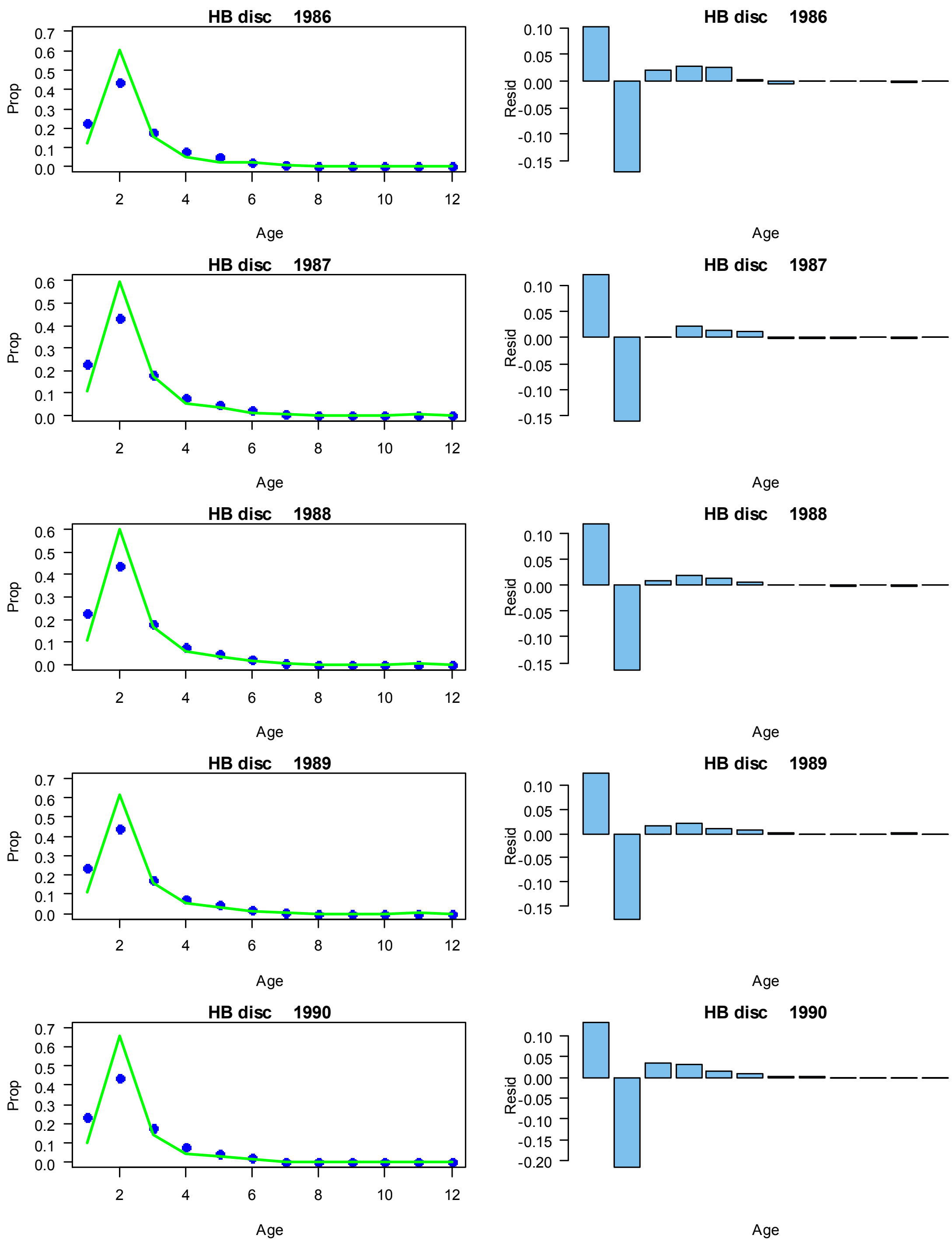


Figure 11.1.2 (continued). ASAP2 model fits and standardized residuals of age-length-key configured fleet discard age composition.

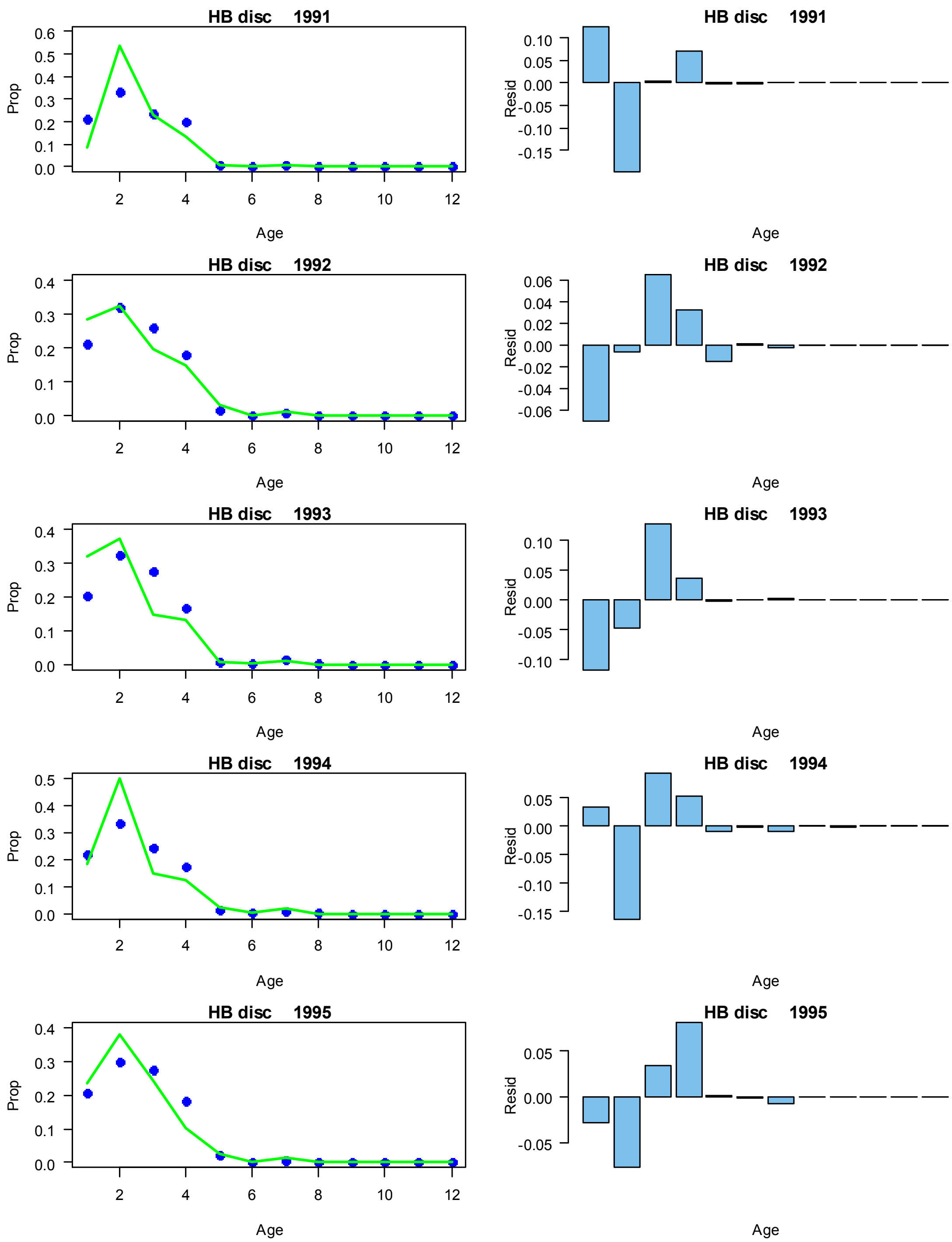


Figure 11.1.2 (continued). ASAP2 model fits and standardized residuals of age-length-key configured fleet discard age composition.

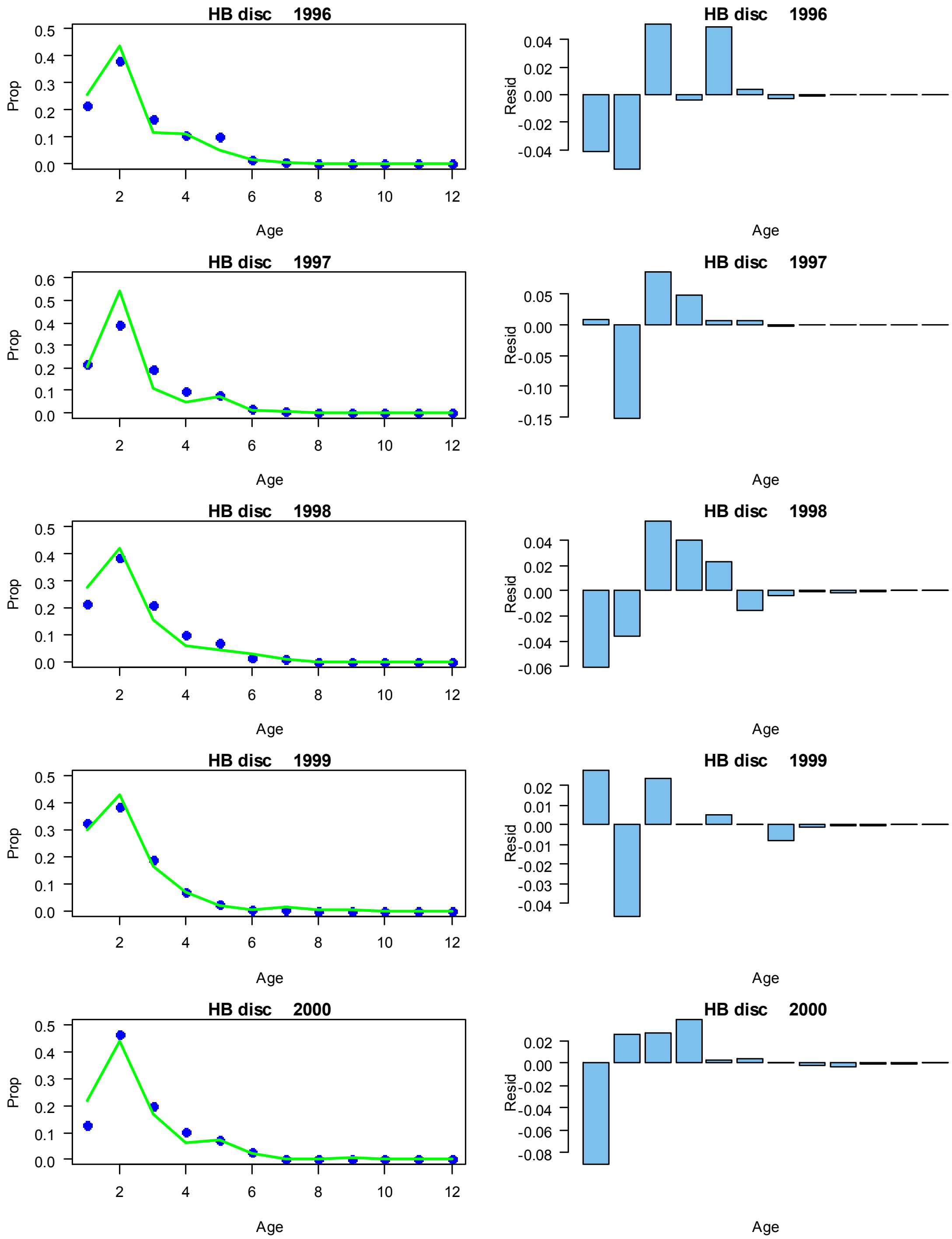


Figure 11.1.2 (continued). ASAP2 model fits and standardized residuals of age-length-key configured fleet discard age composition.

