Northeast Fisheries Science Center Reference Document 09-18

Stock Assessment of Scup for 2009

by Mark Terceiro

October 2009

Recent Issues in This Series

08-19 *11th Flatfish Biology Conference Program and Abstracts, Dec. 3-4, 2008, Water's Edge Resort and Spa, Westbrook, Connecticut*, by Conference Steering Committee: R Mercaldo-Allen (Chair), A Calabrese, D Danila, M Dixon, A Jearld, T Munroe, Deborah Pacileo, C Powell, and S Sutherland. November 2008.

08-20 *Estimated average annual bycatch of loggerhead sea turtles (Caretta caretta) in US Mid-Atlantic bottom otter trawl gear, 1996-2004 (2nd edition)*, by KT Murray. November 2008.

09-01 *Report of the Retrospective Working Group, January 14-16, 2008, Woods Hole, Massachusetts*, by CM Legault, Chair. January 2009.

09-02 *The Northeast Data Poor Stocks Working Group Report, December 8-12, 2008 Meeting*, by Northeast Data Poor Stocks Working Group. January 2009.

09-03 *The 2008 Assessment of the Gulf of Maine Atlantic Cod (Gadus morhua) Stock*, by RK Mayo, G Shepherd, L O'Brien, LA Col, and M. Traver. February 2009.

09-04 *Mortality and serious injury determinations for baleen whale stocks along the United States eastern seaboard and adjacent Canadian maritimes, 2003-2007*, by AH Glass, TVN Cole, and M Garron. March 2009.

09-05 *North Atlantic Right Whale Sighting Survey (NARWSS) and Right Whale Sighting Advisory System (RWSAS) 2008 Results Summary*, by C Khan, TVN Cole, P Duley, AH Glass, M Niemeyer, and C Christman. March 2009.

09-06 *A Bibliography of the Long-Finned Pilot Whale, Globicephala melas, and the Short-Finned Pilot Whale, Globicephala macrorhynchus, in the North Atlantic Ocean*, compiled by FW Wenzel, JR Nicolas, A Abend, and B Hayward. April 2009.

09-07 *Determination of Conversion Factors for Vessel Comparison Studies*, by HO Milliken and MJ Fogarty. April 2009.

09-08 *The 2008 Assessment of Atlantic Halibut in the Gulf of Maine-Georges Bank Region*, by LA Col and CM Legault. May 2009.

09-09 *Proceedings from a workshop to identify future research priorities for cod tagging in the Gulf of Maine, 12 February, 2009*, by S Tallack, Compiler/Editor. June 2009.

09-10 *48th Northeast Regional Stock Assessment Workshop (48th SAW) assessment summary report*, by Northeast Fisheries Science Center. July 2009.

09-11 *Ecosystem Assessment Report for the Northeast U.S. Continental Shelf Large Marine Ecosystem*, by the Ecosystem Status Program. July 2009.

09-12 *Description of the 2008 Oceanographic Conditions on the Northeast U.S. Continental Shelf*, by MH Taylor, T Holzwarth-Davis, C Bascuñán, and JP Manning. August 2009.

09-13 *Northeast Fisheries Science Center Publications, Reports, Abstracts, and Web Documents for Calendar Year 2008*, compiled by A Toran. August 2009.

09-14 *Update on Harbor Porpoise Take Reduction Plan Monitoring Initiatives: Compliance and Consequential Bycatch Rates from June 2007 through May 2008, Pinger Tester Development and Enforcement from January 2008 through July of 2009*, by CD Orphanides, S Wetmore, and A Johnson. September 2009.

09-15 *48th Northeast Regional Stock Assessment Workshop (48th SAW) Assessment Report*, by Northeast Fisheries Science Center. October 2009.

09-16 *Black Sea Bass 2009 Stock Assessment Update*, by GR Shepherd. October 2009.

09-17 *Stock assessment of summer flounder for 2009*, by M Terceiro. October 2009.

Northeast Fisheries Science Center Reference Document 09-18

Stock Assessment of Scup for 2009

by Mark Terceiro

NOAA's National Marine Fisheries Serv., 166 Water St., Woods Hole MA 02543

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Northeast Fisheries Science Center
Woods Hole, Massachusetts

October 2009

Northeast Fisheries Science Center Reference Documents

This series is a secondary scientific series designed to assure the long-term documentation and to enable the timely transmission of research results by Center and/or non-Center researchers, where such results bear upon the research mission of the Center (see the outside back cover for the mission statement). These documents receive internal scientific review, and most receive copy editing. The National Marine Fisheries Service does not endorse any proprietary material, process, or product mentioned in these documents.

All documents issued in this series since April 2001, and several documents issued prior to that date, have been copublished in both paper and electronic versions. To access the electronic version of a document in this series, go to *http://www.nefsc.noaa.gov/nefsc/publications/*. The electronic version is available in PDF format to permit printing of a paper copy directly from the Internet. If you do not have Internet access, or if a desired document is one of the pre-April 2001 documents available only in the paper version, you can obtain a paper copy by contacting the senior Center author of the desired document. Refer to the title page of the document for the senior Center author's name and mailing address. If there is no Center author, or if there is corporate (*i.e.*, non-individualized) authorship, then contact the Center's Woods Hole Laboratory Library (166 Water St., Woods Hole, MA 02543-1026).

This document's publication history is as follows: manuscript submitted for review August 24, 2009; manuscript accepted through technical review October 25, 2009; manuscript accepted through policy review October 26, 2009; and final copy submitted for publication August 24, 2009. Pursuant to section 515 of Public Law 106-554 (the Information Quality Act), this information product has undergone a pre-dissemination review by the Northeast Fisheries Science Center, completed on October 25, 2009. The signed pre-dissemination review and documentation is on file at the NEFSC Editorial Office. This document may be cited as:

Terceiro M. 2009. Stock assessment of scup for 2009. US Dept Commer, Northeast Fish Sci Cent Ref Doc. 09-18; 82 p. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026, or online at http://www.nefsc.noaa.gov/nefsc/publications/

Table of Contents

List of Tables

List of Figures

EXECUTIVE SUMMARY

The 2008 Northeast Data Poor Stocks (DPS) Peer Review Panel accepted a revised stock assessment for scup using a statistical catch at age model as the basis for biological reference points and status determination, with fishery and survey catch data through 2007. The new model of scup population dynamics provided a more stable tool for monitoring stock status and specifying annual fishery regulations than the previous single index-based model. This 2009 assessment update uses the same model configuration as the 2008 DPS assessment, with fishery and survey catch information through 2008. The 2009 evaluation of stock status is made with respect to the 2008 DPS biological reference points.

The 2008 DPS Panel recommended F40% as the proxy for FMSY, and the corresponding SSBF40% as the proxy for SSBMSY. The proxy for FMSY = 0.177, the proxy estimate for SSBMSY = 92,044 mt, and the proxy estimate for MSY = 16,161 mt (13,134 mt of landings, 3,027 mt of discards). Fishing mortality varied between F = 0.1 and F = 0.3 during the 1960s and 1970s, and then increased during the 1980s and early 1990s, peaking at about F = 1.0 in 1994. Fishing mortality decreased after 1994, falling to less than F = 0.1 since 2003, with F in 2008 = 0.048, well below the FMSY proxy. There is a 50% chance that F in 2008 was between 0.041 and 0.066. Spawning stock biomass (SSB) decreased from about 100,000 mt in 1963 to about 50,000 mt in 1969, then increased to about 75,000 mt during the late 1970s. SSB declined through the 1980s and early 1990s to less than 5,000 mt in the mid-1990s. With greatly improved recruitment and low fishing mortality rates since 1998, SSB increased to about 188,000 mt in 2008, well above the SSBMSY proxy. There is a 50% chance that SSB in 2008 was between 180,000 and 196,000 mt. Recruitment at age 0 averaged 92 million fish during 1963-1983, the period in which recruitment estimates are influenced mainly by the assessment model stock-recruitment relationship. Since 1984, recruitment estimates from the model are influenced mainly by the fishery and survey catches at age, and recruitment at age 0 has averaged 110 million fish during 1984-2008. The 1999 and 2000 year classes are estimated to be the largest of the time series, at 218 and 267 million age 0 fish. Recruitment exceeded the 1984-2008 average of 110 million in 2001, 2004-2006, and 2008. There is no consistent retrospective pattern in F, SSB, or recruitment evident in the 2009 updated assessment model. While the MSY estimate appears feasible given historical evidence from the fishery, the 2008 DPS Panel and 2009 Southern Demersal Working Group both advised that a gradual increase in the TAC/TAL toward the MSY level would facilitate an evaluation of the performance of the new assessment model and BRPs in monitoring stock status, while reducing the risk to the stock due to rapidly increased catch.

INTRODUCTION

The Stock Assessment Workshop (SAW) Southern Demersal Working Group (SDWG) met on June 18, 2009 by conference call to review the assessment of scup updated with data through 2008. The following scientists and managers contributed data compilations and expertise to the assessment:

Erin Bohaboy	University of Rhode Island Graduate School of Oceanography (URIGSO)
Chris Bonzak	Virginia Institute of Marine Science (VIMS)
Jeff Brust	New Jersey Department of Fish and Wildlife (NJDFW)
Don Byrne	New Jersey Department of Fish and Wildlife (NJDFW)
Paul Caruso	Massachusetts Division of Marine Fisheries (MADMF)
Jessica Coakley	Mid-Atlantic Fishery Management Council (MAFMC)
Scott Crosson	North Carolina Division of Marine Fisheries (NCDMF); Mid-Atlantic Fishery Management Council (MAFMC) Scientific and Statistical Committee (SSC)
Toni Kerns	Atlantic States Marine Fisheries Commission (ASMFC)
Cynthia Jones	Old Dominion University; Mid-Atlantic Fishery Management Council (MAFMC) Scientific and Statistical Committee (SSC)
Jason McNamee	Rhode Island Division of Fish and Wildlife (RIDFW)
Tom Miller	University of Maryland; Mid-Atlantic Fishery Management Council (MAFMC) Scientific and Statistical Committee (SSC)
Rob O'Reilly	Virginia Marine Resource Commission
Eric Powell	Rutgers University
Mike Ruccio	National Marine Fisheries Service (NMFS) Northeast Regional Office (NERO)
Mark Terceiro	National Marine Fisheries Service (NMFS) Northeast Fisheries Science Center (NEFSC)
Alice Weber	New York Department of Environmental Conservation (NYDEC)
Greg Wojcik	Connecticut Department of Environmental Protection (CTDEP)

BACKGROUND

Biology

Scup (*Stenotomus chrysops*) is a schooling continental shelf species of the Northwest Atlantic that is distributed primarily between Cape Cod and Cape Hatteras (Morse 1978). Scup undertake extensive migrations between coastal waters in summer and offshore waters in winter. Scup migrate north and inshore to spawn in spring, with larger scup (age 2 and older) tending to arrive in spring first, followed by smaller scup (Neville and Talbot 1964; Sisson 1974). Larger scup are found during the summer near the mouth of larger bays and in the ocean within 20-fathoms, and often inhabit rough bottom areas. Smaller scup are more likely to be found in shallow, smooth bottom areas of bays during summer (Morse 1978). Scup migrate south and offshore in autumn as the water temperature decreases, arriving in offshore wintering areas by December (Hamer 1970; Morse 1978).

Spawning occurs from May through August and peaks in June. About 50% of age-2 scup are sexually mature (about 17 cm total length; Morse 1978), while nearly all scup of age 3 and older are mature. Scup reach a maximum fork length of at least 41 cm and a maximum age of at least 14 years, with a likely maximum of 20 years (Dery and Rearden 1979). The largest and oldest scup sampled in NEFSC surveys (1973, 1978) were fish 38-41 cm (fork length) and 14 years old. The largest and oldest scup in NEFSC commercial fishery samples (1974) was 40 cm (fork length) and 14 years old. The instantaneous natural mortality rate (M) for scup has been assumed to be 0.20 (Crecco *et al.* 1981, Simpson *et al.* 1990) in this and all previous stock assessments.

Fishery Management

The MAFMC and ASMFC jointly manage scup under Amendment 8 (1997) to the Summer Flounder, Scup, and Black Sea Bass Fishery Management Plan (FMP). The assessment and management unit includes all scup from Cape Hatteras, NC north to the US-Canada border. Tagging studies (e.g., Neville and Talbot 1964; Cogswell 1960, 1961; Hamer 1970, 1979) have indicated the possibility of two stocks of scup, one in Southern New England waters and another extending south from New Jersey waters. However, the lack of definitive locations for tag return data coupled with distributional data from the NEFSC bottom trawl surveys supports the concept of a single unit stock (Mayo 1982).

Amendment 8 to the FMP established a recovery plan for scup under which exploitation rates were to be reduced to 47% (F=0.72) during 1997-1999, to 33% (F=0.45) during 2000-2001, and to 21% (F=0.26) during 2002-2007. These goals were to be attained through implementation of a Total Allowable Catch (TAC) that included a commercial quota and a recreational harvest limit, commercial fishery minimum net mesh, trap vent and fish sizes and closed areas, and recreational fishery minimum fish sizes, possession limits, and closed seasons.

Amendment 12 (1998) to the FMP established a biomass threshold (a proxy for one-half BMSY) for scup based on the three-year moving average of the NEFSC spring bottom trawl survey index of Spawning Stock Biomass (SSB) during 1977-1979, which was perceived to be a period when the stock was near one-half BMSY. The scup stock was considered to be overfished when the SSB index fell below a value of 2.77 SSB kg per tow. Amendment 12 defined overfishing for scup to occur when the fishing mortality rate exceeded the threshold fishing mortality of Fmax = 0.26 (as a proxy for FMSY).

Broad scale Gear Restricted Areas (GRAs) for scup were implemented in November 2000 under the framework provisions of the FMP to reduce discards of scup in small mesh fisheries for *Loligo* squid and silver hake. Two Northern Areas off Long Island were implemented for November through January, while a Southern Area off the mid-Atlantic coast was implemented for January through April. The size and boundaries of the GRAs were modified in late 2000 and again in 2005 in response to commercial fishing industry recommendations.

Amendment 14 (2007) to the FMP defined the biomass target and implemented a stock rebuilding plan for scup. The stock was to fully rebuild to the biomass target by January 1, 2015.

The proxy for BMSY was two times the 3-year moving average of the NEFSC spring index of SSB during 1977-1979 noted earlier, or 2*2.77 = 5.54 SSB kg per tow. A target fishing mortality rate of F = 0.10 was to be applied in each year of a 7 year rebuilding period beginning in 2008. A TAC of 4,491 mt (9.90 million lbs) and corresponding Total Allowable Landings (TAL) of 3,329 mt (7.34 million lbs) were established for 2008 to achieve the target F.

The current overfished and overfishing definitions are based on revisions to the FMP through Framework 7 (2007) and use the values established in Amendments 12 (1998) and 14 (2007) as follows:

> "The maximum fishing mortality threshold for each of the species under the FMP is defined as FMSY (or a reasonable proxy thereof) as a function of productive capacity, and based upon the best scientific information consistent with National Standards 1 and 2. Specifically, FMSY is the fishing mortality rate associated with MSY. The maximum fishing mortality threshold (FMSY) or a reasonable proxy may be defined as a function of (but not limited to): total stock biomass, spawning stock biomass, total egg production, and may include males, females, both, or combinations and ratios thereof which provide the best measure of productive capacity for each of the species managed under the FMP. Exceeding the established fishing mortality threshold constitutes overfishing as defined by the Magnuson-Stevens Act."

> "The minimum stock size threshold for each of the species under the FMP is defined as one-half BMSY (or a reasonable proxy thereof) as a function of productive capacity, and based upon the best scientific information consistent with National Standards 1 and 2. The minimum stock size threshold (one-half BMSY) or a reasonable proxy may be defined as a function of (but not limited to): total stock biomass, spawning stock biomass, total egg production, and may include males, females, both, or combinations and ratios thereof which provide the best measure of productive capacity for each of the species managed under the FMP. The minimum stock size threshold is the level of productive capacity associated with the relevant one-half MSY level. Should the measure of productive capacity for the stock or stock complex fall below this minimum threshold, the stock or stock complex is considered overfished. The target for rebuilding is specified as BMSY (or reasonable proxy thereof) at the level of productive capacity associated with the relevant MSY level, under the same definition of productive capacity as specified for the minimum stock size threshold."

Stock Assessment

A peer-reviewed assessment including an analytical population model was accepted in 1995 by SAW 19 (NEFSC 1995). The assessment featured a virtual population analysis (VPA) modeled in the ADAPT framework (Conser and Powers 1990), with commercial and recreational landings and discards at age estimates, and with state and NEFSC abundance indices used for calibration. The 1995 SAW 19 assessment indicated that F in 1993 was 1.3, and SSB was 4,600 mt. A yield per recruit (YPR) analysis indicated that Fmax = 0.236.

The VPA was updated through 1996 and reviewed by the 1997 SAW 25 (NEFSC 1997), but due to concerns over the low intensity of fishery length sampling in the 1990s, uncertainty about the magnitude of commercial discards in the late 1990s, and the ongoing high variability and imprecision of survey indices, the VPA was not accepted as a basis for management decisions. Assessment conclusions were therefore based primarily on trends in NEFSC and state agency survey indices and catch curve analyses using those survey data. The 1997 SAW 25 was able to conclude that in 1996 scup were "over-exploited and near record low abundance levels."

The scup assessment was next updated through 1997 and reviewed by the 1998 SAW 27 (NEFSC 1998). Several configurations of a surplus production model (ASPIC; Prager 1994) were reviewed in addition to an updated VPA, but like the VPA, the production model results were not accepted due to concerns over the validity of the input fishery and survey data. An updated YPR analysis was accepted and indicated that Fmax = 0.26. The 1998 SAW 27 concluded that "A VPA or other analytical model formulation for scup will not be feasible until the quality of the input data, particularly the precision of discard estimates, is significantly improved" and that scup was "over exploited and at a low biomass level."

The 1998 SAW 27 Panel recommended the scup assessment be based on the long-term time series of NEFSC trawl survey indices and fishery catches. The Panel noted that commercial landings were sustained at about 19,000 mt annually during the mid-1950s to mid-1960s, and concluded that the stock was likely near BMSY during that period (Figure 1). The nearest subsequent peak in NEFSC survey indices occurred in the late 1970s. Commercial and total fishery catches in the late 1970s were about one-half of those in the 1950s to 1960s, and so the late 1970s were identified as a period when the stock was likely to have been near one-half of BMSY. The Panel considered the NEFSC spring survey series to be most representative of SSB, since older ages were better represented in the age structure than in the NEFSC fall survey or other state agency surveys. The 1998 SAW 27 Panel recommended that the three-year moving average of the NEFSC spring bottom trawl survey index of SSB during 1977-1979 (2.77 SSB kg per tow) be used as the proxy biomass threshold (one-half BMSY) and that Fmax = 0.26 be used as the proxy fishing mortality threshold (FMSY). Those recommendations were subsequently adopted for the Biological Reference Points (BRPs) in Amendment 12 to the FMP.

The scup assessment was next updated through 1999 and reviewed by the 2000 SAW 31 (NEFSC 2000). The assessment continued to be based on trends in research survey indices and fishery catches and indicated that the stock was overfished and that overfishing was occurring. The stock assessment was reviewed again by the 2002 SAW 35 and included fishery data through 2001 (NEFSC 2002). The assessment was again based on trends in research survey indices and fishery catches, but indicated that the stock was no longer overfished, although the 2002 SAW 35 Panel concluded that "stock status with respect to the overfishing definition cannot currently be evaluated," due to the uncertainty of F estimates derived from research survey catch curve calculations. The 2002 SAW 35 Panel found sufficient evidence to conclude that "The relative exploitation rates have declined in recent years..." and that "Survey observations indicated strong recruitment and some rebuilding of age structure."

During 2002-2008, the status of the stock was evaluated by the MAFMC Monitoring Committee using trends in research survey indices and fishery catches. A relative exploitation index based on the annual total fishery landings and the NEFSC spring three-year average SSB index was used as a proxy for F to monitor status with respect to overfishing and provide guidance to the specification of the annual TAC. A projection of the NEFSC spring survey SSB index using assumptions about maturity, partial recruitment to the survey, and the level of future recruitment as indexed by the NEFSC spring survey at age 1 was used in Amendment 14 to the FMP to forecast stock rebuilding and set the F target for 2008-2105. An update to the status monitoring metrics was completed in 2008 to aid in the specification of fishery regulations for 2009. The update indicated that while the stock was overfished in 2007, the exploitation rate was at about the F target, suggesting that overfishing was not occurring in 2007. However, the stock rebuilding progress was slower than forecast by the Amendment 14 projection, with the NEFSC spring 2007 SSB index (three-year average = 1.16 kg per tow) at only 56% of the projected 2007 index (2.08 kg per tow).

The most recent peer review of the scup assessment was conducted by the 2008 Northeast Data Poor Stocks (DPS) Peer Review Panel, which accepted an ASAP statistical catch at age (SCAA) model (NFT 2008a) as the basis for biological reference points and status determination, with fishery and survey catch data through 2007. The new model of scup population dynamics was expected to provide a more stable tool for monitoring stock status and specifying annual fishery regulations than the previous single index-based model. The assessment indicated that the stock was not overfished and overfishing was not occurring in 2008, relative to the revised biological reference points. Fishing mortality was estimated to have decreased rapidly after 1994, with F in 2007 = 0.054. With greatly improved recruitment and relatively low fishing mortality rates since 1998, SSB was estimated to have steadily increased to about 119,300 mt in 2007. There was no consistent retrospective pattern in F, SSB, or recruitment evident in the 2008 assessment model (NEFSC 2009). This 2009 assessment update uses the same model configuration as the 2008 DPS assessment, with fishery and survey catch information through 2008. The 2009 evaluation of stock status is made with respect to the 2008 DPS biological reference points.

COMMERCIAL LANDINGS

US total commercial landings averaged over 18,000 mt per year from 1950 to 1965, peaking at over 22,000 mt in 1960, and then decreased to less than 10,000 mt per year in the late 1960s. Landings fluctuated between about 5,000 and 10,000 mt from 1970 to the early 1990s and then decreased to about 1,200 mt in 2000, less than 6% of the peak observed in 1960. Commercial landings have since increased to average about 4,200 mt during 2003-2008 (Figure 1). About eighty percent of the commercial landings of scup for the period 1979-2008 were in Rhode Island (38%), New Jersey (26%), and New York (16%; Table 1). The otter trawl is the principal commercial fishing gear, accounting for about 75% of the total catch during 1979-2008 (Table 2). The remainder of the commercial landings is taken by floating trap (11%) and hand lines (7%), with paired trawl, pound nets, and pots and traps each contributing between 1 and 4%.

COMMERCIAL DISCARDS

The NEFSC Fishery Observer Program has collected information on landings and discards in the commercial fishery for 1989-2008. Northeast Region (NER; ME-VA) discard estimates were raised to account for North Carolina landings. A discard mortality rate of 100% was assumed because there are no published estimates of scup discard mortality rates. This assumption is based on limited observations and is a point of contention between scientists and fishermen. Previous peer reviews of the assessment have recommended that research be conducted to better characterize the discard mortality rate of scup in different gear types in order to more accurately quantify the absolute magnitude of scup discard mortality (NEFSC 1995, 1997, 1998, 2000, 2002, 2009). Quantifying discards from the commercial fishery is necessary for a reliable scup assessment, but low sample sizes in the past have resulted in uncertain estimates. Despite the uncertainty of the discard data, recent peer review panels have concluded that commercial discarding of scup has been high during most of the last 20 years, generally approaching or exceeding the commercial landings. Since the implementation of the GRAs in 2000, estimated discards as a proportion of the total commercial catch have decreased, averaging about 35%.

Commercial discards for scup are estimated using geometric mean discards to landings (GMDL) ratios. Ratios of discards to landings by landings level (for trip landings < 300 kg (661 lbs), the "bycatch fishery"; or => 300 kg, the "directed fishery") and half-year are calculated and multiplied by corresponding observed landings from the NEFSC Dealer Report database to provide estimates of discards. Geometric mean rates (re-transformed, uncorrected, mean ln-transformed Discards to Landings per trip) are used because the distributions of landings, discards and the ratio of discards to landings on a per-trip basis in the scup fishery are highly variable and positively skewed. Observed trips with both scup landings and discard were used to calculate per trip discard to landings ratios. Only trips with both non-zero landings and discards could be used for this approach to avoid division by zero. The number of trawl gear trips used to calculate geometric mean discard-to-landings ratios (GMDL) by half year for 1997-2008 ranged from 1 to 104 for trips < 300 kg and from 1 to 35 for trips =>300 kg, with the best sampling occurring since 2003. No trawl gear trips were available for half year two in 1997 and 1999 for trips < 300 kg and for half year two in 1997-2001 for trips => 300 kg. The ratio calculated for half year one was used to estimate discards for half year two when no trawl gear trips were available in half year two. The ratios ranged from 0.03 in 2004 (half year two, trips => 300 kg) to 121.71 in 1998 (half year one, trips => 300 kg; Table 3).

The large 1998 "directed fishery" ratio and subsequent very high annual discard estimate (111,973 mt) was based on one trawl gear trip. About 93% of the discard from that trip was attributable to a single tow in which an estimated 68.2 mt (150,000 lbs.) of scup were captured. This tow was not lifted from the water and the captain of the vessel estimated the weight of the catch. There has been debate concerning the validity of the catch weight estimate and whether or not it was representative of other vessels or trips in the fishery. However, the observation was reported by a trained NEFSC observer and was therefore included in the initial calculation of the estimate of scup discards (Tables 3-4). Peer reviews of the assessment have since concluded that the 1998 estimate is infeasible, and it has been replaced by the mean of the 1997 and 1999 estimates (3,331 mt) in subsequent tabulations of catch and in subsequent modeling (Tables 5, 9).

RECREATIONAL CATCH

Scup is the object of a major recreational fishery, with the greatest proportion of catches taken in the states of Massachusetts, Rhode Island, Connecticut and New York. Estimates of the recreational catch in numbers were obtained from the NMFS Marine Recreational Fishery Statistics Survey (MRFSS) for 1981-2008. These estimates were available for three categories: type A - fish landed and available for sampling, type B1 - fish landed but not available for sampling and type B2 - fish caught and released. The estimated recreational landings (types A and B1) in weight during 1981-2008 averaged about 2,000 mt per year (Table 5). Since 1981, the recreational landings have averaged 30% of the commercial and recreational landings total.

The estimated recreational discard in weight during 1984-2008 ranged from 6 mt in 1999 to a high of 393 mt in 2006, averaging about 100 mt per year (Table 5). The weight of discards has been directly calculated only for those years (1984 and later) for which recreational catch at age has been compiled. In compilations of total fishery catch for earlier years, the recreational discards was assumed to be approximately 2% of the estimated recreational landings, based on the mean discard percentage for 1984-1996, the time period with catch at age estimates before the implementation of the FMP. No length frequency samples of the scup discard were collected under the MRFSS program before 2005, so recreational discards were assumed to be fish aged 0 and 1, in the same relative proportions and with the same mean weight as the landed catch less than state regulated minimum fish sizes. An inspection of discard length frequency samples from the New York recreational fishery for 1989-1991 indicated that this assumption was reasonable. Since 2005 length samples of the recreational fishery discard collected in the MRFSS For-Hire Survey sampling have been used the characterize the size frequency of the discard.

The discard mortality rate in the recreational fishery has been reported to range from 0-15% (Howell and Simpson 1985) and from 0-14% (Williams, pers. comm.). Howell and Simpson (1985) found mortality rates were positively correlated with size, due mainly to the tendency for larger fish to take the hook deep in the esophagus or gills. Williams more clearly demonstrated increased mortality with depth of hook location, as well as handling time, but found no association with fish size. Based on these studies, a discard mortality rate in the recreational fishery of 15% has been used in this and previous assessments.

COMMERCIAL FISHERY LANDINGS AT LENGTH AND AGE

The NER commercial fishery length frequency sampling is summarized in Table 6. Annual sampling intensity has varied from 18 to 687 mt per 100 lengths, with sampling exceeding the informal threshold criterion of 200 mt per 100 lengths since 1994. For this assessment, commercial fishery landings at age beginning in 1984 have been updated through 2008, with samples generally pooled by market category (pins/small, medium, large/mix, jumbo, and unclassified) and by half-year (January-June, July-December); samples were pooled on a quarterly basis (e.g., January-March) for 2004-2008. Estimates of commercial fishery landings at age (Figure 2) and mean weights at age are presented in Tables 7-8.

COMMERCIAL FISHERY DISCARDS AT LENGTH AND AGE

The intensity of length sampling of discarded scup from the NEFSC Fishery Observer Program declined in 1992-1995 relative to 1989-1991 (Table 9). Sampling intensity ranged from 489 to 335 mt per 100 lengths sampled in 1992-1995, failing to meet the informal criterion of 200 mt per100 lengths. Sampling intensity improved to 100 mt per 100 lengths in 1996, but then declined to over 200 mt per 100 lengths in 1997-1999. Sampling intensity has generally met the 200 mt per 100 lengths threshold since 2000. The mean weight of the discard was estimated from length frequency data using a length-weight equation, total numbers discarded were then estimated by dividing total weight by mean weight, and numbers at length were then calculated from the length-frequency distribution. Discards at length were aged using a combination of commercial and survey age-length keys, with discards at age dominated by fish aged 0, 1, or 2, depending on the year under consideration. Estimates of commercial fishery discards at age (Figure 3) and mean weights at age are presented in Tables 10-11.

RECREATIONAL FISHERY LANDINGS AT LENGTH AND AGE

For the recreational fishery, length sampling intensity has varied from 45 to 471 mt per 100 lengths. Sampling in all years except one (1984) during 1981-1987 failed to satisfy the above criterion, but since 1987 the criterion has been met except for 1999-2000 (Table 12).

