SEDAR

Southeast Data, Assessment, and Review

SEDAR 28

Gulf of Mexico Spanish Mackerel

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SECTION II: Data Workshop Report

May 2012

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 28 Data Workshop was held February 6-10, 2012 in Charleston, South Carolina. Webinars were held January 11, 2012 and March 14, 2012.

1.2 Terms of Reference

I. Data Workshop

1. Characterize stock structure and develop an appropriate stock definition. Provide maps of species and stock distribution.
2. Review, discuss and tabulate available life history information.
   - 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 (provide maps), sampling intensity, and other relevant characteristics
   - Develop CPUE and index values by appropriate strata (e.g., age, size, area, and fishery) and 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 for use in assessment modeling
4. Characterize commercial and recreational catch.
   - Include both landings and discards, in pounds and number of fish
   - Provide estimates of discard mortality rates by fishery and other strata as 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, and maps of fishery effort and harvest
5. Determine appropriate stock assessment models and/or other methods of evaluating stock status, determining yields, estimating appropriate population benchmarks, and making future projections that are suitable for making management decisions.
6. Describe any environmental covariates or episodic events that would be reasonably expected to affect population abundance.
7. Provide any information available about demographics and socioeconomics of fishermen, especially as they may relate to fishing effort.
8. Provide recommendations for future research, including guidance on sampling design, intensity, and appropriate strata and coverage.

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9. 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.
10. 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
    - Review and describe any ecosystem consideration(s) that should be included in the stock assessment report

II. Assessment Process

1. Review and provide justification for any changes in data following the data workshop and any analyses suggested by the data workshop. Summarize data as used in each assessment model.
2. Recommend a model configuration which is deemed most reliable for providing management advice using available compatible data. Document all input data, assumptions, and equations.
3. Incorporate known applicable environmental covariates into the selected model, and provide justification for why any of those covariates cannot be included at the time of the assessment.
4. Provide estimates of stock population parameters.
    - Include fishing mortality, abundance, biomass, selectivity, stock-recruitment relationship, and other parameters as appropriate given data availability and modeling approaches
    - Include appropriate and representative measures of precision for parameter estimates
5. 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'
6. Provide yield-per-recruit, spawner-per-recruit, and stock-recruitment evaluations.
7. Provide estimates of stock status relative to management criteria consistent with applicable FMPs, proposed FMPs and Amendments, other ongoing or proposed management programs, and National Standards for each model run presented for review.
8. Project future stock conditions and develop rebuilding schedules if warranted, including estimated generation time. Develop stock yield projections in both biomass and numbers of fish in accordance with the following:

    A) If stock is overfished:
    $F=0$, $F_{Current}$, F_{MSY}, F_{OY}
    $F=F_{Rebuild}$ (max that permits rebuild in allowed time)

    B) If stock is undergoing overfishing:
    $F= F_{Current}$, F_{MSY}, F_{OY}

    C) If stock is neither overfished nor undergoing overfishing:
    $F= F_{Current}$, F_{MSY}, F_{OY}

    D) If data limitations preclude classic projections (i.e. A, B, C above), explore alternate models to provide management advice
9. Provide a probability distribution function for the base model, or a combination of models that represent alternate states of nature, presented for review.
    - Determine the yield associated with a probability of exceeding OFL at P* values of 30% to 50% in single percentage increments for use with the Tier 1 ABC control rule

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- Provide justification for the weightings used in producing combinations of models

10. Provide recommendations for future research and data collection. Be as specific as possible in describing sampling design and intensity, and emphasize items which will improve assessment capabilities and reliability. Recommend the interval and type for the next assessment.
11. Prepare a spreadsheet containing all model parameter estimates and all relevant population information resulting from model estimates and projection and simulation exercises. Include all data included in assessment report tables and all data that support assessment workshop figures.
12. Complete the Assessment Workshop Report (Section III: SEDAR Stock Assessment Report).

III. Review Workshop

1. Evaluate the quality and applicability of data used in the assessment.
2. Evaluate the quality and applicability 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. Recommend and provide estimated values for appropriate management benchmarks and declarations of stock status for each model run presented for review.
5. Evaluate the quality and applicability of the methods used to project future population status. Recommend appropriate estimates of future stock condition.
6. Evaluate the quality and applicability 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
   - If there are significant changes to the base model, or to the choice of alternate states of nature, then provide a probability distribution function for the base model, or a combination of models that represent alternate states of nature, presented for review.
   - Determine the yield associated with a probability of exceeding OFL at P* values of 30% to 50% in single percentage increments
   - Provide justification for the weightings used in producing the combinations of models
7. If available, ensure that stock assessment results are accurately presented in the Stock Assessment Report and that stated results are consistent with Review Panel recommendations.
8. Evaluate the quality and applicability of the SEDAR Process as applied to the reviewed assessment and identify the degree to which Terms of Reference were addressed during the assessment process.
9. Make any additional recommendations or prioritizations warranted.
   - Clearly denote research and monitoring needs that could improve the reliability of future assessments
10. Prepare a Review Summary Report summarizing the Panel's evaluation of the stock assessment and addressing each Term of Reference. Develop a list of tasks to be completed following the workshop. Complete and submit the Review Summary Report no later than the date set by the Review Panel Chair at the conclusion of the workshop.

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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, alternate 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

Amy Dukes
Amy Schueller
Beverly Sauls
Bill Parker
Bob Zales II
Chip Collier
Chris Kalinowski
Chris Palmer
Dave Donaldson
David Gloeckner
Donna Bellais
Doug Devries
Doug Mumford
Eric Fitzpatrick
Erik Williams
Ernst Peebles
Jeanne Boylan
Jeff Isely
Jennifer Potts
Jim Franks
Joe Cimino
Joe Smith
John Ward
Julia Byrd
Julie Defilippi
Justin Yost
Karl Brenkert
Katie Andrews
Kelly Fitzpatrick
Ken Brennan
Kevin Craig
Kevin McCarthy
Kyle Shertzer
Lew Coggins
Liz Scott-Denton
Marcel Reichert
Matt Perkinson
Meaghan Bryan
Mike Denson
Nancie Cummings
Neil Baertlein
Pearse Webster
Read Hendon
Refik Orhum
Rob Cheshire
Robert Johnson
Rusty Hudson
Shannon Calay
Stephanie McInerny
Steve Brown
Ben Hartig
Kari Fenske
Ryan Rindone
Rachael Silvas
Mike Errigo
Sue Gerhart
Gregg Waugh
Clay Porch
Todd Gedamke
Mike Larkin
Steve Saul
Adam Pollack
Steve Turner
Patrick Gilles
John Carmichael
Michael Schirripa
Julie Neer
Tanya Darden
Tim Sartwell
Tom Ogle
Vivian Matter
Walter Ingram
Danielle Chesky
Katie Drew
Erik Hiltz
Frank Hester
Peter Barile
Carly Altizer
Marin Hawk
Mark E Brown
C. Michelle Willis
Carrie Hendrix
Jon Richardsen
Patrick Biando

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1.4 List of Data Workshop Working Papers

Gulf and South Atlantic Spanish Mackerel and Cobia
Workshop Document List

Document #	Title	Authors
Documents Prepared for the Data Workshop		
SEDAR28-DW01	Cobia preliminary data analyses – US Atlantic and GOM genetic population structure	T. Darden 2012
SEDAR28-DW02	South Carolina experimental stocking of cobia *Rachycentron canadum*	M. Denson 2012
SEDAR28-DW03	Spanish Mackerel and Cobia Abundance Indices from SEAMAP Groundfish Surveys in the Northern Gulf of Mexico	Pollack and Ingram, 2012
SEDAR28-DW04	Calculated discards of Spanish mackerel and cobia from commercial fishing vessels in the Gulf of Mexico and US South Atlantic	K. McCarthy
SEDAR28-DW05	Evaluation of cobia movement and distribution using tagging data from the Gulf of Mexico and South Atlantic coast of the United States	M. Perkinson and M. Denson 2012
SEDAR28-DW06	Methods for Estimating Shrimp Bycatch of Gulf of Mexico Spanish Mackerel and Cobia	B. Linton 2012
SEDAR28-DW07	Size Frequency Distribution of Spanish Mackerel from Dockside Sampling of Recreational and Commercial Landings in the Gulf of Mexico 1981-2011	N.Cummings and J. Isely
SEDAR28-DW08	Size Frequency Distribution of Cobia from Dockside Sampling of Recreational and Commercial Landings in the Gulf of Mexico 1986-2011	J. Isely and N. Cummings
SEDAR28-DW09	Texas Parks and Wildlife Catch Per unit of Effort Abundance Information for Spanish mackerel	N. Cummings and J. Isely
SEDAR28-DW10	Texas Parks and Wildlife Catch Per unit of Effort Abundance Information for cobia	J. Isely and N. Cummings
SEDAR28-DW11	Size Frequency Distribution of Cobia and Spanish Mackerel from the Galveston, Texas, Reef Fish Observer Program 2006-2011	J Isely and N Cummings
SEDAR28-DW12	Estimated conversion factors for calibrating MRFSS charterboat landings and effort estimates for the South Atlantic and Gulf of Mexico in 1981-1985 with For Hire Survey estimates with application to Spanish mackerel and cobia landings	V. Matter, N Cummings, J Isely, K Brennen, and K Fitzpatrick
SEDAR28-DW13	Constituent based tagging of cobia in the Atlantic and Gulf of Mexico waters	E. Orbesen
SEDAR28-DW14	Recreational Survey Data for Spanish Mackerel and Cobia in the Atlantic and the Gulf of Mexico	V. Matter

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	from the MRFSS and TPWD Surveys	
SEDAR28-DW15	Commercial Vertical Line and Gillnet Vessel Standardized Catch Rates of Spanish Mackerel in the US Gulf of Mexico, 1998-2010	N. Baertlein and K. McCarthy
SEDAR28-DW16	Commercial Vertical Line Vessel Standardized Catch Rates of Cobia in the US Gulf of Mexico, 1993-2010	K. McCarthy
SEDAR28-DW17	Standardized Catch Rates of Spanish Mackerel from Commercial Handline, Trolling and Gillnet Fishing Vessels in the US South Atlantic, 1998-2010	K. McCarthy
SEDAR28-DW18	Standardized catch rates of cobia from commercial handline and trolling fishing vessels in the US South Atlantic, 1993-2010	K. McCarthy
SEDAR28-DW19	MRFSS Index for Atlantic Spanish mackerel and cobia	Drew et al.
SEDAR28-DW20	Preliminary standardized catch rates of Southeast US Atlantic cobia (*Rachycentron canadum*) from headboat data.	NMFS Beaufort
SEDAR28-DW21	Spanish mackerel preliminary data summary: SEAMAP-SA Coastal Survey	Boylan and Webster
SEDAR28-DW22	Recreational indices for cobia and Spanish mackerel in the Gulf of Mexico	Bryan and Saul
SEDAR28-DW23	A review of Gulf of Mexico and Atlantic Spanish mackerel (*Scomberomorus maculatus*) age data, 1987-2011, from the Panama City Laboratory, Southeast Fisheries Science Center, NOAA Fisheries Service	Palmer, DeVries, and Fioramonti
SEDAR28-DW24	SCDNR Charterboat Logbook Program Data, 1993 - 2010	Errigo, Hiltz, and Byrd
SEDAR28-DW25	South Carolina Department of Natural Resources State Finfish Survey (SFS)	Hiltz and Byrd
SEDAR28-DW26	Cobia bycatch on the VIMS elasmobranch longline survey:1989-2011	Parsons et al.
Reference Documents		
SEDAR28-RD01	List of documents and working papers for SEDAR 17 (South Atlantic Spanish mackerel) – all documents available on the SEDAR website	SEDAR 17
SEDAR28-RD02	2003 Report of the mackerel Stock Assessment Panel	GMFMC and SAFMC, 2003
SEDAR28-RD03	Assessment of cobia, *Rachycentron canadum*, in the waters of the U.S. Gulf of Mexico	Williams, 2001

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SEDAR28-RD04	Biological-statistical census of the species entering fisheries in the Cape Canaveral area	Anderson and Gehringer, 1965
SEDAR28-RD05	A survey of offshore fishing in Florida	Moe 1963
SEDAR28-RD06	Age, growth, maturity, and spawning of Spanish mackerel, *Scomberomorus maculates* (Mitchill), from the Atlantic Coast of the southeastern United States	Schmidt et al. 1993
SEDAR28-RD07	Omnibus amendment to the Interstate Fishery Management Plans for Spanish mackerel, spot, and spotted seatrout	ASMFC 2011
SEDAR28-RD08	Life history of Cobia, *Rachycentron canadum* (Osteichthyes: Rachycentridae), in North Carolina waters	Smith 1995
SEDAR28-RD09	Population genetics of cobia *Rachycentron canadum*: Management implications along the Southeastern US coast	Darden et al, 2012
SEDAR28-RD10	Inshore spawning of cobia (*Rachycentron canadum*) in South Carolina	Lefebvre and Denson, 2012
SEDAR28-RD11	A review of age, growth, and reproduction of cobia *Rachycentron canadum*, from US water of the Gulf of Mexico and Atlantic ocean	Franks and Brown-Peterson, 2002
SEDAR28-RD12	An assessment of cobia in Southeast US waters	Thompson 1995
SEDAR28-RD13	Reproductive biology of cobia, *Rachycentron canadum*, from coastal waters of the southern United States	Brown-Peterson et al. 2001
SEDAR28-RD14	Larval development, distribution, and ecology of cobia *Rachycentron canadum* (Family: Rachycentridae) in the northern Gulf of Mexico	Ditty and Shaw 1992
SEDAR28-RD15	Age and growth of cobia, *Rachycentron canadum*, from the northeastern Gulf of Mexico	Franks et al 1999
SEDAR28-RD16	Age and growth of Spanish mackerel, *Scomberomorus maculates*, in the Chesapeake Bay region	Gaichas, 1997
SEDAR28-RD17	Status of the South Carolina fisheries for cobia	Hammond, 2001
SEDAR28-RD18	Age, growth and fecundity of the cobia, *Rachycentron canadum*, from Chesapeake Bay and adjacent Mid-Atlantic waters	Richards 1967
SEDAR28-RD19	Cobia (*Rachycentron canadum*) tagging within Cheasapeake Bay and updating of growth equations	Richards 1977
SEDAR28-RD20	Synopsis of biological data on the cobia *Rachycentron canadum* (Pisces: Rachycentridae)	Shaffer and Nakamura 1989
SEDAR28-RD21	South Carolina marine game fish tagging program 1978-2009	Wiggers, 2010

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SEDAR28-RD22	Cobia (*Rachycentron canadum*), amberjack (*Seriola dumerili*), and dolphin (*Coryphaena hipurus*) migration and life history study off the southwest coast of Florida	MARFIN 1992
SEDAR28-RD23	Sport fish tag and release in Mississippi coastal water and the adjacent Gulf of Mexico	Hendon and Franks 2010
SEDAR28-RD24	VMRC Cobia otolith preparation protocol	VMRC
SEDAR28-RD25	VMRC Cobia otolith ageing protocol	VMRC

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2 Life History

2.1 Overview

Overview
The life history working group (LHG) discussed information regarding stock structure, natural mortality, discard mortality, age, growth, movements, and reproduction of Atlantic and Gulf of Mexico stocks of Spanish mackerel.

Group Membership
Jennifer Potts (Workgroup Leader)……..…NMFS -Beaufort
Doug DeVries (Leader – Cobia)……...NMFS - Panama City
Chris Palmer (Leader – Spanish mackerel)...NMFS – Panama City
Karl Brenkert……..…..SC DNR
Joe Cimino……VMRC
Chip Collier……..SA SSC
Tanya Darden…….……..SC DNR
Mike Denson……SC DNR
Jim Franks…….……USM
Randy Gregory……NC DMF
Read Hendon……USM
Chris Kalinowski……GA DNR
Ernst Peebles……..……USF
Matt Perkinson……SC DNR
Marcel Reichert……..…SA SSC
Joe Smith……NMFS Beaufort
John Ward……....Gulf SSC
Erik Williams……...NMFS Beaufort
Justin Yost……...SC DNR

Issues
Some of the main issues discussed by the LHG were discard mortality rates in both the Atlantic and Gulf of Mexico stocks and fitting the von Bertalanffy parameter t_0 age 0 samples to more accurately model growth parameters as was the case in SEDAR 17.

2.2 Review of Working Papers

(SEDAR28-DW23) A review of Gulf of Mexico and Atlantic Spanish mackerel (Scomberomorus maculatus) age data, 1987-2011, from the Panama City Laboratory, Southeast Fisheries Science Center, NOAA Fisheries Service

C. Palmer, D. DeVries, and C. Fioramonti

Abstract

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A total of 29,168 (n = 16,667 ATL, n = 12,501 GOM) Spanish mackerel collected during 1987 - 2011 have been aged by the Panama City Laboratory. Of those aged, 49% were from the commercial sector, 33% from the recreational sector (CP, HB, and PR combined), 10% from scientific surveys, 4% from tournaments, and 4% from unknown sectors. Spanish mackerel collected during 1987 – 2011 and aged by the NMFS Panama City Lab ranged in age from 0 to 11 yr, with the majority (Atlantic 90%, Gulf 89%) between 0 and 4 yr (Figure 2). Females from the Atlantic and Gulf ranged in age from 0 to 11 yr. Atlantic males ranged from 0 to 11 yr and Gulf males from 0 to 10 yr. Ninety percent of both Atlantic females and males and 89% of both Gulf females and males were ages 0 to 4 yr. The size ranges of Atlantic commercial (N = 10,699) and recreational (N = 3,972) Spanish mackerel age samples were similar (~250 – 700 mm / 9.8 – 27.6 in), and modal sizes were only slightly different (CM: 350-400 mm vs REC: 400-450 mm). Spanish mackerel age samples were similar (~300 – 650 mm / 011.8 – 25.6 in), but modal sizes of recreational samples were ~100 mm smaller than that of commercial samples (400 vs 500-550 mm). Recreationally-caught females from the Atlantic, ages 4 - 10, averaged 53 mm larger at age than those from commercial catches, probably reflecting differences in selectivity and/or spatial distribution of the samples.

Critique: The working paper describes Spanish mackerel age data from the Panama City laboratory. The data is collected from commercial and recreational fisheries. The data sources use uniform sampling methdologies. The data are reviewed using rigorous quality assurance, quality control procedures, validation rules for data entry and proofed against original data sheets. Ages were validated for precision using published techniques. Indexes of precision between readers is documented and descriptive statistics provided are appropriate.

2.3 Stock Definition and Description

Spanish mackerel are found throughout the Gulf of Mexico and US Atlantic Coast (Collette and Russo 1979, 1984). The bulk of the stock is found in Florida waters and are sought after by both the commercial and recreational sectors throughout their range (Trent and Anthony 1978). Based on electrophoresis studies, spawning locations, stock distribution patters, and catch history (Skow and Chittenden 1981; GMFMC and SAFMC 1987), amendment 2 to the Coastal Pelagics FMP designated two groups of Spanish mackerel. The Dade – Monroe County, Florida boundary was acknowledged as feasible boundary, because both commercial and recreational catch data for the Gulf and Atlantic have used this boundary. For SEDAR 28 it was agreed that fish landed north of US Highway 1 in Monroe County Florida were Gulf of Mexico stock and fish landed south of US Highway 1 were Atlantic stock.

Per SEDAR 17:
This species has been investigated for evidence of stock structure by multiple researchers with conflicting results. Early studies of morphometrics and meristics (Collette and Russo, 1984), a single allozyme study (Skow and Chittenden, 1981), and an electrophoresis study using 44 muscle enzyme loci (Nakamura, 1987) noted differences between Spanish mackerel in the Atlantic and Gulf of Mexico. More recent work using

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mitochondrial and nuclear DNA (Buonaccorsi et al., 2001) did not detect a difference between the Atlantic and Gulf of Mexico Spanish mackerel. Given the highly migratory nature of this species, possible mixing of pelagic eggs, and low number of individuals needed to homogenize the genetic signal, it is not surprising that mitochondrial and nuclear DNA differences were not detected; and the authors themselves noted that "From an ecological and fisheries management perspective, even a sensitive genetic analysis is not sufficient to determine that there is no difference among putative stocks. Migration on the order of tens of individuals per generation is sufficient to homogenize allele frequencies among genetic stocks for both markers." In the report of the life history workgroup from the recent data workshop on the closely related king mackerel (SEDAR 16), a discussion on stock structure noted that "a lack of a significant genetic difference in selectively neutral markers, such as mtDNA or nuclear DNA microsatellites, is not definitive evidence that interregional population structure does not exist (Nolan et al. 1991; Pruett et al. 2005)".

Additionally, the differences observed in morphometrics, meristics (Collette and Russo, 1984), and electrophoretic analyses (Nakamura, 1987) indicate separate stocks between the Atlantic and Gulf of Mexico Spanish mackerel. These stocks may have different demographic parameters (eg. length weight relationship, size at age, and fecundity), which will influence inputs and parameters for a stock assessment model. In the co-occurring king mackerel, for which there is ample evidence of movements and mixing between the Atlantic and Gulf of Mexico (Sutter et al. 1991), DeVries et al. (1997) reported significant differences in growth and size at age estimates between fish sampled in Atlantic waters off the SE U.S. and the eastern Gulf of Mexico. More recent studies of otolith shape and elemental composition (Clardy et al. 2008, Patterson and Shepard 2008) strongly supported the existence of separate Atlantic and eastern Gulf of Mexico stocks. The consensus of the LHG was that the management units should remain distinct between the Atlantic and Gulf to remain consistent with Amendment 2 of the Fishery Mangement Plan for the Coastal Migratory Pelagic Resources (Mackerels) (GMFMC and SAFMC, 1987).

<u>Recommendation for the AW:</u>
The Atlantic stock and Gulf of Mexico stock should be split along SAFMC/GMFMC jurisdictions. Atlantic stock consists of all fish caught south of highway US 1 through the Florida Keys, northward along the east coast of Florida to Maine.

2.4 Natural Mortality

Natural mortality (M) in many marine fish stocks is a difficult parameter to estimate. Several equations have been derived to attempt to estimate M that use various life history parameters (L_∞, K, maximum age, age at 50% maturity). The LHG selected 14 equations that give point estimates (Table 2.1) and the age-varying M from Lorenzen (1996) (Figure 2.1).

The point estimates of M ranged widely. The Beverton estimate was the highest at 3.44. Other estimates that rely heavily on K from the von Bertalanffy parameters include

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Ralston, Jenson and Pauly, which also estimated high M, 0.92 – 2.20. The LHG is cautious of using these estimates because of the issues inherent in modeling growth of the species. The L_∞ and K parameters are inversely correlated and can be highly variable depending on the range of the input data and assumptions made when modeling growth.

The other estimates of M rely more on maximum age in the population. These estimates ranged from 0.16 – 0.40. Hoenig (1983), Hewitt and Hoenig (2005), and Alagaraja (1984), which all use maximum age exclusively, averaged 0.37. The Hoenig estimate from the "fish" equation was 0.38. Estimates of M using maximum age in the population have been generally accepted by previous SEDARs. Caution should be taken when selecting maximum age in the population: how many fish were sampled to find that one, old fish; what could be the longevity of the species in an un-fished stock; and what amount of error is associated with the age readings? These questions were taken into consideration by the LHG, and maximum age in the population was set at 11 years. This data point came from an aging study by Nobel et al. (1992).

The LHG recommends modeling the natural mortality rate of Spanish mackerel as a declining 'Lorenzen' function of size (translated to age by use of a growth curve) (Lorenzen 1996), scaled to the Hoenig (fish) point estimate for the fully recruited ages, 2 - 11 years. For sensitivity analysis, the LHG recommends using a CV of 54% (MacCall in Brodziak et al., 2011) about the Hoenig point estimate, though that value may be too high (Hoenig comment in MacCall in Brodziak et al., 2011). The assessment workshop can explore this option. This parallels the recommendations from SEDAR 16 (king mackerel) and 17 (Spanish mackerel).

2.5 Discard Mortality

The discussion concerning discard mortality was not addressed specifically to each region, Gulf or Atlantic, and was considered the same for both stocks.

Discard mortality rate is an important estimation included in stock assessments and rebuilding projections calculated from a stock assessment. Discard mortality rate can be impacted by several factors including: fish size, sea conditions, temperature, air exposure, handling, light conditions, and delayed mortality (Davis 2002). The longer fish are exposed to most of these factors and the more severe they are, the greater the cumulative stress on the fish (Rummer and Bennett 2007). The impacts of many of these factors are difficult to track or quantify and have led to variability in determining discard mortality rates. Spanish mackerel are harvested by several gears, which have varying discard mortality rates. Currently, few data sets are published on discard mortality of Spanish mackerel (Harrington et al. 2005). Data are collected by the NOAA Southeast Fisheries Science Center on discards in the commercial logbook program. This program randomly samples 20% of commercial vessels operating in the South Atlantic and Gulf of Mexico. From the commercial logbooks, discards were classified into five categories of kept, alive, mostly alive, mostly dead, and dead for gillnets, hook and line, and trolling fisheries (McCarthy 2008 SEDAR17-DW10). The gillnet fisheries, including set gillnets, run around gillnets, and cast nets, had a low number of discards due to gear selectivity for

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legal sized fish, but any discarded fish likely had a high release mortality rate. Three sources of information were available to estimate gillnet discard mortality: commercial logbook reports, a published study, and gillnet observers. The commercial logbooks estimated a gillnet discard mortality for Spanish mackerel at 100% (McCarthy 2008 SEDAR17-DW10). A discard mortality rate for Spanish mackerel in gillnets (one hour soak time) was estimated to be 93.4% based a fishery independent study off Florida (Hueter and Manire 1994). Observers have been onboard gillnet boats in the South Atlantic since 1998 with most observed trips occurring off Cape Hatteras and Cape Canaveral. The targeted species on the observed trips varied and included Spanish mackerel, sharks, sea mullet (*Menticirrhus* spp), Atlantic croaker, and other species. All Spanish mackerel that were discarded were reported discarded dead (discard mortality rate- 100%) but the number of fish discarded was very low (Table 2.2., Simon Gulak, Gillnet Coordinator SEFSC NOAA Fisheries, personal communication).

SEDAR 17 estimated a discard mortality of 80% for hand line, 98% for trolling fisheries, and a combined estimate of 88% for all hook fisheries based on logbook reporting. The numbers included a high percentage of discards reported with a kept disposition. The fish with a kept disposition were requested to be removed from the discard estimate and added to landings. The remaining discarded fish would have the discard mortality rate applied to them. Few data were available to estimate a discard mortality rate for hook and line fisheries. Discard mortality from the gill net fishery as reported by observer data is shown in Table 2.2. Commercial and recreational hook and line fishermen suggested discard mortality ranges from 5 to 15% based on personal observations. Potential sources of mortality included predation after release, broken gill arches, and other hooking injuries. The handling time was said to be short especially for the commercial fishermen and there has been an increase in the use of dehooking devices in the recreational fishery. A telemetry study tagged Spanish mackerel and recorded movements for up to five hours (Edwards 1994). The study observed two fish die immediately and two more died during the telemetry. The author estimated a range of discard mortality rate of 9 to 28%. A follow up study combined data for Spanish and king mackerels and estimated a range of discard mortality rate of 7 to 35%. SEDAR 16 for king mackerel used discard mortality rates of 20% for MRFSS and 33% for charter boats. Another surrogate species considered for estimating discard mortality rate was bluefish. The NEFSC used a 15% discard mortality rate in the bluefish stock assessment. Another bluefish study reported catch and release discard mortality was higher (38%) and included size, age, and handling time as factors in the model (Fabrizio et al. 2008). The bluefish were held in tanks for 21 days after capture to include estimates of delayed mortality. Most bluefish died on the first day (65%) and 35% of the mortality occurred after the first day.

A final component of discard mortality for Spanish mackerel would result from the shrimp trawl fishery. Any discarded would most likely have a high discard mortality rate around 100% (SEDAR 17).

Discussion

There was considerable discussion on the discard mortality rate estimates. There was some concern about the rate in hook and line fisheries, and the discussion was tabled for

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a following plenary. Bluefish were thought not be representative of Spanish mackerel discard mortality and there was some concern about holding fish in tanks. An experienced charter boat captain commented that bluefish are much hardier than Spanish mackerel; thus, their discard mortality rates are not comparable. After discussing several issues and reviewing the limited data on Spanish mackerel, the commercial fishery was suspected to have a lower discard mortality rate than the recreational. It was brought up that commercial fishermen can hook and release a fish within 20 seconds. Not all recreational fishermen would have this level of skill; and therefore, the discard mortality in the recreational fishery should be higher. The commercial fishermen present felt the 10% point estimate was appropriate with a range of 5 to 15% for the commercial fishery. The panel agreed to use a discard mortality rate point estimate of 20% for the base assessment run for the recreational fishery based on the Edwards (1994) telemetry study findings, which roughly ranged from 10 to 30%. The recreational fishermen present were comfortable with that estimate.

Recommendation for the AW:
Discard mortality rates:

Gillnet 100%
Handline 10% (5 to 15%) commercial
Handline 20% (10 to 30%) recreational
Shrimp Trawl 100%

2.6 Age

The Panama City NMFS Laboratory provided age and length data (n = 12,501) from 1987-2011 of Spanish mackerel collected in Gulf waters north of U.S. Highway 1 in Monroe County Florida (Figure 2.15.1). Per the SEDAR 17 report, ages from 1987 should be excluded from any analysis for SEDAR 28. A description of the methods, information on quality control, and the distribution of age samples by year, sex, geographical location, gear, fishery, and collection agency or program are detailed in SEDAR 28-DW23. Approximately 423 samples from The North Carolina Division of Marine Fisheries (2011) were not available for ageing at the time of this report and will be made available for the assessment workshop.

Recommendations for the AW:
None.

2.7 Growth

The LHG discussed several growth issues, including whether to model growth with a correction for minimum size-limit bias effect, inversely weighting the von Bertalanffy model by samples size at each age, the need to constrain t_0, and whether to use sex-specific growth curves.

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Growth of Atlantic Spanish mackerel was estimated for all fish combined and by sex. Spanish mackerel exhibit sexually-dimorphic growth, with females attaining larger sizes at age and a much larger maximum size than males. Because the majority of the age data was derived from fishery-dependent samples, which were subject to a minimum size limit, it was assumed that the fastest growers in the population would recruit to the fishery first. The presumed bias in size-at-age of the age affected most by the size-limit could be "corrected" by a model developed by Diaz et al. (2004). This model has been used in several previous SEDARs and specifically in SEDAR 17.

The LHG group agreed to run the growth model using the Diaz et al. (2004) correction that incorporates inverse weighted growth (Figure 2.3). The initial model run for all data combined resulted in the following parameter estimates: $t_0 = -1.03$, $K = 0.45$, and $L\infty = 572.8$. This t_0, which predicts an unrealistic size at age – 0 (Figure 2.4), results from the lack of very small fish (needed to estimate initial growth of the fish) in the age data set. Also, the value of k was lower than expected for a fast growing pelagic species. One way to handle these issues is to fix t_0 to a more biologically reasonable value, such as -0.5 and when this is done, the resulting parameters were $t_0 = -0.5$, $K = 0.61$, and $L\infty = 60.1$ (Figure 2.4). Because most of the aged samples are in the middle of the age distribution, the model was driven by those samples and had trouble fitting the tails (youngest and oldest fish) of the curve. Inverse weighting by sample size-at-age, an accepted practice in modeling growth, produces a better fit in the tails of the data distribution.

Due to the dimorphic growth exhibited by Spanish mackerel, sex specific growth models were run. The models incorporated the size-limit bias correction, inverse weighting, and a fixed t_0 value to -0.5 years (Figure 2.3). For females, the resulting parameter estimates were $t_0 = -0.5$, $K = 0.58$, and $L\infty = 586.9$. For males, the resulting parameter estimates were $t_0 = -0.5$, $K = 0.54$, and $L\infty = 538.1$.

<u>Recommendations for the AW:</u>
Because most of the fishery data does not identify the sex of the fish, use the model for the sexes combined, corrected for the minimum size limit bias and inversly weighted by sample size at calendar age for the overall population model. Use sex-specific growth models where appropriate

Fix t_0 at -0.5 to more realistically model the growth rate of younger fish.

2.8 Reproduction

Recent data concerning Spanish mackerel sexual maturity were queried from databases (Panama City Lab - PCLAB) and taken from at-sea surveys (MARMAP and SEAMAP). Results showed no notable departures from prior estimates (SEDAR 17). For consistency, the PCLAB maturity data included records of macroscopic maturity stage from northwest Florida (Apalachicola Bay west to St. Andrew's Bay) for all years available (1999 – 2011) from the months of April – September and were combined with the macroscopic Finucane and Collins (1986) tabular data from Gulf waters. Macroscopically staged mature fish were defined as having the characteristics of

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developing, spent, regressed, or ripe gonads (NMFS PCLAB, AGR 2008). Data from SEAMAP and MARMAP (both Atlantic data sets) sampling surveys were based on histological readings (Schmidt et al., 1993) and were filtered for the same monthly period and combined with the macroscopic Finucane and Collins (1986) tabular data from Atlantic waters. Percent maturity per size-class instead of age was used due to the lack of age data for all samples. Data sets from SEAMAP, MARMAP, and the Panama City Lab were combined and filtered by region. Tabular data by size-class as reported by Schmidt et al. (1993) and Finucane and Collins (1986) were combined with the newer data sets using the same size classes. The size classes used by Finucane and Collins (1986) were 1 mm FL smaller versus the size classes used by Schmidt et al. (1993) and it was decided that this would not be an issue when combining the data.

2.8.1 Spawning Seasonality

Per SEDAR 17:

The spawning season of Spanish mackerel is progressively longer from north to south, primarily due to water temperature. In lower Chesapeake Bay, Cooksey (1996) found partially spent, gravid, and running ripe females from June through August. Off the Carolinas and Georgia, females spawn from May through August (Finucane and Collins 1986; Schmidt et al. 1993), perhaps as late as September based on the presence of larvae (Collins and Stender 1987). Off the Atlantic coast of Florida, spawning females have been collected during April through September (Beaumariage 1970; Powell 1975; Finucane and Collins 1986), and as late as October in some years (Klima 1959).

The gonadosomatic index of females is at a maximum during June in the lower Chesapeake (Cooksey 1996) and off southeast Florida (Finucane and Collins 1986).

Spawning appears to take place on the inner continental shelf, as females with "maturing" (hydrated) oocytes have been collected with gillnets near inlets and shoals along Florida's east coast (Powell 1975) and ripe females have been collected at depths of ca. 9 m from Onslow Bay (North Carolina) through Georgia (Schmidt et al. 1993). The spatial distribution of Spanish mackerel larvae also indicates that spawning takes place on the inner shelf (Collins and Stender 1987).

The major spawning period in Atlantic waters off of North Carolina and south into the Gulf of Mexico off of the Mississippi delta extended from May into September and peaked during the spring and early summer (Finucane and Collins 1986). There have been no new recent studies concerning spawning seasonality of Spanish mackerel in the Gulf of Mexico. The PCLAB maturity data shows the peak GSI occurring in the month of June (Figure 2.5). It should be noted that the low sample size (N =261) of Spanish mackerel data available may not confidently represent the spawning season.

2.8.2 Sexual Maturity

Combined tabular data of percent maturity by size class and region for females from the Atlantic and Gulf are shown in Table 2.3. In the Gulf, the smallest size-class of females collected was 226-250 mm FL; 1 of the 2 fish in that class was mature and it was 236 mm

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FL. The size at 50% maturity for Gulf females fell in the 301-325 mm FL size class (Figure 2.6). Age at 50% maturity for Gulf females was 0.20 yr (std err 0.04-0.44) (Figure 2.8). This relatively young age at maturity may be attributed to the fact that all of the Gulf female gonads were staged macroscopically and the potential to stage immature gonads from younger fish, as mature, is high. Atlantic females were staged using histological methods, a more precise method. The youngest mature female was age 0 from both regions. In the Gulf both males in the smallest size-class (201-225 mm FL) were immature (Table 2.4). The smallest mature Gulf male was 274 mm FL and the size at 50% maturity was approximately 276-300 mm FL (Figure 2.7). The youngest mature male was age 0 from both regions.

2.8.3 Sex ratio

Strong sexual dimorphism in Spanish mackerel (females larger than males at aged 1- 5; see Powel 1975; Fable et al. 1987; Schmidt et al. 1993) may result in skewed adult sex ratios when data are analyzed by gear type. In the PCLAB data set females age 0 - 7 made up 69% of all gill net samples from commercial and scientific surveys and recreational hook-and-line samples (Figure 2.9, Table 2.5). Size selectivity due to gill net mesh size may have resulted in the targeting of larger fish which are generally females. Recreational hook and line caught females age 0 - 7 made up 63% of the catch (Table 2.6). However, above 40 cm females make up 72% of gill net sampled fish (Figure 2.10). Females above 40 cm from recreational hook-and-line samples totaled 76% of the catch (Figure 2.11). In recreational hook-and-line catches off southeast Florida Klima (1959) noted a highly skewed sex ratio (80% females, including immature fish). Klima speculated that the higher percentage of females was a product of their more aggressive feeding behavior and not the absence of males in the areas fished.

<u>Recommendations for the AW:</u>
Use the Atlantic age at 50% maturity value (0.70 yr) as a proxy for both regions.

Over all ages and gears, weighted percent females 66%.

Collect Spanish mackerel maturity data from both regions and both sexes from specimens approximately 275 mm FL. and lower to be staged via histological methods.

2.9 Movements and Migrations

Per SEDAR 17:
The following is quoted from section 3.1 of the Atlantic States Marine Fisheries Commission's fishery management plan for Spanish mackerel (Mercer et al. 1990): "Spanish mackerel make seasonal migrations along the Atlantic coast and appear to be much more abundant in Florida during the winter. They move northward each spring to occur off the Carolinas by April or May, off Chesapeake Bay by May or June, and some years, as far north as Narragansett Bay by July (Berrien and Finan 1977)." In a tagging study in North Carolina, 1986-1990, by the NC Division of Marine Fisheries, fish were recaptured as far south as Sebastian Inlet, FL and as far north as the York River in

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Virginia (Noble 1992). The few fish recaptured in Florida were caught in winter and spring, confirming a southern movement during the fall, while those recaptured in Virginia were caught in summer and fall, supporting a northerly movement during that time of year (Phalen 1989, Noble 1992).

Recommendations for the AW:
None

2.10 Meristics and Conversion Factors

Equations to make length-length and weight-length conversions were derived using the simple linear regression model and power functions, respectively (Table 2.7). All weights are shown in kilograms and lengths in millimeters. Coefficients of determination (r^2) ranged from 0.916 to 0.989 for these linear (length) and nonlinear (weight) regressions.

Recommendations for the AW:
1) Use the equations based on combined sources.

2.11 Comments on adequacy of data for assessment analyses

Included in individual sections above.

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2.13 Tables

Table 2.1. Point estimates of natural mortality (M) for the Gulf stock of Spanish macerele based on maximum age = 11 years and von Bertalanffy parameter estimates: $t_0 = -0.5$, k = 0.61, and $L_\infty = 560$.

Equations for Estimating M:	Parameters:	M
Alverson & Carney	k, tmax	0.16
Beverton	k, am	3.44
$Hoenig_{fish}$	tmax	0.38
$Hoenig_{alltaxa}$	tmax	0.4
Pauly		1.03
Ralston	k	1.28
Ralston (geometric mean)	k	2.20
Ralston (method II)	k	2.11
Hewitt & Hoenig	tmax	0.36
Jensen	k	0.92
Rule of thumb	tmax	0.27
Alagaraja	survivorship to tmax: 0.1	0.42
Alagaraja	survivorship to tmax: 0.2	0.36
Alagaraja	survivorship to tmax: 0.5	0.27

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Table 2.2. Number, percent kept, and percent discarded dead for Spanish mackerel caught in gillnet fisheries based on observed trips from 1998-2011. Data were provided by Simon Gulak (Gillnet Coordinator SEFSC NOAA Fisheries).

Gear Type	Species	Total Number Caught	% Kept	% Discarded Dead
Drift	Spanish mackerel	14,531	99%	99%
Sink	Spanish mackerel	40,810	99%	99%
Strike	Spanish mackerel	45	100%	0

Table 2.3. Percent maturity per size class of females from the Atlantic and Gulf; Finucane and Collins (1986), MARMAP, PCLAB, and SEAMAP combined data sets.

Atlantic Females					Gulf Females				
Size Class	No	Yes	Total	% Mature	Size Class	No	Yes	Total	% Mature
151-175	3	0	3	0	151-175				
176-200	6	0	6	0	176-200				
201-225	49	0	49	0	201-225				
226-250	72	0	72	0	226-250	1	1	2	50
251-275	97	4	101	4	251-275	5	1	6	17
276-300	73	14	87	16	276-300	16	3	19	16
301-325	54	38	92	41	301-325	18	25	43	58
326-350	32	63	95	66	326-350	29	115	144	80
351-375	20	81	101	80	351-375	22	159	181	88
376-400	4	73	77	95	376-400	10	212	222	95
401-425	3	64	67	96	401-425	10	190	200	95
426-450	1	41	42	98	426-450	11	146	157	93
451-475	0	24	24	100	451-475	4	147	151	97
476-500	0	17	17	100	476-500	11	85	96	89
501-525	0	17	17	100	501-525	0	101	101	100
526-550	0	6	6	100	526-550	1	66	67	99
551-575	0	7	7	100	551-575	2	60	62	97
576-600	0	4	4	100	576-600	1	57	58	98
601-625	0	12	12	100	601-625	0	31	31	100
626-650	0	4	4	100	626-650	1	20	21	95
651-725	0	7	7	100	651-725	0	12	12	100

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Table 2.4. Percent maturity per size class of males from the Atlantic and Gulf from Finucane and Collins (1986), MARMAP, PCLAB, and SEAMAP combined data sets.

Atlantic Males					Gulf Males				
Size Class	No	Yes	Total	% Mature	Size Class	No	Yes	Total	% Mature
151-175	4	1	5	20	151-175				
176-200	15	1	16	6	176-200				
201-225	20	13	33	39	201-225	2	0	2	0
226-250	9	56	65	86	226-250	3	0	3	0
251-275	20	90	110	82	251-275	5	3	8	38
276-300	7	64	71	90	276-300	58	35	93	38
301-325	15	55	70	79	301-325	25	49	74	66
326-350	13	73	86	85	326-350	18	142	160	89
351-375	14	93	107	87	351-375	7	154	161	96
376-400	11	113	124	91	376-400	6	139	145	96
401-425	0	45	45	100	401-425	2	76	78	97
426-450	0	22	22	100	426-450	0	42	42	100
451-475	0	6	6	100	451-475	1	21	22	95
476-500	0	6	6	100	476-500	0	12	12	100
501-525	0	3	3	100	501-525	0	14	14	100
526-550	0	5	5	100	526-550	0	10	10	100
551-575	0	1	1	100	551-575	0	7	7	100
576-600	0	1	1	100	576-600	0	4	4	100
601-625	0	1	1	100	601-625				
626-650	0	1	1	100	626-650				
651-725	0	1	1	100	651-725				

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Table 2.5. Sex ratios of Gulf of Mexico Spanish mackerel gill net samples by age from commercial and scientific surveys in the PCLAB data set; 5% and 95% confidence intervals.

Age	Females	Males	Total	% Female	F : M	low C.I.	high C.I.
0	60	14	74	81	4.3 : 1.0	71	88
1	451	152	603	75	2.8 : 1.0	71	78
2	639	284	923	69	2.2 : 1.0	66	72
3	754	318	1,072	70	2.4 : 1.0	68	73
4	485	194	679	71	2.5 : 1.0	68	75
5	215	118	333	65	1.8 : 1.0	59	70
6	70	53	123	57	1.3 : 1.0	48	65
7	36	21	57	63	1.7 : 1.0	50	74
8	6	10	16	38	0.6 : 1.0	18	61
9	2	6	8	25	0.3 : 1.0	7	59
10	0	0	0	0			
11	1	0	1	100	1.0 : 0.0	21	100
Total	2,719	1,170	3,889	69*	2.3 : 1.0		

* ages 0 - 7

Table 2.6. Sex ratios of Gulf of Mexico Spanish mackerel recreational hook-and-line samples by age in the PCLAB data set; 5% and 95% confidence intervals.

Sex ratio of GOM recreational hook-and-line SMK by age

Age	Females	Males	Total	% Female	F : M	low C.I.	high C.I.
0	215	98	313	69	2.2 : 1.0	63	74
1	1,168	692	1,860	63	1.7 : 1.0	61	65
2	831	571	1,402	59	1.5 : 1.0	57	62
3	636	335	971	65	1.9 : 1.0	62	68
4	357	187	544	66	1.9 : 1.0	62	69
5	154	107	261	59	1.4 : 1.0	53	65
6	66	45	111	59	1.5 : 1.0	50	68
7	17	11	28	61	1.5 : 1.0	42	76
8	5	6	11	45	0.8 : 1.0	21	72
9	1	0	1	100	1.0 : 0.0	21	100
10	0	2	2	0	0.0 : 2.0	0	66
Total	3,450	2,054	5,504	63*	1.7 : 1.0		

* ages 0 - 7

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Table 2.7. Meristics and conversion factors.

LENGTH TO WEIGHT CONVERSIONS[1]				(see sex-specific results below)								
Data	Area	Dep. Var.	Ind. Var.	a	b	r2	n	LEN SE	WT SE	Length Range	Units	Function
Sexes Combined	S. Atl.	Weight	FL	2.2492e-8	2.8452	0.9132	49,471	0.3400	0.0019	160-900	kg mm	Power
Sexes Combined	Gulf	Weight	FL	2.0284e-8	2.8640	0.9152	37,785	0.4221	0.0024	110-892	kg mm	Power
Sexes Combined	Combined	Weight	FL	2.1591e-8	2.8530	0.9159	87,579	0.2692	0.0015	110-900	kg mm	Power
Sexes Combined	S. Atl.	Weight	TL	2.8627e-9	3.1056	0.9293	23,473	0.4653	0.0021	210-882	kg mm	Power
Sexes Combined	Gulf	Weight	TL	1.2237e-8	2.8790	0.9804	8,404	1.0660	0.0060	210-978	kg mm	Power
Sexes Combined	Combined	Weight	TL	5.4935e-9	3.0025	0.9644	31,877	0.5082	0.0025	210-978	kg mm	Power
LENGTH TO LENGTH CONVERSIONS[1]				RECOMMENDED								
Data	Area	Dep. Var.	Ind. Var.	a	b	r2	n	a SE	b SE	Length Range	Units	Function
Sexes Combined	S. Atl.	TL	FL	16.6508	1.1262	0.9874	19,334	0.3551	0.0009	194-780	mm	Linear
Sexes Combined	S. Atl.	FL	TL	-9.7850	0.8768	0.9874	19,334	0.3231	0.0007	224-882	mm	Linear
Sexes Combined	Gulf	TL	FL	27.6228	1.0995	0.9871	954	2.0529	0.0041	217-872	mm	Linear
Sexes Combined	Gulf	FL	TL	-18.4462	0.8978	0.9871	954	1.9335	0.0033	245-980	mm	Linear
Sexes Combined	Combined	TL	FL	18.4306	1.1214	0.9886	20,288	0.3339	0.0008	194-872	mm	Linear
Sexes Combined	Combined	FL	TL	-11.8218	0.8816	0.9886	20,288	0.3064	0.0007	224-980	mm	Linear
Sexes Combined	S. Atl.	SL	FL	-6.3811	0.9630	0.9923	2,640	0.6506	0.0016	194-753	mm	Linear
Sexes Combined	S. Atl.	FL	SL	9.5589	1.0306	0.9924	2,640	0.6594	0.0018	177-728	mm	Linear
Sexes Combined	S. Atl.	SL	TL	-19.4029	0.8450	0.9855	2,695	0.9197	0.0020	224-860	mm	Linear
Sexes Combined	S. Atl.	TL	SL	29.3078	1.1663	0.9855	2,695	1.0210	0.0027	177-728	mm	Linear
SEX-SPECIFIC WEIGHT AT LENGTH[1]				RECOMMENDED								
Data Source	Area	Dep. Var.	Ind. Var.	a	b	r2	n	LEN SE	WT SE	Length Range	Units	Function
Female	S. Atl.	Weight	FL	7.4558e-9	3.0244	0.9514	2,896	1.2412	0.0068	218-753	kg mm	Power
Male	S. Atl.	Weight	FL	1.6486e-8	2.8934	0.9091	2,141	0.9747	0.0039	252-605	kg mm	Power
Female	Gulf	Weight	FL	2.5969e-8	2.8310	0.9123	320	4.9400	0.0300	294-687	kg mm	Power
Male	Gulf	Weight	FL	5.1469e-9	3.0884	0.9657	124	7.1702	0.0395	298-640	kg mm	Power
Female	Combined	Weight	FL	7.9232e-9	3.0155	0.9464	3,216	1.2514	0.0070	218-753	kg mm	Power
Male	Combined	Weight	FL	1.0511e-8	2.9694	0.9280	2,265	1.0274	0.0044	252-640	kg mm	Power
Sexes Combined	Combined	Weight	FL	2.154E-08	2.8534	0.9161	88,067	0.2688	0.0015	110-900	kg mm	Power

[1] Data restrictions – TL < 1000, FL < 900, obvious errors omitted. Dep. Var. = Dependent variable, Ind. Var. = Independent variable.

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2.14 Figures

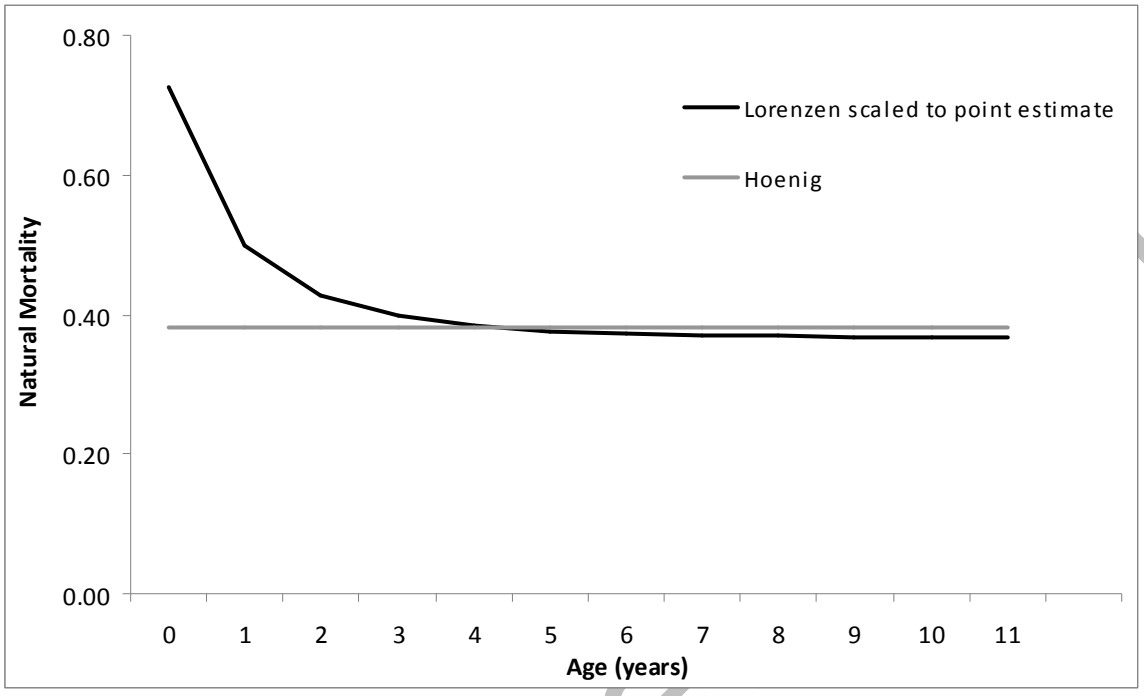

Figure 2.1. Lorenzen age-varying natural mortality of the Gulf stock of Spanish mackerel.

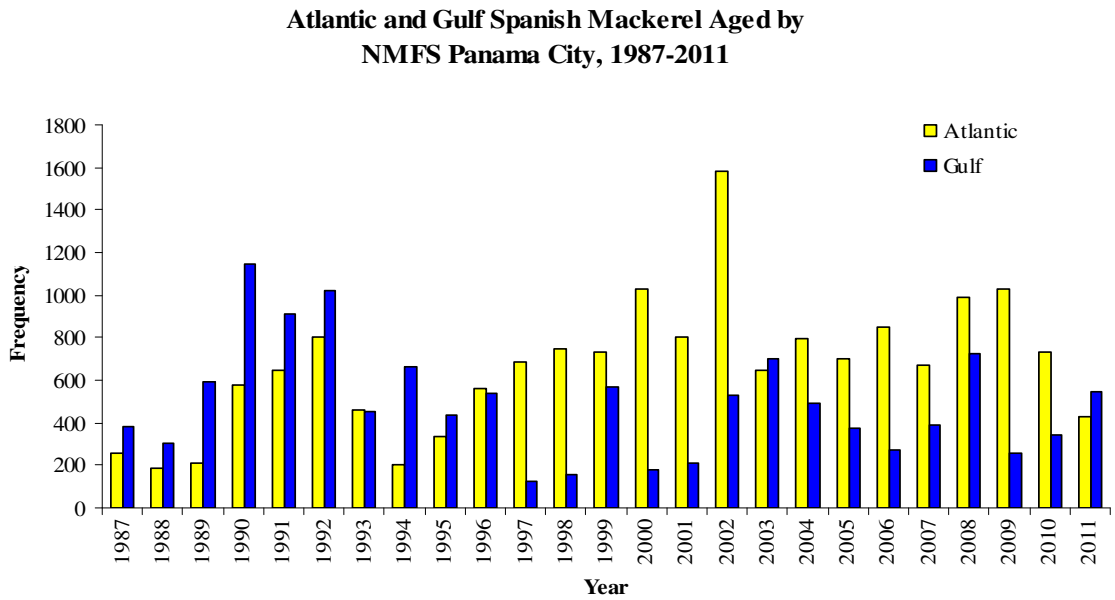

Figure 2.2. Atlantic and Gulf Spanish mackerel aged by NMFS Panama City, 1987-2011.

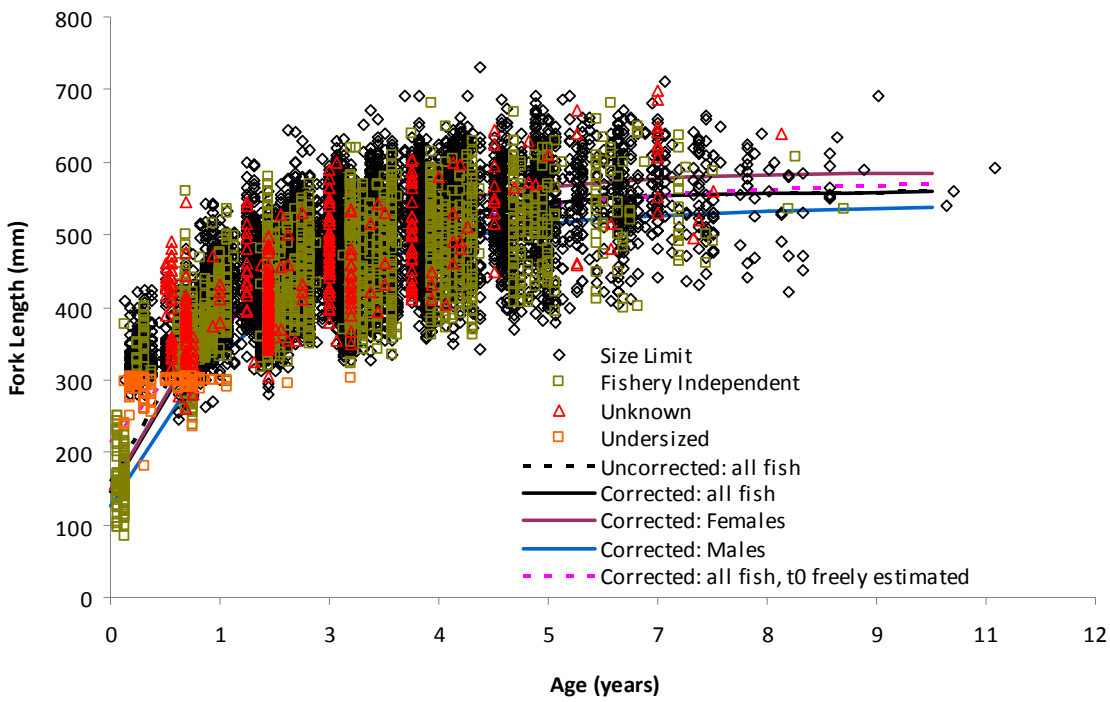

Figure 2.3. Gulf Spanish mackerel inversely weighted von Bertalanffy growth curves and raw data from the PCLAB data set. "Corrected" refers to the Diaz et al. correction in the growth model to handle the bias in the size-at-age data under the influence of the minimum size limit regulation.

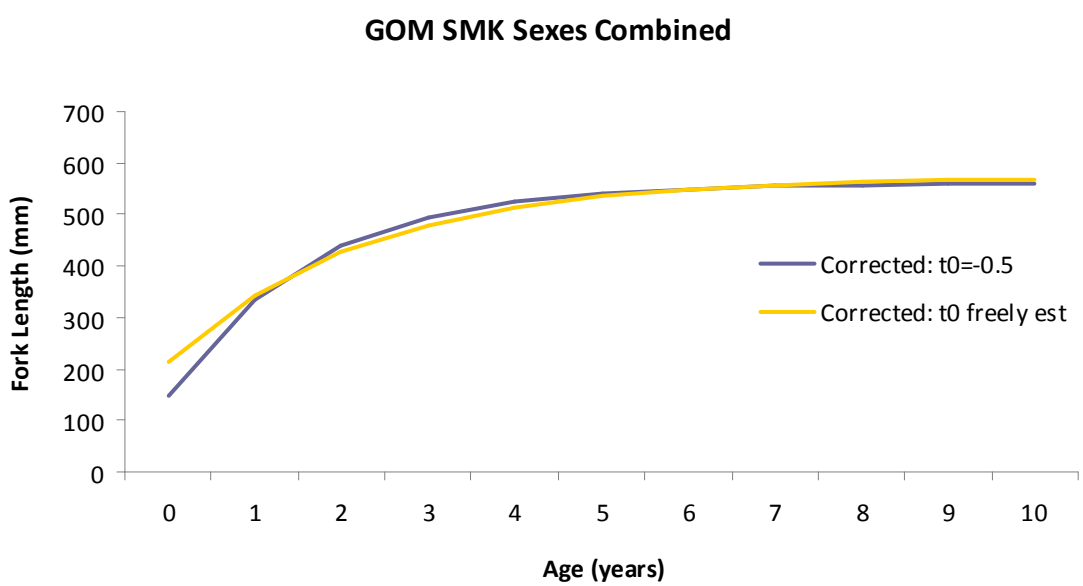

Figure 2.4. Spanish mackerel overall von Bertalanffy growth curves: corrected for size limit bias and inverse weighted with fixed $t_0 = -0.5$ and freely estimated $t_0 = -1.03$.

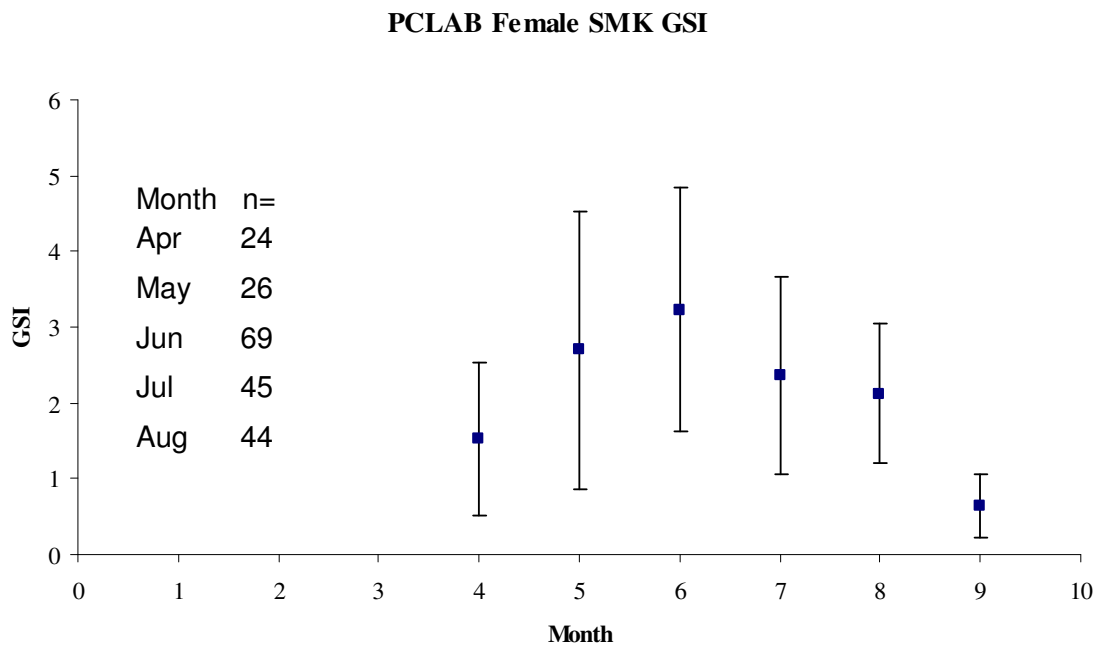

Figure 2.5. Gonadosmotic index of Gulf females from the PCLAB data set. Error bars are +/- 1 standard deviation.

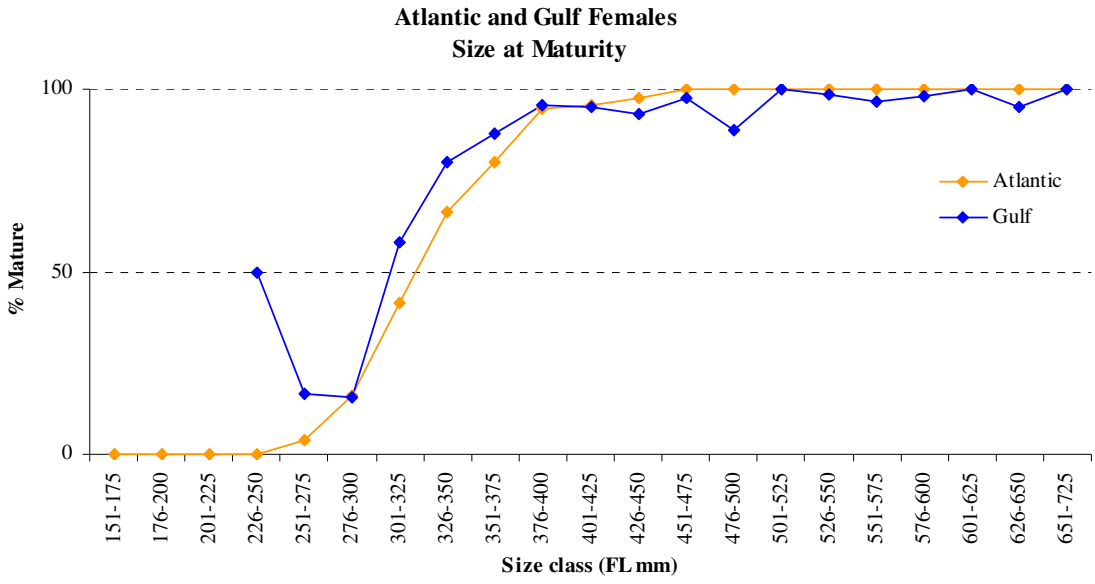

Figure 2.6. Size at maturity of female Spanish mackerel from the Atlantic and Gulf; Finucane and Collins (1986), MARMAP, PCLAB, and SEAMAP combined data sets.

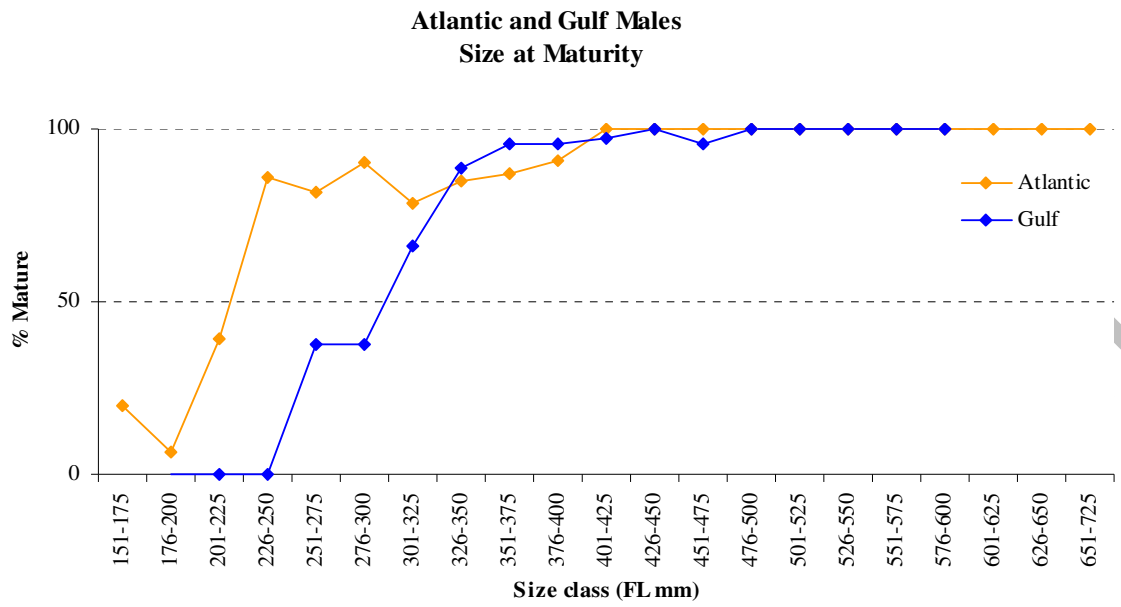

Figure 2.7. Size at maturity of male Spanish mackerel from the Atlantic and Gulf; Finucane and Collins (1986), MARMAP, PCLAB, and SEAMAP combined data sets.

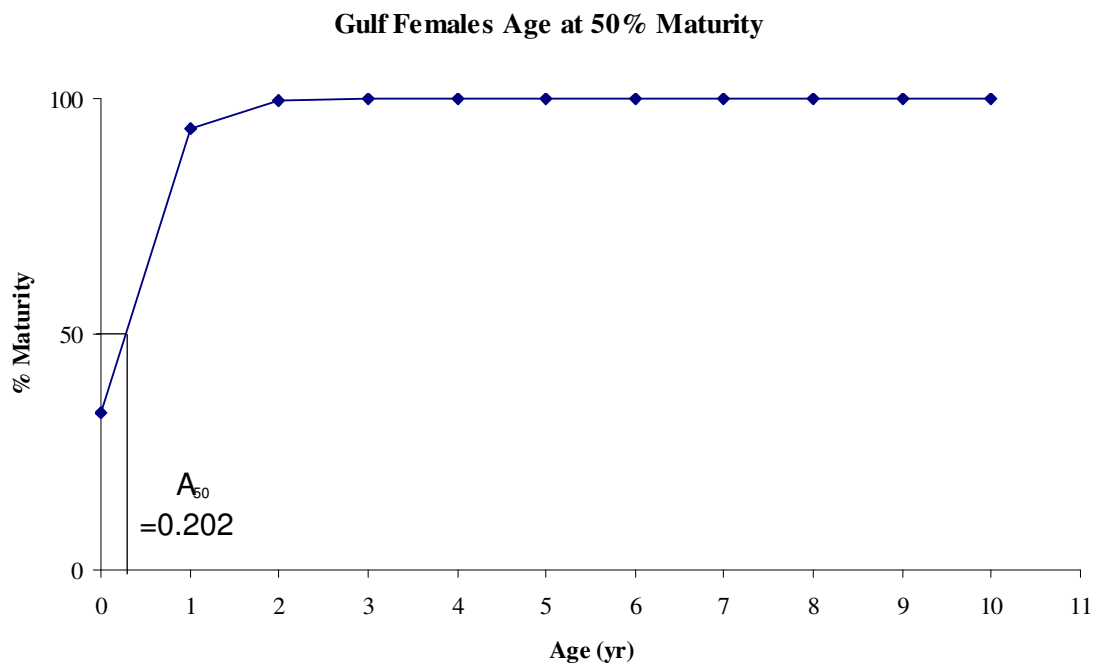

Figure 2.8. Age at 50% maturity of Gulf females from the PCLAB data set.

