SEDAR

Southeast Data, Assessment, and Review

SEDAR 22
Stock Assessment Report

Gulf of Mexico Tilefish

July 2011

SEDAR
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North Charleston, SC 29405

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SECTION I: Introduction

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1. SEDAR PROCESS DESCRIPTION

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

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

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

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

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

2. MANAGEMENT OVERVIEW

2.1 *FISHERY MANAGEMENT PLAN AND AMENDMENTS*

The following summary describes only those management actions that likely affect tilefish fisheries and harvest

Original GMFMC FMP

The Fishery Management Plan (FMP) for the reef fish fishery of the Gulf of Mexico was implemented in November 8, 1984. This plan is for the management of reef fish resources under authority of the Gulf of Mexico Fishery Management Council Management Council. The plan considers reef fish resources throughout its range from Florida through Texas. The area which will be regulated by the federal government under this plan is confined to the waters of the fishery conservation zone (FCZ). The FCZ estimated area is 6.82×10^5 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. Tilefish species of the genus *Caulolatilus*, plus the great northern tilefish (also known as golden tilefish or simply tilefish) (*Lopholatilus chamaeleonticeps*), were listed in the original Reef Fish FMP in 1981 as "Species included in the Fishery but Not in the Management Unit". Species on this list were included in the FMP for purposes of data collection. They were considered to be species that were not normally targeted, but were taken incidentally to the directed fishery. One additional tilefish species found in the Gulf of Mexico, the sand tilefish (*Malacanthus plumieri*) was not listed. This species is generally considered to be a shallow-water species inhabiting sand and rubble bottoms near reefs and grass beds (FishBase[1]), but it has also been reported to occur in Pulley Ridge in depths of 196 feet or deeper (USGS[2]).

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 groupers of the resource and conflicts for space.

[1] http://fishbase.org
[2] http://coastal.er.usgs.gov/pulley-ridge/

Amendment 1 (EA/RIR/IRFA), implemented in 1990, added the tilefish (*Lopholatilus chamaeleonticeps*) and the tilefish of the genus *Caulolatilus* to the management unit, listing the four *Caulolatilus* species by name: goldface tilefish, blackline tilefish, anchor tilefish, and blueline tilefish. This meant that tilefish (other than sand tilefish) were now subject to permit requirements and other requirements of the Reef Fish FMP. However, no tilefish specific management measures were implemented.

Amendment 12, including EA, RIR and IRFA, implemented in January 1997, established a recreational aggregate bag limit of 20 reef fish for reef fish species not otherwise subject to a bag limit, including tilefish.

Measures in the original FMP that would have affected permits and gear specifications for fish traps along with a limit on the number of fish traps allowed per vessel, establishment of a stressed area within which the use of fish traps, roller trawls, and powerheads for the taking of reef fish was prohibited, and a prohibition on the use of poison or explosives for taking reef fish.

GMFMC FMP Amendments affecting tilefish

Description of Action	FMP/Amendment	Effective Date
Following species were placed in the Fishery Management Plan: *Caulolatilus spp.*, plus the great northern tilefish (also known as golden tilefish or simply tilefish) (*Lopholatilus chamaeleonticeps*)	Original FMP	1981
Following species were added: goldenface tilefish, *Caulolatilus chrysops*, blackline tilefish, *Caulolatilus cyanops*, anchor tilefish, *Caulolatilus intermedius*, and blueline, *Caulolatilus microps*), (1)Established 20-50 fathom buoy/longline gear boundary (2) Established a commercial reef fish vessel permit (3) Established fish trap permits, 100 traps per person (4) Established fishing season January 1-December 31 (5)Established a framework for setting total allowable catch	Amendment 1 (GMFMC 1990)	2/21/90
Set a three-year moratorium on issuance of new commercial reef fish permits	Amendment 4 (GMFMC 1992)	5/8/92
Established reef fish dealer permitting and record	Amendment 7	2/7/94

keeping requirements, allowed transfer of fish trap permits, and endorsements between immediate family members during the fish trap moratorium, and allowed transfer of other reef fish permits or endorsements in the event of death or disability of the person who was the qualifier for the permit or endorsement.	(GMFMC 1994)	
(1) Limit sale of Gulf reef fish by permitted vessels to permitted reef fish dealers,(2) require that permitted reef fish dealers purchase reef fish caught in Gulf federal waters only from permitted vessels, (3) allow transfer of reef fish permits and fish trap endorsements in the event of death of disability, (4) implement a new reef fish permit moratorium for no more than 5 years or until 12/31/00, (5) allow permit transfers to other persons with vessels by vessel owners (not operators) who qualified for their reef fish permit, and (6) allow a onetime transfer of existing fish trap endorsements to permitted reef fish vessels whose owners have landed reef fish from fish traps in federal waters, as reported on logbooks received by the science and research director of NMFS from 11/20/92 through 2/6/94.	Amendment 11 (GMFMC 1996)	1/1/96
Established 20 reef fish aggregate bag limit	Amendment 12 (GMFMC 1995)	1997
Ten year phase-out for the fish trap fishery in the EEZ; allowed transfer of fish trap endorsements for the first two years and thereafter only upon death or disability of the endorsement holder, to another vessel owned by the same entity, or to any of the 56 individuals who were fishing traps after 11/19/92 and were excluded by the moratorium; and prohibited the use of fish traps west of Cape San Blas, Florida.	Amendment 14 (GMFMC 1997)	4/24/97
Prohibit harvest of reef fish from traps other than permitted reef fish traps.	Amendment 15 (GMFMC 1998)	1/29/98
Prohibits the possession of reef fish exhibiting the condition of trap rash on board any vessel in the Gulf EEZ and that does not have a valid fish trap endorsement and requires fish trap owners or operators to provide trip initiation and termination reports and to comply with a vessel/gear inspection requirement.	Amendment 16A (GMFMC 2000)	1/10/00
Extended the commercial reef fish permit moratorium	Amendment 17	8/2/00

until December 31, 2005	(GMFMC 2000)	
1) Prohibits vessels from retaining reef fish caught under recreational bag/possession limits when commercial quantities of Gulf reef fish are aboard, (2) adjusts maximum crew size on charter vessels that also have a commercial reef fish permit, and (3) prohibits the use of reef fish for bait except for sand or dwarf sand perch.	Amendment 18A (GMFMC 2007)	5/6/07
Establish 3-year moratorium on issuance of charter and headboat permits for-hire reef fish	Amendment 20 (GMFMC 2001)	7/1/03
Continues the Steamboat Lumps and Madison-Swanson reserves for an additional six years, until June 2010.	Amendment 21 (GMFMC 2003)	6/3/04
Implemented specific bycatch reporting methodologies for logbooks and a mandatory commercial and for-hire (charter vessel/headboat) observer program for the reef fish fishery.	Amendment 22 (GMFMC 2004)	7/5/05
Replaced the commercial reef fish permit moratorium with a permanent limited access system	Amendment 24 (GMFMC 2005)	8/17/05
Replaced reef fish for-hire moratorium with limited access system	Amendment 25 (GMFMC 2005)	6/15/06
Requires the use of non-stainless steel circle hooks when using natural baits to fish for Gulf reef fish and the use of venting tools and dehooking devices when participating in the commercial or recreational reef fish fisheries.	Amendment 27 (GMFMC 2007)	6/1/08
Reduced aggregate bag limit from 5 to 4 fish	Amendment 30B (GMFMC 2008)	4/16/09
Established grouper and tilefish IFQ system	Amendment 29 (GMFMC 2009)	1/1/10

2.2. Secretarial Amendments

Secretarial Amendment 1, implemented July 15, 2004, established a commercial quota of 0.44 mp gutted weight, for all tilefish's in the management unit combined. This quota was equal to the average annual tilefish harvest during 1996-2000. It was implemented as a pro-active measure to prevent an uncontrolled increase in Gulf tilefish harvest as a result of a reduction in the deep-water grouper quota and increased restrictions on the overfished Atlantic tilefish fishery.

2.3. Control Date Notices

Notice of Control Date 11/1/89 54 FR 46755:

-Anyone entering the commercial reef fish fishery in the Gulf of Mexico after 11/1/89 may be assured of future access to the reef fish resource of a management regime is developed and implemented that limits the number of participants in the fishery.

Notice of Control Date 11/18/98 63 FR 64031:

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

Notice of Control Date 7/12/00 65 FR 42978:

-The Council considered whether there was a need to limit participation by gear type in the commercial reef fish fisheries in the Gulf EEZ and if so what management measures should be imposed. Possible measures include modifications to the existing limited entry program to control fishery participation or effort, based on gear type, such as a requirement for gear endorsement on the commercial reef fish vessel permit for the appropriate gear. Gear types that may be included are longlines, buoy gear, handlines, rod-and-reel, bandit gear, spear fishing gear, and powerheads used with spears.

Notice of Control Date 10/15/04 69 FR 67106:

-The Council is considered the establishment of an IFQ to control participation or effort in the commercial grouper fishery of the Gulf of Mexico. The control data above would determine eligibility of catch histories in the commercial grouper fishery.

2.4. Management Program Specifications

Table 2.4.1. General Management Information

Species	tilefish, *Lopholatilus chamaeleonticeps,* goldenface tilefish, *Caulolatilus chrysops* blackline tilefish, *Caulolatilus cyanops* anchor tilefish, *Caulolatilus intermedius,* and

	blueline, *Caulolatilus microps*
Management Unit	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	/ Carrie Simmons
Current stock exploitation status	Not yet determined
Current stock biomass status	Not yet determined

Table 2.4.2. Specific Management Criteria

Criteria	Gulf of Mexico – Current		Gulf of Mexico - Alternative	
	Definition	Value	Definition	Value
MSST	undefined*	To Be Determined (TBD)	MSST = [(1-M) or 0.5 whichever is greater]*B_{MSY}	SEDAR 22
MFMT	F30%SPR	TBD	F_{MSY}	SEDAR 22
MSY	undefined**	TBD	Yield at F_{MSY}	SEDAR 22
F_{MSY}	no proxy defined	TBD	F_{MSY}	SEDAR 22
OY	undefined**	TBD	Yield at F_{OY}	SEDAR 22
F_{OY}	undefined***	TBD	F_{OY} =65%, 75%, 85% F_{MSY}	SEDAR 22
M	--	TBD	Instantaneous natural mortality	SEDAR 22
Probability value for evaluating status	50% Fcurr> MFMT = overfishing		Annual yield @ F_{MFMT}	

The Generic SFA Amendment (1999) states that MSST will be implemented by framework amendment for each stock as estimates of B_{MSY} and MSST are developed by NMFS, the Reef Fish Stock Assessment Panel, and Council. Thus, MSST is undefined until established following a stock assessment in which B_{MSY} or a proxy is determined. However, the Council has generally adopted (1-M)SSB_{MSY} as the MSST for stocks with stock assessments.

**Proposed SPR based proxies of MSY and OY in the Generic SFA Amendment were rejected by NMFS on the basis that such proxies must be biomass based.

*** The Council has typically used 75% of F_{MSY} (or F_{MSY} proxy) as its definition of F_{OY}. However, no generic definition of F_{OY} has been set, and it is therefore undefined for stocks without prior assessments.

Yields (MSY and OY) are in terms of pounds landed under prevailing selectivity's and after estimating and accounting for discards in the stock assessment.

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

Stock Rebuilding Information

The current stock biomass is unknown; therefore, no rebuilding plan is required at this time.

Table 2.4.4. Stock projection information.

Requested Information	Value
First Year of Management	2013
Projection Criteria during interim years should be based on (e.g., exploitation or harvest)	Fixed exploitation at F_{OY} or Frebuilding as appropriate.
Projection criteria values for interim years should be determined from (e.g., terminal year, avg of X years)	Average of previous 3 years

First year of Management: Earliest year in which management changes resulting from this assessment are expected to become effective *interim years*: those between the terminal assessment year and the first year that any management could realistically become effective.

Projection Criteria: The parameter which should be used to determine population removals, typically either an exploitation rate or an average landings value or a pre-specified landings target.

Table 2.4.5. Quota Calculation Details

There is currently a commercial quota = 0.44 mp gutted weight.

Current Quota Value	Commercial = 0.44 mp GW
Next Scheduled Quota Change	None at this time
Annual or averaged quota ?	Annual
If averaged, number of years to average	
Does the quota include bycatch/discard?	Bycatch/discards incorporated into assessment

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

The commercial quota of 0.44 mp gutted weight is calculated on an annual basis. The commercial fishery has closed the quota as early as April or as late as November.

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

Discard mortality estimates are to be estimated and incorporated into the assessment in order to estimate quotas and allocations in terms of landed catches that take into account discard mortality. Appropriate values for current levels of discards and discard mortality rates are to be determined and calculated as part of the Data and Assessment workshops using available data, research, and observations (both observer and anecdotal) to determine values that represent the best available scientific information.

There is only a 20 aggregate bag limit for the recreational sector. Species included in the 20 reef fish aggregate are: all tilefish (tilefish, *Lopholatilus chamaeleonticeps*, goldenface tilefish, *Caulolatilus chrysops*, blackline tilefish, *Caulolatilus cyanops*, anchor tilefish, *Caulolatilus intermedius*, and blueline, *Caulolatilus microps*), Almaco Jack, and gray triggerfish.

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

There are numerous species of tilefish in the fishery management plan.

2.5. Management and Regulatory Timeline

The following tables provide a timeline of Federal management actions by fishery.

Table 2.5.1. Annual Commercial Tilefish Regulatory Summary

Year	Fishing Year	Size Limit	Possession Limit
1983	Calendar Year	None	--
1984	Calendar Year	None	--
1985	Calendar Year	None	--
1986	Calendar Year	None	--
1987	Calendar Year	None	--
1988	Calendar Year	None	--
1989	Calendar Year	None	--
1990	Calendar Year	None	--
1991	Calendar Year	None	--
1992	Calendar Year	None	--
1993	Calendar Year	None	--
1994	Calendar Year	None	--
1995	Calendar Year	None	--
1996	Calendar Year	None	--
1997	Calendar Year	None	--
1998	Calendar Year	None	"
1999	Calendar Year	None	"
2000	Calendar Year	None	
2001	Calendar Year	None	"
2002	Calendar Year	None	"
2003	Calendar Year	None	"
2004	Calendar Year	None	Quota* of 0.44 mp gutted weight, for all tilefishes in the management unit combined
2005	Calendar Year	None	Commercial fishery closed on November 21, 2005
2006	Calendar Year	None	Commercial fishery closed on July 22, 2006
2007	Calendar Year	None	Commercial fishery closed on April 18, 2007
2008	Calendar Year	None	Commercial fishery closed May 10, 2008 The quota was not met so the fishery re-opened for tilefish November 1 through November 11
2009	Calendar Year	None	Commercial fishery closed May 15, 2009

* This quota was equal to the average annual tilefish harvest during 1996-2000. It was implemented as a pro-active measure to prevent an uncontrolled increase in Gulf tilefish harvest as a result of a reduction in the deep-water grouper quota and increased restrictions on the overfished Atlantic tilefish fishery.

Table 2.5.2. Annual Recreational Tilefish Regulatory Summary

Year	Fishing Year	Size Limit	Bag Limit
1983[1]	Calendar Year	None	--
1984[1]	Calendar Year	None	--
1985[2]	Calendar Year	None	--
1986	Calendar Year	None	--
1987	Calendar Year	None	--
1988	Calendar Year	None	--
1989	Calendar Year	None	--
1990[3]	Calendar Year	None	--
1991	Calendar Year	None	--
1992	Calendar Year	None	--
1993	Calendar Year	None	--
1994	Calendar Year	None	--
1995	Calendar Year	None	--
1996	Calendar Year	None	--
1997	Calendar Year	None	Established 20 reef fish aggregate bag limit
1998	Calendar Year	None	"
1999	Calendar Year	None	"
2000	Calendar Year	None	"
2001	Calendar Year	None	"
2002	Calendar Year	None	"
2003	Calendar Year	None	"
2004	Calendar Year	None	"
2005	Calendar Year	None	"
2006	Calendar Year	None	"
2007	Calendar Year	None	"
2008	Calendar Year	None	"
2009	Calendar Year	None	"

[1] Included in the 20 reef fish aggregate are: all tilefish (tilefish, *Lopholatilus chamaeleonticeps*, goldenface tilefish, *Caulolatilus chrysops*, blackline tilefish, *Caulolatilus cyanops*, anchor tilefish, *Caulolatilus intermedius*, and blueline, *Caulolatilus microps*), Almaco Jack, and gray triggerfish

2.6 State Regulatory History

Florida:

Alabama:

February 24, 1997- Established a 20 fish aggregate bag limit for all reef fish species for which there is no other bag limit

There are no regulations for commercial fishing for these species.

*Alabama Marine Resources is proposing regulations this year to the Conservation Advisory Board that will close Alabama waters at any time adjacent federal waters are closed to the taking of a specific reef fish species. These would include both the recreational fisheries and the commercial fisheries. We hope to have these regulations in place by May 2010.

Mississippi:

Historically Mississippi has followed the regulations set forth by the Gulf Council; however, we have not changed our regulations to reflect the regulations put into effect by the council on July 29, 2009. We are still currently at a twenty fish aggregate for the tilefish for the recreational sector.

Louisiana:

For Louisiana the only significant differences for these two species between federal and state management occurred in 2009, when modifications to include IFQ rules were not adopted, and rules on having charter vessels comply with more restrictive rules were also not adopted.

Texas: There are no matching rules in Texas waters, but enforce federal rules under Joint Enforcement Agreements.

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GMFMC (Gulf of Mexico Fishery Management Council). 2009. Amendment 29 to the reef fish fishery management plan. Effort Management in the Commercial Grouper and Tilefish Fisheries. Gulf of Mexico Fishery Management Council, Tampa, Florida 33607. 300 pp.

3. ASSESSMENT HISTORY AND REVIEW

Tilefish and blueline tilefish have not been formally assessed prior to SEDAR 22.

4. REGIONAL MAPS

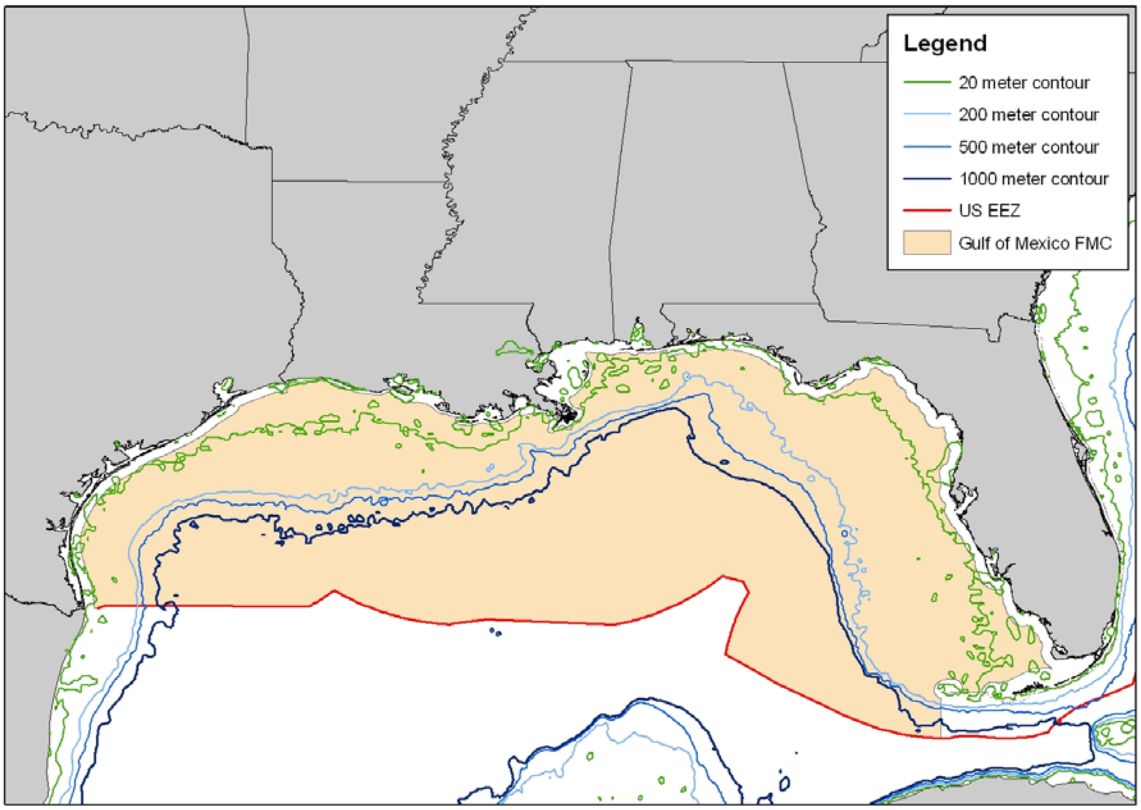


Figure 4.1. Gulf of Mexico management region including Council and EEZ Boundaries

5. ASSESSMENT SUMMARY

The Summary Report provides a broad but concise view of the salient aspects of the stock assessment. It recapitulates: (a) the information available to and prepared by the Data Workshop; (b) the application of those data, development and execution of one or more assessment models; and (c) the findings and advice determined during the Review Workshop.

Stock Status and Determination Criteria

It proved difficult for the Review Panel to choose a single model realization that stood out as being ‘best’. For pragmatic reasons the SS3 central run was suggested as the run to use for estimates of abundance, biomass and exploitation in order to visualize trends. It is very important to appreciate that the base run is only one of many equally plausible runs and it was suggested mainly because it makes use of the best expert knowledge in configuring the model. However, other runs with different model configurations or model parameters can give stock trajectories that suggest different trends and may be equally valid.

All of the Review Panel selected runs indicate that the stock is neither overfished nor undergoing overfishing, except for Run 3 (low M scenario) using the Fspr40% reference point, which indicates that the stock is not overfished but is undergoing overfishing.

Table 1. Summary of stock status determination criteria.

The Review Panel chose three runs for stochastic projections which they felt represented realistic levels of between-model-uncertainty for the assessment and cover the likely levels of stock productivity and alternative states of nature: Run 1, which is the central run, Run 3, which represents a low M scenario (Mref = 0.09), and Run 9, which represents a high recruitment variability scenario (sigma R = 0.3). Unfortunately, Run 9 failed to reach satisfactory convergence. Given these diagnostic results, only Runs 1 and 3 were used to generate uncertainty estimates for management advice. Values represent means of marginal posterior distributions. Spawning biomass units are gonad weight in pounds, and yield units are thousand pounds gutted weight. Fishing mortality rates are reported as F relative to Fcurrent.

Criteria	Recommended Values from SEDAR 22		
	Definition	Run 1	Run 3
M (Instantaneous natural mortality; per year)	Mean of M values from DW	0.13	0.13
$F_{current}$ (per year)	Average F 2007 - 2009	1.00	1.00
F_{MSY} (per year)	$F_{SPR30\%}$	2.07	1.30
$SSB_{current}$ (pounds)	Spawning stock biomass in 2009	35,932.13	28,687.96
$SSB_{SPR30\%}$ (pounds)	Equilibrium SSB @ $F_{SPR30\%}$	17,986.44	14,620.77
MSST (pounds)	(1-M)*$SSB_{SPR30\%}$	15,648.20	12,720.07
MFMT (per year)	$F_{SPR30\%}$	2.07	1.30
MSY (1000 pounds)	Equilibrium Yield at $F_{SPR30\%}$	156.88	108.85
OY (1000 pounds)	Equilibrium Yield at F_{OY}	154.45	107.76
F_{OY} (per year)	75% of $F_{SPR30\%}$	1.55	0.98
Biomass Status	$SSB_{current}$/MSST	2.30	2.26
Exploitation Status	$F_{current}$/MFMT	0.49	0.78

Stock Identification and Management Unit

- The stock structure of tilefish, *Lopholatilus chamaeleonticeps*, was examined from the U.S. east coast including mid-Atlantic, south Atlantic and the Gulf of Mexico (Katz et al. 1983). The Mid- Atlantic group broke out distinctly. The south Atlantic and Gulf of Mexico stocks exhibited clinal variation indicating evidence for gene flow from Gulf of

Mexico to south Atlantic. However Katz et al. 1983 concluded that wide geographic separation may necessitate management as separate south Atlantic and Gulf of Mexico stocks.

- Given the evidence of limited movements and limited possibility of adult exchange between the Gulf of Mexico and other regions, the Life History Working Group recommended treatment of tilefish harvested from the Gulf of Mexico as a distinct stock.

Stock Life History

Life history data used in the assessment included natural mortality, growth, sex ratio, maturity, fecundity, and sex transition rates. Stock Synthesis uses the life history quantities as initial parameter values, rather than as data inputs.

- Although 98 estimates of M were derived using different functions and sets of data, the Data Workshop Panel recommended a triangular distribution with a peak around 0.1125 (center of the bin containing the most estimates), falling to 0 at 0.0375 and at 0.235 (centers of the bins on either end of the plausible zone) be used as a prior for natural mortality in the assessment.
- A total of 4841 otoliths were collected from fishery dependent and independent sampling (1985, 1997-2009). Tilefish otoliths were obtained primarily from Florida's federal waters (68%) with 20% collected in Texas' waters. The source was primarily the commercial fishery (92% of otoliths sampled).
- Length and associated age data reflected a large size range (274-1123 mm TL, mean 653 ± 2 mm se) and age range (2-40 years, mean 10 ± 0.06). A majority of the fish was 400-899 mm in length (94%) and age 5-18 (95%). Sexually dimorphic differences in length and age were apparent reflecting slow growing female and faster growing male tilefish at older age classes.
- Tilefish ages and total lengths from the entire time series (1997-2009) were fit to a von Bertalanffy growth function (VBGF) by region (east and west). The predicted VBGF parameters used as initial parameter values in the SS model were east: L_∞= 878 mm, k = 0.109, t_o = -2.8645; west: L_∞ = 773 mm, k = 0.1721, t_o = -2.3592.
- Female tilefish from the Gulf of Mexico exhibited a spawning season extending from January to June with peak development in April.
- Mature females ranged in size from 351 to 780 mm TL and age 3-27 (S22-DW-01). Based on logistic regression, size and age at 50% maturity for females in the Gulf were 344 mm TL and age 2, respectively

Assessment Methods

Stock Synthesis 3.2 (SS3) was used as the principal assessment method. It is an age-structured population assessment tool and is a well-established approach. It includes a population simulation model to calculate the abundance and mortality of a harvested population, an observation model to relate this population model to observable data from the population, and a statistical model to adjust parameters of the population model and observation model to achieve the best fit to all the data. As SS3 can tolerate missing values, it is well designed to deal with the data available for the tilefish assessment, but does require the analyst to make a number of choices in the configuration of the model.

Two regions were specified for tilefish: 1) eastern Gulf and 2) western Gulf. These regions were partitioned to allow SS to account for spatial differences in fishing pressure on tilefish across the Gulf. Since adult tilefish live in burrows, it was assumed that they do not move great distance. Therefore, there was no movement of tilefish specified between regions.

Exploratory analysis was also performed using Stock Reduction Analysis (SRA). While a much simpler approach, SRA is based on a similar age structured population model that uses an historical catch stream to estimate a stock biomass trajectory. The principal limitation of the method is that it does not use data on age and length within the model.

Assessment Data

- Input data comprised catches, length and age compositions, abundance indices and life history data.
- Landings data were available for the years 1965 onwards and were split into two areas (Eastern and Western Gulf). Golden tilefish have only been identified to species since 1992 so earlier landings were derived by apportioning aggregate landings by using a ratio estimator based on the period 1992-1996. Discards and recreational catches were small and were added to the total landings.
- Length composition data were available for more recent years and were stratified into two commercial gears (handline and longline) and the NMFS BLL survey. They were further stratified by gender and region that resulted in small sample sizes in some strata.
- Age compositions are also available for the more recent years and are similarly stratified for gear and region. Age determination has been validated but aging error is nevertheless large.
- One commercial and one fishery independent survey were available which had been standardized using a delta-lognormal model. These are partitioned into two assessment areas. The commercial longline CPUE is a longer and continuous series since 1992 while the NMFS Bottom Longline (BLL) CPUE series begins in 2000 and was interrupted in 2005 due to a hurricane event.
- Overall the data summarized above were considered by the Review Panel to be adequate for the purpose of assessment, but noted that the quantity of data was low and there are concerns over some aspects of its quality.

Release Mortality

There is no information available regarding discard mortality for tilefish. However, given the depths fished and common information regarding the condition of captured fish, the assumption was that discard mortality is equal to 100%.

Catch Trends

- Significant landings for golden tilefish began to occur in the early 1980s, with a rapid increase in 1988 to a high of 848,378 gutted pounds.
- The landings generally decreased from 1988 through 1999.
- Landings averaged ~420,000 gutted pounds from 2000-2004 before beginning to increase to a peak of 525,877 gutted pounds in 2005.
- The fishery has landed an average of ~310,000 gutted pounds over the last four years of the assessment timeframe (2006-2009).

Fishing Mortality Trends

Stock Synthesis does produce region and fishery-specific estimates of instantaneous fishing mortality rates. In a multi-area, multi-fishery model, it is impossible to produce an overall instantaneous fishing mortality rate. Therefore, a proxy must be used to get estimates of Gulfwide fishing mortality. The Assessment Panel decided to use F relative to Fcurrent to determine stock status, as was done in the SEDAR 7 Gulf of Mexico red snapper assessment and in the 2009 Gulf of Mexico red snapper assessment update. Exploitation rates (catch / total biomass) are used to represent region-specific (i.e., eastern and western Gulf) fishing mortality rates.

In the eastern Gulf, fishing mortality was relatively low from 1965-1980. Fishing mortality increased, but remained relatively constant, from 1985-1996, and has increased continually from 1997-2009. In the western Gulf, fishing mortality varied without trend from 1981-2005, with the highest peak in 1988. From 2006-2009, fishing mortality decreased to lower levels on par with the early 1980s.

Stock Abundance and Biomass Trends

Predicted abundance at age showed an overall decline during the assessment timeframe. Mean age of females follows similar trends in the east and west. Females in both regions have a mean age of 6 years in 1965, decline to a mean age of 2 years in 1997, and increase to a mean age of 4 years in the east and 6 years in the west in 2009.

Mean age of males follows similar trends in the east and west during the early years of the assessment. Males have a mean age of 12 years in the east and 11 years in the west in 1965, decline to a mean age of 3 years in the east and 2 years in the west in 1997. Mean age of males in the east increases to 6 years in 2005 before declining to 4 years in 2009. Mean age of males in the west increases to 6 years in 2005 and remains at that level through 2009.

Total biomass and spawning biomass in the east show steady declines beginning in the early 1980s. Total biomass and spawning biomass in the west decline until 1990, increase from 1996 to 2000, and remain relatively constant from 2000 onward. These trends in total and spawning biomass correspond to what is happening in the fisheries. The decline in total and spawning biomass in the east corresponds with increasing catches in the eastern fisheries. The constant, or possibly declining, catches in the west correspond to constant or increasing biomass in the west.

Recruitment patterns were highly variable between model runs, due to a lack of signal in the data concerning recruitment and year class strength. In addition, model results were highly sensitive to the value used to specify recruitment variability, which is typically not the case in assessments run using SS. For SS Run 1, there was an unusual pattern to the annual recruitment deviations. Annual recruitments were all less than the mean recruitment from 1965 to 1982 during the data poor period (i.e., only catch data available). Annual recruitments were all greater than the mean recruitment from 1983 to 2001 during the data rich period (i.e., length and age compositions and indices available). Finally, annual recruitments were all less than the mean recruitment from 2002 to 2009, when data quality begins to decline due to incomplete cohorts at the end of the time series. There was an unusually high recruitment peak in 1998, which was largely responsible for supporting the population through the remainder of the time series. This recruitment pattern suggests that either productivity has increased in recent years, or historical catches were higher than estimated by the Data Workshop.

Projections

The Review Panel chose three runs for both deterministic and stochastic projections, which they felt represented realistic levels of between-model-uncertainty for the assessment and cover the likely levels of stock productivity and alternative states of nature: Run 1, which is the central run, Run 3, which represents a low M scenario (Mref = 0.09), and Run 9, which represents a high recruitment variability scenario (sigma R = 0.3). All of the Review Panel selected runs indicate that the stock is neither overfished nor undergoing overfishing, except for Run 3 using the Fspr40% reference point, which indicates that the stock is not overfished but is undergoing overfishing.

- One important result of the deterministic projection results is that, while projected Gulfwide population and spawning biomass levels appear to be sustainable for the fixed F projection scenarios evaluated, projected population biomass and spawning biomass in the eastern Gulf are driven to low levels in all of the runs. In fact, the eastern stock actually collapses in all of the Run 3 projection scenarios.

- In all of the projection runs evaluated, this severe decline or collapse of the eastern stock occurs between 2011 and 2012, when the projected catch is fixed at the current quota of 0.44 mp gw. Due to the F allocation pattern, which is based on recent fishing effort, the majority of that quota is landed in the eastern Gulf, heavily impacting the eastern stock. In fact, SS is not even able to catch the current quota of 0.44 mp gw in the Run 3 projections, because there are not enough fish predicted to be in the eastern Gulf.
- Despite these stark declines in the eastern Gulf, the Gulfwide stock is not overfished according to any of the SS runs. The reason for this counter-intuitive result is that the western stock receives very little fishing effort (i.e., only about 8% of F is allocated to the west), allowing the western stock to support the Gulfwide stock status. Because SS uses a single stock-recruitment function and then distributes the recruits between the two areas, the western stock is able to supply recruits to the eastern stock, even when the east has no spawners of its own.

Scientific Uncertainty

- Uncertainty in parameter estimates was quantified by computing asymptotic standard errors for each parameter. Asymptotic standard errors provide a minimum estimate of uncertainty in parameter values. In addition, uncertainty in parameter estimates and key derived quantities was estimated using MCMC methods for the three runs selected by the Review Panel.
- Uncertainty in data inputs and model configuration was examined through a sensitivity analysis. Fourteen alternative runs were included in the assessment report. One additional sensitivity analysis was run at the request of the Review Panel.
- Of the 15 sensitivity runs examined, six were identified as representing the range of uncertainty (see Table 1 of the Review Workshop Report). The central run (Run 1), Low M (Run 3) and the SigmaR=0.3 (Run 9) were chosen by the Review Panel to represent the uncertainty using MCMC stochastic simulations. The Low M seems to represent a plausible level of low productivity for the stock, and the SigmaR=0.3 allows greater variability in the stock recruitment relationship covering alternative recruitment scenarios in the stochastic projections.

Significant Assessment Modifications

- The stock assessment team found it necessary to make several changes to the Gulf of Mexico tilefish assessment to better respond to the requests of the review panel (RP). The primary change was to rerun the assessment using SS version 3.21beta, which was the latest version of SS at the time of this writing. This new version of SS included new options, which directly addressed some of the concerns and suggestions made by the RP. All of the SS results presented in the addendum come from version 3.21beta, and may differ slightly (i.e., generally less than 2% difference) from SS results presented in the

SEDAR 22 Gulf of Mexico Tilefish Assessment Report, due to improvements made to the software.

- There were difficulties producing good convergence of Run 2 when using SSv3.21beta. As a result, the assessment team ended up increasing the reference M from 0.03 to 0.05 for this low M scenario.
- Tables 1 and 2 in the addendum replace assessment report Tables 3.8 and 3.9, respectively, with the updated results from SSv3.21beta.

Summary Comments

Gulf of Mexico tilefish is a data poor species, and suffers many of the problems that make assessments of data poor species so difficult. Data quality is the primary problem with this assessment. This can be seen specifically in the effect of the age composition data on the estimation of recruitment. Unless the recruitment SD parameter is used to constrain the model, current biomass estimates will often exceed virgin levels. The age composition data are not the only problematic data source in this assessment. The indices of abundance, particularly in the east, appear to track abundance trends that conflict with signals from the landings data. For these reasons, the Assessment Panel has recommended that management advice not be based solely on this assessment, but should take into account other information like expert opinion and knowledge of the tilefish fishery.

Sources of Information

All information was copied directly or generated from the information available in the final Stock Assessment Report for SEDAR 22: Gulf of Mexico Tilefish.

TABLES:

Table 2: Catch and discards* by fishery sector*:*

Commercial landings (gutted lbs) for Gulf of Mexico tilefish. Landings are separated into four fisheries: commercial hand line east (CM HL E), commercial hand line west (CM HL W), commercial long line east (CM LL E), and commercial long line west (CM LL W). Recreational landings (gutted lbs) for Gulf of Mexico tilefish. Landings are separated into eastern (Rec E) and western (Rec W) Gulf of Mexico regions. (*Extracted from Table 2.1 and 2.2 of the Assessment report*)

Year	CM HL E	CM HL W	CM LL E	CM LL W	Rec E	Rec W
1965	6,226	0	0	0	0	0
1966	1,789	0	0	0	0	0
1967	962	0	0	0	0	0
1968	1,316	0	0	0	0	0
1969	280	0	0	0	0	0
1971	2,936	0	0	0	0	0
1972	986	0	0	0	0	0
1973	3,567	0	0	0	0	0
1974	3,755	0	0	0	0	0
1975	13,235	0	0	0	0	0
1976	21,995	0	0	0	0	0
1977	32,500	0	0	0	0	0
1978	21,090	536	0	0	0	0
1979	26,187	0	5,108	1,058	0	0
1980	17,163	0	6,161	1,611	0	0
1981	115,753	0	80,306	24,919	0	0
1982	54,406	0	123,761	91,512	0	0
1983	12,732	469	123,702	71,188	0	0
1984	11,722	1,882	164,303	91,749	0	0
1985	8,933	10,981	81,961	146,854	0	0
1986	43,415	8,783	131,873	112,927	0	0
1987	68,123	17,721	153,011	240,647	291	0
1988	79,095	42,236	230,902	496,145	0	0
1989	36,400	56,729	91,733	221,046	0	0
1990	59,551	3,023	111,799	143,322	3,523	0
1991	16,494	22,008	106,531	46,243	0	0
1992	11,976	13,180	85,586	78,776	0	2
1993	13,956	6,515	135,052	98,482	0	0
1994	11,214	1,465	238,069	96,025	0	0
1995	2,085	7,166	147,563	266,117	2	0
1996	1,297	2,641	108,004	76,068	0	0
1997	2,321	517	257,008	41,280	0	0

1998	1,209	1,444	200,473	62,185	0	5
1999	5,569	3,925	195,822	128,980	0	0
2000	3,785	4,931	240,861	178,492	0	0
2001	14,315	264	301,424	116,424	0	1
2002	8,633	1,420	220,305	252,624	0	0
2003	3,087	1,938	210,431	142,111	0	0
2004	2,741	561	253,256	160,661	0	0
2005	3,593	3,826	305,560	212,898	4,197	0
2006	5,230	175	220,861	51,604	0	0
2007	931	1,851	260,255	21,568	0	0
2008	121	292	258,967	51,863	0	68
2009	1,193	72	313,480	52,061	0	0

*Commercial discards in numbers were separated by gear type: commercial hand line (981) and commercial long line (3509). Due to confidentiality restrictions, discard numbers are combined across all years.

Table 3: Predicted total biomass (gutted lbs), spawning biomass (gonad wt thousand lbs, age-0 recruits (thousand fish), and fishing mortality (exploitation rate) for Gulf of Mexico tilefish from SS Run 1.

	East				West			
Year	Total Biomass	Spawning Biomass	Recruits	F	Total Biomass	Spawning Biomass	Recruits	F
1965	3,914,249	38.2	86	1.59E-03	2,810,146	25.3	74	0.00
1966	3,904,860	38.5	85	4.59E-04	2,807,016	25.4	74	0.00
1967	3,897,852	38.9	85	2.47E-04	2,800,718	25.5	74	0.00
1968	3,888,148	39.2	85	3.39E-04	2,789,635	25.5	74	0.00
1969	3,873,700	39.4	86	7.11E-05	2,773,219	25.5	75	0.00
1970	3,855,531	39.6	86	0.00	2,751,724	25.3	75	0.00
1971	3,832,973	39.7	87	7.65E-04	2,725,819	25.0	76	0.00
1972	3,803,270	39.6	89	2.59E-04	2,696,431	24.6	77	0.00
1973	3,771,834	39.4	91	9.45E-04	2,664,602	24.1	80	0.00
1974	3,734,946	39.1	95	1.01E-03	2,631,355	23.6	83	0.00
1975	3,695,834	38.7	100	3.58E-03	2,597,715	23.1	87	0.00
1976	3,646,505	38.2	106	6.03E-03	2,564,705	22.6	93	0.00
1977	3,588,929	37.5	113	9.06E-03	2,533,328	22.1	98	0.00
1978	3,522,751	36.7	117	5.98E-03	2,504,570	21.7	102	2.12E-04
1979	3,470,470	36.0	117	9.02E-03	2,478,784	21.3	102	4.29E-04
1980	3,411,693	35.3	111	6.84E-03	2,456,501	21.0	97	6.57E-04
1981	3,364,963	34.7	108	0.06	2,437,880	20.8	94	0.01
1982	3,154,933	32.6	113	0.06	2,400,283	20.5	99	0.04
1983	2,971,005	30.8	133	0.05	2,302,020	19.8	116	0.03
1984	2,836,287	29.5	170	0.06	2,229,307	19.4	148	0.04
1985	2,670,605	28.0	170	0.03	2,141,575	18.9	148	0.07
1986	2,598,719	27.5	148	0.07	2,001,601	18.0	129	0.06
1987	2,456,029	26.3	150	0.09	1,910,192	17.5	131	0.14
1988	2,281,214	24.8	162	0.14	1,698,233	16.2	141	0.32
1989	2,032,859	22.6	163	0.06	1,231,138	12.7	142	0.23
1990	1,974,712	22.5	166	0.09	1,034,482	11.5	145	0.14
1991	1,882,118	22.0	186	0.07	975,597	11.4	162	0.07
1992	1,850,482	22.2	251	0.05	1,002,300	12.3	219	0.09
1993	1,853,415	22.8	296	0.08	1,016,162	12.9	258	0.10
1994	1,815,944	22.8	209	0.14	1,028,335	13.5	182	0.09
1995	1,696,239	21.7	180	0.09	1,063,805	14.1	157	0.26
1996	1,686,462	21.9	180	0.06	943,035	12.8	156	0.08
1997	1,738,757	22.8	716	0.15	1,021,384	14.2	623	0.04
1998	1,635,657	22.0	158	0.12	1,127,854	16.1	138	0.06
1999	1,620,768	22.1	172	0.12	1,253,822	17.7	150	0.11
2000	1,625,266	22.1	226	0.15	1,329,819	18.6	197	0.14
2001	1,594,074	21.9	166	0.20	1,355,924	19.6	144	0.09

2002	1,495,915	21.2	98	0.15	1,437,662	21.5	86	0.18
2003	1,474,031	21.8	71	0.14	1,375,793	21.4	62	0.10
2004	1,454,256	22.5	61	0.18	1,392,834	22.2	53	0.12
2005	1,375,384	22.4	65	0.23	1,369,307	22.4	57	0.16
2006	1,218,074	20.9	85	0.19	1,267,719	21.3	74	0.04
2007	1,119,758	20.1	106	0.24	1,301,787	21.9	92	0.02
2008	966,282	17.9	109	0.27	1,349,582	22.5	95	0.04
2009	801,292	15.2	109	0.41	1,359,601	22.3	95	0.04

FIGURES:

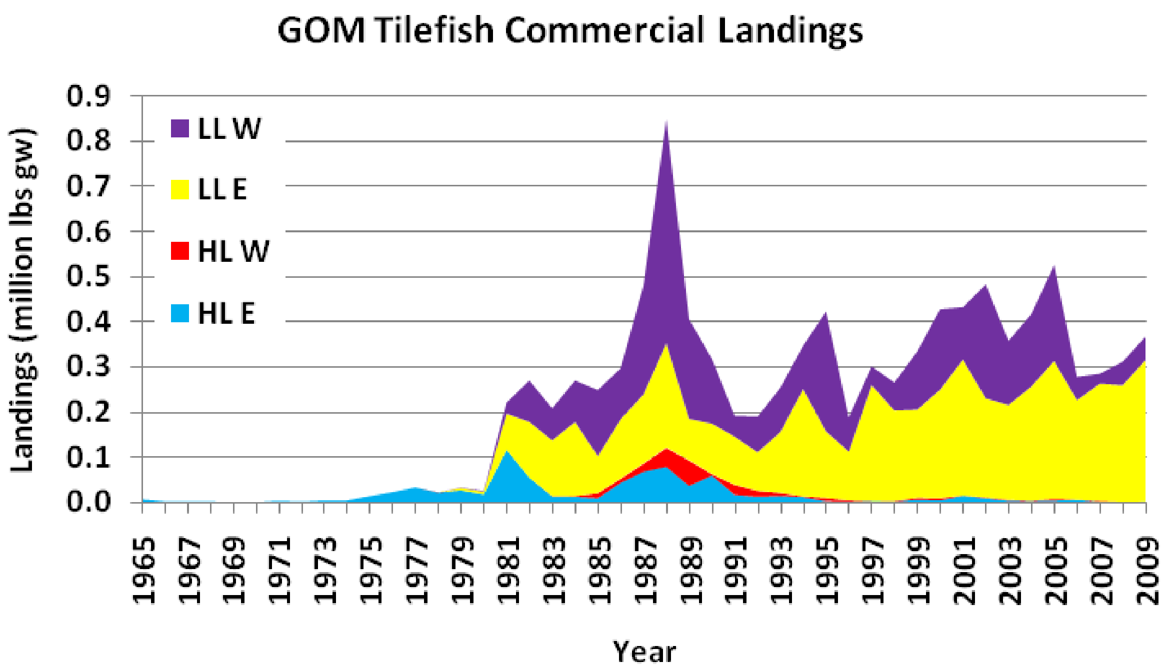
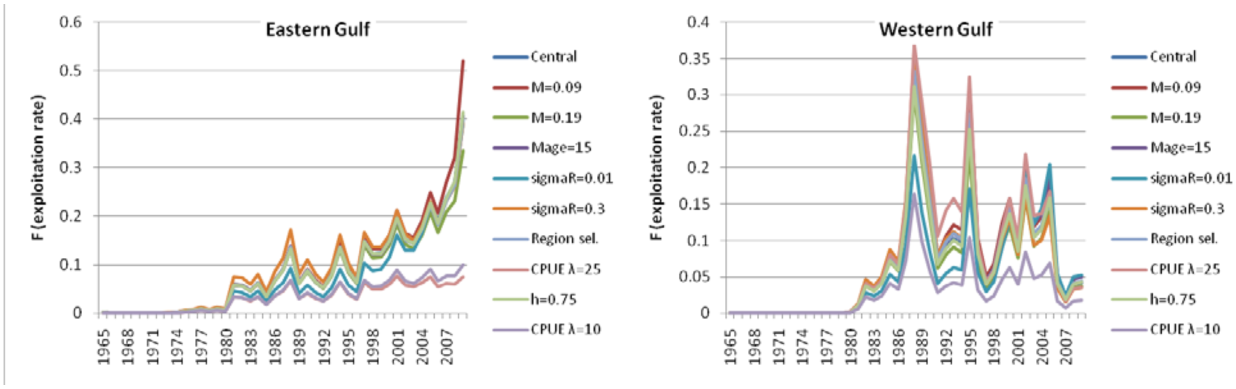


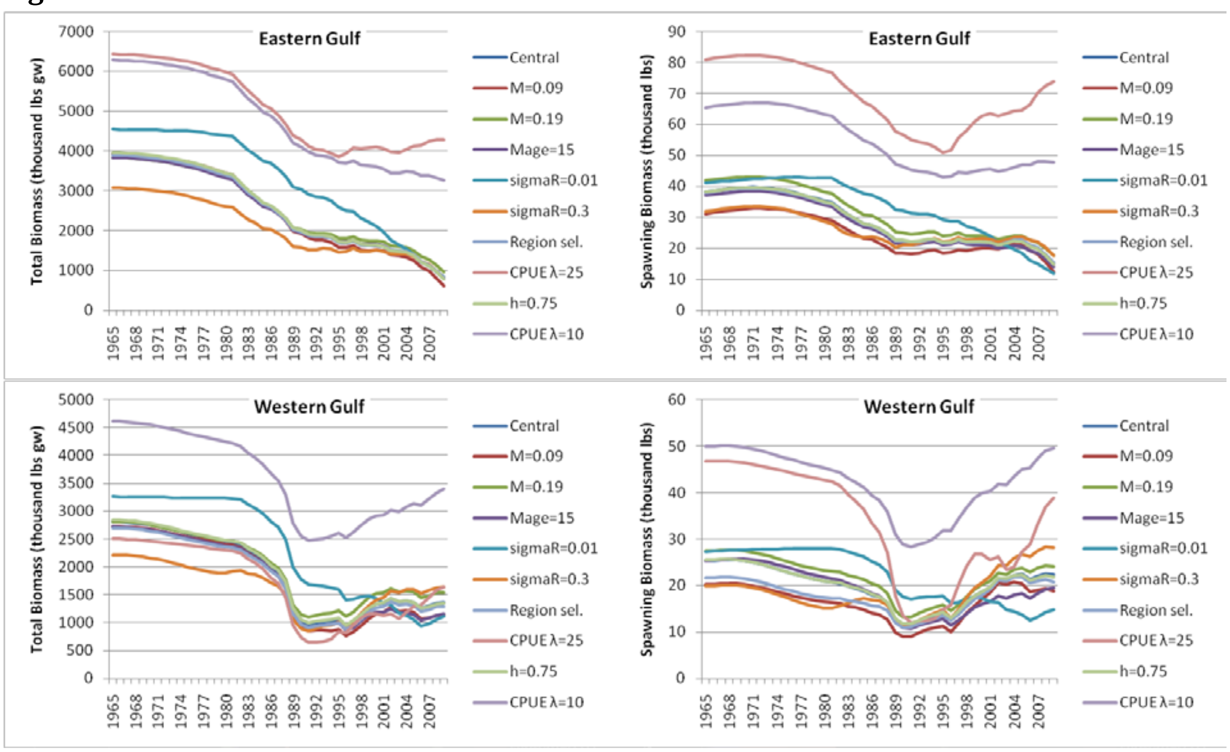
Figure 1: Landings by fishery sector
Commercial landings (million gutted lbs) for Gulf of Mexico tilefish. Landings are separated into four fisheries: hand line east (HL E), hand line west (HL W), long line east (LL E), and long line west (LL W). (*Figure 2.1 from the Assessment Workshop Report*)

Figure 2: Fishing Mortality



Comparisons of eastern Gulf F and western Gulf F for Gulf of Mexico tilefish from a selection of SS runs. The selected SS runs include the runs chosen for management advice by the AP (Runs 1, 3, 4, 6, 8, 9, 11, and 13), and the runs emphasizing the fit to the indices (Runs 12 and 15). (*Extracted from Figure 9 of the Addendum*)

Figure 3: Stock Biomass



Predicted total biomass (thousand gutted lbs) and spawning biomass (gonad weight thousand lbs) for Gulf of Mexico tilefish from a selection of SS runs. The selected SS runs include the runs chosen for management advice by the AP (Runs 1, 3, 4, 6, 8, 9, 11, and 13), and the runs emphasizing the fit to the indices (Runs 12 and 15).

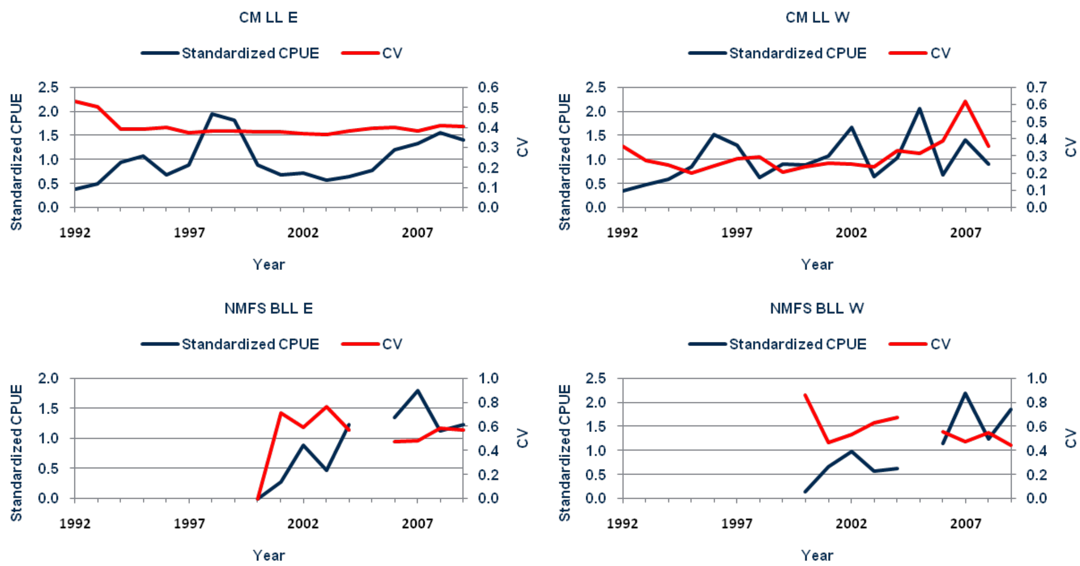
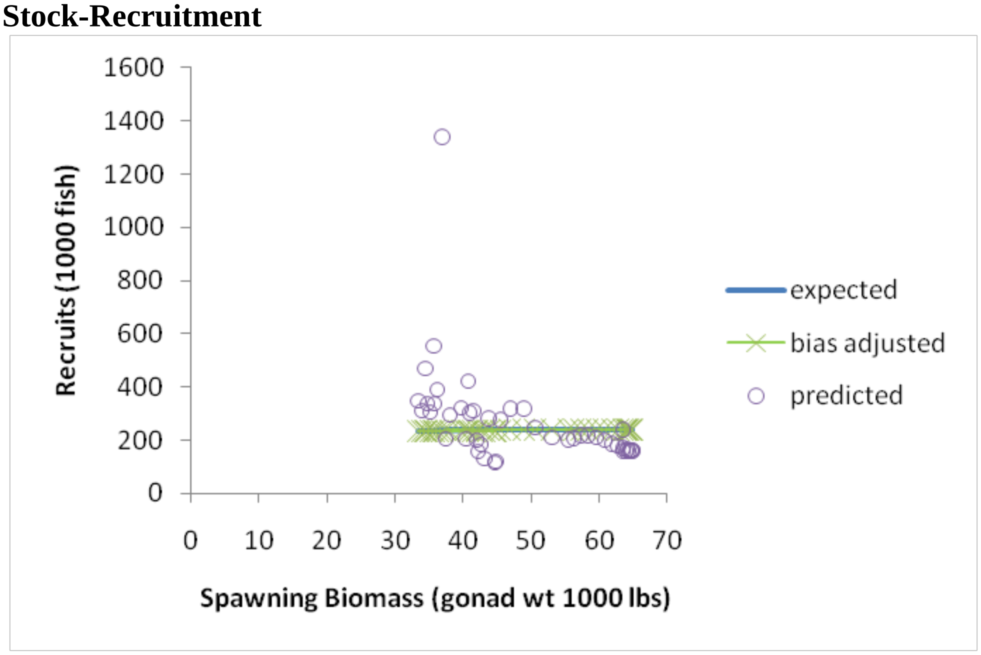


Figure 4: Abundance Indices

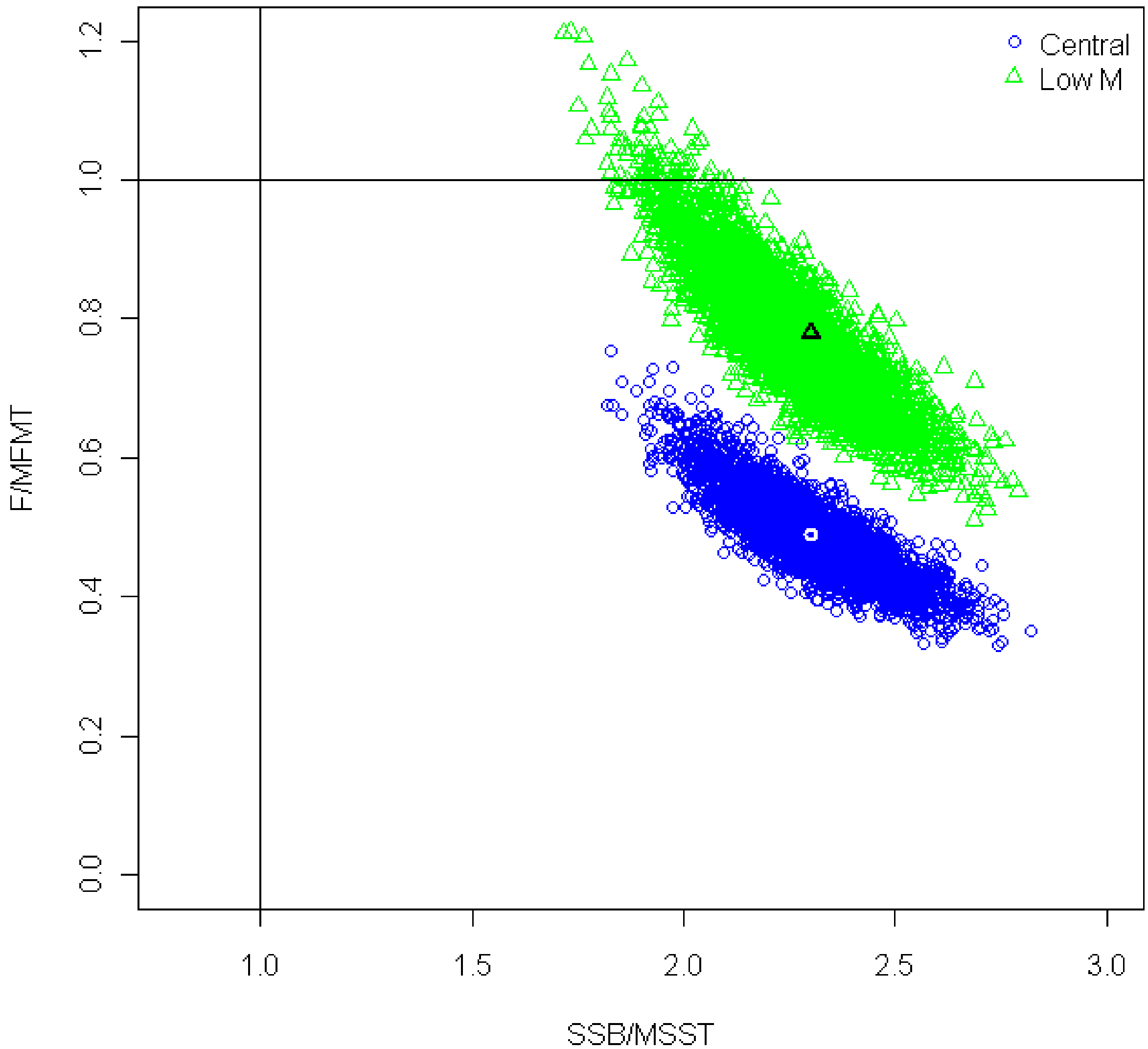
Standardized indices of relative abundance and associated coefficients of variation for Gulf of Mexico tilefish. The indices are from the commercial long line east (CM LL E), commercial long line west (CM LL W), NMFS bottom long line survey east (NMFS BLL E), and NMFS bottom long line survey west (NMFS BLL W). (*Figure 2.14 from the Assessment Workshop Report*)

Figure 5: Stock-Recruitment



Predicted stock-recruitment relationship for Gulf of Mexico tilefish from SS Run1. Plotted are predicted annual recruitments from SS (circles), expected recruitment from the stock-recrit relationship (line), and bias adjusted recruitment from the stock-recruit relationship (line with X).

Figure 7: Stock Status and Control Rule



Stock status of Gulf of Mexico tilefish for the SPR 30% reference point, based upon MCMC runs of the Central (blue circles) and Low M (green triangles) models. The means of the distributions are marked by a white circle (Central) and black triangle (Low M).

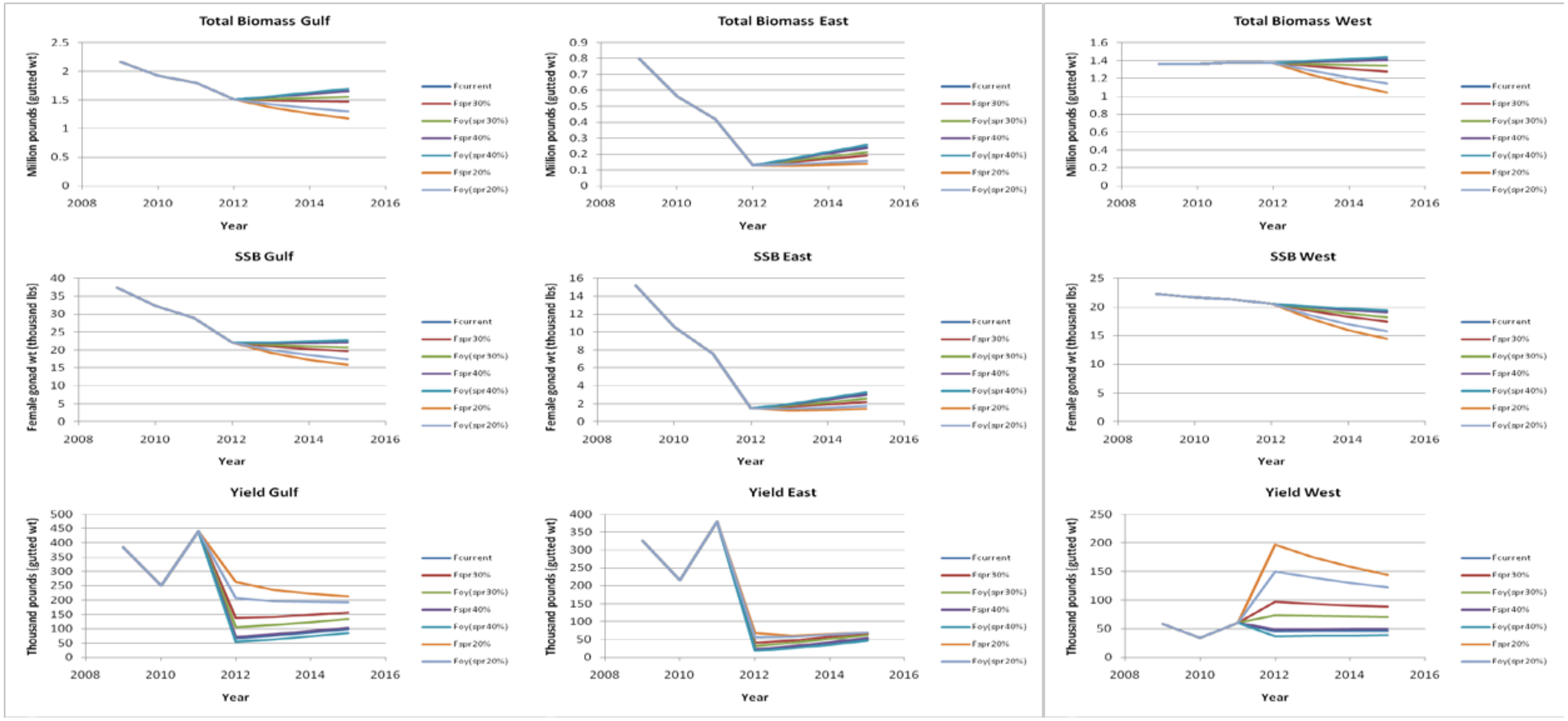


Figure 8: Projections

Deterministic projection results for Gulf of Mexico tilefish SS Run 1. Fixed F projection scenarios include Fcurrent, Fspr20%, Foy at SPR 20%, Fspr30%, Foy at SPR 30%, Fspr40%, and Foy at SPR 40%. Total biomass is reported as million pounds gutted weight. Spawning biomass is reported as female gonad weight in thousand pounds. Yield is reported as thousand pounds gutted weight. (*Figure 11 in the Addendum*)

6. SEDAR ABBREVIATIONS

ABC	Allowable Biological Catch
ACCSP	Atlantic Coastal Cooperative Statistics Program
ADMB	AD Model Builder software program
ALS	Accumulated Landings System; SEFSC fisheries data collection program
ASMFC	Atlantic States Marine Fisheries Commission
B	stock biomass level
BMSY	value of B capable of producing MSY on a continuing basis
CFMC	Caribbean Fishery Management Council
CIE	Center for Independent Experts
CPUE	catch per unit of effort
F	fishing mortality (instantaneous)
F_{MAX}	fishing mortality that maximizes the average weight yield per fish recruited to the fishery
F_{MSY}	fishing mortality to produce MSY under equilibrium conditions
F_{OY}	fishing mortality rate to produce Optimum Yield under equilibrium
$F_{XX\%\ SPR}$	fishing mortality rate that will result in retaining XX% of the maximum spawning production under equilibrium conditions
F_0	a fishing mortality close to, but slightly less than, Fmax
FL FWCC	Florida Fish and Wildlife Conservation Commission
FWRI	(State of) Florida Fisheries and Wildlife Research Institute
GA DNR	Georgia Department of Natural Resources
GLM	general linear model
GMFMC	Gulf of Mexico Fishery Management Council
GSMFC	Gulf States Marine Fisheries Commission
GULF FIN	GSMFC Fisheries Information Network
M	natural mortality (instantaneous)
MARMAP	Marine Resources Monitoring, Assessment, and Prediction
MFMT	maximum fishing mortality threshold, a value of F above which overfishing is deemed to be occurring
MRFSS	Marine Recreational Fisheries Statistics Survey; combines a telephone survey of households to estimate number of trips with creel surveys to estimate catch and effort per trip
MRIP	Marine Recreational Information Program

MSST	minimum stock size threshold, a value of B below which the stock is deemed to be overfished
MSY	maximum sustainable yield
NC DMF	North Carolina Division of Marine Fisheries
NMFS	National Marine Fisheries Service
NOAA	National Oceanographic and Atmospheric Administration
OY	optimum yield
SAFMC	South Atlantic Fishery Management Council
SAS	Statistical Analysis Software, SAS Corporation
SC DNR	South Carolina Department of Natural Resources
SEDAR	Southeast Data, Assessment and Review
SEFSC	Fisheries Southeast Fisheries Science Center, National Marine Fisheries Service
SERO	Fisheries Southeast Regional Office, National Marine Fisheries Service
SPR	spawning potential ratio, stock biomass relative to an unfished state of the stock
SSB	Spawning Stock Biomass
SSC	Science and Statistics Committee
TIP	Trip Incident Program; biological data collection program of the SEFSC and Southeast States.
Z	total mortality, the sum of M and F

SEDAR

Southeast Data, Assessment, and Review

SEDAR 22

Gulf of Mexico Tilefish

SECTION II: Data Workshop Report

August 2010

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

Table of Contents

1. INTRODUCTION

1.1. *WORKSHOP TIME AND PLACE*

The SEDAR 22 Data Workshop was held March 15 - 19, 2010 in Tampa, Florida.

1.2. *TERMS OF REFERNCE*

1. Characterize stock structure and develop unit stock definitions for the tilefish complex. Provide maps of species and stock distribution.
2. Review, discuss and tabulate available life history information (e.g., age, growth, natural mortality, reproductive characteristics); provide appropriate models to describe growth, maturation, and fecundity by age, sex, or length as applicable. Evaluate the adequacy of available life-history information for conducting stock assessments and recommend life history information for use in population modeling.
3. Provide measures of population abundance that are appropriate for stock assessment. Consider and discuss all available and relevant fishery dependent and independent data sources. Document all programs evaluated, addressing program objectives, methods, coverage, sampling intensity, and other relevant characteristics. Provide maps of survey coverage. Develop CPUE and index values by appropriate strata (e.g., age, size, area, and fishery); provide measures of precision and accuracy. Evaluate the degree to which available indices adequately represent fishery and population conditions. Recommend which data sources are considered adequate and reliable for use in assessment modeling.
4. Characterize commercial and recreational catch, including both landings and discard, in pounds and number. Provide estimates of discard mortality rates by fishery and other strata as appropriate or feasible. Evaluate and discuss the adequacy of available data for accurately characterizing harvest and discard by species and fishery sector. Provide length and age distributions if feasible. Provide maps of fishery effort and harvest.
5. Provide recommendations regarding the feasibility of conducting a benchmark assessment for each species in the tilefish complex. If the data are deemed insufficient for a benchmark assessment, provide guidance on the type of management advice that can be provided with that data (see SEDAR Caribbean Data Evaluation Workshop report).
6. Provide recommendations for future research in areas such as sampling, fishery monitoring, and stock assessment. Include specific guidance on sampling intensity (number of samples including age and length structures) and appropriate strata and coverage.

7. Develop a spreadsheet of assessment model input data that reflects the decisions and recommendations of the Data Workshop. Review and approve the contents of the input spreadsheet by June 1.

8. Prepare the Data Workshop report providing complete documentation of workshop actions and decisions (Section II. of the SEDAR assessment report). Develop a list of tasks to be completed following the workshop.

1.3. *LIST OF PARTICIPANTS*

Workshop Panel

Adam Pollack .... NMFS Pascagoula
Bob Spaeth .... GMFMC AP
Brad Kenyon .... GMFMC AP
Brian Linton .... NMFS Miami
Charlie Bergmann .... NMFS Pascagoula
Debbie Fable .... NMFS Panama City
Elbert Whorton .... GMFMC SSC
Gary Fitzhugh .... NMFS Panama City
Harry Blanchet .... GMFMC SSC/LADWLF
Hope Lyon .... NMFS Panama City
John Quinlan .... NMFS Miami
John Walter .... NMFS Miami
Kevin McCarthy .... NMFS Miami
Linda Lombardi .... NMFS Panama City
Martin Fisher .... GMFMC AP
Melissa Cook .... NMFS Panama City
Neil Baertlein .... NMFS Miami
Refik Orhun .... NMFS Miami
Richard Fulford .... GMFMC SSC/Univ of S. MS
Steve Turner .... NMFS Miami
Walter Ingram .... NMFS Pascagoula

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Yong Chen .... Univ. of Maine

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Bob Shipp .... GMFMC

Observers

Greg Abrams ....

Staff

Carrie Simmons ....GMFMC Staff
Julie Neer .... SEDAR
Tina O'Hern ....GMFMC Staff
Patrick Gilles..NMFS Miami

1.4. *LIST OF DATA WORKSHOP WORKING PAPERS AND REFERNCE DOCUMENTS*

Document #	Title	Authors	Working Group
Documents Prepared for the Data Workshop			
SEDAR22-DW-01	Golden tilefish (*Lopholatilus chamaeleonticeps*) age, growth, and reproduction from the northeastern Gulf of Mexico: 1985,1997-2009	Linda Lombardi, Gary Fitzhugh, Hope Lyon	Life History
SEDAR22-DW-02	Commercial longline vessel standardized catch rates of yellowedge grouper in the Gulf of Mexico	Neil Baertlein and Kevin McCarthy	Indices
SEDAR22-DW-03	Golden tilefish and blueline tilefish standardized catch rates from commercial longline vessels in the Gulf of Mexico	Kevin McCarthy	Indices
SEDAR22-DW-04	Discards of yellowedge grouper, golden tilefish, and blueline tilefish from commercial fishing vessels in the Gulf of Mexico	Kevin McCarthy	Catch Statistics
SEDAR22-DW-05	Explorations of habitat associations of yellowedge grouper and golden tilefish	John F Walter, Melissa Cook, Brian Linton, Linda Lombardi, and John A. Quinlan	Life History
SEDAR22-DW-06	Abundance Indices of subadult Yellowedge Grouper, *Epinephelus*	Adam G. Pollack and G. Walter	Indices

	flavolimbatus, Collected in Summer and Fall Groundfish Surveys in the northern Gulf of Mexico	Ingram, Jr.	
SEDAR22-DW-07	Abundance Indices of Yellowedge Grouper and Golden Tilefish Collected in NMFS Bottom Longline Surveys in the northern Gulf of Mexico	G. Walter Ingram, Jr. and Adam G. Pollack	Indices
SEDAR22-DW-08	Yellowedge grouper (Epinephelus flavolimbatus) age, growth and reproduction from the northern Gulf of Mexico	Melissa Cook and Michael Hendon	Life History
SEDAR22-DW-09	Observed Length frequency distributions and otolith sampling issues for yellowedge groupers caught in the Gulf of Mexico from 1984 to 2009.	Ching-Ping Chih	Life History/ Catch Statistics
SEDAR22-DW-10	Observed Length frequency distributions and otolith sampling issues for tile fish caught in the Gulf of Mexico from 1984 to 2009	Ching-Ping Chih	Life History/ Catch Statistics
SEDAR22-DW-11	Length frequency distributions for blue line tile fish caught in the Gulf of Mexico from 1984 to 2009	Ching-Ping Chih	Life History/ Catch Statistics
SEDAR22-DW-12	Estimation of species misidentification in the commercial landing data of tile fish in the Gulf of Mexico from 1984 to 2009	Ching-Ping Chih	Catch Statistics
SEDAR22-DW-13	Estimation of species misidentification in the commercial landing data of yellowedge groupers in the Gulf of Mexico from 1984 to 2009	Ching-Ping Chih	Catch Statistics
SEDAR22-DW-14	Evidence of hermaphroditism in Golden Tilefish (*Lopholatilus chamaeleonticeps*) in the Gulf of Mexico	Hope Lyon	Life History
SEDAR22-DW-15	Recreational Survey Data for Yellowedge Grouper, Tilefish (golden), and Blueline Tilefish in	Vivian M. Matter	Catch Statistics

	the Gulf of Mexico		
SEDAR22-DW-16	Estimated Recreational Catch in Weight: Method for Filling in Missing Weight Estimates from the Recreational Surveys	Vivian M. Matter	Catch Statistics
SEDAR22-DW-17	Commercial Landings of Yellowedge Grouper, Golden Tilefish, and Blueline Tilefish from the Gulf of Mexico region	Refik Orhun	Catch Statistics
Reference Documents			
SEDAR22-RD01	Lead-radium dating of golden tilefish (*Lopholatilus chamaeleonticeps*)	Allen Andrew	
SEDAR22-RD02	Status of the yellowedge grouper fishery in the Gulf of Mexico	Shannon L. Cass-Calay and Melissa Bahnick	
SEDAR22-RD03	Yellowedge grouper (*Epinephelus flavolimbatus*) and golden tilefish (*Lopholatilus chamaeleonticeps*) distributions, habitat preferences and available biological samples	Melissa Cook and Linda Lombardi-Carlson	
SEDAR22-RD04	Validation of yellowedge grouper, *Epinephelus flavolimbatus*, age using nuclear bomb-produced radiocarbon	Melissa Cook & Gary R. Fitzhugh & James S. Franks	
SEDAR22-RD05	Population dynamics structure, and per –recruit analyses of yellowedge grouper, *Epinephelus flavolimbatus* from the northern Gulf of Mexico	Melissa Cook	
SEDAR22-RD06	Reproduction of yellowedge grouper *Epinephelus flavolimbatus*, from the eastern Gulf of Mexico	Bullock, L. H., M. F. Godcharles and R. E. Crabtree	
SEDAR22-RD07	Burrow utilization by yellowedge grouper, *Epinephelus flavolimbatus*, in the northwestern Gulf of Mexico	Jones, R. S., E. J. Gutherz, W. R. Nelson and G. C. Matlock	

SEDAR22-RD08	Age and growth of the yellowedge grouper, *Epinephelus flavolimbatus*, and the yellowmouth grouper, *Mycteroperca interstitialis*, off Trinidad and Tobago	Manickchand-Heileman, S. C. and D. A. T. Phillip
SEDAR22-RD09	A descriptive survey of the bottom longline fishery in the Gulf of Mexico	Prytherch, H. F.

2. **LIFE HISTORY**

2.1. ***OVERVIEW***

2.1.1 Group membership

Gary Fitzhugh	SEFSC, Panama City, WG leader and editor
Linda Lombardi	SEFSC, Panama City, Data provider
Hope Lyon	SEFSC, Panama City, Data provider
Melissa Cook	SEFSC, Panama City
Harry Blanchet	LDWF, GMFMC SSC
Brian Linton	SEFSC, Miami
Carrie Simmons	GMFMC, Staff lead

2.1.2. Issues discussed in the Life History Working Group

Issues discussed in the Life History Working Group (WG) for Gulf of Mexico tilefish, *Lopholatilus chamaeleonticeps,* included stock definition, movements, distributions, age sampling and age determinations, growth, potential for discards, mortality and reproduction. Of these, expanded plenary discussions with the Data Workshop Panel (DW) focused more on particular key issues: 1) the ability to make age determinations from otolith sections, 2) the adequacy of sampling for parameters such as age and sex ratio, 3) the applications/estimations of natural mortality (M) relevant to the assessment model choices, 4) the data sets and parameters, such as the growth coefficients, that informed estimates of M, 5) the evidence suggesting tilefish may be protogynous, and 6) uncertainty about specific reproductive inputs to the model including onset of maturity and the form of reproductive potential.

2.2. *REVIEW 0F WORKING PAPERS*

Working papers were reviewed that were pertinent to the WG. A central paper was S22-DW-01 which presented the age, growth and reproduction results for Gulf of Mexico tilefish. Working document S22-DW-05 presented Gulf habitat associations of tilefish and yellowedge grouper. Also reviewed was S22-DW-14 which presented histological evidence of hermaphrodism, and S22-DW-10 which presented comparisons of length data collected by the Trip Interview Program and reported with hard part collection by port agents.

2.3. *STOCK DEFINITION AND DESCRIPTION*

Tilefish (*Lopholatilus chamaeleonticeps*) have fairly distinct sediment (habitat), depth, and temperature preferences (Nelson and Carpenter 1968, Able et al. 1982, Katz et al. 1983, S22-DW-05). These results together with tagging results suggest adult movements are minimal (Katz et al. 1983, Grimes 1983).

The stock structure of tilefish, *Lopholatilus chamaeleonticeps,* was examined from the U.S. east coast including mid-Atlantic, south Atlantic and the Gulf of Mexico (Katz et al. 1983). Methods included eye, liver, muscle electrophoresis and morphology (e.g., gill raker number). The Mid-Atlantic group broke out distinctly. The south Atlantic and Gulf of Mexico stocks exhibited clinal variation indicating evidence for gene flow from Gulf of Mexico to south Atlantic. However Katz et al. 1983 concluded that wide geographic separation may necessitate management as separate south Atlantic and Gulf of Mexico stocks.

Given the evidence of limited movements (more below) and limited possibility of adult exchange between the Gulf of Mexico and other regions, the WG recommends treatment of tilefish harvested from the Gulf of Mexico as a distinct stock.

2.4. *NATURAL MORTALITY*

The WG reviewed estimates of total and natural mortality (M) from catch curves and various equations (Table 1). The panel developed a table of estimated M values as informative priors for the assessment (Table 2).

The base model to be used for analysis of the species considered under SEDAR 22 will be Stock Synthesis V3 (Methot 2010). This model has the capacity to accept a distribution of informative priors, and estimate M within the model. That capacity reduces some of the need to specify a single estimate for M. However, other analytic methods that are intended to be run in the assessment process do require a specified value of M, or have difficulty in resolving M in some circumstances. Therefore, providing a good estimate of M for those cases will help evaluate the relative performance of the various models.

Several data sources were utilized in order to develop the estimates of M presented. Average water temperatures were obtained from NMFS bottom longline cruise data where the species of interest was collected. Age at maturity was derived from either available literature on the species (Palmer et al. 2004) or from data reports developed for this SEDAR (S22-DW-01). Values for k, L_{inf} and t_{max} were obtained from fish aged using thin sectioned sagittal otoliths. The otoliths for golden tilefish were aged by the same readers, using the same methods. Details of that aging process and methods of validation of otolith aging for each species are presented in S22-DW-01.

Disappearance rates were obtained through catch curve analysis, using data from different datasets, or from subsets of the data (S22-DW-01). Since protogyny may also be present in tilefish, one subset of the data was to consider females only, through those ages between full recruitment to longline gear and significant transition to males. Another case considered was to use all sexed fish, regardless of sex. Thirdly, all aged fish were considered (sex was often unreported). This last case increases the sample size significantly. In each case, the t_{max} associated with that dataset or subset was utilized for calculation of M.

The true value of Z should be considered as an upper limit of M, since with no fishing Z=M. Under fished conditions, Z=M+F, so some value of M below Z is reasonable. However negative estimates of M are not, since this would only be possible if there were contributions to the stock from some additional area. Catch curve analyses conducted here showed negative slopes (positive M), so negative values for M are discounted.

One of the caveats that should be mentioned here is that the species being assessed in this SEDAR are outer continental shelf / shelf break / continental slope species, while most of the published literature considers species that occur in more coastal zones. This may be pertinent to many aspects of the life history, since these deeper waters may be more constant in temperature and salinity than the coastal waters, and those factors may contribute to development of successful life history strategies.

Ninety-eight estimates of M were derived using different functions and sets of data (Table 2 and Figure 1). These tilefish M values include estimates that are higher than current estimates of Z from catch curve calculations. We suggest that these unrealistic high estimates be discounted in development of any prior distributions of F (Figure 1). Therefore, a triangular distribution with a peak around 0.1125 (center of the bin containing the most estimates), falling to 0 at 0.0375 and at 0.235 (centers of the bins on either end of the plausible zone) could be recommended (Figure 1).

During previous SEDAR workshops, it has been discussed that it is unlikely that there is a constant natural mortality rate across all sizes and ages and thus a age-variable approach has been advocated (e.g., SEDARs 4,10, 12,15A and 19). A method for estimating mortality rates by age was developed by Lorenzen 1996. Based upon WG recommendations, Lorenzen estimates were computed for ages 0+ based upon $Hoenig_{fish}$ estimates of M for records where sexes were distinguished and data combined, females only, and all available records regardless of whether sex was noted (Table 2 and Figure 2).

2.5. *DISCARD MORTALITY*

The Life History Working Group noted that there was no tilefish information available regarding discard mortality. However, given the depths fished and common information regarding the condition of captured fish, the assumption is that discard mortality is equal to 100%.

2.6. *AGE*

A total of 4841 otoliths were collected from fishery dependent and independent sampling (1985, 1997-2009; S22-DW-01). Tilefish otoliths were obtained primarily from Florida's federal waters (68%) with 20% collected in Texas' waters (Figure 3a). The source was primarily the commercial fishery (92% of otoliths sampled; Figure 3b). Sectioned otoliths are difficult to interpret and previous validation methods were inconclusive in determining the timing of band depositions. Andrews (2009) determined good agreement between radiometric age and estimated age from growth zone counts for female and unknown age groups but there remain questions about interpretation for the oldest male ages. Given the difficulty in determining accurate age estimates, an ageing workshop was conducted among several federal and state agencies (NOAA Fisheries

Service Panama City, FL; NOAA Fisheries Service Beaufort, NC; South Carolina Department of Natural Resources, Charleston, SC). Each agency provided thin sectioned sagittal otoliths to create a reference collection. Indices of precision were calculated from the reference collection (n = 289) with an overall average percent error of 11%, with percent agreement of 5% increasing to 77% ± 3 years (S22-DW-01).

Length and associated age data reflected a large size range (274-1123 mm TL, mean 653 ± 2 mm se) and age range (2-40 years, mean 10 ± 0.06). A majority of the fish was 400-899 mm in length (94%; Figure 4a) and age 5-18 (95%; Figure 4b). Sexually dimorphic differences in length and age were apparent reflecting slow growing female and faster growing male tilefish at older age classes (Figure 4c).

Commercial longline results revealed similarly sized and aged fish each year; annual mean lengths of 606-687 mm TL, with an overall mean size of 654 ± 2 (se) mm TL (range = 274-1145 mm S22-DW-01). Tilefish collected by the commercial sectors reached an average age of 10 ± 0.1 yrs (range = 2-40 yrs). Some regional differences in demographics were noted; i.e., larger and older tilefish were sampled from the western Gulf in early years of the age record (S22-DW-01). Based upon aggregated data, recruitment to the long line fishery occurs by age 8 (S22-DW-01).

2.7. ***GROWTH***

Tilefish ages and total lengths from the entire time series (1997-2009) were fit to a von Bertalanfy growth function (VBGF). For all data: L_∞ = 830 mm, k = 0.13, t_o = -2.14 (S22-DW-01). VBGF fits and size-at-age contrasts were also made by sex (S22-DW-01). Males grew faster at each age class compared and the VBGF predicted males grow faster and obtain a larger asymptotic size (male: L_∞ = 767 mm, k = 0.15, t_o = -1.46; female: L_∞ = 613 mm, k = 0.13, t_o = -4.56; Figure 5). The panel noted data distribution issues that typically affect VBGF fits. In particular, the low number of samples of very young fish resulted in unrealistic fits of t_o. It was discussed that an iterative fitting process, allowing for sample size weighting by sex and region would be conducted within the assessment (e.g., by Stock Synthesis 3 model) and would correct this effect. However, the panel provided unconstrained estimates of VBGF as well as VGBF fits constrained to t_o = zero, needed to complete mortality equations and develop “prior values” to enter into the model (Table 2).

2.8. ***REPRODUCTION***

Female tilefish from the Gulf of Mexico exhibited a spawning season extending from January to June with peak development in April (S22-DW-01). This was largely in agreement with Atlantic studies in terms of peak spawning time (spring-to-summer) but an extended season is possible (perhaps 9 months or longer). Immature females were rare among available Gulf samples (n = 4) and ranged in size 301-414 mm TL and age 4-6. Mature females ranged in size from 351 to 780 mm TL and age 3-27 (S22-DW-01). Based on logistic regression, size and age at 50% maturity for females in the Gulf were 344 mm TL and age 2, respectively (Figure 6a and 6b). The panel noted that fit of the logistic maturity function may be constrained by the lack of small (and young) tilefish and may not have adequate resolution concerning the onset of maturity. Interestingly, the rarity of immature female tilefish was also noted during the S. Atlantic assessment (Palmer et al. 2004). In the Atlantic analysis, four immature female tilefish were measured at a maximum length of 540 mm TL and maximum age of 6. From the Gulf data set presented here, it was noted that age-6 was also the earliest age of spawning. Female golden tilefish from the south Atlantic were determined to reach maturity at 582 mm TL in 1996-1998, a decrease of 150 mm in the size at maturity compared to fish collected in 1980-1987 (Palmer et al. 2004). Thus the panel recommended that given the uncertainty, a range of values for onset of maturity be explored within the assessment (recommendations below).

During SEDAR4 (US south Atlantic), reproductive information was reviewed including histological assessment of gonads. Although there were 15 males with previtellogenic oocytes (no transitional fish or ovotestes) it was concluded tilefish were to be considered gonochorists (Palmer et al. 2004). However, the histological findings from the Gulf of Mexico gonads reveal the possibility of sex change; particularly directed towards protogyny. While transitional fish were not detected among Gulf samples, 62% (n = 330) of males and 11% (n = 39) of females exhibited gonadal tissue of the opposite sex (S22-DW-01, S22-DW-14). Other evidence for protogyny is the larger size-at-age among males and the apparent increasing proportion of males with age (S22-DW-1). Assuming protogny occurs, logistic regression determined the size at transition at 564 mm TL (Figure 7a). It was noted that males and females were present in each age class and age at transition was calculated to be greater than 50% at each age class examined which is quite unlike other instances of protogny reviewed during prior SEDAR assessments (Figure 7b).

The panel noted the uncertainty about sex transition was partly due to the uncertainty about sex ratio. During a directed Cooperative Research Project (Summers, 08CRP009) conducted in 2008-2009, sex ratio was observed to be seasonally dynamic (Figure 8). The pattern was noted to be of great interest in that males dominated the samples during the spawning season (March-September) while females dominated in months outside of the spawning season (November-January). The panel discussed the value of monthly samples for the seasonal contrast, however, only single trips were observed each month and thus relatively low sample sizes were obtained to draw inference. There could be several possible explanations for the sex ratio pattern such as spatial segregation of sizes and or/sexes or changes in behavior among the sexes related to spawning period. While intriguing, it was never-the-less concluded that more investigation would better inform sex ratios and the likelihood of protogyny (see research recommendations below).

Based upon histologically sexed tilefish, 331 females were available to estimate average somatic weight at age (S22-DW-01, Figure 9). These data (extrapolated to spawning stock biomass, SBB) may be selected as the proxy for fecundity similar to the decision in SEDAR 4. However, the average gonad weight of hydrated females at age suggests that reproductive output is non-proportional to somatic weight with older individuals being much more productive (Figure 9). Since spawning females were not detected until age 6 yet 50% maturity at age is predicted at age 2, there may be an overestimate of the reproductive contribution of the youngest mature fish relative to older ages if an SSB approach is used (total SSB or female SSB). The panel developed a gonad-weight at age function as another possible proxy for fecundity to examine the possible non-proportional effect (Figure 10). The panel recommends that three forms of reproductive potential for the assessment be explored in sensitivity runs (see recommendations below).

2.9. *MOVEMENTS AND MIGRATIONS*

Grimes (1983) conducted an experimental tagging study using detachable leaders from bottom longline gear. Of 384 tags deployed, 7 tags were returned. Fish were at liberty for 115 to 557 days. Only 1 of the 7 tagged fish was reported as moving from its original site (1.9 km west of tagging site).

2.10. *MERISTICS AND CONVERSIONS FACTORS*

Conversions for length and weight were presented to the data workshop (Table 3). Measurements have been reported in terms of total length (TL), fork length (FL), whole weight (W. Wt.) and gutted weight (G. Wt.).

2.11. *COMMENTS ON ADEQUACY OF DATA FOR ASSESSMENT ANALYSES*

Aging: Difficulties determining ages from otolith sections were discussed. Validation studies of otolith increment (annual) periodicity and longevity were conducted and progress was noted over earlier studies. But there was less aging precision than observed in some SEDARs for shallow water species. The WG and DW panel noted that these are reasonable results given the deeper water depth and generally slow growth of species with similar habitat affiliations and life history. More work is recommended to clarify the potential bias in otolith-estimated ages (underestimated age) of large males based upon radiometric age.

Biological sampling: The DW panel noted that age sampling levels from recent years were in general informative for assessment purposes. But there were sample size concerns (S22-DW-10); the WG recommends minimum otolith sampling levels (i.e., >= 500 per year per major strata) based upon GulfFIN guidelines. An increase in otolith sampling level is particularly needed for the western Gulf. The WG recommends expanded data collection of secondary sex characters in commercial fish (observer, port agent programs) to improve information on sex ratio. Given sexually dimorphic growth rates, identification of sex is important when lengths and hardparts (for aging) are collected.

Reproduction Parameters: If benchmark values are sensitive to the form of reproductive potential, the DW panel recommends that increased data needs should be amplified as a priority by the assessment and review panels. In particular the DW panel recommends directed studies for better estimation of onset of maturity, batch fecundity by age, spawning frequency by age, and spawning duration by age. The panel noted in general the mating system of tilefish needs to be better studied.

Age of Maturity: The DW panel noted small number of immature tilefish and thus low contrast for fitting maturity by age/size. The recommendation is to consider sensitivity analysis of maturity by age (e.g., 50% age at maturity ranging from age 2 to age 6).

Spawning Stock Biomass: The DW panel recommends model sensitivity runs of SSB-total, SSB-female, and the female gonad weight proxy. Lacking better resolution about reproductive potential, and given the possibility for protogyny and uncertainty about sex ratio, the DW panel recommends further consultation, if desired, with the life history group and panel members during the sensitivity runs, particularly regarding the possible choice of SSB-total as the preferred form of reproductive potential following Brooks et al. 2008.

Natural Mortality: The DW panel recommend model sensitivity runs using M as an age-fixed value and as an age-variable value (Lorenzen M). As in earlier SEDARs, the panel believes an age-variable approach is more realistic and thus the preferred approach.

2.12. *ITEMIZED LIST OF TASKS FOR COMPLETION FOLLOWING WORKSHOP*

Complete age composition for use in auxiliary model runs (VPA, SRA), taking into account the low age sample sizes available in earlier years (late 80s-90s).

Confrmation of the form of the Lorenzen function preferred for the base model (Stock Synthesis V3).

2.13. *LITERATURE CITED*

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2.14. ***TABLES***

Table 1. Equations for estimating natural mortality (M). Parameter definitions: k = von Bertalanffy growth coefficient, tmax = maximum aged fish, Amat = age at 50% maturity, Linf = von Bertalanffy asymptotic length, T = average water (^oC) temperature within species habitat, Wage = weight at age vector, S = survivorship to tmax. Equations provided in Microsoft Excel notation. Note that the "Rule of thumb" used here pertains to equation 7 in Hewitt and Hoenig (2005).

Method	Parameters	Citation	Equation
Alverson & Carney	k, tmax	Quinn & Deriso (1999)	M = 3*k/[exp(0.38*tmax*k)-1]
Beverton & Holt	k, Amat	Beverton and Holt (1956)	M = 3*k/[exp(Amat*k)-1])
$Hoenig_{fish}$	tmax	Hoenig (1983; for fish)	M=exp(1.46 - 1.01*ln(tmax))
$Hoenig_{all\ taxa}$	tmax	Hoenig(1983; all taxa)	M=exp(1.44-0.982*ln(tmax))
Pauly I	Linf, k, T	Pauly (1980)	M=exp[-0.0152+0.6543*ln(k)-0.279*ln(Linf)+0.4634*ln(T)]
Pauly Method II	Linf, k, T	Pauly and Binohlan (1996)	M=exp[-0.1464+0.6543*ln(k)-0.279*ln(Linf)+0.4634*ln(T)]
Ralston I	k	Ralston (1987)	M=0.0189 + 2.06*k
Ralston (geometric mean)	k	Ralston (1987)	M=-0.0666+2.52*k
Ralston Method II	k	Pauly and Binohlan (1996)	M=-0.1778+3.1687*k
Lorenzen			
Age-Specific	Wage	Lorenzen (1996; ocean)	M=3.69*W^(-0.305)
Jensen	k	Jensen (1996)	M = 1.5*K
Alagaraja	tmax, S	Alagaraja (1984)	M=-(lnS)/tmax
Rule of thumb	tmax	Hewitt and Hoenig (2005)	M = 2.996/tmax

Table 2. Estimates of natural morality (M) using multiple regressions (see Table 1), values shaded are greater than total mortality (Z = 0.25). Data sets include data collected in the Gulf of Mexico (1997-2009). Fixed refers to the von Bertalanffy t_o parameters set at zero. The notation "*" indicates the age 2.2 at maturity obtained through logistic regression

Data Source	Observed Max Age (years)	Number of Fish Aged	von Bertalanffy Linf (mm)	von Bertalanffy k	Water Temp. (°C)	$Age_{.50Maturity}$	Alverson & Carney	Beverton & Holt	$Hoenig_{fish}$	$Hoenig_{all\ taxa}$	Pauly I	Pauly Method II	Ralston I	Ralston (geometric mean)	Ralston Method II	Jensen	Rule of thumb	Alagaraja 0.01	Alagaraja 0.02	Alagaraja 0.05
2000-2009 Females*	27	341	613.34	0.13	13	2.2	0.135	1.171	0.154	0.166	0.276	0.242	0.297	0.273	0.250	0.202	0.111	0.171	0.145	0.111
000-2009 Females*, fixed	27	341	569.85	0.28	13	2.2	0.050	0.986	0.154	0.166	0.455	0.399	0.596	0.640	0.711	0.421	0.111	0.171	0.145	0.111
2000-2009 Combined*	33	875	766.57	0.15	13	2.2	0.078	1.146	0.126	0.136	0.283	0.248	0.336	0.321	0.310	0.231	0.091	0.140	0.119	0.091
2000-2009 Combined*, fixed	33	875	738.54	0.20	13	2.2	0.053	1.084	0.126	0.136	0.341	0.299	0.434	0.441	0.460	0.302	0.091	0.140	0.119	0.091
1997-2009 all data*	40	4647	830.00	0.13	13	2.2	0.063	1.178	0.104	0.113	0.248	0.217	0.287	0.261	0.234	0.195	0.075	0.115	0.098	0.075
1997-2009 all data - age 6 at maturity	40	4647	830.00	0.13	13	6	0.063	0.330	0.104	0.113	0.248	0.217	0.287	0.261	0.234	0.195	0.075	0.115	0.098	0.075
1997-2009 all data*, fixed	40	4647	782.35	0.20	13	2.2	0.031	1.087	0.104	0.113	0.333	0.292	0.428	0.434	0.451	0.298	0.075	0.115	0.098	0.075

Table 3. Meristic regressions for golden tilefish from the Gulf of Mexico (1997-2009).

Conversion and Units	Equation	n	r^2 values	Data Ranges
FL (mm) to TL (mm)	TL = 1.07 * FL – 5.50	677	0.98	TL (mm): 301 – 1109
				FL (mm): 290 – 1040
TL (mm) to W. Wt (kg)	W. Wt = $6.27 \times 10^{-09} * (TL^{\wedge 3.08})$	701	0.94	TL (mm): 301 – 1109
				W. Wt (kg): 0.26 – 14.00
FL (mm) to W. Wt (kg)	W. Wt = $4.65 \times 10^{-09} * (FL^{\wedge 3.15})$	740	0.95	FL (mm): 280 – 1040
				W. Wt (kg): 0.20 – 14.00
FL (mm) to G. Wt (kg)	G. Wt = $1.51 \times 10^{-09} * (FL^{\wedge 3.15})$	1885	0.97	FL (mm): 290 – 1055
				G. Wt (kg): 0.23 – 17.04

2.15. ***FIGURES***

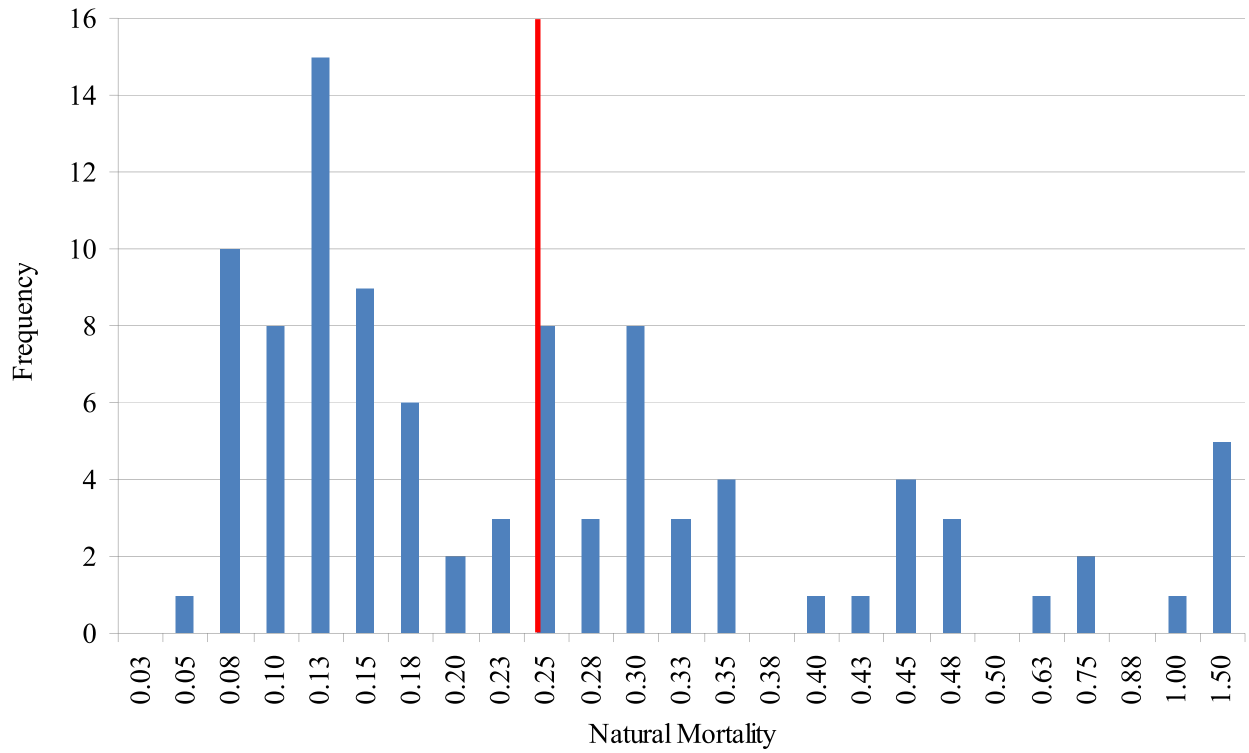


Figure 1. Distribution of natural mortality estimates (M) derived from permutations of available data sets and mortality equations (Table 2). Estimates of M considered as plausible were those where M<= Z (from catch curve analyses). Each bin value represents maximum value. Red line indicates upper bound for M, based on Z approximately = 0.25 (estimates 0.26 - 0.29; S22-DW-01).

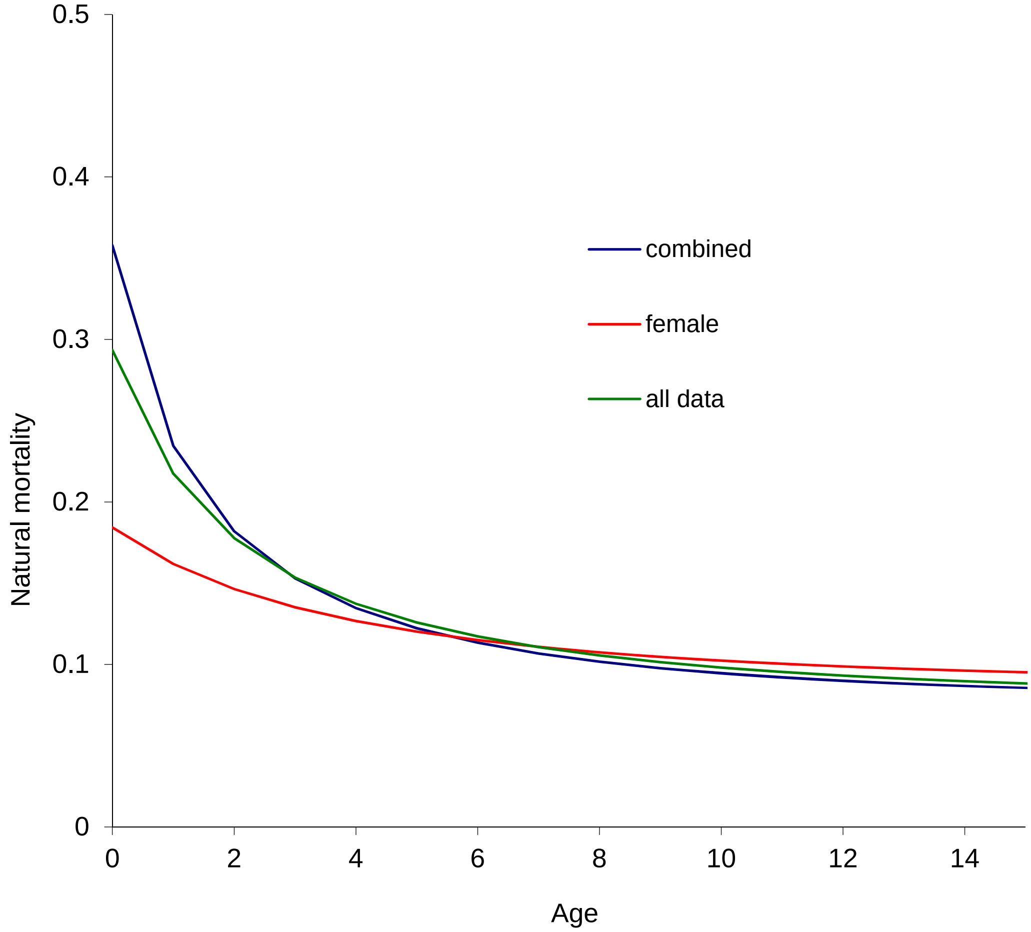
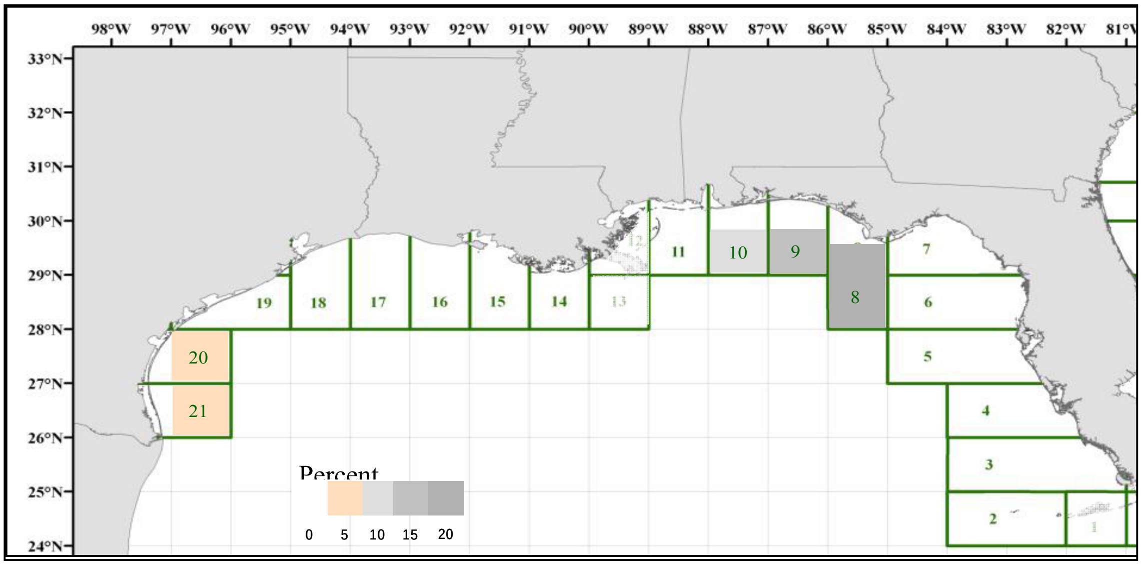


Figure 2. Lorenzen M projections based upon inputs of fixed values of Hoenig$_{fish}$ M for records where sexes were distinguished and data combined, females only, and all available records regardless of whether sex was noted (See Tables 1 and 2).

a. Gulf of Mexico



b. frequency of occurrence

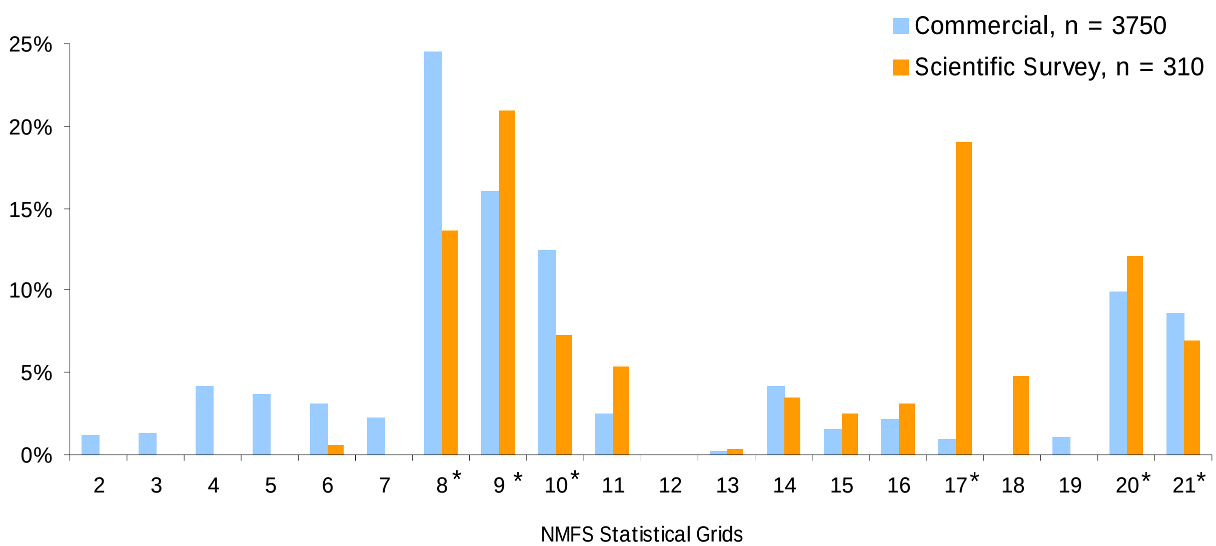
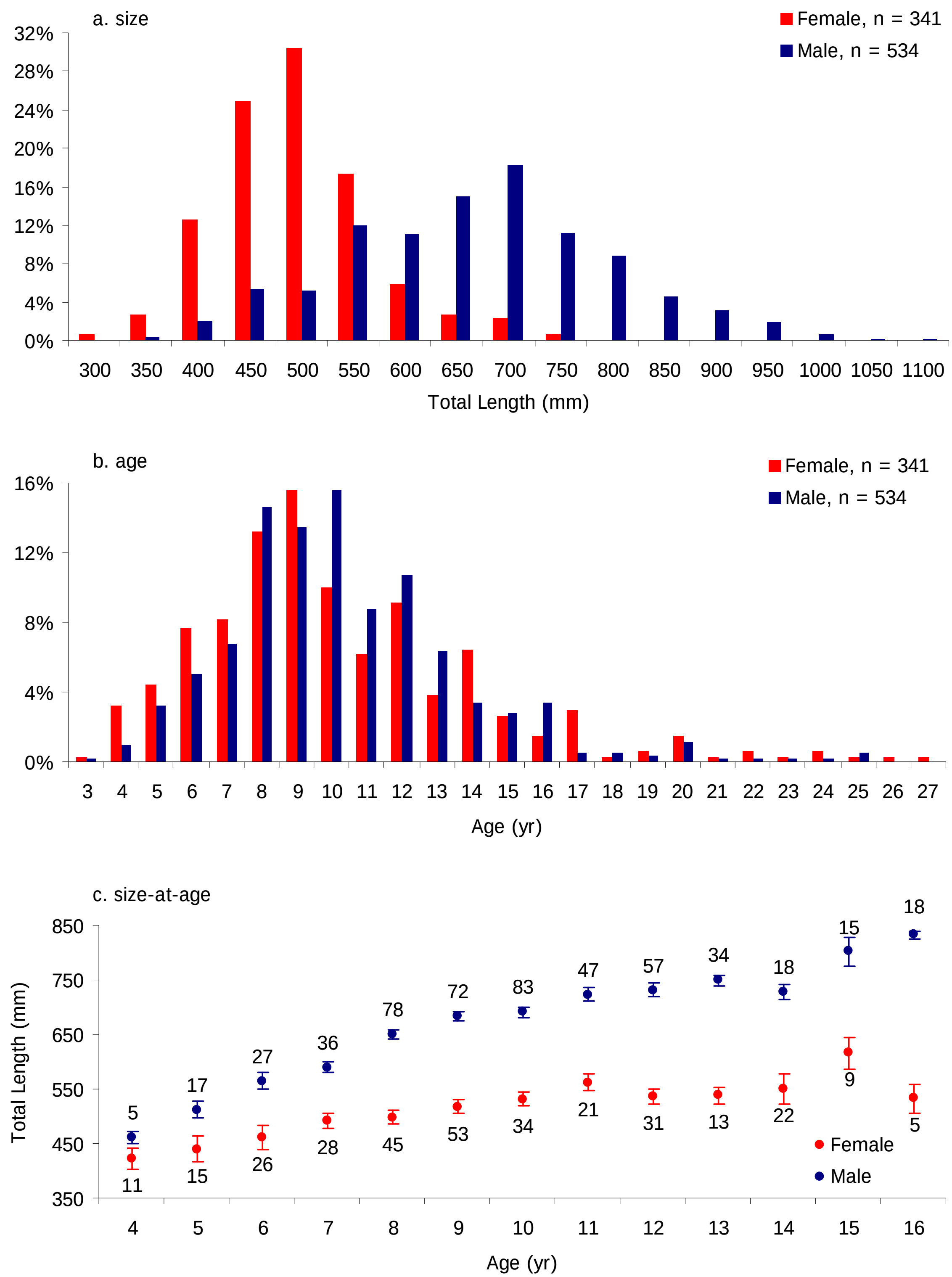


Figure 3. Description of the capture locations of golden tilefish from the Gulf of Mexico as reported through dockside interview for the commercial longline fishery and through reported latitude and longitude of scientific longline surveys: (a) map of the Gulf of Mexico displaying the NMFS Statistical Grids, shaded areas represent the percentage of commercial longline fish caught; (b) frequency of occurrence by source and NMFS Statistical Grid.

Figure 4. Sex-specific description of (a) size, (b) age, and (c) size-at-age (n ≥ 5; mean ± se) of golden tilefish from the Gulf of Mexico (2000-2009). Sample sizes above and below error bars by sex, respectively.



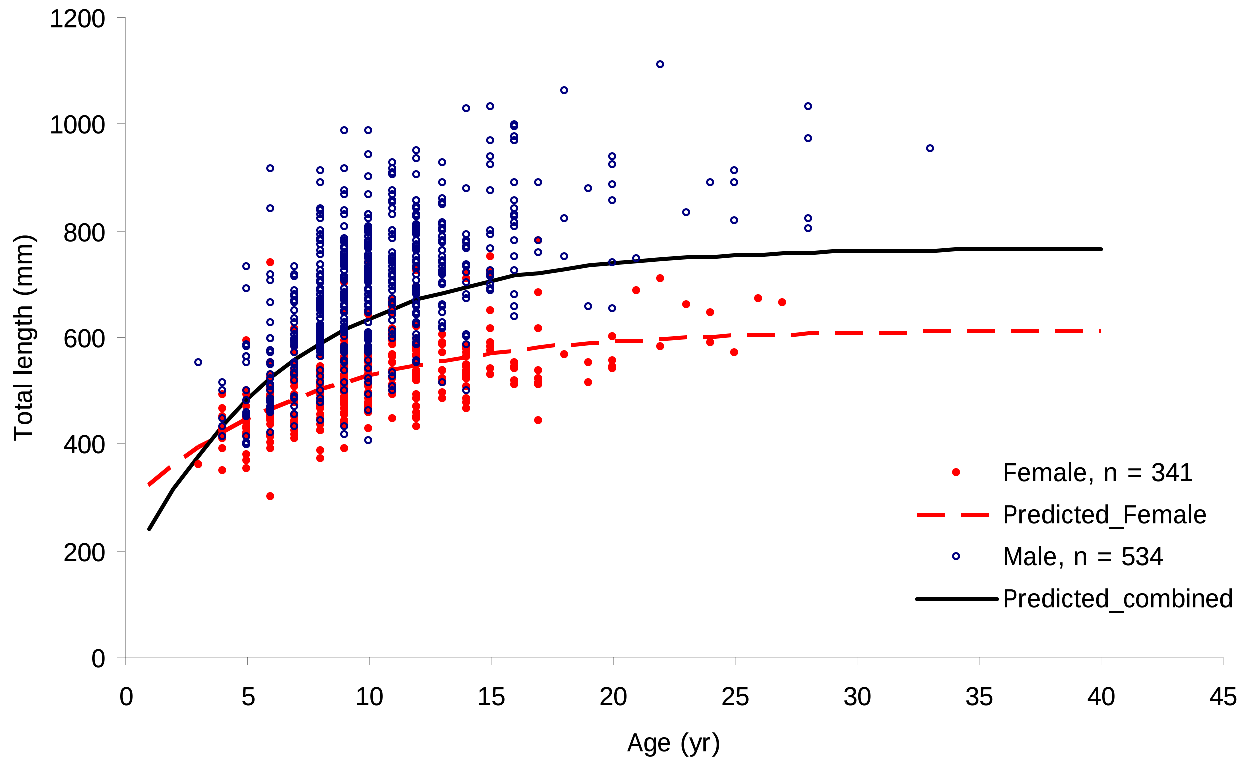
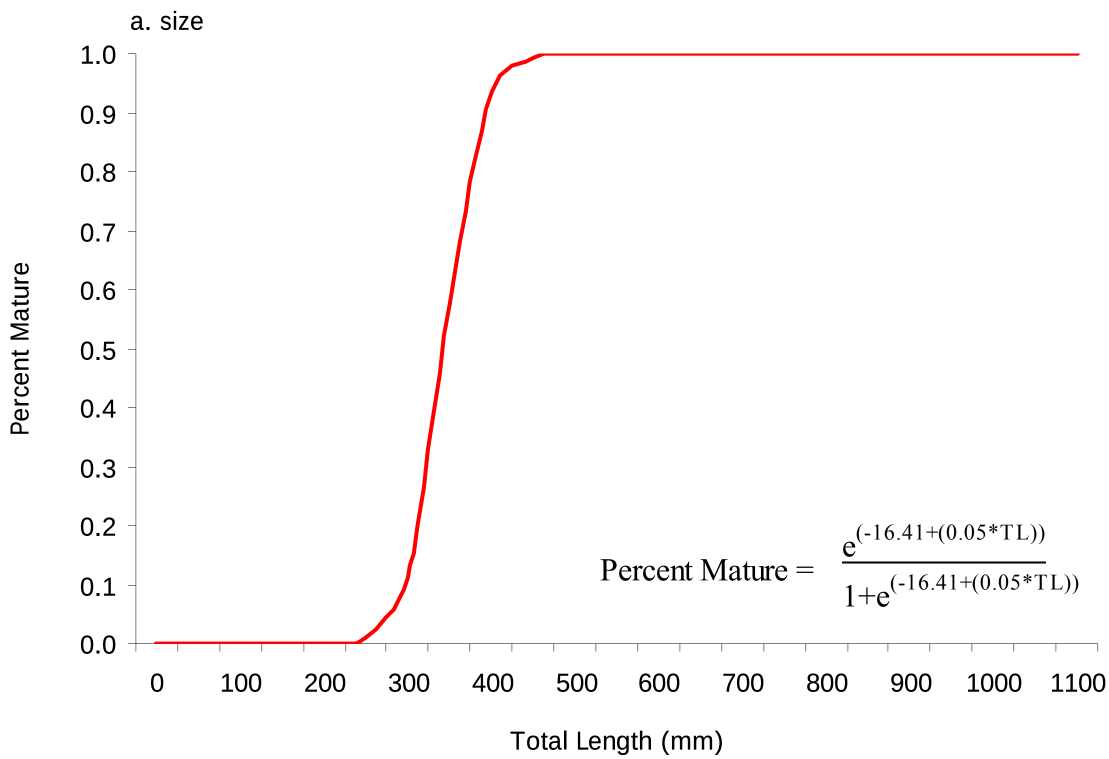


Figure 5. Results of von Bertalanffy growth model for sex-specific data fit to observed total length and ages for golden tilefish collected 2000-2009 from the Gulf of Mexico.

Figure 6. Logistic regressions for (a) size (344 mm) and (b) age (2 yr) at maturity for female golden tilefish from the Gulf of Mexico.



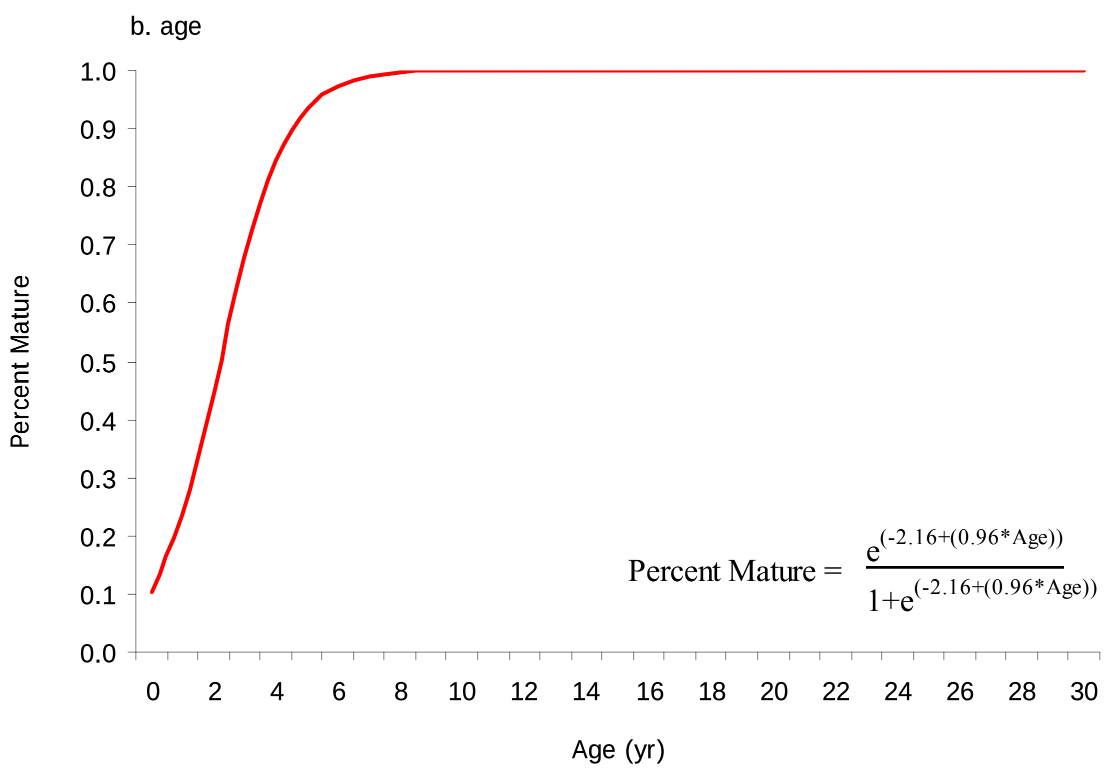


Figure 7. Logistic regressions for (a) size (564 mm) and (b) age (-yr) at transition for golden tilefish from the Gulf of Mexico, assuming protogyny (transition from female to male) occurs.

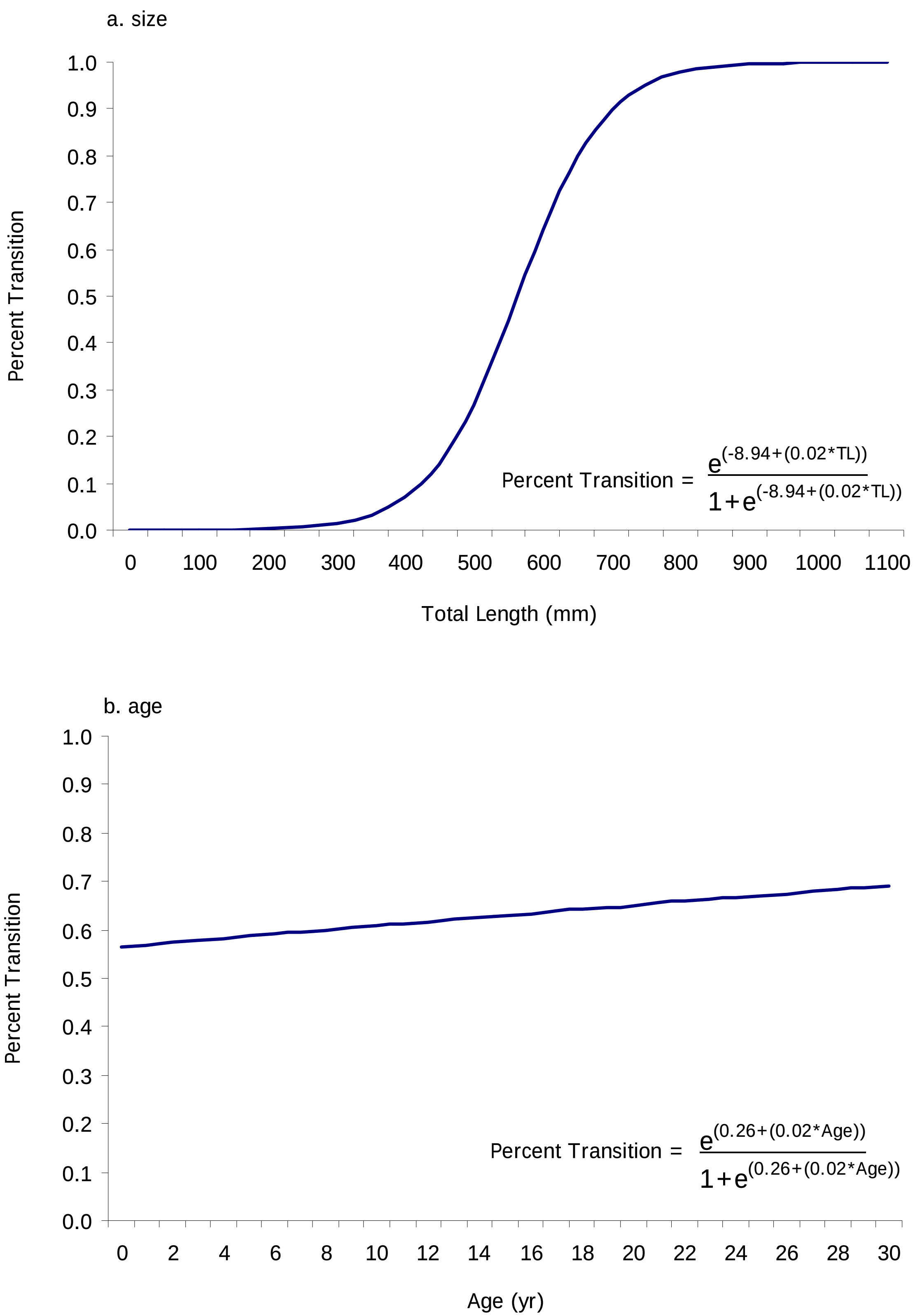


Figure 8. Golden tilefish from the Gulf of Mexico sex ratio determined from 2008-2009 directed Cooperative Research Project.

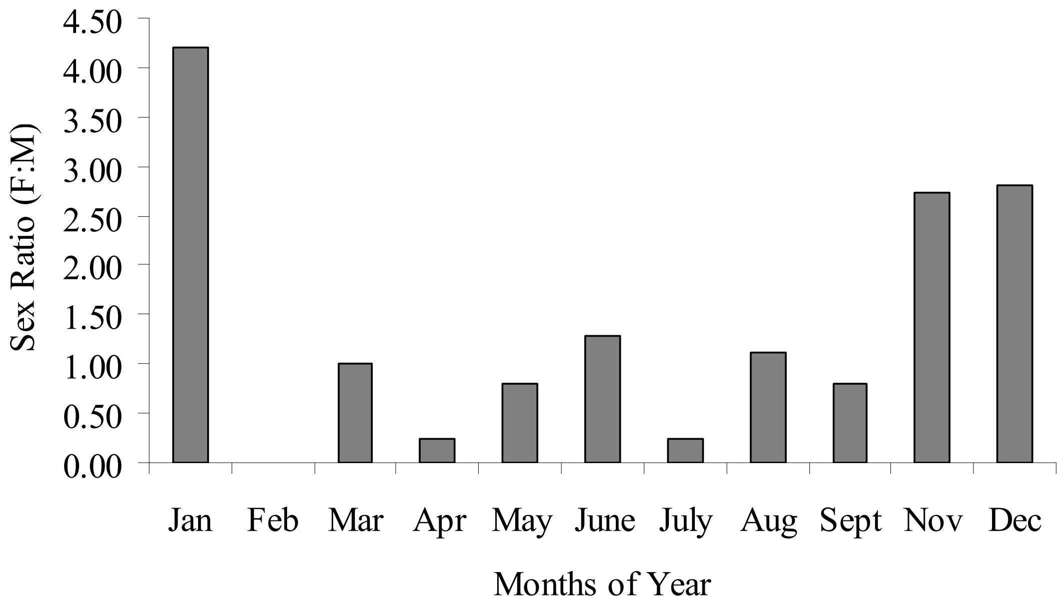


Figure 9. Comparison of mean ± se female somatic weight (whole weight minus gutted weight, n = 341, primary vertical axis), and mean ovary weights of spawning (hydrated, n= 44) and active (vitellogenic, n= 19) females by age.

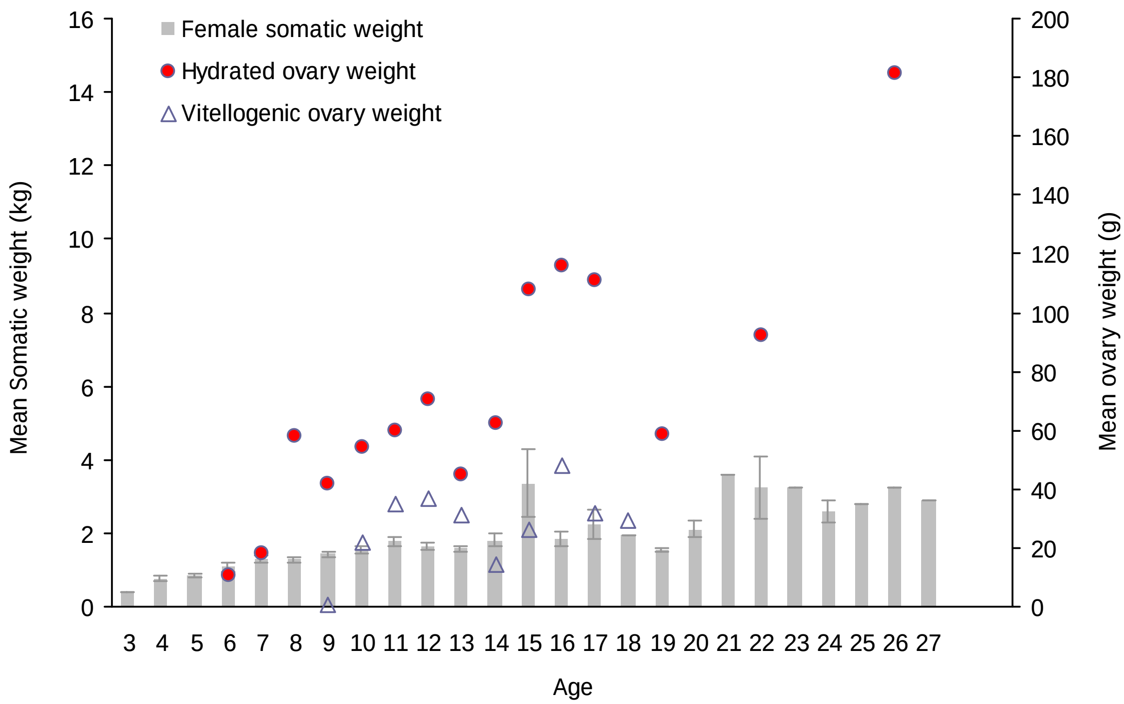
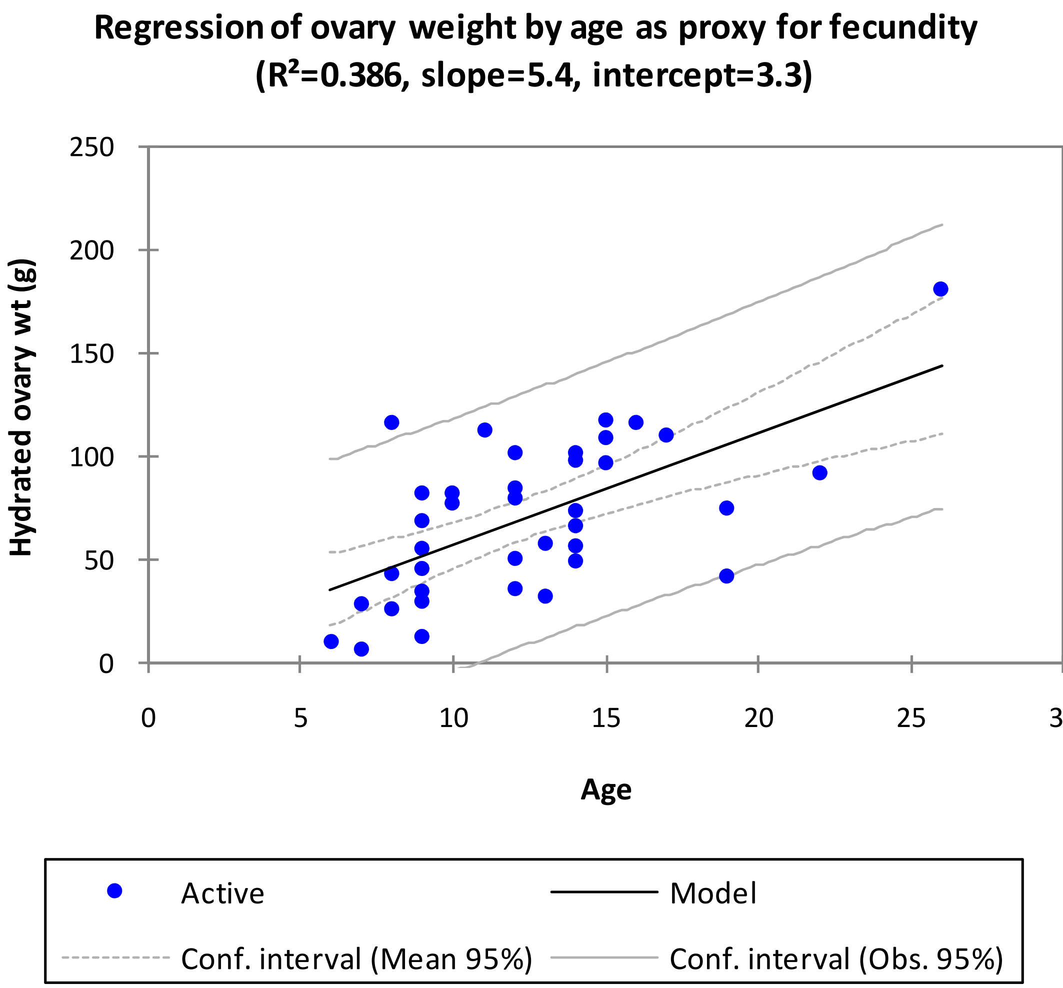


Figure 10. Proxy for fecundity based upon ovary weights of tilefish females in spawning condition.



3. COMMERCIAL STATISTICS

3.1. *OVERVIEW*

The deepwater grouper-complex consists of eight species of fishes from 3 families of fishes, groupers (5 species), tilefishes (2 species) and a snapper species. The primary three species of importance and considered in the SEDAR 22 data workshop for stock assessment are the yellowedge grouper *Epinephelus flavolimbatus*; tilefish (often imprecisely called golden tilefish) *Lopholatilus chamaeleonticeps;* and blueline tilefish *Caulolatilus microps*. The other five secondary species also in the deep water grouper complex are warsaw grouper *Epinephelus nigritus*; snowy grouper *Epinephelus niveatus*; misty grouper, *Epinephelus mystacinus;* speckled hind *Epinephelus drummondhayi*; and queen snapper *Etelis oculatus*. These five secondary species were not considered in the data workshop, although commercial landings were presented.

