SEDAR

Southeast Data, Assessment, and Review

SEDAR 28

Gulf of Mexico Cobia

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Pre-Review Draft

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 justifications 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.

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

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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 alternative 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.

The review panel may request additional sensitivity analyses, evaluation of alternative assumptions, and correction of errors identified in the assessments provided by the assessment

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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.**

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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

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	V. Matter

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	and Cobia in the Atlantic and the Gulf of Mexico 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

State and federal biologist and industry representatives comprised the Life History Work Group (LHWG)

Jennifer Potts – NMFS, Beaufort, NC, Leader of LHWG
Doug DeVries – NMFS Panama City, Leader of Gulf cobia LHWG
Chris Palmer –NMFS Panama City, Leader of Gulf Spanish mackerel LHWG
Chip Collier – Data provider, SA SSC
Michael Denson – Data provider, SCDNR, Charleston, SC
Tanya Darden – Data provider, SCDNR, Charleston, SC
Justin Yost – Data provider, SCDNR, Charleston, SC
Karl Brenkert – Data provider, SCDNR, Charleston, SC
Matt Perkinson – Data provider, SCDNR, Charleston, SC
Jim Franks – GC Data provider, USM
Randy Gregory – Data provider, NC DMF
Read Hendon – GC Data provider, USM
Chris Kalinowski – SAC Data provider, GA DNR
Tom Ogle AP, Recreational, SC
Bill Parker – Charter, SC
Ernst Peebles – Data provider, USF
Marcel Reichert – Data provider, SA SSC
Joe Smith – SAC Data provider, NMFS Beaufort
John Ward – Gulf socioeconomics, Gulf SSC
Erik Williams – Data provider, NMFS Beaufort

The LHWG was tasked with combining age data sets from four sources: a Gulf Coast Research Lab (GCRL) study (Franks et al. 1999), a Mote Marine Lab study (Burns et al. 1998), the National Marine Fisheries Service Beaufort Laboratory, and the NMFS Panama City laboratory. In order to combine age data from all sources, the LHWG needed to be sure that aging methodology between agencies was consistent.

2.2 Review of Working Papers

(SEDAR28-DW01) Cobia Preliminary Data Analyses U.S. Atlantic and **GOM Genetic Population Structure** Author: Tanya Darden

Abstract
With available data (west FL and northern GOM have low sample sizes), GOM appears to be a genetically homogenous group continuing around the FL peninsula with a genetic break occurring around northern FL and GA. The Atlantic population segment appears to have a genetically homogenous offshore component and genetically unique inshore components.

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Critique
The working paper submitted by Darden presented preliminary information on stock structure for cobia in the Gulf of Mexico and U.S. Atlantic Coast using 10 microsatellite loci. The methods and microsatellite loci were based on a report that is currently in review. The study sampled fish from April through July from 2004-2011 with most overlap coming from 2008 to 2010. There was temporal overlap in most samples and had adequate sample sizes for most areas (>100 for NC, SC, SC offshore, FL East Coast, and TX). An increase in the samples off Florida would help provide more resolution in the location of genetic break. Although there is some difference in the collection year by area, the samples were collected from fish during the spawning season and all fish were mature from multiple year classes (described by author later). The methods and data used were appropriate and results can be used for management.

(SEDAR28-DW05) Evaluation of Cobia Movements and Distribution Using Tagging Data from the Gulf of Mexico and South Atlantic Coast of the United States. Authors: Matt Perkinson and M.R. Denson

Abstract
Cobia movement and distribution in the Southeastern United States and the Gulf of Mexico was evaluated using tag-recapture information provided from recreational anglers, commercial fishermen and charterboat captains. Three data sets were provided by the South Carolina Department of Natural resources, the Mote Marine Laboratory, and the Gulf Coast Research Laboratory. A fourth data set of tagged cultured fish from the South Carolina Department of Natural Resources was also evaluated. Cobia were tagged over similar periods, with methodologies and tags that were not appreciably different between programs. Tag-recapture in all four studies yielded similar patterns. Only fish at large for greater than 30 days were included in the analysis. Approximately 79% of tagged fish were recaptured in the region in which they were tagged. Only 1% of cobia tagged in the South Atlantic north of Florida were recaptured in the Gulf, and of those tagged in the Gulf only 1% were recaptured in the Atlantic north of Florida. Cobia tagged on the east coast of Florida are caught North of Florida and in the Gulf of Mexico suggesting a mixed stock off of Florida. Datasets were pooled and partitioned by tag recapture location off of Florida beginning with the Georgia-Florida border and north (GAN), the Georgia Florida border to the Brevard/Volusia County line (N-BR), the Brevard County from Brevard/Volusia County line to Sebastian Inlet (Brevard/Indian River County line)(BR), waters offshore of Sebastian Inlet to Biscayne Bay (S-BR), from Biscayne Bay around the tip of Florida to First Bay on the Gulf side, encompassing all of the Florida Keys (Keys) and the Gulf from First Bay through the Gulf States to the Texas/Mexico line. Cobia tagged south of Brevard County are much more likely to be recaptured in the Keys or Gulf (95%). These results suggest two stocks of fish that overlap at Brevard county Florida.

Critique
Working paper 05 provides a good overview and comparison of the methods, scope, and results of the three major cobia tagging efforts conducted in the Southeast U.S. since 1974. More importantly it reported the results of an analysis using a pooled data set of all three studies which examined movement patterns between Gulf and Atlantic waters with a special emphasis on fish tagged on the east coast of Florida. The findings presented in this

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document, which were widely vetted before and during SEDAR28 and well received, were very helpful and influential in defining cobia stock boundaries. This document was recommended for use by the LHWG.

(SEDAR28-DW13) Constituent based tagging of cobia in the Atlantic and Gulf of Mexico waters. Author: E. Orbesen

Abstract
Data used in this analysis were derived from the Southeast Fisheries Science Center's Cooperative Tagging Center conventional tagging program. The data set contains 1510 cobia tag releases and 148 recaptures over 58 years of data collection. Exchange and mixing were examined between six geographical regions.

Critique
Working paper 13 summarizes the tag recapture data provided by the Southeast Fisheries Science Center's Cooperative Tagging Center conventional tagging program. The time series and methods are comparable with the data included in ***SEDAR28-DW05****, v2; fish were tagged by recreational anglers using anchor or dart tags mostly during the 1990's and 2000's. Tag returns (N=148) have also been assigned to the zones (GAN, N-BR, BR, S-BR, KEYS, GULF) used in* ***SEDAR28-DW05****. The results appear to support the suggestion of separate stocks in the South Atlantic and Gulf, with mixing occurring somewhere around Brevard County, FL. Fish tagged north of Brevard County were largely recaptured north of Brevard County (91%). Fish tagged south or west of Brevard County were largely recaptured south or west of Brevard County (97%). Fish tagged in Brevard County were recaptured to the north (18%), in Brevard (35%), and to the south and west (44%). Recapture percentages are also reported for each zone, but I would be hesitant to include these data in any analyses, as recaptures are often reported without any coinciding tagging data (i.e., anglers may not report all fish they have tagged), leading to an overestimation of recapture rate. The methods appear sound and the data strongly agree with the result of other tagging datasets for the South Atlantic and Gulf of Mexico.*

(SEDAR28-DW02) South Carolina experimental stocking of cobia *Rachycentron canadum*. Author: M.R. Denson

Abstract
The South Carolina Department of Natural Resources has been experimentally spawning wild cobia adults captured in local waters, rearing larvae to a number of juvenile sizes and stocking them back in the same systems. All fish released into the wild are identifiable using a unique genetic tag (microsatellites) and differentiated from wild fish when they are collected in the recreational fishery. Size permitting; fish were also tagged with external dart tags prior to release to make them identifiable to anglers. Fish enter SC waters to spawn in April and are available to recreational anglers at a legal minimum size of 33-inch fork length. This size represents a three- year-old fish (when full recruitment occurs). In order to determine the contribution of stocked fish to the local population, fin clips are removed from fish sampled at fishing tournaments, collected from charterboat captains, recreational fishermen and from SCDNR staff. Stocking contributions are determined and analyzed as a general contribution

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to the sampled population, as well as to specific yearclasses as determined by otolith-based age determination. Contributions are also evaluated by inshore and offshore collections.

Critique

The paper is a brief overview of the contribution of cobia stocked in 2007 and 2008 by SC-DNR in the Colleton River (SC) has on the wild stock in SC and Georgia, where sampling of the wild stock occurred. Genetic techniques were used to follow this contribution. The paper provides a brief but thorough overview of the data, as well as some limited other information. The data indicate that the contribution of fish stocked to fish in the wild population was at a maximum of 7.3% in 2010, 4.6% in 2011, and is expected be diminish in future years. The paper does not address the potential if and how the stocked fish may affect the population, if an effect exists at all. The information in this paper seems of limited use for the LH WG.

2.3 Stock Definition and Description

2.3.1 Population genetics

Evidence was presented by Dr. Tanya Darden regarding a genetic-based evaluation of population structure between the U.S. South Atlantic and Gulf of Mexico populations described in more detail in SEDAR 28-DW01 (Darden, 2012). Complete methods are documented in SEDAR 28-DW01 and SEDAR 28-RD09 (Darden et al., 2012). Microsatellite-based analyses demonstrated that tissue samples collected from NC, SC, the east coast of Florida (near St. Lucie), MS and TX showed disparate allele frequency distributions and subsequent analysis of molecular variance showed population structuring occurring between the states. Results showed that the Gulf of Mexico stock appears to be genetically homogeneous and that segment of the population continues around the Florida peninsula to St. Lucie, Florida, with a genetic break between where the St. Lucie samples were collected and Port Royal Sound in South Carolina (Figure 2.3.1.1). Finer-scale analyses of the sample areas in the South Atlantic segment of the population suggest a genetically homogenous offshore component and genetically unique inshore components.

Following the January 11, 2012 SEDAR28 webinar, the panel had come to consensus on key points of the South Atlantic and Gulf of Mexico stock definitions:

- Panel consensus: For South Atlantic (SA) cobia, combine estuarine and offshore stocks (data isn't fine enough to split in many cases).
- Panel consensus: Northern boundary for SA should include data through New York.
- Panel consensus: Southern boundary for SA should be Cape Canaveral (based on tagging and genetic data), subject to further review at DW if further data can be examined, Gulf would be south of Cape Canaveral through the Gulf. Consider Volusia/Flagler line for data division of recreational data.

2.3.2 Tagging

Tag-recapture data

Cobia movement and distribution in the southeastern United States and the Gulf of Mexico was evaluated using tag-recapture information provided from recreational anglers, commercial

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fishermen and charter boat captains. The South Carolina Department of Natural Resources (Wiggers, 2010), the Mote Marine Laboratory (Burns and Neidig, 1992) and the Gulf Coast Research Laboratory (Hendon and Franks, 2010) provided three data sets. Cobia were tagged over similar periods with methodologies and tags that were not appreciably different between programs. Only fish at large >30 days were included in the analysis. Tag-recaptures in all three studies yielded similar patterns. Approximately 78% of tagged fish were recaptured in the region in which they were tagged. Only 1% of cobia tagged in the U.S. south Atlantic north of Florida were recaptured in the Gulf, and of those tagged in the Gulf, only 1% were recaptured in the Atlantic north of Florida. Cobia tagged off the east coast of Florida were recaptured north of Florida and in the Gulf of Mexico, suggesting stocks mix in that area. Datasets were pooled and partitioned by initial tagging location beginning with the Georgia / Florida border and north (GAN), the Georgia/Florida border to the Brevard/Volusia County line (N-BR), Brevard County from the Brevard/Volusia County line to Sebastian Inlet (Brevard/Indian River County line)(BR), Sebastian Inlet to Miami (S-BR), Miami around the tip of Florida to Marco Island on the Gulf side, encompassing all of the Florida Keys (Keys), and the Gulf from Marco Island through the Gulf states to the Texas/Mexico line. The combined data show that cobia tagged north of Brevard County were primarily recaptured from Brevard County to the north (99%) (Table 2.3.2.2). Of cobia tagged in Brevard County, 25% were recaptured north of there, 39% in Brevard County and 36% in S-BR, the Keys or the Gulf (Figure 2.3.2.1). Cobia tagged in S-BR, the Keys, or the Gulf were mostly recaptured from Brevard south through the Keys and Gulf (98%)(Table 2.3.2.1). Additional tagging datasets from the Virginia Institute of Marine Science (Susanna Musick, personal communication), SCDNR stock enhancement program (Denson, 2012) and Southeast Fisheries Science Center (Orbesen, 2012) reflect a similar pattern with very little movement between the Gulf and GAN, while fish tagged in BR moved both to the north and to the south through the Keys and Gulf. These results suggest two stocks of fish that overlap at Brevard County Florida and corroborate the genetic findings presented in SEDAR 28-DW01.

It was noted that the recorded location of recaptures were not pin-pointed, but rather given a more general description (e.g., 10 miles off Cape Canaveral). A judgment call was made to assign the recaptured fish to a particular region when the reported location was between regions (e.g. Sebastian Inlet for BR vs. S-BR). A more complete evaluation of the tagging datasets can be found in SEDAR28-DW05 (Perkinson and Denson, 2012).

Discussion of cobia stock definition/delineation between South Atlantic and Gulf of Mexico.

Data workshop LHWG discussions considered specific suggestions to set a stock boundary split at Brevard county Florida based on data that fish tagged in Brevard County are caught both north and south of Brevard County. Discussions of the tagging data pointed out that the available landings data lacked the resolution to separate the stocks within a county.

- A proposal was made to separate the stocks at the FL/GA line because the genetic data suggest that the split is north of the Brevard/Indian River County line and there is no tagging data to dispute this split.
- A second proposal was made suggesting the split at the Brevard County/Indian River County line.

Neither proposal is disputed by the genetic and tagging data.

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****During Plenary session the first option FL/GA line was selected based on recommendations from the commercial and recreational work groups and comments that for ease of management the FL/GA line would be the preferable stock boundary and did not conflict with the life history information available. However, there is not enough resolution in the genetic or tagging data to suggest that a biological stock boundary exists specifically at the FL/GA line, only that a mixing zone occurs around Brevard County, FL and potentially to the north. The Atlantic stock would extend northward to New York.**

2.4 Natural Mortality

Natural mortality rate (M) in many marine fish stocks is a difficult parameter to estimate. Several equations that use various life history parameters (L_∞, k, maximum age, age at 50% maturity) have been derived to attempt to estimate M. Refer to other sections of this life history report for the methodologies used to calculate each of the life history parameters. Because cobia will migrate due to changes in water temperature, cobia's preferred water temperature, 25^o C, was used in the Pauly M calculation. The LHWG examined point estimates of M for Gulf stock cobia from 14 equations (Table 2.4.1) and the age-varying M from Lorenzen (1996), and those estimates ranged widely.

The five methods which rely heavily on the von Bertalanffy k yielded the five highest estimates of M, ranging from 1.73 (Ralston geometric mean) to 0.64 (Pauly) (Table 2.4.2 and Figure 2.4.1). The LHWG cautions using these estimates because of the issues inherent in modeling growth of the species. L_∞ and k are inversely correlated and can be highly variable depending on the range of the input data and assumptions made when modeling growth.

The estimates of M derived from methods relying more on maximum age in the population ranged from 0.26 to 0.63, although 7 of the 8 fell between 0.26 and 0.42 (Table 2.4.2). 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 have been generally accepted by previous SEDARs. Before selecting a maximum age in the population, it is critical to consider how many fish were sampled to find that one, old fish; what the longevity of the species could be in an un-fished stock; and what amount of error is associated with the age readings. These questions were considered by the LHWG, and maximum age in the population was set at 11 years based on the oldest fish in the GCRL study (Franks et al.1999).

The maximum reported age of 16 yr for putative Atlantic stock cobia was 5 years older than that for the Gulf – hence the Hoenig estimate of M (0.26) for that stock was much lower. After considerable discussion, the LHWG concluded, based on the available evidence, that this difference was real. Cobia are not particularly difficult to age and the size at age data was reasonably consistent among all the groups doing the ageing, even between stocks. Sample sizes of both stocks were sufficiently large, and maximum ages were similar among studies within stocks. In the two major studies providing most of the age data for the Gulf stock in SEDAR 28, maximum reported ages for females and males, respectively, were 7 and 9 (Burns et al. 1998) and 11 and 9 (Franks et al. 1999). In the much smaller Beaufort NMFS (n=113)

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and Panama City NMFS (n=62) data sets, the oldest fish was a 9 yr old male in the former and a 9 yr old female in the latter. Thompson et al. (1992), whose raw data were not available for SEDAR 28, found maximum ages of 10 for both sexes in Louisiana. In contrast, among Atlantic studies north of Florida, Virginia collections (n=905) produced one 16 and four 15 yr olds, North Carolina (n=365) yielded one 14 and four 13 yr olds, and in South Carolina (n=1469) one age 13 and 7 age 12 fish were caught. It is not uncommon for the same species of fish or close congeners in the Gulf of Mexico and the Atlantic to exhibit a difference in maximum age, e.g., red drum (Beckman et al., 1989; Murphy and Taylor, 1990; Ross et al., 1995) and Gulf menhaden and Atlantic menhaden (Ahrenholz, 1991).

Consistent with the recommendations of previous SEDAR panels for other species, including king mackerel *Scomberomorus cavalla* in SEDAR 16 and Spanish mackerel *S. maculatus* in SEDAR 17, the LHWG recommends modeling the natural mortality rate of Gulf stock cobia as a declining 'Lorenzen' function of size (translated to age by use of a growth curve) (Lorenzen 1996). The growth curve used was the von Bertalanffy equation corrected for size-selection bias, inversely weighted by sample size, and for which t_0 was freely estimated. The Lorenzen curve was scaled such that the average value of M over the range of fully-selected ages (3-11 yr) was the same as the point estimate of 0.38 from Hoenig's (1983) regression. Preliminary calculations of M based on the growth information available at the data workshop, along with sensitivity runs scaled to low (0.26) and high (0.42) estimates of M are shown in Figure 2.4.2.

LHWG Recommendation:
Use an age-variable M estimated using the Lorenzen method (Lorenzen 2005) assuming a base M = 0.38 calculated from Hoenig_{fish} (1983). Sensitivity runs using a range of Lorenzen age-variable M values equating to a CV of 0.54 (MacCall 2011) of the Hoenig estimate are also recommended, though that value may be too high (Hoenig comment in MacCall in Brodziak et al., 2011). The LHWG recommends the assessment workshop explore this issue by applying a range of CVs.

2.5 Discard Mortality

Discard mortality 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 lead to variability in determining discard mortality rates for a variety of species. Cobia are harvested by several gears, which have varying discard mortality rates. Currently, few data sets are published on discard mortality of cobia (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. There few data sources that had information on discard

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mortality. Information was available from logbooks and one observer program. The logbooks reported most cobia released were released alive in bandit (98%) and longline (92%) fisheries. Some anecdotal information on hook and line discard mortality was brought forward during SEDAR 28 including fish recaptured in the VA Marine Resources Commission Tagging Program and SC Department of Natural Resources broodstock collection. The VMRC had 20 fish recaptured that were released in poor condition. The recaptured fish, when initially released, were reported to have been gut hooked, have broken gill arches, bleeding from deep hooking, and one fish was tied off for two hours before tagging. SC DNR collected 60 cobia for brood stock using hook and line and only had one mortality within one week of collection and transportation.

Cobia are also caught in gillnet fisheries. These fisheries target a variety of species including: Spanish mackerel, sharks, sea mullet (*Menticirrhus* spp), Atlantic croaker, and other species. Observers have been onboard boats in the gillnet fishery and reported the number of fish released dead and alive. Of 539 cobia discarded during the observer study, 51% were released dead (Table 2.5.1, Simon Gulak, Gillnet Coordinator SEFSC NOAA Fisheries, personal communication).

Discussion
There was limited discussion on the discard mortality rates of cobia. The panel felt the fish were hardy and not likely to have the barotraumas issues common to many of the snapper and grouper species in the South Atlantic and Gulf of Mexico. A 5% discard mortality rate was estimated for the hook and line fishery with a range of 2 to 8%. The gillnet fishery discard mortality was agreed to be 51% with a range of 36 to 77%. The range was developed from gillnet fisheries with 10 or greater cobia observed released. The discard mortality rate developed for the gillnet fishery may not reflect the discard mortality rate for the remaining gears in the "other gears" category. Informed judgment should be used to develop a discard mortality rate potentially weighted on the number of discards in each fishery as has been done in past SEDARs.

LHWG Recommendation: Use the following discard rates and examine sensitivities at the ranges within parentheses:

Hook 5% (2 to 8%)
Recreational and Commercial Gillnet 51% (36-77%)

2.6 Age

The final age data set for Gulf stock cobia for SEDAR 28 contains 1231 observations which came largely from two studies – one at the Gulf Coast Research Lab (GCRL) (Franks et al. 1999) (n=513, 1987-1991) and the other at Mote Marine Lab (Burns et al. 1998)(n=545, 1995-1997). In addition, 113 fish were collected by the Beaufort NMFS lab (2004-2007) and 62 by the Panama City NMFS lab (1992-2010) (Figure 2.6.1). The vast majority of fish aged were caught by hook and line: 100% of GCRL, 93% of Mote, 93% of Beaufort NMFS, and 81% of Panama City NMFS; and virtually all were from the recreational fishery, i.e., fishery dependent samples. Specimens for the GCRL and Mote studies came primarily from

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dockside and fishing tournament sampling. Samples for the Beaufort NMFS study came almost entirely from headboats and charter boats, while the majority of Panama City NMFS samples were about equally spread among headboats and commercial reef fish vessels, with a few from private recreational boats and scientific surveys.

Fish in the final age data set ranged from 355 to 1639 mm FL, and 98% were <1350 mm (Figure 2.6.2). The overall size distribution of the age samples was somewhat knife-edged at the lower end because of the 838 mm (33 inch) federal minimum size limit imposed in 1985 and the very high proportion of fishery dependent samples. Reflecting their sexually dimorphic growth patterns, males ranged from 365 to 1390 mm FL and females from 355 to 1639 mm; 98 % of males were <1240 mm and 98 % of females were <1390 mm (Figure 2.6.3).

The only other significant source of cobia age data (n=646 fish aged) from the Gulf of Mexico was a MARFIN-funded study conducted at Louisiana State University from 1987 through 1991 (Thompson et al. 1992). Unfortunately, the lead investigator on that study is deceased, and despite significant efforts on the part of other investigators on the project, the raw data files could not be located.

All cobia ages were derived from annulus counts taken from transverse sections of sagittal otoliths (Burns et al. 1998, Franks et al. 1999, SEDAR28-RD25). All age data included an increment count. Based on the timing of annulus formation and an estimate of the amount of translucent edge present, all increment counts were converted to calendar age (SEDAR25-RD41). Calendar ages were converted to fractional age using a May 1 birthday. Ages in the original GCRL data set were simply increment counts – not calendar ages – but the data set did include marginal increment codes which were easily converted to the Gulf States Marine Fisheries Commission system (Table 2.6.1) currently used by all Gulf states. These in turn were used to determine calendar age. For any fish caught July-December, calendar age = increment count regardless of edge code. For any fish caught Jan-Jun with an edge code of 3 or 4, calendar age = annulus count + 1. No fish with an edge code of 1 or 2 were caught during Jan-Mar, but for those caught Apr-Jun, calendar age = annulus count (i.e., ages were not advanced). In the original Mote data set, only raw annulus counts were available (i.e., there were no marginal increment codes and they did not calculate calendar age). Based on examination of monthly distribution of annulus edge types in the GCRL study, the decision was made to estimate calendar age of Mote fish using the following protocol: advance the ages of all Mote fish collected Jan-Apr by one year, i.e., final or calendar age = ring count + 1. For fish collected during May-Dec, ages were not advanced, i.e., the final or calendar age = ring count.

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2.6.1 Age Reader Precision and Aging Error Matrix

Because 86% of Gulf stock cobia ages for SEDAR 28 came from the GCRL and Mote studies conducted 15-20 yr ago, it was not possible to do reader comparisons and generate an aging error matrix. However, the scientists who conducted the ageing for the Mote study were trained by those who conducted the GCRL study (primarily Jim Franks), and he was quite confident the Mote fish were aged accurately. In addition, a simple comparison between those two studies of mean size at age showed very little difference between them for all the most common ages (Figure 2.7.1). All of the Beaufort NMFS samples were aged by Beaufort lab personnel, while those from the Panama City NMFS lab were aged by the same SCDNR personnel who aged a large portion of the Atlantic stock fish for SEDAR28; and both Beaufort and SCDNR personnel are currently taking part in a reader comparison exercise to ensure there are no non-random differences in their ageing results.

2.7 Growth

Cobia, like many pelagic fishes, have very fast growth in the first few years of life. Cobia also exhibit sexually-dimorphic growth, with females attaining larger sizes-at-age and maximum sizes than males. Growth was modeled using the von Bertalanffy growth model. To account for growth of the fish throughout the year, increment counts were converted to calendar ages (Age_{cal}) based on timing of increment formation, and then a fraction of the year was added or subtracted based on the month in which the fish was caught (Age_{frac}). Most of the fish were caught during the time of increment formation, which is in May and June, or later. For those fish caught before June with a wide translucent marginal, the increment counts were bumped by one (1) to get the calendar age. For all fish caught after June, the increment count equaled the calendar age of the fish. Peak spawning in the Gulf, based on maximum GSI, was determined to be in May (Brown-Peterson et al. 2001); thus, the assumed birthdate of each fish was May 1. Fractional age of each fish was computed with the following equation:

$$Age_{frac} = Age_{cal} + ((Month_{capture} - Month_{birth})/12)$$

Because cobia have been subject to a 33 inch minimum size limit regulation since 1985, the fish that recruit to the fishery first tend to be the fastest growers at those early ages, which results in a knife edge size distribution in fishery dependent samples at those affected ages. Dias et al. (2004) developed a correction to account for that size-selection bias, and that was used for the growth models presented herein. Also, because age samples in the youngest and oldest ages are few, the model incorporated an inverse weighting by sample size at each age. The resulting growth parameters are in Table 2.7.1. Weight at age was also modeled for females only using the von Bertalanffy model both with and without inverse weighting by sample size (Table 2.7.2). The Diaz correction was not used for the weight at age models.

2.8 Reproduction

The majority of the reproductive information on cobia in the U.S. is contained in published works by Brown-Peterson et al. (2001) and Franks and Brown-Peterson (2002) and is referenced as such. All age-related results presented in this section were based on calendar age. Information below on spawning seasonality, sexual maturity, sex ratio, and spawning frequency is based on the most accurate technique (histology) utilized to assess reproductive condition in fishes.

2.8.1 Spawning Seasonality

Spawning season was determined based on the occurrence of hydrated oocytes and/or postovulatory follicles from spawning cobia collected in the Gulf of Mexico. Cobia have a

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protracted spawning season (April through September) throughout the southeastern United States as determined from GSI values and histological assessments (Brown-Peterson et al., 2001). There was no significant difference (P>0.05) in GSI values between corresponding months in 1996 and 1997 for males or females in any region, with the exception of males in September from the north central Gulf of Mexico (NCGOM) (P=0.049). Therefore, monthly data for 1996 and 1997 by region were combined (Fig. 2.8.1.1). GSI values for both sexes of cobia from the eastern Gulf of Mexico (EGOM) began to increase in March, peaked in July, and declined and leveled off thereafter (Fig. 2.8.1.1). GSI values for females from the NCGOM increased in March, peaked in May, and then declined through September (Fig. 2.8.1.1). In contrast, GSI values of males from NCGOM steadily increased through July, then fell precipitously in August (Fig. 2.8.1.1). Brown-Peterson et al. (2001) concluded their GSI data for females mirrored those of Lotz et al. (1996), who found peak values in May. Biesiot et al. (1994) reported peak female GSI's in April based on 115 fish collected over 2 years from Texas to Florida, and Thompson et al. (1992) reported peak female GSI values in Louisiana in June. Ditty and Shaw (1992) reported that cobia larvae were found in estuarine and shelf waters of the Gulf primarily May-September; although their conclusions were based on a very small sample size. They noted that only 70 larvae <20mmSL were collected and identified from the Gulf of Mexico between 1967 and 1988.

2.8.2 Sexual Maturity

Because cobia have been subject to a 33 inch minimum size limit since 1985, and most studies were based almost entirely on fishery dependent sampling, data on size and age at maturity for Gulf stock cobia are very limited. Only 6 of 383 females collected by Brown-Peterson et al. (2001) were sexually immature so they did not attempt to estimate size or age at maturity. From Franks and Brown-Peterson (2002), "Historically, few small and immature cobia of either sex have been captured due to a minimum retention size in state territorial waters and the EEZ. Thus, accurate estimates of length or age at 50% sexual maturity cannot be made. However, reports of the smallest sexually mature male cobia observed vary from 365 mm FL and age 0 in the eastern Gulf of Mexico (Brown-Peterson et al. 2001) to 640 mm FL and age 1 in the north central Gulf of Mexico (Lotz et al. 1996). The smallest reported sexually mature female cobia range from 700 mm FL and age 1 in the eastern Gulf of Mexico (Brown-Peterson et al. 2001) to 834 mm FL and age 2 in the north central Gulf of Mexico (Lotz et al. 1996)". Of 31 one year old cobia collected in Louisiana by Thompson et al. (1992), none were mature; while among two year olds, some females and most males appeared mature; and all three year olds of both sexes were mature.

Sexual maturity in male cobia in the South Atlantic appears to occur at a very small size. Because of the paucity of samples of cobia < 200 mm FL, it is not possible to determine the smallest size at which male cobia reach sexual maturity, but this appears to occur well before they reach age 1. The smallest histologically mature male evaluated by SCDNR using histological techniques was 207 mm FL and 2-4 mo old, corroborating findings reported by Brown-Peterson et al. (2001) and Brown-Peterson et al. (2002). Sample sizes of small female cobia were also limited. Only eight fish ages 0-1 were examined, and all were immature (including 4 samples from 2011). Of the age 2 fish (n=27), 70% were sexually mature (Table 2.8.2.1). The only caveat regarding these animals was that they were likely the fastest growing and largest two-year olds collected from the fishery. Tables 2.8.2.2 and 2.8.2.3 both

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suggest that female cobia above 800 mm FL are likely to be mature, regardless of age. Smith (1995) similarly found that most 2 year-old females were sexually mature, with 25% maturity at 700-800 mm FL and 100% maturity above 800 mm FL.

LHWG Recommendation:
Maturity in cobia appears to more strongly correlate with size than age. Due to the paucity of samples at the youngest ages for both stocks, and the influence of the minimum size limit on size at age of those young fish, the LHWG recommends using age-2 for age at 50% maturity for Gulf and Atlantic stocks. All fish age-3+ in the samples were mature. Again, due to the influence of the minimum size limit on the young fish, there is a chance that not all age-3 fish are mature. When back-calculating the length of the fish to age using the von Bertalanffy growth curve, not all age-3 fish would be mature. Thus, the LHWG recommends examining model sensitivity by also using the following schedule: 0% mature at ages 0 and 1, 50% mature at age-2, 75% mature at age-3, and 100% mature age-4+.

Because of the lack of samples below the minimum size limit of 838 mm FL and the fact that female cobia above 800 mm FL are likely to be mature (Tables 2.8.2.2 and 2.8.2.3), one can only guess at the size at 50% maturity. If the AW desires to use size rather than age at maturity, as a first estimate the LHWG suggests using 700 mm and examine model sensitivity by trying 650 and 750 mm as well.

2.8.3 Sex ratio

From Franks et al. (2002), "In general, most studies found a higher percentage of females than males in their samples. Along the Gulf of Mexico, Thompson et al. (1992) reported an overall sex ratio of 1.2:1 that was skewed towards males, whereas, Franks et al. (1999) reported a predominance of females (2.7:1). Since both studies were conducted concurrently in the northern Gulf, it is difficult to explain the discrepancy, except to suggest differential segregation or a higher mortality for males east of the Mississippi River Delta. Burns et al. (1998) reported an overall ratio (all areas sampled) of 2.2:1 (female:male), but noted an overwhelming number of females in the northeast Gulf of Mexico sample (3.3:1)."

Analysis of the pooled GCRL, Mote, NMFS Beaufort, and NMFS Panama City data set, composed almost entirely of fishery dependent samples subject to the minimum size limit, clearly showed steadily increasing proportions of females with size. Although sex ratios are highly variable and sample sizes are small for fish <800 mm, the data suggests a 1:1 ratio up to about that size, then the proportion of females steadily increases until about 1200 mm FL, after which basically all fish are females (Figure 2.8.3.1A, Table 2.8.3.1). By age, sex ratio in the Gulf stock appeared quite stable through at least age 6, averaging 63% females (Figure 2.8.3.1B, Table 2.8.3.2). That trend likely continues for older fish, but sample sizes were too small for ages 7-9 to clearly determine that.

LHWG Recommendation:
By length, consider using 50% females up to 800 mm FL, derive a function to describe the increasing proportion of females between 800 and 1200 mm, and use 100 % females above 1200 mm.
By age, use 60% females for all ages.

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2.8.4 Spawning Frequency

Brown-Peterson et al. (2001), using both oocytes undergoing final oocyte maturation (FOMs) and postovulatory follicles (POFs) (Hunter and Macewicz 1985), estimated cobia from the north central Gulf of Mexico (NCGOM)(n=135) spawn every 4 to 5 days, while those from the southeastern U.S. Atlantic coast spawn every 5.2 days (Table 2.8.4.1). The authors estimated a spawning frequency of 9-12 days for cobia from the western Gulf, but cautioned considering that as typical for the entire Gulf of Mexico, because samples were collected in July, i.e., the latter part of the spawning season. The spawning frequency estimates for the NCGOM were based on data from April, May, and July (spawning season), and both the FOM and POF methods showed good agreement.

The SCDNR, using the presence of POFs (Hunter and Macewicz 1985), estimated an average spawning frequency of 6.4 days for Atlantic stock cobia (n=213) collected inshore and offshore of South Carolina (Table 2.8.4.2).

LHWG Recommendation:
Use a spawning frequency of 4-5 days for Gulf stock cobia.

2.8.5 Batch Fecundity

Only limited information to estimate fecundity is available for cobia along the Atlantic coast and Gulf of Mexico.

Batch fecundity (BF) estimates were taken from datasets published by Brown-Peterson et al. (2001) but the BF method was found to be difficult to apply to cobia as hydrated females were rarely sampled. Estimates were based on an indirect method (denoted as neutral buffered formalin or NBF method) as recently recommended by the lead investigator (Pers Comm. Nancy Brown-Peterson). Sample size is low (n=39) and therefore observations were combined from the S.E. U.S., eastern Gulf of Mexico, and north central Gulf. Relative batch fecundity ranged from 0.99 to 255 eggs/g ovary free body weight (mean 53.1, SD 59.1) by the NBF method. The data suggested a power- rather than a linear function for the relation of batch fecundity and body weight, but the coefficient of determination was low (r^2=0.146, Figure 2.8.5.1).

Batch fecundity alone does not fully represent reproductive investment. No size or age-based estimates are available regarding the number of spawns per year thus annual egg production can only be poorly estimated.

A simplification is to assume that egg production is proportional to biomass of spawning females such that the number of eggs or larvae produced per gram of female body mass is constant among mature females with no effect of age structure on a per-unit basis. This is the Spawning Stock Biomass (SSB) assumption which is equivalent to the exponent b equal to 1 in the generalized fecundity (F) equation $F = aW^b$ where W = female weight.

However the batch fecundity relationship, while poorly fit, suggests b is greater than one (Figure 2.8.5.1). Also, it is becoming better understood generally among fishes with indeterminate fecundity type that older and larger females are more likely to spawn more

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batches per year, thus further increasing the likelihood that b > 1. While difficult to estimate it is likely older cobia contribute disproportiately more to egg production.

LHWG Recommendation:
Use female SSB as an estimate of reproductive potential but apply a sensitivity analysis on outputs including F_{msy} for the fecundity-weight exponent of b in the range from 1 to 2.4 as suggested by Figure 2.8.5.1.

2.9 Meristics and conversion factors

Cobia have a strongly forked tail and fork length has been the most consistently used length measurement. Equations to make length-length and weight-length conversions were derived using the simple linear regression model and the power function, respectively (Tables 2.10.1 and 2.10.2). Data from the GCRL (n=824), Mote (n=352), and NMFS Headboat (n=5287) studies were used to derive length-weight relationships. These data were linearized by a ln-ln transformation and then converted to the power equation W = *a*TL*b*. Only GCRL data was used for length-length equations. All weights are shown in kilograms and all lengths in millimeters. Coefficients of determination (r^2) ranged from 0.913 to 0.921 for the linear length-weight regressions, and 0.952 to 0.974 for the length-length equations. There was a weak suggestion of sexually dimorphic growth in the length-weight model, although it is likely this was driven by sample size and was not biologically significant. There was no evidence of sexually dimorphic growth in the length-length model.

LHWG Recommendation:
1) Use the equations based on combined sources.

2.10 Comments on adequacy of data for assessment analyses

Included in individual sections above.

2.11 Itemized list of tasks for completion following workshop

None.

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2.13 Tables – refer to numbered life history paragraphs

Table 2.3.2.1. Combined table of SC, GCRL and Mote recaptured cobia.

	Region Recap	GAN	N-BR	BR	S-BR	Keys	Gulf
Region Tagged	N						
GAN	121	110	4	6	0	0	1
N-BR	0	0	0	0	0	0	0
BR	36	5	4	14	2	4	7
S-BR	13	2	0	1	5	2	3
Keys	156	0	0	1	8	88	59
Gulf	744	4	8	12	25	78	617

Table 2.3.2.2. Combined table of SC, GCRL and Mote recaptured cobia. Percentages of cobia tagged in a region that are recaptured.

	Region Recap	GAN	N-BR	BR	S-BR	Keys	Gulf
Region Tagged	N						
GAN	121	91%	3%	5%	0%	0%	1%
N-BR	0	0%	0%	0%	0%	0%	0%
BR	36	14%	11%	39%	6%	11%	19%
S-BR	13	15%	0%	8%	38%	15%	23%
Keys	156	0%	0%	1%	5%	56%	38%
Gulf	745	1%	1%	2%	3%	10%	83%

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Table 2.4.1. List of age based instantaneous natural mortality rate (M) point estimate methods. Parameters: k – von Bertalanffy growth coefficient (yr^{-1}), age mat – age at 50% maturity, tmax – maximum age (yr), L∞ - asymptotic length (mm) determined from von Bertalanffy growth model, temp – average water temperature (oC), S – survivorship. Equations provided in Microsoft Excel notation.

Method	Parameters	Equation
Alverson & Carney (1975)	k, tmax	M = 3*k/[exp(0.38*tmax*k)-1]
Beverton & Holt (1956)	k, age mat	M = 3*k/[exp(age mat*k)-1])
Hoenig fish (1983)	tmax	M=exp(1.46 - 1.01*ln(tmax))
Hoenig all taxa (1983)	tmax	M=exp(1.44-0.982*ln(tmax))
Pauly I (1980)	k, L∞, temp	M=exp[-0.0152+0.6543*ln(k)-0.279*ln(L∞)+0.4634*ln (temp)]
Pauly II (Pauly & Binohlan 1996)	k, L∞, temp	M=exp[-0.1464+0.6543*ln(k)-0.279*ln(L∞)+0.4634*ln (temp)]
Ralston I (1987)	k	M=0.0189 + 2.06*k
Ralston II (Pauly & Binohlan 1996)	k	M=-0.1778+3.1687*k
Jensen (1996)	k	M = 1.5*k
Hewitt & Hoenig (2005)	tmax	M = 4/tmax
Alagaraja (1984)	S, tmax	M=-(lnS)/tmax

Table 2.4.2. Point estimates of instantaneous natural morality rate (M) (see Table 2.4.1 for equations and citations) based on all data combined, maximum age (tmax) of 11 yr; von Bertalanffy parameter estimates: t_0 = -0.53, k = 0.42 and L_∞ = 1281.5; and mean water temperature of 25ºC.

Method	M	Method	M
Alverson & Carney	0.26	Ralston (method II)	1.51
Beverton	0.96	Hewitt & Hoenig	0.36
$Hoenig_{fish}$	0.38	Jensen	0.63
$Hoenig_{alltaxa}$	0.40	Rule of thumb	0.27
Pauly	0.64	Alagaraja 0.01	0.42
Ralston	0.88	Alagaraja 0.02	0.36
Ralston (geometric mean)	1.73	Alagaraja 0.05	0.27

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Table 2.5.1. Number, percent kept, and percent discarded dead for cobia 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	Cobia	900	69%	63%
Sink	Cobia	309	16%	39%
Strike	Cobia	6	50%	67%
Overall	Cobia	1,215	56%	51%

Table 2.6.1. Gulf States Marine Fisheries Commission otoliths margin codes used in determining calendar age of fish from the GCRL data set.

Code 1.	opaque zone present on edge
Code 2.	translucent zone forming to 1/3 complete on edge
Code 3.	translucent zone 1/3 to 2/3 complete on edge
Code 4.	translucent zone 2/3 to fully complete on edge

Table 2.7.1. Gulf of Mexico cobia von Bertalanffy growth parameters for length at age using Diaz et al. (2004) correction and inverse weighting by sample size at age.

Parameter	All fish	Females	Males
L_∞ in mm	1281.5	1362.6	1221.7
K	0.42	0.41	0.36
t_0	-0.53	-0.50	-0.50

Table 2.7.2. Weighted (inversely with sample size) and unweighted Gulf of Mexico cobia von Bertalanffy growth parameters for females (n=563) for weight at age.

Parameter	Weighted	Unweighted
W_∞ in kg	60.5972	160.7
K	0.0937	0.0249
t_0	0.4491	-0.22

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Table 2.8.1.1. Published methods for assessing cobia spawning season.

Region	Spawning Season	Method	Reference
Virginia	June-August	GSI, histology	Joseph et al., 1964; Richards, 1967
Virginia	June-August	egg, larval collections	Joseph et al., 1964; Mills, 2000
North Carolina	May-July	GSI	Smith, 1995
North Carolina	May-August	egg, larval collections	Hassler and Rainville, 1975; Smith, 1995
South Carolina	May-August	egg, larval collections	Shaffer and Nakamura, 1989
North central Gulf of Mexico	April-September	GSI, histology	Biesiot et al., 1994; Lotz et al., 1996; Brown-Peterson et al., 2001
North central Gulf of Mexico	May-September	egg, larval collections	Ditty and Shaw, 1992
Louisiana	April-August	GSI, histology	Thompson et al., 1992
Texas	May-September	egg, larval collections	Baughman, 1950; Finucane et al., 1978

Table 2.8.2.1. Count of Atlantic stock female cobia by age and reproductive phase. Reproductive phase terminology from Brown-Peterson et al. (2011).

Age	Immature	Developing	Spawning Capable	Regressing	Regenerating	POFs	Total
0	1						1
1	7						7
2	8	15	3		1		27
3		142	69	4		25	240
4		41	63	2		30	136
5		28	57	1		28	114
6		26	44	1		21	92
7		22	32	2		11	67
8		11	23	2		1	37
9		9	13	1		4	27
10		6	11			2	19
11		3	7			5	15
12		4	7	1		1	13
13		2	1			1	4
14			2				2
15							0
16			1				1
Total	**16**	**309**	**333**	**14**	**1**	**129**	**802**

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Table 2.8.2.2. Atlantic female cobia mean fork length (mm) by age and reproductive phase.

Age	Immature	Developing	Spawning Capable	Regressing	Regenerating	POFs (<24hr)	POFs (>24hr)	Total
0	440							440
1	451							451
2	701	788	847		950			771
3		946	931	969		959	945	942
4		1025	1073	1087		1040	1039	1050
5		1098	1134	1178			1097	1116
6		1129	1216	1081		1145	1170	1177
7		1179	1268	1386		1208	1202	1233
8		1249	1267	1318			1164	1261
9		1243	1254				1182	1238
10		1300	1370				1384	1345
11		1316	1422				1290	1357
12		1264	1417	1565			1448	1363
13		1380	1410				1399	1392
14			1384					1384
15								
16			1372					1372
Total	**575**	**1031**	**1133**	**1175**	**950**	**1051**	**1101**	**1076**

Table 2.8.2.3. Size at maturity for Atlantic stock female cobia fork length (mm).

Female FL (mm)	% Mature	n	Female FL (mm)	% Mature	n
≤350	0	0	1001-1050	100%	93
351-400	0%	2	1051-1100	100%	67
401-450	0%	3	1101-1150	100%	89
451-500	0%	2	1151-1200	100%	80
501-550	0	0	1201-1250	100%	55
551-600	0%	1	1251-1300	100%	52
601-650	33%	3	1301-1350	100%	27
651-700	100%	1	1351-1400	100%	18
701-750	44%	9	1401-1450	100%	8
751-800	75%	4	1451-1500	100%	10
801-850	100%	24	1501-1550		0
851-900	100%	53	1551-1600	100%	1
901-950	100%	73	1601-1650	100%	1
951-1000	100%	89	**Total**	**98%**	**765**

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Table 2.8.3.1. Sex ratios and percent maturity by size (and 95% conf. limits) of female Gulf stock cobia; GCRL (n=513), Mote (n=506), NMFS Panama City (n=25), and NMFS Beaufort (n=9) combined data set. The Wilson score method without continuity correction was used to calculate 95% confidence limits (Newcombe 1998).

FL (mm)	Round FL	Females	Males	Total	%Females	F : M	Lower 95% CL	Upper 95% CL
490-509	500	1	0	1	100.0	1:1.0	20.7	100.0
510-529	520		1	1	0.0	0:1.0	0.0	79.3
530-549	540							
550-569	560		1	1	0.0	0:1.0	0.0	79.3
570-589	580							
590-609	600	4	0	4	100.0	1:1.0	51.0	100.0
610-629	620							
630-649	640	4	2	6	66.7	2:1.0	30.0	90.3
650-669	660	4	0	4	100.0	1:1.0	51.0	100.0
670-689	680	2	1	3	66.7	2:1.0	20.8	93.9
690-709	700	1	3	4	25.0	0.3:1.0	4.6	69.9
710-729	720	4	3	7	57.1	1.3:1.0	25.0	84.2
730-749	740	2	1	3	66.7	2:1.0	20.8	93.9
750-769	760	2	2	4	50.0	1:1.0	15.0	85.0
770-789	780	4	0	4	100.0	1:1.0	51.0	100.0
790-809	800	6	4	10	60.0	1.5:1.0	31.3	83.2
810-829	820	8	10	18	44.4	0.8:1.0	24.6	66.3
830-849	840	16	28	44	36.4	0.6:1.0	23.8	51.1
850-869	860	29	28	57	50.9	1.0:1.0	38.3	63.4
870-889	880	21	22	43	48.8	1.0:1.0	34.6	63.2
890-909	900	29	22	51	56.9	1.3:1.0	43.3	69.5
910-929	920	19	22	41	46.3	0.9:1.0	32.1	61.3
930-949	940	36	25	61	59.0	1.4:1.0	46.5	70.5
950-969	960	39	26	65	60.0	1.5:1.0	47.9	71.0
970-989	980	40	19	59	67.8	2.1:1.0	55.1	78.3
990-1009	1000	46	16	62	74.2	2.9:1.0	62.1	83.4
1010-1029	1020	39	14	53	73.6	2.8:1.0	60.4	83.6
1030-1049	1040	40	15	55	72.7	2.7:1.0	59.8	82.7
1050-1069	1060	34	15	49	69.4	2.3:1.0	55.5	80.5
1070-1089	1080	32	16	48	66.7	2:1.0	52.5	78.3
1090-1109	1100	37	4	41	90.2	9.3:1.0	77.5	96.1
1110-1129	1120	26	3	29	89.7	8.7:1.0	73.6	96.4
1130-1149	1140	28	8	36	77.8	3.5:1.0	61.9	88.3
1150-1169	1160	29	1	30	96.7	29:1.0	83.3	99.4
1170-1189	1180	19	3	22	86.4	6.3:1.0	66.7	95.3
1190-1209	1200	21	2	23	91.3	10.5:1.0	73.2	97.6
1210-1229	1220	25	1	26	96.2	25:1.0	81.1	99.3

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1230-1249	1240	17	4	21	81.0	4.3:1.0	60.0	92.3
1250-1269	1260	7	1	8	87.5	7:1.0	52.9	97.8
1270-1289	1280	10	1	11	90.9	10:1.0	62.3	98.4
1290-1309	1300	8	0	8	100.0	1:1.0	67.6	100.0
1310-1329	1320	9	1	10	90.0	9:1.0	59.6	98.2
1330-1349	1340	5	1	6	83.3	5:1.0	43.6	97.0
1350-1369	1360	5	1	6	83.3	5:1.0	43.6	97.0
1370-1389	1380	2	0	2	100.0	1:1.0	34.2	100.0
1390-1409	1400	1	1	2	50.0	1:1.0	9.5	90.5
1410-1429	1420	5	0	5	100.0	1:1.0	56.6	100.0
1430-1449	1440	2	0	2	100.0	1:1.0	34.2	100.0
1450-1469	1460	1	0	1	100.0	1:1.0	20.7	100.0
1470-1489	1480							
1490-1509	1500							
1510-1529	1520	2	0	2	100.0	1:1.0	34.2	100.0
1530-1549	1540	1	0	1	100.0	1:1.0	20.7	100.0
1550-1569	1560							
1570-1589	1580	1	0	1	100.0	1:1.0	20.7	100.0
1590-1609	1600							
1610-1629	1620							
1630-1649	1640	1	0	1	100.0	1:1.0	20.7	100.0
Total		724	329	1053	68.8			

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Table 2.8.3.2. Sex ratios and percent maturity by age (and 95% conf. limits) of female Gulf stock cobia; GCRL (n=513), Mote (n=507), NMFS Panama City (n=26), and NMFS Beaufort (n=9) combined data set. The Wilson score method without continuity correction was used to calculate 95% confidence limits (Newcombe 1998).

Final Age	Females	Males	Total	% Female	F : M	lower 95% CL	upper 95% CL
0							
1	33	15	48	68.8	2.2:1.0	54.7	80.1
2	194	80	274	70.8	2.4:1.0	65.2	75.9
3	264	122	386	68.4	2.2:1.0	63.6	72.8
4	134	60	194	69.1	2.2:1.0	62.3	75.2
5	53	28	81	65.4	1.9:1.0	54.6	74.9
6	32	9	41	78.0	3.6:1.0	63.3	88.0
7	7	8	15	46.7	0.9:1.0	24.8	69.9
8	6	3	9	66.7	2.0:1.0	35.4	87.9
9	2	4	6	33.3	0.5:1.0	9.7	70.0
Total	725	329	1,054				

Table 2.8.4.1. Mean estimated spawning frequencies of cobia from the southeastern United States and north central Gulf of Mexico. Spawning frequencies were estimated from the percentage of ovaries in the late developing ovarian class containing either postovulatory follicles (POF) or undergoing final oocyte maturation (FOM). Spawning frequency estimates were based on data from April to June in the SEUS, and from April, May, and July in the NCGOM. From Brown Peterson et al. (2001).

	Region	
	S.E. United States (SEUS)	North Central Gulf of Mexico (NCGOM)
Spawning frequency	(n=23)	(n=135)
POFs %	19.4	24.8
Frequency (POFs)	5.2 days	4.0 days
FOM %	19.4	19.8
Frequency (FOM)	5.2 days	5.0 days

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Table 2.8.4.2. Mean estimated spawning frequencies of cobia from inshore and offshore collections off South Carolina. Spawning frequencies were based on presence or absence of postovulatory follicles (POF) in the late developing ovaries. Source: SCDNR.

Spawning frequency	Inshore Captures	Offshore Captures	Unknown Capture Location	All areas combined
Samples (n)	64	34	115	**213**
% POFs	15.625	35.294	11.304	**16.432**
Frequency (POFs)	6.4 days	2.8 days	8.8 days	**6.1 days**

Table 2.10.1. Linear and power functions to convert fork length (mm) of Gulf stock cobia to weight in kilograms. Overall range of weights: 0.009-53.39 kg. The LHWG recommends the combined functions (highlighted in yellow).

Sex	Model	n	FL range	a	SE a	b	SE b	MSE	R2
Male	Ln(Wt) = a+b*Ln(FL)	304	310-1450	-21.0459	0.391345	3.391908	0.057139	0.18917	0.9208
Female	Ln(Wt) = a+b*Ln(FL)	851	315-1639	-20.2313	0.23385	3.27777	0.03351	0.16409	0.9184
Combined	Ln(Wt) = a+b*Ln(FL)	6463	99-1639	-18.5393	0.079677	3.034126	0.011619	0.16839	0.91344
Combined[1]	Wt=aFL^b			9.00E-09		3.03			

[1]Ln-Ln transformed to power equation adjusting for transformation bias with 1/2 MSE

Table 2.10.2 Linear functions to convert total length (mm) of Gulf stock cobia to fork length (mm). The LHWG recommends the combined functions (highlighted in yellow).

Sex	Model	n	FL range	a	SE a	b	SE b	MSE	R2
Male	FL = a+b*TL	212	838-1450	-35.1237	15.68561	0.931389	0.014264	22.399	0.95283
Female	FL = a+b*TL	567	420-1626	4.776873	7.476194	0.895853	0.006144	24.47	0.97407
Combined	FL = a+b*TL	3105	99-1626	-10.024	3.650035	0.900559	0.0033	27.169	0.95999

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2.14 Figures – refer to numbered life history paragraphs

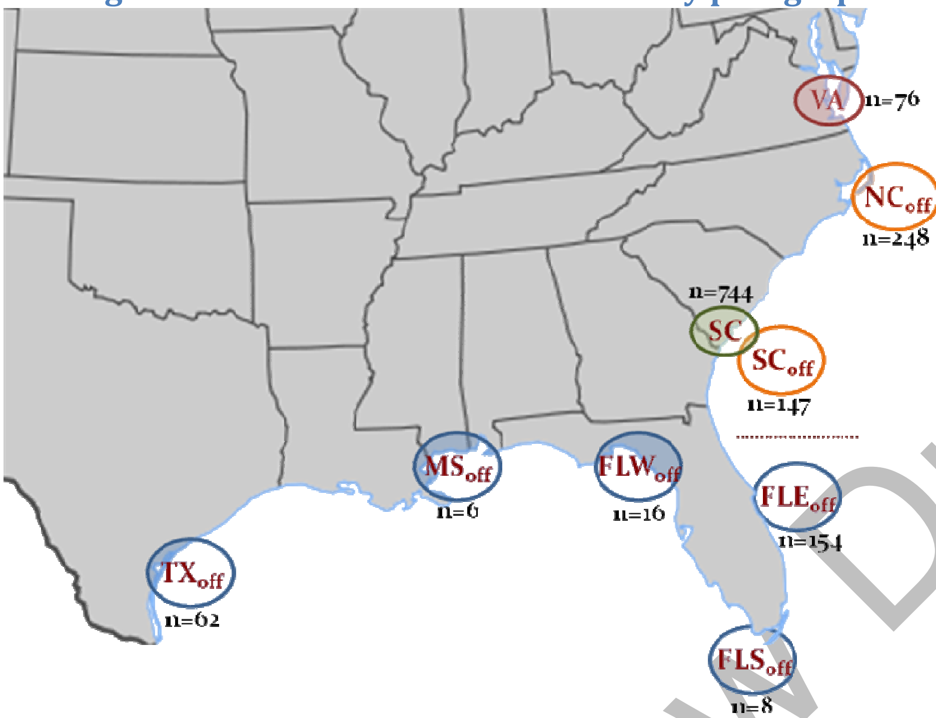

Figure 2.3.1.1. Map depicting the approximate sample sites where cobia genetic samples were taken along the south Atlantic and Gulf coast.

