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The 2008 Assessment of the Gulf of Maine Atlantic Cod (*Gadus morhua*) Stock

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ABSTRACT

The status of the Gulf of Maine Atlantic cod (*Gadus morhua*) stock is reviewed, and terminal year VPA estimates of 2007 fishing mortality and spawning stock biomass, and the survivors in 2008 are presented. Precision estimates of the 2007 fishing mortality and spawning stock biomass estimates for Gulf of Maine cod are also provided. The 2008 assessment is based on several sources of information including: the age composition of USA commercial and recreational landings, commercial fishing vessel trip reports (VTR), Northeast Fisheries Science Center (NEFSC) Fishery Observer Program data, MRFSS estimates of recreational harvest, NEFSC and Massachusetts Division of Marine Fisheries (DMF) spring and autumn research vessel survey data, and standardized USA commercial fishing effort data. This assessment represents a major revision to the analyses presented in the 2001 assessment of the Gulf of Maine cod stock reviewed at SAW 33 (NEFSC 2001b, Mayo *et al.* 2002) and those reviewed in 2002 at the first Groundfish Assessment Review Meeting (GARM) (NEFSC 2002b) and in 2005 at the 2nd Groundfish Assessment Review Meeting (GARM II) (NEFSC 2005, Mayo and Col 2006). The analyses presented herein were recently reviewed in 2008 at the 3rd Groundfish Assessment Review Meeting (GARM III) (NEFSC 2008).

Input data and the assessment formulation were revised in the present assessment as follows. Landings data from 1994 forward were revised based on a preferred allocation of trips to statistical area. Discard estimates were revised from 1989 forward based on SBRM methodology and recreational catches were revised from 1981 forward based on revised MRFSS data and a revised approach to allocate catches to stock. The assessment formulation now employs an age 11+ group vs. age 7+, and includes survey indices out to age 8 for calibration. Biological reference points are estimated using a non-parametric approach incorporating an SSB per recruit analysis and a stochastic equilibrium projection of MSY and SSB_{msy}.

Total catches (commercial and recreational landings and commercial discards) of Gulf of Maine cod decreased from 21,650 metric tons (mt) in 1991 to 4,700 – 4,800 mt in 1998 and 1999, increased to 7,600 mt in 2003 and have since declined to 5,500 mt in 2007. Commercial discards increased sharply from 97 mt in 1998 to 2,624 mt in 1999, likely due to the imposition of very low trip limits during 1999, but declined thereafter as trip limits were relaxed in early 2000.

Fishery-independent spring and autumn bottom trawl surveys conducted by the NEFSC have documented a steady decline in total stock biomass since the 1960s; the largest decreases occurred during the 1980s. Although the most recent indices suggest a modest increase since the early 1990s, the Gulf of Maine cod stock biomass remains low compared to the 1960s and 1970s. Except for the 1998 year class, recruitment during the 1990s has been well below the long-term mean. The 1999 and 2000 year classes are weak but the 2003 and 2005 year classes are well above average. Spawning stock biomass (SSB) declined from over 29,600 mt in 1990 to a low of 9,900 mt in 1997; SSB increased to 28,700 mt in 2002 but declined to 11,000 mt in 2005 due to very low abundance of the poor 1999 and 2000 year classes. SSB has since increased to 33,877 mt in 2007 due to the maturation of the above-average 2003 year class. Fully recruited instantaneous fishing mortality (F, ages 5-7) remained close to or above 1.0 between 1983 and 1997, but declined to 0.32 by 2000, increased to greater than 0.5 from 2002–2006, and declined to 0.46 in 2007. SSB_{msy} is estimated to be 58,248 mt with a corresponding F_{msy} of 0.237, (fully recruited, ages 5+). With respect to the age-structured MSY-based reference points, 2007 spawning stock biomass is above ½ $SSB_{msy,}$ and 2007 F is 1.9 times F_{msy}.

INTRODUCTION

Atlantic cod (*Gadus morhua*) in the Gulf of Maine region (Figure 1) have been commercially exploited since the 17th century, and landings statistics are available since 1893. Historically, the Gulf of Maine fishery can be separated into four periods (Figure 2): (1) an early era from 1893-1915 in which record-high landings (> 17,000 mt) in 1895 and 1906 were followed by about 10 years of sharply-reduced catches; (2) a later period from 1916-1940 in which annual landings were relatively stable, fluctuating between 5,000 and 11,500 mt, and averaging 8,300 mt per year; (3) a period from 1941-1963 when landings sharply increased (1945: 14,500 mt) and then rapidly decreased, reaching a record-low of 2,600 mt in 1957; and (4) the most recent period from 1964 onward during which Gulf of Maine landings have generally increased but have declined steadily since the early 1990s. Total commercial landings doubled between 1964 and 1968, doubled again between 1968 and 1977, and averaged 12,200 mt per year during 1976-1985 (Table 1). Gulf of Maine cod landings subsequently increased, reaching 17,800 mt in 1991, the highest level since the early 1900s. Total landings declined sharply in 1992 to 10,891 mt, and have since decreased steadily to 1,636 mt in 1999 before increasing to 3,730 mt in 2000. Total commercial landings have since fluctuated between 3,800 and 4,400 mt. Landed cod from the recreational sector have represented between 6 and 39 percent of the combined commercial and recreational harvest.

This report presents an updated and revised analytical assessment of the Gulf of Maine cod stock (NAFO Division 5Y) for the period 1982-2007 based on analyses of commercial and recreational data through 2007 and research vessel survey data through spring 2008. From the early 1960s through 1993, information on the catch quantity by market category was derived from reports of landings transactions submitted voluntarily by processors and dealers. More detailed data on fishing effort and location of fishing activity were obtained for a subset of trips from personal interviews of fishing captains conducted by port agents in the major ports of the Northeast. Information acquired during the course of these interviews was used to augment the total landings information obtained from the dealers. Procedures for collecting and processing commercial fishery data in the Northeast were revised after 1993.

Beginning in 1994, data on number of hauls, average haul time, and catch locale were obtained from logbooks submitted to the National Marine Fisheries Service (NMFS) by operators fishing for groundfish in the Northeast under a mandatory reporting program. Landings were allocated to statistical area based on dealer trip reports and species landings records matched to fishing vessel logbooks (VTRs). Thus, commercial landings data utilized in the present assessment from 1994 to present were revised from those reported in previous assessments using a more comprehensive approach to allocate fishing trips and landings of all species among statistical areas (Wigley *et al*. 2008). This approach represents a substantial improvement over the previous method (Wigley *et al*. 1998) that addressed the spatial proration of landings on an aggregate trip basis at the quarter – stock level.

An initial analytical assessment of this stock (Serchuk and Wigley 1986) was presented at the Seventh NEFC Stock Assessment Workshop in November 1988 (NEFC 1989) and subsequent assessments were reviewed at the 12th, 15th, 19th, 24th and 27th Northeast Regional Stock Assessment Workshops in June 1991, December 1992, December 1994, June 1997 and June 1998 (NEFSC 1991, 1993, 1995, 1997, 1998; Mayo 1995, 1998; Mayo *et al.* 1993, 1998). Interim assessments were reviewed by the Northern Demersal Working Group in July 1999 (NEFSC 2000) and August 2000 (NEFSC 2001a). A peer review of this assessment (Mayo *et al*.

2002) occurred at the 33rd Northeast Regional Stock Assessment Workshop in June 2001 (NEFSC 2001b). An updated assessment through 2001 was reviewed at the Groundfish Assessment Review Meeting in October 2002 (NEFSC 2002b, Mayo and Col 2002) and a further update through 2004 was reviewed at the second Groundfish Assessment Review Meeting in August 2005 (NEFSC 2005, Mayo and Col 2006). The present assessment was reviewed at the third Groundfish Assessment Review Meeting in August 2008 (NEFSC 2008**,** Mayo *et al*. 2008)**.**

THE FISHERY

Management History

Fishing for Gulf of Maine cod has been managed under international treaty prior to 1977 and by domestic management authority since 1977 (Appendix A). Annual Total Allowable Catches (TACs) were first established under the International Commission for the Northwest Atlantic Fisheries (ICNAF) for Division 5Y (*i.e*., the Gulf of Maine) cod in 1973 (Serchuk *et al.* 1994). The TAC remained at 10,000 mt from 1973-1975; the 1976 TAC was reduced to 8,000 mt and the TAC proposed for 1977 was reduced further to 5,000 mt.

Following implementation of the Magnuson Fishery Conservation and Management Act (FCMA) in 1977, management of this stock fell under the auspices of the New England Fishery Management Council. TACs were carried forward for the first few years under the Fishery Management Plan for Atlantic Groundfish, and were distributed among vessel tonnage classes and quarters of the years until 1982 when the "Interim" Plan for Atlantic groundfish was implemented. This plan eliminated all direct catch controls (quotas) and established mesh size and minimum landing size regulations as the primary regulatory measures for cod, haddock and yellowtail flounder.

Management of the Gulf of Maine cod fishery has been carried out since 1985 under the Northeast Multispecies Fishery Management Plan (FMP). This plan and its Amendments 1 through 4 essentially carried forward the regulatory measures originally implemented in 1982 under the "Interim" Plan (Appendix A). Beginning in 1994 with the implementation of Amendment 5, the primary goal of the FMP became a reduction in fishing mortality for 5 key monitoring stocks. This was to be achieved through a combination of reductions in days at sea (DAS) usage and, under Amendment 7, an additional series of seasonal and year-round area closures oriented primarily towards Gulf of Maine stocks. Amendment 13, implemented in May 2004, added additional restrictions on Days at Sea (DAS) usage and further defined the use of A DAS and B DAS to allow fishing on stocks in relatively good condition while still restricting effort on stocks of concern (including Gulf of Maine cod). Framework 42, implemented in 2006, established Bmsy targets and Fmsy thresholds for 18 groundfish stocks reviewed at GARMII in August 2005. This framework also established formal rebuilding plans for stocks that were classified as overfished, *i.e*., where the 2004 stock biomass was estimated to be less than ½ B_{msy}.

Commercial Landings

Total commercial landings

Annual commercial landings data for Gulf of Maine cod in years prior to 1994 were obtained from trip-level detailed landings records maintained by the Northeast Fisheries Science Center (NEFSC), Woods Hole, Massachusetts (1963-1993) and from summary reports of the Bureau of Commercial Fisheries and its predecessor the U.S. Fish Commission (1895-1962).

More detailed data on fishing effort and location of fishing activity were obtained for a subset of trips from personal interviews of fishing captains conducted by port agents in the major ports of the Northeast. Information acquired during the course of these interviews was used to augment the total landings information obtained from the dealers.

Beginning in 1994, data on number of hauls, average haul time, and catch locale were obtained from logbooks submitted to the National Marine Fisheries Service (NMFS) by operators fishing for groundfish in the Northeast under a mandatory reporting program that replaced the earlier interview system. Thus, an interim, species-based scheme was developed in 1997 to allocate landings by market category to stock based on a matched subset of trips between the dealer and logbook databases. Data in both databases were stratified by calendar quarter, port group, and gear group to form a pool of observations from which proportions of landings by stock could be allocated to market category within the matched subset. The cross-products of the market category by stock proportions derived from the matched subset were employed to compute the total landings by stock, market category, calendar quarter, port group, and gear group on an annual basis. A full description of the proration methodology and an evaluation of the 1994-1996 logbook data is given in Wigley *et al.* (1998) and DeLong *et al.* (MS 1997). This scheme was used in all assessments conducted between 1994 and 2005.

Commercial landings data used in the present assessment represent a substantial departure from those used in previous assessments. The quantity of each species landed on every trip since 1994 has now been allocated to statistical area based on dealer trip reports and species-market category landings records matched to logbooks (fishing vessel trip reports or VTRs) under a four tiered scheme. This allocation scheme produces comprehensive annual data sets that are virtually identical to the data sets produced prior to 1994. Thus, commercial landings data from 1994 to present utilized in the present assessment were revised from those reported in previous assessments using this comprehensive approach to allocate fishing trips and landings of all species among statistical areas (Wigley *et al*. 2008)**.** This approach represents a substantial improvement over the previous method (Wigley *et al*. 1998) that addressed the spatial proration of landings on an aggregate trip basis at the quarter – stock level.

Annual commercial landings declined from 17,781 mt in 1991 to a low of 1,380 mt in 1999 Landings remained relatively stable between 2000 and 2007, varying between 3,000 and 4,300 mt. Total landings in 2007 were 3,989 mt, slightly below those from 2002-2006 (Table 1, Figure 2). Since 1977, the USA fishery has accounted for all of the commercial landings. Canadian landings reported as Gulf of Maine catch after 1977 are believed by Canadian scientists to have been misreported catches from the Scotian Shelf stock (Campana and Simon 1985; Campana and Hamel 1990) and have thus been excluded.

Landings by market category

Since 1964 market cod have generally dominated the landings with percentages ranging from 40 – 60% in most years (Table 2, Figure 3). The percentage of large cod has fluctuated over time, accounting for over 50% during the early 1970s and then declining to a low of 13% in 1996. Large cod have since accounted for a higher percentage of the total landings, reaching 52% in 2004 before declining once again. Scrod cod have generally represented about 20% of the total, but this share has declined to less than 10% since 2000, likely due to recent increases in minimum mesh size regulations. In 2007, the percentages by market category were: Large – 24%, Market – 65%, and Scrod – 5%. Approximately 1% of the landings were classified as Mixed.

Landings by gear type

Although otter trawl catches account for most of the landings (averaging 62% between 1965 and 2007), the otter trawl percentage has declined considerably since 1993 compared to the period prior to 1993 from an average of 68% to 51% (Table 3, Figure 4). Most of this change can be attributed to an increase in the percentage of cod taken by sink gillnets from an average of 25% prior to1993, to an average of 41% since 1993. The percentage from combined handline and line trawls also increased substantially during the 1990s, but still remains below levels observed during the 1970s. In 2007, the percentages by gear type were: Otter Trawl – 37.5%, Sink Gill Net – 53.2%, and combined Line Trawl and Handline – 5.7%.

Commercial Sampling Intensity

A summary of USA length frequency and age sampling of Gulf of Maine cod landings during 1982-2007 is presented in Table 4. Most of the USA samples have been taken from otter trawl landings, but sampling and the estimation of length composition is stratified by market category (large, market, and scrod). Although the length composition of cod differs among gear types (primarily between otter trawl and gillnet), the length composition of cod landings within each market category is virtually identical among gear types.

USA length frequency sampling averaged one sample per 155-200 mt landed during 1983-1987 but the sampling intensity was reduced in 1990 (1 sample per 387 mt) and 1993 (1 sample per 360 mt), and the absolute level of sampling was extremely low in 1993. Overall, sampling improved slightly in 1994 and 1995, but the seasonal distribution was uneven and poorly matched to the landings. Sampling improved substantially in 1996 and remained equally high in 1997, reaching all-time highs in terms of both absolute number of samples and samples per ton landed in both years.

The quality of commercial port sampling for Gulf of Maine cod began to decline again in 1998. The total number of samples taken declined sharply in 1998 and again in 1999, a possible outcome of the very low trip limits imposed in 1999. Although the number of samples collected increased in 2000, the distribution by market category was out of phase with actual landings. In particular, the number of 'Large' market category cod samples had diminished to the point that the representation of the older age groups may have been somewhat compromised. As well, the seasonal distribution of samples remained skewed for several years such that, although there appears to have been sufficient numbers of samples taken, there had been insufficient sampling in some quarters and half-years, requiring pooling of samples on an annual basis.

Sampling improved considerably in 2001, especially in the case of large market category cod as a result of augmented sampling effort, and has remained high (less than 50 mt landed per sample). This increase has allowed quarterly pooling since 2003. However, in many cases large samples comprise less than 10 fish; thus, number of fish sampled is a better representation of sampling intensity.

Of the 10,702 cod measured in 2007, 4,782 were large (45%), 4,781 were market (45%), and 1,073 were scrod (10%). Compared with the 2007 market category landings distribution by weight (large: 24%, market: 65%, scrod: 5%) (Table 2), large cod were over-sampled and market cod were under-sampled. The average sample sizes in 2007 were: Large - 17, Market – 85, and. Scrod – 31.

Commercial Landings Age Composition

The age composition of landings during 1982-1993 was estimated, by market category, from length frequency and age samples, pooled by calendar quarter. Quarterly mean weights, by market category, were obtained by applying the NEFSC research vessel survey length-weight equation for cod:

$$\ln Weight_{(kg,\ live)} = -11.7231 + 3.0521 \ln Length_{(cm)}$$

to the quarterly market category sample length frequencies. Computed mean weights were then divided into quarterly market category landed weight to derive estimated numbers landed by quarter, by market category. Quarterly age/length keys were applied to the quarterly market category numbers at length distributions to provide numbers at age. These results were summed over market categories and quarters to derive the annual landings-at-age matrix (Table 5a).

Age composition of landings from 1994 through 2002 was estimated in a manner similar to that employed for the 1982-1993 estimates except that samples and landings were, at times, pooled to semi-annual or annual resolution because of the uneven distribution of length and age samples by quarter (Table 4). Semi-annual pooling was required for the 1st and 2nd quarters of 1994 because of incomplete sampling coverage of scrod and large cod landings; in 1995, samples were pooled in both semi-annual periods due to the absence of large cod samples and the sparse coverage of market cod in quarters 1 and 3. Quarterly allocation of samples to landings was achieved for all market categories in 1996 and 1997, but semi-annual and annual pooling was required in 1998 and annual pooling was required in 1999 and 2000. Quarterly stratification resumed in 2003 and continued through 2007.

Gulf of Maine cod commercial landings have generally been dominated by age 3 and 4 fish in numbers (Table 5a, Figure 5) and by ages 3, 4, and 5 in weight. Representation of age 2 cod was relatively high in the early 1980s but, in response to a series of minimum mesh size increases during the 1990s, age 2 fish have gradually all but disappeared from the landings. Cod from the strong 1987 year class predominated from 1990 through 1992 but, by 1993, fish from the 1990 year class accounted for the greatest proportion of the total number landed. In terms of weight, the 1993 landings were equally distributed between the 1987 and 1990 year classes. In 1993 these two year classes accounted for approximately 70% of the total number and weight landed. From 1994 through 1996, landings were dominated by age 4 cod in both number and weight. In 1997 age 5 fish were dominant in terms of both number and weight, reflecting the higher abundance of the 1992 year class. More recently, the 1998 year class has dominated the landings at ages 3 through 6 in 2001 through 2004, respectively. In 2005 and 2006, the below average 2001 year class predominated at ages 4 and 5, respectively. However, in 2007, the above average 2003 year class dominated the landings at age 4.

Although traditionally low in terms of their contribution to the total landings, age 10 and 11+ fish were absent for several years during the 1990s, and numbers of age 8 and 9 fish were also unusually low (Table 5a, Figure 5). In recent years, however, the contribution of these older fish has steadily increased. Although this pattern may be partly a result of the poor sampling of ‘Large' category cod, especially during the mid- to late 1990s, the trend towards fewer older fish in the landings began in 1991 before sampling had begun to decline. The proportion of cod older than age 7 has been increasing since 2001 (Table 5a, Figure 5). In 2004 - 2006 ages 8 and older represented 13 -16% of the landed weight, more than the 7-13% contribution during 1982-1984 and the very low 1% contribution in 2000. Although the percentage of ages 8 and older fish in

the landings decreased to 7.7% in 2007, this value remained greater than any of the percentages observed between 1991 and 2003. Unlike previous assessments that carried out ages to only 7+, representation of these older ages now allows us to carry out the age composition to age 11+ and explore the age structure of the age 7+ group used since the 1995 assessment.

Commercial Landings Mean Weights at Age

Mean weights at age in the landings during 1982-2007 are presented in Table 5b for ages 1-11+. These are considered mid-year values based on seasonal patterns of the fishery. Mean weights of age 2 and 3 cod have increased since about 1992 and mean weights of age 4 cod have increased since 2000, likely reflecting reduced partial recruitment to the fishery of the slower-growing, smaller fish at these ages, while the average weights for age 5 and 6 cod have fluctuated without trend. Mean weights for ages 7-10 fluctuate considerably and are particularly sensitive to sampling variability. However, a marked decline is evident in mean weights of these older ages during the 1990s. The generally higher mean weights of age 2 and 3 cod since the mid - 1990s may be related to an increase in minimum codend mesh size from 140 mm (5.5 in.) to 152 mm (6 in.) in 1994, while the increase in mean weights of age 4 cod occurred after an increase in the minimum codend square mesh to 165 mm (6.5 in.) in May, 1999.

Commercial Discards

In past assessments, discard rates were routinely calculated for Gulf of Maine cod by quarter and gear from NEFSC Observer Program data collected since 1989 (*e.g.*, Mayo and Col 2006). Discard and kept components of the catch were summed for all observed tows within each gear type occurring in Division 5Y, and the ratio of the discarded- to-kept quantity was applied to landings for the corresponding quarter and gear type within each year. Data were available for otter trawls, shrimp trawls (through 1993 only), and sink gillnets.

Previous assessments (*e.g.*, Mayo and Col 2006) also evaluated Vessel Trip Report (VTR) data from trips reporting some catch of cod in the Gulf of Maine to further evaluate the extent of discards. The discard estimates of Gulf of Maine cod derived from the two data sets have been reasonably close to each other, with annual differences of 3 -18 percent on the estimates of total commercial catch. Given that they saw no objective basis to select the results obtained from either data set, the SAW 33 SARC Panel (NEFSC 2001b) concluded that both estimates could be used to derive annual estimates to the nearest 500 mt increment. This approach was adopted in assessments that were accepted by the SAW33 SARC Panel and the 2 meetings of the GARM in 2002 (NEFSC 2002b) and 2005 (NEFSC 2005).

In the present assessment, commercial discards were re-estimated for the 1989-2007 period on a gear-quarter basis from NEFSC Observer Program data using SBRM methods (Wigley *et al*. 2007) incorporating cod discard/cod kept ratios (Table 6). The revised estimates compare favorably with those presented at GARMII using the approach used in past assessments based on the observer data (Table 6). Both approaches indicate a substantial increase in the overall discard/kept ratio in 1999 compared to previous years. Ratios calculated for years after 1999 were lower, but still remain substantially greater than the 1991-1998 ratios. Discards re-estimated from the Observer Program data have ranged from 97 mt in 1998 to 3,092 in 1990. These discard estimates were then used to generate the discards at age from 1999 to present (Table 7).

For otter trawl gear, discard-to-kept ratios (d/k) and absolute quantities of discarded cod declined from relatively high values in 1989 and 1990 to relatively low levels from 1991 through

1998 as the overall d/k ratios generally fluctuated between 0.02 and 0.06. Discards from the sink gill net fishery remained relatively low between 1989 and 1998, at less than 200 mt. In 1999, discard ratios increased sharply for otter trawl and sink gill nets during the second and third quarters, declined from these peak levels in the fourth quarter, but continued to remain relatively high from 2000 to early 2004 compared to pre-1999 ratios. Ratios declined in 2004 after trip limits were further relaxed in the second quarter.

The relatively high discards calculated for otter trawl and shrimp trawl gear during 1989-1991 (Table 6) coincide with recruitment of the strong 1987 year class to the small mesh shrimp trawl gear and then to the large mesh general otter trawl gear. Available length composition data for these gear types suggest that most of the discarded cod were about 30-50 cm with a mode around 40 cm. Discards emanating from these two gears are the likely result of minimum size regulations. In contrast, the relatively low, but persistent, discards of cod in the gillnet fishery comprised fish of all lengths, up to 125 cm. The larger size range reflects discarding resulting from minimum size regulations as well as poor fish quality (in the case of the larger, marketable cod). Discards in 1999 were estimated to be 2,624 mt, one of the highest in the data series, likely due to the imposition of very low trip limits. Estimated discards declined to 998 mt in 2000 as trip limits were relaxed to 400 lbs/day in early 2000, and fluctuated between 1,200 and 1,500 mt between 2001 and 2003 before declining to less than 500 mt from 2004 – 2006 (Table 6) as trip limits were further relaxed to 800 lbs/day. In 2007, the estimated discards were 516 mt.

Adjustment of the 1999 - 2007 Commercial Landings at Age

The fishery for Gulf of Maine cod was affected by specific management actions that began in 1999 and have continued into 2007. The implementation of extremely low trip limits in 1999 likely precipitated a substantial increase in the amount of cod discarded compared to previous years, as noted above. While these trip limits were relaxed to some extent in subsequent years, a substantial portion of the total catch continues to be discarded. Consequently, the 1999-2007 estimated commercial landings at age presented in Table 5a do not reflect the full extent of removals from the stock by the commercial fishery. Therefore, prior to inclusion in the VPA, the 1999-2007 estimates of numbers landed at age had to be adjusted upwards by the ratio of total estimated catch biomass (landings + discard) to the landed catch biomass.

This approach assumes that the age composition of the discarded component of the catch is the same as the landed component. In cases where discards occur because the mesh selectivity in the fishery is not consistent with minimum landing size regulations, it is necessary to estimate the size and age composition of the discarded component separate from the landed component. In general, discards comprise the smaller, younger fish compared to those that are landed. However, where regulatory discards are generated as a result of low trip limits (as occurred during 1999-2007), it is presumed that cod of all sizes and ages are discarded without prejudice. Examination of the 1998, 1999 and 2000 kept and discarded length composition samples from the NEFSC Observer Program database support this assumption. The sizes of discarded cod in 1998, when trip limits were considerably higher, were primarily below the 48 cm minimum landing size, and the sizes of retained cod were approximately the same as those observed in the commercial port samples. In 1999 and 2000, however, the sizes of discarded and retained cod were generally the same, well above the minimum landing size and similar to those observed in the commercial port samples. Therefore, the 1999 -2007 commercial landings at age estimates in Table 5a were multiplied by the discard to kept ratios in Table 6 to derive the discarded numbers

at age in Table 7, and commercial landings mean weights at age were used to estimate the discarded weight at age (Table 7).

Recreational Catches

Estimates of the recreational cod catch were obtained from the Marine Recreational Fishery Statistics Survey (MRFSS), which has been conducted annually since 1979. For this assessment, recreational catches (Table 8) were re-estimated and partitioned by Gulf of Maine and Georges Bank stocks for the 1981-2007 period using revised MRFSS data and a revised site register (Steinbak and Thunberg, pers. comm.). Further information on the details of the allocation scheme and sampling intensity are given in NEFSC (1992). Estimates of the total Gulf of Maine cod recreational catch as well as the retained portion of the catch (*i.e.,* excluding those caught and released) are provided in Table 8. The estimated recreational catch of Gulf of Maine cod (retained component only) has varied considerably over the past decades, ranging from 337 mt in 1997 to 4,218 mt in 1981 (Table 8).

The quantity of cod retained generally exceeded 80% of the total recreational catch during 1981 through 1988, but has been steadily declining, averaging less than 40% since 1994 and less than 30% in 2006 and 2007. The estimated total cod catch (including those caught and released) declined from over 4,500 mt in 1981 to about 2,000 mt between 1983 and 1986, increased to over 3,500 mt in 1990 and 1991, and fluctuated between 1,200 and 3,300 mt between 1992 and 1999. The total catch increased sharply beginning in 2000, reaching 7,100 mt in 2003 before declining to between 3,600 and 4,500 mt in 2006 and 2007. Trends in the weight of retained cod were similar to the total catch, but the magnitude of the removals has been considerably less, especially since 1992.

Recreational Sampling Intensity

Information on the length frequency sampling levels of Gulf of Maine cod taken in the recreational fishery is also provided in Table 8. Overall, sampling of cod taken by recreational gear is poor, ranging from less than 1 ton retained per fish measured annually to over 40 tons retained per fish measured, averaging about 5 tons retained per fish measured. Sampling of the recreational fishery improved during the 1990s, declined between 1999 and 2003 and has improved again in recent years. The age composition of the 1982-1996 recreational landings was estimated for the 1997 assessment (Mayo 1998) but, given the highly variable sampling, these estimates were not formally included in the VPA conducted in 1997 (NEFSC 1997; Mayo 1998). However, the retained recreational catch became a substantial portion of the combined commercial and recreational landings beginning in 1999. Therefore, the age composition of the recreational landings from 1997 through 2000 was estimated for the 2001 assessment, and the 1982-2000 recreational landings at age estimates were incorporated into the total catch at age (Mayo *et al*. 2002) despite the noted sampling variability.

In the present assessment, the recreational fishery landings age composition was re-estimated from 1982 to 2007 using available length measurements from the MRFSS database allocated to the Gulf of Maine area and a combination of commercial, survey (NEFSC and MADMF) and the cod industry-based survey (2004 and 2005 only) age/length keys.

Recreational Landings Age Composition

Given the limited length sampling coverage in the recreational sector of the fishery, the estimation of the number of Gulf of Maine cod caught by length and age required that samples

be pooled on an annual basis. The low inter-seasonal variability displayed by the sample length composition data supported this approach. Differences between the party/charter and private/rental fishing modes are also minimal. Therefore, estimates of the age composition of cod retained by the recreational sector were derived from the length composition data applied to the retained numbers of cod based on pooled annual length frequency samples from Gulf of Maine trips. Only the retained numbers of cod were included because the intercept sampling is not likely to accurately reflect the size composition of the released cod. Age-length keys obtained from sampling the commercial landings, augmented by age samples from trawl surveys for cod less than 40 cm, were applied to the numbers retained at length on an annual basis to derive the numbers retained at age (Table 9a).

During the 1980s, Gulf of Maine cod recreational landings in numbers were dominated by age 3 fish with age 2 fish next in importance (Table 9a, Figure 6). Following the increases in minimum retention size in 1989 and again in 1996, the proportion of age 2 cod declined, and the age composition of the recreational landings now resembles that of the commercial fishery with ages 3, 4 and 5 predominant (Tables 5a and 9a, Figures 5 and 6). The strong 1987 year class dominated the recreational catch in 1990, 1991 and 1992. The 1992 year class can also be tracked in the estimated catch at age between 1995 and 1999 and the 1998 year class predominates after 2000. Ages 3 and 4 cod generally predominate in terms of weight caught, although the 1987, 1992, and 1998 year classes predominated at age 5 in 1992, 1997 and 2003 respectively. The 2001 year class was predominant in 2004, 2005 and 2006, and the 2003 year class dominated the recreational fishery landings in 2007.

Recreational Landings Mean Weights at Age

Mean weights at age were obtained by applying the NEFSC research vessel survey length-weight equation for cod to the numbers retained at age on an annual basis:

$$\ln \text{Weight}_{(kg,\ live)} = -11.7231 + 3.0521 \ln \text{Length}_{(cm)}$$

Mean lengths and weights at age of cod landed by the recreational sector (Table 9b) are consistently lower than those taken in the commercial fishery. This pattern persists through age 5 but, for ages 6 and older, mean weights are highly variable due to the relatively poor sampling of fish at the larger sizes combined with the lack of market category stratification. Despite this variability, patterns present in the commercial landings mean weights are also evident in the recreational landings, *i.e.*, an increase in the mean weight of age 2 and 3 cod beginning in the mid-to-late 1990s, apparent stability of mean weights of age 4, 5 and 6 cod, and an indication of a similar decline in the mean weight of age 7 -10 fish.

Components of the Total Catch

Commercial landings account for the greatest share of the total catch of Gulf of Maine cod (Figure 7), generally exceeding 75% of the total. However, beginning in 1999, when commercial discards and recreational landings began to consistently account for a substantial share of the total catch, commercial landings have generally represented between 50 and 60% of the total catch (Table 10, Figure 7). Commercial discards were relatively low, generally representing less than 10% of the total commercial catch (landings and discards) between 1989 and 1998. The percentage of discards increased sharply in 1999 to 65.5% and remained between

20 and 30% between 2000 and 2003. Since 2004, discards have accounted for 7.1 -13.0% of the total commercial catch.

The fraction of the total landings (commercial and recreational) taken by the recreational sector (retained cod) has ranged from 5.5 to 39.6% since 1981 (Table 10, Figure 7). The proportion taken by the recreational sector fluctuated between 11.3% and 20% between 1981 and 1989, then remained relatively low, ranging from 5% to 15% between 1990 and 1998. Recreational landings equaled or exceeded 30% of the combined landings between 1999 and 2004, but declined somewhat in 2006 and 2007.