Numbers at length for recreational landings were determined from recreational fishery length samples pooled by half-years (January-June; July-December) over all regions and fishing modes, and were converted to numbers at age by applying half-year age-length keys constructed from NEFSC commercial and survey samples. Age-length keys from spring surveys and first and second quarter commercial samples were applied to numbers at length from the first half of the year, while age-length keys from fall surveys and third and fourth quarter commercial samples were applied to numbers at length from the second half of the year. Estimates of recreational fishery landings at age (Figure 4) and mean weights at age are presented in Tables 13-14.

RECREATIONAL FISHERY DISCARDS AT LENGTH AND AGE

As noted earlier, no length samples of the discard were routinely collected under the MRFSS program prior to 2005, so recreational discards were assumed to be fish less than state minimum sizes, in the same relative proportions at length as the landed catch less than the respective state minimum sizes (i.e., sub-legal fish). This assumption for the coastwide fishery is supported by discard length frequency samples from the New York recreational fishery (1989-1991) and samples collected since 2005 by the MRFSS For-Hire Survey. Since 2005, the MRFSS For-Hire Survey discard samples have been used in concert with the MRFSS sub-legal landed lengths to characterize the length frequency of the recreational discard. Numbers at length were converted to numbers at age by applying half-year (January-June; July-December) age-length keys constructed from NEFSC commercial and survey samples. As noted earlier, a 15% discard mortality rate is assumed. Estimates of recreational fishery discards at age (Figure 5) and mean weights at age are presented in Tables 15-16.

TOTAL FISHERY CATCH

Estimates of the total fishery catch at age and mean weights at age for 1984-2008 (the time series is limited by the availability of sampled fishery ages) are presented in Tables 17-18. An extended time series of the total catch of scup has been estimated to provide an historical perspective of the exploitation of scup in the years before fishery aging data were available (Table 19). These estimates include commercial and recreational landings and discards. The catches before 1981 are the least reliable due to uncertainty about a) the magnitude of domestic commercial fishery discards, b) the magnitude of the distant water fleet (DWF) catch and c) the uncertainty of assumptions made to estimate the recreational catch (50% reduction from interpolations made in Mayo 1982 for 1960-1978; recreational discards assumed to be 2% of the adjusted recreational landings). For years in which no commercial fishery observer data were collected (prior to 1989), commercial discards were estimated using the mean of landings to discards ratios for 1989-2001.

RESEARCH SURVEY INDICES OF ABUNDANCE

NEFSC

The NEFSC spring and fall research surveys provide long time series of fishery-independent indices for scup. The NEFSC spring and fall surveys are conducted annually during March-May and September-November, ranging from just south of Cape Hatteras, NC to Canadian waters. NEFSC spring and fall abundance and biomass indices for scup exhibit considerable inter-annual variability (Table 20). NEFSC spring survey catches are characterized mainly by scup of ages 1 and 2, while the fall survey often captures large numbers of age 0 fish.

The NEFSC survey indices sometimes appear to mainly reflect the availability of scup to the survey, rather than true abundance, making it difficult to interpret large inter-annual changes in the indices. For example, the 2002 spring SSB index was about twice the second highest spring SSB index, which was observed in 1977 (Figure 6). The spring numeric abundance indices are similar; the 2002 index is the highest observed in the series and about twice the 1970 index. These dramatic increases were evident across all ages in the estimated 2002 spring numbers at age (Table 21; Figure 7). However, the previous Fall survey estimates of numbers at age in 2001 had not reflected relatively large values from which the corresponding 2002 spring numbers at age might have been expected to derive (Table 22, Figure 8), nor did they subsequently translate to exceptional indices of biomass or SSB in fall 2002 or spring 2003. Spring survey SSB and abundance indices decreased subsequent to 2002, but are still above the low values of the late 1990s. Fall survey abundance and biomass have been highly variable since 2002.

The NEFSC winter survey was started in 1992 primarily as a flatfish survey, was conducted during February, and ranged from Cape Hatteras, NC to the southwestern part of Georges Bank. The winter survey 2002 abundance and biomass indices were, like the spring survey, the largest of the time series (Table 23). Similar to the spring estimates, numbers at age estimated for the 2002 winter survey were also exceptionally large (Table 24, Figure 9). Winter survey abundance and biomass decreased subsequent to 2002, but were still above the low values of the late 1990s. The winter trawl series ended in 2007.

Massachusetts DMF

The Massachusetts Division of Marine Fisheries (MADMF) has conducted a semi-annual bottom trawl survey of Massachusetts territorial waters in May and September since 1978. Survey coverage extends from the New Hampshire to Rhode Island boundaries and seaward to three nautical miles, including Cape Cod Bay and Nantucket Sound. The study area is stratified into geographic zones based on depth and area. The MADMF spring survey catches are characterized mainly by scup of ages 1 and 2, while the fall survey often captures large numbers of age 0 fish. The spring biomass and abundance indices decreased sharply from a high in the early 1980s to relatively low levels through the remainder of the time series, with the exception of spikes in 1990, 2000, and 2002, the latter event in common with the NEFSC spring trawl survey (Table 25, Figure 10). The MADMF fall indices can include large numbers of age 0 fish, and on a numeric basis are more variable than the spring indices (Figure 11). The fall biomass index is less variable than the spring, however, and exhibits an increasing trend since the mid 1990s (Figure 10).

Rhode Island DFW

The Rhode Island Division of Fish and Wildlife (RIDFW) has conducted autumn and spring surveys based on a stratified random sampling design since 1979. Three major fishing grounds are considered in the spatial stratification, including Narragansett Bay, Rhode Island Sound, and Block Island Sound. Stations are either fixed or randomly selected for each stratum. The RIDFW spring survey mainly catches scup of ages 1 and 2. The spring indices show relatively low scup abundance and biomass through 1999 followed by a steep increase during

2000-2002, in common with the NEFSC and MADMF indices (Table 26; Figure 12). The RIDFW fall survey is dominated by age 0 scup (Figure 11). Fall indices show a general increase to its 1993 peak, followed by a steep decline until 1998, and a general increase since then (Figure 12).

Connecticut DEP

The Connecticut Department of Environmental Protection (CTDEP) trawl survey program was initiated in May 1984 and encompasses both New York and Connecticut waters of Long Island Sound. The stratified random design survey is conducted in the spring (April-June) and fall (September-October). The CTDEP spring indices indicate relatively low abundance through most of the survey period, but have increased substantially since 1999 (Table 27, Figure 13). The CTDEP fall survey, which often catches large numbers of age-0 scup, indicates that recruitment was relatively stable during most of the survey period, but the aggregate fall indices have also increased substantially since 1999 (Table 28, Figures 11, 13). The age compositions of the CTDEP spring and fall surveys generally include a higher proportion of age 2 and older fish than the other state or NEFSC surveys (Figures 14-15).

New York DEC

The New York Department of Environmental Conservation (NYDEC) initiated a small mesh trawl survey in 1985 to collect fisheries-independent data on the age and size composition of scup in local waters. This survey is conducted in the Peconic Bays, the estuarine waters which lie between the north and south forks of eastern Long Island. The NYDEC survey provides age 0, 1, and 2+ indices of scup abundance. The age 0 indices are generally low over the survey period, with peaks in 2000, 2002, 2003, 2006, and 2007 that may indicate recruitment of strong cohorts in those years (Table 29, Figure 11). In the early years of the survey there often has not been a strong correspondence between the age 0 indices and age 1 and 2+ indices in the following years (Figure 16).

New Jersey BMF

The New Jersey Bureau of Marine Fisheries (NJBMF) conducts a stratified random bottom trawl survey of New Jersey coastal waters from Ambrose Channel south to Cape Henlopen Channel. Latitudinal strata boundaries correspond to those in the NEFSC trawl survey; longitudinal boundaries correspond to the 30, 60, and 90 foot isobaths. Each survey includes two tows per stratum plus one additional tow in each of nine larger strata for a total of 39 tows. The NJBMF abundance indices exhibit variable patterns over the early part of the time series. The index reached a minimum in 1996, and has generally increased since then (Table 29; Figure 17).

University of Rhode Island Graduate School of Oceanography (URIGSO)

University of Rhode Island Graduate School of Oceanography (URIGSO) has conducted a standardized, two-station trawl survey in Narragansett Bay and Rhode Island Sound since the 1950s, with consistent sampling since 1963. Irregular length-frequency samples for scup indicate that most of the survey catch is of fish from ages 0 to 2. The aggregate numbers-based index reached a peak in the late 1970s, was relatively low during the late 1990s, reached a second peak in 2002 in common with the NEFSC, MADMF, RIDFW spring biomass indices, and has since been variable at relatively high level (Table 30, Figure 18).

Virginia Institute of Marine Science (VIMS)

The Virginia Institute of Marine Science (VIMS) has conducted a juvenile scup survey in lower Chesapeake Bay during June-September since 1988. The VIMS age-0 scup survey shows a general decline in recruitment from relatively high levels with peaks in 1990 and 1993 to relatively low levels from 1994 to 2004, and the indication of stronger year classes in 2006 and 2007 (Table 29, Figure 11).

The VIMS Chesapeake Bay Multispecies Monitoring and Assessment Program (ChesMMAP) trawl survey is designed to support bay-specific stock assessment activities at both a single and multispecies scale. While no single gear or monitoring program can collect all of the data necessary for quantitative assessments, ChesMMAP was designed to fulfill data gaps by maximizing the biological and ecological data collected for several recreationally and commercially important species in the bay. Total abundance and biomass indices composed mainly of age 0 and 1 fish are available since 2002, and indicate strong recruitment in 2005 and 2006 (Table 31, Figure 19).

The VIMS NEAMAP survey was started in Fall 2006, providing research survey samples along the Atlantic Coastal waters from New York to North Carolina, in depths of 20-90 feet (9-43 meters). Due to the brevity of the series, it has not yet been included in population models (Table 32).

2009 UPDATED FISHING MORTALITY RATE AND STOCK SIZE ESTIMATES

Fishing mortality rates and stock sizes were estimated using the ASAP SCAA model (NFT 2008a). The catch at age, mean weight at age, maturity at age, and survey index calibration time series were input as in the 2008 DPS assessment (NEFSC 2009). Winter, spring, and mid-year survey indices and all survey recruitment (age-0) indices were compared to population numbers of the same age at the beginning of the same year. Fall survey indices were compared to population numbers one year older at the beginning of the next year. Lognormal error distributions were assumed for the total catch in weight, research survey catch at age calibration indices, internal Beverton-Holt stock-recruitment relationship and parameters, selectivity parameters, annual fishing mortality parameters, survey catchability parameters, and estimated stock numbers at age. A multinomial distribution was assumed for fishery catch at age. Additional model settings including specification of likelihood component emphasis factors (lambdas), size of the deviation factors expressed as standard deviations and penalty functions for extreme fishing mortality estimates were left at the consensus values set in the 2008 DPS assessment.

Summary estimates, estimated January 1 stock size at age in numbers, and estimated fishing mortality (F) at age from the 2009 updated model for 1984-2008 (the years with input fishery catches at age) are provided in Tables 33-35. Spawning stock biomass (SSB) decreased from about 100,000 mt in 1963 to about 50,000 mt in 1969, then increased to about 75,000 mt during the late 1970s. SSB declined through the 1980s and early 1990s to less than 5,000 mt in the mid-1990s. With greatly improved recruitment and low fishing mortality rates since 1998, SSB increased to about 188,000 mt in 2008 (Figures 20-21). There is a 50% chance that SSB in 2008 was between 180,000 and 196,000 mt (Figure 22). Fishing mortality calculated from the average of the currently fully recruited ages (2-7+) varied between F = 0.1 and F = 0.3 during the 1960s and 1970s. Fishing mortality increased during the 1980s and early 1990s, peaking at about F = 1.0 in the mid-1990s. Fishing mortality decreased after 1994, falling to less than F = 0.1 since 2003, with F in 2008 = 0.048 (Figure 23). There is a 50% chance that F in 2008 was between 0.041 and 0.066 (Figure 24).

Recruitment at age 0 averaged 92 million fish during 1963-1983, the period in which recruitment estimates are influenced mainly by the assessment model stock-recruitment relationship. Since 1984, recruitment estimates from the model are influenced mainly by the fishery and survey catches at age, and averaged 110 million fish during 1984-2008. The 1999 and 2000 year classes are estimated to be the largest of the time series, at 218 and 267 million age 0 fish (Figures 20-21). Recruitment has exceeded the 1984-2008 average of 110 million in 2001, 2004-2006 and 2008. There is no consistent retrospective pattern in F, SSB, or recruitment evident in the 2009 updated assessment model (Figure 25).

2008 DPS ASSESSMENT BIOLOGICAL REFERENCE POINTS (BRPs)

The 2008 DPS Peer Review Panel accepted the ASAP SCAA model results as the basis for BRPs and status determination for scup (NEFSC 2009). BRPs were calculated using the non-parametric yield and SSB per recruit/long-term projection approach adopted for summer flounder (NEFSC 2008a) and the New England groundfish stocks (NEFSC 2008b). In the yield and SSB per recruit calculations, the most recent five year averages were used for mean weights and fishery partial recruitment pattern. For the estimation of MSY and SSBMSY, the cumulative distribution function of the 1984-2007 recruitments (corresponding to the period of input fishery catches at age) was re-sampled to provide future recruitment estimates (mean = 117 million age 0 fish). The 2008 DPS Peer Review Panel recommended F40% as the proxy for FMSY, and the corresponding SSBF40% as the proxy for SSBMSY. The F40% proxy for FMSY = 0.177, the proxy estimate for SSBMSY = 92,044 mt, and the proxy estimate for MSY = 16,161 mt (13,134 mt of landings, 3,027 mt of discards).

2009 UPDATED STOCK STATUS

The scup stock was not overfished and overfishing was not occurring in 2008 relative to the BRPs recommended by the 2008 DPS Peer Review Panel (NEFSC 2009; Figure 27). Fishing mortality varied between F = 0.1 and F = 0.3 during the 1960s and 1970s. Fishing mortality increased during the 1980s and early 1990s, peaking at about F = 1.0 in 1994. Fishing mortality decreased after 1994, falling to less than F = 0.1 since 2003, with F in 2008 = 0.048, well below the fishing mortality threshold of F40% = 0.177 (Figures 23, 26). There is a 50% chance that F in 2008 was between 0.041 and 0.066 (Figure 24). Spawning stock biomass (SSB) decreased from about 100,000 mt in 1963 to about 50,000 mt in 1969, then increased to about 75,000 mt during the late 1970s. SSB declined through the 1980s and early 1990s to less than 5,000 mt in the mid-1990s. With greatly improved recruitment and low fishing mortality rates since 1998, SSB increased to about 188,000 mt in 2008, well above the biomass target of SSB40% = 92,044 mt (Figures 20, 26). There is a 50% chance that SSB in 2008 was between 180,000 and 196,000 mt (Figure 22). Recruitment at age 0 averaged 92 million fish during 1963-1983, the period in which recruitment estimates are influenced mainly by the assessment model stock-recruitment relationship. Since 1984, recruitment estimates from the model are influenced mainly by the fishery and survey catches at age, and recruitment at age 0 averaged 110 million fish during

1984-2008. The 1999 and 2000 year classes are estimated to be the largest of the time series, at 218 and 267 million age 0 fish (Figures 20-21). Recruitment has exceeded the 1984-2008 average of 110 million in 2001, 2004-2006, and 2008.

2009 ASSESSMENT UNCERTAINTY CONSIDERATIONS

The 2009 assessment indicates that the stock was well above the SSBMSY proxy and being fished at well below the FMSY proxy in 2008. The high level of 2008 stock abundance is the result of historically low fishing mortality rates and historically high levels of recruitment since the late 1990s. Age 0 fish accounted for about 30% of the stock size in 2008 due to the large size of the 2008 year class, but the relative percentages of the age 1 and older fish are within of few percent of what might be expected in the stock if it was fished at Fmax = FMSY = 0.283 over the long-term (Figure 27). The age 7+ fish accounted for about 12% of the stock size in 2008, near the 16% in the age 7+ group that would be expected if the stock were fished at F = 0.05 over the long-term (Figure 27). Since 2000, a high proportion of the SSB has accumulated at fully mature ages 3 and older. The percentage of SSB in 2008 at fully mature ages 3-6 (44%) is near the 46% that would be expected if the stock were fished at F = 0.050 over the long-term, while age 7+ fish accounted for about 44% of the SSB in 2008 (Figure 28).

The MSY proxy in terms of total catch is 16,161 mt (35.6 million lbs), with total landings of 13,134 mt (29.0 million lbs) and total discards of 3,027 mt (6.7 million lbs). The extended catch series estimated for scup (Table 19) indicates that this MSY proxy is a feasible estimate. Total fishery catch is estimated to have averaged about 34,000 mt (75.0 million lbs) during 1960-1965, while reported commercial landings alone averaged about 19,000 mt (41.9 million lbs) in that period. While the MSY estimate appears feasible given historical evidence from the fishery, managers may wish to take an adaptive approach to the specification of the TAC/TAL in the short-term. Total fishery landings during 2003-2007 averaged 6,214 mt (13.7 million lbs), and were 4,177 (9.2 million lbs) mt in 2008; the 2009 TAL was set at 5,071 mt (11.2 million lbs). The 2008 DPS Peer Review Panel and 2009 SDWG both advised that a gradual increase in the TAC/TAL toward the MSY level would facilitate an evaluation of the performance of the new assessment model and BRPs in monitoring stock status, while reducing the risk to the stock due to rapidly increased catch.

PROJECTIONS

Stochastic projections were made to provide forecasts of stock size and catches in 2010 consistent with the 2008 DPS assessment biological reference points. The projections assume that recent (2006-2008) patterns of discarding will continue over the time span of the projections. Different patterns that could develop in the future due to different trip and bag limits and fishery closures have not been evaluated. One hundred projections were made for each of the 1000 MCMC realizations of 2009 stock sizes from the 2009 updated assessment results using NFT AGEPRO version 3.1.3 (NFT 2008b). Future recruitment at age 0 was generated randomly from a cumulative density function of the 2009 updated recruitment series for 1984-2008. The projected quantities are 50%ile estimates for 2010. Three projections were made for 2010: at F40% = 0.177 (the FMSY proxy), at F = 0.033 (equal to F2009 given the 2009 TAL = 5,071 mt is landed), and at 2010 TAL = 5,578 mt (12.297 million lbs), a 10% increase above the 2009 TAL.

Landings, Discards, and Spawning Stock Biomass (SSB) in metric tons

	2010		
	Landings	Discards	SSB
F2010 = F40%= 0.177	27,382	5,785	196,383
2010 TAL = 2009 TAL + 10%	5,578	1,180	207,319
F2010 = F2009 = 0.033	5,431	1,147	207,389

RESEARCH RECOMMENDATIONS

Short term analytical tasks

a) Evaluation of indicators of potential changes in stock status that could provide signs to management of potential reductions of stock productivity in the future would be helpful
b) A management strategy evaluation of alternative approaches to setting quotas would be helpful.

Long term data and analytical needs

a) Current research trawl surveys are likely adequate to index the abundance of scup at ages 0 to 2. However, the implementation of new standardized research surveys that focus on accurately indexing the abundance of older scup (ages 3 and older) would likely improve the accuracy of the stock assessment.
b) Continuation of at least the current levels of at-sea and port sampling of the commercial and recreational fisheries in which scup are landed and discarded is critical to adequately characterize the quantity, length and age composition of the fishery catches.
c) Quantification of the biases in the catch and discards, including non-compliance, would help confirm the weightings used in the model. Additional studies would be required to address this issue
d) The commercial discard mortality rate was assumed to be 100% in this assessment. Experimental work to better characterize the discard mortality rate of scup captured by different commercial gear types should be conducted to more accurately quantify the magnitude of scup discard mortality.

ACKNOWLEDGMENTS

Special thanks to Jay Burnett and the staff of the NOAA Fisheries NEFSC Population Biology Branch for their timely preparation of the 2008 scup ages used in this assessment update.

LITERATURE CITED

Cogswell SJ. 1960. Summary of tagging operations, July 1, 1959 through June 30, 1960. US Bur. Comm. Fish. Woods Hole Laboratory. Lab Ref No. 60-1.
Cogswell SJ. 1961. Summary of tagging operations, July 1, 1960 through June 30, 1961. US Bur. Comm. Fish. Woods Hole Laboratory. Lab Ref No. 61-12.

Conser RJ, Powers JE. 1990. Extension of the ADAPT VPA tuning method designed to facilitate assessment work on tuna and swordfish stocks. ICCAT Coll Vol Sci Pap 32:461-477.

Crecco V, Maltezos G, Howell-Heller P. 1981. Population dynamics and stock assessment of the scup, Stenotomus chrysops, from New England waters. Conn Dept Environ Protect. Mar. Fish. Completion Rep. No. 3-328-R-2 CT, 62 p.

Dery L, Rearden C. 1979. Report of the state-federal scup (Stenotomus chrysops) age and growth workshop. National Marine Fisheries Service, Northeast Fisheries Center, Woods Hole Laboratory Lab Ref Doc. 79-57.

Hamer PE. 1970. Studies of the scup, Stenotomus chrysops, in the Middle Atlantic Bight. NJ Div. Fish Game and Shellfish. Misc Rep No. 5M. 14 p.

Hamer PE. 1979. Studies of the scup, Stenotomus chrysops, in the Middle Atlantic Bight. NJ Div. Fish Game and Shellfish. Misc Rep No. 18M. 67 p.

Howell PT, Simpson DG. 1985. A study of marine recreational fisheries in Connecticut. March 1, 1981 - February 28, 1984. CTDEP, Fed Aid to Sport Fish Restoration F54R. Final Rep. 60 p.

Mayo RK. 1982. An assessment of the scup, Stenotomus chrysops (L.), population in the Southern New England and Middle Atlantic regions. NMFS NEFC, Woods Hole Lab. Ref Doc No. 82-46. 60 p.

Morse WW. 1978. Biological and fisheries data on scup, Stenotomus chrysops (Linnaeus). NMFS NEFC. Sandy Hook Lab Tech Ser Rep. No 12. 41 p.

NEFSC. 1995. Report of the 19th Northeast Regional Stock Assessment Workshop (19th SAW): Stock Assessment Review Committee (SARC) consensus summary of assessments. Northeast Fish Sci Cent Ref Doc. 95-08: 221 p.

NEFSC. 1997. Report of the 25th Northeast Regional Stock Assessment Workshop (25th SAW): Stock Assessment Review Committee (SARC) consensus summary of assessments. Northeast Fish Sci Cent Ref Doc. 97-14: 143 p.

NEFSC. 1998. Report of the 27th Northeast Regional Stock Assessment Workshop (27th SAW). Stock Assessment Review Committee (SARC) consensus summary of assessments. Northeast Fish Sci Cent Ref Doc. 98-15: 350 p.

NEFSC. 2000. Report of the 31st Northeast Regional Stock Assessment Workshop (31st SAW). Stock Assessment Review Committee (SARC) consensus summary of assessments. Northeast Fish Sci Cent Ref Doc. 00-15: 400 p.

NEFSC. 2002. Report of the 35th Northeast Regional Stock Assessment Workshop (35th SAW). Stock Assessment Review Committee (SARC) consensus summary of assessments. Northeast Fish Sci Cent Ref Doc. 02-14: 259 p.

NEFSC. 2008a. 47th Northeast Regional Stock Assessment Workshop (47th SAW) Assessment Report & Appendixes. by Northeast Fisheries Science Center. CRD 08-12. 339 p.

NEFSC. 2008b. Assessment of 19 Northeast Groundfish Stocks through 2007: Report of the 3rd Groundfish Assessment Review Meeting (GARM III). Northeast Fisheries Science Center (NEFSC) Woods Hole, Massachusetts. August 4-8, 2008. NEFSC. CRD 08-15. 867 p.

NEFSC 2009. The Northeast Data Poor Stocks Working Group Report, December 8-12, 2008 Meeting. Part A. Skate species complex, deep sea red crab, Atlantic wolfish, scup, and black sea bass. US Dept Commerce, Northeast Fish Sci Cent Ref Doc. 09-02; 496 p.

Neville WC, Talbot GB. 1964. The fishery for scup with special reference to fluctuations in yield and their courses. US Fish Wildl Serv. Spec Sci Rep - Fish. No 459. 61 p.

NFT. 2008a. NOAA Fisheries Toolbox (NFT) version 3.0. ASAP version 2.0.17. [Internet address: http://nft.nefsc.noaa.gov].

NFT. 2008b. NOAA Fisheries Toolbox (NFT) version 3.0. AGEPRO version 3.1.3. [Internet address: http://nft.nefsc.noaa.gov].

Prager MH. 1994. A suite of extensions to a non-equilibrium surplus production model. Fish Bull US. 92:374-389.

Simpson DG, Howell PT, Johnson MW. 1990. Section 2 Job 6: Marine finfish survey in State of Connecticut D.E.P., A study of marine recreational fisheries in Connecticut, 1984-1988. CTDEP Fed Aid to Sport Fish Restoration. F54R Final Rep. 265 p.

Sisson RT. 1974. The growth and movement of scup (Stenotomus chrysops) in Narragansett Bay, RI and along the Atlantic coast. RI Division of Fish and Wildlife Completion Report. 3-138-R-3. 21 p.

Williams E. Pers. comm. University of Rhode Island, Department of Fisheries and Aquaculture. Kingston, RI. November 1, 1994.

Table 1. Commercial landings (mt) of scup by state. One mt was landed in DE in 1995, included with MD 1995 total. Eight mt were landed in PA in 2004 included with MD 2004 total. Landings include revised Massachusetts landings for 1986-1997.

Year	ME	MA	RI	CT	NY	NJ	MD	VA	NC	Total
1979		782	3,123	92	1,422	2,159	21	397	589	8,585
1980	1	706	2,934	17	1,294	2,310	32	531	599	8,424
1981		523	2,959	44	1,595	2,990	9	1,054	682	9,856
1982		545	3,203	25	1,473	1,746	2	1,042	668	8,704
1983		672	2,583	49	1,103	2,536	13	536	302	7,794
1984		540	2,919	32	904	2,217	6	673	478	7,769
1985		387	3,583	41	861	1,493	17	74	271	6,727
1986		875	2,987	67	893	1,895	14	273	172	7,176
1987	5	735	2,162	301	911	1,817		232	113	6,276
1988	9	536	2,832	359	687	1,334	1	127	58	5,943
1989	32	579	1,401	89	603	1,219	1	45	15	3,984
1990	4	696	1,786	165	755	1,005	4	75	81	4,571
1991	16	553	2,902	287	1,223	1,960	15	56	69	7,081
1992		655	2,676	193	1,043	1,475	17	73	127	6,259
1993		556	1,332	148	729	1,822	10	76	53	4,726
1994		354	1,514	142	688	1,456	7	92	139	4,392
1995		310	1,045	90	511	1,084	2	20	11	3,073
1996		436	773	99	377	1,141	20	72	27	2,945
1997		676	486	50	376	596	1	2	1	2,188
1998		435	361	44	282	758	5	4	7	1,896
1999		300	581	44	206	361		13		1,505
2000		161	461	65	287	232		1		1,207
2001		149	734	45	297	479	1	24		1,729
2002		330	1,668	4	714	419		25	13	3,173
2003		407	1,730	64	839	1,033	21	253	58	4,405
2004		353	1,562	116	865	862	21	203	249	4,231
2005		515	1,553	149	989	880	1	130	50	4,266
2006		493	1,653	135	1,096	632	0	36	17	4,062
2007		501	1,785	118	1,054	714	1	10	13	4,196
2008		239	968	127	551	351	3	44	60	2,343
mean	11	509	1,906	106	830	1,332	10	212	187	5,074

Table 2. Commercial landings (mt) of scup by major gear types. Midwater paired trawl landings are combined with other gears during 1994 and later. Landings include revised Massachusetts landings for 1986-1997.

Year	Otter trawl	Paired trawl	Floating trap	Pound net	Pots and traps	Hand lines	Other gear	Total mt
1979	6,387	146	1,305	429	26	215	77	8,585
1980	6,192	160	1,559	194	8	303	8	8,424
1981	7,836	79	1,291	246	49	306	49	9,856
1982	6,563	104	1,514	244	9	226	44	8,704
1983	5,861	398	850	390	8	265	22	7,794
1984	5,617	272	1,266	295	8	287	24	7,769
1985	4,856	417	1,022	229	5	182	16	6,727
1986	5,163	540	629	332	9	493	10	7,176
1987	4,607	237	590	193	213	423	13	6,276
1988	4,142	166	1,052	53	44	396	90	5,943
1989	3,174	89	193	74	104	334	16	3,984
1990	3,205	200	505	60	239	340	22	4,571
1991	5,217	152	988	40	258	395	31	7,081
1992	4,371	94	934	67	303	450	40	6,259
1993	3,865	46	166	25	202	402	20	4,726
1994	3,416		331	79	76	340	150	4,392
1995	2,204		331	42	57	215	224	3,073
1996	2,196		229	8	120	374	18	2,945
1997	1,491		86	12	104	489	6	2,188
1998	1,379		11	4	98	390	14	1,896
1999	1,005		140	30	77	184	69	1,505
2000	773		56		78	205	95	1,207
2001	1,088		229	65	52	215	80	1,729
2002	2,084		220		221	450	198	3,173
2003	2,777		723		168	445	292	4,405
2004	3,767		20		121	196	127	4,231
2005	3,475		117		174	448	52	4,266
2006	3,422		106		201	291	42	4,062
2007	3,332		181		279	373	31	4,196
2008	1,958		103		99	171	12	2,343
mean	3,775	207	574	141	114	332	65	5,074

Table 3. Summary NEFSC Fishery Observer Program data for scup. Geometric mean discards to landings ratios (GMDL; retransformed, mean ln-transformed discards to landings ratios [D/L], per trip) are stratified by half-year period (HY1, HY2) and trip landings level (< 300 kg, => 300 kg). N is number of observed trips with both scup landings and discard, which are used to calculate the ratios. Corresponding dealer landings are from the NEFSC database.