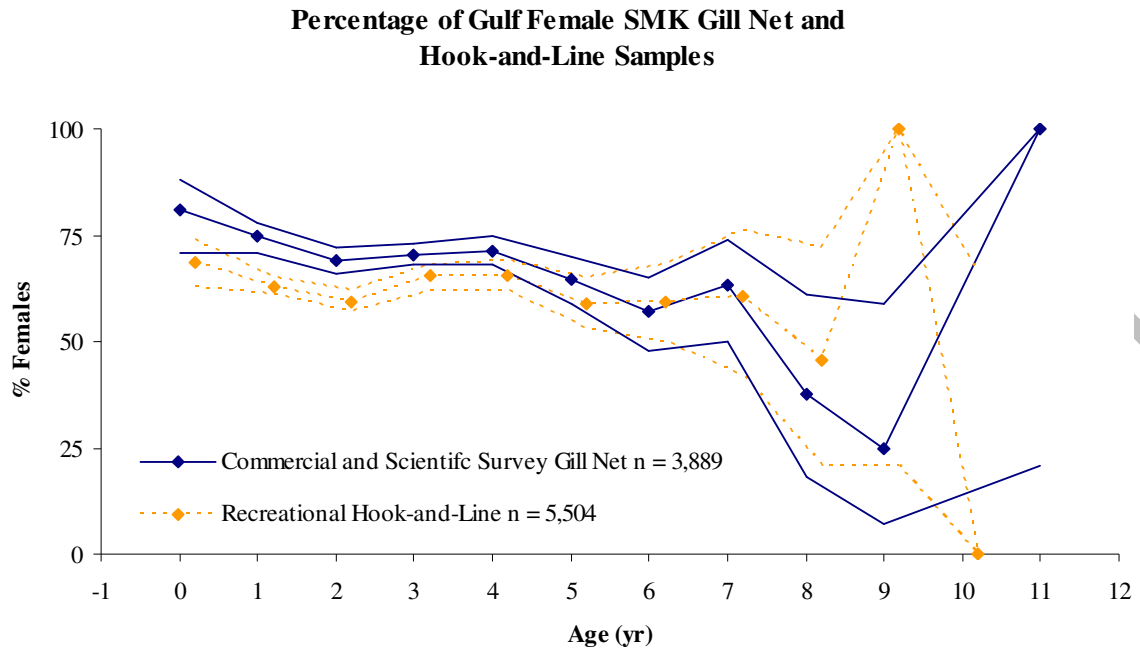

Figure 2.9. Percentage by age of Gulf female Spanish mackerel commercial and scientific survey gill nets, and recreational hook-an-line samples in the PCLAB data set; 5% and 95% confidence intervals.

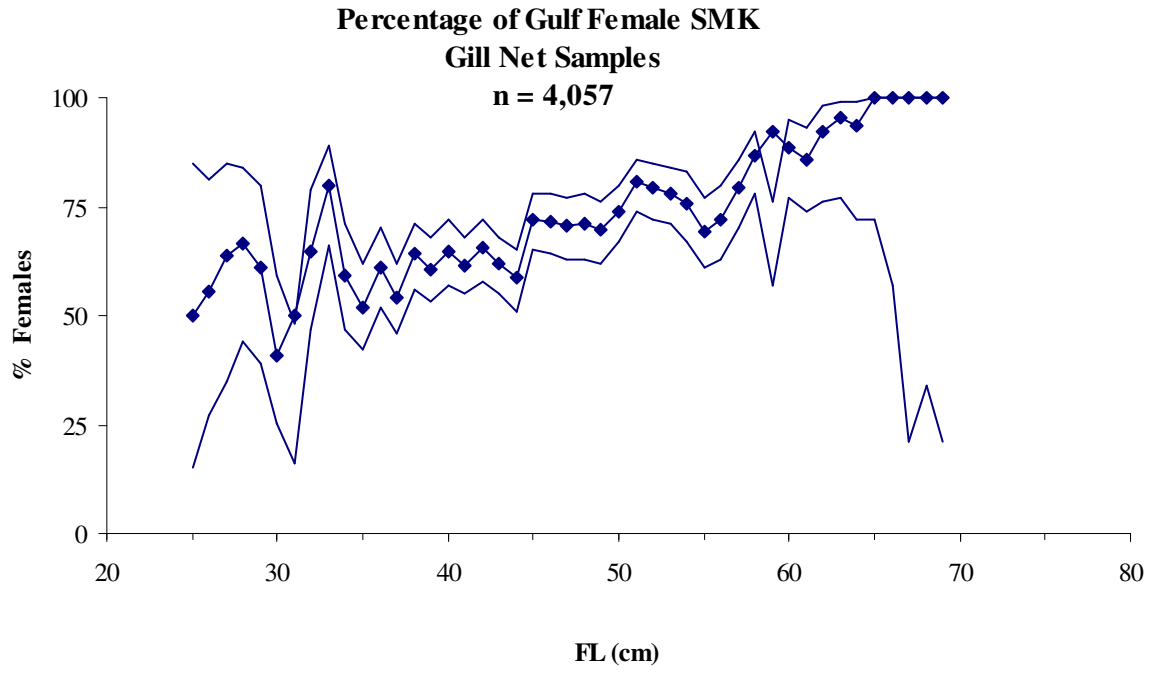

Figure 2.10. Percentage by size of Gulf females by size in the PCLAB data set from commercial and scientific survey gill nets; 5% 95% confidence intervals.

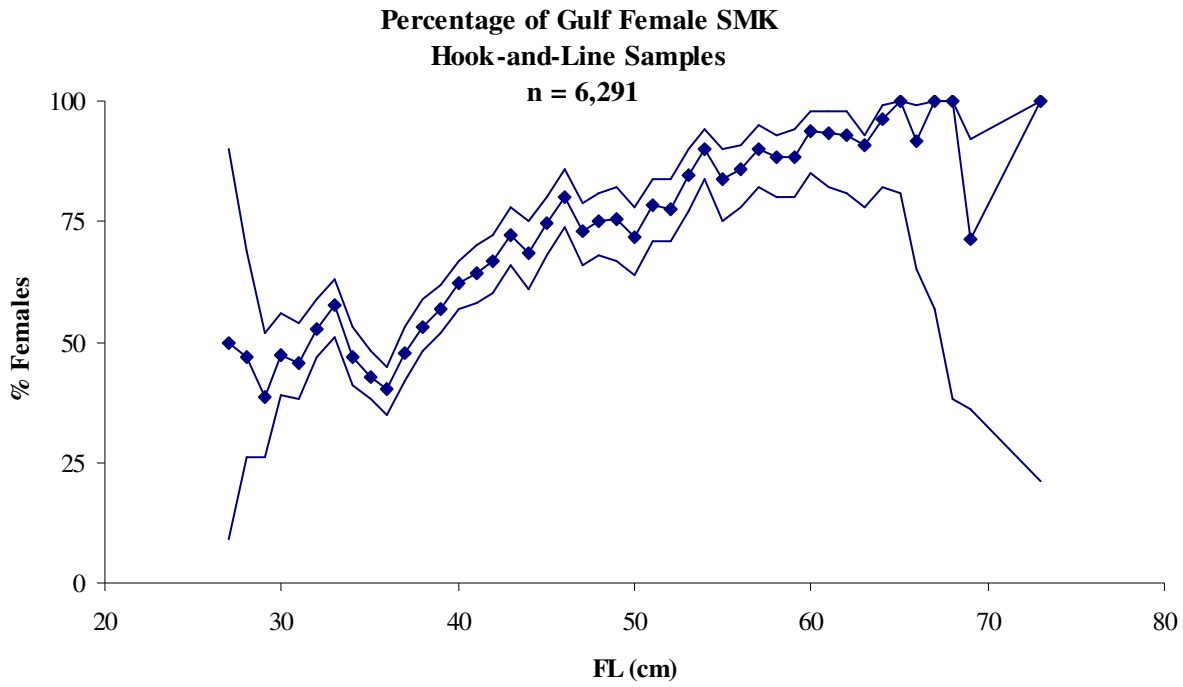

Figure 2.11. Percentage by size of Gulf females by size in the PCLAB data set from recreational hook-and-line samples; 5% and 95% confidence intervals.

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3 Commercial Fishery Statistics

3.1 Overview

Commercial landings for the U.S. Gulf of Mexico (GoM) Spanish mackerel stock were developed by gear (gill net, hand lines, and miscellaneous) in whole weight for the period 1890–2010 based on federal and state databases. Corresponding landings in numbers were based on mean weights estimated from the Trip Interview Program (TIP) by gear, state, and year.

Commercial discards were calculated from vessels fishing in the US Gulf of Mexico and reporting to the NMFS Coastal Logbook Program. Shrimp bycatch of Spanish mackerel was estimated from observer data and SEAMAP trawl data and scaled using shrimping effort.

Sampling intensity for lengths and ages by gear and year were considered, and length and age compositions were developed by gear and year for which samples were available.

3.1.1 Participants Commercial Workgroup

David Gloeckner, NMFS, Miami, FL (co-leader)
Kyle Shertzer, NMFS, Beaufort, NC (co-leader)
Donna Bellais, GulfFIN, Ocean Springs, MS
Steve Brown, FL FWC, St. Petersburg, FL
Joe Cimino, VMRC, Newport News, VA
Julie Defilippi, ACCSP, Arlington, VA
Amy Dukes, SCDNR, Charleston, SC
Stephanie McInerny, NCDMF, Morehead City, NC (rapporteur)
Tim Sartwell, ACCSP, Arlington, VA

Other contributors: Katie Andrews, Meaghan Bryan, Rob Cheshire, Ben Hartig, Rusty Hudson, Kevin McCarthy, Julie Califf, Liz Scott-Denton

3.1.2 Issues Discussed at the Data Workshop

The Workgroup (WG) discussed several issues that needed to be resolved before data could be compiled. The major issues discussed included: stock boundaries, length of time series, primary gears, discard estimates from the directed fishery and shrimp fishery, as well as length composition adequacy for characterizing size of the catch. All decisions are described in more detail in the following sections.

3.1.3 Map of Fishing Area

A map of the council boundaries is presented in Figure 3.1. The GoM Spanish mackerel fishery is considered to include the area north of the Florida Keys around to the Texas/ Mexico border.

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3.2 Review of Working Papers

The WG reviewed four working papers. All four of these papers were focused on GoM stocks.

SEDAR28-DW6: This working paper described a Bayesian approach to estimating shrimp bycatch in the GoM of both cobia and Spanish mackerel. The group found the methods to be sound, but questioned whether sample sizes for cobia were adequate to support the Bayesian model.

SEDAR28-DW7: This working paper described length frequency distributions of Spanish mackerel from commercial and recreational fleets in the GoM. Length frequencies of commercial landings were compiled from TIP data, and these data were considered adequate for use in the assessment.

SEDAR28-DW8: This working paper described length frequency distributions of cobia from commercial and recreational fleets in the GoM. Length frequencies of commercial landings were compiled from TIP data, and these data were considered adequate for use in the assessment.

SEDAR28-DW04: This working paper described the calculation of Spanish mackerel discard from the commercial gillnet, vertical line, and trolling fisheries. Discards were calculated as the product of gear-specific self-reported discard rates and total effort.

3.3 Commercial Landings

3.3.1 Time Series Duration

The WG made the decision to examine landings as far back in time as possible, because the longer time period might shed light on stock resilience and potential. Landings were compiled starting in 1880, the first year of available data, but the reliability of information improved substantially in 1950 with several additional improvements since (described along with methods).

> **Decision 1:** Landings will be presented from the earliest available year to the agreed upon terminal year. This was accepted by the plenary.

The terminal year considered for this report was 2010. However, the intent is to provide data through 2011 in time for the assessment workshop. Several data streams (e.g., discards) depend on statistics computed across years and could therefore change throughout the time series with the inclusion of 2011.

> **Decision 2:** Terminal year will be 2010 for this report, but the intent is to update with 2011 data for input to the assessment model. This decision was accepted by the plenary.

3.3.2 Fishing Year vs. Calendar Year

The WG recommended that commercial landings be aligned to the calendar year running from January 1 through December 31 because fishing years can change over time and calendar year will facilitate easier comparisons over time.

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Decision 3: The data will be compiled by calendar year. This was accepted by the plenary.

3.3.3 Stock Boundaries

Commercial landings were compiled from FL through TX. The eastern boundary was the FL Keys along the South Atlantic and Gulf of Mexico Council Boundary. Landings north and west of the Keys to the TX/Mexico border were considered to be from the Gulf of Mexico stock, and landings south of the Keys were considered to be from the Atlantic stock (Figures 3.1 and 3.2).

Data reported as north and west of the Keys (ALS fishing areas: 0018, 0020, 0028, 0030-0219, 7441, 7481, 1121-1202, 2121-5189, 8141-9202) were included in the GoM stock. If an area fished was not specified (ALS fishing areas 0000, 9999, 7994) then the landing was assigned to the Gulf of Mexico if it was landed on the FL West Coast, AL, MS, LA or TX (ALS states 11, 01, 21, 27, 46).

Decision 4: Eastern boundary is the South Atlantic/Gulf of Mexico Fisheries Management Council boundary along the Florida Keys and the western boundary is the Texas/Mexico border. This was accepted by the plenary.

3.3.4 Identification Issues

The conclusion from the SEDAR 17 Spanish mackerel assessment was not revisited. The SEDAR 17 report states: "There was discussion about whether small king mackerel are mis-identified as Spanish mackerel, and vice versa (SEDAR, 2008). This was not thought to be an issue. The recent king mackerel assessment made a similar judgment in the SEDAR 16 data workshop. Currently, a landings category does not exist for unclassified mackerels. Further, Spanish mackerels have been identified as such historically back to the 1800s."

Decision 5: There is not a misidentification issue with Spanish mackerel. This was accepted by the plenary.

3.3.5 Commercial Gears

The WG evaluated the distribution of gears in the landings and in the TIP data, and concluded that the data supported grouping commercial landings into two primary gears and one miscellaneous group. Thus, commercial landings were apportioned into: gill net, hand line (including trolling), and miscellaneous (including longline) (Table 3.1). Gill nets were the dominant gear type. The WG recommended that, for the assessment model, landings from the miscellaneous gear might be distributed among the other two gears according to their annual proportions of total landings.

Decision 6: Landings will be aggregated by gill net, hand line and miscellaneous (other) gears. For the assessment model, the miscellaneous gears should be proportioned into gill net and hand line gears based on the annual proportions of landings by those gears. This was accepted by the plenary.

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Data on commercial landings from 1926-1961 are housed in a database in the National Marine Fisheries Service's Office of Science and Technology (S&T). Historical commercial landings (1962 to present) for all species on the GoM coast are maintained in the Accumulated Landings System (ALS) at the Southeast Fisheries Science Center (SEFSC). Data prior to 1968 were collected by the Bureau of Commercial Fisheries or US Fish and Fisheries Commission and are available from the database at the NMFS office of Science and Technology (NMFS personal communication). Original reports from the Bureau are available at:
http://docs.lib.noaa.gov/rescue/cof/data_rescue_fish_commission_annual_reports.html. These historical landings are also reported in NMFS, 1990.

The data collected prior to the advent of the trip ticket programs in each state are generally referred to as the NMFS General Canvass data. General Canvass data were collected by port agents stationed in each county. The port agents would collect total landings from dealers and use local knowledge to proportion the landings into the proper fishing areas and gears. The ALS uses trip level data after the advent of trip ticket programs in each state.

Data from state trip ticket programs begin in various years, depending on the state. In the Gulf of Mexico, trip ticket data were available directly from the state trip ticket program or through the Gulf of Mexico Fisheries Information Network (GulfFIN) housed at the Gulf States Marine Fisheries Commission (GSMFC). Where data were available from state trip ticket programs, those data were used in lieu of data from ALS. Data are presented using the gear categories as determined at the workshop. The specific NMFS gears in each category are listed in Table 3.1. Commercial landings in pounds (whole weight) were developed based on methodologies for gear as defined by the WG for each state as available by gear for 1890-2010.

A precipitous drop in landings occurred in 1977 following a cold weather event in Florida during 1976 and 1977. After these cold weather events, landings remained much lower than previous years. There is evidence that this cold weather event affected other coastal migratory species as well (Fable et al., 1981).

Florida – Prior to 1986, Florida commercial landings data were collected through the NMFS General Canvass via monthly dealer reports. In 1984, the state of Florida instituted a mandatory trip level reporting program to report harvest of commercial marine fisheries products in Florida via a marine fisheries trip ticket. The program requires seafood dealers to report all transactions of marine fisheries products purchased from commercial fishers, and to interview fishers for pertinent effort data. Trip tickets are required to be received monthly, or weekly for federally managed species. Data reported on trip tickets include participant identifiers, dates of activity, effort and location data, gear used, as well as composition and disposition of catch. The program encompasses commercial fishery activity in waters of the Gulf of Mexico and South Atlantic from the Alabama-Florida border to the Florida-Georgia border. The first full year of available data from Florida trip tickets is 1986.

A data set was provided to the commercial WG of summarized Spanish mackerel landings by year and gear with pounds (whole weight) from Florida Gulf of Mexico waters (Monroe

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county landings were assigned to the Gulf when catch area indicated a Gulf catch area; Monroe county landings were assigned to Gulf if no catch area was reported). Gear categories include gill net, hand line (including trolling), and miscellaneous (including longline). Gear was not accurately reported on trip ticket data from 1986 to 1996, so for those years the landings by gear from the NMFS General Canvass data were used.

NMFS logbook data were evaluated and it was decided to use Florida trip ticket data from 1997 forward for landings, area, and gear distributions, and NMFS General Canvass landings data prior to 1997. All vessels permitted for coastal species were not required to submit logbooks until 1993, and while gear distributions were similar to Florida trip ticket landings data, logbook did not account for inshore landings of Spanish mackerel, and total landings of Spanish mackerel were significantly less than trip ticket landings from 1993 to 2010.

Alabama – Alabama trip ticket data have been collected since 2000. These data are recoded in the FIN format and copied to the GulfFIN database every few months. GulfFIN provided the Spanish mackerel landings data from AL for 2000-2010. ALS data were used for 1962-1999.

Mississippi –Mississippi finfish landings are currently collected by a NMFS port agent and housed in the ALS. Mississippi intends to begin a state trip ticket program for finfish during 2012. All MS landings for Spanish mackerel were compiled from the ALS 1962-2010.

Louisiana – Louisiana trip ticket data has been collected since 1993, however, gear and fishing area were not required. In 1998 LA began to require information on gear and area of capture. Data collected since 2000 are recoded in the FIN format and copied to the GulfFIN database every few months. GulfFIN provided the Spanish mackerel landings data from LA for 2000-2010. ALS data were used for 1962-1999.

Texas – Texas trip ticket data have been collected since 2009, however, TX is still developing quality control procedures to allow the data to be edited for errors before transfer to GulfFIN. Prior to the beginning of the TX trip ticket program, NMFS port agents had collected TX landings data. Because the NMFS data collection method has been in place since the 1970s, ALS was used for TX Spanish mackerel landings from 1962-2010.

Gulf of Mexico Spanish mackerel landings by gear and year are presented in Table 3.2 and Figure 3.3. The distribution of catches reported on coastal logbooks are presented in Figures 3.6 and 3.7.

Decision 7: The WG made the following decisions for reporting of commercial landings:

- Landings would be presented by calendar year/gear across all states.
- Final landings data would come from the following sources:
  - FL:
  - 1890-1949 (Bureau of Commercial Fisheries reports)
  - 1950-1961 (S&T)
  - 1962-1996 (ALS)

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- 1997-2010 (FLFWC)
- AL:
- 1890-1949 (Bureau of Commercial Fisheries reports)
- 1950-1961 (S&T)
- 1962-1999 (ALS)
- 2000-2010 (GulfFIN)
- MS:
- 1890-1949 (Bureau of Commercial Fisheries reports)
- 1950-1961 (S&T)
- 1962-2010 (ALS)
- LA:
- 1890-1949 (Bureau of Commercial Fisheries reports)
- 1950-1961 (S&T)
- 1962-1999 (ALS)
- 2000-2010 (GulfFIN)
- TX:
- 1890-1949 (Bureau of Commercial Fisheries reports)
- 1950-1961 (S&T)
- 1962-2010 (ALS)

Whole vs Gutted Weight – The Commercial WG discussed the topic of what units to use to report commercial landings. Spanish mackerel are typically landed whole, therefore for this analysis, landings were provided in whole weight.

> **Decision 8:** Landings will be presented in pounds whole weight. This was accepted by the plenary.

Confidentiality Issues – The Commercial WG agreed that it was necessary to hide commercial landings with fewer than three submitters. The WG recommended that landings be hidden if they fail to meet the rule of 3.

> **Decision 9:** Landings with fewer than 3 submitters should be hidden for years when the number of submitters is known. This was accepted by the plenary.

3.3.6 Converting Landings in Weight to Landings in Numbers

The weight in pounds for each sample was calculated, as was the mean weight by gear and year (weighted by: weight of fish in the sample in pounds whole weight, trip weight in pounds whole weight, and strata landing weight in pounds whole weight). Where the sample size was less than 20, the mean across all years for that gear was used, if the sample size was less than 20 across all years for the gear, then the mean across all gears and years was used (Table 3.3). It was suggested by the lead analyst that 50 be considered as the cutoff for minimum sample size, as was done in previous assessments by SEFSC. This was examined, but resulted in an average difference of only 0.02 pounds between the 20 fish minimum and the 50 fish minimum size, so 20 fish was used as the minimum sample size. The landings in pounds whole weight were divided by the mean weight for that stratum to derive landings in numbers (Table 3.4 and Figure 3.4).

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3.4 Commercial Discards

3.4.1 Discards from Commercial Finfish Operations

Spanish mackerel discards from the commercial vertical line, trolling, and gillnet fisheries were calculated for the US South Atlantic (statistical areas 2300-3700; Table 3.5) and Gulf of Mexico (statistical areas 1-21; Table 3.5). A map of logbook areas is presented in Figure 3.5. The number of trips that reported discards of Spanish mackerel was very low (Table 3.5), limiting the complexity of any analysis. Methods for calculating discards are detailed in SEDAR28-DW04 and are summarized below.

Spanish mackerel discard rates were calculated as the mean nominal discard rate among all trips (by gear) that reported to the discard logbook program during the period 2002–2010. Rates were separately calculated for vertical line, trolling, and gill net gears. Yearly gear specific discards were calculated as the product of the gear specific discard rate and gear specific yearly total effort (vertical line and trolling effort = total hook-hours fished; gill net effort = square yard hours fished) reported to the coastal logbook program. Discards were calculated for the years 1998–2010. Prior to 1998, federal permits were not required to land Spanish mackerel caught in federal waters. Total Spanish mackerel fishing effort, particularly for trolling vessels, was not reported to the coastal logbook program by all commercial vessels, and thus any estimates of total discards would have been erroneously low for years prior to 1998.

Approximately 1.3 percent of all Spanish mackerel discard reports for the period 2002–2010 were from trips reporting fishing gears other than vertical lines, trolling, and gill nets. Data reported for those other gears were not included in the discard calculations.

Yearly total gear specific discards (calculated in number of fish) from the Gulf of Mexico are provided in Table 3.6. Those totals include all discards reported to the discard logbook program including those reported as "kept, not sold".

The yearly calculated Spanish mackerel discards from the commercial fishery (of vessels with federal permits reporting to the coastal logbook program) were relatively low. During the 13 years included in the analysis, fewer than 20,000 Spanish mackerel were discarded in the Gulf of Mexico per year. The number of trips upon which the calculations were based, however, was very small. An additional concern was the possible under-reporting of commercial discards. The percentage of fishers returning discard logbooks with reports of "no discards" has been much greater than the percentage of observer reports of "no discards" on commercial fishing trips suggesting that under-reporting of discards may be occurring. These results should, therefore, be used with caution. Discards calculated here may represent the minimum number of discards from the commercial fishery.

A high percentage of Spanish mackerel discards were reported as "dead" or "majority dead" in the South Atlantic gill net fishery (Table 3.7). The vertical line and trolling fisheries in both regions report many fish that may have otherwise been discards as "kept" (Table 3.7). Many of those "kept" fish may have been used as bait.

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Decision 10: The Commercial WG supports the methodology of calculating discards and recommends the use of these data. However, the discards reported as "kept, not sold" should be added to the landings, not included with the discards. This was accepted by the plenary.

3.4.2 Discards from the Shrimp Fishery

The WG considered the estimates of Spanish mackerel bycatch in the Gulf of Mexico shrimp fishery presented in SEDAR28-DW06 as prepared by Brian Linton. This method used a Bayesian approach to estimating bycatch, developed by Scott Nichols for the SEDAR 7 Gulf Red Snapper Assessment. The methods used and preliminary results are repeated below.

The data used in this analysis came from various shrimp observer programs, the SEAMAP groundfish survey, shrimp effort estimates, and the Vessel Operating Units file. The primary data on CPUE in the shrimp fishery came from a series of shrimp observer programs, which began in 1972 and extend to the current shrimp observer program. Additional CPUE data were obtained from the SEAMAP groundfish survey. Only data from 40 ft trawls by the Oregon II were used in this analysis, because these trawls were identified as being most similar to trawls conducted by the shrimp fishery. Point estimates and associated standard errors of shrimp effort were generated by the NMFS Galveston Lab using their SN-pooled method of effort estimation (Nance 2004). Most observer program CPUE data were expressed in numbers per net-hour, while the shrimp effort data were expressed in vessel-hours. Therefore, data from the NMFS Vessel Operating Units file were used to estimate the average number of nets per vessel for the shrimp fishery.

The following Bayesian model was used to estimate shrimp bycatch (i.e., model 02 from Nichols 2004a):

$$Ln(CPUE)_{ijklm} = year_i + season_j + area_k + depth_l + data_set_m + local_{ijklm}.$$

The factor levels for the main effects are presented in Table 3.8. Catch in numbers for each cell was assumed to follow a negative binomial distribution. The main effects and local term, as expressed above (i.e, on the log-scale), were assigned normal prior distributions. A lognormal hyperprior was assigned to the precision ($1/\sigma 2$) parameter of the local term. Therefore, the data determined the distribution of the local term in cells with data, while the distribution of the local term defaulted to the prior with fitted precision for cells without data. In effect, the local term became a fixed effect for cells with data and a random effect for cells without data.

The shrimp bycatch estimation model was fit using WinBUGS version 1.4.3. Markov Chain Monte Carlo (MCMC) methods were used to estimate the marginal posterior distributions of the parameters and important derived quantities. Two parallel chains of 29,000 iterations each were run. The first 4,000 iterations of each chain were dropped as a burn-in period, to remove the effects of the initial parameter values. A thinning interval of five iterations (i.e., only every fifth iteration was used) was applied to each chain, to reduce autocorrelation in parameter estimates and derived quantities. The marginal posterior distributions were calculated from the remaining 10,000 iterations. Convergence of the chains was determined

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by visual inspection of trace plots, marginal posterior density plots, and Gelman-Rubin statistic (Brooks and Gelman, 1998) plots.

Annual observed bycatch is reported in Table 3.9. Annual estimates (predicted) of total Spanish mackerel bycatch in the Gulf of Mexico shrimp fishery are presented in Table 3.10. The CVs associated with these estimates ranged from 25% to 911%. Ten of the 39 years had CVs below 100%. The marginal posterior densities of the estimates showed a high degree of skew in every year, with 2008 having the least amount of skew.

Although there were some years with small sample sizes, the WG felt the method was adequate for estimating Spanish mackerel bycatch in the Gulf of Mexico shrimp fishery.

> **Decision 11:** The Commercial WG supports the methodology of calculating Spanish mackerel bycatch in the Gulf of Mexico shrimp fishery and recommends the use of these data. This was accepted by the plenary.

3.5 Commercial Effort

The distribution of commercial effort in trips by year was compiled from the Coastal Logbook Program for 1990-2010 and supplied here for informational purposes. These data are presented in Figures 3.8 and 3.9.

3.6 Biological Sampling

Biological sample data were obtained from the TIP sample data at NMFS/SEFSC. Data that were not already in the TIP database were also incorporated from NCDMF, as well as sample data from VMRC covering Virginia commercial fisheries. Data were filtered to eliminate those records that included a size or effort bias, were known to be collected non-randomly, were not from commercial trips, were selected by quota sampling, or were not collected shore-side (observer data). These data were further limited to those that could be assigned a year, gear, and state. Data that had an unknown landing year, gear, or state were deleted from the file. Additionally, samples were removed if they were drawn from market categories. This was due to the potential for bias in sampling, although a review of length data during SEDAR 17 indicated only trivial difference in the length distributions if the market categories were excluded. Further, only lengths from fish caught in the Gulf were included in the analysis.

The group reviewed the distribution of sample size to size of the catch to determine if trip weighting was needed. For Spanish mackerel there was not a significant relationship between catch size and sample size, indicating that sampling fraction varied by trip, thus the WG recommended weighting the length data by trip. Where no trip landings data were available, the sample weight was used as a proxy, as the sample weight gives a minimum weight landed for the species. If there was no landing weight or sample weight recorded for the sample, the length sample was dropped. Length data were also weighted spatially by the landings for the particular year, state and gear stratum, and thus were limited to where those strata could be identified in the corresponding landings. Landings and biological data were assigned a state based on landing location or sample location if there was no landing location assigned.

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Decision 12: The Commercial WG recommends weighting the length samples by trip weight to overcome any sampling bias arising from differences in sampling fractions across trips. This was accepted by the plenary.

3.6.1 Sampling Intensity for Lengths

The number of trips with samples used in the length compositions ranged from a high of 21 for hand line gear in 2010 to a low of zero for many strata (Table 3.11). The number of trips with samples used in the length compositions was consistently greater than 10 trips for hand line gear since 2008. The number of trips with samples used averaged 10 for gill net gear since 2005. Trips using other miscellaneous gear were rarely sampled. Table 3.11 displays number of trips with samples with unbiased samples and number of trips with samples used (trip weights and landings available).

The number of fish sampled had a high of 794 for gill net gear in 2006 and lows of zero for many of the strata (Table 3.12). The number of lengths sampled was consistently greater than 100 for gill net gear since 2004. Hand line gear had over 100 lengths available for only years within 2006-2008. For other miscellaneous gears, the numbers of length samples available were above 100 for 1992, 2004 and 2006-2008. Table 3.12 displays the number of valid samples and number of samples used (trip weights and landings available).

3.6.2 Length/Age Distribution

All lengths were converted to fork length (FL) in mm using the formula provided in the Spanish mackerel Life History section of the SEDAR 28 Data Workshop Report and binned into one centimeter groups with a floor of 0.6 cm and a ceiling of 0.5 cm. Length was converted to weight (whole weight in pounds) using conversions provided by the life history group. The length data and landings data were divided into gill net, hand line, and other miscellaneous gears. Length compositions were weighted by the trip landings in numbers and the landings in numbers by strata (state, year, gear). Annual length compositions of Spanish mackerel are summarized in Figures 3.10-3.12.

Observer samples were provided from the Reeffish Observer Program by the NMFS Galveston Lab. These data were filtered to remove non-random samples. Of the remaining data, only two Spanish mackerel were reported as discarded (43 cm FL, and 45 cm FL).

Sample size of Spanish mackerel ages are summarized by gear from commercial landings in the U.S. Gulf of Mexico for 1983-2010 (Table 3.13). Age compositions were developed for gill net (1988-2010 with exceptions in Figure 3.13), hand line (1988-2010, Figure 3.14), and other miscellaneous (1988-2010, Figure 3.15) gear types. The commercial group suggests ages are weighted by the length composition with the formula:

$$RW_i = \frac{NLi \,/\, TN}{OLi \,/\, TO},$$

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where *NLi* is the number of fish measured with length *i*, *TN* is the total number of fish measured in that strata, *OLi* is the number of ages sampled at length *i,* and *TO* is the total number of ages sampled within the strata and RW_i is the weight to apply to the age (Chih, 2009). This weighting corrects for a potential sampling bias of age samples relative to length samples (SEDAR, 2006). Weighting by length composition was not done at this time, pending resolution of how to correct the age data when length compositions are not available for the given year and gear strata. The age compositions presented in Figures 3.13-3.15 are unweighted.

3.7 Comments on Adequacy of Data for Assessment Analyses

Landings data appear to be adequate to support the assessment, with landings reports beginning in the 1880s. Landings have greatest certainty since the individual state's trip ticket programs were initiated. Landings prior to 1950 are considered highly uncertain.

Discard estimates have greater uncertainty than the landings, as there are very few trips where Spanish mackerel discards were observed by the Reeffish Observer Program. Additionally, the NMFS logbook doesn't capture the entire fishery, so the discards reported to this program should be considered a minimum estimate. Bycatch in the shrimp fishery is difficult to determine given the low encounter rate between shrimp trawls and Spanish mackerel, and because of irregular observer coverage. As a consequence, the annual variability in shrimp bycatch may be poorly estimated, although the estimated mean bycatch may be at the appropriate scale.

Commercial discards and shrimp bycatch are based on estimated encounter rates and effort. In years when multi-year averages are used to compute encounter rates, these estimates do not account for year-specific age structure in the Spanish mackerel stock.

Sample sizes for developing length compositions were inadequate for a considerable number of year and gear strata. This may impact the ability in those years to use length compositions to correct for potential biases in age compositions. In some year and gear strata, sample sizes appeared adequate, although a small proportion of the overall catch was sampled. The annual proportion of commercial trips sampled for lengths was typically less than 1% in all years (Table 3.14).

3.8 Literature Cited

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Addendum to Commercial Landings (Section 3.3):

NMFS SEFIN Accumulated Landings (ALS)

Information on the quantity and value of seafood products caught by fishermen in the U.S. has been collected starting in the late1800s (first year varies by species). Fairly serious collection activity began in the 1920s. The data set maintained by the Southeast Fisheries Science Center (SEFSC) in the SEFIN database management system is a continuous data set that begins in 1962.

In addition to the quantity and value, information on the gear used to catch the fish, the area where the fishing occurred and the distance from shore are also recorded. Because the quantity and value data are collected from seafood dealers, the information on gear and fishing location are estimated and added to the data by data collection specialists. In some states, this ancillary data are not available.

Commercial landings statistics have been collected and processed by various organizations during the 1962-to-present period that the SEFIN data set covers. During the 16 years from 1962 through 1978, these data were collected by port agents employed by the Federal government and stationed at major fishing ports in the southeast. The program was run from the Headquarters Office of the Bureau of Commercial Fisheries in Washington DC. Data collection procedures were established by Headquarters and the data were submitted to Washington for processing and computer storage. In 1978, the responsibility for collection and processing were transferred to the SEFSC.

In the early 1980s, the NMFS and the state fishery agencies within the Southeast began to develop a cooperative program for the collection and processing of commercial fisheries statistics. With the exception of two counties, one in Mississippi and one in Alabama, all of the general canvass statistics are collected by the fishery agency in the respective state and provided to the SEFSC under a comprehensive Cooperative Statistics Program (CSP).

The purpose of this documentation is to describe the current collection and processing procedures that are employed for the commercial fisheries statistics maintained in the SEFIN database.

1960 - Late 1980s

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Although the data processing and database management responsibility were transferred from the Headquarters in Washington DC to the SEFSC during this period, the data collection procedures remained essentially the same. Trained data collection personnel, referred to as fishery reporting specialists or port agents, were stationed at major fishing ports throughout the Southeast Region. The data collection procedures for commercial landings included two parts.

The primary task for the port agents was to visit all seafood dealers or fish houses within their assigned areas at least once a month to record the pounds and value for each species or product type that were purchased or handled by the dealer or fish house. The agents summed the landings and value data and submitted these data in monthly reports to their area supervisors. All of the monthly data were submitted in essentially the same form.

The second task was to estimate the quantity of fish that were caught by specific types of gear and the location of the fishing activity. Port agents provided this gear/area information for all of the landings data that they collected. The objective was to have gear and area information assigned to all monthly commercial landings data.

There are two problems with the commercial fishery statistics that were collected from seafood dealers. First, dealers do not always record the specific species that are caught and second, fish or shellfish are not always purchased at the same location where they are unloaded, i.e., landed.

Dealers have always recorded fishery products in ways that meet their needs, which sometimes make it ambiguous for scientific uses. Although the port agents can readily identify individual species, they usually were not at the fish house when fish were being unloaded and thus, could not observe and identify the fish.

The second problem is to identify where the fish were landed from the information recorded by the dealers on their sales receipts. The NMFS standard for fisheries statistics is to associate commercial statistics with the location where the product was first unloaded, i.e., landed, at a shore-based facility. Because some products are unloaded at a dock or fish house and purchased and transported to another dealer, the actual 'landing' location may not be apparent from the dealers' sales receipts. Historically, communications between individual port agents and the area supervisors were the primary source of information that was available to identify the actual unloading location.

Cooperative Statistics Program

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In the early 1980s, it became apparent that the collection of commercial fisheries statistics was an activity that was conducted by both the Federal government and individual state fishery agencies. Plans and negotiations were initiated to develop a program that would provide the fisheries statistics that are needed for management by both Federal and state agencies. By the mid- 1980s, formal cooperative agreements had been signed between the NMFS/SEFSC and each of the eight coastal states in the southeast, Puerto Rico and the US Virgin Islands.

Initially, the data collection procedures that were used by the states under the cooperative agreements were essentially the same as the historical NMFS procedures. As the states developed their data collection programs, many of them promulgated legislation that authorized their fishery agencies to collect fishery statistics. Many of the state statutes include mandatory data submission by seafood dealers.

Because the data collection procedures (regulations) are different for each state, the type and detail of data varies throughout the Region. The commercial landings database maintained in SEFIN contains a standard set of data that is consistent for all states in the Region.

A description of the data collection procedures and associated data submission requirements for each state follows.

Florida

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Prior to 1986, commercial landings statistics were collected by a combination of monthly mail submissions and port agent visits. These procedures provided quantity and value, but did not provide information on gear, area or distance from shore. Because of the large number of dealers, port agents were not able to provide the gear, area and distance information for monthly data. This information, however, is provided for annual summaries of the quantity and value and known as the Florida Annual Canvas data (see below).

Beginning in 1986, mandatory reporting by all seafood dealers was implemented by the State of Florida. The State requires that a report (ticket) be completed and submitted to the State for every trip. Dealers have to report the type of gear as well as the quantity (pounds) purchased for each species. Information on the area of catch can also be provided on the tickets for individual trips. As of 1986 the ALS system relies solely on the Florida trip ticket data to create the ALS landings data for all species other than shrimp.

Alabama
=======
Data collection in Alabama is voluntary and is conducted by state and federal port agents that visit dealers and docks monthly. Summaries of the total landings (pounds) and value for species or market category are recorded. Port agents provide information on gear and fishing area from their knowledge of the fisheries and interaction with fishermen and dealers. As of mid- 2000, the State of Alabama required fishermen and dealers to report all commercial landings data through a trip ticket system. As of 2001 the ALS system relies solely on the Alabama trip ticket data to create the ALS landings data for Alabama.

Mississippi
==========
Data collection in Mississippi is voluntary and is conducted by state and federal port agents that visit dealers and docks monthly. Summaries of the total landings (pounds) and value for species or market category are recorded. Port agents provide information on gear and fishing area from their knowledge of the fisheries and interaction with fishermen and dealers.

Louisiana
==========
Prior to 1993, commercial landings statistics were collected in Louisiana by Federal port agents following the traditional procedures established by the NMFS. Monthly summaries of the quantity and value were collected from each dealer in the state. The information on gear, area and distance from shore were added by the individual port agents.

Beginning in January 1993, the Department of Wildlife and Fisheries, State of Louisiana began to enforce the states' mandatory reporting requirement. Dealers have to be licensed by the State and are required to submit monthly summaries of the purchases that were made for individual species or market categories. With the implementation of the State statute, Federal port agents did not participate in the collection of commercial fishery statistics.

Since the implementation of the State program, information on the gear used, the area of catch and the distance from shore has not been added to the landings statistics (1992-1999). In 1998 the State of Louisiana required fishermen and dealers to report all commercial landings data through a trip ticket system. These data contain detailed landings information by trip including gear, area of capture and vessel information. As of 2000, the ALS system relies solely on the Louisiana trip ticket data to create the ALS landings data for Louisiana.

Texas
=====
The State has a mandatory reporting requirement for dealers licensed by the State. Dealers are required to submit monthly summaries of the quantities (pounds) and value of the purchases that were made for individual species or market categories.

Information on gear, area and distance from shore are added to the state data by SEFSC personnel. Furthermore, landings of species that are unloaded in Texas, but transported to locations in other states are added to the commercial landings statistics by SEFSC personnel.

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NMFS SEFIN Annual Canvas Data for Florida

The Florida Annual Data files from 1976 – 1996 represent annual landings by county (from dealer reports) which are broken out on a percentage estimate by species, gear, area of capture, and distance from shore. These estimates are submitted by Port agents, which were assigned responsibility for the particular county, from interviews and discussions from dealers and fishermen collected throughout the year. The estimates are processed against the annual landings totals by county on a percentage basis to create the estimated proportions of catch by the gear, area and distance from shore. (The sum of percentages for a given Year, State, County, Species combination will equal 100.)

Area of capture considerations: ALS is considered to be commercial landings data base which reports where the marine resource was landed. With the advent of some State trip ticket programs as the data source the definition is more loosely applied. As such one cannot assume reports from the ALS by State or county will accurately inform you of Gulf vs South Atlantic vs Foreign catch. To make that determination you must consider the area of capture.

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3.9 Tables

Table 3.1. NMFS gears in each gear category for Spanish mackerel commercial landings.

NMFS GEAR CODE	GEAR DESCRIPTION	GEAR CATEGORY
000	Not Coded	OTHER
020	Haul Seines, Beach	OTHER
030	Haul Seines, Long	OTHER
032	Haul Seines, Long(Danish)	OTHER
040	Stop Seines	OTHER
050	Stop Nets	OTHER
100	Encircling Nets (Purse)	OTHER
103	Purse Seines, Anchovy	OTHER
105	Purse Seines, Barracuda	OTHER
110	Purse Seines, Herring	OTHER
120	Purse Seines, Mackerel	OTHER
125	Purse Seines, Menhaden	OTHER
130	Purse Seines, Salmon	OTHER
135	Purse Seines, Sardine	OTHER
140	Purse Seines, Tuna	OTHER
145	Purse Seines, Other	OTHER
150	Nets Unc, Hawaii	OTHER
151	Nets, excluding trawls	OTHER
155	Lampara & Ring Nets, Mackerel	OTHER
160	Lampara & Ring Nets, Sardine	OTHER
165	Lampara & Ring Nets, Squid	OTHER
170	Lampara & Ring Nets, Tuna	OTHER
175	Lampara & Ring Nets, Other	OTHER
180	Bag Nets	OTHER
185	Paranella Nets	OTHER
187	Skimmer Nets	OTHER
189	Butterfly Nets	OTHER
191	Beam Trawls, Crab	OTHER
192	Beam Trawls, Shrimp	OTHER
193	Beam Trawls, Other	OTHER
194	BEAM TRAWLS, CHOPSTICKS	OTHER
200	Trawls, Unspecified	OTHER
205	Otter Trawl Bottom, Crab	OTHER
210	Otter Trawl Bottom, Fish	OTHER
212	Otter Trawl Bottom, Lobster	OTHER
214	Otter Trawl Bottom, Scallop	OTHER
215	Otter Trawl Bottom, Shrimp	OTHER

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217	Otter Trawl Bottom, Twin	OTHER
220	Otter Trawl Bottom, Other	OTHER
230	Otter Trawl Midwater	OTHER
233	Trawl Midwater, Paired	OTHER
235	Trawl Bottom, Paired	OTHER
240	Scottish Seine	OTHER
250	Weirs	OTHER
275	Pound Nets, Fish	OTHER
280	Pound Nets, Crab	OTHER
285	Pound Nets, Horseshoe Crab	OTHER
289	Pound Nets, Other	OTHER
290	Trap Nets	OTHER
295	Floating Traps (Shallow)	OTHER
300	Pots And Traps, Cmb	OTHER
305	Fyke And Hoop Nets, Crab	OTHER
310	Fyke And Hoop Nets, Fish	OTHER
315	Fyke And Hoop Nets, Turtle	OTHER
320	Fyke Net, Other	OTHER
325	Pots And Traps, Conch	OTHER
330	Pots And Traps, Crab, Blue	OTHER
331	Pots And Traps, Crab, Dungens	OTHER
332	Pots And Traps, Crab, King	OTHER
333	Pots And Traps, Crab, Other	OTHER
334	Pots and Traps, Crab, Blue Peeler	OTHER
335	Pots And Traps,Crayfsh(frhwa)	OTHER
340	Pots And Traps, Eel	OTHER
345	Pots And Traps, Fish	OTHER
350	Pots And Traps, Lobster Inshore	OTHER
351	Pots And Traps, Lobster Ofshore	OTHER
355	Pots And Traps, Spiny Lobster	OTHER
360	Pots And Traps, Octopus	OTHER
365	Pots And Traps, Perwkle Or Ckle	OTHER
370	Pots And Traps, Shrimp	OTHER
375	Pots And Traps, Turtle	OTHER
379	Pots And Traps, Other	OTHER
380	Pots And Traps, Box Trap	OTHER
385	Pots And Traps, Wire Baskets	OTHER
387	Pots, Unclassified	OTHER
390	Slat Traps (Virginia)	OTHER
400	Entangling Nets (Gill) Unspc	GILL NET
405	Gill Nets, California Halibut	GILL NET
410	Gill Nets, Crab	GILL NET
415	Gill Nets, Salmon	GILL NET

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420	Gill Nets, Sea Bass	GILL NET
425	Gill Nets, Other	GILL NET
430	Gill Nets, Sink/Anchor, Other	GILL NET
450	Gill Nets, Drift, Barracuda	GILL NET
455	Gill Nets, Drift, Salmon	GILL NET
460	Gill Nets, Drift, Sea Bass	GILL NET
465	Gill Nets, Drift, Shad	GILL NET
470	Gill Nets, Drift, Other	GILL NET
475	Gill Nets, Drift, Runaround	GILL NET
480	Gill Nets, Stake	GILL NET
490	Gill Nets, Gl Shoal	GILL NET
500	Gill Nets, Gl 1 - 2 Inch	GILL NET
505	Gill Nets, Gl 2 - 4 Inch	GILL NET
510	Gill Nets, Gl 4 - 7 Inch	GILL NET
515	Gill Nets, Gl 7 - 14 Inch	GILL NET
520	Gill Nets, Drift Large Pelagic	GILL NET
530	Trammel Nets	OTHER
600	Troll & Hand Lines Cmb	HAND LINE
601	Lines Hand, Albacore	HAND LINE
605	Lines Hand, Rockfish	HAND LINE
607	Lines Hand, Yellowfish	HAND LINE
610	Lines Hand, Other	HAND LINE
611	Rod and Reel	HAND LINE
612	Reel, Manual	HAND LINE
613	Reel, Electric or Hydraulic	HAND LINE
614	BUOY GEAR, VERTICAL	OTHER
616	Rod and Reel, Electric (Hand)	HAND LINE
621	Lines Jigging Machine	HAND LINE
650	Lines Troll, Salmon	HAND LINE
651	Lines Power Troll Salmon	HAND LINE
655	Lines Troll, Tuna	HAND LINE
656	Lines Power Troll Tuna	HAND LINE
657	LINES TROLL, GREEN-STICK	HAND LINE
660	Lines Troll, Other	HAND LINE
661	Lines Power Troll Other	HAND LINE
665	Lines Troll, Mackerel	HAND LINE
675	Lines Long Set With Hooks	OTHER
676	Lines Long, Reef Fish	OTHER
677	Lines Long, Shark	OTHER
678	Lines Long Drift With Hooks	OTHER
680	Lines Trot With Baits	OTHER
685	Lines Snag	OTHER
690	Lines Electrical Devices	OTHER

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703	Dip Nets, Common	OTHER
705	Dip Nets, Drop	OTHER
710	Brail Or Scoop	OTHER
715	Lift Net	OTHER
720	Reef Net	OTHER
725	Push Net	OTHER
730	Wheels	OTHER
735	Cast Nets	OTHER
751	Harpoons, Swordfish	OTHER
752	Harpoons, Turtle	OTHER
753	Harpoons, Whale	OTHER
754	Harpoons, Other	OTHER
760	Spears	OTHER
765	Powerheads (Bangsticks)	OTHER
770	Scrapes	OTHER
781	Water Pump,Sand Shrimp	OTHER
785	Barge Kelp	OTHER
802	Dredge Clam Hydraulic	OTHER
803	Dredge Clam	OTHER
804	Dredge Conch	OTHER
805	Dredge Crab	OTHER
810	Dredge Mussel	OTHER
815	Dredge Oyster, Common	OTHER
820	Dredge Oyster, Suction	OTHER
823	Dredge Scallop, Bay	OTHER
825	Dredge Scallop, Sea	OTHER
827	Dredge Urchin, Sea	OTHER
830	Dredge Other	OTHER
840	Tongs and Grabs, Oyster	OTHER
841	Tongs Patent, Oyster	OTHER
845	Tongs and Grabs, Other	OTHER
846	Tongs Patent, Clam Other	OTHER
853	Rakes, Oyster	OTHER
855	Rakes, Other	OTHER
860	Hoes	OTHER
865	Forks	OTHER
870	Shovels	OTHER
875	Picks	OTHER
880	Brush Trap	OTHER
890	Crowfoot Bars	OTHER
895	Frog Grabs	OTHER
925	Hooks, Sponge	OTHER
930	Hooks, Abalone	OTHER

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935	Hooks, Other	OTHER
941	Diving Outfits, Abalone	OTHER
942	Diving Outfits, Sponge	OTHER
943	Diving Outfits, Other	OTHER
944	Diving with Nets	OTHER
951	By Hand, Oyster	OTHER
955	By Hand, Other	OTHER
966	Other Gear, Hawaii	OTHER
967	Various Gear, Fishponds Hawaii	OTHER
989	Unspecified Gear	OTHER
999	Combined Gears	OTHER

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Table 3.2. Spanish mackerel landings (pounds whole weight) by gear from the U.S. Gulf of Mexico, 1880-2010.

	GEAR		
YEAR	GILL NET	HAND LINE	OTHER
1880			
1881			
1882			
1883			
1884			
1885			
1886			
1887	124,613	7,544	27,843
1888	242,995	14,711	54,294
1889	465,740	28,196	104,064
1890	539,729	32,675	120,596
1891			
1892			
1893			
1894			
1895			
1896			
1897	584,901	35,410	130,689
1898			
1899			
1900			
1901			
1902	1,233,667	74,686	275,648
1903			
1904			
1905			
1906			
1907			
1908	1,157,341	70,065	258,594
1909			
1910			
1911			
1912			
1913			
1914			
1915			
1916			
1917			

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1918	2,743,039	166,062	612,898
1919			
1920			
1921			
1922			
1923	3,010,178	182,235	672,587
1924			
1925			
1926			
1927	3,716,484	224,987	830,395
1928	2,573,232	155,777	574,952
1929	2,784,325	168,556	622,117
1930	3,267,511	197,807	730,079
1931	1,853,856	112,228	414,217
1932	2,285,394	138,352	510,639
1934	2,753,561	166,694	615,244
1936	4,100,885	248,258	916,284
1937	3,103,491	187,878	693,431
1938	3,204,253	193,978	715,944
1939	3,341,472	202,285	746,604
1940	2,877,597	174,203	642,958
1945	72,198	4,371	16,132
1948	698,846	42,307	156,147
1949	3,018,910	182,758	674,532
1950	2,019,590	122,261	451,248
1951	5,070,822	306,976	1,133,002
1952	3,518,064	212,975	786,061
1953	2,324,192	140,701	519,307
1954	2,248,178	136,099	502,323
1955	1,267,472	76,730	283,198
1956	2,273,412	137,627	507,961
1957	2,841,726	172,031	634,943
1958	3,013,692	182,442	673,366
1959	3,653,581	221,179	816,340
1960	4,258,500	257,800	951,501
1961	3,126,701	189,283	698,616
1962	5,644,600	116,000	1,150,300
1963	4,538,400	68,100	840,700
1964	3,479,100	160,000	316,800
1965	4,159,400	257,600	488,500
1966	6,070,600	301,500	694,200
1967	4,745,000	235,700	995,400
1968	5,849,800	215,400	1,166,200

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1969	7,079,500	190,100	1,072,600
1970	6,650,500	220,000	1,399,200
1971	5,907,900	219,500	1,530,600
1972	4,524,700	335,400	1,671,900
1973	5,370,100	120,000	704,200
1974	6,972,000	646,700	648,500
1975	4,527,900	739,800	353,600
1976	6,619,600	790,900	372,500
1977	1,805,690	580,377	250,351
1978	964,343	511,574	229,130
1979	1,712,868	57,728	351,376
1980	1,415,870	75,811	440,165
1981	2,772,772	157,368	778,927
1982	2,823,398	155,258	476,935
1983	1,752,312	123,738	389,939
1984	3,281,759	49,140	174,816
1985	1,744,186	55,486	257,023
1986	2,534,583	29,282	168,292
1987	2,570,864	219,854	58,722
1988	2,155,022	24,134	136,357
1989	2,845,737	53,464	218,525
1990	2,312,456	16,210	249,192
1991	2,972,476	145,310	323,905
1992	3,357,279	34,455	354,716
1993	2,371,091	26,445	206,101
1994	2,511,070	20,743	245,888
1995	1,323,496	19,152	166,447
1996	350,340	26,362	30,261
1997	486,266	39,634	14,086
1998	345,020	44,375	72,293
1999	747,682	55,126	69,308
2000	815,645	39,180	56,128
2001	984,247	71,016	127,664
2002	855,151	36,098	57,047
2003	1,345,072	42,359	40,667
2004	999,017	40,274	37,311
2005	1,446,003	34,262	14,906
2006	1,163,146	53,596	199,389
2007	898,808	28,785	13,906
2008	1,129,503	83,865	21,091
2009	1,717,062	75,316	23,638
2010	1,065,323	139,223	45,203

** = indicates confidential data withheld.

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Table 3.3. Mean weights in pounds whole weight used to derive landings in numbers by year and gear. Source indicates the level of aggregation used: GEAR_MEANS = mean weight for the gear across all years, STRATA = mean weight within the gear and year strata.

	GEAR								
	GILL NET			HAND LINE			OTHER		
YEAR	MEAN WEIGHT	STANDARD DEVIATION	SOURCE	MEAN WEIGHT	STANDARD DEVIATION	SOURCE	MEAN WEIGHT	STANDARD DEVIATION	SOURCE
1880	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1881	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1882	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1883	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1884	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1885	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1886	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1887	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1888	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1889	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1890	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1891	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1892	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1893	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1894	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1895	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1896	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1897	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1898	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1899	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1900	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1901	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1902	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1903	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS

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1904	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1905	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1906	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1907	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1908	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1909	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1910	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1911	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1912	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1913	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1914	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1915	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1916	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1917	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1918	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1919	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1920	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1921	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1922	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1923	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1924	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1925	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1926	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1927	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1928	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1929	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1930	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1931	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1932	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1933	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1934	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS

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1935	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1936	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1937	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1938	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1939	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1940	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1941	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1942	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1943	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1944	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1945	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1946	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1947	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1948	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1949	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1950	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1951	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1952	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1953	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1954	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1955	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1956	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1957	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1958	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1959	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1960	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1961	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1962	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1963	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1964	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1965	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS

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1966	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1967	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1968	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1969	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1970	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1971	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1972	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1973	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1974	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1975	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1976	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1977	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1978	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1979	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1980	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1981	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1982	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1983	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1984	2.808	1.951	GEAR_MEANS	5.869	4.472	STRATA	3.099	2.459	GEAR_MEANS
1985	2.808	1.951	GEAR_MEANS	15.216	35.299	STRATA	3.099	2.459	GEAR_MEANS
1986	2.808	1.951	STRATA	5.265	7.977	GEAR_MEANS	1.161	0.809	STRATA
1987	2.483	1.296	STRATA	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1988	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1989	1.612	1.035	STRATA	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1990	1.882	1.139	STRATA	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1991	1.580	0.708	STRATA	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1992	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	1.016	0.599	STRATA
1993	1.533	0.631	STRATA	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1994	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1995	2.978	1.276	STRATA	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1996	3.468	1.352	STRATA	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS

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1997	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1998	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
1999	2.808	1.951	GEAR_MEANS	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
2000	2.063	0.842	STRATA	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
2001	1.820	0.547	STRATA	5.265	7.977	GEAR_MEANS	3.099	2.459	GEAR_MEANS
2002	2.808	1.951	GEAR_MEANS	5.120	3.098	STRATA	2.488	1.295	STRATA
2003	1.983	0.770	STRATA	5.497	3.121	STRATA	3.099	2.459	GEAR_MEANS
2004	3.317	2.465	STRATA	5.265	7.977	GEAR_MEANS	3.630	5.766	STRATA
2005	2.893	2.160	STRATA	4.386	3.280	STRATA	3.099	2.459	GEAR_MEANS
2006	2.462	1.778	STRATA	5.222	3.601	STRATA	2.799	1.834	STRATA
2007	2.962	2.115	STRATA	3.321	3.119	STRATA	3.168	2.355	STRATA
2008	3.004	2.183	STRATA	3.967	3.316	STRATA	2.977	1.623	STRATA
2009	2.968	2.012	STRATA	4.675	3.325	STRATA	2.869	1.297	STRATA
2010	2.369	1.705	STRATA	5.476	4.515	STRATA	1.645	0.410	STRATA

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Table 3.4. Gulf of Mexico Spanish mackerel commercial landings by gear and year in numbers (thousands)

	GEAR		
YEAR	GILL NET	HAND LINE	OTHER
1880	0	0	0
1881	0	0	0
1882	0	0	0
1883	0	0	0
1884	0	0	0
1885	0	0	0
1886	0	0	0
1887	44	1	9
1888	87	3	18
1889	166	5	34
1890	192	6	39
1891	0	0	0
1892	0	0	0
1893	0	0	0
1894	0	0	0
1895	0	0	0
1896	0	0	0
1897	208	7	42
1898	0	0	0
1899	0	0	0
1900	0	0	0
1901	0	0	0
1902	439	14	89
1903	0	0	0
1904	0	0	0
1905	0	0	0
1906	0	0	0
1907	0	0	0
1908	412	13	83
1909	0	0	0
1910	0	0	0
1911	0	0	0
1912	0	0	0
1913	0	0	0
1914	0	0	0
1915	0	0	0
1916	0	0	0

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1917	0	0	0
1918	977	32	198
1919	0	0	0
1920	0	0	0
1921	0	0	0
1922	0	0	0
1923	1,072	35	217
1924	0	0	0
1925	0	0	0
1926	0	0	0
1927	1,323	43	268
1928	916	30	186
1929	991	32	201
1930	1,163	38	236
1931	660	21	134
1932	814	26	165
1933	0	0	0
1934	980	32	199
1935	0	0	0
1936	1,460	47	296
1937	1,105	36	224
1938	1,141	37	231
1939	1,190	38	241
1940	1,025	33	207
1941	0	0	0
1942	0	0	0
1943	0	0	0
1944	0	0	0
1945	26	1	5
1946	0	0	0
1947	0	0	0
1948	249	8	50
1949	1,075	35	218
1950	719	23	146
1951	1,806	58	366
1952	1,253	40	254
1953	828	27	168
1954	801	26	162
1955	451	15	91
1956	810	26	164
1957	1,012	33	205
1958	1,073	35	217
1959	1,301	42	263

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1960	1,516	49	307
1961	1,113	36	225
1962	2,010	22	371
1963	1,616	13	271
1964	1,239	30	102
1965	1,481	49	158
1966	2,162	57	224
1967	1,690	45	321
1968	2,083	41	376
1969	2,521	36	346
1970	2,368	42	451
1971	2,104	42	494
1972	1,611	64	539
1973	1,912	23	227
1974	2,483	123	209
1975	1,612	140	114
1976	2,357	150	120
1977	643	110	81
1978	343	97	74
1979	610	11	113
1980	504	14	142
1981	987	30	251
1982	1,005	29	154
1983	624	23	126
1984	1,169	8	56
1985	621	4	83
1986	903	6	145
1987	1,035	42	19
1988	767	5	44
1989	1,766	10	71
1990	1,229	3	80
1991	1,881	28	105
1992	1,195	7	349
1993	1,547	5	66
1994	894	4	79
1995	444	4	54
1996	101	5	10
1997	173	8	5
1998	123	8	23
1999	266	10	22
2000	395	7	18
2001	541	13	41
2002	304	7	23

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2003	678	8	13
2004	301	8	10
2005	500	8	5
2006	472	10	71
2007	303	9	4
2008	376	21	7
2009	579	16	8
2010	450	25	27

** = indicates confidential data withheld

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Table 3.5. Number of trips reporting Spanish mackerel discards by region and gear fished; all years combined (2002-2010). "Other species" totals include all other reports to the discard logbook program. Also included in "other species" totals are trips with no reported discards. Trips with multiple gears fished reported or that fished in both regions may be counted more than once. Totals include only those vessels with federal fishing permits.

Region	Species	Gillnet	Vertical line	Trolling	All other gears
GOM	Spanish Mackerel	0	39	17	0
	Other species (sm boundaries)	73	14,423	1,342	2,532
SA	Spanish Mackerel	37	84	46	confidential
	Other species (sm boundaries)	2,470	23,990	14,079	3,541

Table 3.6. Spanish mackerel yearly total calculated discards from commercial gill net, vertical line, and trolling vessels with federal fishing permits in the Gulf of Mexico. Discards are reported as number of fish. No Spanish mackerel discards were reported from gill net trips in the Gulf of Mexico, although discards of other species were reported.

Year	Gill net	Vertical line	Trolling	Calculated discards
1998	0	16,808	623	17,431
1999	0	18,918	611	19,528
2000	0	17,995	363	18,358
2001	0	16,746	385	17,131
2002	0	17,559	337	17,897
2003	0	18,962	345	19,307
2004	0	17,018	251	17,269
2005	0	16,350	168	16,518
2006	0	15,909	279	16,187
2007	0	15,075	295	15,370
2008	0	13,207	217	13,425
2009	0	16,529	218	16,747
2010	0	15,244	153	15,397

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Table 3.7. Self-reported discard mortality/disposition of Spanish mackerel caught on commercial fishing vessels with federal fishing permits, 2002-2010. No Spanish mackerel discards were reported from gill net vessels in the Gulf of Mexico.

Region	Gear	Disposition							Number of fish
		All Dead	Majority Dead	All Alive	Majority Alive	Kept	Unable to Determine	Unreported	
South Atlantic	Gillnet	71%	24%	0%	0%	5%	0%	0%	398
	Hand line/Electric	3%	3%	21%	4%	47%	23%	0%	577
	Trolling	1%	0%	33%	8%	58%	0%	0%	722
Gulf of Mexico	Gill net	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0
	Hand line/Electric	12%	4%	3%	31%	41%	0%	9%	625
	Trolling	1%	0%	19%	21%	59%	0%	0%	126

Table 3.8. List of factor levels for the main effects of the shrimp bycatch estimation model.

Main Effect	Levels	Description
Year	39	1972-2010
Season	3	Jan-Apr, May-Aug, Sep-Dec
Area	4	Stat grids 1-9, 10-12, 13-17, 18-21
Depth	2	Inside 10 fm, Outside 10 fm
Data Set	2	Observer program, Research vessel

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Table 3.9. Observed shrimp bycatch of Spanish mackerel in the Gulf of Mexico from the observer program and SEAMAP groundfish survey. Bycatch is reported in numbers of fish.

Year	Spanish Mackerel bycatch
1972	57
1973	111
1974	96
1975	338
1976	739
1977	1,228
1978	526
1979	76
1980	2,048
1981	275
1982	165
1983	41
1984	554
1985	13
1986	69
1987	29
1988	92
1989	129
1990	181
1991	140
1992	1,787
1993	6,164
1994	790
1995	242
1996	115
1997	55
1998	83
1999	79
2000	156
2001	1,243
2002	2,968
2003	2,444
2004	17,407
2005	11,432
2006	64
2007	3,545
2008	7,096
2009	5,027
2010	5,351

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Table 3.10. Predicted annual shrimp bycatch (millions of fish) of Spanish mackerel in the Gulf of Mexico.

year	mean	sd	MC error	2.50%	25.00%	median	75.00%	97.50%	start	sample
1972	22.05	53.44	0.981	1.194	4.487	9.378	20.59	122.6	4001	10000
1973	2.035	4.095	0.06811	0.2053	0.6094	1.096	2.125	9.168	4001	10000
1974	5.957	23.65	0.3076	0.4607	1.411	2.686	5.483	29.74	4001	10000
1975	5.087	9.934	0.1324	0.9573	2.052	3.216	5.501	19.29	4001	10000
1976	7.031	5.969	0.0854	2.433	4.135	5.682	8.142	19.2	4001	10000
1977	20.24	18.72	0.2544	5.826	10.36	15.02	23.01	67.97	4001	10000
1978	22.96	37.12	0.5091	5.326	10.02	14.85	24.01	86.13	4001	10000
1979	68.18	620.9	7.318	2.5	9.513	20.86	50.7	340.1	4001	10000
1980	17.2	11.11	0.1539	6.621	10.88	14.53	20.31	42.55	4001	10000
1981	9.979	27.39	0.3813	1.346	2.768	4.567	8.762	52.79	4001	10000
1982	15.48	43.81	0.577	0.9467	3.19	6.35	13.92	84.47	4001	10000
1983	13.8	56.97	0.8974	0.8958	2.932	5.925	12.87	73.64	4001	10000
1984	32.54	82.47	1.225	2.278	7.124	14.03	30.82	173.1	4001	10000
1985	7.824	24.26	0.3157	0.4689	1.663	3.354	7.241	39.12	4001	10000
1986	20	56.73	0.6918	1.118	3.989	8.151	18	104.5	4001	10000
1987	17.9	54.35	0.675	0.958	3.627	7.335	16.42	96.49	4001	10000
1988	31	105.2	1.292	1.796	6.149	12.63	27.54	162.4	4001	10000
1989	45.25	211	2.662	2.594	8.899	17.75	38.1	253.6	4001	10000
1990	63.69	340.5	3.603	3.792	12.67	25.75	56.09	335	4001	10000
1991	44.37	124.5	1.61	2.809	9.5	18.97	40.88	240.9	4001	10000
1992	23.91	15.12	0.1936	9.944	15.71	20.53	27.57	58.61	4001	10000
1993	69.27	61.61	0.7912	21.34	36.96	53.08	80.59	214.9	4001	10000
1994	12.89	42.35	0.5414	1.423	3.123	5.479	11.02	66.6	4001	10000
1995	12.8	32.24	0.3707	1.09	3.095	5.826	12.11	65.56	4001	10000
1996	11.69	38.36	0.472	0.7456	2.502	4.969	10.62	61.63	4001	10000
1997	12.84	34.18	0.4091	0.871	2.82	5.561	11.75	67.04	4001	10000

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1998	17.97	62.92	0.6922	1.043	3.58	7.443	16.39	96.55	4001	10000
1999	12.81	35.74	0.4432	0.7573	2.738	5.555	12.06	65.19	4001	10000
2000	31.68	140.5	1.66	1.807	6.258	12.94	28.21	161.4	4001	10000
2001	14.4	36.56	0.4504	1.925	4.005	7.007	13.54	70.56	4001	10000
2002	8.296	13.72	0.1602	2.393	3.953	5.718	8.95	28.61	4001	10000
2003	15.9	15.84	0.1806	4.245	7.811	11.49	18.17	54.36	4001	10000
2004	23.01	18.39	0.2313	11.44	15.83	19.32	24.64	56.29	4001	10000
2005	26.84	20.9	0.2839	11.36	17.32	22.66	30.67	64.84	4001	10000
2006	12.21	34.85	0.3982	0.7668	2.592	5.3	11.44	64.48	4001	10000
2007	10.34	6.653	0.1023	4.164	6.683	8.831	12.12	25.27	4001	10000
2008	4.105	4.462	0.05798	2.099	2.7	3.204	4.069	11.8	4001	10000
2009	2.873	0.7141	0.008543	1.77	2.371	2.766	3.268	4.527	4001	10000
2010	2.913	1.05	0.01266	1.762	2.32	2.723	3.244	5.229	4001	10000

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Table 3.11. Number of Gulf of Mexico trips from logbooks landing any amount of Spanish mackerel, where Spanish mackerel was targeted (Spanish mackerel was at least 30% of catch) and the number of trips with valid samples (no biases) and number of trips with samples usable for analysis (trip weights available) by year and gear.