3.1.1. Group Membership

Refik Orhun (Group Leader).. NMFS-Miami
Steve Turner.. NMFS-Miami
Kevin McCarthy.. NMFS-Miami
John Quinlan .... NMFS-Miami
Bob Spaeth ....Commercial Fisheries
Martin Fisher..Commercial Fisheries
Brad Kenyon ....Recreational Fisheries
Linda Lombardi .... NMFS-Panama City
Gary Fitzhugh .... NMFS-Panama City
Debbie Fable...NMFS-Pascagoula
Charlie Bergmann..NMFS-Pascagoula
Melissa Cook ....NMFS-Pascagoula
Richard Fulford.. SSC - Univ. of Mississippi
Harry Blanchet ....Louisiana Sea Grant
Yong Chen……………...... ....CIE Reviewer - Univ. of Maine

3.1.2. Issues

Commercial landings of (golden) tilefish and to some degree blueline tilefish were explored to address a variety of issues. Some are evident from the list of working papers presented and discussed. Other issues included the historical onset and composition of the deep water grouper complex long line (LL) and vertical line (VL = hand and bandit or electric line) fisheries and separation of blueline from golden tilefish:

(1) Commercial landings

(2) Discards

(3) Length Frequency Distribution of samples by gear

   a. Mis-identification or mislabeling of blueline tilefish as (golden) tilefish in the most of the Southeastern Gulf fishing area, statistical areas or shrimp grids 1-5 from 1980-1991

(4) Composition of the deep water fisheries landings for golden tilefish 1980 to 1990 prior to recording of blueline tilefish landings in the Southeastern Gulf, i.e. statareas 1-5, and comparison of landings of both species 1992-1996 in the statarea, after blueline tilefish were properly identified and recorded

3.2. *REVIEW OF WORKING PAPERS* (Author and Presenter)

All SEDAR 22 Data Workshop (DW) working papers relevant to the commercial fisheries group were presented, reviewed, and discussed during the data workshop. The recommendations resulting from the discussion will be presented in each the relevant chapter, e.g. size distribution of landings samples by gear, misidentification, discards, effort, etc. Below is the list of the papers reviewed in the group

SEDAR **-22 DW-17:** Commercial Landings of Yellowedge Grouper, Golden Tilefish, and Blueline Tilefish from the Gulf of Mexico region (Refik Orhun)

SEDAR **-22-DW-15:** Recreational Survey Data for Yellowedge Grouper, Tilefish (Golden), and Blueline Tilefish in the Gulf of Mexico (Vivian Matter, Author; Richard Fulford, Presenter)

SEDAR **-22-DW-04:** Discards of Yellowedge Grouper, Golden Tilefish, and Blueline Tilefish from commercial fishing vessels in the Gulf of Mexico (Kevin McCarthy)

SEDAR**-22-DW-10:** Observed Length frequency distributions and otolith sampling issues for tile fish caught in the Gulf of Mexico from 1984 to 2009 (Ching-Ping Chih, author; John Quinlan, presenter)

SEDAR**-22-DW-11:** Length frequency distributions for blue line tile fish caught in the Gulf of Mexico from 1984 to 2009 (Ching-Ping Chih, author; John Quinlan, presenter)

SEDAR**-22-DW-12:** Estimation of species misidentification in the commercial landing data of tile fish in the Gulf of Mexico from 1984 to 2009 (Ching-Ping Chih, author; John Quinlan, presenter)

3.3. *COMMERCIAL LANDINGS*

3.3.1. Historical Catch Area

Prytherch (1983) divided the fishing grounds of the bottom longline fishery into three regions; Southern Gulf (SE), Northeastern Gulf (NE) and Western Gulf (W) (Figure 3.1). On the basis of similar landings species composition we propose a similar stratification of the 21 Gulf of Mexico 'shrimp grid' or '**statareas**' extending from statistical area 1 at the Southeastern edge of the Gulf of Mexico in Monroe county, North of the US 1 Line, to the West to statistical area 21 ending at the Texas US/Mexican Border (Figure 3.2) into three fishing regions. This classification differs from Prytherch only in that the Western Gulf region includes statistical areas 13-21 and the Northeastern Gulf encompasses stat areas 6-12. These regions also generally reflect similarities in the species composition of bottom longline trips from each of the three areas. These spatial classifications will be used in the assessment modeling as well. The general goal of these classifications is to partition the assessment into areas which have received fairly similar levels of overall fishing mortality over time, while maintaining enough aggregation of the data so that there are few missing cells for age composition, CPUE or landings.

3.3.2. Discussion of Methods to Calculate Landings of Golden and Blueline Tilefish

For the development of the historical landings record prior to 1986, commercial fishermen and dealers who had fished during that period from the mid-70's onward, Bob Spaeth, Martin Fisher, Gregg Abrams and others were asked to recollect the early fishery on yellowedge grouper and deepwater-complex fishery, e.g. snowy grouper, speckled hind, tilefish and blueline tilefish. Several fish houses were contacted by phone during the working group sessions and their comments were incorporated in the discussion and recommendations of the group.

In response to the anecdotal observations that most of the tilefish catch in statistical grids south of statistical grid-6 were blueline tilefish (also known as grey tilefish), we calculated the ratio of the number of golden to blueline captured in scientific bottom long line surveys and fishing trips with observers aboard on a set by set basis:

$$Ratio = \frac{No. Golden}{(No. Golden + No. Blueline)}$$

The results of this analysis are shown in Figure 3.3. Tilefish captured in areas 3, 4, and 5 were mostly blueline (grey) tilefish with a few sets capturing both species, and one with only golden tilefish.

Blueline tilefish were not reported in the commercial landings prior to 1992. Commercial fisherman reported that blueline were caught prior 1992 and landings recorded as golden tilefish in statistical fishing areas 1-5 in 1965-1991 would likely have included a lot of blueline tilefish. .

Accordingly golden tilefish and blueline tilefish landings were analyzed together for the period of 1992-1996, when both species were classified and reported separately. The proportions of the 1992-1996 combined landings were calculated for each species and gear. Those proportions could then be used to partition the 1965-1991 of golden tilefish landings. The combined analysis was done separately for each gear to maintain a higher level of accuracy than would have been achieved if the analysis had used combined gears.

The results of the analysis of landings by species and gear are shown in Table 3.1 and Figure 3.4. The following percentages were calculated by gear and species from 1992 to 1996:

- 27 % of vertical line landings from 1992-1996 in statareas 1-5 were reported as golden tilefish 73% of vertical line landings from 1992-1996 in statareas 1-5 were reported as blueline tilefish
- 41% of long line landings from 1992-1996 in statareas 1-5 were reported as golden tilefish
- 59% of long line landings from 1992-1996 in statareas 1-5 were reported as blueline tilefish

These percentages by species and gear were multiplied by the reported landings of golden tilefish in statistical areas 1-5 from 1965 to 1991 to adjust for the fraction of landings which were actually blueline tilefish as recommended by the SEDAR 22 data workshop landings group.

In contrast to the treatment of the yellowedge landings (where three regions were used), the working group decided to divide the golden tilefish landings into two regions and to use only one region for blueline tilefish. The golden tilefish landings were separated into an East (stat areas 1-12) and West (stat areas 13-21); it was noted that golden tilefish landings were quite low in stat areas 1-5. For blueline tilefish only one region was used because they are only infrequently caught west of statistical area 12.

Updated commercial landings of Gulf of Mexico golden tilefish from 1965-2009 were compiled by gear type based on recommendations by the SEDAR 22 data workshop, see above and Table 3.2 and Figure 3.5.). Updated commercial landings of Gulf of Mexico blueline tilefish from 1965-2009 were compiled by gear type based on recommendations by the SEDAR 22 data workshop, see above and Table 3.3and Figure 3.6.

3.3.3 Mis-Identification

The working group reviewed two documents on mis-identification of yellowedge grouper and golden tilefish. Members of the group had extensive discussions both during the workshop and after on ways of calculating quantities of mis-identified fish eventually concluding that with adequate sample size the two proposed methods yielded identical results.

The group also concluded that in the years when sample sizes were adequate, the amounts of the total landings of yellowedge and golden tilefish which had been classified as other species (bony fish, unclassified grouper, …) was sufficiently low compared to the calculated total landings of yellowedge and golden tilefish, that it could be neglected.

Mis-identification Sampling and Calculation

The misidentification and improper allocation of fishes into (other species recorded as yellowedge) and out of (yellowedge recorded as other species) the yellowedge grouper landings estimates is discussed in SEDAR 22- DW-13. (Note: The same issue holds for tilefish as described in SEDAR 22 – DW 12.) The Data Workshop requested a secondary analysis of yellowedge misidentified as general grouper, bony fishes, and black grouper. The focus of this analysis was to examine the occurrence of misidentified yellowedge in those three landings categories. Rather than base this estimate on the number of yellowedge sampled as described in SEDAR 22 – DW 13, the Workshop recommended basing the calculations on the number of the general grouper, bony fishes, and black grouper sampled. This issue was thoroughly reviewed algebraically and through an examination of sampling protocols.

Algebraically, the DW-13 method simplifies to consideration of the reported landings and sampling data. The sampling data is used to generate estimates of the proportion of yellowedge grouper reported by dealers as some other species (bony fish, for instance). The sampling data also provides the total number of yellowedge grouper identified by the port agents. Note that these estimates are based on sampling of individual trips and the reports submitted by dealers. The ratio of these two estimates multiplied by the reported landings returns the number or weight of yellowedge grouper that must be added to the reported landings to estimate the true landings. If sample sizes are adequate, this method does correctly estimate the misidentified landings.

An examination of TIP sampling protocols indicates that implementing the methods suggested by the Data Workshop would greatly increase the uncertainties in the estimation of a misidentification rate. This is because dealers often categorize landings such as bony fish or unclassified grouper after TIP agents have already done their dock-site sampling. As a result, it is not feasible to conduct random sampling of fish that belong to bony fish or unclassified grouper landings. Consequently, estimation of species compositions for bony fish or unclassified grouper can be biased. Also, sampling for the dominant misidentification categories (bony fish, unclassified grouper, and black grouper) is inconsistent and of low intensity especially in the early years of the sampling program. Low intensity sampling in combination with low misidentification rates, can create biases which will exacerbate uncertainty issues.

Recommendation: Although the method suggested by the Data Workshop is mathematically valid, and perhaps conceptually cleaner, the sampling protocols of the TIP program were not structured to allow accurate estimation of misidentification rates by this method. The method suggested by the Data Workshop introduces an additional source of uncertainty because the exact landing categories often cannot be determined at the time of dock site sampling, and because the low sampling intensity common to general categories such as bony fish or unclassified grouper can result in biased estimates of misidentified landings for a target species.

Further, review of the methods specified in SEDAR 22 – DW 12 and SEDAR 22 – DW 13 indicates that, when sampling intensity is sufficient, they produce fully adequate, unbiased estimates of the number of fish misidentified and true landings. Given this, no change in the approach taken in documents SEDAR 22 – DW 12 and SEDAR 22 – DW 13 is recommended.

3.2. *COMMERCIAL DISCARDS*

Data from the SEFSC coastal fisheries self-reported logbook program were used to calculate the number of golden and blueline tilefish discarded during the period January 1, 1990 through December 31, 2009.A detailed description of the available data and methods used for calculating discards are available in SEDAR22-DW-04.

Too few trips reported golden or blueline tilefish discards for any reliable discard calculation to be completed for those species (Table 3.4).Those data could not be provided when categorized by year and deep-water grouper season (open or closed) due to confidentiality restrictions. Only yellowedge grouper discards were calculated, although the available discard reports were very limited for that species, as well.

The number of trips reporting yellowedge grouper and tilefish discards in the Gulf of Mexico was low. This was particularly true of the tilefish species and the deep-water grouper open season yellowedge grouper data. Given that the observed discard observations were so few, the discard rate of yellowedge grouper may be poorly characterized. Even with the limited available data, it does appear likely that the majority of yellowedge grouper discards occur during closed seasons and that yellowedge grouper discards are likely to be few. An additional concern associated with these data is the high percentage of trips that report “no discards”. Vessels selected to report discards must submit discard logbooks or report no discards to remain in permit compliance. The percentage of logline trips reporting no discards for a trip has ranged from 20 to 42 percent. Such high rates of “no discards” reports seem unlikely, suggesting that discards have been underreported in general. The calculated discards provided here should be used with caution, given the limitations and uncertainties of the available data.

3.3. *COMMERCIAL EFFORT*

Total effort reported to the coastal logbook program from the commercial golden tilefish, blueline tilefish, and yellowedge grouper fisheries is provided in Table 3.5. Effort of all trips reporting landings of one pound or more of those species was summed by year. Effort totals are provided for logline and vertical line (hand line and electric reel/bandit rig) vessels only. Very few landings of golden tilefish, blueline tilefish, or yellowedge grouper were reported from vessels fishing other gears. Total yearly logline and vertical line effort in the Gulf of Mexico is provided in Table 3.6 for comparison.

3.4. *BIOLOGICAL SAMPLING: SIZE COMPOSITION BY GEAR TYPE*

3.4.1. Tilefish Length Composition Data from Trip Intercept Program

Length measurements for individual golden tilefish sampled in the Trip Intercept Program were examined to see if the length distributions from the handline and longline fisheries differed. Figure 3.7. shows the length frequency distributions for these two golden tilefish fisheries. Handline length frequency distributions were near normal and shifted toward larger individuals in comparison to longline samples. Longline length frequency distributions were left skewed (smaller fish predominated). To test whether or not the two fisheries were producing the same length frequency distributions, a quantile-quantile plot was produced (Figure 3.8.). This plot indicates that the two distributions differ from one another primarily in the tails of the distributions. The distribution-free two-sample Kolmogorov-Smirnov analysis was used to test whether or not the two data sets were drawn from the same distribution. This test indicated that the longline and handline length measurements were not drawn from the same distribution (p-value << 0.05). Recommendations: Handline and longline fisheries for tilefish do not produce identical length frequency distributions. This can arise through differences in selectivity or through an interaction between the locations of the fisheries and the spatial distribution of the population of golden tilefish. Given these observations, handline and longline fisheries should be treated as different fleets in the assessment.

3.5. *COMPARISION BETWEEN TIP AND AGE AND GROWTH LENGTH FREQUENCIES*

Two SEDAR 22 Data Workshop reports (S22-DW-09 and S22-DW–10) indicated that there were differences between the length frequencies derived from the length and otolith samples from the Trip Interview Program. The Data Workshop recommended a review of the issue. Subsequent review indicates that the length frequencies distributions of the two sample types are different in some years, particularly in the early years of the sampling programs (Figure 3.9). The length frequency distributions of the two sample types are reasonably similar in the more recent years of the sampling period. It is recommended that the assessment team adjust (reweight) the data used for determining the catch-at-age and growth relationships in the assessment model on a year-by-year basis. This will ensure that proper corrections are made when required, and that all the data will be handled in a consistent manner.

3.6. *COMMENTS ON ADEQUACY OF DATA FOR ASSESSMENT ANALYSES*

The commercial landings working group considered the landings of golden tilefish in statistical areas south of statistical area 5 to be mostly blueline tilefish and only some proportion golden tilefish. This update of landings reduces golden tilefish landings and increases blueline tilefish landings according to the landings working group's recommendation. The years especially affected are 1965-1990. Previous estimates of blueline tilefish landings began in 1991, now with this update, blueline landings begin in 1965. Although from fishermen reports it seems certain that mostly blueline tilefish are caught in statistical areas 1-5, there is an uncertainty regarding if there are also some catches of golden tilefish. This may be happening to certain extent in statistical area 1 and with boats from other areas that fish deeper waters for Golden Tilefish instead of Yellowedge grouper that is said to be distributed somewhat shallower and associated with a different bottom sediment type.

Golden tilefish and blueline tilefish are the primary species managed within the Gulf of Mexico tilefish quota. The golden tilefish fishery is considered to be relatively distinct from the yellowedge fishery while the blueline tilefish is a major by-catch of the yellowedge grouper fishery, where fishermen report about 3,000 lbs. of blueline tilefish are caught for every 10,000 lbs. of yellowedge grouper. Additionally the price of blueline tilefish is less than half of the price of golden tilefish. Due to these differences between the fisheries and in the markets for golden tilefish and blueline tilefish, fishermen expressed a sincere interest in a separation of quotas for golden and blueline tilefish in the Gulf of Mexico.

Decision: To determine the amount of Blueline tilefish in statistical areas 1-5 from 1980 to 1991, Blueline to Golden Tilefish proportions were analyzed in the years 1991-1995 and used to calculate blueline tilefish landings in 198-1991.

3.7. *LITERATURE*

Prytherch, H.F. (1983). A descriptive survey of the bottom long line fishery in the Gulf of Mexico. NOAA Technical Memorandum NMFS-SEFSC-122. 33p.

3.8. ***TABLES***

Table 3.1. Analysis of golden and blueline tilefish commercial landings 1992-1996 in the Southeastern Gulf of Mexico, statistical fishing areas (statareas) 1-5 by gear (in lbs whole wt). These calculated proportions were applied back to golden tilefish landings from 1965-1991 from statareas 1-5 and separated into golden and blueline tile landings according to the analysis shown in below and in Figure 3.4.

	Golden Tilefish			Blueline Tilefish		
YEAR	HandLine+	LongLine	Grand Total	HandLine+	LongLine	Grand Total
1992	54%	18%	21%	46%	82%	79%
1993	44%	40%	41%	56%	60%	59%
1994	14%	57%	52%	86%	43%	48%
1995	15%	39%	36%	85%	61%	64%
1996	5%	42%	35%	95%	58%	65%
Grand Total	27%	41%	39%	73%	59%	61%

Table 3.2. Calculated commercial landings of Gulf of Mexico golden tilefish from 1965-2009 (in lbs whole wt) by gear type based on recommendations by the SEDAR 22 data workshop.

YEAR	VL East	LL East	VL West	LL West	Gulf Total
1965	6,973	-			6,973
1966	2,003	-			2,003
1967	1,077	-			1,077
1968	1,474	-			1,474
1969	314	-			314
1970	-	-			-
1971	3,288	-			3,288
1972	1,104	-			1,104
1973	3,995	-			3,995
1974	4,205	-			4,205
1975	14,823	-			14,823
1976	24,635	-			24,635
1977	36,400	-			36,400
1978	*	0	*	0	24,221
1979	29,329	5,721	0	1,185	36,235
1980	19,223	6,900	0	1,805	27,927
1981	129,643	*	0	*	247,495
1982	60,935	*	0	*	302,040
1983	*	138,546	*	79,731	233,062
1984	*	*	*	102,759	302,015
1985	10,005	*	*	164,477	278,577
1986	*	*	9,837	126,478	332,638
1987	*	*	19,848	269,525	537,044
1988	*	*	47,304	555,682	950,182
1989	40,768	102,741	63,536	247,572	454,617
1990	*	*	*	160,521	355,819
1991	18,473	*	*	51,793	214,229
1992	13,413	*	14,761	*	212,259
1993	15,630	*	*	110,300	284,485
1994	12,560	*	*	107,548	388,386
1995	*	*	*	298,051	473,682
1996	1,453	120,964	2,957	85,196	210,570
1997	*	287,849	*	*	337,262
1998	*	224,529	*	*	297,147
1999	*	219,320	4,396	*	374,412
2000	4,239	269,764	5,523	199,911	479,437
2001	16,033	337,594	295	130,394	484,317
2002	9,669	246,741	1,591	282,939	540,939
2003	3,457	235,683	2,171	159,164	400,475
2004	3,070	283,647	*	*	467,286
2005	4,024	342,227	4,285	238,446	588,982
2006	5,858	247,364	*	*	311,215
2007	1,042	291,486	2,073	24,156	318,758
2008	136	290,043	327	58,086	348,591
2009	1,336	351,098	80	58,308	410,823

* Confidential data are blanked out

Table 3.3. Calculated commercial landings of blueline tilefish from 1980-2009 (in lbs whole wt) from the eastern Gulf of Mexico, statistical fishing areas 1-12 by gear type based on recommendations by the SEDAR 22 data workshop.

YEAR	VL East	LL East	VL West	LL West	Gulf Total
1965	18,927	-			18,927
1966	5,437	-			5,437
1967	2,923	-			2,923
1968	4,000	-			4,000
1969	853	-			853
1970	-	-			-
1971	8,924	-			8,924
1972	2,996	-			2,996
1973	8,057	-			8,057
1974	10,961	-			10,961
1975	23,677	-			23,677
1976	28,665	-			28,665
1977	26,833	-			26,833
1978	17,301	-			17,301
1979	32,208	8,228			40,436
1980	13,529	1,783	-	-	15,313
1981	*	*	-	-	146,632
1982	*	*	-	-	36,468
1983	16,570	5,412	-	-	21,982
1984	*	*	-	-	18,073
1985	*	*	-	-	23,069
1986	*	*	-	-	36,382
1987	*	*	-	-	84,116
1988	*	*	-	-	89,413
1989	48,025	6,336	-	-	54,361
1990	*	*	-	-	81,169
1991	*	*	-	-	105,454
1992	18,699	117,835	1,516	1,209	139,260
1993	24,394	68,560	*	227	94,470
1994	*	*	*	81	132,837
1995	16,090	71,596	60	242	87,988
1996	*	47,632	*	100	63,882
1997	18,610	169,428	*	*	188,402
1998	17,149	98,691	*	*	116,083
1999	14,532	70,750	*	*	85,423
2000	6,567	104,874	709	215	112,365
2001	16,342	83,959	2,633	17	102,952
2002	14,092	59,834	*	*	74,997
2003	10,642	91,264	*	*	102,036
2004	15,327	123,054	*	*	138,471
2005	15,129	86,851	*	-	101,991
2006	15,816	128,945	*	-	144,834
2007	14,029	124,674	43	*	138,765
2008	9,427	175,784	118	*	185,351
2009	12,348	105,201	*	*	117,591

Table 3.4. Tilefish reported trips and discards, all years (2002-2009) all areas in the Gulf of Mexico. Number of discards per trip differed between open and closed seasons, however so few vessels reported tilefish discards that those data cannot be presented if stratified by open/closed season due to confidentiality restrictions.

Species	Gear	Total trips reporting discards	Total discards reported
Blueline Tilefish	Vertical lines	3	68
	Logline	13	3,498
Golden tilefish	Vertical lines	3	981
	Logline	11	3,509

Table 3.5. Reported golden tilefish, blueline tilefish, and yellowedge grouper total commercial fishing effort by year and gear fished in the Gulf of Mexico. Effort is defined as: logline – hooks fished and vertical line – hook hours fished. No trips reported blueline tilefish landings prior to 1993.

Year	Golden Tilefish		Blueline Tilefish		Yellowedge Grouper	
	Logline	Vertical line	Logline	Vertical line	Long line	Vertical line
1990	20,650	1,040			791,035	99,370
1991	108,500	5,400			2,522,020	441,027
1992	1,075,000	64,866			2,098,220	482,698
1993	2,594,250	135,590	2,005,250	567,496	4,571,870	956,650
1994	6,932,075	162,965	4,693,875	898,625	9,424,561	1,307,637
1995	6,236,350	123,126	3,490,965	969,045	9,089,235	1,277,702
1996	4,110,850	116,560	1,517,430	852,144	6,006,520	1,103,339
1997	5,888,940	542,766	4,538,250	1,242,228	10,807,900	2,050,354
1998	4,916,652	237,388	3,943,072	1,027,750	8,833,422	1,726,876
1999	5,673,450	430,605	3,006,200	843,317	10,646,450	1,898,750
2000	7,456,880	259,038	4,576,300	1,313,126	11,349,830	2,022,895
2001	5,922,225	164,764	3,551,050	1,028,506	9,779,535	1,918,324
2002	4,629,702	265,156	2,278,300	867,862	6,907,956	2,235,470
2003	6,613,000	312,199	3,536,280	771,210	11,584,630	2,177,766
2004	5,711,598	354,598	3,059,200	524,475	8,210,618	1,215,133
2005	4,583,876	285,094	1,903,716	417,132	6,177,386	945,872
2006	3,504,900	81,999	2,748,150	407,758	6,688,896	650,908
2007	3,339,650	191,992	2,076,950	347,626	6,977,050	784,539
2008	3,484,770	204,106	2,253,800	308,538	5,175,470	554,300
2009	2,866,200	173,140	1,854,650	299,472	5,202,350	804,327

Table 3.6. . Total effort by year in the Gulf of Mexico reported to the coastal logbook program. Effort is defined as: logline – hooks fished and vertical line – hook hours fished.

Year	Long line	Vertical line
1990	2,860,561	523,538
1991	7,540,045	1,672,538
1992	6,534,972	1,854,139
1993	20,672,475	3,647,862
1994	25,182,372	4,264,703
1995	23,207,479	5,120,010
1996	19,824,375	4,578,622
1997	29,199,055	7,011,492
1998	27,203,196	6,717,985
1999	33,491,739	7,658,254
2000	28,375,357	7,396,677
2001	27,302,818	7,388,187
2002	22,980,633	7,606,856
2003	28,149,288	7,865,746
2004	26,832,283	6,536,835
2005	21,676,581	5,587,754
2006	24,766,701	5,262,599
2007	19,868,725	5,745,021
2008	17,834,960	5,008,894
2009	9,294,394	5,839,076

3.9. ***FIGURES***

Figure 3.1. Historical Major Long line Fishing Grounds (Prytherch 1982).

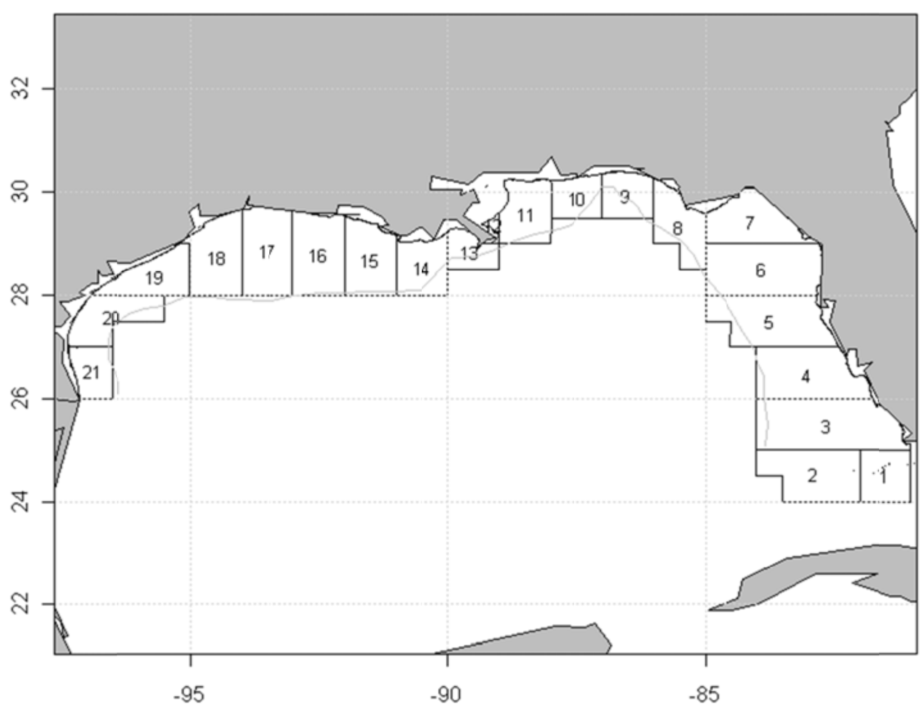


Figure 3.2. Statistical fishing or 'statareas' 1-21 in the Gulf of Mexico ranging from about Key West, FL in the Southeast to the Texas US/Mexican border in the Western Gulf.

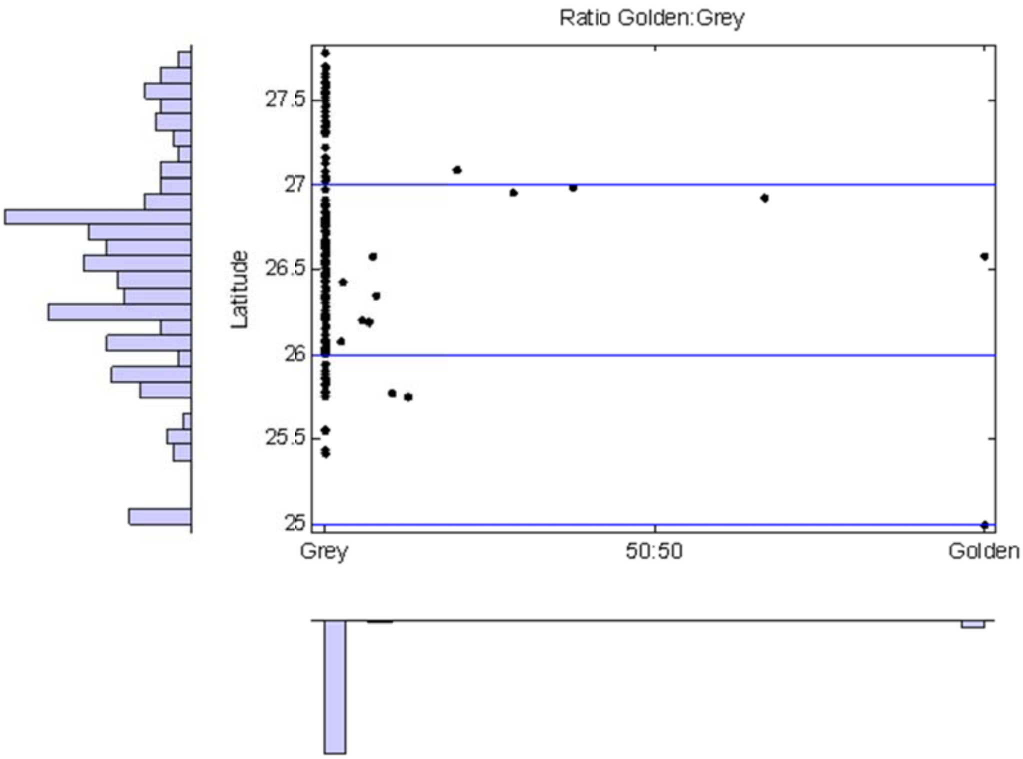


Figure 3.3. Ratio of golden tilefish to blueline (grey) tilefish. The main panel shows the distribution of the calculated ratio of golden: blueline tilefish by latitude for all scientific or observed long line sets along the West Florida Shelf. The histogram on the left shows the distribution of sets by latitude. The histogram on the bottom shows the distribution of the calculated ratio. Numbers along the right hand side indicate statistical grids. Horizontal blue lines demark the boundaries between statistical grids. The vast majority of scientific or observed long line sets in statistical grids3, 4, and 5 captured blueline (grey) tilefish. Those in statistical grid 2 captured only golden tilefish. Note that due to confidentiality, all observations in grid-2 were plotted as along latitude 25 degrees.

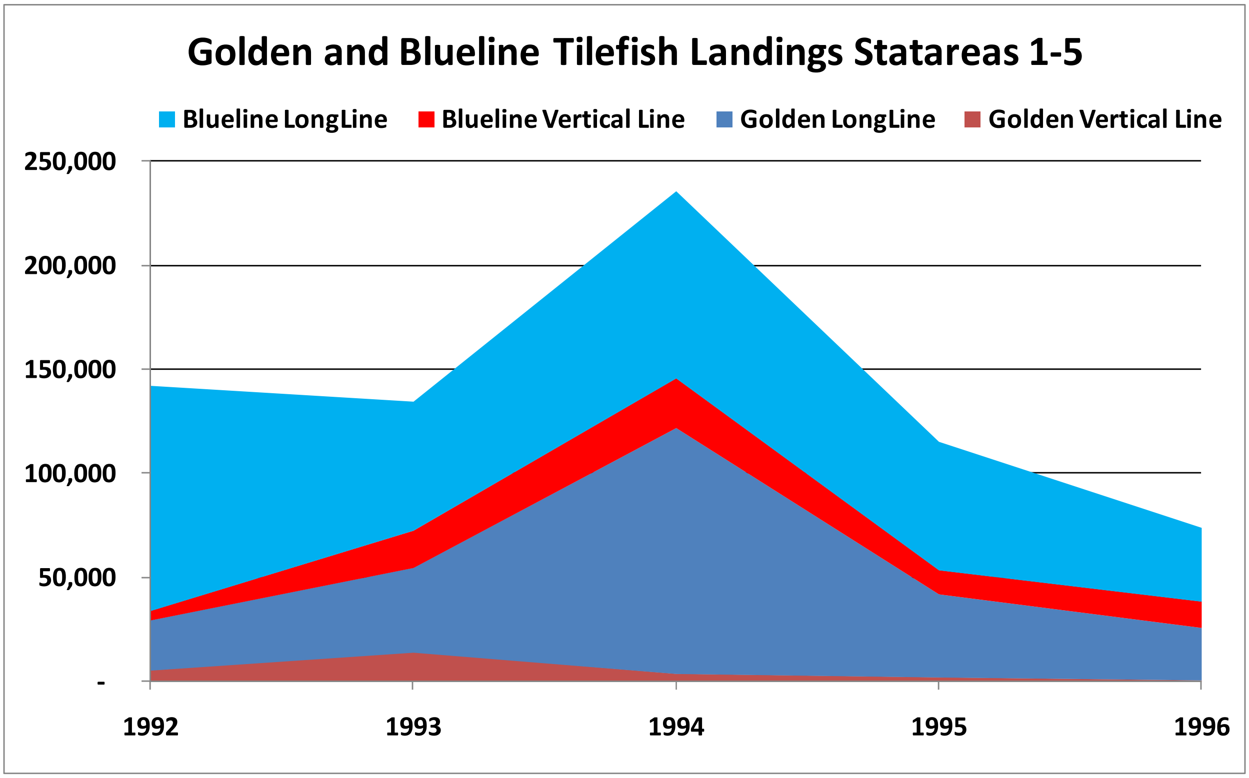


Figure 3.4. Golden and Blueline tilefish commercial landings for the Southeastern Gulf, statistical fishing areas 1-5, by gear from 1992-1996. Corresponding data are in Table 3.3.8

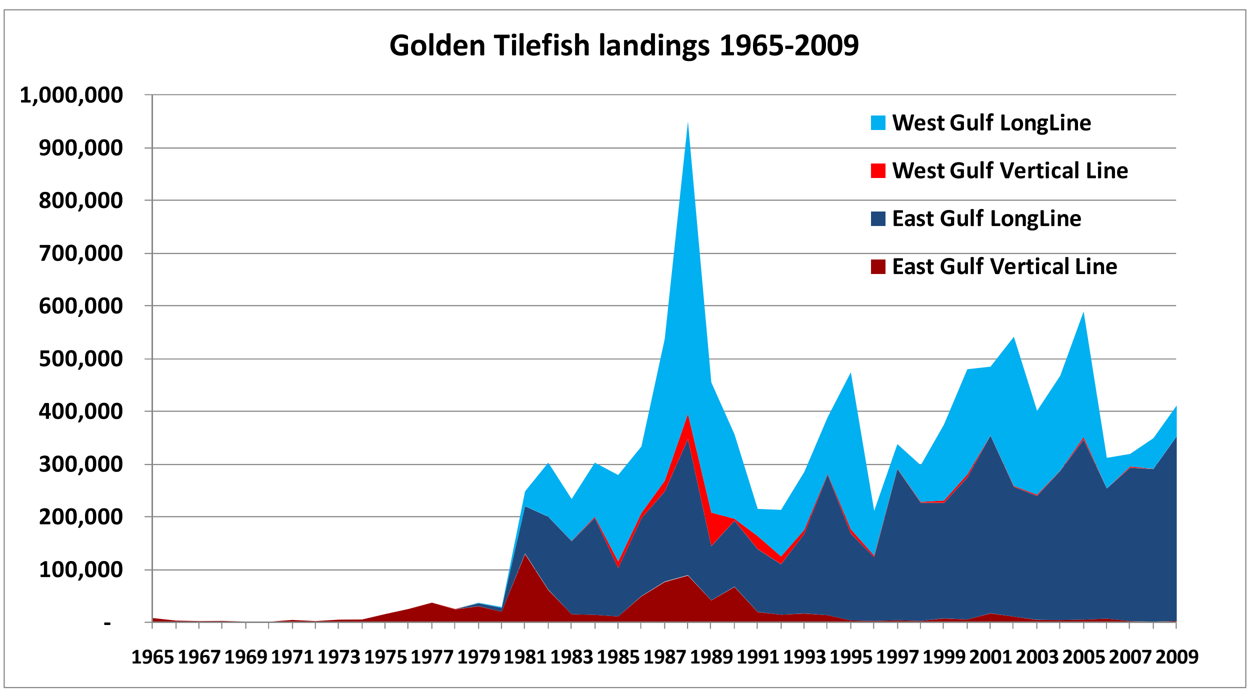


Figure 3.5. Calculated commercial landings of golden tilefish from the Gulf of Mexico management region gear type from 1967-2009.

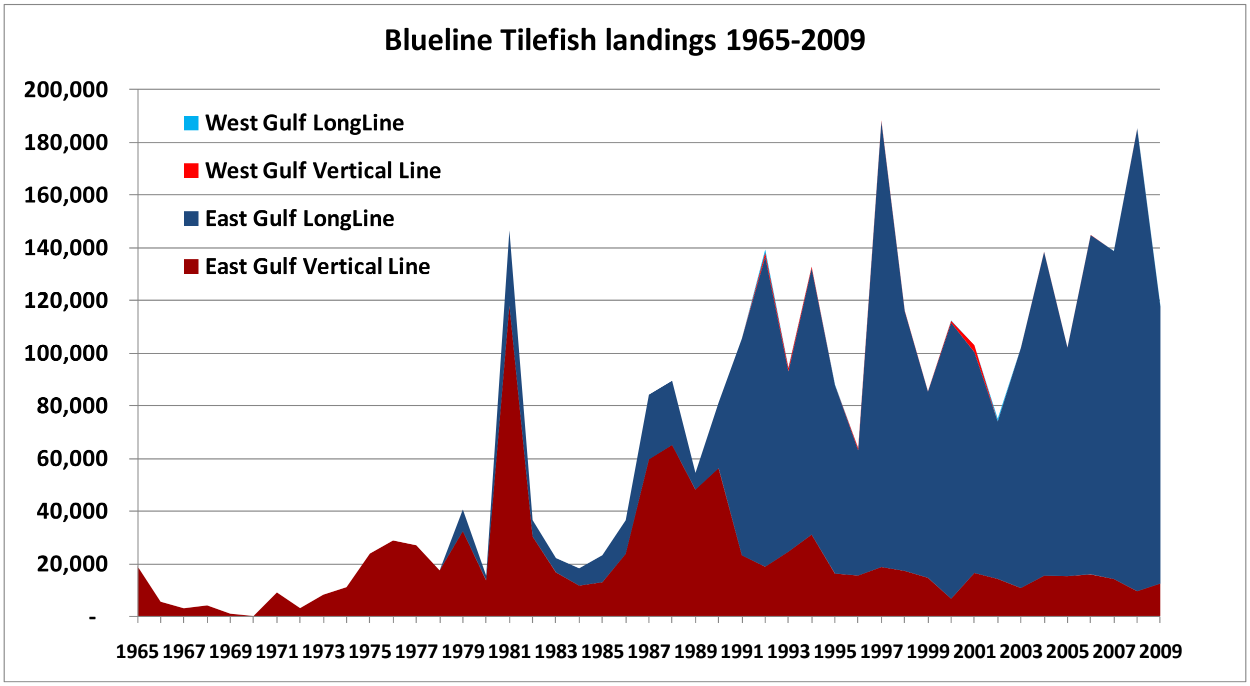


Figure 3.6. Updated calculated commercial landings of blueline tilefish from the Eastern Gulf of Mexico statistical fishing areas 1-12by gear 1980-2009.

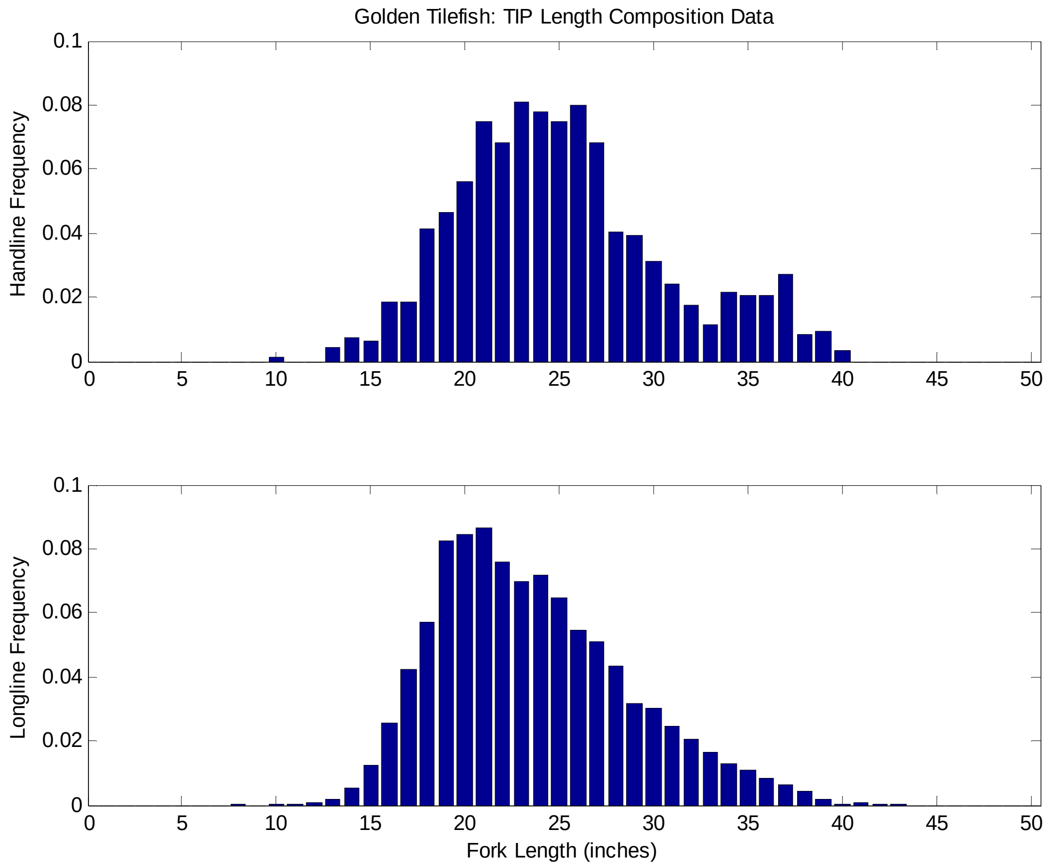


Figure 3.7. Length frequency distributions for the Golden Tilefish handline (top panel) and longline (bottom panel) Trip Intercept Program data. There were 1,007 length observations from the handline fishery and 15,767 observations from the longline fishery.

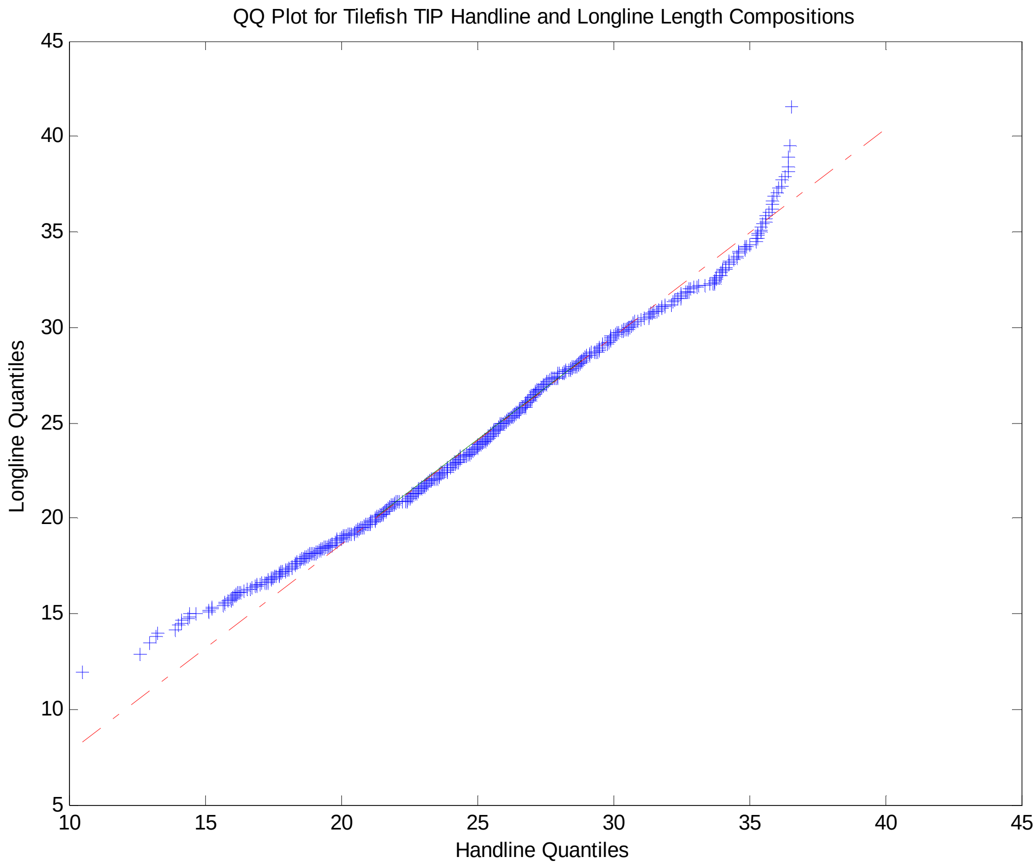


Figure 3.8. Quantile-Quantile plot for the golden tilefish handline and long line length data measured by the Trip Intercept Program. This plot demonstrates deviations between the handline and longline length frequency distributions. Data drawn from identical distributions would fall on the red dotted line.

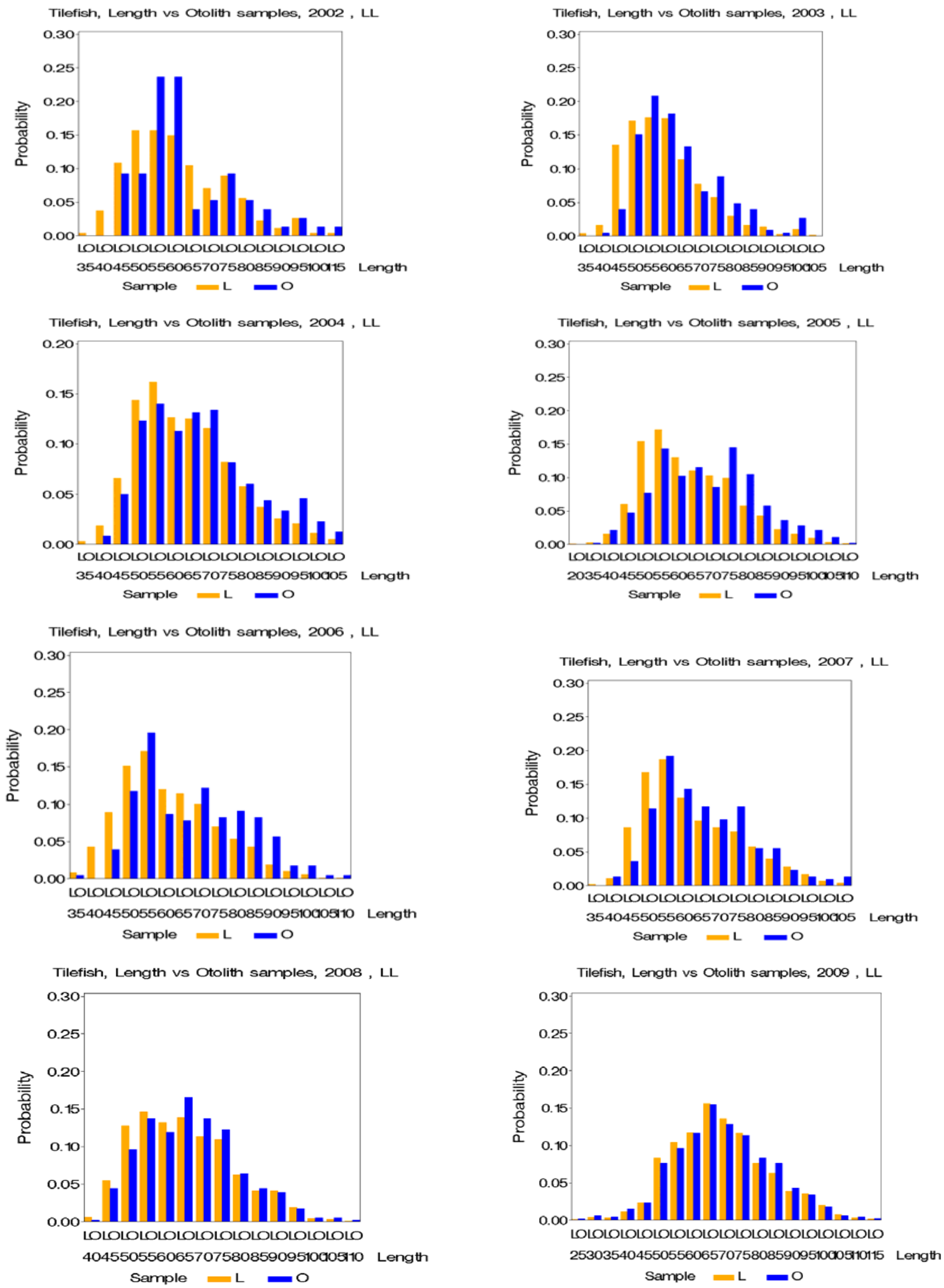


Figure 3.9. Comparisons of tilefish length frequency distributions derived from TIP length and otolith samples from 1986 to 2009. Orange bars indicate data derived from length samples, blue bars indicate data derived from otolith samples. Lengths (x-axis) are given in centimeters.

4. RECREATIONAL STATISTICS

4.1. *OVERVIEW*

4.1.1. Group membership:

Refik Orhun (Group Leader).. NMFS-Miami
Steve Turner.. NMFS-Miami
Kevin McCarthy.. NMFS-Miami
John Quinlan .... NMFS-Miami
Bob Spaeth ....Commercial Fisheries
Martin Fisher..Commercial Fisheries
Brad Kenyon ....Recreational Fisheries
Linda Lombardi .... NMFS-Panama City
Gary Fitzhugh .... NMFS-Panama City
Debbie Fable ....NMFS-Pascagoula
Charlie Bergmann ....NMFS-Pascagoula
Melissa Cook ....NMFS-Pascagoula
Richard Fulford.. SSC - Univ. of Mississippi
Harry Blanchet ....Louisiana Sea Grant
Yong Chen……………..... ....CIE Reviewer - Univ. of Maine

4.1.2. ISSSUES:

The recreational landings for tilefish in the Gulf of Mexico are small in comparison to landings in the commercial sector and for this reason the recreational and commercial landing s groups were merged.The primary issue with estimates of recreational landings of tilefish are the validity of data for several years in which landings were abnormally high. This will be addressed below.

4.2. *REVIEW OF WORKING PAPERS*

Two working papers were provided to the working group (DW-15 and 16).The first summarized estimates of recreational landings since 1982 based on three surveys: The MRFSS survey, the NMFS Headboat survey (HBT), and the Texas Parks and Wildlife Department recreational harvest survey. Data were given as number of fish landed per year estimated for each region or sector. The second working paper summarized an approach for filling in missing weight data when it was not provided as a part of the catch estimates.

4.3. *RECREATIONAL LANDINGS*

Recreational landings of were sporadic and low as reported in the three recreational surveys; typically less than 1,000 lbs in all years except 1981 and 1987.The data as originally presented in DW-15 reported landings of over 49,000 fish in 1981 and over 4,000 fish in 1987.It was the consensus of the data workshop panel, particularly members from the fishing community that estimates for these years were overestimates most likely due to misallocation of catch from the Atlantic side of Florida that was landed in Monroe Co. The group recommended that the recreational catch data be recalculated after all intercept and effort data for Monroe Co., Fl was removed. Recreational landings in number of fish and weight in numbers of fish are shown in Tables 4.1.

4.4. *RECREATIONAL DISCARDS*

Recreational discards were reported only for the MRFSS survey and were given by year in DW-15. It was the consensus of the Data workshop panel that these data be recalculated as described in section 4.3. There were no recreational discards for golden tilefish from 1987 to 2008 as shown in Table 4.1 (last two columns on the left).

4.5. *BIOLOGICAL SAMPLING*

Due to very low amount of recreational landings and its accordingly very low impact on the stock assessment process, biological sampling was not considered in the data workshop.

4.6. *RECREATIONAL CATCH-AT-AGE DATA*

Due to very low amount of recreational landings and its accordingly very low impact on the stock assessment process, sampling of recreational catch-at-age/length was not considered in the data workshop.

4.7. *RECREATIONAL EFFORT*

Estimates of recreational effort were not provided to the working group but they were included in the conversion of recreational survey data to total catch. No recommendations were made by the working group regarding the estimation of recreational effort for Golden Tilefish.

4.8. *COMMENTS ON ADEQUACY OF DATA FOR ASSESSMENT ANALYSES*

Members of the working group expressed concern regarding the validity of the estimates for 1982 and 1987. The overall reliability of the recreational data is not known as the nature of the effort calculation was not described. The consensus of the group was that recreational landings for Tilefish are small in comparison to commercial landings and should not therefore overly influence the assessment. For this reason, summary estimates of landings across years are being considered for generating a final estimate of total landings for the assessment model.

4.9. *TABLES*

Table 4.1. Recreational landings and discards of Golden Tilefish from 1982 to 2009 collected by two data sampling survey sources, Headboat and MRFSS. Landings exclude Monroe County and are in numbers of fish and lbs gutted weight.

Year	Headboat (#)	MRFSS (#)	Headboat (lb)	MRFSS (lb)	Discards Headboat (#)	Discards MRFSS (#)
1987		118		326		0
1990		678		3,946		0
1992	1		3			
1995	1		2			
1998	1		6			
2001	5		1			
2005		519		4,701		0
2008		64		76		0

5. MEASURES OF POPULATION ABUNDANCE

5.1. *OVERVIEW*

Several indices of abundance were considered for use in the assessment model. The possible indices came from fishery independent and dependent data sources. The DW recommended the use of one fishery independent indices (NOAA Fisheries bottom longline survey) and one fishery dependent indices (commercial logbook data).

5.1.1. Group Membership

Membership of this DW working group included Neil Baertlein, Walter Ingram (leader), Kevin McCarthy, Adam Pollack, John Walter and Elbert Whorton, with assistance from Melissa Cook and Linda Lombardi-Carlson.

5.2. *REVIEW OF WORKING PAPERS*

The working group reviewed a two working papers and reference documents describing index construction, including:

SEDAR22-DW-03 (Commercial logbook)
SEDAR22-DW-07 (NOAA Fisheries bottom longline)

Several improvements to analyses were identified. In some cases these modifications are described in appendices to original working documents; otherwise, they are reported here. We refer the reader to the original working documents for further details on exploratory data analysis, technical analysis, and diagnostics.

5.3. *FISHERY INDEPENDENT INDICES*

5.3.1 NOAA Fisheries Bottom Longline Survey (SEDAR22-DW-07)

5.3.1.1 General Description

The Southeast Fisheries Science Center (SEFSC) Mississippi Laboratories has conducted standardized bottom longline surveys in the Gulf of Mexico, Caribbean, and Western North Atlantic since 1995. The objective of these surveys is to provide fisheries independent data for stock assessment purposes for as many species as possible. These surveys are conducted annually in U.S. waters of the Gulf of Mexico (GOM) and/or the Atlantic Ocean, and they provide an important source of fisheries independent information on large coastal sharks, snappers and groupers from the GOM and Atlantic.

5.3.1.2 Analysis Methods & Issues Discussed at the DW

For the SEDAR 22, we used the time series of data between 2000 and 2009 to develop abundance indices for golden tilefish. Due to the effects of Hurricane Katrina on the distribution of effort, the 2005 survey was dropped. Only data from stations within the depth range of capture for golden tilefish (i.e. 125 – 365 m) were used in development of annual indices for this species. Standardized indices of abundance, based on CPUE (number of golden tilefish per 100 hook hours) were constructed using a delta lognormal modeling approach (Lo *et al.* 1992). Initially, three factors were considered for inclusion in the binomial and lognormal submodels: water depth, survey area (three demarcations in the GOM: Eastern Gulf (east of 88^o west longitude); Central Gulf (between 88^o and 93^o west longitude); and Western Gulf (west of 93^o west longitude) and year. A backward selection procedure was used to determine which variables were to be included into each submodel based on type 3 analyses with a level of significance for inclusion of $\alpha = 0.05$. If year was not significant then it was forced into each submodel in order to estimate least-squares means for each year. The findings of this initial model run are described in SEDAR22-DW-07.

During the workshop I was asked to incorporate sediment data into the delta-lognormal model. This data is summarized by Rester (2009). The variables included for testing, along with those listed above, were the amounts of mud, clay, and carbonate in core samples taken nearest to the station location and the linear critical sheer stress and sorting factor of the sediment in said core sample. Modeling methods were conducted as described above. The findings of this second model run are described in Addendum 1 of SEDAR22-DW-07.

Finally, during the data workshop, I was also asked by the stock assessment scientist to develop indices for three areas of the Gulf. These areas were based on the NMFS shrimp statistical zones, employed in many fishery independent survey designs: southwest Florida (SWFLA), zones 2-5; northwest Florida (NWFLA), zones 6-11; and the western Gulf (WEST), zones 13-21. This area variable and a variable denoting the interaction of this area and year were forced into the models developed for each species in Addendum 1 of SEDAR22-DW-07. Table 5.8.1 and Figure 5.9.1 summarize these area-specific abundance indices.

5.3.1.4 Sampling Intensity

The positions of all stations, within the depth range golden tilefish were collected (i.e. 125 – 365 m), and positions of stations where golden tilefish were captured were plotted for all survey years combined (Figure 5.9.2). Survey coverage area varied during the time series due to weather or mechanical problems. For annual maps of survey coverage, see SEDAR22-DW-07.

5.3.1.5 Size/Age Data

Length data was collected on specimens throughout the time series whenever possible. Golden tilefish range from 300 to 1250 mm total length, with an average total length of 707 mm.

5.3.1.6 Catch Rates and Measures of Precision

Catch rates (CPUE) are presented as number of golden tilefish per 100 hook hours and have been standardized as aforementioned in Analysis Methods. Measures of precision are presented as coefficients of variation (CV). The standardized and nominal CPUE as well as the CV are presented in Table 5.8.1.

5.3.1.7 Comments on Adequacy for Assessment

The workshop group recommends using this index for the assessment.

5.4. ***FISHERY DEPENDENT INDICES***

5.4.1 Commercial Logbook (Longline) (SEDAR22-DW-03)

5.4.1.1 General Description & Issues Discussed at the DW

Self-reported commercial bottom longline logbook catch per unit effort (CPUE) data were used to construct separate standardized abundance indices for golden and blueline tilefish. Golden tilefish data were sufficient to construct an index of abundance including the years 1992-2009. Data for constructing a blueline tilefish index were available for the years 1993-2009. Methods and results of those analyses are described in SEDAR22-DW-03.

5.4.1.2 Analysis Methods

Golden and blueline tilefish trips were identified separately using a data subsetting technique (modified from Stephens and MacCall, 2004) intended to restrict the data set to trips with fishing effort in tilefish habitat. For each species, targeted trips were identified independently for the eastern Gulf of Mexico (statistical areas 2-7) and the western Gulf (statistical areas 8-21). This east-west partitioning approximately matched the demarcation line at Cape San Blas where longline gear is restricted to 20 fathoms or greater depths (east) and 50 fathoms or greater depths (west). Prior to identifying targeted trips, data from areas 1 and 12 were excluded from the analyses of both species, due to small sample sizes from those areas. Data from areas 18-21 were excluded from the blueline tilefish analysis, also due to small sample size. Figure 5.9.3A-D provides species-specific regression coefficients. The magnitude of the coefficients indicates the predictive impact of each species.

The delta lognormal model approach (Lo et al. 1992) was used to construct standardized indices of abundance. Parameterization of each model was accomplished using a GLM procedure (GENMOD; Version 8.02 of the SAS System for Windows © 2000. SAS Institute Inc., Cary, NC, USA). Eight factors (year, season, area fished, longline length, days at sea, number of crew, distance between hooks) were considered as possible influences on longline proportion of trips that landed tilefish and on the catch rate of tilefish. Longline catch rate was calculated as weight of tilefish per hook fished. An additional factor, number of hooks fished, was examined for its affect on the proportion of positive trips. Factor categories are defined in SEDAR22-DW-03. For each GLM analysis of proportion positive trips, a type-3 model was fit, a binomial error distribution was assumed, and the logit link was selected. The response variable was proportion successful trips. During the analysis of catch rates on successful trips, a type-3 model assuming lognormal error distribution was examined. The linking function selected was "normal", and the response variable was log(CPUE). All 2-way interactions among significant main effects were examined. Higher order interaction terms were not examined. YEAR*FACTOR interaction terms were included in the model as random effects.

The final delta-lognormal model was fit using a SAS macro, GLIMMIX (Russ Wolfinger, SAS Institute). To facilitate visual comparison, a relative standardized index and relative nominal CPUE series were calculated by dividing each value in the series by the mean value of the series.

5.4.1.3 Results & Discussion

The final models for the binomial on proportion positive trips (PPT) and the lognormal on CPUE of successful trips for each species were:

Golden tilefish:

PPT = Subregion + Days at Sea + Year

LOG(CPUE) = Subregion + Days at Sea + Year + Subregion*Year + Days at Sea*Year + Subregion*Days at Sea

In the proportion positive analysis, Year was included in the final model although it did not meet the inclusion criteria. No two-way interactions involving Year were tested for inclusion in the final binomial portion of the model.

Blueline tilefish:

PPT = Subregion + Year

LOG(CPUE) = Subregion + Distance Between Hooks + Year + Distance Between Hooks*Year

In the proportion positive analysis, Year was included in the model even though it did not meet the inclusion criteria. The two-way interaction Subregion*Year was not tested for inclusion in the final binomial portion of the model.

Relative nominal CPUE, number of trips, proportion positive trips, and relative abundance indices are provided in Tables 5.8.2 and 5.8.3 for the golden tilefish and blueline tilefish models. The delta-lognormal abundance indices developed for each species, with 95% confidence intervals, are shown in Figures 5.9.4 and 5.9.5.

Golden tilefish standardized catch rates for longline vessels had no clear trend over much of the time series. CPUE increased through 1994, but no trend was apparent from 1994 through 2002. CPUE decreased in 2003 then generally increased from 2003 to 2009. Coefficients of variation (CV) were in the range 0.33-0.37 except for the first two years of the series when CVs were slightly larger. Those higher initial CVs may have been due to smaller sample sizes (i.e. sampling error) during the period of 20 percent reporting in Florida.

Blueline tilefish CPUE increased during the first three years of the time series (1993-1995) with no apparent trend from 1995-2003. Yearly standardized CPUE increased from 2003 to 2008, but decreased again in 2009. Uncertainty in CPUE was much greater for blueline tilefish than was found for golden tilefish. Smaller sample size cannot fully explain the greater within year blueline tilefish CPUE variability, although sample size may play a role. Given the large confidence intervals around the blueline tilefish index, little may be concluded regarding trends in CPUE. There may be no trend in mean yearly CPUE over the time series or, alternatively, any actual trend in blueline tilefish CPUE over time cannot be detected from the available data.

5.4.1.4 Comments on Adequacy for Assessment

The workshop group recommends using the golden tilefish index for the assessment. However, due to high variability, the group does not recommend the blueline tilefish index for assessment purposes, except for a possible sensitivity run.

5.5. ***CONSENSUS RECOMMENDATIONS AND SURVEY EVALUATIONS***

The workshop group recommends using the golden tilefish indices described above as inputs into the assessment model. However, due to high variability, the blueline tilefish index should not be used for assessment purposes, except for a possible sensitivity run in the assessment model. Figure 5.9.6 illustrates linear coverage of specific abundance indices along the coast of the Gulf of Mexico.

5.6. ***ITEMIZED LIST OF TASKS FOR COMPLETION FOLLOWING WORKSHOP***

The group was tasked with developing an extended time series for golden tilefish, which included data from historic exploratory fishing surveys conducted by NMFS, the current NOAA Fisheries bottom longline (SEDAR22-DW-07), and current observer data from the commercial bottom longline fishery. This will be submitted as a document for the upcoming Assessment Workshop.

For the fisheries dependent bottom longline index the assessment scientists requested the construction of three separate indices for golden tilefish, and blueline tilefish for three regions in the Gulf of Mexico (areas 2-5, 6-11, & 13-21).

The results of these tasks will be submitted as documents for the upcoming Assessment Workshop.

5.7. ***LITERATURE CITED***

Lo, N.C., L.D. Jackson, J.L. Squire. 1992. Indices of relative abundance from fish spotter data based on delta-lognormal models. Can. J. Fish. Aquat. Sci. 49: 2515-2526.

Rester, J. 2009. Distribution of bottom habitat information in the Gulf of Mexico. Gulf States Marine Fisheries Commission NA05NMF4331073.

Stephens, A. and A. McCall. 2004. A multispecies approach to subsetting logbook data for purposes of estimating CPUE. Fisheries Research 70:299-310.

5.8. *TABLES*

Table 5.8.1. Area-specific abundance indices and summaries of Type 3 tests for model inclusion.

Table 5.8.1.a: *Type 3 Tests of Fixed Effects for the Binomial Submodel for Golden Tilefish*

Effect	*Num DF*	*Den DF*	*Chi-Square*	*F Value*	*Pr > ChiSq*	*Pr > F*
YEAR	8	221	12.07	1.51	0.1480	0.1552
Area	2	221	0.80	0.40	0.6707	0.6712
sta_dpth	1	221	32.99	32.99	<.0001	<.0001
Clay	1	221	1.80	1.80	0.1793	0.1807
Sorting	1	221	1.10	1.10	0.2944	0.2955
*YEAR*Area*	7	221	6.97	1.00	0.4318	0.4350

Table 5.8.1.b *Type 3 Tests of Fixed Effects for the Lognormal Submodel for Golden Tilefish*

Effect	*Num DF*	*Den DF*	*F Value*	*Pr > F*
YEAR	8	78	1.40	0.2087
Area	2	78	1.02	0.3658
sta_dpth	1	78	5.48	0.0218
*YEAR*Area*	7	78	0.90	0.5110

Table 5.8.1.c: *Abundance Indices and Variability*

Survey Year	*Area*	*Nominal Frequency*	*N*	*Index*	*Scaled Index*	*CV*	*LCL*	*UCL*
2000	NWFLA	0.00000	4	0.00000	0.00000	.	.	.
2001	NWFLA	0.28571	21	0.36233	0.27630	0.71024	0.07696	0.99193
2002	NWFLA	0.40000	10	1.15490	0.88070	0.58965	0.29537	2.62601
2003	NWFLA	0.29412	17	0.60755	0.46330	0.76620	0.11900	1.80374
2004	NWFLA	0.41667	11	1.62034	1.23564	0.57235	0.42612	3.58307
2006	NWFLA	0.66667	6	1.77768	1.35562	0.47528	0.54973	3.34292
2007	NWFLA	0.53846	13	2.35840	1.79847	0.47926	0.72435	4.46539
2008	NWFLA	0.80000	5	1.47560	1.12527	0.58283	0.38154	3.31868
2009	NWFLA	0.50000	10	1.61015	1.22787	0.57008	0.42500	3.54744
2001	SWFLA	0.00000	7	0.00000	0.00000	.	.	.
2003	SWFLA	0.00000	17	0.00000	0.00000	.	.	.
2004	SWFLA	0.00000	17	0.00000	0.00000	.	.	.
2006	SWFLA	0.00000	12	0.00000	0.00000	.	.	.
2007	SWFLA	0.00000	14	0.00000	0.00000	.	.	.
2008	SWFLA	0.00000	3	0.00000	0.00000	.	.	.
2009	SWFLA	0.09091	11	0.29951	0.22840	1.20561	0.03434	1.51905
2000	WEST	0.21053	19	0.18039	0.13756	0.86394	0.03090	0.61244
2001	WEST	0.47368	19	0.87397	0.66647	0.46705	0.27412	1.62037
2002	WEST	0.27586	29	1.27283	0.97064	0.53226	0.35748	2.63547
2003	WEST	0.40000	10	0.75335	0.57449	0.62844	0.18120	1.82137
2004	WEST	0.33333	18	0.82481	0.62899	0.67514	0.18465	2.14260
2006	WEST	0.46154	13	1.49065	1.13674	0.55433	0.40369	3.20092
2007	WEST	0.54545	11	2.87709	2.19401	0.47416	0.89142	5.40000
2008	WEST	0.66667	9	1.63184	1.24441	0.55130	0.44413	3.48676
2009	WEST	0.50000	14	2.43270	1.85513	0.44300	0.79560	4.32566

Table 5.8.2. Longline relative nominal CPUE, number of trips, proportion positive trips, and standardized abundance index for golden tilefish (1992-2009) in the Gulf of Mexico.

YEAR	Relative Nominal CPUE	Trips	Proportion Successful Trips	Standardized Index	Lower 95% CI (Index)	Upper 95% CI (Index)	CV (Index)
1992	0.696285	72	0.638889	0.511599	0.1763	1.484593	0.572795
1993	0.576969	103	0.699029	0.784492	0.342475	1.796997	0.432865
1994	1.350587	195	0.815385	1.137181	0.595081	2.173119	0.332482
1995	1.037016	229	0.820961	1.109442	0.576145	2.136373	0.336618
1996	0.924305	146	0.863014	0.881585	0.432639	1.7964	0.367483
1997	1.275656	228	0.767544	0.981243	0.492683	1.954276	0.354954
1998	1.295589	209	0.76555	1.145312	0.581097	2.257352	0.349257
1999	1.206708	236	0.758475	1.224067	0.63577	2.356736	0.336534
2000	1.04836	294	0.782313	0.829545	0.424442	1.621294	0.344678
2001	1.108935	255	0.815686	1.019424	0.526665	1.97322	0.339424
2002	0.97124	251	0.812749	0.900457	0.457502	1.772284	0.348499
2003	1.103007	277	0.823105	0.58315	0.286881	1.185383	0.366142
2004	0.537684	163	0.760736	0.71944	0.349189	1.482272	0.37356
2005	0.676155	158	0.727848	0.911633	0.444968	1.867719	0.370463
2006	0.85811	161	0.689441	1.078831	0.5349	2.175879	0.361849
2007	1.279	128	0.859375	1.642863	0.841468	3.207487	0.344104
2008	0.823009	154	0.701299	1.030535	0.493889	2.150288	0.380554
2009	1.231386	125	0.728	1.5092	0.746835	3.049782	0.362911

Table 5.8.3. Longline relative nominal CPUE, number of trips, proportion positive trips, and relative abundance index for tilefish (1993-2009) in the Gulf of Mexico.

Year	Relative Nominal CPUE	Trips	Proportion Successful Trips	Standardized Index	Lower 95% CI (Index)	Upper 95% CI (Index)	CV (Index)
1993	0.498682	51	0.490196	0.437784	0.026067	7.35235	2.512461
1994	0.345656	106	0.603774	0.619062	0.065784	5.825683	1.585217
1995	1.542235	94	0.606383	0.803995	0.095155	6.793211	1.456823
1996	0.935702	46	0.478261	0.505964	0.030113	8.501312	2.513407
1997	0.936111	127	0.677165	0.978834	0.146929	6.520939	1.207218
1998	0.825907	97	0.731959	1.100601	0.165933	7.300052	1.202992
1999	0.636485	84	0.595238	0.51631	0.040921	6.514403	1.996501
2000	1.09752	114	0.675439	1.409594	0.259333	7.661797	1.02337
2001	0.569687	126	0.595238	0.472304	0.039849	5.597843	1.900127
2002	0.87944	85	0.6	0.914954	0.108287	7.730744	1.456823
2003	0.769957	128	0.640625	0.541005	0.055665	5.258001	1.625787
2004	0.969509	119	0.647059	0.849812	0.107124	6.741535	1.386385
2005	1.179599	92	0.641304	1.091026	0.136287	8.734088	1.396333
2006	1.373769	119	0.731092	1.451889	0.272369	7.739445	1.006974
2007	1.63564	74	0.72973	1.864569	0.356819	9.743356	0.990414
2008	1.641751	102	0.823529	2.280721	0.568797	9.145065	0.787104
2009	1.16235	89	0.741573	1.161576	0.185036	7.29185	1.150989

5.9. *FIGURES*

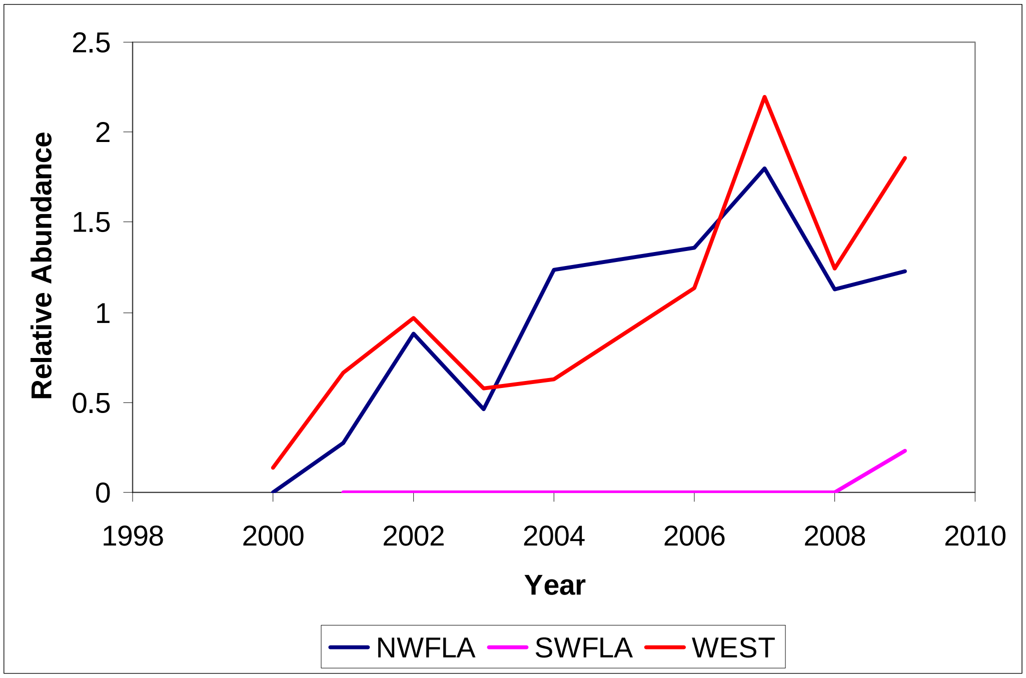


Figure 5.9.1. Area-specific abundance indices for yellowedge grouper

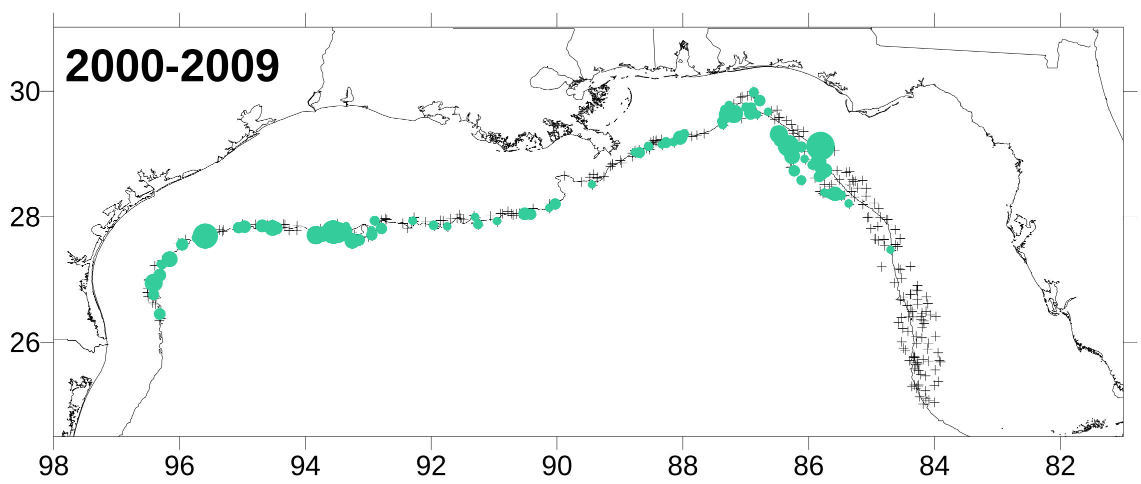
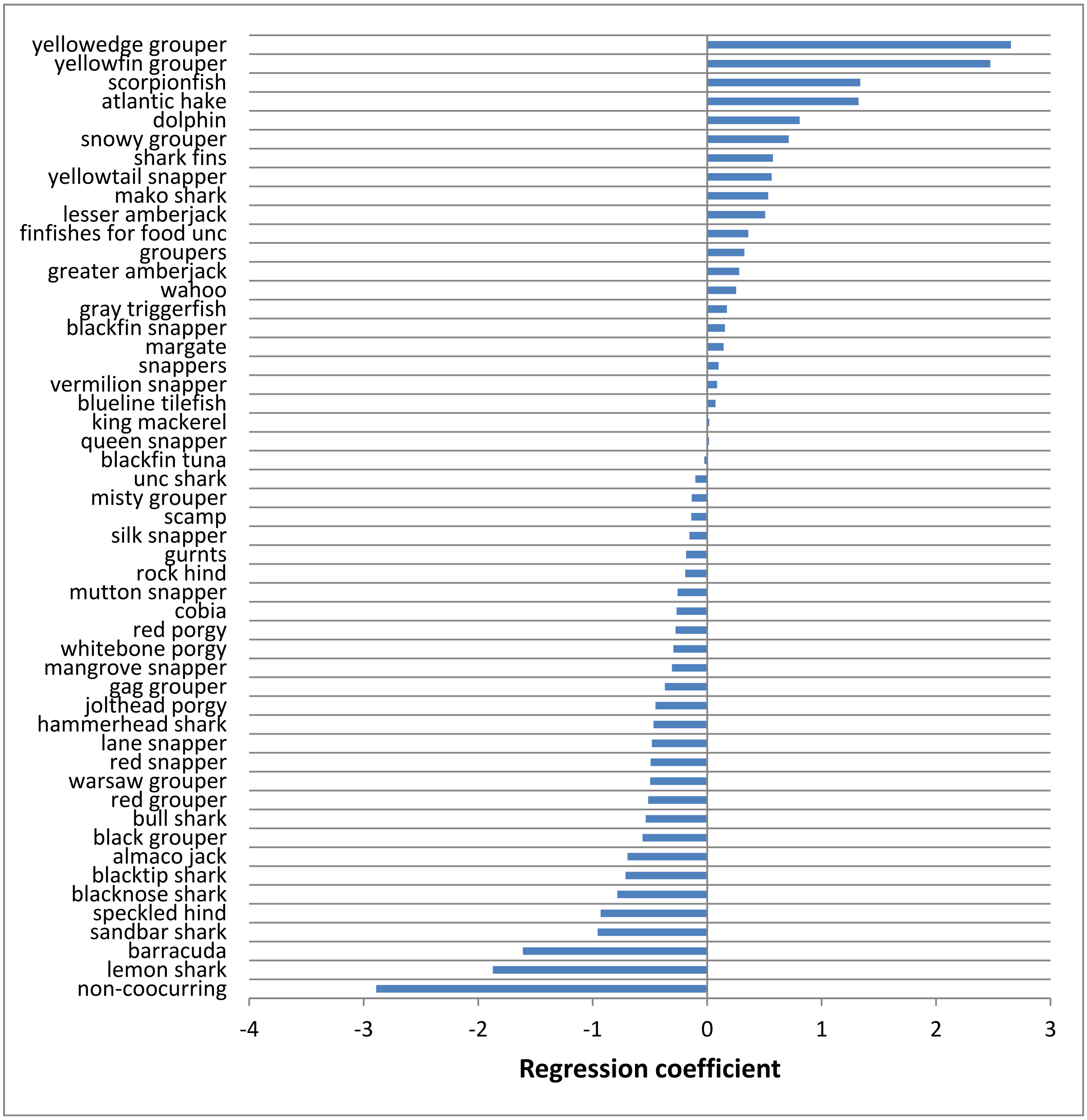
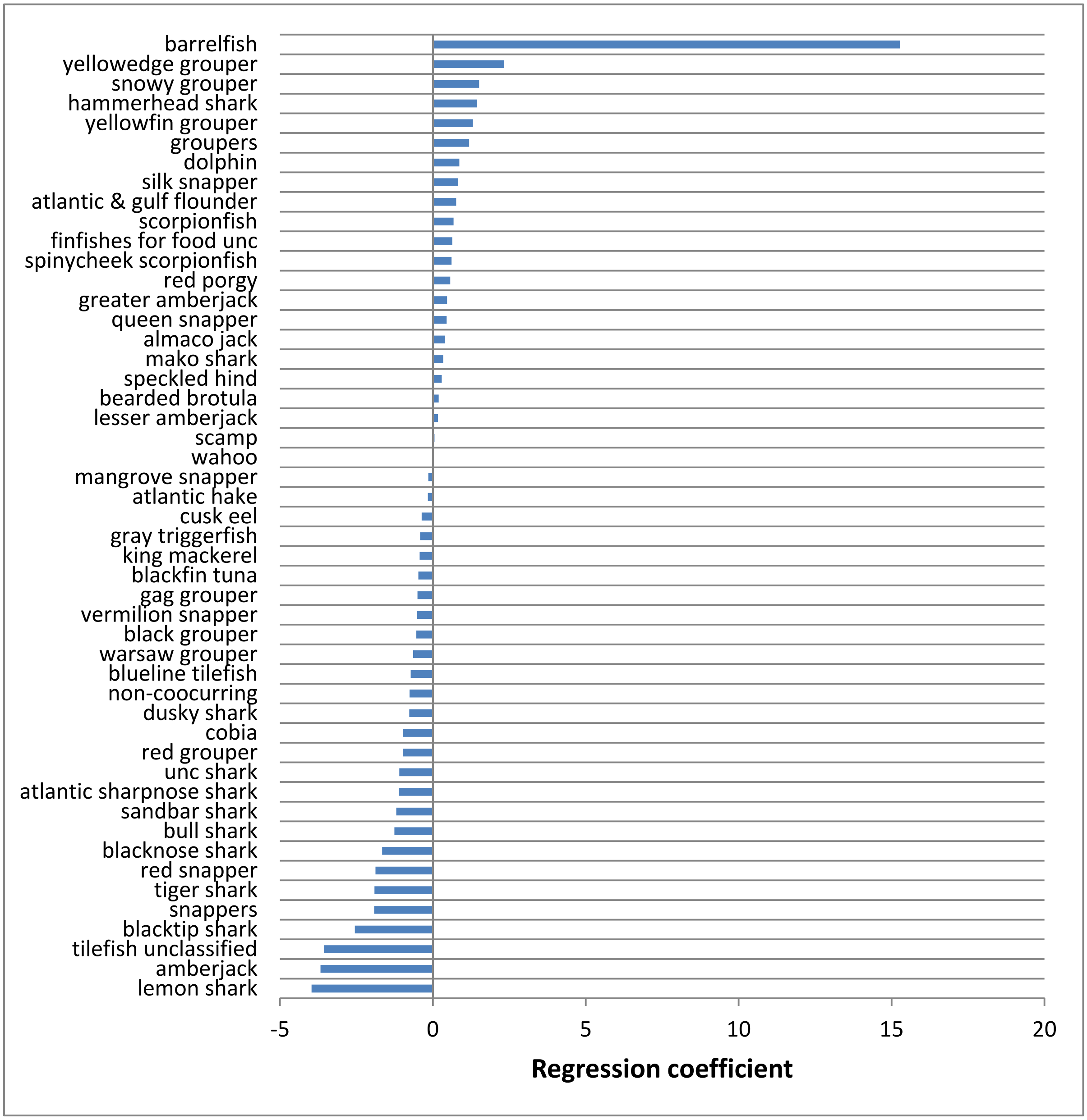


Figure 5.9.2. Survey effort included in analyses and CPUE of golden tilefish from 2000 through 2009 in the Gulf of Mexico. Crosses indicate effort with no catch. The size of green circles is linearly related to positive CPUE (range: 0.7 – 14.5 golden tilefish per 100 hook hours).

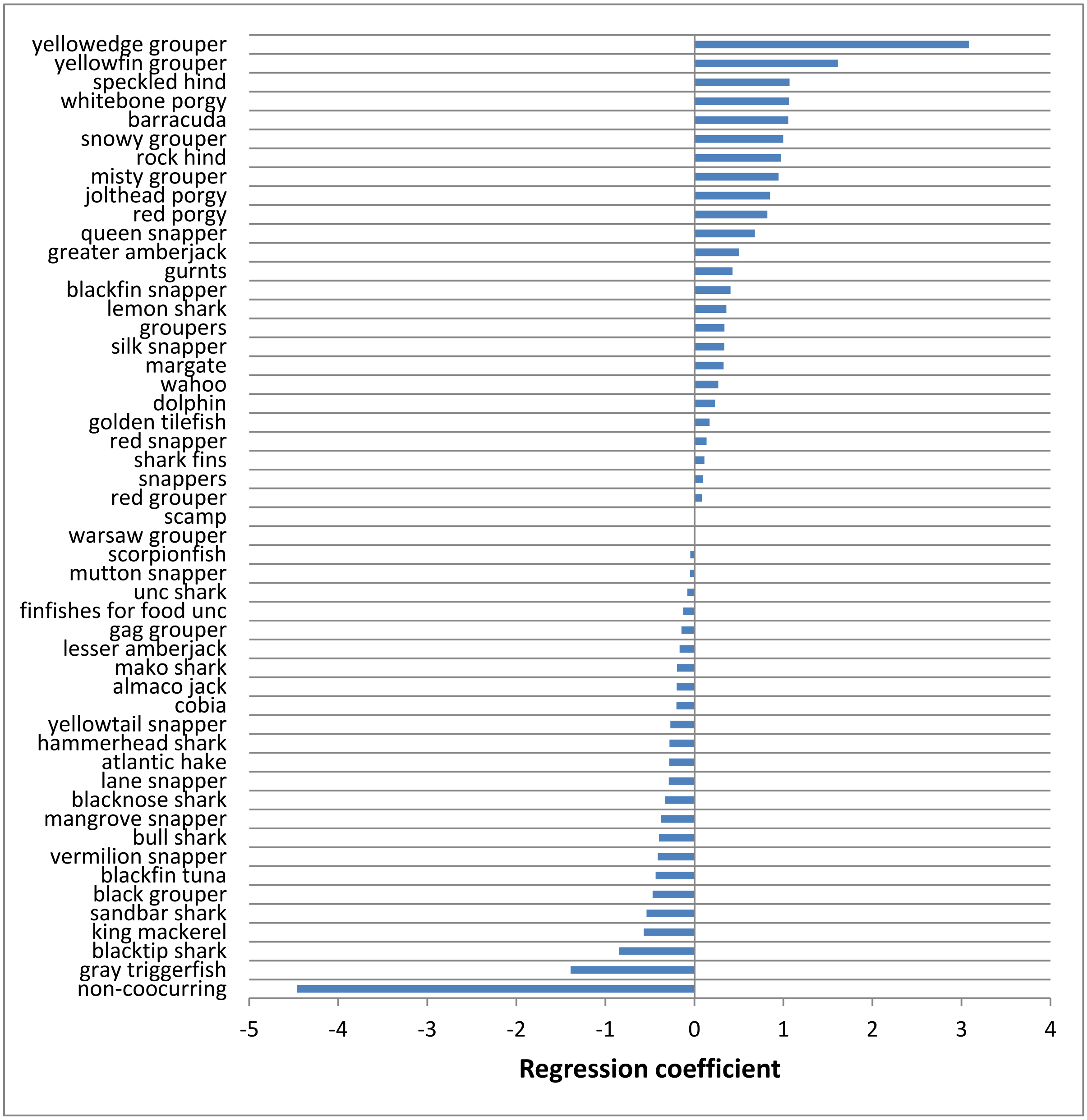
Figure 5.9.3. Regression coefficients from the Stephens & MacCall analyses. Positive coefficients signify species that had positive associations with the target species. The magnitude of the coefficients indicates the predictive impact of each species. The value for "non-coocurring" is the regression intercept and denotes the probability a trip was fishing in the target species' habitat, but did not report any of the listed species. Species included were reported on at least one percent of longline trips in the eastern or western Gulf of Mexico.



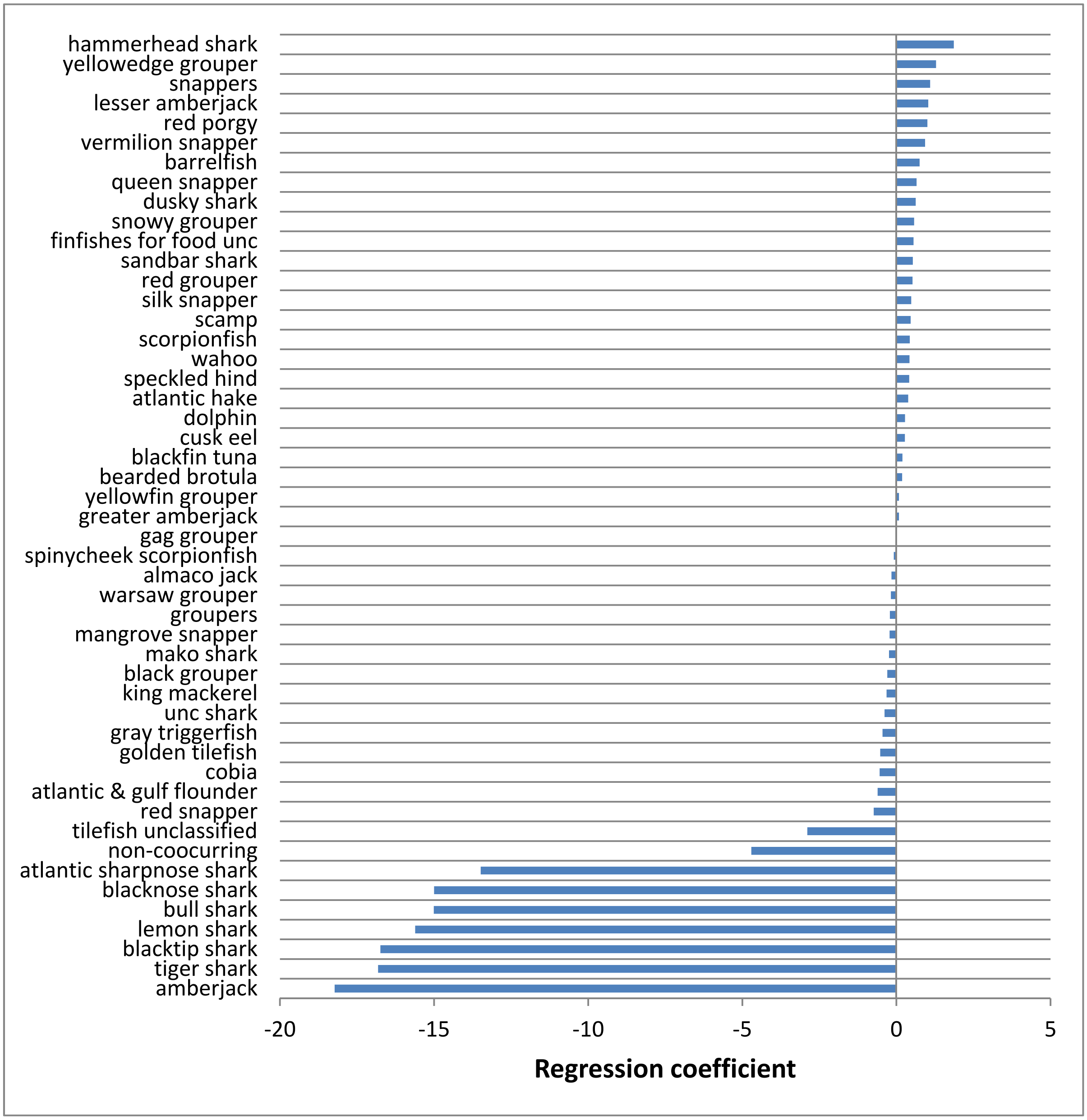
5.9.3A. Golden tilefish eastern Gulf of Mexico longline



5.9.3B. Golden tilefish western Gulf of Mexico longline



5.9.3C. Blueline tilefish eastern Gulf of Mexico longline



5.9.3D. Blueline tilefish western Gulf of Mexico longline

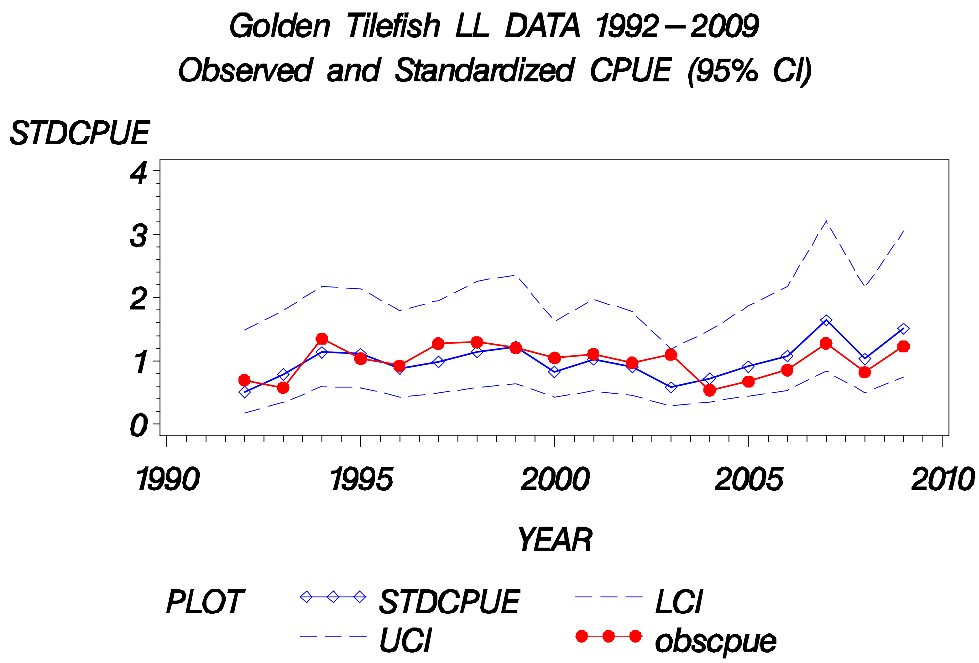


Figure 5.9.4. Golden tilefish nominal CPUE (solid circles), standardized CPUE (open diamonds) and upper and lower 95% confidence limits of the standardized CPUE estimates (dashed lines) for vessels fishing longline gear in the Gulf of Mexico.

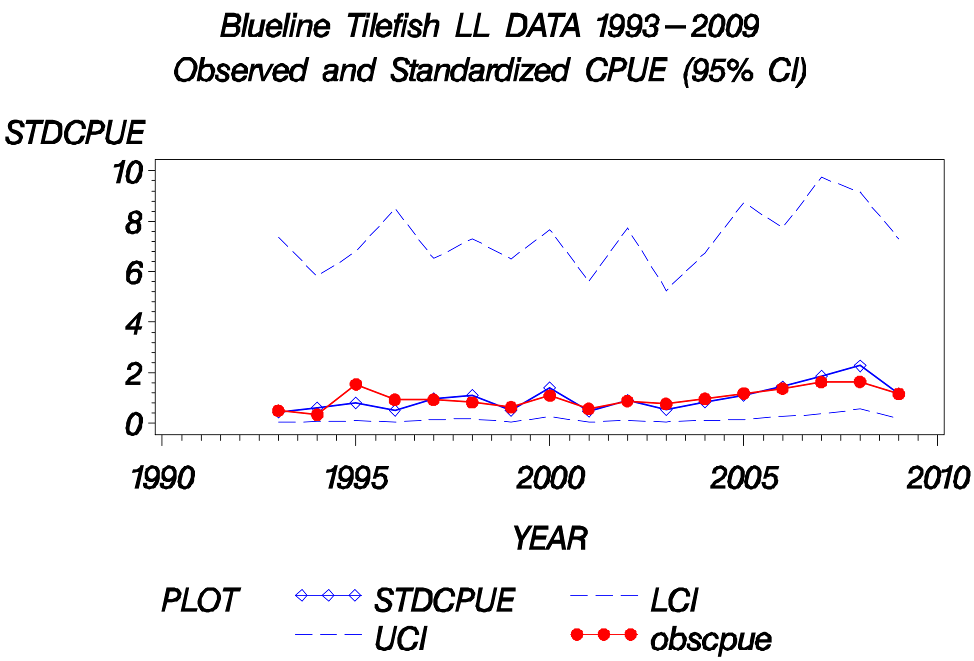


Figure 5.9.5. Blueline tilefish nominal CPUE (solid circles), standardized CPUE (open diamonds) and upper and lower 95% confidence limits of the standardized CPUE estimates (dashed lines) for vessels fishing longline gear in the Gulf of Mexico.

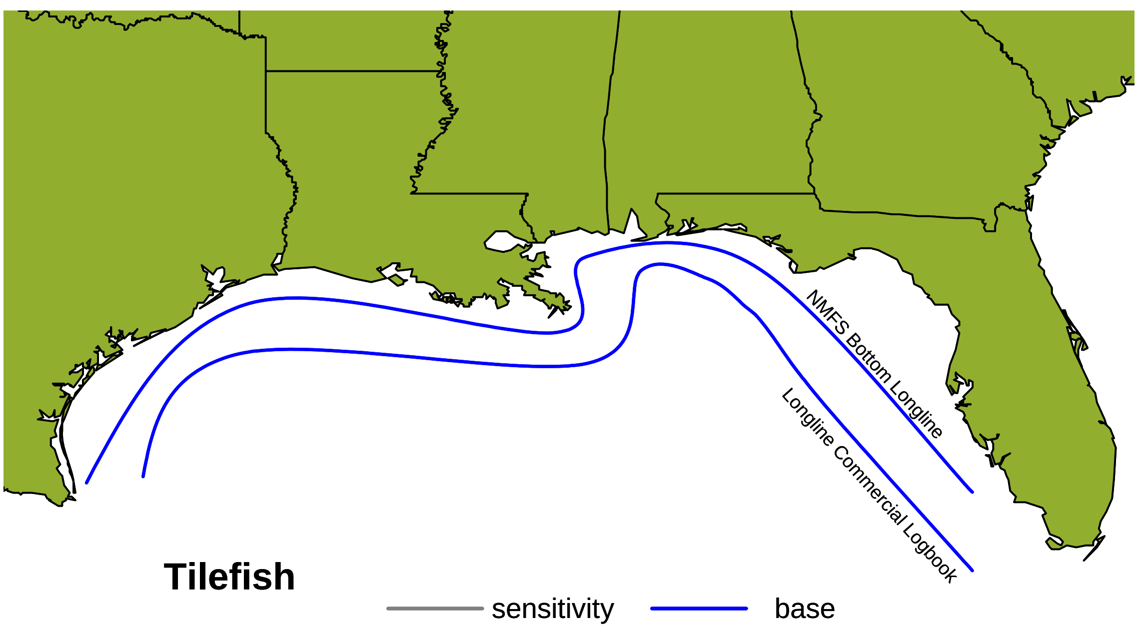


Figure 5.9.6. Linear coverage of specific abundance indices along the coast of the Gulf of Mexico.

6. ANALYTIC APPROACH

6.1. *SUGGESTED ANALYTIC APPROACH GIVEN THE DATA*

Stock Synthesis III (SSIII, Methot 2000) will be the first assessment modeling approach for both yellowedge grouper (YEG) and tilefish. SSIII is an integrated statistical catch-at-age model which is widely used for stock assessments in the United States and throughout the world. SSIII takes relatively unprocessed input data and incorporates many of the important processes (mortality, selectivity, growth, etc) that operate in conjunction to produce observed catch, size and age composition and CPUE indices. In addition, SSIII can incorporate time series of environmental data. Because many of these inputs are correlated, the concept behind SSIII is that they should be modeled together, which helps to ensure that uncertainties in the input data are properly accounted for in the assessment. SSIII has the ability to incorporate an early, data poor time period for which only catch data are available and a more recent, data-rich time period for which indices and length and age observations are available. Such a situation exists for both YEG and tilefish, however both fisheries are rather short (~40 years) and for YEG we have the benefit of substantial age composition data from fairly early in the fishery. However, in either case, there is evidence of substantial landings prior to the routine collection of age composition data from throughout the spatial distribution of the stock.

As a second assessment modeling approach, stochastic stock reduction analysis (SRA, Walters et al. 2005) will also be applied to both species. SRA is a less data-intensive method which can help to determine how large the stock needed to be to have produced the time series of observed landings. This will provide a necessary check on the SSIII results and may be very useful in determining stock status relative to the initial population size. SRA has been applied to several other Gulf of Mexico species including gag and red grouper and red snapper.

For both species, there are sources of uncertainty which will have to be incorporated within the modeling framework or through sensitivity analyses. Uncertainties in assigned ages created by aging error, changing growth rates and unknown M can be incorporated within the SSIII framework. Given the complex reproductive biology of YEG and tilefish, the most effective proxy for spawning stock biomass is another source of uncertainty and will have to be considered in some manner as well. Unfortunately, the greatest uncertainties in either of these two assessments are in the actual landings levels themselves, because of a lack of historical identification of groupers and tilefishes to species. Very few modeling approaches can deal with large uncertainties in total catch, so these may have to be considered through sensitivity runs with both SRA and SS3.

6.2. ***REFERENCES***

Walters, C. J., S. J.D. Martell, and J. Korman 2006. A stochastic approach to stock reduction analysis. Can. J. Fish. Aquat. Sci. 63: 212–223.

Methot, R.D. 2000. Technical description of the stock synthesis assessment program. U.S. Dept. Commerce, NOAA Tech. Memo. NMFS-NWFSC-43, 4

APPENDIX 1: INDICES WORKSHEETS

Evaluation of Abundance Indices of Blueline Tilefish: Commercial Logbook (Longline) (SEDAR22-DW-02)

DESCRIPTION OF THE DATA SOURCE

Item	Not Applicable	Absent	Incomplete	Complete
1. Fishery Independent Indices				
A. Describe the survey design (e.g. fixed sampling sites, random stratified sampling), location, seasons/months and years of sampling.	✓			
B. Describe sampling methodology (e.g. gear, vessel, soak time etc.)	✓			
C. Describe any changes in sampling methodology (e.g. gear, vessel, sample design etc.)	✓			
D. Describe the variables reported in the data set (e.g. location, time, temperature, catch, effort etc.).	✓			
E. What species or species assemblages are targeted by this survey (e.g. red snapper, reef fish, pelagic).	✓			
F. Describe the size/age range that the index applies to. Include supporting figures (e.g. size comp) if available.	✓			
2. Fishery Dependent Indices				
A. Describe the data source and type of fishery (e.g. commercial handline, commercial longline, recreational hook and line etc.).				✓
B. Describe any changes to reporting requirements, variables reported, etc.	✓			
C. Describe the variables reported in the data set (e.g. location, time, temperature, catch, effort etc.).				✓
D Describe the size/age range that the index applies to. Include supporting figures (e.g. size comp) if available.		✓		

METHODS

Item	Not Applicable	Absent	Incomplete	Complete
1. Data Reduction and Exclusions				
A. Describe any data exclusions (e.g. gears, fishing modes, sampling areas etc.). Report the number of records removed and justify removal.				✓
B. Describe data reduction techniques (if any) used to address targeting (e.g. Stephens and MacCall, 2004; gear configuration, species assemblage etc).				✓
C. Discuss procedures used to identify outliers. How many were identified? Were they excluded?				✓

Working Group Comments:

No minimum size regulation, but size/age range unknown.

2. Management Regulations (for FD Indices)

Item	Not Applicable	Absent	Incomplete	Complete
A. Provide (or cite) history of management regulations (e.g. bag limits, size limits, trip limits, closures etc.).				✓
B. Describe the effects (if any) of management regulations on CPUE		✓		
C. Discuss methods used (if any) to minimize the effects of management measures on the CPUE series.		✓		

3. Describe Analysis Dataset (after exclusions and other treatments)

Item	Not Applicable	Absent	Incomplete	Complete
A. Provide tables and/or figures of number of observations by factors (including year, area, etc.) and interaction terms.		✓		
B. Include tables and/or figures of number of positive observations by factors and interaction terms.		✓		
C. Include tables and/or figures of the proportion positive observations by factors and interaction terms.		✓		
D. Include tables and/or figures of average (unstandardized) CPUE by factors and interaction terms.		✓		
E. Include annual maps of locations of survey sites (or fishing trips) and associated catch rates ***OR*** supply the raw data needed to construct these maps (Observation, Year, Latitude, Longitude (or statistical grid, area), Catch, Effort).		✓		
F. Describe the effort variable and the units. If more than one effort variable is present in the dataset, justify selection.				✓
G. What are the units of catch (e.g. numbers or biomass, whole weight, gutted weight, kilograms, pounds).				✓

4. Model Standardization

Item	Not Applicable	Absent	Incomplete	Complete
A. Describe model structure (e.g. delta-lognormal)				✓
B. Describe construction of GLM components (e.g. forward selection from null etc.)				✓
C. Describe inclusion criteria for factors and interactions terms.				✓
D. Were YEAR*FACTOR interactions included in the model? If so, how (e.g. fixed effect, random effect)? Were random effects tested for significance using a likelihood ratio test?				✓
E. Provide a table summarizing the construction of the GLM components.				✓
F. Summarize model statistics of the mixed model formulation(s) (e.g. log likelihood, AIC, BIC etc.)				✓
G. Report convergence statistics.		✓		

Working Group Comments:

Data from closed seasons were excluded. There is no minimum size or tilefish trip limits in the regulations.

Number of observations by factors and interaction terms were examined, but were not included in the document due to confidentiality concerns.

MODEL DIAGNOSTICS

Comment: Other model structures are possible and acceptable. Please provide appropriate diagnostics to the CPUE indices working group.

1. Binomial Component

Item	Not Applicable	Absent	Incomplete	Complete	Working Group Comments:
A. Include plots of the chi-square residuals by factor.				✓	
B. Include plots of predicted and observed proportion of positive trips by year and factor (e.g. year*area)		✓			
C. Report overdispersion parameter and other fit statistics (e.g. chi-square / degrees of freedom).		✓			

2. Lognormal/Gamma Component

Item	Not Applicable	Absent	Incomplete	Complete	Working Group Comments:
A. Include histogram of log(CPUE) or a histogram of the residuals of the model on CPUE. Overlay the expected distribution.				✓	
B. Include plots describing error distribution (e.g. Studentized residuals vs. linear predictor.		✓			
C. Include QQ-plot – (e.g. Student deviance residuals vs. theoretical quantiles), Overlay expected distribution.				✓	
D. Include diagnostic plot for variance function (e.g. square root of std residuals vs. fitted values). Overlay expected distribution.		✓			
E. Include diagnostic plot for link function (e.g. linear response variable vs. linear predictor). Overlay expected distribution.		✓			
F. Include plots of the residuals by factor				✓	

3. Poisson Component

Item	Not Applicable	Absent	Incomplete	Complete	Working Group Comments:
A. Report overdispersion parameter and other fit statistics (e.g. chi-square / degrees of freedom).	✓				
B. Include plots describing error distribution (e.g. Studentized residuals vs. linear predictor.	✓				
C. Include QQ-plot – (e.g. Student deviance residuals vs. theoretical quantiles), Overlay expected distribution.	✓				
D. Include diagnostic plot for variance function (e.g. square root of std residuals vs. fitted values). Overlay expected distribution.	✓				
E. Include diagnostic plot for link function (e.g. linear response variable vs. linear predictor). Overlay expected distribution.	✓				***The feasibility of this diagnostic is still under review.***

4. Zero-inflated model

Item	Not Applicable	Absent	Incomplete	Complete	Working Group Comments:
A. Include ROC curve to quantify goodness of fit.	✓				
B. Include plots describing error distribution (e.g. Studentized residuals vs. linear predictor).	✓				
C. Include QQ-plot (e.g. Student dev. residuals vs. theoretical quantiles), Overlay expected distribution.	✓				

MODEL DIAGNOSTICS (CONT.)

	Not Applicable	Absent	Incomplete	Complete	Working Group Comments:

D. Include diagnostic plot for variance function (e.g. square root of std residuals vs. fitted values). Overlay expected distribution.	✓			
E. Include diagnostic plot for link function (e.g. linear response variable vs. linear predictor). Overlay expected distribution.	✓			

MODEL RESULTS

A. Tables of Nominal CPUE, Standardized CPUE, Observations, Positive Observations, Proportion Positive Observations and Coefficients of Variation (CVs). Other statistics may also be appropriate to report				✓
B. Figure of Nominal and Standardized Indices with measure of variance (i.e. CVs).				✓

IF MULTIPLE MODEL STRUCTURES WERE CONSIDERED:

(***Note: this is always recommended but required when model diagnostics are poor***.)

1. Plot of resulting indices and estimates of variance	✓			
2. Table of model statistics (e.g. AIC criteria)	✓			

	Date Received	*Workshop Recommendation*	*Revision Deadline ****	*Author and Rapporteur Signatures*
First Submission	3/17/10	Reject/reevaluate with revsions	5/10/10	
Revision				

The revision deadline is negotiated by the author, the SEDAR coordinator and the CPUE rapporteur. The author ***DOES NOT*** *commit to any* ***LEGAL OBLIGATION*** *by agreeing to submit a manuscript before this deadline. The maximum penalty for failure to submit a revised document prior to the submission deadline is rejection of the CPUE series.*

Justification of Working Group Recommendation

Working group recommendations:
-Following the workshop, it was recommended by the assessment biologists and indices work group that separate indices be created for Gulf of Mexico areas 2-5, 6-11, and 13-21. Results of these analyses will be disseminated in a working paper prior to the assessment workshop/webinar.

Evaluation of Abundance Indices of Golden Tilefish: Commercial Logbook (Longline) (SEDAR22-DW-02)

DESCRIPTION OF THE DATA SOURCE

	Not Applicable	Absent	Incomplete	Complete
1. Fishery Independent Indices				
A. Describe the survey design (e.g. fixed sampling sites, random stratified sampling), location, seasons/months and years of sampling.	✓			
B. Describe sampling methodology (e.g. gear, vessel, soak time etc.)	✓			
C. Describe any changes in sampling methodology (e.g. gear, vessel, sample design etc.)	✓			
D. Describe the variables reported in the data set (e.g. location, time, temperature, catch, effort etc.).	✓			
E. What species or species assemblages are targeted by this survey (e.g. red snapper, reef fish, pelagic).	✓			
F. Describe the size/age range that the index applies to. Include supporting figures (e.g. size comp) if available.	✓			
2. Fishery Dependent Indices				
A. Describe the data source and type of fishery (e.g. commercial handline, commercial longline, recreational hook and line etc.).				✓
B. Describe any changes to reporting requirements, variables reported, etc.	✓			
C. Describe the variables reported in the data set (e.g. location, time, temperature, catch, effort etc.).				✓
D Describe the size/age range that the index applies to. Include supporting figures (e.g. size comp) if available.		✓		

METHODS

	Not Applicable	Absent	Incomplete	Complete
1. Data Reduction and Exclusions				
A. Describe any data exclusions (e.g. gears, fishing modes, sampling areas etc.). Report the number of records removed and justify removal.				✓
B. Describe data reduction techniques (if any) used to address targeting (e.g. Stephens and MacCall, 2004; gear configuration, species assemblage etc).				✓
C. Discuss procedures used to identify outliers. How many were identified? Were they excluded?				✓

Working Group Comments:

No minimum size regulation, but size/age range unknown.

2. Management Regulations (for FD Indices)

	Not Applicable	Absent	Incomplete	Complete
A. Provide (or cite) history of management regulations (e.g. bag limits, size limits, trip limits, closures etc.).				✓
B. Describe the effects (if any) of management regulations on CPUE		✓		
C. Discuss methods used (if any) to minimize the effects of management measures on the CPUE series.		✓		

3. Describe Analysis Dataset (after exclusions and other treatments)

	Not Applicable	Absent	Incomplete	Complete
A. Provide tables and/or figures of number of observations by factors (including year, area, etc.) and interaction terms.		✓		
B. Include tables and/or figures of number of positive observations by factors and interaction terms.		✓		
C. Include tables and/or figures of the proportion positive observations by factors and interaction terms.		✓		
D. Include tables and/or figures of average (unstandardized) CPUE by factors and interaction terms.		✓		
E. Include annual maps of locations of survey sites (or fishing trips) and associated catch rates ***OR*** supply the raw data needed to construct these maps (Observation, Year, Latitude, Longitude (or statistical grid, area), Catch, Effort).		✓		
F. Describe the effort variable and the units. If more than one effort variable is present in the dataset, justify selection.				✓
G. What are the units of catch (e.g. numbers or biomass, whole weight, gutted weight, kilograms, pounds).				✓

4. Model Standardization

	Not Applicable	Absent	Incomplete	Complete
A. Describe model structure (e.g. delta-lognormal)				✓
B. Describe construction of GLM components (e.g. forward selection from null etc.)				✓
C. Describe inclusion criteria for factors and interactions terms.				✓
D. Were YEAR*FACTOR interactions included in the model? If so, how (e.g. fixed effect, random effect)? Were random effects tested for significance using a likelihood ratio test?				✓
E. Provide a table summarizing the construction of the GLM components.				✓
F. Summarize model statistics of the mixed model formulation(s) (e.g. log likelihood, AIC, BIC etc.)				✓
G. Report convergence statistics.		✓		

Working Group Comments:

Data from closed seasons were excluded. There is no minimum size or tilefish trip limits in the regulations.

Number of observations by factors and interaction terms were examined, but were not included in the document due to confidentiality concerns.

MODEL DIAGNOSTICS

Comment: Other model structures are possible and acceptable. Please provide appropriate diagnostics to the CPUE indices working group.

	Not Applicable	Absent	Incomplete	Complete
1. Binomial Component				
A. Include plots of the chi-square residuals by factor.				✓
B. Include plots of predicted and observed proportion of positive trips by year and factor (e.g. year*area)		✓		
C. Report overdispersion parameter and other fit statistics (e.g. chi-square / degrees of freedom).		✓		
2. Lognormal/Gamma Component				
A. Include histogram of log(CPUE) or a histogram of the residuals of the model on CPUE. Overlay the expected distribution.				✓
B. Include plots describing error distribution (e.g. Studentized residuals vs. linear predictor.		✓		
C. Include QQ-plot – (e.g. Student deviance residuals vs. theoretical quantiles), Overlay expected distribution.				✓
D. Include diagnostic plot for variance function (e.g. square root of std residuals vs. fitted values). Overlay expected distribution.		✓		
E. Include diagnostic plot for link function (e.g. linear response variable vs. linear predictor). Overlay expected distribution.		✓		
F. Include plots of the residuals by factor				✓
3. Poisson Component				
A. Report overdispersion parameter and other fit statistics (e.g. chi-square / degrees of freedom).	✓			
B. Include plots describing error distribution (e.g. Studentized residuals vs. linear predictor.	✓			
C. Include QQ-plot – (e.g. Student deviance residuals vs. theoretical quantiles), Overlay expected distribution.	✓			
D. Include diagnostic plot for variance function (e.g. square root of std residuals vs. fitted values). Overlay expected distribution.	✓			
E. Include diagnostic plot for link function (e.g. linear response variable vs. linear predictor). Overlay expected distribution.	✓			
4. Zero-inflated model				
A. Include ROC curve to quantify goodness of fit.	✓			
B. Include plots describing error distribution (e.g. Studentized residuals vs. linear predictor).	✓			
C. Include QQ-plot (e.g. Student dev. residuals vs. theoretical quantiles), Overlay expected distribution.	✓			

Working Group Comments:

The feasibility of this diagnostic is still under review.

MODEL DIAGNOSTICS (CONT.)

	Not Applicable	Absent	Incomplete	Complete

Working Group Comments:

D. Include diagnostic plot for variance function (e.g. square root of std residuals vs. fitted values). Overlay expected distribution.	✓			
E. Include diagnostic plot for link function (e.g. linear response variable vs. linear predictor). Overlay expected distribution.	✓			

MODEL RESULTS

A. Tables of Nominal CPUE, Standardized CPUE, Observations, Positive Observations, Proportion Positive Observations and Coefficients of Variation (CVs). Other statistics may also be appropriate to report				✓
B. Figure of Nominal and Standardized Indices with measure of variance (i.e. CVs).				✓

IF MULTIPLE MODEL STRUCTURES WERE CONSIDERED:

(***Note: this is always recommended but required when model diagnostics are poor***.)

1. Plot of resulting indices and estimates of variance	✓			
2. Table of model statistics (e.g. AIC criteria)	✓			

	Date Received	*Workshop Recommendation*	*Revision Deadline* ***	*Author and Rapporteur Signatures*
First Submission	3/17/10	Accept with revisions	5/10/10	
Revision				

The revision deadline is negotiated by the author, the SEDAR coordinator and the CPUE rapporteur. The author ***DOES NOT*** *commit to any* ***LEGAL OBLIGATION*** *by agreeing to submit a manuscript before this deadline. The maximum penalty for failure to submit a revised document prior to the submission deadline is rejection of the CPUE series.*

Justification of Working Group Recommendation

Working group recommendations:
-Following the workshop, it was recommended by the assessment biologists and indices work group that separate indices be created for Gulf of Mexico areas 2-5, 6-11, and 13-21. Results of these analyses will be disseminated in a working paper prior to the assessment workshop/webinar.

Evaluation of Abundance Indices Golden Tilefish: NOAA Fisheries Bottom Longline Survey (SEDAR22-DW-07)

Working Group Comments:

DESCRIPTION OF THE DATA SOURCE

1. Fishery Independent Indices	Not Applicable	Absent	Incomplete	Complete
A. Describe the survey design (e.g. fixed sampling sites, random stratified sampling), location, seasons/months and years of sampling.				✓
B. Describe sampling methodology (e.g. gear, vessel, soak time etc.)				✓
C. Describe any changes in sampling methodology (e.g. gear, vessel, sample design etc.)				✓
D. Describe the variables reported in the data set (e.g. location, time, temperature, catch, effort etc.).				✓
E. What species or species assemblages are targeted by this survey (e.g. red snapper, reef fish, pelagic).				✓
F. Describe the size/age range that the index applies to. Include supporting figures (e.g. size comp) if available.				✓

2. Fishery Dependent Indices	Not Applicable	Absent	Incomplete	Complete
A. Describe the data source and type of fishery (e.g. commercial handline, commercial longline, recreational hook and line etc.).	✓			
B. Describe any changes to reporting requirements, variables reported, etc.	✓			
C. Describe the variables reported in the data set (e.g. location, time, temperature, catch, effort etc.).	✓			
D Describe the size/age range that the index applies to. Include supporting figures (e.g. size comp) if available.	✓			

METHODS

1. Data Reduction and Exclusions	Not Applicable	Absent	Incomplete	Complete
A. Describe any data exclusions (e.g. gears, fishing modes, sampling areas etc.). Report the number of records removed and justify removal.				✓
B. Describe data reduction techniques (if any) used to address targeting (e.g. Stephens and MacCall, 2004; gear configuration, species assemblage etc).				✓
C. Discuss procedures used to identify outliers. How many were identified? Were they excluded?		✓		

Working Group Comments:

2. Management Regulations (for FD Indices)

	Not Applicable	Absent	Incomplete	Complete
A. Provide (or cite) history of management regulations (e.g. bag limits, size limits, trip limits, closures etc.).	✓			
B. Describe the effects (if any) of management regulations on CPUE	✓			
C. Discuss methods used (if any) to minimize the effects of management measures on the CPUE series.	✓			

3. Describe Analysis Dataset (after exclusions and other treatments)

	Not Applicable	Absent	Incomplete	Complete
A. Provide tables and/or figures of number of observations by factors (including year, area, etc.) and interaction terms.		✓		
B. Include tables and/or figures of number of positive observations by factors and interaction terms.		✓		
C. Include tables and/or figures of the proportion positive observations by factors and interaction terms.		✓		
D. Include tables and/or figures of average (unstandardized) CPUE by factors and interaction terms.				✓
E. Include annual maps of locations of survey sites (or fishing trips) and associated catch rates ***OR*** supply the raw data needed to construct these maps (Observation, Year, Latitude, Longitude (or statistical grid, area), Catch, Effort).				✓
F. Describe the effort variable and the units. If more than one effort variable is present in the dataset, justify selection.				✓
G. What are the units of catch (e.g. numbers or biomass, whole weight, gutted weight, kilograms, pounds).				✓

4. Model Standardization

	Not Applicable	Absent	Incomplete	Complete
A. Describe model structure (e.g. delta-lognormal)				✓
B. Describe construction of GLM components (e.g. forward selection from null etc.)				✓
C. Describe inclusion criteria for factors and interactions terms.			✓	
D. Were YEAR*FACTOR interactions included in the model? If so, how (e.g. fixed effect, random effect)? Were random effects tested for significance using a likelihood ratio test?		✓		
E. Provide a table summarizing the construction of the GLM components.				✓
F. Summarize model statistics of the mixed model formulation(s) (e.g. log likelihood, AIC, BIC etc.)				✓
G. Report convergence statistics.		✓		

MODEL DIAGNOSTICS

Comment: Other model structures are possible and acceptable. Please provide appropriate diagnostics to the CPUE indices working group.

1. Binomial Component

Item	Not Applicable	Absent	Incomplete	Complete	Working Group Comments:
A. Include plots of the chi-square residuals by factor.		✓			
B. Include plots of predicted and observed proportion of positive trips by year and factor (e.g. year*area)		✓			
C. Report overdispersion parameter and other fit statistics (e.g. chi-square / degrees of freedom).				✓	

2. Lognormal/Gamma Component

Item	Not Applicable	Absent	Incomplete	Complete	Working Group Comments:
A. Include histogram of log(CPUE) or a histogram of the residuals of the model on CPUE. Overlay the expected distribution.				✓	
B. Include plots describing error distribution (e.g. Studentized residuals vs. linear predictor.				✓	
C. Include QQ-plot – (e.g. Student deviance residuals vs. theoretical quantiles), Overlay expected distribution.				✓	
D. Include diagnostic plot for variance function (e.g. square root of std residuals vs. fitted values). Overlay expected distribution.		✓			
E. Include diagnostic plot for link function (e.g. linear response variable vs. linear predictor). Overlay expected distribution.		✓			
F. Include plots of the residuals by factor			✓		

3. Poisson Component

Item	Not Applicable	Absent	Incomplete	Complete	Working Group Comments:
A. Report overdispersion parameter and other fit statistics (e.g. chi-square / degrees of freedom).	✓				
B. Include plots describing error distribution (e.g. Studentized residuals vs. linear predictor.	✓				
C. Include QQ-plot – (e.g. Student deviance residuals vs. theoretical quantiles), Overlay expected distribution.	✓				
D. Include diagnostic plot for variance function (e.g. square root of std residuals vs. fitted values). Overlay expected distribution.	✓				
E. Include diagnostic plot for link function (e.g. linear response variable vs. linear predictor). Overlay expected distribution.	✓				***The feasibility of this diagnostic is still under review.***

4. Zero-inflated model

Item	Not Applicable	Absent	Incomplete	Complete	Working Group Comments:
A. Include ROC curve to quantify goodness of fit.	✓				
B. Include plots describing error distribution (e.g. Studentized residuals vs. linear predictor).	✓				
C. Include QQ-plot (e.g. Student dev. residuals vs. theoretical quantiles), Overlay expected distribution.	✓				

MODEL DIAGNOSTICS (CONT.)

	Not Applicable	Absent	Incomplete	Complete	Working Group Comments:

D. Include diagnostic plot for variance function (e.g. square root of std residuals vs. fitted values). Overlay expected distribution.	✓			
E. Include diagnostic plot for link function (e.g. linear response variable vs. linear predictor). Overlay expected distribution.	✓			

MODEL RESULTS

A. Tables of Nominal CPUE, Standardized CPUE, Observations, Positive Observations, Proportion Positive Observations and Coefficients of Variation (CVs). Other statistics may also be appropriate to report				✓
B. Figure of Nominal and Standardized Indices with measure of variance (i.e. CVs).			✓	

IF MULTIPLE MODEL STRUCTURES WERE CONSIDERED:

(***Note: this is always recommended but required when model diagnostics are poor***.)

1. Plot of resulting indices and estimates of variance	✓			
2. Table of model statistics (e.g. AIC criteria)	✓			

	Date Received	*Workshop Recommendation*	*Revision Deadline* ***	*Author and Rapporteur Signatures*
First Submission	3/15/10	Accept with revisions		
Revision	4/12/10 (Addendum)	Accept		

The revision deadline is negotiated by the author, the SEDAR coordinator and the CPUE rapporteur. The author ***DOES NOT*** *commit to any* ***LEGAL OBLIGATION*** *by agreeing to submit a manuscript before this deadline. The maximum penalty for failure to submit a revised document prior to the submission deadline is rejection of the CPUE series.*

Justification of Working Group Recommendation

Revisions described in Section 1.3.2.2

SEDAR

Southeast Data, Assessment, and Review

SEDAR 22

Gulf of Mexico Tilefish

SECTION III: Assessment Process Report

January 2011

NOTE: Modifications to the model results reported in this report were made during the Review Workshop held 14-17 February 2011. For complete results reflecting those changes, please see the Addendum of this Stock Assessment Report (Section VI).

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

Table of Contents

1. WORKSHOP PROCEEDINGS

1.1. INTRODUCTION

1.1.1 Workshop time and Place

The SEDAR 22 Assessment Process was held via a series of webinars between May and November 2010.

1.1.2 Terms of Reference

1. Review any changes in data following the data workshop and any analyses suggested by the data workshop. Summarize data as used in each assessment model. Provide justification for any deviations from Data Workshop recommendations.
2. Develop population assessment models that are compatible with available data and recommend which model and configuration is deemed most reliable or useful for providing advice. Document all input data, assumptions, and equations.
3. Provide estimates of stock population parameters (fishing mortality, abundance, biomass, selectivity, stock-recruitment relationship, etc); include appropriate and representative measures of precision for parameter estimates.
4. Characterize uncertainty in the assessment and estimated values, considering components such as input data, modeling approach, and model configuration. Provide appropriate measures of model performance, reliability, and 'goodness of fit'.
5. Provide yield-per-recruit, spawner-per-recruit, and stock-recruitment evaluations, including figures and tables of complete parameters.
6. Provide estimates for SFA criteria consistent with applicable FMPs, proposed FMPs and Amendments, other ongoing or proposed management programs, and National Standards. This may include: evaluating existing SFA benchmarks, estimating alternative SFA benchmarks; and recommending proxy values. **In addition, specify OFL, and recommend a range of ABC for review by the SSC in compliance with ACL guidelines.**
7. Provide declarations of stock status relative to SFA benchmarks.
8. Perform a probabilistic analysis of proposed reference points and provide the probability of overfishing at various harvest or exploitation levels.
9. Project future stock conditions (biomass, abundance, and exploitation) and develop rebuilding schedules if warranted; include estimated generation time. Stock projections shall be developed in accordance with the following:
    - A) If stock is overfished:
        - F=0, F=current, F=Fmsy, Ftarget (OY),
        - F=Frebuild (max that rebuild in allowed time)
    - B) If stock is overfishing
        - F=Fcurrent, F=Fmsy, F= Ftarget (OY)
    - C) If stock is neither overfished nor overfishing
        - F=Fcurrent, F=Fmsy, F=Ftarget (OY)

10. Evaluate the results of past management actions and, if appropriate, probable impacts of current management actions with emphasis on determining progress toward stated management goals.
11. Provide recommendations for future research and data collection (field and assessment); be as specific as practicable in describing sampling design and sampling intensity and emphasize items which will improve future assessment capabilities and reliability.
12. Prepare an accessible, documented, labeled, and formatted spreadsheet containing all model parameter estimates and all relevant population information resulting from model estimates and any projection and simulation exercises. Include all data included in assessment report tables and all data that support assessment workshop figures.
13. Complete the Assessment Workshop Report (Section III of the SEDAR Stock Assessment Report).

1.1.3. List of Participants

SEDAR 22: Gulf of Mexico Yellowedge Grouper and Tilefish

SEDAR 22 ASSESSMENT WEBINARS ATTENDANCE REPORT

x = present

First	Last	Web1 13-May	Web2 1-Jul	Web3 21-Jul	Web4 12-Aug	Web4 cont 13-Aug	Web5 23-Aug	Web6 1-Sep	Web7 4-Oct	Web8 3-Nov	Web9 12-Jan-11
PANELISTS											
Brian	Linton	x	x	x	x	x	x	x	x	x	x
John	Walter	x	x	x	x	x	x	x	x	x	x
John	Quinlan	x		x	x		x		x		
Linda	Lombardi	x	x	x	x	x	x	x	x	x	x
Harry	Blanchet	x	x	x	x		x	x	x		x
Shannon	Cass-Calay		x	x	x	x	x	x	x	x	x
Richard	Fulford		x	x	x	x	x			x	
Joe	Powers										
Will	Patterson	x	x	x				x	x		x
Robert	Allman	x	x	x			x	x			
Irby	Basco										
Bob	Spaeth										
Martin	Fischer										
TJ	Tate										
Neil	Baertein										
COUNCIL REPRESENTATION											
Bob	Shipp				x		x			x	
STAFF											
Julie	Neer	x	x	x	x	x	x	x	x	x	x
Carrie	Simmons		x	x	x	x	x	x	x		

John	Froeschke	x									x
Kari	Fenske				x						
John	Carmichael				x						
OBSERVERS											
Clay	Porch	x					x	x			
Nancy	Cummings	x	x	x				x			
Nick	Farmer				x	x	x	x	x	x	x
Rich	Malinowski							X			x
Todd	Gedamke		x								x

1.1.4. List of Assessment Process Working and Reference Papers

Documents Prepared for the Assessment Workshop		
SEDAR22-AW-01	United States Commercial Longline Vessel Standardized Catch Rates of Golden and Blueline Tilefish in the Gulf of Mexico, 1992-2009: Revised	Kevin McCarthy
SEDAR22-AW-02	United States Commercial Longline Vessel Standardized Catch Rates of Yellowedge Grouper (*Epinephelus flavolimbatus*) for Three Regions in the Gulf of Mexico, 1991-2009	Neil Baertlein and Kevin McCarthy
SEDAR22-AP-03	Pre-review draft of the tilefish assessment report (23 Nov 2010)	SEDAR 22 Assessment Panel
SEDAR22-AP-04	Pre-review draft of the yellowedge grouper assessment report (23 Nov 2010)	SEDAR 22 Assessment Panel
Reference Documents		
SEDAR22-RD10	Comparison of Two Techniques for Estimating Tilefish, Yellowedge Grouper, and Other Deepwater Fish Populations	Matlock, Gary C., Walter R. Nelson, Robert S. Jones, Albert W. Green, Terry J. Cody, Elmer Gutherz, and Jeff Doerzbacher
SEDAR22-RD11	Deep-water sinkholes and biotherms of South Florida and the Pourtales Terrace – Habitat and Fauna	John K. Reed, Shirley A. Pomponi, Doug Weaver, Charles K. Paull, and Amy E. Wright
SEDAR22-RD12	Tilefishes of the genus *Caulolatilus* construct burrows in the sea floor	K.W. Able, D.C. Twichell, C.B. Grimes, and R.S. Jones
SEDAR22-RD13	Spawning Locations for Atlantic Reef Fishes off the Southeastern U.S.	GEORGE R. SEDBERRY, O. PASHUK, D.M. WYANSKI, J.A. STEPHEN, and P. WEINBACH
SEDAR22-RD14	Trends in tilefish distribution and relative abundance off South Carolina and Georgia	Charles A. Barnes and Bruce W. Stender
SEDAR22-RD15	Age, growth, and reproductive biology	Patrick J. Harris, David M.

	of blueline tilefish along the Southeastern coast of the United States, 1982-1999	Wyanski, and Paulette T. Powers Mikell
SEDAR22-RD16	Temporal and spatial variation in habitat characteristics of tilefish (Lopholatilus chamaeleonticeps) off the east coast of Florida	Kenneth W. Able, Churchill B. Grimes, Robert S. Jones and David C. Twichell
SEDAR22-RD17	The Complex Life History of Tilefish *Lopholatilus chamaeleonticeps* and Vulnerability to Exploitation	Churchill B. Grimes and Stephen C. Turner
SEDAR22-RD18	The fishery for tilefish, *Lopholatilus chamaeleonticeps*, off South Carolina and Georgia	Bob Low, Glenn Ulrich, and Frank Blum
SEDAR22-RD19	Tilefish off South Carolina and Georgia	R.A. Low, Jr., G.F. Ulrich, and F. Blum
SEDAR22-RD20	Spawner-recruit relationships of demersal marine fishes: Prior distribution of steepness for possible use in SEDAR stock assessments	SEDAR 24−AW−06 - Sustainable Fisheries Branch

1.2. PANEL RECOMMENDATIONS AND COMMENT

1.2.1. Term of Reference 1

Review any changes in data following the data workshop and any analyses suggested by the data workshop. Summarize data as used in each assessment model. Provide justification for any deviations from Data Workshop recommendations.

All changes to the data following the data workshop are reviewed in Section 2. The two primary changes include 1) segregating the data into eastern and western Gulf of Mexico regions, and 2) making the age composition data conditional on length.

1.2.2. Term of Reference 2

Develop population assessment models that are compatible with available data and recommend which model and configuration is deemed most reliable or useful for providing advice. Document all input data, assumptions, and equations.

Two stock assessment models were used for this assessment: 1) stochastic stock reduction analysis (SRA), and 2) stock synthesis (SS). These models and their configurations are described more fully in Sections 3.1.1 and 3.2.1, respectively. Stock synthesis was considered the primary assessment model, since SRA is designed to give only rough estimates of stock trends and status.

1.2.3. Term of Reference 3

Provide estimates of stock population parameters (fishing mortality, abundance, biomass, selectivity, stock-recruitment relationship, etc); include appropriate and representative measures of precision for parameter estimates.

Estimates of assessment model parameters and their associated standard errors are reported in Section 3.1.2 for SRA and Section 3.2.2 for SS.

1.2.4. Term of Reference 4

Characterize uncertainty in the assessment and estimated values, considering components such as input data, modeling approach, and model configuration. Provide appropriate measures of model performance, reliability, and 'goodness of fit'.

Uncertainty in the assessment and estimated values is characterized in Section 3.1.2 for SRA and Section 3.2.2 for SS.

1.2.5. Term of Reference 5

Provide yield-per-recruit, spawner-per-recruit, and stock-recruitment evaluations, including figures and tables of complete parameters.

Yield-per-recruit, spawner-per-recruit, and stock-recruitment evaluations are provided in Section 3.1.2 for SRA and Section 3.2.2 for SS.

1.2.6. Term of Reference 6

Provide estimates for SFA criteria consistent with applicable FMPs, proposed FMPs and Amendments, other ongoing or proposed management programs, and National Standards. This may include: evaluating existing SFA benchmarks, estimating alternative SFA benchmarks; and recommending proxy values. In addition, specify OFL, and recommend a range of ABC for review by the SSC in compliance with ACL guidelines.

Estimates of SFA criteria from SS are provided in Section 3.2.2. For reasons explained in Section 3.2.2, OFL yield streams and recommended ABCs were not produced for this assessment.

1.2.7. Term of Reference 7

Provide declarations of stock status relative to SFA benchmarks.

Stock status relative to SFA benchmarks from SS is reported in Section 3.2.2 and Section 3.1.2 for SRA.

1.2.8. Term of Reference 8

Perform a probabilistic analysis of proposed reference points and provide the probability of overfishing at various harvest or exploitation levels.

For reasons explained in Section 3.2.2, the probability of overfishing at various harvest levels was not estimated for this assessment.

1.2.9. Term of Reference 9

Project future stock conditions (biomass, abundance, and exploitation) and develop rebuilding schedules if warranted; include estimated generation time.

For reasons explained in Section 3.2.2, future stock conditions were not projected for SS. Projections under three different catch scenarios are reported for SRA in Section 3.1.2.

1.2.10. Term of Reference 10

Evaluate the results of past management actions and, if appropriate, probable impacts of current management actions with emphasis on determining progress toward stated management goals.

This is the first benchmark assessment of Gulf of Mexico tilefish, which has the purpose of informing management goals for the stock.

1.2.11. Term of Reference 11

Provide recommendations for future research and data collection (field and assessment); be as specific as practicable in describing sampling design and sampling intensity and emphasize items which will improve future assessment capabilities and reliability.

Recommendations for future research and data collection were made in the SEDAR 22 Data Workshop report. Additional recommendations are made in Section 3.4.

2. DATA REVIEW AND UPDATE

2.1. LANDINGS

2.1.1. Commercial Landings

Commercial landings data used in the assessment are presented in Table 2.1 and Figure 2.1. Final commercial landings were computed following the data workshop (DW), but a full description of the landings and how they were calculated is given in the SEDAR 22 Data Workshop Report.

Prytherch (1983) identified three fishing grounds in the Gulf of Mexico. The regions consisted of the southeastern Gulf (statistical grids 1-5), northeastern Gulf (statistical grids 6-12), and western Gulf (statistical grids 13-21). Initially, commercial landings were stratified by these three regions to more accurately capture spatial differences in fishing pressure on tilefish across the Gulf. Due to the reclassification of a large proportion of tilefish landings from statistical grids 3-5 as blueline tilefish landings (see SEDAR 22 Data Workshop Report), commercial tilefish landings from the southeastern Gulf were small relative to landings from the northeastern and western regions. Therefore, the assessment panel (AP) decided to combine landings from the southeastern and northeastern regions into a single eastern Gulf region (statistical grids 1-12).

