SEDAR

Southeast Data, Assessment, and Review

SEDAR 42

Gulf of Mexico Red Grouper

SECTION III: Assessment Process Report

June 2015

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

Table of Contents

1 Workshop Proceedings

1.1 Introduction

1.1.1. Workshop Time and Place

The SEDAR 42 Assessment Process for Gulf of Mexico red grouper was conducted via a series of webinars held between February and June 2015.

1.1.2. Terms of Reference

1. Review any changes in data following the data workshop and any analyses suggested by the data workshop. Summarize data as used in each assessment model. Provide justification for any deviations from Data Workshop recommendations.
2. Develop population assessment models that are compatible with available data and document input data, model assumptions and configuration, and equations for each model considered.
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, including:
   - Fishing mortality, abundance, biomass, selectivity, stock-recruitment relationship, red grouper being a protogynous hermaphrodite, and other parameters as necessary to describe the population.
   - Appropriate measures of precision for parameter estimates.
5. Characterize uncertainty in the assessment and estimated values.
   - Consider uncertainty in input data, modeling approach, and model configuration.
   - Provide a continuity model consistent with the prior assessment configuration, if one exists, updated to include the most recent observations. Alternative approaches to a strict continuity run that distinguish between model, population, and input data influences on findings, may be considered.
   - Consider and include other sources as appropriate for this assessment.
   - Provide appropriate measures of model performance, reliability, and 'goodness of fit'.
   - Provide measures of uncertainty for estimated parameters.
6. Provide estimates of yield and productivity.
   - Include yield-per-recruit, spawner-per-recruit, and stock-recruitment models.
7. Provide estimates of population benchmarks or management criteria consistent with available data, applicable FMPs, proposed FMPs and Amendments, other ongoing or proposed management programs, and National Standards.
   - Examine the effect of being a protogynous hermaphrodite on stock status criteria and other management benchmarks.
   - Evaluate existing or proposed management criteria as specified in the management summary.
   - Recommend proxy values when necessary.
8. Provide declarations of stock status relative to management benchmarks or alternative data poor approaches if necessary.
9. Provide uncertainty distributions of proposed reference points and stock status metrics that provides the values indicated in the management specifications. Include probability density functions for biological reference point estimates and population metrics (e.g., biomass and exploitation) used to evaluate stock status.
10. Project future stock conditions (biomass, abundance, and exploitation; including probability density functions) and develop rebuilding schedules if warranted; include estimated generation time. Develop stock projections for the following circumstances, in accordance with the guidance on management needs provided in the management history:

    A) If stock is overfished:

    $F=0$, $F_{Current}$, $F=F_{MSY}$, F_{Target}

    $F=F_{Rebuild}$ (max exploitation that rebuild in greatest allowed time)

    Fixed landings equal to the ABC

    B) If stock is overfishing

    $F=F_{Current}$, $F=F_{MSY}$, $F= F_{Target,}$ Fixed landings equal to the ABC

    C) If stock is neither overfished nor overfishing

$F=F_{Current}$, $F=F_{MSY}$, $F=F_{Target}$, Fixed landings equal to the ABC

D) If data limitations preclude classic projections (i.e. A, B, C above), explore alternate models to provide management advice.

11. Provide recommendations for future research and data collection.
    - Be as specific as practicable in describing sampling design and sampling intensity.
    - Emphasize items which will improve future assessment capabilities and reliability.
    - Consider data, monitoring, and assessment needs.
12. Complete the Assessment Workshop Report in accordance with project schedule deadlines (Section III of the SEDAR Stock Assessment Report).

1.1.3. List of Participants

Workshop Panel

Meaghan Bryan, Lead Analyst....................NMFS Miami
Bob Gill....................SSC
Patrick Lynch....................NMFS Silver Spring
Sean Powers....................SSC
Adyan Rios....................NMFS Miami
Skyler Sagarese....................UM
Jim Tolan....................SSC
John Walter....................NMFS Miami

Appointed Observers

Jim Clements....................
Paul Giordano....................

Staff

Julie Neer....................SEDAR
Ryan Rindone....................GMFMC

Additional Participants via Webinar

Neil Baertlein....................NMFS Miami
Shannon Cass-Calay....................NMFS Miami
Nancie Cummings....................NMFS Miami
Michael Drexler....................Ocean Conservancy
Michael Larkin....................NMFS/SERO
Linda Lombardi....................NMFS Panama City
Rich Malinowski....................NMFS/SERO
Vivian Matter....................NMFS Miami
Adam Pollack....................NMFS Pascagoula
Jessica Stephen....................NMFS/SERO
Elbert Whorton....................SSC

1.1.4. List of Assessment Workshop Working Papers

Documents Prepared for the Assessment Process			
SEDAR42-AW-01	Red tide mortality on red grouper (*Epinephelus morio*) between 1980 and 2009 on the West Florida Shelf	Skyler R. Sagarese, Alisha M. Gray, Cameron H. Ainsworth, David D. Chagaris, Behzad Mahmoudi	5 Feb 2015
SEDAR42-AW-02	Standardized catch rates for red grouper from the Unites States Gulf of Mexico vertical line and longline fisheries	Meaghan D. Bryan and Kevin McCarthy	10 March 2015
SEDAR42-AW-03	Standardized Catch Rates of Red Grouper (*Epinephelus morio*) from the U.S. Headboat Fishery in the Gulf of Mexico, 1986-2013	Adyan Rios	13 March 2015
SEDAR42-AW-04	Standardized Catch Rates of Red Grouper (*Epinephelus morio*) from the Gulf of Mexico Recreational Charterboat and Private Boat Fisheries (MRFSS) 1986-2013	Adyan Rios	13 March 2015
SEDAR 42-AW-05	Estimating age- and size-specific natural mortality rates for Gulf of Mexico red grouper (*Epinephelus morio*) using the ecosystem model OSMOSE-WFS	A. Grüss, M. J. Schirripa, D. Chagaris, P. Verley, Y.-J. Shin, L. Velez, C. H. Ainsworth, S. R. Sagarese, and L. Lombardi-Carlson	11 March 2015

1.2 Panel Recommendations and Comment on Terms of Reference

Term of Reference 1: *Review any changes in data following the data workshop and any analyses suggested by the data workshop. Summarize data as used in each assessment model. Provide justification for any deviations from Data Workshop recommendations.*

All changes to the data following the data workshop are reviewed in Section **Error! Reference source not found.**.

Term of Reference 2: *Develop population assessment models that are compatible with available data and document input data, model assumptions and configuration, and equations for each model considered.*

A fully integrated age and length based statistical-catch-at-age model configured using Stock Synthesis was used for the assessment. The model configuration and data inputs are described in Section **Error! Reference source not found.**. See section **Error! Reference source not found.** for a complete description of all data inputs. Appendix A includes the data file to run the Stock Synthesis model.

Term of Reference 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.*

The Assessment Panel recommended that mortality associated with the 2005 red tide event be incorporated into the assessment model. Two alternative approaches to incorporating red tide were explored (see section **Error! Reference source not found.**).

Term of Reference 4: *Provide estimates of stock population parameters, including:*
• Fishing mortality, abundance, biomass, selectivity, stock-recruitment relationship, red grouper being a protogynous hermaphrodite, and other parameters as necessary to describe the population. • Appropriate measures of precision for parameter estimates.

Estimates of assessment model parameters and their associated standard errors are reported in Section 3.1.4 and Table 3.1.1. Estimates of stock biomass, spawning stock biomass, recruitment, and fishing mortality are presented in Table 3.2.2 and Table 3.2 3.

Term of Reference 5: *Characterize uncertainty in the assessment and estimated values.*
• Consider uncertainty in input data, modeling approach, and model configuration.
• Provide a continuity model consistent with the prior assessment configuration, if one exists, updated to include the most recent observations. Alternative approaches to a strict continuity run that distinguish between model, population, and input data influences on findings, may be considered.
• Consider and include other sources as appropriate for this assessment.
• Provide appropriate measures of model performance, reliability, and 'goodness of fit'.
• Provide measures of uncertainty for estimated parameters.

Uncertainty in the assessment and estimated values was characterized using sensitivity analyses. Results of the sensitivity analyses are characterized in Section 3.1.7, Table 3.2.4 - Table 3.2. **6**, and Figure 3.2.67 - Figure 3.2.76. Model convergence was tested by varying starting parameters and refitting the model (Table 3.1.3). Uncertainty in the assessment parameters and estimated values is characterized in Section 3.2.2 and Table 3.2.1.

Term of Reference 6: *Provide estimates of yield and productivity.*
• Include yield-per-recruit, spawner-per-recruit, and stock-recruitment models.

Estimates of yield per recruit and spawner per recruit are summarized in Figure 3.2.84.

Term of Reference 7: *Provide estimates of population benchmarks or management criteria consistent with available data, applicable FMPs, proposed FMPs and Amendments, other ongoing or proposed management programs, and National Standards.*
• Examine the effect of being a protogynous hermaphrodite on stock status criteria and other management benchmarks.

• *Evaluate existing or proposed management criteria as specified in the management summary.*
• *Recommend proxy values when necessary.*
Reference points were calculated for a SSB-female model, where SSB was derived as a function of the proportion of mature females and batch fecundity. Stock synthesis can calculate reference points in terms of yield-per recruit, spawner biomass per-recruit and equilibrium yield as a function of fishing mortality. Reference points were calculated in terms of equilibrium yield. See section 3.1.9 and 3.2.9.

Term of Reference 8: *Provide declarations of stock status relative to management benchmarks or alternative data poor approaches if necessary.*

Stock status was evaluated with respect to the minimum stock size threshold (MSST= (1-M)*SSBmsy) and Fmsy. This terms of reference is addressed in section 3.2.9.

Term of Reference 9: *Provide uncertainty distributions of proposed reference points and stock status metrics that provides the values indicated in the management specifications. Include probability density functions for biological reference point estimates and population metrics (e.g., biomass and exploitation) used to evaluate stock status.*

Estimates of uncertainty in the proposed reference points and stock status will be provided at the review workshop.

Term of Reference 10: *Project future stock conditions (biomass, abundance, and exploitation; including probability density functions) and develop rebuilding schedules if warranted; include estimated generation time. Develop stock projections for the following circumstances, in accordance with the guidance on management needs provided in the management history:*
A) If stock is overfished: F=0, $F_{Current}$, F=F_{MSY}, F_{Target} F=$F_{Rebuild}$ (max exploitation that rebuild in greatest allowed time) Fixed landings equal to the ABC
B) If stock is overfishing F=$F_{Current}$, F=F_{MSY}, F= F_{Target}, Fixed landings equal to the ABC
C) If stock is neither overfished nor overfishing F=$F_{Current}$, F=FMSY, F=F_{Target}, Fixed landings equal to the ABC
D) If data limitations preclude classic projections (i.e. A, B, C above), explore alternate models to provide management advice.

Projections were carried out for three fishing mortality scenarios F = Fmsy, F= Foy, and F=Fcurrent. The projection methods are described in Section 3.1.10 and the results are summarized in Section 3.2.10, Figure 3.2.83, and Table 3.2.7.

Term of Reference 11: *Provide recommendations for future research and data collection.*
• *Be as specific as practicable in describing sampling design and sampling intensity.*
• *Emphasize items which will improve future assessment capabilities and reliability.*
• *Consider data, monitoring, and assessment needs.*

Recommendations are provided in Section 3.3.2.

Term of Reference 12: *Complete the Assessment Workshop Report in accordance with project schedule deadlines (Section III of the SEDAR Stock Assessment Report).*

This report satisfies this Term of Reference.

2 Data Review and Update

The following list summarizes the main data inputs used in the assessment model:

- Life history
  - Age and growth
  - Natural mortality
  - Maturity
  - Sex transition
  - Fecundity
- Landings
  - Commercial vertical line: 1880-2013
  - Commercial longline: 1981-2013
  - Commercial trap: 1964-2006
  - Recreational charterboat and private: 1946-2013
  - Recreational headboat: 1946-2013
  - Commercial Cuban landings in present day US waters: 1937-1977
- Discards
  - Commercial vertical line: 1993-2013
  - Commercial longline: 1993-2013
  - Commercial trap: 1990-2006
  - Recreational charterboat and private: 1981-2013
  - Recreational headboat: 1981-2013
- Age composition of landings
  - Commercial vertical line: 1991-2013
  - Commercial longline: 1991-2013
  - Commercial trap: 1992-2006
  - Recreational charterboat and private: 1991-2013
  - Recreational headboat: 1991-2013
- Length composition of discards
  - Commercial vertical line: 2006-2013
  - Commercial longline: 2006-2013
  - Recreational charterboat: 2010-2013
  - Recreational headboat: 2005-2007 & 2009-2013
- Abundance indices
  - Fishery-independent
    - SEAMAP groundfish: 2009-2013
    - NMFS bottom longline: 2001 & 2003-2013
    - Combined video: 1993-1997, 2002 & 2004-2013
  - Fishery-dependent
    - Commercial vertical line: 1993-2009
    - Commercial longline: 1993-2009
    - Recreational charterboat and private: 1986-2013
    - Recreational headboat: 1986-2013
- Length composition data from fishery-independent survey
    - Combined video: 2002 & 2004-2013

SEAMAP groundfish: 2008-2013
NMFS bottom longline: 2000-2013

Discard mortality
Commercial vertical line
Commercial longline pre-IFQ
Commercial longline post-IFQ
Commercial trap
Recreational fleets

A brief summary of each input will be provided in the following sections.

2.1 Life history

2.1.1 Age and growth

A single von Bertalanffy equation was used to model growth of Red Grouper for both sexes (Figure 2.1.1). The von Bertalanffy parameters; L_{inf}, the asymptotic length, k, the von Bertalanffy growth coefficient, and t_0, the theoretical age at length zero, were fixed within the SS model.

The von Bertalanffy parameter values recommended from the Data Workshop and described in SEDAR42-DW10 were:

L_{inf} (cm FL) = 82.89
K (year^{-1}) = 0.1251
t_0 (year) = -1.20

The recommendation from the Data Workshop (DW) was to model the distribution of length at age using a constant CV at age (CV = 0.15). More recently, the distribution of length at age was modeled with a CV that increased linearly (CV_{young} = 0.1435 and CV_{old} = 0.1647). Furthermore, t_0 was adjusted to account for peak spawning on May 15th. The von Bertalanffy parameter values used in the SS model were:

L_{inf} (cm FL) = 82.72
K (year^{-1}) = 0.1243
t_0 (year) = -0.89

Meristic relationships were provided at the Data Workshop. The parameters describing these relationships are summarized in Table 2.1.1.

2.1.2 Natural mortality

The recommendation from the Data Workshop was to estimate natural mortality using the Lorenzen (2005) estimator with a target M determined using Hoenig (1983) and a maximum age of 29 years. The natural mortality vector was fixed within the assessment model. The natural mortality vector along with the lower and upper ranges are included in table 2.1.2 and plotted in Figure 2.1.2.

2.1.3 Maturity

A logistic relationship was recommended by the DW to model maturity. The logistic fit via the Gompertz equation predicts age at 50% maturity to be 2.8 years (Figure 2.1.3).

$$\text{Proportion mature at age} = \exp(-\exp(-(-2.55+1.05*\text{age}))).$$

2.1.4 Sex transition

A logistic relationship was recommended by the Data Workshop to model transition of females to males. The logistic fit via the Gompertz equation predicts 50% male at age 11.2 years (Figure 2.1.4).

$$\text{Proportion female at age} = \exp(-\exp(-(2.14-0.16*\text{age})))$$

2.1.5 Fecundity

The Data Workshop recommendation of a power function fit to batch fecundity data was used to model female reproductive potential (Figure 2.1.5).

$$\text{Batch fecundity (in thousands)} = 3.878 * \text{age}^{2.12}$$

In the combined single sex SS model, males and females were treated identically. To account for a decrease in fecundity as females transition and become males, the equation characterizing total fecundity at age was modeled as the proportion female * proportion mature * batch fecundity (Figure 2.1.6). The fecundity at age vector was fixed within the SS model.

2.2 Landings

2.2.1 Commercial landings

The commercial landings reviewed at the Data Workshop and described in SEDAR42-RD-02 are presented in Table 2.2.1 and in Figure 2.2.1 (units converted to metric tons). The commercial landings are available by gear including vertical line, longline, trap, and 'other'. Prior to 1982, almost all of the commercial landings were from the vertical line fishery. In 1983, annual landings by the longline fishery were similar to the landings by the vertical line fishery. In all years after 1990, except 2009 and 2010, landings by the longline fishery made up more than 50% of annual commercial landings. Landings by the trap fishery were largest between 1984 and 2006 and ranged from 5-23% of annual commercial landings.

Landings by vertical line, longline and trap fleets were used in the assessment model. Landings reported under 'other' were excluded as they made up less than 1% of overall commercial landings.

2.2.2 Recreational landings

The recreational landings reviewed at the Data Workshop are presented in Table 2.2.2 and Figure 2.2.2 (units in thousands of fish). The recreational landings are available by mode and include headboat, charterboat, private boat, and shore. Prior to 1981 the private and charterboat landings are only available as a single combined mode. Between 1946 and 1980, the combined private and charterboat mode made up 76-95% of annual recreational landings. Between 1981 and 2013 the private mode made up 45-92%, the charterboat mode made up 4-44%, and the headboat mode made up 2-17% of annual recreational landings.

Landings by the headboat, charterboat, and private modes were used in the assessment model. Landings for the charterboat and private modes were aggregated into a combined mode. Landings reported for the shore mode were excluded since they made up only 1% of overall recreational landings.

2.2.3 Commercial Cuban landings in present day US waters

The numbers of Red Grouper caught in the U.S. Gulf of Mexico and landed in Cuba that were reviewed at the Data Workshop and are presented in Table 2.2.1 and in Figure 2.2.1 (units converted to metric tons, the native units of the Stock Synthesis model). Landings are from 1937 through 1977. During these years, Cuban landings made up 0-68% of annual commercial landings. Missing landings in 1959-1962 were likely attributed to the Cuban revolution. The Cuban landings series ends in 1977 due to the expansion of the US Exclusive Economic Zone (EEZ) to 200 nautical miles and the expulsion of Cuban vessels.

Landings in US waters by the Cuban vertical line fleet were used in explorations of the assessment model where the start year was set to 1880. However, these landings were not included in model runs that started in 1986.

2.3 Discards

2.3.1 Commercial discards

The commercial discards are available by gear for vertical line, longline and trap. They are summarized in Table 2.3.1 and Figure 2.3.1 (units in thousands of fish). Numbers of discards for the commercial trap fishery were retained from the SEDAR12 2006 benchmark and 2009 update assessments (fish traps were banned in the Gulf of Mexico beginning in 2006). The vertical line and longline commercial discards that were reviewed at the Data Workshop were re-estimated after evaluating the reliability of the logbook effort data used in the discard calculation. Following a Data Workshop research recommendation to investigate appropriate methods for calculating discards using observer reported discard rates and coastal logbook reported fishing effort, effort data were investigated by calculating total landings as kept rate*logbook effort and comparing the results to the estimates of landings compiled from trip ticket data. The calculated landings differed from the trip ticket landings, particularly in the vertical line fishery (Figure 2.3.2 A and B), and an additional investigation of discard calculation using observer reported discard rates and fisher reported total effort is needed. An alternative method was recommended for the current Red Grouper assessment. That alternative method of estimating discards was:

$$\left(\frac{observer\ reported\ Red\ Grouper\ discard\ rate}{observer\ reported\ Red\ Grouper\ kept\ rate}\right) \times Red\ Grouper\ landings$$

For 2007 and 2008, discards were calculated for each year/subregion/season, whereas for 2009-2013, discards were calculated for each year/subregion/season/IFQ allocation category. Calculated discards across strata within each year were summed to obtain yearly total discards.

Strata were:

- Year (2007-2013)
- Subregion (east = statistical zones 1-8, west = 9-21)
- Season (shallow water grouper season – open or closed)
- IFQ allocation available to a vessel during a trip (none or 1+ pounds, applicable to 2009-2013)
- Fishery (shark or reef fish, used for bottom longline discard calculations only – shark fishery discards were calculated using shark fishery observer data, reef fish discards were calculated using reef fish fishery observer data)

For years 1993-2006, discard and kept rates were calculated over the years 2007-2009 for each subregion/season/fishery. Calculated discards across strata within each year were summed to obtain yearly total discards. Prior to 1993, only 20% of Florida vessels were required to report the coastal logbook program, therefore proportion of landings by strata could not be accurately calculated.

2.3.2 Recreational discards

The recreational discards reviewed at the Data Workshop are presented in Table 2.3.2 and Figure 2.3.3 (units in thousands of fish). The recreational landings are available by mode for headboat, charterboat, private boat, and shore. The majority of annual discards, 75% on average, are from the private recreational fleet. The discards from the charterboat, headboat and shore fleets make-up 15%, 6% and 4% on average of annual discards.

Discards by the headboat, charterboat, and private modes were used in the assessment model. The discards from the recreational shore mode were excluded since landings from this fleet were excluded from the model (shore mode made up 1% of overall recreational landings).

2.4 Age composition of landings

2.4.1 Commercial age composition of landings

The age composition data for Red Grouper landed by the commercial fleet are summarized in Figures 2.4.1, 2.4.2 and 2.4.3. Age composition data were available by gear for vertical line, longline, and trap (SEDAR 42-DW-12). The number of aged fish by gear was quite small in some years, particularly for the trap fishery (Table 2.4.1).

Cohorts are apparent in the vertical line data in years 1994-1996, 2000-2003, 2004-2006, 2007-2009, and 2011-2013, corresponding to year classes from 1988, 1995, 1998, 2001 and 2005, respectively (Figure 2.4.1). Although less apparent, the 1998, 2001, and 2005 cohorts were also present in the longline data (Figure 2.4.2). Cohorts were not particularly apparent in the trap data (Figure 2.4.3).

2.4.2 Recreational age composition of landings

The age composition data for Red Grouper landed by the recreational fleet are summarized in Figures 2.4.4 and 2.4.5. Age composition data were available by mode for headboat, charterboat, and private boat. The number of aged fish was quite small in some years, particularly for the private fishery (Table 2.4.1). Data for the charterboat and private modes were aggregated into a combined mode.

Previous SEDAR assessments for Red Grouper modeled the recreational fishery using a single combined fleet. In the current assessment, the recreational fishery was separated into two fleets. The assessment panel agreed to have a separate headboat fleet since mode-specific total landings, total discards, age composition of landings, length composition of discards, and a headboat index of abundance wereavailable. The private and charterboat modes were modeled as a single, combined fleet for the following reasons. First, private and charterboat landings between 1946 and 1980 were only available in a single combined mode (Section 2.2). Further, private and charterboat catch rates from 1986 to 2013 were modeled into a single index of abundance (Section 2.6). Lastly, there were few annual age samples (Section 2.4) and no discard lengths associated with the private recreational fishery (Section 2.5).

Cohorts are apparent in the combined charterboat and private mode data in years 1995-1997, 2000-2002, 2003-2007 and 2009-2012, corresponding to year classes from 1989, 1995, 1998 and 2005, respectively (Figure 2.4.4). The 1989, 1998 and 2005 cohorts are also apparent in the headboat data (Figure 2.4.5). In general, the recreational sector captured younger Red Grouper than the commercial sector.

2.5 Length composition of discards

2.5.1 Commercial length composition of discards

In July 2006, a mandatory observer program was implemented to characterize the commercial reef fish fishery operating in the U.S. Gulf of Mexico (SEDAR42-DW-01). The observer program provides detailed information for each trip and each fish captured, including the size and disposition of Red Grouper caught. Length composition data of discarded fish from the commercial fishery were only available and included in the model for the vertical line and longline fleets for 2006-2013. These data are shown in Figures 2.5.1 and 2.5.2.

A 20 inch (50.8 cm) total length commercial size limit was implemented between 1990 and 2008. This size limit was reduced to 18 inches (45.7 cm) in 2009. The majority of the observed length distribution of discards from the vertical line and longline fisheries have been below the size limits with some observations of larger discarded fish in 2009 (Figures 2.5.1 and 2.5.2).

2.5.2 Recreational length composition of discards

A fisheries observer program on recreational for-hire vessels, including headboats and charter vessels, was implemented in 2005 in the U.S. Gulf of Mexico (SEDAR42-DW14). The observer program provides detailed information for each trip and each fish captured, including the size and disposition of all Red Grouper caught. Length composition data of discarded fish from the recreational fleets were only available and included in the model for the headboat and charterboat fleets. These data are shown in Figures 2.5.3 and 2.5.4.

The recreational fishery has been managed using size limits and bag limits. A 20 inch (50.8 cm) total length recreational size limit was implemented in 1990. Also in 1990, a 5 fish bag limit for Red Grouper was implemented. The recreational bag limit was changed to 2 fish in 2004, and was then further reduced to 1 fish in 2005. The bag limit was increased to 4 fish in 2011. The majority of discards from the recreational charterboat and headboat fisheries have been below the size limits (Figures 2.5.3 and 2.5.4). Discards of fish above the size limit were observed in both fleets and particularly in the charterboat fleet. Generally, the Red Grouper discarded by the recreational sector show a larger range in size than Red Grouper discarded by the commercial sector.

2.6 Measures of population abundance

Fifteen indices of abundance were presented and considered during the Data Workshop, seven of which were recommended for use. The indices of abundance that were recommended for use in the assessment include:

Fishery-independent indices	
SEAMAP groundfish	2009-2013
NMFS bottom longline	2001 & 2003-2013
Combined video	1993-1997, 2002 & 2004-2013
Fishery-dependent indices	
Commercial vertical line	1993-2009
Commercial longline	1993-2009
Recreational charterboat and private	1986-2013
Recreational headboat	1986-2013

Three of the seven recommended indices were from fishery-independent data sources: the SEAMAP summer groundfish survey, the NMFS bottom longline survey, and the combined SEAMAP, Panama City and FWRI video survey (Table 2.6.1 and Figures 2.6.1 – 2.6.3). The SEAMAP groundfish index was derived as the number of Red Grouper caught per trawl hour. The NMFS bottom longline index was derived as the number of Red Grouper caught per 100 hook hours. The combined video survey was derived as the minimum count of Red Grouper (maximum number of individuals in the field of view at one instance) per 20 minute recording.

There were four recommended fishery-dependent indices: the Marine Recreational Fishery Statistic Survey (MRFSS) index, the Southeast Regional Headboat Survey index (SERHS), the commercial vertical line index, and the commercial longline index (Table 2.6.2 and Figures 2.6.4 – 2.6.7). The SERHS index was derived using numbers of Red Grouper landed per angler hour and the MRFSS index, which represents the charterboat and private modes, was derived using the numbers of Red Grouper landed or discarded per angler hour. The commercial vertical line index was derived as pounds of Red Grouper landed per hook hour. The commercial longline index was derived as pounds of Red Grouper landed per number of hooks fished. The recommended terminal year for both commercial indices was 2009, prior to the implementation of commercial individual fishing quotas in 2010. This terminal year was chosen because the influence of individual fishing quotas is not well understood.

The standardized indices of relative abundance and associated CVs used in the assessment are presented in Tables 2.6.1 and 2.6.2. For input into the Stock Synthesis assessment model, the coefficients of variation (CV) associated with the standardized indices were converted to log-scale standard errors by:

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

A brief summary of the limitations of the 8 rejected indices will be provided here but the reader is referred to the SEDAR 42 Data Workshop Report for a more comprehensive explanation.

Of the datasets/indices not recommended for use, three (SEAMAP VIDEO, Panama City Video, and FWRI Video) were combined into the Combined Video index. Two trap indices, the Panama City Trap and the FWRI Trap indices, which covered the same portion of the population as the Combined Video index, were not recommended because they had lower spatial coverage and a shorter time series than the Combined Video index. The Commercial Trap and Everglades National Park Creel indices were not recommended because of low numbers of Red Grouper present in the data. Finally, the Headboat Observer Discard index, which covers sub-legal sized fish, was not recommended for two reasons. The first reason is that the observed discards covered similar sizes of fish but had lower spatial coverage and a shorter time series when compared to the Combined Video index. The second reason is that only one fishery-dependent index can represent a single fleet in the assessment model and the Southeast Region Headboat index was favored over the Headboat Observer Discard index to represent the headboat fleet.

2.7 Length composition data from fishery-independent surveys

The length composition data for the fishery-independent surveys are plotted in Figures 2.7.1 – 2.7.3. Cohorts were not particularly apparent in the length composition data for the surveys. Generally, smaller Red Grouper were observed in the SEAMAP groundfish survey than in the combined video and bottom longline surveys.

2.8 Discard Mortality

The Data Workshop included a working group that focused on discard mortality. Based on new data available since the previous assessment (see the SEDAR 42 Data Workshop Report), the following discard mortality rates were used in the assessment model for SEDAR42:

1. An estimate of 11.6% for the recreational fishery (sensitivity range 5.8% to 14.5%).
2. An estimate of 19.0% for the commercial vertical line fishery (sensitivity range 10.0% to 31.0%).
3. An estimate of 41.4% for the commercial bottom longline fishery pre-IFQ (sensitivity range 34.3% to 48.7%).
4. An estimate of 43.6% for the commercial bottom longline fishery post-IFQ (sensitivity range 36.7% to 50.8%).

5. An estimate of 10% for the commercial trap fishery. No new data on discard mortality rates were available for the commercial trap fishery. This estimate was retained from the SEDAR12 2006 benchmark and 2009 update assessments.

2.9 Tables

Table 2.1.1 Meristic regressions for Red Grouper (1978-2013) from the Gulf of Mexico. Data combined from all data sources, both fishery-independent and dependent. Length Type: Max TL – Maximum Total Length, FL – Fork Length, Nat TL – Natural Total Length, SL – Standard Length. Weight Type: G Wt – Gutted Weight, W Wt – Whole Weight. Units: length (mm) and weight (kg). Linear and non-linear regressions calculated using R (lm and nls functions, respectively).

Regression	Equation	Statistic	N	Data Range
Max TL to FL	FL = 5.35 + max_TL *0.95	r^2 = 0.9963	5818	Max TL: 120 – 954; FL: 116 – 910
Nat TL to FL	FL = 5.71 + nat_TL * 0.95	r^2 = 0.9909	3901	Nat TL: 151 – 957; FL: 149 – 910
SL to FL	FL = 15.90 + SL * 1.14	r^2 = 0.9938	985	SL: 130 – 686; FL: 159 – 830
SL to Max TL	Max_TL = 9.19 + SL * 1.21	r^2 = 0.9944	3399	SL: 130 – 720; Max TL: 161 – 876
SL to Nat TL	Nat_TL = -51.18 + SL * 1.32	r^2 = 0.9791	7	SL: 404 – 670; Nat TL: 484 – 860
Max TL to G Wt	GWT = 4.33 x 10^{-8}* (max_TL^$^{2.83}$)	RSE = 0.7421	633	Max TL: 458 – 980; G WT: 0.82 – 15.05
Max TL to W Wt	WWT = 5.21 x 10^{-09}* (max_TL^$^{3.16}$)	RSE = 0.5152	3725	Max TL: 127 – 954; W WT: 0.03 – 16.96
Nat TL to G Wt	GWT = 5.70 x 10^{-08}* (nat_TL^$^{2.78}$)	RSE = 0.6398	34	Nat TL: 490 – 802; G WT: 1.28 – 7.17
Nat TL to W Wt	WWT = 7.58 x 10^{-09}* (nat_TL^$^{3.10}$)	RSE = 0.3482	3912	Nat TL: 120 – 957; W WT: 0.02 – 14.00
FL to G Wt	GWT = 3.37 10^{-09}* (FL^$^{3.25}$)	RSE = 0.3499	37414	FL: 230 – 935; G WT: 0.26 – 16.96
FL to W Wt	WWT = 5.46 x 10^{-09}* (FL^$^{3.18}$)	RSE = 0.4667	7361	FL: 123 – 965; W WT: 0.05 – 16.96
SL to W Wt	WWT = 2.32 x 10^{-08}* (SL^$^{3.03}$)	RSE = 0.1825	483	SL: 147 – 670; W WT: 0.10 – 9.00

Table 2.1.2 Recommended values for age-specific natural mortality for Red Grouper in the Gulf of Mexico. The standard deviation (± 5 yrs) at age for the maximum age (29 yrs) was used to calculate the upper and lower range for natural mortality.

Age	Age-specific natural mortality	Lower	Upper
0	0.5837	0.5053	0.7336
1	0.3952	0.3421	0.4967
2	0.3082	0.2669	0.3874
3	0.2583	0.2236	0.3247
4	0.2261	0.1957	0.2841
5	0.2036	0.1763	0.256
6	0.1873	0.1621	0.2354
7	0.1749	0.1514	0.2198
8	0.1652	0.1431	0.2077
9	0.1576	0.1364	0.198
10	0.1514	0.1311	0.1903
11	0.1463	0.1267	0.1839
12	0.1421	0.123	0.1786
13	0.1386	0.12	0.1742
14	0.1356	0.1174	0.1705
15	0.1331	0.1152	0.1673
16	0.131	0.1134	0.1646
17	0.1291	0.1118	0.1623
18	0.1276	0.1105	0.1603
19	0.1262	0.1093	0.1586
20	0.125	0.1083	0.1572
21	0.124	0.1074	0.1559
22	0.1231	0.1066	0.1548
23	0.1224	0.106	0.1538
24	0.1217	0.1054	0.153
25	0.1211	0.1049	0.1522
26	0.1206	0.1044	0.1516
27	0.1202	0.104	0.151
28	0.1198	0.1037	0.1505
29	0.1194	0.1034	0.1501

Table 2.2.1 Annual Red Grouper commercial landings from the U.S. Gulf of Mexico in metric tons gutted weight from 1880-2013.

Commercial Landings in Metric Tons						
Year	Vertical Line	Longline	Trap	Other	Cuban Vertical Line	Total Commercial
1880	686.997	0.000	0.000	0.000	0.000	686.997
1881	620.472	0.000	0.000	0.000	0.000	620.472
1882	553.947	0.000	0.000	0.000	0.000	553.947
1883	487.421	0.000	0.000	0.000	0.000	487.421
1884	420.895	0.000	0.000	0.000	0.000	420.895
1885	354.369	0.000	0.000	0.000	0.000	354.369
1886	287.844	0.000	0.000	0.000	0.000	287.844
1887	221.318	0.000	0.000	0.000	0.000	221.318
1888	159.244	0.000	0.000	0.000	0.000	159.244
1889	173.697	0.000	0.000	0.000	0.000	173.697
1890	166.687	0.000	0.000	0.000	0.000	166.687
1891	190.366	0.000	0.000	0.000	0.000	190.366
1892	214.046	0.000	0.000	0.000	0.000	214.046
1893	237.726	0.000	0.000	0.000	0.000	237.726
1894	261.406	0.000	0.000	0.000	0.000	261.406
1895	273.991	0.000	0.000	0.000	0.000	273.991
1896	287.227	0.000	0.000	0.000	0.000	287.227
1897	295.172	0.000	0.000	0.000	0.000	295.172
1898	289.298	0.000	0.000	0.000	0.000	289.298
1899	284.818	0.000	0.000	0.000	0.000	284.818
1900	275.815	0.000	0.000	0.000	0.000	275.815
1901	264.775	0.000	0.000	0.000	0.000	264.775
1902	298.395	0.000	0.000	0.000	0.000	298.395
1903	308.433	0.000	0.000	0.000	0.000	308.433
1904	316.754	0.000	0.000	0.000	0.000	316.754
1905	323.373	0.000	0.000	0.000	0.000	323.373
1906	332.766	0.000	0.000	0.000	0.000	332.766
1907	336.208	0.000	0.000	0.000	0.000	336.208
1908	337.999	0.000	0.000	0.000	0.000	337.999
1909	410.998	0.000	0.000	0.000	0.000	410.998
1910	468.978	0.000	0.000	0.000	0.000	468.978
1911	556.488	0.000	0.000	0.000	0.000	556.488
1912	644.279	0.000	0.000	0.000	0.000	644.279
1913	732.350	0.000	0.000	0.000	0.000	732.350
1914	820.702	0.000	0.000	0.000	0.000	820.702
1915	909.335	0.000	0.000	0.000	0.000	909.335

Table 2.2.1 (Continued) Annual Red Grouper commercial landings from the U.S. Gulf of Mexico in metric tons gutted weight from 1880-2013.

Commercial Landings in Metric Tons						
Year	Vertical Line	Longline	Trap	Other	Cuban Vertical Line	Total Commercial
1916	998.249	0.000	0.000	0.000	0.000	998.249
1917	1087.443	0.000	0.000	0.000	0.000	1087.443
1918	1176.918	0.000	0.000	0.000	0.000	1176.918
1919	1124.535	0.000	0.000	0.000	0.000	1124.535
1920	1071.979	0.000	0.000	0.000	0.000	1071.979
1921	1019.249	0.000	0.000	0.000	0.000	1019.249
1922	966.345	0.000	0.000	0.000	0.000	966.345
1923	913.267	0.000	0.000	0.000	0.000	913.267
1924	894.808	0.000	0.000	0.000	0.000	894.808
1925	875.637	0.000	0.000	0.000	0.000	875.637
1926	855.755	0.000	0.000	0.000	0.000	855.755
1927	836.900	0.000	0.000	0.000	0.000	836.900
1928	858.404	0.000	0.000	0.000	0.000	858.404
1929	946.896	0.000	0.000	0.000	0.000	946.896
1930	633.553	0.000	0.000	0.000	0.000	633.553
1931	560.586	0.000	0.000	0.000	0.000	560.586
1932	723.965	0.000	0.000	0.000	0.000	723.965
1933	947.109	0.000	0.000	0.000	0.000	947.109
1934	912.600	0.000	0.000	0.000	0.000	912.600
1935	1146.351	0.000	0.000	0.000	0.000	1146.351
1936	1397.849	0.000	0.000	0.000	0.000	1397.849
1937	1514.672	0.000	0.000	0.000	2942.136	4456.808
1938	1393.206	0.000	0.000	0.000	2942.136	4335.342
1939	2083.867	0.000	0.000	0.000	2942.136	5026.003
1940	1477.932	0.000	0.000	0.000	2942.136	4420.068
1941	1581.255	0.000	0.000	0.000	2942.136	4523.391
1942	1828.679	0.000	0.000	0.000	1197.935	3026.614
1943	1905.614	0.000	0.000	0.000	920.542	2826.156
1944	2151.527	0.000	0.000	0.000	1360.752	3512.279
1945	2252.730	0.000	0.000	0.000	756.891	3009.621
1946	2448.134	0.000	0.000	0.000	812.822	3260.956
1947	2460.674	0.000	0.000	0.000	858.088	3318.762
1948	2382.752	0.000	0.000	0.000	892.689	3275.441
1949	2432.453	0.000	0.000	0.000	916.625	3349.078
1950	1627.280	0.000	0.000	0.000	929.896	2557.176
1951	1832.909	0.000	0.000	0.000	932.501	2765.410

Table 2.2.1 (Continued) Annual Red Grouper commercial landings from the U.S. Gulf of Mexico in metric tons gutted weight from 1880-2013.

Commercial Landings in Metric Tons						
Year	Vertical Line	Longline	Trap	Other	Cuban Vertical Line	Total Commercial
1952	1160.141	0.000	0.000	0.000	924.441	2084.582
1953	898.587	0.000	0.000	0.000	905.716	1804.304
1954	822.813	0.000	0.000	0.000	876.326	1699.140
1955	757.298	0.000	0.000	0.000	836.271	1593.569
1956	1056.799	0.000	0.000	0.000	884.107	1940.907
1957	1293.115	0.000	0.000	0.000	1258.068	2551.183
1958	1325.103	0.000	0.000	0.000	966.525	2291.627
1959	1790.434	0.000	0.000	0.000	0.000	1790.434
1960	2052.356	0.000	0.000	0.000	0.000	2052.356
1961	2015.890	0.000	0.000	0.000	0.000	2015.890
1962	2359.066	0.000	0.000	0.000	0.000	2359.066
1963	1616.872	0.000	0.000	1.308	460.788	2078.968
1964	1878.026	0.000	2.099	6.246	985.746	2872.117
1965	2094.211	0.000	2.292	0.000	1916.580	4013.083
1966	2010.955	0.000	2.972	0.496	2274.056	4288.479
1967	1625.397	0.000	3.358	7.007	2391.069	4026.832
1968	1788.373	0.000	6.128	1.454	2508.082	4304.038
1969	2080.768	0.000	3.540	0.933	2625.096	4710.336
1970	2027.152	0.000	5.516	0.000	2551.595	4584.263
1971	1729.196	0.000	5.511	0.000	1426.257	3160.964
1972	1797.869	0.000	1.033	0.005	1454.697	3253.604
1973	1387.552	0.000	0.000	0.240	2744.581	4132.373
1974	1618.772	0.000	0.000	0.375	1828.073	3447.220
1975	1956.078	0.000	5.636	0.074	1828.073	3789.861
1976	1690.673	0.000	5.173	0.000	1828.073	3523.919
1977	1350.602	0.000	18.993	2.048	1828.073	3199.715
1978	1238.823	0.000	40.321	2.553	0.000	1281.697
1979	1714.108	0.000	31.813	0.000	0.000	1745.921
1980	1745.249	0.000	20.309	4.841	0.000	1770.399
1981	1507.819	0.001	30.248	4.457	0.000	1542.526
1982	1394.360	369.979	22.689	5.894	0.000	1792.921
1983	1318.835	1389.905	0.503	5.738	0.000	2714.981
1984	1336.999	1128.127	141.326	1.519	0.000	2607.971
1985	1654.628	940.352	290.486	3.303	0.000	2888.770
1986	1421.948	1136.626	327.249	5.088	0.000	2890.912
1987	1153.087	1712.243	203.246	5.027	0.000	3073.603

Table 2.2.1 (Continued) Annual Red Grouper commercial landings from the U.S. Gulf of Mexico in metric tons gutted weight from 1880-2013.

Commercial Landings in Metric Tons						
Year	Vertical Line	Longline	Trap	Other	Cuban Vertical Line	Total Commercial
1988	929.465	994.634	245.043	2.371	0.000	2171.514
1989	1730.406	1414.392	268.877	5.013	0.000	3418.688
1990	1116.269	918.839	154.628	2.425	0.000	2192.161
1991	949.748	1171.895	169.529	15.371	0.000	2306.543
1992	655.426	1092.953	273.147	3.917	0.000	2025.443
1993	589.817	1938.815	322.543	19.629	0.000	2870.805
1994	563.102	1224.284	414.504	17.092	0.000	2218.982
1995	531.270	1101.965	479.444	7.277	0.000	2119.956
1996	392.427	1318.679	244.649	4.609	0.000	1960.364
1997	430.177	1371.747	311.088	3.102	0.000	2116.115
1998	336.390	1207.755	134.966	2.326	0.000	1681.437
1999	550.097	1730.638	341.019	7.906	0.000	2629.660
2000	780.627	1319.655	464.846	13.789	0.000	2578.916
2001	705.660	1542.048	337.150	9.641	0.000	2594.499
2002	738.529	1419.999	444.653	8.384	0.000	2611.565
2003	507.236	1344.782	318.271	5.585	0.000	2175.874
2004	624.441	1534.715	338.021	6.409	0.000	2503.586
2005	636.955	1456.744	277.924	5.625	0.000	2377.248
2006	624.002	1366.521	266.189	4.062	0.000	2260.774
2007	708.094	900.102	0.000	5.941	0.000	1625.239
2008	856.484	1271.938	0.000	11.237	0.000	2139.659
2009	1109.096	510.213	0.000	55.212	0.000	1674.521
2010	614.033	596.212	0.000	125.008	0.000	1335.253
2011	765.790	1381.228	0.000	22.811	0.000	2169.836
2012	1011.300	1333.590	0.000	22.470	0.000	2367.359
2013	698.756	1368.763	0.000	18.553	0.000	2086.071

Table 2.2.2. Annual Red Grouper recreational landings from the U.S. Gulf of Mexico in thousands of fish from 1946-2013.

Recreational Landings in Thousands of Fish						
Year	Charterboat	Private	Combined Charterboat Private	Headboat	Shore	Total Recreational
1946	-	-	12.022	0.689	0.000	12.711
1947	-	-	24.044	1.378	0.000	25.422
1948	-	-	36.067	2.066	0.000	38.133
1949	-	-	48.089	2.755	0.000	50.844
1950	-	-	60.111	3.444	0.000	63.555
1951	-	-	72.133	4.133	0.000	76.266
1952	-	-	84.155	4.821	0.000	88.977
1953	-	-	96.178	5.510	0.000	101.688
1954	-	-	108.200	6.199	0.000	114.399
1955	-	-	120.222	6.888	0.000	127.110
1956	-	-	127.848	9.184	0.000	137.032
1957	-	-	135.474	11.480	0.000	146.953
1958	-	-	143.100	13.775	0.000	156.875
1959	-	-	150.726	16.071	0.000	166.797
1960	-	-	158.352	18.367	0.000	176.719
1961	-	-	158.764	20.663	0.000	179.428
1962	-	-	159.177	22.959	0.000	182.136
1963	-	-	159.589	25.255	0.000	184.844
1964	-	-	160.002	27.551	0.000	187.553
1965	-	-	160.415	29.847	0.000	190.261
1966	-	-	164.277	32.602	0.000	196.879
1967	-	-	168.140	35.357	0.000	203.497
1968	-	-	172.002	38.112	0.000	210.114
1969	-	-	175.865	40.867	0.000	216.732
1970	-	-	179.727	43.622	0.000	223.349
1971	-	-	186.048	43.622	0.000	229.670
1972	-	-	192.369	45.918	0.000	238.287
1973	-	-	198.690	48.214	0.000	246.904
1974	-	-	205.011	48.214	0.000	253.225
1975	-	-	211.332	66.581	0.000	277.914
1976	-	-	223.354	64.285	0.000	287.639
1977	-	-	235.376	59.694	0.000	295.069
1978	-	-	247.397	57.398	0.000	304.795
1979	-	-	259.419	64.285	0.000	323.704
1980	-	-	271.441	64.285	0.000	335.726
1981	44.565	77.072	121.637	24.813	0.000	146.450

Table 2.2.2 (Continued) Annual Red Grouper recreational landings from the U.S. Gulf of Mexico in thousands of fish from 1946-2013.

Recreational Landings in Thousands of Fish						
Year	Charterboat	Private	Combined Charterboat Private	Headboat	Shore	Total Rec.
1982	9.413	163.825	173.238	5.241	0.000	178.479
1983	27.335	351.074	378.409	15.219	0.000	393.628
1984	75.279	118.114	193.393	41.913	28.098	263.404
1985	107.215	418.989	526.204	59.694	0.000	585.898
1986	79.799	525.519	605.318	32.913	6.969	645.200
1987	38.279	298.229	336.508	25.729	0.000	362.237
1988	51.948	687.306	739.254	27.954	9.160	776.368
1989	38.012	713.005	751.017	49.777	0.000	800.794
1990	50.212	130.122	180.334	14.582	16.048	210.964
1991	11.401	284.585	295.986	9.509	10.155	315.650
1992	52.191	419.526	471.717	9.049	26.238	507.004
1993	27.501	331.594	359.095	8.802	18.946	386.843
1994	32	279.441	311.441	9.617	2.750	323.808
1995	59.008	226.726	285.734	14.499	0.000	300.233
1996	22.673	87.205	109.878	15.594	0.000	125.472
1997	22.229	55.004	77.233	4.676	0.000	81.909
1998	25.665	83.245	108.910	4.382	0.000	113.292
1999	34.514	160.692	195.206	6.918	0.000	202.124
2000	126.774	240.164	366.938	8.861	0.000	375.799
2001	63.966	173.124	237.090	5.560	0.000	242.650
2002	49.186	218.694	267.880	4.402	0.000	272.282
2003	53.85	164.178	218.028	7.521	0.000	225.549
2004	91.84	438.051	529.891	13.810	0.000	543.701
2005	86.712	96.952	183.664	13.967	0.000	197.631
2006	37.001	94.509	131.510	4.630	0.000	136.140
2007	26.289	128.452	154.741	4.245	0.000	158.986
2008	41.527	91.601	133.128	5.003	0.000	138.131
2009	28.96	95.599	124.559	4.666	1.607	130.832
2010	55.165	100.922	156.087	4.952	0.000	161.039
2011	48.798	62.111	110.909	7.387	0.000	118.296
2012	91.304	208.979	300.283	13.544	0.000	313.827
2013	139.184	301.203	440.387	14.089	0.000	454.476

Table 2.3.1 Annual Red Grouper commercial discards from the U.S. Gulf of Mexico in thousands of fish from 1990-2013.

Commercial Discards in Thousands of Fish				
Year	Vertical Line	Longline	Trap	Total Commercial
1990			69.050	69.050
1991			131.400	131.400
1992			87.500	87.500
1993	510.274	3188.763	169.870	3868.907
1994	487.564	2024.416	53.900	2565.880
1995	459.256	1885.655	124.730	2469.641
1996	338.619	2308.812	732.740	3380.171
1997	370.695	2336.638	598.570	3305.903
1998	290.808	2053.713	50.190	2394.710
1999	474.742	2926.611	106.190	3507.543
2000	674.094	2186.000	234.980	3095.074
2001	728.260	2479.017	167.620	3374.898
2002	853.126	2296.999	146.060	3296.185
2003	549.732	2194.268	134.700	2878.700
2004	709.340	2497.772	81.900	3289.012
2005	829.348	2359.919	122.090	3311.357
2006	612.745	2216.679	139.270	2968.695
2007	553.145	1511.243		2064.388
2008	975.072	1275.026		2250.098
2009	1289.459	793.207		2082.665
2010	994.088	616.223		1610.311
2011	593.650	1408.009		2001.659
2012	599.240	1133.235		1732.476
2013	405.278	840.290		1245.567

Table 2.3.2 Annual Red Grouper recreational discards from the U.S. Gulf of Mexico in thousands of fish from 1981-2013.

Recreational Discards in Thousands of Fish						
Year	Charterboat	Private	Combined Charterboat Private	Headboat	Shore	Total Recreational
1981	7.906	53.292	61.198	4.005	11.623	76.826
1982	3.078	35.734	38.812	1.559	0.000	40.371
1983	6.516	42.091	48.607	3.301	0.000	51.908
1984	18.893	27.223	46.116	9.570	0.000	55.686
1985	27.212	35.973	63.185	13.784	31.584	108.553
1986	75.968	388.292	464.260	57.059	36.162	557.481
1987	55.687	255.963	311.650	68.103	0.000	379.753
1988	45.691	727.407	773.098	44.776	71.741	889.615
1989	112.586	1718.771	1831.357	268.558	11.065	2110.980
1990	217.875	1244.607	1462.482	115.232	128.784	1706.498
1991	57.281	2586.268	2643.549	87.707	206.175	2937.431
1992	165.448	2115.433	2280.881	52.245	505.104	2838.230
1993	133.344	1444.787	1578.131	77.613	46.668	1702.412
1994	119.009	1344.305	1463.314	65.148	101.182	1629.644
1995	165.497	1295.002	1460.499	74.073	2.252	1536.824
1996	62.371	705.629	768.000	78.145	20.857	867.002
1997	108.861	703.972	812.833	41.698	33.507	888.038
1998	326.922	1139.286	1466.208	101.358	10.471	1578.037
1999	393.899	1572.920	1966.819	143.725	21.518	2132.062
2000	634.966	1524.541	2159.507	80.840	23.009	2263.356
2001	279.996	1289.411	1569.407	44.312	0.000	1613.719
2002	273.975	1571.390	1845.365	44.637	0.000	1890.002
2003	386.452	1573.177	1959.629	98.172	5.635	2063.436
2004	452.240	2697.519	3149.759	123.862	39.812	3313.433
2005	274.709	999.489	1274.198	80.594	7.549	1362.341
2006	127.967	503.284	631.251	29.164	0.000	660.415
2007	133.750	666.434	800.184	17.365	19.033	836.582
2008	425.320	2549.796	2975.116	89.615	556.633	3621.364
2009	479.498	2713.425	3192.923	153.829	117.783	3464.535
2010	543.936	1667.811	2211.747	117.879	6.583	2336.209
2011	502.370	1526.879	2029.249	134.114	9.170	2172.533
2012	539.422	1202.880	1742.302	117.809	6.982	1867.093
2013	613.660	2036.644	2650.304	112.267	1.281	2763.852

Table 2.4.1 Number of Red Grouper aged in the Gulf of Mexico by year and fleet.

Number of Aged Fish									
	Commercial				Recreational				
Year	Vertical Line	Longline	Trap	Total	Charterboat	Private	Combined CBT/PRI	Headboat	Total
1980								5	5
1981								13	13
1985								1	1
1986								8	8
1987								11	11
1988								10	10
1989								11	11
1991	43	37	2	80	1	0	1	36	37
1992	42	143	14	185	24	1	25	33	58
1993	93	200	84	293	61	1	62	21	83
1994	239	88	29	327	72	0	72	29	101
1995	180	140	39	320	91	0	91	53	144
1996	141	96	8	237	134	0	134	41	175
1997	35	7	17	42	61	9	70	28	98
1998	39	122	33	161	72	4	76	21	97
1999	77	643	31	720	104	2	106	8	114
2000	206	405	38	611	59	0	59	12	71
2001	575	1210	39	1785	45	2	47	1	48
2002	573	1067	89	1640	292	7	299	50	349
2003	561	1080	65	1641	101	68	169	30	199
2004	1062	1153	38	2215	144	41	185	43	228
2005	626	1455	173	2081	64	1	65	52	117
2006	629	538		1167	38	6	44	33	77
2007	497	599		1096	52	10	62	28	90
2008	503	509		1012	73	32	105	44	149
2009	895	994		1889	90	27	117	102	219
2010	1030	650		1680	263	47	310	85	395
2011	629	499		1128	391	13	404	114	518
2012	1019	861		1880	223	14	237	39	276
2013	558	1130		1688	216	25	241	45	286

Table 2.5.1 Number of discarded Red Grouper lengths measured in the Gulf of Mexico by year and fleet.

Number of Discard Length Measurements						
	Commercial			Recreational		
Year	Vertical Line	Longline	Total	Charterboat	Headboat	Total
2005					1126	1126
2006	937	3926	4863		1058	1058
2007	2064	2931	4995		1633	1633
2008	1073	920	1993			
2009	1529	6496	8025		1734	1734
2010	2980	18735	21715	2313	1592	3905
2011	5190	40572	45762	1834	1056	2890
2012	8917	12028	20945	1324	635	1959
2013	2291	22261	24552	1195	772	1967

Table 2.6.1 Fishery-independent standardized indices of abundance and associated log-scale standard errors for the Gulf of Mexico Red Grouper. The indices are scaled to a mean of one over each respective time series.

Fishery-Independent Indices						
Year	Combined Video		NMFS Bottom Longline		SEAMAP Groundfish	
	Index	SE	Index	SE	Index	SE
1993	0.7660	0.1634				
1994	1.0119	0.1660				
1995	1.0444	0.1890				
1996	0.9761	0.1354				
1997	1.1872	0.1042				
1998						
1999						
2000						
2001			0.6445	0.2868		
2002	1.1571	0.1082				
2003			0.8907	0.2003		
2004	1.3156	0.0979	1.4493	0.1906		
2005	1.0877	0.0809	0.5438	0.3892		
2006	0.9176	0.0812	0.4974	0.3767		
2007	0.5652	0.1132	0.7700	0.4413		
2008	0.6947	0.0962	0.5298	0.3132		
2009	0.8743	0.0724	0.8180	0.2587	1.4703	0.2646
2010	1.1093	0.0632	1.1009	0.2597	0.9486	0.2701
2011	1.2464	0.0506	2.0208	0.1799	0.9334	0.2890
2012	1.0255	0.0600	1.8742	0.2503	0.9518	0.2514
2013	1.0211	0.0741	0.8606	0.2980	0.6959	0.2831

Table 2.6.2. Fishery-dependent standardized indices of abundance and associated log-scale standard errors for Gulf of Mexico Red Grouper. The indices are scaled to a mean of one over each respective time series.

Fishery-Dependent Indices								
Year	Commercial Vertical Line		Commercial Longline		Recreational MRFSS		Recreational Headboat	
	Index	SE	Index	SE	Index	SE	Index	SE
1986					1.0925	0.2752	1.0334	0.6450
1987					0.8681	0.3258	1.6494	0.5837
1988					1.1339	0.3675	1.6056	0.5734
1989					1.3293	0.3179	1.5487	0.5934
1990					1.5569	0.2834	0.6990	0.6698
1991					1.4756	0.3589	0.4941	0.7086
1992					1.2438	0.3113	0.4723	0.7077
1993	0.7311	0.3042	0.9785	0.0535	0.7682	0.3662	0.6343	0.6513
1994	0.7160	0.3006	0.7235	0.0474	0.8707	0.3448	0.5523	0.6713
1995	0.7886	0.3041	0.7742	0.0491	0.8627	0.3396	0.8352	0.6310
1996	0.4907	0.3126	1.0397	0.0513	0.5555	0.3998	0.4933	0.6856
1997	0.5647	0.3132	0.9069	0.0428	0.5467	0.4064	0.4750	0.6884
1998	0.5185	0.3119	0.9552	0.0441	0.6533	0.3583	0.5671	0.6762
1999	0.7399	0.3059	0.9968	0.0438	0.7350	0.3378	0.4741	0.6845
2000	0.9911	0.2987	0.8980	0.0465	0.8305	0.3295	0.5944	0.6754
2001	1.3470	0.2904	1.0563	0.0447	0.6524	0.3360	0.8726	0.6229
2002	1.3871	0.2900	1.0600	0.0471	0.7901	0.3281	0.8929	0.6086
2003	0.9471	0.2859	0.9284	0.0453	0.9794	0.3142	1.4145	0.5301
2004	1.2740	0.2810	1.1124	0.0440	1.2459	0.2753	2.1247	0.4972
2005	1.4169	0.2828	1.4437	0.0455	0.8296	0.3100	2.3719	0.4915
2006	1.1435	0.2862	1.0927	0.0435	0.4391	0.3920	0.8687	0.6264
2007	1.2066	0.2834	0.7796	0.0502	0.6953	0.3325	0.9534	0.6002
2008	1.5309	0.2819	1.1811	0.0496	1.1731	0.2788	0.8800	0.6073
2009	1.2061	0.2816	1.0731	0.0730	1.5401	0.2685	0.6800	0.6245
2010					1.1744	0.2759	1.1157	0.5603
2011					1.3397	0.2742	1.0953	0.5353
2012					1.1216	0.2744	1.4104	0.5064
2013					1.4966	0.3006	1.1915	0.5479

Table 2.7.1 Number of Red Grouper lengths measured in the Gulf of Mexico by year and survey.

	Number of Measured Lengths			
Year	Combined Video	SEAMAP Groundfish	NMFS Bottom Longline	Total Fishery-Ind.
1996			10	10
1997			6	6
1998			7	7
1999			1	1
2000			26	26
2001			79	79
2002			16	16
2003			162	162
2004			170	170
2005			32	32
2006			32	32
2007			51	51
2008	32	33	31	96
2009	99	298	64	461
2010	48	187	81	316
2011	116	114	312	542
2012	105	151	111	367
2013	39	72	47	158
2014			24	24

2.10 Figures

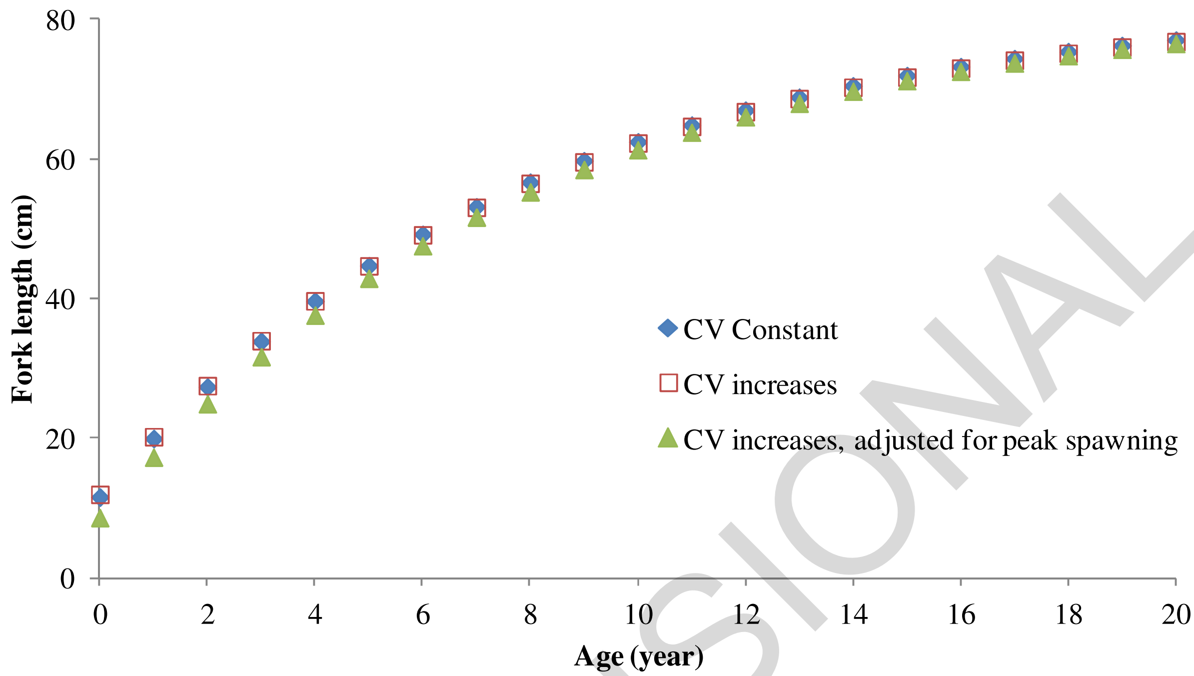


Figure 2.1.1 Von Bertalanffy growth relationship recommended by the Data Workshop (blue diamond) compared to the relationship used in the SS model (green triangle). The von Bertalanffy parameters using constant CV were: L_{inf} = 82.89 cm, K = 0.125, and t_0 = -1.20. The parameters using increasing CV with age were: L_{inf} = 82.72 cm, K = 0.124, and t_0 = -1.26. After adjusting to account for peak spawning on May 15th the parameters were, L_{inf} = 82.72 cm, K = 0.124, and t_0 = -0.89.

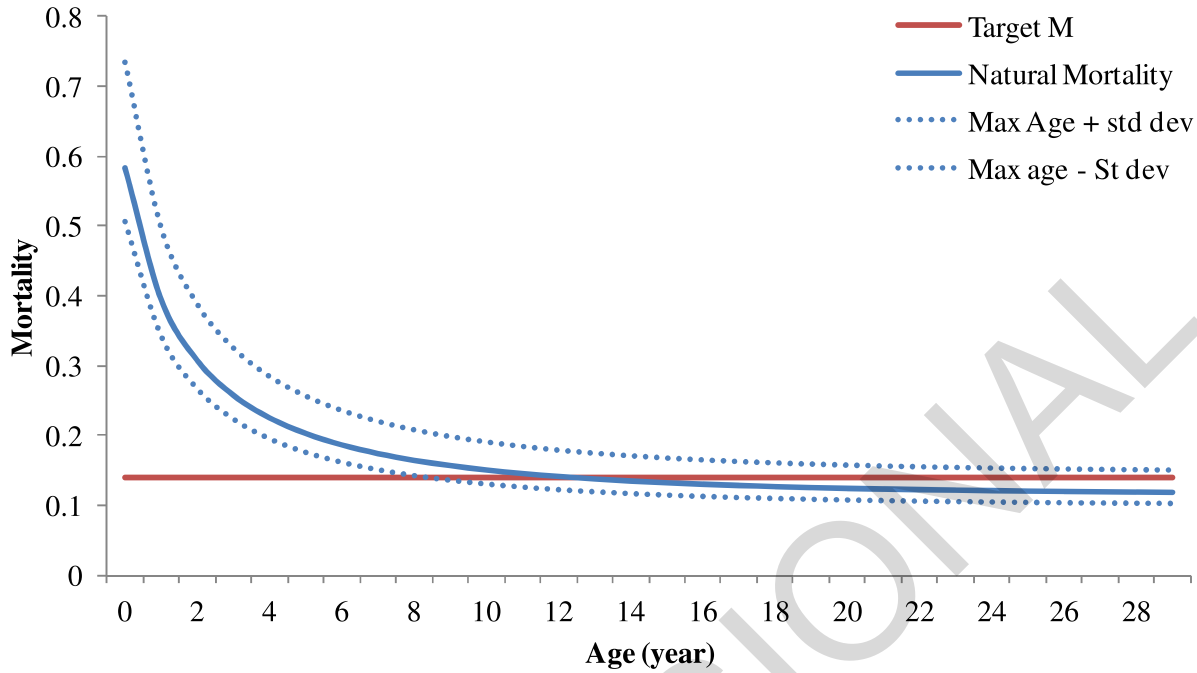


Figure 2.1.2 Recommended age-specific natural mortality vector and upper and lower range recommended by the Data Workshop. The standard deviation (±5 years) at age for the maximum age (29 years) was used to calculate the upper and lower range for natural mortality. The target mortality was 0.14.

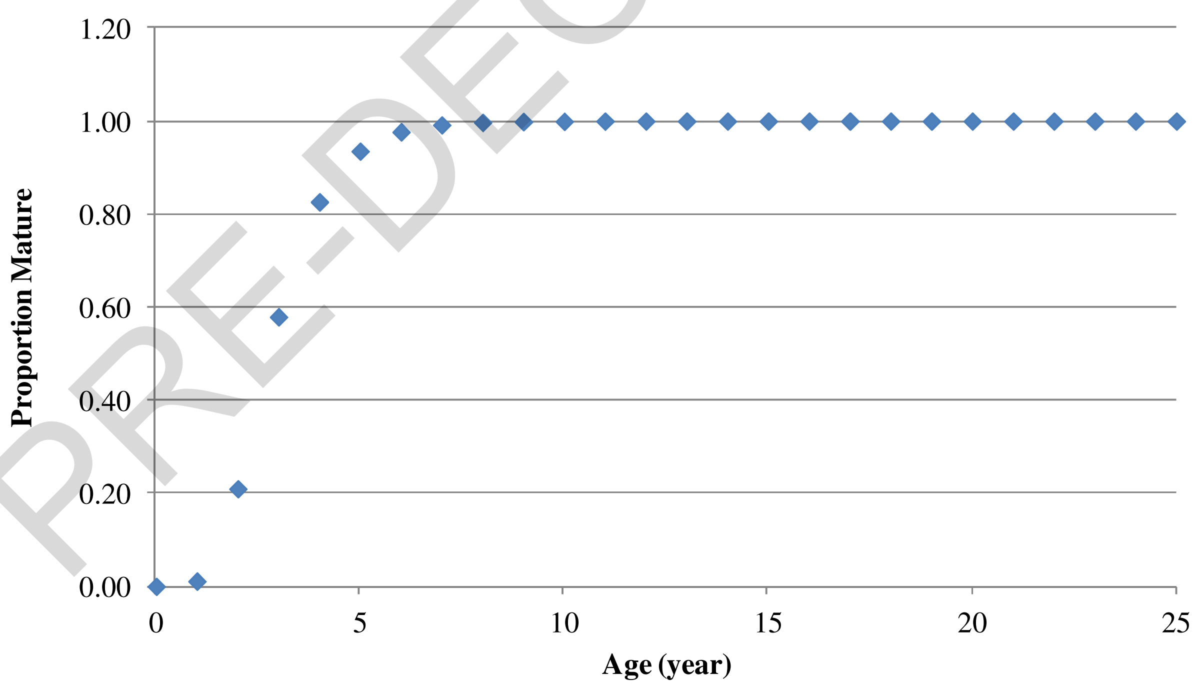


Figure 2.1.3 Proportion mature at age.

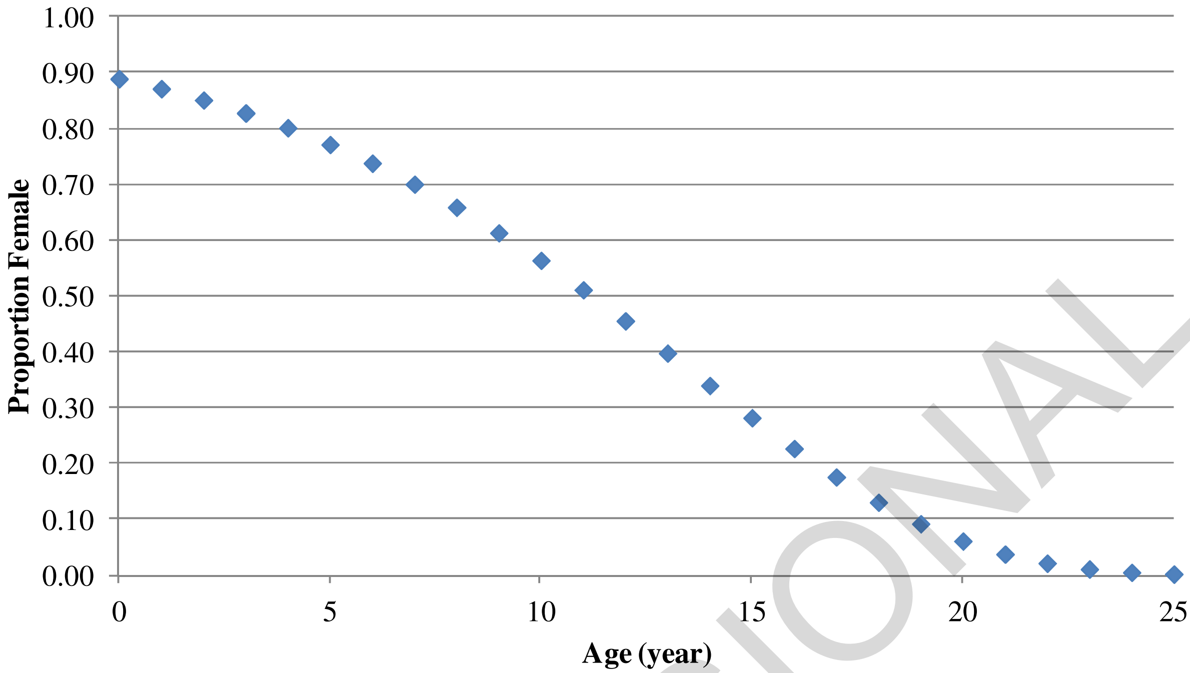


Figure 2.1.4 Proportion female at age.

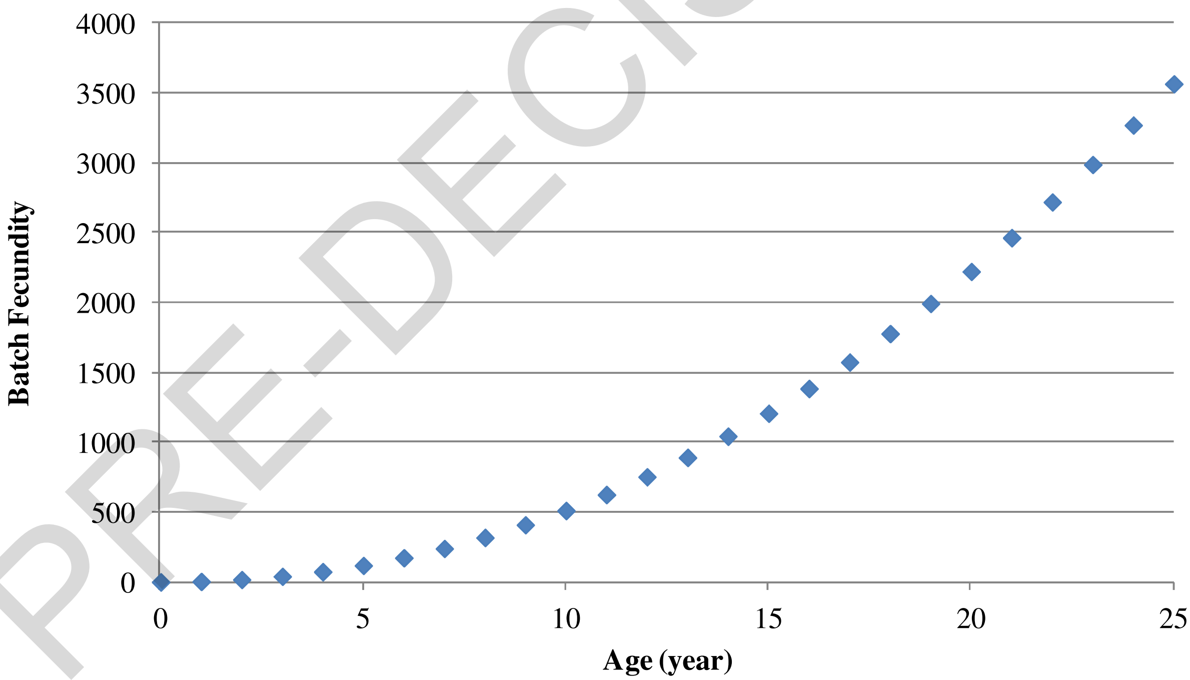


Figure 2.1.5 Batch fecundity at age.

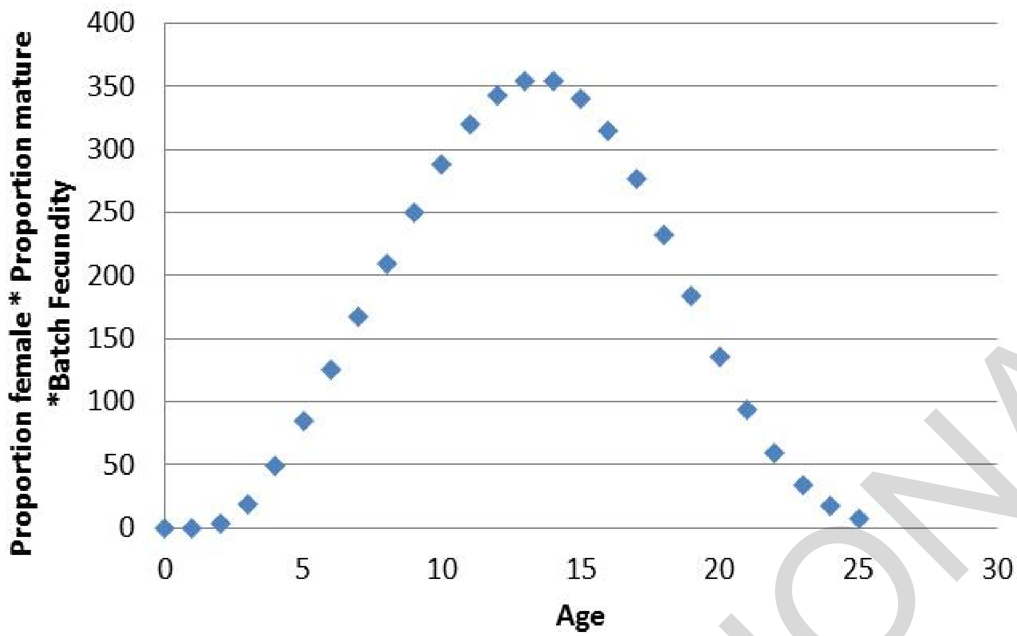


Figure 2.1.6. Fecundity at age equal to proportion mature * proportion female * batch fecundity.