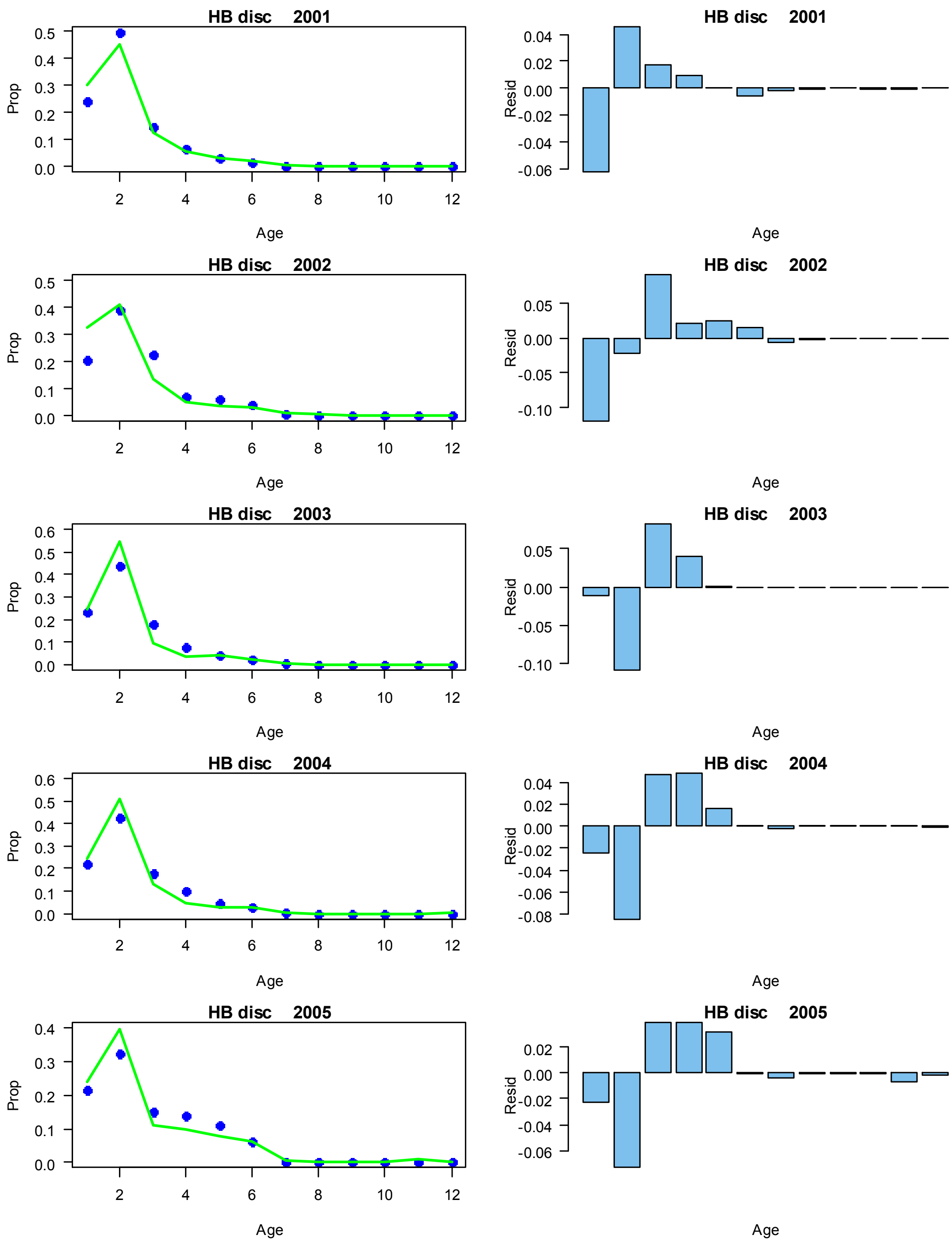


Figure 11.1.2 (continued). ASAP2 model fits and standardized residuals of age-length-key configured fleet discard age composition.

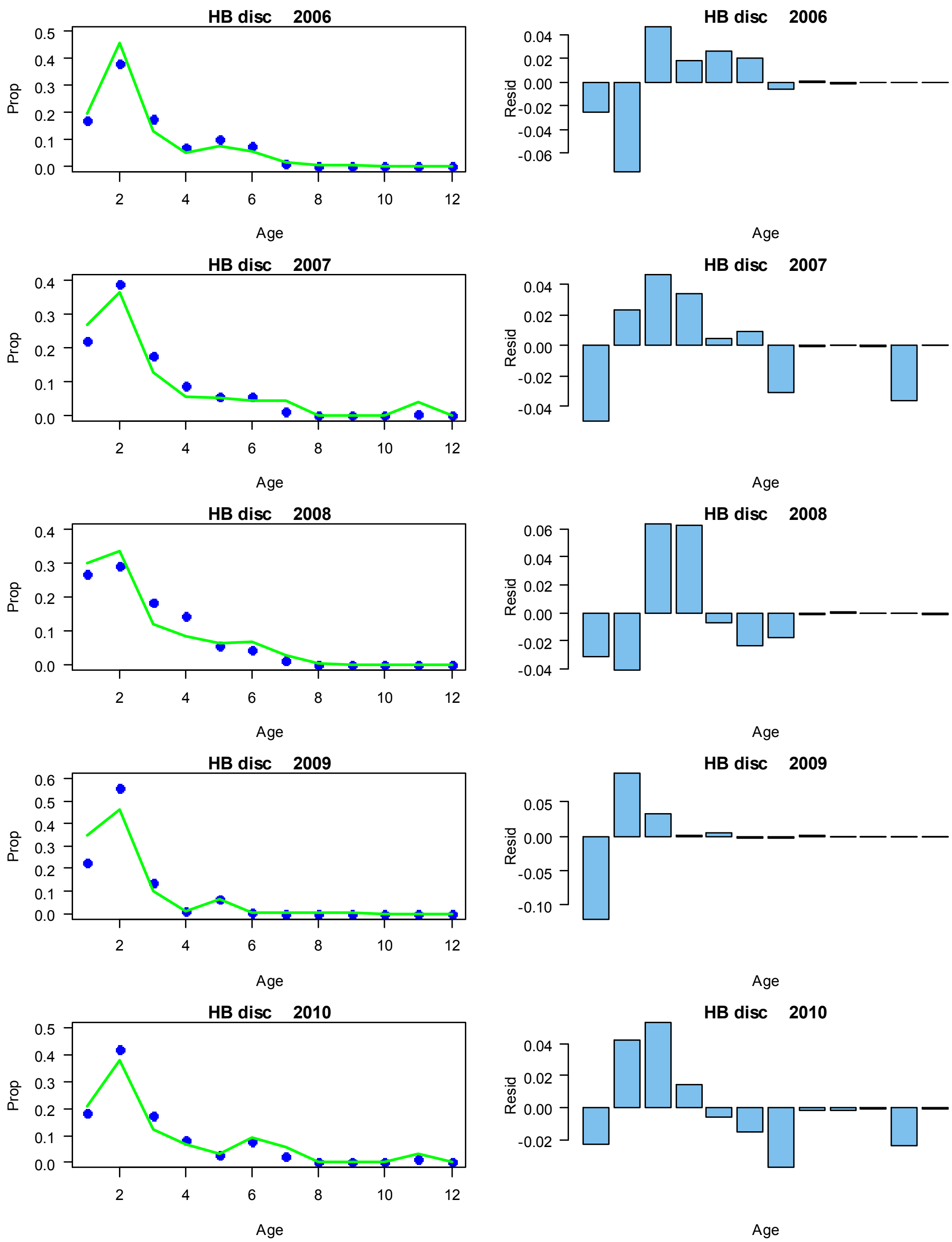


Figure 11.1.3 ASAP2 model fits and standardized residuals of age-length-key configured age composition for the NMFS-UM RVC index of abundance.

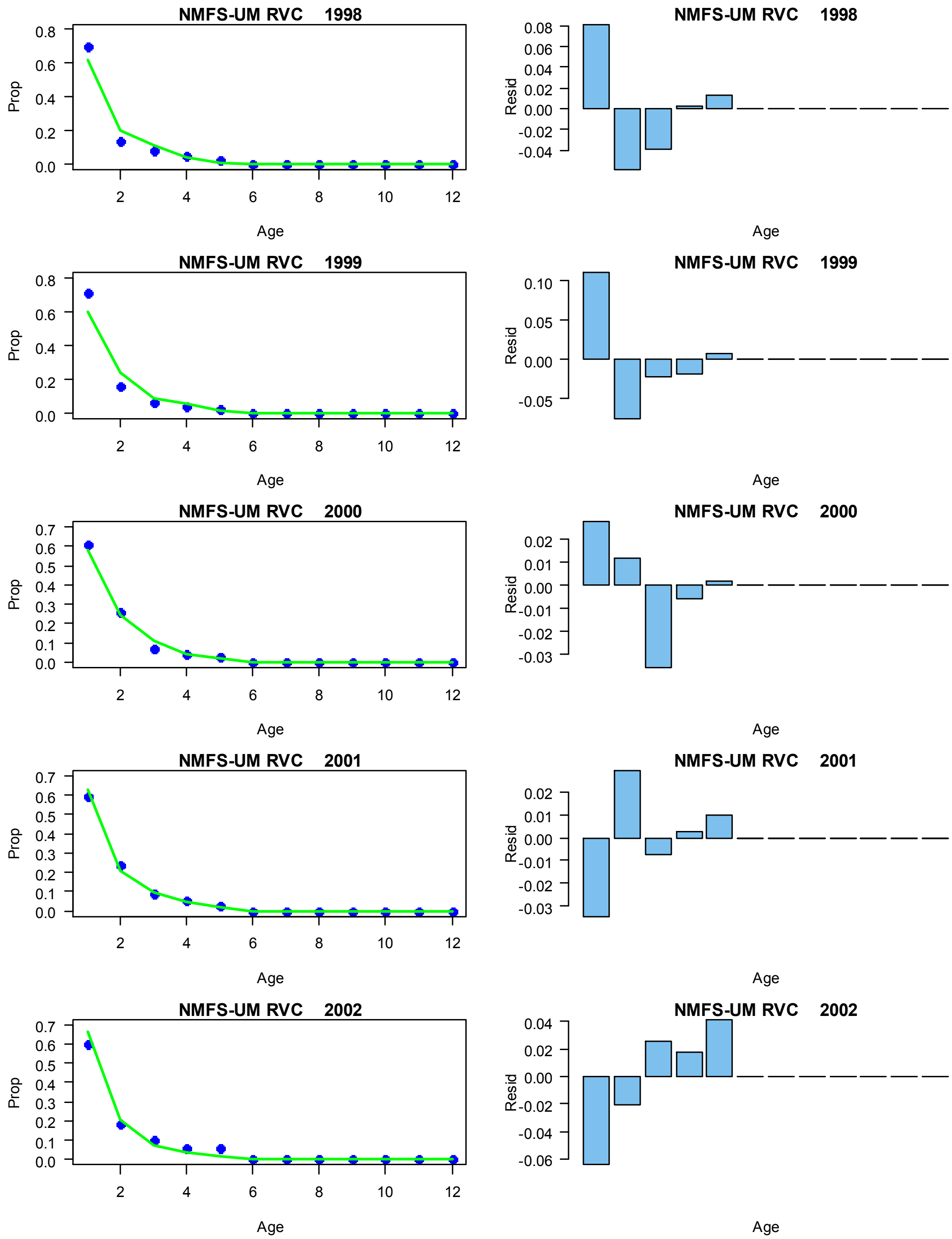


Figure 11.1.3 (continued). ASAP2 model fits and standardized residuals of age-length-key configured age composition for the NMFS-UM RVC index of abundance.