In the end, commercial landings were stratified by gear type (hand line and long line) and region (eastern and western Gulf of Mexico). This stratification resulted in four commercial fisheries (hand line east, hand line west, long line east, and long line west) that were included in the assessment.

2.1.2. Recreational Landings

The recreational landings data used in the assessment are presented in Table 2.2. Following the DW, recreational landings were stratified by region based on state. The eastern Gulf region included landings from Florida, Alabama, and Mississippi. The western Gulf region included landings from Louisiana and Texas. Recreational landings were small compared to commercial landings (i.e., only 9,060 lbs from 1987-2009). Therefore, the AP decided to combine recreational landings with commercial hand line landings.

2.2. DISCARDS

2.2.1. Commercial Discards

Commercial discards data used in the assessment are presented in Table 2.3. Few commercial trips reported any discards of tilefish (i.e., only 3 hand line trips and 11 long line trips from 2002-2009. Therefore, the AP decided to combine commercial discards with commercial landings. Based on the DW recommendation, discard mortality was assumed to be 100%. Discard numbers were converted to weight using the average weight of a tilefish (5.2 gutted lbs) from Trip Interview Program (TIP) age and growth data. Commercial discards were separated into eastern and western Gulf regions by reported statistical grids.

2.3. LENGTH COMPOSITION

Length composition data used in the assessment are presented in Figures 2.2-2.7 and Appendix A. Lengths are in units of total length in centimeters. Following the DW, length compositions were computed as numbers at length using length data from TIP. Length data were aggregated into 2 cm length bins. Length bins ranged from 20 cm to 114 cm, where the bin size represents the minimum size of the bin (e.g., the 20 cm length bin contains fish greater than or equal to 20 cm and less than 22 cm). Length data were stratified by fishery/survey (commercial hand line, commercial long line, and NMFS bottom long line survey), region (eastern and western Gulf), and gender (female, male, and unknown). Length composition sample sizes were capped at a maximum effective sample size of 200 fish to prevent the length composition data from driving the model fitting process due to large sample sizes.

2.4. AGE COMPOSITION

Age composition data used in the assessment are presented in Figures 2.8-2.13 and Appendix B. Following the DW, age compositions were computed as numbers at age using age data from TIP. Initially, a plus group of age 20 was used for the age data, but preliminary assessment model runs revealed that a significant portion of the spawning biomass was part of the plus group. Therefore, the AP decided to increase the plus group to age 30 to better model the dynamics of the spawning population.

It was observed at the DW that the length frequency distributions of the TIP age samples differed from the length frequency distributions of the TIP length samples, particularly in earlier years when age sample sizes were smaller (see SEDAR 22 Data Workshop Report). As a result, the DW recommended that the age compositions be reweighted by the length samples, so that the length frequency distributions of the age and length samples more closely matched each other.

The AP decided to pursue an alternative approach to dealing with these discrepancies in length frequency distributions. Instead of reweighting the age compositions, the age compositions were made conditional on length. In other words, a separate age composition was specified for each 2 cm length bin containing fish whose ages had been estimated. Using these conditional age compositions has the advantage of linking age data directly to length data. As a result, the length frequency distributions of the age samples are explicitly defined as a subset of the overall length frequency distributions of the length samples, and differences between the two length distributions can be accounted for by the assessment model.

Age data were stratified by fishery/survey (commercial hand line, commercial long line, and NMFS bottom long line survey), region (eastern and western Gulf), and gender (female, male, and unknown). Age composition sample sizes were capped at a maximum effective sample size of 100 fish to prevent the age composition data driving the model fitting process due to large sample sizes.

An age estimation error matrix was developed following the DW to account for errors in the estimation of ages for tilefish (Table 2.4). The matrix includes mean coded ages and their associated standard deviations. The standard deviations came from an analysis of tilefish ages estimated by two independent readers (S22-DW-01). A simple power function:

$$\sigma_{pred} = 1.1746\sigma_{obs}^{0.3318},$$

was used to smooth the observed standard deviations from the age precision analysis.

2.5. INDICES

The standardized indices of relative abundance used in the assessment are presented in Figure 2.14 and Table 2.5. The DW recommended the use of two indices: a fishery-dependent commercial long line index and a fishery-independent NMFS bottom long line survey index (see SEDAR 22 Data Workshop Report). The coefficients of variation (CV) associated with the standardized indices were converted to log-scale standard errors by:

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

for input into the Stock Synthesis assessment model.

Prytherch (1983) identified three fishing grounds in the Gulf of Mexico. The regions consisted of the southeastern Gulf (statistical grids 1-5), northeastern Gulf (statistical grids 6-12), and western Gulf (statistical grids 13-21). Following the DW, region-specific indices were developed for the commercial long line index (S22-AW-01) and NMFS bottom long line survey index (Addendum 2 to S22-DW-07) to more accurately track spatial differences in tilefish abundance across the Gulf. Both the commercial long line index and NMFS bottom long line survey index from the southeastern region had small sample sizes and high variances compared to the indices from the northeastern and western regions. Therefore, the AP decided to combine the southeastern and northeastern regions into a single eastern Gulf region (statistical grids 1-12), and use the commercial long line index and NMFS bottom long line survey index from the northeastern region to represent abundance in the eastern region.

2.6. LIFE HISTORY

Life history data used in the assessment included natural mortality, growth, sex ratio, maturity, fecundity, and sex transition rates. Stock Synthesis uses the life history quantities as initial parameter values, rather than as data inputs. Therefore, the life history data are described in the Parameters Estimated section (3.2.1.4) of the report.

2.7. REFERENCES

Prytherch, H.F. (1983). A descriptive survey of the bottom long line fishery in the Gulf of Mexico. NOAA Technical Memorandum NMFS-SEFSC-122. 33p.

2.8. TABLES

Table 2.1. Commercial landings (gutted lbs) for Gulf of Mexico tilefish. Landings are separated into four fisheries: commercial hand line east (CM HL E), commercial hand line west (CM HL W), commercial long line east (CM LL E), and commercial long line west (CM LL W).

Year	CM HL E	CM HL W	CM LL E	CM LL W
1965	6,226	0	0	0
1966	1,789	0	0	0
1967	962	0	0	0
1968	1,316	0	0	0
1969	280	0	0	0
1971	2,936	0	0	0
1972	986	0	0	0
1973	3,567	0	0	0
1974	3,755	0	0	0
1975	13,235	0	0	0
1976	21,995	0	0	0
1977	32,500	0	0	0
1978	21,090	536	0	0
1979	26,187	0	5,108	1,058
1980	17,163	0	6,161	1,611
1981	115,753	0	80,306	24,919
1982	54,406	0	123,761	91,512
1983	12,732	469	123,702	71,188
1984	11,722	1,882	164,303	91,749
1985	8,933	10,981	81,961	146,854
1986	43,415	8,783	131,873	112,927
1987	68,123	17,721	153,011	240,647
1988	79,095	42,236	230,902	496,145
1989	36,400	56,729	91,733	221,046
1990	59,551	3,023	111,799	143,322
1991	16,494	22,008	106,531	46,243
1992	11,976	13,180	85,586	78,776
1993	13,956	6,515	135,052	98,482
1994	11,214	1,465	238,069	96,025
1995	2,085	7,166	147,563	266,117
1996	1,297	2,641	108,004	76,068
1997	2,321	517	257,008	41,280
1998	1,209	1,444	200,473	62,185
1999	5,569	3,925	195,822	128,980
2000	3,785	4,931	240,861	178,492

2001	14,315	264	301,424	116,424
2002	8,633	1,420	220,305	252,624
2003	3,087	1,938	210,431	142,111
2004	2,741	561	253,256	160,661
2005	3,593	3,826	305,560	212,898
2006	5,230	175	220,861	51,604
2007	931	1,851	260,255	21,568
2008	121	292	258,967	51,863
2009	1,193	72	313,480	52,061

Table 2.2. Recreational landings (gutted lbs) for Gulf of Mexico tilefish. Landings are separated into eastern (Rec E) and western (Rec W) Gulf of Mexico regions.

Year	Rec E	Rec W
1987	291	0
1988	0	0
1989	0	0
1990	3,523	0
1991	0	0
1992	0	2
1993	0	0
1994	0	0
1995	2	0
1996	0	0
1997	0	0
1998	0	5
1999	0	0
2000	0	0
2001	0	1
2002	0	0
2003	0	0
2004	0	0
2005	4,197	0
2006	0	0
2007	0	0
2008	0	68
2009	0	0

Table 2.3. Commercial discards in numbers for Gulf of Mexico tilefish. Discards are separated by gear type: commercial hand line (CM HL) and commercial long line (CM LL). Due to confidentiality restrictions, discard numbers are combined across all years.

<table>
<tr><th>Year</th><th>CM HL</th><th>CM LL</th></tr>
<tr><td>2002</td><td rowspan="8">981</td><td rowspan="8">3,509</td></tr>
<tr><td>2003</td></tr>
<tr><td>2004</td></tr>
<tr><td>2005</td></tr>
<tr><td>2006</td></tr>
<tr><td>2007</td></tr>
<tr><td>2008</td></tr>
<tr><td>2009</td></tr>
</table>

Table 2.4. Age estimation error matrix for Gulf of Mexico tilefish.

Mean Age`	0.5	1.5	2.5	3.5	4.5	5.5	6.5	7.5	8.5	9.5	10.5	11.5	12.5	13.5	14.5	15.5
SD of Age`	0.01	0.27	0.96	1.37	1.65	1.88	2.06	2.21	2.35	2.46	2.57	2.66	2.75	2.83	2.9	2.97

Mean Age`	16.5	17.5	18.5	19.5	20.5	21.5	22.5	23.5	24.5	25.5	26.5	27.5	28.5	29.5	30.5
SD of Age`	3.04	3.1	3.16	3.21	3.26	3.31	3.36	3.4	3.44	3.48	3.52	3.56	3.6	3.63	3.67

Table 2.5. Standardized indices of relative abundance and associated log-scale standard errors for Gulf of Mexico tilefish. The indices are from the commercial long line east (CM LL E), commercial long line west (CM LL W), NMFS bottom long line survey east (NMFS BLL E), and NMFS bottom long line survey west (NMFS BLL W).

	CM LL E		CM LL W		NMFS BLL E		NMFS BLL W	
Year	Std CPUE	log SE	Std CPUE	log SE	Std CPUE	log SE	Std CPUE	log SE
1992	0.3887	0.50	0.3516	0.35	-	-	-	-
1993	0.4976	0.48	0.4825	0.27	-	-	-	-
1994	0.9339	0.38	0.5812	0.24	-	-	-	-
1995	1.0734	0.38	0.8402	0.20	-	-	-	-
1996	0.6793	0.38	1.5196	0.24	-	-	-	-
1997	0.8870	0.36	1.3002	0.28	-	-	-	-
1998	1.9493	0.37	0.6337	0.29	-	-	-	-
1999	1.8209	0.37	0.9104	0.21	-	-	-	-
2000	0.8802	0.37	0.8896	0.23	-	-	0.1376	0.75
2001	0.6851	0.37	1.0779	0.25	0.2763	0.64	0.6665	0.44
2002	0.7215	0.36	1.6720	0.25	0.8807	0.55	0.9706	0.50
2003	0.5691	0.35	0.6342	0.23	0.4633	0.68	0.5745	0.58
2004	0.6519	0.37	1.0384	0.32	1.2356	0.53	0.6290	0.61
2005	0.7694	0.38	2.0646	0.31	-	-	-	-
2006	1.2016	0.39	0.6881	0.37	1.3556	0.45	1.1367	0.52
2007	1.3385	0.37	1.4041	0.57	1.7985	0.45	2.1940	0.45
2008	1.5484	0.39	0.9117	0.34	1.1253	0.54	1.2444	0.52
2009	1.4041	0.39	-	-	1.2279	0.53	1.8551	0.42

2.9. FIGURES

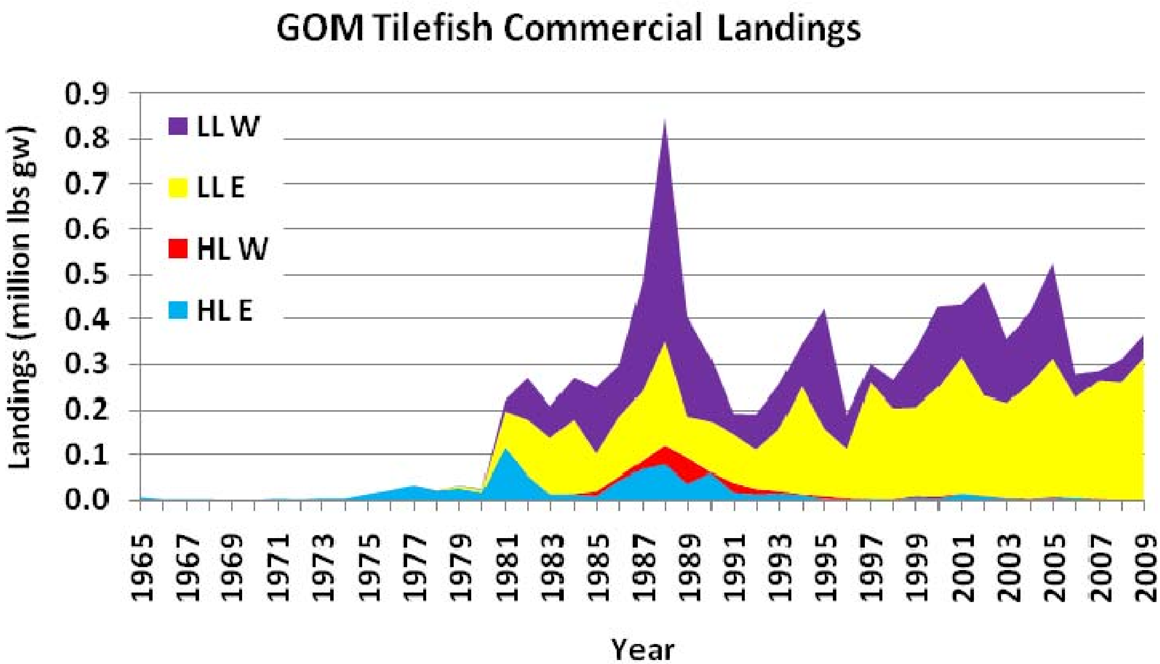


Figure 2.1. Commercial landings (million gutted lbs) for Gulf of Mexico tilefish. Landings are separated into four fisheries: hand line east (HL E), hand line west (HL W), long line east (LL E), and long line west (LL W).

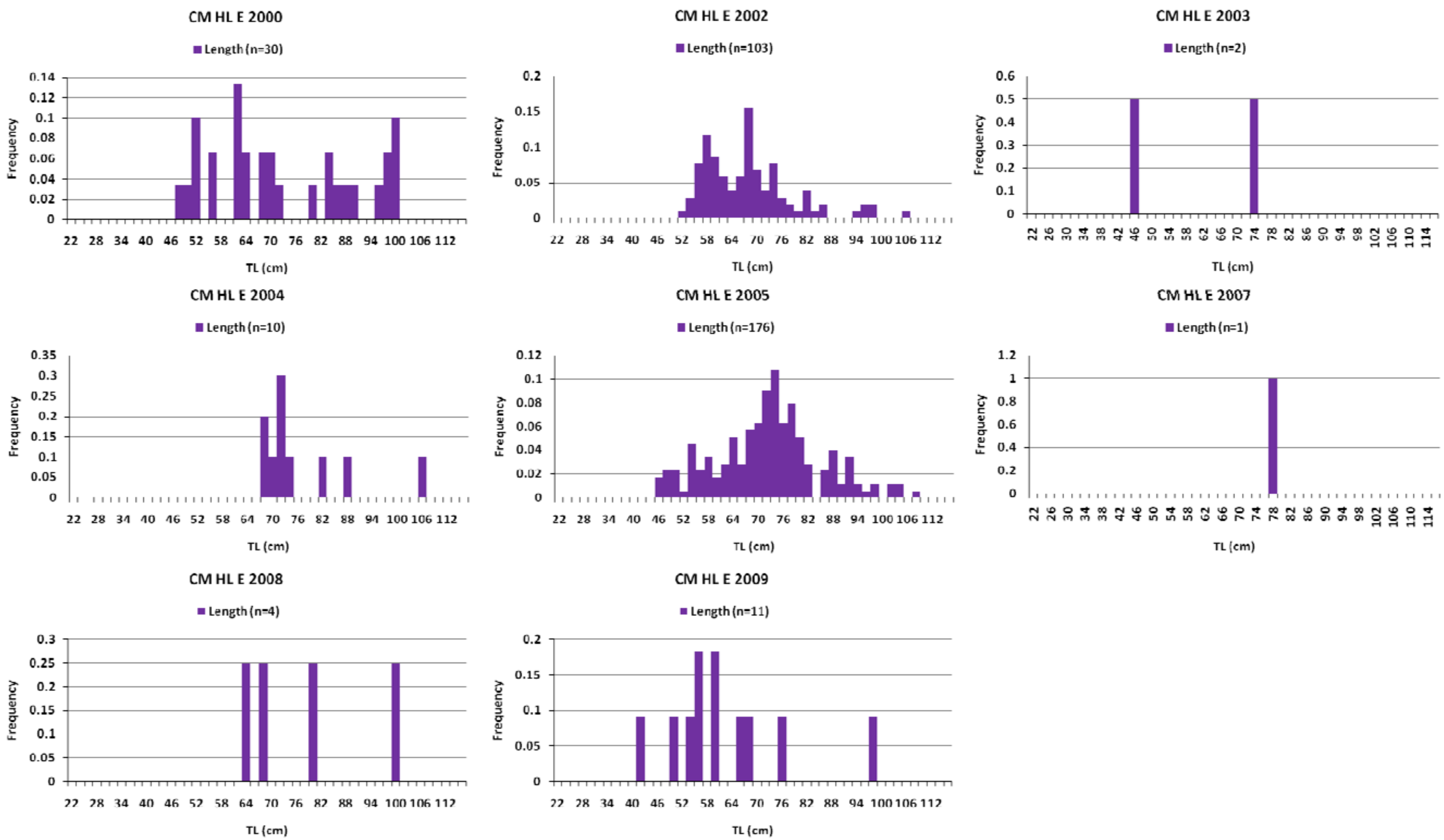


Figure 2.2. Numbers at length for tilefish in the commercial hand line fishery of the eastern Gulf of Mexico (CM HL E). All genders are combined.

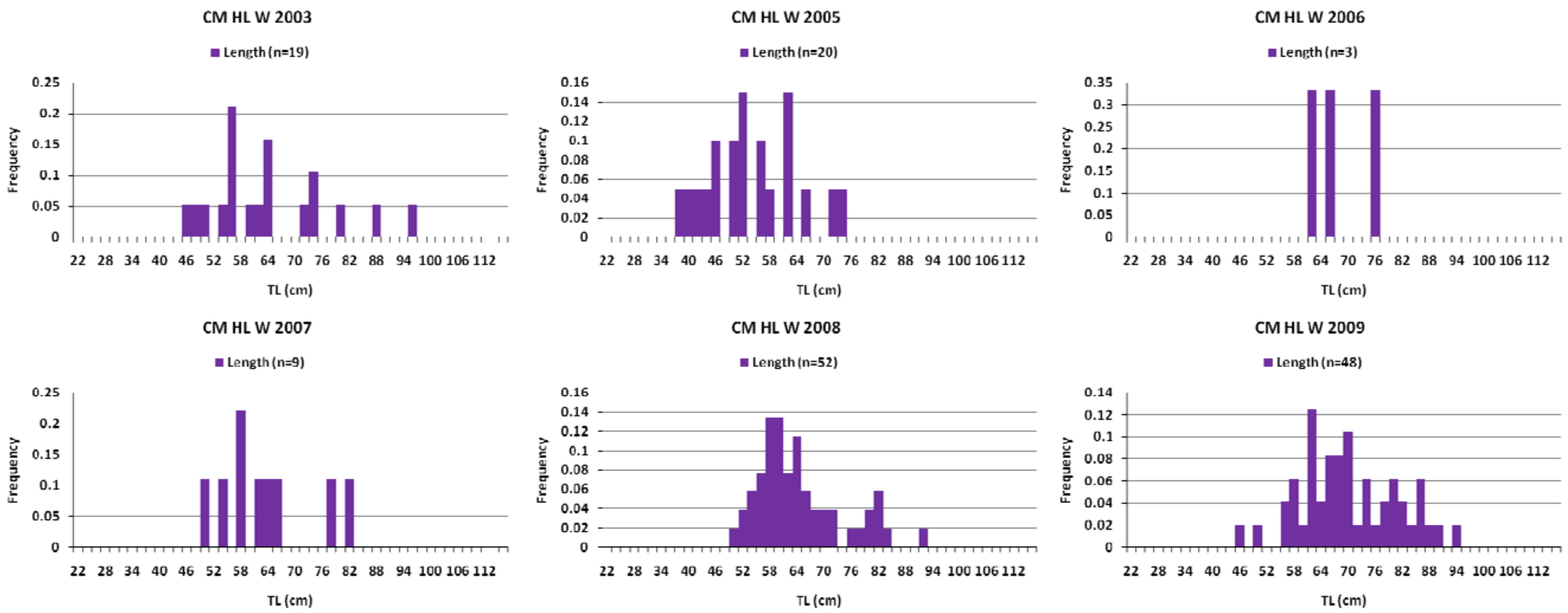


Figure 2.3. Numbers at length for tilefish in the commercial hand line fishery of the western Gulf of Mexico (CM HL W). All genders are combined.

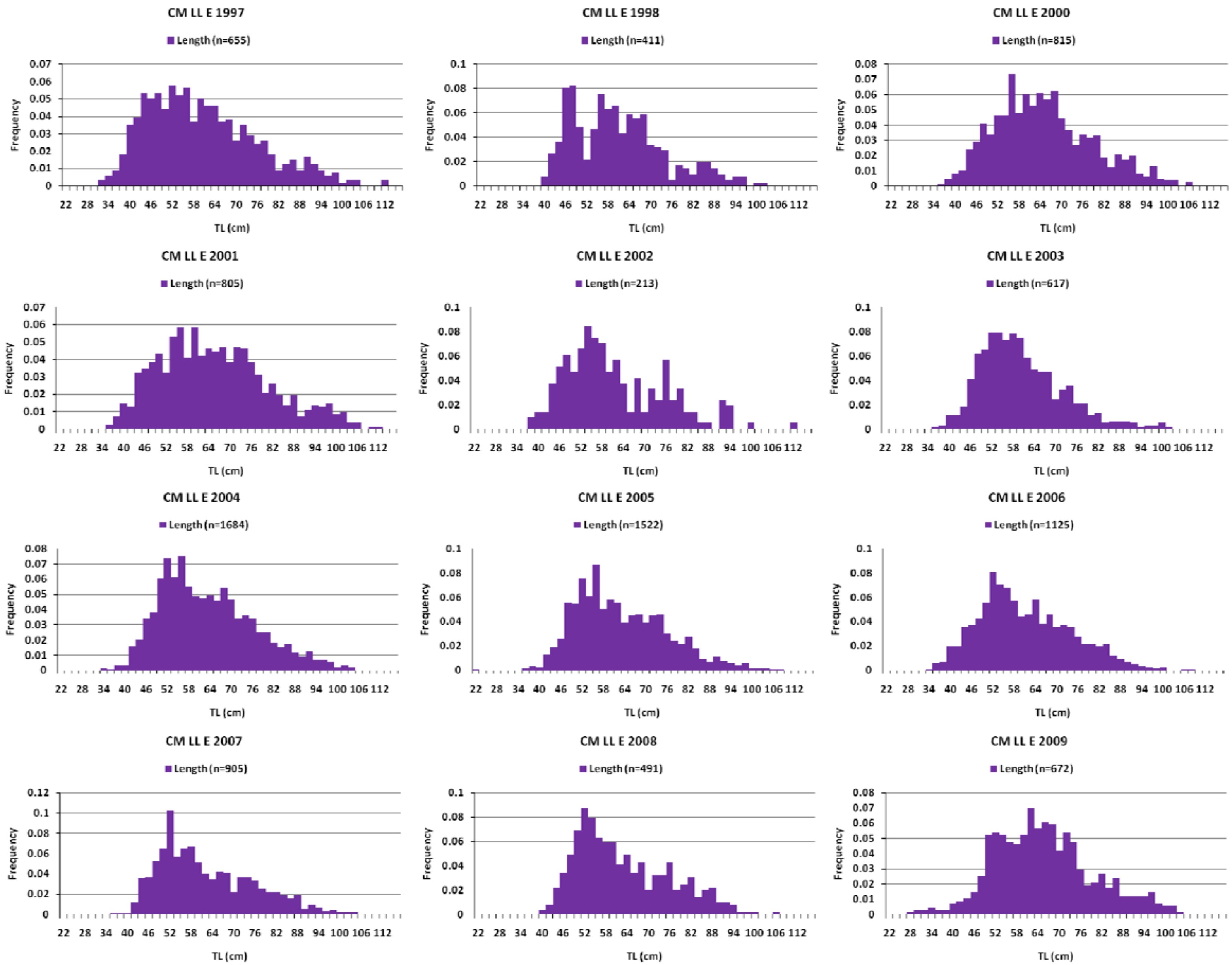


Figure 2.4. Numbers at length for tilefish in the commercial long line fishery of the eastern Gulf of Mexico (CM LL E). All genders are combined.

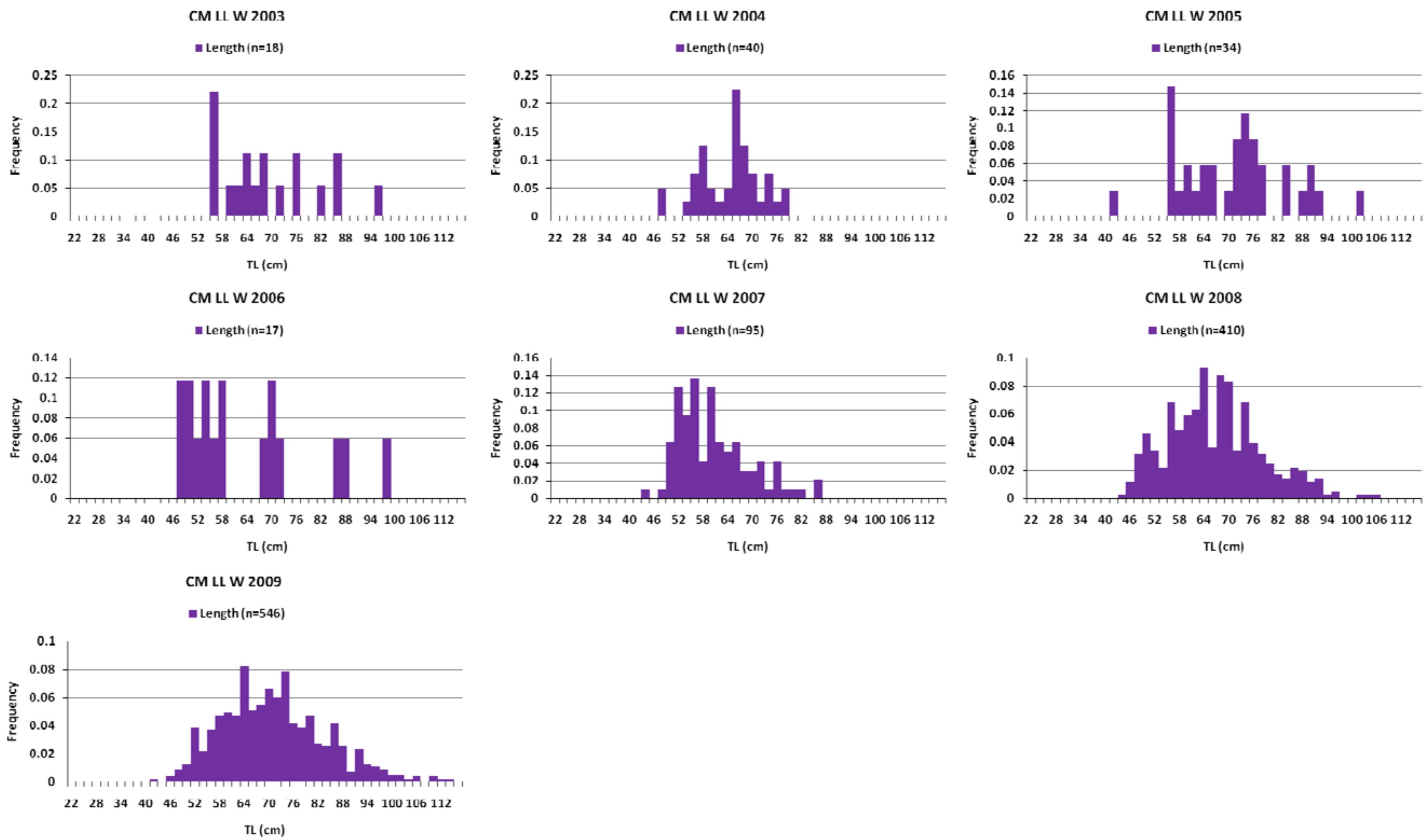


Figure 2.5. Numbers at length for tilefish in the commercial long line fishery of the western Gulf of Mexico (CM LLW). All genders are combined.

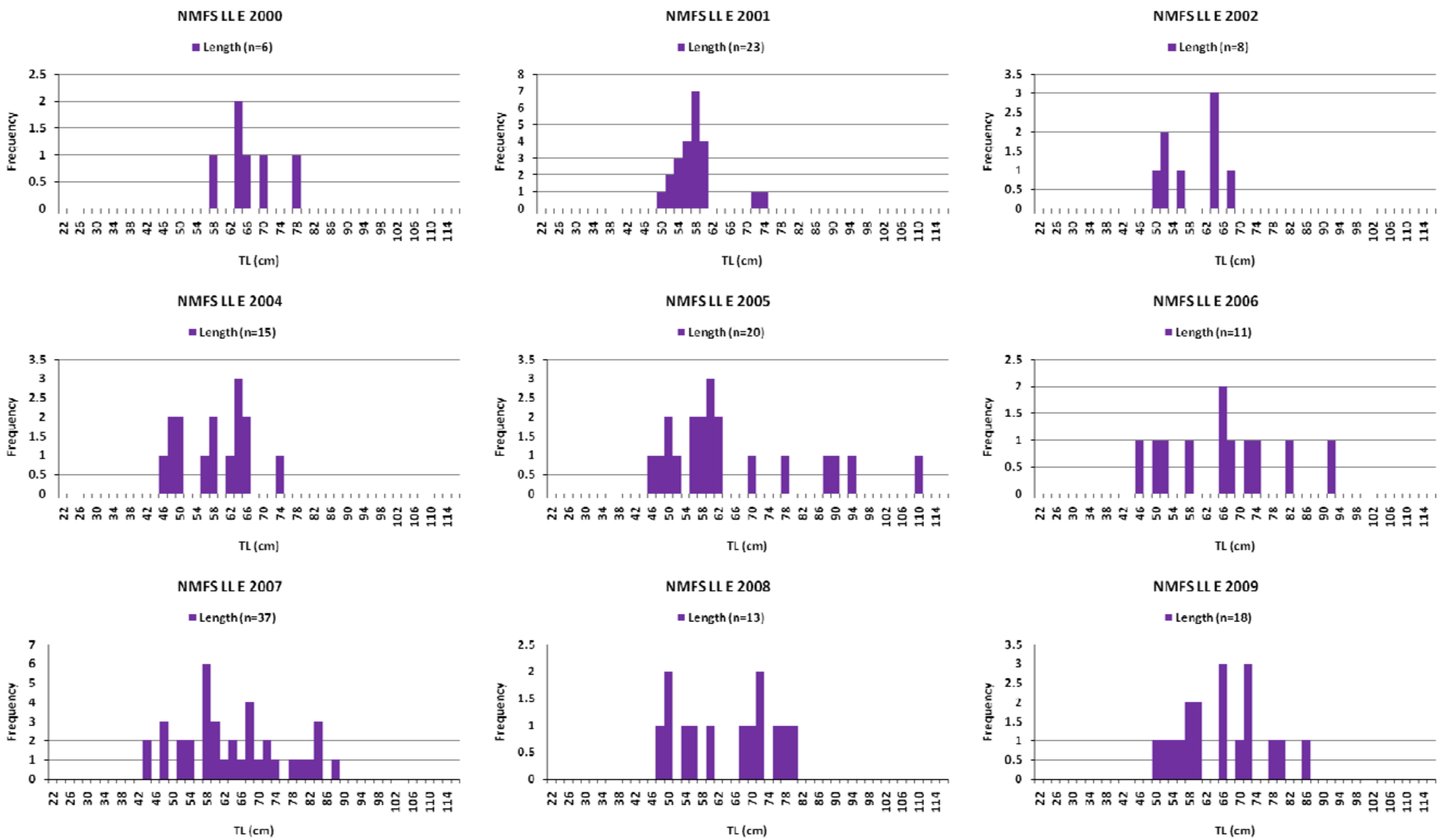


Figure 2.6. Numbers at length for tilefish in the NMFS bottom long line survey of the eastern Gulf of Mexico (NMFS LL E). All genders are combined.

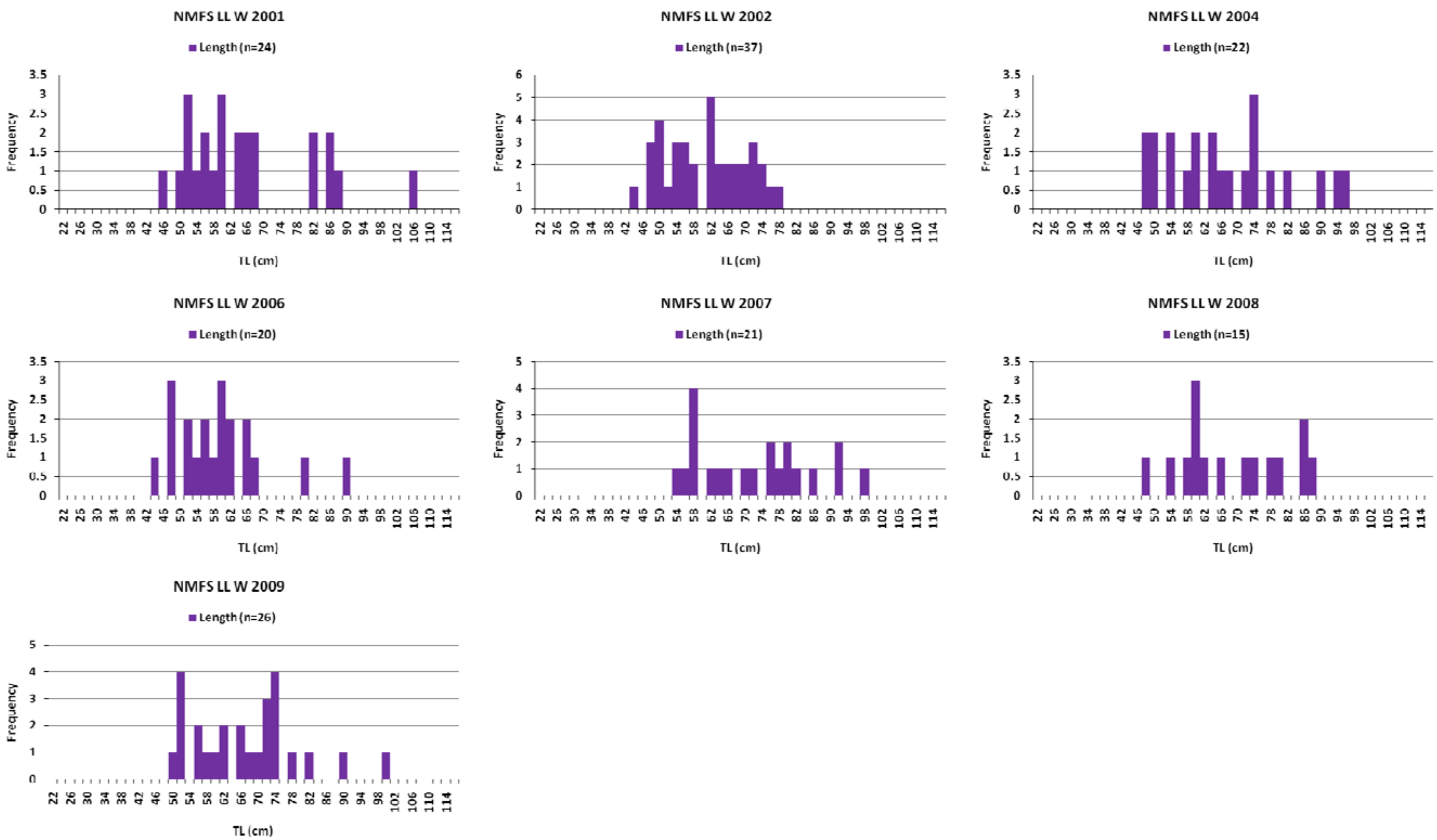


Figure 2.7. Numbers at length for tilefish in the NMFS bottom long line survey of the western Gulf of Mexico (NMFS LL W). All genders are combined.

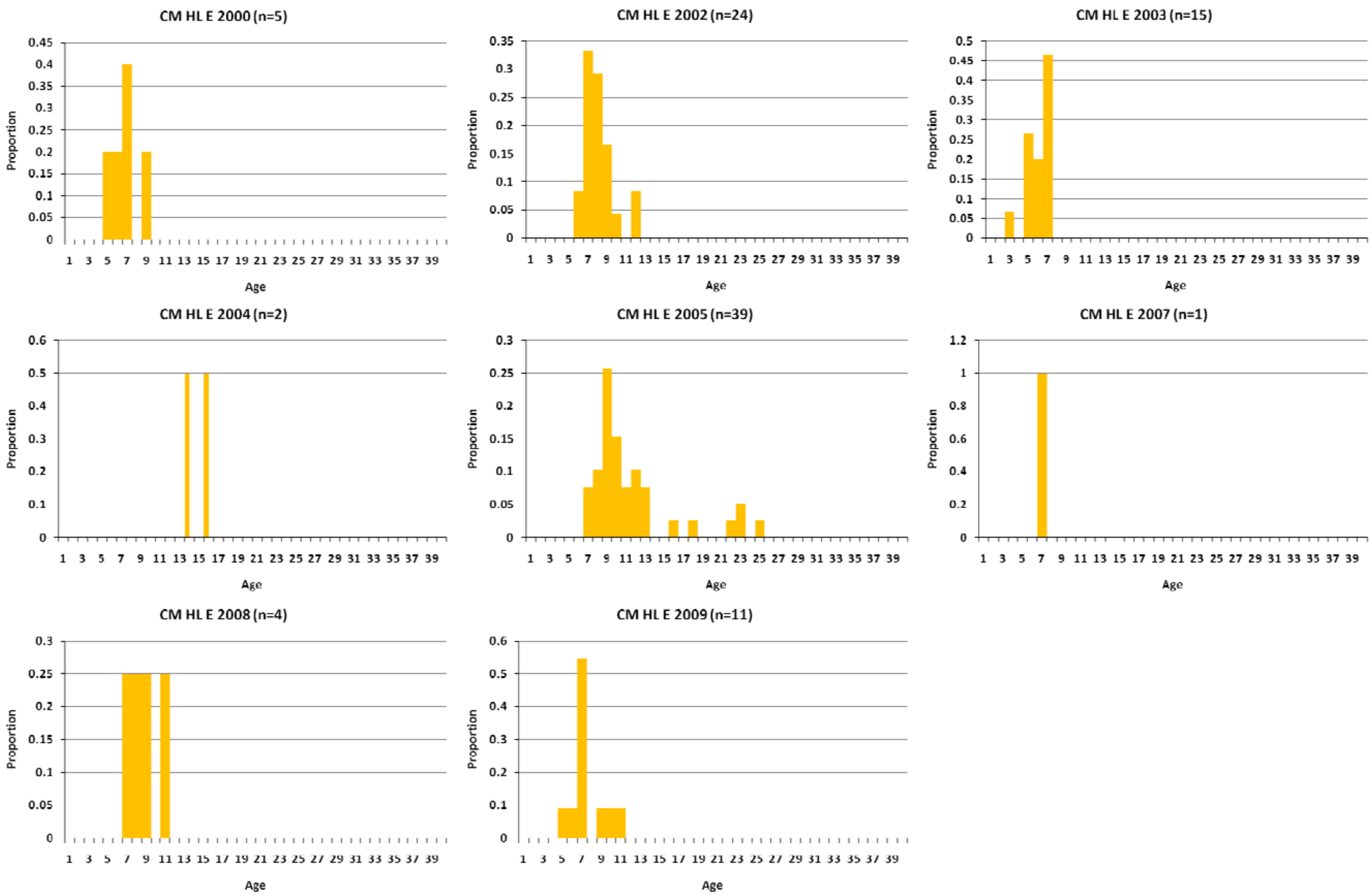


Figure 2.8. Proportions at age for tilefish in the commercial hand line fishery of the eastern Gulf of Mexico (CM HL E). All genders and lengths are combined.

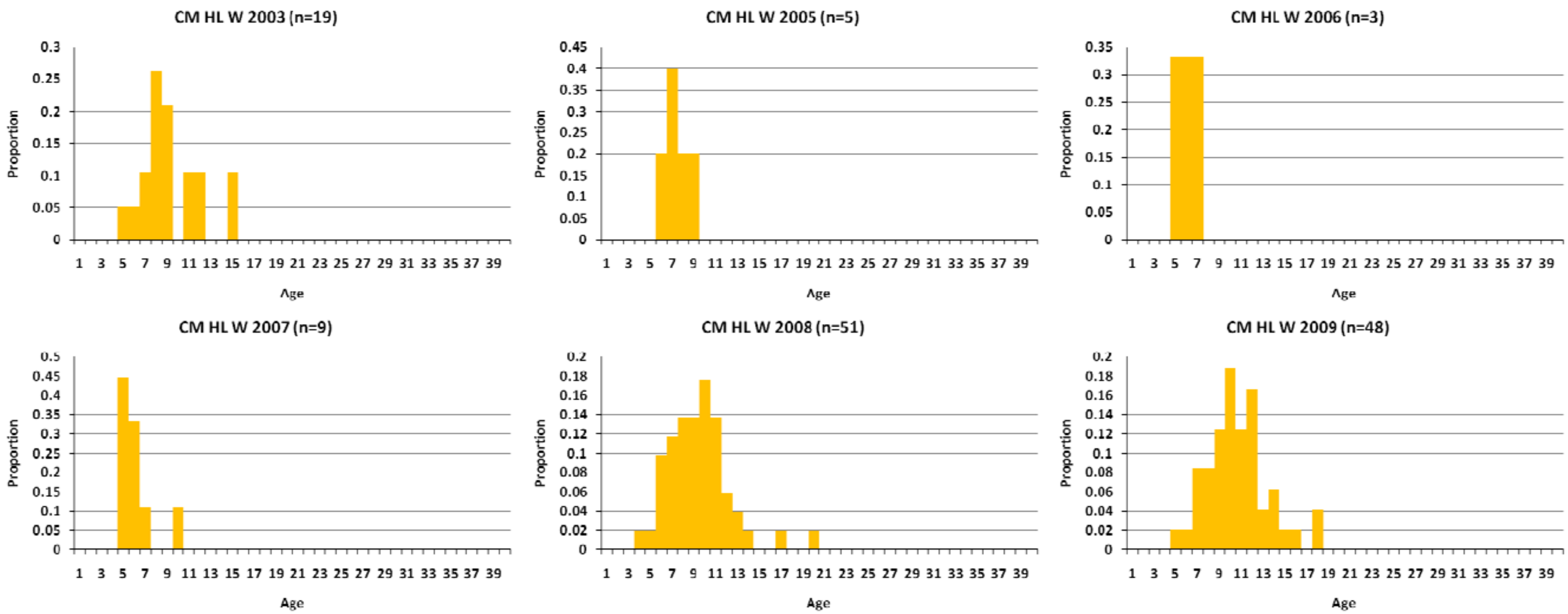


Figure 2.9. Proportions at age for tilefish in the commercial hand line fishery of the western Gulf of Mexico (CM HL W). All genders and lengths are combined.

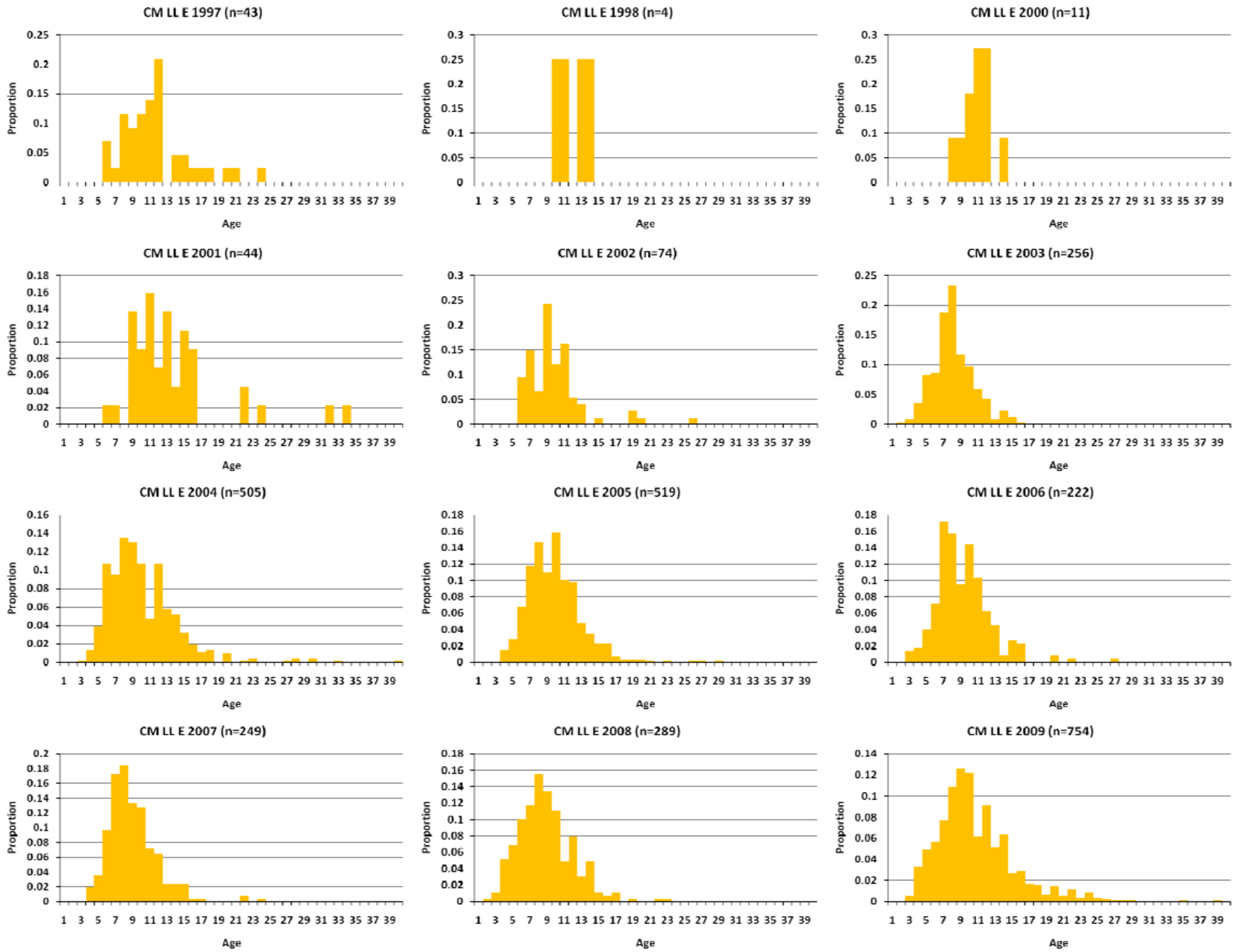


Figure 2.10. Proportions at age for tilefish in the commercial long line fishery of the eastern Gulf of Mexico (CM LL E). All genders and lengths are combined.

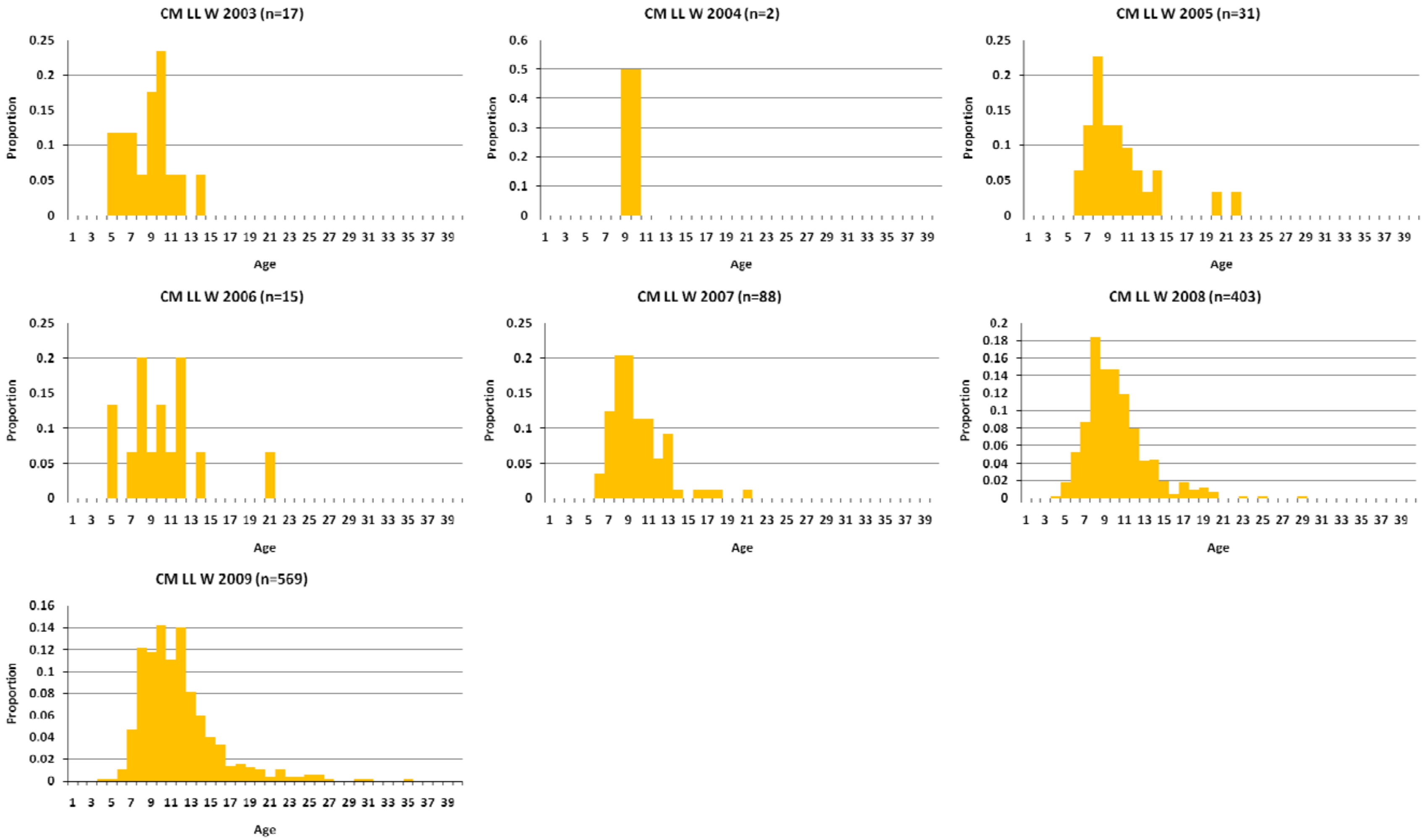


Figure 2.11. Proportions at age for tilefish in the commercial long line fishery of the western Gulf of Mexico (CM LL W). All genders and lengths are combined.

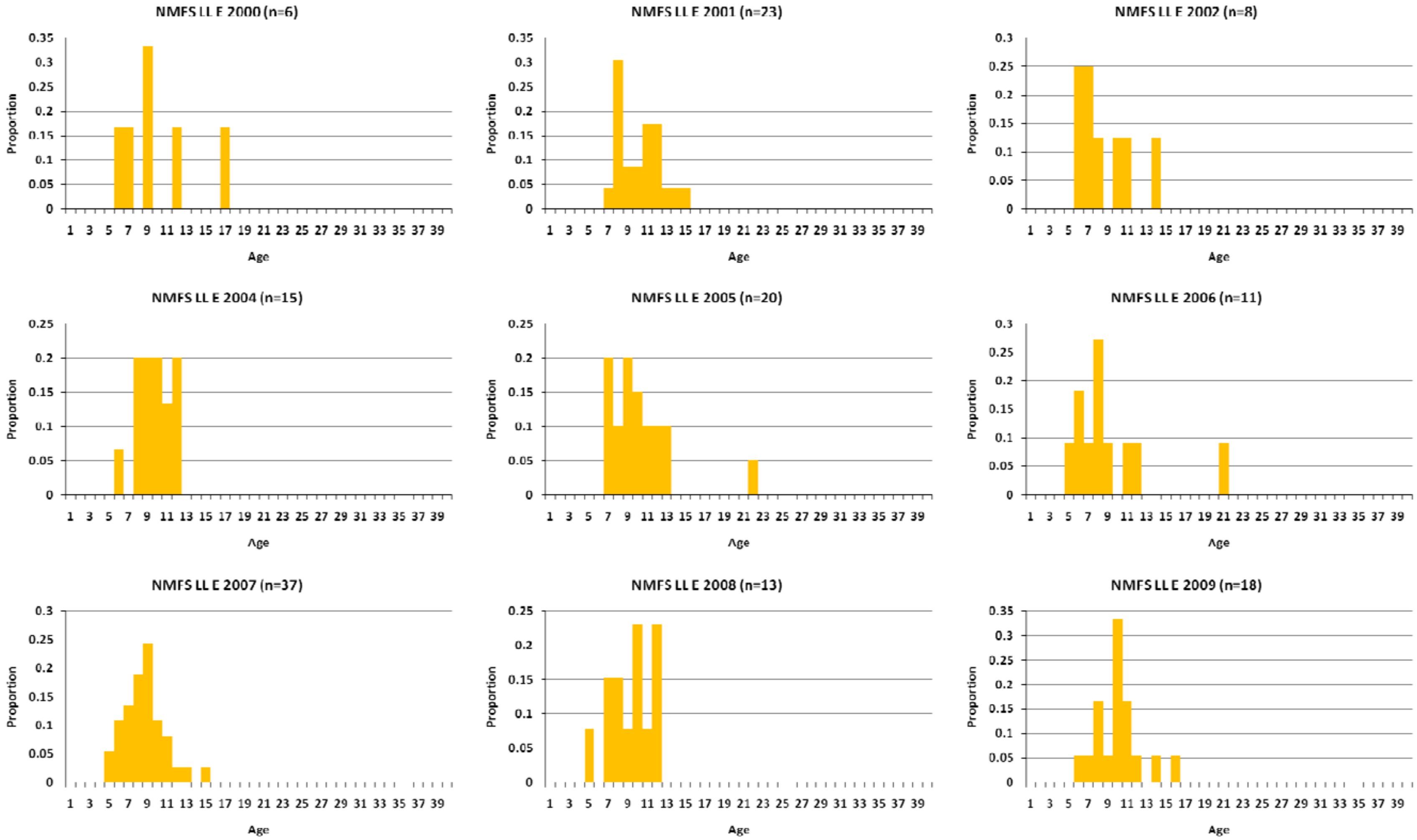


Figure 2.12. Proportions at age for tilefish in the NMFS bottom long line survey of the eastern Gulf of Mexico (NMFS LL E). All genders and lengths are combined.

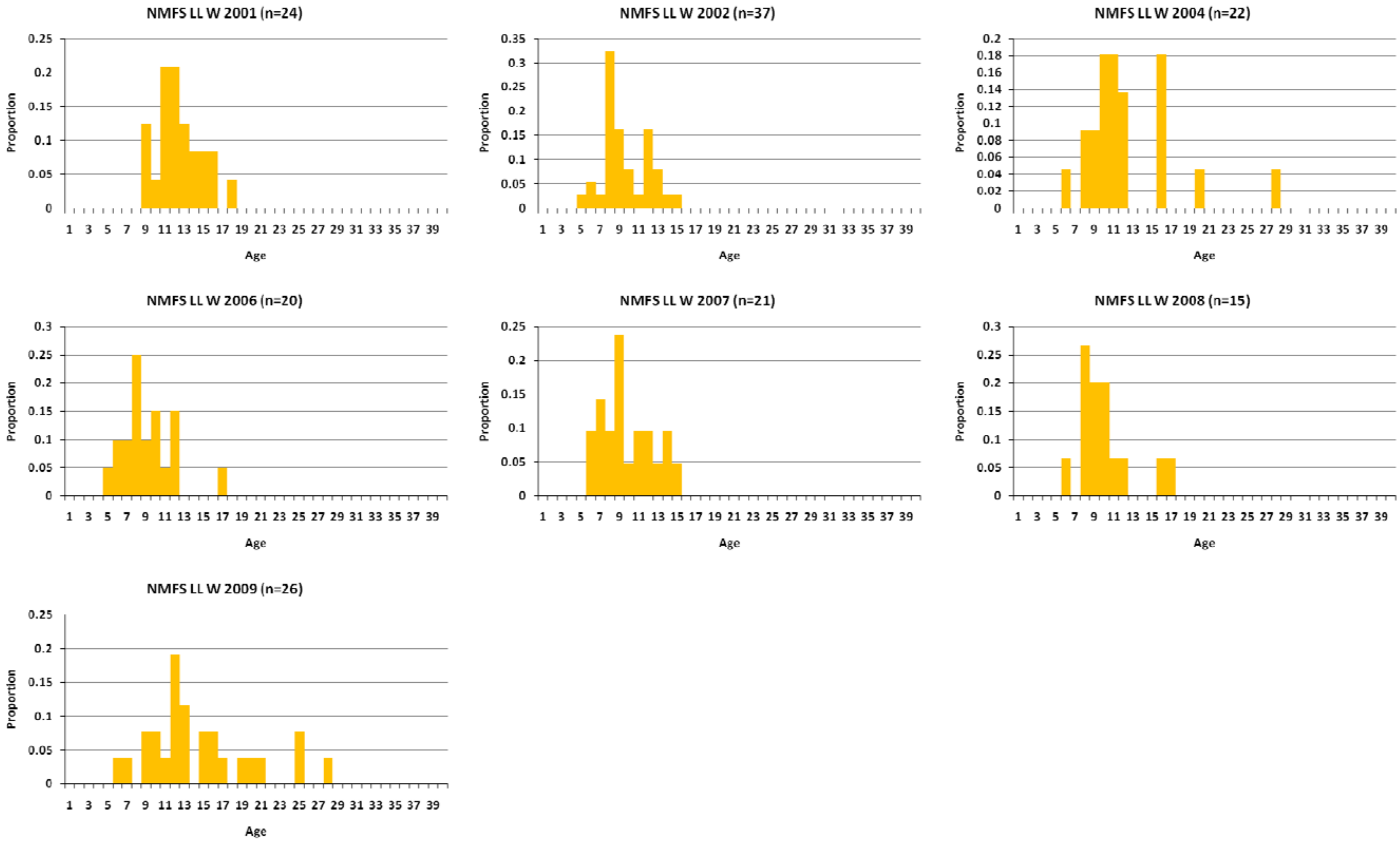


Figure 2.13. Proportions at age for tilefish in the NMFS bottom long line survey of the western Gulf of Mexico (NMFS LL W). All genders and lengths are combined.

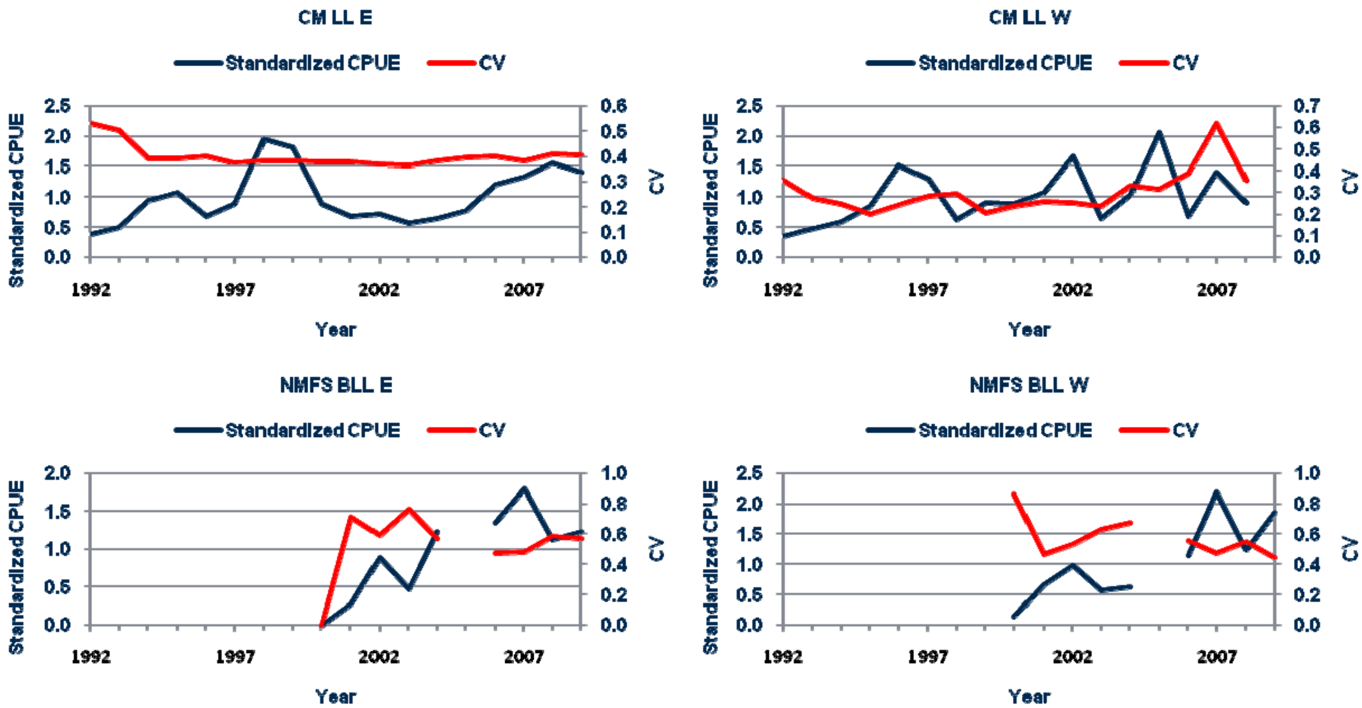


Figure 2.14. Standardized indices of relative abundance and associated coefficients of variation for Gulf of Mexico tilefish. The indices are from the commercial long line east (CM LL E), commercial long line west (CM LL W), NMFS bottom long line survey east (NMFS BLL E), and NMFS bottom long line survey west (NMFS BLL W).

3. STOCK ASSESSMENT MODELS AND RESULTS

3.1. MODEL 1: STOCHASTIC STOCK REDUCTION ANALYSIS

3.1.1. Model 1 Methods

3.1.1.1. Overview

Stochastic stock reduction analysis (SRA) was applied to golden tilefish (*Lopholatilus chamaeleonticeps*) from the Gulf of Mexico. Stochastic SRA (Walters et al. 2006) is a deterministic age structured population model with Beverton-Holt stock-recruitment function that estimates forward in time. SRA uses maximum sustainable yield (MSY) and exploitation at MSY (Umsy) as leading parameters, and given these parameters the model simulates changes in biomass by subtracting estimates of morality and adding recruits. A single trajectory of biomass over time is produced, as well as, estimates of MSY, Umsy, Ucurrent, Goodyear's Compensation

Ratio (recK), and stock status. SRA is a less data-intensive method which can help to determine how large the stock needed to be to have produced the time series of observed landings. SRA should not be a replacement for more computational complex assessment models (such as stock synthesis, referred to as SS) but used more as a tool to make possible conclusions of stock status based on historical catches and recent abundances. SRA has been applied to several Gulf of Mexico species including red snapper (*Lutjanus campechanus*, SEDAR 2005), gag (*Mycteroperca microlepis*, SEDAR 2006a), and red grouper *(Epinephelus morio*, SEDAR 2006b).

3.1.1.2. Data Sources

Stochastic SRA inputs were obtained through SEDAR 22 Data Workshop documents:

Document Reference	Parameter(s)
S22_tilefish_DW_Final.pdf, Chapter 2 Life History	Growth parameters Natural mortality Length at Maturity Weight at 100 cm
S22_tilefish_DW_Final.pdf, Chapter 3 Commercial Statistics	Catch histories
S22_tilefish_DW_Final.pdf, Chapter 5 Measures of Population Abundance	Indices of Abundance

3.1.1.3. Model Configuration and Equations

Stochastic SRA (Walters et al. 2006) is an age structured population model with Beverton-Holt stock-recruitment function that simulates biomass forward in time from the start of the fishery, with exploitation rates calculated each year from observed catch divided by modeled vulnerable population (sum of vulnerabilities at age multiplied by modeled numbers at age). In Stochastic SRA, recruitment is assumed to have had lognormally distributed annual anomalies (with variance estimated from VPA estimates of recent recruitment variability), and to account for the effects of these a very large number of simulation runs is made with anomaly sequences chosen from normal prior distributions (with or without autocorrelation). The resulting sample of possible historical stock trajectories is sampled using Markov Chain Monte Claro integration (MCMC). Summing frequencies of occurrence of different values of leading population parameter values over this sample amounts to solving the full state space estimation problem for the leading parameters (i.e. find marginal probability distribution for the leading population parameters integrated over the probability distribution of historical state trajectories implied by recruitment process errors and by the likelihood of observed population trend indices).

The stochastic SRA is parameterized by taking Umsy (annual exploitation rate producing MSY at equilibrium) and MSY as leading parameters, then calculating the Beverton-Holt stock-recruit parameters from these parameters and from per-recruit fished and unfished eggs and vulnerable biomasses (Forrest et al. 2008). Under this parameterization, we effectively assume a uniform Bayes prior for Umsy and MSY, rather than a uniform prior for the stock-recruitment parameters. This is an age-structured version of the stock-recruitment parameterization in terms of policy parameters suggested by Schnute and Kronlund (1996).

Natural mortality rate was treated as age-independent, and was sampled for each simulation trial from a uniform prior distribution with M ranging from 0.12-0.16.

Vulnerabilities at age were provided from SS from logistic functions of age selectivities given size selectivities and size-at-age data (SS, Asel2). Fecundity was assumed to be proportional to the differences between age-specific body weight and weight at maturity calculated from inputed parameters.

SRA provides probability distributions of leading parameters (Umsy, MSY) and other population parameters (vulnerable biomass, catch, exploitation), as well as the probabilities of the population being overfished and undergoing overfishing based on the ratios of current biomass/biomass at MSY and the ratios of current exploitation/exploitation at MSY. Each of these parameters is reported with a level of uncertainty determined through MCMC resampling.

3.1.1.4. Uncertainty and Measures of Precision

Stochastic SRA uses a Monte Carlo approach, as well as Bayesian and likelihood approaches for estimating leading parameters.

3.1.1.5. Benchmark / Reference points methods

Stochastic SRA estimates the probability of being overfished as the proportion of MCMC runs for which the ratio of Biomass current/Biomass MSY is less than 1.0 and the probability of overfishing as the proportion of MCMC runs for which the ratio of Exploitation current/Exploitation MSY is greater than 1.

3.1.1.6. Projection methods

Future vulnerable biomass was projected for three scenarios of future landings given the amount of fish landed. The three scenarios were 1) keep landings the current level given the regulations established in 2004 (400,000 gutted lbs), 2) decrease future landings by half (200,000 gutted lbs), or 3) double future landings (800,000 gutted lbs). Stochastic SRA obtains probability distributions for future stock status using Markov Chain Monte Carlo methods.

3.1.2 Model I Results

Stochastic SRA model was applied to golden tilefish life history parameters (Table 3.1) and catch history (Table 3.2) by region (East and West of Mississippi River) in the Gulf of Mexico. Vulnerabilities at age were provided from SS from logistic functions of age selectivities given size selectivities and size-at-age data (SS, Asel2) and were the same in both regions (Table 3.3). Commercial longline indices by region were used with varying degrees of uncertainty (index standard error) and the default value for recruitment anomalies was used (1.0)(Table 3.4). An increase in the uncertainty (value of 1.0 for all years) in the commercial longline index for all data and east region SRA model runs was necessary to complete a satisfactory number of model iterations (all data, 2.3×10^6; east, 2.1×10^6). The west region SRA model was manually ceased after several million (4.4×10^6) MCMC iterations.

3.1.2.1. Measures of Overall Model Fit

Stochastic SRA does not provide measures of overall model fit.

3.1.2.2. Parameter estimates & associated measures of uncertainty

Stochastic SRA model provided estimates of population parameters such as vulnerable biomass, maximum sustainable yield, exploitation (current and at maximum sustainable yield), and Goodyear's compensation ratio for each MCMC iteration. Summary statistics were calculated for these parameters given combinations of Umsy and MSY that yielded positive Goodyear's compensation ratio (recK) values.

The eastern region of the Gulf of Mexico yielded a higher carrying capacity of golden tilefish compared to the western region given the historical catches (Figure 3.1, Table 3.5) and the west region was predicted to have the higher historical exploitation (Figure 3.2).

SRA model estimated maximum sustainable yield (MSY) to be higher in the east region with central tendency of MSY at 264,000 gutted lbs compared to only 127,100 gutted lbs in the west (Figure 3.3).

Exploitation at MSY was predicted higher in the western region (0.18 ± 0.04 and 0.30 ± 0.05, east and west respectively) (Figure 3.4).

The central tendencies of current exploitation (Ucurrent 0.08 ± 0.02 and 0.07 ± 0.02, east and west respectively) were similar between the regions.

The eastern region has a larger sample distribution of MSY values given a wider distribution of MSY and smaller distribution of Umsy values as the west (Figure 3.5). Given the sample distribution of MSY and Umsy, in the eastern region there is a high probability that recent catches have been at or above MSY and in the western region there is a high probability that recent catches have been at MSY.

The west was predicted to have a higher Goodyear's compensation ratio (East, recK = 31.01; West, recK = 43.39).

3.1.2.3. Stock Abundance and Recruitment

Stochastic SRA does not provide measures of stock abundance.

Recruitment for golden tilefish from each region was modeled using the default value of 0.5 for the standard deviation of recruitment without autocorrelation. Normally distributed recruitment anomalies were predicted for each region, with both regions having similar recruitment anomalies throughout the time series (Figure 3.6).

3.1.2.4. Stock Biomass (total and spawning stock)

Stochastic SRA does not provide measures of spawning stock biomass. Total egg production was calculated as a proxy for stock biomass.

3.1.2.5. Fishery Selectivity

Stochastic SRA does not provide measures of fishery selectivity.

3.1.2.6. Fishing Mortality

Stochastic SRA does not provide measures of fishing mortality.

3.1.2.7. Stock-Recruitment Parameters

Stochastic SRA does provide measures of Goodyear's Compensation Ratio (recK) which is comparable to the steepness of the stock-recruitment curve. The west was predicted to have a higher Goodyear's compensation ratio (East, recK = 31.01; West, recK = 43.39), these recK values are analogous to steepness values of 0.89 and 0.92, respectively.

3.1.2.8. Evaluation of Uncertainty

Stochastic SRA does not provide other evaluations of uncertainty than those presented in 3.1.2.2.

3.1.2.9. Benchmarks / Reference Points / ABC values

The default benchmark for overfishing and overfished status in the SRA program employs the Pacific Fisheries Management Council 40:10 rule and is not directly comparable to the benchmarks employed by the Gulf of Mexico Fisheries Management Council. However, the model employed here provided vectors of total biomass in the current year, spawning stock biomass in the current year, and spawning stock biomass at maximum sustainable yield for each MCMC iteration. The probability of being overfished shown in the figures and calculated here comes from the number of MCMC iterations in which the ratio of SSBcurrent/SSBmsy is less than 1.0 and the probability of overfishing comes from the number of MCMC runs in which the ratio of Ucurrent/Umsy is greater than 1.0. Under this rule, SRA results predict that golden tilefish in the Gulf of Mexico likely are not experiencing overfishing (prob. overfishing: east 1.6%, west 0%) and are not overfished (prob. overfished: east 0%, west 4%) (Figure 3.7).

3.1.2.10. Projections

Three future landings scenarios were compiled for Gulf of Mexico golden tilefish (Figure 3.8). Two scenarios (a) future landings remain at 400,000 gutted lbs and (b) future landings decreased by half (200,000 gutted lbs) predicted that the vulnerable biomass of golden tilefish would return to virgin conditions, doubling landings (800,000 gutted lbs) resulted in the vulnerable biomass reaching unrecoverable low levels.

3.1.3. References

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3.2. MODEL 2: STOCK SYNTHESIS

3.2.1. Model 2 Methods

3.2.1.1. Overview

Stock Synthesis (SS) is an integrated statistical catch-at-age model which is widely used for stock assessments in the United States and throughout the world. SS takes relatively unprocessed input data and incorporates many of the important processes (mortality, selectivity, growth, etc) that operate in conjunction to produce observed catch, size and age composition and CPUE indices. In addition, SS can incorporate time series of environmental data. Because many of these inputs are correlated, the concept behind SS is that they should be modeled together, which helps to ensure that uncertainties in the input data are properly accounted for in the assessment. SS has the ability to incorporate an early, data poor time period for which only catch data are available and a more recent, data-rich time period for which indices and length and age observations are available.

3.2.1.2. Data Sources

The landings, discards, length composition, age composition, and indices of abundance used in SS are described in Section 2.

3.2.1.3. Model Configuration and Equations

The primary assessment model selected for the Gulf of Mexico tilefish assessment was Stock Synthesis (Methot 2010) version 3.10g. Stock Synthesis has been widely used and tested for assessment evaluations, particularly in the US west coast NMFS centers (Methot 2010). Descriptions of SS algorithms and options are available in the SS user's manual (Methot 2010) and at the NOAA Fisheries Toolbox website (http://nft.nefsc.noaa.gov/).

Two regions were specified for tilefish: 1) eastern Gulf and 2) western Gulf. These regions were partitioned to allow SS to account for spatial differences in fishing pressure on tilefish across the Gulf. Since adult tilefish live in burrows, it was assumed that they do not move great distance. Therefore, there was no movement of tilefish specified between regions.

Two growth patterns were specified for tilefish: 1) eastern Gulf and 2) western Gulf; as well as two genders: 1) female and 2) male. The AP decided to include separate growth patterns for the eastern and western Gulf, because there was evidence that growth differed between the two regions (Figures 3.9 and 3.10), with the east having a higher L_{inf} (878 vs. 773 mm TL) and lower K (0.11 vs. 0.17) than the west. Based on these specifications, four growth curves were estimated in SS: 1) eastern females, 2) western females, 3) eastern males, and 4) western males.

A single Beverton-Holt stock-recruitment function was estimated in SS. A Ricker stock-recruitment function also can be specified in SS, but the AP found no reason to suspect there was any density-dependent effect on tilefish recruitment. Stock synthesis is hard-coded to model recruits as age 0 fish. The AP decided to include only females in the spawning stock, because males were not thought to be limiting. Maturity was modeled as a logistic function of length. The DW life history group noted a nonlinear relationship between body weight and female gonad weight in tilefish (see SEDAR 22 Data Workshop Report). Therefore, fecundity (represented by female gonad weight) was modeled as a power function of body weight. Annual deviations from the stock-recruit function were estimated in SS as a vector of deviations forced to sum to zero. Stock synthesis assumes a lognormal error structure for recruitment. Therefore, expected recruitments were bias adjusted. Methot (2010) recommends that the full bias adjustment only be applied to data-rich years in the assessment. Therefore, no bias adjustment was applied from 1965 to 1983, when only catch data are available. The bias adjustment then followed a linear ramp from 1984, when the length composition data begins, to full bias adjustment in 1997, when age composition data also becomes available. No bias adjustment is applied to the last three years (2007-2009), because the age composition data contains little information on recruitments for those years. The proportion of female recruits was set at 0.57, based on age-specific sex ratio data provided by the DW life history group (see SEDAR 22 Data Workshop Report). Recruits were distributed between the two regions according to a recruitment distribution parameter estimated in SS.

Natural mortality was specified using a Lorenzen M curve. The AP felt that it was more realistic for tilefish to have age-specific natural mortality than to assume constant natural mortality across ages. For the Lorenzen M curve in SS, a parameter describing the natural mortality at a specified reference age is defined. Natural mortality values for the remaining ages are scaled according to the estimated growth curve. Four Lorenzen M curves were specified for tilefish: 1) eastern females, 2) western females, 3) eastern males, and 4) western males. Natural mortality was assumed to be constant over time.

The DW life history group found there was evidence of protogyny in Gulf of Mexico tilefish (see SEDAR 22 Data Workshop Report). Therefore, the AP decided to use the hermaphroditism option in SS for this assessment. Hermaphroditism in SS is implemented by specifying the rate of transition from female to male as a cumulative normal function of age.

Size based selectivity patterns were specified for each fishery and survey in SS. Double normal functions were used to model selectivity, because of the flexibility this functional form provides. The double normal can model dome-shaped selectivity, but it also can model asymptotic selectivity by holding several of the function's parameters at fixed values. Six selectivity patterns were defined in SS: 1) commercial hand line east, 2) commercial hand line west, 3) commercial long line east, 4) commercial long line west, 5) NMFS bottom long line survey east, and 6) NMFS bottom long line survey west. The AP decided to constrain all six selectivity patterns to be asymptotic, because there was no evidence of dome-shaped selectivity. The fisheries cover the entire range of the stock, so there does not appear to be a cryptic biomass of larger tilefish that are not vulnerable to the gear. In addition, the AP decided to mirror selectivity patterns across regions (e.g., the eastern and western commercial hand line fisheries share the same selectivity pattern). This decision was made because it was felt that gear configuration and fisher behavior was similar across the Gulf for each fishery/survey.

The SS input files are presented in Appendices C-D.

3.2.1.4. Parameters Estimated

A list of all model parameters is presented in Table 3.6. The table includes predicted parameter values and their associated standard errors from SS, initial parameter values, minimum and maximum values a parameter could take, and prior densities assigned to parameters. Parameters designated as fixed were held at their initial values. In all, 62 parameters were estimated in the assessment model.

The reference age for all four region and gender-specific Lorenzen M curves was set to age 4. There is no accepted methodology for determining what the reference age should be. Age 4 was chosen, because it allowed the Lorenzen M curve produced by SS to most closely match the Lorenzen M curve produced by the DW life history group using all available data, when the same growth curve was assumed for both Lorenzen M curves. Natural mortality at the reference age was assigned an initial value of 0.137 for all four Lorenzen M curves, because this was the value of M at age 4 from the Lorenzen M curve produced by the DW life history group using all available data. The reference M parameter was fixed at its initial value, because the AP believed the reference M parameter could not be well estimated given the available data. Therefore, differences in the region and gender-specific Lorenzen M curves would be due to differences in growth between the regions and genders.

In preliminary model runs, the parameter for length at age 0 was not well estimated, due to a lack of data for tilefish less than 3 years of age. This led to large differences in length at age 0 between the four region and gender-specific growth curves. These differences in growth translated into large differences in natural mortality at age 0, which the AP felt were unrealistic. Therefore, the AP decided to fix the parameter for length at age 0 for all four region and gender-specific growth curves at 1.4 cm, which was the average length at age 0 across regions and genders when the parameter was estimated in SS. The initial values for L_{inf} and K were taken from the region-specific growth curves (Figure 3.10). These two parameters were then estimated in SS for each region and gender-specific growth curve. The CVs for growth of young and old fish for the region and gender-specific growth curves were calculated outside of SS. The CVs for length at age were calculated using all available length and age data. The CV for young fish was calculated as the average CV of the youngest five age classes for which data were available (ages 2-6). The CV for old fish was calculated as the average CV of the oldest five age classes for which data were available (ages 27-30 and 35). The same CVs were used for all four region and gender-specific growth curves. The CVs were fixed at their initial values, because variance parameters generally are difficult to estimate in an assessment model.

Initial parameter values for the weight-length relationship and maturity schedule were taken from the SEDAR 22 Data Workshop report. The same weight-length relationship was assumed for both males and females. Initial parameter values for the fecundity curve were obtained from the power function mentioned in Section 3.2.1.3. The parameters describing weight-length, maturity, and fecundity were all fixed at their initial values, because no data was available in SS from which to estimate them.

The probability of transition from female to male was modeled as a cumulative normal function of age. The initial values for the transition curve were calculated outside of SS using sex ratio date (i.e., observed proportions of males at age) provided by the DW life history group. An attempt was made to estimate the sex transition parameters in SS, but parameters were poorly estimated due to the sparsity of gender-specific age data. Therefore, the sex transition parameters were fixed at their initial values.

The initial parameter value for virgin recruitment was taken from a study that estimated virgin recruitment of Gulf of Mexico tilefish from habitat data (S22-DW-05). The study estimated virgin recruitment of age 1 fish. Virgin recruitment of age 0 fish was backcalculated assuming a natural mortality of 0.126, which is the average of the natural mortality estimates reported in the SEDAR 22 Data Workshop Report. The initial parameter value for steepness was taken from a meta-analysis of steepness values for demersal marine fish in the South Atlantic and Gulf of Mexico (S24-AW-06). Virgin recruitment and steepness parameters were estimated in SS. Attempts to estimate the recruitment standard deviation parameter in SS resulted in high parameter values (i.e., greater than one), which allowed current total biomass to exceed virgin total biomass. The AP did not believe these biomass estimates to be plausible, given that a tilefish fishery has existed since the 60s. Further exploration revealed that recruitment SDs greater than 0.3 led to this situation where current biomass exceeded virgin levels. Therefore, the AP decided to fix the recruitment SD parameter at a value of 0.15, which is halfway between a maximum plausible value of 0.3 and having a recruitment SD of 0 (i.e., annual recruitments coming directly from the stock-recruit curve).

Initial parameter values for the size selectivity patterns were chosen arbitrarily to produce a reasonably shaped asymptotic curve. The same initial values were used for all of the fisheries/surveys. Four of the selectivity parameters were fixed at their initial values to force an asymptotic selectivity pattern. The remaining two selectivity parameters were estimated in SS.

3.2.1.5. Uncertainty and Measures of Precision

Uncertainty in parameter estimates was quantified by computing asymptotic standard errors for each parameter (Table 3.6). Asymptotic standard errors are calculated by inverting the Hessian matrix (i.e., the matrix of second derivatives) after the model fitting process. Asymptotic standard errors provide a minimum estimate of uncertainty in parameter values.

Uncertainty in data inputs and model configuration was examined through a sensitivity analysis. Fourteen alternative runs are included in this report.

Run 1: The central run off of which the sensitivity runs were based. This run used the model configuration and initial parameter values described in Sections 3.2.1.3 and 3.2.1.4.

Run 2: The age-4 natural mortality parameter was fixed at 0.031, which was the minimum value of natural mortality estimates produced by the DW life history group. The AP felt that this minimum natural mortality value was low, even for a longer lived species like tilefish. Therefore, this run was made solely as a model exploration exercise.

Run 3: The age-4 natural mortality parameter was fixed at 0.087, which was the value from Run 1 (0.137) minus 0.5. The AP felt that the minimum natural mortality value from Run 2 was low, even for a longer lived species like tilefish. Therefore, the AP wanted to see a run with a natural mortality value between those of Run 1 and 2.

Run 4: The age-4 natural mortality parameter was fixed at 0.187, which was the value from Run 1 (0.137) plus 0.5. The AP felt that the maximum natural mortality value from Run 5 (see below) was high for a longer lived species like tilefish. Therefore, the AP wanted to see a run with a natural mortality value between those of Run 1 and 5.

Run 5: The age-4 natural mortality parameter was fixed at 0.242, which was the maximum value of natural mortality estimates produced by the DW life history group. The AP felt that this maximum natural mortality value was high for a longer lived species like tilefish. Therefore, this run was made solely as a model exploration exercise.

Run 6: The reference age for natural mortality was specified as age-15, which was near the midpoint of the age range for the assessment. Since there is no accepted method for selecting the reference age for natural mortality, the AP wanted to see runs exploring alternative reference ages.

Run 7: The reference age for natural mortality was specified as age-25, which was near the upper end of the age range for the assessment. Since there is no accepted method for selecting the reference age for natural mortality, the AP wanted to see runs exploring alternative reference ages.

Run8: The recruitment SD parameter was fixed at a value of 0.01, which effectively constrains annual recruitments to follow the stock-recruit relationship. This value was chosen to represent the lower end of the range of possible recruitment SD values.

Run 9: The recruitment SD parameter was fixed at a value of 0.3. Recruitment SD values greater than 0.3 led to estimates of current total biomass which were greater than virgin total biomass. The AP did not feel these results were plausible given the history of a fishery for tilefish. Therefore, this value was chosen to represent the upper end of the range of possible recruitment SD values.

Run 10: The fixed selectivity parameters were freed up to allow SS to estimate dome-shaped selectivity. The AP included this run solely as a model exploration exercise, since there was no evidence of dome-shaped selectivity. The fisheries cover the entire range of the stock, so there does not appear to be a cryptic biomass of larger tilefish that are not vulnerable to the gear.

Run 11: Separate selectivity patterns were estimated by region for each fishery/survey. The AP wished to determine what affect mirroring selectivity across regions had on model results.

Run 12: The fit to the indices was improved by emphasizing the index data and de-emphasizing the length and age composition data. The AP wished to determine how the signal from the index data would affect model results. This run was included solely as a model exploration exercise.

Run 13: The steepness parameter was fixed at its initial value (0.75) to create a "low" steepness scenario, and to determine how sensitive model results were to the steepness parameter.

Run 14: An alternate landings time series was created using the tilefish landings as originally reported. The AP agreed with the decision of the DW that most of the tilefish landings from statistical grids 3-5 were blueline tilefish landings, but the AP wanted to evaluate model sensitivity to the landings time series. Therefore, this run was made solely as a model exploration exercise.

In addition, a retrospective analysis of Run 1 was conducted, in which the model was refit while sequentially dropping the last five years of data. Retrospective analysis is used to look for systematic bias in key model output quantities over time.

3.2.1.6. Benchmark/Reference points methods

Benchmarks and reference points are calculated in SS. The user can select reference points based on MSY, SPR, and spawning biomass. Stock Synthesis calculates SPR as the equilibrium spawning biomass per recruit that would result from a given year's pattern and intensity of Fs. For SPR-based reference points, SS searches for an F that will produce the specified level of spawning biomass per recruit relative to the unfished value. For spawning biomass-based reference points, SS searches for an F that produces the specified level of spawning biomass relative to the unfished value. Both MSY and spawning biomass-based reference points are dependent on the stock-recruit relationship.

The AP decided to use SPR-based reference points for Gulf of Mexico tilefish, due to uncertainty in the estimation of the stock-recruit relationship. In addition, the AP chose to calculate benchmarks based on two alternative SPR reference points. The first reference point was SPR 30%, which is specified as the default value in the Gulf of Mexico Reef Fish Management Plan. The AP also wanted to use a more conservative reference point given the life history of tilefish. Therefore, the second reference point was SPR 40%.

3.2.1.7. Projection methods

For reasons described in the model results section (3.2.2), the AP decided not to run projections for this assessment using SS.

3.2.2. Model 2 Results

3.2.2.1. Measures of Overall Model Fit

Stock Synthesis effectively treats the landings data as being known without error. Therefore, the landings are fit precisely.

The indices of abundance were poorly fit by the model (Figure 3.11). Observed index CPUEs from all four fisheries/surveys showed an increasing trend in abundance. The commercial long line west index was the only index to capture the observed increasing trend. Predicted CPUE for the NMFS bottom long line west showed no trend in abundance. Predicted CPUE for the commercial long line east and NMFS bottom long line survey east showed declining trends in abundance. This poor fit to the indices is caused in part by the high variances associated with the indices. Even the fishery-dependent indices had relatively high variances associated with them, when normally the fishery-dependent indices have relatively low variances due to the large sample sizes (relative to the fishery-independent indices) involved. The indices in the east also conflicted with the catch data, which showed catches in the east increasing to record levels (Figure 2.1), while the eastern indices indicated that abundance was increasing at the same time. Another possible cause for the problems with the indices is the fact that bottom temperature was not included as a factor in the GLMs used to standardize the indices. Tilefish are known to survive in a very narrow range of temperatures. Anecdotal information from fishermen suggests that tilefish may only take a hook within a narrow temperature range as well. Perhaps inclusion of bottom temperature data as a factor in the GLMs would improve the indices' usefulness in tracking abundance.

The length compositions were not fit particularly well by the model, but there were no real discernable patterns in the residuals (Figures 3.12-3.45). Small sample sizes are probably the cause of the poor fit in most cases. In cases where there were larger sample sizes, primarily in the commercial long line east, the model fit the length compositions reasonably well.

The conditional age compositions were poorly fit by the model (Figure 3.46-3.61), with strong residual patterns in all of the fisheries and surveys. In particular, there appear to be many 10-15 year old fish in the age compositions during the mid 2000s, for which SS is having difficulty accounting. This can be most clearly seen in the commercial long line east age compositions (Figures 3.50-3.52), since the majority of age samples come from this fishery. It is possible this issue is an artifact of where the age samples are collected, rather than some dynamic within the stock. There is evidence that the majority of age samples in the east for 10-15 year old tilefish were collected from statistical grids 2-5 in the early 2000s, and that sampling shifted more towards grids 6-10 in the mid to late 2000s, when large numbers of 10-15 year olds begin to appear (Figure 3.62). There is additional information that during this same time period there was a shift in from which vessels the age samples were collected. This vessel information cannot be presented here due to confidentiality restrictions.

3.2.2.2. Parameter estimates & associated measures of uncertainty

A list of all model parameters is presented in Table 3.6. The table includes predicted parameter values and their associated standard errors from SS, initial parameter values, minimum and maximum values a parameter could take, and prior densities assigned to parameters. Parameters designated as fixed were held at their initial values.

3.2.2.3. Stock Abundance and Recruitment

Predicted abundance at age is presented in Figure 3.63. Mean age of females follows similar trends in the east and west. Females in both regions have a mean age of 6 years in 1965, decline to a mean age of 2 years in 1997, and increase to a mean age of 4 years in the east and 6 years in the west in 2009. Mean age of males follows similar trends in the east and west during the early years of the assessment. Males have a mean age of 12 years in the east and 11 years in the west in 1965, decline to a mean age of 3 years in the east and 2 years in the west in 1997. Mean age of males in the east increases to 6 years in 2005 before declining to 4 years in 2009. Mean age of males in the west increases to 6 years in 2005 and remains at that level through 2009.

Predicted age-0 recruits are presented in Table 3.7 and Figure 3.64. For both the east and the west, there was an unusual pattern to the annual recruitment deviations. Annual recruitments were all less than the mean recruitment from 1965 to 1982 during the data poor period (i.e., only catch data available). Annual recruitments were all greater than the mean recruitment from 1983 to 2001 during the data rich period (i.e., length and age compositions and indices available). Finally, annual recruitments were all less than the mean recruitment from 2002 to 2009, when data quality begins to decline due to incomplete cohorts at the end of the time series. There was an unusually high recruitment peak in 1997, which was largely responsible for supporting the population through the remainder of the time series. Such reliance on sporadic high recruitment events seems out of keeping with the life history of tilefish. Given that tilefish are a relatively long lived and slow growing species, one would suspect the population would be support by a spawning stock of older individuals producing low but constant numbers of recruits each year. It appears that this unusual recruitment pattern is an artifact of the model's attempt to fit the age composition data described above (Section 3.2.2.1). Stock Synthesis estimates high recruitment events in the 1990s to try and account for the large number of 10-15 year old tilefish that appear in the 2000s.

3.2.2.4. Stock Biomass

Predicted total biomass and spawning biomass are presented in Table 3.7 and Figure 3.65. Total biomass and spawning biomass in the east show steady declines beginning in the early 1980s. Total biomass and spawning biomass in the west decline until 1990, increase from 1996 to 2000, and remain relatively constant from 2000 onward. These trends in total and spawning biomass correspond to what is happening in the fisheries (Figure 2.1). The decline in total and spawning biomass in the east corresponds with increasing catches in the eastern fisheries. The constant, or possibly declining, catches in the west correspond to constant or increasing biomass in the west.

3.2.2.5. Fishery Selectivity

Predicted size selectivity patterns are presented in Figure 3.66. As expected, selectivity patterns for the commercial long line fisheries and NMFS bottom long line surveys are fairly similar. Though, the NMFS bottom long line survey is slightly less selective for fish 30-50 cm, and slightly more selective for fish 50-60 cm compared to the commercial long line fisheries. The commercial hand line fishery is less selective for fish 40-70 cm compared to the commercial long line fisheries and NMFS bottom long line surveys.

3.2.2.6. Fishing Mortality

Predicted fishing mortality rates are presented in Table 3.7 and Figure 3.67. Stock Synthesis does produce region and fishery-specific estimates of instantaneous fishing mortality rates. In a multi-area, multi-fishery model, it is impossible to produce an overall instantaneous fishing mortality rate. Therefore, a proxy must be used to get estimates of Gulfwide fishing mortality. The AP decided to use exploitation rate (catch / total biomass) as a proxy for Gulfwide instantaneous fishing mortality. Fishing mortality was relatively low from 1965-1980. From 1981-2009, fishing mortality has steadily increased, with the highest peak in 1988. The trend in Gulfwide fishing mortality is strongly influenced by the commercial long line fishery in the east, where most of the catch occurs.

3.2.2.7. Stock-Recruitment Parameters

The predicted stock-recruitment relationship is presented in Figure 3.68, while the stock-recruitment parameter values are reported in Table 3.6. Predicted virgin recruitment was lower than the initial value (240,000 vs. 850,000 fish) and predicted steepness was higher than the initial value (0.93 vs. 0.75). The AP felt that the predicted steepness seemed unrealistically high given the life history of tilefish. Part of the difficulty in obtaining a good estimate of steepness is the lack of contrast in spawning biomass. In particular, spawning biomass never drops low enough to capture recruitment dynamics near the origin.

3.2.2.8. Evaluation of Uncertainty

Estimates of asymptotic standard errors for all model parameters are presented in Table 3.6.

Results of the retrospective analysis are presented in Figure 3.69. Three model output quantities were examined in the analysis: 1) total biomass, 2) spawning biomass, and 3) recruitment. There was variability in model results as years of data were dropped from the assessment. Total biomass and spawning biomass in the western Gulf were affected in particular. But, there was no strong systematic bias to that variability.

Results of the sensitivity analysis are summarized in Tables 3.8 and 3.9. As expected, decreasing reference natural mortality rate (Runs 2 and 3) led to a less productive stock that was experiencing greater fishing mortality. As expected, increasing the reference natural mortality rate (Runs 4 and 5) led to a more productive stock that was experiencing less fishing mortality. Increasing the value of the natural mortality reference age (Runs 6 and 7) effectively increased natural mortality (i.e., natural mortality increased as the reference age increased) as in Runs 4 and 5. The results from Run 6 are in line with a higher natural mortality, but the results of Run 7 are unusual in that the western spawning biomass (virgin and current) is lower, rather than higher, than spawning biomass in Run 1. This unusual result is due to the growth curve estimated for western females in Run 7 by SS (Figure 3.70). Run 7 western females are smaller than Run 1 western females for the ages between when they become mature and when most of them have transitioned to males. This smaller size at age translates to lower numbers at size and lower spawning biomass, even under virgin conditions. The model was very sensitive to the value specified for recruitment SD (Runs 8 and 9). As recruitment SD was increased, SS would estimate more recruitment peaks, and those peaks would be higher. These recruitment peaks had the biggest impact on western biomass (total and spawning). As recruitment SD increased, the western biomass trajectory would go from declining, to stable, to increasing, to the point that current biomass would exceed virgin levels. Well behaved models generally are not sensitive to the recruitment SD. As long as recruitment SD is set at a reasonable level (e.g., around 0.3-0.6), annual recruitments will fluctuate randomly around the mean recruitment, which is not the case in this assessment. As expected, when selectivity was allowed to be dome-shaped (Run 10), the stock became more productive and impacted less by the fishery due to the biomass of large tilefish that were no longer vulnerable to the fisheries. Estimating region-specific selectivity patterns (Run 11) had little impact on model results. Though selectivity patterns did differ by region, the selectivity pattern for the commercial long line fishery east, which is responsible for the majority of tilefish landings, was very similar between Runs 1 and 11. Improving the fit to the indices (Run 12) had a big impact on model results, particularly for eastern biomass (total and spawning). In all of the other runs, eastern biomass was predicted to be declining. Run 12 is the only run to show an increasing trend in biomass, because SS was forced to fit the increasing abundance trend observed in the eastern indices (Figures 3.71 and 3.72). Fixing steepness at 0.75 (Run 13) had little impact on model results. Using the alternate landings time series (Run 14), which does not reclassify tilefish from statistical grids 3-5 as blueline tilefish, had little impact on model results.

3.2.2.9. Benchmarks/Reference Points/ABC Values

Benchmarks for the SPR 30% reference point are presented in Table 3.10. Benchmarks for the SPR 40% reference point are presented in Table 3.11. The AP decided not to select a single base model for benchmark determination due to the uncertainty involved with specifying quantities such as the reference age for natural mortality, the natural mortality value at the reference age, and the value for the recruitment SD. Therefore, the AP selected a subset of the sensitivity runs for use in benchmark calculations. The sensitivity runs designed solely for exploring model performance, rather than those designed to represent possible states of nature, were not used for benchmark calculations (i.e., Runs 2, 5, 10, 12, and 14). In addition, the AP decided to exclude Run 7 from benchmark calculations due to the unusual growth curve estimated for western females, which was not consistent with growth curves estimated in the other model runs. All of the alternative states of nature model runs, regardless of the reference point used, agreed that the stock was undergoing overfishing but was not overfished. Yield at SPR 30% ranged from 101-209 thousand pounds (gutted weight), and yield at SPR 40% ranged from 98-201 thousand pounds (gutted weight). There are no projected yield streams for OFL and OY to include in the benchmark tables, due to the AP's decision not to conduct projections for this assessment (see Section 3.2.2.10).

3.2.2.10. Projections

The AP decided not to run projections for the tilefish assessment, given the uncertainties involved in specifying key model quantities (e.g., recruitment SD, reference age for M, and reference M) and the issues affecting several of the data sources (e.g., indices of abundance and age compositions). In particular, there is no objective way to select between recruitment SD values, while the choice of recruitment SD can have a profound influence on the assessment results. Selecting a recruitment SD value, that would be considered reasonable in most other assessments, results in biomass trajectories that are not plausible for a stock that has been fished for several decades (i.e., current biomass greater than virgin levels). The difficulty with selecting a recruitment SD value is caused, at least in part, by the age composition data and the affect they have on the estimation of recruitment (see Sections 3.2.2.1 and 3.2.2.3). In general, tilefish is a data poor species that suffers from small sample sizes that are highly correlated with each other, due to being collected from a small number of trips. Instead, the AP recommends that management advice be based off of multiple sources of information such as the suite of SS runs discussed here, the results from SRA, and knowledge of the tilefish fishery in the Gulf of Mexico.

3.2.3. Discussion

Gulf of Mexico tilefish is a data poor species, and suffers many of the problems that make assessments of data poor species so difficult. Data quality is the primary problem with this assessment. This can be seen specifically in the effect of the age composition data on the estimation of recruitment. Unless the recruitment SD parameter is used to constrain the model, current biomass estimates will often exceed virgin levels. The age composition data are not the only problematic data source in this assessment. The indices of abundance, particularly in the east, appear to track abundance trends that conflict with signals from the landings data. For these reasons, the AP has recommended that management advice not be based solely on this assessment, but should take into account other information like expert opinion and knowledge of the tilefish fishery.

3.2.4 References

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3.3. COMPARISON OF MODELS

Stock synthesis and stochastic SRA provide contrast in model complexity (i.e., the number of estimated parameters) and biological realism. While SS may better capture the complex dynamics of the stock than SRA, it does so at a cost of requiring more parameters to be estimated than SRA.

Comparison of SRA and SS results suggests that SRA is most similar to SS Run 12, which emphasized the fits to the indices over the fits to the age and length composition data. Direct comparisons of predicted biomass between SRA and SS are not possible, because SRA produces estimates of vulnerable biomass, while SS produces estimates of total biomass. That being said, trends in predicted vulnerable biomass from SRA are similar to trends in predicted total biomass from SS, particularly in the eastern Gulf of Mexico (Figure 3.73). Predicted exploitation rates are nearly identical between SRA and SS through 1993, and trends in exploitation rate are similar from 1994 to 2009 (Figure 3.74). The similarities between SRA and SS Run 12 can be explained by the fact that SRA is fitting the commercial long line indices and does not include length and age composition data, while SS Run 12 emphasizes the fit to the indices over the fit to the length and age composition data. The commercial long line indices have lower log-scale standard errors than the commercial hand line indices. Therefore, population trends in both SS Run 12 and SRA are driven by the fit to the commercial long line indices. Differences between the two model results can be explained by the fact that SS uses data sources that are not included in SRA. In particular, SRA uses commercial landings and indices from the commercial long line fishery, while SS also includes commercial long line and hand line discards, recreational landings, and length and age composition data from all of the fisheries and surveys. These differences in population trends between the two models begin in the mid 90s, which is the same time period where the additional SS data sources come into play.

As explained previously, SRA's default setting is to produce probabilities of overfishing and of being overfished using a 40/10 rule. When the SRA probability of overfishing is recalculated as the proportion of MCMC runs in which U_{2009}/U_{MSY} is greater than 1.0, then the Gulf-wide probability of overfishing is 1.26%. The SRA probability of overfishing likely would be higher if SPR 30% or SPR 40% were used in place of MSY for determining benchmarks and reference points, as was done in SS. When the SRA probability of being overfished is recalculated as the proportion of MCMC runs in which SSB_{2009}/SSB_{MSY} is less than 1.0, then the Gulf-wide probability of being overfished is 0.11%. Thus, SRA suggests that the stock likely is not undergoing overfishing and is not overfished. This status determination agrees with the stock status predicted by SS Run 12 (Table 3.9). SRA is in disagreement over stock status with the SS runs selected for management advice, which all suggest that the stock is undergoing overfishing, but is not overfished (Tables 3.10 and 3.11).

3.4. RECOMMENDATIONS

In addition to the recommendations made in the SEDAR 22 Data Workshop Report, the AP makes the following recommendations for research and data collection.

- In a fishery with multiple data deficiencies, one of the objects of modeling is to identify those data sets that, by their inadequacy or absence, have a disproportionate impact on the outcome of the assessment. This then provides an independent assessment of the prioritization of future research effort aimed at improving the assessment most effectively. More could probably be made of this in defining immediate future research focus.

- Analyze existing data, or collect and analyze new data to confirm that the tilefish is composed of only a single stock. This could focus on a genetics program aimed at a number of species in the region, as this appears to be a shared problem amongst a number of species.

- Review the information about distribution of tilefish age in time and geographical area with a view to obtain better quality data going forward (i.e. attempts to obtain a balance of samples from the different areas of (i) the fishery and (ii) the wider stock distribution should be developed and implemented).

- Evaluating whether the amount of remaining quota influences how landings are reported by species should be considered.

- While the recreational landings represent a small proportion of the landings it could be worth reviewing the biological data available as recreational fisheries often either target or catch different age or length components of the stock compared to other fisheries. If this is the case then this small part of the fishery may contain useful information about length or age. A basic analysis of length and possibly otolith weight (as a proxy for age) would advise whether this merits further consideration.

3.5. TABLES

Table 3.1. SRA life history parameters for golden tilefish from the Gulf of Mexico

Parameter	Definition	All	East	West
# ages	Number of age classes	30	30	30
Bhat 2009	Biomass in the last year	6.0E+06	6.0E+06	6.0E+06
SD Bhat	Standard Deviation Bhat	1.0E+08	1.0E+08	1.0E+08
Uhat 2009	Exploitation for the last year	0.10	0.10	0.10
SD Uhat	Standard Deviation of Uhat	0.02	0.02	0.02
SD rec	Standard Deviation of RecK	0.50	0.50	0.50
Rec rho	Recruitment Residuals	0	0	0
Future Catch*	Amount of future landings (catch)			
Ufuture	Future exploitation	0.2	0.2	0.2
growth von B K	von Bertalanffy growth coefficient	0.14	0.11	0.17
growth Linfinity (cm)	von Bertalanffy asymptotic length	83	88	77
CV length age	Variation of length at age	0.08	0.08	0.08
length maturity (cm)	Length at maturity	34	34	34
wt (kg) at 100 cm	Size (weight) of fish at 100 cm	11	11	11
growth tzero	Size (length, cm) at time zero			
MSY min (gutted lbs)	Maximum Sustainable Yield Minimum	20,000	20,000	20,000
MSY max (gutted lbs)	Maximum Sustainable Yield Maximum	1,100,000	880,000	440,000
Umsy min	Minimum Exploitation at MSY	0.05	0.05	0.05
Umsy max	Maximum Exploitation at MSY	0.50	0.40	0.50
S min	Minimum Survivalship (S-0.02)	0.84	0.84	0.84
S max	Maximum Survivalship (S+0.02)	0.88	0.88	0.88

* Future catch scenarios were completed for all data combined: 400,000 gutted lbs, 200,000 gutted lbs, and 800,000 gutted lbs

Table 3.2. Commercial catch histories (gutted pounds) for golden tilefish by region (East and West of Mississippi River) in the Gulf of Mexico.

Year	All	East	West
1965	6,226	6,226	0
1966	1,789	1,789	0
1967	962	962	0
1968	1,316	1,316	0
1969	280	280	0
1971	2,936	2,936	0
1972	986	986	0
1973	3,567	3,567	0
1974	3,755	3,755	0
1975	13,235	13,235	0
1976	21,995	21,995	0
1977	32,500	32,500	0
1978	21,626	21,090	536
1979	32,353	31,295	1,058
1980	24,935	23,324	1,611
1981	220,978	196,059	24,919
1982	269,679	178,167	91,512
1983	208,091	136,434	71,657
1984	269,656	176,025	93,631
1985	248,730	90,894	157,836
1986	296,998	175,288	121,710
1987	479,503	221,135	258,369
1988	848,377	309,997	538,380
1989	405,908	128,133	277,775
1990	317,696	171,350	146,346
1991	191,276	123,025	68,251
1992	189,517	97,561	91,956
1993	254,005	149,007	104,998
1994	346,773	249,283	97,490
1995	422,930	149,647	273,283
1996	188,009	109,301	78,709
1997	301,127	259,330	41,797
1998	265,310	201,681	63,628
1999	334,296	201,391	132,906
2000	428,069	244,646	183,423
2001	432,426	315,739	116,687
2002	482,982	228,937	254,044
2003	357,567	213,518	144,049
2004	417,220	255,997	161,222
2005	525,877	309,152	216,725
2006	277,871	226,091	51,779
2007	284,605	261,186	23,420
2008	311,242	259,088	52,155
2009	366,806	314,673	52,133

Table 3.3. Golden tilefish vulnerabilities at age for SRA were provided from SS3 from logistic functions of age selectivities given size selectivities and size-at-age data (SS, Asel2). The same age vulnerabilities were used for all data combined and for each region.

Age	Vulnerability	Age	Vulnerability
1	0.0000	16	0.9832
2	0.0060	17	0.9856
3	0.0617	18	0.9873
4	0.2143	19	0.9886
5	0.4130	20	0.9896
6	0.5885	21	0.9903
7	0.7204	22	0.9909
8	0.8128	23	0.9913
9	0.8746	24	0.9917
10	0.9148	25	0.9920
11	0.9405	26	0.9922
12	0.9571	27	0.9924
13	0.9679	28	0.9925
14	0.9750	29	0.9926
15	0.9798	30	0.9928

Table 3.4. Commercial longline indices and coefficient of variation (CV) for golden tilefish. An increase in the uncertainty (value of 1.0 for all years) in the commercial longline index for all data and east region SRA model runs was necessary to complete a satisfactory number of model iterations.

Year	All Index	All CV	East Index	East CV	West Index	West CV
1992	0.5116	0.57	0.3887	0.50	0.3516	0.35
1993	0.7845	0.43	0.4976	0.48	0.4825	0.27
1994	1.1372	0.33	0.9339	0.38	0.5812	0.24
1995	1.1094	0.34	1.0734	0.38	0.8402	0.20
1996	0.8816	0.37	0.6793	0.38	1.5196	0.24
1997	0.9812	0.35	0.8870	0.36	1.3002	0.28
1998	1.1453	0.35	1.9493	0.37	0.6337	0.29
1999	1.2241	0.34	1.8209	0.37	0.9104	0.21
2000	0.8295	0.34	0.8802	0.37	0.8896	0.23
2001	1.0194	0.34	0.6851	0.37	1.0779	0.25
2002	0.9005	0.35	0.7215	0.36	1.6720	0.25
2003	0.5832	0.37	0.5691	0.35	0.6342	0.23
2004	0.7194	0.37	0.6519	0.37	1.0384	0.32
2005	0.9116	0.37	0.7694	0.38	2.0646	0.31
2006	1.0788	0.36	1.2016	0.39	0.6881	0.37
2007	1.6429	0.34	1.3385	0.37	1.4041	0.57
2008	1.0305	0.38	1.5484	0.39	0.9117	0.34
2009	1.5092	0.36	1.4041	0.39	0.3516	0.35

Table 3.5. Vulnerable biomass (gutted pounds) trajectories by region for golden tilefish from SRA.

Year	All	East	West
1965	6,713,589	4,470,878	
1966	6,821,873	4,292,043	
1967	6,713,589	4,381,461	
1968	6,713,589	4,381,461	
1969	6,605,306	4,292,043	
1971	6,821,873	4,292,043	
1972	6,821,873	4,292,043	
1973	6,605,306	4,292,043	
1974	6,713,589	4,292,043	
1975	6,605,306	4,202,626	
1976	6,497,022	4,113,208	
1977	6,605,306	4,113,208	
1978	6,497,022	4,113,208	
1979	6,172,171	3,934,373	1,568,789
1980	6,172,171	3,844,955	1,607,525
1981	6,172,171	3,844,955	1,568,789
1982	6,172,171	3,934,373	1,568,789
1983	5,955,603	3,666,120	1,530,054
1984	5,522,469	3,487,285	1,413,847
1985	5,414,185	3,308,450	1,336,376
1986	5,197,617	3,040,197	1,258,905
1987	4,764,483	2,950,780	1,142,698
1988	4,656,199	2,950,780	1,045,859
1989	4,223,064	2,771,945	852,182
1990	3,573,362	2,593,109	426,091
1991	3,356,795	2,414,274	251,781
1992	3,248,511	2,414,274	213,045
1993	3,356,795	2,503,692	251,781
1994	3,465,078	2,503,692	348,620
1995	3,573,362	2,682,527	426,091
1996	3,681,646	2,771,945	542,297
1997	3,573,362	2,950,780	484,194
1998	3,681,646	3,040,197	542,297
1999	3,465,078	2,950,780	600,401
2000	3,681,646	2,950,780	658,504
2001	3,573,362	2,950,780	697,240
2002	3,573,362	2,861,362	639,136
2003	3,465,078	2,861,362	697,240
2004	3,465,078	2,861,362	619,769
2005	3,573,362	2,950,780	639,136
2006	3,573,362	3,040,197	619,769
2007	3,573,362	3,129,615	522,930
2008	3,789,929	3,308,450	561,665
2009	3,898,213	3,308,450	677,872

Table 3.6. List of SS parameters for Gulf of Mexico tilefish. The list includes predicted parameter values and their associated standard errors from SS Run 1, initial parameter values, minimum and maximum values a parameter could take, and prior densities assigned to parameters. Parameters designated as fixed were held at their initial values.

	Predicted					Prior				
Label	Value	SD	Initial	Min	Max	Type	Value	SD	Status	Description
NatM_p_1_Fem_GP_1	_	_	0.137	_	_	_	_	_	Fixed	East female reference M
L_at_Amin_Fem_GP_1	_	_	1.4	_	_	_	_	_	Fixed	East female length at age 0
L_at_Amax_Fem_GP_1	82.0603	1.93313	87.8	60	120	Symmetric Beta	_	5	Estimated	East female Linf
VonBert_K_Fem_GP_1	0.10823	0.00471722	0.109	0.01	0.3	Symmetric Beta	_	0.8	Estimated	East female K
CV_young_Fem_GP_1	_	_	0.16	_	_	_	_	_	Fixed	Young east female growth CV
CV_old_Fem_GP_1	_	_	0.12	_	_	_	_	_	Fixed	Old east female growth CV
NatM_p_1_Fem_GP_2	_	_	0.137	_	_	_	_	_	Fixed	West female reference M
L_at_Amin_Fem_GP_2	_	_	1.4	_	_	_	_	_	Fixed	West female length at age 0
L_at_Amax_Fem_GP_2	65.6036	1.20958	77.3	60	120	Symmetric Beta	_	0.8	Estimated	West female Linf
VonBert_K_Fem_GP_2	0.188231	0.0106731	0.1721	0.01	0.3	Symmetric Beta	_	0.8	Estimated	West female K
CV_young_Fem_GP_2	_	_	0.16	_	_	_	_	_	Fixed	Young west female growth CV
CV_old_Fem_GP_2	_	_	0.12	_	_	_	_	_	Fixed	Old west female growth CV
NatM_p_1_Mal_GP_1	_	_	1.37E-01	_	_	_	_	_	Fixed	East male reference M
L_at_Amin_Mal_GP_1	_	_	1.4	_	_	_	_	_	Fixed	East male length at age 0
L_at_Amax_Mal_GP_1	92.3779	0.735422	87.8	60	120	Symmetric Beta	_	0.8	Estimated	East male Linf
VonBert_K_Mal_GP_1	0.133416	0.0026338	0.109	0.01	0.3	Symmetric Beta	_	0.8	Estimated	East male K
CV_young_Mal_GP_1	_	_	0.16	_	_	_	_	_	Fixed	Young east male growth CV
CV_old_Mal_GP_1	_	_	0.12	_	_	_	_	_	Fixed	Old east male growth CV
NatM_p_1_Mal_GP_2	_	_	1.37E-01	_	_	_	_	_	Fixed	West male reference M
L_at_Amin_Mal_GP_2	_	_	1.4	_	_	_	_	_	Fixed	West male length at age 0
L_at_Amax_Mal_GP_2	86.5538	0.699975	77.3	60	120	Symmetric Beta	_	0.8	Estimated	West male Linf
VonBert_K_Mal_GP_2	0.160307	0.00442129	0.1721	0.01	0.3	Symmetric Beta	_	0.8	Estimated	West male K
CV_young_Mal_GP_2	_	_	0.16	_	_	_	_	_	Fixed	Young west male growth CV
CV_old_Mal_GP_2	_	_	0.12	_	_	_	_	_	Fixed	Old west male growth CV
Wtlen_1_Fem	_	_	7.53E-06	_	_	_	_	_	Fixed	Female weight-length scalar
Wtlen_2_Fem	_	_	3.082	_	_	_	_	_	Fixed	Female weight-length exponent
Mat50%_Fem	_	_	34.4	_	_	_	_	_	Fixed	Maturity inflection point
Mat_slope_Fem	_	_	-0.478	_	_	_	_	_	Fixed	Maturity slope
Eggs_scalar_Fem	_	_	29.87	_	_	_	_	_	Fixed	Fecundity scalar
Eggs_exp_wt_Fem	_	_	1.42	_	_	_	_	_	Fixed	Fecundity exponent
Wtlen_1_Mal	_	_	7.53E-06	_	_	_	_	_	Fixed	Male weight-length scalar
Wtlen_2_Mal	_	_	3.082	_	_	_	_	_	Fixed	Male weight-length exponent
Herm_Infl_age	_	_	47.4945	_	_	_	_	_	Fixed	Sex transition inflection point
Herm_stdev	_	_	20	_	_	_	_	_	Fixed	Sex transition standard deviation
Herm_asymptote	_	_	0.190862	_	_	_	_	_	Fixed	Sex transition asymptote
RecrDist_GP_1	_	_	0	_	_	_	_	_	Fixed	East growth pattern recruit distr
RecrDist_GP_2	_	_	0	_	_	_	_	_	Fixed	West growth pattern recruit distr
RecrDist_Area_1	1.13913	0.0300277	1	-4	4	Uniform	_	_	Estimated	East region recruit distr
RecrDist_Area_2	_	_	1	_	_	_	_	_	Fixed	West region recruit distr
RecrDist_Seas_1	_	_	1	_	_	_	_	_	Fixed	Seasonal recruit distr
CohortGrowDev	_	_	1	_	_	_	_	_	Fixed	Cohort growth deviations
SR_R0	5.48191	0.0211672	6.75	1	10	Normal	6.75	0.4	Estimated	Virgin recruit
SR_steep	0.93439	0.0236374	0.75	0.2	0.99	Symmetric Beta	_	5	Estimated	Steepness
SR_sigmaR	_	_	0.15	_	_	_	_	_	Fixed	Stock -recruit standard deviation
SR_envlink	_	_	0	_	_	_	_	_	Fixed	Stock-recruit environmental link
SR_R1_offset	_	_	0	_	_	_	_	_	Fixed	Stock-recruit offset
SR_autocorr	_	_	0	_	_	_	_	_	Fixed	Stock-recruit autocorrelation
Main_RecrDev_1965	-0.407848	0.13235	_	_	_	_	_	_	Estimated	1965 recruit deviation
Main_RecrDev_1966	-0.411064	0.132159	_	_	_	_	_	_	Estimated	1966 recruit deviation
Main_RecrDev_1967	-0.412649	0.132049	_	_	_	_	_	_	Estimated	1967 recruit deviation

Main_RecrDev_1968	-0.411905	0.132052	_	_	_	_	_	_	Estimated	1968 recruit deviation
Main_RecrDev_1969	-0.408155	0.132201	_	_	_	_	_	_	Estimated	1969 recruit deviation
Main_RecrDev_1970	-0.400568	0.132535	_	_	_	_	_	_	Estimated	1970 recruit deviation
Main_RecrDev_1971	-0.388022	0.133108	_	_	_	_	_	_	Estimated	1971 recruit deviation
Main_RecrDev_1972	-0.369308	0.133984	_	_	_	_	_	_	Estimated	1972 recruit deviation
Main_RecrDev_1973	-0.341097	0.135342	_	_	_	_	_	_	Estimated	1973 recruit deviation
Main_RecrDev_1974	-0.301884	0.13727	_	_	_	_	_	_	Estimated	1974 recruit deviation
Main_RecrDev_1975	-0.250397	0.139854	_	_	_	_	_	_	Estimated	1975 recruit deviation
Main_RecrDev_1976	-0.188564	0.143003	_	_	_	_	_	_	Estimated	1976 recruit deviation
Main_RecrDev_1977	-0.1281	0.146105	_	_	_	_	_	_	Estimated	1977 recruit deviation
Main_RecrDev_1978	-0.0889557	0.148035	_	_	_	_	_	_	Estimated	1978 recruit deviation
Main_RecrDev_1979	-0.089737	0.147642	_	_	_	_	_	_	Estimated	1979 recruit deviation
Main_RecrDev_1980	-0.140869	0.144835	_	_	_	_	_	_	Estimated	1980 recruit deviation
Main_RecrDev_1981	-0.171314	0.143723	_	_	_	_	_	_	Estimated	1981 recruit deviation
Main_RecrDev_1982	-0.122182	0.147157	_	_	_	_	_	_	Estimated	1982 recruit deviation
Main_RecrDev_1983	0.0393318	0.157311	_	_	_	_	_	_	Estimated	1983 recruit deviation
Main_RecrDev_1984	0.292073	0.170231	_	_	_	_	_	_	Estimated	1984 recruit deviation
Main_RecrDev_1985	0.299366	0.171068	_	_	_	_	_	_	Estimated	1985 recruit deviation
Main_RecrDev_1986	0.161165	0.161776	_	_	_	_	_	_	Estimated	1986 recruit deviation
Main_RecrDev_1987	0.181632	0.163554	_	_	_	_	_	_	Estimated	1987 recruit deviation
Main_RecrDev_1988	0.258494	0.168461	_	_	_	_	_	_	Estimated	1988 recruit deviation
Main_RecrDev_1989	0.266986	0.17141	_	_	_	_	_	_	Estimated	1989 recruit deviation
Main_RecrDev_1990	0.277863	0.176604	_	_	_	_	_	_	Estimated	1990 recruit deviation
Main_RecrDev_1991	0.379833	0.195912	_	_	_	_	_	_	Estimated	1991 recruit deviation
Main_RecrDev_1992	0.662179	0.29045	_	_	_	_	_	_	Estimated	1992 recruit deviation
Main_RecrDev_1993	0.888989	0.332272	_	_	_	_	_	_	Estimated	1993 recruit deviation
Main_RecrDev_1994	0.515308	0.247788	_	_	_	_	_	_	Estimated	1994 recruit deviation
Main_RecrDev_1995	0.365263	0.203779	_	_	_	_	_	_	Estimated	1995 recruit deviation
Main_RecrDev_1996	0.356601	0.215994	_	_	_	_	_	_	Estimated	1996 recruit deviation
Main_RecrDev_1997	1.75974	0.122446	_	_	_	_	_	_	Estimated	1997 recruit deviation
Main_RecrDev_1998	0.228781	0.191037	_	_	_	_	_	_	Estimated	1998 recruit deviation
Main_RecrDev_1999	0.313314	0.189459	_	_	_	_	_	_	Estimated	1999 recruit deviation
Main_RecrDev_2000	0.584996	0.187028	_	_	_	_	_	_	Estimated	2000 recruit deviation
Main_RecrDev_2001	0.278179	0.168338	_	_	_	_	_	_	Estimated	2001 recruit deviation
Main_RecrDev_2002	-0.243613	0.135278	_	_	_	_	_	_	Estimated	2002 recruit deviation
Main_RecrDev_2003	-0.575778	0.122165	_	_	_	_	_	_	Estimated	2003 recruit deviation
Main_RecrDev_2004	-0.724587	0.118014	_	_	_	_	_	_	Estimated	2004 recruit deviation
Main_RecrDev_2005	-0.66183	0.121036	_	_	_	_	_	_	Estimated	2005 recruit deviation
Main_RecrDev_2006	-0.391828	0.133871	_	_	_	_	_	_	Estimated	2006 recruit deviation
Main_RecrDev_2007	-0.180409	0.146309	_	_	_	_	_	_	Estimated	2007 recruit deviation
Main_RecrDev_2008	-0.14982	0.148349	_	_	_	_	_	_	Estimated	2008 recruit deviation
Main_RecrDev_2009	-0.149612	0.148366	_	_	_	_	_	_	Estimated	2009 recruit deviation
InitF_1HLE	_	_	0	_	_	_	_	_	Fixed	Hand line east initial F
InitF_2HLW	_	_	0	_	_	_	_	_	Fixed	Hand line west initial F
InitF_3LLE	_	_	0	_	_	_	_	_	Fixed	Long line east initial F
InitF_4LLW	_	_	0	_	_	_	_	_	Fixed	Long line west initial F
SizeSel_1P_1_HLE	71.1341	1.53473	60	20	113	Symmetric Beta	_	0.05	Estimated	HLE size select peak
SizeSel_1P_2_HLE	_	_	3	_	_	_	_	_	Fixed	HLE size select top
SizeSel_1P_3_HLE	5.77046	0.112582	5	-4	12	Symmetric Beta	_	0.05	Estimated	HLE size select ascending width
SizeSel_1P_4_HLE	_	_	2.5	_	_	_	_	_	Fixed	HLE size select descending width
SizeSel_1P_5_HLE	_	_	-15	_	_	_	_	_	Fixed	HLE size select initial
SizeSel_1P_6_HLE	_	_	5	_	_	_	_	_	Fixed	HLE size select final
SizeSel_2P_1_HLW	_	_	0	_	_	_	_	_	Fixed	HLW size select min length
SizeSel_2P_2_HLW	_	_	0	_	_	_	_	_	Fixed	HLW size select max length
SizeSel_3P_1_LLE	58.3103	0.683248	60	20	113	Symmetric Beta	_	0.05	Estimated	LLE size select peak
SizeSel_3P_2_LLE	_	_	3	_	_	_	_	_	Fixed	LLE size select top
SizeSel_3P_3_LLE	5.09259	0.0722288	5	-4	12	Symmetric Beta	_	0.05	Estimated	LLE size select ascending width
SizeSel_3P_4_LLE	_	_	2.5	_	_	_	_	_	Fixed	LLE size select descending width
SizeSel_3P_5_LLE	_	_	-15	_	_	_	_	_	Fixed	LLE size select initial
SizeSel_3P_6_LLE	_	_	5	_	_	_	_	_	Fixed	LLE size select final

SizeSel_4P_1_LLW	_	_	0	_	_	_	_	_	Fixed	LLW size select min length
SizeSel_4P_2_LLW	_	_	0	_	_	_	_	_	Fixed	LLW size select max length
SizeSel_5P_1_NMFSE	52.6511	1.76578	60	20	113	Symmetric Beta	_	0.05	Estimated	NMFSE size select peak
SizeSel_5P_2_NMFSE	_	_	3	_	_	_	_	_	Fixed	NMFSE size select top
SizeSel_5P_3_NMFSE	3.62436	0.434985	5	-4	12	Symmetric Beta	_	0.05	Estimated	NMFSE size select ascending width
SizeSel_5P_4_NMFSE	_	_	2.5	_	_	_	_	_	Fixed	NMFSE size select descending width
SizeSel_5P_5_NMFSE	_	_	-15	_	_	_	_	_	Fixed	NMFSE size select initial
SizeSel_5P_6_NMFSE	_	_	5	_	_	_	_	_	Fixed	NMFSE size select final
SizeSel_6P_1_NMFSW	_	_	0	_	_	_	_	_	Fixed	NMFSW size select min length
SizeSel_6P_2_NMFSW	_	_	0	_	_	_	_	_	Fixed	NMFSW size select max length
AgeSel_1P_1_HLE	_	_	0	_	_	_	_	_	Fixed	HLE age select min age
AgeSel_1P_2_HLE	_	_	30	_	_	_	_	_	Fixed	HLE age select max age
AgeSel_2P_1_HLW	_	_	0	_	_	_	_	_	Fixed	HLW age select min age
AgeSel_2P_2_HLW	_	_	30	_	_	_	_	_	Fixed	HLW age select max age
AgeSel_3P_1_LLE	_	_	0	_	_	_	_	_	Fixed	LLE age select min age
AgeSel_3P_2_LLE	_	_	30	_	_	_	_	_	Fixed	LLE age select max age
AgeSel_4P_1_LLW	_	_	0	_	_	_	_	_	Fixed	LLW age select min age
AgeSel_4P_2_LLW	_	_	30	_	_	_	_	_	Fixed	LLW age select max age
AgeSel_5P_1_NMFSE	_	_	0	_	_	_	_	_	Fixed	NMFSE age select min age
AgeSel_5P_2_NMFSE	_	_	30	_	_	_	_	_	Fixed	NMFSE age select max age
AgeSel_6P_1_NMFSW	_	_	0	_	_	_	_	_	Fixed	NMFSW age select min age
AgeSel_6P_2_NMFSW	_	_	30	_	_	_	_	_	Fixed	NMFSW age select max age

Table 3.7. Predicted total biomass (gutted lbs), spawning biomass (gonad wt lbs), age-0 recruits (thousand fish), and fishing mortality for Gulf of Mexico tilefish from SS Run 1.

	East			West			Gulf
Year	Total Biomass	Spawning Biomass	Recruits	Total Biomass	Spawning Biomass	Recruits	F
Virgin	3,915,863	38.4	128	2,815,303	25.4	112	0.00
1965	3,914,820	38.4	85	2,814,398	25.4	74	9.2E-04
1966	3,905,391	38.7	85	2,811,268	25.5	74	2.7E-04
1967	3,898,324	39.0	85	2,804,930	25.6	74	1.4E-04
1968	3,888,522	39.3	85	2,793,769	25.6	74	2.0E-04
1969	3,873,936	39.6	85	2,777,234	25.6	74	4.1E-05
1970	3,855,590	39.7	86	2,755,542	25.4	75	0.00
1971	3,832,796	39.8	87	2,729,402	25.1	76	4.5E-04
1972	3,802,817	39.7	89	2,699,758	24.7	77	1.5E-04
1973	3,771,047	39.5	91	2,667,633	24.2	79	5.5E-04
1974	3,733,804	39.2	95	2,634,072	23.7	83	5.9E-04
1975	3,694,318	38.8	100	2,600,117	23.2	87	2.1E-03
1976	3,644,576	38.2	106	2,566,791	22.7	93	3.5E-03
1977	3,586,607	37.6	113	2,535,100	22.2	98	5.3E-03
1978	3,520,015	36.7	117	2,506,046	21.7	102	3.6E-03
1979	3,467,360	36.1	117	2,480,004	21.3	102	5.4E-03
1980	3,408,229	35.3	111	2,457,485	21.0	97	4.3E-03
1981	3,361,144	34.7	108	2,438,648	20.8	94	0.04
1982	3,150,879	32.6	113	2,400,893	20.5	99	0.05
1983	2,966,773	30.8	133	2,302,512	19.9	116	0.04
1984	2,831,897	29.5	171	2,229,701	19.5	149	0.05
1985	2,666,157	28.0	172	2,141,949	19.0	150	0.05
1986	2,594,270	27.4	150	2,002,034	18.1	130	0.06
1987	2,451,757	26.2	152	1,910,865	17.6	133	0.11
1988	2,277,336	24.7	164	1,699,347	16.2	143	0.21
1989	2,029,592	22.5	165	1,232,898	12.7	143	0.12
1990	1,972,232	22.4	166	1,037,094	11.5	145	0.11
1991	1,880,642	22.0	184	979,179	11.5	160	0.07
1992	1,849,946	22.2	244	1,006,721	12.4	212	0.07
1993	1,854,161	22.8	306	1,021,520	13.0	266	0.09
1994	1,817,194	22.9	210	1,033,716	13.6	183	0.12
1995	1,698,188	21.8	181	1,069,457	14.2	157	0.15
1996	1,689,174	22.0	179	949,102	12.9	156	0.07
1997	1,742,666	22.9	729	1,028,401	14.3	634	0.11
1998	1,640,385	22.1	158	1,135,662	16.2	137	0.10
1999	1,627,092	22.2	172	1,263,375	17.9	150	0.12

2000	1,633,561	22.3	226	1,341,440	18.8	197	0.14
2001	1,604,501	22.0	166	1,369,626	19.8	145	0.15
2002	1,508,442	21.4	99	1,453,246	21.8	86	0.16
2003	1,488,481	22.0	71	1,392,875	21.6	62	0.12
2004	1,470,393	22.8	61	1,411,071	22.5	53	0.14
2005	1,392,920	22.7	65	1,388,344	22.8	57	0.19
2006	1,236,699	21.2	85	1,287,212	21.6	74	0.11
2007	1,139,276	20.4	106	1,321,599	22.3	93	0.12
2008	986,480	18.3	110	1,369,510	22.9	95	0.13
2009	822,035	15.6	109	1,379,450	22.6	95	0.17

Table 3.8. Summary of SS results from sensitivity runs for Gulf of Mexico tilefish. Results include virgin recruitment (thousand fish; R0), steepness, virgin total biomass (gutted lbs; B0), 2009 total biomass (gutted lbs; Bcurrent), virgin spawning biomass (gonad wt lbs; SSB0), 2009 spawning biomass (gonad wt lbs; SSBcurrent), and 2009 SPR (SPRcurrent).

				B0		Bcurrent		SSB0		SSBcurrent		
Run	Description	R0	Steepness	East	West	East	West	East	West	East	West	SPRcurrent
1	Central	240	0.93	3,915,863	2,815,303	822,035	1,379,450	38.4	25.4	15.6	22.6	0.37
2	Mref=0.03	17	0.92	3,268,649	2,376,190	481,452	790,655	39.2	9.6	15.2	13.7	0.11
3	Mref=0.09	87	0.94	3,904,997	2,728,674	639,917	1,145,323	31.3	20.3	12.6	19.1	0.31
4	Mref=0.19	582	0.92	3,846,122	2,828,649	993,805	1,568,440	42.1	27.6	18.2	24.5	0.42
5	Mref=0.24	1,412	0.89	3,783,861	2,866,029	1,220,178	1,793,663	43.8	28.3	21.2	26.0	0.47
6	Mref age=15	377	0.94	3,839,036	2,724,245	827,521	1,175,357	37.4	25.5	14.4	19.8	0.36
7	Mref age=25	622	0.93	3,771,381	2,591,613	829,405	990,490	35.7	10.6	13.7	7.4	0.25
8	sigmaR=0.01	311	0.94	4,567,329	3,283,825	856,655	1,141,381	41.4	27.7	12.1	15.3	0.37
9	sigmaR=0.3	166	0.84	3,059,170	2,215,725	844,343	1,654,658	31.9	19.9	18.0	28.4	0.37
10	Dome-shaped sel.	430	0.91	12,958,183	9,775,455	6,696,522	5,918,074	115.0	50.7	72.6	46.7	0.44
11	Region-specific sel.	239	0.93	3,903,068	2,707,001	836,723	1,314,646	38.1	21.8	15.6	21.0	0.36
12	Fit CPUE indices	362	0.88	5,597,734	2,591,692	4,269,607	1,931,023	68.2	38.9	69.7	38.8	0.66
13	steepness=0.75	244	0.75	3,955,940	2,847,448	807,685	1,364,232	38.4	25.6	15.2	22.2	0.37
14	alternate landings	250	0.94	4,403,656	2,796,151	847,855	1,267,908	43.6	25.0	16.4	20.7	0.34

Table 3.9. Reference points and benchmarks from sensitivity runs for Gulf of Mexico tilefish from SS. Benchmarks are reported for two reference points: 1) SPR 30% and 2) SPR 40%. *Current* refers to 2009 values. *Ref* refers to the reference point, either SPR 30% or SPR 40%. MSST is (1-M)*SSBref with M = 0.13. Fratio is Fcurrent / Fref. SSBratio is SSBcurrent / MSST. Spawning biomass units are gonad weight in pounds, and yield units are gutted pounds.

				SPR30%						SPR40%					
Run	Description	Fcurrent	SSBcurrent	Yref	Fref	SSBref	MSST	Fratio	SSBratio	Yref	Fref	SSBref	MSST	Fratio	SSBratio
1	Central	0.17	38.2	159,816	0.12	18.3	16.0	1.48	2.39	151,641	0.08	24.8	21.6	2.32	1.77
2	Mref=0.03	0.30	28.9	51,886	0.03	13.9	12.1	9.22	2.39	52,432	0.03	18.9	16.4	11.58	1.76
3	Mref=0.09	0.21	31.7	111,042	0.09	14.9	13.0	2.30	2.45	107,563	0.06	20.2	17.5	3.67	1.81
4	Mref=0.19	0.15	42.7	200,894	0.14	19.8	17.2	1.10	2.48	187,900	0.09	26.9	23.4	1.69	1.82
5	Mref=0.24	0.13	47.2	243,091	0.15	20.1	17.5	0.83	2.70	225,547	0.10	27.5	23.9	1.26	1.97
6	Mref age=15	0.19	34.2	170,476	0.12	18.1	15.8	1.54	2.17	162,458	0.08	24.5	21.3	2.34	1.60
7	Mref age=25	0.21	21.1	163,827	0.09	13.3	11.6	2.42	1.82	154,565	0.06	18.0	15.7	3.35	1.35
8	sigmaR=0.01	0.19	27.3	209,288	0.14	20.0	17.4	1.40	1.57	201,751	0.09	27.0	23.5	2.13	1.16
9	sigmaR=0.3	0.15	46.3	101,316	0.10	13.7	12.0	1.58	3.87	98,022	0.06	19.2	16.7	2.50	2.78
10	Dome-shaped sel.	0.03	119.3	248,575	0.04	46.7	40.7	0.77	2.93	229,952	0.03	63.7	55.4	1.16	2.15
11	Region-specific sel.	0.18	36.7	158,015	0.12	17.2	14.9	1.48	2.45	149,973	0.08	23.3	20.3	2.38	1.81
12	Fit CPUE indices	0.06	108.5	307,362	0.19	29.4	25.6	0.33	4.24	304,122	0.13	40.5	35.2	0.47	3.08
13	steepness=0.75	0.18	37.4	133,448	0.12	15.1	13.2	1.48	2.84	136,619	0.08	22.1	19.2	2.33	1.94
14	alternate landings	0.18	37.1	166,790	0.11	19.8	17.2	1.62	2.16	159,789	0.07	26.7	23.3	2.46	1.59

Table 3.10. Required SFA and MSRA evaluations using SPR 30% reference point for Gulf of Mexico tilefish SS runs. Spawning biomass units are gonad weight in pounds, and yield units are gutted pounds.