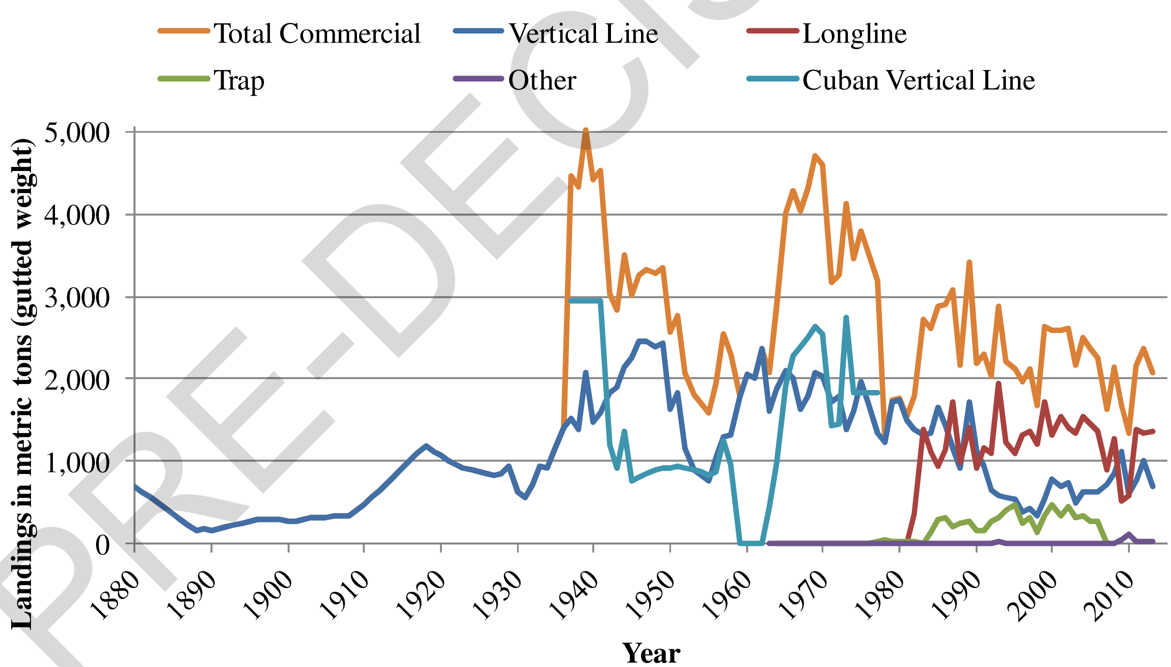


Figure 2.2.1 Red Grouper commercial landings from the U.S. Gulf of Mexico in metric tons gutted weight from 1880-2013.

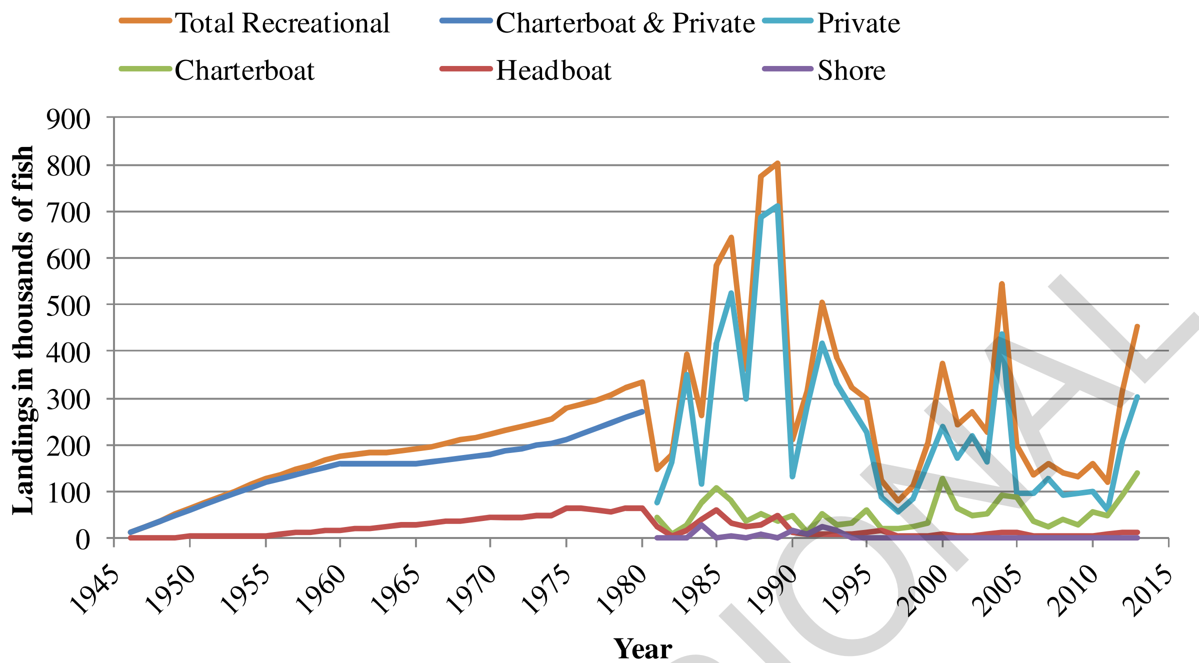


Figure 2.2.2 Red Grouper recreational landings from the U.S. Gulf of Mexico in thousands of fish from 1945-2013.

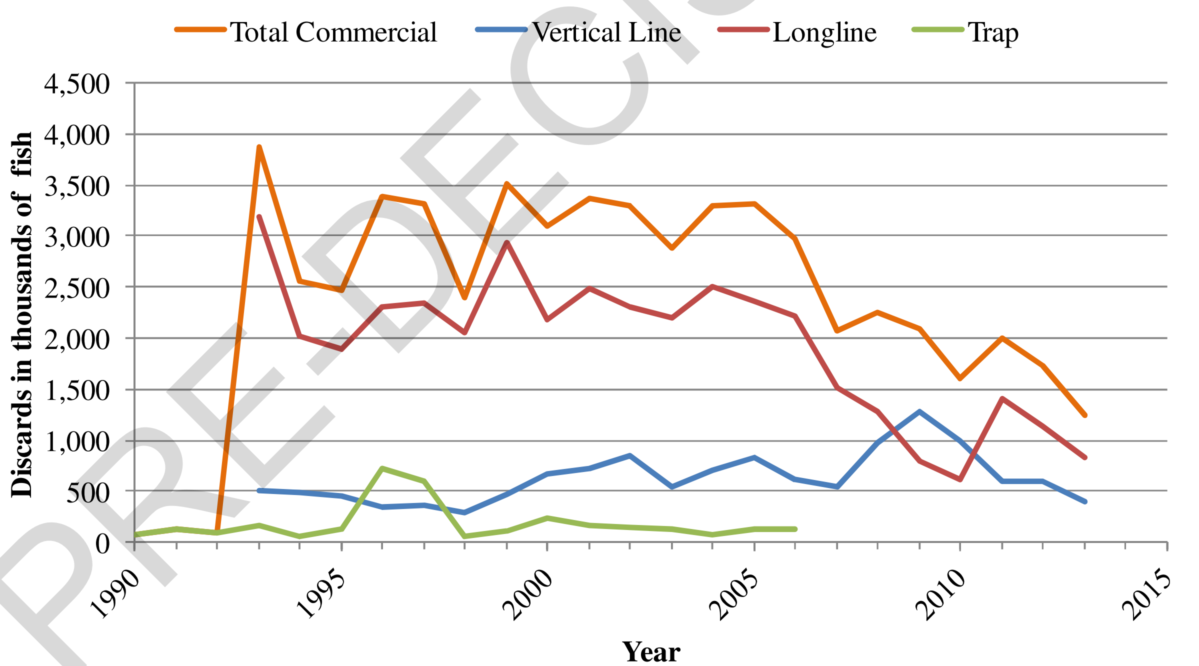
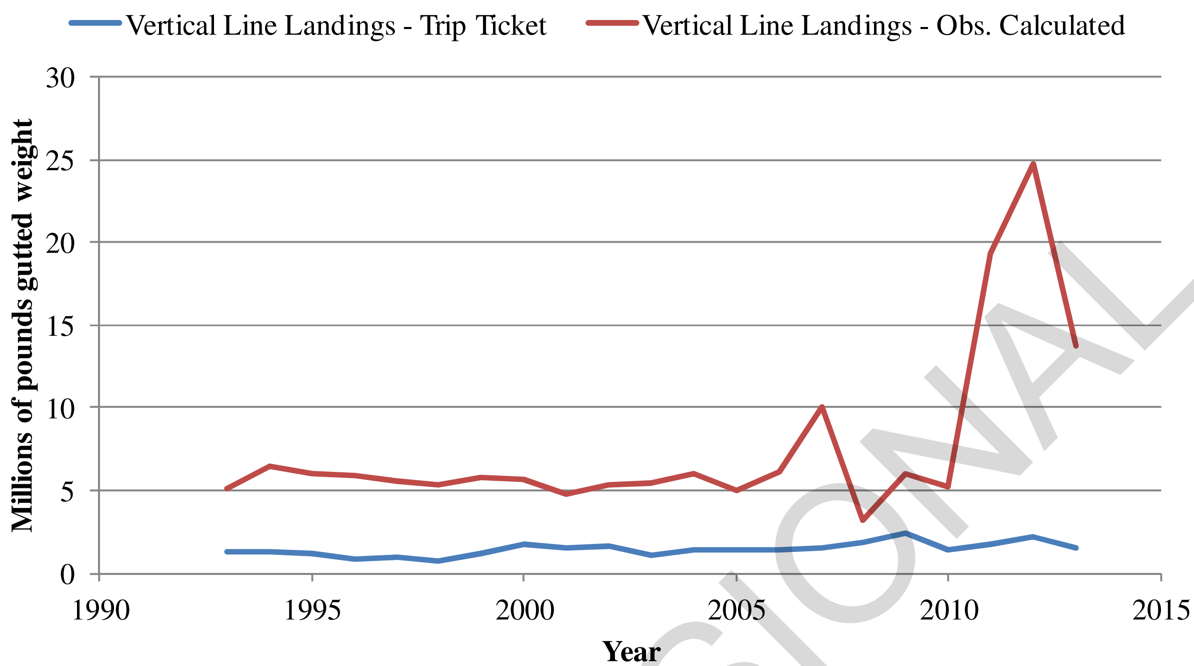


Figure 2.3.1 Red Grouper commercial discards from the U.S. Gulf of Mexico in thousands of fish from 1990-2013.

A.



B.

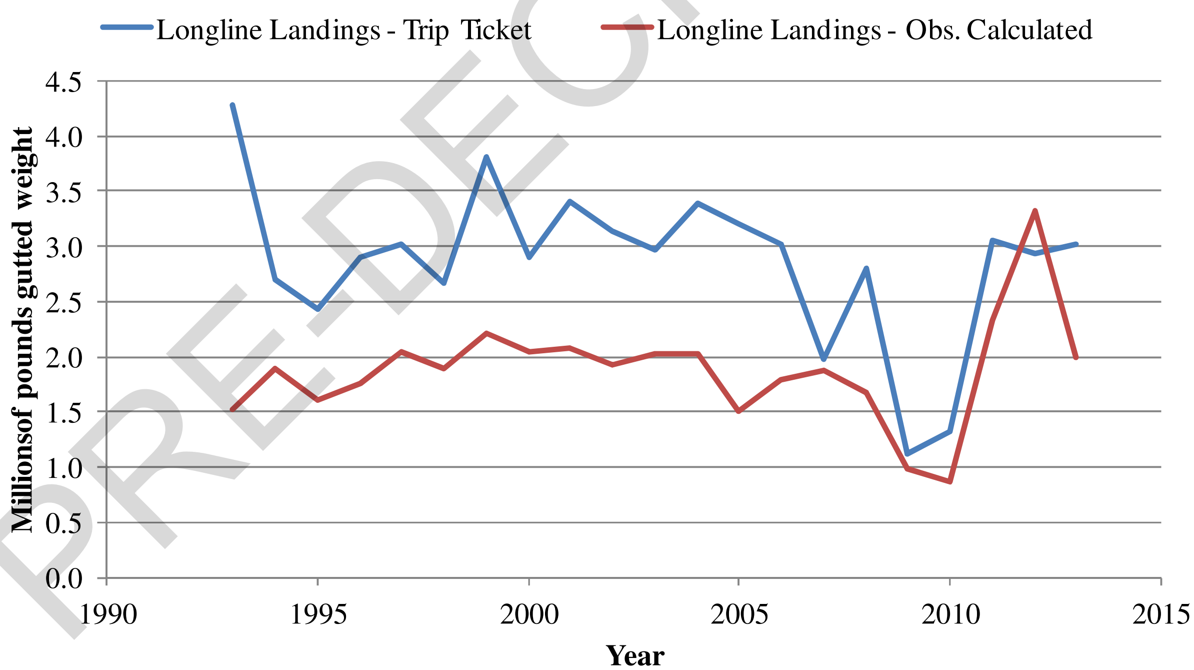


Figure 2.3.2. Comparison of Red Grouper landings compiled for SEDAR 42 and landings calculated as: observer reported Red Grouper kept rate*effort reported in coastal logbook. A. Vertical line landings compared. B. Bottom longline landings compared. Landings from trip ticket data are in blue. Calculated landings are in red.

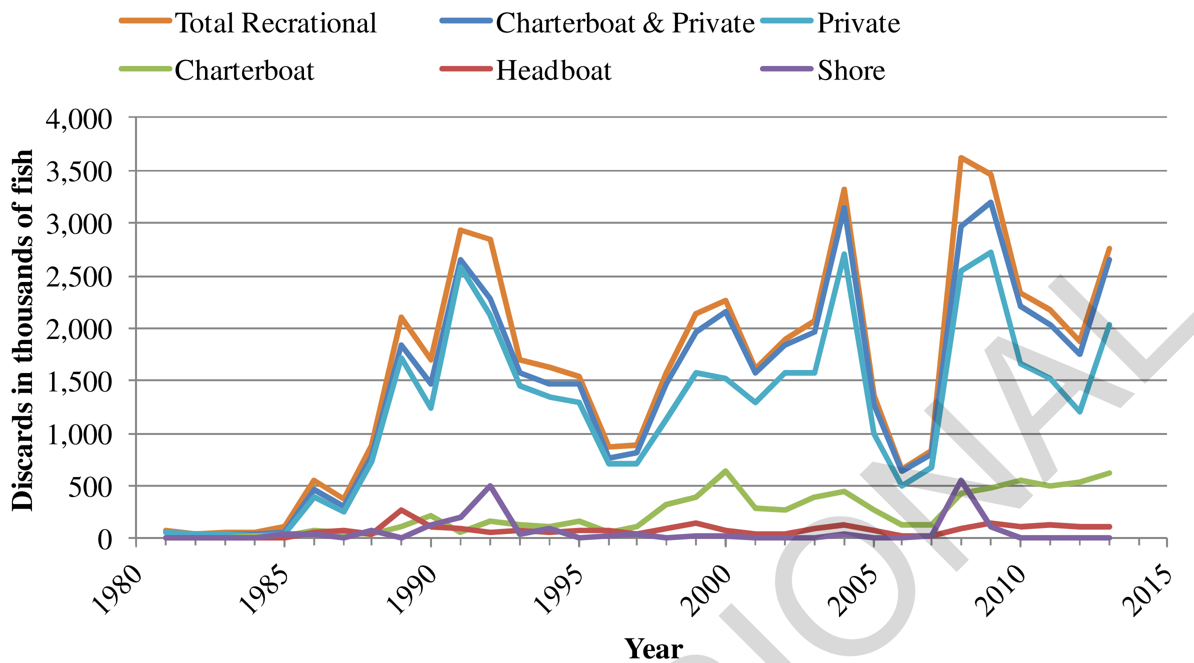


Figure 2.3.3 Red Grouper recreational discards from the U.S. Gulf of Mexico in thousands of fish from 1981-2013.

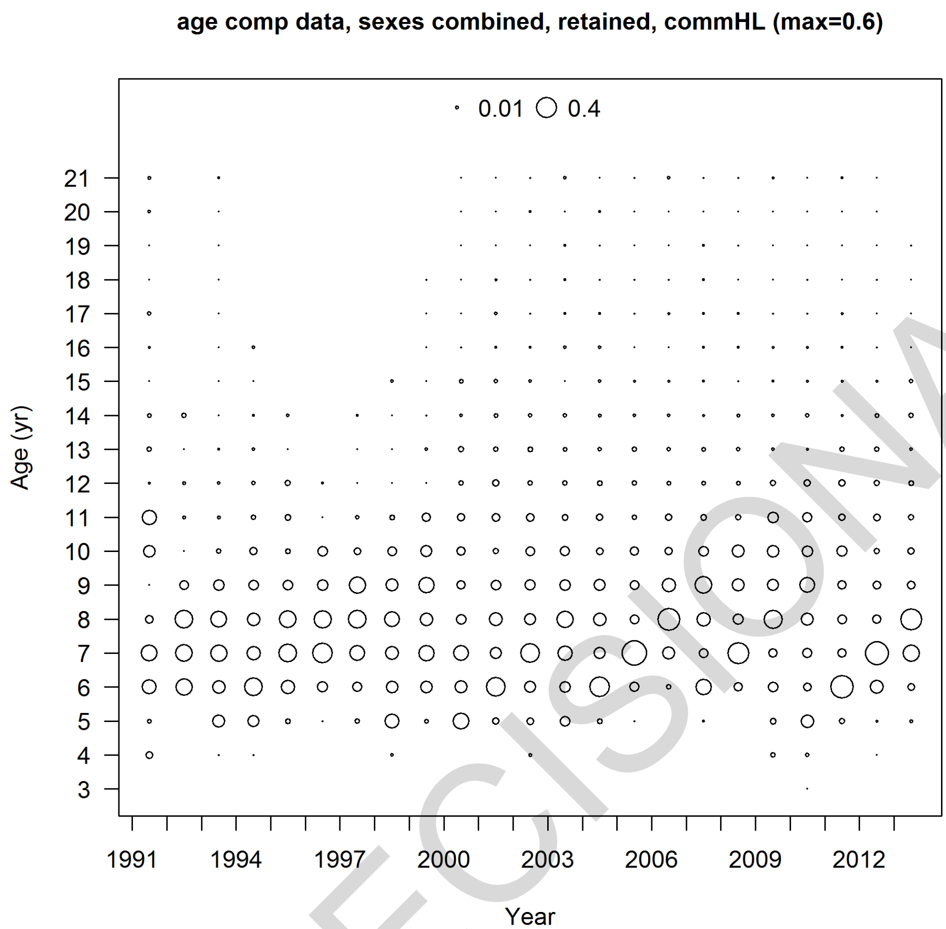


Figure 2.4.1 Annual age composition data of Red Grouper landed by the commercial vertical line fishery.

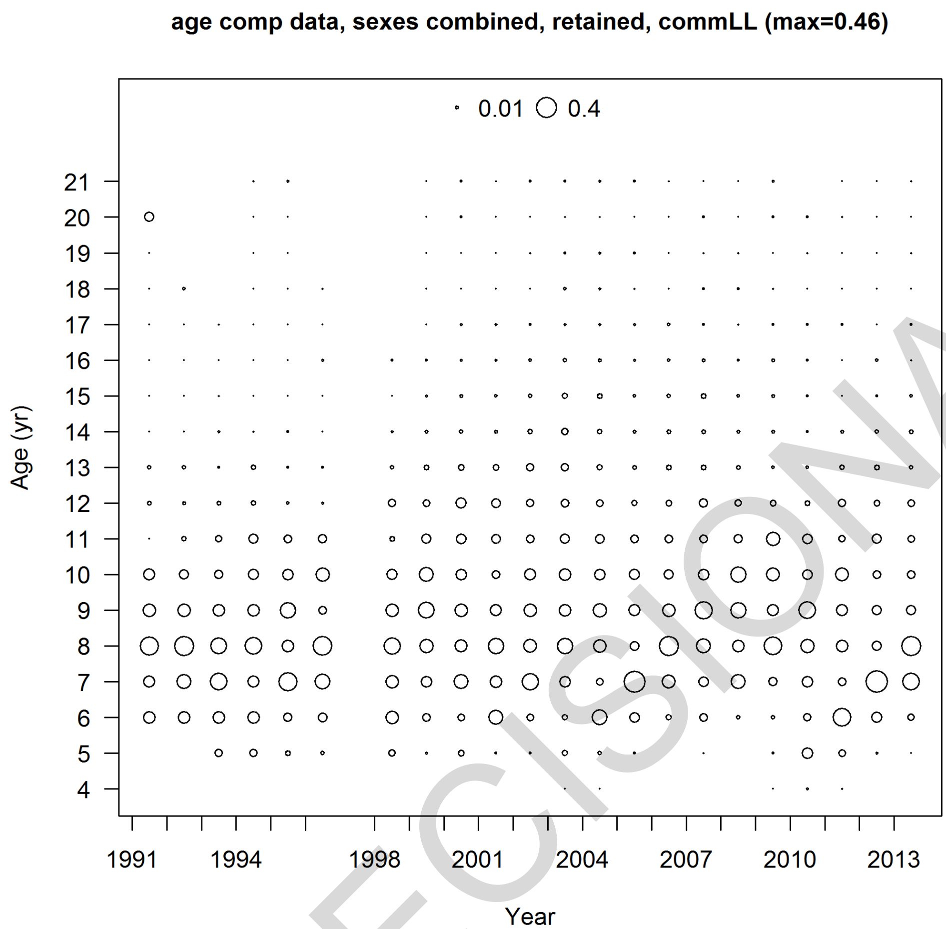


Figure 2.4.2 Annual age composition data of Red Grouper landed by the commercial longline fishery.

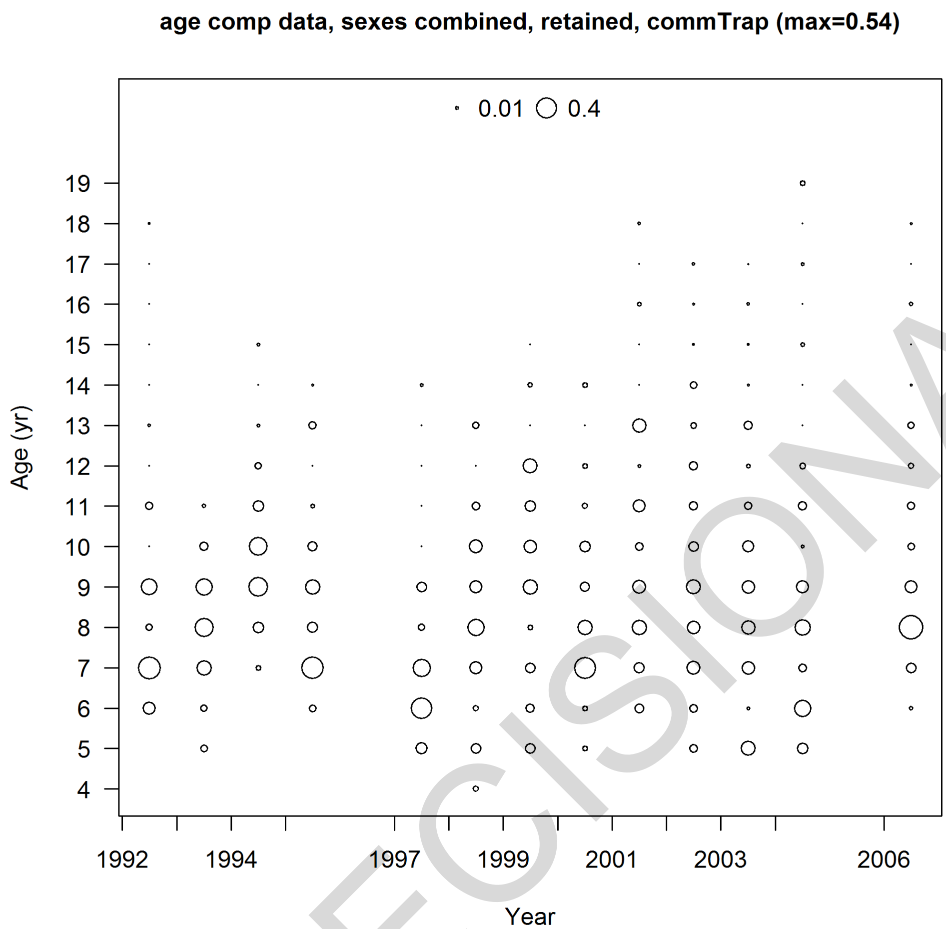


Figure 2.4.3 Annual age composition data of Red Grouper landed by the commercial trap fishery.

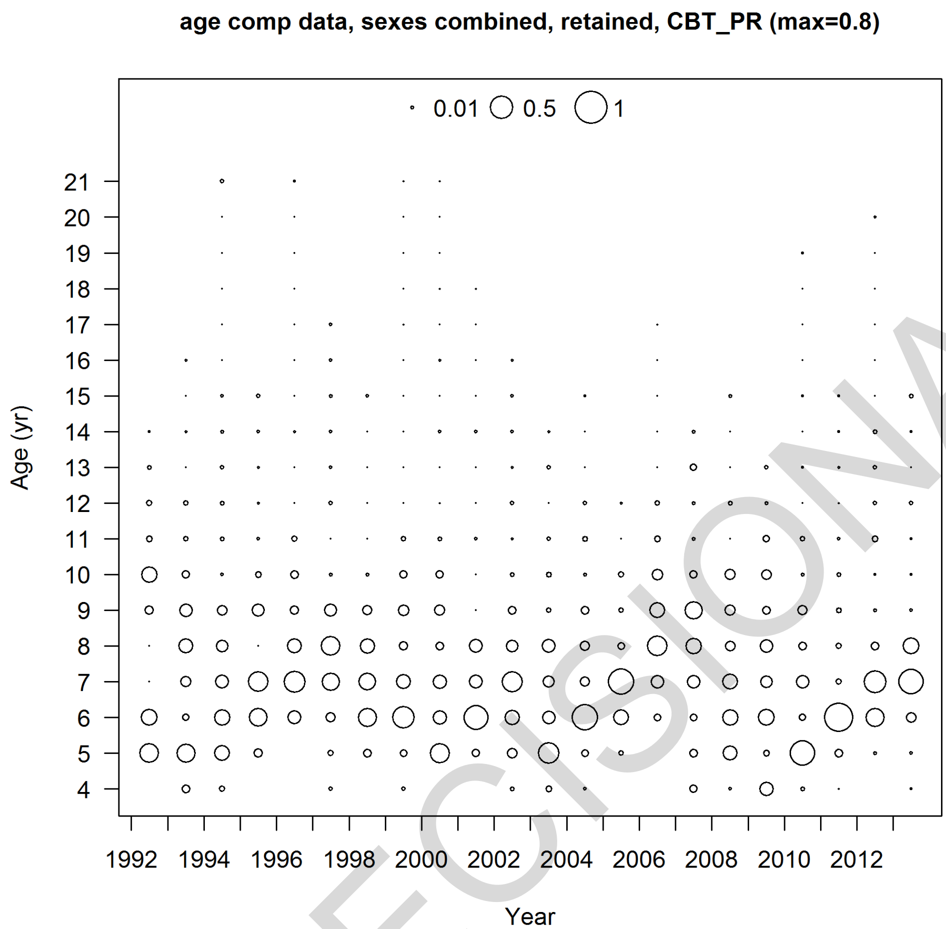


Figure 2.4.4 Annual age composition data of Red Grouper landed by the recreational combined charterboat and private fishery.

Figure 2.4.5 Annual age composition data of Red Grouper landed by the recreational headboat fishery.

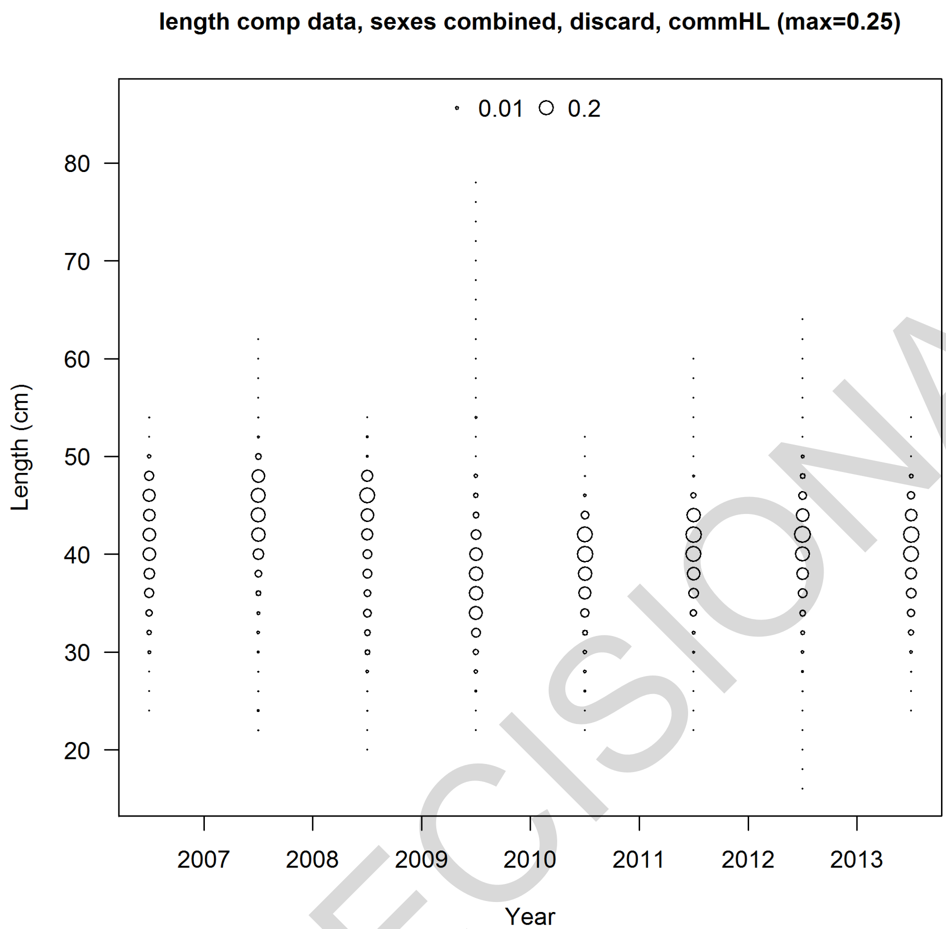


Figure 2.5.1 Annual length composition data of Red Grouper discarded by the commercial vertical line fishery. The y-axis represents fork length of Red Grouper in centimeters.

Figure 2.5.2 Annual length composition data of Red Grouper discarded by the commercial longline fishery. The y-axis represents fork length of Red Grouper in centimeters.

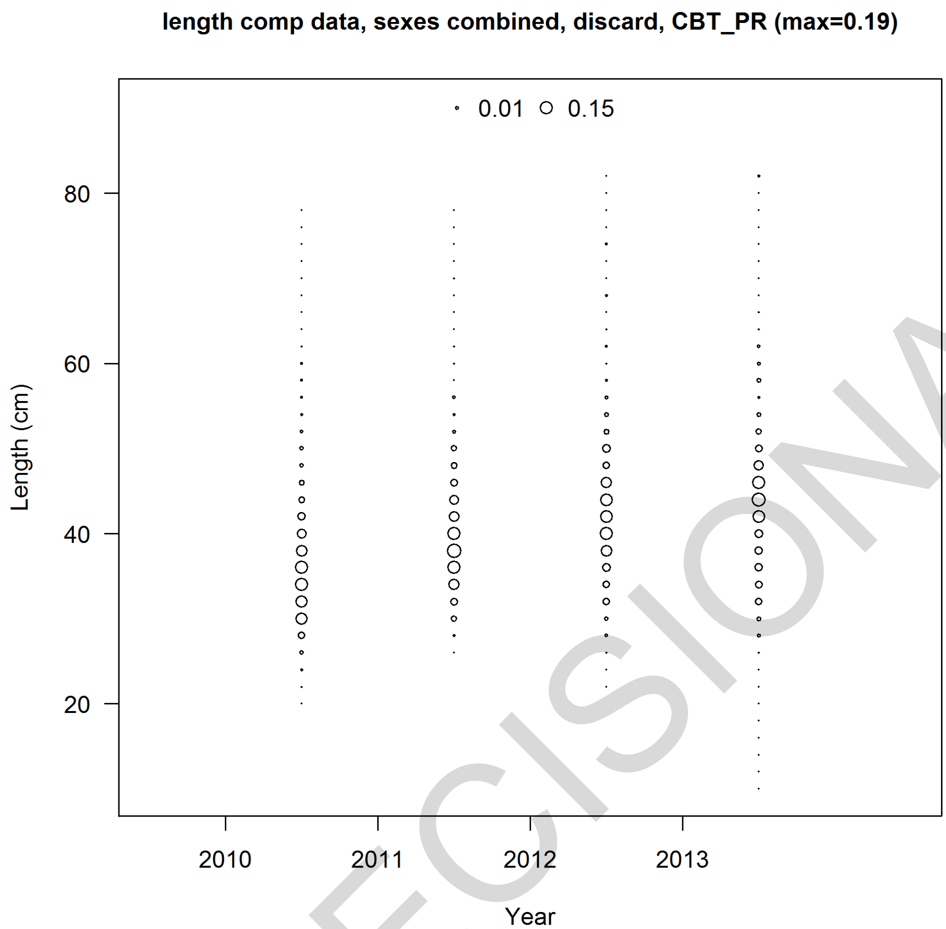


Figure 2.5.3 Annual length composition data of Red Grouper discarded by the recreational combined charterboat and private fishery. The y-axis represents fork length of Red Grouper in centimeters.

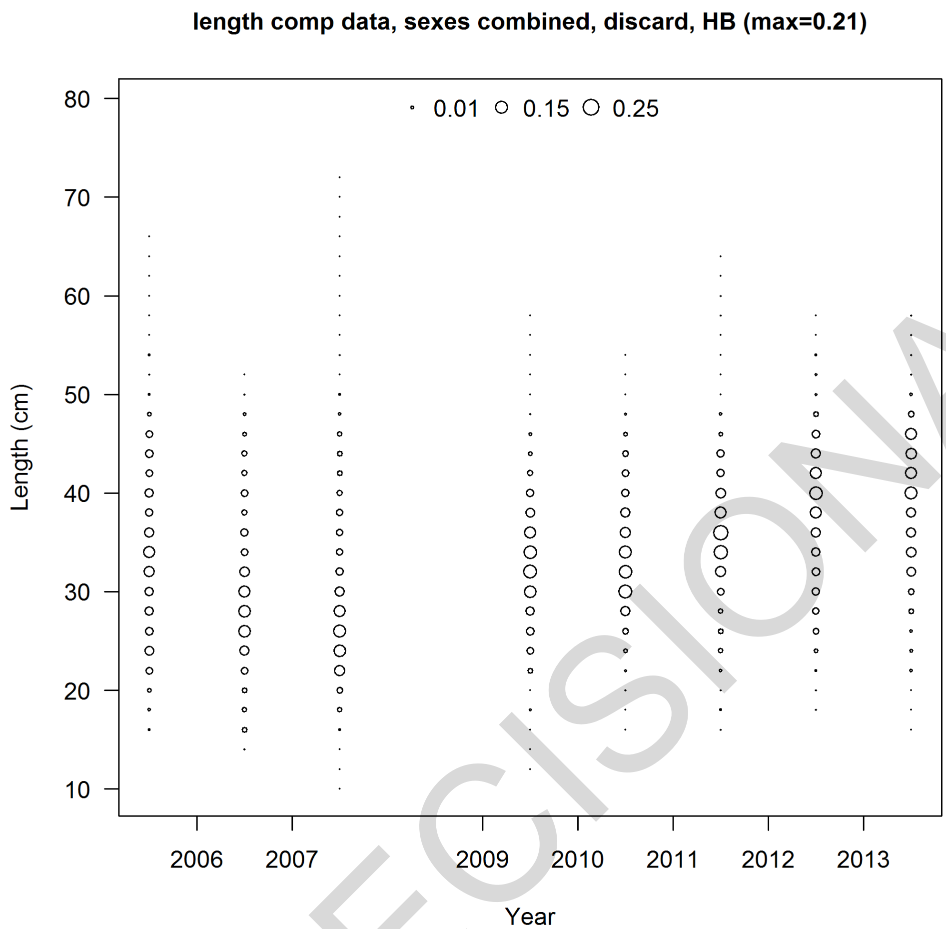


Figure 2.5.4 Annual length composition data of Red Grouper discarded by the recreational headboat fishery. The y-axis represents fork length of Red Grouper in centimeters.

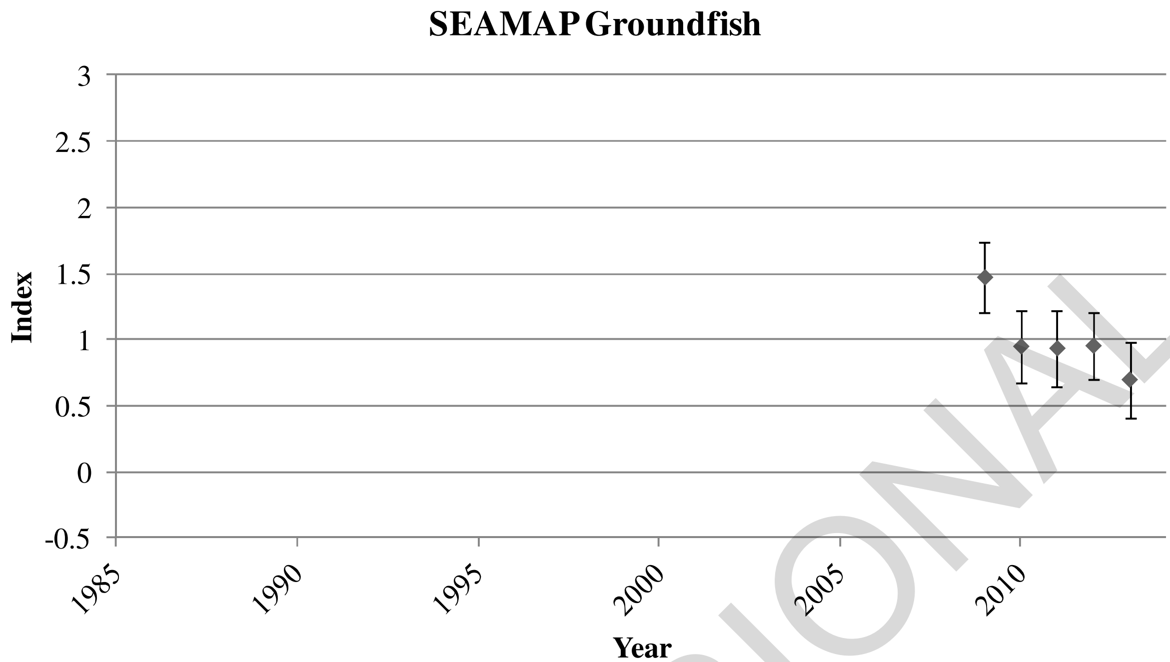


Figure 2.6.1 Standardized indices of abundance and the associated log-scale standard errors from the Gulf of Mexico SEAMAP groundfish survey. The index is scaled to a mean of one over the time series and was derived using the number of Red Grouper per trawl hour.

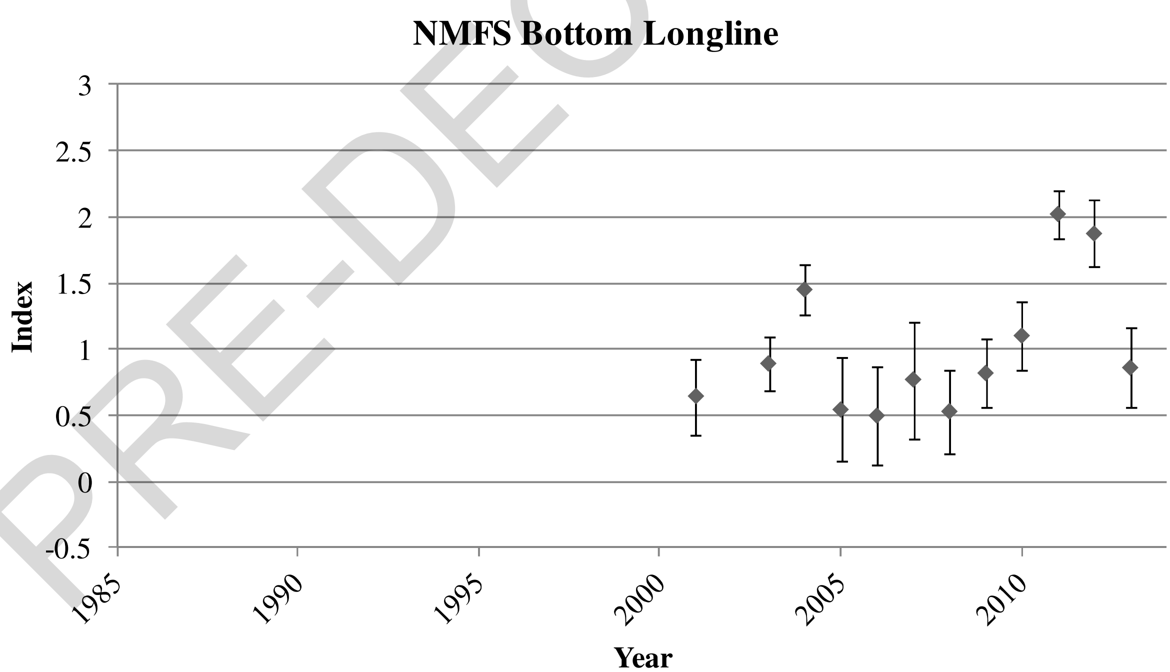


Figure 2.6.2 Standardized indices of abundance and the associated log-scale standard errors from the Gulf of Mexico NMFS bottom longline survey. The index is scaled to a mean of one over the time series and was derived using the number of Red Grouper per 100 hook hours.

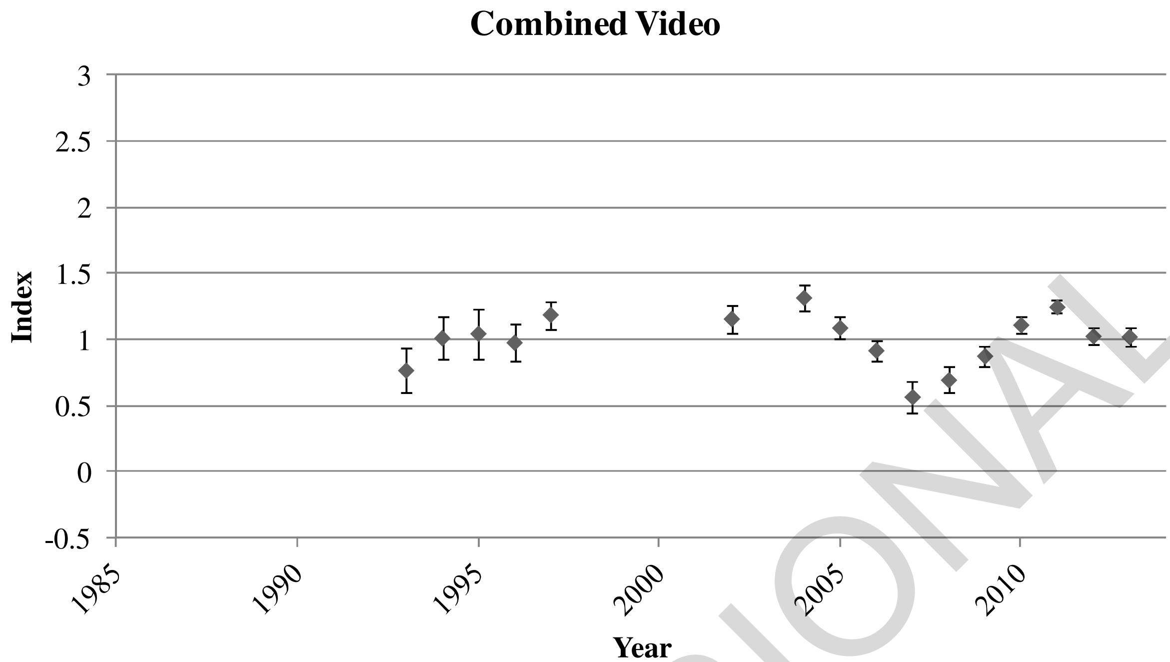


Figure 2.6.3 Standardized indices of abundance and the associated log-scale standard errors from the combined the Gulf of Mexico combined SEAMAP, Panama City and FWRI video survey. The index is scaled to a mean of one over the time series and was derived using the minimum count (maximum number of individuals in the field of view at one instance) of Red Grouper per 20 minute recording.

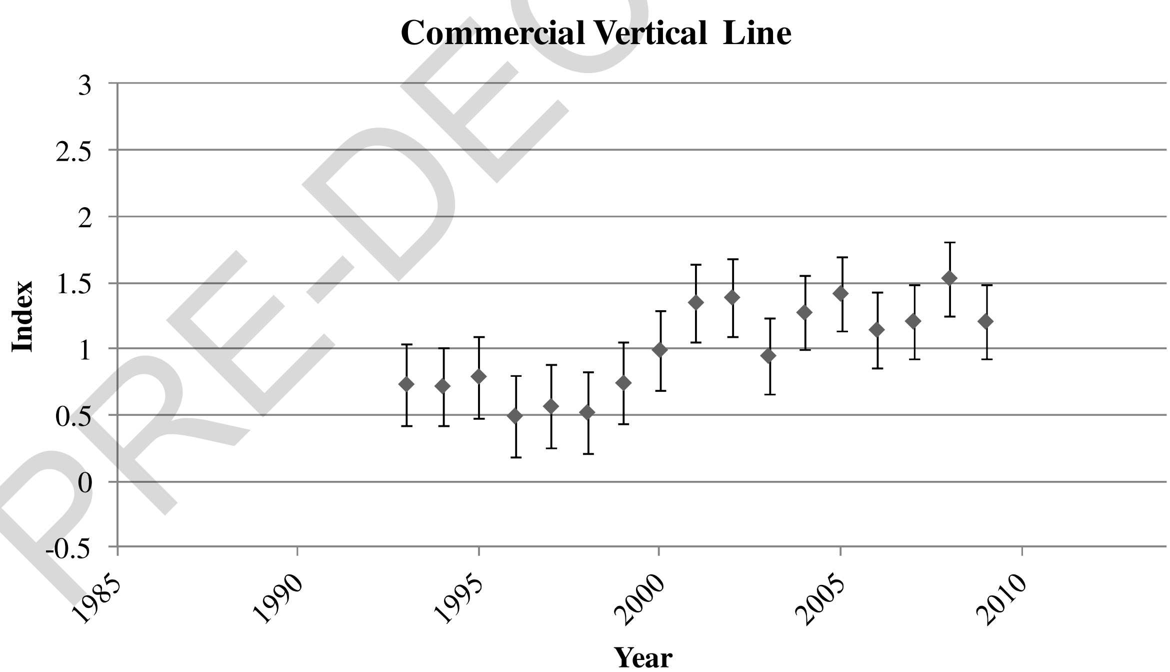


Figure 2.6.4 Standardized indices of abundance and the associated log-scale standard errors from the Gulf of Mexico vertical line commercial fishery. The index is scaled to a mean of one over the time series and was derived using the pounds of Red Grouper per number of hook hours.

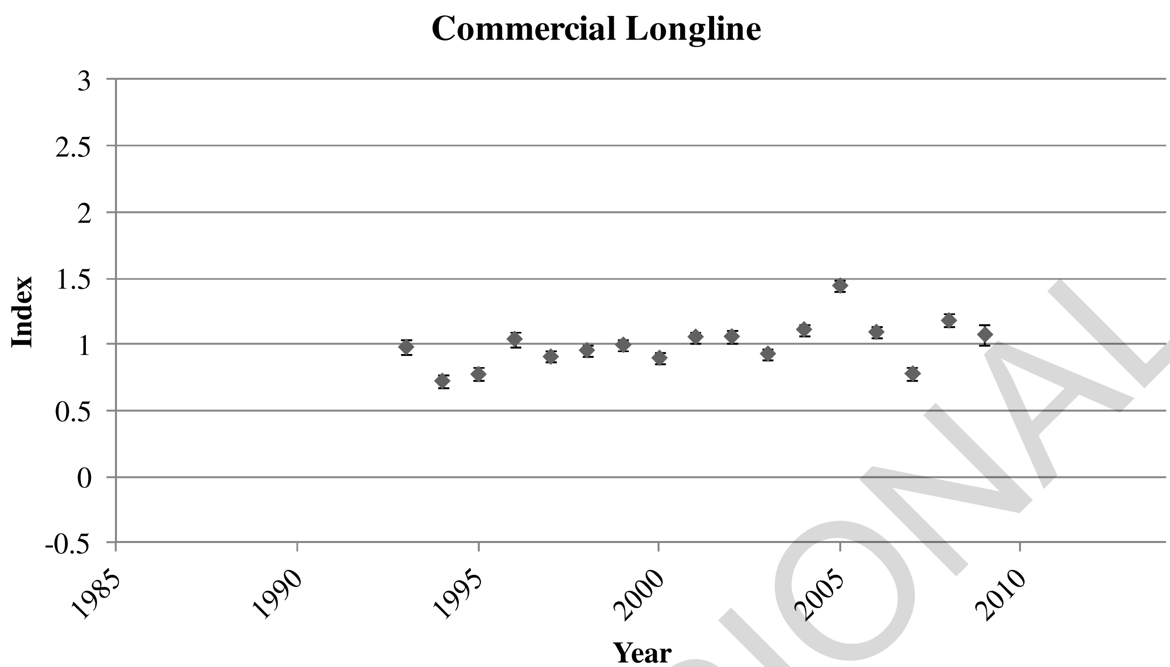


Figure 2.6.5 Standardized indices of abundance and the associated log-scale standard errors from the Gulf of Mexico longline commercial fishery. The index is scaled to a mean of one over the time series and was derived using the pounds of Red Grouper per number of hooks fished.

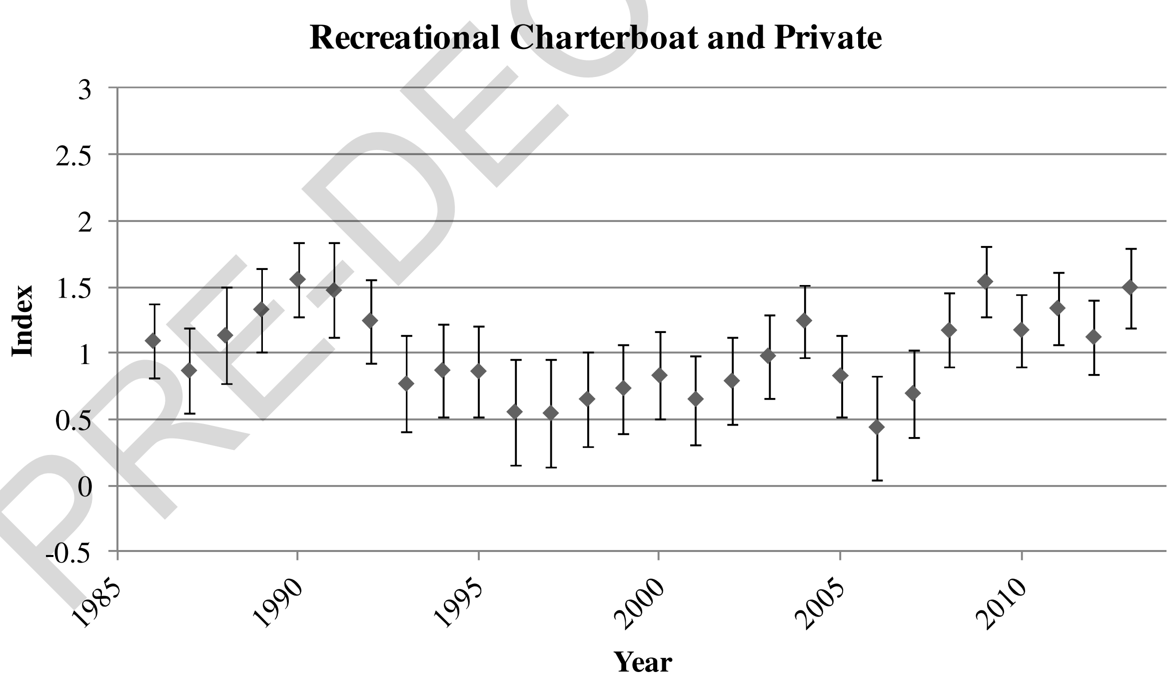


Figure 2.6.6 Standardized indices of abundance and the associated log-scale standard errors from the Gulf of Mexico charterboat and private boat recreational fishery. The index is scaled to a mean of one over the time series and was derived using the number of Red Grouper per angler hour.

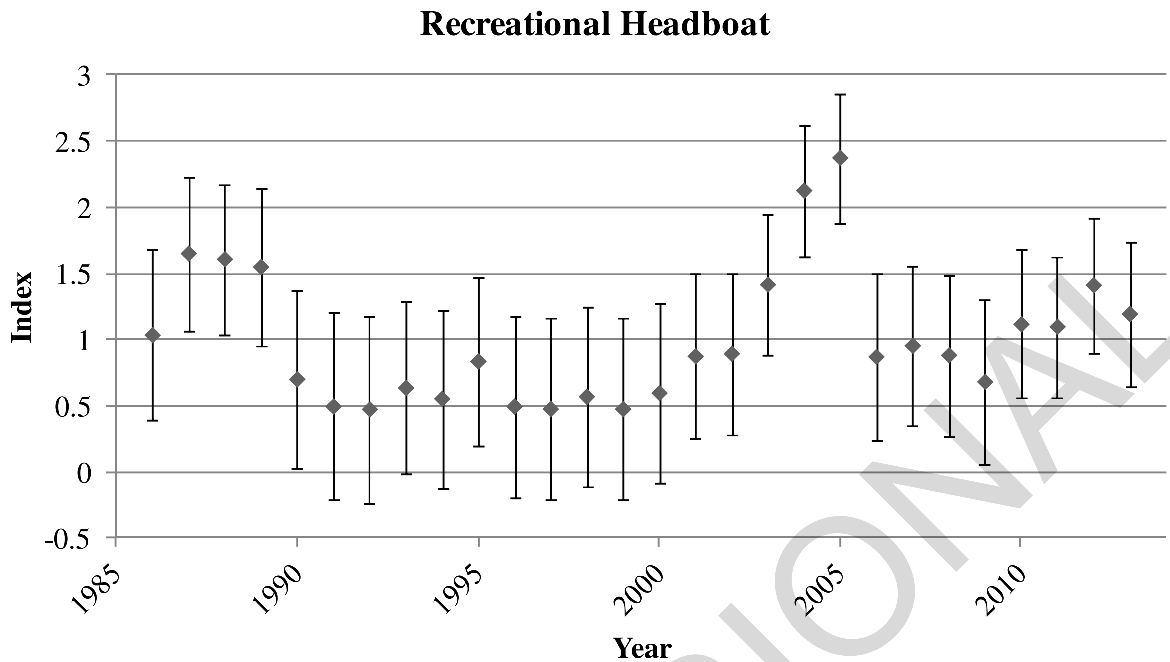


Figure 2.6.7 Standardized indices of abundance and the associated log-scale standard errors from the Gulf of Mexico headboat recreational fishery. The index is scaled to a mean of one over the time series and was derived using the number of Red Grouper per angler hour.

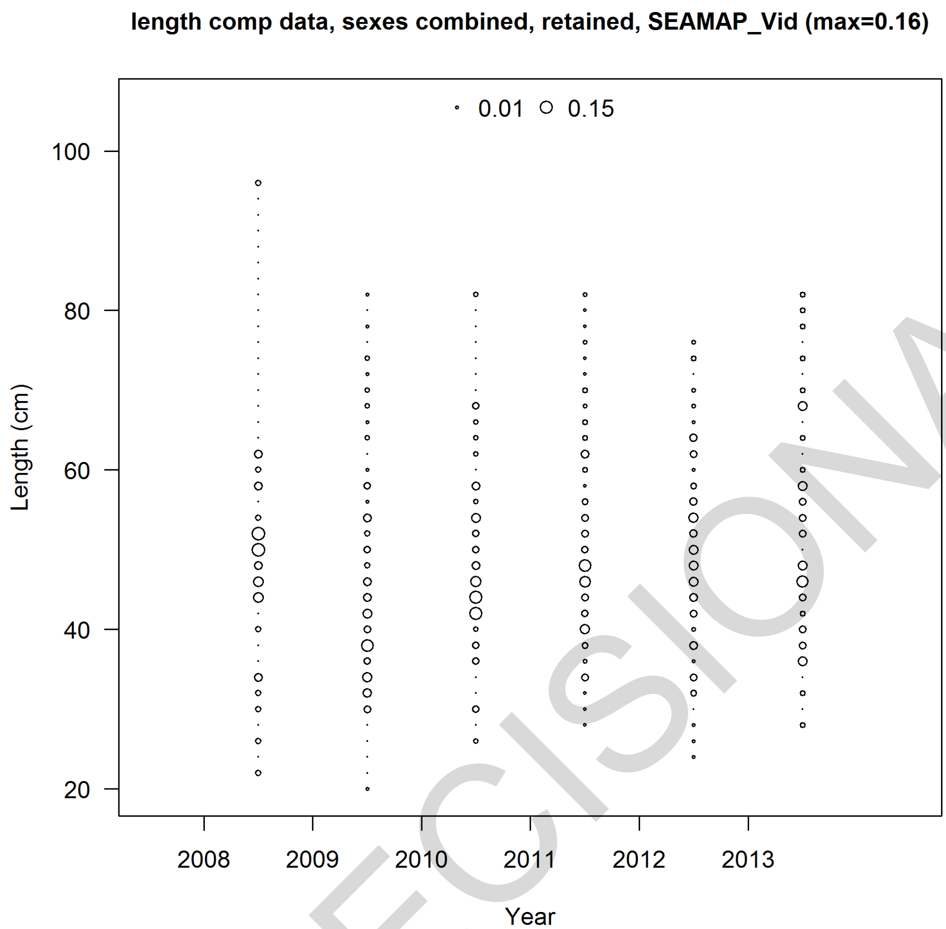


Figure 2.7.1 Annual length composition data of Red Grouper observed in the Combined Video survey.

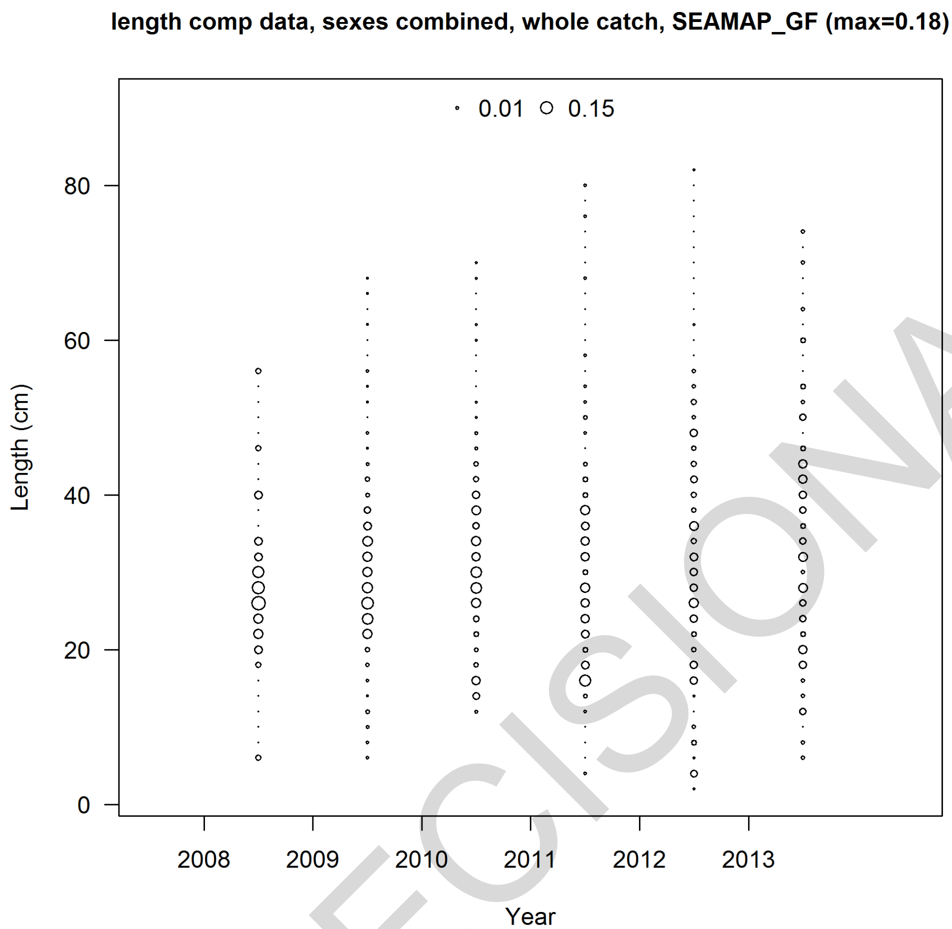


Figure 2.7.2 Annual length composition data of Red Grouper observed in the SEAMAP groundfish survey.

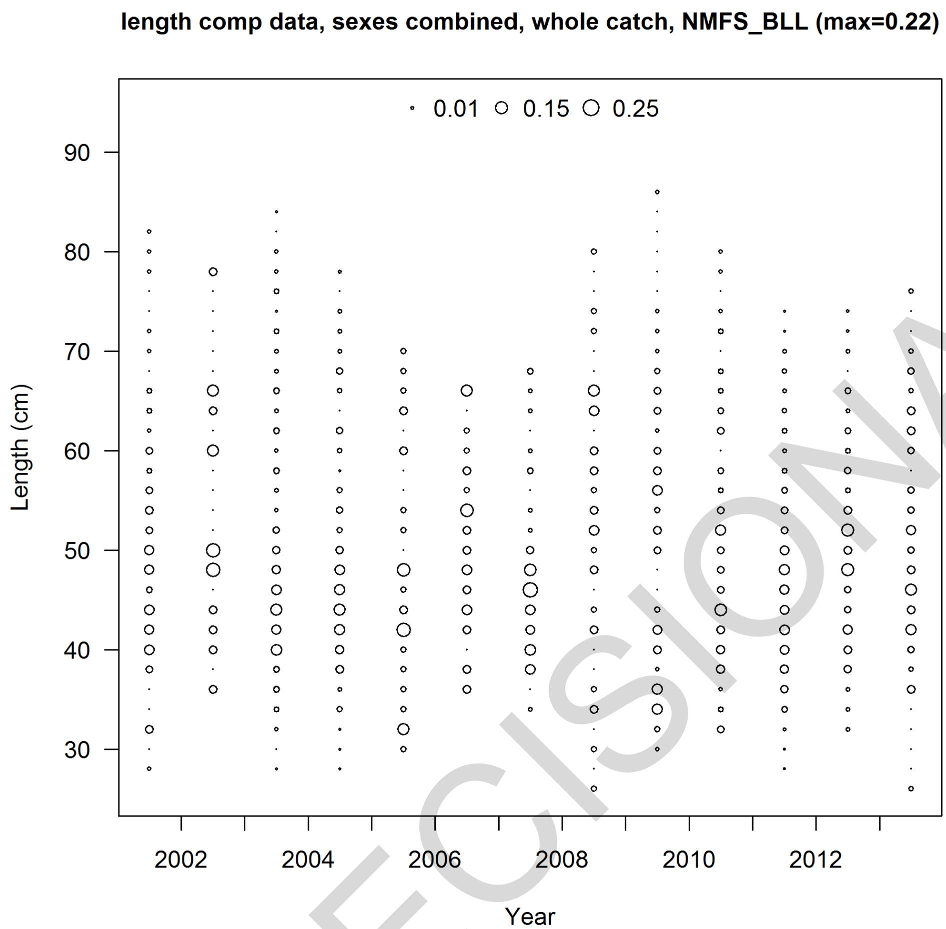


Figure 2.7.3 Annual length composition data of Red Grouper observed in the NMFS bottom longline survey.

3 Stock assessment models and results

3.1 Stock Synthesis

3.1.1 Overview

The primary assessment model selected for the Gulf of Mexico Red Grouper assessment was Stock Synthesis (Methot 2013) version 3.24P. Stock Synthesis (SS) has been widely used and tested for assessment evaluations, particularly in the US west coast NMFS centers (Methot 2013). Descriptions of SS algorithms and options are available in the SS user's manual (Methot 2013; http://nft.nefsc.noaa.gov/Stock_Synthesis_3.htm) and Methot and Wetzel (2013).

Stock Synthesis is an integrated statistical catch-at-age model which is widely used for stock assessments in the United States and throughout the world (Methot and Wetzel 2013). SS takes relatively unprocessed input data and incorporates many important processes (mortality, selectivity, growth, etc.) that operate in conjunction to produce observed catch, size and age composition and CPUE indices. Because many of these inputs are correlated, the concept behind SS is that they should be modeled together, which helps to ensure that uncertainties in the input data are properly accounted for in the assessment. SS is comprised of three sub-models: 1) a population sub-models that recreates an estimate of the numbers/biomass at age using estimates of natural mortality, growth, fecundity, etc.; 2) an observational sub-model that consists of observed (measured) quantities such as CPUE or proportion at length/age; and 3) a statistical sub-model that uses likelihoods to quantify the fit of the observations to the recreated population.

3.1.2 Data sources

The data sources used in the assessment model are described in Section 2. Figure 3.1.1 illustrates the data sources and their corresponding temporal scale. The Stock Synthesis data file is included in Appendix A.

3.1.3 Model configuration and equations

<u>*Life history*</u>

Growth rates were estimated externally from the model and a single growth curve was estimated for both sexes. The growth curve was modeled using the von Bertalanffy equation. The parameterization of von Bertalanffy included two additional parameters used to describe the variability in size-at-age. These parameters represent the CV in size-at-age at the minimum (age 1) and maximum (age 20) ages. Models testing the variance structure were compared; they assumed either constant standard deviation at age, constant CV at age, linear increase in CV with age, or linear increase in CV with length. AIC results indicated that assuming a linear increase in CV with length best described the data. The growth parameter estimates were used as fixed inputs in the SS3 model.

Growth within SS was modeled with a three parameter von Bertalanffy equation (Lmin, Lmax, and K). In SS, when fish recruit at the real age of 0.0 they have a body size equal to the lower limit of the first population bin (Lbin; fixed at 2 cm FL). Fish then grow linearly until they reach a real age equal to the input value of Amin (growth age for Lmin) and have a size equal to the Lmin. As they age further, they grow according to the von Bertalanffy growth equation. Lmax was specified as equivalent to L_{inf}. Two additional parameters are used to describe the variability in size-at-age; these parameters represent the CV in length-at-age at Amin (age 1) and Amax (age 20). For intermediate ages a linear interpolation of the CV on mean size-at-age is used. The three parameters of the von Bertalanffy equation (Lmin, Lmax, and K) were fixed in the SS model (Table 3.1.1). The CVs for length-at-age were input as fixed parameters at 0.144 and 0.165 for age-1 and age-20 fish, respectively (Table 3.1.1). A fixed length-weight relationship was used to convert body length (cm) to body weight (kg) (Table 3.1.1).

The natural mortality rate (M) was assumed constant over time, but decreasing with age. The form of M as a function of age was based on Lorenzen (2005). The Data Workshop life history working group recommended using a base M = 0.144 y-1, which was developed using the relationship between maximum age (29) and M (Hoenig 1983). The age-specific natural mortality vector developed at the Data Workshop was input into SS as a fixed vector (Table 2.1.1). The Data Workshop life history working group recommended sensitivity runs where the natural mortality vector was adjusted by the base M, where base M was adjusted by the standard deviation in the maximum age (29 ± 5). Figure 2.1.2 illustrates the base natural mortality values and the sensitivities.

Red Grouper are protogynous hermaphrodites (female at birth, then a portion of the population transitions to male). Hermaphroditism was accounted for implicitly in the fecundity vector in the model. Fecundity was modeled as the product of batch fecundity, the proportion of mature Red Grouper, and the proportion of female Red Grouper (Figure 2.1.6). Immature females transitioned to mature females based on a logistic function of age (Figure 2.1.4). Mature females transitioned to mature males based on a fixed logistic function of age (Figure 2.1.3). In previous Gulf of Mexico assessments of Red Grouper, the form of reproductive potential used in the assessment model was spawning stock biomass of females (SSB-female), based upon a female maturity function, a sex-transition function, and average gonad weight-at-age. The SEDAR 42 life history working group indicated that batch fecundity was a better proxy for fecundity than gonad weight because "the variation in gonad weight, even when classified by stage of development is quite large due to the temporal changes in oocyte size affecting gonad weight". As such, batch fecundity was used in this assessment.

Stock-recruitment model

The Beverton-Holt stock-recruitment model was used in this assessment. Three parameters of the stock recruitment relationship were estimated in the model; the log of unexploited equilibrium recruitment (Ln(R0)), an offset parameter for initial equilibrium recruitment relative to virgin recruitment log(R1) and the steepness (h) parameter. The steepness parameter describes the fraction of the unexploited recruits produced at 20% of the equilibrium spawning biomass level. A fourth parameter representing the standard deviation in recruitment (σ_R) was also estimated.

Annual deviations from the stock-recruit function were estimated for an early period (prior to 1986) and a later data-rich period (1986-2012). Stock Synthesis follows cohorts through time so it was assumed that the age composition data provided some indication of early recruitment. Early recruitment was estimated as far back as 1969. The central tendency that penalizes the log (recruitment) deviations for deviating from zero was assumed to sum to zero over each of the two estimated periods. Stock Synthesis assumes a lognormal error structure for recruitment. Therefore, expected recruitments were bias adjusted. Methot and Taylor (2011) recommend that the full bias adjustment only be applied to data-rich years in the assessment. This is done so Stock Synthesis will apply the full bias-correction only to those recruitment deviations that have enough data to inform the model about the full range of recruitment variability (Methot 2011). Full bias adjustment was used from 1986 to 2012. Bias adjustment was phased in from no bias adjustment to full bias adjustment in 1986 linearly. Bias adjustment was phased out over the last year, decreasing from full bias adjustment to no bias adjustment.

Starting conditions

The starting year of the assessment model is 1986. Removals of Red Grouper are known to have occurred in the Gulf of Mexico prior to 1986, so the stock was not assumed to be at equilibrium at the start of the model. Estimates of Red Grouper removals prior to 1986 were provided at the Data Workshop. Estimates were reconstructed back to 1880. An initial step in transitioning the read grouper assessment to SS3 was to develop a model with the same start year as the previous assessment and ensure its stability. Model runs starting in 1880 were shown to the Assessment Workshop panel; however, this was not done for the resulting base model. Anomalous recruitment events were predicted by the preliminary model runs; thus, the panel recommended starting the model in 1986.

Starting the assessment model in 1986 requires the estimation of initial conditions. These initial conditions include estimates of equilibrium catch and fishing mortality. Equilibrium catch is the catch taken from a stock for which removals and natural mortality are balanced by stable recruitment and growth. This equilibrium catch can be used to estimate the initial fishing mortality rates in the assessment model. Not fitting to the equilibrium catch is equivalent to estimating the catch and therefore the initial fishing mortality rates (Fs) that best correspond to the data during the dynamic period. Equilibrium catches and fishing mortalities for all fleets were estimated in this assessment. In addition, early recruitment deviations were estimated prior to the data-rich period to allow the initial population to better match composition information available at the start of the dynamic period of the model.

Fleet structure and indices of abundance

The assessment model includes five fishing fleets. The fleets represent the commercial handline, commercial longline, commercial trap, the recreational headboat, and the combined recreational charterboat and private fisheries. The previous assessment used the same fleet structure except the recreational fleets were aggregated and modeled as a single recreational fleet.

The assessment model includes seven indices of abundance. The four fishery-dependent indices include the commercial handline (commHL), the commercial longline (commLL), the headboat (HB), and the charter-private mode (CBT_PR) indices (Figures 2.6.4 – 2.6.7). These indices were modeled as landings indices with the exception of the charter-private index. The charter-private index of abundance included discards and as such was treated as a total catch index. The three fishery-independent indices include the combined SEAMAP/PC Lab/FWRI video survey (video), the SEAMAP summer groundfish survey (SEAMAP-GF), and the NMFS bottom-longline survey (NMFS-BLL) (Figures 2.6.1 – 2.6.3). The SEAMAP-GF and NMFS-BLL indices were not used in the previous assessment.

Selectivity and retention distributions

Age-based selectivity functions were specified for the commercial and recreational fleets, whereas length-based selectivity functions were specified for the fishery-independent surveys. Selectivity patterns represent the probability of capture for a given gear and are used to model not only gear function but fishery availability (spatial patterns of fish and fishers) by spatially stratified fisheries.

The age-based selectivities were modeled using the random walk function in SS3. This function models the selectivity of each age as a random walk of the previous age. The first two ages (age-0 and age-1) were fixed parameters; the parameters associated with all other ages were estimated. A normal prior was used to penalize the random walk between ages. The assumed distribution of the penalty for age-2 through age-11 was ~ N(0.25) and for age-12 through age-20 was ~ N(0, 0.1).

The functional form of the double normal curve was used in this assessment to approximate selectivity patterns for the fishery-independent surveys. The double normal selectivity pattern is described by two adjacent normal distributions. Each has its own variance term and the two are joined by a horizontal line. This selectivity pattern is described by six parameters, all of which were estimated.

Selectivity patterns were assumed to be constant over time for each fishery and survey. The Red Grouper fishery has experienced changes in management regulation over time, which were assumed to influence the discard patterns more so than selectivity. As such, these changes were accounted for in the model using time-varying retention patterns and modeling discards explicitly.

Changes in the management regulations for the commercial fleets includes the implementation of a 20 inch total length (50.8 cm TL, 48.80 cm FL) size limit from 1990 until 2008. The commercial size limit was reduced to 18 inches TL (45.7 cm TL, 43.97 cm FL) in 2009. The reduction in the commercial size limit was followed by the implementation of the individual fishing quota (IFQ) program in 2010. The retention patterns were assumed to change with the changes in the size limit. Retention is modeled as a logistic function with size in SS3. Four parameters describe this function; the inflection point, the slope, the asymptote, and the male offset inflection, which is not applicable to this model and assumed to be zero.

The retention pattern associated with the 1990-2008 time block and 20 inch TL commercial size limit was assumed to be knife-edge at the size limit where 100% of individuals were retained above the size limit (Figure 3.1 2 - Figure 3.1 **4**). This was the assumed relationship for the commercial trap fleet since its discard observations only pertain to this time block. The parameters describing the retention pattern for the commercial handline and longline fleets associated with the 2009-2013 time block and 18 inch TL commercial size limit were freely estimated given that the majority of discard length composition data corresponded to this time block (Figure 3.1 2 - Figure 3.1 **3**).

The recreational fishery has also experienced changes in management regulations. An 18 inch TL size limit (43.97 cm FL) was implemented in Florida state waters prior to 1990. Similar to the commercial fishery, a 20 inch TL size limit (50.8 cm FL) was implemented in federal waters starting in 1990 until present. The retention pattern for the 1986-1989 time block and 18 inch TL size limit in FL state waters was assumed to be knife-edge at the size limit where 100% of individuals were retained above the size limit (Figure 3.1 5Figure 3.1 6). The parameters describing the retention pattern associated with the 1990-2013 time block and 20 inch TL recreational size limit in Federal waters were freely estimated (Figure 3.1 5Figure 3.1 6).

<u>Accounting for mortality due to red tide</u>

The Assessment Panel recommended the continued consideration of a mortality event associated with the 2005 red tide on the West Florida Shelf in the assessment model. The model configuration used to make management recommendations in the previous assessment (SEDAR 2006) and update (SEDAR

2009) included the 2005 red tide event by estimating an extra mortality term, M_{rt}, in 2005. By including red tide mortality, the model was better able to explain the sudden declines in abundance indices between 2005 and 2006. The point estimate for M_{rt} was applied to all ages in the model in 2005 and was assumed constant with age. Two alternative approaches for incorporating red tide mortality were evaluated using the SS model built to mimic the previous assessment model. The objective was to incorporate red tide mortality into SS such that it would provide similar model predictions as the ASAP model.