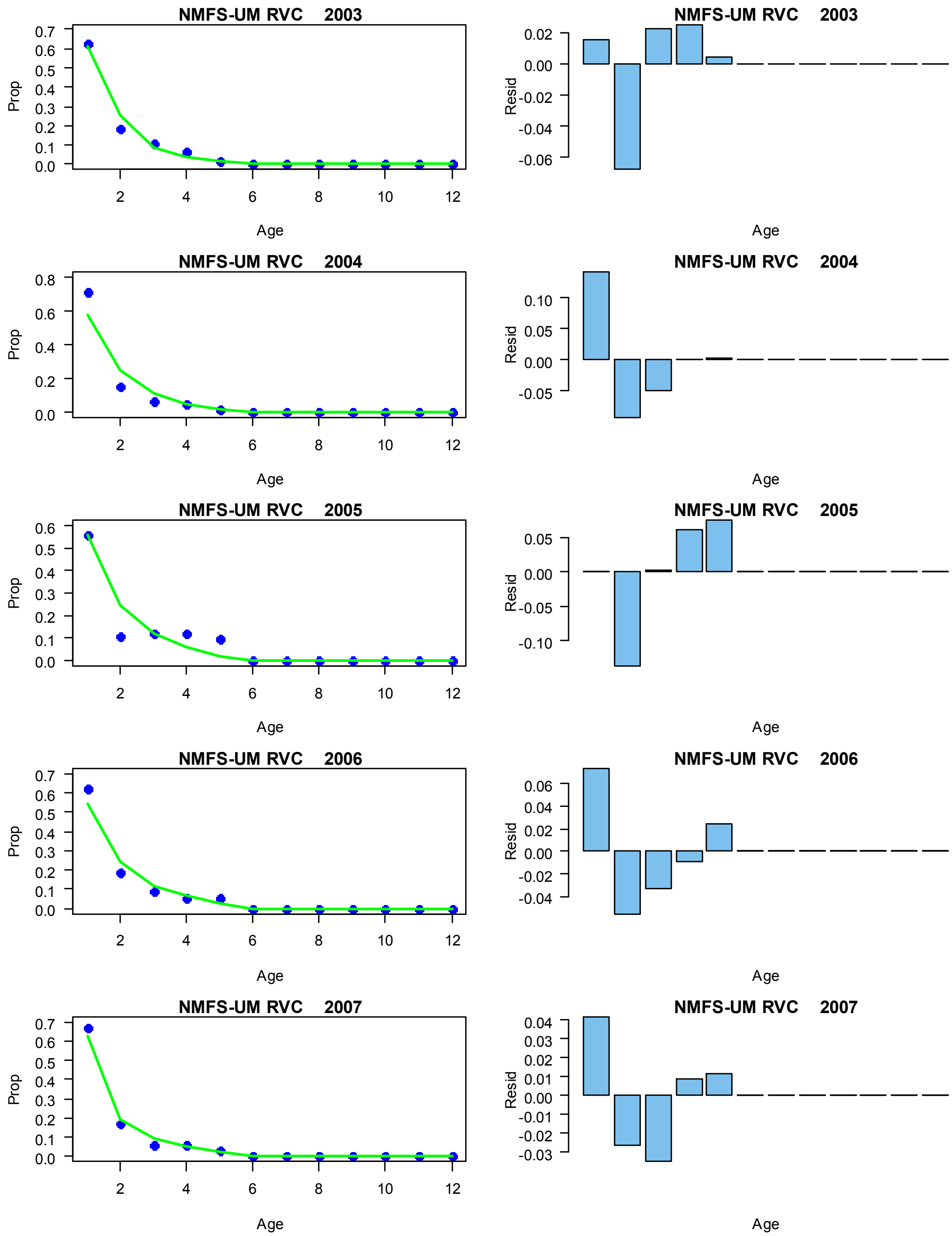
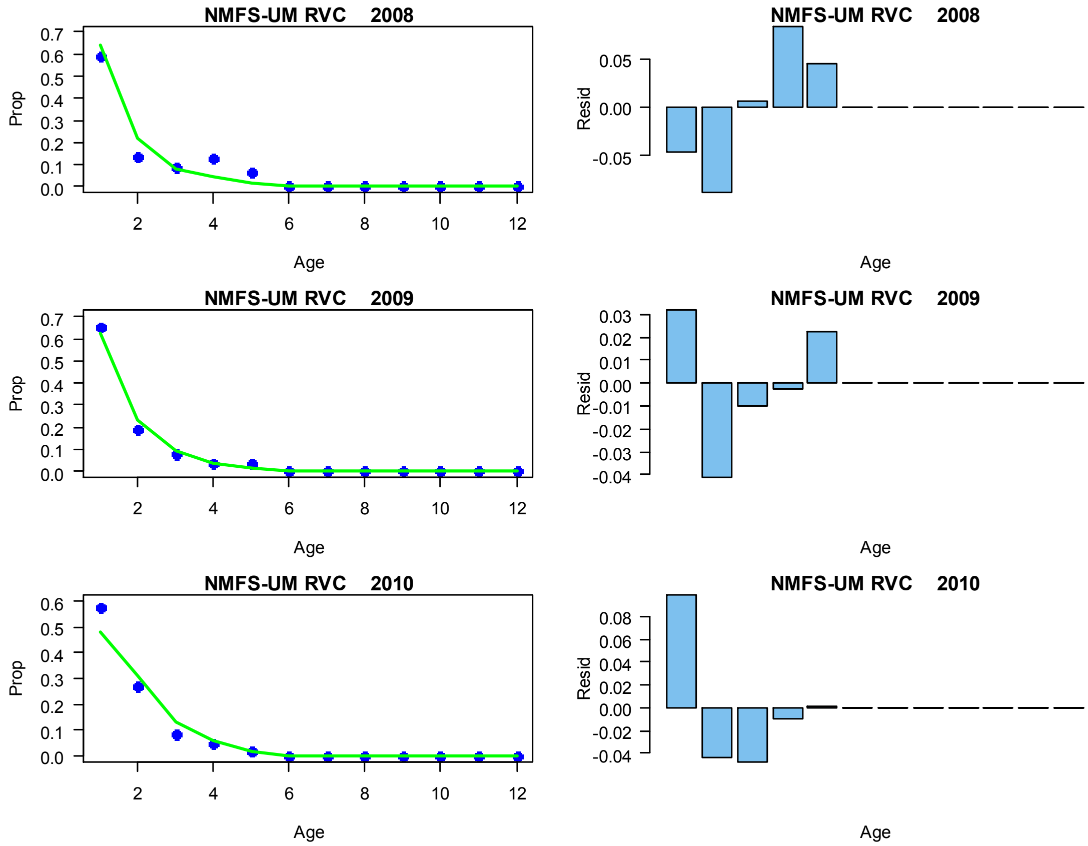


Figure 11.1.3 (continued). ASAP2 model fits and standardized residuals of age-length-key configured age composition for the NMFS-UM RVC index of abundance.



12 Appendix B

This appendix contains the input data files for the base run, yts_ALK_base.DAT. An alternate run, yts_DA_alt.dat was also configured but not used for this assessment. Both configurations were with the Lorenzen age-specific natural mortality curve with an average of 0.194 per year for ages 3-20, three fleets: commercial vessels using vertical line fishing gear, general recreational (MRFSS), and headdboat; one fishery independent indices of abundance: NMFS-UM Reef Visual Census (1998-2010) incorporating ages 1-5 (survey lengths converted to ages using age-length keys); initial steepness, 0.75; release mortality rates of 0.115 for commercial vertical lines, and 0.10 for recreational anglers and head boat anglers; and constant catchability for the three fishery-dependent indices (NMFS Coastal Fisheries Log Book Program (1993-2010), NMFS Marine Recreational Fishery Statistics Survey (1981-2010), and NMFS Southeast Head Boat Survey (1981-2010). The ALK (age-length-key) configuration based age compositions for landed fish and the NMFS_UM RVC index on length measurements taken annually from the fleets by region, from annual underwater observations by the RVCdivers, and annual age-length keys by region. The DA (direct-ageing) configuration based the age compositions of landed yellowtail snapper by fleets on age samples from landings from a fleet by region. Both configurations based age compositions of discards on length measurements from at-sea sampling of yellowtail snapper caught by head boat anglers in each region and applied these to all fleets. The DA configuration was an alternative to the ALK configuration, but was not used in this assessment.

12.1 ALK-configured ASAP2 input data file: yts_ALK_base.dat

```
# ASAP VERSION 2.0
# Yellowtail snapper (81-10); yts_Apr2012
#
# ASAP GUI - 15 JAN 2008
#
# Number of Years
30
# First Year
1981
# Number of Ages
12
# Number of Fleets
3
# Number of Selectivity Blocks (sum over all fleets)
9
# Number of Available Indices
4
# Fleet Names
#$Commercial
#$Recreational
#$Headboat
# Index Names
#$NMFS-UM
#$Headboat
#$MRFSS
#$Commercial
#
# Natural Mortality Rate Matrix
0.342 0.298 0.268 0.246 0.230 0.217 0.207 0.199 0.193 0.188 0.183 0.179
0.342 0.298 0.268 0.246 0.230 0.217 0.207 0.199 0.193 0.188 0.183 0.179
0.342 0.298 0.268 0.246 0.230 0.217 0.207 0.199 0.193 0.188 0.183 0.179
0.342 0.298 0.268 0.246 0.230 0.217 0.207 0.199 0.193 0.188 0.183 0.179
0.342 0.298 0.268 0.246 0.230 0.217 0.207 0.199 0.193 0.188 0.183 0.179
0.342 0.298 0.268 0.246 0.230 0.217 0.207 0.199 0.193 0.188 0.183 0.179
0.342 0.298 0.268 0.246 0.230 0.217 0.207 0.199 0.193 0.188 0.183 0.179
0.342 0.298 0.268 0.246 0.230 0.217 0.207 0.199 0.193 0.188 0.183 0.179
0.342 0.298 0.268 0.246 0.230 0.217 0.207 0.199 0.193 0.188 0.183 0.179
0.342 0.298 0.268 0.246 0.230 0.217 0.207 0.199 0.193 0.188 0.183 0.179
0.342 0.298 0.268 0.246 0.230 0.217 0.207 0.199 0.193 0.188 0.183 0.179
0.342 0.298 0.268 0.246 0.230 0.217 0.207 0.199 0.193 0.188 0.183 0.179
0.342 0.298 0.268 0.246 0.230 0.217 0.207 0.199 0.193 0.188 0.183 0.179
0.342 0.298 0.268 0.246 0.230 0.217 0.207 0.199 0.193 0.188 0.183 0.179
0.342 0.298 0.268 0.246 0.230 0.217 0.207 0.199 0.193 0.188 0.183 0.179
0.342 0.298 0.268 0.246 0.230 0.217 0.207 0.199 0.193 0.188 0.183 0.179
0.342 0.298 0.268 0.246 0.230 0.217 0.207 0.199 0.193 0.188 0.183 0.179
0.342 0.298 0.268 0.246 0.230 0.217 0.207 0.199 0.193 0.188 0.183 0.179
0.342 0.298 0.268 0.246 0.230 0.217 0.207 0.199 0.193 0.188 0.183 0.179
0.342 0.298 0.268 0.246 0.230 0.217 0.207 0.199 0.193 0.188 0.183 0.179
0.342 0.298 0.268 0.246 0.230 0.217 0.207 0.199 0.193 0.188 0.183 0.179
0.342 0.298 0.268 0.246 0.230 0.217 0.207 0.199 0.193 0.188 0.183 0.179
0.342 0.298 0.268 0.246 0.230 0.217 0.207 0.199 0.193 0.188 0.183 0.179
0.342 0.298 0.268 0.246 0.230 0.217 0.207 0.199 0.193 0.188 0.183 0.179
0.342 0.298 0.268 0.246 0.230 0.217 0.207 0.199 0.193 0.188 0.183 0.179
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0.342 0.298 0.268 0.246 0.230 0.217 0.207 0.199 0.193 0.188 0.183 0.179
0.342 0.298 0.268 0.246 0.230 0.217 0.207 0.199 0.193 0.188 0.183 0.179
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0.342 0.298 0.268 0.246 0.230 0.217 0.207 0.199 0.193 0.188 0.183 0.179
0.342 0.298 0.268 0.246 0.230 0.217 0.207 0.199 0.193 0.188 0.183 0.179
Fecundity Option
0
Fraction of year that elapses prior to SSB calculation (0=Jan-1)
0.5
Maturity Matrix
0.065 0.345 0.485 0.499 0.500 0.500 0.500 0.500 0.500 0.500 0.500 0.500
0.065 0.345 0.485 0.499 0.500 0.500 0.500 0.500 0.500 0.500 0.500 0.500
0.065 0.345 0.485 0.499 0.500 0.500 0.500 0.500 0.500 0.500 0.500 0.500
0.065 0.345 0.485 0.499 0.500 0.500 0.500 0.500 0.500 0.500 0.500 0.500
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0.065 0.345 0.485 0.499 0.500 0.500 0.500 0.500 0.500 0.500 0.500 0.500
0.065 0.345 0.485 0.499 0.500 0.500 0.500 0.500 0.500 0.500 0.500 0.500
0.065 0.345 0.485 0.499 0.500 0.500 0.500 0.500 0.500 0.500 0.500 0.500
Weight at Age for Catch Matrix
0.1383 0.2916 0.4362 0.5449 0.7264 0.8903 0.9629 1.1345 1.3978 1.5491 1.0649 1.5321
0.1355 0.2660 0.5245 0.5504 0.8039 1.0042 1.0853 0.8866 1.3884 1.4595 1.3396 1.5429
0.1314 0.2991 0.4870 0.4888 0.7893 0.8737 0.9956 1.0730 1.2870 1.4792 0.9723 1.5689
0.1231 0.2304 0.4586 0.4942 0.7967 0.9265 1.0135 1.1058 1.3945 1.4129 1.2244 1.5302
0.1575 0.3253 0.5671 0.6612 0.9028 1.0347 1.1263 1.2970 1.5462 1.6947 1.3170 1.7257
0.1691 0.2861 0.4715 0.6459 0.7456 0.8270 1.0348 1.2015 1.2969 1.3455 1.4205 1.6215
0.1568 0.2617 0.3916 0.5234 0.6272 0.7211 0.9218 1.1333 1.2272 1.3294 1.3822 1.7133
0.1487 0.2781 0.4126 0.5346 0.5871 0.6678 0.8063 0.9369 1.0427 1.1224 1.1302 1.4727
0.1470 0.2662 0.4069 0.5164 0.6048 0.6888 0.8631 1.0185 1.1266 1.2040 1.2432 1.5140
0.1562 0.2675 0.4040 0.5020 0.5603 0.6217 0.7246 0.8231 0.8840 0.9957 0.9690 1.2552
0.1262 0.2354 0.3215 0.3907 0.6666 0.6586 0.9165 0.9918 0.9638 1.3710 1.2538 1.4934
0.1517 0.2867 0.3902 0.4488 0.6322 0.7404 0.8264 1.1125 1.0721 1.3959 1.2060 1.4831
0.1383 0.2709 0.3711 0.4687 0.5911 0.5804 0.6135 0.6930 0.8041 1.3540 0.9688 1.3602
0.1375 0.2884 0.4043 0.4488 0.5538 0.6176 0.7973 0.7321 0.6668 1.2727 1.0101 1.6323
0.1443 0.2328 0.3593 0.4364 0.4729 0.5581 0.6418 0.7274 0.7327 1.2955 0.9425 1.2197
0.1546 0.2488 0.3747 0.4226 0.4336 0.5713 0.5939 0.5985 0.6572 1.0201 1.0534 1.5541

0.1418 0.2371 0.3718 0.4143 0.4714 0.5716 0.6836 0.7415 0.7629 0.9111 1.0045 1.4891
0.1561 0.2675 0.3737 0.4556 0.4956 0.6274 0.6519 0.7269 0.6697 0.7787 1.1253 1.7758
0.1606 0.3005 0.3752 0.5247 0.5598 0.6034 0.6246 0.7488 0.7860 0.9571 1.4252 1.6032
0.1818 0.2968 0.4313 0.4707 0.5596 0.6033 0.6271 0.7304 0.8624 0.8697 0.9030 1.4421
0.1881 0.3018 0.4191 0.5097 0.5452 0.6090 0.7270 0.6421 1.1576 0.6095 0.8826 1.3962
0.1624 0.2882 0.4139 0.5060 0.5450 0.6085 0.7751 0.8538 0.8231 0.9283 1.2206 1.3212
0.1991 0.2804 0.4273 0.4910 0.5536 0.6457 0.7966 0.7880 1.0231 1.1994 1.0841 1.5398
0.1620 0.2937 0.4117 0.5110 0.5786 0.5975 0.7291 0.7884 1.2394 1.2395 1.1168 1.0632
0.1789 0.3125 0.4725 0.5341 0.5727 0.5952 0.8694 0.8171 0.8884 0.8004 0.8713 1.0492
0.1541 0.2942 0.4237 0.5148 0.4830 0.5150 0.7331 0.8065 0.7301 0.8761 1.6288 1.0423
0.1904 0.3046 0.4427 0.4854 0.5797 0.5695 0.8652 0.9996 1.8730 1.1390 1.1357 1.2021
0.1836 0.3041 0.4221 0.4777 0.5684 0.5745 0.6776 0.7847 0.9556 1.0055 1.0258 0.9540
0.1668 0.3149 0.4621 0.5507 0.5852 0.6636 0.7661 0.9049 0.9263 1.0655 0.9212 1.1737
0.1502 0.3151 0.4687 0.5669 0.6318 0.6617 0.7137 0.8296 0.9005 1.1421 0.8672 1.2344
WEIGHT AT AGE FOR SPAWNING STOCK BIOMASS MATRIX
0.1865 0.2808 0.3846 0.4932 0.6029 0.7107 0.8147 0.9132 1.0054 1.0909 1.1694 1.3772
0.1865 0.2808 0.3846 0.4932 0.6029 0.7107 0.8147 0.9132 1.0054 1.0909 1.1694 1.3772
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0.1865 0.2808 0.3846 0.4932 0.6029 0.7107 0.8147 0.9132 1.0054 1.0909 1.1694 1.3772
0.1865 0.2808 0.3846 0.4932 0.6029 0.7107 0.8147 0.9132 1.0054 1.0909 1.1694 1.3772
WEIGHT AT AGE FOR JAN-1 BIOMASS MATRIX
0.1446 0.2321 0.3318 0.4385 0.5481 0.6572 0.7633 0.8647 0.9601 1.0490 1.1310 1.3497
0.1446 0.2321 0.3318 0.4385 0.5481 0.6572 0.7633 0.8647 0.9601 1.0490 1.1310 1.3497
0.1446 0.2321 0.3318 0.4385 0.5481 0.6572 0.7633 0.8647 0.9601 1.0490 1.1310 1.3497
0.1446 0.2321 0.3318 0.4385 0.5481 0.6572 0.7633 0.8647 0.9601 1.0490 1.1310 1.3497
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0.1446 0.2321 0.3318 0.4385 0.5481 0.6572 0.7633 0.8647 0.9601 1.0490 1.1310 1.3497

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0.1446 0.2321 0.3318 0.4385 0.5481 0.6572 0.7633 0.8647 0.9601 1.0490 1.1310 1.3497
0.1446 0.2321 0.3318 0.4385 0.5481 0.6572 0.7633 0.8647 0.9601 1.0490 1.1310 1.3497
0.1446 0.2321 0.3318 0.4385 0.5481 0.6572 0.7633 0.8647 0.9601 1.0490 1.1310 1.3497
0.1446 0.2321 0.3318 0.4385 0.5481 0.6572 0.7633 0.8647 0.9601 1.0490 1.1310 1.3497
0.1446 0.2321 0.3318 0.4385 0.5481 0.6572 0.7633 0.8647 0.9601 1.0490 1.1310 1.3497
0.1446 0.2321 0.3318 0.4385 0.5481 0.6572 0.7633 0.8647 0.9601 1.0490 1.1310 1.3497
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0.1446 0.2321 0.3318 0.4385 0.5481 0.6572 0.7633 0.8647 0.9601 1.0490 1.1310 1.3497
0.1446 0.2321 0.3318 0.4385 0.5481 0.6572 0.7633 0.8647 0.9601 1.0490 1.1310 1.3497
0.1446 0.2321 0.3318 0.4385 0.5481 0.6572 0.7633 0.8647 0.9601 1.0490 1.1310 1.3497
0.1446 0.2321 0.3318 0.4385 0.5481 0.6572 0.7633 0.8647 0.9601 1.0490 1.1310 1.3497
0.1446 0.2321 0.3318 0.4385 0.5481 0.6572 0.7633 0.8647 0.9601 1.0490 1.1310 1.3497
0.1446 0.2321 0.3318 0.4385 0.5481 0.6572 0.7633 0.8647 0.9601 1.0490 1.1310 1.3497
0.1446 0.2321 0.3318 0.4385 0.5481 0.6572 0.7633 0.8647 0.9601 1.0490 1.1310 1.3497
0.1446 0.2321 0.3318 0.4385 0.5481 0.6572 0.7633 0.8647 0.9601 1.0490 1.1310 1.3497
0.1446 0.2321 0.3318 0.4385 0.5481 0.6572 0.7633 0.8647 0.9601 1.0490 1.1310 1.3497
0.1446 0.2321 0.3318 0.4385 0.5481 0.6572 0.7633 0.8647 0.9601 1.0490 1.1310 1.3497
0.1446 0.2321 0.3318 0.4385 0.5481 0.6572 0.7633 0.8647 0.9601 1.0490 1.1310 1.3497
# Selectivity Blocks (fleet outer loop, year inner loop)
# Sel block for fleet 1
1
1
1
1
2
2
2
2
2
2
2
3
3
3
3
3
3
3
3
3
3
3
3
3
3
3
3
3
3
3
# Sel block for fleet 2
4
4
4
4
5
```