Criteria	Definition	Run 1	Run 3	Run 4	Run 6	Run 8	Run 9	Run 11	Run 13
	Mortality Rate Criteria								
$F_{MSY\ or\ proxy}$	$F_{SPR30\%}$	0.12	0.09	0.14	0.12	0.14	0.10	0.12	0.12
MFMT	$F_{SPR30\%}$	0.12	0.09	0.14	0.12	0.14	0.10	0.12	0.12
F_{OY}	75% of $F_{SPR30\%}$	-	-	-	-	-	-	-	-
$F_{CURRENT}$	F_{2009}	0.17	0.21	0.15	0.19	0.19	0.15	0.18	0.18
$F_{CURRENT}$/MFMT	F_{2009}	1.48	2.30	1.10	1.54	1.40	1.58	1.48	1.48
Base M									
	Biomass Criteria								
$SSB_{MSY\ or\ proxy}$	Equilibrium SSB @ $F_{SPR30\%}$	18.3	14.9	19.8	18.1	20.0	13.7	17.2	15.1
MSST	(1-M)*$SSB_{SPR30\%}$ M=0.13	16.0	13.0	17.2	15.8	17.4	12.0	14.9	13.2
$SSB_{CURRENT}$	SSB_{2009}	38.2	31.7	42.7	34.2	27.3	46.3	36.7	37.4
$SS_{CURRENT}$/MSST	SSB_{2009}	2.39	2.45	2.48	2.17	1.57	3.87	2.45	2.84
Equilibrium MSY	Equilibrium Yield @ $F_{SPR30\%}$	159,816	111,042	200,894	170,476	209,288	101,316	158,015	133,448
Equilibrium OY	Equilibrium Yield @ F_{OY}	-	-	-	-	-	-	-	-
OFL	Annual Yield @ FMFMT								
	OFL 2010	-	-	-	-	-	-	-	-
	OFL 2011	-	-	-	-	-	-	-	-
	OFL 2012	-	-	-	-	-	-	-	-
	OFL 2013	-	-	-	-	-	-	-	-
	OFL 2014	-	-	-	-	-	-	-	-
	OFL 2015	-	-	-	-	-	-	-	-
Annual OY (ACT)	Annual Yield @ F_{OY}								
	OY 2010	-	-	-	-	-	-	-	-
	OY 2011	-	-	-	-	-	-	-	-
	OY 2012	-	-	-	-	-	-	-	-
	OY 2013	-	-	-	-	-	-	-	-
	OY 2014	-	-	-	-	-	-	-	-
	OY 2015	-	-	-	-	-	-	-	-
	Annual Yield (2011) @ 65% FMFMT	-	-	-	-	-	-	-	-
Alternative ACT:	Annual Yield (2011) @ 75% FMFMT	-	-	-	-	-	-	-	-
	Annual Yield (2011) @ 85% FMFMT	-	-	-	-	-	-	-	-
Generation Time									
Rebuild Time	(if B_{2009}<MSST)								
Tmin	@ F=0	-	-	-	-	-	-	-	-
Midpoint	mid of Tmin, Tmax	-	-	-	-	-	-	-	-
Tmax	if Tmin>10y, Tmin + 1 Gen	-	-	-	-	-	-	-	-
ABC	Recommend Range	-	-	-	-	-	-	-	-

Table 3.11. Required SFA and MSRA evaluations using SPR 40% reference point for Gulf of Mexico tilefish SS runs. Spawning biomass units are gonad weight in pounds, and yield units are gutted pounds.

Criteria	Definition	Run 1	Run 3	Run 4	Run 6	Run 8	Run 9	Run 11	Run 13
	Mortality Rate Criteria								
$F_{MSY\ or\ proxy}$	$F_{SPR40\%}$	0.08	0.06	0.09	0.08	0.09	0.06	0.08	0.08
MFMT	$F_{SPR40\%}$	0.08	0.06	0.09	0.08	0.09	0.06	0.08	0.08
F_{OY}	75% of $F_{SPR40\%}$	-	-	-	-	-	-	-	-
$F_{CURRENT}$	F_{2009}	0.17	0.21	0.15	0.19	0.19	0.15	0.18	0.18
$F_{CURRENT}$/MFMT	F_{2009}	2.32	3.67	1.69	2.34	2.13	2.50	2.38	2.33
Base M									
	Biomass Criteria								
$SSB_{MSY\ or\ proxy}$	Equilibrium SSB @ $F_{SPR40\%}$	24.8	20.2	26.9	24.5	27.0	19.2	23.3	22.1
MSST	(1-M)*$SSB_{SPR40\%}$ M=0.13	21.6	17.5	23.4	21.3	23.5	16.7	20.3	19.2
$SSB_{CURRENT}$	SSB_{2009}	38.2	31.7	42.7	34.2	27.3	46.3	36.7	37.4
$SS_{CURRENT}$/MSST	SSB_{2009}	1.77	1.81	1.82	1.60	1.16	2.78	1.81	1.94
Equilibrium MSY	Equilibrium Yield @ $F_{SPR40\%}$	151,641	107,563	187,900	162,458	201,751	98,022	149,973	136,619
Equilibrium OY	Equilibrium Yield @ F_{OY}	-	-	-	-	-	-	-	-
OFL	Annual Yield @ FMFMT								
	OFL 2010	-	-	-	-	-	-	-	-
	OFL 2011	-	-	-	-	-	-	-	-
	OFL 2012	-	-	-	-	-	-	-	-
	OFL 2013	-	-	-	-	-	-	-	-
	OFL 2014	-	-	-	-	-	-	-	-
	OFL 2015	-	-	-	-	-	-	-	-
Annual OY (ACT)	Annual Yield @ F_{OY}								
	OY 2010	-	-	-	-	-	-	-	-
	OY 2011	-	-	-	-	-	-	-	-
	OY 2012	-	-	-	-	-	-	-	-
	OY 2013	-	-	-	-	-	-	-	-
	OY 2014	-	-	-	-	-	-	-	-
	OY 2015	-	-	-	-	-	-	-	-
	Annual Yield (2011) @ 65% FMFMT	-	-	-	-	-	-	-	-
Alternative ACT:	Annual Yield (2011) @ 75% FMFMT	-	-	-	-	-	-	-	-
	Annual Yield (2011) @ 85% FMFMT	-	-	-	-	-	-	-	-
Generation Time									
Rebuild Time	(if B_{2009}<MSST)								
Tmin	@ F=0	-	-	-	-	-	-	-	-
Midpoint	mid of Tmin, Tmax	-	-	-	-	-	-	-	-
Tmax	if Tmin>10y, Tmin + 1 Gen	-	-	-	-	-	-	-	-
ABC	Recommend Range	-	-	-	-	-	-	-	-

3.6. FIGURES

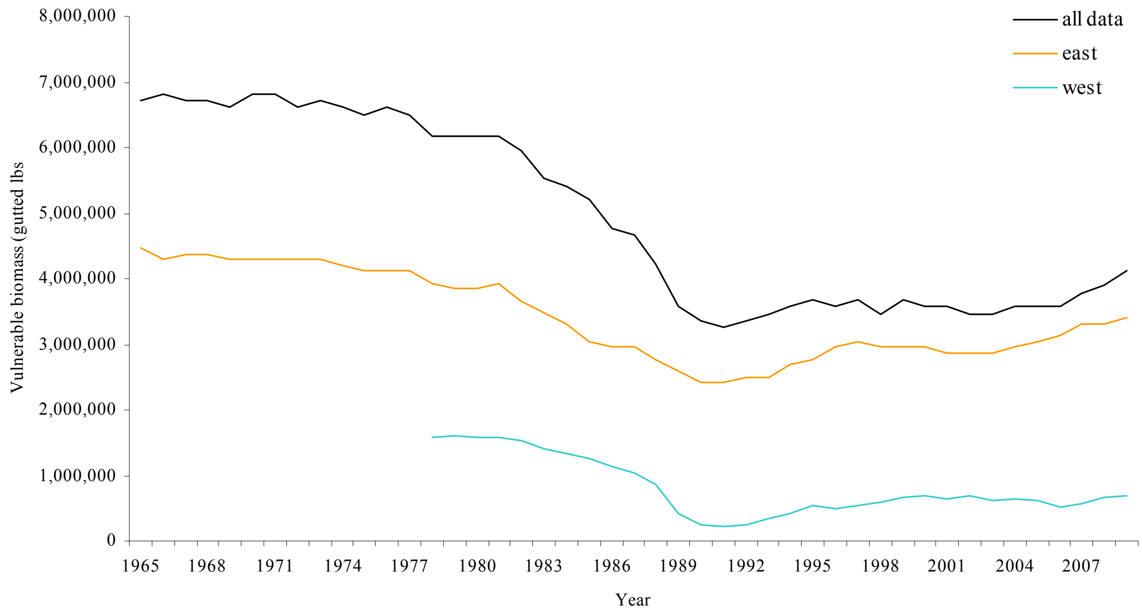


Figure 3.1. SRA estimates of vulnerable biomass for golden tilefish by region (east and west of the Mississippi River) and all data combined in the Gulf of Mexico for the time period catch histories exist. Note that the 'all data' model is an independent model and not the sum of the East and West biomass.

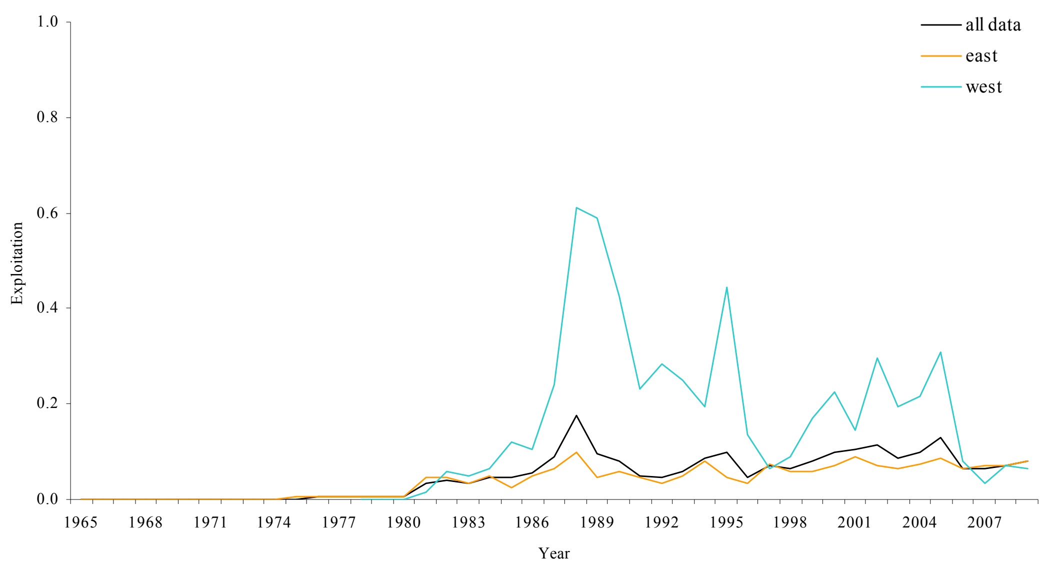
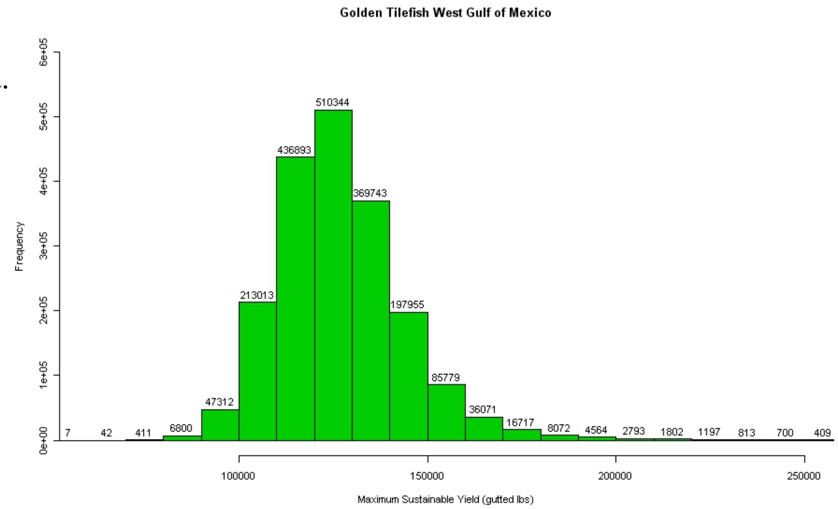


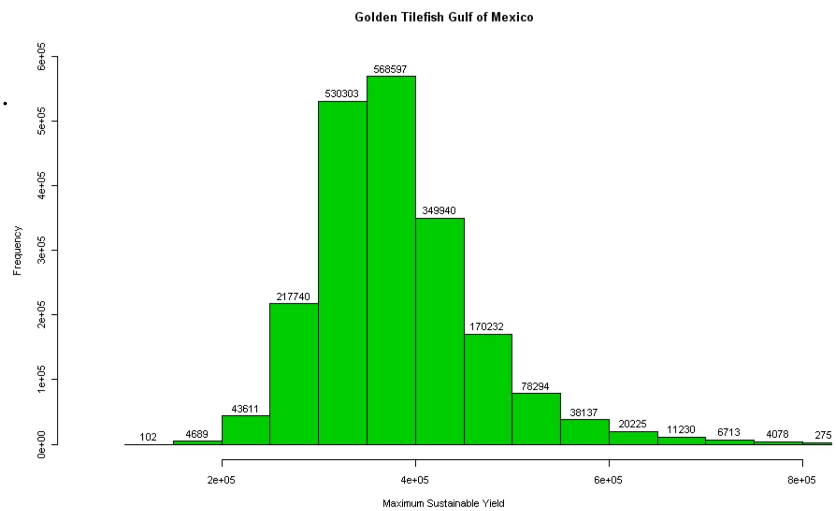
Figure 3.2. SRA estimates of exploitation for golden tilefish by region (east and west of the Mississippi River) and all data combined in the Gulf of Mexico for the time period catch histories exist.

Figure 3.3. Distribution of maximum sustainable yield (gutted pounds) values for (a) all data combined, (b) East Gulf of Mexico and (c) West Gulf of Mexico for golden tilefish from SRA. Sample sizes per size bin are above each respective column. Note, figures not drawn on the same x-axis.

a.



b.



c.

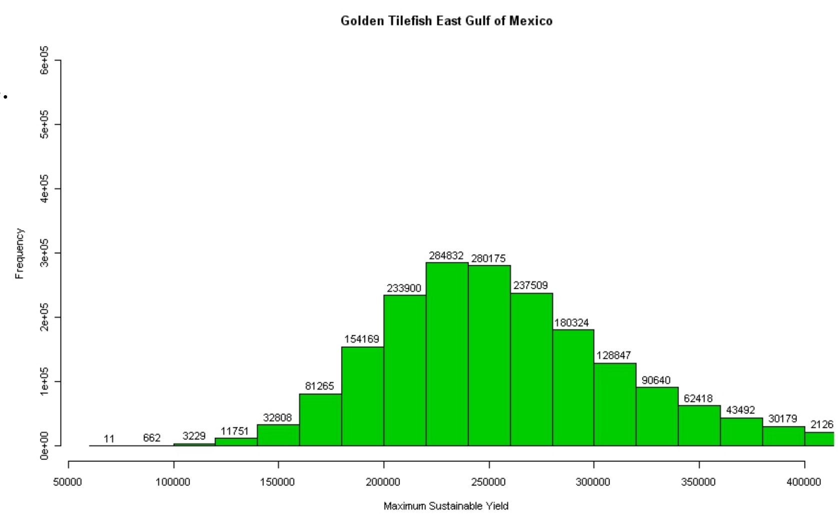
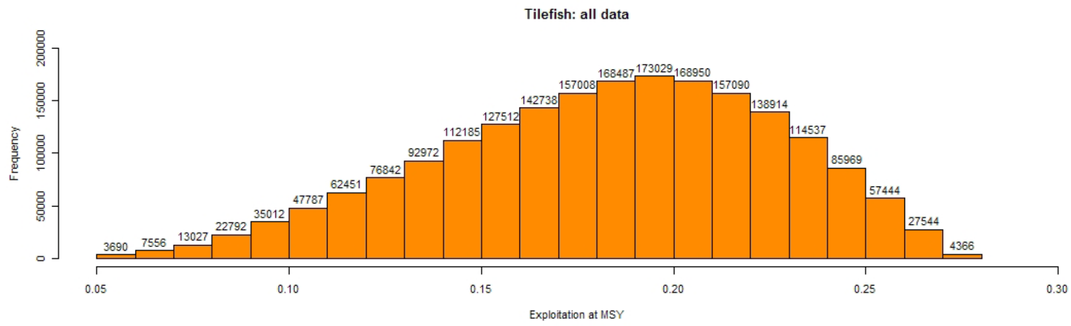
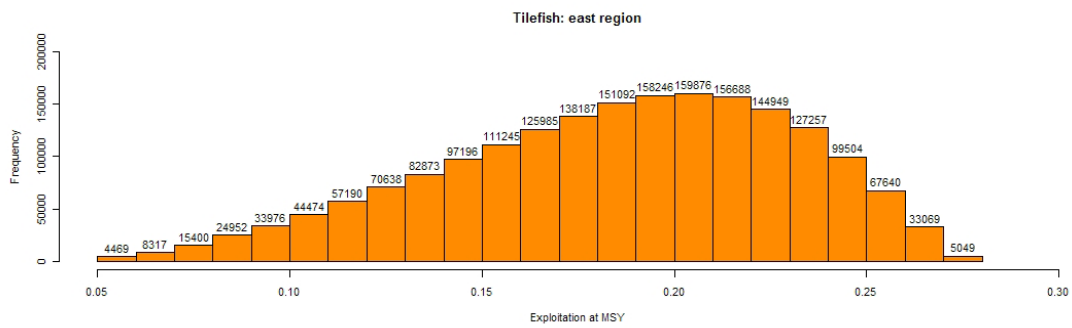


Figure 3.4. Distribution of exploitation at maximum sustainable yield (MSY) values (a) all data combined, (b) East Gulf of Mexico and (c) West Gulf of Mexico for golden tilefish from SRA. Sample sizes per size bin are above each respective column. Note, figure (c) not drawn on the same x-axis or y-axis.

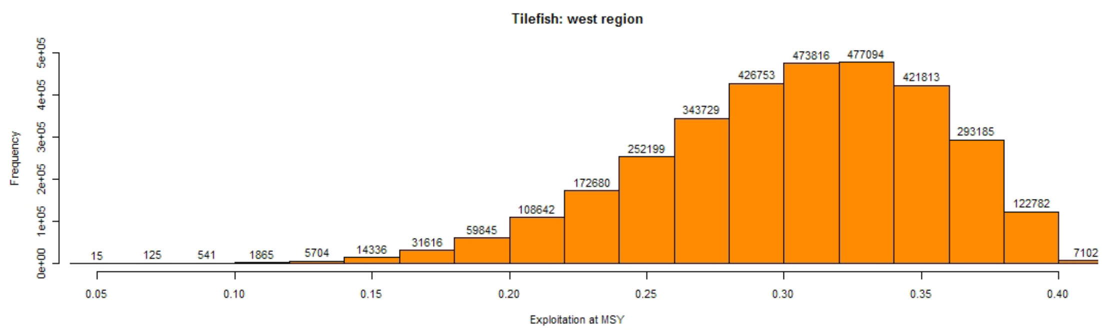
a.



b.



c.



a. All data

b. East Gulf of Mexico

c. West

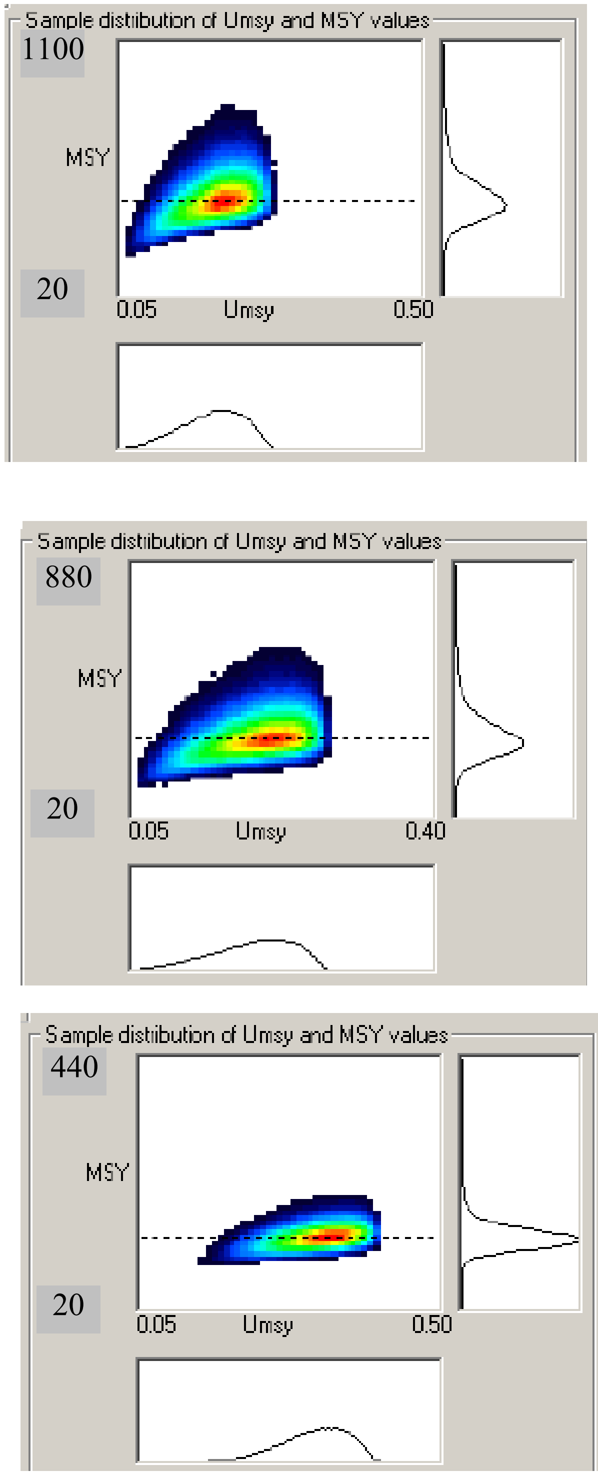
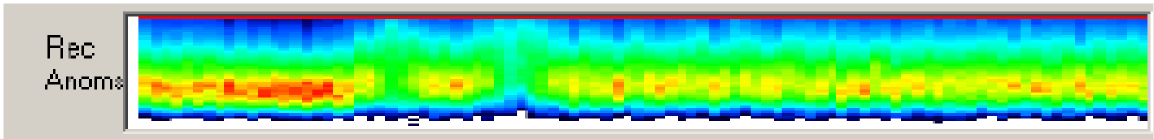
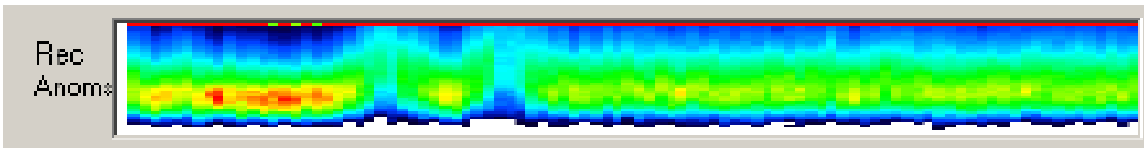


Figure 3.5. Sample distributions of maximum sustainable yield (MSY) given the sample distribution of exploitation at maximum sustainable yield (Umsy) for (a) all data combined, (b) East Gulf of Mexico and (c) West Gulf of Mexico for golden tilefish from SRA. Dotted line indicate the average catch for the given time series for either region. Note: range of MSY and Umsy differ for each figure.

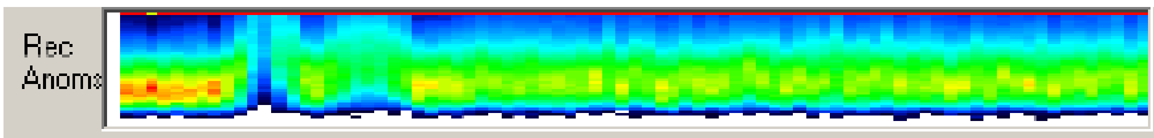
a. All data



b. East Gulf of Mexico

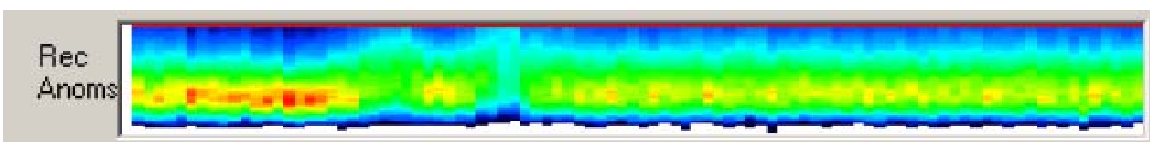


c. West Gulf of Mexico

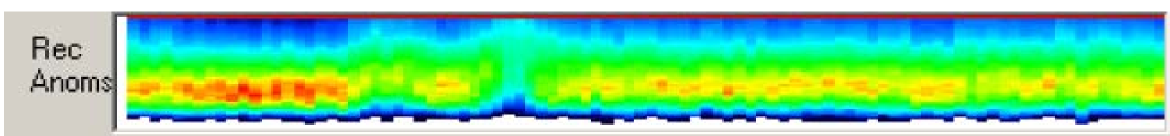


Note: the time series began in 1965 for the east and in 1978 for the west.

d. All data, future landings kept the same



e. All data, future landings decreased by half



f. All data, future landings doubled

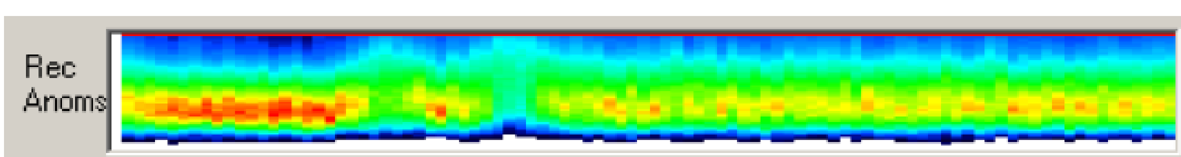
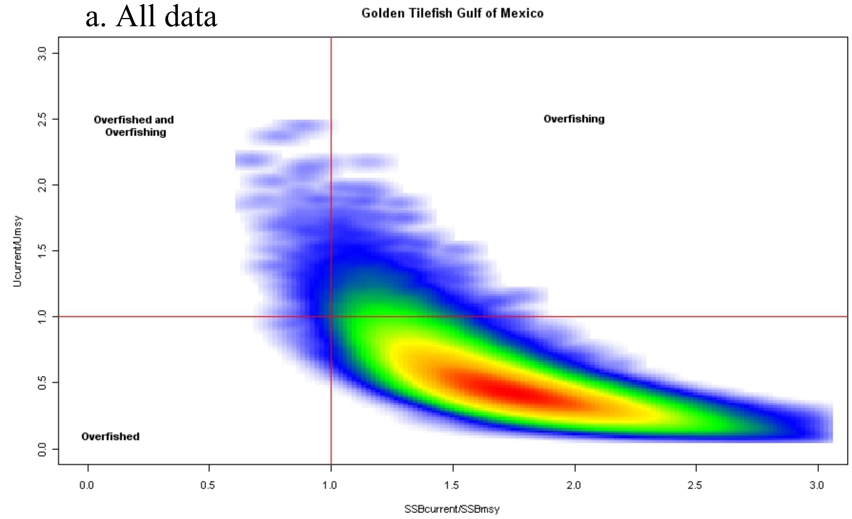
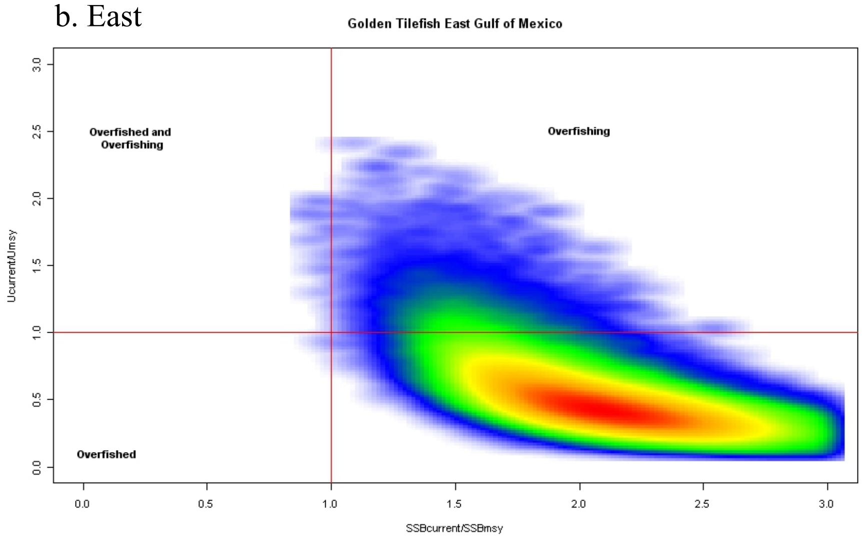


Figure 3. 6. Recruitment anomalies for the historical and future projection time periods for (a) all data combined, (b) East Gulf of Mexico and (c) West Gulf of Mexico for golden tilefish, and for all data combined with (d) landings kept the same, (e) landings decreased by half, and (f) landings doubled from SRA.

a. All data



b. East



c. West

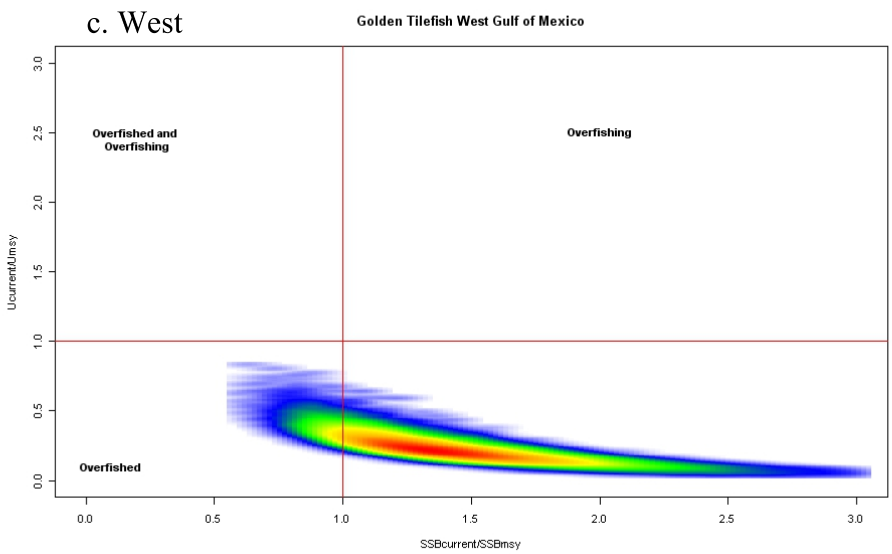


Figure 3.7. Current stock status and harvest rate for golden tilefish from SRA for (a) all data combined, (b) East Gulf of Mexico and (c) West Gulf of Mexico. Smooth Scatter plot (R Developing Core Team) color symbolizes density of points (red highest density).

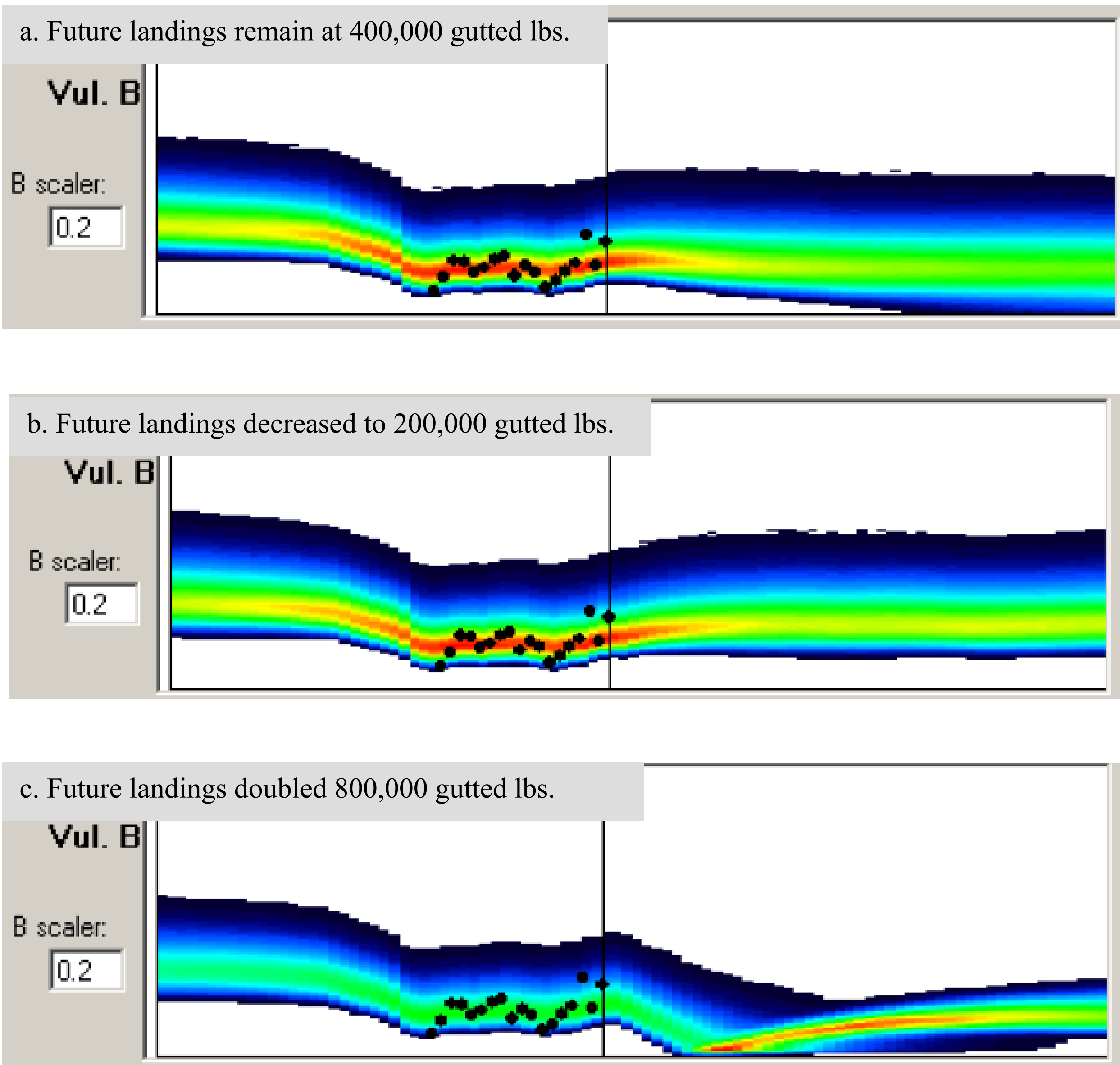


Figure 3.8. Future projections of vulnerable biomass for golden tilefish from SRA with all data combined for (a) landings kept the same, (b) landings decreased by half and (c) landings doubled for golden tilefish. The vertical line indicates the last year of data, 2009. Black dots represent the commercial longline index.

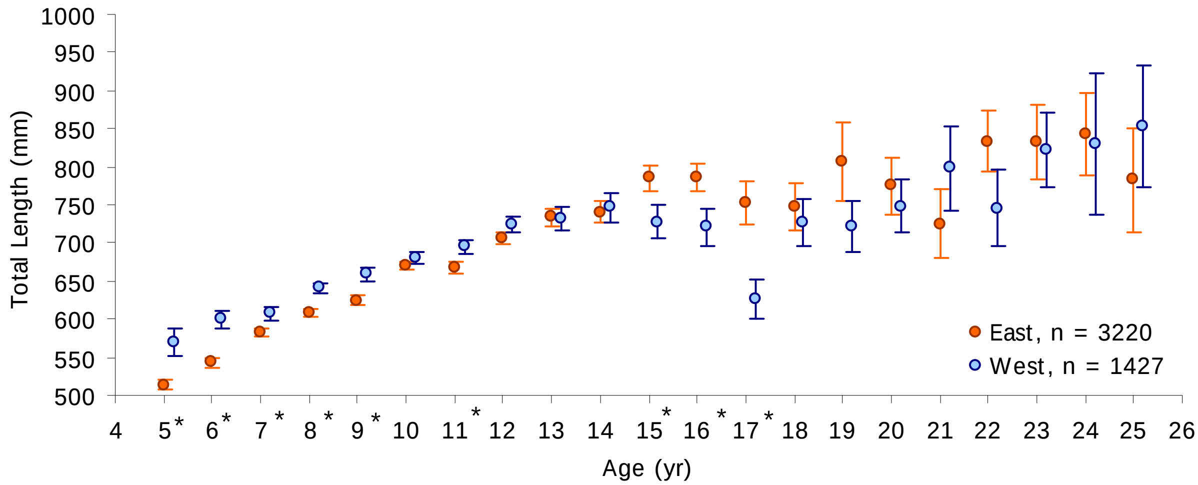


Figure 3.9. Observed mean size at age by region for Gulf of Mexico tilefish. Whiskers represent standard errors.

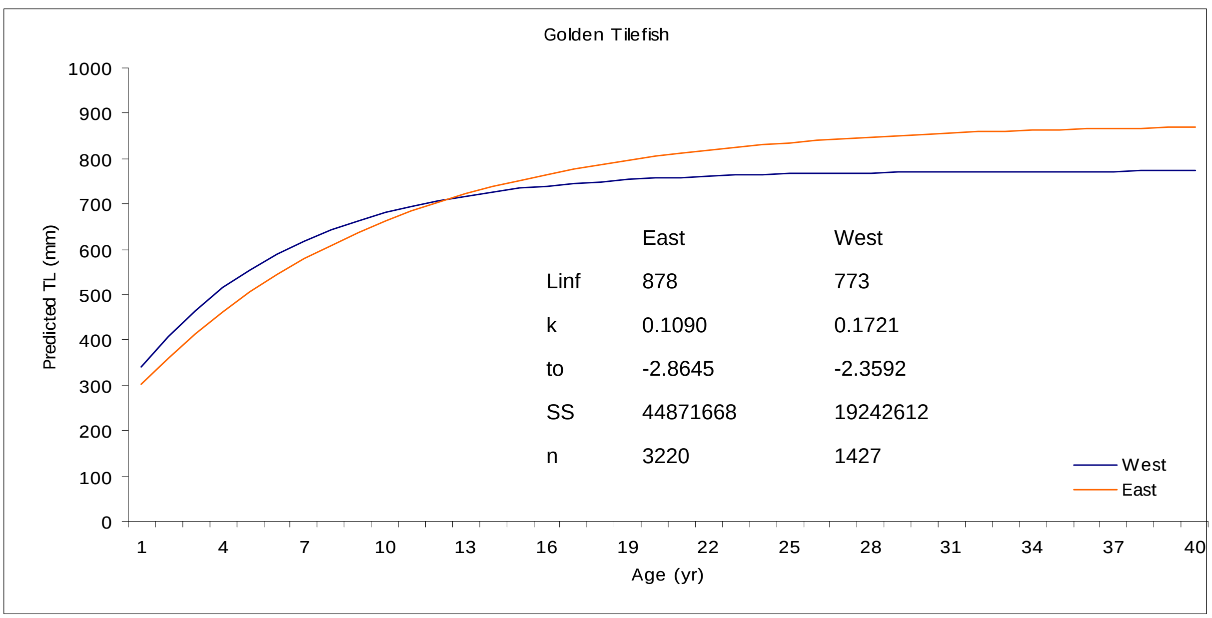


Figure 3.10. Von Bertalanffy growth curves by region for Gulf of Mexico tilefish.

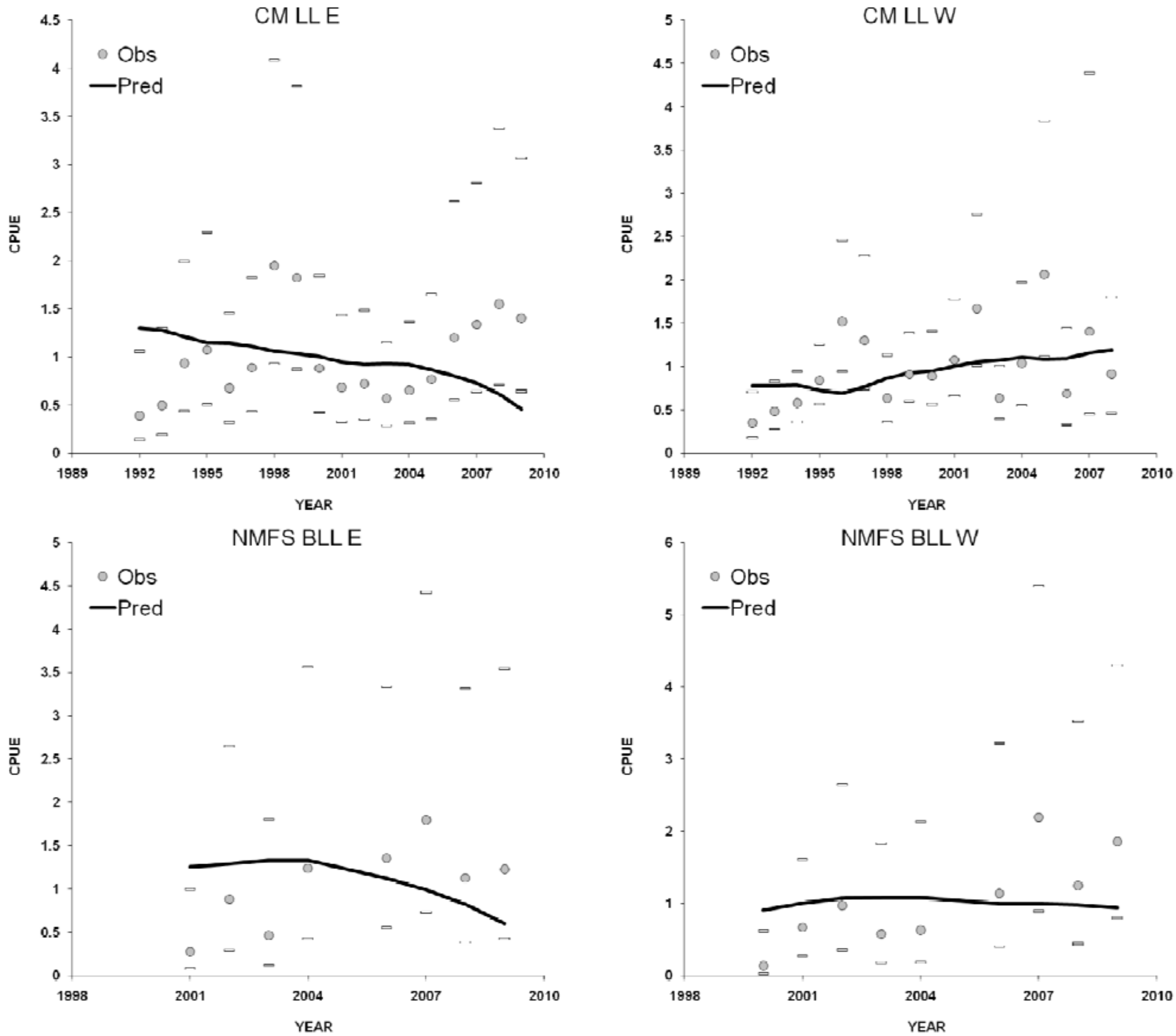


Figure 3.11. Observed and predicted index CPUE for Gulf of Mexico tilefish from SS Run1. Indices include the commercial long line east (CM LL E), commercial long line west (CM LL W), NMFS bottom long line survey east (NMFS BLL E), and NMFS bottom long line west (NMFS BLL W). Error bars represent the observed log-scale standard errors.

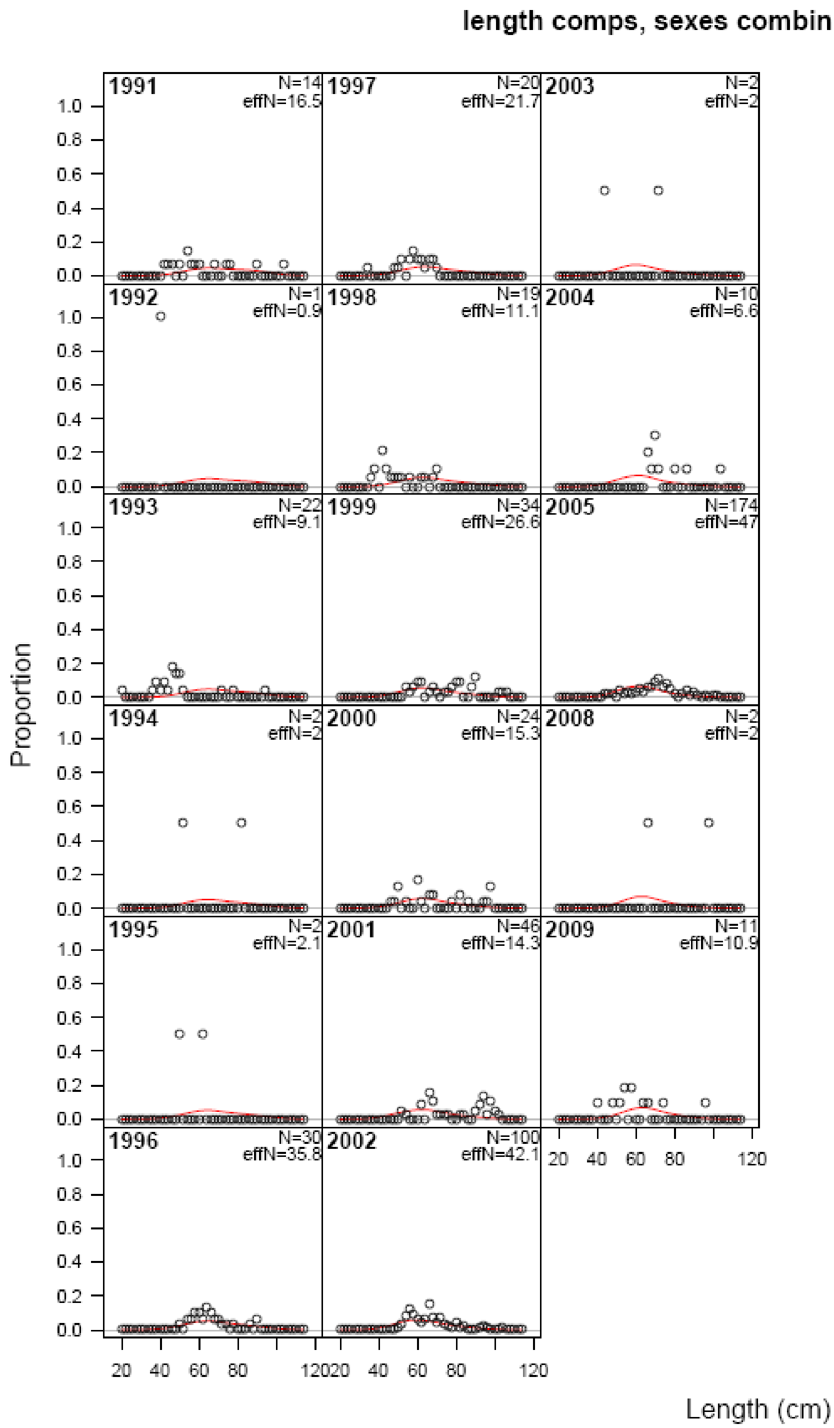


Figure 3.12. Observed (open circles) and predicted (lines) length compositions for Gulf of Mexico tilefish of unknown gender in the commercial hand line east fishery from SS Run1. Observed (N) sample sizes and effective sample sizes (effN) estimated by SS are also reported. Observed sample sizes were capped at a maximum of 200 fish.

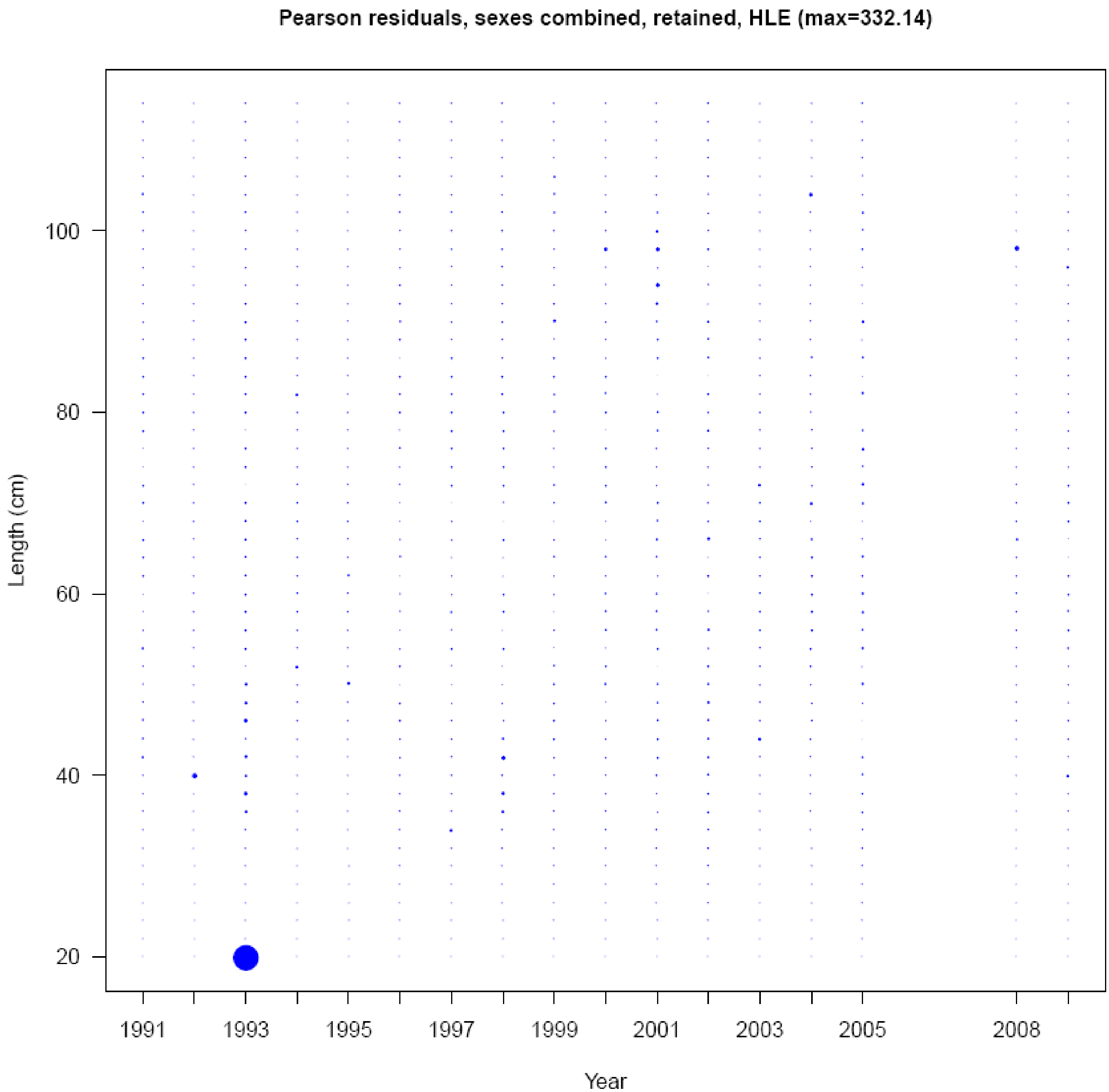


Figure 3.13. Pearson residuals of length composition fits for Gulf of Mexico tilefish of unknown gender in the commercial hand line east fishery from SS Run1. Solid circles are positive residuals (i.e., observed greater than predicted) and open circles are negative residuals (i.e., predicted greater than observed).

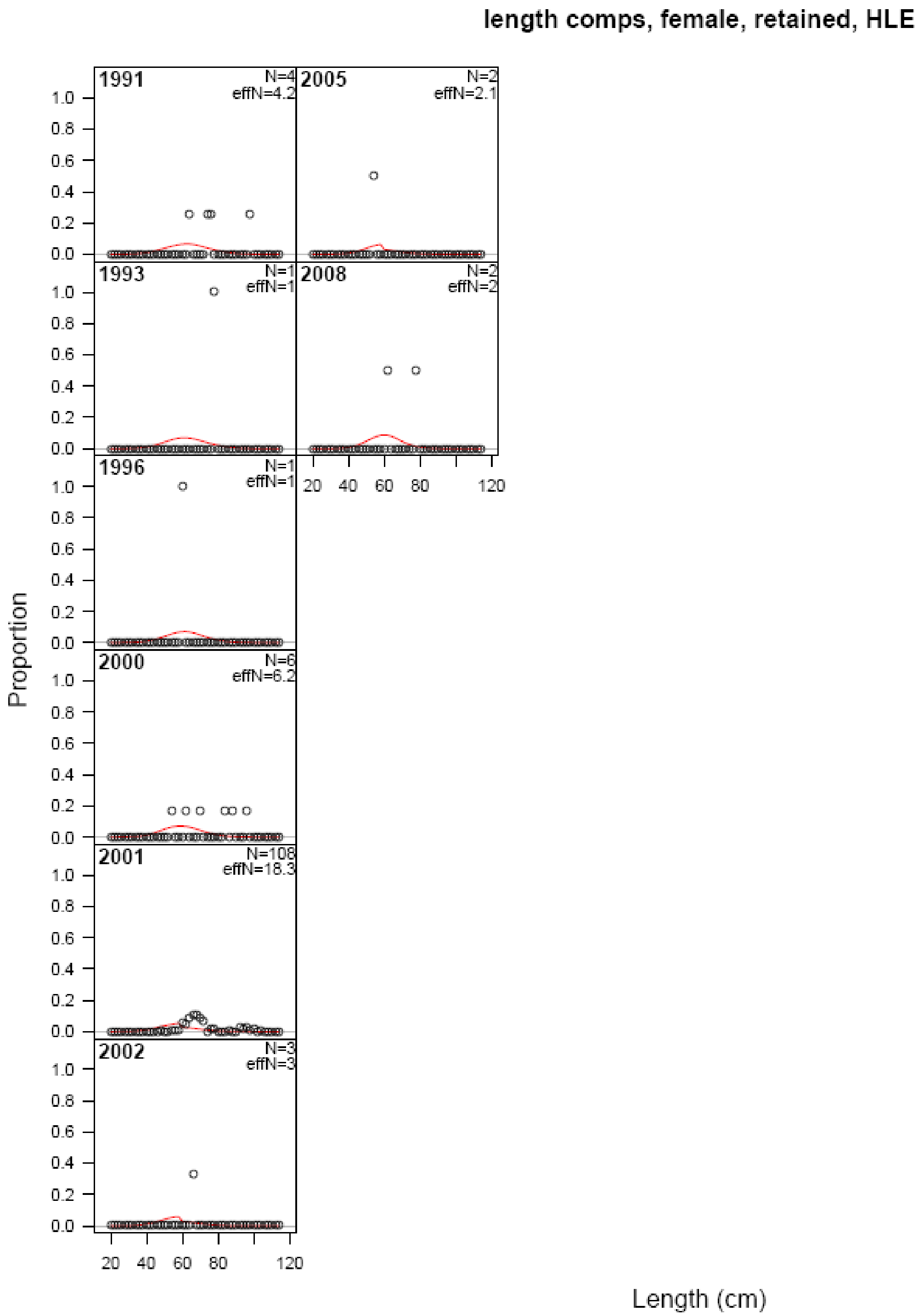


Figure 3.14. Observed (open circles) and predicted (lines) length compositions for female Gulf of Mexico tilefish in the commercial hand line east fishery from SS Run1. Observed (N) sample sizes and effective sample sizes (effN) estimated by SS are also reported. Observed sample sizes were capped at a maximum of 200 fish.

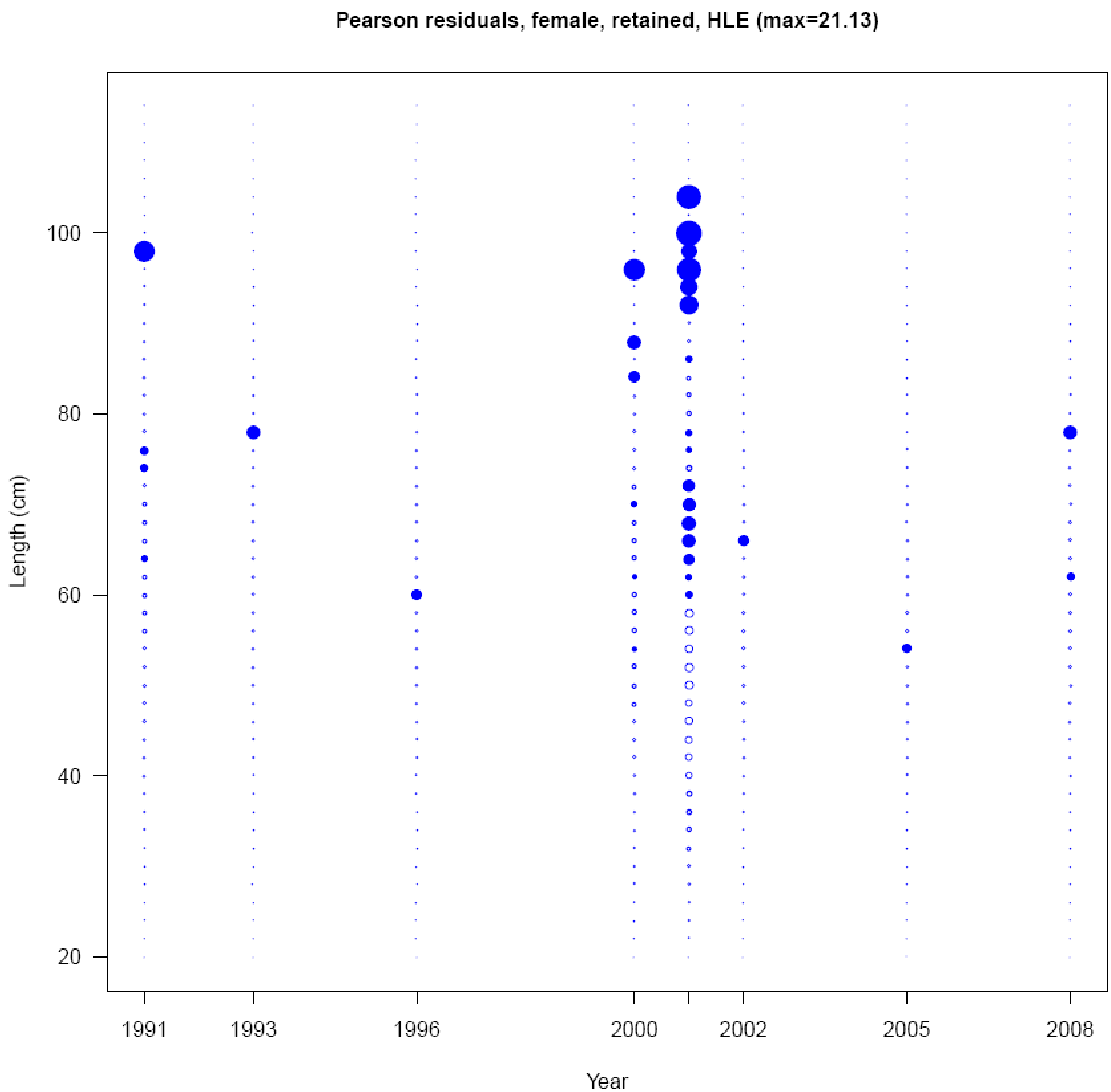


Figure 3.15. Pearson residuals of length composition fits for female Gulf of Mexico tilefish in the commercial hand line east fishery from SS Run1. Solid circles are positive residuals (i.e., observed greater than predicted) and open circles are negative residuals (i.e., predicted greater than observed).

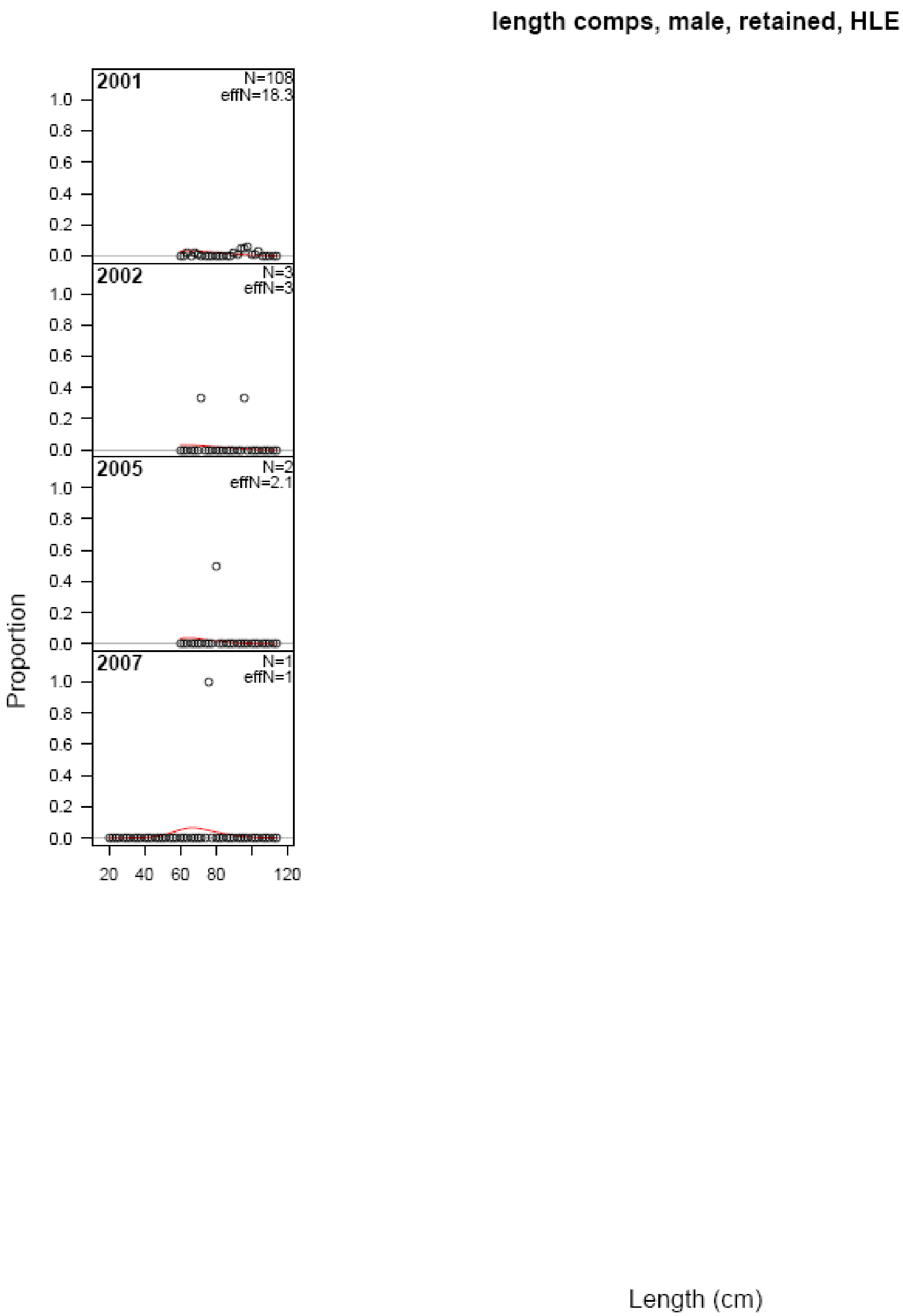


Figure 3.16. Observed (open circles) and predicted (lines) length compositions for male Gulf of Mexico tilefish in the commercial hand line east fishery from SS Run1. Observed (N) sample sizes and effective sample sizes (effN) estimated by SS are also reported. Observed sample sizes were capped at a maximum of 200 fish.

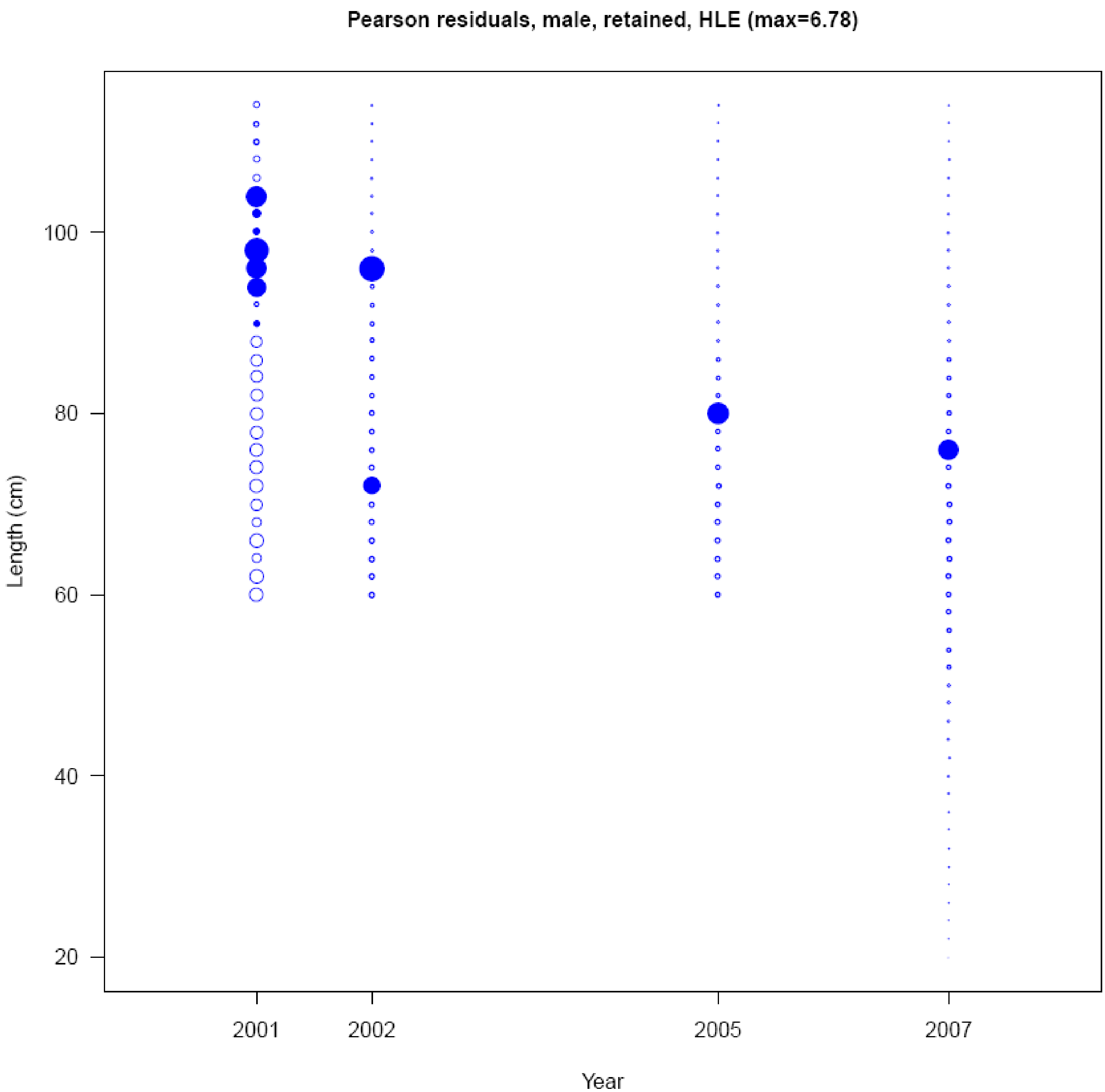


Figure 3.17. Pearson residuals of length composition fits for male Gulf of Mexico tilefish in the commercial hand line east fishery from SS Run1. Solid circles are positive residuals (i.e., observed greater than predicted) and open circles are negative residuals (i.e., predicted greater than observed).

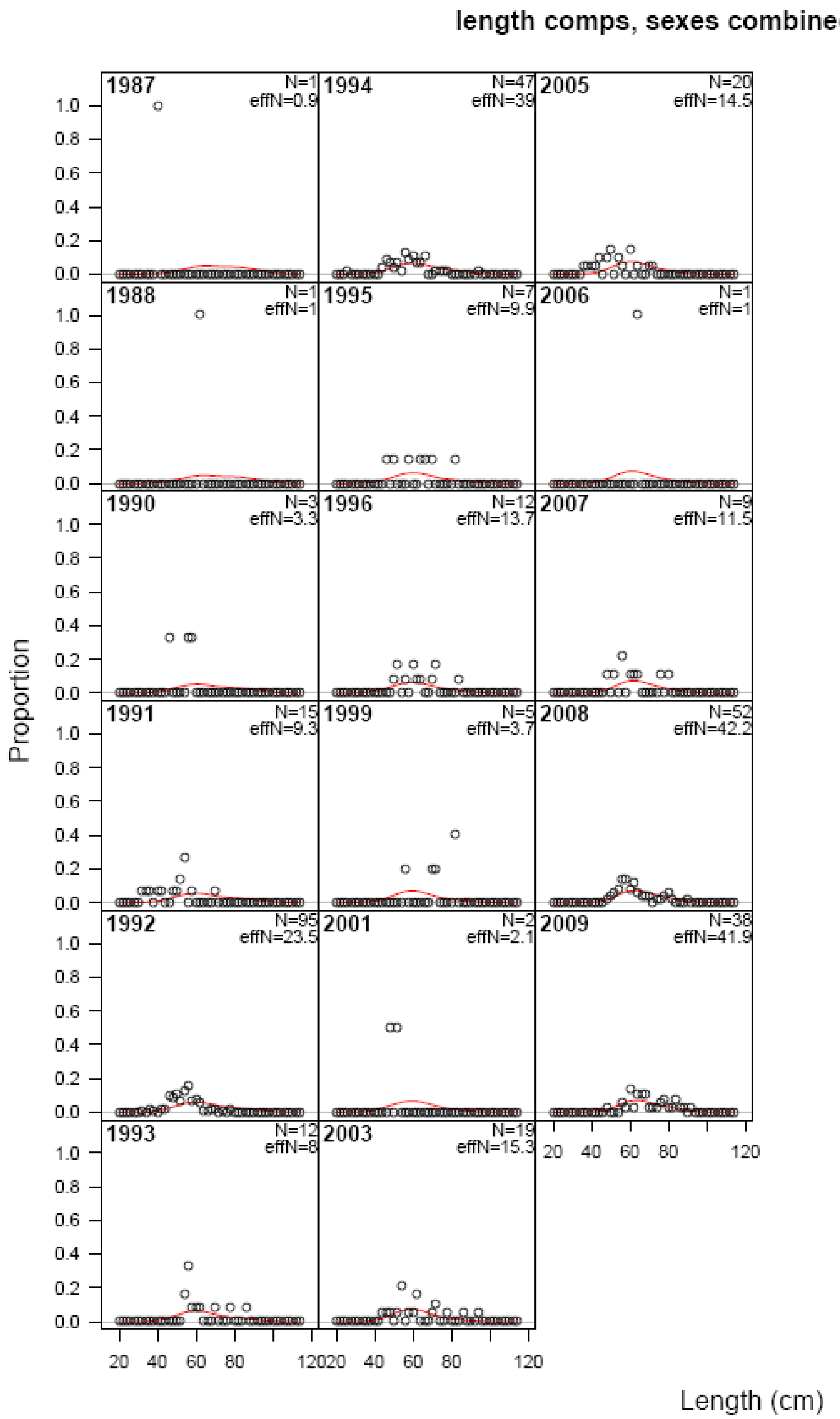


Figure 3.18. Observed (open circles) and predicted (lines) length compositions for Gulf of Mexico tilefish of unkown gender in the commercial hand line west fishery from SS Run1. Observed (N) sample sizes and effective sample sizes (effN) estimated by SS are also reported. Observed sample sizes were capped at a maximum of 200 fish.

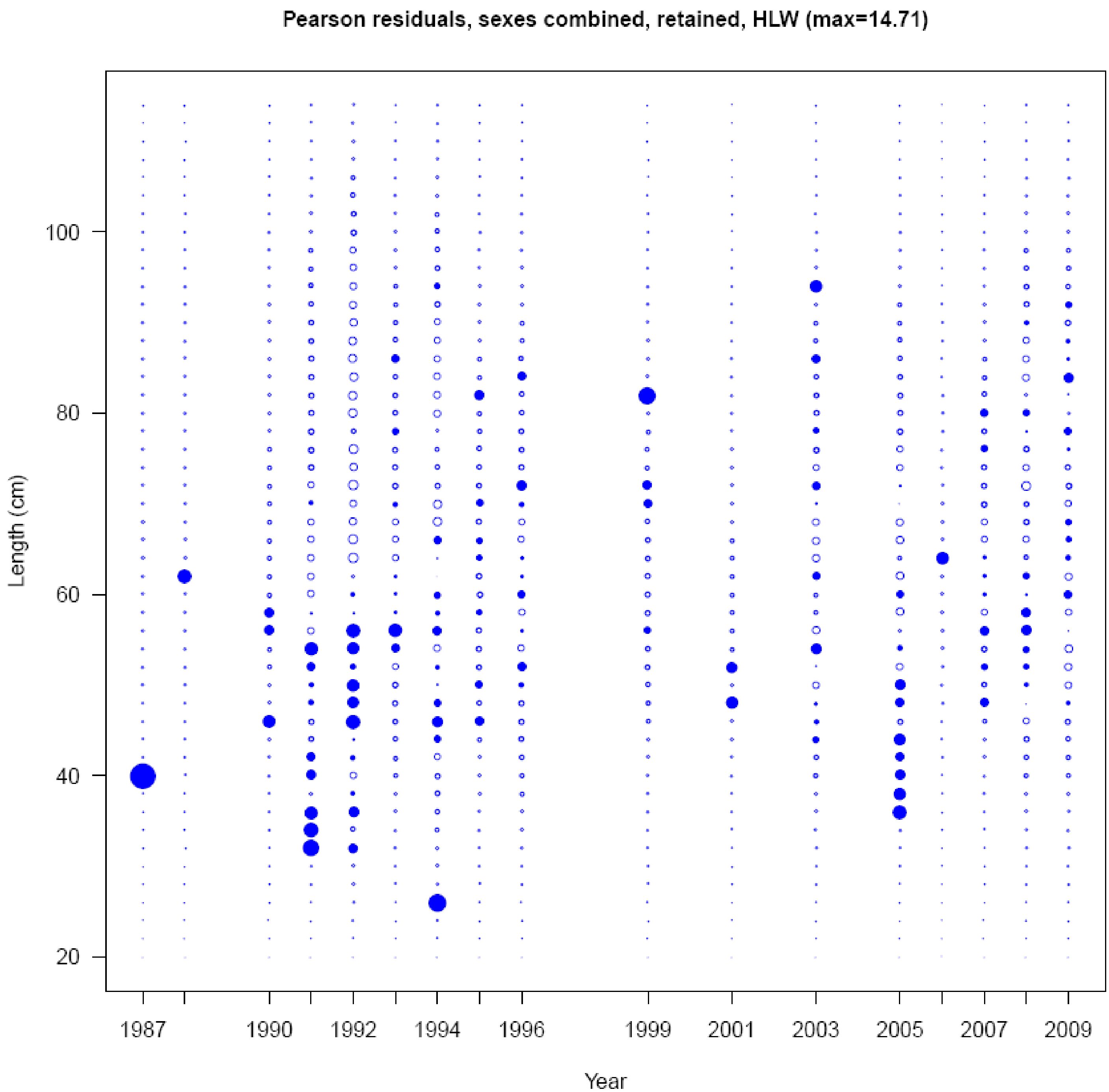


Figure 3.19. Pearson residuals of length composition fits for Gulf of Mexico tilefish of unknown gender in the commercial hand line west fishery from SS Run1. Solid circles are positive residuals (i.e., observed greater than predicted) and open circles are negative residuals (i.e., predicted greater than observed).

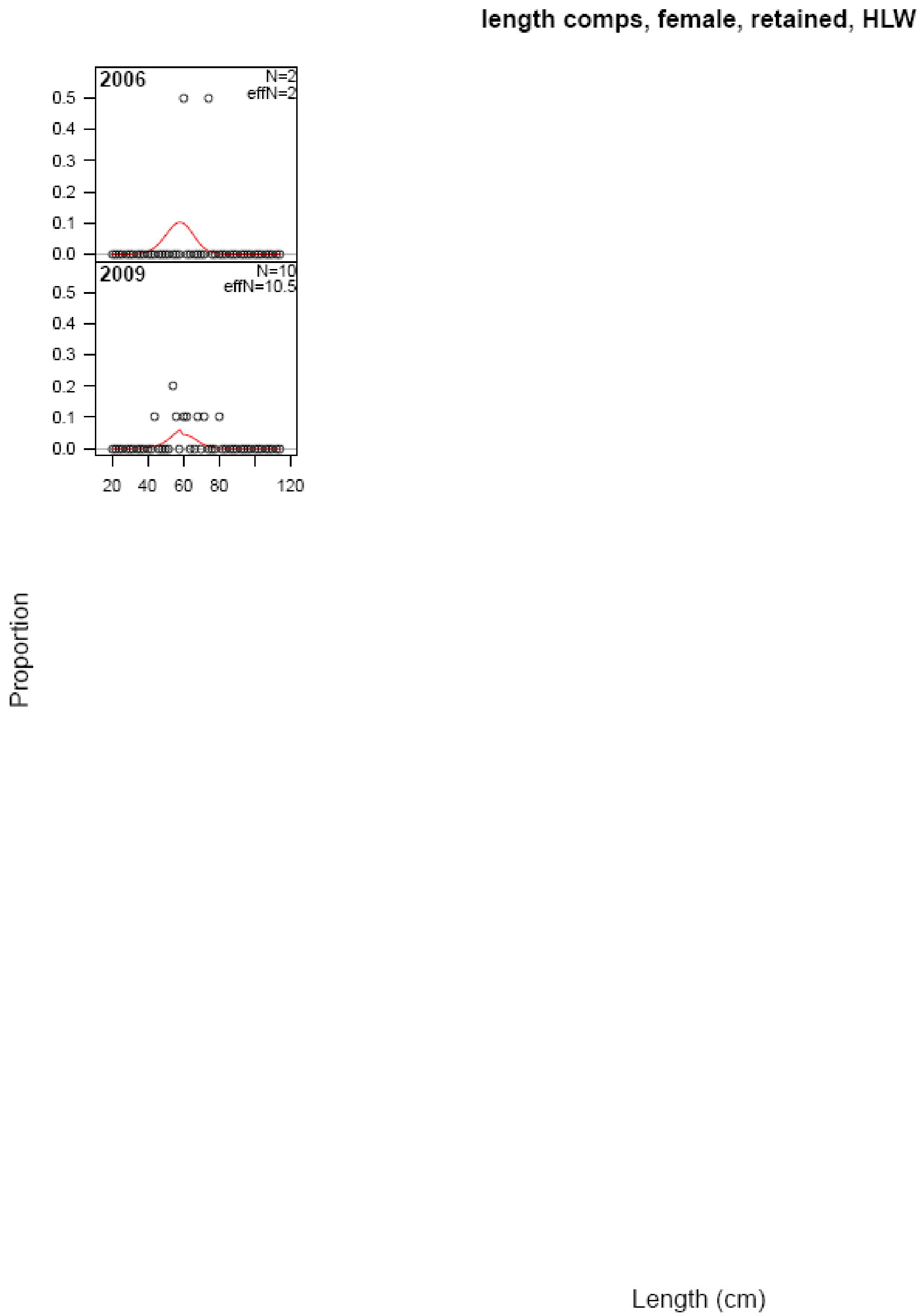


Figure 3.20. Observed (open circles) and predicted (lines) length compositions for female Gulf of Mexico tilefish in the commercial hand line west fishery from SS Run1. Observed (N) sample sizes and effective sample sizes (effN) estimated by SS are also reported. Observed sample sizes were capped at a maximum of 200 fish.

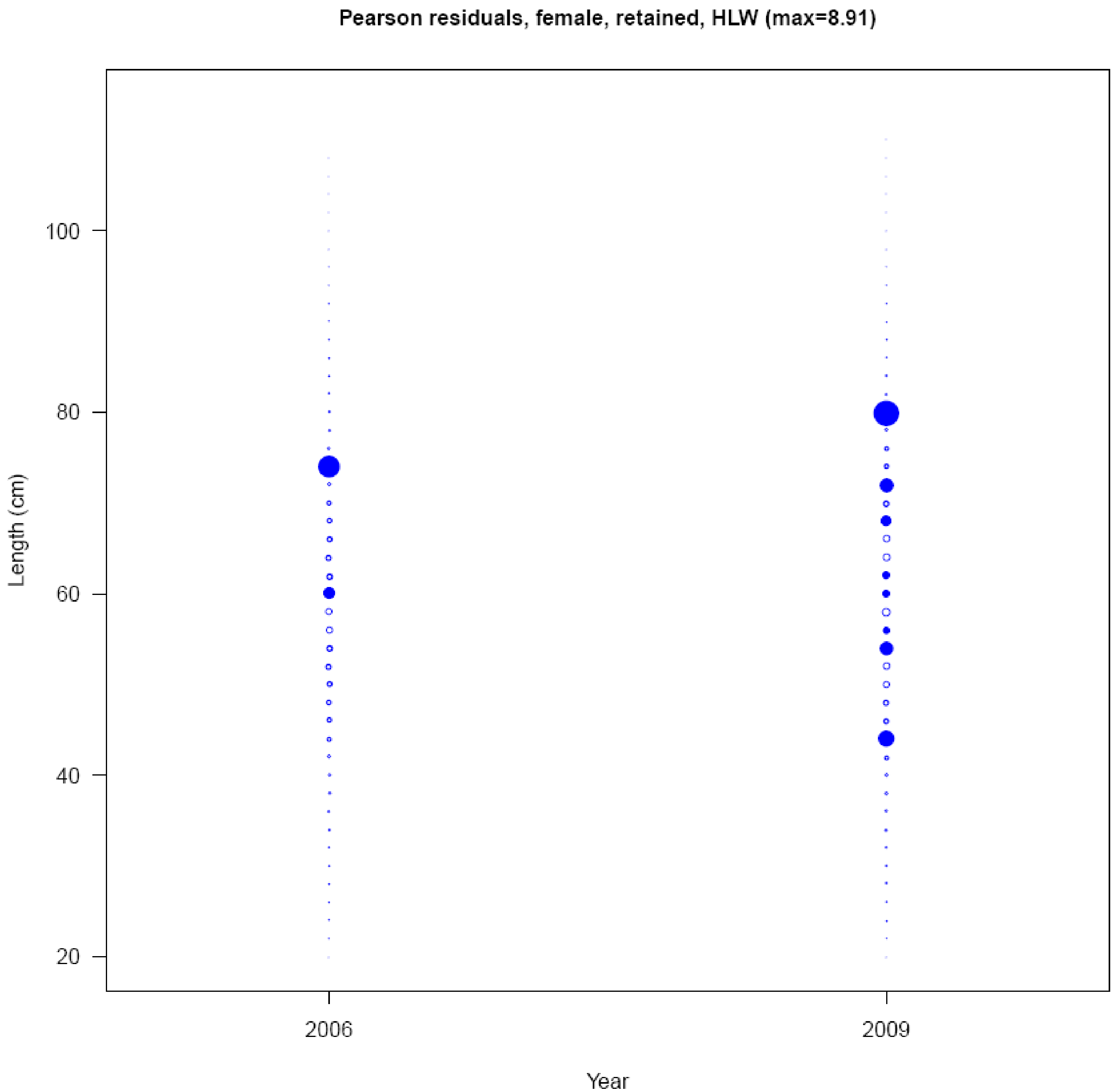


Figure 3.21. Pearson residuals of length composition fits for female Gulf of Mexico tilefish in the commercial hand line west fishery from SS Run1. Solid circles are positive residuals (i.e., observed greater than predicted) and open circles are negative residuals (i.e., predicted greater than observed).

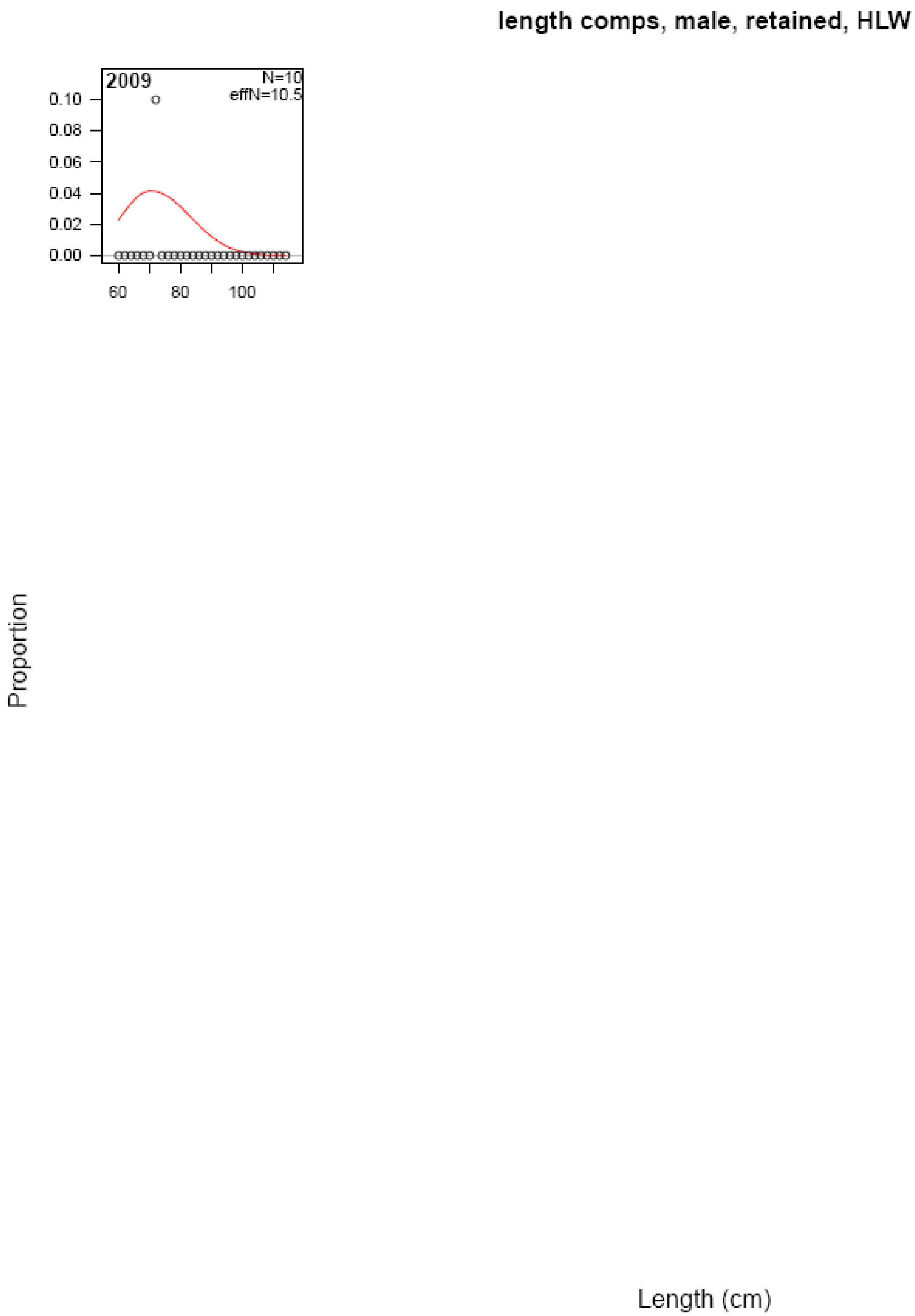


Figure 3.22. Observed (open circles) and predicted (lines) length compositions for male Gulf of Mexico tilefish in the commercial hand line west fishery from SS Run1. Observed (N) sample sizes and effective sample sizes (effN) estimated by SS are also reported. Observed sample sizes were capped at a maximum of 200 fish.

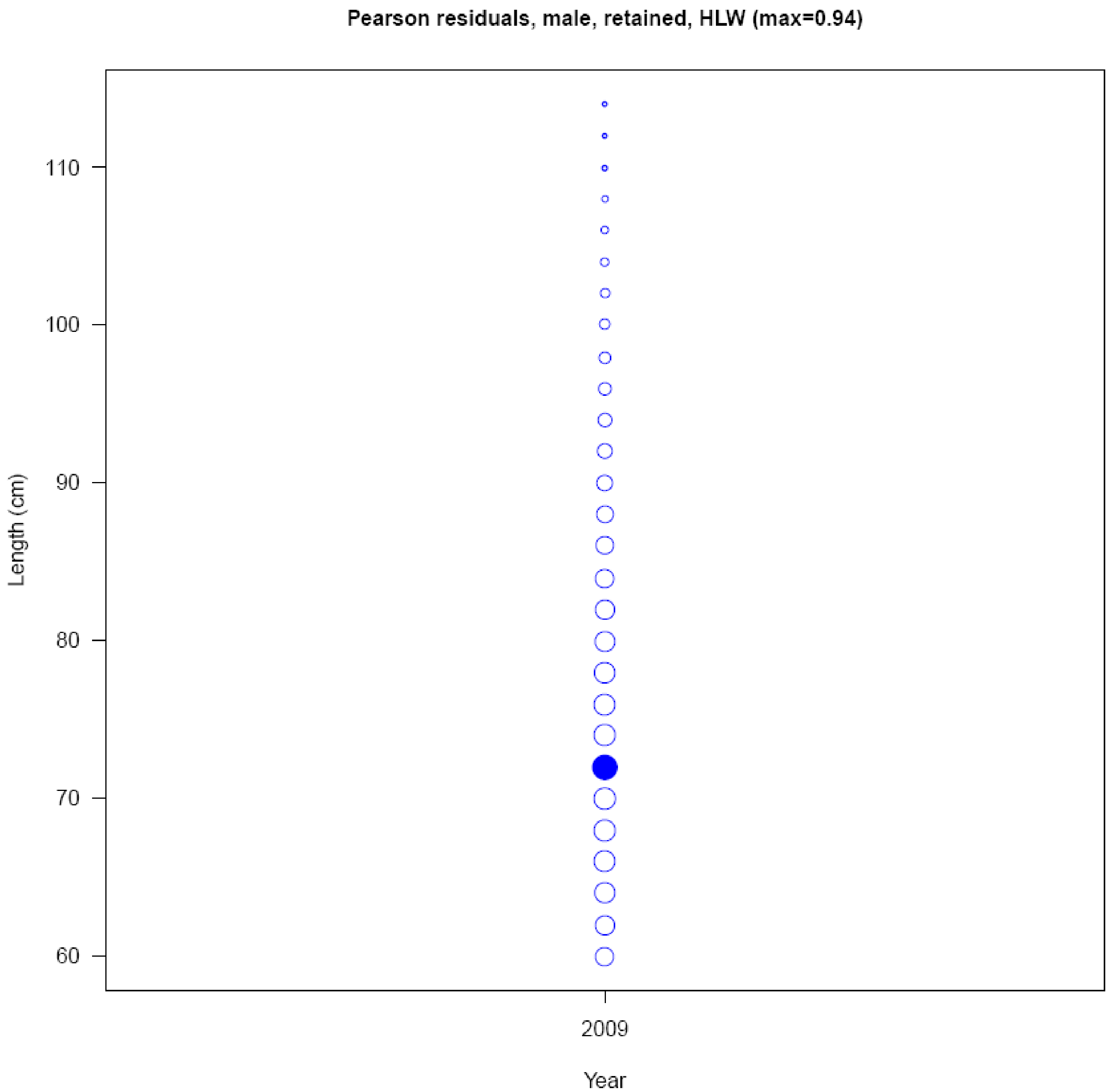


Figure 3.23. Pearson residuals of length composition fits for male Gulf of Mexico tilefish in the commercial hand line west fishery from SS Run1. Solid circles are positive residuals (i.e., observed greater than predicted) and open circles are negative residuals (i.e., predicted greater than observed).

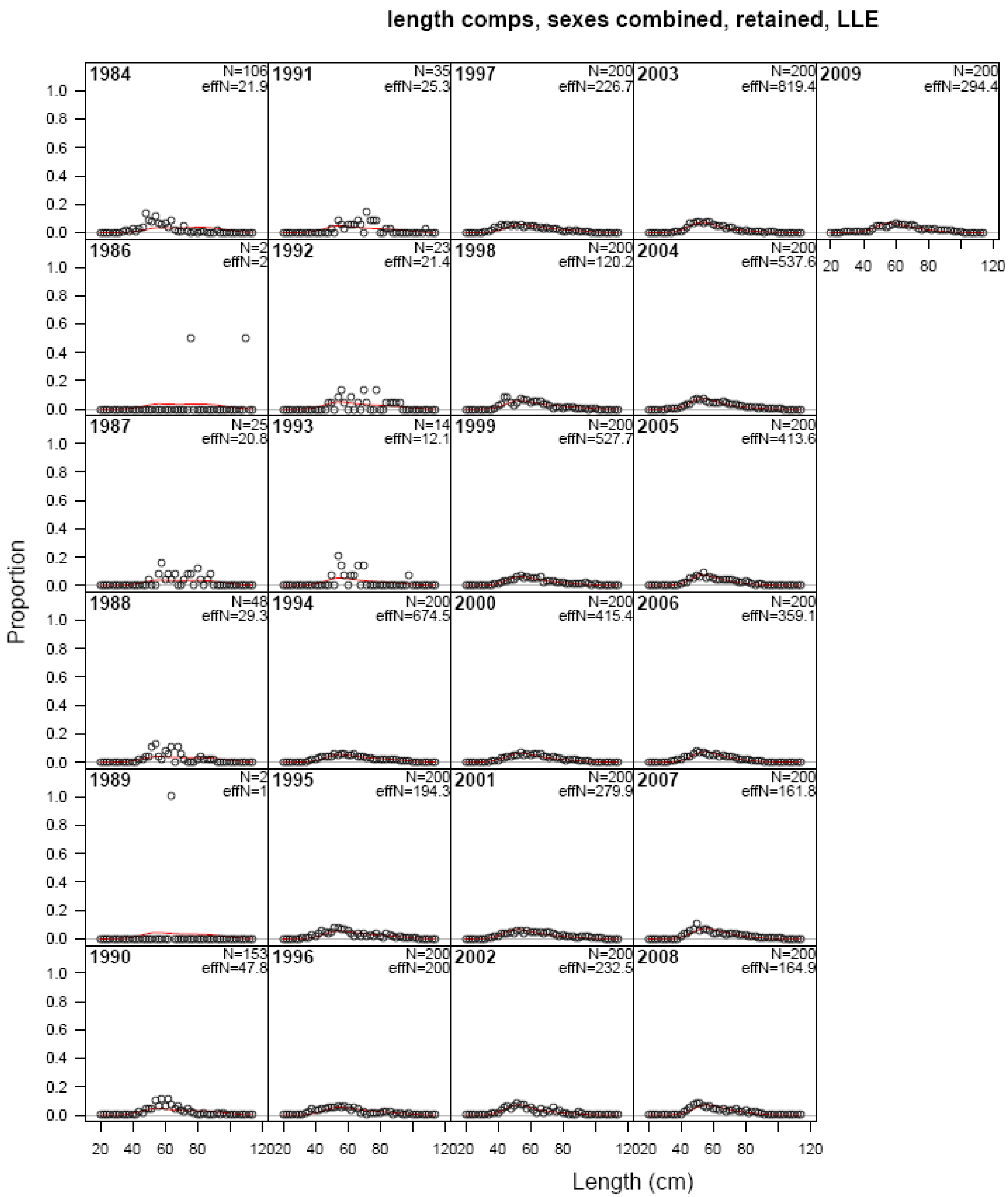


Figure 3.24. Observed (open circles) and predicted (lines) length compositions for Gulf of Mexico tilefish of unknown gender in the commercial long line east fishery from SS Run1. Observed (N) sample sizes and effective sample sizes (effN) estimated by SS are also reported. Observed sample sizes were capped at a maximum of 200 fish.

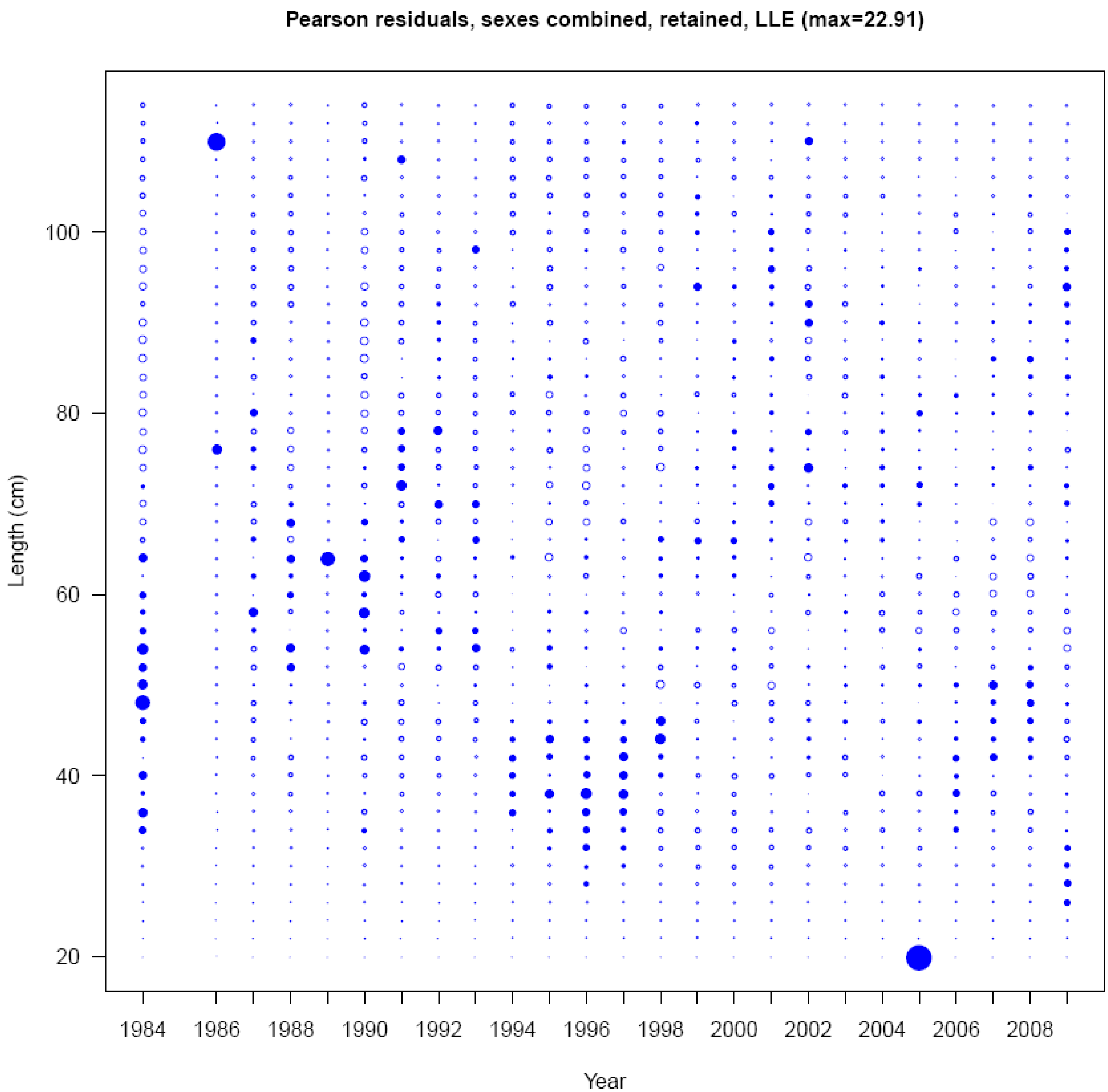


Figure 3.25. Pearson residuals of length composition fits for Gulf of Mexico tilefish of unknown gender in the commercial long line east fishery from SS Run1. Solid circles are positive residuals (i.e., observed greater than predicted) and open circles are negative residuals (i.e., predicted greater than observed).

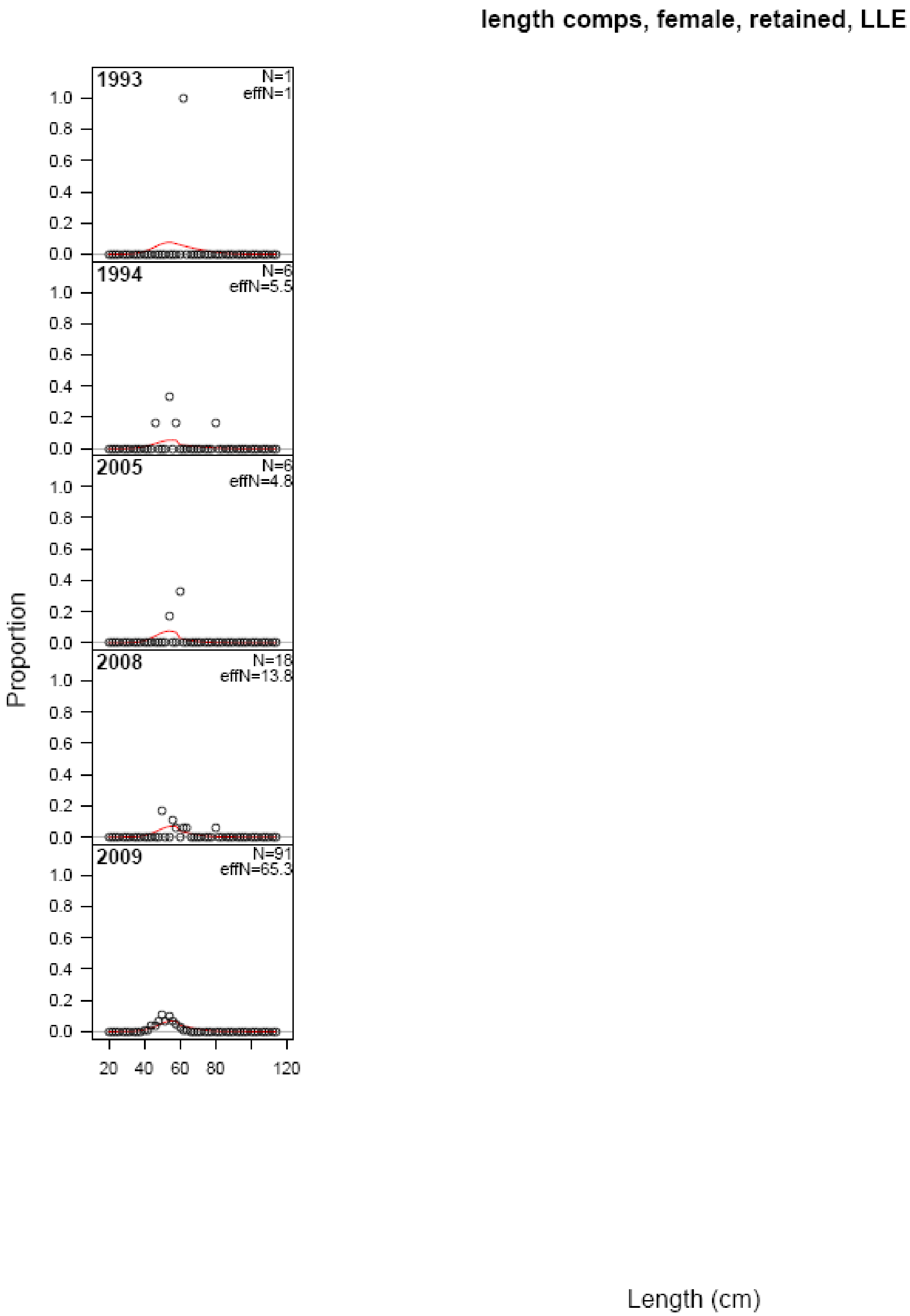


Figure 3.26. Observed (open circles) and predicted (lines) length compositions for female Gulf of Mexico tilefish in the commercial long line east fishery from SS Run1. Observed (N) sample sizes and effective sample sizes (effN) estimated by SS are also reported. Observed sample sizes were capped at a maximum of 200 fish.

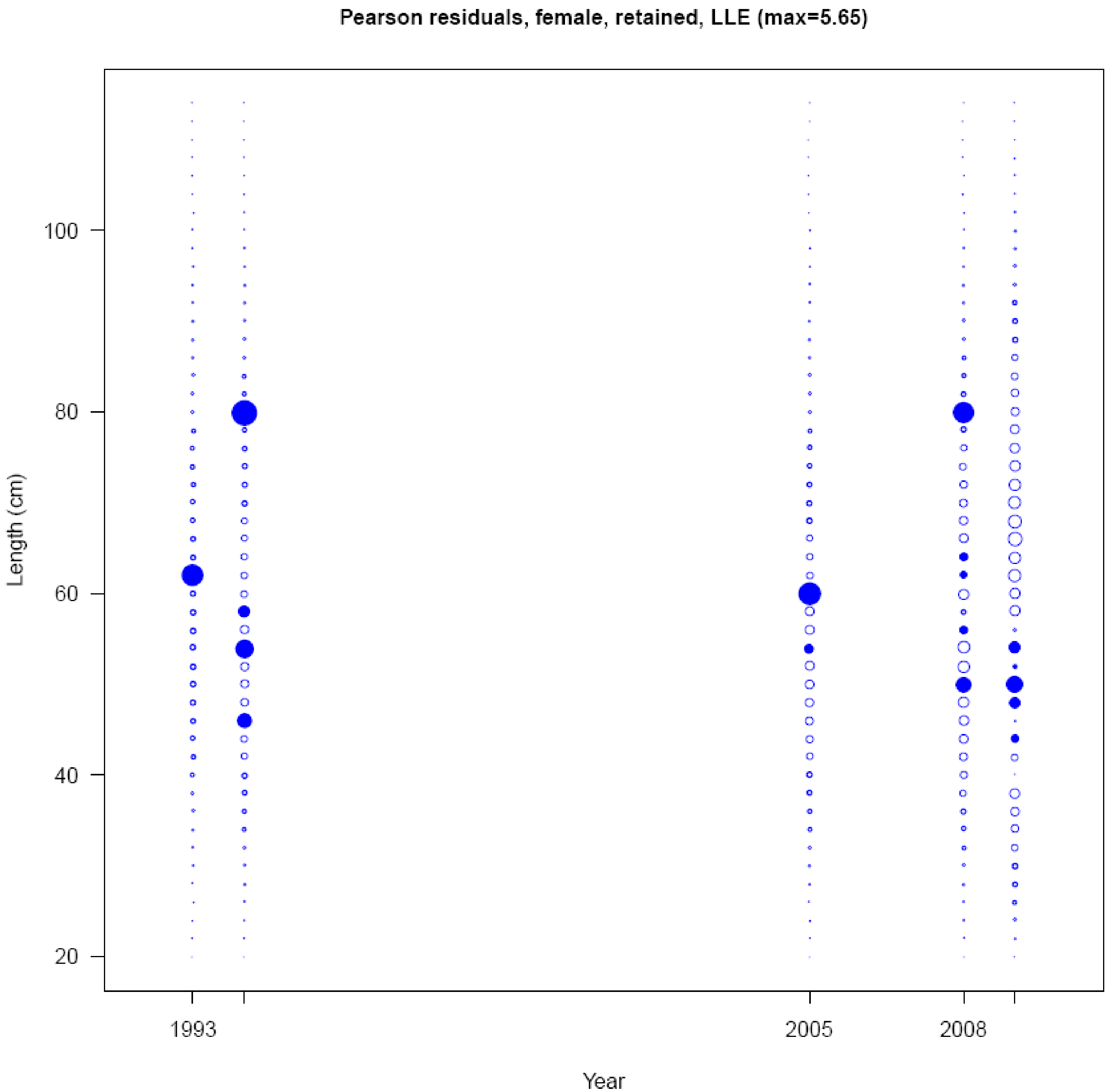


Figure 3.27. Pearson residuals of length composition fits for female Gulf of Mexico tilefish in the commercial long line east fishery from SS Run1. Solid circles are positive residuals (i.e., observed greater than predicted) and open circles are negative residuals (i.e., predicted greater than observed).

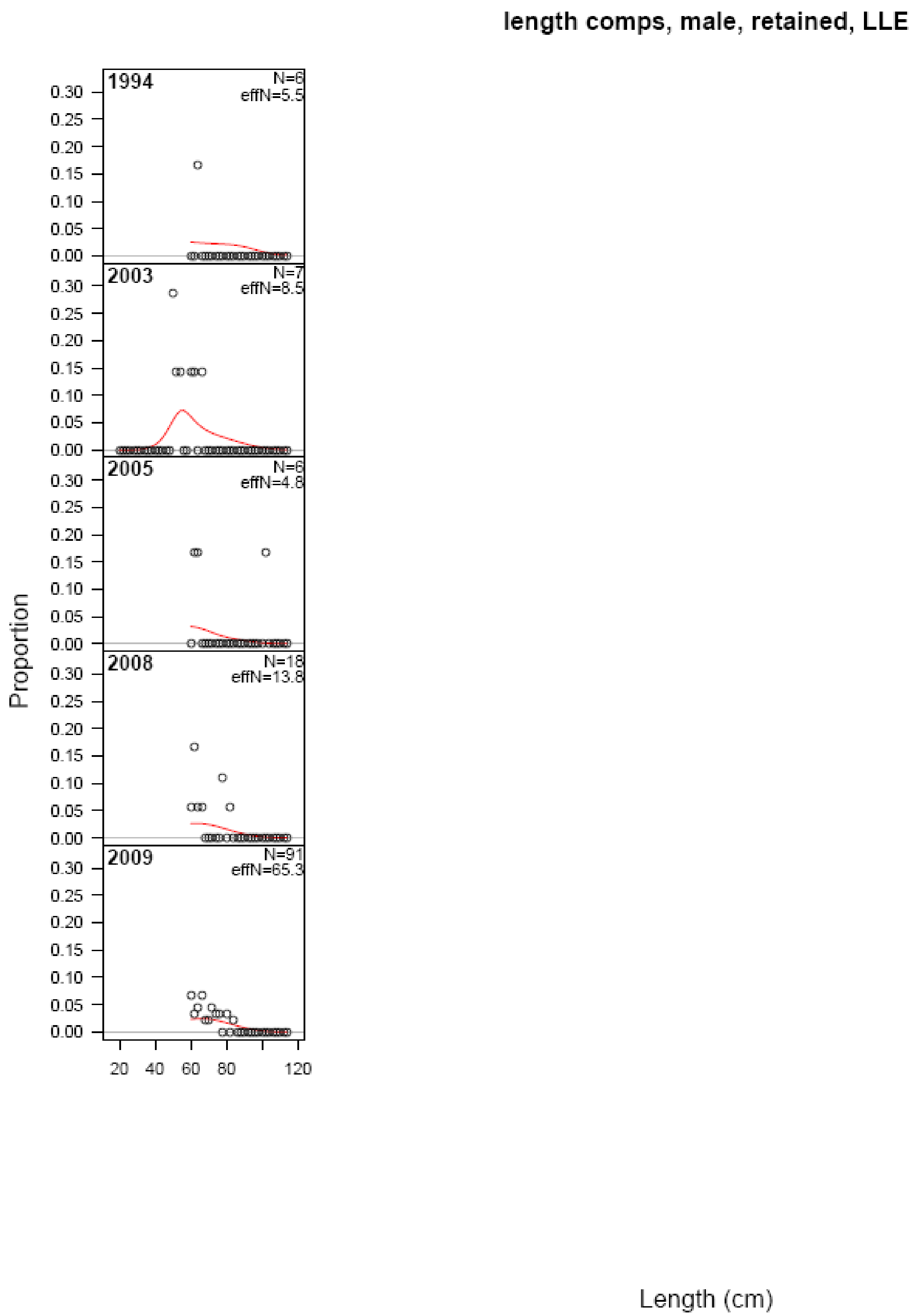


Figure 3.28. Observed (open circles) and predicted (lines) length compositions for male Gulf of Mexico tilefish in the commercial long line east fishery from SS Run1. Observed (N) sample sizes and effective sample sizes (effN) estimated by SS are also reported. Observed sample sizes were capped at a maximum of 200 fish.

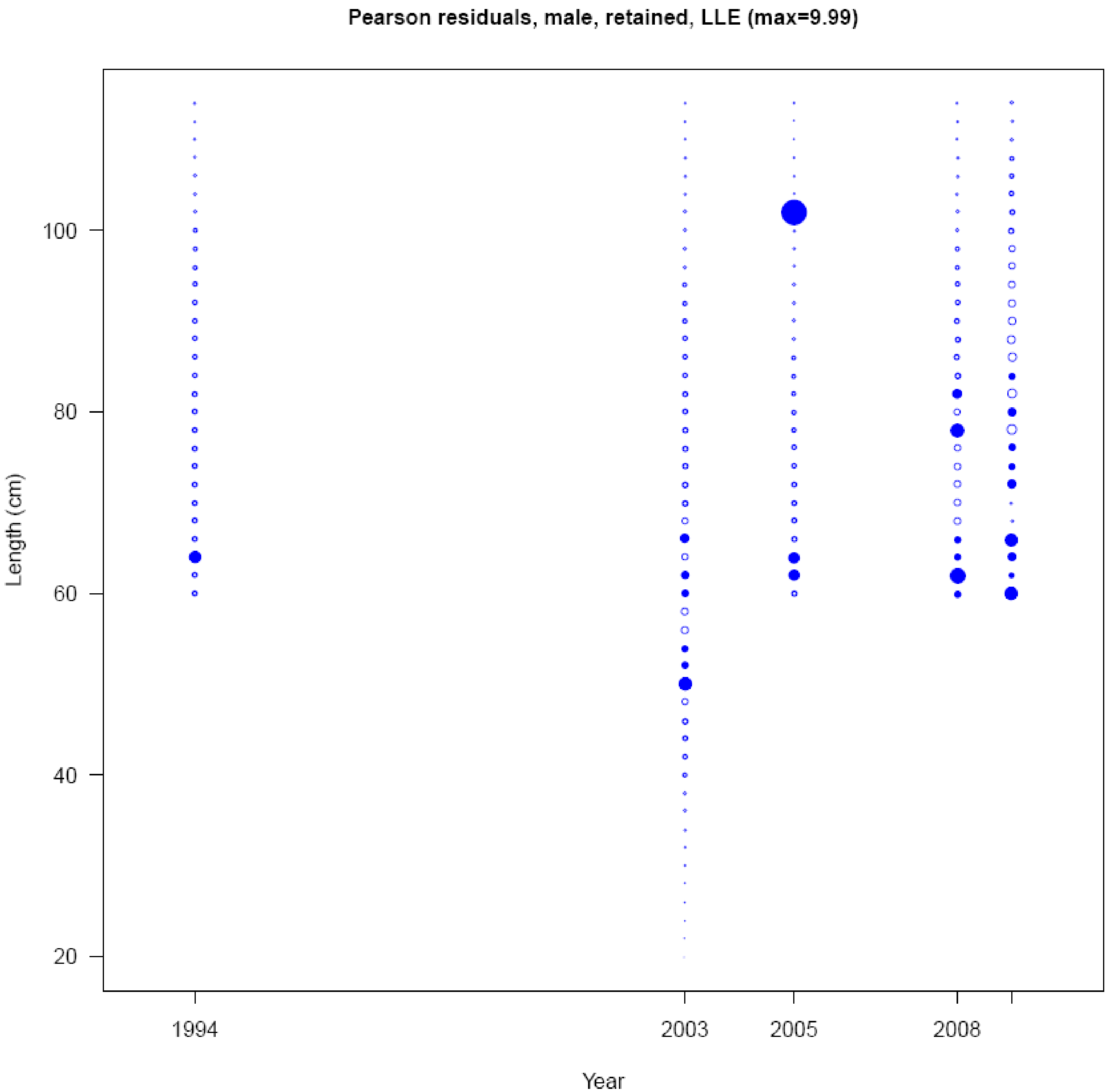


Figure 3.29. Pearson residuals of length composition fits for male Gulf of Mexico tilefish in the commercial long line east fishery from SS Run1. Solid circles are positive residuals (i.e., observed greater than predicted) and open circles are negative residuals (i.e., predicted greater than observed).

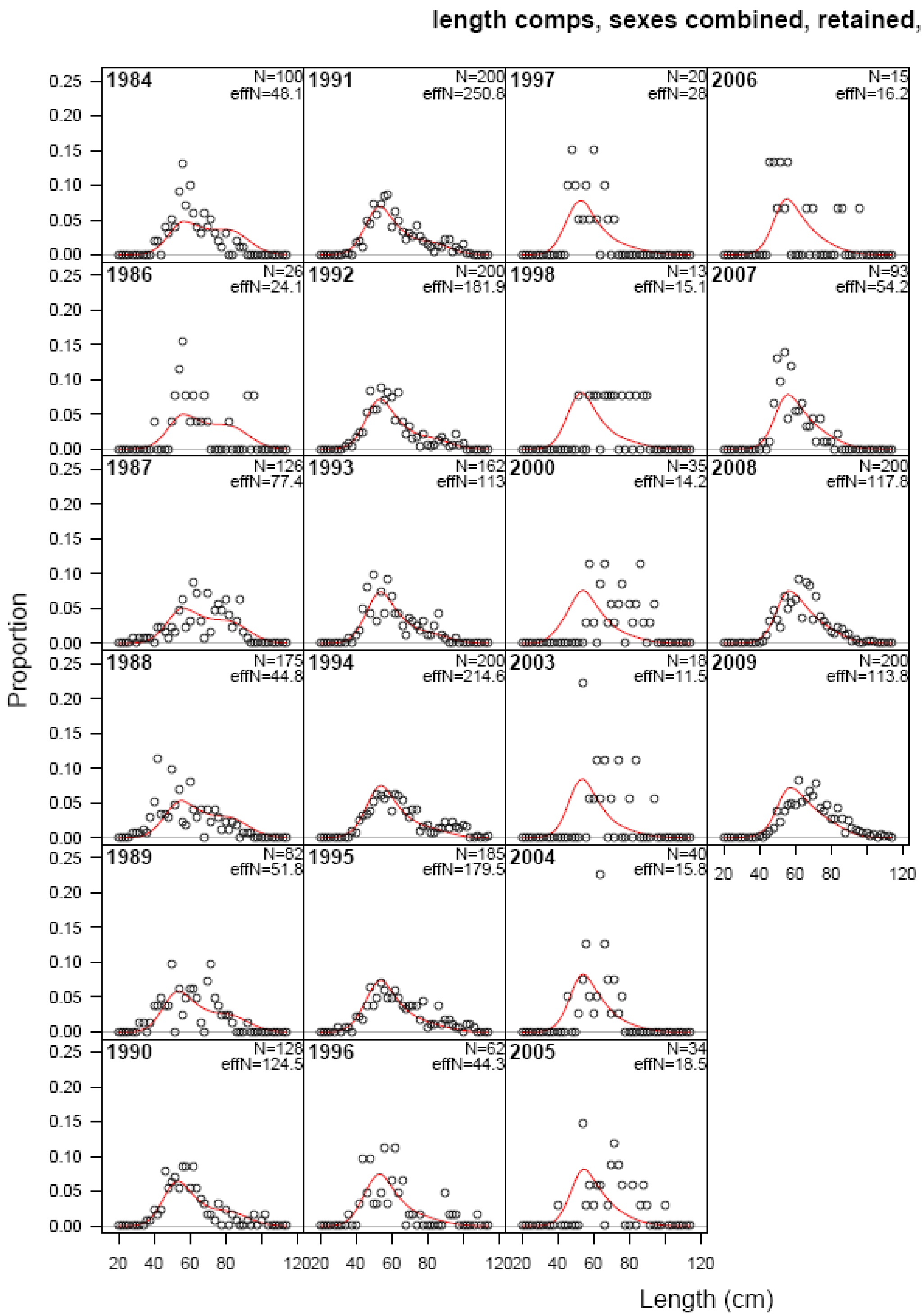


Figure 3.30. Observed (open circles) and predicted (lines) length compositions for Gulf of Mexico tilefish of unknown gender in the commercial long line west fishery from SS Run1. Observed (N) sample sizes and effective sample sizes (effN) estimated by SS are also reported. Observed sample sizes were capped at a maximum of 200 fish.

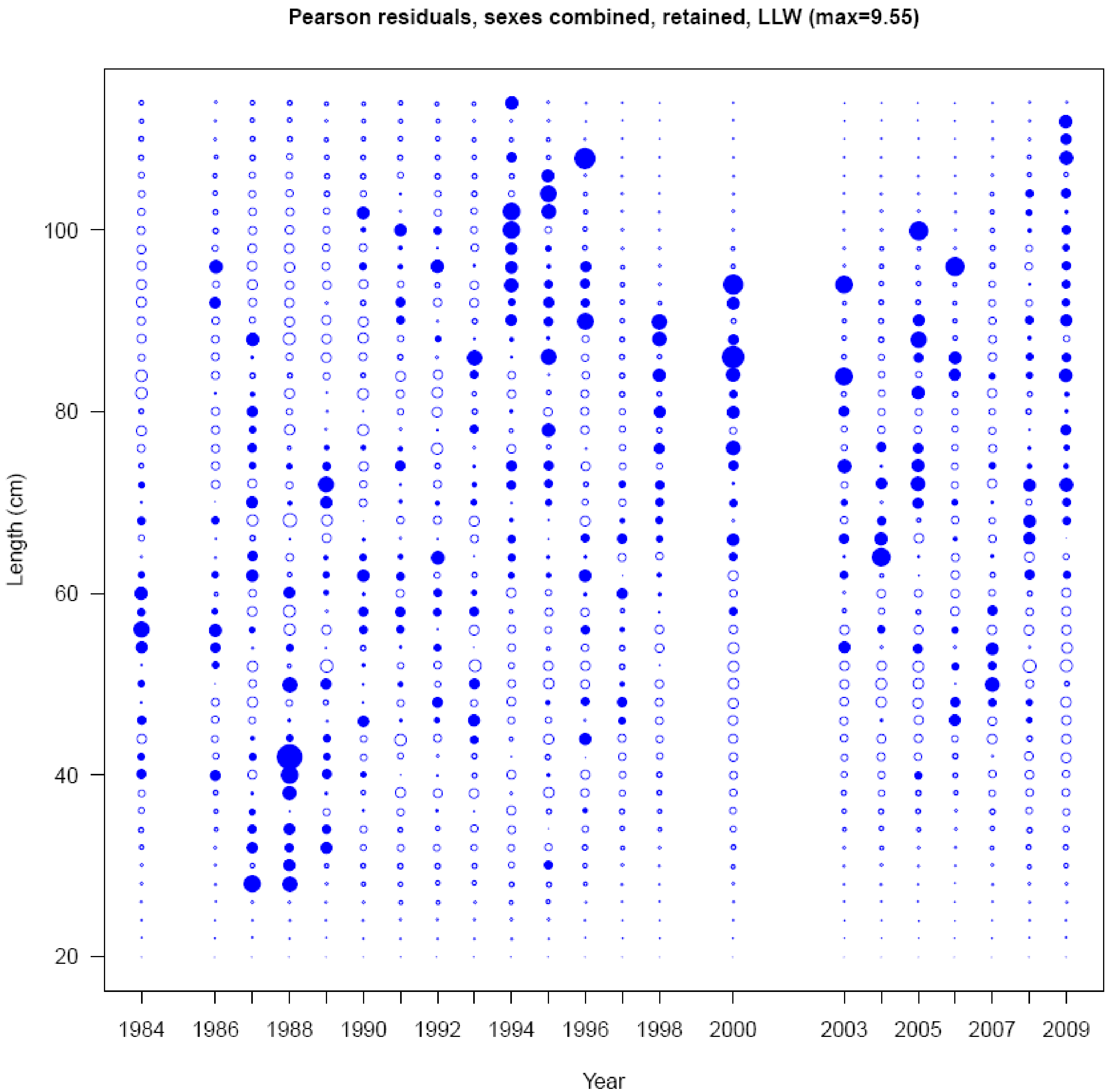


Figure 3.31. Pearson residuals of length composition fits for Gulf of Mexico tilefish of unknown gender in the commercial long line west fishery from SS Run1. Solid circles are positive residuals (i.e., observed greater than predicted) and open circles are negative residuals (i.e., predicted greater than observed).

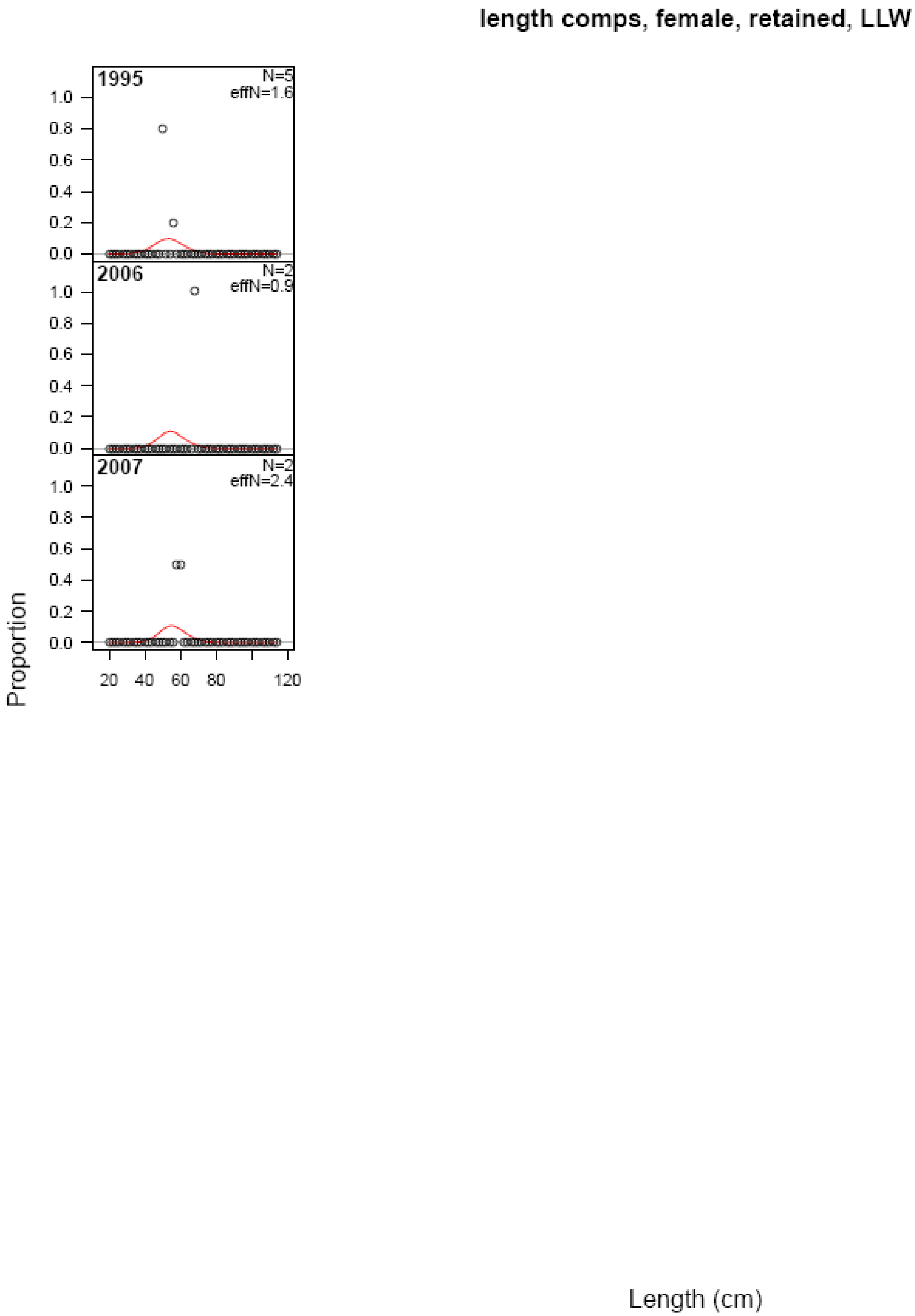


Figure 3.32. Observed (open circles) and predicted (lines) length compositions for female Gulf of Mexico tilefish in the commercial long line west fishery from SS Run1. Observed (N) sample sizes and effective sample sizes (effN) estimated by SS are also reported. Observed sample sizes were capped at a maximum of 200 fish.

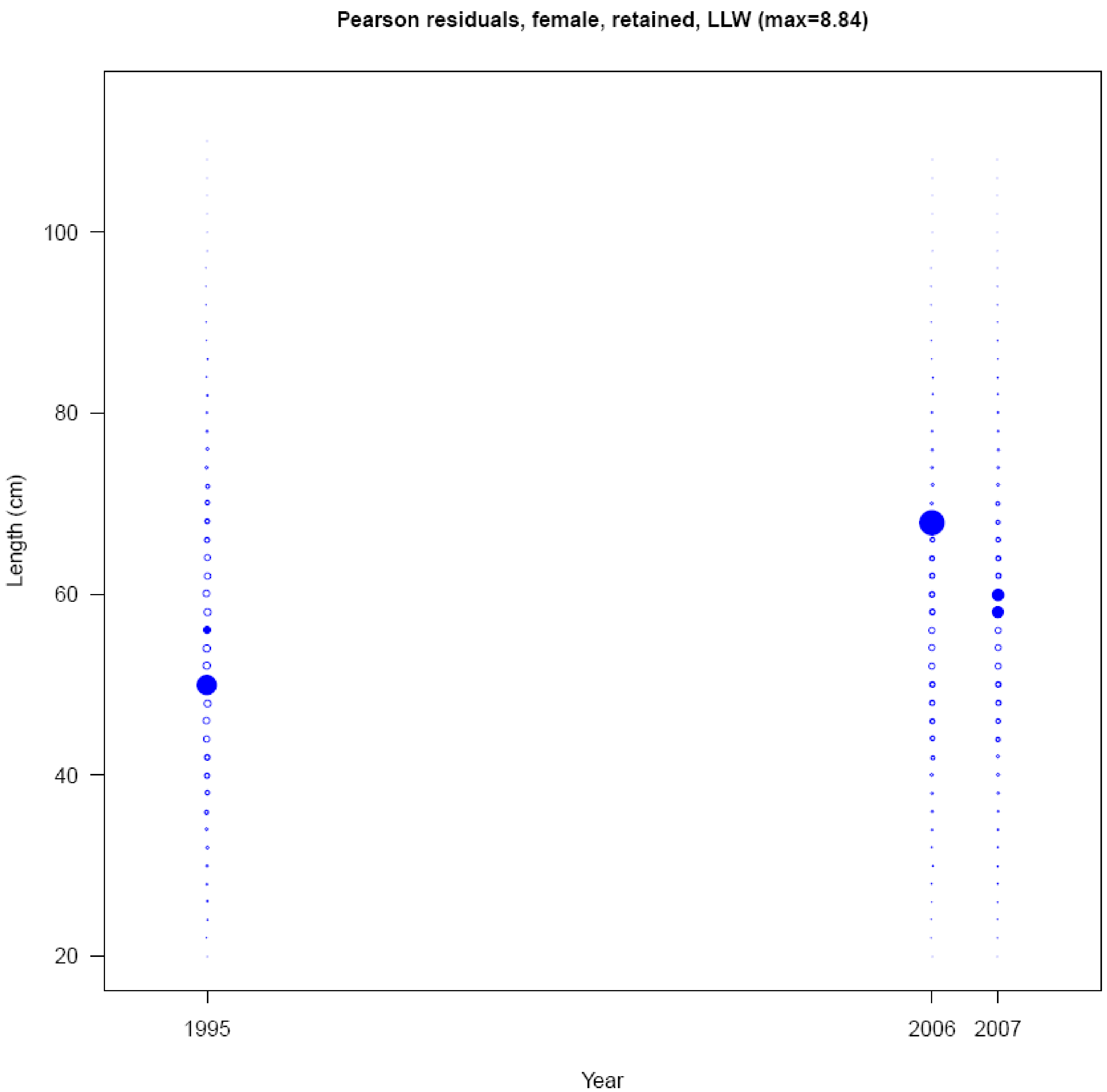


Figure 3.33. Pearson residuals of length composition fits for female Gulf of Mexico tilefish in the commercial long line west fishery from SS Run1. Solid circles are positive residuals (i.e., observed greater than predicted) and open circles are negative residuals (i.e., predicted greater than observed).

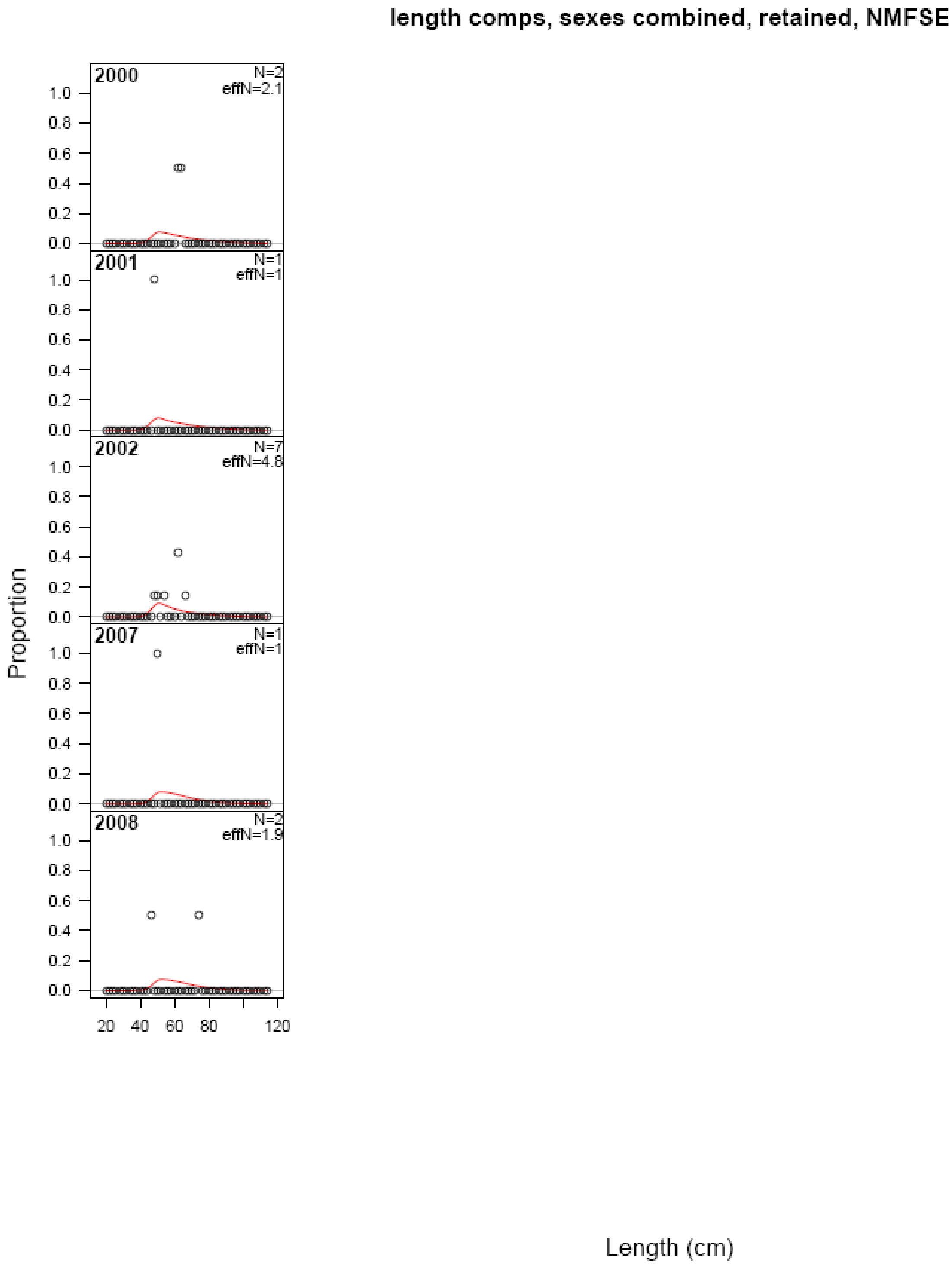


Figure 3.34. Observed (open circles) and predicted (lines) length compositions for Gulf of Mexico tilefish of unknown gender in the NMFS bottom long line survey east from SS Run1. Observed (N) sample sizes and effective sample sizes (effN) estimated by SS are also reported. Observed sample sizes were capped at a maximum of 200 fish.