The first approach used to incorporate red tide mortality involved adding a constant M deviate to all 21 age classes. This approach is similar to the approach used in ASAP; however, SS does not have the capability of estimating a constant deviate to be added to all ages. Instead, natural mortality was modeled as a vector of age-specific natural mortality and then a fixed deviate was added to each age-specific M solely in 2005. Two fixed deviates were considered within the SS model: (1) the point estimate of extra mortality from the ASAP assessment model (M_{rt} = 0.2548) (SEDAR 2009) and (2) the point estimate that was best supported by the data and was determined using likelihood profiling in SS.

The second approach evaluated for incorporating red tide mortality used a red tide fishing fleet to model removals of Red Grouper from red tide. For this pseudo-fishery, all fish encountered were discarded with 100% mortality and therefore no catches were required as input. An index of fishing effort for the red tide fleet was based on the Walter Threshold Index (Walter et al. 2013), a binary index where red tide events were depicted as present (= 1, solely in 2005) or absent (= 0) between 1998 and 2010 based on the predicted probability of a severe red tide bloom. This threshold index was extended to include 2011 through 2013 (= 0) based on evidence of no severe red tides during these years from both field observations and modeling approaches. This index assumed that negative effects, i.e., red tide mortality, only occurred under severe red tide events. Baseline levels of red tide are likely already accounted for within estimates of natural mortality derived from empirical data. A catchability parameter (Q) was estimated to scale the fishing mortality rate. No discards were input into the model; instead the model used information from data sources already in the model to scale red tide removals. Selectivity of the red tide fishing fleet was set to 1 for age-0 through age-20 and was assumed constant at age due to the lack of available data on size-specific red tide mortality.

The Assessment Panel decided to use this approach (red tide fishing fleet) as the central approach for incorporating red tide mortality. This approach gave similar results as the approach that used a fixed constant M_{rt} applied to all ages (Table 3.1.2, Figure 3.1.7). However, the red tide fishing fleet allows for the level of mortality to be estimated by the assessment model rather than input as a fixed parameter. This configuration should lead to a better representation of model uncertainty to the 2005 red tide mortality event.

3.1.4 Estimated parameters

A total of 331 parameters were estimated for the base case model (Table 3.1.1). Of the 331 parameters, 151 were fleet specific fishing mortality rates. The remaining 180 estimated parameters include 125 used to estimate selectivity and retention curves, 28 annual recruitment deviations, 1 catchability parameter used to scale the red tide mortality index, and 5 initial fishing mortality rates.

Table 3.2.1 includes predicted parameter values and their associated standard errors from SS, initial parameter values, and minimum and maximum values a parameter could take. Parameters designated as fixed were held at their initial values. Steepness was estimated in the base model using a symmetrical beta prior; the mean and standard deviation associated with this parameter was taken from the SEDAR update assessment and is in line with the recommendation of 0.84 by Shertzer et al. (2012). Normal priors were used to penalize the random walk. Parameter bounds were selected to be sufficiently wide to avoid truncating the searching procedure during maximum likelihood estimation. The soft bounds option in SS was utilized when fitting the assessment model. This option creates a weak symmetric beta penalty on selectivity parameters to move parameters away from the bounds (Methot 2011).

3.1.5 Model Convergence

Model convergence was evaluated using jitter analysis. The jitter analysis perturbs the initial values so that a broad range of parameter values along the likelihood surface are used as starting values. This ensures that the model converged to a global solution rather than a local minima. Starting values of all estimated parameters were randomly perturbed by 10% and 50 trials were run. A total of 28 runs converged on a solution that was within 2 likelihood units of the base case (Table 3.1.3). A total of 42 out of 50 runs converged on a solution which provided similar levels (within 5%) of ending depletion and spawning biomass. While this test cannot prove convergence of the model, it did not provide any evidence to the contrary.

3.1.6 Uncertainty and Measures of Precision

Uncertainty in parameter estimates and derived quantities was evaluated using multiple approaches. First, uncertainty in parameter estimates was quantified by computing asymptotic standard errors for each parameter (Table 3.1.1). Asymptotic standard errors are calculated by inverting the Hessian matrix (i.e., the matrix of second derivatives of the likelihood with respect to the parameters) after the model fitting process. Asymptotic standard errors are based upon the model's analytical estimate of the variance near the converged solution.

Likelihood profiles were completed for five model parameters: steepness of the stock-recruit relationship (h), the log of unexploited equilibrium recruitment (R0), the standard deviation in recruitment (σ_R), the offset parameter for initial equilibrium recruitment relative to virgin recruitment log(R1), and the last parameter describing the double normal distribution for the selectivity of the NMFS bottom longline survey. Likelihood profiles are commonly used to elucidate conflicting information among various data sources, to determine how asymmetric the likelihood surfaces surrounding point estimates may be, and to provide an additional evaluation of how precisely parameters are being estimated.

3.1.7 Sensitivity analysis

Uncertainty in data inputs and model configuration was examined through sensitivity analyses. The models reported in this section are by no means a comprehensive evaluation of all possible aspects of model uncertainty, nor do they reflect the full range of models considered in developing the base case. These scenarios are intended to provide more information about sensitivity to key model parameters and potential conflict in signal among data sources. The order in which they are presented is not intended to reflect their importance; each run included here provided important information for developing or evaluating the base case model and alternate states of nature.

Steepness

Steepness is generally a one of the most uncertain but critical parameters estimated in a stock assessment model. In this assessment model, a symmetric beta prior centered at 0.83 and with a standard deviation of 1 on steepness was used. This was an informative prior, as the model tended to estimate steepness at 0.99 when the prior was removed. Given the information provided by the prior about steepness and the model's tendency to estimate steepness at 0.99 two fixed values of steepness were evaluated: a lower value of 0.65 (Run 1) and an upper value of 0.98 (Run 2).

Natural mortality

Model sensitivity to the specification of the natural mortality rate was evaluated. The natural mortality rate (M) was assumed constant over time, but decreasing with age. The form of M as a function of age was based on Lorenzen (2005). The central model uses a base M = 0.144 y-1 .The Data Workshop life history working group recommended two sensitivity runs where the natural mortality vector was adjusted by the base M. More specifically, they recommended that the base M be adjusted assuming higher or lower maximum age where the maximum age was varied by the standard deviation around the maximum age of 29 (+/- 5 or 24-34) and the Hoenig (1983) estimator of M used for the base M in the scaled Lorenzen functions (Figure 2.1.2).

Discards

The absolute magnitude of the commercial discards from 1993 to 2005 is a source of uncertainty in this assessment model. As such, fairly large CVs were put on the total commercial discards. The model's sensitivity to discard weighting was evaluated in two ways. The first was to upweight all discards (Run 5). The second was to remove the discards from 1993-2005, allow them to be estimated given the retention patterns and upweight the 2006-2013 discards (Run 6).

Selectivity pattern of the NMFS bottom longline survey

During the assessment webinars the assessment panel discussed the shape of the NMFS bottom longline selectivity pattern. More specifically, it was suggested that the selectivity of this survey be fixed as asymptotic. The assessment panel was not in total agreement about this and it was decided to allow the model to freely estimate the NMFS bottom longline selectivity parameters for the base case. As such, a sensitivity fixing the NMFS bottom longline selectivity as asymptotic was evaluated as a sensitivity run (Run 7).

Jack-knife analysis

The final set of sensitivity runs was used to evaluate the model sensitivity to each of the indices of abundance. A jack-knife approach was used where each index of abundance was removed from the model and then the model was refit to the remaining data.

3.1.8 Retrospective analysis

Retrospective analysis was conducted to assess the consistency of stock assessment results by sequentially eliminating a year of data from the terminal year while using the same model configuration. The results of this analysis were useful in assessing potential biases and uncertainty in terminal year estimates.

3.1.9 Benchmarks/reference points

Various stock status benchmarks and reference points are calculated in SS. The user can select reference points based on maximum sustainable yield (MSY), equilibrium spawning biomass per recruit (SPR), and spawning stock biomass (SSB). Stock Synthesis calculates SPR as the ratio of the equilibrium reproductive output per recruit that would occur with the current year's F intensities and biology, to the equilibrium reproductive output per recruit that would occur with the current year's biology and no fishing. For SPR-based reference points, SS searches for an F that will produce the specified level of spawning biomass per recruit relative to the unfished value. For spawning biomass-based reference points, SS searches for an F that produces the specified level of spawning biomass relative to the unfished value. Both MSY and spawning biomass-based reference points are dependent on the stock-recruit relationship. YPR and SPR fishing mortality reference points can be calculated independent of the stock-recruit relationship.

The Assessment Workshop panel for SEDAR 42 recommended using MSY-based reference points (i.e., Fmsy) to determine stock status, which is similar to the recommendation from the previous Red Grouper Assessment (SEDAR 2006). MSY-based reference points were recommended because an informative prior on steepness was used, which informed the stock-recruit relationship. The panel also discussed the appropriate units of SSB. The frame of reference for this discussion was Brooks et al. (2008). Brooks et al. (2008) conducted a simulation study evaluating various SSB approaches and stock assessment performance given uncertainties regarding loss of males and reduced fertility. They concluded that the SSB-female approach best estimates biological reference points if the potential for decreased fertilization is weak. Brooks et al. (2008) determined SSB-combined is best when the potential for decreased fertility is moderate or unknown. The Assessment Workshop panel recommended that SSB-female to be used when calculating SSB, where the unit of SSB was the number of eggs. This recommendation was made given that the sex ratio of Red grouper, ~28% male, was relatively high reducing concerns about reduced fertilization. The Assessment Workshop panel also recommended that this decision be revisted by the Review Workshop Panel and the Science and Statistical Committee (SSC).

3.1.10 Projections

Projections were run to evaluate stock status and associated yields for a range of fishing mortality rate scenarios. Projections were run from 2014 to 2030 for the base model configuration . The projections assumed current (2013) yields into the future for 2014. Projections were run assuming that selectivity, discarding, and retention were the same as the most recent five years (2009-2013). This timeframe corresponds to the most recent time block on retention. The catch allocation among fleets used for the projections reflects those used for management, 76% for commercial fleet and 24% for the recreational fleet.

Deterministic projections were run for three fishing mortality rate scenarios:

F = Fmsy,

F=Foy, where Foy is 75% of Fmsy, and

F = Fcurrent.

3.2 Model Results

3.2.1 Measures of model fit

Landings

The predicted landings fit the observed landings perfectly since SS3 effectively treats the landings as known without error. Figure 3.2.1- Figure 3.2.5 show the precise fit of the predicted landings to the observed landings.

Discards

The model was fit to the discards of five fleets including commercial handline, commercial longline, commercial trap, charterboat-private, and headboat. Figure 3.2.6 - Figure 3.2.10 illustrate the model fit to the discards. The observed discards from the commercial handline fleet have an increasing trend between 1993 and 2009 and then decline. The model underestimated the commercial handline discards in all years (Figure 3.2.6). The observed discards from the commercial longline fleet are relatively stable between 1993 and 2006 and then decline. The model underestimated these discards in all years (Figure 3.2.7). The observed commercial trap discards increase between 1990 and 1996 and then generally decline until 2006 (the last year of the fishery). The discards from this fleet are fewer than either the commercial handline or longline discards. The model underestimated the commercial trap discards in all years (Figure 3.2.8).

The observed charterboat-private mode discards varied over time with peaks in 1990, 2005, and 2009. The fits to these discards were generally good, with a systematic underestimation between 2008 and 2013 (Figure 3.2.9). The observed headboat discards were also variable over time with peaks every ten years in 1989, 1999, and 2009. The fits to the headboat discards were generally good with systematic underestimation between 2009 and 2013 (Figure 3.2.10).

Indices of abundance

The model was fit to four fishery-dependent indices, the red tide index, and three fishery-independent indices. Figure 3.2.11 - Figure 3.2.18 show the model fit to the standardized indices.

The model fit to the commercial handline standardized index (RMSE = 0.3097) predicted an increase in the index between 1993 and 2005 (Figure 3.2.11). The standardized index demonstrates a general increase during this time period, however; the main increase was between 1996 and 2005. The model fit dampens this increase. The predicted fit follows the decline between 2005 and 2006 and predicts a stable index between 2006 and 2009 when the observed index increases. The model fit to the commercial longline index (RMSE= 0.1572) predicts an increase in the index between 1993 and 2005 (Figure 3.2.12). The standardized index peaked in 2005 and the model fit underestimates this peak. The model fit also underestimates the decline in the commercial longline index between 2005 and 2007 and instead predicts that the index between 2006 and 2009 is generally flat.

The model fit to the standardized charterboat-private (RMSE = 0.316) and headboat indices (RSME = 0.3067) are shown in Figure 3.2.13 - Figure 3.2.14. The charterboat-private standardized index increased between 1986 and 1990, declined between 1990 and 1995, and then increased between 1986 and 2004 (Figure 3.2.13). The model fit between 1986 and 1996 is rather flat and misses the changes in the index between 1986 and 1996. The model fit predicts the increase between 1996 and 2004, predicting the peak in 2004 exactly. The model fit predicts the decline between 2005 and 2007 fairly well and the following increase between 2006 and 2009. The standardized index is variable between 2010 and 2013 with an increase between 2012 and 2013. The model fit predicts a peak in 2010 followed by a decline. The model fit to the standardized headboat index generally predicts the trends throughout time (Figure 3.2.14). The model predicts the initial increase between 1986 and 1987, albeit an underestimate, followed by a moderate decline between 1987 and 1989, The standardized index exhibits a steep decline between 1989 and 1990, which is predicted by the model fit. The decline is followed by a moderately stable period between 1990 and 2000, which is predicted by the model, although the model overestimates the index during this time period. The standardized headboat index increases between 2000 and 2005 when the index peaks and then steeply declines between 2005 and 2006. The model predicts an increase, but predicts the peak in 2004 followed by a predicted decline between 2004 and 2006. The standardized index was stable between 2006 and 2010 before it exhibits an increase to 2012 and then a decline to 2013. The model fit generally predicts this trend.

The fit to the red tide index was perfect (Figure 3.2.15).

The model fits to the standardized fishery-independent indices are shown in Figure 3.2.16 - Figure 3.2.18. The standardized video survey has a slight increasing trend between 1993 and 2004, which is underestimated by the model fit (Figure 3.2.16). The standardized video index declines between 2004 and 2007. This decline in predicted, but the model predicts an increase after 2006 missing the lowest point of the index in 2007. The increase in the video index between 2008 and 2010 is predicted as is the following decline. The standardized SEAMAP groundfish summer survey (SEAMAP-GF) declines between 2009 and 2013. The model over-predicts this decline (Figure 3.2.17). The standardized NMFS bottom longline index increased between 2001 and 2004, declined between 2004 and 2006, generally increased between 2006 and 2010, and then declined (Figure 3.2.18). The model fit predicts a stable index between 2001 and 2004 that declines between 2004 and 2006. It then predicts an increase between 2007 and 2010 followed by a decline. The model fit misses the peaks in 2011 and 2012 underestimating the final decline in the index.

Length composition

The model fits to the length composition data associated with the discard series and fishery-independent surveys and the Pearson residuals for each fleet and data type are presented in Figure 3.2.19 - Figure 3.2.32. The quality of the fit varied among the fleets and surveys.

The fit to the commercial handline and longline discard length composition was similar (Figure 3.2.19 - Figure 3.2.22). In general, the model fit the discard length composition data relatively well. The peaks of the distributions were underestimated between 2009 and 2011 for commercial handline and between 2010 and 2012 for commercial longline (Figure 3.2.19 - Figure 3.2.22). The Pearson residuals indicate that there is a bit of noise in the model fit to the data for these fleets. This noise is mainly concentrated in the upper tails of the distributions between 2007 and 2009 for the commercial handline fleet and between 2006 and 2009 for the commercial longline fleet. These large residuals are likely due to the underestimation of few individuals.

The model fit to the recreational discard length composition is marginal for both charterboat-private and headboat (Figure 3.2.23 - Figure 3.2.26). The expected distributions are skewed to larger sized fish and the peaks are generally underestimated in all years, except in 2007 for the headboat fishery. The Pearson residuals for the recreational fleets show that there is some evidence of cohorts that are not being accurately predicted by the model.

The model was fit to the length composition data from the three fishery independent surveys (Figure 3.2.27 - Figure 3.2.32). The model fit to these data was relatively good with Pearson residuals that did not exhibit any systematic patterns.

Age composition

The model fits to the age data associated with the landings series and the Pearson residuals for each fleet are presented in Figure 3.2.33 - Figure 3.2.42. The quality of the fit varies among the fleets.

The model fit to the commercial landings age composition is relatively good for the commercial handline and slightly better for the commercial longline (Figure 3.2.33 - Figure 3.2.35). For the handline there are years where the peaks are underestimated (e.g., 2011-2013) and years where the bimodal distribution of the observed data is not accurately captured in the model predictions (e.g., 1991, 1998-2000, 2010). Patterns in the Pearson residuals for the handline provide evidence that the cohorts tracked in the observed data are not being accurately predicted (Figure 3.2.34). More specifically they seem to be underestimated to some degree. The fit to the age composition data for longline is quite good in most years. Similar to the handline fleet but to a lesser extent, the fit to the longline age data shows years with underestimated peaks (e.g., 1999, 2012) and years with lack of fit to observed binomial distributions (e.g., 1995-1996, 2001). While there are patterns in the Pearson residuals for both the handline and longline fleets, the observable patterns for the longline fleet are less pronounced than for the handline fleet (Figure 3.2.34 - Figure 3.2.36). The fit to the age data from the trap fishery is marginal, and in most years the age data for the trap fishery has relatively low sample sizes (Figure 3.2.37). There are fewer systematic patterns in the Pearson residuals fit to the trap data than in the residuals associated with the handline and longline data (Figure 3.2.38).

The fits to the recreational discard length composition for the charterboat-private and headboat fisheries are marginal (Figure 3.2.39 - Figure 3.2.41). In general, the recreational age composition has relatively low samples sizes and the distributions of ages each year are irregular and jagged. The Pearson residuals for the recreational fleets show that there is some evidence of cohorts that are not being accurately predicted by the model, particularly for the 1998 and 2005 cohorts.

3.2.2 Parameter estimates and associated uncertainty

Table 3.1.1 summarizes the parameter estimates and the asymptotic standard errors from SS3. The majority of parameters have relatively low standard errors. Table 3.2.1 summarizes the parameters and their associated coefficients of variation (CVs). The parameters with larger CVs are mainly the size and age selectivity parameters, the initial age parameters, the inflection and slope parameters describing the charterboat-private and headboat retention patterns, and some of the main recruitment deviations (

Table 3.2.1). The size selectivity parameters had the highest uncertainty indicating that they were not well estimated.

Likelihood profiles were generated for several key parameters in this assessment. They include steepness (h), recruitment at an unexploited state (Ln(R0)), variation in recruitment (σ_R), the offset in recruitment from unexploited equilibrium (Ln(R1_offset)), and the parameter describing selectivity of the final population length bin for the NMFS bottom longline survey. This was done to evaluate how well estimated these parameters are and to identify conflicts in the data.

The likelihood profile of the steepness parameter shows that there are conflicts between data sources (Figure 3.2.43). The obvious conflict is between the length composition data and the recruitment, discard, and index information. Less obvious is the conflict between the age data and the recruitment, discard, and index information. The length and age data components favor a smaller steepness value, whereas the recruitment, discard and catch components favor a higher steepness value.

The total likelihood component from the Ln(R0) likelihood profile indicates that the global solution for this parameter is approximately 9.5 (Figure 3.2.44). The recruitment likelihood component is the largest component of the total dictating this outcome. The data conflicts are seemingly minimal, but the length and prior components are in conflict with the other components, favoring a lower Ln(R0) estimate.

The likelihood profile on the variation in recruitment parameter, σ_R, indicates that all likelihood components favor an estimate of larger than 0.5, which is considerably larger than the previous assessment (Figure 3.2.45). The previous assessment estimated σ_R to be ~ 0.3.

The likelihood profile on the parameter accounting for the offset in recruitment from unexploited equilibrium (Ln (R1_offset)) shows that the dominating influence on the likelihood is the recruitment likelihood component (Figure 3.2.46). This likelihood component is in conflict with the other likelihood components favoring a higher offset between the initial recruitment and recruitment at the unexploited equilibrium. This profile also indicates that this parameter is difficult to estimate.

The likelihood profile of the parameter describing the selectivity of the final length bin of the NMFS bottom longline selectivity pattern, indicates that this parameter cannot be well estimated (Figure 3.2.47).

3.2.3 Selectivity and retention

The estimated age-based selectivity patterns for the fishing fleets are shown in Figure 3.2.48 - Figure 3.2.53. Selectivity was assumed to be constant over time in the assessment model. All age-based selectivity patterns were modeled as a random walk and were estimated to have a dome-shape. The estimated selectivity patterns illustrate that the headboat and charterboat-private fleets select smaller Red Grouper than the commercial fleets. Additionally, the age at full selection for headboat is age-3, whereas age-7, age-8, age-9, and age-10 are fully selected for by the charterboat-private, the commercial handline, the commercial trap, and the commercial longline fleets, respectively.

Time blocks were used to describe the retention process in response to changes in size limits over time. Separate time blocks were used for the commercial and recreational fleets due to different management regulations. The first time block used for the commercial fleets corresponds to the 20 in TL (50.8 cm TL and 48.79 cm FL) size limit. The parameters describing this retention function were fixed given that there were few years of discard length composition data for this time period. The retention function for the first time block was assumed to be knife-edged at the size limit with 100% retention of individuals above the size limit (Figure 3.1 2 - Figure 3.1 **4**). The second time block corresponded to the reduction in the commercial size limit to 18 in TL (43.97 cm FL) and the parameters were freely estimated. The estimated inflection points were 45.46 cm FL and 46.38 cm FL, slightly higher than the size limit, for the commercial handline and longline fleets, respectively. Both the slope and asymptote estimates were approximately one for both fleets. Figure 3.1 2 and Figure 3.1 3 show the estimated retention patterns for the commercial handline and longline fleets. These figures show that the majority of retained fish are above the limit.

The retention pattern for the pre-1990 time block for the recreational fleets was a fixed, knife-edge relationship at the 18 inch TL size limit. It was assumed that 100% of fish above the size limit were retained. The charterboat-private and headboat retention patterns were estimated for the 1990-2013 time block. The inflection parameters were estimated to be 53.704 cm FL and 50.304 cm FL for the charterboat-private and headboat fleets, respectively (Table 3.1.1). The slope parameter was estimated at 0.545 for the charterboat-private fleet and 0.319 for the headboat fleet. The asymptote parameter was estimated at 0.833 for the charterboat-private fleet and 0.972 for the headboat fleet. The charterboat-private inflection point is slightly larger than the 20 in TL (50.8 cm FL) size limit. The retention patterns allow for the discarding of legal size Red Grouper due to the combination of the slope and asymptote parameters (Figure 3.1 5 - Figure 3.1 6).

The fishery-independent surveys selectivity patterns were length-based and estimated using the double normal function. Figure 3.2.54 shows the estimated selectivity patterns for the three fishery-independent surveys. The video survey selectivity pattern was estimated to be essentially asymptotic, where Red Grouper are fully selected above 50 cm (Figure 3.2.55). The SEAMAP-GF selectivity pattern was estimated to be dome-shaped, where the pattern increases to full selection sharply between 15 cm FL and 18 cm FL and are fully selected between 18 cm FL and 30 cm FL (Figure 3.2.56). The NMFS_BLL longline survey selectivity pattern was estimated to be dome-shaped, but was essentially asymptotic over the range of observed sizes in the length composition data (Figure 3.2.57).

The Assessment Workshop panel discussed whether the selectivity pattern for the NMFS bottom longline should be fixed as an asymptotic relationship. Support for fixing this relationship to asymptotic was that the fishing gear captures a wide range of sizes and covers a wide distribution of the West Florida shelf where Red Grouper of all sizes should be available for capture. Additionally, as seen in the profiles explained in Section 3.2.2, the parameter that was fixed to ensure asymptotic selectivity was not well estimated from the data. Nonetheless, the Assessment Workshop panel decided to allow the selectivity parameters to be freely estimated because the assessment outcomes were similar between the model where the NMFS bottom longline selectivity pattern was freely estimated and the model that assumed asymptotic selectivity. The reason for the relatively minor differences between these two states was that there were very few fish in the population above the 100 cm where the selectivity was estimated to decline and these differences in estimation of the bottom longline selectivity had relatively minor effects upon the estimation of the selectivities of the other fleets.

3.2.4 Recruitment

The three leading parameters for defining the stock-recruitment relationship were steepness (*h*), virgin recruitment (*R0*), and an offset parameter for initial equilibrium recruitment relative to virgin recruitment Ln (*R1*). Steepness was estimated with a symmetric beta prior centered at 0.83 and the other parameters were estimated without priors (Table 3.1.1). Steepness was estimated at 0.802 for the base model. The log of virgin recruitment was estimated at 9.67 (15,835,350 age-0 recruits). The R1 offset parameter was estimated at -0.048, which suggests the stock was at 95% of virgin recruitment (R1=R0*exp(-Ln(R1_offset)) when the model starts in 1986.

The plot of the stock-recruitment relationship shows high recruitment associated with years 1995, 1998, 2001, and 2005 (Figure 3.2.58). This agrees with the cohort structure seen in the age composition data associated with landings for fishing fleets (Figure 3.2.33, Figure 3.2.35, Figure 3.2.39, Figure 3.2.41).Both high and low levels of recruitment are predicted across the range of spawning biomass values, resulting in a relatively flat stock-recruit relationship.

The likelihood profile for steepness shows that the most likely solution is near 0.8 (Figure 3.2.43). This profile is driven by reductions in the likelihood components for recruitment, discards, and indices. The likelihood profile of equilibrium recruitment shows that this parameter is well estimated (Figure 3.2.44). The recruitment component of the likelihood seems to be the most influential dataset for informing unfished recruitment. The likelihood profile for the offset parameter for initial equilibrium recruitment relative to virgin recruitment log(*R1*) shows that this parameter is not well estimated (Figure 3.2.46).

Predicted age-0 recruits are presented in Figure 3.2.59 and Table 3.2.2. Average recruitment is variable over time. The higher average recruitments are generally preceded and followed by relatively low average recruitments. The RMSE for recruitment deviations was 1.03. The age composition data provides evidence of strong year classes moving through the different fisheries. Recruitment in 2005 is predicted to be the highest recruitment over the time series. Age-0 recruitments in the six most recent years are predicted to be relatively low.

3.2.5 Stock biomass

Predicted total biomass and spawning output in eggs are summarized in Table 3.2.2 and Figure 3.2.60 - Figure 3.2.61 for the base model configuration. Total biomass generally increased from 1986 until 2005, declined in 2006, and increased from 2006 to 2013 (Figure 3.2.60). The decline in 2006 is associated with the red tide event in 2005. The trend seen in total biomass is also evident in the predicted spawning output time-series (Figure 3.2.61).

The predicted numbers-at-age and mean age is presented in Figure 3.2.62. The predicted numbers-at-age indicate that two strong recruitment events were predicted in 1998 and 2005. Mean age varied between two and three between 1986 and 1996. The mean age declined from three to one in 1997 and then varied between one and three between 1998 and 2003. Mean age increased to four in 2003 and then declined to one in 2005 when there was a strong recruitment event (Figure 3.2.59). Predicted mean age steadily increased to five between 2004 and 2013 (Figure 3.2.62).

The trend in the numbers-at-length and mean length is obviously similar to the predicted numbers-at-age and mean age (Figure 3.2.63). Mean length varied between 20 cm FL and approximately 35 cm FL between 1986 and 2004. Mean length declined in 2005 and then steadily increased to approximately 40 cm FL.

3.2.6 Fishing mortality

The overall fishing mortality rate was expressed as exploitation rate in biomass. Fleet specific fishing mortalities are presented as instantaneous rates. The predicted fishing mortalities overall and by fleet are presented in Table 3.2 3 and Figure 3.2.64- Figure 3.2.65. Predicted total fishing mortality declined, on average, between 1986 and 2004. The highest predicted fishing mortality rate was in 2005, which is the year of the red tide event in the eastern Gulf of Mexico (Figure 3.2.64). This red tide event was modeled as a fishing fleet that removed Red Grouper. Its effect was not seen in the landings history, but rather, it was seen as a discard fishery and caused a substantial increase in total catch in 2005 (Figure 3.2.66). The estimated mortality rate from the red tide event was 0.44. Fishing mortality declined in 2006 and continued to do so until 2010, the lowest point of the time series. This decline was followed by an increase in total fishing mortality.

Early in the time series the main sources of fishing mortality were the commercial longline and handlines fleets and the charterboat-private fleet (Figure 3.2.65). The commercial handline fishing mortality declined after 1989 until 1999, remained relatively low and lower than that of the charterboat and private and longline fleets until 2005, increased until 2009 and then declined (Figure 3.2.65). The fishing morality rate of the charterboat-private declined after 1993 until 1997, increased after 1997 until 2000, and then generally declined over the rest of the time period, with a final increase between 2011 and 2013 (Figure 3.2.65). The fishing mortality trends for the commercial handline and charterboat-private fleets are similar to the trends in observed landings. The fishing mortality from the commercial longline fleet has generally declined since 1993 (Figure 3.2.65). Unlike the commercial handline and charterboat-private fleets, this trend in fishing mortality cannot be explained by the trend in landings, which has remained relatively stable over time. Rather this decline in fishing mortality may be better explained by the decline in commercial longline discards (Figure 3.2.7).

The fishing mortalities associated with the commercial trap fleet and headboat fleet were relatively low over time compared to the other fleets (Figure 3.2.65). This corresponds to relatively low landings and discards over time (Figure 3.2.66).

3.2.7 Sensitivity analysis

The results of the sensitivity analyses are summarized in Table 3.2.5 and Figure 3.2.67 - Figure 3.2.73.

Steepness

The absolute magnitude of SSB, recruitment and fishing mortality rate seemed insensitive to the assumed values of steepness (Figure 3.2.71). Nonetheless, stock status estimates will likely be affected by different fixed values of steepness.

Natural mortality

The assessment results seemed most sensitive to the assumed natural mortality vector (

Figure 3.2.70). Estimates of SSB and age-0 recruits were higher than the base when natural mortality was larger and lower when natural mortality was smaller. Fishing mortality was lower than the base when natural mortality was larger and was higher when natural mortality was small than base.

Total discards

The assessment results were relatively insensitive to the data weighting of the total discards (Figure 3.2.72)

Selectivity of NMFS bottom longline survey

The assessment results seemed insensitive to the assumption of asymptotic selectivity for the NMFS bottom longline survey (Figure 3.2.73).

Jack-knife of indices

The results of the jack-knife analysis are summarized in Table 3.2. 6 and Figure 3.2.74 - Figure 3.2.76.

The jack knife analysis of the abundance indices revealed that the model was sensitive to the charterboat-private index and the headboat index. This sensitivity is most obvious when comparing the SSB estimates. Removal of the charterboat-private index exaggerated the increase in SSB in 2005, whereas the removal of the headboat index reduced the absolute estimate of SSB in 2005. This was also true for the fishing mortality estimates. The fits to these indices were similar when comparing the RMSEs, 0.316 and 0.3067 for the charterboat-private fleet and headboat fleet, respectively.

The estimate of the age-0 recruits, especially in the last 4-5 years of the model seemed sensitive to the SEAMAP groundfish index. This makes intuitive sense since this index can be considered as a recruitment index and only covers the last five years of the model.

3.2.8 Retrospective results

The results from the retrospective analysis are summarized in Figure 3.2.77 - Figure 3.2.80. There were no major patterns or systematic bias in the spawning stock biomass, the fishing mortality, or the ratio of SSB and SSB achieved at MSY. The retrospective pattern in the recruits was highly variable for the years prior to the SEAMAP survey, but largely indicative of random fluctuations in the estimates of recruitment in years prior to having a recruitment index. This variability in recruitment does not translate to substantial retrospective bias in SSB (Figure 3.2.79).

3.2.9 Benchmark and reference points

Stock status relative to the minimum stock size threshold (MSST) and maximum fishing mortality threshold (MFMT) are presented in Table 3.2.2 and Figures 3.2.81 – 3.2.82. The comparison of SSB and MSST indicates that Red Grouper were overfished between 1986 and 1996 since spawning stock biomass was below MSST (Figure 3.2.81). Spawning stock biomass has been above the MSST since 1997. The comparison of fishing mortality and MFMT indicates that Red Grouper experienced overfishing between 1986 and 1995 and did not experience overfishing between 1996 and 2013, except for 2000 and 2005 (Figure 3.2.82).

Estimates of yield per recruit and spawner per recruit are summarized in Figure 3.2.84.

3.2.10 Projections

Three projection scenarios were run where fishing mortality was equal to either Fmsy, Foy (i.e., 75% of Fmsy), or Fcurrent. Figure 3.2.83 summarizes the results with respect to the ratio between SSB and the minimum stock size threshold (MSST), age-0 recruits, the ratio between fishing mortality and Fmsy, and retained yield. The ratio between SSB and MSST is projected to decline between 2014 and 2018 and then increase and equilibrate between 2019 and 2030. The ratio between SSB and MSST is projected to drop below 1 (i.e., the stock is expected to be overfished) between 2018 and 2019 when fishing mortality was set equal to Fmsy and be above 1 in all other years. The ratio between fishing mortality and the maximum fishing mortality threshold (MFMT) was projected to increase between 2014 and 2017 and be greater than 1 (i.e., the stock is projected to experience overfishing), decline below 1 after 2017, and equilibrate at sustainable levels between 2024 and 2030. The projections have similar trends under the Foy and Fcurrent fishing mortality scenarios as the Fmsy scenario, but the stock is not expected to be overfished over experience overfishing during the projection period. Retained yield was projected to equilibrate between 2025 and 2030 at ~3700 mt, ~3500 mt, and ~3300 mt for the Fmsy, Foy, and Fcurrent fishing mortality scenarios (Table 3.2.7).

3.3 Discussion and recommendations

3.3.1 Discussion

The assessment model predicts that total biomass and the spawning potential (egg production) increased from 2006 to 2012 and declined slightly between 2012 and 2013 (Figure 3.2.60, Figure 3.2.61). The predicted biomass in 2006 was at a record low due to the red tide event in 2005 and has increased since. In 2005, a large recruitment event was predicted, which may help explain the predicted increase in total biomass and spawning output (Figure 3.2.59). This large recruitment event was supported by the age composition data, which does not suggest subsequent strong year classes (Figure 2.4.1 – Figure 2.4.5).

Overall, total biomass increased between 1986 and 2005. This corresponded to a period of decline in predicted fishing mortality. The fishing mortality rate since 2005 has remained low suggesting that biomass has had the opportunity to accumulate between 2006 and 2012. Biomass is 2013 is similar to biomass in 2012.

3.3.2 Recommendations

1. Evaluate existing methods for deriving historical discard numbers and discard rates and improve methods as appropriate.

2. Develop/evaluate methods to maintain continuity of fishery-dependent indices in light of management regulations and ITQs.

3. Considering red tide is an unpredictable event, but can be a significant source of mortality, a response protocol should be developed for data collection and incorporation of the information into updated assessments.

4. The start year of this assessment is 1986. Future assessments should investigate extending the assessment model further back in time.

5. Develop protocol for reliable estimation of fishery discards.

3.4 Acknowledgements

Many people from state and federal agencies worked diligently to assemble the data included in this stock assessment and the Data Workshop Panel was incredibly helpful with addressing the issues and nuances of the data. The Assessment Panel, as well as scientists from the Sustainable Fisheries Division at the Southeast Fisheries Science Center were instrumental in guiding the stock assessment model configuration.

3.5 References

Brooks, E.N., K.W. Shertzer, T. Gedamke, and D.S. Vaughan. 2008. Stock assessment of protogynous fish: evaluating measures of spawning biomass used to estimate biological reference points. Fish Bull. U.S. 106:12-28.

SEDAR. 2006. SEDAR 12 Stock Assessment Report Gulf of Mexico Red Grouper. 358 pp.

SEDAR. 2009. Stock assessment of Red Grouper in the Gulf of Mexico - SEDAR Update Assessment. 143pp.

Shertzer, K.W., Conn, P.B. 2012. Spawner-recruit relationships of demersal marine fishes:Prior distribution of steepness. Bulletin of Marine Science 88(1): 39-50.

Walter, J., M.C. Christman, J.H. Landsberg, B. Linton, K. Steidinger, R. Stumpf, and J. Tustison. 2013. Satellite derived indices of red tide severity for input for Gulf of Mexico Gag grouper stock assessment. SEDAR33-DW08. 43 pp.

3.6 Tables

Table 3.1.1 List of SS parameters for Gulf of Mexico Red Grouper. The list includes predicted parameter values and their associated standard errors from the base model run, initial parameter values, lower and upper bounds of the parameters, and the prior densities assigned to the parameters. Parameters designated as fixed were held at their initial values.

			Predicted			Prior		
Label	Lower bound	Upper bound	Value	SD	Type	Value	SD	Status
L_at_Amin_Fem_GP_1	1	40	17.29	_	No_prior			Fixed
L_at_Amax_Fem_GP_1	60	100	82.72	_	No_prior			Fixed
VonBert_K_Fem_GP_1	0.05	0.3	0.124	_	No_prior			Fixed
CV_young_Fem_GP_1	1.00E-06	0.2	0.144	_	No_prior			Fixed
CV_old_Fem_GP_1	1.00E-06	0.2	0.165	_	No_prior			Fixed
Wtlen_1_Fem	-3	3	0.000	_	No_prior			Fixed
Wtlen_2_Fem	-3	4	3.250	_	No_prior			Fixed
Mat50%_Fem	1	10	2.8	_	No_prior			Fixed
Mat_slope_Fem	-30	3	-1.15	_	No_prior			Fixed
Eggs_scalar_Fem	-3	3	4.47E-08	_	No_prior			Fixed
Eggs_exp_len_Fem	-3	3	5.48	_	No_prior			Fixed
RecrDist_GP_1	-4	4	0	_	No_prior			Fixed
RecrDist_Area_1	-4	4	0	_	No_prior			Fixed
RecrDist_Seas_1	-4	4	0	_	No_prior			Fixed
CohortGrowDev	0.5	1.5	1	_	No_prior			Fixed
SR_LN(R0)	1	40	9.670	0.126	No_prior			Estimated
SR_BH_steep	0.2	0.99	0.802	0.132	Sym_Beta	0.83	1	Estimated
SR_sigmaR	0	2	0.965	0.117	No_prior			Estimated
SR_envlink	-5	5	0.000	_	No_prior			-
SR_R1_offset	-5	5	-0.048	0.123	No_prior			Estimated
SR_autocorr	0	0	0.000	_	No_prior			-
Early_InitAge_17	_	_	0.185	1.052				Estimated
Early_InitAge_16	_	_	0.249	1.081				Estimated
Early_InitAge_15	_	_	0.331	1.116				Estimated
Early_InitAge_14	_	_	-0.037	0.957				Estimated
Early_InitAge_13	_	_	-0.266	0.869				Estimated
Early_InitAge_12	_	_	-0.431	0.813				Estimated
Early_InitAge_11	_	_	-0.633	0.765				Estimated
Early_InitAge_10	_	_	-0.761	0.730				Estimated
Early_InitAge_9	_	_	-0.727	0.712				Estimated
Early_InitAge_8	_	_	-0.567	0.709				Estimated
Early_InitAge_7	_	_	-0.254	0.731				Estimated
Early_InitAge_6	_	_	0.133	0.739				Estimated
Early_InitAge_5	_	_	0.717	0.457				Estimated

Table 3.1.1. Continued

			Predicted		Prior			
Label	Lower bound	Upper bound	Value	SD	Value	SD	Status	Value
Early_InitAge_4	_	_	0.063	0.603				Estimated
Early_InitAge_3	_	_	-0.176	0.485				Estimated
Early_InitAge_2	_	_	0.670	0.187				Estimated
Early_InitAge_1	_	_	0.309	0.193				Estimated
Main_RecrDev_1986	_	_	0.706	0.132				Estimated
Main_RecrDev_1987	_	_	-0.495	0.285				Estimated
Main_RecrDev_1988	_	_	0.947	0.108				Estimated
Main_RecrDev_1989	_	_	0.704	0.118				Estimated
Main_RecrDev_1990	_	_	0.160	0.170				Estimated
Main_RecrDev_1991	_	_	0.017	0.180				Estimated
Main_RecrDev_1992	_	_	-0.188	0.182				Estimated
Main_RecrDev_1993	_	_	0.666	0.108				Estimated
Main_RecrDev_1994	_	_	-1.118	0.380				Estimated
Main_RecrDev_1995	_	_	1.190	0.083				Estimated
Main_RecrDev_1996	_	_	-0.353	0.189				Estimated
Main_RecrDev_1997	_	_	-1.383	0.404				Estimated
Main_RecrDev_1998	_	_	1.867	0.071				Estimated
Main_RecrDev_1999	_	_	-0.333	0.278				Estimated
Main_RecrDev_2000	_	_	-0.759	0.355				Estimated
Main_RecrDev_2001	_	_	1.252	0.099				Estimated
Main_RecrDev_2002	_	_	-0.841	0.307				Estimated
Main_RecrDev_2003	_	_	0.430	0.118				Estimated
Main_RecrDev_2004	_	_	-2.499	0.521				Estimated
Main_RecrDev_2005	_	_	2.206	0.100				Estimated
Main_RecrDev_2006	_	_	0.897	0.113				Estimated
Main_RecrDev_2007	_	_	0.804	0.124				Estimated
Main_RecrDev_2008	_	_	0.016	0.166				Estimated
Main_RecrDev_2009	_	_	-0.282	0.150				Estimated
Main_RecrDev_2010	_	_	-0.619	0.170				Estimated
Main_RecrDev_2011	_	_	-1.418	0.234				Estimated
Main_RecrDev_2012	_	_	-0.893	0.237				Estimated
Main_RecrDev_2013	_	_	-0.682	0.450				Estimated
InitF_1commHL	0	1	0.097	0.018	No_prior			Estimated
InitF_2commLL	0	1	0.142	0.030	No_prior			Estimated
InitF_3commTrap	0	1	0.025	0.006	No_prior			Estimated
InitF_4CBT_PR	0	1	0.104	0.011	No_prior			Estimated
InitF_5HB	0	1	0.012	0.001	No_prior			Estimated
InitF_6RedTide	0	1	0.000	_	Normal	0.01	0.1	-
F_fleet_1_YR_1986_s_1	0	8	0.198	0.026				Estimated

Table 3.1.1. Continued

			Predicted		Prior			
Label	Lower bound	Upper bound	Value	SD	Value	SD	Status	Value
F_fleet_1_YR_1987_s_1	0	8	0.154	0.018				Estimated
F_fleet_1_YR_1988_s_1	0	8	0.116	0.012				Estimated
F_fleet_1_YR_1989_s_1	0	8	0.241	0.020				Estimated
F_fleet_1_YR_1990_s_1	0	8	0.194	0.017				Estimated
F_fleet_1_YR_1991_s_1	0	8	0.146	0.013				Estimated
F_fleet_1_YR_1992_s_1	0	8	0.094	0.008				Estimated
F_fleet_1_YR_1993_s_1	0	8	0.086	0.008				Estimated
F_fleet_1_YR_1994_s_1	0	8	0.082	0.007				Estimated
F_fleet_1_YR_1995_s_1	0	8	0.065	0.006				Estimated
F_fleet_1_YR_1996_s_1	0	8	0.043	0.004				Estimated
F_fleet_1_YR_1997_s_1	0	8	0.046	0.004				Estimated
F_fleet_1_YR_1998_s_1	0	8	0.035	0.003				Estimated
F_fleet_1_YR_1999_s_1	0	8	0.058	0.005				Estimated
F_fleet_1_YR_2000_s_1	0	8	0.083	0.008				Estimated
F_fleet_1_YR_2001_s_1	0	8	0.076	0.007				Estimated
F_fleet_1_YR_2002_s_1	0	8	0.073	0.008				Estimated
F_fleet_1_YR_2003_s_1	0	8	0.049	0.005				Estimated
F_fleet_1_YR_2004_s_1	0	8	0.052	0.006				Estimated
F_fleet_1_YR_2005_s_1	0	8	0.050	0.006				Estimated
F_fleet_1_YR_2006_s_1	0	8	0.062	0.005				Estimated
F_fleet_1_YR_2007_s_1	0	8	0.074	0.008				Estimated
F_fleet_1_YR_2008_s_1	0	8	0.087	0.010				Estimated
F_fleet_1_YR_2009_s_1	0	8	0.117	0.012				Estimated
F_fleet_1_YR_2010_s_1	0	8	0.061	0.007				Estimated
F_fleet_1_YR_2011_s_1	0	8	0.059	0.007				Estimated
F_fleet_1_YR_2012_s_1	0	8	0.053	0.007				Estimated
F_fleet_1_YR_2013_s_1	0	8	0.032	0.004				Estimated
F_fleet_2_YR_1986_s_1	0	8	0.230	0.035				Estimated
F_fleet_2_YR_1987_s_1	0	8	0.363	0.051				Estimated
F_fleet_2_YR_1988_s_1	0	8	0.194	0.023				Estimated
F_fleet_2_YR_1989_s_1	0	8	0.284	0.031				Estimated
F_fleet_2_YR_1990_s_1	0	8	0.229	0.025				Estimated
F_fleet_2_YR_1991_s_1	0	8	0.271	0.027				Estimated
F_fleet_2_YR_1992_s_1	0	8	0.233	0.024				Estimated
F_fleet_2_YR_1993_s_1	0	8	0.409	0.043				Estimated
F_fleet_2_YR_1994_s_1	0	8	0.258	0.027				Estimated
F_fleet_2_YR_1995_s_1	0	8	0.208	0.023				Estimated
F_fleet_2_YR_1996_s_1	0	8	0.204	0.021				Estimated
F_fleet_2_YR_1997_s_1	0	8	0.191	0.021				Estimated

Table 3.1.1 Continued

Label	Lower bound	Upper bound	Value	SD	Value	SD	Status	Value
			Predicted		Prior			
F_fleet_2_YR_1998_s_1	0	8	0.154	0.016				Estimated
F_fleet_2_YR_1999_s_1	0	8	0.223	0.022				Estimated
F_fleet_2_YR_2000_s_1	0	8	0.178	0.019				Estimated
F_fleet_2_YR_2001_s_1	0	8	0.215	0.024				Estimated
F_fleet_2_YR_2002_s_1	0	8	0.192	0.023				Estimated
F_fleet_2_YR_2003_s_1	0	8	0.165	0.020				Estimated
F_fleet_2_YR_2004_s_1	0	8	0.188	0.027				Estimated
F_fleet_2_YR_2005_s_1	0	8	0.169	0.020				Estimated
F_fleet_2_YR_2006_s_1	0	8	0.173	0.022				Estimated
F_fleet_2_YR_2007_s_1	0	8	0.120	0.017				Estimated
F_fleet_2_YR_2008_s_1	0	8	0.156	0.017				Estimated
F_fleet_2_YR_2009_s_1	0	8	0.064	0.009				Estimated
F_fleet_2_YR_2010_s_1	0	8	0.075	0.010				Estimated
F_fleet_2_YR_2011_s_1	0	8	0.155	0.020				Estimated
F_fleet_2_YR_2012_s_1	0	8	0.114	0.016				Estimated
F_fleet_2_YR_2013_s_1	0	8	0.087	0.013				Estimated
F_fleet_3_YR_1986_s_1	0	8	0.053	0.009				Estimated
F_fleet_3_YR_1987_s_1	0	8	0.035	0.006				Estimated
F_fleet_3_YR_1988_s_1	0	8	0.040	0.006				Estimated
F_fleet_3_YR_1989_s_1	0	8	0.044	0.006				Estimated
F_fleet_3_YR_1990_s_1	0	8	0.034	0.004				Estimated
F_fleet_3_YR_1991_s_1	0	8	0.036	0.005				Estimated
F_fleet_3_YR_1992_s_1	0	8	0.053	0.007				Estimated
F_fleet_3_YR_1993_s_1	0	8	0.061	0.008				Estimated
F_fleet_3_YR_1994_s_1	0	8	0.077	0.010				Estimated
F_fleet_3_YR_1995_s_1	0	8	0.084	0.010				Estimated
F_fleet_3_YR_1996_s_1	0	8	0.035	0.005				Estimated
F_fleet_3_YR_1997_s_1	0	8	0.039	0.005				Estimated
F_fleet_3_YR_1998_s_1	0	8	0.016	0.002				Estimated
F_fleet_3_YR_1999_s_1	0	8	0.042	0.006				Estimated
F_fleet_3_YR_2000_s_1	0	8	0.060	0.008				Estimated
F_fleet_3_YR_2001_s_1	0	8	0.044	0.006				Estimated
F_fleet_3_YR_2002_s_1	0	8	0.056	0.008				Estimated
F_fleet_3_YR_2003_s_1	0	8	0.034	0.006				Estimated
F_fleet_3_YR_2004_s_1	0	8	0.036	0.005				Estimated
F_fleet_3_YR_2005_s_1	0	8	0.032	0.005				Estimated
F_fleet_3_YR_2006_s_1	0	8	0.030	0.005				Estimated
F_fleet_3_YR_2007_s_1	0	8	0.001	0.000				Estimated
F_fleet_3_YR_2008_s_1	_	_	0.000	_				-

Table 3.1.1 Continued

Label	Lower bound	Upper bound	Predicted Value	Predicted SD	Prior Type	Prior Value	Prior SD	Status
F_fleet_3_YR_2009_s_1	_	_	0.000	_				-
F_fleet_3_YR_2010_s_1	_	_	0.000	_				-
F_fleet_3_YR_2011_s_1	0	8	0.000	0.000				Estimated
F_fleet_3_YR_2012_s_1	_	_	0.000	_				-
F_fleet_3_YR_2013_s_1	_	_	0.000	_				-
F_fleet_4_YR_1986_s_1	0	8	0.151	0.016				Estimated
F_fleet_4_YR_1987_s_1	0	8	0.087	0.008				Estimated
F_fleet_4_YR_1988_s_1	0	8	0.193	0.018				Estimated
F_fleet_4_YR_1989_s_1	0	8	0.208	0.019				Estimated
F_fleet_4_YR_1990_s_1	0	8	0.180	0.020				Estimated
F_fleet_4_YR_1991_s_1	0	8	0.253	0.029				Estimated
F_fleet_4_YR_1992_s_1	0	8	0.408	0.044				Estimated
F_fleet_4_YR_1993_s_1	0	8	0.312	0.038				Estimated
F_fleet_4_YR_1994_s_1	0	8	0.252	0.027				Estimated
F_fleet_4_YR_1995_s_1	0	8	0.201	0.023				Estimated
F_fleet_4_YR_1996_s_1	0	8	0.083	0.010				Estimated
F_fleet_4_YR_1997_s_1	0	8	0.064	0.008				Estimated
F_fleet_4_YR_1998_s_1	0	8	0.091	0.011				Estimated
F_fleet_4_YR_1999_s_1	0	8	0.160	0.018				Estimated
F_fleet_4_YR_2000_s_1	0	8	0.272	0.035				Estimated
F_fleet_4_YR_2001_s_1	0	8	0.173	0.020				Estimated
F_fleet_4_YR_2002_s_1	0	8	0.183	0.025				Estimated
F_fleet_4_YR_2003_s_1	0	8	0.138	0.020				Estimated
F_fleet_4_YR_2004_s_1	0	8	0.242	0.032				Estimated
F_fleet_4_YR_2005_s_1	0	8	0.094	0.014				Estimated
F_fleet_4_YR_2006_s_1	0	8	0.113	0.015				Estimated
F_fleet_4_YR_2007_s_1	0	8	0.125	0.015				Estimated
F_fleet_4_YR_2008_s_1	0	8	0.113	0.016				Estimated
F_fleet_4_YR_2009_s_1	0	8	0.128	0.017				Estimated
F_fleet_4_YR_2010_s_1	0	8	0.104	0.015				Estimated
F_fleet_4_YR_2011_s_1	0	8	0.048	0.006				Estimated
F_fleet_4_YR_2012_s_1	0	8	0.096	0.014				Estimated
F_fleet_4_YR_2013_s_1	0	8	0.168	0.025				Estimated
F_fleet_5_YR_1986_s_1	0	8	0.024	0.003				Estimated
F_fleet_5_YR_1987_s_1	0	8	0.017	0.002				Estimated
F_fleet_5_YR_1988_s_1	0	8	0.019	0.002				Estimated
F_fleet_5_YR_1989_s_1	0	8	0.037	0.004				Estimated
F_fleet_5_YR_1990_s_1	0	8	0.022	0.003				Estimated
F_fleet_5_YR_1991_s_1	0	8	0.013	0.002				Estimated

Table 3.1.1 Continued

Label	Lower bound	Upper bound	Predicted Value	Predicted SD	Type	Prior Value	Prior SD	Status
F_fleet_5_YR_1992_s_1	0	8	0.012	0.002				Estimated
F_fleet_5_YR_1993_s_1	0	8	0.012	0.002				Estimated
F_fleet_5_YR_1994_s_1	0	8	0.012	0.002				Estimated
F_fleet_5_YR_1995_s_1	0	8	0.016	0.002				Estimated
F_fleet_5_YR_1996_s_1	0	8	0.019	0.003				Estimated
F_fleet_5_YR_1997_s_1	0	8	0.006	0.001				Estimated
F_fleet_5_YR_1998_s_1	0	8	0.006	0.001				Estimated
F_fleet_5_YR_1999_s_1	0	8	0.009	0.001				Estimated
F_fleet_5_YR_2000_s_1	0	8	0.011	0.002				Estimated
F_fleet_5_YR_2001_s_1	0	8	0.006	0.001				Estimated
F_fleet_5_YR_2002_s_1	0	8	0.005	0.001				Estimated
F_fleet_5_YR_2003_s_1	0	8	0.007	0.001				Estimated
F_fleet_5_YR_2004_s_1	0	8	0.010	0.002				Estimated
F_fleet_5_YR_2005_s_1	0	8	0.012	0.002				Estimated
F_fleet_5_YR_2006_s_1	0	8	0.006	0.001				Estimated
F_fleet_5_YR_2007_s_1	0	8	0.006	0.001				Estimated
F_fleet_5_YR_2008_s_1	0	8	0.007	0.001				Estimated
F_fleet_5_YR_2009_s_1	0	8	0.007	0.001				Estimated
F_fleet_5_YR_2010_s_1	0	8	0.005	0.001				Estimated
F_fleet_5_YR_2011_s_1	0	8	0.005	0.001				Estimated
F_fleet_5_YR_2012_s_1	0	8	0.007	0.001				Estimated
F_fleet_5_YR_2013_s_1	0	8	0.009	0.002				Estimated
F_fleet_6_YR_1986_s_1	_	_	0.000	_				-
F_fleet_6_YR_1987_s_1	_	_	0.000	_				-
F_fleet_6_YR_1988_s_1	_	_	0.000	_				-
F_fleet_6_YR_1989_s_1	_	_	0.000	_				-
F_fleet_6_YR_1990_s_1	_	_	0.000	_				-
F_fleet_6_YR_1991_s_1	_	_	0.000	_				-
F_fleet_6_YR_1992_s_1	_	_	0.000	_				-
F_fleet_6_YR_1993_s_1	_	_	0.000	_				-
F_fleet_6_YR_1994_s_1	_	_	0.000	_				-
F_fleet_6_YR_1995_s_1	_	_	0.000	_				-
F_fleet_6_YR_1996_s_1	_	_	0.000	_				-
F_fleet_6_YR_1997_s_1	_	_	0.000	_				-
F_fleet_6_YR_1998_s_1	0	8	0.000	0.000				Estimated
F_fleet_6_YR_1999_s_1	0	8	0.000	0.000				Estimated
F_fleet_6_YR_2000_s_1	0	8	0.000	0.000				Estimated
F_fleet_6_YR_2001_s_1	0	8	0.000	0.000				Estimated
F_fleet_6_YR_2002_s_1	0	8	0.000	0.000				Estimated

Table 3.1.1 Continued

			Predicted		Prior			
Label	Lower bound	Upper bound	Value	SD	Value	SD	Status	Value
F_fleet_6_YR_2003_s_1	0	8	0.000	0.000				Estimated
F_fleet_6_YR_2004_s_1	0	8	0.000	0.000				Estimated
F_fleet_6_YR_2005_s_1	0	8	0.442	0.096				Estimated
F_fleet_6_YR_2006_s_1	0	8	0.000	0.000				Estimated
F_fleet_6_YR_2007_s_1	0	8	0.000	0.000				Estimated
F_fleet_6_YR_2008_s_1	0	8	0.000	0.000				Estimated
F_fleet_6_YR_2009_s_1	0	8	0.000	0.000				Estimated
F_fleet_6_YR_2010_s_1	0	8	0.000	0.000				Estimated
F_fleet_6_YR_2011_s_1	0	8	0.000	0.000				Estimated
F_fleet_6_YR_2012_s_1	0	8	0.000	0.000				Estimated
F_fleet_6_YR_2013_s_1	0	8	0.000	0.000				Estimated
LnQ_base_6_RedTide	-15	15	0.816	0.217	No_prior			Estimated
Retain_1P_1_commHL	0	85	0.000	_	No_prior			-
Retain_1P_2_commHL	0	20	0.250	_	No_prior			-
Retain_1P_3_commHL	0	1	1.000	_	No_prior			-
Retain_1P_4_commHL	-1	2	0.000	_	No_prior			-
DiscMort_1P_1_commHL	-20	20	-15.000	_	No_prior			-
DiscMort_1P_2_commHL	-2	2	1.000	_	No_prior			-
DiscMort_1P_3_commHL	-1	2	0.190	_	No_prior			-
DiscMort_1P_4_commHL	-1	2	0.000	_	No_prior			-
Retain_2P_1_commLL	0	85	0.000	_	No_prior			-
Retain_2P_2_commLL	0	20	0.250	_	No_prior			-
Retain_2P_3_commLL	0	1	1.000	_	No_prior			-
Retain_2P_4_commLL	-1	10	0.000	_	No_prior			-
DiscMort_2P_1_commLL	-20	20	-15.000	_	No_prior			-
DiscMort_2P_2_commLL	-2	2	1.000	_	No_prior			-
DiscMort_2P_3_commLL	-1	2	0.415	_	No_prior			-
DiscMort_2P_4_commLL	-1	2	0.000	_	No_prior			-
Retain_3P_1_commTrap	0	85	0.000	_	No_prior			-
Retain_3P_2_commTrap	0	20	0.250	_	No_prior			-
Retain_3P_3_commTrap	0	1	1.000	_	No_prior			-
Retain_3P_4_commTrap	-1	2	0.000	_	No_prior			-
DiscMort_3P_1_commTrap	-20	20	-15.000	_	No_prior			-
DiscMort_3P_2_commTrap	-2	2	1.000	_	No_prior			-
DiscMort_3P_3_commTrap	-1	2	0.100	_	No_prior			-
DiscMort_3P_4_commTrap	-1	2	0.000	_	No_prior			-
Retain_4P_1_CBT_PR	20	85	43.969	_	No_prior			-
Retain_4P_2_CBT_PR	0	20	0.500	_	No_prior			-
Retain_4P_3_CBT_PR	0	1	1.000	_	No_prior			-

Table 3.1.1 Continued

Label	Lower bound	Upper bound	Predicted Value	Predicted SD	Prior Value	Prior SD	Status	Value
Retain_4P_4_CBT_PR	-1	2	0.000	_	No_prior			-
DiscMort_4P_1_CBT_PR	-20	20	-15.000	_	No_prior			-
DiscMort_4P_2_CBT_PR	-2	2	1.000	_	No_prior			-
DiscMort_4P_3_CBT_PR	-1	2	0.116	_	No_prior			-
DiscMort_4P_4_CBT_PR	-1	2	0.000	_	No_prior			-
Retain_5P_1_HB	20	85	43.969	_	No_prior			-
Retain_5P_2_HB	0	20	0.500	_	No_prior			-
Retain_5P_3_HB	0	1	1.000	_	No_prior			-
Retain_5P_4_HB	-1	2	0.000	_	No_prior			-
DiscMort_5P_1_HB	-20	20	-15.000	_	No_prior			-
DiscMort_5P_2_HB	-2	2	1.000	_	No_prior			-
DiscMort_5P_3_HB	-1	2	0.116	_	No_prior			-
DiscMort_5P_4_HB	-1	2	0.000	_	No_prior			-
SizeSel_7P_1_SEAMAP_Vid	10	60	55.290	3.457	No_prior			Estimated
SizeSel_7P_2_SEAMAP_Vid	-15	15	3.145	75.845	No_prior			Estimated
SizeSel_7P_3_SEAMAP_Vid	-15	15	5.721	0.313	No_prior			Estimated
SizeSel_7P_4_SEAMAP_Vid	-15	15	0.243	400.230	No_prior			Estimated
SizeSel_7P_5_SEAMAP_Vid	-15	15	-4.830	1.409	No_prior			Estimated
SizeSel_7P_6_SEAMAP_Vid	-15	15	2.504	196.010	No_prior			Estimated
SizeSel_8P_1_SEAMAP_GF	10	60	13.350	6.561	No_prior			Estimated
SizeSel_8P_2_SEAMAP_GF	-15	15	-2.147	0.574	No_prior			Estimated
SizeSel_8P_3_SEAMAP_GF	-15	15	-1.068	37.904	No_prior			Estimated
SizeSel_8P_4_SEAMAP_GF	-15	15	4.941	0.279	No_prior			Estimated
SizeSel_8P_5_SEAMAP_GF	-15	15	-2.103	0.251	No_prior			Estimated
SizeSel_8P_6_SEAMAP_GF	-15	15	-2.055	0.231	No_prior			Estimated
SizeSel_9P_1_NMFS_BLL	0.5	129	45.565	0.966	No_prior			Estimated
SizeSel_9P_2_NMFS_BLL	-15	15	0.516	6.058	No_prior			Estimated
SizeSel_9P_3_NMFS_BLL	-15	15	4.284	0.182	No_prior			Estimated
SizeSel_9P_4_NMFS_BLL	-15	15	-0.089	294.529	No_prior			Estimated
SizeSel_9P_5_NMFS_BLL	-15	15	-5.759	0.680	No_prior			Estimated
SizeSel_9P_6_NMFS_BLL	-15	15	0.808	45.495	No_prior			Estimated
AgeSel_1P_1_commHL	-1010	1	-1000	_	No_prior			-
AgeSel_1P_2_commHL	-5	5	0.000	_	Normal	0	0.25	-
AgeSel_1P_3_commHL	-5	5	1.210	0.231	Normal	1	0.25	Estimated
AgeSel_1P_4_commHL	-5	5	1.511	0.217	Normal	1	0.25	Estimated
AgeSel_1P_5_commHL	-5	5	1.516	0.211	Normal	1	0.25	Estimated
AgeSel_1P_6_commHL	-5	5	1.316	0.173	Normal	1	0.25	Estimated
AgeSel_1P_7_commHL	-5	5	0.966	0.103	Normal	0	0.25	Estimated
AgeSel_1P_8_commHL	-5	5	0.674	0.085	Normal	0	0.25	Estimated

Table 3.1.1 Continued

			Predicted			Prior		
Label	Lower bound	Upper bound	Value	SD	Value	SD	Status	Value
AgeSel_1P_9_commHL	-5	5	0.096	0.091	Normal	0	0.25	Estimated
AgeSel_1P_10_commHL	-5	5	-0.056	0.106	Normal	0	0.25	Estimated
AgeSel_1P_11_commHL	-5	5	-0.101	0.124	Normal	0	0.25	Estimated
AgeSel_1P_12_commHL	-5	5	-0.161	0.138	Normal	0	0.25	Estimated
AgeSel_1P_13_commHL	-5	5	-0.130	0.089	Normal	0	0.1	Estimated
AgeSel_1P_14_commHL	-5	5	-0.100	0.089	Normal	0	0.1	Estimated
AgeSel_1P_15_commHL	-5	5	-0.077	0.091	Normal	0	0.1	Estimated
AgeSel_1P_16_commHL	-5	5	-0.062	0.093	Normal	0	0.1	Estimated
AgeSel_1P_17_commHL	-5	5	-0.051	0.095	Normal	0	0.1	Estimated
AgeSel_1P_18_commHL	-5	5	-0.038	0.096	Normal	0	0.1	Estimated
AgeSel_1P_19_commHL	-5	5	-0.024	0.097	Normal	0	0.1	Estimated
AgeSel_1P_20_commHL	-5	5	-0.011	0.097	Normal	0	0.1	Estimated
AgeSel_1P_21_commHL	-5	5	-0.004	0.098	Normal	0	0.1	Estimated
AgeSel_2P_1_commLL	-1010	1	-1000	_	No_prior			-
AgeSel_2P_2_commLL	-5	5	0.000	_	Normal	0	0.25	-
AgeSel_2P_3_commLL	-5	5	1.241	0.229	Normal	1	0.25	Estimated
AgeSel_2P_4_commLL	-5	5	1.581	0.219	Normal	1	0.25	Estimated
AgeSel_2P_5_commLL	-5	5	1.156	0.219	Normal	1	0.25	Estimated
AgeSel_2P_6_commLL	-5	5	1.070	0.201	Normal	1	0.25	Estimated
AgeSel_2P_7_commLL	-5	5	0.807	0.124	Normal	0	0.25	Estimated
AgeSel_2P_8_commLL	-5	5	1.082	0.097	Normal	0	0.25	Estimated
AgeSel_2P_9_commLL	-5	5	0.537	0.091	Normal	0	0.25	Estimated
AgeSel_2P_10_commLL	-5	5	0.119	0.105	Normal	0	0.25	Estimated
AgeSel_2P_11_commLL	-5	5	0.140	0.117	Normal	0	0.25	Estimated
AgeSel_2P_12_commLL	-5	5	-0.181	0.118	Normal	0	0.25	Estimated
AgeSel_2P_13_commLL	-5	5	-0.171	0.086	Normal	0	0.1	Estimated
AgeSel_2P_14_commLL	-5	5	-0.139	0.087	Normal	0	0.1	Estimated
AgeSel_2P_15_commLL	-5	5	-0.098	0.089	Normal	0	0.1	Estimated
AgeSel_2P_16_commLL	-5	5	-0.106	0.092	Normal	0	0.1	Estimated
AgeSel_2P_17_commLL	-5	5	-0.089	0.094	Normal	0	0.1	Estimated
AgeSel_2P_18_commLL	-5	5	-0.075	0.095	Normal	0	0.1	Estimated
AgeSel_2P_19_commLL	-5	5	-0.053	0.096	Normal	0	0.1	Estimated
AgeSel_2P_20_commLL	-5	5	-0.033	0.097	Normal	0	0.1	Estimated
AgeSel_2P_21_commLL	-5	5	-0.024	0.098	Normal	0	0.1	Estimated
AgeSel_3P_1_commTrap	-1010	1	-1000	_	No_prior			-
AgeSel_3P_2_commTrap	-5	5	0.000	_	Normal	0	0.25	-
AgeSel_3P_3_commTrap	-5	5	0.920	0.259	Normal	1	0.25	Estimated
AgeSel_3P_4_commTrap	-5	5	0.799	0.270	Normal	1	0.25	Estimated
AgeSel_3P_5_commTrap	-5	5	0.615	0.270	Normal	1	0.25	Estimated

Table 3.1.1 Continued

			Predicted			Prior		
Label	Lower bound	Upper bound	Value	SD	Value	SD	Status	Value
AgeSel_3P_6_commTrap	-5	5	0.429	0.232	Normal	1	0.25	Estimated
AgeSel_3P_7_commTrap	-5	5	0.255	0.174	Normal	0	0.25	Estimated
AgeSel_3P_8_commTrap	-5	5	0.798	0.169	Normal	0	0.25	Estimated
AgeSel_3P_9_commTrap	-5	5	0.688	0.159	Normal	0	0.25	Estimated
AgeSel_3P_10_commTrap	-5	5	0.146	0.164	Normal	0	0.25	Estimated
AgeSel_3P_11_commTrap	-5	5	-0.036	0.186	Normal	0	0.25	Estimated
AgeSel_3P_12_commTrap	-5	5	-0.238	0.186	Normal	0	0.25	Estimated
AgeSel_3P_13_commTrap	-5	5	-0.048	0.095	Normal	0	0.1	Estimated
AgeSel_3P_14_commTrap	-5	5	-0.036	0.096	Normal	0	0.1	Estimated
AgeSel_3P_15_commTrap	-5	5	-0.077	0.096	Normal	0	0.1	Estimated
AgeSel_3P_16_commTrap	-5	5	-0.070	0.096	Normal	0	0.1	Estimated
AgeSel_3P_17_commTrap	-5	5	-0.053	0.097	Normal	0	0.1	Estimated
AgeSel_3P_18_commTrap	-5	5	-0.043	0.098	Normal	0	0.1	Estimated
AgeSel_3P_19_commTrap	-5	5	-0.033	0.098	Normal	0	0.1	Estimated
AgeSel_3P_20_commTrap	-5	5	-0.025	0.099	Normal	0	0.1	Estimated
AgeSel_3P_21_commTrap	-5	5	-0.020	0.099	Normal	0	0.1	Estimated
AgeSel_4P_1_CBT_PR	-1010	1	-1000	_	No_prior			-
AgeSel_4P_2_CBT_PR	-5	5	0.000	_	Normal	0	0.25	-
AgeSel_4P_3_CBT_PR	-5	5	1.225	0.228	Normal	1	0.25	Estimated
AgeSel_4P_4_CBT_PR	-5	5	1.343	0.216	Normal	1	0.25	Estimated
AgeSel_4P_5_CBT_PR	-5	5	0.411	0.211	Normal	1	0.25	Estimated
AgeSel_4P_6_CBT_PR	-5	5	0.107	0.129	Normal	1	0.25	Estimated
AgeSel_4P_7_CBT_PR	-5	5	0.019	0.104	Normal	0	0.25	Estimated
AgeSel_4P_8_CBT_PR	-5	5	-0.029	0.102	Normal	0	0.25	Estimated
AgeSel_4P_9_CBT_PR	-5	5	-0.625	0.119	Normal	0	0.25	Estimated
AgeSel_4P_10_CBT_PR	-5	5	-0.192	0.139	Normal	0	0.25	Estimated
AgeSel_4P_11_CBT_PR	-5	5	-0.535	0.161	Normal	0	0.25	Estimated
AgeSel_4P_12_CBT_PR	-5	5	-0.264	0.172	Normal	0	0.25	Estimated
AgeSel_4P_13_CBT_PR	-5	5	-0.105	0.094	Normal	0	0.1	Estimated
AgeSel_4P_14_CBT_PR	-5	5	-0.041	0.094	Normal	0	0.1	Estimated
AgeSel_4P_15_CBT_PR	-5	5	-0.013	0.095	Normal	0	0.1	Estimated
AgeSel_4P_16_CBT_PR	-5	5	-0.033	0.096	Normal	0	0.1	Estimated
AgeSel_4P_17_CBT_PR	-5	5	-0.017	0.097	Normal	0	0.1	Estimated
AgeSel_4P_18_CBT_PR	-5	5	-0.008	0.098	Normal	0	0.1	Estimated
AgeSel_4P_19_CBT_PR	-5	5	0.003	0.099	Normal	0	0.1	Estimated
AgeSel_4P_20_CBT_PR	-5	5	0.008	0.099	Normal	0	0.1	Estimated
AgeSel_4P_21_CBT_PR	-5	5	0.010	0.099	Normal	0	0.1	Estimated
AgeSel_5P_1_HB	-1010	1	-1000	_	No_prior			-
AgeSel_5P_2_HB	-5	5	0.000	_	Normal	0	0.25	-

Table 3.1.1. Continued

				Predicted		Prior		
Label	Lower bound	Upper bound	Value	SD	Value	SD	Status	Value
AgeSel_5P_3_HB	-5	5	1.615	0.181	Normal	1	0.25	Estimated
AgeSel_5P_4_HB	-5	5	1.371	0.162	Normal	1	0.25	Estimated
AgeSel_5P_5_HB	-5	5	-1.066	0.159	Normal	1	0.25	Estimated
AgeSel_5P_6_HB	-5	5	-0.215	0.141	Normal	1	0.25	Estimated
AgeSel_5P_7_HB	-5	5	0.231	0.123	Normal	0	0.25	Estimated
AgeSel_5P_8_HB	-5	5	-0.005	0.123	Normal	0	0.25	Estimated
AgeSel_5P_9_HB	-5	5	-0.515	0.143	Normal	0	0.25	Estimated
AgeSel_5P_10_HB	-5	5	-0.200	0.166	Normal	0	0.25	Estimated
AgeSel_5P_11_HB	-5	5	-0.380	0.186	Normal	0	0.25	Estimated
AgeSel_5P_12_HB	-5	5	-0.387	0.197	Normal	0	0.25	Estimated
AgeSel_5P_13_HB	-5	5	-0.038	0.097	Normal	0	0.1	Estimated
AgeSel_5P_14_HB	-5	5	-0.031	0.097	Normal	0	0.1	Estimated
AgeSel_5P_15_HB	-5	5	-0.017	0.098	Normal	0	0.1	Estimated
AgeSel_5P_16_HB	-5	5	-0.006	0.098	Normal	0	0.1	Estimated
AgeSel_5P_17_HB	-5	5	0.006	0.099	Normal	0	0.1	Estimated
AgeSel_5P_18_HB	-5	5	0.013	0.099	Normal	0	0.1	Estimated
AgeSel_5P_19_HB	-5	5	0.016	0.099	Normal	0	0.1	Estimated
AgeSel_5P_20_HB	-5	5	0.018	0.100	Normal	0	0.1	Estimated
AgeSel_5P_21_HB	-5	5	0.018	0.100	Normal	0	0.1	Estimated
AgeSel_6P_1_RedTide	0.1	21	0.100	_	No_prior			-
AgeSel_6P_2_RedTide	21	21	21.000	_	No_prior			-
Retain_1P_1_commHL_BLK2repl_1990	20	85	48.795	_	No_prior			-
Retain_1P_1_commHL_BLK2repl_2009	20	85	45.462	0.254	No_prior			Estimated
Retain_1P_2_commHL_BLK2repl_1990	0	20	0.100	_	No_prior			-
Retain_1P_2_commHL_BLK2repl_2009	0	20	0.986	0.111	No_prior			Estimated
Retain_1P_3_commHL_BLK2repl_1990	0	1	1.000	_	No_prior			-
Retain_1P_3_commHL_BLK2repl_2009	0	1	0.998	0.001	No_prior			Estimated
Retain_2P_1_commLL_BLK2repl_1990	20	85	48.795	_	No_prior			-
Retain_2P_1_commLL_BLK2repl_2009	20	85	46.383	0.305	No_prior			Estimated
Retain_2P_2_commLL_BLK2repl_1990	0	20	0.100	_	No_prior			-
Retain_2P_2_commLL_BLK2repl_2009	0	20	1.229	0.129	No_prior			Estimated
Retain_2P_3_commLL_BLK2repl_1990	0	1	1.000	_	No_prior			-
Retain_2P_3_commLL_BLK2repl_2009	0	1	1.000	0.001	No_prior			Estimated
Retain_3P_1_commTrap_BLK3repl_1990	20	85	48.975	_	No_prior			-
Retain_3P_2_commTrap_BLK3repl_1990	0	20	0.100	_	No_prior			-
Retain_3P_3_commTrap_BLK3repl_1990	0	1	1.000	_	No_prior			-
Retain_4P_1_CBT_PR_BLK1repl_1990	20	85	53.704	0.611	No_prior			Estimated
Retain_4P_2_CBT_PR_BLK1repl_1990	0	20	0.545	0.265	No_prior			Estimated
Retain_4P_3_CBT_PR_BLK1repl_1990	0	1	0.833	0.047	No_prior			Estimated

Table 3.1.1 Continued

Label	Lower bound	Upper bound	Predicted Value	Predicted SD	Prior Value	Prior SD	Status	Value
Retain_5P_1_HB_BLK1repl_1990	20	85	50.304	1.323	No_prior			Estimated
Retain_5P_2_HB_BLK1repl_1990	0	20	0.319	0.615	No_prior			Estimated
Retain_5P_3_HB_BLK1repl_1990	0	1	0.972	0.014	No_prior			Estimated

Table 3.1.2 Model performance comparison: NoRT = no red tide model, EpiM0.25 = model adding an additional mortality due to red tide of 0.2541 to the natural mortality vector in 2005, EpiM0.48 = model adding an additional mortality due to red tide of 0.48 to the natural mortality vector, and FLEET = model accounting for red tide as a fleet.