5
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5
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6
6
6
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6
6
6
6
6
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6
6
6
6
6
6
6
Sel block for fleet 3
7
7
7
7
8
8
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9
Selectivity Options for each block 1=by age, 2=logisitic, 3=double logistic

```
2 2 2 2 2 2 2 2 2 2
# Selectivity initial guess, phase, lambda, and CV
# (have to enter values for nages + 6 parameters for each block)
# Sel Block 1
1	-6	0	1
1	-6	0	1
1	-6	0	1
1	-6	0	1
1	-6	0	1
1	-6	0	1
1	-6	0	1
1	-6	0	1
1	-6	0	1
1	-6	0	1
1	-6	0	1
1	-6	0	1
1.8841	6	1	0.25
0.3089	6	1	0.25
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
# Sel Block 2
1	-6	0	1
1	-6	0	1
1	-6	0	1
1	-6	0	1
1	-6	0	1
1	-6	0	1
1	-6	0	1
1	-6	0	1
1	-6	0	1
1	-6	0	1
1	-6	0	1
1	-6	0	1
1.8683	6	1	0.25
0.3038	6	1	0.25
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
# Sel Block 3
1	-6	0	1
1	-6	0	1
1	-6	0	1
1	-6	0	1
1	-6	0	1
1	-6	0	1
1	-6	0	1
1	-6	0	1
1	-6	0	1
1	-6	0	1
1	-6	0	1
1	-6	0	1
2.0071	6	1	0.25
0.2697	6	1	0.25
0	0	0	0
```

```
0	0	0	0
0	0	0	0
0	0	0	0
# SEL BLOCK 4
1	-1	0	1
1	-1	0	1
1	-1	0	1
1	-1	0	1
1	-1	0	1
1	-1	0	1
1	-1	0	1
1	-1	0	1
1	-1	0	1
1	-1	0	1
1	-1	0	1
1	-1	0	1
0.955	6	1	0.25
0.0478	6	1	0.25
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
# SEL BLOCK 5
1	-6	0	1
1	-6	0	1
1	-6	0	1
1	-6	0	1
1	-6	0	1
1	-6	0	1
1	-6	0	1
1	-6	0	1
1	-6	0	1
1	-6	0	1
1	-6	0	1
1	-6	0	1
1.0204	6	1	0.25
0.0525	6	1	0.25
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
# SEL BLOCK 6
1	-6	0	1
1	-6	0	1
1	-6	0	1
1	-6	0	1
1	-6	0	1
1	-6	0	1
1	-6	0	1
1	-6	0	1
1	-6	0	1
1	-6	0	1
1	-6	0	1
1	-6	0	1
0.9949	6	1	0.25
0.0511	6	1	0.25
0	0	0	0
```

0	0	0	0
0	0	0	0
0	0	0	0

SEL BLOCK 7

1	-6	0	1
1	-6	0	1
1	-6	0	1
1	-6	0	1
1	-6	0	1
1	-6	0	1
1	-6	0	1
1	-6	0	1
1	-6	0	1
1	-6	0	1
1	-6	0	1
1	-6	0	1
1.0333	6	1	0.25
0.0409	6	1	0.25
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0

SEL BLOCK 8

1	-6	0	1
1	-6	0	1
1	-6	0	1
1	-6	0	1
1	-6	0	1
1	-6	0	1
1	-6	0	1
1	-6	0	1
1	-6	0	1
1	-6	0	1
1	-6	0	1
1	-6	0	1
1.0454	6	1	0.25
0.041	6	1	0.25
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0