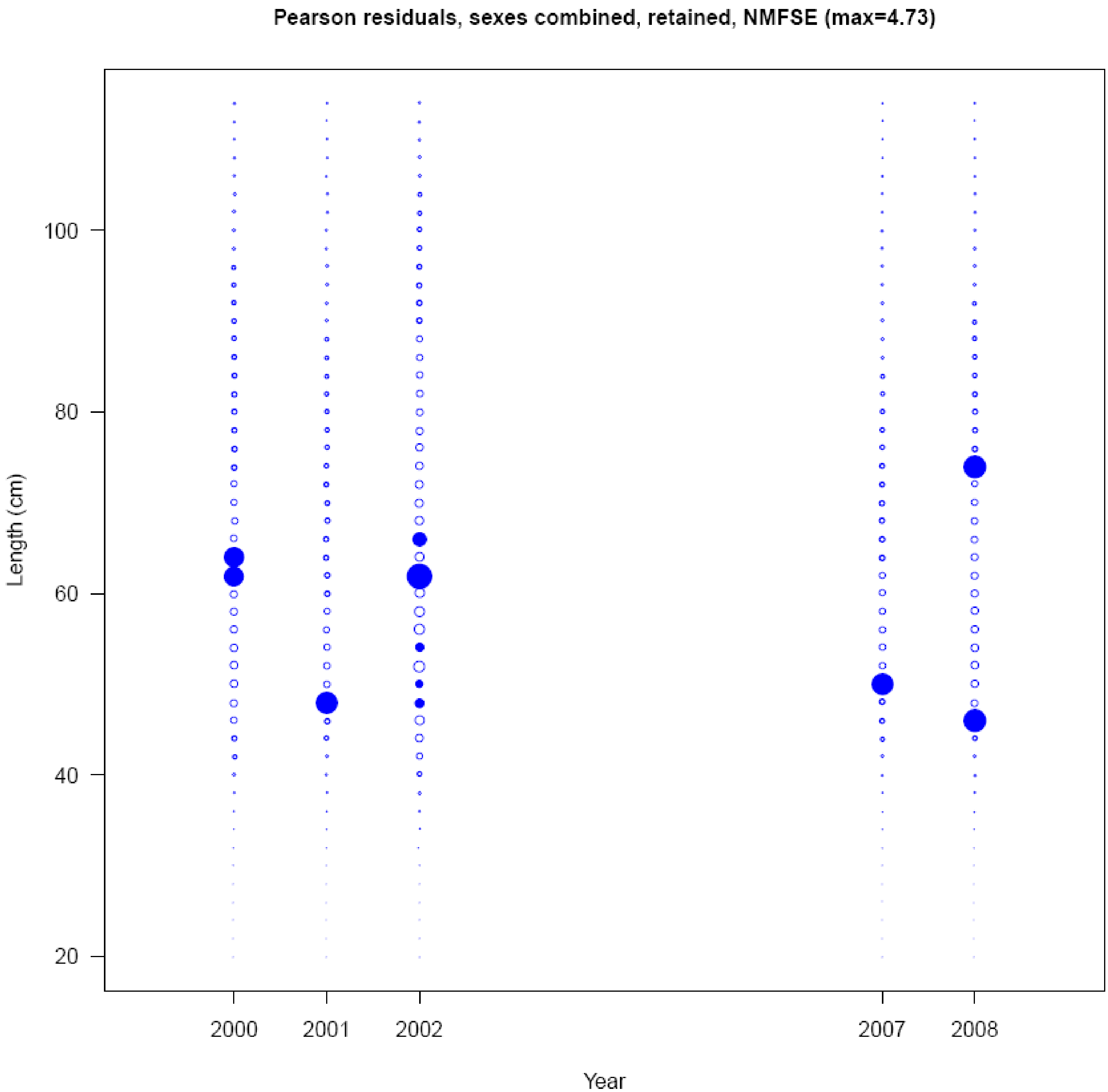


Figure 3.35. Pearson residuals of length composition fits for Gulf of Mexico tilefish of unknown gender in the NMFS bottom long line survey east from SS Run1. Solid circles are positive residuals (i.e., observed greater than predicted) and open circles are negative residuals (i.e., predicted greater than observed).

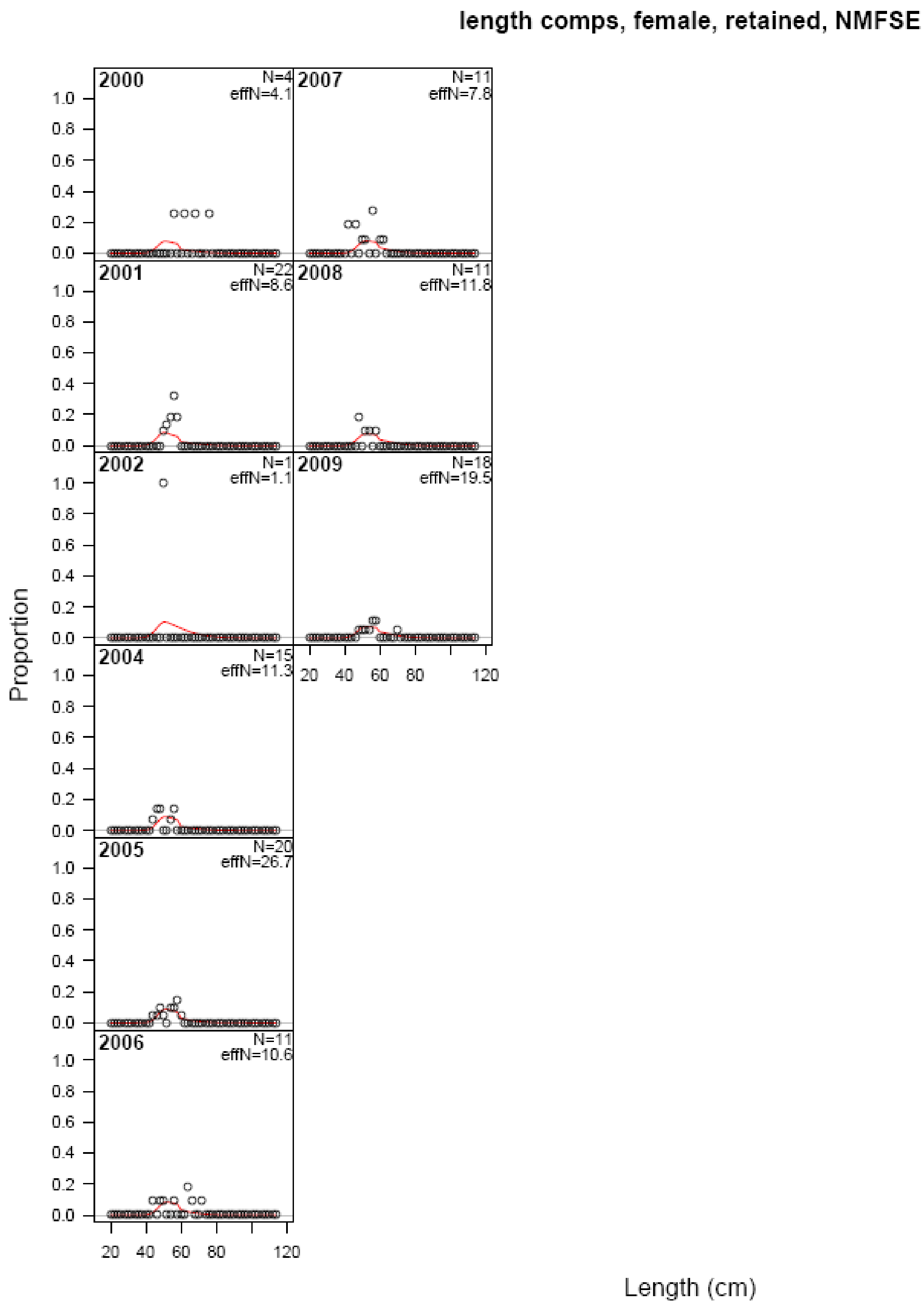


Figure 3.36. Observed (open circles) and predicted (lines) length compositions for female Gulf of Mexico tilefish in the NMFS bottom long line survey east from SS Run1. Observed (N) sample sizes and effective sample sizes (effN) estimated by SS are also reported. Observed sample sizes were capped at a maximum of 200 fish.

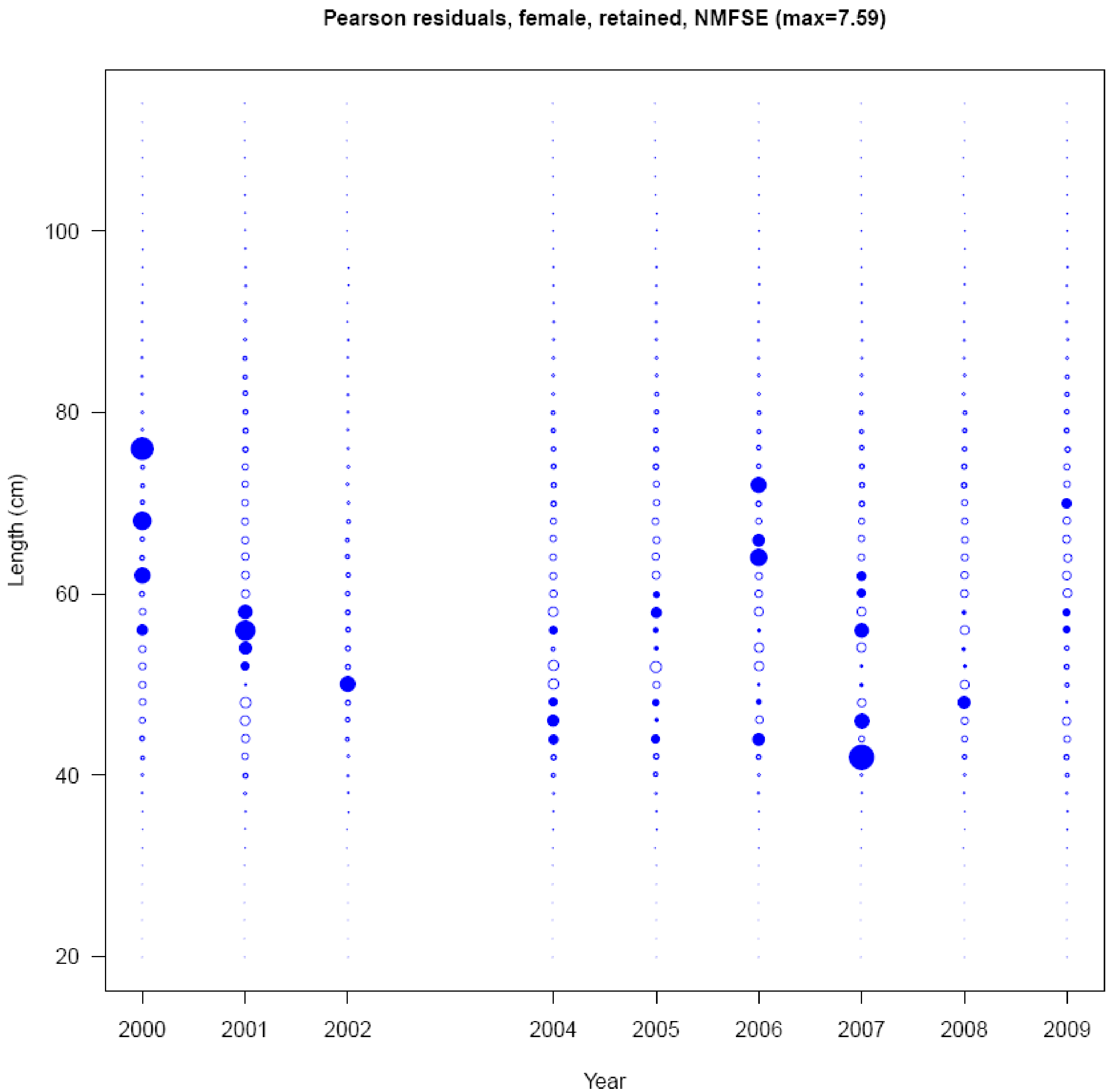


Figure 3.37. Pearson residuals of length composition fits for female Gulf of Mexico tilefish in the NMFS bottom long line survey east from SS Run1. Solid circles are positive residuals (i.e., observed greater than predicted) and open circles are negative residuals (i.e., predicted greater than observed).

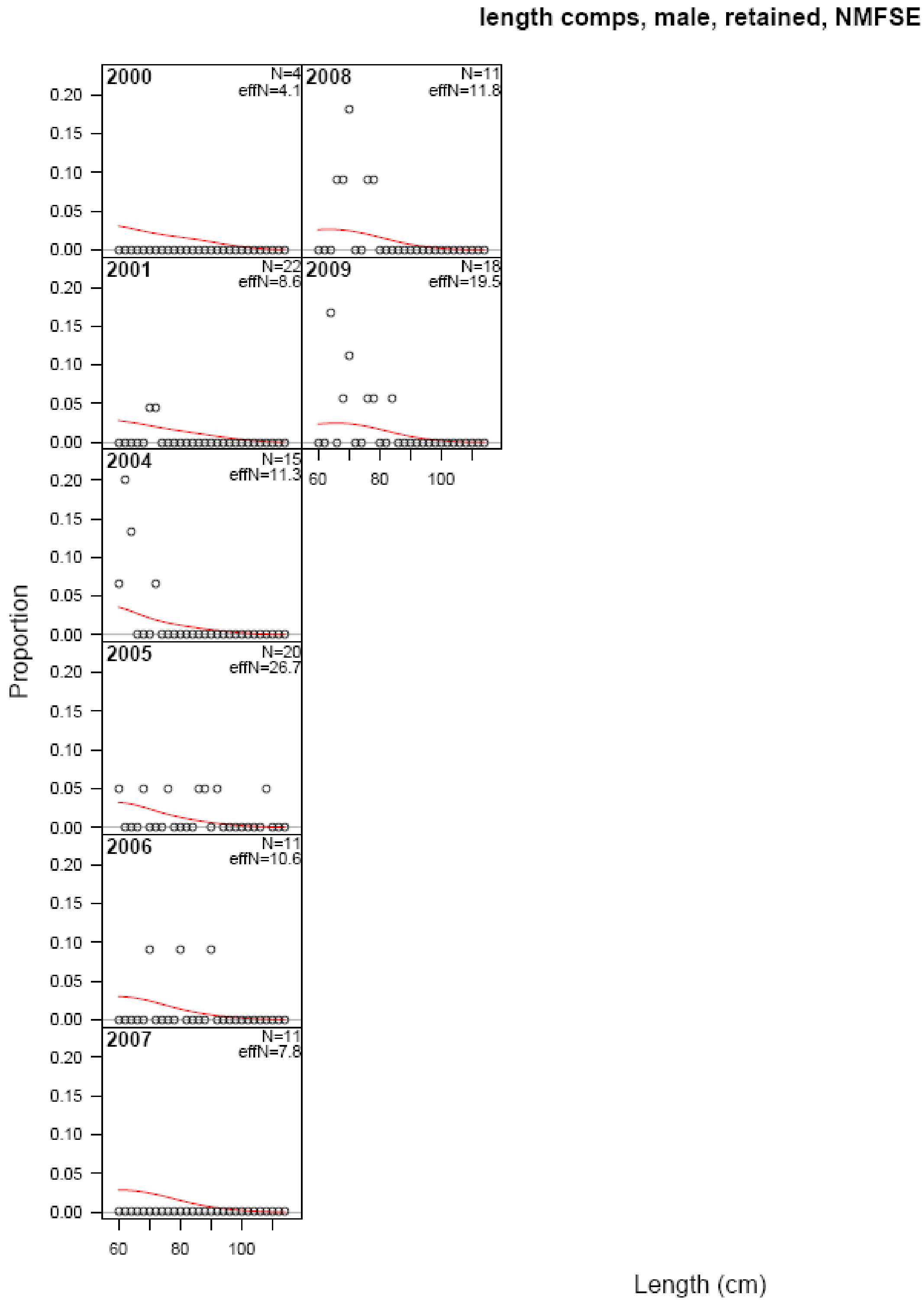


Figure 3.38. Observed (open circles) and predicted (lines) length compositions for male Gulf of Mexico tilefish in the NMFS bottom long line survey east from SS Run1. Observed (N) sample sizes and effective sample sizes (effN) estimated by SS are also reported. Observed sample sizes were capped at a maximum of 200 fish.

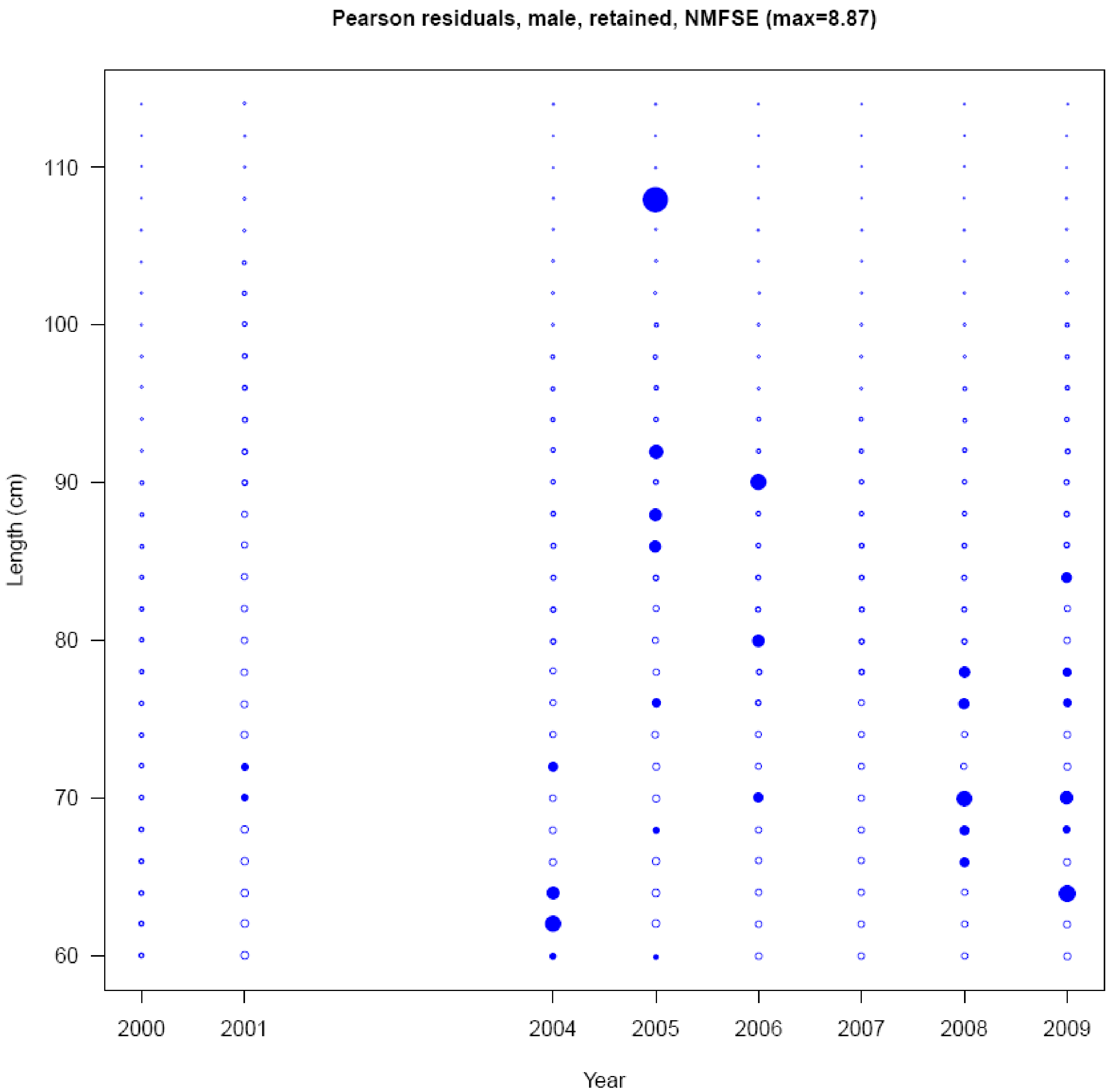


Figure 3.39. Pearson residuals of length composition fits for male Gulf of Mexico tilefish in the NMFS bottom long line survey east from SS Run1. Solid circles are positive residuals (i.e., observed greater than predicted) and open circles are negative residuals (i.e., predicted greater than observed).

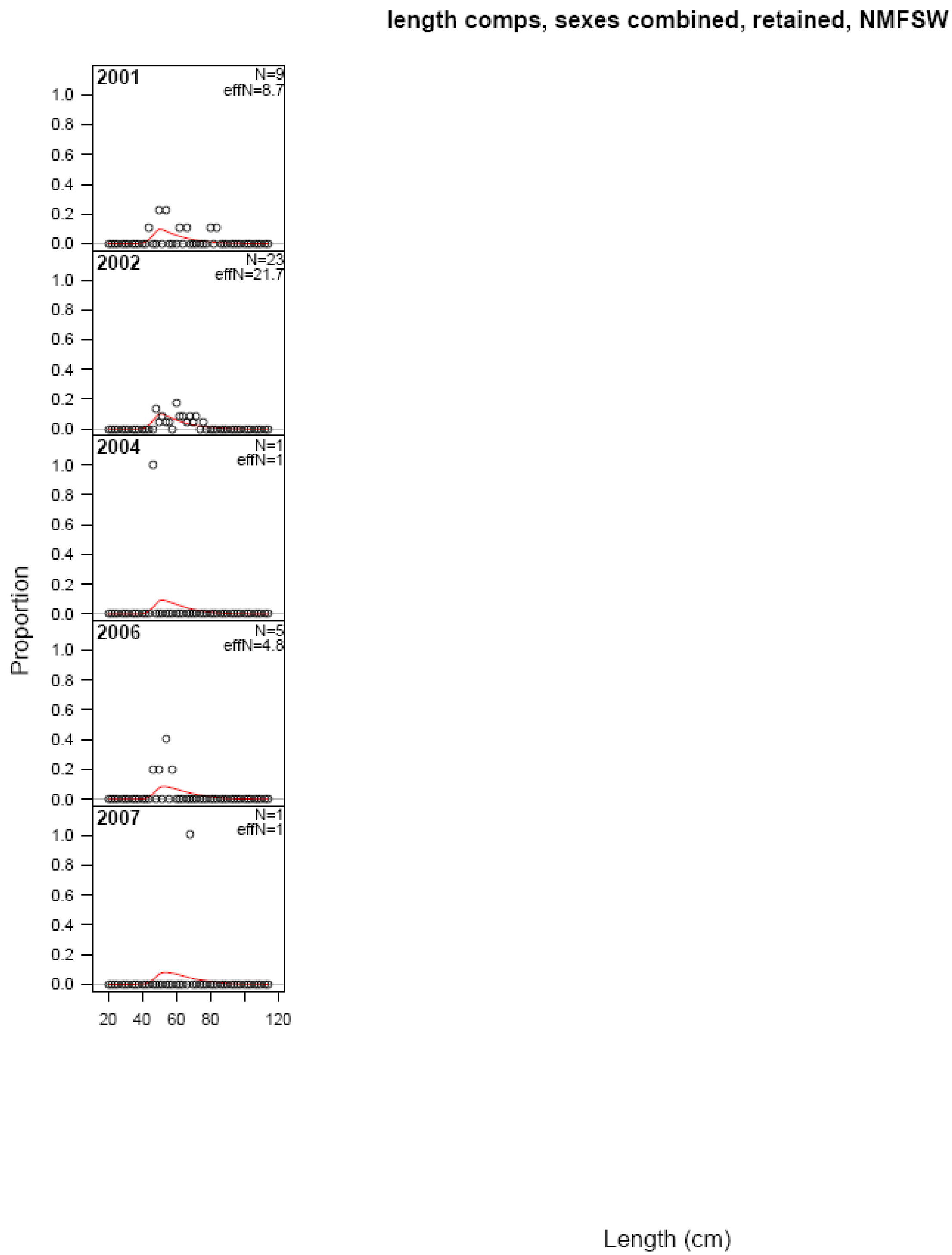


Figure 3.40. Observed (open circles) and predicted (lines) length compositions for Gulf of Mexico tilefish of unknown gender in the NMFS bottom long line survey west from SS Run1. Observed (N) sample sizes and effective sample sizes (effN) estimated by SS are also reported. Observed sample sizes were capped at a maximum of 200 fish.

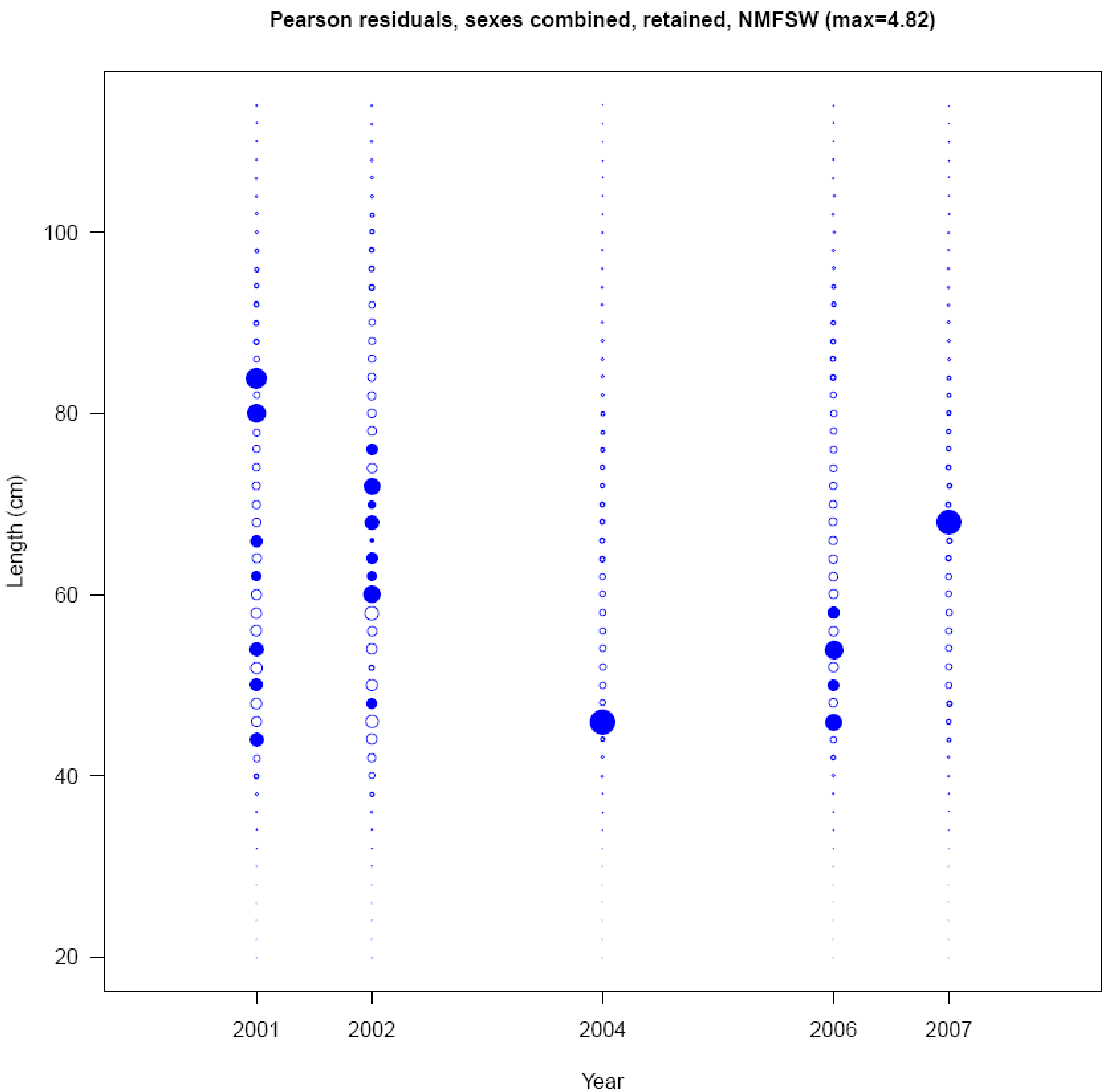


Figure 3.41. Pearson residuals of length composition fits for Gulf of Mexico tilefish of unknown gender in the NMFS bottom long line survey west from SS Run1. Solid circles are positive residuals (i.e., observed greater than predicted) and open circles are negative residuals (i.e., predicted greater than observed).

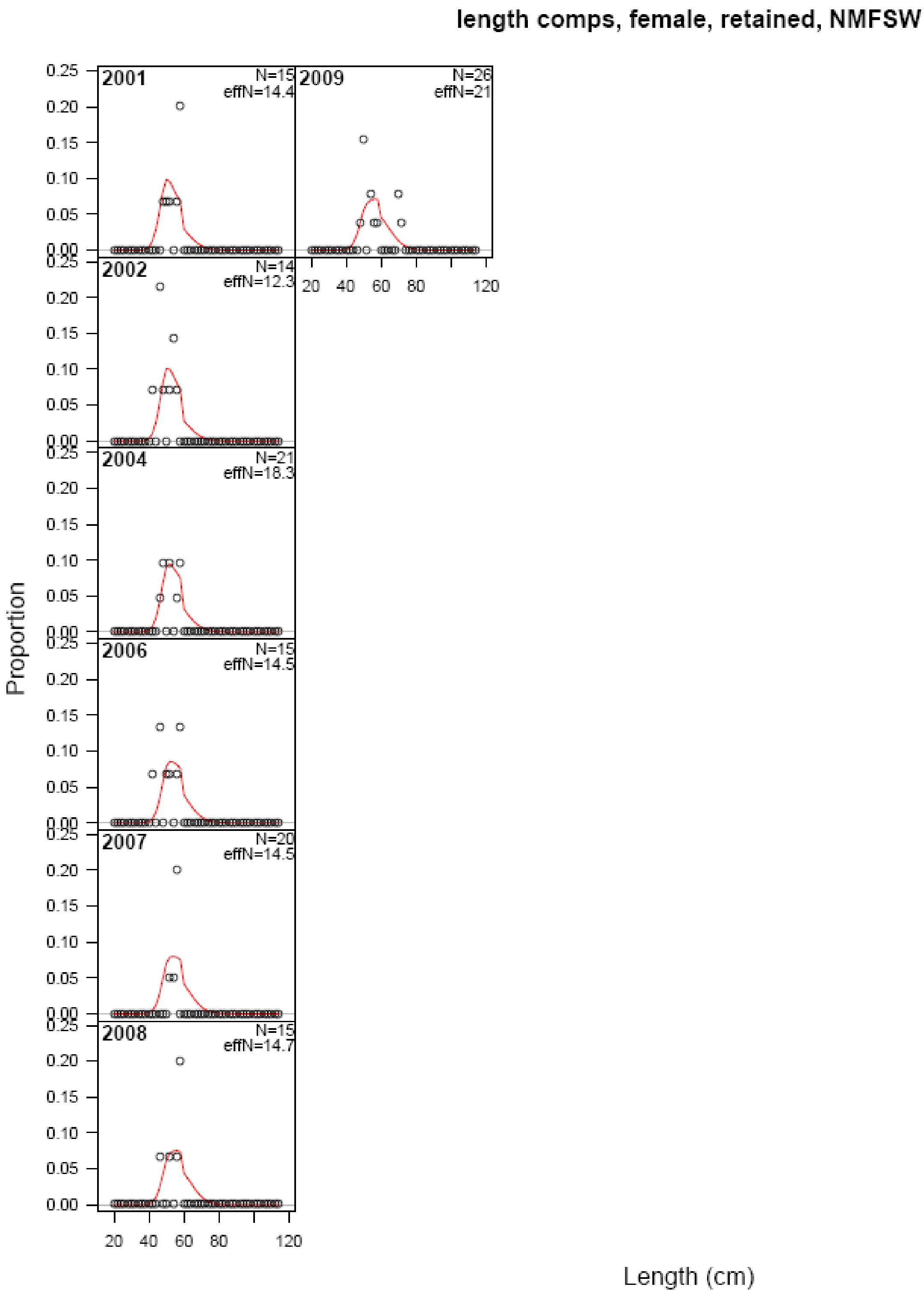


Figure 3.42. Observed (open circles) and predicted (lines) length compositions for female Gulf of Mexico tilefish in the NMFS bottom long line survey west from SS Run1. Observed (N) sample sizes and effective sample sizes (effN) estimated by SS are also reported. Observed sample sizes were capped at a maximum of 200 fish.

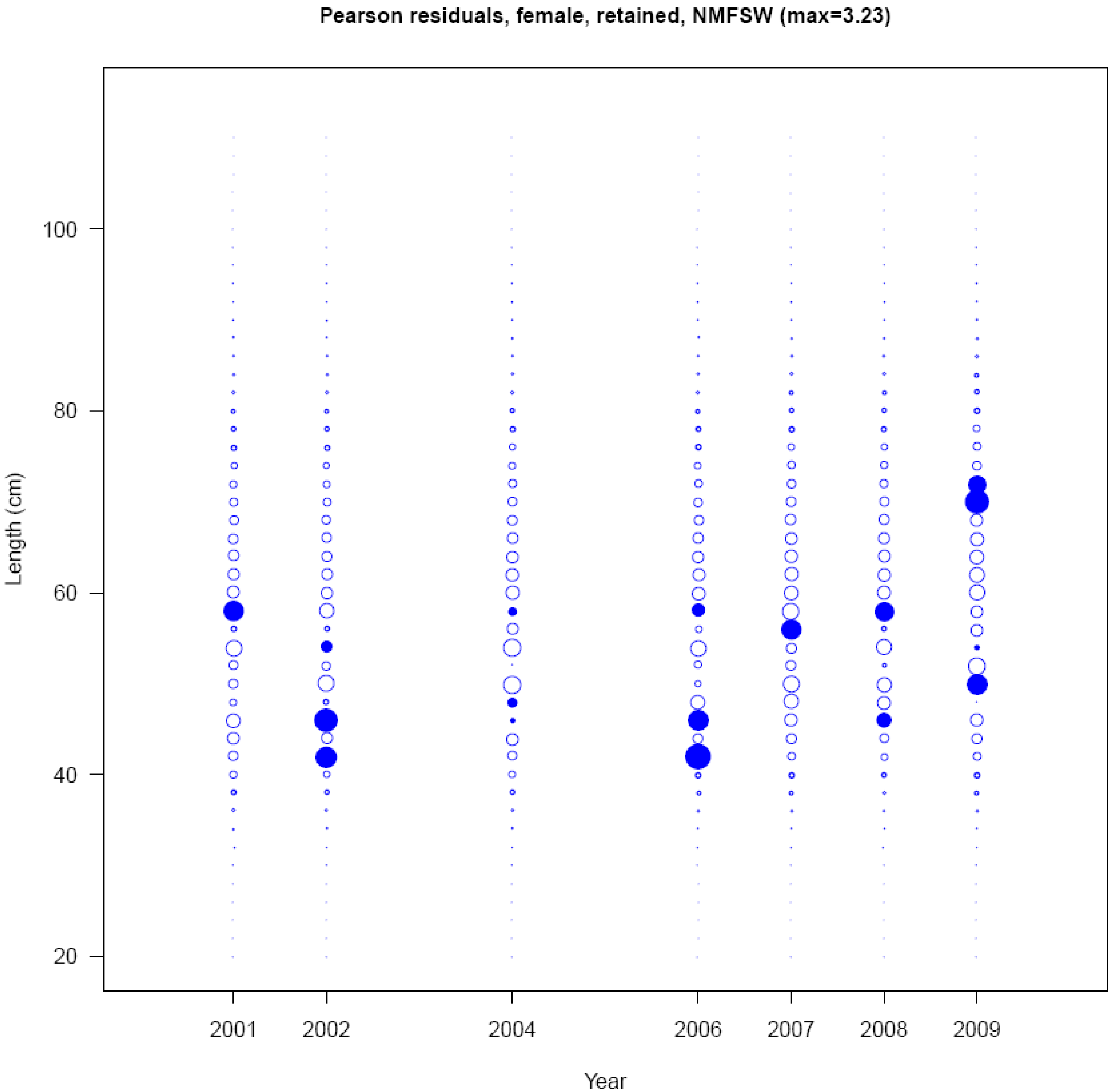


Figure 3.43. Pearson residuals of length composition fits for female Gulf of Mexico tilefish in the NMFS bottom long line survey west from SS Run1. Solid circles are positive residuals (i.e., observed greater than predicted) and open circles are negative residuals (i.e., predicted greater than observed).

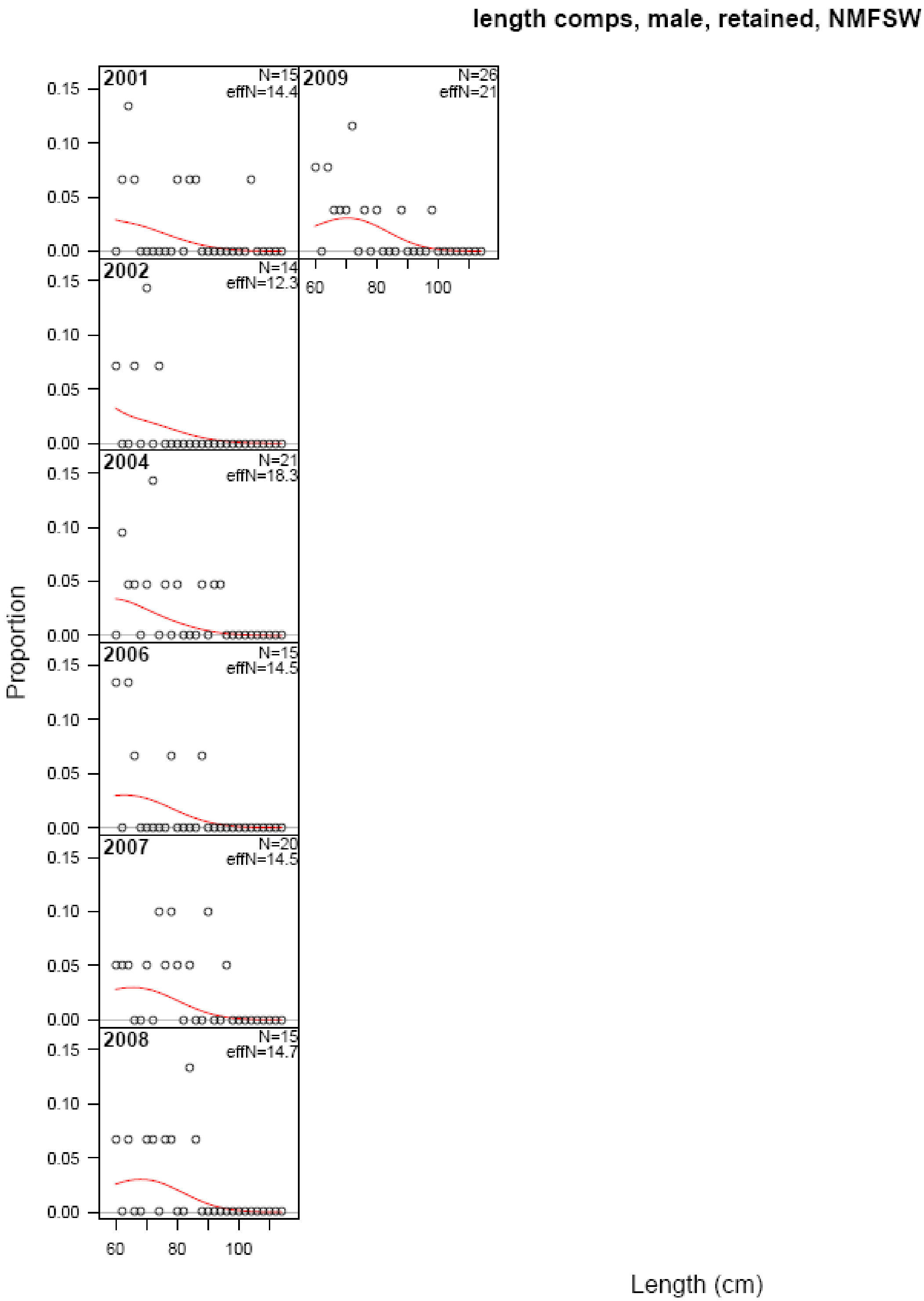


Figure 3.44. Observed (open circles) and predicted (lines) length compositions for male Gulf of Mexico tilefish in the NMFS bottom long line survey west from SS Run1. Observed (N) sample sizes and effective sample sizes (effN) estimated by SS are also reported. Observed sample sizes were capped at a maximum of 200 fish.

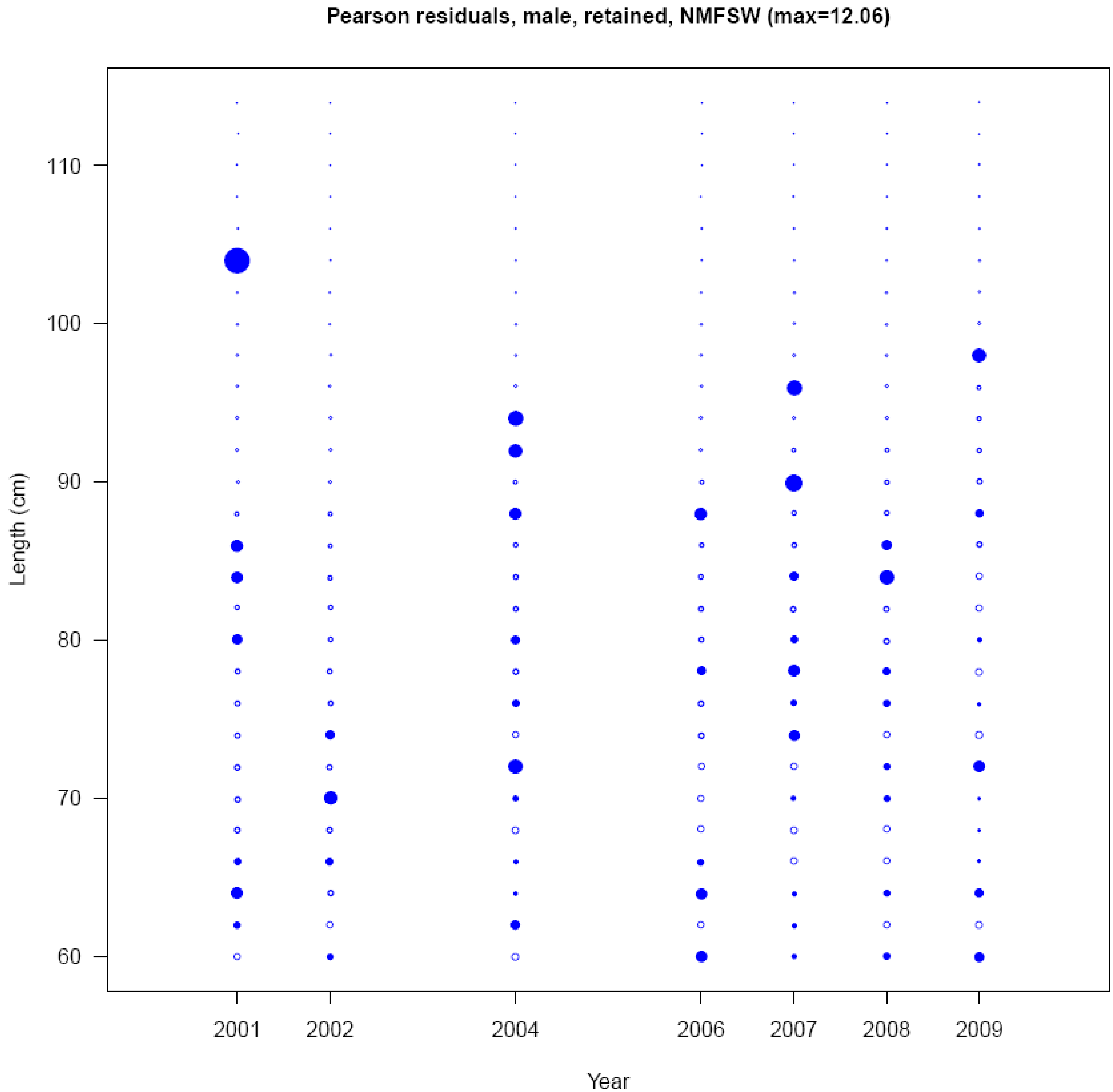


Figure 3.45. Pearson residuals of length composition fits for male Gulf of Mexico tilefish in the NMFS bottom long line survey west from SS Run1. Solid circles are positive residuals (i.e., observed greater than predicted) and open circles are negative residuals (i.e., predicted greater than observed).

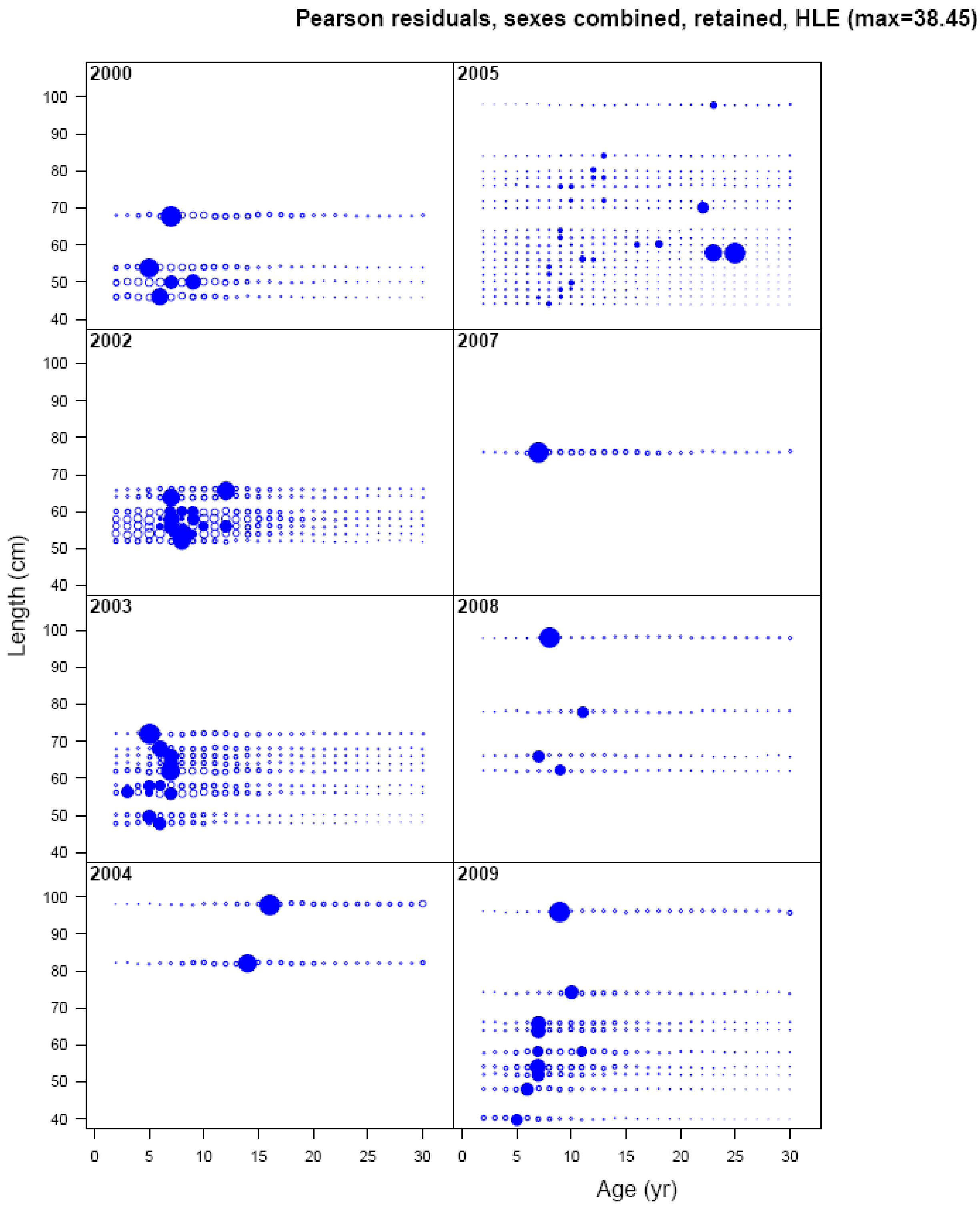


Figure 3.46. Pearson residuals of conditional age composition fits for unknown gender Gulf of Mexico tilefish in the commercial hand line fishery east from SS Run1. Solid circles are positive residuals (i.e., observed greater than predicted) and open circles are negative residuals (i.e., predicted greater than observed).

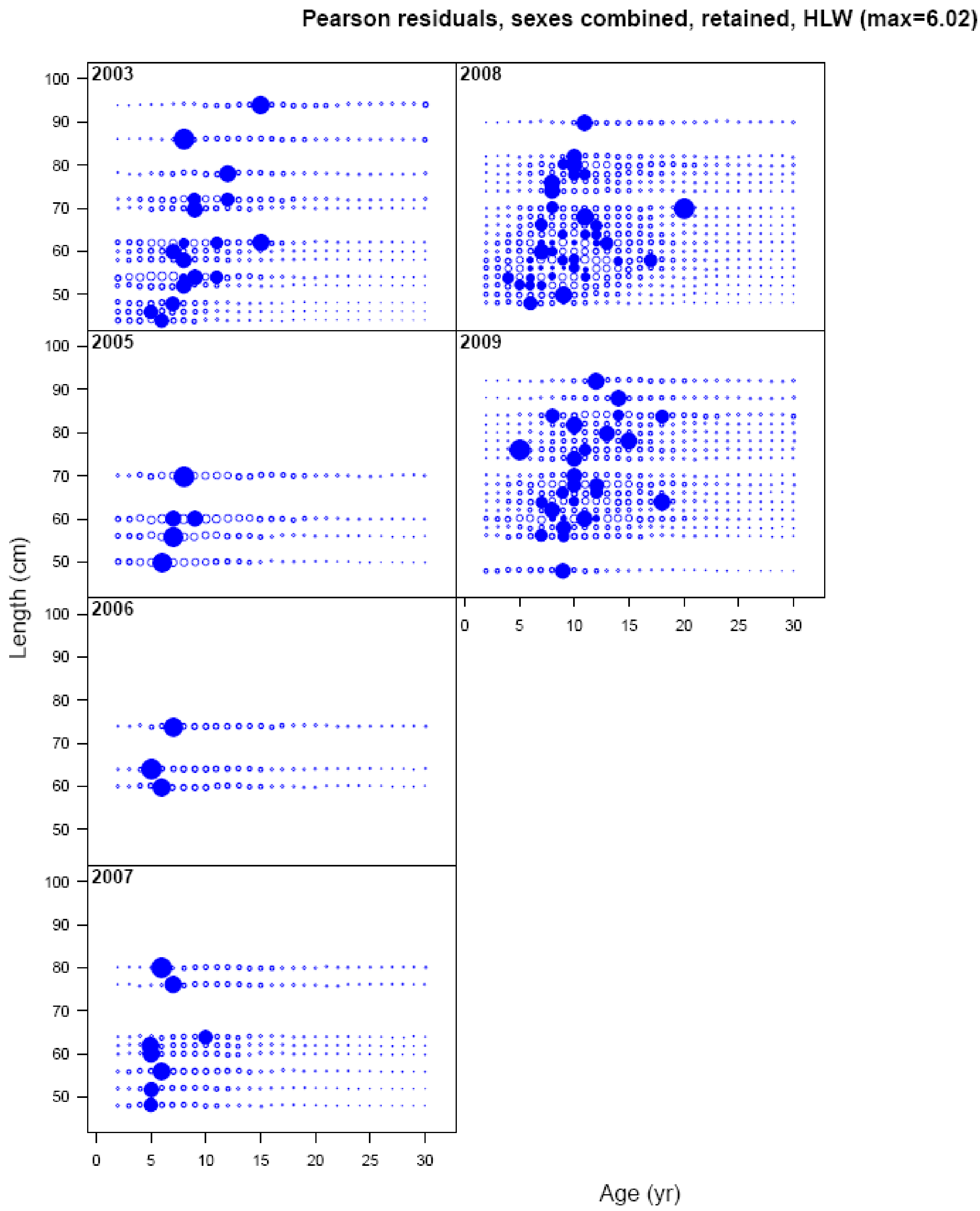


Figure 3.47. Pearson residuals of conditional age composition fits for unknown gender Gulf of Mexico tilefish in the commercial hand line fishery west from SS Run1. Solid circles are positive residuals (i.e., observed greater than predicted) and open circles are negative residuals (i.e., predicted greater than observed).

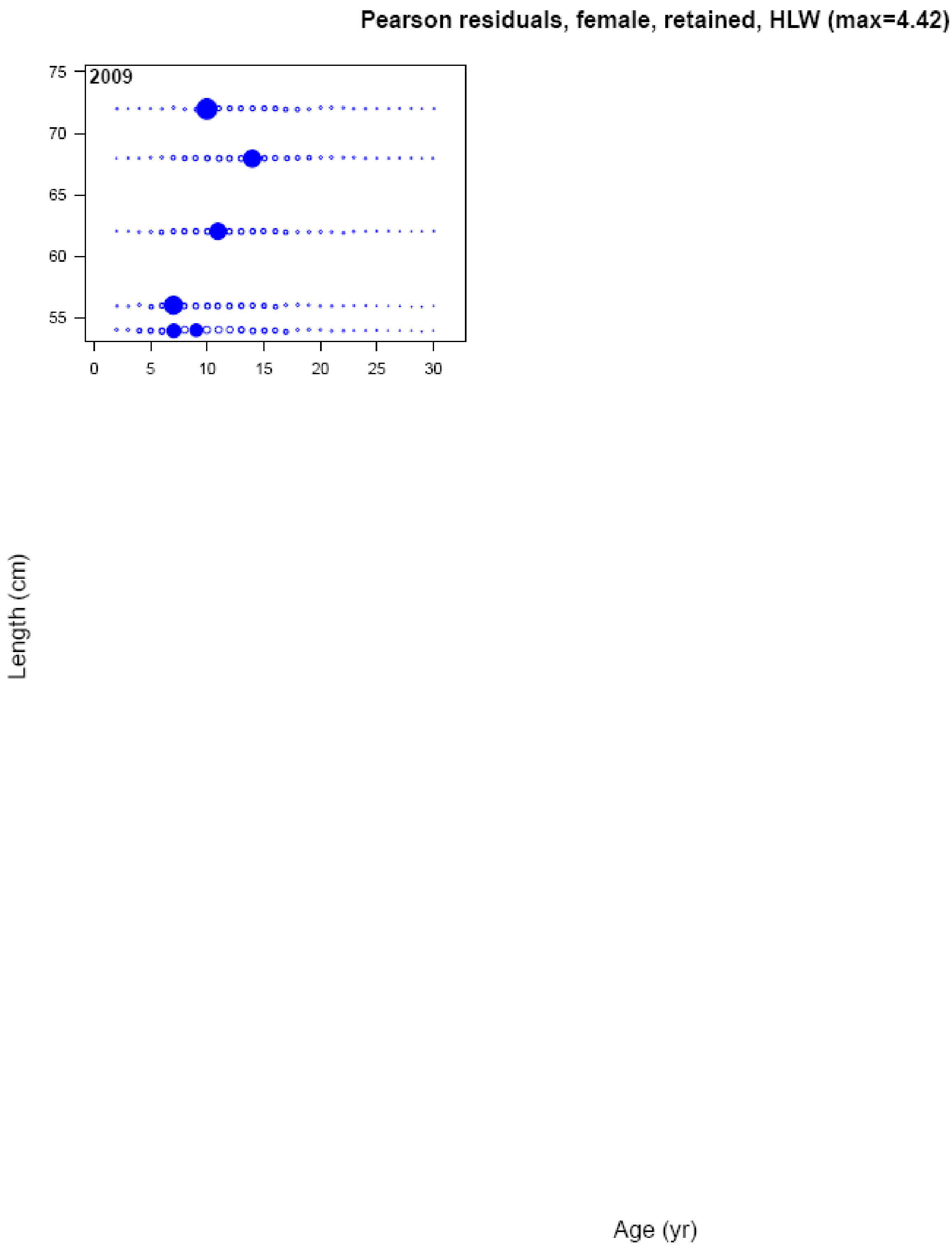


Figure 3.48. Pearson residuals of conditional age composition fits for female Gulf of Mexico tilefish in the commercial hand line fishery west from SS Run1. Solid circles are positive residuals (i.e., observed greater than predicted) and open circles are negative residuals (i.e., predicted greater than observed).

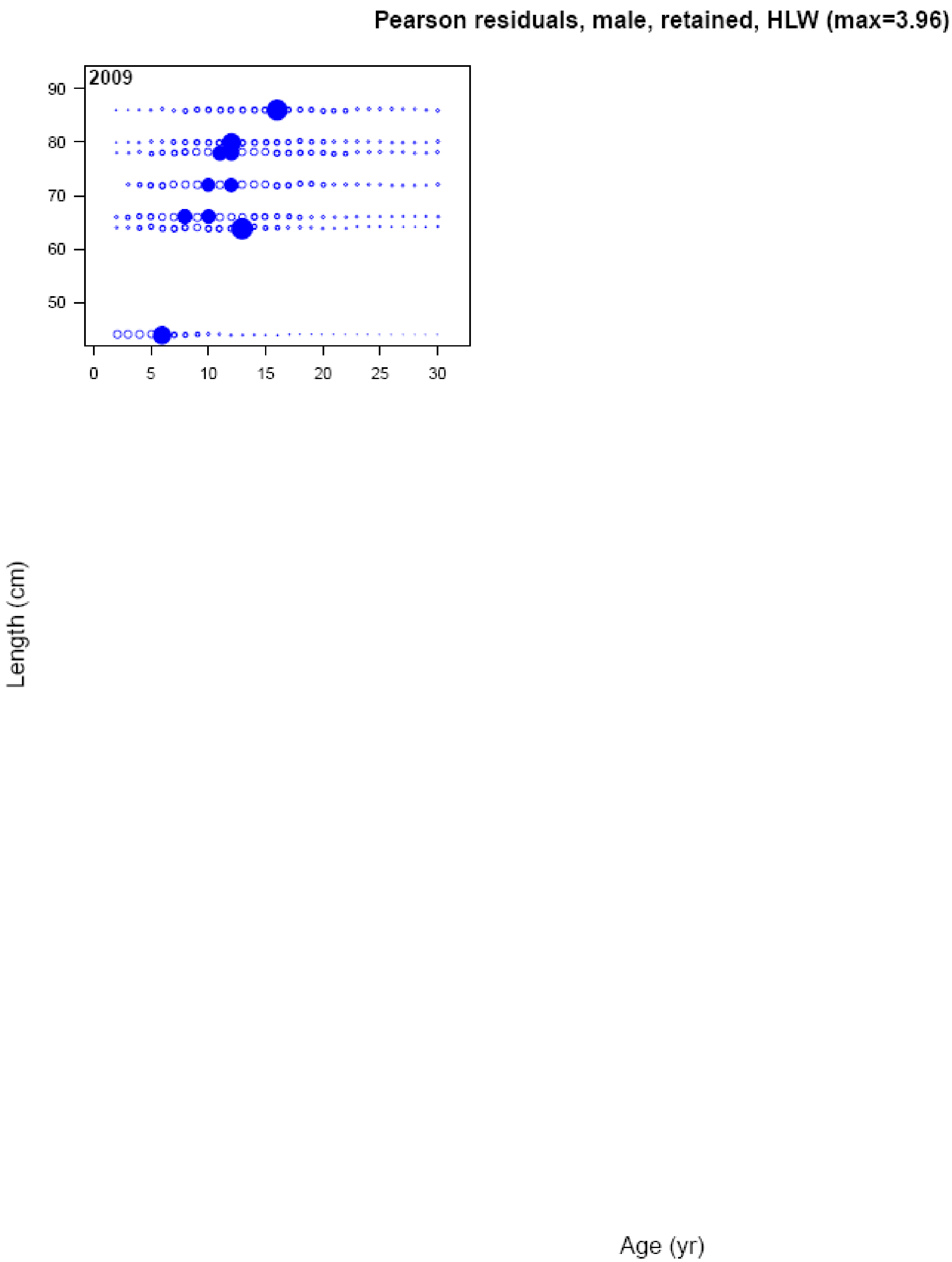


Figure 3.49. Pearson residuals of conditional age composition fits for male Gulf of Mexico tilefish in the commercial hand line fishery west from SS Run1. Solid circles are positive residuals (i.e., observed greater than predicted) and open circles are negative residuals (i.e., predicted greater than observed).

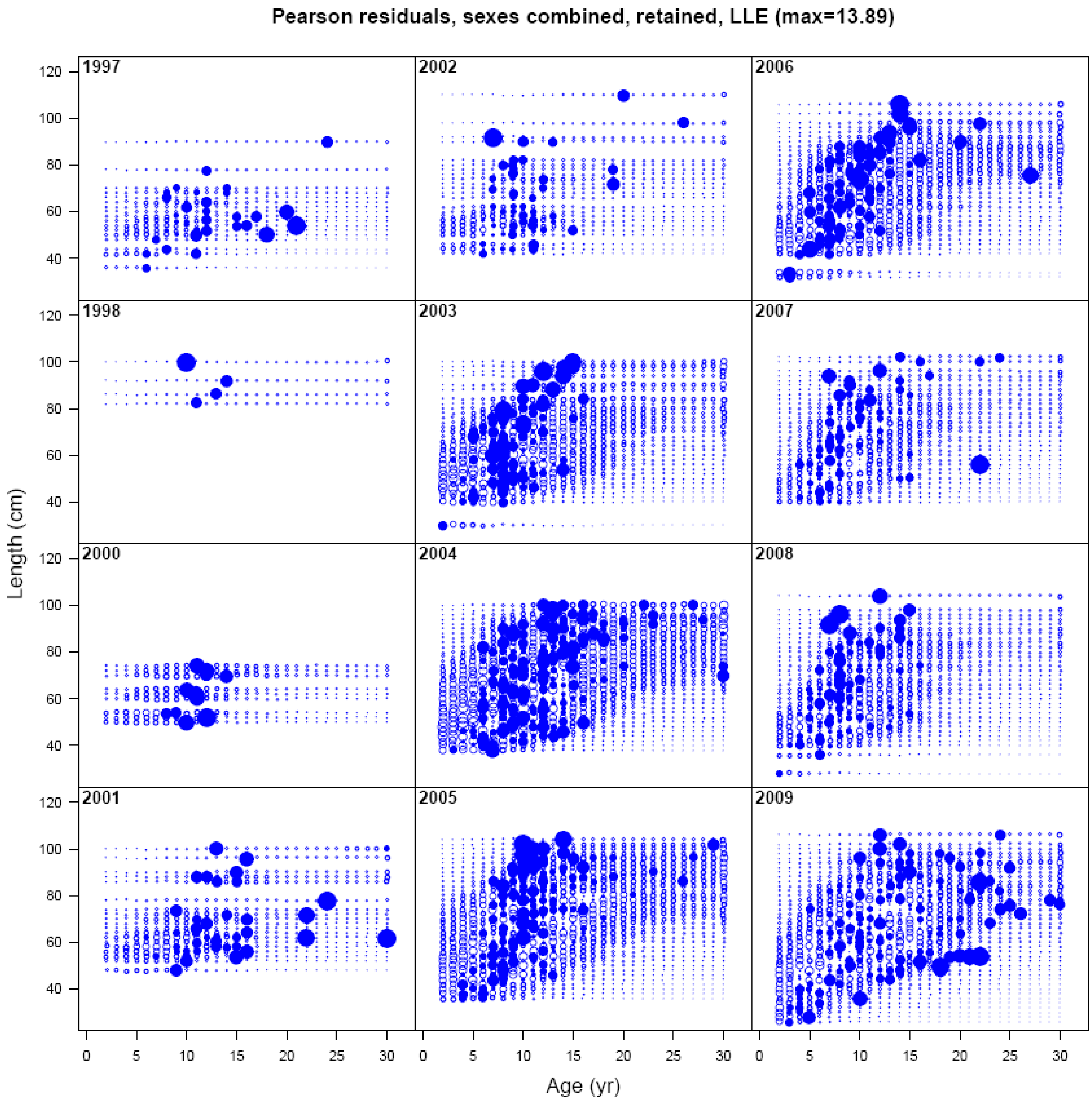


Figure 3.50. Pearson residuals of conditional age composition fits for unknown gender Gulf of Mexico tilefish in the commercial long line fishery east from SS Run1. Solid circles are positive residuals (i.e., observed greater than predicted) and open circles are negative residuals (i.e., predicted greater than observed).

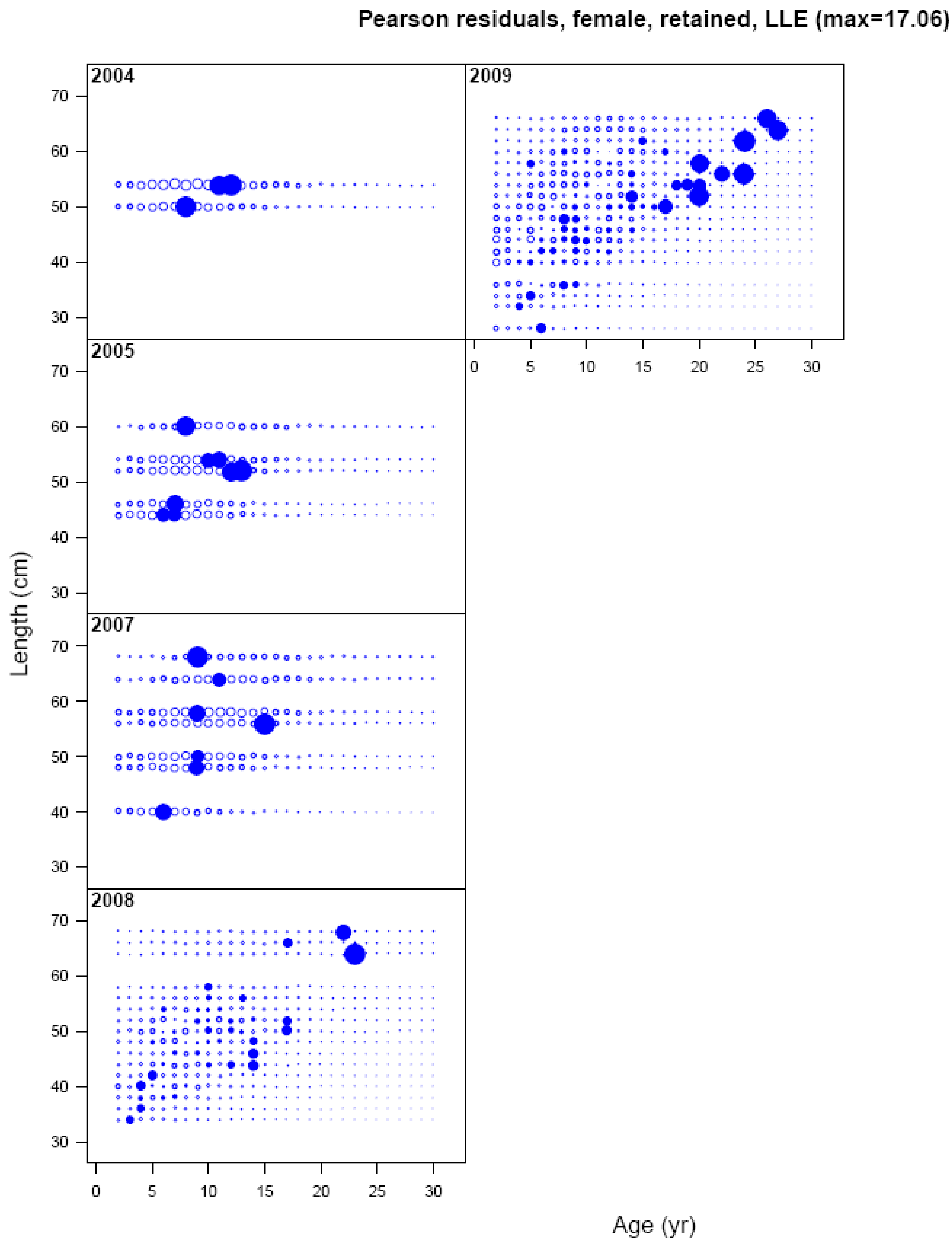


Figure 3.51. Pearson residuals of conditional age composition fits for female Gulf of Mexico tilefish in the commercial long line fishery east from SS Run1. Solid circles are positive residuals (i.e., observed greater than predicted) and open circles are negative residuals (i.e., predicted greater than observed).

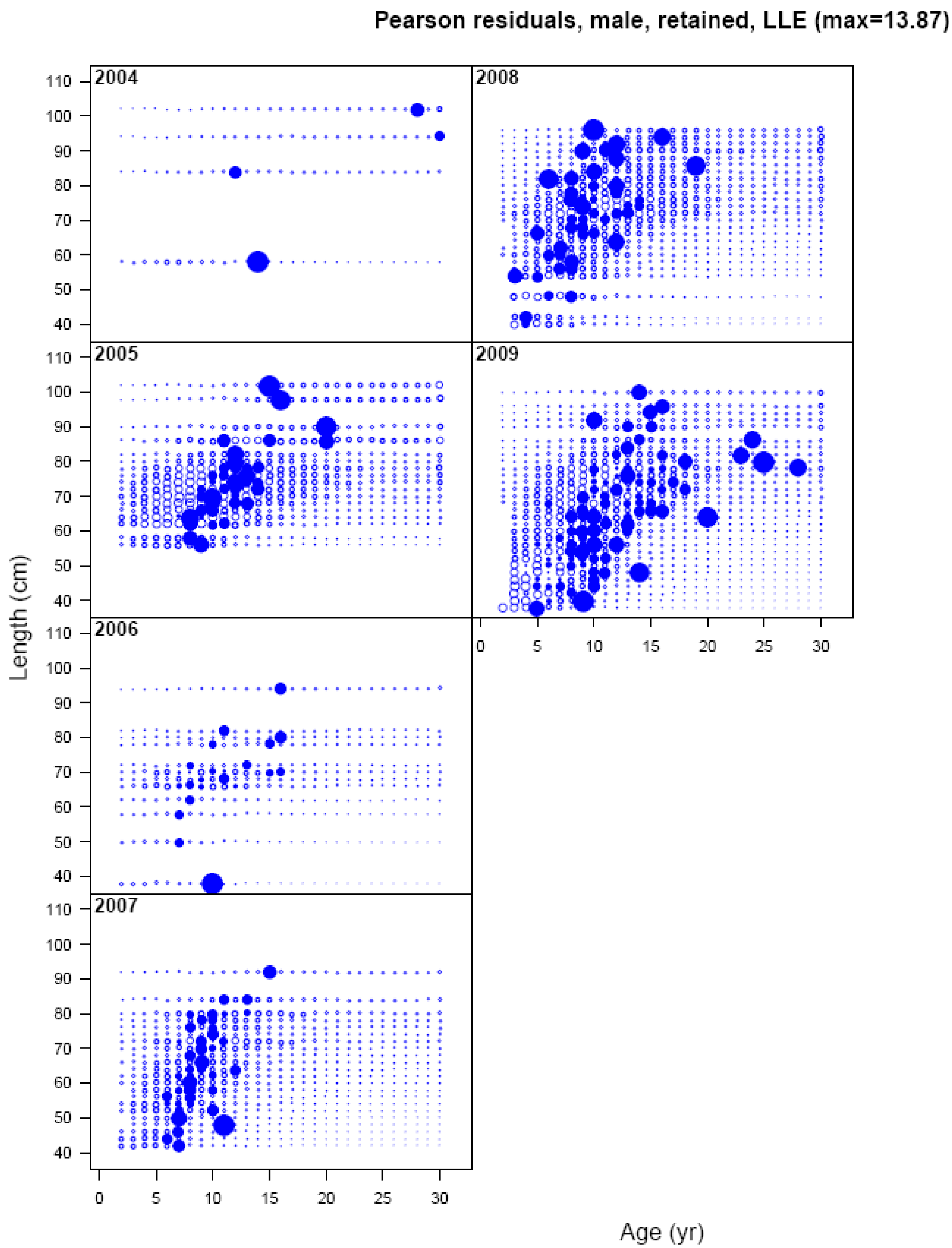


Figure 3.52. Pearson residuals of conditional age composition fits for male Gulf of Mexico tilefish in the commercial long line fishery east from SS Run1. Solid circles are positive residuals (i.e., observed greater than predicted) and open circles are negative residuals (i.e., predicted greater than observed).

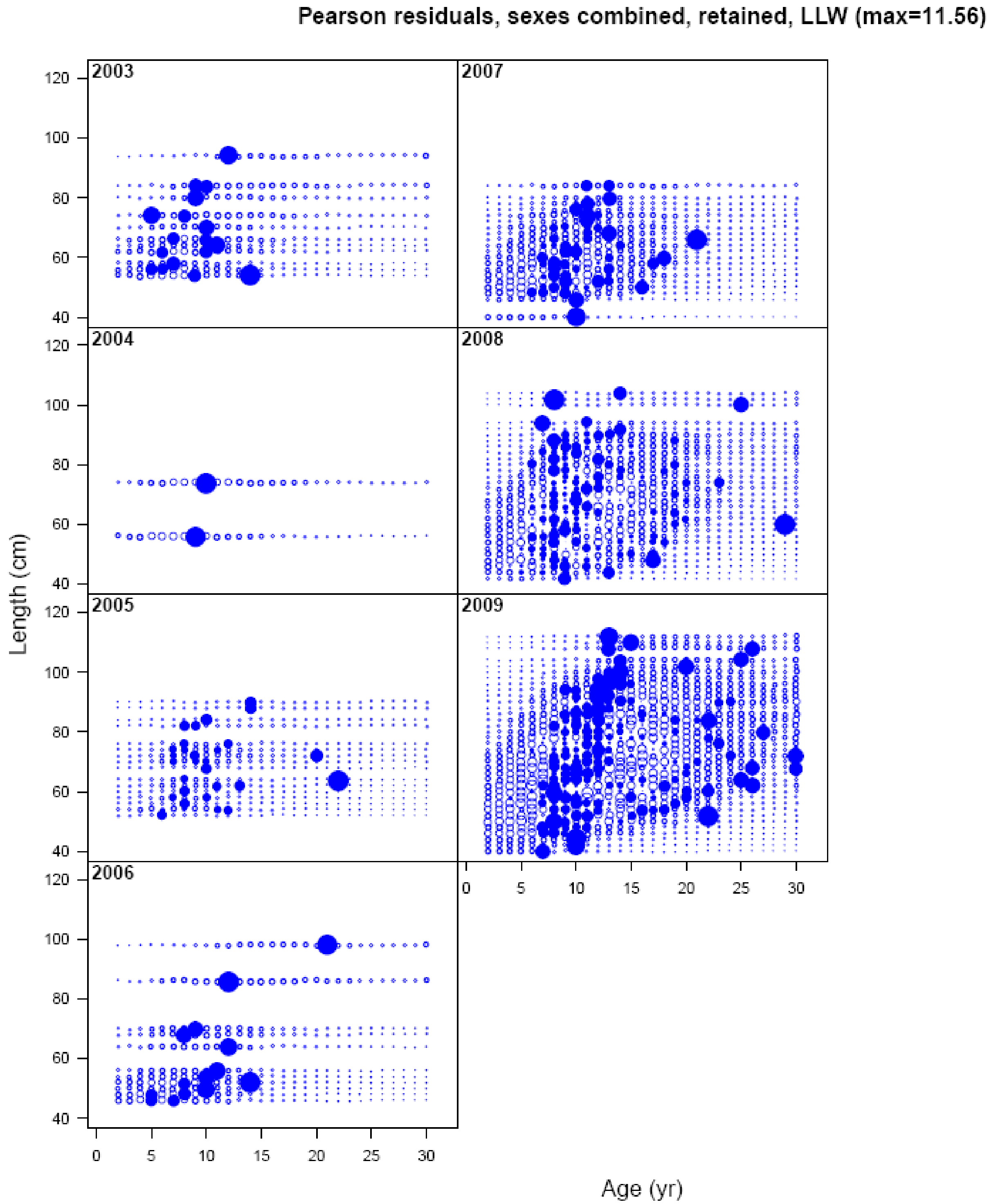


Figure 3.53. Pearson residuals of conditional age composition fits for unknown gender Gulf of Mexico tilefish in the commercial long line fishery west from SS Run1. Solid circles are positive residuals (i.e., observed greater than predicted) and open circles are negative residuals (i.e., predicted greater than observed).

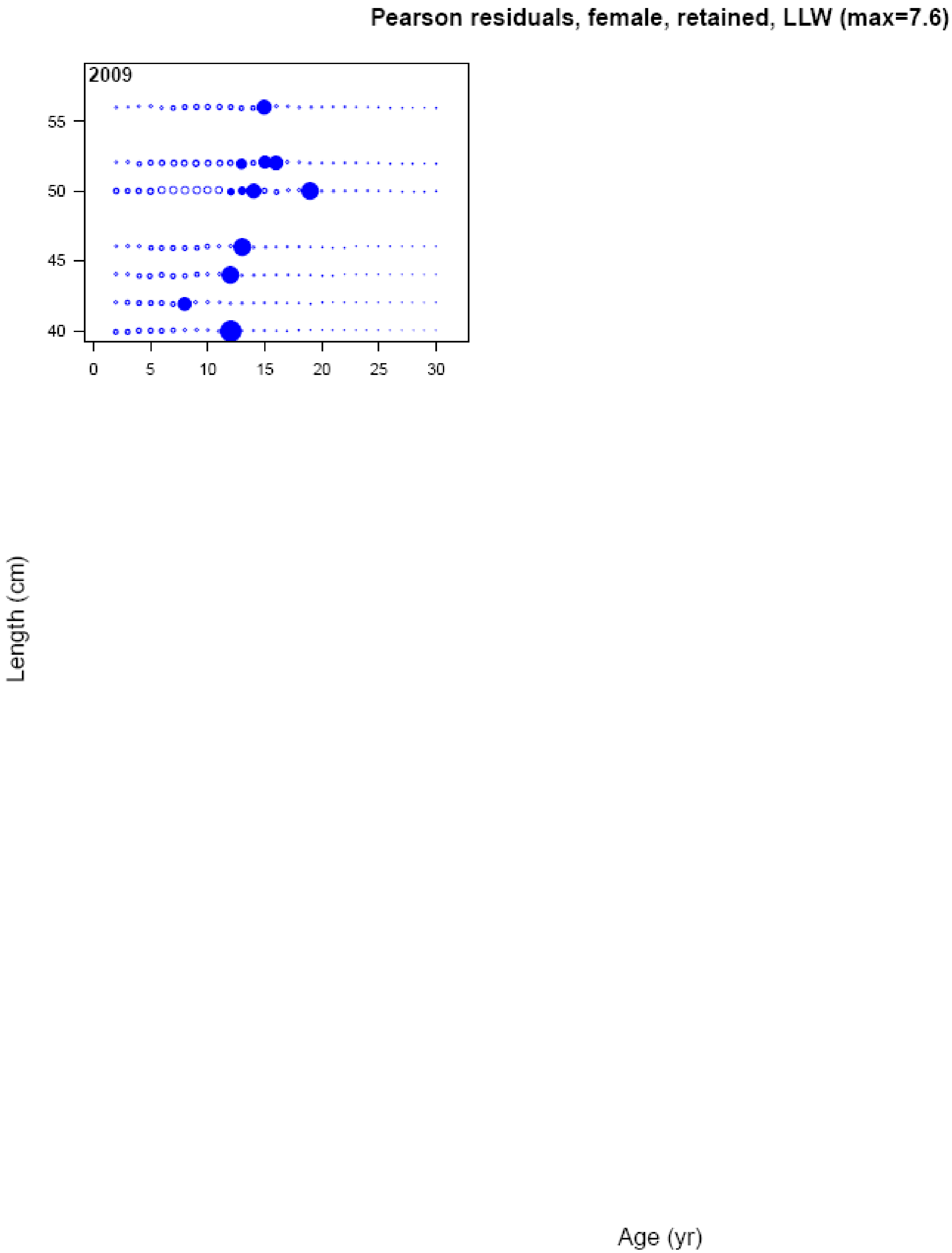


Figure 3.54. Pearson residuals of conditional age composition fits for female Gulf of Mexico tilefish in the commercial long line fishery west from SS Run1. Solid circles are positive residuals (i.e., observed greater than predicted) and open circles are negative residuals (i.e., predicted greater than observed).

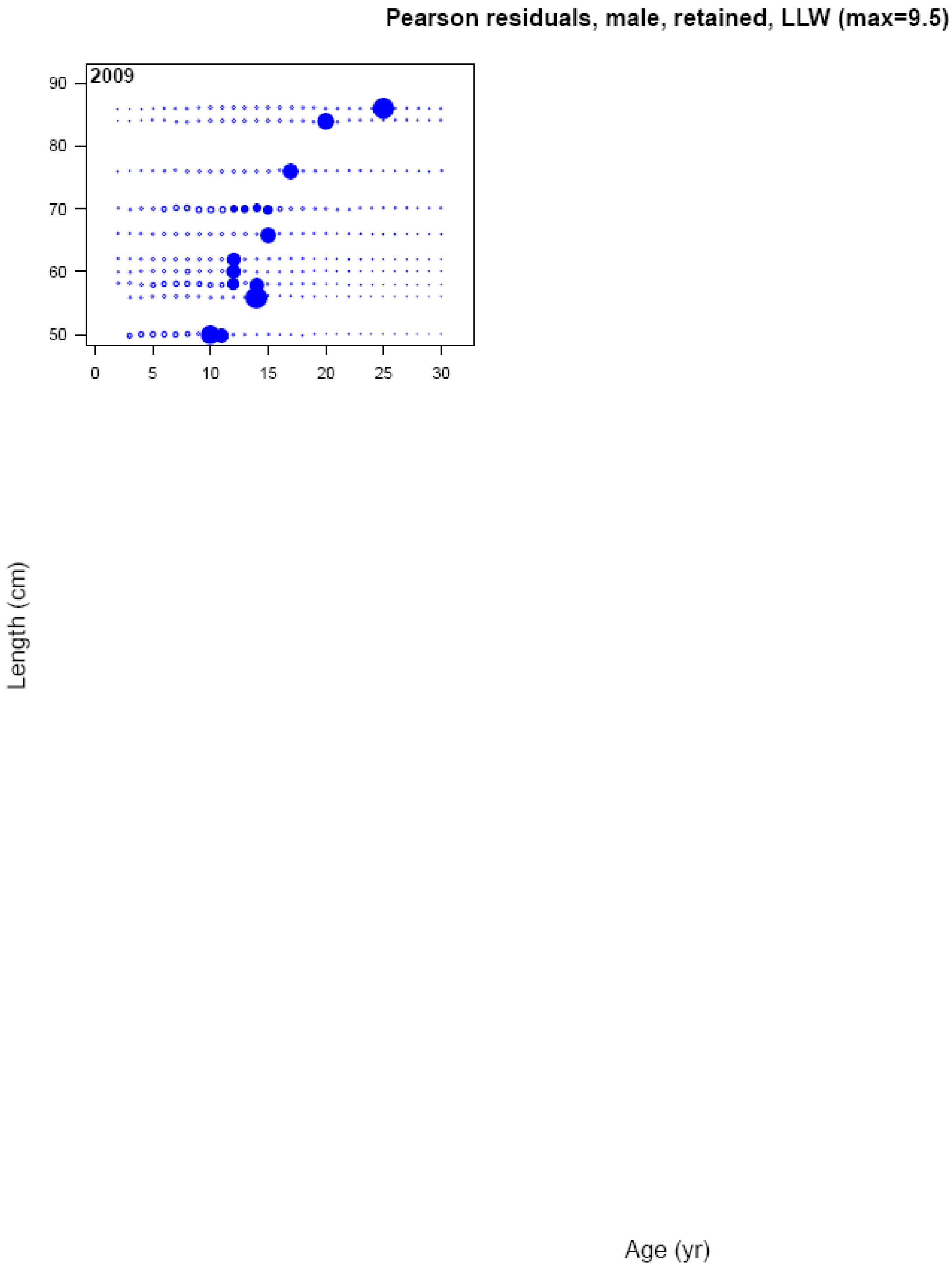


Figure 3.55. Pearson residuals of conditional age composition fits for male Gulf of Mexico tilefish in the commercial long line fishery west from SS Run1. Solid circles are positive residuals (i.e., observed greater than predicted) and open circles are negative residuals (i.e., predicted greater than observed).

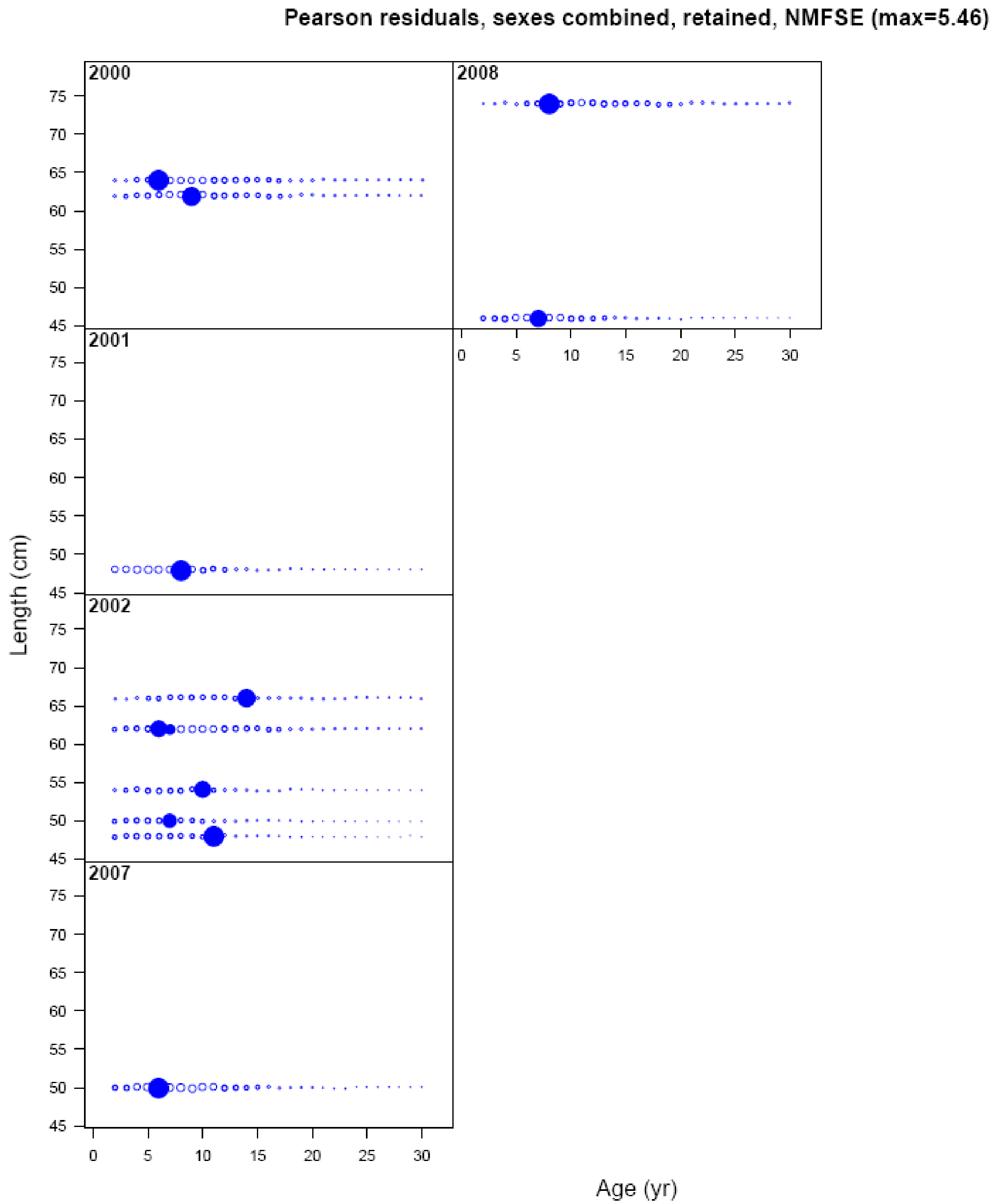


Figure 3.56. Pearson residuals of conditional age composition fits for unknown gender Gulf of Mexico tilefish in the NMFS bottom long line survey east from SS Run1. Solid circles are positive residuals (i.e., observed greater than predicted) and open circles are negative residuals (i.e., predicted greater than observed).

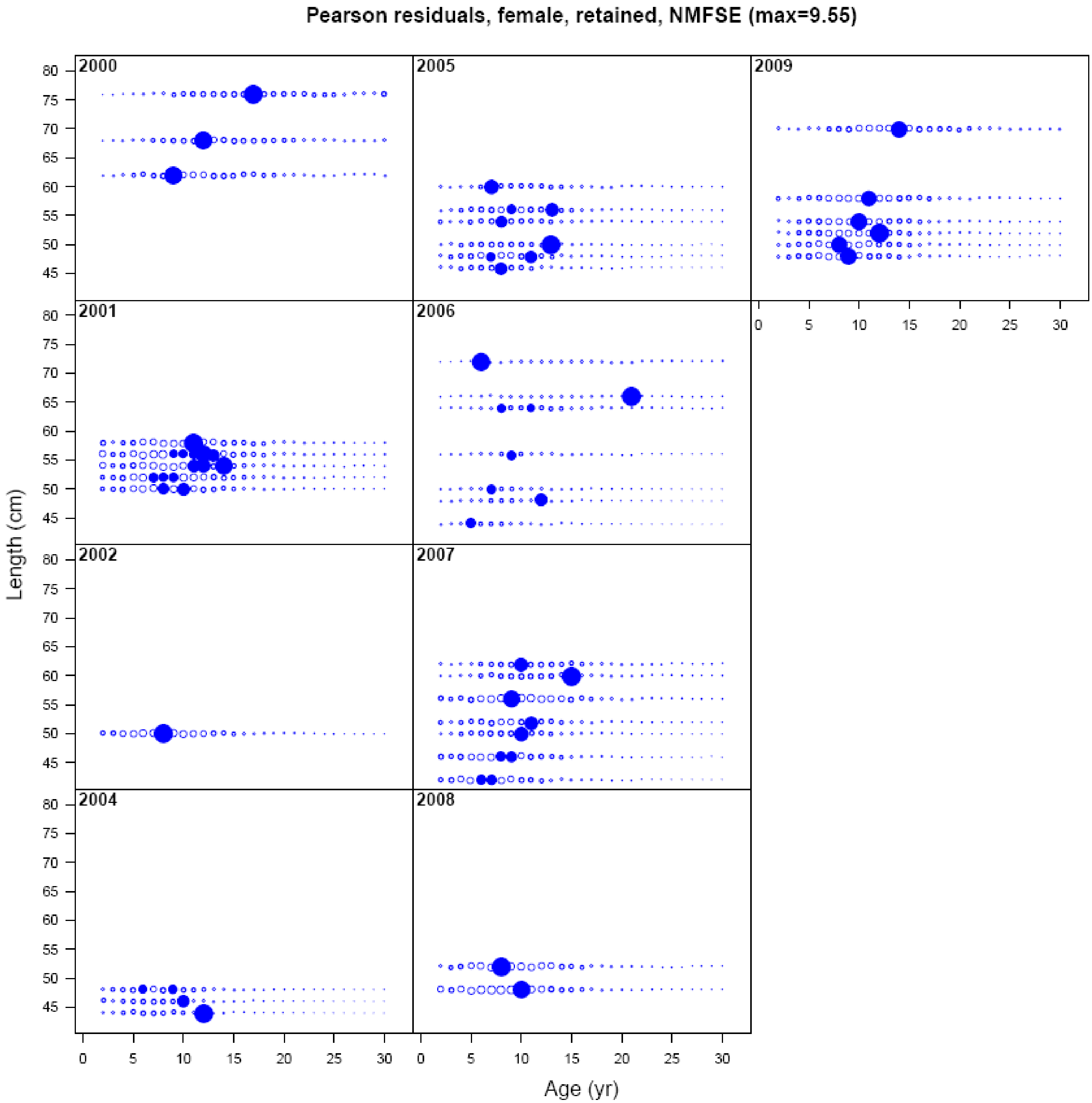


Figure 3.57. Pearson residuals of conditional age composition fits for female Gulf of Mexico tilefish in the NMFS bottom long line survey east from SS Run1. Solid circles are positive residuals (i.e., observed greater than predicted) and open circles are negative residuals (i.e., predicted greater than observed).

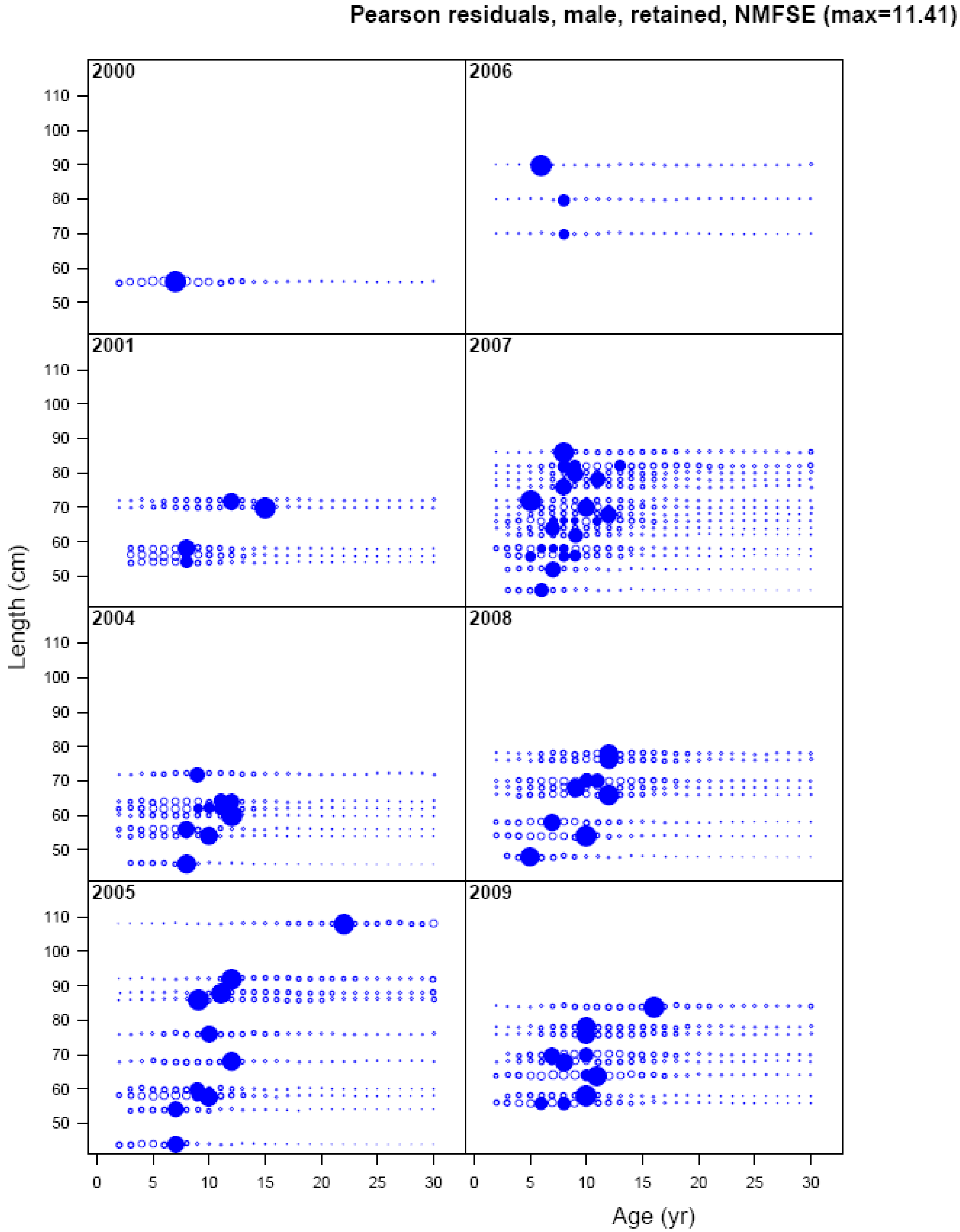


Figure 3.58. Pearson residuals of conditional age composition fits for male Gulf of Mexico tilefish in the NMFS bottom long line survey east from SS Run1. Solid circles are positive residuals (i.e., observed greater than predicted) and open circles are negative residuals (i.e., predicted greater than observed).

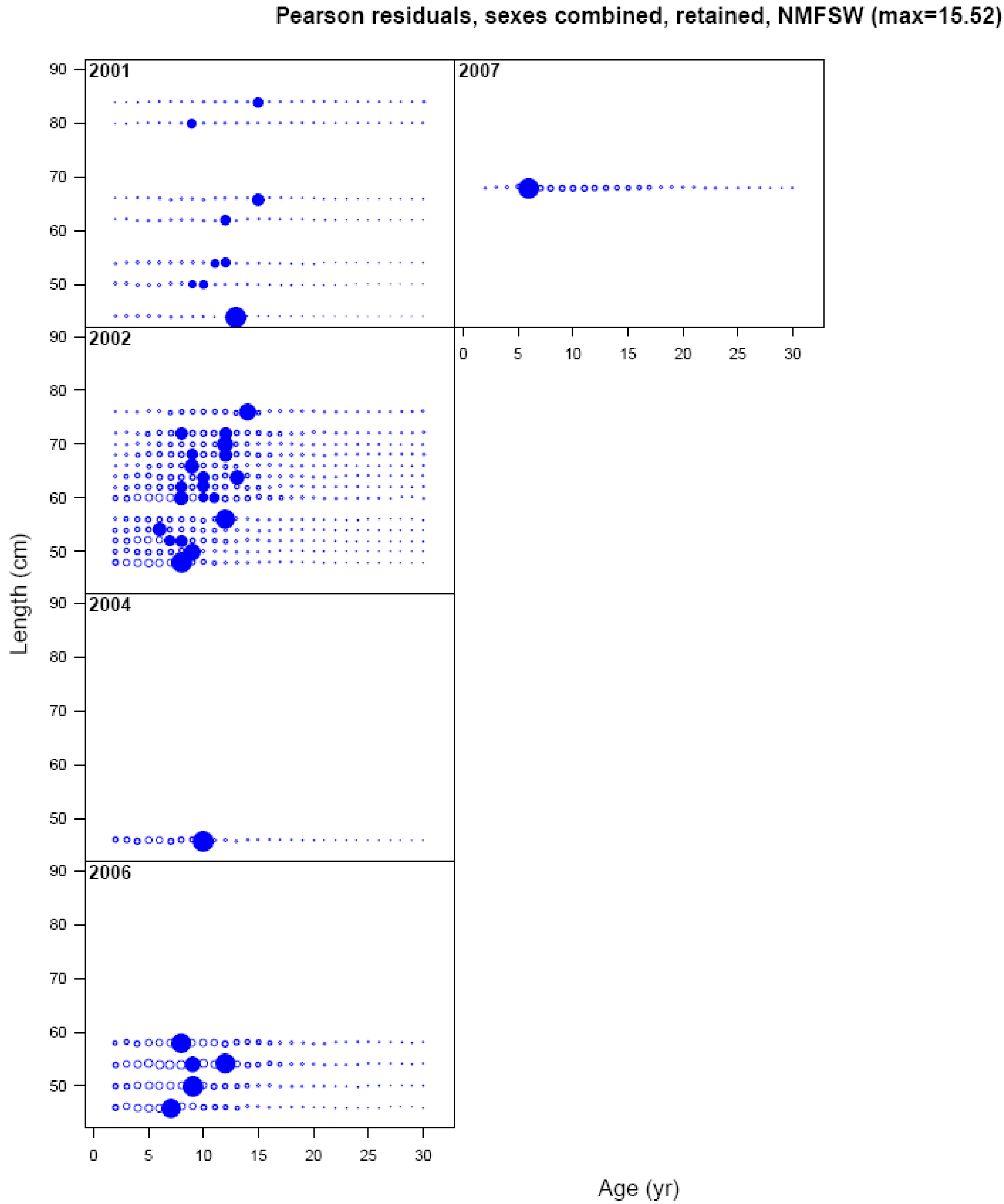


Figure 3.59. Pearson residuals of conditional age composition fits for unknown gender Gulf of Mexico tilefish in the NMFS bottom long line survey west from SS Run1. Solid circles are positive residuals (i.e., observed greater than predicted) and open circles are negative residuals (i.e., predicted greater than observed).

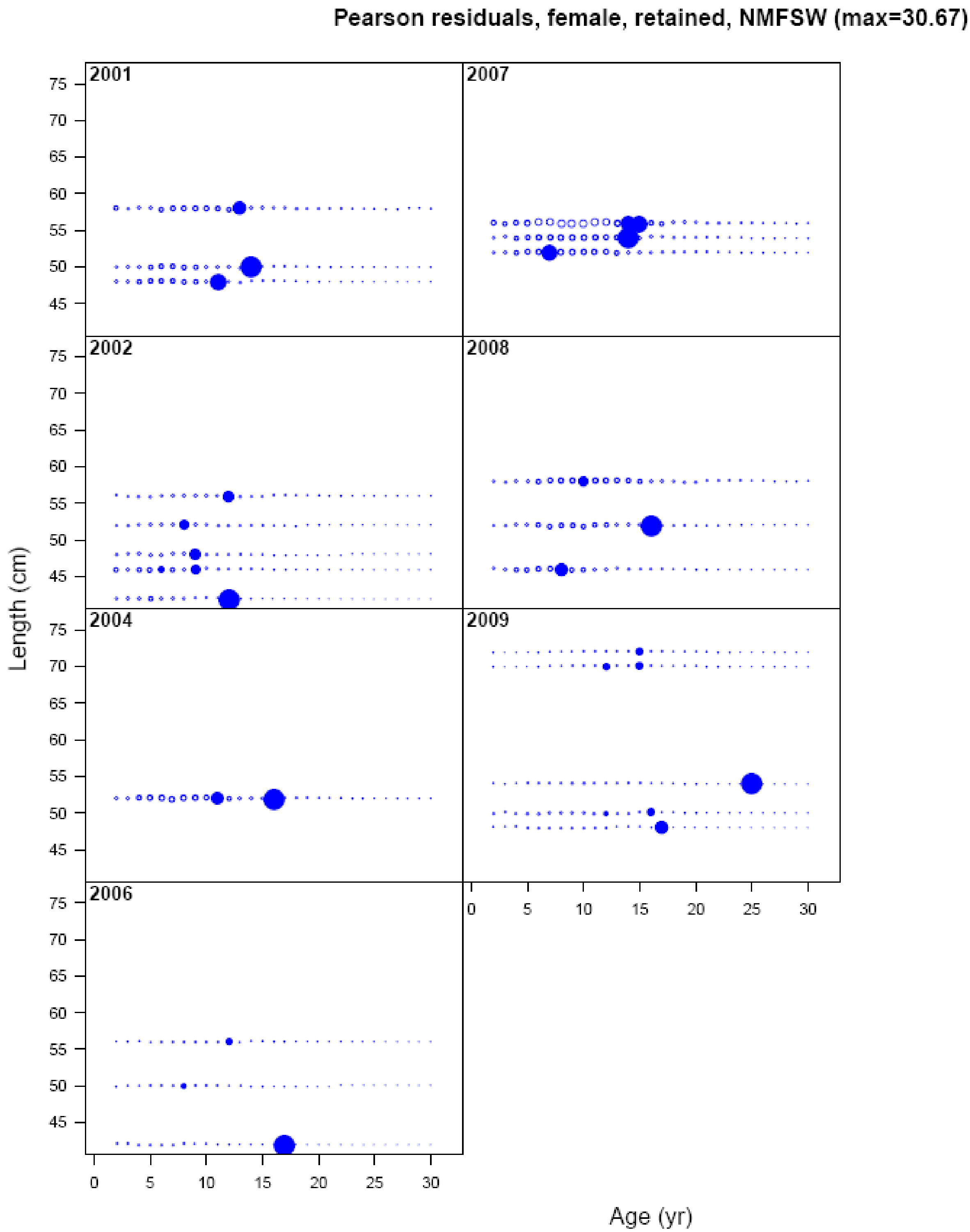


Figure 3.60. Pearson residuals of conditional age composition fits for female Gulf of Mexico tilefish in the NMFS bottom long line survey west from SS Run1. Solid circles are positive residuals (i.e., observed greater than predicted) and open circles are negative residuals (i.e., predicted greater than observed).

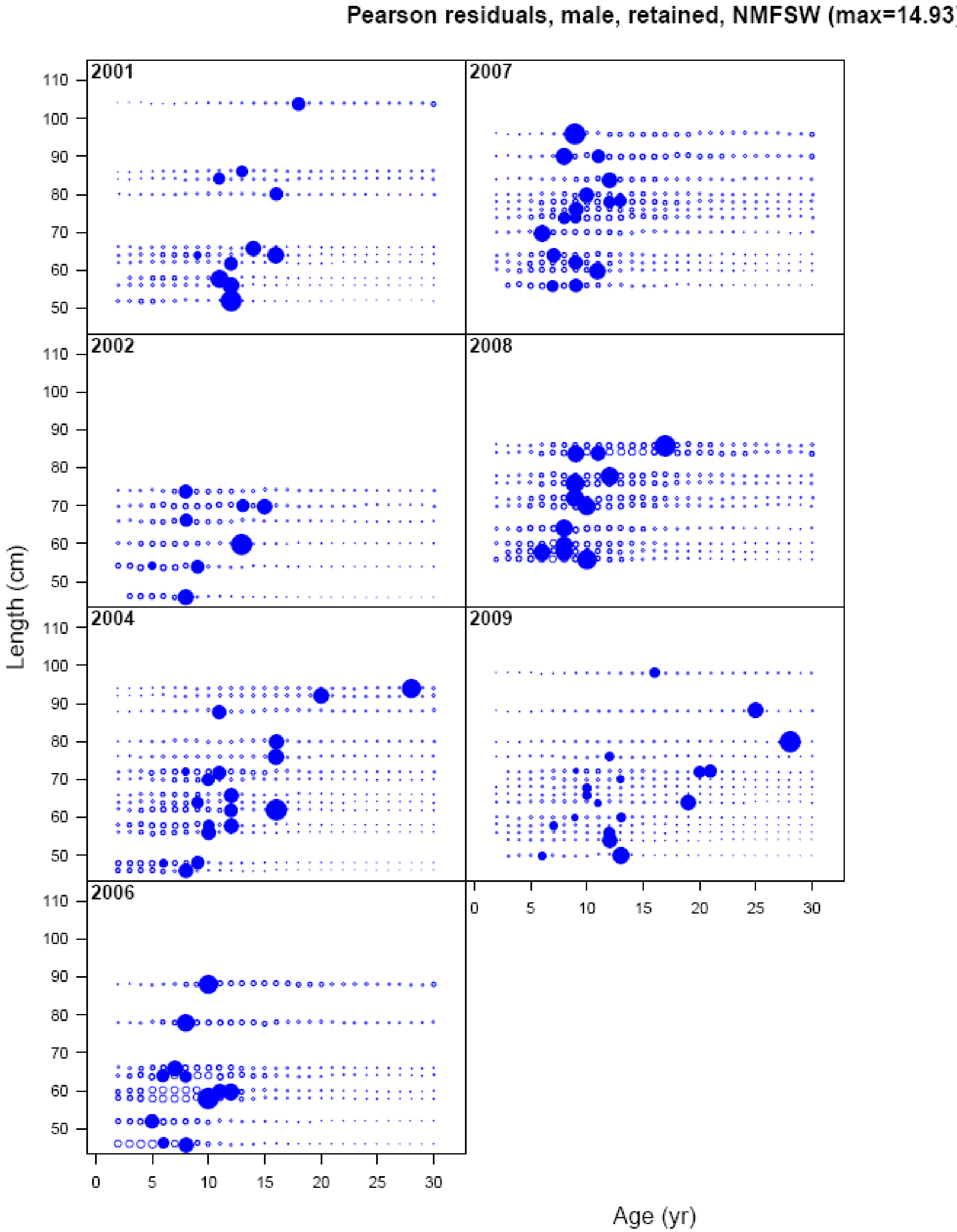


Figure 3.61. Pearson residuals of conditional age composition fits for male Gulf of Mexico tilefish in the NMFS bottom long line survey west from SS Run1. Solid circles are positive residuals (i.e., observed greater than predicted) and open circles are negative residuals (i.e., predicted greater than observed).

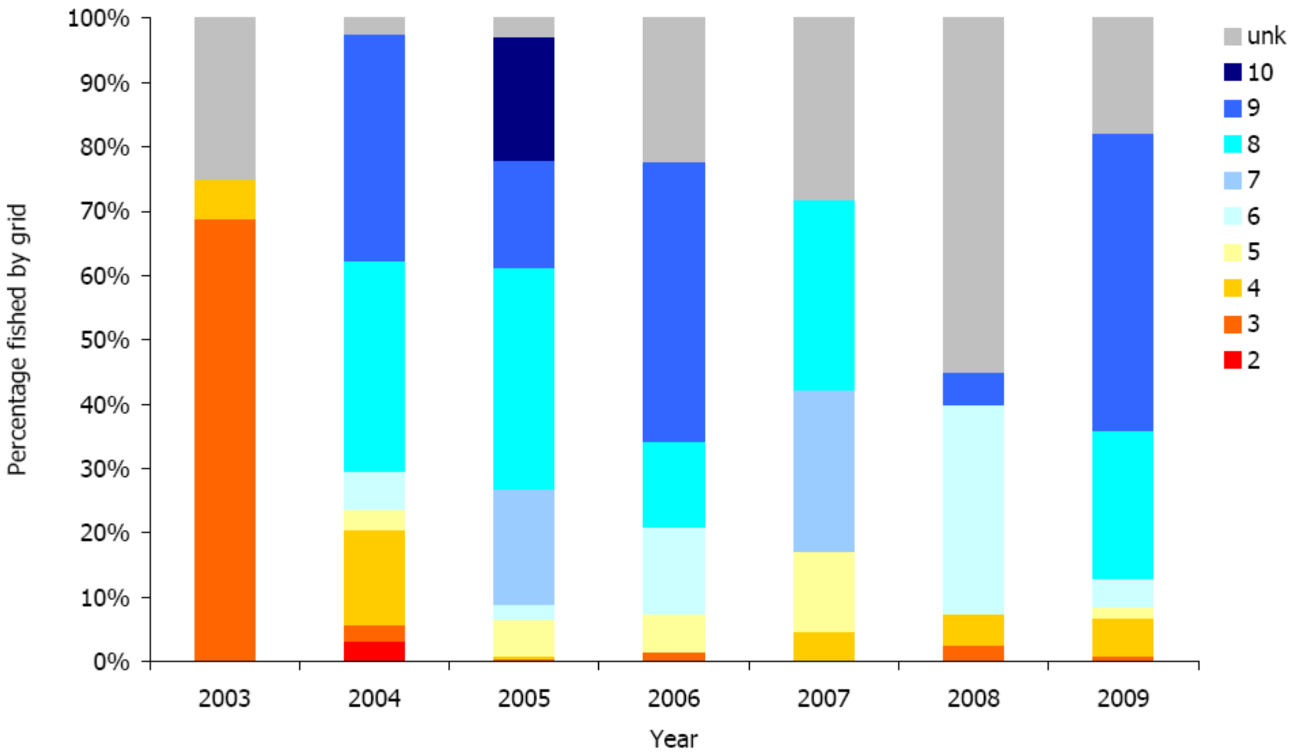


Figure 3.62. Distribution of age 10-15 year old tilefish by statistical grid for the eastern Gulf of Mexico, 2003-2009.

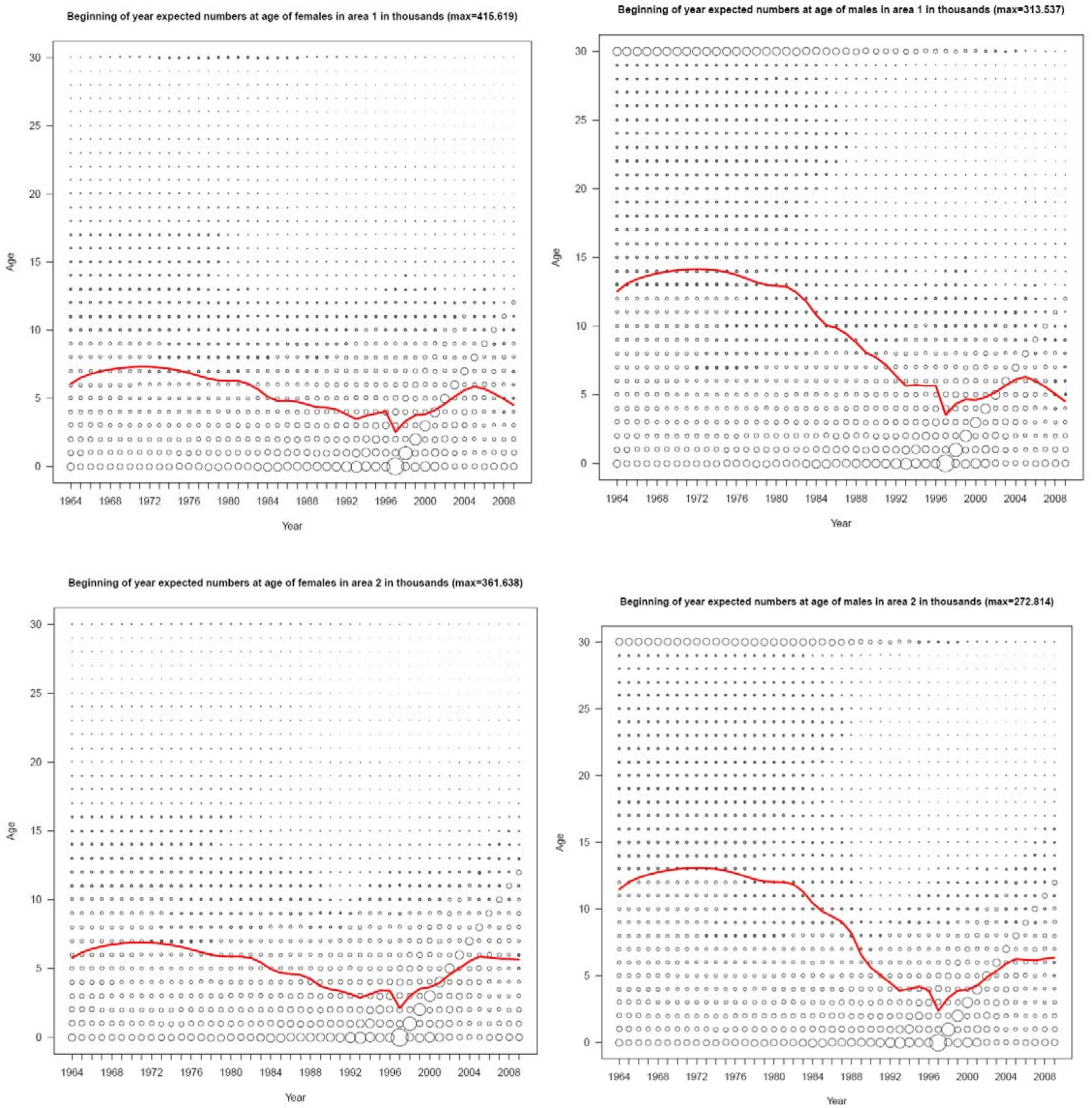
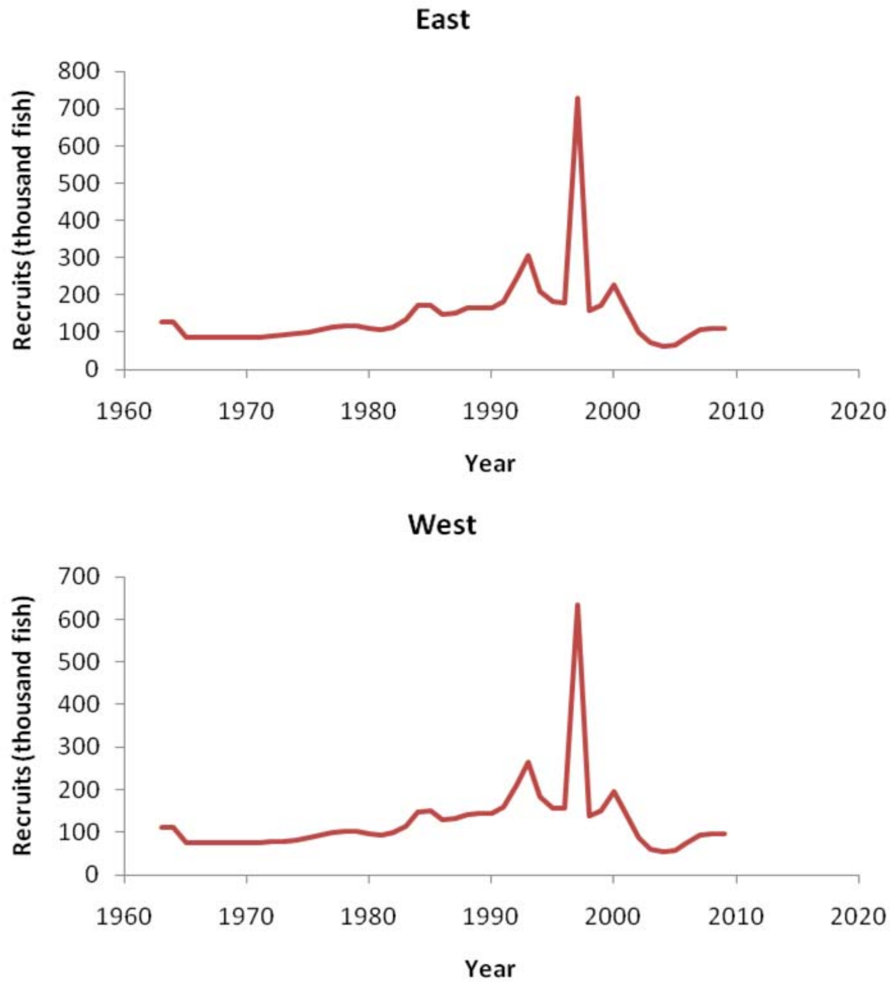


Figure 3.63. Predicted abundance at age (circles) and mean age (line) for females (left column) and males (right column), eastern (top row) and western (bottom row) Gulf from SS Run1. Abundances reported as thousand fish.



3.64. Predicted age-0 recruits in thousand fish for Gulf of Mexico tilefish from SS Run1.

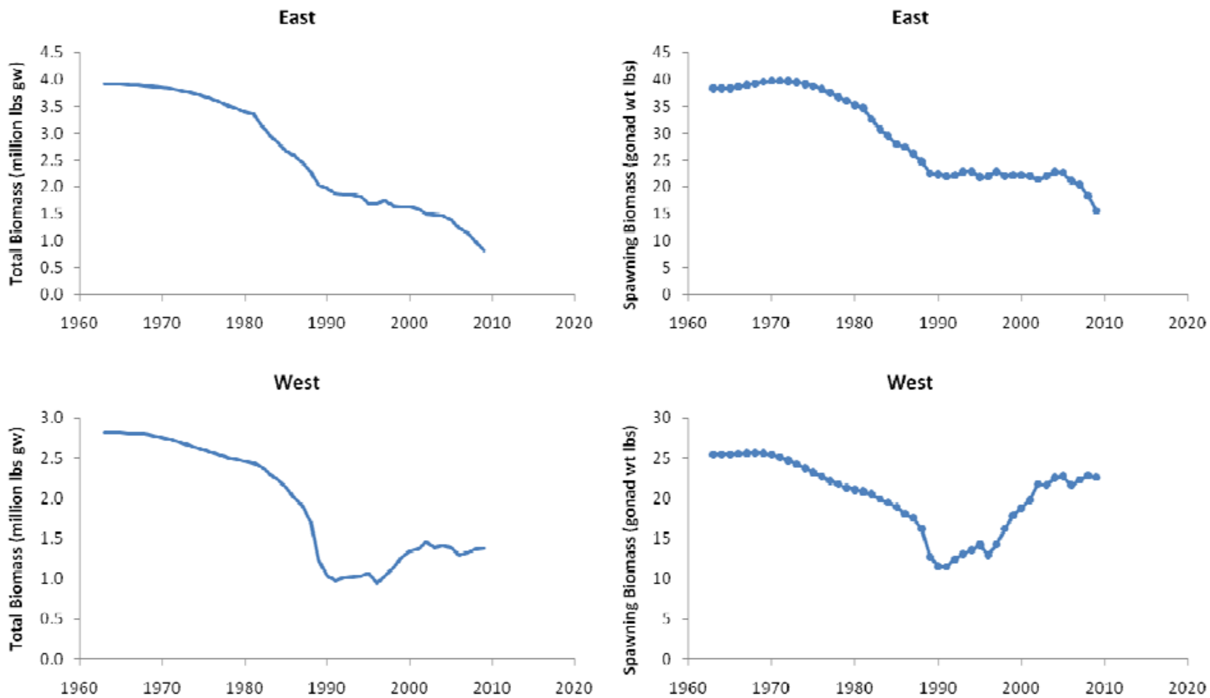


Figure 3.65. Predicted total biomass (million gutted lbs) and spawning biomass (gonad wt lbs) by region for Gulf of Mexico tilefish from SS Run1.

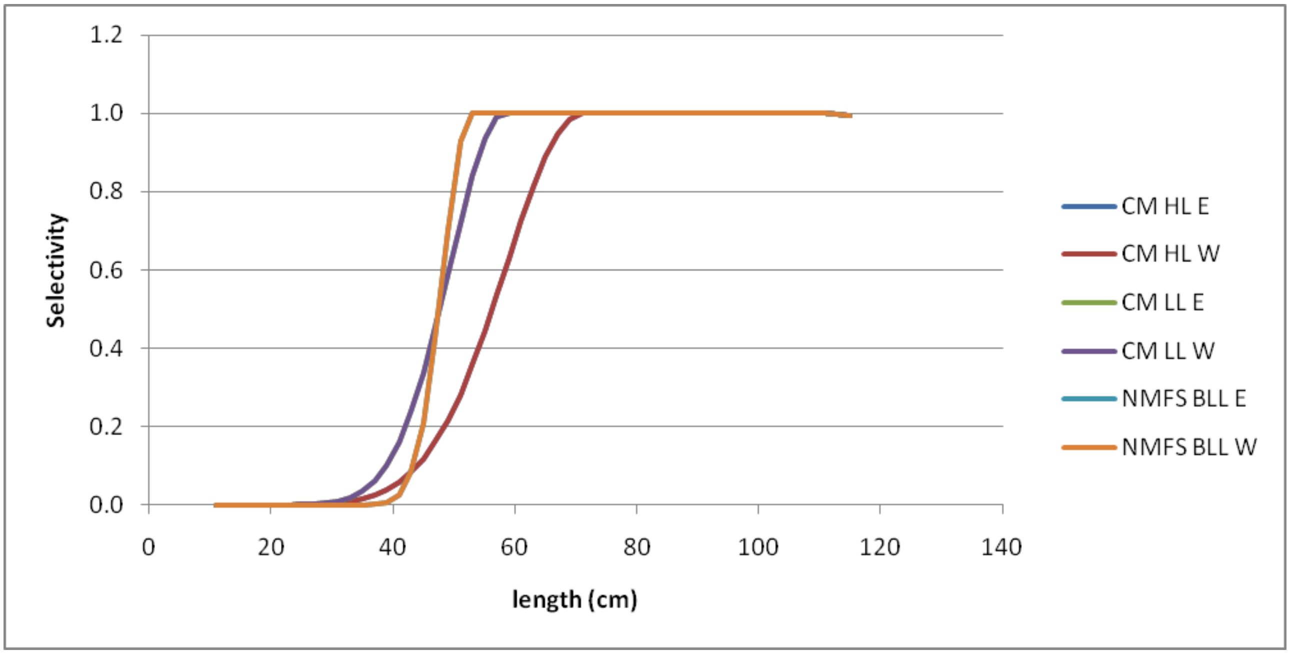


Figure 3.66. Predicted size selectivity for Gulf of Mexico tilefish from SS Run1. Fisheries/Surveys include the commercial hand line east (CM HL E), commercial hand line west (CM HL W), commercial long line east (CM LL E), commercial long line west (CM LL W), NMFS bottom long line survey east (NMFS BLL E), and NMFS bottom long line survey west (NMFS BLL W).

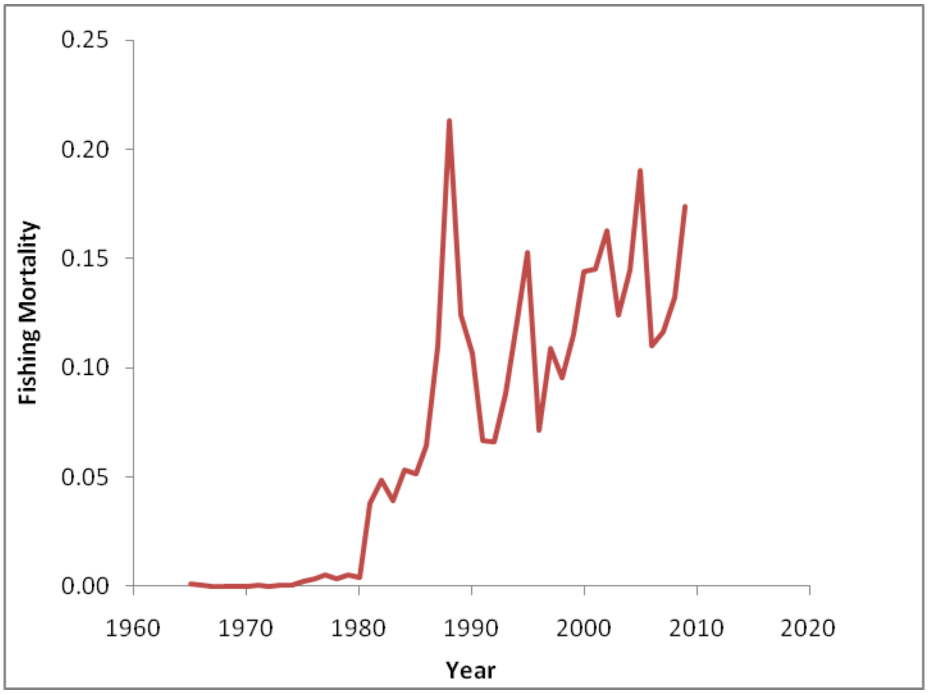


Figure 3.67. Predicted Gulfwide fishing mortality for Gulf of Mexico tilefish from SS Run1.

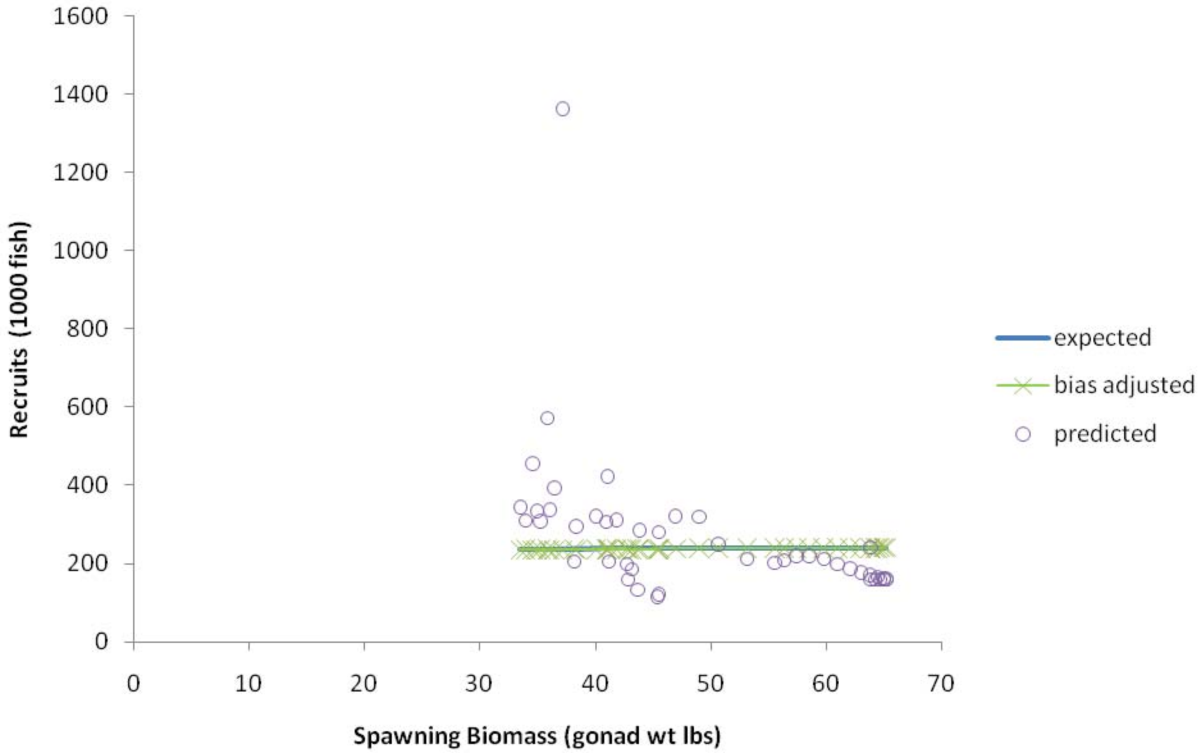


Figure 3.68. Predicted stock-recruitment relationship for Gulf of Mexico tilefish from SS Run1. Plotted are predicted annual recruitments from SS (circles), expected recruitment from the stock-recrit relationship (line), and bias adjusted recruitment from the stock-recruit relationship (line with X).

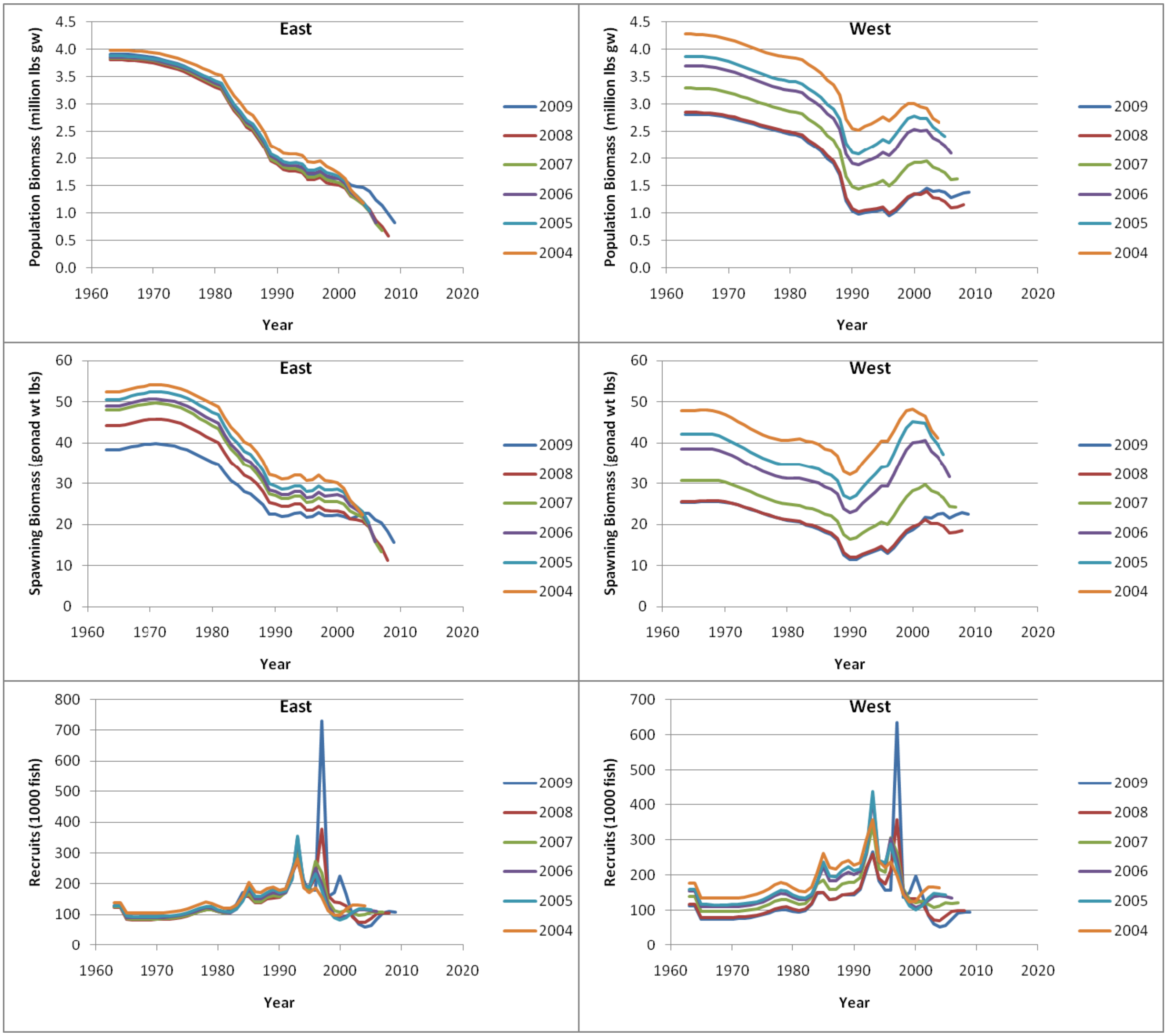


Table 3.69. Retrospective analysis for Gulf of Mexico tilefish with last five years of data sequentially dropped from SS Run1. Model quantities examined include total biomass (top row), spawning biomass (middle row), and recruiment (bottom row).

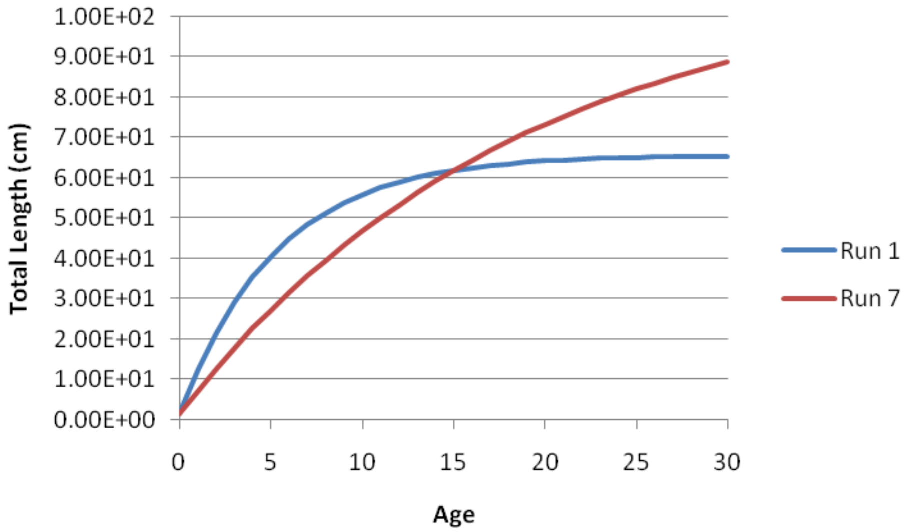


Figure 3.70. Predicted growth curves for western female tilefish from SS Run 1 (central) and Run 7 (Mref age = 25).