Total Catch Age Composition

Estimates of the age composition of total cod catch (Table 11a) were derived by combining the separate age composition estimates obtained for the commercial landings (Table 5a) and discards (Table 7) and recreational landings (Table 9a). Given the general similarities between the age compositions estimated for the commercial and recreational sectors, the total age composition reflects the same dominant year classes and age structure over time. The total catch at age in numbers was dominated by age 3 and 4 fish through 2001, with ages 4-6 predominating during the past 6 years (Table 11a, Figure 8) and the total catch at age in weight is dominated by ages 3, 4, and 5 (Table 11a, Figure 9). Representation of age 2 cod was relatively high in the early 1980s but age 2 fish have gradually all but disappeared from the total catch. The 1987 year class dominated the total catch in 1990, 1991 and 1992 and the 1992 year class can also be tracked between 1995 and 1999. The 1998 year class dominated the period between 2001 and 2003, while the above average 2003 year class predominated in 2007. When viewed over time, the age composition of the total catch (Figures 8 and 9) displays a strong contraction and subsequent expansion of the age range. The maximum age seen in the catch was reduced to ages 7 or 8 during the mid-to-late 1990s. Since then, the age structure has begun to resemble the pattern of the early 1980s. In 2004-2006, the proportion of cod ages 8 and older was equal to or greater than that observed during 1982-1984.

Total Catch Mean Weights at Age

Estimates of the mean length and weight at age of the total cod catch (Table 11b, Figure 10) were derived as an average of the separate mean weights at age of the commercial (Tables 5b and 7) and recreational sectors (Table 9b) weighted by the corresponding numbers at age (Tables 5a, 7 and 9a). Mean lengths and weights at age of cod taken by the combined commercial and recreational sectors (Table 11b) are intermediate to those obtained from the individual sectors. Mean weights at age are highly variable for the older ages due to the relatively low sampling of fish at the larger sizes

Mean weights at age for the total catch show persistent increases over time at ages 2 and 3, a moderate increase at age 4, no apparent trend at age 5, a moderate decline at age 6, and persistent declines at ages 7 and older (Table 11b, Figure 10). The increase in mean weights at the younger ages primarily reflects the trends in the recreational landings**.** Ages that constitute the majority of the catch (ages 3, 4 and 5) show only minor trends in mean weight over time. The declines at the older ages may reflect changes in the spatial distribution pattern and/or selectivity of the fishery.

Stock Mean Weights at Age

Mean weights at age used in the estimation of spawning stock biomass and January 1 biomass were derived from the total catch mean weights at age using methods described by Rivard (1980, 1982). This method adjusts the catch mean weights at age, which are considered to represent mid-year mean weights, to the beginning of the year. The mean weights at the beginning of a given year for a specific age are calculated as the geometric mean of the mean weight of that age in the same year and of the previous age in the previous year. The marginal calculations for the initial and final years and ages are also described by Rivard (1980, 1982).

Trends in stock mean weights at age over time (Table 12, Figure 11) reflect the trends exhibited by the catch mean weights but with slightly less variability, likely due to the smoothing effect of the geometric mean calculations.

STOCK ABUNDANCE and BIOMASS INDICES

Commercial Catch Rates

Trends in commercial landings per unit effort (LPUE) and fishing effort for the period 1965-1993 and 1994-1996 were reported by Mayo (1998). The 1982-1993 age composition of the landings corresponding to the effort sub-fleet as presented by Mayo *et al.* (1994) was used with the standardized effort estimates through 1996 to calculate updated LPUE-at-age indices. Numbers landed at age were estimated by applying quarterly commercial age-length keys to quarterly commercial numbers landed at length by market category. The LPUE-at-age indices were derived by dividing the estimated numbers landed at age by corresponding 1982 through 1996 standardized fishing effort. Further details regarding data selection, preparation and estimation procedures are provided in Mayo *et al.* (1994).

Given the uncertainty in reported fishing effort since 1994, LPUE data after 1993 were not formally included in the VPA conducted in 1998 (NEFSC 1998; Mayo *et al*.1998). Recent management actions, including imposition of trip limits and rolling closures, continue to make interpretation of 1994-2007 LPUE inconsistent with previous years.

Research Vessel Surveys

Background

The Northeast Fisheries Science Center (NEFSC) has conducted research vessel bottom trawl surveys in offshore waters (> 27 m) off the northeast coast of the United States since 1963 (autumn) and 1968 (spring). Inshore areas of the Gulf of Maine (< 27 m) have also been sampled during spring and autumn since 1978. Gear and door changes have occurred during the survey period. Details on the NEFSC survey sampling design and procedures are provided in Azarovitz (1981) and Clark (1981). The Commonwealth of Massachusetts Division of Marine Fisheries (MADMF) has conducted research vessel bottom trawl surveys during spring and autumn primarily in state waters in the southwest portion of the Gulf of Maine since 1978. These surveys are conducted in relatively shallow water and, as such do not provide an abundance index of the stock as a whole. However they do provide an abundance index of recruiting year classes. The MADMF inshore bottom trawl sampling program is described in Howe *et al*. (1981).

The NOAA research vessels *Albatross IV* and *Delaware II* have been used exclusively during the NEFSC surveys. For the NEFSC surveys, a "36 Yankee" trawl has been the standard

sampling gear except during spring 1973-1981 when a modified "41 Yankee" trawl was used. Prior to 1985, BMV oval doors (550 kg) were used in all NEFSC surveys; since 1985, Portuguese polyvalent doors (450 kg) have been used. No adjustments in the survey catch-per-tow data for cod have been made for any of the trawl differences, but vessel and door coefficients have been applied to adjust the stratified means (number and weight per tow) as described in Table 13.

Indices of cod abundance (stratified mean catch per tow in numbers) and biomass (stratified mean weight per tow in kilograms) developed from the NEFSC and MADMF trawl survey data, have been used to monitor changes and assess trends in population size and recruitment of cod populations off New England. Standardized stratified mean catch-per-tow-at-age (number) indices from NEFSC spring and autumn surveys are listed in Appendix B: Tables 1 and 2, and catch-per-tow-at-age indices from MADMF spring and autumn surveys are listed in Appendix B: Tables 3 and 4. The entire series of NEFSC spring and autumn abundance and biomass indices was re-estimated for the 2005 assessment (Mayo and Col 2006) to better account for vessel effects between *RV Albatross IV* and *RV Delaware II*. Although the only major difference during the 1982-2007 assessment period occurred in 1987, minor changes to the indices occurred in most years. In the present assessment, the MADMF survey indices were recalculated over the entire time period beginning in 1978 to account for minor changes to the strata boundaries. Therefore, the indices listed in Tables 13 and 14 and Appendix B: Tables 1, 2, 3 and 4 may differ slightly from those provided in previous assessments.

Trends in Relative Abundance and Biomass

NEFSC spring and autumn offshore stratified mean catch per tow indices for Gulf of Maine cod have generally exhibited similar trends throughout the survey time series (Table 13, Figure 12). Biomass indices declined during the mid- and late 1960s, but between 1972 and 1985 they fluctuated as a result of a series of recruitment pulses. Biomass declined again between the mid-1980s and early 1990s, and then remained relatively low throughout the 1990s. Both spring and autumn indices began to show modest increases after 2000 but the large value in autumn 2002 is the result of a single very large tow that unduly influenced the calculation of the mean. Although the autumn biomass indices have returned to the relatively low levels of the 1990s, the spring indices have shown some increases in 2007 and 2008 (Table 13, Figure 12).

Spring NEFSC number-per-tow indices have remained relatively low since 1985, below the 1981-1984 average (Table 13), but the index increased temporarily in 1988 due to a large contribution from the 1987 year class (Appendix B: Table 1). The index declined thereafter and fluctuated until 2002 and 2003 based in part on contributions from the 1998 year class. The sharp increases in 2007 and 2008 reflect the appearance of the large 2003 and 2005 year classes (Appendix B: Table 1, Figure 13).

Sharp increases in the autumn number per tow indices reflect above-average recruitment of the 1971, 1973, 1977-1980, and 1985-1987 year classes at ages 1 and 2 (Appendix B: Table 2**,** Figure 14**).** The sequential dominance of these cohorts at older ages is evident from number-per-tow-at-age values in both spring and autumn NEFSC surveys (Appendix B: Tables 1 and 2). Increases in the autumn 1994-1995 and spring 1996-1997 biomass indices may be attributed to somatic growth of fish from the 1992 year class which was the largest within a series of poor year classes. The 1998 year class is equivalent to the 1992 year class, and the 2003 and 2005 year classes appear to be the strongest since the 1987 year class.

Overall, the 1987 year class appears to have been one of the strongest ever produced; catch-per-tow indices for this cohort at ages 1-3 in the NEFSC autumn surveys (Appendix B: Table 2) and at ages 0 and 1 in the MADMF autumn inshore surveys (Appendix B: Table 4) were nearly all high values. Based on MADMF and NEFSC survey catch per tow indices, the 1992, 1998, 2003 and 2005 year classes of Gulf of Maine cod appear to be moderate to large, and the intervening year classes, particularly the 1993, 1994, 1995, 1997, 1999 and 2000 year classes, have been well below average (Figures 13 and 14).

Maturity at Age Estimates

Observations of external gonadal characteristics, classified according to the maturity stages described by Burnett *et al*. (1989) and recorded during NEFSC spring bottom trawl surveys, were also analyzed in order to construct a series of maturity at age moving window ogives over the assessment time period using probit analysis. A series of annual 3-year moving windows was employed in order to achieve a smooth transition across years. O'Brien *et al.* (2008) developed the following procedure for deriving the annual moving window ogives. To calculate an ogive for year t, the data for year t-1 and year t+1 were combined with the data for year t in order to estimate a single ogive for year t. Ogives for subsequent years were estimated in a similar manner by advancing the years by 1. Two years of data were used for the first year and 2008 was included in the last year of the time series (2007). Ninety-five percent confidence limits for proportion mature at age were estimated using the approximate variance for large samples (Ashton 1972, O'Brien *et al*. 1993). Inverse 95% confidence limits for A_{50} (median age at maturity) were estimated within the SAS PROBIT procedure. This was accomplished to provide a smoother transition in the maturity schedule used to determine spawning stock biomass. Annual female maturity ogives are presented in Table 15, and trends in female and male A50 with 95% confidence limits are illustrated in Figure 15.

The maturity ogives reveal two cycles where full maturation occurs as early as age 4 alternating with two cycles where full maturation is delayed to ages 5 or 6. Earliest maturation occurred during the mid -1980s and mid -1990s whereas delayed maturation occurred during the early 1980s and early 1990s and since 2000. Trends in A50 for both females and males (Figure 15) are consistent with the changes in the maturity ogives with the lowest values occurring during the mid -1980s and mid -1990s.

Total Mortality Estimates

In recent assessments (*e.g.*, Mayo and Col 2006) instantaneous total mortality (Z) estimates were calculated annually. Total mortality was calculated from NEFSC survey mean number per tow at age data (Appendix B: Tables 1 and 2) by the $\log_e$ ratio of the pooled age 3+/age 4+ indices in the autumn surveys, and the pooled age 4+/age 5+ indices in the spring surveys. For example, the 1983 estimates were derived from:

Spring: ln (E ages 4+ for 1983/ E ages 5+ for 1984)
Autumn: ln (E ages 3+ for 1982/ E ages 4+ for 1983)

Different age groups were used in the spring and autumn analyses so that Z could be evaluated over the same year classes within each year. Given recent increases in codend mesh sizes, the ages were increased by one year so that total mortality is calculated for the pooled age

4+/age 5+ indices in the autumn surveys, and the pooled age 5+/age 6+ indices in the spring surveys. In this example, the 1983 estimates were derived from:

Spring: ln (E ages 5+ for 1983/ E ages 6+ for 1984)
Autumn: ln (E ages 4+ for 1982/ E ages 5+ for 1983)

Values of Z derived from the spring surveys are generally comparable to those calculated from the autumn data (Figure 16). These values of Z exhibit considerable inter-annual variability due primarily to year effects in the surveys. When smoothed with a 3-year moving average, however, the annual estimates suggest a pattern of increasing mortality during the1980s, with total mortality remaining in the range of 1-1.5 from the mid-1980s through the mid 1990s, depending on the age ranges used in the calculations. Total mortality declined during the late 1990s, but the most recent estimates suggest an increase.

ESTIMATION of FISHING MORTALITY RATES and STOCK SIZE

Natural Mortality

Instantaneous natural mortality (M) for Gulf of Maine cod is assumed to be 0.20, the conventional value of M used for all Northwest Atlantic cod stocks (Paloheimo and Koehler 1968, Pinhorn 1975, Minet 1978).

Assessment

Input Data and Model Formulation

The present assessment represents more than a three-year update to the previous assessment (Mayo and Col 2006). As noted above, each component of the total catch at age has changed since the 2005 GARMII assessment. This required re-estimation of the landings at age from 1994 to present, the recreational landings at age from 1981 to present and the observer based discards at age since 1989.

The VPA formulation used in the previous assessment was evaluated and, based on an observed shift in the age of full recruitment from age 4 to age 5, the age 7 plus group formulation was discontinued in favor of an extended age range out to age 11+. This effectively reverses the decision reported by Mayo (1995) to restrict the age range to ages 7+ due to high coefficients of variation (CV) on the terminal year stock size estimates and variable estimates of F on ages 7-9 in most years prior to the terminal year.

Catch at age data were revised or updated over the 1982 to 2007 assessment time period to account for the data changes described above. NEFSC survey abundance indices (stratified mean number per tow at age) were updated through spring 2008. The MADMF spring and autumn survey indices were recalculated over the entire period since 1978 due to slight changes in the strata boundaries that affected the stratified mean calculations. Differences were minor in most cases.

Virtual Population Analysis Calibration

The ADAPT calibration method (Parrack 1986, Gavaris 1988, Conser and Powers 1990) was used to derive estimates of terminal fishing mortality (F) in 2007 and stock sizes in 2008. The formulation in the present assessment is: catch at age from 1982-2007 out to age 11+,

estimation of age 2-10 stock sizes in terminal year+1. Calibration included NEFSC spring and autumn age 2-8 indices, and MADMF spring age 2-4 and autumn age 2 indices. The NEFSC and MADMF autumn indices were lagged forward by one age and one year whereby age 1-7 indices were related to age 2-8 stock sizes in the subsequent year for corresponding cohorts. All NEFSC and MADMF indices were related to January 1 stock sizes, and USA commercial LPUE indices were related to mid-year stock sizes. As in recent assessments (*e.g.*, Mayo and Col 2006), commercial LPUE indices, derived from the catch at age corresponding to the effort sub-fleet used in the estimation of standardized fishing effort as described by Mayo *et al.* (1994), were included only through 1993. This change effectively removed the influence of the LPUE indices on the terminal year outcome of the calibration, while preserving the historic relationship employed in previous assessments.

This formulation provided direct stock size estimates for ages 2 through 10 in 2008 and estimates of F for corresponding cohorts on ages 1 through 9 in 2007. Since the age at full recruitment was defined as 5 years in the input partial recruitment vector, the terminal year F on age 10 was estimated as the mean of the age 5 through 9 Fs; age 10 is also the oldest true age in the terminal year. In all years prior to the terminal year, F on the oldest true age (age 10) was determined from weighted estimates (by age group abundance, in numbers) of Z for ages 5 through 9. In all years, the age 10 F was applied to the age 11+ group. Spawning stock biomass (SSB) was calculated at spawning time (March 1) by applying a series of annual maturity ogives calculated on a 3 – year moving average basis as presented in Table 15. Because there is a moderate dome in the partial recruitment beginning at age 8, the average fully recruited F in each year is calculated as the unweighted average of the Fs on ages 5 through 7.

Precision and bias of the 2008 stock size estimates and 2007 spawning stock biomass and fishing mortality estimates was calculated from 1,000 bootstrap replicates (Efron 1982) of the VPA. Retrospective analyses of terminal year estimates of stock sizes, fully recruited fishing mortality and SSB were also carried out. Residuals of the observed and predicted indices derived from VPA calibration are also provided.

This formulation of the present assessment addresses the recommendations of the GARMIII Model Selection Panel and the GARMIII Biological Reference Point Panel, and was accepted by the GARMIII Assessment Review Panel (NEFSC 2008) as the final assessment.

Virtual Population Analysis Results

Fully recruited fishing mortality (unweighted average of ages 5-7) is estimated at 0.46 in 2007, a moderate decrease since 2004 and 2005 (Table 17; Figure 17). The 2004 year class is estimated to be equivalent to the 1998 year class (approximately 7-8 million fish), the 2003 year class (11 million fish) is about twice the long term average and the 2005 year class (24 million fish) is equivalent to the strong 1987 year class (Table 16a, Figure 18). The 2000 year class (1.2 million fish) is by far the weakest in the entire VPA series and the 2002 year class (1.7 million fish) is the second weakest.

Spawning stock biomass increased to 18,000 mt in 2001, but declined to 11,000 mt in 2005 as a result of the above average 1998 year class being removed from the population, followed by subsequent poor recruiting year classes of 2000 and 2002 (Tables 16a and 16c; Figure 18). Spawning stock biomass increased substantially to 19,000 mt in 2006 on the strength of the 2003 year class becoming partially mature, and further to 34,000 mt in 2007 on the combined strength of the 2003 year class (95% mature) and the partially mature 2005 year class (34% mature). A complete listing of the final ADAPT VPA results, and bootstrap and

retrospective analyses is given in Appendix C, and key results, including age-specific estimates of stock size, instantaneous fishing mortality (F), and spawning stock biomass, are presented in Table 16. Annual estimates of fully recruited (ages 5-7) average fishing mortality are also given in Table 17.

VPA Diagnostics and Uncertainty

Extension of the age range out to 11+ resulted in a partial recruitment pattern that peaked at ages 5-7, followed by a reduction at ages 8 and 9 to about 70-80 percent of the maximum. Estimates of F at ages 8 and 9 were highly variable, however, especially during the 1990s. The calculation of F on the oldest true age (age 10) was evaluated over a range of ages ranging from ages 5-6 to ages 5-9. There were only minor differences in the estimates of F on age 10, no discernable differences in the age 5-7 average F estimates, and no appreciable differences in the estimates of SSB over time. An additional trial using ages 8 and 9 to estimate F on age 10 produced similar trends in SSB but highly variable estimates of F on age 10. Taking account of these results we elected to include as many ages as possible (ages 5-9) to calculate F on age 10. Further details and graphics of this analysis can be found in Appendix D.

The 2008 NLLS stock size estimates were relatively precise for ages less than 8, with Coefficients of Variation (CVs) on these ages ranging from 26% (ages 4 and 5) to 44% (ages 2 and 7) (Table 18). However the CVs on ages 8-10 were considerably higher, ranging from 55% (age 8) to 72% (age 10). The bootstrapped estimates of bias were relatively low for intermediate ages ranging from 3% (ages 4 and 5) to 6-7% (ages 3, 6 and 7). Bias was higher on other ages, ranging from 13% on age 8 to about 21% on ages 2, 9 and 10 (Table 19a). Coefficients of Variation on the NEFSC survey Qs varied between 10% and 17% for ages 2-6, increasing to between 20% and 28% on ages 7 and 8. The CVs on the MADMF spring survey Qs ranged from 9% to15% while the CV on the MADMF autumn survey Q was estimated to be about 30% (Table 18).

An analysis was also carried out to determine the magnitude and trends in survey Qs by raising the Qs estimated by the VPA using survey swept area calculations. For Gulf of Maine cod, these raised values of Q ranged from about 10% at age 2, increasing to about 50-60% at age 5, and leveling off at about 70-90% at ages 7-8. Further details and graphics of this analysis can be found in Appendix E.

Residual patterns from the NEFSC and MADMF survey data used to calibrate the VPA appear for the most part random, although there are some instances of 3 to 4 year blocks of positive and negative residuals (Figure 19).

Precision of 2007 F and SSB Estimates

The bootstrap procedure was also used to evaluate the precision of age-aggregated terminal year estimates, by generating 1000 estimates of the 2007 fully recruited fishing mortality rate and spawning stock biomass**.** Summary statistics for these bootstrap analyses are provided in Table 19b and Appendix C, and the distributions of the bootstrap estimates and the corresponding cumulative probability curves are shown in Figures 20 and 21. The cumulative probability expresses the likelihood that the fishing mortality rate was greater than a given level (Figure 20) or the likelihood that spawning stock biomass was less than a given level (Figure 21), when measurement error is considered.

The bootstrap analysis (Table 19b) provides an 80% CI about the 2007 fully recruited F estimate (0.46) of 0.36 – 0.67 (Figure 20) and an 80% CI about the 2007 SSB estimate (33,877

mt) of 29,133 mt – 41,747 mt (Figure 21). The average fully-recruited fishing mortality in 2007 for ages 5-7 was reasonably well estimated (CV = 0.27) and the mean bootstrap estimate of F (0.50) was slightly higher than the point estimate (0.46) from the NLLS solution. Spawning stock biomass in 2007 was also reasonably well estimated (CV = 0.14) and the mean bootstrap estimate of SSB (35,356 mt) was slightly higher than the point estimate (33,877 mt) from the NLLS solution.

Retrospective Analyses of Terminal Year Estimates of F, SSB and Recruitment

A weak retrospective pattern is evident in the estimates of the terminal year F whereby fully recruited F alternates between over- and under-estimation (Figure 22). The same pattern is evident for SSB (Figure 23). A retrospective pattern is also evident for age 1 recruitment estimates whereby recruitment was well overestimated for the 2001 and 2003 year classes (Figure 24). The estimate of the size of the 2005 year class appears to not suffer the same fate, as it is supported by an additional year of data in the present assessment (Figure 24). The degree of retrospective change in the estimates of average F (ages 5-7), SSB and age 1 recruitment was computed by calculating a Mohn's average rho (Mohn 1999) based on the relative difference between terminal year estimates over the last 7 years of the assessment (2000 – 2006). The relative differences are as follows:

Mohn's average rho

Year	Avg F (Ages 5-7)	SSB	Recruits (Age 1)
2000	0.8828	-0.0170	0.9246
2001	0.2544	0.2032	-0.6116
2002	-0.2325	0.5366	1.8357
2003	-0.0181	0.1856	1.8471
2004	0.0925	0.1677	1.0833
2005	0.2243	0.0653	-0.2613
2006	-0.1045	0.2228	0.1340
Avg	0.1570	0.1949	0.7074

The relative differences are mostly positive during these years, although some negative values appear in each of the retrospective analyses. These results suggest a 16% positive relative difference for average F, a 19% positive difference for SSB, and a 71% positive relative difference for age 1 recruitment. The latter result is driven by very high values in 2002 and 2003. A complete listing of the retrospective analyses is given in Appendix C.

Spawning Stock and Recruitment

The relationship between spawning stock biomass and recruitment for Gulf of Maine cod was examined from two perspectives. First, a traditional spawning stock-recruitment scatterplot (Figure 25) was constructed over the period covering the 1981-2006 year classes. In addition, a survival ratio, expressed as age 1 recruits per unit of SSB (R/SSB) was also calculated for each year class (Figure 26). The two most prominent features in these graphs are the large 1987

(middle) and 2005 (left) year classes, each at over 20 million fish, produced by low to moderate spawning stock

Survival ratios of pre-recruits up to age 1 are highest for the 1987, 1992, 1998, 2003 and 2005 year classes. The 1987 and 2003 year classes were produced by about average SSB, and the 1998, 2003 and 2005 year class from relatively low SSB. Survival ratios were generally higher during the early-to-mid 1980s prior to the emergence of the large 1987 year class. Survival declined after the 1992 year class appeared, but increased in 1996, 1997 and 1998, declined thereafter and increased again with the appearance of the 2003 and 2005 year classes.

BIOLOGICAL REFERENCE POINTS

The following biological reference points first developed by the Working Group on Re-Evaluation of Biological Reference Points for New England Groundfish (NEFSC 2002a) have existed since 2002:

F_{msy} 0.225
SSB_{msy} 82,830 mt
MSY 16,600 mt

Two approaches for estimating biological reference points have been evaluated for this stock. The existing reference points are based on a parametric approach whereby spawning biomass and age 1 recruitment results obtained from the VPA were included in a model (SRFIT) that also included life history and fishery parameters using the Sissenwine-Shepherd approach (see Brodziak and Legault 2005). This approach was employed by the Working Group on Re-Evaluation of Biological Reference Points for New England Groundfish (NEFSC 2002a). The GARMIII Biological Reference Point Panel recommended against this approach in favor of a non-parametric approach in order to provide consistency between reference point estimation and projection methodology.

Non-Parametric Approach

Yield and Spawning Stock Biomass per Recruit Analysis

In the non-parametric empirical approach, a yield and SSB per recruit analysis (Thompson and Bell 1934, Gabriel *et al*. 1989) was first conducted using catch and stock mean weights at age and maturity at age averaged over the 2003-2007 time period. Partial recruitment at age was derived from the average of the 2003-2007 time period Fs from the VPA results as:

Age 1: 0.0000, Age 2: 0.0021, Age 3: 0.1618, Age 4: 0.6821, Age 5: 0.9004,
Age 6: 1.0000, Age 7: 0.8260, Age 8: 0.7326, Age 9: 0.7705, Ages 10 and 11+: 0.7530.

Yield and SSB per recruit input and results are given in Table 20 and are illustrated in Figure 27. A proxy for F_{msy} taken from this analysis is F40% MSP = 0.237.

Stochastic Equilibrium Projections of MSY and SSB_{msy}

A stochastic projection program (AGEPRO, Brodziak *et al*. 1998) was then used to project 100 year scenarios to obtain equilibrium SSB_{msy} and MSY estimates. The initial

conditions of 2008 stock sizes were based on the 1,000 bootstrap iterations performed by the VPA. Recruitment was derived by resampling the cumulative distribution function of age 1 cod from the 1981-2005 year classes estimated by the current VPA. Catch and stock mean weights at age, maturity at age and partial recruitment averaged over the 2003-2007 time period were the same as used in the yield and SSB per recruit analyses above. A constant F strategy was employed setting F at the F_{msy} proxy F40% MSP (0.237) obtained from the SSB per recruit analysis. Results from this approach provide the following estimates:

F_{msy}	0.237
SSB_{msy}	58,248 mt
MSY	10,014 mt

CONCLUSIONS

Gulf of Maine cod spawning stock biomass has increased from 10,974 mt in 2005 to 33,877 mt in 2007. Although the stock remains low relative to SSB_{msy} (58,248 mt), spawning stock biomass was above the ½ SSB_{msy} threshold in 2007. Fully recruited fishing mortality declined to about 0.46 in 2007, indicating that F continues to remain very high relative to fully recruited F reference points ($F_{40\%}$ F_{msy} proxy = 0.237). Thus, the stock is not overfished but overfishing continues to occur.

The 1987and 2005 year classes are the strongest in the VPA assessment period (1982-2007). The 1992, 1998, 2001 and 2003 cohorts have been above average and the 1993-1995, 1999-2000 and 2002 year classes are among the poorest in the VPA time series. Survival ratios (R/SSB) declined after 1998 but survival increased substantially with the appearance of the strong 2003 and 2005 year classes.

A retrospective pattern has existed in the VPA results for this stock, but the pattern has reversed several times over the past decade. At present, it appears that there is a slight tendency to over-estimate fully recruited F and spawning stock biomass in the terminal year and to over-estimate the magnitude of large incoming year classes in some years.

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TABLES

Table 1. Commercial landings (metric tons, live) of Atlantic cod from the Gulf of Maine (NAFO Division 5Y), 1960 - 2007.[1]

	Country				
Year	USA	Canada	USSR	Other	Total
1960	3448	129	-	-	3577
1961	3216	18	-	-	3234
1962	2989	83	-	-	3072
1963	2595	3	133	-	2731
1964	3226	25	-	-	3251
1965	3780	148	-	-	3928
1966	4008	384	-	-	4392
1967	5676	297	-	-	5973
1968	6360	61	-	-	6421
1969	8157	59	-	268	8484
1970	7812	26	-	423	8261
1971	7380	119	-	163	7662
1972	6776	53	11	77	6917
1973	6069	68	-	9	6146
1974	7639	120	-	5	7764
1975	8903	86	-	26	9015
1976	10172	16	-	-	10188
1977	12426	-	-	-	12426
1978	12426	-	-	-	12426
1979	11680	-	-	-	11680
1980	13528	-	-	-	13528
1981	12534	-	-	-	12534
1982	13582	-	-	-	13582
1983	13981	-	-	-	13981
1984	10806	-	-	-	10806
1985	10693	-	-	-	10693
1986	9664	-	-	-	9664
1987	7527	-	-	-	7527
1988	7958	-	-	-	7958
1989	10397	-	-	-	10397
1990	15154	-	-	-	15154
1991	17781	-	-	-	17781
1992	10891	-	-	-	10891
1993	8287	-	-	-	8287
1994	7994	-	-	-	7994
1995	6536	-	-	-	6536
1996	6976	-	-	-	6976
1997	5420	-	-	-	5420
1998	4045	-	-	-	4045
1999	1380	-	-	-	1380
2000	3721	-	-	-	3721
2001	4280	-	-	-	4280
2002	3604	-	-	-	3604
2003	3851	-	-	-	3851
2004	3776	-	-	-	3776
2005	3525	-	-	-	3525
2006	3028	-	-	-	3028
2007	3989	-	-	-	3989

[1] USA 1960-1993 landings from NMFS, NEFSC Detailed Weighout Files and Canvass data.
[2] USA 1994-2007 landings from NMFS, NEFSC Detailed Weighout Files estimated by allocating landings on a trip basis from Vessel Trip Reports.

Table 2. Percentage (by weight) of USA commercial Atlantic cod landings from the Gulf of Maine (NAFO Division 5Y), by market category, 1964 - 2007.

Year	Large	Market	Scrod	Total[1]
1964	29	59	12	100
1965	39	54	7	100
1966	42	48	10	100
1967	41	41	17	100
1968	47	43	9	100
1969	35	55	9	100
1970	43	52	6	100
1971	52	42	6	100
1972	58	35	7	100
1973	52	36	11	100
1974	39	33	28	100
1975	32	42	26	100
1976	29	45	20	100
1977	33	42	22	100
1978	38	44	17	100
1979	37	49	14	100
1980	36	45	19	100
1981	29	45	22	100
1982	29	45	24	100
1983	25	45	28	100
1984	26	51	19	100
1985	25	51	20	100
1986	22	51	23	100
1987	29	52	16	100
1988	26	45	23	100
1989	17	55	23	100
1990	34	43	19	100
1991	26	51	20	100
1992	31	49	18	100
1993	32	44	21	100
1994[2]	24	54	18	100
1995	21	53	24	100
1996	13	61	24	100
1997	18	60	19	100
1998	23	57	18	100
1999	29	53	15	100
2000	30	59	9	100
2001	39	51	8	100
2002	42	52	4	100
2003	47	46	4	100
2004	52	42	3	100
2005	38	51	5	100
2006	30	57	5	100
2007	24	65	5	100

1 Includes landings of 'mixed' cod.
2 Landings estimates revised since 1994

Table 3. USA commercial landings (metric tons, live) of Atlantic cod from the Gulf of Maine (NAFO Division 5Y), by gear type, 1965 - 2007.