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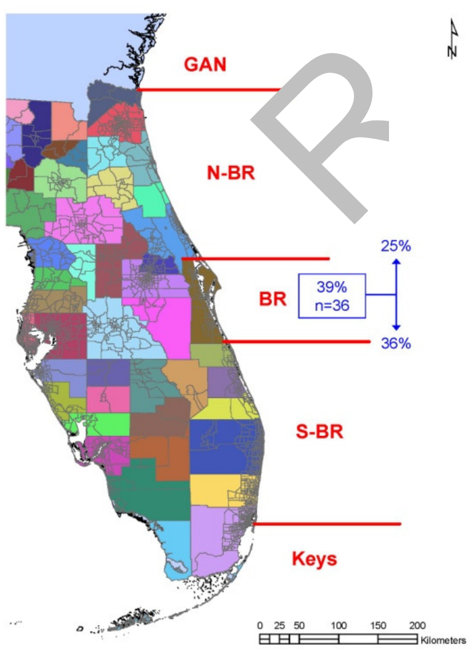

Figure 2.3.2.1. Movement of tagged cobia from Brevard County, FL (BR) to the north and south.

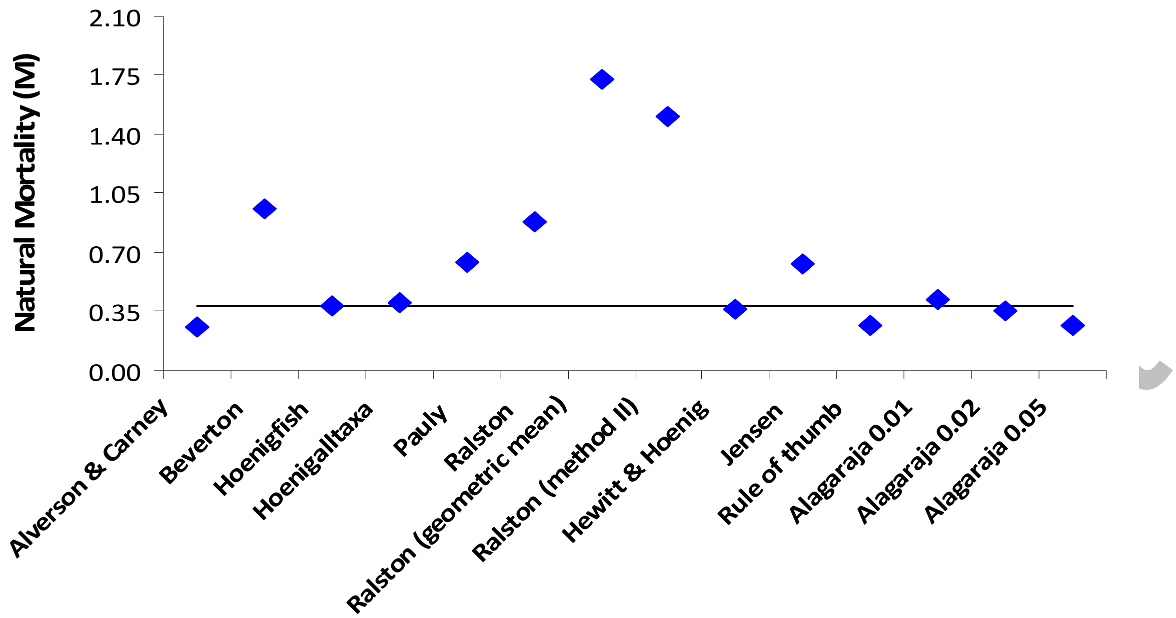

Figure 2.4.1. Point estimates of instantaneous natural mortality rates (M) for Gulf of Mexico stock cobia. The LHWG recommends using the Hoenig$_{fish}$ estimate (black line, 0.38) for scaling the age specific Lorenzen estimates.

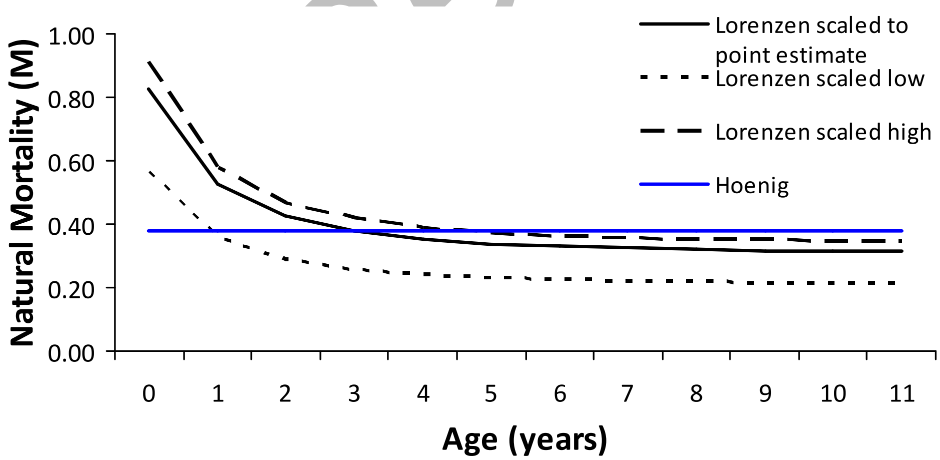

Figure 2.4.2. Age-varying instantaneous natural mortality (M) for Gulf stock cobia using the Lorenzen approach (Lorenzen 1996) and scaled to the Hoenig$_{fish}$ estimate of 0.38 with low and high sensitivity runs at 0.26 and 0.42, respectively.

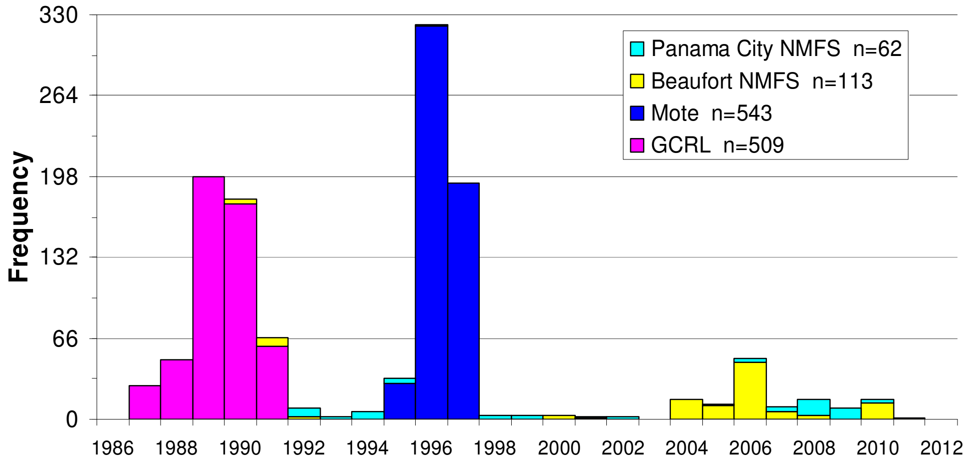

Figure 2.6.1. Overall temporal distribution by source (sexes combined) of the Gulf of Mexico cobia age samples to be used for the SEDAR28 assessment.

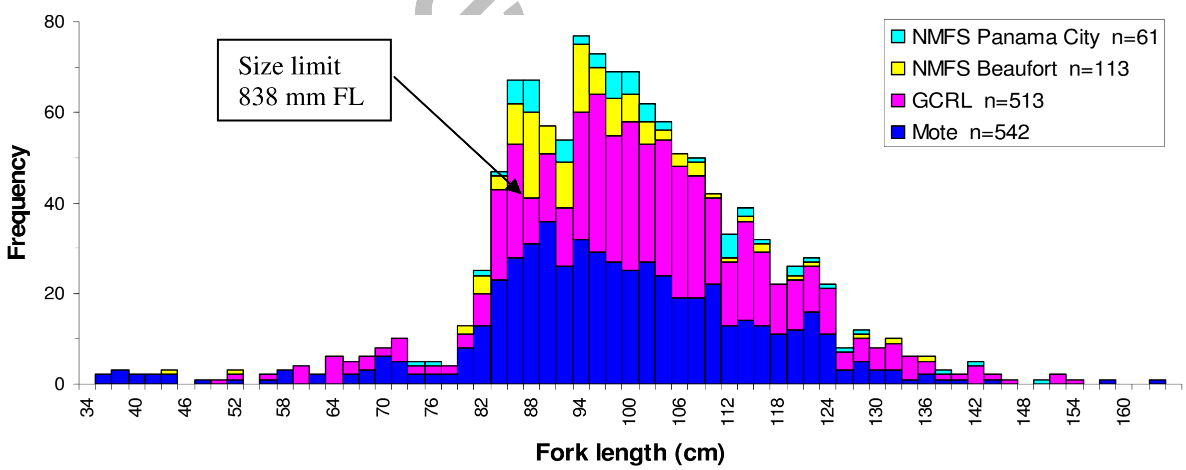

Figure 2.6.2 Overall size distribution by source (sexes combined) of the Gulf of Mexico cobia age samples to be used for the SEDAR28 assessment. The sharp increase at about 84 cm reflects the effect of the 838 mm FL minimum size limit on the mainly fishery-dependent samples.

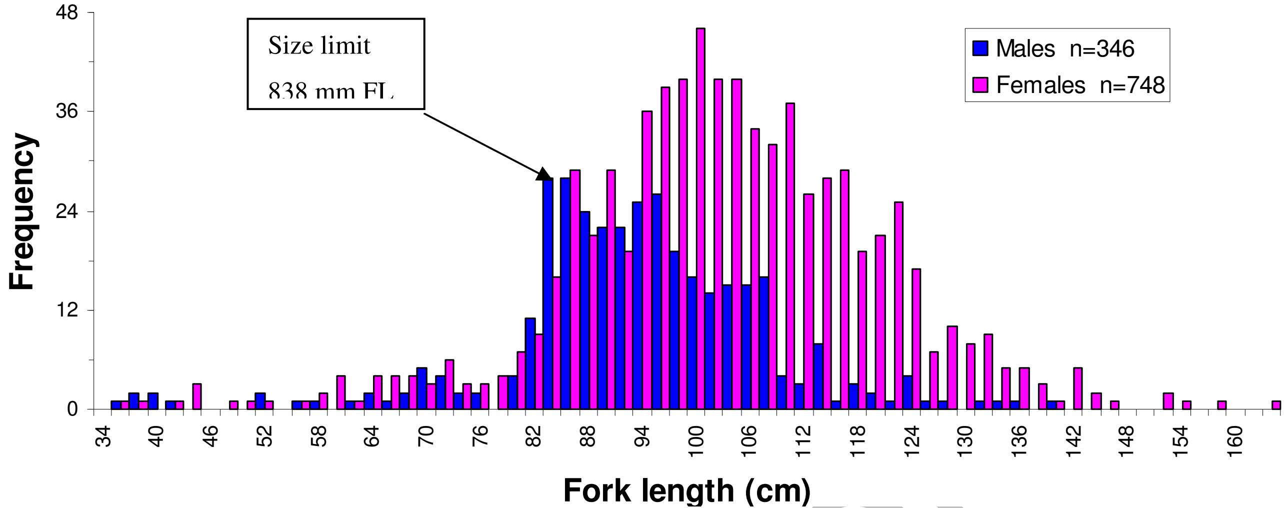

Figure 2.6.3. Overall size distributions by sex (sources combined) of the Gulf of Mexico cobia age data set to be used for the SEDAR28 assessment.

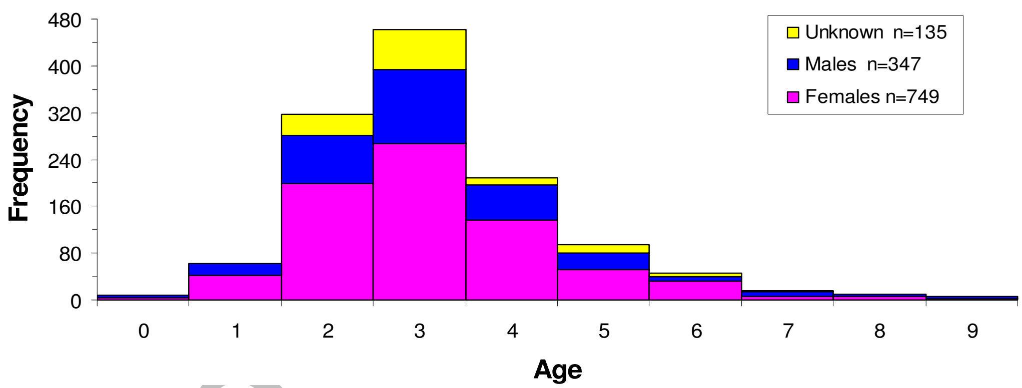

Figure 2.6.4. Overall age distributions by sex (sources combined) of the Gulf of Mexico cobia age data set to be used for the SEDAR28 assessment.

Preview D

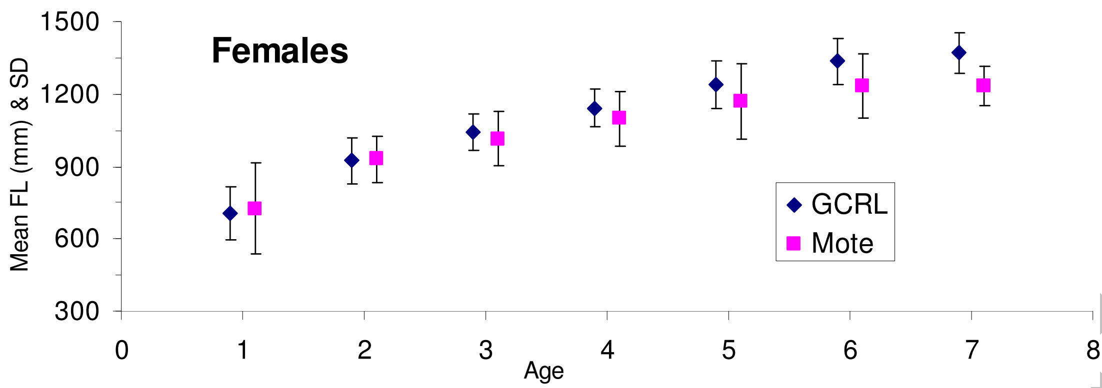

Figure 2.7.1. Mean sizes at age of Gulf stock cobia from the Gulf Coast Research Lab (GCRL) and Mote Marine Lab data sets.

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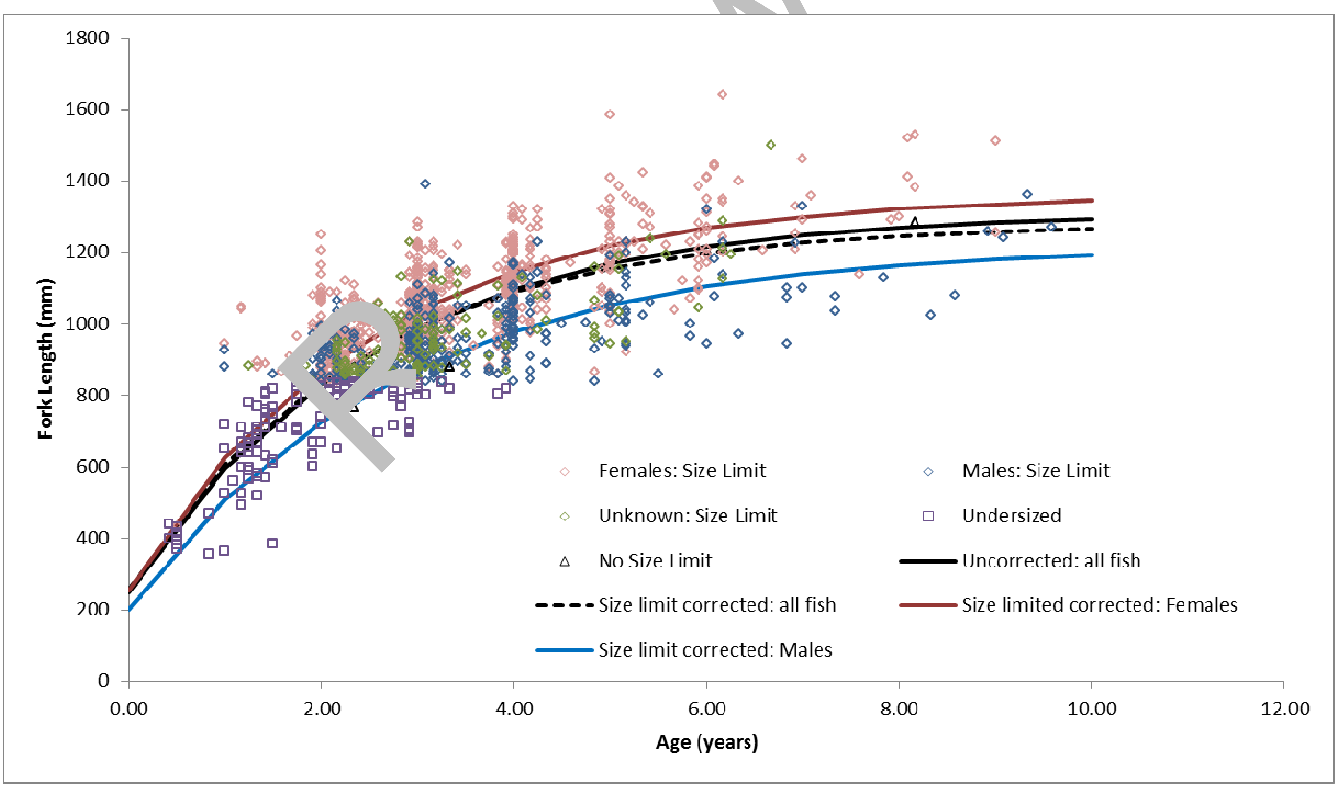

Figure 2.7.2. Gulf stock cobia raw size at age data, uncorrected, inverse-weighted Von Bertalanffy growth curves for sexes combined, and inverse-weighted Von Bertalanffy growth curves, corrected for the 33 inch size limit, for sexes combined and by sex.

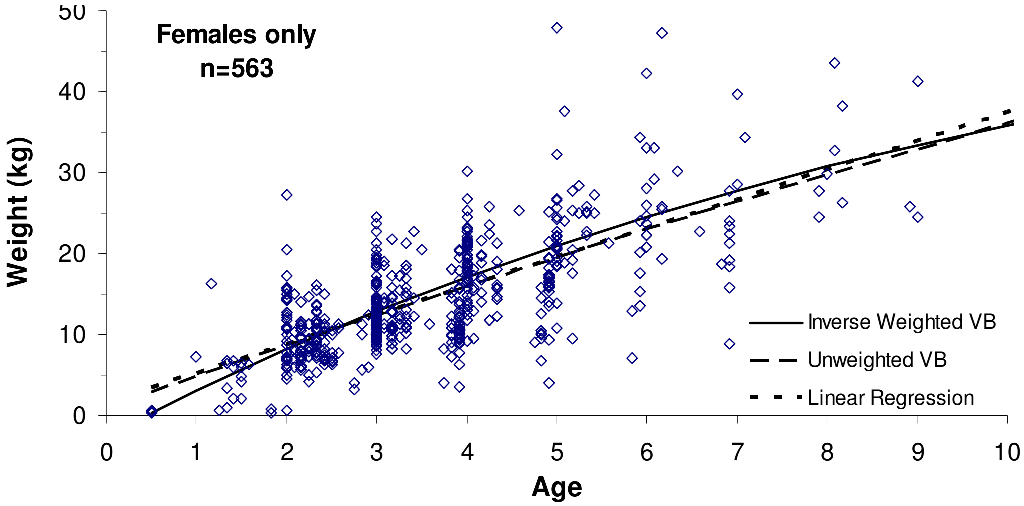

Figure 2.7.3. Gulf stock cobia raw weight at age data, and uncorrected (for size limits), inverse-weighted and unweighted Von Bertalanffy growth curves for females.

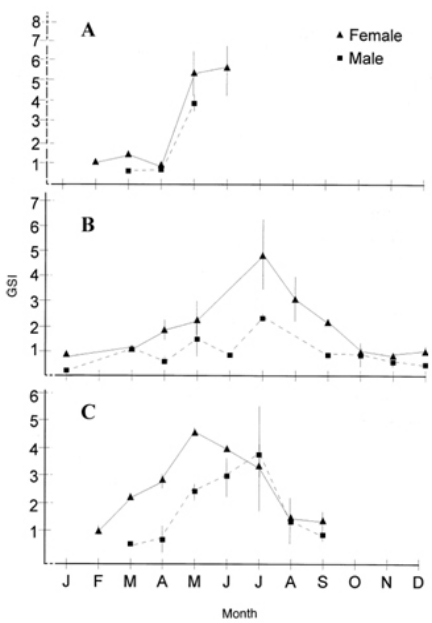

Figure 2.8.1.1. Monthly (1996 and 1997 combined) gonadosomatic index (GSI) values for cobia from the southern United States. Values represent mean ± ISE. (solid trianges=female, solid squares=male) (A) southeastern United States. (B) Eastern Gulf of Mexico. (C) North-Central Gulf of Mexico. From Brown-Peterson et al. (2001).

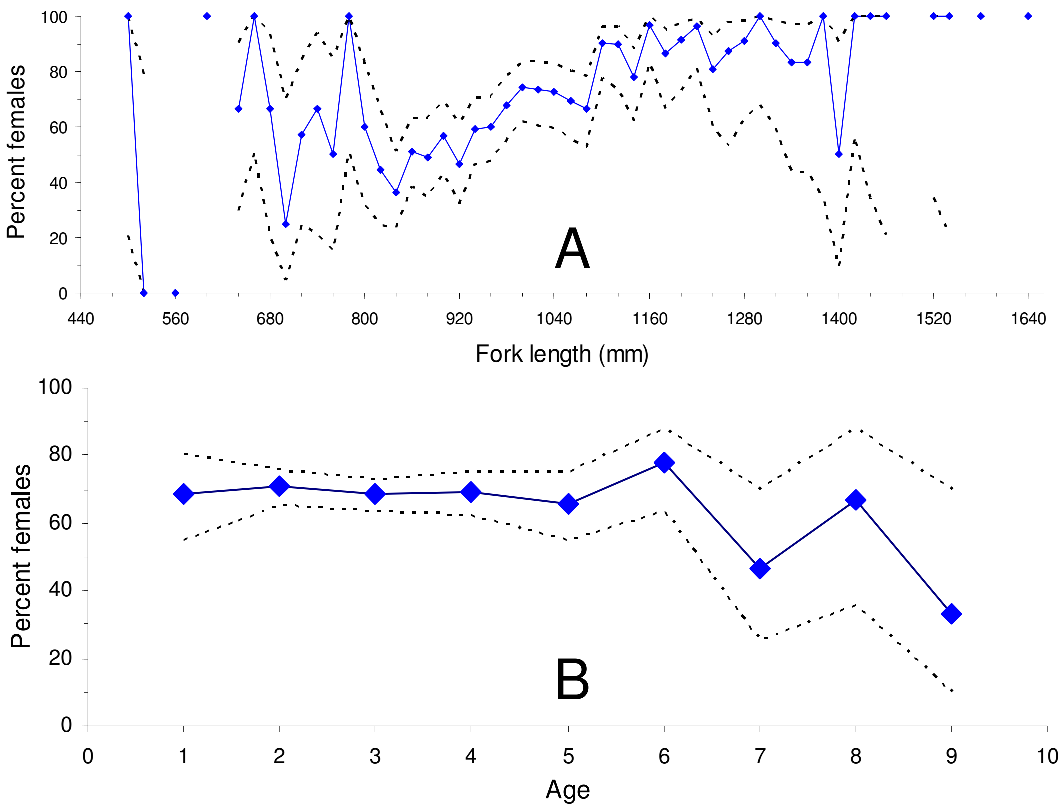

Figure 2.8.3.1. Percent Gulf of Mexico female cobia and 95% confidence limits from the pooled GCRL, Mote, NMFS Beaufort, and NMFS Panama City age data sets by 20 mm length intervals (A) and by age (B).

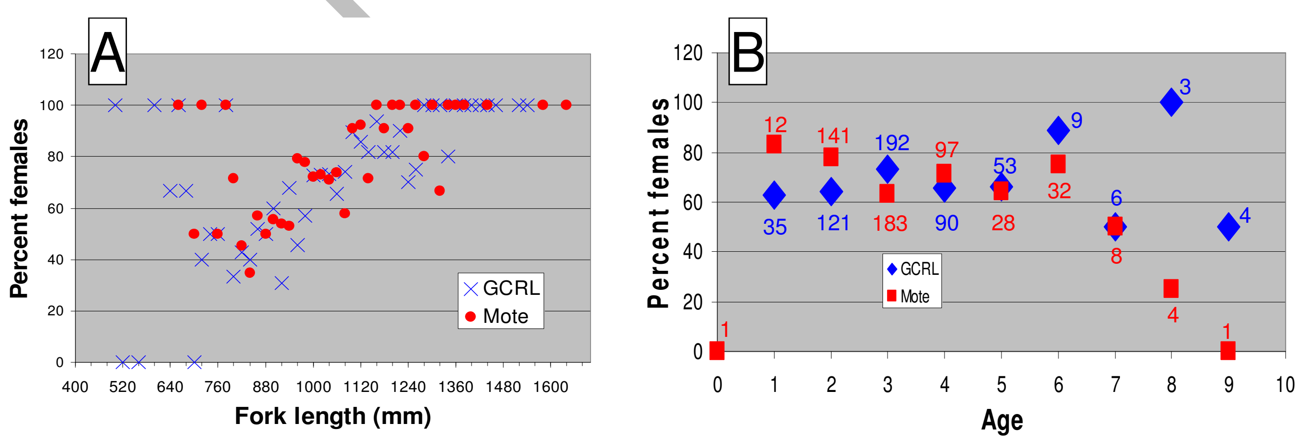

Figure 2.8.3.2. Comparison of percent Gulf of Mexico female cobia in Mote and GCRL studies by 20 mm length interval (A) and by age (B). Numbers adjacent to data points are sample sizes.

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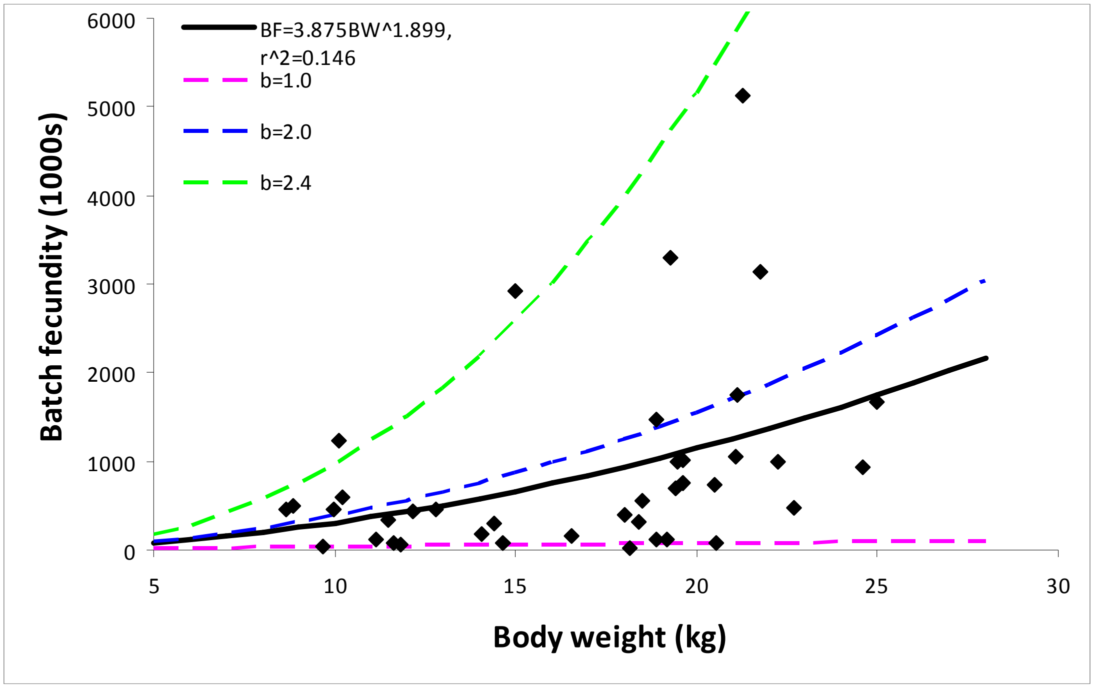

Figure 2.8.5.1. Relationship between batch fecundity and total body weight of cobia (n=39) collected in the eastern Gulf of Mexico, north central Gulf of Mexico, and in the Atlantic Ocean off the southeastern United States, April – September, 1996-97. Batch fecundity was determined from formalin-fixed oocytes > 700 um in diameter. Data from Brown-Peterson et al. (2001) and function fit by G. Fitzhugh.

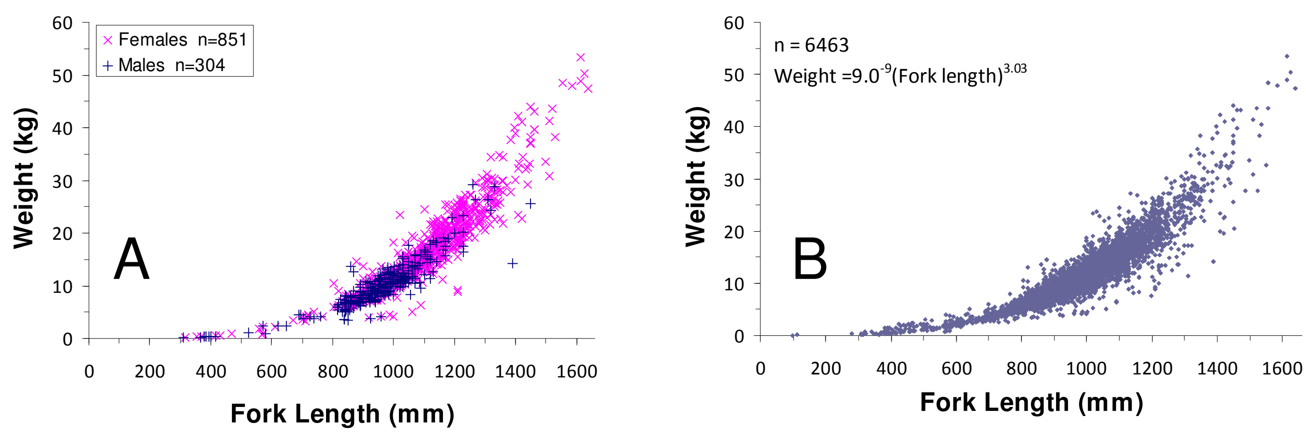

Figure 2.10.1. Gulf of Mexico cobia length-weight relationships by sex (A) and sexes combined (B).

3 Commercial Fishery Statistics

3.1 Overview

Commercial landings for the U.S. Gulf of Mexico (GoM) cobia stock were developed by gear (gill net, hand lines, and miscellaneous) in whole weight for the period 1926–2010 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 GoM and reporting to the NMFS Coastal Logbook Program. Shrimp bycatch of cobia 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 in SEDAR 28 Data Workshop 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 cobia fishery is considered to include the area from the Georgia/Florida border 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 1926, 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 GA/FL border. Landings south of the GA/FL border to the TX/Mexico border were considered to be from the GoM stock, and landings north of the GA/FL border were considered to be from the Atlantic stock (Figures 3.1 and 3.2).

Data reported as south of the GA/FL border (ALS fishing areas: 7220-7510, 0010-0219, 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 GoM if it was landed in FL, AL, MS, LA or TX (ALS states 11, 01, 21, 27, 46).

Decision 4: Eastern boundary is the Georgia/Florida border and the western boundary is the Texas/Mexico border. This was accepted by the plenary.

3.3.4 Identification Issues

The commercial WG felt there was not an identification issue for cobia, so there is no need to account for misidentified cobia in the landings data.

Decision 5: There is not a misidentification issue with cobia. 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: hand line (including trolling), long line and miscellaneous (Table 3.1). Hand lines were the dominant gear type. The WG recommended that, for the assessment model, landings from the miscellaneous gear be added to the landings for the predominant gear (hand lines).

Decision 6: Landings will be aggregated by hand line, long line and miscellaneous (other) gears. For the assessment model, the miscellaneous gears should be included with the predominant (hand line) gear. This was accepted by the plenary.

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:

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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 were generally referred to as the NMFS General Canvass data. The 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 GoM, trip ticket data are available directly from the state trip ticket program or through the GoM 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 1926-2010.

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 GoM 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 cobia landings by year and gear with pounds (whole weight) from Florida waters. Gear categories include hand line (including trolling), long line, and miscellaneous. Gear was not accurately reported on trip ticket data from 1986 to 1996, so for these 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. Cobia is not required on logbooks, so commercial logbooks are not a valid source of gear information for cobia.

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

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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 cobia were compiled from the ALS 1962-2010.

Louisiana – Louisiana trip ticket data have 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 were recoded in the FIN format and copied to the GulfFIN database every few months. GulfFIN provided the cobia 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 have collected TX landings data. Because the NMFS data collection method has been in place since the 1970s, ALS was used for TX cobia landings from 1962-2010.

GoM cobia 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:
  - 1926-1949 (Bureau of Commercial Fisheries reports)
  - 1950-1961 (S&T)
  - 1962-1996 (ALS)
  - 1997-2010 (FLFWC)
  - AL:
  - 1926-1949 (Bureau of Commercial Fisheries reports)
  - 1950-1961 (S&T)
  - 1962-1999 (ALS)
  - 2000-2010 (GulfFIN)
  - MS:
  - 1926-1949 (Bureau of Commercial Fisheries reports)
  - 1950-1961 (S&T)
  - 1962-2010 (ALS)
  - LA:
  - 1926-1949 (Bureau of Commercial Fisheries reports)
  - 1950-1961 (S&T)
  - 1962-1999 (ALS)
  - 2000-2010 (GulfFIN)
  - TX:
  - 1926-1949 (Bureau of Commercial Fisheries reports)
  - 1950-1961 (S&T)
  - 1962-2010 (ALS)

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Whole vs Gutted Weight – The Commercial WG discussed the topic of what units to use to report commercial landings. Cobia 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 data is available to determine number of submitters. 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 at length in pounds whole weight, trip weight in pounds whole weight, and 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). 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).

Remaining tasks for Commercial Landings:
Data for 2011 were not available prior to the workshop. Landings in pounds for 2011 will be added to the landings when the data have been finalized.

3.4 Commercial Discards

3.4.1 Discards from Commercial Finfish Operations

Cobia discards from the commercial vertical line, trolling, and gillnet fisheries were calculated for the US South Atlantic (statistical areas 2300-3700; Figure 3.5) and GoM (statistical areas 1-21; Figure 3.5). The number of trips that reported discards of cobia was very low (Table 3.5), limiting the complexity of any analysis. Methods for calculating discards are detailed in SEDAR 28-DW04 and are summarized below.

Cobia 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 1993–2010. Federal permits were not required to land cobia caught in federal waters, therefore, total cobia fishing effort may not have been reported to the coastal logbook

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program by all commercial vessels, and thus any estimates of total discards would be erroneously low.

Approximately 6.2 percent of all cobia 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 GoM 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 cobia discards from the commercial fishery (of vessels with federal permits reporting to the coastal logbook program) were relatively low. During the 18 years included in the analysis, fewer than 14,000 cobia per year were discarded in the GoM. 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 a commercial fishing trip 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 cobia discards were reported as "all alive" or "majority alive" in the GoM hand line and trolling fisheries (Table 3.7). The vertical line and trolling fisheries in the GoM 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.

> **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 cobia bycatch in the GoM 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

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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/σ2) 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 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 cobia bycatch in the GoM shrimp fishery are presented in Table 3.10. The CVs associated with these estimates ranged from 66% to 208%. Only 4 of the 39 years had CVs below 100%. The marginal posterior densities of the estimates showed a high degree of skew in every year.

Since there were many years with small sample sizes and concern about the large fraction of SEAMAP samples used in this analysis, the commercial group felt that this method may not be appropriate for cobia. Additionally, it appeared as though some of the estimates were stuck on a bound, yielding the same estimate over several years. The commercial group proposed using the empirical means from the observed commercial catch as an alternative.

After the workshop the model parameters were investigated further. It was discovered that a large fraction of the cobia samples were dropped during the initial model run and these were added back to the model. This increased the sample size from 724 fish to 2,110 fish, alleviating the concerns about the small sample sizes. Additionally, it was revealed that only samples from 40ft nets fished similarly to the commercial sector were used from the

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SEAMAP trawls. This alleviated concerns about using SEAMAP samples in the construction of the bycatch model. It was also discovered that some tows from SEAMAP were erroneously assigned short tow time, leading to very high discard estimates. NMFS staff are working on correcting these erroneous tow times, which should reduce the number of outliers. However, the original model still had observations that appeared to be stuck on a bound. If the new model does not display this trend, the commercial group supports using the bycatch estimates from the Bayesian model.

> **Decision 11:** The Commercial WG supports the Bayesian methodology of calculating cobia bycatch in the GoM shrimp fishery and recommends the use of these data, as long as the updated model does not appear to have a problem with the estimates getting stuck on a bound. This was accepted by the plenary on the March 14, 2012 data webinar.

3.5 Commercial Effort

The distribution of commercial effort in trips by year were 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. 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.

Given the low sample sizes resulting from the strict trip limit for cobia, the commercial WG recommended that no trip weighting was needed to correct for any sampling bias. Length data were 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.

> **Decision 12:** The Commercial WG recommends weighting the length samples by the landings to overcome any sampling bias arising from spatial differences in sampling. This was accepted by the plenary.

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3.6.1 Sampling Intensity for Lengths

The number of trips with samples used in the length compositions ranged from a high of 42 for long line gear in 2004 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 2001. The number of trips with samples was greater than 10 for long line gear from 1998 to 2005. Trips using other miscellaneous gear were rarely sampled. Table 3.13 displays the number of trips with unbiased samples and number of trips with samples used (landings available).

The number of fish sampled had a high of 66 for hand line gear in 2010 to lows of zero for many of the strata (Table 3.12). The number of lengths sampled was consistently greater than 10 for hand line gear since 2000. Long line gear had over 10 lengths available for only years within 1997-2005. For other miscellaneous gears, the numbers of length samples available were never above 10. Table 3.14 displays the number of valid samples and number of samples used (landings available).

3.6.2 Length/Age Distribution

All lengths were converted to fork length (FL) in mm using the formula provided in the cobia 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 hand line, long line, and other miscellaneous gears. Length compositions were weighted by the landings in numbers by strata (state, year, gear). Annual length compositions of cobia 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 nine cobia were reported as discarded. One fish was measured at 73.4 FL in cm was reported for 2006, six fish in 2007 (51.5, 65, 70, 71, 77.5, and 88.9 FL in cm), and two fish in 2008 (73.1 and 78.5 FL in cm).

Sample size of cobia ages are summarized by gear from commercial landings in the U.S. GoM for 1983-2010 (Table 3.13). Age compositions were developed for hand line (1988-2010 with exceptions in Figure 3.13), long 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:

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

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

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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 1920s. 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 cobia 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 cobia, 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 cobia 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. The annual proportion of commercial landings sampled for lengths is typically less than 1% in all years (Table 3.14). Age compositions were inadequate for all years, which will limit the ability to construct catch at age.

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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
=================

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.

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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
=======

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

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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.

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 a 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 cobia commercial landings.

NMFS GEAR CODE	GEAR DESCRIPTION	GEAR CATEGORY
0	Not Coded	OTHER
20	Haul Seines, Beach	OTHER
30	Haul Seines, Long	OTHER
32	Haul Seines, Long(Danish)	OTHER
40	Stop Seines	OTHER
50	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

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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
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 Offshore	OTHER
355	Pots And Traps, Spiny Lobster	OTHER
360	Pots And Traps, Octopus	OTHER
365	Pots And Traps, Perwkle Or	OTHER

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	Ckle	
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	OTHER
405	Gill Nets, California Halibut	OTHER
410	Gill Nets, Crab	OTHER
415	Gill Nets, Salmon	OTHER
420	Gill Nets, Sea Bass	OTHER
425	Gill Nets, Other	OTHER
430	Gill Nets, Sink/Anchor, Other	OTHER
450	Gill Nets, Drift, Barracuda	OTHER
455	Gill Nets, Drift, Salmon	OTHER
460	Gill Nets, Drift, Sea Bass	OTHER
465	Gill Nets, Drift, Shad	OTHER
470	Gill Nets, Drift, Other	OTHER
475	Gill Nets, Drift, Runaround	OTHER
480	Gill Nets, Stake	OTHER
490	Gill Nets, Gl Shoal	OTHER
500	Gill Nets, Gl 1 - 2 Inch	OTHER
505	Gill Nets, Gl 2 - 4 Inch	OTHER
510	Gill Nets, Gl 4 - 7 Inch	OTHER
515	Gill Nets, Gl 7 - 14 Inch	OTHER
520	Gill Nets, Drift Large Pelagic	OTHER
530	Trammel Nets	OTHER
600	Troll & Hand Lines Cmb	HOOK & LINE
601	Lines Hand, Albacore	HOOK & LINE
605	Lines Hand, Rockfish	HOOK & LINE
607	Lines Hand, Yellowfish	HOOK & LINE
610	Lines Hand, Other	HOOK & LINE
611	Rod and Reel	HOOK & LINE
612	Reel, Manual	HOOK & LINE
613	Reel, Electric or Hydraulic	HOOK & LINE
614	BUOY GEAR, VERTICAL	LONG LINE
616	Rod and Reel, Electric (Hand)	HOOK & LINE

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621	Lines Jigging Machine	HOOK & LINE
650	Lines Troll, Salmon	HOOK & LINE
651	Lines Power Troll Salmon	HOOK & LINE
655	Lines Troll, Tuna	HOOK & LINE
656	Lines Power Troll Tuna	HOOK & LINE
657	LINES TROLL, GREEN-STICK	HOOK & LINE
660	Lines Troll, Other	HOOK & LINE
661	Lines Power Troll Other	HOOK & LINE
665	Lines Troll, Mackerel	HOOK & LINE
675	Lines Long Set With Hooks	LONG LINE
676	Lines Long, Reef Fish	LONG LINE
677	Lines Long, Shark	LONG LINE
678	Lines Long Drift With Hooks	LONG LINE
680	Lines Trot With Baits	OTHER
685	Lines Snag	OTHER
690	Lines Electrical Devices	OTHER
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

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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
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. Cobia landings (pounds whole weight) by gear from the U.S. Gulf of Mexico, 1926-2010.

	GEAR		
YEAR	HAND LINE	LONG LINE	OTHER
1927	5,511	0	3,939
1928	13,312	0	9,515
1929	8,588	0	6,139
1930	8,365	0	5,979
1931	6,093	0	4,355
1932	3,385	0	2,420
1933			
1934	4,315	0	3,085
1935			
1936	3,441	0	2,459
1937	1,166	0	834
1938	4,315	0	3,085
1939	3,732	0	2,668
1940	816	0	584
1941			
1942			
1943			
1944			
1945	175	0	125
1946			
1947			
1948	2,508	0	1,792
1949	15,978	0	11,422
1950	25,717	0	18,383
1951	29,041	0	20,759
1952	21,926	0	15,674
1953	16,853	0	12,047
1954	15,337	0	10,963
1955	17,844	0	12,756
1956	8,747	0	6,253
1957	15,045	0	10,755
1958	14,229	0	10,171
1959	24,084	0	17,216
1960	33,123	0	23,677
1961	20,352	0	14,548
1962	33,700	0	5,800
1963	42,000	0	2,800
1964	27,400	0	600
1965	22,700	0	2,800
1966	31,400	0	11,200
1967	24,300	0	23,800
1968	51,000	0	38,300
1969	42,900	0	32,600

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1970	59,900	0	59,700
1971	66,100	0	44,300
1972	51,200	0	36,300
1973	35,400	0	52,200
1974	45,600	0	55,300
1975	47,800	0	49,900
1976	69,100	127	47,900
1977	64,500	0	47,810
1978	62,356	0	51,106
1979	58,144	0	42,842
1980	71,258	0	47,845
1981	86,138	0	56,922
1982	79,806	0	47,328
1983	98,561	0	51,986
1984	124,268	0	33,979
1985	135,223	**	37,615
1986	159,649	4,238	30,013
1987	174,586	8,646	49,772
1988	163,172	13,395	56,628
1989	225,910	11,793	66,115
1990	169,632	6,619	64,171
1991	161,148	19,210	93,502
1992	191,904	22,664	132,256
1993	184,195	24,864	144,023
1994	174,849	19,345	157,620
1995	183,322	13,722	133,997
1996	222,452	27,020	116,387
1997	174,026	20,195	107,602
1998	177,084	16,957	94,333
1999	155,769	24,159	104,689
2000	142,489	26,150	43,370
2001	117,670	19,320	40,876
2002	130,631	24,148	28,752
2003	141,183	29,757	23,892
2004	124,077	27,601	27,612
2005	91,243	19,531	26,077
2006	90,134	24,910	36,001
2007	108,604	15,073	23,511
2008	99,241	19,084	21,089
2009	102,707	9,462	25,135
2010	173,107	5,920	15,906

** = indicates confidential data withheld.

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Table 3.3. Mean weights in pounds whole weight used to derive cobia 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								
	HAND LINE			LONG LINE			OTHER		
YEAR	MEAN WEIGHT	STANDARD DEVIATION	SOURCE	MEAN WEIGHT	STANDARD DEVIATION	SOURCE	MEAN WEIGHT	STANDARD DEVIATION	SOURCE
1927	33.395	91.365	GEAR_MEANS	40.158	106.344	GEAR_MEANS	33.764	79.631	GEAR_MEANS
1928	33.395	91.365	GEAR_MEANS	40.158	106.344	GEAR_MEANS	33.764	79.631	GEAR_MEANS
1929	33.395	91.365	GEAR_MEANS	40.158	106.344	GEAR_MEANS	33.764	79.631	GEAR_MEANS
1930	33.395	91.365	GEAR_MEANS	40.158	106.344	GEAR_MEANS	33.764	79.631	GEAR_MEANS
1931	33.395	91.365	GEAR_MEANS	40.158	106.344	GEAR_MEANS	33.764	79.631	GEAR_MEANS
1932	33.395	91.365	GEAR_MEANS	40.158	106.344	GEAR_MEANS	33.764	79.631	GEAR_MEANS
1933	33.395	91.365	GEAR_MEANS	40.158	106.344	GEAR_MEANS	33.764	79.631	GEAR_MEANS
1934	33.395	91.365	GEAR_MEANS	40.158	106.344	GEAR_MEANS	33.764	79.631	GEAR_MEANS
1935	33.395	91.365	GEAR_MEANS	40.158	106.344	GEAR_MEANS	33.764	79.631	GEAR_MEANS
1936	33.395	91.365	GEAR_MEANS	40.158	106.344	GEAR_MEANS	33.764	79.631	GEAR_MEANS
1937	33.395	91.365	GEAR_MEANS	40.158	106.344	GEAR_MEANS	33.764	79.631	GEAR_MEANS
1938	33.395	91.365	GEAR_MEANS	40.158	106.344	GEAR_MEANS	33.764	79.631	GEAR_MEANS
1939	33.395	91.365	GEAR_MEANS	40.158	106.344	GEAR_MEANS	33.764	79.631	GEAR_MEANS
1940	33.395	91.365	GEAR_MEANS	40.158	106.344	GEAR_MEANS	33.764	79.631	GEAR_MEANS
1941	33.395	91.365	GEAR_MEANS	40.158	106.344	GEAR_MEANS	33.764	79.631	GEAR_MEANS
1942	33.395	91.365	GEAR_MEANS	40.158	106.344	GEAR_MEANS	33.764	79.631	GEAR_MEANS
1943	33.395	91.365	GEAR_MEANS	40.158	106.344	GEAR_MEANS	33.764	79.631	GEAR_MEANS
1944	33.395	91.365	GEAR_MEANS	40.158	106.344	GEAR_MEANS	33.764	79.631	GEAR_MEANS
1945	33.395	91.365	GEAR_MEANS	40.158	106.344	GEAR_MEANS	33.764	79.631	GEAR_MEANS
1946	33.395	91.365	GEAR_MEANS	40.158	106.344	GEAR_MEANS	33.764	79.631	GEAR_MEANS
1947	33.395	91.365	GEAR_MEANS	40.158	106.344	GEAR_MEANS	33.764	79.631	GEAR_MEANS
1948	33.395	91.365	GEAR_MEANS	40.158	106.344	GEAR_MEANS	33.764	79.631	GEAR_MEANS
1949	33.395	91.365	GEAR_MEANS	40.158	106.344	GEAR_MEANS	33.764	79.631	GEAR_MEANS
1950	33.395	91.365	GEAR_MEANS	40.158	106.344	GEAR_MEANS	33.764	79.631	GEAR_MEANS
1951	33.395	91.365	GEAR_MEANS	40.158	106.344	GEAR_MEANS	33.764	79.631	GEAR_MEANS
1952	33.395	91.365	GEAR_MEANS	40.158	106.344	GEAR_MEANS	33.764	79.631	GEAR_MEANS
1953	33.395	91.365	GEAR_MEANS	40.158	106.344	GEAR_MEANS	33.764	79.631	GEAR_MEANS
1954	33.395	91.365	GEAR_MEANS	40.158	106.344	GEAR_MEANS	33.764	79.631	GEAR_MEANS

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1955	33.395	91.365	GEAR_MEANS	40.158	106.344	GEAR_MEANS	33.764	79.631	GEAR_MEANS
1956	33.395	91.365	GEAR_MEANS	40.158	106.344	GEAR_MEANS	33.764	79.631	GEAR_MEANS
1957	33.395	91.365	GEAR_MEANS	40.158	106.344	GEAR_MEANS	33.764	79.631	GEAR_MEANS
1958	33.395	91.365	GEAR_MEANS	40.158	106.344	GEAR_MEANS	33.764	79.631	GEAR_MEANS
1959	33.395	91.365	GEAR_MEANS	40.158	106.344	GEAR_MEANS	33.764	79.631	GEAR_MEANS
1960	33.395	91.365	GEAR_MEANS	40.158	106.344	GEAR_MEANS	33.764	79.631	GEAR_MEANS
1961	33.395	91.365	GEAR_MEANS	40.158	106.344	GEAR_MEANS	33.764	79.631	GEAR_MEANS
1962	33.395	91.365	GEAR_MEANS	40.158	106.344	GEAR_MEANS	33.764	79.631	GEAR_MEANS
1963	33.395	91.365	GEAR_MEANS	40.158	106.344	GEAR_MEANS	33.764	79.631	GEAR_MEANS
1964	33.395	91.365	GEAR_MEANS	40.158	106.344	GEAR_MEANS	33.764	79.631	GEAR_MEANS
1965	33.395	91.365	GEAR_MEANS	40.158	106.344	GEAR_MEANS	33.764	79.631	GEAR_MEANS
1966	33.395	91.365	GEAR_MEANS	40.158	106.344	GEAR_MEANS	33.764	79.631	GEAR_MEANS
1967	33.395	91.365	GEAR_MEANS	40.158	106.344	GEAR_MEANS	33.764	79.631	GEAR_MEANS
1968	33.395	91.365	GEAR_MEANS	40.158	106.344	GEAR_MEANS	33.764	79.631	GEAR_MEANS
1969	33.395	91.365	GEAR_MEANS	40.158	106.344	GEAR_MEANS	33.764	79.631	GEAR_MEANS
1970	33.395	91.365	GEAR_MEANS	40.158	106.344	GEAR_MEANS	33.764	79.631	GEAR_MEANS
1971	33.395	91.365	GEAR_MEANS	40.158	106.344	GEAR_MEANS	33.764	79.631	GEAR_MEANS
1972	33.395	91.365	GEAR_MEANS	40.158	106.344	GEAR_MEANS	33.764	79.631	GEAR_MEANS
1973	33.395	91.365	GEAR_MEANS	40.158	106.344	GEAR_MEANS	33.764	79.631	GEAR_MEANS
1974	33.395	91.365	GEAR_MEANS	40.158	106.344	GEAR_MEANS	33.764	79.631	GEAR_MEANS
1975	33.395	91.365	GEAR_MEANS	40.158	106.344	GEAR_MEANS	33.764	79.631	GEAR_MEANS
1976	33.395	91.365	GEAR_MEANS	40.158	106.344	GEAR_MEANS	33.764	79.631	GEAR_MEANS
1977	33.395	91.365	GEAR_MEANS	40.158	106.344	GEAR_MEANS	33.764	79.631	GEAR_MEANS
1978	33.395	91.365	GEAR_MEANS	40.158	106.344	GEAR_MEANS	33.764	79.631	GEAR_MEANS
1979	33.395	91.365	GEAR_MEANS	40.158	106.344	GEAR_MEANS	33.764	79.631	GEAR_MEANS
1980	33.395	91.365	GEAR_MEANS	40.158	106.344	GEAR_MEANS	33.764	79.631	GEAR_MEANS
1981	33.395	91.365	GEAR_MEANS	40.158	106.344	GEAR_MEANS	33.764	79.631	GEAR_MEANS
1982	33.395	91.365	GEAR_MEANS	40.158	106.344	GEAR_MEANS	33.764	79.631	GEAR_MEANS
1983	33.395	91.365	GEAR_MEANS	40.158	106.344	GEAR_MEANS	33.764	79.631	GEAR_MEANS
1984	22.388	38.167	STRATA	40.158	106.344	GEAR_MEANS	33.764	79.631	GEAR_MEANS
1985	39.832	90.649	STRATA	40.158	106.344	GEAR_MEANS	33.764	79.631	GEAR_MEANS
1986	20.878	41.797	STRATA	40.158	106.344	GEAR_MEANS	33.764	79.631	GEAR_MEANS
1987	33.395	91.365	GEAR_MEANS	40.158	106.344	GEAR_MEANS	33.764	79.631	GEAR_MEANS
1988	33.395	91.365	GEAR_MEANS	40.158	106.344	GEAR_MEANS	33.764	79.631	GEAR_MEANS
1989	33.395	91.365	GEAR_MEANS	40.158	106.344	GEAR_MEANS	33.764	79.631	GEAR_MEANS

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1990	33.395	91.365	GEAR_MEANS	40.158	106.344	GEAR_MEANS	33.764	79.631	GEAR_MEANS
1991	33.395	91.365	GEAR_MEANS	40.158	106.344	GEAR_MEANS	33.764	79.631	GEAR_MEANS
1992	33.395	91.365	GEAR_MEANS	40.158	106.344	GEAR_MEANS	33.764	79.631	GEAR_MEANS
1993	27.407	59.325	STRATA	40.158	106.344	GEAR_MEANS	33.764	79.631	GEAR_MEANS
1994	33.395	91.365	GEAR_MEANS	40.158	106.344	GEAR_MEANS	33.764	79.631	GEAR_MEANS
1995	33.395	91.365	GEAR_MEANS	40.158	106.344	GEAR_MEANS	33.764	79.631	GEAR_MEANS
1996	33.395	91.365	GEAR_MEANS	40.158	106.344	GEAR_MEANS	33.764	79.631	GEAR_MEANS
1997	33.395	91.365	GEAR_MEANS	40.158	106.344	GEAR_MEANS	33.764	79.631	GEAR_MEANS
1998	33.395	91.365	GEAR_MEANS	40.158	106.344	GEAR_MEANS	33.764	79.631	GEAR_MEANS
1999	33.395	91.365	GEAR_MEANS	40.158	106.344	GEAR_MEANS	33.764	79.631	GEAR_MEANS
2000	33.395	91.365	GEAR_MEANS	44.074	116.257	STRATA	33.764	79.631	GEAR_MEANS
2001	44.181	85.472	STRATA	40.158	106.344	GEAR_MEANS	33.764	79.631	GEAR_MEANS
2002	33.395	91.365	GEAR_MEANS	40.158	106.344	GEAR_MEANS	33.764	79.631	GEAR_MEANS
2003	39.370	117.017	STRATA	40.158	106.344	GEAR_MEANS	33.764	79.631	GEAR_MEANS
2004	35.400	60.989	STRATA	36.458	87.262	STRATA	33.764	79.631	GEAR_MEANS
2005	27.666	58.409	STRATA	39.321	108.323	STRATA	33.764	79.631	GEAR_MEANS
2006	28.735	56.703	STRATA	40.158	106.344	GEAR_MEANS	33.764	79.631	GEAR_MEANS
2007	26.780	55.542	STRATA	40.158	106.344	GEAR_MEANS	33.764	79.631	GEAR_MEANS
2008	33.395	91.365	GEAR_MEANS	40.158	106.344	GEAR_MEANS	33.764	79.631	GEAR_MEANS
2009	25.622	47.069	STRATA	40.158	106.344	GEAR_MEANS	33.764	79.631	GEAR_MEANS
2010	28.325	63.084	STRATA	40.158	106.344	GEAR_MEANS	33.764	79.631	GEAR_MEANS

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Table 3.4. Gulf of Mexico cobia commercial landings by gear and year in numbers.