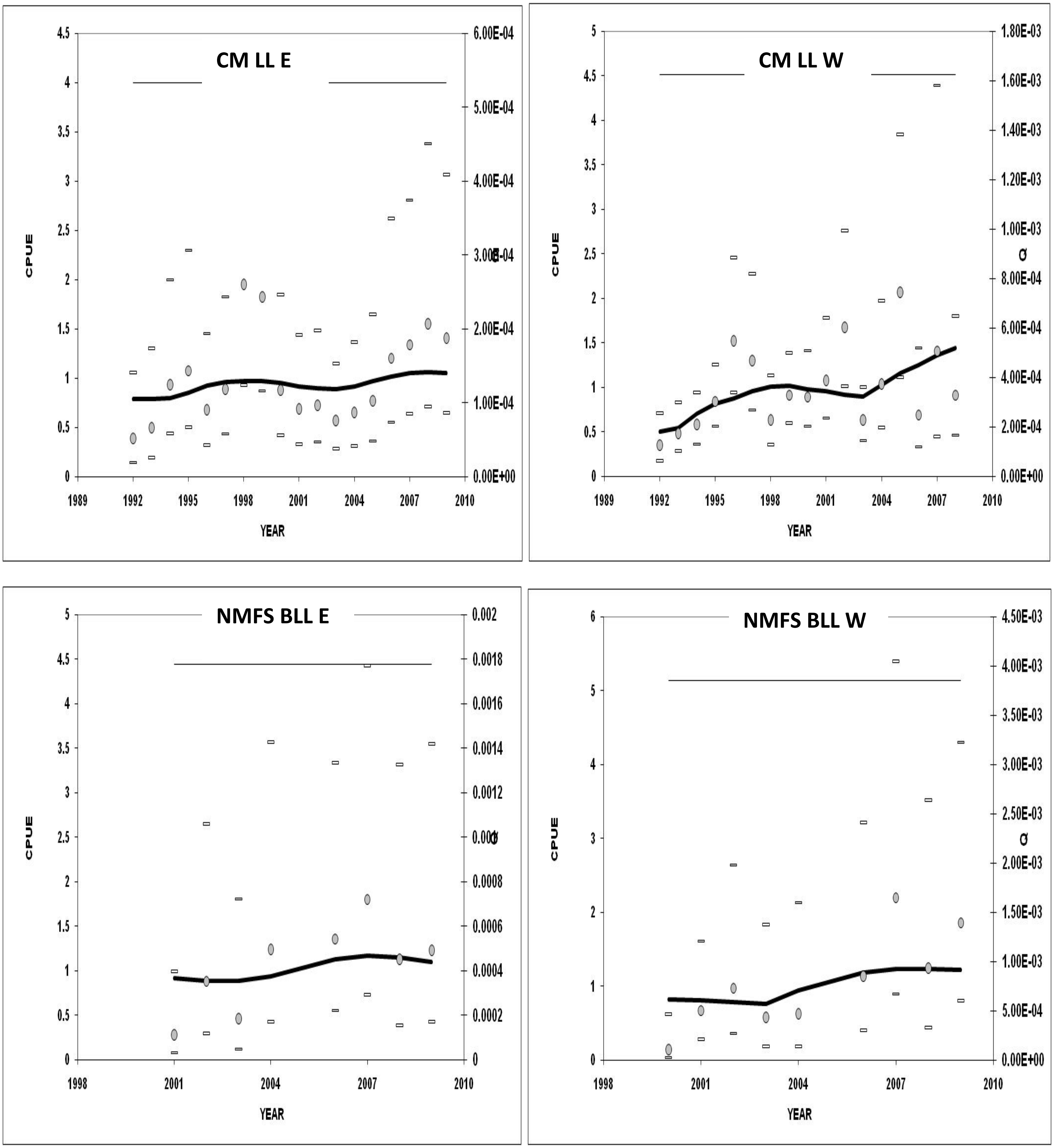


Figure 3.71. Observed and predicted index CPUE from SS Run 12 for Gulf of Mexico tilefish. Indices include the commercial long line east (CM LL E), commercial long line west (CM LL W), NMFS bottom long line survey east (NMFS BLL E), and NMFS bottom long line west (NMFS BLL W). Error bars represent the observed log-scale standard errors.

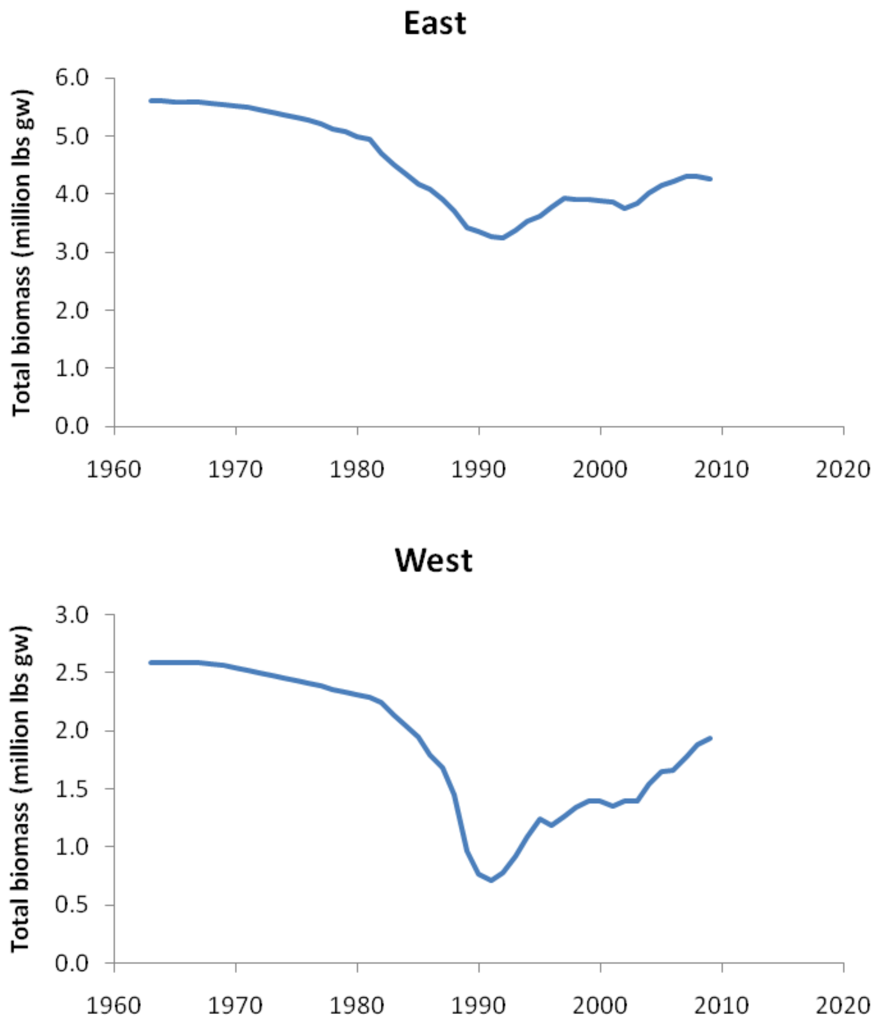


Figure 3.72. Predicted total biomass (million gutted lbs) by region from SS Run 12 for Gulf of Mexico tilefish.

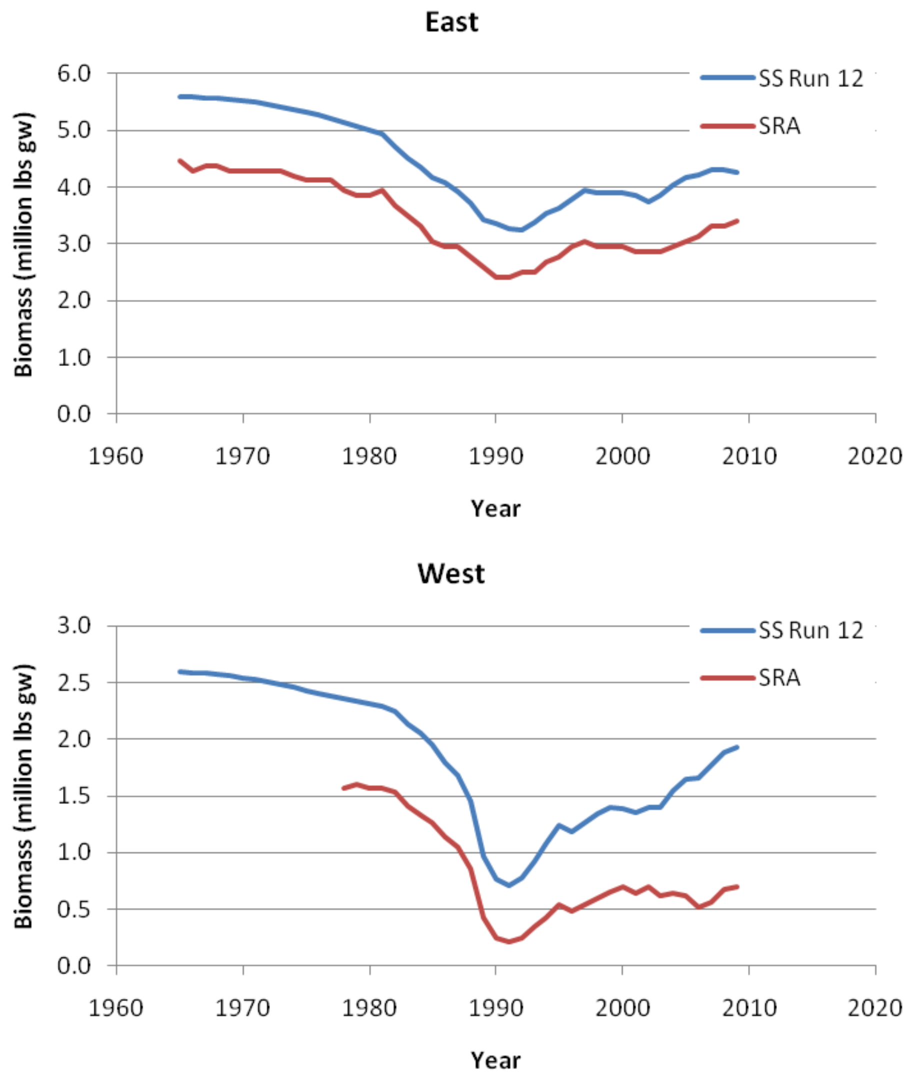


Figure 3.73. Predicted biomass (million gutted lbs) by region from SS Run 12 and SRA for Gulf of Mexico tilefish. Biomass from SS is reported as total biomass. Biomass from SRA is reported as vulnerable biomass.

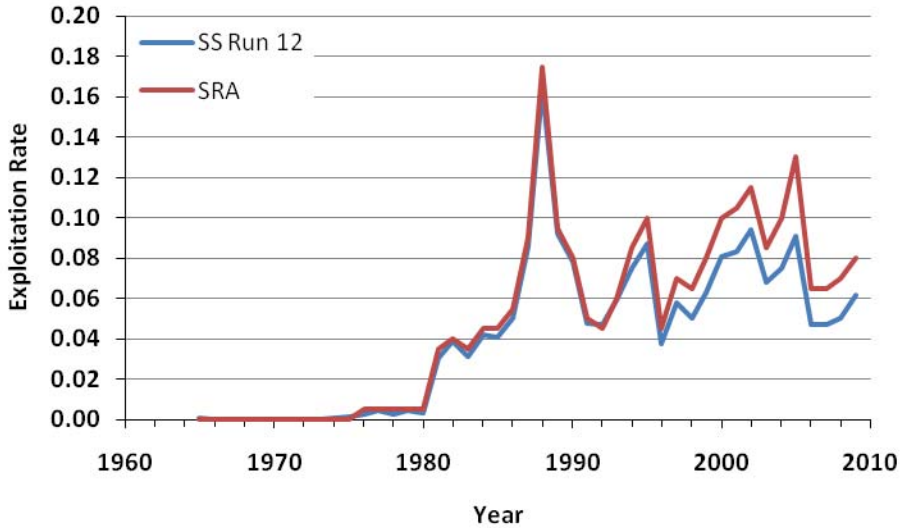


Figure 3.74. Predicted Gulf-wide exploitation rates from SS Run 12 and SRA for Gulf of Mexico tilefish.

3.7. Appendix A. Length Composition Data

Length composition data for Gulf of Mexico tilefish by fishery/survey, region, and gender.

Commercial Hand Line East

		Sample	Length Bin																						
Year	Gender	Size	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66
1991	Female	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
1991	Unknown	14	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	1	0	2	1	1	1	0	0	0
1992	Unknown	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
1993	Female	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1993	Unknown	22	1	0	0	0	0	0	0	0	1	2	1	2	1	4	3	3	1	0	0	0	0	0	0	0
1994	Unknown	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
1995	Unknown	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0
1996	Female	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
1996	Unknown	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2	2	3	3	2	4	3
1997	Unknown	20	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	1	2	0	2	3	2	2	1	2
1998	Unknown	19	0	0	0	0	0	0	0	0	1	2	0	4	2	1	1	1	1	0	1	0	0	1	1	0
1999	Unknown	34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	2	3	3	0	1
2000	Female	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0
2000	Unknown	24	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	3	0	1	0	0	4	1	0	2
2001	Female	78	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	1	6	5	9	11
2001	Male	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	2	0
2001	Unknown	46	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	0	0	0	4	0	7
2002	Female	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
2002	Male	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
2002	Unknown	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	3	8	12	9	6	4	6	15
2003	Unknown	2	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
2004	Unknown	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
2005	Female	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
2005	Male	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	Unknown	174	0	0	0	0	0	0	0	0	0	0	0	0	3	4	4	1	8	3	6	3	5	9	5	10
2007	Male	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Female	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
2008	Unknown	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
2009	Unknown	11	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	1	2	0	2	0	0	1	1

Commercial Hand Line East (continued)

Year	Gender	Sample Size	Length Bin 68	70	72	74	76	78	80	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110	112	114
1991	Female	4	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
1991	Unknown	14	1	0	0	1	1	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0
1992	Unknown	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1993	Female	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1993	Unknown	22	0	0	1	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
1994	Unknown	2	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1995	Unknown	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
1996	Female	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1996	Unknown	30	2	2	1	1	0	1	0	0	0	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0
1997	Unknown	20	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1998	Unknown	19	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1999	Unknown	34	2	1	0	1	1	2	3	3	0	0	2	4	0	0	0	0	0	1	1	1	0	0	0	0
2000	Female	6	0	1	0	0	0	0	0	0	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0
2000	Unknown	24	2	0	0	0	0	1	0	2	0	1	0	0	0	1	1	3	0	0	0	0	0	0	0	0
2001	Female	78	11	9	7	0	2	2	0	0	0	1	0	0	3	2	3	1	2	0	1	0	0	0	0	0
2001	Male	30	2	1	0	0	0	0	0	0	0	0	0	2	1	5	5	6	1	1	3	0	0	0	0	0
2001	Unknown	46	5	1	1	1	1	0	0	1	1	0	0	2	4	6	1	5	2	1	0	0	0	0	0	0
2002	Female	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2002	Male	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
2002	Unknown	100	7	4	7	3	2	1	4	1	2	0	0	0	1	2	1	0	0	0	1	0	0	0	0	0
2003	Unknown	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2004	Unknown	10	1	3	1	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0
2005	Female	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	Male	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	Unknown	174	11	16	19	11	14	9	4	0	4	7	2	6	2	1	2	0	2	2	0	1	0	0	0	0
2007	Male	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Female	2	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Unknown	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
2009	Unknown	11	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0

Commercial Hand Line West

Year	Gender	Sample Size	Length Bin 20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66
1987	Unknown	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
1988	Unknown	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
1990	Unknown	3	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1	0	0	0	0
1991	Unknown	15	0	0	0	0	0	0	1	1	1	0	1	1	0	0	1	1	2	4	0	1	0	0	0	0
1992	Unknown	95	0	0	0	0	0	0	1	0	2	1	0	2	2	9	8	10	6	12	15	6	7	5	1	1
1993	Unknown	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	4	1	1	1	0	0
1994	Unknown	47	0	0	0	1	0	0	0	0	0	0	0	0	2	4	3	2	3	1	6	4	5	3	3	5
1995	Unknown	7	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	1	0	0	1	1
1996	Unknown	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	0	1	0	2	1	1	0
1999	Unknown	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
2001	Unknown	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0
2003	Unknown	19	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	1	4	0	1	1	3	0	0
2005	Unknown	20	0	0	0	0	0	0	0	0	1	1	1	1	2	0	2	3	0	2	1	0	3	0	1	0
2006	Female	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
2006	Unknown	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
2007	Unknown	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	2	0	1	1	1	0
2008	Unknown	52	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	3	4	7	7	4	6	3	2
2009	Female	9	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	2	1	0	1	1	0	0
2009	Male	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Unknown	38	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	2	1	5	1	4	4

Commercial Hand Line West (continued)

Year	Gender	Sample Size	Length Bin 68	70	72	74	76	78	80	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110	112	114
1987	Unknown	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1988	Unknown	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1990	Unknown	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
1991	Unknown	15	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1992	Unknown	95	2	2	0	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1993	Unknown	12	0	1	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1994	Unknown	47	0	0	1	1	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
1995	Unknown	7	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

1996	Unknown	12	0	1	2	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1999	Unknown	5	0	1	1	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	Unknown	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
2003	Unknown	19	0	1	2	0	0	1	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0
2005	Unknown	20	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	Female	2	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	Unknown	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Unknown	9	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Unknown	52	2	2	0	1	1	2	3	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
2009	Female	9	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Male	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Unknown	38	4	1	1	1	2	3	1	1	3	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0

Commercial Long Line East

		Sample											Length Bin												
Year	Gender	Size	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66
1984	Unknown	106	0	0	0	0	0	0	0	1	2	1	3	1	3	4	14	9	8	12	7	6	7	4	9	2
1986	Unknown	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
1987	Unknown	25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	2	4	1	2	1	2
1988	Unknown	48	0	0	0	0	0	0	0	0	0	0	0	0	1	1	2	2	5	6	2	1	4	3	5	0
1989	Unknown	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0
1990	Unknown	153	0	0	0	0	0	0	0	1	0	1	1	1	4	2	7	6	6	16	9	17	9	17	11	6
1991	Unknown	35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	3	2	1	2	2	2	3
1992	Unknown	23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	2	3	1	0	2	0	1
1993	Female	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
1993	Unknown	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	3	2	1	0	1	1	2
1994	Female	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	1	0	0	0	0
1994	Male	2	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0
1994	Unknown	740	0	0	0	0	0	0	1	2	10	12	18	25	28	28	30	32	40	34	42	40	37	35	40	30
1995	Unknown	248	0	0	0	0	0	0	1	2	2	7	4	8	13	11	9	12	18	19	16	16	13	10	4	9
1996	Unknown	347	0	0	0	0	1	1	3	4	7	14	11	11	16	15	17	20	19	22	17	22	18	12	19	16
1997	Unknown	655	0	0	0	0	0	2	4	6	12	23	26	35	33	35	29	38	34	37	24	33	30	30	24	25
1998	Unknown	411	0	0	0	0	0	0	0	0	0	3	11	15	33	34	20	9	19	31	26	27	18	24	23	24
1999	Unknown	560	0	0	0	0	0	0	0	0	2	5	6	11	19	18	26	22	34	40	29	33	27	31	29	36
2000	Unknown	815	0	0	0	0	0	0	0	1	4	7	8	20	24	33	28	38	38	60	39	49	43	50	46	51
2001	Unknown	805	0	0	0	0	0	0	0	2	6	12	10	26	28	31	35	26	43	47	33	47	34	37	36	38
2002	Unknown	213	0	0	0	0	0	0	0	0	2	3	3	8	11	13	10	14	18	16	15	10	12	8	3	9
2003	Male	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	1	0	0	1	1	0	1

2003	Unknown	610	0	0	0	0	0	0	0	1	2	7	7	11	25	38	40	47	48	44	48	46	35	29	29	28
2004	Unknown	1684	0	0	0	0	0	0	2	1	6	6	27	34	57	65	102	124	103	126	93	82	80	83	77	92
2005	Female	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	2	0	0	0
2005	Male	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0
2005	Unknown	1516	1	0	0	0	0	0	0	2	5	4	19	29	40	85	84	115	92	131	76	88	83	58	67	70
2006	Unknown	1125	0	0	0	0	0	0	1	7	8	22	22	40	42	48	63	91	79	76	64	50	52	65	43	52
2007	Unknown	905	0	0	0	0	0	0	0	1	1	1	11	33	34	48	59	93	51	59	61	47	36	32	38	37
2008	Female	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0
2008	Male	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	2	1	1	3	1	1
2008	Unknown	473	0	0	0	0	0	0	0	0	0	2	4	11	17	24	34	40	39	31	27	28	19	20	15	20
2009	Female	34	0	0	0	0	0	0	0	0	0	0	1	1	3	3	5	6	2	5	3	1	2	1	1	0
2009	Male	57	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	4	4	4	3	3	6	3	4	6
2009	Unknown	581	0	0	0	1	2	2	3	2	2	5	5	6	7	14	29	26	29	23	25	31	39	34	36	34

Commercial Long Line East (continued)

		Sample													Length Bin									
Year	Gender	Size	68	70	72	74	76	78	80	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110	112	114
1984	Unknown	106	1	1	5	1	0	1	0	1	1	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0
1986	Unknown	2	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
1987	Unknown	25	0	0	1	2	2	0	3	1	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0
1988	Unknown	48	5	3	1	0	0	0	1	2	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
1989	Unknown	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
1990	Unknown	153	9	5	3	6	3	2	1	1	2	0	0	0	2	0	2	0	0	1	1	0	1	0	0	0
1991	Unknown	35	2	0	5	3	3	3	0	0	1	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0
1992	Unknown	23	0	3	1	0	0	3	0	0	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0
1993	Female	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1993	Unknown	14	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
1994	Female	4	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1994	Male	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
1994	Unknown	740	29	27	22	20	18	18	13	13	17	18	13	13	6	9	10	7	2	1	0	0	0	0	0	0
1995	Unknown	248	5	10	4	7	4	8	4	2	8	6	5	2	3	1	1	1	1	2	0	0	0	0	0	0
1996	Unknown	347	6	9	3	4	5	4	6	7	9	7	3	4	4	3	3	4	1	0	0	0	0	0	0	0
1997	Unknown	655	17	23	19	16	17	12	6	8	10	6	11	8	6	4	5	1	2	2	0	0	0	2	0	0
1998	Unknown	411	14	13	12	2	7	6	4	8	8	6	4	2	3	3	0	1	1	0	0	0	0	0	0	0
1999	Unknown	560	15	18	19	19	15	14	12	7	8	8	8	6	5	13	5	4	5	4	4	1	0	1	1	0
2000	Unknown	815	36	30	22	28	26	27	15	10	17	14	16	7	5	11	4	3	3	0	2	0	0	0	0	0
2001	Unknown	805	31	38	37	31	25	17	21	16	11	16	6	9	11	10	12	7	8	3	3	0	1	1	0	0
2002	Unknown	213	3	7	5	12	5	7	3	3	1	1	0	5	4	0	0	1	0	0	0	0	0	1	0	0

2003	Male	7	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	Unknown	610	15	20	22	13	13	7	8	3	4	4	4	3	1	2	2	3	1	0	0	0	0	0	0	0
2004	Unknown	1684	78	57	61	58	42	42	30	26	29	20	15	21	12	12	9	3	5	4	0	0	0	0	0	0
2005	Female	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
2005	Male	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
2005	Unknown	1516	60	68	70	46	36	33	42	27	14	10	17	12	9	6	9	3	2	1	1	1	0	0	0	0
2006	Unknown	1125	40	42	40	31	25	24	22	24	13	11	8	6	4	3	2	3	0	0	1	1	0	0	0	0
2007	Unknown	905	20	34	34	31	23	20	20	17	14	17	5	9	6	3	4	2	2	2	0	0	0	0	0	0
2008	Female	3	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Male	15	0	0	0	0	0	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Unknown	473	10	16	16	21	10	10	14	6	10	11	5	5	4	1	1	1	0	0	1	0	0	0	0	0
2009	Female	34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Male	57	2	2	4	3	3	0	3	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Unknown	581	26	34	28	17	10	14	15	12	14	8	8	8	8	10	5	4	4	1	0	0	0	0	0	0

Commercial Long Line West

		Sample											Length Bin													
Year	Gender	Size	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66
1984	Unknown	100	0	0	0	0	0	0	0	0	0	0	2	2	0	4	3	5	4	9	13	7	10	6	4	3
1986	Unknown	26	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	2	3	4	2	1	2	1	1
1987	Unknown	126	0	0	0	0	1	0	1	1	1	1	0	3	3	2	1	3	2	6	8	3	4	11	9	4
1988	Unknown	175	0	0	0	0	1	1	1	2	1	5	9	20	6	6	5	17	8	12	4	3	14	7	5	7
1989	Unknown	82	0	0	0	0	0	0	1	1	0	1	3	3	4	3	3	8	0	5	2	4	5	5	4	1
1990	Unknown	128	0	0	0	0	0	0	0	0	1	1	3	2	3	10	7	8	9	7	11	11	7	11	7	5
1991	Unknown	415	0	0	0	0	0	0	0	1	1	0	7	8	4	20	18	30	24	30	35	36	16	26	20	14
1992	Unknown	395	0	0	0	0	0	0	0	1	3	1	7	9	9	21	33	22	22	35	28	32	29	16	32	15
1993	Unknown	162	0	0	0	0	0	0	0	0	1	0	2	3	8	13	7	16	5	12	7	15	11	7	7	4
1994	Unknown	320	0	0	0	0	0	0	0	0	0	3	2	8	10	11	12	16	20	19	18	20	12	20	19	17
1995	Female	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	1	0	0	0	0	0
1995	Unknown	185	0	0	0	0	0	1	0	1	1	0	4	4	3	7	12	7	9	13	11	9	9	11	9	7
1996	Unknown	62	0	0	0	0	0	0	0	0	1	0	0	2	6	3	6	2	2	3	7	2	4	7	3	4
1997	Unknown	20	0	0	0	0	0	0	0	0	0	0	0	0	0	2	3	2	1	1	2	1	3	1	0	2
1998	Unknown	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1	1	0	1
2000	Unknown	35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	4	1	0	3	4
2003	Unknown	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	1	1	2	1	2
2004	Unknown	40	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	1	3	5	2	1	2	9	5
2005	Unknown	34	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	5	1	2	1	2	2	0
2006	Female	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

2006	Unknown	15	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	1	2	1	2	0	0	0	0	1
2007	Female	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0
2007	Unknown	93	0	0	0	0	0	0	0	0	0	0	0	1	0	1	6	12	9	13	4	11	5	5	6	3
2008	Unknown	410	0	0	0	0	0	0	0	0	0	0	0	1	5	13	19	14	9	28	20	24	26	38	15	36
2009	Unknown	546	0	0	0	0	0	0	0	0	0	0	1	0	2	5	7	21	12	20	26	27	26	45	28	30

Commercial Long Line West (continued)

		Sample	Length Bin																							
Year	Gender	Size	68	70	72	74	76	78	80	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110	112	114
1984	Unknown	100	6	4	5	3	2	1	3	0	0	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0
1986	Unknown	26	2	1	0	0	0	0	0	1	0	0	0	0	2	0	2	0	0	0	0	0	0	0	0	0
1987	Unknown	126	1	9	2	6	7	6	8	5	3	4	8	2	1	0	0	0	0	0	0	0	0	0	0	0
1988	Unknown	175	0	7	4	7	5	2	4	2	4	3	0	1	1	1	0	0	0	0	0	0	0	0	0	0
1989	Unknown	82	0	6	8	4	3	2	2	2	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
1990	Unknown	128	4	2	2	1	4	0	3	0	2	1	0	0	1	0	2	0	1	2	0	0	0	0	0	0
1991	Unknown	415	9	13	11	17	11	8	6	4	2	5	4	9	9	2	4	3	6	1	1	0	0	0	0	0
1992	Unknown	395	8	13	6	7	1	8	2	1	2	5	7	4	1	2	8	2	3	0	0	0	0	0	0	0
1993	Unknown	162	2	6	5	4	3	5	2	2	4	7	2	1	0	0	1	0	0	0	0	0	0	0	0	0
1994	Unknown	320	12	9	13	13	3	5	6	2	2	4	4	7	4	7	5	4	6	5	0	0	1	0	0	1
1995	Female	5	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	Unknown	185	6	7	7	7	3	8	1	2	2	7	2	3	3	2	1	1	0	2	2	1	0	0	0	0
1996	Unknown	62	0	1	1	0	1	0	0	0	0	0	0	3	1	1	1	0	0	0	0	0	1	0	0	0
1997	Unknown	20	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1998	Unknown	13	1	1	1	0	1	0	1	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0
2000	Unknown	35	1	2	1	2	3	0	2	1	2	4	1	0	1	2	0	0	0	0	0	0	0	0	0	0
2003	Unknown	18	0	1	0	2	0	0	1	0	2	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
2004	Unknown	40	3	1	3	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	Unknown	34	1	3	4	3	2	0	0	2	0	1	2	1	0	0	0	0	1	0	0	0	0	0	0	0
2006	Female	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	Unknown	15	0	1	0	0	0	0	0	0	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0
2007	Female	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
2007	Unknown	93	3	4	1	4	1	1	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Unknown	410	34	14	28	16	13	10	7	6	9	8	5	6	1	2	0	0	1	1	1	0	0	0	0	0
2009	Unknown	546	36	33	43	23	21	26	15	14	23	14	4	13	7	6	5	3	3	1	2	0	2	1	1	0

NMFS Bottom Long Line Survey East

		Sample	Length Bin																						
Year	Gender	Size	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66
2000	Female	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
2000	Male	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
2000	Unknown	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0
2001	Female	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	3	3	6	2	0	0	0	0
2001	Male	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	2	0	0	0	0
2001	Unknown	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
2002	Female	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
2002	Unknown	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	0	0	0	3	0	1
2004	Female	4	0	0	0	0	0	0	0	0	0	0	0	0	1	1	2	0	0	0	0	0	0	0	0	0
2004	Male	11	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	2	0	1	3	2	0
2005	Female	8	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	1	0	1	2	0	1	0	0	0
2005	Male	12	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	3	1	0	0	0
2006	Female	8	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	0	0	1	0	0	0	2	1
2006	Male	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
2007	Female	11	0	0	0	0	0	0	0	0	0	0	0	2	0	2	0	1	1	0	3	0	1	1	0	0
2007	Male	25	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	3	3	0	1	1	4
2007	Unknown	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
2008	Female	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0
2008	Male	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	1	0	0	0	1
2008	Unknown	2	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
2009	Female	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0	1	0	0	0	0
2009	Male	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	0	0	3	0

NMFS Bottom Long Line Survey East (continued)

		Sample	Length Bin																						
Year	Gender	Size	68	70	72	74	76	78	80	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110	112	114
2000	Female	3	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2000	Male	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2000	Unknown	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
2001	Female	16	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	Male	6	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	Unknown	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2002	Female	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2002	Unknown	7	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	Female	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
2004	Male	11	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

2005	Female	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	Male	12	1	0	0	0	1	0	0	0	0	1	1	0	1	0	0	0	0	0	0	0	1	0	0	0
2006	Female	8	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	Male	3	0	1	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
2007	Female	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Male	25	1	2	1	0	1	1	1	3	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Unknown	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Female	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
2008	Male	9	1	2	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Unknown	2	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Female	6	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Male	12	1	2	0	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

NMFS Bottom Long Line Survey West

		Sample	Length Bin																							
Year	Gender	Size	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66
2001	Female	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	1	0	0	0	0
2001	Male	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	2	0	1	2	1
2001	Unknown	9	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	2	0	2	0	0	0	1	0	1
2002	Female	6	0	0	0	0	0	0	0	0	0	0	0	1	0	2	1	0	1	0	1	0	0	0	0	0
2002	Male	8	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	2	0	0	1	0	0	1
2002	Unknown	23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	1	2	1	1	0	4	2	2	1
2004	Female	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0
2004	Male	19	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0	1	2	0	2	1	1
2004	Unknown	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
2006	Female	3	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	1	0	0	0	0	0
2006	Male	12	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	1	0	0	2	2	0	2	1
2006	Unknown	5	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	2	0	1	0	0	0	0
2007	Female	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	2	0	0	0	0	0
2007	Male	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	1	1	1	0
2007	Unknown	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Female	3	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	1	0	0	0	0
2008	Male	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	1	0	1	0
2009	Female	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	0	1	0	0	0	0	0	0
2009	Male	19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	1	1	1	2	0	2	1

NMFS Bottom Long Line Survey West (continued)

Year	Gender	Sample Size	Length Bin 68	70	72	74	76	78	80	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110	112	114
2001	Female	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
2001	Male	12	0	0	0	0	0	0	1	0	1	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0
2001	Unknown	9	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2002	Female	6	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	Male	8	0	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2002	Unknown	23	2	1	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2004	Female	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
2004	Male	19	0	1	3	0	1	0	1	0	0	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0
2004	Unknown	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	Female	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
2006	Male	12	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	Unknown	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Female	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
2007	Male	16	0	1	0	2	1	2	1	0	1	0	0	2	0	0	1	0	0	0	0	0	0	0	0	0
2007	Unknown	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Female	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
2008	Male	12	0	1	1	0	1	1	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Female	7	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Male	19	1	1	3	0	1	0	1	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0

3.8. Appendix B. Age Composition Data

Conditional age composition data for Gulf of Mexico tilefish by fishery/survey, region, and gender. Length bins are at 2 cm intervals based on total length. Age 30 is a plus group.

Commercial Hand Line East

		Length	Sample	Age																												
Year	Gender	Bin	Size	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
2000	Unknown	46	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2000	Unknown	50	2	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2000	Unknown	54	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2000	Unknown	68	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2002	Unknown	52	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2002	Unknown	54	6	0	0	0	0	0	1	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2002	Unknown	56	5	0	0	0	0	1	2	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2002	Unknown	58	7	0	0	0	0	1	3	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2002	Unknown	60	3	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2002	Unknown	64	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2002	Unknown	66	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	Unknown	48	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	Unknown	50	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	Unknown	56	4	0	1	0	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	Unknown	58	2	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	Unknown	62	3	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	Unknown	64	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	Unknown	66	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	Unknown	68	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	Unknown	72	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2004	Unknown	82	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2004	Unknown	98	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	Unknown	44	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	Unknown	46	2	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	Unknown	48	4	0	0	0	0	0	1	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	Unknown	50	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	Unknown	52	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	Unknown	54	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	Unknown	56	3	0	0	0	0	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	Unknown	58	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0
2005	Unknown	60	4	0	0	0	0	0	0	0	1	1	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0

2005	Unknown	62	6	0	0	0	0	0	1	1	3	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	Unknown	64	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	Unknown	70	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
2005	Unknown	72	2	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	Unknown	76	5	0	0	0	0	0	0	0	2	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	Unknown	78	2	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	Unknown	80	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	Unknown	84	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	Unknown	98	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
2007	Unknown	76	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Unknown	62	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Unknown	66	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Unknown	78	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Unknown	98	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Unknown	40	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Unknown	48	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Unknown	52	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Unknown	54	2	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Unknown	58	2	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	0
2009	Unknown	64	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Unknown	66	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Unknown	74	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Unknown	96	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Commercial Hand Line West

		Length	Sample	Age																												
Year	Gender	Bin	Size	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
2003	Unknown	44	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	Unknown	46	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	Unknown	48	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	Unknown	52	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	Unknown	54	4	0	0	0	0	0	0	1	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	Unknown	58	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	Unknown	60	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	Unknown	62	3	0	0	0	0	0	0	1	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	Unknown	70	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	Unknown	72	2	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	Unknown	78	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

2003	Unknown	86	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	Unknown	94	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	Unknown	50	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	Unknown	56	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	Unknown	60	2	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	Unknown	70	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	Unknown	60	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	Unknown	64	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	Unknown	74	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Unknown	48	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Unknown	52	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Unknown	56	2	0	0	0	0	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
2007	Unknown	60	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Unknown	62	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Unknown	64	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Unknown	76	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Unknown	80	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Unknown	48	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Unknown	50	2	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Unknown	52	3	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Unknown	54	4	0	0	1	0	1	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Unknown	56	7	0	0	0	0	1	1	1	1	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Unknown	58	7	0	0	0	0	1	0	0	2	2	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Unknown	60	3	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Unknown	62	6	0	0	0	0	0	1	1	0	1	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Unknown	64	3	0	0	0	0	0	0	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Unknown	66	2	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Unknown	68	2	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Unknown	70	2	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
2008	Unknown	74	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Unknown	76	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Unknown	78	2	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Unknown	80	3	0	0	0	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Unknown	82	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Unknown	90	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Unknown	48	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Unknown	56	2	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Unknown	58	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Unknown	60	6	0	0	0	0	0	0	1	1	0	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Unknown	62	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Unknown	64	3	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0

2009	Unknown	66	2	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Unknown	68	4	0	0	0	0	0	0	0	0	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Unknown	70	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Unknown	74	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Unknown	76	2	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Unknown	78	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Unknown	80	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Unknown	82	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Unknown	84	3	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
2009	Unknown	88	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Unknown	92	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Female	54	2	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Female	56	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Female	62	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Female	68	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Female	72	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Male	44	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Male	64	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Male	66	2	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Male	72	2	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Male	78	2	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Male	80	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Male	86	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Commercial Long Line East

		Length	Sample	Age																												
Year	Gender	Bin	Size	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1997	Unknown	36	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1997	Unknown	42	3	0	0	0	0	2	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1997	Unknown	44	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1997	Unknown	48	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1997	Unknown	50	5	0	0	0	0	0	0	0	1	0	3	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
1997	Unknown	52	4	0	0	0	0	0	0	1	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1997	Unknown	54	4	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0
1997	Unknown	56	4	0	0	0	0	0	0	0	1	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1997	Unknown	58	3	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
1997	Unknown	60	2	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
1997	Unknown	62	2	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1997	Unknown	64	5	0	0	0	0	0	0	1	0	1	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

1997	Unknown	66	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1997	Unknown	68	3	0	0	0	0	0	0	1	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1997	Unknown	70	2	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1997	Unknown	78	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1997	Unknown	90	1	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	0	0	0	0
1998	Unknown	82	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1998	Unknown	86	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1998	Unknown	92	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1998	Unknown	100	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2000	Unknown	50	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2000	Unknown	52	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2000	Unknown	54	2	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2000	Unknown	60	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2000	Unknown	62	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2000	Unknown	64	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2000	Unknown	70	2	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2000	Unknown	72	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2000	Unknown	74	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	Unknown	48	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	Unknown	52	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	Unknown	54	3	0	0	0	0	0	1	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	Unknown	56	4	0	0	0	0	0	0	0	1	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	Unknown	58	8	0	0	0	0	0	0	0	2	1	1	0	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	Unknown	60	2	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	Unknown	62	6	0	0	0	0	1	0	0	0	0	0	1	1	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
2001	Unknown	64	3	0	0	0	0	0	0	0	1	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	Unknown	66	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	Unknown	68	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	Unknown	70	2	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	Unknown	72	2	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
2001	Unknown	74	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	Unknown	78	1	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	0	0	0	0
2001	Unknown	86	2	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	Unknown	88	2	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	Unknown	90	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	Unknown	96	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	Unknown	100	2	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
2002	Unknown	42	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2002	Unknown	44	5	0	0	0	0	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2002	Unknown	46	2	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2002	Unknown	50	5	0	0	0	0	1	1	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2002	Unknown	52	8	0	0	0	0	0	1	1	2	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2002	Unknown	54	9	0	0	0	0	1	2	0	3	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2002	Unknown	56	11	0	0	0	0	2	2	0	0	3	3	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

2002	Unknown	58	5	0	0	0	0	0	0	0	1	2	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2002	Unknown	60	3	0	0	0	0	0	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2002	Unknown	62	3	0	0	0	0	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2002	Unknown	66	2	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2002	Unknown	68	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2002	Unknown	70	2	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2002	Unknown	72	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
2002	Unknown	74	4	0	0	0	0	0	1	0	1	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2002	Unknown	76	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2002	Unknown	78	2	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
2002	Unknown	80	2	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2002	Unknown	82	2	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2002	Unknown	90	2	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2002	Unknown	92	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2002	Unknown	98	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
2002	Unknown	110	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
2003	Unknown	30	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	Unknown	40	3	0	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	Unknown	42	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	Unknown	44	6	0	0	1	2	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	Unknown	46	23	0	0	0	4	3	4	6	2	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	Unknown	48	24	0	1	2	2	2	7	7	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	Unknown	50	20	0	0	3	2	3	2	1	6	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	Unknown	52	32	0	0	1	2	4	5	8	3	4	3	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	Unknown	54	19	0	0	0	0	2	6	1	3	2	2	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	Unknown	56	23	0	0	1	1	3	2	6	5	1	2	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	Unknown	58	15	0	1	0	3	2	4	2	1	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	Unknown	60	14	0	0	0	0	0	7	5	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	Unknown	62	8	0	0	0	0	0	2	4	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	Unknown	64	12	0	0	0	0	1	3	5	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	Unknown	66	6	0	0	0	1	0	1	2	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	Unknown	68	3	0	0	0	1	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	Unknown	70	8	0	0	0	1	1	2	1	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	Unknown	72	8	0	0	0	0	1	0	1	1	4	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	Unknown	74	5	0	0	0	0	0	1	1	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	Unknown	76	5	0	0	0	0	0	1	2	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	Unknown	78	4	0	0	0	0	0	0	2	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	Unknown	80	4	0	0	0	0	0	0	2	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	Unknown	82	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	Unknown	84	3	0	0	0	0	0	0	0	0	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	Unknown	88	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	Unknown	90	2	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	Unknown	94	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	Unknown	96	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

2003	Unknown	98	2	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	Unknown	100	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2004	Unknown	38	3	0	1	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2004	Unknown	40	5	0	0	0	1	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2004	Unknown	42	6	0	0	1	0	3	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2004	Unknown	44	21	0	0	1	4	6	2	2	1	2	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2004	Unknown	46	20	0	0	3	4	1	4	6	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2004	Unknown	48	36	0	0	0	4	5	5	7	7	1	3	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2004	Unknown	50	30	0	0	0	1	5	4	2	8	4	2	2	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2004	Unknown	52	26	0	0	0	0	6	4	5	3	6	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2004	Unknown	54	32	0	0	2	2	3	3	6	6	3	3	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2004	Unknown	56	28	0	0	0	1	7	1	5	6	0	3	4	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2004	Unknown	58	16	0	0	0	0	4	0	5	1	1	1	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2004	Unknown	60	26	0	0	0	1	2	4	5	2	5	1	2	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2004	Unknown	62	19	0	0	0	1	3	1	1	4	6	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2004	Unknown	64	24	0	0	0	0	3	2	5	7	1	2	3	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2004	Unknown	66	31	0	0	0	1	1	5	7	2	3	1	3	3	2	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2004	Unknown	68	23	0	0	0	0	0	4	4	1	2	3	4	2	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0
2004	Unknown	70	17	0	0	0	0	1	1	1	3	4	1	4	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
2004	Unknown	72	18	0	0	0	0	0	3	1	4	4	1	2	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2004	Unknown	74	16	0	0	0	0	0	0	0	2	3	1	3	1	0	4	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
2004	Unknown	76	14	0	0	0	0	1	0	2	1	3	0	4	2	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
2004	Unknown	78	12	0	0	0	0	0	0	0	2	0	0	3	3	1	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2004	Unknown	80	10	0	0	0	0	0	1	1	1	1	0	2	1	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2004	Unknown	82	8	0	0	0	0	1	0	0	0	1	0	1	1	1	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2004	Unknown	84	5	0	0	0	0	0	0	1	0	1	0	0	0	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
2004	Unknown	86	8	0	0	0	0	0	0	0	0	0	0	0	2	1	0	2	0	2	0	1	0	0	0	0	0	0	0	0	0	0
2004	Unknown	88	7	0	0	0	0	0	0	0	2	1	0	0	0	0	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	1
2004	Unknown	90	11	0	0	0	0	0	0	1	1	0	0	0	3	2	1	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0
2004	Unknown	92	7	0	0	0	0	0	0	0	0	1	0	2	0	1	0	0	0	1	0	1	0	0	1	0	0	0	0	0	0	0
2004	Unknown	94	8	0	0	0	0	0	0	0	0	0	0	1	1	1	0	2	1	0	0	1	0	0	0	0	0	0	0	1	0	0
2004	Unknown	96	5	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	0	0	0	0	0	1	0	0	0	0	0	0	0
2004	Unknown	98	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2004	Unknown	100	5	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0	0	0	0	0	1	0	0	0	0	1	0	0	0
2004	Female	50	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2004	Female	54	2	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2004	Male	58	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2004	Male	84	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2004	Male	94	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
2004	Male	102	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
2005	Unknown	36	2	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	Unknown	38	4	0	0	2	0	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
2005	Unknown	40	6	0	0	1	2	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	Unknown	42	4	0	0	2	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

2005	Unknown	44	12	0	0	0	0	2	5	3	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	Unknown	46	14	0	0	2	2	1	3	4	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	Unknown	48	13	0	0	0	3	1	1	5	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	Unknown	50	21	0	0	0	1	4	6	6	1	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	Unknown	52	26	0	0	0	1	2	5	4	7	2	3	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	Unknown	54	35	0	0	0	4	6	10	2	7	1	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	Unknown	56	19	0	0	0	0	2	2	6	3	2	0	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	Unknown	58	14	0	0	0	1	0	4	2	4	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	Unknown	60	26	0	0	0	0	1	4	5	7	4	1	2	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	Unknown	62	18	0	0	0	0	1	2	3	1	8	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	Unknown	64	26	0	0	0	1	4	2	5	2	5	0	5	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	Unknown	66	17	0	0	0	0	1	1	4	2	3	4	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	Unknown	68	21	0	0	0	0	1	1	2	2	8	4	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	Unknown	70	23	0	0	0	0	1	4	1	4	6	2	2	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
2005	Unknown	72	30	0	0	0	0	1	2	4	1	8	6	4	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	Unknown	74	21	0	0	0	0	1	0	2	0	2	1	4	3	3	2	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	Unknown	76	13	0	0	0	0	0	2	2	1	1	2	1	2	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	Unknown	78	20	0	0	0	0	0	1	2	1	5	3	3	3	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	Unknown	80	19	0	0	0	0	0	0	3	4	2	2	2	0	1	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0
2005	Unknown	82	5	0	0	0	0	0	0	0	0	1	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	Unknown	84	6	0	0	0	0	0	0	2	0	1	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	Unknown	86	8	0	0	0	0	0	1	0	1	1	0	2	0	0	1	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0
2005	Unknown	88	5	0	0	0	0	0	0	0	0	1	0	1	0	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
2005	Unknown	90	8	0	0	0	0	0	0	0	1	2	1	1	1	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
2005	Unknown	92	5	0	0	0	0	0	0	0	1	1	0	0	0	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	Unknown	94	5	0	0	0	0	0	0	0	0	1	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	Unknown	96	7	0	0	0	0	0	0	0	0	1	0	1	0	0	2	0	1	0	1	0	0	0	0	0	0	0	1	0	0	0
2005	Unknown	98	2	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
2005	Unknown	100	2	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	Unknown	102	2	0	0	0	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	0
2005	Unknown	104	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	Female	44	2	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	Female	46	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	Female	52	2	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	Female	54	2	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	Female	60	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	Male	56	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	Male	58	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	Male	62	4	0	0	0	0	0	0	2	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	Male	64	6	0	0	0	0	0	1	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	Male	66	2	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	Male	68	4	0	0	0	0	0	0	0	0	2	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	Male	70	7	0	0	0	0	0	0	0	2	4	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	Male	72	4	0	0	0	0	0	0	0	1	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

2005	Male	74	6	0	0	0	0	0	0	0	0	1	0	3	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	Male	76	4	0	0	0	0	0	0	0	0	1	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	Male	78	4	0	0	0	0	0	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	Male	80	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	Male	82	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	Male	86	3	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
2005	Male	90	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
2005	Male	98	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	Male	102	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	Unknown	32	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	Unknown	34	2	0	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
2006	Unknown	42	2	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	Unknown	44	4	0	0	0	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
2006	Unknown	46	9	0	0	1	0	3	3	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	Unknown	48	9	0	0	0	0	3	4	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	Unknown	50	16	0	0	0	1	3	3	4	0	3	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	Unknown	52	20	0	0	2	1	0	4	6	2	1	1	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	Unknown	54	13	0	0	0	1	2	5	1	1	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	Unknown	56	8	0	0	0	0	2	3	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	Unknown	58	6	0	0	0	0	0	2	1	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	Unknown	60	2	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	Unknown	62	12	0	0	0	0	2	2	5	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	Unknown	64	4	0	0	0	0	0	0	1	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	Unknown	66	6	0	0	0	0	0	2	0	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	Unknown	68	3	0	0	0	1	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	Unknown	70	3	0	0	0	0	0	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	Unknown	72	8	0	0	0	0	0	0	2	1	3	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	Unknown	74	6	0	0	0	0	0	0	0	1	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	Unknown	76	8	0	0	0	0	0	0	0	2	1	1	0	2	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
2006	Unknown	78	9	0	0	0	0	1	1	1	2	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	Unknown	80	7	0	0	0	0	0	1	0	1	1	3	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	Unknown	82	5	0	0	0	0	0	1	1	0	0	0	0	1	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	Unknown	84	7	0	0	0	0	0	0	1	0	2	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	Unknown	86	6	0	0	0	0	0	0	0	0	2	1	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	Unknown	88	7	0	0	0	0	0	0	1	0	2	1	1	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
2006	Unknown	90	2	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
2006	Unknown	92	2	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	Unknown	94	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	Unknown	96	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	Unknown	98	2	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
2006	Unknown	102	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	Unknown	106	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	Male	38	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	Male	50	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

2006	Male	58	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	Male	62	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	Male	66	8	0	0	0	0	0	2	3	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	Male	68	3	0	0	0	0	0	0	0	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	Male	70	7	0	0	0	0	0	1	1	0	2	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	Male	72	2	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	Male	78	2	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	Male	80	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	Male	82	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	Male	94	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Unknown	40	4	0	0	0	0	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Unknown	42	2	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Unknown	44	4	0	0	0	1	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
2007	Unknown	46	6	0	0	1	1	0	3	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Unknown	48	7	0	0	0	2	1	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Unknown	50	11	0	0	0	1	2	1	2	1	1	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Unknown	52	7	0	0	0	1	2	1	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Unknown	54	9	0	0	0	0	2	1	2	1	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Unknown	56	9	0	0	2	2	0	1	2	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
2007	Unknown	58	10	0	0	1	0	1	5	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Unknown	60	10	0	0	0	1	2	1	3	0	1	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Unknown	62	9	0	0	0	0	2	2	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Unknown	64	7	0	0	0	0	1	3	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Unknown	66	9	0	0	0	0	1	3	2	1	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Unknown	68	7	0	0	0	0	0	2	3	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Unknown	70	9	0	0	0	0	0	1	2	1	1	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Unknown	72	12	0	0	0	0	0	0	2	4	2	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Unknown	74	12	0	0	0	0	0	3	1	2	3	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Unknown	76	3	0	0	0	0	0	0	0	0	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Unknown	78	7	0	0	0	0	0	1	0	0	1	1	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Unknown	80	8	0	0	0	0	0	1	1	0	3	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Unknown	82	6	0	0	0	0	0	0	1	1	2	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Unknown	84	3	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Unknown	86	4	0	0	0	0	0	0	2	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Unknown	88	2	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Unknown	90	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Unknown	92	2	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Unknown	94	2	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Unknown	96	2	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Unknown	100	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0
2007	Unknown	102	2	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
2007	Female	40	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Female	48	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Female	50	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

2007	Female	56	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Female	58	2	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Female	64	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Female	68	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Male	42	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Male	44	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Male	46	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Male	48	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Male	50	2	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Male	52	2	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Male	54	3	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Male	56	2	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Male	58	4	0	0	0	0	0	1	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Male	60	3	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Male	62	3	0	0	0	0	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Male	64	3	0	0	0	0	0	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Male	66	3	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Male	68	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Male	70	3	0	0	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Male	72	7	0	0	0	0	0	1	0	3	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Male	74	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Male	76	2	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Male	78	2	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Male	80	5	0	0	0	0	0	0	1	0	2	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Male	84	2	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Male	92	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Unknown	28	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Unknown	36	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Unknown	40	4	0	1	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Unknown	42	3	0	0	1	0	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
2008	Unknown	44	9	0	0	2	1	3	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Unknown	46	10	0	0	1	2	1	2	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Unknown	48	11	0	0	0	2	2	1	1	1	1	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Unknown	50	18	0	0	1	0	3	6	3	2	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Unknown	52	21	0	0	0	4	1	5	2	4	4	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Unknown	54	10	0	0	1	1	1	1	2	2	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Unknown	56	6	0	0	0	1	1	1	2	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Unknown	58	4	0	0	0	0	2	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Unknown	60	7	0	0	0	1	1	0	3	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Unknown	62	9	0	0	0	1	1	4	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Unknown	64	9	0	0	0	1	1	1	0	2	2	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Unknown	66	6	0	0	0	0	0	1	3	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Unknown	68	4	0	0	0	0	0	0	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Unknown	70	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

2008	Unknown	72	4	0	0	0	0	1	0	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Unknown	74	6	0	0	0	0	0	0	1	1	1	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Unknown	76	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Unknown	78	6	0	0	0	0	0	0	2	0	0	1	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Unknown	80	5	0	0	0	0	0	1	0	1	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Unknown	82	5	0	0	0	0	0	0	1	0	0	1	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Unknown	84	5	0	0	0	0	0	0	0	1	1	2	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Unknown	86	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Unknown	88	3	0	0	0	0	0	0	0	2	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Unknown	90	2	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Unknown	92	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Unknown	94	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Unknown	96	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Unknown	98	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Unknown	104	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Female	34	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Female	36	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Female	38	3	0	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Female	40	6	0	0	3	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Female	42	2	0	0	0	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
2008	Female	44	4	0	0	0	0	1	0	0	0	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Female	46	3	0	0	0	0	0	1	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Female	48	6	0	0	0	1	0	0	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Female	50	11	0	0	0	0	1	2	0	1	3	0	2	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Female	52	11	0	0	0	0	0	1	1	3	2	0	2	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Female	54	4	0	0	0	0	1	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Female	56	2	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Female	58	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Female	64	1	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	0	0	0	0
2008	Female	66	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Female	68	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
2008	Male	40	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Male	42	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Male	48	2	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Male	54	2	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Male	56	2	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Male	58	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Male	60	2	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Male	62	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Male	64	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Male	66	3	0	0	0	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Male	68	2	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Male	70	3	0	0	0	0	0	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Male	72	8	0	0	0	0	0	0	0	1	2	1	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

2008	Male	74	5	0	0	0	0	0	0	0	3	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Male	76	5	0	0	0	0	0	0	2	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Male	78	2	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
2008	Male	80	3	0	0	0	0	0	0	0	0	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Male	82	2	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Male	84	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Male	86	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
2008	Male	88	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Male	90	2	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Male	92	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Male	94	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Male	96	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Unknown	26	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Unknown	28	2	0	0	0	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
2009	Unknown	30	2	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Unknown	32	4	0	2	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
2009	Unknown	34	2	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Unknown	36	2	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Unknown	38	5	0	0	2	1	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
2009	Unknown	40	7	0	0	3	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Unknown	42	7	0	0	1	2	1	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Unknown	44	7	0	0	1	0	0	4	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Unknown	46	19	0	0	2	3	3	3	1	2	1	2	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Unknown	48	26	0	0	2	0	3	4	5	2	1	2	2	2	2	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
2009	Unknown	50	21	0	0	0	2	0	2	3	7	1	1	1	0	1	0	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0
2009	Unknown	52	26	0	0	0	1	0	3	3	6	4	1	1	1	3	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Unknown	54	19	0	0	0	1	1	1	3	2	1	2	3	0	0	1	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0
2009	Unknown	56	18	0	0	0	1	0	4	3	2	3	0	2	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Unknown	58	27	0	0	0	0	1	3	8	3	6	2	2	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Unknown	60	27	0	0	0	1	1	2	1	4	6	4	5	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Unknown	62	27	0	0	0	0	1	3	3	4	6	1	4	4	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Unknown	64	20	0	0	0	0	2	3	3	0	4	3	2	0	0	0	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0
2009	Unknown	66	20	0	0	0	0	1	2	0	5	2	3	2	2	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
2009	Unknown	68	21	0	0	0	0	0	0	4	2	3	2	7	0	1	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0
2009	Unknown	70	21	0	0	0	0	0	1	1	2	4	4	3	0	2	0	2	0	0	1	1	0	0	0	0	0	0	0	0	0	0
2009	Unknown	72	18	0	0	0	0	0	2	0	3	3	2	2	1	1	1	1	1	0	0	0	0	0	0	0	0	1	0	0	0	0
2009	Unknown	74	11	0	0	0	1	0	0	0	1	0	2	1	1	1	1	2	0	0	0	0	0	0	0	1	0	0	0	0	0	0
2009	Unknown	76	10	0	0	0	0	0	0	0	2	0	1	1	1	1	1	1	0	0	0	0	0	0	0	0	1	0	0	0	0	1
2009	Unknown	78	16	0	0	0	0	0	0	0	0	1	0	4	1	4	0	0	1	1	0	0	2	0	0	0	0	0	0	0	1	1
2009	Unknown	80	11	0	0	0	0	0	0	0	0	3	0	1	2	2	0	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0
2009	Unknown	82	13	0	0	0	0	0	1	1	1	2	1	2	0	1	0	0	1	0	0	1	0	1	0	1	0	0	0	0	0	0
2009	Unknown	84	12	0	0	0	0	0	0	1	1	1	0	1	3	2	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0
2009	Unknown	86	6	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	3	1	0	0	0	0	0	0	0
2009	Unknown	88	5	0	0	0	0	0	0	0	0	1	0	0	0	2	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0

2009	Unknown	90	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Unknown	92	3	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0
2009	Unknown	94	9	0	0	0	0	0	0	0	0	0	0	2	0	2	2	1	0	0	1	0	0	1	0	0	0	0	0	0	0	0
2009	Unknown	96	2	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
2009	Unknown	98	3	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0
2009	Unknown	100	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Unknown	102	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Unknown	106	2	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
2009	Female	28	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Female	32	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Female	34	2	0	0	0	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
2009	Female	36	5	0	0	0	1	1	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Female	40	12	0	0	2	3	2	2	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Female	42	17	0	0	1	2	4	4	1	3	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Female	44	21	0	0	1	0	4	1	5	6	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Female	46	21	0	0	1	0	2	3	5	4	3	0	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Female	48	19	0	0	0	1	1	1	8	5	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Female	50	22	0	0	0	0	0	2	1	5	1	1	3	2	2	1	1	3	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Female	52	10	0	0	0	0	0	0	1	2	1	0	0	0	4	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0
2009	Female	54	8	0	0	0	0	0	0	0	0	2	1	1	0	1	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0
2009	Female	56	4	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0
2009	Female	58	6	0	0	0	1	0	0	0	1	1	0	1	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0
2009	Female	60	5	0	0	0	0	0	0	2	0	0	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Female	62	2	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
2009	Female	64	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
2009	Female	66	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
2009	Male	38	3	0	0	0	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
2009	Male	40	4	0	0	0	1	1	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Male	42	2	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	0	0	0	0
2009	Male	44	8	0	0	0	3	2	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Male	46	5	0	0	0	2	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Male	48	5	0	0	1	0	1	0	0	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Male	50	6	0	0	1	0	2	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Male	52	6	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Male	54	5	0	0	0	0	0	0	2	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Male	56	10	0	0	0	1	1	0	2	1	3	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Male	58	2	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Male	60	9	0	0	0	0	0	0	2	3	3	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Male	62	2	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Male	64	12	0	0	0	0	0	0	3	2	4	1	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
2009	Male	66	6	0	0	0	0	0	0	0	2	1	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Male	68	6	0	0	0	0	1	0	0	0	0	2	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Male	70	7	0	0	0	0	0	0	0	3	1	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Male	72	8	0	0	0	0	0	0	0	0	2	0	3	1	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0

2009	Male	74	5	0	0	0	0	0	0	0	0	1	1	0	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Male	76	7	0	0	0	0	0	0	0	0	1	0	1	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Male	78	8	0	0	0	0	0	0	0	0	2	0	1	2	0	1	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0
2009	Male	80	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0
2009	Male	82	3	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0
2009	Male	84	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Male	86	2	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
2009	Male	90	2	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Male	92	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Male	94	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Male	96	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Male	100	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Commercial Long Line West

		Length	Sample	Age																												
Year	Gender	Bin	Size	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
2003	Unknown	54	2	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	Unknown	56	2	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	Unknown	58	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	Unknown	62	2	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	0	0
2003	Unknown	64	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	Unknown	66	2	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	Unknown	70	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	Unknown	74	2	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	Unknown	80	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	Unknown	84	2	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	Unknown	94	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2004	Unknown	56	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2004	Unknown	74	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	Unknown	52	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	Unknown	54	4	0	0	0	0	1	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	Unknown	56	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	Unknown	58	2	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	Unknown	60	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	Unknown	62	2	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	Unknown	64	2	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
2005	Unknown	68	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	Unknown	70	3	0	0	0	0	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	Unknown	72	4	0	0	0	0	0	1	0	2	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0

2005	Unknown	74	3	0	0	0	0	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	Unknown	76	2	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
2005	Unknown	82	2	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	Unknown	84	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	Unknown	88	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	Unknown	90	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	Unknown	46	2	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	Unknown	48	2	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	Unknown	50	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	Unknown	52	2	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	Unknown	54	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	Unknown	56	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	Unknown	64	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	Unknown	68	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	Unknown	70	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	Unknown	86	2	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	Unknown	98	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
2007	Unknown	40	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Unknown	46	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Unknown	48	6	0	0	0	0	2	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Unknown	50	10	0	0	0	0	0	2	3	2	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Unknown	52	7	0	0	0	0	0	0	1	3	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Unknown	54	12	0	0	0	0	1	2	4	3	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Unknown	56	4	0	0	0	0	0	0	2	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Unknown	58	11	0	0	0	0	0	2	4	3	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Unknown	60	6	0	0	0	0	0	2	1	0	1	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
2007	Unknown	62	4	0	0	0	0	0	0	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Unknown	64	6	0	0	0	0	0	1	1	2	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Unknown	66	3	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
2007	Unknown	68	3	0	0	0	0	0	0	0	0	0	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Unknown	70	4	0	0	0	0	0	0	1	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Unknown	72	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Unknown	74	4	0	0	0	0	0	0	0	0	0	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Unknown	76	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Unknown	78	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Unknown	80	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Unknown	84	2	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Unknown	42	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Unknown	44	4	0	0	0	1	0	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Unknown	46	13	0	0	1	2	0	1	3	4	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Unknown	48	18	0	0	0	0	1	3	5	3	1	2	1	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0

2008	Unknown	50	14	0	0	0	1	2	3	3	0	1	1	0	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Unknown	52	9	0	0	0	1	2	2	0	1	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Unknown	54	28	0	0	0	0	1	2	8	3	6	2	0	1	2	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0
2008	Unknown	56	20	0	0	0	1	4	4	6	2	0	1	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Unknown	58	24	0	0	0	0	0	2	4	8	5	2	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Unknown	60	25	0	0	0	0	2	2	4	5	4	2	2	0	2	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0
2008	Unknown	62	36	0	0	0	1	2	5	8	3	5	4	2	1	1	0	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0
2008	Unknown	64	15	0	0	0	0	0	1	1	2	3	2	3	0	1	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0
2008	Unknown	66	35	0	0	0	0	3	4	6	5	5	8	0	1	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Unknown	68	34	0	0	0	0	1	2	6	3	10	3	3	3	2	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
2008	Unknown	70	14	0	0	0	0	1	0	3	2	4	1	0	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
2008	Unknown	72	28	0	0	0	0	1	1	3	3	4	8	6	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
2008	Unknown	74	16	0	0	0	0	0	0	2	2	3	2	3	1	0	1	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0
2008	Unknown	76	13	0	0	0	0	0	0	1	2	2	1	4	0	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Unknown	78	9	0	0	0	0	0	0	3	2	1	0	0	0	2	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
2008	Unknown	80	7	0	0	0	0	1	0	1	1	0	1	0	2	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
2008	Unknown	82	6	0	0	0	0	0	0	2	1	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Unknown	84	9	0	0	0	0	0	1	1	1	3	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Unknown	86	8	0	0	0	0	0	0	1	2	2	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Unknown	88	5	0	0	0	0	0	0	2	1	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
2008	Unknown	90	6	0	0	0	0	0	0	0	1	0	1	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Unknown	92	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Unknown	94	2	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	0
2008	Unknown	100	1	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	0	0
2008	Unknown	102	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Unknown	104	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Unknown	40	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Unknown	42	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Unknown	44	2	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Unknown	46	6	0	0	0	0	0	2	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Unknown	48	5	0	0	0	0	0	2	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Unknown	50	19	0	0	0	0	1	2	8	4	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Unknown	52	12	0	0	0	0	0	1	2	1	3	3	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
2009	Unknown	54	21	0	0	0	1	0	1	4	4	1	2	3	1	0	0	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0
2009	Unknown	56	27	0	0	0	0	0	4	3	3	6	4	4	2	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
2009	Unknown	58	26	0	0	1	0	0	3	5	6	5	0	0	1	0	3	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0
2009	Unknown	60	28	0	0	0	0	2	1	9	3	3	0	2	1	2	1	1	1	0	0	1	0	1	0	0	0	0	0	0	0	0
2009	Unknown	62	46	0	0	0	0	0	6	8	5	5	4	2	5	4	1	2	0	3	0	0	0	0	0	0	0	1	0	0	0	0
2009	Unknown	64	28	0	0	0	0	0	0	4	5	6	4	2	1	0	2	2	0	0	1	0	0	0	0	0	1	0	0	0	0	0
2009	Unknown	66	29	0	0	0	0	1	0	3	5	6	6	4	2	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0
2009	Unknown	68	34	0	0	0	0	0	0	5	5	8	3	6	0	1	0	1	1	1	0	1	0	0	0	0	0	1	0	0	0	1

2009	Unknown	70	33	0	0	0	0	0	1	5	3	5	6	5	5	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0
2009	Unknown	72	42	0	0	0	0	1	1	5	6	5	7	6	2	1	3	0	1	1	0	0	0	0	0	1	0	0	0	0	0	2
2009	Unknown	74	23	0	0	0	0	1	0	2	3	3	2	6	3	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Unknown	76	20	0	0	0	0	0	1	1	2	2	4	3	2	1	0	1	1	1	0	0	0	0	1	0	0	0	0	0	0	0
2009	Unknown	78	23	0	0	0	0	0	1	0	2	1	4	4	3	2	2	2	0	1	0	0	0	1	0	0	0	0	0	0	0	0
2009	Unknown	80	15	0	0	0	0	0	0	0	2	2	3	3	0	2	1	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0
2009	Unknown	82	15	0	0	0	0	0	0	2	1	3	2	2	2	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Unknown	84	21	0	0	0	0	0	0	0	2	3	1	5	0	2	0	2	0	0	2	0	1	3	0	0	0	0	0	0	0	0
2009	Unknown	86	14	0	0	0	0	0	0	0	2	3	3	3	0	0	0	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0
2009	Unknown	88	4	0	0	0	0	0	0	0	0	0	1	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Unknown	90	14	0	0	0	0	0	0	0	0	1	1	2	2	3	2	1	0	0	0	0	0	0	1	1	0	0	0	0	0	0
2009	Unknown	92	7	0	0	0	0	0	0	0	0	1	0	4	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Unknown	94	6	0	0	0	0	0	0	0	1	1	0	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Unknown	96	5	0	0	0	0	0	0	0	0	0	0	0	2	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Unknown	98	3	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Unknown	100	3	0	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Unknown	102	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
2009	Unknown	104	2	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
2009	Unknown	108	2	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
2009	Unknown	110	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Unknown	112	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Female	40	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Female	42	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Female	44	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Female	46	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Female	50	5	0	0	0	0	0	0	0	0	0	0	1	1	2	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
2009	Female	52	3	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Female	56	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Male	50	3	0	0	0	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Male	56	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Male	58	2	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Male	60	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Male	62	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Male	66	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Male	70	4	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Male	76	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Male	84	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
2009	Male	86	1	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	0	0

NMFS Bottom Long Line Survey East

		Length	Sample	Age																												
Year	Gender	Bin	Size	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
2000	Unknown	62	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2000	Unknown	64	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2000	Female	62	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2000	Female	68	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2000	Female	76	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2000	Male	56	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	Unknown	48	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	Female	50	2	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	Female	52	3	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	Female	54	3	0	0	0	0	0	0	0	0	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	Female	56	6	0	0	0	0	0	0	0	1	1	1	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	Female	58	2	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	Male	54	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	Male	56	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	Male	58	2	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	Male	70	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	Male	72	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2002	Unknown	48	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2002	Unknown	50	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2002	Unknown	54	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2002	Unknown	62	3	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2002	Unknown	66	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2002	Female	50	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2004	Female	44	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2004	Female	46	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2004	Female	48	2	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2004	Male	46	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2004	Male	54	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2004	Male	56	2	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2004	Male	60	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2004	Male	62	3	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2004	Male	64	2	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

2004	Male	72	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	Female	46	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	Female	48	2	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	0
2005	Female	50	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	Female	54	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	Female	56	2	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
2005	Female	60	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	Male	44	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	Male	54	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	Male	58	3	0	0	0	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	Male	60	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	Male	68	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	Male	76	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	Male	86	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	Male	88	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	Male	92	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	Male	108	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
2006	Female	44	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	Female	48	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	Female	50	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	Female	56	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	Female	64	2	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	Female	66	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
2006	Female	72	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	Male	70	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	Male	80	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	Male	90	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Unknown	50	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Female	42	2	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Female	46	2	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Female	50	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Female	52	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Female	56	3	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Female	60	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Female	62	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Male	46	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Male	52	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Male	56	3	0	0	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Male	58	3	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Male	62	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Male	64	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

2007	Male	66	4	0	0	0	0	0	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Male	68	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Male	70	2	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Male	72	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Male	76	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Male	78	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Male	80	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Male	82	3	0	0	0	0	0	0	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Male	86	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Unknown	46	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Unknown	74	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Female	48	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Female	52	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Male	48	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Male	54	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Male	58	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Male	66	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Male	68	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Male	70	2	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Male	76	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Male	78	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Female	48	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Female	50	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Female	52	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Female	54	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Female	58	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Female	70	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Male	56	2	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Male	58	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Male	64	3	0	0	0	0	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Male	68	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Male	70	2	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Male	76	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Male	78	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Male	84	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0

NMFS Bottom Long Line Survey West

		Length	Sample	Age

Year	Gender	Bin	Size	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
2001	Unknown	44	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	Unknown	50	2	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	Unknown	54	2	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	Unknown	62	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	Unknown	66	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	Unknown	80	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	Unknown	84	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	Female	48	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	Female	50	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	Female	58	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	Male	52	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	Male	56	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	Male	58	2	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	Male	62	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	Male	64	2	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	Male	66	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	Male	80	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	Male	84	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	Male	86	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	Male	104	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
2002	Unknown	48	3	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2002	Unknown	50	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2002	Unknown	52	2	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2002	Unknown	54	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2002	Unknown	56	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2002	Unknown	60	4	0	0	0	0	0	0	2	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2002	Unknown	62	2	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2002	Unknown	64	2	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2002	Unknown	66	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2002	Unknown	68	2	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2002	Unknown	70	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2002	Unknown	72	2	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
2002	Unknown	76	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2002	Female	42	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2002	Female	46	2	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2002	Female	48	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2002	Female	52	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2002	Female	56	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2002	Male	46	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2002	Male	54	2	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	0	0	0

2002	Male	60	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2002	Male	66	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2002	Male	70	2	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2002	Male	74	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2004	Unknown	46	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2004	Female	52	2	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2004	Male	46	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2004	Male	48	2	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2004	Male	56	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2004	Male	58	2	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2004	Male	62	2	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
2004	Male	64	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2004	Male	66	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2004	Male	70	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2004	Male	72	3	0	0	0	0	0	0	1	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2004	Male	76	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2004	Male	80	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2004	Male	88	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2004	Male	92	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
2004	Male	94	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
2006	Unknown	46	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	Unknown	50	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	Unknown	54	2	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	Unknown	58	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	Female	42	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	Female	50	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	Female	56	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	Male	46	2	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	Male	52	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	Male	58	2	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	Male	60	2	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	Male	64	2	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	Male	66	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	Male	78	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	Male	88	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Unknown	68	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Female	52	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Female	54	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Female	56	2	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Male	56	2	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Male	60	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

2007	Male	62	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Male	64	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Male	70	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Male	74	2	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Male	76	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Male	78	2	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Male	80	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Male	84	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Male	90	2	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Male	96	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Female	46	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Female	52	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Female	58	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Male	56	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Male	58	2	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Male	60	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Male	64	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Male	70	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Male	72	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Male	76	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Male	78	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Male	84	2	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Male	86	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Female	48	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Female	50	2	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
2009	Female	54	1	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	0	0
2009	Female	70	2	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Female	72	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Male	50	2	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Male	54	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Male	56	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Male	58	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Male	60	2	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
2009	Male	64	2	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
2009	Male	66	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Male	68	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Male	70	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Male	72	3	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
2009	Male	76	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	Male	80	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
2009	Male	88	1	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	0	0

2009	Male	98	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0

3.9. Appendix C. Starter.SS File

```
#C GOM Tilefish Assessment
Tilefish.dat
Tilefish.ctl
0 # 0=use init values in control file; 1=use ss3.par
0 # run display detail (0,1,2)
1 # detailed age-structured reports in REPORT.SSO (0,1)
0 # write detailed checkup.sso file (0,1)
0 # write parm values to ParmTrace.sso (0=no,1=good,active; 2=good,all; 3=every_iter,all_parms;
4=every,active)
1 # write to cumreport.sso (0=no,1=like&timeseries; 2=add survey fits)
1 # Include prior_like for non-estimated parameters (0,1)
1 # Use Soft Boundaries to aid convergence (0,1) (recommended)
1 # Number of bootstrap datafiles to produce
10 # Turn off estimation for parameters entering after this phase
10 # MCMC burn interval
2 # MCMC thin interval
0 # jitter initial parm value by this fraction
-1 # min yr for sdreport outputs (-1 for styr)
-1 # max yr for sdreport outputs (-1 for endyr; -2 for endyr+Nforecastyrs
1 # N individual STD years
#vector of year values
2009
0.0001 # final convergence criteria (e.g. 1.0e-04)
0 # retrospective year relative to end year (e.g. -4)
0 # min age for calc of summary biomass
1 # Depletion basis: denom is: 0=skip; 1=rel X*B0; 2=rel X*Bmsy; 3=rel X*B_styr
1.0 # Fraction (X) for Depletion denominator (e.g. 0.4)
4 # (1-SPR)_reporting: 0=skip; 1=rel(1-SPR); 2=rel(1-SPR_MSY); 3=rel(1-SPR_Btarget); 4=notrel
1 # F_std reporting: 0=skip; 1=exploit(Bio); 2=exploit(Num); 3=sum(frates)
0 # F_report_basis: 0=raw; 1=rel Fspr; 2=rel Fmsy ; 3=rel Fbtgt
999 # check value for end of file
```

3.10. Appendix D. Forecast.SS File

```
0 # Forecast: 0=none; 1=F(SPR); 2=F(MSY) 3=F(Btgt); 4=F(endyr); 5=Ave F (enter yrs); 6=read Fmult
# -4 # first year for recent ave F for option 5 (not yet implemented)
# -1 # last year for recent ave F for option 5 (not yet implemented)
# 0.74 # F multiplier for option 6 (not yet implemented
2009 # first year to use for averaging selex to use in forecast (e.g. 2004; or use #NAME? to be rel endyr)
2009 # last year to use for averaging selex to use in forecast
1 # Benchmarks: 0=skip; 1=calc F_spr,F_btgt,F_msy
2 # MSY: 1= set to F(SPR); 2=calc F(MSY); 3=set to F(Btgt); 4=set to F(endyr)
0.3 # SPR target (e.g. 0.40)
0.3 # Biomass target (e.g. 0.40)
6 # N forecast years
1 # read 10 advanced options
 0 # Do West Coast gfish rebuilder output (0/1)
 -1 # Rebuilder: first year catch could have been set to zero (Ydecl)(-1 to set to endyear+1)
 2009 # Rebuilder: year for current age structure (Yinit) (-1 to set to endyear+1)
 2 # Control rule method (1=west coast adjust catch; 2=adjust F)
 0 # Control rule Biomass level for constant F (as frac of Bzero, e.g. 0.40)
 0.1 # Control rule Biomass level for no F (as frac of Bzero, e.g. 0.10)
 1 # Control rule fraction of Flimit (e.g. 0.75)
 0 # basis for max forecast catch by seas and area (0=none; 1=deadbio; 2=retainbio; 3=deadnum; 4=retainnum)
 0 # 0= no implementation error; 1=use implementation error in forecast (not coded yet)
 0.1 # stddev of log(realized F/target F) in forecast (not coded yet)
# end of advanced options
# max forecast catch
# rows are seasons, columns are areas
# 1000
1 # fleet allocation (in terms of F) (1=use endyr pattern, no read; 2=read below)
# 0.225768
0 # Number of forecast catch levels to input (rest calc catch from forecast F
# 1 # basis for input forecatch: 1=retained catch; 2=total dead catch
#Year Seas Fleet Catch


999 # verify end of input
```

3.11. Appendix E. Tilefish.DAT File

```
#.dat file for Tilefish SSIII
#_bootstrap file: 1
1965 #_styr
2009 #_endyr
1 #_nseas
12 #_months/season
1 #_spawn_seas
4 #_Nfleet CM_HL_E, CM_HL_W, CM_LL_E, CM_LL_W
2 #_Nsurveys NMFS_E_index, NMFS_W_index
2 #_N_areas
# CM_HL_E, CM_HL_W, CM_LL_E, CM_LL_W, NMFS_E_index, NMFS_W_index
HLE%HLW%LLE%LLW%NMFSE%NMFSW
0.5 0.5 0.5 0.5 0.5 0.5 #_surveytiming_in_season
1 2 1 2 1 2 #_area_assignments_for_each_fishery_and_survey
1 1 1 1    #_units of catch:  2=num
0.01 0.01 0.01 0.01 #_se of log(catch) only used for init_eq_catch and for  2 and 3
2 #_Ngenders
30 #_Nages
0 0 0 0 #_init_equil_catch_for_each_fishery
44 #_N_lines_of_catch_to_read
#_catch_biomass(mt):_columns_are_fisheries,year,season
 3.16 0.00 0.00 0.00 1965 1
 0.91 0.00 0.00 0.00 1966 1
 0.49 0.00 0.00 0.00 1967 1
 0.67 0.00 0.00 0.00 1968 1
 0.14 0.00 0.00 0.00 1969 1
 1.49 0.00 0.00 0.00 1971 1
```

0.50 0.00 0.00 0.00 1972 1
1.81 0.00 0.00 0.00 1973 1
1.91 0.00 0.00 0.00 1974 1
6.72 0.00 0.00 0.00 1975 1
11.17 0.00 0.00 0.00 1976 1
16.51 0.00 0.00 0.00 1977 1
10.71 0.27 0.00 0.00 1978 1
13.30 0.00 2.60 0.54 1979 1
8.72 0.00 3.13 0.82 1980 1
58.81 0.00 40.80 12.66 1981 1
27.64 0.00 62.87 46.49 1982 1
6.47 0.24 62.84 36.17 1983 1
5.95 0.96 83.47 46.61 1984 1
4.54 5.58 41.64 74.61 1985 1
22.06 4.46 66.99 57.37 1986 1
34.76 9.00 77.73 122.25 1987 1
40.18 21.46 117.30 252.05 1988 1
18.49 28.82 46.60 112.30 1989 1
32.04 1.54 56.80 72.81 1990 1
8.38 11.18 54.12 23.49 1991 1
6.08 6.70 43.48 40.02 1992 1
7.09 3.31 68.61 50.03 1993 1
5.70 0.74 120.94 48.78 1994 1
1.06 3.64 74.97 135.19 1995 1
0.66 1.34 54.87 38.64 1996 1
1.18 0.26 130.57 20.97 1997 1
0.61 0.74 101.84 31.59 1998 1
2.83 1.99 99.48 65.53 1999 1
1.92 2.51 122.36 90.68 2000 1

7.27 0.13 153.13 59.15 2001 1
4.39 0.72 111.92 128.34 2002 1
1.57 0.98 106.90 72.20 2003 1
1.39 0.28 128.66 81.62 2004 1
3.96 1.94 155.23 108.16 2005 1
2.66 0.09 112.20 26.22 2006 1
0.48 0.99 133.33 10.96 2007 1
0.06 0.18 131.57 26.92 2008 1
0.61 2.24 164.81 27.27 2009 1

52 #_N_cpue_and_surveyabundance_observations
#_year seas index obs se(log)
1992 1 3 0.388729358 0.50 #CM_LL_E_index
1993 1 3 0.497613432 0.48 #CM_LL_E_index
1994 1 3 0.933917031 0.38 #CM_LL_E_index
1995 1 3 1.073417615 0.38 #CM_LL_E_index
1996 1 3 0.679337972 0.38 #CM_LL_E_index
1997 1 3 0.887044147 0.36 #CM_LL_E_index
1998 1 3 1.949292905 0.37 #CM_LL_E_index
1999 1 3 1.82087748 0.37 #CM_LL_E_index
2000 1 3 0.880234569 0.37 #CM_LL_E_index
2001 1 3 0.685054359 0.37 #CM_LL_E_index
2002 1 3 0.721522232 0.36 #CM_LL_E_index
2003 1 3 0.56912321 0.35 #CM_LL_E_index
2004 1 3 0.651857236 0.37 #CM_LL_E_index
2005 1 3 0.769378104 0.38 #CM_LL_E_index
2006 1 3 1.20161629 0.39 #CM_LL_E_index
2007 1 3 1.338505747 0.37 #CM_LL_E_index
2008 1 3 1.548394986 0.39 #CM_LL_E_index

2009 1 3 1.404083326 0.39 #CM_LL_E_index
1992 1 4 0.351612127 0.35 #CM_LL_W_index
1993 1 4 0.482485199 0.27 #CM_LL_W_index
1994 1 4 0.581232287 0.24 #CM_LL_W_index
1995 1 4 0.840238575 0.20 #CM_LL_W_index
1996 1 4 1.519611989 0.24 #CM_LL_W_index
1997 1 4 1.300153447 0.28 #CM_LL_W_index
1998 1 4 0.633733859 0.29 #CM_LL_W_index
1999 1 4 0.910370964 0.21 #CM_LL_W_index
2000 1 4 0.889629594 0.23 #CM_LL_W_index
2001 1 4 1.077905955 0.25 #CM_LL_W_index
2002 1 4 1.672015693 0.25 #CM_LL_W_index
2003 1 4 0.634179417 0.23 #CM_LL_W_index
2004 1 4 1.038398218 0.32 #CM_LL_W_index
2005 1 4 2.064560373 0.31 #CM_LL_W_index
2006 1 4 0.688100164 0.37 #CM_LL_W_index
2007 1 4 1.404058707 0.57 #CM_LL_W_index
2008 1 4 0.911713432 0.34 #CM_LL_W_index
2001 1 5 0.2763 0.64 #NMFS_E_index
2002 1 5 0.8807 0.55 #NMFS_E_index
2003 1 5 0.4633 0.68 #NMFS_E_index
2004 1 5 1.23564 0.53 #NMFS_E_index
2006 1 5 1.35562 0.45 #NMFS_E_index
2007 1 5 1.79847 0.45 #NMFS_E_index
2008 1 5 1.12527 0.54 #NMFS_E_index
2009 1 5 1.22787 0.53 #NMFS_E_index
2000 1 6 0.13756 0.75 #NMFS_W_index
2001 1 6 0.66647 0.44 #NMFS_W_index
2002 1 6 0.97064 0.50 #NMFS_W_index

2003 1 6 0.57449 0.58 #NMFS_W_index
2004 1 6 0.62899 0.61 #NMFS_W_index
2006 1 6 1.13674 0.52 #NMFS_W_index
2007 1 6 2.19401 0.45 #NMFS_W_index
2008 1 6 1.24441 0.52 #NMFS_W_index
2009 1 6 1.85513 0.42 #NMFS_W_index
1 #_discard_type (1=bio or num; 2=fraction)
0 #_N_discard_obs
0 #_N_meanbodywt_obs

2 # length bin method: 1=use databins; 2=generate from binwidth,min,max below; vector
2 # binwidth for population size comp
10 # minimum size in the population (lower edge of first and size at age 0.00)
114 # maximum size in the population (lower edge of last

-0.0001 #_comp_tail_compression
1.00E-07 #_add_to_comp
20 #_combine males into females at or below this bin number
48 #_N_LengthBins
20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66 68 70 72 74 76 78 80 82 84 86 88 90 92 94 96 98 100 102 104 106 108 110 112 114
127 #_N_Length_obs
#Yr Seas Flt/Svy Gender Part Nsamp datavector(female-male)
1991 1 1 1 2 4 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 0 1 1 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 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 1 1 0 2 14 0 0 0 0 0 0 0 0 0 0 0 1 1 1 0 1 0 2 1 1 1 0 0 0 1 0 0 1 1 0 0 0 0 0 0 1 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 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 1 1 0 2 1 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 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 1 1 1 2 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 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 1 1 0 2 22 1 0 0 0 0 0 0 0 1 2 1 2 1 4 3 3 1 0 0 0 0 0 0 0 0 0 1 0 0 1 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 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 1 1 0 2 2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 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 1 1 0 2 2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 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 1 1 1 2 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 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 1 1 0 2 30 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 2 2 3 3 2 4 3 2 2 1 1 0 1 0 0 0 1 0 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 0 0 0 0 0 0 0 0 0 0 0

1997 1 1 0 2 20 0 0 0 0 0 0 0 1 0 0 0 0 0 0 1 1 2 0 2 3 2 2 1 2 2 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 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 1 1 0 2 19 0 0 0 0 0 0 0 0 1 2 0 4 2 1 1 1 1 0 1 0 0 1 1 0 1 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 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

1999 1 1 0 2 34 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 2 1 2 3 3 0 1 2 1 0 1 1 2 3 3 0 0 2 4 0 0 0 0 0 1 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 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 1 1 1 2 6 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 1 0 0 0 0 0 0 1 0 1 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 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 1 1 0 2 24 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 3 0 1 0 0 4 1 0 2 2 0 0 0 0 1 0 2 0 1 0 0 0 1 1 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 0 0 0 0 0 0 0

2001 1 1 3 2 108 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 1 1 6 5 9 11 11 9 7 0 2 2 0 0 0 1 0 0 3 2 3 1 2 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 0 0 0 0 2 0 2 1 0 0 0 0 0 0 0 0 0 2 1 5 5 6 1 1 3 0 0 0 0 0

2001 1 1 0 2 46 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 2 1 0 0 0 4 0 7 5 1 1 1 1 0 0 1 1 0 0 2 4 6 1 5 2 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 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 1 1 3 2 3 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 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 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 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0

2002 1 1 0 2 100 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 3 8 12 9 6 4 6 15 7 4 7 3 2 1 4 1 2 0 0 0 1 2 1 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 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 1 1 0 2 2 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 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 1 1 0 2 10 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 2 1 3 1 0 0 0 1 0 0 1 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2005 1 1 3 2 2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 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 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2005 1 1 0 2 174 0 0 0 0 0 0 0 0 0 0 0 0 3 4 4 1 8 3 6 3 5 9 5 10 11 16 19 11 14 9 4 0 4 7 2 6 2 1 2 0 2 2 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2007 1 1 2 2 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 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 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2008 1 1 1 2 2 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 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2008 1 1 0 2 2 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 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2009 1 1 0 2 11 0 0 0 0 0 0 0 0 0 0 1 0 0 0 1 0 1 2 0 2 0 0 1 1 0 0 0 1 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 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 1 2 0 2 1 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 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 1 2 0 2 1 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 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 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 1 2 0 2 3 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 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 1 2 0 2 15 0 0 0 0 0 0 1 1 1 0 1 1 0 0 1 1 2 4 0 1 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 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 1 2 0 2 95 0 0 0 0 0 0 1 0 2 1 0 2 2 9 8 10 6 12 15 6 7 5 1 1 2 2 0 1 0 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 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

1993 1 2 0 2 12 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 2 4 1 1 1 0 0 0 1 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 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 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 1 2 0 2 47 0 0 0 1 0 0 0 0 0 0 0 0 2 4 3 2 3 1 6 4 5 3 3 5 0 0 1 1 1 1 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 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 1 2 0 2 7 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 1 0 0 0 1 0 0 1 1 0 1 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 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 1 2 0 2 12 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 2 0 1 0 2 1 1 0 0 1 2 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 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 1 2 0 2 5 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 1 1 0 0 0 0 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 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2001 1 2 0 2 2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 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 1 2 0 2 19 0 0 0 0 0 0 0 0 0 0 0 0 1 1 1 0 1 4 0 1 1 3 0 0 0 1 2 0 0 1 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 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2005 1 2 0 2 20 0 0 0 0 0 0 0 0 1 1 1 1 2 0 2 3 0 2 1 0 3 0 1 0 0 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2006 1 2 1 2 2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2006 1 2 0 2 1 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 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2007 1 2 0 2 9 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 1 0 2 0 1 1 1 0 0 0 0 0 1 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2008 1 2 0 2 52 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 2 3 4 7 7 4 6 3 2 2 2 0 1 1 2 3 1 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2009 1 2 3 2 10 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 2 1 0 1 1 0 0 1 0 1 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2009 1 2 0 2 38 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 2 1 5 1 4 4 4 1 1 1 2 3 1 1 3 1 1 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 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 1 3 0 2 106 0 0 0 0 0 0 0 1 2 1 3 1 3 4 14 9 8 12 7 6 7 4 9 2 1 1 5 1 0 1 0 1 1 0 0 0 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 0 0 0 0 0 0 0 0 0 0
1986 1 3 0 2 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 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
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0 0 0 2 0 1 1 1 0 0 1 0 2 1 2 1 0 1 0 0 2 0 0 1 0 0 0 0 0 0 0 0 0
2007 1 6 0 2 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2008 1 6 3 2 15 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 1 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 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 2 1 0 1 0 0 1 1 0 1 1 0 0 2 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2009 1 6 3 2 26 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 2 0 1 0 0 0 0 0 0 0 2 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2 0 1 1 1 2 0 2 1 1 1 3 0 1 0 1 0 0 0 1 0 0 0 0 1 0 0 0 0 0 0 0 0

29 #_N_age_bins
2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
2 #_N_ageerror_definitions

0.5 1.5 2.5 3.5 4.5 5.5 6.5 7.5 8.5 9.5 10.5 11.5 12.5 13.5 14.5 15.5 16.5 17.5 18.5 19.5 20.5 21.5 22.5 23.5 24.5 25.5 26.5 27.5 28.5 29.5 30.5
0.001 0.001
0.5 1.5 2.5 3.5 4.5 5.5 6.5 7.5 8.5 9.5 10.5 11.5 12.5 13.5 14.5 15.5 16.5 17.5 18.5 19.5 20.5 21.5 22.5 23.5 24.5 25.5 26.5 27.5 28.5 29.5 30.5
0.01 0.27 0.96 1.37 1.65 1.88 2.06 2.21 2.35 2.46 2.57 2.66 2.75 2.83 2.90 2.97 3.04 3.10 3.16 3.21 3.26 3.31 3.36 3.40 3.44 3.48 3.52 3.56 3.60 3.63 3.67

914 #_N_Agecomp_obs
2 #_Lbin_method: 1=poplenbins; 2=datalenbins; 3=lengths
1 #_combine males into females at or below this bin number
#Year Season Fleet Gender Partition AgeError Def Lbin_Lo Lbn_hi Nsamp 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
2000 1 1 0 2 2 14 14 1 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 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 1 1 0 2 2 16 16 2 0 0 0 0 0 1 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 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 1 1 0 2 2 18 18 1 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 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 1 1 0 2 2 25 25 1 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 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 1 1 0 2 2 17 17 1 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 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 1 1 0 2 2 18 18 6 0 0 0 0 0 1 4 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 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 1 1 0 2 2 19 19 5 0 0 0 0 1 2 0 0 1 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2002 1 1 0 2 2 20 20 7 0 0 0 0 1 3 1 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
2002 1 1 0 2 2 21 21 3 0 0 0 0 0 1 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 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 1 1 0 2 2 23 23 1 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 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 1 1 0 2 2 24 24 1 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2003 1 1 0 2 2 15 15 1 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 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 1 1 0 2 2 16 16 1 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 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 1 1 0 2 2 19 19 4 0 1 0 1 0 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 0
2003 1 1 0 2 2 20 20 2 0 0 0 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 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 1 1 0 2 2 22 22 3 0 0 0 0 0 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 0 0 0 0 0
2003 1 1 0 2 2 23 23 1 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 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 1 1 0 2 2 24 24 1 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 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 1 1 0 2 2 25 25 1 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 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 1 1 0 2 2 27 27 1 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 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 1 1 0 2 2 32 32 1 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2004 1 1 0 2 2 40 40 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2005 1 1 0 2 2 13 13 1 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
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2005 1 1 0 2 2 15 15 4 0 0 0 0 0 1 0 2 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2005 1 1 0 2 2 16 16 1 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
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2005 1 1 0 2 2 19 19 3 0 0 0 0 0 0 0 0 0 2 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2005 1 1 0 2 2 20 20 2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2005 1 1 0 2 2 21 21 4 0 0 0 0 0 0 0 1 1 0 0 0 0 0 1 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2005 1 1 0 2 2 22 22 6 0 0 0 0 0 1 1 3 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2005 1 1 0 2 2 23 23 1 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2005 1 1 0 2 2 26 26 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2005 1 1 0 2 2 27 27 2 0 0 0 0 0 0 0 0 1 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2005 1 1 0 2 2 29 29 5 0 0 0 0 0 0 0 2 2 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2005 1 1 0 2 2 30 30 2 0 0 0 0 0 0 0 0 0 0 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2005 1 1 0 2 2 31 31 1 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2005 1 1 0 2 2 33 33 1 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2005 1 1 0 2 2 40 40 1 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 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2007 1 1 0 2 2 29 29 1 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2008 1 1 0 2 2 22 22 1 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2008 1 1 0 2 2 24 24 1 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2008 1 1 0 2 2 30 30 1 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

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2008 1 1 0 2 2 40 40 1 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2009 1 1 0 2 2 11 11 1 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2009 1 1 0 2 2 15 15 1 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2009 1 1 0 2 2 17 17 1 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2009 1 1 0 2 2 18 18 2 0 0 0 0 0 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 0 0
2009 1 1 0 2 2 20 20 2 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 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2009 1 1 0 2 2 23 23 1 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2009 1 1 0 2 2 24 24 1 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2009 1 1 0 2 2 28 28 1 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2009 1 1 0 2 2 39 39 1 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 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 1 2 0 2 2 13 13 1 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 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 1 2 0 2 2 14 14 1 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 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 1 2 0 2 2 15 15 1 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
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2003 1 2 0 2 2 18 18 4 0 0 0 0 0 0 1 2 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2003 1 2 0 2 2 20 20 1 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 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 1 2 0 2 2 21 21 1 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 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 1 2 0 2 2 22 22 3 0 0 0 0 0 0 1 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 0 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 1 2 0 2 2 26 26 1 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
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2003 1 2 0 2 2 30 30 1 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
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2005 1 2 0 2 2 16 16 1 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2005 1 2 0 2 2 19 19 1 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2005 1 2 0 2 2 21 21 2 0 0 0 0 0 1 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
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2006 1 2 0 2 2 23 23 1 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
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2006 1 2 0 2 2 28 28 1 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2007 1 2 0 2 2 15 15 1 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2007 1 2 0 2 2 17 17 1 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2007 1 2 0 2 2 19 19 2 0 0 0 0 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 0 0 0 0 0
2007 1 2 0 2 2 21 21 1 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2007 1 2 0 2 2 22 22 1 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2007 1 2 0 2 2 23 23 1 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2007 1 2 0 2 2 29 29 1 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
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2008 1 2 0 2 2 18 18 4 0 0 1 0 1 0 1 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
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2008 1 2 0 2 2 20 20 7 0 0 0 0 1 0 0 2 2 0 0 0 1 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2008 1 2 0 2 2 21 21 3 0 0 0 0 0 2 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2008 1 2 0 2 2 22 22 6 0 0 0 0 0 1 1 0 1 0 1 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
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2008 1 2 0 2 2 24 24 2 0 0 0 0 0 1 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2008 1 2 0 2 2 25 25 2 0 0 0 0 0 0 0 0 0 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
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2008 1 2 0 2 2 28 28 1 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2008 1 2 0 2 2 29 29 1 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2008 1 2 0 2 2 30 30 2 0 0 0 0 0 0 0 0 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2008 1 2 0 2 2 31 31 3 0 0 0 0 0 0 0 0 1 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
2008 1 2 0 2 2 32 32 1 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2008 1 2 0 2 2 36 36 1 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2009 1 2 0 2 2 15 15 1 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2009 1 2 0 2 2 19 19 2 0 0 0 0 0 1 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

2009 1 2 0 2 2 20 20 1 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

2009 1 2 0 2 2 21 21 6 0 0 0 0 0 0 1 1 0 3 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

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2004 1 3 0 2 2 27 27 18 0 0 0 0 0 3 1 4 4 1 2 2 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
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2005 1 3 0 2 2 17 17 26 0 0 0 1 2 5 4 7 2 3 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
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2005 1 3 1 2 2 17 17 2 0 0 0 0 0 0 0 0 0 0 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
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2006 1 3 0 2 2 19 19 8 0 0 0 0 2 3 1 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
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2008 1 3 0 2 2 35 35 3 0 0 0 0 0 0 0 2 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
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2008 1 3 0 2 2 37 37 1 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2008 1 3 0 2 2 38 38 1 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2008 1 3 0 2 2 39 39 1 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2008 1 3 0 2 2 40 40 1 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2008 1 3 0 2 2 43 43 1 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2008 1 3 1 2 2 8 8 1 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2008 1 3 1 2 2 9 9 1 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2008 1 3 1 2 2 10 10 3 0 0 1 0 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2008 1 3 3 2 2 11 11 7 0 0 3 1 1 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2008 1 3 3 2 2 12 12 3 0 0 0 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 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
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2008 1 3 1 2 2 16 16 11 0 0 0 0 1 2 0 1 3 0 2 1 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2008 1 3 1 2 2 17 17 11 0 0 0 0 0 1 1 3 2 0 2 0 1 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2008 1 3 3 2 2 18 18 6 0 0 0 0 1 0 0 1 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
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2008 1 3 2 2 2 22 22 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2008 1 3 2 2 2 26 26 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 1 1 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2008 1 3 2 2 2 27 27 8 0 0 0 0 0 0 0 0 0 0 0 0 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 2 1 2 2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2008 1 3 2 2 2 28 28 5 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 3 0 0 0 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2008 1 3 2 2 2 29 29 5 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 2 1 1 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

2008 1 3 2 2 2 30 30 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 1 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2008 1 3 2 2 2 31 31 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 1 0 2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
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2009 1 3 0 2 2 15 15 26 0 0 2 0 3 4 5 2 1 2 2 2 2 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
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2009 1 3 0 2 2 20 20 27 0 0 0 0 1 3 8 3 6 2 2 1 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
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2009 1 3 0 2 2 23 23 20 0 0 0 0 2 3 3 0 4 3 2 0 0 0 0 1 1 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2009 1 3 0 2 2 24 24 20 0 0 0 0 1 2 0 5 2 3 2 2 1 0 1 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
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2009 1 3 0 2 2 29 29 10 0 0 0 0 0 0 0 2 0 1 1 1 1 1 0 0 0 0 0 0 0 0 0 1 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
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2009 1 3 0 2 2 37 37 3 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 1 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
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2009 1 3 3 2 2 15 15 24 0 0 0 1 1 1 8 5 1 1 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 1 0 0 0 1 1 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
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2009 1 4 0 2 2 39 39 5 0 0 0 0 0 0 0 0 0 0 0 2 2 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

2009 1 4 0 2 2 40 40 3 0 0 0 0 0 0 0 0 0 0 1 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2009 1 4 0 2 2 41 41 3 0 0 0 0 0 0 0 0 0 0 0 1 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
2009 1 4 0 2 2 42 42 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2009 1 4 0 2 2 43 43 2 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2009 1 4 0 2 2 45 45 2 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2009 1 4 0 2 2 46 46 1 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2009 1 4 0 2 2 47 47 1 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2009 1 4 1 2 2 11 11 1 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2009 1 4 1 2 2 12 12 1 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
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2005 1 5 2 2 2 20 20 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 1 2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
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2007 1 5 2 2 2 26 26 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 2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
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2009 1 6 2 2 2 29 29 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

2009 1 6 2 2 2 31 31 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 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

2009 1 6 2 2 2 35 35 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 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 0 0

2009 1 6 2 2 2 40 40 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0

0 #_N_size@age_obs
1 #_N_environ_variables
0 #_N_environ_obs
0 # N sizefreq methods to read

0 # no tag data

0 # no morphcomp data

999

3.12. Appendix F. Tilefish.CTL File

```
#.ctl file for Tilefish SSIII
2 #_N_Growth_Patterns
1 #_N_Morphs_Within_GrowthPattern
#_Cond 1 #_Morph_between/within_stdev_ratio (no read if N_morphs=1)
#_Cond 1 #vector_Morphdist_(-1_in_first_val_gives_normal_approx)

2 # N recruitment designs goes here if N_GP*nseas*area>1
0 # placeholder for recruitment interaction request
1 1 1 # example recruitment design element for GP=1, seas=1, area=1
2 1 2 # recruitment design element for GP=2, seas=1, area=2

0 # N_movement_definitions goes here if N_areas > 1
1 # first age that moves (real age at begin of season, not integer) also cond on do_migration>0
#_Cond 1 1 1 2 4 10 # example move definition for seas=1, morph=1, source=1 dest=2, age1=4, age2=10

0 #_Nblock_Patterns
# 3 2 #_blocks_per_pattern
# begin and end years of blocks
# 1975 1985 1986 1990 1995 2001
# 1987 1990 1995 2001

0.57 #_fracfemale
2 #_natM_type:_0=1Parm; 1=N_breakpoints;_2=Lorenzen;_3=agespecific;_4=agespec_withseasinterpolate
# 2 #_N_breakpoints
# 4 15 # age(real) at M breakpoints
4 #_ref age for Lorenzen function
1 # GrowthModel: 1=vonBert with L1&L2; 2=Richards with L1&L2; 3=not implemented; 4=not implemented
```

0 #_Growth_Age_for_L1
999 #_Growth_Age_for_L2 (999 to use as Linf)
0 #_SD_add_to_LAA (set to 0.1 for SS2 V1.x compatibility)
0 #_CV_Growth_Pattern: 0 CV=f(LAA); 1 CV=F(A); 2 SD=F(LAA); 3 SD=F(A)
1 #_maturity_option: 1=length logistic; 2=age logistic; 3=read age-maturity matrix by growth_pattern; 4=read age-fecundity
#_placeholder for empirical age-maturity by growth pattern
1 #_First_Mature_Age
3 #_fecundity option:(1)eggs=Wt*(a+b*Wt);(2)eggs=a*L^b;(3)eggs=a*Wt^b
1 #_hermaphroditism
-1 #_season of transition (-1 at end of each season)
0 #_include males in spawning biomass (0=no, 1=yes)
1 #_parameter_offset_approach (1=none, 2= M, G, CV_G as offset from female-GP1, 3=like SS2 V1.x)
2 #_env/block/dev_adjust_method (1=standard; 2=with logistic trans to keep within base parm bounds)

#_growth_parms
#_LO HI INIT PRIOR PR_type SD PHASE env-var use_dev dev_minyr dev_maxyr dev_stddev Block Block_Fxn
0.01 0.3 0.137 0.137 1 5.0 -4 0 0 0 0 0.5 0 0 # NatM_p1_Fem_GP1
0 30 1.4 1.4 1 5.0 -2 0 0 0 0 0.5 0 0 # L_at_Amin_Fem_GP1
60 120 87.8 87.8 1 5.0 2 0 0 0 0 0.5 0 0 # L_at_Amax_Fem_GP1
0.01 0.3 0.1090 0.1090 1 0.8 2 0 0 0 0 0.5 0 0 # VBK_Fem_GP1
COND(Growth_Model=2)_Richards_coefficient_fem
0.05 0.5 0.16 0.16 -1 0.05 -3 0 0 0 0 0.5 0 0 # CV_young_Fem_GP1
0.05 0.5 0.12 0.12 -1 0.05 -3 0 0 0 0 0.5 0 0 # CV_old_Fem_GP1
0.01 0.3 0.137 0.137 1 5.0 -4 0 0 0 0 0.5 0 0 # NatM_p1_Fem_GP2
0 30 1.4 1.4 1 5.0 -2 0 0 0 0 0.5 0 0 # L_at_Amin_Fem_GP2
60 120 77.3 77.3 1 0.8 2 0 0 0 0 0.5 0 0 # L_at_Amax_Fem_GP2
0.01 0.3 0.1721 0.1721 1 0.8 2 0 0 0 0 0.5 0 0 # VBK_Fem_GP2
COND(Growth_Model=2)_Richards_coefficient_fem
0.05 0.5 0.16 0.16 -1 0.05 -3 0 0 0 0 0.5 0 0 # CV_young_Fem_GP2

0.05 0.5 0.12 0.12 -1 0.05 -3 0 0 0 0 0.5 0 0 # CV_old_Fem_GP2
0.05 0.25 0.137 0.137 1 5.0 -4 0 0 0 0 0.5 0 0 # NatM_p1_Mal_GP1
0 30 1.4 1.4 1 0.8 -2 0 0 0 0 0.5 0 0 # L_at_Amin_Mal_GP1
60 120 87.8 87.8 1 0.8 2 0 0 0 0 0.5 0 0 # L_at_Amax_Mal_GP1
0.01 0.3 0.1090 0.1090 1 0.8 2 0 0 0 0 0.5 0 0 # VBK_Mal_GP1
COND(Growth_Model=2)_Richards_coefficient_mal
0.05 0.5 0.16 0.16 -1 0.05 -3 0 0 0 0 0.5 0 0 # CV_young_Mal_GP1
0.05 0.5 0.12 0.12 -1 0.05 -3 0 0 0 0 0.5 0 0 # CV_old_Mal_GP1
0.05 0.25 0.137 0.137 1 5.0 -4 0 0 0 0 0.5 0 0 # NatM_p1_Mal_GP2
0 30 1.4 1.4 1 0.8 -2 0 0 0 0 0.5 0 0 # L_at_Amin_Mal_GP2
60 120 77.3 77.3 1 0.8 2 0 0 0 0 0.5 0 0 # L_at_Amax_Mal_GP2
0.01 0.3 0.1721 0.1721 1 0.8 2 0 0 0 0 0.5 0 0 # VBK_Mal_GP2
COND(Growth_Model=2)_Richards_coefficient_mal
0.05 0.5 0.16 0.16 -1 0.05 -3 0 0 0 0 0.5 0 0 # CV_young_Mal_GP2
0.05 0.5 0.12 0.12 -1 0.05 -3 0 0 0 0 0.5 0 0 # CV_old_Mal_GP2
0.000002 0.000009 0.000007526 0.000007526 1 0.2 -2 0 0 0 0 0.5 0 0 # Wtlen_1_Fem
2.5 3.8 3.082 3.082 1 0.2 -3 0 0 0 0 0.5 0 0 # Wtlen_2_Fem
25 50 34.4 34.4 -1 0.8 -3 0 0 0 0 0.5 0 0 # Mat50%_Fem
-0.6 -0.2 -0.478 -0.478 -1 0.8 -3 0 0 0 0 0.5 0 0 # Mat_slope_Fem
0 50 29.87 29.87 1 0.2 -2 0 0 0 0 0.5 0 0 # Fec_1_Fem
0 5 1.42 1.42 1 0.2 -3 0 0 0 0 0.5 0 0 # Fec_2_Fem
0.000002 0.000009 0.000007526 0.000007526 1 0.2 -2 0 0 0 0 0.5 0 0 # Wtlen_1_Mal
2.5 3.8 3.082 3.082 1 0.2 -3 0 0 0 0 0.5 0 0 # Wtlen_2_Mal
1 60 47.49449 47.49449 -1 0 -4 0 0 0 0 0.5 0 0 # herm_inflection_age
0.1 40 20 20 -1 0 -4 0 0 0 0 0.5 0 0 # herm_stdev(in_age)
0 1 0.190861916 0.190861916 -1 0 -4 0 0 0 0 0.5 0 0 # herm_asymptotic_rate
-4 4 0 0 -1 99 -4 0 0 0 0 0 0 0 # RecrDist_GP1
-4 4 0 0 -1 99 -4 0 0 0 0 0 0 0 # RecrDist_GP2
-4 4 1 1 -1 0.01 4 0 0 0 0 0 0 0 # RecrDist_Area1

-4 4 1 1 -1 0.01 -4 0 0 0 0 0 0 0 # RecrDist_Area2
-4 4 1 1 -1 0.01 -4 0 0 0 0 0 0 0 # RecrDist_Seas1
COND(Rec_Dist_Interact=1)_N_patterns*N_areas*N_seasons
1 1 1 1 -1 0 -4 0 0 0 0 0 0 0 # CohortGrowDev
#_Cond 0 #custom_MG-env_setup (0/1)
#_Cond -2 2 0 0 -1 99 -2 #_placeholder when no MG-environ parameters

#_Cond 0 #custom_MG-block_setup (0/1)
#_Cond -2 2 0 0 -1 99 -2 #_placeholder when no MG-block parameters

#_seasonal_effects_on_biology_parms
0 0 0 0 0 0 0 0 0 0 #_femwtlen1,femwtlen2,mat1,mat2,fec1,fec2,Malewtlen1,malewtlen2,L1,K
#_Cond -2 2 0 0 -1 99 -2 #_placeholder when no seasonal MG parameters

#_Cond -4 #_MGparm_Dev_Phase

#_Spawner-Recruitment
3 #_SR_function
#_LO HI INIT PRIOR PR_type SD PHASE
1 10 6.75 6.75 0 0.4 1 # SR_log(R0)
0.2 0.99 0.75 0.75 1 5.0 3 # SR_steep
0 2 0.15 0.15 -1 50 -4 # SR_sigmaR
-5 5 0 0 -1 50 -3 # SR_envlink
-5 5 0 0 -1 50 -3 # SR_R1_offset
0 0.5 0 0 -1 50 -2 # SR_autocorr
0 #_SR_env_link
0 #_SR_env_target_0=none;1=devs;_2=R0;_3=steepness

1 #do_recdev: 0=none; 1=devvector; 2=simple deviations

1965 # first year of main recr_devs; early devs can preceed this era
2009 # last year of main recr_devs; forecast devs start in following year
4 #_recdev phase
1 # (0/1) to read 11 advanced options
0 #_recdev_early_start (0=none; neg value makes relative to recdev_start)
-5 #_recdev_early_phase
0 #_forecast_recruitment phase (incl. late recr) (0 value resets to maxphase+1)
1 #_lambda for prior_fore_recr occurring before endyr+1
1983 #_last_early_yr_nobias_adj_in_MPD
1997 #_first_yr_fullbias_adj_in_MPD
2006 #_last_yr_fullbias_adj_in_MPD
2007 #_first_recent_yr_nobias_adj_in_MPD
1
0
-5 #min rec_dev
5 #max rec_dev
0 #_read_recdevs
#_end of advanced SR options

read specified recr devs
#_Yr Input_value

all recruitment deviations
#DisplayOnly -0.28147 # RecrDev_1971
#DisplayOnly 0.358653 # RecrDev_1972
#DisplayOnly -0.0613461 # RecrDev_1973
#DisplayOnly 0.0765681 # RecrDev_1974
#DisplayOnly 0.792201 # RecrDev_1975
#DisplayOnly 0.0675588 # RecrDev_1976

#DisplayOnly 0.278372 # RecrDev_1977
#DisplayOnly -0.272589 # RecrDev_1978
#DisplayOnly -0.327367 # RecrDev_1979
#DisplayOnly 0.485895 # RecrDev_1980
#DisplayOnly 0.497595 # RecrDev_1981
#DisplayOnly -0.587451 # RecrDev_1982
#DisplayOnly -0.732346 # RecrDev_1983
#DisplayOnly -0.645347 # RecrDev_1984
#DisplayOnly 0.602779 # RecrDev_1985
#DisplayOnly 0.0265801 # RecrDev_1986
#DisplayOnly 0.474477 # RecrDev_1987
#DisplayOnly -0.0120026 # RecrDev_1988
#DisplayOnly -0.125787 # RecrDev_1989
#DisplayOnly 0.367247 # RecrDev_1990
#DisplayOnly -0.74953 # RecrDev_1991
#DisplayOnly -0.543472 # RecrDev_1992
#DisplayOnly -0.609505 # RecrDev_1993
#DisplayOnly 0.340329 # RecrDev_1994
#DisplayOnly -0.0701799 # RecrDev_1995
#DisplayOnly -0.159475 # RecrDev_1996
#DisplayOnly 0.44237 # RecrDev_1997
#DisplayOnly 0.1719 # RecrDev_1998
#DisplayOnly -0.419804 # RecrDev_1999
#DisplayOnly 0.302961 # RecrDev_2000
#DisplayOnly 0.312186 # RecrDev_2001
#DisplayOnly 0 # ForeRecr_2002
#DisplayOnly 0 # ForeRecr_2003
#DisplayOnly 0 # ForeRecr_2004
#DisplayOnly 0 # ForeRecr_2005

#DisplayOnly 0 # ForeRecr_2006
#DisplayOnly 0 # ForeRecr_2007
#DisplayOnly 0 # ForeRecr_2008
#DisplayOnly 0 # ForeRecr_2009
#DisplayOnly 0 # ForeRecr_2010
#DisplayOnly 0 # ForeRecr_2011
#DisplayOnly 0 # ForeRecr_2012
#DisplayOnly 0 # ForeRecr_2013

#Fishing Mortality info
0.1 # F ballpark for tuning early phases
2009 # F ballpark year (neg value to disable)
3 # F_Method: 1=Pope; 2=instan. F; 3=hybrid (hybrid is recommended)
4 # max F or harvest rate, depends on F_Method
4
no additional F input needed for Fmethod 1
read overall start F value; overall phase; N detailed inputs to read for Fmethod 2
read N iterations for tuning for Fmethod 3 (recommend 3 to 7)
#Fleet Year Seas F_value se phase (for detailed setup of F_Method=2)

#_initial_F_parms
#_LO HI INIT PRIOR PR_type SD PHASE
0 1 0 0.01 -1 99 -99 # Init_F_CM_HL_E
0 1 0 0.01 -1 99 -99 # Init_F_CM_HL_W
0 1 0 0.01 -1 99 -99 # Init_F_CM_LL_E
0 1 0 0.01 -1 99 -99 # Init_F_CM_LL_W
#_Q_setup

A=do power, B=env-var, C=extra SD, D=devtype(<0=mirror, 0/1=none, 2=cons, 3=rand, 4=randwalk); E=0=num/1=bio, F=err_type
#_A B C D E F
0 0 0 0 1 0 # CM_HL_E
0 0 0 0 1 0 # CM_HL_W
0 0 0 0 1 0 # CM_LL_E
0 0 0 0 1 0 # CM_LL_W
0 0 0 0 0 0 # NMFS_E_index
0 0 0 0 0 0 # NMFS_W_index
#_Cond 0 #_If q has random component, then 0=read one parm for each fleet with random q; 1=read a parm for each year of index
#_Q_parms(if_any)
LO HI INIT PRIOR PR_type SD PHASE
#_place holder for catchability parameters
#_size_selex_types
#_Pattern Discard Male Special
24 0 0 0 # CM_HL_E
5 0 0 1 # CM_HL_W
24 0 0 0 # CM_LL_E
5 0 0 3 # CM_LL_W
24 0 0 0 # NMFS_E_index
5 0 0 5 # NMFS_W_index
#_age_selex_types
#_Pattern Discard Male Special
11 0 0 0 # CM_HL_E
11 0 0 1 # CM_HL_W
11 0 0 0 # CM_LL_E
11 0 0 3 # CM_LL_W
11 0 0 0 # NMFS_E_index
11 0 0 5 # NMFS_W_index

#_LO HI INIT PRIOR PR_type SD PHASE env-var use_dev dev_minyr dev_maxyr dev_stddev Block Block_Fxn
20 113 60 60 1 0.05 3 0 0 0 0 0.5 0 0 #HLE_SizeSel_p1
-5 3 3.0 3.0 1 0.05 -3 0 0 0 0 0.5 0 0 #HLE_SizeSel_p2
-4 12 5 5 1 0.05 3 0 0 0 0 0.5 0 0 #HLE_SizeSel_p3
-2 6 2.5 2.5 1 0.05 -3 0 0 0 0 0.5 0 0 #HLE_SizeSel_p4
-15 5 -15 -15 1 0.05 -3 0 0 0 0 0.5 0 0 #HLE_SizeSel_p5
-5 5 5.0 5.0 1 0.05 -3 0 0 0 0 0.5 0 0 #HLE_SizeSel_p6
-5 5 0 0 1 0.05 -3 0 0 0 0 0.5 0 0 #HLW_SizeSel_p1
-5 5 0 0 1 0.05 -3 0 0 0 0 0.5 0 0 #HLW_SizeSel_p2
#20 113 60 60 1 0.05 3 0 0 0 0 0.5 0 0 #HLW_SizeSel_p1
#-5 3 3.0 3.0 1 0.05 -3 0 0 0 0 0.5 0 0 #HLW_SizeSel_p2
#-4 12 5 5 1 0.05 3 0 0 0 0 0.5 0 0 #HLW_SizeSel_p3
#-2 6 2.5 2.5 1 0.05 -3 0 0 0 0 0.5 0 0 #HLW_SizeSel_p4
#-15 5 -15 -15 1 0.05 -3 0 0 0 0 0.5 0 0 #HLW_SizeSel_p5
#-5 5 5.0 5.0 1 0.05 -3 0 0 0 0 0.5 0 0 #HLW_SizeSel_p6
20 113 60 60 1 0.05 3 0 0 0 0 0.5 0 0 #CMLLE_SizeSel_p1
-5 3 3.0 3.0 1 0.05 -3 0 0 0 0 0.5 0 0 #CMLLE_SizeSel_p2
-4 12 5 5 1 0.05 3 0 0 0 0 0.5 0 0 #CMLLE_SizeSel_p3
-2 6 2.5 2.5 1 0.05 -3 0 0 0 0 0.5 0 0 #CMLLE_SizeSel_p4
-15 5 -15 -15 1 0.05 -3 0 0 0 0 0.5 0 0 #CMLLE_SizeSel_p5
-5 5 5.0 5.0 1 0.05 -3 0 0 0 0 0.5 0 0 #CMLLE_SizeSel_p6
-5 5 0 0 1 0.05 -3 0 0 0 0 0.5 0 0 #CMLLW_SizeSel_p1
-5 5 0 0 1 0.05 -3 0 0 0 0 0.5 0 0 #CMLLW_SizeSel_p2
#20 113 60 60 1 0.05 3 0 0 0 0 0.5 0 0 #CMLLW_SizeSel_p1
#-5 3 3.0 3.0 1 0.05 -3 0 0 0 0 0.5 0 0 #CMLLW_SizeSel_p2
#-4 12 5 5 1 0.05 3 0 0 0 0 0.5 0 0 #CMLLW_SizeSel_p3
#-2 6 2.5 2.5 1 0.05 -3 0 0 0 0 0.5 0 0 #CMLLW_SizeSel_p4
#-15 5 -15 -15 1 0.05 -3 0 0 0 0 0.5 0 0 #CMLLW_SizeSel_p5
#-5 5 5.0 5.0 1 0.05 -3 0 0 0 0 0.5 0 0 #CMLLW_SizeSel_p6

20 113 60 60 1 0.05 3 0 0 0 0 0.5 0 0 #NMFSE_index_SizeSel_p1
-5 3 3.0 3.0 1 0.05 -3 0 0 0 0 0.5 0 0 #NMFSE_index_SizeSel_p2
-4 12 5 5 1 0.05 3 0 0 0 0 0.5 0 0 #NMFSE_index_SizeSel_p3
-2 6 2.5 2.5 1 0.05 -3 0 0 0 0 0.5 0 0 #NMFSE_index_SizeSel_p4
-15 5 -15 -15 1 0.05 -3 0 0 0 0 0.5 0 0 #NMFSE_index_SizeSel_p5
-5 5 5.0 5.0 1 0.05 -3 0 0 0 0 0.5 0 0 #NMFSE_index_SizeSel_p6
-5 5 0 0 1 0.05 -3 0 0 0 0 0.5 0 0 #NMFSW_index_SizeSel_p1
-5 5 0 0 1 0.05 -3 0 0 0 0 0.5 0 0 #NMFSW_index_SizeSel_p2
#20 113 60 60 1 0.05 3 0 0 0 0 0.5 0 0 #NMFSW_index_SizeSel_p1
#-5 3 3.0 3.0 1 0.05 -3 0 0 0 0 0.5 0 0 #NMFSW_index_SizeSel_p2
#-4 12 5 5 1 0.05 3 0 0 0 0 0.5 0 0 #NMFSW_index_SizeSel_p3
#-2 6 2.5 2.5 1 0.05 -3 0 0 0 0 0.5 0 0 #NMFSW_index_SizeSel_p4
#-15 5 -15 -15 1 0.05 -3 0 0 0 0 0.5 0 0 #NMFSW_index_SizeSel_p5
#-5 5 5.0 5.0 1 0.05 -3 0 0 0 0 0.5 0 0 #NMFSW_index_SizeSel_p6
0 30 0 5 0 99 -1 0 0 0 0 0.5 0 0 #HLE_AgeSel_p1
0 30 30 6 0 99 -1 0 0 0 0 0.5 0 0 #HLE_AgeSel_p2
0 30 0 5 0 99 -1 0 0 0 0 0.5 0 0 #HLW_AgeSel_p1
0 30 30 6 0 99 -1 0 0 0 0 0.5 0 0 #HLW_AgeSel_p2
0 30 0 5 0 99 -1 0 0 0 0 0.5 0 0 #CMLLE_AgeSel_p1
0 30 30 6 0 99 -1 0 0 0 0 0.5 0 0 #CMLLE_AgeSel_p2
0 30 0 5 0 99 -1 0 0 0 0 0.5 0 0 #CMLLW_AgeSel_p1
0 30 30 6 0 99 -1 0 0 0 0 0.5 0 0 #CMLLW_AgeSel_p2
0 30 0 5 0 99 -1 0 0 0 0 0.5 0 0 #NMFSE_index_AgeSel_p1
0 30 30 6 0 99 -1 0 0 0 0 0.5 0 0 #NMFSE_index_AgeSel_p2
0 30 0 5 0 99 -1 0 0 0 0 0.5 0 0 #NMFSW_index_AgeSel_p1
0 30 30 6 0 99 -1 0 0 0 0 0.5 0 0 #NMFSW_index_AgeSel_p2
#_Cond 0 #_custom_sel-env_setup (0/1)
#_Cond -2 2 0 0 -1 99 -2 #_placeholder when no enviro fxns

Tag loss and Tag reporting parameters go next
0 # TG_custom: 0=no read; 1=read if tags exist
#_Cond -6 6 1 1 2 0.01 -4 0 0 0 0 0 0 0 #_placeholder if no parameters

1 #_Variance_adjustments_to_input_values
#_1 2 3 4 5 6
0 0 0 0 0 0 #_add_to_survey_CV
0 0 0 0 0 0 #_add_to_discard_stddev
0 0 0 0 0 0 #_add_to_bodywt_CV
1 1 1 1 1 1 #_mult_by_lencomp_N
1 1 1 1 1 1 #_mult_by_agecomp_N
1 1 1 1 1 1 #_mult_by_size-at-age_N
30 #_DF_for_discard_like
30 #_DF_for_meanbodywt_like

4 #_maxlambdaphase
1 #_sd_offset

4 # number of changes to make to default Lambdas (default value is 1.0)
Like_comp codes: 1=surv; 2=disc; 3=mnwt; 4=length; 5=age; 6=SizeFreq; 7=sizeage; 8=catch;
9=init_equ_catch; 10=recrdev; 11=parm_prior; 12=parm_dev; 13=CrashPen; 14=Morphcomp; 15=Tag-comp; 16=Tag-negbin
#like_comp fleet/survey phase value sizefreq_method
1 3 1 1 1
1 4 1 1 1
1 5 1 1 1
1 6 1 1 1

lambdas (for info only; columns are phases)

```
# 0 0 0 0 #_CPUE/survey:_1
# 1 1 1 1 #_CPUE/survey:_2
# 1 1 1 1 #_CPUE/survey:_3
# 1 1 1 1 #_lencomp:_1
# 1 1 1 1 #_lencomp:_2
# 0 0 0 0 #_lencomp:_3
# 1 1 1 1 #_agecomp:_1
# 1 1 1 1 #_agecomp:_2
# 0 0 0 0 #_agecomp:_3
# 1 1 1 1 #_size-age:_1
# 1 1 1 1 #_size-age:_2
# 0 0 0 0 #_size-age:_3
# 1 1 1 1 #_init_equ_catch
# 1 1 1 1 #_recruitments
# 1 1 1 1 #_parameter-priors
# 1 1 1 1 #_parameter-dev-vectors
# 1 1 1 1 #_crashPenLambda
0 # (0/1) read specs for more stddev reporting
# 1 1 -1 5 1 5 1 -1 5 # selex type, len/age, year, N selex bins, Growth pattern, N growth ages, area For N-at-age, Year, N bins
# -5 16 27 38 46 # vector with selex std bin picks (-1 in first bin to self-generate)
# -1 2 14 26 40 # vector with growth std bin picks (-1 in first bin to self-generate)
# -1 2 14 26 40 # vector with N-at-age std bin picks (-1 in first bin to self-generate)
999
```

SEDAR

Southeast Data, Assessment, and Review

SEDAR 22

Gulf of Mexico Tilefish

SECTION IV: Research Recommendations

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

1. DATA WORKSHOP RESEARCH RECOMMENDATIONS

1.1 LIFE HISTORY WORKING GROUP

- In addition to the tilefish reproductive data needs (above), the WG recommends examination of the size frequency of commercial catch by month to examine potential inference concerning the sex ratio of the catch.
- Improve information on stock structure/rates of possible exchange between Gulf and Atlantic, including pathways for larval transport.
- Expand the fishery-independent long-line survey to deeper depths. In addition, increase collection of sediment/habitat data to allow post-stratification of survey results. Increased resolution of spatial population structure is important given the spatially divergent landings and demographic differences (east and western Gulf) and given the potential for localized over-exploitation within the larger Gulf of Mexico stock.
- Last, the WG recommends monitoring the possibility of increased discards/highgrading as ITQs (catch shares) is undertaken as a management approach.

Procedural Recommendation:

At points during the SEDAR 22 process, WG and DW panel members noted some confusion about “tilefish” as a species and as a species complex during discussions. Given the lack of clarity about common names for several species and their associated complexes, The WG recommends that scientific names be added to future SEDAR schedules and announcements.

1.2 COMMERCIAL STATISTICS WORKING GROUP

No recommendations were provided.

1.3 RECREATIONAL STATISTICS WORKING GROUP

No recommendations were provided.

1.4 INDICES OF ABUNDANCE WORKING GROUP

In the fishery-independent survey presented above, precision in abundance indices could be improved by increasing the number of samples at least two- to three-fold.

Research recommendations for fishery dependent data:

1.) Expand observer coverage to provide a subsample adequate to construct indices of abundance (Pelagic Longline Observer Progam has 5-8% coverage). Observer data provides finer spacial resolution and a more accurate measure of CPUE. It also provides size frequency and discard information that is currently unavailable in the self-reported dataset. Current observer coverage is inadequate for the construction of indices of abundance.

2.) Self logbook data should be restructured to collect data on a per set basis rather than per trip. This would allow for a more accurate calculation of CPUE. Data subsetting (determining targeting) would be vastly improved with set-based data.

2. CIE REVIEWER RECOMMENDATIONS - DATA WORKSHOP

Conclusions and recommendations

I would like to commend the great efforts of all the participating scientists, managers and fishermen in the SEDAR 22 DW in the identification, evaluation and compilation of the information on life history, fishery-dependent and fishery-independent abundance indices, and landings in the commercial and recreational fisheries for YG, tilefish (i.e., golden tilefish), and blueline tilefish in the GOM. I was impressed by the breadth of expertise and experience of the panelists, openness of discussion for considering alternative approaches/suggestions, and constructive dialogs in each working group and at the plenary meetings throughout the workshop. All the comments, whether they were from scientists, managers, or fishermen, were fully considered and discussed. In particular, I commend the inclusion in the Data Workshop of fishermen, who provided insights on the quality of the fishery data, in particular for historical fisheries data. I observed on many occasions constructive interactions and dialogs between scientists/mangers and representatives of the industry in the Workshop.

In general, I consider the information identified and compiled in the DW represents the best efforts given all the limitations associated with data quality and quantity. I consider the approaches used in developing life history parameters, fisheries landings, and abundance indices sound.

Having said that, I believe that there are large uncertainties associated with data identified and compiled in the DW, and that there is room for further improvement. I have made the following general comments and specific recommendations.

General comments

Although the SoW states that all the working papers and reference/background information for the workshop will be available two weeks before the workshop, only a few working papers (less than 25% of all the working papers promised) were available before the start of the workshop (not mention two weeks before the start of the workshop). Many working papers were still not ready in the middle of the workshop, which made my work difficult. The three separate working groups worked concurrently every day, making it impossible for me, as the only CIE reviewer, to be fully involved in each group's discussions.

I was told at the DW that Stock Synthesis 3 (SS3) will be used for the assessment of YG and tilefish. This choice of stock assessment model has direct impacts on the quality and quantity of the data that need to be evaluated and compiled in the Workshop. However, I observed that most DW panelists did not know exactly the data requirements, key assumptions, and options of the SS3 program. I recommend that future data workshop start with the introduction of the stock assessment model that will be used in the assessment so that data workshop participants understand the information needs of the stock assessment model.

I noticed that the time period that the SEDAR 22 assessment covers had not been defined prior to the DW. I suggest that a stock assessment time period be defined prior to the DW so that working groups can focus on the defined time period, and not waste time discussing data falling outside the target stock assessment. The DW may also be a good place to discuss and make a decision about the time period the stock assessment should cover.

There is a need to include scientific names for all species covered in the TORs and SoW. The tilefish is the official name of golden tilefish in the American Fisheries Society list of fish species. However, both golden tilefish and blueline tilefish were discussed at the Workshop. This creates some confusion. It is clear from all the discussions at this Workshop that the information for blueline tilefish is not sufficient for a formal stock assessment using an assessment model like SS3.

Specific recommendations

Although I have provided detailed comments and recommendations under each TOR, I re-iterate the following recommendations.

- Possible existence of local stocks for both species needs to be evaluated;
- More comparative studies need to be done to evaluate differences in data collected from different monitoring programs;
- More comparative studies need to be done to evaluate differences in parameters estimated using different methods to improve our understanding of the degree of uncertainty associated with these parameters;
- More comparative studies need to be done to evaluate spatial and temporal variability in key life history parameters, abundance indices and landings;
- More habitat variables need to be included in CPUE and abundance index standardization;
- General additive models need to be considered in standardizing abundance index and CPUE;
- Instead of using a point estimate as a bias correction factor in correcting potential biases in landings data, a range of correction factors can be used so that large uncertainty in landings data can be incorporated into the stock assessment;
- The quality of catch data (landings, catch size/age composition, catch sex ratio etc.) is probably the most questionable of the data available to the stock assessment for both fish species, and the stock assessment model should have an ability to incorporate uncertainty in catch data;
- A critical evaluation of fishery-independent monitoring programs should be done to identify problems associated with the current program design in quantifying population dynamics;
- A systematic mail survey/interview of fishermen who have been involved in the GOM YG and tilefish needs to be done to have a better understanding of the degree of misreporting/underreporting and to identify if there is spatial and temporal variability in underreporting;

- It appears that outliers may exist in the assessment and given the data quality concerns, I suggest that robust estimation methods be used in the assessment (although this may be the choice of the modelers, but I believe that the Data Workshop is a place to make the recommendation because this is the place to deal with data quality issues);
- Uncertainty should be considered in all life history modeling, and confidence intervals should be estimated for the key life history parameters for the GOM YG and tilefish;
- Because of the extremely small YG catch in the SEAMAP bottom trawl survey, caution should be used in applying the derived abundance index, and the change in survey protocol in 1987 calls for a separate analysis of the two time periods and two different catchabilities in population modeling;
- Different measures for SSB should be considered for both tilefish and YG in stock assessment modeling; and
- I recommend conducting a systematic evaluation of current sampling programs for quantifying size composition and age composition of commercial catch. Factors such as adequate spatial and temporal coverage and sampling intensity to have high effective sample sizes should be considered. I recommend developing alternative sampling designs, developing a simulated fishery that mimics temporal and spatial variability in size and age compositions in commercial landings, applying current and alternative sampling programs to the simulated fishery, comparing the performance of the sampling programs with respect to their replications of built-in size and age compositions in the simulated fishery, and identifying a cost-effective port sampling program for quantifying size and age compositions of commercial landings.

Finally, I strongly concur with the recommendations made by the LHG in their draft DW report regarding life history work for the GOM YG and tilefish, and I think all the issues raised in the report are critical to improve the life history data quality. The draft reports of the other two groups (IG and LDG) were not available when I prepared this report so I cannot make any comments regarding the recommendations they will list in the DW reports.

3. ASSESSMENT WORKSHOP RESEARCH RECOMMENDATIONS

In addition to the recommendations made in the SEDAR 22 Data Workshop Report, the AP makes the following recommendations for research and data collection.

- In a fishery with multiple data deficiencies, one of the objects of modeling is to identify those data sets that, by their inadequacy or absence, have a disproportionate impact on the outcome of the assessment. This then provides an independent assessment of the prioritization of future research effort aimed at improving the assessment most effectively. More could probably be made of this in defining immediate future research focus.

- Analyze existing data, or collect and analyze new data to confirm that the tilefish is composed of only a single stock. This could focus on a genetics program aimed at a number of species in the region, as this appears to be a shared problem amongst a number of species.

- Review the information about distribution of tilefish age in time and geographical area with a view to obtain better quality data going forward (i.e. attempts to obtain a balance of samples from the different areas of (i) the fishery and (ii) the wider stock distribution should be developed and implemented).

- Evaluating whether the amount of remaining quota influences how landings are reported by species should be considered.

- While the recreational landings represent a small proportion of the landings it could be worth reviewing the biological data available as recreational fisheries often either target or catch different age or length components of the stock compared to other fisheries. If this is the case then this small part of the fishery may contain useful information about length or age. A basic analysis of length and possibly otolith weight (as a proxy for age) would advise whether this merits further consideration.

4. CIE REVIEW RECOMMENDATIONS – ASSESSMENT PROCESS

The research recommendations in the tilefish assessment report were all identifying appropriate areas for further investigation but a number of them were rather short on proposed investigative methodologies.