	Landings (metric tons, live)						Percentage of Annual Landings					
Year	Otter Trawl	Sink Gill Net	Line Trawl	Handline	Other Gear	Total	Otter Trawl	Sink Gill Net	Line Trawl	Handline	Other Gear	Total
1965	2480	501	462	168	1	3612	68.7	13.9	12.8	4.6	-	100.0
1966	2549	830	308	150	4	3841	66.4	21.6	8.0	3.9	0.1	100.0
1967	4312	734	206	274	<1	5526	78.0	13.3	3.7	5.0	-	100.0
1968	4143	1377	213	339	4	6076	68.2	22.7	3.5	5.6	-	100.0
1969	6553	851	258	162	4	7828	83.7	10.9	3.3	2.1	-	100.0
1970	5967	951	407	178	9	7512	79.4	12.7	5.4	2.4	0.1	100.0
1971	5117	1043	927	98	8	7193	71.1	14.5	12.9	1.4	0.1	100.0
1972	4004	1492	1234	54	2	6786	59.0	22.0	18.2	0.8	-	100.0
1973	3542	1182	1305	23	9	6061	58.4	19.5	21.5	0.4	0.2	100.0
1974	5056	1412	904	36	17	7425	68.1	19.0	12.2	0.5	0.2	100.0
1975	6255	1480	920	12	8	8675	72.1	17.1	10.6	0.1	0.1	100.0
1976	6701	2511	621	4	41	9878	67.8	25.4	6.3	0.1	0.4	100.0
1977	8415	2872	534	6	166	11993	70.2	23.9	4.5	-	1.4	100.0
1978	7958	3438	393	10	91	11890	66.9	28.9	3.3	0.1	0.8	100.0
1979	7567	2900	334	19	167	10987	68.9	26.4	3.0	0.2	1.5	100.0
1980	8420	3733	251	48	61	12513	67.3	29.8	2.0	0.4	0.5	100.0
1981	7937	4102	276	23	45	12383	64.1	33.1	2.2	0.2	0.4	100.0
1982	9758	3453	188	46	34	13479	72.4	25.6	1.4	0.3	0.3	100.0
1983	9975	3744	77	4	67	13867	71.9	27.0	0.6	-	0.5	100.0
1984	6646	3985	22	3	69	10725	62.0	37.2	0.2	-	0.6	100.0
1985	7119	3090	55	6	326	10596	67.2	29.1	0.5	0.1	3.1	100.0
1986	6664	2692	56	12	180	9604	69.4	28.0	0.6	0.1	1.9	100.0
1987	4356	2994	70	13	68	7501	58.1	39.9	0.9	0.2	0.9	100.0
1988	4513	3308	68	27	22	7938	56.9	41.7	0.8	0.3	0.3	100.0
1989	6152	4000	72	36	119	10379	59.3	38.5	0.7	0.4	1.1	100.0
1990	10420	4343	126	20	186	15095	69.0	28.8	0.8	0.1	1.2	100.0
1991	13049	4158	212	59	266	17744	73.5	23.4	1.2	0.3	1.5	100.0
1992	7344	3081	359	94	14	10891	67.4	28.3	3.3	0.9	0.1	100.0
1993	4876	3130	236	16	29	8287	58.8	37.8	2.8	0.2	0.3	100.0
1994[1]	4368	3287	302	19	18	7994	54.6	41.1	3.8	0.2	0.2	100.0
1995	3309	2876	255	57	39	6536	50.6	44.0	3.9	0.9	0.6	100.0
1996	3901	2642	308	83	42	6976	55.9	37.9	4.4	1.2	0.6	100.0
1997	2891	2109	326	68	26	5420	53.3	38.9	6.0	1.3	0.5	100.0
1998	2277	1400	228	115	25	4045	56.3	34.6	5.6	2.8	0.6	100.0
1999	762	442	69	101	6	1380	55.2	32.0	5.0	7.3	0.4	100.0
2000	2025	1387	74	214	21	3721	54.4	37.3	2.0	5.8	0.6	100.0
2001	2375	1546	89	260	10	4280	55.5	36.1	2.1	6.1	0.2	100.0
2002	1903	1402	119	174	6	3604	52.8	38.9	3.3	4.8	0.2	100.0
2003	1912	1631	139	148	21	3851	49.6	42.4	3.6	3.8	0.5	100.0
2004	1612	1878	114	75	97	3776	42.7	49.7	3.0	2.0	2.6	100.0
2005	1448	1658	119	79	221	3525	41.1	47.0	3.4	2.2	6.3	100.0
2006	1329	1437	139	36	87	3028	43.9	47.5	4.6	1.2	2.9	100.0
2007	1495	2123	155	70	146	3989	37.5	53.2	3.9	1.8	3.7	100.0

1 Landings estimates revised since 1994, '-' = < 0.1%

Table 4. USA sampling of commercial Atlantic cod landings from the Gulf of Maine stock (NAFO Division 5Y), 1982 - 2007.

Year	Number of Samples				Number of Samples, by Market Category & Quarter															No.Tons
	Length Samples		Age Samples		Scrod					Market					Large					
	No.	No. Fish Measured	No.	No. Fish Aged	Q1	Q2	Q3	Q4	3	Q1	Q2	Q3	Q4	3	Q1	Q2	Q3	Q4	3	per Sample
1982	48	3848	48	866	6	7	6	6	25	4	3	7	4	18	0	2	1	2	5	266
1983	71	5241	67	1348	14	10	10	4	38	4	10	6	2	22	1	3	5	2	11	197
1984	55	3925	55	1224	7	5	6	7	25	4	3	5	6	18	1	6	3	2	12	193
1985	69	5426	66	1546	5	6	7	5	23	8	6	7	4	25	7	5	3	6	21	155
1986	53	3970	51	1160	5	5	6	3	19	5	6	8	2	21	1	5	4	3	13	182
1987	43	3184	42	939	4	4	3	4	15	5	5	3	5	18	4	2	3	1	10	175
1988	34	2669	33	741	4	3	4	4	15	1	5	3	5	14	1	2	2	0	5	234
1989	32	2668	32	714	3	3	3	3	12	4	1	5	4	14	2	2	1	1	6	325
1990	39	2982	38	789	3	7	3	5	18	4	7	4	3	18	0	2	1	0	3	387
1991	56	4519	56	1152	2	10	4	3	19	5	11	11	3	30	0	3	3	1	7	318
1992	51	4086	51	1002	2	8	6	3	19	6	7	7	3	23	3	1	1	4	9	214
1993	23	1753	23	447	3	3	3	1	10	1	2	4	1	8	1	1	2	1	5	360
1994	29	2575	33	649	0	2	2	3	7	1	5	3	6	15	0	2	3	2	7	275
1995	31	2557	32	682	4	3	2	4	13	2	8	2	2	14	0	3	0	1	4	208
1996	71	6486	66	1380	5	4	7	9	25	6	9	11	11	37	1	2	3	3	9	97
1997	89	7559	80	1643	7	13	3	10	33	12	11	10	9	42	2	8	2	2	14	61
1998	50	4536	46	992	4	7	0	3	14	9	9	9	5	32	1	0	2	1	4	80
1999	10	733	10	195	5	0	0	0	5	2	1	1	0	4	1	0	0	0	1	137
2000	74	5737	74	1680	15	6	4	7	32	13	14	5	9	41	0	0	0	1	1	49
2001	109	6895	107	2436	4	4	4	7	19	4	9	8	15	36	2	15	18	19	54	38
2002	129	5263	124	2405	4	2	0	1	7	15	3	6	5	29	50	8	16	19	93	29
2003	248	11479	231	5630	5	1	17	8	31	14	8	25	19	66	50	34	34	33	151	15
2004	221	11031	162	3467	17	11	6	22	56	18	21	15	15	69	37	20	11	25	95	15
2005	364	10073	256	3486	23	29	33	16	101	13	15	20	19	67	20	41	68	63	192	9
2006	322	10735	255	4309	15	8	8	3	34	17	20	18	12	67	48	48	62	60	218	9
2007	376	10702	285	3907	10	6	11	8	35	7	14	18	17	56	43	73	104	60	280	11

Table 5a. Commercial landings of Gulf of Maine cod at age (numbers in 000's, weight in mt), 1982 - 2007.

	Total Commercial Landings in Numbers (000's) at Age								Revised LAA 1994+		Jul-08	
Year	1	2	3	4	5	6	7	8	9	10	11+	Total
1982	30.0	1380.0	1633.0	1143.0	633.0	69.0	91.0	61.0	41.0	4.0	33.0	5118.0
1983	0.0	866.0	2357.0	1058.0	638.0	422.0	47.0	61.0	23.0	9.0	15.0	5496.0
1984	4.0	446.0	1240.0	1500.0	437.0	194.0	74.0	19.0	15.0	11.0	17.0	3957.0
1985	0.0	407.0	1445.0	991.0	630.0	128.0	78.0	32.0	4.0	11.0	11.0	3737.0
1986	0.0	84.0	2164.0	813.0	250.0	177.0	39.0	24.0	20.0	4.0	8.0	3583.0
1987	2.0	216.0	595.0	1109.0	277.0	66.0	51.0	9.0	8.0	8.0	3.0	2344.0
1988	0.0	160.0	1443.0	953.0	406.0	43.0	9.0	17.0	1.0	2.0	1.0	3035.0
1989	0.0	337.0	1583.0	1454.0	449.0	81.0	35.0	6.0	3.0	5.0	7.0	3960.0
1990	0.0	205.0	3425.0	2064.0	430.0	157.0	27.0	30.0	10.0	15.0	17.0	6380.0
1991	0.0	344.0	934.0	4161.0	851.0	143.0	41.0	30.0	6.0	1.0	1.0	6512.0
1992	0.0	313.0	530.0	484.0	2018.0	202.0	62.0	7.0	12.0	3.0	0.0	3631.0
1993	0.0	76.0	1487.0	641.0	129.0	457.0	28.0	6.0	2.0	0.0	0.0	2825.0
1994	0.0	37.5	1094.5	1113.7	305.3	69.5	84.2	29.2	6.6	0.6	1.2	2742.3
1995	18.1	221.4	884.9	1034.7	222.5	26.8	13.9	18.3	0.8	1.6	0.2	2443.2
1996	0.0	68.7	513.3	1743.9	365.4	36.6	4.4	0.5	1.2	0.0	0.0	2734.0
1997	0.0	79.1	444.6	427.1	800.8	68.3	5.0	2.6	0.3	0.7	0.1	1828.6
1998	0.0	93.8	395.9	530.5	146.2	175.7	25.2	3.8	0.4	1.1	0.4	1372.7
1999	0.0	2.9	183.8	176.1	81.3	16.2	22.4	2.3	0.0	1.5	0.0	486.5
2000	0.0	101.8	255.9	501.4	122.0	69.0	11.1	5.5	0.0	0.0	0.0	1066.7
2001	0.0	46.0	483.6	323.1	211.9	68.0	38.5	5.7	9.3	0.9	0.4	1187.4
2002	0.0	1.6	115.3	438.7	172.4	106.4	42.9	12.1	4.0	4.2	0.4	898.1
2003	0.0	7.0	48.1	205.3	393.4	124.2	53.7	20.7	9.4	4.8	3.4	870.1
2004	0.0	0.5	155.6	133.1	225.5	178.3	54.1	27.7	14.6	7.8	2.1	799.4
2005	0.0	1.2	39.6	436.9	64.9	181.3	85.1	22.5	13.2	5.5	5.5	855.6
2006	0.0	1.0	119.9	191.8	307.0	22.3	65.7	30.7	11.0	6.3	5.0	760.8
2007	0.0	5.4	100.9	642.7	101.4	186.9	6.3	16.9	8.1	4.1	4.6	1077.2

	Total Commercial Landings in Weight (Tons) at Age											
Year	1	2	3	4	5	6	7	8	9	10	11+	Total
1982	24.0	1595.0	2717.0	3160.0	3019.0	461.0	813.0	608.0	531.0	41.0	613.0	13582.0
1983	0.0	1009.0	3913.0	2619.0	2410.0	2518.0	271.0	643.0	227.0	102.0	269.0	13981.0
1984	3.0	516.0	2071.0	4080.0	1607.0	1145.0	603.0	186.0	193.0	152.0	250.0	10816.0
1985	0.0	513.0	2523.0	2816.0	2814.0	705.0	615.0	363.0	51.0	141.0	152.0	10693.0
1986	0.0	110.0	3976.0	2375.0	1153.0	1072.0	296.0	243.0	253.0	54.0	132.0	9664.0
1987	2.0	283.0	1001.0	3641.0	1340.0	451.0	455.0	88.0	116.0	110.0	40.0	7527.0
1988	0.0	203.0	2715.0	2311.0	2097.0	295.0	85.0	191.0	11.0	36.0	14.0	7958.0
1989	0.0	420.0	2811.0	4351.0	1737.0	325.0	323.0	67.0	43.0	87.0	163.0	10397.0
1990	0.0	219.0	5794.0	4687.0	1834.0	1200.0	290.0	354.0	153.0	214.0	350.0	15095.0
1991	0.0	388.0	1463.0	10455.0	3520.0	1045.0	399.0	369.0	93.0	32.0	17.0	17781.0
1992	0.0	480.0	1019.0	1313.0	6175.0	1011.0	594.0	88.0	161.0	49.0	0.0	10891.0
1993	0.0	99.0	2809.0	1611.0	561.0	2819.0	281.0	79.0	27.0	0.0	0.0	8286.0
1994	0.0	52.5	2059.8	3378.9	1054.0	439.5	602.5	305.8	68.1	10.7	25.8	7997.7
1995	5.0	307.3	1640.6	2870.2	1143.1	156.2	150.0	211.2	15.5	31.2	5.0	6535.2
1996	0.0	106.0	1139.4	4098.2	1294.8	268.9	45.9	6.4	18.3	0.0	0.0	6977.9
1997	0.0	140.5	996.7	1319.7	2539.4	333.5	42.4	29.6	4.3	11.7	2.1	5420.0
1998	0.0	124.0	813.5	1527.2	614.4	759.0	132.4	43.3	6.9	16.4	7.4	4044.5
1999	0.0	4.3	332.5	442.2	300.1	92.4	163.4	23.6	0.0	20.2	0.0	1378.8
2000	0.0	170.4	643.2	1828.0	565.7	401.0	70.7	47.0	0.0	0.0	0.0	3726.1
2001	0.0	84.8	1204.6	1087.3	1034.1	432.2	286.9	49.8	81.6	11.4	8.8	4281.6
2002	0.0	2.1	296.1	1456.6	715.8	645.6	291.6	104.2	38.1	44.5	6.3	3601.0
2003	0.0	12.7	116.2	652.5	1645.5	663.8	389.1	175.7	97.1	56.6	42.4	3851.8
2004	0.0	0.8	396.8	477.5	933.3	1024.0	387.7	258.3	170.7	100.3	27.2	3776.5
2005	0.0	2.2	86.5	1318.6	289.9	838.1	529.5	173.8	136.5	73.4	77.2	3525.7
2006	0.0	2.4	291.4	627.3	1163.6	106.6	358.4	223.6	102.0	76.0	78.6	3029.9
2007	0.0	10.4	251.5	2083.1	401.6	902.0	39.4	115.8	77.9	46.6	65.3	3993.5

Table 5b. Mean weights (kg) and mean lengths (cm) at age in the commercial landings of Gulf of Maine cod, 1982 - 2007.

Total Commercial Landings Mean Weight (kg) at Age

Year	1	2	3	4	5	6	7	8	9	10	11+	Average
1982	0.801	1.156	1.664	2.764	4.770	6.739	8.944	9.931	12.922	10.618	18.456	2.654
1983		1.164	1.660	2.475	3.778	5.962	5.808	10.522	10.089	10.898	17.813	2.544
1984	0.589	1.159	1.670	2.721	3.677	5.898	8.119	9.595	12.889	13.951	15.028	2.731
1985		1.260	1.746	2.840	4.466	5.525	7.901	11.218	11.420	13.386	14.523	2.861
1986		1.304	1.837	2.923	4.619	6.067	7.669	10.030	12.463	12.907	16.554	2.698
1987	1.028	1.313	1.684	3.283	4.831	6.824	8.878	10.023	13.752	14.738	14.596	3.212
1988		1.268	1.881	2.426	5.166	6.767	9.932	11.126	14.960	15.763	20.356	2.622
1989		1.247	1.776	2.993	3.864	4.872	9.267	11.938	14.806	18.196	21.521	2.626
1990		1.071	1.692	2.271	4.265	7.645	10.734	11.758	15.015	14.784	20.295	2.366
1991		1.130	1.568	2.512	4.136	7.309	9.642	12.322	15.547	24.328	21.885	2.731
1992		1.533	1.922	2.714	3.061	5.000	9.566	12.462	13.449	16.631		2.999
1993		1.293	1.889	2.513	4.356	6.174	9.999	13.869	17.544			2.933
1994		1.401	1.882	3.034	3.452	6.324	7.159	10.464	10.362	18.542	20.637	2.915
1995	0.274	1.388	1.854	2.774	5.138	5.837	10.760	11.510	18.893	20.064	20.347	2.675
1996		1.543	2.220	2.350	3.543	7.347	10.406	14.126	14.929	0.000	0.000	2.551
1997		1.777	2.242	3.090	3.171	4.880	8.409	11.560	14.726	15.814	21.874	2.964
1998		1.323	2.055	2.879	4.204	4.321	5.254	11.391	18.893	14.953	20.347	2.947
1999		1.483	1.809	2.511	3.691	5.712	7.311	10.081		13.402		2.837
2000		1.673	2.513	3.646	4.637	5.813	6.394	8.580				3.488
2001		1.843	2.491	3.365	4.880	6.359	7.451	8.733	8.789	12.414	24.418	3.605
2002		1.348	2.569	3.320	4.152	6.066	6.792	8.618	9.589	10.482	14.333	4.013
2003		1.810	2.415	3.179	4.183	5.343	7.247	8.480	10.295	11.771	12.638	4.426
2004		1.483	2.550	3.588	4.138	5.742	7.167	9.329	11.688	12.822	12.914	4.723
2005		1.876	2.185	3.018	4.467	4.622	6.226	7.736	10.355	13.331	14.098	4.120
2006		2.394	2.430	3.271	3.790	4.789	5.453	7.284	9.245	11.974	15.718	3.980
2007		1.945	2.493	3.241	3.961	4.827	6.243	6.839	9.625	11.369	14.255	3.703

Total Commercial Landings Mean Length (cm) at Age

Year	1	2	3	4	5	6	7	8	9	10	11+	Average
1982	43.2	48.3	53.8	63.4	76.8	86.1	94.6	97.9	107.4	101.0	120.7	59.9
1983		48.6	53.8	61.4	70.8	82.4	80.5	98.8	97.5	100.0	118.7	59.8
1984	39.0	48.4	54.1	63.4	69.7	81.8	91.5	96.7	106.9	109.6	112.0	61.6
1985		49.8	55.1	64.6	74.9	80.3	90.8	101.9	103.1	108.2	109.7	62.8
1986		50.3	55.9	65.0	75.4	82.6	89.9	98.7	105.8	107.5	116.2	61.6
1987	47.0	50.4	54.4	67.8	76.9	86.5	93.8	98.7	109.5	111.7	111.3	65.4
1988		50.1	56.4	61.1	78.7	86.4	98.6	102.3	113.0	114.8	125.0	61.4
1989		49.8	55.5	65.7	71.5	76.7	95.8	103.4	112.6	120.4	126.8	61.7
1990		47.5	54.8	60.0	73.7	90.0	100.9	104.0	111.8	112.6	124.6	59.2
1991		47.7	52.6	61.8	72.6	88.6	97.2	105.0	113.3	132.5	128.0	62.2
1992		53.1	56.6	62.9	65.6	77.0	97.3	106.1	109.1	117.0		64.3
1993		50.5	56.8	61.7	74.2	83.7	98.6	110.0	119.1			63.5
1994		51.8	56.6	65.8	68.3	83.3	86.8	98.3	100.0	121.2	125.5	63.8
1995	30.4	50.5	56.2	63.7	78.7	78.1	101.1	102.7	122.0	124.4	125.0	61.6
1996		52.8	59.6	60.4	68.6	88.6	100.0	110.8	112.6			61.6
1997		55.4	59.8	66.0	66.3	76.2	92.3	102.9	112.1	115.0	128.0	64.7
1998		50.7	58.1	64.4	73.0	73.3	75.8	101.9	122.0	113.0	125.0	64.1
1999		53.0	55.8	62.0	69.2	78.6	87.6	99.3		109.0		62.9
2000		54.6	61.7	70.1	76.1	82.3	84.3	93.9				68.4
2001		56.1	62.0	68.1	77.4	84.6	89.2	93.6	94.1	106.2	132.4	68.8
2002		51.3	62.5	68.0	72.9	83.2	86.1	93.5	96.9	99.3	110.0	71.5
2003		56.3	61.5	67.0	73.2	79.5	88.2	92.7	98.7	103.5	106.3	73.8
2004		53.0	62.7	70.1	73.1	81.4	87.8	96.1	103.7	107.1	106.4	75.2
2005		57.0	59.7	66.1	75.2	75.9	83.3	89.8	99.2	108.1	109.8	71.9
2006		62.0	61.7	67.9	71.0	76.3	79.7	87.1	94.7	103.6	113.8	71.2
2007		57.8	62.3	67.9	72.1	77.0	83.7	86.0	96.7	102.6	110.0	70.2

Table 6. Discard estimates (mt) and associated variance (coefficient of variation) by gear type for Gulf of Maine cod, 1989-2007, with a comparison of estimates presented in the 2005 assessment.

Year	Number of Trips	Otter Trawl	Shrimp Trawl	Gillnet	Total	d/k ratio	CV	2005 est.
1989	190	746.6	242.1	169.0	1157.8	0.111	32.3%	1545.0
1990	185	2505.6	349.0	238.0	3092.5	0.204	37.0%	3598.0
1991	935	774.6	94.9	143.4	1012.9	0.057	28.1%	1049.0
1992	1038	546.9	15.0	98.7	660.7	0.061	17.9%	603.0
1993	664	335.0	0.0	86.0	421.0	0.051	26.2%	329.0
1994	171	74.1	63.4	80.4	217.8	0.027	18.8%	239.0
1995	202	121.0	0.0	186.5	307.4	0.047	22.5%	426.0
1996	140	58.9	0.0	123.7	182.6	0.026	20.7%	199.0
1997	59	12.6	0.0	91.0	103.7	0.019	56.5%	179.0
1998	85	16.6		80.3	96.9	0.024	37.8%	154.0
1999	108	1170.3		1453.8	2624.2	1.902	25.1%	2630.0
2000	202	718.1		280.3	998.5	0.268	17.7%	1170.0
2001	192	667.6	0.0	708.6	1376.2	0.322	18.8%	1621.0
2002	311	943.1		594.9	1538.0	0.427	16.2%	1950.0
2003	608	930.3	0.0	293.8	1224.1	0.318	19.4%	1486.0
2004	1175	301.5	0.0	168.0	469.5	0.124	21.1%	575.0
2005	1262	157.0	0.0	112.1	269.0	0.076	9.5%	
2006	384	324.9	0.0	129.2	454.1	0.150	34.9%	
2007	381	327.3	0.0	188.4	515.7	0.129	12.8%	

Table 7. Commercial discards of Gulf of Maine cod at age (numbers in 000's, weight in mt), 1982 - 2007.

	Total Commercial Discards in Numbers (000's) at Age							Revised Discards 1999+				
Year	1	2	3	4	5	6	7	8	9	10	11+	Total
1999	0.0	5.5	349.5	334.9	154.6	30.7	42.5	4.5	0.0	2.9	0.0	925.1
2000	0.0	27.3	68.6	134.5	32.7	18.5	3.0	1.5	0.0	0.0	0.0	286.1
2001	0.0	14.8	155.5	103.9	68.1	21.9	12.4	1.8	3.0	0.3	0.1	381.7
2002	0.0	0.7	49.2	187.2	73.6	45.4	18.3	5.2	1.7	1.8	0.2	383.3
2003	0.0	2.2	15.3	65.2	125.0	39.5	17.1	6.6	3.0	1.5	1.1	276.5
2004	0.0	0.1	19.4	16.6	28.1	22.2	6.7	3.4	1.8	1.0	0.3	99.5
2005	0.0	0.1	3.0	33.3	5.0	13.8	6.5	1.7	1.0	0.4	0.4	65.3
2006	0.0	0.2	18.0	28.8	46.0	3.3	9.9	4.6	1.7	1.0	0.7	114.1
2007	0.0	0.7	13.0	83.0	13.1	24.1	0.8	2.2	1.0	0.5	0.6	139.1
	Total Commercial Discards in Weight (Tons) at Age											
Year	1	2	3	4	5	6	7	8	9	10	11+	Total
1999	0.0	8.2	632.3	840.9	570.6	175.6	310.8	44.9	0.0	38.4	0.0	2626.1
2000	0.0	45.7	172.5	490.3	151.7	107.6	19.0	12.6	0.0	0.0	0.0	992.5
2001	0.0	27.3	387.3	349.6	332.4	139.0	92.2	16.0	26.2	3.7	2.8	1375.0
2002	0.0	0.9	126.4	621.6	305.5	275.5	124.5	44.5	16.2	19.0	2.7	1541.1
2003	0.0	4.0	36.9	207.4	523.0	211.0	123.7	55.8	30.9	18.0	13.5	1223.0
2004	0.0	0.1	49.4	59.4	116.2	127.5	48.3	32.2	21.2	12.5	3.4	468.9
2005	0.0	0.2	6.6	100.6	22.1	64.0	40.4	13.3	10.4	5.6	5.9	268.3
2006	0.0	0.4	43.7	94.1	174.5	16.0	53.7	33.5	15.3	11.4	11.8	452.0
2007	0.0	1.3	32.5	268.9	51.9	116.4	5.1	14.9	10.1	6.0	8.4	510.4

Table 8. Total catch of Atlantic cod taken from the Gulf of Maine stock by the recreational fishery, 1981-2007.

Year	Total Number (000s) a,b1,b2	Total Weight (mt) a,b1,b2	Retained Number (000s) a, b1	Retained Weight (mt) a, b1	Number of Fish Measured	Weight (mt) Retained per Fish Measured
1981	2841.9	4523.3	2650.0	4218.0	380	11.10
1982	1943.9	3412.6	1849.2	3246.4	267	12.16
1983	1488.2	2110.3	1257.8	1783.7	712	2.51
1984	1107.5	1728.3	910.8	1421.3	430	3.31
1985	1833.5	2348.9	1633.9	2093.2	233	8.98
1986	1111.6	2059.8	990.1	1834.6	62	29.59
1987	2597.8	4308.1	2031.1	3368.3	120	28.07
1988	1448.7	2626.7	1272.3	2306.9	212	10.88
1989	1775.1	3763.5	1203.0	2550.5	326	7.82
1990	1727.1	3659.6	1254.5	2658.1	74	35.92
1991	1788.2	3711.7	1377.8	2859.9	59	48.47
1992	560.7	1097.4	321.6	629.5	679	0.93
1993	1517.8	2762.8	766.6	1395.3	120	11.63
1994	1272.2	2333.4	542.6	995.2	477	2.09
1995	1192.3	2116.8	509.6	904.8	928	0.98
1996	801.4	1816.3	350.6	794.6	959	0.83
1997	440.0	1060.0	139.8	336.7	458	0.74
1998	577.3	1585.3	194.3	533.5	508	1.05
1999	724.7	2338.6	248.9	803.2	117	6.86
2000	1443.8	4306.8	522.8	1559.5	89	17.52
2001	2330.3	6079.1	1018.3	2656.5	68	39.07
2002	1640.6	5050.7	551.4	1697.6	70	24.25
2003	1721.0	7095.2	613.0	2527.1	300	8.42
2004	1427.6	4897.2	531.9	1824.5	493	3.70
2005	1859.0	6237.5	584.2	1960.3	530	3.70
2006	932.4	3561.1	249.7	953.6	410	2.33
2007	1337.1	4470.4	307.0	1026.5	533	1.93

Table 9a. Recreational landings of Gulf of Maine cod at age (numbers in 000's, weight in mt), 1982 - 2007.

	Total Recreational Landings in Numbers (000's) at Age						Revised Recr Catch 1982+					
Year	1	2	3	4	5	6	7	8	9	10	11+	Total
1982	41.4	600.9	787.3	279.1	114.1	8.1	6.7	4.6	0.0	0.0	0.0	1842.1
1983	11.3	458.4	560.6	131.0	49.2	30.6	3.0	4.4	2.2	2.8	4.4	1258.0
1984	20.7	355.5	341.5	136.5	33.1	13.6	4.4	0.3	0.0	0.6	1.4	907.9
1985	44.3	657.5	742.8	146.1	37.5	5.2	0.5	0.1	0.0	0.0	0.0	1634.0
1986	12.8	102.0	592.8	116.6	27.0	22.9	6.7	6.2	15.6	4.0	51.5	958.1
1987	94.3	673.6	726.0	396.8	69.4	25.5	32.7	4.9	5.6	2.3	0.0	2031.0
1988	2.4	389.1	685.0	164.1	22.8	6.3	2.2	0.9	0.0	0.0	0.0	1273.0
1989	3.8	182.5	697.6	261.7	39.0	11.8	6.2	0.4	0.0	0.0	0.0	1203.0
1990	0.0	48.6	700.6	391.9	93.3	19.6	0.0	0.0	0.0	0.0	0.0	1254.0
1991	0.0	94.5	407.1	749.7	79.6	15.8	5.8	0.0	1.9	0.3	0.0	1354.6
1992	0.0	25.3	57.1	47.9	170.4	17.1	3.3	0.4	0.0	0.0	0.0	321.5
1993	0.0	51.8	544.8	142.0	10.4	16.8	1.2	0.0	0.0	0.0	0.0	767.0
1994	0.9	16.5	393.7	102.9	25.5	1.5	1.5	0.2	0.2	0.0	0.0	543.0
1995	0.0	55.7	285.0	157.3	10.1	1.8	0.0	0.1	0.0	0.0	0.0	510.0
1996	0.0	21.3	117.5	192.8	18.9	0.3	0.0	0.1	0.1	0.0	0.0	351.0
1997	0.0	6.4	50.6	28.4	51.5	3.1	0.0	0.0	0.0	0.0	0.0	140.0
1998	0.0	13.7	86.5	64.4	12.5	15.7	1.0	0.1	0.0	0.0	0.0	194.0
1999	1.2	13.6	113.8	57.0	36.8	11.1	14.4	1.1	0.0	0.0	0.0	249.0
2000	0.0	71.9	209.4	192.5	35.6	11.4	2.1	0.1	0.0	0.0	0.0	523.0
2001	0.0	86.4	544.4	258.5	98.0	19.3	8.9	1.4	1.1	0.0	0.0	1018.0
2002	0.0	0.8	95.0	258.4	100.0	51.7	19.7	18.2	3.8	3.3	0.0	551.0
2003	0.0	7.2	55.2	172.4	247.7	67.6	32.5	12.6	9.3	3.5	3.0	611.0
2004	0.0	0.3	182.8	100.2	155.9	65.5	13.8	5.8	2.9	2.5	1.1	530.9
2005	0.0	6.2	91.5	343.5	25.4	70.1	29.4	8.4	5.0	2.2	2.4	584.0
2006	0.0	0.4	39.5	60.8	96.2	6.9	21.6	12.7	5.5	3.5	3.0	250.0
2007	0.0	1.9	41.0	181.8	25.9	42.9	1.4	4.2	3.5	2.1	2.4	307.0

	Total Recreational Landings in Weight (Tons) at Age											
Year	1	2	3	4	5	6	7	8	9	10	11+	Total
1982	22.0	606.2	1201.4	676.2	505.6	46.1	40.8	32.4	0.0	0.0	0.0	3130.7
1983	5.1	397.6	784.6	282.4	168.0	208.9	17.7	36.9	23.6	49.8	81.8	2056.4
1984	9.5	301.8	480.7	335.8	113.6	61.0	30.0	2.0	0.3	10.9	25.9	1371.3
1985	20.6	545.9	980.3	339.7	113.2	17.6	1.9	0.7	0.0	0.0	0.0	2019.9
1986	5.1	98.7	976.0	307.8	108.2	131.5	75.5	84.1	229.7	55.0	1032.8	3104.4
1987	17.8	563.6	1041.5	1073.2	326.2	203.9	341.9	51.7	64.0	24.7	0.0	3708.5
1988	0.8	326.1	982.5	345.3	88.6	23.3	14.9	6.6	0.0	0.0	0.0	1788.0
1989	2.6	202.7	1117.2	683.1	138.8	74.7	48.9	3.7	0.0	0.0	0.0	2271.7
1990	0.0	55.4	1160.4	961.2	357.4	107.9	0.0	0.0	0.0	0.0	0.0	2642.3
1991	0.0	130.2	604.6	1491.7	207.6	133.3	54.8	0.0	18.3	1.0	0.0	2641.5
1992	0.0	45.8	125.9	145.3	566.3	82.5	25.8	1.0	0.0	0.0	0.0	992.6
1993	0.0	53.0	891.4	266.6	27.9	70.5	11.3	0.0	0.0	0.0	0.0	1320.6
1994	0.1	22.2	630.1	224.4	53.2	6.6	12.9	2.1	1.5	0.0	0.0	953.2
1995	0.0	84.8	461.8	302.7	31.4	3.3	0.0	0.3	0.0	0.0	0.0	884.2
1996	0.0	32.9	212.4	376.4	45.0	2.4	0.5	1.0	1.5	0.0	0.0	672.3
1997	0.0	11.0	100.9	67.6	123.1	8.6	0.1	0.0	0.0	0.0	0.0	311.3
1998	0.0	23.6	186.2	165.5	41.7	49.3	3.4	0.4	0.0	0.0	0.0	470.2
1999	0.4	17.1	222.8	173.9	177.2	67.1	96.4	9.4	0.0	0.0	0.0	764.3
2000	0.0	109.4	404.0	517.4	126.2	56.0	7.1	0.5	0.0	0.0	0.0	1220.5
2001	0.0	148.3	1233.4	752.6	422.1	115.8	55.3	8.6	7.4	0.0	0.0	2743.6
2002	0.0	1.1	215.3	813.0	371.6	276.9	126.7	259.8	42.4	36.8	0.0	2143.5
2003	0.0	15.0	132.5	494.6	894.4	348.9	263.9	117.6	107.5	46.7	41.5	2462.5
2004	0.0	0.5	391.3	268.7	444.2	247.5	78.1	56.7	35.6	33.8	15.4	1571.6
2005	0.0	9.4	183.0	886.5	98.0	294.1	184.4	68.0	53.0	29.8	35.8	1841.9
2006	0.0	0.9	95.0	195.8	347.4	34.7	123.6	108.4	58.1	43.6	46.8	1054.2
2007	0.0	4.3	107.2	572.0	97.8	198.6	9.9	34.3	39.4	25.9	34.4	1123.9

Table 9b. Mean weights (kg) and mean lengths (cm) at age in the recreational catch of Gulf of Maine cod, 1982 - 2007.