	GEAR											
	GILL NET				HAND LINE				OTHER			
YEAR	ALL LOGBOOK TRIPS	TARGETED LOGBOOK TRIPS	SAMPLES USED	VALID SAMPLES	ALL LOGBOOK TRIPS	TARGETED LOGBOOK TRIPS	SAMPLES USED	VALID SAMPLES	ALL LOGBOOK TRIPS	TARGETED LOGBOOK TRIPS	SAMPLES USED	VALID SAMPLES
1983	0	0	0	0	0	0	3	3	0	0	0	0
1984	0	0	0	0	0	0	12	12	0	0	2	2
1985	0	0	0	0	0	0	12	12	0	0	2	2
1986	0	0	0	1	0	0	0	1	0	0	2	2
1987	0	0	0	2	0	0	0	0	0	0	0	0
1988	0	0	0	0	0	0	0	0	0	0	0	0
1989	0	0	2	2	0	0	0	0	0	0	0	0
1990	0	0	1	1	13	0	0	0	**	0	0	0
1991	0	0	0	2	18	0	0	25	**	0	2	2
1992	0	0	0	9	141	**	0	37	**	**	6	6
1993	0	0	3	5	267	**	3	29	33	**	3	3
1994	**	0	4	13	356	**	0	28	58	**	2	2
1995	**	**	4	11	365	26	0	13	25	**	0	0
1996	24	23	3	6	370	49	2	5	**	**	0	0
1997	48	32	0	2	398	98	0	1	**	**	0	0
1998	62	55	0	0	519	124	1	3	**	0	0	0
1999	145	129	2	2	622	139	0	1	14	**	2	2
2000	98	86	3	3	704	145	0	0	13	0	0	0
2001	86	82	2	2	663	192	0	1	22	**	0	0
2002	46	34	0	0	578	85	4	4	27	**	0	1
2003	52	48	1	3	526	99	10	11	16	**	0	0
2004	31	29	8	8	384	86	6	6	13	**	4	4
2005	45	45	14	14	314	65	14	14	**	0	0	0

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2006	23	20	11	11	337	62	13	13	**	**	2	2
2007	44	44	9	9	286	57	8	8	**	0	11	11
2008	39	36	10	10	394	60	17	17	**	0	5	5
2009	91	82	6	6	474	84	19	20	20	**	0	1
2010	24	24	11	11	550	91	21	21	21	**	1	1

**=data deemed confidential have been removed

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Table 3.12. Number of length samples used for analysis and number of valid (no biases) length samples collected by year and gear.

	GEAR					
	GILL NET		HAND LINE		OTHER	
YEAR	SAMPLES USED	VALID SAMPLES	SAMPLES USED	VALID SAMPLES	SAMPLES USED	VALID SAMPLES
1983	0	0	7	7	0	0
1984	0	0	23	23	19	19
1985	0	0	178	178	41	41
1986	0	17	0	1	96	96
1987	0	557	0	0	0	0
1988	0	0	0	0	0	0
1989	62	62	0	0	0	0
1990	66	66	0	0	0	0
1991	0	54	0	197	5	5
1992	0	447	0	235	152	152
1993	72	82	28	119	25	25
1994	443	496	0	109	2	2
1995	212	279	0	38	0	0
1996	256	296	10	22	0	0
1997	0	12	0	1	0	0
1998	0	0	6	16	0	0
1999	17	17	0	1	19	19
2000	38	38	0	0	0	0
2001	23	23	0	1	0	0
2002	0	0	21	21	0	97
2003	28	31	35	37	0	0
2004	484	484	16	16	413	413
2005	636	636	78	78	0	0
2006	794	794	100	100	192	192
2007	381	381	207	207	342	342
2008	462	462	209	209	105	105
2009	153	153	70	79	0	32
2010	457	457	67	67	20	20

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Table 3.13. U.S. Gulf of Mexico commercial Spanish mackerel age samples by gear and year.

	GEAR		
YEAR	GILL NET	HAND LINE	OTHER
1988	32	3	0
1989	0	117	0
1990	245	160	89
1991	198	177	1
1992	508	117	27
1993	178	63	16
1994	452	23	0
1995	213	18	14
1996	243	8	0
1997	0	5	0
1998	0	10	0
1999	0	2	0
2000	21	0	0
2001	37	12	0
2002	0	13	0
2003	0	36	0
2004	12	5	0
2005	0	28	113
2006	0	11	0
2007	0	19	0
2008	0	22	0
2009	0	35	0
2010	0	38	0

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Table 3.14. Gulf of Mexico Spanish mackerel commercial length sampling fractions (length samples used/landings in numbers) by gear and year.

	GEAR		
YEAR	GILL NET	HAND LINE	OTHER
1983	0.000	0.000	0.000
1984	0.000	0.003	0.000
1985	0.000	0.049	0.000
1986	0.000	0.000	0.001
1987	0.000	0.000	0.000
1988	0.000	0.000	0.000
1989	0.000	0.000	0.000
1990	0.000	0.000	0.000
1991	0.000	0.000	0.000
1992	0.000	0.000	0.000
1993	0.000	0.006	0.000
1994	0.000	0.000	0.000
1995	0.000	0.000	0.000
1996	0.003	0.002	0.000
1997	0.000	0.000	0.000
1998	0.000	0.001	0.000
1999	0.000	0.000	0.001
2000	0.000	0.000	0.000
2001	0.000	0.000	0.000
2002	0.000	0.003	0.000
2003	0.000	0.005	0.000
2004	0.002	0.002	0.040
2005	0.001	0.010	0.000
2006	0.002	0.010	0.003
2007	0.001	0.024	0.078
2008	0.001	0.010	0.015
2009	0.000	0.004	0.000
2010	0.001	0.003	0.001

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3.10 Figures

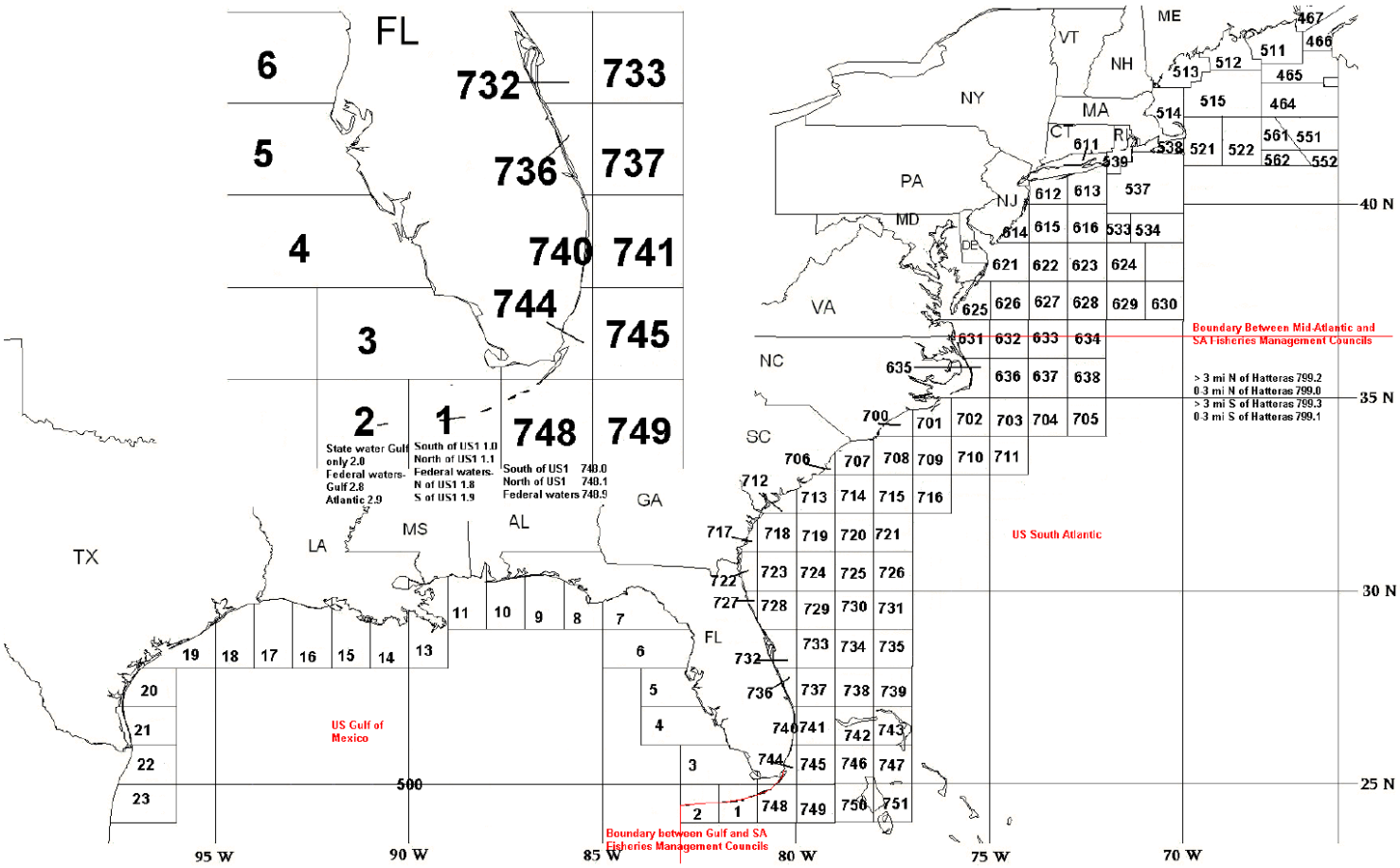

Figure 3.1. Map of U.S. Atlantic and Gulf coast with shrimp area designations and council boundaries. Boundary used for Gulf and Atlantic Spanish Mackerel is the SAFMC/GMFMC boundary along the FL Keys.

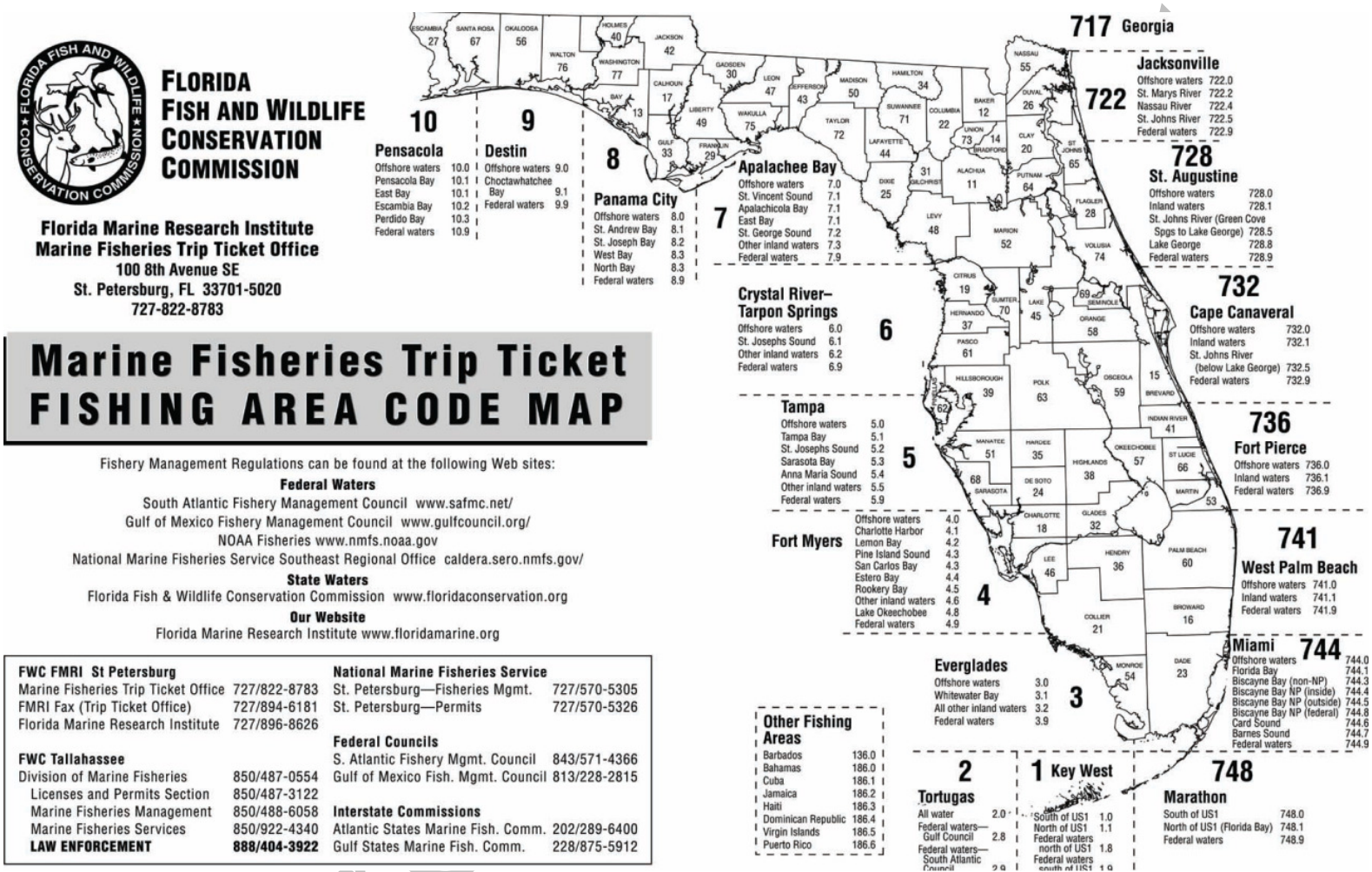

Figure 3.2. Map showing marine fisheries trip ticket fishing area code map for Florida.

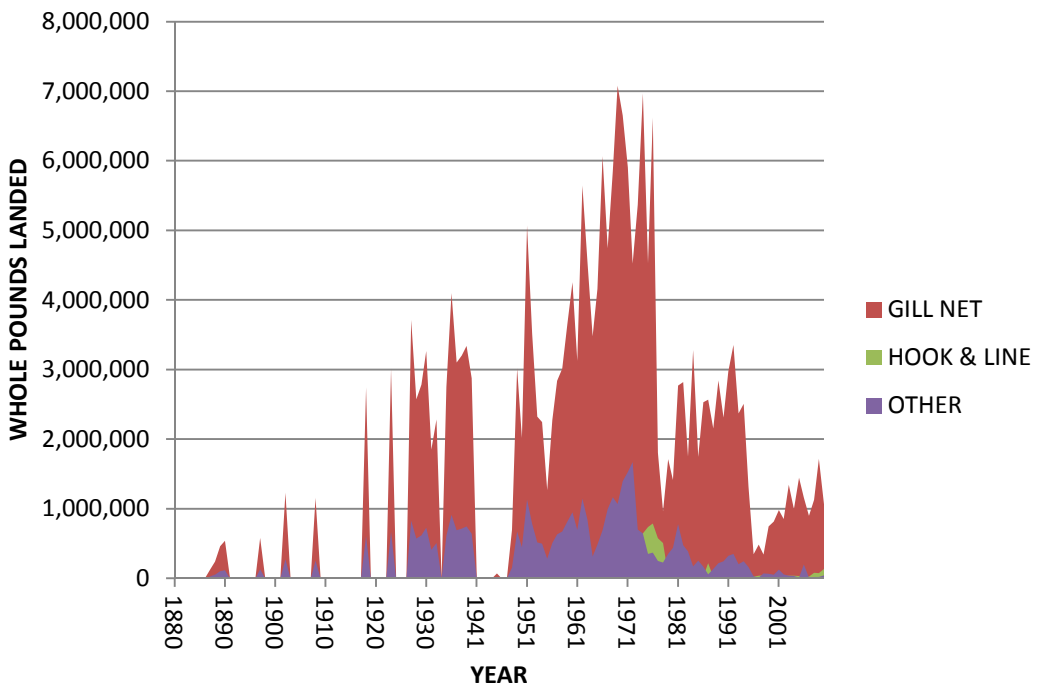

Figure 3.3. Spanish mackerel landings in pounds (whole weight) by gear (gill net, hand line, and other) from the Gulf of Mexico, 1880-2010.

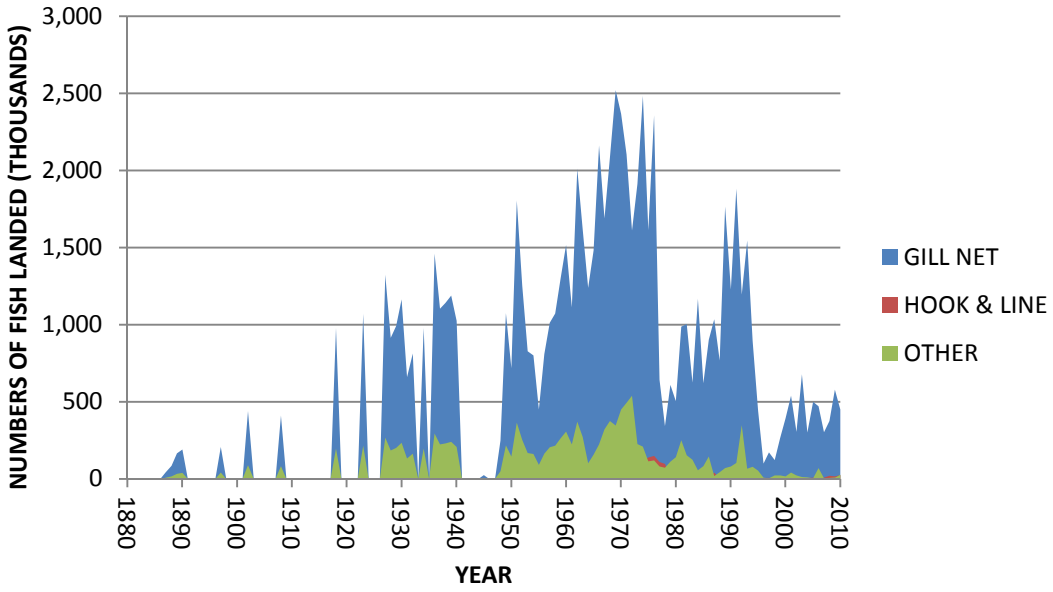

Figure 3.4. Spanish mackerel landings in numbers of fish (thousands) by gear (gill net, hand line, and other) from the Gulf of Mexico, 1880-2010.

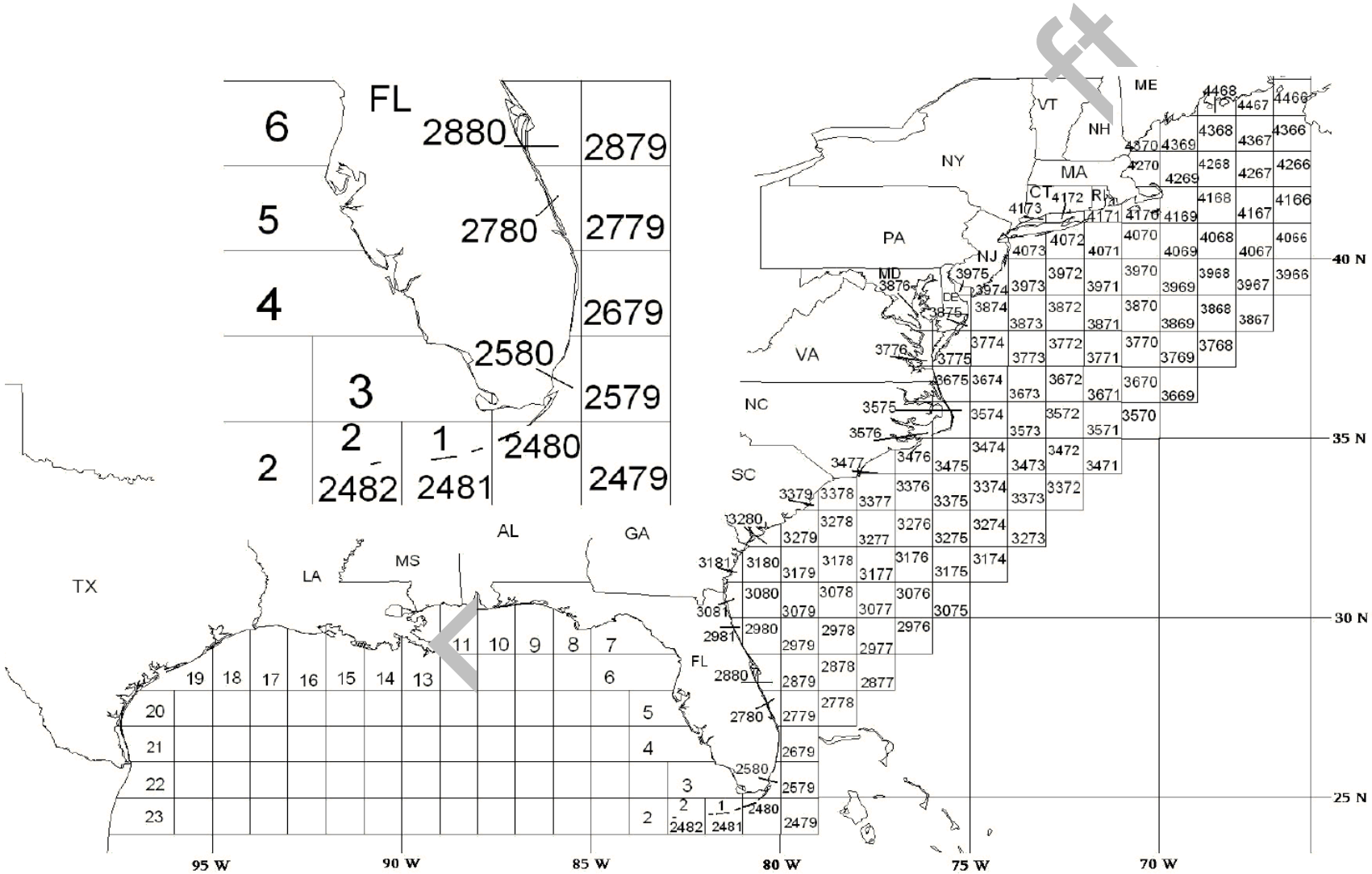

Figure 3.5. Map of U.S. Atlantic and Gulf coast logbook areas.

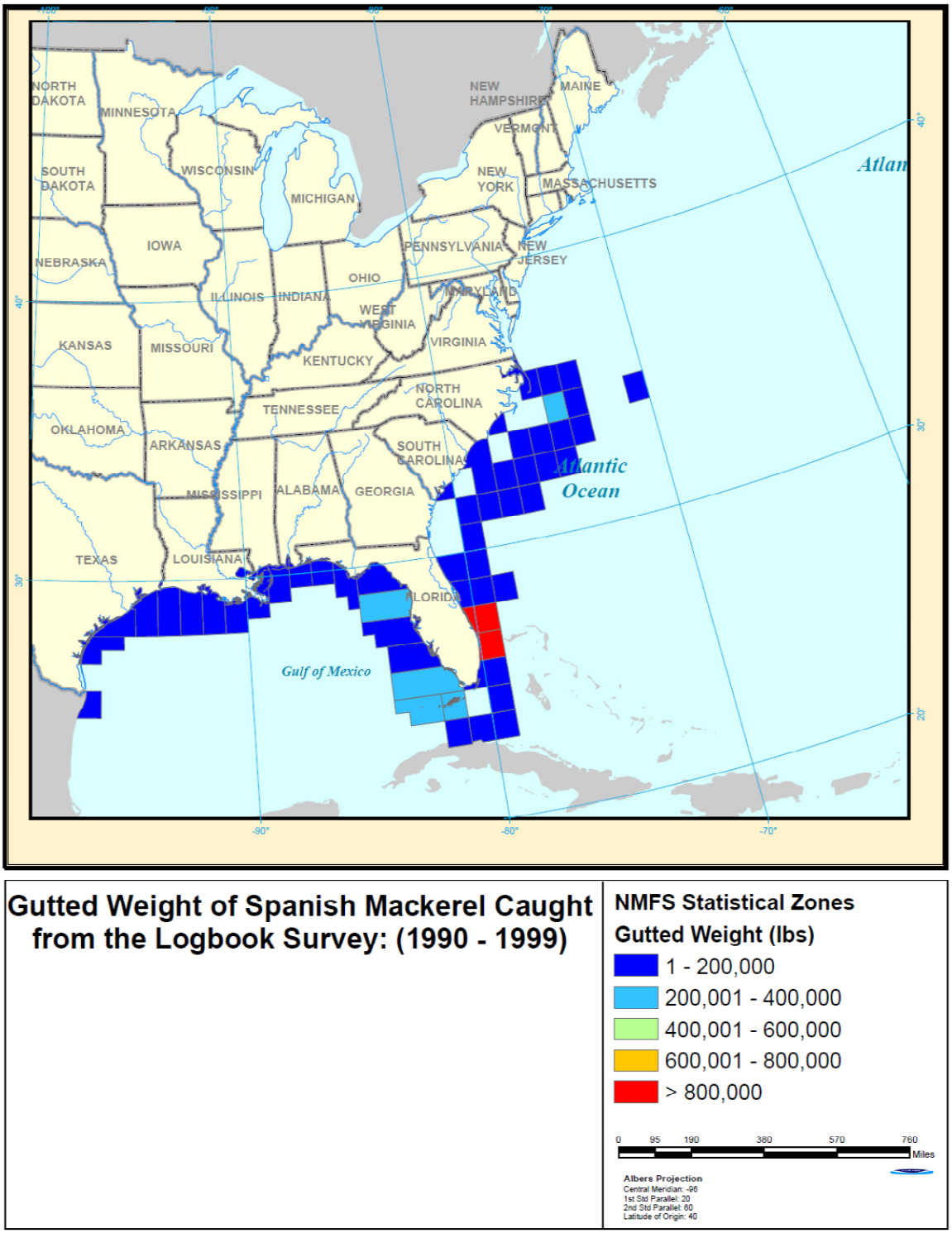

Figure 3.6. Map of Spanish mackerel catches reported to the Coastal Logbook Program for the U.S. Atlantic and Gulf coast areas (1990-1999).

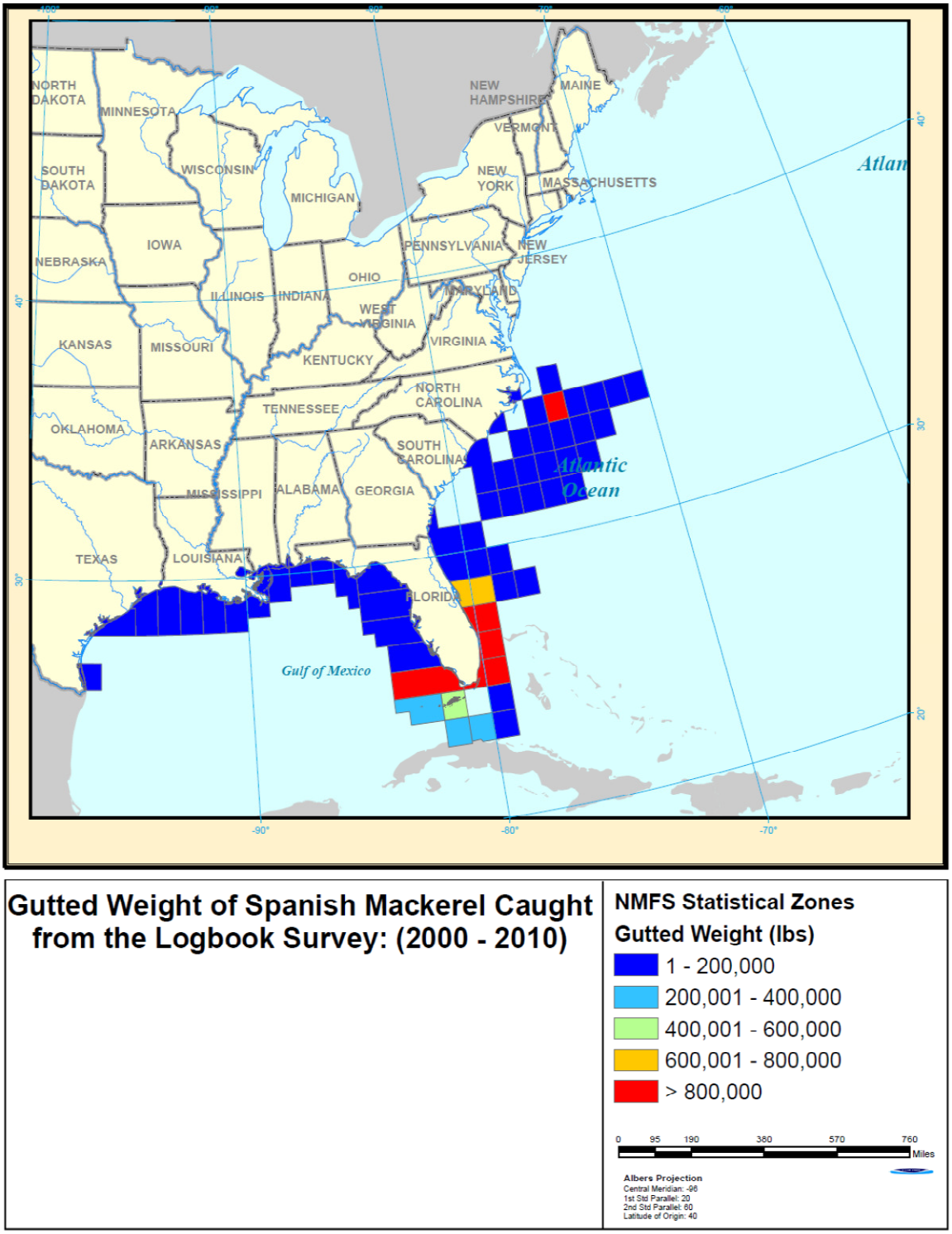

Figure 3.7. Map of Spanish mackerel catches reported to the Coastal Logbook Program for the U.S. Atlantic and Gulf coast areas (2000-2010).

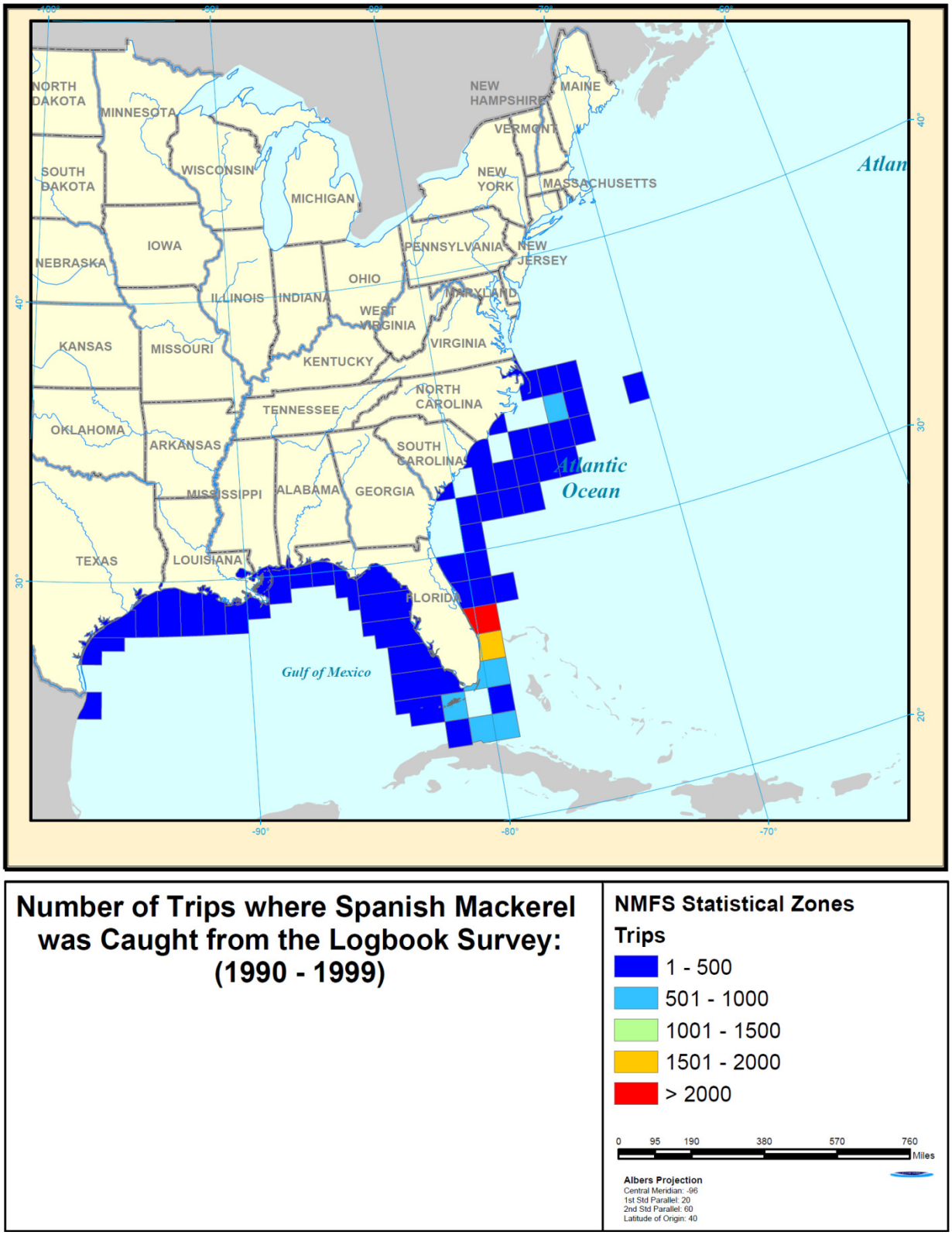

Figure 3.8. Map of Spanish mackerel trips reported to the Coastal Logbook Program for the U.S. Atlantic and Gulf coast areas (1990-1999).

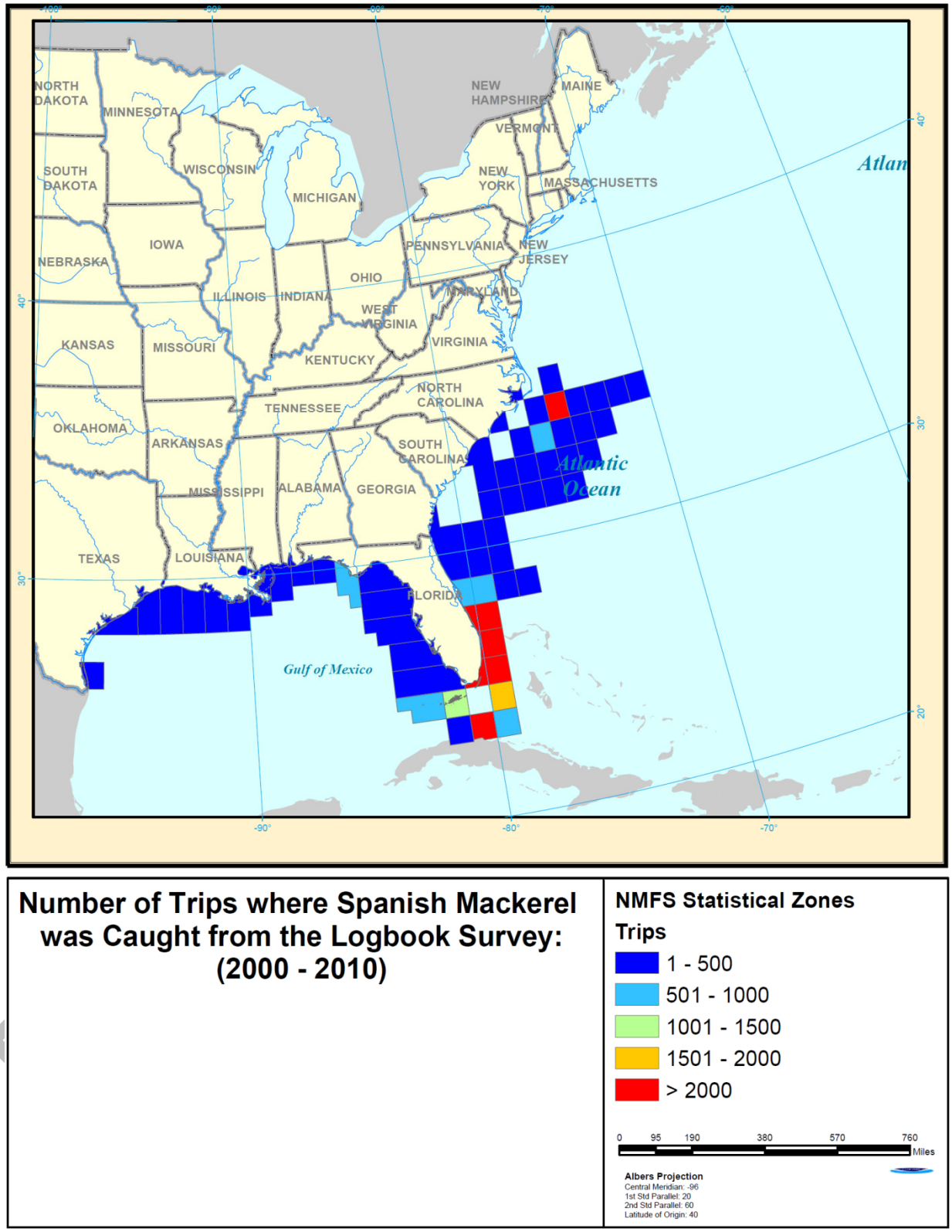

Figure 3.9. Map of Spanish mackerel trips reported to the Coastal Logbook Program for the U.S. Atlantic and Gulf coast areas (2000-2010).

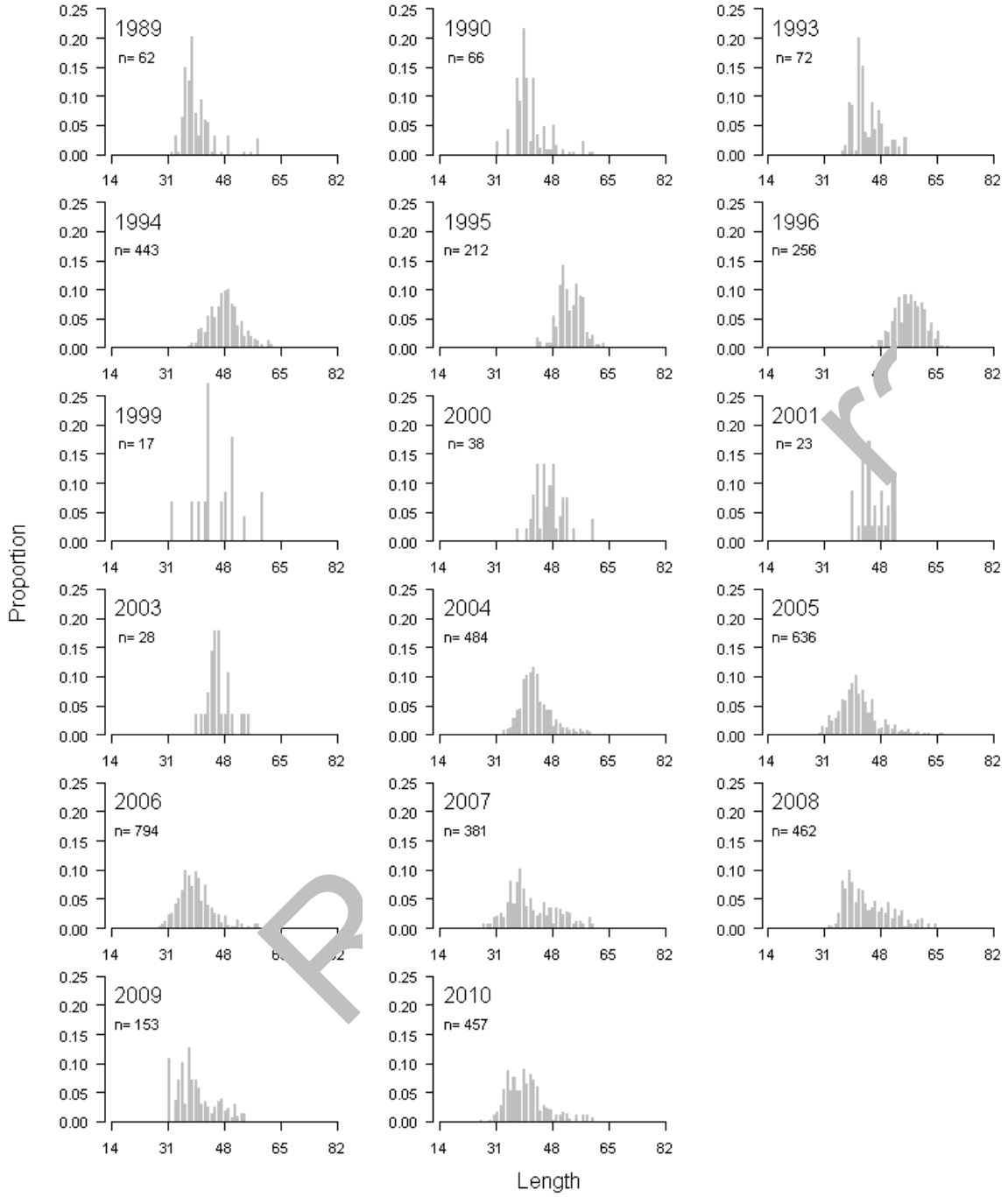

Figure 3.10. Relative length composition of commercial length (FL in mm) samples by year for gill net gear (n = number of fish).

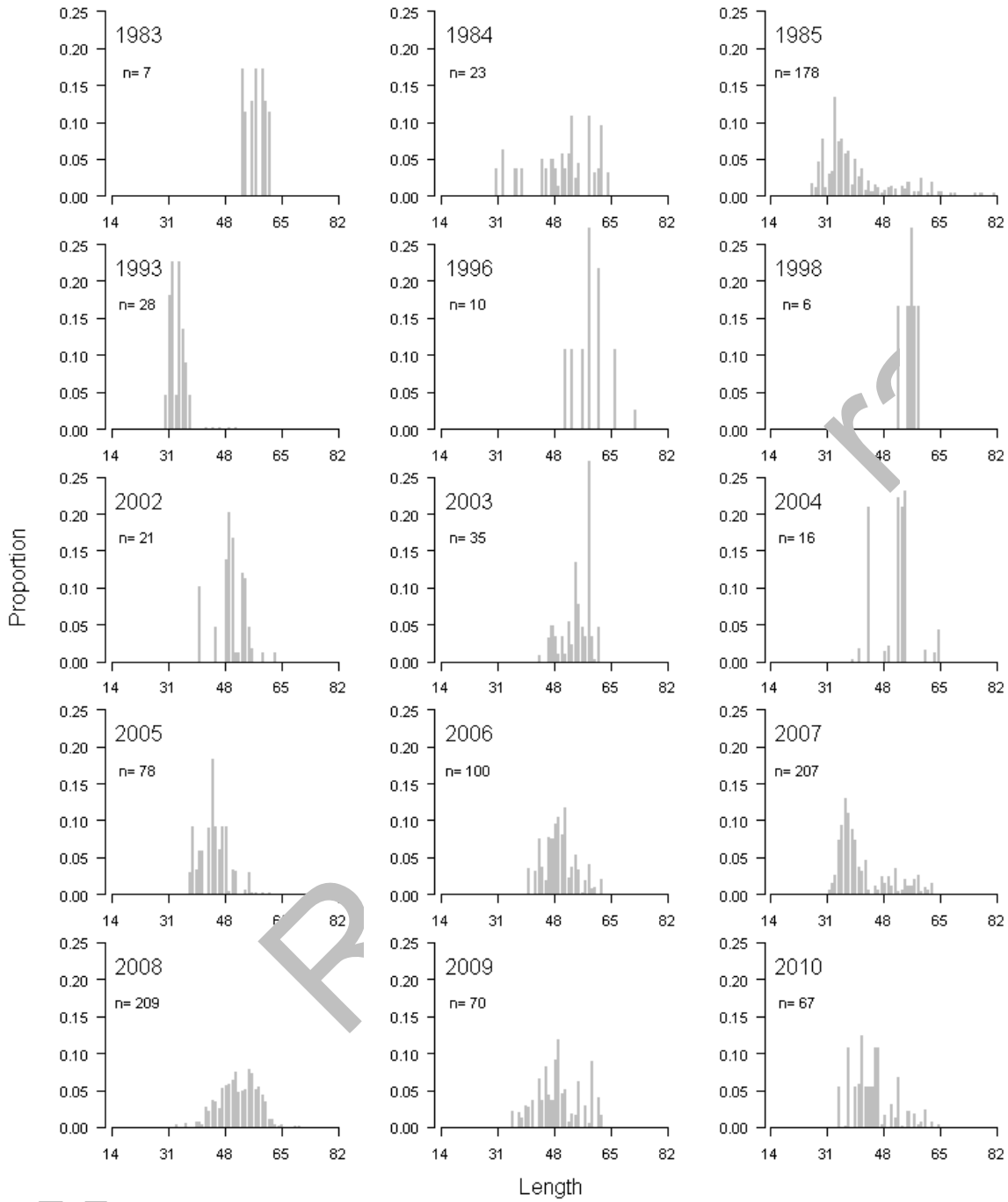

Figure 3.11. Relative length composition of commercial length (FL in mm) samples by year for hand line gear (n = number of fish).

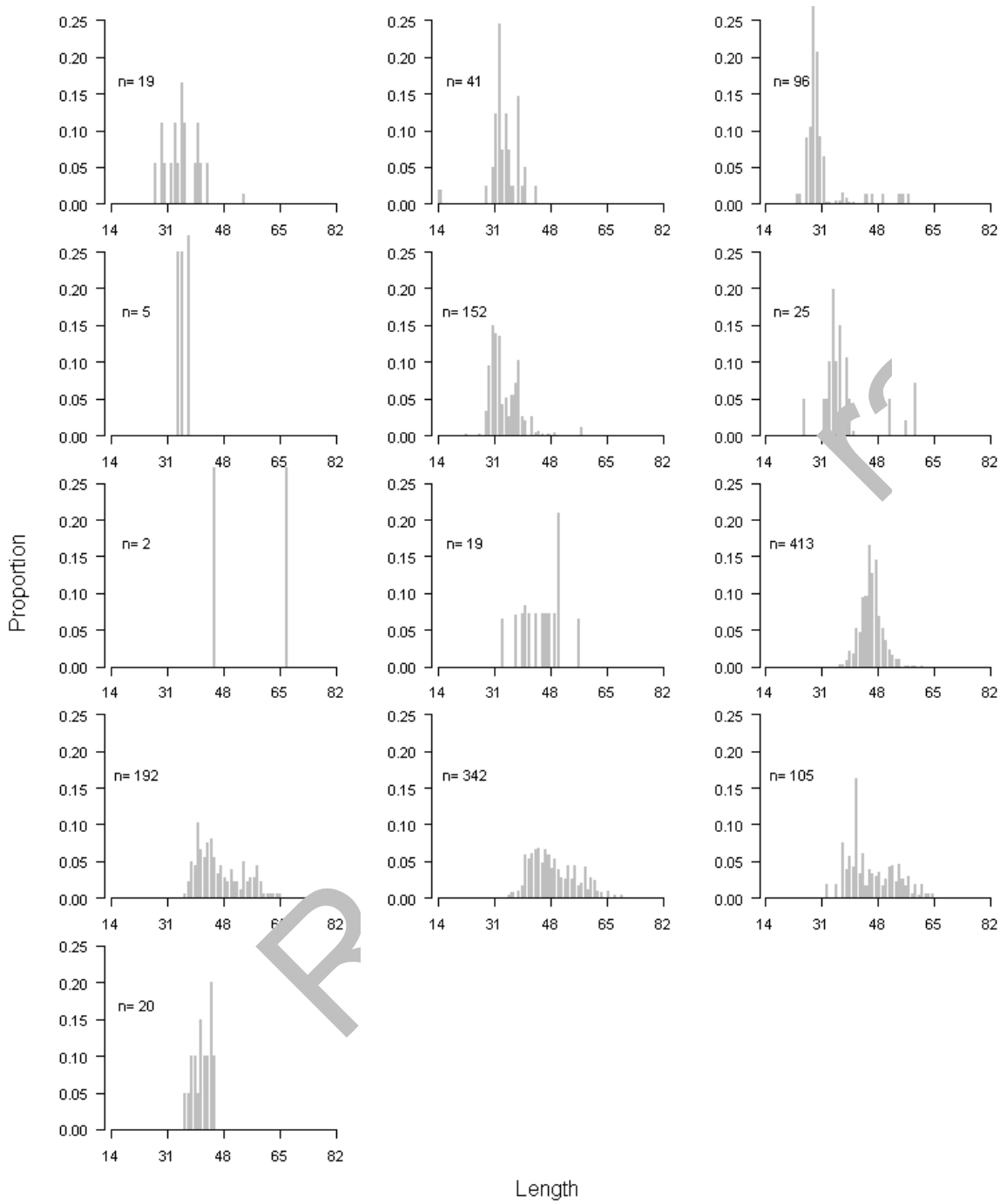

Figure 3.12. Relative length composition of commercial length (FL in mm) samples by year for other miscellaneous gear (n = number of fish).

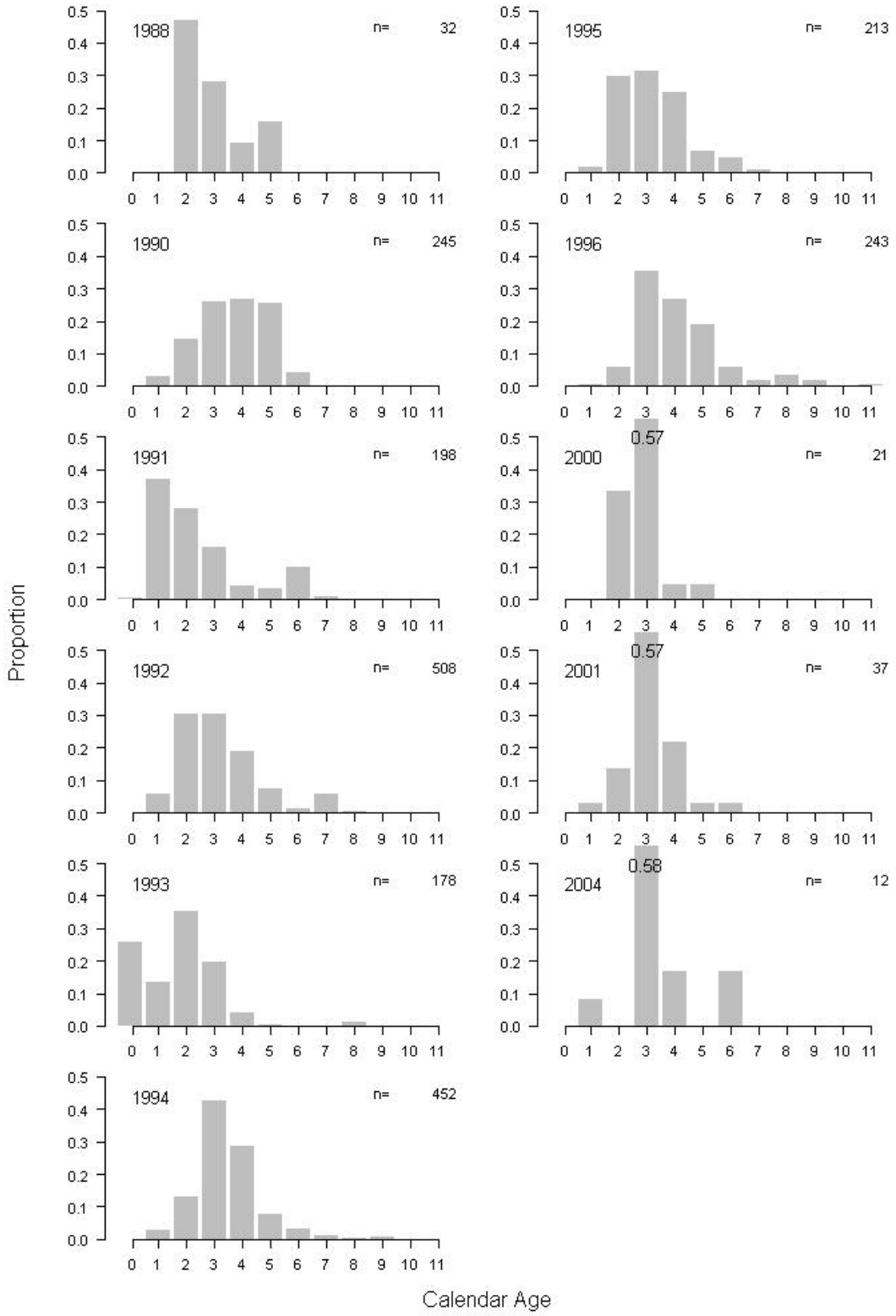

Figure 3.13. Unweighted relative age composition of commercial age (calendar years) samples by year for gill net gear (n = number of fish).

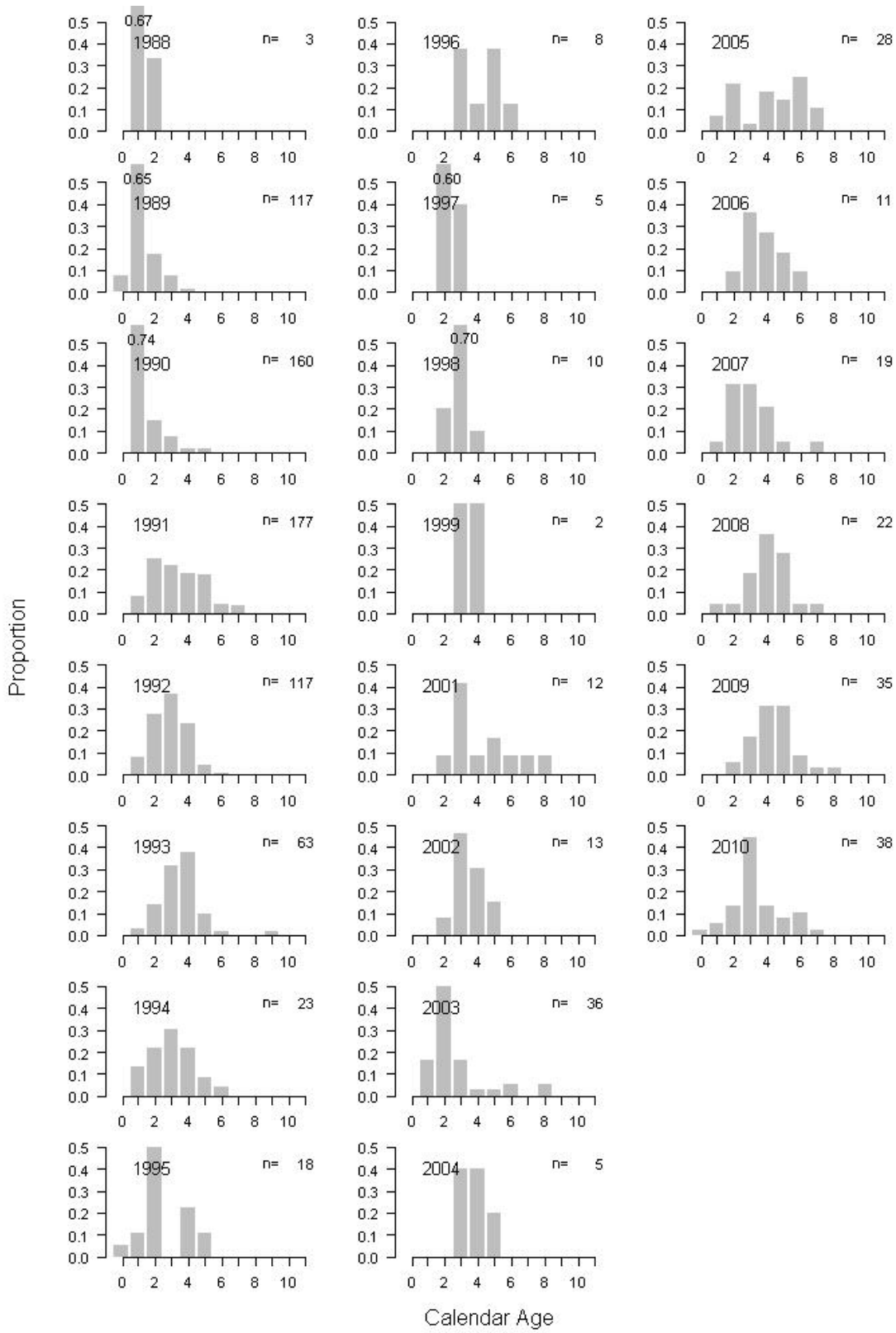

Figure 3.14. Unweighted relative age composition of commercial age (calendar years) samples by year for hand line gear (n = number of fish).

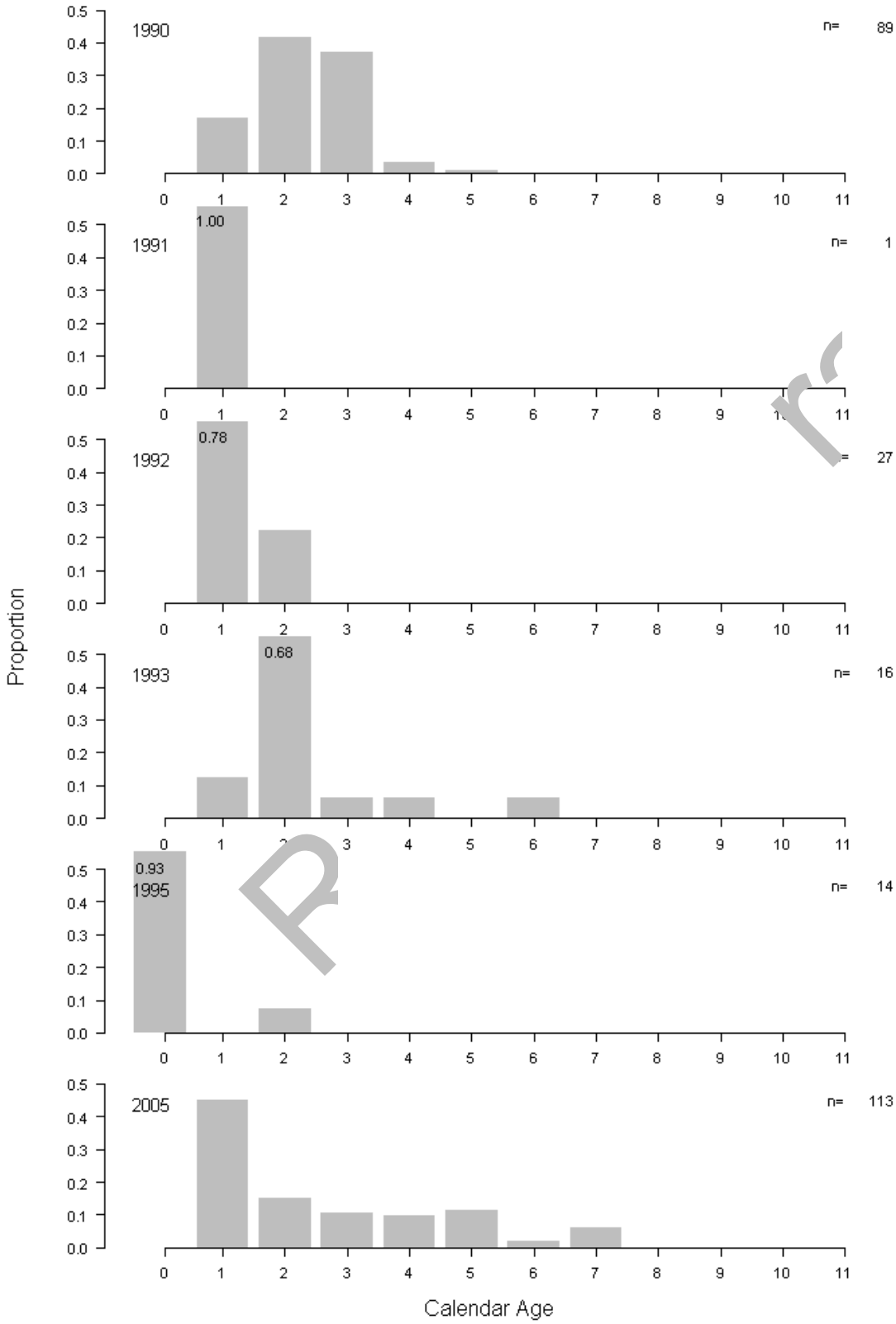

Figure 3.15. Unweighted relative age composition of commercial age (calendar years) samples by year for other miscellaneous gear (n = number of fish).

4 Recreational Fishery Statistics

4.1 Overview

4.1.1 Group membership

Members- Ken Brennan (Leader South Atlantic\NMFS Beaufort), Julia Byrd (SCDNR), Kelly Fitzpatrick (NMFS Beaufort), Eric Hiltz (SCDNR), Robert Johnson (SAFMC Appointee\ Industry rep FL), Vivian Matter (Leader Gulf of Mexico\NMFS SEFSC), Bill Parker (SAFMC Appointee/Industry rep SC), Tom Ogle (SAFMC Appointee/Industry rep SC), Bob Zales (GMFMC Appointee/Industry rep FL).

4.1.2 Issues

1) Allocation of Monroe county catches to the Atlantic or the Gulf of Mexico: may vary by data source depending on differing spatial resolutions of the datasets.
2) Missing weight estimates for some recreational "cells" (i.e., specific year, state, fishing mode, wave combinations).
3) Headboat discards. Data are available from the SRHS since 2004. Review whether they are reliable for use, and determine if there are other sources of data prior to 2004 that could be used as a proxy to estimate headboat discards.
4) Charter boat landings: MRFSS charter survey methods changed in 1998 in the Gulf of Mexico.
5) New MRIP weighted estimates are available for 2004-2011: Determine appropriate use of datasets to cover the entire period from 1981-2011.
6) Texas estimates in the MRFSS is only available from 1981-1985 and is sporadic, not covering all modes and waves.
7) TPWD survey does not estimate landings in weight or discards.
8) Usefulness of historical data sources such as the 1960, 1965, and 1970 U.S. Fish and Wildlife Service (FWS) surveys to generate estimates of landings prior to 1981. Review whether other data sources also available.

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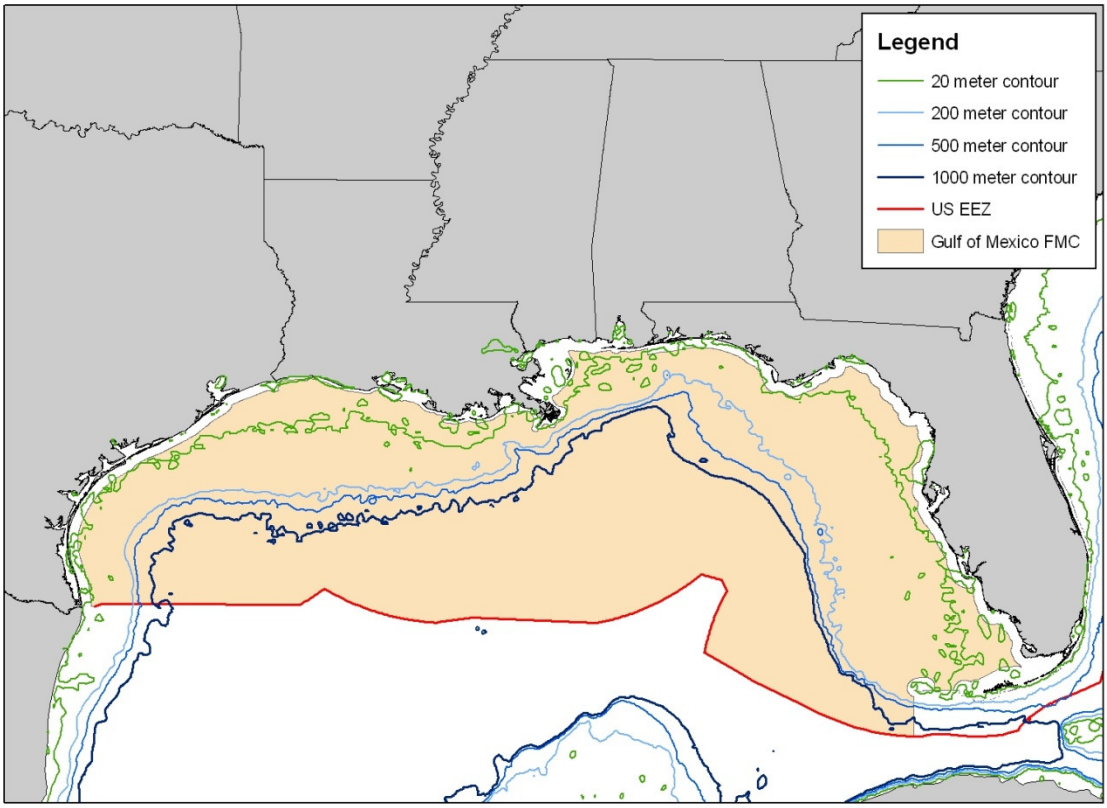
4.1.3 Gulf of Mexico Fishery Management Council Jurisdictional Boundaries



4.2 Review of Working Papers

SEDAR28-DW12, *Estimated conversion factors for calibrating MRFSS charter boat landings and effort estimates for the South Atlantic and Gulf of Mexico in 1981-1985 with For Hire Survey estimates with application to Spanish mackerel and cobia landings. Vivian M. Matter, Nancie Cummings, John Jeffrey Isely, Kenneth Brennan, and Kelly Fitzpatrick.*

This working paper presents correction factors to calibrate the traditional MRFSS charter boat/headboat combined mode estimates with the For-Hire Survey for 1981-1985. These calibration factors are based on equivalent units of effort and consistent methodologies across both sub regions.

SEDAR28-DW14, *Recreational Survey Data for Spanish Mackerel and Cobia in the Atlantic and the Gulf of Mexico from the MRFSS and TPWD Surveys. Vivian Matter*

This working paper presents recreational survey data for Spanish mackerel and cobia from the Marine Recreational Fishery Statistics Survey (MRFSS) and the Texas Parks and Wildlife Department (TPWD) surveys in the Atlantic and the Gulf of Mexico. Issues addressed include the allocation of the Spanish mackerel landings in the Keys into the Gulf of Mexico or Atlantic

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Ocean, the split of cobia landings along the east coast of Florida, the calibration of MRFSS charter boat estimates back in time, 1981-1985 adjustments and substitutions, MRIP vs MRFSS estimates for 2004-2011, and estimating recreational landings in weight from the surveys.

4.3 Recreational Landings

4.3.1 Marine Recreational Fisheries Statistics Survey (MRFSS)

Introduction

The Marine Recreational Fisheries Statistics Survey (MRFSS) provides a long time series of estimated catch per unit effort, total effort, landings, and discards for six two-month periods (waves) each year. The survey provides estimates for three recreational fishing modes: shore-based fishing (SH), private and rental boat fishing (PR), and for-hire charter and guide fishing (CH). When the survey first began in Wave 2 (Mar/Apr), 1981, headboats were included in the for-hire mode, but were excluded after 1985 to avoid overlap with the Southeast Region Headboat Survey (SRHS) conducted by the NMFS Beaufort, NC lab.

The MRFSS survey covers coastal Gulf of Mexico states from Florida to Louisiana. The state of Texas was included in the survey from 1981-1985, although not all modes and waves were covered. The state of Florida is sampled as two sub-regions. The east Florida sub-region includes counties adjacent to the Atlantic coast from Nassau County south through Miami-Dade County, and the west Florida sub-region includes Monroe County (Florida Keys) and counties adjacent to the Gulf of Mexico. Separate estimates are generated for each Florida sub-region, and those estimates may be post-stratified into smaller regions based on proportional sampling.

The MRFSS design incorporates three complementary survey methods for estimating catch and effort. Catch data are collected through angler interviews during dockside intercept surveys of recreational fishing trips after they have been completed. Effort data are collected using two telephone surveys. The Coastal Household Telephone Survey (CHTS) uses random digit dialing of coastal households to obtain detailed information about the previous two months of recreational fishing trips from the anglers. The weekly For-Hire Survey interviews charter boat operators (captains or owners) to obtain the trip information with only one-week recall period. These effort data and estimates are aggregated to produce the wave estimates. Catch rates from dockside intercept surveys are combined with estimates of effort from telephone interviews to estimate total landings and discards by wave, mode, and area fished (inland, state, and federal waters). Catch estimates from early years of the survey are highly variable with high proportional standard errors (PSE's), and sample size in the dockside intercept portion have been increased over time to improve precision of catch estimates. Full survey documentation and ongoing efforts to review and improve survey methods are available on the MRFSS website at: http://www.st.nmfs.gov/st1/recreational.

Survey methods for the for-hire fishing mode have seen the most improvement over time. Catch rate data has improved through increased sample quotas and additional sampling (requested and funded by the states) to the intercept portion of the survey. It was also recognized that the random household telephone survey was intercepting relatively few anglers in the for-hire fishing mode and the For-Hire Telephone Survey (FHS) was developed to estimate effort in the for-hire mode. The new method draws a random sample of known for-hire charter and guide

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vessels each week and vessel operators are called and asked directly to report their fishing activity. The FHS was pilot tested in the Gulf of Mexico in 1998 and officially adopted in 2000. The two pilot years' estimates are considered unofficial but have been used in many SEDARs (SEDAR 7 red snapper, SEDAR 16 king mackerel, etc). The FHS was pilot tested in east Florida in 2000 and officially adopted in 2003.