One proposal to look at stock structure should be part of a larger, probably genetics program to look at regional stock structure in a number of similar species.

The fishery dependent research recommendations were both good but it is probably worth defining how much observer coverage would be required to provide adequate data from which to construct alternative indices. The additional fishery information obtained from an expanded observer program (on such things as discards) would, however, also be welcome.

Additional research recommendations have been identified by the reviewer and are presented below in priority order.

Reviewer Recommendations

• In a fishery with multiple data deficiencies, one of the objects of modeling is to identify those data sets that, by their inadequacy or absence, have a disproportionate impact on the outcome of the assessment. This then provides an independent assessment of the prioritization of future research effort aimed at improving the assessment most effectively. More could probably be made of this in defining immediate future research focus.

• Analyze existing data, or collect and analyze new data to confirm that the tilefish is composed of only a single stock. This could focus on a genetics program aimed at a number of species in the region, as this appears to be a shared problem amongst a number of species.

• Review the information about distribution of tilefish age in time and geographical area with a view to obtain better quality data going forward (i.e. attempts to obtain a balance of samples from the different areas of (i) the fishery and (ii) the wider stock distribution should be developed and implemented).

• Evaluating whether the amount of remaining quota influences how landings are reported by species should be considered.

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• The core input data are in imperial units (lbs) while processes data (e.g. weight at length or age) are presented in metric units. More importantly the landings/catch data are in lbs and model outputs are in kgs making comparison somewhat difficult. Input and output data should be presented in consistent units.

5. REVIEW PANEL RESEARCH RECOMMENDATIONS

The review panel was in agreement with the research recommendations from the Data Workshop and Assessment Workshop reports. These identify the main shortcomings in the data and assessment which might be improved by research. However, the recommendations are extensive and some priority may be placed so that research having the greatest impact on the assessment might be given priority.

The RP noted that the AP suggested using the models to identify the most important data deficiencies to prioritize research and that more work on this could be undertaken. Based on the observations made during the review, the RP suggested priority might be determined for the following research topics:

1. Research to improve abundance indices and their development from fishery-dependent and fishery-independent data sources would appear to have relatively high priority as they would have a great impact on the assessment. Topics could include, but not be limited to:
   - Improve precision in fishery-independent survey abundance indices by increasing the number of samples, including expansion into deeper water.
   - Improve precision in fishery-independent survey abundance indices by expanding observer coverage to at least 5% coverage to provide additional accurate information adequate to construct indices of abundance. Observer data should provide finer spatial resolution, a more accurate measure of CPUE, size frequency and discard information that is currently unavailable in the self-reported dataset. Current observer coverage is inadequate for this purpose.
   - Improve fishery-independent survey abundance indices by using logbooks to collect data on a set-by-set basis rather than per trip. This would allow for a much more accurate calculation of CPUE.
   - Re-examination of the standardisation of CPUE indices, both the models and the covariates (habitat, sediment, depth etc.).
2. Research to improve stock definition and structure. For the stock assessment, the biggest impact of this sort of research is on the way data are broken down into areas to try to improve coherence within sub-sets of data. This suggests that priority for this sort of research should depend upon demonstrating that the data can support alternative stock structures and that there would be greater coherence within these subsets of data. There were no apparent cohorts identifiable in the age composition data from the two areas used in this assessment, but insufficient data to support break down into three areas. Improving the basic data through, for example, re-examination of the sampling design for size and age composition from the commercial fishery, might have higher priority.
3. Research on life history is high priority, but should first and foremost be reflected in data collection before assessment model structure. While model structure might be seen as improved in representing real biological processes, such as protogynous hermaphroditism, unless there are sufficient monitoring and other data, the model will effectively be unable to incorporate the process in the assessment.

In addition to research identified in the DW and AW, the RP recommends further work on the stock assessment modelling. The RP found results depended on how different sources of information were weighted, and alternative weighting schemes could be considered in developing future stock assessments. The age and length composition likelihood models appear appropriate, so research may be more focused on the abundance index standardisation and ensuring their likelihood model and scale parameters are compatible with the age and length composition likelihood.

The RP also suggested some additional methods which would improve the absolute stock size estimate. These methods would help determine the shape of the selection curve, the value of M, and therefore would improve the MSY estimation. Even though M has been reasonable well estimated, the assessment is still very uncertain, because F and M are low, so further improvements in the estimate of M would be beneficial. Absolute stock estimates might be obtained from 1) underwater video surveys to count fish burrows; 2) deep water tagging, as done for redfish in the Irminger Sea; or 3) depletion fishing experiments within a small area (e.g. 1 x 1 km) combined with NMFS survey type long line fishing to estimate survey catchability, like that done in the REX project for cod and other species in the north-eastern North Sea. This last method may be particularly suitable for tilefish, which is a sedentary species.

SEDAR
Southeast Data, Assessment, and Review

SEDAR 22

Gulf of Mexico Tilefish

SECTION V: Review Workshop Report

April 2011

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

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1. INTRODUCTION

1.1 WORKSHOP TIME AND PLACE

The SEDAR 22 Review Workshop was held February 14-17, 2011 in Tampa, Florida.

1.2 TERMS OF REFERENCE

1. Evaluate the adequacy, appropriateness, and application of data used in the assessment.
2. Evaluate the adequacy, appropriateness, and application of methods used to assess the stock.
3. Recommend appropriate estimates of stock abundance, biomass, and exploitation.
4. Evaluate the methods used to estimate population benchmarks and management parameters (*e.g., MSY, OFL***,** *Fmsy, Bmsy, MSST, MFMT, or their proxies*); recommend appropriate management benchmarks and provide estimated values for management benchmarks, a range of ABC, and declarations of stock status.
5. Evaluate the adequacy, appropriateness, and application of the methods used to project future population status; recommend appropriate estimates of future stock condition (e.g., exploitation, abundance, biomass).
6. Evaluate the adequacy, appropriateness, and application of methods used to characterize uncertainty in estimated parameters. Provide measures of uncertainty for estimated parameters. Ensure that the implications of uncertainty in technical conclusions are clearly stated.
7. Ensure that stock assessment results are clearly and accurately presented in the Stock Assessment Report and that reported results are consistent with Review Panel recommendations.
8. Evaluate the SEDAR Process as applied to the reviewed assessments and identify any Terms of Reference which were inadequately addressed by the Data or Assessment Workshops.

9. Consider the research recommendations provided by the Data and Assessment workshops and make any additional recommendations or prioritizations warranted. Clearly denote research and monitoring needs that could improve the reliability of future assessments. Recommend an appropriate interval for the next assessment, and whether a benchmark or update assessment is warranted.
10. Prepare a Peer Review Summary summarizing the Panel's evaluation of the stock assessment and addressing each Term of Reference. Develop a list of tasks to be completed following the workshop.

The review panel may request additional sensitivity analyses, evaluation of alternative assumptions, and correction of errors identified in the assessments provided by the assessment workshop panel; the review panel may not request a new assessment. Additional details regarding the latitude given the review panel to deviate from assessments provided by the assessment workshop panel are provided in the *SEDAR Guidelines* and the *SEDAR Review Panel Overview and Instructions*.

** The panel shall ensure that corrected estimates are provided by addenda to the assessment report in the event corrections are made in the assessment, alternative model configurations are recommended, or additional analyses are prepared as a result of review panel findings regarding the TORs above.**

1.3 LIST OF PARTICIPANTS

Workshop Panel
Doug Gregory, Chair ....GMFMC SSC
Henrik Sparholt..CIE Reviewer
Paul Medley ....CIE Reviewer
Robin Cook..CIE Reviewer
Stephen Szedlmayer..GMFMC SSC

Analytic Representation
Brian Linton..NMFS SEFSC Miami
Linda Lombardi ....NMFS SEFSC Panama City
John Walter ....NMFS SEFSC Miami

Council Representation
John Greene ....GMFMC

Official Observers
Martin Fisher..GMFMC AP

Other Observers
Michael Larkin.. SERO
Nick Framer .... SERO

Todd Gedamke...NMFS Miami

Staff

Carrie Simmons ....GMFMC Staff
Charlotte Schiaffo ....GMFMC Staff
John Froeschke...GMFMC Staff
Julie Neer .... SEDAR
Ryan Rindone.. SEDAR
Tyree Davis..NMFS Miami

2. REVIEW PANEL REPORT

SEDAR 22 Benchmark Review Consensus Report

Gulf of Mexico golden tilefish (*Lopholatilus chamaeleonticeps*)

1. Summary

Based on the $SPR_{30\%}$ benchmark, it was concluded that overfishing is not occurring, and the stock was not overfished in 2009. All terms of reference were addressed by the Data Workshop (DW) and Assessment Workshop (AW). Three AW ToRs awaited decisions from the Review Panel (RP), but have now been completed. The stock assessment presented by the Assessment Workshop (AW) was accepted after minor modifications made during the review meeting. The Review Panel (RP) thanked all the members of the DW and AW for their diligence in preparing their reports and willingness to respond to questions from the RP.

2. Terms of Reference

2.1 Evaluate the adequacy, appropriateness, and application of data used in the assessment.

Input data comprised catches, length and age compositions, abundance indices and life history data based mainly on proposals from the Data Workshop.

Landings data were available for the years 1965 onwards and were split into two areas (Eastern and Western Gulf). Golden tilefish have only been identified to species since 1992 so earlier landings were derived by apportioning aggregate landings by using a ratio estimator based on the period 1992-1996. This is a pragmatic decision, which while reasonable, results in uncertainty in the precision of the catch estimate. Discards and recreational catches are small and have been added to the total landings.

Length composition data are available for more recent years and were stratified into two commercial gears and the NMFS BLL survey. They were further stratified by gender that resulted in small sample sizes in some strata.

Age compositions are also available for the more recent years and are similarly stratified for gear and region. Age determination has been validated but aging error is nevertheless large. A particular problem seems to occur for males in the 10-15 year old range. There is little evidence of visible cohorts in the age compositions.

One commercial and one fishery independent survey were available which had been standardized using a delta-lognormal model. These are partitioned into two assessment areas. The commercial CPUE is a longer and continuous series since 1992 while the NMFS Bottom Longline (BLL) CPUE series begins in 2000 and was interrupted in 2005 due to a hurricane event. The Coefficients of Variation (CVs) on the survey estimates are large in relation to the apparent signal in the point estimates.

Overall the data summarized above were considered by the Review Panel to be adequate for the purpose of assessment, but noted that the quantity of data was low and there are concerns over some aspects of its quality, as noted above.

Life history data were provided by the DW and were considered adequate for the assessment as they are based on a thorough review of existing information pertaining to this or related species. There is some biological evidence that tilefish transition from female to male with age. The RP questioned whether this effect was sufficiently large or adequately modeled to justify inclusion in the assessment model. However, results are not sensitive to this part of the model.

2.2 Evaluate the adequacy, appropriateness, and application of methods used to assess the stock.

Stock Synthesis 3.2 (SS3) was used as the principal assessment method. It is an age-structured population assessment tool and is a well established approach. It includes a population simulation model to calculate the abundance and mortality of a harvested population, an observation model to relate this population model to observable data from the population, and a statistical model to adjust parameters of the population model and observation model to achieve the best fit to all the data. Data are presented to the model in its most natural form and hence a wide variety of data can be included. SS3 can tolerate missing values. It is well designed to deal with the data available for the tilefish assessment, but does require the analyst to make a number of choices in the configuration of the model.

The RP supported the choices made by the AW and assessment analysts and considered them adequate for characterizing the fishery and stock given the limitations of the data available. The central run of the model assumed two geographical areas (eastern and western gulf) that allowed for differences in growth and, hence, natural mortality. Asymptotic selectivity was assumed for all gears and mirrored in each area. Recruitment was assumed to follow a Beverton-Holt relationship applicable to the combined area but with year classes partitioned to the two areas. It did not prove possible to estimate a satisfactory standard deviation for recruitment variability (Sigma) and this was set to 0.15.

Exploratory analysis was also performed using Stock Reduction Analysis (SRA). While a much simpler approach, SRA is based on a similar age structured population model that uses an historical catch stream to estimate a stock biomass trajectory. In the implementation used by the AW, SRA uses the CPUE data series with prior estimates of MSY and U_{MSY} (exploitation rate at MSY) to construct the biomass trajectory over time. Extensions of the model allow a full Monte-Carlo Markov-Chain (MCMC) analysis to estimate the probability distribution of quantities of interest. The principal limitation of the method is that it does not use data on age and length within the model, although these data can be used externally to define the age-dependent vulnerabilities of the stock. The RP felt that SRA was a useful additional analysis and assisted in interpreting the behavior of the SS3 runs, particularly in understanding the influence of the age and length data on the assessment. SRA estimates a positive development of stock biomass in recent years reflecting the CPUE series more closely, which contrasts with the SS3 central run where the influence of the age and length data is to result in a more-or-less flat recent stock trajectory.

Both SRA and SS3 treat the total catches as exact values, so that errors or biases in these values will be translated directly into the estimated quantities including the annual fishing mortality/exploitation rate estimates. Given the limited quantity and quality of data available, treating the catches as exact is probably necessary in SS3 (it is unavoidable for SRA) in order to obtain a satisfactory fit, but it is not a requirement of the model. It does mean, however, that the stock trajectory, especially for the earlier years when catches are much less certain should be treated with caution.

2.3 Recommend appropriate estimates of stock abundance, biomass, and exploitation.

It proved difficult to choose a single realization that stood out as being ‘best’. For pragmatic reasons the SS3 central run is suggested as the run to use for estimates of abundance, biomass and exploitation in order to visualize trends. It is very important to appreciate that the base run is only one of many equally plausible runs and it is suggested mainly because it makes use of the best expert knowledge in configuring the model. However, other runs with different model configurations or model parameters can give stock trajectories that suggest different trends and may be equally valid.

The way output is generated from SS3 can give the impression that the values in the whole time series of population estimates are all equally accurate. In practice the early year values are predicated on assumptions of historical constancy in the fishery and the stock. Hence it may be unwise to interpret the stock trajectory in the early years as representing what actually occurred.

Table 1, below, summarizes current (2009) and SPR30% benchmark SSB and fishing mortality estimates. The assessment did not provide independent MSY estimates based on a stock-recruit curve.

Table 1. Golden tilefish spawning stock biomass and fishing mortality rates for six likely scenarios depicting status of the stock relative to the SPR30% reference point. SSB is in whole 1000 lbs of gonad weight. Yield is lbs of gutted weight. Natural mortality = 0.13. MSST = (1-0.13)*$SSB_{SPR30\%}$

Run #	Name	SSB_{2009}	SSBmsy = $SSB_{SPR30\%}$	SSB_{2009}/ $SSB_{SPR30\%}$	$F_{2007-09}$	F_{MSY} = $F_{SPR30\%}$	$F_{2007-09}$/ $F_{SPR30\%}$	MSY = $Y_{SPR30\%}$	MSST
1	Central/Base	37.5	18.3	2.049	1	2.17	0.46	160,777	15.9
3	Mref = -.09	31.3	14.9	2.101	1	1.45	0.69	113,036	12.9
4	Mref = 0.19	41.9	19.7	2.127	1	2.96	0.34	200,947	17.1
9	SigmaR-0.3	45.7	13.8	3.312	1	2.15	0.47	102,661	12
13	Steepness=0.75	36.6	15.1	2.424	1	2.18	0.46	134,356	13.1
15	Equal weighting	97.5	31	3.145	1	6.8	0.15	294,955	27

2.4 Evaluate the methods used to estimate population benchmarks and management parameters (e.g., MSY, OFL, Fmsy, Bmsy, MSST, MFMT, or their proxies); recommend appropriate management benchmarks and provide estimated values for management benchmarks, a range of ABC, and declarations of stock status.

The MSY benchmarks were not calculated using a Beverton-Holt recruitment curve estimated from within the model. The Beverton-Holt curve has a number computationally convenient attributes that make it the curve of choice for many assessments. Unfortunately most stock-recruitment curves cannot be estimated with any precision and this assessment is no exception. Consequently there is a question mark about the reliability of the MSY values not least because the estimated recruitment curve has few values to define the asymptote and steepness proved problematic to estimate.

Fourteen different runs were presented to the review workshop. A fifteenth run was requested by the RP representing a more balanced weighting between the main sources of information (length and age compositions and abundance indices). These different runs were presented to the review workshop scoping possible interpretations of the stock development. The RP identified six of these sensitivities were identified from these runs representing the range of likely scenarios which apply to this stock. These runs were chosen as follows:

Run	Name	Description	Used	Justification
1	**Central**	**The "base case" developed by the AW from which the sensitivities are developed.**	**Yes**	**The central run is used as the most likely scenario for comparison with the other runs.**
2	Mref=0.03	The very low natural mortality set at the extreme end of the possible range identified by the Data Workshop.	No	The natural mortality was considered too low to represent a realistic value. This run was changed for the final analysis to M=0.05 due to the poor fit.
3	**Mref=0.09**	**The lower natural mortality set closer to the most likely value.**	**Yes**	**The assessment is highly sensitive to natural mortality, so a realistic range was included in management advice.**
4	**Mref=0.19**	**The higher natural mortality set closer to the most likely value.**	**Yes**	
5	Mref=0.24	The very high natural mortality set at the extreme end of the possible range identified by the Data Workshop.	No	The natural mortality was considered too high to represent a realistic value.
6	Mref age=15	The model includes length-dependent natural mortality which requires a reference age to allow for the effect of changes in the estimated growth on mortality. Alternative reference ages change the effective natural mortality.	No	Because these were closely related to the natural mortality sensitivity runs, they were felt to be redundant and therefore not included in the management advice.
7	Mref age=25		No	
8	sigmaR=0.01	The model allows deviations from the stock recruitment curve, which are limited by the standard deviation (sigmaR), which could not be fitted. Two sensitivities varied these from the default 0.15.	No	The RP decided that the lower sigmaR was too restrictive to take account of information in the length/age composition and too low to realistically represent recruitment variation.
9	**sigmaR=0.3**		**Yes**	**The effect of an alternative higher SigmaR value was required allowing higher recruitment variation in the model.**
10	Dome-shaped selectivity	Alternative gear selectivities were considered to the default logistic selectivity, allowing domed rather than logistic, and alternative selectivities	No	The alternative selectivities were not used as they did not represent improvements in the model. The domed selectivity had a similar effect as higher natural mortality,

Run	Name	Description	Used	Justification
11	Region-specific selectivity	among the regions.	No	reducing older fish in the compositions. The regional selectivities showed little improvement in fit.
12	CPUE λ=25	This run increased the relative weight on the commercial and survey indices and reduced the weight on the age and length compositions.	No	The shift in weight between the compositions and indices was unbalanced, so Run 15 was requested instead.
13	**Steepness= 0.75**	**The alternative steepness was lower than the fitted value and possibly more appropriate for a long-lived slow-growing species.**	**Yes**	**This is proposed as an alternative stock recruitment relationship and should produce different benchmarks.**
14	Alternate landings	An alternative landings time series was developed making different assumptions on the designation of undifferentiated tilefish between the tilefish species.	No	Alternative landings time series were not significantly different.
15	**Higher Weighting for CPUE data (λ=10)**	**As for Run 12, but a more balanced weighting was applied between the indices and compositions.**	**Yes**	**This balanced the high contribution to the likelihood of the age and length data which the RP felt could give more credence to the survey data.**

From the six runs identified as representing the range of uncertainty (see Table 1), the central run (Run 1), Low M (Run 3) and the SigmaR=0.3 (Run 9) were chosen to represent the uncertainty using MCMC stochastic simulations. The Low M seems to represent a plausible level of low productivity for the stock, and the SigmaR=0.3 allows greater variability in the stock recruitment relationship covering alternative recruitment scenarios in the stochastic projections.

The RP recommends that proxies ($SPR_{30\%}$ or $SPR_{40\%}$) are used as benchmarks. Proxies are more robust rather than relying on estimates of MSY where information is lacking. The RP does not believe that steepness can be reliably estimated for this stock, and therefore MSY benchmarks cannot be estimated reliably.

The RP noted that if species interactions are taken into account $SPR_{10\%}$ or $SPR_{20\%}$ may be better proxies for MSY than the $SRP_{30\%}$ and $SPR_{40\%}$ which are more widely accepted internationally as appropriate precautionary targets. This argument is based on accumulated experience from some data rich stocks and from multispecies and ecosystem research results from the recent decades especially in the North Atlantic area (see the individual CIE report of Henrik Sparholt).

Based on the central assessment (Run 1), the golden tilefish fishery is below the target fishing mortality. The stock is not overfished, and overfishing is not occurring based on $SPR_{30\%}$ reference points, and spawning biomass units are gonad weight in thousand pounds, and yield units are gutted pounds (see Table 1).

Acceptable Biological Catch and associated probabilities of overfishing were still worked on by the assessment analysts when the RP finalised this report: Therefore Table 2, below, was not completed.

Table 2. Estimates of ABC and P* for the six equally valid "states of nature" for the yellowedge grouper population in the Gulf of Mexico.

		ABC (probability of overfishing)						
Run	Name	*15%*	*20%*	*25%*	*30%*	*35%*	*40%*	*45%*
1	Central							
3	Mref=0.09							
4	Mref=0.19							
9	sigmaR=0.3							
13	steepness=0.75							
15	CPUE lambda=10							

2.5 Evaluate the adequacy, appropriateness, and application of the methods used to project future population status; recommend appropriate estimates of future stock condition (e.g., exploitation, abundance, biomass).

The methods applied for projecting population status were appropriate. All projections are carried out in SS3. Projections were made from 2010 to 2020 using a standard age-structured forward catch equation method applying a fixed fishing mortality.

Of the 15 sensitivity runs presented to the RP, 6 (Runs, 1, 3, 4, 9, 13, and 15) were selected as more appropriate for prediction due to their degree of realism to the actual stock population dynamic. The start year for catches affected by future management actions was 2011. Deterministic projections were carried out for all main six sensitivities.

The RP requested that stochastic projections (MCMC) should be carried out for the Central (Run 1), Low M (Run 3) and SigmaR=0.3 (Run 9) runs only. These were selected to cover the likely levels of stock productivity and alternative states of nature. The run giving more emphasis to the CPUE series (run 15) was also considered by the RP as a good alternative to the central run, but the RP was not confident enough in the final fit to propose this alternative for the MCMC projections. Although more sensitivity runs could legitimately be used to cover more uncertainty, there is a limit on the number of sensitivities which can be treated in this way. The RP believes that the selected runs are sufficient to cover uncertainty for use in the harvest control rule.

Uncertainty in initial stock abundance was modeled in the projection by using replicate MCMC fits as starting points where appropriate. Additional uncertainty was introduced in projections by stochastic selection of annual recruitment values from the fitted stock-recruitment relationship. The RP agreed with this standard approach. The RP also agreed that projections correctly modeled the time series of future F and biomass values required for evaluation of the various management options examined.

For tilefish, final year F estimates were used for the current fishing mortality projections. Fishing mortality showed little variation in the final three years, so using the geometric mean of the last three years would make little difference.

The RP endorsed with reservations the assessment analysts decision to use F relative to Fcurrent to determine stock status instead of a Gulf-wide estimate for F. This decision was taken by the assessment analysts after the review panel meeting. The RP believes that a more consideration should be given to the way the reference fishing mortality should be determined where more than one population spatial component is modelled.

The RP recommended that a harvest control rule, similar to the 40:10 harvest control rule used by the Pacific Fisheries Management Council, be developed for these fisheries, rather than rely on a constant fishing mortality. The rule would automatically reduce fishing mortality if the stock fell below the trigger level (biomass target proxy i.e. $B_{SPR30\%}$) in projections. This should increase safety for the stock between assessment periods.

Table 3. Golden tilefish stock status (ratio SSB/$SSB_{SPR30\%}$) and yield (thousands pounds gutted weigth) for $F_{SPR30\%}$.

Stock Status:

Run	Name	2009	2010	2011	2012	2013	2014	2015
1	Central	2.05	1.77	1.58	1.22	1.16	1.11	1.08
3	Mref=0.09	2.10	1.70	1.43	1.13	1.09	1.05	1.03
9	SigmaR=0.3	3.31	2.89	2.57	1.95	1.78	1.64	1.52

Yield at $F_{SPR30\%}$.

Run	Name	2009	2010	2011	2012	2013	2014	2015
1	Central	383.7	250	439.1	146.8	146.8	151.5	157.2
3	Mref=0.09	383.7	249.7	435	66.1	71	80.2	90.5
9	SigmaR=0.3	383.7	250	439.2	135.8	124.8	121.4	122

2.6 Evaluate the adequacy, appropriateness, and application of methods used to characterize uncertainty in estimated parameters. Provide measures of uncertainty for estimated parameters. Ensure that the implications of uncertainty in technical conclusions are clearly stated.

The use of the SRA model seems appropriate in order to understand the dynamics of the stock and as an indicator of model uncertainty. However, SS3 meets the requirements for management advice and makes better use of all the available data (i.e. includes the length and age data).

Uncertainty in the assessment was characterised in two ways. Major sources of uncertainty, particularly errors associated with model structure and fixed parameters, were assessed through sensitivity analyses. Within model errors (observation and process errors) were estimated using MCMC over the likelihood function.

The SS3 model was run with more than 15 different configurations. This gave a good overview of the uncertainties in the data, population dynamic parameters and the various values being estimated. The RP requested an additional run (Run 15) where the CPUE indices got a higher weight and the age and length data a lower weight in order to balance the importance of these input data or observations in the model.

In the Central model, a 'natural' weighting was applied between the different sources of information. This natural weight arises from standard likelihoods used for the data. Justification for the alternative weighting sensitivity runs rests on the potential incompatibility between the likelihoods used for the length and age composition data, and the abundance indices. The likelihoods for the compositions are based on the multinomial, whereas a lognormal is used the abundance indices, where the scale parameter for the lognormal are obtained from the observations through the standardisation. Standardisation is carried out using generalised linear models, which also have an assumed likelihood. It is possible that the scaling factor for this likelihood, represented by the standard errors on the (log) abundance indices, is not consistent with the effective variance used in the length and age likelihoods.

The RP recommended three sensitivity runs be taken forward for MCMC analysis which would characterise the broad range of uncertainty in estimated values. Further MCMC runs can be added to this analysis. The RP identified a further three candidate runs which would extend this range of uncertainty if required. The RP agreed that these gave the most appropriate representation of the stock dynamics and its uncertainties.

The diagnostics suggest the Central (Run 1) and Low M (Run 3) MCMC simulations converge. The majority of variables pass the diagnostic tests, and therefore the model output is probably adequate for characterizing the uncertainty for management advice, even if quantitative estimates of uncertainty (e.g. confidence intervals, variance) might still be improved. However, the assessment team was unable to get the MCMC simulations to converge for Run 9 (Sigma=0.3) after the review panel meeting, and therefore has suggested removing this alternative from the sensitivity. It is not clear to the RP why MCMC convergence was so slow in this case, but there clearly is a problem. Setting recruitment deviation penalties to a less restrictive value should allow greater variation in recruitment estimates, increasing the uncertainty being accounted for in the model. Rejecting this source of uncertainty may lead to worse management advice than accepting the MCMC runs despite their limitations. The RP urges the assessment team, if Run 9 is unsatisfactory, to try a lower Sigma (Sigma=0.25), to try to capture the RP intention.

It was unclear how a number of sensitivity model MCMC runs could be combined into a single assessment. There is no standard way to combine uncertainty over models. It can be assumed, however, that MCMC are random independent draws from separate underlying probability density functions which represent the uncertainty for each model (i.e. sensitivity run). These MCMC sets can be combined if each model is assumed equally likely and mutually exclusive. This should be assumed by default. If some sensitivity runs are considered more likely, a weight can be applied to each MCMC set in proportion to this probability. In this case, if the MCMC are to be combined to calculate the decision rule, the RP agreed that the three models proposed should be considered equally likely.

2.7 Ensure that stock assessment results are clearly and accurately presented in the Stock Assessment Report and that reported results are consistent with Review Panel recommendations.

The RP found that stock assessment results were clearly presented in the stock assessment report and that reported results are consistent with the RP recommendations. This includes the RP recommendations for the stochastic projections which should form the basis for the harvest control rules.

2.8 Evaluate the SEDAR Process as applied to the reviewed assessments and identify any Terms of Reference which were inadequately addressed by the Data or Assessment Workshops.

The SEDAR benchmark process was applied to golden tilefish and the process was adequately followed. The major difficulties in the process centered around two basic problems. First, this is a data-poor assessment and second, the model used was the relatively complex Stock Synthesis Model. This was the first application of the Stock Synthesis Model to a Gulf of Mexico population and the combination of data limitations and model complexity made model output interpretations difficult.

The Data Workshop addressed all the terms of reference appropriately. These species are limited to deep water. It was assumed the Gulf populations were independent of those found on the Atlantic east coast of the US or elsewhere in the Caribbean. The ageing validation and the efforts to reconstruct pre-trip ticket catch composition are commendable.

The abundance indices available were thoroughly evaluated through the modeling processes. The combined availability of fishery dependent and fishery independent indices was good. However, one point of concern is how to balance the relative influences of the CPUE indices and the age/length compositions when they apparently impart differing or contradicting signals. It would be useful for the DW ToR to include providing specific guidance on data quality to help the assessment and review workshops decide among conflicting information sources.

The Terms of Reference of the Assessment Workshop were generally adequately addressed, although some ToRs were delayed based on decisions from the review workshop. ToR 6 OFL yield streams and recommended ABCs were not produced (AW ToR 6), the probability of overfishing at various harvest levels was not estimated (AW ToR 8) and future stock conditions were not projected (AW ToR 9) for the main assessment. The reason given was the uncertainties associated with the model configuration (i.e. a determination of parameters which could not be estimated). Therefore the RP made a series of choices on how to complete these tasks for the AP, which are identified in this report. Also, past management actions were only partially evaluated (ToR 10) because this was the first benchmark assessment, so full management objectives have not been formulated.

A major element of the assessment relating to projections had not been undertaken at the time of the Review Workshop. This partly reflects the need to review the estimates of historical stock size and trends before conducting the projections. However, it became clear after the review workshop that the method used for projections had not been fully developed and tested. The assessment team encountered difficulties in running the MCMC analyses and the Review Panel were not well placed to subject the results to thorough review by correspondence. In future consideration should be given to ensuring that even if final projection runs cannot be anticipated before the Review workshop, the relevant methodology and software is fully tested with illustrative exploratory runs so that the Review Panel is better placed to review the final results.

2.9 Consider the research recommendations provided by the Data and Assessment workshops and make any additional recommendations or prioritizations warranted. Clearly denote research and monitoring needs that could improve the reliability of future assessments. Recommend an

appropriate interval for the next assessment, and whether a benchmark or update assessment is warranted.

The review panel was in agreement with the research recommendations from the Data Workshop and Assessment Workshop reports. These identify the main shortcomings in the data and assessment which might be improved by research. However, the recommendations are extensive and some priority may be placed so that research having the greatest impact on the assessment might be given priority.

The RP noted that the AP suggested using the models to identify the most important data deficiencies to prioritize research and that more work on this could be undertaken. Based on the observations made during the review, the RP suggested priority might be determined for the following research topics:

1. Research to improve abundance indices and their development from fishery-dependent and fishery-independent data sources would appear to have relatively high priority as they would have a great impact on the assessment. Topics could include, but not be limited to:
    - Improve precision in fishery-independent survey abundance indices by increasing the number of samples, including expansion into deeper water.
    - Improve precision in fishery-independent survey abundance indices by expanding observer coverage to at least 5% coverage to provide additional accurate information adequate to construct indices of abundance. Observer data should provide finer spatial resolution, a more accurate measure of CPUE, size frequency and discard information that is currently unavailable in the self-reported dataset. Current observer coverage is inadequate for this purpose.
    - Improve fishery-independent survey abundance indices by using logbooks to collect data on a set-by-set basis rather than per trip. This would allow for a much more accurate calculation of CPUE.
    - Re-examination of the standardisation of CPUE indices, both the models and the covariates (habitat, sediment, depth etc.).
2. Research to improve stock definition and structure. For the stock assessment, the biggest impact of this sort of research is on the way data are broken down into areas to try to improve coherence within sub-sets of data. This suggests that priority for this sort of research should depend upon demonstrating that the data can support alternative stock structures and that there would be greater coherence within these subsets of data. There were no apparent cohorts identifiable in the age composition data from the two areas used in this assessment, but insufficient data to support break down into three areas. Improving the basic data through, for example, re-examination of the sampling design for size and age composition from the commercial fishery, might have higher priority.
3. Research on life history is high priority, but should first and foremost be reflected in data collection before assessment model structure. While model structure might be seen as improved in representing real biological processes, such as protogynous hermaphroditism, unless there are sufficient monitoring and other data, the model will effectively be unable to incorporate the process in the assessment.

In addition to research identified in the DW and AW, the RP recommends further work on the stock assessment modelling. The RP found results depended on how different sources of information were weighted, and alternative weighting schemes could be considered in developing future stock assessments. The age and length composition likelihood models appear appropriate, so research may be more focused on the abundance index standardisation and ensuring their likelihood model and scale parameters are compatible with the age and length composition likelihood.

The RP also suggested some additional methods which would improve the absolute stock size estimate. These methods would help determine the shape of the selection curve, the value of M, and therefore would improve the MSY estimation. Even though M has been reasonable well estimated, the assessment is still very uncertain, because F and M are low, so further improvements in the estimate of M would be beneficial. Absolute stock estimates might be obtained from 1) underwater video surveys to count fish burrows; 2) deep water tagging, as done for redfish in the Irminger Sea; or 3) depletion fishing experiments within a small area (e.g. 1 x 1 km) combined with NMFS survey type long line fishing to estimate survey catchability, like that done in the REX project for cod and other species in the north-eastern North Sea. This last method may be particularly suitable for tilefish, which is a sedentary species.

The next assessment should be conducted within 2 years. Given the problems with the assessment and methods for this stock which were not available for full review, the next assessment should be a benchmark assessment.

2.10 Prepare a Peer Review Summary summarizing the Panel's evaluation of the stock assessment and addressing each Term of Reference. Develop a list of tasks to be completed following the workshop.

This report is the peer review summary.

The following tasks were required on completion of the review panel workshop, the results of which are reflected in this report. These tasks complete the assessment panel's terms of reference:

1. Conduct deterministic projections of biomass, stock status and estimate benchmarks and management parameters for 6 runs identified in this report.
2. Conduct MCMC analyses for three runs identified in this report. These can be used for probabilistic projections and benchmarks, and the ABC based on the overfishing probability harvest control rule (P*).

SEDAR

Southeast Data, Assessment, and Review

SEDAR 22

Gulf of Mexico Tilefish

Section VI: Addenda and Post-Review Updates

May 2011

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SEDAR 22 Tilefish Addendum

1. Executive Summary

The Stock Synthesis (SS) assessment model for Gulf of Mexico tilefish has failed to capture the dynamics of the stock, due to several issues with the input data. The commercial longline index and NMFS bottom longline index in the eastern Gulf both indicated that abundance was increasing, but SS failed to fit either index and instead predicted a declining trend in the eastern stock's abundance (Figure 3.11 in the SEDAR 22 Assessment Report). This failure to fit the indices was due to strong signals from the age composition and catch data, which drove model fit. In particular, catches in the eastern Gulf were increasing at the same time that the indices indicated an increase in abundance (Figure 2.1 in the SEDAR 22 Assessment Report).

There were also two issues involving the age composition data, which influenced model results. First, there were no discernable year classes moving through the age compositions (Figure 3), and, thus, no recruitment signal to inform the model. Second, there was a lack of age 17-21 year old fish in the age composition data, perhaps owing to difficulty estimating the ages of older male fish (SEDAR22-DW-01). As a result, the proportions of age 10-15 year old fish were relatively high in the age composition data. With no strong recruitment signal to inform the model, SS estimated a large wave of recruitment events in the 1990s to fit the observed proportions of age 10-15 year old fish in the 2000s (Figure 3.64 in the SEDAR 22 Assessment Report).

Due to the issues described above, assessment results were highly sensitive to the value specified for the standard deviation parameter associated with recruitment (sigma-R). In most assessments conducted using SS, sigma-R is fixed at a value around 0.6, and assessment results are relatively insensitive to changes in sigma-R. In the tilefish assessment, the assessment team was forced to fix sigma-R at relatively low values (i.e., 0.01-0.3). If sigma-R was set much above 0.3, the resulting current population biomass would be several orders of magnitude greater than virgin population biomass, despite the existence of a fishery that had been exploiting the stock for several decades. This instability in the estimation of recruitment and the stock-recruit function meant that the productivity of the stock was poorly estimated.

Based on the problems described above, the assessment panel (AP) decided that the uncertainties in the assessment results were too great to justify running projections. The AP recommended that the assessment results be used in conjunction with historical catch data and expert judgment to provide management advice. The review panel (RP) felt that there would be value in running projections, and selected three SS runs for providing management advice.

In the process of running the projections, the assessment team discovered some additional problems tied to the F allocation pattern used during the projection period. As in most SEDAR assessments, the projected Fs were allocated between the fisheries according to the allocation pattern from the most recent years of the assessment. In this case, the projected Fs were allocated according to the 2007-2009 average allocation. Due to a recent shift in fishing effort from the western to the eastern Gulf (Figure 5), approximately 92% of the projected F was allocated to the eastern Gulf. This resulted in the eastern stock being driven to low levels in all of the projection runs, and to the collapse of the eastern stock in some runs (Figures 11-13). Despite this situation in the eastern Gulf, the Gulfwide stock is not projected to be overfished. The western stock, which only experiences about 8% of the projected F, remains relatively untouched, and is able to maintain the status of the Gulfwide stock.

In all of the RP selected model runs, current spawning stock biomass was greater than the reference point spawning stock biomass, which means the stock must be fished down to maximize yield (Tables 13-15). Yet, the projected OFL yields were substantially lower than the current yield. This counter-intuitive result was caused by the F allocation pattern. Since the eastern stock declined to such low levels, it produced low yields, even though it received the majority of the projected F. The western Gulf also produced low yields, even though it had more fish, because it only received a small portion of the projected F.

2. Assessment Report Errata

After the review workshop, it was discovered that the spawning stock biomass units were mislabeled throughout the SEDAR 22 Gulf of Mexico tilefish assessment report. The spawning stock biomass units should be female gonad weight in thousand pounds, rather than female gonad weight in pounds.

3. Post-Review Workshop Changes

The stock assessment team found it necessary to make several changes to the Gulf of Mexico tilefish assessment to better respond to the requests of the review panel (RP). The primary change was to rerun the assessment using SS version 3.21beta, which was the latest version of SS at the time of this writing. This new version of SS included new options, which directly addressed some of the concerns and suggestions made by the RP. All of the SS results presented in this addendum come from version 3.21beta, and may differ slightly (i.e., generally less than 2% difference) from SS results presented in the SEDAR 22 Gulf of Mexico Tilefish Assessment Report, due to improvements made to the software. There were difficulties producing good convergence of Run 2 when using SSv3.21beta. As a result, the assessment team ended up increasing the reference M from 0.03 to 0.05 for this low M scenario. In addition to using SPR 30% and SPR 40% as reference points, the RP also requested that SPR 20% be used as a reference point, because there was some concern on the part of the RP that using SPR 30% and SPR 40% would fail to maximize the yield of the stock. Tables 1 and 2 replace assessment report Tables 3.8 and 3.9, respectively, with the updated results from SSv3.21beta.

The second change was to abandon exploitation rate as the proxy for the Gulfwide fishing mortality rate. For reasons that are described in Section 7, the assessment team determined that the Gulfwide exploitation rate did not reliably represent the total F for a multi-area, multi-fishery assessment model. After evaluating several alternatives, the assessment team decided to use F relative to Fcurrent to determine stock status, as was done in the SEDAR 7 Gulf of Mexico red snapper assessment and in the 2009 Gulf of Mexico red snapper assessment update. Exploitation rates are still used to represent region-specific (i.e., eastern and western Gulf) fishing mortality rates.

4. Additional Model Runs

The RP requested one additional model run for the Gulf of Mexico tilefish assessment.

Run 15: The fit to the indices was improved by emphasizing the index data and de-emphasizing the length and age composition data. The RP wished to see an intermediate run between Runs 1 and 12, where the adjustments to the likelihood components were not as great as in Run 12.

As expected, the Run 15 fits to the indices were not as poor as in Run 1, and were not as good as in Run 12 (Figure 1). In Run 1, predicted CPUEs in the eastern Gulf showed declining trends, were fairly stable in Run 15, and were increasing in Run 12. These differences in CPUE trends were reflected in predicted total biomass trends for the three runs. Predicted total biomass in the eastern Gulf from Run 15 showed a continuous decline over time, but the rate of decline was not as great as in Run 1 (Figure 2). This decline differed from the increasing trend in biomass predicted in Run 12 for the east in recent years. Runs 12 and 15 both showed an increasing trend in total biomass for recent years in the western Gulf, while Run 1 showed a biomass to be relatively stable for recent years in the western Gulf (Figure 2).

5. Additional Model Results

The RP requested that the stock assessment team provide them with additional output from the Stock Synthesis (SS) assessment model to better evaluate the Gulf of Mexico tilefish assessment. These model outputs included observed age composition data, temporal and spatial distributions of commercial longline effort, residual trends, co-occurring species caught with tilefish, and negative log likelihood component values for the different sensitivity runs. In addition, the RP requested several plots comparing results of the different sensitivity runs.

5.1. Observed Age Composition

The RP wished to see the observed age composition data used in the tilefish assessment to determine whether the data provided any signal of age classes moving through the population. In particular, the RP wanted to see if the large 1998 age class predicted by SS was visible in the observed age composition data. Review of the age composition data showed no clear year classes moving through the population (Figure 3).

As stated in the assessment report, SS appears to be estimating high levels of recruitment in the 1990s to account for the relatively high proportions of 10-15 year old fish that appear in the age composition data in the 2000s. Further investigation revealed that these apparently high proportions of 10-15 year olds actually is due to a lack of 17-21 year old fish in the age composition data. In the early stages of the assessment, a simple virtual population analysis was run on the tilefish data to obtain a vulnerability pattern for the stochastic SRA model (Figure 4). The resulting vulnerability pattern shows a drop in the vulnerability of age 17-21 year old fish. The assessment team could find no explanation for the lack of 17-21 year old fish in the data, but the team did note that the lead-radium radiometric age validation analysis, reported in SEDAR22-DW-01, revealed good agreement for the majority of age groups, except for age 10-14 year old males.

5.2. Commercial Longline Effort Distribution

In the tilefish assessment report (Section 3.2.2.1), it was reported that there was a spatial shift in where otoliths were collected between the early 2000s and the mid to late 2000s. This shift, along with the difficulty estimating ages for older male fish described above, may account for the residual patterns seen in the age composition fits (Figures 3.50-3.52 in the assessment report). The RP looked at spatial and temporal distributions of commercial longline fishing effort (i.e., the primary source of otolith collections) from trips selected by Stephens and MacCall (2004), and determined that the spatial shifts in otolith collections may have been part of a larger spatial shift within the commercial longline fleet. In particular, there appeared to be a shift in effort from the western Gulf to the eastern Gulf in the late 2000s (Figure 5), due to several vessels shifting their effort from the western to the eastern Gulf.

5.3 Residual Trends

The RP wanted to look for potential patterns in residuals over time for the length and age composition data. Inspection of the mean Pearson's residuals over time for both length and age compositions did not reveal any obvious trends (Figures 6 and 7). The commercial longline east age composition is the one exception that demonstrates a pattern in residuals. In particular, there are positive residuals in the late 1990s and early 2000s, and negative residuals in the mid to late 2000s. This residual pattern likely reflects the model's difficulty in fitting the observed age composition data, due to the reasons described above (Section 5.1).

5.4. Co-occurring Species

The RP wanted to look at what species co-occur with tilefish in commercial catches. Examination of the catch composition of commercial longline fishery trips selected by Stephens and MacCall revealed that yellowedge grouper was the primary co-occurring species caught with tilefish (Figure 8). The regression coefficient plot from the Stephens and MacCall analysis was also examined (Figure 2 in SEDAR22-DW-03).

5.5. Likelihood Component Values

The RP requested that a table displaying negative log likelihood values from the different sensitivity runs be constructed, so that model fits could be compared (Table 3). Negative log likelihood values for Runs 12 and 15 are not comparable with the other runs, because they use different likelihood weighting factors. Of the runs considered for management advice by the AP, Run 9 (i.e., region-specific selectivity) has the lowest negative log likelihood value, but it also has more parameters then most of the other runs, which naturally would produce lower negative log likelihood values.

5.6. Comparison of SS Runs

The RP requested additional figures comparing results from the SS runs recommended by the AP for management advice (i.e., Runs 1, 3, 4, 6, 8, 9, 11, and 13), as well as the two runs (i.e., Runs 12 and 15) which emphasized the fit to the indices (Figure 9). The predicted trends and absolute values for spawning stock biomass and the region-specific Fs were similar for most of the runs.

The primary exceptions being Runs 12 and 15, which had higher spawning stock biomass and lower Fs than the other runs. This makes sense given that these two runs emphasize the fits to the indices, which show increasing abundance in the eastern Gulf, while catches in that region are increasing at the same time. Stock synthesis reconciles these two data sources by increasing the size and productivity of the stock, so that abundance can increase, while still supporting the observed catches.

The other exception being Run 8 (i.e., sigma R = 0.01), which differed slightly in spawning stock biomass, and F trends from the most of the other runs due to the fact that recruitment was constrained to follow the stock recruitment function in this run.

Predicted age-0 recruitment trends and absolute values were highly variable between the different SS runs. This variability in recruitment is due to the fact that recruitment is the primary means by which the model can account for changes to the data and model structure. The model is able to adjust recruitment with such freedom, because there is no strong recruitment signal in the data.

It should be noted that even though the majority of SS runs produce similar results, that this is no guarantee that those results accurately reflect the status of the true stock.

6. Projections

The RP disagreed with the AP's decision not to run projections for Gulf of Mexico tilefish due to the uncertainties in the assessment. Instead, the RP chose three runs for projections, which they felt represented realistic levels of between-model-uncertainty for the assessment: Run 1, which is the central run, Run 3, which represents a low M scenario (Mref = 0.09), and Run 9, which represents a high recruitment variability scenario (sigma R = 0.3). All of the RP selected runs indicate that the stock is neither overfished nor undergoing overfishing, except for Run 3 using the Fspr40% reference point, which indicates that the stock is not overfished but is undergoing overfishing (Table 2).

6.1. Projection Methods

Projections were run from 2010 to 2029 under seven fixed F scenarios: 1) Fcurrent, which was the 2007-2009 average F, 2) Fspr20%, 3) Foy at SPR 20%, which is 75% of Fspr20%, 4) Fspr30%, 5) Foy at SPR 30%, 6) Fspr40%, and 7) Foy at SPR 40%. The reported landings of 0.25 mp gw from the Quota Monitoring System were used for 2010 projected catch and the current quota of 0.44 mp gw was used for 2011 projected catch, and the fixed F scenarios were begun in 2012. The projected Fs were partitioned between the four fisheries according to the 2007-2009 average F allocation.

Preliminary projection runs showed unexpected trends in projected exploitation rate, which served as the proxy for Gulfwide F. In particular, exploitation rate declined over time to an asymptote (Figure 10), even though the projections were carried out using fixed area- and fishery-specific Fs. In addition to using exploitation rate based on biomass as a proxy for Gulfwide F, the assessment team also tried using exploitation rate based on numbers, and instantaneous F averaged over fully-selected ages. In each case, the same declining trend in the projected Gulfwide F proxy was produced. The assessment team determined that none of these approaches served as adequate proxies in the case of tilefish, because of the F allocation pattern used in the projections. As stated earlier (Section 5.2), several commercial longline vessels shifted their effort from the western to the eastern Gulf in recent years. That shift in effort means the approximately 91% of F has been allocated to the eastern commercial longline fishery, and approximately 92% of F has been allocated to the eastern Gulf in recent years. This extreme disparity in fishing intensity between the eastern and western Gulf leads to the unreliable behavior of the Gulfwide F proxies described above.

In the end, the assessment team decided to use a reference F relative to Fcurrent as a proxy for the Gulfwide F for the purpose of stock status determination. This relative F reference point can be calculated from the F multiplier that SS estimates to obtain the reference F (e.g., Fspr30%), and is constant across fisheries and areas, which eliminates the problems with the other Gulfwide F proxies described above. The CATCHEM model used in the SEDAR 7 Gulf of Mexico red snapper assessment and in the 2009 Gulf of Mexico red snapper assessment update estimates a similar F multiplier for reference point calculations, and both of those assessments used a similar relative F reference point for stock status determination.

6.2. Projection Results

Deterministic projection results for SS Runs 1, 3, and 9 are presented in Tables 4-6 and Figures 11-13. One important result to point out is that, while projected Gulfwide population and spawning biomass levels appear to be sustainable for the fixed F projection scenarios evaluated, projected population biomass and spawning biomass in the eastern Gulf are driven to low levels in all of the runs. In fact, the eastern stock actually collapses in all of the Run 3 projection scenarios.

In all of the projection runs evaluated, this severe decline or collapse of the eastern stock occurs between 2011 and 2012, when the projected catch is fixed at the current quota of 0.44 mp gw. Due to the F allocation pattern described in Section 6.1, the majority of that quota is landed in the eastern Gulf, heavily impacting the eastern stock. In fact, SS is not even able to catch the current quota of 0.44 mp gw in the Run 3 projections, because there are not enough fish in the eastern Gulf (Table 5 and Figure 12).

Despite these stark declines in the eastern Gulf, the Gulfwide stock is not overfished according to any of the SS runs (Table 2). The reason for this counter-intuitive result is that the western stock receives very little fishing effort (i.e., only about 8% of F is allocated to the west), allowing the western stock to support the Gulfwide stock status. Because SS uses a single stock-recruitment function and then distributes the recruits between the two areas, the western stock is able to supply recruits to the eastern stock, even when the east has no spawners of its own.

In reality, as catch rates dropped in the eastern Gulf, fishing effort probably would shift to other areas of the Gulf. Unfortunately, the timing and magnitude of that shift, not to mention the resulting impact on the stock, are difficult to predict with any certainty.

7. Uncertainty Estimates

Uncertainty in assessment parameter estimates and derived quantities for SS Runs 1, 3, and 9 was quantified using Markov chain Monte Carlo (MCMC) methods as implemented in SSv3.21beta.

7.1. MCMC Methods

For each of the three selected runs, MCMCs were run for 1,000,000 cycles, saving every 200th cycle. The first 1,000 of the saved cycles were dropped as part of a burn-in period, to remove the effect of the starting values, leaving a sample size of 4,000 cycles.

To evaluate convergence of the MCMC chains, trace plots, the cumulative means and effective sample sizes of the posterior values for all estimated parameters and derived quantities were visually inspected. Two diagnostics tests for convergence were performed with the *CODA* library for R. The first diagnostic tests the equality of the means of two subsets of the MCMC chain (Geweke 1992) taking into account autocorrelation in the estimate of the standard errors. We used the CODA default first 10% and the last 50% of the chain. A rejection of the null hypothesis indicates that the two means are different and hence the chain is unlikely to have converged on a stable estimate. A p-value less than 0.025 indicates rejection of the null hypothesis as this is a two-sided test.

The second diagnostic tests whether enough samples have been taken to estimate the mean with a certain level of precision (Heidelberger and Welch 1981, 1983). The test proceeds in two parts; the first part tests the null hypothesis that the sampled values come from a stationary distribution using the Cramer-von-Mises statistic. The test is applied to the whole chain, and, if the null hypothesis is rejected, then two subsets of the data are obtained by successively discarding the first 10%, 20% and up to 50% of the chain. If, at this point, the null hypothesis is still rejected, the chain is deemed to have failed the test and is likely to be non-stationary. For this test we use a p-value for rejection of the null hypothesis of 0.05. The second part examines whether the mean has been estimated to a certain level of precision. A 95% confidence interval for the mean, is calculated using the subset of the chain which passed the previous stationarity test. Half the width of this interval is then compared with the estimate of the mean. If the ratio of the half-width divided by the mean is lower than a chosen value of precision (here we used the default value of 0.1) the half-width test is passed. If the test fails then the chain length may not be sufficient to estimate the mean with the desired level of precision.

7.2. MCMC Diagnostics

Trace plots and diagnostic test results are presented for key parameters and derived quantities from the three assessment runs. These key quantities include the negative log likelihood value, which gives some measure of the overall mixing of the chain, virgin spawning biomass, 2009 spawning biomass, spawning biomass at SPR 30%, yield at SPR 30%, forecasted catches for 2010-2015, Fspr30% relative to Fcurrent, which is the 2007-2009 average F, the recruitment distribution parameter, which distributes recruits between the eastern and western Gulf, steepness, and virgin recruitment. Additional MCMC diagnostic outputs for the three runs are given in Appendix I.

Initial examination of the MCMC chains revealed that a small number of cycles within each chain (i.e., 1% to 10% of the cycles depending on the chain) converged on unrealistic solutions, which produced negative fishing mortality and catch values in the projection period. Theses unrealistic results were caused by the model's difficulty in estimating Fs for the projection period, given the unusual F allocation pattern. These aberrant cycles were dropped from the MCMC chains.

The MCMC chain for Run 1 appears to have reached good convergence (Table 7, Figure 14). Even though the chains for yield at SPR 30% and forecasted catches for 2010-2015 failed to pass Geweke's test, they did pass both stages of Heidelberger and Welch's test. In addition there were no obvious patterns in the trace plots, and the effective sample sizes were all relatively large (i.e., greater than 2,000).

The MCMC chain for Run 3 appears to have reached good convergence (Table 8, Figure 15). Even though the chain for yield at SPR 30% failed to pass Geweke's test, it did pass both stages of Heidelberger and Welch's test. In addition there were no obvious patterns in the trace plots, and the effective sample sizes were all relatively large (i.e., greater than 1,700).

The MCMC chain for Run 9 appears to have not reached good convergence. After the initial MCMC run, multiple parameters and derived quantities failed one or more of the two diagnostic tests. In addition, there were obvious patterns in the trace plots, and many quantities had effective sample sizes less than 1,000. The MCMC chain was extended an additional 1,000,000 cycles, for a total of 2,000,000 cycles saving every 200th cycle. The first 6,000 of the saved cycles were dropped as part of a burn-in period, resulting in a sample size of 4,000 cycles. Running the diagnostics on this new chain revealed that Run 9 had still not reached good convergence (Table 9; Figure 16). Even though only the objective function failed Geweke's test and virgin recruitment failed Heidelberger and Welch's test, there were obvious patterns in many of the trace plots, and effective sample sizes were less than 1,000 for many of the parameters and derived quantities. Additional attempts were made to increase the thinning interval, but none of these attempts showed good convergence.

The poor convergence of the Run 9 MCMC chain is not surprising given that this was a run which increased sigma R from 0.15 (i.e., the Run 1 value) to 0.3. Deterministic sensitivity runs and model explorations revealed that the assessment results were highly sensitive to the value of sigma R. In particular, the recruitment pattern, population biomass trends, and spawning biomass trends become increasingly unrealistic the higher the value of sigma R. In a stable well behaved model, the results should be relatively robust to different sigma R values.

Given these diagnostic results, only Runs 1 and 3 were used to generate uncertainty estimates for management advice.

7.3. MCMC Results

Marginal posterior distributions of key parameters and derived quantities from Run 1 are reported in Table 10 and Figure 17. The most unusual results were the bimodal posterior distributions for the projected catches from 2013 through 2015. It is not clear what is causing these bimodal distributions.

One possibility might be that the eastern stock collapses in some of the cycles of the MCMC chain. If that were the case, then the first mode would represent catches in cases where the eastern stock collapsed, and the second mode would represent cases where the eastern stock did not collapse. But, if that was the underlying cause of the bimodal distributions, then one would expect to see similar bimodal distributions for spawning biomass in the projection period, and that is not the case.

Marginal posterior distributions of key parameters and derived quantities from Run 3 are reported in Table 11 and Figure 18. Note that the posterior distribution of projected catches in 2011 lies below the current quota of 0.44 mp gw. Due to the F allocation pattern, the model attempts to remove most of the quota from the eastern stock, with the result that there is not enough vulnerable biomass in the eastern Gulf to meet the quota.

Probabilities of overfishing and of the stock being overfished are presented in Table 12 for Runs 1 and 3 at three different reference points: 1) SPR 20%, 2) SPR 30%, and 3) SPR 40%. The probabilities were calculated using the marginal posterior distributions from the MCMC runs. In particular, the probability of overfishing was calculated as the proportion of MCMC cycles in which Fcurrent was greater than MFMT. The probability of the stock being overfished was calculated as the proportion of MCMC cycles in which SSBcurrent was less than MSST. The probability of the stock being overfished was 0.0 for all runs at all three reference points. For the SPR 30% reference point, Run 3 gave a 0.02 probability of overfishing. For the SPR 40% reference point, Run 1 gave a 0.46 probability of overfishing, and Run 3 gave a 1.0 probability of overfishing.

The SFA and MSRA evaluations for the SPR 20%, SPR 30%, and SPR 40% reference points are reported in Tables 13, 14, and 15, respectively. The values reported in the tables are the means of the marginal posterior distributions generated by the MCMC runs. For the SPR 20%, 30%, and 40% reference points, SSBcurrent is above SSB at the SPR reference point for both Runs 1 and 3, meaning that the stock must be fished down to maximize yield. Yet, the projected OFL yields are substantially lower than the current yield (Tables 13 and 14). This counter-intuitive result is caused by the F allocation pattern. Since the eastern stock declines to such low levels, it produces low yields, even though it receives around 92% of the projected F. The western Gulf also produces low yields, even though it has more fish, because it only receives about 8% of the projected F.

Probabilities of exceeding OFL for Runs 1 and 3 at SPR 20%, SPR 30%, and SPR 40% reference points are reported in Tables 16, 17, and 18, respectively. The probabilities were calculated from the marginal posterior distributions of the projected yields at the Fspr reference points. These probabilities are similar, but not identical, to those generated by a p-star approach (Shertzer et al. 2008). In the p-star approach, the catch associated with a given p-star in a given year is based on the assumption that fishing at that p-star occurred in the previous years. In the approach presented here, the catch associated with a given probability of exceeding OFL is based on the assumption that fishing at the Fspr reference point occurred in the previous years. For short term projections, the differences in catches produced by these two approaches should be slight.

8. References

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9. Tables

Table 1. Summary of SS results from sensitivity runs for Gulf of Mexico tilefish. Results include virgin recruitment (thousand fish; R0), steepness, virgin total biomass (gutted lbs; B0), 2009 total biomass (gutted lbs; Bcurrent), virgin spawning biomass (gonad wt thousand lbs; SSB0), 2009 spawning biomass (gonad wt thousand lbs; SSBcurrent), and 2009 SPR (SPRcurrent). Highlighted runs were recommended by the AP for management advice.

				B0		Bcurrent		SSB0		SSBcurrent		
Run	Description	R0	Steepness	East	West	East	West	East	West	East	West	SPRcurrent
1	Central	240	0.93	3,915,273	2,811,032	801,292	1,359,601	38.2	25.3	15.2	22.3	0.37
2	Mref=0.05	17	0.92	3,727,584	2,525,612	505,132	975,323	24.6	13.9	10.8	16.2	0.11
3	Mref=0.09	87	0.94	3,909,092	2,727,237	625,711	1,134,017	31.2	20.2	12.4	18.9	0.31
4	Mref=0.19	582	0.92	3,842,284	2,820,441	971,747	1,544,864	41.8	27.4	17.7	24.1	0.42
5	Mref=0.24	1,412	0.89	3,778,606	2,854,239	1,195,994	1,765,533	43.5	28.0	20.7	25.6	0.47
6	Mref age=15	377	0.94	3,840,296	2,721,843	807,494	1,155,169	37.0	25.3	14.1	19.5	0.36
7	Mref age=25	622	0.93	3,777,011	2,590,629	812,230	977,067	35.3	10.8	13.4	7.4	0.25
8	sigmaR=0.01	311	0.94	4,549,102	3,262,015	831,113	1,109,725	41.1	27.3	11.7	14.9	0.37
9	sigmaR=0.3	166	0.84	3,075,803	2,220,252	828,753	1,638,881	31.9	19.9	17.6	28.1	0.37
10	Dome-shaped sel.	430	0.91	13,079,280	9,859,763	6,719,356	5,930,475	116.5	50.3	74.4	45.9	0.44
11	Region-specific sel.	239	0.93	3,902,891	2,701,706	816,443	1,293,348	38.0	21.6	15.2	20.7	0.36
12	CPUE lambda = 25	362	0.88	6,433,503	2,504,491	4,277,028	1,648,343	81.0	46.7	73.8	38.9	0.66
13	steepness=0.75	244	0.75	3,956,393	2,843,806	786,155	1,342,643	38.3	25.5	14.8	21.8	0.37
14	alternate landings	250	0.94	4,404,817	2,793,356	829,796	1,250,153	43.4	24.8	16.0	20.4	0.34
15	CPUE lambda = 10	439	0.86	6,288,333	4,611,520	3,252,941	3,394,568	65.5	49.9	47.8	49.7	0.64

Table 2. Reference points and benchmarks from sensitivity runs for Gulf of Mexico tilefish from SS. Benchmarks are reported for three reference points: 1) SPR 20%, 2) SPR 30%, and 3) SPR 40%. *Fcurrent* refers to 2007-2009 average. *SSBcurrent* refers to 2009 value. *Ref* refers to the reference point (i.e., SPR 20%, SPR 30%, or SPR 40%). *MSST* is (1-M)**SSBref* with M = 0.13. *Fratio* is *Fcurrent* / Fref. *SSBratio* is *SSBcurrent* / *MSST*. F values are relative to *Fcurrent*. Spawning biomass units are gonad weight in thousand pounds, and yield units are gutted pounds. Highlighted runs were recommended by the AP for management advice.

				SPR20%						SPR30%					
Run	Description	Fcurrent	SSBcurrent	Yref	Fref	SSBref	MSST	Fratio	SSBratio	Yref	Fref	SSBref	MSST	Fratio	SSBratio
1	Central	1.00	37.5	158,202	4.57	11.8	10.3	0.22	3.65	160,777	2.17	18.3	15.9	0.46	2.36
2	Mref=0.05	1.00	27.1	68,829	1.90	7.2	6.3	0.53	4.32	72,816	0.86	11.1	9.7	1.17	2.80
3	Mref=0.09	1.00	31.3	108,871	3.05	9.6	8.4	0.33	3.73	113,036	1.45	14.9	12.9	0.69	2.42
4	Mref=0.19	1.00	41.9	199,672	6.36	12.6	10.9	0.16	3.83	200,947	2.96	19.7	17.1	0.34	2.45
5	Mref=0.24	1.00	46.3	240,753	9.22	12.5	10.9	0.11	4.26	242,225	4.16	19.9	17.3	0.24	2.68
6	Mref age=15	1.00	33.5	168,822	3.88	11.6	10.1	0.26	3.32	171,663	1.91	18.0	15.6	0.52	2.15
7	Mref age=25	1.00	20.8	170,101	1.88	8.5	7.4	0.53	2.80	166,218	0.95	13.2	11.5	1.06	1.81
8	sigmaR=0.01	1.00	26.6	203,865	3.84	12.8	11.2	0.26	2.38	209,518	1.90	19.8	17.2	0.53	1.55
9	sigmaR=0.3	1.00	45.7	95,951	4.71	8.3	7.2	0.21	6.31	102,661	2.15	13.8	12.0	0.47	3.82
10	Dome-shaped sel.	1.00	120.3	247,061	4.59	29.6	25.8	0.22	4.67	242,379	2.33	46.8	40.7	0.43	2.96
11	Region-specific sel.	1.00	36.0	155,820	4.99	11.0	9.6	0.20	3.75	159,362	2.14	17.1	14.9	0.47	2.42
12	CPUE lambda = 25	1.00	112.7	245,656	5.91	21.5	18.7	0.17	6.02	265,332	3.68	34.8	30.3	0.27	3.72
13	steepness=0.75	1.00	36.6	110,156	4.61	8.1	7.1	0.22	5.20	134,356	2.18	15.1	13.1	0.46	2.80
14	alternate landings	1.00	36.4	165,602	3.85	12.7	11.1	0.26	3.29	167,905	1.79	19.7	17.1	0.56	2.13
15	CPUE lambda = 10	1.00	97.5	275,977	12.96	19.0	16.5	0.08	5.90	294,955	6.80	31.0	27.0	0.15	3.61

				SPR40%					
Run	Description	Fcurrent	SSBcurrent	Yref	Fref	SSBref	MSST	Fratio	SSBratio
1	Central	1.00	37.5	153,333	1.08	24.7	21.5	0.92	1.74
2	Mref=0.05	1.00	27.1	72,977	0.43	15.0	13.1	2.35	2.07
3	Mref=0.09	1.00	31.3	110,507	0.72	20.1	17.5	1.38	1.79
4	Mref=0.19	1.00	41.9	188,539	1.47	26.7	23.3	0.68	1.80
5	Mref=0.24	1.00	46.3	225,141	2.05	27.3	23.7	0.49	1.95
6	Mref age=15	1.00	33.5	164,493	1.01	24.3	21.1	0.99	1.59
7	Mref age=25	1.00	20.8	157,222	0.56	17.9	15.6	1.80	1.33
8	sigmaR=0.01	1.00	26.6	203,054	1.02	26.7	23.2	0.98	1.15
9	sigmaR=0.3	1.00	45.7	99,735	1.03	19.2	16.7	0.97	2.74
10	Dome-shaped sel.	1.00	120.3	224,864	1.42	63.9	55.6	0.71	2.16
11	Region-specific sel.	1.00	36.0	152,170	1.01	23.2	20.2	0.99	1.78
12	CPUE lambda = 25	1.00	112.7	266,055	2.48	48.1	41.8	0.40	2.70
13	steepness=0.75	1.00	36.6	138,270	1.09	22.0	19.1	0.92	1.91
14	alternate landings	1.00	36.4	161,478	0.91	26.6	23.1	1.10	1.57
15	CPUE lambda = 10	1.00	97.5	290,802	3.86	43.1	37.5	0.26	2.60

Table 3. Negative log likelihood component values for Gulf of Mexico tilefish SS runs. *Value* is *λ**negative log likelihood value and *λ* is the weighting factor.

	Run 1		Run 2		Run 3		Run 4		Run 5		Run 6		Run 7		Run 8	
Component	Value	λ	Value	λ	Value	λ	Value	λ	Value	λ	Value	λ	Value	λ	Value	λ
TOTAL	7576.49	1	8615.92	1	7970.18	1	7374.92	1	7273.43	1	7461.90	1	7410.35	1	8162.17	1
Catch	3.06E-06	1	3.17E-04	1	8.80E-06	1	3.02E-06	1	3.03E-06	1	3.05E-06	1	3.10E-06	1	2.99E-06	1
Survey	1.51	1	22.16	1	9.66	1	-2.24	1	-5.04	1	1.36	1	2.46	1	16.52	1
Length_comp	2399.07	1	2669.66	1	2499.73	1	2363.69	1	2351.40	1	2404.50	1	2412.01	1	2564.76	1
Age_comp	4967.49	1	5200.01	1	5072.97	1	4880.27	1	4812.43	1	4863.95	1	4801.89	1	5610.73	1
Recruitment	172.85	1	588.79	1	331.73	1	102.23	1	65.89	1	153.02	1	154.08	1	-66.32	1
Parm_priors	35.57	1	135.30	1	56.08	1	30.98	1	48.75	1	39.07	1	39.91	1	36.48	1
Parm_softbounds	2.04E-04	1	2.71E-04	1	2.37E-04	1	1.59E-04	1	1.45E-04	1	1.71E-04	1	1.67E-04	1	2.02E-04	1

	Run 9		Run 10		Run 11		Run 12		Run 13		Run 14		Run 15	
Component	Value	λ	Value	λ	Value	λ	Value	λ	Value	λ	Value	λ	Value	λ
TOTAL	7341.71	1	7322.73	1	7506.24	1	34.68	1	7589.29	1	7516.52	1	738.45	1
Catch	3.21beta-06	1	3.11E-06	1	3.09E-06	1	3.27E-06	1	3.08E-06	1	2.74E-06	1	3.14E-06	1
Survey	-0.87	1	-10.13	1	1.37	1	-596.43	25	2.31	1	0.35	1	-125.35	10
Length_comp	2314.01	1	2263.52	1	2335.85	1	136.40	0.05	2397.70	1	2389.04	1	243.14	0.1
Age_comp	4842.40	1	4947.55	1	4952.69	1	318.18	0.05	4976.28	1	4936.95	1	560.65	0.1
Recruitment	152.03	1	83.30	1	175.22	1	143.03	1	183.21	1	154.68	1	29.61	1
Parm_priors	34.13	1	38.46	1	41.12	1	33.50	1	29.79	1	35.51	1	30.41	1
Parm_softbounds	2.20E-04	1	2.70E-02	1	4.01E-04	1	5.50E-04	1	2.04E-04	1	2.03E-04	1	2.47E-04	1

Table 4. Deterministic projection results for Gulf of Mexico tilefish SS Run 1. Fixed F projection scenarios include Fcurrent, Fspr20%, Foy at SPR 20%, Fspr30%, Foy at SPR 30%, Fspr40%, and Foy at SPR 40%. Population biomass is reported as million pounds gutted weight. Spawning biomass is reported as female gonad weight in thousand pounds. Yield is reported as thousand pounds gutted weight.

Year	Fcurrent	Fspr20%	Foy spr20%	Fspr30%	Foy spr30%	Fspr40%	Foy spr40%
	Gulfwide Biomass						
2009	2.16	2.16	2.16	2.16	2.16	2.16	2.16
2010	1.92	1.92	1.92	1.92	1.92	1.92	1.92
2011	1.80	1.80	1.80	1.80	1.80	1.80	1.80
2012	1.51	1.51	1.51	1.51	1.51	1.51	1.51
2013	1.55	1.37	1.42	1.49	1.52	1.55	1.57
2014	1.61	1.26	1.36	1.48	1.53	1.60	1.63
2015	1.66	1.18	1.30	1.47	1.55	1.64	1.70
	Gulfwide Spawning Biomass						
2009	37.5	37.5	37.5	37.5	37.5	37.5	37.5
2010	32.3	32.3	32.3	32.3	32.3	32.3	32.3
2011	28.9	28.9	28.9	28.9	28.9	28.9	28.9
2012	22.1	22.1	22.1	22.1	22.1	22.1	22.1
2013	21.9	19.3	20.0	21.0	21.4	21.9	22.1
2014	22.0	17.3	18.6	20.2	21.0	21.9	22.3
2015	22.2	15.8	17.5	19.7	20.8	22.0	22.7
	Gulfwide Yield						
2009	383.7	383.7	383.7	383.7	383.7	383.7	383.7
2010	249.7	249.7	249.7	249.7	249.7	249.7	249.7
2011	440.0	440.0	440.0	440.0	440.0	440.0	440.0
2012	66.8	264.5	206.7	137.4	105.5	72.2	54.9
2013	75.5	235.9	195.8	141.1	112.9	80.9	63.1
2014	86.6	222.7	193.2	148.4	123.0	92.2	73.7
2015	98.4	213.5	191.9	155.5	133.2	103.9	85.3

Year	Fcurrent	Fspr20%	Foy spr20%	Fspr30%	Foy spr30%	Fspr40%	Foy spr40%
	Eastern Gulf Biomass						
2009	0.80	0.80	0.80	0.80	0.80	0.80	0.80
2010	0.56	0.56	0.56	0.56	0.56	0.56	0.56
2011	0.42	0.42	0.42	0.42	0.42	0.42	0.42
2012	0.13	0.13	0.13	0.13	0.13	0.13	0.13
2013	0.17	0.12	0.13	0.15	0.16	0.16	0.17
2014	0.21	0.13	0.15	0.17	0.18	0.20	0.21
2015	0.24	0.14	0.16	0.19	0.21	0.24	0.26
	Eastern Gulf Spawning Biomass						
2009	15.2	15.2	15.2	15.2	15.2	15.2	15.2
2010	10.6	10.6	10.6	10.6	10.6	10.6	10.6
2011	7.6	7.6	7.6	7.6	7.6	7.6	7.6
2012	1.5	1.5	1.5	1.5	1.5	1.5	1.5
2013	1.9	1.3	1.4	1.6	1.8	1.9	2.0
2014	2.5	1.3	1.6	1.9	2.2	2.4	2.6
2015	3.1	1.4	1.7	2.2	2.6	3.0	3.3
	Eastern Gulf Yield						
2009	325.6	325.6	325.6	325.6	325.6	325.6	325.6
2010	215.4	215.4	215.4	215.4	215.4	215.4	215.4
2011	379.6	379.6	379.6	379.6	379.6	379.6	379.6
2012	21.2	68.0	56.5	40.4	32.1	22.8	17.6
2013	29.7	60.7	56.7	47.4	40.7	31.4	25.4
2014	40.5	65.0	63.4	57.5	51.8	42.4	35.6
2015	51.9	69.6	69.8	66.9	62.6	53.9	46.5

Year	Fcurrent	Fspr20%	Foy spr20%	Fspr30%	Foy spr30%	Fspr40%	Foy spr40%
	Western Gulf Biomass						
2009	1.36	1.36	1.36	1.36	1.36	1.36	1.36
2010	1.36	1.36	1.36	1.36	1.36	1.36	1.36
2011	1.38	1.38	1.38	1.38	1.38	1.38	1.38
2012	1.38	1.38	1.38	1.38	1.38	1.38	1.38
2013	1.39	1.24	1.29	1.34	1.36	1.38	1.40
2014	1.40	1.13	1.21	1.31	1.35	1.39	1.42
2015	1.42	1.04	1.15	1.28	1.34	1.41	1.44
	Western Gulf Spawning Biomass						
2009	22.3	22.3	22.3	22.3	22.3	22.3	22.3
2010	21.7	21.7	21.7	21.7	21.7	21.7	21.7
2011	21.3	21.3	21.3	21.3	21.3	21.3	21.3
2012	20.6	20.6	20.6	20.6	20.6	20.6	20.6
2013	20.0	18.0	18.6	19.3	19.6	20.0	20.1
2014	19.5	16.0	17.0	18.3	18.9	19.4	19.7
2015	19.2	14.4	15.8	17.4	18.2	19.0	19.5
	Western Gulf Yield						
2009	58.1	58.1	58.1	58.1	58.1	58.1	58.1
2010	34.3	34.3	34.3	34.3	34.3	34.3	34.3
2011	60.4	60.4	60.4	60.4	60.4	60.4	60.4
2012	45.7	196.4	150.2	97.0	73.4	49.5	37.3
2013	45.8	175.2	139.1	93.6	72.2	49.5	37.7
2014	46.2	157.8	129.7	90.9	71.2	49.7	38.1
2015	46.6	143.8	122.1	88.6	70.6	50.1	38.7

Table 5. Deterministic projection results for Gulf of Mexico tilefish SS Run 3. Fixed F projection scenarios include Fcurrent, Fspr20%, Foy at SPR 20%, Fspr30%, Foy at SPR 30%, Fspr40%, and Foy at SPR 40%. Population biomass is reported as million pounds gutted weight. Spawning biomass is reported as female gonad weight in thousand pounds. Yield is reported as thousand pounds gutted weight.

Year	Fcurrent	Fspr20%	Foy spr20%	Fspr30%	Foy spr30%	Fspr40%	Foy spr40%
	Gulfwide Biomass						
2009	1.76	1.76	1.76	1.76	1.76	1.79	1.76
2010	1.49	1.49	1.49	1.49	1.49	1.52	1.49
2011	1.33	1.33	1.33	1.33	1.33	1.36	1.33
2012	1.12	1.12	1.12	1.12	1.12	1.14	1.12
2013	1.13	1.04	1.07	1.11	1.12	1.16	1.15
2014	1.13	0.98	1.03	1.10	1.13	1.18	1.17
2015	1.15	0.93	1.01	1.10	1.14	1.21	1.21
	Gulfwide Spawning Biomass						
2009	31.3	31.3	31.3	31.3	31.3	31.7	31.3
2010	25.3	25.3	25.3	25.3	25.3	25.8	25.3
2011	21.3	21.3	21.3	21.3	21.3	21.8	21.3
2012	16.8	16.8	16.8	16.8	16.8	17.1	16.8
2013	16.1	15.0	15.4	15.9	16.1	16.6	16.4
2014	15.6	13.5	14.2	15.1	15.5	16.2	16.1
2015	15.1	12.3	13.3	14.5	15.0	15.8	15.8
	Gulfwide Yield						
2009	383.7	383.7	383.7	383.7	383.7	383.7	383.7
2010	249.7	249.7	249.7	249.7	249.7	249.7	249.7
2011	314.9	314.9	314.9	314.9	314.9	332.8	314.9
2012	44.4	130.0	99.0	63.6	48.1	33.3	24.3
2013	44.3	119.7	93.9	62.4	47.8	33.6	24.7
2014	44.5	111.3	89.8	61.5	47.8	34.0	25.2
2015	45.9	107.3	88.8	62.5	49.2	35.4	26.4

Year	Fcurrent	Fspr20%	Foy spr20%	Fspr30%	Foy spr30%	Fspr40%	Foy spr40%
	Eastern Gulf Biomass						
2009	0.63	0.63	0.63	0.63	0.63	0.64	0.63
2010	0.36	0.36	0.36	0.36	0.36	0.37	0.36
2011	0.19	0.19	0.19	0.19	0.19	0.21	0.19
2012	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2013	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2014	0.01	0.01	0.01	0.01	0.01	0.01	0.01
2015	0.02	0.02	0.02	0.02	0.02	0.02	0.02
	Eastern Gulf Spawning Biomass						
2009	12.4	12.4	12.4	12.4	12.4	12.5	12.4
2010	7.1	7.1	7.1	7.1	7.1	7.4	7.1
2011	3.6	3.6	3.6	3.6	3.6	3.8	3.6
2012	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2013	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2014	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2015	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Eastern Gulf Yield						
2009	325.6	325.6	325.6	325.6	325.6	325.6	325.6
2010	215.4	215.4	215.4	215.4	215.4	215.4	215.4
2011	254.5	254.5	254.5	254.5	254.5	272.4	254.5
2012	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2013	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2014	0.1	0.2	0.2	0.1	0.1	0.1	0.0
2015	1.3	3.6	2.8	1.8	1.4	0.9	0.7

Year	Fcurrent	Fspr20%	Foy spr20%	Fspr30%	Foy spr30%	Fspr40%	Foy spr40%
	Western Gulf Biomass						
2009	1.13	1.13	1.13	1.13	1.13	1.15	1.13
2010	1.12	1.12	1.12	1.12	1.12	1.14	1.12
2011	1.14	1.14	1.14	1.14	1.14	1.15	1.14
2012	1.12	1.12	1.12	1.12	1.12	1.14	1.12
2013	1.12	1.04	1.07	1.10	1.12	1.15	1.14
2014	1.13	0.97	1.02	1.09	1.12	1.17	1.17
2015	1.13	0.91	0.99	1.08	1.12	1.19	1.19
	Western Gulf Spawning Biomass						
2009	18.9	18.9	18.9	18.9	18.9	19.2	18.9
2010	18.2	18.2	18.2	18.2	18.2	18.5	18.2
2011	17.7	17.7	17.7	17.7	17.7	18.0	17.7
2012	16.8	16.8	16.8	16.8	16.8	17.1	16.8
2013	16.1	15.0	15.4	15.9	16.1	16.6	16.4
2014	15.6	13.5	14.2	15.1	15.5	16.2	16.1
2015	15.1	12.3	13.3	14.5	15.0	15.8	15.8
	Western Gulf Yield						
2009	58.1	58.1	58.1	58.1	58.1	58.1	58.1
2010	34.3	34.3	34.3	34.3	34.3	34.3	34.3
2011	60.4	60.4	60.4	60.4	60.4	60.4	60.4
2012	44.4	130.0	99.0	63.6	48.1	33.3	24.3
2013	44.3	119.7	93.9	62.4	47.8	33.6	24.7
2014	44.4	111.0	89.6	61.4	47.7	34.0	25.2
2015	44.6	103.8	86.0	60.7	47.8	34.5	25.7

Table 6. Deterministic projection results for Gulf of Mexico tilefish SS Run 9. Fixed F projection scenarios include Fcurrent, Fspr20%, Foy at SPR 20%, Fspr30%, Foy at SPR 30%, Fspr40%, and Foy at SPR 40%. Population biomass is reported as million pounds gutted weight. Spawning biomass is reported as female gonad weight in thousand pounds. Yield is reported as thousand pounds gutted weight.

Year	Fcurrent	Fspr20%	Foy spr20%	Fspr30%	Foy spr30%	Fspr40%	Foy spr40%
	Gulfwide Biomass						
2009	2.47	2.47	2.47	2.47	2.47	2.47	2.47
2010	2.21	2.21	2.21	2.21	2.21	2.21	2.21
2011	2.05	2.05	2.05	2.05	2.05	2.05	2.05
2012	1.69	1.69	1.69	1.69	1.69	1.69	1.69
2013	1.69	1.51	1.56	1.63	1.66	1.69	1.71
2014	1.70	1.37	1.46	1.58	1.63	1.70	1.72
2015	1.71	1.25	1.37	1.54	1.61	1.70	1.75
	Gulfwide Spawning Biomass						
2009	45.7	45.7	45.7	45.7	45.7	45.7	45.7
2010	39.9	39.9	39.9	39.9	39.9	39.9	39.9
2011	35.6	35.6	35.6	35.6	35.6	35.6	35.6
2012	26.5	26.5	26.5	26.5	26.5	26.5	26.5
2013	25.3	22.4	23.2	24.3	24.8	25.3	25.5
2014	24.2	19.4	20.7	22.5	23.2	24.2	24.6
2015	23.3	17.0	18.7	20.9	21.9	23.2	23.8
	Gulfwide Yield						
2009	383.7	383.7	383.7	383.7	383.7	383.7	383.7
2010	249.7	249.7	249.7	249.7	249.7	249.7	249.7
2011	440.0	440.0	440.0	440.0	440.0	440.0	440.0
2012	62.1	253.1	197.5	126.7	97.2	63.7	48.4
2013	64.0	211.9	173.6	119.9	95.4	65.4	50.8
2014	67.9	193.4	163.6	118.8	97.2	69.3	54.9
2015	73.2	181.9	158.8	120.6	101.1	74.6	60.4

Year	Fcurrent	Fspr20%	Foy spr20%	Fspr30%	Foy spr30%	Fspr40%	Foy spr40%
	Eastern Gulf Biomass						
2009	0.83	0.83	0.83	0.83	0.83	0.83	0.83
2010	0.58	0.58	0.58	0.58	0.58	0.58	0.58
2011	0.42	0.42	0.42	0.42	0.42	0.42	0.42
2012	0.09	0.09	0.09	0.09	0.09	0.09	0.09
2013	0.11	0.08	0.08	0.10	0.10	0.11	0.11
2014	0.13	0.08	0.09	0.11	0.12	0.13	0.14
2015	0.16	0.09	0.10	0.12	0.13	0.15	0.17
	Eastern Gulf Spawning Biomass						
2009	17.6	17.6	17.6	17.6	17.6	17.6	17.6
2010	12.6	12.6	12.6	12.6	12.6	12.6	12.6
2011	9.0	9.0	9.0	9.0	9.0	9.0	9.0
2012	1.4	1.4	1.4	1.4	1.4	1.4	1.4
2013	1.5	0.8	1.0	1.2	1.3	1.5	1.6
2014	1.7	0.8	0.9	1.2	1.4	1.7	1.8
2015	2.0	0.8	1.0	1.4	1.6	2.0	2.2
	Eastern Gulf Yield						
2009	325.6	325.6	325.6	325.6	325.6	325.6	325.6
2010	215.4	215.4	215.4	215.4	215.4	215.4	215.4
2011	379.6	379.6	379.6	379.6	379.6	379.6	379.6
2012	17.9	55.2	46.7	33.2	26.6	18.3	14.2
2013	20.4	36.3	35.2	30.7	27.0	20.8	17.0
2014	25.0	37.0	36.4	33.8	31.0	25.3	21.4
2015	30.9	41.5	41.2	39.2	36.8	31.3	27.0

Year	Fcurrent	Fspr20%	Foy spr20%	Fspr30%	Foy spr30%	Fspr40%	Foy spr40%
	Western Gulf Biomass						
2009	1.64	1.64	1.64	1.64	1.64	1.64	1.64
2010	1.63	1.63	1.63	1.63	1.63	1.63	1.63
2011	1.63	1.63	1.63	1.63	1.63	1.63	1.63
2012	1.60	1.60	1.60	1.60	1.60	1.60	1.60
2013	1.58	1.43	1.48	1.53	1.56	1.58	1.59
2014	1.57	1.29	1.37	1.47	1.52	1.56	1.59
2015	1.55	1.17	1.28	1.42	1.48	1.55	1.58
	Western Gulf Spawning Biomass						
2009	28.1	28.1	28.1	28.1	28.1	28.1	28.1
2010	27.3	27.3	27.3	27.3	27.3	27.3	27.3
2011	26.5	26.5	26.5	26.5	26.5	26.5	26.5
2012	25.1	25.1	25.1	25.1	25.1	25.1	25.1
2013	23.8	21.6	22.3	23.1	23.4	23.8	24.0
2014	22.5	18.6	19.8	21.2	21.8	22.5	22.8
2015	21.3	16.2	17.6	19.5	20.3	21.2	21.6
	Western Gulf Yield						
2009	58.1	58.1	58.1	58.1	58.1	58.1	58.1
2010	34.3	34.3	34.3	34.3	34.3	34.3	34.3
2011	60.4	60.4	60.4	60.4	60.4	60.4	60.4
2012	44.3	197.9	150.8	93.5	70.6	45.4	34.2
2013	43.6	175.6	138.3	89.1	68.4	44.7	33.9
2014	42.9	156.4	127.2	85.1	66.2	44.0	33.6
2015	42.3	140.3	117.5	81.4	64.3	43.3	33.3

Table 7. MCMC diagnostics for key parameters and derived quantities from Gulf of Mexico tilefish SS Run 1. Key quantities include the negative log likelihood value (Objective_function), virgin spawning biomass (SPB_Virgin), 2009 spawning biomass (SPB_2009), spawning biomass at SPR 30% (SSB_SPRtgt), yield at SPR 30% (TotYield_SPRtgt), forecasted catches for 2010-2015 (ForeCatch_20XX), Fspr30% relative to Fcurrent (relative_Fref), the recruitment distribution parameter (RecrDist_Area_1), steepness (SR_steep), and virgin recruitment (SR_R0). Diagnostics include actual sample size (SS), effective sample size (EffSS), Geweke's test (GWE_conv), Heidelberger and Welch's test stages I (HeidelStat) and II (HeidelWidth), the MLE value, and the cumulative mean of the MCMC chain in the last cycle (cumMean). Spawning biomass (SPB and SSB) is female gonad weight in pounds. Catch/Yield is in thousand pounds gutted weight.

	SS	EffSS	GWE_conv	HeidelStat	HeidelWidth	MLE	cumMean
Objective_function	3,958	2,119	pass	pass	pass	7,576.5	7,555.3
SPB_Virgin	3,958	2,614	pass	pass	pass	63,464	63,099
SPB_2009	3,958	2,271	pass	pass	pass	37,439	35,932
SSB_SPRtgt	3,958	2,317	pass	pass	pass	18,239	17,986
TotYield_SPRtgt	3,958	2,469	fail	pass	pass	160.6	156.9
ForeCatch_2010	3,958	3,958	pass	pass	pass	249.4	249.4
ForeCatch_2011	3,958	3,958	pass	pass	pass	439.6	445.7
ForeCatch_2012	3,958	2,350	fail	pass	pass	137.3	115.7
ForeCatch_2013	3,958	2,349	fail	pass	pass	140.9	116.5
ForeCatch_2014	3,958	2,428	fail	pass	pass	148.2	121.1
ForeCatch_2015	3,958	2,503	fail	pass	pass	155.4	127.4
relative_Fref	3,958	2,630	pass	pass	pass	2.17	2.07
RecrDist_Area_1	3,958	2,818	pass	pass	pass	1.14	1.14
SR_steep	3,958	2,609	pass	pass	pass	0.93	0.92
SR_R0	3,958	2,421	pass	pass	pass	5.48	5.47

Table 8. MCMC diagnostics for key parameters and derived quantities from Gulf of Mexico tilefish SS Run 3. Key quantities include the negative log likelihood value (Objective_function), virgin spawning biomass (SPB_Virgin), 2009 spawning biomass (SPB_2009), spawning biomass at SPR 30% (SSB_SPRtgt), yield at SPR 30% (TotYield_SPRtgt), forecasted catches for 2010-2015 (ForeCatch_20XX), Fspr30% relative to Fcurrent (relative_Fref), the recruitment distribution parameter (RecrDist_Area_1), steepness (SR_steep), and virgin recruitment (SR_R0). Diagnostics include actual sample size (SS), effective sample size (EffSS), Geweke's test (GWE_conv), Heidelberger and Welch's test stages I (HeidelStat) and II (HeidelWidth), the MLE value, and the cumulative mean of the MCMC chain in the last cycle (cumMean). Spawning biomass (SPB and SSB) is female gonad weight in pounds. Catch/Yield is in thousand pounds gutted weight.

	SS	EffSS	GWE_conv	HeidelStat	HeidelWidth	MLE	cumMean
Objective_function	3,660	1,742	pass	pass	pass	7,970.2	7,954.5
SPB_Virgin	3,660	2,595	pass	pass	pass	51,391	50,951
SPB_2009	3,660	1,973	pass	pass	pass	31,252	28,688
SSB_SPRtgt	3,660	2,608	pass	pass	pass	14,855	14,621
TotYield_SPRtgt	3,660	2,553	fail	pass	pass	112.9	108.9
ForeCatch_2010	3,660	3,392	pass	pass	pass	249.4	247.4
ForeCatch_2011	3,660	1,835	pass	pass	pass	314.6	202.0
ForeCatch_2012	3,660	2,246	pass	pass	pass	63.6	57.7
ForeCatch_2013	3,660	2,357	pass	pass	pass	62.3	57.2
ForeCatch_2014	3,660	2,682	pass	pass	pass	61.5	57.4
ForeCatch_2015	3,660	3,088	pass	pass	pass	62.5	59.7
relative_Fref	3,660	2,226	pass	pass	pass	1.45	1.30
RecrDist_Area_1	3,660	2,783	pass	pass	pass	1.14	1.13
SR_steep	3,660	2,525	pass	pass	pass	0.94	0.93
SR_R0	3,660	2,673	pass	pass	pass	4.47	4.45

Table 9. MCMC diagnostics for key parameters and derived quantities from Gulf of Mexico tilefish SS Run 9. Key quantities include the negative log likelihood value (Objective_function), virgin spawning biomass (SPB_Virgin), 2009 spawning biomass (SPB_2009), spawning biomass at SPR 30% (SSB_SPRtgt), yield at SPR 30% (TotYield_SPRtgt), forecasted catches for 2010-2015 (ForeCatch_20XX), Fspr30% relative to Fcurrent (relative_Fref), the recruitment distribution parameter (RecrDist_Area_1), steepness (SR_steep), and virgin recruitment (SR_R0). Diagnostics include actual sample size (SS), effective sample size (EffSS), Geweke's test (GWE_conv), Heidelberger and Welch's test stages I (HeidelStat) and II (HeidelWidth), the MLE value, and the cumulative mean of the MCMC chain in the last cycle (cumMean). Spawning biomass (SPB and SSB) is female gonad weight in pounds. Catch/Yield is in thousand pounds gutted weight.

	SS	EffSS	GWE_conv	HeidelStat	HeidelWidth	MLE	cumMean
Objective_function	3,989	623	fail	pass	pass	7,341.7	7,333.2
SPB_Virgin	3,989	204	pass	pass	pass	51,751	50,142
SPB_2009	3,989	1,100	pass	pass	pass	45,675	45,688
SSB_SPRtgt	3,989	137	pass	pass	pass	13,751	12,694
TotYield_SPRtgt	3,989	104	pass	pass	pass	102.6	89.0
ForeCatch_2010	3,989	3,586	pass	pass	pass	249.4	249.5
ForeCatch_2011	3,989	1,406	pass	pass	pass	439.6	417.0
ForeCatch_2012	3,989	1,254	pass	pass	pass	126.6	114.5
ForeCatch_2013	3,989	1,142	pass	pass	pass	119.8	104.5
ForeCatch_2014	3,989	1,119	pass	pass	pass	118.7	99.8
ForeCatch_2015	3,989	1,148	pass	pass	pass	120.5	98.2
relative_Fref	3,989	725	pass	pass	pass	2.15	2.01
RecrDist_Area_1	3,989	790	pass	pass	pass	1.10	1.08
SR_steep	3,989	357	pass	pass	pass	0.84	0.81
SR_R0	3,989	91	pass	fail	fail	5.12	5.04

Table 10. Summary of marginal posterior distributions for key parameters and derived quantities from Gulf of Mexico tilefish SS Run 1. Key quantities include the negative log likelihood value (Objective_function), virgin spawning biomass (SPB_Virgin), 2009 spawning biomass (SPB_2009), spawning biomass at SPR 30% (SSB_SPRtgt), yield at SPR 30% (TotYield_SPRtgt), forecasted catches for 2010-2015 (ForeCatch_20XX), Fspr30% relative to Fcurrent (relative_Fref), the recruitment distribution parameter (RecrDist_Area_1), steepness (SR_steep), and virgin recruitment (SR_R0). Summary statistics include the mean, 10th percentile (Lower10th), and 90th percentile (Upper90th) from the posterior distribution, as well as the MLE value and associated standard deviation (StdDev). Spawning biomass (SPB and SSB) is female gonad weight in pounds. Catch/Yield is in thousand pounds gutted weight.

	Lower10th	Mean	Upper90th	MLE	StdDev
Objective_function	7,547.8	7,555.4	7,563.5	7,576.5	<NA>
SPB_Virgin	60,332	63,099	66,010	63,464	2,160
SPB_2009	32,786	35,932	39,246	37,439	2,293
SSB_SPRtgt	17,043	17,986	18,930	18,239	693
TotYield_SPRtgt	150.5	156.9	163.1	160.6	4.93
ForeCatch_2010	249.5	249.5	249.5	249.5	0.00
ForeCatch_2011	426.7	445.7	486.0	439.6	0.04
ForeCatch_2012	81.0	115.7	166.3	137.3	46.36
ForeCatch_2013	79.6	116.5	160.8	140.9	30.78
ForeCatch_2014	78.6	121.1	161.8	148.2	21.37
ForeCatch_2015	79.2	127.4	165.5	155.4	15.71
relative_Fref	1.76	2.07	2.38	2.17	<NA>
RecrDist_Area_1	1.10	1.14	1.17	1.14	0.03
SR_steep	0.89	0.92	0.95	0.93	0.02
SR_R0	5.44	5.47	5.50	5.48	0.02

Table 11. Summary of marginal posterior distributions for key parameters and derived quantities from Gulf of Mexico tilefish SS Run 3. Key quantities include the negative log likelihood value (Objective_function), virgin spawning biomass (SPB_Virgin), 2009 spawning biomass (SPB_2009), spawning biomass at SPR 30% (SSB_SPRtgt), yield at SPR 30% (TotYield_SPRtgt), forecasted catches for 2010-2015 (ForeCatch_20XX), Fspr30% relative to Fcurrent (relative_Fref), the recruitment distribution parameter (RecrDist_Area_1), steepness (SR_steep), and virgin recruitment (SR_R0). Summary statistics include the mean, 10th percentile (Lower10th), and 90th percentile (Upper90th) from the posterior distribution, as well as the MLE value and associated standard deviation (StdDev). Spawning biomass (SPB and SBB) is female gonad weight in pounds. Catch/Yield is in thousand pounds gutted weight.

	Lower10th	Mean	Upper90th	MLE	StdDev
Objective_function	7,944.6	7,954.5	7,965.9	7,970.2	<NA>
SPB_Virgin	48,834	50,951	53,128	51,391	1,634
SPB_2009	25,932	28,688	31,360	31,252	1,842
SSB_SPRtgt	13,941	14,621	15,318	14,855	521
TotYield_SPRtgt	104.1	108.9	113.3	112.9	3.31
ForeCatch_2010	249.2	247.4	250.2	249.5	0.00
ForeCatch_2011	61.4	202.0	297.1	314.6	64.51
ForeCatch_2012	49.2	57.7	66.6	63.6	7.07
ForeCatch_2013	49.0	57.2	65.6	62.3	6.61
ForeCatch_2014	49.3	57.4	65.6	61.5	6.19
ForeCatch_2015	51.2	59.7	68.7	62.5	5.93
relative_Fref	1.11	1.30	1.51	1.45	<NA>
RecrDist_Area_1	1.10	1.13	1.16	1.14	0.03
SR_steep	0.90	0.93	0.96	0.94	0.02
SR_R0	4.43	4.45	4.48	4.47	0.02

Table 12. Probabilities of overfishing (Fcurrent > MFMT) and being overfished (SSBcurrent < MSST) for Gulf of Mexico tilefish from SS Runs 1 and 3. Probabilities calculated for three reference points: 1) SPR 20%, 2) SPR 30%, and 3) SPR 40%. Probabilities based on marginal posterior distributions from MCMC runs.

	SPR 20%		SPR 30%		SPR 40%	
	Run 1	Run 3	Run 1	Run 3	Run 1	Run 3
P(Fcurrent > MFMT)	0.00	0.00	0.00	0.02	0.46	1.00
P(SSBcurrent < MSST)	0.00	0.00	0.00	0.00	0.00	0.00

Table 13. Required SFA and MSRA evaluations using SPR 20% reference point for Gulf of Mexico tilefish SS Runs 1 and 3. Values represent means of marginal posterior distributions. Spawning biomass units are gonad weight in pounds, and yield units are thousand pounds gutted weight.

Criteria	Definition	Run 1	Run 3
	Mortality Rate Criteria		
$F_{MSY\ or\ proxy}$	$F_{SPR20\%}$	4.41	2.81
MFMT	$F_{SPR20\%}$	4.41	2.81
F_{OY}	75% of $F_{SPR20\%}$	3.31	2.11
$F_{CURRENT}$	Avg. F 2007-2009	1.00	1.00
$F_{CURRENT}$/MFMT	Avg. F 2007-2009	0.23	0.36
Base M		0.13	0.13
	Biomass Criteria		
$SSB_{MSY\ or\ proxy}$	Equilibrium SSB @ $F_{SPR20\%}$	11,542.14	9,438.04
MSST	(1-M)*$SSB_{SPR20\%}$ M=0.13	10,041.66	8,211.09
$SSB_{CURRENT}$	SSB_{2009}	35,951.65	28,701.86
$SS_{CURRENT}$/MSST	SSB_{2009}	3.58	3.50
Equilibrium MSY	Equilibrium Yield @ $F_{SPR20\%}$	153.88	105.11
Equilibrium OY	Equilibrium Yield @ F_{OY}	156.85	107.74
OFL	Annual Yield @ FMFMT		
	OFL 2010	249.45	248.18
	OFL 2011	439.92	201.30
	OFL 2012	229.53	120.76
	OFL 2013	207.03	112.54
	OFL 2014	197.04	106.41
	OFL 2015	190.98	104.62
Annual OY (ACT)	Annual Yield @ F_{OY}		
	OY 2010	249.45	248.18
	OY 2011	439.92	201.30
	OY 2012	178.07	91.93
	OY 2013	169.06	88.27
	OY 2014	167.78	85.92
	OY 2015	168.69	86.70
Generation Time			
Rebuild Time	(if B_{2009}<MSST)		
Tmin	@ F=0		
Midpoint	mid of Tmin, Tmax		
Tmax	if Tmin>10y, Tmin + 1 Gen		
ABC	Recommend Range		

Table 14. Required SFA and MSRA evaluations using SPR 30% reference point for Gulf of Mexico tilefish SS Runs 1 and 3. Values represent means of marginal posterior distributions. Spawning biomass units are gonad weight in pounds, and yield units are thousand pounds gutted weight.

Criteria	Definition	Run 1	Run 3
	Mortality Rate Criteria		
$F_{MSY\ or\ proxy}$	$F_{SPR30\%}$	2.07	1.30
MFMT	$F_{SPR30\%}$	2.07	1.30
F_{OY}	75% of $F_{SPR30\%}$	1.55	0.98
$F_{CURRENT}$	Avg. F 2007-2009	1.00	1.00
$F_{CURRENT}$/MFMT	Avg. F 2007-2009	0.49	0.78
Base M		0.13	0.13
	Biomass Criteria		
$SSB_{MSY\ or\ proxy}$	Equilibrium SSB @ $F_{SPR30\%}$	17,986.44	14,620.77
MSST	(1-M)*$SSB_{SPR30\%}$ M=0.13	15,648.20	12,720.07
$SSB_{CURRENT}$	SSB_{2009}	35,932.13	28,687.96
$SS_{CURRENT}$/MSST	SSB_{2009}	2.30	2.26
Equilibrium MSY	Equilibrium Yield @ $F_{SPR30\%}$	156.88	108.85
Equilibrium OY	Equilibrium Yield @ F_{OY}	154.45	107.76
OFL	Annual Yield @ FMFMT		
	OFL 2010	249.45	247.36
	OFL 2011	445.68	202.00
	OFL 2012	115.69	57.68
	OFL 2013	116.51	57.18
	OFL 2014	121.14	57.40
	OFL 2015	127.41	59.68
Annual OY (ACT)	Annual Yield @ F_{OY}		
	OY 2010	249.45	247.36
	OY 2011	445.68	202.00
	OY 2012	88.44	43.57
	OY 2013	92.11	43.79
	OY 2014	98.65	44.57
	OY 2015	106.65	46.97
Generation Time			
Rebuild Time	(if B_{2009}<MSST)		
Tmin	@ F=0		
Midpoint	mid of Tmin, Tmax		
Tmax	if Tmin>10y, Tmin + 1 Gen		
ABC	Recommend Range		

Table 15. Required SFA and MSRA evaluations using SPR 40% reference point for Gulf of Mexico tilefish SS Runs 1 and 3. Values represent means of marginal posterior distributions. Spawning biomass units are gonad weight in pounds, and yield units are thousand pounds gutted weight.

Criteria	Definition	Run 1	Run 3
	Mortality Rate Criteria		
$F_{MSY\ or\ proxy}$	$F_{SPR40\%}$	1.02	0.62
MFMT	$F_{SPR40\%}$	1.02	0.62
F_{OY}	75% of $F_{SPR40\%}$	0.76	0.47
$F_{CURRENT}$	Avg. F 2007-2009	1.00	1.00
$F_{CURRENT}$/MFMT	Avg. F 2007-2009	1.00	1.64
Base M		0.13	0.13
	Biomass Criteria		
$SSB_{MSY\ or\ proxy}$	Equilibrium SSB @ $F_{SPR40\%}$	24,428.91	19,813.79
MSST	(1-M)*$SSB_{SPR40\%}$ M=0.13	21,253.15	17,238.00
$SSB_{CURRENT}$	SSB_{2009}	35,938.05	28,604.42
$SS_{CURRENT}$/MSST	SSB_{2009}	1.69	1.66
Equilibrium MSY	Equilibrium Yield @ $F_{SPR40\%}$	149.47	105.56
Equilibrium OY	Equilibrium Yield @ F_{OY}	145.29	103.69
OFL	Annual Yield @ FMFMT		
	OFL 2010	249.45	247.90
	OFL 2011	440.44	197.68
	OFL 2012	59.75	27.85
	OFL 2013	65.18	28.31
	OFL 2014	73.02	29.01
	OFL 2015	82.16	30.73
Annual OY (ACT)	Annual Yield @ F_{OY}		
	OY 2010	249.45	247.90
	OY 2011	440.44	197.68
	OY 2012	45.28	20.96
	OY 2013	50.44	21.44
	OY 2014	57.71	22.12
	OY 2015	66.37	23.57
Generation Time			
Rebuild Time	(if B_{2009}<MSST)		
Tmin	@ F=0		
Midpoint	mid of Tmin, Tmax		
Tmax	if Tmin>10y, Tmin + 1 Gen		
ABC	Recommend Range		

Table 16. Probabilities of exceeding OFL for Gulf of Mexico tilefish SS Runs 1 and 3 at SPR 20% reference point. Probabilities calculated from marginal posterior distribution of yield at Fspr20%. Catches are reported in thousand pounds gutted weight.

Catch	2012	2013	2014	2015
(1,000 lbs gw)	Run 1			
(105,110]	0.0000	0.0000	0.0003	0.0008
(110,115]	0.0000	0.0000	0.0008	0.0018
(115,120]	0.0000	0.0003	0.0020	0.0111
(120,125]	0.0000	0.0013	0.0091	0.0290
(125,130]	0.0003	0.0023	0.0232	0.0541
(130,135]	0.0010	0.0083	0.0456	0.0977
(135,140]	0.0020	0.0186	0.0796	0.1345
(140,145]	0.0058	0.0388	0.1189	0.1740
(145,150]	0.0133	0.0652	0.1584	0.2047
(150,155]	0.0247	0.1005	0.1977	0.2246
(155,160]	0.0426	0.1355	0.2266	0.2387
(160,165]	0.0713	0.1783	0.2480	0.2493
(165,170]	0.1038	0.2163	0.2684	0.2581
(170,175]	0.1468	0.2543	0.2823	0.2692
(175,180]	0.1843	0.2924	0.3007	0.2808
(180,185]	0.2357	0.3238	0.3211	0.3024
(185,190]	0.2803	0.3576	0.3490	0.3329
(190,195]	0.3269	0.3916	0.3785	0.3800
(195,200]	0.3732	0.4279	0.4251	0.4510
(200,205]	0.4195	0.4631	0.4805	0.5437
(205,210]	0.4558	0.5029	0.5457	0.6527
(210,215]	0.4906	0.5470	0.6202	0.7590
(215,220]	0.5298	0.6004	0.7044	0.8426
(220,225]	0.5653	0.6537	0.7739	0.9043
(225,230]	0.5991	0.7044	0.8346	0.9499
(230,235]	0.6318	0.7472	0.8816	0.9756
(235,240]	0.6593	0.7852	0.9227	0.9874
(240,245]	0.6855	0.8217	0.9554	0.9947
(245,250]	0.7036	0.8560	0.9710	0.9975
(250,255]	0.7285	0.8892	0.9829	0.9990
(255,260]	0.7512	0.9139	0.9917	0.9997
(260,265]	0.7718	0.9358	0.9955	1.0000
(265,270]	0.7887	0.9499	0.9972	0.0000
(270,275]	0.8026	0.9620	0.9985	0.0000
(275,280]	0.8177	0.9748	0.9997	0.0000
(280,285]	0.8353	0.9819	0.0000	0.0000
(285,290]	0.8494	0.9889	1.0000	0.0000

(290,295]	0.8638	0.9929	0.0000	0.0000
(295,300]	0.8748	0.9950	0.0000	0.0000
(300,305]	0.8842	0.9967	0.0000	0.0000
(305,310]	0.8925	0.9975	0.0000	0.0000
(310,315]	0.9033	0.9985	0.0000	0.0000
(315,320]	0.9119	0.9990	0.0000	0.0000
(320,325]	0.9184	0.9997	0.0000	0.0000
(325,330]	0.9255	1.0000	0.0000	0.0000
(330,335]	0.9345	0.0000	0.0000	0.0000
(335,340]	0.9398	0.0000	0.0000	0.0000
(340,345]	0.9474	0.0000	0.0000	0.0000
(345,350]	0.9537	0.0000	0.0000	0.0000
(350,355]	0.9602	0.0000	0.0000	0.0000
(355,360]	0.9640	0.0000	0.0000	0.0000
(360,365]	0.9675	0.0000	0.0000	0.0000
(365,370]	0.9703	0.0000	0.0000	0.0000
(370,375]	0.9738	0.0000	0.0000	0.0000
(375,380]	0.9768	0.0000	0.0000	0.0000
(380,385]	0.9806	0.0000	0.0000	0.0000
(385,390]	0.9826	0.0000	0.0000	0.0000
(390,395]	0.9856	0.0000	0.0000	0.0000
(395,400]	0.9887	0.0000	0.0000	0.0000
(400,405]	0.9902	0.0000	0.0000	0.0000
		Run 3		
(65,70]	0.0000	0.0000	0.0003	0.0006
(70,75]	0.0003	0.0006	0.0020	0.0017
(75,80]	0.0008	0.0025	0.0048	0.0045
(80,85]	0.0028	0.0070	0.0191	0.0225
(85,90]	0.0070	0.0217	0.0591	0.0740
(90,95]	0.0194	0.0605	0.1450	0.1924
(95,100]	0.0524	0.1360	0.2953	0.3803
(100,105]	0.1102	0.2666	0.4780	0.5685
(105,110]	0.2082	0.4319	0.6540	0.7359
(110,115]	0.3452	0.5999	0.7965	0.8408
(115,120]	0.4928	0.7475	0.8820	0.8987
(120,125]	0.6374	0.8547	0.9352	0.9280
(125,130]	0.7644	0.9217	0.9586	0.9564
(130,135]	0.8521	0.9586	0.9747	0.9724
(135,140]	0.9197	0.9783	0.9862	0.9865
(140,145]	0.9566	0.9862	0.9927	0.9944
(145,150]	0.9766	0.9932	0.9961	0.9975
(150,155]	0.9876	0.9966	0.9977	0.9983
(155,160]	0.9930	0.9972	0.9980	0.9986

Table 17. Probabilities of exceeding OFL for Gulf of Mexico tilefish SS Runs 1 and 3 at SPR 30% reference point. Probabilities calculated from marginal posterior distribution of yield at Fspr30%. Catches are reported in thousand pounds gutted weight.

Catch	2012	2013	2014	2015
(1,000 lbs gw)		Run 1		
(55,60]	0.0000	0.0003	0.0005	0.0000
(60,65]	0.0013	0.0020	0.0025	0.0020
(65,70]	0.0096	0.0138	0.0161	0.0118
(70,75]	0.0325	0.0440	0.0498	0.0435
(75,80]	0.0866	0.1067	0.1248	0.1133
(80,85]	0.1704	0.1953	0.2127	0.1903
(85,90]	0.2668	0.2827	0.2867	0.2580
(90,95]	0.3564	0.3511	0.3380	0.3038
(95,100]	0.4357	0.3974	0.3617	0.3262
(100,105]	0.4908	0.4264	0.3801	0.3423
(105,110]	0.5444	0.4609	0.3964	0.3526
(110,115]	0.5968	0.4971	0.4133	0.3655
(115,120]	0.6464	0.5389	0.4369	0.3786
(120,125]	0.6902	0.6011	0.4697	0.3954
(125,130]	0.7277	0.6602	0.5115	0.4168
(130,135]	0.7609	0.7100	0.5736	0.4480
(135,140]	0.7908	0.7579	0.6464	0.4916
(140,145]	0.8163	0.8027	0.7156	0.5643
(145,150]	0.8382	0.8389	0.7808	0.6524
(150,155]	0.8590	0.8689	0.8377	0.7448
(155,160]	0.8754	0.8940	0.8825	0.8233
(160,165]	0.8938	0.9190	0.9177	0.8898
(165,170]	0.9051	0.9338	0.9439	0.9343
(170,175]	0.9162	0.9504	0.9627	0.9645
(175,180]	0.9275	0.9638	0.9791	0.9811
(180,185]	0.9386	0.9718	0.9877	0.9919
(185,190]	0.9474	0.9814	0.9902	0.9970
(190,195]	0.9580	0.9872	0.9930	0.9992
(195,200]	0.9658	0.9892	0.9957	0.9997
(200,205]	0.9700	0.9909	0.9970	1.0000
(205,210]	0.9753	0.9914	0.9977	0.0000
(210,215]	0.9776	0.9935	0.9980	0.0000
(215,220]	0.9826	0.9942	0.9987	0.0000
(220,225]	0.9862	0.9950	0.9990	0.0000
(225,230]	0.9882	0.9960	0.9995	0.0000
(230,235]	0.9892	0.0000	0.9997	0.0000
(235,240]	0.9904	0.9962	1.0000	0.0000

Run 3				
(30,35]	0.0003	0.0003	0.0003	0.0000
(35,40]	0.0030	0.0027	0.0027	0.0011
(40,45]	0.0287	0.0284	0.0238	0.0095
(45,50]	0.1289	0.1303	0.1215	0.0666
(50,55]	0.3597	0.3757	0.3768	0.2696
(55,60]	0.6408	0.6836	0.6838	0.5800
(60,65]	0.8570	0.8800	0.8790	0.8143
(65,70]	0.9575	0.9634	0.9534	0.9093
(70,75]	0.9854	0.9873	0.9775	0.9453
(75,80]	0.9949	0.9943	0.9859	0.9667
(80,85]	0.9959	0.9957	0.9927	0.9794
(85,90]	0.9962	0.9962	0.9949	0.9884
(90,95]	0.0000	0.9965	0.9965	0.9938

Table 18. Probabilities of exceeding OFL for Gulf of Mexico tilefish SS Runs 1 and 3 at SPR 40% reference point. Probabilities calculated from marginal posterior distribution of yield at Fspr40%. Catches are reported in thousand pounds gutted weight.

Catch (1,000 lbs gw)	2012	2013	2014	2015
		Run 1		
(25,30]	0.0008	0.0003	0.0000	0.0000
(30,35]	0.0131	0.0091	0.0058	0.0028
(35,40]	0.0887	0.0753	0.0615	0.0383
(40,45]	0.2542	0.2209	0.1992	0.1594
(45,50]	0.3990	0.3194	0.2851	0.2569
(50,55]	0.5186	0.3690	0.3121	0.2881
(55,60]	0.6234	0.4428	0.3315	0.2977
(60,65]	0.6995	0.5370	0.3557	0.3080
(65,70]	0.7630	0.6259	0.4003	0.3206
(70,75]	0.8098	0.7060	0.4829	0.3364
(75,80]	0.8491	0.7710	0.5766	0.3644
(80,85]	0.8781	0.8257	0.6688	0.4155
(85,90]	0.9038	0.8683	0.7494	0.5024
(90,95]	0.9229	0.8977	0.8166	0.6066
(95,100]	0.9380	0.9227	0.8678	0.7061
(100,105]	0.9564	0.9451	0.9028	0.7930
(105,110]	0.9685	0.9630	0.9345	0.8592
(110,115]	0.9786	0.9763	0.9589	0.9066
(115,120]	0.9836	0.9849	0.9773	0.9454
(120,125]	0.9897	0.9907	0.9882	0.9693
(125,130]	0.9927	0.9935	0.9927	0.9874
(130,135]	0.9942	0.9957	0.9945	0.9924
		Run 3		
(30,35]	0.0003	0.0003	0.0003	0.0000
(35,40]	0.0030	0.0027	0.0027	0.0011
(40,45]	0.0287	0.0284	0.0238	0.0095
(45,50]	0.1289	0.1303	0.1215	0.0666
(50,55]	0.3597	0.3757	0.3768	0.2696
(55,60]	0.6408	0.6836	0.6838	0.5800
(60,65]	0.8570	0.8800	0.8790	0.8143
(65,70]	0.9575	0.9634	0.9534	0.9093
(70,75]	0.9854	0.9873	0.9775	0.9453
(75,80]	0.9949	0.9943	0.9859	0.9667
(80,85]	0.9959	0.9957	0.9927	0.9794
(85,90]	0.9962	0.9962	0.9949	0.9884
(90,95]	0.0000	0.9965	0.9965	0.9938

10. Figures

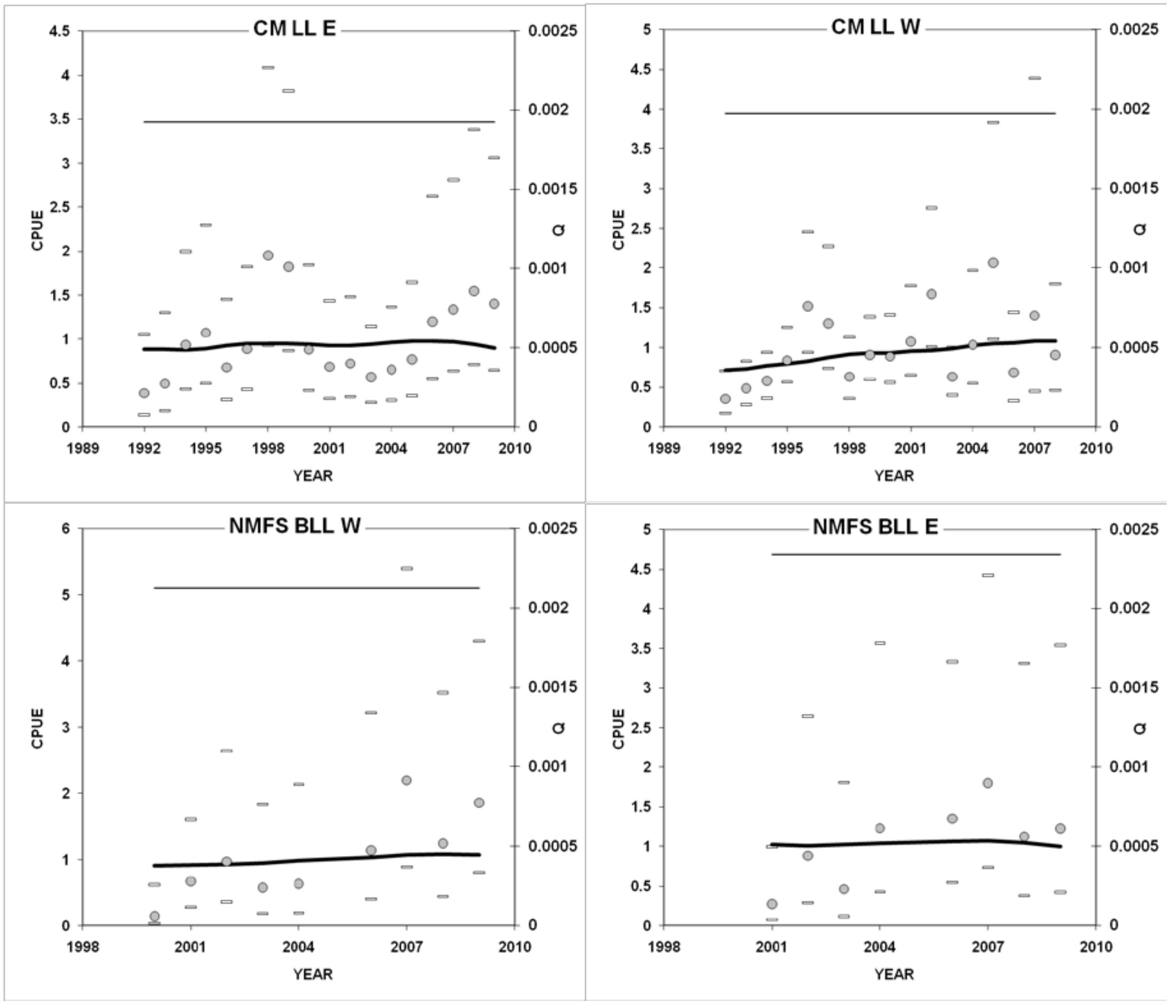


Figure 1. Observed and predicted index CPUE from SS Run 15 for Gulf of Mexico tilefish. Indices include the commercial long line east (CM LL E), commercial long line west (CM LL W), NMFS bottom long line survey east (NMFS BLL E), and NMFS bottom long line west (NMFS BLL W). Error bars represent the observed log-scale standard errors.

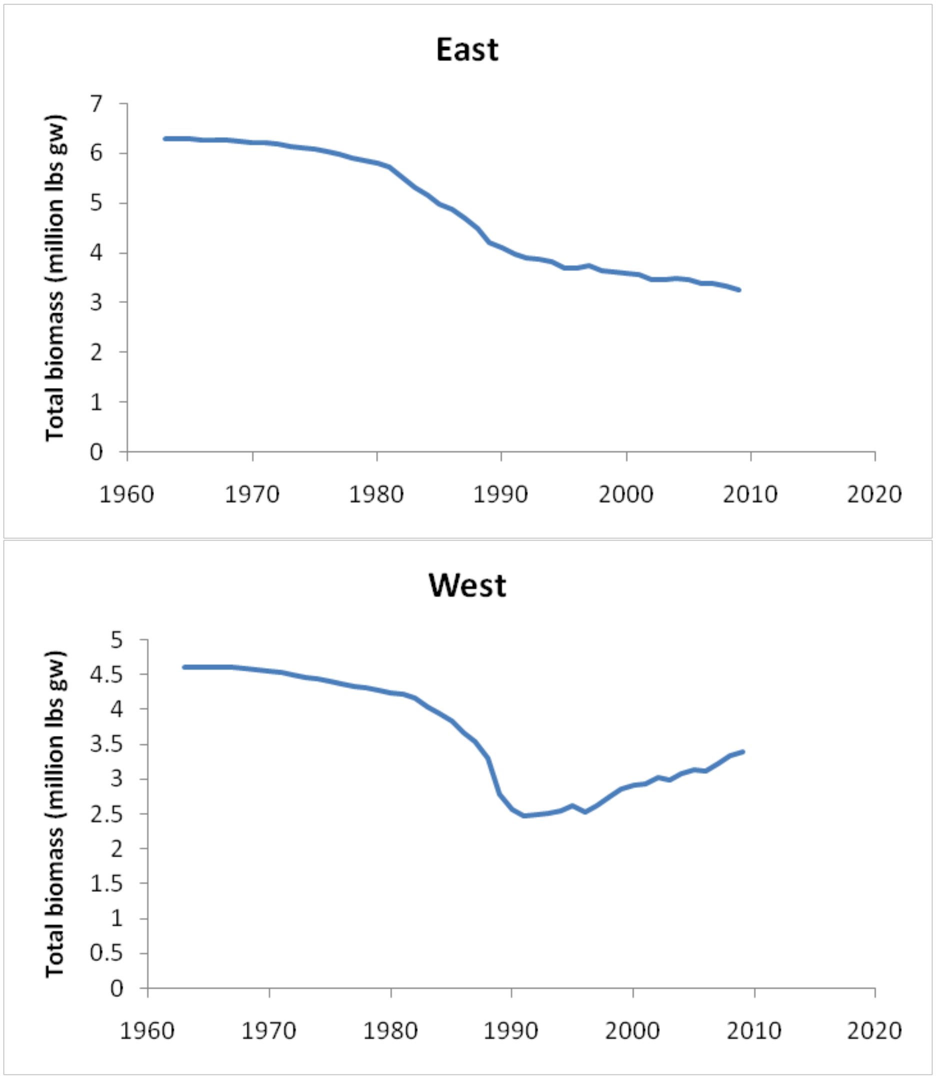


Figure 2. Predicted total biomass (million gutted lbs) by region from SS Run 15 for Gulf of Mexico tilefish.

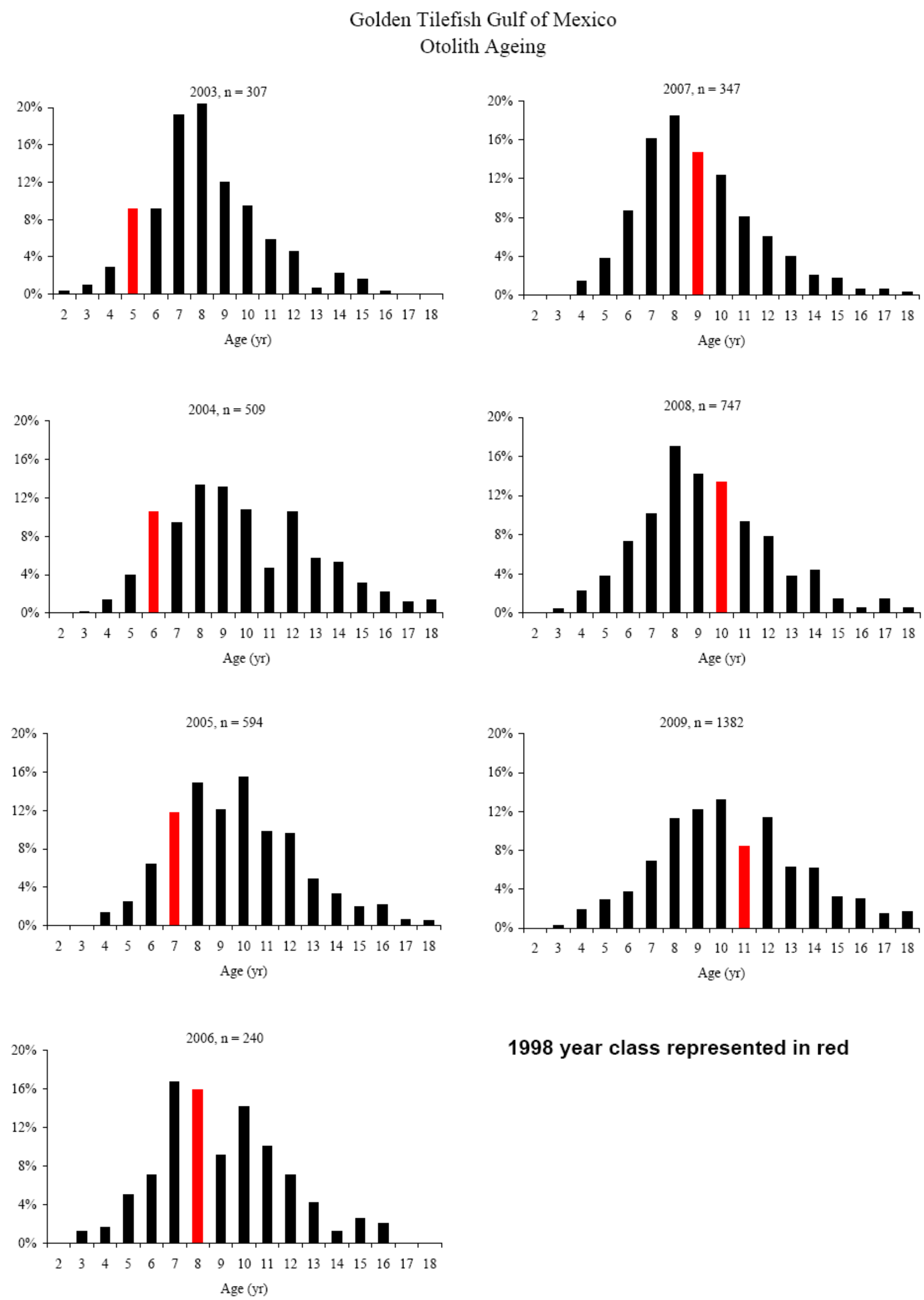


Figure 3. Observed age composition data for Gulf of Mexico tilefish. The 1998 year class is represented in red.

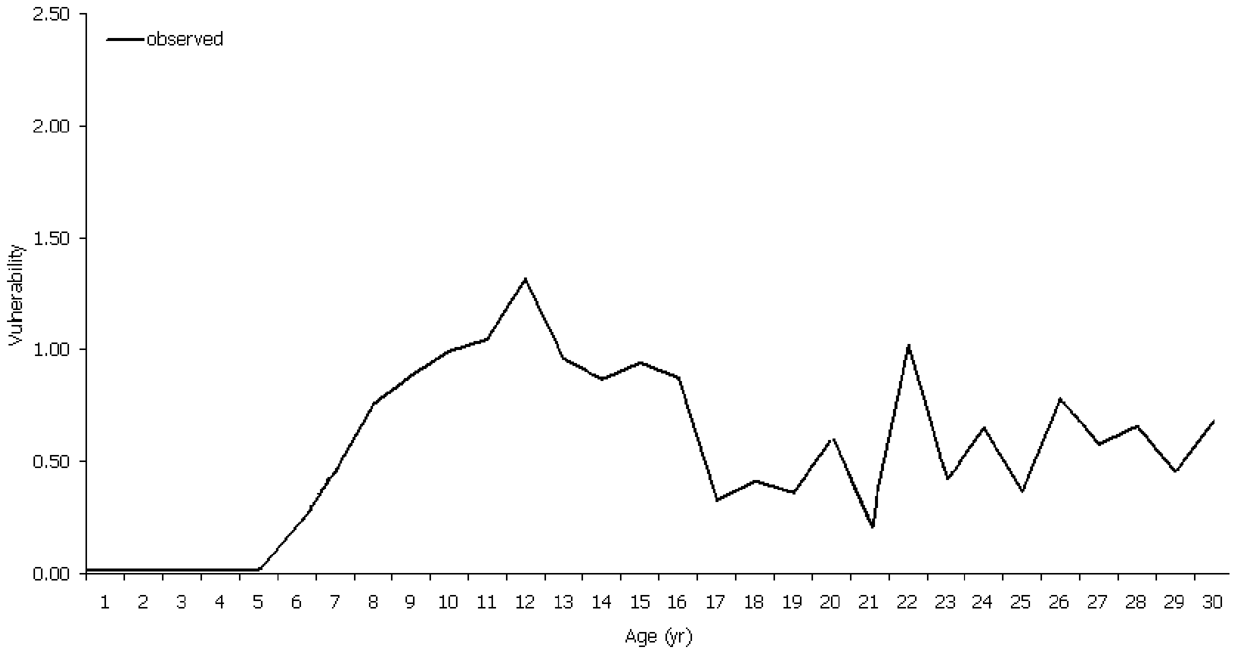


Figure 4. Terminal vulnerabilities at age for Gulf of Mexico tilefish from a virtual population analysis.

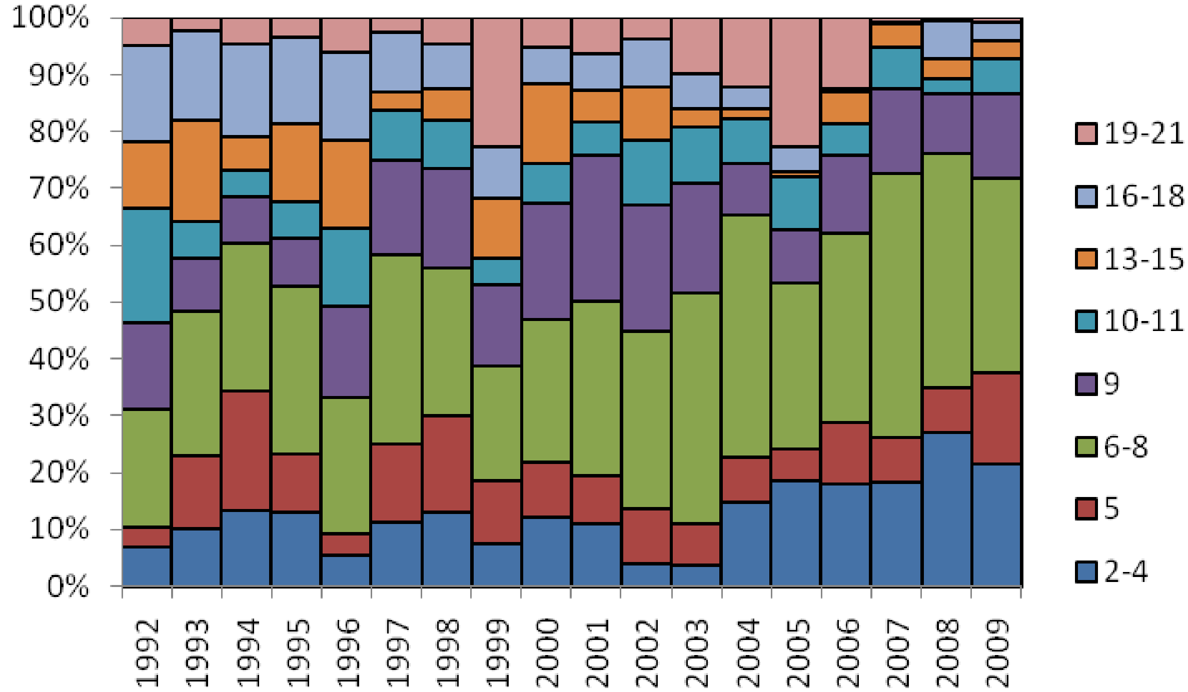


Figure 5. Commercial longline fishery effort from selected Gulf of Mexico tilefish trips, and partitioned by year and statistical grid.

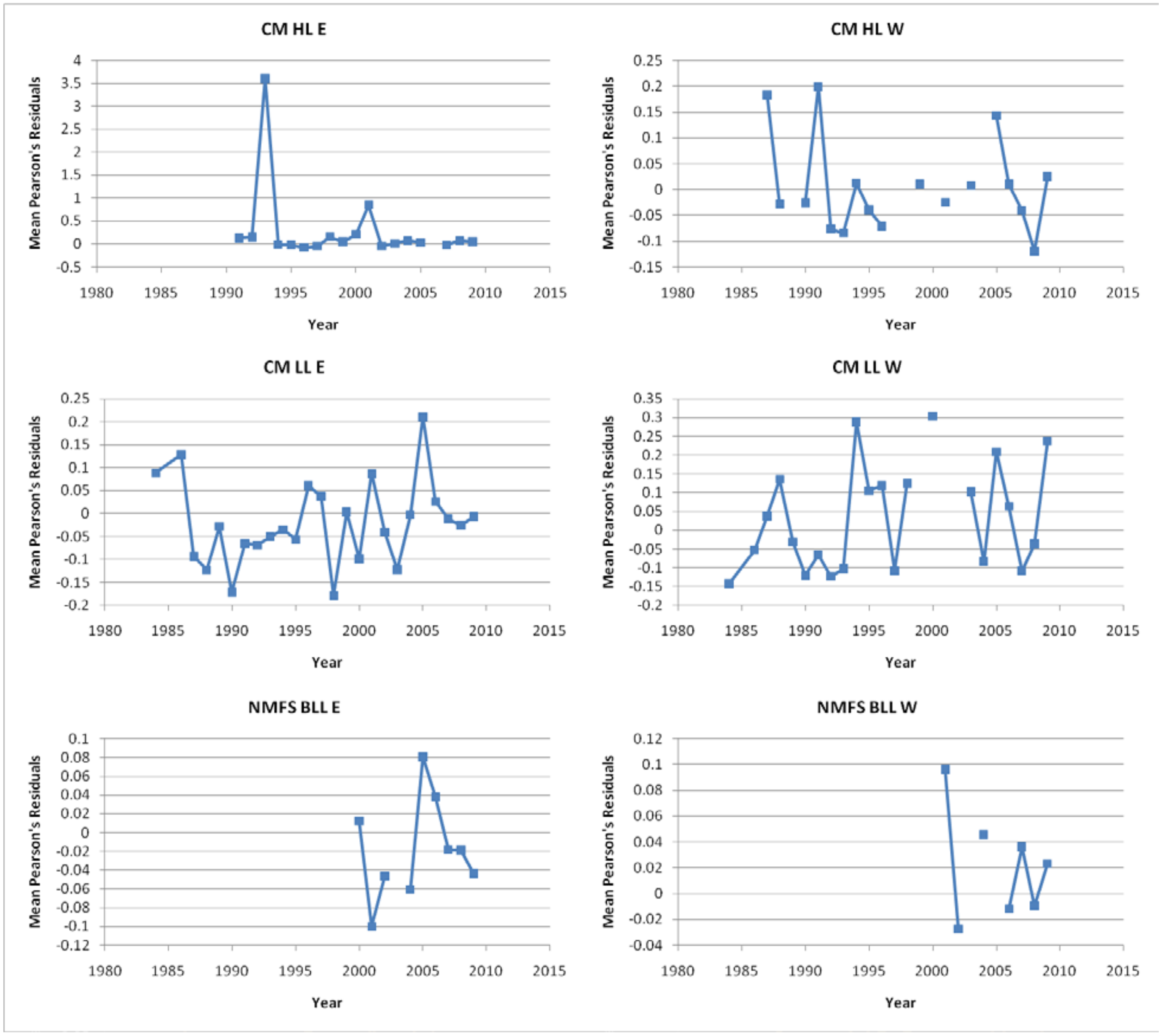


Figure 6. Mean Pearson's residuals over time for length compositions from Gulf of Mexico tilefish SS Run 1.