1997		Trips <300 kg				Trips =>300 kg		
Period	GM D/L	N	Dealer Landings (mt)	Estimated Discard (mt)	GM D/L	N	Dealer Landings (mt)	Estimated Discard (mt)
HY 1	0.8957	17	258	231	0.8221	4	1,244	1,023
HY 2	0.8957	0	279	250	0.8221	0	413	340
Total			537	481			1,657	1,362

1998		Trips <300 kg				Trips =>300 kg		
Period	GM D/L	N	Dealer Landings (mt)	Estimated Discard (mt)	GM D/L	N	Dealer Landings (mt)	Estimated Discard (mt)
HY 1	2.401	7	196	471	121.71	1	920	111,973
HY 2	3.126	10	281	878	121.71	0	496	60,368
Total			477	1,349			1,416	172,341

1999		Trips <300 kg				Trips =>300 kg		
Period	GM D/L	N	Dealer Landings (mt)	Estimated Discard (mt)	GM D/L	N	Dealer Landings (mt)	Estimated Discard (mt)
HY 1	1.742	6	245	427	3.766	2	785	2,956
HY 2	1.742	0	178	310	3.766	0	299	1,126
Total			423	737			1,084	4,082

Table 3 continued .

2000		Trips <300 kg				Trips =>300 kg		
Period	GM D/L	N	Dealer Landings (mt)	Estimated Discard (mt)	GM D/L	N	Dealer Landings (mt)	Estimated Discard (mt)
HY 1	4.5818	13	196	898	0.6018	2	655	394
HY 2	3.5001	1	292	1,022	0.6018	0	63	38
Total		14	488	1,920		2	718	432

2001		Trips <300 kg				Trips =>300 kg		
Period	GM D/L	N	Dealer Landings (mt)	Estimated Discard (mt)	GM D/L	N	Dealer Landings (mt)	Estimated Discard (mt)
HY 1	0.8916	10	180	160	0.9185	4	1,013	930
HY 2	0.4606	2	307	141	0.9185	0	290	266
Total		14	487	302		4	1,303	1,197

2002		Trips <300 kg				Trips =>300 kg		
Period	GM D/L	N	Dealer Landings (mt)	Estimated Discard (mt)	GM D/L	N	Dealer Landings (mt)	Estimated Discard (mt)
HY 1	2.6088	11	423	1,104	0.0653	2	1,484	97
HY 2	3.4522	12	829	2,862	3.6028	3	437	1,574
Total		23	1,252	3,965		5	1,921	1,671

Table 3 continued .

2003		Trips <300 kg				Trips =>300 kg		
Period	GM D/L	N	Dealer Landings (mt)	Estimated Discard (mt)	GM D/L	N	Dealer Landings (mt)	Estimated Discard (mt)
HY 1	0.1371	9	315	43	0.2560	2	2,473	633
HY 2	1.4299	4	921	1,317	0.2304	5	696	160
Total		13	1,236	1,360		7	3,169	793

2004		Trips <300 kg				Trips =>300 kg		
Period	GM D/L	N	Dealer Landings (mt)	Estimated Discard (mt)	GM D/L	N	Dealer Landings (mt)	Estimated Discard (mt)
HY 1	0.3370	40	344	116	0.1685	25	2,353	396
HY 2	0.4200	64	868	365	0.0309	10	550	17
Total		104	1,212	480		35	2,903	413

2005		Trips <300 kg				Trips =>300 kg		
Period	GM D/L	N	Dealer Landings (mt)	Estimated Discard (mt)	GM D/L	N	Dealer Landings (mt)	Estimated Discard (mt)
HY 1	0.7354	31	292	215	0.0732	7	2,390	175
HY 2	0.2740	67	850	233	0.0563	2	694	39
Total		98	1,142	448		9	3,084	214

Table 3 continued .

2006		Trips <300 kg				Trips =>300 kg		
Period	GM D/L	N	Dealer Landings (mt)	Estimated Discard (mt)	GM D/L	N	Dealer Landings (mt)	Estimated Discard (mt)
HY 1	0.6621	37	472	313	0.0740	10	1,814	134
HY 2	0.8573	40	814	698	0.2631	10	921	242
Total		77	1,286	1,010		20	2,735	377

2007		Trips <300 kg				Trips =>300 kg		
Period	GM D/L	N	Dealer Landings (mt)	Estimated Discard (mt)	GM D/L	N	Dealer Landings (mt)	Estimated Discard (mt)
HY 1	0.4821	41	461	222	0.2628	10	2,177	572
HY 2	0.9404	54	892	839	0.3389	7	666	226
Total		95	1,353	1,061		17	2,843	798

2008		Trips <300 kg				Trips =>300 kg		
Period	GM D/L	N	Dealer Landings (mt)	Estimated Discard (mt)	GM D/L	N	Dealer Landings (mt)	Estimated Discard (mt)
HY 1	0.8719	40	422	368	0.2350	16	1,218	286
HY 2	5.2030	12	401	2,086	0.4596	6	303	139
Total		52	823	2,454		22	1,521	425

Table 4. A summary of landings, discards, and the aggregate geometric mean discards to landings ratio (GMDL).

Year	Landings (mt)	Discards (mt)	GMDL ratio	GMDL Discards PSE (%)
1997	2,194	1,843	0.84	61
1998	1,893	173,690	91.75	32
1999	1,507	4,819	3.20	9
2000	1,206	2,352	1.95	48
2001	1,790	1,499	0.84	32
2002	3,173	5,636	1.78	95
2003	4,405	2,153	0.49	41
2004	4,227	893	0.21	25
2005	4,226	662	0.16	29
2006	4,021	1,387	0.34	27
2007	4,196	1,859	0.44	26
2008	2,343	2,879	1.23	31

Table 5. Total catch (mt) of scup from Maine through North Carolina. Landings include revised Massachusetts landings for 1986-1997. Commercial discards for 1984-1988 calculated as the geometric mean ratio of discards to landings numbers at age for 1989-1993. Commercial discards estimate for 1998 is the mean of 1997 and 1999 estimates.

Year	Commercial Landings	Commercial Discards	Recreational Landings	Recreational Discards	Total Catch
1981	9,856	n/a	2,636	n/a	12,492
1982	8,704	n/a	2,361	n/a	11,065
1983	7,794	n/a	2,836	n/a	10,630
1984	7,769	2,158	1,096	30	11,053
1985	6,727	4,184	2,764	54	13,729
1986	7,176	2,005	5,264	87	14,532
1987	6,276	2,537	2,811	38	11,662
1988	5,943	1,657	1,936	31	9,567
1989	3,984	2,229	2,521	39	8,773
1990	4,571	3,909	1,878	38	10,396
1991	7,081	3,530	3,668	78	14,357
1992	6,259	5,668	2,001	47	13,975
1993	4,726	1,436	1,450	28	7,640
1994	4,392	807	1,192	37	6,428
1995	3,073	2,057	609	13	5,752
1996	2,945	1,522	978	20	5,465
1997	2,188	1,843	543	8	4,582
1998	1,896	3,331	397	14	5,638
1999	1,505	4,819	856	6	7,186
2000	1,207	2,352	2,469	55	6,083
2001	1,729	1,499	1,933	165	5,326
2002	3,173	5,636	1,644	137	10,590
2003	4,405	2,153	3,848	158	10,564
2004	4,231	893	1,923	134	7,181
2005	4,266	662	1,153	227	6,308
2006	4,062	1,387	1,331	393	7,173
2007	4,196	1,859	1,655	316	8,026
2008	2,343	2,879	1,834	296	7,352
mean	4,731	2,520	1,985	98	9,054

Table 6. Summary of the landed fish length sampling for scup in the NER (ME-VA) commercial fishery.

Year	No. of samples	No. of lengths	NER Landings (mt)	Sampling intensity (mt/100 lengths)
1979	10	1,250	8,585	687
1980	26	3,478	8,424	242
1981	16	2,005	9,856	492
1982	81	9,896	8,704	88
1983	72	7,860	7,794	99
1984	60	6,303	7,769	123
1985	31	3,058	6,727	220
1986	54	5,467	7,176	131
1987	61	6,491	6,276	97
1988	85	8,691	5,943	68
1989	46	4,806	3,984	83
1990	46	4,736	4,571	97
1991	31	3,150	7,081	225
1992	33	3,260	6,259	192
1993	23	2,287	4,726	207
1994	22	2,163	4,392	203
1995	22	2,487	3,073	124
1996	61	6,544	2,945	45
1997	37	3,732	2,188	59
1998	41	4,022	1,896	47
1999	56	6,040	1,505	25
2000	22	2,352	1,207	51
2001	40	3,934	1,729	44
2002	26	2,587	3,173	123
2003	78	6,681	4,405	66
2004	144	13,172	4,231	32
2005	124	9,324	4,266	46
2006	152	12,506	4,062	32
2007	198	15,704	4,196	27
2008	154	12,764	2,343	18

Table 7. Commercial fishery scup landings (000s) at age.

Year	0	1	2	3	4	5	6	7	8	9	10	Total
1984	1	2691	6114	7090	5793	1418	536	251	1	0	0	23895
1985	79	3245	6767	7696	2640	346	520	159	0	0	0	21452
1986	9	301	12321	4773	1004	75	106	337	5	0	0	18931
1987	2	1679	9952	10399	1725	177	124	21	18	0	1	24098
1988	17	423	7709	9526	2424	58	127	39	0	0	0	20323
1989	17	1484	4943	7071	685	22	69	24	0	0	0	14315
1990	0	247	10203	6781	1022	355	149	2	0	0	0	18759
1991	0	2412	12956	10202	2161	409	193	0	0	0	0	28334
1992	21	1577	10883	3737	3797	1243	138	0	0	0	0	21396
1993	1	230	6558	6877	1500	1143	124	0	0	0	0	16433
1994	0	1052	13544	6358	836	82	39	0	0	0	0	21911
1995	0	2198	8345	2878	891	248	31	0	0	0	0	14591
1996	0	346	6343	1640	770	469	62	0	0	0	0	9630
1997	0	131	2080	4089	732	84	97	0	0	0	0	7213
1998	0	340	1453	2373	1092	381	2	0	0	0	0	5641
1999	0	1	1148	2688	527	117	0	0	0	0	0	4481
2000	0	0	661	2144	511	15	0	0	0	0	0	3331
2001	0	31	1635	3033	695	46	6	1	1	0	0	5448
2002	0	124	1219	5051	2132	393	5	0	0	0	0	8922
2003	0	2	955	2974	4553	1131	121	41	5	14	0	9796
2004	0	1	844	2406	2826	2089	296	40	4	14	0	8520
2005	0	31	683	1558	2361	2515	807	92	3	3	0	8053
2006	0	89	2233	2231	1119	1477	1219	366	28	3	0	8765
2007	0	91	2787	2661	1390	680	940	590	124	12	0	9275
2008	0	36	1299	2402	1104	305	253	256	34	1	1	5691

Table 8. Commercial fishery scup landings mean weights (kg) at age.

Year	0	1	2	3	4	5	6	7	8	9	10	Total
1984	0.033	0.155	0.190	0.293	0.344	0.398	0.767	1.044	1.545	0.000	0.000	0.288
1985	0.043	0.134	0.197	0.293	0.409	0.517	0.739	1.042	0.000	0.000	0.000	0.272
1986	0.036	0.140	0.219	0.357	0.676	0.670	1.010	1.246	1.616	0.000	2.500	0.302
1987	0.034	0.136	0.203	0.244	0.407	0.544	0.747	1.194	1.068	0.000	0.000	0.237
1988	0.044	0.123	0.201	0.263	0.441	0.636	0.715	0.982	0.000	0.000	0.000	0.263
1989	0.025	0.144	0.188	0.275	0.367	0.651	0.721	1.036	0.000	0.000	0.000	0.240
1990	0.000	0.140	0.189	0.246	0.367	0.518	0.842	0.846	0.000	1.096	0.000	0.230
1991	0.000	0.187	0.194	0.263	0.389	0.511	0.729	0.000	0.000	0.000	0.000	0.241
1992	0.039	0.173	0.199	0.325	0.419	0.503	0.859	0.000	0.000	1.096	0.000	0.280
1993	0.031	0.140	0.197	0.261	0.442	0.510	0.782	0.000	0.000	0.000	0.000	0.272
1994	0.000	0.203	0.193	0.259	0.430	0.663	0.742	0.000	0.000	0.000	0.000	0.224
1995	0.000	0.161	0.209	0.295	0.396	0.480	0.724	0.000	0.000	0.000	0.000	0.236
1996	0.000	0.206	0.200	0.325	0.468	0.554	0.784	0.000	0.000	0.000	0.000	0.264
1997	0.000	0.227	0.253	0.300	0.386	0.529	0.749	0.000	0.000	0.000	0.000	0.303
1998	0.000	0.200	0.254	0.313	0.459	0.556	0.748	0.000	0.000	0.000	0.000	0.336
1999	0.000	0.075	0.220	0.323	0.497	0.748	0.000	0.000	0.000	0.000	0.000	0.328
2000	0.000	0.000	0.221	0.367	0.504	0.674	0.000	0.000	0.000	0.000	0.000	0.360
2001	0.000	0.229	0.265	0.346	0.476	0.562	0.779	1.003	1.003	0.000	0.000	0.340
2002	0.000	0.231	0.281	0.339	0.465	0.577	0.748	0.000	0.000	0.000	0.000	0.370
2003	0.000	0.187	0.285	0.362	0.471	0.659	0.859	0.884	1.241	0.000	0.000	0.448
2004	0.000	0.182	0.313	0.398	0.518	0.591	0.812	1.002	1.370	1.674	0.000	0.496
2005	0.000	0.196	0.269	0.362	0.471	0.652	0.809	1.044	1.099	1.311	0.000	0.529
2006	0.000	0.213	0.283	0.344	0.460	0.591	0.727	0.915	1.108	1.314	0.000	0.463
2007	0.000	0.217	0.265	0.353	0.470	0.646	0.768	0.894	1.077	1.697	0.000	0.452
2008	0.000	0.197	0.264	0.321	0.486	0.634	0.804	0.973	1.176	1.435	2.437	0.412

Table 9. Summary of length sampling for scup in the NEFSC Fishery Observer Program. OT =number of otter trawl trips sampled with scup discard lengths. H1 = first half year; H2 = second half year.

Year	OT trips	Lengths H1	Lengths H2	Lengths Total	Discards (mt)	Intensity (mt/100 lengths)
1989	61	4,449	2,910	7,359	2,229	30
1990	52	2,582	781	3,363	3,909	116
1991	91	1,237	1,780	3,017	3,530	117
1992	53	1,158	0	1,158	5,668	489
1993	29	275	154	429	1,436	335
1994	7	99	119	218	807	370
1995	18	162	383	556	2,057	370
1996	27	1,093	435	1,528	1,522	100
1997	45	750	1	751	1,843	245
1998	33	618	64	682	3,331	488
1999	35	586	89	675	4,819	714
2000	62	3,981	762	4,743	2,352	50
2001	67	1,231	229	1,460	1,499	103
2002	65	1,422	866	2,288	5,636	246
2003	72	925	284	1,209	2,153	178
2004	80	1,948	1,051	2,999	893	30
2005	73	797	1,159	1,956	662	34
2006	47	1,486	777	2,263	1,387	61
2007	59	1,313	1,058	2,371	1,859	78
2008	54	1,217	1,259	2,476	2,879	116

Table 10. Commercial fishery scup discards (000s) at age.

Year	0	1	2	3	4	5	6	7	8	9	10	Total
1984	78	10847	6367	924	21	0	0	0	0	0	0	18237
1985	52773	13093	6534	1060	10	0	0	0	0	0	0	73470
1986	78	1180	14040	602	3	0	0	0	0	0	0	15903
1987	78	6814	12215	1366	5	0	0	0	0	0	0	20478
1988	1552	1698	9242	1339	10	0	0	0	0	0	0	13841
1989	387	8943	13603	813	28	0	0	0	0	0	0	23774
1990	822	8269	17249	2801	0	0	0	0	0	0	0	29141
1991	1794	17231	5397	1733	5	0	0	0	0	0	0	26160
1992	38804	10023	26380	72	0	0	0	0	0	0	0	75279
1993	5386	1549	6960	224	0	0	0	0	0	0	0	14119
1994	6858	3099	3422	74	0	0	0	0	0	0	0	13453
1995	1855	50174	335	108	14	0	0	0	0	0	0	52486
1996	199	3009	5990	691	21	1	0	0	0	0	0	9911
1997	1	618	8250	1871	0	0	0	0	0	0	0	10740
1998	18	17524	11849	1127	247	57	0	0	0	0	0	30822
1999	1338	2563	18123	3139	691	201	0	0	0	0	0	26055
2000	853	11206	4890	1475	55	57	0	0	0	0	0	18536
2001	3536	4232	2647	355	281	207	57	0	0	0	0	11315
2002	9561	22393	5834	4431	518	571	75	0	0	0	0	43383
2003	1480	1578	3779	937	752	503	93	0	0	0	0	9122
2004	545	1397	1423	1176	220	187	8	0	0	0	0	4956
2005	460	893	1879	516	79	47	15	0	0	0	0	3889
2006	4809	8083	2354	642	53	13	16	0	0	0	0	15970
2007	1412	3936	5370	1420	94	41	87	0	0	0	0	12360
2008	1061	7526	2937	821	215	86	81	128	86	0	0	12941

Table 11. Commercial fishery scup discards mean weights (kg) at age.

Year	0	1	2	3	4	5	6	7	8	9	10	Total
1984	0.033	0.108	0.125	0.198	0.222	0	0	0	0	0	0	0.118
1985	0.033	0.108	0.125	0.198	0.222	0	0	0	0	0	0	0.057
1986	0.033	0.108	0.125	0.198	0.222	0	0	0	0	0	0	0.126
1987	0.033	0.108	0.125	0.198	0.222	0	0	0	0	0	0	0.124
1988	0.033	0.108	0.125	0.198	0.222	0	0	0	0	0	0	0.120
1989	0.039	0.060	0.111	0.198	0.217	0	0	0	0	0	0	0.094
1990	0.026	0.121	0.137	0.187	0	0	0	0	0	0	0	0.134
1991	0.057	0.127	0.163	0.207	0.252	0	0	0	0	0	0	0.135
1992	0.033	0.078	0.136	0.243	0	0	0	0	0	0	0	0.075
1993	0.026	0.106	0.154	0.269	0	0	0	0	0	0	0	0.102
1994	0.024	0.068	0.122	0.198	0	0	0	0	0	0	0	0.060
1995	0.038	0.037	0.229	0.310	0.331	0	0	0	0	0	0	0.039
1996	0.033	0.110	0.169	0.240	0.268	0.532	0	0	0	0	0	0.154
1997	0.020	0.028	0.137	0.362	0.000	0.000	0	0	0	0	0	0.170
1998	0.092	0.069	0.147	0.224	0.418	0.564	0	0	0	0	0	0.108
1999	0.010	0.037	0.158	0.398	0.599	0.690	0	0	0	0	0	0.183
2000	0.044	0.076	0.195	0.299	0.486	0.768	0	0	0	0	0	0.127
2001	0.015	0.063	0.168	0.345	0.500	0.670	0.944	0	0	0	0	0.108
2002	0.035	0.064	0.201	0.361	0.524	0.757	1.071	0	0	0	0	0.123
2003	0.022	0.091	0.212	0.315	0.537	0.784	0.878	0	0	0	0	0.236
2004	0.029	0.109	0.166	0.268	0.371	0.453	0.750	0	0	0	0	0.180
2005	0.019	0.090	0.154	0.267	0.416	0.652	0.912	0	0	0	0	0.153
2006	0.026	0.086	0.166	0.217	0.313	0.549	0.755	0	0	0	0	0.087
2007	0.041	0.094	0.163	0.282	0.342	0.597	0.770	0	0	0	0	0.148
2008	0.039	0.096	0.182	0.294	0.495	0.742	0.884	1.078	1.442	0	0	0.158

Table 12. Summary of the landed fish length sampling for scup in the recreational fishery (includes MRFSS and state agency sampling).

Year	No. of lengths	Estimated landings (A + B1) (mt)	Sampling intensity (mt/100 lengths)
1981	642	2,636	411
1982	1,057	2,361	223
1983	1,384	2,836	205
1984	943	1,096	116
1985	741	2,764	373
1986	2,580	5,264	204
1987	777	2,811	362
1988	2,156	1,936	90
1989	4,111	2,521	61
1990	2,698	1,878	70
1991	4,230	3,668	87
1992	4,419	2,001	45
1993	2,206	1,450	66
1994	1,374	1,192	87
1995	822	609	74
1996	526	978	186
1997	399	543	136
1998	286	397	139
1999	265	856	323
2000	524	2,469	471
2001	1,038	1,933	186
2002	1,006	1,644	163
2003	2,508	3,848	153
2004	1,802	1,923	107
2005	1,794	1,153	64
2006	2,217	1,331	60
2007	2,262	1,655	73
2008	2,426	1,834	76

Table 13. Recreational fishery scup landings (000s) at age.

Year	0	1	2	3	4	5	6	7	8	9	10	Total
1984	23	3036	1353	570	182	219	442	86	51	30	66	6058
1985	431	4478	3054	1330	788	441	137	33	0	0	115	10807
1986	538	4353	15570	2617	845	431	87	5	4	57	315	24822
1987	77	2299	4686	1261	824	598	112	0	0	11	46	9914
1988	9	1001	2229	1824	460	216	123	92	20	0	86	6060
1989	311	3978	3371	823	86	235	154	13	0	50	148	9169
1990	169	1352	5091	1102	147	112	36	7	2	3	22	8043
1991	299	4838	3797	3319	700	210	19	0	2	20	68	13272
1992	99	1850	4457	530	672	84	12	6	8	7	30	7755
1993	46	1245	3051	908	254	133	2	2	0	2	7	5650
1994	31	1473	1840	691	95	88	21	6	0	0	0	4245
1995	15	613	1399	225	89	20	3	3	0	0	0	2367
1996	9	351	1467	812	365	54	10	15	0	0	0	3083
1997	32	52	983	562	168	63	33	17	6	0	0	1916
1998	13	223	257	415	248	19	13	23	0	0	0	1211
1999	61	469	2169	359	182	11	0	0	0	0	0	3251
2000	6	912	3443	2113	641	129	0	0	0	0	0	7244
2001	0.3	514	1511	1705	806	244	101	218	0	0	0	5099
2002	7	70	688	1635	1005	179	24	39	0	0	0	3647
2003	0.3	75	1723	2655	3127	1407	350	115	0	0	0	9452
2004	0.9	45	284	1551	1441	1166	470	32	0	0	0	4990
2005	0	13	100	513	700	845	349	26	0	0	0	2546
2006	1	50	658	819	404	431	541	46	0	1	0	2951
2007	3	47	456	1347	775	378	605	206	26	1	0	3844
2008	2	52	732	1352	842	205	338	133	17	1	0	3674

Table 14. Recreational fishery scup landings mean weights (kg) at age.

Year	0	1	2	3	4	5	6	7	8	9	10	Total
1984	0.044	0.117	0.266	0.373	0.472	0.557	0.678	0.825	0.912	1.002	1.145	0.274
1985	0.038	0.125	0.253	0.340	0.573	0.718	0.913	1.087	0.000	0.000	1.673	0.270
1986	0.052	0.101	0.234	0.374	0.534	0.654	0.801	0.912	1.003	1.003	1.638	0.261
1987	0.029	0.105	0.242	0.381	0.548	0.698	0.737	0.000	0.000	1.003	3.808	0.302
1988	0.026	0.142	0.240	0.325	0.497	0.663	0.794	1.144	1.099	0.000	1.532	0.330
1989	0.035	0.123	0.234	0.376	0.433	0.653	0.696	0.657	0.000	1.003	1.332	0.235
1990	0.057	0.128	0.208	0.325	0.461	0.567	0.761	0.939	1.088	1.202	1.947	0.225
1991	0.064	0.150	0.275	0.361	0.474	0.714	0.675	0.000	1.003	1.003	1.305	0.271
1992	0.092	0.140	0.240	0.373	0.454	0.598	0.804	0.859	1.311	1.003	2.117	0.256
1993	0.087	0.135	0.226	0.336	0.460	0.524	0.912	0.827	0.000	1.026	1.100	0.242
1994	0.054	0.180	0.281	0.357	0.467	0.674	0.905	1.430	0.000	0.000	0.000	0.274
1995	0.065	0.155	0.279	0.450	0.557	0.756	1.044	1.311	0.000	0.000	0.000	0.279
1996	0.093	0.171	0.231	0.368	0.540	0.772	0.876	1.383	0.000	0.000	0.000	0.314
1997	0.083	0.110	0.253	0.299	0.510	0.684	0.819	1.342	0.779	0.000	0.000	0.318
1998	0.072	0.121	0.211	0.312	0.491	0.866	1.066	1.950	0.000	0.000	0.000	0.337
1999	0.095	0.173	0.274	0.451	0.635	0.900	0.000	0.000	0.000	0.000	0.000	0.298
2000	0.075	0.138	0.296	0.424	0.544	0.825	0.000	0.000	0.000	0.000	0.000	0.345
2001	0.092	0.220	0.344	0.485	0.637	0.776	0.875	1.127	0.000	0.000	0.000	0.490
2002	0.110	0.152	0.296	0.427	0.618	0.795	0.932	1.427	0.000	0.000	0.000	0.481
2003	0.092	0.161	0.314	0.416	0.536	0.720	0.908	1.499	0.000	0.000	0.000	0.512
2004	0.094	0.151	0.325	0.437	0.523	0.575	0.858	0.748	0.000	0.000	0.000	0.527
2005	0.000	0.112	0.270	0.384	0.516	0.679	0.881	1.098	0.000	0.000	0.000	0.588
2006	0.092	0.151	0.304	0.411	0.525	0.695	0.883	0.999	0.000	1.311	0.000	0.536
2007	0.111	0.152	0.313	0.418	0.509	0.672	0.882	0.935	1.056	1.322	0.000	0.551
2008	0.080	0.162	0.318	0.442	0.545	0.714	0.996	1.035	1.201	1.350	0.000	0.528

Table 15. Recreational fishery scup discards (000s) at age.

Year	0	1	2	3	4	5	6	7	8	9	10	Total
1984	2	255	0	0	0	0	0	0	0	0	0	257
1985	40	417	0	0	0	0	0	0	0	0	0	457
1986	100	807	0	0	0	0	0	0	0	0	0	907
1987	12	357	0	0	0	0	0	0	0	0	0	369
1988	2	219	0	0	0	0	0	0	0	0	0	221
1989	24	308	0	0	0	0	0	0	0	0	0	332
1990	36	284	0	0	0	0	0	0	0	0	0	320
1991	31	505	0	0	0	0	0	0	0	0	0	536
1992	17	325	0	0	0	0	0	0	0	0	0	342
1993	8	204	0	0	0	0	0	0	0	0	0	212
1994	4	203	0	0	0	0	0	0	0	0	0	207
1995	63	135	0	0	0	0	0	0	0	0	0	198
1996	44	222	0	0	0	0	0	0	0	0	0	266
1997	163	10	0	0	0	0	0	0	0	0	0	173
1998	80	139	0	0	0	0	0	0	0	0	0	219
1999	208	0	0	0	0	0	0	0	0	0	0	208
2000	20	561	25	0	0	0	0	0	0	0	0	606
2001	0.3	484	325	0	0	0	0	0	0	0	0	809
2002	14	199	381	55	0	0	0	0	0	0	0	649
2003	1	168	550	63	0	0	0	0	0	0	0	782
2004	7	232	242	211	0	0	0	0	0	0	0	692
2005	5	88	232	135	44	46	11	1	0	0	0	562
2006	1	143	644	66	0	0	0	0	0	0	0	854
2007	20	185	375	124	20	2	1	0	0	0	0	727
2008	24	230	511	282	50	9	5	8	1	0	0	1120

Table 16. Recreational fishery scup discards mean weights (kg) at age.

Year	0	1	2	3	4	5	6	7	8	9	10	Total
1984	0.044	0.117	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.116
1985	0.038	0.125	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.117
1986	0.052	0.101	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.096
1987	0.029	0.105	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.103
1988	0.026	0.142	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.141
1989	0.035	0.123	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.117
1990	0.057	0.128	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.120
1991	0.064	0.150	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.145
1992	0.092	0.140	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.138
1993	0.087	0.135	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.133
1994	0.054	0.180	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.178
1995	0.063	0.065	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.064
1996	0.075	0.075	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.075
1997	0.043	0.075	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.045
1998	0.061	0.068	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.065
1999	0.028	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.028
2000	0.075	0.087	0.189	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.091
2001	0.092	0.194	0.218	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.204
2002	0.110	0.155	0.238	0.250	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.211
2003	0.092	0.141	0.215	0.251	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.202
2004	0.094	0.149	0.206	0.233	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.194
2005	0.035	0.114	0.215	0.311	0.481	0.698	0.810	1.110	0.000	0.000	0.000	0.294
2006	0.092	0.148	0.229	0.243	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.216
2007	0.067	0.127	0.220	0.322	0.408	0.567	0.000	0.000	0.000	0.000	0.000	0.215
2008	0.039	0.121	0.242	0.343	0.507	0.781	0.854	1.074	1.233	0.000	0.000	0.264

Table 17. Total fishery scup catch (000s) at age.