Total Recreational Landings Mean Weight (kg) at Age

Year	1	2	3	4	5	6	7	8	9	10	11+	Average
1982	0.531	1.009	1.526	2.423	4.431	5.686	6.100	7.050	10.522	12.655	16.456	1.700
1983	0.446	0.867	1.399	2.156	3.412	6.831	5.913	8.331	10.808	17.726	18.784	1.635
1984	0.459	0.849	1.408	2.460	3.428	4.476	6.755	6.618	5.621	16.868	17.991	1.510
1985	0.466	0.830	1.320	2.326	3.021	3.370	3.798	4.458	10.522	12.655	16.456	1.236
1986	0.399	0.968	1.646	2.641	4.014	5.740	11.181	13.651	14.756	13.780	20.055	3.240
1987	0.189	0.837	1.435	2.705	4.704	8.009	10.456	10.559	11.344	10.943	16.456	1.826
1988	0.318	0.838	1.434	2.104	3.881	3.669	6.773	7.109	10.522	12.655	16.456	1.405
1989	0.680	1.111	1.601	2.610	3.555	6.351	7.837	9.095	10.522	12.655	16.456	1.888
1990	0.421	1.141	1.656	2.453	3.830	5.508	7.176	8.160	10.522	12.655	16.456	2.107
1991	0.421	1.378	1.485	1.990	2.609	8.450	9.387	8.160	9.387	3.468	16.456	1.950
1992	0.421	1.810	2.205	3.030	3.323	4.827	7.781	2.515	10.522	12.655	16.456	3.087
1993	0.421	1.023	1.636	1.877	2.681	4.207	9.685	8.160	10.522	12.655	16.456	1.722
1994	0.131	1.342	1.601	2.182	2.086	4.300	8.623	8.476	9.095	12.655	16.456	1.755
1995	0.482	1.523	1.620	1.924	3.120	1.798	7.176	5.833	10.522	12.655	16.456	1.734
1996	0.582	1.542	1.808	1.952	2.387	8.127	12.664	12.664	12.664	12.655	16.456	1.915
1997	0.421	1.733	1.992	2.381	2.388	2.806	6.275	6.501	10.522	12.655	16.456	2.224
1998	0.456	1.718	2.151	2.570	3.332	3.140	3.288	6.735	10.522	12.655	16.456	2.423
1999	0.334	1.253	1.958	3.048	4.820	6.032	6.706	8.851	10.522	12.655	16.456	3.070
2000	0.421	1.521	1.929	2.688	3.543	4.898	3.419	4.826	10.522	12.655	16.456	2.334
2001	0.421	1.716	2.266	2.912	4.308	6.000	6.211	6.261	6.966	12.655	16.456	2.695
2002	0.421	1.381	2.265	3.147	3.716	5.357	6.422	14.256	11.036	10.987	16.456	3.890
2003	0.421	2.083	2.402	2.869	3.611	5.159	8.120	9.367	11.555	13.161	13.712	4.031
2004	0.421	1.459	2.140	2.681	2.849	3.780	5.664	9.757	12.265	13.369	14.001	2.960
2005	0.421	1.523	1.990	2.574	3.857	4.187	6.270	8.120	10.685	13.692	15.088	3.154
2006	0.421	2.053	2.409	3.222	3.610	5.054	5.727	8.514	10.601	12.556	15.562	4.217
2007	0.421	2.292	2.617	3.146	3.776	4.634	6.958	8.142	11.376	12.503	14.439	3.661

Total Recreational Landings Mean Length (cm) at Age

Year	1	2	3	4	5	6	7	8	9	10	11+	Average
1982	36.3	44.8	51.5	60.1	74.4	81.0	83.7	88.7	99.4	104.6	115.5	52.0
1983	34.5	42.8	50.2	57.9	67.4	85.4	80.6	91.6	99.2	118.0	121.0	50.4
1984	34.4	42.3	50.1	60.1	67.4	72.6	84.3	85.6	83.0	116.1	119.4	49.5
1985	35.0	42.0	48.9	59.9	65.5	68.7	72.0	77.0	99.4	104.6	115.5	47.2
1986	34.0	44.3	53.2	62.0	71.5	81.2	101.6	108.7	111.9	110.0	124.1	59.9
1987	25.9	41.8	50.4	62.9	75.2	90.0	99.4	99.6	102.8	101.0	115.5	51.3
1988	32.0	42.4	50.5	57.7	70.1	67.1	85.2	86.6	99.4	104.6	115.5	49.4
1989	40.0	46.6	52.7	61.9	68.3	84.3	91.8	95.0	99.4	104.6	115.5	54.8
1990	33.7	47.3	53.3	60.9	71.0	81.1	86.3	90.3	99.4	104.6	115.5	57.2
1991	33.7	50.6	51.6	56.9	61.6	93.2	98.0	90.3	98.0	71.0	115.5	55.8
1992	33.7	54.9	58.1	64.6	66.7	75.6	89.7	62.0	99.4	104.6	115.5	64.6
1993	33.7	45.2	53.3	55.8	61.8	69.0	98.0	90.3	99.4	104.6	115.5	53.7
1994	23.6	49.3	52.9	58.1	57.4	70.9	93.4	93.0	95.0	104.6	115.5	54.2
1995	36.0	52.1	53.1	55.9	65.5	54.6	86.3	83.0	99.4	104.6	115.5	54.1
1996	38.0	52.3	55.0	56.4	60.0	89.9	107.0	107.0	107.0	104.6	115.5	56.0
1997	33.7	54.5	57.0	60.1	60.0	62.8	85.0	86.0	99.4	104.6	115.5	58.8
1998	35.0	54.2	58.4	61.7	66.9	65.3	67.2	86.0	99.4	104.6	115.5	60.3
1999	33.0	47.9	56.4	65.0	75.6	81.5	84.9	94.0	99.4	104.6	115.5	63.6
2000	33.7	52.1	56.1	62.3	68.2	76.3	67.1	77.0	99.4	104.6	115.5	59.1
2001	33.7	54.1	59.2	64.0	73.6	82.6	83.2	84.0	87.8	104.6	115.5	62.1
2002	33.7	51.1	59.2	66.1	69.6	79.0	83.6	108.7	101.2	101.0	115.5	69.2
2003	33.7	58.0	60.6	64.0	68.5	76.9	90.4	95.1	102.4	107.0	108.9	70.0
2004	33.7	51.6	58.5	62.9	63.9	69.2	78.7	97.0	105.2	108.4	109.9	63.8
2005	33.7	51.6	57.0	61.8	70.4	72.1	81.8	89.9	99.9	108.5	112.1	64.7
2006	33.7	57.2	60.6	66.6	68.9	76.1	79.3	90.4	98.7	105.0	113.4	70.9
2007	33.7	60.1	62.6	66.4	70.0	74.7	85.7	90.5	102.2	105.9	111.1	68.8

Table 10. Components (commercial landings, commercial discard and recreational landings) of the total catch of Gulf of Maine cod expressed as a percentage of the sum of certain components (when estimated), 1960-2007.

	Components of the Gulf of Maine Cod Catch (percentages)			
Year	Commercial Landings/ Total Catch	Recreational Landings/ Total Catch	Discards/ Commercial Land&Disc	Recreational/ Commercial& Recreational
1960	n/a	n/a	n/a	n/a
1961	n/a	n/a	n/a	n/a
1962	n/a	n/a	n/a	n/a
1963	n/a	n/a	n/a	n/a
1964	n/a	n/a	n/a	n/a
1965	n/a	n/a	n/a	n/a
1966	n/a	n/a	n/a	n/a
1967	n/a	n/a	n/a	n/a
1968	n/a	n/a	n/a	n/a
1969	n/a	n/a	n/a	n/a
1970	n/a	n/a	n/a	n/a
1971	n/a	n/a	n/a	n/a
1972	n/a	n/a	n/a	n/a
1973	n/a	n/a	n/a	n/a
1974	n/a	n/a	n/a	n/a
1975	n/a	n/a	n/a	n/a
1976	n/a	n/a	n/a	n/a
1977	n/a	n/a	n/a	n/a
1978	n/a	n/a	n/a	n/a
1979	n/a	n/a	n/a	n/a
1980	n/a	n/a	n/a	n/a
1981	74.8	25.2	n/a	25.2
1982	80.7	19.3	n/a	19.3
1983	88.7	11.3	n/a	11.3
1984	88.4	11.6	n/a	11.6
1985	83.6	16.4	n/a	16.4
1986	84.0	16.0	n/a	16.0
1987	69.1	30.9	n/a	30.9
1988	77.5	22.5	n/a	22.5
1989	73.7	18.1	10.0	19.7
1990	72.5	12.7	16.9	14.9
1991	82.1	13.2	5.4	13.9
1992	89.4	5.2	5.7	5.5
1993	82.0	13.8	4.8	14.4
1994	86.8	10.8	2.7	11.1
1995	84.4	11.7	4.5	12.2
1996	87.7	10.0	2.6	10.2
1997	92.5	5.7	1.9	5.8
1998	86.5	11.4	2.3	11.7
1999	28.7	16.7	65.5	36.8
2000	59.3	24.8	21.2	29.5
2001	51.5	32.0	24.3	38.3
2002	52.7	24.8	29.9	32.0
2003	50.7	33.2	24.1	39.6
2004	62.2	30.1	11.1	32.6
2005	61.3	34.1	7.1	35.7
2006	68.3	21.5	13.0	24.0
2007	72.1	18.6	11.4	20.5

Table 11a. Total catch of Gulf of Maine cod at age (numbers in 000's, weight in mt), 1982 - 2007.

	Total Catch in Numbers (000's) at Age							Revised CAA 1982+				
Year	1	2	3	4	5	6	7	8	9	10	11+	Total
1982	71.4	1980.9	2420.3	1422.1	747.1	77.1	97.7	65.6	41.0	4.0	33.0	6960.1
1983	11.3	1324.4	2917.6	1189.0	687.2	452.6	50.0	65.4	25.2	11.8	19.4	6754.0
1984	24.7	801.5	1581.5	1636.5	470.1	207.6	78.4	19.3	15.0	11.6	18.4	4864.9
1985	44.3	1064.5	2187.8	1137.1	667.5	133.2	78.5	32.1	4.0	11.0	11.0	5371.0
1986	12.8	186.0	2756.8	929.6	277.0	199.9	45.7	30.2	35.6	8.0	59.5	4541.1
1987	96.3	889.6	1321.0	1505.8	346.4	91.5	83.7	13.9	13.6	10.3	3.0	4375.0
1988	2.4	549.1	2128.0	1117.1	428.8	49.3	11.2	17.9	1.0	2.0	1.0	4308.0
1989	3.8	519.5	2280.6	1715.7	488.0	92.8	41.2	6.4	3.0	5.0	7.0	5163.0
1990	0.0	253.6	4125.6	2455.9	523.3	176.6	27.0	30.0	10.0	15.0	17.0	7634.0
1991	0.0	438.5	1341.1	4910.7	930.6	158.8	46.8	30.0	7.9	1.3	1.0	7866.6
1992	0.0	338.3	587.1	531.9	2188.4	219.1	65.3	7.4	12.0	3.0	0.0	3952.5
1993	0.0	127.8	2031.8	783.0	139.4	473.8	29.2	6.0	2.0	0.0	0.0	3592.0
1994	0.9	54.0	1488.2	1216.6	330.9	71.0	85.7	29.5	6.7	0.6	1.2	3285.3
1995	18.1	277.0	1169.9	1192.0	232.5	28.6	13.9	18.4	0.8	1.6	0.2	2953.2
1996	0.0	90.0	630.7	1936.7	384.3	36.9	4.5	0.5	1.3	0.0	0.0	3085.0
1997	0.0	85.4	495.2	455.5	852.4	71.4	5.0	2.6	0.3	0.7	0.1	1968.6
1998	0.0	107.5	482.4	594.8	158.7	191.4	26.2	3.9	0.4	1.1	0.4	1566.7
1999	1.2	22.1	647.2	568.0	272.6	58.0	79.2	7.9	0.0	4.4	0.0	1660.7
2000	0.0	201.1	534.0	828.3	190.3	98.9	16.1	7.1	0.0	0.0	0.0	1875.8
2001	0.0	147.2	1183.5	685.5	378.0	109.1	59.8	8.9	13.3	1.2	0.5	2587.1
2002	0.0	3.0	259.5	884.3	346.0	203.5	81.0	35.5	9.5	9.4	0.6	1832.4
2003	0.0	16.4	118.6	442.9	766.1	231.4	103.3	39.9	21.7	9.9	7.4	1757.5
2004	0.0	0.9	357.8	249.9	409.6	266.0	74.6	36.9	19.3	11.3	3.5	1429.8
2005	0.0	7.5	134.1	813.8	95.2	265.3	120.9	32.5	19.2	8.1	8.3	1504.9
2006	0.0	1.6	177.4	281.3	449.3	32.5	97.2	48.0	18.2	10.8	8.8	1124.9
2007	0.0	7.9	154.8	907.5	140.4	253.8	8.5	23.3	12.6	6.7	7.5	1523.3

	Total Catch in Weight (Tons) at Age											
Year	1	2	3	4	5	6	7	8	9	10	11+	Total
1982	46.0	2201.2	3918.4	3836.2	3524.6	507.1	853.8	640.4	531.0	41.0	613.0	16712.7
1983	5.1	1406.6	4697.6	2901.4	2578.0	2726.9	288.7	679.9	250.6	151.8	350.8	16037.4
1984	12.5	817.8	2551.7	4415.8	1720.6	1206.0	633.0	188.0	193.3	162.9	275.9	12187.3
1985	20.6	1058.9	3503.3	3155.7	2927.2	722.6	616.9	363.7	51.0	141.0	152.0	12712.9
1986	5.1	208.7	4952.0	2682.8	1261.2	1203.5	371.5	327.1	482.7	109.0	1164.8	12768.4
1987	19.8	846.6	2042.5	4714.2	1666.2	654.9	796.9	139.7	180.0	134.7	40.0	11235.5
1988	0.8	529.1	3697.5	2656.3	2185.6	318.3	99.9	197.6	11.0	36.0	14.0	9746.0
1989	2.6	622.7	3928.2	5034.1	1875.8	399.7	371.9	70.7	43.0	87.0	163.0	12668.7
1990	0.0	274.4	6954.4	5648.2	2191.4	1307.9	290.0	354.0	153.0	214.0	350.0	17737.3
1991	0.0	518.2	2067.6	11946.7	3727.6	1178.3	453.8	369.0	111.3	33.0	17.0	20422.5
1992	0.0	525.8	1144.9	1458.3	6741.3	1093.5	619.8	89.0	161.0	49.0	0.0	11883.6
1993	0.0	152.0	3700.4	1877.6	588.9	2889.5	292.3	79.0	27.0	0.0	0.0	9606.6
1994	0.1	74.7	2690.0	3603.4	1107.2	446.1	615.4	307.9	69.6	10.7	25.8	8950.9
1995	5.0	392.0	2102.4	3172.9	1174.5	159.5	150.0	211.5	15.5	31.2	5.0	7419.3
1996	0.0	138.9	1351.8	4474.6	1339.8	271.3	46.4	7.4	19.8	0.0	0.0	7650.1
1997	0.0	151.5	1097.5	1387.3	2662.5	342.1	42.4	29.7	4.3	11.7	2.1	5731.3
1998	0.0	147.6	999.7	1692.7	656.2	808.3	135.8	43.7	6.9	16.4	7.4	4514.7
1999	0.4	29.6	1187.7	1457.0	1047.8	335.1	570.6	78.0	0.0	58.6	0.0	4769.2
2000	0.0	325.4	1219.7	2835.7	843.7	564.7	96.7	60.1	0.0	0.0	0.0	5939.0
2001	0.0	260.3	2825.3	2189.5	1788.6	687.0	434.5	74.5	115.3	15.0	11.7	8400.2
2002	0.0	4.1	637.8	2891.3	1392.9	1198.0	542.8	408.5	96.7	100.3	8.9	7285.6
2003	0.0	31.7	285.7	1354.5	3062.8	1223.8	776.7	349.1	235.5	121.3	97.4	7537.3
2004	0.0	1.3	837.4	805.6	1493.6	1398.9	514.1	347.1	227.5	146.6	46.0	5817.0
2005	0.0	11.8	276.1	2305.7	410.0	1196.1	754.4	255.0	199.9	108.7	118.9	5635.9
2006	0.0	3.6	430.1	917.2	1685.5	157.2	535.7	365.6	175.4	131.0	137.1	4536.1
2007	0.0	16.1	391.1	2924.0	551.3	1217.0	54.4	165.1	127.4	78.5	108.1	5627.8

Table 11b. Mean weights (kg) and mean lengths (cm) at age in the total catch of Gulf of Maine cod, 1982 - 2007.

Year	Total Catch Mean Weight (kg) at Age 1	2	3	4	5	6	7	8	9	10	11+	Average
1982	0.644	1.111	1.619	2.698	4.718	6.577	8.740	9.763	12.951	10.250	18.576	2.401
1983	0.446	1.062	1.610	2.440	3.751	6.025	5.775	10.391	9.951	12.855	18.125	2.375
1984	0.506	1.020	1.613	2.698	3.660	5.808	8.070	9.741	12.845	13.987	14.962	2.505
1985	0.466	0.995	1.601	2.775	4.385	5.424	7.859	11.312	12.750	12.818	13.818	2.367
1986	0.399	1.122	1.796	2.886	4.554	6.020	8.120	10.845	13.572	13.640	19.578	2.812
1987	0.206	0.952	1.546	3.131	4.811	7.161	9.521	10.053	13.195	13.132	13.333	2.568
1988	0.318	0.964	1.738	2.378	5.097	6.450	8.919	11.022	11.000	18.000	14.000	2.262
1989	0.680	1.199	1.722	2.934	3.844	4.309	9.018	11.034	14.333	17.400	23.286	2.454
1990	0.416	1.082	1.686	2.300	4.187	7.407	10.741	11.800	15.300	14.267	20.588	2.323
1991	0.416	1.182	1.542	2.433	4.006	7.421	9.689	12.300	14.003	25.672	17.000	2.596
1992	0.416	1.554	1.950	2.741	3.080	4.991	9.489	12.027	13.417	16.333	17.576	3.007
1993	0.416	1.189	1.821	2.398	4.225	6.099	10.022	13.167	13.500	14.785	17.576	2.674
1994	0.132	1.383	1.808	2.962	3.347	6.280	7.185	10.448	10.331	18.542	20.637	2.725
1995	0.274	1.415	1.797	2.662	5.051	5.578	10.760	11.492	18.893	20.064	20.347	2.512
1996	0.588	1.543	2.143	2.310	3.486	7.353	10.426	13.912	14.724	14.785	17.576	2.480
1997	0.416	1.774	2.216	3.046	3.124	4.791	8.405	11.547	14.726	15.814	21.874	2.911
1998	0.417	1.373	2.072	2.846	4.135	4.224	5.177	11.313	18.893	14.953	20.347	2.882
1999	0.334	1.341	1.835	2.565	3.843	5.773	7.201	9.915	12.870	13.402	17.576	2.872
2000	0.416	1.619	2.284	3.423	4.432	5.707	6.013	8.521	12.870	14.785	17.576	3.166
2001	0.416	1.768	2.387	3.194	4.732	6.296	7.266	8.351	8.643	12.414	24.418	3.247
2002	0.416	1.357	2.458	3.269	4.026	5.886	6.702	11.514	10.174	10.662	14.333	3.976
2003	0.416	1.929	2.409	3.058	3.998	5.289	7.522	8.760	10.834	12.269	13.074	4.289
2004	0.416	1.474	2.340	3.224	3.647	5.259	6.889	9.396	11.775	12.944	13.260	4.068
2005	0.416	1.574	2.058	2.833	4.307	4.509	6.239	7.835	10.440	13.428	14.382	3.745
2006	0.416	2.303	2.425	3.261	3.751	4.845	5.514	7.610	9.654	12.162	15.664	4.033
2007	0.416	2.027	2.526	3.222	3.927	4.794	6.362	7.075	10.106	11.721	14.314	3.695

Year	Total Catch Mean Length (cm) at Age 1	2	3	4	5	6	7	8	9	10	11+	Average
1982	39.2	47.2	53.0	62.8	76.4	85.6	93.9	97.3	107.4	101.0	120.7	57.8
1983	34.5	46.6	53.1	61.0	70.6	82.6	80.5	98.3	97.6	104.3	119.2	58.0
1984	35.2	45.7	53.2	63.1	69.5	81.2	91.1	96.5	106.8	110.0	112.6	59.3
1985	35.0	45.0	53.0	64.0	74.4	79.8	90.7	101.8	103.1	108.2	109.7	58.1
1986	34.0	47.0	55.3	64.6	75.0	82.4	91.6	100.7	108.4	108.7	123.0	61.3
1987	26.3	43.9	52.2	66.5	76.6	87.5	96.0	99.0	106.7	109.3	111.3	58.9
1988	32.0	44.6	54.5	60.6	78.2	83.9	96.0	101.5	113.0	114.8	125.0	57.9
1989	40.0	48.7	54.6	65.1	71.2	77.7	95.2	102.9	112.6	120.4	126.8	60.1
1990	33.6	47.5	54.5	60.1	73.2	89.0	100.9	104.0	111.8	112.6	124.6	58.9
1991	33.6	48.3	52.3	61.0	71.7	89.1	97.3	105.0	109.6	118.9	128.0	61.1
1992	33.6	53.2	56.7	63.1	65.7	76.9	96.9	103.7	109.1	117.0	119.3	64.3
1993	33.6	48.4	55.9	60.6	73.3	83.2	98.6	110.0	119.1	110.9	119.3	61.4
1994	23.6	51.0	55.6	65.1	67.4	83.0	86.9	98.3	99.9	121.2	125.5	62.2
1995	30.4	50.8	55.4	62.6	78.1	76.5	101.1	102.6	122.0	124.4	125.0	60.3
1996	38.0	52.7	58.8	60.0	68.2	88.6	100.1	110.2	112.1	110.9	119.3	61.0
1997	33.6	55.3	59.5	65.6	65.9	75.6	92.3	102.9	112.1	115.0	128.0	64.2
1998	35.0	51.1	58.2	64.1	72.6	72.6	75.5	101.6	122.0	113.0	125.0	63.6
1999	33.0	49.8	55.9	62.3	70.1	79.1	87.1	98.6	107.2	109.0	119.3	63.0
2000	33.6	53.7	59.5	68.3	74.6	81.6	82.1	93.6	107.2	110.9	119.3	65.8
2001	33.6	54.9	60.7	66.6	76.4	84.2	88.3	92.1	93.6	106.2	132.4	66.2
2002	33.6	51.3	61.3	67.5	71.9	82.1	85.4	101.3	98.6	99.9	110.0	70.8
2003	33.6	57.0	61.1	65.8	71.7	78.7	88.9	93.4	100.3	104.7	107.4	72.5
2004	33.6	52.5	60.5	67.2	69.6	78.4	86.1	96.3	103.9	107.4	107.5	70.9
2005	33.6	52.5	57.8	64.3	73.9	74.9	83.0	89.8	99.4	108.2	110.5	69.1
2006	33.6	60.7	61.5	67.6	70.6	76.3	79.6	87.9	95.9	104.0	113.7	71.1
2007	33.6	58.3	62.4	67.6	71.7	76.6	84.1	86.8	98.2	103.6	110.3	69.9

Table 12. Stock mean weights (kg) at age for Gulf of Maine cod, calculated as beginning year means of the total catch mean weights at age using methods described by Rivard (1980, 1982).

	Beginning Year Stock Mean Weight (kg) at Age										
Year	1	2	3	4	5	6	7	8	9	10	11+
1982	0.502	0.923	1.319	2.288	4.175	7.019	8.016	9.670	12.999	11.522	18.576
1983	0.295	0.827	1.337	1.988	3.181	5.332	6.163	9.530	9.857	12.903	18.125
1984	0.361	0.675	1.309	2.084	2.988	4.668	6.973	7.500	11.553	11.798	14.962
1985	0.300	0.710	1.278	2.116	3.440	4.456	6.756	9.555	11.144	12.832	13.818
1986	0.258	0.723	1.337	2.150	3.555	5.138	6.637	9.232	12.391	13.188	19.578
1987	0.095	0.616	1.317	2.371	3.726	5.711	7.571	9.035	11.962	13.350	13.333
1988	0.164	0.446	1.286	1.917	3.995	5.571	7.992	10.244	10.516	15.411	14.000
1989	0.539	0.618	1.288	2.258	3.023	4.687	7.627	9.920	12.569	13.835	23.286
1990	0.247	0.858	1.422	1.990	3.505	5.336	6.803	10.316	12.993	14.300	20.588
1991	0.215	0.701	1.292	2.025	3.035	5.574	8.472	11.494	12.854	19.819	17.000
1992	0.246	0.804	1.518	2.056	2.738	4.472	8.392	10.795	12.846	15.123	17.576
1993	0.228	0.703	1.682	2.162	3.403	4.334	7.073	11.178	12.742	14.084	17.576
1994	0.040	0.759	1.466	2.323	2.833	5.151	6.620	10.233	11.663	15.821	20.637
1995	0.116	0.432	1.577	2.194	3.868	4.321	8.220	9.087	14.050	14.397	20.347
1996	0.339	0.650	1.741	2.037	3.046	6.094	7.626	12.235	13.008	16.713	17.576
1997	0.229	1.021	1.849	2.555	2.686	4.087	7.861	10.972	14.313	15.259	21.874
1998	0.233	0.756	1.917	2.511	3.549	3.633	4.980	9.751	14.770	14.839	20.347
1999	0.152	0.748	1.587	2.305	3.307	4.886	5.515	7.165	12.066	15.912	17.576
2000	0.202	0.735	1.750	2.506	3.372	4.683	5.892	7.833	11.296	13.794	17.576
2001	0.230	0.858	1.966	2.701	4.025	5.282	6.440	7.086	8.582	12.640	24.418
2002	0.193	0.751	2.085	2.793	3.586	5.278	6.496	9.147	9.218	9.600	14.333
2003	0.221	0.896	1.808	2.742	3.615	4.615	6.654	7.662	11.169	11.173	13.074
2004	0.214	0.783	2.125	2.787	3.340	4.585	6.036	8.407	10.156	11.842	13.260
2005	0.177	0.809	1.742	2.575	3.726	4.055	5.728	7.347	9.904	12.574	14.382
2006	0.189	0.979	1.954	2.591	3.260	4.568	4.986	6.891	8.697	11.268	15.664
2007	0.189	0.918	2.412	2.795	3.579	4.241	5.552	6.246	8.770	10.637	14.314
2008	0.185	0.902	2.036	2.654	3.522	4.288	5.422	6.828	9.124	11.493	14.787
Avg All	0.235	0.763	1.644	2.351	3.410	4.891	6.759	9.087	11.526	13.560	17.355
Avg 03-07	0.198	0.877	2.008	2.698	3.504	4.413	5.791	7.310	9.739	11.499	14.139

Table 13. Standardized [a,b,c,d] stratified mean catch per tow in numbers and weight (kg) for Atlantic cod from NEFSC offshore (> 27 m) spring and autumn research vessel bottom trawl surveys in the Gulf of Maine (NEFSC strata 01260-01300 and 01360-01400), 1963 - 2008.

	Spring Indices				Autumn Indices			
Year	Mean No. Per Tow	Coeff. Of Variation	Mean Wgt Per Tow	Coeff. Of Variation	Mean No. Per Tow	Coeff. Of Variation	Mean Wgt Per Tow	Coeff. Of Variation
1963	Survey Commenced in 1968				5.914	32.0	17.950	41.3
1964	Survey Commenced in 1968				4.015	44.7	22.799	53.6
1965	Survey Commenced in 1968				4.500	31.8	12.005	30.9
1966	Survey Commenced in 1968				3.784	23.4	12.916	25.8
1967	Survey Commenced in 1968				2.560	25.8	9.225	24.6
1968	5.583	17.3	18.195	17.8	4.374	20.4	19.437	21.7
1969	3.247	36.0	13.194	36.3	2.758	16.9	15.368	24.6
1970	2.191	25.9	11.077	28.5	4.905	34.7	16.442	26.5
1971	1.429	21.0	6.996	24.1	4.361	22.3	16.527	33.5
1972	2.057	23.4	8.029	25.4	9.301	57.9	12.988	23.0
1973	7.525	37.8	18.807	45.2	4.452	17.3	8.758	30.2
1974	2.902	21.1	7.418	21.7	4.328	28.1	8.959	22.1
1975	2.512	25.2	6.039	28.5	6.143	22.8	8.619	16.2
1976	2.782	19.6	7.556	17.8	2.148	21.9	6.740	24.4
1977	3.872	27.2	8.541	23.0	3.073	13.5	10.199	13.2
1978	2.050	20.8	7.697	23.0	5.773	19.8	12.899	16.3
1979	3.993	28.4	8.363	22.2	3.142	11.6	13.927	13.3
1980	2.154	19.8	6.232	20.3	7.034	29.0	14.202	16.7
1981	4.831	22.3	10.650	22.9	2.349	25.7	7.533	25.8
1982	3.763	24.6	8.616	24.8	7.768	70.5	15.919	74.6
1983	3.912	28.8	10.962	24.6	2.786	19.7	8.416	21.3
1984	3.667	52.7	6.143	37.6	2.449	24.4	8.735	35.4
1985	2.517	22.5	7.645	23.6	2.821	19.9	8.264	40.4
1986	1.957	35.1	3.476	22.4	1.950	26.0	4.715	26.1
1987	1.083	31.0	1.976	36.2	2.996	33.9	3.394	26.0
1988	3.127	24.0	3.603	30.2	5.903	38.1	6.616	26.3
1989	2.112	20.8	2.424	22.8	4.553	25.7	4.535	19.8
1990	2.362	26.9	3.076	29.2	2.986	21.7	4.912	22.5
1991	2.393	28.2	2.891	27.1	1.252	27.7	2.781	28.1
1992	2.435	34.0	8.626	41.1	1.433	24.2	2.448	28.4
1993	2.507	25.2	5.875	36.4	1.232	29.6	1.002	29.4
1994	1.271	25.2	2.427	23.7	2.130	35.4	2.737	32.5
1995	1.930	30.0	2.431	29.4	2.008	31.6	3.665	34.9
1996	2.465	28.5	5.427	32.0	1.327	28.7	2.351	29.3
1997	2.192	18.4	5.615	21.4	0.872	33.9	1.872	32.6
1998	1.710	37.1	4.180	34.6	0.843	37.8	1.500	30.7
1999	2.301	27.0	5.089	35.5	1.807	19.2	3.505	20.6
2000	3.083	24.4	3.211	17.9	2.604	34.1	4.652	37.6
2001	2.147	35.5	6.216	34.6	1.980	28.5	7.325	31.2
2002	3.724	22.1	10.933	24.1	5.328	72.1	24.659	84.3
2003	3.677	25.1	9.495	45.2	2.529	34.3	5.993	27.6
2004	0.981	27.0	2.414	31.6	3.533	36.3	4.905	24.4
2005	1.765	27.1	2.700	27.6	1.338	7.6	2.897	25.6
2006	1.363	21.6	2.702	27.8	3.594	33.6	4.229	20.4
2007	12.393	73.0	15.811	61.4	1.992	42.1	2.714	31.2
2008	6.811	78.5	9.386	66.3				

[a] Indices in all years have been recalculated and may differ slightly from those reported previously(e.g., Mayo *et al.* 2002) due to a better accounting of vessel effects in years when Albatross IV and Delaware II were used to conduct a portion of the same survey (e.g. 1979 and 1987).