	NoRT	EpiM0.25	EpiM0.48	FLEET
Performance				
Gradient	0.005	0.047	0.021	0.300
K	179	179	179	331
N	305	305	305	321
AICc	6723	6708	6703	-13645
BIC	6873	6858	6853	7584
Likelihood				
Total	2925	2917	2915	2837
Discard	320	318	316	311
Length composition	1079	1083	1086	1086
Age composition	1454	1453	1452	1451
Recruitment	18	17	17	17
Survey	-80	-88	-90	-164
commHL	-10	-11	-12	-12
commLL	-17	-18	-18	-18
commTrap	0	0	0	0
CBT_PR	0	0	0	0
HB	-11	-15	-18	-18
RedTide	-	-	-	-74
CBT_PRSurv	-22	-20	-18	-18
SEAMAP_Vid	-13	-14	-15	-15
SEAMAP_GF	-4	-4	-4	-4
NMFS_BLL	-3	-5	-5	-5
Red tide				
Ln(Q)	-	-	-	0.83
F_2005	-	-	-	0.48
	NoRT	EpiM0.25	EpiM0.48	FLEET
Performance				
Gradient	0.005	0.047	0.021	0.300
K	179	179	179	331

Table 3.1.3 Model total likelihood, predicted unfished spawning biomass (eggs), predicted 2013 spawning biomass, spawning biomass achieved at MSY (eggs), and unexploited recruitment from 50 model runs from the jitter analysis. * indicates that a positive definite hessian was not obtained.

Run	Total likelihood	SSB_Virgin	SSB_2013	SSB_MSY	R0
1	2838.47	4056110	2215550	1414710	15985
2	2838.34	4057960	2227670	1412140	15992
3*	2954.07	8.28e-317	0	0	8.28e-317
4	2838.47	4056180	2216090	1414580	15985
5	2838.48	4057230	2216910	1415080	15990
6	2888.39	3585530	1936580	1352220	14131
7	2838.48	4057410	2217900	1414890	15990
8	2838.48	4057430	2217910	1414890	15990
9	2838.47	4056190	2216100	1414590	15985
10	2838.47	4055890	2216050	1414490	15984
11	4904.46	2728690	1256910	1051720	10754
12	2888.99	3982000	2303260	1363420	15693
13*	3318.05	8.76e-317	0	0	8.76e-317
14	2866.57	4058480	2198010	1444760	15995
15	2838.47	4056190	2216100	1414590	15985
16	2839.91	4054760	2212850	1414480	15980
17	2839.91	4054960	2213830	1414290	15981
18	2838.35	4059220	2229520	1412450	15997
19	2838.47	4056190	2216090	1414590	15985
20	22225.2	2389670	953613	934868	9418
21	2838.47	4056190	2216100	1414590	15985
22	2861.18	4018010	2164290	1402800	15835
23	2838.35	4059240	2229530	1412450	15997
24	3265.59	3655900	2169240	1188870	14408
25	3072.25	4066880	2218050	1411330	16028
26	2838.35	4059230	2229520	1412450	15997
27	2838.34	4057960	2227670	1412140	15992
28*	2838.58	6.89e-317	0	0	6.89e-317
29	2861.31	4016170	2152180	1405410	15828
30	2862.29	4326920	2075190	1547260	17052
31	2843.67	4049140	2219390	1422530	15958
32	3337.03	4092410	2190690	1418020	16128
33	2892.66	4008420	2289150	1397400	15797
34	2838.48	4057310	2216830	1415140	15990
35	2838.47	4056180	2216090	1414590	15985
36	2838.48	4057420	2217900	1414890	15990
37	2838.47	4056060	2215030	1414840	15985
38	2838.65	4055950	2216760	1416430	15985
39	2866.57	4058540	2198470	1444650	15995
40	2863.54	4055000	2222970	1414200	15981
41	2838.47	4056180	2216090	1414590	15985
42	2838.34	4057960	2227660	1412140	15992
43	2838.47	4055990	2215110	1414780	15985
44	2838.48	4057440	2217900	1414900	15990
45	2838.47	4056170	2216090	1414580	15985
46	7380.78	1449990	3432890	718108	5714
47	2838.47	4056190	2216090	1414590	15985
48	2864.09	4021490	2190740	1405090	15849
49	5618.6	10987900	1099610	3979560	43303
50	2838.51	4056400	2226500	1413620	15986

Table 3.2.1 Parameter estimates with coefficient of variation (CV).

Parameter Label	Value	CV	Parameter description
SizeSel_7P_4_SEAMAP_Vid	0.24	1647.04	Descending width of double normal for video survey
SizeSel_7P_6_SEAMAP_Vid	2.50	78.28	Selectivity of last length bin in double normal for video survey
SizeSel_9P_6_NMFS_BLL	0.81	56.31	Selectivity of last length bin in double normal for NMFS bottom longline
AgeSel_4P_19_CBT_PR	0.00	33.00	Age-18 penalty for charterboat-private fleet
SizeSel_7P_2_SEAMAP_Vid	3.15	24.12	Width of double normal plateau for video survey
AgeSel_5P_17_HB	0.01	16.50	Age-16 penalty for headboat fleet
AgeSel_4P_20_CBT_PR	0.01	12.38	Age-19 penalty for charterboat-private fleet
SizeSel_9P_2_NMFS_BLL	0.52	11.74	Width of double normal plateau for NMFS bottom longline
Main_RecrDev_1991	0.02	10.59	Recruitment deviation in 1991
Main_RecrDev_2008	0.02	10.38	Recruitment deviation in 2008
AgeSel_4P_21_CBT_PR	0.01	9.90	Age-20 penalty for charterboat-private fleet
Early_InitAge_4	0.06	9.57	
AgeSel_5P_18_HB	0.01	7.62	Age-17 penalty for headboat fleet
AgeSel_5P_19_HB	0.02	6.19	Age-18 penalty for headboat fleet
Early_InitAge_17	0.19	5.69	
Early_InitAge_6	0.13	5.56	
AgeSel_5P_20_HB	0.02	5.56	Age-19 penalty for headboat fleet
AgeSel_5P_21_HB	0.02	5.56	Age-20 penalty for headboat fleet
AgeSel_4P_7_CBT_PR	0.02	5.47	Age-6 penalty for charterboat-private fleet
Early_InitAge_16	0.25	4.34	
Early_InitAge_15	0.33	3.37	
Retain_5P_2_HB_BLK1repl_1990	0.32	1.93	Retention slope for headboat fleet 1990-2008
AgeSel_4P_6_CBT_PR	0.11	1.21	Age-6 penalty for charterboat-private fleet
AgeSel_3P_10_commTrap	0.15	1.12	Age-9 penalty for commercial trap fleet
Main_RecrDev_1990	0.16	1.06	Recruitment deviation in 1990
AgeSel_1P_9_commHL	0.10	0.95	Age-8 penalty for commercial handline fleet
AgeSel_2P_10_commLL	0.12	0.88	Age-9 penalty for commercial longline fleet
AgeSel_2P_11_commLL	0.14	0.84	Age-10 penality for commercial longline fleet
AgeSel_3P_7_commTrap	0.26	0.68	Age-6 penalty for commercial trap fleet
Early_InitAge_5	0.72	0.64	
Early_InitAge_1	0.31	0.62	
AgeSel_3P_6_commTrap	0.43	0.54	Age-5 penalty for commercial trap fleet
AgeSel_5P_7_HB	0.23	0.53	Age-6 penalty for headboat fleet
AgeSel_4P_5_CBT_PR	0.41	0.51	Age-4 penalty for charterboat-private fleet
SizeSel_8P_1_SEAMAP_GF	13.35	0.49	Beginning size bin for double normal plateau for SEAMAP groundfish
Retain_4P_2_CBT_PR_BLK1repl_1990	0.55	0.49	Retention slope for charterboat-private fleet 1990-2008
AgeSel_3P_5_commTrap	0.62	0.44	Age-4 penalty for commercial trap fleet
AgeSel_3P_4_commTrap	0.80	0.34	Age-3 penalty for commercial trap fleet
AgeSel_3P_3_commTrap	0.92	0.28	Age-2 penalty for commercial trap fleet
Early_InitAge_2	0.67	0.28	
Main_RecrDev_2003	0.43	0.27	Main recruitment deviation in 2003
LnQ_base_6_RedTide	0.82	0.27	Natural log of the Red Tide fleet's catchability

Table. 3.2.1 continued

Parameter Label	Value	CV	Parameter description
InitF_3commTrap	0.03	0.24	Initial fishing mortality for commercial trap fleet
AgeSel_3P_9_commTrap	0.69	0.23	Penalty on age-8 for commercial trap fleet
F_fleet_5_YR_2013_s_1	0.01	0.22	2013 instantaneous F for headboat fleet
F_fleet_6_YR_2005_s_1	0.44	0.22	2005 instantaneous F for Red Tide fleet
AgeSel_3P_8_commTrap	0.80	0.21	Penalty on age-7 for commercial trap fleet
InitF_2commLL	0.14	0.21	Initial fishing mortality for commercial longline fleet
F_fleet_5_YR_2002_s_1	0.01	0.20	2002 instantaneous F for headboat fleet
F_fleet_5_YR_2004_s_1	0.01	0.20	2004 instantaneous F for headboat fleet
F_fleet_5_YR_2010_s_1	0.01	0.20	2010 instantaneous F for headboat fleet
F_fleet_5_YR_2011_s_1	0.01	0.20	2011 instantaneous F for headboat fleet
AgeSel_1P_3_commHL	1.21	0.19	Penalty on age-2 for commercial handline fleet
AgeSel_2P_5_commLL	1.16	0.19	Penalty on age-4 for commercial longline fleet
AgeSel_2P_6_commLL	1.07	0.19	Penalty on age-5 for commercial longline fleet
Main_RecrDev_1986	0.71	0.19	Main recruitment deviation for 1986
AgeSel_4P_3_CBT_PR	1.23	0.19	Penalty on age-2 for charterboat-private fleet
InitF_1commHL	0.10	0.19	Initial fishing mortality for commercial handline fleet
AgeSel_2P_3_commLL	1.24	0.18	Penalty on age-2 for commercial longline fleet
F_fleet_5_YR_2000_s_1	0.01	0.18	2000 instantaneous F for headboat fleet
F_fleet_3_YR_2003_s_1	0.03	0.18	2003 instantaneous F for commercial trap fleet
F_fleet_3_YR_1987_s_1	0.04	0.17	1987 instantaneous F for commercial trap fleet
F_fleet_3_YR_1986_s_1	0.05	0.17	1986 instantaneous F for commercial trap fleet
AgeSel_2P_9_commLL	0.54	0.17	Penalty on age-8 for commercial longline fleet
Main_RecrDev_1989	0.70	0.17	Main recruitment deviation for 1989
F_fleet_3_YR_2006_s_1	0.03	0.17	2006 instantaneous F for commercial trap fleet
F_fleet_5_YR_1992_s_1	0.01	0.17	1992 instantaneous F for headboat fleet
F_fleet_5_YR_1993_s_1	0.01	0.17	1993 instantaneous F for headboat fleet
F_fleet_5_YR_1994_s_1	0.01	0.17	1994 instantaneous F for headboat fleet
F_fleet_5_YR_1997_s_1	0.01	0.17	1997 instantaneous F for headboat fleet
F_fleet_5_YR_1998_s_1	0.01	0.17	1998 instantaneous F for headboat fleet
F_fleet_5_YR_2001_s_1	0.01	0.17	2001 instantaneous F for headboat fleet
F_fleet_5_YR_2005_s_1	0.01	0.17	2005 instantaneous F for headboat fleet
F_fleet_5_YR_2006_s_1	0.01	0.17	2006 instantaneous F for headboat fleet
F_fleet_5_YR_2007_s_1	0.01	0.17	2007 instantaneous F for headboat fleet
SR_BH_steep	0.80	0.16	Steepness
Main_RecrDev_1993	0.67	0.16	Main recruitment deviation for 1993
AgeSel_4P_4_CBT_PR	1.34	0.16	Penalty on age-3 for charterboat-private fleet
F_fleet_5_YR_1996_s_1	0.02	0.16	1996 instantaneous F for headboat fleet
F_fleet_3_YR_2005_s_1	0.03	0.16	2005 instantaneous F for commercial trap fleet
Main_RecrDev_2007	0.80	0.15	Main recruitment deviation for 2007
F_fleet_5_YR_1991_s_1	0.01	0.15	1991 instantaneous F for headboat fleet
AgeSel_2P_7_commLL	0.81	0.15	Penalty on age-6 for commercial longline fleet
F_fleet_2_YR_1986_s_1	0.23	0.15	1986 instantaneous F for commercial longline fleet
F_fleet_3_YR_1988_s_1	0.04	0.15	1988 instantaneous F for commercial trap fleet
F_fleet_2_YR_2013_s_1	0.09	0.15	2013 instantaneous F for commercial longline fleet
F_fleet_4_YR_2005_s_1	0.09	0.15	2005 instantaneous F for charterboat-private fleet

Table. 3.2.1 continued

Parameter Label	Value	CV	Parameter description
F_fleet_3_YR_1988_s_1	0.04	0.15	1988 instantaneous F for commercial trap fleet
F_fleet_2_YR_2013_s_1	0.09	0.15	2013 instantaneous F for commercial longline fleet
F_fleet_4_YR_2005_s_1	0.09	0.15	2005 instantaneous F for charterboat-private fleet
F_fleet_4_YR_2013_s_1	0.17	0.15	2013 instantaneous F for charterboat-private fleet
F_fleet_4_YR_2012_s_1	0.10	0.15	2012 instantaneous F for charterboat-private fleet

Table 3.2.2 Predicted total biomass (mt), mature biomass (SSB, eggs), and age-0 recruits (thousand fish), minimum stock size threshold (MSST), the ratio between SSB and MSST, fishing mortality (F), maximum fishing mortality threshold (MFMT), which is equal to F_{MSY}, and the ratio between F and MFMT for Gulf of Mexico Red Grouper from the base model run.

Year	Total biomass	SSB	Age-0 recruits	MSST	SSB/MSST	F	MFMT	F/MFMT
1986	21144.7	1156630	17910	1416320	0.95	0.21	0.16	1.32
1987	20727.8	1129980	5363.6		0.93	0.19		1.21
1988	20410.8	1139280	22718.3		0.94	0.20		1.28
1989	20365.1	1144990	17843		0.94	0.27		1.68
1990	19183.6	1050940	10184.5		0.87	0.17		1.04
1991	20302.1	1132070	8957.31		0.93	0.19		1.17
1992	20786.9	1203400	7380.53		0.99	0.21		1.31
1993	20505.6	1228180	17397.2		1.01	0.23		1.44
1994	19794.5	1187210	2905.62		0.98	0.19		1.18
1995	19569.5	1180980	29175		0.97	0.18		1.13
1996	20067.1	1182310	6233.87		0.98	0.13		0.82
1997	21133.3	1228460	2241.56		1.01	0.12		0.77
1998	21897.9	1310930	58466.6		1.08	0.10		0.65
1999	24611.1	1408770	6552.14		1.16	0.15		0.93
2000	26173.7	1430260	4292.6		1.18	0.17		1.04
2001	27042.1	1532670	32396.7		1.26	0.14		0.88
2002	28860.9	1685460	4050.1		1.39	0.14		0.88
2003	29976.9	1775000	14539.2		1.46	0.11		0.70
2004	31571.5	1909760	784.179		1.58	0.16		0.99
2005	31065.4	1925010	86737.4		1.59	0.48		2.97
2006	21545.3	1239230	21962.3		1.02	0.14		0.87
2007	23495.3	1231680	19982.6		1.02	0.10		0.65
2008	26626.1	1399270	9284.35		1.15	0.11		0.69
2009	29283.4	1633450	7049.86		1.35	0.08		0.52
2010	32017.7	1902920	5133.91		1.57	0.07		0.41
2011	34456.5	2140040	2340.96		1.77	0.08		0.51
2012	35330.1	2252710	3978.58		1.86	0.11		0.67
2013	34516.6	2222750	5271.35		1.83	0.12		0.76

Table 3.2 3 Annual fishing mortality, overall and by fleet.

		Fleet					
Year	Overall	commHL	commLL	commTrap	CBT_PR	HB	Red Tide
1986	0.21	0.20	0.23	0.05	0.15	0.02	0.00
1987	0.19	0.15	0.36	0.04	0.09	0.02	0.00
1988	0.20	0.12	0.19	0.04	0.19	0.02	0.00
1989	0.27	0.24	0.28	0.04	0.21	0.04	0.00
1990	0.17	0.19	0.23	0.03	0.18	0.02	0.00
1991	0.19	0.15	0.27	0.04	0.25	0.01	0.00
1992	0.21	0.09	0.23	0.05	0.41	0.01	0.00
1993	0.23	0.09	0.41	0.06	0.31	0.01	0.00
1994	0.19	0.08	0.26	0.08	0.25	0.01	0.00
1995	0.18	0.07	0.21	0.08	0.20	0.02	0.00
1996	0.13	0.04	0.20	0.04	0.08	0.02	0.00
1997	0.12	0.05	0.19	0.04	0.06	0.01	0.00
1998	0.10	0.04	0.15	0.02	0.09	0.01	0.00
1999	0.15	0.06	0.22	0.04	0.16	0.01	0.00
2000	0.17	0.08	0.18	0.06	0.27	0.01	0.00
2001	0.14	0.08	0.22	0.04	0.17	0.01	0.00
2002	0.14	0.07	0.19	0.06	0.18	0.00	0.00
2003	0.11	0.05	0.17	0.03	0.14	0.01	0.00
2004	0.16	0.05	0.19	0.04	0.24	0.01	0.00
2005	0.48	0.05	0.17	0.03	0.09	0.01	0.44
2006	0.14	0.06	0.17	0.03	0.11	0.01	0.00
2007	0.10	0.07	0.12	0.00	0.12	0.01	0.00
2008	0.11	0.09	0.16	0.00	0.11	0.01	0.00
2009	0.08	0.12	0.06	0.00	0.13	0.01	0.00
2010	0.07	0.06	0.07	0.00	0.10	0.01	0.00
2011	0.08	0.06	0.15	0.00	0.05	0.00	0.00
2012	0.11	0.05	0.11	0.00	0.10	0.01	0.00
2013	0.12	0.03	0.09	0.00	0.17	0.01	0.00

Table 3.2.4 Likelihood values for the data components for each sensitivity run.

Run	Model	Data component	Total	commHL	comm LL	comm Trap	CBT_ PR	HB	Red Tide	Video	SEAMAP-GF	NMFS BLL	CBT_ PRSurv
0	Base	Age_like:	1451.0	352.0	283.6	143.6	459.4	212.4	0	0	0	0	0
1	low M	Age_like:	1449.4	351.6	283.2	143.5	459.0	212.2	0	0	0	0	0
2	high M	Age_like:	1452.2	352.3	284.4	143.7	459.3	212.4	0	0	0	0	0
3	low steepness	Age_like:	1451.0	351.9	283.8	143.5	459.4	212.4	0	0	0	0	0
4	high steepness	Age_like:	1450.9	352.0	283.5	143.6	459.4	212.5	0	0	0	0	0
5	Upweight discards	Age_like:	1709.4	433.9	433.8	147.9	476.2	217.6	0	0	0	0	0
6	Upweight recent discards	Age_like:	1523.1	380.6	314.5	145.0	467.9	215.1	0	0	0	0	0
7	Asymptotic selectivity NFMS_BLL	Age_like:	1452.3	351.9	284.7	143.6	459.4	212.7	0	0	0	0	0
0	Base	Catch_like:	3.7	1.0	2.1	0.1	0.1	0.3	0	0	0	0	0
1	low M	Catch_like:	3.8	1.1	2.2	0.1	0.1	0.3	0	0	0	0	0
2	high M	Catch_like:	3.4	1.0	1.9	0.1	0.1	0.3	0	0	0	0	0
3	low steepness	Catch_like:	3.7	1.0	2.1	0.1	0.1	0.3	0	0	0	0	0
4	high steepness	Catch_like:	3.7	1.0	2.1	0.1	0.1	0.3	0	0	0	0	0
5	Upweight discards	Catch_like:	22.5	8.4	9.0	1.9	1.0	2.1	0	0	0	0	0
6	Upweight recent discards	Catch_like:	20.0	6.6	10.2	0.5	0.9	1.9	0	0	0	0	0
7	Asymptotic selectivity NFMS_BLL	Catch_like:	3.7	1.0	2.1	0.1	0.1	0.3	0	0	0	0	0
0	Base	Disc_like:	310.7	108.8	187.1	14.3	-7.0	7.5	0	0	0	0	0
1	low M	Disc_like:	311.5	108.9	187.3	14.9	-7.2	7.6	0	0	0	0	0
2	high M	Disc_like:	307.4	108.4	186.4	13.2	-7.1	6.5	0	0	0	0	0
3	low steepness	Disc_like:	311.3	108.8	187.1	14.3	-6.8	7.8	0	0	0	0	0
4	high steepness	Disc_like:	310.4	108.8	187.0	14.3	-7.1	7.4	0	0	0	0	0
5	Upweight discards	Disc_like:	481.3	207.8	223.4	30.9	-5.2	24.3	0	0	0	0	0
6	Upweight recent discards	Disc_like:	436.8	172.3	246.0	9.8	-9.5	18.0	0	0	0	0	0
7	Asymptotic selectivity NFMS_BLL	Disc_like:	310.8	108.8	187.1	14.3	-6.9	7.6	0	0	0	0	0
0	Base	Length_like:	1085.8	161.4	170.6	0.0	83.3	105.4	0	110.6	201.8	252.7	0
1	low M	Length_like:	1082.9	161.0	170.2	0.0	83.6	105.3	0	110.4	200.9	251.5	0
2	high M	Length_like:	1121.2	162.4	171.8	0.0	83.4	105.2	0	110.5	234.0	253.9	0
3	low steepness	Length_like:	1085.3	161.3	170.6	0.0	83.2	105.2	0	110.6	201.6	252.7	0
4	high steepness	Length_like:	1085.9	161.4	170.7	0.0	83.3	105.4	0	110.5	201.9	252.7	0
5	Upweight discards	Length_like:	1433.5	281.9	400.9	0.0	80.4	111.3	0	108.1	205.2	245.8	0

6	Upweight recent discards	Length_like:	1173.6	193.0	214.2	0.0	80.2	112.8	0	112.7	208.5	252.1	0
7	Asymptotic selectivity NFMS_BLL	Length_like:	1085.4	161.4	170.6	0.0	83.2	105.3	0	110.5	201.7	252.6	0
0	Base	Surv_like:	-164.0	-11.9	-18.4	0.0	0.0	-17.6	-73.7	-14.7	-4.2	-5.0	-18.5
1	low M	Surv_like:	-164.8	-11.8	-18.5	0.0	0.0	-17.3	-73.7	-14.7	-4.4	-5.4	-19.1
2	high M	Surv_like:	-162.3	-12.0	-18.3	0.0	0.0	-18.0	-73.7	-14.7	-4.1	-4.2	-17.3
3	low steepness	Surv_like:	-163.8	-11.8	-18.4	0.0	0.0	-17.3	-73.7	-14.9	-4.1	-4.8	-18.8
4	high steepness	Surv_like:	-164.0	-12.0	-18.4	0.0	0.0	-17.7	-73.7	-14.7	-4.2	-5.0	-18.3
5	Upweight discards	Surv_like:	-166.5	-12.7	-18.6	0.0	0.0	-19.2	-73.7	-16.0	-4.6	-4.7	-16.9
6	Upweight recent discards	Surv_like:	-162.3	-9.6	-18.6	0.0	0.0	-14.6	-73.7	-14.0	-5.0	-6.5	-20.4
7	Asymptotic selectivity NFMS_BLL	Surv_like:	-163.9	-11.9	-18.4	0.0	0.0	-17.6	-73.7	-14.8	-4.2	-4.9	-18.5

Table 3.2.5 Summary of sensitivity runs. The results include estimated virgin recruitment (thousand fish; R0), virgin total biomass (mt; B0), total biomass in final year (mt; B2013), virgin spawning biomass (eggs; SSB0), spawning biomass in final year (eggs; SSB-2013), spawning biomass achieved at MSY (SSB_MSY), fishing mortality in 2013 (F2013), fishing mortality achieved at MSY (F_MSY), the ratio of F2013 and F_MSY, minimum spawning stock threshold (MSST), and the ratio of SSB and MSST.

Run	Model	R0	B0	B2013	SSB0	SSB2013	SSB_MSY	F2013	F_MSY	F/F_MSY	MSST	SSB/MSST
0	Base	15833.9	88350.3	34516.6	4.02E+06	2.22E+06	1.42E+06	0.13	0.160043	0.817643	1.22E+06	1.82E+00
1	low M	11303	99234.8	31910	4.22E+06	2.06E+06	1.50E+06	0.130858	0.152182	0.859878	1.29E+06	1.60E+00
2	high M	30846.1	78346.5	40991.6	3.89E+06	2.62E+06	1.36E+06	0.101834	0.171161	0.59496	1.17E+06	2.24E+00
3	low steepness	17218.7	96077.1	33643.5	4.37E+06	2.17E+06	1.68E+06	0.12389	0.126604	0.978563	1.44E+06	1.50E+00
4	high steepness	14846.4	82840.3	35008.2	3.77E+06	2.25E+06	1.19E+06	0.119219	0.20051	0.594579	1.02E+06	2.21E+00
5	Upweight discards	17300	96530.8	32592.6	4.39E+06	2.09E+06	1.51E+06	0.134786	0.163063	0.826588	1.30E+06	1.60E+00
6	Upweight recent discards	16613.3	92699.1	34800.1	4.22E+06	2.24E+06	1.48E+06	0.125734	0.166162	0.756695	1.27E+06	1.77E+00
7	Asymptotic selectivity NFMS_BLL	15985	89193.5	34407.9	4.06E+06	2.22E+06	1.41E+06	0.121216	0.163763	0.740192	1.22E+06	1.82E+00

Table 3.2. 6 Estimates of key population parameters from the jack-knife analysis of indices of abundance.

Parameter	Base	No_commHL	No_commLL	No_HB	No_CBT_PRSurv	No_Video	No_SEAMAP_GF	No_NMFS_BLL
SR_LN(R0)	9.69197	9.71233	9.72768	9.69684	9.73454	9.68229	9.71466	9.6794
SR_BH_steep	0.811118	0.826445	0.83691	0.815204	0.839927	0.811591	0.819052	0.799961
SR_sigmaR	1.01222	0.899639	0.893099	0.906837	0.951769	0.972815	1.03534	1.01334
SR_R1_offset	-0.0681964	-0.0841788	-0.101037	-0.0705069	-0.109375	-0.0561492	-0.0854636	-0.0467304
SPB_Virgin	4.11E+06	4.19E+06	4.26E+06	4.13E+06	4.29E+06	4.07E+06	4.20E+06	4.06E+06
SPB_Initial	1.52E+06	1.58E+06	1.57E+06	1.57E+06	1.54E+06	1.57E+06	1.58E+06	1.63E+06
Recr_Virgin	16187.1	16520	16775.6	16266.1	16891.1	16031.1	16558.6	15984.8
Recr_Initial	15120	15186.3	15163.5	15158.7	15141.1	15155.8	15202.2	15255
TotBio_Unfished	90321.1	92178.7	93604.6	90761.7	94249.3	89450.6	92393.7	89192.3
SSB_MSY	1.44E+06	1.48E+06	1.49E+06	1.45E+06	1.49E+06	1.44E+06	1.47E+06	1.47E+06
TotYield_MSY	4000.59	4156.9	4241.07	4126.63	4154.14	3995.33	4135.86	3913.51
RetYield_MSY	3430.84	3527.96	3584.44	3581.05	3392.11	3416.72	3517.51	3304.11

Table 3.2.7. Preliminary results from projections.

Criteria	Definition	Value
Base M		0.144
Steepness		0.801
Virgin Recruitment		15833.9
SSB unfished		4017750
	Mortality rate criteria	
Fmsy or proxy	Fmsy	0.1600
MFMT	Fmsy	0.1600
Foy	75% of Fmsy	0.1200
Fcurrent	F2013	0.1209
Fcurrent/MFMT	F2013	0.7554
	Biomass criteria	
SSBmsy	SSB at Fmsy	1416320
MSST	(1-M)*SSBmsy	1212370
SSBcurrent	SSB2013	2222750
SSBcurrent/MSST	SSB2013	1.83
Equilibrium MSY	Equilibrium yield at Fmsy	3329.33
Equilibrium OY	Equilibrium yield at Foy	2497.00
OFL	**Annual yield at MFMT**	
	OFL 2014	3946.13
	OFL 2015	6263.09
	OFL 2016	4835.98
	OFL 2017	3700.32
	OFL 2018	2885.36
	OFL 2019	2499.72
	OFL 2020	2503.59
Annual OY	**Annual yield at Foy**	
	OY2014	3946.13
	OY2015	4839.32
	OY2016	3962.91
	OY2017	3194.04
	OY2018	2596.36
	OY2019	2295.19
	OY2020	2286.2
Annual Yield	**Annual yield at Fcurrent**	
	Y 2014	3946.13
	Y 2015	3961.65
	Y 2016	3358.72
	Y 2017	2792.16
	Y 2018	2327.98
	Y 2019	2086.98
	Y 2020	2078.44

3.7 Figures

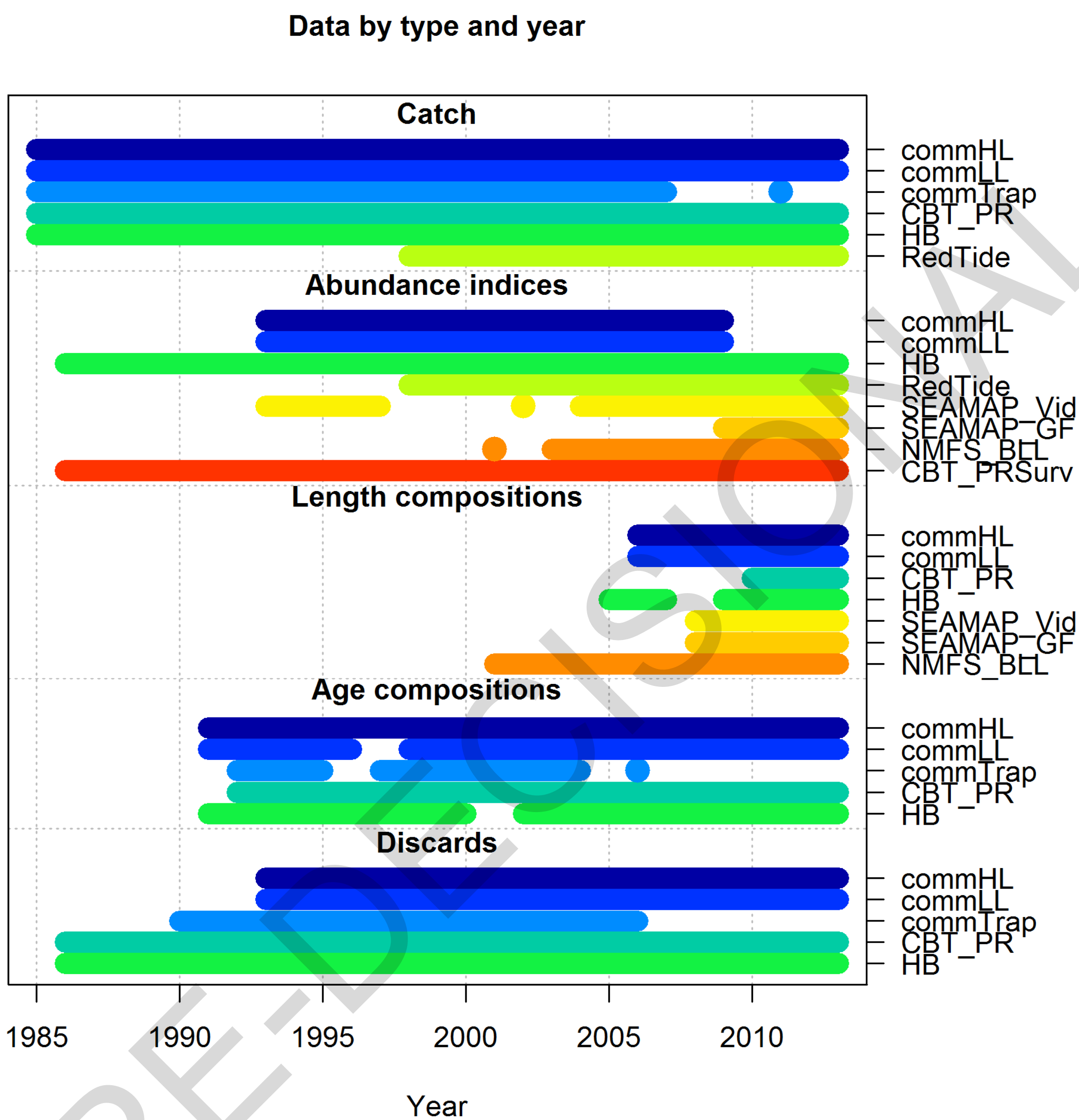


Figure 3.1.1 Data inputs for SEDAR 42 base model.

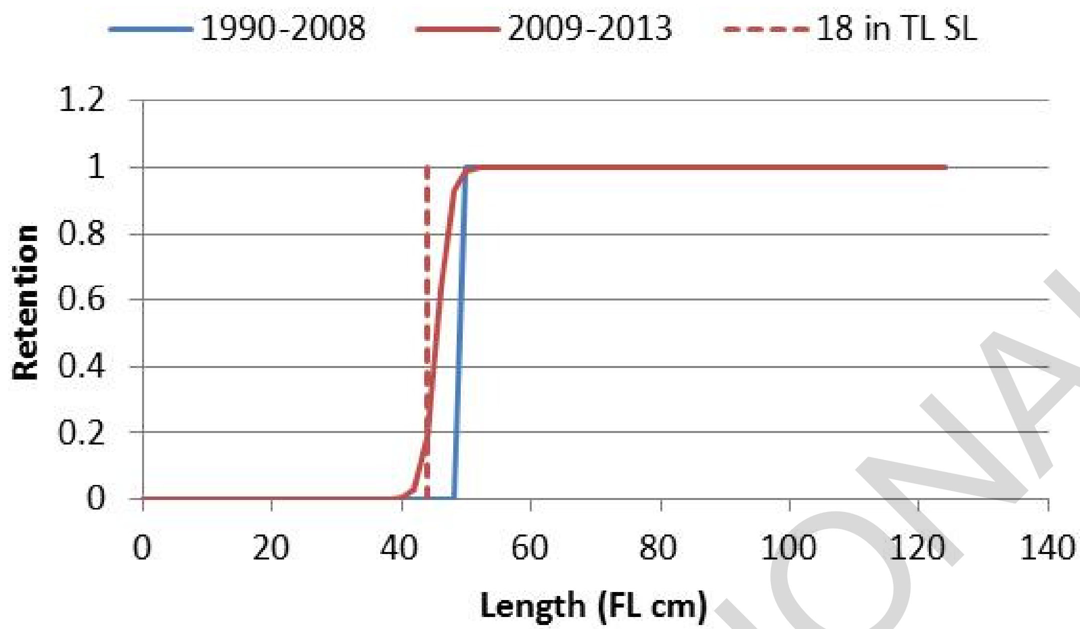


Figure 3.1 2 The commercial handline retention patterns. The 1990-2008 retention pattern was fixed, whereas the 2009-2013 retention pattern was estimated.

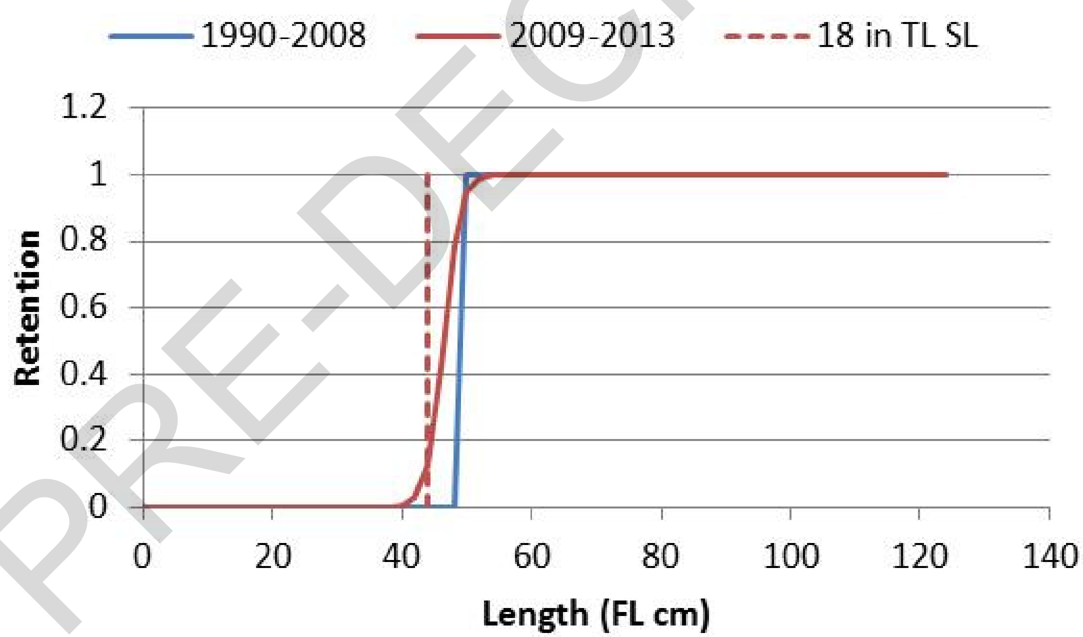


Figure 3.1 3 The commercial longline retention patterns. The 1990-2008 retention pattern was fixed, whereas the 2009-2013 retention pattern was estimated.

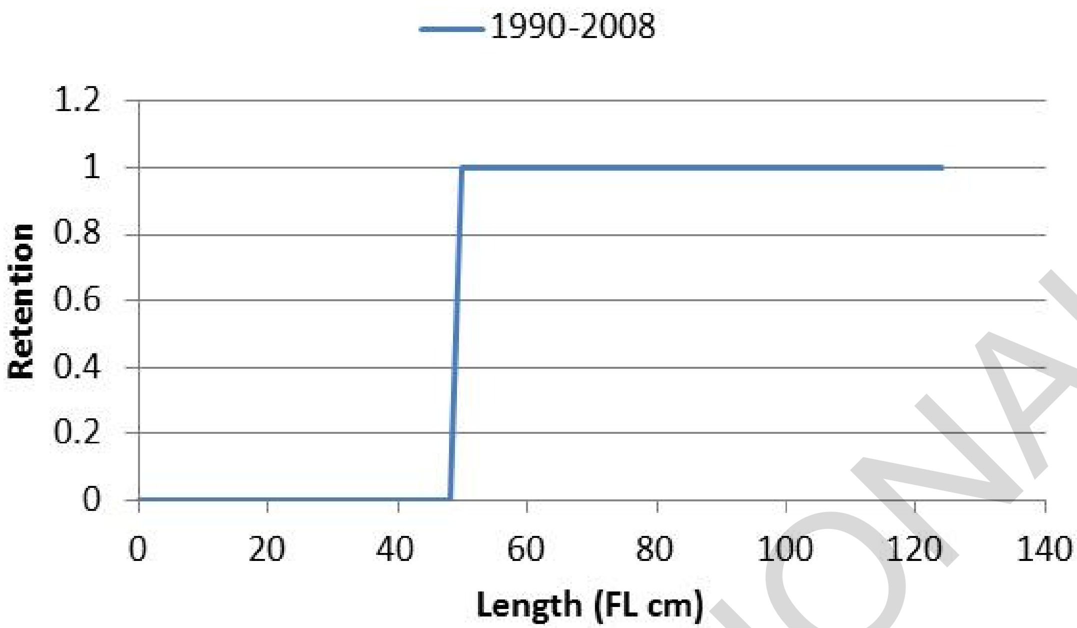


Figure 3.1 4 The commercial trap retention pattern. This pattern was fixed.

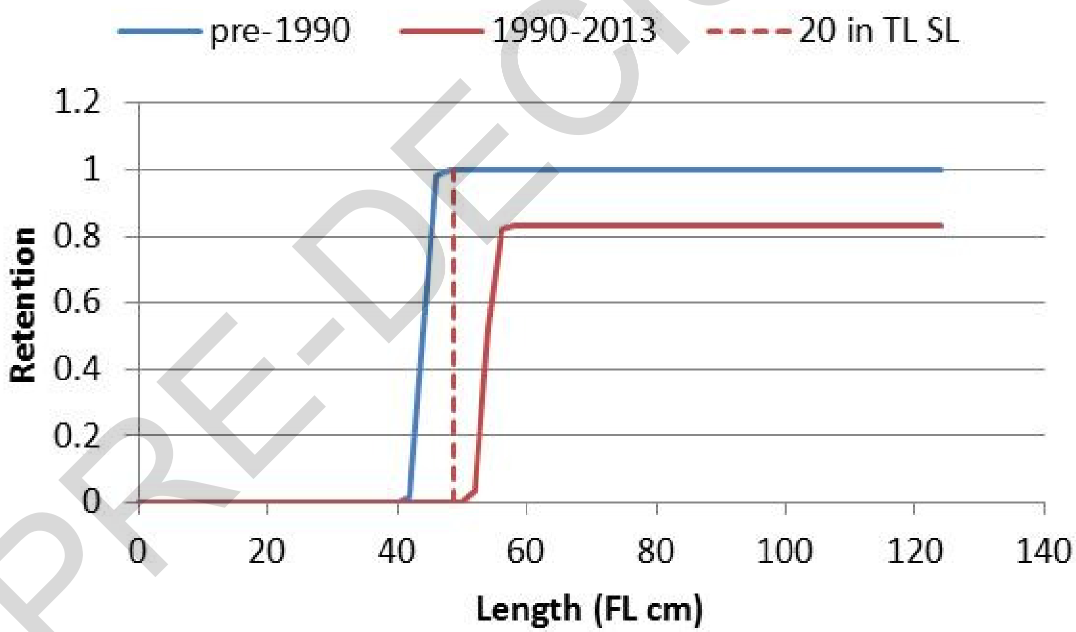


Figure 3.1 5 The recreational charterboat-private mode retention pattern. The pre-1990 retention pattern was fixed, whereas the 1990-2013 retention pattern was estimated.

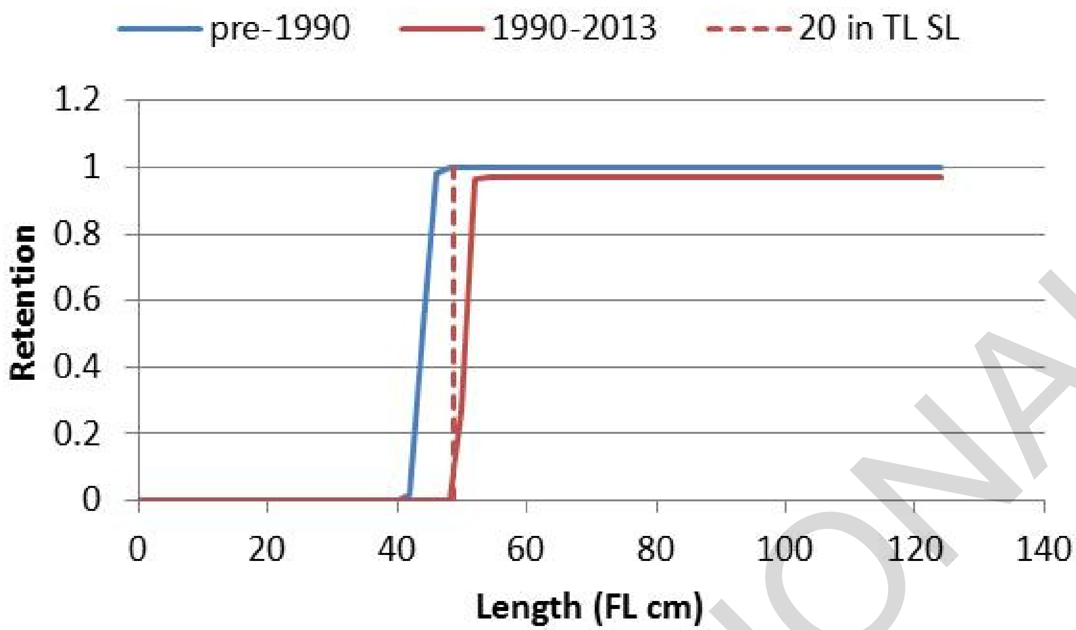


Figure 3.1 6 The recreational headboat retention pattern. The pre-1990 retention pattern was fixed, whereas the 1990-2013 retention pattern was estimated.

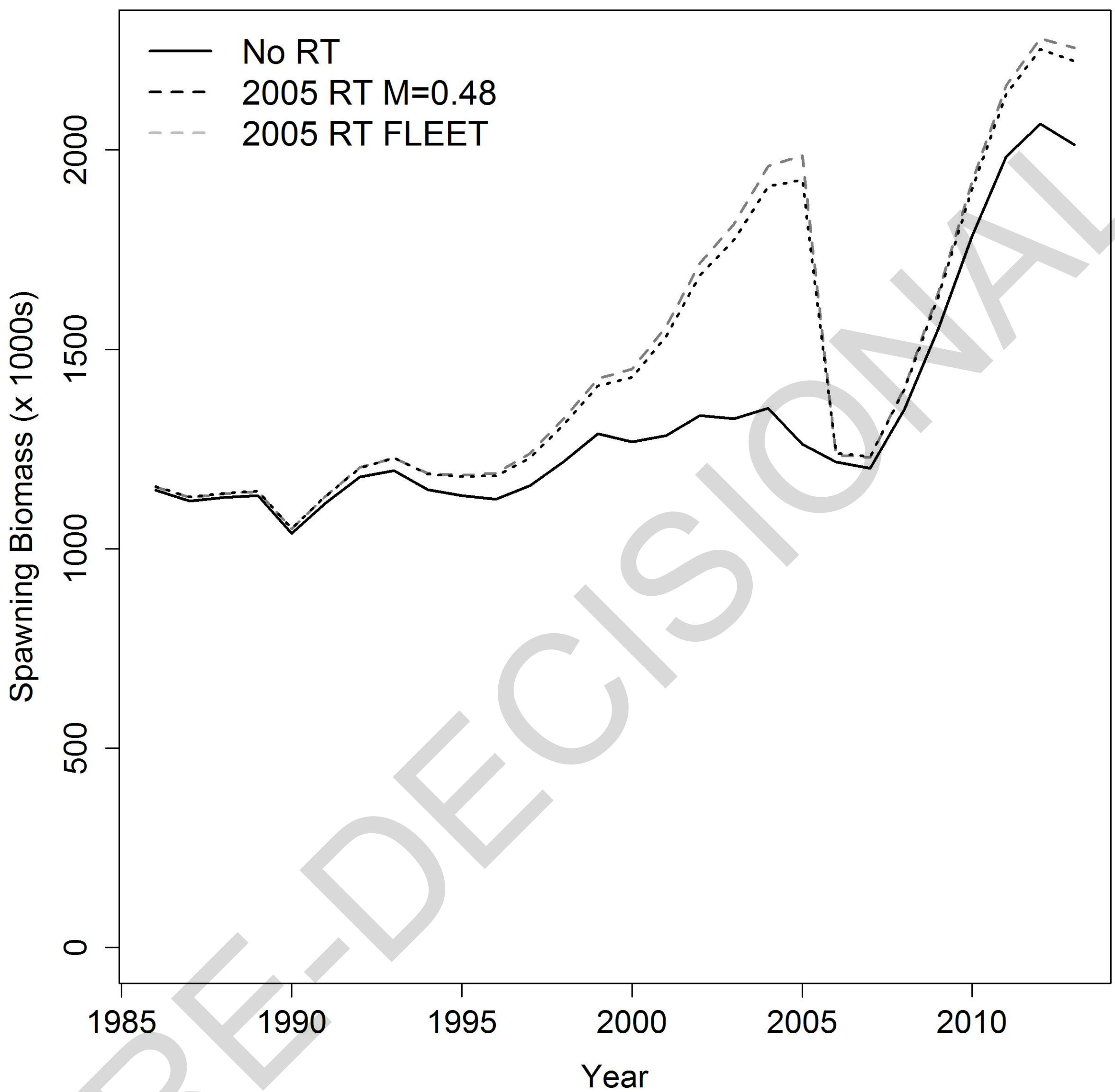


Figure 3.1.7 Comparison of annual estimates of spawning stock biomass (SSB in 1000s of eggs) for Gulf of Mexico Red Grouper derived from a model with no red tide (No RT), a model with an episodic red tide mortality estimate of 0.48 in 2005 (2005 RT M=0.48), and a model with red tide treated as a fishing fleet (2005 RT FLEET).

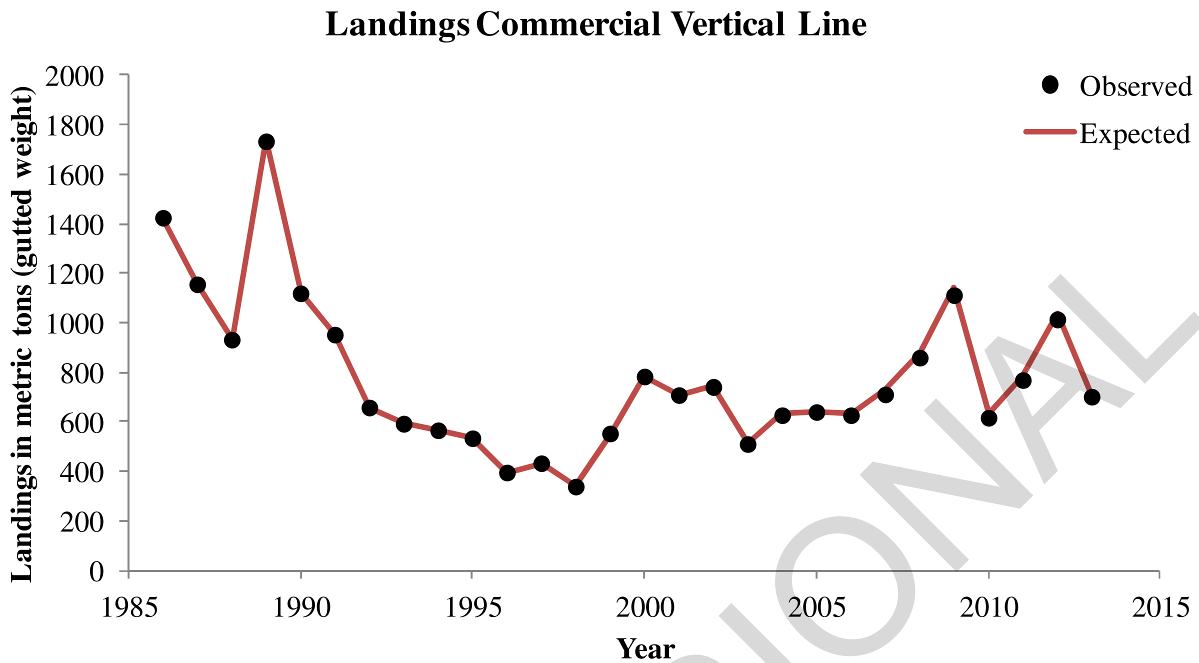


Figure 3.2.1 Observed (black dots) and predicted landings (red line) (mt) of Gulf of Mexico Red Grouper from the commercial vertical line fishing fleet, 1986-2013.

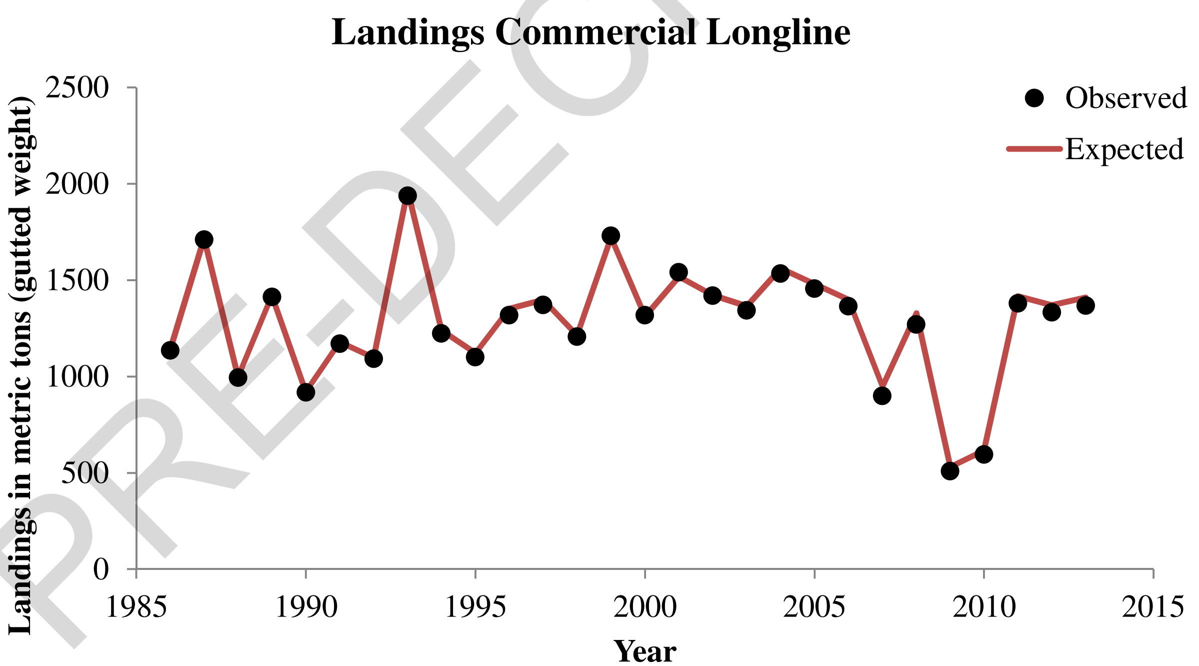


Figure 3.2.2 Observed (black dots) and predicted landings (red line) (mt) of Gulf of Mexico Red Grouper from the commercial longline fishing fleet, 1986-2013.

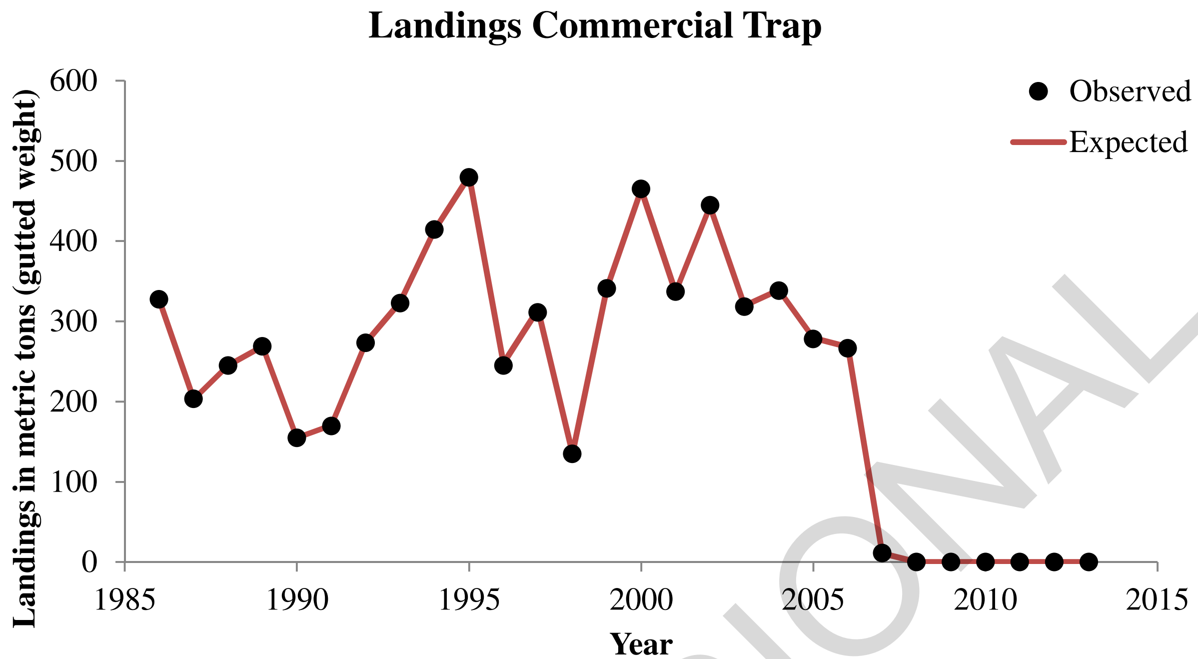


Figure 3.2.3 Observed (black dots) and predicted landings (red line) (mt) of Gulf of Mexico Red Grouper from the commercial trap fishing fleet, 1986-2013.

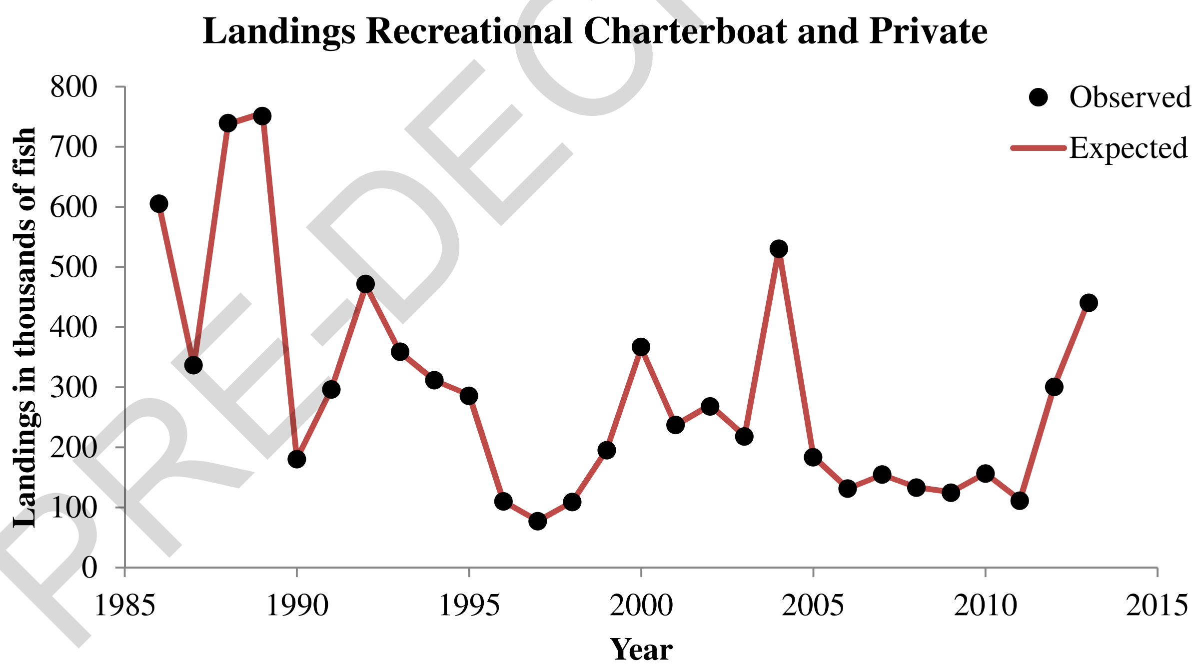


Figure 3.2.4 Observed (black dots) and predicted landings (red line) (thousands of fish) of Gulf of Mexico Red Grouper from the combined recreational charterboat and private fishing fleet, 1986-2013.

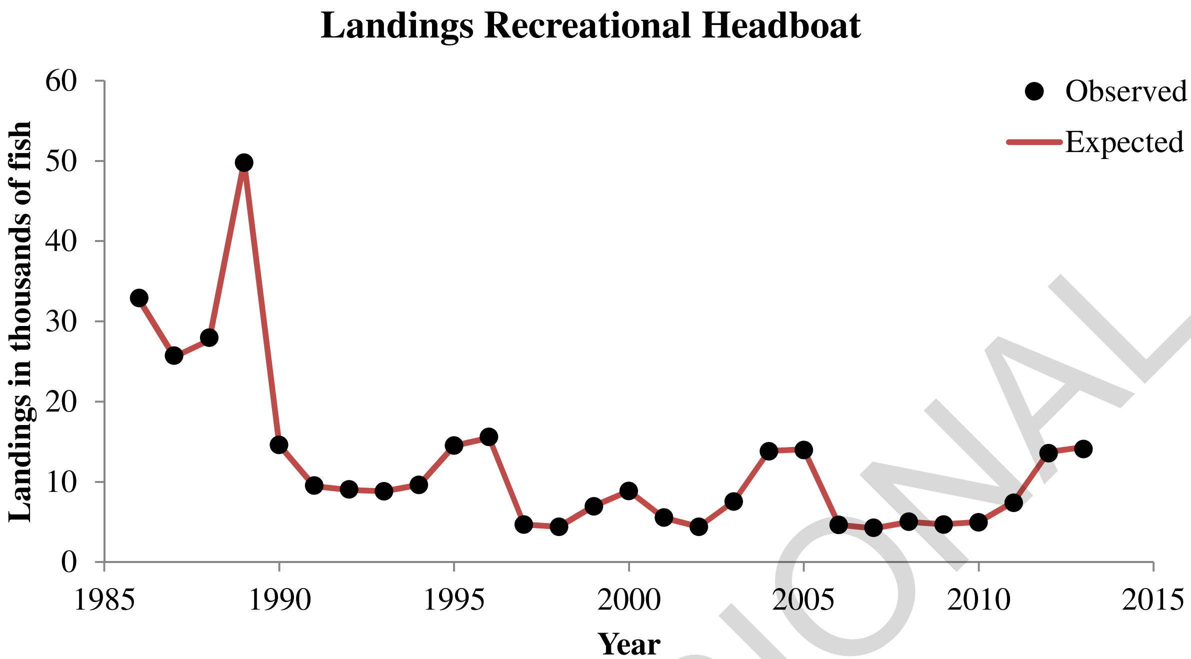


Figure 3.2.5 Observed (black dots) and predicted landings (red line) (thousands of fish) of Gulf of Mexico Red Grouper from the recreational headboat fishing fleet, 1986-2013.

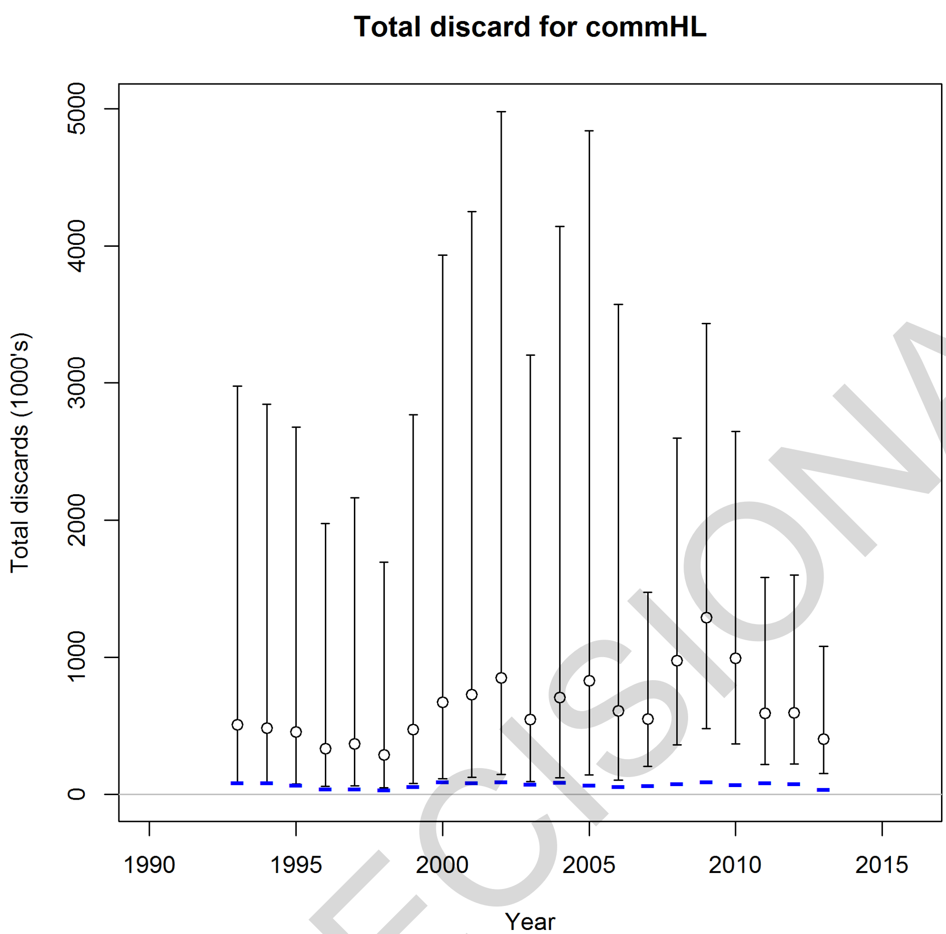


Figure 3.2.6 Observed (open circles) and predicted discards (blue dashes) (thousands of fish) of Gulf of Mexico Red Grouper from the commercial vertical line fishing fleet, 1993-2013.

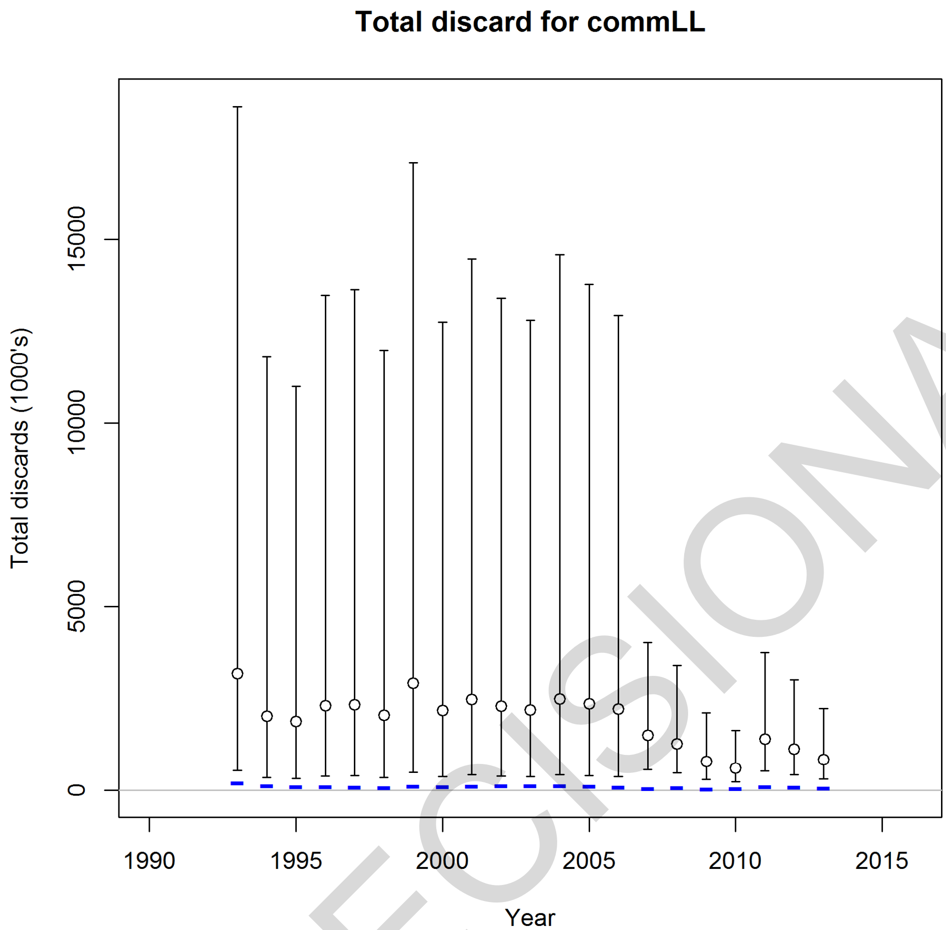


Figure 3.2.7 Observed (open circles) and predicted discards (blue dashes) (thousands of fish) of Gulf of Mexico Red Grouper from the commercial longline fishing fleet, 1993-2013.

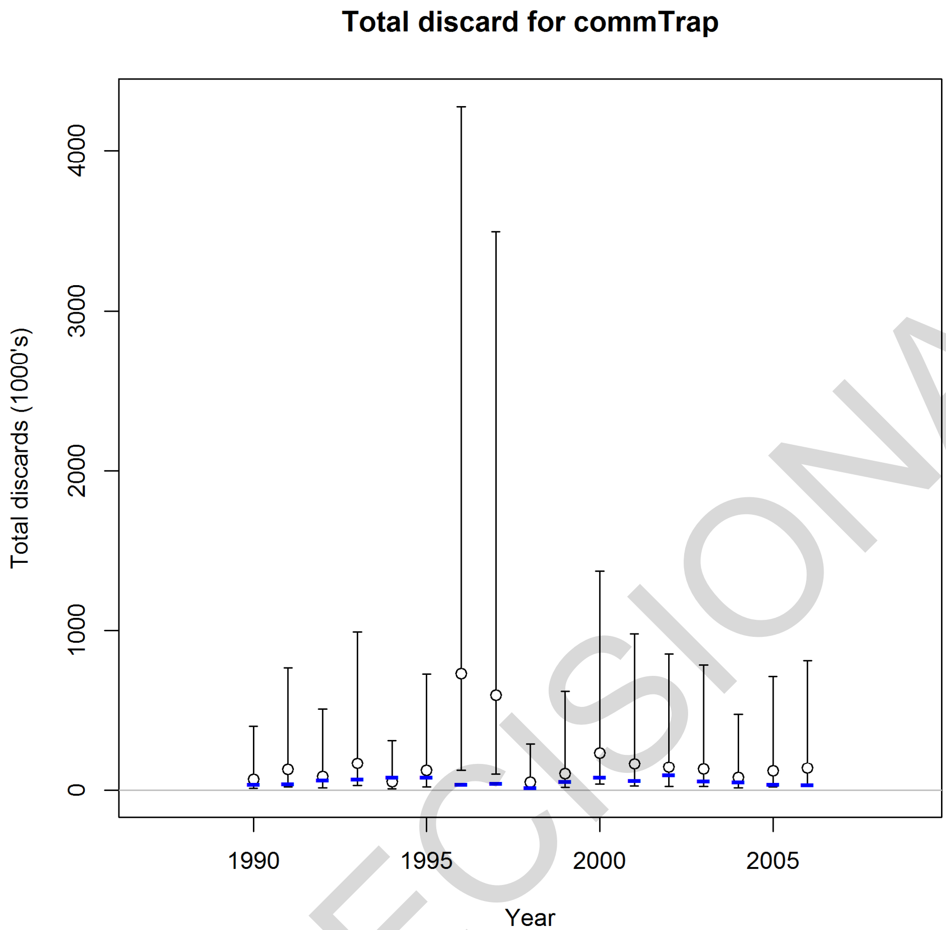


Figure 3.2.8 Observed (open circles) and predicted discards (blue dashes) (thousands of fish) of Gulf of Mexico Red Grouper from the commercial trap fishing fleet, 1990-2006.

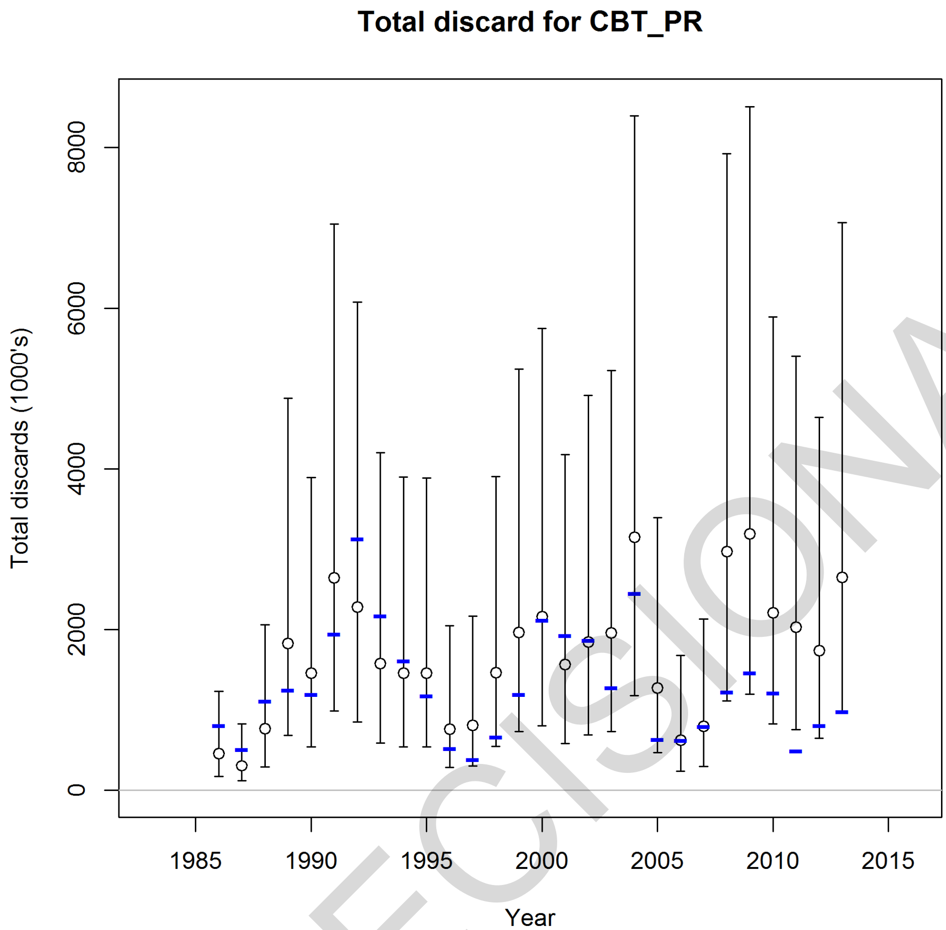


Figure 3.2.9 Observed (open circles) and predicted discards (blue dashes) (thousands of fish) of Gulf of Mexico Red Grouper from the combined recreational charterboat and private fishing fleet, 1986-2013.