Year	0	1	2	3	4	5	6	7	8	9	10	Total
1984	104	16829	13834	8584	5996	1637	978	337	52	30	66	48447
1985	53323	21233	16355	10086	3438	787	657	192	0	0	115	106186
1986	725	6641	41931	7992	1852	506	193	342	9	57	315	60563
1987	169	11149	26853	13026	2554	775	236	21	18	11	47	54859
1988	1580	3341	19180	12689	2894	274	250	131	20	0	86	40445
1989	739	14713	21917	8707	799	257	223	37	0	50	148	47590
1990	1027	10152	32543	10684	1169	467	185	9	2	3	22	56263
1991	2124	24986	22150	15254	2866	619	212	0	2	20	68	68302
1992	38941	13775	41720	4339	4469	1327	150	6	8	7	30	104772
1993	5441	3228	16569	8009	1754	1276	126	2	0	2	7	36414
1994	6893	5827	18806	7123	931	170	60	6	0	0	0	39816
1995	1933	53120	10079	3211	994	268	34	3	0	0	0	69642
1996	252	3928	13800	3143	1156	524	72	15	0	0	0	22890
1997	196	811	11313	6522	900	147	130	17	6	0	0	20042
1998	111	18226	13559	3915	1587	457	15	23	0	0	0	37893
1999	1607	3033	21440	6186	1400	329	0	0	0	0	0	33995
2000	879	12679	9019	5732	1207	201	0	0	0	0	0	29717
2001	3537	5261	6118	5093	1782	497	164	219	1	0	0	22671
2002	9582	22786	8122	11172	3655	1143	104	39	0	0	0	56601
2003	1481	1823	7007	6629	8432	3041	564	156	5	14	0	29152
2004	553	1675	2793	5344	4487	3442	774	72	4	14	0	19158
2005	465	1025	2894	2722	3184	3453	1182	119	3	3	0	15050
2006	4811	8365	5889	3758	1576	1921	1776	412	28	4	0	28540
2007	1435	4259	8988	5552	2279	1101	1633	796	150	13	0	26206
2008	1087	7844	5479	4857	2211	605	677	525	138	2	1	23426

Table 18. Total fishery scup catch mean weights (kg) at age.

Year	0	1	2	3	4	5	6	7	8	9	10	Total
1984	0.036	0.117	0.168	0.288	0.348	0.419	0.727	0.988	0.924	1.002	1.145	0.222
1985	0.033	0.116	0.179	0.289	0.446	0.629	0.775	1.050	0.000	0.000	1.673	0.122
1986	0.050	0.104	0.193	0.351	0.611	0.656	0.916	1.241	1.344	1.003	1.638	0.236
1987	0.031	0.112	0.174	0.253	0.452	0.663	0.742	1.194	1.068	1.003	3.727	0.206
1988	0.033	0.122	0.169	0.265	0.449	0.657	0.754	1.096	1.099	0.000	1.532	0.223
1989	0.037	0.087	0.147	0.277	0.369	0.653	0.704	0.903	0.000	1.003	1.332	0.165
1990	0.032	0.123	0.164	0.239	0.379	0.530	0.826	0.918	1.088	1.195	1.947	0.179
1991	0.058	0.138	0.201	0.278	0.409	0.580	0.724	0.000	1.003	1.003	1.305	0.206
1992	0.033	0.099	0.164	0.329	0.424	0.509	0.854	0.859	1.311	1.004	2.117	0.131
1993	0.027	0.121	0.184	0.270	0.445	0.512	0.784	0.827	0.000	1.026	1.100	0.200
1994	0.024	0.125	0.189	0.267	0.434	0.669	0.799	1.430	0.000	0.000	0.000	0.174
1995	0.039	0.044	0.219	0.306	0.409	0.501	0.752	1.311	0.000	0.000	0.000	0.088
1996	0.042	0.122	0.190	0.317	0.487	0.577	0.796	1.327	0.000	0.000	0.000	0.221
1997	0.049	0.066	0.168	0.318	0.409	0.595	0.767	1.342	0.779	0.000	0.000	0.231
1998	0.067	0.072	0.160	0.287	0.458	0.570	1.024	1.950	0.000	0.000	0.000	0.149
1999	0.016	0.058	0.173	0.368	0.565	0.718	0.947	1.538	0.000	0.000	0.000	0.212
2000	0.045	0.081	0.235	0.371	0.524	0.798	0.947	1.538	0.000	0.000	0.000	0.205
2001	0.015	0.091	0.240	0.392	0.553	0.712	0.896	1.126	0.000	0.000	0.000	0.253
2002	0.035	0.066	0.223	0.360	0.515	0.701	1.024	1.427	0.000	0.000	0.000	0.186
2003	0.022	0.099	0.247	0.376	0.501	0.708	0.893	1.337	1.241	0.000	0.000	0.396
2004	0.030	0.116	0.230	0.374	0.512	0.578	0.839	0.889	1.370	1.674	0.000	0.412
2005	0.019	0.096	0.190	0.346	0.480	0.659	0.832	1.056	1.099	1.311	0.000	0.433
2006	0.026	0.089	0.233	0.335	0.472	0.614	0.775	0.924	1.108	1.313	0.000	0.253
2007	0.042	0.099	0.205	0.350	0.477	0.653	0.810	0.905	1.073	1.668	0.000	0.316
2008	0.039	0.098	0.225	0.351	0.510	0.679	0.910	1.016	1.345	1.393	2.437	0.283

Table 19. Extended series of total fishery catch. Catches in metric tons (mt). To estimate commercial discards for 1960-1988, D/L ratio for 1989-1997 = 0.504 was applied to commercial landings. To estimate recreational catch for 1960-1980, 50% of the Mayo 1982 estimates were included.

Year	Comm. Land.	Comm. Disc.	DWF Land.	Rec Catch	Total Catch
1960	22236	11198	0	3765	37,199
1961	20944	10548	0	3716	35,208
1962	20831	10491	0	3667	34,989
1963	18884	9510	5863	3528	37,785
1964	17204	8664	459	3341	29,668
1965	15785	7950	2089	3265	29,089
1966	11960	6023	823	2474	21,280
1967	8748	4406	896	1879	15,929
1968	6630	3339	2251	1473	13,693
1969	5149	2593	485	1107	9,334
1970	4493	2263	288	1003	8,047
1971	3974	2001	889	853	7,717
1972	4203	2117	1647	796	8,763
1973	5024	2530	1783	1118	10,455
1974	7106	3579	958	1,388	13,031
1975	7623	3839	685	1,403	13,550
1976	7302	3677	87	1,183	12,249
1977	8330	4195	28	1,398	13,951
1978	8936	4500	3	1,256	14,695
1979	8585	4324	0	1,198	14,107
1980	8424	4242	16	3,109	15,791
1981	9,856	4964	1	2,636	17,457
1982	8,704	4383	0	2,361	15,448
1983	7,794	3925	0	2,836	14,555
1984	7,769	2158	0	1,126	11,053
1985	6,727	4184	0	2,818	13,729
1986	7,176	2005	0	5,351	14,532
1987	6,276	2537	0	2,849	11,662
1988	5,943	1657	0	1,967	9,567
1989	3,984	2229	0	2,560	8,773
1990	4,571	3909	0	1,916	10,396
1991	7,081	3530	0	3,746	14,357
1992	6,259	5668	0	2,048	13,975
1993	4,726	1436	0	1,478	7,640
1994	4,392	807	0	1,229	6,428
1995	3,073	2,057	0	622	5,752
1996	2,945	1,522	0	998	5,465
1997	2,188	1,843	0	551	4,582
1998	1,896	3,331	0	411	5,638
1999	1,505	4,819	0	862	7,186
2000	1,207	2,352	0	2,524	6,083
2001	1,729	1,499	0	2,098	5,326
2002	3,173	5,636	0	1,781	10,590
2003	4,405	2,153	0	4,006	10,564
2004	4,231	893	0	2,057	7,181
2005	4,266	662	0	1,380	6,308
2006	4,062	1,387	0	1,724	7,173
2007	4,196	1,859	0	1,971	8,026
2008	2,343	2,879	0	2,130	7,352

Table 20. NEFSC spring and fall trawl survey indices for scup. Strata set includes only offshore strata 1-12, 23, 25 and 61-76 for consistency over entire time series. Fall strata set excludes inshore strata 1-61 that are included in the 1984 and later indices at age.

Year	Spring No./tow	Spring Kg/tow	Spring SSB kg/tow	Spring SSB 3-yr avg	Fall No./tow	Fall Kg/tow
1963					2.12	1.21
1964					118.70	2.23
1965					3.84	0.62
1966					2.00	0.41
1967					29.38	1.46
1968	59.21	2.25	0.94		14.35	0.54
1969	2.26	0.40	0.39	0.88	99.41	4.48
1970	78.50	3.01	1.30	1.09	10.34	0.22
1971	70.91	2.41	1.57	1.28	7.730	0.25
1972	49.80	2.30	0.98	1.21	40.56	2.34
1973	3.62	1.19	1.09	1.38	22.82	0.93
1974	30.28	3.24	2.06	1.92	9.94	1.01
1975	14.01	3.12	2.61	1.73	52.21	3.40
1976	4.09	0.63	0.53	2.50	161.14	7.35
1977	42.46	4.48	4.35	2.49	32.69	1.71
1978	39.85	3.49	2.59	2.77	12.17	1.32
1979	22.42	1.95	1.38	1.69	15.77	0.61
1980	9.31	1.31	1.09	1.12	11.05	0.92
1981	14.72	1.16	0.89	1.00	67.14	3.01
1982	7.88	1.16	1.02	0.65	25.47	1.17
1983	0.80	0.29	0.03	0.46	4.59	0.34
1984	8.52	0.51	0.33	0.24	24.03	1.22
1985	14.67	0.80	0.37	0.68	68.30	3.56
1986	11.74	1.30	1.33	0.98	46.19	1.66
1987	10.82	1.21	1.24	1.10	5.76	0.15
1988	25.41	1.26	0.73	0.66	5.75	0.09
1989	1.63	0.12	0.00	0.35	94.05	3.37
1990	1.17	0.39	0.34	0.26	16.53	0.83
1991	12.61	0.75	0.45	0.32	9.52	0.43
1992	6.79	0.40	0.21	0.32	16.19	1.12
1993	2.93	0.33	0.31	0.18	0.43	0.04
1994	1.54	0.09	0.03	0.15	3.59	0.11
1995	2.90	0.22	0.12	0.06	24.72	0.91
1996	0.53	0.03	0.02	0.08	4.46	0.23
1997	0.91	0.11	0.11	0.06	16.92	0.88
1998	40.04	0.87	0.05	0.08	25.35	0.69
1999	1.70	0.12	0.09	0.08	85.23	2.07
2000	6.71	0.33	0.11	0.25	99.33	4.79
2001	13.03	0.80	0.54	3.30	20.28	1.11
2002	154.86	13.46	9.24	3.31	95.62	3.79
2003	6.01	0.28	0.15	3.74	28.18	0.80
2004	57.58	2.84	1.82	0.69	10.38	0.27
2005	19.22	0.55	0.10	1.32	4.50	0.07
2006	5.71	2.10	2.04	0.76	96.41	1.92
2007	10.60	0.36	0.14	1.16	41.52	2.21
2008	9.68	1.44	1.30		38.49	1.38

Table 21. NEFSC spring trawl survey stratified mean number of scup per tow at age. Strata set includes only offshore strata 1-12, 23, 25, and 61-76.

Spring	Age													
Year	0	1	2	3	4	5	6	7	8	9	10	11	Total	age 2+	age 3+
1977		6.62	32.08	3.54	0.16	0.04	0.01	0.01					42.46	35.84	3.76
1978		26.90	4.67	6.50	1.31	0.32	0.12	0.03					39.85	12.95	8.28
1979		15.63	4.04	0.88	1.28	0.37	0.06	0.13	0.02	0.01			22.42	6.79	2.75
1980		2.39	5.61	0.57	0.17	0.25	0.15	0.08	0.08	0.01			9.31	6.92	1.31
1981		10.78	2.16	1.15	0.17	0.14	0.05	0.15	0.12				14.72	3.94	1.78
1982		3.80	1.77	1.39	0.38	0.17	0.13	0.07	0.07	0.10			7.88	4.08	2.31
1983		0.70	0.03	0.06				0.01					0.80	0.10	0.07
1984		6.14	1.97	0.22	0.12	0.07							8.52	2.38	0.41
1985		12.11	2.32	0.20	0.04								14.67	2.56	0.24
1986		1.05	10.26	0.43									11.74	10.69	0.43
1987		4.57	3.60	1.81	0.74	0.04	0.02	0.03	0.01				10.82	6.25	2.65
1988		16.74	8.36	0.17	0.03	0.01	0.03	0.07					25.41	8.67	0.31
1989		0.79	0.74	0.09	0.01								1.63	0.84	0.10
1990		0.12	0.30	0.30	0.18	0.09	0.13	0.05					1.17	1.05	0.75
1991		10.61	0.70	1.11	0.19								12.61	2.00	1.30
1992		5.72	0.88	0.07	0.05	0.06	0.01						6.79	1.07	0.19
1993		0.61	2.02	0.17	0.11	0.02							2.93	2.32	0.30
1994		1.34	0.16	0.04									1.54	0.20	0.04
1995		2.29	0.44	0.11	0.05	0.01							2.90	0.61	0.17
1996		0.44	0.05	0.03	0.01								0.53	0.09	0.04
1997		0.17	0.64	0.10									0.91	0.74	0.10
1998		39.90	0.12	0.02									40.04	0.14	0.02
1999		1.03	0.67										1.70	0.67	0.00
2000		5.93	0.71	0.07									6.71	0.78	0.07
2001		7.90	5.03	0.08		0.02							13.03	5.13	0.10
2002		109.01	15.60	26.67	3.27	0.31							154.86	45.85	30.25
2003		5.08	0.79	0.07	0.06								6.01	0.92	0.14
2004		38.69	16.15	1.31	0.82	0.60							57.58	18.89	2.74
2005		18.26	0.81	0.13	0.02								19.22	0.96	0.15
2006		1.56	0.51	0.80	0.35	0.70	1.69	0.10					5.71	4.15	3.64
2007		9.73	0.41	0.44	0.00	0.01	0.01						10.60	0.87	0.46
2008		0.40	5.82	2.92	0.18	0.09	0.15	0.05	0.07				9.68	9.28	3.46

Table 22. NEFSC fall trawl survey stratified mean number of scup per tow at age. Strata set includes offshore strata 1-12, 23, 25, 61-76, and inshore strata 1-61.

Fall	Age														
Year	0	1	2	3	4	5	6	7	8	9	10	11	Total	age 2+	age 3+
1984	47.64	9.20	0.34	0.03	0.01		0.01						59.96	0.39	0.05
1985	61.22	11.53	1.10	0.26	0.06	0.05							74.71	1.47	0.37
1986	70.19	6.58	0.57		0.01								77.36	0.58	0.01
1987	49.93	29.85	0.46	0.01									80.45	0.47	0.01
1988	47.44	15.95	0.67	0.10									64.22	0.77	0.10
1989	176.37	25.92	0.66	0.03									202.99	0.69	0.03
1990	77.45	9.21	0.75	0.04									87.46	0.79	0.04
1991	151.62	12.51	0.07	0.02									164.24	0.09	0.02
1992	25.92	14.51	1.66	0.04	0.02								42.15	1.72	0.06
1993	46.78	9.76	0.32										56.86	0.32	0.00
1994	39.54	3.92	0.04	0.01									43.52	0.05	0.01
1995	33.04	2.61	0.08	0.01									35.74	0.09	0.01
1996	24.42	2.86	0.43	0.01									27.73	0.44	0.01
1997	46.91	0.61	0.02		0.01								47.66	0.03	0.01
1998	57.73	9.64	0.09	0.03	0.01								67.50	0.13	0.04
1999	96.06	9.77	1.37	0.07	0.01								107.28	1.45	0.08
2000	98.72	20.60	3.14	0.48	0.11	0.07							123.12	3.80	0.66
2001	91.84	10.32	1.82	0.12	0.04	0.01							104.15	1.99	0.17
2002	180.09	43.31	0.90	0.35	0.04	0.01							224.70	1.30	0.40
2003	53.70	5.66	2.30	1.33	0.82	0.20	0.02						64.02	4.67	2.37
2004	41.83	33.46	1.14	1.70	0.39	0.12	0.04	0.01					78.69	3.40	2.26
2005	27.26	7.94	1.02	0.14	0.04	0.04							36.43	1.23	0.21
2006	146.85	20.08	0.92	0.07	0.05	0.01	0.03	0.01					168.02	1.09	0.17
2007	113.95	40.28	0.60	0.24	0.05	0.03	0.05	0.02					155.22	0.99	0.39
2008	70.43	65.48	0.52	0.06	0.01								136.50	0.59	0.07

Table 23. NEFSC 1992-2007 winter trawl survey indices of abundance for scup, offshore survey strata 1-12 and 61-76. The winter survey ended in 2007.

Year	Mean number per tow	Mean kg per tow
1992	65.56	2.87
1993	25.71	2.73
1994	17.09	0.66
1995	69.50	2.26
1996	18.28	1.19
1997	13.90	0.32
1998	46.92	1.20
1999	15.04	0.71
2000	24.21	1.33
2001	55.49	1.58
2002	267.83	7.56
2003	24.16	0.49
2004	380.59	3.82
2005	84.74	1.96
2006	201.96	3.72
2007	101.08	2.95

Table 24. NEFSC 1992-2007 winter trawl survey stratified mean number of scup per tow at age, offshore survey strata 1-12 and 61-76. The 1992, 1993, and 1996 lengths are aged with the corresponding annual spring survey age-length key. The winter survey ended in 2007.

Winter	Age											
Year	0	1	2	3	4	5	6	7	8	Total	age 2+	age 3+
1992		57.61	4.75	0.19	0.09	0.10	0.45			63.18	5.57	0.82
1993		2.51	22.05	0.56	0.57	0.02				25.71	23.19	1.15
1994		16.31	0.73	0.02	0.02	0.01				17.09	0.78	0.05
1995		64.94	1.87	0.15	0.01	0.01	0.02	0.01		67.01	2.07	0.20
1996		12.95	5.31	0.03	0.01					18.29	5.34	0.04
1997		13.27	0.52	0.11						13.90	0.64	0.11
1998		45.62	0.75	0.22	0.21	0.08	0.03	0.01		46.92	1.30	0.55
1999		12.48	2.41	0.12	0.02	0.01				15.04	2.56	0.15
2000		20.28	3.21	0.68	0.03			0.01		24.21	3.93	0.72
2001		48.54	6.48	0.36	0.09	0.02				55.49	6.95	0.47
2002		257.08	7.44	2.96	0.33	0.01	0.01			267.83	10.75	3.31
2003		23.77	0.28	0.07	0.03		0.02			24.16	0.39	0.11
2004		380.22	0.29	0.07	0.01					380.59	0.37	0.08
2005		80.03	4.62	0.09						84.74	4.71	0.09
2006		198.52	2.64	0.66	0.03	0.04	0.07			201.96	3.44	0.80
2007		99.18	1.86	0.02	0.02					101.08	1.90	0.04

Table 25. MADMF trawl survey mean number of scup per tow and mean weight (kg) per tow for spring (survey regions 1-3) and fall (survey regions 1-5).

	Spring		Fall	
Year	No./Tow	Kg/tow	No./Tow	Kg/Tow
1978	90.08	31.71	1859.40	14.82
1979	76.14	18.05	1150.16	12.20
1980	189.82	41.39	1183.02	12.53
1981	298.53	17.63	971.87	14.34
1982	10.46	0.98	2153.76	9.17
1983	25.29	3.51	1623.13	12.90
1984	17.90	6.53	963.49	12.29
1985	67.02	3.40	647.63	12.09
1986	44.17	7.35	773.61	9.15
1987	6.05	1.37	561.61	7.72
1988	13.98	2.09	1396.86	14.15
1989	13.32	2.02	580.73	7.77
1990	144.06	21.45	1128.07	7.21
1991	28.73	6.05	1150.71	10.18
1992	14.49	2.52	2440.96	11.54
1993	19.13	4.23	1023.11	10.06
1994	9.71	2.85	820.31	9.84
1995	49.29	2.76	507.02	4.11
1996	5.18	0.68	1019.96	9.15
1997	3.22	0.71	921.21	7.25
1998	1.37	0.21	709.61	6.94
1999	11.61	1.93	1212.23	18.07
2000	307.00	18.02	867.00	11.63
2001	7.28	2.37	1205.60	9.89
2002	281.36	18.77	1137.64	8.32
2003	0.22	0.07	3209.61	14.87
2004	41.71	13.04	1483.56	10.07
2005	9.32	3.25	4005.89	21.53
2006	92.97	22.41	1231.49	9.46
2007	13.30	2.03	1774.23	11.65
2008	145.72	27.89	743.19	10.78

Table 26. RIDFW trawl survey mean number of scup per tow and mean weight (kg) per tow for spring and fall.

	Spring		Fall	
Year	No./Tow	Kg/tow	No./Tow	Kg/Tow
1981	12.49	0.40	196.22	2.54
1982	0.43	0.04	63.87	0.70
1983	3.59	0.32	173.63	2.75
1984	13.24	0.88	589.68	10.57
1985	8.30	0.41	74.27	1.51
1986	1.78	0.33	340.06	4.20
1987	0.04	0.01	314.20	4.73
1988	0.23	0.04	804.00	7.10
1989	0.17	0.04	326.86	6.62
1990	0.64	0.15	527.31	5.66
1991	2.93	0.57	655.69	16.62
1992	1.88	0.61	1105.51	9.10
1993	1.12	0.06	1246.35	8.90
1994	2.08	0.53	236.12	3.66
1995	4.33	0.53	423.02	5.03
1996	0.52	0.07	184.73	3.83
1997	1.93	0.15	597.90	6.04
1998	0.15	0.03	150.38	1.89
1999	0.38	0.07	832.22	12.39
2000	84.05	3.54	588.73	9.11
2001	29.68	5.08	1139.17	11.07
2002	174.80	10.28	716.12	9.27
2003	0.00	0.00	1181.83	11.38
2004	2.59	0.45	1616.24	9.58
2005	2.95	1.63	2216.72	21.35
2006	53.12	3.90	765.90	11.26
2007	1.95	0.24	2410.00	23.76
2008	0.19	0.04	705.10	18.15

Table 27. CTDEP spring trawl survey mean number of scup per tow at age, total mean number per tow, and total mean weight (kg) per tow.

						Age								Total	Total	Age
Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	No./Tow	Kg/Tow	2+
1984	0.49	1.31	0.59	0.30	0.08	0.00	0.00	0.00	0.00	0.03	0.02	0.00	0.00	0.00	2.80	0.64	2.31
1985	2.94	2.00	0.33	0.24	0.05	0.02	0.05	0.00	0.00	0.01	0.00	0.00	0.00	0.00	5.61	1.22	2.71
1986	4.44	1.65	0.99	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.40	0.78	2.79
1987	0.43	1.65	0.07	0.03	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.17	0.37	1.76
1988	1.18	0.30	0.51	0.05	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.11	0.32	0.88
1989	5.63	0.56	0.03	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.77	0.63	0.62
1990	2.56	2.06	0.21	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.25	0.61	2.30
1991	4.25	1.44	1.26	0.09	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.09	0.94	2.80
1992	0.39	1.21	0.09	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.75	0.48	1.36
1993	0.04	2.29	0.19	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.32	0.49	2.49
1994	0.81	2.03	0.93	0.10	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.88	0.58	3.09
1995	12.94	0.39	0.20	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.24	0.65	0.64
1996	5.20	2.48	0.07	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.25	0.73	2.56
1997	3.16	2.61	1.68	0.06	0.01	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.23	0.75	4.39
1998	10.07	0.58	0.12	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.25	0.75	0.76
1999	2.71	1.75	0.16	0.07	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.22	0.56	2.02
2000	124.51	17.18	4.24	0.20	0.06	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	28.46	4.56	21.71
2001	1.65	18.99	1.57	0.25	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.20	2.85	20.84
2002	49.15	66.61	123.25	17.44	1.29	0.10	0.04	0.04	0.00	0.00	0.00	0.00	0.00	0.00	257.91	13.16	208.76
2003	0.14	4.05	3.28	4.96	0.61	0.07	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	13.12	2.28	12.98
2004	0.01	3.97	8.96	4.90	8.21	0.76	0.08	0.02	0.01	0.00	0.00	0.00	0.00	0.00	26.92	3.93	26.90
2005	1.16	1.28	1.06	1.51	1.27	1.94	0.22	0.05	0.00	0.00	0.00	0.00	0.00	0.00	8.49	1.65	7.33
2006	18.48	23.72	5.63	2.07	2.56	3.16	2.90	0.53	0.01	0.00	0.00	0.00	0.00	0.00	59.06	10.41	40.58
2007	7.51	15.86	5.84	1.49	0.55	0.54	0.54	0.39	0.07	0.01	0.00	0.00	0.00	0.00	32.80	3.32	25.29
2008	16.96	40.62	27.82	4.94	0.91	0.16	0.30	0.24	0.15	0.02	0.00	0.00	0.00	0.00	92.10	5.88	75.14

Table 28. CTDEP fall trawl survey mean number of scup per tow at age, total mean number per tow, and total mean weight (kg) per tow.

Year	0	1	2	3	4	5	Age 6	7	8	9	10	Total No/Tow	Total Kg/Tow	Age 2+
1984	7.99	1.04	0.78	0.52	0.28	0.09	0.02	0.00	0.00	0.00	0.00	10.72	1.36	1.69
1985	25.01	4.71	0.40	0.59	0.19	0.04	0.03	0.00	0.00	0.00	0.00	30.97	2.50	1.25
1986	13.06	9.98	2.50	0.19	0.01	0.01	0.01	0.00	0.00	0.00	0.00	25.76	2.95	2.72
1987	12.47	4.17	1.25	0.58	0.06	0.01	0.01	0.00	0.00	0.00	0.00	18.55	1.79	1.91
1988	31.89	5.71	1.82	0.24	0.03	0.00	0.00	0.00	0.00	0.00	0.00	39.69	2.27	2.09
1989	40.88	22.60	1.51	0.08	0.01	0.00	0.00	0.00	0.00	0.00	0.00	65.08	3.65	1.60
1990	54.34	7.74	6.95	0.40	0.03	0.01	0.01	0.00	0.00	0.01	0.00	69.49	5.00	7.41
1991	291.58	17.03	1.76	1.04	0.15	0.01	0.00	0.00	0.00	0.00	0.00	311.57	8.30	2.96
1992	50.91	26.58	5.54	0.40	0.29	0.01	0.01	0.00	0.00	0.00	0.00	83.74	4.96	6.25
1993	74.06	1.83	1.02	0.12	0.01	0.01	0.00	0.00	0.00	0.00	0.00	77.05	3.72	1.16
1994	90.76	1.12	0.46	0.18	0.01	0.00	0.00	0.00	0.00	0.00	0.00	92.53	3.33	0.65
1995	32.46	26.52	0.14	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	59.13	4.63	0.15
1996	51.50	8.56	1.37	0.03	0.00	0.01	0.00	0.00	0.00	0.00	0.00	61.47	3.68	1.41
1997	31.79	8.68	0.63	0.17	0.01	0.00	0.00	0.00	0.00	0.00	0.00	41.28	2.49	0.81
1998	90.40	12.24	0.54	0.07	0.02	0.00	0.00	0.00	0.00	0.00	0.00	103.27	4.50	0.63
1999	498.18	30.93	8.35	0.19	0.02	0.01	0.00	0.00	0.00	0.00	0.00	537.68	22.72	8.57
2000	250.39	261.45	8.32	0.79	0.14	0.01	0.00	0.00	0.00	0.00	0.00	521.10	30.76	9.26
2001	140.51	16.90	18.42	1.61	0.19	0.03	0.00	0.00	0.00	0.00	0.00	177.66	11.28	20.25
2002	259.90	47.62	23.32	16.81	0.67	0.33	0.05	0.00	0.01	0.00	0.00	348.70	23.69	41.18
2003	52.91	15.35	32.07	22.39	26.44	2.49	0.54	0.02	0.02	0.00	0.00	152.23	28.95	83.96
2004	251.05	4.13	8.34	15.08	5.98	6.25	0.53	0.07	0.01	0.02	0.00	291.46	16.31	36.28
2005	373.32	32.56	8.14	2.44	4.01	1.50	1.69	0.33	0.06	0.00	0.00	424.05	13.79	18.17
2006	52.16	51.02	9.52	2.34	0.26	0.35	0.38	0.68	0.04	0.00	0.00	116.75	10.49	13.57
2007	319.89	118.06	29.34	5.93	0.90	0.23	0.30	0.31	0.31	0.03	0.00	475.30	24.42	37.35
2008	243.68	35.10	11.92	7.04	3.56	1.05	0.50	0.14	0.12	0.14	0.00	303.26	16.53	24.48

Table 29. NYDEC trawl survey indices at ages 0, 1 and 2 and older (2+); NJBMF trawl survey mean number of scup per tow and mean weight (kg) per tow; VIMS age 0 index.