[b] Spring surveys during 1973-1981 were conducted with a '41 Yankee' trawl; in all other years, spring surveys were conducted with a '36 Yankee' trawl. No adjustments have been made to the catch per tow data for these differences.

[c] During 1963-1984, BMV oval doors were used in the spring and autumn surveys; since 1985, Portuguese polyvalent doors have been used in both surveys. Adjustments have been made to the 1963-1984 catch per tow data to standardize these data to polyvalent door equivalents. Conversion coefficients of 1.56 (numbers) and 1.62 (weight) were used in the standardization (NEFSC 1991).

[d] In the Gulf of Maine, spring and autumn surveys were conducted primarily by R/V ALBATROSS IV. During several periods since 1979, however, surveys were conducted either entirely or in part by R/V DELAWARE II. Adjustments have been made to the R/V DELAWARE II catch per tow data to standardize these to R/V ALBATROSS IV equivalents. Conversion coefficients of 0.79 (number) and 0.67 (weight) were used in the standardization (NEFSC 1991)

Table 14. Stratified mean catch per tow in numbers and weight (kg) for Atlantic cod from Massachusetts DMF inshore bottom trawl surveys, 1978-2007 (regions 4 and 5, strata 28-36) [a].

	Spring		Autumn	
Year	Mean No. per Tow	Mean Wt. (kg) per Tow	Mean No. per Tow	Mean Wt. (kg) per Tow
1978	47.89	11.05	156.06	1.51
1979	96.56	14.28	8.92	1.05
1980	65.98	14.51	12.53	1.28
1981	69.41	18.69	9.29	3.64
1982	25.84	12.16	6.12	0.66
1983	54.85	18.75	1.68	0.09
1984	10.33	7.24	10.55	0.13
1985	8.46	4.77	2.87	0.07
1986	24.09	7.84	2.75	0.25
1987	17.21	7.87	313.15	0.35
1988	22.24	7.70	8.87	0.37
1989	52.24	16.82	4.15	0.22
1990	32.41	15.88	12.71	0.76
1991	13.70	8.73	7.48	0.48
1992	16.92	8.77	27.50	0.27
1993	92.66	5.86	51.50	1.35
1994	15.96	3.89	49.00	2.00
1995	23.36	3.99	4.66	0.81
1996	12.96	3.15	7.01	0.08
1997	17.89	2.50	1.46	0.01
1998	27.57	3.25	4.33	0.36
1999	161.06	9.00	8.01	0.31
2000	50.77	20.60	0.68	0.27
2001	41.84	26.45	49.55	0.76
2002	24.34	11.16	3.30	3.99
2003	1120.37	10.98	122.28	1.85
2004	131.59	8.15	57.62	5.58
2005	193.26	10.40	40.35	0.21
2006	1077.03	9.18	7.50	1.94
2007	61.58	8.43	7.92	2.94

[a] Indices in all years have been recalculated based on revised strata boundaries, and may differ slightly from those reported previously (e.g., Mayo and Col. 2006).

Table 15. Female maturity ogives estimated from external inspection of ovaries on NEFSC spring bottom trawl surveys.

AGE	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
1	0.11	0.07	0.01	0.01	0.07	0.03	0.04	0.07	0.30	0.10
2	0.32	0.26	0.21	0.36	0.59	0.39	0.42	0.35	0.51	0.26
3	0.64	0.61	0.85	0.96	0.97	0.93	0.92	0.81	0.72	0.53
4	0.87	0.88	0.99	1	1	1	0.99	0.97	0.86	0.79
5	0.96	0.97	1	1	1	1	1	1	0.94	0.92
6	0.99	0.99	1	1	1	1	1	1	0.97	0.97
7	1	1	1	1	1	1	1	1	0.99	0.99
8	1	1	1	1	1	1	1	1	1	1
9	1	1	1	1	1	1	1	1	1	1
10	1	1	1	1	1	1	1	1	1	1
11	1	1	1	1	1	1	1	1	1	1

AGE	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
1	0.06	0.06	0.01	0.00	0.03	0.01	0.06	0.09	0.14	0.09
2	0.19	0.22	0.19	0.15	0.33	0.16	0.36	0.34	0.39	0.28
3	0.47	0.57	0.82	0.93	0.90	0.79	0.82	0.72	0.71	0.61
4	0.78	0.87	0.99	1	0.99	0.99	0.97	0.93	0.91	0.86
5	0.93	0.97	1	1	1	1	1	0.98	0.97	0.96
6	0.98	0.99	1	1	1	1	1	1	0.99	0.99
7	0.99	1	1	1	1	1	1	1	1	1
8	1	1	1	1	1	1	1	1	1	1
9	1	1	1	1	1	1	1	1	1	1
10	1	1	1	1	1	1	1	1	1	1
11	1	1	1	1	1	1	1	1	1	1

AGE	2002	2003	2004	2005	2006	2007
1	0.19	0.15	0.13	0.03	0.12	0.08
2	0.41	0.38	0.30	0.11	0.32	0.34
3	0.68	0.67	0.55	0.34	0.63	0.76
4	0.86	0.87	0.77	0.69	0.86	0.95
5	0.95	0.96	0.90	0.90	0.96	0.99
6	0.98	0.99	0.96	0.98	0.99	1
7	0.99	1	0.99	0.99	1	1
8	1	1	1	1	1	1
9	1	1	1	1	1	1
10	1	1	1	1	1	1
11	1	1	1	1	1	1

Table 16a. January 1 population numbers (000s) of Gulf of Maine cod derived by virtual population analysis (VPA), 1982 – 2008.

AGE	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
1	7857	7929	10674	6679	10260	12744	24612	4254	4135	6975
2	11123	6368	6481	8717	5428	8388	10347	20148	3480	3386
3	5520	7314	4015	4581	6174	4276	6063	7974	16026	2620
4	3128	2329	3348	1856	1771	2560	2306	3038	4465	9388
5	1767	1274	831	1261	491	609	734	877	935	1434
6	226	771	421	255	428	151	185	213	276	292
7	260	116	222	157	88	170	41	107	90	66
8	140	124	49	111	58	31	63	24	50	49
9	71	55	42	23	62	20	13	35	14	14
10	10	21	22	21	15	18	4	10	26	2
11	79	35	36	21	113	5	2	13	30	2
Total	30180	26336	26143	23683	24888	28973	44369	36694	29528	24228

AGE	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
1	6340	9123	3180	3805	3545	5245	4458	7847	4016	1187
2	5711	5191	7469	2603	3099	2902	4294	3650	6424	3288
3	2375	4369	4134	6066	1880	2455	2299	3419	2969	5077
4	931	1414	1739	2038	3908	969	1562	1446	2213	1947
5	3243	281	449	323	590	1447	381	741	670	1063
6	332	675	104	68	54	135	414	168	360	376
7	96	73	124	21	30	11	46	166	85	205
8	12	19	34	24	5	20	4	14	64	55
9	13	3	10	1	3	3	14	0	4	46
10	4	0	1	2	0	1	2	11	0	4
11	0	0	2	0	0	0	1	0	0	2
Total	19057	21148	17245	14951	13113	13190	13477	17462	16805	13250

AGE	2002	2003	2004	2005	2006	2007	2008
1	4953	1681	10966	6713	23910	4808	6105
2	972	4055	1377	8979	5496	19576	3937
3	2559	793	3305	1126	7344	4498	16020
4	3086	1860	542	2382	801	5852	3543
5	974	1726	1122	218	1214	401	3970
6	528	484	720	548	92	587	201
7	209	248	187	349	209	46	251
8	114	98	110	86	176	83	30
9	37	61	44	56	41	101	47
10	25	22	30	19	29	17	71
11	2	16	9	19	23	21	19
Total	13459	11046	18414	20495	39336	35992	34196

1. 2008 age 1 numbers is the geometric mean of 1982-2007 age 1 recruits

Table 16b. Instantaneous fishing mortality for Gulf of Maine cod derived by virtual population analysis (VPA), 1982 – 2007.

AGE	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
1	0.0101	0.0016	0.0026	0.0074	0.0014	0.0084	0.0001	0.0010	0	0
2	0.2192	0.2612	0.1470	0.1450	0.0386	0.1247	0.0604	0.0289	0.0840	0.1545
3	0.6628	0.5814	0.5714	0.7503	0.6802	0.4177	0.4909	0.3799	0.3348	0.8343
4	0.6981	0.8305	0.7769	1.1299	0.8676	1.0499	0.7667	0.9783	0.9361	0.8630
5	0.6295	0.9064	0.9811	0.8800	0.9766	0.9906	1.0384	0.9547	0.9634	1.2635
6	0.4723	1.0461	0.7862	0.8605	0.7259	1.1023	0.3485	0.6584	1.2250	0.9179
7	0.5377	0.6505	0.4954	0.8028	0.8481	0.7884	0.3576	0.5545	0.4021	1.5057
8	0.7294	0.8727	0.5657	0.3866	0.8646	0.6852	0.3761	0.3568	1.0760	1.1140
9	1.0140	0.7010	0.4948	0.2139	1.0200	1.4099	0.0904	0.0981	1.7050	0.9720
10	0.6088	0.9342	0.8265	0.8317	0.8523	0.9568	0.7939	0.8422	0.9642	1.2033
11	0.6088	0.9342	0.8265	0.8317	0.8523	0.9568	0.7939	0.8422	0.9642	1.2033

AGE	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
1	0	0	0.0003	0.0053	0	0	0	0.0002	0	0
2	0.0677	0.0276	0.0080	0.1251	0.0326	0.0331	0.0281	0.0067	0.0352	0.0507
3	0.3191	0.7214	0.5072	0.2397	0.4631	0.2522	0.2638	0.2347	0.2216	0.2979
4	0.9977	0.9473	1.4838	1.0395	0.7934	0.7331	0.5461	0.5695	0.5337	0.4927
5	1.3696	0.7941	1.6866	1.5888	1.2721	1.0524	0.6167	0.5220	0.3769	0.4994
6	1.3085	1.4954	1.4035	0.6248	1.4090	0.8742	0.7161	0.4791	0.3620	0.3864
7	1.4079	0.5791	1.4467	1.3241	0.1825	0.7168	0.9838	0.7526	0.2337	0.3888
8	1.1311	0.4254	3.4380	1.9107	0.1292	0.1523	6.4333	0.9591	0.1311	0.1957
9	8.8324	1.1807	1.2844	6.1427	0.6870	0.1066	0.0314	0.2164	0.0002	0.3866
10	1.3641	1.1501	1.6321	1.3635	1.1851	1.0156	0.6873	0.5515	0.3465	0.4486
11	1.3641	1.1501	1.6321	1.3635	1.1851	1.0156	0.6873	0.5515	0.3465	0.4486

AGE	2002	2003	2004	2005	2006	2007
1	0	0	0	0	0	0
2	0.0034	0.0045	0.0007	0.0009	0.0003	0.0004
3	0.1189	0.1807	0.1274	0.1411	0.0271	0.0388
4	0.3808	0.3053	0.7125	0.4741	0.4914	0.1880
5	0.4985	0.6741	0.5164	0.6606	0.5260	0.4892
6	0.5550	0.7507	0.5245	0.7653	0.4948	0.6492
7	0.5582	0.6163	0.5806	0.4825	0.7225	0.2288
8	0.4224	0.5975	0.4648	0.5426	0.3577	0.3714
9	0.3310	0.4983	0.6597	0.4716	0.6789	0.1484
10	0.5163	0.6793	0.5218	0.6406	0.5272	0.4888
11	0.5163	0.6793	0.5218	0.6406	0.5272	0.4888

Table 16c. Spawning stock biomass (SSB, mt) of Gulf of Maine cod derived by virtual population analysis (VPA), 1982 – 2007.

AGE	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
1	419	158	37	19	179	35	156	155	296	145
2	3063	1268	866	2102	2226	1910	1854	4192	1452	582
3	4035	5238	3928	4797	6913	4725	6394	7555	15007	1509
4	5361	3431	5870	3147	3186	4929	3725	5469	6324	12582
5	6169	3270	2040	3621	1435	1861	2384	2187	2538	3137
6	1406	3307	1669	952	1885	696	941	864	1128	1311
7	1840	618	1377	898	492	1089	300	719	549	420
8	1160	989	326	959	446	241	587	213	420	456
9	755	469	437	239	622	182	128	424	128	148
10	96	226	223	229	168	200	52	111	310	32
11	1283	521	449	247	1854	58	24	262	506	21
Total	25587	19494	17223	17211	19406	15926	16546	22151	28657	20342

AGE	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
1	91	121	1	0	35	12	60	104	110	24
2	834	773	1040	160	640	456	1125	897	1771	757
3	1554	3593	4418	8266	2639	3326	3345	3634	3438	5603
4	1223	2196	3020	3637	6680	2098	3361	2727	4467	4030
5	6355	786	928	927	1406	3155	1180	2129	1990	3654
6	1131	2183	410	256	252	463	1290	735	1519	1784
7	607	456	623	133	213	73	189	779	468	1198
8	104	193	188	153	53	210	14	84	473	367
9	38	32	93	4	32	45	203	0	49	357
10	51	0	9	26	0	15	31	159	0	41
11	0	0	24	5	0	3	15	0	0	33
Total	11988	10334	10755	13566	11949	9856	10814	11246	14285	17848

AGE	2002	2003	2004	2005	2006	2007
1	176	54	295	34	523	70
2	289	1334	313	773	1665	5911
3	3440	902	3657	630	8704	7924
4	6729	4079	999	3782	1590	14568
5	2953	5179	2993	632	3366	1267
6	2408	1889	2810	1855	371	2162
7	1186	1441	982	1767	893	237
8	939	658	826	557	1108	471
9	314	608	389	500	307	836
10	217	211	319	204	288	161
11	21	185	111	239	326	271
Total	18673	16539	13693	10974	19139	33877

Table 17. Average fully recruited fishing mortality (F) for Gulf of Maine cod. The unweighted values in column 1 are used to indicate fishing mortality on this stock in each year.

	Average Fishing Mortality on Ages 5-7			
Year	Average F	N Weighted	Biomass Wtd	Catch Wtd
1982	0.5465	0.6031	0.5896	0.6066
1983	0.8677	0.9426	0.9506	0.9488
1984	0.7543	0.8523	0.7919	0.8772
1985	0.8478	0.8698	0.8641	0.8702
1986	0.8502	0.8588	0.8383	0.8695
1987	0.9605	0.9719	0.9537	0.9778
1988	0.5815	0.8761	0.8204	0.9533
1989	0.7225	0.8662	0.8154	0.8839
1990	0.8635	0.9800	0.9711	1.0061
1991	1.2290	1.2161	1.1983	1.2252
1992	1.3620	1.3651	1.3643	1.3652
1993	0.9562	1.2385	1.2349	1.3016
1994	1.5123	1.5992	1.5540	1.6032
1995	1.1792	1.4161	1.3970	1.4752
1996	0.9545	1.2348	1.1860	1.2724
1997	0.8811	1.0350	1.0243	1.0369
1998	0.7722	0.6858	0.6925	0.6928
1999	0.5846	0.5508	0.5638	0.5605
2000	0.3242	0.3611	0.3550	0.3645
2001	0.4249	0.4598	0.4506	0.4648
2002	0.5373	0.5233	0.5298	0.5244
2003	0.6804	0.6834	0.6816	0.6848
2004	0.5405	0.5252	0.5285	0.5256
2005	0.6362	0.6564	0.6361	0.6736
2006	0.5811	0.5512	0.5613	0.5572
2007	0.4557	0.5685	0.5686	0.5845

Table 18. VPA model diagnostics and stock size estimates from the NLLS solution for Gulf of Maine cod.

Levenburg-Marquardt Algorithm Completed 21 Iterations

```
Residual Sum of Squares =    279.707
Number of Residuals     =    508
Number of Parameters    =      9
Degrees of Freedom      =    499
Mean Squared Residual   =     0.560535
Standard Deviation      =     0.748689
Number of Years =    26
Number of Ages  =    11
First Year      =  1982
Youngest Age    =     1
Oldest True Age =    10
Number of Survey Indices Available        =    25
Number of Survey Indices Used in Estimate =    23
VPA Classic Method - Auto Estimated Q's
```

Stock Numbers Predicted in Terminal Year Plus One (2008)

Age	Stock Predicted	Std. Error	CV
2	3936.752	0.173583E+04	0.440929E+00
3	16020.398	0.499998E+04	0.312101E+00
4	3542.738	0.930299E+03	0.262593E+00
5	3970.448	0.103469E+04	0.260597E+00
6	201.340	0.776978E+02	0.385903E+00
7	251.280	0.110401E+03	0.439357E+00
8	29.920	0.163265E+02	0.545679E+00
9	46.873	0.324104E+02	0.691456E+00
10	71.277	0.516470E+02	0.724592E+00

Catchability Values for Each Survey Used in Estimate

INDEX No.	INDEX	Catchability	Std. Error	CV
1	S Age 2	0.639060E-04	0.988283E-05	0.154646E+00
2	S Age 3	0.131940E-03	0.141520E-04	0.107261E+00
3	S Age 4	0.225008E-03	0.228294E-04	0.101460E+00
4	S Age 5	0.293998E-03	0.386906E-04	0.131602E+00
5	S Age 6	0.382779E-03	0.641901E-04	0.167695E+00
6	S Age 7	0.566609E-03	0.109588E-03	0.193411E+00
7	S Age 8	0.511812E-03	0.139644E-03	0.272843E+00
8	A Age 2	0.533836E-04	0.687041E-05	0.128699E+00
9	A Age 3	0.113582E-03	0.128656E-04	0.113272E+00
10	A Age 4	0.223833E-03	0.225992E-04	0.100965E+00
11	A Age 5	0.370258E-03	0.463840E-04	0.125275E+00
12	A Age 6	0.478237E-03	0.565335E-04	0.118212E+00
13	A Age 7	0.451154E-03	0.836411E-04	0.185394E+00
14	A Age 8	0.566767E-03	0.129170E-03	0.227906E+00
15	S Age 2	0.710558E-03	0.107424E-03	0.151183E+00
16	S Age 3	0.544643E-03	0.474923E-04	0.871988E-01
17	S Age 4	0.453706E-03	0.562280E-04	0.123930E+00
19	A Age 2	0.122958E-03	0.367937E-04	0.299238E+00
21	C Age 2	0.245830E-05	0.690050E-06	0.280702E+00
22	C Age 3	0.140563E-04	0.164576E-05	0.117084E+00
23	C Age 4	0.231650E-04	0.128111E-05	0.553035E-01
24	C Age 5	0.229116E-04	0.123947E-05	0.540979E-01
25	C Age 6	0.218712E-04	0.246650E-05	0.112774E+00

Table 19a. Bootstrap estimates of precision and bias on 2008 N and 2007 F estimates at age from the Gulf of Maine cod VPA.

```
Bootstrap Summary Report
 Number of Bootstrap Repetitions Requested =  1000
 Number of Bootstrap Repetitions Completed =  1000
```

Bootstrap Output Variable: Stock Size Estimates (2008)

	NLLS Estimate	Bootstrap Mean	Bootstrap Std Error	C.V. For NLLS Soln.
N 2	3937.	4778.	3549.	0.7428
N 3	16020.	17071.	6345.	0.3717
N 4	3543.	3648.	986.	0.2703
N 5	3970.	4078.	1050.	0.2575
N 6	201.	214.	80.	0.3741
N 7	251.	270.	126.	0.4652
N 8	30.	34.	19.	0.5717
N 9	47.	56.	45.	0.7909
N 10	71.	86.	70.	0.8079

	Bias Estimate	Bias Std. Error	Per Cent Bias	NLLS Estimate Corrected For Bias	C.V. For Corrected Estimate
N 2	841.	115.	21.3697	3095.	1.1466
N 3	1050.	203.	6.5570	14970.	0.4239
N 4	105.	31.	2.9687	3438.	0.2868
N 5	107.	33.	2.6968	3863.	0.2718
N 6	13.	3.	6.5231	188.	0.4263
N 7	19.	4.	7.4963	232.	0.5406
N 8	4.	1.	13.6268	26.	0.7521
N 9	9.	1.	20.1704	37.	1.1906
N 10	15.	2.	21.1718	56.	1.2418

Bootstrap Output Variable: Fishing Mortality (2007)

	NLLS Estimate	Bootstrap Mean	Bootstrap Std Error	C.V. For NLLS Soln.
AGE 1	0.0000	0.0000	0.000000	0.7193
AGE 2	0.0004	0.0005	0.000180	0.3776
AGE 3	0.0388	0.0403	0.010717	0.2657
AGE 4	0.1880	0.1940	0.047462	0.2446
AGE 5	0.4892	0.5077	0.151260	0.2979
AGE 6	0.6492	0.7011	0.268324	0.3827
AGE 7	0.2288	0.2890	0.246963	0.8546
AGE 8	0.3714	0.5913	0.645212	1.0911
AGE 9	0.1484	0.3630	0.603834	1.6637
AGE 10	0.4888	0.5279	0.202048	0.3827
AGE 11	0.4888	0.5279	0.202048	0.3827

	Bias Estimate	Bias Std. Error	Per Cent Bias	NLLS Estimate Corrected For Bias	C.V. For Corrected Estimate
AGE 1	0.000000	0.000000	25.9547	0.0000	1.2235
AGE 2	0.000031	0.000006	6.9738	0.0004	0.4343
AGE 3	0.001556	0.000342	4.0140	0.0372	0.2880
AGE 4	0.006058	0.001513	3.2227	0.1819	0.2609
AGE 5	0.018527	0.004819	3.7875	0.4706	0.3214
AGE 6	0.051977	0.008643	8.0070	0.5972	0.4493
AGE 7	0.060197	0.008039	26.3126	0.1686	1.4650
AGE 8	0.219925	0.021557	59.2126	0.1515	4.2591
AGE 9	0.214574	0.020266	144.6129	-0.0662	-9.1219
AGE 10	0.039139	0.006508	8.0070	0.4497	0.4493
AGE 11	0.039139	0.006508	8.0070	0.4497	0.4493

Table 19b. Bootstrap estimates of precision and bias of 2007 average fully recruited fishing mortality and spawning stock biomass (SSB) from the Gulf of Maine cod VPA.

Bootstrap Output Variable: Average F (2007) AGES 5-7

	NLLS Estimate	Bootstrap Mean	Bootstrap Std Error	C.V. For NLLS Soln.
AVG F	0.4557	0.4993	0.136083	0.2726

	Bias Estimate	Bias Std. Error	Per Cent Bias	NLLS Estimate Corrected For Bias	C.V. For Corrected Estimate
AVG F	0.043567	0.004519	9.5605	0.4121	0.3302

	LOWER 80% CI	UPPER 80% CI
AVG F	0.355693	0.669985

Bootstrap Output Variable: Spawning Stock Biomass SSB (2007)

	NLLS Estimate	Bootstrap Mean	Bootstrap Std Error	C.V. For NLLS Soln.
SSB	33877.	35256.	5061.	0.1435

	Bias Estimate	Bias Std. Error	Per Cent Bias	NLLS Estimate Corrected For Bias	C.V. For Corrected Estimate
SSB	1379.	166.	4.0692	32499.	0.1557

	LOWER 80% CI	UPPER 80% CI
SSB	29133.	41747.

Table 20. Yield and SSB per recruit input data and results calculated according to the method of Thompson and Bell (1934) for the Gulf of Maine stock of Atlantic cod.

Yield and SSB per Recruit Input Data

Age	Partial Recruitment	Sel on M	Mean Wts Stock	Mean Wts Catch	Mean Wts Sp Stock	Maturity Ogive
1	0.000	1.00	0.198	0.416	0.198	0.077
2	0.002	1.00	0.877	1.862	0.877	0.272
3	0.162	1.00	2.008	2.352	2.008	0.627
4	0.682	1.00	2.698	3.120	2.698	0.883
5	0.900	1.00	3.504	3.926	3.504	0.971
6	1.000	1.00	4.413	4.939	4.413	0.993
7	0.826	1.00	5.791	6.505	5.791	0.999
8	0.733	1.00	7.310	8.135	7.310	1.000
9	0.772	1.00	9.739	10.562	9.739	1.000
10	0.753	1.00	11.499	12.505	11.499	1.000
11+	0.753	1.00	14.139	14.139	14.139	1.000

Yield and SSB per Recruit Results

	F	YpR	SSBpR	TBpR	Mean Age	Mean Gen	Exp Spws
F Zero	0.000	0.000	21.320	23.482	5.144	9.806	2.502
F0.1	0.233	1.475	8.638	10.607	3.541	7.144	1.589
Fmax	0.535	1.618	4.586	6.431	2.851	5.289	1.099
F40%	0.237	1.482	8.529	10.494	3.524	7.105	1.578

FIGURES

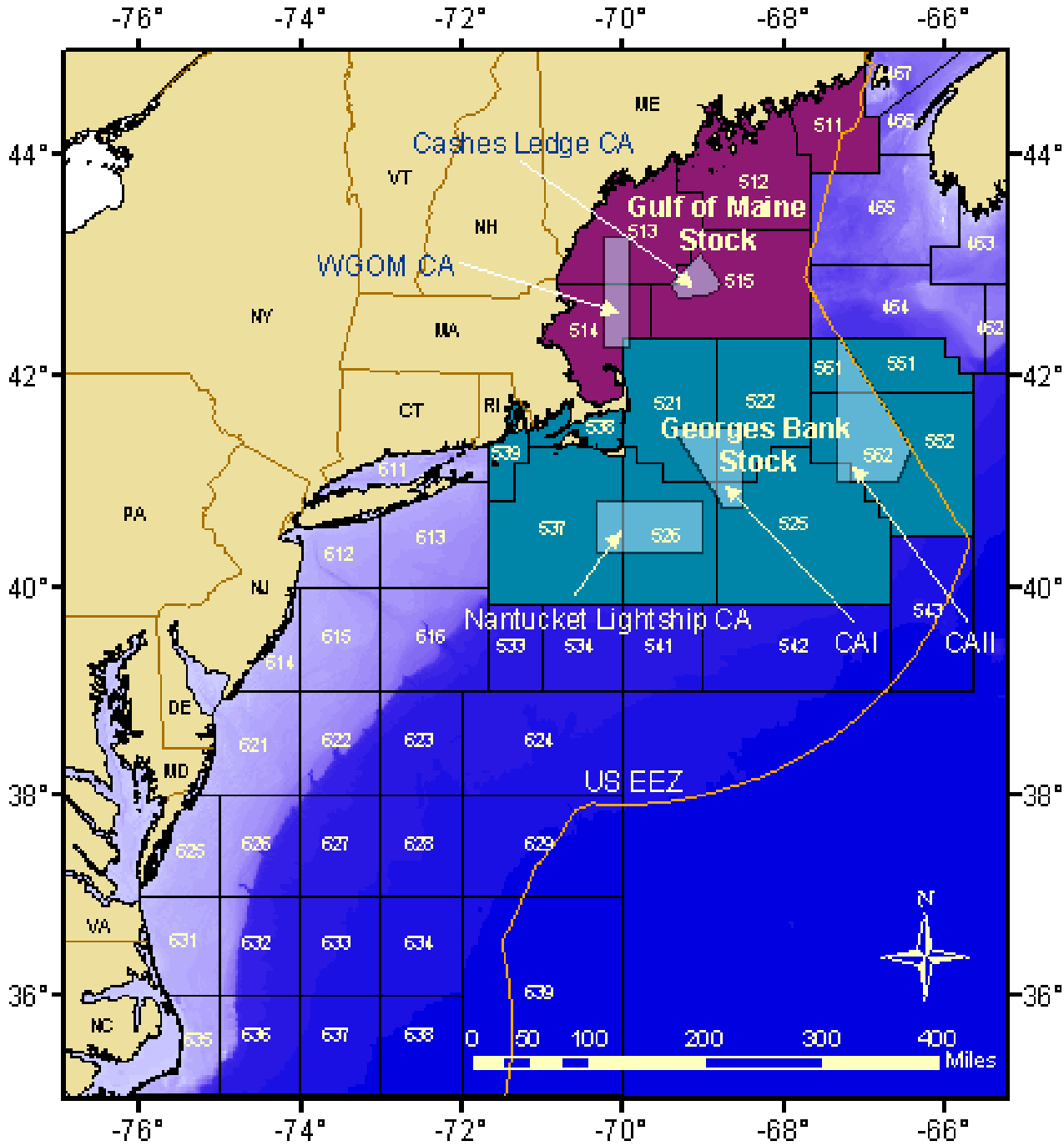


Figure 1.1. Statistical areas used to define the Gulf of Maine and Georges Bank cod stocks.

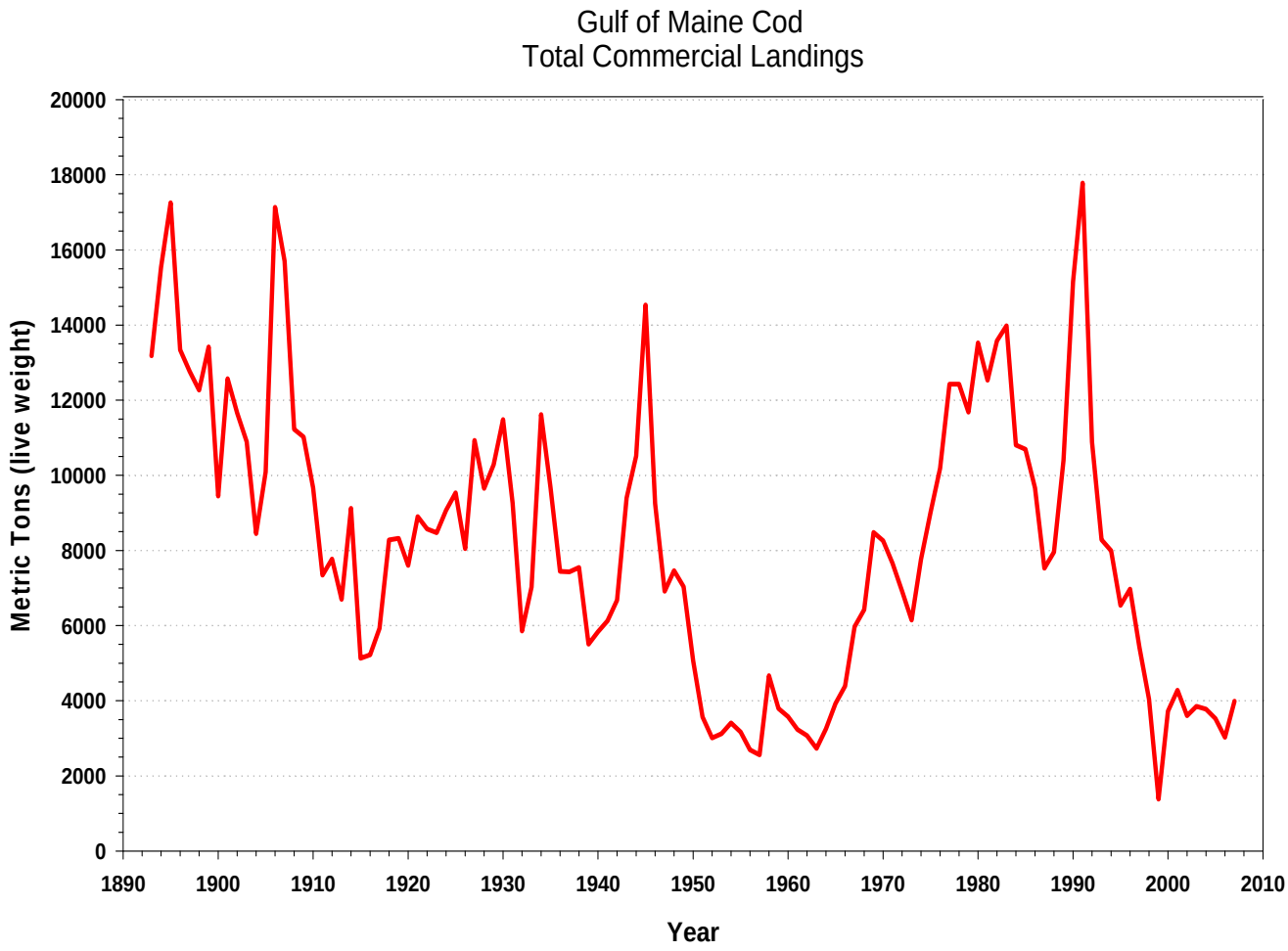


Figure 2. Total commercial landings (mt) of Atlantic cod from the Gulf of Maine stock, 1893-2007.