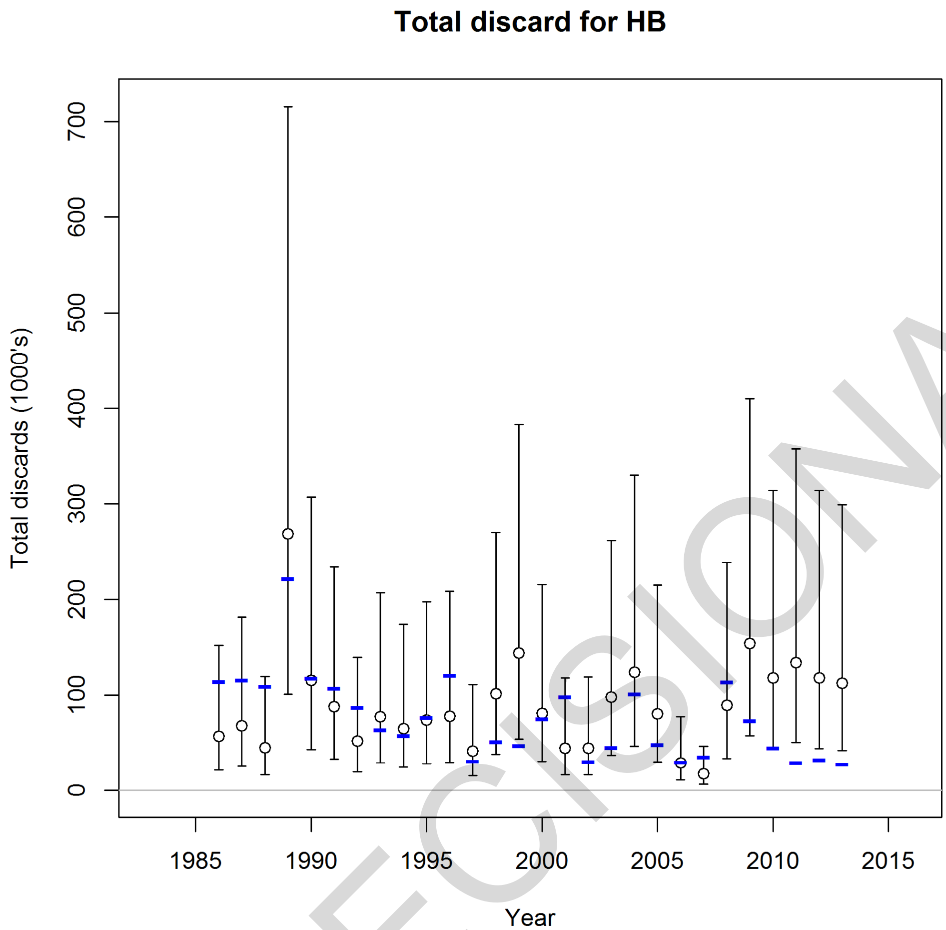


Figure 3.2.10 Observed (open circles) and predicted discards (blue dashes) (thousands of fish) of Gulf of Mexico Red Grouper from the recreational headboat fishing fleet, 1986-2013.

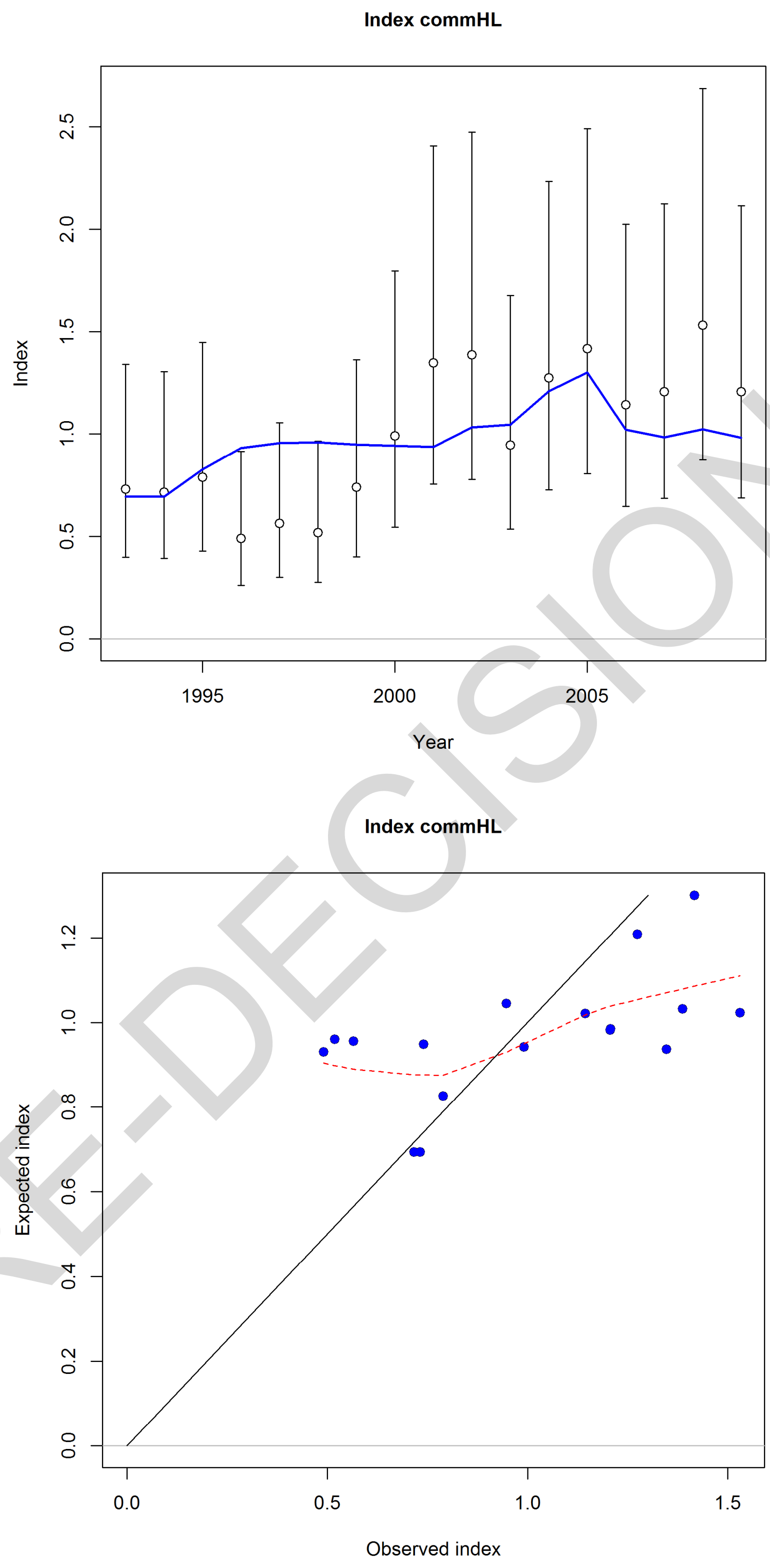
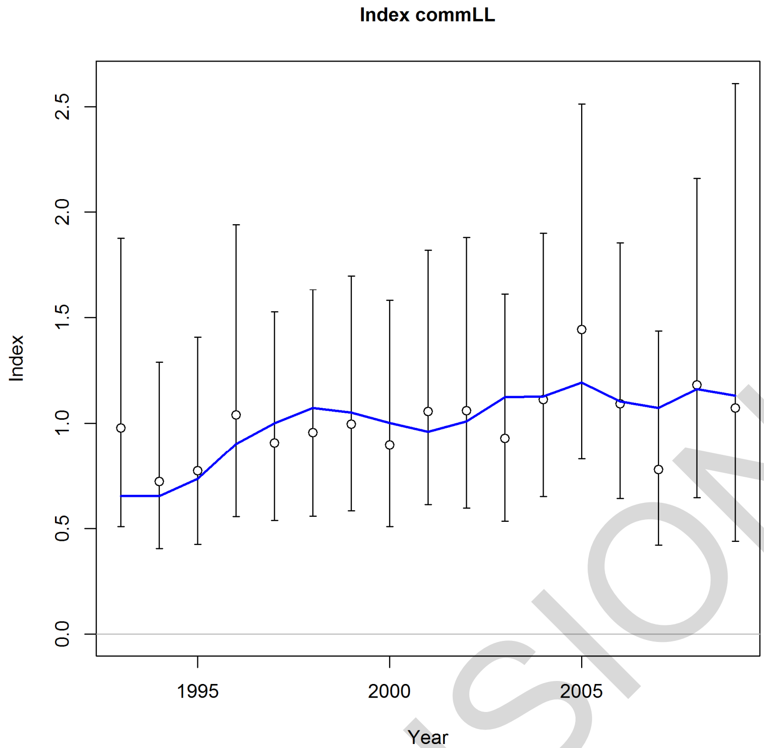


Figure 3.2.11 Model fit (blue line) to the standardized commercial vertical line CPUE index (open circles), 1993-2009 (top panel). The bottom panel also shows a comparison of the observed and predicted indices, where the black line is the 1:1 line.



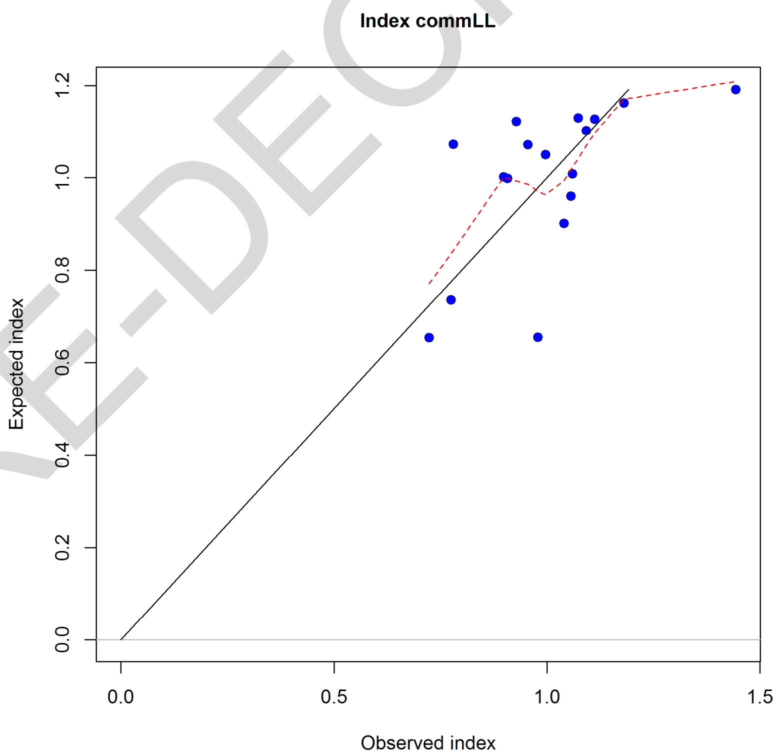


Figure 3.2.12 Model fit (blue line) to the standardized commercial longline CPUE index (open circles), 1993-2009 (top panel). The bottom panel also shows a comparison of the observed and predicted indices, where the black line is the 1:1 line.

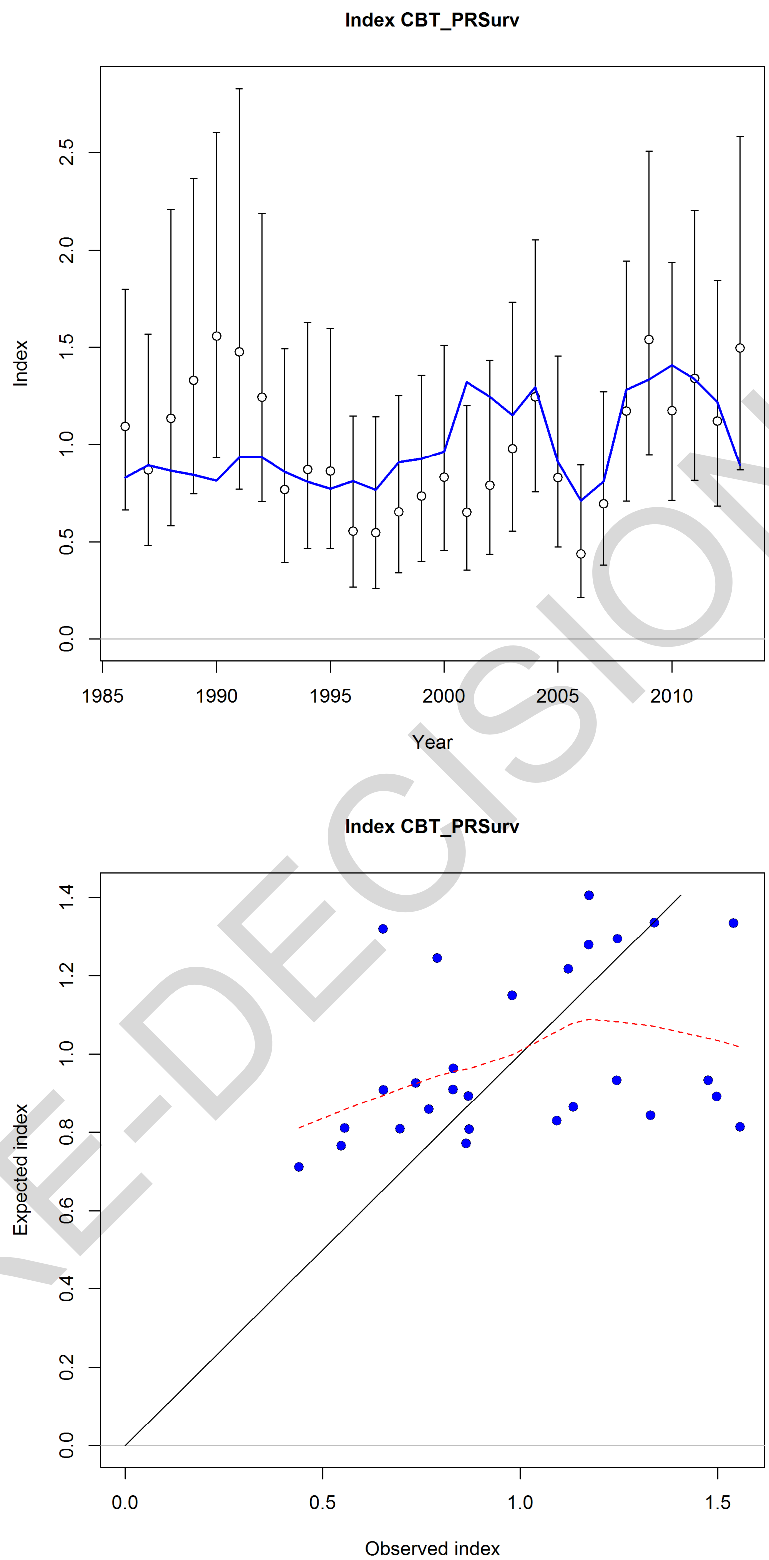


Figure 3.2.13 Model fit (blue line) to the standardized combined recreational charterboat and private CPUE index (open circles), 1986-2013 (top panel). The bottom panel also shows a comparison of the observed and predicted indices, where the black line is the 1:1 line.

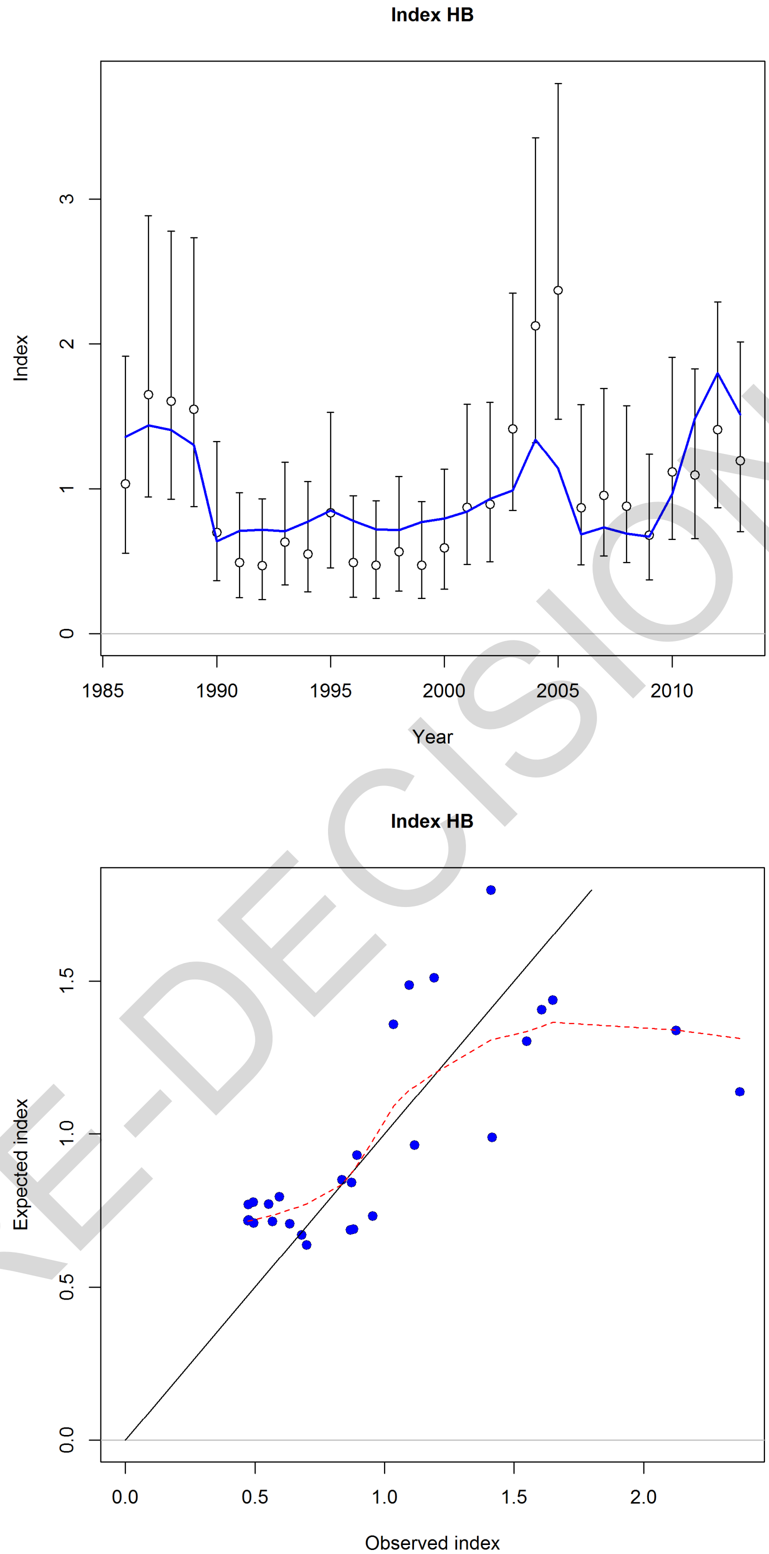


Figure 3.2.14 Model fit (blue line) to the standardized recreational headboat CPUE index (open circles), 1986-2013 (top panel). The bottom panel also shows a comparison of the observed and predicted indices, where the black line is the 1:1 line.

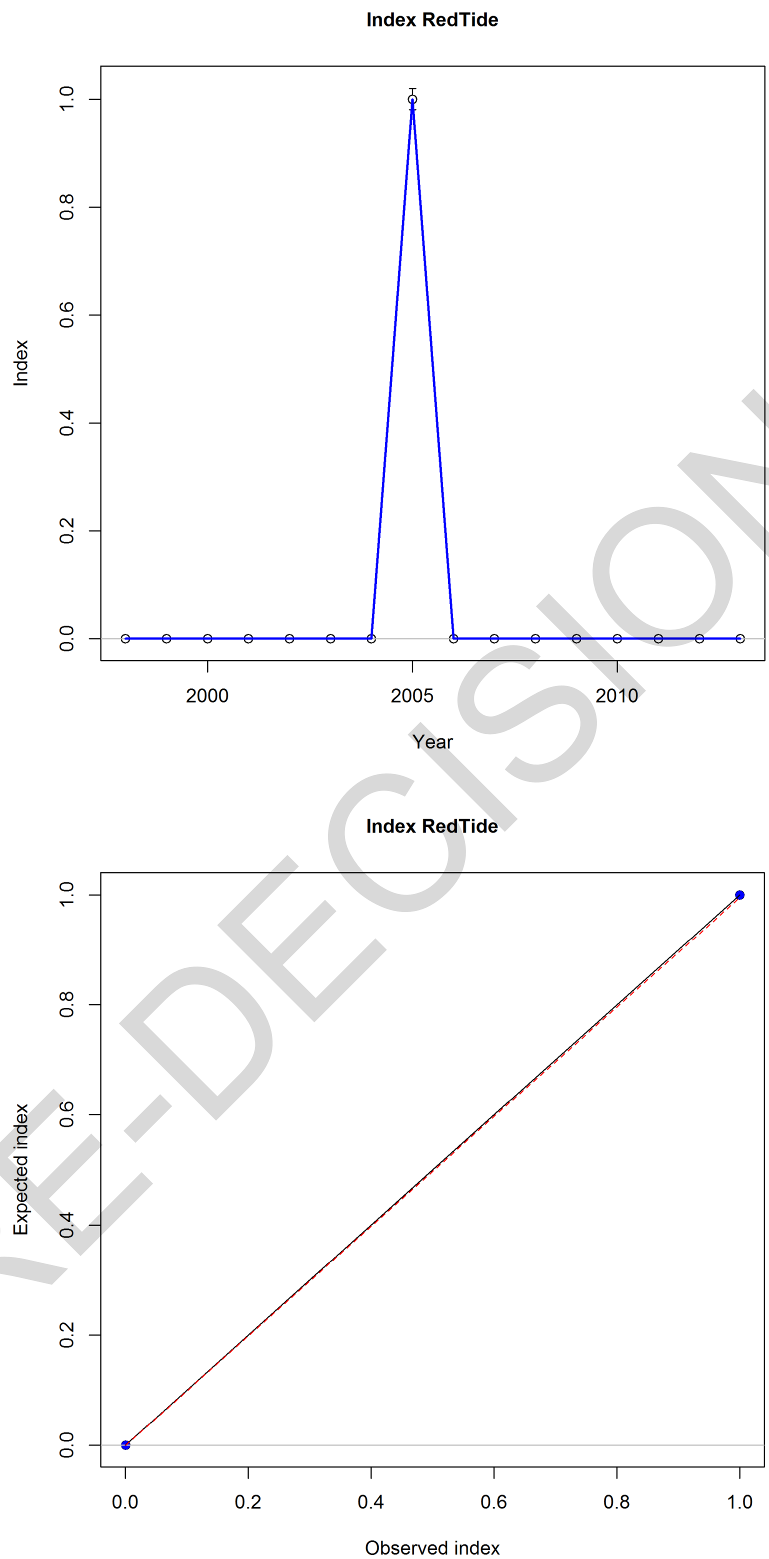


Figure 3.2.15 Model fit (blue line) to the red tide index (open circles), 1998-2013 (top panel). The bottom panel also shows a comparison of the observed and predicted indices, where the black line is the 1:1 line.

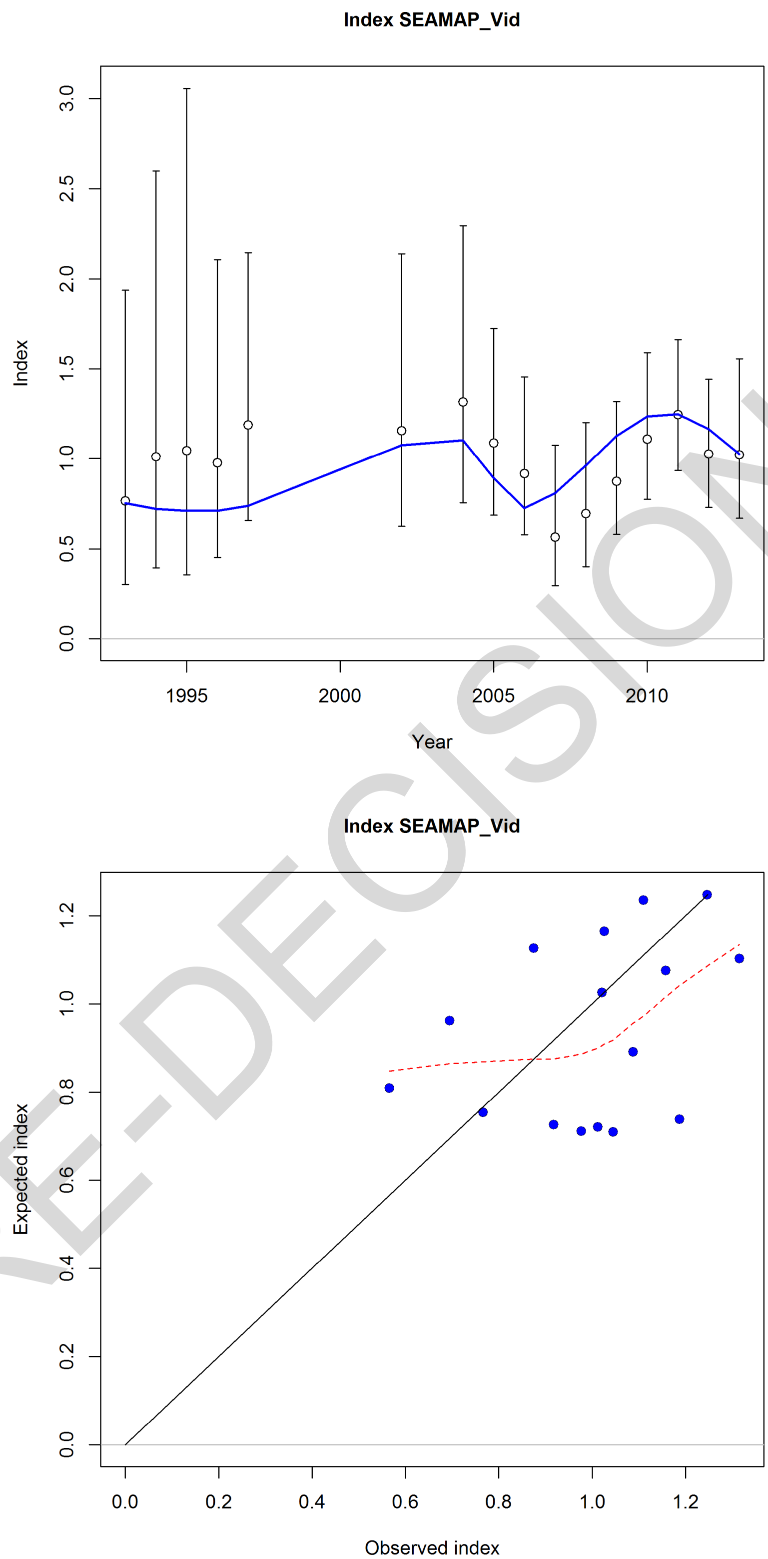


Figure 3.2.16 Model fit (blue line) to the standardized combined video survey index (open circles), 1993-1997, 2002, and 2004-2013 (top panel). The bottom panel also shows a comparison of the observed and predicted indices, where the black line is the 1:1 line.

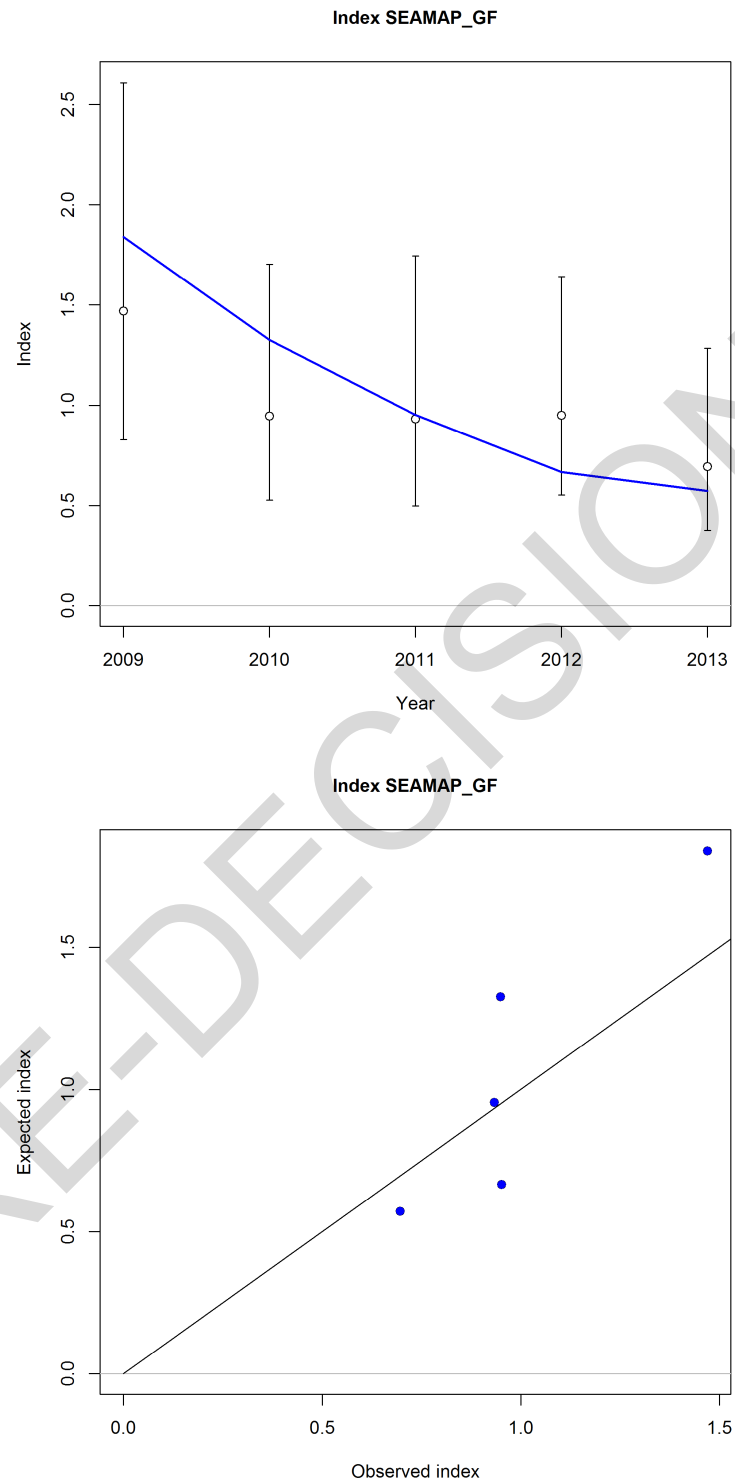


Figure 3.2.17 Model fit (blue line) to the standardized SEAMAP groundfish survey index (open circles), 2009-2013 (top panel). The bottom panel also shows a comparison of the observed and predicted indices, where the black line is the 1:1 line.

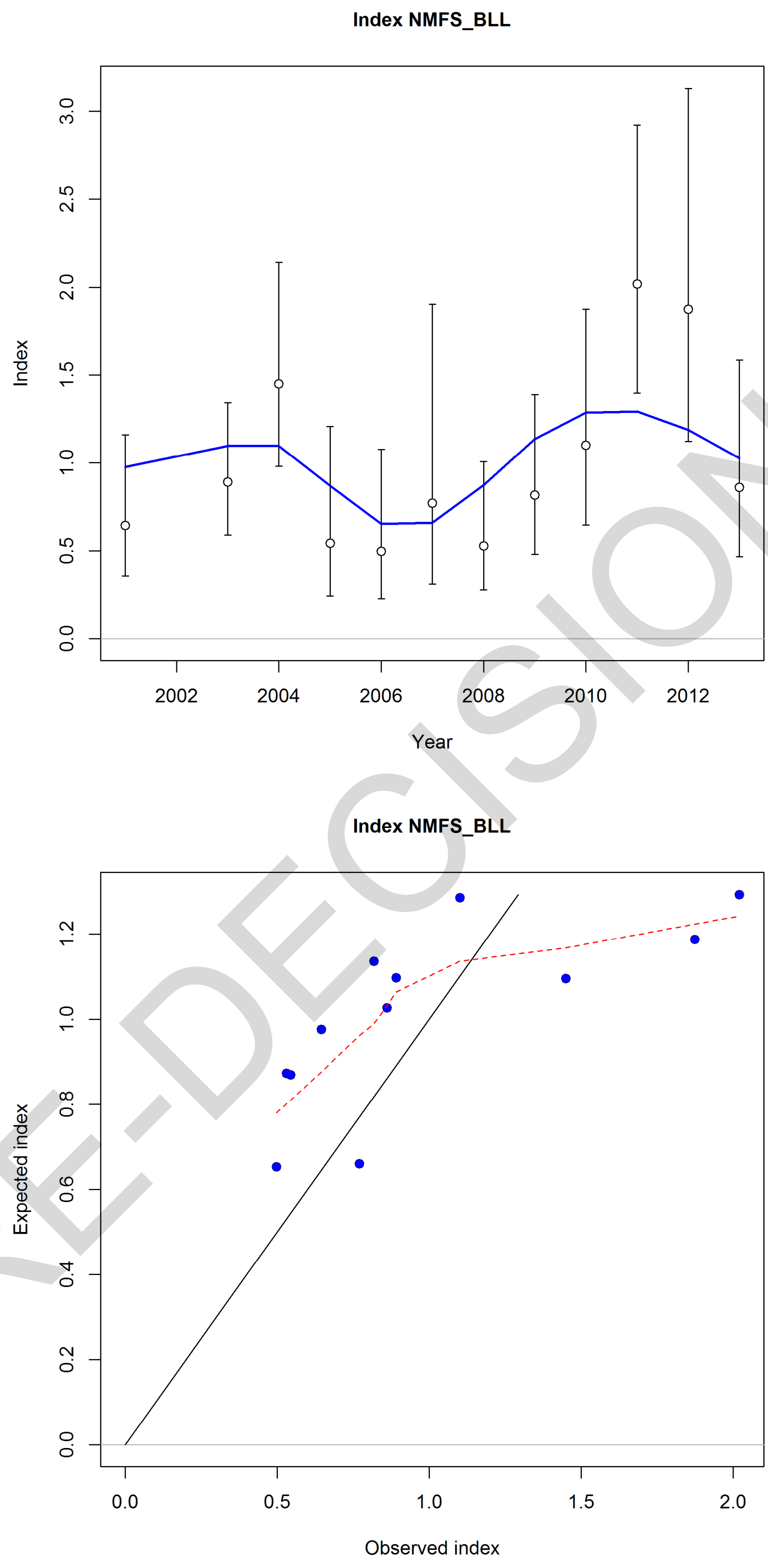


Figure 3.2.18 Model fit (blue line) to the standardized NMFS bottom longline survey index (open circles), 2001, 2003-2013 (top panel). The bottom panel also shows a comparison of the observed and predicted indices, where the black line is the 1:1 line.

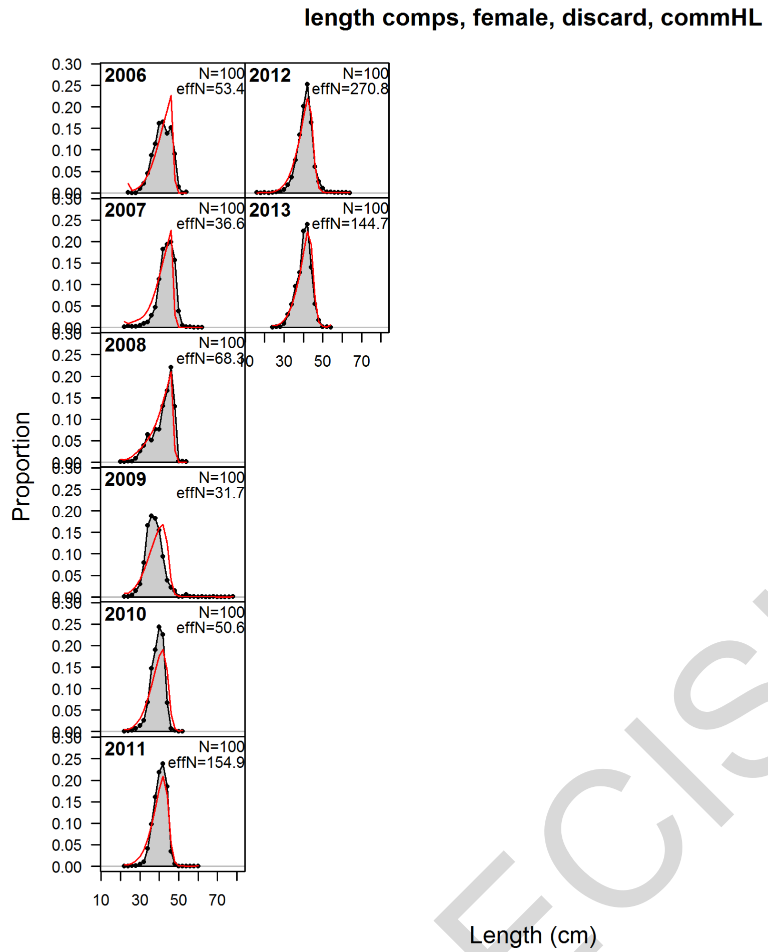


Figure 3.2.19 Observed and predicted length compositions of discards of Red Grouper in the commercial vertical line fleet. Observed (N) sample sizes and effective sample sizes (effN) estimated by SS are also reported. Observed sample sizes were capped at a maximum of 200 fish.

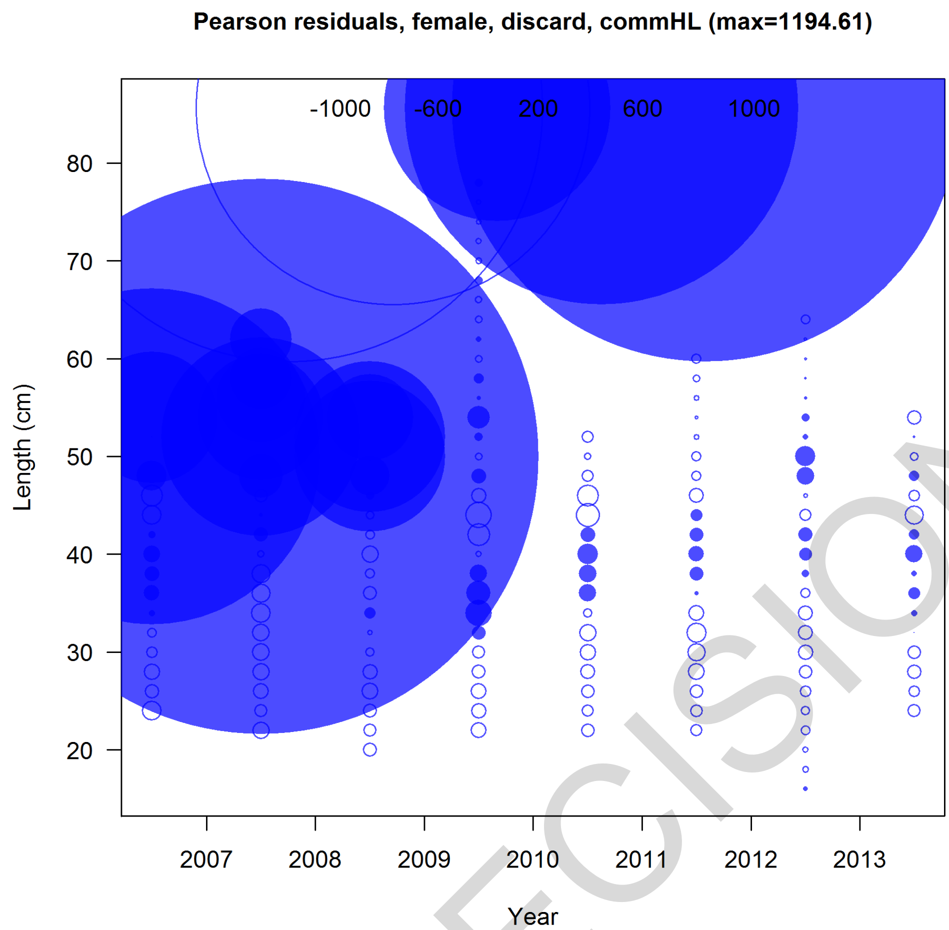


Figure 3.2.20 Pearson residuals for the length composition fit to commercial vertical line discards. Solid circles are positive residuals (i.e., observed greater than predicted) and open circles are negative residuals (i.e., predicted greater than observed).

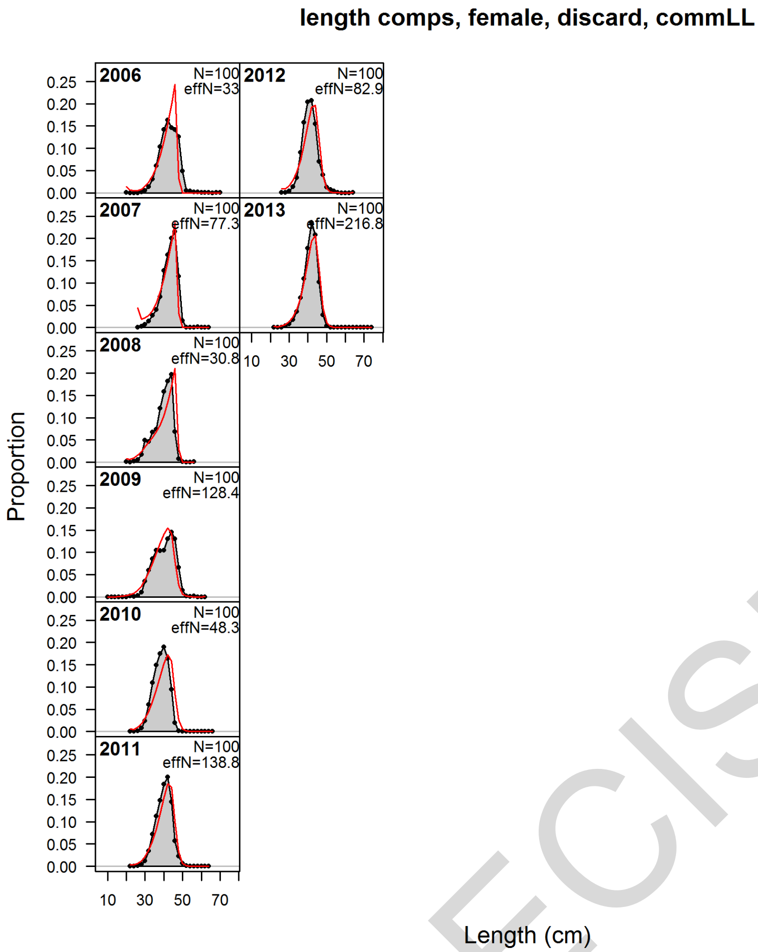


Figure 3.2.21 Observed and predicted length compositions of discards of Red Grouper in the commercial longline fleet. Observed (N) sample sizes and effective sample sizes (effN) estimated by SS are also reported. Observed sample sizes were capped at a maximum of 200 fish.

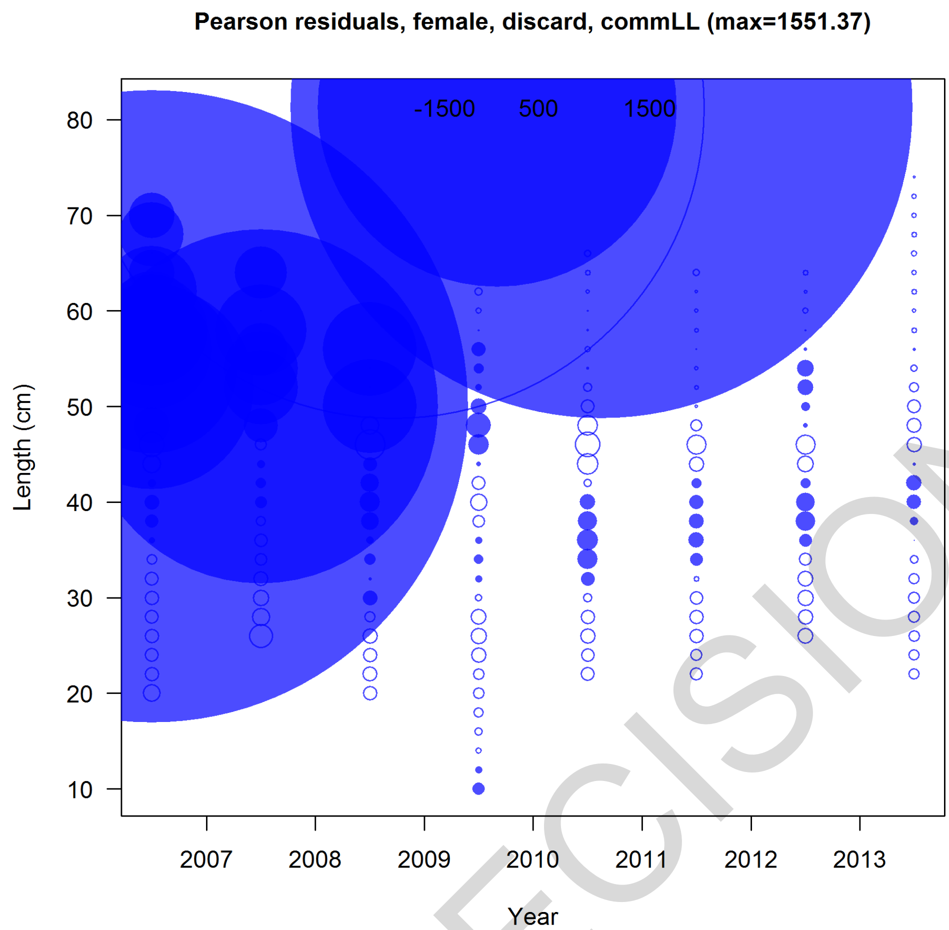


Figure 3.2.22 Pearson residuals for the length composition fit to commercial longline discards. Solid circles are positive residuals (i.e., observed greater than predicted) and open circles are negative residuals (i.e., predicted greater than observed).

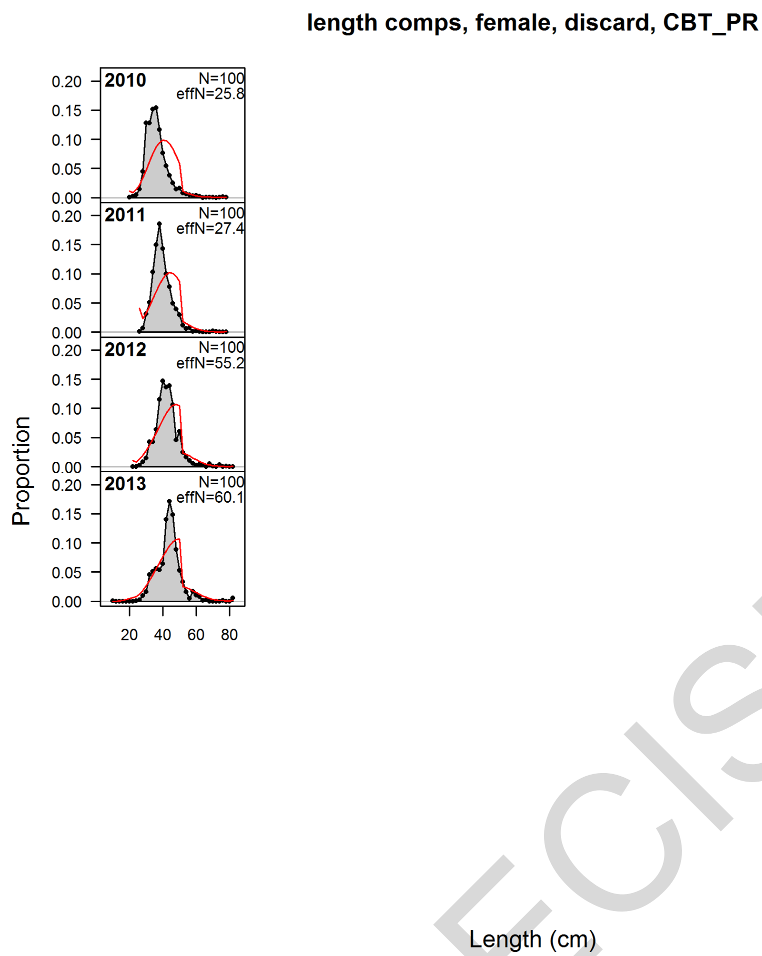


Figure 3.2.23 Observed and predicted length compositions of discards of Red Grouper in the combined recreational charterboat and private fleet. Observed (N) sample sizes and effective sample sizes (effN) estimated by SS are also reported. Observed sample sizes were capped at a maximum of 200 fish.

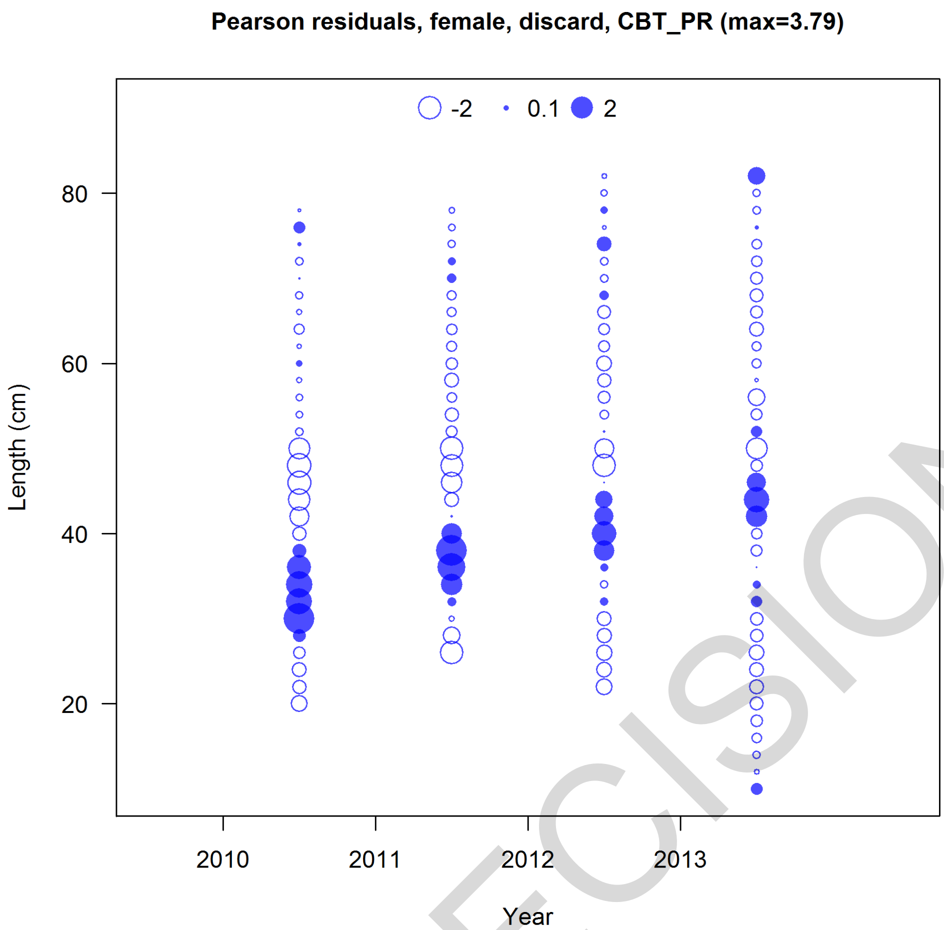


Figure 3.2.24 Pearson residuals for the length composition fit to the combined recreational charterboat and private discards. Solid circles are positive residuals (i.e., observed greater than predicted) and open circles are negative residuals (i.e., predicted greater than observed).

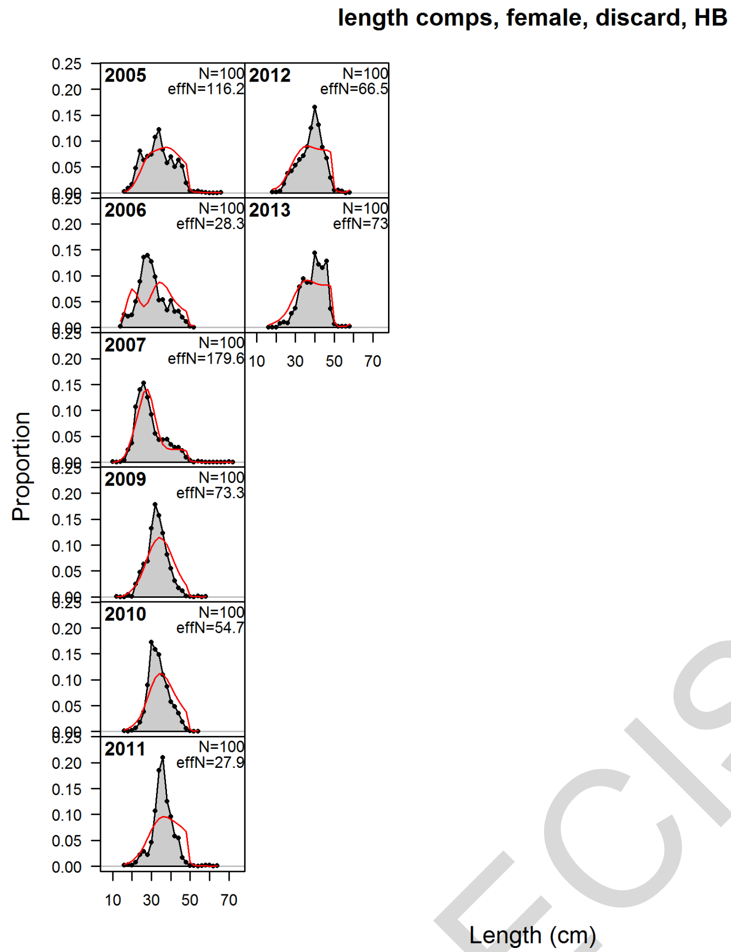


Figure 3.2.25 Observed and predicted length compositions of discards of Red Grouper in the recreational headboat fleet. Observed (N) sample sizes and effective sample sizes (effN) estimated by SS are also reported. Observed sample sizes were capped at a maximum of 200 fish.

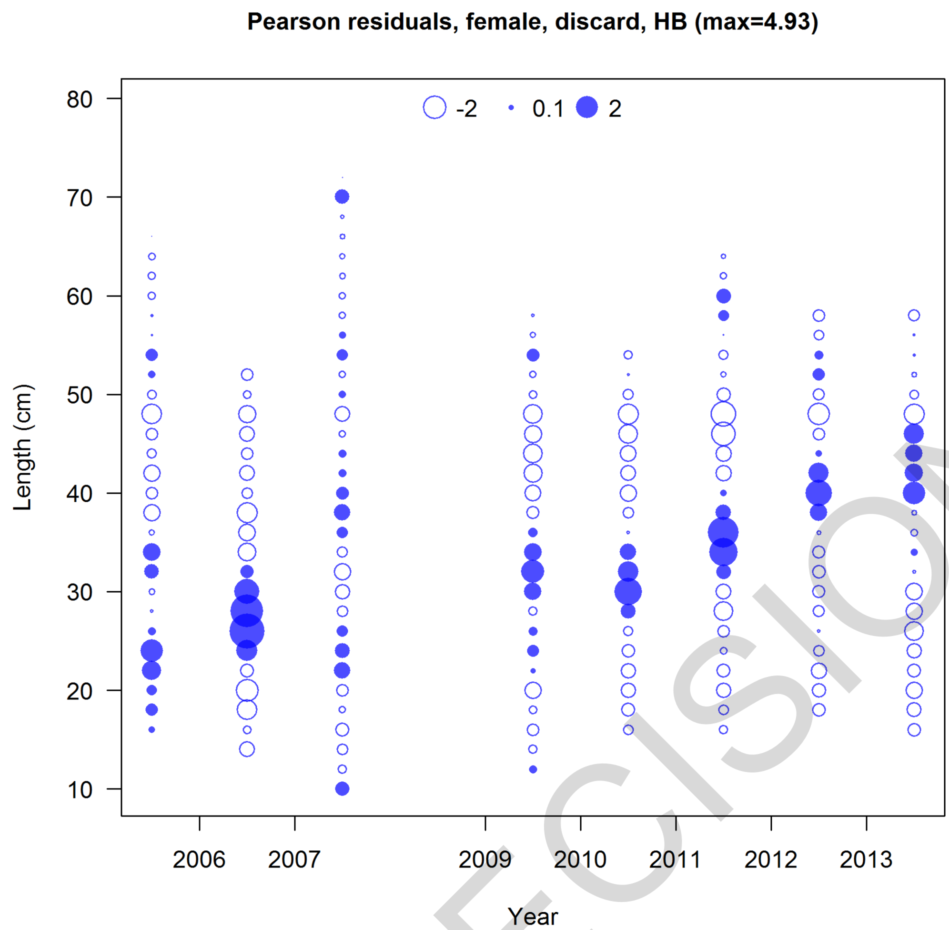


Figure 3.2.26 Pearson residuals for the length composition fit to recreational headboat discards. Solid circles are positive residuals (i.e., observed greater than predicted) and open circles are negative residuals (i.e., predicted greater than observed).

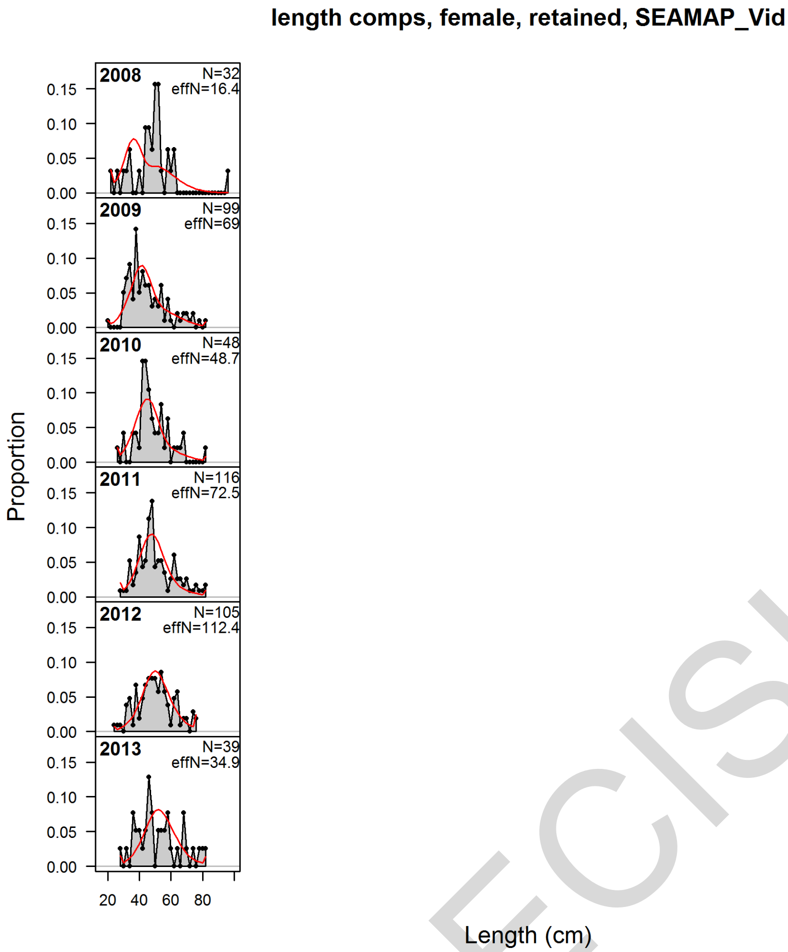


Figure 3.2.27 Observed and predicted length compositions of landings from the combined video survey. Observed (N) sample sizes and effective sample sizes (effN) estimated by SS are also reported.

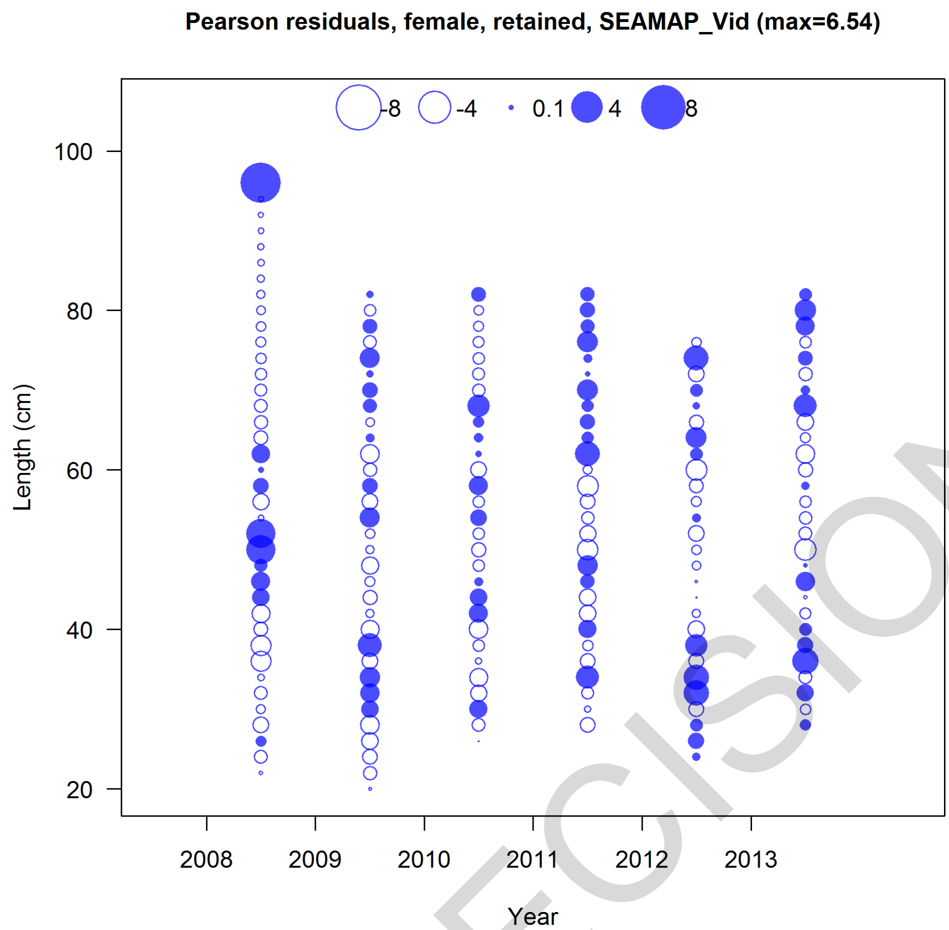


Figure 3.2.28 Pearson residuals for the length composition fit to the combined video survey length observations. Solid circles are positive residuals (i.e., observed greater than predicted) and open circles are negative residuals (i.e., predicted greater than observed).

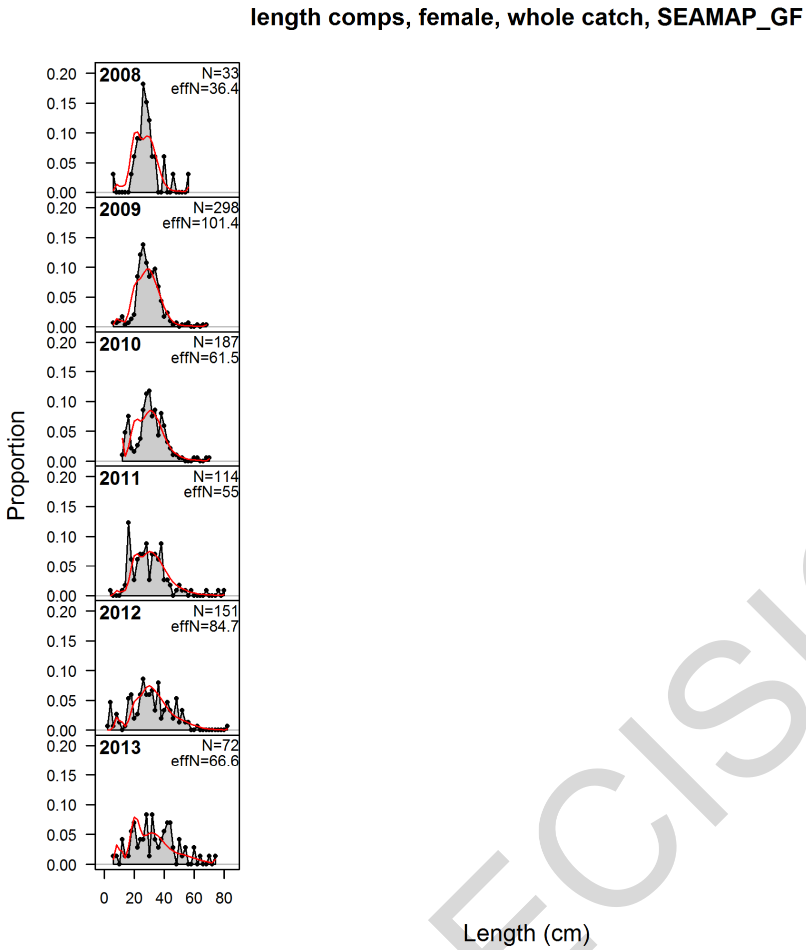


Figure 3.2.29 Observed and predicted length compositions of landings from the SEAMAP groundfish survey. Observed (N) sample sizes and effective sample sizes (effN) estimated by SS are also reported.

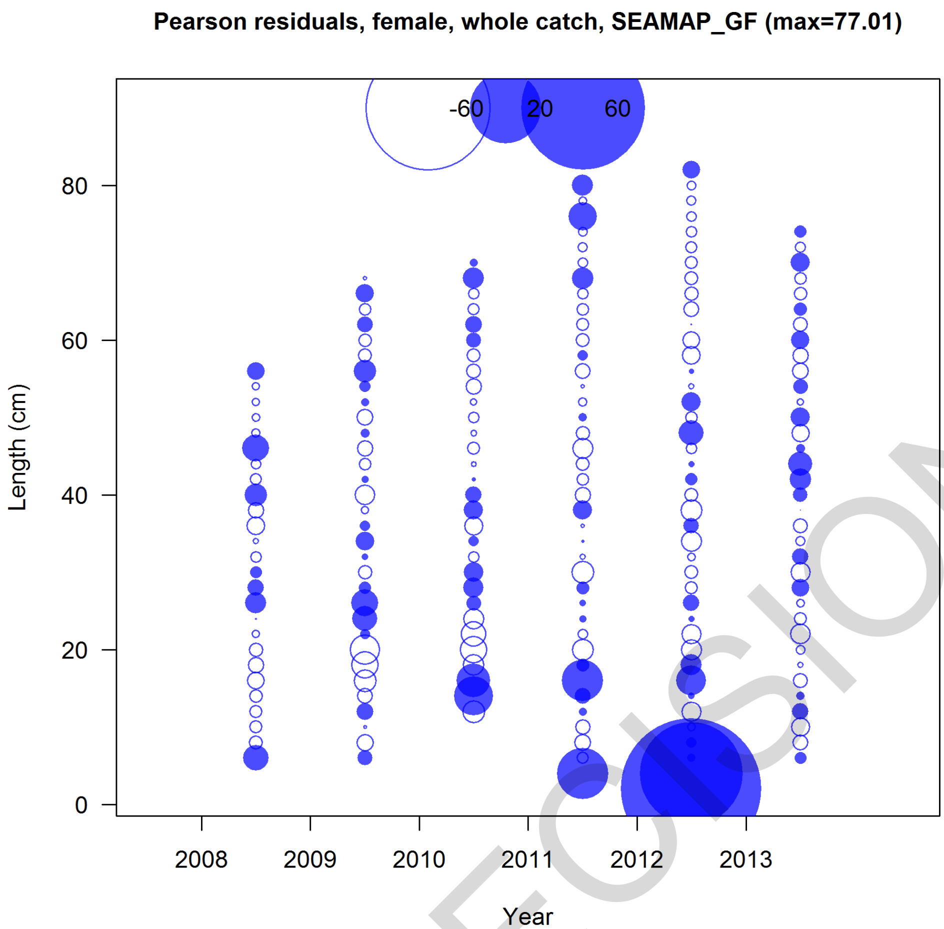


Figure 3.2.30 Pearson residuals for the length composition fit to the SEAMAP groundfish survey length observations. Solid circles are positive residuals (i.e., observed greater than predicted) and open circles are negative residuals (i.e., predicted greater than observed).

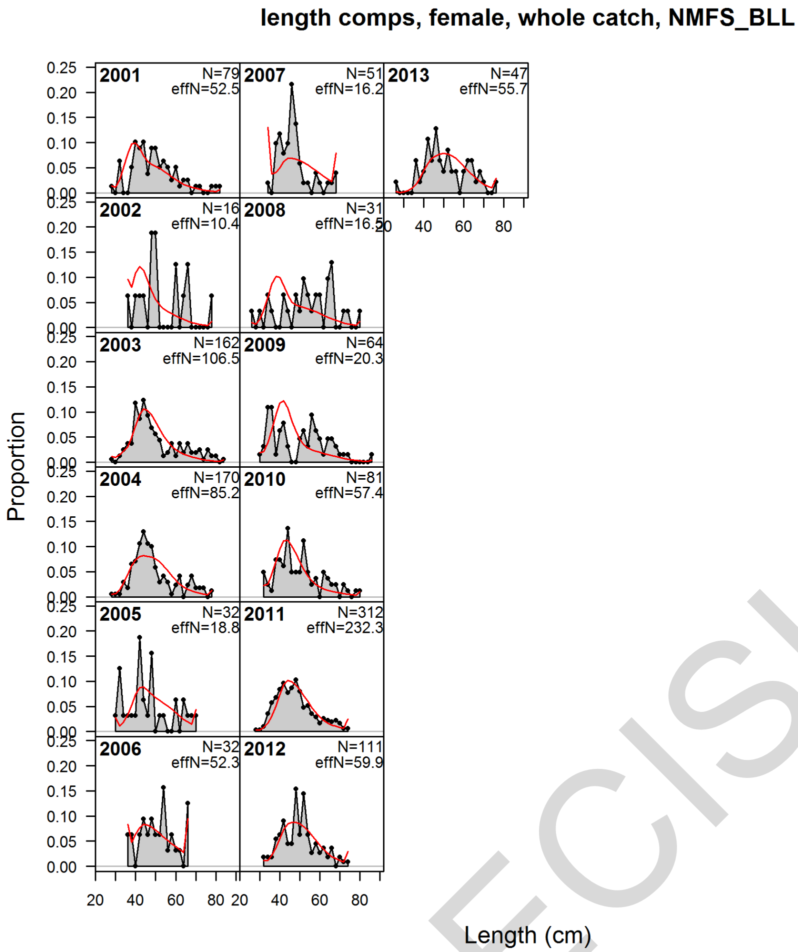


Figure 3.2.31 Observed and predicted length compositions of landings from the NMFS bottom longline survey. Observed (N) sample sizes and effective sample sizes (effN) estimated by SS are also reported.

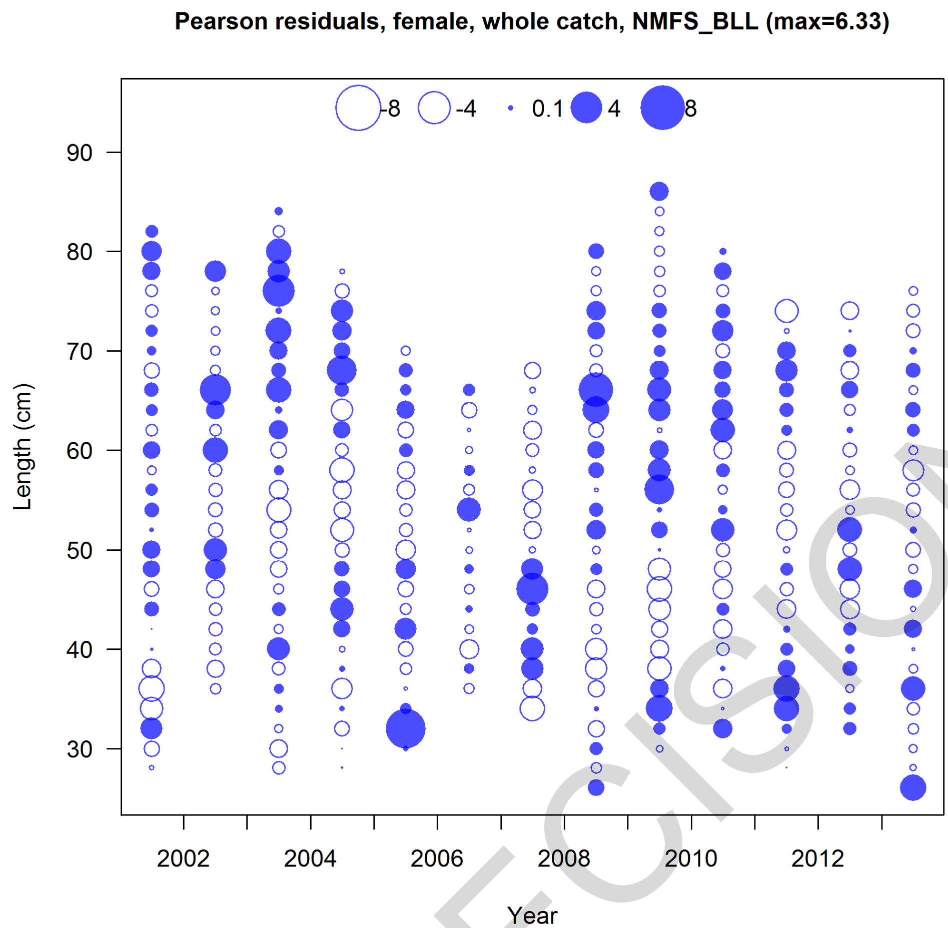


Figure 3.2.32 Pearson residuals for the length composition fit to the NMFS bottom longline survey length observations. Solid circles are positive residuals (i.e., observed greater than predicted) and open circles are negative residuals (i.e., predicted greater than observed).

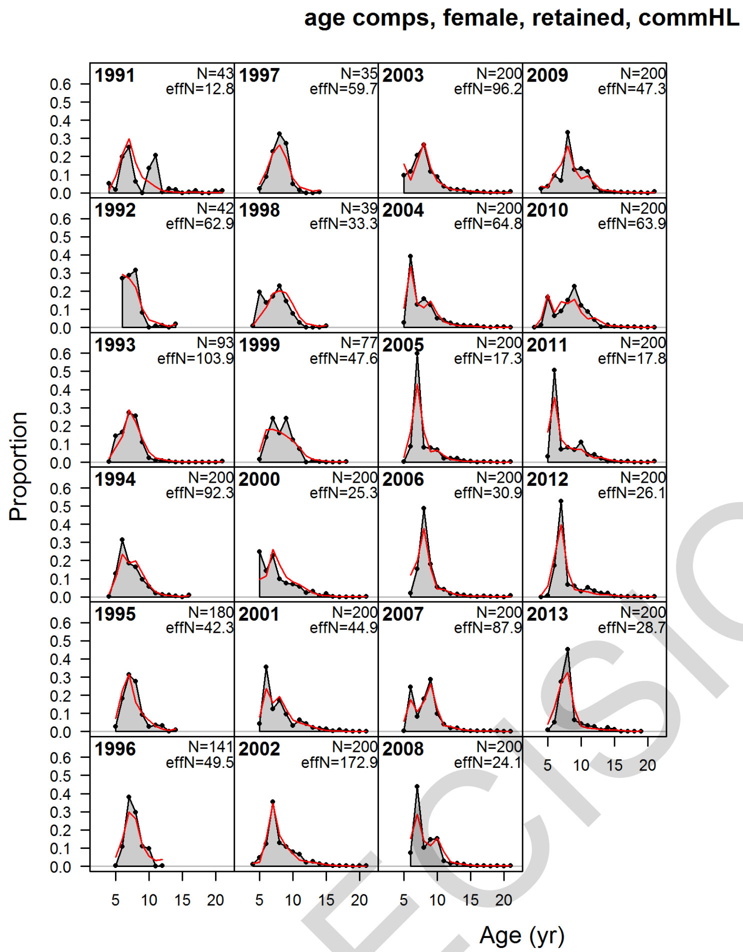


Figure 3.2.33 Observed and predicted age compositions of landings of Red Grouper in the commercial vertical line fleet. Observed (N) sample sizes and effective sample sizes (effN) estimated by SS are also reported. Observed sample sizes were capped at a maximum of 200 fish.