	GEAR		
YEAR	HAND LINE	LONG LINE	OTHER
1927	165		117
1928	399		282
1929	257		182
1930	250		177
1931	182		129
1932	101		72
1933			
1934	129		91
1935			
1936	103		73
1937	35		25
1938	129		91
1939	112		79
1940	24		17
1941			
1942			
1943			
1944			
1945	5		4
1946			
1947			
1948	75		53
1949	478		338
1950	770	0	544
1951	870	0	615
1952	657	0	464
1953	505	0	357
1954	459	0	325
1955	534	0	378
1956	262	0	185
1957	451	0	319
1958	426	0	301
1959	721	0	510
1960	992	0	701
1961	609	0	431
1962	1,009	0	172
1963	1,258	0	83
1964	820	0	18
1965	680	0	83
1966	940	0	332
1967	728	0	705
1968	1,527	0	1,134
1969	1,285	0	966
1970	1,794	0	1,768
1971	1,979	0	1,312
1972	1,533	0	1,075
1973	1,060	0	1,546
1974	1,365	0	1,638
1975	1,431	0	1,478
1976	2,069	3	1,419
1977	1,931	0	1,416

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1978	1,867	0	1,514
1979	1,741	0	1,269
1980	2,134	0	1,417
1981	2,579	0	1,686
1982	2,390	0	1,402
1983	2,951	0	1,540
1984	5,551	0	1,006
1985	3,395	**	1,114
1986	7,647	106	889
1987	5,228	215	1,474
1988	4,886	334	1,677
1989	6,765	294	1,958
1990	5,080	165	1,901
1991	4,825	478	2,769
1992	5,746	564	3,917
1993	6,721	619	4,266
1994	5,236	482	4,668
1995	5,489	342	3,969
1996	6,661	673	3,447
1997	5,211	503	3,187
1998	5,303	422	2,794
1999	4,664	602	3,101
2000	4,267	593	1,285
2001	2,663	481	1,211
2002	3,912	601	852
2003	3,586	741	708
2004	3,505	757	818
2005	3,298	497	772
2006	3,137	620	1,066
2007	4,055	375	696
2008	2,972	475	625
2009	4,009	236	744
2010	6,112	147	471

** = indicates confidential data withheld

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Table 3.5. Number of trips reporting cobia 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	Cobia	0	349	83	29
	Other species (cobia boundaries)	586	32,072	13,224	4,203
SA	Cobia	43	44	13	6
	Other species (cobia boundaries)	1,952	6,049	2,165	1,838

Table 3.6. Cobia 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 cobia discards were reported from gill net trips in the Gulf of Mexico, although discards of other species were reported.

Year	Gillnet	Vertical line	Trolling	Calculated discards
1993		9,131	42	9,173
1994		10,877	43	10,919
1995		10,246	48	10,293
1996		11,080	71	11,151
1997		12,350	64	12,415
1998	0	11,854	273	12,127
1999	0	13,569	276	13,845
2000	0	12,743	265	13,008
2001	0	11,847	236	12,083
2002	0	12,522	198	12,720
2003	0	13,385	189	13,574
2004	0	11,715	142	11,858
2005	0	11,421	111	11,532
2006	0	11,327	143	11,471
2007	0	10,728	158	10,886
2008	0	9,482	159	9,641
2009	0	11,769	163	11,932
2010	0	9,557	141	9,698

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Table 3.7. Self-reported discard mortality/disposition of cobia caught on commercial fishing vessels with federal fishing permits, 2002-2010. No cobia 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	3%	23%	43%	28%	3%	0%	3%	87
	Handline/Electric	5%	2%	88%	6%	0%	0%	5%	65
	Trolling	0%	0%	93%	0%	7%	0%	0%	27
Gulf of Mexico	Gillnet	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0
	Handline/Electric	0%	1%	86%	4%	9%	0%	0%	774
	Trolling	1%	0%	66%	5%	29%	0%	1%	132

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 cobia in the Gulf of Mexico from the observer program and SEAMAP groundfish survey. Bycatch is reported in numbers of fish.

Year	Cobia bycatch
1972	8
1973	3
1974	32
1975	34
1976	16
1977	5
1978	8
1979	10
1980	164
1981	6
1982	13
1983	16
1984	9
1985	5
1986	1
1987	3
1988	0
1989	4
1990	5
1991	6
1992	65
1993	39
1994	50
1995	10
1996	16
1997	24
1998	9
1999	17
2000	2
2001	18
2002	34
2003	11
2004	17
2005	9
2006	10
2007	6
2008	19
2009	7
2010	13

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

year	mean	sd	MC error	2.50%	25.00%	median	75.00%	97.50%	start	sample
1972	1.244	1.753	0.05454	0.1671	0.4659	0.8064	1.419	5.08	4001	10000
1973	0.2121	0.258	0.007769	0.03364	0.08707	0.1481	0.2501	0.7686	4001	10000
1974	1.737	1.906	0.06236	0.3185	0.7509	1.224	2.047	6.272	4001	10000
1975	0.506	0.5604	0.01377	0.1117	0.2402	0.3688	0.5898	1.71	4001	10000
1976	0.3027	0.3229	0.008143	0.08088	0.1568	0.2293	0.3528	0.9417	4001	10000
1977	0.1424	0.1349	0.003506	0.03105	0.06922	0.1074	0.17	0.463	4001	10000
1978	0.188	0.1884	0.004405	0.04033	0.09085	0.1411	0.2232	0.5986	4001	10000
1979	2.704	3.312	0.09374	0.3463	0.9971	1.748	3.189	10.5	4001	10000
1980	0.6132	0.4181	0.01206	0.2153	0.3734	0.5108	0.7286	1.582	4001	10000
1981	0.2806	0.3764	0.009106	0.04663	0.1167	0.1902	0.3272	1.049	4001	10000
1982	1.025	1.493	0.04325	0.1777	0.4286	0.7015	1.18	3.745	4001	10000
1983	1.534	1.763	0.0566	0.2654	0.6522	1.063	1.793	5.61	4001	10000
1984	0.9985	1.424	0.03663	0.1608	0.3975	0.6644	1.162	3.783	4001	10000
1985	1.187	1.436	0.03371	0.181	0.4737	0.8142	1.407	4.403	4001	10000
1986	1.271	1.825	0.04377	0.1367	0.428	0.7761	1.482	5.314	4001	10000
1987	1.968	2.471	0.05831	0.2287	0.6957	1.25	2.353	8.177	4001	10000
1988	0.7849	1.016	0.02604	0.07888	0.2659	0.4874	0.9271	3.355	4001	10000
1989	1.797	2.587	0.06434	0.2483	0.6807	1.181	2.092	7.01	4001	10000
1990	1.445	1.723	0.04351	0.205	0.5653	0.9971	1.707	5.42	4001	10000
1991	1.781	2.182	0.05984	0.2459	0.6668	1.159	2.044	7.193	4001	10000
1992	1.053	0.6917	0.01574	0.3664	0.641	0.8837	1.251	2.703	4001	10000
1993	0.751	0.6681	0.01453	0.2103	0.4002	0.5731	0.8687	2.363	4001	10000
1994	1.081	1.081	0.02497	0.2475	0.534	0.8122	1.289	3.539	4001	10000
1995	3.936	4.779	0.1273	0.5401	1.511	2.612	4.6	15.24	4001	10000
1996	4.843	6.439	0.1674	0.6576	1.816	3.114	5.576	19.58	4001	10000
1997	8.827	11.74	0.3109	1.259	3.313	5.77	10.29	34.75	4001	10000

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1998	3.502	4.734	0.1125	0.4319	1.269	2.251	4.119	13.99	4001	10000
1999	4.044	4.454	0.1243	0.6899	1.676	2.766	4.791	15.02	4001	10000
2000	1.271	1.813	0.05021	0.1508	0.4327	0.795	1.445	5.339	4001	10000
2001	3.074	4.714	0.1099	0.4582	1.201	2.053	3.566	11.32	4001	10000
2002	0.476	0.5503	0.01354	0.1114	0.226	0.3451	0.5399	1.669	4001	10000
2003	2.712	3.809	0.08589	0.3775	1.044	1.788	3.159	10.26	4001	10000
2004	4.407	6.559	0.1545	0.616	1.645	2.878	5.122	17.25	4001	10000
2005	4.023	8.383	0.1464	0.4599	1.358	2.419	4.502	16.06	4001	10000
2006	2.182	3.282	0.07989	0.2966	0.7888	1.373	2.43	8.716	4001	10000
2007	8.272	10.05	0.264	0.8996	2.9	5.338	9.87	33.55	4001	10000
2008	19.2	21.47	0.5524	2.868	7.902	13.49	23	69.45	4001	10000
2009	0.8531	1.04	0.028	0.1161	0.3287	0.5635	0.9894	3.31	4001	10000
2010	0.05572	0.07236	0.001798	0.00741	0.02039	0.03628	0.06586	0.222	4001	10000

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Table 3.11. Number of Gulf of Mexico cobia trips with valid samples (no biases) and number of trips with samples usable for analysis (landings available) by year and gear.

	GEAR					
	HAND LINE		LONG LINE		OTHER	
YEAR	SAMPLES USED	VALID SAMPLES	SAMPLES USED	VALID SAMPLES	SAMPLES USED	VALID SAMPLES
1983	2	2	0	0	0	0
1984	10	10	0	1	0	0
1985	7	7	0	0	1	2
1986	11	11	0	0	5	5
1987	1	1	3	3	1	1
1988	0	0	0	0	0	0
1989	2	2	0	0	0	0
1990	0	22	1	1	0	0
1991	3	39	0	0	0	1
1992	10	34	2	6	0	0
1993	6	27	9	12	2	2
1994	3	31	14	14	3	3
1995	13	27	9	13	1	1
1996	3	11	7	12	0	0
1997	1	19	9	13	0	0
1998	2	6	19	19	2	2
1999	8	8	17	17	1	1
2000	8	8	23	23	2	2
2001	23	24	12	12	0	0
2002	10	10	14	14	3	3
2003	25	25	15	15	0	0
2004	33	33	42	42	0	0
2005	21	21	24	24	0	0
2006	21	21	4	4	2	2
2007	29	29	1	1	2	2
2008	15	15	5	5	4	4
2009	26	26	2	2	0	0
2010	34	34	1	1	4	4

**=data deemed confidential have been removed

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

	GEAR					
	HAND LINE		LONG LINE		OTHER	
YEAR	SAMPLES USED	VALID SAMPLES	SAMPLES USED	VALID SAMPLES	SAMPLES USED	VALID SAMPLES
1983	10	10	0	0	0	0
1984	31	31	0	1	0	0
1985	35	35	0	0	1	2
1986	36	36	0	0	6	6
1987	1	1	3	3	2	2
1988	0	0	0	0	0	0
1989	2	2	0	0	0	0
1990	0	46	1	1	0	0
1991	3	87	0	0	1	1
1992	10	70	2	26	0	0
1993	20	56	11	20	2	2
1994	3	76	16	16	5	5
1995	13	41	9	21	1	1
1996	3	18	8	21	0	0
1997	1	25	10	18	0	0
1998	2	8	19	19	2	2
1999	9	9	17	17	1	1
2000	10	10	24	24	3	3
2001	47	48	14	14	0	0
2002	13	13	16	16	3	3
2003	31	31	18	18	0	0
2004	63	63	62	62	0	0
2005	34	34	41	41	0	0
2006	37	37	5	5	3	3
2007	54	54	2	2	2	2
2008	18	18	7	7	4	4
2009	45	45	2	2	0	0
2010	66	66	2	2	6	6

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

	GEAR		
YEAR	HAND LINE	LONG LINE	OTHER
1998	3	0	0
2000	3	0	0
2001	1	0	0
2007	1	0	0
2008	7	4	1
2009	2	2	0
2010	1	0	0

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

	GEAR		
YEAR	HAND LINE	LONG LINE	OTHER
1983	0.003	0.000	0.000
1984	0.006	0.000	0.000
1985	0.010	0.000	0.001
1986	0.005	0.000	0.007
1987	0.000	0.014	0.001
1988	0.000	0.000	0.000
1989	0.000	0.000	0.000
1990	0.000	0.006	0.000
1991	0.001	0.000	0.000
1992	0.002	0.004	0.000
1993	0.003	0.018	0.000
1994	0.001	0.033	0.001
1995	0.002	0.026	0.000
1996	0.000	0.012	0.000
1997	0.000	0.020	0.000
1998	0.000	0.045	0.001
1999	0.002	0.028	0.000
2000	0.002	0.040	0.002
2001	0.018	0.029	0.000
2002	0.003	0.027	0.004
2003	0.009	0.024	0.000
2004	0.018	0.082	0.000
2005	0.010	0.083	0.000
2006	0.012	0.008	0.003
2007	0.013	0.005	0.003
2008	0.006	0.015	0.006
2009	0.011	0.008	0.000
2010	0.011	0.014	0.013

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3.11 Figures

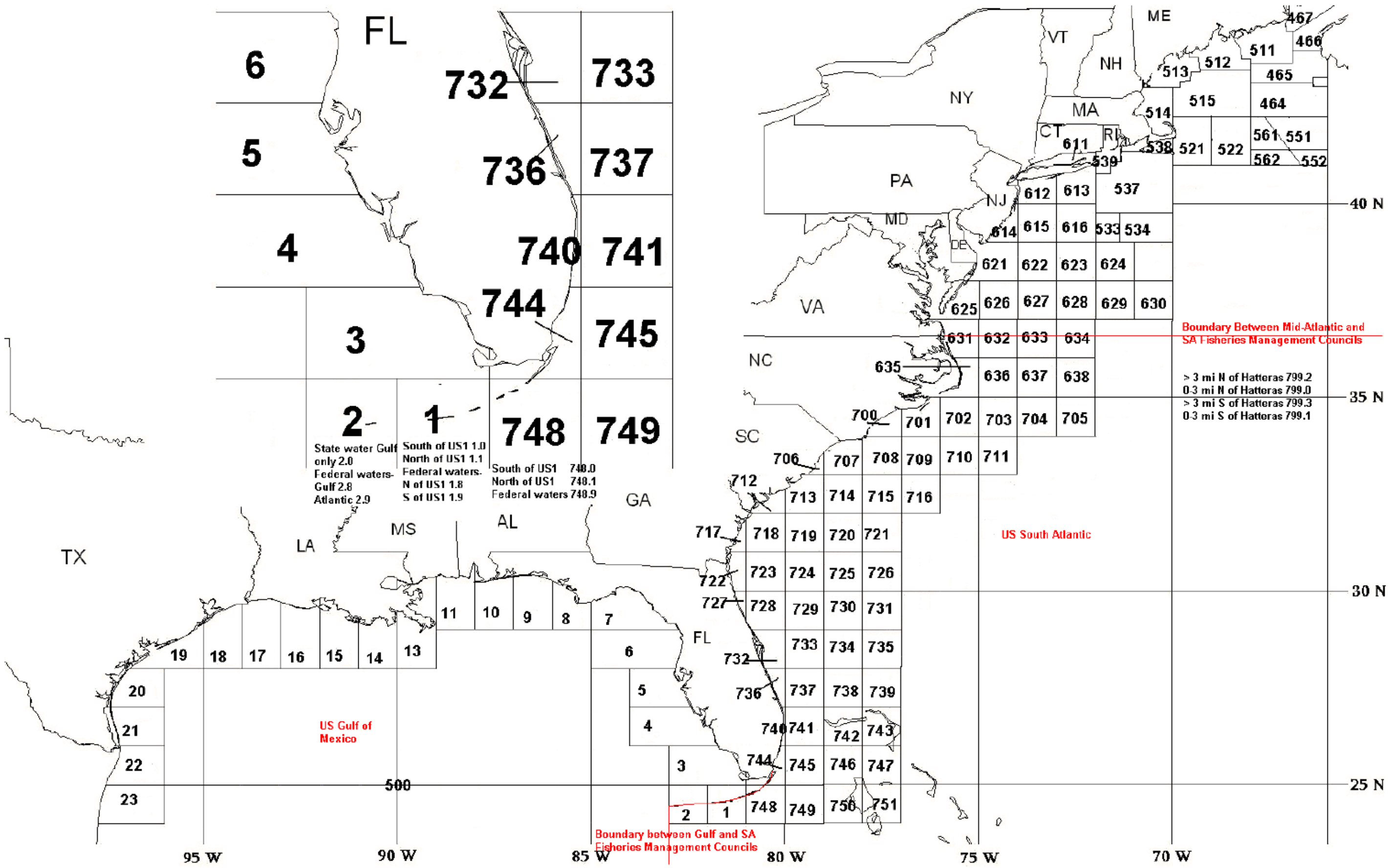

Figure 3.1. Map of U.S. Atlantic and Gulf coast with shrimp area designations and council boundaries. Boundary used for Gulf and Atlantic cobia is the GA/FL border and data were separated by the line of latitude between area 717 and 722.

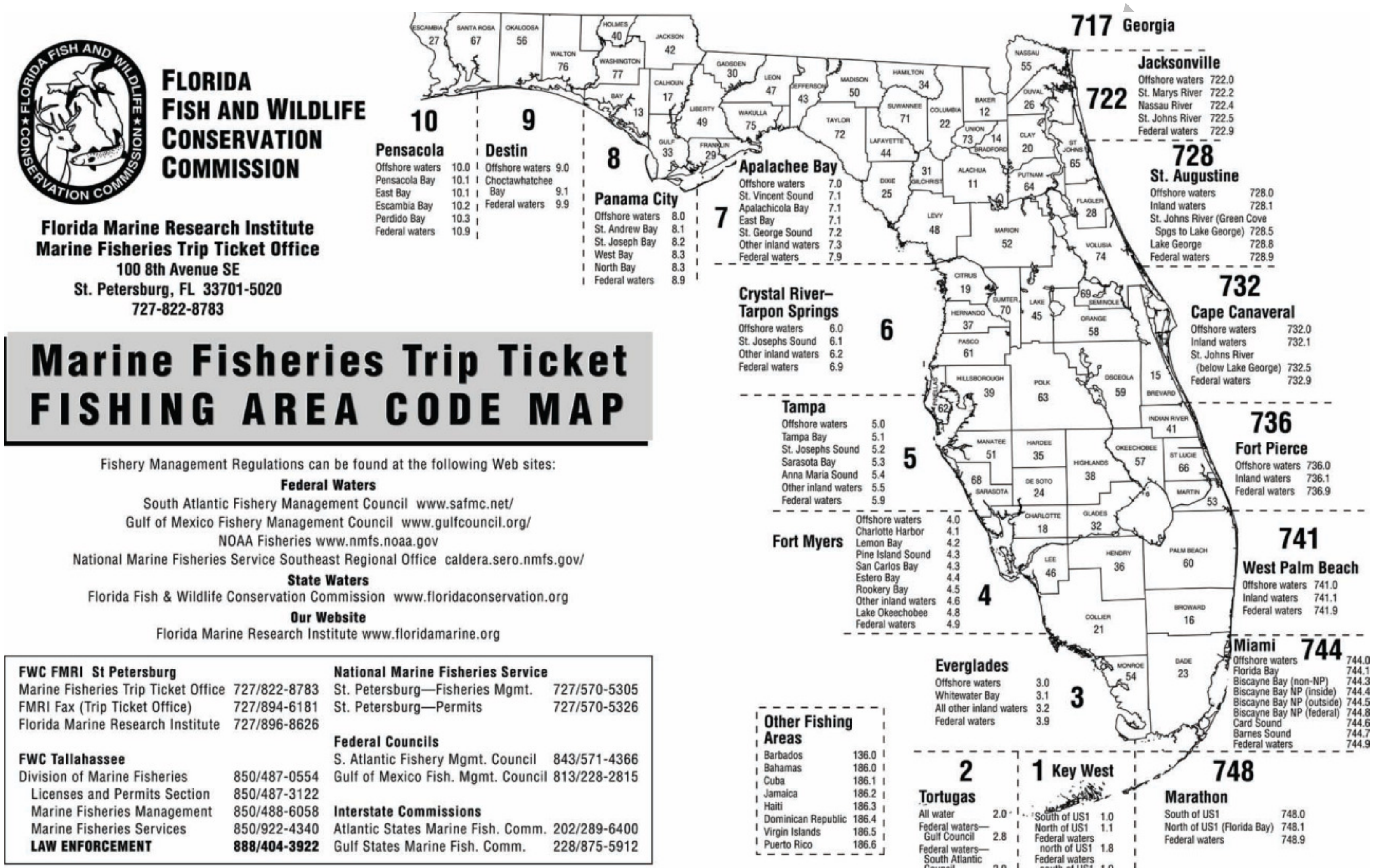

Figure 3.2. Map showing marine fisheries trip ticket fishing area code map for Florida.

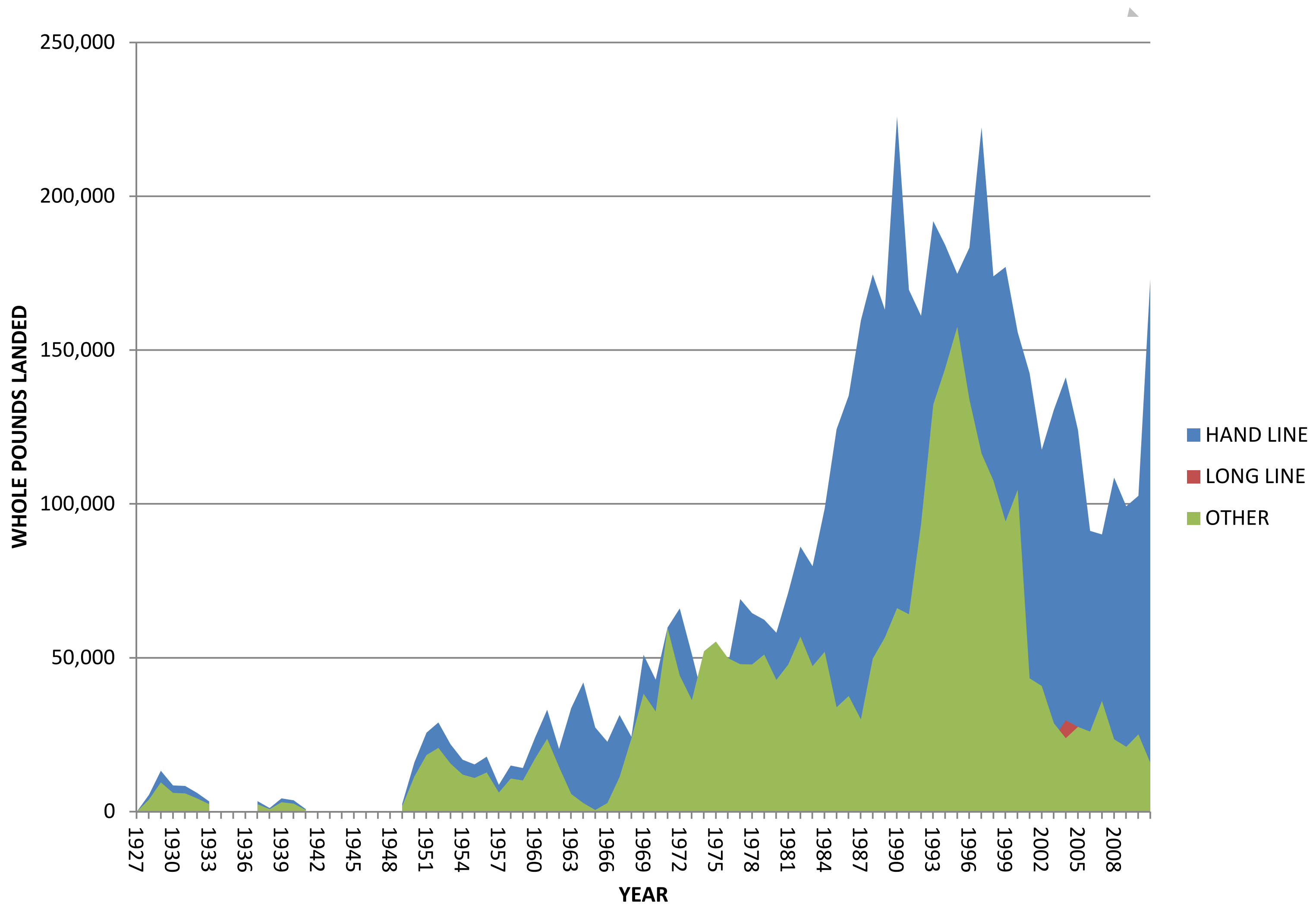

Figure 3.3. Cobia landings in pounds (whole weight) by gear (hand line, long line, and other) from the Gulf of Mexico, 1926-2010.

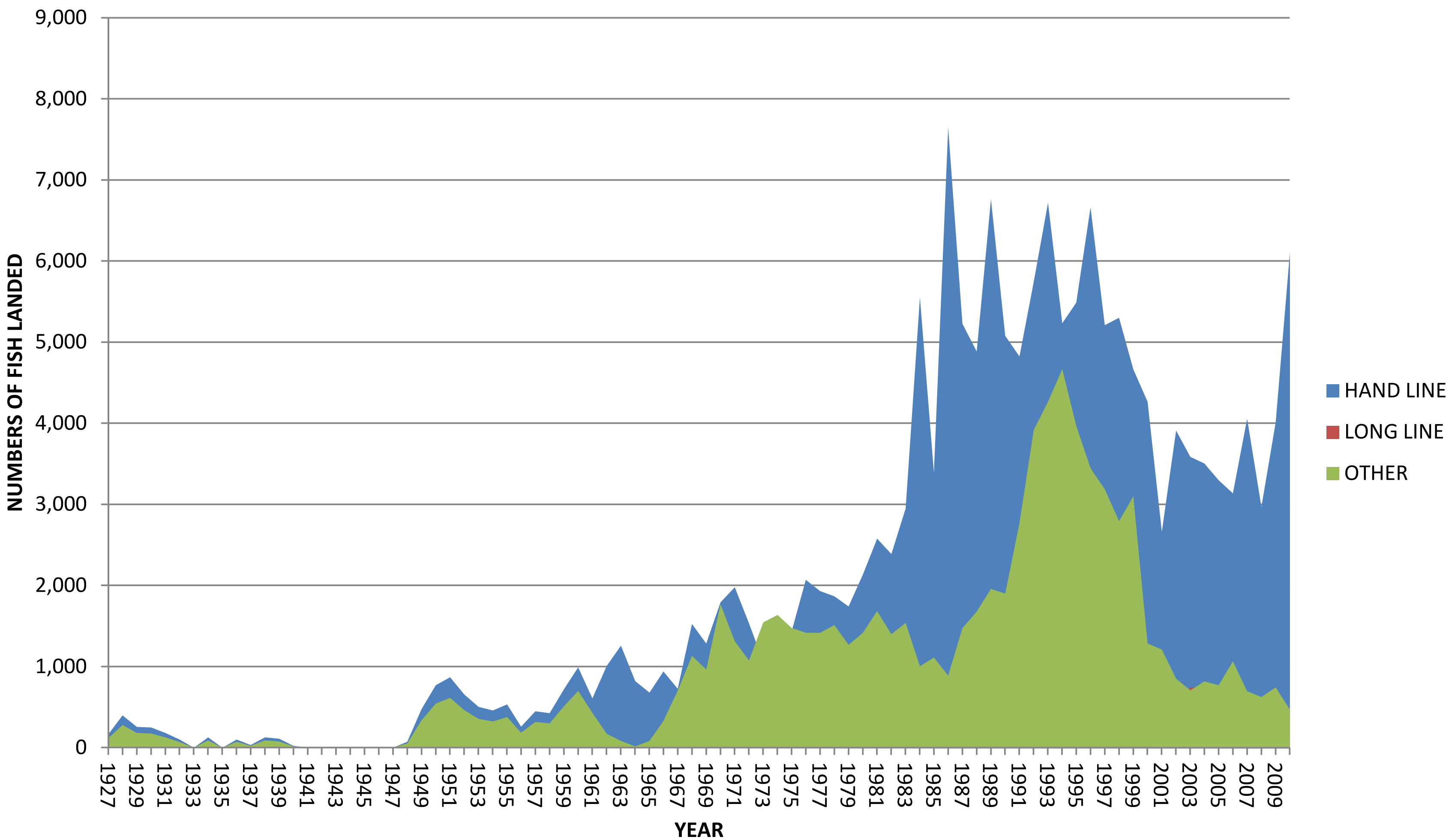

Figure 3.4. Cobia landings in numbers of fish by gear (hand line, long line, and other) from the Gulf of Mexico, 1926-2010.

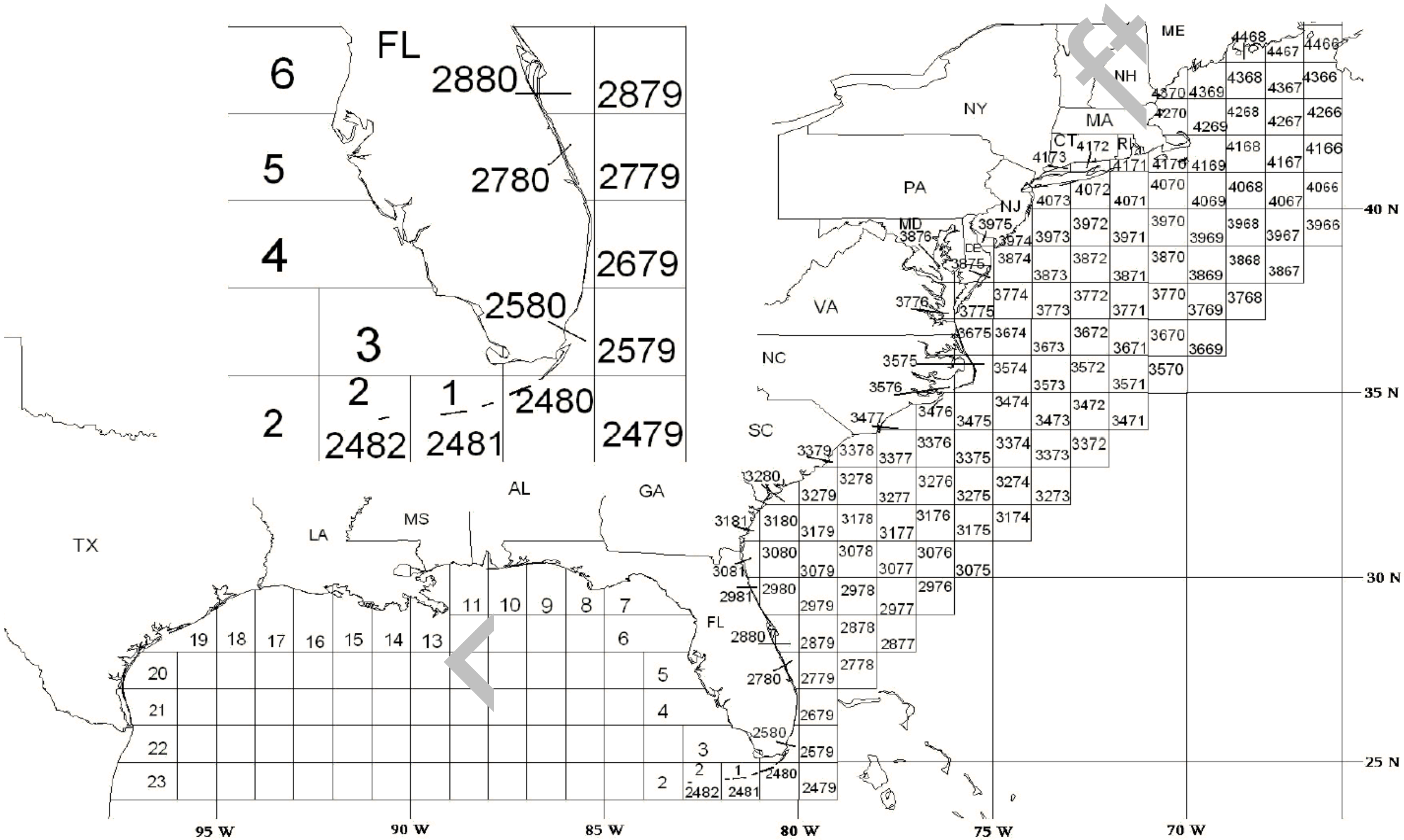

Figure 3.5. Map of U.S. Atlantic and Gulf coast logbook areas.

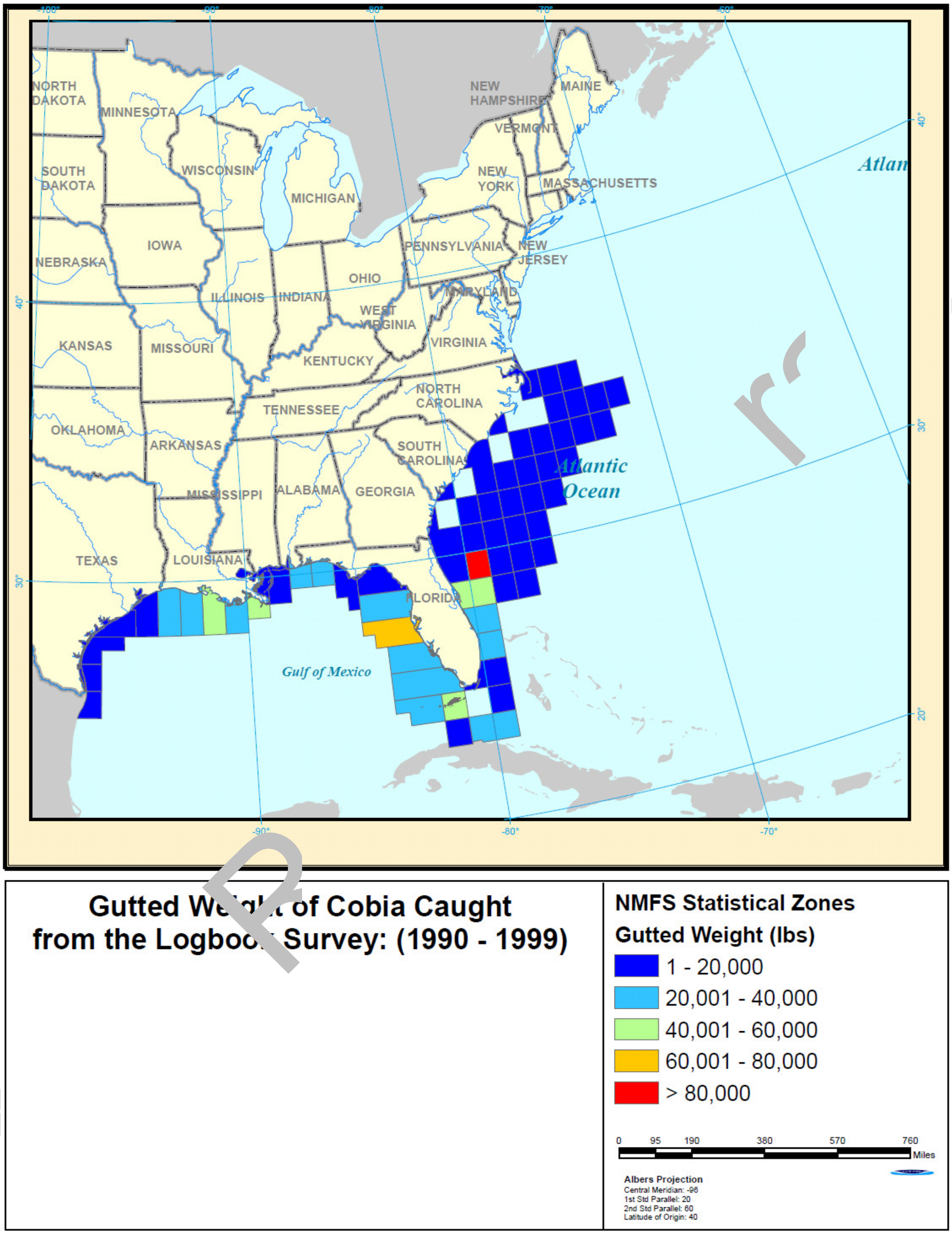

Figure 3.6. Map of cobia catches reported to the Coastal Logbook Program for the U.S. Atlantic and Gulf coast areas (1990-1999).

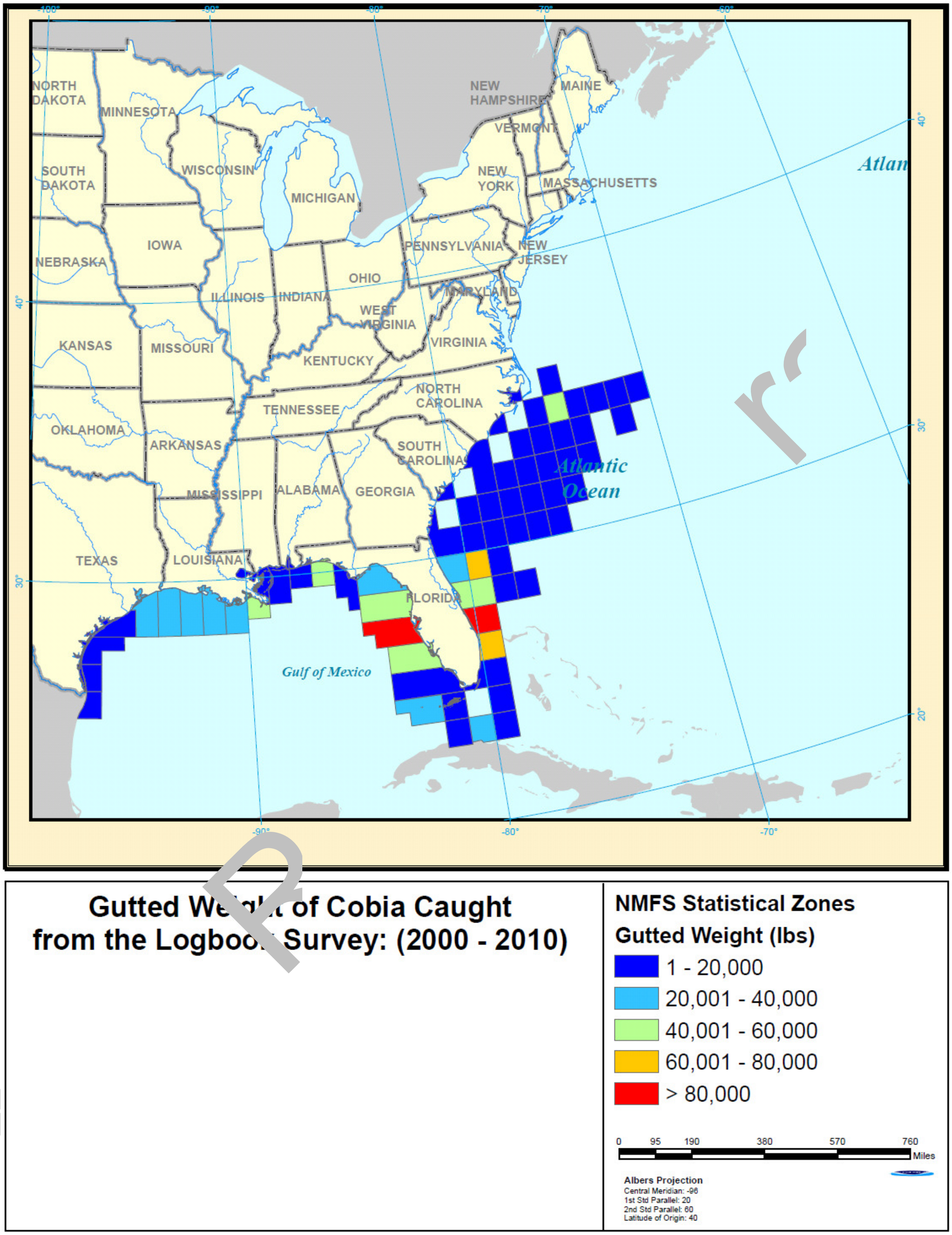

Figure 3.7. Map of cobia catches reported to the Coastal Logbook Program for the U.S. Atlantic and Gulf coast areas (2000-2010).

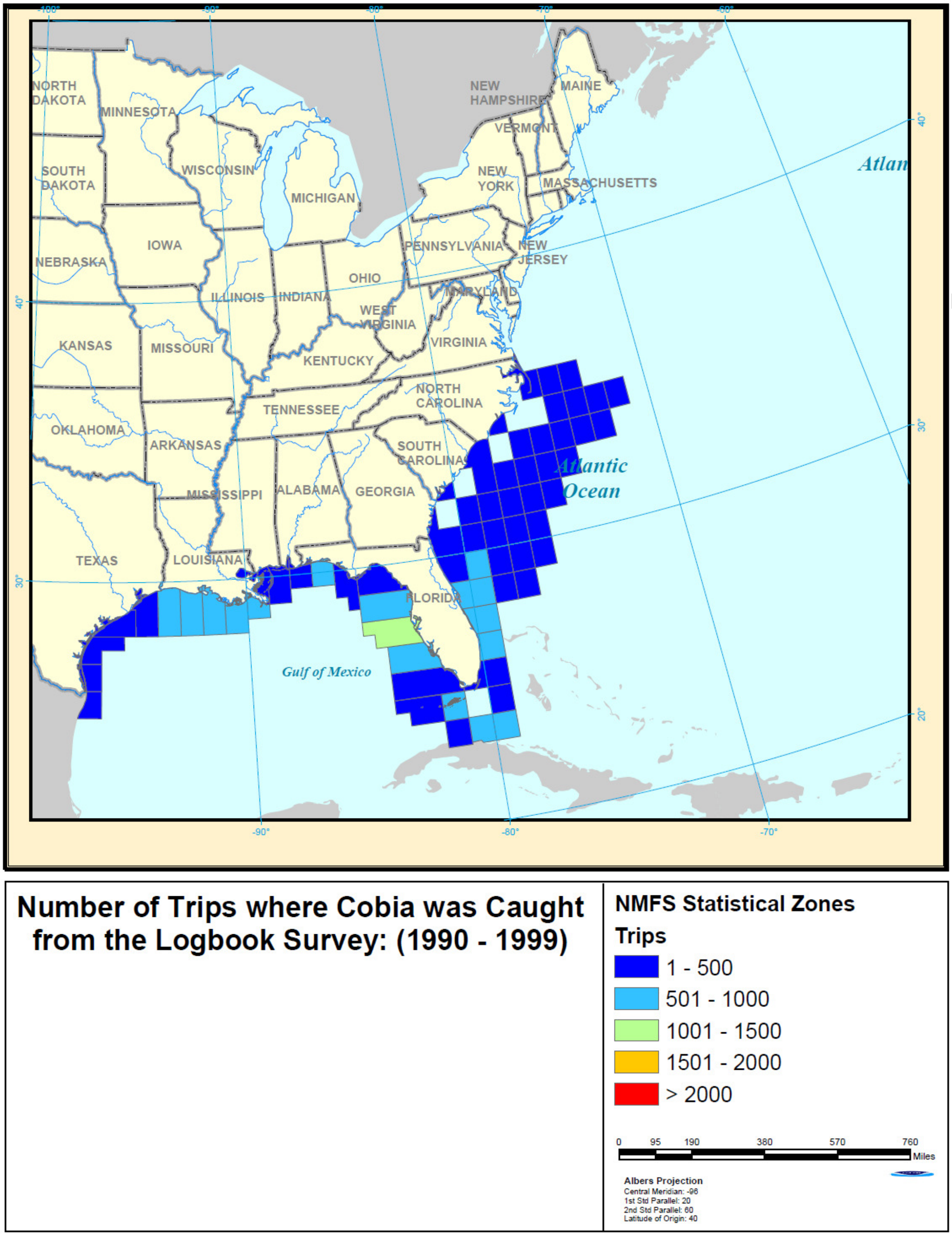

Figure 3.8. Map of cobia trips reported to the Coastal Logbook Program for the U.S. Atlantic and Gulf coast areas (1990-1999).

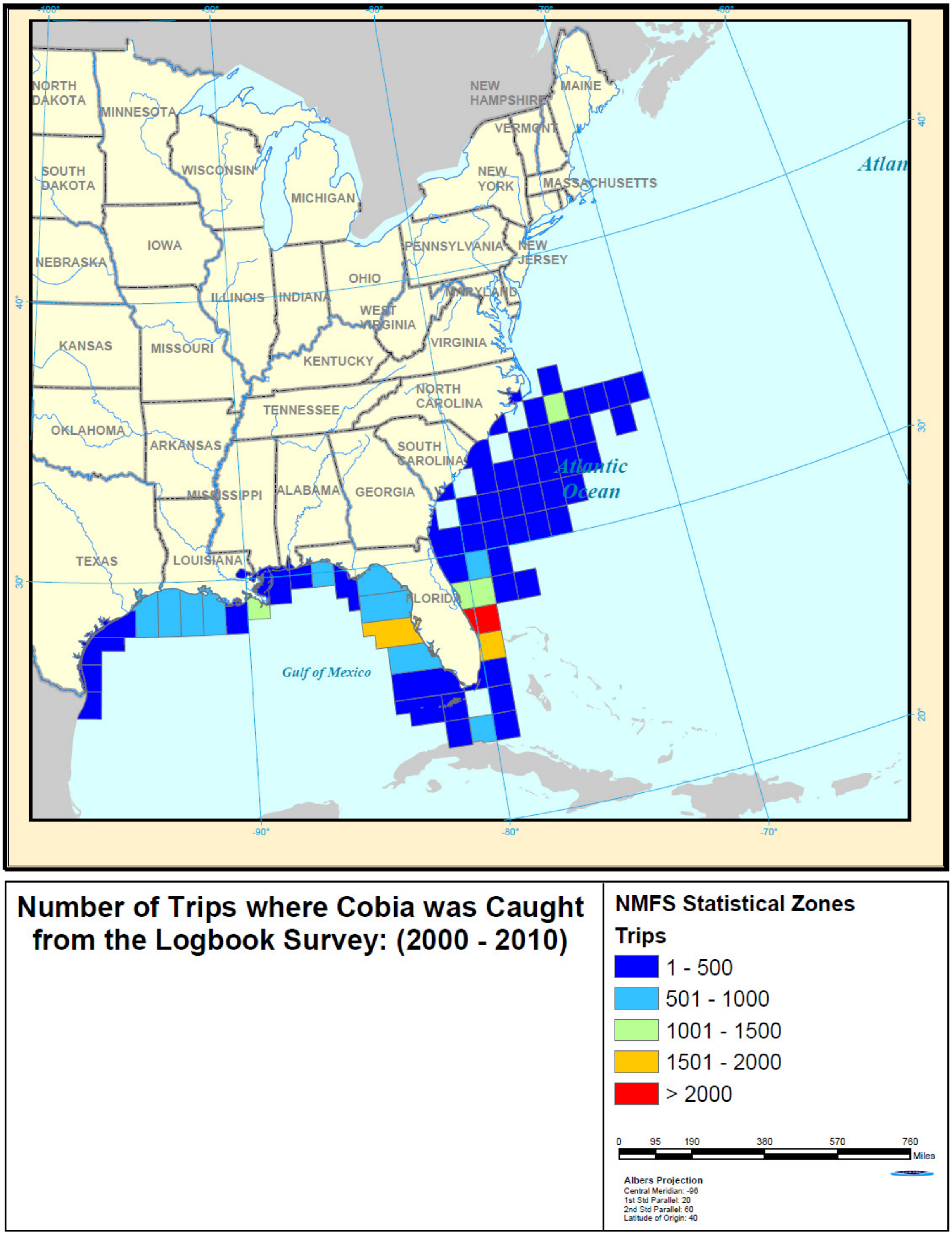

Figure 3.9. Map of cobia trips reported to the Coastal Logbook Program for the U.S. Atlantic and Gulf coast areas (2000-2010).

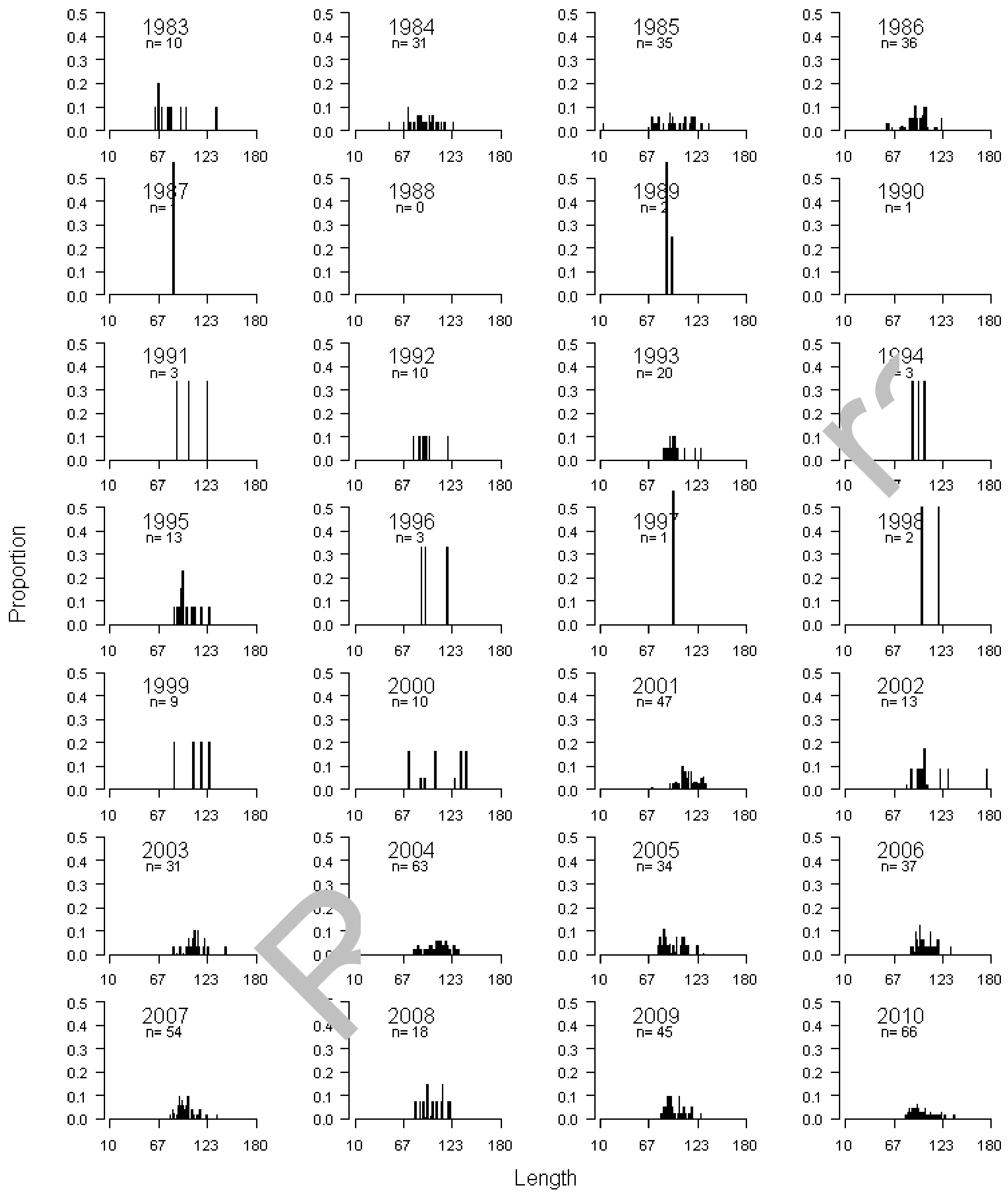

Figure 3.10. Relative length composition of commercial length (FL in mm) samples by year for hand line gear (n = number of fish).

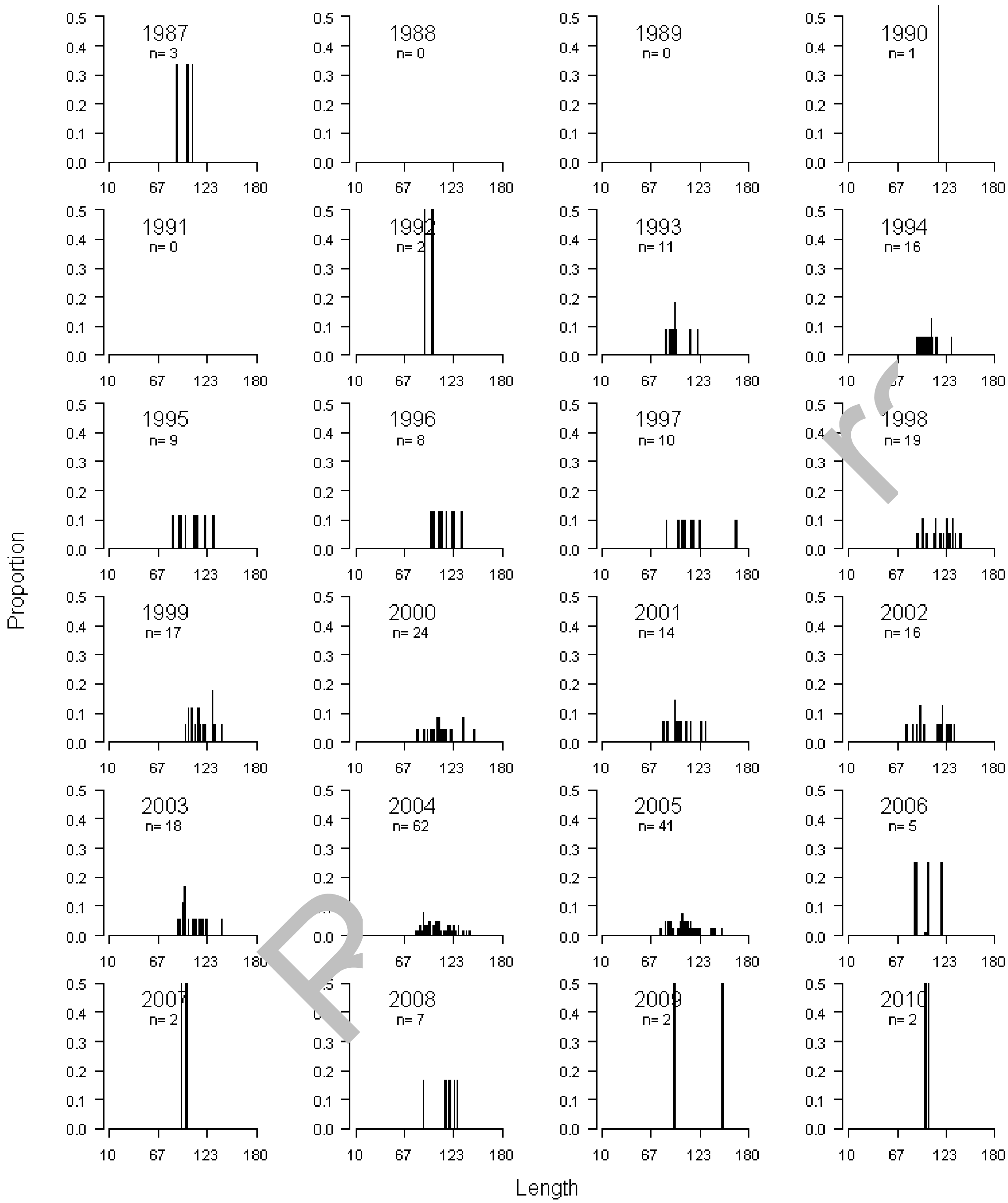

Figure 3.11. Relative length composition of commercial length (FL in mm) samples by year for long line gear (n = number of fish).