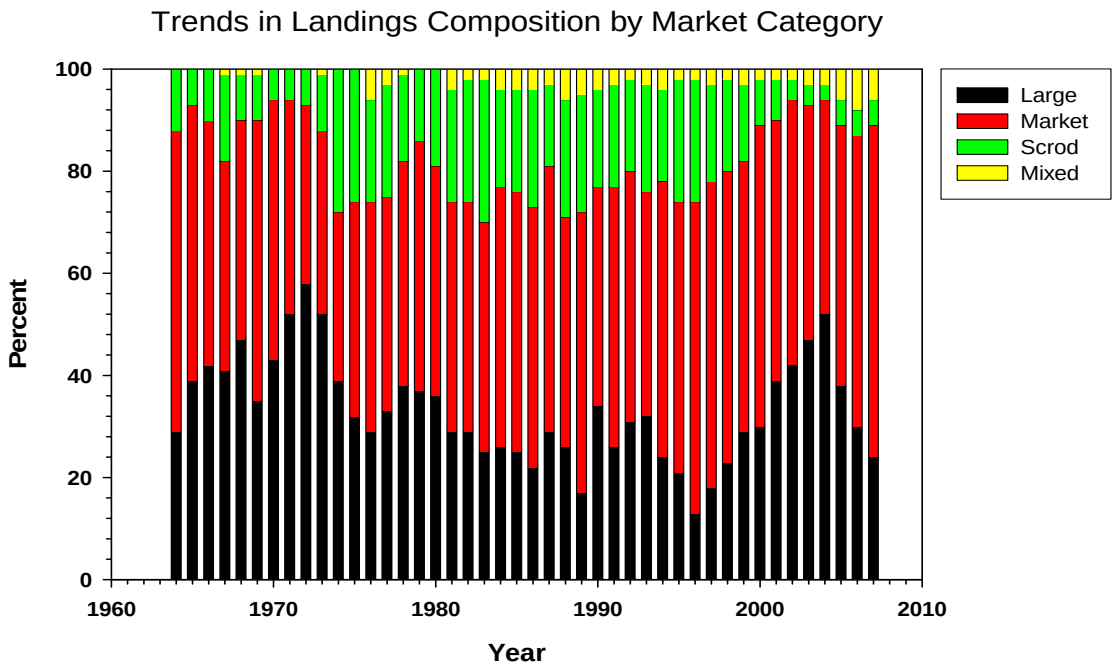


Figure 3. Changes in the composition of USA Gulf of Maine cod landings by market category, 1964 - 2007.

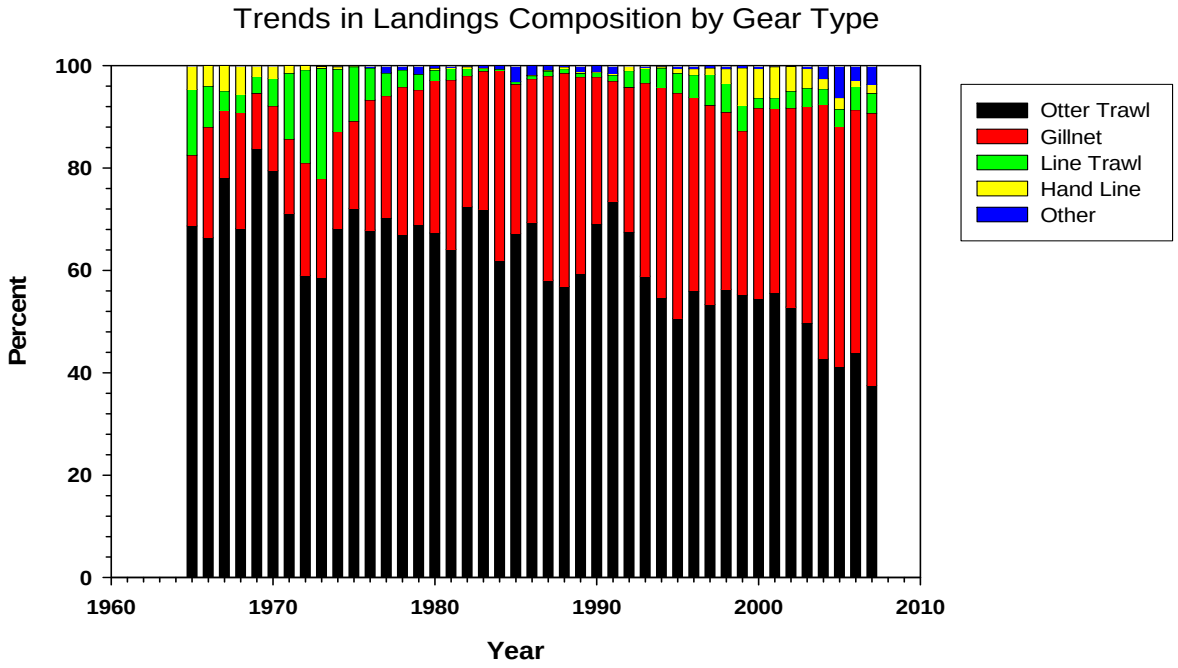


Figure 4. Changes in the composition of USA Gulf of Maine cod landings by gear type, 1965 - 2007.

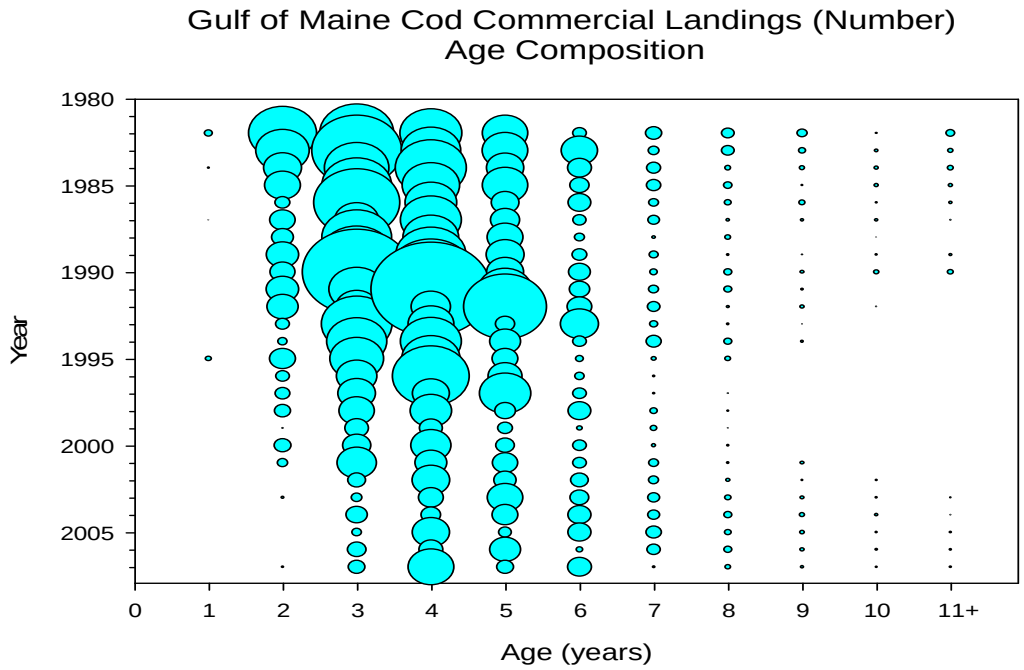


Figure 5. Age composition of commercial landings of Gulf of Maine cod.

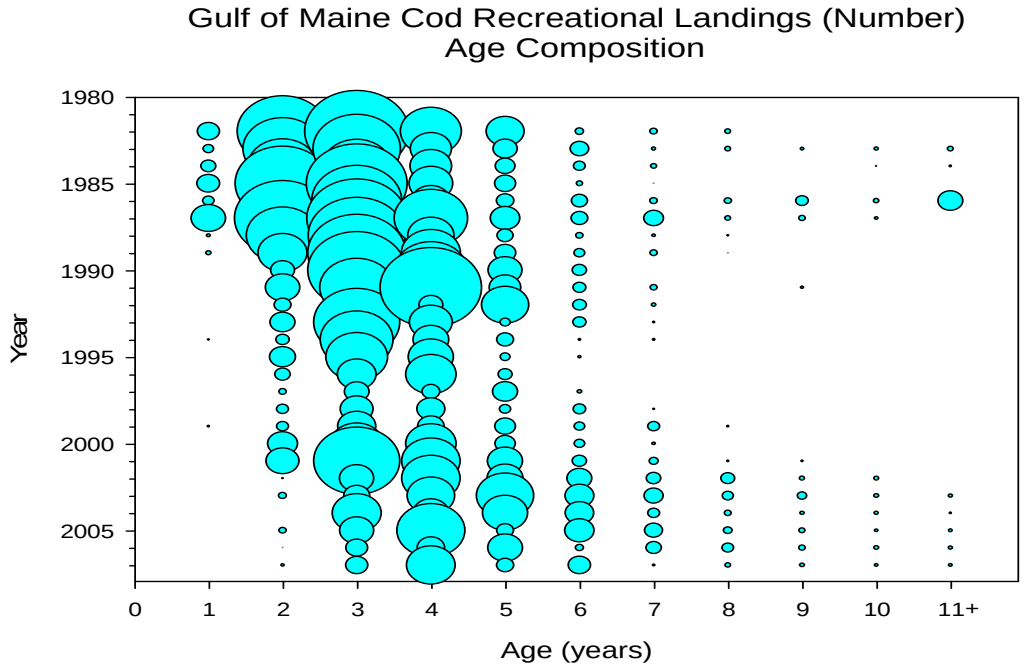
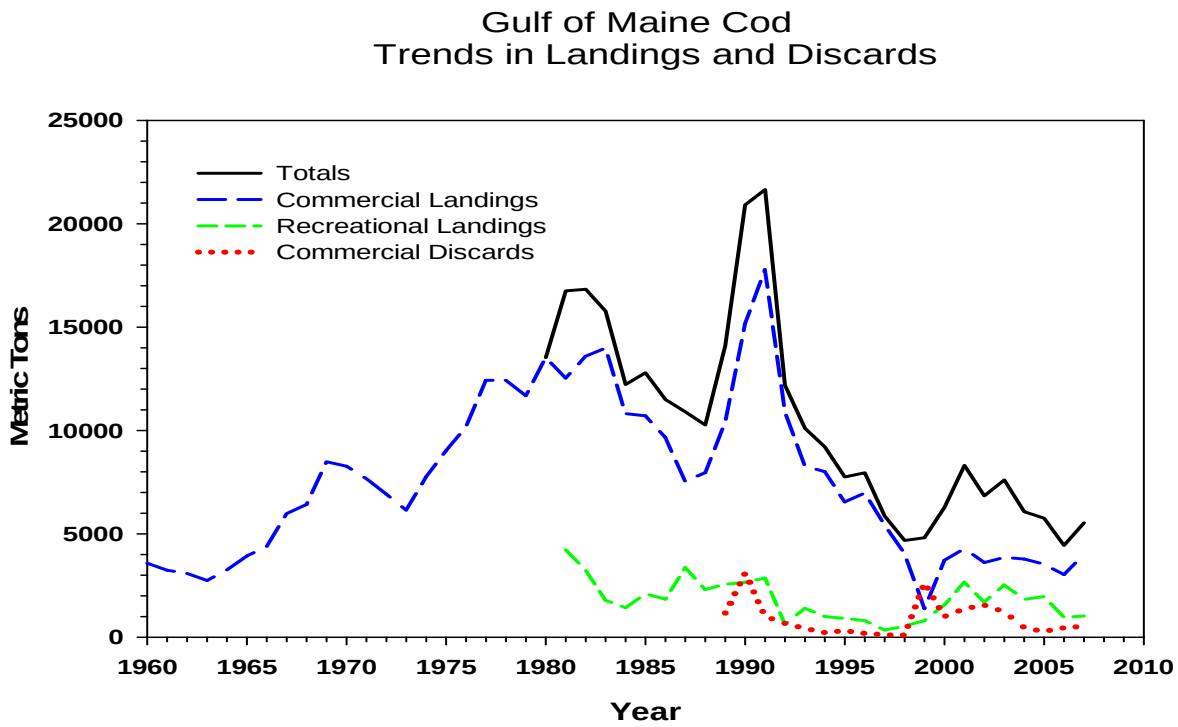


Figure 6. Age composition of recreational landings of Gulf of Maine cod.



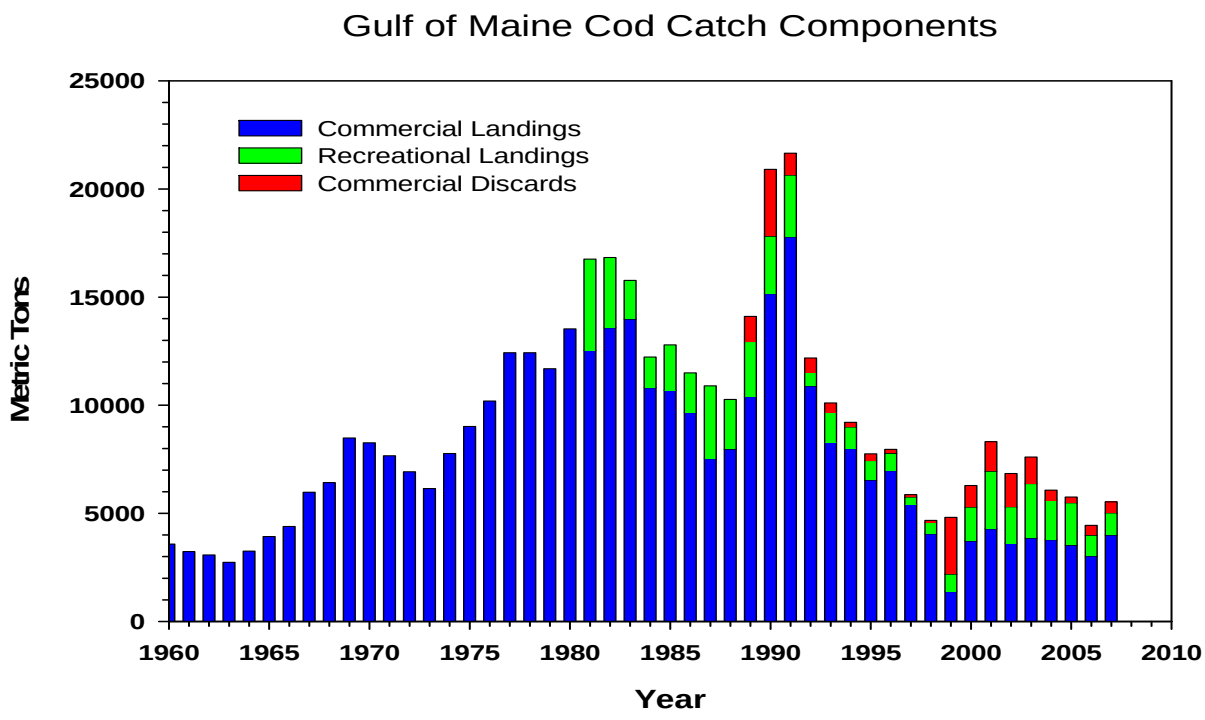


Figure 7. Commercial and recreational landings and commercial discards of Atlantic cod from the Gulf of Maine stock from 1960 to 2007. Catch components are shown as trend lines (upper) and as cumulative bars (lower).

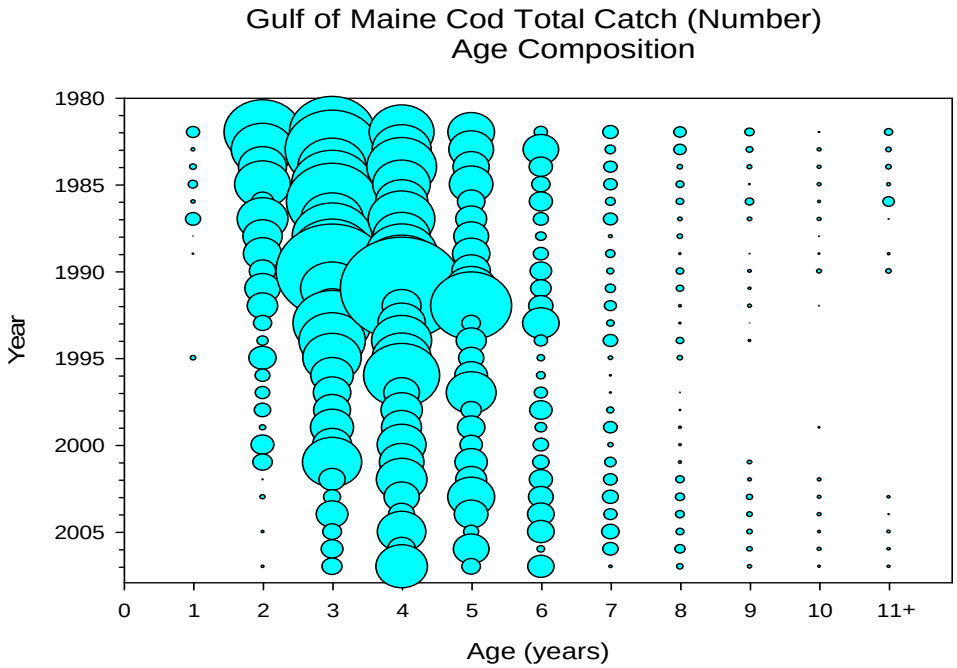


Figure 8. Age composition (number of fish) of the total catch (commercial and recreational landings and commercial discard) of Gulf of Maine cod.

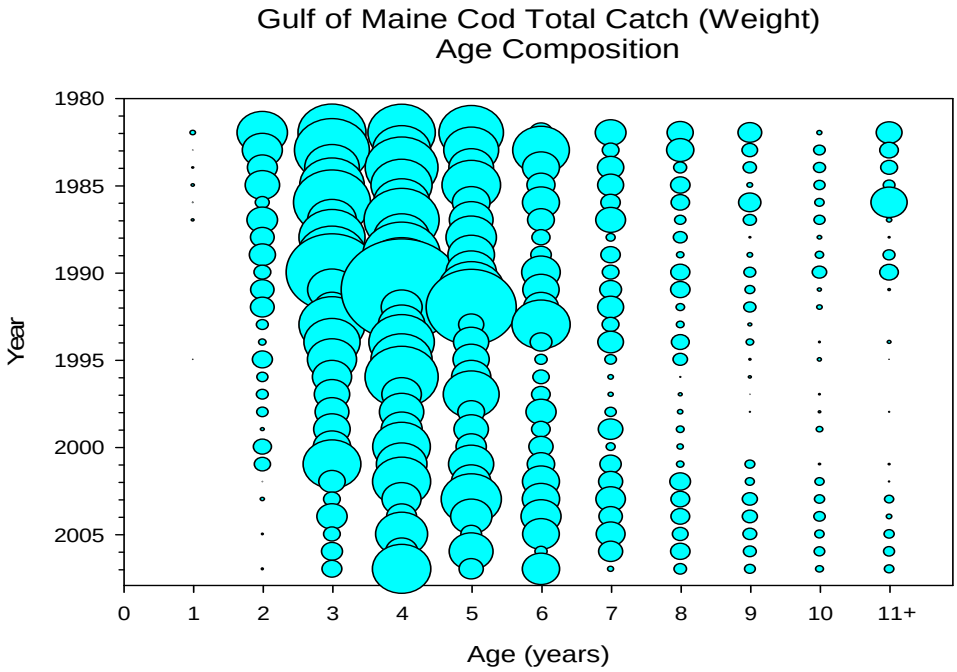


Figure 9. Age composition (weight of fish) of the total catch (commercial and recreational landings and commercial discard) of Gulf of Maine cod.

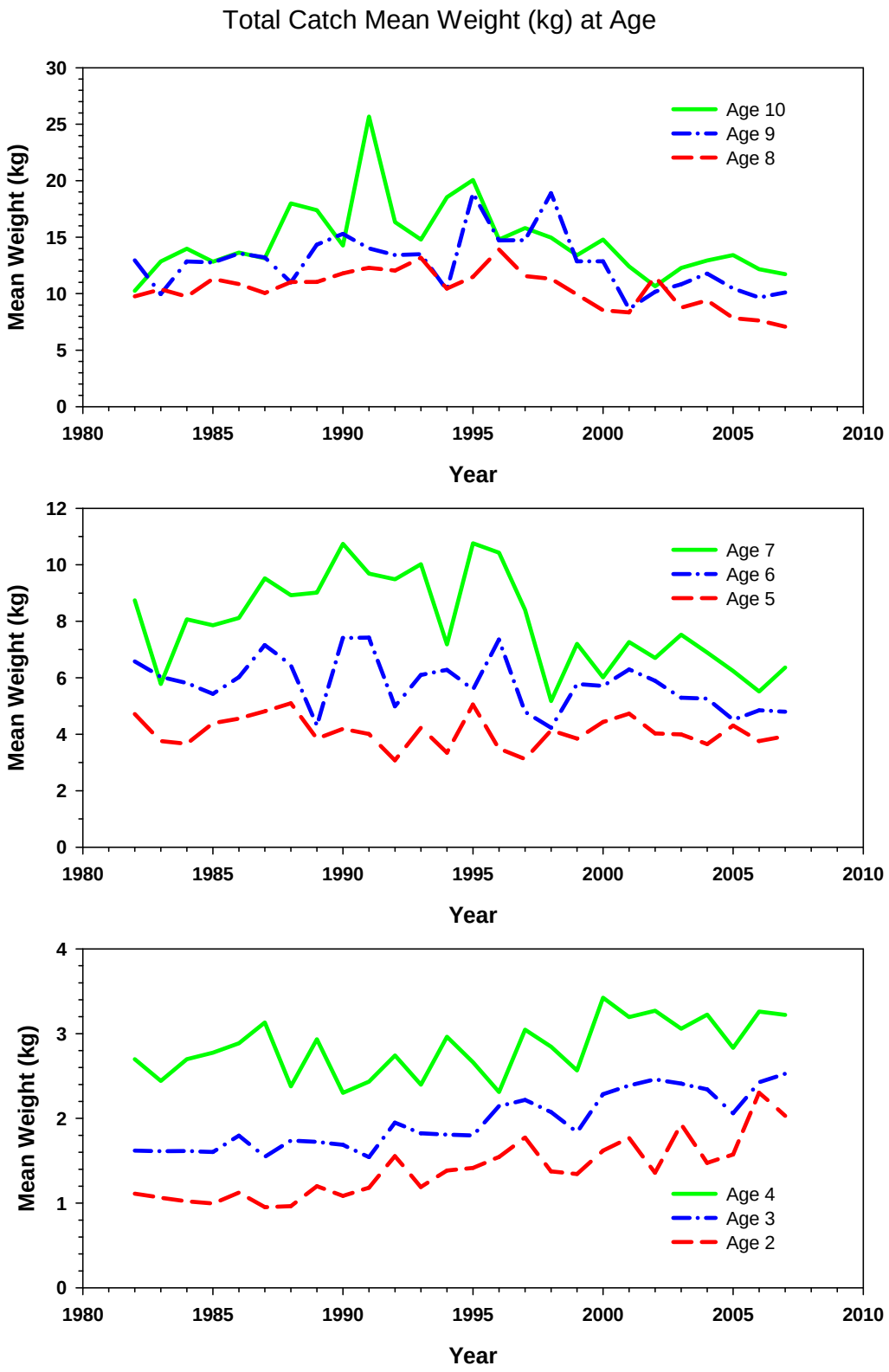


Figure 10. Trends in total catch mean weight (kg) at age for Gulf of Maine cod, 1982 – 2007.

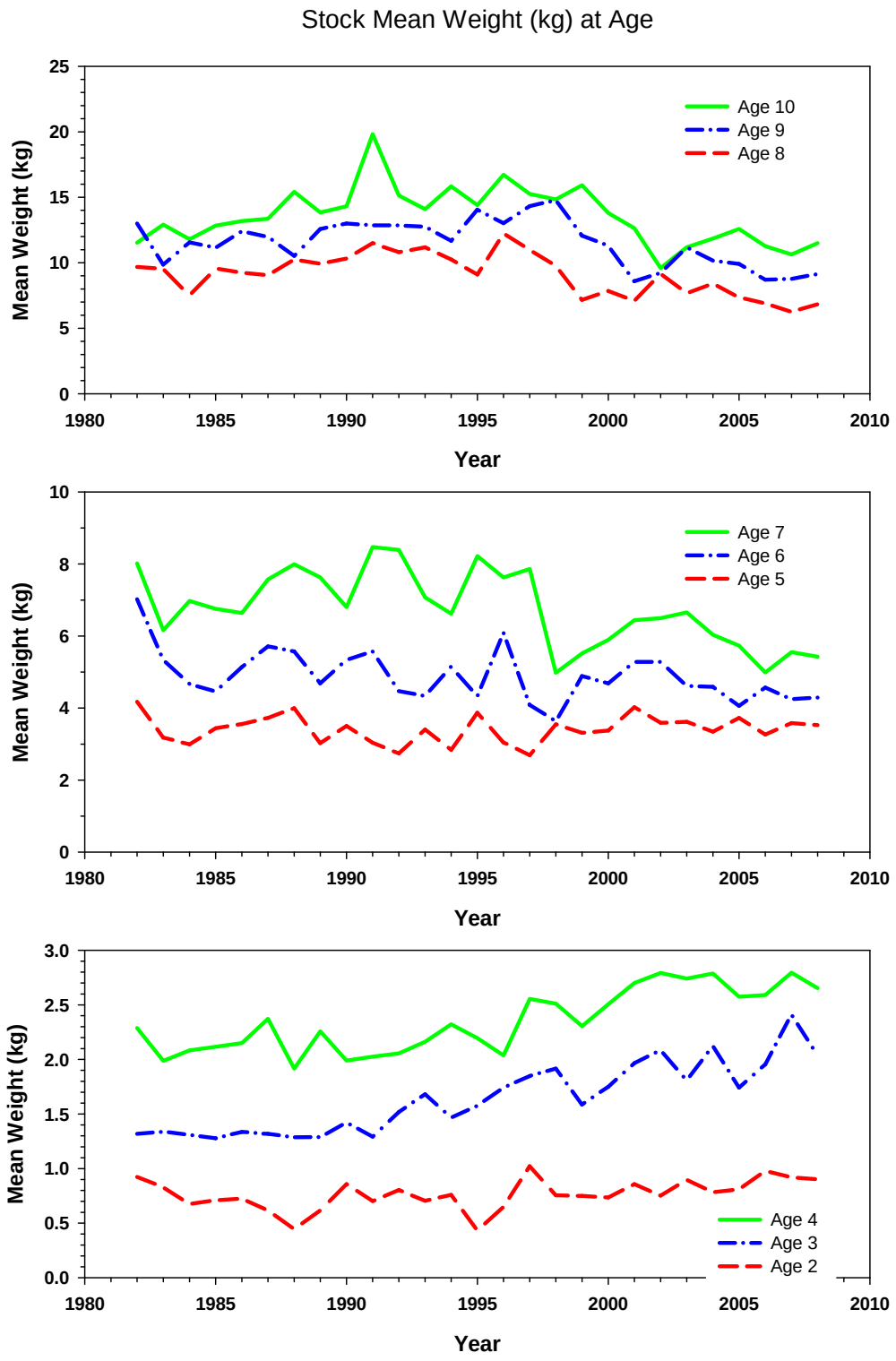


Figure 11. Trends in stock mean weight (kg) at age for Gulf of Maine cod, 1982 – 2007.

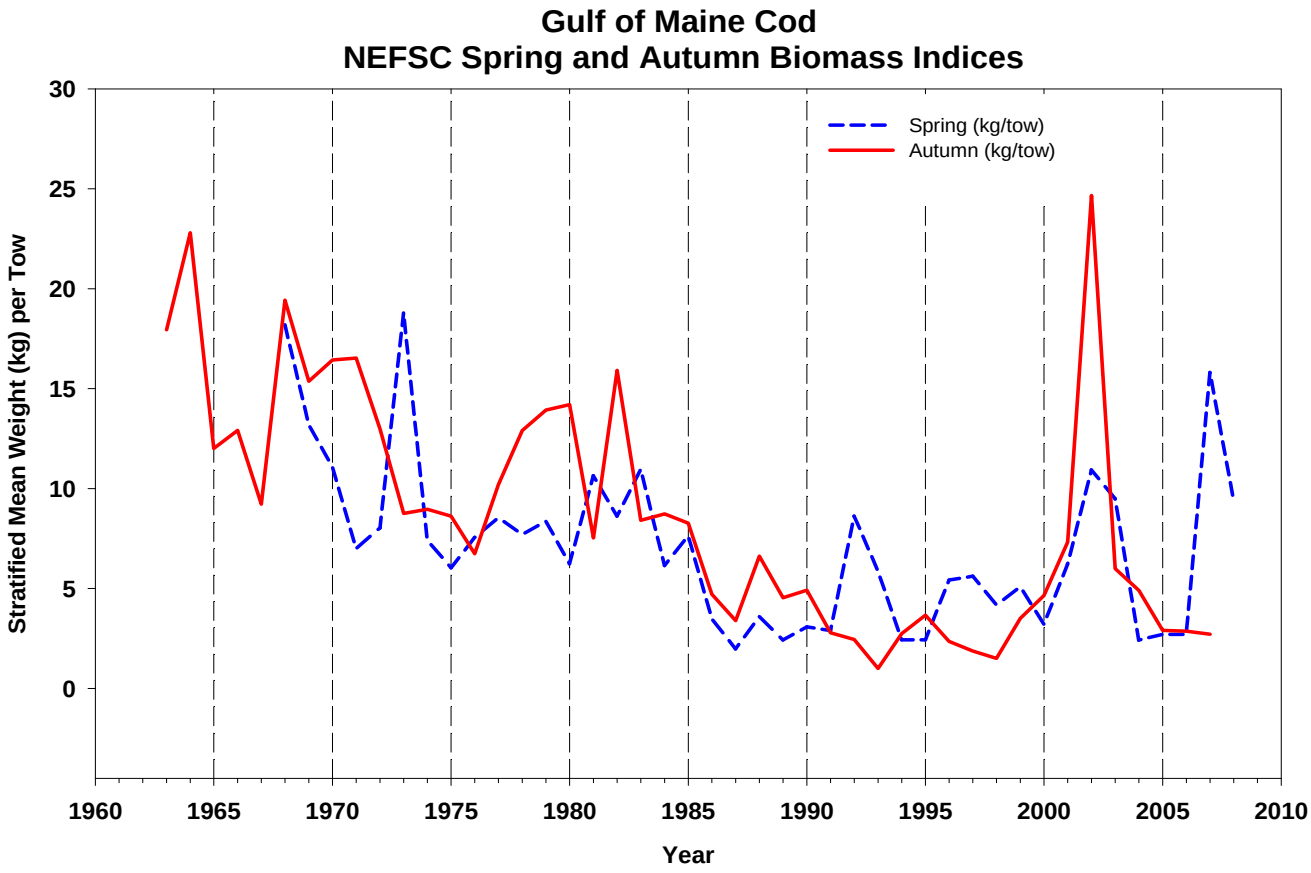


Figure 12. Trends in biomass (stratified mean weight, kg, per tow) of Atlantic cod in the Gulf of Maine based on NEFSC spring and autumn surveys, 1963-2008.