A further improvement in the FHS method was the pre-stratification of Florida into smaller sub-regions for estimating effort. Pre-stratification defines the sample unit on a sub-state level to produce separate effort estimates by these finer geographical regions. The FHS sub-regions include five distinct regions: NW Florida panhandle from Escambia to Dixie counties (sub-region 1), SW Florida peninsula from Levy to Collier counties (sub-region 2), Monroe county (sub-region 3), SE Florida from Dade through Indian River counties (sub-region 4), and NE Florida from Martin through Nassau counties (sub-region 5). The coastal household telephone survey method for the for-hire fishing mode continues to run concurrently with the newer FHS method.

Calibration of traditional MRFSS charter boat estimates

Conversion factors have been estimated to calibrate the traditional MRFSS charter boat estimates with the FHS for 1986-1997 in the Gulf of Mexico (SEDAR7-AW03, Diaz and Phares, 2004), for 1986-2003 in the South Atlantic (SEDAR16-DW15, Sminkey, 2008), and for 1981-2003 in the mid-Atlantic (SEDAR17-Data Workshop Report, 2008). 1986-2003 South Atlantic calibration factors were updated in 2011 (SEDAR25-Data Workshop Report, 2011). These calibration factors are tabulated in SEDAR 28-DW14. The relationship between the old charter boat method estimates of angler trips and the FHS estimates of angler trips was used to estimate the conversion factors. Since these factors are based on effort, they can be applied to all species' landings. In the Gulf of Mexico and South Atlantic, the period of 1981-1985 could not be calibrated with the same ratios developed for 1986+ because in the earlier 1981-1985 time period, MRFSS considered charter boat and headboat as a single combined mode in both regions. Thus, in order to properly calibrate the estimates from 1981-1985, headboat data from the Southeast Region Head-boat Survey (SRHS) must be included in the analysis. To calibrate the MRFSS combined charter boat and headboat mode effort estimates in 1981-1985, conversion factors were estimated using 1986-1990 effort estimates from both modes, in equivalent effort units, an angler trip (SEDAR 28-DW12).

New MRIP weighted estimates

Revised catch and effort estimates, based on an improved estimation method, were released on January 25, 2012. These estimates are available for the Atlantic and Gulf Coasts for January 2004 through October 2011. This new estimation method, developed as part of the Marine Recreational Information Program (MRIP), provides more accurate data by removing potential biases that were included in the previous estimates. Since new MRIP estimates are only available for a portion of the recreational time series that the MRFSS covers, calibration factors between the MRFSS estimates and the MRIP estimates must be developed in order to maintain one consistent time series for the recreational estimates. To that end a calibration workshop is planned for the spring that will address this important data need.

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Figure 4.12.1 shows the comparison of the MRIP and MRFSS estimates for 2004-2011. At the SEDAR 28 DW plenary, the MRFSS estimates were identified as the best available data for 1981-2003. The MRIP estimates were identified as the best available data for 2004-2011. If the calibration workshop is able to produce correction factors that can be applied to the data in time for the SEDAR 28 Assessment Workshop in May, then these correction factors will be used to adjust the MRFSS estimates from 1981-2003. If the calibration workshop is not able to produce results in time then MRFSS estimates will be used from 1981-2003 and MRIP estimates will be used from 2004-2011.

Monroe County

Monroe County landings can be post-stratified to separate them from the MRFSS West Florida estimates. Post-stratification proportionally distributes the state-wide (FLE and FLW) effort into finer scale sub-regions and then produces effort estimates at this finer geographical scale. This is needed for the private and shore modes (all years) and charter boat mode (prior to FHS). FHS charter boat mode estimates are already pre-stratified, as discussed above. Although Monroe county estimates can be separated using this process, they cannot be partitioned into those from the Atlantic Ocean and those from the Gulf of Mexico. Anecdotal information from recreational fishermen revealed most, if not all, recreational Spanish mackerel fishing in the Florida Keys occurs in the Gulf of Mexico. Therefore, the recreational workgroup decided to leave the Monroe county landings in the Gulf of Mexico as part of the official MRFSS West Florida estimate.

Missing cells in MRFSS weight estimates

MRFSS landings estimates in weight must be treated with caution due to the occurrence of missing fish mean weight estimates in some strata. MRFSS weight estimates are calculated by multiplying the estimated number harvested in a cell (year/wave/state/mode/area/species) by the mean weight of the measured fish in that cell. When there are no fish measured in the cell (fish were gutted or too big for the sampler to weigh, harvest was all self-reported, etc.) estimates of landings in number are provided but there are no corresponding estimates of landings in weight.

The MRFSS Spanish mackerel estimates of landings in weight are used when provided by the survey. In cases where there is an estimate of landings in number but not weight, the Southeast Fisheries Science Center has used the MRFSS sample data to obtain an average weight using the following hierarchy: species, region, year, state, mode, and wave (SEDAR 22-DW16). The minimum number of weights used at each level of substitution is 30 fish, except for the final species level, where the minimum is 1 fish. In some cases, the MRFSS sample data records length, but not weight. These lengths were converted to weights using length weight equations developed by the Life History Working Group. These converted weights were used only in cases where having these additional converted weights would increase the number of weights available at each hierarchy level to meet the 30 fish minimum. Average weights are then multiplied by the landings estimates in number to obtain estimates of landings in weight. These estimates are provided in pounds whole weight.

1981, wave 1

MRFSS began in 1981, wave 2. In the Gulf of Mexico and east coast of Florida, catch needs to be estimated for 1981, wave 1. This gap was filled by determining the proportion of wave 1 to

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other waves in years 1982-1984 by fishing mode and area. These proportions were then used to estimate wave 1 in 1981 from the estimated catches in other waves of that year. (SEDARs 10 and 12 gag and red grouper).

Texas
Texas data from the MRFSS is only available from 1981-1985 and is sporadic, not covering all modes and waves. Boat mode estimates from Texas were eliminated from the MRFSS. Instead, TPWD data, which covers charter and private modes, was used to fill in theses modes prior to the start of the TPWD survey in May 1983. This method has been used in past SEDARs (king mackerel, red snapper). The only shore mode estimates available from Texas from any data source are from the MRFSS. These estimates seemed reasonable and were kept. Hurricane Alicia in 1983 may have affected the shore mode landings in Texas in 1984 and 1985. The lack of shore mode estimates from Texas 1986+ was discussed but there is no reasonable method available to fill in that gap.

Catch Estimates
Final MRFSS/MRIP landings estimates are shown in tables 4.11.1 and 4.11.2 by year and mode and in Figure 4.12.2.

Maps
Figures 4.12.3, 4.12.4, and 4.12.5 show the number of Spanish mackerel intercepted by the MRFSS from 1981-1989, 1990-1999, and 2000-2010 respectively. Numbers of fish mapped are intercepted by the survey as an A fish (seen by the interviewer) or a B1 fish (reported dead but not seen by the interviewer). Latitude and longitudes of the intercept site are mapped when available; otherwise, the mid-point of the county of intercept is mapped. Intercepted fish are shown for the Gulf of Mexico and Atlantic Ocean.

4.3.2 Southeast Region Headboat Survey (SRHS)

Introduction
The Southeast Region Headboat Survey estimates landings and effort for headboats in the South Atlantic and Gulf of Mexico. The Headboat Survey was started in 1972 but only included vessels from North Carolina and South Carolina until 1975. In 1976 the survey was expanded to northeast Florida (Nassau-Indian River counties) and Georgia, followed by southeast Florida (St. Lucie-Monroe counties) in 1978. The SRHS began in the Gulf of Mexico in 1986 and extends from Naples, FL to South Padre Island, TX. Due to headboat area definitions, West Florida and Alabama landings are combined. The South Atlantic and Gulf of Mexico Headboat Surveys generally include 70-80 vessels participating in each region annually.

The Headboat Survey incorporates two components for estimating catch and effort. 1) Information about the size of fishes landed are collected by port samplers during dockside sampling, where fish are measured to the nearest mm and weighed to the nearest 0.01 kg. These data are used to generate mean weights for all species by area and month. Port samplers also collect otoliths for ageing studies during dockside sampling events. 2) Information about total catch and effort are collected via the logbook, a form filled out by vessel personnel and containing total catch and effort data for individual trips. These logbooks are summarized by vessel to generate estimated landings by species, area, and time strata.

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Issue 1: Gulf of Mexico Spanish mackerel headboat landings prior to 1986: From 1981-1985 headboat landings were combined with MRFSS charter boat landings for FLW to LA.

Option 1: Start headboat time series in 1986 when the SRHS began in the Gulf of Mexico.

Option 2: Use combined MRFSS charter\headboat mode estimates for FLW to LA to take headboat estimates back to 1981 for recreational Spanish mackerel landings in the Gulf of Mexico.

Decision: Option 2

Issue 2: Texas Spanish mackerel headboat landings 1981 to 1985: From 1981 to 1985 Texas was not included in the MRFSS charter\headboat combined landings 1981 -1985.

Option 1: Use the average Texas headboat landings for Spanish mackerel from 1986 to 1988 for years prior to the start of the SRHS, 1981 to 1985.

Option 2: Start headboat landings time series in 1986 when the SRHS began in the Gulf of Mexico.

Decision: Option 1

Catch Estimates
Final SRHS landings estimates are shown in Table 4.11.3 by year and state and in Figure 4.12.6 SRHS areas 18-28 are included in the Gulf of Mexico Spanish mackerel stock. Figures 4.12.7, 4.12.8, and 4.12.9 show the Gulf of Mexico Spanish mackerel headboat landings from 1986-1989, 1990-1999, and 2000-2011 respectively. Headboat landings of Spanish mackerel in the Gulf of Mexico, from the 1980's to present, have mostly been concentrated in three areas: southwest Florida, Louisiana, and Texas. Catch of Spanish mackerel was evenly distributed between these areas in the 1980s (Figure 4.12.7), however, since 1990 headboat landings of Spanish mackerel have declined and shifted between these areas in the Gulf of Mexico (Figures 4.12.8 and 4.12.9).

Mississippi headboats were added to the SRHS in 2010. These headboats are smaller vessels that carry 10-15 anglers and combine trolling trips with bottom fishing trips. The MS vessels running these types of trips accounted for the increased landings of Spanish mackerel in the GOM for 2011.

4.3.3 Texas Parks and Wildlife Department

Introduction
The TPWD Sport-boat Angling Survey was implemented in May 1983 and samples fishing trips made by sport-boat anglers fishing in Texas marine waters. All sampling takes place at recreational boat access sites. The raw data includes information on catch, effort and length composition of the catch for sampled boat-trips. These data are used by TPWD to generate recreational catch and effort estimates. The survey is designed to estimate landings and effort by

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high-use (May 15-November 20) and low-use seasons (November 21-May 14). SEFSC personnel disaggregates the TPWD seasonal estimates into waves (2 month period) using the TPWD intercept data, in order to be compatible with MRFSS. Only private boat and charter boat fishing are surveyed. Most of the sampled trips are private boats fishing in bay/pass because these represent most of the fishing effort, but all trips (private, charter boat, ocean, bay/pass) are sampled. Charter boat trips in ocean waters are the least encountered in the survey.

Producing landings estimates in weight
In the TPWD survey, landings estimates are produced only in number of fish. In addition, the TPWD sample data does not provide weights, only lengths of the intercepted fish. TPWD length-weight equations were applied to the lengths in order to obtain weights. In order to obtain estimated landings in weight, a similar method used to fill in the missing weights in MRFSS (described above) is applied to the TPWD landings. The hierarchy used for TPWD is expanded to include area fished (species, region, year, state, mode, wave, and area). This is equivalent to the MRFSS estimate of weight provided by that survey.

1981-1983 Texas estimates
The TPWD survey begins with the high-use season in 1983 (May15, 1983). Charter and private mode estimates need to be filled in for this state and these modes back to 1981. Averages from TPWD 1983-1985 were used by mode and wave to fill in the missing estimates. In addition, headboat landings from TX from 1981-1985 are not covered by any survey. As discussed above, SRHS 1986-1988 average landings were used to fill in this time period.

Catch Estimates
Final TPWD landings estimates are shown in table 4.11.4 by year and mode and in Figure 4.12.10.

Maps
Figures 4.12.11, 4.12.12, and 4.12.13 show the number of Spanish mackerel intercepted by the TPWD from 1983-1989, 1990-1999, and 2000-2010 respectively. Numbers of fish intercepted by the survey are mapped by Texas major bay areas. They are Sabine Lake, Galveston, Matagorda, San Antonio, Aransas, Corpus Christi, Upper Laguna Madre, and Lower Laguna Madre.

4.3.4 Historic Recreational Landings

Introduction
The historic recreational landings time period is defined as pre-1981 for the charter boat, headboat, private boat, and shore fishing modes, which represents the start of the Marine Recreational Fisheries Statistics Survey (MRFSS) and availability of landings estimates for Spanish mackerel. The Recreational Working Group was tasked with evaluating other potential historical sources and methods to compile landings of Spanish mackerel prior to the available time series of MRFSS and headboat estimated landings.

The sources of historical landings that were reviewed for potential use are as follows:

- Salt Water Angler Surveys (SWAS),1960, 1965 &1970.

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- The U.S Fish and Wildlife Service (USFWS), 2001 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation Survey (FHWAR).

SWAS
During the SEDAR 28 data workshop the RWG reviewed the Salt Water Angler Surveys (SWAS) from 1960, 1965 &1970. The workgroup noted that the salt-water angling survey estimates for Spanish mackerel are on the order of 6 times those in recent years. These high estimates have been attributed to recall bias and possible exaggeration of catches by anglers (SWAS 1960). This may have been compounded further by the small sample size of salt water angler interviews conducted in these surveys. The average interview sample size for the three surveys was 0.0002% of total estimated saltwater anglers in the United States. The changes in methodology were also discussed by the RWG as part of the overall discussion of using this method.

FHWAR census method
The 2001 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation Survey presented summary tables of U.S. population estimates, along with estimates of hunting and fishing participation and effort from surveys conduct by the USFWS every 5 years from 1955 to 1985. (Table 4.11.5). This information was used to develop an alternative method for estimating recreational landings prior to 1981.

The two key components from these FHWAR surveys that were used in the census method were the estimates of U.S. saltwater anglers and the estimates of U.S. saltwater days. The first objective was to determine the total saltwater anglers and saltwater days for the Gulf of Mexico (GOM) by using the summary information of U.S. anglers and U.S. saltwater anglers from the FHWAR surveys. The ratio of U.S saltwater anglers to the total U.S anglers was applied to the total number of anglers for the GOM to yield the total saltwater anglers for the GOM. The same method was used to calculate the total saltwater days for the GOM from the FHWAR surveys from 1955-1985.

The FHWAR surveys included the entire state of Florida, east and west coasts, and the South Atlantic. In order to address the management boundaries for Spanish mackerel the saltwater angler days for Florida's west coast (FLW) were separated from Florida's east coast (FLE) saltwater angler days using the ratio of the MRFSS total angler trips for FLW to the MRFSS total angler trips for the GOM (TX to AL). The average ratio from 1983-1985 was applied to the total saltwater days for the 1955-1985 to include FLW effort.

Similar to the SWAS there was a 12 month recall period for respondents, which resulted in greater reporting bias. Research concluded this bias resulted in overestimates of both the catch and effort estimates in the FHWAR surveys from 1955 to 1985. Consequently, an adjustment for recall bias was necessary. The total saltwater days for the GOM 1955-1985 were adjusted for recall bias in the FHWAR surveys. The MRFSS total angler trips for the GOM 1983 to1985 was averaged and divided by the total saltwater days for 1985 from the FHWAR survey. This multiplier was then applied to the total GOM saltwater days 1955-1985 to adjust for recall bias.

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The mean CPUE for Spanish mackerel in the Gulf of Mexico from the MRFSS estimates from 1981 to 1985 was then applied to the adjusted saltwater angler days for the GOM 1955-1985 to estimate the historical Spanish mackerel landings for those years (Table 4.11.5).

A bootstrap analysis was used to capture the range of uncertainty in the historic recreational catch estimates. More specifically, the historic catch estimates are based on the average CPUE and the ratio of MRFSS effort to historic effort estimates. These two quantities were bootstrapped 200 times using the empirical estimates that went into each of them. The 5th and 95th percentiles were then computed from the distribution of bootstrap estimates to characterize the uncertainty (Figure 4.12.14).

Issue: Available historical Spanish mackerel landings limited 1950-1980.

Option 1: Use the Adjusted SWAS Spanish mackerel estimated landings.

Option 2: Use average ratio from entire time series (1981-2010) applied to commercial landings to estimate recreational landings (1950-1980).

Option 3: Use available recreational time series for the MRFSS\MRIP and headboat estimates 1981- 2010.

Option 4: Total Spanish mackerel landings using the FHWAR census method (GOM 1955-1980) are presented with the total estimated Spanish mackerel landings (MRFSS/MRIP and SRHS landings) (GOM 1981-2011) in Table 4.11.6 and Figure 4.12.15.

Decision: *Option 4*

4.4 Recreational Discards

4.4.1 MRFSS discards

Discarded live fish are reported by the anglers interviewed by the MRFSS so both the identity and quantities reported are unverified. Discarded fish size is unknown for all modes of fishing covered by the MRFSS. At-sea sampling of headboat discards was initiated as part of the improved for-hire surveys to characterize the size distribution of live discarded fishes in the headboat fishery, however, the Beaufort, NC Logbook program (SRHS) produces estimates of total discards in the headboat fishery since that class of caught fish was added to their logbook (2004). All estimates of live released fish (B2 fish) in charter or charter boat/headboat combined mode were adjusted in the same manner as the landings (calibration factors, substitutions, etc. described above in section 4.3.1). Size or weight of discarded fishes is not estimated by the MRFSS. Final MRFSS/MRIP discard estimates are shown in Table 4.11.7 by year and mode and in Figure 4.12.16.

4.4.2 Headboat Logbook Discards

The Southeast Region Headboat Survey logbook form was modified in 2004 to include a category to collect self-reported discards for each reported trip. This category is described on the

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form as the number of fish by species released alive and number released dead. Port agents instructed each captain on criteria for determining the condition of discarded fish. A fish is considered "released alive" if it is able to swim away on its own. If the fish floats off or is obviously dead or unable to swim, it is considered "released dead". These self-reported data are currently not validated within the Headboat Survey. Due to low Spanish mackerel sample sizes in the MRFSS At-Sea Observer Headboat program, it was determined that the logbook discard data would be used from 2004-2011. The RWG further concluded that a proxy should be used to estimate the headboat Spanish mackerel discards for previous years. The RWG considered the following two possible data sources to be used as a proxy for estimated headboat discards for 1981-2003 (Figure 4.12.17).

- MRFSS charter boat discard estimates (corrected for FHS adjustment) applied– Extend back to 1981.
- MRFSS private boat discard ratio estimates– Extend back to 1981 and follows the pattern exhibited in the Southeast Region Headboat Survey in later years.

Issue: Proxy for estimated headboat discards from 1981-2003.

Option 1: Apply the MRFSS charter boat discard:landings ratio to estimated headboat landings in order to estimate headboat discards from 1981-2003.
Option 2: Apply the MRFSS private boat discard:landings ratio to estimated headboat landings in order to estimate headboat discards from 1981-2003.
Option 3: Calculate a ratio of the mean ratio of SRHS discard:landings (2004-2011) to the mean ratio of MRFSS CH discard:landings (2004-2011). Apply this ratio to the yearly MRFSS charter boat discard:landings ratio (1981-2003) in order to estimate the yearly SRHS discard:landings ratio (1981-2003). This ratio is then applied to the SRHS landings (1981-2003) in order to estimate headboat discards (1981-2003).

Decision: Option 3. Calculate a ratio of the mean ratio of SRHS discard:landings (2004-2010) to the mean MRFSS CH discard:landings ratio (2004-2010). Apply this ratio to the yearly MRFSS charter boat discard:landings ratio (1981-2003) in order to estimate the yearly SRHS discard:landings ratio (1981-2003). This ratio is then applied to the SRHS landings (1981-2003) in order to estimate headboat discards (1981-2003). The MRFSS charter boat discard estimates followed the pattern exhibited in the SRHS in later years. Because the MRFSS charter boat discard ratio was greater than the SRHS discard ratio, using the MRFSS charter boat ratio without the adjustment described in Option 3 could result in overestimating the SRHS discards. Headboat discard estimates for Texas in 1981-1985 were estimated in the same manner as the landings, using the mean of the resulting discard estimates from 1986-1988.

Final discard estimates from the SRHS are shown in Table 4.11.8 by year and state and in Figure 4.12.18.

4.4.3 Headboat At-Sea Observer Survey Discards

An observer survey of the recreational headboat fishery was run in some Gulf region states to collect more detailed information on recreational headboat catch, particularly for discarded fish.

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The survey was conducted in Alabama from 2004 to 2007, in West Florida from 2005-2007, and in East Florida from 2005 to the present. Headboat vessels are randomly selected throughout the year in each state, and the east coast of Florida is further stratified into northern and southern sample regions. Biologists board selected vessels with permission from the captain and observe anglers as they fish on the recreational trip. Data collected include number and species of fish landed and discarded, size of landed and discarded fish, and the release condition of discarded fish (FL only). Biological samples such as scales, otoliths, spines, stomachs and gonads, are not typically collected as part of this protocol. Data are also collected on the length of the trip, area fished (inland, state, and federal waters) and, in Florida, the minimum and maximum depth fished. In the Florida Keys (sub-region 3) some vessels that run trips that span more than 24 hours are also sampled to collect information on trips that fish farther offshore and for longer durations, primarily in the vicinity of the Dry Tortugas. Due to low Spanish mackerel sample sizes the MRFSS At-Sea Observer data was not used in this assessment.

4.4.4 Texas Parks and Wildlife Department Discards

The TPWD recreational survey does not estimate discards. The recreational workgroup looked at the data available and decided to use a Gulf wide ratio from the MRFSS by mode (charter and private) and apply it to the TPWD landings in order to estimate discards from Texas. Similar methods have been used in past SEDARs (red snapper). Discard estimates for Texas charter and private modes are shown in Table 4.11.9 by year and mode and in Figure 4.12.19.

4.4.5 Alternatives for characterizing discards

Due to low Spanish mackerel sample sizes in the MRFSS At-Sea Observer data it was concluded that the headboat logbook discard estimates should be used from 2004-2011 for the Gulf of Mexico headboat fishery. Further, the group decided to use the charter mode as a proxy to calculate headboat discards for 1981-2003, since the discard rates from the longer time series of MRFSS reflect historic changes in discard rates. These rates include the impacts from changes in recreational size limits and bag limits for Spanish mackerel over time.

4.5 Biological Sampling

4.5.1 Sampling Intensity Length/Age/Weight

MRFSS Charter, Private, and Shore

The MRFSS' angler intercept survey includes the collection of fish lengths from the harvested (landed, whole condition) catch. Up to 15 of each species landed per angler interviewed are measured to the nearest mm along a center line (defined as tip of snout to center of tail along a straight line, not curved over body). In those fish with a forked tail, this measure would typically be referred to as a fork length, e.g., Spanish mackerel, and in those fish that do not have a forked tail it would typically be referred to as a total length with the exception of some fishes that have a single, or few, caudal fin rays that extend further. Weights are typically collected for the same fish measured although weights are preferred when time is constrained. Ageing structures and other biological samples are not collected during MRFSS assignments because of concerns over the introduction of bias to survey data collection.

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The number of Spanish mackerel measured or weighed in the Gulf of Mexico (FLW-TX) in the MRFSS charter fleet, private-rental mode, and shore mode are summarized by year and state in tables 4.11.10, 4.11.11, and 4.11.12, respectively. The number of angler trips with measured or weighed Spanish mackerel in the Gulf of Mexico (FLW-TX) in the MRFSS charter fleet, private-rental mode, and shore mode are summarized by year and state in tables 4.11.13, 4.11.14, and 4.11.15, respectively. The number of MRFSS intercept trips conducted in the Gulf of Mexico (FLW-TX) and the percentage of intercepts that encountered Spanish mackerel are summarized by year and mode in Table 4.11.16. Dockside mean weights of Spanish mackerel weighed from the MRFSS in the Gulf of Mexico (FLW-TX) are tabulated for 1981-2011 in Table 4.11.17.

Headboat Survey Biological Sampling
Lengths were collected from 1986 to 2011 by headboat dockside samplers in the Gulf of Mexico. Mississippi was added to the survey in 2010. Weights are typically collected for the same fish measured during dockside sampling. Also, biological samples (scales, otoliths, spines, stomachs and gonads) are collected routinely and processed for aging, diet studies, and maturity studies.

Annual numbers of Spanish mackerel measured for length in the headboat fleet and the number of trips from which Spanish mackerel were measured are summarized in Table 4.11.18. The number of Spanish mackerel aged from the headboat fleet by year and state are summarized in Table 4.11.19. Dockside mean weights for the headboat fishery are tabulated for 1986-2011 in Table 4.11.20.

Texas Parks and Wildlife Department Biological Sampling
The TPWD Sport-boat Angling Survey samples fishing trips made by sport-boat anglers fishing in Texas marine waters. All sampling takes place at recreational boat access sites. Length composition of the catch for sampled boat-trips has been collected since the high-season of 1983 (mid-May). Total length is measured by compressing the caudal fin lobes dorsoventrally to obtain the maximum possible total length. Weight of sampled fish is not recorded.

The number of Spanish mackerel measured in the TPWD charter and private-rental modes are summarized by year in table 4.11.21. The number of trips with measured Spanish mackerel in the TPWD charter and private-rental modes are summarized by year in table 4.11.22. The number of TPWD intercept trips conducted in Texas and the percentage of intercepts that encountered Spanish mackerel are summarized by year and mode in Table 4.11.23.

Aging data
The number of Spanish mackerel aged from the SRHS by year and state is summarized in Table 4.11.19. Age samples collected from the private/rental boat, charter boat, and shore modes are not typically collected as part of the MRFSS sampling protocol. These samples come from a number of sources including state agencies, special projects, and sometimes as add-ons to the MRFSS survey. The number of Spanish mackerel aged from the charter boat fleet by year and state is summarized in Table 4.11.24. The number of Spanish mackerel aged from the private fleet by year and state is summarized in Table 4.11.25. The number of Spanish mackerel aged from the recreational fishery (mode unknown) by year and state is summarized in Table 4.11.26. In some cases mode of catch was either not recorded or the samples were taken from tournament

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weigh stations where trip information was not collected. It was not possible to determine the number of trips from which age samples were taken for approximately half of the age samples. Therefore number of trips with age samples was not reported.

4.5.2 Length – Age distributions

MRFSS and TPWD Length Frequency Analysis Protocol

The angler intercept survey is stratified by wave (2-month period), state, and fishing mode (shore, charter boat, party boat, private or rental boat) so simple aggregations of fish lengths across strata cannot be used to characterize a regional, annual length distribution of landed fish; a weighting scheme is needed to representatively include the distributions of each stratum value. The MRFSS' angler intercept length frequency analysis produces unbiased estimates of length-class frequencies for more than one stratum by summing respectively weighted relative length-class frequencies across strata. The steps used are:

1) Output a distribution of measured fish among state/mode /wave strata,
2) Output a distribution of estimated catch among state/mode/wave strata,
3) Calculate and output relative length-class frequencies for each state/mode/wave stratum,
4) Calculate appropriate relative weighting factors to be applied to the length-class frequencies for each state/mode/ wave stratum prior to pooling among strata,
5) Sum across strata as defined, e.g., annual, sub-region length frequencies, by year in 1-cm length bins.
6) Convert to annual proportion in each size bin (Figure 4.12.20).

Lengths were taken from the MRFSS (charter boat, private/rental boat, and shore modes) during 1981 to 2011. The number of vessel trips sampled were not available from the MRFSS. Lengths from the TPWD survey were converted to fork length using the equation FL = 0.8816*(TL) – 11.82 as recommended by the SEDAR 28 DW panel.

Southeast Region Headboat Survey Length Frequency Analysis Protocol

Headboat landings (1983 to 2011) were pooled across five time intervals (Jan-May, Jun, July, Aug, Sep-Dec) because landings were not estimated by month until 1996. Spatial weighting was developed by region for the headboat survey by pooling landings by region; western FL and AL, MS, LA, and TX. For each measured fish a landings value was assigned based on month of capture and region. The landings associated with each length measurement were summed by year in 1-cm length bins. These landings are typically then converted to annual proportion in each size bin (Figure 4.12.21).

Recreational Age Frequency

Age compositions were calculated for the charter, private/rental, and recreational (unknown mode) fisheries (Figure 4.12.22) and for the headboat fishery (Figure 4.12.23). Ages 0-10 were plotted for the charter, private/rental, and recreational (unknown mode) fisheries. Ages 0-7 were plotted for the headboat fishery.

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It was not possible to determine the number of trips from which age samples were taken for approximately half of the age samples. Therefore number of trips with age samples was not reported.

4.6 Recreational Catch-at-Age/Length; directed and discard

Catch at age is handled within the assessment model and does not require discussion or presentation here.

4.7 Recreational Effort

4.7.1 MRFSS Recreational & Charter Effort

Effort estimation for the recreational fishery surveys are produced via telephone surveys of both anglers (private/rental boats and shore fishers) and for-hire boat operators (charter boat anglers, and in early years, party or charter anglers). The methods have changed during the full time series (see section 4.3 for descriptions of survey method changes and adjustments to survey estimates for uniform time-series of catch estimates). Angler trip estimates are tabulated in table 4.11.27 by year and mode. An angler-trip is a single day of fishing in the specified mode, not to exceed 24 hours.

Figures 4.12.24, 4.12.25, and 4.12.26 show the number of angler trips that intercepted Spanish mackerel from the MRFSS from 1981-1989, 1990-1999, and 2000-2010 respectively. Latitude and longitudes of the intercept site are mapped when available; otherwise, the mid-point of the county of intercept is mapped. Intercepted trips that caught Spanish mackerel are shown for the Gulf of Mexico and Atlantic Ocean.

4.7.2 Headboat Effort

Catch and effort data are reported on logbooks provided to all headboats in the survey. These forms are completed by the captain or designated crew member after each trip and represent the total number and weight of all the species kept, along with the total number of fish discarded for each species. Data on effort are provided as number of anglers on a given trip. Numbers of anglers are standardized, depending on the type of trip (length in hours), by converting number of anglers to "angler days" (e.g., 40 anglers on a half-day trip would yield 40 * 0.5 = 20 angler days). Angler days are summed by month for individual vessels. Each month, port agents collect these logbook trip reports and check for accuracy and completeness. Although reporting via the logbooks is mandatory, compliance is not 100% and is variable by location. To account for non-reporting, a correction factor is developed based on sampler observations, angler numbers from office books and all available information. This information is used to provide estimates of total catch by month and area, along with estimates of effort.

Figures 4.12.27, 4.12.28, and 4.12.29 show the Gulf of Mexico Spanish mackerel positive headboat trips from 1980-1989, 1990-1999, and 2000-2011 respectively. During the 1980s and 1990s, Louisiana and north Texas also showed concentrations of Spanish mackerel positive trips on headboats (Figures 4.12.27 and 4.12.28). In more recent years from 2000-2011, positive

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Spanish mackerel trips were concentrated off Louisiana and the west coast of Florida (Figures 4.12.29).

Estimated headboat angler days have decreased in the Gulf of Mexico in recent years (Table 4.11.28). The most obvious factor which impacted the headboat fishery in both the Atlantic and Gulf of Mexico was the high price of fuel. This coupled with the economic down turn starting in 2008 has resulted in a marked decline in angler days in the Gulf of Mexico headboat fishery. Reports from industry staff, captains\owners, and port agents indicated fuel prices, the economy and fishing regulations are the factors that most affected the amount of trips, number of passengers, and overall fishing effort. Also important to note, is the noticeable decrease in effort in Louisiana, Alabama and west Florida due to the Deepwater Horizon oil spill in the Gulf of Mexico in 2010.

4.7.3 Texas Parks and Wildlife Effort

The TPWD survey is designed to estimate landings and effort by high-use (May 15-November 20) and low-use seasons (November 21-May 14). Only private boat and charter boat fishing are surveyed. Most of the sampled trips are private boats fishing in bay/pass because these represent most of the fishing effort, but all trips (private, charter boat, ocean, bay/pass) are sampled. Charter boat trips in ocean waters are the least encountered in the survey.

Estimates of TPWD angler trips are shown in table 4.11.29 by year, season, and mode. Figures 4.12.30, 4.12.31, and 4.12.32 show the number of angler hours from trips that intercepted Spanish mackerel from the TPWD from 1983-1989, 1990-1999, and 2000-2010 respectively. Angler hours are mapped by Texas major bay areas. They are Sabine Lake, Galveston, Matagorda, San Antonio, Aransas, Corpus Christi, Upper Laguna Madre, and Lower Laguna Madre.

4.8 Comments on adequacy of data for assessment analyses

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

- Landings, as adjusted, appear to be adequate for the time period covered.
- Size data appear to adequately represent the landed catch for the charter and headboat sector.

4.9 Literature Cited

Matter, V. and S. Turner 2010. Estimated Recreational Catch in Weight: Method for Filling in Missing Weight Estimates from the Recreational Surveys with Application to Yellowedge Grouper, Tilefish (golden), and Blueline Tilefish (SEDAR 22-DW16), National Marine Fisheries Service, Southeast Fisheries Science Center, Sustainable Fisheries Division (SFD-2010-003).

Historical Fisheries Working Group (HFWG) 2010. SEDAR24-DW11, Estimation of Historic Recreational Landings 2010.

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Clark, J.R. 1962. The 1960 Salt-Water Angling Survey. U.S. Department of the Interior, Bureau of Sport Fisheries and Wildlife, Circular 153, 36 pp.
Deuel, D.G. 1973. The 1970 Salt-Water Angling Survey. U.S. Department of Commerce, National Marine Fisheries Service, Current Fishery Statistics No. 6200, 54 pp.
Deuel, D.G. and J.R. Clark. 1968. The 1965 Salt-Water Angling Survey. U.S. Department of the Interior, Bureau of Sport Fisheries and Wildlife, Resource Publication 67, 51 pp.

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4.10 Tables

Table 4.11.1. Gulf of Mexico (FLW-LA) Spanish mackerel landings (numbers of fish and whole weight in pounds) for charter boat mode and charter boat/headboat mode (MRFSS, NMFS, 1981-2003; MRIP, NMFS, 2004-2011). CH and CH/HB mode adjusted for FHS conversion prior to 1997. CH/HB mode landings from 1981-1985 only. 2011 data is preliminary and through October.

	Estimated CH Landings			Estimated CH/HB Landings		
YEAR	Number	CV	Pounds	Number	CV	Pounds
1981				942,170	0.33	999,274
1982				1,569,489	0.29	1,846,794
1983				582,555	0.39	826,316
1984				385,137	0.25	503,035
1985				388,053	0.25	533,690
1986	354,699	0.25	482,316			
1987	335,781	0.22	495,719			
1988	125,666	0.36	205,167			
1989	196,290	0.22	305,182			
1990	203,674	0.25	370,623			
1991	86,893	0.21	211,477			
1992	99,051	0.26	158,410			
1993	76,330	0.24	125,521			
1994	166,952	0.23	220,634			
1995	337,320	0.24	532,316			
1996	130,534	0.27	190,518			
1997	159,434	0.38	333,330			
1998	127,348	0.09	234,461			
1999	121,573	0.10	238,184			
2000	213,272	0.11	366,095			
2001	170,786	0.09	278,357			
2002	131,692	0.10	254,485			
2003	171,765	0.10	302,770			
2004	146,385	0.20	194,663			
2005	68,578	0.20	123,791			
2006	307,135	0.20	562,234			
2007	179,424	0.18	327,774			
2008	226,053	0.23	350,013			
2009	226,333	0.24	305,900			
2010	131,864	0.16	250,844			
2011	275,494	0.12	427,721			

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Table 4.11.2. Gulf of Mexico (FLW-TX) Spanish mackerel landings (numbers of fish and whole weight in pounds) for private/rental boat mode and shore mode (MRFSS, NMFS, 1981-2003; MRIP, NMFS, 2004-2011). TX landings for shore mode from 1981-1985 only. 2011 data is preliminary and through October.

	Estimated PR Landings			Estimated SH Landings		
YEAR	Number	CV	Pounds	Number	CV	Pounds
1981	793,825	0.22	935,490	353,215	0.28	349,489
1982	1,576,510	0.29	1,569,107	283,874	0.18	391,016
1983	1,222,084	0.24	1,441,054	614,142	0.23	787,227
1984	272,316	0.27	395,700	272,610	0.34	386,743
1985	532,221	0.17	626,199	246,748	0.26	321,479
1986	2,536,448	0.12	2,590,750	3,498,704	0.25	3,703,806
1987	824,869	0.09	1,509,214	608,050	0.18	829,874
1988	1,070,955	0.10	1,555,563	258,849	0.19	359,773
1989	694,372	0.09	1,106,122	236,696	0.17	210,012
1990	703,798	0.10	1,241,017	678,748	0.13	860,659
1991	1,043,554	0.09	1,592,566	576,463	0.16	734,535
1992	988,084	0.05	1,588,078	1,296,872	0.08	1,737,928
1993	356,467	0.10	696,190	1,050,065	0.09	1,098,361
1994	424,917	0.08	624,728	817,555	0.07	974,511
1995	313,021	0.14	688,173	396,766	0.14	489,486
1996	463,174	0.11	781,511	638,295	0.12	727,071
1997	494,843	0.15	1,039,336	591,042	0.12	704,404
1998	404,157	0.11	821,234	632,420	0.12	840,299
1999	630,435	0.09	1,085,320	823,952	0.09	1,017,865
2000	584,505	0.10	1,185,553	916,551	0.09	1,383,914
2001	772,196	0.09	1,313,957	1,534,160	0.09	1,957,295
2002	721,118	0.09	1,480,183	1,109,254	0.09	1,467,450
2003	572,993	0.08	1,189,324	759,608	0.11	1,122,474
2004	834,347	0.11	1,314,717	1,144,339	0.17	1,239,844
2005	665,629	0.15	1,097,404	457,444	0.24	539,439
2006	677,614	0.11	1,182,120	773,926	0.28	755,261
2007	557,693	0.10	977,828	593,883	0.17	715,410
2008	1,027,872	0.22	1,961,999	642,929	0.31	631,962
2009	681,267	0.18	1,105,777	595,596	0.22	661,319
2010	606,458	0.12	1,012,579	826,898	0.16	1,282,606
2011	520,844	0.15	728,938	611,632	0.16	767,059

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Table 4.11.3. Estimated headboat landings of Spanish mackerel in the Gulf of Mexico 1981-2011. Due to headboat area definitions, West Florida and Alabama landings are combined.

	FLW/AL		MS*		LA**		TX†		Gulf of Mexico	
Year	Number	Weight (lb)	Number	Weight (lb)	Number	Weight (lb)	Number	Weight (lb)	Number	Weight (lb)
1981							153	478	153	478
1982							153	478	153	478
1983							153	478	153	478
1984							153	478	153	478
1985							153	478	153	478
1986	278	546			29	18	84	305	391	869
1987	455	1,215			671	1,808	204	551	1,330	3,574
1988	44	133			113	300	170	484	327	918
1989	201	184			150	292	211	492	562	967
1990	639	1,543			137	361	101	261	877	2,165
1991	489	708			845	1,600	385	3,238	1,719	5,546
1992	480	1,169			558	1,526	304	823	1,342	3,517
1993	277	628			80	191	212	486	569	1,305
1994	815	2,246			382	978	406	993	1,603	4,217
1995	147	476			550	1,859	183	585	880	2,921
1996	198	471			231	388	212	598	641	1,457
1997	187	407			303	1,071	50	139	540	1,617
1998	277	444			41	143	18	73	336	659
1999	359	1,068			44	116	71	202	474	1,386
2000	411	1,230			46	167	60	178	517	1,576
2001	169	434			14	38	28	86	211	559
2002	169	448			14	27	82	164	265	639
2003	194	373			-	-	77	145	271	518
2004	241	418					20	32	261	449
2005	230	774					52	171	282	945
2006	264	639			-	-	128	314	392	953
2007	425	1,446			3	11	106	361	534	1,817
2008	542	1,367			22	50	70	179	634	1,596
2009	560	1,097			29	20	104	181	693	1,298
2010	279	294	1,288	1,318	-	-	30	31	1,597	1,642
2011	528	1,302	4,513	8,200	-	-	220	543	5,261	10,046

*MS added to survey in 2010.
**LA not sampled during 2004-2005 due to Hurricane Katrina.
†TX 1981-1985 landings estimated using the mean landings 1986-1988.

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Table 4.11.4 Texas Spanish mackerel landings (numbers of fish and whole weight in pounds) for charter boat mode and private mode (TPWD). 2011 data is through mid-May.

	Estimated CH Landings		Estimated PR Landings		Total Landings	
year	Number	Pounds	Number	Pounds	Number	Pounds
1981	303	611	3,922	8,226	4,225	8,837
1982	303	611	3,922	8,226	4,225	8,837
1983	801	1,633	2,952	6,044	3,753	7,677
1984	98	180	5,472	11,096	5,570	11,276
1985	40	79	3,353	7,556	3,393	7,635
1986	76	157	2,448	5,117	2,524	5,274
1987	378	649	7,797	12,296	8,175	12,944
1988	95	179	1,291	2,432	1,386	2,610
1989	34	51	2,526	4,142	2,560	4,193
1990	172	296	3,274	5,547	3,446	5,843
1991	357	737	9,626	23,599	9,983	24,336
1992			2,561	6,996	2,561	6,996
1993	223	444	1,417	2,692	1,640	3,136
1994	186	372	5,336	11,554	5,522	11,927
1995	86	231	8,401	24,231	8,487	24,462
1996	15	35	9,234	24,111	9,249	24,146
1997	264	543	5,070	11,475	5,334	12,018
1998	27	66	5,545	13,953	5,572	14,018
1999	223	529	4,403	11,888	4,626	12,417
2000	262	601	5,119	13,934	5,381	14,535
2001	7	14	1,465	2,937	1,472	2,951
2002	896	1,909	3,685	7,814	4,581	9,723
2003	214	523	4,356	10,851	4,570	11,374
2004	43	90	8,293	18,133	8,336	18,223
2005	232	529	7,926	18,657	8,158	19,185
2006	823	2,286	9,336	21,381	10,159	23,667
2007	603	2,037	6,529	14,810	7,132	16,847
2008	133	266	2,443	5,554	2,576	5,820
2009	64	142	4,912	11,313	4,976	11,455
2010	264	451	11,175	22,361	11,439	22,812
2011	880	1,203	474	648	1,354	1,850

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Table 4.11.5. FHWAR estimation method for historical recreational Spanish mackerel landings in the Gulf of Mexico (1955-1985).

Year	US saltwater angler days	Proportion anglers GOM	Saltwater angler days (GOM)	Mean CPUE (MRFSS 1981-1985)	Recall bias adjustment	Adjusted saltwater days (GOM)	Adjusted Spanish mackerel landings (n)
1955	58,621,000	0.19	17,551,372	0.11	0.40	7,034,684	774,329
1960	80,602,000	0.21	27,144,209	0.11	0.40	10,879,544	1,197,544
1965	95,837,000	0.19	29,581,307	0.11	0.40	11,856,346	1,305,064
1970	113,694,000	0.20	35,428,990	0.11	0.40	14,200,129	1,563,051
1975	167,499,000	0.19	51,531,494	0.11	0.40	20,654,099	2,273,458
1980	164,040,000	0.20	51,984,003	0.11	0.40	20,835,467	2,293,422
1985	171,055,000	0.20	54,291,623	0.11	0.40	21,760,373	2,395,229

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Table 4.11.6. Gulf of Mexico estimated recreational Spanish mackerel landings (number) using FHWAR census method (1955-1980), MRFSS (1981-2003), MRIP (2004-2011),TPWD (81-11), and SRHS (81-11) estimation methods.

Year	Estimated landings (n)	Year	Estimated landings (n)
1955	774,329	1984	935,785
1956	858,972	1985	1,170,567
1957	943,615	1986	6,392,766
1958	1,028,258	1987	1,778,205
1959	1,112,901	1988	1,457,183
1960	1,197,544	1989	1,130,480
1961	1,219,048	1990	1,590,542
1962	1,240,552	1991	1,718,612
1963	1,262,056	1992	2,387,911
1964	1,283,560	1993	1,485,071
1965	1,305,064	1994	1,416,548
1966	1,356,661	1995	1,056,474
1967	1,408,258	1996	1,241,893
1968	1,459,856	1997	1,251,192
1969	1,511,453	1998	1,169,834
1970	1,563,051	1999	1,581,061
1971	1,705,132	2000	1,720,226
1972	1,847,214	2001	2,478,825
1973	1,989,295	2002	1,966,911
1974	2,131,377	2003	1,509,207
1975	2,273,458	2004	2,133,669
1976	2,277,451	2005	1,200,092
1977	2,281,444	2006	1,769,226
1978	2,285,437	2007	1,338,667
1979	2,289,429	2008	1,900,065
1980	2,293,422	2009	1,508,864
1981	2,093,589	2010	1,578,256
1982	3,434,252	2011	1,414,585
1983	2,422,686		

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Table 4.11.7. Gulf of Mexico (FLW-TX) Spanish mackerel discards for the recreational fishing modes by year (MRFSS, NMFS, 1981-2003; MRIP, NMFS, 2004-2011. CH and CH/HB mode adjusted for FHS conversion prior to 1997. CH/HB mode discards from 1981-1985 only. 2011 data is preliminary and through October. TX estimates for 1981-1985 shore mode only.

	Estimated CH Discards		Estimated CH/HB Discards		Estimated PR Discards		Estimated SH Discards	
YEAR	Number	CV	Number	CV	Number	CV	Number	CV
1981			6,371	1.00	28,533	0.46	42,872	0.43
1982			33,938	0.73	20,734	0.52	483,958	0.51
1983			0	0.00	33,953	0.46	1,144,786	0.61
1984			9,794	0.58	36,422	0.75	13,898	0.54
1985			393	1.00	76,648	0.45	63,611	0.45
1986	34,884	0.35			1,477,188	0.16	2,497,470	0.33
1987	11,982	0.88			208,933	0.16	191,520	0.36
1988	22,312	0.43			541,171	0.16	154,673	0.35
1989	81,812	0.37			279,559	0.22	134,107	0.34
1990	55,639	0.63			533,147	0.21	1,579,443	0.18
1991	10,840	0.37			409,828	0.14	813,299	0.27
1992	65,660	0.59			489,251	0.08	1,125,772	0.14
1993	51,089	0.48			185,858	0.15	812,998	0.13
1994	17,571	0.54			229,742	0.14	409,293	0.14
1995	49,663	0.39			256,240	0.46	257,388	0.23
1996	11,968	0.49			273,371	0.12	404,150	0.22
1997	48,643	0.38			263,843	0.15	541,915	0.18
1998	71,196	0.18			218,006	0.14	457,726	0.18
1999	23,635	0.18			479,096	0.10	731,813	0.09
2000	41,917	0.19			574,323	0.43	880,679	0.15
2001	41,348	0.30			633,266	0.09	1,170,206	0.11
2002	49,595	0.37			550,088	0.08	1,320,444	0.10
2003	38,521	0.13			789,883	0.10	1,382,511	0.13
2004	55,788	0.24			1,222,939	0.20	1,037,331	0.15
2005	21,159	0.20			809,693	0.21	542,023	0.23
2006	55,502	0.37			1,101,592	0.13	1,697,021	0.32
2007	53,778	0.25			705,093	0.14	1,345,546	0.32
2008	26,193	0.27			584,706	0.13	1,430,259	0.28
2009	99,643	0.50			799,311	0.14	736,605	0.17
2010	111,390	0.22			717,842	0.11	1,646,305	0.22
2011	97,599	0.22			704,535	0.14	911,046	0.27

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Table 4.11.8. Estimated Gulf of Mexico Spanish mackerel discards for SRHS by year and state.† Due to headboat area definitions, West Florida and Alabama discards are combined.

Year	FLW\AL	MS*	LA**	TX†	Gulf of Mexico
1981				2	2
1982				2	2
1983				2	2
1984				2	2
1985				2	2
1986	-		-	-	-
1987	10		-	2	12
1988	0		-	-	0
1989	6		-	3	9
1990	29		-	-	29
1991	13		-	-	13
1992	8		-	1	8
1993	27		-	2	29
1994	72		-	-	72
1995	1		-	-	1
1996	4		-	1	5
1997	3		-	-	3
1998	16		-	0	16
1999	31		-	-	31
2000	9		-	0	9
2001	4		-	-	4
2002	5		-	1	5
2003	9		-	1	10
2004	-			-	-
2005	4			-	4
2006	15		-	4	19
2007	48		-	4	52
2008	11		-	-	11
2009	20		-	-	20
2010	8	10	-	-	18
2011	13	24	-	-	37

*MS added to survey in 2010.
**LA not sampled during 2004-2005 due to Hurricane Katrina.
†TX 1981-1985 discards estimated using the mean discards 1986-1988.

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Table 4.11.9 Texas Spanish mackerel discards (numbers of fish) for charter boat mode and private mode (TPWD). 2011 data is through mid-May.

year	Estimated CH Discards	Estimated PR Discards	Total Discards
1981	1	271	272
1982	1	271	272
1983	0	87	87
1984	5	273	278
1985	0	456	457
1986	7	1,233	1,240
1987	11	1,202	1,213
1988	71	311	381
1989	11	815	825
1990	31	1,381	1,413
1991	54	3,235	3,288
1992		1,039	1,039
1993	51	524	574
1994	150	3,055	3,205
1995	58	5,341	5,399
1996	2	4,566	4,568
1997	58	1,966	2,024
1998	8	2,901	2,909
1999	28	2,960	2,988
2000	45	3,984	4,028
2001	1	921	922
2002	255	2,506	2,760
2003	40	4,140	4,180
2004	13	9,450	9,463
2005	44	7,033	7,077
2006	142	11,080	11,222
2007	203	5,420	5,623
2008	29	1,460	1,489
2009	25	3,959	3,984
2010	136	10,484	10,619
2011	464	659	1,123

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Table 4.11.10. Number of Spanish mackerel measured or weighed in the Gulf of Mexico (FLW-LA) in the MRFSS charter fleet by year and state.

YEAR	LA	MS	AL	FLW	TOTAL
1981		53	17	34	104
1982		91	10	4	105
1983	1	250		35	286
1984	2	361		3	366
1985	2	146	5		153
1986	4	400	46	163	613
1987	6	271	81	211	569
1988	5	302	33	46	386
1989	2	337	44	62	445
1990	8	331	12	39	390
1991	24	248	36	26	334
1992	13	288	23	42	366
1993	5	20	18	57	100
1994	3	56	13	59	131
1995	11	34	7	200	252
1996	2	55	20	40	117
1997	6	113	7	321	447
1998	5	138	132	350	625
1999	4	475	550	475	1,504
2000	1	397	374	1,294	2,066
2001		332	162	1,799	2,293
2002	4	209	48	792	1,053
2003	5	182	42	807	1,036
2004	6	190	74	842	1,112
2005	1	71	31	373	476
2006	5	70	19	406	500
2007	6	140	108	450	704
2008	3	201	129	449	782
2009	15	210	89	345	659
2010		107	108	666	881
2011	2	197	227	907	1,333
Grand Total	151	6,275	2,465	11,297	20,188

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Table 4.11.11. Number of Spanish mackerel measured or weighed in the Gulf of Mexico (FLW-TX) in the MRFSS private fleet by year and state. TX data for 1981-1985 only.

YEAR	TX	LA	MS	AL	FLW	TOTAL
1981	2	5	42	77	46	172
1982		45	77	73	53	248
1983		9	18	33	36	96
1984		11	8	19	5	43
1985	1	20	12	27	18	78
1986		8	16	147	121	292
1987		22	37	219	260	538
1988		34	28	56	133	251
1989		50	6	48	121	225
1990		32	4	92	138	266
1991		45	35	119	234	433
1992		107	54	212	613	986
1993		23	6	63	117	209
1994		11	16	61	199	287
1995		16	6	24	73	119
1996		16	5	72	258	351
1997		14	31	41	185	271
1998		2	18	49	382	451
1999		17	14	331	477	839
2000		10	14	134	323	481
2001		1	4	248	429	682
2002		5	8	89	498	600
2003		2	5	68	417	492
2004		3	4	126	557	690
2005		7	8	71	275	361
2006		13	6	87	429	535
2007		3	1	37	499	540
2008		6	6	67	407	486
2009		3	14	43	386	446
2010				67	519	586
2011		2	1	34	564	601
Grand Total	3	542	504	2,834	8,772	12,655

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Table 4.11.12. Number of Spanish mackerel measured or weighed in the Gulf of Mexico (FLW-TX) in the MRFSS shore mode by year and state. TX data for 1981-1985 only.

YEAR	TX	LA	MS	AL	FLW	TOTAL
1981	1	2		2	28	33
1982	2	17	1	8	60	88
1983	1	4		103	29	137
1984	2			30	6	38
1985				1	35	36
1986				3	123	126
1987			1	51	93	145
1988				16	38	54
1989			1	43	33	77
1990		1		85	71	157
1991		1		50	46	97
1992		8	3	70	271	352
1993		6	7	35	235	283
1994		4		42	256	302
1995		5		13	64	82
1996				5	110	115
1997		3		11	201	215
1998		2		3	176	181
1999		1	1	38	325	365
2000				44	196	240
2001		1		34	388	423
2002			1	24	309	334
2003		1			184	185
2004		7		28	264	299
2005		1	1	13	154	169
2006		1		13	172	186
2007				15	243	258
2008					225	225
2009		3	1	4	275	283
2010			2	38	258	298
2011		1	1	35	272	309
Grand Total	6	69	20	857	5,140	6,092

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Table 4.11.13. Number of angler trips with measured or weighed Spanish mackerel in the Gulf of Mexico (FLW-LA) in the MRFSS charter fleet by year and state.

YEAR	LA	MS	AL	FLW	TOTAL
1981		10	3	7	20
1982		14	1	3	18
1983	1	32		5	38
1984	1	44		2	47
1985	2	18	4		24
1986	3	51	10	26	90
1987	2	36	21	49	108
1988	5	47	13	21	86
1989	1	56	9	17	83
1990	5	61	6	10	82
1991	10	35	9	12	66
1992	9	35	13	15	72
1993	1	7	4	16	28
1994	3	9	7	12	31
1995	7	5	3	24	39
1996	1	11	4	16	32
1997	6	47	6	82	141
1998	3	22	24	103	152
1999	2	83	81	149	315
2000	1	51	64	297	413
2001		46	27	170	243
2002	3	25	10	146	184
2003	4	30	7	166	207
2004	5	28	13	185	231
2005	1	13	10	98	122
2006	2	11	8	64	85
2007	4	25	23	103	155
2008	2	25	20	98	145
2009	6	29	31	70	136
2010		12	15	109	136
2011	2	23	29	154	208
Grand Total	92	941	475	2,229	3,737

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Table 4.11.14. Number of angler trips with measured or weighed Spanish mackerel in the Gulf of Mexico (FLW-TX) in the MRFSS private fleet by year and state. TX data for 1981-1985 only.

YEAR	TX	LA	MS	AL	FLW	TOTAL
1981	1	3	10	21	20	55
1982		16	27	37	17	97
1983		5	4	11	16	36
1984		2	3	14	5	24
1985	1	6	3	13	14	37
1986		7	10	41	43	101
1987		8	9	60	134	211
1988		14	14	16	70	114
1989		24	6	11	53	94
1990		14	2	28	69	113
1991		24	7	27	98	156
1992		48	20	43	247	358
1993		11	2	21	64	98
1994		9	9	24	100	142
1995		13	4	10	46	73
1996		6	2	15	117	140
1997		7	6	17	93	123
1998		2	9	20	161	192
1999		6	8	80	193	287
2000		5	9	66	152	232
2001		1	4	52	189	246
2002		4	5	38	232	279
2003		2	1	21	202	226
2004		3	2	33	238	276
2005		4	4	19	138	165
2006		4	6	27	168	205
2007		2	1	15	251	269
2008		3	6	15	191	215
2009		3	7	25	169	204
2010				22	207	229
2011		1	1	11	213	226
Grand Total	2	257	201	853	3,910	5,223

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Table 4.11.15. Number of angler trips with measured or weighed Spanish mackerel in the Gulf of Mexico (FLW-TX) in the MRFSS shore mode by year and state. TX data for 1981-1985 only.

YEAR	TX	LA	MS	AL	FLW	TOTAL
1981	1	2		2	13	18
1982	2	5	1	7	31	46
1983	1	1		26	18	46
1984	2			12	4	18
1985				1	13	14
1986				1	30	31
1987			1	23	29	53
1988				5	19	24
1989			1	7	16	24
1990		1		19	31	51
1991		1		14	23	38
1992		1	3	19	93	116
1993		6	3	7	69	85
1994		3		18	98	119
1995		1		3	28	32
1996				3	42	45
1997		2		5	59	66
1998		1		3	63	67
1999		1	1	9	115	126
2000				11	65	76
2001		1		14	122	137
2002			1	10	95	106
2003		1			53	54
2004		2		11	78	91
2005		1	1	7	54	63
2006		1		10	49	60
2007				5	72	77
2008					70	70
2009		1	1	2	92	96
2010			2	13	86	101
2011		1	1	7	80	89
Grand Total	6	33	16	274	1,710	2,039

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Table 4.11.16. Number of MRFSS intercept trips conducted in the Gulf of Mexico (FLW-TX) by year and mode with the percentage of intercepts that encountered Spanish mackerel. TX data for 1981-1985 only.

	Shore			Cbt			Priv		
YEAR	TOT int	SM int	%sm	TOT int	SM int	%sm	TOT int	SM int	%sm
1981	2,106	55	2.61%	360	33	9.17%	1,970	95	4.82%
1982	3,971	85	2.14%	329	37	11.25%	4,146	216	5.21%
1983	2,739	72	2.63%	713	45	6.31%	1,822	73	4.01%
1984	3,130	39	1.25%	847	70	8.26%	2,301	52	2.26%
1985	3,679	40	1.09%	543	63	11.60%	2,792	84	3.01%
1986	2,108	92	4.36%	2,601	214	8.23%	9,597	416	4.33%
1987	2,323	92	3.96%	2,421	191	7.89%	8,951	433	4.84%
1988	3,771	62	1.64%	1,952	143	7.33%	9,343	325	3.48%
1989	3,060	89	2.91%	1,510	130	8.61%	6,304	252	4.00%
1990	2,641	185	7.00%	1,145	157	13.71%	5,480	259	4.73%
1991	3,096	106	3.42%	1,778	140	7.87%	6,203	309	4.98%
1992	6,162	385	6.25%	3,243	203	6.26%	14,523	742	5.11%
1993	8,408	365	4.34%	1,825	67	3.67%	10,676	227	2.13%
1994	9,625	436	4.53%	1,909	77	4.03%	12,644	320	2.53%
1995	8,768	179	2.04%	1,731	102	5.89%	10,945	175	1.60%
1996	6,324	202	3.19%	1,966	80	4.07%	14,013	363	2.59%
1997	6,241	205	3.28%	3,193	198	6.20%	14,027	318	2.27%
1998	7,009	296	4.22%	6,272	289	4.61%	16,086	408	2.54%
1999	9,162	584	6.37%	10,759	500	4.65%	20,494	722	3.52%
2000	7,410	340	4.59%	13,493	582	4.31%	16,887	525	3.11%
2001	7,650	473	6.18%	11,546	366	3.17%	18,399	634	3.45%
2002	7,648	482	6.30%	11,550	347	3.00%	19,901	740	3.72%
2003	8,277	356	4.30%	12,298	447	3.63%	19,054	644	3.38%
2004	7,539	429	5.69%	12,746	476	3.73%	20,872	936	4.48%
2005	7,532	239	3.17%	10,589	288	2.72%	18,478	570	3.08%
2006	7,121	343	4.82%	8,319	211	2.54%	19,601	753	3.84%
2007	7,604	420	5.52%	8,543	315	3.69%	20,215	750	3.71%
2008	7,715	379	4.91%	7,914	300	3.79%	21,008	707	3.37%
2009	8,193	177	2.16%	6,754	147	2.18%	21,518	374	1.74%
2010	8,141	544	6.68%	6,898	387	5.61%	19,973	899	4.50%

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Table 4.11.17. Mean weight (lb) of Spanish mackerel weighed from the MRFSS in the Gulf of Mexico (FLW-TX) by year and mode, 1981-2011. TX data for 1981-1985 only.

	Cbt				Priv				Shore			
YEAR	N	Mean (lbs)	Min (lbs)	Max (lbs)	N	Mean (lbs)	Min (lbs)	Max (lbs)	N	Mean (lbs)	Min (lbs)	Max (lbs)
1981	99	1.11	0.44	2.65	171	1.34	0.22	3.31	33	1.10	0.66	5.95
1982	97	0.90	0.22	3.31	231	1.42	0.22	5.73	88	1.23	0.22	4.41
1983	286	1.49	0.44	3.75	96	1.24	0.44	3.09	134	1.33	0.22	3.97
1984	363	1.32	0.44	4.41	42	1.63	0.44	4.19	38	1.18	0.44	4.85
1985	153	1.45	0.88	4.41	78	1.46	0.22	5.07	36	1.14	0.22	2.20
1986	608	1.38	0.22	5.07	289	1.22	0.22	5.51	126	1.05	0.44	1.98
1987	564	1.60	0.22	7.05	529	1.72	0.44	7.50	140	1.35	0.44	4.41
1988	331	1.53	0.44	5.29	248	1.71	0.44	5.29	53	1.26	0.22	4.41
1989	445	1.23	0.44	5.51	215	1.61	0.44	6.61	77	0.76	0.22	1.98
1990	346	1.38	0.44	5.07	244	1.78	0.22	5.73	144	1.09	0.22	4.19
1991	309	1.80	0.44	7.72	416	1.61	0.44	11.24	85	1.02	0.22	3.09
1992	355	1.47	0.44	10.14	963	1.56	0.22	27.56	342	1.34	0.44	5.51
1993	98	1.99	0.44	5.73	199	1.87	0.22	5.73	278	1.08	0.44	4.85
1994	109	1.66	0.55	5.29	276	1.49	0.44	6.17	269	1.22	0.22	6.61
1995	237	1.57	0.44	4.41	114	1.87	0.44	5.29	76	1.25	0.33	3.53
1996	115	1.47	0.22	4.85	316	1.79	0.44	5.95	111	1.12	0.44	3.97
1997	407	2.63	0.22	18.52	243	2.10	0.44	13.23	212	1.18	0.33	4.19
1998	607	1.85	0.44	7.72	438	2.09	0.11	6.50	177	1.28	0.22	3.53
1999	1,489	1.73	0.33	6.61	827	1.65	0.22	6.50	356	1.21	0.11	4.72
2000	2,028	1.59	0.11	6.06	466	2.05	0.51	7.28	230	1.54	0.44	5.75
2001	2,219	1.34	0.35	6.11	661	1.65	0.31	6.17	402	1.29	0.33	5.69
2002	1,033	1.88	0.29	6.00	586	1.99	0.44	6.17	331	1.36	0.40	4.59
2003	960	1.85	0.24	7.72	472	2.03	0.24	12.13	178	1.39	0.31	4.74
2004	1,065	1.80	0.33	9.92	669	1.56	0.33	7.05	282	1.24	0.35	4.76
2005	468	1.79	0.42	10.71	353	1.67	0.44	5.51	159	1.05	0.22	4.45
2006	472	1.71	0.49	7.72	514	1.72	0.40	5.75	185	1.12	0.40	4.08
2007	690	1.57	0.13	6.06	516	1.69	0.40	5.91	247	1.25	0.44	5.73
2008	725	1.61	0.31	6.22	412	1.85	0.49	6.61	162	1.06	0.22	5.07
2009	633	1.59	0.40	7.32	411	1.70	0.44	5.62	259	1.14	0.26	3.73
2010	815	1.76	0.37	6.70	574	1.66	0.33	6.17	290	1.34	0.35	5.07
2011	1,222	1.39	0.22	5.78	526	1.46	0.44	5.86	258	1.14	0.40	4.06

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Table 4.11.18. Number of Spanish mackerel measured and positive trips in the SRHS by year and area. Due to headboat area definitions, West Florida and Alabama data are combined.

	Fish(N)					Trips(N)				
YEAR	FLW/AL	MS*	LA**	TX	Total	FLW/AL	MS*	LA**	TX	Total
1986	14	-	-	4	18	10	-	-	4	14
1987	1	-	6	8	15	1	-	4	8	13
1988	-	-	5	12	17	-	-	1	8	9
1989	15	-	29	32	76	11	-	18	13	42
1990	7	-	58	5	70	7	-	3	3	13
1991	12	-	49	36	97	7	-	8	8	23
1992	3	-	28	33	64	3	-	12	7	22
1993	4	-	21	16	41	4	-	13	8	25
1994	9	-	24	36	69	7	-	11	17	35
1995	1	-	48	14	63	1	-	14	13	28
1996	2	-	32	23	57	2	-	14	8	24
1997	19	-	75	-	94	12	-	24	-	36
1998	15	-	33	-	48	12	-	10	-	22
1999	5	-	29	4	38	5	-	14	1	20
2000	5	-	33	-	38	5	-	15	-	20
2001	3	-	19	6	28	3	-	14	3	20
2002	12	-	73	-	85	12	-	8	-	20
2003	7	-	27	-	34	5	-	11	-	16
2004	5	-	-	8	13	5	-	-	2	7
2005	1	-	2	1	4	1	-	2	1	4
2006	6	-	-	1	7	4	-	-	1	5
2007	11	-	-	1	12	7	-	-	1	8
2008	13	-	-	-	13	10	-	-	-	10
2009	23	-	-	1	24	10	-	-	1	11
2010	4	-	-	1	5	4	-	-	1	5
2011	1	52	-	1	54	1	3	-	1	5

*MS added to survey in 2010.
**LA not sampled during 2004-2005 due to Hurricane Katrina.

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Table 4.11.19. Number of Gulf of Mexico Spanish mackerel aged from the SRHS by year and state. Due to headboat area definitions, West Florida and Alabama data are combined.

Year	FLW/AL	MS*	LA**	TX	Total
1981	-	-	-	-	-
1982	-	-	-	-	-
1983	-	-	-	-	-
1984	-	-	-	-	-
1985	-	-	-	-	-
1986	-	-	-	-	-
1987	-	-	-	-	-
1988	-	-	-	1	1
1989	-	-	-	68	68
1990	-	-	-	10	10
1991	6	-	-	75	81
1992	16	7	-	21	44
1993	2	-	-	2	4
1994	-	-	-	-	-
1995	-	-	-	-	-
1996	-	-	-	-	-
1997	-	-	-	-	-
1998	-	-	-	-	-
1999	2	-	-	-	2
2000	-	-	-	-	-
2001	-	-	-	-	-
2002	1	-	-	-	1
2003	-	-	-	-	-
2004	-	-	-	-	-
2005	-	-	-	-	-
2006	-	-	-	-	-
2007	1	-	-	-	1
2008	3	-	-	-	3
2009	3	-	-	-	3
2010	-	-	-	-	-
2011	2	-	-	-	2

*MS added to survey in 2010.
**LA not sampled during 2004-2005 due to Hurricane Katrina.

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Table 4.11.20. Mean weight (kg) of Spanish mackerel measured in the SRHS by year and state, 1986-2011. Due to headboat area definitions, West Florida and Alabama data are combined.