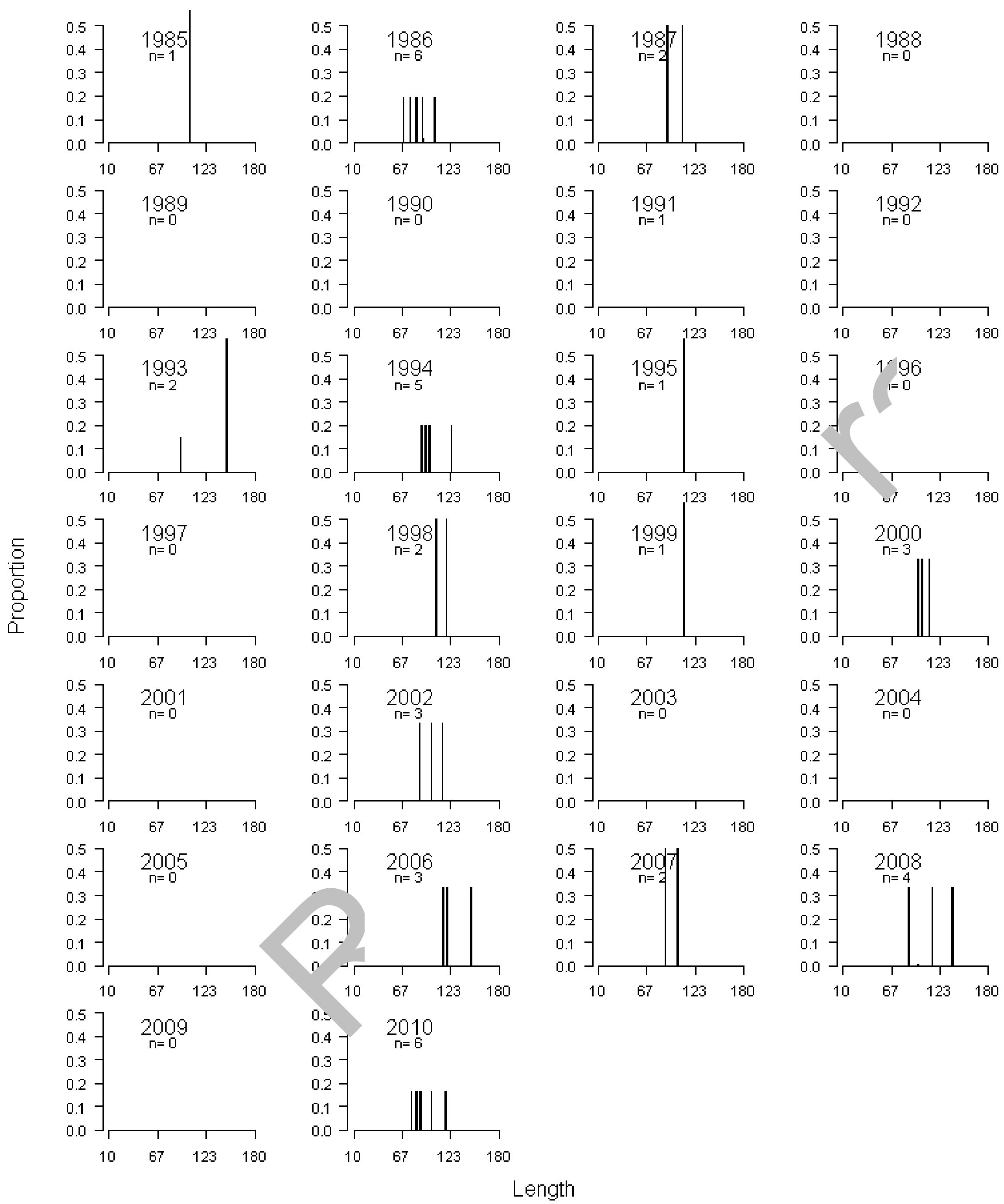

Figure 3.12. Relative length composition of commercial length (FL in mm) samples by year for other miscellaneous gear (n = number of fish).

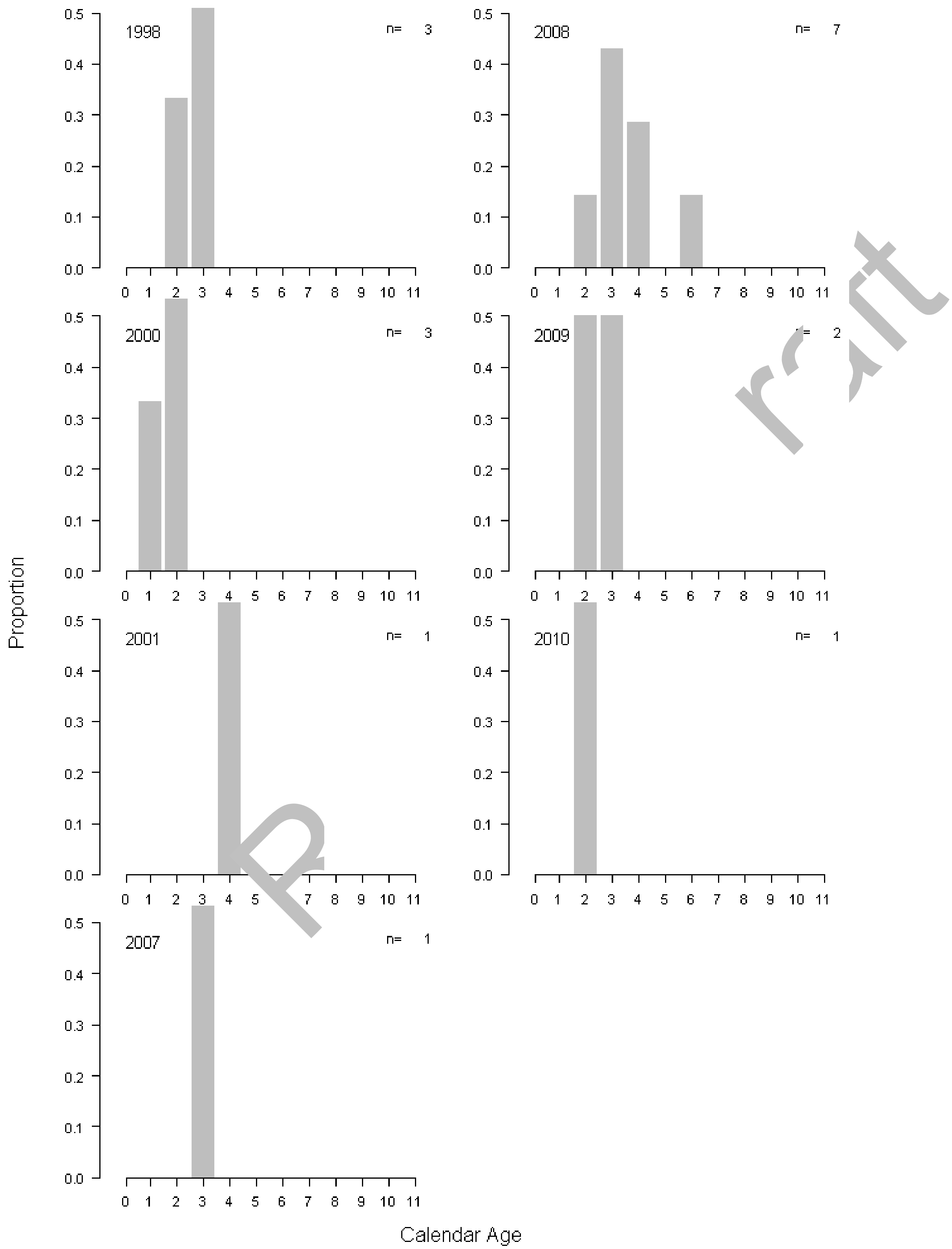

Figure 3.13. Unweighted relative age composition of commercial age (calendar years) samples by year for hand line gear (n = number of fish).

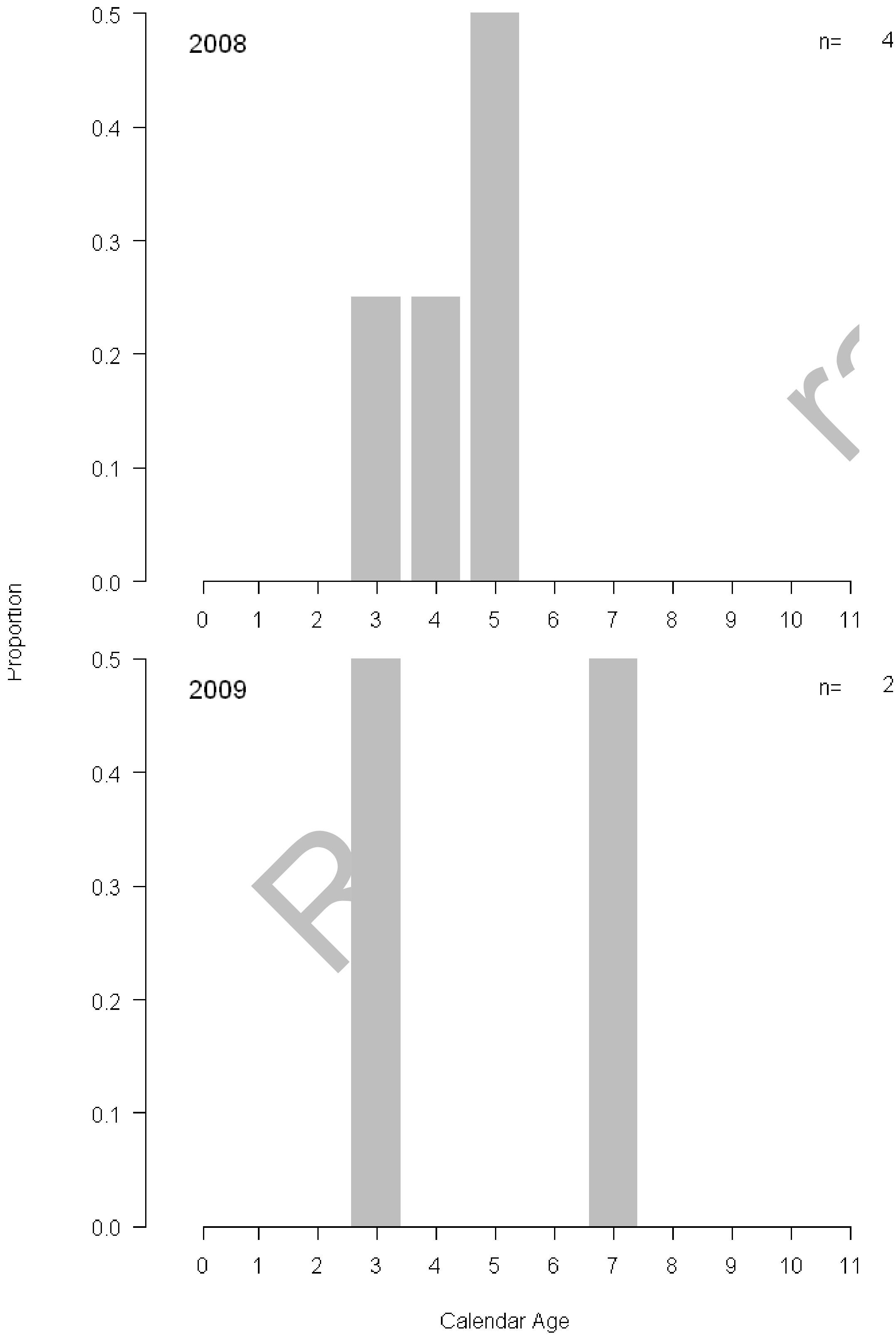

Figure 3.14. Unweighted relative age composition of commercial age (calendar years) samples by year for long line gear (n = number of fish).

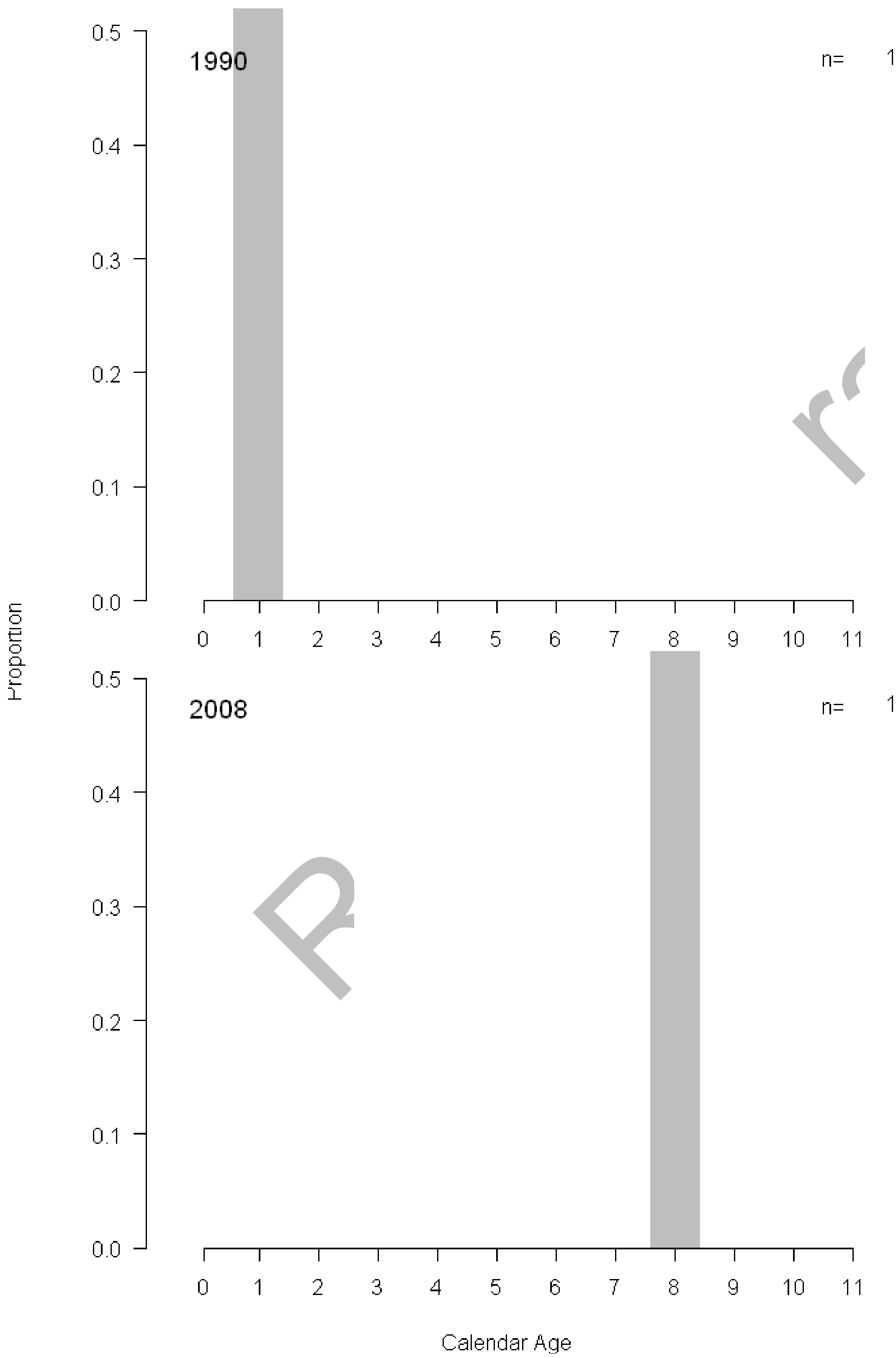

Figure 3.15. Unweighted relative age composition of commercial age (calendar years) samples by year for other miscellaneous gear (n = number of fish).

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) Division of the stock between the Atlantic and Gulf of Mexico along the East Florida coast: may vary by data source depending on differing spatial resolutions of the datasets.
2) Headboat logbook forms did not include cobia on a universal form until 1984 in the South Atlantic. This affects East Florida cobia landings.
3) Missing weight estimates for some recreational "cells" (i.e., specific year, state, fishing mode, wave combinations).
4) 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.
5) Charter boat landings: MRFSS charter survey methods changed in 1998 in the Gulf of Mexico and in 2003 in East Florida.
6) Combined charter boat/headboat landings, East Florida 1981-1985: Official headboat landings are available from the SRHS. Therefore, the headboat component of the MRFSS combined charter boat/headboat mode must be parsed out.
7) New MRIP weighted estimates are available for 2004-2011: Determine appropriate use of datasets to cover the entire period from 1981-2011.
8) Texas estimates in the MRFSS is only available from 1981-1985 and is sporadic, not covering all modes and waves.
9) TPWD survey does not estimate landings in weight or discards.
10) 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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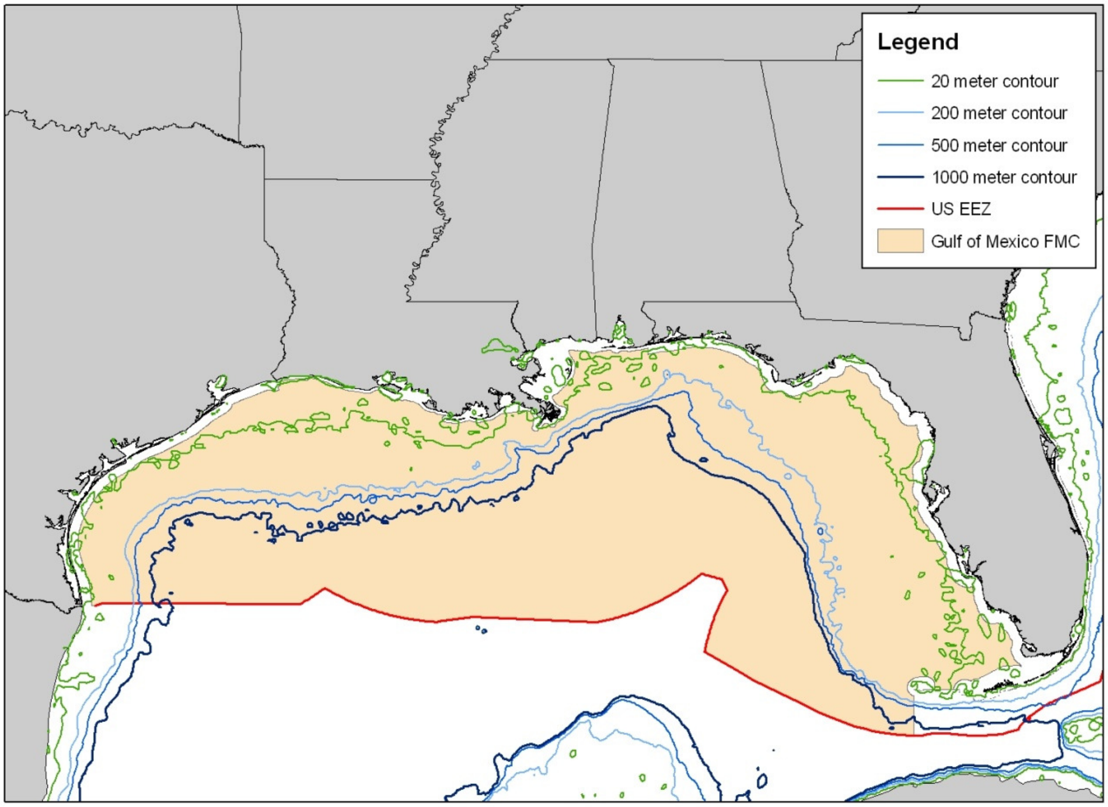
4.1.3 Gulf of Mexico Fishery Management Council Jurisdictional Boundaries



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 have 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 (SEDAR 17-Data Workshop Report, 2008). 1986-2003 South Atlantic calibration factors were updated in 2011 (SEDAR 25-Data Workshop Report, 2011). These calibration factors are tabulated in SEDAR28-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.

Division of stock along East Florida coast
The MRFSS Florida estimates can be post-stratified into finer scale geographical regions. 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. East Florida can be post-stratified into two Florida sub_regions: SE Florida from Dade through Indian River counties (sub-region 4) and NE Florida from Martin through Nassau counties (sub-region 5). It was decided at the SEDAR 28 DW plenary to split the stock at the Georgia/Florida border. Therefore, no post-stratified estimates are required. Official MRFSS East Florida estimates are included in the Gulf of Mexico stock.

Separation of East Florida combined charter boat/headboat mode
In East Florida, 1981-1985 charter and headboat modes were combined into one single mode for estimation purposes. Since the NMFS Headboat Survey (HBS) began in this region in 1981, the MRFSS combined charter boat/headboat mode must be split in order to not double estimate the headboat mode for these years. MRFSS charter boat/headboat mode was split in these years by using a ratio of HBS headboat angler trip estimates to MRFSS charter boat angler trip estimates for 1986-1990. A similar method (using landings data instead of effort data) has been used in the past (SEDAR 25- black sea bass). The mean ratio was calculated by state (or state equivalent to match HBS areas to MRFSS states) and then applied to the 1981-1985 estimates to strip out the headboat component when needed.

For cobia, which is considered a high profile species in headboat catch, the SRHS estimates will start in 1981 since captains were more likely to include this species as a write-in. Cobia MRFSS charter/headboat mode from East Florida was split for all years 1981-1985 and the headboat component was deleted from the MRFSS dataset to avoid duplication with the SRHS.

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.

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The MRFSS cobia 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 (SEDAR22-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 numbers 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 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.

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 cobia 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.

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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.

Issue 1: Gulf of Mexico cobia 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 cobia in the Gulf of Mexico.

Decision: Option 2

Issue 2: FLE headboat landings 1981-1983: From 1981 to 1983 cobia was not listed on all versions of the headboat survey form. If cobia were not listed, any landings would have been written in voluntarily. Cobia is considered a high profile species in headboat catches. Cobia estimated headboat landings are consistent coast wide from 1981-1983. Cobia was routinely written in by captains, this was evident by examining numerous logbooks from 1981 to 1983.

Option 1: Start FLE headboat time series in 1984 when a universal form was in use in all areas from NC- FL.

Option 2: Start FLE headboat landings time series in 1981 when the SRHS began in FLE.

Decision: Option 2

Issue 3: Texas cobia 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 cobia 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.

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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 7-8 and 11-28 are included in the Gulf of Mexico cobia stock. Figures 4.12.7, 4.12.8, and 4.12.9 show the Gulf of Mexico cobia headboat landings from 1981-1989, 1990-1999, and 2000-2011 respectively. Headboat landings of cobia in the Gulf of Mexico, from the 1980's to present, have mostly been concentrated in 3 areas: southwest Florida, Louisiana, and Texas. Catch of cobia was evenly distributed between these areas in the 1980s (Figure 4.12.7), however, since 1990 headboat landings of cobia 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 cobia 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 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.

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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 cobia 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 cobia. The Recreational Working Group was tasked with evaluating other potential historical sources and methods to compile landings of cobia 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.
- 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. Cobia was not listed on the SWAS for the Gulf of Mexico until 1965 and 1970 for the South Atlantic. Cobia estimates in the 1965 and 1970 SWAS were subject to a 1 year recall bias, similar to the 1960 SWAS. The average interview sample size for the 3 surveys was 0.0002% of total estimated saltwater anglers in the United States.

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

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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 cobia 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.

The mean CPUE for cobia 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 cobia 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 5^{th} and 95^{th} percentiles were then computed from the distribution of bootstrap estimates to characterize the uncertainty (Figure 4.12.14).

Issue: Available historical cobia landings limited 1950-1980.

Option 1: Use the Adjusted SWAS cobia 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 cobia landings using the FHWAR census method (GOM 1955-1980) are presented with the total estimated cobia landings (MRFSS/MRIP and SRHS landings) (GOM 1981-2011) in Table 4.11.6 and Figure 4.12.15.

Decision: *Option 4*

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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 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 cobia 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 cobia 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).

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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. The resulting discard estimates for headboats from 1981 to 2003 are represented in Table 4.11.8. The final estimated headboat discard estimates 1981-2011 as well as the discards:landings ratio are presented in Figure 4.11.18.

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. 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 cobia 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 cobia 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

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reflect historic changes in discard rates. These rates include the impacts from changes in recreational size limits and bag limits for cobia 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., cobia, 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.

The number of cobia measured or weighed in the Gulf of Mexico (FLE-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 cobia in the Gulf of Mexico (FLE-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 (FLE-TX) and the percentage of intercepts that encountered cobia are summarized by year and mode in Table 4.11.16. Dockside mean weights of cobia weighed from the MRFSS in the Gulf of Mexico (FLE-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 cobia measured for length in the headboat fleet and the number of trips from which cobia were measured are summarized in Table 4.11.18. The number of cobia 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.

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The number of cobia measured in the TPWD charter and private-rental modes are summarized by year in table 4.11.21. The number of trips with measured cobia 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 cobia are summarized by year and mode in Table 4.11.23.

Aging data
The number of cobia 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 cobia aged from the charter boat fleet by year and state is summarized in Table 4.11.24. The number of cobia aged from the private fleet by year and state is summarized in Table 4.11.25. The number of cobia 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 freezers or coolers left outside of fishing centers or marinas and trip information was not collected. Therefore the number of trips with aged samples was not reported in any mode.

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 was 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

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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; eastern FL, 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 0-9 were plotted for the charter, private/rental, and recreational (unknown mode) fisheries. Ages 0-8 were plotted for the headboat fishery.

In some cases mode of catch was either not recorded or the samples were taken from freezers or coolers left outside of fishing centers or marinas and trip information was not collected. Therefore the number of trips with aged samples was not reported in any mode.

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 cobia 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 cobia 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

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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.

SRHS areas 7-8 and 11-28 are included in the Gulf of Mexico cobia stock. Figures 4.12.27, 4.12.28, and 4.12.29 show the Gulf of Mexico cobia positive headboat trips from 1980-1989, 1990-1999, and 2000-2011 respectively. During the 1980s and 1990s, Louisiana and north Texas showed concentrations of cobia positive trips on headboats (Figures 4.12.27 and 4.12.28). In more recent years from 2000-2011, positive cobia 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 cobia 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.

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- Size data appear to adequately represent the landed catch for the charter and headboat sector.

4.9 Literature Cited

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

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-DW-16), National Marine Fisheries Service, Southeast Fisheries Science Center, Sustainable Fisheries Division (SFD-2010-003).

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4.10 Tables

Table 4.11.1. Gulf of Mexico (FLE-LA) cobia landings (numbers of fish and whole weight in pounds) for charter boat mode and charterboat/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	0	0.00	0	18,049	0.47	294,487
1982	0	0.00	0	15,299	0.35	150,367
1983	310	0.94	7,046	19,773	0.29	338,571
1984	839	0.93	17,107	14,511	0.31	231,588
1985	629	1.38	13,507	11,381	0.27	155,648
1986	7,925	0.30	141,906			
1987	10,543	0.42	194,098			
1988	13,942	0.43	236,488			
1989	7,337	0.28	166,865			
1990	8,272	0.38	152,840			
1991	25,739	0.28	522,789			
1992	9,505	0.32	188,843			
1993	23,632	0.38	534,309			
1994	16,089	0.28	344,958			
1995	11,949	0.44	319,191			
1996	27,739	0.33	622,612			
1997	20,934	0.29	531,678			
1998	8,710	0.15	215,761			
1999	7,819	0.18	237,435			
2000	6,505	0.26	152,332			
2001	12,470	0.18	271,898			
2002	8,937	0.14	219,238			
2003	12,439	0.21	299,953			
2004	15,218	0.19	405,891			
2005	12,456	0.30	316,564			
2006	10,287	0.27	264,956			
2007	11,216	0.23	263,479			
2008	12,357	0.33	285,129			
2009	7,455	0.34	164,110			
2010	4,946	0.22	103,686			
2011	10,285	0.25	267,316			

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Table 4.11.2. Gulf of Mexico (FLE-LA) cobia 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). 2011 data is preliminary and through October.

	Estimated PR Landings			Estimated SH Landings		
YEAR	Number	CV	Pounds	Number	CV	Pounds
1981	69,670	0.31	753,995	1,723	1.00	35,889
1982	123,718	0.20	1,097,256	11,502	0.45	113,156
1983	75,493	0.22	858,628	3,397	1.00	64,909
1984	55,385	0.23	1,119,444	6,740	0.53	103,860
1985	46,865	0.26	672,098	11,420	0.43	148,947
1986	69,609	0.19	1,265,404	0	0.00	0
1987	57,313	0.17	1,040,789	2,101	1.00	53,663
1988	68,545	0.16	1,280,483	2,503	1.00	80,009
1989	64,027	0.27	1,682,264	3,181	0.71	73,180
1990	46,764	0.19	1,025,760	0	0.00	0
1991	38,228	0.22	793,723	7,939	1.00	140,895
1992	62,656	0.11	1,141,810	13,859	0.35	272,458
1993	46,757	0.15	863,039	6,316	0.38	134,534
1994	54,875	0.11	1,085,134	6,618	0.36	146,406
1995	40,194	0.21	733,169	4,665	0.46	95,866
1996	46,414	0.16	908,621	14,964	0.56	316,751
1997	91,550	0.17	2,047,330	7,345	0.47	211,418
1998	48,914	0.13	1,076,964	1,926	0.80	46,193
1999	56,590	0.12	1,280,079	4,097	0.40	102,551
2000	49,153	0.13	1,135,946	7,213	0.41	141,844
2001	46,935	0.15	1,066,534	5,690	0.50	136,704
2002	37,225	0.13	812,414	5,910	0.41	129,467
2003	67,106	0.11	1,625,953	2,435	0.60	64,980
2004	51,775	0.24	1,616,452	538	1.00	6,287
2005	43,317	0.20	1,077,500	0	0.00	0
2006	48,883	0.18	1,180,439	2,874	0.51	54,813
2007	58,441	0.15	1,343,956	0	0.00	0
2008	37,419	0.18	848,465	4,723	0.59	87,737
2009	34,184	0.18	732,994	0	0.00	0
2010	46,228	0.18	1,030,204	3,329	0.70	103,390
2011	47,816	0.25	1,224,253	4,429	0.61	133,966

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

	FLE		FLW/AL		MS*		LA**		TX†	
Year	N	Weight (lb)	N	Weight (lb)	N	Weight (lb)	N	Weight (lb)	N	Weight (lb)
1981	1,373	28,059							371	7,643
1982	2,174	36,360							371	7,643
1983	1,644	36,561							371	7,643
1984	1,782	34,581							371	7,643
1985	1,669	30,474							371	7,643
1986	1,653	30,493	465	7,879			44	1,024	388	9,428
1987	1,953	54,949	316	3,415			68	796	317	5,902
1988	2,145	44,298	150	3,742			107	2,870	407	10,383
1989	2,130	45,473	264	4,382			60	1,131	290	5,650
1990	1,923	48,146	478	10,115			257	6,153	222	5,027
1991	2,589	49,292	417	9,173			364	7,667	227	5,184
1992	2,470	58,981	285	6,426			730	15,327	473	9,821
1993	2,956	58,748	635	13,706			794	15,661	842	13,140
1994	1,937	42,321	369	7,657			1,783	39,882	944	20,681
1995	1,471	33,359	365	10,431			2,182	48,624	850	15,447
1996	1,130	30,223	141	3,111			1,972	42,861	1,033	21,562
1997	1,071	19,949	116	2,978			2,135	54,670	1,190	26,209
1998	959	24,690	179	4,271			714	17,899	1,114	20,524
1999	1,074	23,548	117	3,105			1,155	29,434	551	11,438
2000	962	21,274	72	2,043			547	15,837	538	15,117
2001	1,091	25,145	109	3,161			647	16,692	472	7,689
2002	1,084	20,799	142	3,550			655	16,343	510	9,408
2003	708	13,962	120	2,395			971	18,817	465	7,418
2004	648	15,763	99	1,571					760	11,762
2005	1,664	32,216	71	1,673					776	12,053
2006	885	19,564	116	2,167					802	15,579
2007	1,411	27,975	97	1,712			505	8,693	737	10,787
2008	1,167	29,120	148	3,045			202	4,410	421	9,336
2009	1,143	24,831	271	5,010			227	4,038	684	15,434
2010	1,570	38,127	103	2,331	11	261	7	166	671	15,015
2011	1,165	29,209	138	2,606	20	310	132	2,075	599	9,376

*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 cobia 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	27	486	823	13,991	850	14,477
1982	27	486	823	13,991	850	14,477
1983	81	1,458	1,192	21,462	1,273	22,921
1984	0	0	533	8,577	533	8,577
1985	43	691	743	11,932	786	12,623
1986	10	177	316	5,609	326	5,786
1987	151	2,389	670	10,601	821	12,990
1988	0	0	521	8,328	521	8,328
1989	0	0	312	5,877	312	5,877
1990	0	0	440	9,572	440	9,572
1991	0	0	1,005	19,327	1,005	19,327
1992	0	0	2,735	64,611	2,735	64,611
1993	285	5,563	229	4,470	514	10,033
1994	0	0	1,166	19,339	1,166	19,339
1995	0	0	817	15,795	817	15,795
1996	489	10,892	2,693	62,558	3,182	73,450
1997	446	9,939	2,033	43,931	2,479	53,870
1998	266	6,008	1,964	42,814	2,230	48,822
1999	813	18,206	927	19,759	1,740	37,965
2000	135	2,930	956	21,166	1,091	24,096
2001	192	3,965	1,173	23,868	1,365	27,833
2002	357	5,887	643	10,602	1,000	16,489
2003	178	3,439	1,140	23,506	1,318	26,945
2004	203	4,615	1,225	28,084	1,428	32,699
2005	109	2,079	972	18,954	1,081	21,033
2006	146	3,168	1,519	31,950	1,665	35,119
2007	422	8,475	982	20,325	1,404	28,800
2008	405	8,197	1,776	36,687	2,181	44,884
2009	319	7,318	1,665	42,370	1,984	49,688
2010	261	6,033	759	18,515	1,020	24,548
2011	27	486	823	13,991	850	14,477

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Table 4.11.5. FHWAR estimation method for historical cobia landings (1955-1985).

Year	US saltwater angler days	Proportion anglers TX-FLE	Saltwater angler days (TX-FLE)	Mean CPUE (MRFSS 1981-1985)	Recall bias adjustment	Adjusted saltwater angler days (TX-FLE)	Adjusted cobia landings (n)
1955	58,621,000	0.19	19,285,109	0.0037	0.52	9,952,808	36,996
1960	80,602,000	0.21	29,825,532	0.0037	0.52	15,392,592	57,217
1965	95,837,000	0.19	32,503,369	0.0037	0.52	16,774,590	62,354
1970	113,694,000	0.20	38,928,690	0.0037	0.52	20,090,620	74,680
1975	167,499,000	0.19	56,621,809	0.0037	0.52	29,221,822	108,622
1980	164,040,000	0.20	57,119,017	0.0037	0.52	29,478,425	109,576
1985	171,055,000	0.20	59,654,586	0.0037	0.52	30,787,001	114,440

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Table 4.11.6. Estimated cobia 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	36,996	1984	13,779
1956	41,040	1985	20,758
1957	45,084	1986	32,593
1958	49,128	1987	12,515
1959	53,172	1988	11,881
1960	57,217	1989	17,131
1961	58,244	1990	17,538
1962	59,271	1991	25,550
1963	60,299	1992	18,681
1964	61,326	1993	15,485
1965	62,354	1994	14,495
1966	64,819	1995	20,912
1967	67,284	1996	29,847
1968	69,749	1997	20,202
1969	72,215	1998	15,278
1970	74,680	1999	15,324
1971	81,468	2000	15,637
1972	88,257	2001	15,707
1973	95,045	2002	12,451
1974	101,833	2003	31,053
1975	108,622	2004	30,773
1976	108,813	2005	31,612
1977	109,003	2006	33,112
1978	109,194	2007	27,526
1979	109,385	2008	19,161
1980	109,576	2009	28,400
1981	92,036	2010	29,320
1982	9,514	2011	13,329
1983	2,852		

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Table 4.11.7. Gulf of Mexico (FLE-TX) cobia 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	0	0.00	0	0.00	8,114	0.59	3,115	1.00
1982	0	0.00	2,837	1.00	15,582	0.44	0	0.00
1983	0	0.00	354	1.00	0	0.00	0	0.00
1984	107	1.90	1,602	0.48	39,097	0.87	1,878	0.83
1985	0	0.00	112	1.01	1,013	1.00	0	0.00
1986	1,409	0.72			41,084	0.42	0	0.00
1987	4,089	0.85			20,112	0.24	0	0.00
1988	14,080	0.58			58,742	0.23	0	0.00
1989	2,726	0.55			65,203	0.27	4,629	0.65
1990	12,722	0.52			76,403	0.18	1,580	0.84
1991	40,839	0.52			167,199	0.22	32,968	0.56
1992	12,988	0.53			100,155	0.13	4,949	0.60
1993	14,605	0.59			65,590	0.15	7,319	0.39
1994	21,742	0.27			84,197	0.13	13,566	0.32
1995	19,030	0.33			59,299	0.20	8,786	0.32
1996	34,243	0.35			69,600	0.18	7,351	0.45
1997	16,924	0.38			105,676	0.14	8,366	0.38
1998	6,760	0.35			83,145	0.12	22,301	0.32
1999	10,598	0.27			88,778	0.10	13,399	0.25
2000	11,657	0.36			97,436	0.11	15,069	0.33
2001	5,436	0.21			105,311	0.10	33,088	0.27
2002	7,358	0.15			115,516	0.10	15,325	0.25
2003	5,956	0.15			66,730	0.12	14,288	0.31
2004	10,224	0.31			77,726	0.16	4,685	0.60
2005	4,157	0.23			49,648	0.20	3,287	0.60
2006	7,576	0.30			52,950	0.17	12,985	0.43
2007	10,526	0.30			65,103	0.18	4,669	0.59
2008	11,042	0.29			88,784	0.18	31,120	0.44
2009	6,317	0.25			73,029	0.16	4,001	0.58
2010	1,858	0.26			59,819	0.22	7,108	0.54
2011	8,137	0.37			80,750	0.19	3,913	0.70

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

Year	FLE	FLW/AL	MS*	LA**	TX†	Gulf of Mexico
1981	-				439	439
1982	-				439	439
1983	-				439	439
1984	137				439	577
1985	-				439	439
1986	-	189		-	-	189
1987	-	161		2	33	196
1988	-	103		26	364	494
1989	-	169		-	-	169
1990	222	610		126	399	1,357
1991	-	1,299		5	11	1,315
1992	443	637		10	24	1,114
1993	-	609		3	10	621
1994	-	920		51	100	1,071
1995	-	1,150		102	146	1,398
1996	934	272		70	134	1,410
1997	1,292	43		436	892	2,662
1998	1,450	105		40	227	1,822
1999	104	380		33	58	575
2000	-	389		32	114	535
2001	278	59		26	69	432
2002	72	306		14	40	432
2003	101	153		12	21	288
2004	56	15			20	91
2005	556	15			38	609
2006	390	16		-	61	467
2007	282	53		7	151	493
2008	762	109		13	138	1,022
2009	1,051	147		14	161	1,373
2010	857	17	1	-	93	968
2011	514	241	9	3	50	817

*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 cobia discards (numbers of fish) for charter boat mode and private mode (TPWD). No cobia data from 2011 through mid-May.

year	Estimated CH Discards	Estimated PR Discards	Total Discards
1981	0	58	58
1982	0	58	58
1983	1	25	27
1984	0	47	47
1985	1	100	101
1986	1	167	168
1987	41	106	148
1988	0	163	163
1989	0	106	106
1990	0	282	282
1991	0	421	421
1992	0	1,160	1,160
1993	153	134	287
1994	0	690	690
1995	0	548	548
1996	203	1,381	1,584
1997	128	815	943
1998	99	1,137	1,236
1999	249	667	917
2000	61	1,077	1,138
2001	42	816	859
2002	271	516	787
2003	35	1,097	1,132
2004	87	1,397	1,485
2005	23	957	980
2006	44	1,804	1,847
2007	161	850	1,011
2008	163	1,406	1,569
2009	179	1,366	1,544
2010	112	736	847
2011	0	0	0

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

YEAR	LA	MS	AL	FLW	FLE	TOTAL
1981	2	2	1	2		7
1982		1	5			6
1983	9	8	1			18
1984	21			7		28
1985	3			12		15
1986	50	4	2	4	3	63
1987	13	10	4	9		36
1988	7	3	3	10		23
1989			4	8	5	17
1990	8		10			18
1991	46	1	6	19		72
1992	13	3	18	11	6	51
1993	15	2	7	9	3	36
1994	28	2	5	12	3	50
1995	11	2		7	3	23
1996	9	1	3	22	1	36
1997	7	1	1	44	3	56
1998	5	1	2	55	4	67
1999	9	5	3	61	19	97
2000		2	3	54	5	64
2001	1	1	10	60	29	101
2002	34	11	11	31	22	109
2003	60		5	49	33	147
2004	77		8	44	19	148
2005	47			36	9	92
2006	39		4	22	27	92
2007	71		3	32	14	120
2008	3			25	11	39
2009	13	1	3	10	10	37
2010			5	28	28	61
2011	6	3	4	29	34	76
Grand Total	607	64	131	712	291	1,805

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Table 4.11.11. Number of cobia measured or weighed in the Gulf of Mexico (FLE-LA) in the MRFSS private fleet by year and state.

YEAR	LA	MS	AL	FLW	FLE	TOTAL
1981	5		5	4		14
1982	23	8	8	16	14	69
1983	8	3		5	4	20
1984	4	1	2	7	7	21
1985	7		3	2	6	18
1986	5	3	3	33	2	46
1987	3	3	14	16	7	43
1988	7	1	2	18	5	33
1989	8	1		5	9	23
1990	8	1	3	10	3	25
1991	2		3	8	3	16
1992	1	7	7	22	30	67
1993	1	2	3	12	17	35
1994	8	4	7	26	11	56
1995	7	4		21	4	36
1996	5		2	14	17	38
1997	10	9	3	20	13	55
1998	2	7	5	27	18	59
1999	5	3	14	34	52	108
2000	3	7	6	18	17	51
2001	3	4	8	25	14	54
2002	1	2	5	23	15	46
2003	1	1	5	39	25	71
2004	3	5	6	15	6	35
2005	3	1	5	24	5	38
2006	6	1	3	9	28	47
2007	4	1	4	20	18	47
2008	1	4	3	19	19	46
2009	1	3	6	15	21	46
2010	2			17	36	55
2011	5	4	5	6	33	53
Grand Total	152	90	140	530	459	1,371

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Table 4.11.12. Number of cobia measured or weighed in the Gulf of Mexico (FLE-LA) in the MRFSS shore mode by year and state.

YEAR	LA	AL	FLW	FLE	TOTAL
1982	5		6		11
1984				2	2
1985		1		5	6
1987			1		1
1988			1		1
1991			1		1
1992			2	3	5
1993			3		3
1994			4		4
1995			2		2
1996			6		6
1997			5	1	6
1998			2		2
1999			6	1	7
2000			3		3
2001			2		2
2002			1	1	2
2003			2	1	3
2004			1		1
2005			1		1
2006			1	1	2
2008			3		3
2010			3	1	4
2011			1	2	3
Grand Total	5	1	57	18	81

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

YEAR	LA	MS	AL	FLW	FLE	TOTAL
1981	2	2	1	1		6
1982		1	4			5
1983	7	1	1			9
1984	7			6		13
1985	2			5		7
1986	18	3	2	2	3	28
1987	7	5	4	7		23
1988	3	2	1	6		12
1989			4	5	4	13
1990	5		5			10
1991	19	1	5	10		35
1992	9	3	9	8	6	35
1993	7	2	3	8	2	22
1994	12	2	5	7	2	28
1995	7	2		3	3	15
1996	5	1	2	15	1	24
1997	4	1	1	22	3	31
1998	5	1	2	36	4	48
1999	4	4	2	45	13	68
2000		2	3	42	5	52
2001	1	1	8	47	18	75
2002	16	5	11	25	17	74
2003	22		5	35	18	80
2004	23		8	38	16	85
2005	13			30	7	50
2006	18		4	17	16	55
2007	20		3	27	6	56
2008	3			23	10	36
2009	5	1	3	8	7	24
2010			2	19	17	38
2011	3	1	4	21	15	44
Grand Total	247	41	102	518	193	1,101

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Table 4.11.14. Number of angler trips with measured or weighed cobia in the Gulf of Mexico (FLE-LA) in the MRFSS private fleet by year and state.

YEAR	LA	MS	AL	FLW	FLE	TOTAL
1981	3		4	4		11
1982	13	7	8	11	11	50
1983	4	2		2	4	12
1984	2	1	2	4	7	16
1985	2		3	2	6	13
1986	4	2	2	14	2	24
1987	1	3	7	11	6	28
1988	4	1	1	13	5	24
1989	2	1		4	7	14
1990	2	1	3	7	3	16
1991	2		3	8	3	16
1992	1	6	3	19	24	53
1993	1	2	3	12	13	31
1994	6	2	7	22	11	48
1995	2	3		17	4	26
1996	2		2	11	16	31
1997	6	9	2	18	11	46
1998	2	5	5	24	17	53
1999	5	3	12	29	32	81
2000	3	3	6	15	16	43
2001	1	3	7	20	13	44
2002	1	2	5	21	12	41
2003	1	1	5	37	24	68
2004	2	1	6	13	5	27
2005	2	1	5	19	4	31
2006	3	1	3	9	22	38
2007	4	1	4	17	14	40
2008	1	2	1	13	17	34
2009	1	3	5	13	17	39
2010	1			15	32	48
2011	3	1	2	5	20	31
Grand Total	87	67	116	429	378	1,077

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Table 4.11.15. Number of trips with measured or weighed cobia in the Gulf of Mexico (FLE-LA) in the MRFSS shore mode by year and state.

YEAR	LA	AL	FLW	FLE	TOTAL
1982	1		4		5
1984				2	2
1985		1		5	6
1987			1		1
1988			1		1
1991			1		1
1992			2	2	4
1993			3		3
1994			4		4
1995			2		2
1996			6		6
1997			4	1	5
1998			2		2
1999			6	1	7
2000			3		3
2001			2		2
2002			1	1	2
2003			2	1	3
2004			1		1
2005			1		1
2006			1	1	2
2008			3		3
2010			3	1	4
2011			1	2	3
Grand Total	1	1	54	17	73

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Table 4.11.16. Number of MRFSS intercept trips conducted in the Gulf of Mexico (FLE-LA) by year and mode with the percentage of intercepts that encountered cobia.

	Shore			Cbt			Priv		
YEAR	TOT int	COB int	%cob	TOT int	COB int	%cob	TOT int	COB int	%cob
1981	2,985	2	0.07%	410	10	2.44%	2,674	16	0.60%
1982	6,393	5	0.08%	365	6	1.64%	5,968	60	1.01%
1983	5,295	1	0.02%	1,038	19	1.83%	3,125	15	0.48%
1984	5,844	5	0.09%	1,250	25	2.00%	3,980	22	0.55%
1985	6,245	7	0.11%	724	12	1.66%	4,232	20	0.47%
1986	2,919		0.00%	3,342	41	1.23%	12,952	41	0.32%
1987	3,075	1	0.03%	2,736	32	1.17%	12,543	65	0.52%
1988	5,625	1	0.02%	2,556	34	1.33%	12,967	59	0.46%
1989	4,535	7	0.15%	2,190	23	1.05%	9,530	47	0.49%
1990	4,124	2	0.05%	1,745	33	1.89%	8,454	67	0.79%
1991	4,843	6	0.12%	2,403	67	2.79%	9,849	71	0.72%
1992	9,910	10	0.10%	4,370	78	1.78%	21,082	156	0.74%
1993	15,367	14	0.09%	2,493	38	1.52%	16,444	103	0.63%
1994	17,450	20	0.11%	2,570	70	2.72%	19,302	136	0.70%
1995	16,043	15	0.09%	2,379	34	1.43%	17,061	76	0.45%
1996	10,361	21	0.20%	2,684	68	2.53%	21,011	124	0.59%
1997	10,516	22	0.21%	4,158	69	1.66%	21,012	203	0.97%
1998	11,448	22	0.19%	7,513	78	1.04%	24,086	176	0.73%
1999	14,900	24	0.16%	12,017	127	1.06%	31,527	248	0.79%
2000	12,084	16	0.13%	15,114	134	0.89%	27,650	170	0.61%
2001	12,913	23	0.18%	14,065	166	1.18%	30,345	181	0.60%
2002	14,423	24	0.17%	14,628	173	1.18%	32,239	211	0.65%
2003	14,252	15	0.11%	14,851	181	1.22%	30,359	184	0.61%
2004	12,131	6	0.05%	14,641	199	1.36%	30,603	137	0.45%
2005	12,463	9	0.07%	12,658	144	1.14%	28,175	119	0.42%
2006	12,129	10	0.08%	10,132	125	1.23%	31,696	145	0.46%
2007	12,708	3	0.02%	10,237	135	1.32%	31,234	138	0.44%
2008	11,769	20	0.17%	9,233	137	1.48%	30,787	164	0.53%
2009	12,797	4	0.03%	7,784	30	0.39%	30,549	90	0.29%
2010	12,408	10	0.08%	8,140	81	1.00%	29,507	146	0.49%

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Table 4.11.17. Mean weight (lb) of cobia weighed from the MRFSS in the Gulf of Mexico (FLE-LA) by year and mode, 1981-2011.

	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	6	17.23	13.23	27.56	13	12.38	2.43	33.07				
1982	6	12.90	4.19	28.66	59	10.59	0.88	44.97	7	6.68	1.10	27.12
1983	9	19.45	4.41	45.19	17	7.53	0.88	22.05				
1984	26	19.50	0.22	52.47	19	18.80	2.65	43.21	2	10.36	10.36	10.36
1985	13	20.18	12.13	33.95	10	9.50	1.98	21.83	6	12.93	5.51	20.06
1986	37	17.73	1.32	46.30	38	17.42	1.10	44.09				
1987	33	20.84	1.54	77.16	41	14.43	0.88	38.58	1	18.74	18.74	18.74
1988	19	16.85	10.14	29.10	29	15.56	3.53	33.07	1	36.60	36.60	36.60
1989	15	25.24	9.70	60.63	16	25.39	9.92	56.00				
1990	9	20.99	16.53	26.46	12	20.06	1.10	50.26				
1991	44	22.50	12.35	45.19	11	16.09	5.51	36.38	1	13.45	13.45	13.45
1992	34	22.08	5.73	64.15	53	18.65	1.32	82.23	5	14.81	9.92	20.72
1993	21	20.39	9.48	37.48	25	17.54	8.82	29.98	1	18.74	18.74	18.74
1994	31	22.37	10.58	48.94	37	19.53	5.07	46.30	1	11.68	11.68	11.68
1995	12	28.01	8.16	56.77	23	15.35	0.66	27.12	2	17.53	16.53	18.52
1996	21	23.68	14.33	69.00	31	19.05	12.57	28.88	1	20.39	20.39	20.39
1997	43	24.59	6.83	67.90	38	19.00	3.31	50.71	5	24.71	13.67	40.34
1998	59	27.25	5.51	96.01	37	18.63	7.05	34.17	2	8.27	5.51	11.02
1999	92	32.57	12.13	90.94	90	21.72	4.41	54.01	7	25.21	10.47	37.48
2000	54	23.74	9.92	52.27	49	23.91	6.44	65.08	2	6.48	1.72	11.24
2001	98	24.48	9.92	92.70	47	21.70	6.17	95.08	2	16.89	12.83	20.94
2002	107	25.53	10.23	89.02	37	21.13	6.17	33.91	2	15.12	14.81	15.43
2003	131	24.14	9.57	49.56	58	23.74	5.40	50.44	2	18.19	13.89	22.49
2004	143	25.44	12.13	55.12	29	24.77	4.19	45.68	1	11.68	11.68	11.68
2005	89	26.17	10.47	52.34	36	21.44	5.51	44.09	1	9.70	9.70	9.70
2006	85	22.51	11.57	41.89	40	21.73	9.57	38.85	2	14.57	13.05	16.09
2007	103	22.49	9.92	58.80	42	24.84	8.51	50.26				
2008	36	23.15	12.04	46.52	41	24.06	12.79	50.04	3	18.85	12.79	24.85
2009	35	24.04	11.33	52.47	44	19.86	6.08	41.27				
2010	55	22.33	10.63	48.02	50	22.34	11.42	51.15	4	26.18	14.46	34.83
2011	68	23.22	10.19	47.84	52	23.04	12.57	46.30	1	1.01	1.01	1.01

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Table 4.11.18. Number of cobia 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	FLE	FLW/AL	MS	LA	TX	Total	FLE	FLW/AL	MS	LA	TX	Total
1972	-					-	-					-
1973	-					-	-					-
1974	-					-	-					-
1975	-					-	-					-
1976	-					-	-					-
1977	-					-	-					-
1978	-					-	-					-
1979	23					23	20					20
1980	15					15	15					15
1981	31					31	27					27
1982	28					28	24					24
1983	29					29	27					27
1984	47					47	41					41
1985	24					24	21					21
1986	39	28		7	18	92	34	22		6	17	79
1987	42	15		3	8	68	33	13		2	6	54
1988	34	7		9	6	56	24	7		8	6	45
1989	36	11		19	4	70	27	10		19	4	60
1990	40	9		6	3	58	32	8		3	3	46
1991	25	12		11	3	51	18	11		9	3	41
1992	53	9		52	10	124	33	7		29	8	77
1993	53	10		74	21	158	35	5		36	15	91
1994	23	22		58	40	143	21	14		27	26	88
1995	16	12		109	37	174	11	7		54	27	99
1996	10	1		115	36	162	7	1		33	23	64
1997	19	1		127	8	155	15	1		62	5	83
1998	31	13		185	14	243	25	8		77	13	123
1999	28	2		182	8	220	26	2		68	8	104
2000	18	7		67	1	93	15	4		41	1	61
2001	32	3		59	34	128	28	1		36	13	78
2002	47	1		33	8	89	36	1		18	8	63
2003	43	1		51	10	105	26	1		26	4	57
2004	31	-		-	18	49	20	-		-	16	36
2005	16	1		10	10	37	14	1		8	9	32
2006	45	4		1	19	69	27	3		1	13	44
2007	43	2		26	15	86	27	2		16	8	53
2008	41	5		18	-	64	28	1		11	0	40
2009	40	6		25	2	73	33	5		17	2	57
2010	77	8	-	-	1	86	37	5	-	-	1	43
2011	54	2	-	3	-	59	41	2	-	3	0	46

*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 cobia aged from the SRHS by year and state. Due to headboat area definitions, West Florida and Georgia data are combined.