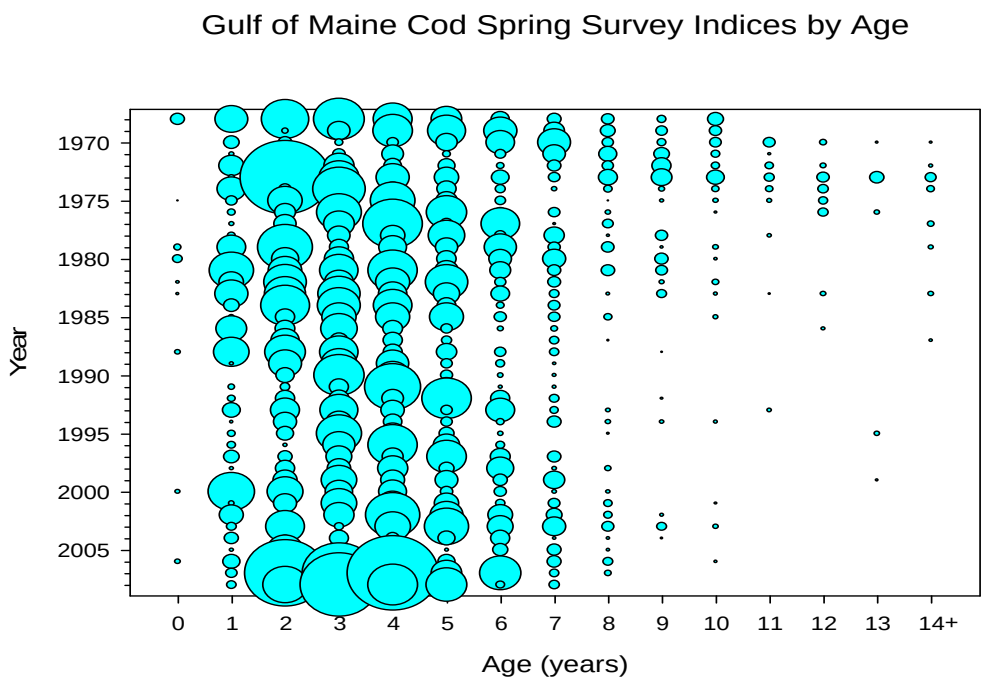


Figure 13. Relative abundance of Atlantic cod by age in the Gulf of Maine based on NEFSC spring bottom trawl surveys, 1970-2008.

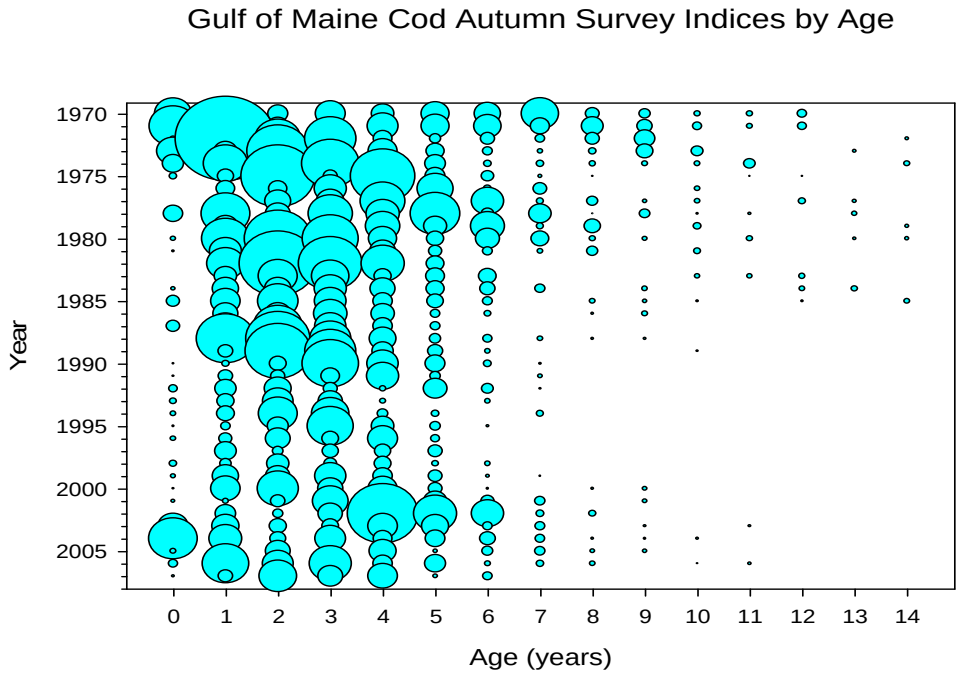


Figure 14. Relative abundance of Atlantic cod by age in the Gulf of Maine based on NEFSC autumn bottom trawl surveys, 1970-2007.

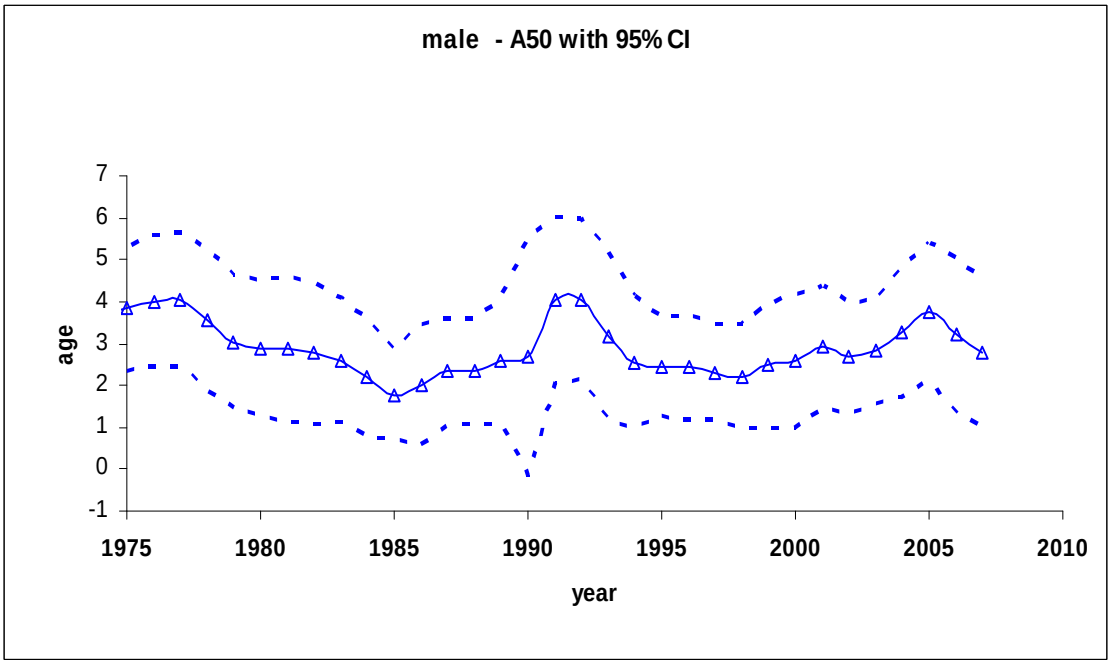


Figure 15. Trends in 3-year average moving window A50 for female (upper) and male (lower) Atlantic cod from the Gulf of Maine stock, 1975-2007, based on observations from NEFSC spring bottom trawl surveys. Moving window maturity ogives used to compute spawning stock biomass were based on female data.

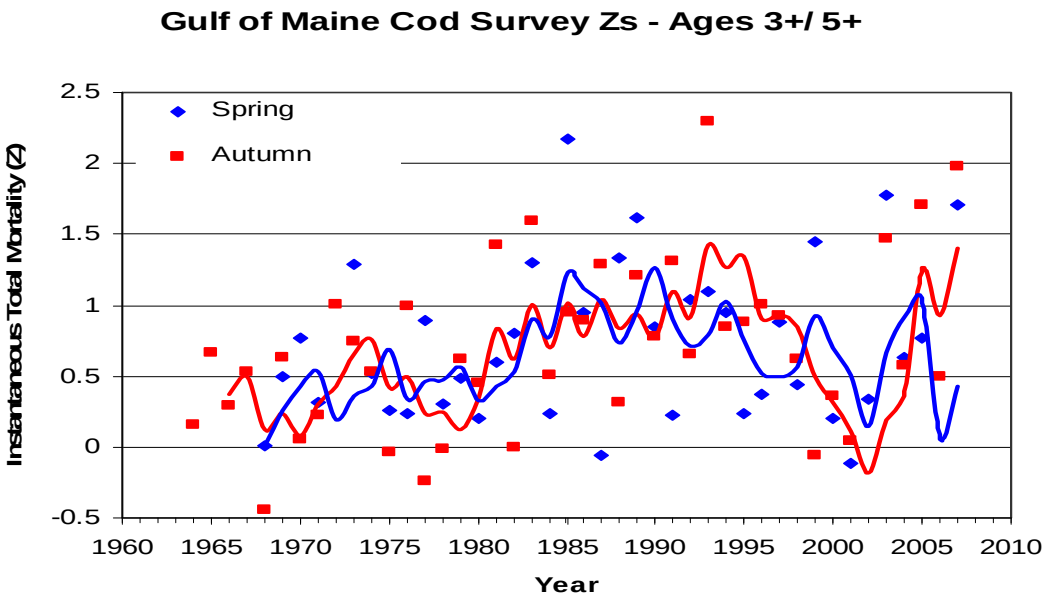


Figure 16a. Estimates of instantaneous total mortality (Z) from annual spring and autumn NEFSC bottom trawl surveys (ages 3+/ 5+). Solid lines are 3- year moving averages of the point estimates. See text for equations.

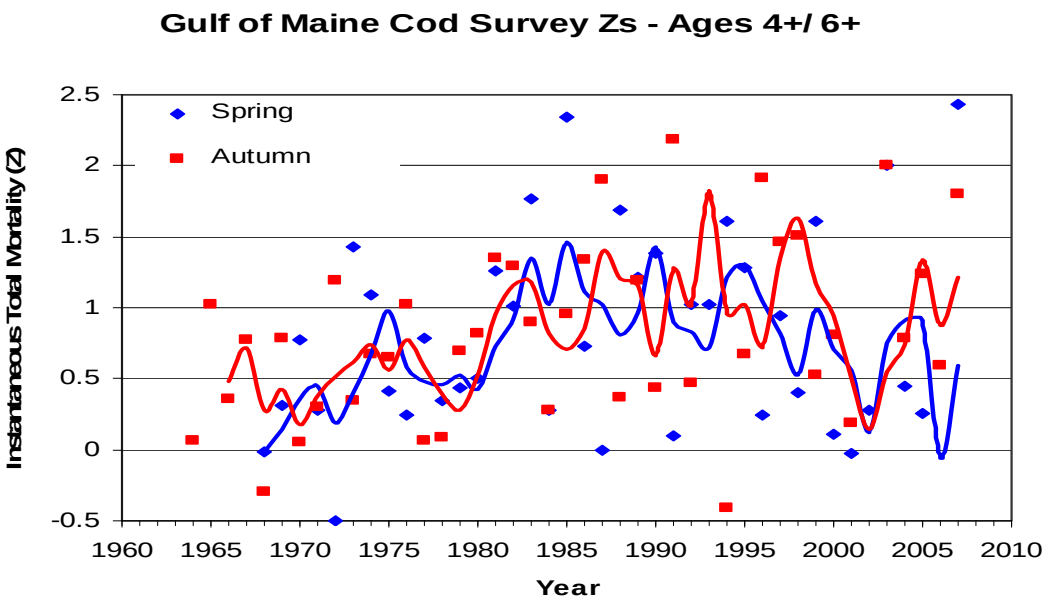


Figure 16b. Estimates of instantaneous total mortality (Z) from annual spring and autumn NEFSC bottom trawl surveys (ages 4+/ 6+). Solid lines are 3-year moving averages of the point estimates. See text for equations.

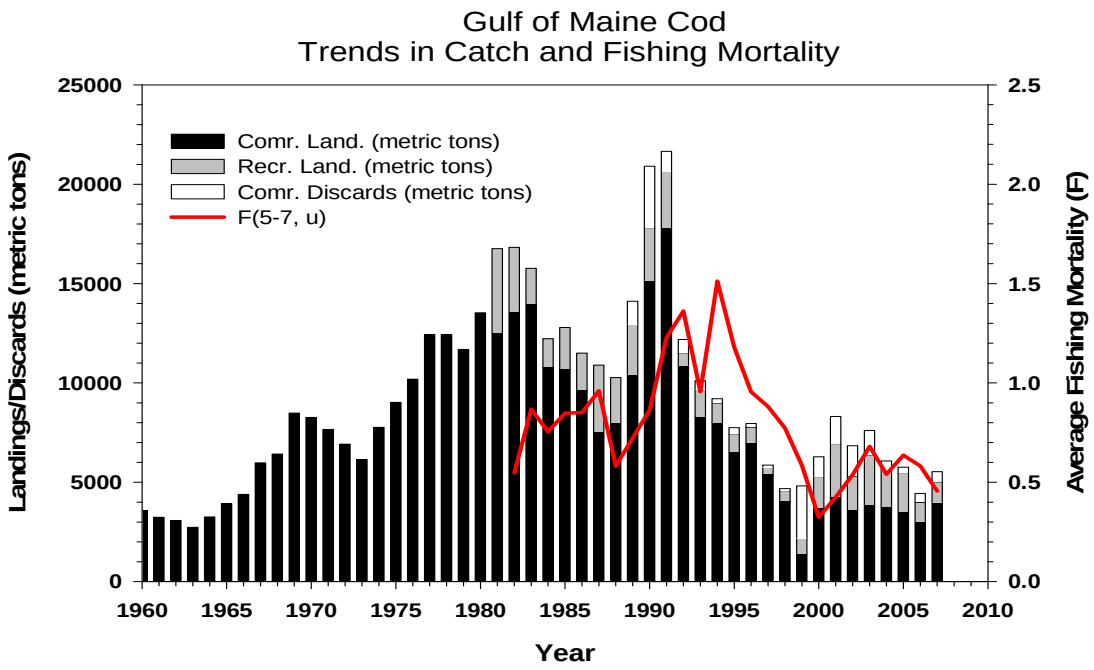


Figure 17. Trends in commercial and recreational landings and commercial discards compared to estimates of instantaneous fishing mortality (average of ages 5-7) for Gulf of Maine cod.

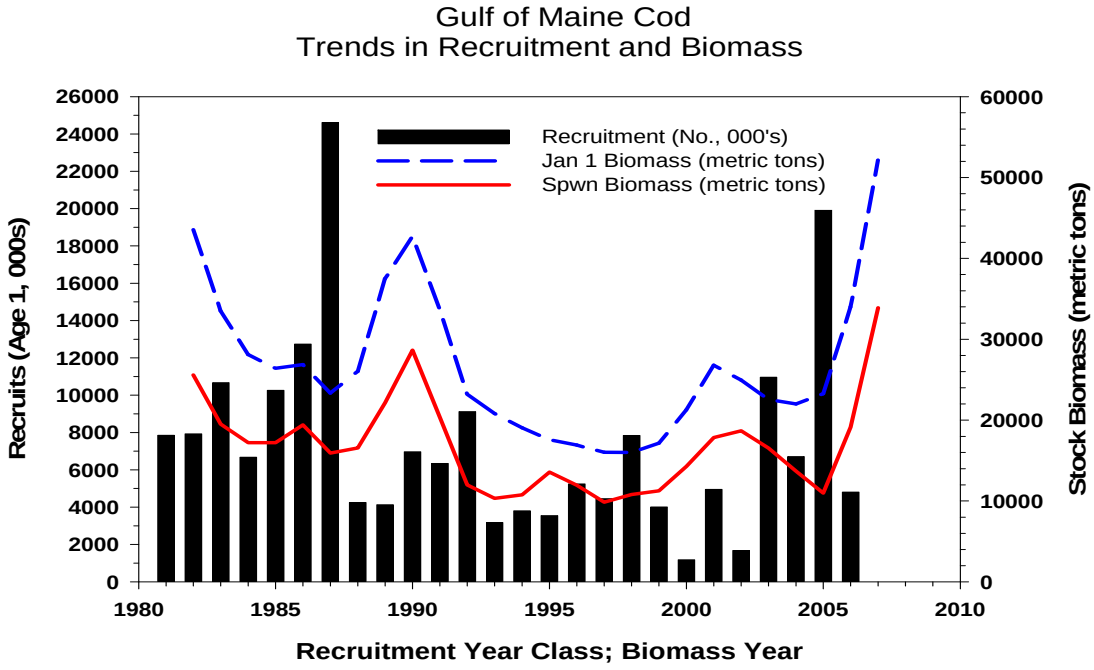


Figure 18. Trends in spawning stock biomass (SSB) and age 1 recruitment for Gulf of Maine cod.

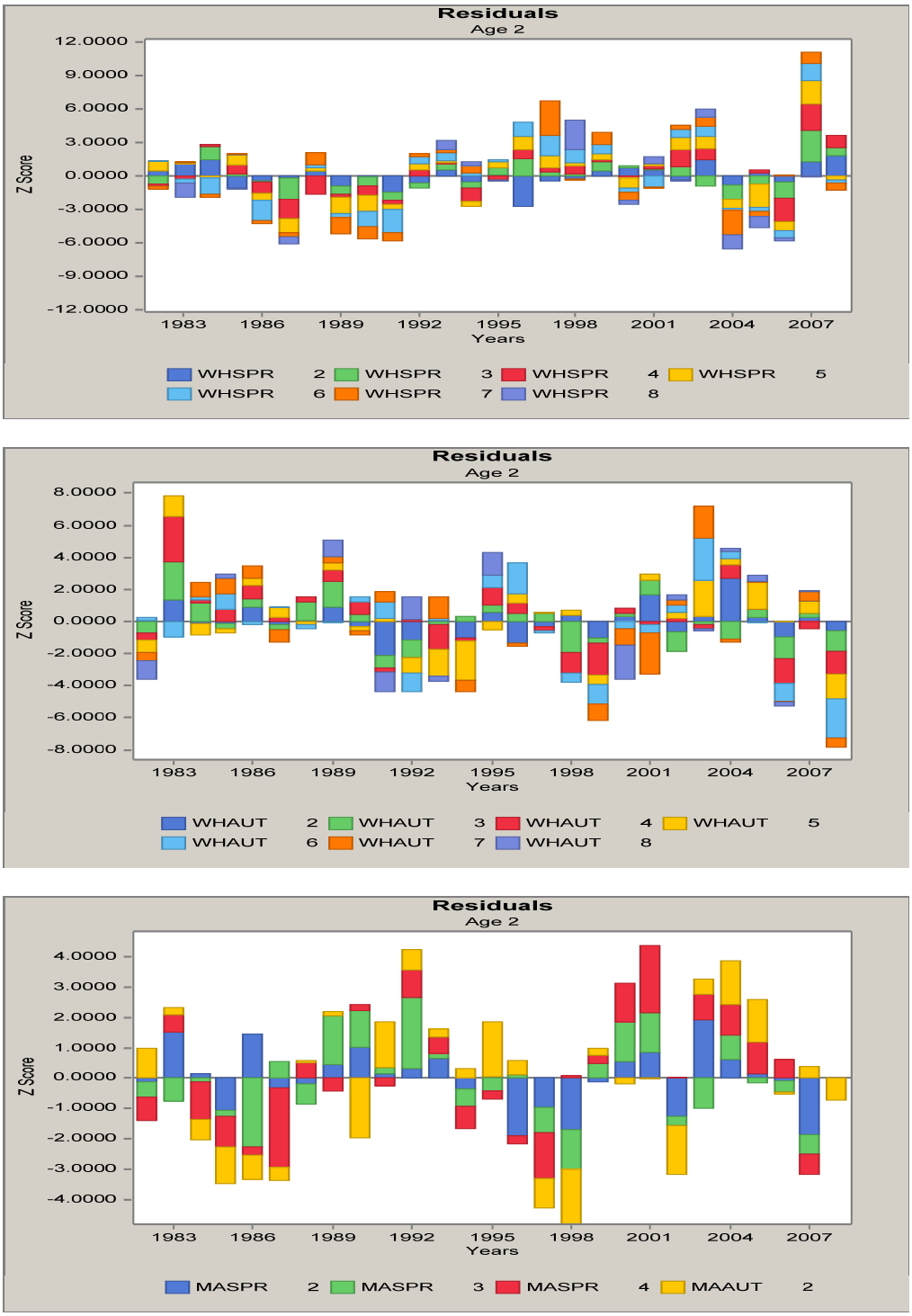


Figure 19. Residual patterns for NEFSC spring (upper), autumn (middle) and Massachusetts DMF (lower) bottom trawl surveys for ages included in the calibration of the Gulf of Maine cod VPA.

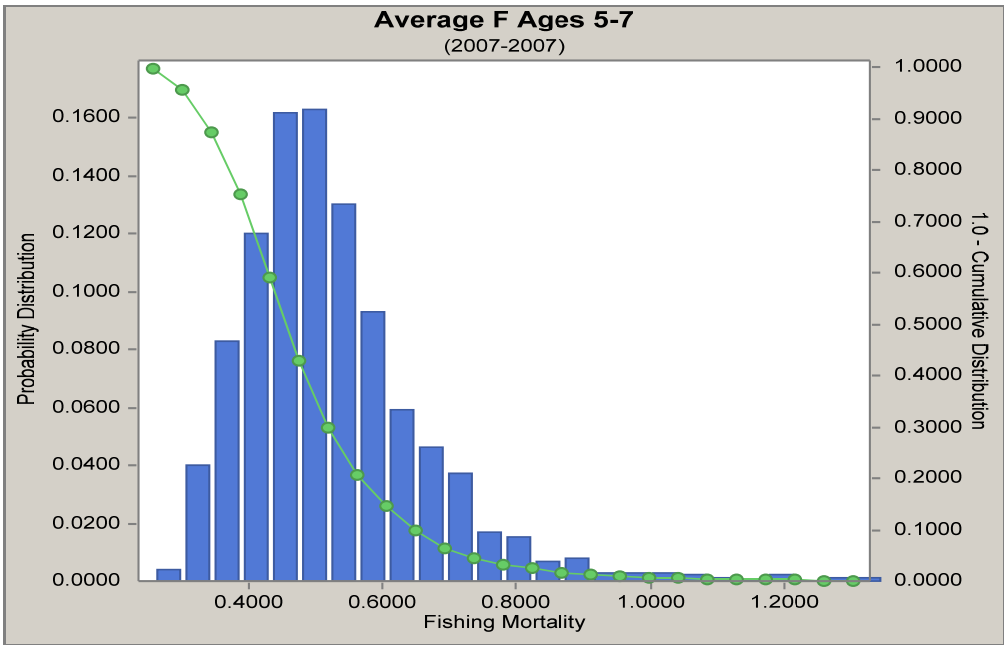


Figure 20. Distribution of estimates of 2007 average F (ages 5-7) for Gulf of Maine cod based on 1000 VPA bootstrap iterations. The median value is 0.46 and the 10-90 percentile range is 0.36 – 0.67.

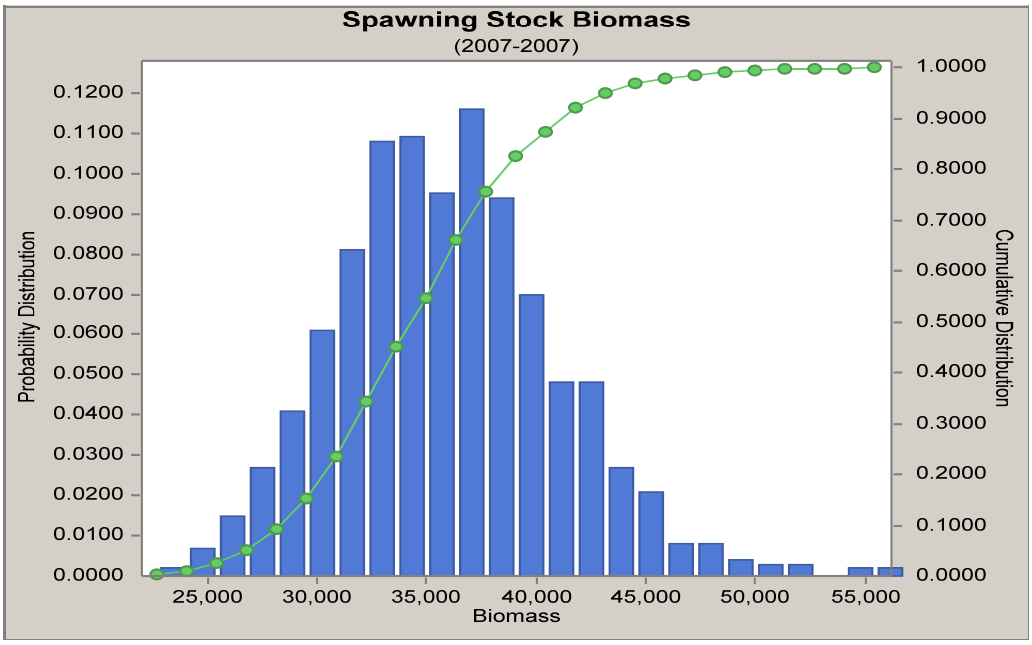
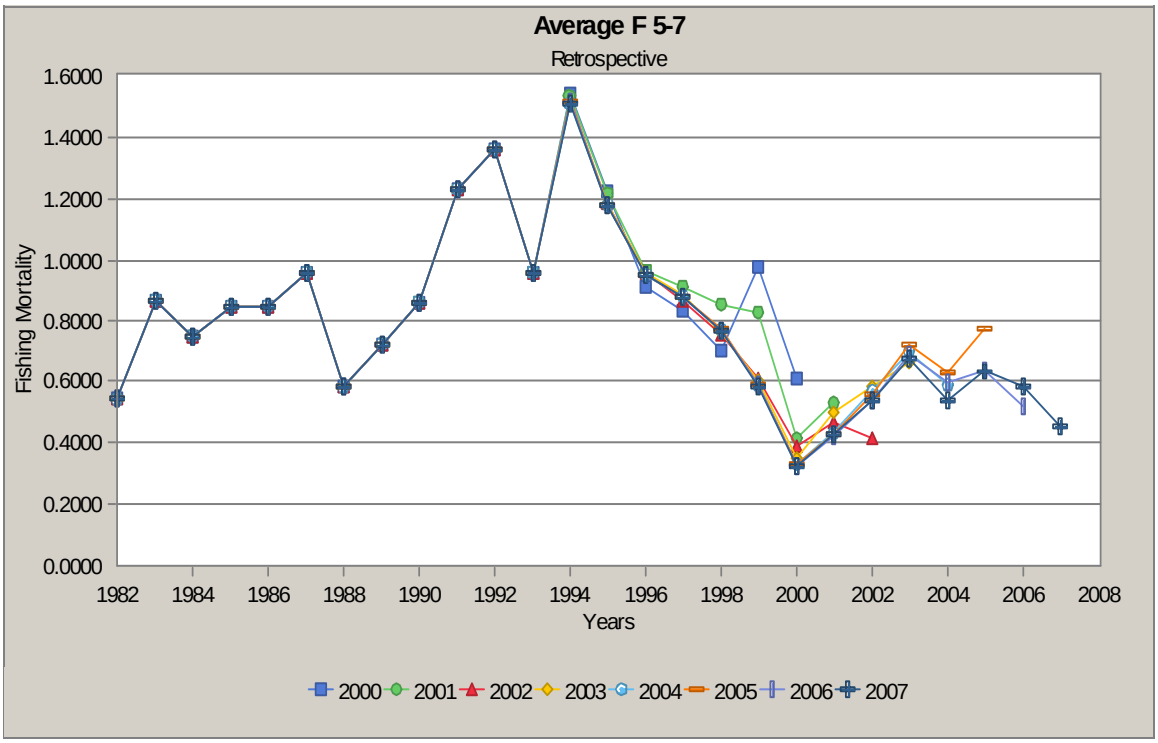


Figure 21. Distribution of estimates of 2007 spawning stock biomass for Gulf of Maine cod based on 1000 VPA bootstrap iterations. The median value is 33,877 mt and the 10-90 percentile range is 29,133 mt – 41,747 mt.



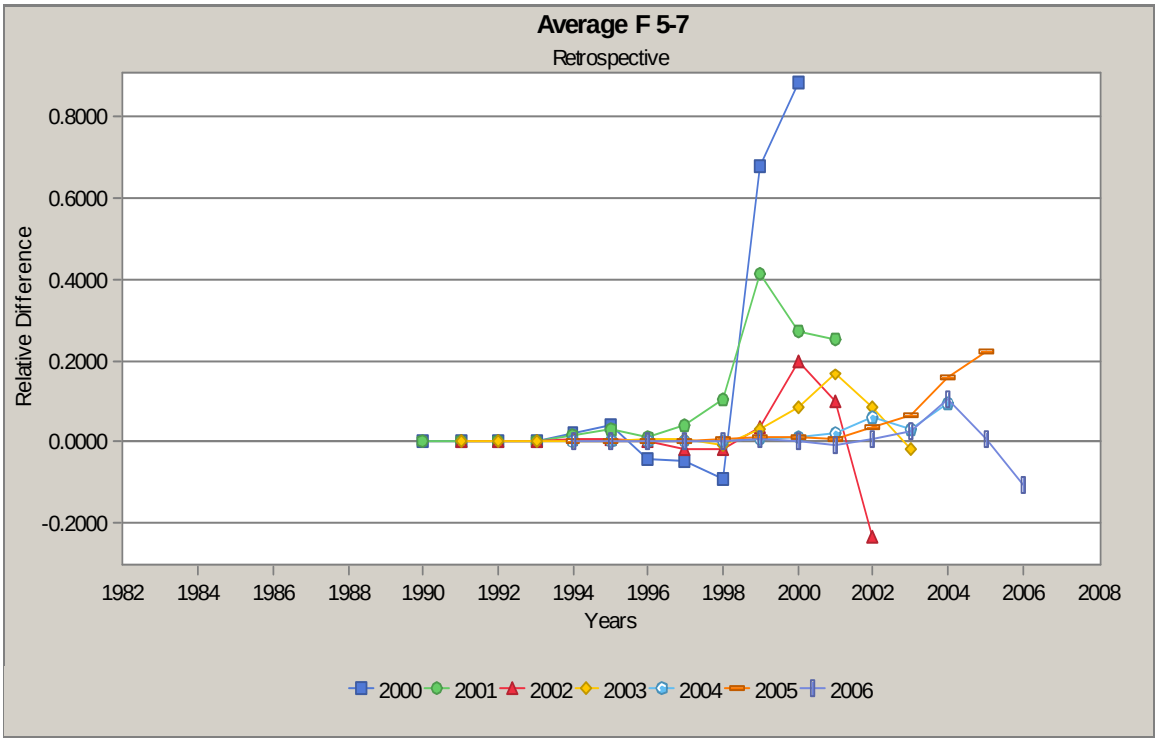
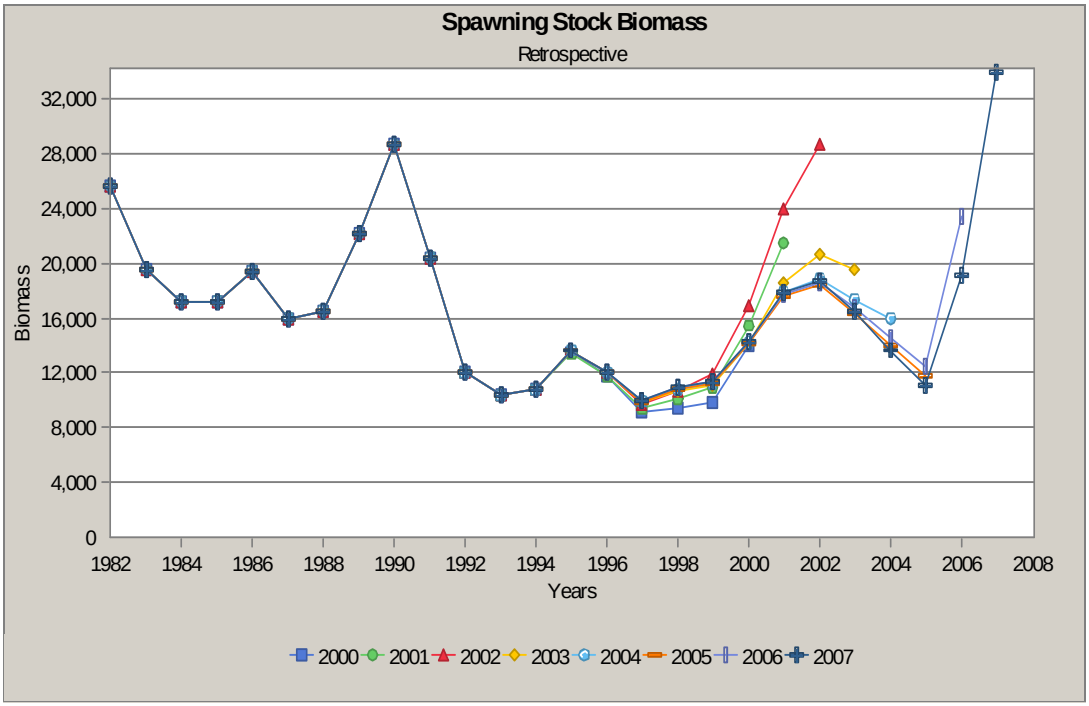


Figure 22. Retrospective plots (standard upper, relative difference lower) of average fully recruited F (ages 5-7) for Gulf of Maine cod. Mohn's average rho based on relative difference = 0.157.