	FLW/AL				MS*				LA**				TX			
Year	N	Mean (kg)	Min (kg)	Max (kg)	N	Mean (kg)	Min (kg)	Max (kg)	N	Mean (kg)	Min (kg)	Max (kg)	N	Mean (kg)	Min (kg)	Max (kg)
1986	14	0.79	0.32	1.89	-	-	-	-	-	-	-	-	4	1.65	1.30	2.00
1987	1	1.10	1.10	1.10	-	-	-	-	6	0.86	0.53	1.40	8	1.40	0.34	2.60
1988	-	-	-	-	-	-	-	-	5	1.05	0.60	1.60	12	1.20	0.17	2.10
1989	15	0.44	0.00	0.99	-	-	-	-	29	0.76	0.01	3.06	32	1.08	0.22	2.10
1990	7	0.69	0.33	1.02	-	-	-	-	58	1.19	0.30	2.25	5	0.92	0.29	2.29
1991	12	0.58	0.30	0.99	-	-	-	-	49	1.04	0.40	10.19	36	3.64	0.48	7.80
1992	3	1.20	0.87	1.52	-	-	-	-	28	1.18	0.33	2.32	33	3.56	0.79	8.66
1993	4	1.00	0.65	1.40	-	-	-	-	21	1.01	0.28	1.89	16	1.02	0.45	1.57
1994	9	1.24	0.50	2.90	-	-	-	-	24	1.19	0.32	2.12	36	1.11	0.41	2.24
1995	1	0.95	0.95	0.95	-	-	-	-	48	1.28	0.45	2.69	14	1.44	0.52	2.21
1996	2	1.22	0.63	1.80	-	-	-	-	32	0.88	0.32	2.22	23	2.06	0.67	5.29
1997	19	1.07	0.28	2.97	-	-	-	-	75	1.21	0.32	2.73	-	-	-	-
1998	15	0.72	0.32	1.84	-	-	-	-	33	1.20	0.48	2.44	-	-	-	-
1999	5	0.92	0.45	1.40	-	-	-	-	29	1.28	0.37	3.21	4	1.09	0.81	1.43
2000	5	1.33	0.46	2.56	-	-	-	-	33	1.36	0.29	4.39	-	-	-	-
2001	3	1.26	0.72	2.06	-	-	-	-	19	1.54	0.53	9.01	6	1.68	0.97	2.33
2002	12	1.30	0.55	2.57	-	-	-	-	73	0.85	0.42	1.82	-	-	-	-
2003	7	0.82	0.52	1.05	-	-	-	-	27	0.90	0.41	1.84	-	-	-	-
2004	5	1.36	0.63	1.91	-	-	-	-	-	-	-	-	8	0.40	0.17	0.71
2005	1	0.92	0.92	0.92	-	-	-	-	2	2.30	2.19	2.40	1	0.86	0.86	0.86
2006	6	1.14	0.41	1.90	-	-	-	-	-	-	-	-	1	2.16	2.16	2.16
2007	11	0.72	0.23	1.34	-	-	-	-	-	-	-	-	1	2.30	2.30	2.30
2008	13	0.73	0.26	1.46	-	-	-	-	-	-	-	-	-	-	-	-
2009	23	0.82	0.22	2.89	-	-	-	-	-	-	-	-	1	1.19	1.19	1.19
2010	4	0.68	0.37	1.41	-	-	-	-	-	-	-	-	1	0.59	0.59	0.59
2011	1	0.37	0.37	0.37	52	0.69	0.03	1.79	-	-	-	-	1	1.87	1.87	1.87

*MS added to survey in 2010. **LA not sampled during 2004-2005 due to Hurricane Katrina.

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Table 4.11.21. Number of Spanish mackerel measured in Texas in the TPWD survey by year and mode. 2011 data is through mid-May.

YEAR	Cbt	Priv	Grand Total
1983	8	125	133
1984	1	94	95
1985	2	169	171
1986	1	55	56
1987	13	239	252
1988	4	136	140
1989	3	221	224
1990	13	230	243
1991	22	307	329
1992	6	163	169
1993	8	178	186
1994	13	276	289
1995	2	423	425
1996	8	479	487
1997	13	245	258
1998	3	214	217
1999	4	171	175
2000	8	320	328
2001	4	111	115
2002	22	163	185
2003	7	196	203
2004	20	295	315
2005	12	441	453
2006	47	640	687
2007	34	312	346
2008	41	348	389
2009	14	328	342
2010	32	255	287
2011	2	5	7
Grand Total	367	7,139	7,506

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Table 4.11.22. Number of trips with measured Spanish mackerel in Texas from the TPWD survey by year and mode. 2011 data is through mid-May.

YEAR	Cbt	Priv	Grand Total
1983	6	79	85
1984	1	46	47
1985	2	97	99
1986	1	41	42
1987	6	105	111
1988	3	60	63
1989	2	87	89
1990	7	111	118
1991	11	146	157
1992	3	101	104
1993	3	100	103
1994	5	136	141
1995	2	206	208
1996	6	214	220
1997	9	127	136
1998	3	103	106
1999	4	109	113
2000	3	157	160
2001	4	59	63
2002	8	101	109
2003	7	102	109
2004	10	135	145
2005	7	180	187
2006	19	299	318
2007	17	133	150
2008	17	161	178
2009	10	166	176
2010	10	110	120
2011	2	5	7
Grand Total	188	3,476	3,664

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Table 4.11.23 Number of TPWD intercept trips conducted in Texas by year and mode with the percentage of intercepts that encountered Spanish mackerel.

	Cbt			Priv			Total		
YEAR	TOT int	SM int	%sm	TOT int	SM int	%sm	TOT int	SM int	%sm
1983	367	6	1.63%	14,223	79	0.56%	14,590	85	0.58%
1984	247	1	0.40%	9,149	46	0.50%	9,396	47	0.50%
1985	403	2	0.50%	12,149	97	0.80%	12,552	99	0.79%
1986	474	1	0.21%	12,306	41	0.33%	12,780	42	0.33%
1987	498	6	1.20%	16,333	105	0.64%	16,831	111	0.66%
1988	570	3	0.53%	14,929	60	0.40%	15,499	63	0.41%
1989	665	2	0.30%	12,285	87	0.71%	12,950	89	0.69%
1990	425	7	1.65%	9,740	111	1.14%	10,165	118	1.16%
1991	694	11	1.59%	12,090	146	1.21%	12,784	157	1.23%
1992	991	3	0.30%	15,294	101	0.66%	16,285	104	0.64%
1993	968	3	0.31%	16,538	100	0.60%	17,506	103	0.59%
1994	1,045	5	0.48%	18,654	136	0.73%	19,699	141	0.72%
1995	1,089	2	0.18%	17,727	206	1.16%	18,816	208	1.11%
1996	1,264	6	0.47%	16,780	214	1.28%	18,044	220	1.22%
1997	1,194	9	0.75%	17,032	127	0.75%	18,226	136	0.75%
1998	1,355	3	0.22%	17,064	103	0.60%	18,419	106	0.58%
1999	1,538	4	0.26%	20,017	109	0.54%	21,555	113	0.52%
2000	1,731	3	0.17%	18,950	157	0.83%	20,681	160	0.77%
2001	1,861	4	0.21%	16,853	59	0.35%	18,714	63	0.34%
2002	1,561	8	0.51%	15,623	100	0.64%	17,184	108	0.63%
2003	1,799	7	0.39%	17,339	102	0.59%	19,138	109	0.57%
2004	1,703	10	0.59%	17,175	135	0.79%	18,878	145	0.77%
2005	1,705	7	0.41%	16,632	179	1.08%	18,337	186	1.01%
2006	2,072	19	0.92%	18,468	298	1.61%	20,540	317	1.54%
2007	2,067	17	0.82%	16,864	133	0.79%	18,931	150	0.79%
2008	1,797	17	0.95%	17,045	161	0.94%	18,842	178	0.94%
2009	1,891	10	0.53%	18,204	166	0.91%	20,095	176	0.88%
2010	1,963	10	0.51%	16,796	110	0.65%	18,759	120	0.64%

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Table 4.11.24. Number of Spanish mackerel aged in the Gulf of Mexico (FLW-TX) from the charter boat fleet by year and state.

Year	FLW/AL	MS	LA	TX	Total
1981	-	-	-	-	-
1982	-	-	-	-	-
1983	-	-	-	-	-
1984	-	-	-	-	-
1985	-	-	-	-	-
1986	-	-	-	-	-
1987	-	-	-	-	-
1988	-	-	-	-	-
1989	27	47	-	42	116
1990	216	125	-	43	384
1991	78	-	2	22	102
1992	168	-	-	13	181
1993	42	-	-	2	44
1994	98	-	-	-	98
1995	46	-	-	-	46
1996	245	-	-	-	245
1997	109	-	-	-	109
1998	108	-	-	-	108
1999	156	196	-	-	352
2000	153	-	-	-	153
2001	105	-	-	-	105
2002	342	-	-	-	342
2003	458	-	-	-	458
2004	270	-	-	-	270
2005	52	-	-	-	52
2006	132	-	-	-	132
2007	186	-	-	-	186
2008	329	-	-	-	329
2009	101	-	-	-	101
2010	209	-	-	-	209
2011	266	-	-	-	266

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Table 4.11.25. Number of Spanish mackerel aged in the Gulf of Mexico (FLW-TX) from the private/rental fleet by year and state.

Year	FLW/AL	MS	LA	TX	Total
1981	-	-	-	-	-
1982	-	-	-	-	-
1983	-	-	-	-	-
1984	-	-	-	-	-
1985	-	-	-	-	-
1986	-	-	-	-	-
1987	-	-	-	-	-
1988	-	-	-	-	-
1989	-	-	-	-	-
1990	-	1	-	1	2
1991	12	-	-	-	12
1992	16	-	-	-	16
1993	31	-	-	-	31
1994	3	-	-	-	3
1995	62	-	-	-	62
1996	3	-	-	-	3
1997	1	-	-	-	1
1998	21	-	-	-	21
1999	6	129	-	-	135
2000	-	-	-	-	-
2001	-	-	-	-	-
2002	86	-	-	-	86
2003	128	-	-	-	128
2004	71	-	-	-	71
2005	6	-	-	-	6
2006	1	-	-	-	1
2007	20	-	-	-	20
2008	70	-	-	-	70
2009	8	-	-	-	8
2010	21	-	-	-	21
2011	11	-	-	-	11

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Table 4.11.26. Number of Spanish mackerel aged in the Gulf of Mexico (FLW-TX) from the recreational fishery (mode unknown) by year and state.

Year	FLW/AL	MS	LA	TX	Total
1981	-	-	-	-	-
1982	-	-	-	-	-
1983	-	-	-	-	-
1984	-	-	-	-	-
1985	-	-	-	-	-
1986	-	-	-	-	-
1987	-	-	-	-	-
1988	1	107	21	6	135
1989	32	-	2	-	34
1990	2	-	44	-	46
1991	-	-	-	-	-
1992	-	-	-	-	-
1993	-	-	-	-	-
1994	-	-	-	-	-
1995	-	-	-	-	-
1996	-	-	-	-	-
1997	-	-	-	-	-
1998	-	-	-	-	-
1999	-	-	-	-	-
2000	-	-	-	-	-
2001	-	-	-	-	-
2002	-	-	-	-	-
2003	-	-	-	-	-
2004	-	-	-	-	-
2005	-	-	-	-	-
2006	-	-	-	-	-
2007	-	-	-	-	-
2008	-	-	-	-	-
2009	-	-	-	-	-
2010	-	-	-	-	-
2011	-	-	-	-	-

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Table 4.11.27. Gulf of Mexico (FLW-TX) estimated number of angler trips for charter boat mode, charter boat/headboat mode, private/rental mode, and shore mode (MRFSS, NMFS, 1981-2003; MRIP, NMFS, 2004-2011). CH and CH/HB mode adjusted for FHS conversion prior to 1997. CH/HB mode estimates from 1981-1985 only. TX estimates for 1981-1985 only. 2011 data is preliminary and through October.

	Estimated CH Angler Trips		Estimated CH/HB Angler Trips		Estimated PR Angler Trips		Estimated SH Angler Trips	
YEAR	Trips	CV	Trips	CV	Trips	CV	Trips	CV
1981			341,346	0.10	7,764,455	0.20	7,119,118	0.09
1982			843,916	0.08	5,438,965	0.07	10,051,388	0.07
1983			672,312	0.10	6,841,641	0.06	16,623,065	0.11
1984			547,252	0.10	7,506,796	0.07	13,709,706	0.10
1985			796,565	0.09	8,314,889	0.08	10,268,895	0.10
1986	513,342	0.13			8,136,242	0.05	10,405,962	0.07
1987	546,764	0.16			8,517,788	0.04	6,923,388	0.12
1988	559,513	0.12			10,698,532	0.03	8,524,356	0.05
1989	524,157	0.13			8,712,307	0.03	6,419,667	0.06
1990	426,134	0.15			7,216,506	0.03	5,706,778	0.05
1991	449,908	0.12			9,086,738	0.03	8,642,251	0.04
1992	469,662	0.10			9,373,254	0.02	8,265,502	0.03
1993	788,055	0.08			9,041,306	0.02	7,642,451	0.02
1994	860,370	0.07			9,384,801	0.02	7,293,305	0.02
1995	1,020,387	0.07			9,570,896	0.02	6,925,453	0.02
1996	990,457	0.07			9,351,017	0.02	6,800,513	0.03
1997	1,091,871	0.08			10,195,083	0.02	7,423,022	0.03
1998	760,667	0.03			8,938,905	0.02	6,861,289	0.03
1999	683,768	0.03			9,097,803	0.02	5,918,885	0.03
2000	811,634	0.03			11,728,464	0.02	8,477,685	0.03
2001	742,386	0.03			12,371,138	0.02	9,776,174	0.03
2002	764,222	0.03			11,635,095	0.02	7,266,262	0.03
2003	691,362	0.03			14,110,007	0.02	8,155,304	0.03
2004	831,069	0.03			15,644,093	0.03	9,954,045	0.05
2005	690,735	0.03			13,585,144	0.03	9,013,928	0.05
2006	836,049	0.03			13,620,320	0.03	8,836,552	0.05
2007	851,757	0.03			14,980,146	0.03	8,457,361	0.05
2008	819,045	0.03			15,194,949	0.03	8,775,859	0.05
2009	822,266	0.03			13,442,881	0.03	8,332,102	0.05
2010	580,190	0.03			12,684,738	0.03	7,782,505	0.05
2011	698,725	0.03			11,024,029	0.03	7,800,767	0.05

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Table 4.11.28. Gulf of Mexico headboat estimated angler days by year and state, 1986-2011.

Year	FLW/AL	MS*	LA**	TX
1986	480,154		11,782	113,136
1987	434,098		12,724	126,726
1988	391,896		15,382	140,792
1989	416,650		5,734	126,778
1990	427,812		13,796	116,288
1991	348,624		12,746	119,938
1992	369,604		19,822	152,436
1993	415,793		22,512	161,809
1994	409,123		25,302	201,555
1995	364,821		20,996	180,929
1996	309,826		21,976	183,706
1997	298,884		18,016	164,415
1998	370,666		15,709	155,303
1999	352,234		16,052	116,470
2000	318,662		9,904	116,790
2001	314,486		12,444	110,722
2002	283,662		12,444	133,902
2003	288,422		13,272	127,164
2004	316,860			129,980
2005	260,466			119,714
2006	248,125		10,010	141,577
2007	273,755		5,044	127,524
2008	260,349		5,889	82,373
2009	284,873		6,536	101,470
2010	222,035	995	434	94,304
2011	314,046	3,541	3,772	94,566

*MS added to survey in 2010.
**LA not sampled during 2004-2005 due to Hurricane Katrina.

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Table 4.11.29. Texas estimated angler trips by year, season, and mode, 1983-2011.

	Estimated CH trips		Estimated PR trips		Total
year	High	Low	High	Low	
1983	31,710		637,416		669,126
1984	19,292	3,287	540,420	172,321	735,321
1985	23,578	6,852	587,673	254,969	873,072
1986	23,137	6,772	553,830	346,804	930,542
1987	24,636	11,866	751,020	350,008	1,137,530
1988	23,674	4,778	705,650	335,498	1,069,600
1989	35,518	9,580	678,535	234,013	957,645
1990	30,298	4,319	620,597	215,878	871,092
1991	38,340	10,997	637,275	214,490	901,102
1992	35,486	11,501	730,467	252,919	1,030,374
1993	40,419	15,111	681,545	313,340	1,050,415
1994	73,902	17,829	719,053	375,014	1,185,798
1995	51,984	21,696	675,113	404,477	1,153,270
1996	58,813	19,753	741,427	357,446	1,177,440
1997	80,733	19,298	694,991	305,589	1,100,611
1998	90,497	22,903	668,794	303,733	1,085,927
1999	91,571	25,287	796,383	407,326	1,320,566
2000	109,834	53,419	718,916	441,329	1,323,498
2001	109,895	53,006	681,733	306,038	1,150,672
2002	116,305	25,583	632,336	332,565	1,106,789
2003	96,782	26,336	665,238	343,297	1,131,654
2004	85,355	35,320	665,287	340,596	1,126,558
2005	86,159	22,429	616,715	336,175	1,061,479
2006	121,298	41,601	602,954	390,877	1,156,730
2007	120,344	33,387	599,832	304,208	1,057,770
2008	122,555	28,351	557,073	349,425	1,057,404
2009	88,148	33,703	619,872	293,770	1,035,493
2010	97,303	25,859	604,487	259,673	987,323
2011		35,471		346,716	382,188

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4.11 Figures

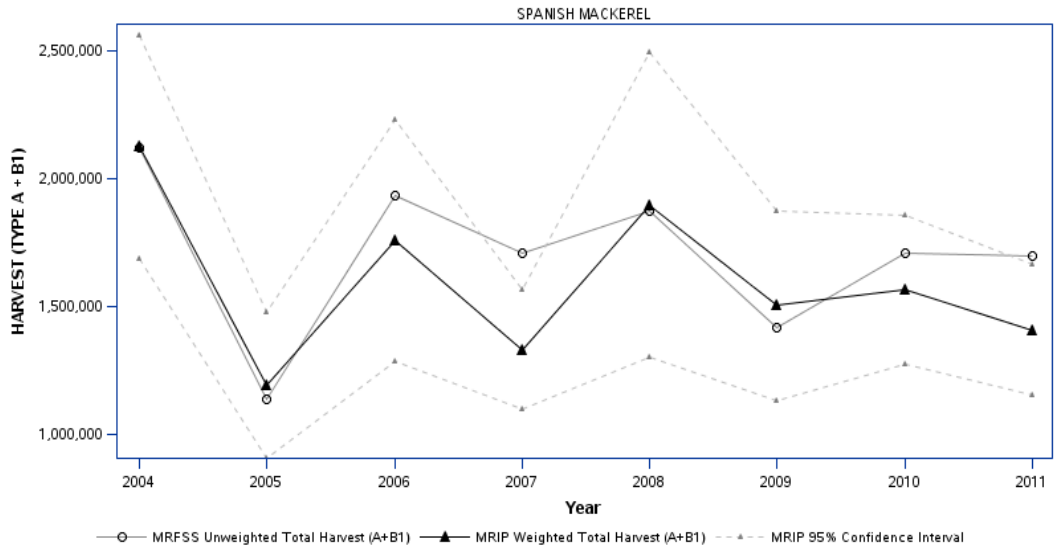

Figure 4.12.1. Comparison of MRIP and MRFSS landings (A+B1) for Gulf of Mexico Spanish mackerel (FLW-LA).

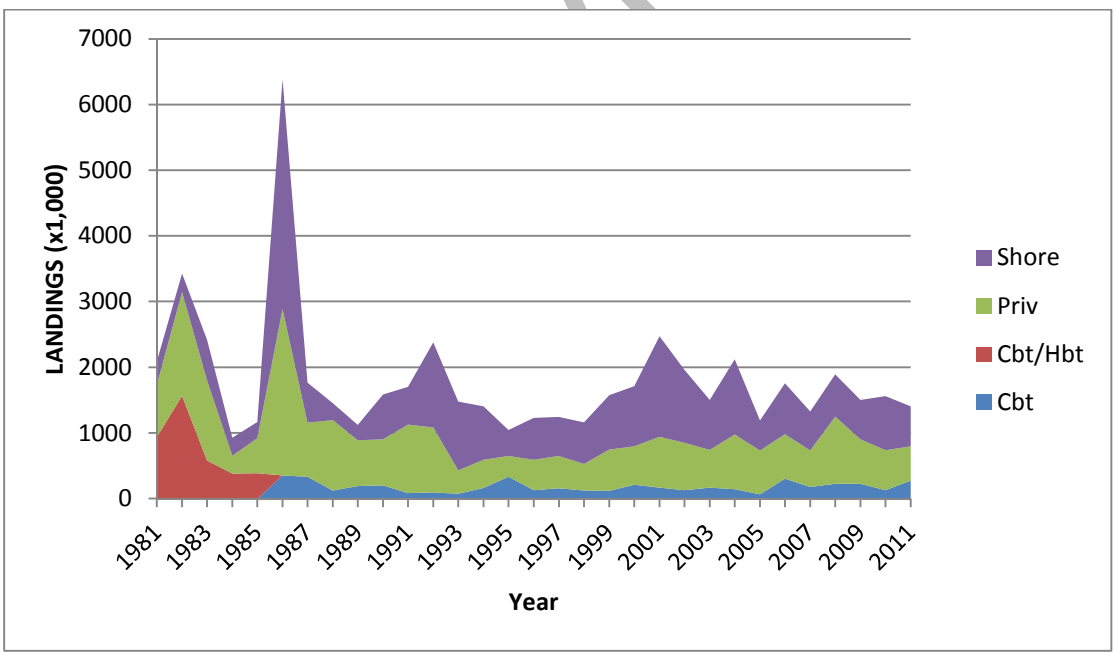

Figure 4.12.2. Gulf of Mexico (FLW-TX) Spanish mackerel landings (numbers of fish) by year and mode (MRFSS, NMFS, 1981-2003; MRIP, NMFS, 2004-2011). 2011 data is preliminary and through October. TX estimates for 1981-1985 shore mode only.

Figure 4.12.3. The number of Spanish mackerel intercepted by the MRFSS from 1981-1989.

Number of Intercepted Spanish Mackerel by Site from the MRFSS: (1990 - 1999)

Spanish Mackerel Caught

- 0 - 15
- 16 - 30
- 31 - 60
- 61 - 100
- > 100

0 85 170 340 510 680 Miles

Albers Projection
Central Meridian: -96
1st Std Parallel: 20
2nd Std Parallel: 60
Latitude of Origin: 40

Figure 4.12.4. The number of Spanish mackerel intercepted by the MRFSS from 1990-1999.

Number of Intercepted Spanish Mackerel by Site from the MRFSS: (2000 - 2010)

Spanish Mackerel Caught

- 0 - 15
- 16 - 30
- 31 - 60
- 61 - 100
- > 100

0 85 170 340 510 680 Miles

Albers Projection
Central Meridian: -96
1st Std Parallel: 20
2nd Std Parallel: 60
Latitude of Origin: 40

Figure 4.12.5. The number of Spanish mackerel intercepted by the MRFSS from 2000-2010.

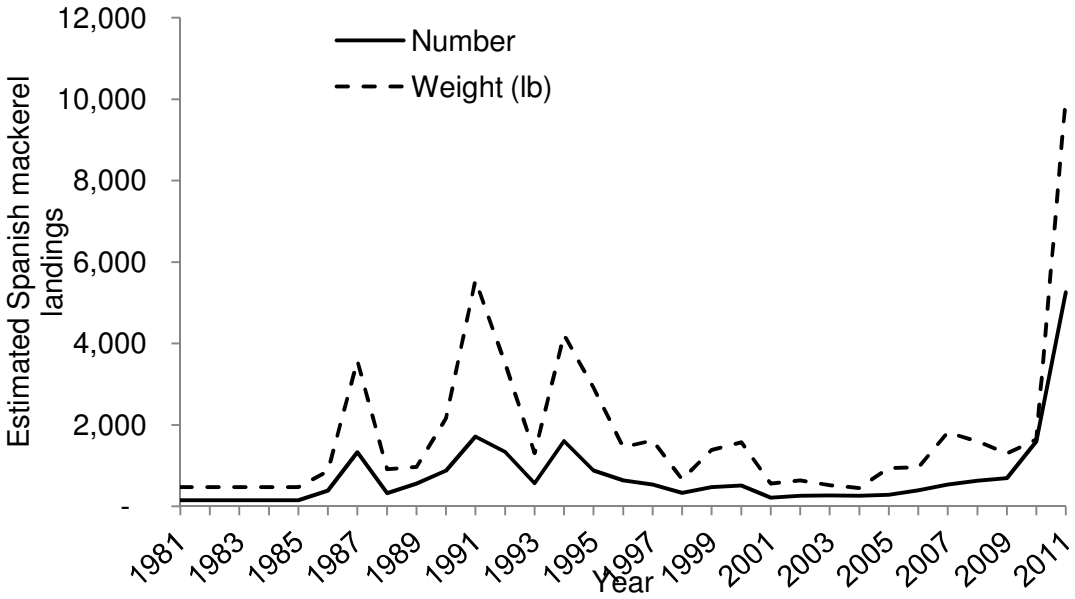

Figure 4.12.6. Gulf of Mexico estimated Spanish mackerel landings (number and pounds) for the headboat fishery, 1981-2011.

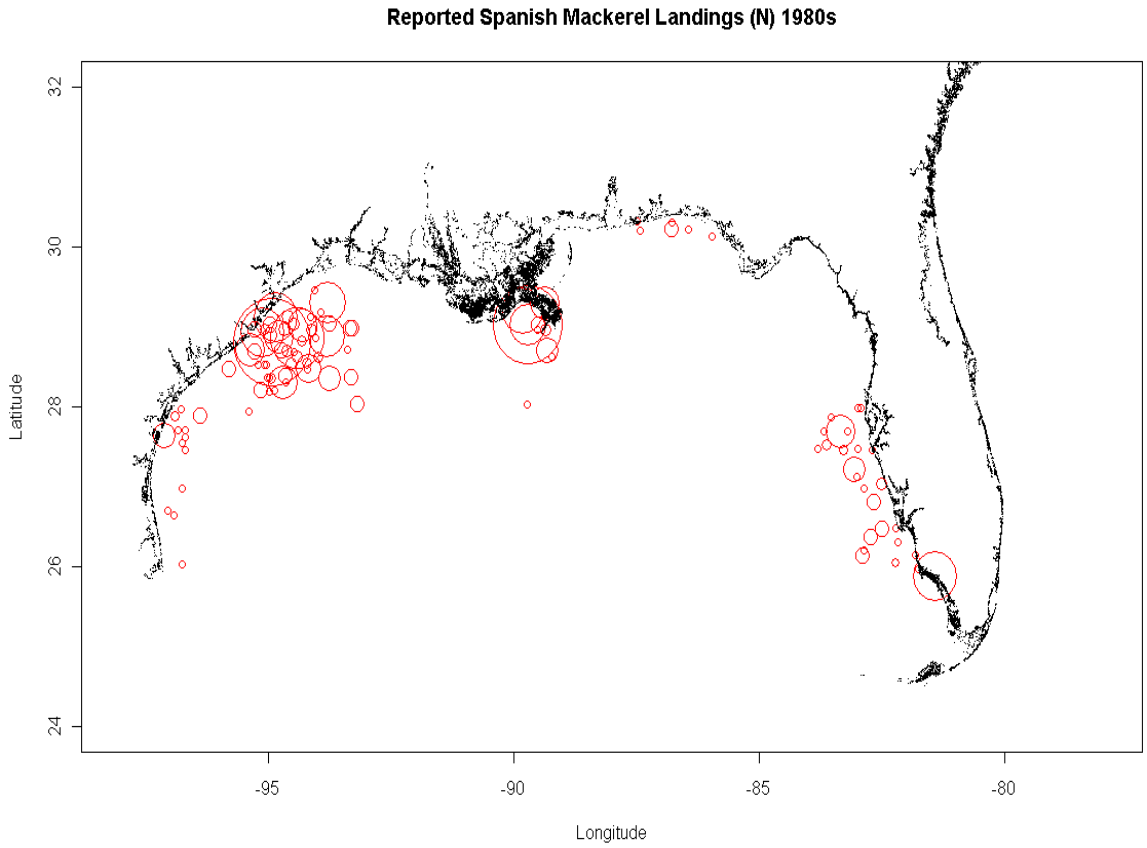

Figure 4.12.7. Reported Spanish mackerel landings (numbers of fish) from SRHS, 1986-1989. The size of each point is proportional to the reported landings (N) at the given location.

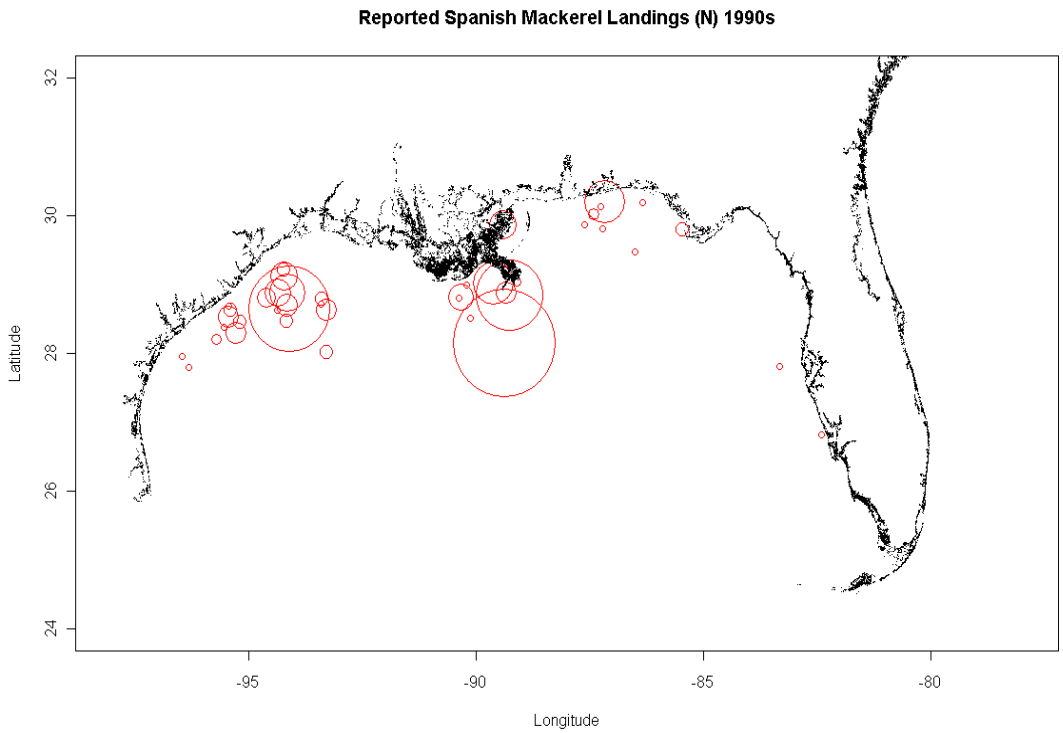

Figure 4.12.8. Reported Spanish mackerel landings (numbers of fish) from SRHS, 1990-1999. The size of each point is proportional to the reported landings (N) at the given location.

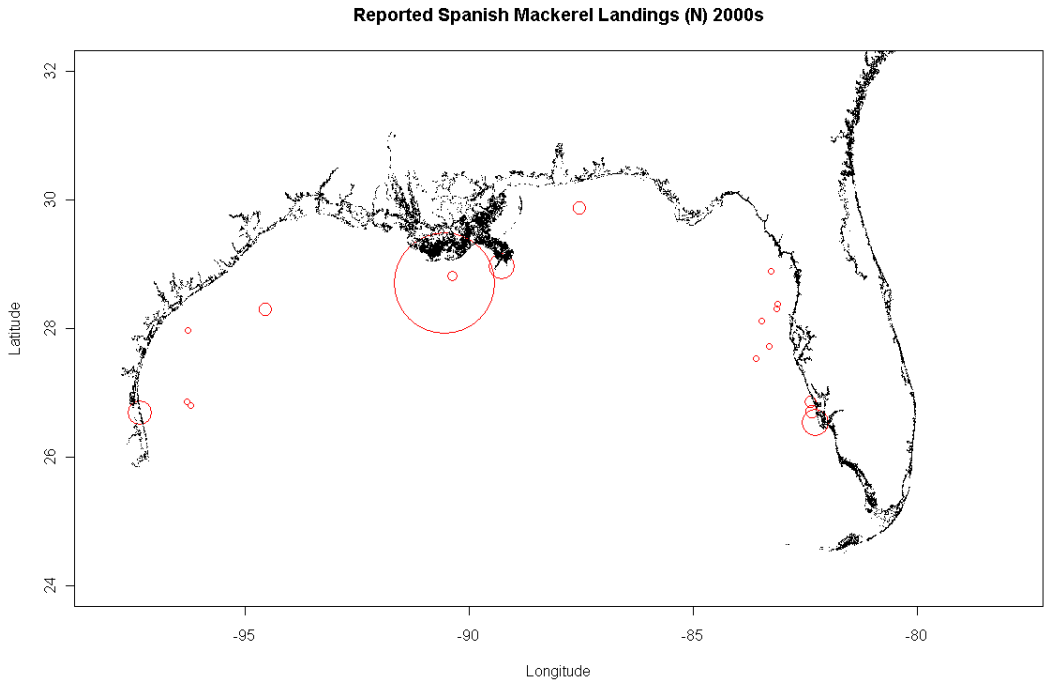

Figure 4.12.9. Reported Spanish mackerel landings (numbers of fish) from SRHS, 2000-2011. The size of each point is proportional to the reported landings (N) at the given location.

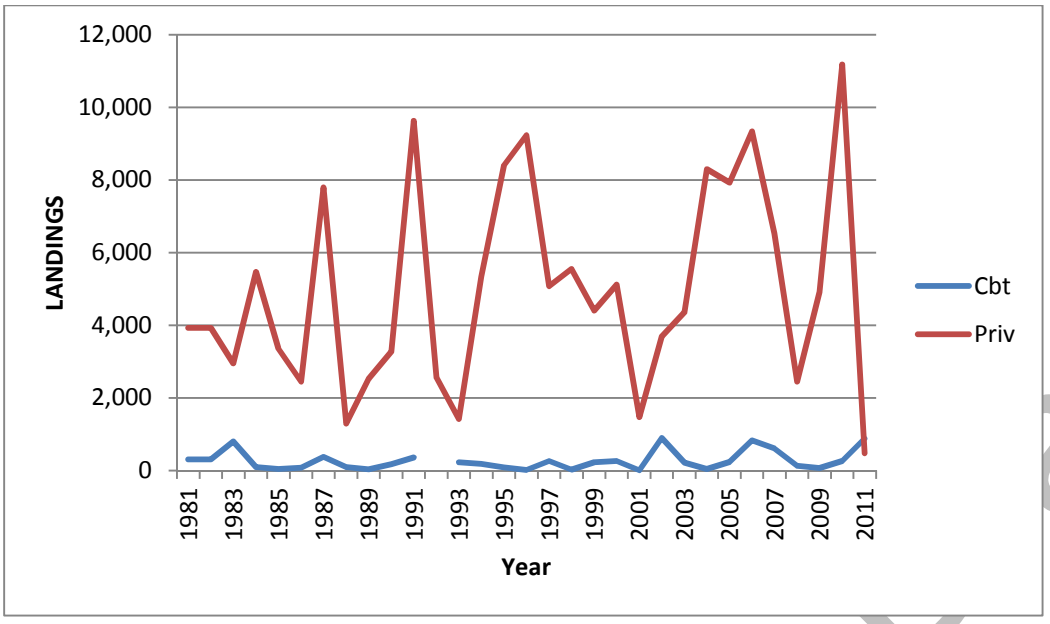

Figure 4.12.10 Texas Spanish mackerel landings (numbers of fish) for charter boat mode and private mode (TPWD). 2011 data is through mid-May.

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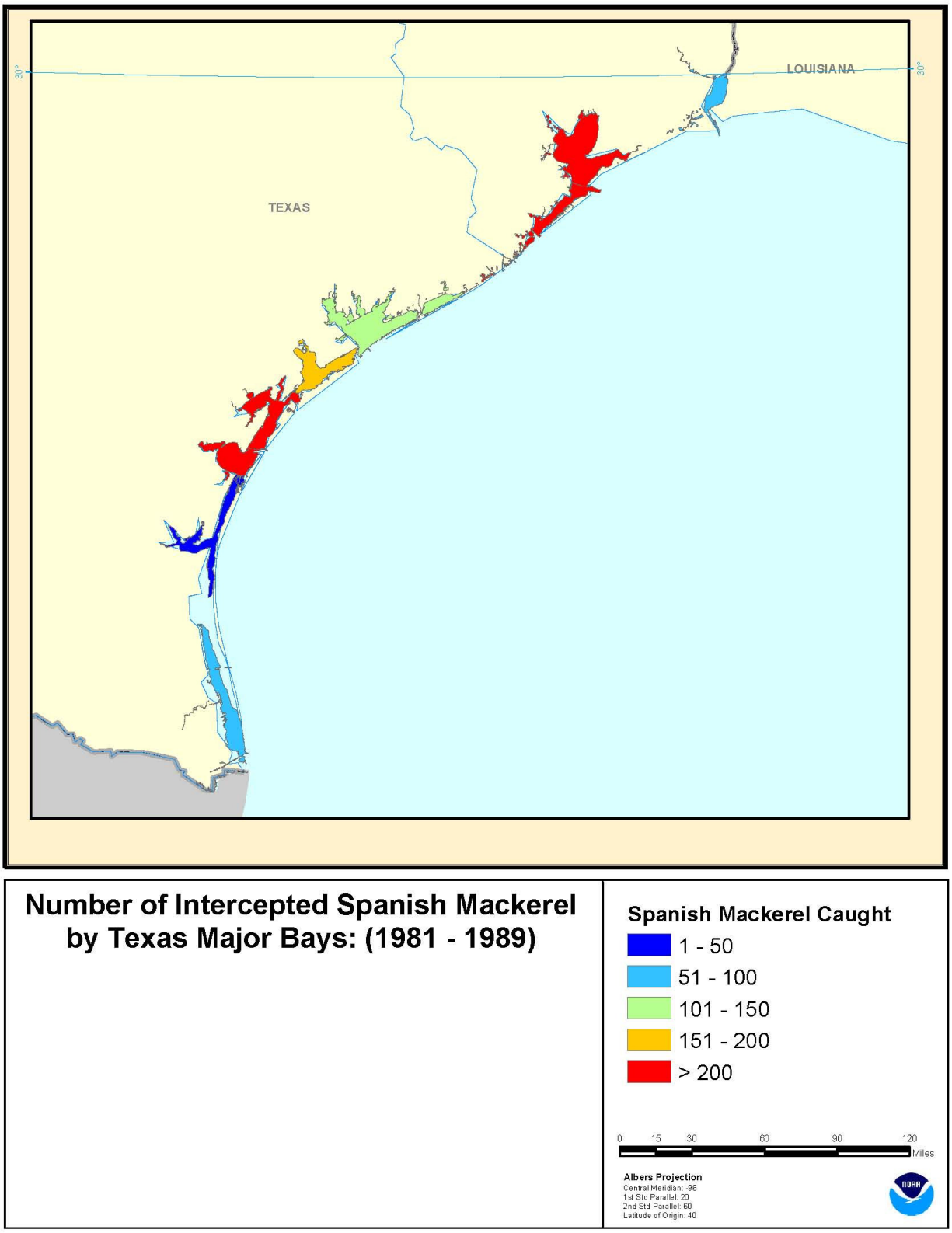

Figure 4.12.11. The number of Spanish mackerel intercepted by the TPWD from 1983-1989.

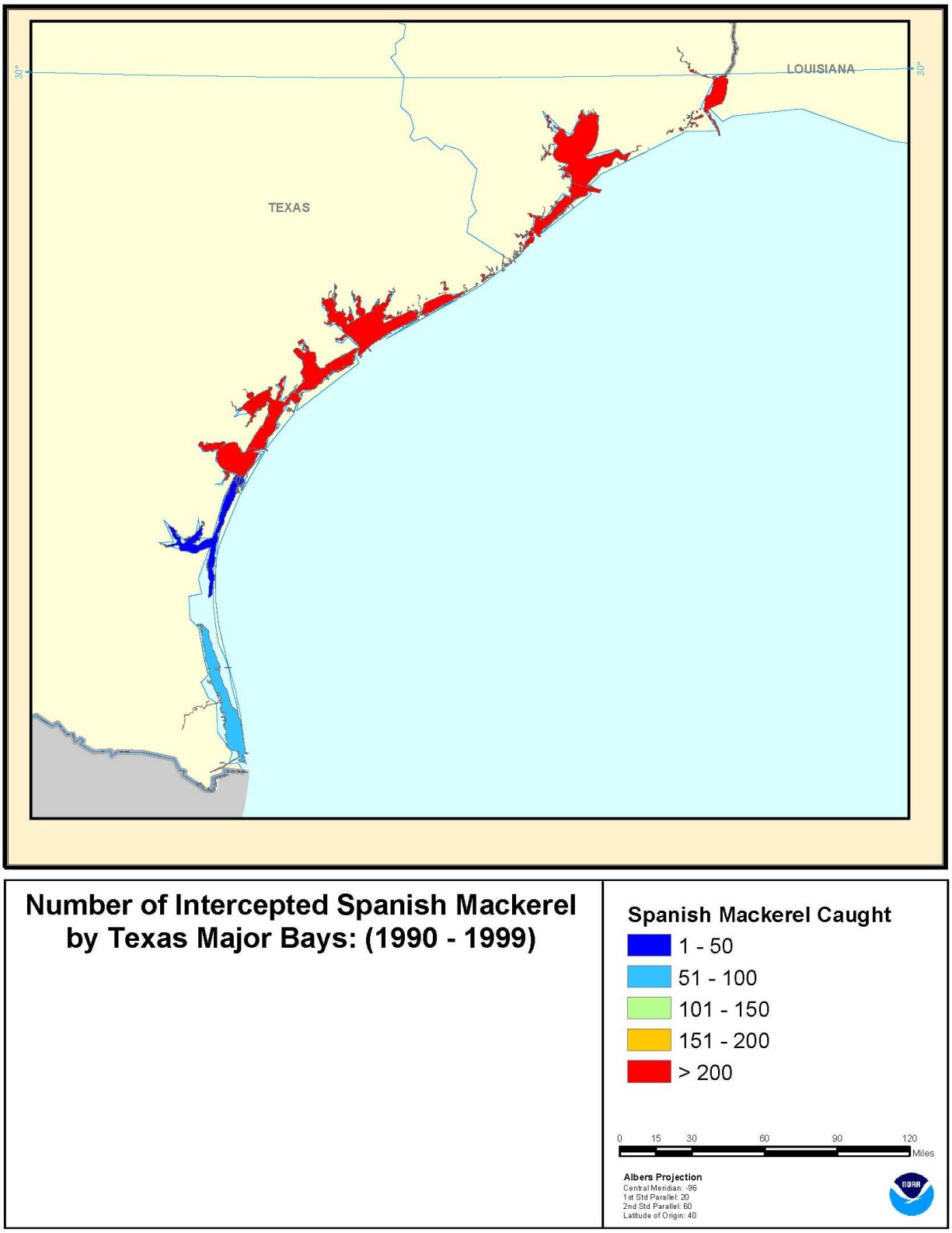

Figure 4.12.12. The number of Spanish mackerel intercepted by the TPWD from 1990-1999.

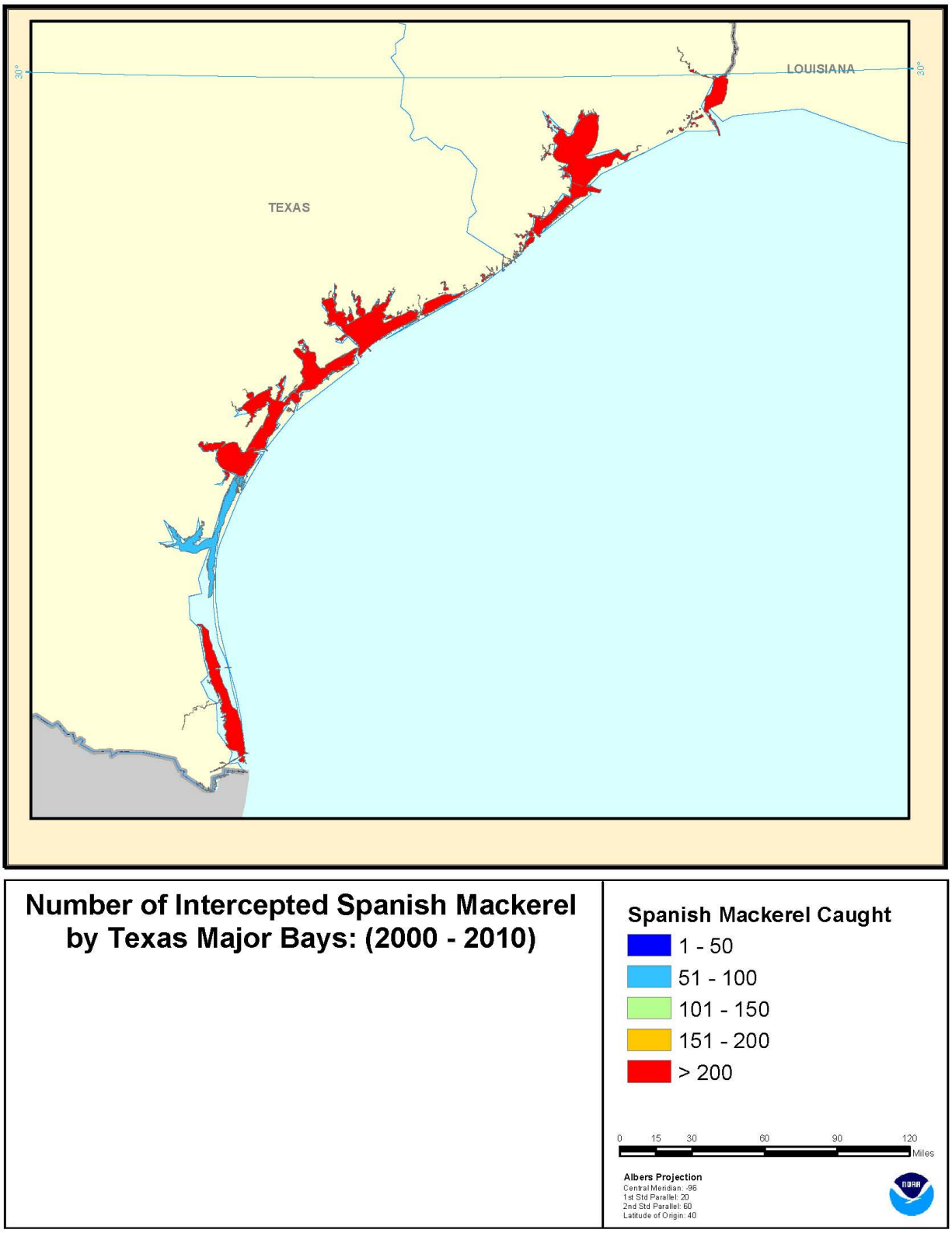

Figure 4.12.13. The number of Spanish mackerel intercepted by the TPWD from 2000-2010.

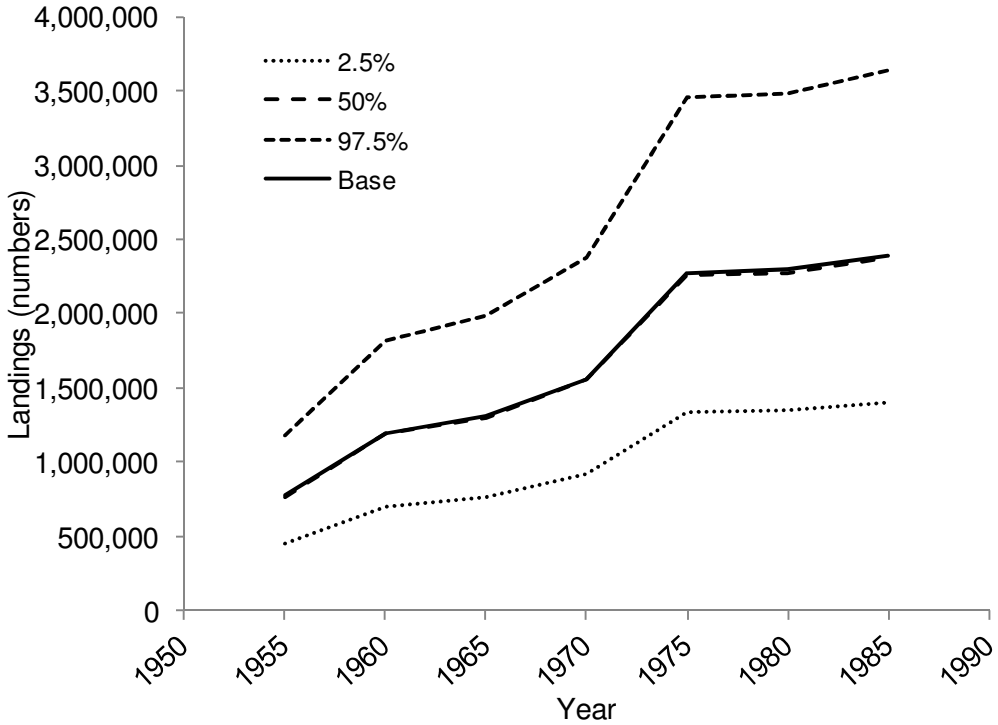

Figure 4.12.14. Bootstrap analysis of FHWAR census method (1955-1984) Gulf of Mexico Spanish mackerel landings estimates.

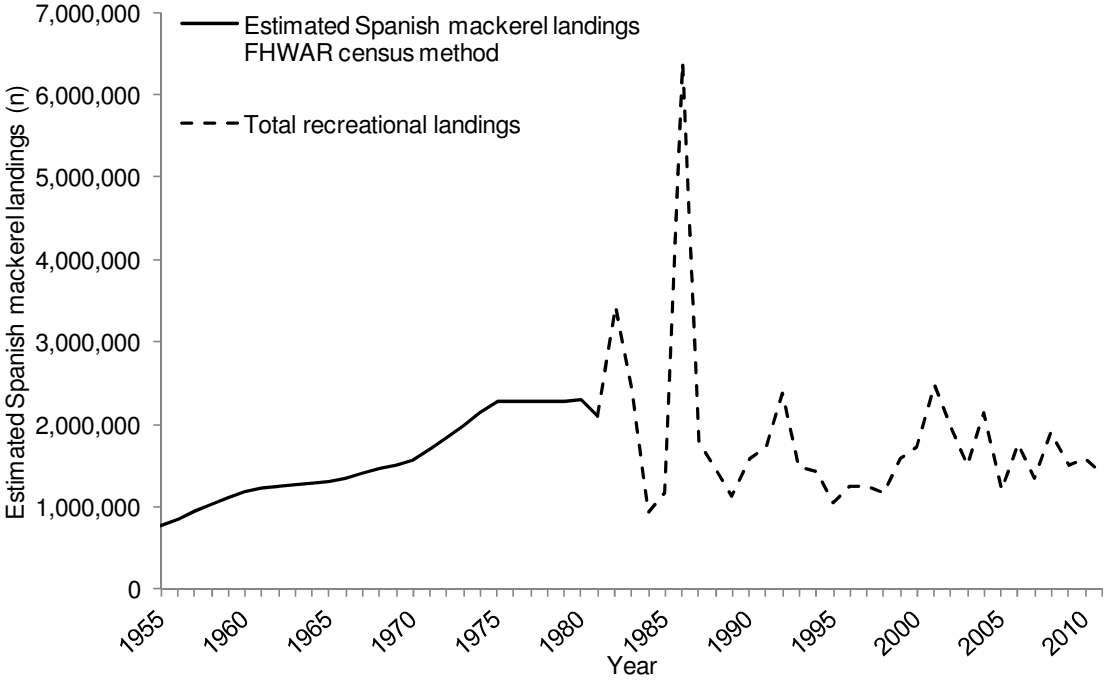

Figure 4.12.15. Estimated Spanish mackerel landings (number) using FHWAR census method (1955-1980), MRFSS (1981-2003), MRIP (2004-2011), TPWD (81-11), and SRHS (81-11) estimation methods.

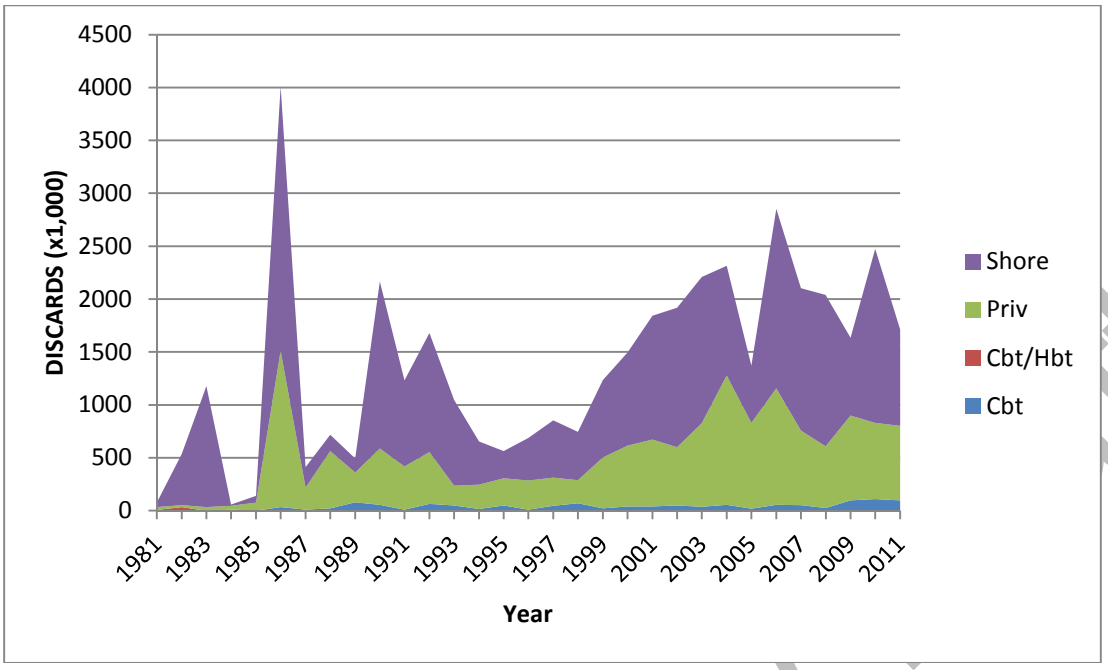

Figure 4.12.16. Gulf of Mexico (FLW-TX) Spanish mackerel discards (numbers of fish) by year and mode (MRFSS, NMFS, 1981-2003; MRIP, NMFS, 2004-2011). 2011 data is preliminary and through October. TX estimates for 1981-1985 shore mode only.

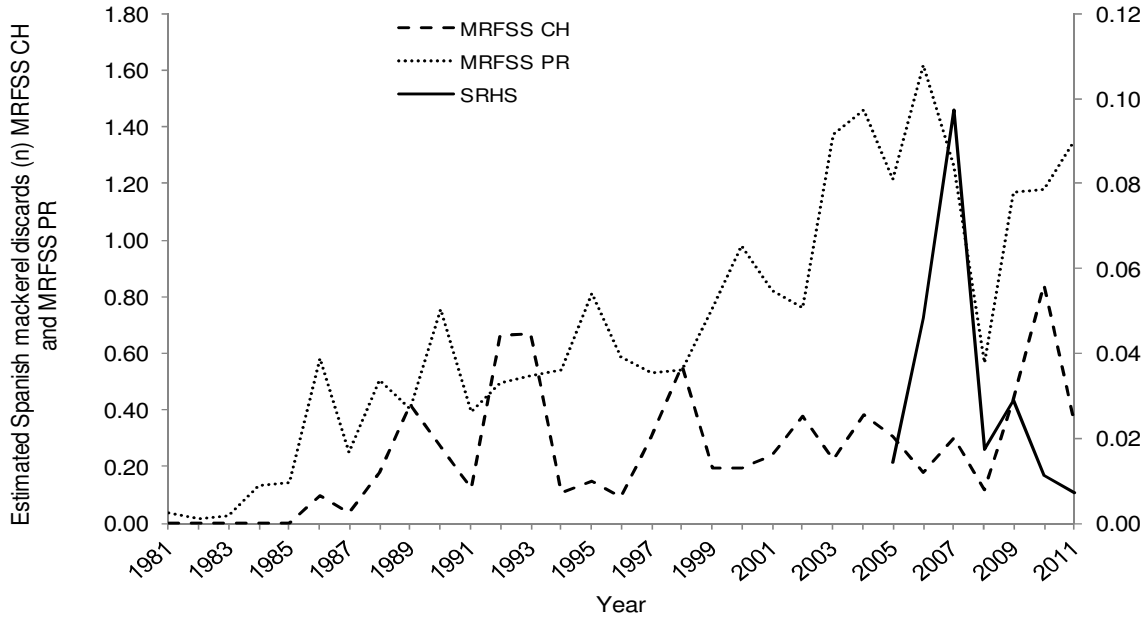

Figure 4.12.17. Percentage of Spanish mackerel discards in the recreational fishery, 1981-2011.

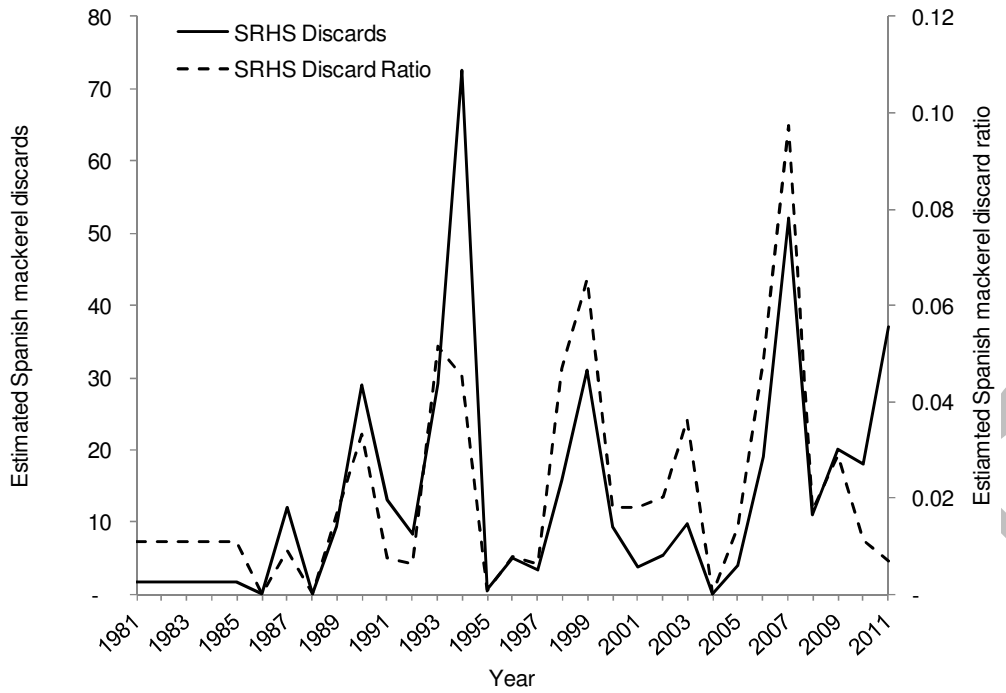

Figure 4.12.18. Gulf of Mexico estimated Spanish mackerel discards and discard ratio for the headboat fishery (MRFSS proxy 1981-2003; SRHS 2004-2011).

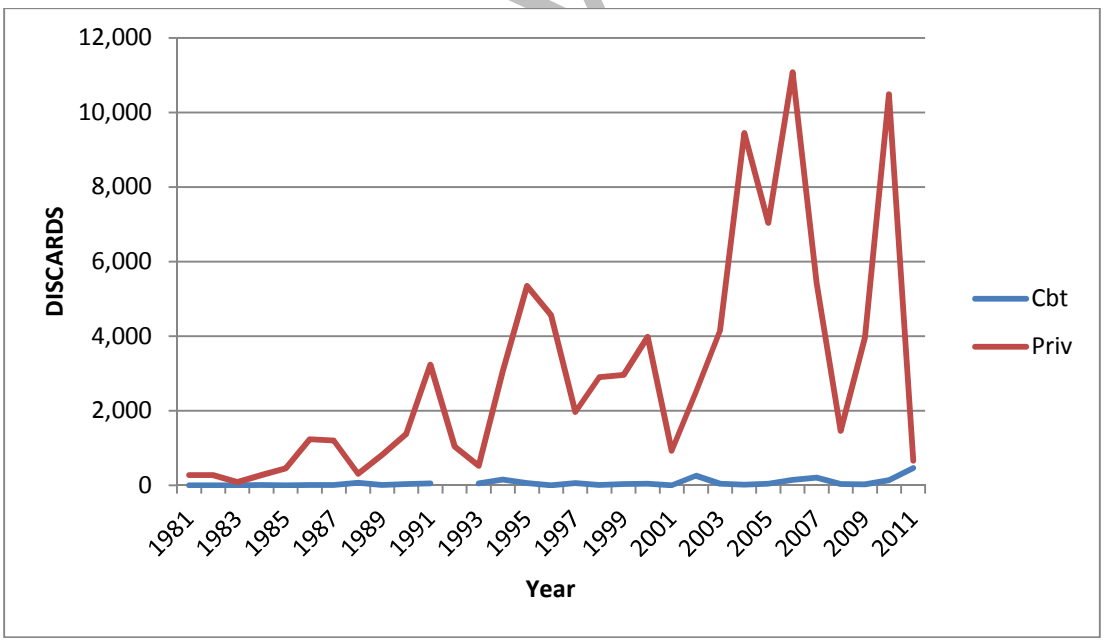

Figure 4.12.19 Texas Spanish mackerel discards (numbers of fish) for charter boat mode and private mode (TPWD). 2011 data is through mid-May.

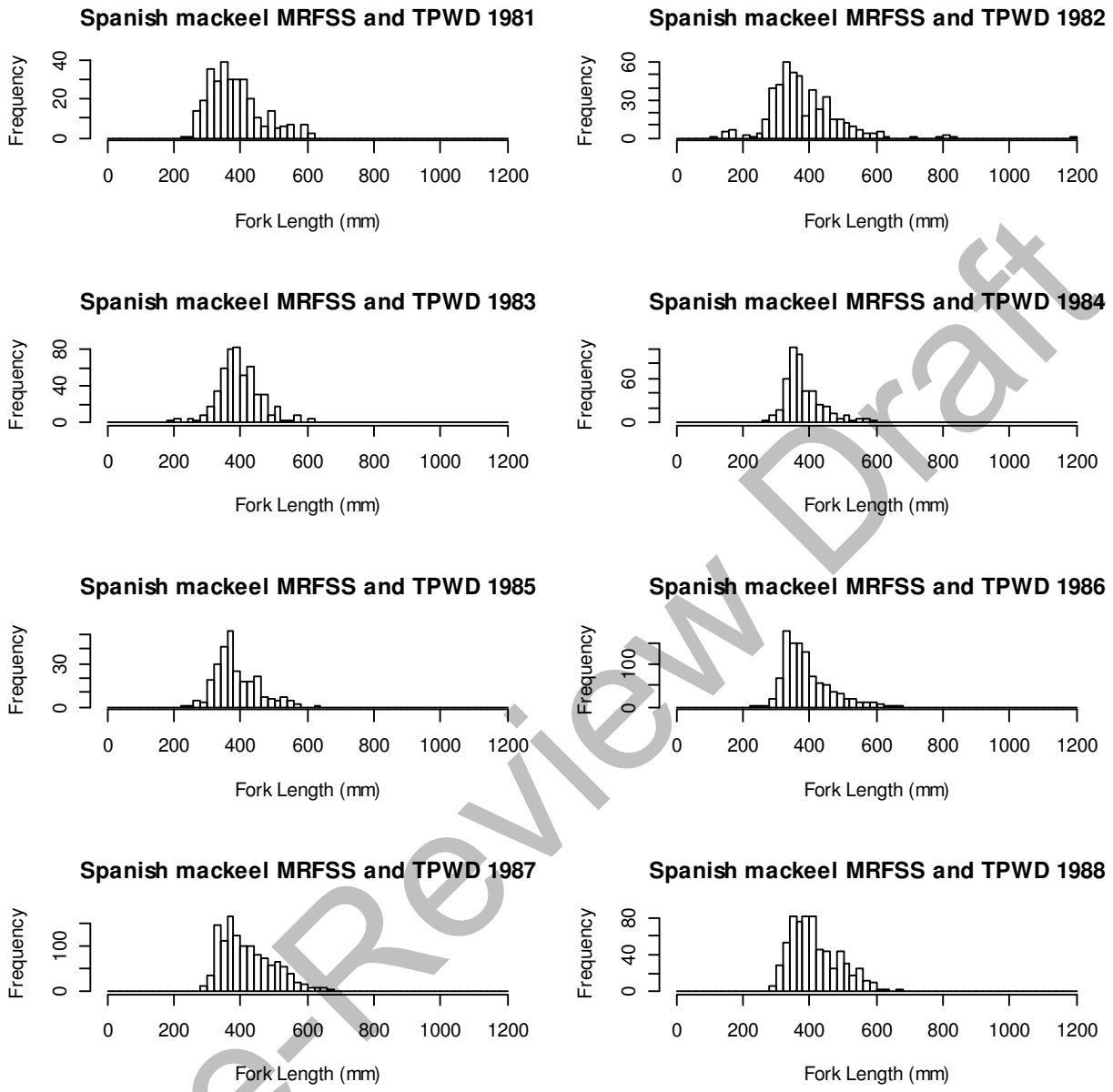

Figure 4.12.20. Length composition from the MRFSS (1981-2011) and TPWD (1983-2011).

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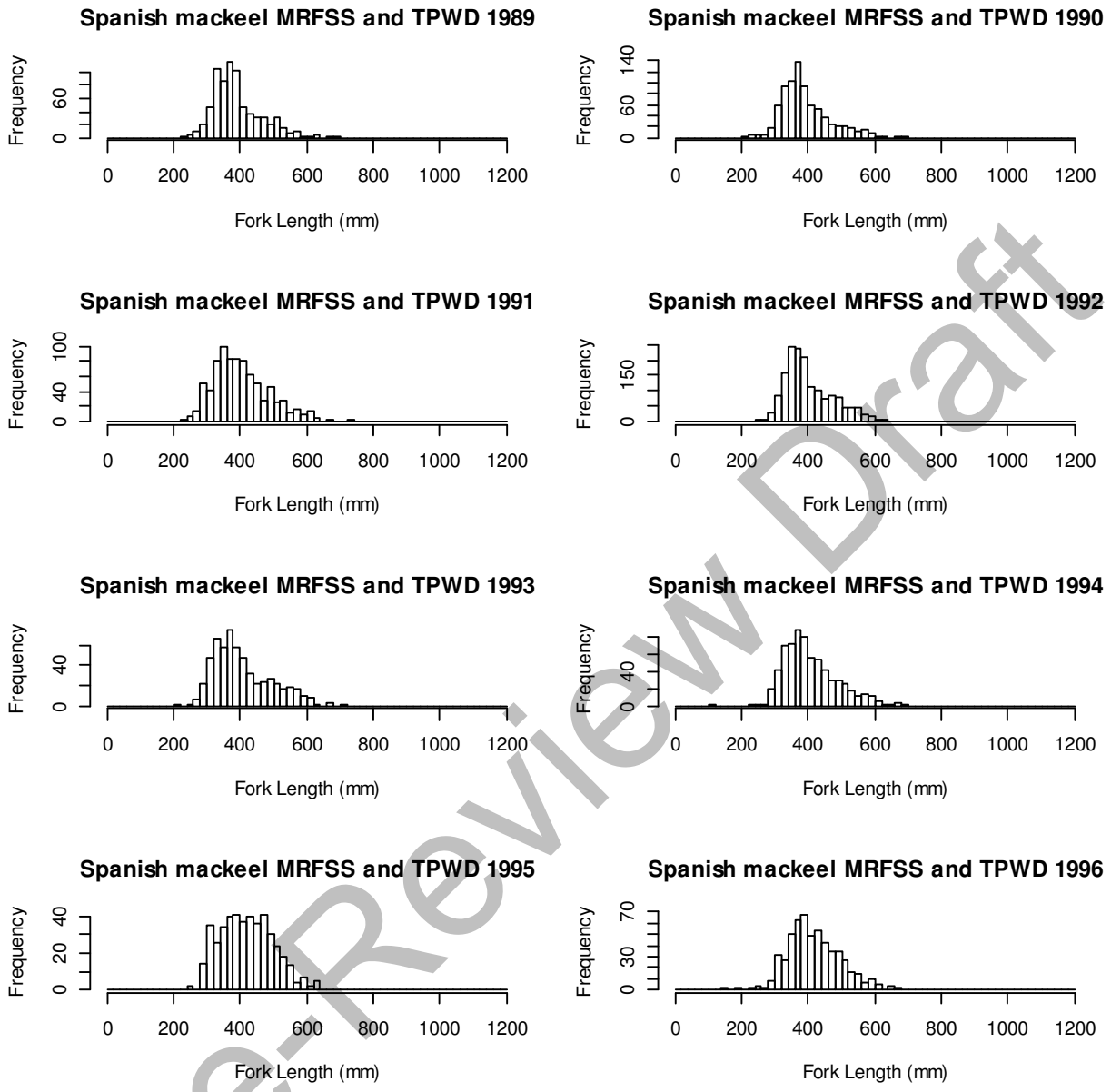

Figure 4.12.20. Length composition from the MRFSS (1981-2011) and TPWD (1983-2011) (continued).