	NYDEC Trawl			NJBMF Trawl		VIMS
Year	Age 0	Age 1	Age 2+	No/tow	Kg/tow	Age 0
1987	0.33	3.43	0.09			2.07
1988	1.19	1.96	0.05			3.06
1989	0.67	11.02	0.04	72.75	2.75	4.81
1990	5.32	1.30	0.14	74.72	3.77	1.90
1991	13.17	2.31	0.22	200.61	6.17	0.65
1992	15.25	1.54	0.06	227.70	7.16	3.30
1993	0.29	0.72	0.04	256.91	5.21	0.90
1994	6.11	0.36	0.06	86.45	3.30	0.39
1995	0.61	7.49	0.03	27.13	2.08	0.54
1996	0.42	0.94	0.15	30.81	1.04	0.21
1997	20.23	0.74	0.20	52.09	3.82	0.50
1998	73.22	1.46	0.05	220.05	4.88	0.27
1999	35.85	2.25	0.03	209.10	10.30	0.13
2000	186.07	16.73	1.02	260.97	6.56	1.34
2001	83.01	2.99	1.22	163.37	4.32	0.24
2002	346.32	5.47	6.01	565.96	25.65	0.96
2003	266.56	0.38	1.35	804.08	10.19	0.46
2004	40.82	0.92	0.70	449.12	11.70	1.11
2005	n/a	n/a	n/a	147.98	4.19	1.58
2006	122.23	3.12	0.35	943.63	16.52	2.99
2007	109.47	4.18	0.61	1185.54	38.27	0.20
2008	245.48	4.80	0.30	141.17	3.19	

Table 30. University of Rhode Island Graduate School of Oceanography (URIGSO) trawl survey indices for scup (total catch number).

Year	Number
1963	59.81
1964	60.73
1965	41.11
1966	20.73
1967	114.35
1968	36.15
1969	23.31
1970	24.27
1971	87.04
1972	56.93
1973	114.13
1974	90.01
1975	207.22
1976	430.70
1977	294.15
1978	161.94
1979	151.06
1980	83.27
1981	143.61
1982	75.11
1983	246.22
1984	206.00
1985	235.10
1986	177.01
1987	134.73
1988	127.01
1989	397.63
1990	158.81
1991	290.54
1992	104.91
1993	295.76
1994	77.84
1995	113.70
1996	104.74
1997	85.96
1998	91.79
1999	304.98
2000	352.34
2001	171.02
2002	221.10
2003	90.47
2004	67.70
2005	158.42
2006	275.27
2007	311.41
2008	361.89

Table 31. VIMS ChesMMAP trawl survey indices for scup. Indices are geometric mean numbers (N) and biomass per tow.

Year	Number	Biomass	Age 0 N	Age 1 N
2002	3.61	1.03	1.04	1.91
2003	5.28	1.51	0.98	4.09
2004	13.00	2.64	0.42	10.92
2005	13.78	2.99	4.91	3.46
2006	10.69	2.03	3.53	2.57
2007	19.32	2.29	1.16	11.97
2008	1.24	0.41	n/a	n/a

Table 32. VIMS NEAMAP trawl survey indices for scup. Indices are minimum swept area estimates, in millions of fish (N) or metric tons (B). Where available, ages are percent of total number.

Season	Total N	Total B	Age 0	Age 1	Age 2+
Fall 2006	1,269.5	32,136.3	n/a	n/a	n/a
Fall 2007	943.9	15,083.8	89.1	10.5	0.0
Fall 2008	236.9	7,875.4	n/a	n/a	n/a
Spring 2008	217.9	5,081.3	n/a	n/a	n/a

Table 33. Summary results for 1984-2008 from the 2009 updated assessment. Spawning Stock Biomass (SSB) in metric tons (mt); Recruitment (R) at age 0 in millions; Fishing Mortality (F) for fully recruited ages 2-7+.

Year	SSB	R	F
1984	18,087	107.3	0.531
1985	17,049	79.1	0.607
1986	15,949	57.7	0.782
1987	13,501	57.6	0.682
1988	10,487	88.6	0.711
1989	8,978	69.7	0.697
1990	9,554	106.2	0.665
1991	9,458	93.4	1.008
1992	8,081	39.8	1.047
1993	6,216	46.6	1.093
1994	4,562	70.2	1.095
1995	4,210	36.6	0.880
1996	5,211	29.2	0.738
1997	5,663	85.8	0.477
1998	6,813	114.6	0.325
1999	12,338	217.6	0.205
2000	25,189	266.9	0.150
2001	50,332	154.9	0.081
2002	80,491	118.1	0.086
2003	105,428	89.7	0.082
2004	118,421	157.9	0.055
2005	133,136	159.2	0.044
2006	142,519	199.3	0.043
2007	158,208	113.0	0.043
2008	187,888	192.4	0.042

Table 34. January 1 population number (N, 000s) estimates for 1984-2008 from the 2009 assessment update.

N	Age							
	0	1	2	3	4	5	6	7+
1984	107,341	60,493	29,895	8,319	3,445	3,016	4,811	13,258
1985	79,087	79,847	39,861	13,953	4,081	1,630	1,427	8,894
1986	57,749	57,288	49,485	16,265	6,439	1,773	708	4,781
1987	57,638	42,971	36,554	21,386	6,469	2,309	636	2,179
1988	88,642	43,146	28,119	16,683	9,233	2,592	925	1,210
1989	69,709	66,699	28,531	12,989	6,967	3,601	1,011	876
1990	106,187	51,791	42,871	12,552	5,563	2,740	1,416	777
1991	93,372	78,531	33,220	18,702	5,491	2,273	1,119	923
1992	39,814	67,053	46,241	11,504	5,961	1,561	646	618
1993	46,605	27,134	35,912	12,764	3,481	1,641	429	370
1994	70,221	32,640	15,259	10,932	3,690	913	430	223
1995	36,584	51,380	19,918	5,575	3,154	965	239	179
1996	29,222	25,777	29,788	6,647	1,961	1,038	317	143
1997	85,793	21,508	16,327	12,450	2,703	744	394	180
1998	114,610	64,582	14,277	8,194	6,238	1,356	373	295
1999	217,572	87,619	44,737	8,016	4,804	3,661	796	400
2000	266,878	170,021	64,071	28,386	5,317	3,189	2,430	802
2001	154,859	212,330	129,613	44,410	19,907	3,730	2,237	2,282
2002	118,078	124,701	166,898	97,115	33,467	15,006	2,812	3,425
2003	89,656	90,965	89,095	104,763	72,784	25,111	11,259	4,703
2004	157,942	71,911	70,894	65,792	78,823	54,779	18,900	12,059
2005	159,170	127,749	57,165	54,632	50,898	60,989	42,386	24,029
2006	199,275	128,879	101,865	44,588	42,768	39,850	47,751	52,121
2007	112,965	160,728	101,919	78,566	34,912	33,494	31,209	78,437
2008	192,401	91,018	126,810	77,975	61,525	27,346	26,236	86,187

Table 35. Fishing mortality (F) estimates for 1984-2008 from the 2009 assessment update.

F	Age							
	0	1	2	3	4	5	6	7+
1984	0.096	0.217	0.562	0.512	0.548	0.548	0.549	0.495
1985	0.122	0.278	0.696	0.573	0.634	0.634	0.635	0.559
1986	0.096	0.249	0.639	0.722	0.825	0.826	0.826	0.709
1987	0.090	0.224	0.584	0.640	0.715	0.715	0.715	0.624
1988	0.084	0.214	0.572	0.673	0.742	0.742	0.742	0.654
1989	0.097	0.242	0.621	0.648	0.733	0.733	0.734	0.635
1990	0.102	0.244	0.630	0.627	0.695	0.695	0.696	0.611
1991	0.131	0.330	0.860	0.943	1.058	1.058	1.059	0.922
1992	0.183	0.424	1.087	0.995	1.090	1.090	1.092	0.967
1993	0.156	0.376	0.989	1.041	1.138	1.138	1.139	1.010
1994	0.112	0.294	0.807	1.043	1.141	1.141	1.142	1.010
1995	0.150	0.345	0.897	0.845	0.912	0.912	0.914	0.817
1996	0.106	0.257	0.672	0.700	0.769	0.769	0.770	0.680
1997	0.084	0.210	0.489	0.491	0.490	0.490	0.478	0.438
1998	0.069	0.167	0.377	0.334	0.333	0.333	0.325	0.298
1999	0.047	0.113	0.255	0.211	0.210	0.210	0.206	0.187
2000	0.029	0.071	0.167	0.155	0.154	0.154	0.153	0.135
2001	0.017	0.041	0.089	0.083	0.083	0.083	0.081	0.073
2002	0.061	0.136	0.266	0.088	0.087	0.087	0.086	0.080
2003	0.021	0.049	0.103	0.084	0.084	0.084	0.083	0.075
2004	0.012	0.029	0.061	0.057	0.057	0.057	0.055	0.050
2005	0.011	0.026	0.048	0.045	0.045	0.045	0.044	0.040
2006	0.015	0.035	0.060	0.045	0.044	0.044	0.043	0.040
2007	0.016	0.037	0.068	0.044	0.044	0.044	0.043	0.040
2008	0.019	0.043	0.079	0.043	0.043	0.043	0.042	0.039

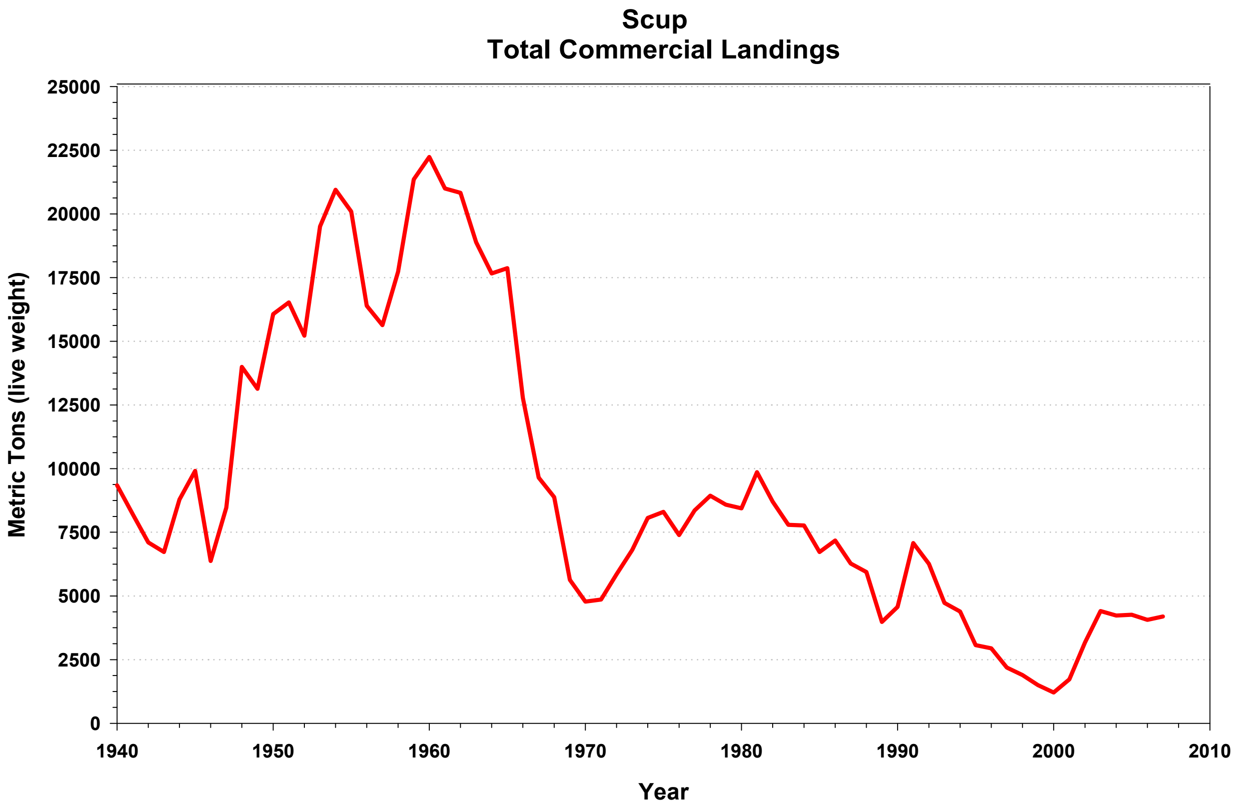

Figure 1. Total commercial fishery landings for scup.

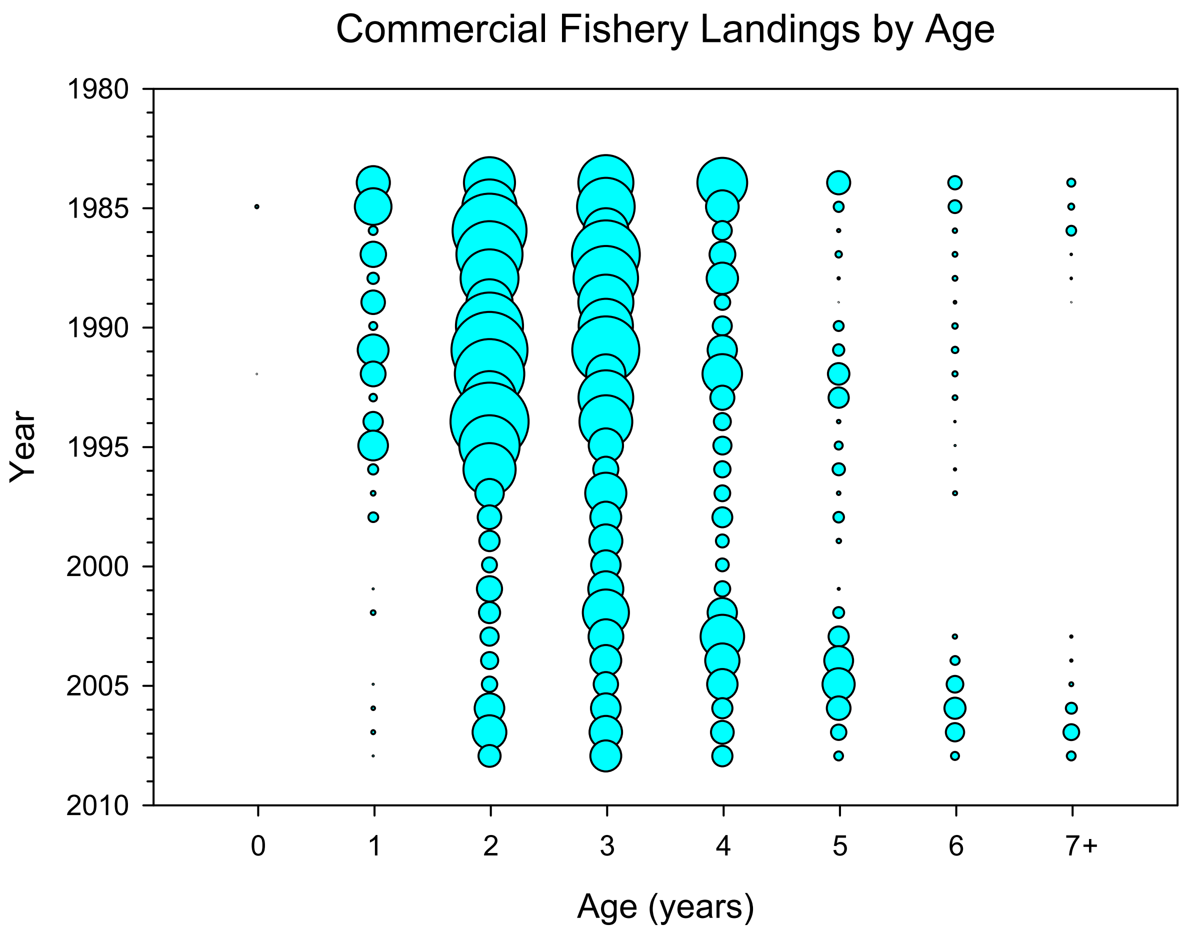

Figure 2. Commercial fishery landings by age for scup.

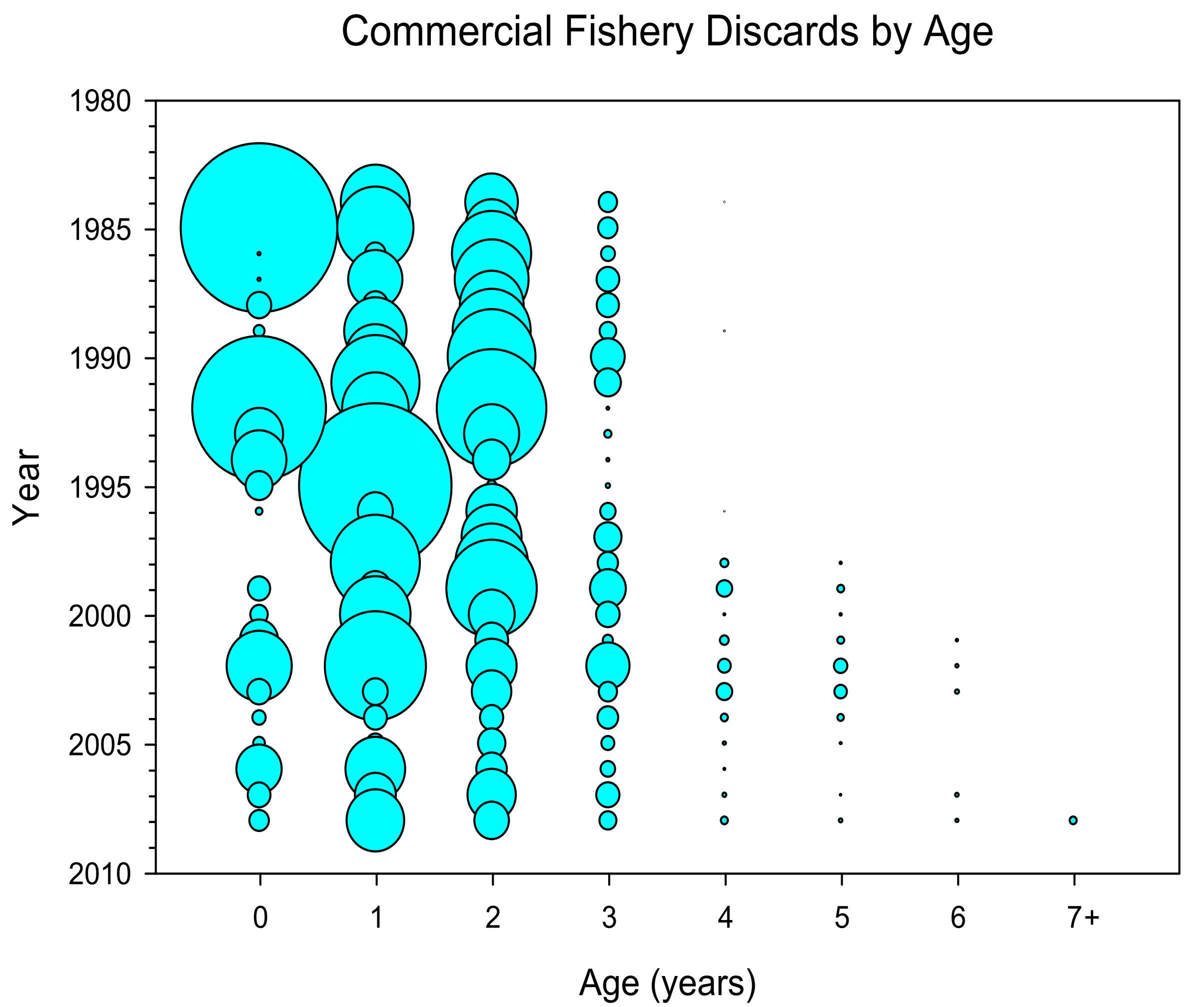

Figure 3. Commercial fishery discards by age for scup.

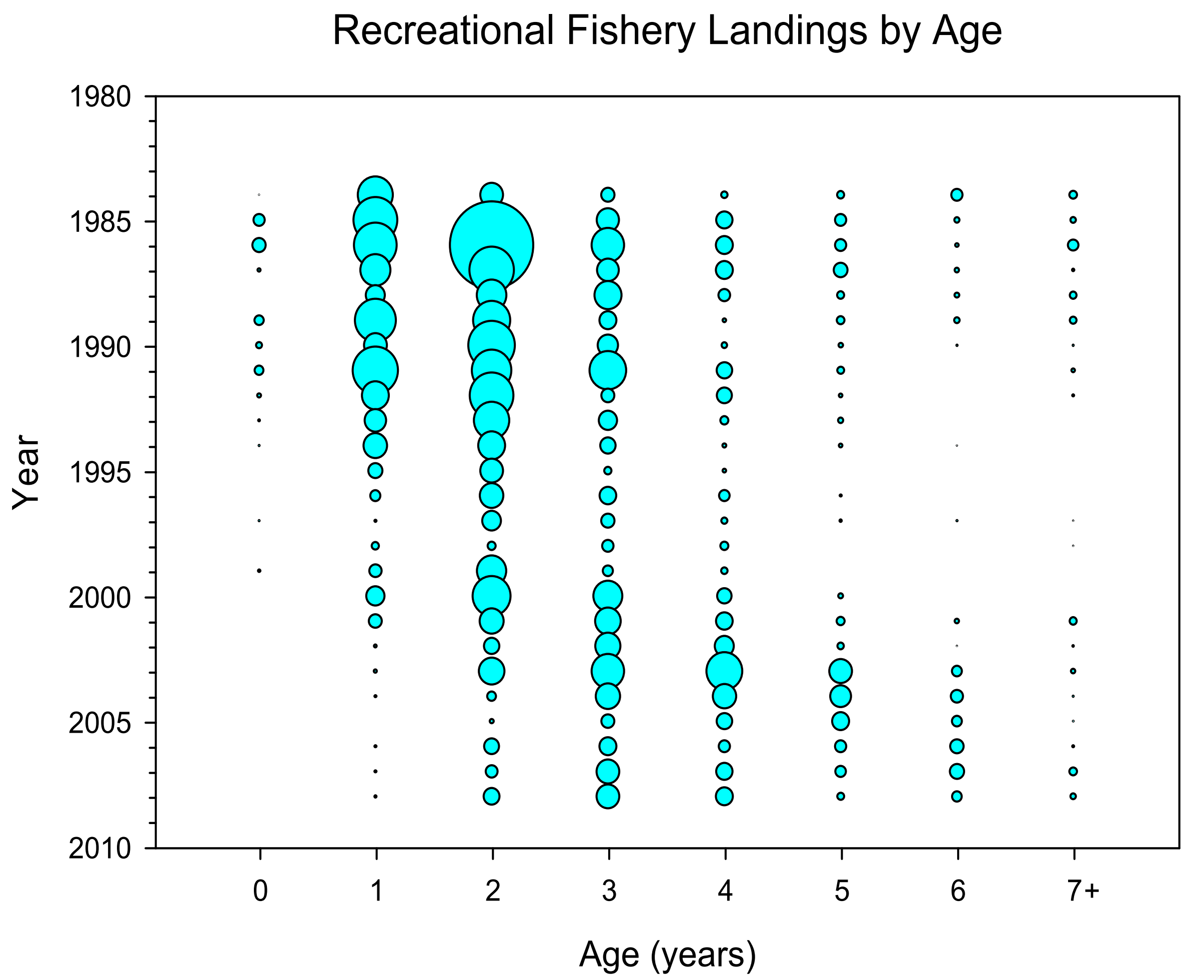

Figure 4. Recreational fishery landings by age for scup.

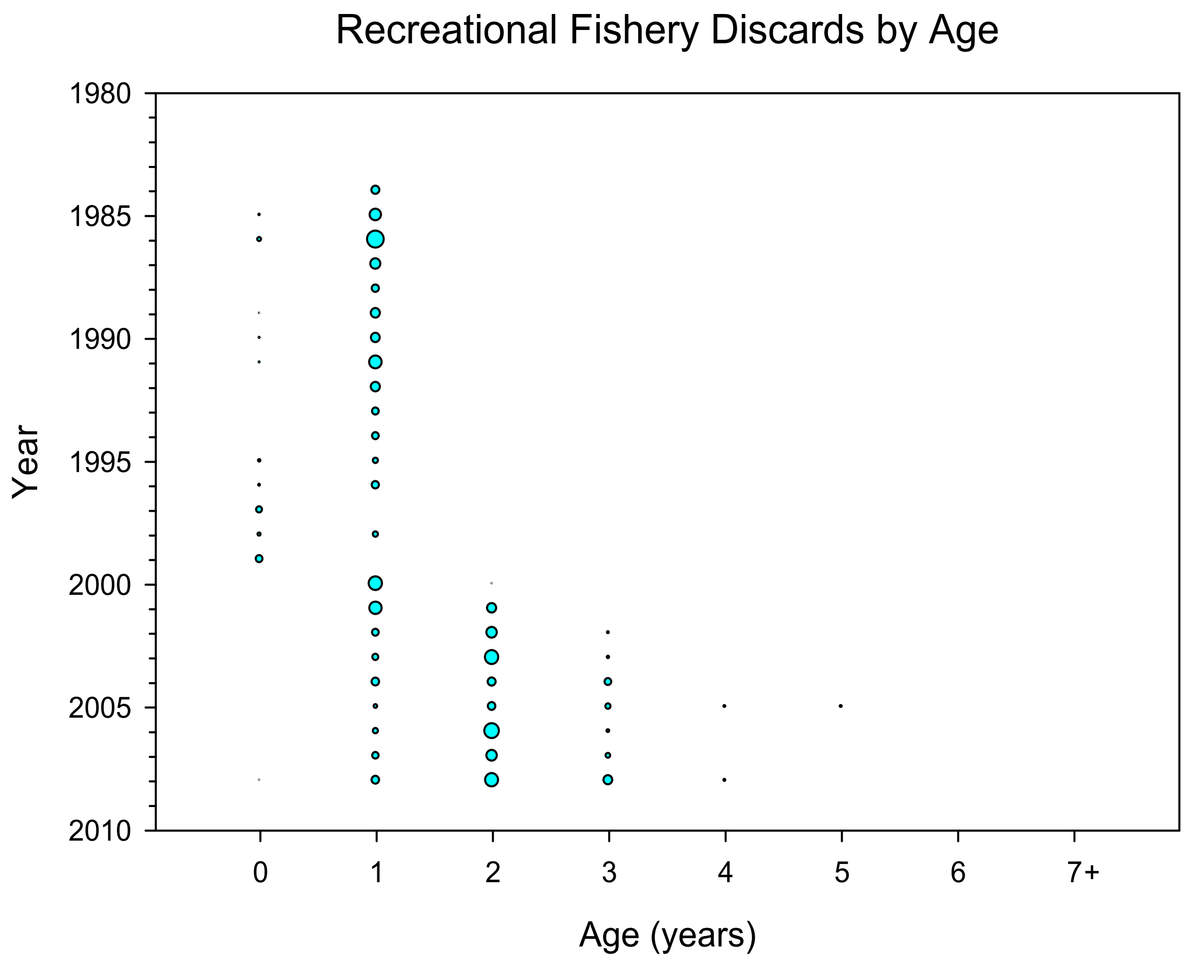

Figure 5. Recreational fishery discards by age for scup.

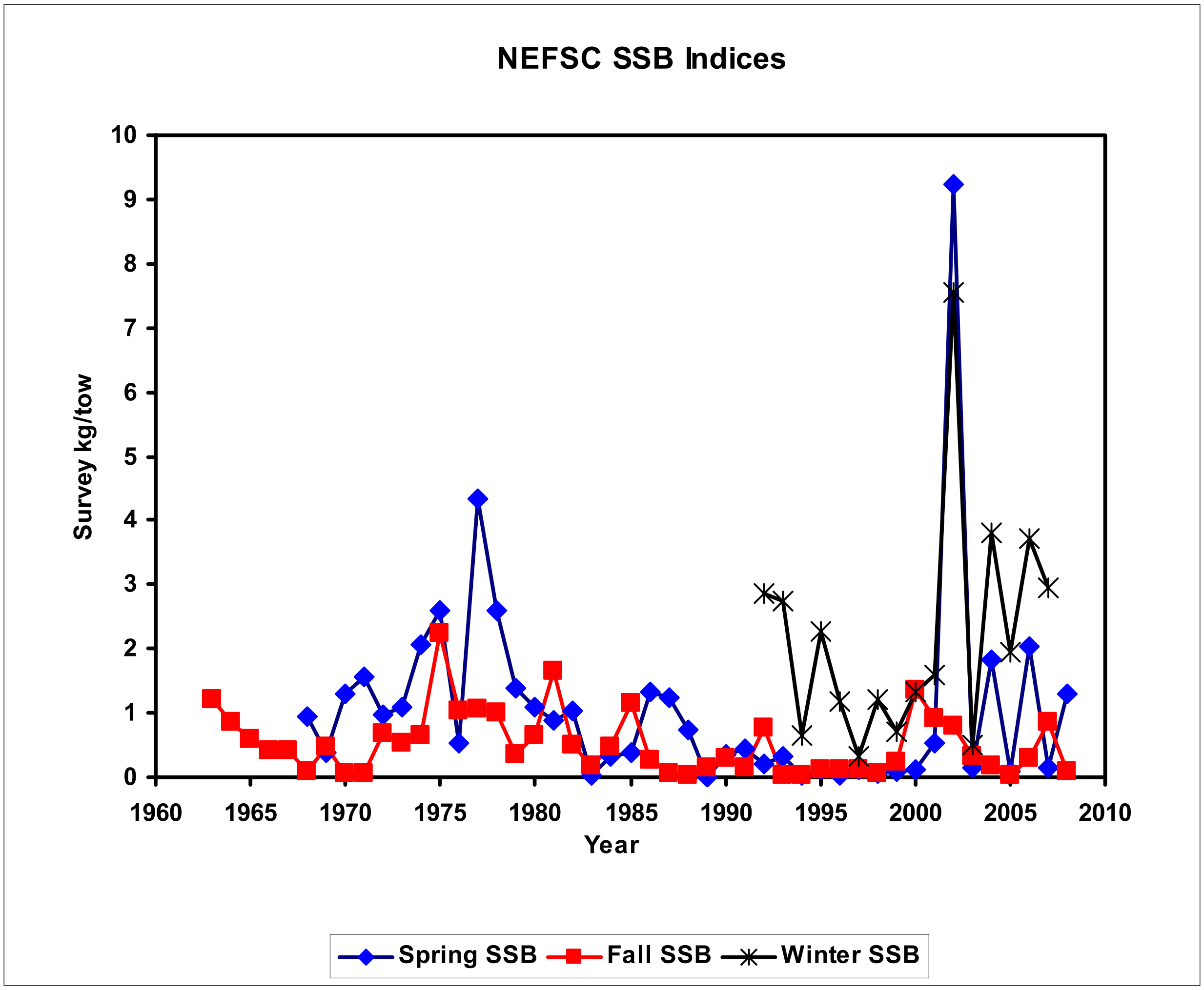

Figure 6. NEFSC Spring and Fall survey Spawning Stock Biomass (SSB) indices for scup.