Year	FLE	FLW/AL	MS	LA	TX
1981	-	-	-	-	-
1982	-	-	-	-	-
1983	-	-	-	-	-
1984	-	-	-	-	-
1985	-	-	-	-	-
1986	-	-	-	-	-
1987	-	-	-	-	-
1988	-	-	-	-	-
1989	-	-	-	-	-
1990	-	-	-	-	-
1991	-	-	-	-	-
1992	-	7	-	-	-
1993	-	2	-	-	-
1994	-	6	-	-	-
1995	-	4	-	-	-
1996	-	1	-	-	-
1997	-	-	-	-	-
1998	-	-	-	-	-
1999	-	-	-	-	-
2000	-	-	-	-	-
2001	-	-	-	-	-
2002	-	-	-	-	-
2003	-	-	-	-	-
2004	-	-	-	-	-
2005	4	-	-	-	-
2006	22	1	-	-	-
2007	4	-	-	-	-
2008	-	-	-	-	-
2009	-	1	-	-	-
2010	13	1	-	-	-
2011	1	-	-	-	-

*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 cobia measured in the SRHS by year and state, 1986-2011. Due to headboat area definitions, West Florida and Georgia data are combined.

	FLE				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)	N	Mean (kg)	Min (kg)	Max (kg)
1972	-	-	-	-																
1973	-	-	-	-																
1974	-	-	-	-																
1975	-	-	-	-																
1976	-	-	-	-																
1977	-	-	-	-																
1978	-	-	-	-																
1979	23	10.76	2.26	20.43																
1980	15	6.21	0.24	15.89																
1981	31	8.54	3.90	24.55																
1982	28	7.78	1.85	23.15																
1983	29	8.24	1.40	18.36																
1984	47	8.68	0.53	23.61																
1985	25	7.87	0.45	18.90																
1986	39	8.53	0.47	18.91	28	8.36	0.62	20.80					7	10.55	6.20	22.50	18	10.53	6.00	32.66
1987	42	9.50	2.07	24.43	15	5.12	1.50	11.30					3	6.77	1.60	10.20	8	9.08	5.93	12.00
1988	34	10.56	4.05	32.72	7	8.68	3.96	19.61					9	13.42	1.53	46.54	6	9.08	5.25	13.39
1989	36	9.69	0.91	21.97	11	7.36	3.73	12.56					19	8.52	0.03	29.23	4	10.34	8.32	14.12
1990	40	12.75	5.55	32.01	9	9.94	5.22	14.15					6	10.95	4.73	18.23	3	8.96	6.00	12.03
1991	25	9.23	4.62	17.97	12	10.68	5.98	17.48					11	9.56	5.35	16.82	3	8.31	6.84	10.21
1992	53	10.93	0.88	28.67	9	10.22	1.86	17.15					52	9.29	5.43	17.68	10	12.96	6.59	28.36
1993	53	9.87	4.72	20.66	10	9.90	5.80	14.90					74	8.83	4.53	17.50	21	8.60	5.67	18.08
1994	23	10.22	6.11	19.98	22	9.57	4.85	16.12					58	10.07	4.37	18.68	40	10.35	5.52	22.01
1995	16	9.51	0.77	21.38	12	15.37	4.54	32.70					109	10.16	5.54	19.71	37	9.63	5.29	22.20
1996	10	13.08	6.93	19.55	1	10.34	10.34	10.34					115	11.31	5.65	31.25	36	10.68	5.20	24.01
1997	19	10.08	4.39	24.97	1	12.42	12.42	12.42					127	11.38	4.25	28.70	8	7.86	5.65	11.52
1998	31	11.33	4.85	18.91	13	10.92	6.43	17.82					185	11.52	5.57	39.53	14	9.05	6.02	15.25
1999	28	9.61	4.64	22.13	2	12.63	12.13	13.12					182	12.11	3.47	30.02	8	6.14	5.46	7.90

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2000	18	9.29	5.07	15.46	7	10.27	5.28	21.56					67	13.04	5.35	26.70	1	14.92	14.92	14.92
2001	33	9.95	5.26	20.62	3	22.38	20.43	25.09					59	11.37	5.52	19.21	34	8.23	0.00	17.40
2002	47	8.96	5.55	20.26	1	8.94	8.94	8.94					33	11.95	5.12	21.33	8	6.27	5.69	7.15
2003	43	9.24	5.34	17.01	1	6.05	6.05	6.05					51	9.97	5.49	18.57	10	7.24	5.66	8.91
2004	31	11.04	6.45	16.33	-	-	-	-									18	7.06	4.18	10.16
2005	16	8.28	4.59	16.92	1	7.32	7.32	7.32					10	11.0	6.6	20.9	10	7.05	4.54	10.80
2006	45	9.94	4.04	21.98	4	11.03	7.97	17.64					1	9.7	9.7	9.7	19	9.19	6.12	15.74
2007	44	9.28	1.69	20.36	2	8.12	7.97	8.26					28	8.7	0.0	33.6	15	8.71	4.69	16.24
2008	41	10.12	4.88	26.21	5	10.38	7.71	15.11					18	9.9	0.5	18.4	-	-	-	-
2009	40	9.64	5.53	23.38	6	8.44	6.20	10.73					25	12.2	5.5	21.4	2	11.48	10.70	12.27
2010	77	9.46	5.41	23.32	8	11.42	6.47	19.14	-	-	-	-	-	-	-	-	1	8.50	8.50	8.50
2011	54	11.37	6.52	21.27	2	9.71	6.63	12.79	-	-	-	-	3	10.0	6.2	13.7	-	-	-	-

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Table 4.11.21. Number of cobia measured in Texas in the TPWD survey by year and mode. No cobia data from 2011 through mid-May.

YEAR	Cbt	Priv	Grand Total
1983	1	24	25
1984		21	21
1985		27	27
1986	1	18	19
1987	2	29	31
1988		19	19
1989		20	20
1990		18	18
1991	2	20	22
1992		34	34
1993	3	20	23
1994	1	45	46
1995	1	46	47
1996	21	101	122
1997	9	76	85
1998	14	70	84
1999	13	35	48
2000	7	45	52
2001	6	41	47
2002	6	28	34
2003	8	68	76
2004	10	53	63
2005	6	44	50
2006	7	64	71
2007	17	47	64
2008	27	64	91
2009	11	75	86
2010	12	37	49
2011			
Grand Total	185	1,189	1,374

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Table 4.11.22. Number of trips with measured cobia in Texas from the TPWD survey by year and mode. No cobia data from 2011 through mid-May.

YEAR	Cbt	Priv	Grand Total
1983	1	20	21
1984		18	18
1985		24	24
1986	1	13	14
1987	2	21	23
1988		14	14
1989		15	15
1990		14	14
1991	1	19	20
1992		26	26
1993	2	15	17
1994	1	36	37
1995	1	41	42
1996	7	81	88
1997	8	65	73
1998	10	55	65
1999	10	31	41
2000	3	37	40
2001	5	34	39
2002	5	24	29
2003	5	53	58
2004	6	37	43
2005	4	32	36
2006	5	55	60
2007	12	40	52
2008	18	47	65
2009	6	53	59
2010	7	26	33
2011			
Grand Total	120	946	1,066

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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 cobia.

	Cbt			Priv			Total		
YEAR	TOT int	COB int	%cob	TOT int	COB int	%cob	TOT int	COB int	%cob
1983	367	1	0.27%	14,223	20	0.14%	14,590	21	0.14%
1984	247		0.00%	9,149	18	0.20%	9,396	18	0.19%
1985	403		0.00%	12,149	24	0.20%	12,552	24	0.19%
1986	474	1	0.21%	12,306	13	0.11%	12,780	14	0.11%
1987	498	2	0.40%	16,333	21	0.13%	16,831	23	0.14%
1988	570		0.00%	14,929	14	0.09%	15,499	14	0.09%
1989	665		0.00%	12,285	15	0.12%	12,950	15	0.12%
1990	425		0.00%	9,740	14	0.14%	10,165	14	0.14%
1991	694	1	0.14%	12,090	19	0.16%	12,784	20	0.16%
1992	991		0.00%	15,294	26	0.17%	16,285	26	0.16%
1993	968	2	0.21%	16,538	15	0.09%	17,506	17	0.10%
1994	1,045	1	0.10%	18,654	36	0.19%	19,699	37	0.19%
1995	1,089	1	0.09%	17,727	41	0.23%	18,816	42	0.22%
1996	1,264	7	0.55%	16,780	81	0.48%	18,044	88	0.49%
1997	1,194	8	0.67%	17,032	65	0.38%	18,226	73	0.40%
1998	1,355	10	0.74%	17,064	55	0.32%	18,419	65	0.35%
1999	1,538	10	0.65%	20,017	31	0.15%	21,555	41	0.19%
2000	1,731	3	0.17%	18,950	37	0.20%	20,681	40	0.19%
2001	1,861	5	0.27%	16,853	34	0.20%	18,714	39	0.21%
2002	1,561	5	0.32%	15,623	24	0.15%	17,184	29	0.17%
2003	1,799	5	0.28%	17,339	53	0.31%	19,138	58	0.30%
2004	1,703	6	0.35%	17,175	37	0.22%	18,878	43	0.23%
2005	1,705	4	0.23%	16,632	32	0.19%	18,337	36	0.20%
2006	2,072	5	0.24%	18,468	55	0.30%	20,540	60	0.29%
2007	2,067	12	0.58%	16,864	40	0.24%	18,931	52	0.27%
2008	1,797	18	1.00%	17,045	47	0.28%	18,842	65	0.34%
2009	1,891	6	0.32%	18,204	53	0.29%	20,095	58	0.29%
2010	1,963	7	0.36%	16,796	26	0.15%	18,759	33	0.18%

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

Year	FLE	FLW/AL	MS	LA	TX
1981	-	-	-	-	-
1982	-	-	-	-	-
1983	-	-	-	-	-
1984	-	-	-	-	-
1985	-	-	-	-	-
1986	-	-	-	-	-
1987	-	-	-	-	-
1988	-	-	-	-	-
1989	-	-	-	-	-
1990	-	-	-	-	-
1991	-	-	-	-	-
1992	-	-	-	-	-
1993	-	-	-	-	-
1994	-	-	-	-	-
1995	-	-	-	-	-
1996	-	-	-	-	-
1997	-	-	-	-	-
1998	-	-	-	-	-
1999	-	3	-	-	-
2000	-	-	-	-	-
2001	-	-	-	-	-
2002	-	-	-	-	-
2003	-	-	-	-	-
2004	15	-	-	-	-
2005	7	-	-	-	-
2006	19	-	-	-	-
2007	2	1	-	-	-
2008	1	3	-	-	-
2009	-	2	-	-	-
2010	-	-	-	-	-
2011	-	-	-	-	-

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

Year	FLE	FLW/AL	MS	LA	TX
1981	-	-	-	-	-
1982	-	-	-	-	-
1983	-	-	-	-	-
1984	-	-	-	-	-
1985	-	-	-	-	-
1986	-	-	-	-	-
1987	-	-	-	-	-
1988	-	-	-	-	-
1989	-	-	-	-	-
1990	-	-	-	-	-
1991	-	-	-	-	-
1992	-	-	-	-	-
1993	-	-	-	-	-
1994	-	-	-	-	-
1995	-	-	-	-	-
1996	-	-	-	-	-
1997	-	-	-	-	-
1998	-	-	-	-	-
1999	-	-	-	-	-
2000	-	-	-	-	-
2001	-	-	-	-	-
2002	-	-	-	-	-
2003	-	-	-	-	-
2004	1	-	-	-	-
2005	-	1	-	-	-
2006	5	2	-	-	-
2007	-	2	-	-	-
2008	-	-	-	-	-
2009	-	-	-	-	-
2010	-	1	-	-	-
2011	-	-	-	-	-

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

Year	FLE	FLW/AL	MS	LA	TX
1981	-	-	-	-	-
1982	-	-	-	-	-
1983	-	-	-	-	-
1984	-	-	-	-	-
1985	-	-	-	-	-
1986	-	-	-	-	-
1987	-	-	11	4	-
1988	-	8	19	5	-
1989	-	56	61	57	-
1990	2	45	43	50	15
1991	7	11	23	18	-
1992	2	-	-	-	-
1993	-	-	-	-	-
1994	-	-	-	-	-
1995	-	22	-	-	3
1996	54	109	52	37	69
1997	18	67	78	30	-
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 (FLE-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			510,073	0.08	9,737,473	0.16	10,505,491	0.07
1982			1,236,550	0.07	8,413,743	0.05	14,882,315	0.07
1983			970,566	0.08	10,323,717	0.05	21,053,558	0.09
1984			919,543	0.08	11,843,394	0.05	17,987,255	0.08
1985			1,229,933	0.07	12,671,766	0.06	15,361,270	0.07
1986	853,851	0.12			12,516,657	0.04	15,403,850	0.05
1987	897,982	0.13			13,562,422	0.03	12,107,471	0.08
1988	1,032,633	0.11			15,785,242	0.02	14,272,536	0.04
1989	871,175	0.11			13,595,335	0.03	11,880,871	0.04
1990	649,101	0.11			11,192,600	0.02	9,532,145	0.04
1991	656,047	0.09			13,825,224	0.02	14,740,042	0.03
1992	700,526	0.07			14,092,539	0.01	13,598,016	0.02
1993	1,092,434	0.06			13,203,731	0.01	12,722,408	0.02
1994	1,243,458	0.06			14,720,803	0.01	13,344,650	0.02
1995	1,436,657	0.05			14,813,126	0.01	12,822,863	0.02
1996	1,444,312	0.05			14,408,301	0.01	11,788,722	0.02
1997	1,529,432	0.06			15,817,256	0.01	12,619,577	0.02
1998	1,134,248	0.03			13,828,925	0.02	11,631,034	0.02
1999	999,895	0.03			13,293,853	0.02	9,545,549	0.02
2000	1,045,150	0.03			17,481,153	0.02	13,925,312	0.02
2001	949,859	0.02			18,365,263	0.02	15,995,653	0.02
2002	947,643	0.03			17,064,823	0.02	11,923,474	0.02
2003	878,041	0.03			20,322,073	0.02	13,200,343	0.02
2004	1,035,123	0.03			21,188,067	0.02	15,098,692	0.04
2005	884,084	0.02			19,648,863	0.02	14,105,901	0.04
2006	1,007,073	0.03			19,533,380	0.02	14,380,029	0.04
2007	1,020,877	0.03			22,137,137	0.02	13,734,361	0.04
2008	955,752	0.03			21,647,123	0.02	13,426,797	0.04
2009	971,013	0.03			18,837,137	0.02	12,909,041	0.04
2010	698,546	0.03			18,390,788	0.02	12,175,814	0.04
2011	807,950	0.02			15,527,520	0.02	11,936,047	0.04

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

YEAR	FLE	FLW/AL	MS*	LA**	TX
1981	597,408				
1982	586,266				
1983	555,726				
1984	577,988				
1985	561,689				
1986	634,119	480,154		11,782	113,136
1987	666,082	434,098		12,724	126,726
1988	603,549	391,896		15,382	140,792
1989	633,728	416,650		5,734	126,778
1990	645,790	427,812		13,796	116,288
1991	560,044	348,624		12,746	119,938
1992	529,047	369,604		19,822	152,436
1993	473,945	415,793		22,512	161,809
1994	484,591	409,123		25,302	201,555
1995	405,898	364,821		20,996	180,929
1996	394,344	309,826		21,976	183,706
1997	340,729	298,884		18,016	164,415
1998	306,678	370,666		15,709	155,303
1999	324,390	352,234		16,052	116,470
2000	360,194	318,662		9,904	116,790
2001	322,102	314,486		12,444	110,722
2002	298,548	283,662		12,444	133,902
2003	287,170	288,422		13,272	127,164
2004	347,402	316,860			129,980
2005	342,156	260,466			119,714
2006	347,237	248,125		10,010	141,577
2007	310,363	273,755		5,044	127,524
2008	244,728	260,349		5,889	82,373
2009	268,654	284,873		6,536	101,470
2010	243,404	222,035	995	434	94,304
2011	244,948	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

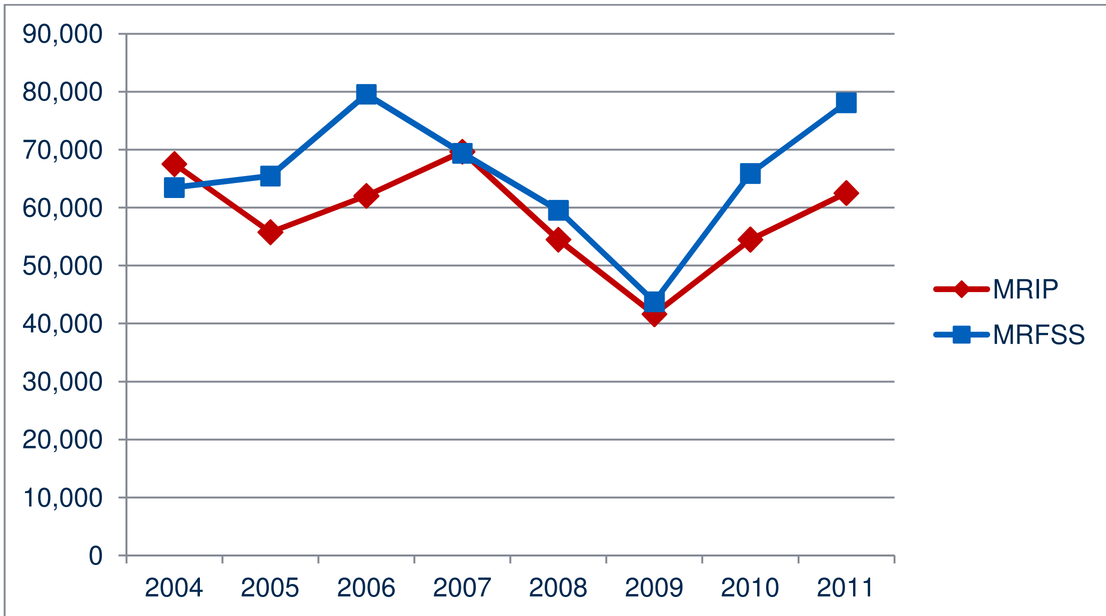

Figure 4.12.1. Comparison of MRIP and MRFSS landings (A+B1) for Gulf of Mexico cobia (FLE-LA).

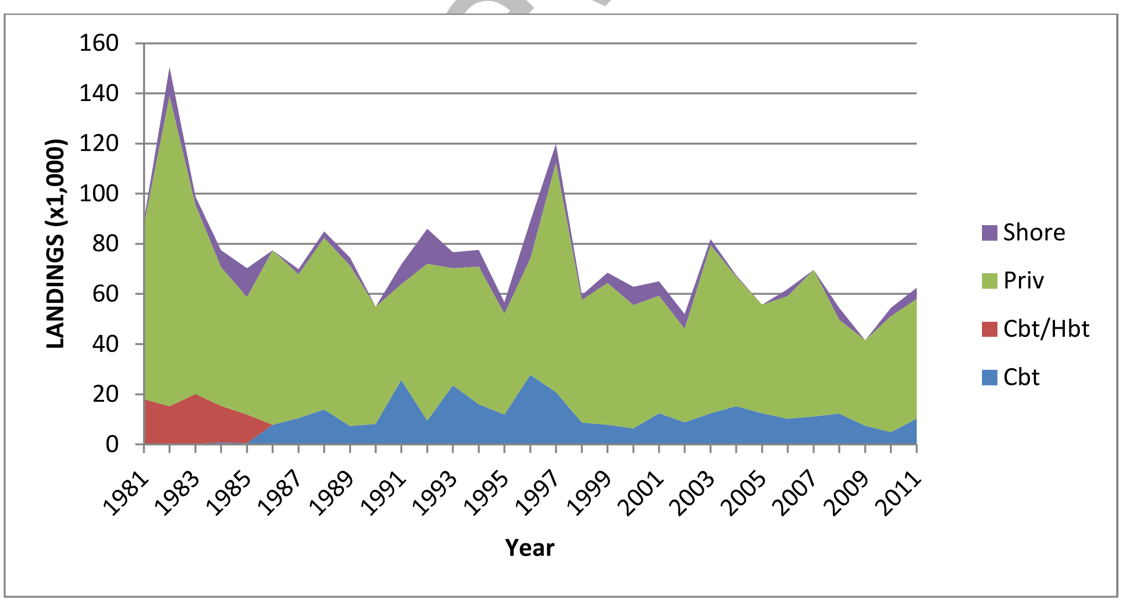

Figure 4.12.2. Gulf of Mexico (FLE-LA) cobia landings (numbers of fish) by year and mode (MRFSS, NMFS, 1981-2003; MRIP, NMFS, 2004-2011). 2011 data is preliminary and through October.

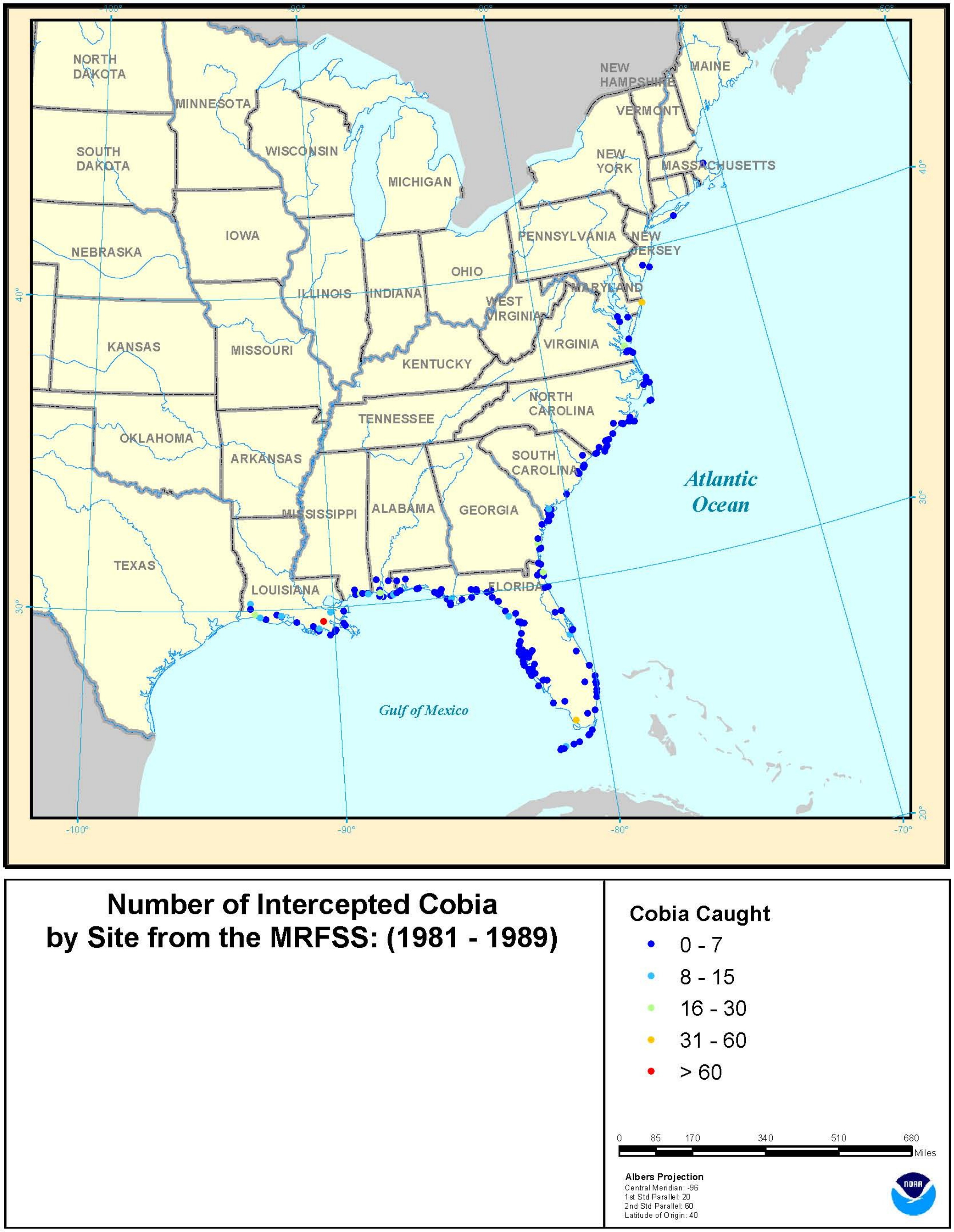

Figure 4.12.3. The number of cobia intercepted by the MRFSS from 1981-1989.

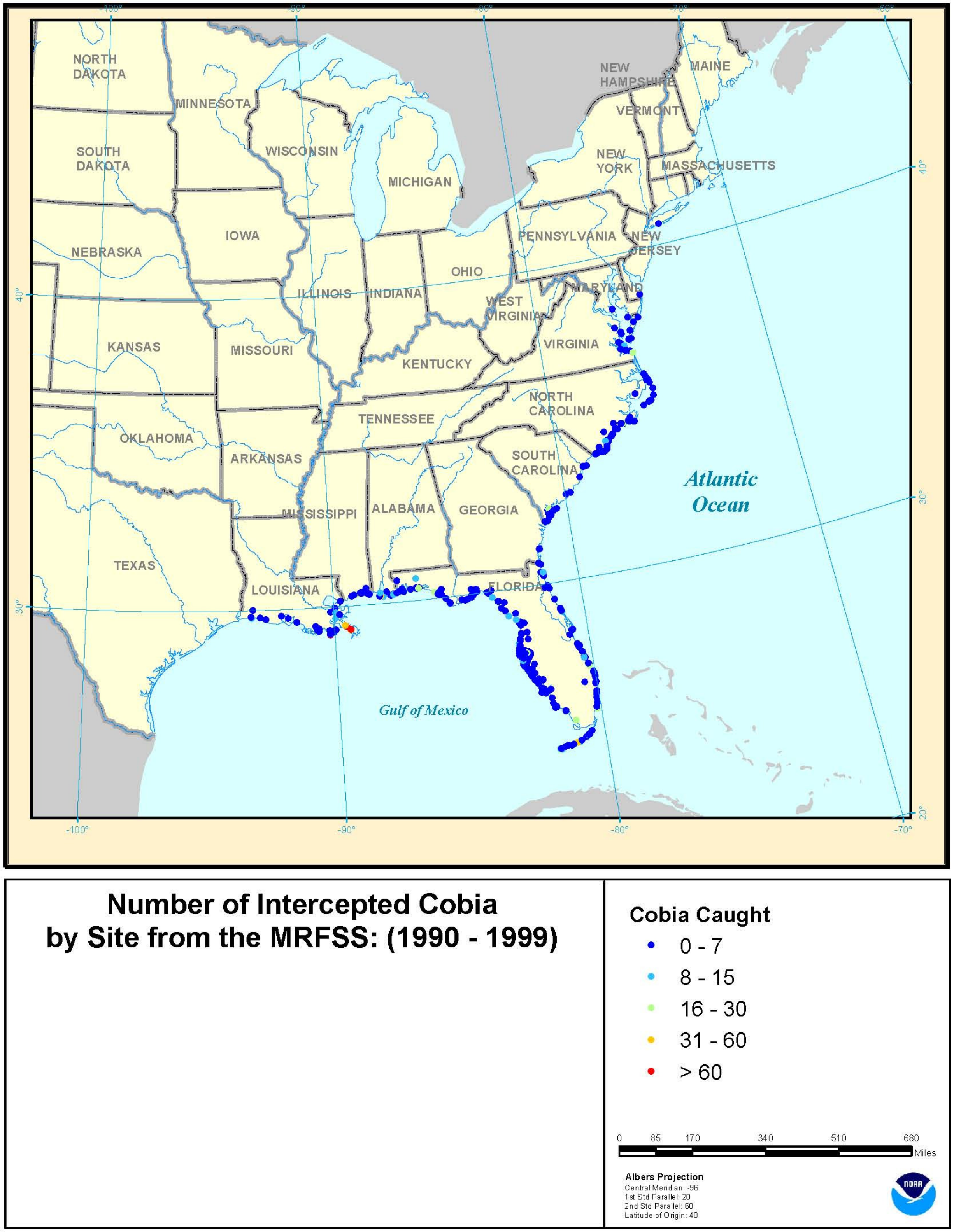

Figure 4.12.4. The number of cobia intercepted by the MRFSS from 1990-1999.

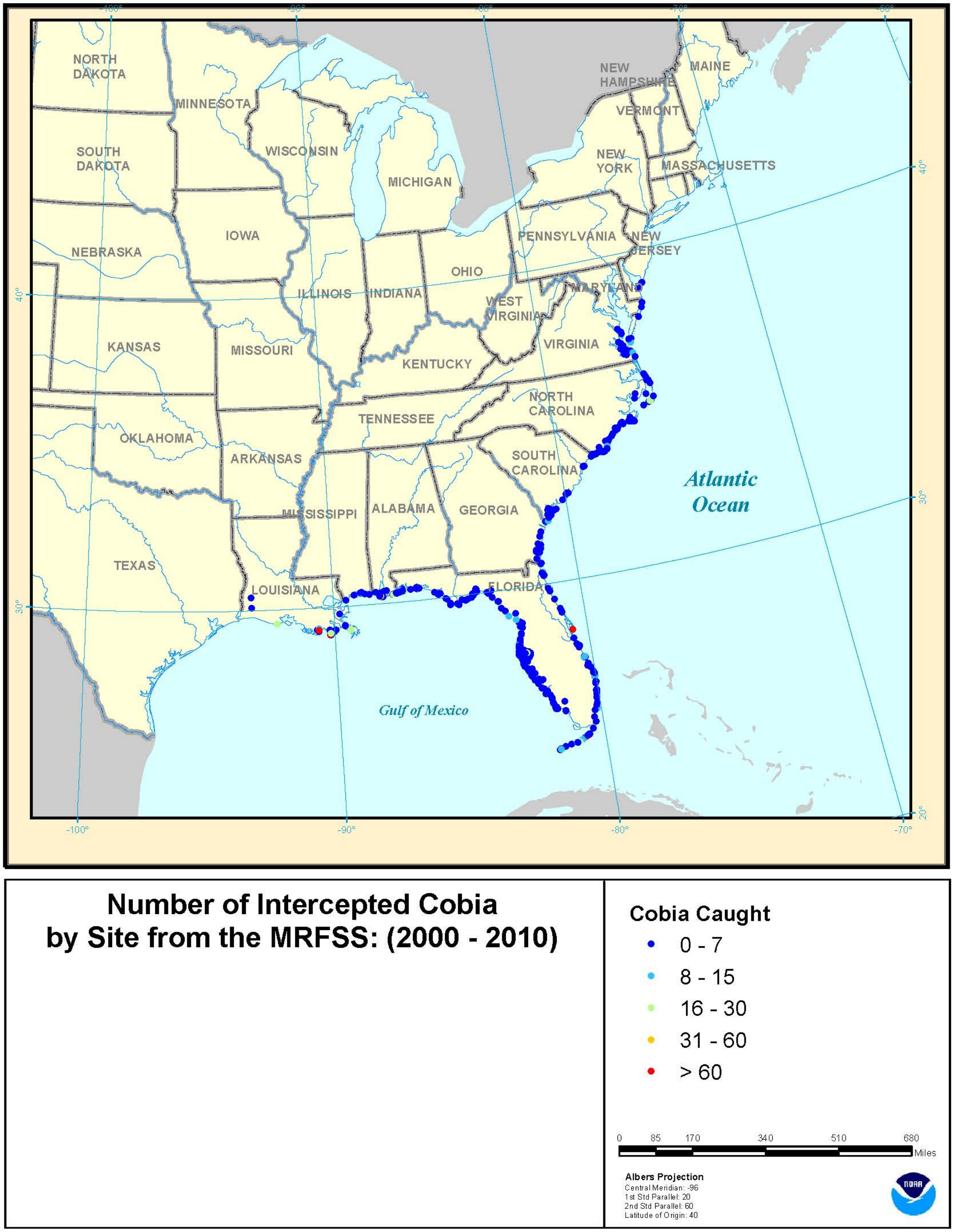

Figure 4.12.5. The number of cobia intercepted by the MRFSS from 2000-2010.

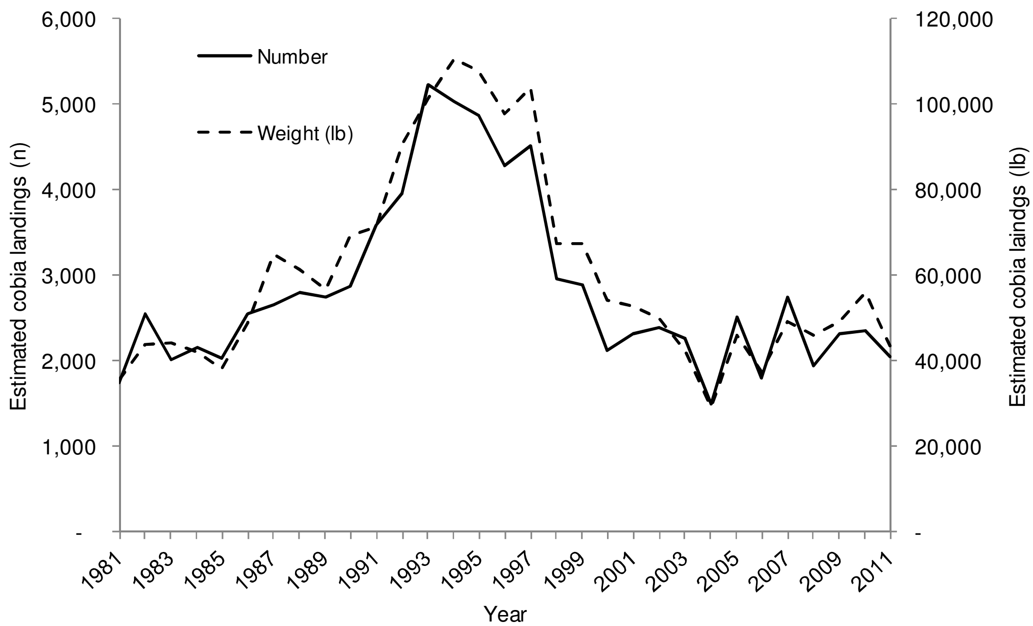

Figure 4.12.6. Gulf of Mexico estimated cobia landings (number and pounds) for the headboat fishery, 1981-2011.

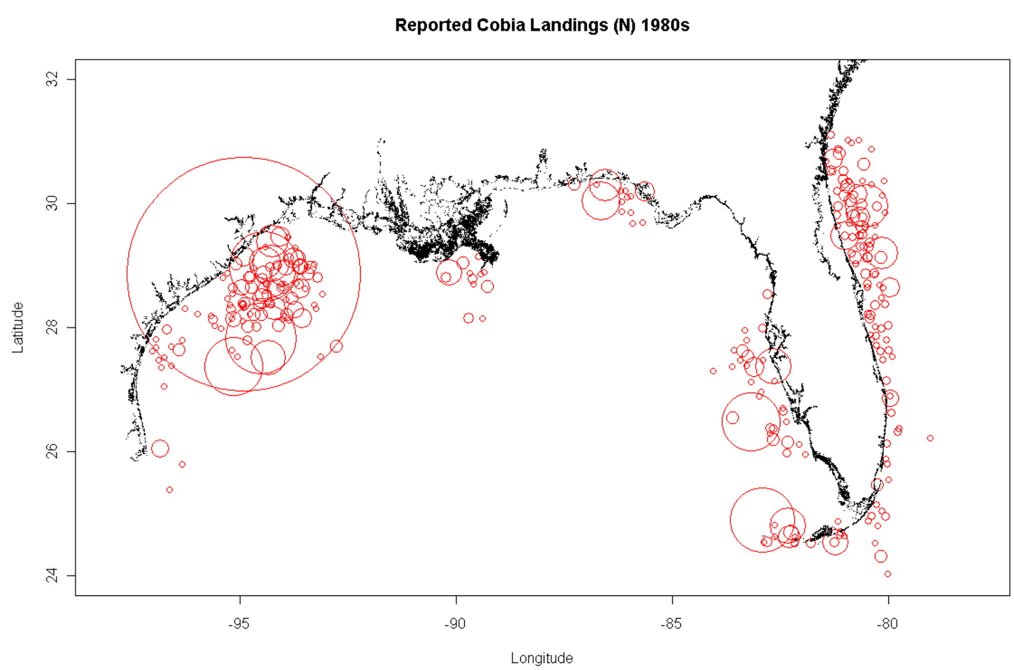

Figure 4.12.7. Reported cobia landings (numbers of fish) from SRHS, 1981-1989. The size of each point is proportional to the reported landings (N) at the given location.

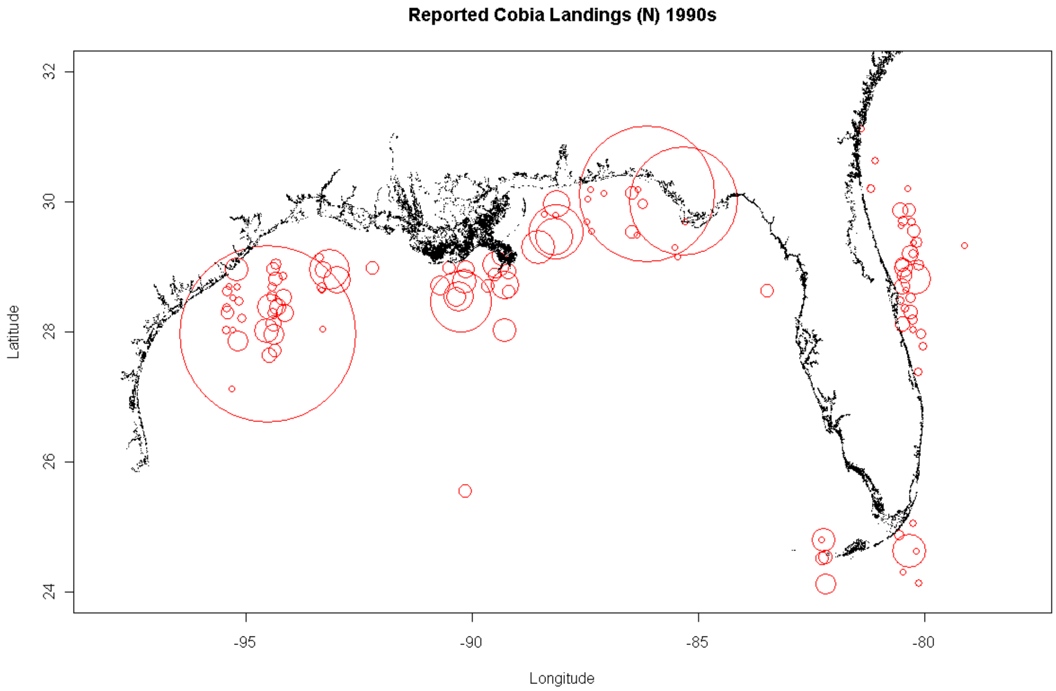

Figure 4.12.8. Reported cobia landings (numbers of fish) from SRHS, 1990-1999. The size of each point is proportional to the reported landings (N) at the given location.

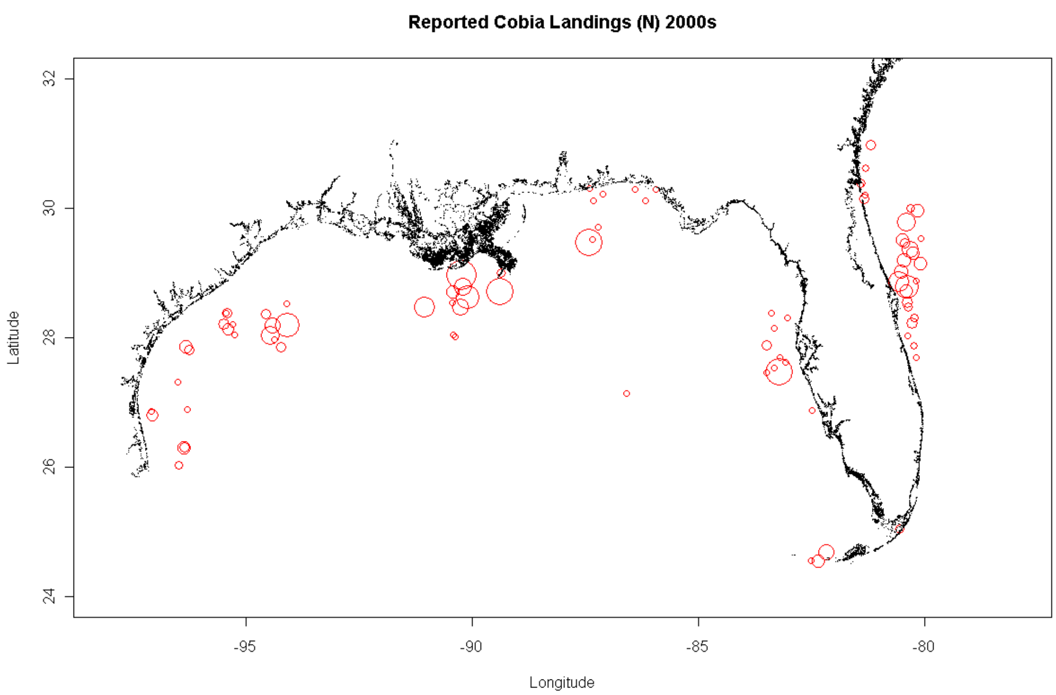

Figure 4.12.9. Reported cobia landings (numbers of fish) from SRHS, 2000-2011. The size of each point is proportional to the reported landings (N) at the given location.

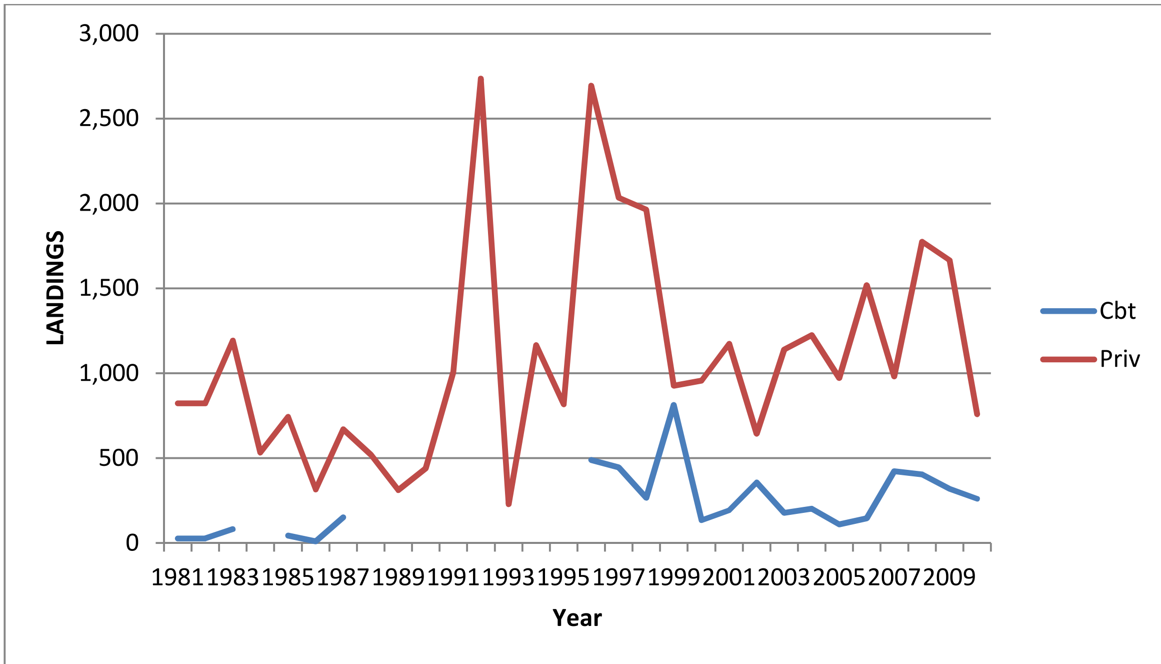

Figure 4.12.10 Texas cobia landings (numbers of fish) for charter boat mode and private mode (TPWD). 2011 data is through mid-May.

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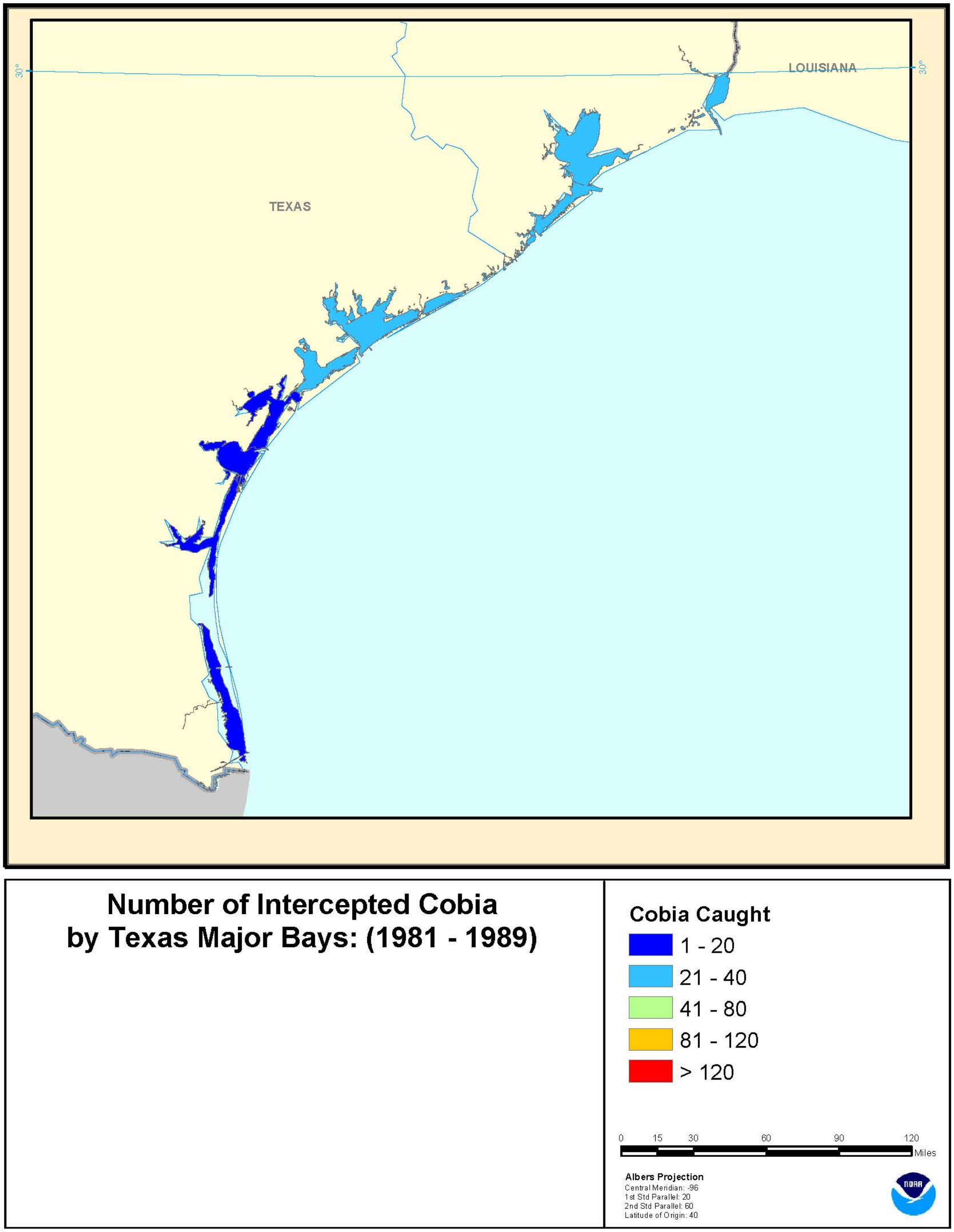

Figure 4.12.11. The number of cobia intercepted by the TPWD from 1983-1989.

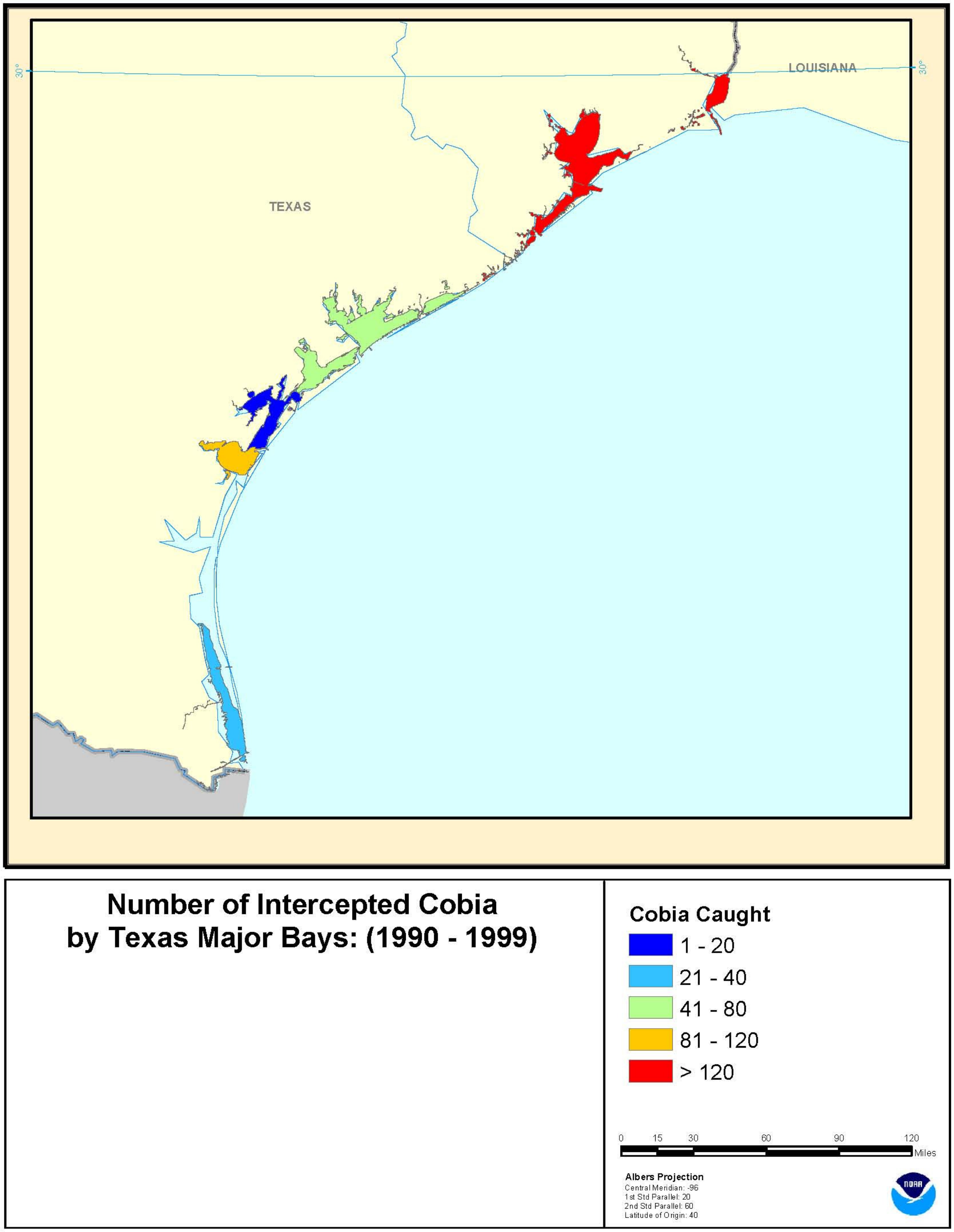

Figure 4.12.12. The number of cobia intercepted by the TPWD from 1990-1999.

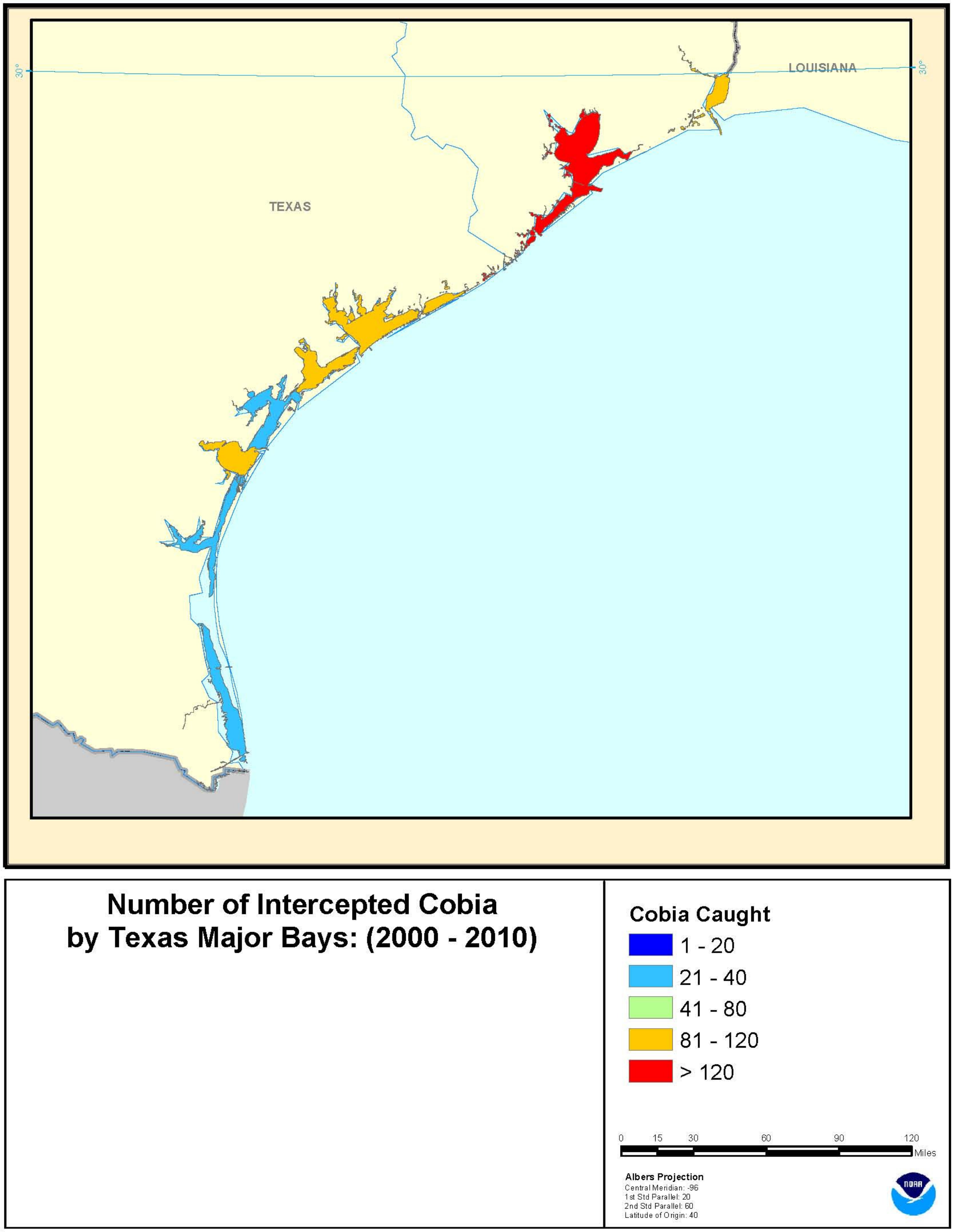

Figure 4.12.13. The number of cobia intercepted by the TPWD from 2000-2010.