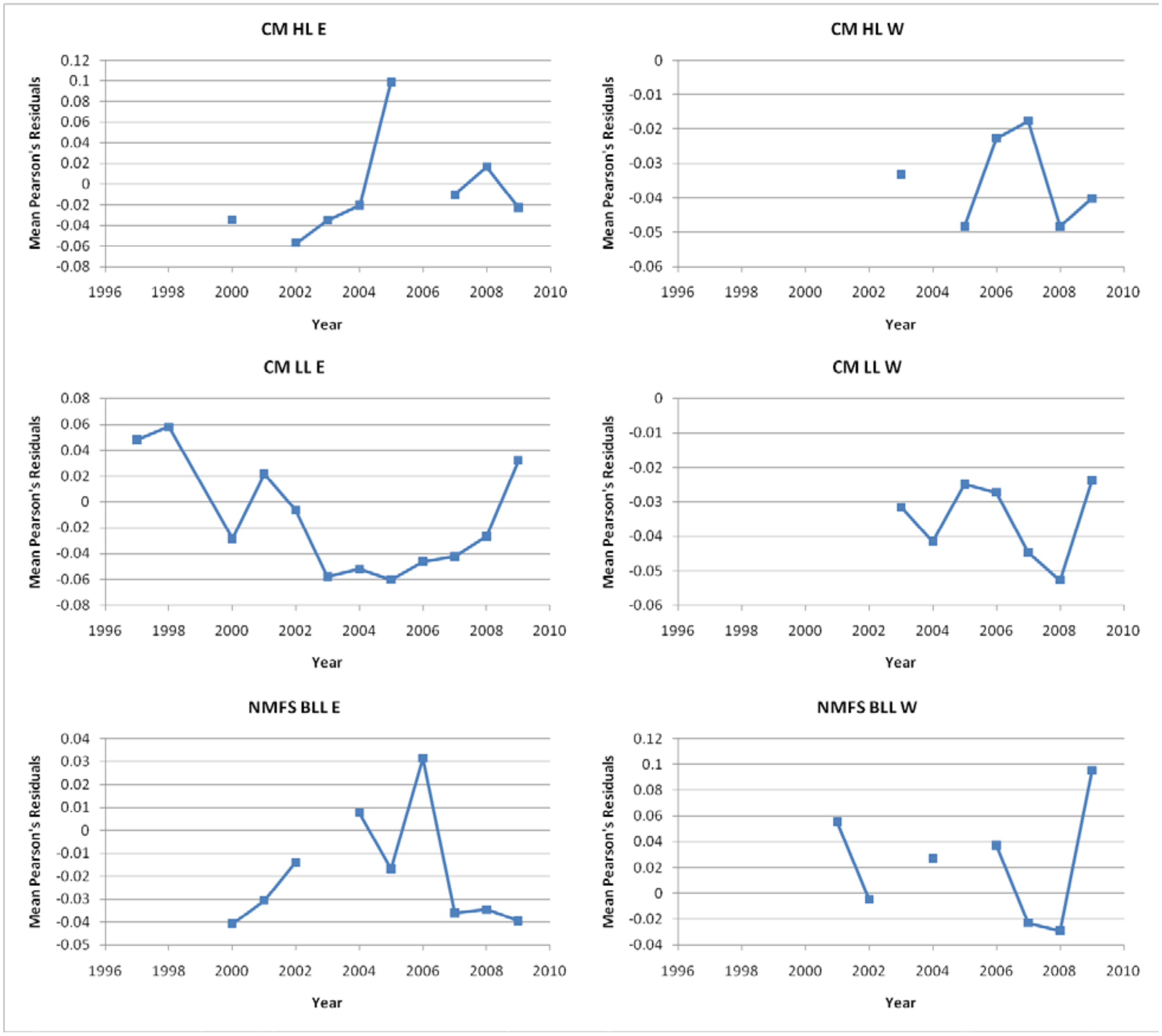


Figure 7. Mean Pearson's residuals over time for age compositions from Gulf of Mexico tilefish SS Run 1.

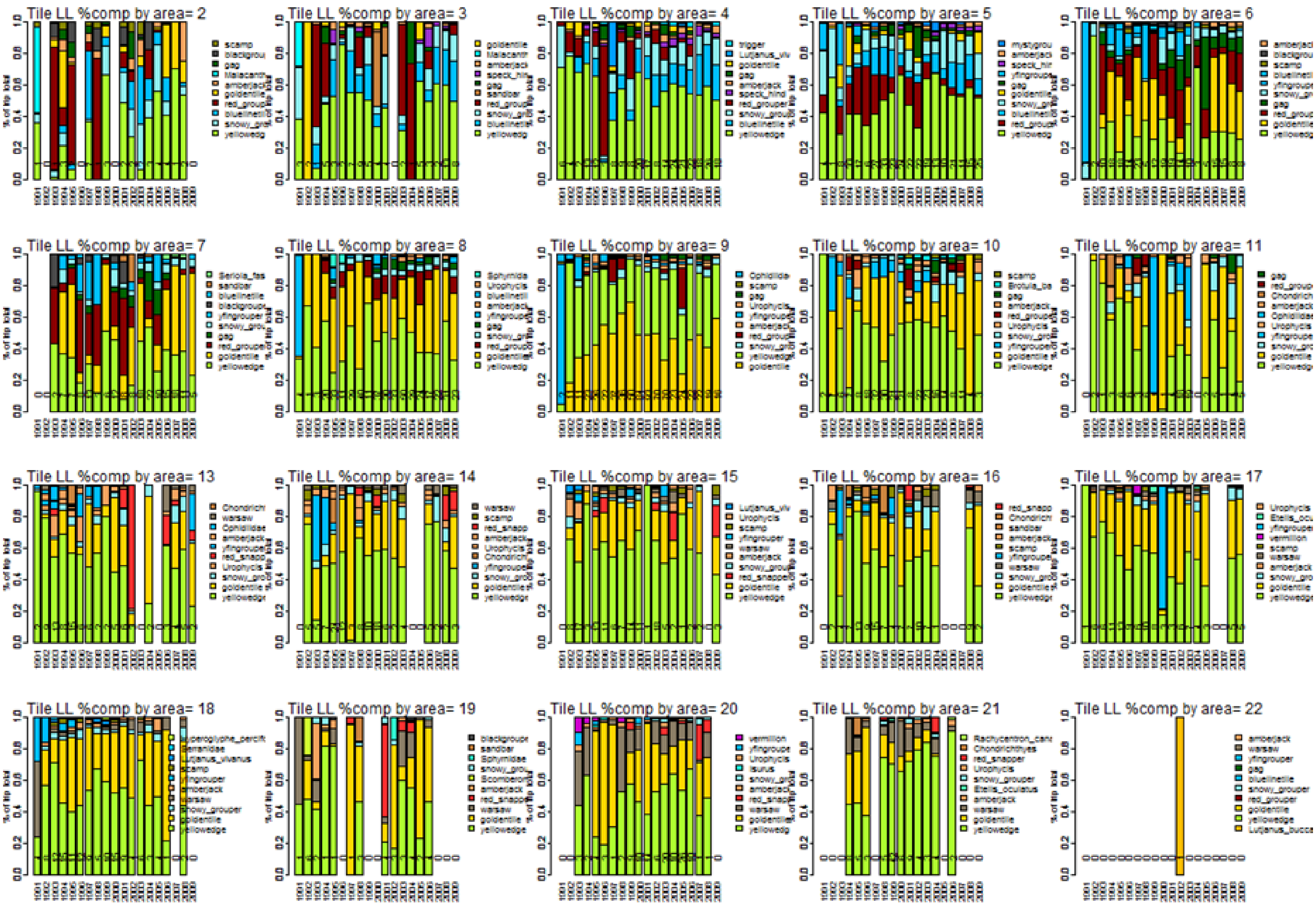


Figure 8. Catch composition of selected Gulf of Mexico tilefish trips from the commercial longline fishery by statistical area.

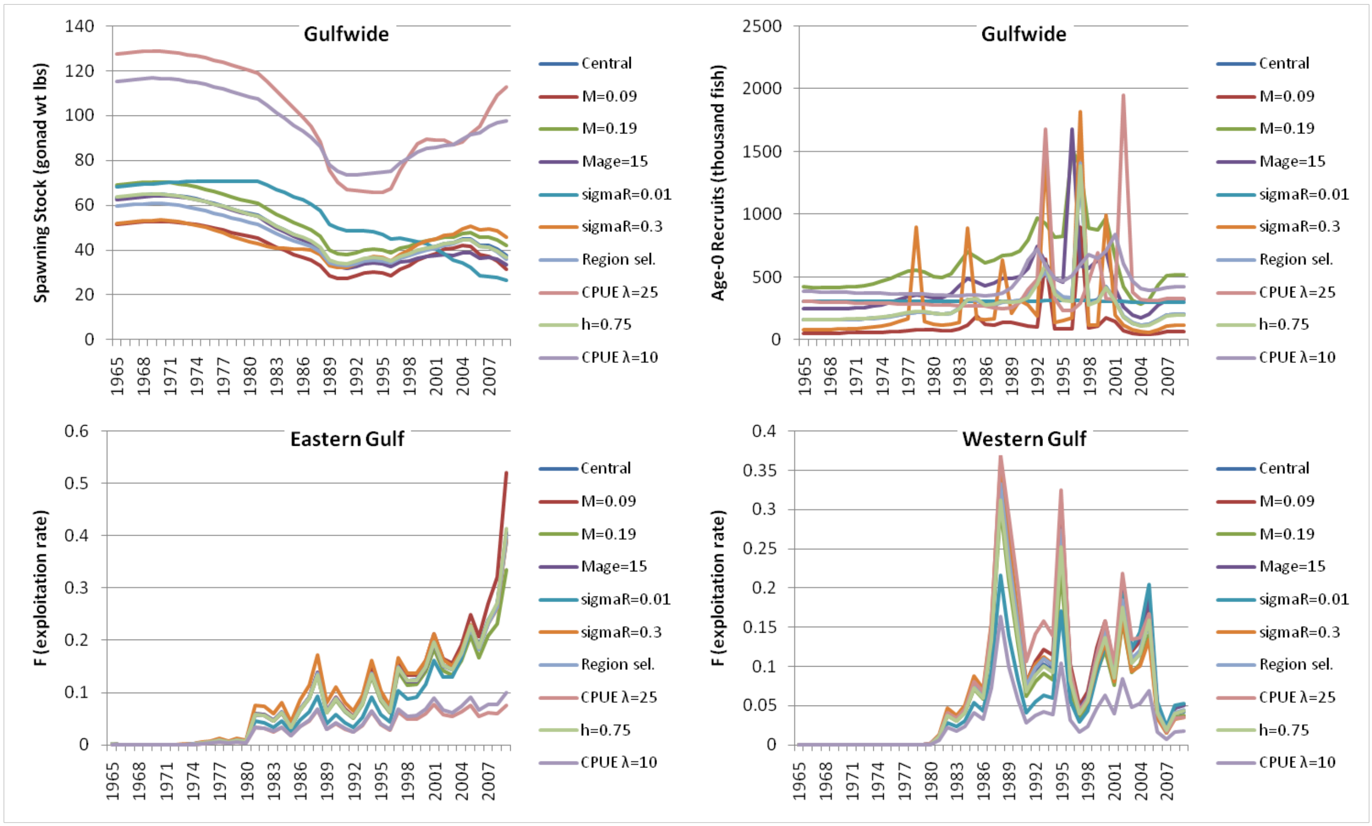


Figure 9. Comparisons of Gulfwide spawning stock biomass, age-0 recruits, eastern Gulf F, and western Gulf F for Gulf of Mexico tilefish from a selection of SS runs. The selected SS runs include the runs chosen for management advice by the AP (Runs 1, 3, 4, 6, 8, 9, 11, and 13), and the runs emphasizing the fit to the indices (Runs 12 and 15).

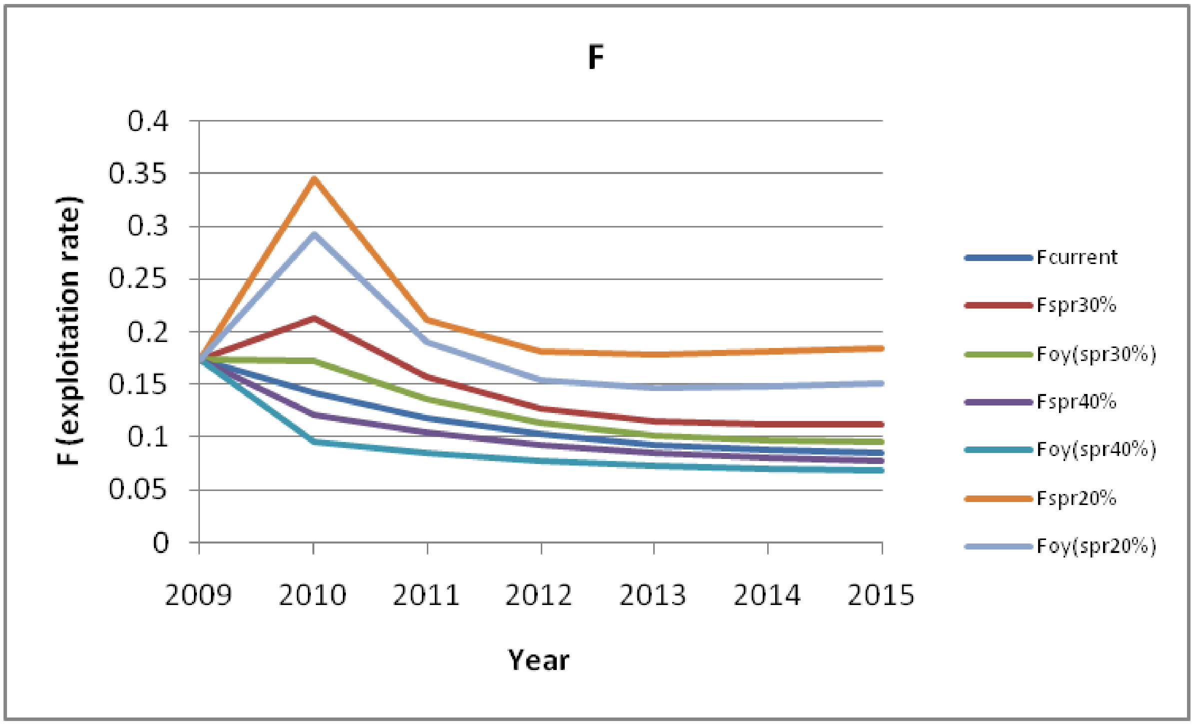


Figure 10. Projected exploitation rate based on biomass for Gulf of Mexico tilefish Run 1. The fixed F projection scenarios include: Fcurrent, Fspr20%, Foy at SPR 20%, Fspr30%, Foy at SPR 30%, Fspr40%, and Foy at SPR 40%. These results are from a preliminary projection run.

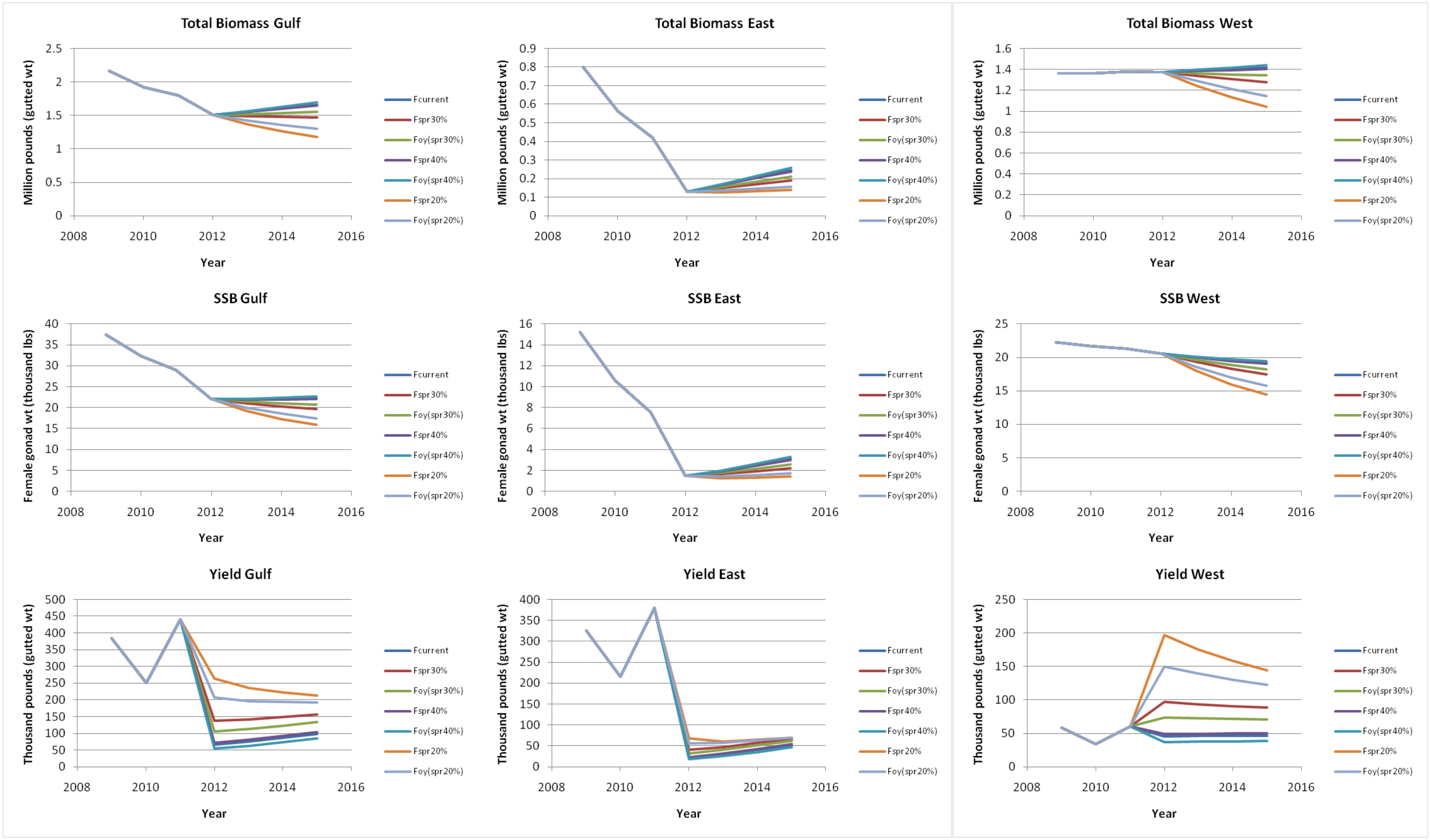


Figure 11. Deterministic projection results for Gulf of Mexico tilefish SS Run 1. Fixed F projection scenarios include Fcurrent, Fspr20%, Foy at SPR 20%, Fspr30%, Foy at SPR 30%, Fspr40%, and Foy at SPR 40%. Total biomass is reported as million pounds gutted weight. Spawning biomass is reported as female gonad weight in thousand pounds. Yield is reported as thousand pounds gutted weight.

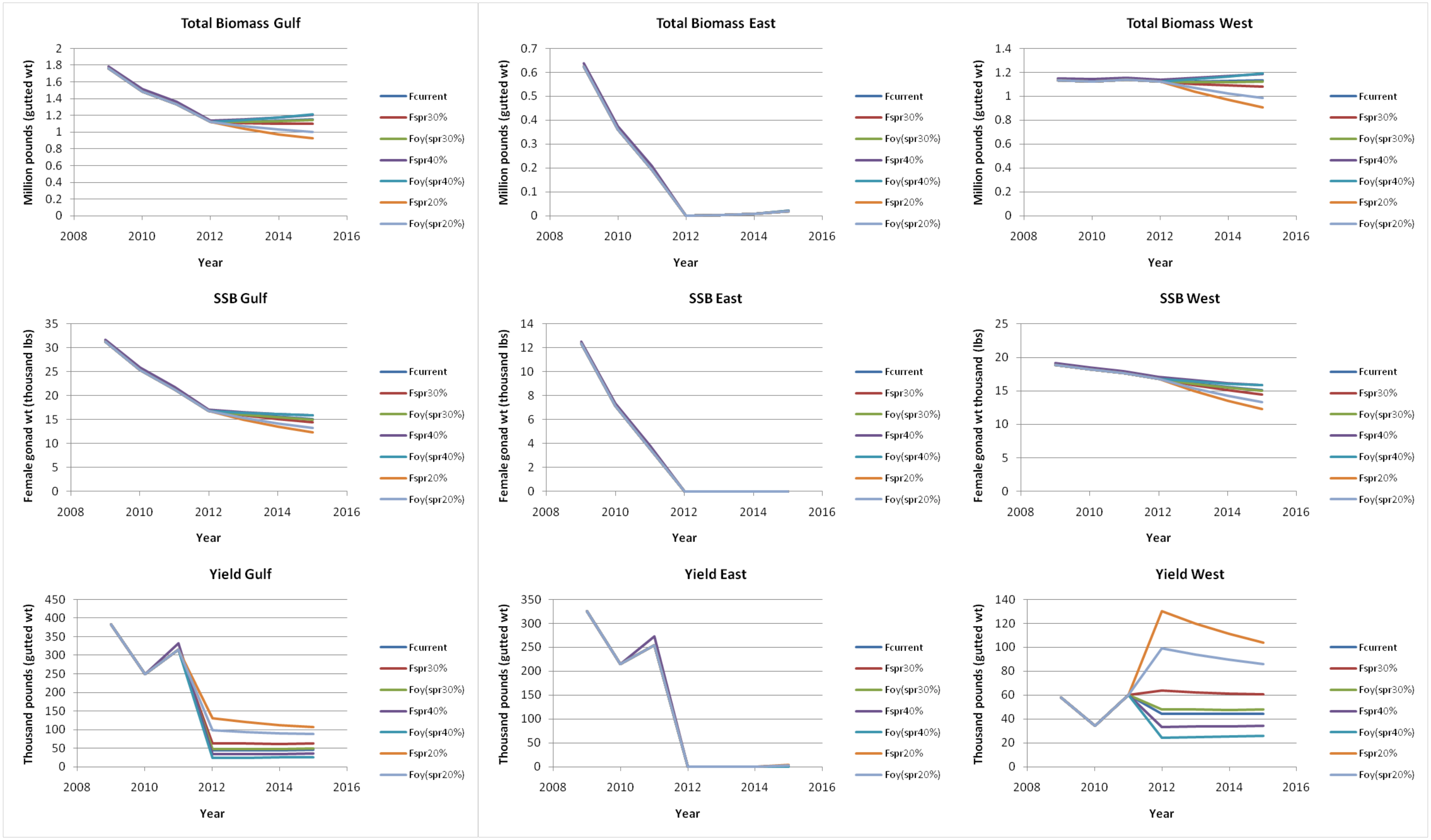


Figure 12. Deterministic projection results for Gulf of Mexico tilefish SS Run 3. Fixed F projection scenarios include Fcurrent, Fspr20%, Foy at SPR 20%, Fspr30%, Foy at SPR 30%, Fspr40%, and Foy at SPR 40%. Total biomass is reported as million pounds gutted weight. Spawning biomass is reported as female gonad weight in thousand pounds. Yield is reported as thousand pounds gutted weight.

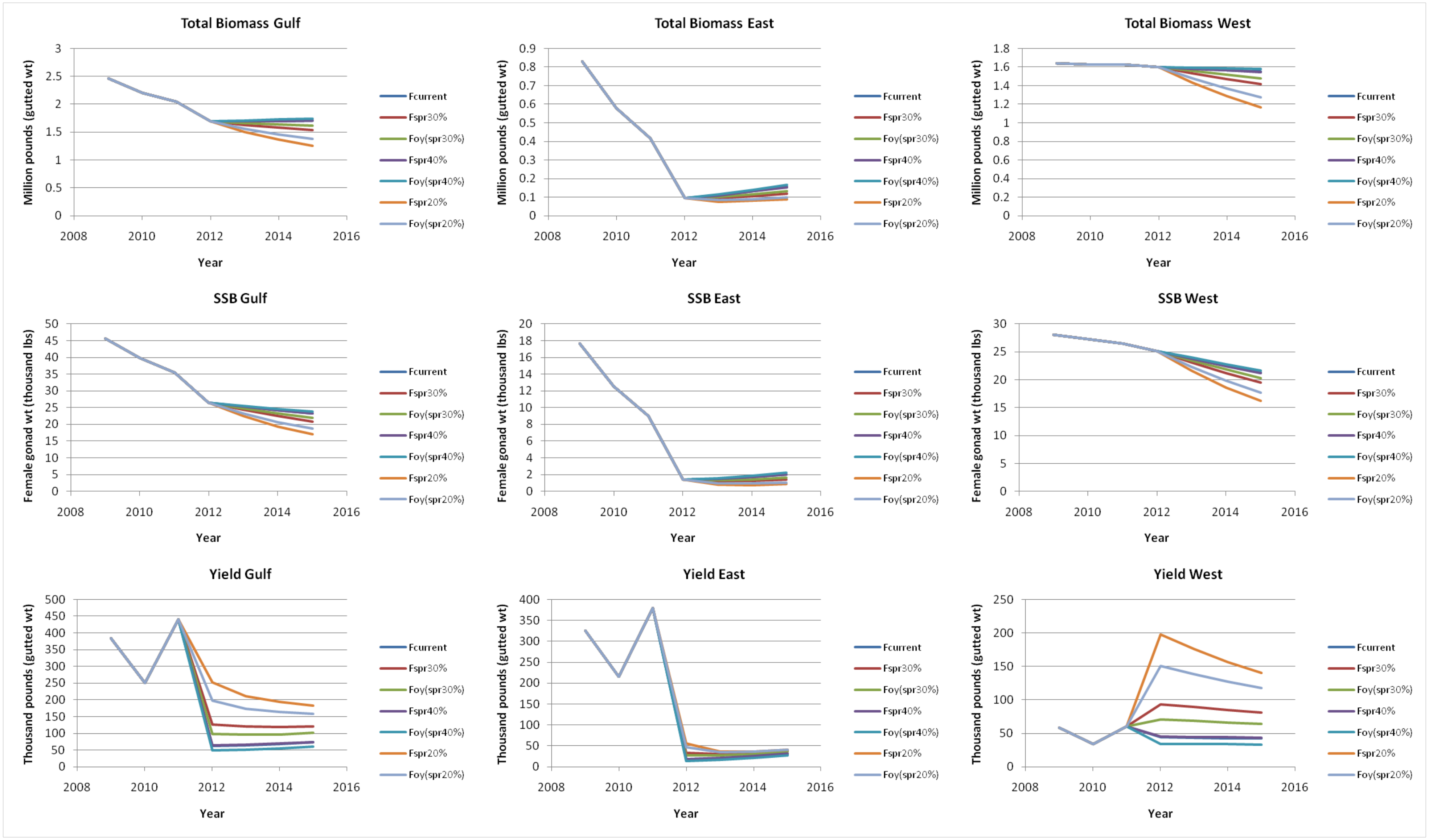


Figure 13. Deterministic projection results for Gulf of Mexico tilefish SS Run 9. Fixed F projection scenarios include Fcurrent, Fspr20%, Foy at SPR 20%, Fspr30%, Foy at SPR 30%, Fspr40%, and Foy at SPR 40%. Total biomass is reported as million pounds gutted weight. Spawning biomass is reported as female gonad weight in thousand pounds. Yield is reported as thousand pounds gutted weight.

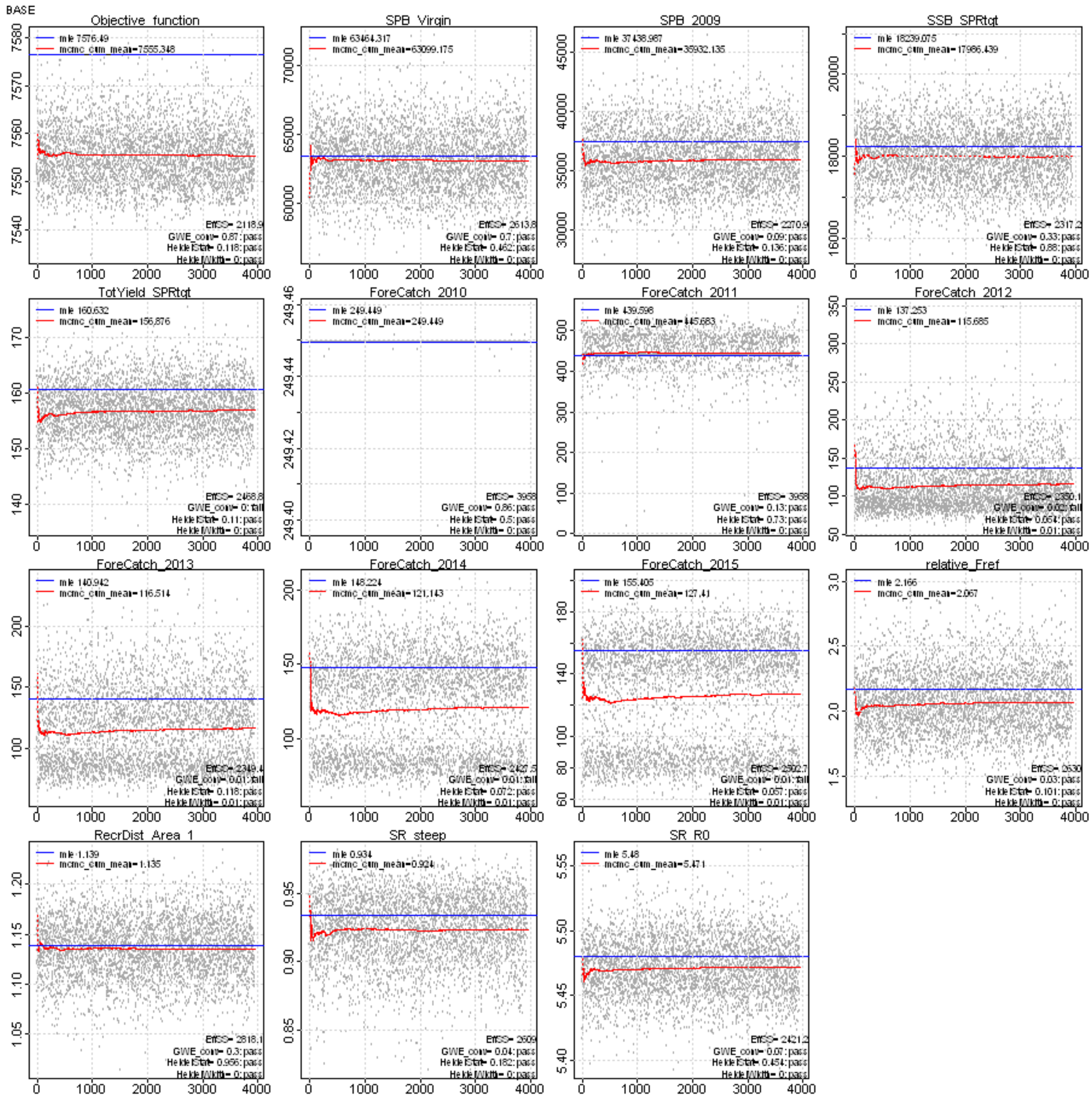


Figure 14. MCMC trace plots for key parameters and derived quantities from Gulf of Mexico tilefish SS Run 1. Key quantities include the negative log likelihood value (Objective_function), virgin spawning biomass (SPB_Virgin), 2009 spawning biomass (SPB_2009), spawning biomass at SPR 30% (SSB_SPRtgt), yield at SPR 30% (TotYield_SPRtgt), forecasted catches for 2010-2015 (ForeCatch_20XX), Fspr30% relative to Fcurrent (relative_Fref), the recruitment distribution parameter (RecrDist_Area_1), steepness (SR_steep), and virgin recruitment (SR_R0). Diagnostics include effective sample size (EffSS), Geweke's test (GWE_conv), Heidelberger and Welch's test stages I (HeidelStat) and II (HeidelWidth), the MLE value (blue line), and the cumulative mean of the MCMC chain (red line). Spawning biomass (SPB and SBB) is female gonad weight in pounds. Catch/Yield is in thousand pounds gutted weight.

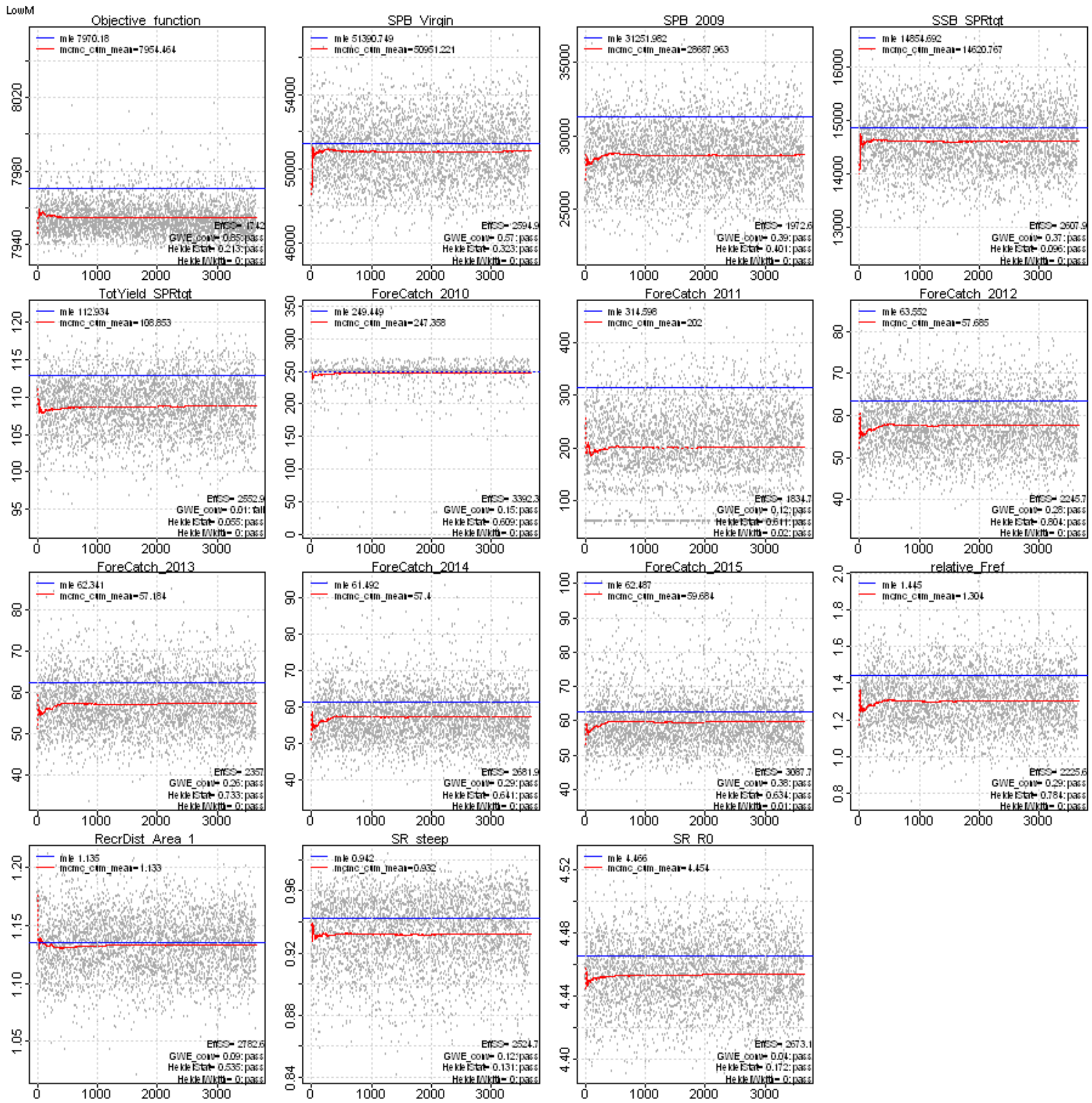


Figure 15. MCMC trace plots for key parameters and derived quantities from Gulf of Mexico tilefish SS Run 3. Key quantities include the negative log likelihood value (Objective_function), virgin spawning biomass (SPB_Virgin), 2009 spawning biomass (SPB_2009), spawning biomass at SPR 30% (SSB_SPRtgt), yield at SPR 30% (TotYield_SPRtgt), forecasted catches for 2010-2015 (ForeCatch_20XX), Fspr30% relative to Fcurrent (relative_Fref), the recruitment distribution parameter (RecrDist_Area_1), steepness (SR_steep), and virgin recruitment (SR_R0). Diagnostics include effective sample size (EffSS), Geweke's test (GWE_conv), Heidelberger and Welch's test stages I (HeidelStat) and II (HeidelWidth), the MLE value (blue line), and the cumulative mean of the MCMC chain (red line). Spawning biomass (SPB and SBB) is female gonad weight in pounds. Catch/Yield is in thousand pounds gutted weight.

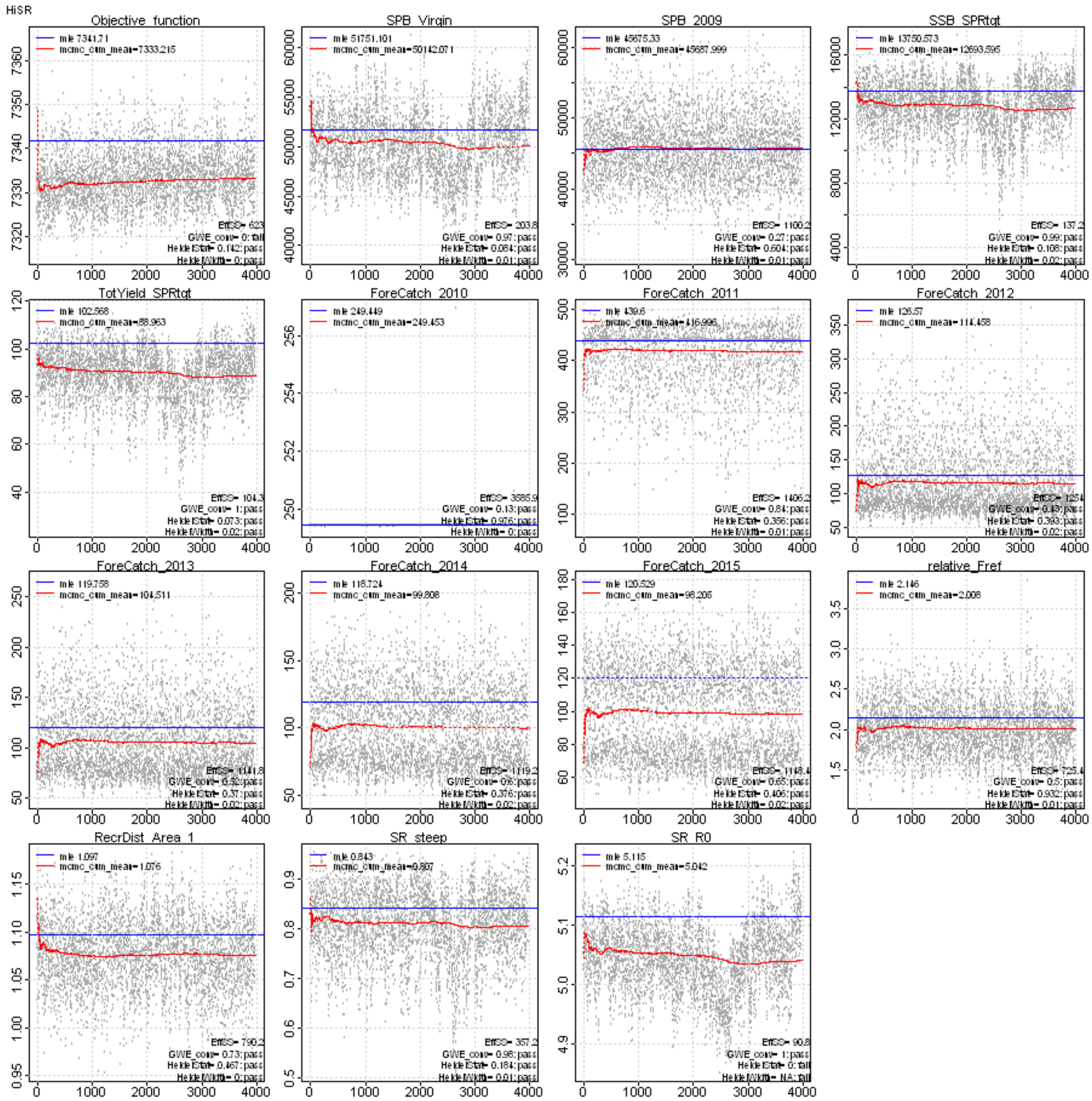


Figure 16. MCMC trace plots for key parameters and derived quantities from Gulf of Mexico tilefish SS Run 9. Key quantities include the negative log likelihood value (Objective_function), virgin spawning biomass (SPB_Virgin), 2009 spawning biomass (SPB_2009), spawning biomass at SPR 30% (SSB_SPRtgt), yield at SPR 30% (TotYield_SPRtgt), forecasted catches for 2010-2015 (ForeCatch_20XX), Fspr30% relative to Fcurrent (relative_Fref), the recruitment distribution parameter (RecrDist_Area_1), steepness (SR_steep), and virgin recruitment (SR_R0). Diagnostics include effective sample size (EffSS), Geweke's test (GWE_conv), Heidelberger and Welch's test stages I (HeidelStat) and II (HeidelWidth), the MLE value (blue line), and the cumulative mean of the MCMC chain (red line). Spawning biomass (SPB and SBB) is female gonad weight in pounds. Catch/Yield is in thousand pounds gutted weight.

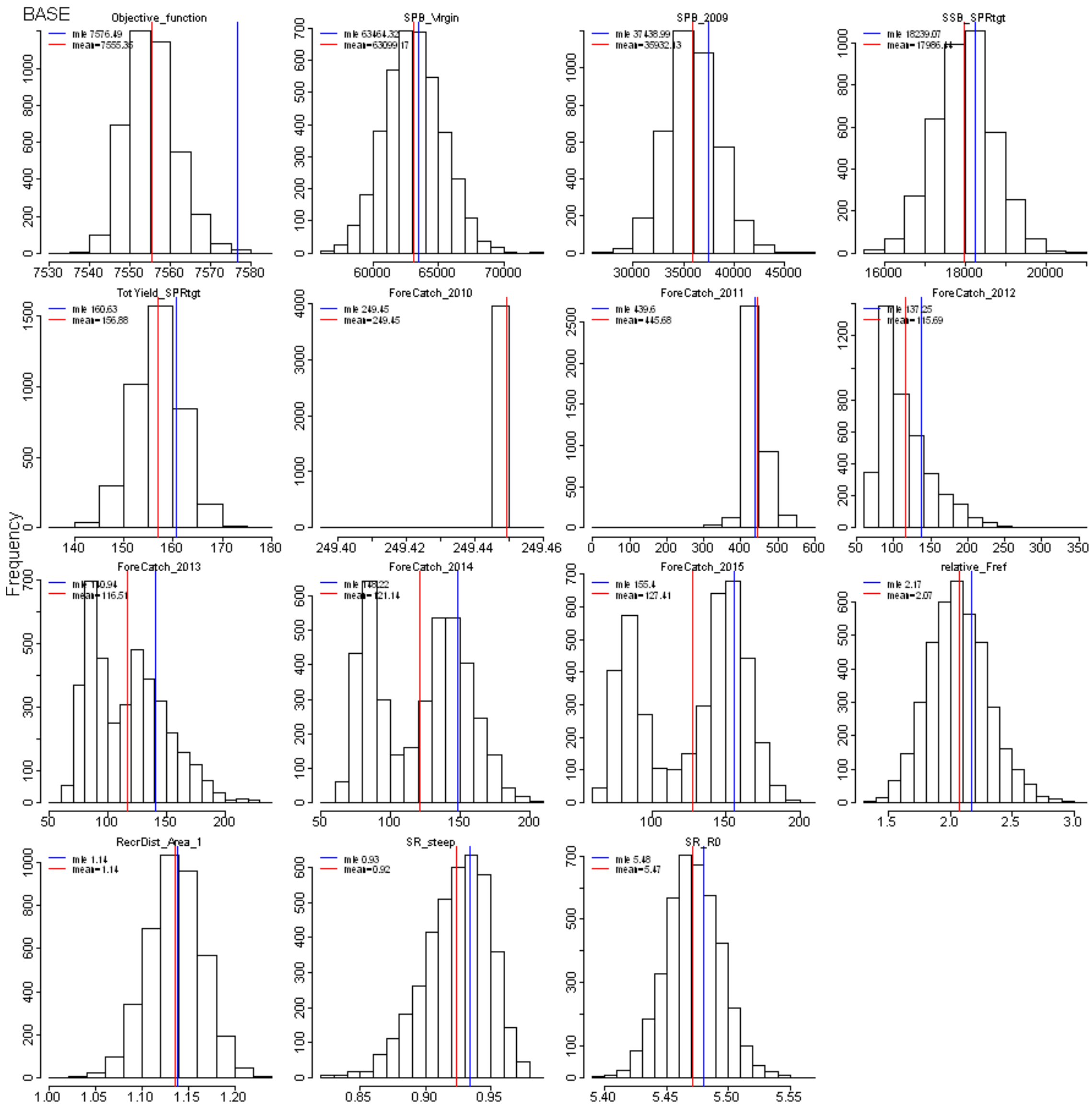


Figure 17. Marginal posterior distributions for key parameters and derived quantities from Gulf of Mexico tilefish SS Run 1. Key quantities include the negative log likelihood value (Objective_function), virgin spawning biomass (SPB_Virgin), 2009 spawning biomass (SPB_2009), spawning biomass at SPR 30% (SSB_SPRtgt), yield at SPR 30% (TotYield_SPRtgt), forecasted catches for 2010-2015 (ForeCatch_20XX), Fspr30% relative to Fcurrent (relative_Fref), the recruitment distribution parameter (RecrDist_Area_1), steepness (SR_steep), and virgin recruitment (SR_R0). The MLE values (blue lines) and posterior distribution means (red lines) are marked. Spawning biomass (SPB and SBB) is female gonad weight in pounds. Catch/Yield is in thousand pounds gutted weight.

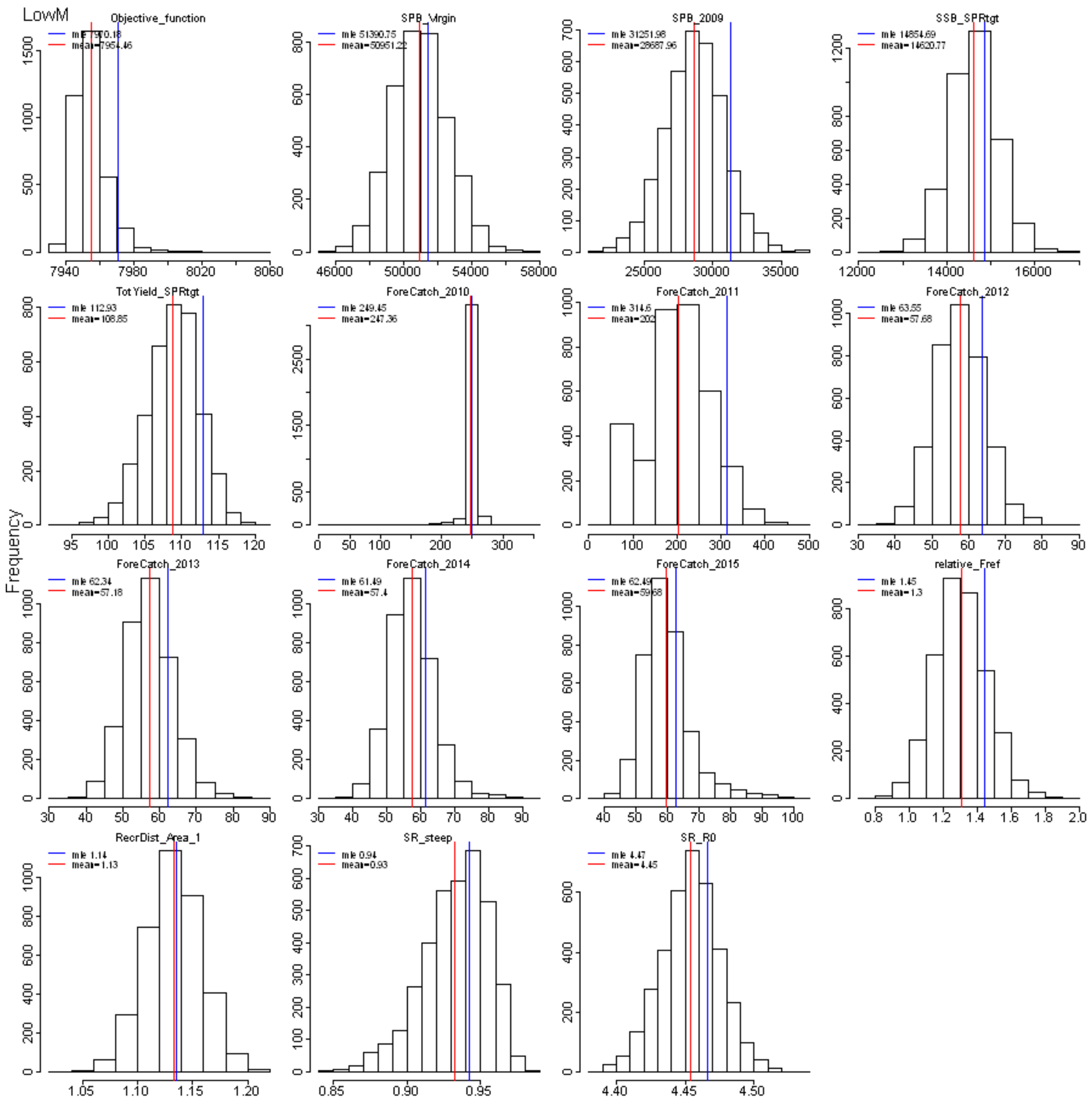
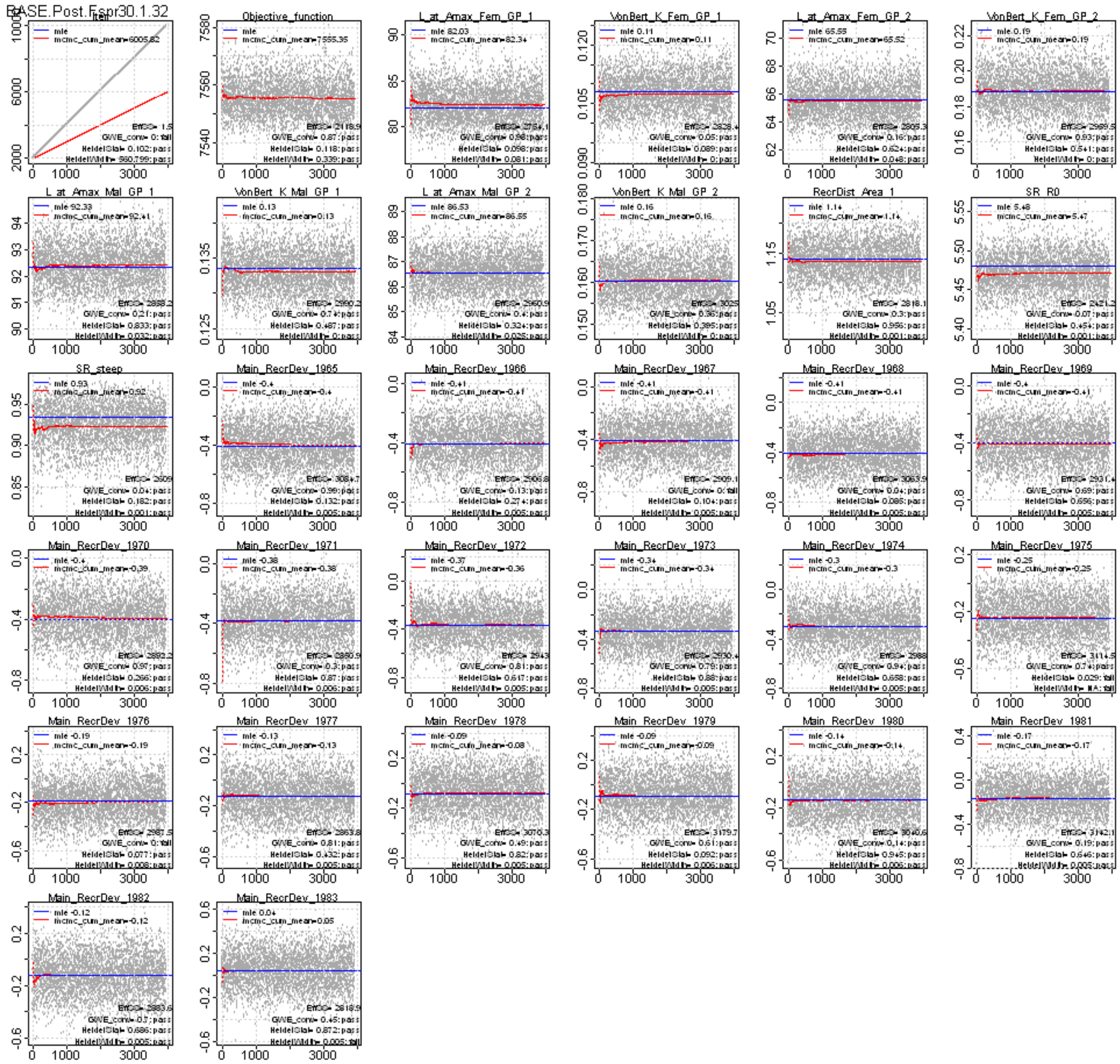


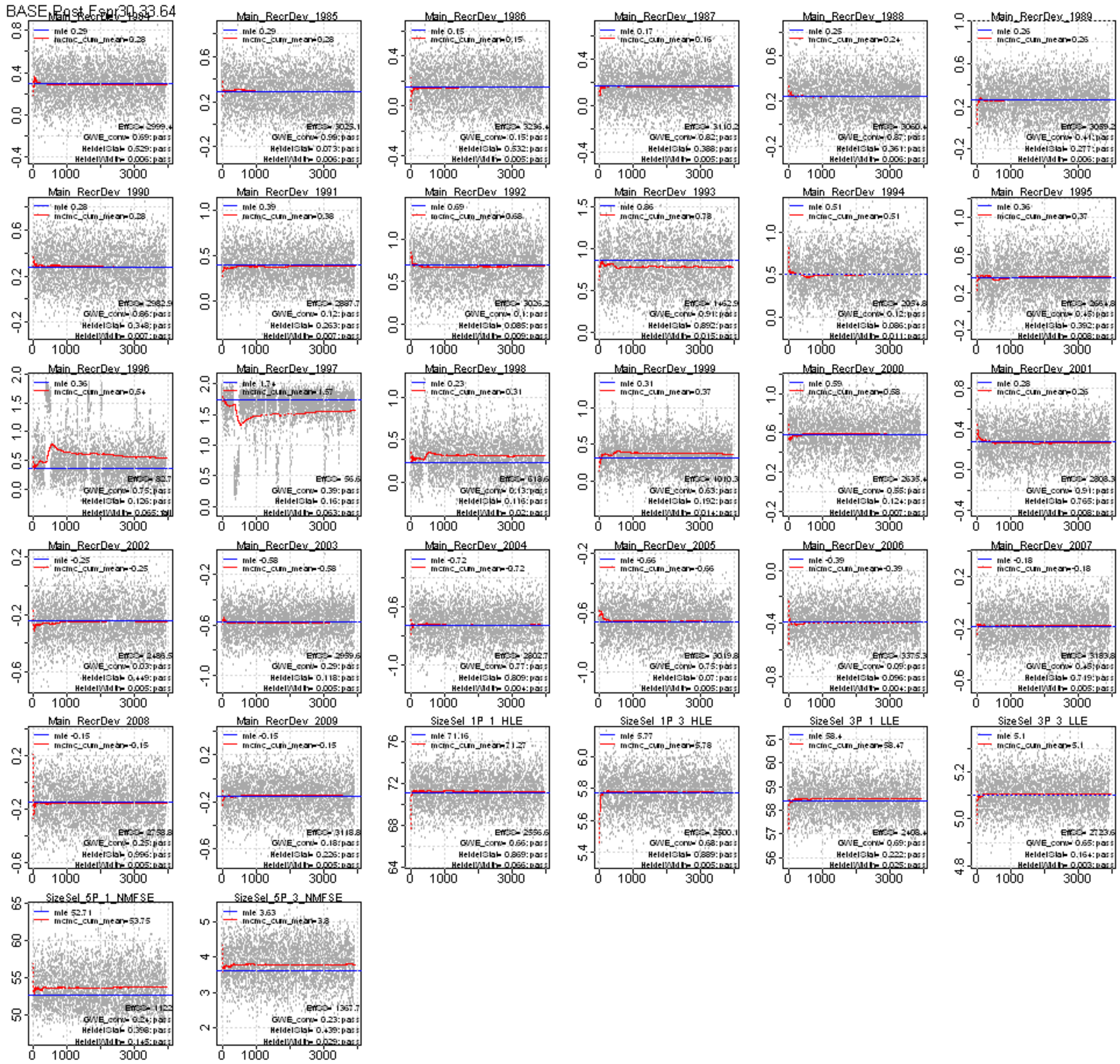
Figure 18. Marginal posterior distributions for key parameters and derived quantities from Gulf of Mexico tilefish SS Run 3. Key quantities include the negative log likelihood value (Objective_function), virgin spawning biomass (SPB_Virgin), 2009 spawning biomass (SPB_2009), spawning biomass at SPR 30% (SSB_SPRtgt), yield at SPR 30% (TotYield_SPRtgt), forecasted catches for 2010-2015 (ForeCatch_20XX), Fspr30% relative to Fcurrent (relative_Fref), the recruitment distribution parameter (RecrDist_Area_1), steepness (SR_steep), and virgin recruitment (SR_R0). The MLE values (blue lines) and posterior distribution means (red lines) are marked. Spawning biomass (SPB and SBB) is female gonad weight in pounds. Catch/Yield is in thousand pounds gutted weight.

Appendix I: Additional MCMC Diagnostics

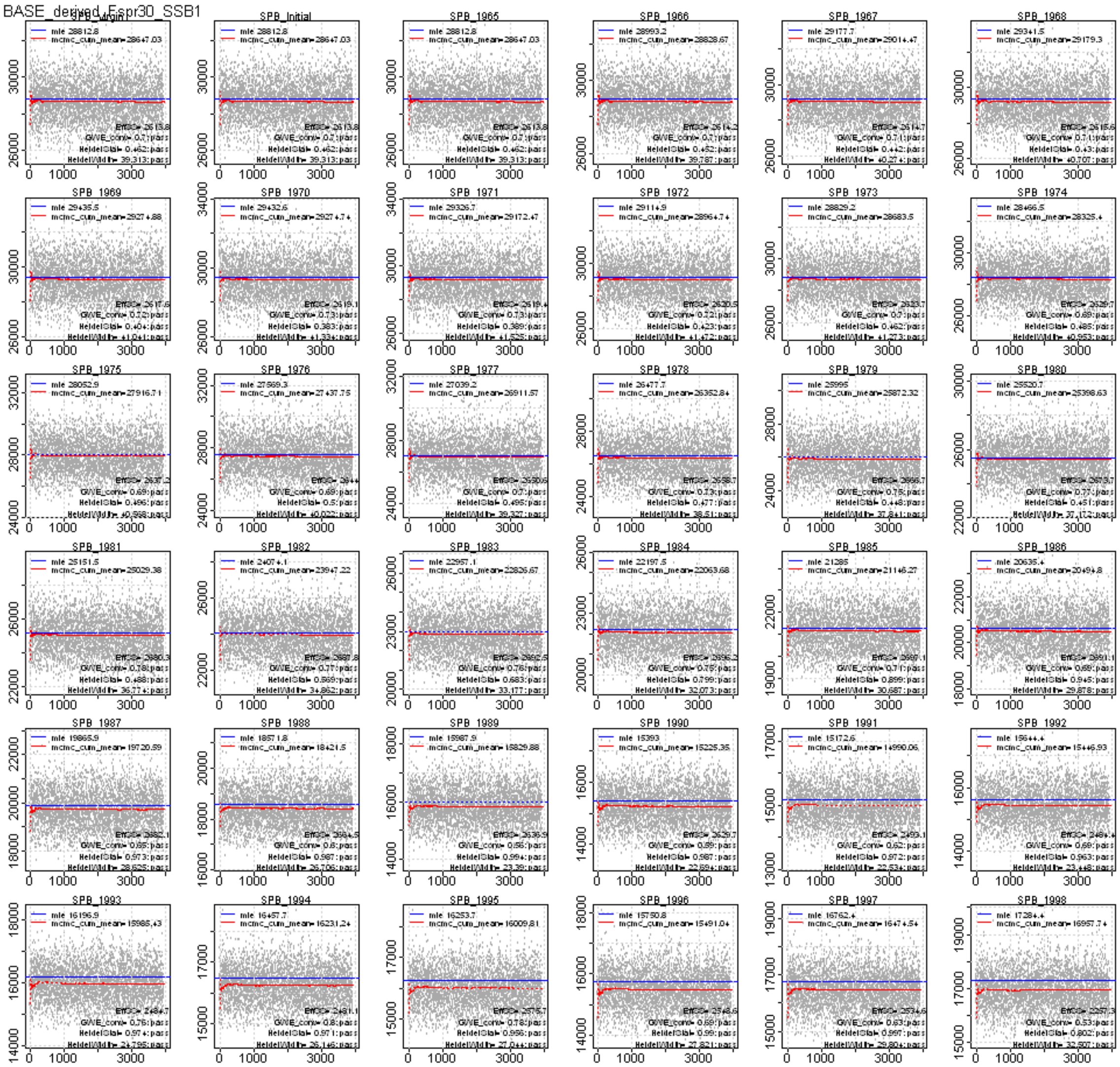
MCMC trace plots and diagnostics from Gulf of Mexico tilefish SS Run 1 with Fspr30% projection scenario.



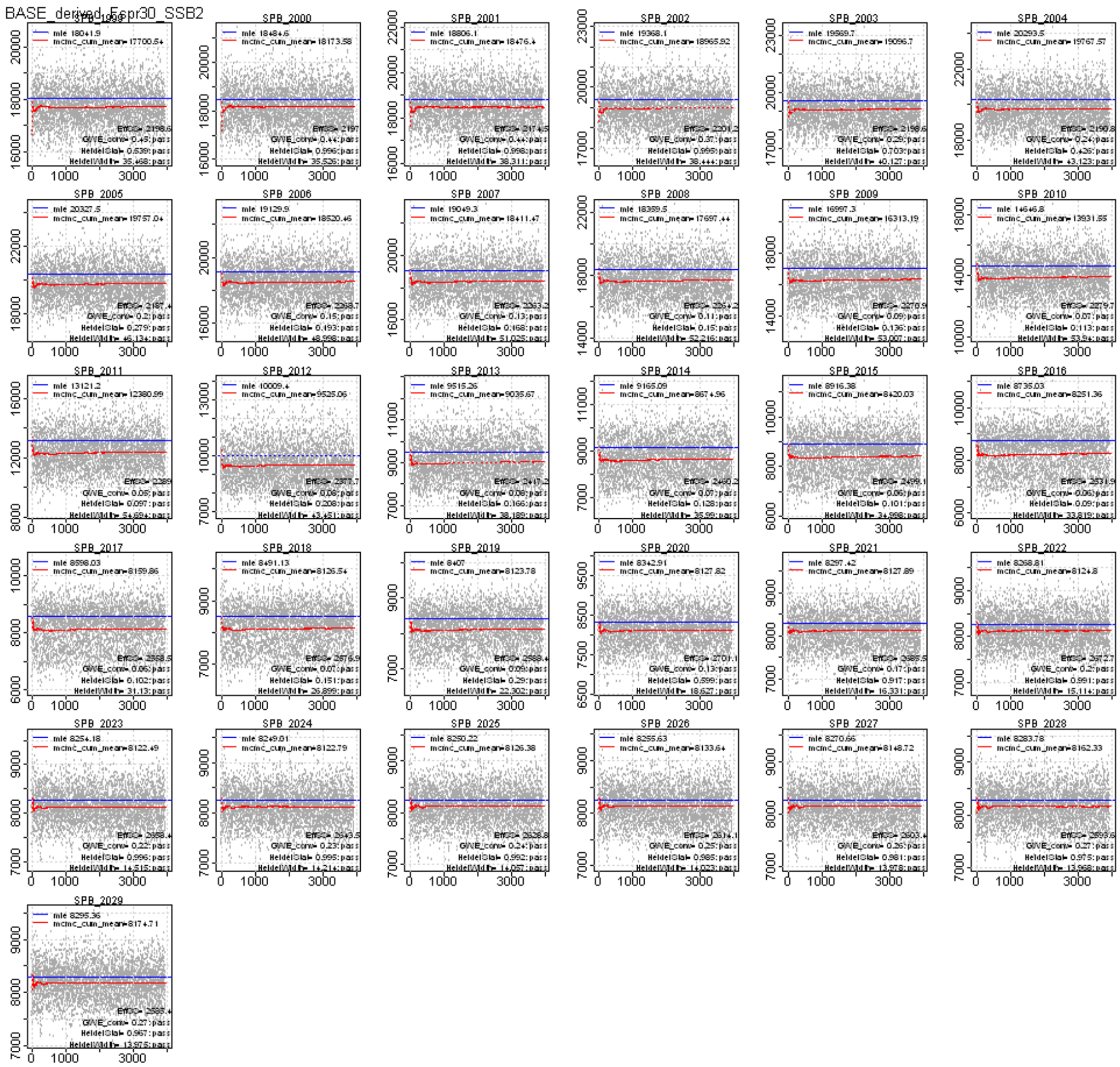
MCMC trace plots and diagnostics from Gulf of Mexico tilefish SS Run 1 with Fspr30% projection scenario (continued).



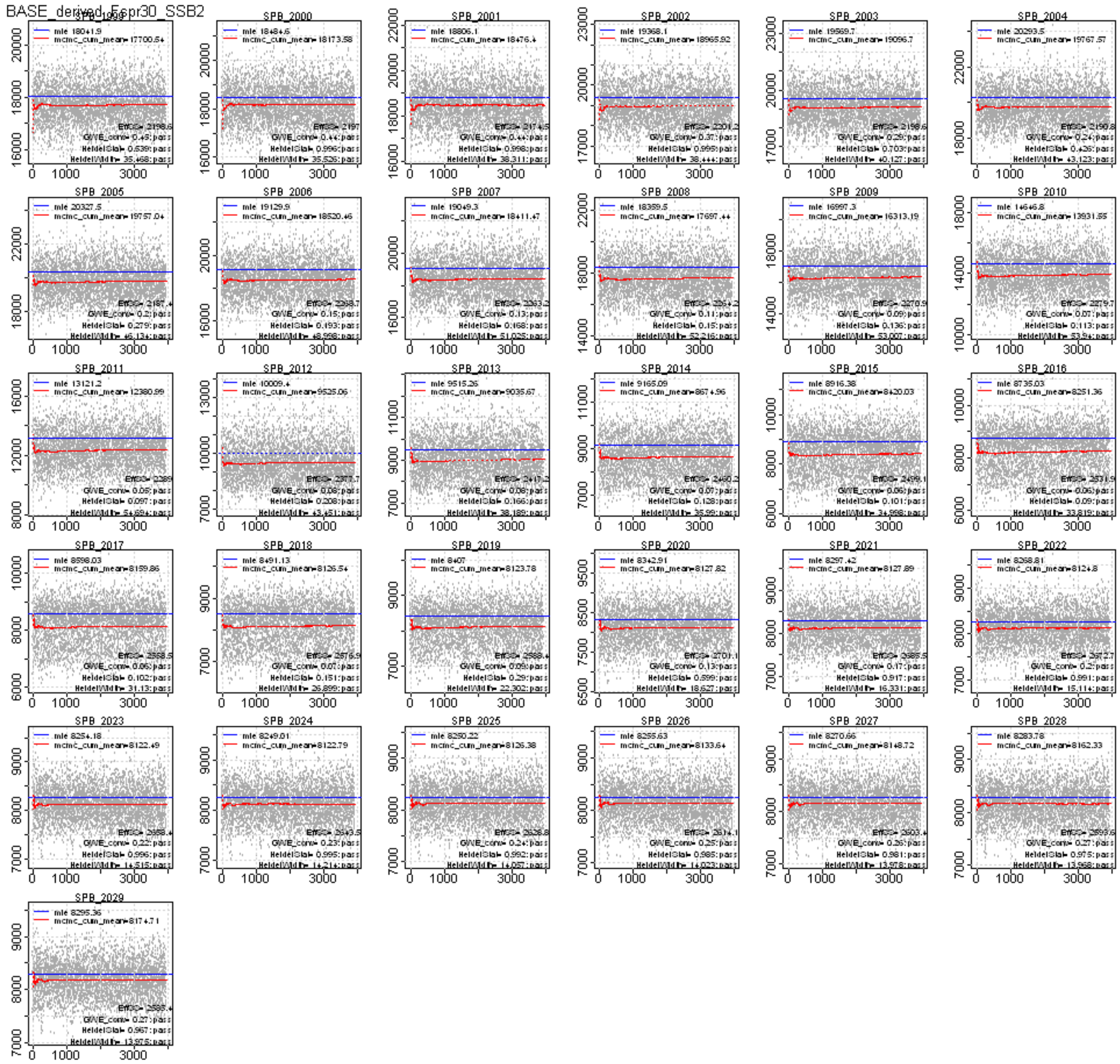
MCMC trace plots and diagnostics from Gulf of Mexico tilefish SS Run 1 with Fspr30% projection scenario (continued).



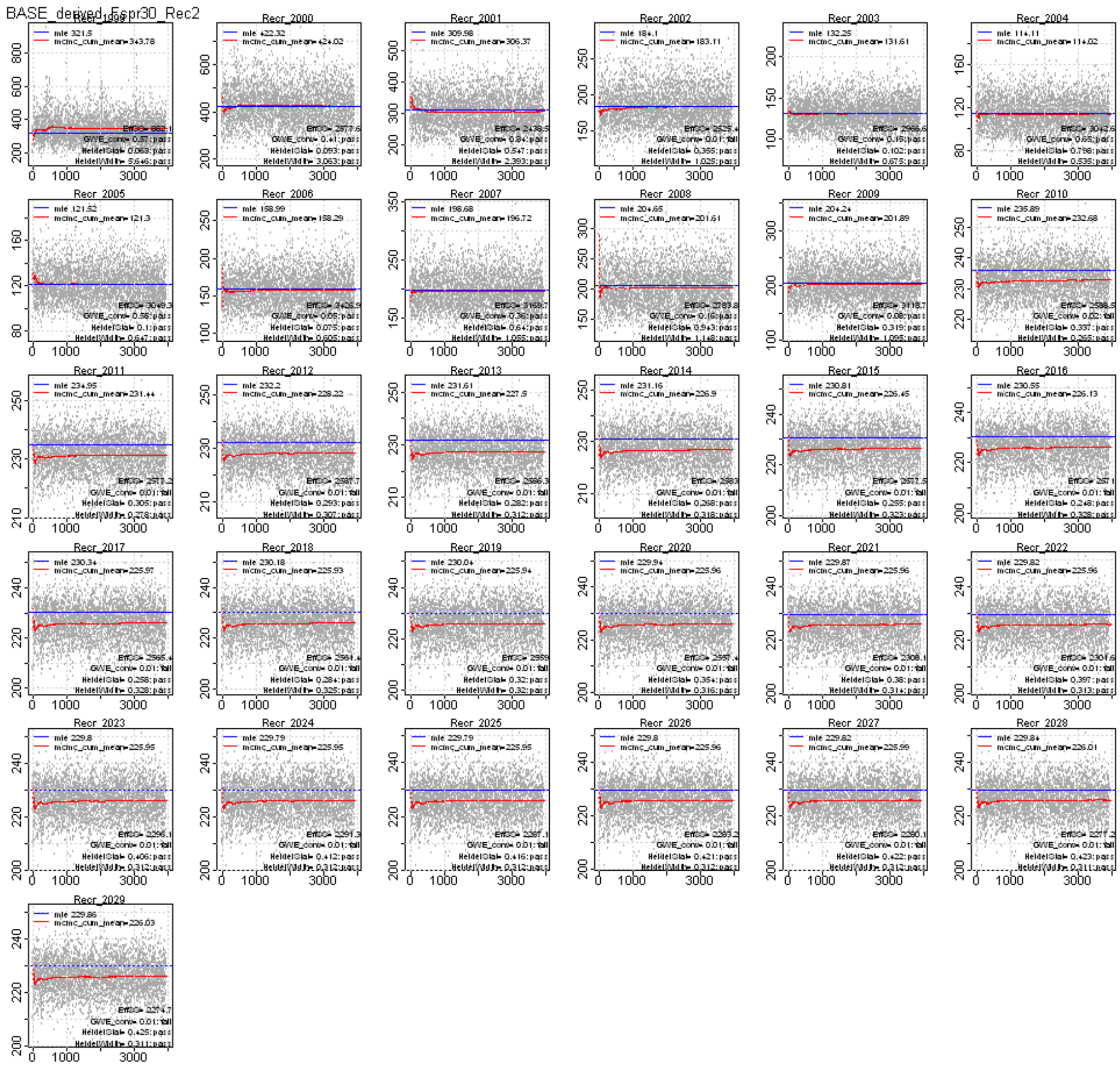
MCMC trace plots and diagnostics from Gulf of Mexico tilefish SS Run 1 with Fspr30% projection scenario (continued).



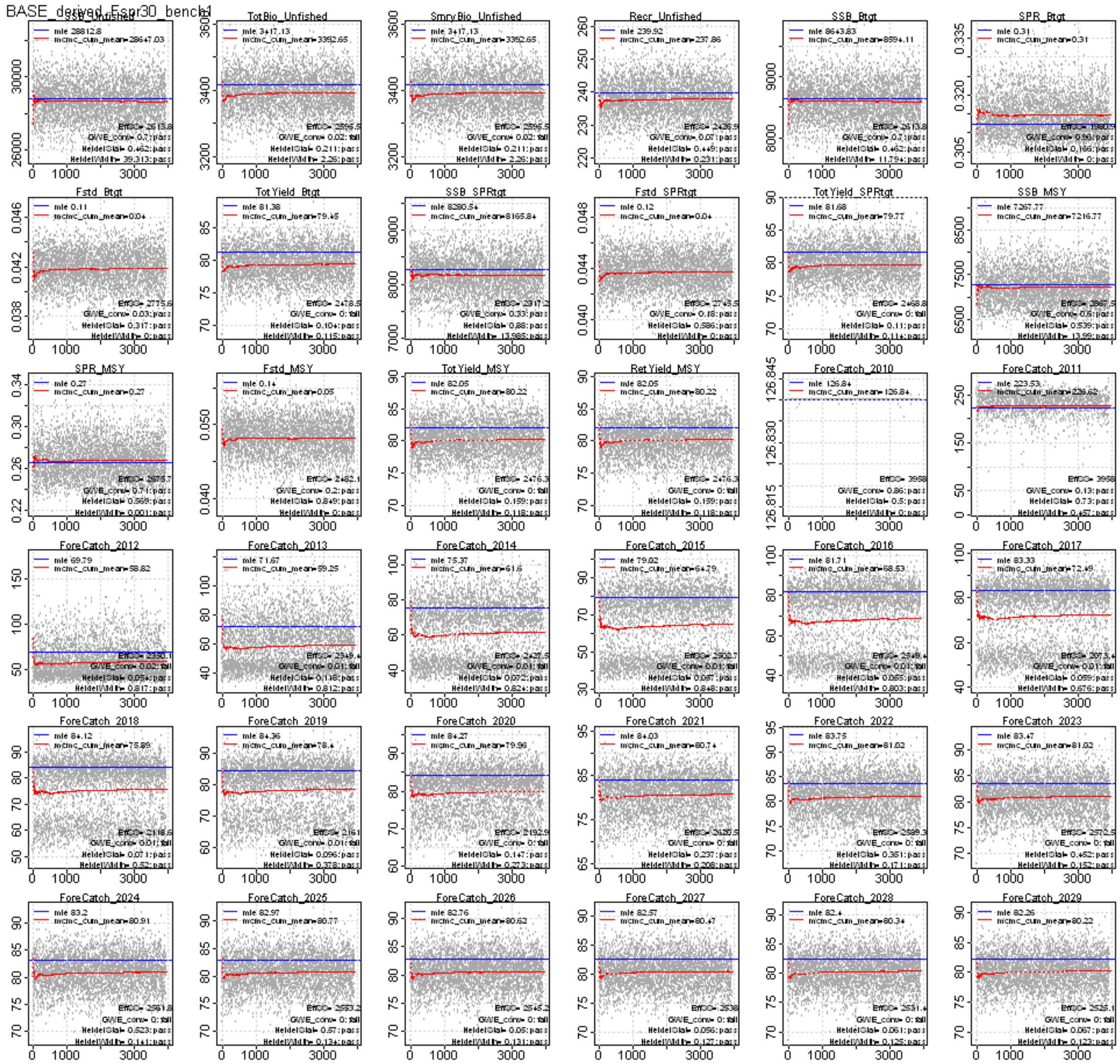
MCMC trace plots and diagnostics from Gulf of Mexico tilefish SS Run 1 with Fspr30% projection scenario (continued).



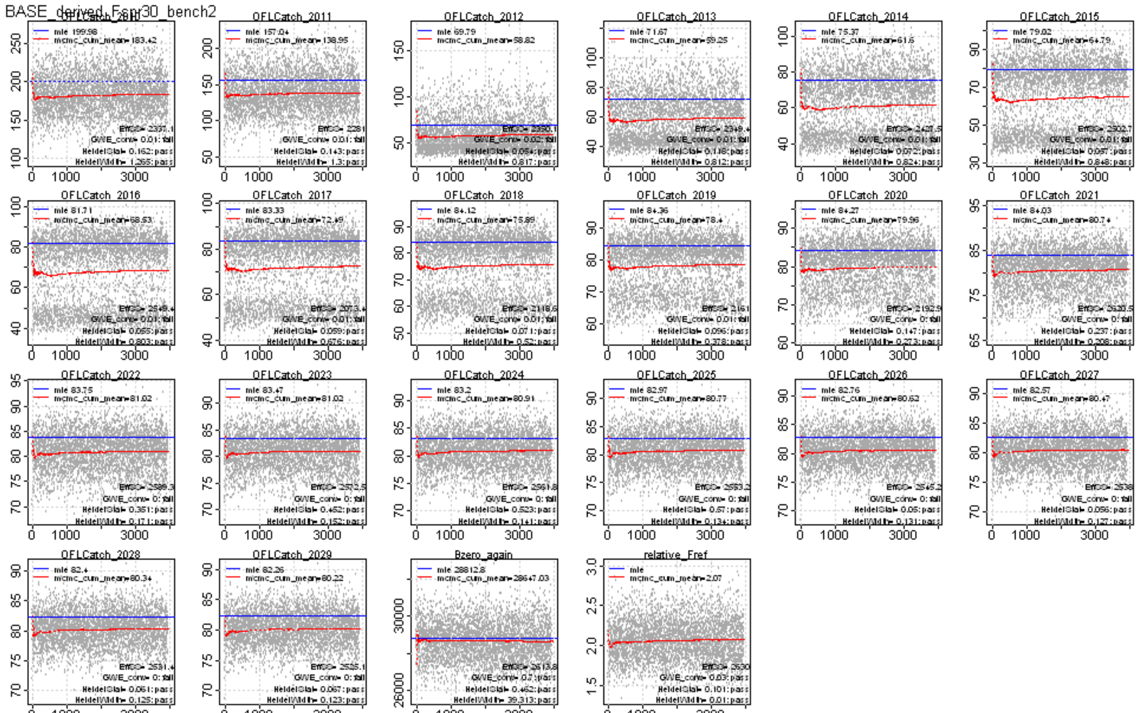
MCMC trace plots and diagnostics from Gulf of Mexico tilefish SS Run 1 with Fspr30% projection scenario (continued).



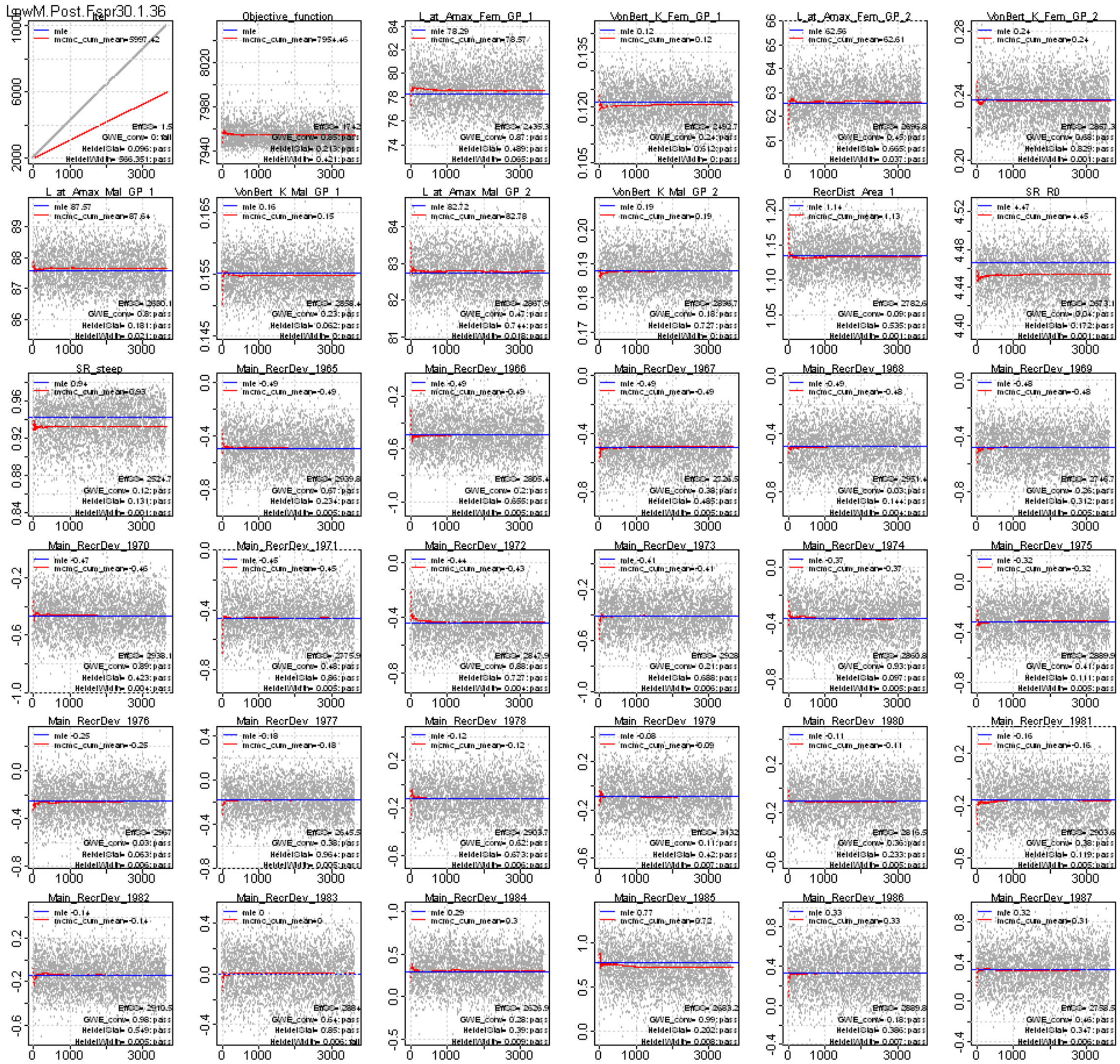
MCMC trace plots and diagnostics from Gulf of Mexico tilefish SS Run 1 with Fspr30% projection scenario (continued).



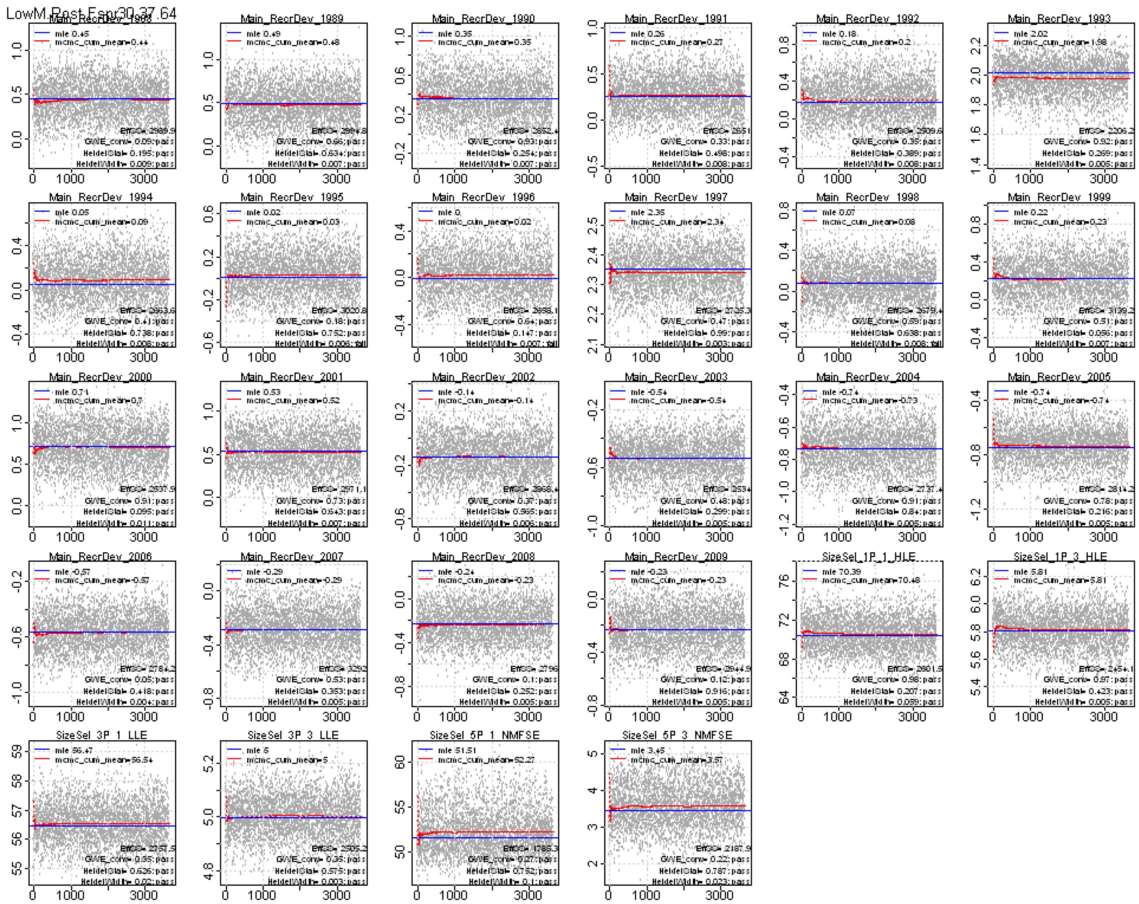
MCMC trace plots and diagnostics from Gulf of Mexico tilefish SS Run 1 with Fspr30% projection scenario (continued).



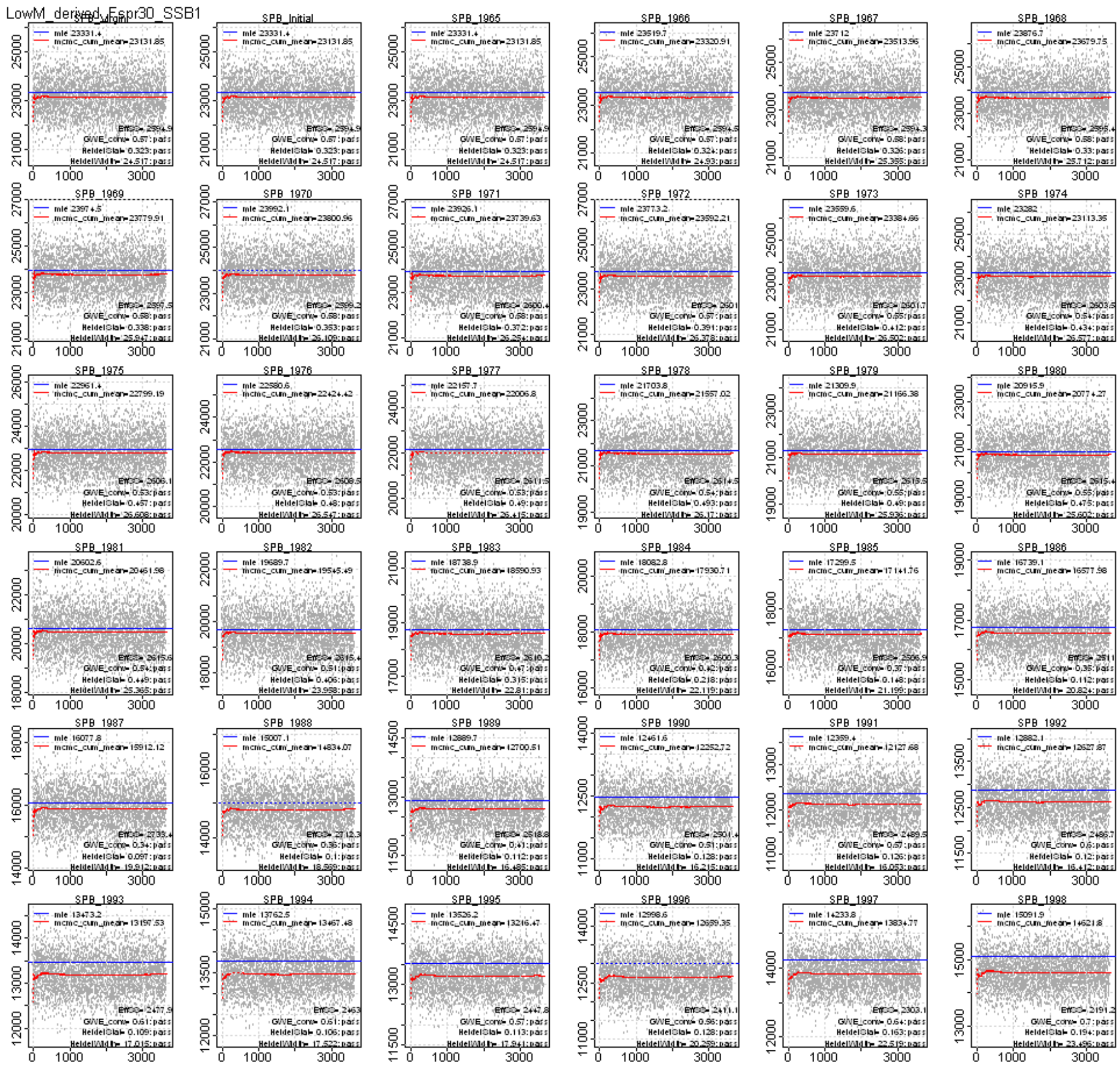
MCMC trace plots and diagnostics from Gulf of Mexico tilefish SS Run 3 with Fspr30% projection scenario.



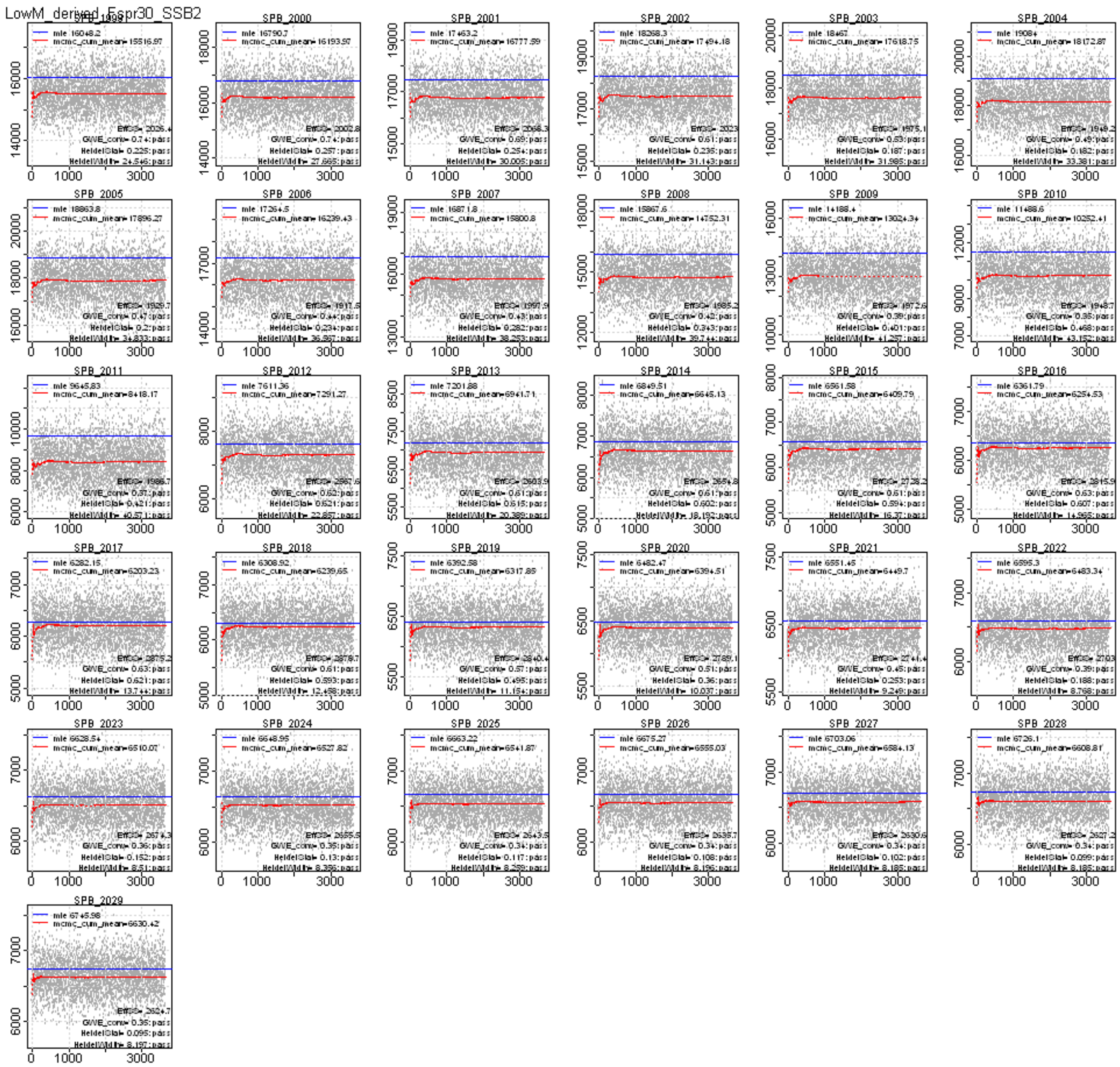
MCMC trace plots and diagnostics from Gulf of Mexico tilefish SS Run 3 with Fspr30% projection scenario (continued).



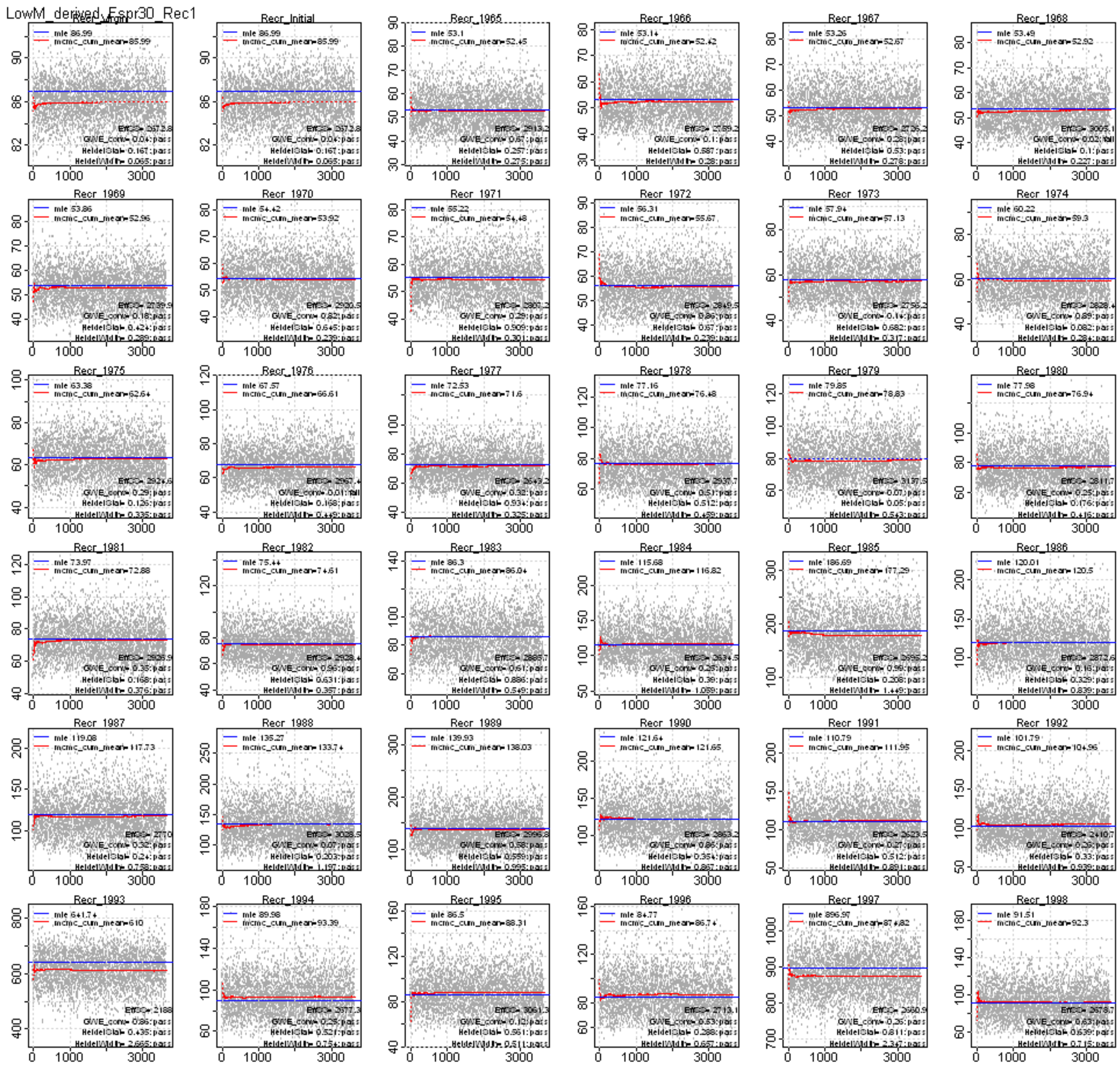
MCMC trace plots and diagnostics from Gulf of Mexico tilefish SS Run 3 with Fspr30% projection scenario (continued).



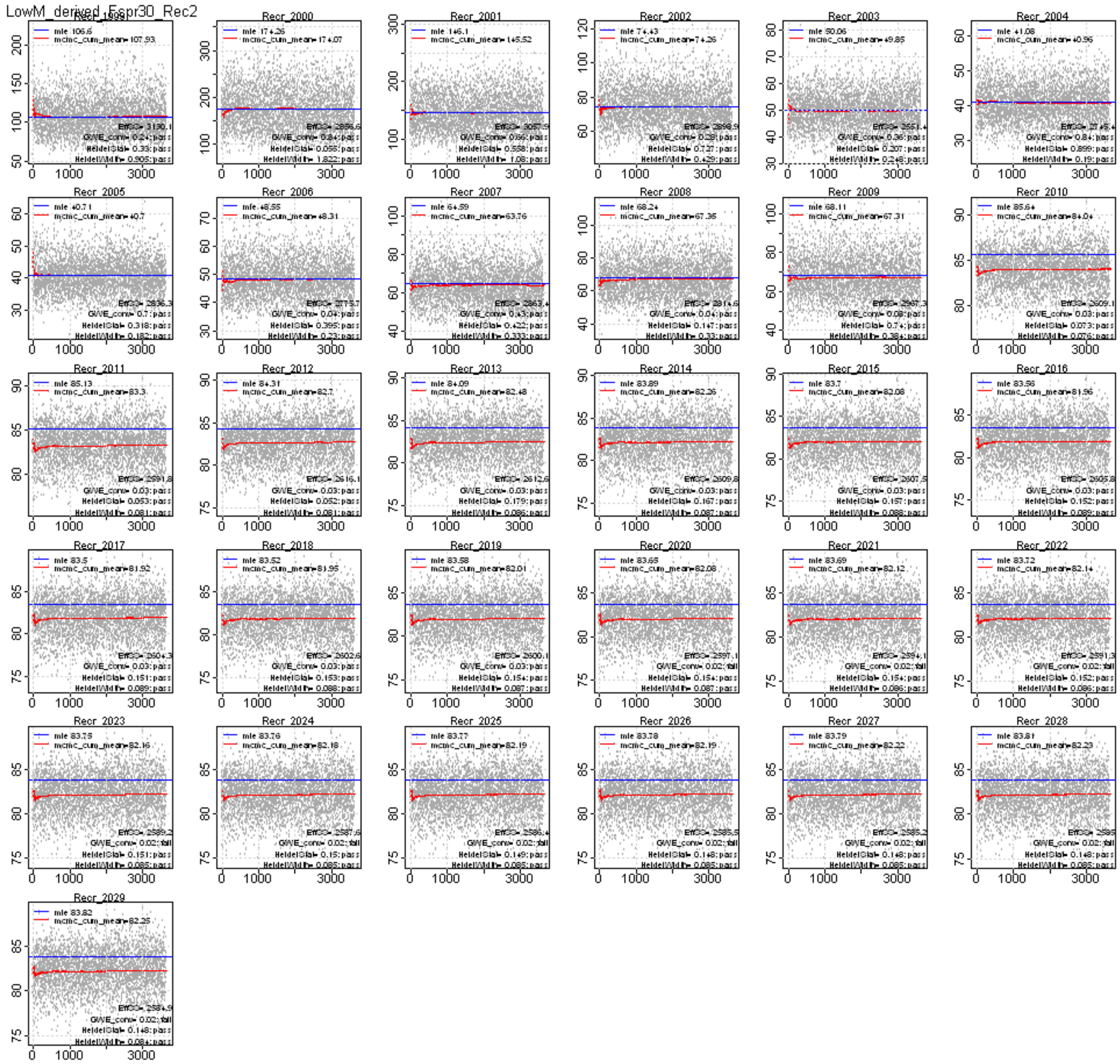
MCMC trace plots and diagnostics from Gulf of Mexico tilefish SS Run 3 with Fspr30% projection scenario (continued).



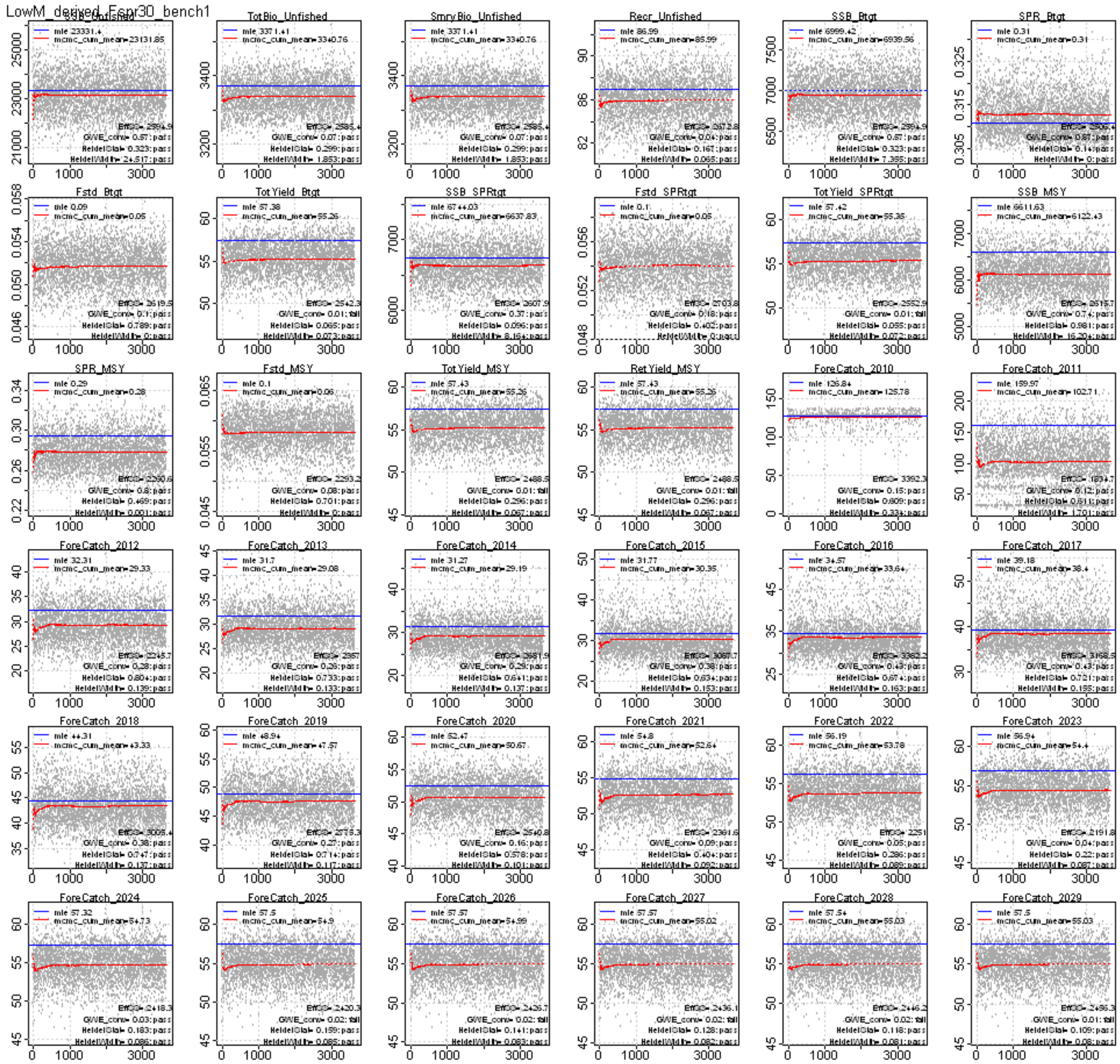
MCMC trace plots and diagnostics from Gulf of Mexico tilefish SS Run 3 with Fspr30% projection scenario (continued).



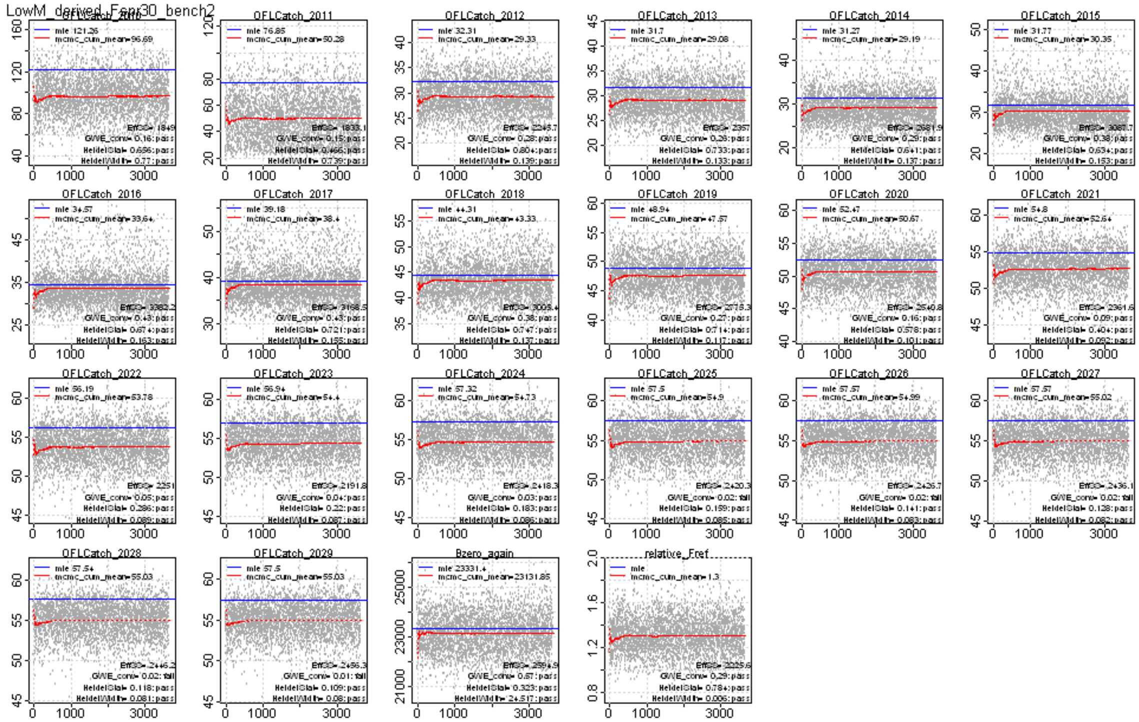
MCMC trace plots and diagnostics from Gulf of Mexico tilefish SS Run 3 with Fspr30% projection scenario (continued).



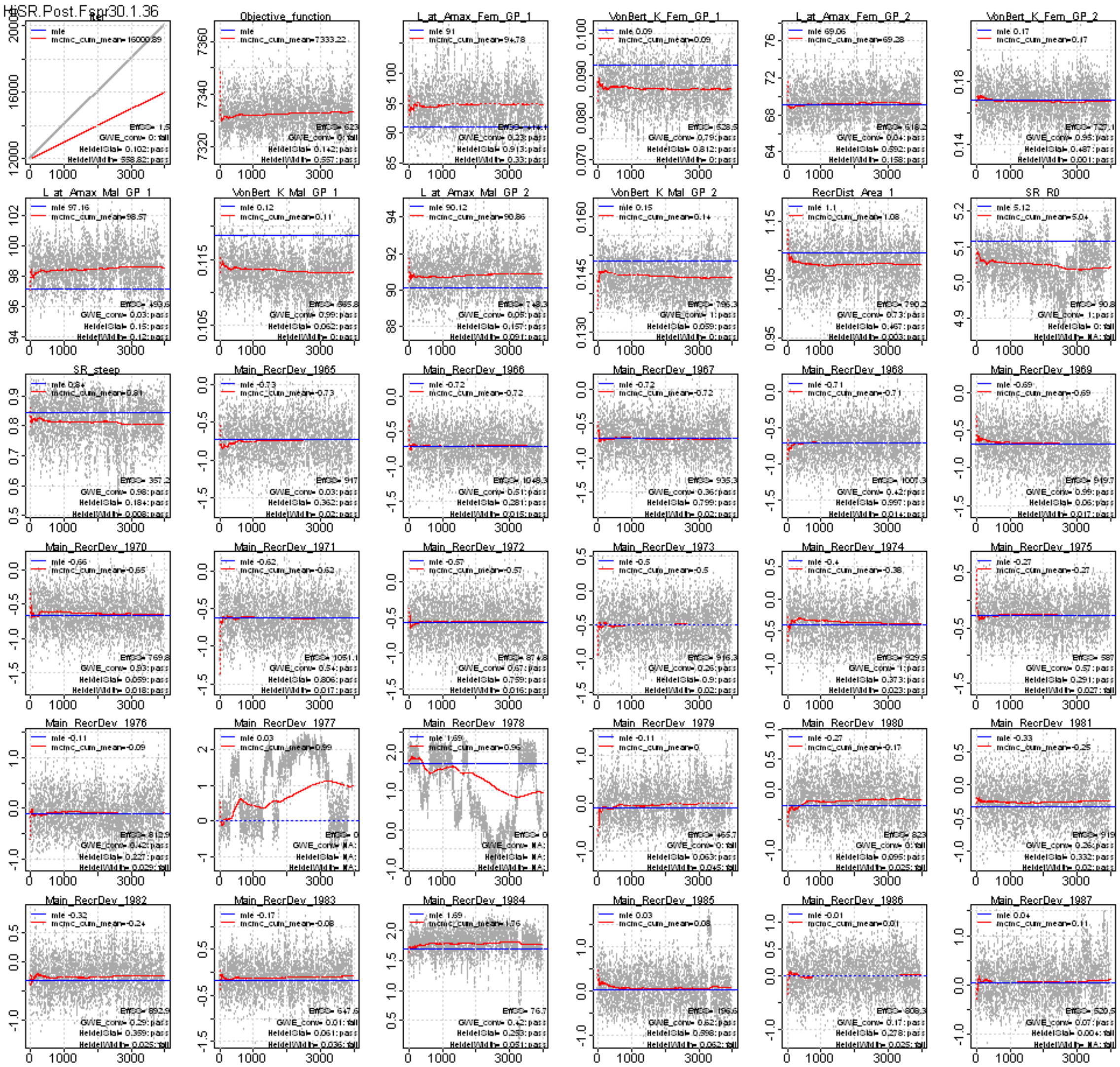
MCMC trace plots and diagnostics from Gulf of Mexico tilefish SS Run 3 with Fspr30% projection scenario (continued).



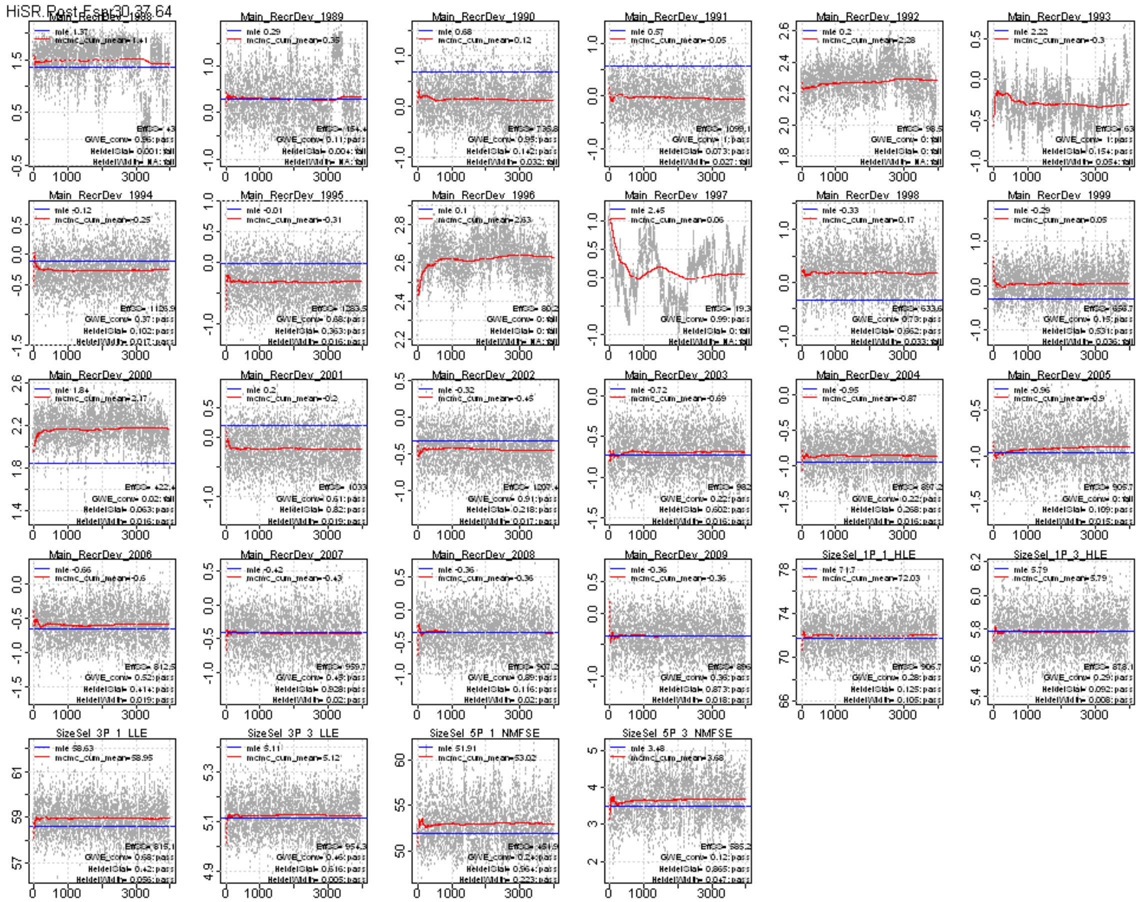
MCMC trace plots and diagnostics from Gulf of Mexico tilefish SS Run 3 with Fspr30% projection scenario (continued).



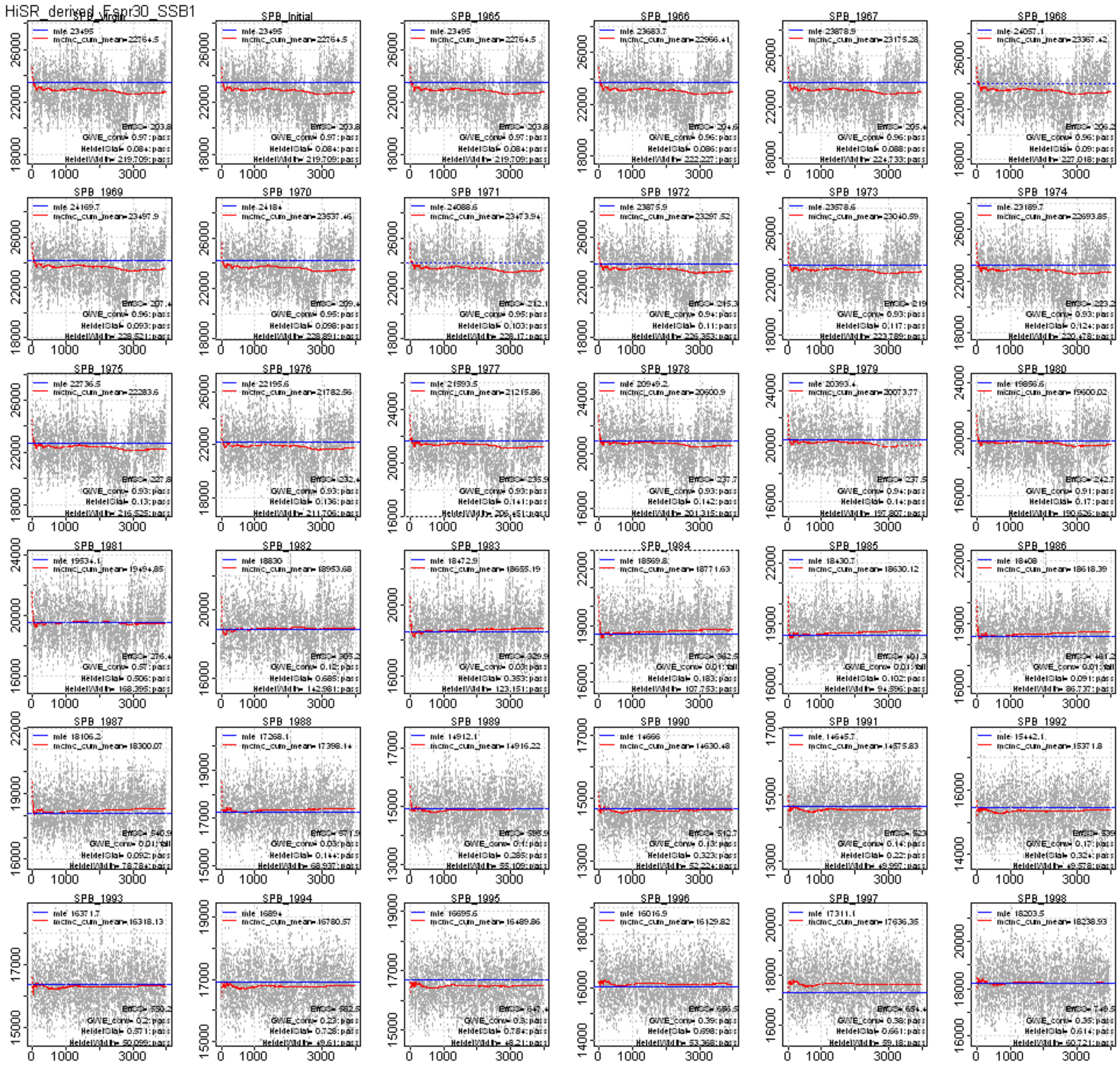
MCMC trace plots and diagnostics from Gulf of Mexico tilefish SS Run 9 with Fspr30% projection scenario.



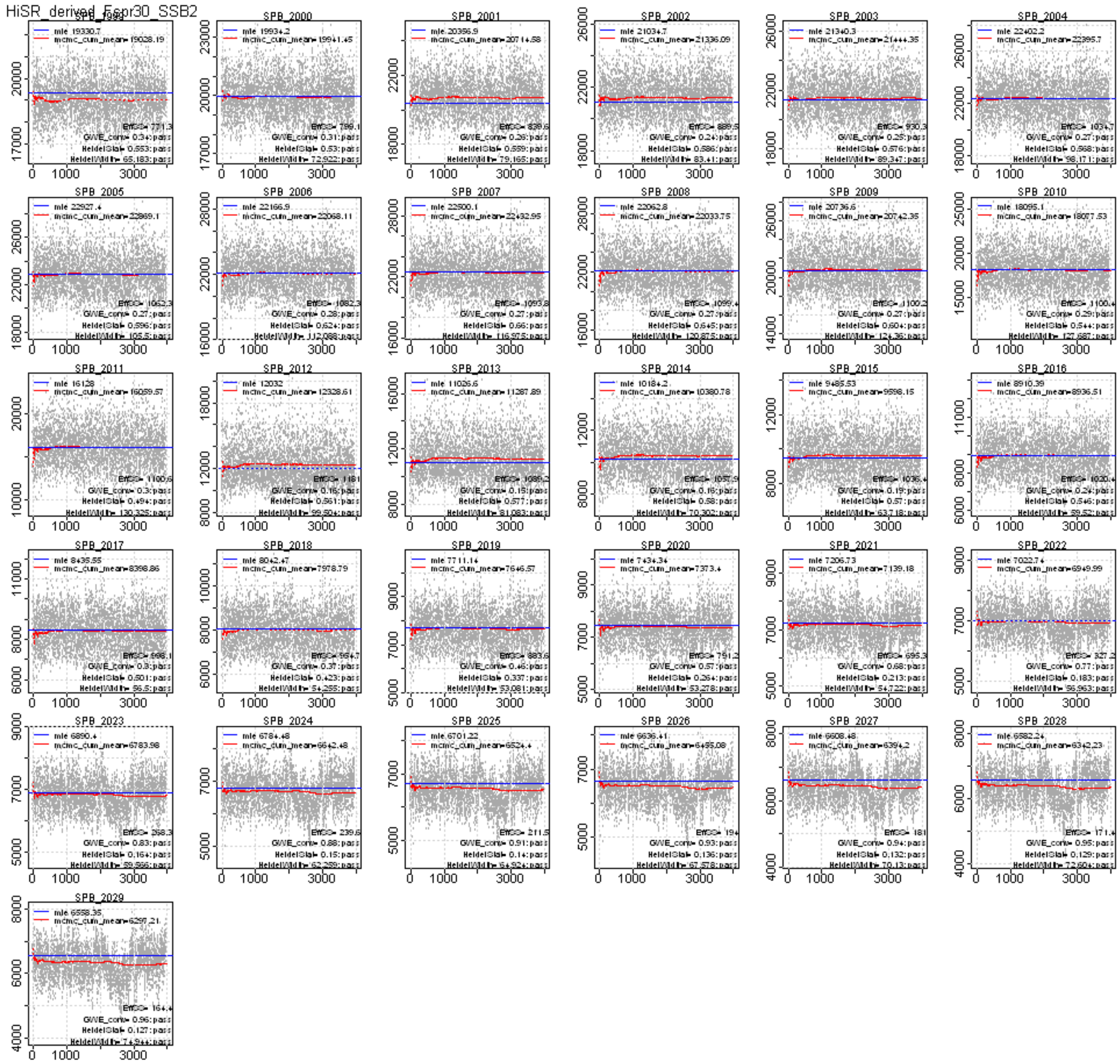
MCMC trace plots and diagnostics from Gulf of Mexico tilefish SS Run 9 with Fspr30% projection scenario (continued).



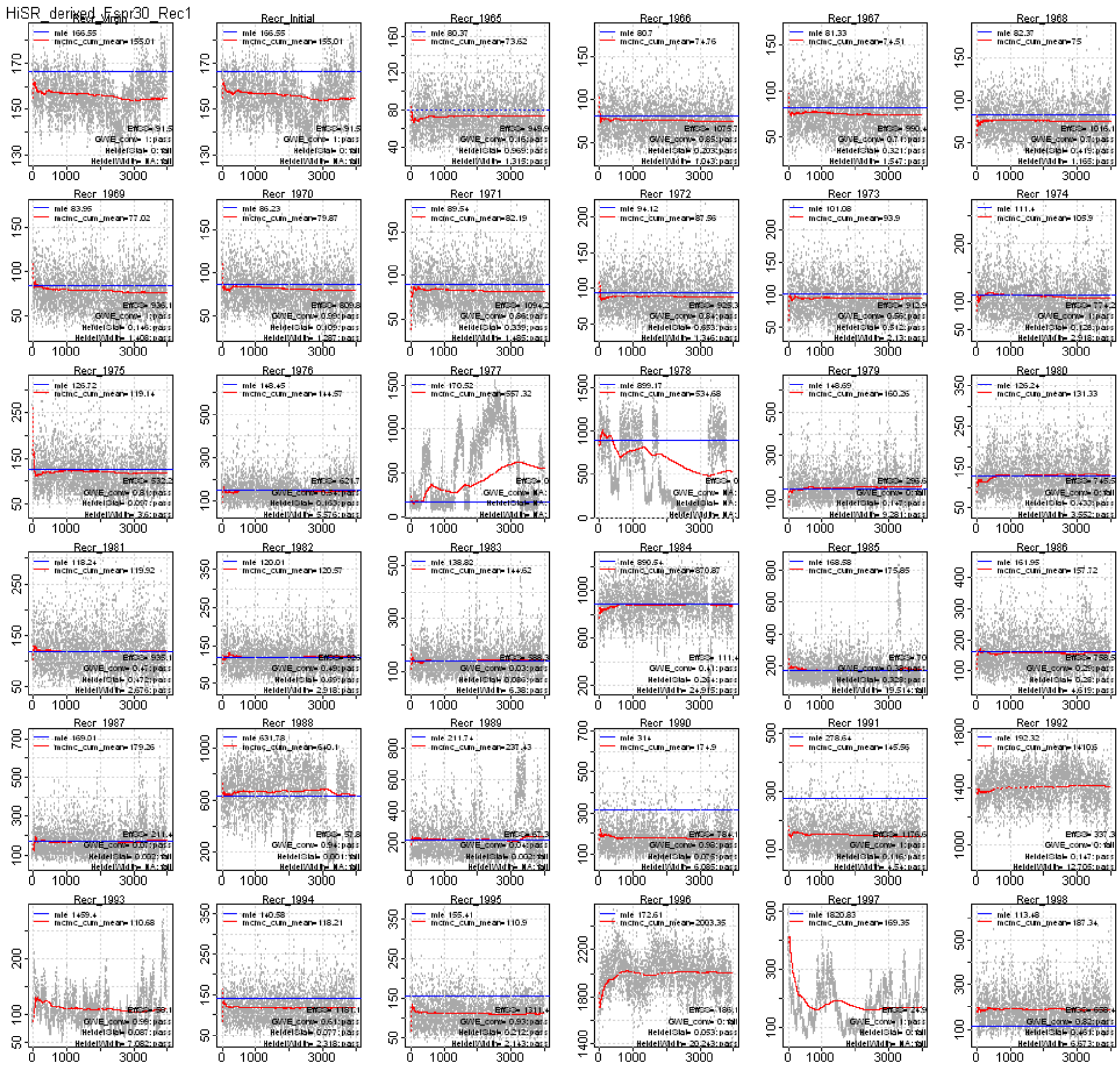
MCMC trace plots and diagnostics from Gulf of Mexico tilefish SS Run 9 with Fspr30% projection scenario (continued).



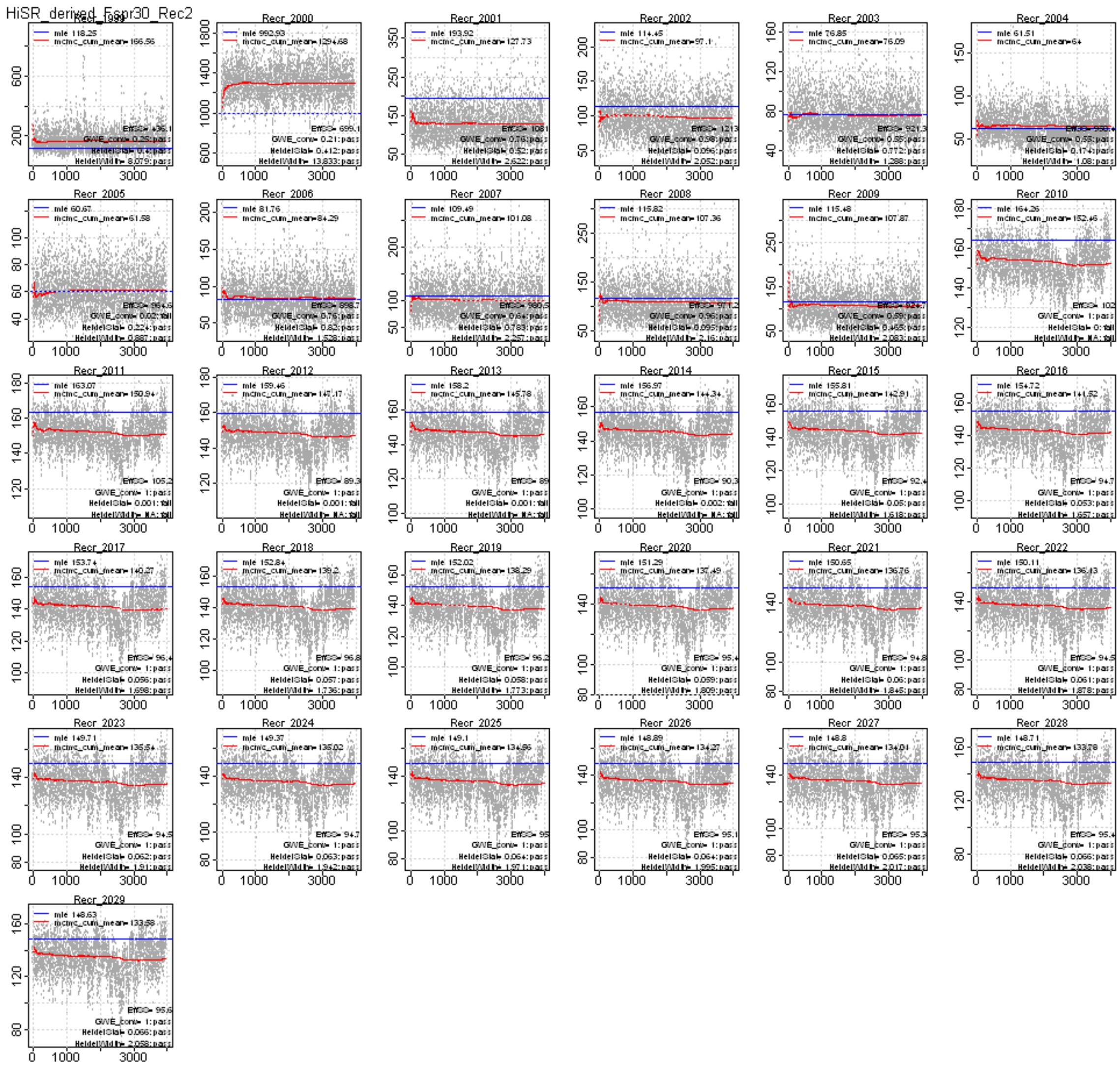
MCMC trace plots and diagnostics from Gulf of Mexico tilefish SS Run 9 with Fspr30% projection scenario (continued).



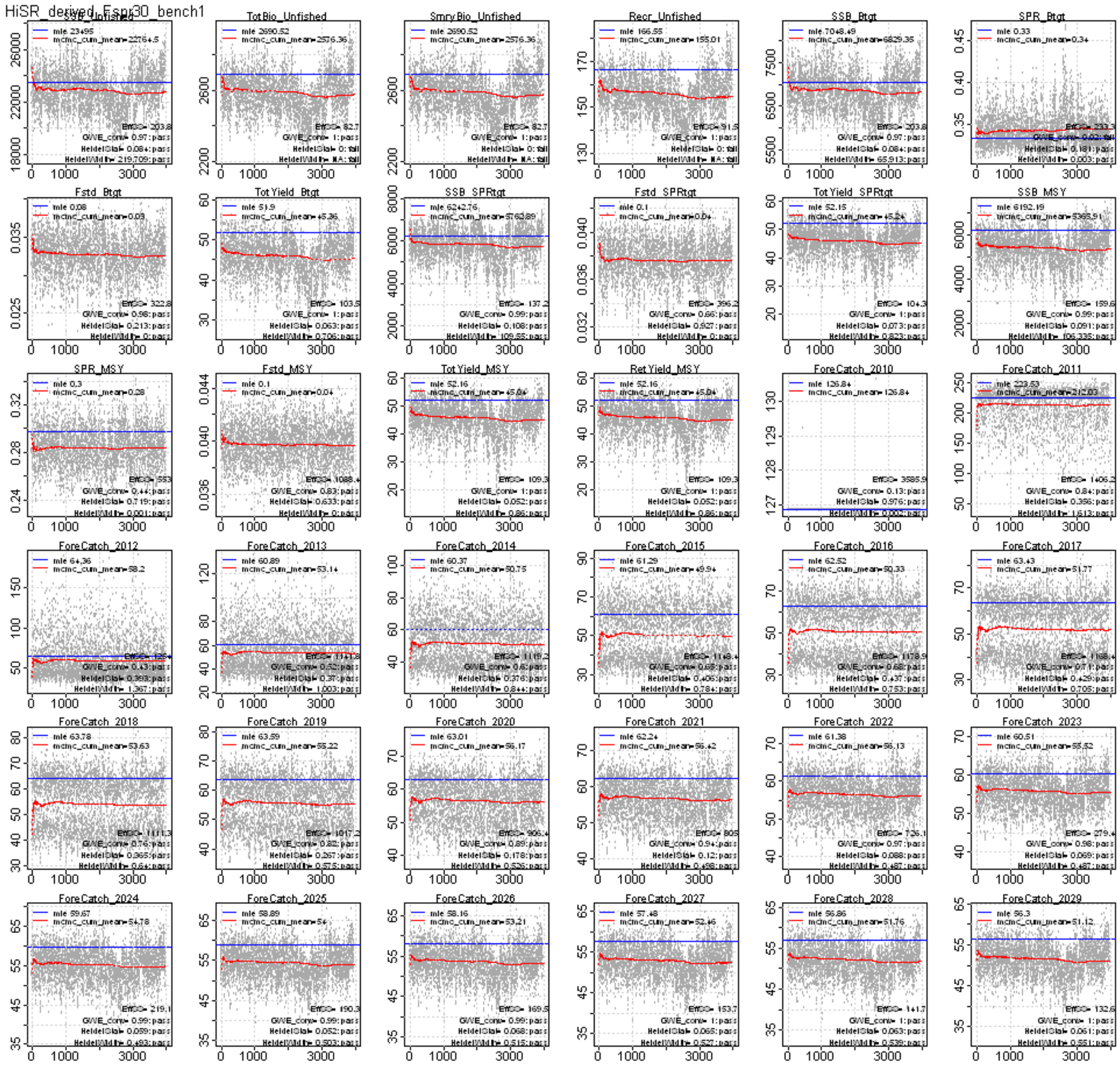
MCMC trace plots and diagnostics from Gulf of Mexico tilefish SS Run 9 with Fspr30% projection scenario (continued).



MCMC trace plots and diagnostics from Gulf of Mexico tilefish SS Run 9 with Fspr30% projection scenario (continued).



MCMC trace plots and diagnostics from Gulf of Mexico tilefish SS Run 9 with Fspr30% projection scenario (continued).



MCMC trace plots and diagnostics from Gulf of Mexico tilefish SS Run 9 with Fspr30% projection scenario (continued).