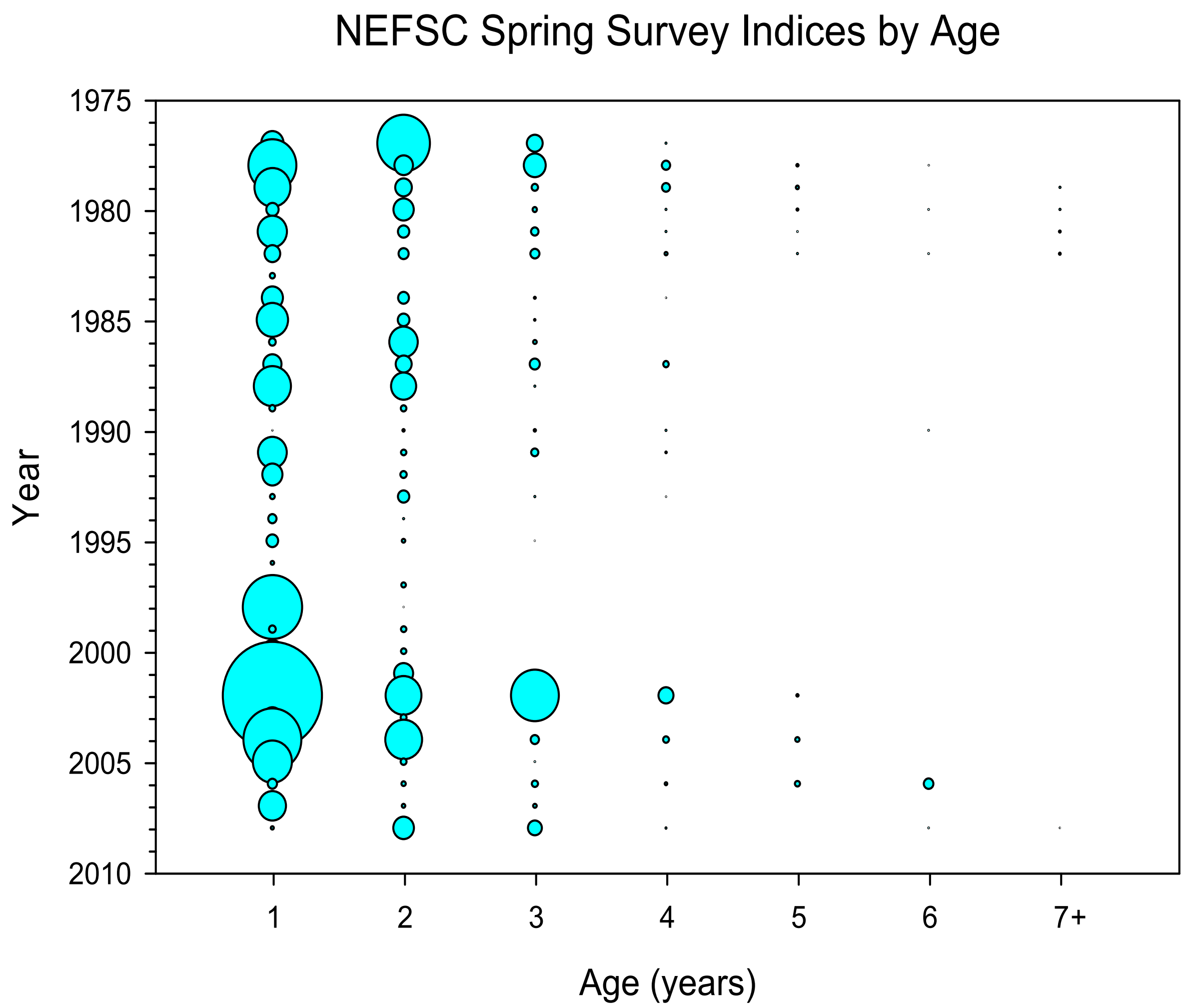

Figure 7. NEFSC Spring survey indices by age for scup.

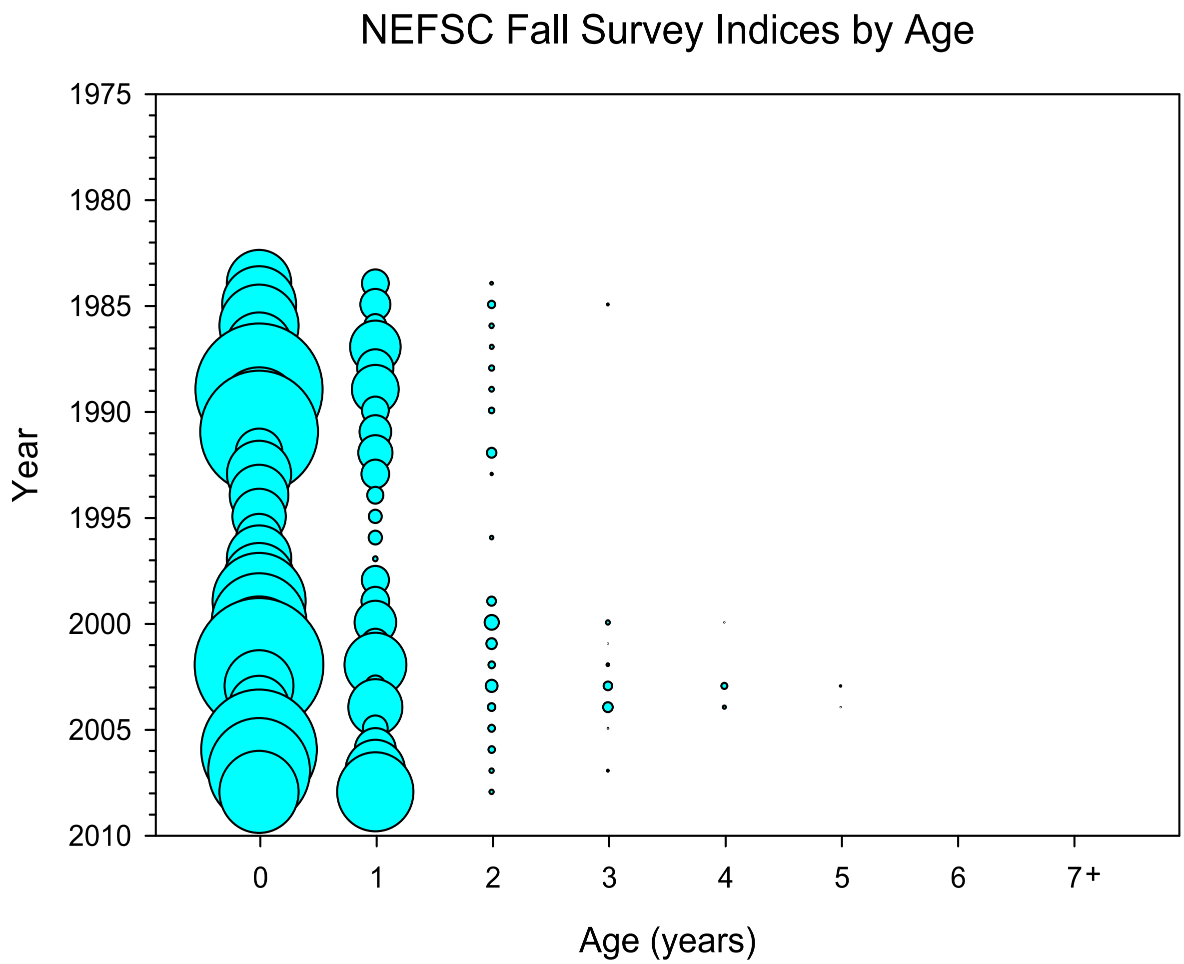

Figure 8. NEFSC Fall survey indices by age for scup.

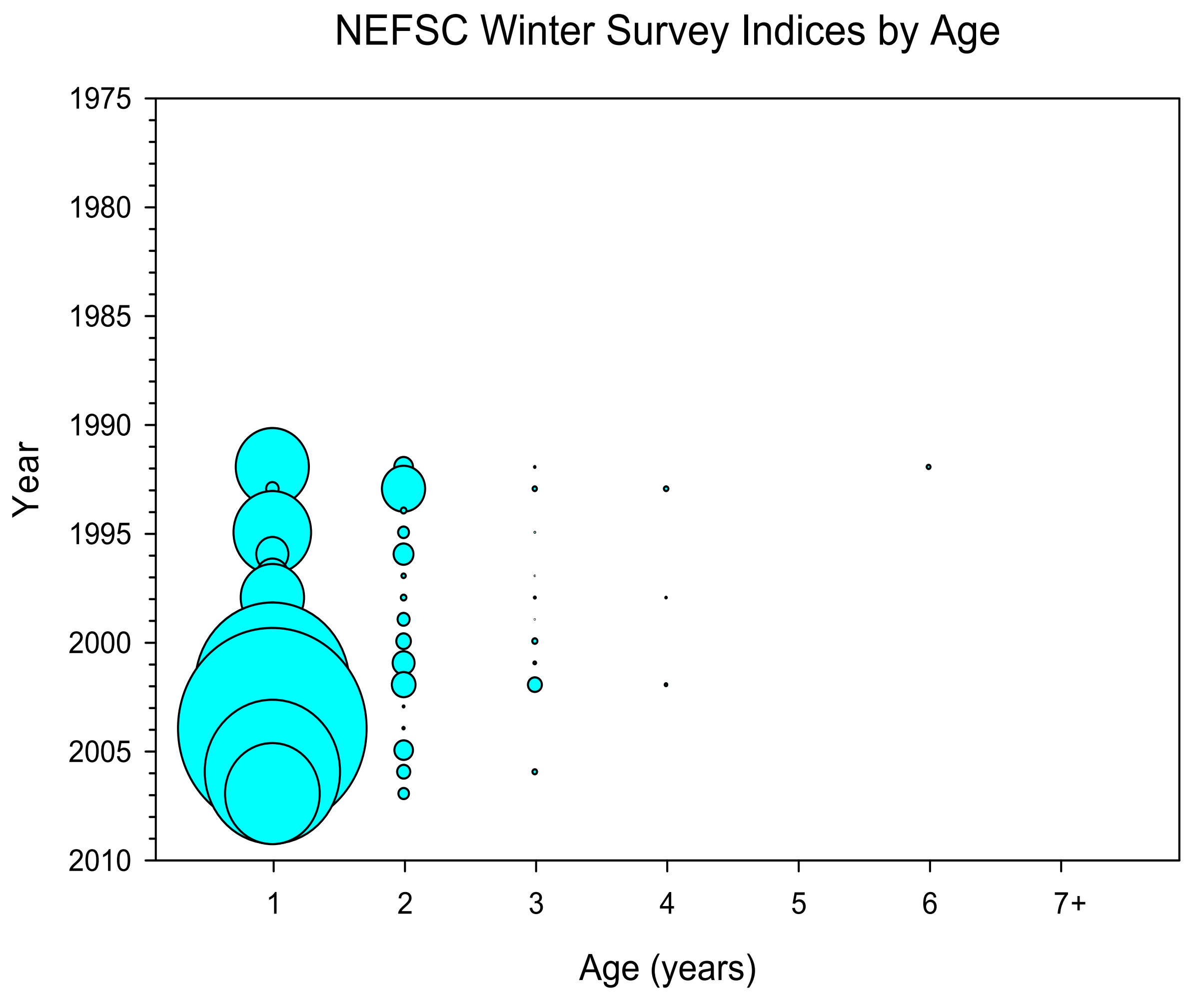

Figure 9. NEFSC Winter survey indices by age for scup.

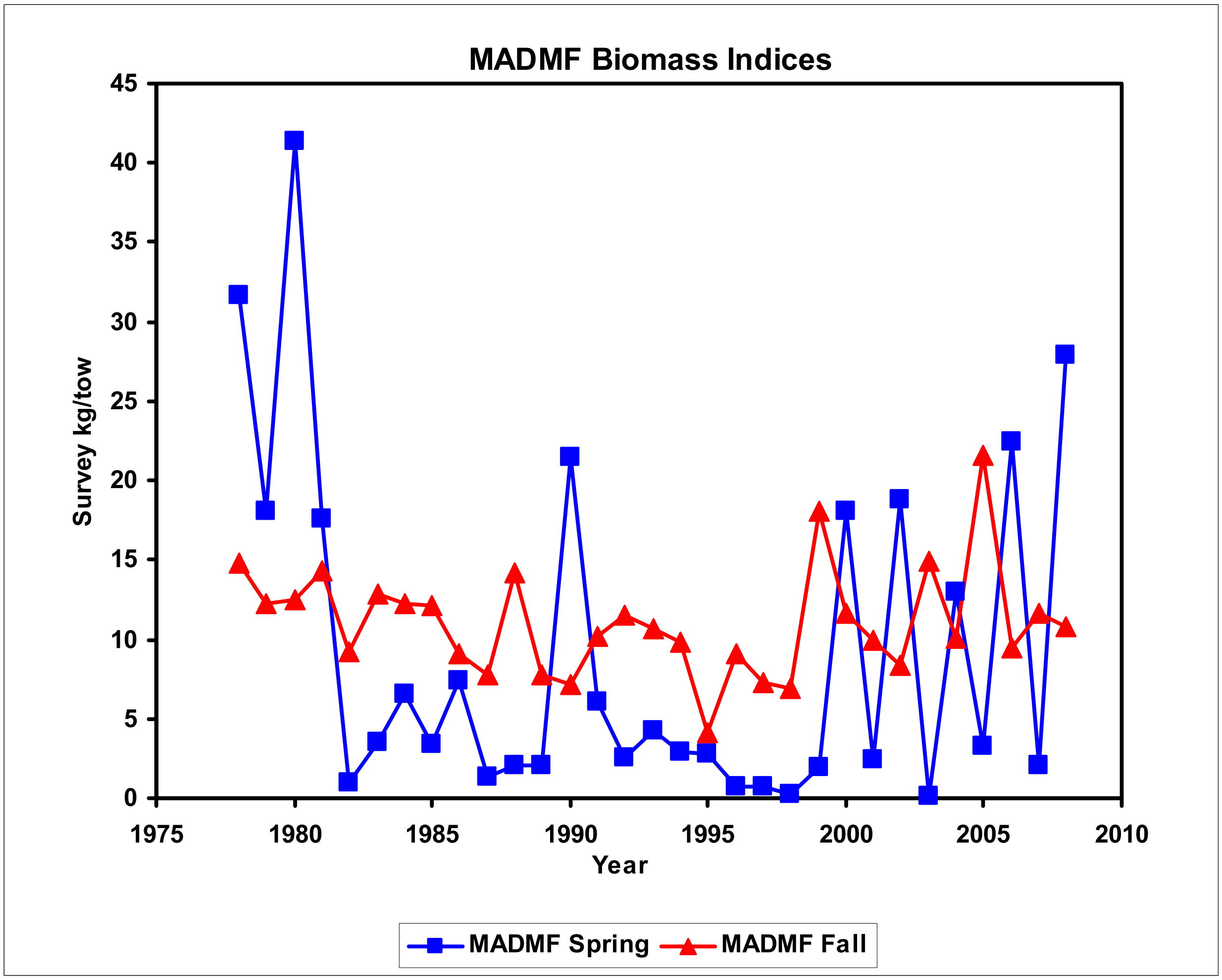

Figure 10. MADMF Spring and Fall survey aggregate biomass indices.

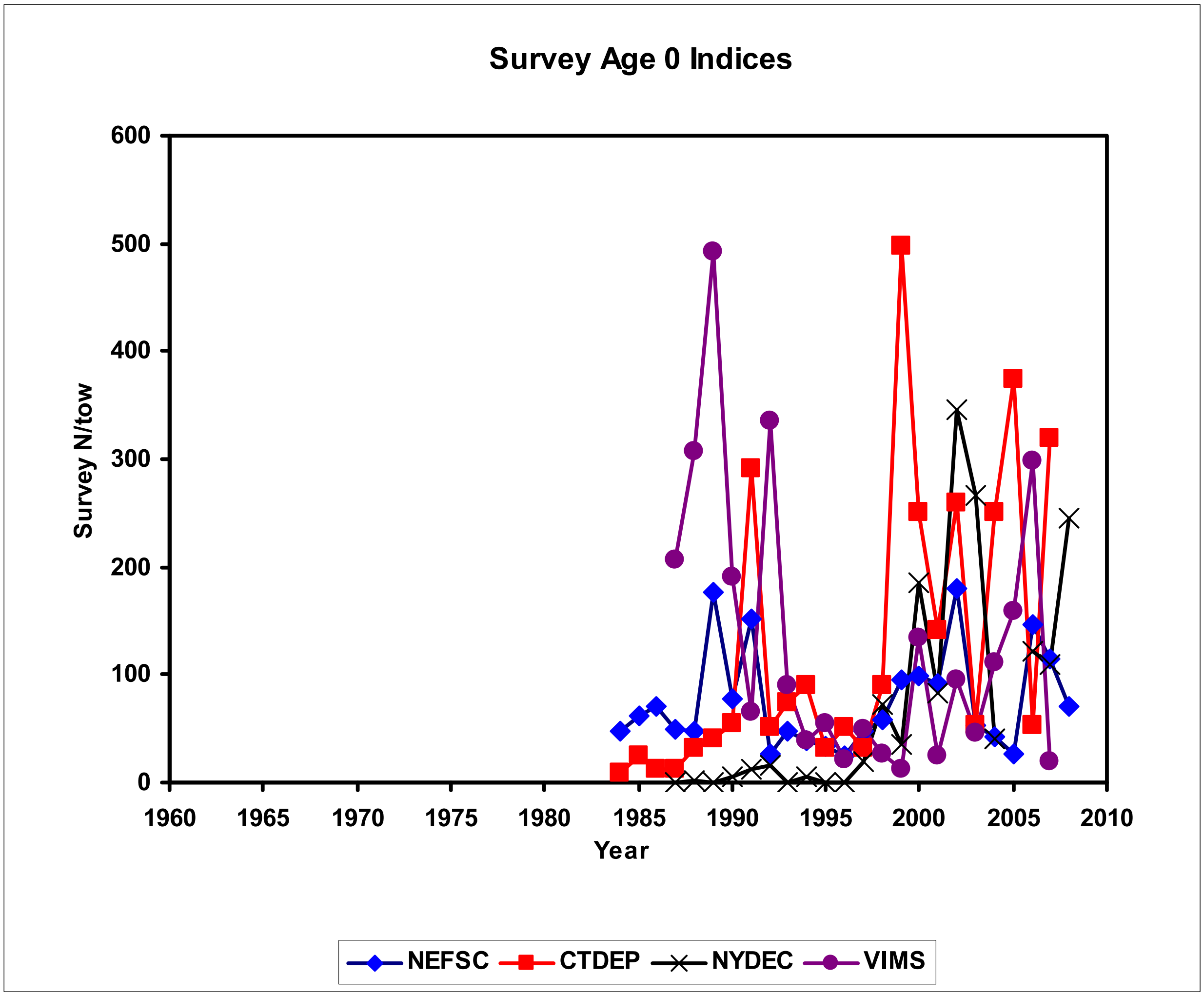

Figure 11. Research survey recruitment (age 0 abundance) indices.

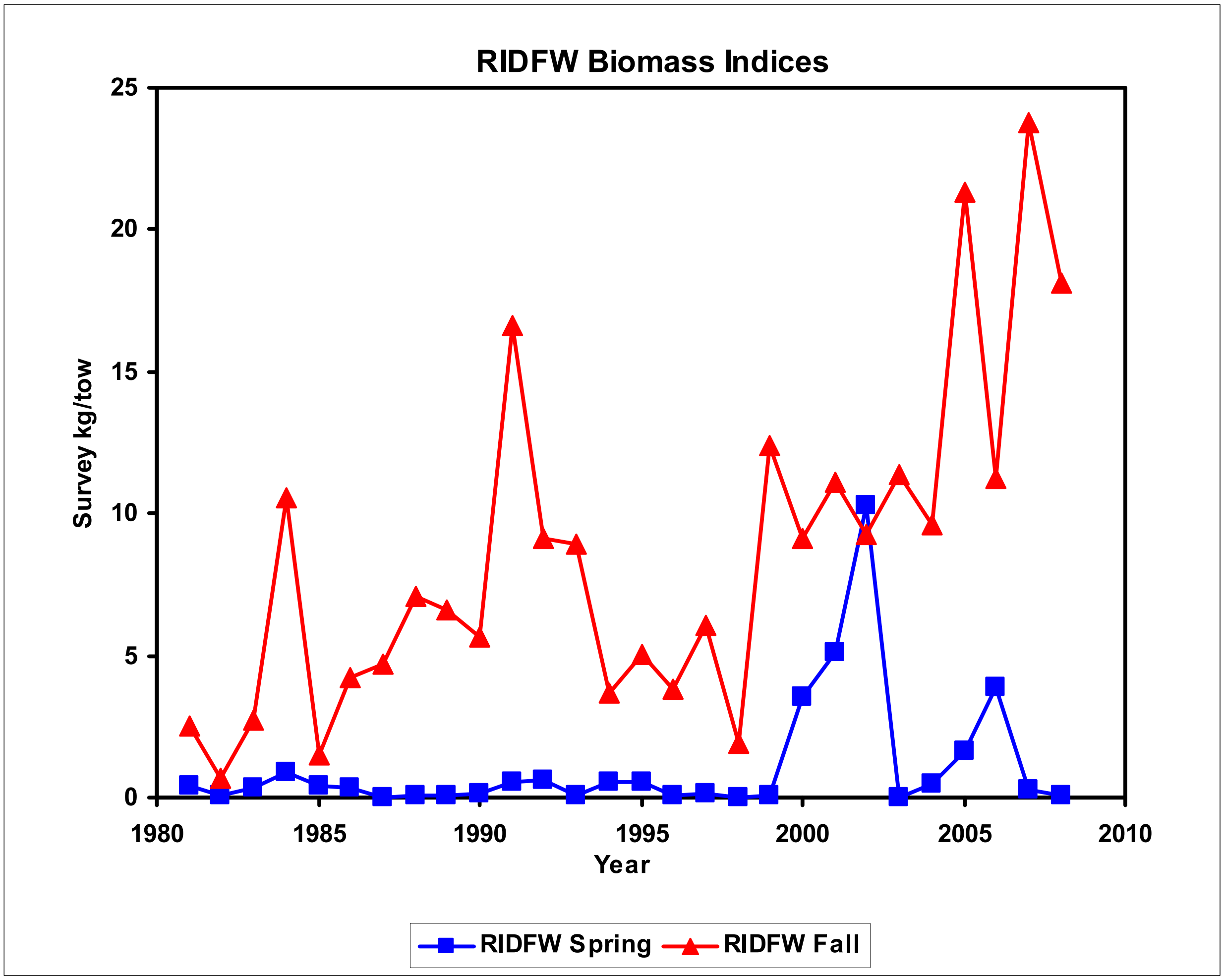

Figure 12. RIDFW Spring and Fall survey aggregate biomass indices.

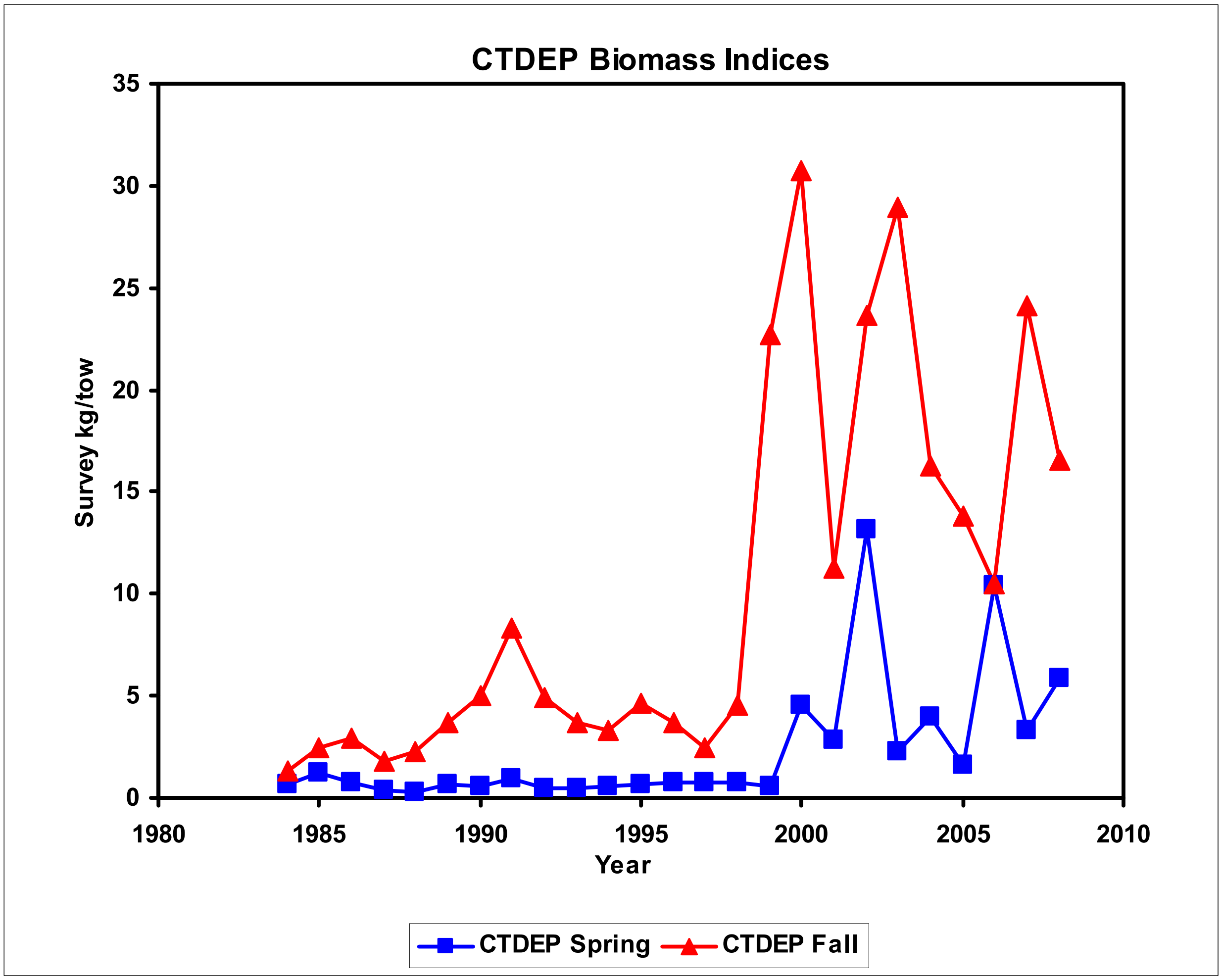

Figure 13. CTDEP Spring and Fall survey aggregate biomass indices.

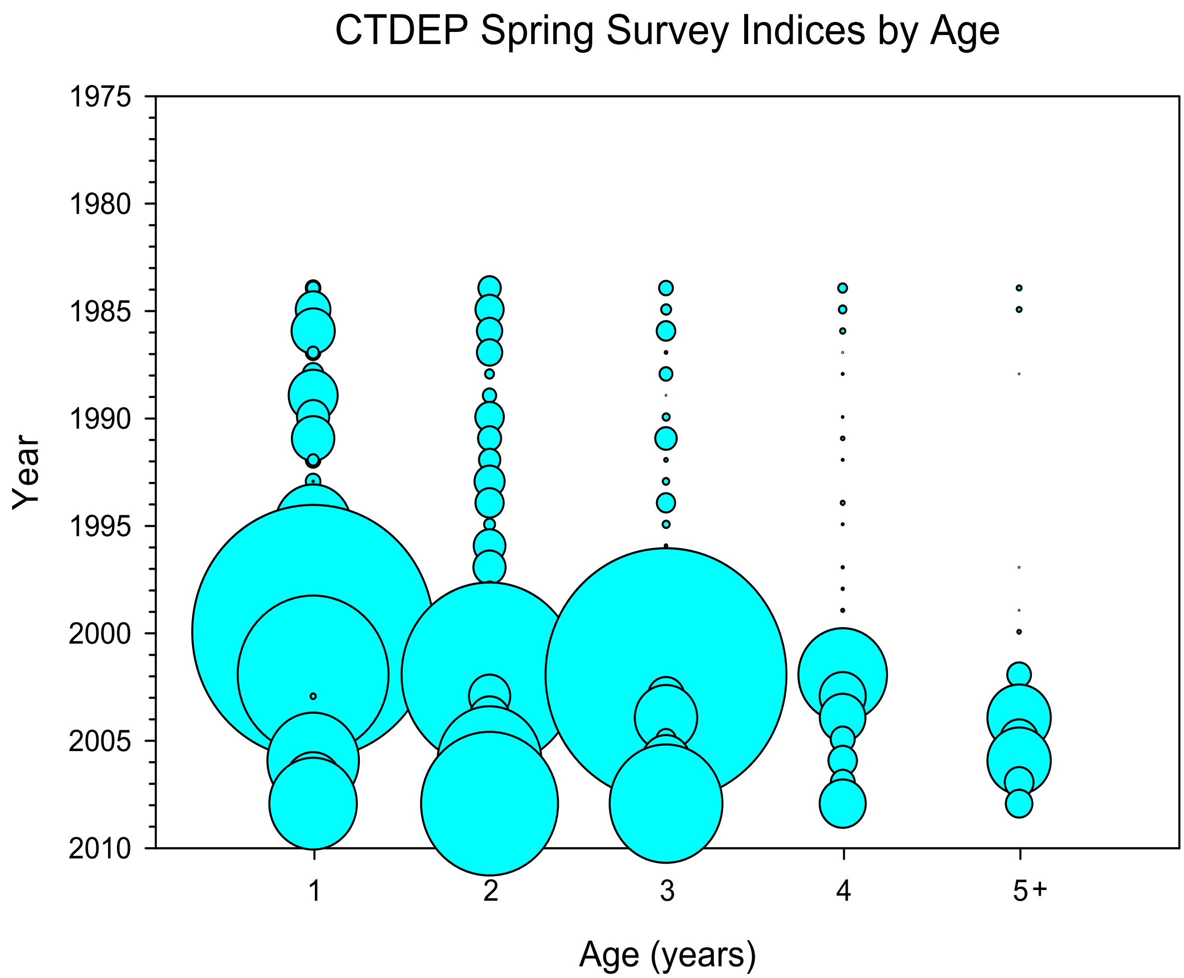

Figure 14. CTDEP Spring survey indices by age for scup.