SEL BLOCK 9

1	-6	0	1
1	-6	0	1
1	-6	0	1
1	-6	0	1
1	-6	0	1
1	-6	0	1
1	-6	0	1
1	-6	0	1
1	-6	0	1
1	-6	0	1
1	-6	0	1
1	-6	0	1
1.0499	6	1	0.25
0.041	6	1	0.25
0	0	0	0

```
0 0 0 0
0 0 0 0
0 0 0 0
# Selectivity Start Age by fleet
1 1 1
# Selectivity End Age by fleet
12 12 12
# Age range for average F
5 5
# Average F report option (1=unweighted, 2=Nweighted, 3=Bweighted)
2
# Use likelihood constants? (1=yes)
1
# Release Mortality by fleet
0.115 0.10 0.10
# Fleet 1 Catch at Age - Last Column is Total Weight
0.0318 0.1848 0.2695 0.1616 0.1337 0.0795 0.0591 0.0358 0.0159 0.0084 0.0127 0.007 331.858
0.0317 0.1508 0.3309 0.1606 0.1156 0.0631 0.0531 0.0567 0.0126 0.0099 0.0091 0.0057 621.746
0.0332 0.1581 0.1679 0.3141 0.1052 0.0744 0.0556 0.0378 0.0161 0.0153 0.0091 0.0132 436.228
0.0296 0.188 0.2173 0.2037 0.124 0.0779 0.0615 0.0409 0.017 0.0159 0.0096 0.0146 429.69
0.0404 0.1131 0.090 0.0613 0.1592 0.1316 0.1421 0.0988 0.0443 0.0479 0.0242 0.0471 374.314
0.0346 0.153 0.1387 0.1678 0.1424 0.1088 0.0756 0.0579 0.0359 0.022 0.0198 0.0435 507.467
0.0352 0.165 0.1874 0.1721 0.1318 0.0941 0.0626 0.0479 0.0299 0.0182 0.0169 0.039 614.165
0.0333 0.1906 0.259 0.2101 0.1303 0.0781 0.0404 0.0248 0.013 0.0069 0.0059 0.0077 640.185
0.0305 0.1647 0.2431 0.2156 0.1405 0.0881 0.047 0.0296 0.0159 0.0085 0.007 0.0095 838.373
0.0309 0.1838 0.2698 0.2178 0.1296 0.0746 0.0379 0.0231 0.0124 0.0066 0.0057 0.0079 796.173
0.0242 0.1876 0.2095 0.2899 0.0959 0.0726 0.0392 0.0398 0.0196 0.0039 0.0089 0.0089 843.84
0.0253 0.1932 0.3254 0.2359 0.0696 0.0363 0.0335 0.0346 0.0155 0.0063 0.0113 0.0132 804.093
0.0158 0.1351 0.2673 0.2025 0.1133 0.0971 0.0582 0.0656 0.0231 0.0032 0.0092 0.0096 1078.784
0.0296 0.1713 0.2527 0.1898 0.1252 0.0688 0.0438 0.0644 0.0293 0.0064 0.0108 0.008 1000.192
0.0193 0.0671 0.2807 0.2803 0.1428 0.0946 0.0469 0.0322 0.0222 0.0019 0.0063 0.0058 842.233
0.0327 0.1251 0.1603 0.1908 0.2365 0.1076 0.0568 0.046 0.0291 0.005 0.0063 0.0039 661.702
0.0339 0.1406 0.2566 0.1628 0.157 0.1259 0.0553 0.0213 0.0202 0.006 0.0123 0.0082 759.133
0.030 0.1347 0.2851 0.2364 0.1182 0.0654 0.0617 0.0279 0.020 0.0112 0.0082 0.0013 691.442
0.0395 0.1784 0.1648 0.2114 0.1903 0.0959 0.0518 0.0377 0.0166 0.0071 0.0016 0.0047 837.386
0.0292 0.1806 0.1997 0.203 0.1464 0.1054 0.055 0.0292 0.0227 0.0095 0.0123 0.0071 722.138
0.0354 0.2158 0.2491 0.2073 0.1133 0.0878 0.0408 0.0253 0.0054 0.0075 0.0094 0.003 644.581
0.0294 0.1825 0.242 0.1809 0.1751 0.0997 0.0346 0.0233 0.0133 0.0092 0.0023 0.0077 639.668
0.0435 0.1451 0.292 0.2225 0.0937 0.0809 0.0479 0.0287 0.0176 0.0037 0.0076 0.0168 639.749
0.0119 0.1114 0.2365 0.2652 0.1728 0.0849 0.0565 0.0335 0.0078 0.002 0.0067 0.0109 673.854
0.0148 0.1131 0.2675 0.2603 0.1634 0.0693 0.0479 0.0144 0.0259 0.0144 0.004 0.0051 600.819
0.0333 0.1327 0.2109 0.2068 0.1529 0.099 0.0449 0.0488 0.0245 0.0272 0.0004 0.0185 561.088
0.0324 0.1298 0.1814 0.253 0.1724 0.1448 0.0376 0.0268 0.0002 0.012 0.0047 0.005 443.643
0.0306 0.1122 0.1871 0.2761 0.1536 0.0959 0.0517 0.0419 0.0177 0.0079 0.0118 0.0135 621.531
0.0154 0.1905 0.2402 0.1398 0.1592 0.0924 0.0685 0.0387 0.0191 0.0094 0.0053 0.0216 895.929
0.0132 0.164 0.2452 0.2413 0.1217 0.0952 0.0412 0.0296 0.0189 0.0077 0.0105 0.0115 768.411
# Fleet 2 Catch at Age - Last Column is Total Weight
0.2069 0.3519 0.173 0.0992 0.0557 0.0382 0.0235 0.0171 0.0106 0.008 0.0061 0.0097 729.77
0.241 0.1801 0.1859 0.0986 0.1035 0.0684 0.0495 0.0415 0.0101 0.0077 0.0067 0.007 911.3
0.2163 0.2348 0.1741 0.2389 0.0541 0.0372 0.0222 0.0112 0.0025 0.0028 0.003 0.003 318.969
0.3287 0.2701 0.1238 0.0968 0.0566 0.0381 0.0378 0.0198 0.0089 0.0052 0.008 0.0062 797.271
0.1397 0.211 0.2372 0.1344 0.0976 0.0621 0.0484 0.0269 0.0143 0.0071 0.0103 0.0108 525.443
0.1691 0.2858 0.1103 0.1317 0.0709 0.0559 0.039 0.0365 0.028 0.0173 0.0168 0.0388 310.419
0.1656 0.3243 0.179 0.1236 0.0818 0.0508 0.0252 0.0166 0.0101 0.0059 0.0057 0.0113 306.717
0.111 0.2581 0.1885 0.1741 0.0945 0.066 0.0324 0.0226 0.0161 0.0085 0.0088 0.0195 396.822
0.1222 0.2626 0.1742 0.1328 0.0953 0.0643 0.0403 0.0319 0.0211 0.0129 0.0128 0.0294 584.83
0.1156 0.2384 0.2022 0.1817 0.1142 0.0701 0.0321 0.0189 0.0105 0.0049 0.0043 0.0072 494.696
```

```
0.1491 0.2701 0.2228 0.213 0.0333 0.0223 0.026 0.0229 0.0107 0.0051 0.0091 0.0154 870.552
0.1968 0.2857 0.2188 0.1478 0.0306 0.0249 0.0429 0.0193 0.0088 0.005 0.0062 0.0131 387.827
0.161 0.2758 0.2818 0.1683 0.0335 0.0242 0.0273 0.0175 0.0048 0.0011 0.0022 0.0025 362.676
0.1508 0.2645 0.2511 0.1724 0.0527 0.0249 0.0289 0.0278 0.0114 0.0042 0.0045 0.0069 283.282
0.1796 0.2276 0.2359 0.1913 0.0586 0.0367 0.0331 0.0166 0.0109 0.0022 0.004 0.0035 251.503
0.195 0.3164 0.1549 0.1132 0.1131 0.0507 0.0201 0.0199 0.0102 0.0033 0.0023 0.001 171.657
0.1665 0.3154 0.2147 0.1131 0.0991 0.0499 0.0185 0.0071 0.0067 0.0015 0.0037 0.0037 209.137
0.1849 0.2903 0.2415 0.1335 0.0739 0.0273 0.0216 0.0093 0.0074 0.0044 0.0035 0.0024 185.974
0.2595 0.3311 0.1592 0.1021 0.0711 0.0341 0.0187 0.0135 0.0059 0.0022 0.0008 0.0016 145.43
0.2064 0.3744 0.1588 0.0993 0.0694 0.0386 0.0185 0.0107 0.0113 0.0041 0.0045 0.0042 142.848
0.2142 0.4417 0.1332 0.0895 0.0485 0.036 0.0166 0.0084 0.0032 0.0024 0.0039 0.0024 102.648
0.1533 0.3671 0.2001 0.0963 0.0882 0.0501 0.0146 0.011 0.0064 0.0036 0.0023 0.007 144.002
0.1814 0.3552 0.195 0.1197 0.0517 0.0423 0.0229 0.0123 0.0079 0.0017 0.0029 0.007 198.788
0.1008 0.4531 0.1813 0.1202 0.0683 0.035 0.0194 0.0109 0.0028 0.0009 0.0028 0.0044 254.878
0.206 0.3922 0.2207 0.0856 0.0513 0.0267 0.0084 0.002 0.0033 0.002 0.0008 0.0009 215.281
0.1754 0.4906 0.1368 0.072 0.0575 0.0391 0.0085 0.0078 0.0053 0.0047 0.0001 0.0021 233.104
0.2626 0.341 0.1894 0.0917 0.051 0.0426 0.0108 0.0049 0.0001 0.0022 0.0022 0.0014 331.66
0.2426 0.2788 0.1814 0.151 0.0632 0.041 0.0165 0.0119 0.0046 0.0021 0.0032 0.0038 294.76
0.2125 0.4578 0.188 0.0575 0.0505 0.0162 0.0088 0.0036 0.0019 0.0008 0.0005 0.0018 131.817
0.120 0.3838 0.2379 0.1179 0.0485 0.053 0.0191 0.0072 0.0038 0.0012 0.006 0.0015 158.337
# Fleet 3 Catch at Age - Last Column is Total Weight
0.0773 0.3309 0.2399 0.1596 0.0706 0.0515 0.0279 0.019 0.0074 0.0054 0.0047 0.0056 107.106
0.0926 0.1556 0.3404 0.1485 0.1065 0.0558 0.0367 0.0408 0.0073 0.0061 0.0044 0.0053 135.527
0.1006 0.1818 0.1778 0.2919 0.0934 0.0619 0.041 0.0248 0.0079 0.0069 0.0062 0.0059 127.218
0.0945 0.2375 0.2328 0.1803 0.110 0.060 0.0411 0.0232 0.0064 0.0052 0.0051 0.0038 94.45
0.0986 0.2799 0.2444 0.1738 0.0826 0.0472 0.0333 0.0194 0.0062 0.0051 0.0052 0.0043 83.006
0.0742 0.2376 0.2112 0.1849 0.1169 0.0753 0.0387 0.0245 0.0131 0.0073 0.0062 0.010 123.299
0.0811 0.2618 0.2206 0.1695 0.1097 0.0688 0.0347 0.0214 0.0117 0.0063 0.0055 0.009 129.713
0.0752 0.2411 0.2397 0.1834 0.1106 0.0673 0.033 0.0202 0.0109 0.0057 0.0051 0.0077 159.776
0.0763 0.2229 0.2298 0.195 0.1135 0.0723 0.0354 0.0223 0.0119 0.0066 0.0055 0.0087 98.728
0.0726 0.1955 0.229 0.1988 0.1187 0.0735 0.040 0.0268 0.015 0.0088 0.0078 0.0138 136.5
0.0657 0.2164 0.2451 0.2275 0.0698 0.0534 0.042 0.0351 0.0173 0.0056 0.009 0.013 126.494
0.0667 0.2386 0.3156 0.2006 0.0501 0.0352 0.0342 0.0233 0.0109 0.0037 0.0081 0.013 116.882
0.0644 0.1914 0.2812 0.189 0.075 0.0647 0.0481 0.0458 0.0152 0.0035 0.0072 0.0146 126.323
0.0642 0.2289 0.3035 0.1821 0.0778 0.0413 0.0309 0.0403 0.0163 0.0046 0.0052 0.0049 128.191
0.0667 0.1302 0.2953 0.2533 0.0949 0.0719 0.0335 0.0242 0.0177 0.0017 0.0056 0.0051 84.826
0.0771 0.1832 0.1664 0.1739 0.1953 0.0906 0.0433 0.0369 0.023 0.0036 0.0037 0.003 70.178
0.0696 0.1822 0.2592 0.1633 0.1408 0.0996 0.0388 0.0165 0.0155 0.0038 0.0065 0.0041 73.989
0.0722 0.200 0.2848 0.206 0.1016 0.0486 0.0425 0.019 0.0122 0.0082 0.0044 0.0004 59.423
0.1121 0.2632 0.2026 0.1708 0.1261 0.0601 0.0332 0.0192 0.0079 0.003 0.0003 0.0014 52.858
0.0494 0.2742 0.2198 0.184 0.1156 0.0767 0.0376 0.0174 0.0136 0.0055 0.0048 0.0013 51.515
0.0865 0.2878 0.2321 0.1747 0.0921 0.067 0.0278 0.0174 0.0024 0.0058 0.0054 0.001 50.366
0.0688 0.2313 0.2495 0.1674 0.1491 0.0817 0.0214 0.0128 0.0093 0.0048 0.0011 0.0028 60.654
0.0879 0.2205 0.2928 0.2018 0.078 0.0574 0.0277 0.0181 0.0071 0.0007 0.0038 0.0043 54.382
0.0741 0.2157 0.2684 0.2266 0.1131 0.0578 0.0262 0.0123 0.0007 0.0002 0.0007 0.0043 54.656
0.0717 0.205 0.2743 0.2183 0.1301 0.0581 0.0172 0.006 0.0092 0.006 0.0024 0.0015 73.013
0.0589 0.1801 0.2389 0.1908 0.1499 0.0895 0.0261 0.028 0.016 0.0151 0.000 0.0066 47.288
0.0739 0.2161 0.227 0.2232 0.124 0.1093 0.0154 0.0066 0.0001 0.0022 0.0014 0.0007 50.953
0.0952 0.2345 0.235 0.2261 0.0942 0.0578 0.0257 0.0174 0.0051 0.002 0.0028 0.0043 50.434
0.0729 0.3643 0.2585 0.1035 0.1025 0.046 0.0271 0.011 0.0057 0.0019 0.0017 0.0049 41.3
0.0551 0.326 0.2954 0.1592 0.0653 0.0559 0.0214 0.0087 0.005 0.001 0.0052 0.0018 48.026
# Fleet 1 Discards at Age - Last Column is Total Weight
0.6625 0.3371 0.0005 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.341
0.6548 0.3449 0.0002 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.633
0.6687 0.3306 0.0007 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.439
0.6587 0.3409 0.0004 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.426
0.315 0.4958 0.1323 0.0519 0.0024 0.0007 0.0015 0.0002 0.0 0.0 0.0002 0.0 0.973
```

```
0.2437 0.4371 0.1706 0.0739 0.0457 0.0216 0.0053 0.0005 0.0004 0.0001 0.0011 0.0 1.775
0.2324 0.4334 0.1784 0.0774 0.048 0.0227 0.0055 0.0005 0.0004 0.0001 0.0012 0.0 2.388
0.2248 0.4325 0.1825 0.0799 0.0491 0.0232 0.0057 0.0006 0.0004 0.0001 0.0012 0.0 3.71
0.2253 0.4325 0.1823 0.0798 0.0491 0.0231 0.0056 0.0006 0.0004 0.0001 0.0012 0.0 4.459
0.2218 0.4316 0.1844 0.0811 0.0497 0.0234 0.0057 0.0006 0.0004 0.0001 0.0012 0.0 4.729
0.2001 0.328 0.2437 0.2148 0.0058 0.0019 0.0047 0.0008 0.0003 0.0 0.0001 0.0 4.714
0.2113 0.3125 0.2644 0.1889 0.0145 0.0009 0.007 0.0004 0.0001 0.0 0.0001 0.0 4.281
0.2007 0.3187 0.2781 0.1775 0.006 0.0027 0.0138 0.0021 0.0003 0.0 0.0001 0.0 3.759
0.1922 0.3273 0.2587 0.2004 0.0149 0.0013 0.0037 0.001 0.0005 0.0 0.0001 0.0 6.625
0.1904 0.2923 0.2857 0.2001 0.0241 0.0026 0.0038 0.0007 0.0004 0.0 0.0001 0.0 4.194
0.2178 0.3755 0.1721 0.1082 0.1007 0.018 0.0053 0.0016 0.0007 0.0 0.0 0.0 4.38
0.222 0.3802 0.1979 0.0956 0.0787 0.0201 0.0044 0.0003 0.0006 0.0001 0.0001 0.0001 5.15
0.2263 0.3755 0.2126 0.0966 0.0682 0.0121 0.0078 0.0004 0.0004 0.0001 0.0 0.0 3.879
0.3101 0.3821 0.2006 0.0707 0.0255 0.0056 0.0046 0.0006 0.0002 0.0001 0.0 0.0 4.38
0.1404 0.4494 0.1976 0.1046 0.0749 0.0254 0.0044 0.0006 0.0023 0.0001 0.0001 0.0 4.758
0.243 0.5028 0.1409 0.0643 0.0308 0.015 0.0024 0.0005 0.0 0.0003 0.0001 0.0 3.254
0.2076 0.4 0.2218 0.0673 0.0566 0.0418 0.0033 0.0012 0.0002 0.0001 0.0 0.0 3.804
0.2348 0.4451 0.1756 0.076 0.0412 0.0241 0.0025 0.0005 0.0001 0.0 0.0001 0.0001 2.727
0.2109 0.4445 0.1789 0.0936 0.0443 0.0247 0.0027 0.0002 0.0 0.0 0.0 0.0001 1.183
0.2174 0.3259 0.146 0.1367 0.1088 0.0612 0.0023 0.0001 0.0002 0.0001 0.0014 0.0 1.557
0.1853 0.3871 0.1723 0.0653 0.0995 0.076 0.0086 0.0028 0.0025 0.0006 0.0 0.0 4.529
0.2387 0.3811 0.1718 0.085 0.0543 0.0535 0.0117 0.0001 0.0 0.0001 0.0038 0.0 2.153
0.2374 0.2904 0.196 0.1576 0.0613 0.0458 0.0105 0.0007 0.0001 0.0 0.0001 0.0001 2.731
0.2289 0.5507 0.1369 0.0108 0.0672 0.0038 0.001 0.0003 0.0002 0.0 0.0 0.0001 2.061
0.1818 0.4001 0.1843 0.0869 0.0295 0.0805 0.024 0.0004 0.0002 0.0 0.0122 0.0 1.437
# FLEET 2 DISCARDS AT AGE - LAST COLUMN IS TOTAL WEIGHT
0.7383 0.2585 0.0032 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 2.437
0.7049 0.2931 0.002 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 4.149
0.6955 0.3028 0.0017 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 2.795
0.6603 0.3393 0.0004 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 12.045
0.4007 0.4495 0.1009 0.045 0.0019 0.0005 0.0011 0.0002 0.0 0.0 0.0001 0.0 2.827
0.3329 0.4772 0.1123 0.0389 0.0237 0.0112 0.0028 0.0003 0.0002 0.0 0.0006 0.0 5.706
0.258 0.4445 0.1618 0.0674 0.0416 0.0197 0.0048 0.0005 0.0004 0.0001 0.001 0.0 14.984
0.2169 0.4329 0.1846 0.0824 0.0508 0.0241 0.0059 0.0006 0.0005 0.0001 0.0012 0.0 8.611
0.2293 0.4362 0.178 0.0781 0.0479 0.0227 0.0056 0.0006 0.0004 0.0001 0.0012 0.0 14.563
0.2666 0.4442 0.1597 0.0658 0.039 0.0184 0.0045 0.0005 0.0003 0.0001 0.0009 0.0 11.675
0.1943 0.3338 0.2445 0.214 0.0062 0.002 0.004 0.0008 0.0003 0.0 0.0001 0.0 63.81
0.2862 0.3319 0.214 0.1314 0.0108 0.0007 0.0245 0.0003 0.0001 0.0 0.0001 0.0 22.816
0.2315 0.3296 0.2558 0.1522 0.0056 0.0026 0.0205 0.002 0.0002 0.0 0.0001 0.0 28.169
0.2382 0.3371 0.2311 0.1644 0.0131 0.0011 0.0136 0.0009 0.0004 0.0 0.0001 0.0 15.65
0.2577 0.3099 0.2414 0.1507 0.0194 0.0021 0.0178 0.0006 0.0003 0.0 0.0001 0.0 18.619
0.2683 0.379 0.1558 0.0914 0.0842 0.015 0.0043 0.0013 0.0006 0.0 0.0 0.0 15.439
0.2222 0.389 0.1941 0.093 0.0764 0.0198 0.0042 0.0003 0.0007 0.0001 0.0001 0.0001 22.108
0.2768 0.3623 0.2 0.0845 0.0583 0.0103 0.0068 0.0003 0.0004 0.0001 0.0 0.0 13.495
0.3829 0.3921 0.1518 0.0482 0.0174 0.0039 0.0032 0.0004 0.0002 0.0 0.0 0.0 10.558
0.3148 0.4321 0.1268 0.0636 0.0425 0.0145 0.0032 0.0007 0.0016 0.0001 0.0001 0.0 8.829
0.314 0.5147 0.0945 0.0428 0.0213 0.0105 0.0016 0.0004 0.0 0.0002 0.0001 0.0 7.295
0.2675 0.4713 0.1518 0.0434 0.0365 0.0263 0.0022 0.0008 0.0002 0.0001 0.0 0.0 6.789
0.2853 0.4831 0.1309 0.0533 0.0285 0.0166 0.0018 0.0003 0.0001 0.0 0.0001 0.0 9.638
0.1832 0.5966 0.1291 0.0518 0.0242 0.0134 0.0016 0.0002 0.0 0.0 0.0 0.0001 10.585
0.3473 0.4212 0.0902 0.0627 0.0489 0.0276 0.0011 0.0001 0.0001 0.0 0.0007 0.0 9.303
0.2956 0.4735 0.096 0.0361 0.0514 0.0395 0.0046 0.0016 0.0014 0.0003 0.0 0.0 14.023
0.4468 0.3337 0.1017 0.0491 0.0302 0.0299 0.0065 0.0001 0.0 0.0 0.0021 0.0 16.441
0.3919 0.2885 0.1463 0.0987 0.0381 0.0291 0.0067 0.0005 0.0001 0.0 0.0 0.0001 15.44
0.348 0.5316 0.0785 0.0068 0.0323 0.002 0.0005 0.0002 0.0001 0.0 0.0 0.0 8.178
0.241 0.4545 0.1386 0.0627 0.0212 0.0566 0.0167 0.0003 0.0001 0.0 0.0083 0.0 6.202
# FLEET 3 DISCARDS AT AGE - LAST COLUMN IS TOTAL WEIGHT
```