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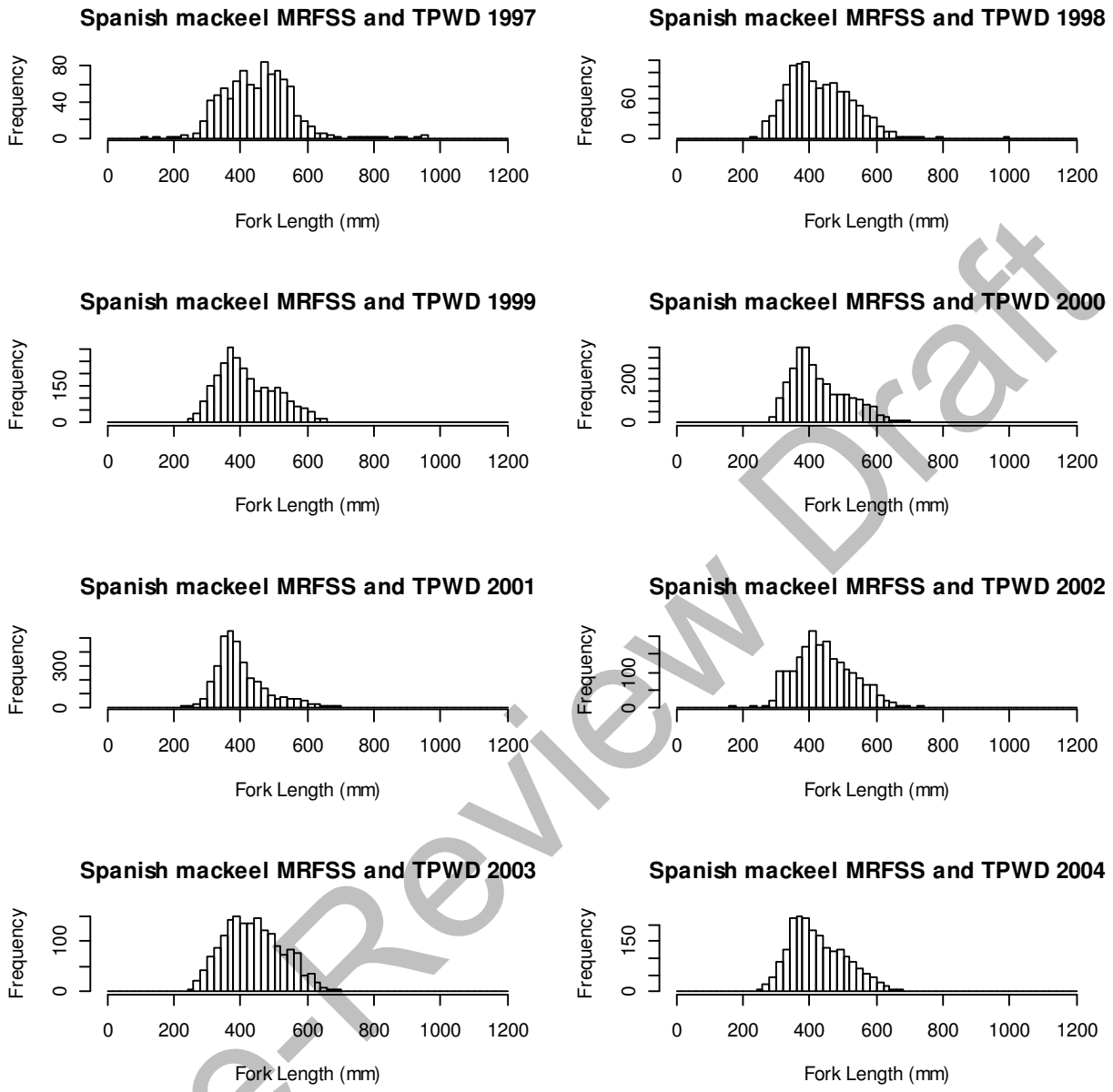

Figure 4.12.20. Length composition from the MRFSS (1981-2011) and TPWD (1983-2011) (continued).

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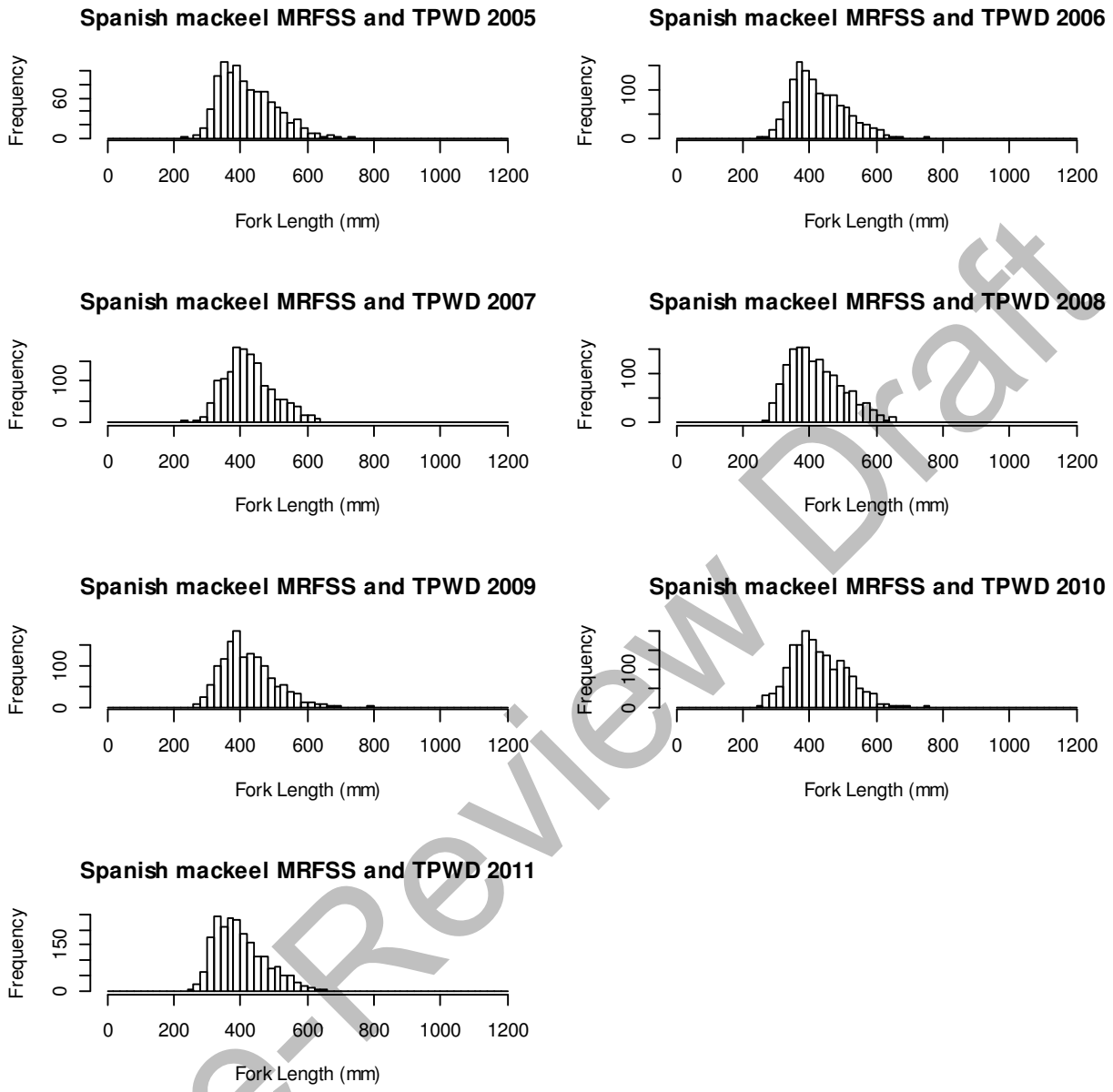

Figure 4.12.20. Length composition from the MRFSS (1981-2011) and TPWD (1983-2011) (continued).

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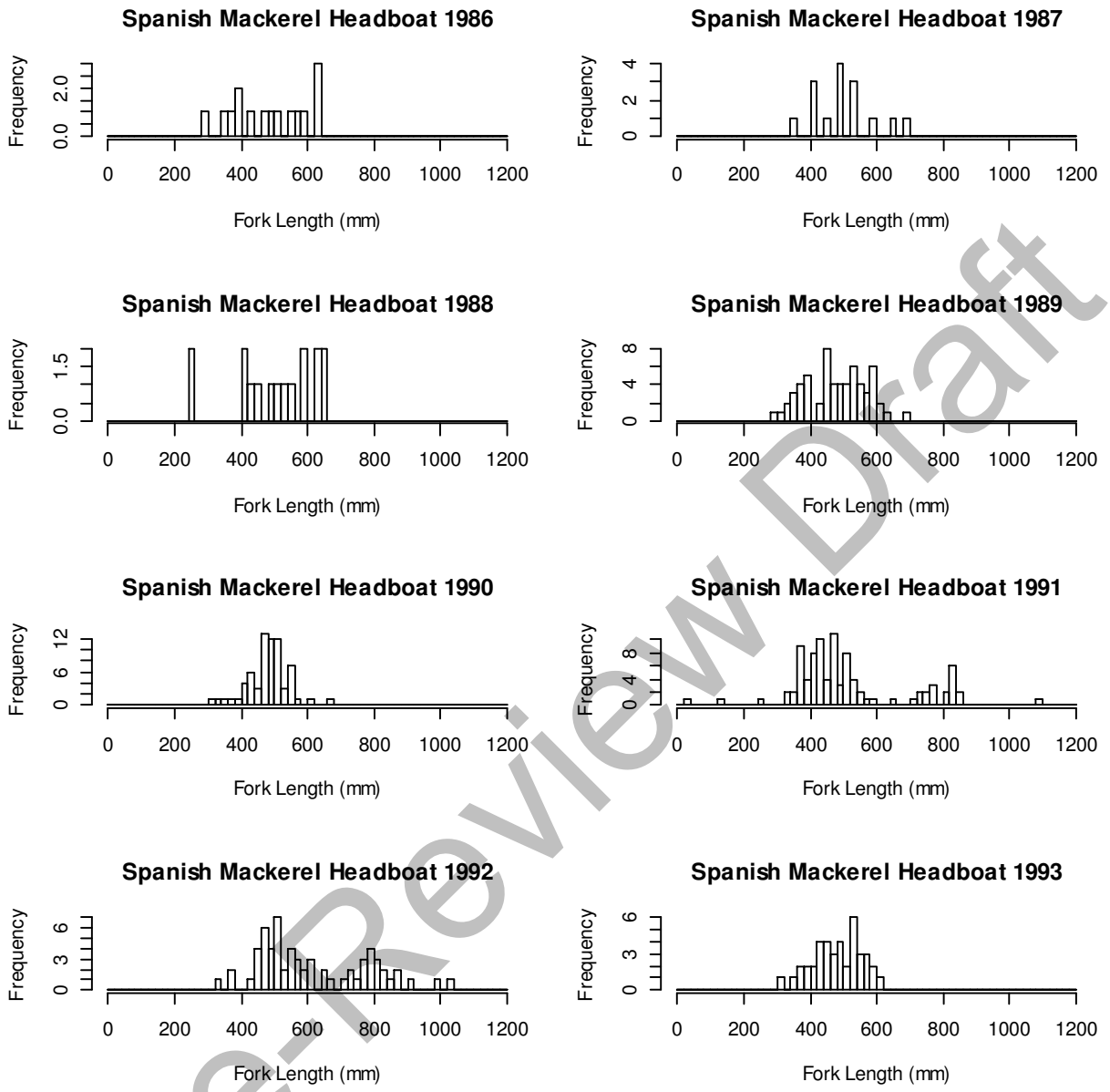

Figure 4.12.21. Headboat length composition 1986-2011.

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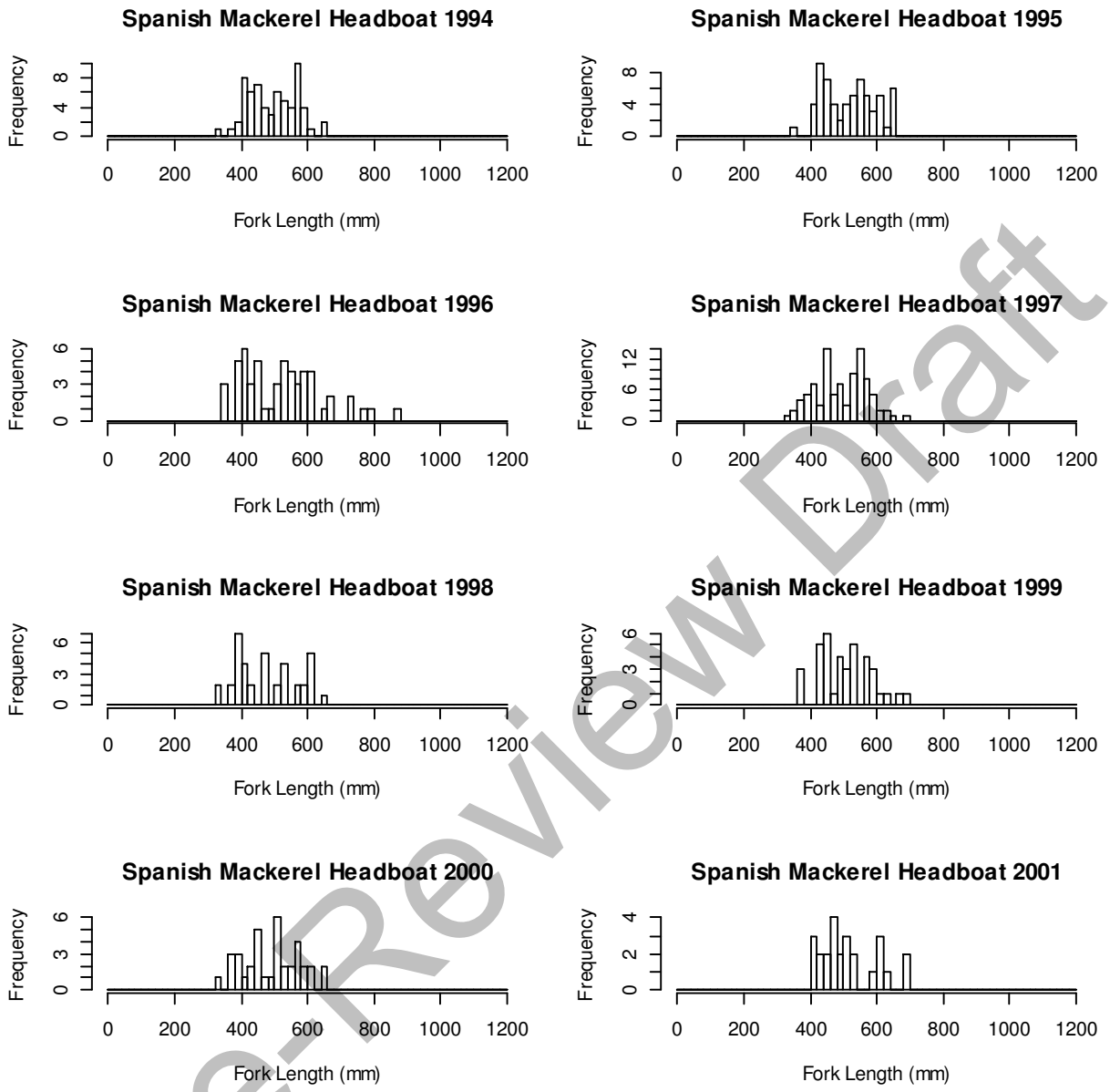

Figure 4.12.21. Headboat length composition 1981-2011 (Continued).

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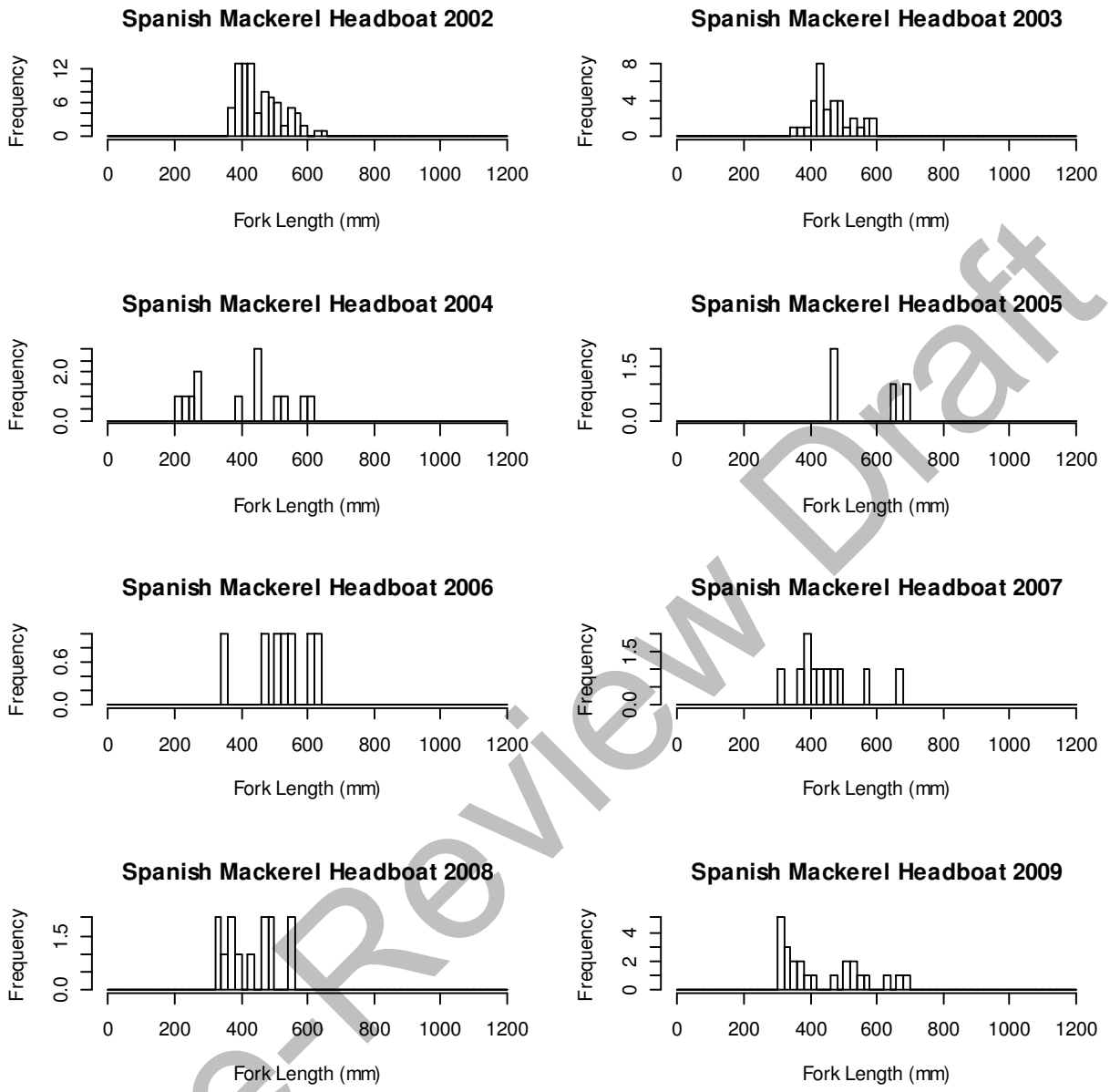

Figure 4.12.21. Headboat length composition 1981-2011 (Continued).

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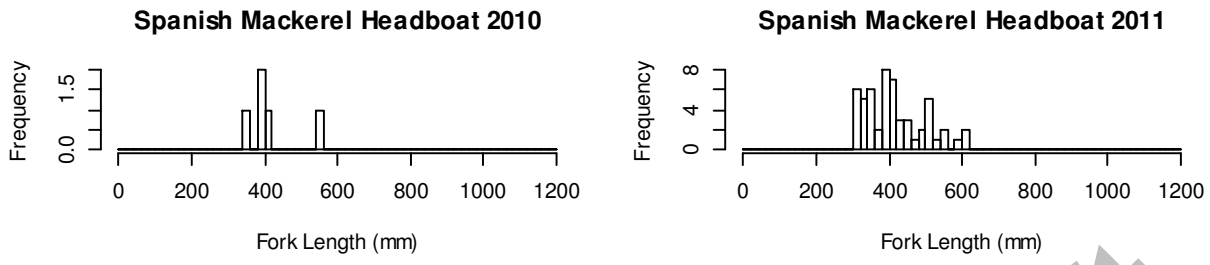

Figure 4.12.21. Headboat length composition 1981-2011 (Continued).

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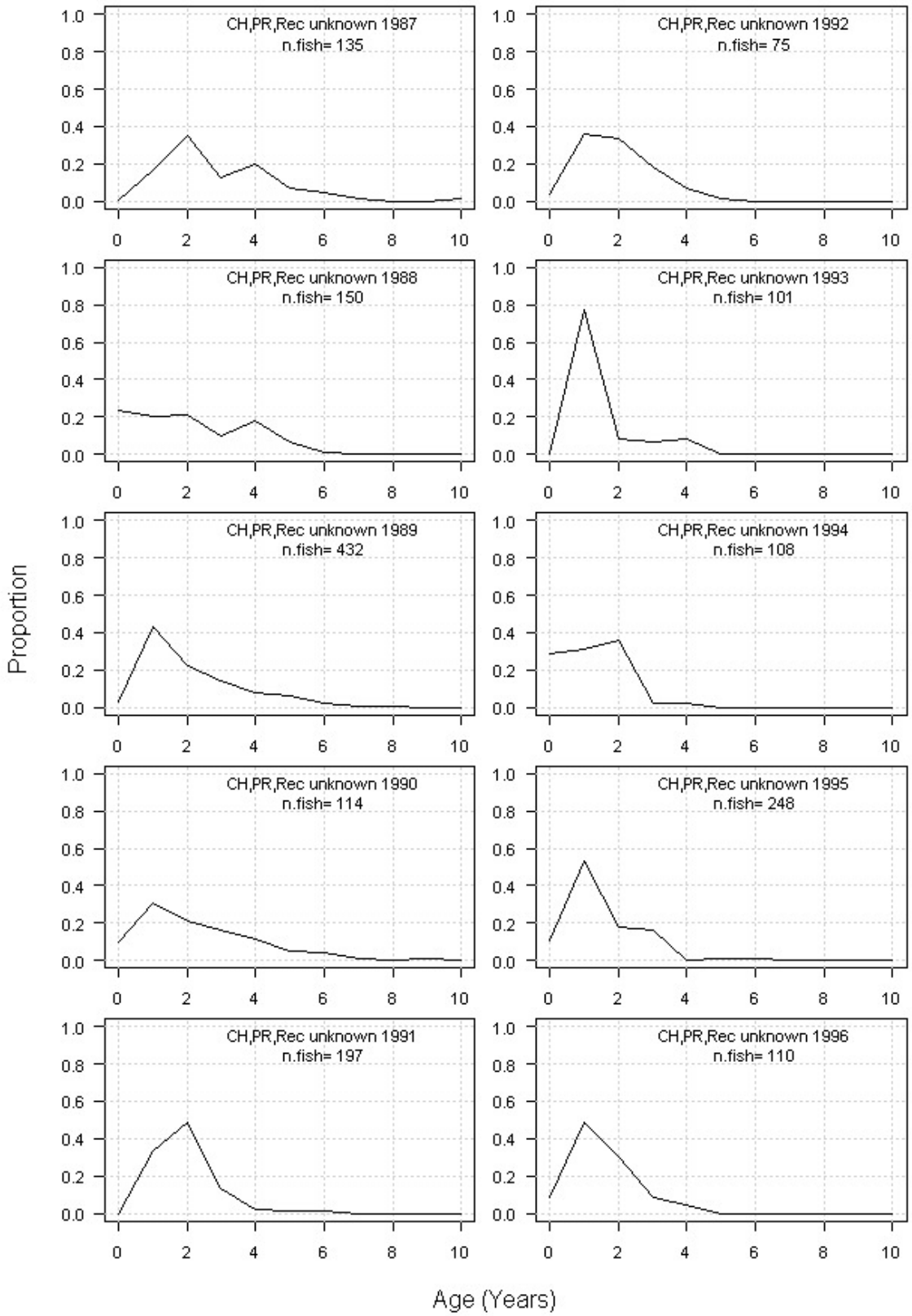

Figure 4.12.22. Age composition of Spanish mackerel from the charter boat, private/rental boat, and recreational (mode unknown) modes (1987-2002, 2004-2011).

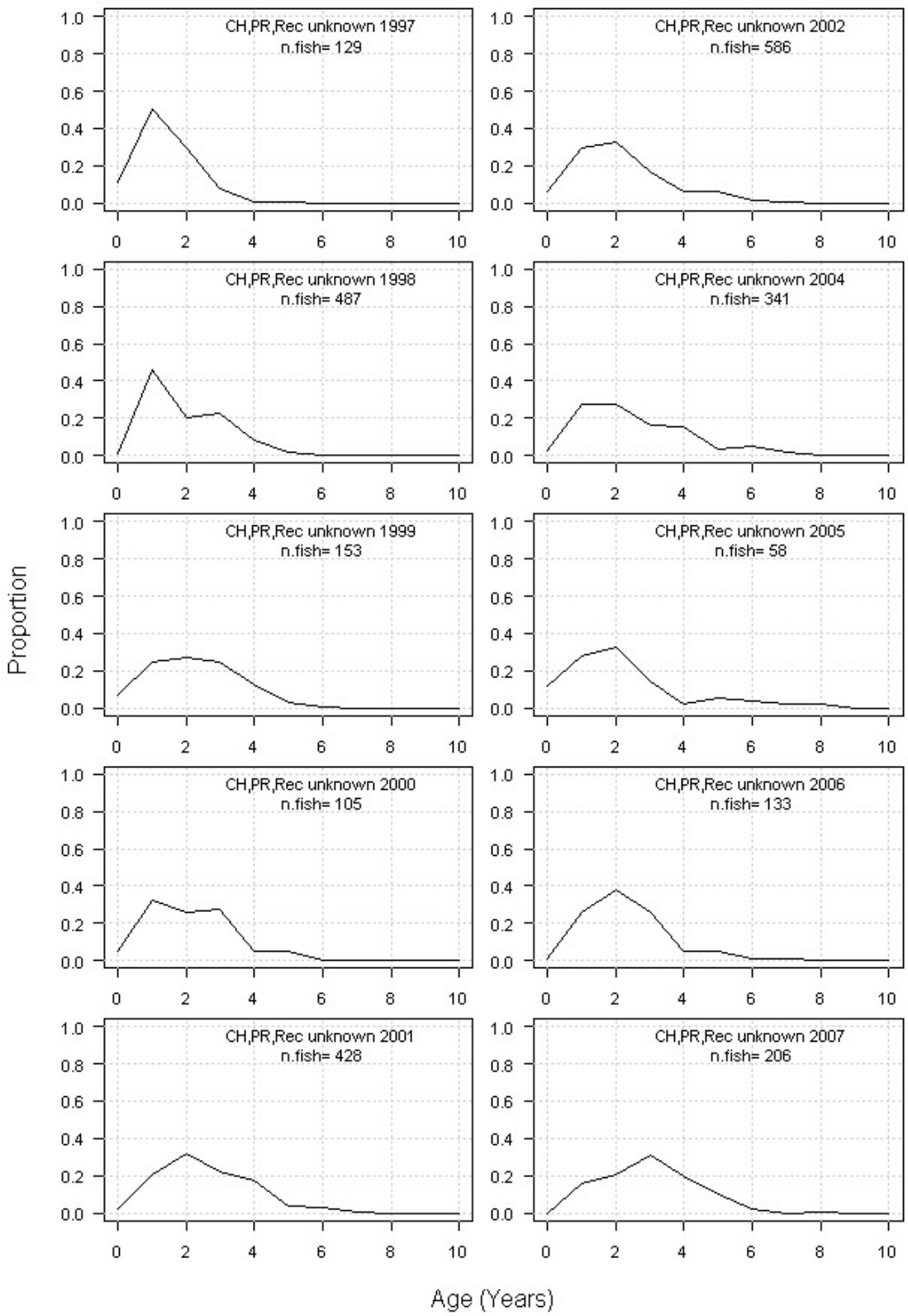

Figure 4.12.22. Age composition of Spanish mackerel from the charter boat, private/rental boat, and recreational (mode unknown) modes (1987-2002, 2004-2011).

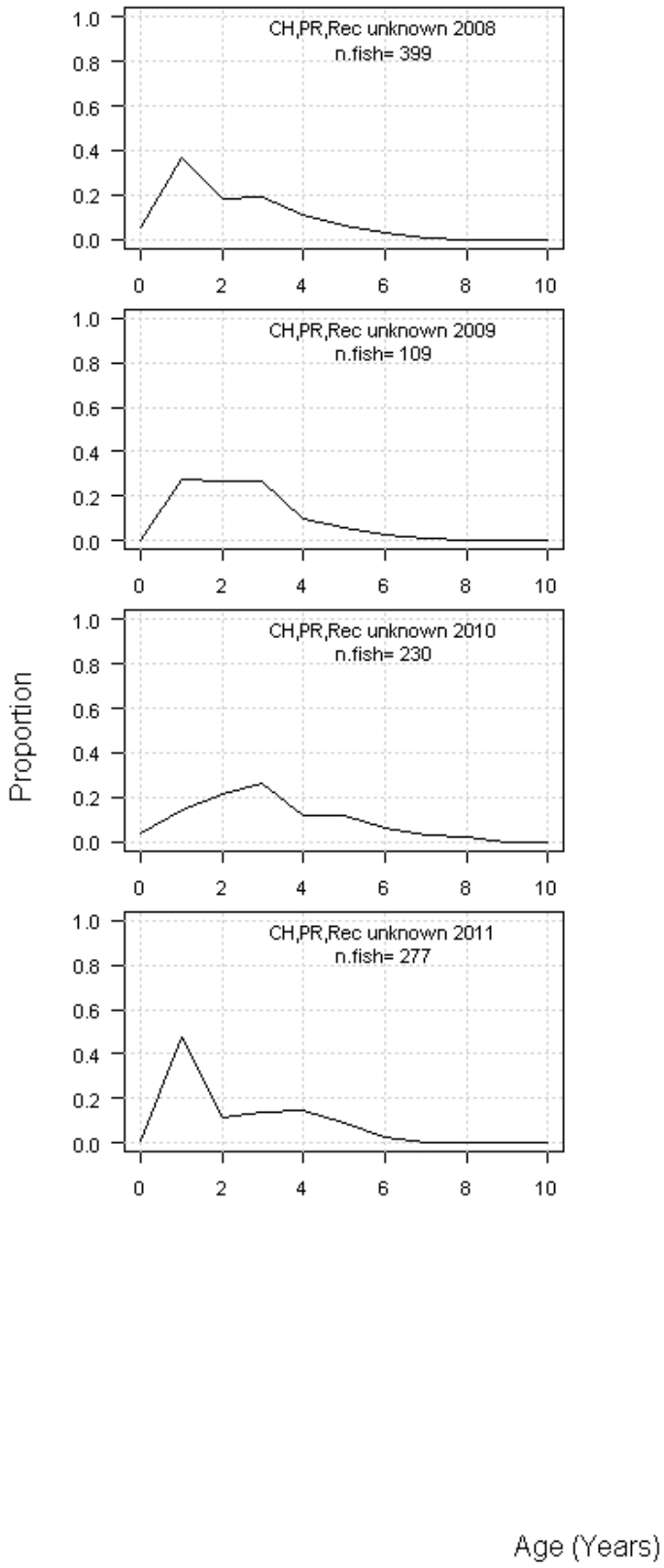

Figure 4.12.22. Age composition of Spanish mackerel from the charter boat, private/rental boat, and recreational (mode unknown) modes (1987-2002, 2004-2011) (continued).

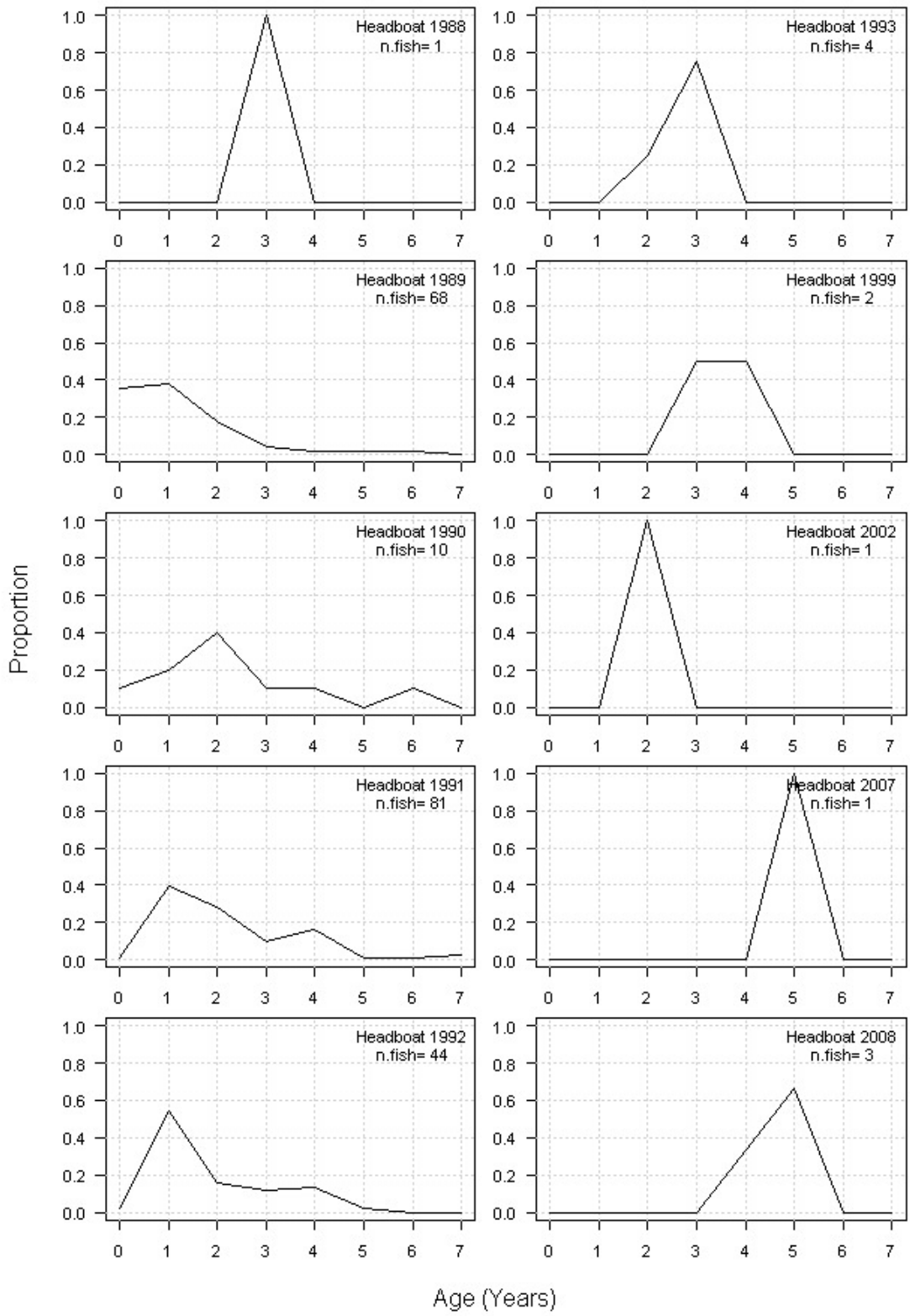

Figure 4.12.23. Age composition of Spanish mackerel from the headboat fleet during 1988-1993, 1999, 2002, 2007-2009, and 2011.

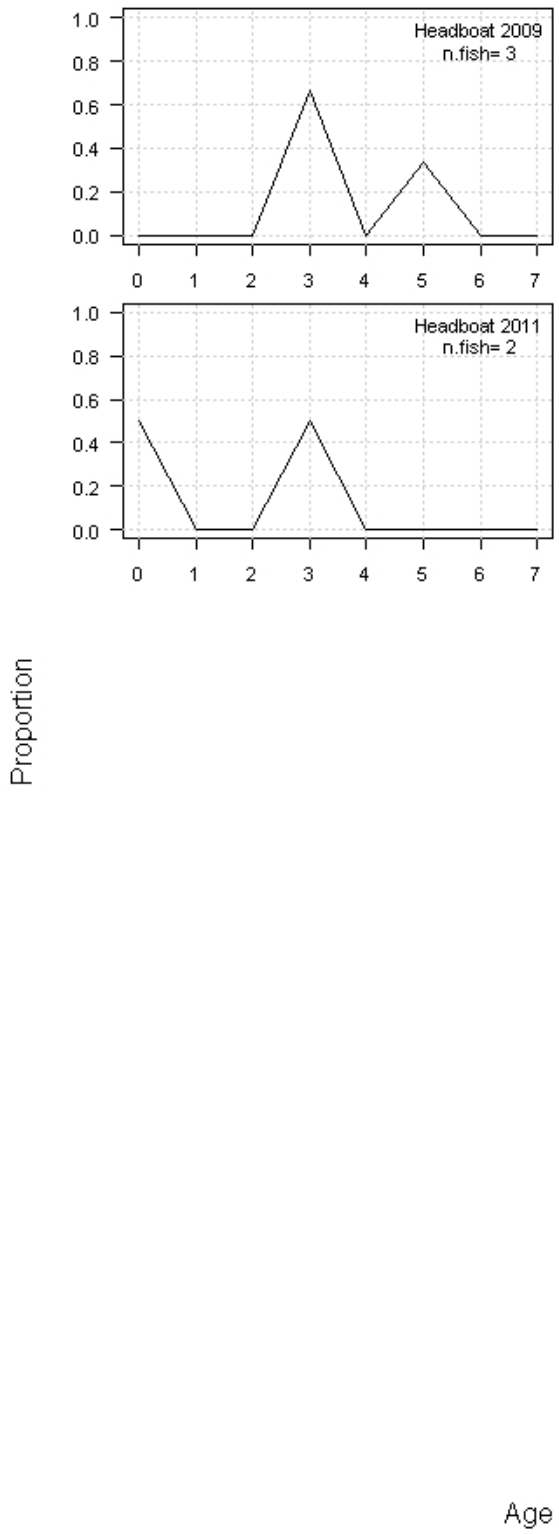

Figure 4.12.23. Age composition of Spanish mackerel from the headboat fleet during 1988-1993, 1999, 2002, 2007-2009, and 2011 (continued).

Number of Intercepted Trips Which Caught Spanish Mackerel by Site from the MRFSS: (1981 - 1989)

Trips

- 1 - 25
- 26 - 50
- 51 - 125
- 126 - 200
- > 200

0 85 170 340 510 680 Miles

Albers Projection
Central Meridian: -96
1st Std Parallel: 20
2nd Std Parallel: 60
Latitude of Origin: 40

Figure 4.12.24. The number MRFSS intercepted trips which caught Spanish mackerel from 1981-1989.

Number of Intercepted Trips Which Caught Spanish Mackerel by Site from the MRFSS: (1990 - 1999)

Trips

- 1 - 25
- 26 - 50
- 51 - 125
- 126 - 200
- > 200

0 85 170 340 510 680 Miles

Albers Projection
Central Meridian: -96
1st Std Parallel: 20
2nd Std Parallel: 60
Latitude of Origin: 40

Figure 4.12.25. The number MRFSS intercepted trips which caught Spanish mackerel from 1990-1999.

Number of Intercepted Trips Which Caught Spanish Mackerel by Site from the MRFSS: (2000 - 2010)

Trips

- 1 - 25
- 26 - 50
- 51 - 125
- 126 - 200
- > 200

0 85 170 340 510 680 Miles

Albers Projection
Central Meridian: -96
1st Std Parallel: 20
2nd Std Parallel: 60
Latitude of Origin: 40

Figure 4.12.26. The number MRFSS intercepted trips which caught Spanish mackerel from 2000-2010.

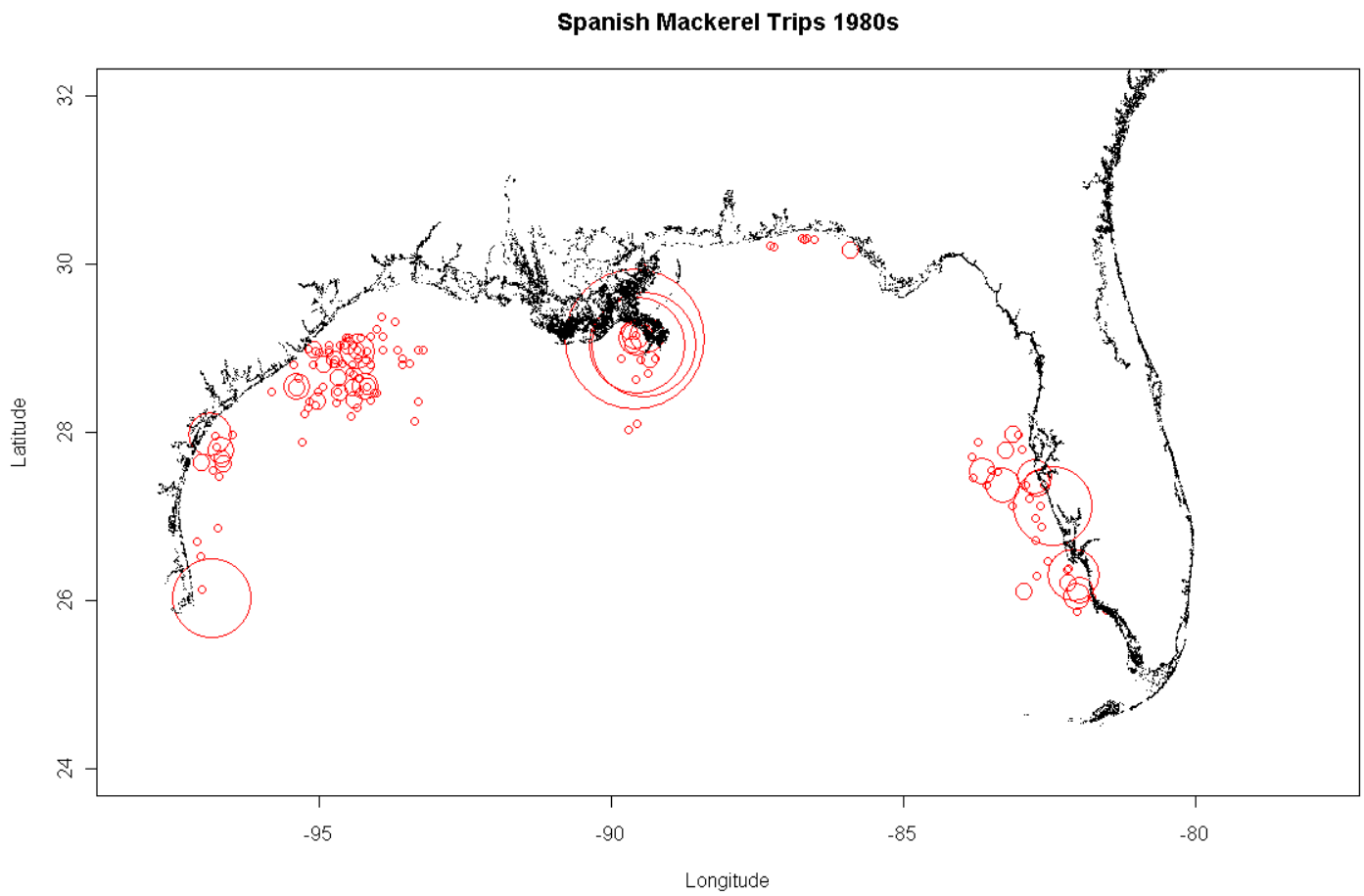

Figure 4.12.27. Reported Spanish mackerel trips from SRHS, 1986-1989. The size of each point is proportional to the frequency of reported trips at the given location.

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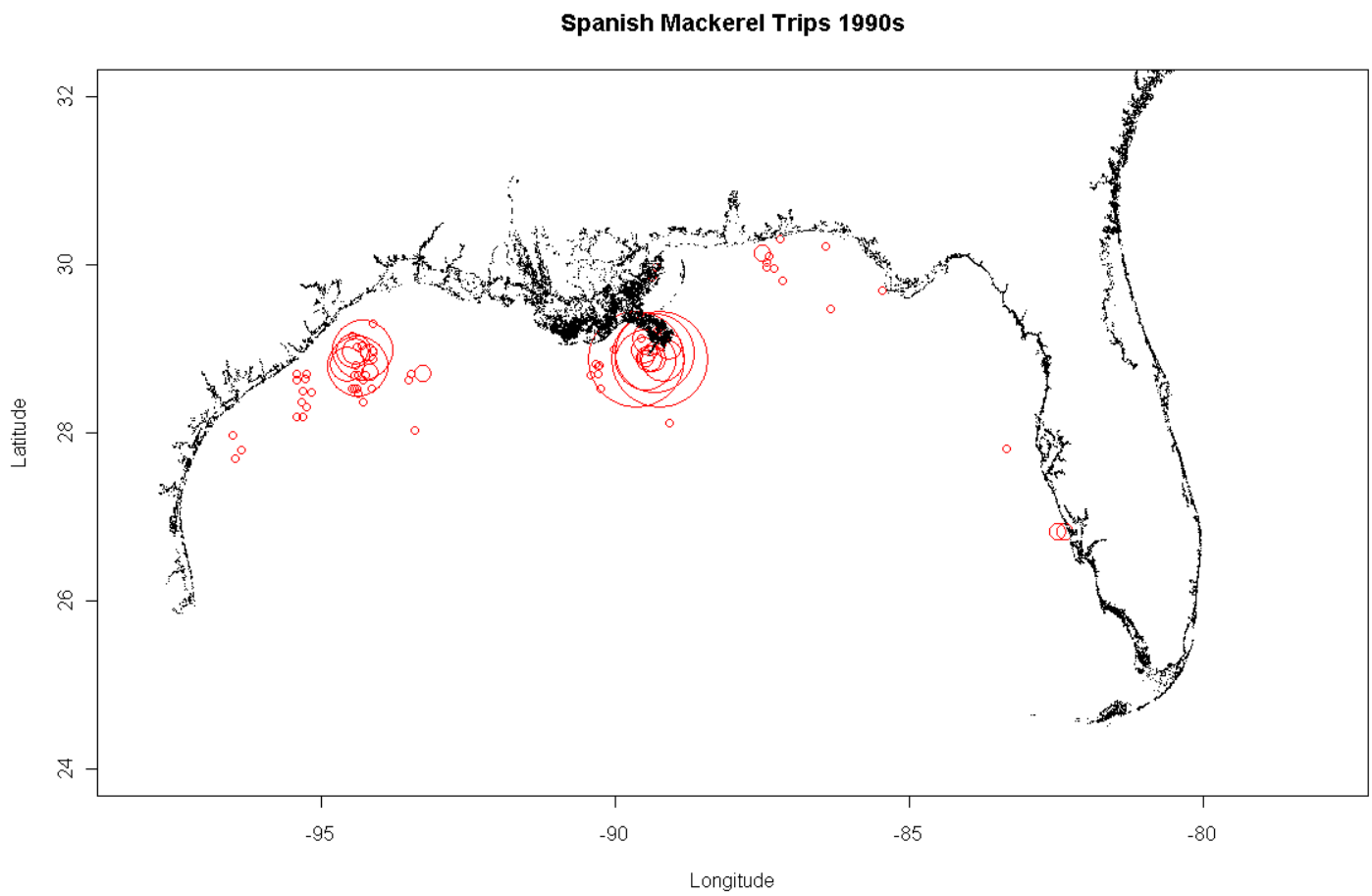

Figure 4.12.28. Reported Spanish mackerel trips from SRHS, 1990-1999. The size of each point is proportional to the frequency of reported trips at the given location.

Pre-Re

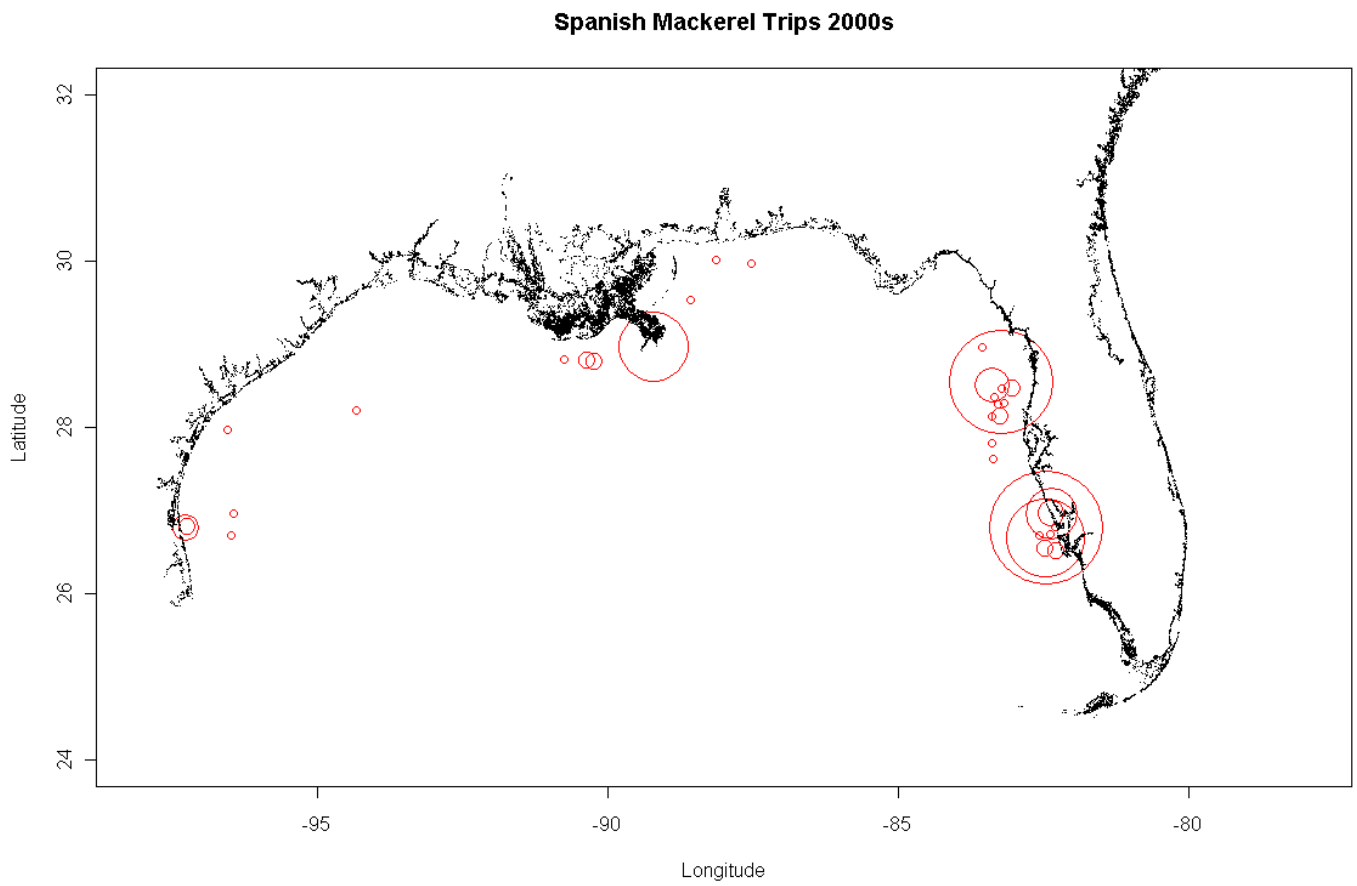

Figure 4.12.29. Reported Spanish mackerel trips from SRHS, 2000-2011. The size of each point is proportional to the frequency of reported trips at the given location.

Pre-Rev

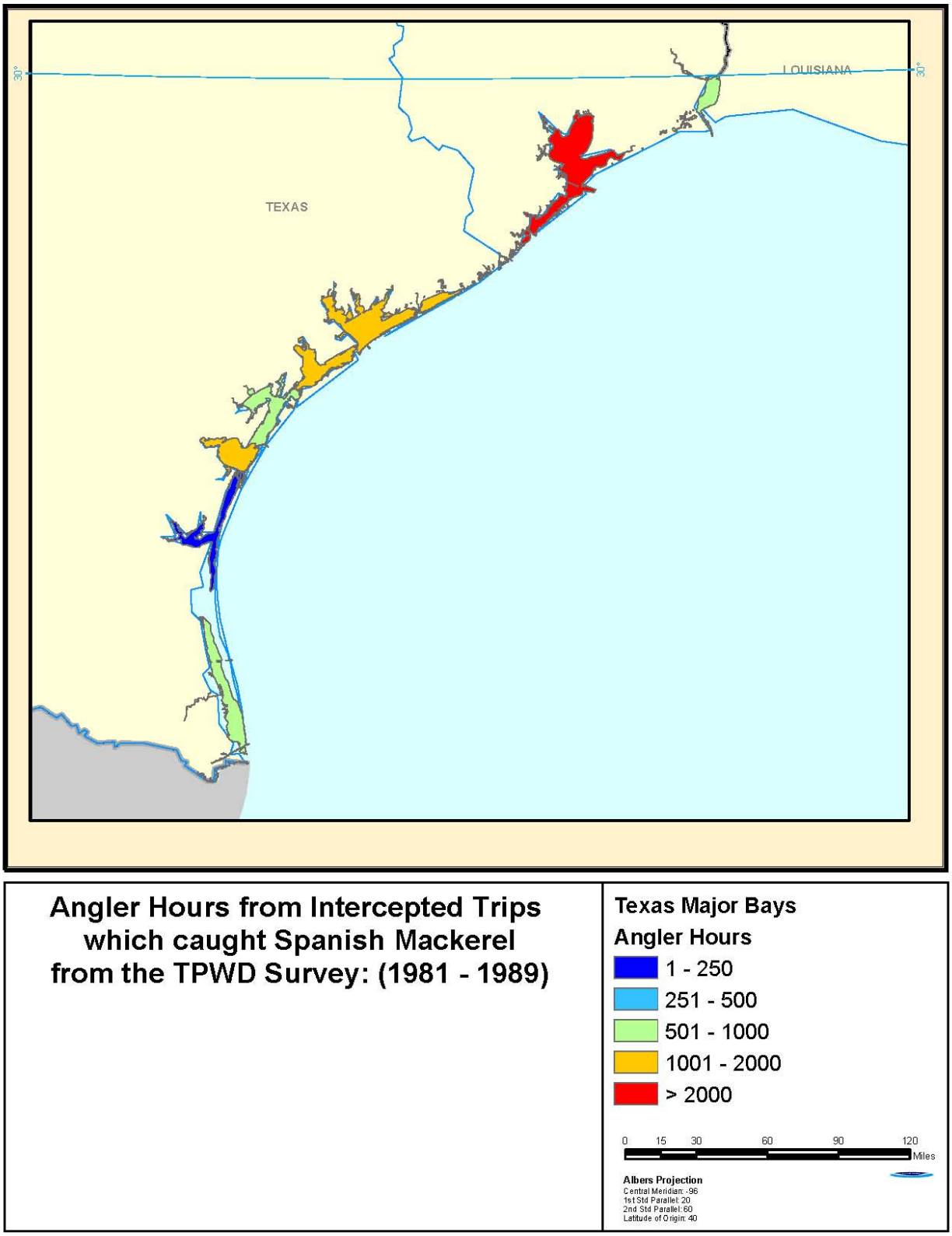

Figure 4.12.30 Angler hours from trips which intercepted Spanish mackerel in the TPWD, 1983-1989.

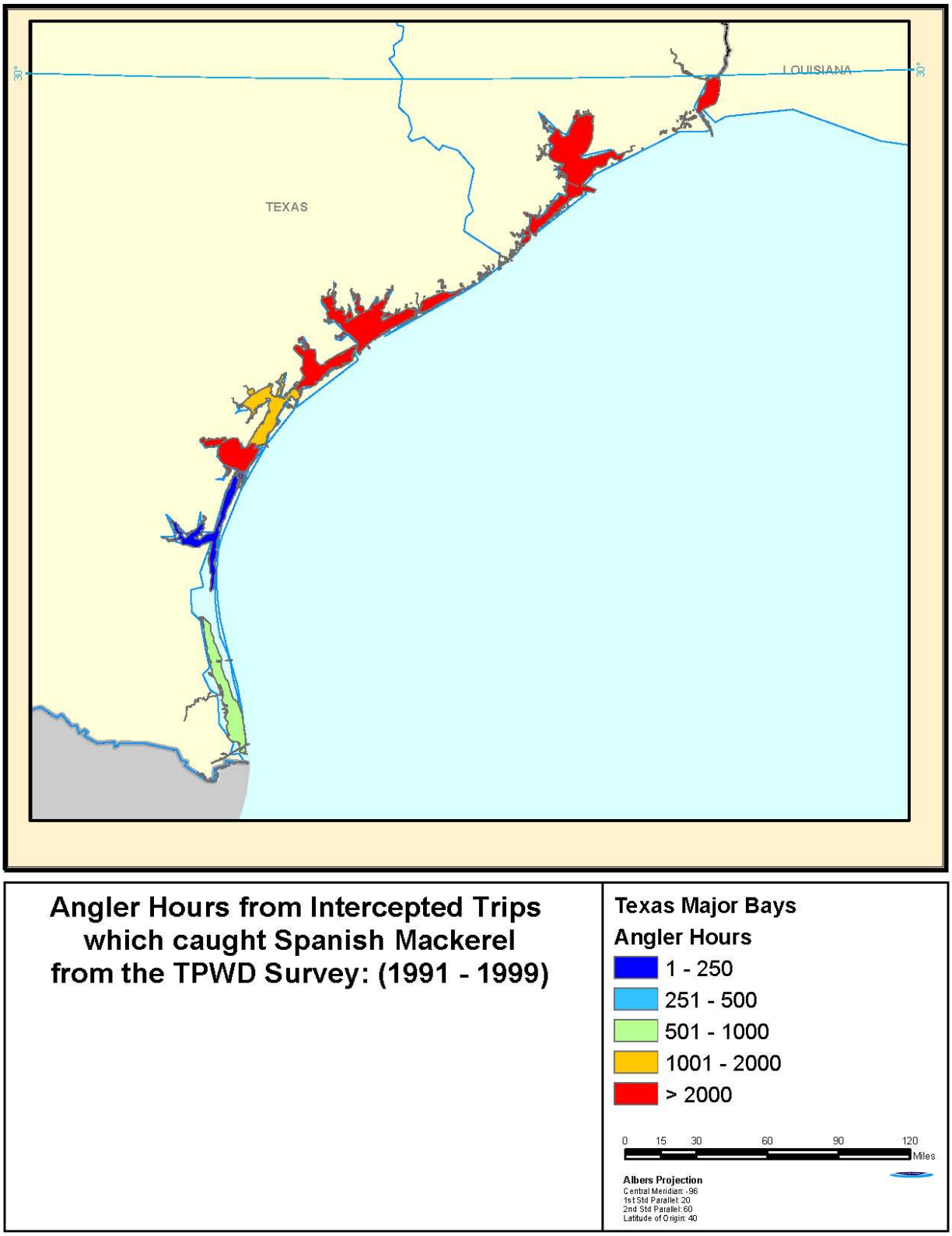

Figure 4.12.31 Angler hours from trips which intercepted Spanish mackerel in the TPWD, 1991-1999.

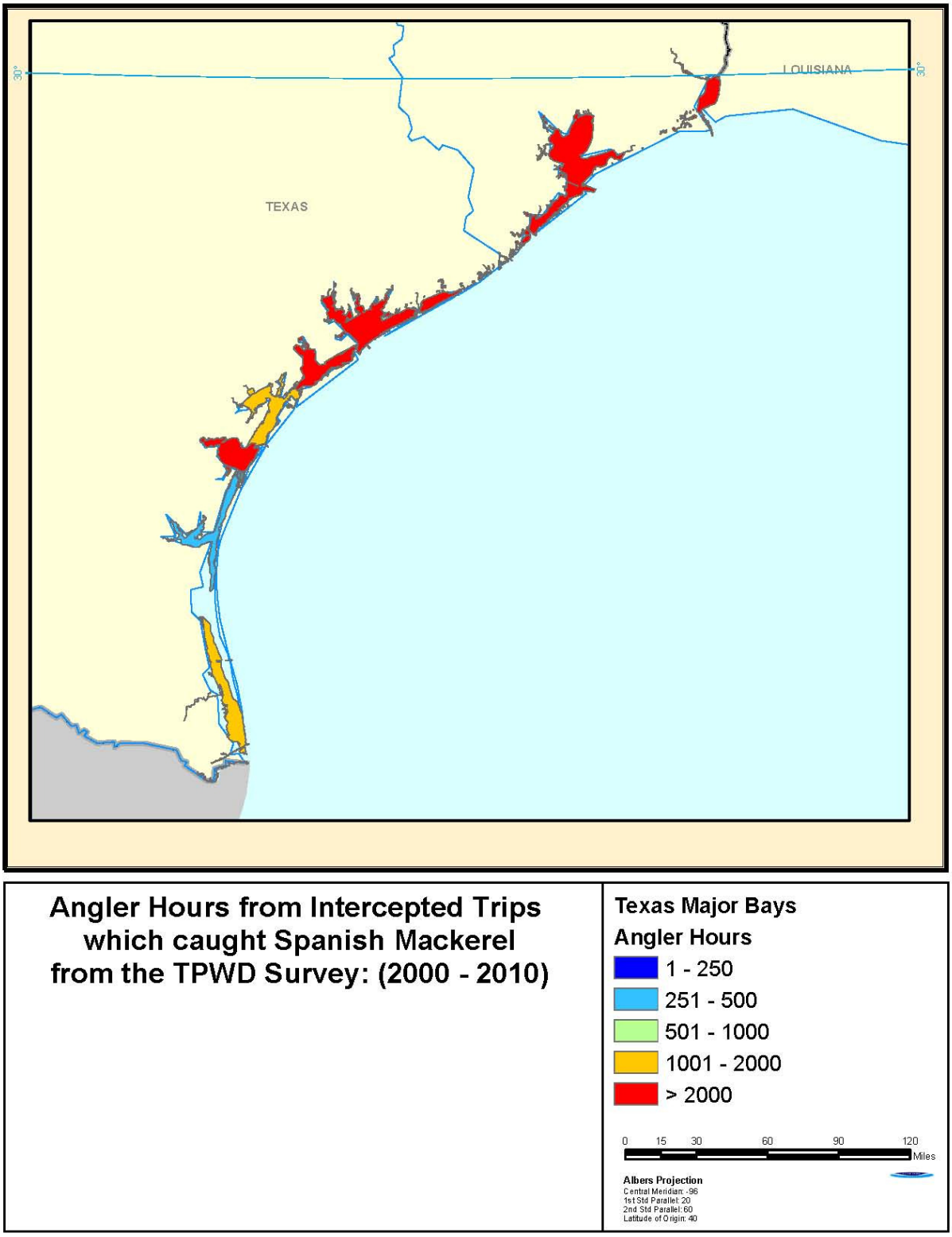

Figure 4.12.32 Angler hours from trips which intercepted Spanish mackerel in the TPWD, 2000-2010.

5 Measures of Population Abundance

5.1 Overview

Analytical results of nine data sets were presented to the Index Working Group (IWG). Eight of the data sets were of fishery-dependent origin and one was of fishery-independent origin. These data sets are listed here along with recommendations by the IWG of whether or not to use the resulting indices in the stock assessment model:

- SEAMAP groundfish survey (*Recommended for use*)
- Texas sport boat angler survey (*Not recommended for use*)
- Commercial logbooks – vertical lines (*Not recommended for use*)
- Commercial logbooks – gillnet (*Not recommended for use*)
- Headboat (*Not recommended for use*)
- MRFSS (*Recommended for use*)
- FL trip ticket – castnet (*Not recommended for use*)
- FL trip ticket – handline/trolling (*Recommended for use*)
- FL trip ticket – gillnet (*Not recommended for use*)

The ranking of indices for Gulf Spanish mackerel by the IWG was 1) SEAMAP 2) trip ticket 3) MRFSS. Also, index adequacies and inadequacies are in report card comments.

Group Membership
IWG members included, Walter Ingram, Jeanne Boylan, Pearse Webster, Clay Porch, Neil Baertlein, Kevin McCarthy, Steve Saul, Meaghan Bryan, Katie Andrews, Kevin Craig, Michael Schirripa, Nancie Cummings, Julia Byrd, Amy Schueller, Eric Fitzpatrick and Mike Errigo, and included other DW participants as needed for discussions throughout the week.

5.2 Review of Working Papers

Not identified.

5.3 Fishery Independent Indices

5.3.1 SEAMAP Groundfish Survey

The Southeast Fisheries Science Center (SEFSC) Mississippi Laboratories have conducted standardized groundfish surveys under the Southeast Area Monitoring and Assessment Program (SEAMAP) in the Gulf of Mexico (GOM) since 1987. SEAMAP is a collaborative effort between federal, state and university programs, designed to collect, manage and distribute fishery independent data throughout the region. The primary objective of this trawl survey is to collect data about the abundance and distribution of demersal organisms in the northern GOM. This survey, which is conducted semi-annually (summer and fall), provides an important source of fisheries independent information on many commercially and recreationally important species throughout the GOM.

A full review of the survey design and methodologies are described in SEDAR28-DW03. The appendix of the document provides an additional index for Spanish mackerel, which was

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requested by the data working group that only includes data from the federal vessels, since complete state data for 2011 was not available at the time for analysis. We caution using this index (1987-2011, federal only), especially under the new survey design since the states make up a larger portion of the survey (2009: 645 vs. 506 total stations; 2010: 389 vs. 286 total stations). A significant about of data is lost east of the Mississippi River, since MS and AL sample about 60 stations a year. It is also important to note that the majority of the state stations are the shallower stations that get included in the analysis due to the depth distribution of Spanish mackerel.

5.3.1.1 Methods of Estimation

Data Filtering Techniques

Based upon the limited recent sampling that has taken place in shrimp statistical zones 3-9 (Table 5.3.1.1), it was decided to limit the data for this analysis to only zones 10-21 (note that zone 12 is completely outside of the depth range of this survey (5 to 60 fathoms), therefore it is not sampled). Of the 495 stations sampled, only 3 occurrences of Spanish mackerel were reported from these statistical zones. Upon examining the depth zone distribution of occurrences of Spanish mackerel (Table 5.3.1.2), the data were also limited by depth zone, in addition to the aforementioned shrimp statistical zones. For the full model run, all depth zones greater than 35 fathoms were excluded from the analysis. These depth zones accounted for less than 1% of all Spanish mackerel occurrence overall, in addition to not having occurrences greater than 1 % individually.

Based upon the recommendations of the Data Working Group, in addition to the indices from the combined summer and fall surveys, individual indices were prepared from summer and fall surveys. For the fall survey, the same depth zones and statistical zones as the full model run were excluded. However, during the summer months, Spanish mackerel were found in shallower depths overall, with only 6 stations outside of 20 fathoms having a positive occurrence, therefore it was necessary to exclude all depth zones greater than 20 fathoms from the analysis.

Standardization

Delta-lognormal modeling methods were used to estimate relative abundance indices for Spanish mackerel (Lo *et al*. 1992). The main advantage of using this method is allowance for the probability of zero catch (Ortiz *et al.* 2000). The index computed by this method is a mathematical combination of yearly abundance estimates from two distinct generalized linear models: a binomial (logistic) model which describes proportion of positive abundance values (i.e. presence/absence) and a lognormal model which describes variability in only the nonzero abundance data (Lo *et al*. 1992).

The submodels of the delta-lognormal model were built using a backward selection procedure based on type 3 analyses with an inclusion level of significance of $\alpha = 0.05$. Binomial submodel performance was evaluated using AIC, while the performance of the lognormal submodel was evaluated based on analyses of residual scatter and QQ plots in addition to AIC.

Submodel Variables

Year: 1987-2010

Area: Texas (statistical zones 18-21), West Delta (statistical zones 13-17),

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East Delta (statistical zones 10-11)

Depth Zone: 5-6, 6-7, 7-8, 8-9, 9-10, 10-11, 11-12, 12-13, 13-14, 14-15, 15-16, 16-17, 17-18, 18-19, 19-20, 20-22, 22-25, 25-30, 30-35
Time of Day: Day, Night
Season: Summer, Fall
Survey: Old, New

Annual Abundance Indices
For a full review of the backward selection procedure for each submodel and diagnostic plots, refer to SEDAR28-DW03.