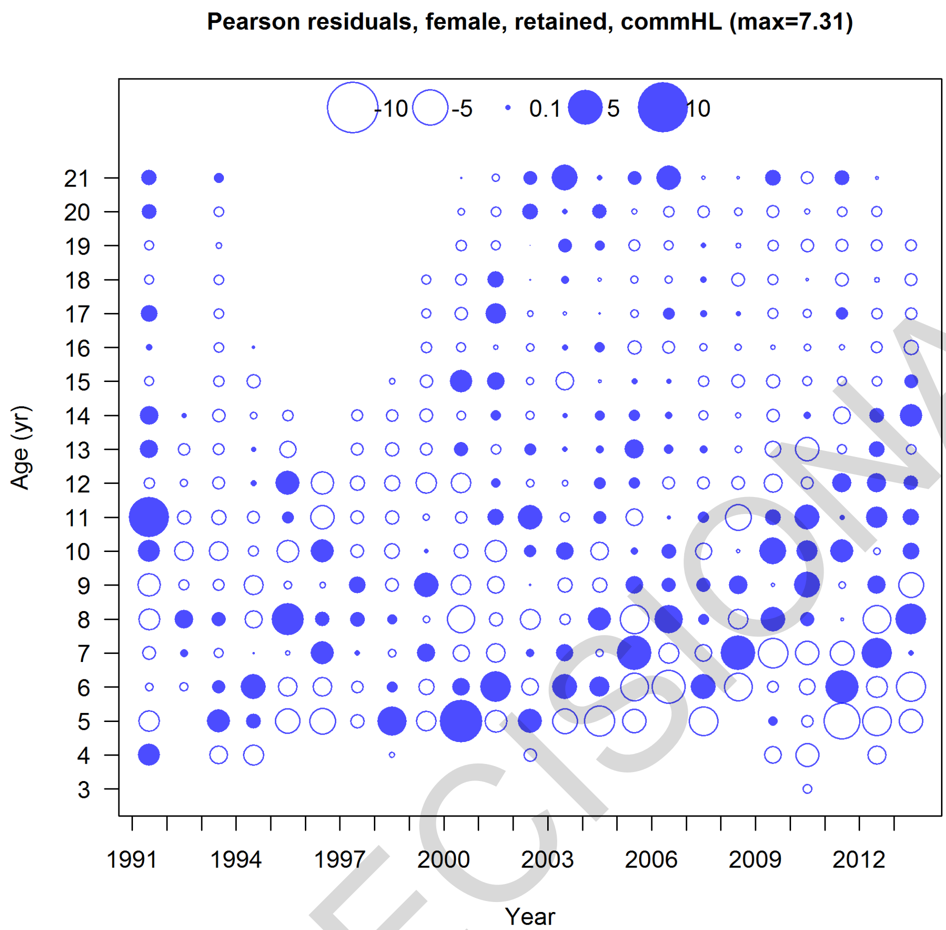


Figure 3.2.34 Pearson residuals for the age composition fit to commercial vertical line landings. Solid circles are positive residuals (i.e., observed greater than predicted) and open circles are negative residuals (i.e., predicted greater than observed).

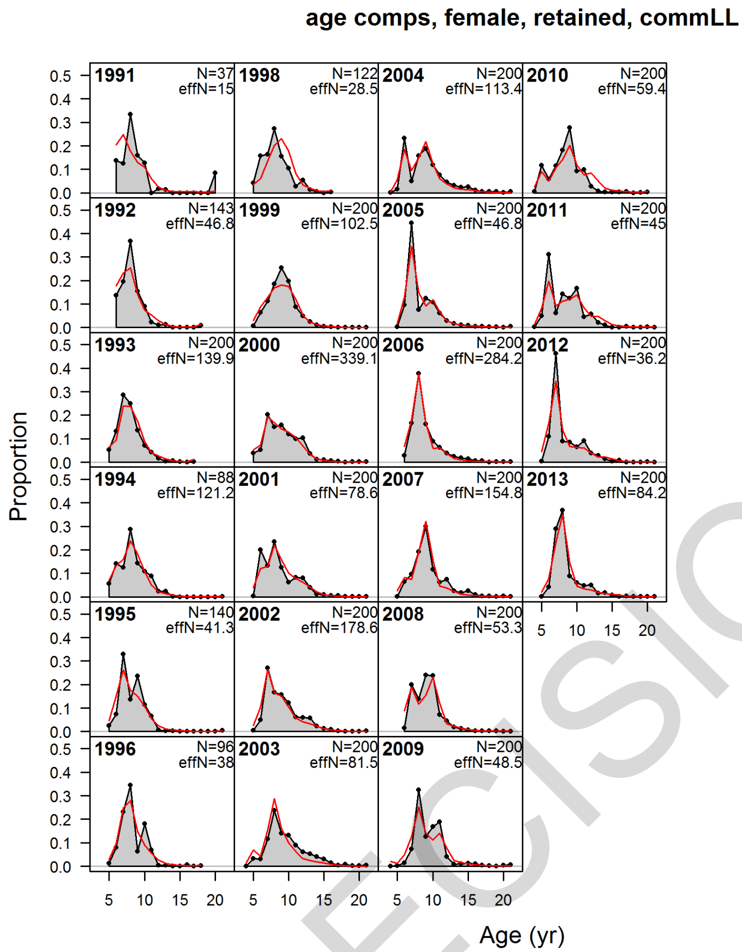


Figure 3.2.35 Observed and predicted age compositions of landings of Red Grouper in the commercial longline fleet. Observed (N) sample sizes and effective sample sizes (effN) estimated by SS are also reported. Observed sample sizes were capped at a maximum of 200 fish.

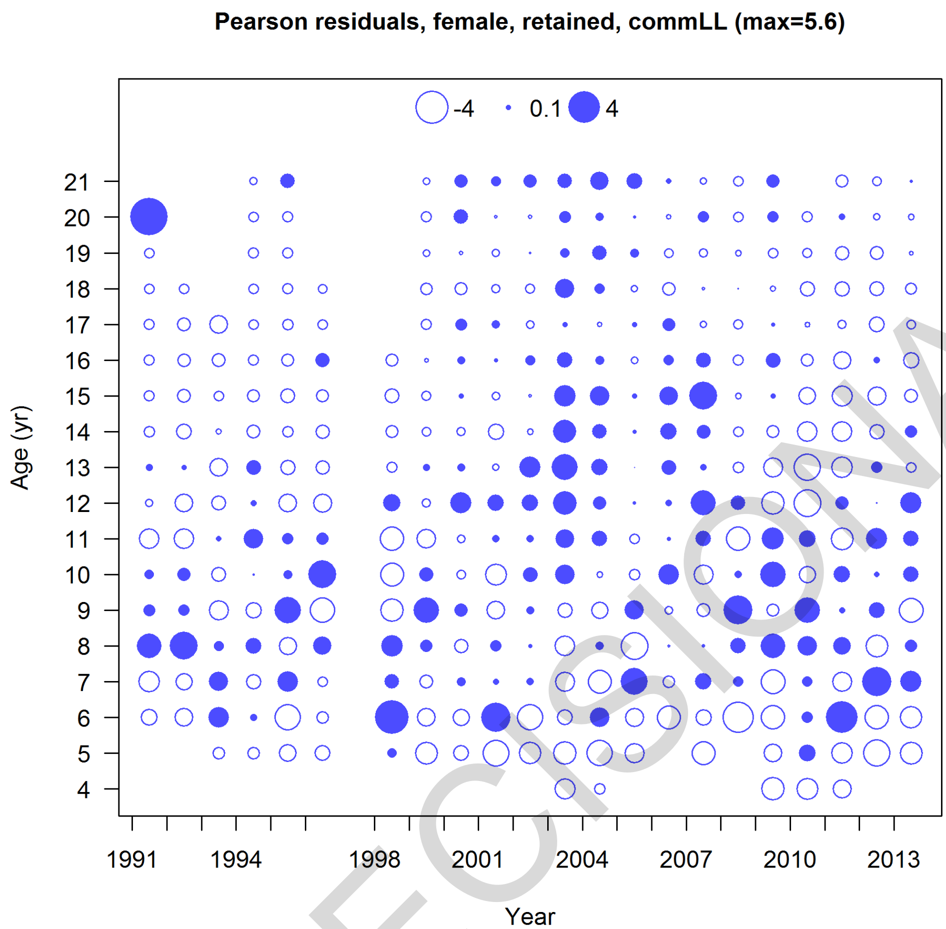


Figure 3.2.36 Pearson residuals for the age composition fit to commercial longline landings. Solid circles are positive residuals (i.e., observed greater than predicted) and open circles are negative residuals (i.e., predicted greater than observed).

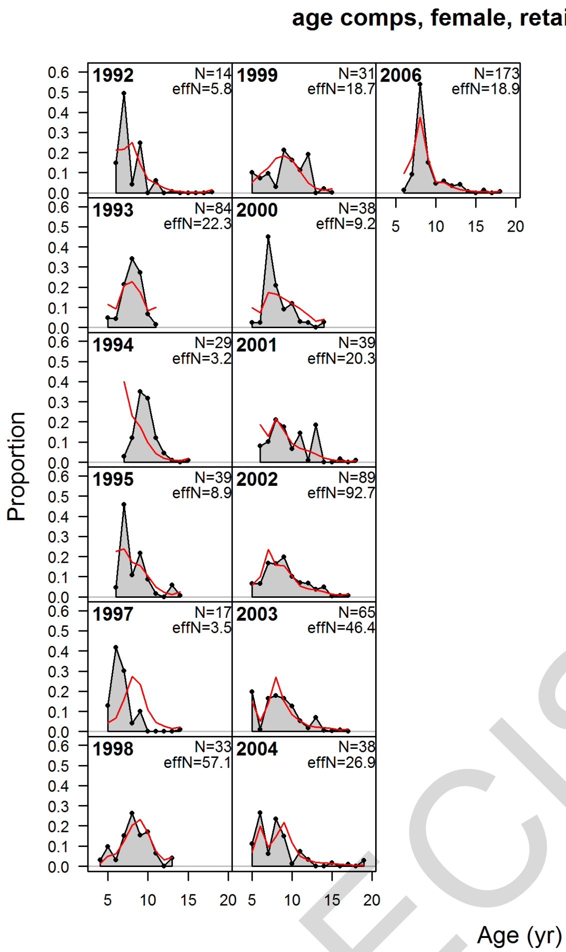


Figure 3.2.37 Observed and predicted age compositions of landings of Red Grouper in the commercial trap fleet. Observed (N) sample sizes and effective sample sizes (effN) estimated by SS are also reported. Observed sample sizes were capped at a maximum of 200 fish.

Figure 3.2.38 Pearson residuals for the age composition fit to commercial trap landings. Solid circles are positive residuals (i.e., observed greater than predicted) and open circles are negative residuals (i.e., predicted greater than observed).

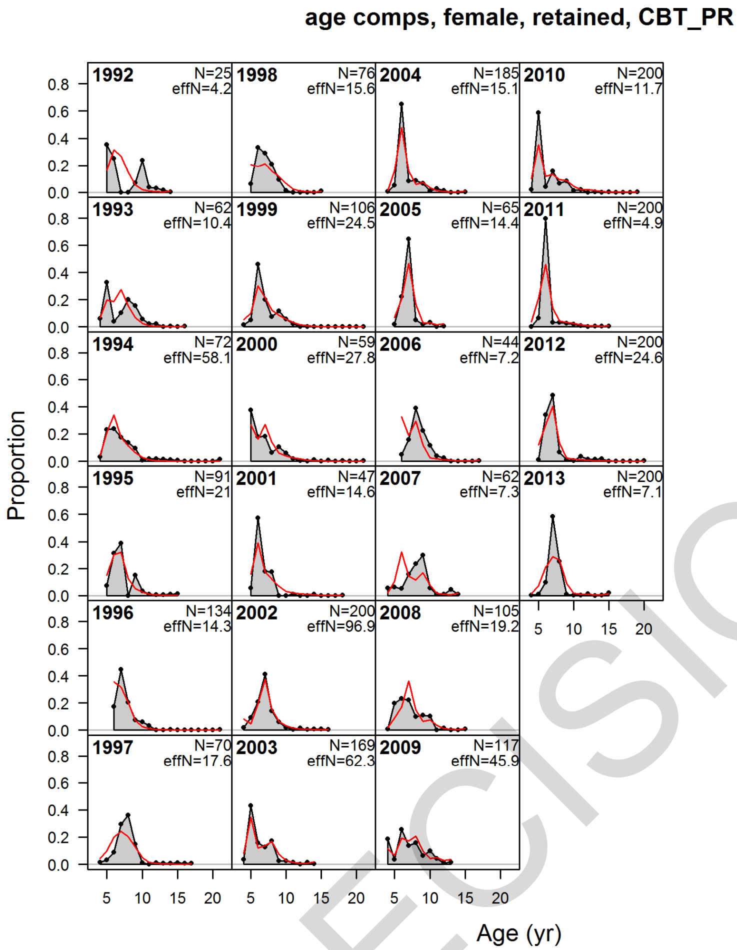


Figure 3.2.39 Observed and predicted age compositions of landings of Red Grouper in the combined recreational charterboat and private fleet. Observed (N) sample sizes and effective sample sizes (effN) estimated by SS are also reported. Observed sample sizes were capped at a maximum of 200 fish.

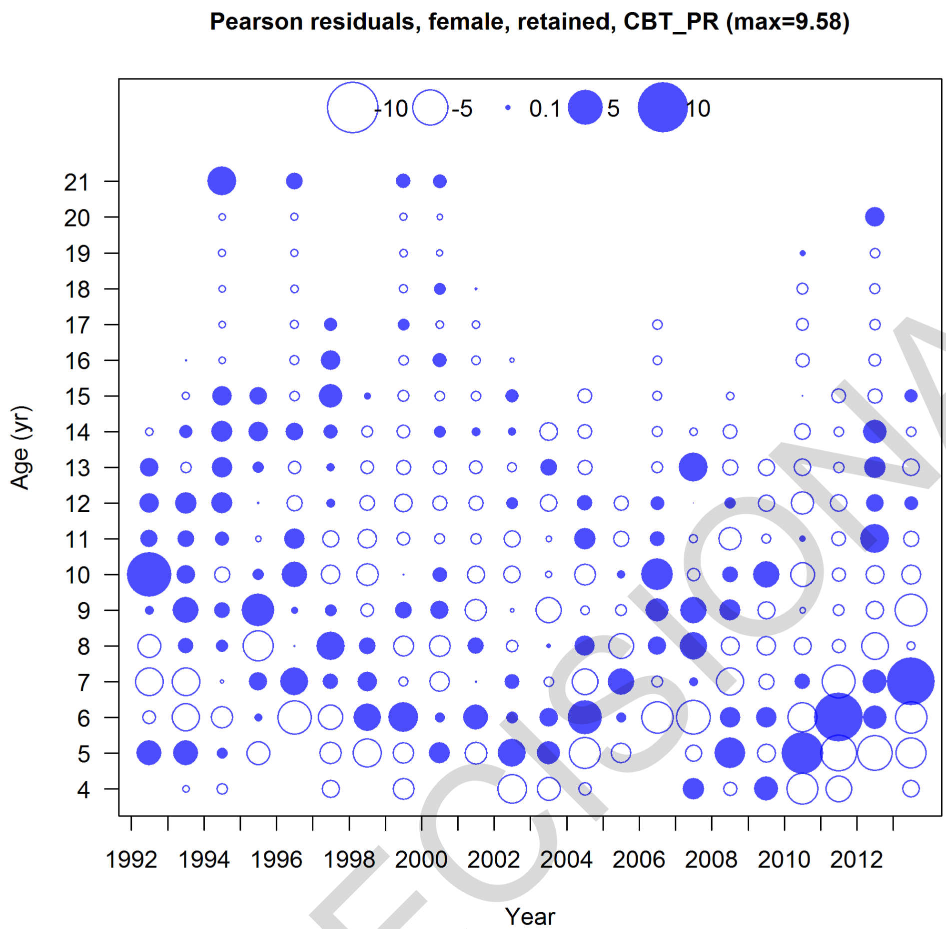


Figure 3.2.40 Pearson residuals for the age composition fit to the combined recreational charterboat and private landings. Solid circles are positive residuals (i.e., observed greater than predicted) and open circles are negative residuals (i.e., predicted greater than observed).

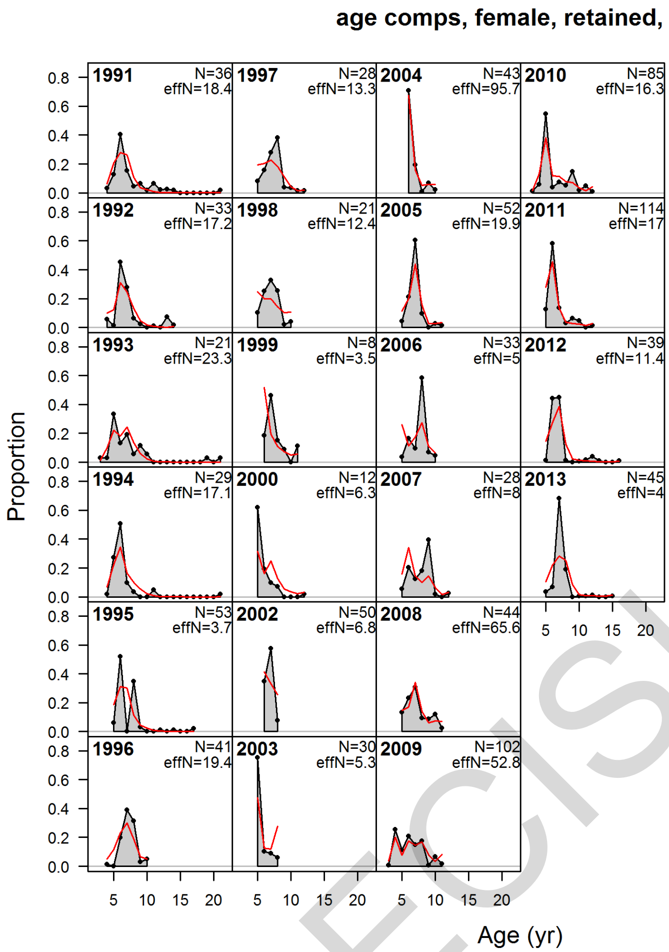


Figure 3.2.41 Observed and predicted age compositions of landings of Red Grouper in the recreational headboat fleet. Observed (N) sample sizes and effective sample sizes (effN) estimated by SS are also reported. Observed sample sizes were capped at a maximum of 200 fish.

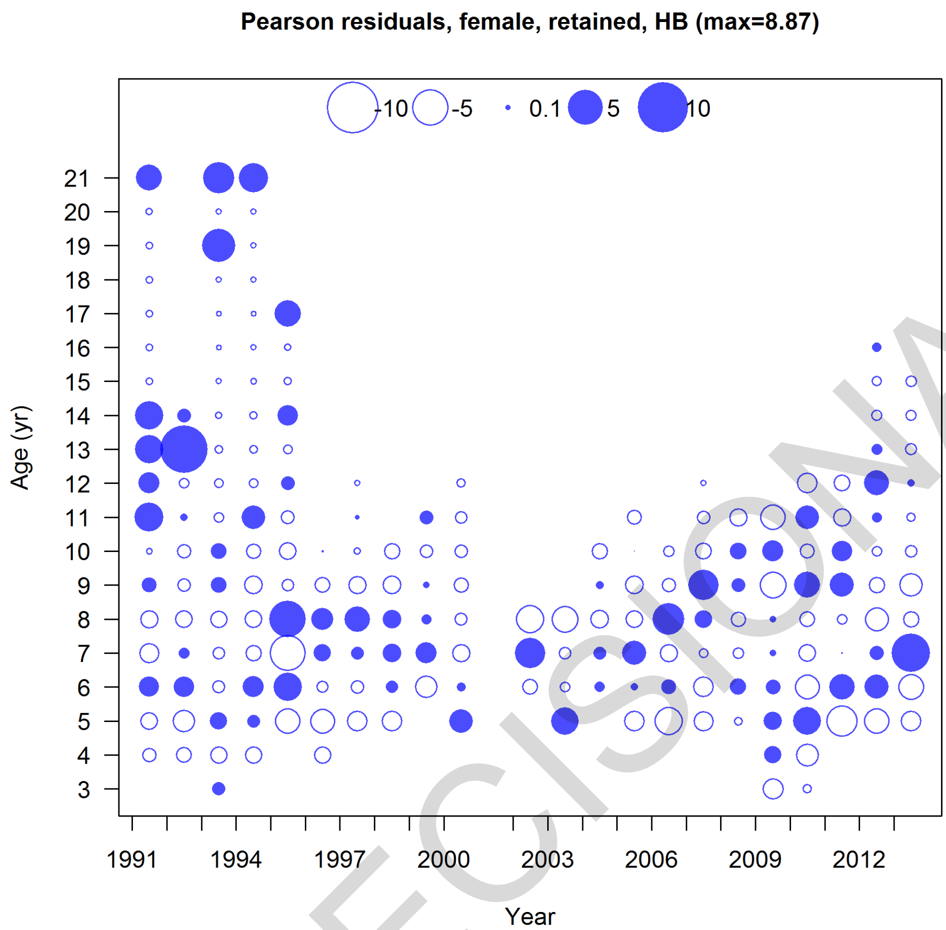


Figure 3.2.42 Pearson residuals for the age composition fit to recreational headboat landings. Solid circles are positive residuals (i.e., observed greater than predicted) and open circles are negative residuals (i.e., predicted greater than observed).

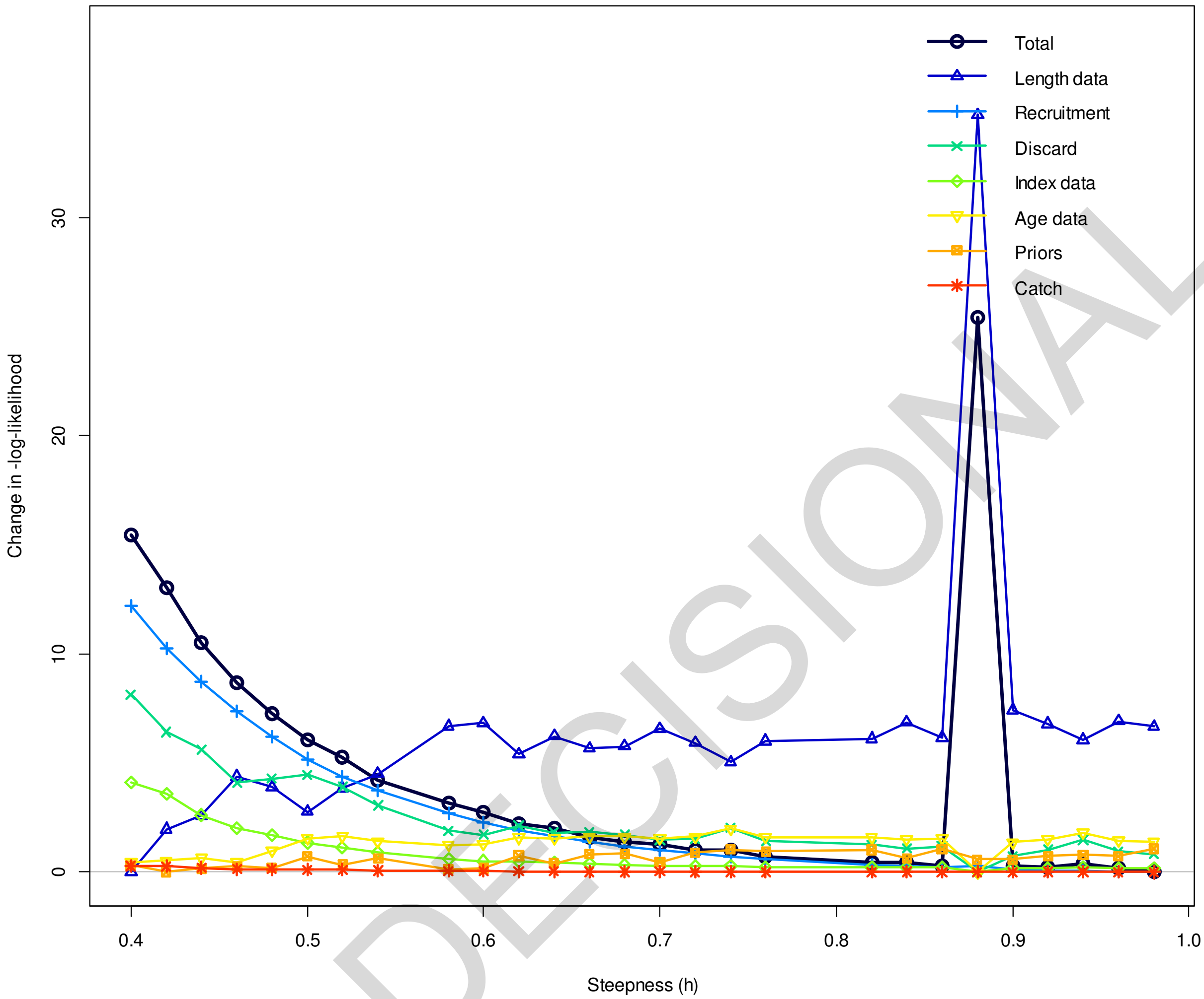


Figure 3.2.43 Likelihood profile on steepness at intervals of 0.02.

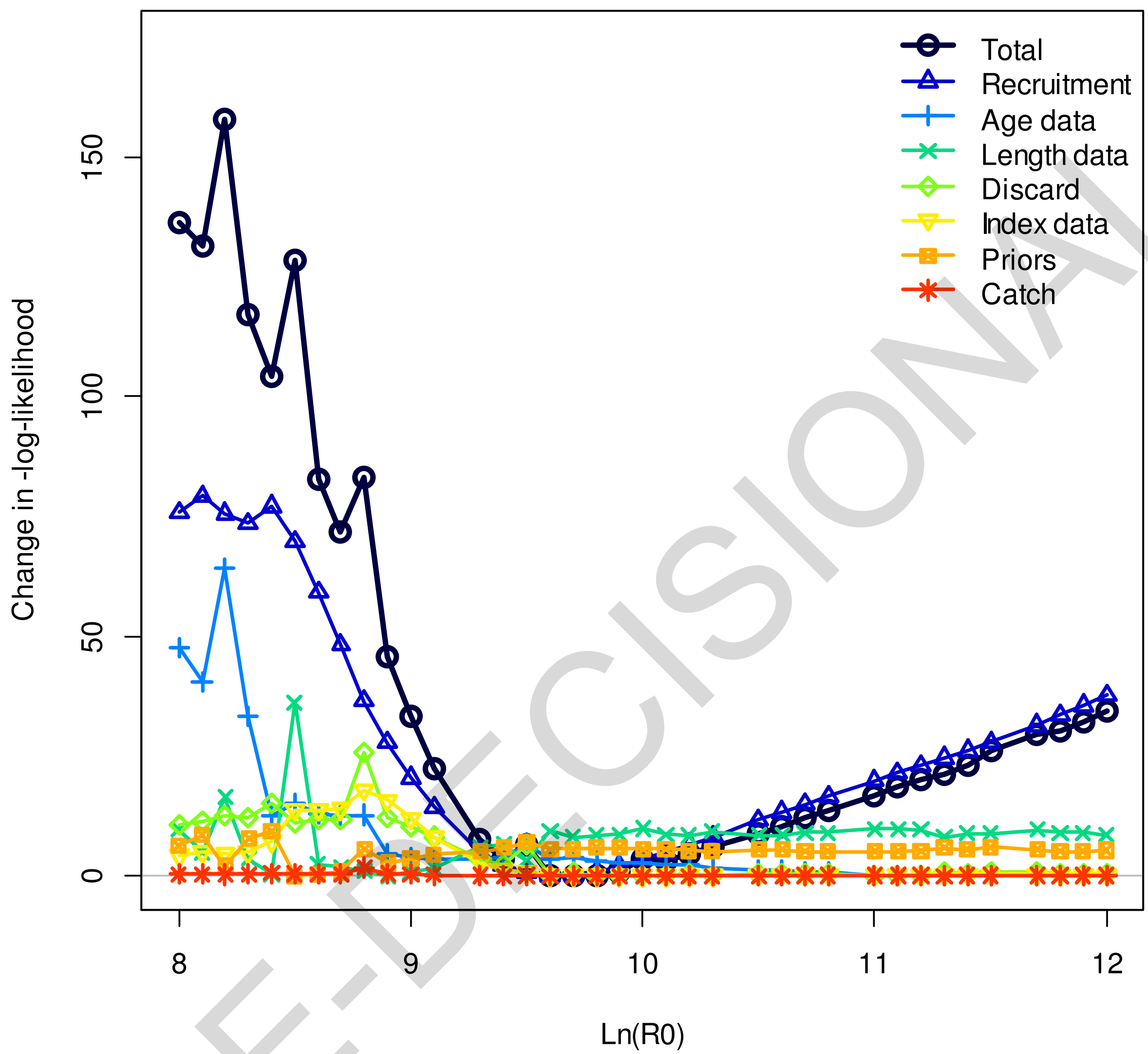


Figure 3.2.44 Likelihood profile on Ln (R0) at intervals of 0.1.

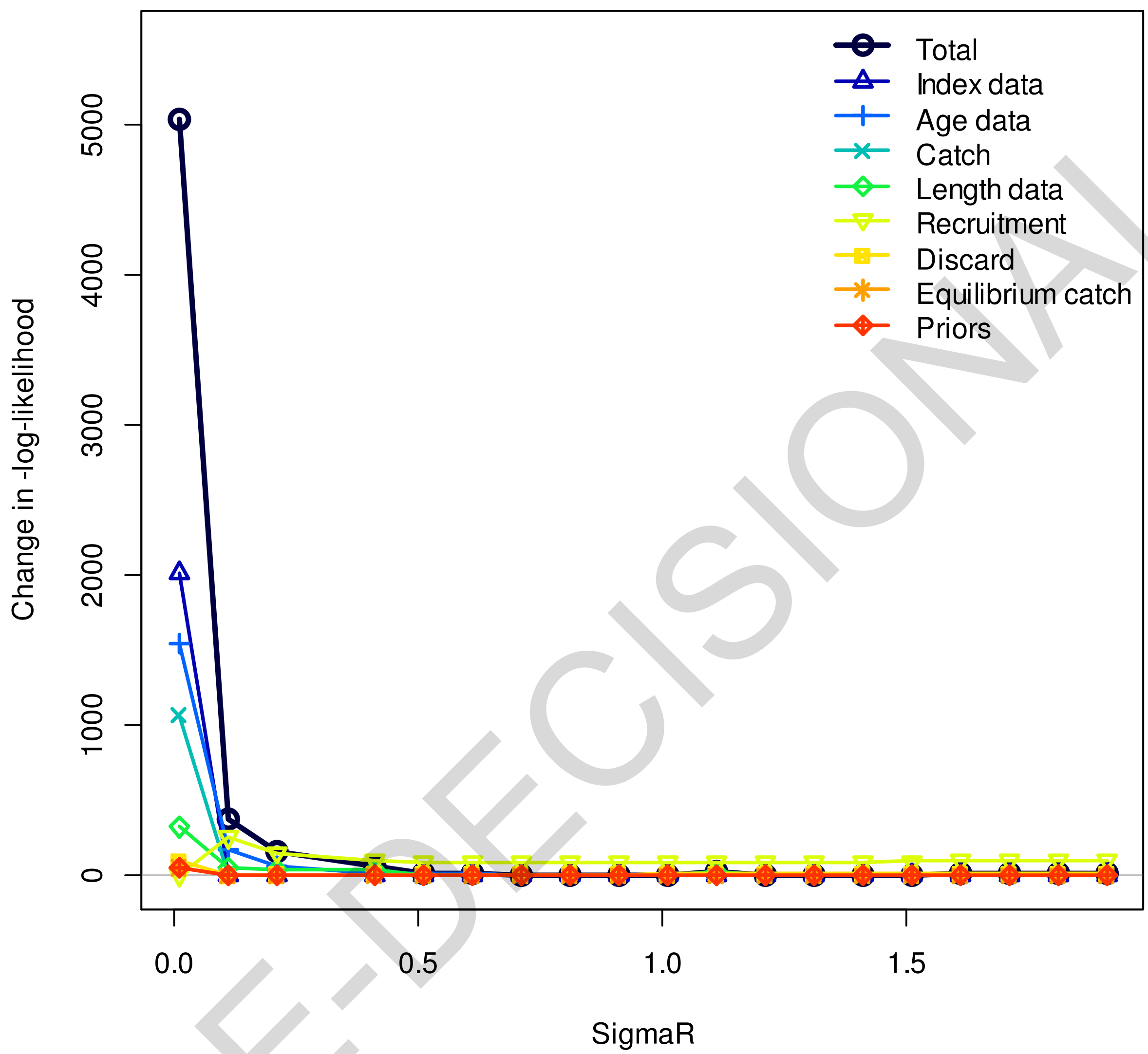


Figure 3.2.45 Likelihood profile on σ_R at intervals of 0.1.

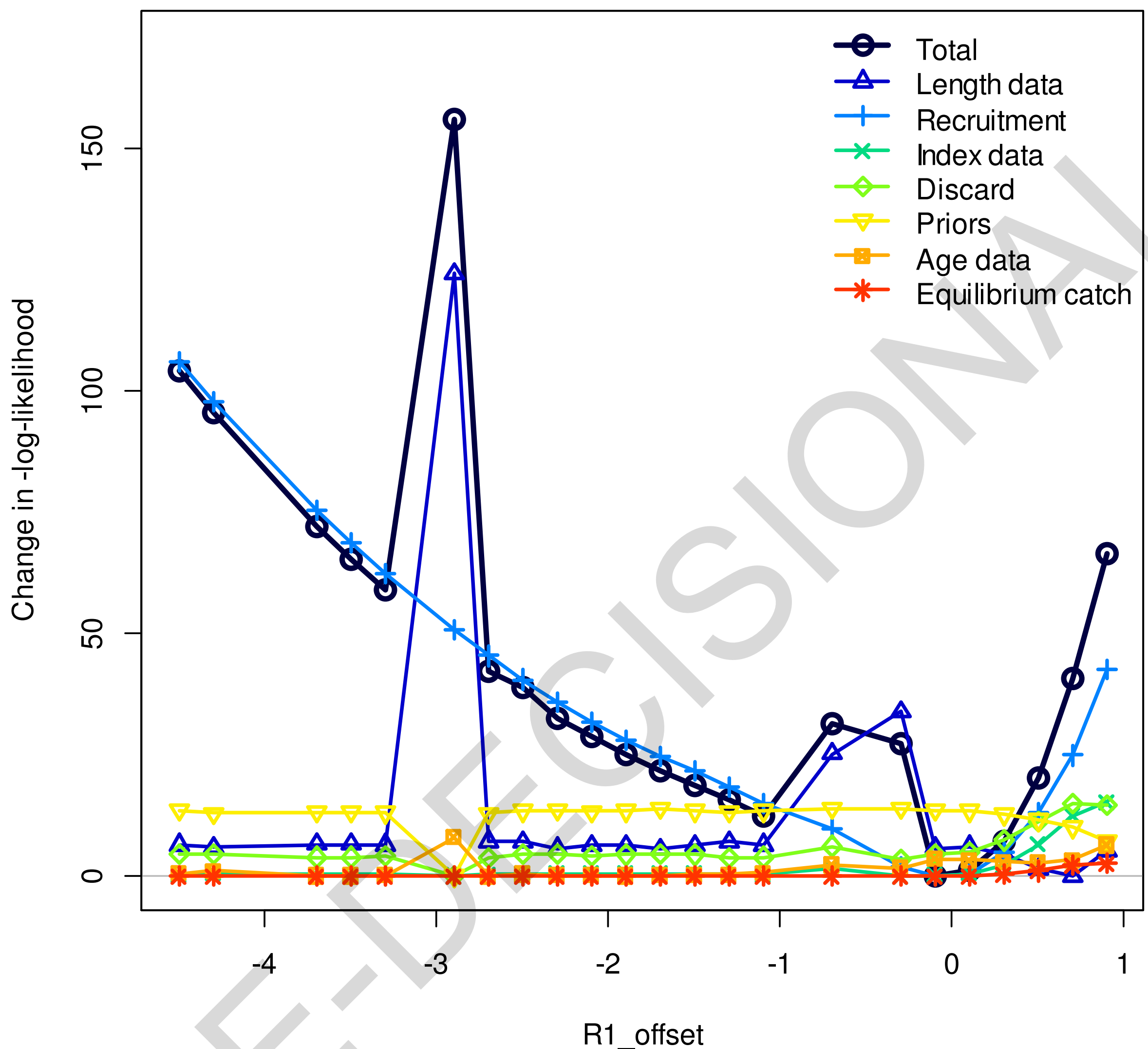


Figure 3.2.46 Likelihood profile on Ln(R1_offset) at intervals of 0.2.

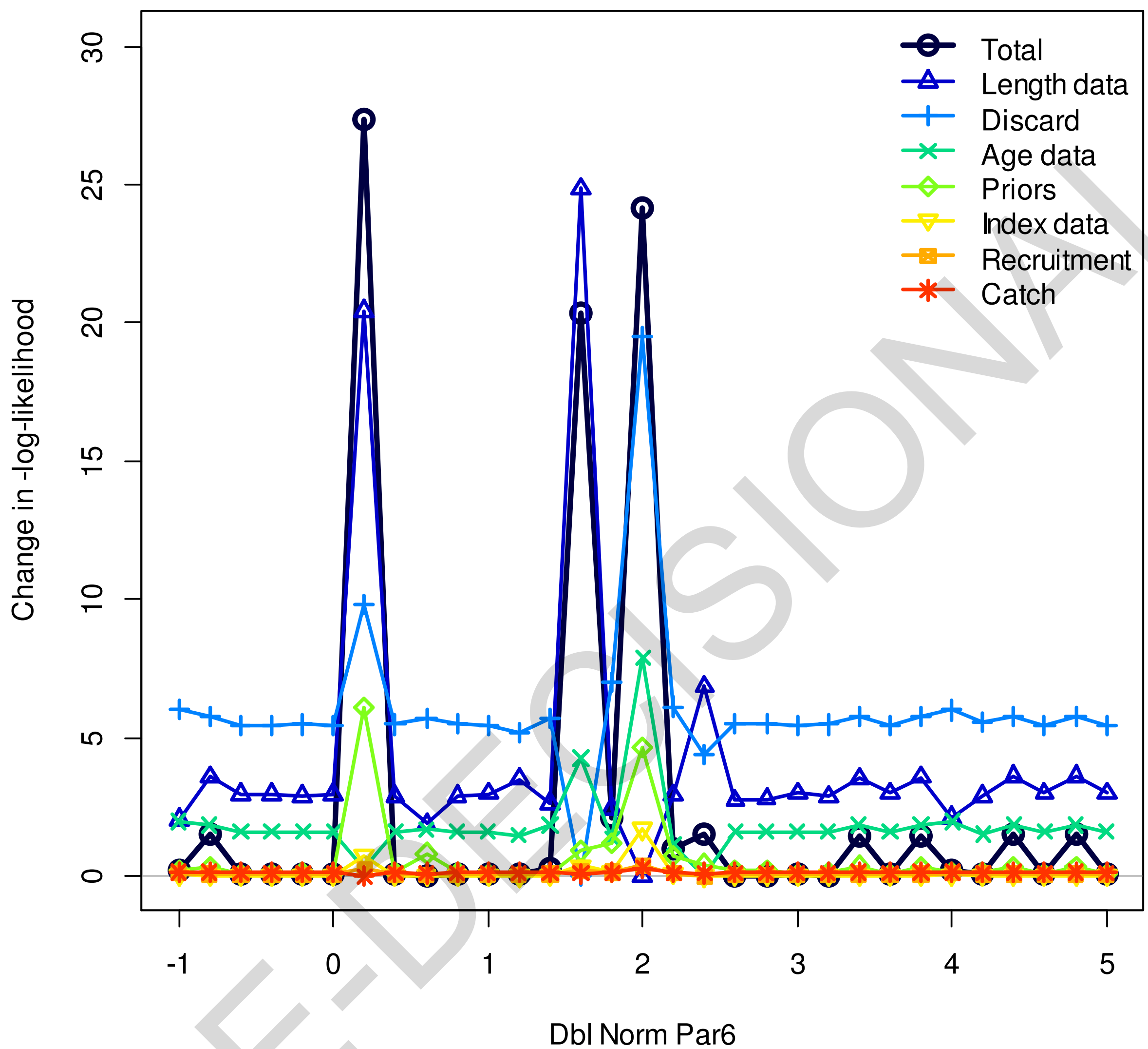


Figure 3.2.47 Likelihood profile on the selectivity of the last length bin for the NMFS bottom longline survey at intervals of 0.2.

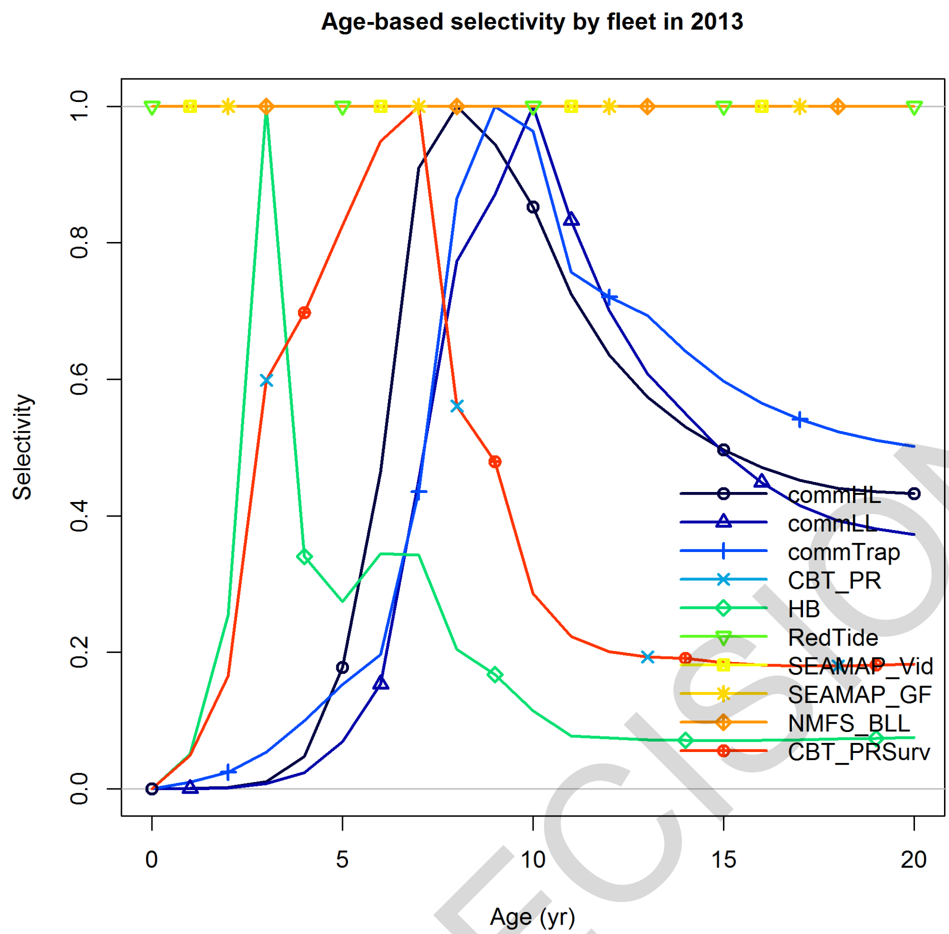


Figure 3.2.48 The estimated age-based selectivity patterns for the five fishing fleets.

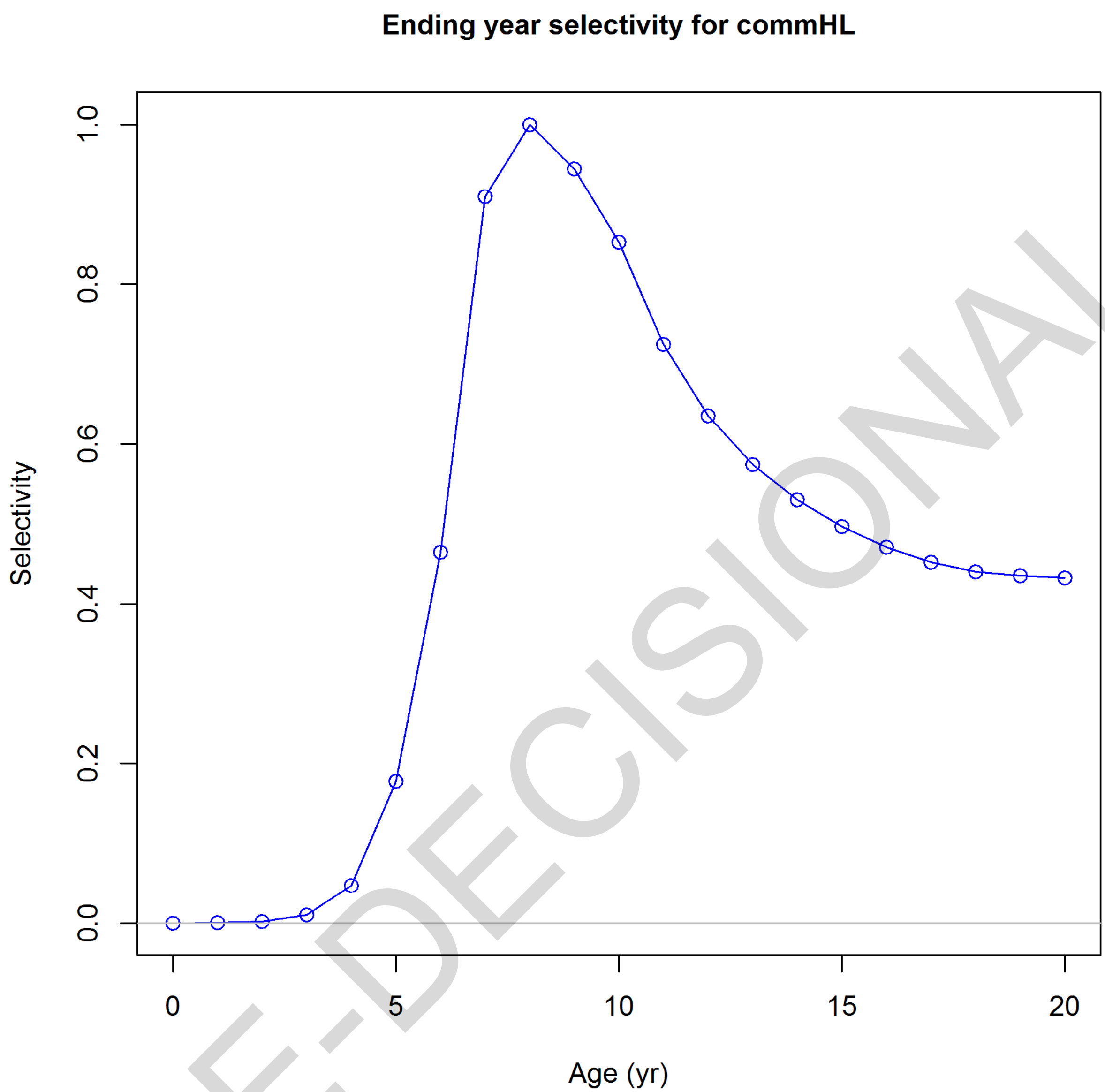


Figure 3.2.49 The estimated, commercial handline selectivity pattern using a random walk.

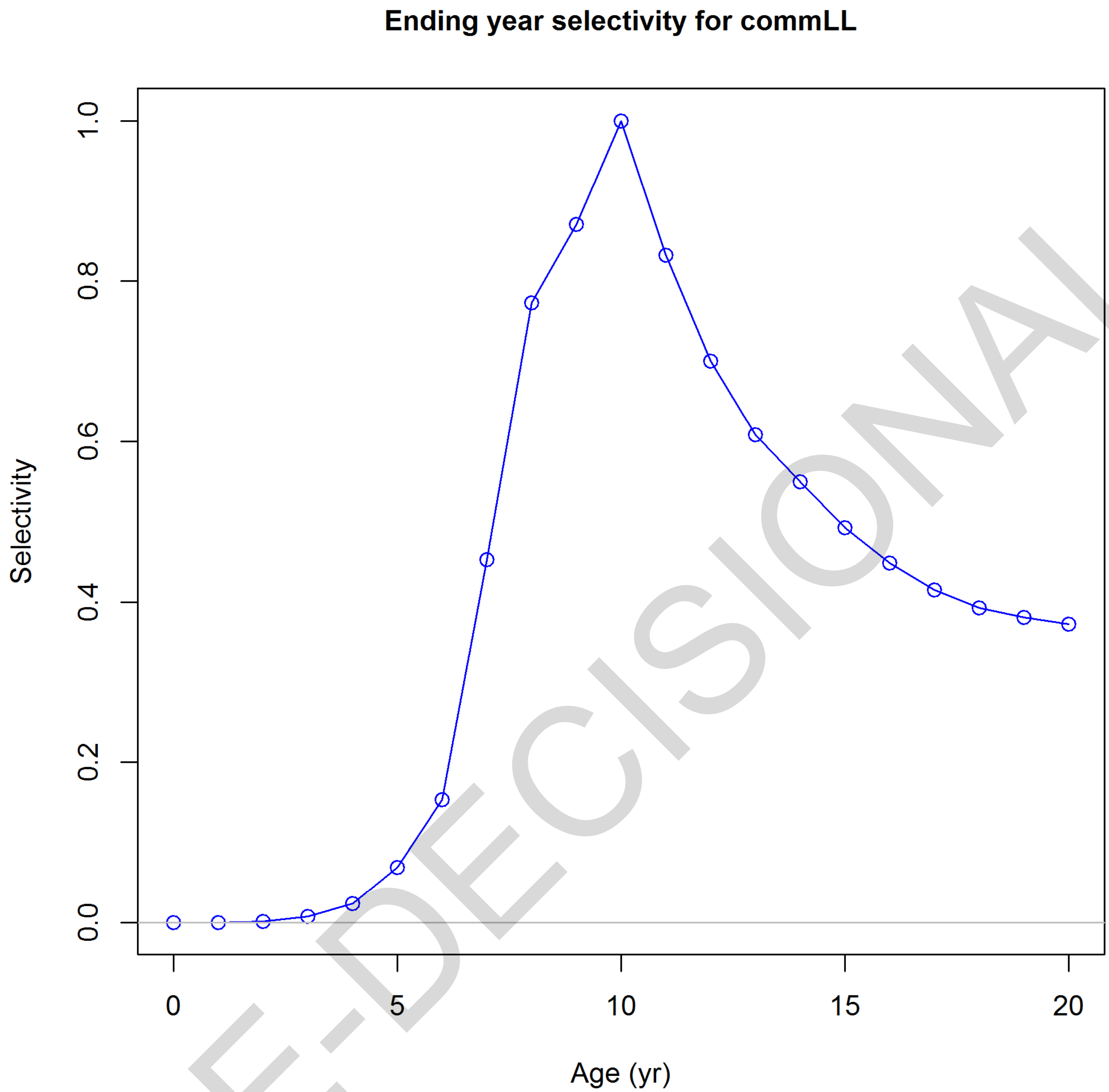


Figure 3.2.50 The estimated, commercial longline selectivity pattern using a random walk.

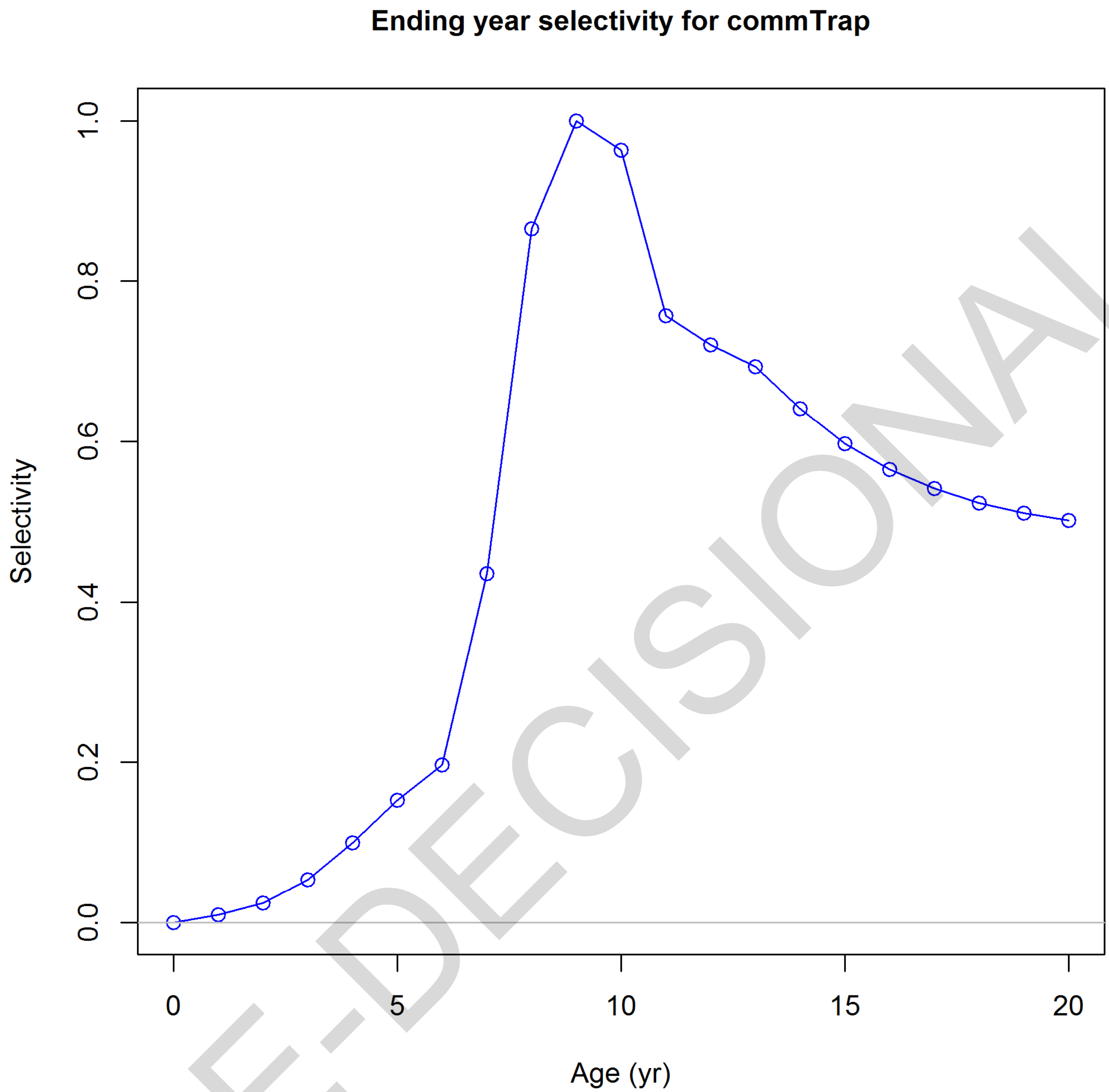


Figure 3.2.51 The estimated commercial trap selectivity pattern using a random walk.

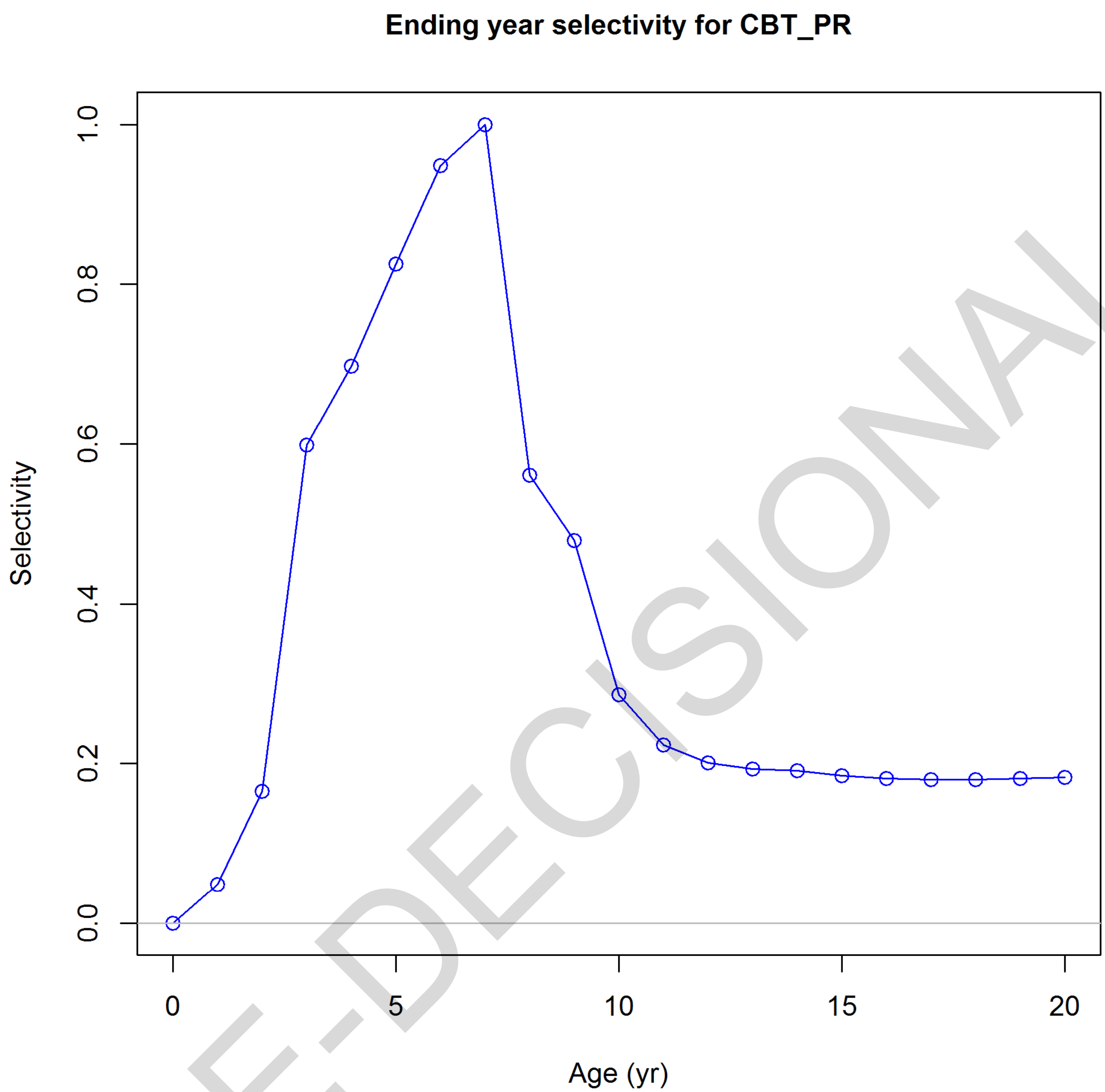


Figure 3.2.52 The estimated charterboat-private mode selectivity pattern using a random walk.

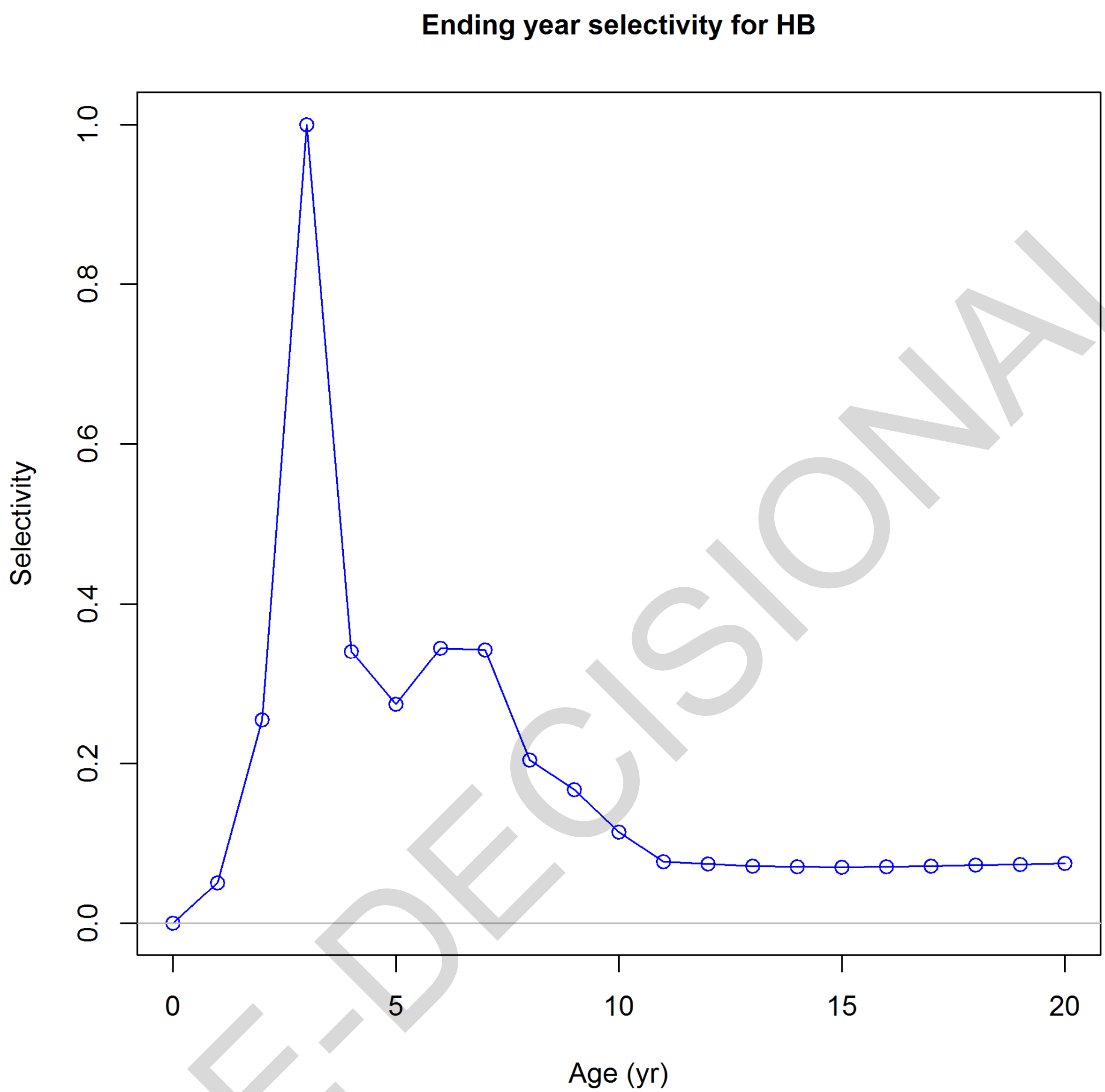


Figure 3.2.53 The estimated headboat mode selectivity pattern using a random walk.

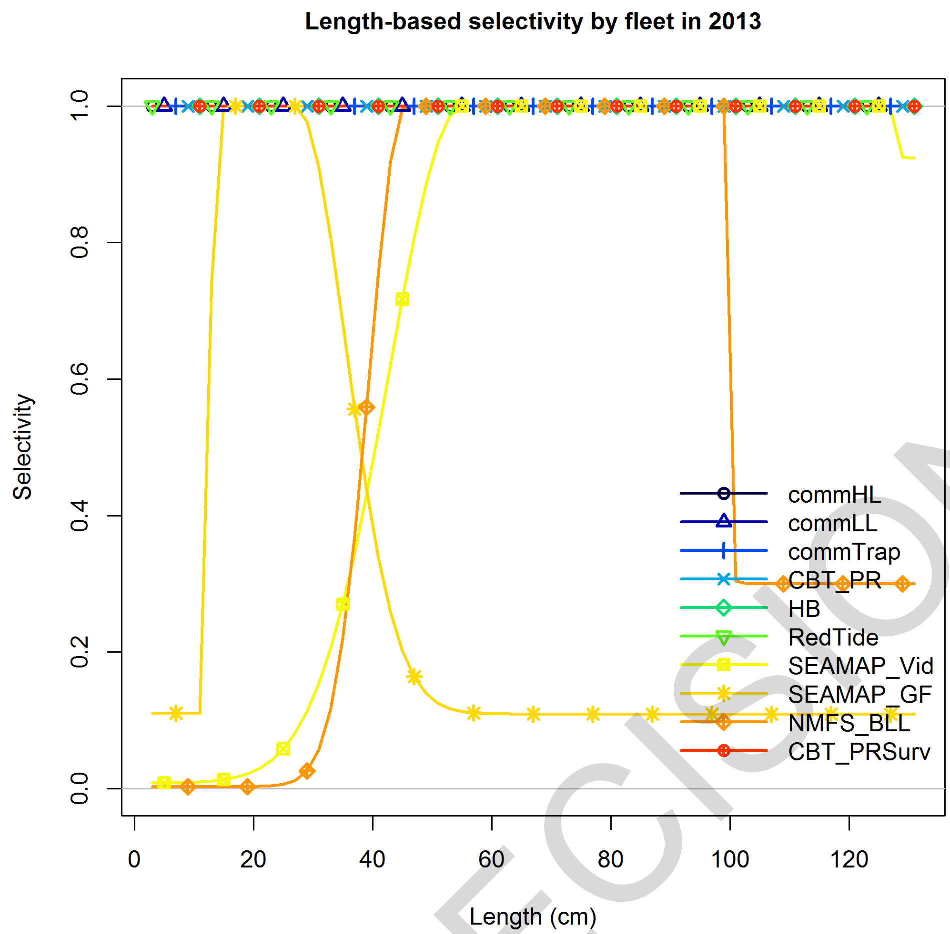


Figure 3.2.54 The estimated length-based selectivity patterns for the three fishery-independent surveys.

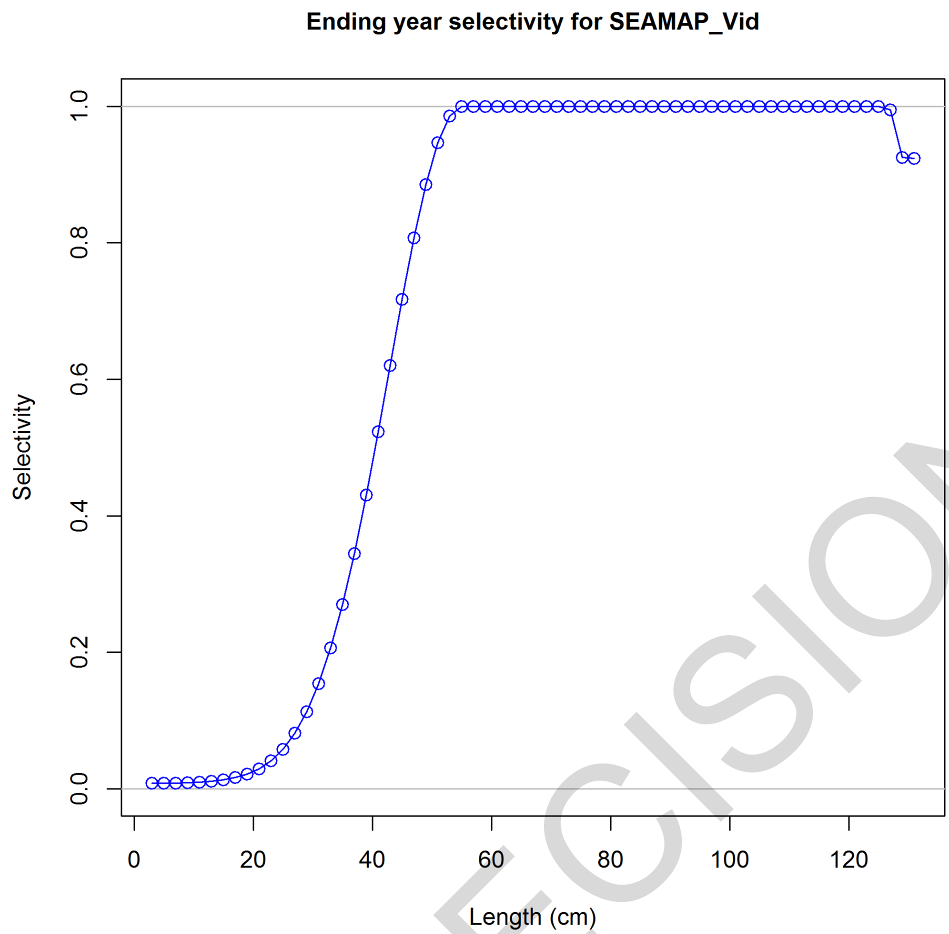


Figure 3.2.55 Length-based selectivity for the fishery-independent combined video survey.

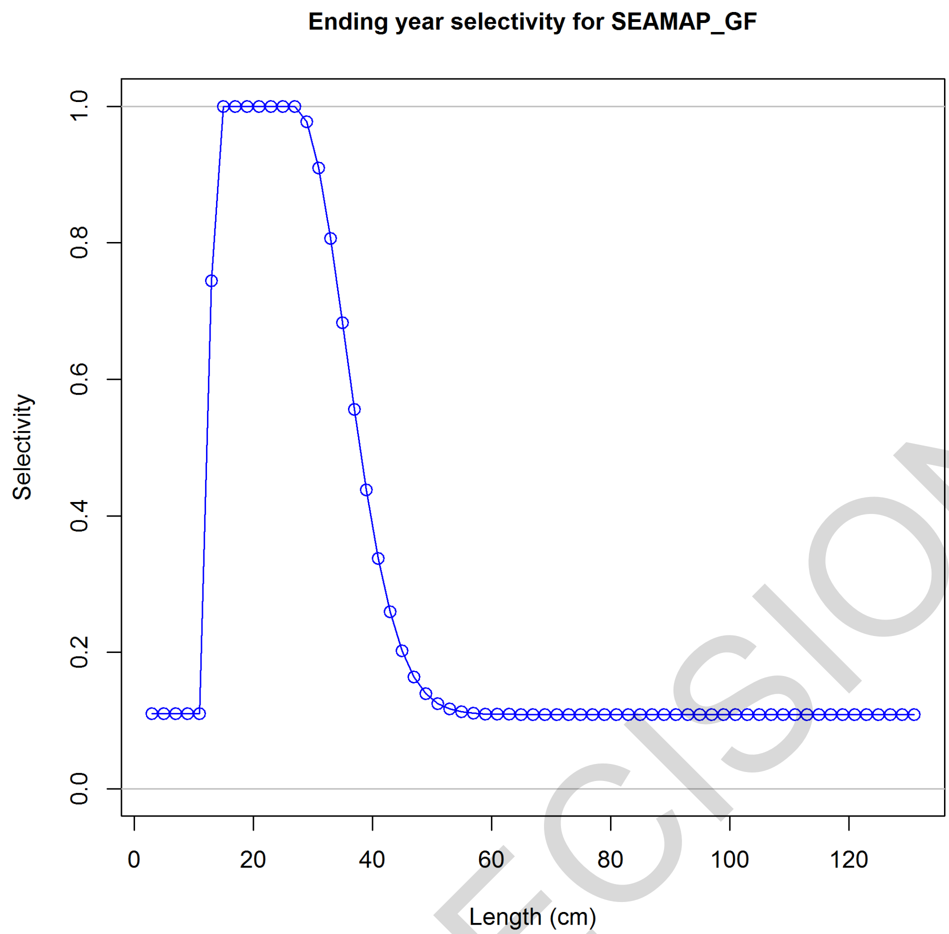


Figure 3.2.56 Length-based selectivity for the fishery-independent SEAMAP groundfish survey.

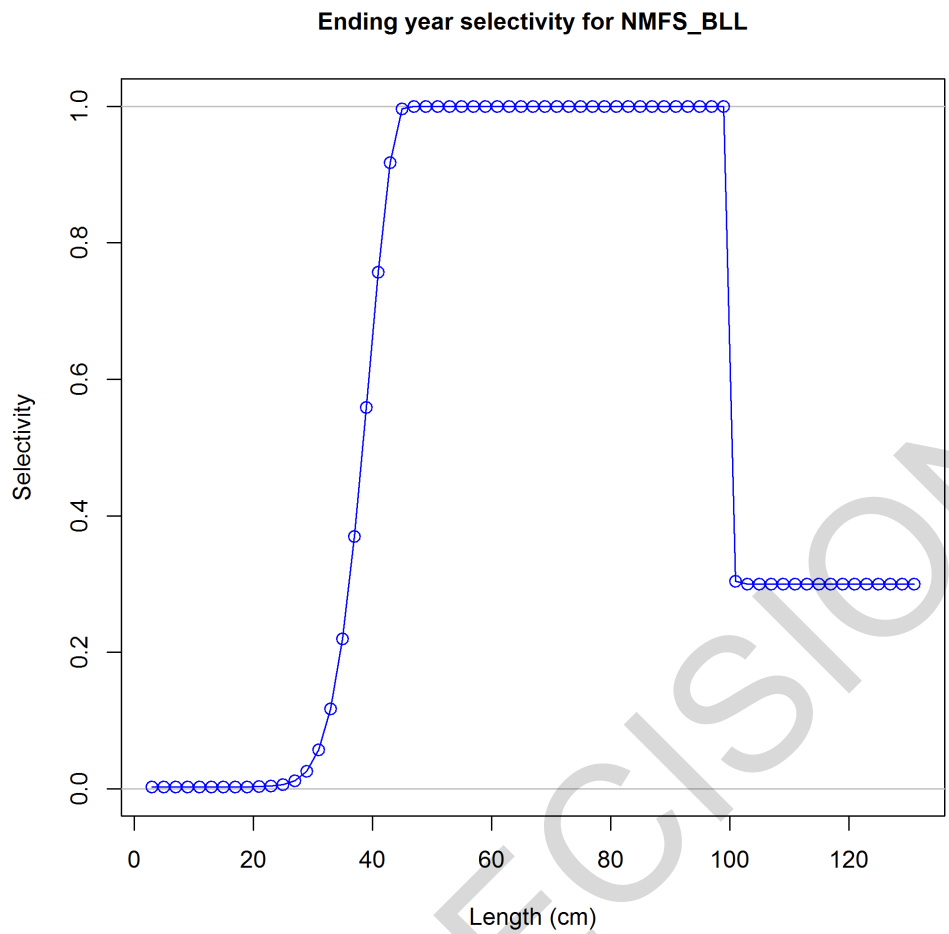


Figure 3.2.57 Length-based selectivity for the fishery-independent NMFS bottom longline survey.

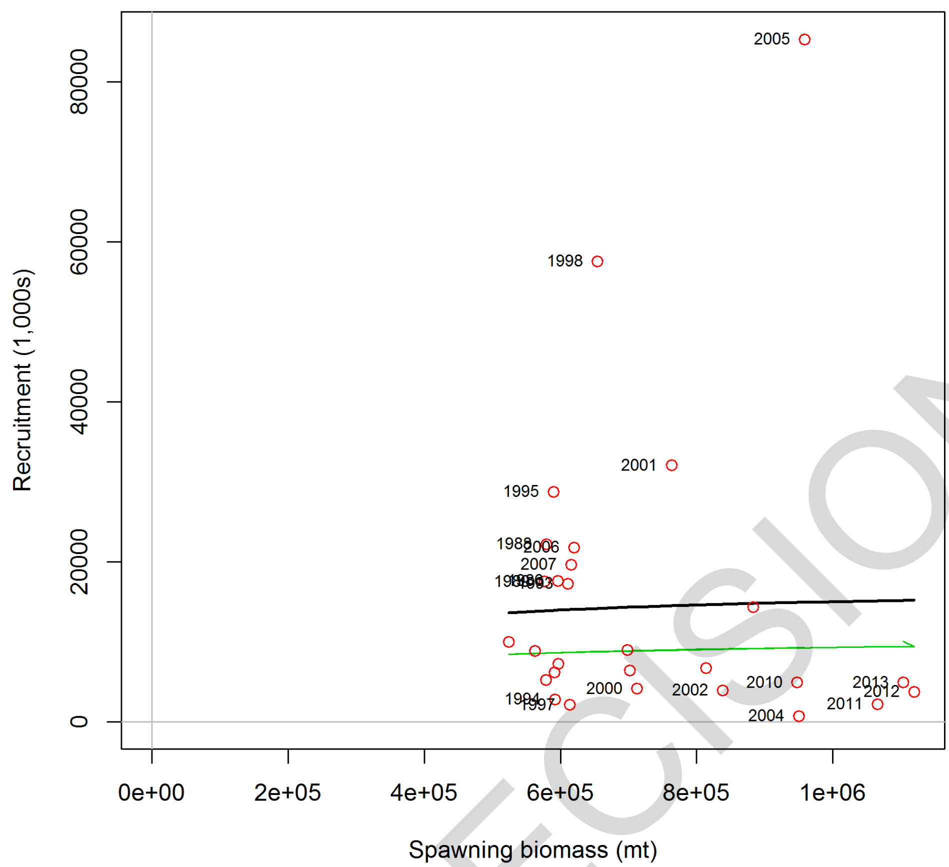


Figure 3.2.58 Predicted stock-recruitment relationship for Gulf of Mexico Red Grouper. Plotted are predicted annual recruitments from SS (circles), expected recruitment from the stock-recruit relationship (black line), and bias adjusted recruitment from the stock-recruit relationship (green line).