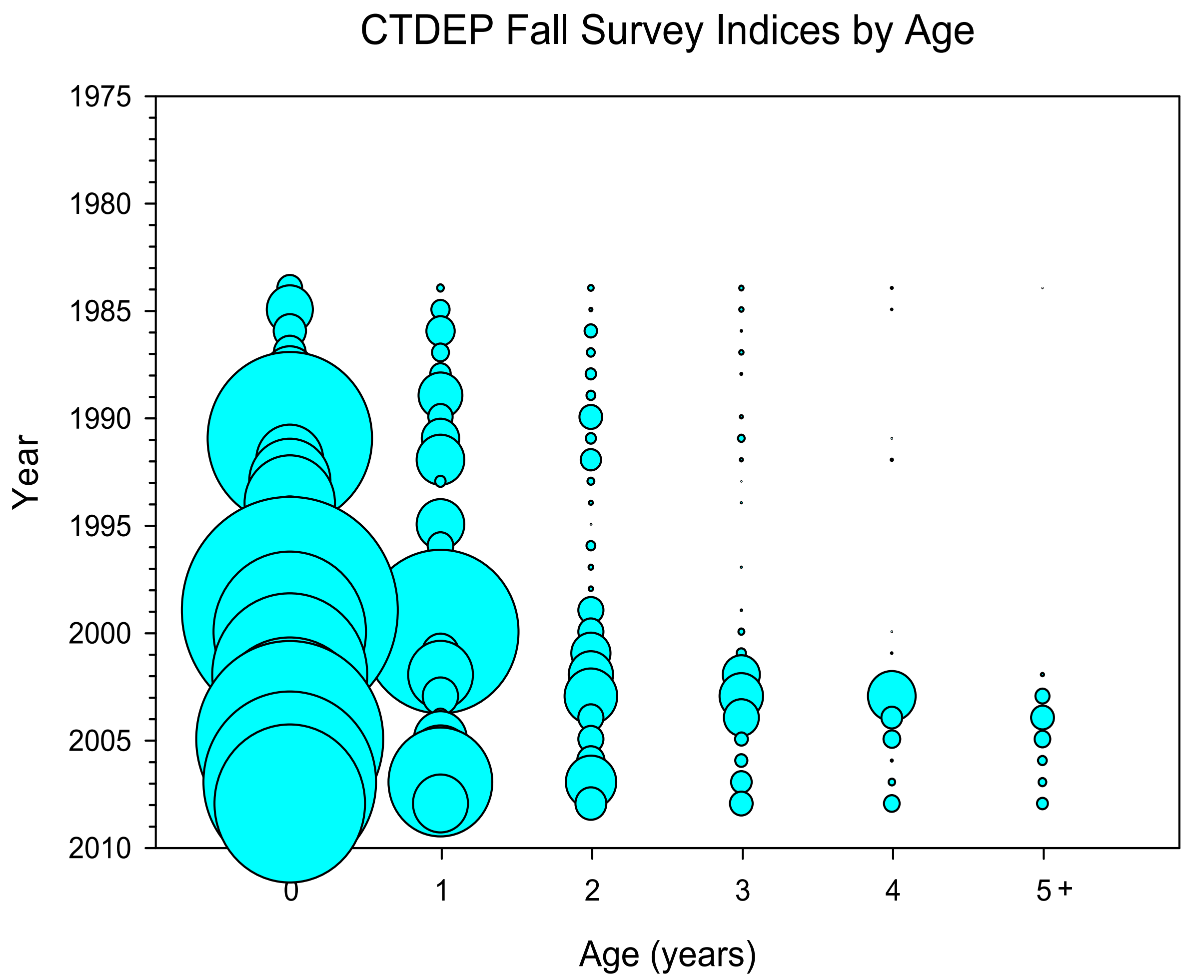

Figure 15. CTDEP Fall survey indices by age for scup.

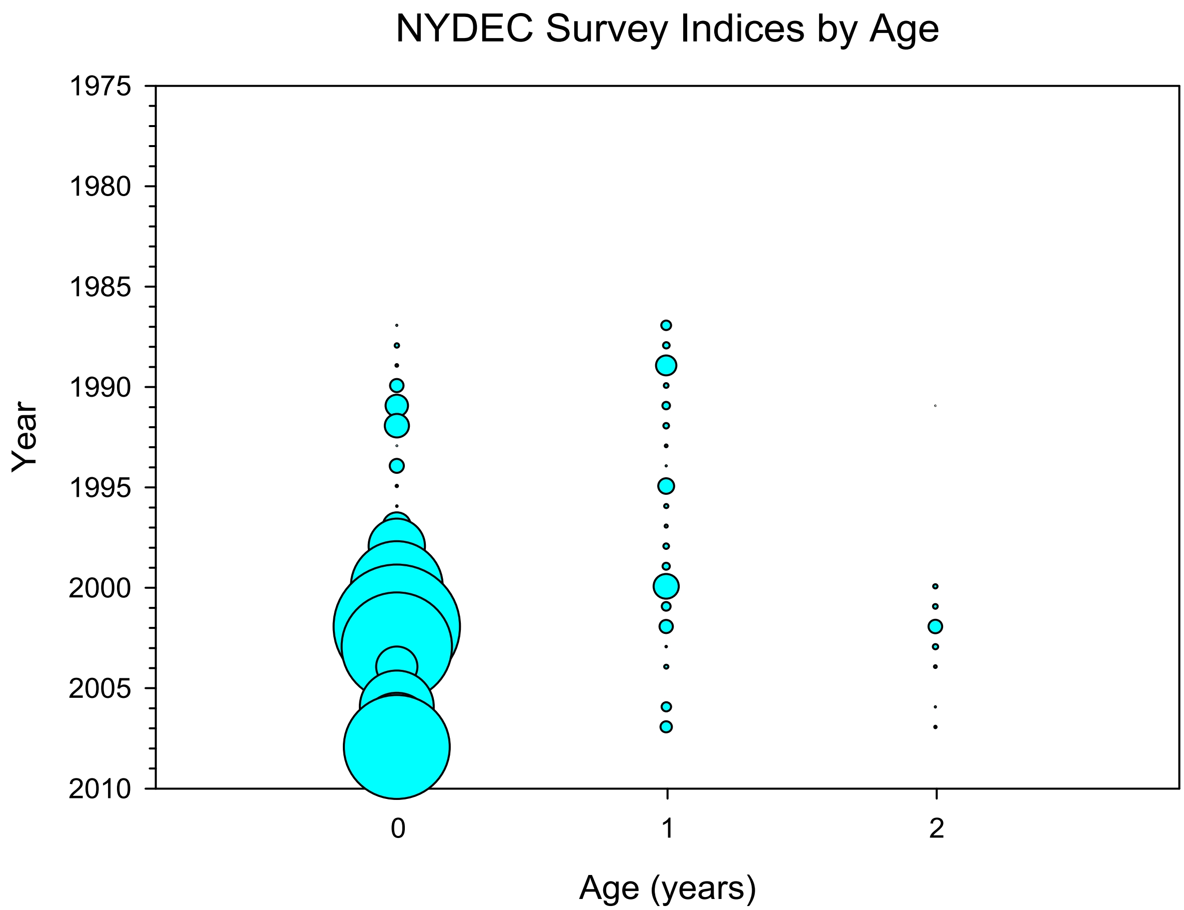

Figure 16. NYDEC survey indices by age for scup.

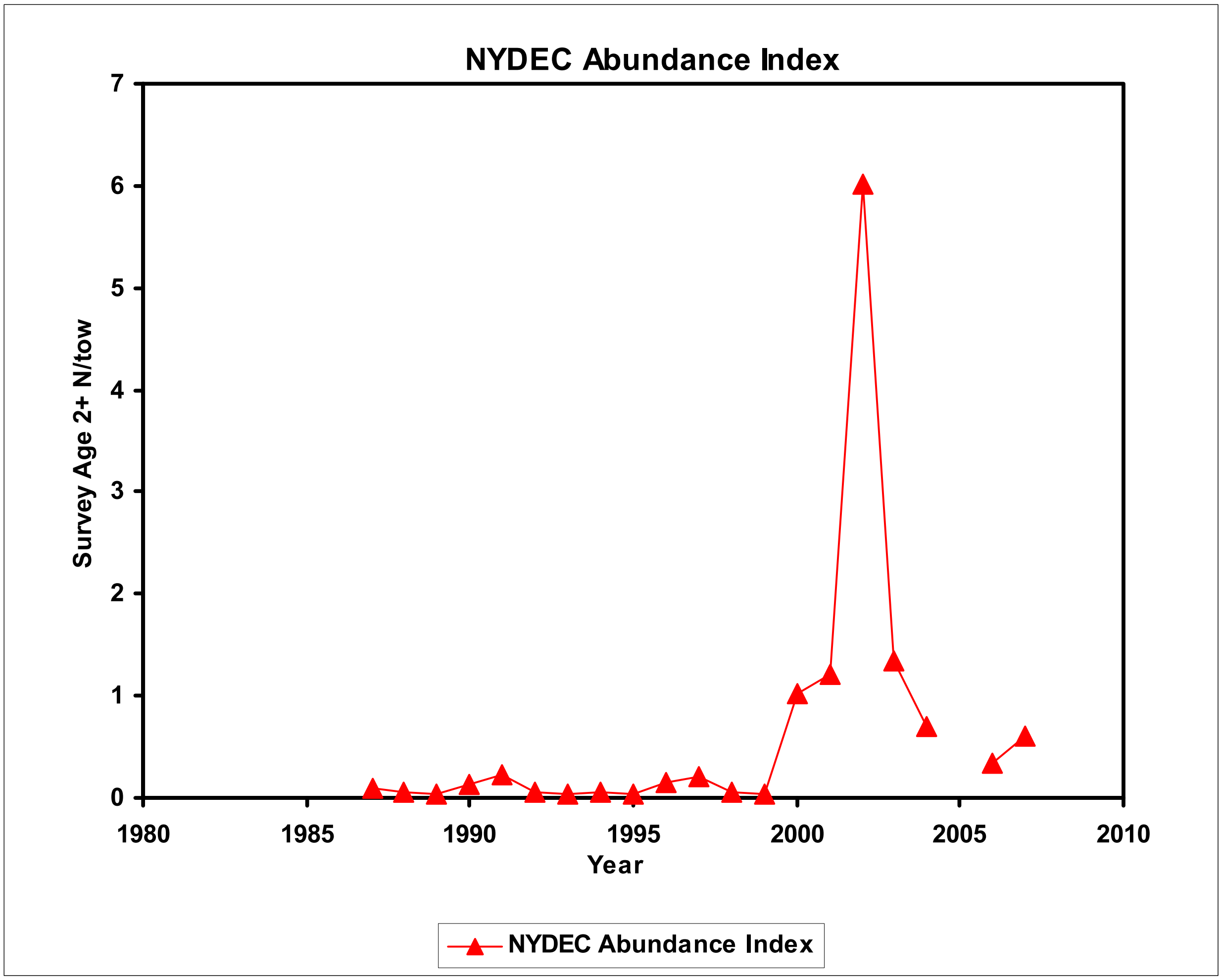

Figure 17. NYDEC survey age 2+ abundance index.

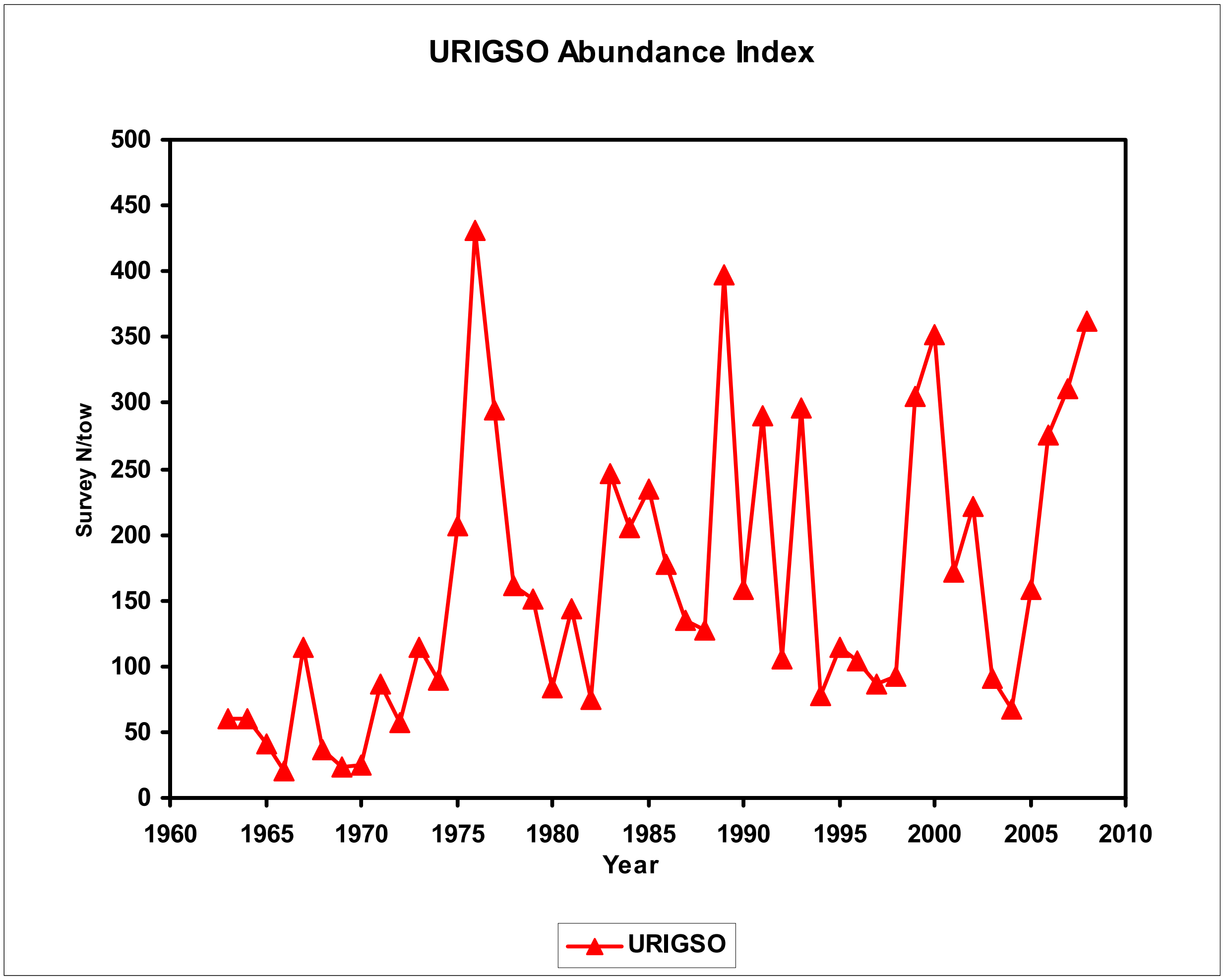

Figure 18. URIGSO aggregate abundance index.

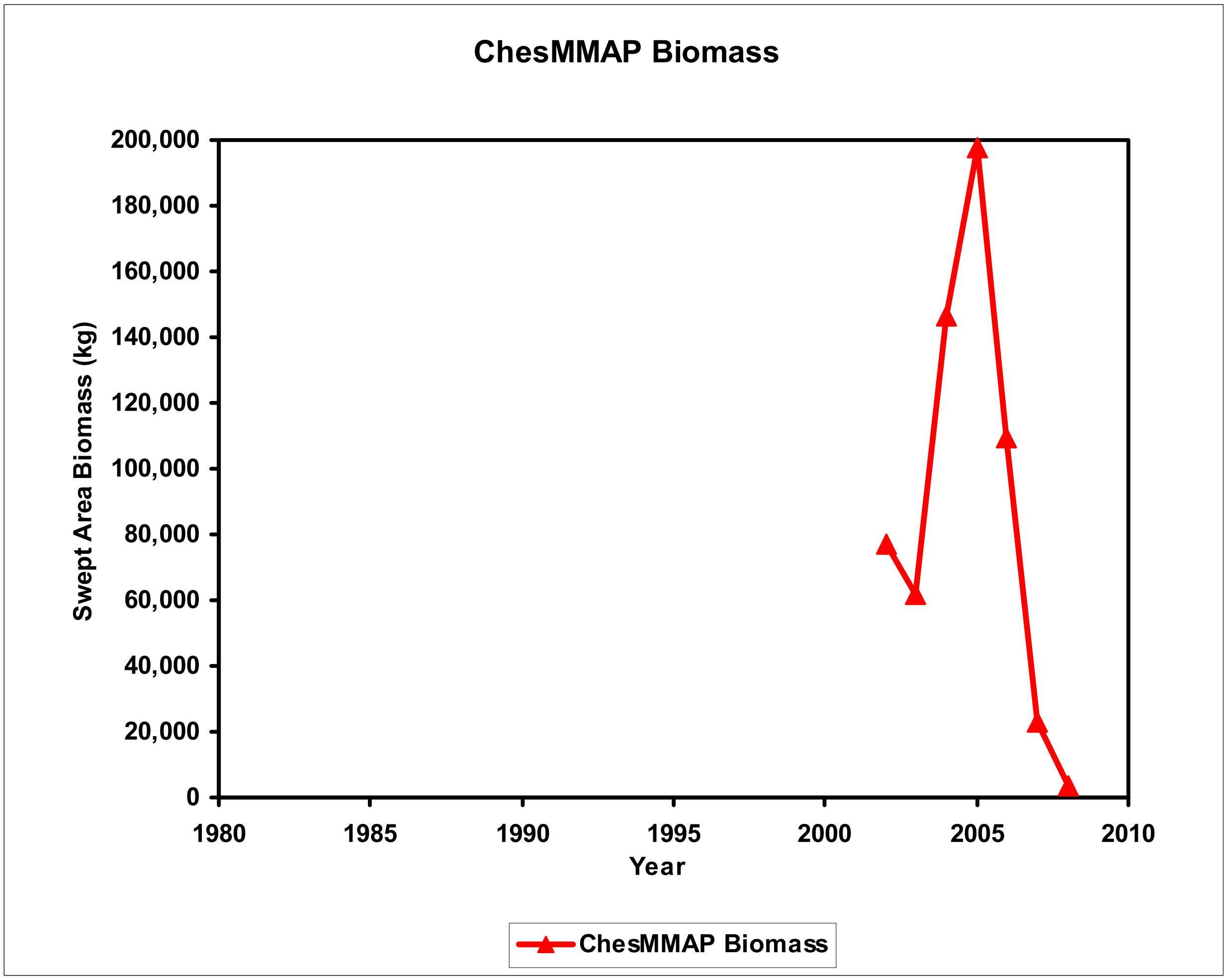

Figure 19. VIMS ChesMMap swept area aggregate biomass index.

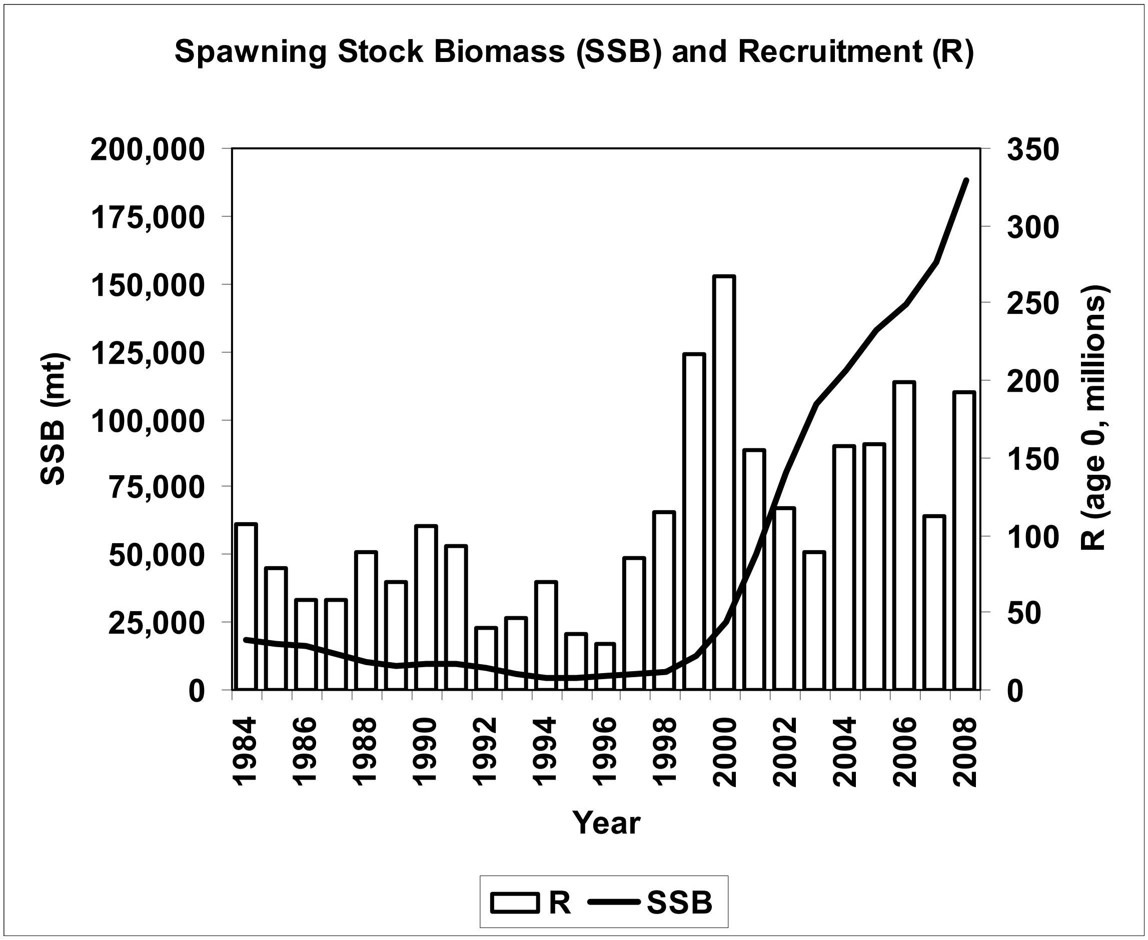

Figure 20. Trends in Spawning Stock Biomass (SSB) and Recruitment (R; age 0 fish).

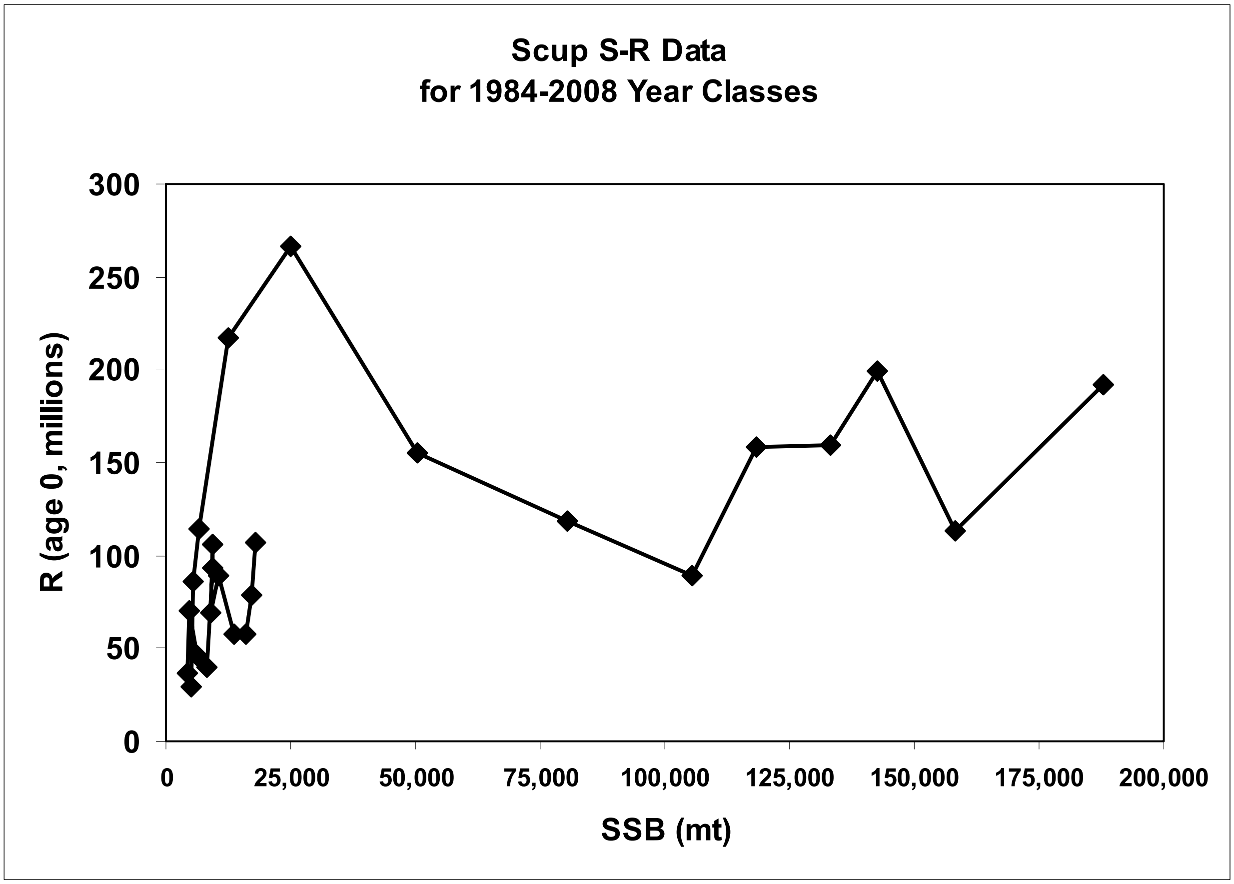

Figure 21. Spawning Stock Biomass (SSB) and Recruitment (R) scatterplot for scup.

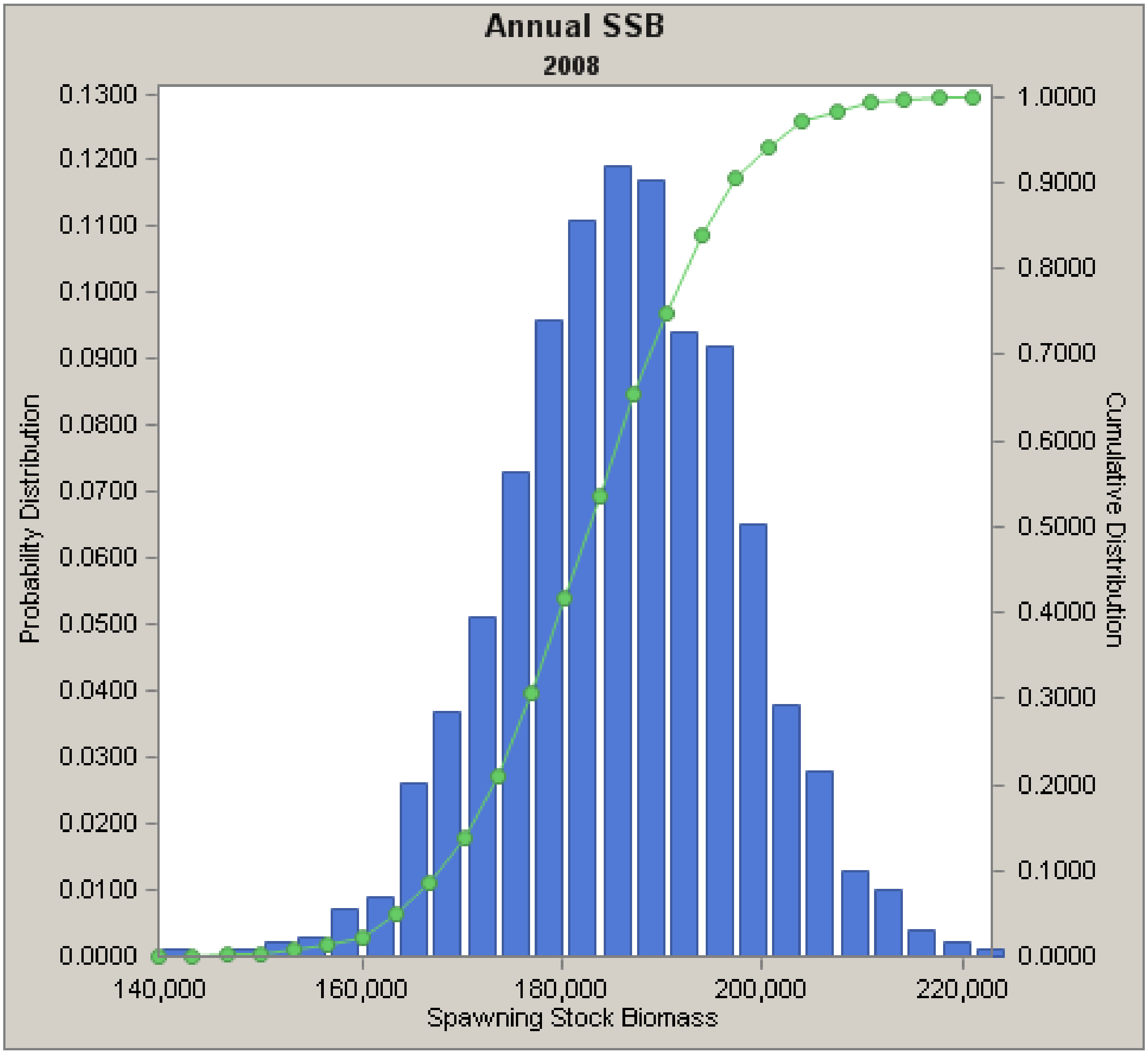

Figure 22. MCMC distribution plot for the 2008 estimate of SSB.