0.6955 0.3028 0.0017 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.243
0.6692 0.33 0.0007 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.399
0.6594 0.3403 0.0004 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.461
0.6626 0.337 0.0005 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.338
0.3057 0.5021 0.1326 0.054 0.0027 0.0008 0.0016 0.0002 0.0 0.0 0.0002 0.0 1.332
0.2244 0.436 0.1794 0.0796 0.0491 0.0233 0.0057 0.0006 0.0004 0.0001 0.0012 0.0 2.048
0.226 0.4351 0.1795 0.0792 0.0489 0.0232 0.0057 0.0006 0.0004 0.0001 0.0012 0.0 2.325
0.2283 0.4355 0.1786 0.0785 0.0482 0.0229 0.0056 0.0006 0.0004 0.0001 0.0012 0.0 2.814
0.2372 0.4377 0.174 0.0754 0.0461 0.0219 0.0054 0.0006 0.0004 0.0001 0.0011 0.0 1.519
0.2316 0.4356 0.1774 0.0777 0.0474 0.0225 0.0055 0.0006 0.0004 0.0001 0.0011 0.0 2.062
0.2101 0.3352 0.2363 0.2021 0.0059 0.0019 0.0074 0.0008 0.0003 0.0 0.0001 0.0 1.976
0.2132 0.3197 0.2614 0.1803 0.0149 0.0009 0.009 0.0004 0.0001 0.0 0.0001 0.0 1.875
0.2039 0.325 0.2755 0.1687 0.0063 0.0029 0.0153 0.0022 0.0003 0.0 0.0001 0.0 2.083
0.2203 0.3353 0.2416 0.1762 0.0142 0.0013 0.0096 0.001 0.0004 0.0 0.0001 0.0 2.145
0.2073 0.2995 0.2747 0.1837 0.0238 0.0026 0.0071 0.0007 0.0004 0.0 0.0001 0.0 1.478
0.2146 0.3829 0.1684 0.1077 0.1007 0.0181 0.0052 0.0016 0.0008 0.0 0.0 0.0 1.347
0.2153 0.39 0.1951 0.0952 0.0784 0.0204 0.0044 0.0003 0.0007 0.0001 0.0001 0.0001 1.348
0.2143 0.3867 0.212 0.0974 0.0684 0.0121 0.008 0.0004 0.0005 0.0001 0.0 0.0 1.209
0.3248 0.3823 0.19 0.0669 0.025 0.0056 0.0046 0.0006 0.0003 0.0001 0.0 0.0 1.029
0.128 0.4637 0.1966 0.1041 0.074 0.0256 0.0046 0.0006 0.0025 0.0001 0.0001 0.0 1.112
0.2411 0.4973 0.145 0.0659 0.0316 0.0156 0.0026 0.0005 0.0 0.0003 0.0002 0.0 1.079
0.2059 0.3909 0.2259 0.07 0.0591 0.0428 0.0036 0.0014 0.0003 0.0001 0.0 0.0 1.302
0.2336 0.4395 0.1788 0.0782 0.0419 0.0245 0.0027 0.0005 0.0002 0.0 0.0001 0.0001 1.119
0.22 0.4278 0.1808 0.0974 0.0454 0.0253 0.0029 0.0003 0.0 0.0 0.0 0.0001 1.237
0.2157 0.3222 0.1492 0.1381 0.1089 0.0615 0.0024 0.0002 0.0003 0.0001 0.0015 0.0 1.516
0.1735 0.3823 0.1775 0.0698 0.1024 0.0788 0.0091 0.0031 0.0027 0.0006 0.0 0.0 1.064
0.2197 0.3893 0.1747 0.089 0.0558 0.0554 0.012 0.0001 0.0 0.0001 0.0038 0.0 1.021
0.2671 0.2938 0.1839 0.1447 0.0564 0.0431 0.0099 0.0007 0.0001 0.0 0.0001 0.0001 0.914
0.2284 0.5547 0.1342 0.0112 0.0658 0.004 0.0011 0.0003 0.0002 0.0 0.0 0.0001 0.831
0.1841 0.4205 0.1742 0.0831 0.0284 0.0756 0.0224 0.0004 0.0002 0.0 0.011 0.0 0.859
Fleet 1 Release Proportion at Age
0.8451 0.0741 0.0001 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
0.8389 0.0929 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
0.8187 0.0849 0.0002 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
0.9028 0.0737 0.0001 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
0.8781 0.4937 0.1655 0.0954 0.0017 0.0006 0.0012 0.0002 0.0001 0.0001 0.0009 0.0001
0.7941 0.3217 0.1385 0.0496 0.0362 0.0223 0.0079 0.001 0.0012 0.0004 0.0065 0.0001
0.7435 0.2957 0.1072 0.0507 0.041 0.0271 0.01 0.0013 0.0015 0.0005 0.008 0.0001
0.7608 0.2555 0.0794 0.0428 0.0425 0.0334 0.0158 0.0025 0.0036 0.0013 0.0233 0.0006
0.8329 0.2958 0.0845 0.0417 0.0393 0.0296 0.0136 0.0021 0.0029 0.001 0.0196 0.0005
0.8095 0.2644 0.077 0.0419 0.0432 0.0353 0.017 0.0027 0.0038 0.0014 0.0243 0.0006
0.9308 0.1969 0.131 0.0834 0.0068 0.0029 0.0135 0.0022 0.0015 0.0001 0.0008 0.0
0.9387 0.1822 0.0915 0.0902 0.0235 0.0028 0.0237 0.0013 0.0007 0.0 0.0006 0.0
0.9632 0.1787 0.0788 0.0664 0.004 0.0021 0.018 0.0024 0.0009 0.0 0.0005 0.0
0.8964 0.2636 0.1413 0.1457 0.0165 0.0025 0.0115 0.0021 0.0022 0.0002 0.0008 0.0
0.939 0.4141 0.0967 0.0678 0.016 0.0026 0.0077 0.002 0.0016 0.0 0.001 0.0
0.8249 0.3723 0.1331 0.0703 0.0528 0.0208 0.0115 0.0042 0.0031 0.0008 0.0004 0.0
0.8806 0.3631 0.1036 0.0789 0.0673 0.0214 0.0106 0.0018 0.0043 0.0017 0.0009 0.0014
0.8257 0.3053 0.0816 0.0448 0.0632 0.0202 0.0138 0.0015 0.0024 0.0011 0.0003 0.0
0.8521 0.2323 0.132 0.0363 0.0146 0.0063 0.0097 0.0017 0.0016 0.0011 0.0 0.0
0.6623 0.3421 0.136 0.0709 0.0704 0.0332 0.011 0.003 0.0141 0.0017 0.0012 0.0
0.6927 0.235 0.0571 0.0313 0.0274 0.0172 0.0061 0.0018 0.0 0.0037 0.0013 0.0004
0.8717 0.2706 0.1132 0.0459 0.04 0.0517 0.0119 0.0065 0.0022 0.0011 0.0011 0.0005
0.5106 0.2902 0.0569 0.0323 0.0416 0.0281 0.0049 0.0015 0.0007 0.0 0.0011 0.0004
0.726 0.1631 0.0309 0.0144 0.0105 0.0119 0.002 0.0003 0.0 0.0 0.0 0.0004
0.9213 0.1813 0.0343 0.033 0.0419 0.0555 0.003 0.0007 0.0006 0.0004 0.0217 0.0004
0.9713 0.5094 0.1427 0.0552 0.1136 0.1341 0.0336 0.0102 0.0175 0.0035 0.0 0.0003