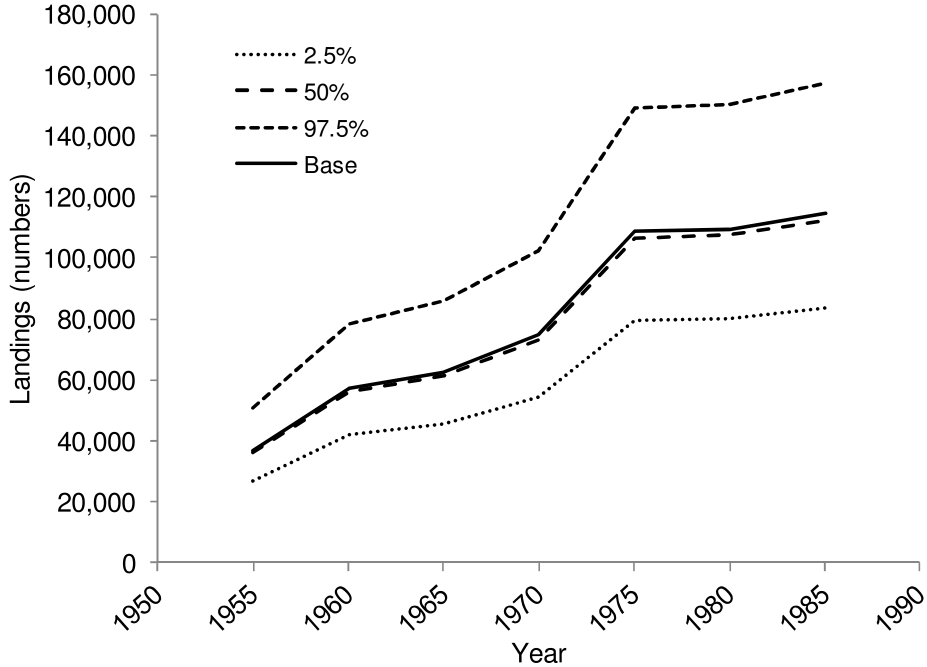

Figure 4.12.14. Bootstrap analysis of FHWAR census method (1955-1984) cobia landings estimates.

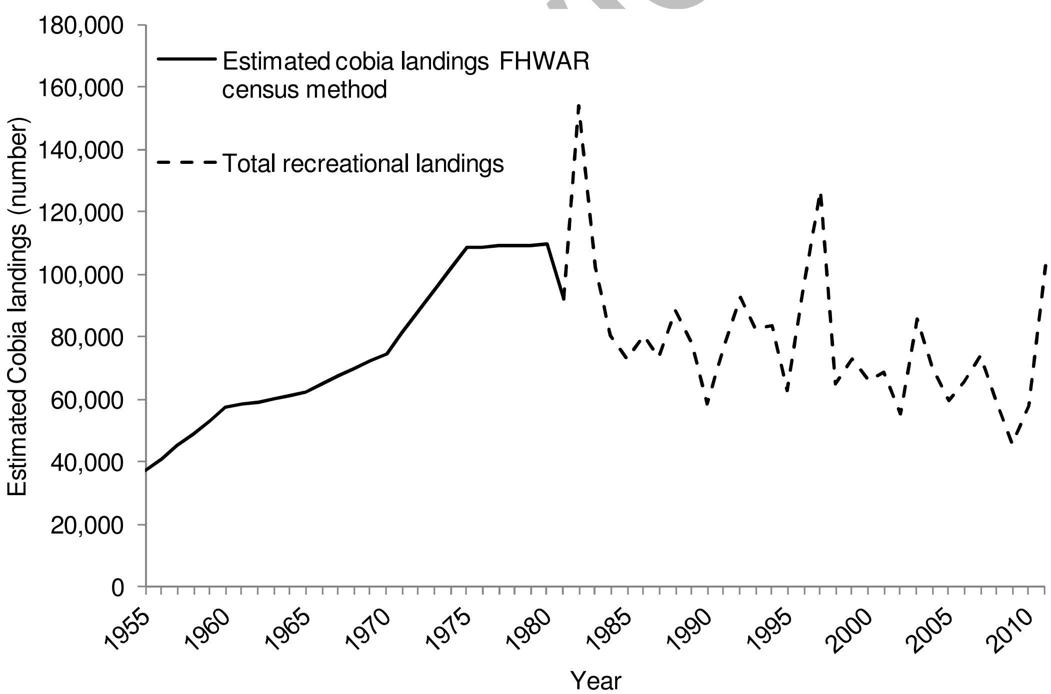

Figure 4.12.15. Estimated cobia landings (number) using FHWAR census method (1955-1980), MRFSS (1981-2003), MRIP (2004-2011), TPWD (81-11), and SRHS (81-11) estimation methods.

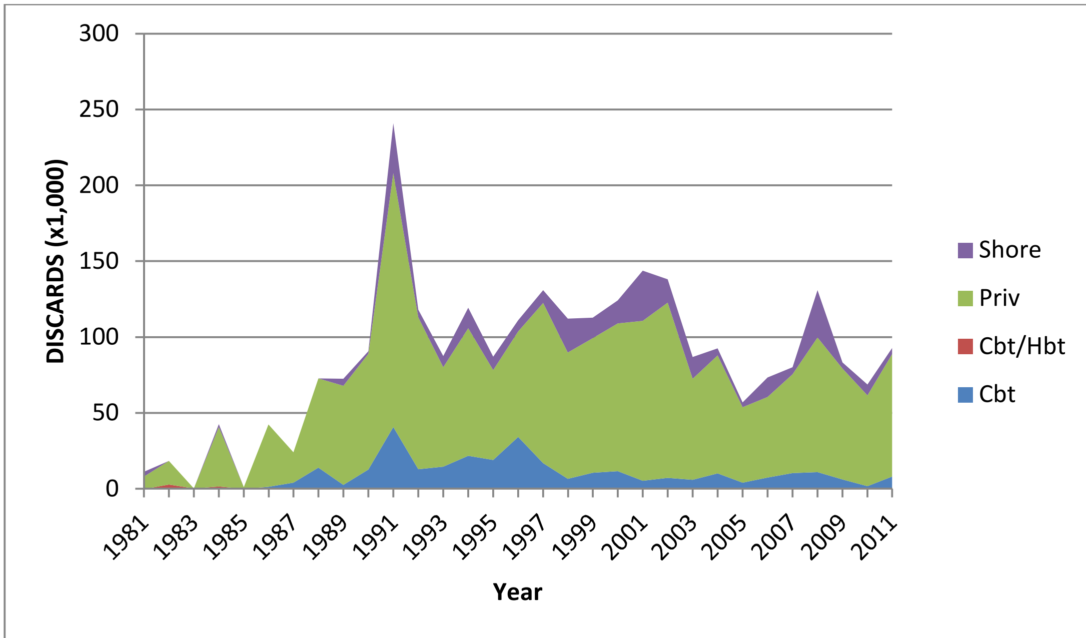

Figure 4.12.16. Gulf of Mexico (FLE-TX) cobia discards (numbers of fish) by year and mode (MRFSS, NMFS, 1981-2003; MRIP, NMFS, 2004-2011). 2011 data is preliminary and through October. TX estimates for 1981-1985 shore mode only.

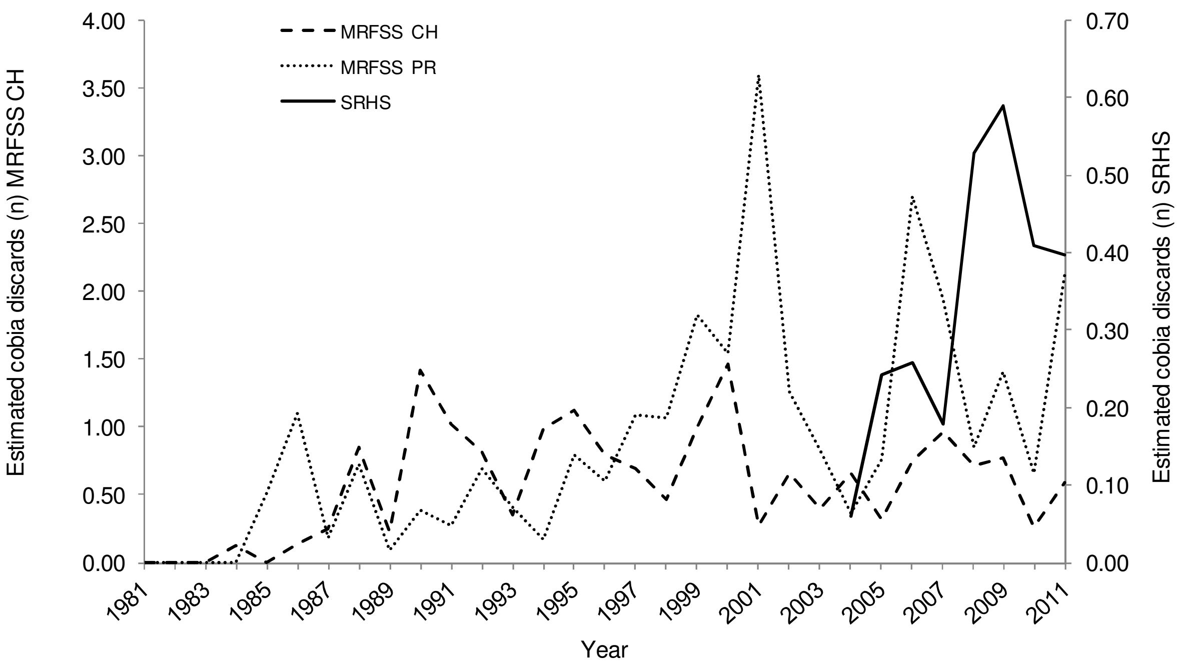

Figure 4.12.17. Percentage of cobia discards in the recreational fishery, 1981-2011.

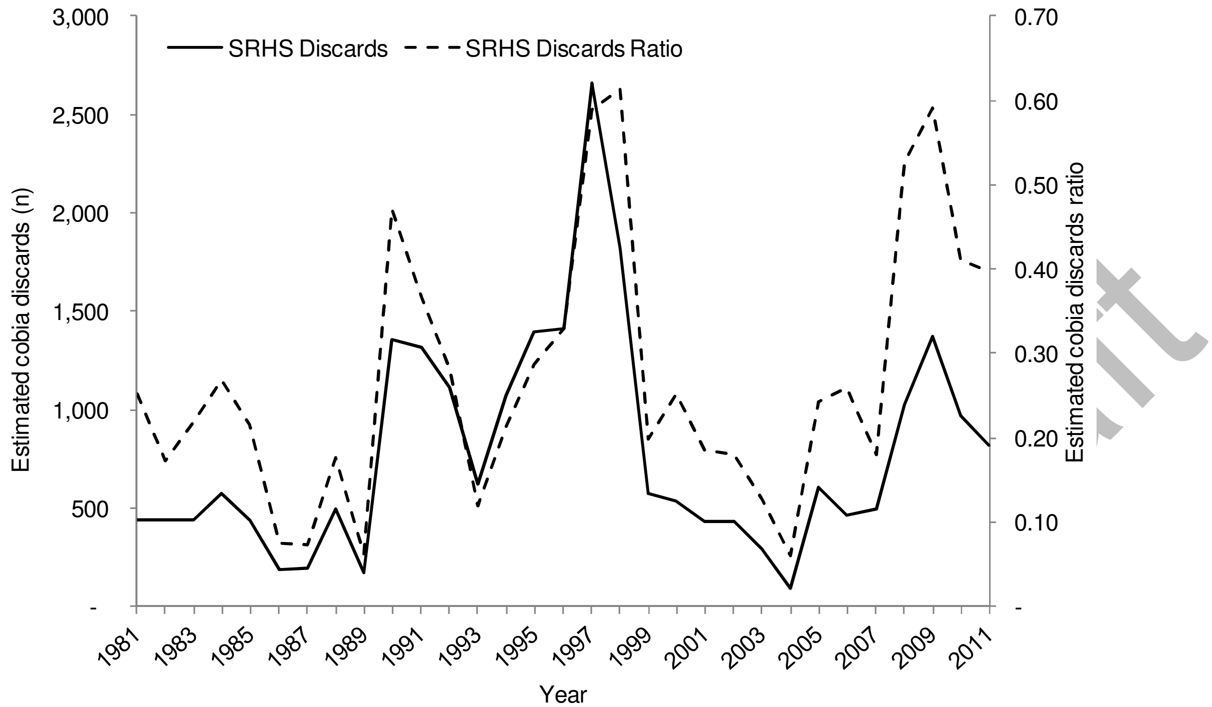

Figure 4.12.18. Gulf of Mexico estimated cobia discards and discard ratio for the headboat fishery (MRFSS proxy 1981-2003; SRHS 2004-2011).

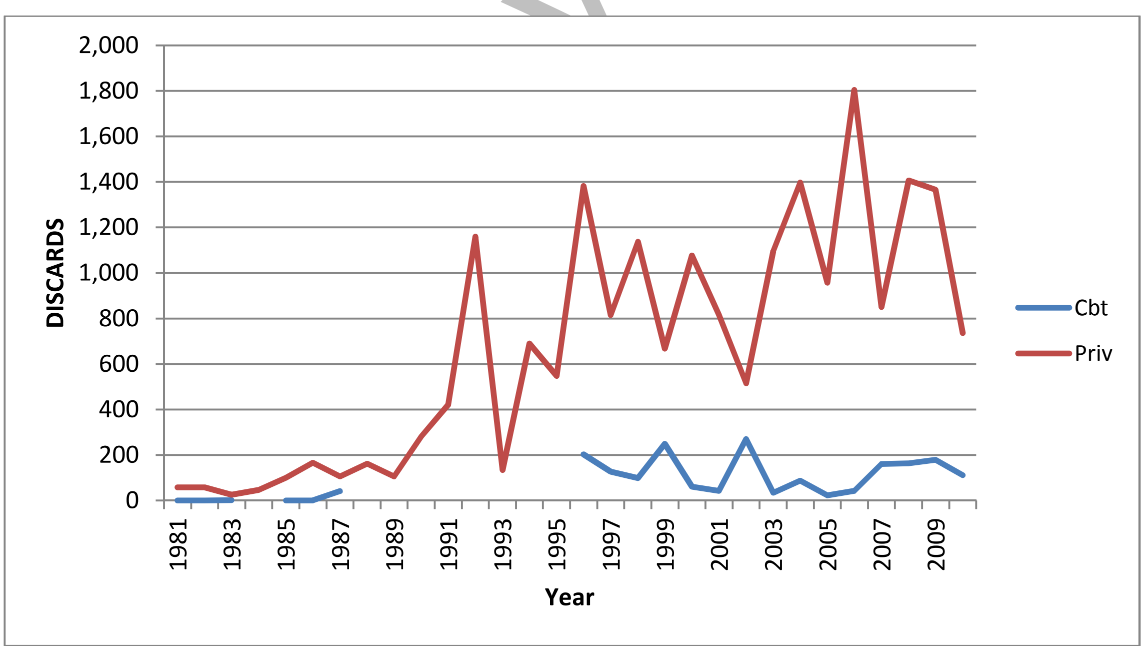

Figure 4.12.19 Texas cobia discards (numbers of fish) for charter boat mode and private mode (TPWD). 2011 data is through mid-May.

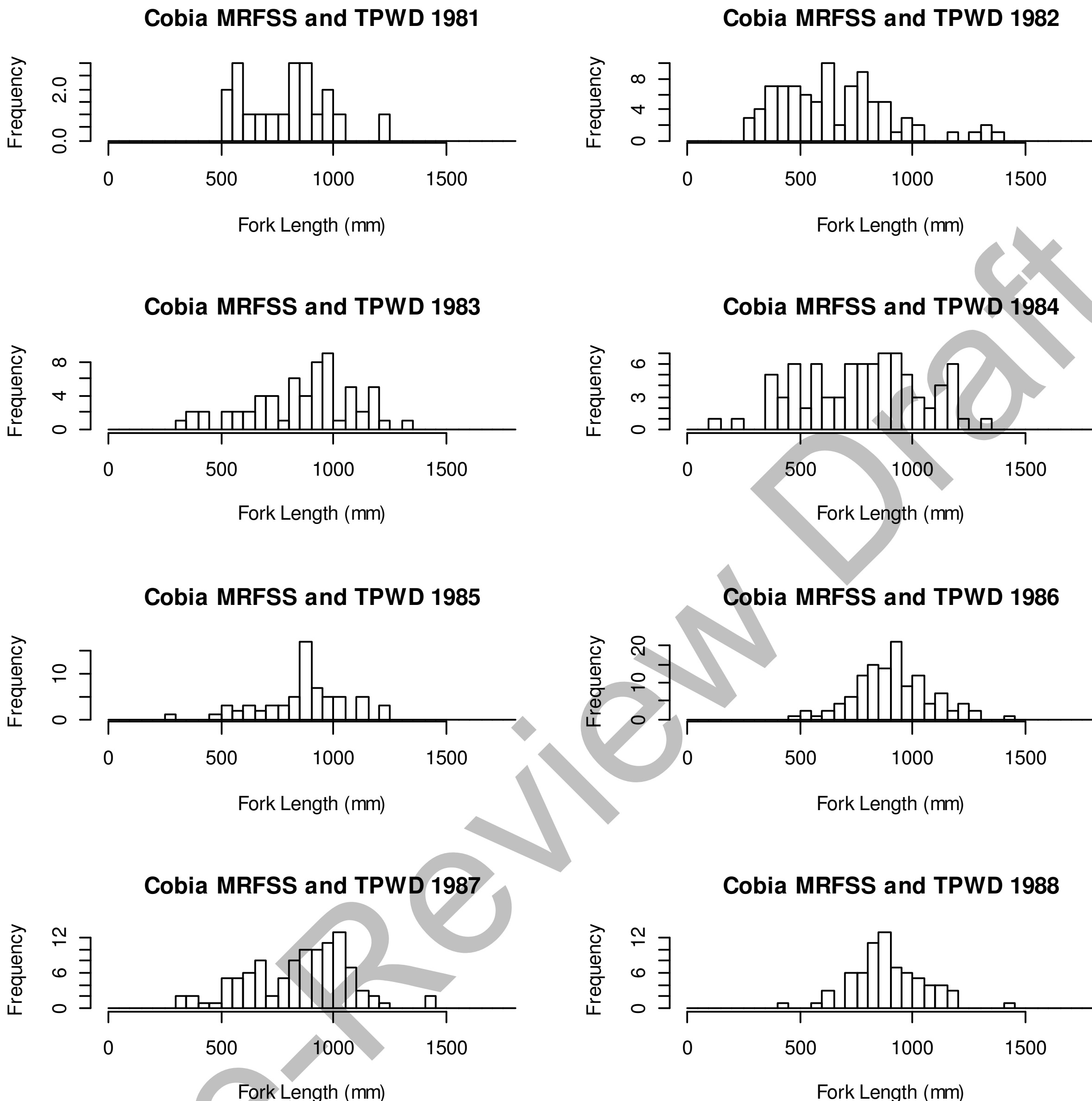

Figure 4.12.20. Length composition from the MRFSS (1981-2011) and TPWD (1983-2011).

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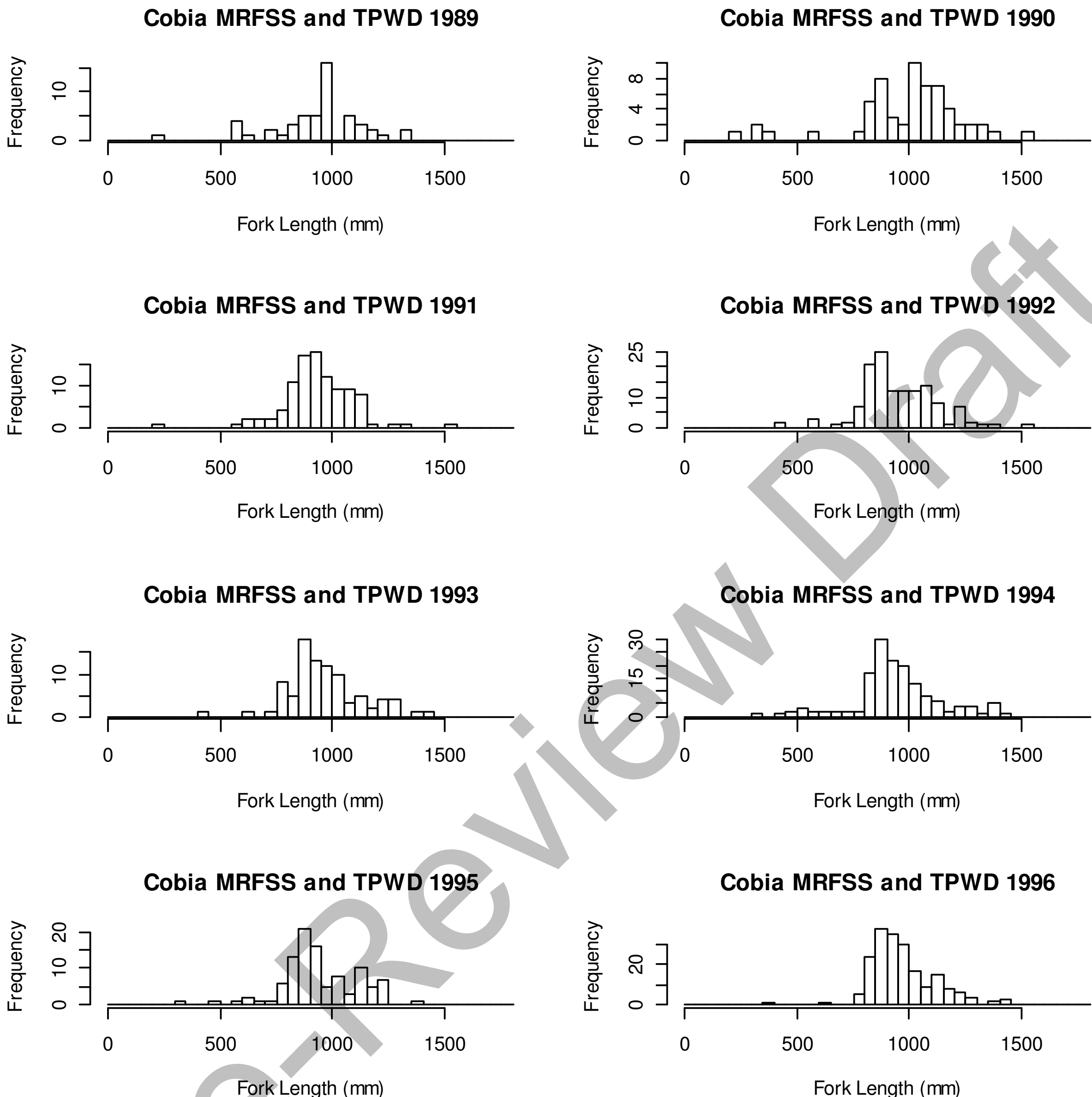

Figure 4.12.20. Length composition from the MRFSS (1981-2011) and TPWD (1983-2011) (continued).

Pre-Review Draft

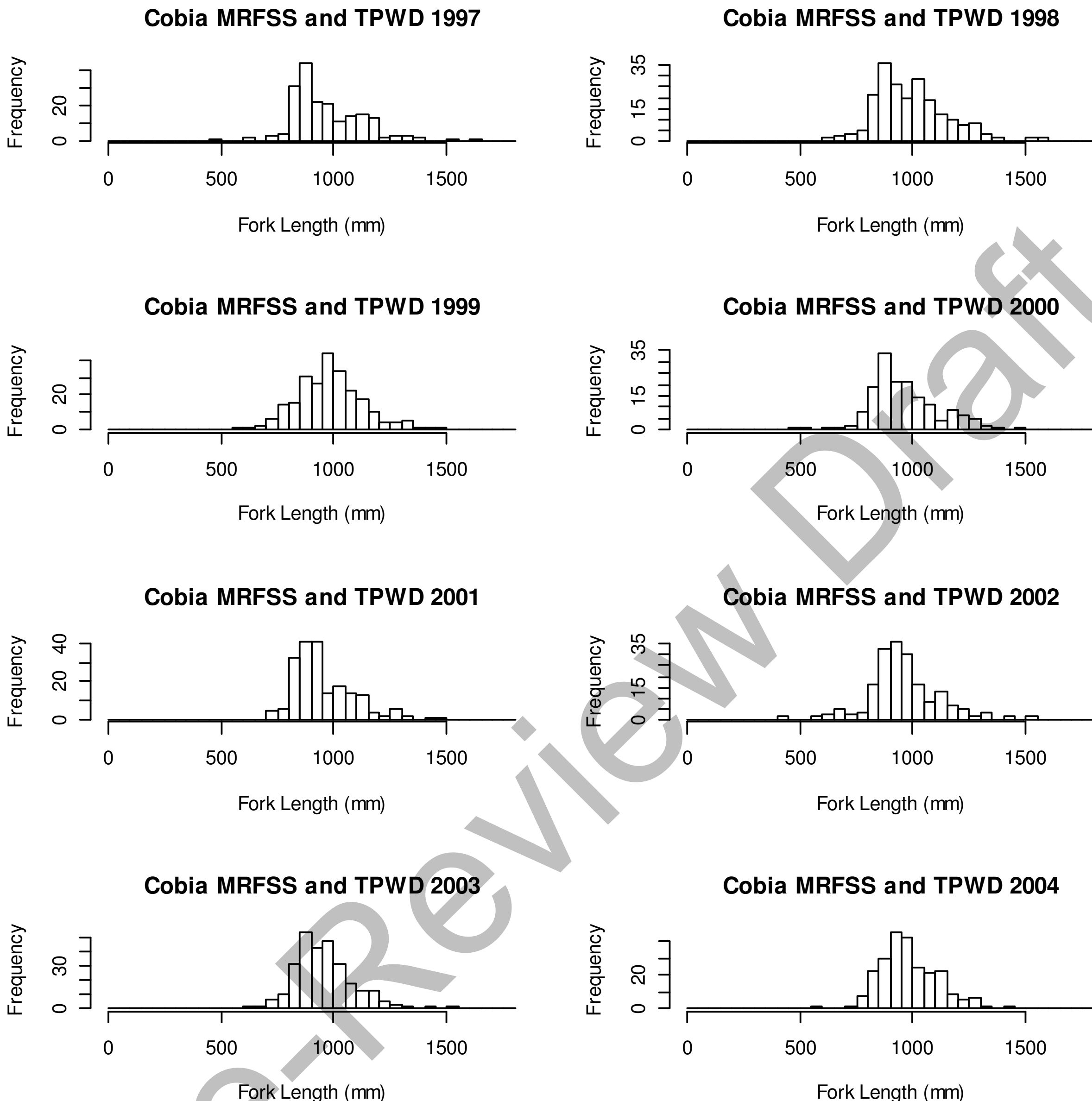

Figure 4.12.20. Length composition from the MRFSS (1981-2011) and TPWD (1983-2011) (continued).

Pre-Review Draft

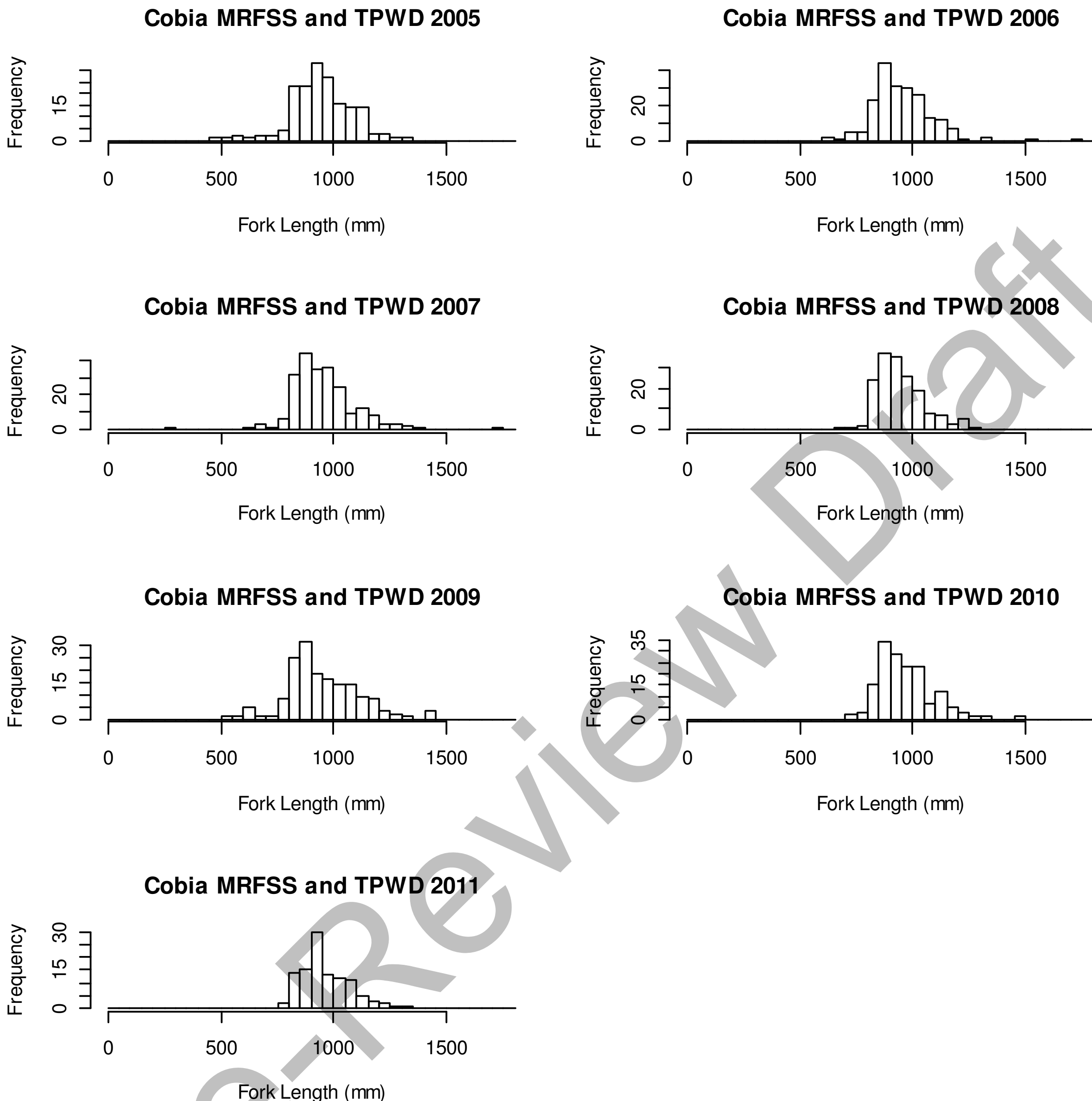

Figure 4.12.20. Length composition from the MRFSS (1981-2011) and TPWD (1983-2011) (continued).

Pre-Review Draft

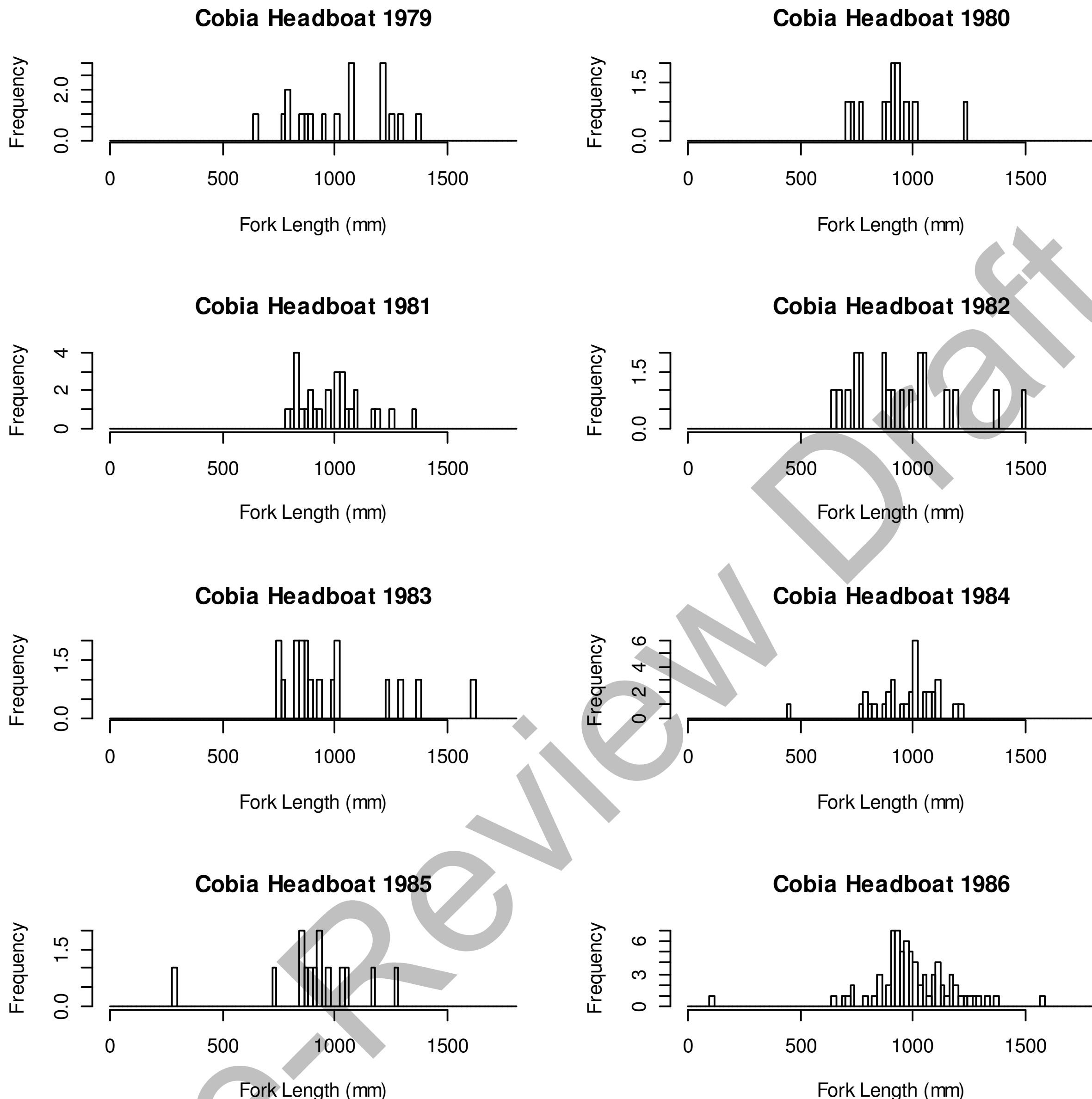

Figure 4.12.21. Headboat length composition 1979-2011 (1979-1985 lengths from East Florida).

Pre-Review Draft

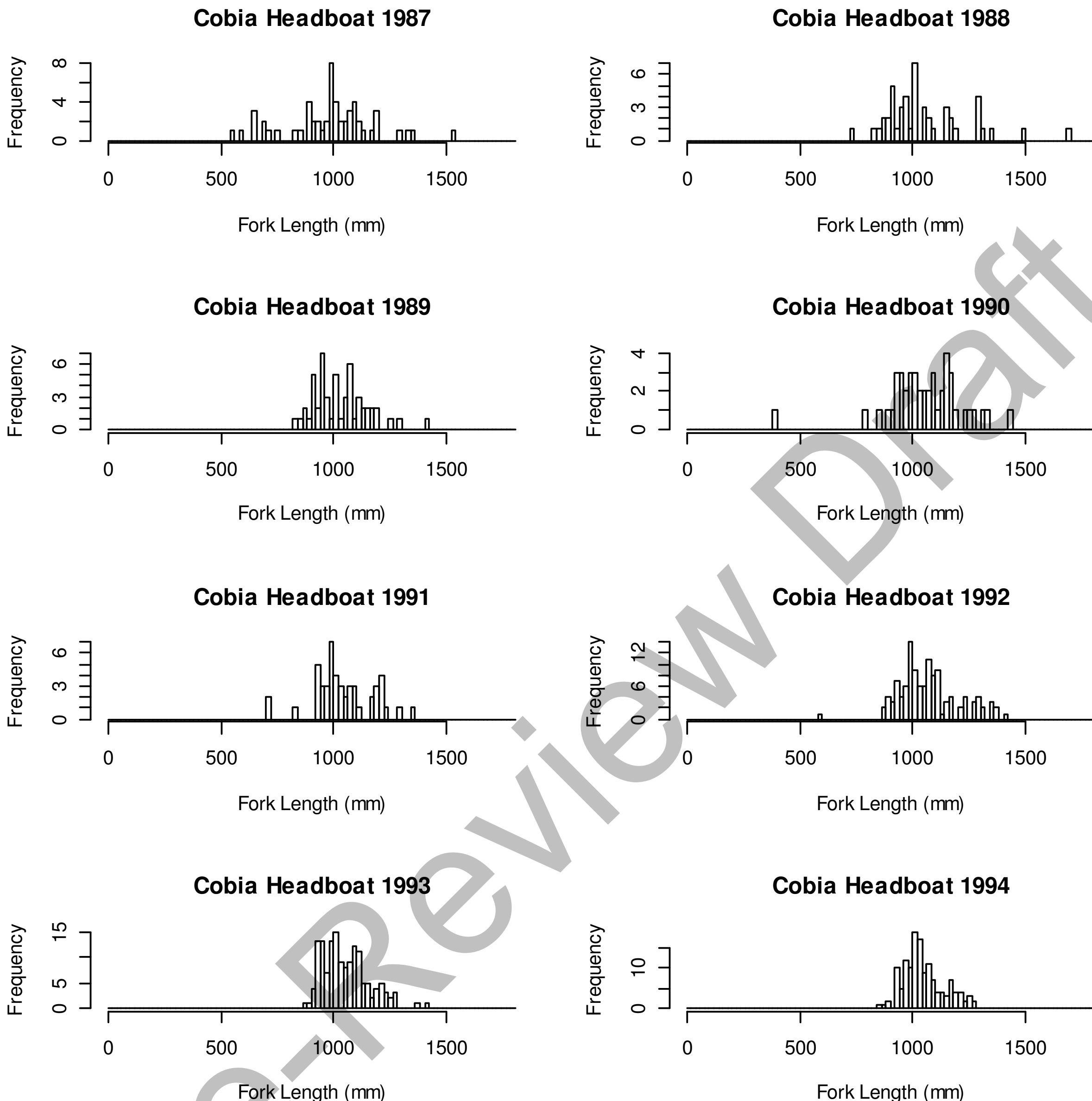

Figure 4.12.21. Headboat length composition 1979-2011 (1979-1985 lengths from East Florida). (Continued).

Pre-Review Draft

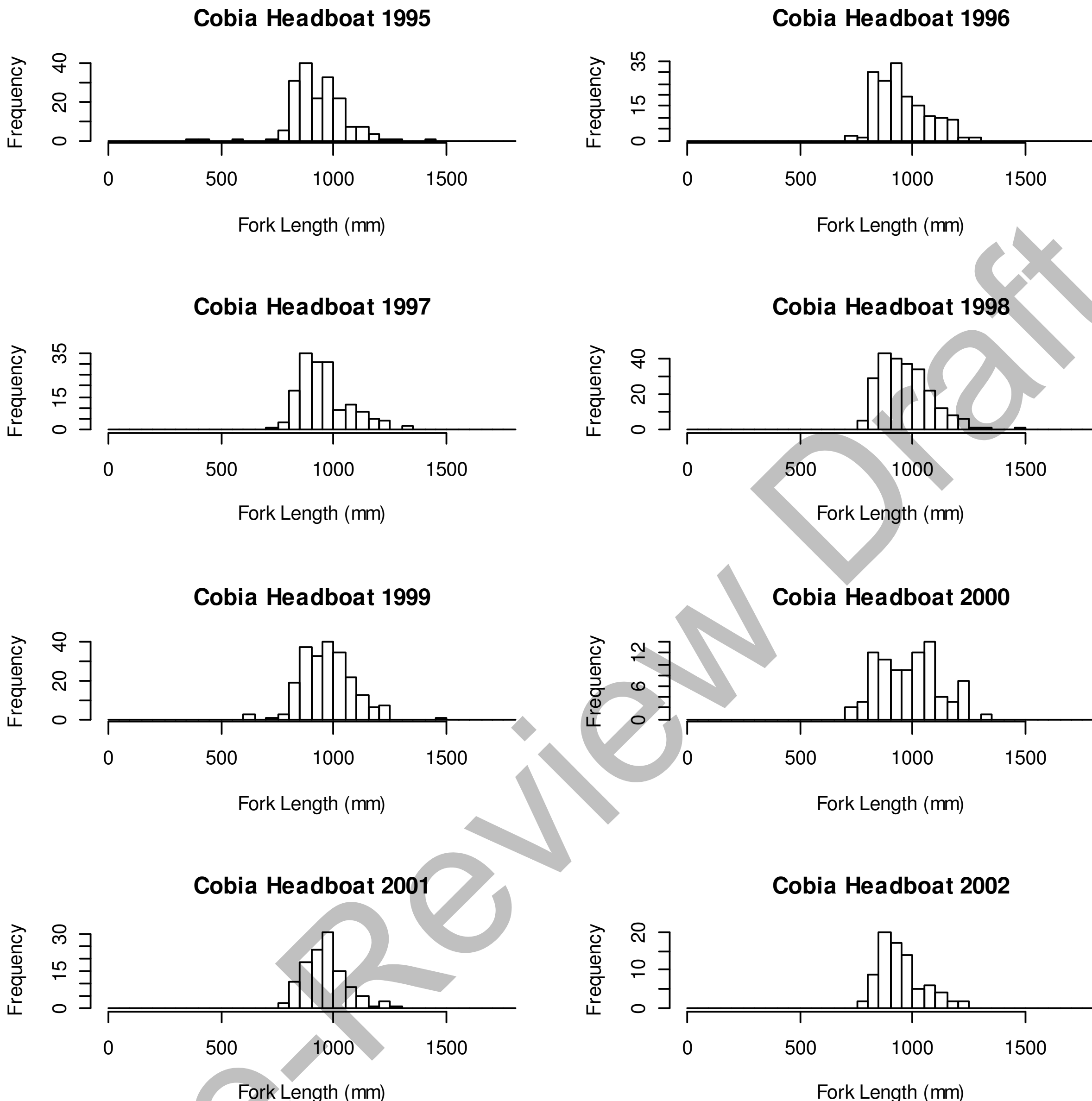

Figure 4.12.21. Headboat length composition 1979-2011 (1979-1985 lengths from East Florida). (Continued).

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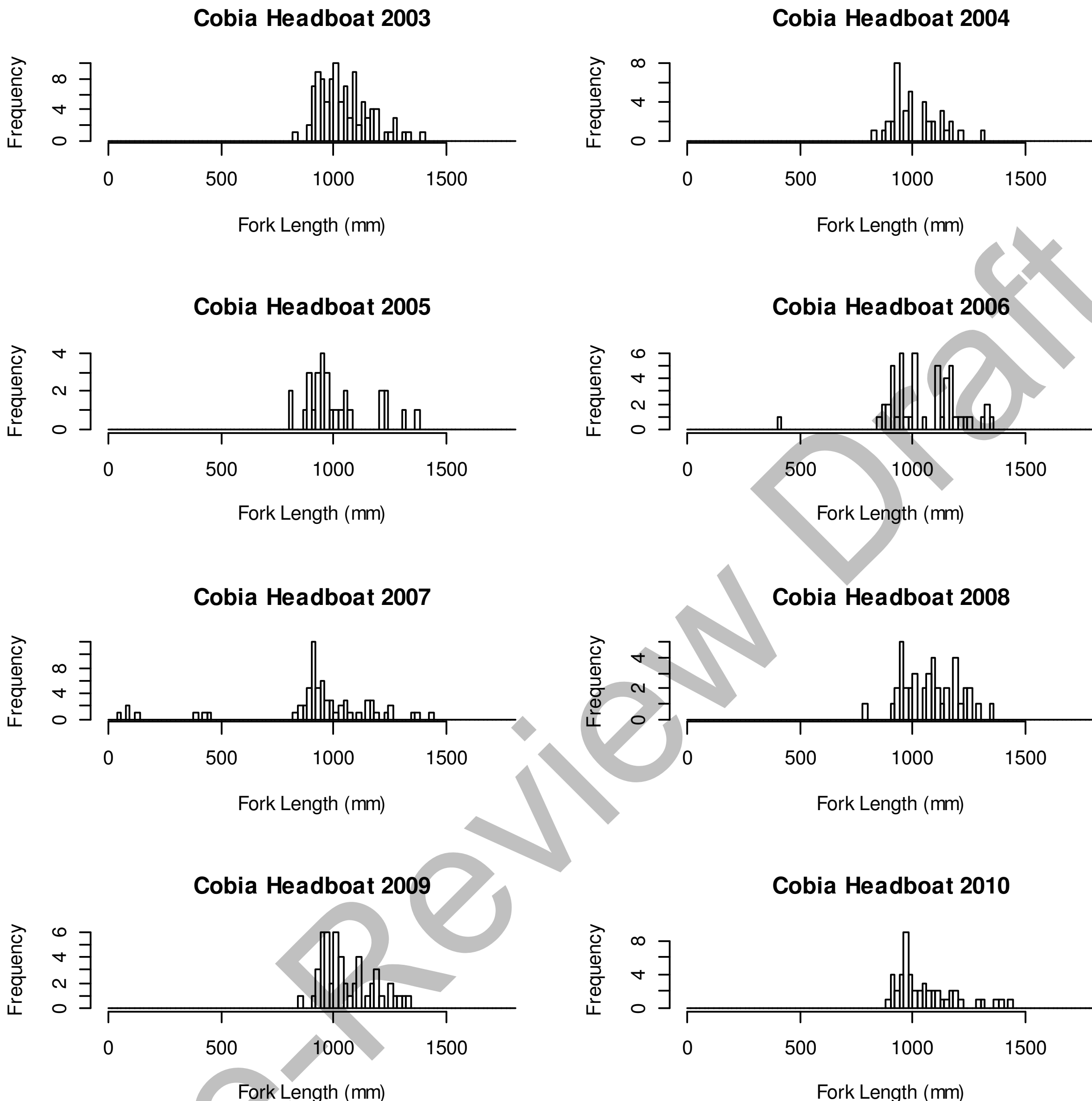

Figure 4.12.21. Headboat length composition 1979-2011 (1979-1985 lengths from East Florida). (Continued).

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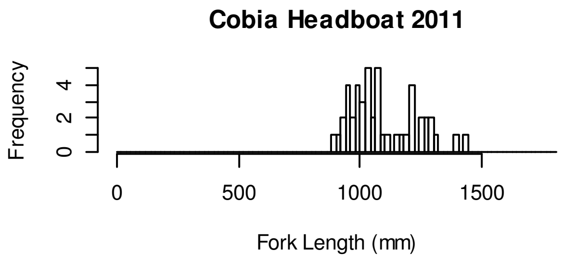

Figure 4.12.21. Headboat length composition 1979-2011 (1979-1985 lengths from East Florida). (Continued).

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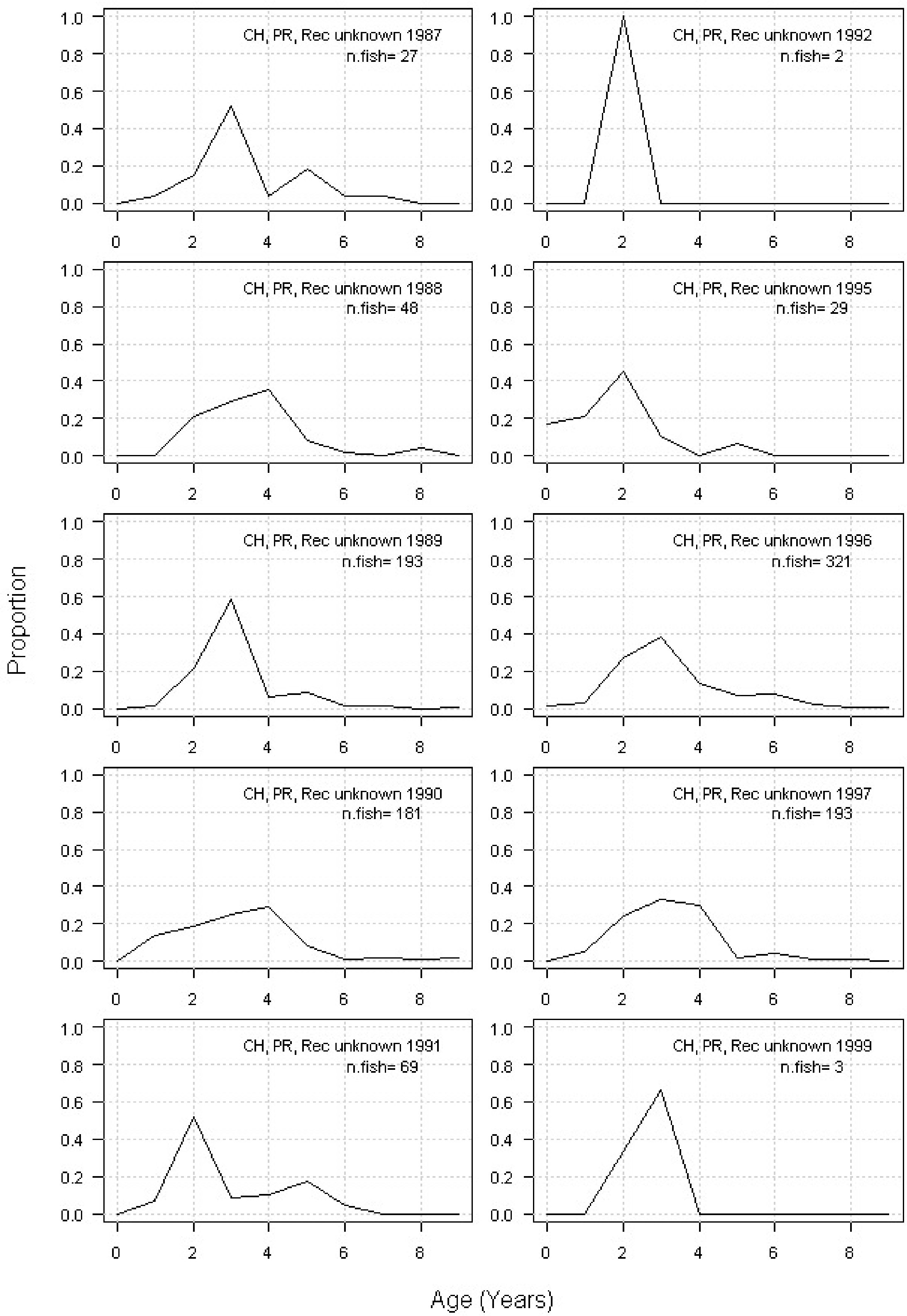

Figure 4.12.22. Age composition of cobia from the charter boat, private/rental boat, recreational fishery (mode unknown) (1987-1992, 1995-1999, 2004-2010).

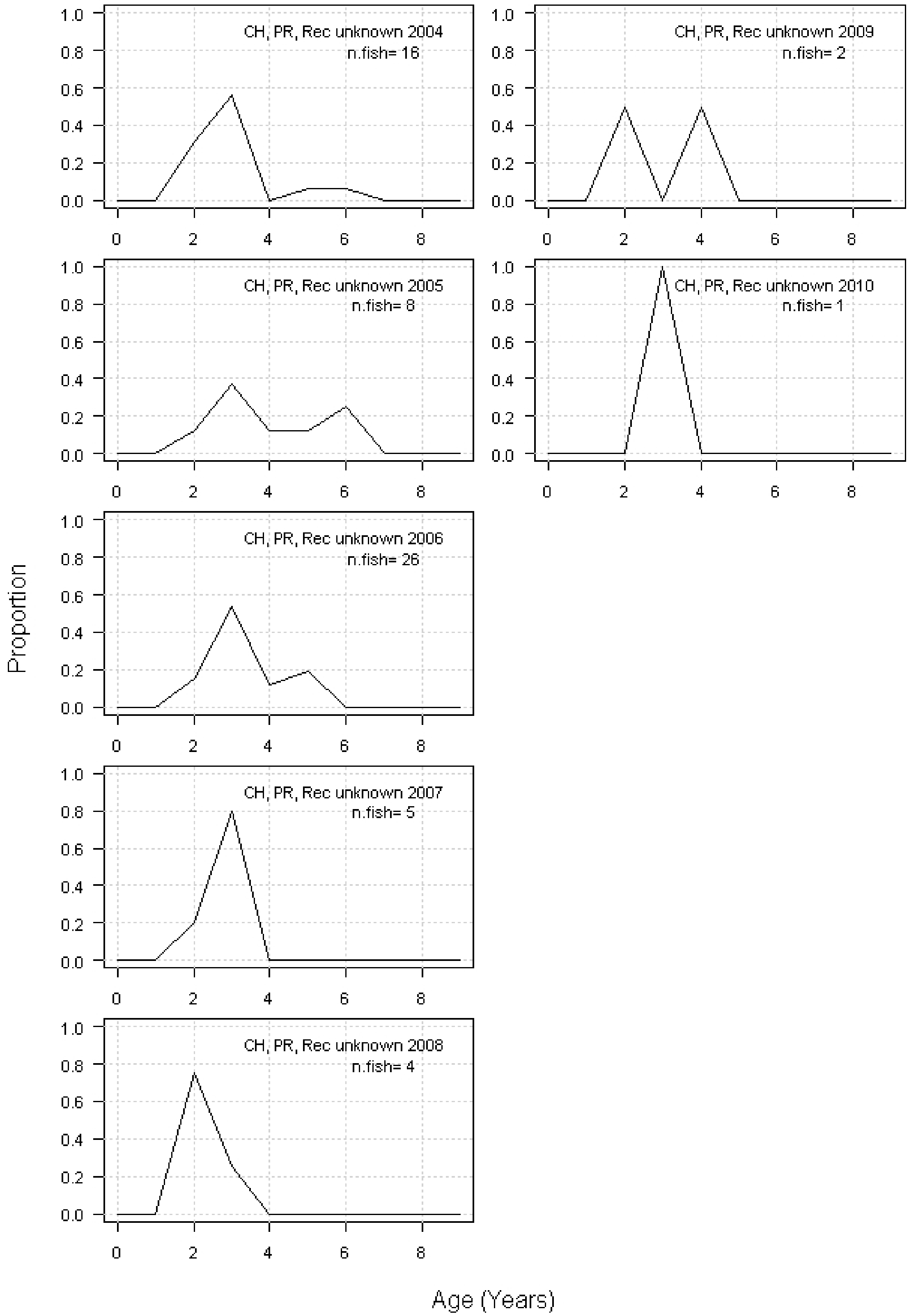

Figure 4.12.22. Age composition of cobia from the charter boat, private/rental boat, recreational fishery (mode unknown) (1987-1992, 1995-1999, 2004-2010) (continued).