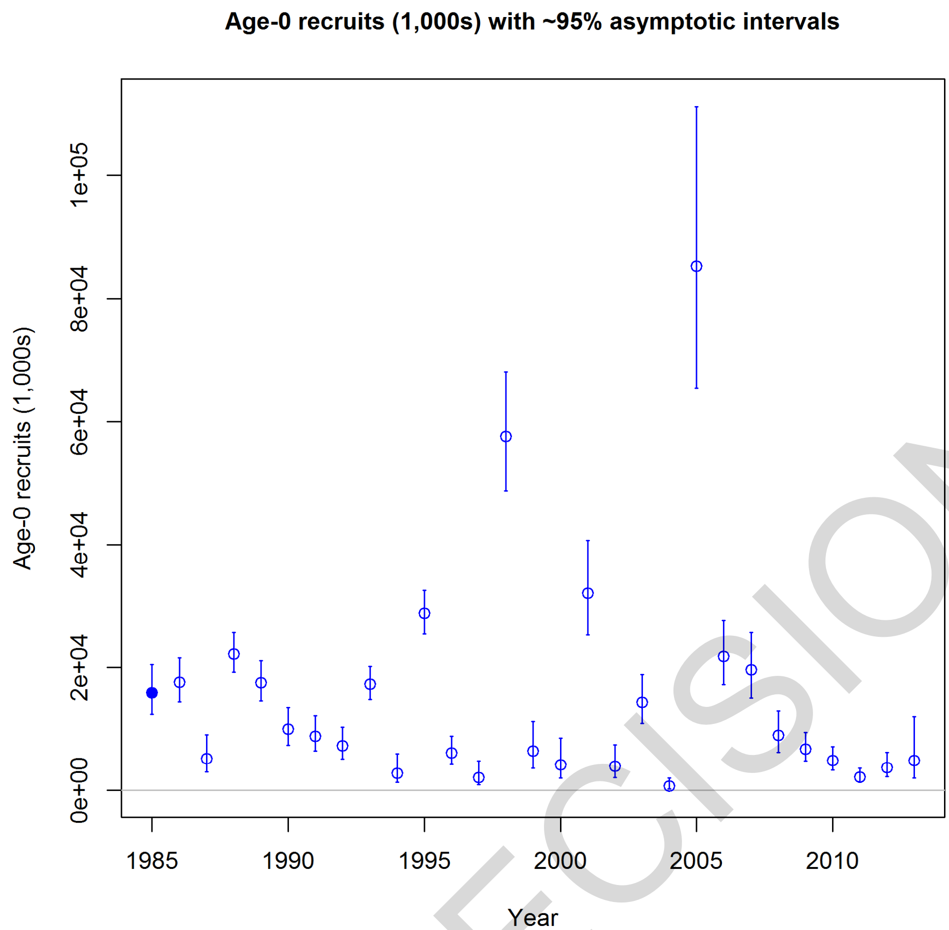


Figure 3.2.59 Predicted age-0 recruits with associated 95% asymptotic intervals.

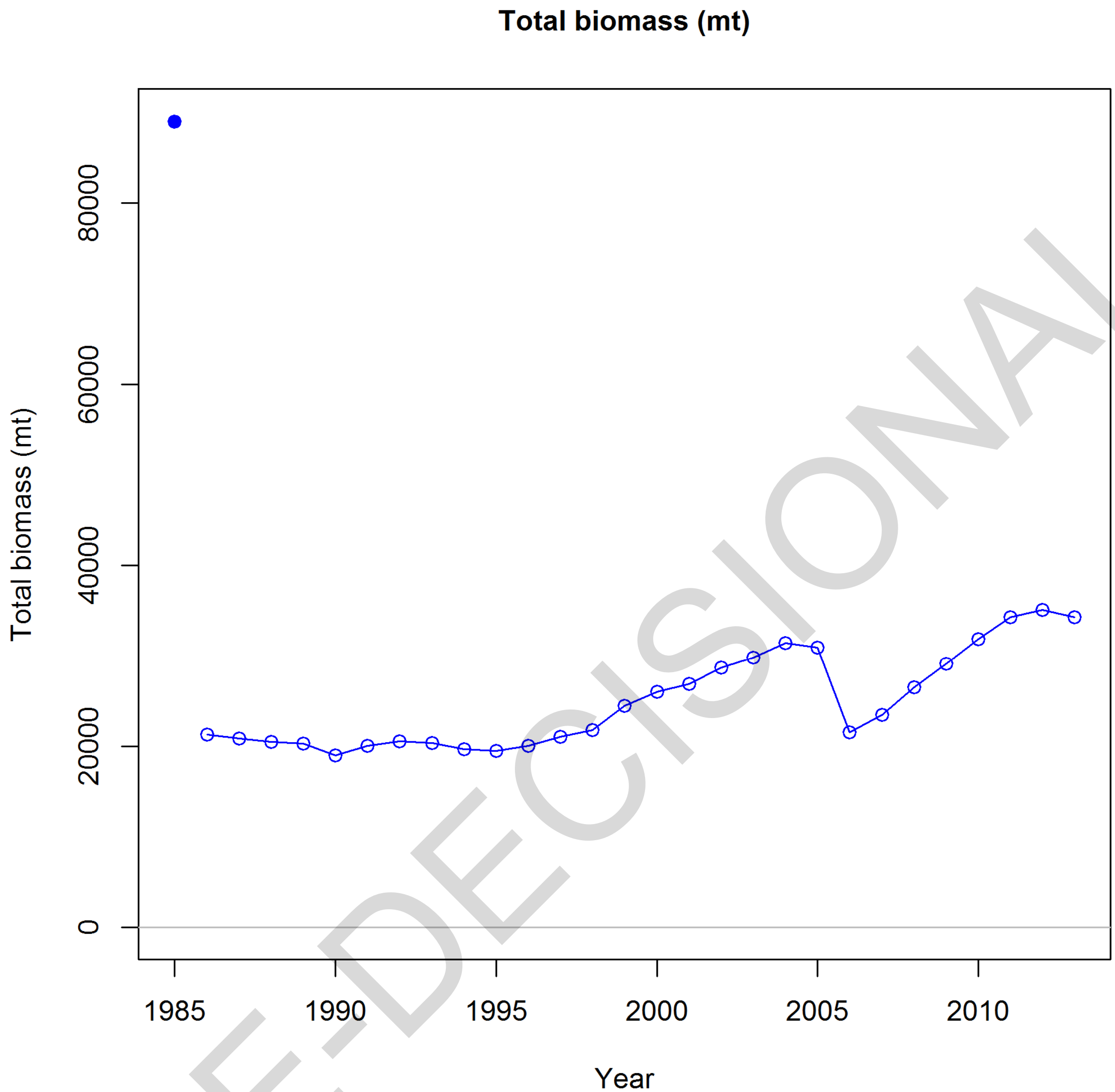


Figure 3.2.60 Predicted total biomass (mt) of Gulf of Mexico Red Grouper from 1986 to 2013

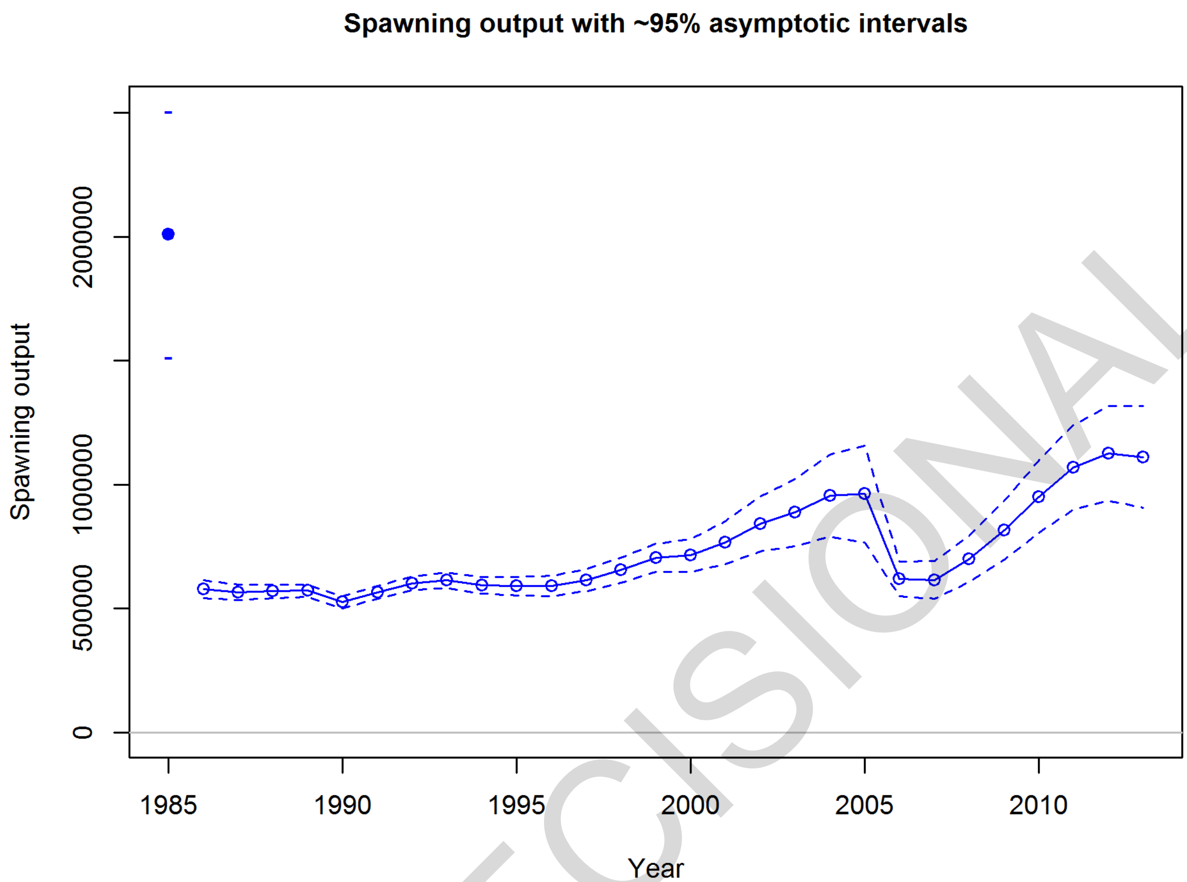


Figure 3.2.61 Predicted spawning output (eggs) with associated 95% asymptotic intervals.

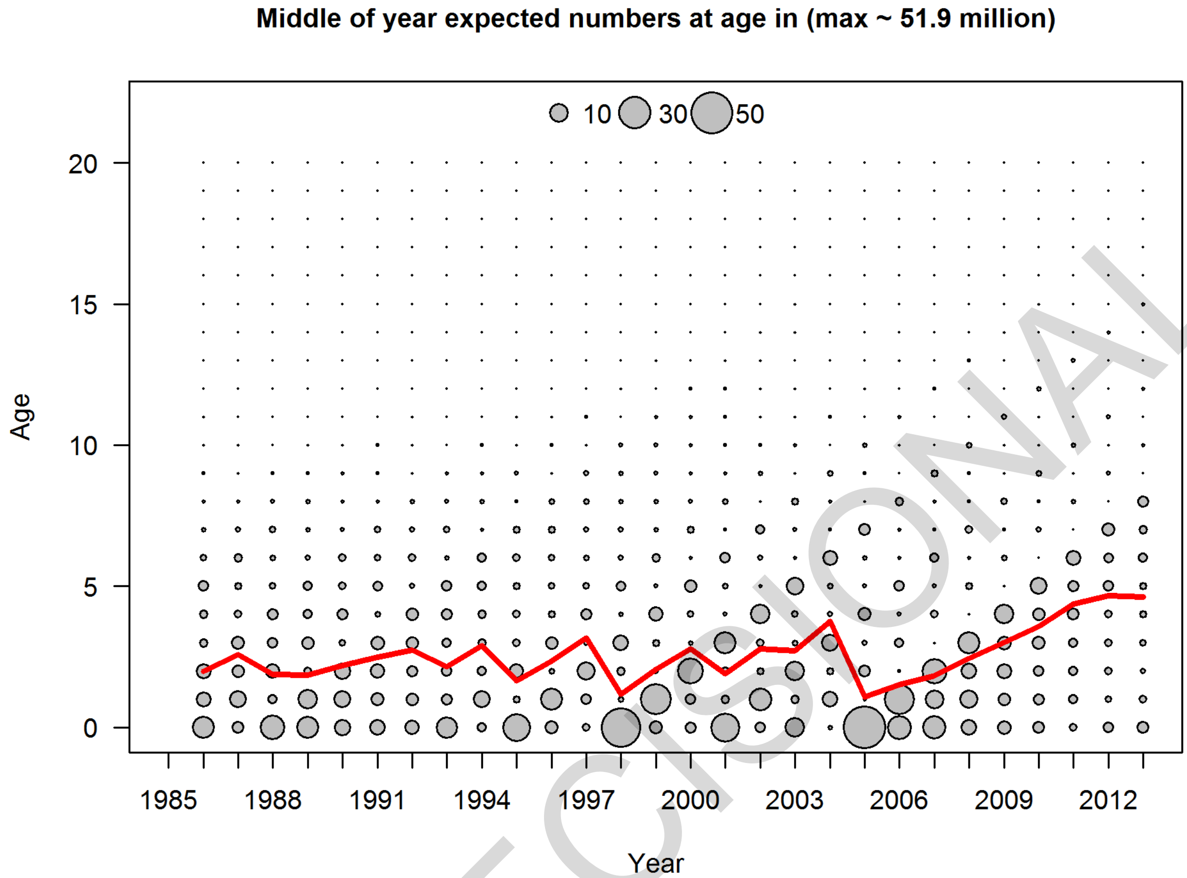


Figure 3.2.62 Predicted numbers-at-age (bubbles) and mean age of Gulf of Mexico Red Grouper.

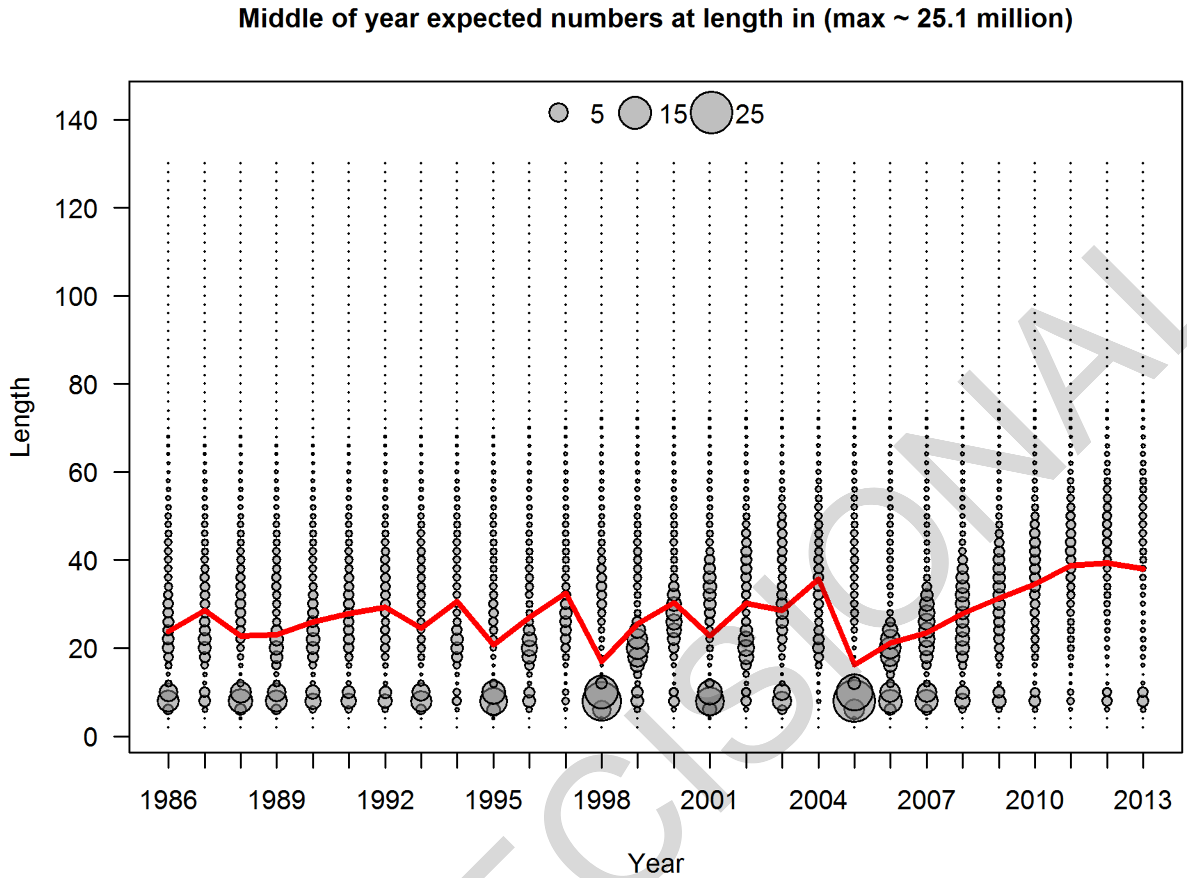


Figure 3.2.63 Predicted numbers-at-length (bubbles) and mean length of Gulf of Mexico Red Grouper.

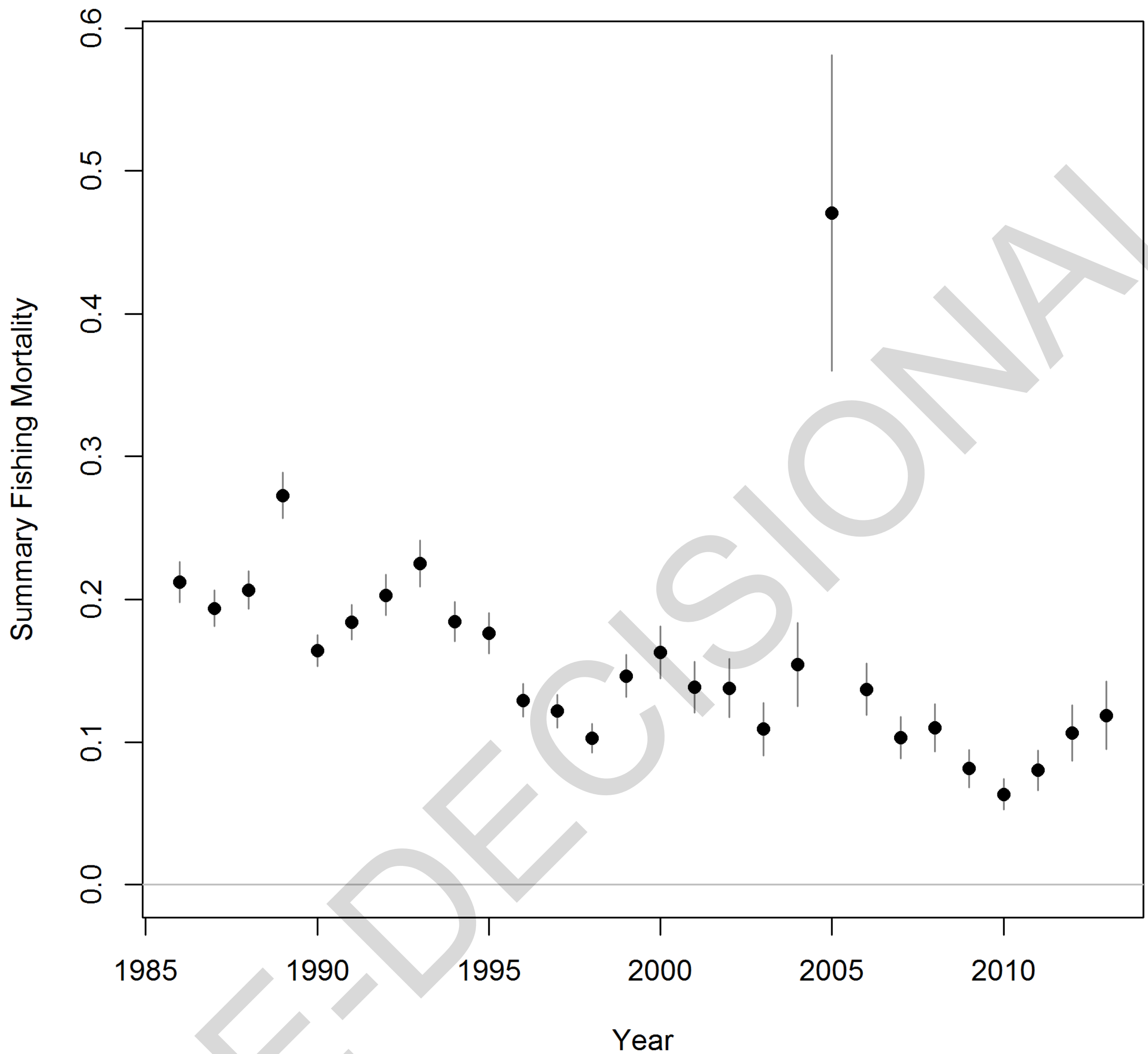


Figure 3.2.64 Predicted annual exploitation rate calculated as the ratio of total annual catch in weight to total biomass in weight. The exceptionally high estimate of exploitation in 2005 is due to the estimation of a red tide mortality term.

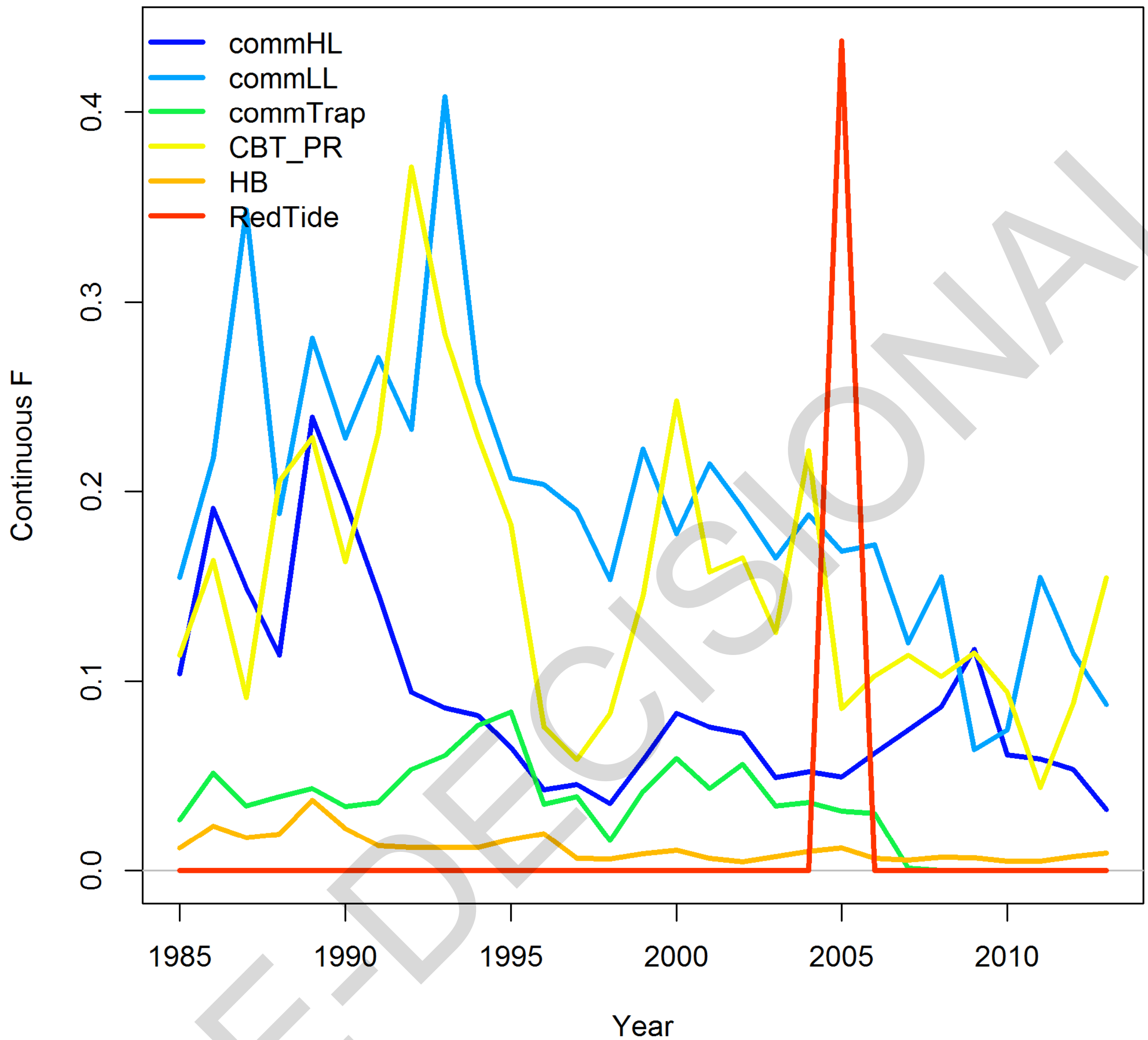


Figure 3.2.65 Predicted fleet specific fishing mortality.

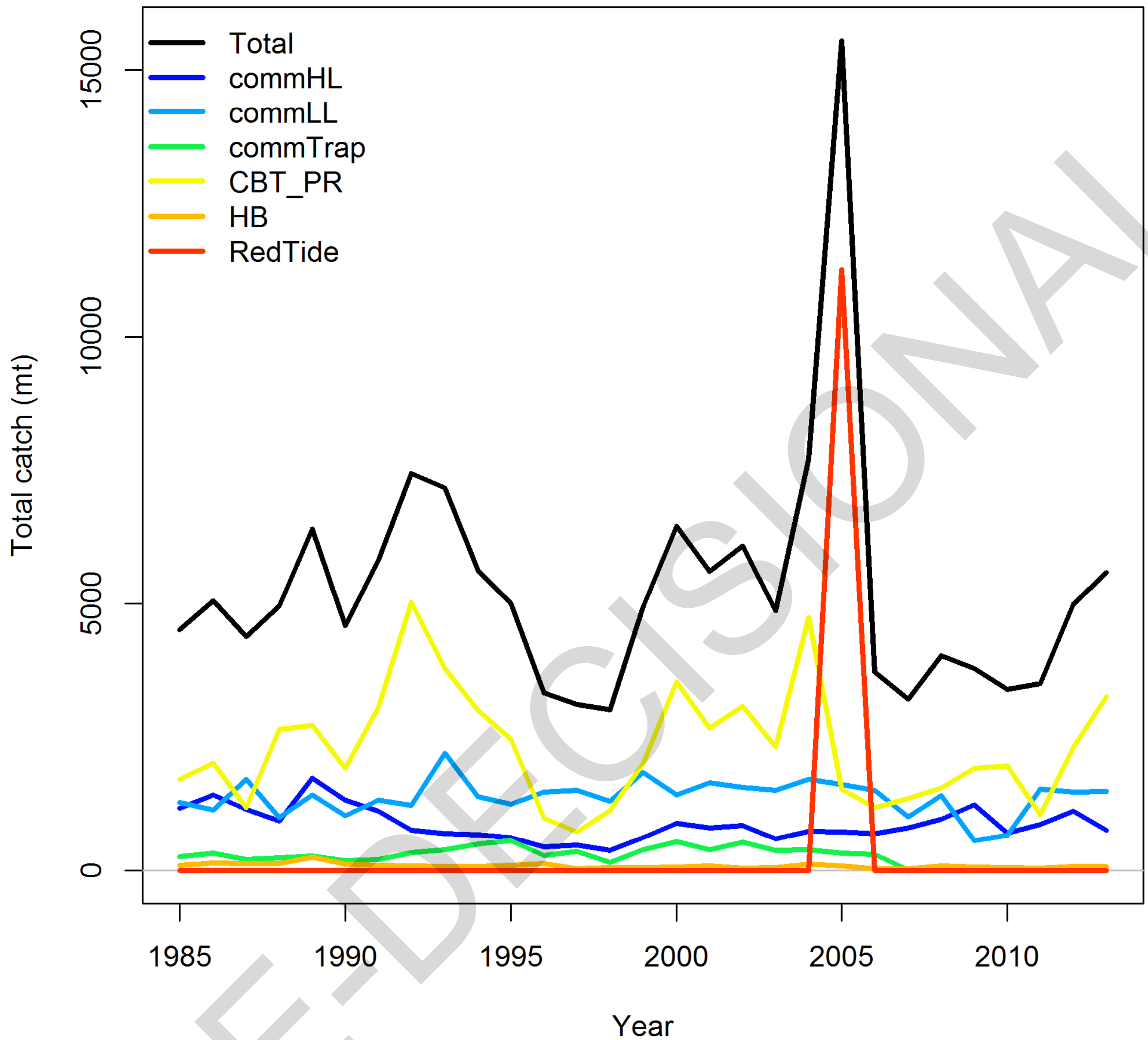


Figure 3.2.66 Fleet specific total catch (landings + discards).

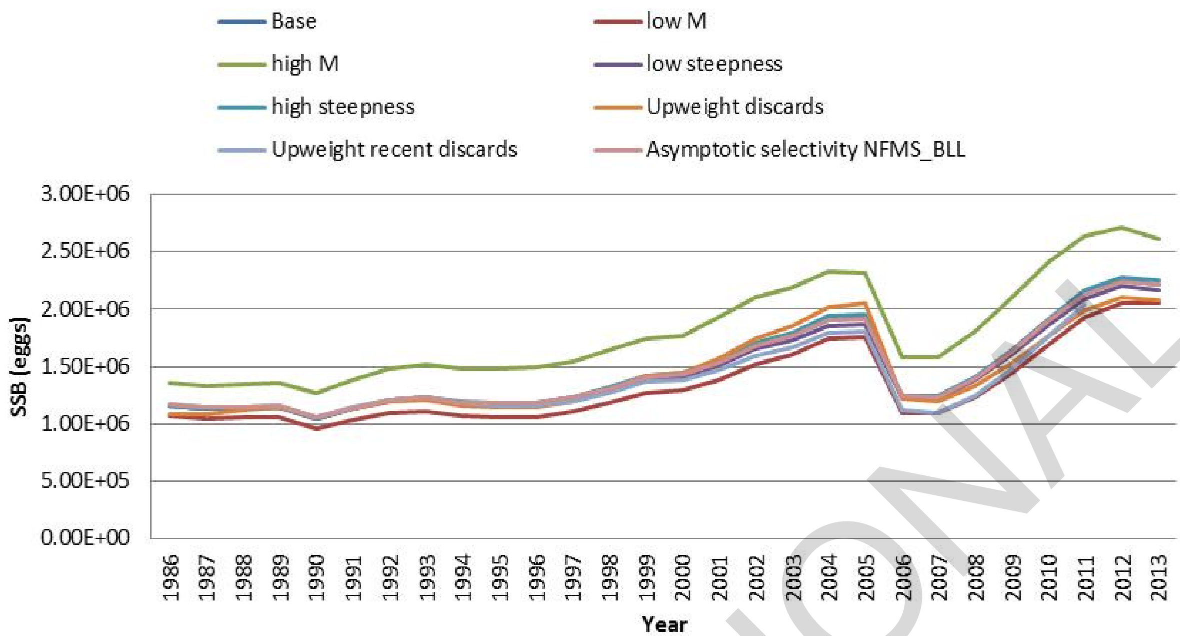


Figure 3.2.67 Estimates of spawning stock biomass (SSB) in eggs from all sensitivity runs.

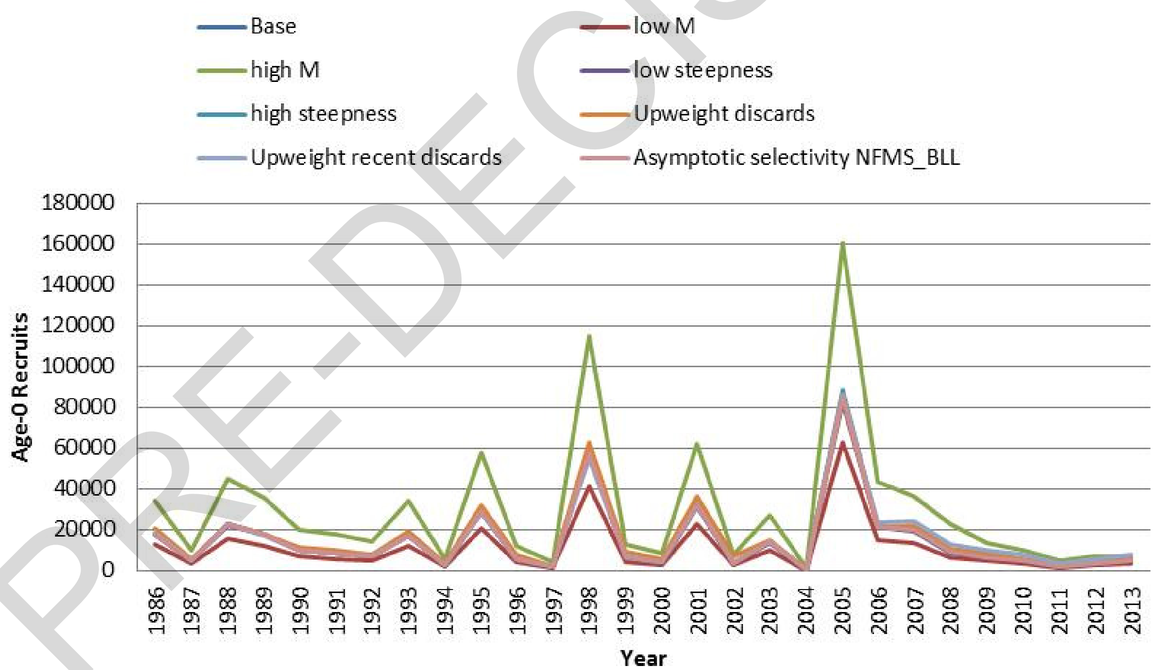


Figure 3.2.68 Estimates of age-0 recruits from all sensitivity runs.

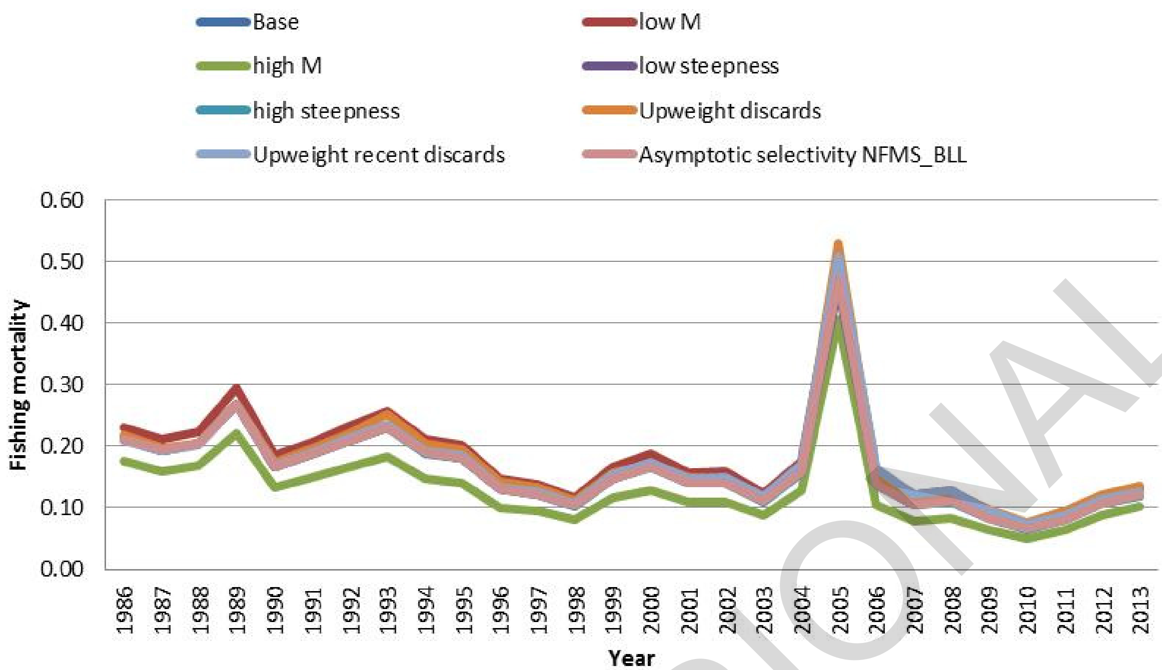


Figure 3.2.69 Estimates of fishing mortality from all sensitivity runs.

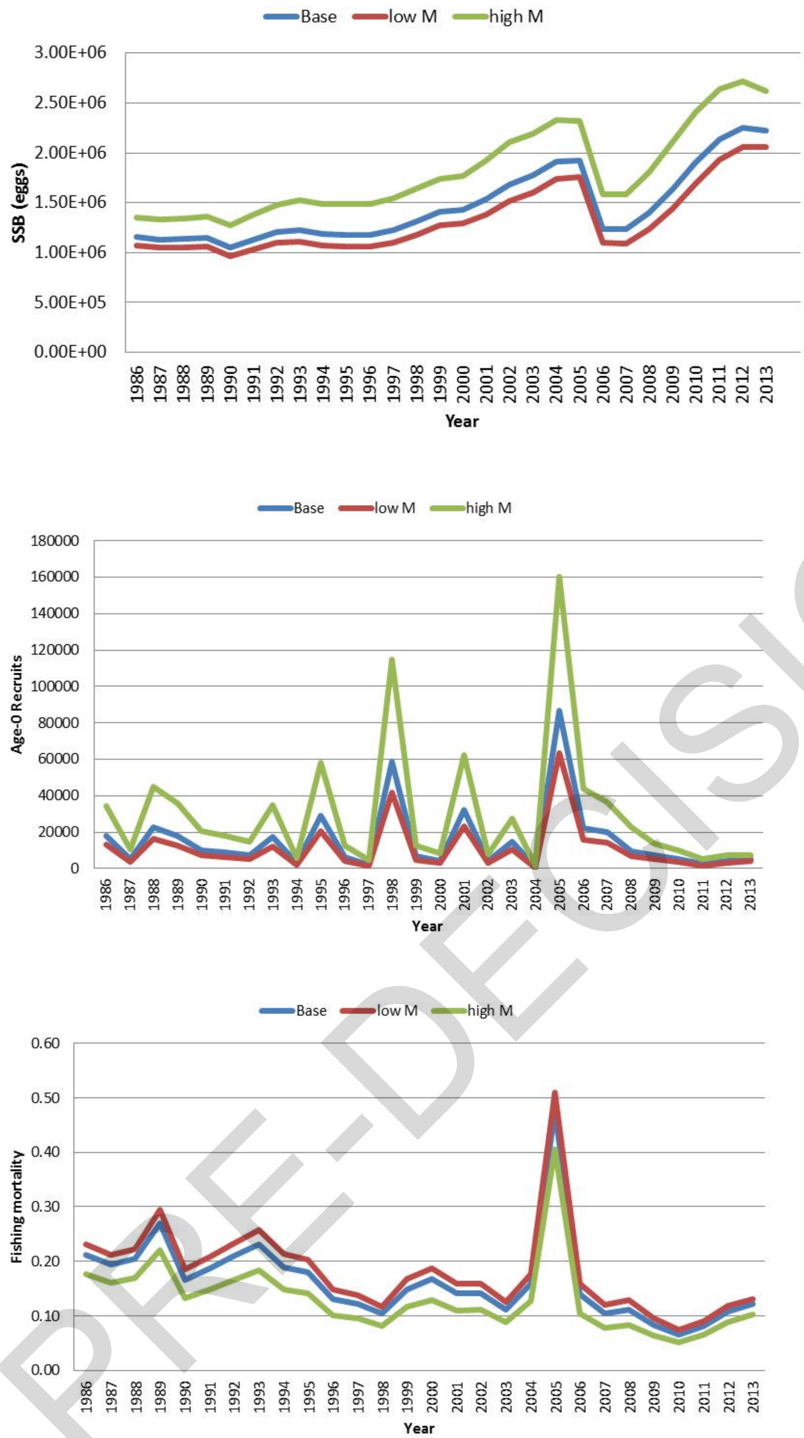


Figure 3.2.70 Estimates of SSB, age-0 recruits, and fishing mortality for the natural mortality sensitivity runs.

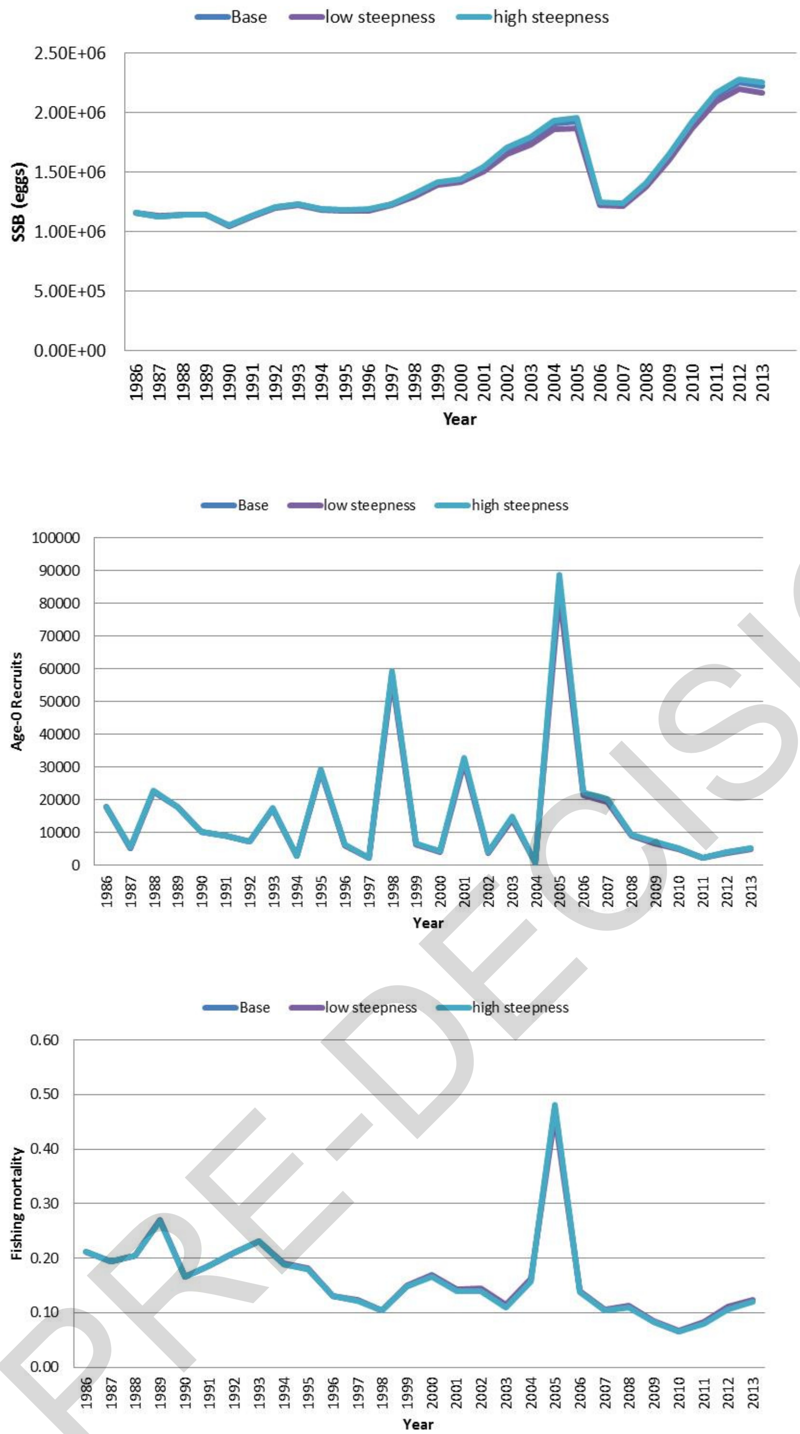


Figure 3.2.71 Estimates of SSB, age-0 recruits, and fishing mortality for the steepness sensitivity runs.

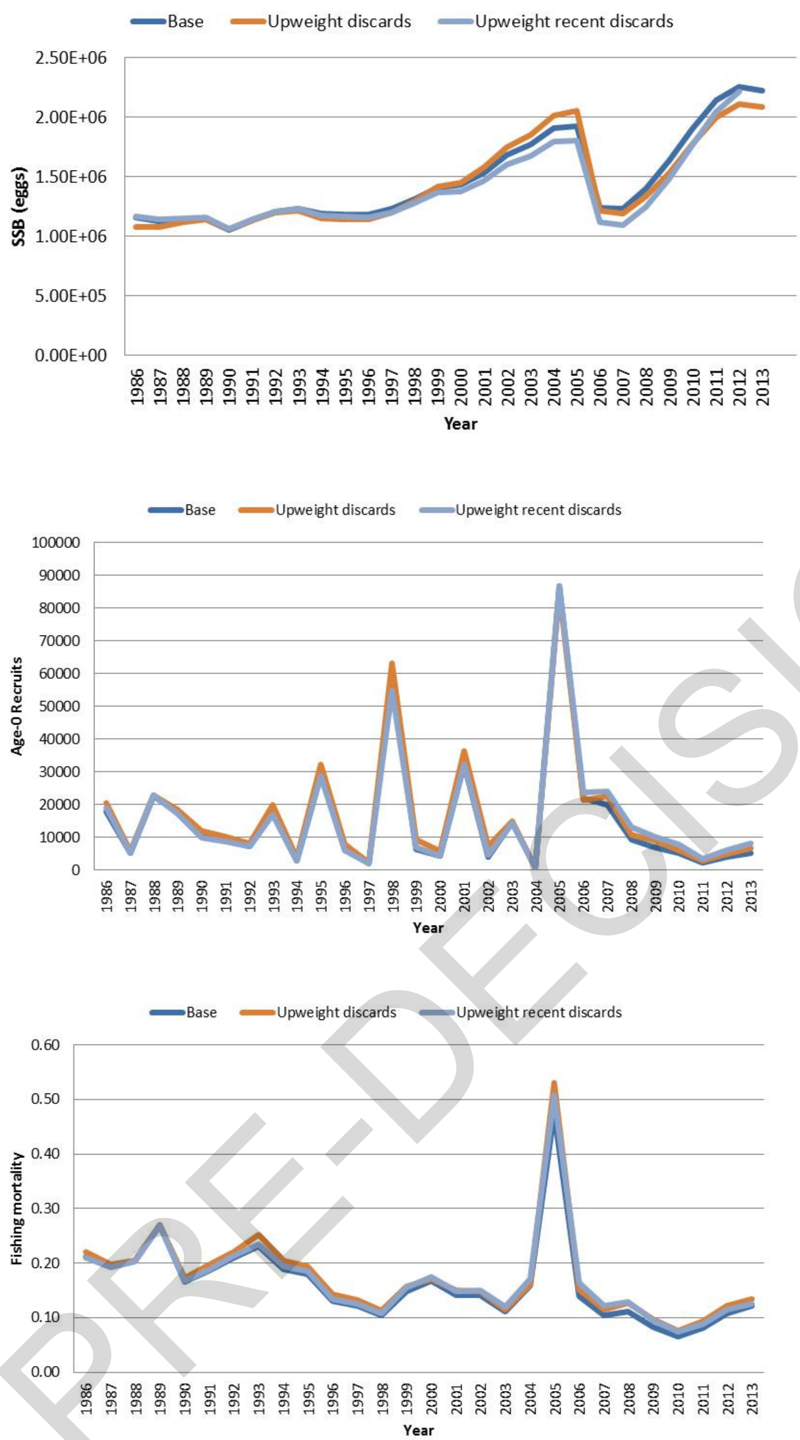


Figure 3.2.72 Estimates of SSB, age-0 recruits, and fishing mortality for the total discard sensitivity runs.

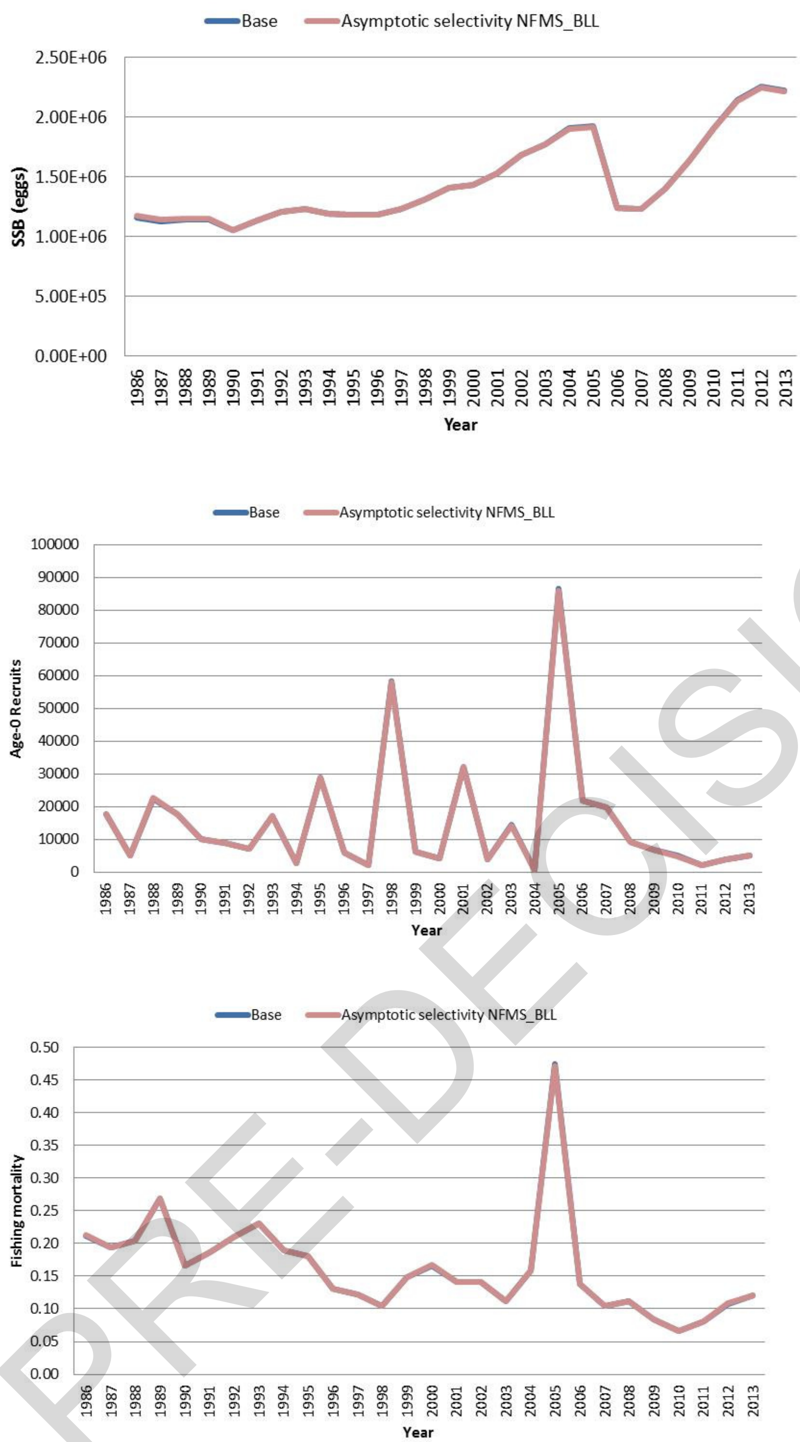


Figure 3.2.73 Estimates of SSB, age-0 recruits, and fishing mortality for the NMFS bottom longline selectivity pattern sensitivity run.

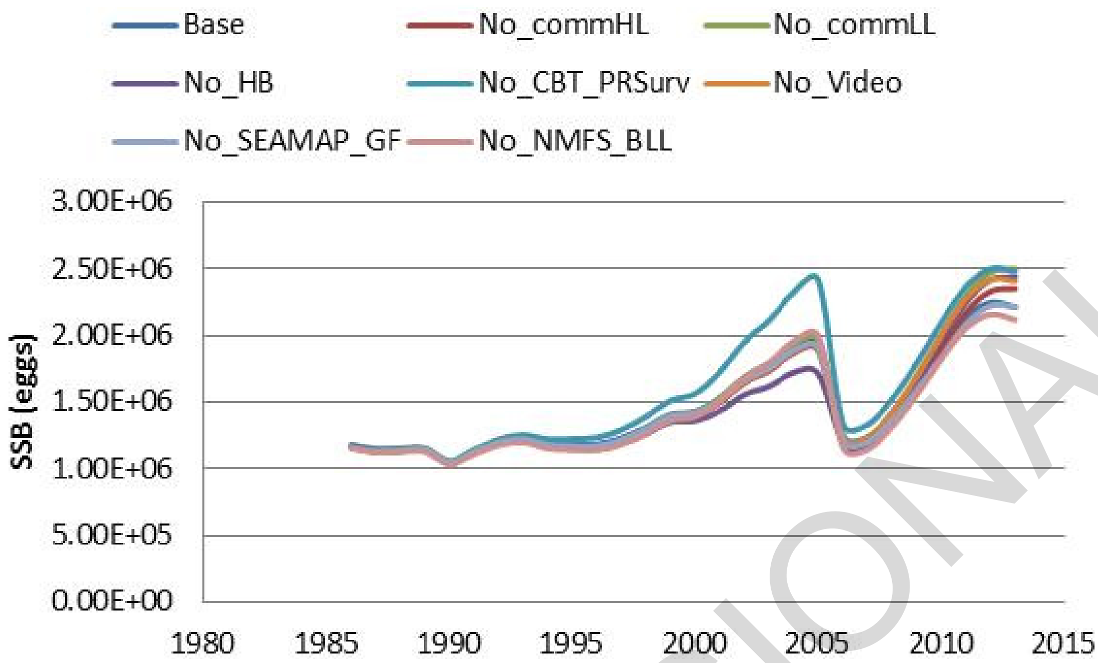


Figure 3.2.74 Estimates of spawning stock biomass (SSB, eggs) from the jack-knife analysis.

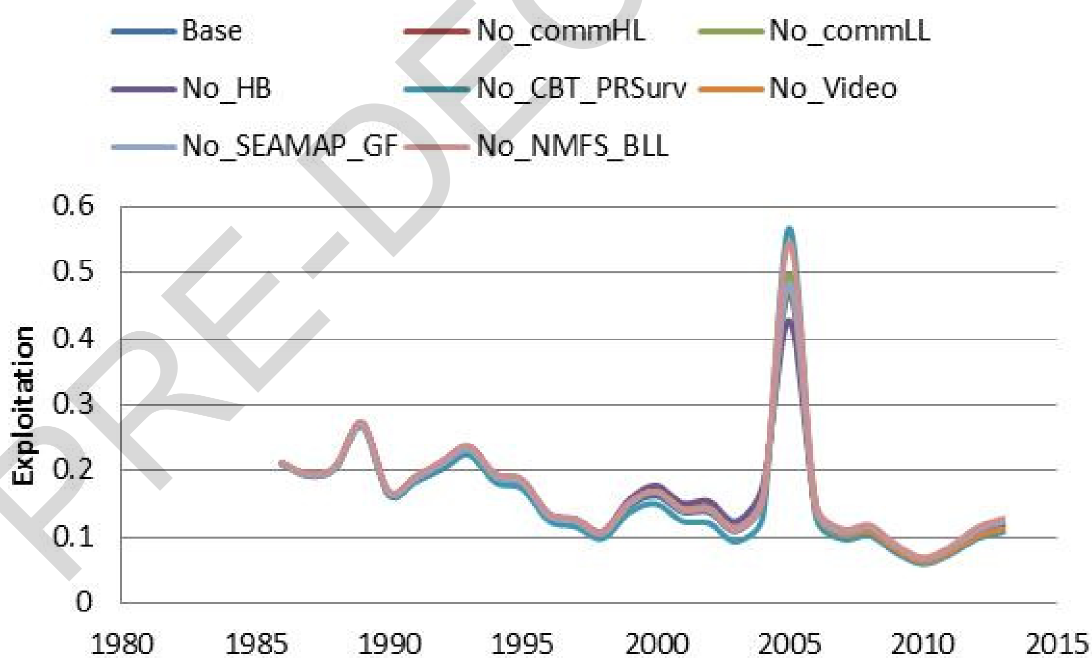


Figure 3.2.75 Estimates of fishing mortality from the jack-knife analysis.

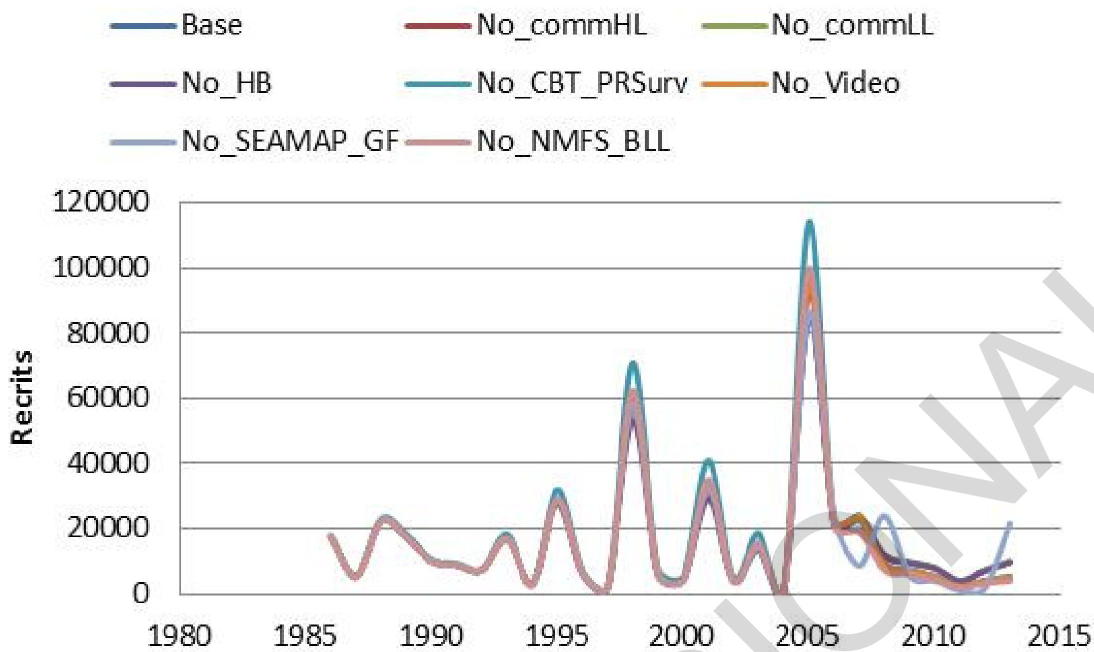


Figure 3.2.76 Estimates of age-0 recruits from the jack-knife analysis.

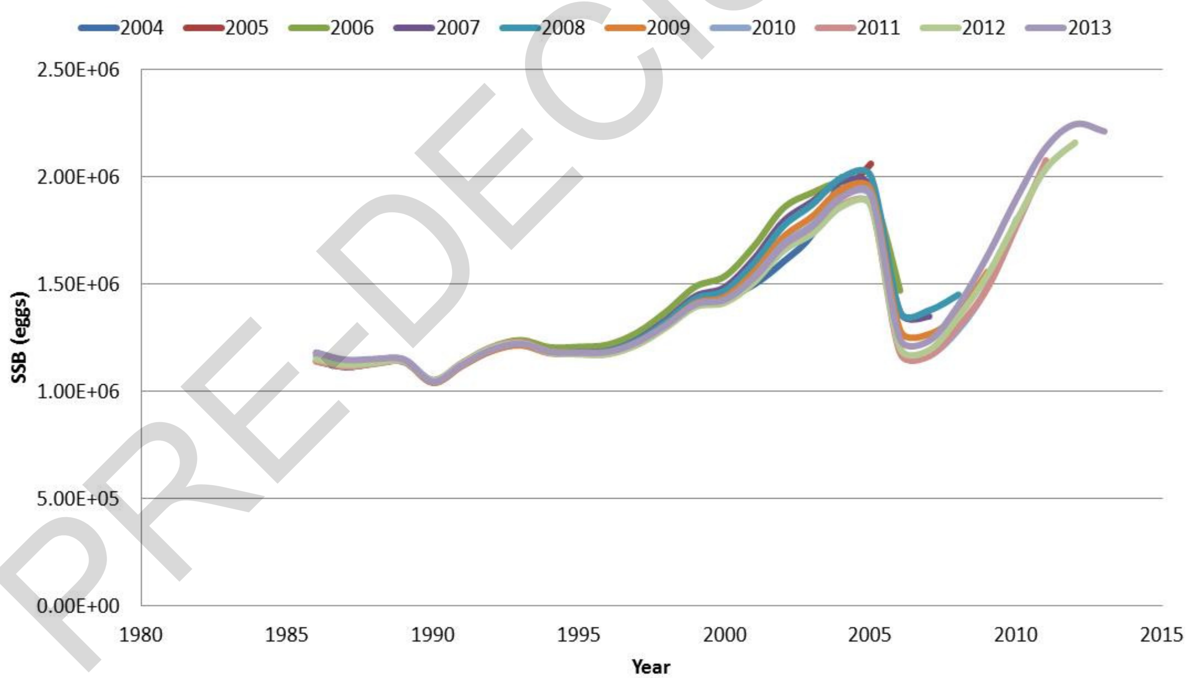


Figure 3.2.77 Estimates of spawning stock biomass (SSB, eggs) from the retrospective analysis.

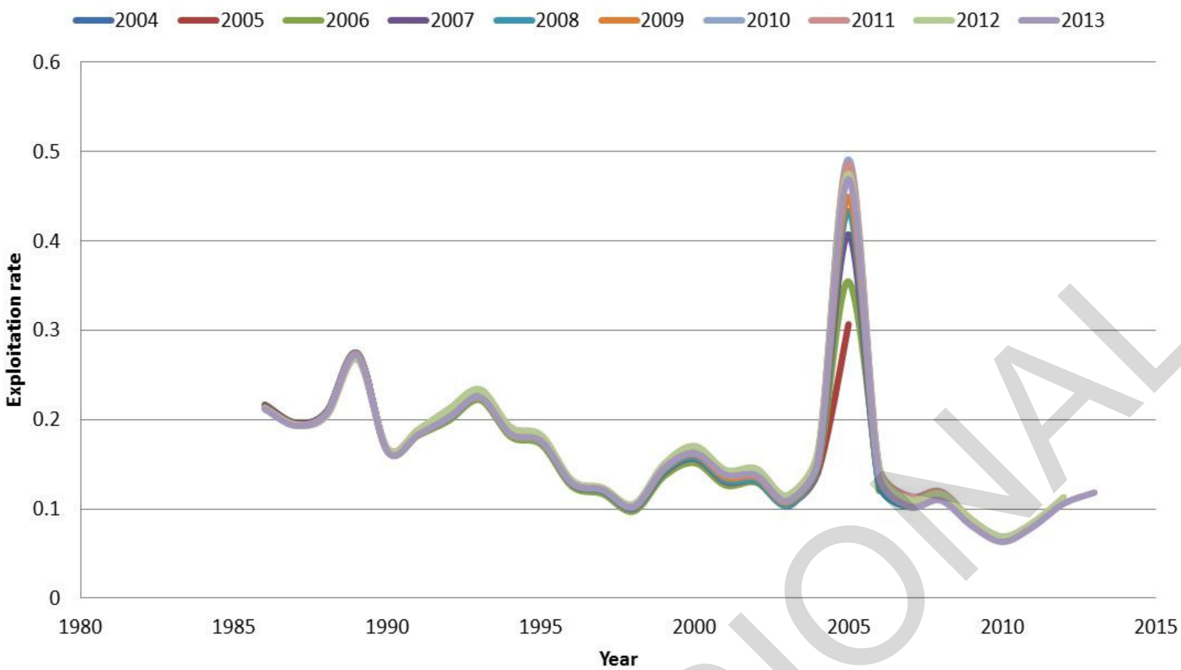


Figure 3.2.78 Estimates of fishing mortality from the retrospective analysis.

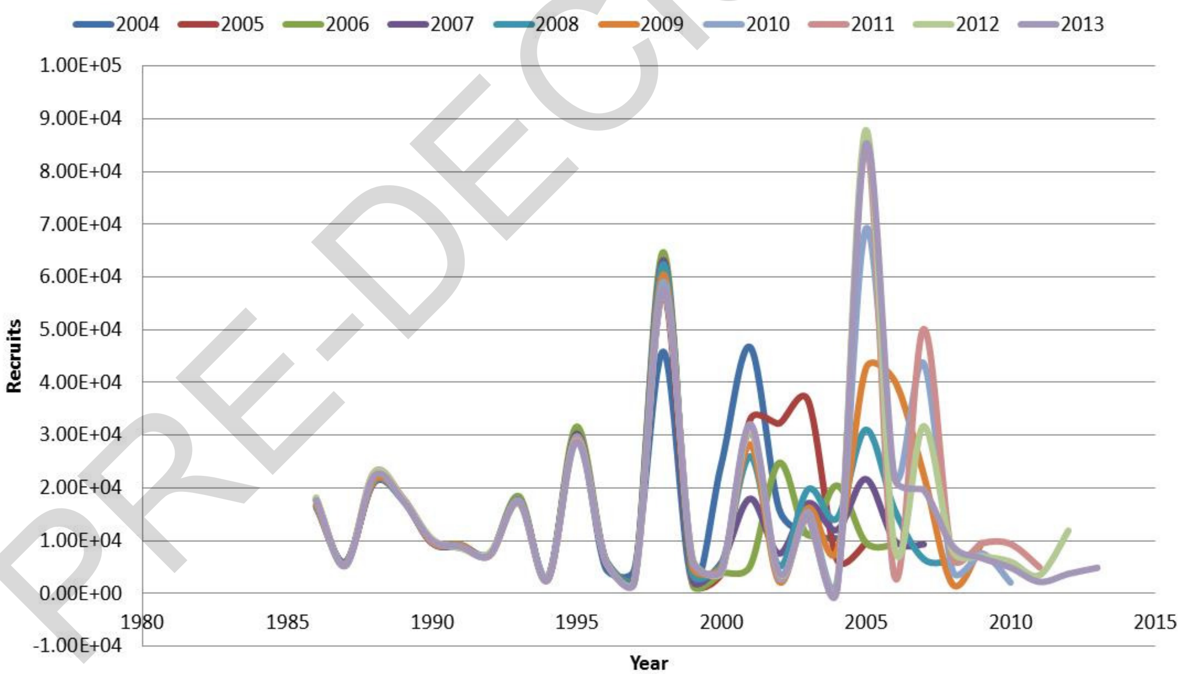


Figure 3.2.79 Estimates of age-0 recruits from the retrospective analysis.

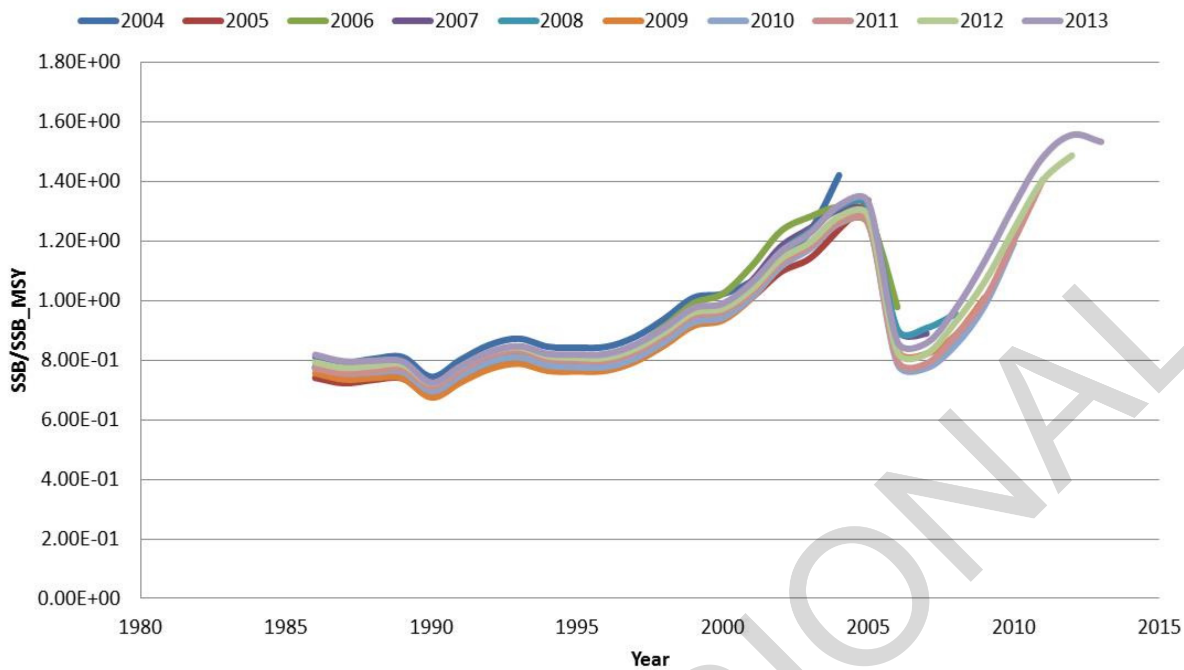


Figure 3.2.80 Estimates of the ratio between spawning stock biomass (SSB) and SSB achieved at MSY (SSB_MSY) from the retrospective analysis.

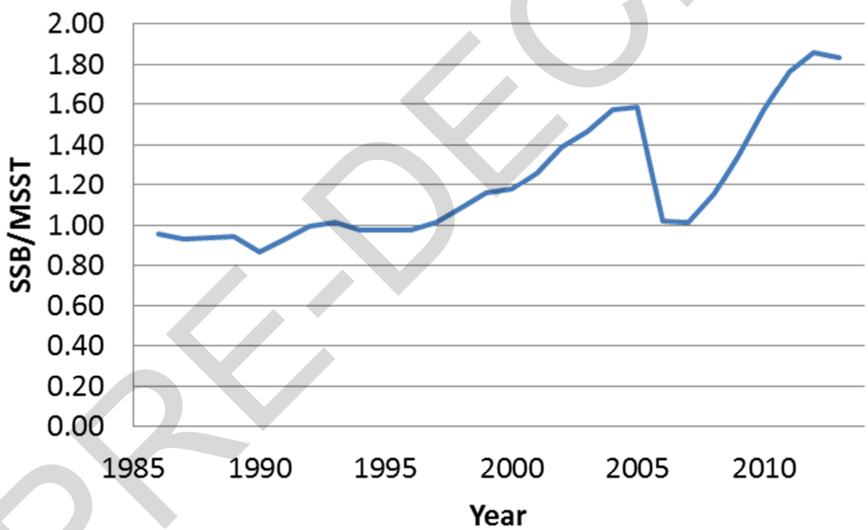


Figure 3.2.81 Stock status with respect to the spawning stock biomass, where the ratio of SSB and the minimum stock stize threshold (MSST) is used to determine whether a population is overfished.

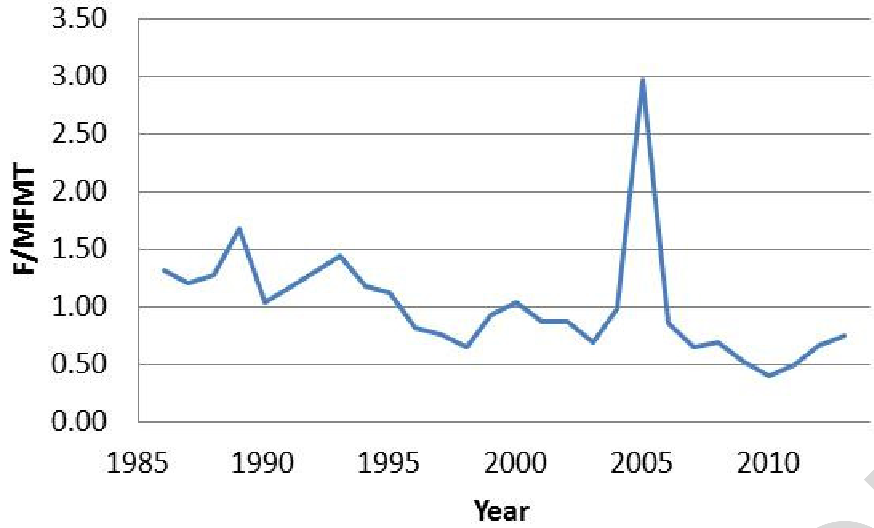


Figure 3.2.82 Stock status with respect to fishing mortality, where the ratio between fishing mortality (F) and the maximum fishing mortlaity threshold (MFMT) is used to determine whether a population is experiencing overfishing.

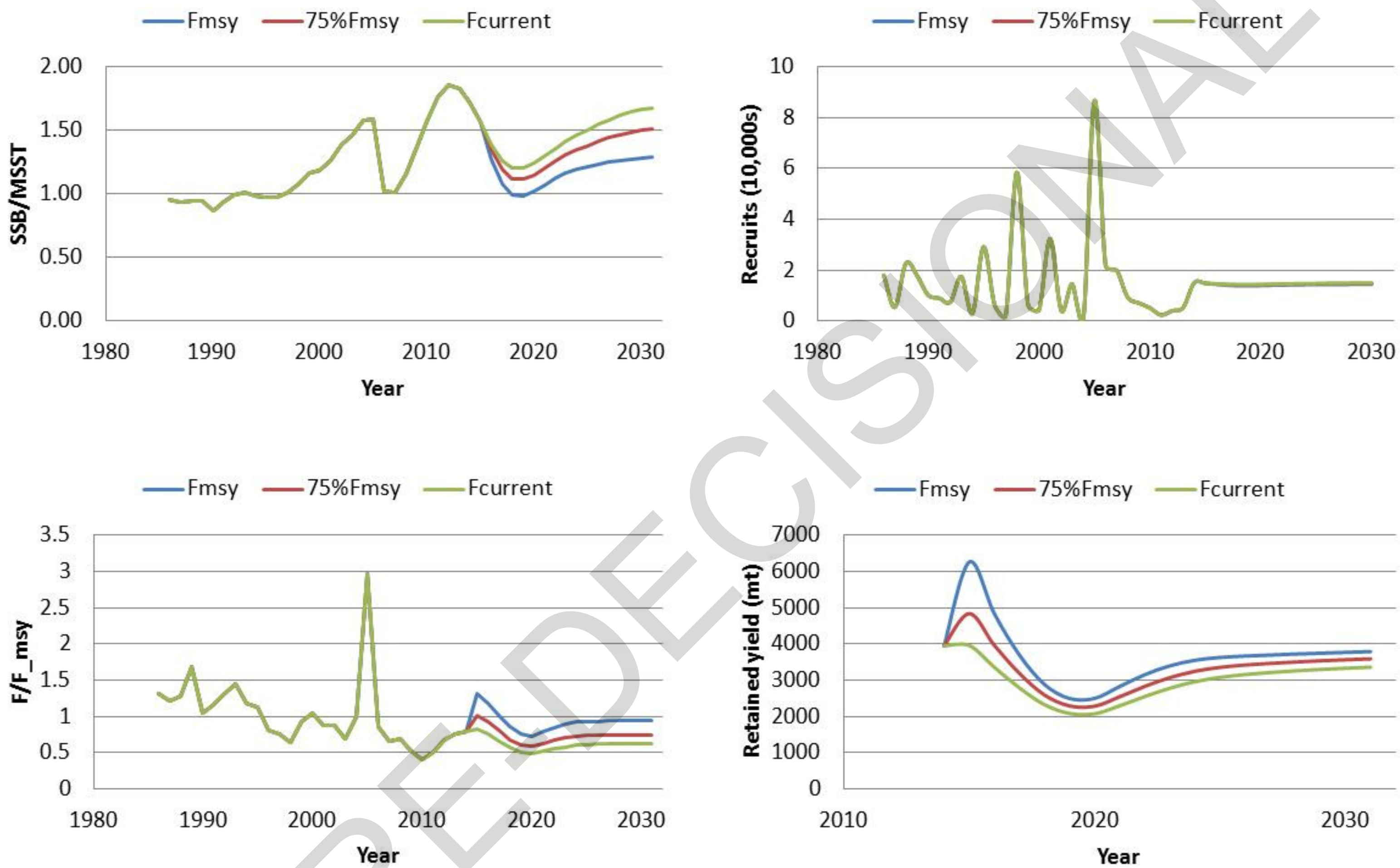


Figure 3.2.83 Projection results, the ratio between reproductive potentional in eggs (SSB) and minimum stock size threshold (MSST, upper left panel), age-0 recruits (upper right panel), the ratio between fishing mortality (F) and Fmsy (lower left panel), and retained yield (lower right panel), for three fishing mortality scenarios: F = Fmsy, F = Foy (75% Fmsy), and F = Fcurrent.