0.8305 0.3308 0.1066 0.0378 0.0355 0.0416 0.0349 0.0005 0.0 0.0005 0.0928 0.0001
0.7911 0.2639 0.1068 0.0582 0.0407 0.0486 0.0207 0.0017 0.0008 0.0005 0.0006 0.0007
0.8235 0.1605 0.0317 0.0043 0.0235 0.0023 0.0008 0.0004 0.0005 0.0001 0.0004 0.0001
0.7554 0.1341 0.0413 0.0198 0.0133 0.0464 0.0321 0.0007 0.0006 0.0002 0.0635 0.0001
FLEET 2 RELEASE PROPORTION AT AGE
0.3622 0.0746 0.0019 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
0.519 0.2888 0.0019 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
0.8354 0.3351 0.0025 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
0.7817 0.489 0.0012 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
0.4496 0.3339 0.0667 0.0524 0.003 0.0013 0.0037 0.0009 0.0002 0.0005 0.0022 0.0004
0.8836 0.7497 0.4569 0.1326 0.15 0.0902 0.0317 0.0035 0.0034 0.0011 0.0153 0.0003
0.9603 0.8447 0.557 0.3362 0.3136 0.2395 0.1183 0.0187 0.0229 0.0075 0.1088 0.0021
0.9181 0.7881 0.4602 0.2225 0.2527 0.1714 0.0856 0.0127 0.0133 0.0048 0.0658 0.0011
0.9616 0.8514 0.5237 0.3013 0.2574 0.1807 0.0706 0.0093 0.0104 0.0033 0.0462 0.0008
0.9468 0.7649 0.3243 0.1487 0.1401 0.1075 0.0574 0.0101 0.0136 0.0056 0.0898 0.002
0.9928 0.9416 0.836 0.7655 0.1419 0.0679 0.1179 0.0282 0.0195 0.0002 0.0065 0.0
0.9906 0.7915 0.6663 0.6057 0.241 0.0188 0.3894 0.0112 0.0061 0.0 0.0057 0.0
0.9786 0.8135 0.6179 0.6156 0.1143 0.0731 0.5101 0.0761 0.0342 0.0 0.021 0.0
0.9867 0.7957 0.5746 0.5953 0.1554 0.0283 0.293 0.0202 0.0214 0.0031 0.009 0.0
0.9822 0.9322 0.7006 0.5392 0.2272 0.0394 0.3682 0.023 0.018 0.0 0.0102 0.0
0.9771 0.8509 0.7141 0.5738 0.5288 0.2103 0.1538 0.0481 0.0434 0.007 0.0063 0.0
0.9917 0.9164 0.6719 0.6106 0.5725 0.2953 0.1689 0.0307 0.0747 0.0362 0.0173 0.0175
0.9823 0.8187 0.5431 0.4154 0.518 0.248 0.2061 0.0245 0.0359 0.0178 0.0047 0.0
0.9737 0.7816 0.6293 0.3112 0.1612 0.075 0.1126 0.0205 0.0185 0.0131 0.0 0.0
0.9732 0.7363 0.5095 0.4084 0.3904 0.2397 0.1096 0.044 0.0918 0.0175 0.0095 0.0
0.9608 0.7638 0.4649 0.3137 0.2872 0.1905 0.0648 0.0278 0.0 0.0527 0.0154 0.0134
0.9621 0.7078 0.4182 0.2484 0.228 0.2896 0.0833 0.0414 0.0144 0.0086 0.0029 0.002
0.8909 0.7704 0.3804 0.2522 0.3121 0.2219 0.0442 0.0155 0.007 0.0 0.0114 0.0036
0.9264 0.6715 0.3632 0.2198 0.1805 0.1954 0.0412 0.0071 0.0 0.0 0.0 0.0059
0.8419 0.5362 0.204 0.3658 0.4764 0.5158 0.0648 0.017 0.0177 0.0106 0.3983 0.0081
0.9624 0.5511 0.4006 0.2863 0.5109 0.5768 0.3068 0.1142 0.1463 0.0372 0.0 0.0052
0.9297 0.5349 0.2935 0.293 0.3233 0.3835 0.3289 0.0082 0.0 0.0067 0.5087 0.0063
0.9111 0.5835 0.455 0.3686 0.3401 0.4 0.2292 0.0221 0.0113 0.0068 0.008 0.0087
0.9781 0.6935 0.2495 0.071 0.3815 0.0719 0.0362 0.0257 0.028 0.0056 0.0206 0.0099
0.9743 0.5747 0.2827 0.2581 0.2123 0.5175 0.4252 0.0182 0.0185 0.0088 0.6683 0.0062
FLEET 3 RELEASE PROPORTION AT AGE
0.8576 0.0873 0.0007 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
0.8709 0.2555 0.0003 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
0.8765 0.2503 0.0003 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
0.9057 0.1832 0.0003 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
0.9283 0.5371 0.1625 0.093 0.0096 0.0048 0.0146 0.0035 0.0015 0.0018 0.0117 0.0031
0.9516 0.5776 0.2674 0.1355 0.1322 0.0976 0.0465 0.0078 0.0107 0.0037 0.0602 0.0015
0.8766 0.5228 0.2559 0.147 0.1403 0.1063 0.0517 0.0088 0.0119 0.0043 0.0675 0.0017
0.9392 0.5587 0.2305 0.1325 0.1348 0.1052 0.0526 0.009 0.0123 0.0046 0.0706 0.0019
0.9318 0.5888 0.227 0.116 0.1219 0.0908 0.0454 0.0076 0.0105 0.0037 0.0609 0.0016
0.9676 0.6754 0.235 0.1185 0.1211 0.0927 0.0418 0.0066 0.0087 0.0029 0.0447 0.001
0.9608 0.4652 0.2897 0.2668 0.0254 0.0108 0.0529 0.0071 0.0047 0.0002 0.0025 0.0
0.955 0.4002 0.2474 0.2685 0.089 0.008 0.0784 0.0056 0.0031 0.0 0.0028 0.0
0.9822 0.5263 0.3038 0.2767 0.0259 0.0137 0.0989 0.0146 0.0057 0.0 0.0034 0.0
0.9957 0.4251 0.2311 0.2809 0.0529 0.0089 0.0903 0.0069 0.0079 0.001 0.0041 0.0
0.935 0.6922 0.2798 0.2183 0.0755 0.011 0.0635 0.0089 0.0063 0.0 0.0042 0.0
0.8713 0.6546 0.3171 0.194 0.1615 0.0626 0.0377 0.0136 0.0107 0.0036 0.0022 0.0
0.9454 0.6544 0.2302 0.1782 0.1704 0.0626 0.0344 0.0058 0.0134 0.0063 0.0044 0.0069
0.9472 0.6172 0.2376 0.151 0.215 0.0797 0.0601 0.0072 0.0131 0.0057 0.0022 0.0
0.9101 0.456 0.2944 0.1229 0.0623 0.0291 0.0434 0.0101 0.01 0.0071 0.0 0.0
0.8316 0.5432 0.2872 0.1817 0.2056 0.1072 0.0393 0.0119 0.0578 0.0077 0.0083 0.0
0.9122 0.5658 0.2046 0.1235 0.1123 0.0763 0.0302 0.0095 0.0 0.0167 0.0092 0.0006

```
0.9906    0.5594    0.2996    0.1384    0.1313    0.1734    0.0553    0.0348    0.0098    0.0067    0.0063    0.0038
0.8525    0.6394    0.1959    0.1242    0.1724    0.1368    0.0308    0.0092    0.0068    0.0    0.0077    0.0051
0.961    0.6423    0.2182    0.1393    0.13    0.1417    0.0357    0.008    0.0    0.0    0.0    0.0077
0.9595    0.5016    0.1736    0.2019    0.267    0.3375    0.0449    0.0084    0.009    0.0053    0.1953    0.0071
0.9846    0.7096    0.2484    0.1223    0.2285    0.2942    0.117    0.0374    0.0564    0.0137    0.0    0.0021
0.9207    0.5581    0.2384    0.1236    0.1394    0.1571    0.2415    0.0067    0.0    0.0073    0.8487    0.0013
0.8074    0.3604    0.2251    0.1841    0.1724    0.2148    0.1112    0.0115    0.008    0.0057    0.0072    0.0061
0.9462    0.4601    0.1568    0.0326    0.1939    0.0264    0.0122    0.0091    0.0099    0.0026    0.0072    0.0039
0.9192    0.3549    0.1623    0.1437    0.1197    0.372    0.287    0.0119    0.0109    0.009    0.587    0.0042
# Index Units
2  2  2  1
# Index Month
-1  -1  -1  -1
# Index Selectivity Choice
-1  3  2  1
# Index Selectivity Option for each Index 1=by age, 2=logisitic, 3=double logistic
1  2  2  2
# Index Start Age
1  2  2  2
# Index End Age
5  8  8  10
# Use Index? 1=yes
1  1  1  1
# Index Selectivity initial guess, phase, lambda, and CV
# (have to enter values for nages + 6 parameters for each block)
# Index-1
1         -1        0         1
0.5883    6         1         0.25
0.3196    6         1         0.25
0.1653    6         1         0.25
0.0833    6         1         0.25
0.0413    6         1         0.25
0.0204    6         1         0.25
0.01      6         1         0.25
0.0049    6         1         0.25
0.0024    6         1         0.25
0.0012    6         1         0.25
0.0006    6         1         0.25
0         0         0         0
0         0         0         0
0         0         0         0
0         0         0         0
0         0         0         0
0         0         0         0
# Index-2
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
0         0         0         0
```

0 -1 0 0
0 -1 0 0
0 0 0 0
0 0 0 0
0 0 0 0
0 0 0 0
Index-3
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
0 0 0 0
0 -1 0 0
0 -1 0 0
0 0 0 0
0 0 0 0
0 0 0 0
0 0 0 0
Index-4
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
0 0 0 0
0 -1 0 0
0 -1 0 0
0 0 0 0
0 0 0 0
0 0 0 0
0 0 0 0
Index Data - Year, Index Value, CV, proportions at age and input effective sample size (only used if estimating parameters)
Index-1
1981 -999 -999 -999.0000 -999.0000 -999.0000 -999.0000 -999.0000 -999.0000 -999.0000 -999.0000 -999.0000 -
999.0000 -999.0000 -999.0000 -999
1982 -999 -999 -999.0000 -999.0000 -999.0000 -999.0000 -999.0000 -999.0000 -999.0000 -999.0000 -999.0000 -
999.0000 -999.0000 -999.0000 -999
1983 -999 -999 -999.0000 -999.0000 -999.0000 -999.0000 -999.0000 -999.0000 -999.0000 -999.0000 -999.0000 -
999.0000 -999.0000 -999.0000 -999
1984 -999 -999 -999.0000 -999.0000 -999.0000 -999.0000 -999.0000 -999.0000 -999.0000 -999.0000 -999.0000 -
999.0000 -999.0000 -999.0000 -999
1985 -999 -999 -999.0000 -999.0000 -999.0000 -999.0000 -999.0000 -999.0000 -999.0000 -999.0000 -999.0000 -
999.0000 -999.0000 -999.0000 -999