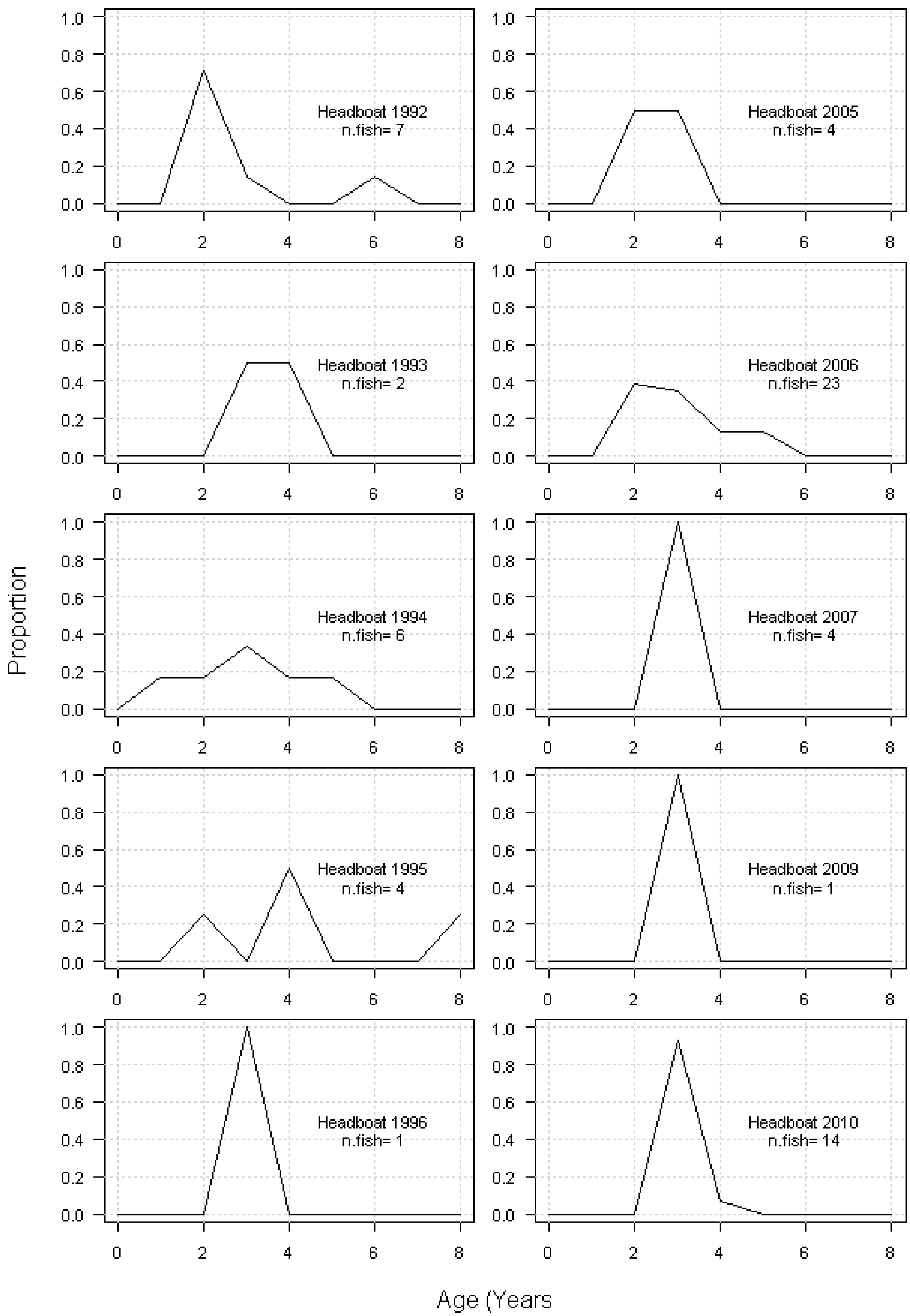

Figure 4.12.23. Age composition of cobia from the headboat fishery (1992-1996, 2005-2007, 2009-2011).

Figure 4.12.23. Age composition of cobia from the headboat fishery (1992-1996, 2005-2007, 2009-2011) (continued).

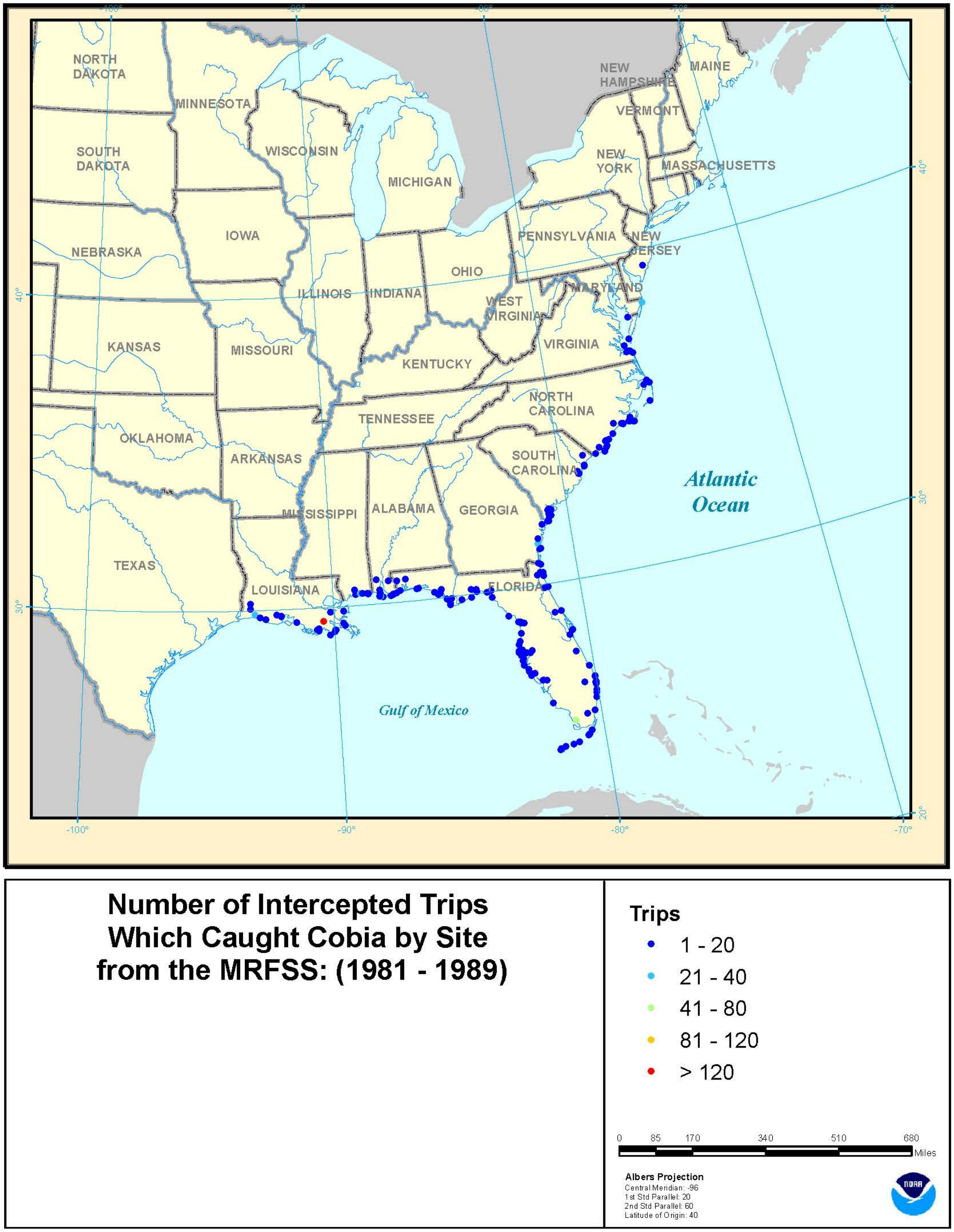

Figure 4.12.24. The number MRFSS intercepted trips which caught cobia from 1981-1989.

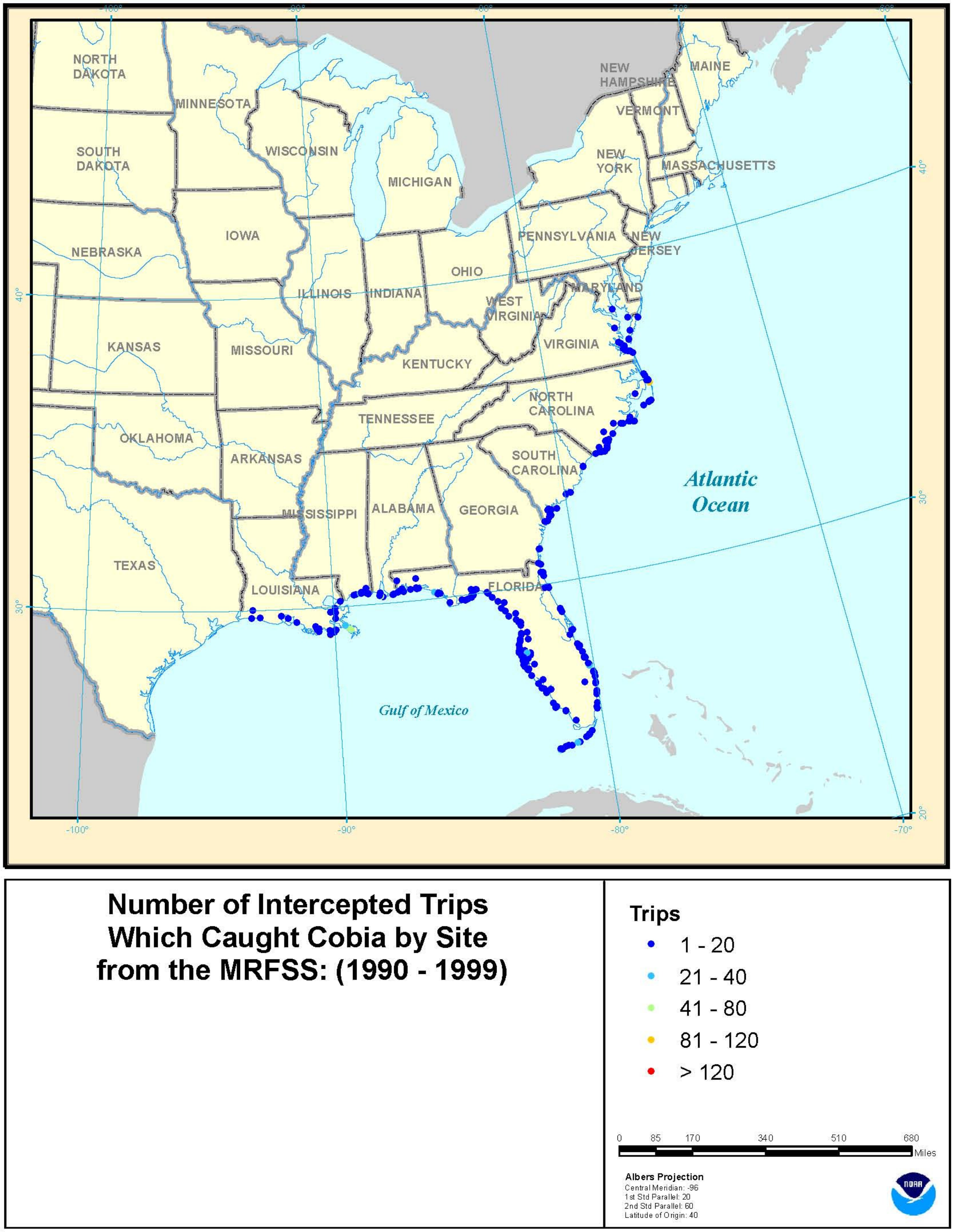

Figure 4.12.25. The number MRFSS intercepted trips which caught cobia from 1990-1999.

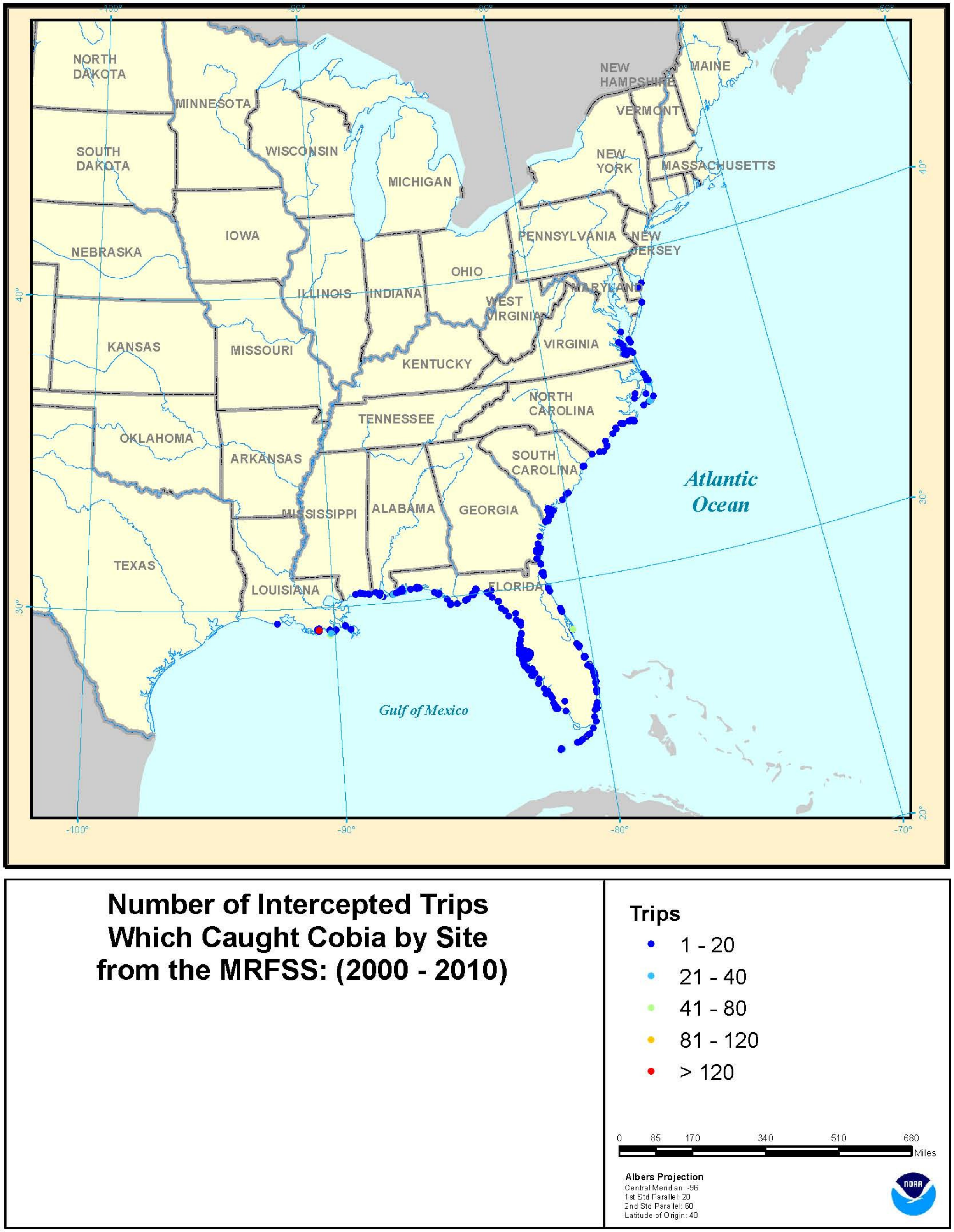

Figure 4.12.26. The number MRFSS intercepted trips which caught cobia from 2000-2010.

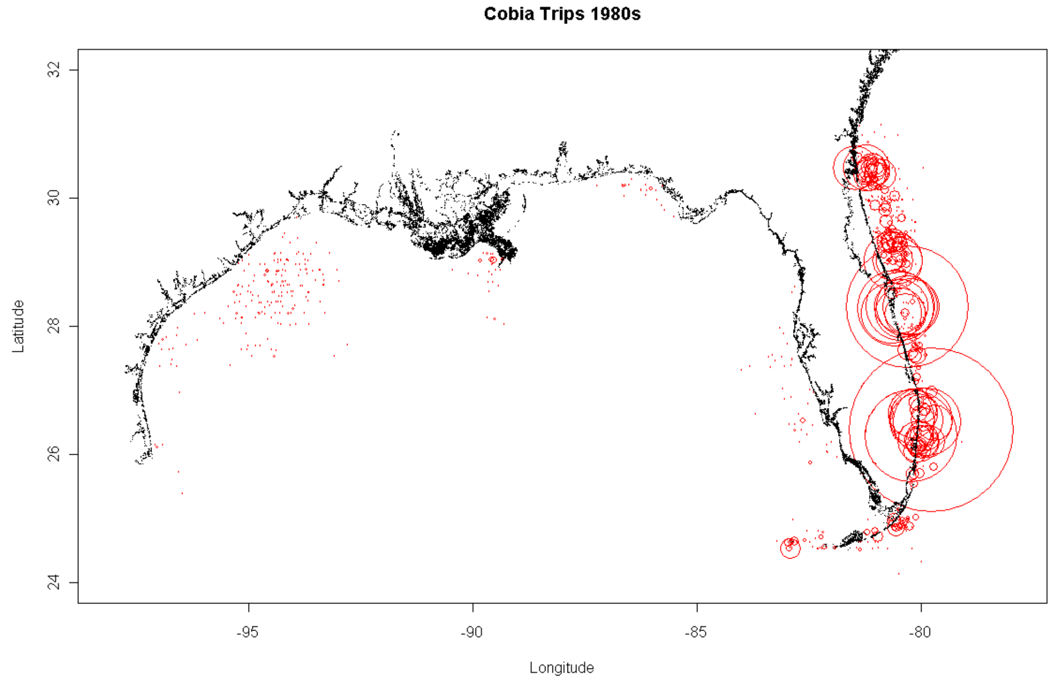

Figure 4.12.27. Reported cobia trips in the Gulf of Mexico from the SRHS, 1981-1989. The size of each point is proportional to the frequency of reported trips at the given location.

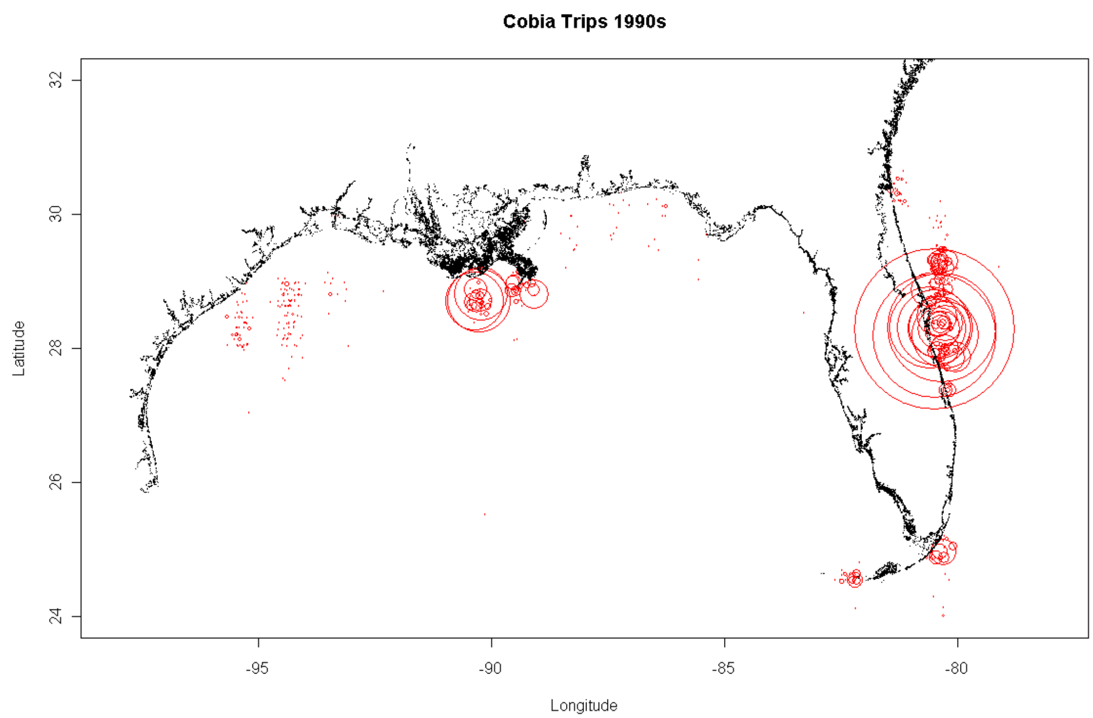

Figure 4.12.28. Reported cobia trips in the Gulf of Mexico from the SRHS, 1990-1999. The size of each point is proportional to the frequency of reported trips at the given location.

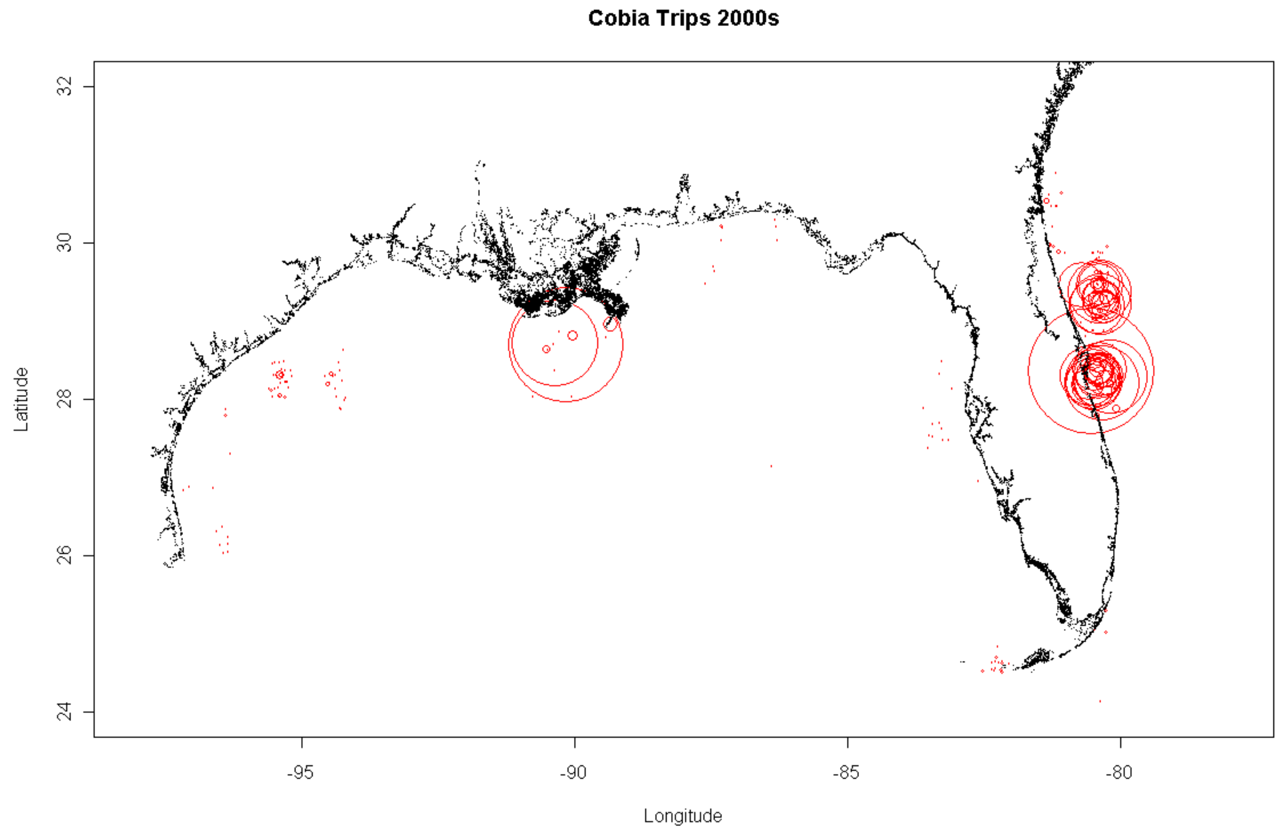

Figure 4.12.29. Reported cobia trips in the Gulf of Mexico from the SRHS, 2000-2011. The size of each point is proportional to the frequency of reported trips at the given location.

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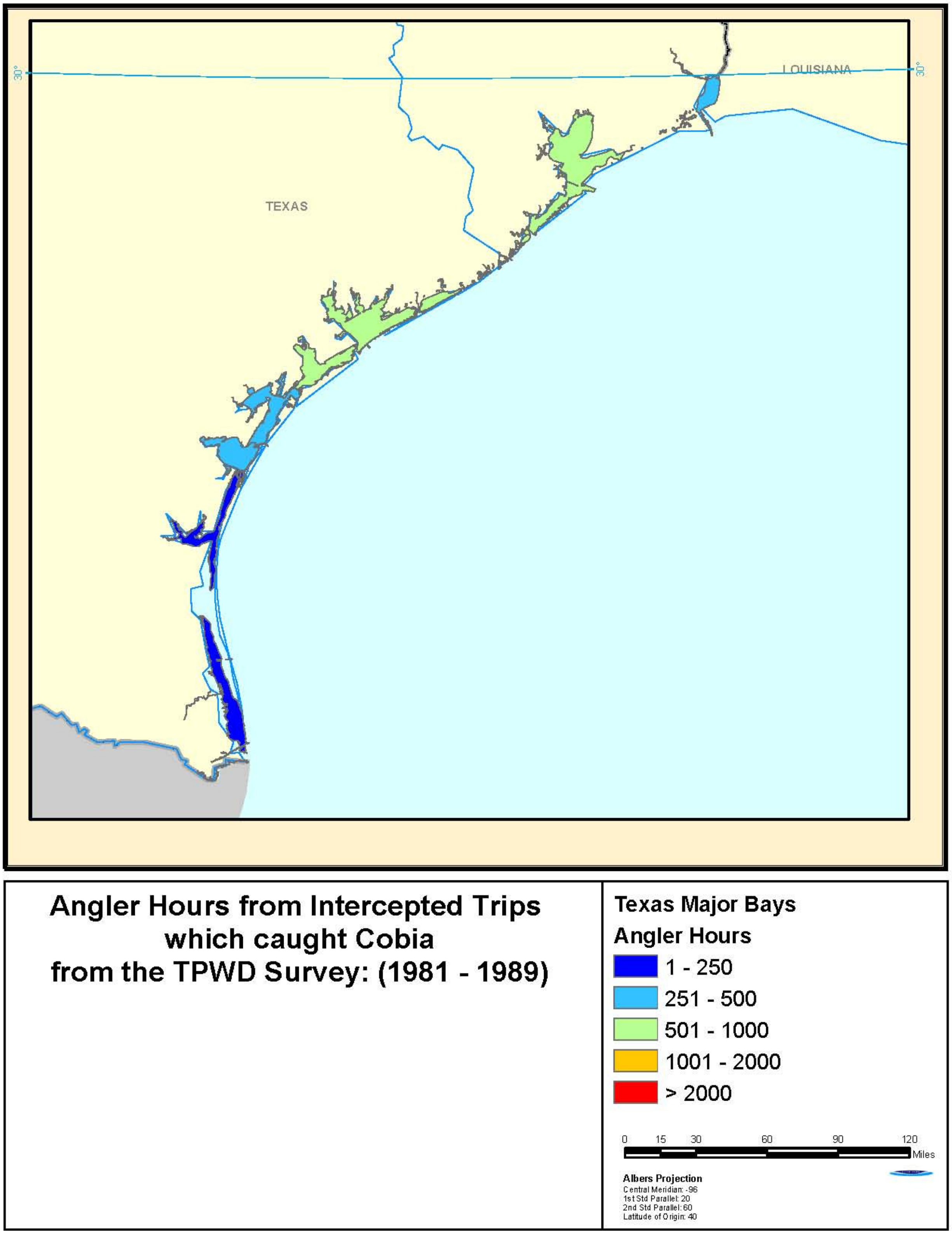

Figure 4.12.30 Angler hours from trips which intercepted cobia in the TPWD, 1983-1989.

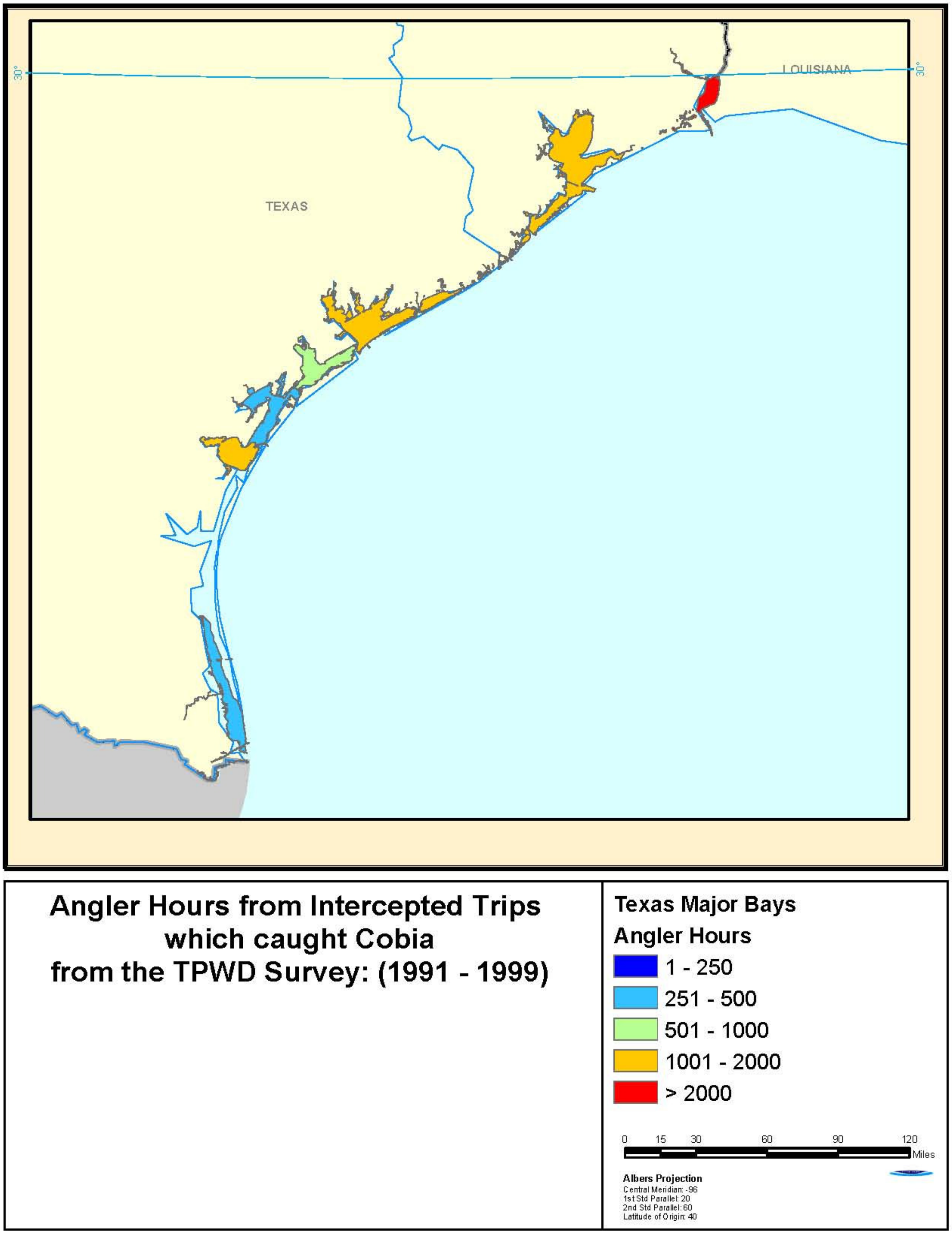

Figure 4.12.31 Angler hours from trips which intercepted cobia in the TPWD, 1990-1999.

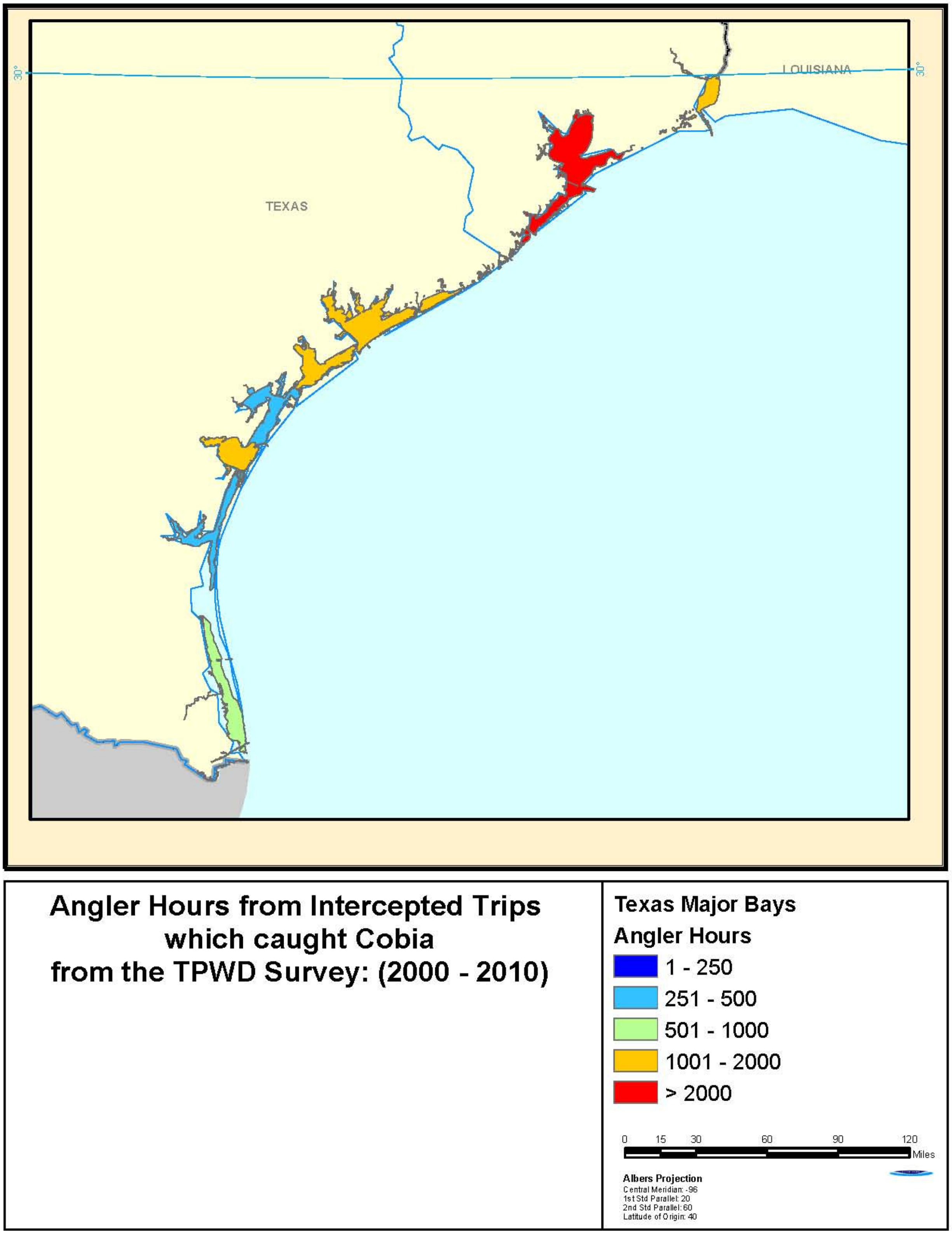

Figure 4.12.32 Angler hours from trips which intercepted cobia in the TPWD, 2000-2010.

5 Measures of Population Abundance

5.1 Overview

Analytical results of five data sets were presented to the Index Working Group (IWG). Four of the data sets were of fishery-dependent origin and one was of fishery-independent origin.

- Texas sport boat angler survey (*Not recommended for use*)
- SEAMAP groundfish survey (*Not recommended for use*)
- Commercial logbooks – handline/trolling (*Not recommended for use*)
- Headboat (*Recommended for use*)
- MRFSS (*Recommended for use*)

At the final plenary it was noted that the two indices recommended for potential use would be considered the same rank when prioritizing for use in the stock assessment. 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, as well as other DW participants as needed for discussions throughout the week.

5.2 Review of Working Papers

Not provided.

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 the index for Cobia requested by the IWG. Initially, the authors did not provide an index for cobia based on the low frequency of occurrence. The indices group requested an attempt at the development of abundance indices of cobia using the zero-inflated delta-lognormal method of Ingram et al. (2010). The results of that model run are listed in Table 5.3.1.1. Ultimately, the index was not recommended for use in the GOM cobia stock assessment due to the low number of cobia collected each year during the surveys.

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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 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 cobia (*Rachycentrum cendrum*) 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 during 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 of anglers x triplength).

The development of the CPUE index was described in more detail in SEDAR28-DW10. The appendix to the working paper describes decisions made by the SEDAR 28 DW panel with updated tables and figures. The SEDAR 28 DW IWG decisions are summarized in SEDAR28-DW10 (Appendix 1).

5.4.1.1 Methods of Estimation

Data Filtering Techniques

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

Stephens & MacCall

First the Stephens and MacCall (2004) method was explored in an attempt to identify directed cobia 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, cobia in this case) could occur. The analysis involves fitting a logistic regression to the 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 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 cobia targeting preference. The species that occurred in at least 1% of all the trips were TPWD species codes: 614, 629, 616, 625, 613,

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602, 621, 772, 758, 818, 611, and 681. Cobia did not occur on at least 1% of all the trips but was included in the list. These species were then included in the logistic regression with cobia 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 cobia. 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 (cobia). In total, across all the time series from 1983 to 2010, cobia occurred on only 0.24% (n=804) of all trips. Thus, we considered two datasets for the CPUE standardization analyses. The first set of observations included all the data, as in the previous Mackerel Stock Assessment Panel (MSAP) 2003 analyses of TPWD CPUE for cobia. The second data set that was evaluated for CPUE was formed by excluding inshore fishing trips from the CPUE standardizations. We found that the majority of the recreational fishing effort for cobia 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 was 25,337 of which cobia occurred in 798 or 3.2% across all years.

Positive Trips
Applying methods described by Stephens & MacCall (2004) to cobia resulted in a 67% reduction in positive cobia trips while identifying approximately 11,000 trips that were unsuccessful at catching cobia. A large reduction in positive cobia trips and an inflation of zero cobia trips was anticipated due to the infrequency of cobia in the Texas recreational sportboat 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 attempted to construct standardized CPUE indices 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 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.

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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.

5.4.1.4 Catch Rates
Standardized catch rates and associated error bars are shown in SEDAR28-DW10.

5.4.1.6 Comments on Adequacy for Assessment
The index of abundance created from the TPWD data was not recommended for potential use in the cobia stock 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 cobia 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 CPUE data, an index of abundance for cobia was constructed for the U.S. GOM from 1993 through 2010. The index was 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 one day trips, an index was constructed using a delta-lognormal approach. The catch per unit effort for vertical lines was defined as gutted pounds per hook hour fished. Complete details concerning the methods and results of the analyses are described in SEDAR28-DW16.

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, hooks, number of days fished, and number of crew fell outside the upper 99.5 percentile. Additional vertical line trips were removed from consideration when trips caught deep water grouper by trolling. For this analysis, only one-day trips were used from 1993 through 2010. Only one day trips were used as the cobia trip limit is two per person per day with a maximum 1

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day possession limit. The Gulf of Mexico for this region includes South Atlantic areas south of the 28th parallel, off of Florida, around southern Florida and into the Gulf of Mexico.

Subsetting trips
All available one day vertical line trips from 1993 through 2010 were used in the construction of the index.

Model Input
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 analyses 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 was calculated as: log(CPUE) = ln(pounds of cobia/hook hour) for vertical lines. All 2-way interactions among significant main effects were examined. Higher order interaction terms were not examined.

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

PPT = Year + Subregion

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

Standardization
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 vertical lines 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.

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5.4.2.2 Sampling Intensity
The final dataset for the vertical lines index contained 269,988 one day vertical line trips.

5.4.2.3 Size/Age data
The sizes and 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
Due to the two fish per person, per day, trip limit, there is a good reason to believe the index is not a true reflection of population abundance. Since the cobia fishery tends to be an opportunistic fishery, there is no way to determine how much of a trip's effort is directed toward catching cobia. In addition, if the cobia landed were unintended catch, the commercial logbook does not reflect total cobia caught as there is a possibility of an indeterminate amount of cobia discarded after the trip limit was met. Therefore, the index of abundance based on vertical lines reported to the CLFP program was not recommended for potential use in the GOM cobia stock assessment.

5.4.3 Recreational Headboat Index - Cobia
The Headboat Survey in the GOM started sampling headboats in 1986, and the data collected were used to develop standardized catch per unit effort (CPUE) indices of abundance for the recreational fishery for cobia (*Rachycentron canadum*) in the GOM (SEDAR28-DW22). A delta-lognormal modeling approach was used to develop the indices and a species association approach (Stephens and MacCall 2004) was explored to identify directed cobia trips.

5.4.3.1 Methods for Estimation
Sample sizes were assessed across different strata for both total trips and positive trips. Shore mode was removed because less than 0.1 percent of the shore mode trips reported catching a cobia, and cobia are typically not caught from shore.
The datasets were spatially partitioned according to the decisions made during the SEDAR 28 data workshop plenary sessions. The stock boundary dividing the GOM stock from the South Atlantic stock for cobia was defined as the state boarder between Florida and Georgia. Therefore, all FL waters were considered to be part of the GOM. The dataset was partitioned where fish surveyed in areas 1,2,3,4,5,6,9 and 10 were considered to be part of the South Atlantic stock, while fish in all other areas were considered to be part of the GOM stock (Figure 5.4.3.1).

Data filtering techniques
Stephens and McCall
The Stephens and MacCall (2004) approach was explored to identify directed cobia trips. This approach resulted in an 83% reduction in the cobia trips on average and was therefore not used to define cobia directed trips.

Core vessels
The IWG discussed subsetting the dataset by identifying individual vessels that tend to target cobia and taking a subset of the data that only uses the trips taken by these vessels. Although this approach was possible for the South Atlantic where there are fewer vessels and more information was known about the boats, the approach could not be implemented in the GOM. The larger volume of vessels fishing in the GOM and the inability to track individual vessels given the frequent change in a vessel's unique identifying number precluded the ability to follow individual vessels.

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All trips versus positive trips
The SEDAR 28 DW IWG and panel 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 reluctantly decided at the data workshop, that fishing effort for cobia would be based on all trips. This decision was made because cobia is rarely a species fishers target, and cobia are opportunistically captured fish while targeting other species. Therefore, most trips in the Headboat database represent potential fishing effort for cobia.

Model Input
Response and explanatory variables
CPUE- Catch per unit effort (CPUE) has units of the number of cobia 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 5.4.3.1.
Month – Tables 5.4.3.2-5.4.3.4 summarize the total number of trips, the number of positive trips, and the percent of positive trips per month and year. There was a significant interaction between month and year.
Area –Tables 5.4.3.5-5.4.3.7 summarize the total number of trips, the number of positive trips, and the percent of positive trips per area and month 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 cobia) 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). 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

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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.

The model used for standardization was:

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

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

5.4.3.2 Sampling Intensity

The resulting data set contained 366,378 trips with 7% positive cobia trips (Table 5.4.3.1).

5.4.3.3 Size/Age data

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

5.4.3.4 Catch Rates

Standardized catch rates and confidence intervals are shown in Figure 5.4.3.2 and tabulated in Table 5.4.3.8. Figure 5.4.3.3 shows the Q-Q plot of the CPUE observations and Figure 5.4.3.4 shows the binomial fit to the observed proportion positive cobia trips.

5.4.3.5 Uncertainty and Measures of Precision

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

5.4.3.6 Comments on Adequacy for Assessment

The IWG recommended this index for potential use in the GOM cobia stock assessment because it represents a fairly long time-series and the number of positive cobia trips was relatively large. Also, the data cover the entire management area.

5.4.4 MRFSS Index - Cobia

The Marine Recreational Fishery Statistics Survey (MRFSS) conducted by the NOAA Fisheries (NMFS) 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 were 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 MRFSS to develop standardized CPUE indices of abundance for the recreational fishery for cobia in the GOM. A delta-lognormal modeling approach was used to develop these indices. Details are given in SEDAR28-DW22.

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5.4.4.1 Methods for Estimation

Sample sizes in the MRFSS data set were explored across different strata for both total trips and positive trips. 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.

The dataset was partitioned according to the decisions that were made during the SEDAR 28 data workshop plenary sessions. For cobia, the stock boundary dividing the GOM from the South Atlantic stock during the data workshop was determined to be the state boarder between Florida and Georgia. For cobia, the MRFSS data was split using the state code designations at the Florida-Georgia state border.

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.

Data filtering techniques

Stephens and MacCall

The Stephens and MacCall (2004) approach was explored to identify cobia directed trips. The results of this exploration were similar to those found when applied to the Headboat data, which precluded applying this approach to the MRFSS data.

Model Input

Response and explanatory variables

CPUE- catch per unit effort (CPUE) has units of the number of cobia 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.

State – Table 5.4.4.2 summarizes the total number of trips, the number of positive trips, and the percent of positive trips per year and state due to the significant interaction between area and month.

Month – Tables 5.4.4.3-5.4.4.5 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.

Area- Table 5.4.4.6 summarizes of the total number of trips, the number of positive trips, and the percent of positive trips per area and year. Area signifies fishing locations inshore and offshore.

Mode - Table 5.4.4.7 summarizes the total number of trips, the number of positive trips, and the percent of positive trips per mode and year. Fishing mode signifies whether fishing was done off a private boat as compared to for hire outfits.

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

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the proportion of successful trips (trips that landed cobia) 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). 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.

The model used for CPUE standardization was:

$$Success = \mu + (Year)\alpha_1 + (Area)\alpha_2 + (State)\alpha_3 + (Mode)\alpha_4 + (Month)\alpha_5 + \varepsilon$$

$$\ln(CPUE) = \mu + (Year)\alpha_1 + (Mode)\alpha_2 + (Month)\alpha_3 + (Area)\alpha_4 + (Year * Area)\alpha_5 + (Year * Month)\alpha_6 + (Mode * Month)\alpha_7 + \varepsilon$$

5.4.4.2 Sampling Intensity

The resulting data set contained 596,828 trips with less than 1% positive cobia trips (Table 5.4.4.1).

5.4.4.3 Size/Age data

The sizes and 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 5.4.4.1 and tabulated in Table 5.4.3.8. Figure 5.4.4.2 shows the Q-Q plot of the CPUE observations and Figure 5.4.4.3 shows the binomial fit to the observed proportion positive cobia 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.

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5.4.4.6 Comments on Adequacy for Assessment

The index was recommended for use due to the long length of the time series, and the fact that cobia was listed as a known target during the MRFSS interviews.

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5.5 Tables

Table 5.3.1.1. Index values and associated statistics for Cobia collected during Gulf SEAMAP Groundfish Trawl Surveys.

Survey Year	Nominal Frequency	N	Index	Scaled_Index	Scaled_Nominal	CV	LCL	UCL
1987	0.01724	116	0.04507	0.38953	0.24074	0.87708	0.08599	1.76453
1988	0	.	0	0	0	.	.	.
1989	0.02158	139	0.03627	0.31352	0.27179	0.71563	0.08664	1.13452
1990	0.03378	148	0.10494	0.90708	1.62447	0.56133	0.31846	2.58364
1991	0.02857	140	0.05787	0.50024	0.43699	0.62916	0.15761	1.58776
1992	0.04380	137	0.10986	0.94959	1.12444	0.51284	0.36126	2.49602
1993	0.09697	165	0.26910	2.32595	2.63955	0.31458	1.25830	4.29951
1994	0.08966	145	0.14044	1.21389	1.13015	0.35055	0.61444	2.39817
1995	0.05036	139	0.09468	0.81836	0.56318	0.47622	0.33133	2.02131
1996	0.07857	140	0.23139	2.00003	1.57674	0.37939	0.96055	4.16442
1997	0.10072	139	0.35074	3.03168	3.66417	0.33497	1.57917	5.82022
1998	0.01370	146	0.02346	0.20279	0.19078	0.87946	0.04463	0.92152
1999	0.08392	143	0.14889	1.28698	1.03974	0.36422	0.63535	2.60692
2000	0.00699	143	0.00508	0.04387	0.05543	1.20879	0.00657	0.29274
2001	0.10156	128	0.23665	2.04554	1.69754	0.34639	1.04332	4.01049
2002	0.04196	143	0.10369	0.89624	0.81252	0.51212	0.34138	2.35294
2003	0.03681	163	0.09970	0.86176	1.08391	0.51213	0.32824	2.26247
2004	0.07031	128	0.10428	0.90131	0.91148	0.41752	0.40428	2.00939
2005	0.05594	143	0.08650	0.74766	0.84892	0.44696	0.31843	1.75546
2006	0.06207	145	0.14883	1.28644	1.06249	0.42076	0.57373	2.88450
2007	0.02963	135	0.06583	0.56898	0.54014	0.62426	0.18064	1.79214
2008	0.01843	217	0.04907	0.42410	0.40003	0.62668	0.13414	1.34087
2009	0.01339	224	0.03502	0.30266	0.25858	0.72172	0.08289	1.10508
2010	0.04286	140	0.11359	0.98180	0.82621	0.31029	0.53540	1.80041

Table 5.4.2.1. Gulf of Mexico vertical line relative nominal CPUE, number of trips, proportion positive trips, relative abundance indices, and associated confidence intervals and CVs.

YEAR	Relative Nominal CPUE	Trips	Proportion Successful Trips	Standardized Index	Lower 95% CI (Index)	Upper 95% CI (Index)	CV (Index)
1993	0.97427	6,764	0.033856	0.62834	0.28600	1.38044	0.40928
1994	0.69071	10,586	0.029378	0.82735	0.41124	1.66452	0.36048
1995	0.75282	11,017	0.029318	0.76212	0.37851	1.53454	0.36093
1996	1.50812	10,156	0.039976	1.60522	0.85752	3.00487	0.32135
1997	1.22542	14,822	0.038254	1.09536	0.59495	2.01667	0.31243
1998	1.13343	19,967	0.034757	1.02538	0.56675	1.85513	0.30308
1999	0.96548	20,177	0.030133	0.91652	0.49748	1.68854	0.31279
2000	1.07147	19,418	0.029148	0.83320	0.44646	1.55497	0.31971
2001	0.87077	19,648	0.027942	0.78473	0.41783	1.47378	0.32311
2002	1.11941	18,262	0.038495	0.98875	0.54612	1.79011	0.30345
2003	1.22733	19,531	0.028007	0.96326	0.51959	1.78575	0.31613
2004	1.27146	17,321	0.029040	1.03168	0.55320	1.92401	0.31933
2005	0.76224	14,317	0.023469	0.64348	0.31682	1.30694	0.36569
2006	0.98464	13,876	0.031637	0.91683	0.48065	1.74884	0.33150
2007	0.86062	13,539	0.029470	1.31593	0.69288	2.49925	0.32915
2008	0.75687	13,635	0.025376	1.01992	0.52074	1.99763	0.34584
2009	0.73253	14,636	0.028833	1.08207	0.56834	2.06014	0.33048
2010	1.09241	12,316	0.031991	1.55988	0.82068	2.96490	0.32958

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Table 5.4.3.1. Annual number of total headboat trips, number of trips catching cobia (i.e., positive trips), and the percentage of trips capturing cobia in the Gulf of Mexico. The GOM region includes all Florida fishing regions.

Year	Total Number of Trips	Positive Trips	Percentage Positive
1986	15832	947	5.98
1987	15831	988	6.24
1988	15678	906	5.78
1989	15976	785	4.91
1990	19856	908	4.57
1991	17979	1008	5.61
1992	22707	1653	7.28
1993	21854	1802	8.25
1994	20689	1634	7.90
1995	18515	1461	7.89
1996	14878	1158	7.78
1997	15689	1299	8.28
1998	13880	1189	8.57
1999	11833	923	7.80
2000	11178	824	7.37
2001	10545	933	8.85
2002	9713	883	9.09
2003	9671	727	7.52
2004	10339	812	7.85
2005	10031	1015	10.12
2006	9449	940	9.95
2007	10176	1028	10.10
2008	13320	924	6.94
2009	16073	1309	8.14
2010	14686	1220	8.31
Total	366378	27276	

Table 5.4.3.2. Annual number of headboat trips catching cobia in the GOM per month. The GOM includes all Florida fishing regions.

	Month											
Year	1	2	3	4	5	6	7	8	9	10	11	12
1986	40	26	55	79	109	163	164	148	55	33	45	30
1987	31	36	46	113	151	186	157	110	52	26	34	46
1988	31	45	55	119	126	131	125	99	41	49	41	44
1989	54	55	87	84	99	73	110	81	44	41	36	21
1990	68	45	82	119	91	91	79	79	64	59	70	61
1991	67	61	76	108	106	87	135	98	79	72	40	79
1992	74	113	176	148	174	194	230	174	110	100	67	93
1993	94	137	145	196	235	207	253	169	125	94	66	81
1994	68	82	104	175	268	215	217	150	111	97	87	60
1995	73	65	58	133	199	216	216	168	139	80	63	51
1996	44	64	52	65	143	176	186	147	118	84	38	41
1997	38	48	79	80	148	168	211	178	118	86	99	46
1998	70	47	70	115	168	173	204	122	57	63	49	51
1999	51	63	58	100	154	154	133	83	32	27	32	36
2000	30	27	22	80	143	157	145	92	40	48	22	18
2001	23	35	35	70	112	137	180	134	82	41	39	45
2002	45	27	64	82	119	120	155	130	47	38	24	32
2003	18	31	51	65	125	115	83	97	41	49	15	37
2004	26	21	34	81	106	128	172	124	33	41	36	10
2005	25	40	33	79	168	187	172	143	43	52	35	38
2006	25	39	46	82	129	163	148	115	93	50	25	25
2007	29	41	52	73	82	194	185	161	86	43	43	39
2008	33	58	66	86	115	176	152	81	22	52	44	39
2009	41	46	59	104	134	263	264	166	80	71	45	36
2010	33	31	70	107	237	240	159	118	69	57	45	54
Total	1131	1283	1675	2543	3641	4114	4235	3167	1781	1453	1140	1113

Table 5.4.3.3. Annual number of headboat trips fishing in the GOM per month. The GOM includes all Florida fishing regions.