In the full model (summer and fall surveys), year, area, depth zone, time of day and season were retained in the binomial submodel. The variables retained in the lognormal submodel were year, area, depth zone and time of day. The AIC for the binomial and lognormal submodels were 56,581.5 and 1999.9, respectively. The AIC for the binomial submodel increased slightly when the survey variable was removed from the submodel, however, based upon the p-value (0.2844), it was determined that the slight increase was acceptable. However, the AIC for the lognormal submodel was the lowest of all the model runs.

For the summer model, year, area, depth zone and time of day were retained in the binomial submodel. The variable retained in the lognormal submodel was year. The AIC for the binomial and lognormal submodels were 23,424.2 and 627.0, respectively. Since all the variables were significant in the binomial submodel the AIC remained unchanged. However, the AIC value increased slightly when variables were removed from the lognormal submodel. Based upon the p-values for area, depth zone and time of day (0.9707, 0.2587 and 0.0691, respectively), it was determined that the slight increase was acceptable.

For the fall model, year, area, depth zone and time of day were retained in both the binomial and lognormal submodels. The AIC for the binomial and lognormal submodels were 27,218.7 and 1300.5, respectively. Since all variables were significant in the both submodels the AIC remained unchanged.

5.3.1.2 Sampling Intensity
A total of 11,433 stations were sampled from 1987- 2010 (Figure 5.3.1.1).

5.3.1.3 Size/Age Data
The sizes of Spanish mackerel represented in this index are presented in Table 5.3.1.3 and Figures 5.3.1.2.

5.3.1.4 Catch Rates
Standardized catch rates are presented in Tables 5.3.1.4 - 5.3.1.6.

5.3.1.5 Uncertainty and Measures of Precision
Annual CVs of catch rates are presented in Tables 5.3.1.4 - 5.3.1.6.

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5.3.1.6 Comments on Adequacy for Assessment

The IWG recommended this index for Spanish mackerel for use in the assessment model, due to the fact that it is a fisheries independent survey across a long time series (1987-2010), with very good spatial converge (TX/Mexico border to Mobile Bay).

5.4 Fishery Dependent Indices

5.4.1 Texas Parks and Wildlife Departments Sport-boat Angling Survey

Information on catch per unit of effort for recreational coastal sport-boat fisheries in Texas was summarized. These data were evaluated for the use of calculating catch per unit of effort (CPUE) abundance trends for Spanish mackerel in the Gulf of Mexico for use in SEDAR 28 stock evaluations. The Texas Parks and Wildlife Departments Sport-boat Angling Survey (TPWD) index included interviews from May through September, private and charterboat modes, Gulf areas off major bay systems in nearshore and offshore waters only. Observations of recreational catch and effort were available for sport-boat fisheries in Texas from 1983 - 2010. The TPWD Sport-boat Angling Survey samples fishing trips made by sport-boat anglers fishing in Texas marine waters; these include private and charterboat fisheries. All sampling takes place at recreational boat access sites. The primary focus of the TPWD survey is on private boats fishing in bays and passes because this accounts for most of the coastwide fishing pressure and landings in TX (78% of fishing effort and 67% of landings during May15, 2002 to May 14, 2003). Private boats in gulf waters (7% of effort), charterboats in bays and passes (14% of effort), and charterboats in gulf waters (<2% of effort) are also included in the TPWD survey, but special surveys are added to increase the precision of trips fishing in gulf areas since they are not encountered frequently in the normal survey. In addition, the survey is designed to estimate landings and effort by high-use seasons (May15-November 20) and low-use seasons (November 21-May 14). More details regarding the TPWD sport-boat fishing surveys are provided in Appendices I and II. For all analyses CPUE was calculated as catch (number fish caught) divided by effort (number anglers x triplength).

The development of the CPUE index is described in more detail in SEDAR28-DW09. The appendix to the working paper describes decisions made by the SEDAR 28 DW panel with updated tables and figures. The SEDAR 28 DW index working group decisions summarized in SEDAR28-DW09 (Appendix 1).

5.4.1.1 Methods of Estimation

Data Filtering Techniques

While exploring TPWD data to develop a standardized index for Spanish mackerel in the Gulf of Mexico, the following methods were investigated.

Stephens & McCall

First the Stephens and MacCall (2004) method was explored in an attempt to identify directed Spanish mackerel trips in the complete TPWD recreational data CPUE data set. This method uses the species composition information on a trip to subset the complete data or to help identify trips or set to only those trips on which the species of interest (the target species, Spanish mackerel in this case) would occur. The analysis involves fitting a logistic regression to the

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presence-absence of each trip's species catch. Routinely, the species composition included in the regression includes only those species occurring in at least 1% of all the trips combined. The analysis results include a critical probability value that predicts the target species presence and/or absence in the study data set which is used to select trips on an objective basis. In the Stephens and MacCall analysis of the TPWD data 329,616 unique trips were evaluated for Spanish mackerel targeting preference. The species that occurred in at least 1% of all the trips were TPWD species codes: 614, 629, 616, 625, 613, 602, 621, 772, 758, 818, 611, and 681 (Spanish mackerel). These species were then included in the logistic regression with Spanish mackerel included as the target species. The results of the Stephens MacCall analyses of the TPWD recreational CPUE data were not successful in identifying a suite of trips targeting Spanish mackerel. We found that on the majority of the 329, 616 fishing trips only one or two species were caught making it difficult to identify a group of species that might associate with the target species (Spanish mackerel). In total, across all the time series, 1983-2010, Spanish mackerel occurred on only 1.1% (n=3,653) of all trips. Thus, we considered two datasets for the CPUE standardization analyses. The first set of observations included all the data. The second data set that was evaluated for CPUE was formed by excluding inshore fishing trips from the CPUE SEDAR28-DW09 2 standardizations. We found that the majority of the recreational fishing effort for Spanish mackerel did not occur inshore but rather in waters <10 miles (TTS, NEWAREA 3) or in waters >10 miles (EEZ, NEWAREA area 4) thus inshore effort in the bays and passes (NEWAREA 5) was excluded from subsequent analyses. The total number of trips in these two areas waters <10 miles and waters >10 miles) was 25, 337 of which Spanish mackerel occurred in 308 or 1.2% across all years. The exclusion of bays and passes is consistent with the previous MSAP 2003 analysis. For each analysis data set (Set 1: all observations (n=329, 616 trips) and Set 2: NEWAREAS 3 and 4 (n=25,337 trips) we then attempted to construct standardized CPUE indices were explored using the delta-lognormal modeling approach (Lo et al. 1992). This method applies two separate models, fitting a lognormal model to the positive CPUE observations and a separate binomial (logistic) model to the proportion of successful (positive) observations and combines results from the two models to obtain a single index. Parameter estimates were obtained using a general linear modeling (GLM) procedure (SAS GLIMMIX and MIXED procedures; SAS v.9.2 2004 of the SAS System, SAS Institute Inc.; Cary, NC, USA) to develop the binomial and lognormal sub models. Factor (covariate) significance was evaluated using Type 3 residual analysis and overall performance was assessed from residual analysis graphics. Residuals by year were plotted and reviewed and QQ plots of the residuals against a normal distribution were plotted. In applying the GLM procedure we assumed the proportion of successful trips per stratum approximated a binomial distribution, where the estimated probability was a linearized function of the fixed factors. We used a second generalized linear model to examine the influence the fixed factors on log(CPUE) of successful trips assuming a normal error distribution for the positive catch rates. As defined earlier, catch rate was calculated as number fish caught divided by (number anglers x triplength). Model Construction A forward stepwise procedure was used to quantify the relative importance of the factors that influenced catch rates. Factors evaluated were: YEAR, MONTH, NEWAREA (3 = <10 miles (TTS), 4 = >10 miles (EEZ), 5 = inshore (bays and passes), major bay (1 = Sabine Lake, 2 = Galveston, 3 = Matagorda, 4 = San Antonio, 5 = Aransas, 6 = Corpus Christi, 7 = Upper Laguna Madre, 8 = lower Laguna Madre), mode (3 = charterboat, 4 = private boat). First the null model was run. These results reflect the distribution of the nominal data. Next we added each potential factor to the null model one at a time, and examined the resulting reduction in

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deviance per degree of freedom. The factor that caused the greatest reduction in deviance per degree of freedom was added to the base model if the factor was significant ($p<0.05$) based upon a Chi-Square test, and the reduction in deviance per degree of freedom was >1%. This model then became the base model, and the process was repeated, adding factors and interactions individually until no factor or interaction met the criteria for incorporation into the final model. Year was always included in the model, regardless of its importance because it is required to calculate the standardized catch index for each year. After the models were identified, they were fit to the proper response variables using the SAS macro GLIMMIX (c/o Russ Wolfinger, SAS Institute Inc.). All factors and interactions were treated as fixed effects except year*factor interactions, which were treated as random effects. Interaction effects at the first level were considered for all the fixed factors.

Positive Trips

Applying methods described by Stephens & MacCall (2004) to Spanish mackerel resulted in a 67% reduction in positive Spanish mackerel trips while identifying approximately 11,000 trips that were unsuccessful at catching Spanish mackerel. A large reduction in positive Spanish mackerel trips and an inflation of zero Spanish mackerel trips was anticipated due to the infrequency of Spanish mackerel in the Texas nearshore fishery, therefore a more appropriate method was pursued.

Analytic Approach

For each analysis data set (Set 1: all observations (n=329, 616 trips) and Set 2: areas 3 and 4 only (n=25,337 trips) we then attempted to construct standardized CPUE indices were explored using the delta-lognormal modeling approach (Lo et al. 1992). This method applies two separate models, fitting a lognormal model to the positive CPUE observations and a separate binomial (logistic) model to the proportion of successful (positive) observations and combines results from the two models to obtain a single index. Parameter estimates were obtained using a general linear modeling (GLM) procedure (SAS GLIMMIX and MIXED procedures; SAS v.9.2 2004 of the SAS System, SAS Institute Inc.; Cary, NC, USA) to develop the binomial and lognormal sub models. Factor (covariate) significance was evaluated using Type 3 residual analysis and overall performance was assessed from residual analysis graphics. Residuals by year were plotted and reviewed and QQ plots of the residuals against a normal distribution were plotted. In applying the GLM procedure we assumed the proportion of successful trips per stratum approximated a binomial distribution, where the estimated probability was a linearized function of the fixed factors. We used a second generalized linear model to examine the influence the fixed factors on log(CPUE) of successful trips assuming a normal error distribution for the positive catch rates. As defined earlier, catch rate was calculated as number fish caught divided by (number anglers x triplength).

5.4.1.2 Sampling Intensity

The resulting data set contained n=329, 616 trips for all areas, and n=25,337 trips for areas 3 and 4 only.

5.4.1.3 Size/Age data

The sizes/ages represented in this index should be the same as those of landings from the corresponding fleet.

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5.4.1.4 Catch Rates

Standardized catch rates and associated error bars are shown in SEDAR28-DW09.

5.4.1.6 Comments on Adequacy for Assessment

The index of abundance created from the TPWD data was considered by the indices working group to be inadequate for potential use in the Spanish mackerel assessment. Although the data set has an adequately large sample size and has a long enough time series to provide potentially meaningful information for the assessment, the survey covers only a small portion of the stock as described for the Gulf of Mexico and mostly surveys an area where Spanish mackerel are not abundant or targeted. In addition, catch rates were extremely low and the index was derived from fishery dependent data.

5.4.2 Commercial Vertical line Index

Using the Coastal Fisheries Logbook Program's (CFLP) available catch per unit effort (CPUE) data, indices of abundance of Spanish mackerel were constructed for the U.S. Gulf of Mexico from 1998 through 2010. The indices were constructed using data submitted by Federally permitted commercial vertical line vessels. Commercial fishing activity reported by fishers to the CFLP is at the trip level. For each fishing trip, the CFLP database includes a unique trip identifier, the landing date, fishing gear deployed, areas, number of days at sea, number of crew, gear specific fishing effort, species caught and weight of the landings.

Using only positive trips, a lognormal model was used for the construction of the vertical line index of abundance. The catch per unit effort for vertical line was defined as gutted pounds per hook hour fished. Complete details concerning the methods and results of the analyses are described in SEDAR28-DW15.

5.4.2.1 Methods

Data Filtering Techniques

Multiple areas fished and multiple gears fished may be recorded for a single fishing trip. In such cases, assigning catch and effort to specific locations or gears was not always possible; therefore, only trips which reported one area category and one gear fished were included in these analyses. Data were further restricted to include only those trips with landings and effort data received by the CFLP within 45 days of the completion of the trip. Reporting delays beyond 45 days likely results in less accurate effort data. Trips in which errant or missing data were present were removed from the analyses. These included missing number lines, number of hooks, and hours fished for vertical gear. Vertical gear trips reporting 24 or more hours per day fishing were also excluded.

Following the exclusion of trips listed above, outliers were removed in which number of lines, and hooks fell outside the upper 99.5 percentile.

Subsetting trips

For the vertical gear analysis, only positive Spanish mackerel trips were used from 1998 through 2010.

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Model Input
Significant effects on the CPUE of positive trips were tested using general linear model (GLM) analysis. For 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). The response variable of data was calculated as: log(CPUE) = ln(pounds of Spanish mackerel/hook hour). All 2-way interactions among significant main effects were examined. Higher order interaction terms were not examined.
The final model for the lognormal on CPUE of successful trips was:
Vertical Line:
LOG(CPUE) = Year + Days_at_sea + Subregion + Quarter + Days_at_sea*Subregion + Subregion*Quarter

Standardization
For vertical trips, only positive trips were included and a lognormal model was used for index construction. The lognormal model was fit using a PROC MIXED SAS procedure (Version 9.2 SAS Institute). All factors were modeled as fixed effects except two-way interaction terms containing YEAR which were examined as random effects to be included in the final model. Selection of the final mixed model was based on the Akaike's Information Criterion (AIC), Schwarz's Bayesian Criterion (BIC), and a chi-square test of the difference between the –2 log likelihood statistics between successive model formulations (Littell et al. 1996). For comparison, a relative index and relative nominal CPUE series were calculated by dividing each value in the series by the mean value of the series.
The standardized indices of abundance, number of trips, and relative nominal CPUE for vertical are shown in Table 5.4.2.1. The relative nominal CPUE and standardized index, with 95% confidence intervals, are shown in Figure 5.4.2.1.

5.4.2.2 Sampling Intensity
The final dataset for the vertical line index contained 4,628 trips, all of which were positive trips.

5.4.2.3 Size/Age data
The sizes/ages represented in these indices would likely be reflective of those in the GOM commercial landings.

5.4.2.4 Catch Rates
The relative nominal CPUE and standardized indices, with 95% confidence intervals, are shown in Figure 5.4.2.1.

5.4.2.5 Comments on Adequacy for Assessment
Despite covering the entire Gulf of Mexico, the working group recommended to not use the vertical line index. It was recommended that the Florida Trip Ticket index be used instead as it showed the same general trend during the common years (1998-2010), but had a much longer time series dating back to 1986. Confidence in the Florida Trip Ticket index was reinforced by the fact that Florida possesses the majority of the Gulf of Mexico Spanish Mackerel fishery. For exploratory purposes, an additional vertical line index was constructed with CFLP data for all areas west of the Florida panhandle as the Florida Trip Ticket program would not capture this data.

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5.4.3 Commercial Gillnet Index

Using the Coastal Fisheries Logbook Program's (CFLP) available catch per unit effort (CPUE) data, indices of abundance of Spanish mackerel were constructed for the U.S. Gulf of Mexico from 1998 through 2010. The index was constructed using data submitted by Federally permitted commercial gillnet vessels. Commercial fishing activity reported by fishers to the CFLP is at the trip level. For each fishing trip, the CFLP database includes a unique trip identifier, the landing date, fishing gear deployed, areas, number of days at sea, number of crew, gear specific fishing effort, species caught and weight of the landings.

A delta-lognormal was model was used for the construction of the gillnet index. The proportion of positive trips for gillnet ranged from 37-79%. Gillnet CPUE was defined as gutted pounds per square yard hour fished. Complete details concerning the methods and results of the analyses are described in SEDAR28-DW15.

5.4.3.1 Methods

Data Filtering Techniques

Multiple areas fished and multiple gears fished may be recorded for a single fishing trip. In such cases, assigning catch and effort to specific locations or gears was not always possible; therefore, only trips which reported one area category and one gear fished were included in these analyses. Data were further restricted to include only those trips with landings and effort data received by the CFLP within 45 days of the completion of the trip. Reporting delays beyond 45 days likely results in less accurate effort data. Trips in which errant or missing data were present were removed from the analyses. Gillnet trips with missing net length, depth (i.e. width), or hours fished were excluded.

Following the exclusion of trips listed above, records were dropped when gillnet length or gillnet depth (width) were below the 0.5 percentile or above the 99.5 percentile. Additional gillnet trips were removed from consideration when stake gillnet was reported or when shark landings were reported as this fishing effort were unlikely to land any Spanish mackerel.

Subsetting trips

All gillnet trips from 1998 through 2010 were considered for the gillnet index. Gillnet trips were also categorized as having, or not having, a king mackerel gillnet endorsement. Catchability of those vessels likely differs from other gillnet vessels.

Model Input

Significant effects on the proportion of positive trips and on the CPUE of positive trips were tested using general linear model (GLM) analyses. For the 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. For 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). The response variable of data was calculated as: log(CPUE) = ln(pounds of Spanish mackerel/square yard hours). All 2-way interactions among significant main effects were examined. Higher order interaction terms were not examined.

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

Gillnet:

PPT = Year + Total_effort + GN_Endorsement + Subregion + Total_effort*GN_Endorsement

LOG(CPUE) = Year + Subregion + Year*Subregion

Standardization

For gillnet, the final delta-lognormal model was fit using a SAS macro, GLMMIX (Russ Wolfinger, SAS Institute). All factors were modeled as fixed effects except two-way interaction terms containing YEAR which were examined as random effects to be included in the final model. Selection of the final mixed model was based on the Akaike's Information Criterion (AIC), Schwarz's Bayesian Criterion (BIC), and a chi-square test of the difference between the –2 log likelihood statistics between successive model formulations (Littell et al. 1996). For comparison, a relative index and relative nominal CPUE series were calculated by dividing each value in the series by the mean value of the series.

The standardized index of abundance, number of trips, and relative nominal CPUE for gillnet are shown in Table 5.4.3.1. The relative nominal CPUE and standardized index, with 95% confidence intervals, are shown in Figure 5.4.3.1.

5.4.3.2 Sampling Intensity

There were 855 gillnet trips used in the construction of the gillnet index. Proportion positive gillnet trips ranged from 37-79%.

5.4.3.3 Size/Age data

The sizes/ages represented in these indices would likely be reflective of those in the GOM commercial landings.

5.4.3.4 Catch Rates

The relative nominal CPUE and standardized indices, with 95% confidence intervals, are shown in Figure 5.4.3.1.

5.4.3.5 Comments on Adequacy for Assessment

The working group decided against recommending the gillnet index as the method of targeting Spanish mackerel schools and using a runaround gillnet to capture them would like cause 'hyper-stability' in the index and would not be a true reflection of abundance.

5.4.4 Recreational Headboat Index – Spanish mackerel

The Headboat Survey covers the Gulf of Mexico headboats starting in 1986 and was used develop standardized catch per unit effort (CPUE) indices of abundance. This work uses the catch and effort observations from the Headboat Survey to develop standardized catch per unit effort (CPUE) indices of abundance for the recreational fishery for Spanish mackerel (*Scomberomorus maculatus*) in the Gulf of Mexico (GOM). A delta lognormal modeling approach was used to develop these indices. The Species Association Approach (Stephens and

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MacCall 2004) was explored to identify directed Spanish mackerel trips, while balancing these subsets of the data with sample size.

5.4.4.1 Methods for Estimation

The Headboat Survey data were looked at across different strata to assess the sample size of total trips and positive trips within each of the strata. The datasets were spatially partitioned according to the decisions that were made during the SEDAR 28 data workshop plenary sessions. For Spanish mackerel, the stock boundary dividing the Gulf of Mexico from the South Atlantic stock during the data workshop was determined to be the Florida Keys. For Spanish mackerel, the headboat dataset was partitioned where fish surveyed in areas 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 14, 15, and 17 (all the areas shown on the map in Figure 5.4.4.1).

Data filtering techniques

Stephens and MacCall

The Stephens and MacCall (2004) approach was explored to identify Spanish mackerel directed trips. This approach resulted in a large reduction in the Spanish mackerel trips and was therefore not used.

All trips versus positive trips

The SEDAR 28 data workshop Indices Working Group and panel evaluated and discussed the various alternatives to identifying targeted trips, and agreed that they served little utility for the GOM subset of the data. The working group also noted that there was little difference in the indices that were estimated for the entire dataset and the indices estimated for the subset of only positive trips. Therefore, it was decided at the data workshop, that fishing effort for Spanish mackerel would be based on all trips. This decision was made because Spanish mackerel represent an opportunistically captured fish while targeting other species. Therefore, most trips in the Headboat database represents potential fishing effort for Spanish mackerel.

Model Input

Response and explanatory variables

CPUE- catch per unit effort (CPUE) has units of the number of caught to the number of fish caught on a given trip divided by the effort, where effort was calculated as the product of the number of people on the headboat and the hours fished.

Year – A summary of the total number of trips, the number of positive trips, and the percent of positive trips per year is presented in Table 5.4.4.1.

Month –The total number of trips, the number of positive trips, and the percent of positive trips per month and year were summarized due to the significant interaction between month and year however tables cannot be displayed for confidentiality reasons.

Area – The total number of trips, the number of positive trips, and the percent of positive trips per area and year were summarized due to the significant interaction between these factors however tables cannot be displayed for confidentiality reasons.

Standardization

For the indices constructed on the complete datasets, the delta lognormal model approach (Lo et al. 1992) was used. This method combines separate generalized linear model (GLM) analyses of the proportion of successful trips (trips that landed Spanish mackerel) and the catch rates on successful trips to construct a single standardized CPUE index. Parameterization of each model

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was accomplished using a GLM procedure (GENMOD; Version 8.02 of the SAS System for Windows © 2000. SAS Institute Inc., Cary, NC, USA). To estimate the response variable, the proportion of positive trips, a binomial model was used. The GLM procedure was fitted to the observed proportion positive trips using a type-3 model with a binomial error distribution and a logit link function. The second component of the delta lognormal approach is to estimate the natural log of the CPUE using a type-3 model with a lognormal error distribution and a normal link function.

A stepwise approach was used to quantify the relative importance of the explanatory factors. First a GLM model was fit on year. These results reflect the distribution of the nominal data. Next, each potential explanatory factor was added to the null model sequentially and the resulting reduction in deviance per degree of freedom was examined. The factor that caused the greatest reduction in deviance per degree of freedom was added to the base model if the factor was significant based upon a Chi-Square test ($p<0.05$), and the reduction in deviance per degree of freedom was ≥1%. This model then became the base model, and the process was repeated, adding factors and interactions individually until no factor or interaction met the criteria for incorporation into the final model. All 2-way interactions among significant main effects were examined, however higher order interaction terms were not examined. The final delta-lognormal model was fit using a SAS macro, GLIMMIX (Russ Wolfinger, SAS Institute). All factors were modeled as fixed effects except two-way interaction terms containing year which were modeled as random effects. 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 entire time-series.

5.4.4.2 Sampling Intensity

The resulting data set contained 186,184 trips with 38.89% positive Spanish mackerel trips (Table 5.4.4.1).

5.4.4.3 Size/Age data

The sizes/ages represented in this index should be the same as those of landings from the corresponding fleet.

5.4.4.4 Catch Rates

Standardized catch rates and confidence intervals are shown in Figure 5.4.4.2 and tabulated in Table 5.4.4.3. Figure 5.4.4.3 shows the Q-Q plot of the CPUE observations and Figure 5.4.4.4 shows the binomial fit to the observed proportion positive Spanish mackerel trips.

5.4.4.5 Uncertainty and Measures of Precision

95% confidence intervals were calculated from the mean square error output from the GLM procedures.

5.4.4.6 Comments on Adequacy for Assessment

The WG group decided that this index was suitable for assessment.

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5.4.5 Recreational MRFSS Index – Spanish mackerel

MRFSS provides information on participation, effort, and species-specific catch. Data are collected to provide catch and effort estimates in two-month periods ("waves") for each recreational fishing mode (shore fishing, private/rental boat, charterboat, or headboat/charterboat combined) and area of fishing (inshore, state Territorial Seas, U.S. Exclusive Economic Zone) in each state, except TX. MRFSS was conducted in TX through 1985 and did not include all modes in all years. Starting in 1986, MRFSS no longer covered headboats in the Gulf of Mexico and South Atlantic. Catch estimates are made for strata used in the intercepts: fish landed whole and observed by the samplers ("Type A"), fish reported as killed by the fishers ("Type B1") and fish reported as released alive by the fishers ("Type B2").

This work uses the catch and effort observations from the MRFSS database to develop standardized catch per unit effort (CPUE) indices of abundance for the recreational fishery for Spanish mackerel (*Scomberomorus maculatus*) in the Gulf of Mexico (GOM). A delta lognormal modeling approach was used to develop these indices.

The MRFSS data set was evaluated across different strata to assess the sample size of total trips and positive trips within each of the strata. Data from Texas, present in the years 1981 through 1985, were removed from the MRFSS data because the State of Texas has its own survey. In addition, data from the headboat mode in MRFSS, also present in the years 1981 through 1985, was removed because this information is covered by the Headboat Survey program.

The dataset was partitioned according to the decisions that were made during the SEDAR 28 data workshop during the plenary sessions. The stock boundary for GOM Spanish mackerel was determined to be the Florida Keys at the Monroe County line.

For the MRFSS data, if there were anglers on a trip that actively fished but were not interviewed, the data were adjusted to account for the catch and effort of these non-interviewed anglers. This adjustment was made by dividing the total catch made by those individuals who were interviewed by the number of people interviewed. This average catch per person was then multiplied by the number of anglers that were not interviewed and the resulting catch was then added to the total catch for that trip.

5.4.5.1 Methods for Estimation

Data filtering techniques

Stephens and MacCall

The Stephens and MacCall (2004) approach was explored to identify Spanish mackerel directed trips. This approach resulted in a large reduction in the Spanish mackerel trips and was therefore not used.

All trips versus positive trips

The SEDAR 28 data workshop Indices Working Group and panel evaluated and discussed the various alternatives to identifying targeted trips, and agreed that they served little utility for the GOM subset of the data. The working group also noted that there was little difference in the indices that were estimated for the entire dataset and the indices estimated for the subset of only positive trips. Therefore, it was decided at the data workshop, that fishing effort for Spanish mackerel would be based on all trips. This decision was made because Spanish mackerel

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represent an opportunistically captured fish while targeting other species. Therefore, most trips in the MRFSS database represent potential fishing effort for Spanish mackerel.

Model Input

Response and explanatory variables

CPUE- catch per unit effort (CPUE) has units of the number of caught to the number of fish caught on a given trip divided by the effort, where effort was calculated as the product of the number of people on the headboat and the hours fished.

Year – A summary of the total number of trips, the number of positive trips, and the percent of positive trips per year is presented in Table 5.4.5.1.

Month – Tables 5.4.5.2-5.4.5.4 summarize the total number of trips, the number of positive trips, and the percent of positive trips per month and year due to the significant interaction between month and year.

Mode – Table 5.4.5.5 summarizes the total number of trips, the number of positive trips, and the percent of positive trips per mode and year.

State – Table 5.4.5.6 summarizes the total number of trips, the number of positive trips, and the percent of positive trips per state and year due to their significant interaction.

Standardization

For the indices constructed on the complete datasets, the delta lognormal model approach (Lo et al. 1992) was used. This method combines separate generalized linear model (GLM) analyses of the proportion of successful trips (trips that landed Spanish mackerel) and the catch rates on successful trips to construct a single standardized CPUE index. 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). To estimate the response variable, the proportion of positive trips, a binomial model was used. The GLM procedure was fitted to the observed proportion positive trips using a type-3 model with a binomial error distribution and a logit link function. The second component of the delta lognormal approach is to estimate the natural log of the CPUE using a type-3 model with a lognormal error distribution and a normal link function.

A stepwise approach was used to quantify the relative importance of the explanatory factors. First a GLM model was fit on year. These results reflect the distribution of the nominal data. Next, each potential explanatory factor was added to the null model sequentially and the resulting reduction in deviance per degree of freedom was examined. The factor that caused the greatest reduction in deviance per degree of freedom was added to the base model if the factor was significant based upon a Chi-Square test ($p<0.05$), and the reduction in deviance per degree of freedom was ≥1%. This model then became the base model, and the process was repeated, adding factors and interactions individually until no factor or interaction met the criteria for incorporation into the final model. All 2-way interactions among significant main effects were examined, however higher order interaction terms were not examined. The final delta-lognormal model was fit using a SAS macro, GLIMMIX (Russ Wolfinger, SAS Institute). All factors were modeled as fixed effects except two-way interaction terms containing year which were modeled as random effects. 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 entire time-series.

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The model used for standardization was:

$$Success = \mu + (Year)\alpha_1 + (Month)\alpha_2 + \varepsilon$$

$$\ln(CPUE) = \mu + (Year)\alpha_1 + (Mode)\alpha_2 + (State)\alpha_3 + (Month)\alpha_4 + (Year * Month)\alpha_5 + (Year * State)\alpha_6 + \varepsilon$$

5.4.5.2 Sampling Intensity

The resulting data set contained 559,659 trips with 4.77% positive Spanish mackerel trips (Table 5.4.5.1).

5.4.5.3 Size/Age data

The sizes/ages represented in this index should be the same as those of landings from the corresponding fleet.

5.4.5.4 Catch Rates

Standardized catch rates and confidence intervals are shown in Figure 5.4.5.1 and tabulated in Table 5.4.4.3. Figure 5.4.5.2 shows the Q-Q plot of the CPUE observations and Figure 5.4.5.3 shows the binomial fit to the observed proportion positive Spanish mackerel trips.

5.4.5.5 Uncertainty and Measures of Precision

95% confidence intervals were calculated from the mean square error output from the GLM procedures.

5.4.5.6 Comments on Adequacy for Assessment

The WG group decided that this index was suitable for assessment.

5.4.6 Florida Trip Ticket

There were eight indices for Spanish mackerel developed from Florida trip tickets: Atlantic Coast (ATL) gill nets for 1986-June 30, 1995 (ATL_GN_early), ATL gill nets for July 1, 1995 to 2010 (ATL_GN_after), ATL cast nets for 1996-2010 (ATL_CN), ATL hook and line gears for 1985-2010 (ATL_HL), Gulf of Mexico (GULF) gill nets for 1986-June 30, 1995 (GULF_GN_early), GULF gill nets for July 1, 1995 to 2010 (GULF_GN_after), GULF cast nets for 1996-2010 (GULF_CN), GULF hook and line gears for 1985-2010 (GULF_HL). Each of the GN and CN indices were analyzed during time periods when trip limits allowed more than 1,500 pounds of Spanish mackerel to be landed, and each of the HL indices used data for time periods when trip limits allowed greater than 500 pounds of Spanish mackerel to be landed. The logic behind these choices for trip limits was that it was less likely for the landings from these trips using these gears to exceed the prevailing trip limit and therefore the landing may be more likely to reflect the availability of fish on that trip.

Introduction

Established by the Florida Legislature in Florida Statute (F.S.) 370.026 during 1983, the Florida Marine Fisheries Commission in conjunction with the Department of Natural Resources (DNR) [1]

[1] The Department of Natural Resources was established by the Florida Legislature in 1968, and incorporated the Florida Board of Conservation into it's structure. Later, in 1993, Governor Lawton Chiles combined the Department of Natural Resources and the Department of Environmental Regulation into a single agency called the Department

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was charged with conserving and managing Florida's marine fisheries. In late-1984, the DNR implemented the mandatory reporting of detailed trip-level commercial fishery landings data by wholesale and retail seafood dealers using marine fisheries trip tickets. Prior to this time, commercial fisheries data was collected from seafood dealers on a monthly basis by the National Marine Fisheries Service (NMFS). Data were collected by both the NMFS and the DNR trip ticket system during 1985 to enable a comparison of the new data collection system. After determinations that the monthly dealer summaries and the detailed trip ticket information were comparable, the trip ticket system became the official commercial fisheries landings data collection system in Florida.

Wholesale and retail dealers operating in Florida are required to purchase dealer licenses, and wholesale dealers that purchase saltwater products (marine fish, invertebrates, live marine specimens, etc.) from commercial fishermen or wholesale and retail dealers that catch saltwater products themselves for sale in Florida are required to report these amounts on marine fisheries trip tickets to the Florida Fish and Wildlife Conservation Commission. Exceptions to the reporting requirements are: 1) restaurants who harvest their own catch for consumption on their premises; 2) transshipments of saltwater products after landing in Florida for destinations outside of the state for which no purchase occurred (e.g., a corporate vessel landing saltwater products at a Florida port without receiving payment and shipping product to another state). Fishermen who harvest saltwater products commercially are required to purchase Saltwater Products Licenses and sell only to licensed wholesale seafood dealers or sell their catches directly to the public if they have a retail dealer license. Fishermen may also be required to have additional license endorsements and federal permits for the legal harvest and sale of some species (e.g., Spanish mackerel).

Trip tickets have been used by wholesale and retail seafood dealers for the reporting of fish and invertebrates purchased in Florida from fishermen since the system's inception in 1984. There have been revisions to the trip ticket fields and the mandatory nature of some fields over time, as well as additions of new species codes, gear codes, and reporting units. Seafood dealers are required to report the preceding month's purchases from fishermen by the tenth day of the month following transaction. In the case of quota-managed species like Spanish mackerel, weekly reporting is required. Time lags for data entry of submitted paper forms is approximately four weeks after forms are received. Editing of computerized data typically takes two to three weeks. Computerized reporting of trip tickets, which eliminates the time lag for data entry, has occurred as early as 1987, and there has been considerable growth in level of computerized reporting by seafood dealers over the years.

5.4.6.1. Methods of Estimation

Geographic range

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of Environmental Protection. During the 1998 general election, a majority Florida voters approved an amendment to the Florida Constitution which combined the Florida Game and Freshwater Fish Commission, the Florida Marine Fisheries Commission, and portions (chiefly, most of the Division of Marine Resources and most of the Florida Marine Patrol) of the Department of Environmental Protection into a single commission. The Florida Legislature, on July 1, 1999, formed the new Florida Fish and Wildlife Conservation Commission in fulfillment of that amendment.

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All commercial harvests landed and sold in Florida are required to be reported on Florida marine fisheries trip tickets. Reports are required to have all mandatory information submitted with the landings data. The area fished information required on trip tickets is based on the NMFS' shrimp grid zones (see SEDAR28 –AW01). Additional areas fished for locations outside of Florida are available, and supplied to dealers upon request.

Assignment of fishing gears to trips:

At the time of applying for or renewing Saltwater Products License (SPL), fishermen were asked to indicate their use of fishing gears for the upcoming license year. Many license holders indicated more than one gear on their annual license application or renewal, and some did not indicate any gear at all. From the inception of the Florida trip ticket program until February of 1990, a "gear fished" field was not on the trip ticket so analysts inferred the gear used by a combination of the reported catch (species, amounts) and the gear fields on a fisherman's SPL license application. Beginning in 1990, the trip ticket was revised to include the gear fished field which consisted of rather generic "check boxes" for gears and a 4-digit gear code if the reporting of a more specific gear was desired. Old trip tickets were still in use for a couple of years, so not all records from 1990 to 1992 contained gear information. As the old stocks of trip tickets were used up by dealers, the reporting of gear used by trip increased.

Gear related to trip tickets was retrieved from the Saltwater Products (SPL) license record for the 1986 to 1992 license years during the editing of trip tickets, and this "gear" record was retained in the trip ticket data base. The SPL number was prohibited from being retained on the trip ticket by the Florida legislature when then trip ticket program was initially approved, but later was allowed to be retained in the trip ticket data base in late 1986.

For trip tickets from 1986-1992, gear was assigned from the commercial fishing license application database (which was retained on the edited trip ticket record) based on a species/gear hierarchy from later years where gear was reported by trip. Target species and species groups were identified on trips where gear was reported from 1991-1994. The species-gear associations from these data were ranked from most common to least common and applied to the trip ticket data from 1986-1992. The target species (defined as the species with the highest poundage) and species groups were identified on trips where gears was not reported by trip from 1986-1992. Gear was assigned to each trip based on matching the species-license gear association with the species-ticket gear association from the 1991-1994 data. Gears by trip for these analyses were grouped into gill net, cast net, trawls, hook and line gears, and other. If gears were not determined for a trip (no license-gear information in the 1986-1992 period, or missing from the trip ticket from 1993-2011), the trip ticket was dropped from the analyses. The majority of Spanish mackerel landings were categorized as one of these gear types, and analyses for gill nets, cast nets, and hook and line gears are provided in this report.

At the Data Workshop, the Indices workgroup examined the preliminary results and suggested that the hook-and-line gear assignments for the 1986-1992 period may have included some landings exceeding reasonable limits for trips using this gear. Trips for this period were re-analyzed and landings in excess of the 99th percentile were excluded from the analyses. For the Florida Atlantic coast Spanish mackerel trips, those with landings greater than 840 pounds were excluded. For Florida Gulf coast Spanish mackerel trips, those with landings greater than 1,223 pounds were excluded. Trips from 1991-1994 where gear was reported on the trip ticket were

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also analyzed for maximum landings of Spanish mackerel on hook-and-line trips. The results from those years verified the 99th percentiles calculated from 1986-1992. The analyses in this report incorporate the recommendations of the Indices workgroup.

Species and species groups
As in SEDAR 17, trip tickets with Spanish mackerel ("positive" trips) were selected for analyses. A suitable method for selecting a universe of trips to evaluate (i.e., all trips which could have caught Spanish mackerel – zeros as well as positives) has not been developed yet, but possibly could be done using clustering techniques (e.g., Shertzer and Williams 2008) or other selection procedure (e.g., Stephens and MacCall 2004).

Species were assigned to fishery groups based upon fishery characteristics. The pounds landed by fishery group were summed for a trip ticket. Spanish mackerel was assigned to its own "group" since this was the species of interest for developing indices. For the purposes of developing the indices, a fishery group was classed as present or absent for the analyses.

Trip limits
Limits on harvest (pounds) of Spanish mackerel per trip during specific periods of the year would potentially affect the observed catch per trip, so the trip limits that were in effect during these periods were added to the trip ticket records. The dates for these trip limits for Atlantic Group Spanish mackerel were taken from SEDAR 17 (index code from Paul Conn, NMFS Beaufort Laboratory, personal communication) and from Sue Gerhart (NMFS SERO, personal communication). Some of the trip limits were based on day of the week. Gill net and cast net trips with trip limits greater than 1,500 pounds and hook and line trips with trip limits greater than 500 pounds were selected for analyses as in SEDAR 17. There were no periods on the Florida Gulf of Mexico Coast when trips were limited as to the number of pounds harvested or landed.

Unit measure of abundance:
Pounds of Spanish mackerel landed on a trip was the response variable for most models (gamma models), and in a few cases the pounds of Spanish mackerel were log transformed (lognormal models).

Trips with Spanish mackerel (pounds whole weight landed) were selected by coast, gear, time period, and trip limit in effect. The pounds of other species landed on the same trip ticket were grouped by fishery code, and converted to '1' or '0' to indicate presence or absence from the landings for a trip. Year, month, Florida sub-region, and fishery codes were the twelve classification variables used to examine for trends in the amount (pounds) of Spanish mackerel landed.

A general linear model [GENMOD procedure (SAS Institute Inc. 2008)] using a forward stepwise selection technique was used to estimate trends in catch per trip by gear and coast. Two types of model probability distributions were explored: gamma (with a log link function) and lognormal. When the lognormal distribution was used, the pounds of Spanish mackerel landed were log-transformed and the model used a normal probability distribution with an identity link function. The forward selection process analyzes the null model (no class variables chosen), and

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then each class variable added singly in the model. If the GLM successfully converged, the reduction in deviance from the null model is assessed for each of these runs, and the class variable with the largest percentage reduction in deviance, a significant χ^2 (Chi-square) value, and a lower AICc than other class variables is selected for the model. The next series of model runs includes the variable selected in the previous series along with each of the remaining variables (one at a time), and each of the resulting two variable models are assessed for model convergence, the largest percentage reduction in deviance from the null model and significance criteria (χ^2, AICc) as before. This process continues until the percentage reduction in deviance becomes less than some desired level. For these model runs, a 0.25% reduction in deviance from the null model was the selected level of acceptance for a suite of class variables. If there were cases when the variable of interest (in this case, year was important) failed to be selected, it would have been included in the model statement so that a year effect could be estimated. However, all of the models included year using the criteria described. Annual values (and associated coefficients of variation) were estimated using the least squares mean method (SAS Institute Inc. 2008) for the year effect.

The model results from the forward stepwise selection of variables for the linear models are in SEDAR28-AW01, and the diagnostic plots (standardized residuals by year, q-q plot, and standardized residuals versus the fitted distribution) and scaled index values (index values scaled to their means) over time are also in SEDAR28-AW01. The adjusted average catch rates (pounds per trip), coefficient of variation (as a percentage of the mean), and the scaled index values are in Tables 5.4.6.1-5.4.6.2. Nominal average catch rates (simple averages) and adjusted averages by gear, and a comparison of the annual scaled index values by gear are detailed in SEDAR28-AW01.

5.4.6.2. Sampling Intensity

Temporal and spatial resolution:
Quotas for Spanish mackerel are managed by the NMFS for the South Atlantic Fishery Management Council (SAFMC) and the Gulf of Mexico Fishery Management Council (GMFMC). The boundary separating the SAFMC and GMFMC in Florida for Spanish mackerel is the line dividing Monroe County (Florida Keys) and Miami-Dade County. For SEDAR 28, discussions during a conference call expressed the desire, if possible, to divide the landings by US 1 in the Florida Keys which corresponds to the councils' jurisdictional boundaries rather than the boundaries used for managing Spanish mackerel quotas.

The separation of landings of Spanish mackerel to coincide with the council jurisdictions rather than how they are currently managed was approximate. Landings were first assigned to a migratory group based upon the area fished (if present on the trip ticket) or county landed corresponding to the quota management regime (separated at the Monroe County and Miami-Dade County boundary) so that any trip limits in effect could be assigned to the records. Once the migratory group was determined, landings were categorized based on the quota management boundaries as either Atlantic Coast or Gulf Coast, and separately by area fished (if present on the trip ticket) and county landed for SEDAR 28. Gulf group Spanish mackerel, if reported from areas 748 or 1 (Florida Keys) were classed as Atlantic Coast landings for SEDAR 28, while those in area 2 were considered Gulf Coast landings. If area fished was not reported on trip tickets from Monroe County (especially prior to 1992 when the reporting of this field was

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optional), the landings were considered to belong to the Gulf Coast. [There is a portion of area 2 that is in the SAFMC jurisdiction, but dividing catches into each council jurisdiction for area 2 is difficult to accomplish unless there are gear restrictions (e.g., SAFMC long line regulations)]. Additionally, the county of landing for Spanish mackerel was grouped into Florida subregions for these analyses. The subregion groupings were Nassau to Brevard (subregion 5), Indian River to Miami-Dade (subregion 4), Monroe County (subregion 3), Collier-Levy (subregion 2), and Dixie-Escambia (subregion 1). Landings may occur in a county in some years but not in others, and this situation can lead to missing cells in the general models that could result in model instability or inappropriate estimates for class variables. Two subregion groupings were devised. The first was based solely on county landed (corresponding to the usual subdivision of Florida landings in the NMFS commercial landings (Nassau County to Miami-Dade County landings are assigned to the Florida Atlantic Coast, and Monroe County to Escambia County are assigned to the Florida Gulf of Mexico Coast). A second subregion grouping modified the subregion based upon area fished (if reported on the trip ticket) as outlined in the preceding paragraph.

Series period:
Florida trip tickets reported for the time period of 1986 to 2010 were used for developing the indices. The hook and line indices were developed over the entire period by coast. Because of the entangling net limitations implemented in Florida on July 1, 1995, trip tickets with the reported or assigned gear of gill nets were split into groups before and after this date by coast. Trip tickets where cast nets were the reported gear were only used after this date because of the rare use of this gear type prior to the net limitation date.

5.4.6.3. Size/Age Data

Not included as part of this index analysis.

5.4.6.4. Catch Rates – Number and Biomass

See Tables 5.4.6.1-5.4.6.2.

5.4.6.5. Uncertainty and Measures of Precision

Gill net and cast net trips were problematic. There are different methods to deploy gill nets (which may have different mesh sizes, lengths, and panels) and each method targets and catches fish differently which can affect the amounts of catch. The highest catches on trips were from run-around gill nets, where a school or portion of a school of fish is surrounded by an actively fished gill net and the fish are "startled" into the net by noise (e.g., by jumping on the bottom of the boat or some other method). If the target species was Spanish mackerel, landings could be in the thousands to tens of thousands of pounds. If the target species was not Spanish mackerel, there may only be a few pounds (i.e., Spanish mackerel may have been part of the retained bycatch). Gill nets may also be fished anchored to the bottom (stab nets, anchored gill nets) as a more passively fished gear, or may drift on the current (drift gill nets). There have also been restrictions on the amount of soak time in some years (e.g., to reduce the potential encounter with marine turtles), and on transfers of catch at sea. The specific type of gill net deployment is not often provided on trip tickets. Prior to July 1, 1995, gill nets could be used in state as well as in federal waters. After Florida's net limitations (Article X of the Florida Constitution) went into effect on July 1, 1995, usage of entangling nets was limited to federal waters only, and other nets (seines, trawls, cast nets) usable in state waters were limited to 500 square feet or smaller in

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mesh area. Changes in the way gears are designed (mesh sizes, panels, depth, etc.), used (deployment method, soak time, etc.), and non-specific gear identification (e.g., "gill nets") make interpretation of patterns observed in the data more complex especially when trying to develop indices of abundance.

In retrospect, there were issues with the choice of the time period analyzed for the gill net indices. Because the four GN indices (2 ATL and 2 GULF) included only a partial year for 1995, the model may not give an appropriate "annual" value for 1995 since it would be based on only 6 months of the year. It may be more appropriate, if these indices are accepted for use, to drop all of the 1995 data from the GN indices.

Catches of Spanish mackerel were infrequent from cast nets until after Florida's net limitations. Several years after the passage of Article X, some fishermen on the southeastern coast of Florida developed a thrown net effective at catching Spanish mackerel especially in an area of shallow offshore hard bottom [offshore of "Peck's Lake", about 3-5 miles southeast of St. Lucie Inlet, Martin County (Hartig, 2007)]. While called a cast net, it is not the typical cast net used for bait fish or mullet. It is of larger mesh, more heavily weighted to sink more quickly, and when retrieved the net does not "purse" in the usual way. In southwest Florida, this type of modified cast net is not being used, and cast net-caught Spanish mackerel are a bycatch species from other nearshore fisheries.

The more important limitation to all of the indices produced is that they are based upon only "positive" trips (i.e., trips when Spanish mackerel were landed). Ideally, an index of abundance includes a component estimating the probability of encountering the target species on a trip ("zero" trips on which the target species might have been caught but was not, and "positive" trips on which the species was caught) as well as a component estimating the rate of capture on a trip (the number or weight of the target species caught on "positive" trips). Including "zero trips" (trips which could have but did not land Spanish mackerel) would be a refinement that would enhance an index's potential value as an indicator of abundance.

5.4.6.6. Comments on Adequacy for Assessment

The indices produced had reasonable fits to the distributions used and most had relatively modest coefficients of variation. The period of time covered by the indices were relatively long (ten years for gill nets over the 1986-1995 period, sixteen years for gill nets for the 1995-2010 period, fifteen years for cast nets over 1996-2010, and 25 years for hook and line gears over 1986-2010). The hook-and-line gears index may be more reliable indicator of abundance because of selectivity issues that complicate the interpretation of data from trips using gill nets (e.g., deployment methods, mesh sizes, configuration of panels, and changes in state/federal waters restrictions) and cast nets (e.g., configuration, depth, bottom types).

Cast Net Index

This index was not recommended for use. It's potentially useful as a year class indicator, but has gear saturation effects, limited spatial extent, and hyperstability issues since it's targeting large schools. Only trips that did not hit up against the trip limits were included in the analysis.

Gillnet Index

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This index was not recommended for use. This index is from a longer time series than the commercial logbook data, and similar trends to the logbook data. But it has hyperstability issues and concerns regarding spatial overlap between gear and population. Changes in the way gill nets are designed and used, and non-specific gear identification on trip tickets (e.g. "gill nets") make interpretation of patterns observed in the data more complex. Only trips that did not hit up against the trip limits were included in the analysis.

Handline/Trolling Index
This index was recommended for use. The data used for this index occurs over a long time series and has similar trends to the commercial logbook data. It also samples the entire fishery, both inshore and offshore.

5.5 Literature Cited

Lo, N.C.H., L.D. Jacobson, and J.L. Squire. 1992. Indices of relative abundance from fish spotter data based on delta-lognormal models. *Canadian Journal of Fisheries and Aquatic Science* 49:2515-2526.

Ortiz, M. 2006. Standardized catch rates for gag grouper (*Mycteroperca microlepis*) from the marine recreational fisheries statistical survey (MRFSS). Southeast Data Assessment and Review (SEDAR) Working Document S10 DW-09.

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5.6 Tables

Table 5.3.1.1. Number of stations sampled by shrimp statistical zone during the Summer (top) and Fall (bottom) SEAMAP groundfish survey from 1987-2010.

	Shrimp Statistical Zone																		
Year	3	4	5	6	7	8	9	10	11	13	14	15	16	17	18	19	20	21	Total
1987								30	66	6	20	19	25	20	16	25	28	19	*274*
1988								19	49	5	4	3	19	24	14	25	28	23	*213*
1989								23	30		3	18	25	7	15	20	29	24	*194*
1990									68	11	20	15	23	16	20	23	24	20	*240*
1991									46	12	24	13	23	22	24	18	23	26	*231*
1992								1	45	2	20	24	20	25	12	31	26	20	*226*
1993									45	10	19	17	24	19	14	29	24	22	*223*
1994									61	6	17	22	25	17	20	22	26	22	*238*
1995									44	10	16	18	22	23	13	27	26	21	*220*
1996									46	14	12	19	22	18	17	21	26	25	*220*
1997									44		12	16	22	23	10	28	26	26	*207*
1998									35	2	14	21	25	18	14	22	36	17	*204*
1999									44	7	20	19	20	23	13	25	32	20	*223*
2000									45	2	19	15	19	27	8	29	31	21	*216*
2001									36	7	18	18	13	3	10	9	17	21	*152*
2002									44	11	14	21	27	19	15	25	29	22	*227*
2003									44	9	10	8	2	17	20	22	26	23	*181*
2004									39	11	18	17	20	25	21	19	25	21	*216*
2005									32	10	9	11	16	21	5	28	22	27	*181*
2006									45	11	21	12	20	23	17	23	31	18	*221*
2007									41		6	15	22	23	7	29	32	21	*196*
2008		1	8	11	6	11	8	11	43	24	19	27	23	22	17	24	21	29	*305*
2009		25	17	29	15	16	18	25	68	25	21	38	39	47	55	34	30	24	*526*
2010	31	24	17	24	10	12	14	15	22	5	20	16	21	33	34	27	27	19	*371*
Total	*31*	*50*	*42*	*64*	*31*	*39*	*40*	*124*	*1082*	*200*	*376*	*422*	*517*	*515*	*411*	*585*	*645*	*531*	*5705*

	Shrimp Statistical Zone																		
Year	3	4	5	6	7	8	9	10	11	13	14	15	16	17	18	19	20	21	Total
1987								16	28	15	14	16	17	15	15	15	18	3	*172*
1988								8	28	7	22	17	18	26	19	21	31	20	*217*
1989									43	12	19	17	22	20	17	22	25	26	*223*
1990									52	14	12	23	22	19	18	22	19	27	*228*
1991									47	6	24	14	20	25	24	19	25	22	*226*
1992									33	7	23	14	25	18	17	27	30	18	*212*
1993									72	10	19	17	26	18	16	25	28	18	*249*
1994									50	9	16	21	25	20	21	23	24	20	*229*
1995									40	10	17	18	24	19	14	26	30	19	*217*
1996									45	9	18	19	17	28	13	25	29	24	*227*
1997									44	10	17	20	26	19	18	23	22	24	*223*
1998									44	10	22	14	34	11	15	24	29	22	*225*
1999									42	10	17	18	29	18	12	28	29	22	*225*
2000									43	10	14	22	20	26	12	30	25	21	*223*
2001									21	10	17	19	26	20	14	27	28	23	*205*
2002								1	51	10	13	22	22	23	14	26	30	21	*233*
2003								1	76	9	16	21	24	22	20	23	25	23	*260*
2004									43		11	18	17	27	14	24	30	21	*205*
2005									44	11	20	16	33	18	14	23	24	27	*230*
2006								1	47	7	22	14	18	28	13	23	32	19	*224*
2007									32	9	20	17	18	28	17	20	18	26	*205*
2008			15	14	4	4	3	4	36	18	28	34	42	46	44	19	36	20	*367*
2009		20	21	25	10	21	13	12	49	12	23	23	31	49	48	31	36	24	*448*
2010		9	10	11	18			14	16	7	15	18	26	31	29	18	19	14	*255*
Total		*29*	*46*	*50*	*32*	*25*	*16*	*57*	*1026*	*232*	*439*	*452*	*582*	*574*	*458*	*564*	*642*	*504*	*5728*

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Table 5.3.1.2. Number of stations with a positive occurrence of Spanish mackerel by depth zone during the Summer (top) and Fall (bottom) SEAMAP groundfish survey from 1987-2010.

Year	Depth Zone																							Total
	0506	0607	0708	0809	0910	1011	1112	1213	1314	1415	1516	1617	1718	1819	1920	2022	2225	2530	3035	3540	4045	4550	5060	
1987	1	1	1	2	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	*7*
1988	2	1	0	1	0	1	0	0	0	1	0	1	0	0	0	0	0	0	0	1	0	0	0	*8*
1989	3	1	1	0	2	1	1	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	*11*
1990	2	3	1	2	1	2	1	3	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	*18*
1991	3	1	2	0	1	0	1	2	2	0	0	1	0	1	0	1	0	0	0	0	0	0	0	*15*
1992	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*3*
1993	1	0	1	0	0	0	0	0	1	1	0	0	0	0	0	0	1	0	0	0	0	0	0	*5*
1994	2	0	0	0	0	0	1	0	0	1	1	1	1	1	0	0	0	0	0	0	0	0	0	*8*
1995	3	2	1	0	1	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	*9*
1996	1	1	2	0	0	2	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*8*
1997	1	1	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*5*
1998	2	2	0	2	2	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*9*
1999	1	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	*3*
2000	1	1	1	3	1	2	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	*11*
2001	0	1	0	1	2	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*6*
2002	0	0	2	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	*4*
2003	1	1	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*5*
2004	2	1	0	0	0	1	2	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	*9*
2005	4	2	0	0	1	2	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	*11*
2006	1	3	3	2	1	0	0	1	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	*13*
2007	2	3	0	1	1	0	0	2	1	1	1	1	2	0	2	0	0	0	0	0	0	0	0	*17*
2008	2	3	2	1	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	*10*
2009	0	0	1	0	1	1	5	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	*10*
2010	0	0	3	1	0	0	1	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	*8*
Total	*36*	*28*	*24*	*17*	*17*	*12*	*17*	*10*	*13*	*9*	*5*	*6*	*5*	*4*	*4*	*2*	*2*	*0*	*1*	*1*	*0*	*0*	*0*	*213*

Year	Depth Zone																							Total
	0506	0607	0708	0809	0910	1011	1112	1213	1314	1415	1516	1617	1718	1819	1920	2022	2225	2530	3035	3540	4045	4550	5060	
1987	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	2	0	1	0	0	0	0	*5*
1988	2	2	2	1	3	1	2	2	1	0	1	1	2	1	0	0	2	0	0	0	0	0	0	*23*
1989	1	2	3	2	2	1	1	0	2	0	0	1	0	0	0	0	0	1	1	0	0	0	0	*17*
1990	3	0	4	1	0	1	1	3	2	1	0	2	0	0	1	0	0	0	0	0	0	0	0	*19*
1991	2	1	2	1	2	2	1	1	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	*14*
1992	2	1	2	2	0	1	4	1	0	1	1	3	0	0	0	1	1	1	0	1	0	0	0	*22*
1993	4	2	3	5	1	3	1	1	0	1	1	3	1	1	1	2	0	1	1	2	1	0	1	*36*
1994	2	3	1	0	0	1	0	1	2	0	2	0	0	0	0	0	1	0	0	0	0	0	0	*13*
1995	3	2	0	1	1	1	0	2	1	2	0	0	2	2	0	1	2	2	1	0	0	0	0	*23*
1996	0	3	3	2	1	0	0	1	0	0	1	0	0	1	1	0	0	0	2	0	0	0	0	*15*
1997	0	0	1	1	2	0	0	3	0	1	0	0	0	1	0	0	1	1	1	1	0	1	0	*14*
1998	1	1	0	0	1	2	0	1	0	1	1	4	1	0	1	0	0	1	0	0	0	0	1	*16*
1999	3	4	3	1	2	2	1	1	0	0	0	1	0	1	0	0	0	1	0	0	0	0	0	*20*
2000	3	1	2	4	2	3	2	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	*19*
2001	0	2	2	0	2	2	1	1	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	*12*
2002	0	2	0	0	2	1	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	*7*
2003	0	0	6	6	5	4	3	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	*25*
2004	0	0	0	0	1	2	2	1	1	1	0	1	2	0	1	1	0	1	1	0	0	0	0	*15*
2005	2	1	4	2	3	1	5	2	2	2	1	0	2	1	2	1	1	3	1	0	0	0	1	*37*
2006	2	2	1	2	1	3	1	2	0	2	1	2	0	0	0	0	1	0	0	0	0	0	0	*20*
2007	0	2	2	1	2	4	3	1	1	1	1	1	1	2	0	0	0	0	0	0	0	0	0	*22*
2008	0	0	1	1	1	1	1	1	0	1	3	0	0	2	0	1	0	1	0	0	0	0	0	*14*
2009	0	2	4	1	7	9	5	5	3	3	4	1	3	1	2	1	0	0	0	0	0	0	0	*51*
2010		1	2	5	3	4	1	1	0	0	1	0	0	0	1	1	0	1	1	0	0	0	0	*22*
Total	*30*	*34*	*48*	*40*	*45*	*49*	*35*	*32*	*16*	*17*	*18*	*20*	*15*	*15*	*10*	*10*	*11*	*15*	*12*	*4*	*1*	*1*	*3*	*481*

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Table 5.3.1.3. Summary of the Spanish mackerel data used in these analyses collected by NOAA Fisheries during Summer and Fall SEAMAP groundfish surveys conducted between 1987 and 2010.

Survey Year	Number of Stations	Number Collected	Number Measured	Minimum Total Length (mm)	Maximum Total Length (mm)	Mean Total Length (mm)	Standard Deviation
1987	385	32	14	120	380	237	94
1988	360	104	82	108	406	255	80
1989	358	129	93	116	370	199	53
1990	405	231	137	100	415	196	76
1991	382	147	107	90	422	311	67
1992	363	123	98	130	530	252	84
1993	403	199	138	92	409	234	72
1994	387	78	61	94	389	197	88
1995	371	99	89	51	518	268	95
1996	372	140	78	154	498	267	74
1997	359	34	34	56	378	246	81
1998	357	67	61	55	432	227	74
1999	374	85	68	80	430	234	85
2000	369	156	97	102	371	204	64
2001	302	90	68	73	435	165	60
2002	384	35	28	149	454	264	96
2003	379	193	129	137	369	213	48
2004	356	61	54	98	362	238	75
2005	363	487	166	105	380	205	58
2006	382	82	75	137	407	271	65
2007	347	203	124	51	441	218	68
2008	489	132	100	75	436	225	83
2009	645	204	161	137	405	216	59
2010	389	112	64	70	382	253	80

Total Number of Years	Total Number of Stations	Total Number Collected	Total Number Measured	Overall Mean Total Length (mm)
24	9281	3223	2127	230

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Table 5.3.1.4. Indices of Spanish mackerel (full model) developed using the delta-lognormal model for 1987-2010. The nominal frequency of occurrence, the number of samples (*N*), the DL Index (number per trawl-hour), the DL indices scaled to a mean of one for the time series, the coefficient of variation on the mean (CV), and lower and upper confidence limits (LCL and UCL) for the scaled index are listed.

Survey Year	Frequency	*N*	DL Index	Scaled Index	CV	LCL	UCL
1987	0.03117	385	0.10039	0.31226	0.67432	0.09178	1.06238
1988	0.08333	360	0.33883	1.05392	0.28133	0.60686	1.83033
1989	0.07821	358	0.45726	1.42231	0.29306	0.80108	2.52530
1990	0.09136	405	0.53600	1.66725	0.28593	0.95171	2.92076
1991	0.07592	382	0.28553	0.88814	0.33637	0.46143	1.70944
1992	0.06612	363	0.18879	0.58722	0.31427	0.31786	1.08487
1993	0.09181	403	0.51389	1.59848	0.25684	0.96421	2.64997
1994	0.05426	387	0.23166	0.72057	0.43390	0.31400	1.65358
1995	0.08625	371	0.35457	1.10289	0.28118	0.63524	1.91482
1996	0.06183	372	0.31361	0.97551	0.37302	0.47394	2.00786
1997	0.04735	359	0.09861	0.30674	0.49132	0.12102	0.77745
1998	0.06723	357	0.17563	0.54631	0.34927	0.27717	1.07678
1999	0.06150	374	0.24460	0.76083	0.33175	0.39868	1.45194
2000	0.08130	369	0.36328	1.12998	0.34691	0.57580	2.21755
2001	0.05960	302	0.25269	0.78600	0.38920	0.37086	1.66583
2002	0.02865	384	0.10442	0.32480	0.60282	0.10667	0.98902
2003	0.07916	379	0.45133	1.40387	0.26920	0.82715	2.38271
2004	0.06742	356	0.14970	0.46564	0.29732	0.26016	0.83339
2005	0.12948	363	0.74764	2.32555	0.25517	1.40725	3.84308
2006	0.08639	382	0.28682	0.89216	0.29229	0.50321	1.58175
2007	0.11239	347	0.56336	1.75234	0.28765	0.99706	3.07977
2008	0.04499	489	0.24844	0.77279	0.38643	0.36645	1.62970
2009	0.09457	645	0.33117	1.03011	0.18099	0.71935	1.47512
2010	0.07455	389	0.37753	1.17432	0.26837	0.69299	1.98997

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Table 5.3.1.5. Indices of Spanish mackerel (summer model) developed using the delta-lognormal model for 1987-2010. The nominal frequency of occurrence, the number of samples (*N*), the DL Index (number per trawl-hour), the DL indices scaled to a mean of one for the time series, the coefficient of variation on the mean (CV), and lower and upper confidence limits (LCL and UCL) for the scaled index are listed.

Survey Year	Frequency	*N*	DL Index	Scaled Index	CV	LCL	UCL
1987	0.03784	185	0.18625	0.46182	0.89668	0.09938	2.14620
1988	0.04930	142	0.23456	0.58162	0.73493	0.15626	2.16494
1989	0.07857	140	1.34106	3.32531	0.46395	1.37506	8.04159
1990	0.10465	172	1.40658	3.48777	0.41285	1.57749	7.71131
1991	0.09150	153	0.60189	1.49245	0.52590	0.55551	4.00965
1992	0.02013	149	0.09337	0.23153	1.20364	0.03488	1.53671
1993	0.02685	149	0.19434	0.48189	0.86371	0.10827	2.14481
1994	0.05229	153	0.36121	0.89565	0.86398	0.20116	3.98779
1995	0.06122	147	0.38049	0.94347	0.59443	0.31401	2.83476
1996	0.05479	146	0.39826	0.98753	0.60307	0.32418	3.00825
1997	0.03650	137	0.03294	0.08167	1.29947	0.01117	0.59685
1998	0.06618	136	0.28571	0.70846	0.58943	0.23768	2.11170
1999	0.02041	147	0.04729	0.11726	1.70488	0.01136	1.21085
2000	0.06338	142	0.27592	0.68418	0.57334	0.23557	1.98716
2001	0.05660	106	0.65155	1.61558	0.60729	0.52682	4.95446
2002	0.02703	148	0.10513	0.26067	1.63964	0.02653	2.56104
2003	0.04000	125	0.19127	0.47428	0.79479	0.11702	1.92227
2004	0.06164	146	0.26634	0.66042	0.57553	0.22658	1.92497
2005	0.07746	142	0.48427	1.20081	0.49449	0.47123	3.05996
2006	0.08000	150	0.29427	0.72967	0.52206	0.27334	1.94782
2007	0.12687	134	1.24088	3.07690	0.47541	1.24746	7.58927
2008	0.04372	183	0.29391	0.72879	0.63276	0.22833	2.32618
2009	0.03831	261	0.12175	0.30190	0.69478	0.08605	1.05923
2010	0.04930	142	0.18968	0.47034	0.97410	0.09181	2.40950

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Table 5.3.1.6. Indices of Spanish mackerel (fall model) developed using the delta-lognormal model for 1987-2010. The nominal frequency of occurrence, the number of samples (*N*), the DL Index (number per trawl-hour), the DL indices scaled to a mean of one for the time series, the coefficient of variation on the mean (CV), and lower and upper confidence limits (LCL and UCL) for the scaled index are listed.

Survey Year	Frequency	*N*	DL Index	Scaled Index	CV	LCL	UCL
1987	0.03268	153	0.04749	0.12163	0.97095	0.02383	0.62068
1988	0.12778	180	0.56827	1.45531	0.34682	0.74169	2.85555
1989	0.09140	186	0.26759	0.68529	0.37082	0.33427	1.40490
1990	0.09794	194	0.21522	0.55116	0.39663	0.25661	1.18381
1991	0.07407	189	0.19748	0.50574	0.41327	0.22857	1.11901
1992	0.12000	175	0.33683	0.86261	0.34460	0.44142	1.68569
1993	0.14884	215	0.86505	2.21538	0.27656	1.28719	3.81290
1994	0.06806	191	0.14301	0.36624	0.50194	0.14191	0.94514
1995	0.12500	184	0.53668	1.37442	0.34304	0.70536	2.67811
1996	0.07979	188	0.26482	0.67819	0.43130	0.29689	1.54921
1997	0.06417	187	0.17352	0.44438	0.54814	0.15942	1.23867
1998	0.07979	188	0.22838	0.58487	0.49573	0.22903	1.49355
1999	0.10638	188	0.49804	1.27546	0.37277	0.61995	2.62408
2000	0.10053	189	0.32053	0.82088	0.36157	0.40721	1.65478
2001	0.07186	167	0.21556	0.55205	0.51677	0.20864	1.46068
2002	0.03571	196	0.13674	0.35020	0.78728	0.08731	1.40453
2003	0.11312	221	0.74927	1.91886	0.28751	1.09209	3.37152
2004	0.08721	172	0.21528	0.55133	0.42316	0.24485	1.24147
2005	0.18462	195	1.09266	2.79826	0.29318	1.57568	4.96947
2006	0.10309	194	0.36455	0.93360	0.39451	0.43632	1.99764
2007	0.12155	181	0.32770	0.83924	0.32478	0.44548	1.58106
2008	0.05224	268	0.25678	0.65760	0.46635	0.27081	1.59688
2009	0.17057	299	0.65631	1.68079	0.19864	1.13408	2.49107
2010	0.12291	179	0.69368	1.77651	0.30726	0.97427	3.23934

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Table 5.4.2.1. Gulf of Mexico vertical line relative nominal CPUE, number of trips, and relative abundance index

YEAR	Relative Nominal CPUE	Trips	Proportion Successful Trips	Standardized Index	Lower 95% CI (Index)	Upper 95% CI (Index)	CV (Index)
1998	0.896733	407	1.0	1.110020	0.916881	1.343842	0.095796
1999	0.676905	484	1.0	0.818040	0.685334	0.976443	0.088676
2000	0.959316	602	1.0	0.821822	0.698381	0.967081	0.081515
2001	1.277024	475	1.0	0.928847	0.776205	1.111506	0.089945
2002	0.627930	442	1.0	0.839362	0.697565	1.009984	0.092722
2003	0.624959	409	1.0	0.912561	0.753036	1.105879	0.096293
2004	1.008903	296	1.0	1.067666	0.856744	1.330516	0.110380
2005	1.390524	246	1.0	1.085462	0.853211	1.380934	0.120814
2006	1.328267	219	1.0	1.229151	0.955510	1.581158	0.126418
2007	1.224061	182	1.0	1.006811	0.764985	1.325084	0.137994
2008	0.841146	242	1.0	0.915937	0.718186	1.16814	0.122061
2009	0.969648	323	1.0	0.961957	0.777388	1.190346	0.106818
2010	1.174585	301	1.0	1.302363	1.043055	1.626136	0.111356

Table 5.4.3.1. Gulf of Mexico gillnet relative nominal CPUE, number of trips, proportion positive trips, and relative abundance indices

YEAR	Relative Nominal CPUE	Trips	Proportion Successful Trips	Standardized Index	Lower 95% CI (Index)	Upper 95% CI (Index)	CV (Index)
1998	1.31587	66	0.77273	0.56137	0.09827	3.2068	1.06611
1999	0.85971	153	0.75163	0.36191	0.07981	1.6411	0.87785
2000	0.66704	105	0.66667	0.25462	0.05378	1.2054	0.91108
2001	0.59857	89	0.77528	0.80905	0.19655	3.3302	0.80595
2002	0.45216	62	0.66129	0.07050	0.00871	0.5705	1.40818
2003	1.26842	43	0.62791	2.19239	0.51953	9.2518	0.82409
2004	1.56015	41	0.58537	2.06259	0.48658	8.7433	0.82740
2005	1.17250	47	0.65957	2.37125	0.56209	10.0034	0.82386
2006	0.82636	25	0.60000	0.19907	0.04456	0.8892	0.86644
2007	0.79055	49	0.69388	0.70306	0.16638	2.9709	0.82508
2008	0.95515	46	0.52174	0.56617	0.12659	2.5321	0.86735
2009	1.59290	102	0.79412	0.57952	0.13959	2.4059	0.81215
2010	0.94061	27	0.37037	2.26850	0.47157	10.9126	0.92363

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Table 5.4.4.1. Total number of trips, positive trips, and the percent positive trips by year in the Gulf of Mexico from the Headboat Survey data for Spanish mackerel.