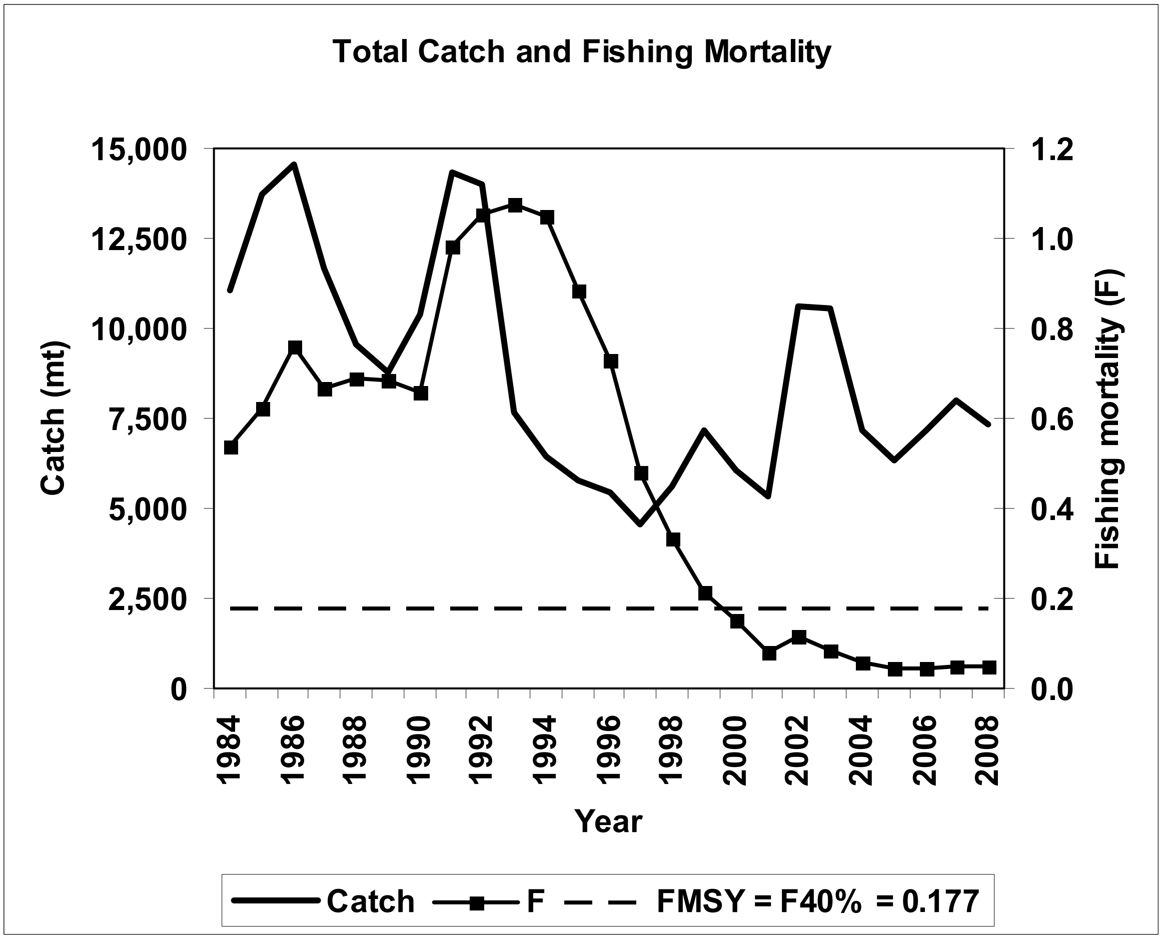

Figure 23. Trends in Total Fishery Catch (Catch) and Fishing Mortality (F, ages 2-7+). The dashed horizontal line is the F40% = 0.177 proxy for FMSY.

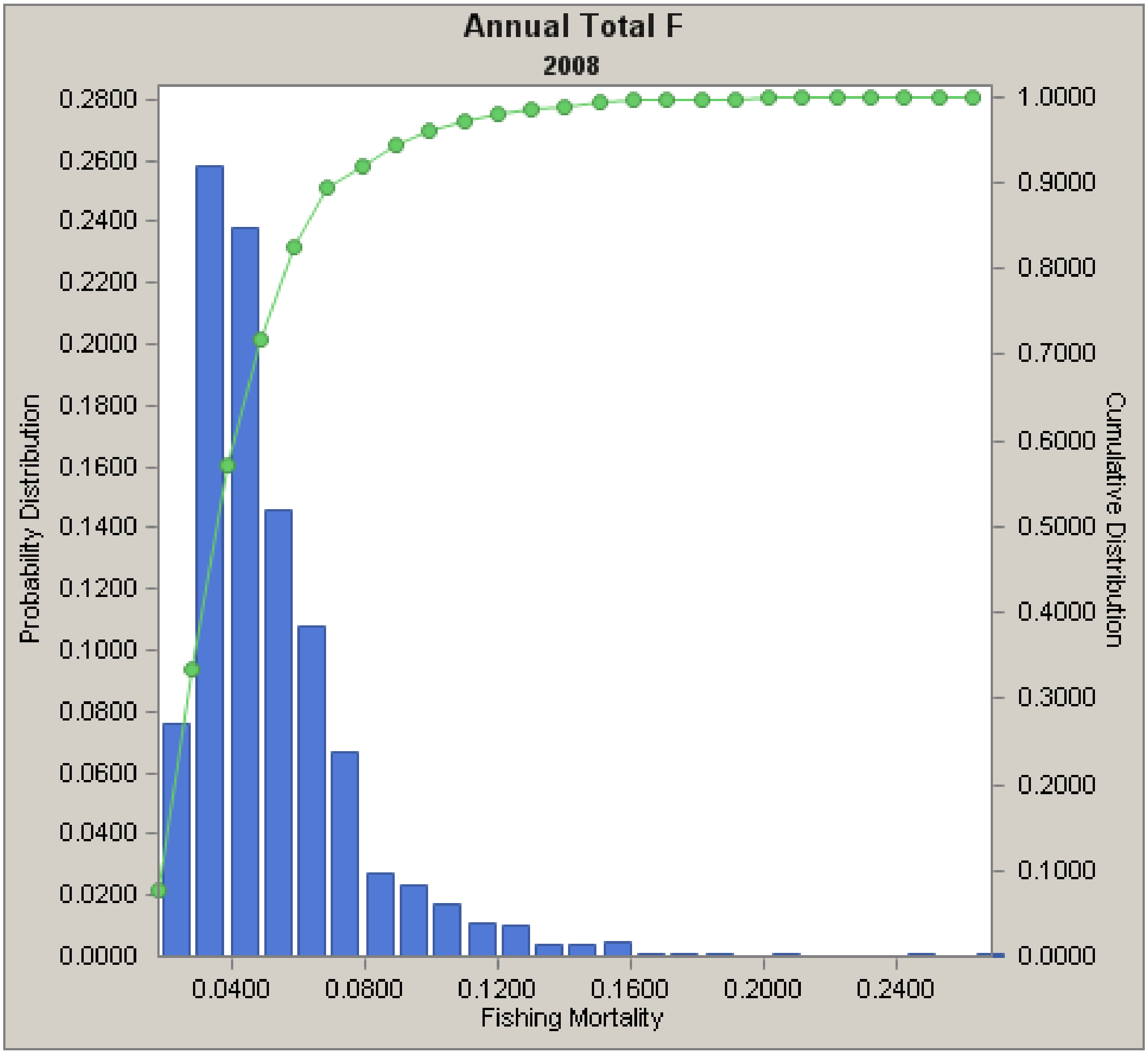

Figure 24. MCMC distribution plot for the 2008 estimate of fishing mortality (F).

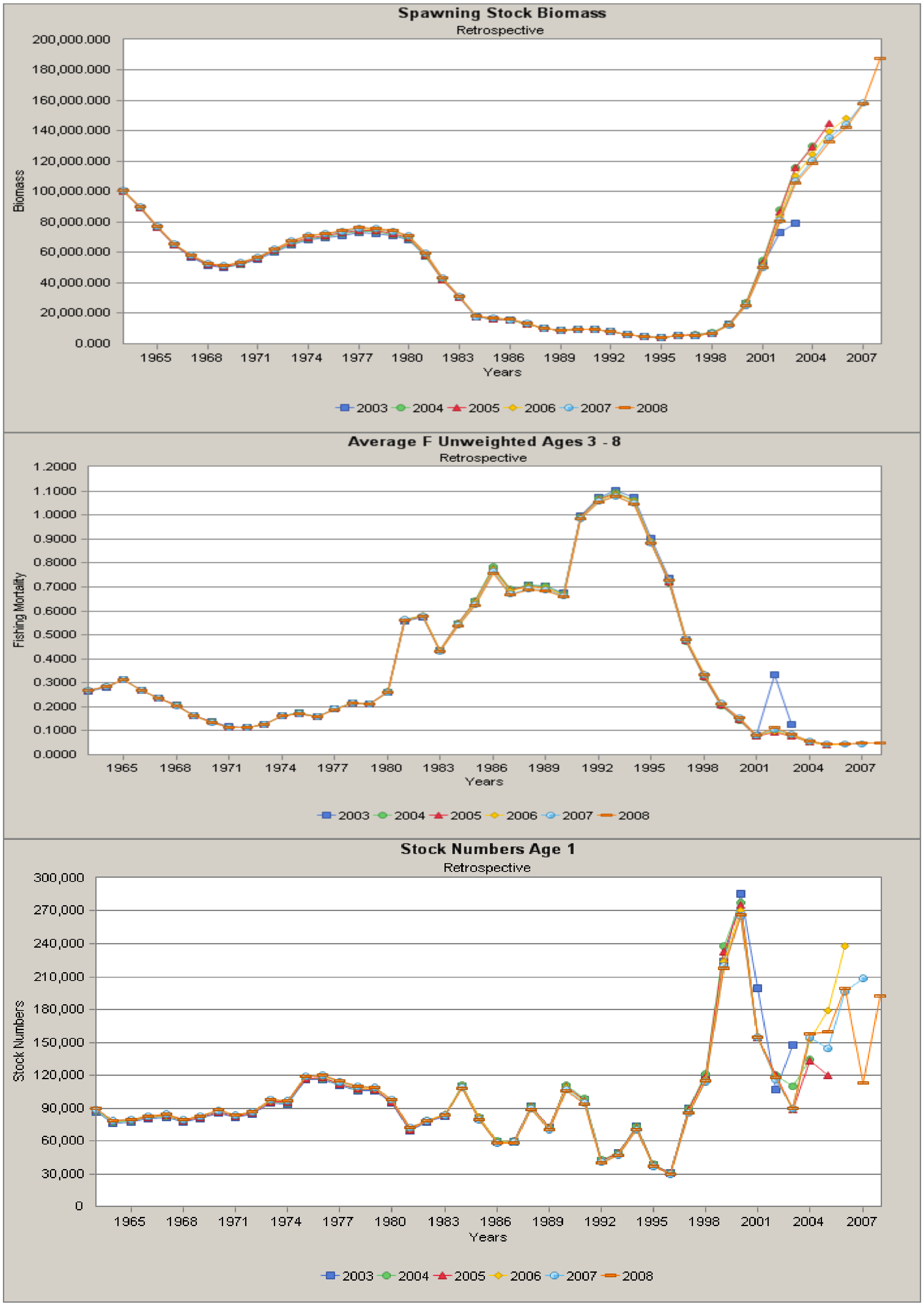

Figure 25. Retrospective analysis of the ASAP SCAA for scup: SSB, F, and R. Note that model ages 3-8 are true ages 2-7+ and model age 1 is true age 0.

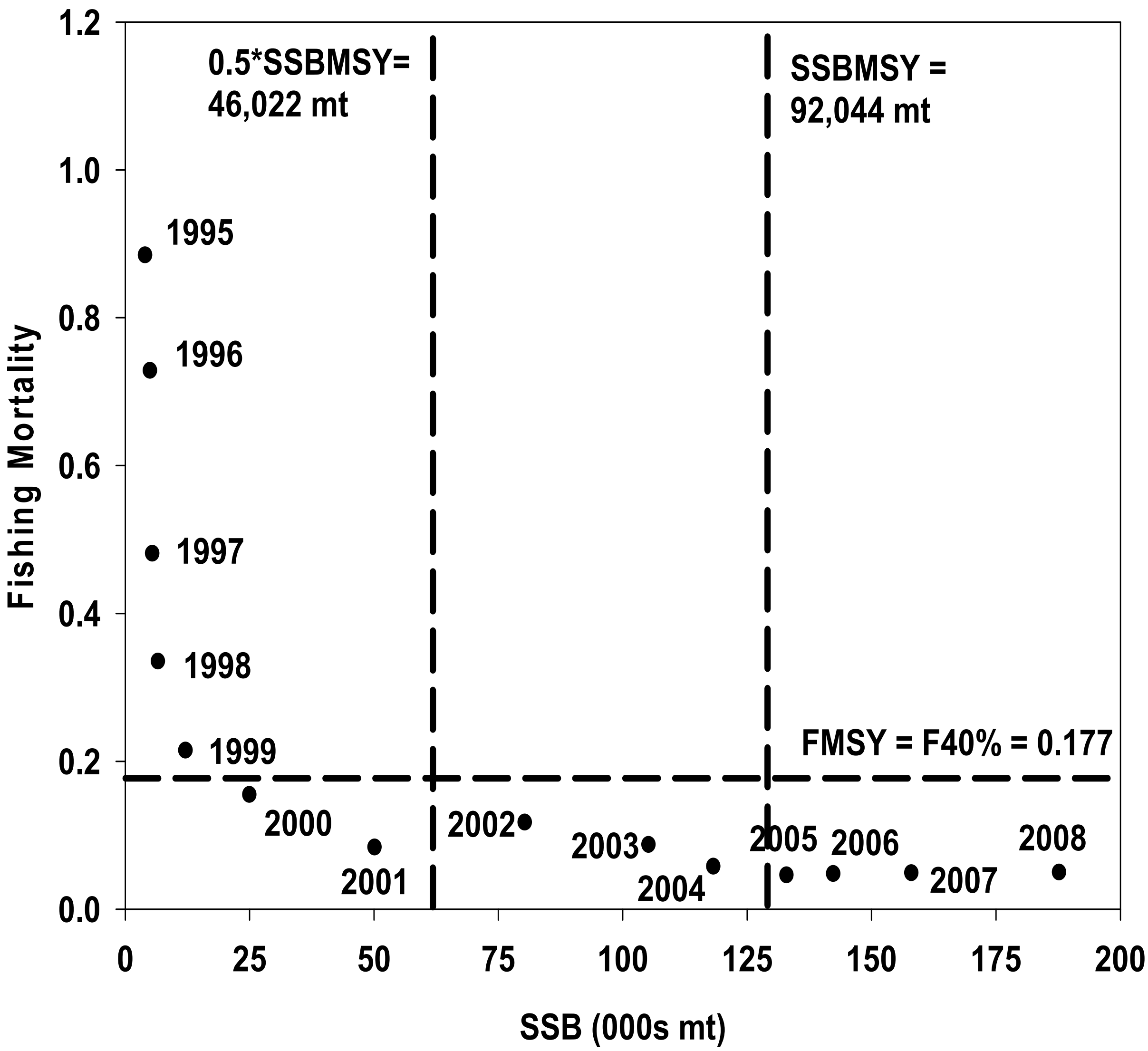

Figure 26. Status determination plot for scup, comparing estimates from the 2009 updated assessment with BRPs from the 2008 DPS assessment.

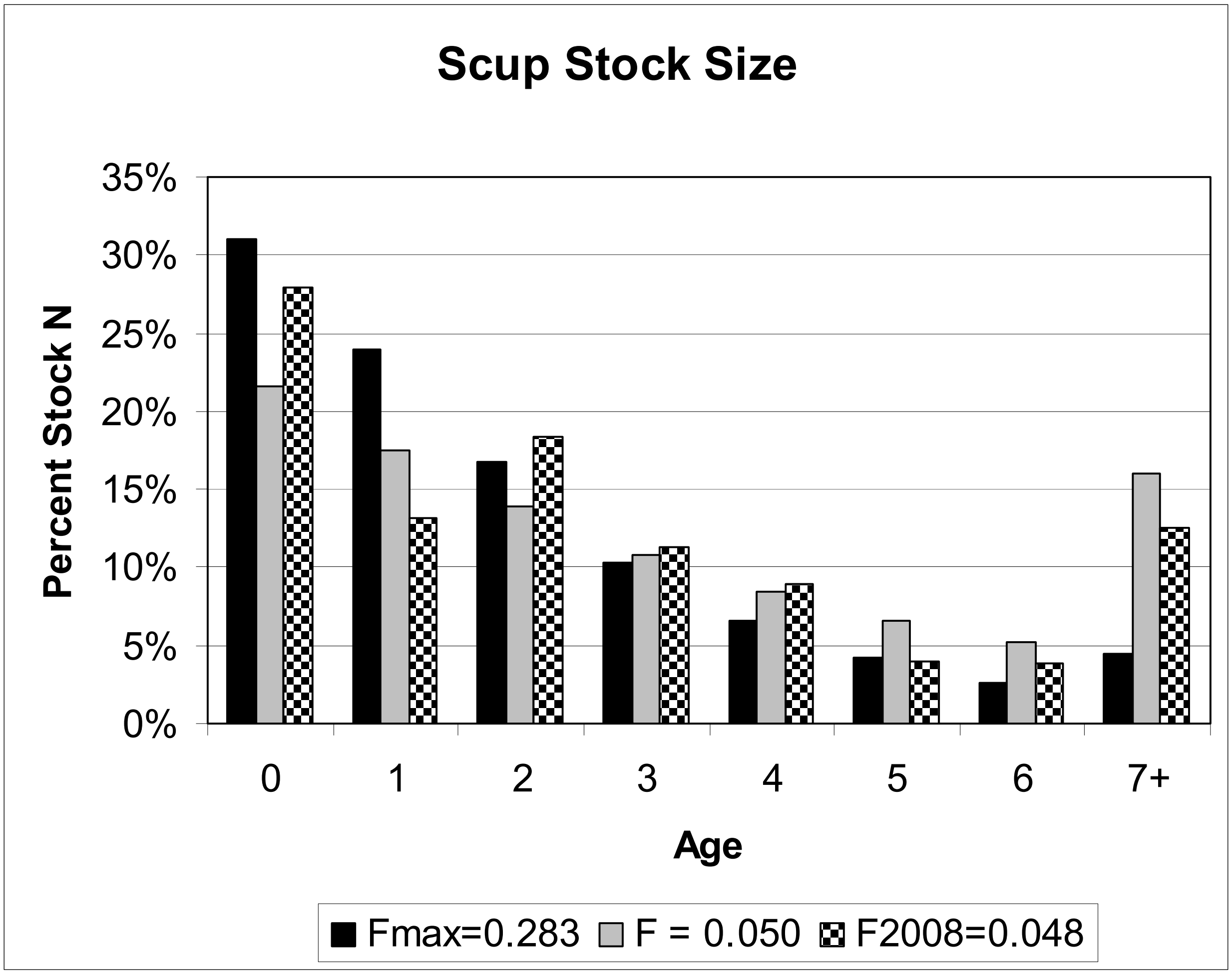

Figure 27. Percentage of scup stock size in numbers expected if the stock were fished at Fmax = FMSY = 0.283 or F = 0.050 over the long-term, compared with stock size percentages estimated for 2008 at F = 0.048.

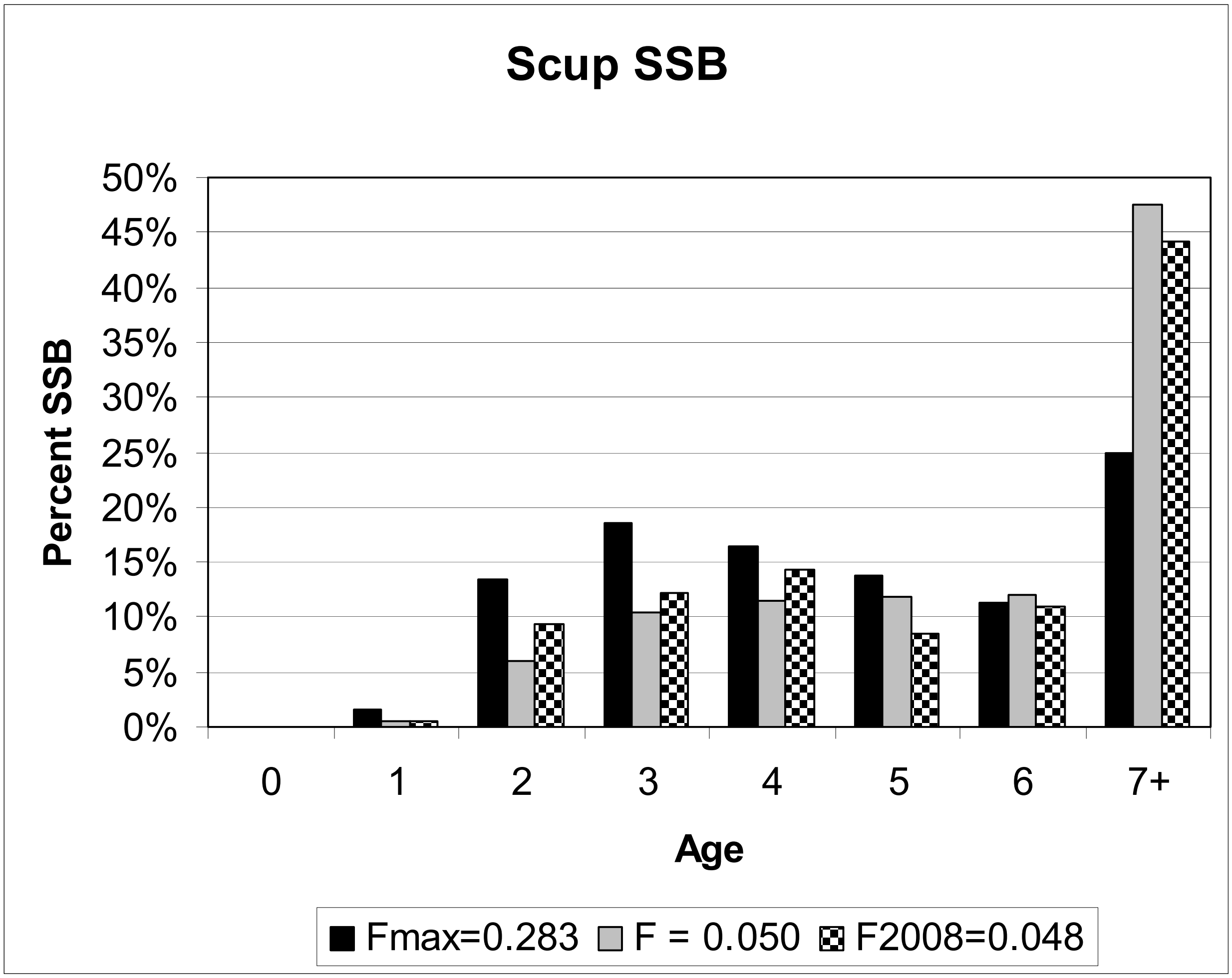

Figure 28. Percentage of SSB in weight expected if the stock were fished at Fmax = FMSY = 0.283 or F = 0.050 over the long-term, compared with SSB percentages estimated for 2008 at F = 0.048. Fish at ages 3 and older are fully (>99%) mature.

Procedures for Issuing Manuscripts in the *Northeast Fisheries Science Center Reference Document* (CRD) Series

Clearance

All manuscripts submitted for issuance as CRDs must have cleared the NEFSC's manuscript/abstract/webpage review process. If any author is not a federal employee, he/she will be required to sign an "NEFSC Release-of-Copyright Form." If your manuscript includes material from another work which has been copyrighted, then you will need to work with the NEFSC's Editorial Office to arrange for permission to use that material by securing release signatures on the "NEFSC Use-of-Copyrighted-Work Permission Form."

For more information, NEFSC authors should see the NEFSC's online publication policy manual, "Manuscript/abstract/webpage preparation, review, and dissemination: NEFSC author's guide to policy, process, and procedure," located in the Publications/Manuscript Review section of the NEFSC intranet page.

Organization

Manuscripts must have an abstract and table of contents, and (if applicable) lists of figures and tables. As much as possible, use traditional scientific manuscript organization for sections: "Introduction," "Study Area" and/or "Experimental Apparatus," "Methods," "Results," "Discussion," "Conclusions," "Acknowledgments," and "Literature/References Cited."

Style

The CRD series is obligated to conform with the style contained in the current edition of the United States Government Printing Office Style Manual. That style manual is silent on many aspects of scientific manuscripts. The CRD series relies more on the CSE Style Manual. Manuscripts should be prepared to conform with these style manuals.

The CRD series uses the American Fisheries Society's guides to names of fishes, mollusks, and decapod crustaceans, the Society for Marine Mammalogy's guide to names of marine mammals, the Biosciences Information Service's guide to serial title abbreviations, and the ISO's (International Standardization Organization) guide to statistical terms.

For in-text citation, use the name-date system. A special effort should be made to ensure that all necessary bibliographic information is included in the list of cited works. Personal communications must include date, full name, and full mailing address of the contact.

Preparation

Once your document has cleared the review process, the Editorial Office will contact you with publication needs – for example, revised text (if necessary) and separate digital figures and tables if they are embedded in the document. Materials may be submitted to the Editorial Office as files on zip disks or CDs, email attachments, or intranet downloads. Text files should be in Microsoft Word, tables may be in Word or Excel, and graphics files may be in a variety of formats (JPG, GIF, Excel, PowerPoint, etc.).

Production and Distribution

The Editorial Office will perform a copy-edit of the document and may request further revisions. The Editorial Office will develop the inside and outside front covers, the inside and outside back covers, and the title and bibliographic control pages of the document.

Once both the PDF (print) and Web versions of the CRD are ready, the Editorial Office will contact you to review both versions and submit corrections or changes before the document is posted online.

A number of organizations and individuals in the Northeast Region will be notified by e-mail of the availability of the document online.

Research Communications Branch
Northeast Fisheries Science Center
National Marine Fisheries Service, NOAA
166 Water St.
Woods Hole, MA 02543-1026

MEDIA MAIL

Publications and Reports of the Northeast Fisheries Science Center

The mission of NOAA's National Marine Fisheries Service (NMFS) is "stewardship of living marine resources for the benefit of the nation through their science-based conservation and management and promotion of the health of their environment." As the research arm of the NMFS's Northeast Region, the Northeast Fisheries Science Center (NEFSC) supports the NMFS mission by "conducting ecosystem-based research and assessments of living marine resources, with a focus on the Northeast Shelf, to promote the recovery and long-term sustainability of these resources and to generate social and economic opportunities and benefits from their use." Results of NEFSC research are largely reported in primary scientific media (*e.g.*, anonymously-peer-reviewed scientific journals). However, to assist itself in providing data, information, and advice to its constituents, the NEFSC occasionally releases its results in its own media. Currently, there are three such media:

NOAA Technical Memorandum NMFS-NE -- This series is issued irregularly. The series typically includes: data reports of long-term field or lab studies of important species or habitats; synthesis reports for important species or habitats; annual reports of overall assessment or monitoring programs; manuals describing program-wide surveying or experimental techniques; literature surveys of important species or habitat topics; proceedings and collected papers of scientific meetings; and indexed and/or annotated bibliographies. All issues receive internal scientific review and most issues receive technical and copy editing.

Northeast Fisheries Science Center Reference Document -- This series is issued irregularly. The series typically includes: data reports on field and lab studies; progress reports on experiments, monitoring, and assessments; background papers for, collected abstracts of, and/or summary reports of scientific meetings; and simple bibliographies. Issues receive internal scientific review and most issues receive copy editing.

Resource Survey Report (formerly *Fishermen's Report*) -- This information report is a regularly-issued, quick-turnaround report on the distribution and relative abundance of selected living marine resources as derived from each of the NEFSC's periodic research vessel surveys of the Northeast's continental shelf. This report undergoes internal review, but receives no technical or copy editing.

TO OBTAIN A COPY of a *NOAA Technical Memorandum NMFS-NE* or a *Northeast Fisheries Science Center Reference Document*, either contact the NEFSC Editorial Office (166 Water St., Woods Hole, MA 02543-1026; 508-495-2350) or consult the NEFSC webpage on "Reports and Publications" (http://www.nefsc.noaa.gov/nefsc/publications/). To access *Resource Survey Report*, consult the Ecosystem Surveys Branch webpage (http://www.nefsc.noaa.gov/femad/ecosurvey/mainpage/).

ANY USE OF TRADE OR BRAND NAMES IN ANY NEFSC PUBLICATION OR REPORT DOES NOT IMPLY ENDORSEMENT.