	Month											
Year	1	2	3	4	5	6	7	8	9	10	11	12
1986	861	952	1015	1171	1197	1897	2219	2002	1238	1057	1236	987
1987	1122	1190	1301	1660	1549	1703	1815	1677	1134	850	815	1015
1988	899	1102	1320	1590	1695	1836	1947	1644	849	1016	775	1005
1989	1175	1106	1411	1437	1378	1498	1752	1704	1206	1270	1156	883
1990	1364	1240	1731	1858	1756	2143	2144	2172	1540	1339	1280	1289
1991	1459	1368	1525	1604	1578	1928	2084	1926	1311	1126	973	1097
1992	1226	1423	2112	2141	2396	2313	2938	2391	1686	1512	1156	1413
1993	1516	1608	1812	1961	1977	2233	2747	2288	1619	1582	1254	1257
1994	1173	1508	2002	1992	2110	2105	2455	2146	1396	1404	1193	1205
1995	1237	1430	1778	1909	1881	2069	2389	1759	1352	845	1037	829
1996	953	1152	1092	1310	1416	1675	1927	1695	1198	896	655	909
1997	1012	1252	1443	1142	1382	1662	1835	1921	1195	1088	1017	740
1998	1181	913	1303	1360	1420	1551	1964	1497	627	762	718	584
1999	738	1007	1127	1101	1267	1407	1598	1238	595	578	578	599
2000	633	762	920	1093	1213	1347	1610	1176	694	721	582	427
2001	515	723	811	1049	1073	1265	1536	1279	765	618	456	455
2002	589	547	841	935	938	1250	1474	1142	556	710	401	330
2003	445	577	811	848	1124	1290	1395	1074	599	724	371	413
2004	625	628	987	1078	1162	1449	1588	1030	367	666	426	333
2005	574	630	785	1002	1340	1343	1383	1014	504	550	471	435
2006	489	554	992	965	1062	1223	1262	909	645	540	441	367
2007	547	627	1001	955	941	1458	1514	1080	589	514	430	520
2008	505	845	1146	1387	1462	1845	2072	1237	482	740	712	887
2009	1034	1106	1318	1388	1498	2160	2446	1797	918	887	706	815
2010	771	744	1329	1569	1510	1820	1640	1395	876	1258	984	790
Total	22643	24994	31913	34505	36325	42470	47734	39193	23941	23253	19823	19584

Table 5.4.3.4. Annual percentage of headboat trips catching cobia in the GOM per month. The GOM includes all Florida fishing regions.

	Month											
Year	1	2	3	4	5	6	7	8	9	10	11	12
1986	4.65	2.73	5.42	6.75	9.11	8.59	7.39	7.39	4.44	3.12	3.64	3.04
1987	2.76	3.03	3.54	6.81	9.75	10.92	8.65	6.56	4.59	3.06	4.17	4.53
1988	3.45	4.08	4.17	7.48	7.43	7.14	6.42	6.02	4.83	4.82	5.29	4.38
1989	4.60	4.97	6.17	5.85	7.18	4.87	6.28	4.75	3.65	3.23	3.11	2.38
1990	4.99	3.63	4.74	6.40	5.18	4.25	3.68	3.64	4.16	4.41	5.47	4.73
1991	4.59	4.46	4.98	6.73	6.72	4.51	6.48	5.09	6.03	6.39	4.11	7.20
1992	6.04	7.94	8.33	6.91	7.26	8.39	7.83	7.28	6.52	6.61	5.80	6.58
1993	6.20	8.52	8.00	9.99	11.89	9.27	9.21	7.39	7.72	5.94	5.26	6.44
1994	5.80	5.44	5.19	8.79	12.70	10.21	8.84	6.99	7.95	6.91	7.29	4.98
1995	5.90	4.55	3.26	6.97	10.58	10.44	9.04	9.55	10.28	9.47	6.08	6.15
1996	4.62	5.56	4.76	4.96	10.10	10.51	9.65	8.67	9.85	9.38	5.80	4.51
1997	3.75	3.83	5.47	7.01	10.71	10.11	11.50	9.27	9.87	7.90	9.73	6.22
1998	5.93	5.15	5.37	8.46	11.83	11.15	10.39	8.15	9.09	8.27	6.82	8.73
1999	6.91	6.26	5.15	9.08	12.15	10.95	8.32	6.70	5.38	4.67	5.54	6.01
2000	4.74	3.54	2.39	7.32	11.79	11.66	9.01	7.82	5.76	6.66	3.78	4.22
2001	4.47	4.84	4.32	6.67	10.44	10.83	11.72	10.48	10.72	6.63	8.55	9.89
2002	7.64	4.94	7.61	8.77	12.69	9.60	10.52	11.38	8.45	5.35	5.99	9.70
2003	4.04	5.37	6.29	7.67	11.12	8.91	5.95	9.03	6.84	6.77	4.04	8.96
2004	4.16	3.34	3.44	7.51	9.12	8.83	10.83	12.04	8.99	6.16	8.45	3.00
2005	4.36	6.35	4.20	7.88	12.54	13.92	12.44	14.10	8.53	9.45	7.43	8.74
2006	5.11	7.04	4.64	8.50	12.15	13.33	11.73	12.65	14.42	9.26	5.67	6.81
2007	5.30	6.54	5.19	7.64	8.71	13.31	12.22	14.91	14.60	8.37	10.00	7.50
2008	6.53	6.86	5.76	6.20	7.87	9.54	7.34	6.55	4.56	7.03	6.18	4.40
2009	3.97	4.16	4.48	7.49	8.95	12.18	10.79	9.24	8.71	8.00	6.37	4.42
2010	4.28	4.17	5.27	6.82	15.70	13.19	9.70	8.46	7.88	4.53	4.57	6.84

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Table 5.4.3.5. The number of headboat trips catching cobia in the Gulf of Mexico per month and area. The Gulf of Mexico region includes all Florida fishing regions.

	Month											
Area	1	2	3	4	5	6	7	8	9	10	11	12
NORTH-EAST_FLORIDA	36	29	127	308	389	528	513	358	164	160	182	96
EAST_CENTRAL_FLORID	641	744	846	679	675	756	826	660	388	332	404	623
SOUTHEAST_FLORIDA	166	170	301	646	664	344	244	181	89	97	105	130
FL_KEYS_ATL_VESS	66	94	119	169	96	74	92	60	30	24	51	60
DRY_TORTUGAS	36	41	36	49	21	8	13	10	5	18	14	27
NAPLES-CRYSTAL_RIVER	63	59	79	81	52	54	52	43	53	97	51	81
FL_MIDDLE_GROUNDS	10	11	9	12	13	8	13	12	12	8	4	5
NW_FLORDIA_&_ALABAMA	10	8	9	105	186	271	318	216	125	90	38	8
LOUISIANA	12	21	33	117	392	499	470	334	297	264	157	44
NE_TX_SABNE-FREEPORT	22	25	39	100	431	672	744	594	253	157	40	5
CENTRAL_TX_PTARANSAS	63	70	71	253	656	766	791	550	304	171	58	28
SOUTH_TX_PTISABEL	6	11	6	24	66	134	159	149	61	35	36	6
	1131	1283	1675	2543	3641	4114	4235	3167	1781	1453	1140	1113

Table 5.4.3.6. The number of headboat trips in the Gulf of Mexico per month and area. The Gulf of Mexico region includes all Florida fishing regions.

	Month											
Area	1	2	3	4	5	6	7	8	9	10	11	12
NORTH-EAST_FLORIDA	242	381	880	1251	1344	1679	1792	1377	758	612	516	350
EAST_CENTRAL_FLORID	2137	2568	3439	3800	3811	4432	4952	4095	2295	1912	1829	2049
SOUTHEAST_FLORIDA	6324	6336	6954	7653	7712	7174	8001	7400	5638	5499	5333	5737
FL_KEYS_ATL_VESS	5168	4949	5303	4813	3768	4710	5351	4447	2136	2569	3535	3998
DRY_TORTUGAS	170	181	171	164	121	87	76	61	38	61	83	120
NAPLES-CRYSTAL_RIVER	6177	7005	8621	8111	6953	7088	7893	6589	4206	5223	5493	5526
FL_MIDDLE_GROUNDS	103	99	104	107	126	134	124	82	50	48	52	35
NW_FLORDIA_&_ALABAMA	570	1143	3170	5071	6617	9073	9753	6951	4019	3414	1044	613
LOUISIANA	121	149	258	416	806	965	1003	820	612	590	423	181
NE_TX_SABNE-FREEPORT	280	394	775	918	1536	2072	2524	2256	1332	877	310	132
CENTRAL_TX_PTARANSAS	957	1208	1687	1708	2713	3745	4567	3745	2163	1950	974	554
SOUTH_TX_PTISABEL	394	581	551	493	818	1311	1698	1370	694	498	231	289
	22643	24994	31913	34505	36325	42470	47734	39193	23941	23253	19823	19584

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Table 5.4.3.7. The percentage of headboat trips catching cobia in the Gulf of Mexico per month and area. The Gulf of Mexico region includes all Florida fishing regions.

	Month											
Area	1	2	3	4	5	6	7	8	9	10	11	12
NORTH-EAST_FLORIDA	14.88	7.61	14.43	24.62	28.94	31.45	28.63	26.00	21.64	26.14	35.27	27.43
EAST_CENTRAL_FLORID	30.00	28.97	24.60	17.87	17.71	17.06	16.68	16.12	16.91	17.36	22.09	30.41
SOUTHEAST_FLORIDA	2.62	2.68	4.33	8.44	8.61	4.80	3.05	2.45	1.58	1.76	1.97	2.27
FL_KEYS_ATL_VESS	1.28	1.90	2.24	3.51	2.55	1.57	1.72	1.35	1.40	0.93	1.44	1.50
DRY_TORTUGAS	21.18	22.65	21.05	29.88	17.36	9.20	17.11	16.39	13.16	29.51	16.87	22.50
NAPLES-CRYSTAL_RIVER	1.02	0.84	0.92	1.00	0.75	0.76	0.66	0.65	1.26	1.86	0.93	1.47
FL_MIDDLE_GROUNDS	9.71	11.11	8.65	11.21	10.32	5.97	10.48	14.63	24.00	16.67	7.69	14.29
NW_FLORDIA_&_ALABAMA	1.75	0.70	0.28	2.07	2.81	2.99	3.26	3.11	3.11	2.64	3.64	1.31
LOUISIANA	9.92	14.09	12.79	28.13	48.64	51.71	46.86	40.73	48.53	44.75	37.12	24.31
NE_TX_SABNE-FREEPORT	7.86	6.35	5.03	10.89	28.06	32.43	29.48	26.33	18.99	17.90	12.90	3.79
CENTRAL_TX_PTARANSAS	6.58	5.79	4.21	14.81	24.18	20.45	17.32	14.69	14.05	8.77	5.95	5.05
SOUTH_TX_PTISABEL	1.52	1.89	1.09	4.87	8.07	10.22	9.36	10.88	8.79	7.03	15.58	2.08

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Table 5.4.3.8. Fitted indices of abundance for the recreational surveys where effort represents all trips.

	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 5.4.4.1. Annual number of trips catching cobia (i.e., positive trips), total trips, and the percent of trips capturing cobia in the GOM obtained from MRFSS, with the MRFSS dataset subset according to the cobia stock boundaries.

Year	Positive Trips	Total Trips	Percent Positive
1981	26	2469	1.05
1982	63	4636	1.36
1983	33	3066	1.08
1984	40	4003	1.00
1985	31	3963	0.78
1986	78	12548	0.62
1987	89	11939	0.75
1988	80	12904	0.62
1989	69	9660	0.71
1990	92	8614	1.07
1991	127	9635	1.32
1992	216	19914	1.08
1993	132	15728	0.84
1994	172	17778	0.97
1995	101	16040	0.63
1996	174	19946	0.87
1997	246	20791	1.18
1998	244	24399	1.00
1999	356	33054	1.08
2000	276	30764	0.90
2001	316	32193	0.98
2002	354	34225	1.03
2003	331	32963	1.00
2004	298	32771	0.91
2005	231	29855	0.77
2006	236	31840	0.74
2007	239	31553	0.76
2008	272	30309	0.90
2009	198	29717	0.67
2010	204	29551	0.69
Total	5324	596828	

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Table 5.4.4.2. Annual number of trips catching cobia (i.e., positive trips), total trips, and the percentage of trips capturing cobia by year and state in the GOM obtained from MRFSS as partitioned for cobia.

	All Trips					Positive Trips					Percent Positive Trips				
Year	LA	MS	AL	West FL	East FL	LA	MS	AL	West FL	East FL	LA	MS	AL	West FL	East FL
1981	395	235	185	1008	646	9	2	5	10	0	2.28	0.85	2.70	0.99	0.00
1982	521	543	517	1564	1491	13	9	14	15	12	2.50	1.66	2.71	0.96	0.80
1983	434	196	266	860	1310	18	4	5	2	4	4.15	2.04	1.88	0.23	0.31
1984	690	300	295	960	1758	12	5	4	12	7	1.74	1.67	1.36	1.25	0.40
1985	910	179	339	1087	1448	7	1	6	10	7	0.77	0.56	1.77	0.92	0.48
1986	3417	709	674	3821	3927	24	8	4	36	6	0.70	1.13	0.59	0.94	0.15
1987	1256	804	855	5425	3599	10	11	18	36	14	0.80	1.37	2.11	0.66	0.39
1988	1804	938	613	5576	3973	6	11	4	48	11	0.33	1.17	0.65	0.86	0.28
1989	1212	668	548	3640	3592	2	5	7	41	14	0.17	0.75	1.28	1.13	0.39
1990	1156	528	386	3204	3340	21	9	13	35	14	1.82	1.70	3.37	1.09	0.42
1991	1275	609	626	3178	3947	27	12	21	55	12	2.12	1.97	3.35	1.73	0.30
1992	2886	1370	922	7900	6836	24	35	25	82	50	0.83	2.55	2.71	1.04	0.73
1993	1708	638	568	6915	5899	11	11	16	62	32	0.64	1.72	2.82	0.90	0.54
1994	1860	805	704	7723	6686	22	10	34	81	25	1.18	1.24	4.83	1.05	0.37
1995	1692	602	577	6827	6342	13	9	11	58	10	0.77	1.50	1.91	0.85	0.16
1996	2129	888	866	8760	7303	31	8	11	84	40	1.46	0.90	1.27	0.96	0.55
1997	2392	939	862	9036	7562	77	19	7	108	35	3.22	2.02	0.81	1.20	0.46
1998	2491	1021	1152	11092	8643	14	14	12	163	41	0.56	1.37	1.04	1.47	0.47
1999	3444	1457	1431	15735	10987	17	18	15	234	72	0.49	1.24	1.05	1.49	0.66
2000	3525	1202	1339	13846	10852	18	11	28	180	39	0.51	0.92	2.09	1.30	0.36
2001	3218	1003	1335	14385	12252	9	5	26	210	66	0.28	0.50	1.95	1.46	0.54
2002	3517	859	1222	15630	12997	28	16	22	228	60	0.80	1.86	1.80	1.46	0.46
2003	3262	1025	1223	15769	11684	36	8	14	196	77	1.10	0.78	1.14	1.24	0.66
2004	3787	1010	1086	16814	10074	38	8	15	187	50	1.00	0.79	1.38	1.11	0.50
2005	3217	693	1148	14677	10120	27	2	10	149	43	0.84	0.29	0.87	1.02	0.42
2006	3851	1029	1138	13928	11894	34	3	17	106	76	0.88	0.29	1.49	0.76	0.64
2007	3826	1071	1234	14595	10827	33	7	15	135	49	0.86	0.65	1.22	0.92	0.45
2008	4237	1116	1159	14501	9296	16	8	12	188	48	0.38	0.72	1.04	1.30	0.52
2009	3819	1137	1302	14950	8509	10	6	13	110	59	0.26	0.53	1.00	0.74	0.69
2010	3395	919	1165	14844	9228	1	1	6	117	79	0.03	0.11	0.52	0.79	0.86
Total	71326	24493	25737	268250	207022	608	276	410	2978	1052	0.85	1.13	1.59	1.11	0.51

Table 5.4.4.3. Annual number of total trips per month in the GOM from the MRFSS database as subset for cobia.

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1981				197	223	248	232	616	199	441	238	75
1982			165	254	615	662	790	747	250	595	324	234
1983	139	156	219	367	314	545	255	292	143	302	231	103
1984	54	530	373	337	570	533	439	133	394	192	351	97
1985	109	176	471	212	417	493	367	287	373	339	411	308
1986	398	932	673	1157	1094	1412	1445	1137	1177	1026	1079	1018
1987	703	998	941	1224	1243	1278	1414	1014	1163	821	685	455
1988	457	627	692	609	1004	904	1548	1386	1416	1880	1217	1164
1989	733	569	870	665	1301	604	1108	1025	911	649	898	327
1990	148	769	729	808	890	856	859	763	850	525	764	653
1991	622	604	594	817	935	1170	905	828	904	826	825	605
1992	958	1406	1422	2458	2527	1272	2321	1384	1303	2095	1381	1387
1993		1872	1521	981	1645	1507	1591	1622	1348	1146	1530	965
1994	1330	1722	1426	1307	1600	2013	1845	1450	1415	1306	1228	1136
1995	1370	1293	1378	1170	1514	1692	1452	1490	1462	1129	1099	991
1996	992	1093	1409	1887	1825	1967	1654	2118	1526	2266	1667	1542
1997	1233	1256	1788	1466	2179	2118	1888	1726	1882	2007	1869	1379
1998	1593	1358	1602	1868	2056	1944	2513	2794	1037	2042	2840	2752
1999	3313	3202	3685	3956	2286	2590	3111	2801	1817	2178	2356	1759
2000	1812	2548	2244	3278	3225	3337	2914	2577	2425	2417	2171	1816
2001	2404	2287	2595	2810	2951	3144	3186	2997	2832	2140	2487	2360
2002	2256	2085	3193	3370	3206	3309	3386	3183	2602	2981	2381	2273
2003	2051	2989	3267	3113	3488	3401	3326	2685	2251	2338	2281	1773
2004	2030	2172	2965	3134	3299	3367	3407	2842	1698	3433	2419	2005
2005	2391	2036	2766	3059	3535	3052	2911	2645	1762	1725	1889	2084
2006	2349	2182	2704	3335	2795	2978	3030	2949	2698	2393	2187	2240
2007	2114	1992	2653	2778	3047	3330	3029	2917	2515	2190	2647	2341
2008	1859	2497	2928	2455	2965	3247	2935	2346	2071	2529	2350	2127
2009	2221	1998	2281	2962	3245	2754	2902	2712	2507	2476	2303	1356
2010	1552	1739	2308	3036	3386	2949	2750	2628	2863	2473	2379	1488
Total	37191	43088	49862	55070	59380	58676	59513	54094	45794	48860	46487	38813

Table 5.4.4.4. Annual number of trips capturing cobia per month in the GOM from the MRFSS database.

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1981				0	2	8	6	5	1	3	1	0
1982			2	3	14	9	18	7	5	2	1	2
1983	0	0	0	1	8	9	7	2	0	2	4	0
1984	1	5	0	4	6	11	7	2	2	2	0	0
1985	1	4	0	2	5	2	10	3	2	2	0	0
1986	1	3	5	6	13	10	8	8	11	7	1	5
1987	3	3	2	7	21	16	8	13	11	5	0	0
1988	1	2	0	2	10	14	9	13	13	7	7	2
1989	1	4	8	5	19	7	5	5	11	3	1	0
1990	0	2	5	7	11	14	8	13	16	9	3	4
1991	6	8	2	7	15	18	24	8	16	14	9	0
1992	9	6	8	26	31	16	55	28	10	16	7	4
1993		2	6	7	27	20	14	19	20	7	6	4
1994	3	3	5	19	14	44	31	21	19	5	6	2
1995	1	2	5	13	21	11	8	11	21	3	3	2
1996	5	3	8	27	24	17	13	20	6	28	13	10
1997	4	3	33	21	45	18	36	20	34	16	11	5
1998	6	4	18	13	28	21	34	43	16	18	28	15
1999	12	27	30	71	46	27	44	29	31	15	15	9
2000	4	9	13	48	47	27	29	31	29	12	18	9
2001	13	20	27	42	31	41	36	44	27	12	14	9
2002	26	11	23	49	46	65	43	25	25	26	10	5
2003	12	12	45	37	56	40	34	27	28	19	18	3
2004	6	11	13	57	40	29	39	33	11	31	18	10
2005	5	4	20	31	43	27	33	21	15	9	14	9
2006	3	18	16	27	29	35	35	33	19	10	8	3
2007	4	9	11	36	27	35	27	30	22	15	9	14
2008	10	25	7	27	29	40	34	24	27	22	18	9
2009	2	2	20	15	26	40	23	24	24	13	5	4
2010	11	6	10	26	47	41	17	15	14	10	2	5
Total	150	208	342	636	781	712	695	577	486	343	250	144

Table 5.4.4.5. Annual percentage of trips capturing cobia per month in the GOM from the MRFSS database.

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1981	0.00	0.00	0.00	0.00	0.90	3.23	2.59	0.81	0.50	0.68	0.42	0.00
1982	0.00	0.00	1.21	1.18	2.28	1.36	2.28	0.94	2.00	0.34	0.31	0.85
1983	0.00	0.00	0.00	0.27	2.55	1.65	2.75	0.68	0.00	0.66	1.73	0.00
1984	1.85	0.94	0.00	1.19	1.05	2.06	1.59	1.50	0.51	1.04	0.00	0.00
1985	0.92	2.27	0.00	0.94	1.20	0.41	2.72	1.05	0.54	0.59	0.00	0.00
1986	0.25	0.32	0.74	0.52	1.19	0.71	0.55	0.70	0.93	0.68	0.09	0.49
1987	0.43	0.30	0.21	0.57	1.69	1.25	0.57	1.28	0.95	0.61	0.00	0.00
1988	0.22	0.32	0.00	0.33	1.00	1.55	0.58	0.94	0.92	0.37	0.58	0.17
1989	0.14	0.70	0.92	0.75	1.46	1.16	0.45	0.49	1.21	0.46	0.11	0.00
1990	0.00	0.26	0.69	0.87	1.24	1.64	0.93	1.70	1.88	1.71	0.39	0.61
1991	0.96	1.32	0.34	0.86	1.60	1.54	2.65	0.97	1.77	1.69	1.09	0.00
1992	0.94	0.43	0.56	1.06	1.23	1.26	2.37	2.02	0.77	0.76	0.51	0.29
1993	0.00	0.11	0.39	0.71	1.64	1.33	0.88	1.17	1.48	0.61	0.39	0.41
1994	0.23	0.17	0.35	1.45	0.88	2.19	1.68	1.45	1.34	0.38	0.49	0.18
1995	0.07	0.15	0.36	1.11	1.39	0.65	0.55	0.74	1.44	0.27	0.27	0.20
1996	0.50	0.27	0.57	1.43	1.32	0.86	0.79	0.94	0.39	1.24	0.78	0.65
1997	0.32	0.24	1.85	1.43	2.07	0.85	1.91	1.16	1.81	0.80	0.59	0.36
1998	0.38	0.29	1.12	0.70	1.36	1.08	1.35	1.54	1.54	0.88	0.99	0.55
1999	0.36	0.84	0.81	1.79	2.01	1.04	1.41	1.04	1.71	0.69	0.64	0.51
2000	0.22	0.35	0.58	1.46	1.46	0.81	1.00	1.20	1.20	0.50	0.83	0.50
2001	0.54	0.87	1.04	1.49	1.05	1.30	1.13	1.47	0.95	0.56	0.56	0.38
2002	1.15	0.53	0.72	1.45	1.43	1.96	1.27	0.79	0.96	0.87	0.42	0.22
2003	0.59	0.40	1.38	1.19	1.61	1.18	1.02	1.01	1.24	0.81	0.79	0.17
2004	0.30	0.51	0.44	1.82	1.21	0.86	1.14	1.16	0.65	0.90	0.74	0.50
2005	0.21	0.20	0.72	1.01	1.22	0.88	1.13	0.79	0.85	0.52	0.74	0.43
2006	0.13	0.82	0.59	0.81	1.04	1.18	1.16	1.12	0.70	0.42	0.37	0.13
2007	0.19	0.45	0.41	1.30	0.89	1.05	0.89	1.03	0.87	0.68	0.34	0.60
2008	0.54	1.00	0.24	1.10	0.98	1.23	1.16	1.02	1.30	0.87	0.77	0.42
2009	0.09	0.10	0.88	0.51	0.80	1.45	0.79	0.88	0.96	0.53	0.22	0.29
2010	0.71	0.35	0.43	0.86	1.39	1.39	0.62	0.57	0.49	0.40	0.08	0.34
Total	0.40	0.48	0.69	1.15	1.32	1.21	1.17	1.07	1.06	0.70	0.54	0.37

Table 5.4.4.6. Annual number of total trips, trips catching cobia (i.e., positive trips), and the percentage of trips capturing cobia by year and area in the GOM obtained from MRFSS as partitioned for cobia

	Total number of trips					Positive trips					Percent positive trips				
Year	ocean <3 miles	ocean > 3miles	ocean <10 miles	ocean>10miles	inshore	ocean <3 miles	ocean > 3miles	ocean <10 miles	ocean>10miles	inshore	ocean <3 miles	ocean > 3miles	ocean <10 miles	ocean>10miles	inshore
1981	1156	482	2135	461	2309	3	13	10	2	0	0.26	2.70	0.47	0.43	0.00
1982	3615	774	3706	283	3173	22	30	18	2	1	0.61	3.88	0.49	0.71	0.03
1983	3019	1233	2984	588	2385	5	34	1	1	0	0.17	2.76	0.03	0.17	0.00
1984	3337	1164	3323	554	3122	13	22	11	2	2	0.39	1.89	0.33	0.36	0.06
1985	2703	888	3461	819	3745	10	14	7	5	0	0.37	1.58	0.20	0.61	0.00
1986	2809	2033	3449	713	5118	9	30	23	13	1	0.32	1.48	0.67	1.82	0.02
1987	2416	1684	4621	923	4175	13	29	25	8	6	0.54	1.72	0.54	0.87	0.14
1988	2786	1907	4574	1002	6970	10	18	28	16	7	0.36	0.94	0.61	1.60	0.10
1989	2616	1891	2969	557	5044	11	19	20	12	12	0.42	1.00	0.67	2.15	0.24
1990	2694	1630	2353	472	4326	13	38	15	6	18	0.48	2.33	0.64	1.27	0.42
1991	3378	1697	2325	397	4821	12	51	34	15	15	0.36	3.01	1.46	3.78	0.31
1992	5038	3135	4823	1087	13172	14	82	48	19	32	0.28	2.62	1.00	1.75	0.24
1993	5154	2156	5666	1208	13748	19	44	38	15	22	0.37	2.04	0.67	1.24	0.16
1994	6603	2323	6553	1054	14827	13	69	40	22	44	0.20	2.97	0.61	2.09	0.30
1995	5829	2099	5412	1091	14563	11	29	52	6	15	0.19	1.38	0.96	0.55	0.10
1996	4788	2529	4789	1549	14051	27	49	55	17	45	0.56	1.94	1.15	1.10	0.32
1997	5011	2833	5396	1089	14096	21	70	67	23	84	0.42	2.47	1.24	2.11	0.60
1998	4933	3137	5450	1944	17812	20	52	76	45	65	0.41	1.66	1.39	2.31	0.36
1999	6365	3969	8313	3831	22634	25	91	138	49	68	0.39	2.29	1.66	1.28	0.30
2000	5706	3739	7260	3581	20114	18	68	83	61	57	0.32	1.82	1.14	1.70	0.28
2001	6096	3846	7626	3420	20922	30	69	95	67	71	0.49	1.79	1.25	1.96	0.34
2002	7335	3982	7584	3739	22516	26	88	117	63	71	0.35	2.21	1.54	1.68	0.32
2003	6999	3695	7714	3964	22367	24	99	78	88	48	0.34	2.68	1.01	2.22	0.21
2004	5930	3043	7812	3925	21953	21	79	70	85	43	0.35	2.60	0.90	2.17	0.20
2005	5613	2626	7065	3083	21825	14	62	77	56	23	0.25	2.36	1.09	1.82	0.11
2006	5650	3129	7715	2586	22451	29	94	61	37	17	0.51	3.00	0.79	1.43	0.08
2007	6167	2544	7243	2558	23507	14	81	73	39	31	0.23	3.18	1.01	1.52	0.13
2008	4740	2275	7435	2485	22752	18	55	108	54	53	0.38	2.42	1.45	2.17	0.23
2009	4760	1995	6604	1806	24501	9	36	37	15	16	0.19	1.80	0.56	0.83	0.07
2010	5434	1568	5964	1904	24204	31	46	73	25	28	0.57	2.93	1.22	1.31	0.12

Table 5.4.4.7. Annual number of trips catching cobia (i.e., positive trips) and total trips per mode in the Gulf of Mexico obtained from MRFSS as partitioned for cobia. Modes are as follows: 3 - Charter and 4 – Private/Rental.

	All Trips		Positive Trips		Percentage Positive Trips	
Year	Charter	Private/ Rental	Charter	Private/ Rental	Charter	Private/ Rental
1981	278	2191	10	16	3.60	0.73
1982	206	4430	6	57	2.91	1.29
1983	598	2468	18	15	3.01	0.61
1984	793	3210	20	20	2.52	0.62
1985	479	3484	12	19	2.51	0.55
1986	2027	10521	40	38	1.97	0.36
1987	1317	10622	29	60	2.20	0.56
1988	1576	11328	24	56	1.52	0.49
1989	1361	8299	22	47	1.62	0.57
1990	1154	7460	28	64	2.43	0.86
1991	1280	8355	60	67	4.69	0.80
1992	2281	17633	67	149	2.94	0.85
1993	1480	14248	33	99	2.23	0.69
1994	1413	16365	50	122	3.54	0.75
1995	1255	14785	28	73	2.23	0.49
1996	1555	18391	57	117	3.67	0.64
1997	2381	18410	61	185	2.56	1.00
1998	3641	20758	75	169	2.06	0.81
1999	5770	27284	118	238	2.05	0.87
2000	6523	24241	118	158	1.81	0.65
2001	5723	26470	143	173	2.50	0.65
2002	6208	28017	151	203	2.43	0.72
2003	6308	26655	155	176	2.46	0.66
2004	6000	26771	169	129	2.82	0.48
2005	5181	24674	116	115	2.24	0.47
2006	4165	27675	105	131	2.52	0.47
2007	4266	27287	108	131	2.53	0.48
2008	4055	26254	119	153	2.93	0.58
2009	3364	26353	61	137	1.81	0.52
2010	3670	25881	73	131	1.99	0.51
Total	86308	510520	2076	3248	2.41	0.64

5.6 Figures

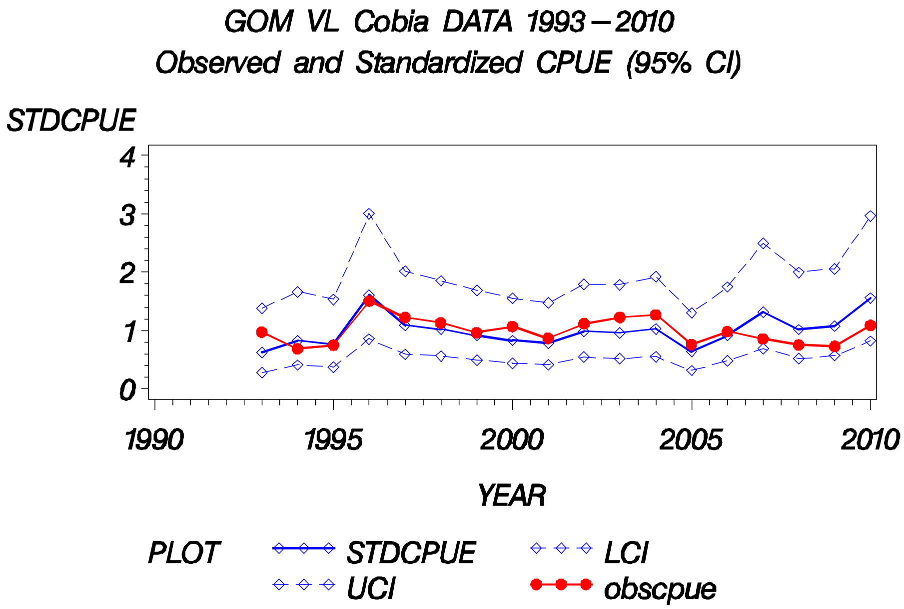

Figure 5.4.2.1. Cobia nominal CPUE (solid circles), standardized CPUE (open diamonds) and upper and lower 95% confidence limits of the standardized CPUE estimates (dashed lines) for vessels fishing Vertical line gear in the Gulf of Mexico.

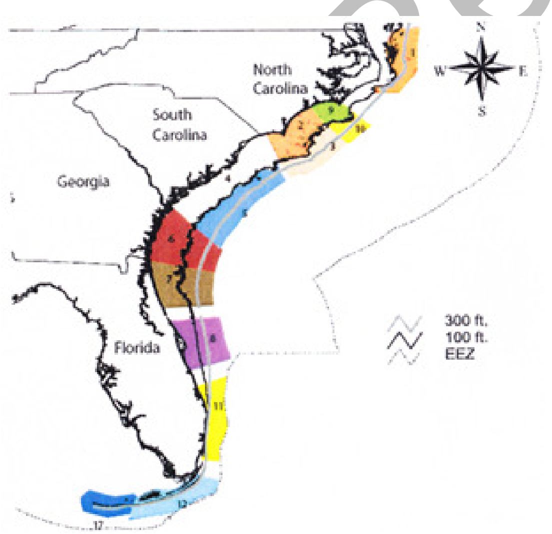

Figure 5.4.3.1. Map of headboat statistical areas.

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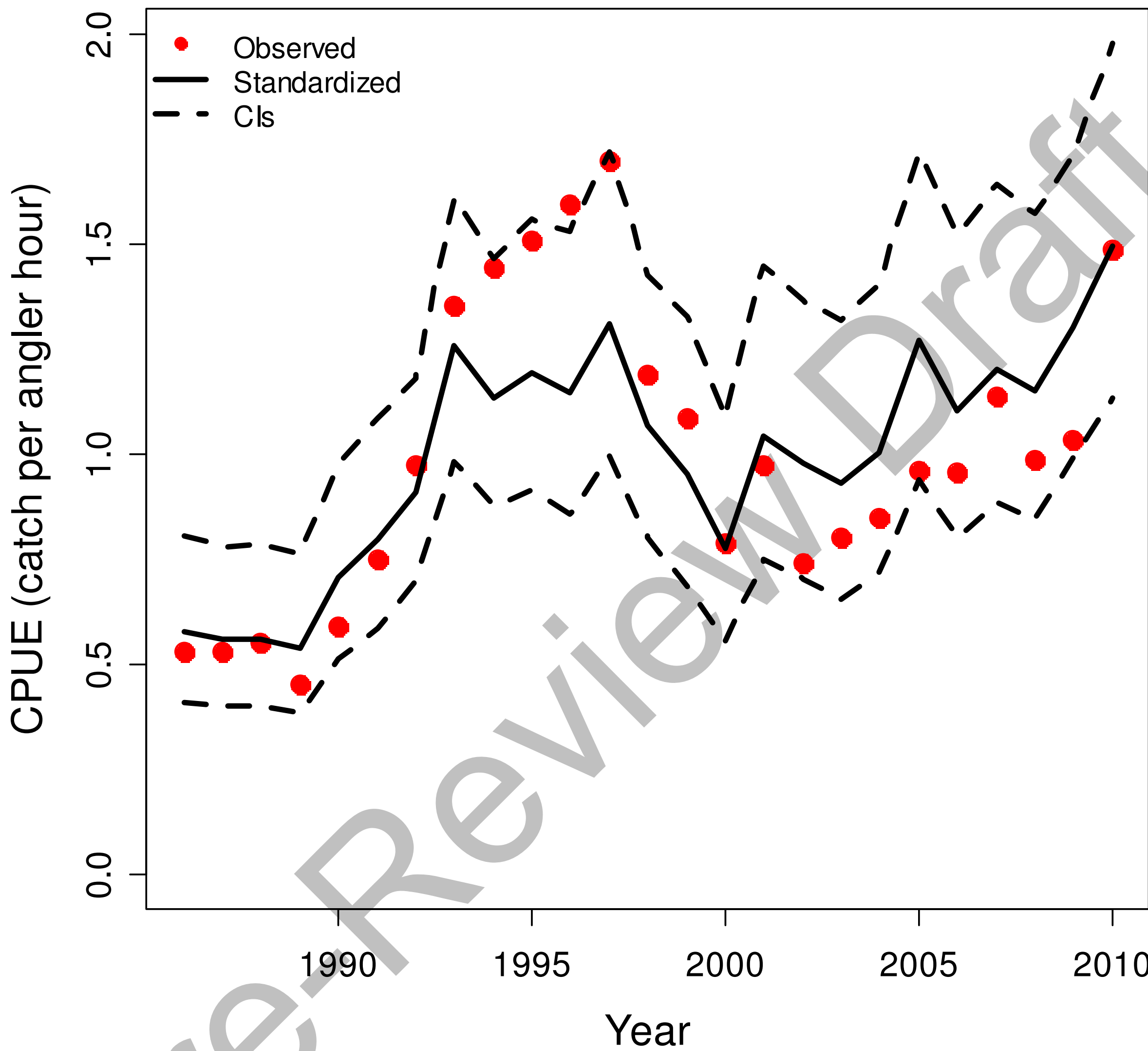

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Figure 5.4.3.2. Nominal (observed) and standardized CPUE and the 95% confidence intervals for cobia from the Headboat Survey in the GOM. CPUE values were normalized by the mean.

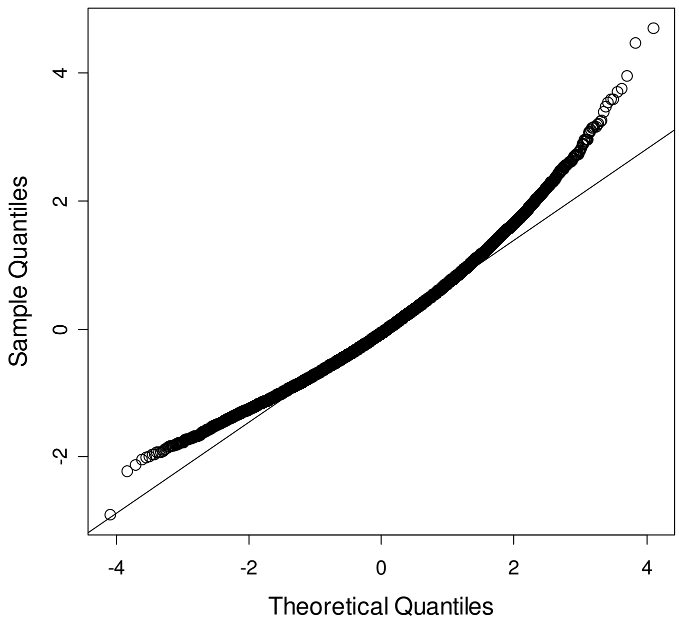

Figure 5.4.3.3. Q-Q plot of CPUE for cobia in the GOM Headboat Survey.

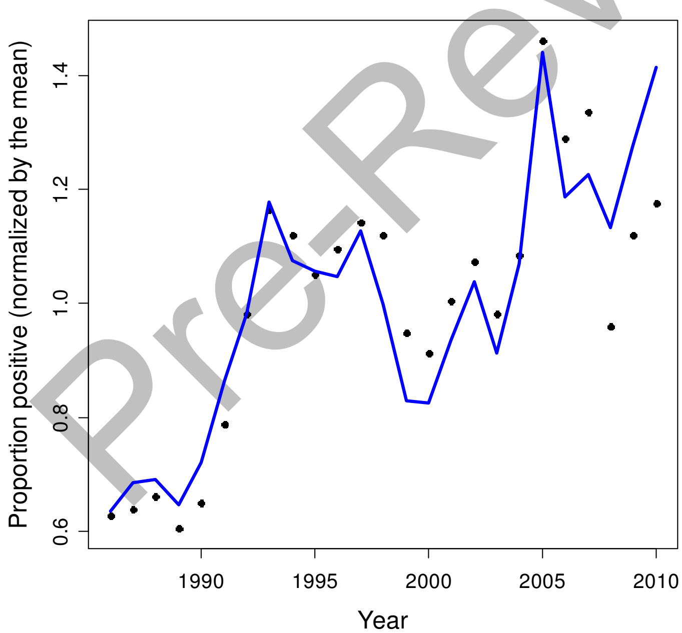

Figure 5.4.3.4. Observed proportion of trips catching cobia (black points) and the binomial model fit (blue line) to the data normalized by the mean for the Headboat Survey.

Pre-Review Draft

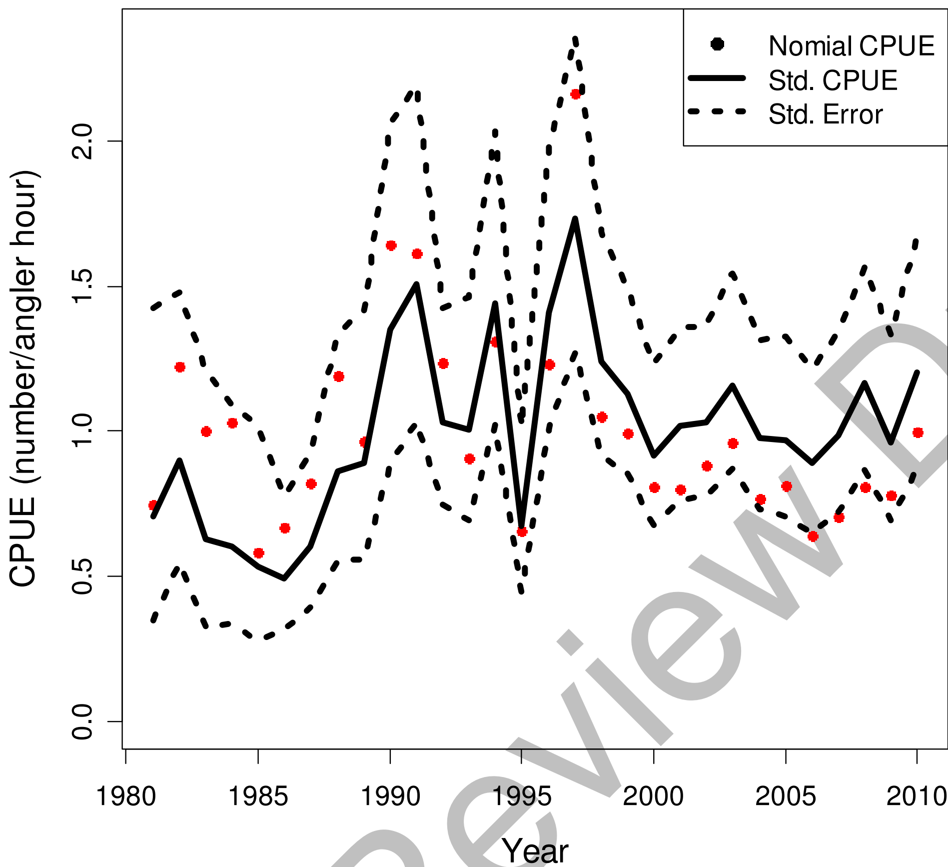

Figure 5.4.4.1. Nominal (observed) and standardized CPUE and the 95% confidence intervals for cobia from MRFSS in the GOM. CPUE values were normalized by the mean.

Pre-Review Draft

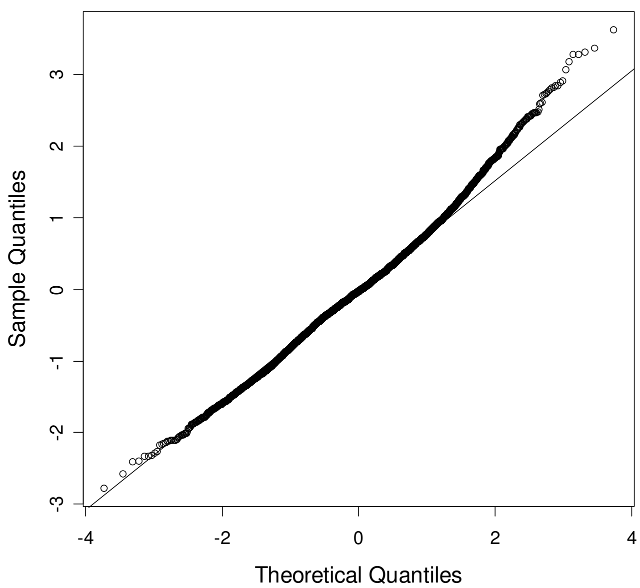

Figure 5.4.4.2. Q-Q plot of CPUE for cobia in the GOM MRFSS Survey.

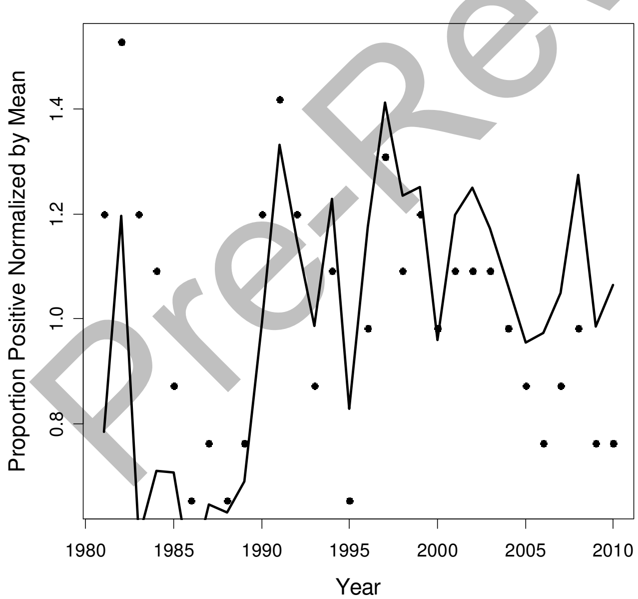

Figure 5.4.4.3. Observed proportion of trips catching cobia (black points) and the binomial model fit (blue line) to the data normalized by the mean for MRFSS.

Pre-Review Draft

6 Analytic Approach

Suggested analytic approach given the data –Gulf of Mexico cobia

The data workshop panel discussed data sources, data quality and data quantity. We determined that landings data are complete from 1981 through 2010, and that preliminary landings for 2011 would be available for the assessment workshop for recreational and commercial fisheries. However, the panel concluded that size composition and age composition data were lacking. Consequently, the analysts recommended updated population analyses should be conducted using the ASPIC production model (ASPIC 5.0 Suite of software). ASPIC data inputs will be limited to updated time series of landings and discards over the period of corresponding CPUE abundance trends. The ASPIC model requires initial estimates for the parameters: B1/K, MSY, K and fishery specific selectivities (q's). All initial runs should allow the program to estimate the above mentioned parameters. ASPIC estimates BMSY as K/2 and FMSY as MSY/BMSY. Prager et al. 1996 and Prager 1994 provide describe the parameter estimating equations and the model fitting process in detail. Time series of abundance trends, fisheries landings and discard data used in the ASPIC model corresponded to 1) the recreational headboat, charter and private angler (MRFSS + headboat + TPWD landings; MRFSS cpue index), 2) the commercial fishery (all gears combined landings; vertical line cpue index), and 3) the shrimp bycatch (Bayesian estimates of median age 1+ shrimp bycatch; SEMAP cpue index) . The analyses will include the years 1981-2011. The Continuity case evaluations will be conducted using updated data presented in the previous cobia assessment (Williams 2002) and will be conducted using SS3. Initial ASPIC model analyses will assume equal index weighting and a penalty term for the B1/K >1.0 (penalty term=10). Sensitivity analyses will be conducted to evaluate the ASPIC model results to a variety of scenario inputs that included: 1) varying assumptions for discard release mortality (0 % and 30%), 2) varying the initial input values for beginning stock size to virgin stock size level (i.e., the B1/K ASPIC model parameter), and 3) evaluating the impact on ASPIC model results to choice of index weighting options (i.e., equal index weighting or relative catch proportional index weighting).

7 Research Recommendations

7.1 Life History

1. Implement a tagging study along the entire east coast of Florida and evaluate genetic samples from the same to determine more precise stock boundaries.
2. Explore the feasibility of satellite tags for Cobia movement studies.
3. Provide genetic sampling kits to interested groups to better understand the stock division line between the Gulf and Atlantic Cobia stocks. Possible collectors of genetic samples could include Charter operators, fishing clubs and state fisheries personnel.
4. Recommend developing a tagging program for inshore and offshore South Atlantic Cobia populations. The goal would be to deploy tags inshore during the spring migration and offshore during the fall and winter to get a clearer picture of fall and spring migrations and to better identify spawning areas and aggregations.
5. Conduct research on cobia release mortality.

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6. To increase overall amount of data available, have port samplers do complete workups when sampling, including otolith removal for aging, length, weight, sex, genetic sampling and record a catch location.

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 encountering cobia
  – 5-10% allocated by strata within states
  – get maximum information from fish
•Need research methods that capture cobia in large enough numbers to create a reasonable index for young (age 0) cobia
•Expand TIP sampling to better cover all statistical strata
  – Predominantly from Florida and by hand line
  – 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

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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.

Section 5 Appendix – Index Report Cards

Appendix 5.1 SEAMAP Groundfish Trawl Index

Appendix 5.2 Texas Parks and Wildlife Index

Appendix 5.3 Commercial Logbook, Vertical Line

Appendix 5.4 Headboat Index

Appendix 5.5 MRFSS Index

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Appendix 5.1
Gulf of Mexico Cobia
SEAMAP Trawl Index

DESCRIPTION OF THE DATA SOURCE

1. Fishery Independent Indices

Item	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

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

METHODS

1. Data Reduction and Exclusions

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

Working Group Comments:

SEDAR28-DW03

SEAMAP Groundfish Survey - Cobia

2. Management Regulations (for FD Indices)

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

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

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

4. Model Standardization

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

Working Group Comments:

3A-E. Available on Demand

4A. Ingram et al. method

4B-G. Available on Demand.

MODEL DIAGNOSTICS

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

Item	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:

2A-B,D-F. Available on Demand.

4A-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	02/07/2012	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

The indices group requested an attempt at the development of abundance indices of cobia using the zero-inflated delta-lognormal method of Ingram et al. (2010). Due to timing of the request, the diagnostics were not provided in the document, but are available on request. Ultimately, the index was deemed unusable due to the low number of cobia collected each year during groundfish surveys.

Ingram, G.W., Jr., W.J. Richards, J.T. Lamkin and B. Muhling. 2010. Annual indices of Atlantic bluefin tuna (Thunnus thynnus) larvae in the Gulf of Mexico developed using delta-lognormal and multivariate models. Aquat. Living Resour. Vol. 23, Issue 1, pp. 35-47.

Reset Fields

Appendix 5.2
Gulf of Mexico Cobia
TPWD Index

DESCRIPTION OF THE DATA SOURCE

1. Fishery Independent Indices

Item	Not Applicable	Absent	Incomplete	Complete	Working Group Comments:
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

Item	Not Applicable	Absent	Incomplete	Complete	Working Group Comments:
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

Item	Not Applicable	Absent	Incomplete	Complete	Working Group Comments:
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 S&M
C. Discuss procedures used to identify outliers. How many were identified? Were they excluded?				✓	Plotted, 2 SE.

2. Management Regulations (for FD Indices)

	Not Applicable	Absent	Incomplete	Complete	Working Group Comments:
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)

	Not Applicable	Absent	Incomplete	Complete	Working Group Comments:
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

	Not Applicable	Absent	Incomplete	Complete	Working Group Comments:
A. Describe model structure (e.g. delta-lognormal)				✓	
B. Describe construction of GLM components (e.g. forward selection from null etc.)			✓		Details provided upon questioning.
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	Working Group Comments:
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).	✓				Poisson component not explored.
B. Include plots describing error distribution (e.g. Studentized residuals vs. linear predictor.	✓				
C. Include QQ-plot – (e.g. Student deviance residuals vs. theoretical quantiles), Overlay expected distribution.	✓				
D. Include diagnostic plot for variance function (e.g. square root of std residuals vs. fitted values). Overlay expected distribution.	✓				
E. Include diagnostic plot for link function (e.g. linear response variable vs. linear predictor). Overlay expected distribution.	✓				***The feasibility of this diagnostic is still under review.***
4. Zero-inflated model					
A. Include ROC curve to quantify goodness of fit.	✓				
B. Include plots describing error distribution (e.g. Studentized residuals vs. linear predictor).	✓				
C. Include QQ-plot (e.g. Student dev. residuals vs. theoretical quantiles), Overlay expected distribution.	✓				

MODEL DIAGNOSTICS (CONT.)

	Not Applicable	Absent	Incomplete	Complete	Working Group Comments:

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

MODEL RESULTS

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

IF MULTIPLE MODEL STRUCTURES WERE CONSIDERED:

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

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

	Date Received	Workshop Recommendation	Revision Deadline ***	Author and Rapporteur Signatures
First Submission	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, no cobia were caught in bays. The data set was reduced to the nearshore Gulf of Mexico habitat samples, reducing the number of trips by over 90%. The Species Association Approach (Stephens and McCall 2004) was explored to try and identify directed cobia trips; however, this approach did not converge. A number of "ad hoc" approaches to subset directed trips for cobia from the 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 nearshore trips, and an index was constructed using a subset of only positive trips using a lognormal model.

The number of cobia 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 Cobia
Comm. Logbook, Vert Line 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

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

METHODS

1. Data Reduction and Exclusions

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

Working Group Comments:

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

Working Group Comments:

2. Management Regulations (for FD Indices)

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

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

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

4. Model Standardization

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

2D. Only 1 day trips were used to accommodate 2 fish/person trip limit.

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.

Item	Not Applicable	Absent	Incomplete	Complete	Working Group Comments:
1. Binomial Component					
A. Include plots of the chi-square residuals by factor.				✓	1.B,C. Available on demand
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					2B,D,E. Available on demand
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.	✓				***The feasibility of this diagnostic is still under review.***
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.	✓				

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. There was concern that with the 2 fish per person/per day(and trip) trip limit that the total legal-sized cobia landed during the trip could not be accounted for. This would mask any changes in abundance. There was also concern that since cobia most often an opportunistic fishery, that the effort could not be apportioned to the time spent targeting cobia.

Reset Fields

Appendix 5.4
Gulf of Mexico Cobia
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

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

METHODS

1. Data Reduction and Exclusions

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

Working Group Comments:

2D. Absent, but available

2. Management Regulations (for FD Indices)

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

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

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

4. Model Standardization

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

Working Group Comments:

3A-D. Confidential data

4F. Available on Demand

MODEL DIAGNOSTICS

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

Item	Not Applicable	Absent	Incomplete	Complete	Working Group Comments:
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.	✓				***The feasibility of this diagnostic is still under review.***
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.	✓				

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 cobia 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 cobia are often not targeted directly. Instead, these species are caught more opportunistically, meaning they are either encountered by chance when targeting another species, or may be caught by making a brief stop while in transit between ports and offshore fishing grounds. A number of "ad hoc" approaches to subset directed trips for cobia 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 Indices Group decided to use the indices of all trips and accepted the Gulf Headboat Survey index for cobia for recommendation.

Appendix 5.5
Gulf of Mexico Cobia
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

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

METHODS

1. Data Reduction and Exclusions

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

Working Group Comments:

2. Management Regulations (for FD Indices)

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

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

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

4. Model Standardization

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

Working Group Comments:

MODEL DIAGNOSTICS

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

1. Binomial Component

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

2. Lognormal/Gamma Component

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

3. Poisson Component

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

4. Zero-inflated model

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

MODEL DIAGNOSTICS (CONT.)

	Not Applicable	Absent	Incomplete	Complete	Working Group Comments:

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

MODEL RESULTS

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

IF MULTIPLE MODEL STRUCTURES WERE CONSIDERED:

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

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

	Date Received	*Workshop Recommendation*	*Revision Deadline* ***	*Author and Rapporteur Signatures*
First Submission	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 cobia 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 cobia 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 cobia MRFSS index for recommendation. This index was particularly favored because it presents a long time series.