Year	Total Trips	Positive Trips	Percent Positive Trips
1986	4459	134	3.01
1987	4597	186	4.05
1988	6288	95	1.51
1989	6920	123	1.78
1990	10336	270	2.61
1991	9111	381	4.18
1992	10273	322	3.13
1993	10755	232	2.16
1994	10691	334	3.12
1995	9001	166	1.84
1996	8417	166	1.97
1997	8288	143	1.73
1998	7675	90	1.17
1999	6665	125	1.88
2000	6421	181	2.82
2001	6229	73	1.17
2002	6420	132	2.06
2003	6339	101	1.59
2004	6823	131	1.92
2005	6527	133	2.04
2006	5896	143	2.43
2007	6404	262	4.09
2008	6622	325	4.91
2009	8401	325	3.87
2010	6626	215	3.24
Total	186184	4788	38.89

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Table 5.4.4.2. Total number of trips by month and year in the Gulf of Mexico from the Headboat Survey for Spanish mackerel.

Year	Jan.	Feb.	March	April	May	June	July	August	Sept.	Oct.	Nov.	Dec.
1986	218	211	327	320	315	594	762	567	342	300	271	232
1987	205	246	341	418	532	575	653	562	323	272	235	235
1988	223	283	438	582	757	892	1002	779	309	445	265	313
1989	381	437	542	644	710	728	891	860	559	544	363	261
1990	543	601	907	948	895	1161	1250	1204	835	775	656	561
1991	583	638	712	789	797	1062	1189	1015	710	653	473	490
1992	496	573	835	864	1025	1148	1425	1213	802	788	540	564
1993	650	677	858	887	1007	1199	1563	1231	866	799	532	486
1994	462	683	969	1026	1126	1181	1374	1260	823	734	569	484
1995	410	539	789	903	931	1221	1397	1054	753	352	378	274
1996	298	417	497	666	845	1116	1327	1152	789	544	364	402
1997	449	563	735	544	753	1071	1125	1126	747	550	432	193
1998	466	392	642	703	923	970	1317	937	383	433	293	216
1999	325	554	615	633	772	868	945	744	371	347	260	231
2000	239	381	504	643	747	906	1002	731	423	475	210	160
2001	172	365	430	663	742	787	1010	768	492	436	202	162
2002	249	295	478	605	633	895	1078	832	408	505	245	197
2003	223	318	470	546	763	891	958	764	449	508	243	206
2004	323	393	691	721	837	999	1069	690	328	426	181	165
2005	333	342	484	601	923	984	906	698	351	416	264	225
2006	281	333	565	509	711	811	826	612	438	361	279	170
2007	263	334	613	552	688	1016	1011	683	403	377	222	242
2008	178	328	504	678	712	1051	1125	662	278	455	313	338
2009	381	406	648	679	797	1359	1516	1057	471	461	334	292
2010	271	289	588	726	644	917	846	620	427	652	408	238
Total	8622	10598	15182	16850	19585	24402	27567	21821	13080	12608	8532	7337

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Table 5.4.4.3. Standardized indices and corresponding 95% confidence intervals.

	HEADBOAT SURVEY								MRFSS SURVEY							
	Cobia				Spanish Mackerel				Cobia				Spanish Mackerel			
Year	Index	Lower CI	Uppder CI	CV	Index	Lower CI	Uppder CI	CV	Index	Lower CI	Uppder CI	CV	Index	Lower CI	Uppder CI	CV
1981									0.705	0.349	1.424	0.363	0.974	0.523	1.814	0.318
1982									0.898	0.546	1.476	0.252	1.292	0.784	2.131	0.254
1983									0.627	0.324	1.211	0.339	0.826	0.451	1.515	0.310
1984									0.605	0.335	1.092	0.302	0.631	0.325	1.223	0.340
1985									0.532	0.278	1.018	0.333	0.701	0.380	1.293	0.313
1986	0.576	0.411	0.808	0.170	0.816	0.432	1.544	0.327	0.495	0.316	0.775	0.227	1.906	1.256	2.892	0.211
1987	0.560	0.402	0.780	0.166	1.624	0.894	2.949	0.305	0.604	0.394	0.926	0.216	1.395	0.920	2.115	0.210
1988	0.563	0.403	0.785	0.168	0.505	0.263	0.970	0.335	0.860	0.554	1.336	0.223	0.802	0.514	1.252	0.225
1989	0.541	0.384	0.764	0.173	0.789	0.419	1.486	0.324	0.889	0.558	1.417	0.236	1.138	0.717	1.807	0.234
1990	0.709	0.513	0.979	0.162	0.998	0.556	1.793	0.299	1.350	0.885	2.059	0.213	1.851	1.199	2.856	0.219
1991	0.799	0.587	1.089	0.155	2.023	1.145	3.572	0.290	1.505	1.034	2.191	0.190	1.350	0.871	2.092	0.222
1992	0.910	0.700	1.183	0.132	1.288	0.722	2.301	0.296	1.032	0.747	1.425	0.163	1.408	0.976	2.031	0.185
1993	1.259	0.982	1.612	0.124	0.960	0.533	1.732	0.301	1.007	0.695	1.459	0.187	0.657	0.427	1.011	0.218
1994	1.136	0.879	1.467	0.129	1.292	0.726	2.298	0.294	1.440	1.021	2.030	0.173	0.613	0.406	0.926	0.208
1995	1.194	0.914	1.561	0.135	0.777	0.423	1.427	0.311	0.673	0.446	1.014	0.207	0.420	0.262	0.673	0.239
1996	1.147	0.860	1.530	0.145	0.777	0.422	1.431	0.313	1.406	1.004	1.970	0.170	0.736	0.477	1.134	0.219
1997	1.309	0.995	1.723	0.138	0.685	0.367	1.279	0.320	1.734	1.274	2.360	0.155	0.627	0.414	0.950	0.210
1998	1.069	0.801	1.427	0.145	0.353	0.181	0.686	0.342	1.241	0.914	1.686	0.154	0.772	0.521	1.146	0.199
1999	0.955	0.687	1.327	0.165	0.705	0.374	1.329	0.325	1.129	0.852	1.495	0.141	1.315	0.922	1.875	0.179
2000	0.777	0.554	1.089	0.170	1.044	0.568	1.916	0.311	0.915	0.679	1.233	0.150	0.960	0.667	1.383	0.184
2001	1.043	0.750	1.450	0.166	0.401	0.201	0.801	0.357	1.019	0.765	1.356	0.144	0.998	0.688	1.449	0.188
2002	0.980	0.702	1.367	0.168	0.789	0.421	1.481	0.323	1.030	0.777	1.365	0.142	0.912	0.630	1.320	0.186
2003	0.931	0.657	1.319	0.176	0.569	0.292	1.108	0.343	1.158	0.870	1.542	0.144	0.987	0.676	1.440	0.191
2004	1.005	0.718	1.408	0.169	0.523	0.273	1.003	0.334	0.978	0.729	1.312	0.148	1.063	0.738	1.532	0.184
2005	1.271	0.939	1.719	0.152	0.542	0.285	1.031	0.330	0.967	0.705	1.325	0.159	0.712	0.478	1.059	0.201
2006	1.105	0.802	1.522	0.161	1.011	0.544	1.880	0.318	0.889	0.650	1.216	0.158	0.871	0.594	1.277	0.193
2007	1.205	0.884	1.641	0.155	1.552	0.861	2.798	0.301	0.984	0.721	1.343	0.156	0.902	0.620	1.310	0.189
2008	1.153	0.845	1.575	0.157	1.961	1.099	3.498	0.296	1.164	0.864	1.569	0.150	1.003	0.687	1.464	0.191
2009	1.304	0.992	1.714	0.137	1.916	1.088	3.374	0.289	0.960	0.693	1.330	0.164	0.822	0.570	1.187	0.185
2010	1.498	1.133	1.981	0.140	1.098	0.603	2.001	0.307	1.205	0.871	1.666	0.163	1.354	0.923	1.987	0.193

Table 5.4.5.1. Total trips, positive trips, and percentage of positive trips that encountered Spanish mackerel from the MRFSS database as subset for Spanish mackerel.

Year	Total Trips	Positive Trips	Percentage Positive Trips
1981	3760	177	4.71
1982	6633	331	4.99
1983	4286	185	4.32
1984	5200	149	2.87
1985	5930	181	3.05
1986	10551	693	6.57
1987	10506	689	6.56
1988	12467	506	4.06
1989	8968	436	4.86
1990	7723	540	6.99
1991	8568	511	5.96
1992	18782	1243	6.62
1993	17628	636	3.61
1994	20027	758	3.78
1995	18023	413	2.29
1996	18652	622	3.33
1997	19110	682	3.57
1998	22447	930	4.14
1999	30760	1701	5.53
2000	27005	1380	5.11
2001	27225	1391	5.11
2002	28550	1470	5.15
2003	29287	1317	4.50
2004	29978	1704	5.68
2005	27006	1000	3.70
2006	26818	1217	4.54
2007	28081	1415	5.04
2008	28436	1276	4.49
2009	29071	1482	5.10
2010	28181	1637	5.81
	559659	26672	4.77

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Table 5.4.5.2. Total number of trips by month and year in the Gulf of Mexico from MRFSS for Spanish mackerel.

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1981				208	275	330	323	825	327	719	538	215
1982			354	642	1024	800	1061	1003	213	778	443	315
1983	107	103	462	647	498	592	401	376	261	440	156	243
1984	167	482	434	381	675	552	568	239	616	444	458	184
1985	150	275	372	549	552	585	645	503	545	642	552	560
1986	255	647	710	871	918	1120	1189	1031	1038	1017	917	838
1987	463	701	842	1091	1128	1047	1461	834	1060	952	685	242
1988	541	601	707	584	1035	744	1324	1501	1340	1804	1262	1024
1989	889	424	913	513	1249	549	905	978	937	634	688	289
1990	136	735	669	822	740	787	701	682	701	467	780	503
1991	357	707	629	717	786	1091	789	600	763	848	785	496
1992	933	1593	1358	2345	2274	1103	1915	973	1343	2083	1851	1011
1993		1776	1903	1137	1807	1712	1840	1978	1414	1367	1636	1058
1994	1330	1768	1681	1574	1813	2239	2204	1811	1599	1319	1456	1233
1995	1494	1258	1655	1484	1695	1829	1799	1743	1671	1114	1250	1031
1996	954	1041	1342	1728	1671	1809	1586	1998	1429	2205	1562	1327
1997	1143	1175	1505	1435	1917	1882	1796	1670	1949	1876	1774	988
1998	1513	1282	1540	1535	1924	1699	2409	2478	882	2196	2483	2506
1999	3076	2892	3587	3978	2192	2337	3012	2552	1683	1978	1911	1562
2000	1608	2185	2322	2774	2736	2936	2663	2257	2033	2193	1714	1584
2001	1750	1998	2306	2631	2655	2743	2571	2503	2529	1931	2003	1605
2002	1753	1794	2640	2690	2990	3113	2550	2724	2122	2350	2044	1780
2003	1742	2573	2725	2715	3089	3021	3001	2441	2208	2021	2238	1513
2004	1788	1810	2865	2828	3038	3177	3086	2662	1921	2980	1935	1888
2005	2094	1933	2541	2898	3073	2806	2562	2286	1458	1762	1889	1704
2006	1753	1582	2176	2458	2462	2689	2688	2492	2437	2202	1864	2015
2007	1497	1653	2316	2471	2861	3075	2736	2550	2418	2160	2306	2038
2008	1704	2209	2671	2223	2703	2887	2883	2163	1995	2581	2548	1869
2009	2067	1758	2245	2845	3338	2811	2887	2480	2586	2393	2222	1439
2010	1497	1437	2142	2859	3182	2734	2578	2441	2653	2803	2396	1459
Total	32761	38392	47612	51633	56300	54799	56133	50774	44131	48259	44346	34519

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Table 5.4.5.3. Number of positive trips that caught Spanish mackerel by month and year in the Gulf of Mexico from MRFSS for Spanish mackerel.

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1981				10	31	11	16	50	20	27	9	3
1982			7	42	72	49	33	83	4	35	4	2
1983	1	0	0	31	29	24	36	17	16	31	0	0
1984	0	2	4	3	10	52	40	1	13	20	3	1
1985	1	0	1	32	19	33	41	12	4	20	13	5
1986	1	5	12	98	86	111	82	82	77	62	72	5
1987	7	2	16	60	145	80	97	80	125	60	17	0
1988	1	4	15	63	96	49	56	84	44	62	25	7
1989	1	7	8	34	49	9	70	132	77	34	15	0
1990	0	16	43	63	34	37	48	96	98	66	35	4
1991	9	8	27	83	61	65	55	43	78	60	12	10
1992	15	52	162	309	224	65	85	56	59	157	53	6
1993		11	17	62	46	70	31	72	148	81	83	15
1994	3	66	55	115	79	82	59	114	83	45	50	7
1995	3	15	25	36	31	24	30	52	110	52	27	8
1996	1	2	17	96	87	56	75	85	82	80	27	14
1997	11	36	72	51	47	48	72	40	131	96	60	18
1998	14	8	13	62	76	66	108	165	59	125	140	94
1999	69	60	143	284	190	154	149	168	144	182	103	55
2000	24	66	171	182	158	153	142	161	136	113	64	10
2001	8	44	58	208	137	137	94	184	226	105	111	79
2002	16	15	99	229	174	159	120	206	150	192	76	34
2003	13	31	197	162	102	69	76	160	173	170	149	15
2004	20	64	287	246	195	147	118	180	83	201	134	29
2005	22	18	57	176	291	125	84	99	39	42	37	10
2006	4	2	19	131	148	222	175	176	129	109	61	41
2007	41	12	130	264	170	135	112	84	119	127	122	99
2008	21	73	122	165	106	126	104	130	138	158	98	35
2009	18	29	117	111	269	131	107	149	184	181	130	56
2010	8	14	50	265	196	124	176	150	214	289	141	10
Total	332	662	1944	3673	3358	2613	2491	3111	2963	2982	1871	672

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Table 5.4.5.4. Percentage of positive trips that caught Spanish mackerel by month and year in the Gulf of Mexico from MRFSS for Spanish mackerel.

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1981	0.00	0.00	0.00	4.81	11.27	3.33	4.95	6.06	6.12	3.76	1.67	1.40
1982	0.00	0.00	1.98	6.54	7.03	6.13	3.11	8.28	1.88	4.50	0.90	0.63
1983	0.93	0.00	0.00	4.79	5.82	4.05	8.98	4.52	6.13	7.05	0.00	0.00
1984	0.00	0.41	0.92	0.79	1.48	9.42	7.04	0.42	2.11	4.50	0.66	0.54
1985	0.67	0.00	0.27	5.83	3.44	5.64	6.36	2.39	0.73	3.12	2.36	0.89
1986	0.39	0.77	1.69	11.25	9.37	9.91	6.90	7.95	7.42	6.10	7.85	0.60
1987	1.51	0.29	1.90	5.50	12.85	7.64	6.64	9.59	11.79	6.30	2.48	0.00
1988	0.18	0.67	2.12	10.79	9.28	6.59	4.23	5.60	3.28	3.44	1.98	0.68
1989	0.11	1.65	0.88	6.63	3.92	1.64	7.73	13.50	8.22	5.36	2.18	0.00
1990	0.00	2.18	6.43	7.66	4.59	4.70	6.85	14.08	13.98	14.13	4.49	0.80
1991	2.52	1.13	4.29	11.58	7.76	5.96	6.97	7.17	10.22	7.08	1.53	2.02
1992	1.61	3.26	11.93	13.18	9.85	5.89	4.44	5.76	4.39	7.54	2.86	0.59
1993	0.00	0.62	0.89	5.45	2.55	4.09	1.68	3.64	10.47	5.93	5.07	1.42
1994	0.23	3.73	3.27	7.31	4.36	3.66	2.68	6.29	5.19	3.41	3.43	0.57
1995	0.20	1.19	1.51	2.43	1.83	1.31	1.67	2.98	6.58	4.67	2.16	0.78
1996	0.10	0.19	1.27	5.56	5.21	3.10	4.73	4.25	5.74	3.63	1.73	1.06
1997	0.96	3.06	4.78	3.55	2.45	2.55	4.01	2.40	6.72	5.12	3.38	1.82
1998	0.93	0.62	0.84	4.04	3.95	3.88	4.48	6.66	6.69	5.69	5.64	3.75
1999	2.24	2.07	3.99	7.14	8.67	6.59	4.95	6.58	8.56	9.20	5.39	3.52
2000	1.49	3.02	7.36	6.56	5.77	5.21	5.33	7.13	6.69	5.15	3.73	0.63
2001	0.46	2.20	2.52	7.91	5.16	4.99	3.66	7.35	8.94	5.44	5.54	4.92
2002	0.91	0.84	3.75	8.51	5.82	5.11	4.71	7.56	7.07	8.17	3.72	1.91
2003	0.75	1.20	7.23	5.97	3.30	2.28	2.53	6.55	7.84	8.41	6.66	0.99
2004	1.12	3.54	10.02	8.70	6.42	4.63	3.82	6.76	4.32	6.74	6.93	1.54
2005	1.05	0.93	2.24	6.07	9.47	4.45	3.28	4.33	2.67	2.38	1.96	0.59
2006	0.23	0.13	0.87	5.33	6.01	8.26	6.51	7.06	5.29	4.95	3.27	2.03
2007	2.74	0.73	5.61	10.68	5.94	4.39	4.09	3.29	4.92	5.88	5.29	4.86
2008	1.23	3.30	4.57	7.42	3.92	4.36	3.61	6.01	6.92	6.12	3.85	1.87
2009	0.87	1.65	5.21	3.90	8.06	4.66	3.71	6.01	7.12	7.56	5.85	3.89
2010	0.53	0.97	2.33	9.27	6.16	4.54	6.83	6.15	8.07	10.31	5.88	0.69
Total	1.01	1.72	4.08	7.11	5.96	4.77	4.44	6.13	6.71	6.18	4.22	1.95

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Table 5.4.5.5. Total trips, positive trips, and the percentage of positive trips that caught Spanish mackerel by mode and year in the Gulf of Mexico from MRFSS for Spanish mackerel.

Year	Total Number of Trips			Positive Trips			Percentage Positive Trips		
	Shore	Charter	Private/ Rental	Shore	Charter	Private/ Rental	Shore	Charter	Private/ Rental
1981	1937	232	1591	54	32	91	2.79	13.79	5.72
1982	3488	177	2968	83	37	211	2.38	20.90	7.11
1983	2530	362	1394	72	43	70	2.85	11.88	5.02
1984	2955	442	1803	39	59	51	1.32	13.35	2.83
1985	3415	326	2189	39	63	79	1.14	19.33	3.61
1986	1930	1303	7318	89	201	403	4.61	15.43	5.51
1987	2166	1014	7326	90	184	415	4.16	18.15	5.66
1988	3536	1017	7914	62	132	312	1.75	12.98	3.94
1989	2900	770	5298	87	107	242	3.00	13.90	4.57
1990	2449	592	4682	177	118	245	7.23	19.93	5.23
1991	2880	696	4992	105	118	288	3.65	16.95	5.77
1992	5704	1322	11756	375	174	694	6.57	13.16	5.90
1993	7799	901	8928	356	60	220	4.56	6.66	2.46
1994	8935	885	10207	394	68	296	4.41	7.68	2.90
1995	8325	709	8989	173	72	168	2.08	10.16	1.87
1996	6009	883	11760	200	72	350	3.33	8.15	2.98
1997	5881	1484	11745	199	184	299	3.38	12.40	2.55
1998	6691	2539	13217	292	249	389	4.36	9.81	2.94
1999	8693	4859	17208	561	462	678	6.45	9.51	3.94
2000	7093	5480	14432	334	544	502	4.71	9.93	3.48
2001	7284	4259	15682	458	332	601	6.29	7.80	3.83
2002	7322	4376	16852	468	305	697	6.39	6.97	4.14
2003	8008	4997	16282	342	373	602	4.27	7.46	3.70
2004	7281	4966	17731	418	418	868	5.74	8.42	4.90
2005	7271	4043	15692	223	243	534	3.07	6.01	3.40
2006	6872	3218	16728	333	178	706	4.85	5.53	4.22
2007	7355	3394	17332	411	295	709	5.59	8.69	4.09
2008	7423	3345	17668	365	259	652	4.92	7.74	3.69
2009	7863	2873	18335	427	272	783	5.43	9.47	4.27
2010	7858	3077	17246	520	290	827	6.62	9.42	4.80
Total	169853	64541	325265	7746	5944	12982	4.56	9.21	3.99

Table 5.4.5.6. Total number of trips, positive trips, and the percentage of positive trips that caught Spanish mackerel by state and year in the Gulf of Mexico from MRFSS for Spanish mackerel.

Year	Total Number of Trips				Positive Trips				Percentage Positive Trips			
	LA	MS	LA	FL West	LA	MS	LA	FL West	LA	MS	LA	FL West
1981	568	367	422	2403	5	33	48	91	0.88	8.99	11.37	3.79
1982	952	1084	1101	3496	26	71	139	95	2.73	6.55	12.62	2.72
1983	873	544	768	2101	11	40	73	61	1.26	7.35	9.51	2.90
1984	1090	855	723	2532	4	56	58	31	0.37	6.55	8.02	1.22
1985	1603	449	803	3075	9	48	51	73	0.56	10.69	6.35	2.37
1986	3811	1056	884	4800	15	81	105	492	0.39	7.67	11.88	10.25
1987	1563	1035	1276	6632	20	93	153	423	1.28	8.99	11.99	6.38
1988	2254	1243	1060	7910	33	81	55	337	1.46	6.52	5.19	4.26
1989	1659	1040	906	5363	33	73	99	231	1.99	7.02	10.93	4.31
1990	1501	882	771	4569	30	97	118	295	2.00	11.00	15.30	6.46
1991	1746	1020	1172	4630	50	78	91	292	2.86	7.65	7.76	6.31
1992	3869	1977	1630	11306	84	163	106	890	2.17	8.24	6.50	7.87
1993	2645	1173	1129	12681	24	28	64	520	0.91	2.39	5.67	4.10
1994	3013	1547	1388	14079	24	32	83	619	0.80	2.07	5.98	4.40
1995	2649	1204	1112	13058	29	32	69	283	1.09	2.66	6.21	2.17
1996	2732	1414	1392	13114	14	37	90	481	0.51	2.62	6.47	3.67
1997	3059	1411	1319	13321	43	65	60	514	1.41	4.61	4.55	3.86
1998	3178	1526	1711	16032	15	94	93	728	0.47	6.16	5.44	4.54
1999	4325	2106	2065	22264	28	124	226	1323	0.65	5.89	10.94	5.94
2000	4390	1743	1873	18999	42	81	187	1070	0.96	4.65	9.98	5.63
2001	4048	1470	1964	19743	15	61	140	1175	0.37	4.15	7.13	5.95
2002	4314	1362	1781	21093	33	43	81	1313	0.76	3.16	4.55	6.22
2003	4076	1571	1786	21854	20	47	72	1178	0.49	2.99	4.03	5.39
2004	4551	1511	1543	22373	23	38	99	1544	0.51	2.51	6.42	6.90
2005	4018	1074	1960	19954	31	22	62	885	0.77	2.05	3.16	4.44
2006	4718	1602	1679	18819	41	23	80	1073	0.87	1.44	4.76	5.70
2007	4753	1650	2028	19650	24	36	79	1276	0.50	2.18	3.90	6.49
2008	5135	1689	2026	19586	21	46	69	1140	0.41	2.72	3.41	5.82
2009	4698	1703	2218	20452	35	60	82	1305	0.74	3.52	3.70	6.38
2010	4056	1462	1901	20762	6	22	106	1503	0.15	1.50	5.58	7.24
Total	91847	38770	42391	386651	788	1805	2838	21241	0.86	4.66	6.69	5.49

Table 5.4.6.1. Atlantic Coast Spanish mackerel adjusted average pounds per trip for various gears, the coefficient of variation (cv), and index values scaled to mean. Commercial fishery data reported on Florida trip tickets.

Atlantic Coast, Florida Trip Ticket indices

Year	Gill nets, 1986-1995			Gill nets, 1995-2010			Cast Nets, 1996-2010			Hook-and-Line Gears		
	index (adjusted mean pounds/trip)	cv (%)	index scaled to mean	index (adjusted mean pounds/trip)	cv (%)	index scaled to mean	index (adjusted mean pounds/trip)	cv (%)	index scaled to mean	index (adjusted mean pounds/trip)	cv (%)	index scaled to mean
1986	293.08	3.66	1.164							20.6	3.89	0.554
1987	261.54	3.77	1.039							24.8	4.19	0.667
1988	260.30	3.78	1.034							30.5	4.85	0.819
1989	318.60	3.81	1.265							27.4	4.81	0.735
1990	222.98	3.36	0.885							29.8	3.97	0.800
1991	220.92	3.38	0.877							22.2	3.14	0.596
1992	196.23	3.23	0.779							27.3	4.01	0.733
1993	317.52	8.14	1.261							31.7	4.27	0.851
1994	268.34	7.30	1.066							22.6	4.58	0.606
1995	413.17	6.97	1.641	140.04	17.47	1.089				32.2	4.03	0.865
1996				176.33	10.30	1.371	3.84	12.55	0.266	28.1	3.31	0.753
1997				87.60	10.55	0.681	9.31	10.70	0.643	27.5	2.93	0.737
1998				124.92	14.34	0.971	0.80	30.09	0.055	26.7	3.02	0.716
1999				115.57	9.83	0.898	1.77	17.21	0.123	32.6	3.10	0.874
2000				121.39	8.93	0.944	9.45	8.05	0.653	33.9	2.83	0.911
2001				116.63	8.24	0.907	11.12	6.99	0.768	33.8	2.81	0.908
2002				103.10	9.20	0.802	10.25	6.78	0.709	32.3	2.69	0.867
2003				132.28	10.62	1.028	16.84	6.18	1.163	34.9	3.03	0.937
2004				77.32	10.17	0.601	19.11	6.24	1.321	45.3	3.01	1.216
2005				149.37	9.09	1.161	15.53	6.94	1.073	44.0	2.73	1.181
2006				155.75	8.71	1.211	15.89	6.50	1.098	47.1	2.80	1.264
2007				144.42	8.98	1.123	10.01	6.49	0.692	40.8	2.58	1.096
2008				143.07	9.13	1.112	12.01	6.39	0.830	42.1	2.42	1.129
2009				128.61	9.09	1.000	12.59	6.19	0.870	55.7	2.24	1.496
2010				103.42	9.50	0.804	20.29	6.24	1.402	47.9	2.25	1.286

Table 5.4.6.2. Gulf Coast Spanish mackerel adjusted average pounds per trip for various gears, the coefficient of variation (cv), and index values scaled to mean. Commercial fishery data reported on Florida trip tickets.

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Gulf Coast, Florida Trip Ticket indices

Year	Gill nets, 1986-1995			Gill nets, 1995-2010			Cast Nets, 1996-2010			Hook-and-Line Gears		
	index (adjusted mean pounds/trip)	cv (%)	index scaled to mean	index (adjusted mean pounds/trip)	cv (%)	index scaled to mean	index (adjusted mean pounds/trip)	cv (%)	index scaled to mean	index (adjusted mean pounds/trip)	cv (%)	index scaled to mean
1986	153.66	2.96	0.602							29.1	4.41	0.694
1987	167.59	2.63	0.656							22.8	4.12	0.545
1988	208.84	3.07	0.818							30.8	4.54	0.735
1989	202.50	2.90	0.793							64.4	5.37	1.539
1990	202.82	2.45	0.794							41.7	4.97	0.996
1991	276.62	2.33	1.083							45.8	4.85	1.095
1992	312.84	2.29	1.225							45.9	5.71	1.097
1993	316.03	2.64	1.238							25.3	6.41	0.604
1994	340.55	2.50	1.334							43.6	5.93	1.042
1995	253.04	3.47	0.991	91.92	32.56	0.449				39.7	7.41	0.949
1996				176.80	15.64	0.864	70.22	32.49	0.937	30.4	6.10	0.727
1997				84.12	18.36	0.411	28.41	33.48	0.379	33.2	7.31	0.794
1998				84.41	15.62	0.412	63.69	33.40	0.850	48.3	7.34	1.155
1999				141.49	17.34	0.691	72.52	34.57	0.967	40.1	7.05	0.958
2000				104.05	15.60	0.508	69.03	32.37	0.921	31.8	6.73	0.760
2001				265.83	17.14	1.299	137.15	32.24	1.830	59.7	6.48	1.427
2002				355.52	23.53	1.737	93.54	32.50	1.248	46.0	6.46	1.100
2003				324.07	22.02	1.583	55.96	32.86	0.747	54.0	6.56	1.289
2004				630.82	27.22	3.082	43.78	36.05	0.584	66.7	7.46	1.594
2005				459.92	22.91	2.247	49.32	33.68	0.658	46.9	7.56	1.119
2006				221.10	22.75	1.080	103.91	33.52	1.386	62.4	6.98	1.490
2007				233.38	21.61	1.140	37.92	36.85	0.506	49.1	6.75	1.173
2008				173.62	18.50	0.848	51.93	34.80	0.693	45.4	7.83	1.086
2009				527.11	20.22	2.575	59.25	34.57	0.790	59.9	5.85	1.431
2010				307.85	22.80	1.504	148.04	35.58	1.975	66.7	5.89	1.594

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5.7 Figures

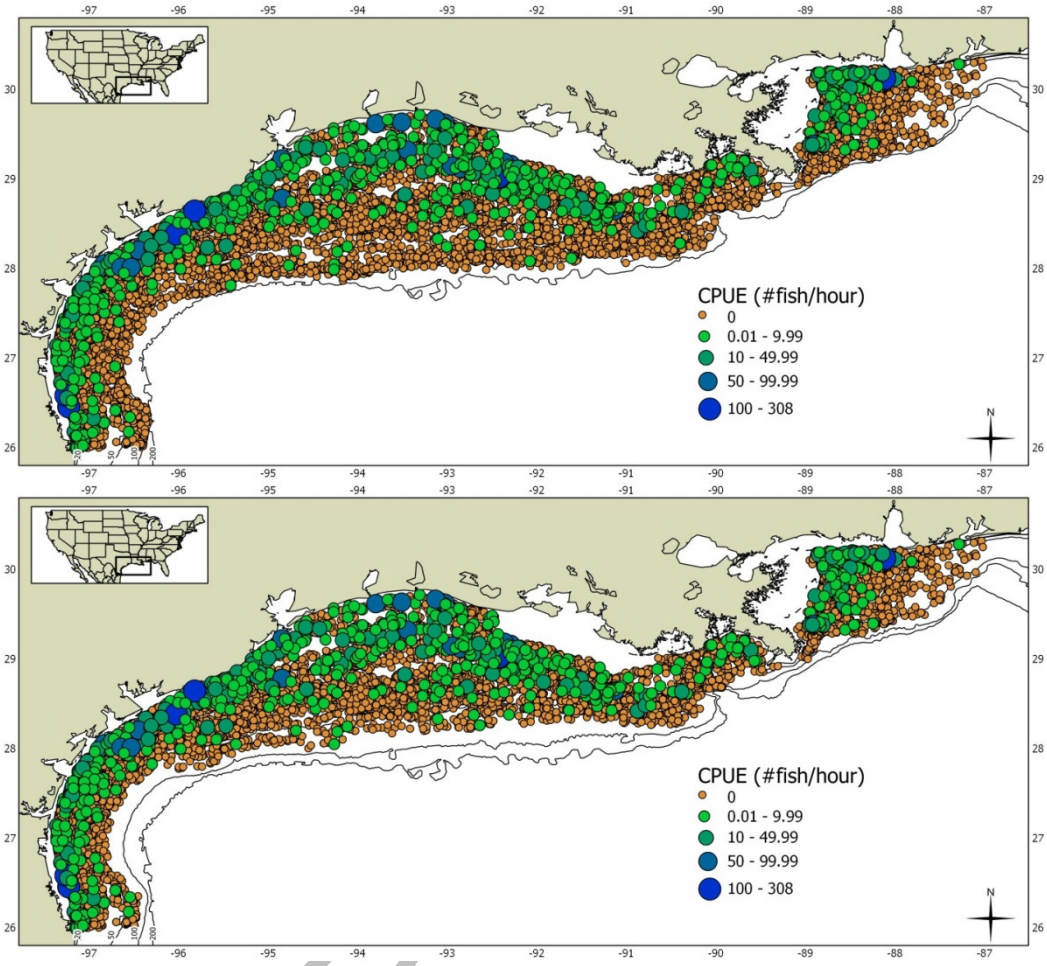

Figure 5.3.1.1. Stations sampled from 1987 to 2010 during the Summer and Fall SEAMAP Groundfish Survey with the CPUE for Spanish mackerel. Top figure has stations from all depth zones, bottom figure has only stations used for the analysis.

Pre-Draft

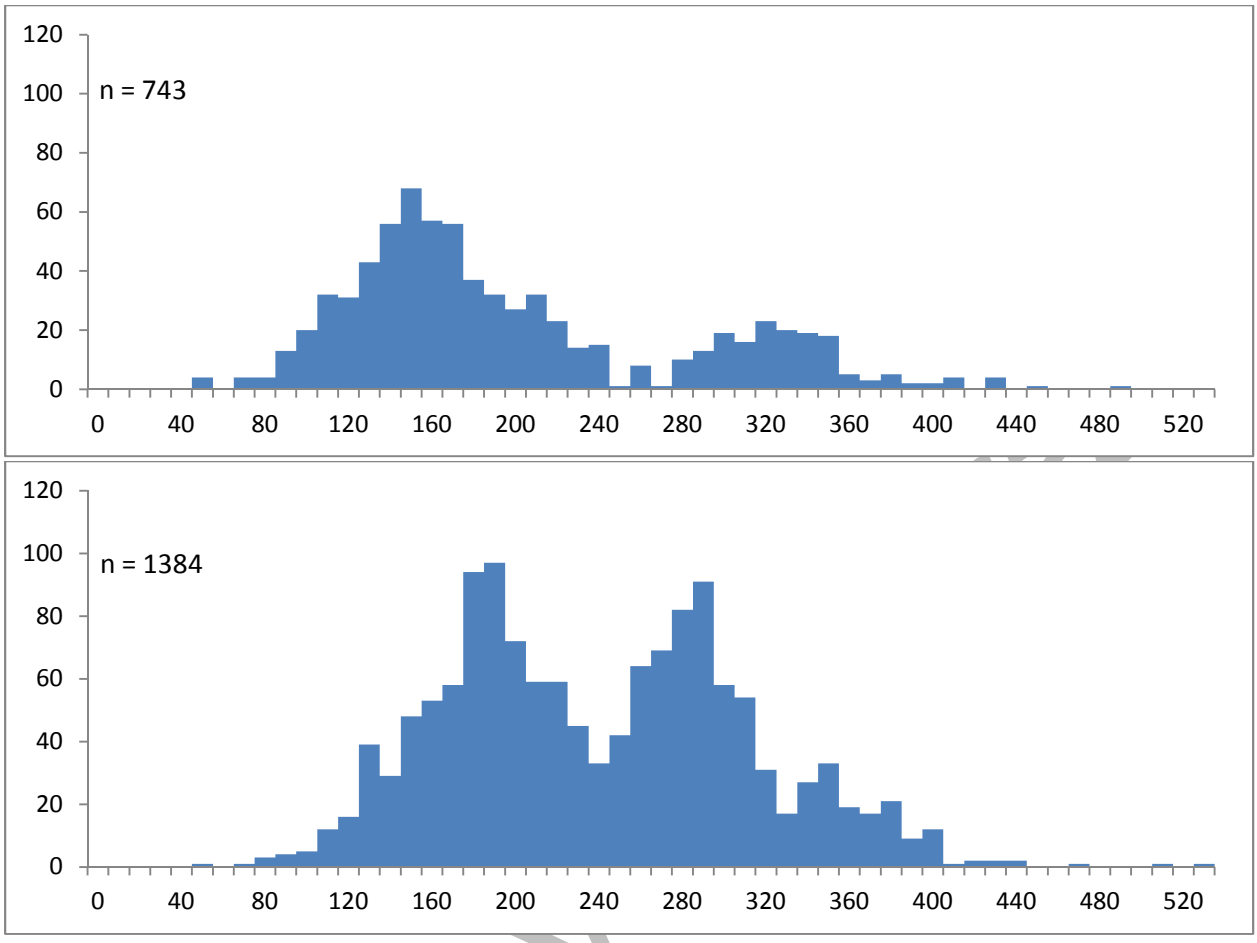

Figure 5.3.1.2. Length frequency distribution for Spanish mackerel caught during the Summer (top) and Fall (bottom) SEAMAP Groundfish Survey from 1987 to 2010.

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Figure 5.4.2.1. Spanish mackerel 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 **(a)** Vertical line gear in the Gulf of Mexico.

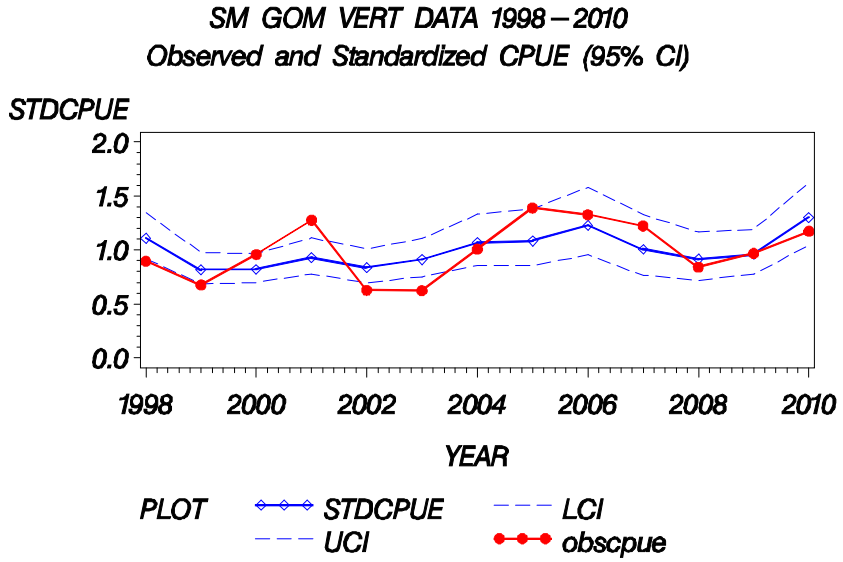
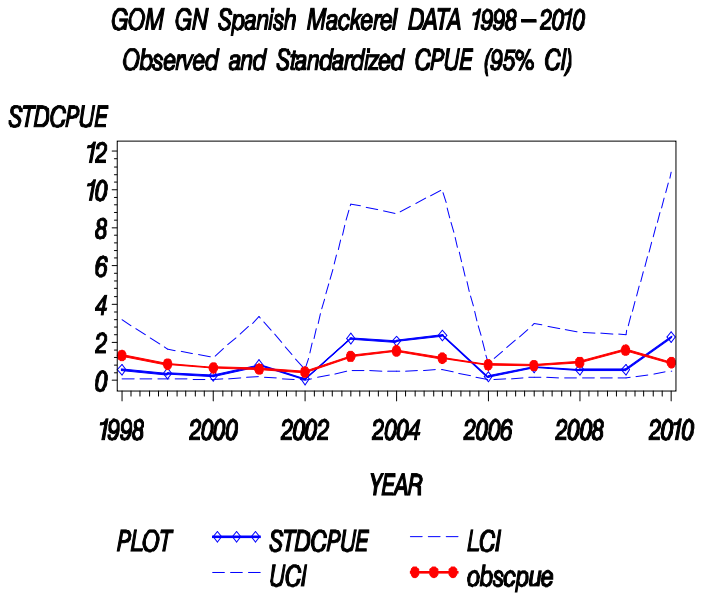


Figure 5.4.3.1. Spanish mackerel nominal CPUE (solid circles), standardized CPUE (open diamonds) and upper and lower 95% confidence limits of the standardized CPUE estimates (dashed lines) for vessels fishing Gillnet gear in the Gulf of Mexico.



Review Draft

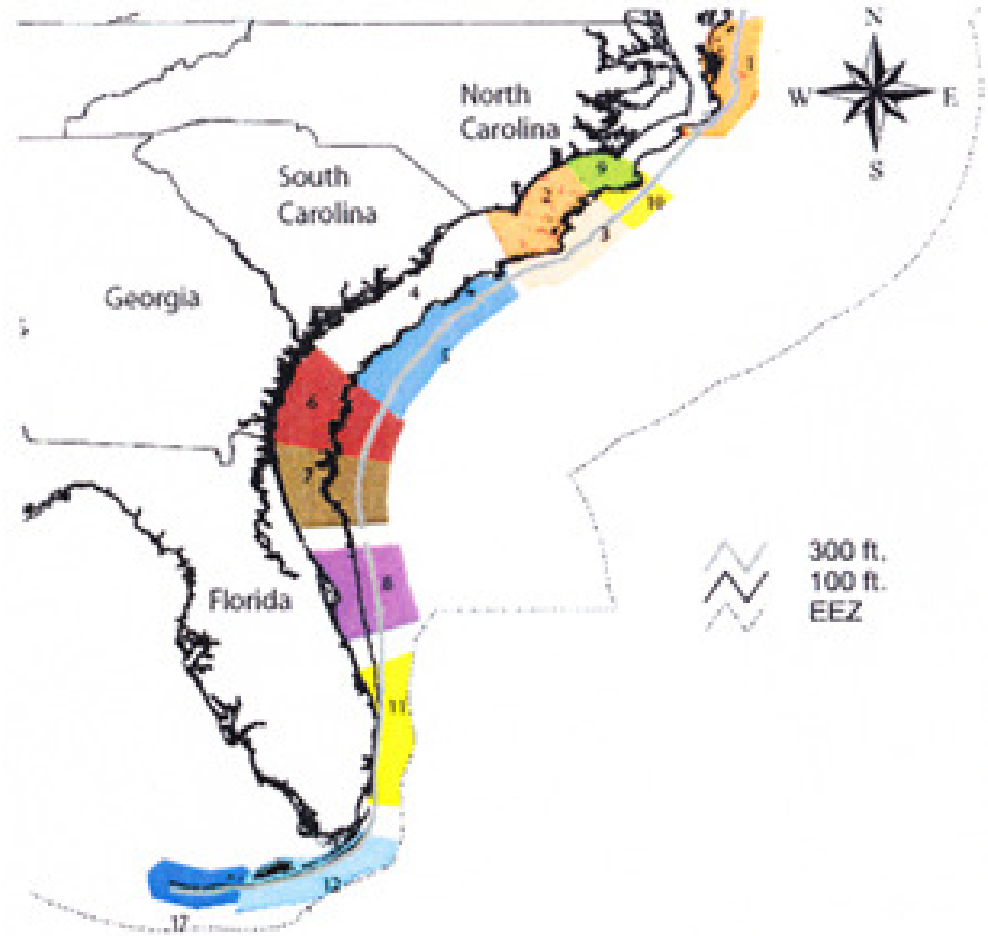


Figure 5.4.4.1. Map of headboat statistical areas.

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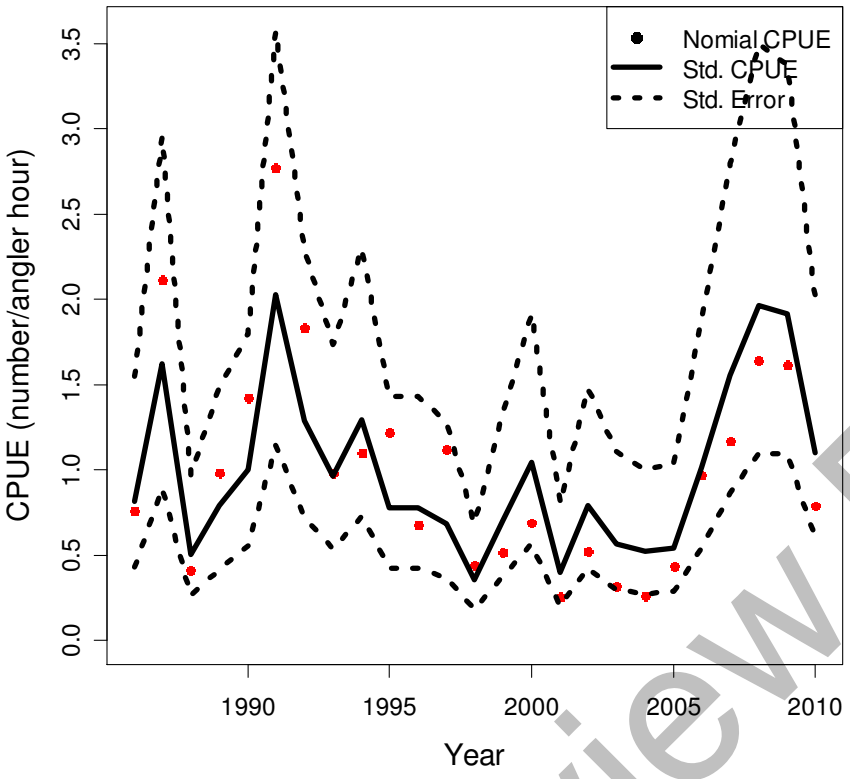

Figure 5.4.4.2. Nominal (observed) and standardized CPUE and the 95% confidence intervals for Spanish mackerel from the Headboat Survey in the GOM. CPUE values were normalized by the mean.

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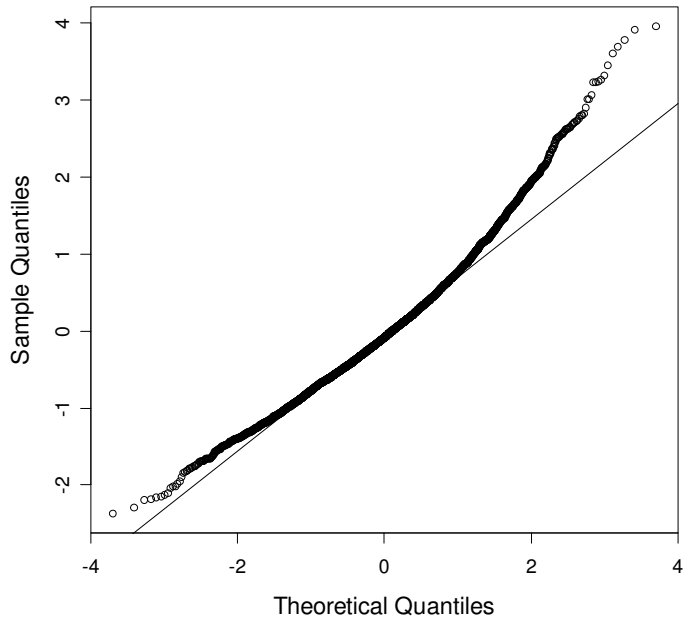

Figure 5.4.4.3. Q-Q plot of CPUE for Spanish mackerel in the GOM for the Headboat Survey.

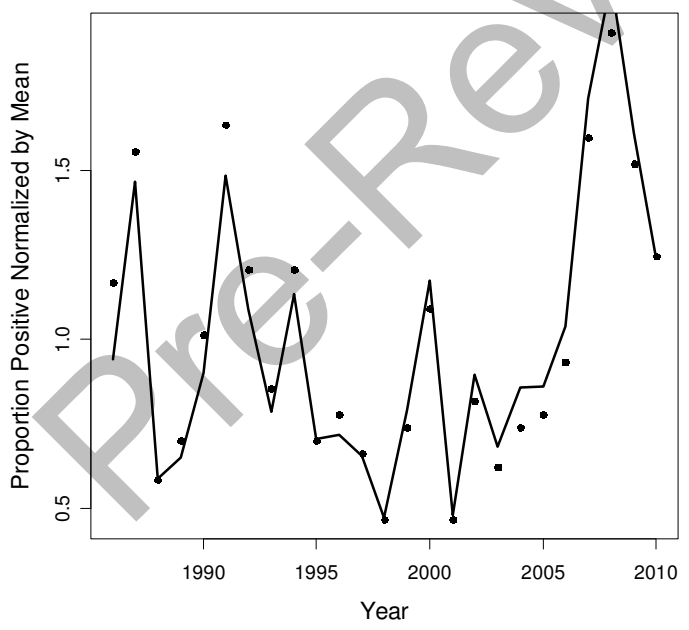

Figure 5.4.4.4. Observed proportion of trips catching Spanish mackerel (black points) and the binomial model fit (blue line) to the data normalized by the mean for the Headboat Survey.

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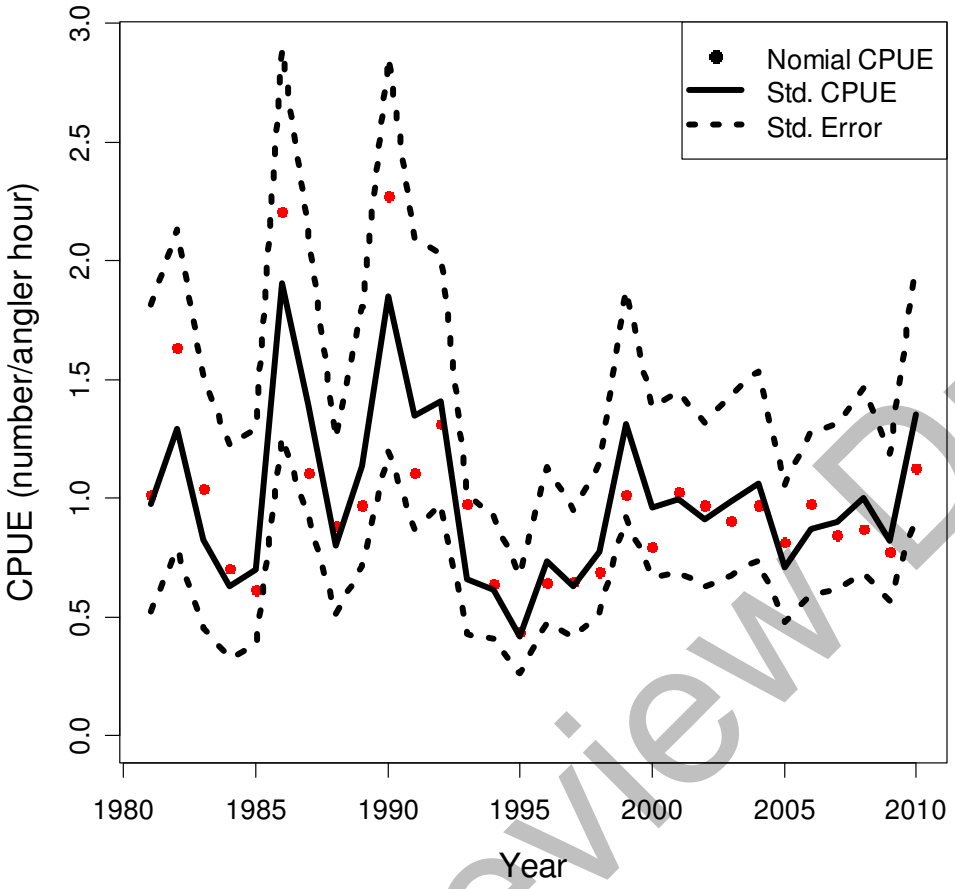

Figure 5.4.5.1. Nominal (observed) and standardized CPUE and the 95% confidence intervals for Spanish mackerel from MRFSS in the GOM. CPUE values were normalized by the mean.

Pre-Review Draft

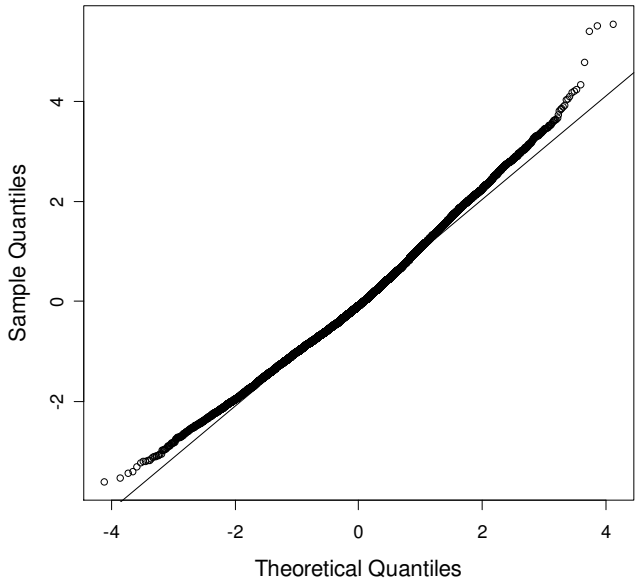

Figure 5.4.5.2. Q-Q plot of CPUE for Spanish mackerel in the GOM MRFSS Survey.

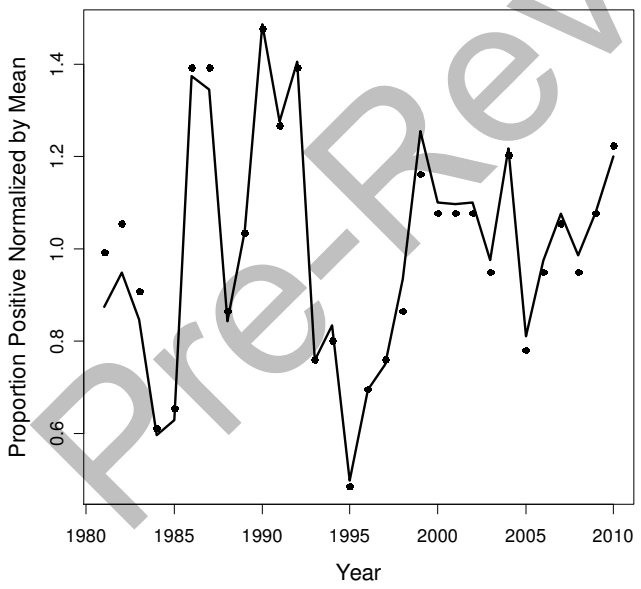

Figure 5.4.5.3. Observed proportion of trips catching Spanish mackerel (black points) and the binomial model fit (line) to the data normalized by the mean for MRFSS.

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6 Analytic Approach

Recommended Analytic Approach – Gulf of Mexico Spanish mackerel

During the SEDAR28 Data Workshop available data, data quality and data sufficiency were discussed. Commercial and recreational landings data were complete from 1981 through 2010, and that preliminary landings for 2011 should be available for the assessment workshop. The panel concluded that size composition and age composition data were sufficient to consider an age and size structured model. The panel also concluded that a substantial commercial and recreational fishery existed prior to the period when abundance indices are available. Consequently, the analysts recommended that updated population analyses should be conducted using Stock Synthesis III (SS3, Methot 2000) as a first modeling approach Spanish mackerel in the Gulf of Mexico. SS3 is an integrated statistical catch-at-age model widely used for stock assessments in the United States. SS3 incorporates landings, size and age data inputs and can incorporate many important processes (mortality, selectivity, growth, etc.) that operate in conjunction to produce estimated catch, size and age composition and abundance. Because many inputs can be \correlated, they are jointly considered in the model process accounting for uncertainties in the input data. SS3 also 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. Because SS3 assumes no uncertainty in landings, model conclusions should be verified using an alternative simple production model such as ASPIC (ASPIC 5.0 Suite of software).

A note on the assessment models
Forward-projecting age-structured assessment models will be attempted for both Gulf of Mexico and Atlantic Spanish mackerel. The Gulf of Mexico Spanish mackerel will be modeled using the Stock Synthesis 3 model, and the Atlantic Spanish mackerel will be conducted using the Beaufort Assessment Model. While the specific model platforms have some differences, fundamentally they can produce the same output if given the same input. The two analytical teams have experience working with their respective model platform and time and resource limitations dictate that they use the modeling platform with which they have the most familiarity and efficiency.

7 Research Recommendations

7.1 Life History

None provided.

7.2 Commercial Statistics

Decision 10. The WG determined the following recommendations be added to any pending recommendations issued in SEDAR 17 that have not been addressed.

- Need expanded observer coverage for the fisheries for Spanish mackerel.

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  – 5-10% allocated by strata within states
  – get maximum information from fish
- Need research methods that capture Spanish mackerel in large enough numbers to create a reasonable index for young (age 0) Spanish mackerel.
- Expand TIP sampling to better cover all statistical strata.
  – Predominantly from Florida and by gillnet
  – Greater emphasis on collecting unbiased samples
- Establish a mechanism for identifying age samples that were collected by length or market categories, so as to better address any potential bias in age compositions.
- Need better information on migration patterns.
- Need to address issue of fish retained for bait (undersized) or used for food by crew (how to capture in landings).
- Compiling commercial data is surprisingly complex. As this is the 28th SEDAR, one might expect that many of the complications would have been resolved by now through better coordination among NMFS, ACCSP, and the states. Increased attention should be given toward the goal of "one-stop shopping" for commercial data.

7.3 Recreational Statistics

1) Increase proportion of fish with biological data within MRFSS sampling.
2) Continue to develop methods to collect a higher degree of information on released fish (length, condition, etc.) in the recreational fishery.
3) Require mandatory reporting for all charter boats state and federal.
4) Continue development of electronic mandatory reporting for for-hire sector.
5) Continued research efforts to incorporate/require logbook reporting from recreational anglers.
6) Establish a review panel to evaluate methods for reconstructing historical landings (SWAS, FWS, etc.).
7) Quantify historical fishing photos for use in reconstructing recreational historical landings.
8) Narrow down the sampling universe. Identify angler preference and effort. Require a reef fish stamp for anglers targeting reef fish, pelagic stamp for migratory species, and deep-water complex stamp for deep-water species. The program would be similar to the federal duck stamp required of hunters. This would allow the managers to identify what anglers were fishing for.
9) Continue and expand fishery dependent at-sea-observer surveys to collect discard information, which would provide for a more accurate index of abundance.

7.4 Indices

None provided.

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Section 5 Appendix – Index Report Cards

Appendix 5.1 SEAMAP Groundfish Trawl
Appendix 5.2 Texas Parks and Wildlife
Appendix 5.3 Commercial Vertical Line
Appendix 5.4 Commercial Gillnet
Appendix 5.5 Headboat
Appendix 5.6 MRFSS
Appendix 5.7 Florida Trip Ticket – Castnet
Appendix 5.8 Florida Trip Ticket – Handline
Appendix 5.9 Florida Trip Ticket – Gillnet

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Appendix 5.1
Gulf of Mexico Spanish Mackerel
SEAMAP Index

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

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

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:

SEDAR28-DW03

SEAMAP Groundfish Survey

	Not Applicable	Absent	Incomplete	Complete
2. Management Regulations (for FD Indices)				
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)				
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				
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:

3A-D. Available On Demand

4A. Lo et al. method

4G. Available On Demand.

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	02/06/2012	accept as prepared	N/A	
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

This index for Spanish mackerel was recommended for use. It is a fisheries independent survey across a long time series (1987-2010), with very good spatial converge (TX/Mexico border to Mobile Bay).

Reset Fields

Appendix 5.2
Gulf of Mexico Spanish Mackerel
Texas Parks and Wildlife Index

DESCRIPTION OF THE DATA SOURCE

	Not Applicable	Absent	Incomplete	Complete	Working Group Comments:
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.).				✓	Rec, bay, creel, TX
B. Describe any changes to reporting requirements, variables reported, etc.				✓	consistent
C. Describe the variables reported in the data set (e.g. location, time, temperature, catch, effort etc.).				✓	date, catch, effort
D Describe the size/age range that the index applies to. Include supporting figures (e.g. size comp) if available.				✓	see size comp report
METHODS					
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.				✓	eliminated bays
B. Describe data reduction techniques (if any) used to address targeting (e.g. Stephens and MacCall, 2004; gear configuration, species assemblage etc).				✓	Ran w/ and w/o Stephens and McCall
C. Discuss procedures used to identify outliers. How many were identified? Were they excluded?				✓	Plotted, 2 SE.

	Not Applicable	Absent	Incomplete	Complete	Working Group Comments:
2. Management Regulations (for FD Indices)					
A. Provide (or cite) history of management regulations (e.g. bag limits, size limits, trip limits, closures etc.).				✓	Management was constant over index period
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)					
A. Provide tables and/or figures of number of observations by factors (including year, area, etc.) and interaction terms.				✓	Data set description provided.
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					
A. Describe model structure (e.g. delta-lognormal)				✓	Details provided upon questioning.
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.

	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:

Poisson component not explored.

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	2/15/2012	Do not include		
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

The TPWD Survey is dominated by bay samples. However, few Spanish mackerel were identified in the survey. The Species Association Approach (Stephens and McCall 2004) was explored to try and identify directed Spanish mackerel trips; however, this approach did not converge. A number of "ad hoc" approaches to subset directed trips for Spanish mackerel from TPWD Survey data were explored; however, these approaches were abandoned because either appropriate subsets could not be identified, they eliminated too many trips leading to the same conclusion as the Species Association Approach, or were not thought to be empirically defensible. An index was constructed using the Delta lognormal approach for the database of all trips, and an index was constructed using a subset of only positive trips using a lognormal model.

The number of Spanish mackerel observed in the survey was extremely small. Consequently, the addition or deletion of a single fish had a drastic impact on the index. Due to the low cpue and high sensitivity of the index, the working group voted to not include the index in the assessment.

Appendix 5.3
Gulf of Mexico Spanish Mackerel
Commercial Vertical line Index

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

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:

2D unknown, data are pounds landed no size data reported - presume legal size with few sublegal

	Not Applicable	Absent	Incomplete	Complete
2. Management Regulations (for FD Indices)				
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)				
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				
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:

3A-E. confidential data.
3C. Only positive trips were used.

4G. Available on demand

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:

1. positive trips only

2B,D,E. Available on demand

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	2/6/12	not recommended		
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

This index was not recommended for use. Most of the Gulf of Mexico Spanish mackerel positive trips were reported from Florida. The Florida trip ticket index, which included all the Florida trips in the coastal logbook data set and was a longer time series, was recommended.
To support the decision to go with the Florida trip ticket index, a Western GOM only index was recommended for comparison.

Reset Fields

Appendix 5.4
Gulf of Mexico Spanish Mackerel
Commercial Gillnet Index

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

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

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:

2D unknown, data are pounds landed no size data reported - presume legal size with few sublegal

	Not Applicable	Absent	Incomplete	Complete
2. Management Regulations (for FD Indices)				
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)				
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				
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:

3A-E. confidential data.

4G. Available on demand

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:

1.B,C. Available on demand

2B,D,E. Available on demand

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	2/6/12	not recommended		
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

This index was not recommended for use. Most gillnet trips were thought to be run-around drift nets, which would like cause hyperstability in the index.

Reset Fields

Appendix 5.5
Gulf of Mexico Spanish Mackerel
Headboat Index

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

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

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:

4D Available on Demand

	Not Applicable	Absent	Incomplete	Complete
2. Management Regulations (for FD Indices)				
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)				
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				
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:

3A-D Confidential Data

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	02/06/2012	accept as prepared		
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

The Species Association Approach (Stephens and McCall 2004) was explored to try and identify directed Spanish mackerel trips however this approach did not properly converge for either of these species and eliminated too many trips indiscriminately. Some possible reasons for this could be because Spanish mackerel are often not targeted by the headboat fleet A number of “ad hoc” approaches to subset directed trips for Spanish mackerel from the Headboat Survey data were explored by the Indices Group at the data workshop, however, these approaches were abandoned because either appropriate subsets could not be identified, they eliminated too many trips leading to the same conclusion as the Species Association Approach, or were not thought to be empirically defensible. Due to the inability to use this approach, an index was constructed using the Delta lognormal approach for the entire database of all trips, and an index was constructed using a subset of only positive trips using a lognormal model. The proportion of positive observations that caught Spanish mackerel was determined to be too small, therefore the Indices Group decided NOT to recommend the use of this data set to develop an index for Spanish Mackerel.

Appendix 5.6
Gulf of Mexico Spanish Mackerel
MRFSS Index

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

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

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:

	Not Applicable	Absent	Incomplete	Complete
2. Management Regulations (for FD Indices)				
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)				
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				
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:

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	02/06/2012	accept as prepared		
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

The Species Association Approach (Stephens and McCall 2004) was explored to try and identify directed Spanish mackerel trips however this approach did not properly converge for either of these species and eliminated too many trips indiscriminately. A number of "ad hoc" approaches to subset directed trips for Spanish mackerel from the MRFSS Survey data were explored by the Indices Group at the data workshop, however, these approaches were abandoned because either appropriate subsets could not be identified, they eliminated too many trips leading to the same conclusion as the Species Association Approach, or were not thought to be empirically defensible. Due to the inability to use this approach, an index was constructed using the Delta lognormal approach for the entire database of all trips, and an index was constructed using a subset of only positive trips using a lognormal model. The Indices Group decided to use the indices of all trips and accepted the Spanish mackerel MRFSS index for recommendation. This index was particularly favored because it presents a long time series.

Appendix 5.7
Gulf of Mexico Spanish Mackerel
Florida Trip Ticket - Castnet

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

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

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:

1.F. No size information in the data set. Commercial size and age data are collected at the fish houses, independent of trip tickets.

	Not Applicable	Absent	Incomplete	Complete
2. Management Regulations (for FD Indices)				
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)				
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				
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:

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:

2.B,D,E-available on demand if needed.

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	02/17/2012			
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

This index was not recommended for use. It's potentially useful as a year class indicator, but has gear saturation effects, limited spatial extent, and hyperstability issues since it's targeting large schools. Only trips that did not hit up against the trip limits were included in the analysis.

Appendix 5.8
Gulf of Mexico Spanish Mackerel
Florida Trip Ticket - Handline

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

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:

1.F. No size information in the data set. Commercial size and age data are collected at the fish houses, independent of trip tickets.

1.C. Outliers ID'd and removed during workshop; result of gear assignments from license data, 1986-1992

	Not Applicable	Absent	Incomplete	Complete
2. Management Regulations (for FD Indices)				
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)				
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				
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:

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:

2.B,D,E-availabl e on demand if needed.

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	02/17/2012			
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

This index was recommended for use. The data used for this index occurs over a long time series and has similar trends to the commercial logbook data. It also samples the entire fishery, both inshore and offshore.

Appendix 5.9
Gulf of Mexico Spanish Mackerel
Florida Trip Ticket - Gillnet

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

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

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:

1,F. No size information in the data set. Commercial size and age data are collected at the fish houses, independent of trip tickets.

	Not Applicable	Absent	Incomplete	Complete
2. Management Regulations (for FD Indices)				
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)				
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				
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:

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:

2.B,D,E-available on demand if needed.

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	02/17/2012			
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

This index was not recommended for use. This index is from a longer time series than the commercial logbook data, and similar trends to the logbook data. But it has hyperstability issues and concerns regarding spatial overlap between gear and population. Changes in the way gill nets are designed and used, and non-specific gear identification on trip tickets (e.g. "gill nets") make interpretation of patterns observed in the data more complex. Only trips that did not hit up against the trip limits were included in the analysis.