1986 -999 -999 -999.0000 -999.0000 -999.0000 -999.0000 -999.0000 -999.0000 -999.0000 -999.0000 -999.0000 -
999.0000 -999.0000 -999.0000 -999
1987 -999 -999 -999.0000 -999.0000 -999.0000 -999.0000 -999.0000 -999.0000 -999.0000 -999.0000 -999.0000 -
999.0000 -999.0000 -999.0000 -999
1988 -999 -999 -999.0000 -999.0000 -999.0000 -999.0000 -999.0000 -999.0000 -999.0000 -999.0000 -999.0000 -
999.0000 -999.0000 -999.0000 -999
1989 -999 -999 -999.0000 -999.0000 -999.0000 -999.0000 -999.0000 -999.0000 -999.0000 -999.0000 -999.0000 -
999.0000 -999.0000 -999.0000 -999
1990 -999 -999 -999.0000 -999.0000 -999.0000 -999.0000 -999.0000 -999.0000 -999.0000 -999.0000 -999.0000 -
999.0000 -999.0000 -999.0000 -999
1991 -999 -999 -999.0000 -999.0000 -999.0000 -999.0000 -999.0000 -999.0000 -999.0000 -999.0000 -999.0000 -
999.0000 -999.0000 -999.0000 -999
1992 -999 -999 -999.0000 -999.0000 -999.0000 -999.0000 -999.0000 -999.0000 -999.0000 -999.0000 -999.0000 -
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1993 -999 -999 -999.0000 -999.0000 -999.0000 -999.0000 -999.0000 -999.0000 -999.0000 -999.0000 -999.0000 -
999.0000 -999.0000 -999.0000 -999
1994 -999 -999 -999.0000 -999.0000 -999.0000 -999.0000 -999.0000 -999.0000 -999.0000 -999.0000 -999.0000 -
999.0000 -999.0000 -999.0000 -999
1995 -999 -999 -999.0000 -999.0000 -999.0000 -999.0000 -999.0000 -999.0000 -999.0000 -999.0000 -999.0000 -
999.0000 -999.0000 -999.0000 -999
1996 -999 -999 -999.0000 -999.0000 -999.0000 -999.0000 -999.0000 -999.0000 -999.0000 -999.0000 -999.0000 -
999.0000 -999.0000 -999.0000 -999
1997 -999 -999 -999.0000 -999.0000 -999.0000 -999.0000 -999.0000 -999.0000 -999.0000 -999.0000 -999.0000 -
999.0000 -999.0000 -999.0000 -999
1998 0.38 0.298 0.6897 0.1399 0.0774 0.0482 0.0264 0.0071 0.0063 0.0022 0.0019 0.0006 0.0001 0.0001 9
1999 0.878 0.186 0.6968 0.1594 0.0632 0.0366 0.0233 0.0096 0.0050 0.0039 0.0014 0.0001 0.0002 0.0006 13
2000 0.988 0.113 0.5983 0.2534 0.0717 0.0381 0.0236 0.0103 0.0026 0.0004 0.0014 0.0001 0.0001 0.0000 15
2001 0.96 0.115 0.5796 0.2311 0.0883 0.0503 0.0248 0.0150 0.0047 0.0032 0.0004 0.0014 0.0011 0.0003 17
2002 1.314 0.142 0.5734 0.1771 0.0974 0.0557 0.0546 0.0259 0.0066 0.0050 0.0027 0.0012 0.0001 0.0002 18
2003 0.782 0.106 0.6178 0.1817 0.1086 0.0611 0.0188 0.0078 0.0022 0.0014 0.0003 0.0000 0.0002 0.0001 15
2004 0.709 0.153 0.7097 0.1539 0.0642 0.0449 0.0161 0.0082 0.0022 0.0004 0.0000 0.0000 0.0001 0.0003 12
2005 1.349 0.116 0.5150 0.0989 0.1113 0.1133 0.0862 0.0365 0.0229 0.0018 0.0080 0.0046 0.0014 0.0002 16
2006 1.086 0.167 0.5908 0.1773 0.0813 0.0532 0.0485 0.0276 0.0058 0.0064 0.0050 0.0025 0.0000 0.0016 18
2007 1.045 0.095 0.6490 0.1623 0.0595 0.0607 0.0331 0.0280 0.0048 0.0017 0.0000 0.0003 0.0005 0.0001 18
2008 1.422 0.077 0.5478 0.1223 0.0770 0.1181 0.0586 0.0369 0.0162 0.0120 0.0035 0.0019 0.0024 0.0031 19
2009 1.154 0.075 0.6345 0.1873 0.0782 0.0321 0.0367 0.0159 0.0085 0.0035 0.0015 0.0005 0.0006 0.0008 23
2010 0.934 0.133 0.5535 0.2577 0.0812 0.0469 0.0176 0.0280 0.0088 0.0014 0.0006 0.0001 0.0035 0.0006 19
Index-2
1981 0.936 0.028 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0
1982 0.792 0.03 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0
1983 0.621 0.035 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0
1984 0.629 0.037 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0
1985 0.612 0.036 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0
1986 0.724 0.031 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0
1987 0.861 0.029 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0
1988 0.92 0.028 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0
1989 1.013 0.026 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0
1990 1.186 0.027 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0
1991 1.197 0.024 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0
1992 1.197 0.025 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0
1993 1.157 0.025 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0
1994 1.404 0.025 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0
1995 1.04 0.03 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0
1996 0.968 0.034 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0
1997 1.065 0.03 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0
1998 0.905 0.037 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0
1999 0.932 0.036 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0

```
2000 0.906 0.041 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0
2001 0.809 0.047 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0
2002 0.803 0.047 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0
2003 1.073 0.044 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0
2004 1.3 0.042 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0
2005 1.495 0.04 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0
2006 1.036 0.043 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0
2007 0.922 0.036 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0
2008 1.187 0.028 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0
2009 1.072 0.029 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0
2010 1.239 0.026 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0
# INDEX-3
1981 0.89 0.15 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0
1982 0.839 0.196 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0
1983 0.675 0.161 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0
1984 0.755 0.199 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0
1985 0.599 0.159 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0
1986 0.805 0.132 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0
1987 0.636 0.142 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0
1988 0.869 0.145 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0
1989 0.864 0.131 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0
1990 1.047 0.112 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0
1991 1.639 0.094 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0
1992 1.395 0.097 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0
1993 1.1 0.106 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0
1994 1.045 0.121 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0
1995 1.182 0.117 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0
1996 0.924 0.12 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0
1997 1.006 0.118 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0
1998 0.928 0.105 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0
1999 1.003 0.106 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0
2000 0.917 0.108 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0
2001 0.951 0.104 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0
2002 0.847 0.1 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0
2003 1.006 0.099 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0
2004 1.169 0.096 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0
2005 1.215 0.094 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0
2006 1.209 0.09 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0
2007 1.241 0.09 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0
2008 1.095 0.1 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0
2009 0.978 0.099 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0
2010 1.173 0.195 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0
# INDEX-4
1981 -999 -999 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0
1982 -999 -999 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0
1983 -999 -999 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0
1984 -999 -999 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0
1985 -999 -999 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0
1986 -999 -999 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0
1987 -999 -999 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0
1988 -999 -999 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0
1989 -999 -999 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0
1990 -999 -999 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0
1991 -999 -999 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0
1992 -999 -999 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0
1993 0.802 0.186 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0
1994 0.835 0.184 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0
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1995	0.751	0.184	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0
1996	0.663	0.185	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0
1997	0.731	0.184	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0
1998	0.81	0.184	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0
1999	1.017	0.184	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0
2000	0.873	0.184	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0
2001	0.895	0.184	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0
2002	0.892	0.184	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0
2003	0.837	0.184	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0
2004	0.937	0.184	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0
2005	1.189	0.184	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0
2006	1.17	0.185	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0
2007	1.101	0.185	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0
2008	1.413	0.185	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0
2009	1.573	0.185	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0
2010	1.51	0.185	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0
# Phase Control Data
# Phase for F mult in 1st Year
2
# Phase for F mult Deviations
7
# Phase for Recruitment Deviations
7
# Phase for N in 1st Year
4
# Phase for Catchability in 1st Year
1
# Phase for Catchability Deviations
-5
# Phase for Stock Recruitment Relationship
3
# Phase for Steepness
8
# Recruitment CV by Year
0.5
0.5
0.5
0.5
0.5
0.5
0.5
0.5
0.5
0.5
0.5
0.5
0.5
0.5
0.5
0.5
0.5
0.5
0.5
0.5
0.5
0.5
0.5
```

0.5
0.5
0.5
0.5
0.5
0.5
0.5
#LAMBDA FOR EACH INDEX
0.470 0.398 0.908 0.868
LAMBDA FOR TOTAL CATCH IN WEIGHT BY FLEET
1 1 1
LAMBDA FOR TOTAL DISCARDS AT AGE BY FLEET
1 1 1
CATCH TOTAL CV BY YEAR AND FLEET
0.100 0.246 0.100
0.100 0.155 0.100
0.100 0.146 0.100
0.100 0.307 0.100
0.100 0.300 0.100
0.100 0.239 0.100
0.100 0.170 0.100
0.100 0.177 0.100
0.100 0.204 0.100
0.100 0.171 0.100
0.100 0.142 0.100
0.100 0.099 0.100
0.100 0.086 0.100
0.100 0.093 0.100
0.100 0.129 0.100
0.100 0.133 0.100
0.100 0.150 0.100
0.100 0.138 0.100
0.100 0.109 0.100
0.100 0.180 0.100
0.100 0.162 0.100
0.100 0.142 0.100
0.100 0.129 0.100
0.100 0.138 0.100
0.100 0.100 0.100
0.100 0.074 0.100
0.100 0.107 0.100
0.100 0.108 0.100
0.100 0.091 0.100
0.100 0.107 0.100
DISCARD TOTAL CV BY YEAR AND FLEET
0.200 0.394 0.200
0.200 0.197 0.200
0.200 0.340 0.200
0.200 0.228 0.200
0.200 0.344 0.200
0.200 0.204 0.200
0.200 0.203 0.200
0.200 0.250 0.200
0.200 0.261 0.200
0.200 0.174 0.200
0.200 0.128 0.200
0.200 0.075 0.200

0.200 0.093 0.200
0.200 0.087 0.200
0.200 0.098 0.200
0.200 0.078 0.200
0.200 0.086 0.200
0.200 0.084 0.200
0.200 0.106 0.200
0.200 0.127 0.200
0.200 0.209 0.200
0.200 0.107 0.200
0.200 0.093 0.200
0.200 0.090 0.200
0.200 0.114 0.200
0.200 0.095 0.200
0.200 0.086 0.200
0.200 0.069 0.200
0.200 0.142 0.200
0.200 0.100 0.200
INPUT EFFECTIVE SAMPLE SIZE FOR CATCH AT AGE BY YEAR & FLEET
0 0 22
0 0 15
0 0 24
0 0 15
0 0 0
0 0 9
0 0 0
0 0 3
0 0 3
0 0 0
0 0 6
10 0 0
13 0 0
16 0 9
16 0 16
20 0 0
31 0 0
23 0 0
29 0 0
23 0 8
25 0 0
0 9 0
18 10 0
21 7 20
26 10 21
27 6 20
19 8 27
29 12 25
27 5 16
22 12 26
INPUT EFFECTIVE SAMPLE SIZE FOR DISCARDS AT AGE BY YEAR & FLEET
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 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
18 15 18
18 8 18
18 18 18
11 11 11
11 5 11
11 11 11
LAMBDA FOR F MULT IN FIRST YEAR BY FLEET
1 1 1
CV FOR F MULT IN FIRST YEAR BY FLEET
0.5 0.5 0.5
LAMBDA FOR F MULT DEVIATIONS BY FLEET
1 1 1
CV FOR F MULT DEVIATIONS BY FLEET
0.5 0.5 0.5
LAMBDA FOR N IN 1ST YEAR DEVIATIONS
1
CV FOR N IN 1ST YEAR DEVIATIONS
0.11
LAMBDA FOR RECRUITMENT DEVIATIONS
1
LAMBDA FOR CATCHABILITY IN FIRST YEAR BY INDEX
1 1 1 1
CV FOR CATCHABILITY IN FIRST YEAR BY INDEX
0.3 0.3 0.3 0.3
LAMBDA FOR CATCHABILITY DEVIATIONS BY INDEX
1 1 1 1
CV FOR CATCHABILITY DEVIATIONS BY INDEX
0.5 0.5 0.5 0.5
LAMBDA FOR DEVIATION FROM INITIAL STEEPNESS
1
CV FOR DEVIATION FROM INITIAL STEEPNESS
0.15
LAMBDA FOR DEVIATION FROM INITIAL UNEXPLOITED STOCK SIZE
1
CV FOR DEVIATION FROM INITIAL UNEXPLOITED STOCK SIZE
0.5
NAA FOR YEAR 1
2.73E+06 2.23E+06 1.82E+06 1.29E+06 6.85E+05 4.30E+05 3.07E+05 2.35E+05 7.58E+04 6.33E+04 5.03E+04 5.01E+04
F MULT IN 1ST YEAR BY FLEET
0.2 0.2 0.2

Catchability in 1st year by index
1.22e-06 1.80e-06 1.71e-06 1.54e-05
Initial unexploited Stock Size
12000
Initial Steepness
0.75
Maximum F
3
Ignore Guesses
0
Projection Control Data
Do Projections? (1=yes, 0=no), still need to enter values even if not doing projections
1
Fleet Directed Flag
1 1 1
Final Year of Projections
2020
Year Projected Recruits, What Projected, Target, non- directed F mult
2011 -1 4 -999 1
2012 -1 4 -999 1
2013 -1 4 -999 1
2014 -1 4 -999 1
2015 -1 4 -999 1
2016 -1 4 -999 1
2017 -1 4 -999 1
2018 -1 4 -999 1
2019 -1 4 -999 1
2020 -1 4 -999 1
MCMC info
doMCMC (1=yes)
0
MCMCnyear option (0=use final year values of NAA, 1=use final year + 1 values of NAA)
0
MCMCnboot
2000
MCMCnthin
200
MCMCseed
14159638
R in agepro.bsn file (enter 0 to use NAA, 1 to use stock-recruit relationship, 2 to used geometric mean of previous years)
2
Starting year for calculation of R
2007
Starting year for calculation of R
2009
Test Value
-23456
#####
---- FINIS ----