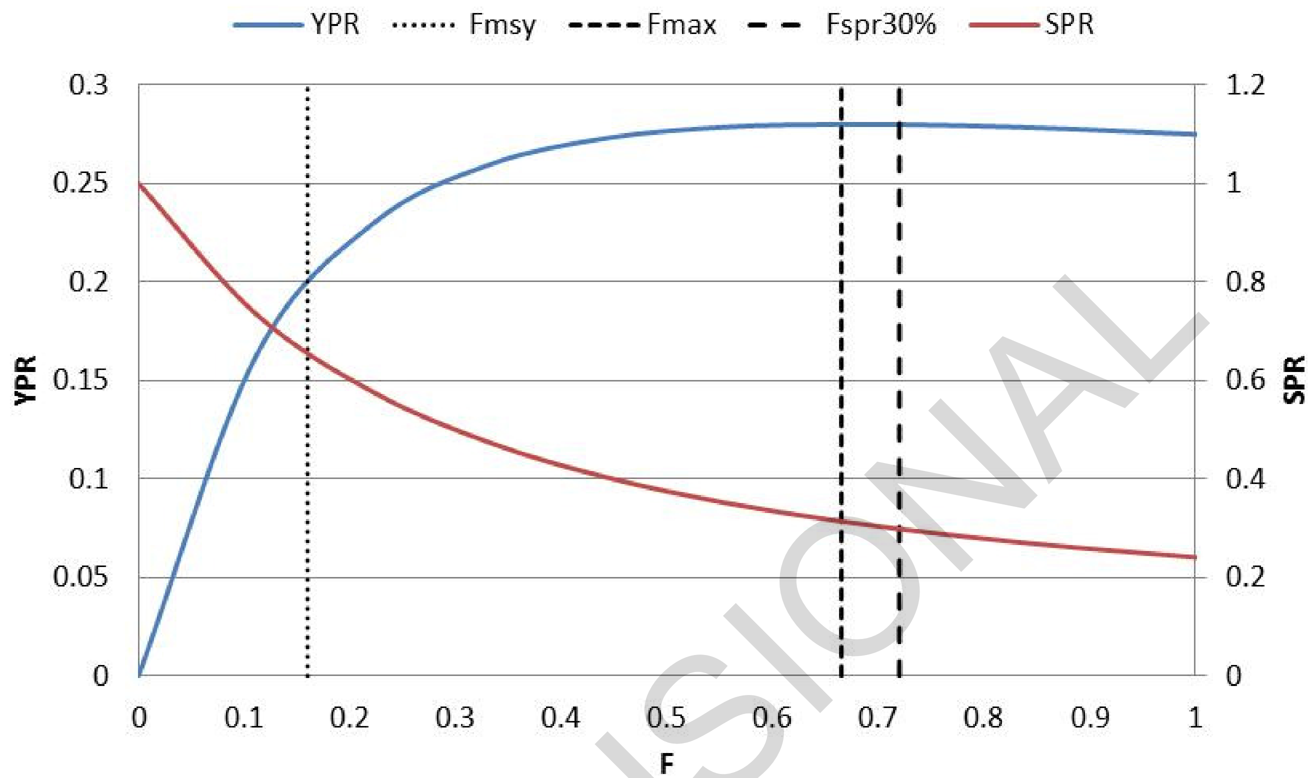


Figure 3.2.84 Yield per recruit (YPR, blue line) and spawner per recruit (SPR, red line) as a function of fishing mortality for SSB-female. Vertical lines represent Fmsy (F = 0.16), Fmax (F = 0.66), and Fspr30% (F = 0.72).

3.8 Appendix

Appendix A. Data file used for the Red Grouper Stock Synthesis model.

#V3.20f

#C this comment will be stored because it starts with #C. It will be written to output files

1986 #_styr

2013 #_endyr

1 #_nseas

12 #_months/season

1 #_spawn_seas

6 #_Nfleet

4 #_Nsurveys

1 #_N_areas

below are the fishery and survey names, separated by a % delimiter; the later the data from first survey will have index number 2 and later survey 2 will have index number3

commHL%commLL%commTrap%CBT_PR%HB%RedTide%SEAMAP_Vid%SEAMAP_GF%NMFS_BLL%CBT_PRSur

-1 -1 -1 -1 -1 -1 0.5 0.5 0.5 0.5 #_surveytiming_in_season; but use -1 for a fishery so that the expected value will be same as the whole season catch-at-age, rather than a midseason sample

1 1 1 1 1 1 1 1 1 1 #_area_assignments_for_each_fishery_and_survey; so in a multi-area setup, each fleet and survey only occurs in one area

1 1 1 2 2 2 #_units_of_Catch_for_each_Fleet:_1=biomass;_2=numbers; It is OK to have some fleets with catch in biomass and some in numbers

0.05 0.05 0.05 0.05 0.05 -1 #_se_of_log(catch) for each fleet. This is used for init_eq_catch_and_for_Fmethod_2_and_3;_do_not_make_this_overly_small. Year specific values can be input in the control file if needed.

1 #_Ngenders: if 2 gendersare used, femaleswill be gender=1 and their data will be enteredfirst

20 #_Nages: this accumulator age should be large enough so that little growth occurs after reaching this age

1168.167 1281.168 258.513 560.36 28.865 0 #_init_equil_catch_for_each_fishery

134 #_N_lines_of_catch_to_read

#_catch_biomass(mtons):_columns_are_fisheries,year,season

Commercial landings are in gutted metric tons

Rec landings are in numbers

1421.948 1136.626 327.249 605.318 32.913 0 1986 1

1153.087 1712.243 203.246 336.508 25.729 0 1987 1

929.465 994.634 245.043 739.254 27.954 0 1988 1

1730.406 1414.392 268.877 751.017 49.777 0 1989 1

1116.269 918.839 154.628 180.334 14.582 0 1990 1

949.749 1171.895 169.529 295.986 9.509 0 1991 1

655.426 1092.953 273.147 471.717 9.049 0 1992 1

589.817 1938.815 322.543 359.095 8.802 0 1993 1

563.102 1224.284 414.504 311.441 9.617 0 1994 1

531.27 1101.965 479.444 285.734 14.499 0 1995 1

392.427 1318.679 244.649 109.879 15.594 0 1996 1

430.178 1371.747 311.088 77.233 4.676 0 1997 1

336.39 1207.755 134.966 108.91 4.382 0.001 1998 1

550.097 1730.638 341.019 195.205 6.918 0.001 1999 1

780.627 1319.655 464.846 366.937 8.861 0.001 2000 1

705.66	1542.048	337.15	237.09	5.56	0.001	2001	1
738.529	1419.999	444.653	267.88	4.402	0.001	2002	1
507.236	1344.782	318.271	218.029	7.521	0.001	2003	1
624.44	1534.715	338.021	529.891	13.81	0.001	2004	1
636.955	1456.744	277.924	183.664	13.967	0.001	2005	1
624.002	1366.521	266.189	131.509	4.63	0.001	2006	1
708.094	900.102	11.102	154.741	4.245	0.001	2007	1
856.484	1271.938	0	133.129	5.003	0.001	2008	1
1109.097	510.213	0	124.559	4.666	0.001	2009	1
614.033	596.212	0	156.087	4.952	0.001	2010	1
765.79	1381.228	0.007	110.909	7.387	0.001	2011	1
1011.3	1333.59	0	300.283	13.544	0.001	2012	1
698.756	1368.763	0	440.387	14.089	0.001	2013	1

139 #_N_cpue_and_surveyabundance_observations

#_Units: 0=numbers; 1=biomass;

#_Errtype: -1=normal; 0=lognormal;

#_Fleet	Units	Errtype		
1	1	0	#	commHL_1
2	1	0	#	commLL_2
3	1	0	#	commTRAP_3
4	0	0	#	CBT_PR_4
5	0	0	#	HB_5
6	2	0	#	RedTide
7	0	0	#	SEAMAP_Vid_7
8	0	0	#	SEAMAP_GF_8

9 0 0 # NMFS_BLL_9

10 0 0 # CBT_PRSurv

#_year seas index obs err # Label #

1993 1 1 0.7311 0.30939 # commHL_1 #

1994 1 1 0.716 0.30573 # commHL_1 #

1995 1 1 0.7886 0.30929 # commHL_1 #

1996 1 1 0.4907 0.31794 # commHL_1 #

1997 1 1 0.5647 0.31855 # commHL_1 #

1998 1 1 0.5185 0.31722 # commHL_1 #

1999 1 1 0.7399 0.31112 # commHL_1 #

2000 1 1 0.9911 0.3038 # commHL_1 #

2001 1 1 1.347 0.29536 # commHL_1 #

2002 1 1 1.3871 0.29495 # commHL_1 #

2003 1 1 0.9471 0.29078 # commHL_1 #

2004 1 1 1.274 0.2858 # commHL_1 #

2005 1 1 1.4169 0.28763 # commHL_1 #

2006 1 1 1.1435 0.29109 # commHL_1 #

2007 1 1 1.2066 0.28824 # commHL_1 #

2008 1 1 1.5309 0.28671 # commHL_1 #

2009 1 1 1.2061 0.28641 # commHL_1 #

1993 1 2 0.9785 0.33218 # commLL_2 #

1994 1 2 0.7235 0.2943 # commLL_2 #

1995 1 2 0.7742 0.30486 # commLL_2 #

1996 1 2 1.0397 0.31852 # commLL_2 #

1997 1 2 0.9069 0.26574 # commLL_2 #

1998	1	2	0.9552	0.27381	#	commLL_2	#
1999	1	2	0.9968	0.27195	#	commLL_2	#
2000	1	2	0.898	0.28871	#	commLL_2	#
2001	1	2	1.0563	0.27754	#	commLL_2	#
2002	1	2	1.06	0.29244	#	commLL_2	#
2003	1	2	0.9284	0.28126	#	commLL_2	#
2004	1	2	1.1124	0.27319	#	commLL_2	#
2005	1	2	1.4437	0.28251	#	commLL_2	#
2006	1	2	1.0927	0.27009	#	commLL_2	#
2007	1	2	0.7796	0.31169	#	commLL_2	#
2008	1	2	1.1811	0.30796	#	commLL_2	#
2009	1	2	1.0731	0.45325	#	commLL_2	#
1986	1	5	1.0334	0.31493	#	HB_5	#
1987	1	5	1.6494	0.285	#	HB_5	#
1988	1	5	1.6056	0.27997	#	HB_5	#
1989	1	5	1.5487	0.28973	#	HB_5	#
1990	1	5	0.699	0.32704	#	HB_5	#
1991	1	5	0.4941	0.34598	#	HB_5	#
1992	1	5	0.4723	0.34554	#	HB_5	#
1993	1	5	0.6343	0.318	#	HB_5	#
1994	1	5	0.5523	0.32777	#	HB_5	#
1995	1	5	0.8352	0.30809	#	HB_5	#
1996	1	5	0.4933	0.33475	#	HB_5	#
1997	1	5	0.475	0.33612	#	HB_5	#
1998	1	5	0.5671	0.33016	#	HB_5	#

1999	1	5	0.4741	0.33421	#	HB_5	#
2000	1	5	0.5944	0.32977	#	HB_5	#
2001	1	5	0.8726	0.30414	#	HB_5	#
2002	1	5	0.8929	0.29716	#	HB_5	#
2003	1	5	1.4145	0.25883	#	HB_5	#
2004	1	5	2.1247	0.24276	#	HB_5	#
2005	1	5	2.3719	0.23998	#	HB_5	#
2006	1	5	0.8687	0.30585	#	HB_5	#
2007	1	5	0.9534	0.29305	#	HB_5	#
2008	1	5	0.88	0.29652	#	HB_5	#
2009	1	5	0.68	0.30492	#	HB_5	#
2010	1	5	1.1157	0.27357	#	HB_5	#
2011	1	5	1.0953	0.26137	#	HB_5	#
2012	1	5	1.4104	0.24726	#	HB_5	#
2013	1	5	1.1915	0.26752	#	HB_5	#
1998	1	6	0.0001	0.01	#	REDTIDE	
1999	1	6	0.0001	0.01	#	REDTIDE	
2000	1	6	0.0001	0.01	#	REDTIDE	
2001	1	6	0.0001	0.01	#	REDTIDE	
2002	1	6	0.0001	0.01	#	REDTIDE	
2003	1	6	0.0001	0.01	#	REDTIDE	
2004	1	6	0.0001	0.01	#	REDTIDE	
2005	1	6	1	0.01	#	REDTIDE	
2006	1	6	0.0001	0.01	#	REDTIDE	
2007	1	6	0.0001	0.01	#	REDTIDE	

2008 1 6 0.0001 0.01 # REDTIDE

2009 1 6 0.0001 0.01 # REDTIDE

2010 1 6 0.0001 0.01 # REDTIDE

2011 1 6 0.0001 0.01 # REDTIDE

2012 1 6 0.0001 0.01 # REDTIDE

2013 1 6 0.0001 0.01 # REDTIDE

1993 1 7 0.766 0.47365 # SEAMAP_Vid_7 #

1994 1 7 1.0119 0.48119 # SEAMAP_Vid_7 #

1995 1 7 1.0444 0.54786 # SEAMAP_Vid_7 #

1996 1 7 0.9761 0.39249 # SEAMAP_Vid_7 #

1997 1 7 1.1872 0.30205 # SEAMAP_Vid_7 #

2002 1 7 1.1571 0.31364 # SEAMAP_Vid_7 #

2004 1 7 1.3156 0.28379 # SEAMAP_Vid_7 #

2005 1 7 1.0877 0.23451 # SEAMAP_Vid_7 #

2006 1 7 0.9176 0.23538 # SEAMAP_Vid_7 #

2007 1 7 0.5652 0.32814 # SEAMAP_Vid_7 #

2008 1 7 0.6947 0.27886 # SEAMAP_Vid_7 #

2009 1 7 0.8743 0.20987 # SEAMAP_Vid_7 #

2010 1 7 1.1093 0.1832 # SEAMAP_Vid_7 #

2011 1 7 1.2464 0.14668 # SEAMAP_Vid_7 #

2012 1 7 1.0255 0.17392 # SEAMAP_Vid_7 #

2013 1 7 1.0211 0.2148 # SEAMAP_Vid_7 #

2009 1 8 1.4703 0.29223 # SEAMAP_GF_8 #

2010 1 8 0.9486 0.2983 # SEAMAP_GF_8 #

2011 1 8 0.9334 0.31917 # SEAMAP_GF_8 #

2012	1	8	0.9518	0.27765	#	SEAMAP_GF_8	#
2013	1	8	0.6959	0.31266	#	SEAMAP_GF_8	#
2001	1	9	0.6445	0.29973	#	NMFS_BLL_9	#
2003	1	9	0.8907	0.20933	#	NMFS_BLL_9	#
2004	1	9	1.4493	0.19919	#	NMFS_BLL_9	#
2005	1	9	0.5438	0.40675	#	NMFS_BLL_9	#
2006	1	9	0.4974	0.39368	#	NMFS_BLL_9	#
2007	1	9	0.77	0.4612	#	NMFS_BLL_9	#
2008	1	9	0.5298	0.32732	#	NMFS_BLL_9	#
2009	1	9	0.818	0.27036	#	NMFS_BLL_9	#
2010	1	9	1.1009	0.27141	#	NMFS_BLL_9	#
2011	1	9	2.0208	0.18801	#	NMFS_BLL_9	#
2012	1	9	1.8742	0.26158	#	NMFS_BLL_9	#
2013	1	9	0.8606	0.31143	#	NMFS_BLL_9	#
1986	1	10	1.0925	0.25451	#	CBT_PRSurv_10	#
1987	1	10	0.8681	0.3013	#	CBT_PRSurv_10	#
1988	1	10	1.1339	0.33987	#	CBT_PRSurv_10	#
1989	1	10	1.3293	0.294	#	CBT_PRSurv_10	#
1990	1	10	1.5569	0.26209	#	CBT_PRSurv_10	#
1991	1	10	1.4756	0.33192	#	CBT_PRSurv_10	#
1992	1	10	1.2438	0.28789	#	CBT_PRSurv_10	#
1993	1	10	0.7682	0.33867	#	CBT_PRSurv_10	#
1994	1	10	0.8707	0.31888	#	CBT_PRSurv_10	#
1995	1	10	0.8627	0.31407	#	CBT_PRSurv_10	#
1996	1	10	0.5555	0.36974	#	CBT_PRSurv_10	#

1997 1 10 0.5467 0.37584 # CBT_PRSurv_10 #

1998 1 10 0.6533 0.33136 # CBT_PRSurv_10 #

1999 1 10 0.735 0.3124 # CBT_PRSurv_10 #

2000 1 10 0.8305 0.30473 # CBT_PRSurv_10 #

2001 1 10 0.6524 0.31074 # CBT_PRSurv_10 #

2002 1 10 0.7901 0.30343 # CBT_PRSurv_10 #

2003 1 10 0.9794 0.29058 # CBT_PRSurv_10 #

2004 1 10 1.2459 0.2546 # CBT_PRSurv_10 #

2005 1 10 0.8296 0.28669 # CBT_PRSurv_10 #

2006 1 10 0.4391 0.36253 # CBT_PRSurv_10 #

2007 1 10 0.6953 0.3075 # CBT_PRSurv_10 #

2008 1 10 1.1731 0.25784 # CBT_PRSurv_10 #

2009 1 10 1.5401 0.24831 # CBT_PRSurv_10 #

2010 1 10 1.1744 0.25516 # CBT_PRSurv_10 #

2011 1 10 1.3397 0.25358 # CBT_PRSurv_10 #

2012 1 10 1.1216 0.25377 # CBT_PRSurv_10 #

2013 1 10 1.4966 0.278 # CBT_PRSurv_10 #

#_discard_units (1=same_as_catchunits(bio/num); 2=fraction; 3=numbers)

#_discard_errtype: >0 for DF of T-dist(read CV below); normal with CV; -1 for normal with se; -2 for lognormal

#_Fleet units errtype

1 3 -2 # commHL_1

2 3 -2 # commLL_2

3 3 -2 # commTRAP_3

4 3 -2 # CBT_PR_4

5 3 -2 # HB_5

6 1 -2 # RedTide_6

125 #_N_discard_obs

#_year	seas	fleet	obs	err		
1993	1	1	510.27	0.9	#	commHL_1
1994	1	1	487.56	0.9	#	commHL_1
1995	1	1	459.26	0.9	#	commHL_1
1996	1	1	338.62	0.9	#	commHL_1
1997	1	1	370.7	0.9	#	commHL_1
1998	1	1	290.81	0.9	#	commHL_1
2000	1	1	674.09	0.9	#	commHL_1
2001	1	1	728.26	0.9	#	commHL_1
2002	1	1	853.13	0.9	#	commHL_1
2003	1	1	549.73	0.9	#	commHL_1
2004	1	1	709.34	0.9	#	commHL_1
2005	1	1	829.35	0.9	#	commHL_1
2006	1	1	612.75	0.9	#	commHL_1
2007	1	1	553.15	0.5	#	commHL_1
2008	1	1	975.07	0.5	#	commHL_1
2009	1	1	1289.46	0.5	#	commHL_1
2010	1	1	994.09	0.5	#	commHL_1
2011	1	1	593.65	0.5	#	commHL_1
2012	1	1	599.24	0.5	#	commHL_1
2013	1	1	405.28	0.5	#	commHL_1
1993	1	2	3188.76	0.9	#	commLL_2
1994	1	2	2024.42	0.9	#	commLL_2
1995	1	2	1885.66	0.9	#	commLL_2

1996	1	2	2308.81	0.9	#	commLL_2
1997	1	2	2336.64	0.9	#	commLL_2
1998	1	2	2053.71	0.9	#	commLL_2
1999	1	2	2926.61	0.9	#	commLL_2
2000	1	2	2186	0.9	#	commLL_2
2001	1	2	2479.02	0.9	#	commLL_2
2002	1	2	2297	0.9	#	commLL_2
2003	1	2	2194.27	0.9	#	commLL_2
2004	1	2	2497.77	0.9	#	commLL_2
2005	1	2	2359.92	0.9	#	commLL_2
2006	1	2	2216.68	0.9	#	commLL_2
2007	1	2	1511.24	0.5	#	commLL_2
2008	1	2	1275.03	0.5	#	commLL_2
2009	1	2	793.21	0.5	#	commLL_2
2010	1	2	616.22	0.5	#	commLL_2
2011	1	2	1408.01	0.5	#	commLL_2
2012	1	2	1133.24	0.5	#	commLL_2
2013	1	2	840.29	0.5	#	commLL_2
1990	1	3	69.05	0.9	#	commTRAP_3
1991	1	3	131.4	0.9	#	commTRAP_3
1992	1	3	87.5	0.9	#	commTRAP_3
1993	1	3	169.87	0.9	#	commTRAP_3
1994	1	3	53.9	0.9	#	commTRAP_3
1995	1	3	124.73	0.9	#	commTRAP_3
1996	1	3	732.74	0.9	#	commTRAP_3
1997	1	3	598.57	0.9	#	commTRAP_3
1998	1	3	50.19	0.9	#	commTRAP_3

1999	1	3	106.19	0.9	#	commTRAP_3
2000	1	3	234.98	0.9	#	commTRAP_3
2001	1	3	167.62	0.9	#	commTRAP_3
2002	1	3	146.06	0.9	#	commTRAP_3
2003	1	3	134.7	0.9	#	commTRAP_3
2004	1	3	81.9	0.9	#	commTRAP_3
2005	1	3	122.09	0.9	#	commTRAP_3
2006	1	3	139.27	0.9	#	commTRAP_3
1981	1	4	61.2	0.5	#	MRFSS_4
1982	1	4	38.81	0.5	#	MRFSS_4
1983	1	4	48.61	0.5	#	MRFSS_4
1984	1	4	46.12	0.5	#	MRFSS_4
1985	1	4	63.19	0.5	#	MRFSS_4
1986	1	4	464.26	0.5	#	MRFSS_4
1987	1	4	311.65	0.5	#	MRFSS_4
1988	1	4	773.1	0.5	#	MRFSS_4
1989	1	4	1831.36	0.5	#	MRFSS_4
1990	1	4	1462.48	0.5	#	MRFSS_4
1991	1	4	2643.55	0.5	#	MRFSS_4
1992	1	4	2280.88	0.5	#	MRFSS_4
1993	1	4	1578.13	0.5	#	MRFSS_4
1994	1	4	1463.31	0.5	#	MRFSS_4
1995	1	4	1460.5	0.5	#	MRFSS_4
1996	1	4	768	0.5	#	MRFSS_4
1997	1	4	812.83	0.5	#	MRFSS_4
1998	1	4	1466.21	0.5	#	MRFSS_4
1999	1	4	1966.82	0.5	#	MRFSS_4

2000	1	4	2159.51	0.5	#	MRFSS_4
2001	1	4	1569.41	0.5	#	MRFSS_4
2002	1	4	1845.37	0.5	#	MRFSS_4
2003	1	4	1959.63	0.5	#	MRFSS_4
2004	1	4	3149.76	0.5	#	MRFSS_4
2005	1	4	1274.2	0.5	#	MRFSS_4
2006	1	4	631.25	0.5	#	MRFSS_4
2007	1	4	800.18	0.5	#	MRFSS_4
2008	1	4	2975.12	0.5	#	MRFSS_4
2009	1	4	3192.92	0.5	#	MRFSS_4
2010	1	4	2211.75	0.5	#	MRFSS_4
2011	1	4	2029.25	0.5	#	MRFSS_4
2012	1	4	1742.3	0.5	#	MRFSS_4
2013	1	4	2650.3	0.5	#	MRFSS_4
1981	1	5	4.01	0.5	#	HBT_5
1982	1	5	1.56	0.5	#	HBT_5
1983	1	5	3.3	0.5	#	HBT_5
1984	1	5	9.57	0.5	#	HBT_5
1985	1	5	13.78	0.5	#	HBT_5
1986	1	5	57.06	0.5	#	HBT_5
1987	1	5	68.1	0.5	#	HBT_5
1988	1	5	44.78	0.5	#	HBT_5
1989	1	5	268.56	0.5	#	HBT_5
1990	1	5	115.23	0.5	#	HBT_5
1991	1	5	87.71	0.5	#	HBT_5
1992	1	5	52.25	0.5	#	HBT_5
1993	1	5	77.61	0.5	#	HBT_5

1994	1	5	65.15	0.5	#	HBT_5
1995	1	5	74.07	0.5	#	HBT_5
1996	1	5	78.15	0.5	#	HBT_5
1997	1	5	41.7	0.5	#	HBT_5
1998	1	5	101.36	0.5	#	HBT_5
1999	1	5	143.73	0.5	#	HBT_5
2000	1	5	80.84	0.5	#	HBT_5
2001	1	5	44.31	0.5	#	HBT_5
2002	1	5	44.64	0.5	#	HBT_5
2003	1	5	98.17	0.5	#	HBT_5
2004	1	5	123.86	0.5	#	HBT_5
2005	1	5	80.59	0.5	#	HBT_5
2006	1	5	29.16	0.5	#	HBT_5
2007	1	5	17.37	0.5	#	HBT_5
2008	1	5	89.62	0.5	#	HBT_5
2009	1	5	153.83	0.5	#	HBT_5
2010	1	5	117.88	0.5	#	HBT_5
2011	1	5	134.11	0.5	#	HBT_5
2012	1	5	117.81	0.5	#	HBT_5
2013	1	5	112.27	0.5	#	HBT_5

0 #_N_meanbodywt_obs

30 #_DF_for_meanbodywt_T-distribution_like

2 # length bin method: 1=use databins(read below); 2=generate from binwidth,min,max below; 3=read vector

2 # binwidth for population size comp

2 # minimum size in the population (lower edge of first bin and size at age 0.00)

130 # maximum size in the population (lower edge of last bin)

#_following two entries are used for all length and age composition processing

0.0001 #_comp_tail_compression

1.00E-07#_add_to_comp

0 #_combine males into females at or below this bin number (useful if hard to sex small fish)

48 #_N_LengthBins

2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36
	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70
	72	74	76	78	80	82	84	86	88	90	92	94	96				
#year	seas	flt/svy	gender	part	Nsamp	2	4	6	8	10	12	14	16	18	20	22	24
	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58
	60	62	64	66	68	70	72	74	76	78	80	82	84	86	88	90	92
	94	96	#	937													
2006	1	1	1	1	100	0	0	0	0	0	0	0	0	0	0	0	0.00107
	0	0	0.00961	0.02134	0.04482	0.08751	0.11419	0.16115	0.16435	0.13767	0.15155	0.09072	0.01387	0	0.00213	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	#	2064	#	937											
2007	1	1	1	1	100	0	0	0	0	0	0	0	0	0	0	0.00145	0.00339
	0.00242	0.00242	0.00436	0.00921	0.01211	0.02762	0.04748	0.1124	0.18169	0.19331	0.19913	0.15649	0.03779	0.00484	0.00194	0.00097	0.00048
	0	0.00048	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	#	1073	#	2064											
2008	1	1	1	1	100	0	0	0	0	0	0	0	0	0	0.00093	0.00093	0.00186
	0.00186	0.00839	0.02516	0.03914	0.06431	0.05126	0.07642	0.07642	0.13048	0.16589	0.22088	0.12954	0.0028	0.0028	0.00093	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	#	1529	#	1073											
2009	1	1	1	1	100	0	0	0	0	0	0	0	0	0	0	0.00065	0.00065
	0.00392	0.01439	0.02943	0.07979	0.16612	0.1877	0.18247	0.155	0.09418	0.03859	0.02224	0.01373	0.00065	0.00131	0.00523	0.00065	0.00131
	0	0.00065	0	0	0.00065	0	0	0	0	0.00065	0	0	0	0	0	0	0
	0	0	#	2980	#	1529											
2010	1	1	1	1	100	0	0	0	0	0	0	0	0	0	0	0.00034	0.00134
	0.00302	0.00705	0.01409	0.0255	0.06779	0.14631	0.18993	0.24262	0.22483	0.06678	0.00671	0.00268	0.00067	0.00034	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	#	5190	#	2980											

2011	1	1	1	1	100	0	0	0	0	0	0	0	0	0	0	0.00019	0
	0.00116	0.00116	0.00482	0.0106	0.04104	0.0975	0.16031	0.21811	0.23873	0.18536	0.0341	0.00559	0.00019	0.00039	0.00039	0.00019	0
	0.00019	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	#	8917	#	5190											
2012	1	1	1	1	100	0	0	0	0	0	0	0	0.00022	0	0.00022	0.00011	0.00101
	0.00168	0.00348	0.00707	0.01884	0.03645	0.07648	0.13514	0.20175	0.25221	0.16384	0.06011	0.02568	0.01054	0.00135	0.00146	0.00079	0.00067
	0.00045	0.00034	0.00011	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	#	2291	#	8917											
2013	1	1	1	1	100	0	0	0	0	0	0	0	0	0	0	0	0.00044
	0.00131	0.00175	0.00873	0.03012	0.05412	0.09603	0.12746	0.22392	0.24007	0.14055	0.055	0.01746	0.00131	0.00131	0.00044	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	#	3912	#	2291											
2006	1	2	1	1	100	0	0	0	0	0	0	0	0	0	0.00026	0	0
	0	0.00204	0.00537	0.0138	0.03093	0.06084	0.10302	0.14238	0.16385	0.14647	0.14162	0.12551	0.04908	0.00511	0.00358	0.00179	0.00153
	0.00077	0.00102	0.00026	0	0.00051	0.00026	0	0	0	0	0	0	0	0	0	0	0
	0	0	#	2921	#	3912											
2007	1	2	1	1	100	0	0	0	0	0	0	0	0	0	0	0	0
	0.00068	0.0024	0.00719	0.01404	0.02705	0.03971	0.06915	0.12735	0.16296	0.20096	0.21499	0.11503	0.01541	0.00068	0.00068	0.00034	0.00103
	0	0	0.00034	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	#	917	#	2921											
2008	1	2	1	1	100	0	0	0	0	0	0	0	0	0	0.00109	0	0.00218
	0.00545	0.01745	0.04907	0.0458	0.06761	0.07415	0.12105	0.15812	0.18212	0.19738	0.0687	0.00763	0.00109	0	0	0.00109	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	#	6447	#	917											
2009	1	2	1	1	100	0	0	0	0	0.00016	0.00016	0	0	0	0.00016	0.00155	0.00062
	0.00295	0.01039	0.03459	0.05972	0.08516	0.10408	0.10346	0.1047	0.13029	0.14518	0.13045	0.06654	0.01474	0.00217	0.00124	0.0014	0.00016
	0	0.00016	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	#	18635	#	6447											

2010	1	2	1	1	100	0	0	0	0	0	0	0	0	0	0.00005	0.00021	0.00059
	0.0015	0.00762	0.02399	0.06075	0.10942	0.14929	0.17526	0.18975	0.16453	0.0945	0.0198	0.00129	0.00043	0.00027	0.00032	0	0.00016
	0.00011	0.00005	0	0.00005	0	0	0.00005	0	0	0	0	0	0	0	0	0	0
	0	0	#	40239	#	18635											
2011	1	2	1	1	100	0	0	0	0	0	0	0	0	0	0	0.00015	0.00052
	0.0008	0.00422	0.01228	0.03402	0.0718	0.11238	0.14759	0.18363	0.20028	0.14414	0.05713	0.02219	0.00678	0.00127	0.0003	0.0002	0.00005
	0.00005	0.00007	0.00005	0.00005	0.00002	0	0	0	0.00002	0	0	0	0	0	0	0	0
	0	0	#	11969	#	40239											
2012	1	2	1	1	100	0	0	0	0	0	0	0	0	0	0	0	0
	0.00042	0.00117	0.00384	0.01345	0.03367	0.09007	0.15766	0.20361	0.20754	0.15507	0.07035	0.03994	0.01211	0.00685	0.00343	0.00033	0.00017
	0	0.00008	0.00017	0	0.00008	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	#	22056	#	11969											
2013	1	2	1	1	100	0	0	0	0	0	0	0	0	0	0.00009	0.00009	0.00005
	0.00086	0.00317	0.00775	0.01759	0.03595	0.06633	0.10954	0.17791	0.23526	0.20842	0.10251	0.02861	0.0039	0.00077	0.00027	0.00045	0.00009
	0.00014	0.00005	0.00005	0	0	0	0	0.00005	0.00005	0.00005	0	0	0	0	0	0	0
	0	0	#	#	22056												
2010	1	4	1	1	100	0	0	0	0	0	0	0	0	0	0.00021	0.00182	0.00459
	0.01406	0.04494	0.1277	0.12816	0.15155	0.15372	0.11611	0.07649	0.05478	0.03796	0.0247	0.01481	0.01571	0.00822	0.00629	0.00439	0.0034
	0.004	0.00187	0	0.00082	0.00028	0.00082	0	0.00059	0.00128	0.00072	0	0	0	0	0	0	0
	0	0	#	#	2313												
2011	1	4	1	1	100	0	0	0	0	0	0	0	0	0	0	0	0
	0.00112	0.00647	0.03107	0.05086	0.10275	0.1499	0.18568	0.14313	0.09952	0.07783	0.04891	0.0391	0.02981	0.01137	0.00562	0.00758	0.00113
	0.00193	0.0015	0.00047	0.00044	0	0.00197	0.00131	0	0	0.00052	0	0	0	0	0	0	0
	0	0	#	#	1834												
2012	1	4	1	1	100	0	0	0	0	0	0	0	0	0	0.0001	0.00011	0
	0.00215	0.00841	0.01495	0.04218	0.0424	0.06393	0.11507	0.14696	0.13591	0.13842	0.10579	0.04571	0.0604	0.02433	0.01664	0.0103	0.00603
	0.00244	0.00401	0.00227	0	0.00503	0.00088	0.00036	0.00364	0.00038	0.00081	0	0.0004	0	0	0	0	0
	0	0	#	#	1324												

2013	1	4	1	1	100	0	0	0	0	0.00026	0	0	0	0	0	0	0.00096
	0.00212	0.00968	0.01631	0.04516	0.05115	0.05577	0.05394	0.06403	0.14031	0.17147	0.14791	0.08885	0.05259	0.03283	0.01593	0.00494	0.01712
	0.01041	0.00793	0.00151	0.00199	0	0	0	0	0.0013	0	0	0.00552	0	0	0	0	0
	0	0	#	1195													
2005	1	5	1	1	100	0	0	0	0	0	0	0	0.00239	0.00723	0.01353	0.04022	0.06889
	0.0541	0.0599	0.0633	0.09093	0.10375	0.07107	0.04886	0.05949	0.04263	0.05341	0.04335	0.01649	0.00334	0.00181	0.00275	0.00094	0.00087
	0.00007	0	0	0.0008	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	#	1126													
2006	1	5	1	1	100	0	0	0	0	0	0	0.00206	0.02105	0.01799	0.0207	0.04287	0.07574
	0.11561	0.11846	0.10795	0.08351	0.04475	0.04589	0.02836	0.0438	0.02643	0.02695	0.01669	0.0093	0.00181	0.00021	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	#	1058													
2007	1	5	1	1	100	0	0	0	0.00003	0.00082	0	0.0007	0.00349	0.02041	0.03143	0.09084	0.1188
	0.12969	0.10632	0.07839	0.04718	0.03707	0.03696	0.03753	0.02913	0.02441	0.02463	0.01842	0.00751	0.00331	0.00013	0.00137	0.00067	0
	0	0	0	0	0.00003	0.0007	0.00013	0	0.00003	0	0	0	0	0	0	0	0
	0	0	#	1633													
2009	1	5	1	1	100	0	0	0	0	0	0.00053	0	0	0.00403	0.0007	0.02064	0.04008
	0.05362	0.05867	0.11222	0.15123	0.13377	0.10421	0.06921	0.04634	0.02634	0.01492	0.00972	0.0016	0.0007	0	0.00106	0	0.00053
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	#	1734													
2010	1	5	1	1	100	0	0	0	0	0	0	0	0.00101	0.0005	0.00151	0.00554	0.01519
	0.03203	0.07606	0.1466	0.13503	0.12659	0.09329	0.07347	0.04869	0.04108	0.03006	0.01614	0.00533	0.00101	0.0005	0.0005	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	#	1592													
2011	1	5	1	1	100	0	0	0	0	0	0	0	0.0016	0.00242	0.00161	0.00632	0.01906
	0.02435	0.01874	0.03954	0.09063	0.15742	0.17804	0.10608	0.08124	0.04937	0.04659	0.01436	0.00632	0.00081	0.00081	0	0.00081	0.0016
	0.00195	0	0.00046	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	#	1056													

2012 1 5 1 1 100 0 0 0 0 0 0 0 0 0.00136 0.00133 0.0027 0.01471
0.03204 0.03607 0.04515 0.05426 0.06052 0.07549 0.10616 0.1409 0.11164 0.07456 0.05706 0.02459 0.00406 0.00406 0.0027 0 0.00077
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 # 635

2013 1 5 1 1 100 0 0 0 0 0 0 0 0.00042 0.00052 0 0.00665 0.00867
0.00763 0.02278 0.03187 0.0671 0.08033 0.07345 0.07364 0.12248 0.10366 0.09838 0.10886 0.03057 0.00612 0.0015 0.00192 0.0015 0.00202
0.00005 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 # 772

2008 1 7 1 2 32 0 0 0 0 0 0 0 0 0 0 0.03125 0
0.03125 0 0.03125 0.03125 0.0625 0 0 0.03125 0 0.09375 0.09375 0.0625 0.15625 0.15625 0.03125 0 0.0625
0.03125 0.0625 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0.03125

2009 1 7 1 2 99 0 0 0 0 0 0 0 0 0 0.010101 0
0 0 0 0.050505 0.070707 0.090909 0.040404 0.141414 0.050505 0.080808
0.060606 0.060606 0.030303 0.040404 0.030303 0.060606 0.010101 0.040404
0.010101 0 0.020202 0.010101 0.020202 0.020202 0.010101 0.020202 0
0.010101 0 0.010101 0 0 0 0 0 0 0

2010 1 7 1 2 48 0 0 0 0 0 0 0 0 0 0 0 0
0.020833 0 0.041667 0 0 0.041667 0.041667 0.020833 0.145833 0.145833
0.104167 0.0625 0.041667 0.041667 0.083333 0.020833 0.0625 0 0.020833 0.020833
0.020833 0.041667 0 0 0 0 0 0 0.020833 0 0 0 0 0
0 0

2011 1 7 1 2 116 0 0 0 0 0 0 0 0 0 0 0 0
0 0.008621 0.008621 0.008621 0.051724 0.017241 0.034483 0.086207 0.043103
0.051724 0.112069 0.137931 0.043103 0.051724 0.051724 0.034483 0.008621
0.025862 0.060345 0.025862 0.025862 0.017241 0.025862 0.008621 0.008621
0.017241 0.008621 0.008621 0.017241 0 0 0 0 0 0 0

2012 1 7 1 2 105 0 0 0 0 0 0 0 0 0 0 0
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0.047619 0.066667 0.07619 0.07619 0.07619 0.057143 0.085714 0.057143 0.038095 0.009524
0.047619 0.057143 0.009524 0.019048 0.019048 0 0.028571 0.019048 0 0
0 0 0 0 0 0 0 0

2013 1 7 1 2 39 0 0 0 0 0 0 0 0 0 0 0 0
0 0.025641 0 0.025641 0 0.076923 0.051282 0.051282 0.025641 0.051282
0.128205 0.076923 0 0.051282 0.051282 0.051282 0.076923 0.025641 0
0.025641 0 0.076923 0.025641 0 0.025641 0 0.025641 0.025641 0.025641
0 0 0 0 0 0 0

2008 1 8 1 0 33 0 0 0.0303 0 0 0 0 0 0.030303 0.060606
0.090909 0.090909 0.181818 0.151515 0.121212 0.060606 0.060606 0 0
0.060606 0 0 0.030303 0 0 0 0 0.030303 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

2009 1 8 1 0 298 0 0 0.00671 0.00671 0.01007 0.01678 0.00336 0.00671 0.013423 0.020134
0.083893 0.120805 0.137584 0.107383 0.083893 0.090604 0.097315 0.067114
0.043624 0.016779 0.02349 0.010067 0.003356 0.006711 0 0.003356 0.003356
0.006711 0 0 0.003356 0 0.003356 0.003356 0 0 0 0 0 0
0 0 0 0 0 0 0 0

2010 1 8 1 0 187 0 0 0 0 0 0.0107 0.04813 0.07487 0.02139 0.016043
0.026738 0.037433 0.085561 0.112299 0.117647 0.074866 0.085561 0.042781
0.080214 0.058824 0.032086 0.02139 0.010695 0.010695 0.005348 0.005348 0 0
0 0.005348 0.005348 0 0 0.005348 0.005348 0 0 0 0 0 0
0 0 0 0 0 0 0

2011 1 8 1 0 114 0 0.00877 0 0 0 0.00877 0.01754 0.12281 0.061404 0.026316
0.061404 0.070175 0.070175 0.087719 0.026316 0.070175 0.070175 0.061404
0.087719 0.026316 0.026316 0.017544 0 0.008772 0.017544 0.008772 0.008772

0 0.008772 0 0 0 0 0.008772 0 0 0 0.008772 0 0.008772
0 0 0 0 0 0 0 0

2012 1 8 1 0 151 0.00662 0.04636 0.00662 0.02649 0.01325 0 0.00662 0.05298 0.059603 0.019868
0.02649 0.059603 0.086093 0.059603 0.059603 0.066225 0.033113 0.07947 0.019868
0.033113 0.046358 0.033113 0.019868 0.05298 0.013245 0.033113 0.013245 0.013245
0 0 0.006623 0 0 0 0 0 0 0 0 0 0.006623 0 0
0 0 0 0 0

2013 1 8 1 0 72 0 0 0.01389 0.01389 0 0.04167 0.01389 0.01389 0.055556 0.069444
0.027778 0.041667 0.041667 0.083333 0.013889 0.083333 0.041667 0.027778
0.041667 0.055556 0.069444 0.069444 0.027778 0 0.041667 0.013889 0.027778
0 0 0.027778 0 0.013889 0 0 0.013889 0 0.013889 0 0 0
0 0 0 0 0 0 0 0

-1995 1 9 1 0 10 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0.1 0.1 0 0 0 0 0.1 0 0.1 0 0 0.1
0.1 0 0.1 0.2 0.1 0 0 0 0 0 0 0 0 0 0 0 0
0 0

-1996 1 9 1 0 6 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0.33333 0.16667 0.16667 0
0.16667 0 0 0 0 0.16667 0 0 0 0 0 0 0 0 0 0 0
0 0

-1997 1 9 1 0 7 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0.14286 0.14286 0.14286
0.14286 0 0 0.28571 0 0 0 0.14286 0 0 0 0 0 0 0 0 0
0 0

-1999 1 9 1 0 1 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0

-2000	1	9	1	0	26	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0.03846	0.03846	0.11538	0.19231	0	0.11538	0.11538	0.15385	0.07692	0.03846	0	0
	0.07692	0	0.03846	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0															
2001	1	9	1	0	79	0	0	0	0	0	0	0	0	0	0	0	0
	0	0.01266	0	0.06329	0	0	0.05063	0.10127	0.08861	0.10127	0.03797	0.08861	0.08861	0.05063	0.06329	0.05063	0.02532
	0.05063	0.01266	0.02532	0.02532	0	0.01266	0.01266	0	0	0.01266	0.01266	0.01266	0	0	0	0	0
	0	0															
2002	1	9	1	0	16	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0.0625	0	0.0625	0.0625	0.0625	0	0.1875	0.1875	0	0	0	0
	0.125	0	0.0625	0.125	0	0	0	0	0	0.0625	0	0	0	0	0	0	0
	0	0															
2003	1	9	1	0	162	0	0	0	0	0	0	0	0	0	0	0	0
	0	0.00617	0	0.01235	0.02469	0.03704	0.03704	0.11728	0.08642	0.12346	0.09259	0.0679	0.05556	0.04321	0.01235	0.01852	0.03704
	0.01235	0.03704	0.01852	0.03704	0.01852	0.01852	0.02469	0.00617	0.02469	0.01235	0.01235	0	0.00617	0	0	0	0
	0	0															
2004	1	9	1	0	170	0	0	0	0	0	0	0	0	0	0	0	0
	0	0.00588	0.00588	0.00588	0.02941	0.01765	0.06471	0.07059	0.10588	0.12941	0.10588	0.1	0.05882	0.02941	0.04118	0.02941	0.00588
	0.02353	0.04118	0	0.02353	0.04118	0.01765	0.01765	0.01765	0	0.01176	0	0	0	0	0	0	0
	0	0															
2005	1	9	1	0	32	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0.03125	0.125	0.03125	0.03125	0.03125	0.03125	0.1875	0.0625	0.03125	0.15625	0	0.03125	0.03125	0	0
	0.0625	0	0.0625	0.03125	0.03125	0.03125	0	0	0	0	0	0	0	0	0	0	0
	0	0															
2006	1	9	1	0	32	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0.0625	0.0625	0	0.0625	0.09375	0.0625	0.09375	0.0625	0.0625	0.15625	0.03125	0.0625
	0.03125	0.03125	0	0.125	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0															

2007	1	9	1	0	51	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0.01961	0	0.09804	0.11765	0.07843	0.09804	0.21569	0.13725	0.05882	0.01961	0.01961	0	0.03922
	0.01961	0	0.01961	0.01961	0.03922	0	0	0	0	0	0	0	0	0	0	0	0
	0	0															
2008	1	9	1	0	31	0	0	0	0	0	0	0	0	0	0	0	0
	0.03226	0	0.03226	0	0.06452	0.03226	0	0	0.06452	0.03226	0	0.06452	0.03226	0.09677	0.06452	0.03226	0.06452
	0.06452	0	0.09677	0.12903	0	0	0.03226	0.03226	0	0	0.03226	0	0	0	0	0	0
	0	0															
2009	1	9	1	0	64	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0.01563	0.03125	0.10938	0.10938	0.01563	0.0625	0.07813	0.03125	0	0	0.04688	0.0625	0.03125	0.09375	0.0625
	0.04688	0.01563	0.04688	0.04688	0.03125	0.01563	0.01563	0.01563	0	0	0	0	0	0.01563	0	0	0
	0	0															
2010	1	9	1	0	81	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0.04938	0.02469	0.01235	0.07407	0.07407	0.06173	0.1358	0.04938	0.04938	0.04938	0.11111	0.04938	0.02469	0.03704
	0	0.04938	0.03704	0.02469	0.02469	0	0.02469	0.01235	0	0.01235	0.01235	0	0	0	0	0	0
	0	0															
2011	1	9	1	0	312	0	0	0	0	0	0	0	0	0	0	0	0
	0	0.00321	0.00321	0.00962	0.03526	0.05769	0.06731	0.08333	0.09615	0.07692	0.08654	0.10256	0.08013	0.04808	0.05128	0.03526	0.02885
	0.01603	0.02564	0.02244	0.01923	0.02244	0.01603	0.00641	0.00641	0	0	0	0	0	0	0	0	0
	0	0															
2012	1	9	1	0	111	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0.01802	0.01802	0.01802	0.05405	0.06306	0.09009	0.04505	0.04505	0.15315	0.06306	0.14414	0.06306	0.02703	0.04505
	0.02703	0.03604	0.01802	0.03604	0	0.01802	0.00901	0.00901	0	0	0	0	0	0	0	0	0
	0	0															
2013	1	9	1	0	47	0	0	0	0	0	0	0	0	0	0	0	0
	0.02128	0	0	0	0	0.06383	0.02128	0.04255	0.10638	0.06383	0.12766	0.06383	0.04255	0.08511	0.04255	0.04255	0
	0.04255	0.06383	0.06383	0.02128	0.04255	0.02128	0	0	0.02128	0	0	0	0	0	0	0	0
	0	0															

-2014	1	9	1	0	24	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0.08333	0.08333	0.08333	0	0.08333	0.08333	0.04167	0.08333	0	0.04167	0	0
	0.08333	0.04167	0.08333	0.16667	0	0	0	0	0.04167	0	0	0	0	0	0	0	0
	0	0		21	#_N_age_bins												
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
	19	20	21														
1	#_N_ageerror_definitions																
0.5	1.5	2.5	3.5	4.5	5.5	6.5	7.5	8.5	9.5	10.5	11.5	12.5	13.5	14.5	15.5	16.5	17.5
	18.5	19.5	20.5														
0.06	0.064	0.272	0.34	0.407	0.474	0.541	0.608	0.676	0.743	0.81	0.877	0.944	1.012	1.079	1.146	1.213	1.28
	1.348	1.415	1.784														
107	#_N_Agecomp_obs																
1	#_Lbin_method:	1=poplenbins;		2=datalenbins;		3=lengths											
1	#_combine		males	into	females	at	or	below	this	bin	number						
#Yr	Seas	Flt/Svy	Gender	Part	Ageerr	Lbin_lo	Lbin_hi	Nsamp	AGE0	AGE1	AGE2	AGE3	AGE4	AGE5	AGE6	AGE7	AGE8
	AGE9	AGE10	AGE11	AGE12	AGE13	AGE14	AGE15	AGE16	AGE17	AGE18	AGE19	AGE20	#				
1991	1	1	1	2	1	-1	-1	43	0	0	0	0.0511	0.0169	0.1973	0.2499	0.0614	0
	0.1345	0.2063	0.0049	0.0227	0.0173	0	0.0045	0.0132	0	0	0.0087	0.0112	#	43			
1992	1	1	1	2	1	-1	-1	42	0	0	0	0	0	0.2716	0.2877	0.3157	0.083
	0	0.01	0.0114	0	0.0205	0	0	0	0	0	0	0	#	42			
1993	1	1	1	2	1	-1	-1	93	0	0	0	0.0019	0.1444	0.1654	0.2725	0.2541	0.1112
	0.0232	0.01	0.0077	0.0041	0	0	0	0	0	0.0012	0	0.0041	#	93			
1994	1	1	1	2	1	-1	-1	200	0	0	0	0.0015	0.1284	0.3128	0.1857	0.1642	0.0951
	0.057	0.0209	0.0133	0.0085	0.0039	0	0.0088	0	0	0	0	0	#	239			

1995	1	1	1	2	1	-1	-1	180	0	0	0	0	0.0276	0.1832	0.3136	0.2767	0.0934
	0.0271	0.036	0.0332	0	0.0092	0	0	0	0	0	0	0	#	180			
1996	1	1	1	2	1	-1	-1	141	0	0	0	0	0.0015	0.1087	0.3815	0.2967	0.1113
	0.0969	0	0.0035	0	0	0	0	0	0	0	0	0	#	141			
1997	1	1	1	2	1	-1	-1	35	0	0	0	0	0.0218	0.0894	0.2267	0.3242	0.2708
	0.0492	0.0136	0	0	0.0043	0	0	0	0	0	0	0	#	35			
1998	1	1	1	2	1	-1	-1	39	0	0	0	0.0081	0.1959	0.1362	0.1715	0.2284	0.1454
	0.0781	0.0278	0	0	0	0.0087	0	0	0	0	0	0	#	39			
1999	1	1	1	2	1	-1	-1	77	0	0	0	0	0.0166	0.1364	0.2409	0.1591	0.2413
	0.1224	0.0728	0	0.0074	0.0015	0	0	0	0.0015	0	0	0	#	77			
2000	1	1	1	2	1	-1	-1	200	0	0	0	0	0.2492	0.1433	0.2277	0.0985	0.0747
	0.0689	0.0562	0.0221	0.0299	0.0081	0.0178	0.0021	0	0	0	0.0004	0.001	#	206			
2001	1	1	1	2	1	-1	-1	200	0	0	0	0	0.0421	0.354	0.124	0.1722	0.0955
	0.0324	0.0643	0.0426	0.0219	0.0175	0.0148	0.0038	0.0092	0.0049	0.0003	0	0.0005	#	575			
2002	1	1	1	2	1	-1	-1	200	0	0	0	0.0111	0.0465	0.1236	0.3553	0.1277	0.1087
	0.0783	0.0665	0.0224	0.0266	0.0126	0.007	0.0032	0.0022	0.0018	0.0012	0.0029	0.0024	#	573			
2003	1	1	1	2	1	-1	-1	200	0	0	0	0	0.0953	0.1162	0.2068	0.2638	0.1162
	0.089	0.0354	0.0199	0.0173	0.0146	0.001	0.0068	0.0031	0.003	0.0034	0.0012	0.0071	#	561			
2004	1	1	1	2	1	-1	-1	200	0	0	0	0	0.0283	0.3927	0.1258	0.1575	0.1248
	0.0515	0.0406	0.0256	0.0136	0.0116	0.0075	0.0081	0.0038	0.002	0.0024	0.0029	0.0013	#	1062			
2005	1	1	1	2	1	-1	-1	200	0	0	0	0	0.0015	0.0879	0.5971	0.0806	0.0793
	0.0695	0.0211	0.0205	0.0207	0.0088	0.0055	0.0008	0.0022	0.0014	0	0.0006	0.0025	#	626			
2006	1	1	1	2	1	-1	-1	200	0	0	0	0	0	0.02	0.1539	0.4878	0.18
	0.0551	0.0411	0.0175	0.0142	0.0085	0.0052	0.0012	0.0056	0.0019	0.0008	0	0.0072	#	629			

2007	1	1	1	2	1	-1	-1	200	0	0	0	0	0.0036	0.2463	0.0834	0.18	0.2865
	0.0984	0.0392	0.0196	0.0193	0.0063	0.003	0.0028	0.0039	0.0035	0.0028	0	0.0014	#	497			
2008	1	1	1	2	1	-1	-1	200	0	0	0	0	0	0.0735	0.4394	0.1023	0.146
	0.1536	0.0298	0.0161	0.015	0.0105	0.0024	0.0032	0.0033	0	0.0019	0.001	0.002	#	503			
2009	1	1	1	2	1	-1	-1	200	0	0	0	0.0221	0.035	0.0965	0.068	0.3336	0.1288
	0.134	0.1169	0.0319	0.0085	0.007	0.0035	0.0045	0.0016	0.0011	0.0007	0	0.0063	#	895			
2010	1	1	1	2	1	-1	-1	200	0	0	0.0011	0.0152	0.1659	0.0629	0.089	0.1508	0.2265
	0.1212	0.0878	0.044	0.0047	0.0141	0.0056	0.0047	0.0024	0.0025	0	0.0013	0.0003	#	1030			
2011	1	1	1	2	1	-1	-1	200	0	0	0	0	0.031	0.5065	0.0717	0.0819	0.0677
	0.1098	0.043	0.0419	0.0217	0.0061	0.0049	0.0037	0.0056	0	0	0.0003	0.0044	#	629			
2012	1	1	1	2	1	-1	-1	200	0	0	0	0.0004	0.0061	0.1718	0.5278	0.0681	0.0607
	0.0301	0.052	0.0335	0.0201	0.0191	0.0055	0.0015	0.0007	0.0015	0	0	0.0011	#	1019			
2013	1	1	1	2	1	-1	-1	200	0	0	0	0	0.0101	0.0521	0.2727	0.4514	0.0653
	0.0431	0.0321	0.026	0.0092	0.0218	0.0127	0.0011	0.0009	0	0.0016	0	0	#	558			
1991	1	2	1	2	1	-1	-1	37	0	0	0	0	0	0.1367	0.1258	0.3341	0.1593
	0.1272	0	0.0183	0.014	0	0	0	0	0	0	0.0846	0	#	37			
1992	1	2	1	2	1	-1	-1	143	0	0	0	0	0	0.1371	0.1949	0.3669	0.1553
	0.0892	0.0232	0.0114	0.0134	0	0	0	0	0.0086	0	0	0	#	143			
1993	1	2	1	2	1	-1	-1	200	0	0	0	0	0.0531	0.1321	0.2866	0.2497	0.135
	0.0709	0.0417	0.0166	0.0039	0.0062	0.0018	0	0.0024	0	0	0	0	#	200			
1994	1	2	1	2	1	-1	-1	88	0	0	0	0	0.056	0.1404	0.1253	0.2879	0.1426
	0.1084	0.0892	0.0236	0.0234	0.0017	0	0	0	0	0	0	0.0014	#	88			
1995	1	2	1	2	1	-1	-1	140	0	0	0	0	0.0251	0.0744	0.3285	0.1364	0.237
	0.1137	0.0647	0.0076	0.0037	0.0037	0	0	0	0	0	0	0.0054	#	140			

1996	1	2	1	2	1	-1	-1	96	0	0	0	0	0.0132	0.0789	0.2309	0.3444	0.0634
	0.1812	0.07	0.0052	0.0041	0	0	0.0064	0	0.0023	0	0	0	#	96			
-1997	1	2	1	2	1	-1	-1	7	0	0	0	0	0.7193	0.0801	0.0583	0.1384	0
	0	0	0	0	0	0	0	0.0039	0	0	0	0	#	7			
1998	1	2	1	2	1	-1	-1	122	0	0	0	0	0.0413	0.1572	0.1643	0.2724	0.1548
	0.1054	0.028	0.0542	0.014	0.0047	0	0.0037	0	0	0	0	0	#	122			
1999	1	2	1	2	1	-1	-1	200	0	0	0	0	0.0061	0.0628	0.1123	0.1849	0.2541
	0.1967	0.0876	0.0492	0.025	0.0105	0.0052	0.0035	0.0007	0	0.0007	0	0.0006	#	643			
2000	1	2	1	2	1	-1	-1	200	0	0	0	0	0.0388	0.0523	0.202	0.1499	0.1586
	0.1197	0.0997	0.1026	0.0363	0.0127	0.0095	0.0063	0.0049	0	0.0011	0.0029	0.0028	#	405			
2001	1	2	1	2	1	-1	-1	200	0	0	0	0	0.0036	0.2011	0.1327	0.2345	0.125
	0.0626	0.0833	0.0809	0.0393	0.012	0.0086	0.0064	0.0049	0.0012	0.0008	0.0009	0.0022	#	1210			
2002	1	2	1	2	1	-1	-1	200	0	0	0	0	0.0042	0.0486	0.2703	0.1661	0.1567
	0.1224	0.0621	0.0588	0.0572	0.0223	0.0129	0.0089	0.0028	0.0013	0.0017	0.0009	0.0028	#	1067			
2003	1	2	1	2	1	-1	-1	200	0	0	0	0.0009	0.0335	0.03	0.1156	0.2377	0.1394
	0.1324	0.0892	0.0611	0.0528	0.041	0.0303	0.0144	0.0048	0.0083	0.0028	0.0024	0.0033	#	1080			
2004	1	2	1	2	1	-1	-1	200	0	0	0	0.0013	0.0146	0.2316	0.0507	0.1566	0.1877
	0.1189	0.0773	0.0463	0.0322	0.0233	0.0255	0.0115	0.0053	0.005	0.005	0.0021	0.0052	#	1153			
2005	1	2	1	2	1	-1	-1	200	0	0	0	0	0.0035	0.0966	0.4442	0.0759	0.1234
	0.1084	0.061	0.0294	0.0172	0.0107	0.0083	0.0053	0.0055	0.0025	0.0029	0.0013	0.004	#	1455			
2006	1	2	1	2	1	-1	-1	200	0	0	0	0	0	0.0293	0.1663	0.3771	0.1627
	0.0898	0.0619	0.0383	0.0242	0.0177	0.0143	0.0069	0.0069	0.0006	0.0011	0.0011	0.0017	#	538			
2007	1	2	1	2	1	-1	-1	200	0	0	0	0	0.002	0.0637	0.0963	0.1927	0.2992
	0.1171	0.0613	0.0743	0.0266	0.0182	0.0265	0.0095	0.0031	0.0033	0.0017	0.0034	0.0013	#	599			

2008	1	2	1	2	1	-1	-1	200	0	0	0	0	0	0.0155	0.2005	0.1393	0.2402
	0.2387	0.0709	0.0457	0.0183	0.012	0.0072	0.003	0.002	0.0029	0.002	0.0008	0.001	#	509			
2009	1	2	1	2	1	-1	-1	200	0	0	0	0.0003	0.003	0.0153	0.0736	0.3252	0.1257
	0.1688	0.1887	0.0399	0.0091	0.0108	0.0119	0.0109	0.0043	0.0025	0.0011	0.0036	0.0054	#	994			
2010	1	2	1	2	1	-1	-1	200	0	0	0	0.0061	0.1163	0.0578	0.1151	0.1808	0.277
	0.093	0.0983	0.0286	0.0073	0.0037	0.0028	0.0043	0.0044	0	0.0014	0.0029	0	#	650			
2011	1	2	1	2	1	-1	-1	200	0	0	0	0.0025	0.0498	0.3107	0.062	0.1427	0.1234
	0.1675	0.0449	0.0571	0.0214	0.0113	0	0.0001	0.0038	0	0	0.0025	0.0004	#	499			
2012	1	2	1	2	1	-1	-1	200	0	0	0	0	0.0047	0.1093	0.4614	0.09	0.0851
	0.0644	0.0917	0.0378	0.0287	0.0134	0.0035	0.0078	0	0	0	0.0011	0.0009	#	861			
2013	1	2	1	2	1	-1	-1	200	0	0	0	0	0.001	0.0422	0.2897	0.3692	0.0887
	0.0602	0.0479	0.0511	0.0158	0.0174	0.0068	0.002	0.0028	0.0008	0.0017	0.001	0.0018	#	1130			
-1991	1	3	1	2	1	-1	-1	2	0	0	0	0	0.0328	0	0.9672	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	#	2			
1992	1	3	1	2	1	-1	-1	14	0	0	0	0	0	0.1471	0.4923	0.0422	0.2481
	0	0.0597	0	0.0068	0	0	0	0	0.0038	0	0	0	#	14			
1993	1	3	1	2	1	-1	-1	84	0	0	0	0	0.047	0.0435	0.2138	0.3409	0.2725
	0.0679	0.0143	0	0	0	0	0	0	0	0	0	0	#	84			
1994	1	3	1	2	1	-1	-1	29	0	0	0	0	0	0	0.0283	0.1208	0.3499
	0.3176	0.12	0.0439	0.0098	0	0.0098	0	0	0	0	0	0	#	29			
1995	1	3	1	2	1	-1	-1	39	0	0	0	0	0	0.0476	0.4586	0.1074	0.2173
	0.0879	0.0166	0	0.0579	0.0066	0	0	0	0	0	0	0	#	39			
-1996	1	3	1	2	1	-1	-1	8	0	0	0	0	0	0	0	0.3504	0.1709
	0.1823	0.2279	0	0.0684	0	0	0	0	0	0	0	0	#	8			

1997	1	3	1	2	1	-1	-1	17	0	0	0	0	0.1291	0.4163	0.3007	0.0421	0.1013
	0	0	0	0	0.0105	0	0	0	0	0	0	0	#	17			
1998	1	3	1	2	1	-1	-1	33	0	0	0	0.03	0.0965	0.03	0.1509	0.2616	0.1537
	0.1716	0.0649	0	0.041	0	0	0	0	0	0	0	0	#	33			
1999	1	3	1	2	1	-1	-1	31	0	0	0	0	0.1012	0.0732	0.0973	0.0288	0.2114
	0.1615	0.1135	0.1914	0	0.021	0.0006	0	0	0	0	0	0	#	31			
2000	1	3	1	2	1	-1	-1	38	0	0	0	0	0.0246	0.0246	0.4501	0.21	0.0902
	0.1193	0.0301	0.0247	0	0.0265	0	0	0	0	0	0	0	#	38			
2001	1	3	1	2	1	-1	-1	39	0	0	0	0	0	0.0807	0.1026	0.2107	0.1754
	0.0658	0.1454	0.0096	0.1843	0	0	0.0171	0	0.0084	0	0	0	#	39			
2002	1	3	1	2	1	-1	-1	89	0	0	0	0	0.0646	0.0649	0.1662	0.1652	0.1977
	0.1002	0.0702	0.0676	0.0374	0.0486	0.0038	0.0066	0.0071	0	0	0	0	#	89			
2003	1	3	1	2	1	-1	-1	65	0	0	0	0	0.1979	0.0102	0.1652	0.1786	0.1629
	0.1271	0.0539	0.0169	0.0696	0.0049	0.0037	0.0073	0.0016	0	0	0	0	#	65			
2004	1	3	1	2	1	-1	-1	38	0	0	0	0	0.1122	0.2652	0.0625	0.2343	0.1503
	0.012	0.0742	0.0343	0	0	0.0167	0	0.0096	0	0.0287	0	0	#	38			
2006	1	3	1	2	1	-1	-1	173	0	0	0	0	0	0.0135	0.0923	0.5382	0.1501
	0.047	0.0595	0.0337	0.0413	0.0058	0	0.013	0	0.0056	0	0	0	#	173			
-1991	1	4	1	2	1	-1	-1	1	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	1	#	1			
1992	1	4	1	2	1	-1	-1	25	0	0	0	0	0.3522	0.2525	0	0	0.0701
	0.2372	0.0359	0.0305	0.018	0.0036	0	0	0	0	0	0	0	#	25			
1993	1	4	1	2	1	-1	-1	62	0	0	0	0.0598	0.3283	0.04	0.1018	0.2007	0.1565
	0.0568	0.0231	0.0228	0	0.0051	0	0.0051	0	0	0	0	0	#	62			

1994	1	4	1	2	1	-1	-1	72	0	0	0	0.0324	0.2312	0.2394	0.1745	0.1369	0.0949
	0.0084	0.0193	0.0182	0.014	0.0111	0.0071	0	0	0	0	0	0.0127	#	72			
1995	1	4	1	2	1	-1	-1	91	0	0	0	0	0.0723	0.3154	0.3879	0	0.1495
	0.0357	0.0089	0.0047	0.0047	0.0082	0.0127	0	0	0	0	0	0	#	91			
1996	1	4	1	2	1	-1	-1	134	0	0	0	0	0	0.1728	0.446	0.203	0.0749
	0.0624	0.0313	0	0	0.0065	0	0	0	0	0	0	0.0032	#	134			
1997	1	4	1	2	1	-1	-1	70	0	0	0	0.0135	0.0322	0.0873	0.2939	0.3596	0.1488
	0.0118	0	0.0124	0.0071	0.0071	0.0118	0.0071	0.0071	0	0	0	0	#	70			
1998	1	4	1	2	1	-1	-1	76	0	0	0	0	0.0606	0.3308	0.2881	0.2088	0.0922
	0.0117	0	0	0	0	0.0078	0	0	0	0	0	0	#	76			
1999	1	4	1	2	1	-1	-1	106	0	0	0	0.0153	0.0499	0.4618	0.1999	0.0744	0.1164
	0.0566	0.0208	0	0	0	0	0	0.0025	0	0	0	0.0025	#	106			
2000	1	4	1	2	1	-1	-1	59	0	0	0	0	0.3738	0.1787	0.1815	0.0618	0.106
	0.0587	0.0167	0.0026	0	0.0092	0	0.0059	0	0.0026	0	0	0.0026	#	59			
2001	1	4	1	2	1	-1	-1	47	0	0	0	0	0.0546	0.5729	0.1771	0.1751	0
	0	0.0092	0	0	0.0092	0	0	0	0.0021	0	0	0	#	47			
2002	1	4	1	2	1	-1	-1	200	0	0	0	0.0179	0.0934	0.2095	0.4108	0.1415	0.0616
	0.0194	0.0051	0.014	0.0063	0.0082	0.0068	0.0054	0	0	0	0	0	#	299			
2003	1	4	1	2	1	-1	-1	169	0	0	0	0.0349	0.4303	0.1575	0.1255	0.1724	0.0233
	0.0244	0.0136	0	0.0136	0.0045	0	0	0	0	0	0	0	#	169			
2004	1	4	1	2	1	-1	-1	185	0	0	0	0.0071	0.0521	0.6512	0.0844	0.0873	0.0648
	0.0108	0.0264	0.0124	0	0	0.0036	0	0	0	0	0	0	#	185			
2005	1	4	1	2	1	-1	-1	65	0	0	0	0	0.0202	0.2226	0.6468	0.0504	0.0201
	0.0337	0	0.0062	0	0	0	0	0	0	0	0	0	#	65			

2006	1	4	1	2	1	-1	-1	44	0	0	0	0	0	0.0509	0.1585	0.3874	0.2226
	0.1163	0.039	0.0231	0	0	0	0	0.002	0	0	0	0	#	44			
2007	1	4	1	2	1	-1	-1	62	0	0	0	0.0554	0.0633	0.0517	0.1577	0.2386	0.3016
	0.0546	0.0112	0.0112	0.0439	0.0112	0	0	0	0	0	0	0	#	62			
2008	1	4	1	2	1	-1	-1	105	0	0	0	0.0085	0.1966	0.2339	0.2222	0.1012	0.1084
	0.1031	0	0.0164	0	0	0.0098	0	0	0	0	0	0	#	105			
2009	1	4	1	2	1	-1	-1	117	0	0	0	0.1854	0.0352	0.2569	0.1365	0.1566	0.0638
	0.098	0.0411	0.0107	0.0157	0	0	0	0	0	0	0	0	#	117			
2010	1	4	1	2	1	-1	-1	200	0	0	0	0.0195	0.5864	0.0413	0.1583	0.0671	0.084
	0.0113	0.0213	0	0.0035	0	0.0036	0	0	0	0.0038	0	0	#	310			
2011	1	4	1	2	1	-1	-1	200	0	0	0	0.0021	0.0646	0.7976	0.0336	0.034	0.0261
	0.0176	0.0082	0.0014	0.0064	0.0042	0.0042	0	0	0	0	0	0	#	404			
2012	1	4	1	2	1	-1	-1	200	0	0	0	0	0.01	0.3389	0.4836	0.0658	0.0101
	0.0037	0.036	0.015	0.0147	0.0171	0	0	0	0	0	0.0051	0	#	237			
2013	1	4	1	2	1	-1	-1	200	0	0	0	0.0039	0.0079	0.0968	0.586	0.255	0.0081
	0.0029	0.0034	0.0139	0	0.0029	0.0193	0	0	0	0	0	0	#	241			
1991	1	5	1	2	1	-1	-1	36	0	0	0	0.0321	0.1284	0.4058	0.1554	0.0451	0.066
	0.0176	0.065	0.0229	0.0245	0.0196	0	0	0	0	0	0	0.0176	#	36			
1992	1	5	1	2	1	-1	-1	33	0	0	0	0.0556	0.0159	0.4546	0.2791	0.0653	0.0247
	0	0.0123	0	0.0741	0.0185	0	0	0	0	0	0	0	#	33			
1993	1	5	1	2	1	-1	-1	21	0	0	0.0286	0.0286	0.3341	0.1315	0.1914	0.0571	0.1143
	0.0571	0	0	0	0	0	0	0	0	0.0286	0	0.0286	#	21			
1994	1	5	1	2	1	-1	-1	29	0	0	0	0.0191	0.2728	0.5085	0.0976	0.0354	0
	0	0.0476	0	0	0	0	0	0	0	0	0	0.0191	#	29			

1995	1	5	1	2	1	-1	-1	53	0	0	0	0	0.0601	0.5195	0	0.3492	0.03
	0	0	0.0103	0	0.0103	0	0	0.0206	0	0	0	0	#	53			
1996	1	5	1	2	1	-1	-1	41	0	0	0	0.0128	0	0.1987	0.391	0.3147	0.0314
	0.0513	0	0	0	0	0	0	0	0	0	0	0	#	41			
1997	1	5	1	2	1	-1	-1	28	0	0	0	0	0.0807	0.1557	0.2781	0.38	0.0391
	0.0351	0.0156	0.0156	0	0	0	0	0	0	0	0	0	#	28			
1998	1	5	1	2	1	-1	-1	21	0	0	0	0	0.102	0.2517	0.3283	0.2568	0.0204
	0.0408	0	0	0	0	0	0	0	0	0	0	0	#	21			
1999	1	5	1	2	1	-1	-1	8	0	0	0	0	0	0.1862	0.4607	0.152	0.0883
	0	0.1128	0	0	0	0	0	0	0	0	0	0	#	8			
2000	1	5	1	2	1	-1	-1	12	0	0	0	0	0.62	0.1938	0.0969	0.0715	0
	0	0	0.0178	0	0	0	0	0	0	0	0	0	#	12			
-2001	1	5	1	2	1	-1	-1	1	0	0	0	0	0	1	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	#	1			
2002	1	5	1	2	1	-1	-1	50	0	0	0	0	0	0.3492	0.5748	0.076	0
	0	0	0	0	0	0	0	0	0	0	0	0	#	50			
2003	1	5	1	2	1	-1	-1	30	0	0	0	0	0.7509	0.1012	0.0886	0.0593	0
	0	0	0	0	0	0	0	0	0	0	0	0	#	30			
2004	1	5	1	2	1	-1	-1	43	0	0	0	0	0	0.7074	0.1921	0.0086	0.0686
	0.0233	0	0	0	0	0	0	0	0	0	0	0	#	43			
2005	1	5	1	2	1	-1	-1	52	0	0	0	0	0.045	0.2121	0.605	0.0978	0
	0.0268	0.0134	0	0	0	0	0	0	0	0	0	0	#	52			
2006	1	5	1	2	1	-1	-1	33	0	0	0	0	0.0373	0.165	0.0964	0.5854	0.0689
	0.047	0	0	0	0	0	0	0	0	0	0	0	#	33			

2007	1	5	1	2	1	-1	-1	28	0	0	0	0	0.0564	0.2025	0.1231	0.1792	0.3941
	0.0184	0	0.0263	0	0	0	0	0	0	0	0	0	#	28			
2008	1	5	1	2	1	-1	-1	44	0	0	0	0	0.1344	0.2317	0.3072	0.0941	0.0873
	0.1198	0.0256	0	0	0	0	0	0	0	0	0	0	#	44			
2009	1	5	1	2	1	-1	-1	102	0	0	0.0069	0.2528	0.1136	0.2083	0.1496	0.1765	0.0083
	0.0666	0.0175	0	0	0	0	0	0	0	0	0	0	#	102			
2010	1	5	1	2	1	-1	-1	85	0	0	0.0105	0.0591	0.5454	0.0373	0.0745	0.0517	0.1462
	0.0202	0.0468	0.0084	0	0	0	0	0	0	0	0	0	#	85			
2011	1	5	1	2	1	-1	-1	114	0	0	0	0	0.1276	0.5803	0.135	0.0315	0.0648
	0.0481	0	0.0128	0	0	0	0	0	0	0	0	0	#	114			
2012	1	5	1	2	1	-1	-1	39	0	0	0	0	0.014	0.4437	0.4486	0.014	0
	0.0064	0.0159	0.0382	0.0096	0	0	0.0096	0	0	0	0	0	#	39			
2013	1	5	1	2	1	-1	-1	45	0	0	0	0	0.0339	0.0679	0.6803	0.1903	0
	0.0055	0.0055	0.011	0	0	0.0055	0	0	0	0	0	0	#	45			

0 #_N_MeanSize-at-Age_obs

0 #_N_environ_variables

0 #_N_environ_obs

0 # N sizefreq methods to read

0 # no tag data

0 # no morph composition data

999 # end of file marker