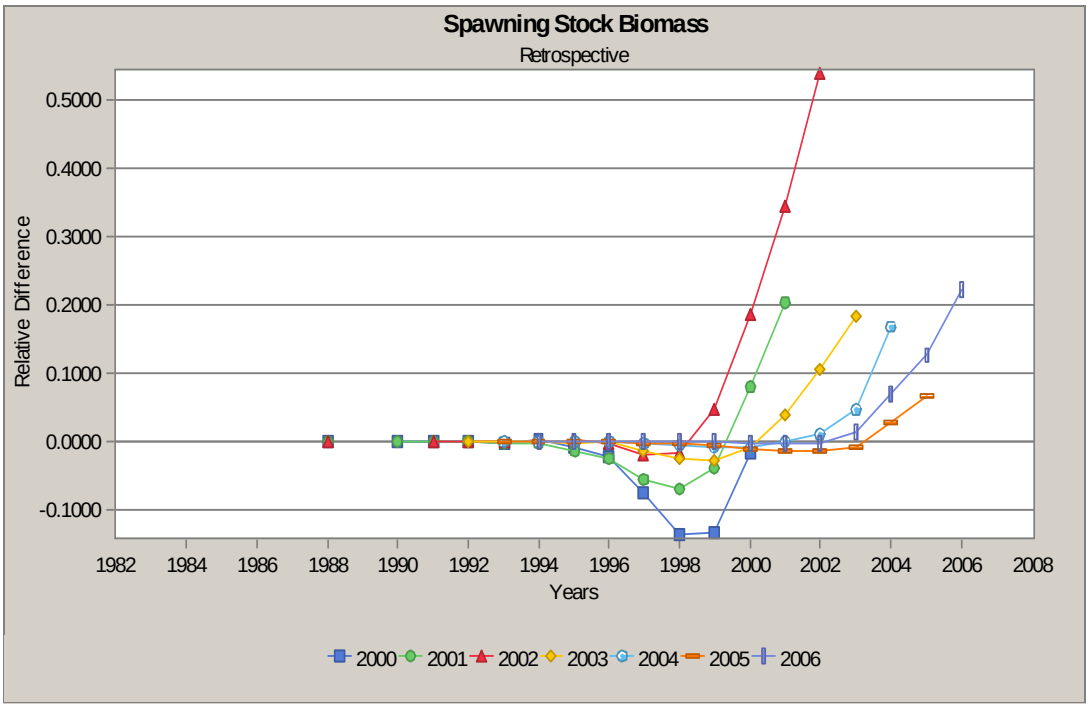
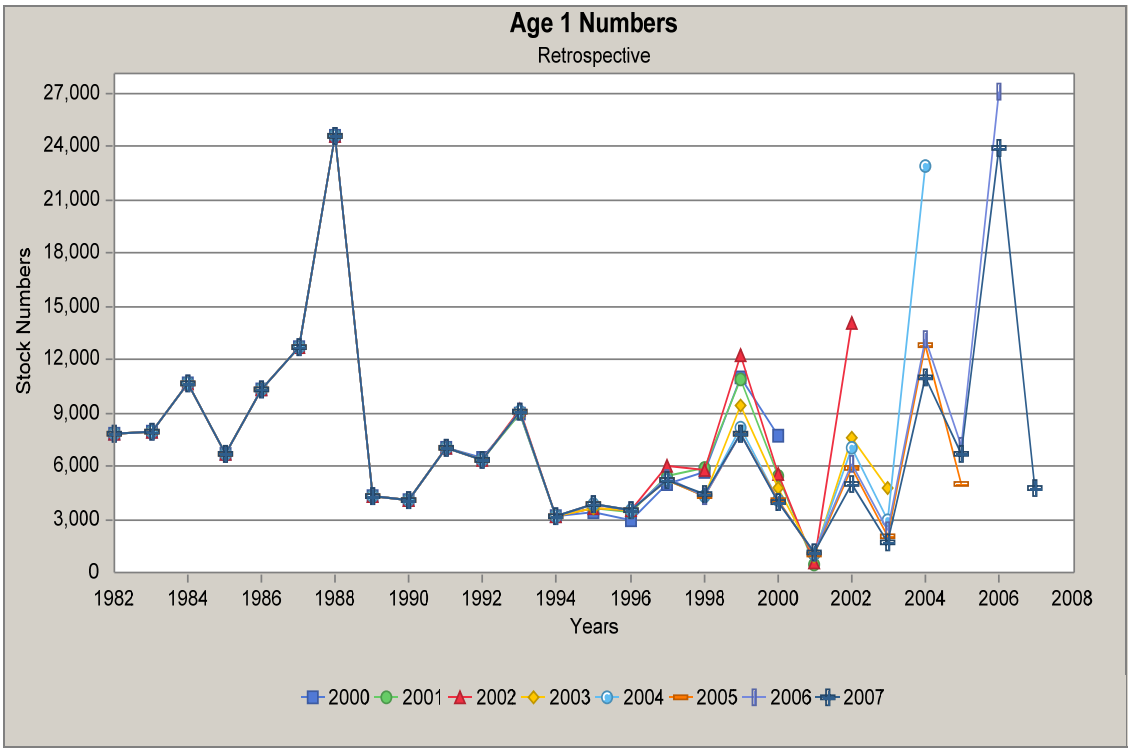


Figure 23 Retrospective plots (standard upper, relative difference lower) of spawning stock biomass for Gulf of Maine cod. Mohn's average rho based on relative difference = 0.195.



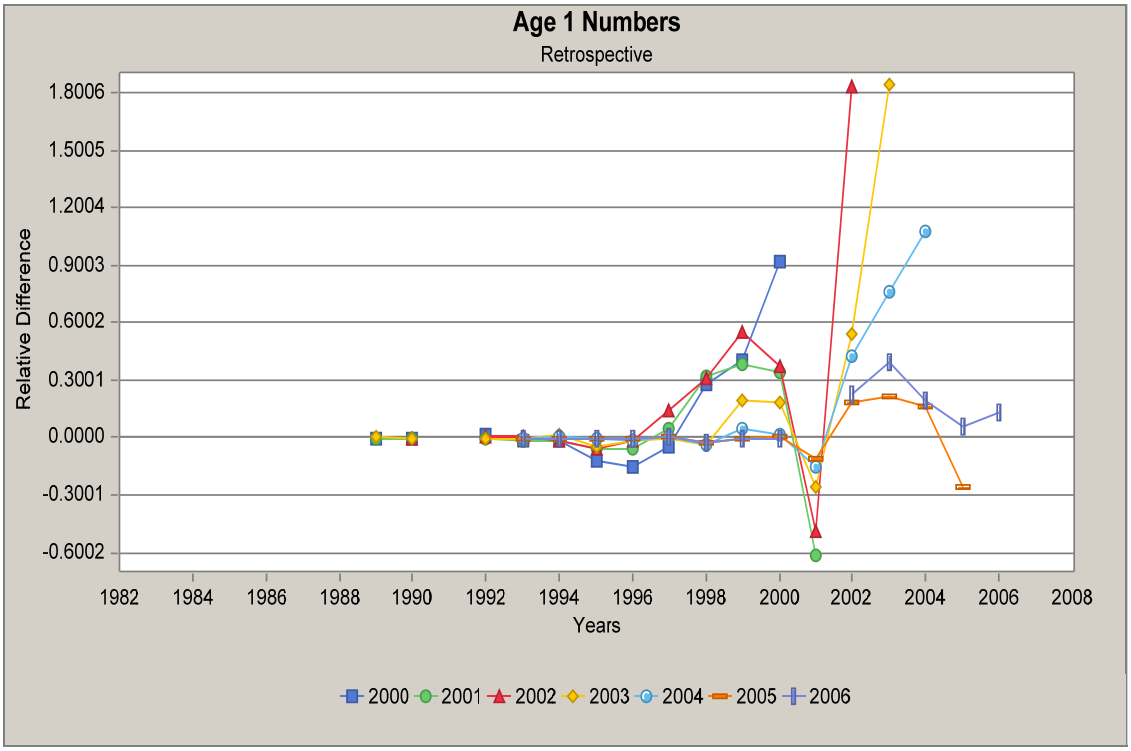


Figure 24. Retrospective plots (standard upper, relative difference lower) of age 1 recruitment for Gulf of Maine cod. Mohn's average rho based on relative difference = 0.707.

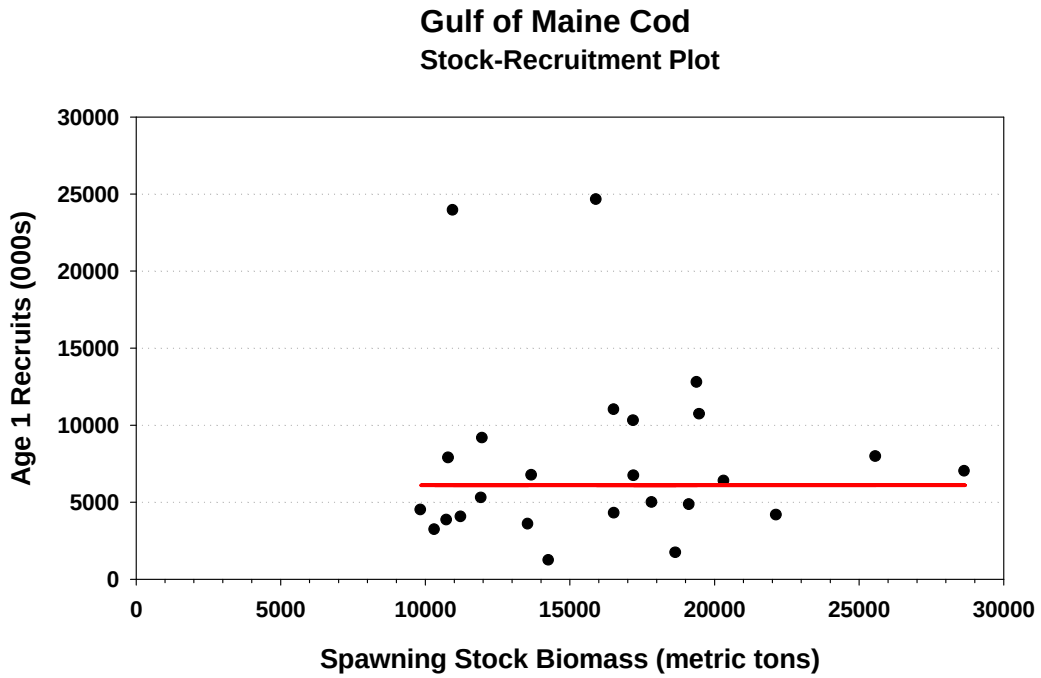


Figure 25. Spawning stock – recruitment scatterplot for Gulf of Maine cod for the 1981 – 2006 year classes. The solid line represents the geometric mean recruitment (6.1 million).

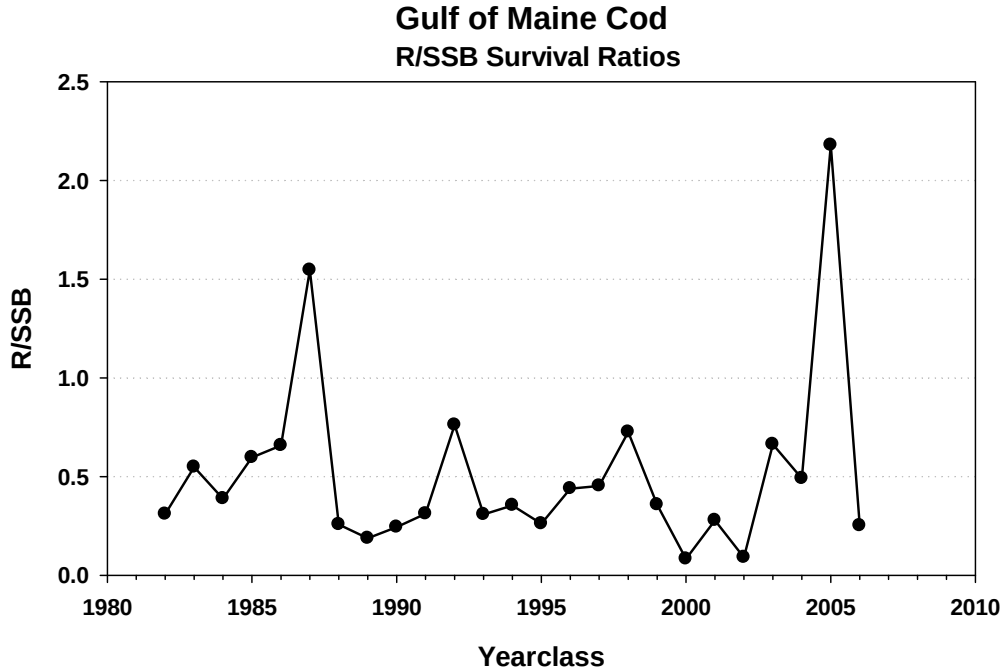


Figure 26. Survival ratios (age 1 Recruits/SSB) for Gulf of Maine cod for the 1981 – 2006 year classes.

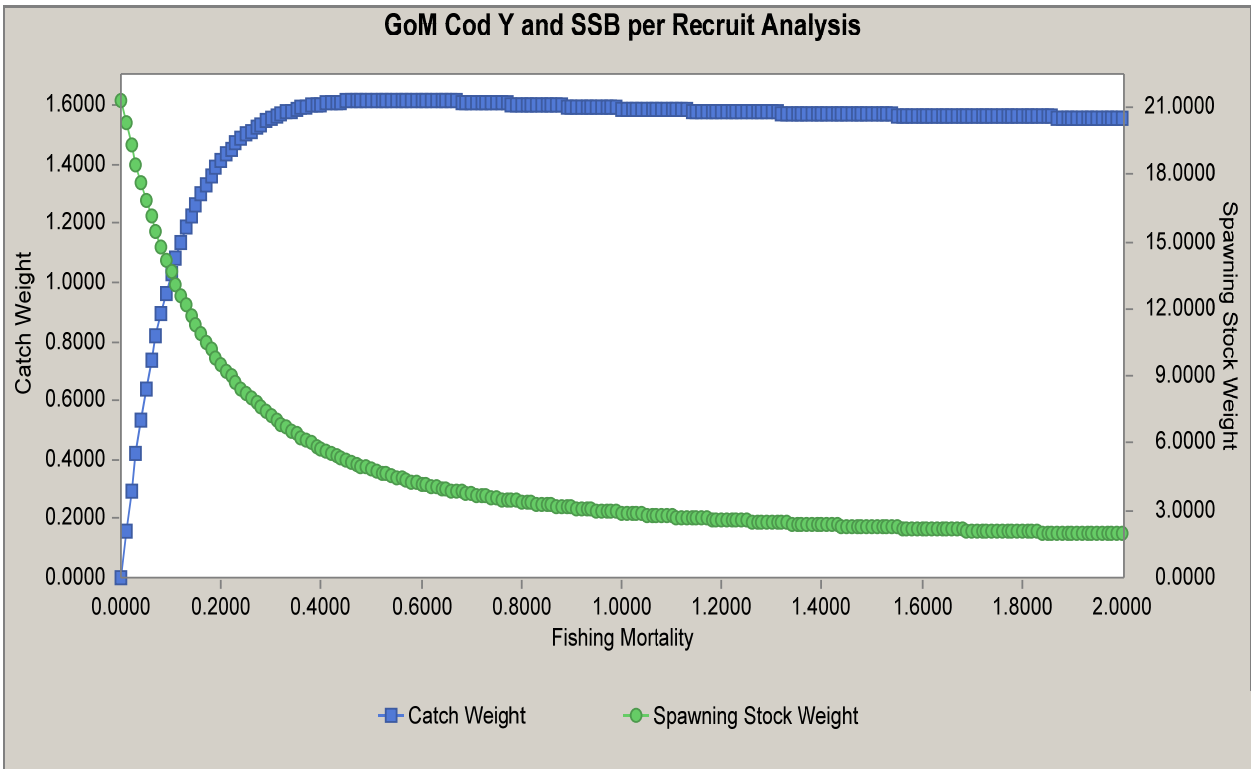


Figure 27. Yield and SSB per recruit results for Gulf of Maine cod. Input data and output values are given in Table 20.

APPENDIXES

Appendix A. Management History of Gulf of Maine Cod.

Table 1. A Brief Chronology of Management Measures Affecting Gulf of Maine Cod, 1973-2003.

Appendix A: Table 1. A brief chronology of management measures affecting Gulf of Maine cod, 1973-2003.

1973
Total Allowable Catch (TAC) limits implemented by the International Commission for the Northwest Atlantic Fisheries (ICNAF) for Division 5Y (Gulf of Maine) cod.
Minimum codend mesh size at 4 2" (114 mm).
1977
Fishery Conservation and Management Act (FCMA) implemented. Management under the auspices of the New England Fishery Management Council.
1977-1982
Management of groundfish resources under the Fishery Management Plan (FMP) for Atlantic groundfish. Carried forward TACs; implemented by vessel tonnage class and calendar quarter with trip limits.
Minimum codend mesh size increased to 5 1/8" (130 mm).
1982-1985
Management of groundfish resources under the AInterim@ Plan for Atlantic groundfish.
Eliminated direct catch controls; primary tools for fishery management were minimum mesh sizes and minimum landing sizes.
1983
Minimum codend mesh size increased to 5 2" (140 mm).
1986
Northeast Multi-species FMP implemented . Amendments 1-4 retained indirect controls, including minimum mesh and minimum fish landing sizes.
1989
Minimum fish size = 19" (48 cm) for commercial and recreational sectors.
1994
January 1 Amendment 5
50% reduction in F and effort over 5-7 years.
Days at Sea (DAS) monitoring
Implemented a Mandatory Reporting Scheme
May 1 Amendment 5 (again)
Minimum codend mesh size increased to 6" (152 mm), diamond or square.
1996
May 1 Amendment 7
Established rebuilding program based on Fmax target fishing mortality
Established Target TACs
Accelerated Days at Sea reductions
Established Framework Adjustment Process and the Multi-species Monitoring Committee to permit annual adjustments to management measures
Minimum fish size increased to 20" (51 cm) for recreational sector.
1997
May 1 Framework 20
Target TAC: 2,605 mt
Gulf of Maine cod trip limit: 1,000 or 1,500 lbs/day
Minimum fish size increased to 21" (53 cm) for recreational sector.

Appendix A: Table 1 (Continued).

1998
May 1 Framework 25
Target TAC: 1,800 mt with trigger provision
Gulf of Maine cod trip limit 700 lbs/day
Series of 1-month rolling closures from Massachusetts Bay to Penobscot Bay.
Year-round closure of portions of Jeffreys Ledge and Stellwagen Bank (WGOM Closed Area)
June 25 Framework trigger pulled
Gulf of Maine cod trip limit: 400 lbs/day
1999
February 1 Framework 26
Additional month-block (30x30 minutes) closures implemented for February and April
May 1 Framework 27
Target TAC: 1,300 mt with trigger provision
Gulf of Maine cod trip limit: 200 lbs/day
Minimum square mesh increased to 6.5" (165 mm); diamond mesh remains at 6" (152 mm).
May 28 Framework trigger pulled
Gulf of Maine cod trip limit: 30 lbs/day
August 3 Interim Rule
Gulf of Maine cod trip limit: 100 lbs/day
November 15
Amendment 9 Implemented with new overfishing definitions, and set Optimum Yield for 12 groundfish species to bring plan into complete compliance with the Sustainable Fisheries Act.
2000
January 5 Framework 31
Gulf of Maine cod trip limit: 400 lbs/day- 4,000 maximum/trip.
Additional month-block (30x30 minutes) closures implemented for February
May 1 Framework 33
Target TAC: 1,900 mt with trigger provision
Continuation of most Framework 27 and 31 measures
Year-round closure of WGOM area extended until April, 2002.
November 1 Framework trigger pulled
One-month closure of Cashes Ledge
2001
January 1 Framework trigger pulled
Additional month-block (30x30 minutes) closures implemented for January
May 1 Annual Adjustment
Target TAC: 1,118 mt
Continuation of most Framework 27 and 31, and 33 measures.

2002
Continuation of most Framework 27 and 31, and 33 measures.

August 1 Interim Rule: Baseline DAS revised as follows:
Additional month-block (30x30 minutes) closures required for May and June, 2003.
The used DAS baseline for a limited access permit is calculated based on the highest number of DAS that a vessel(s) fished during any single fishing year among the 1996 through 2000 fishing years, which includes the period May 1, 1996, through April 30, 2001, not to exceed the vessel=s current DAS allocation in any given year.
Baseline DAS for FY 2002, beginning May 1 reduced by 20% from the above.
Minimum fish size increased to 22" (56 cm) for the commercial sector and 23" (58 cm) for the recreational sector.

Trip limit increased to 500 lbs/day. Maximum possession limit remains at 4000 lbs.

Redefines and divides the Gulf of Maine/Georges Bank (GOM/GB) Regulated Mesh Area (RMA) into two areas: The GOM RMA, which is the area north of the GOM cod exemption line currently used to define the areas where the GOM cod and GB cod trip limits apply (42 deg, 20 min N Lat); and the GB RMA, which is that part of the current GOM/ GB RMA that lies south of the GOM cod exemption.

2003

Continuation of most Framework 27 and 31, and 33 measures.

June 27 Final Emergency Rule:

Continues the DAS baseline that was established for each vessel by the August 1, 2002, interim rule, based on the permit history of that vessel.

Baseline DAS for FY 2003, beginning May 1 until implementation of Amendment 13 reduced by 20% from the above.

Continues the RMAs established by the August 1, 2002, interim rule.

Continues the closure areas established under the August 1, 2002, interim rule for the Western Gulf of Maine (WGOM) Area Closure, the Rolling Closure Areas, and the Cashes Ledge Closure Area.

Table 2. Recent Management Measures affecting New England Groundfish Stocks, 2002-2007.

Appendix A: Table 2. Recent Management Measures affecting New England Groundfish Stocks, 2002-2007.
2002
February 15-March 11: Northern Shrimp season (25 days with days off)
May 1: Interim rule as a result of FW 33 lawsuit settlement agreement. Continuation of most measures from previous frameworks. DAS: 15 hour minimum charged for all trips over 3 hours Vessels limited to 25 percent of allocation May 1 through July 31, 2002 (only) Prohibition on front-loading DAS Minimum size: Cod 22 in. Gear: GOM Regulated Mesh Area (RMA): 6.5 in. diamond or square codend minimum, 6.5 inch mesh for trip gillnets, 6.5 inch mesh standup (roundfish) or 7 inch mesh tiedown (flatfish) for day gillnets. All areas: day gillnets limited to 50 standup/100 tiedown nets. *Hook gear*: de-hooking devices with spacing of less than six inches prohibited. Closures: WGOM year round closure extended (was to sunset May 1); Cashes Ledge Closed Area (year round); year round Cashes Ledge East and West closure added; add blocks 124/125 May, blocks 132/133 June, Recreational: Cod minimum size 23 in., GOM party/charter limited to 10 fish combined cod/haddock, all areas private recreational limited to 10 cod Possession limits: Remain the same. Haddock possession limit of 3,000 lbs.-DAS/30,000 lbs.-trip through September 30.
June 1: Revised interim rule Minimum size: Cod 19 in. Closures: Year-round Cashes Ledge east and west closures removed Gear: *Hook*: Requirement for six-inch spacing for de-hooking gear removed
July 4: Haddock daily limit suspended. Possession limit of 30,000 lbs.-trip until September 30, 50,000 lbs.-trip thereafter.
August 1: Emergency rule implementing FW 33 lawsuit settlement agreement. DAS: DAS allocation for each permit reduced 20 percent from maximum used FY 1996-2000 (est 71,218 allocated, including carry-over). DAS counted by the minute, except for day gillnet vessels (15 hour minimum). (This change reverted to DAS counting in effect in FY 2001). Prohibition on front-loading DAS clock. Minimum size: Cod 22 in. Gear: *Trawl:* GOM/GB RMAs: 6.5 in. diamond or square codend minimum; Southern New England RMA changed to 70W to 74W (vice 72-30W). 6.5 in. square, 7 in. diamond codend in SNE RMA. *Gillnet:* GOM: Trip gillnets – 6.5 in. mesh/150 nets; Day – 6.5 in./50 standup nets, 7 in./100 tiedown nets (prohibited March-June); GB – 6.5 in./50 nets, SNE – 6.5 in./75 nets; Mid-Atlantic: Trip – 5.5 in. diamond/6 in. square, Day – 5.5 in. diamond/6 in. square. *Hook*: no de-hookers with less than 6 in/. spacing, 12/0 circle hooks or larger; GOM: 2,000 rigged hooks, GB: 3,600 rigged hooks Closures: Add GB seasonal closure areas, May – Blocks 80, 81, 118, 119, 120 (south of 42-20N) Possession limits: *Yellowtail flounder*: SNE/MA: landing/possession of yellowtail flounder prohibited south of 40N. Mar 1 – May 31: 250 lbs./trip, June 1 – February 28: 500 lbs.-DAS/4,000 lbs. – trip. *Cod*: GOM: 500 lbs.-DAS/4,000 lbs./trip. Open access commercial permits limited to 200 lbs. regulated groundfish. Recreational: Cod/haddock: 23 in. minimum size. Party/charter: GOM RMA: April-November, 10 cod/haddock combined per person, Dec-Mar – 10 cod/haddock combined, no more than 5 cod per person per trip. Private: GOM RMA: December-March – 10 cod/haddock combined, no more than 5 cod.

Appendix A: Table 2 (Continued)
2003
January 15-February 27: Northern Shrimp season (38 days with days off)
March 13: Haddock possession limit suspended until May 1.
May 1: Haddock possession limit of 3,000 lbs-DAS/30,000 lbs.-trip
May 1: Framework Adjustment 37 Modifications to whiting management measures: extension of Cultivator Shoal whiting fishery by one month (June 15-October 31), changes to default measures, minor changes to Cape Cod Bay Raised Footrope Trawl exemption area.
May 13: Haddock possession limit revised to 30,000 lbs./trip (no daily limit).
July 9: Framework Adjustment 38 Raised footrope trawl whiting fishery in the inshore GOM, July 1 – November 30 each year.
July 28: Final emergency rule implementing FW 33 lawsuit settlement agreement Recreational: Haddock, 21 in. minimum size. Party/charter: GOM: Apr-Nov, 10 cod per person, December-March, 5 cod per person. Private: GOM: December-March, 10 cod/haddock combined, no more than 5 cod. Other areas: 10 cod/haddock combined.
October 7: Haddock possession limit suspended for the remainder of the fishing year.
2004
January 19-March 12: Northern Shrimp season (40 days with days off)
May 1: Implementation of Amendment 13. Measures based on emergency rule and measures in effect prior to interim rule. DAS: DAS for each permit re-categorized. Category 1: 60% of maximum DAS used FY 1996-2001 in years that permit landed 5,000 pounds regulated groundfish (est. 43,000 allocated). Category B: 40% of maximum DAS used FY 1996-2001 in years that permit landed 5,000 pounds regulated groundfish; can only be used in specific programs. DAS leasing and transfer programs allow DAS exchanges between vessels under limited conditions. (200 lbs. of winter flounder can be retained by vessels fishing for fluke west of 72-30 W without using a DAS). Minimum Size: No change from emergency rule Gear**:** *Trawl*: No change from emergency rule. *Gillnet*: GOM/GB: Day-6.5 in./50 standup nets, no seasonal restriction on tie-down nets; Trip: 6.5 in. mesh/150 nets. SNE/MA: 6.5 in. in. mesh/75 nets. *Hook: GOM:* 2,000 hooks. *GB*: 3,600 hooks Closures: Same as emergency rule, with addition of habitat closed areas; all except Jeffrey Bank and NLCA habitat closed area are within existing year-round closed areas. Possession limits: *GOM cod*: 800 lbs-DAS/4,000 lbs.-trip. GB cod: 1,000 lbs.-DAS/10,000 lbs.-trip. *CC/GOM yellowtail flounder*: April, May, October, November - 250 lbs. trip, other months 750 lbs.-DAS/3,000 lbs-trip. *SNE/MA yellowtail flounder*: March –June, 250 lbs. trip, other months 750 lbs.-DAS/3,000 lbs-trip. *Haddock*: 3,000 lbs.-DAS/30,000 lbs.-trip. Special Management Programs: *US/Canada Area*: hard TAC on cod, haddock (SAs 561, 562), yellowtail flounder (SAs 522, 525, 561, 562). Cod possession limit: 500 lbs-DAS/5,000 lbs-trip. No DAS charged to/from SAs 561, 562. Exempted Fisheries: Northern Shrimp fishery area restriction removed; General Category scallop fishery exemption in SAs 537, 538, 539, and 613.
May 14: Haddock possession limit suspended for remainder of the fishing year.
June 1: CAII Yellowtail Flounder Special Access Program Access to CAII south of 41-30N by trawl vessels targeting yellowtail flounder. Limited to 320 trips (total), two trips per vessel per month, yellowtail flounder limited to 30,000 lbs./trip. Authorized use of Category B DAS.
June 23: Amendment 10 to the Atlantic Sea Scallop FMP. 10-in. square mesh twine top required for all scallop dredge vessels in all areas.
September 3: CAII Yellowtail Flounder SAP ends (no trips can begin after this date)

November 2: Framework Adjustment 39 (Scallop Framework Adjustment 16

Appendix A: Table 2 (Continued)

Scallop dredge vessel access to portions of groundfish mortality CAII and NLCA in 2004, CAI and CAII in 2005, and CAI and NLCA in 2006.
Season: June 15 through January 31.
Possession limits: 1,000 lbs. regulated groundfish, no more than 100 lbs. cod. In NLCA, limited to 250 lbs.-trip yellowtail flounder in June. (Outside of access program, scallop vessels continue to be limited to 300 lbs. regulated groundfish per trip).
Yellowtail flounder catch capped at 10 percent of target TAC for the stock.

October 1: Closure of SAs 561 and 562 to all fishing on a multispecies DAS. Prohibition on the possession of yellowtail flounder from SAs 522, 525, 561, 562.

November 19: Framework Adjustment 40A

Closed Area I Haddock SAP

Access to small area of CAI to target haddock using longlines. Limited to 1,000 mt haddock TAC. Season ends December 31.

Eastern US/CA Area Haddock SAP Pilot Program

Access to northern corner of CAII and adjacent area to target haddock using separator trawl. Season: May 1 through December 31. Authorized use of Category B DAS.

Category B (regular) DAS Pilot Program

Vessels can use Category B (regular) DAS to target healthy stocks. Catch (kept and discarded) limited to 100 lbs. of cod, American plaice, white hake, witch flounder, ocean pout, SNE/MA winter flounder and windowpane flounder, 25 lbs.-DAS/250 lbs.-trip of yellowtail flounder. Maximum of 1,000 DAS can be used in each of four quarters from November 1, 2004 through October 31, 2005.

2006 Famework Adjustment 42

Established Bmsy targets and Fmsy thresholds for 18 groundfish stocks reviewed at GARMII in August 2005. This framework also established formal rebuilding plans for stocks that were classified as overfished, i.e., where the 2004 stock biomass was estimated to be less than ½ Bmsy

Appendix B: Tables 1 and 2. NEFSC spring and autumn bottom trawl survey stratified mean number per tow at age for Gulf of Maine cod, (strata 01260-01300, 01360-01400), 1963-2008 .

[a] Indices from 1970-2001 have been recalculated and may differ slightly from those reported previously (Mayo et al. 2002) due to slight modifications to the age-length keys and a better accounting of vessel effects in 1979 and 1987.

[b] Spring catch per tow at age indices for 1968-1969 were obtained by applying combined 1970-1981 age-length keys to stratified mean catch per tow at length distributions from each survey. Calculations were carried out only to age 10+.

[c] Autumn catch per tow at age indices for 1963-1969 were obtained by applying combined 1970-1981 age-length keys to stratified mean catch per tow at length distributions from each survey. Calculations were carried out only to age 10+.

[d] Spring surveys during 1973-1981 were accomplished with a '41 Yankee' trawl; in all other years, spring surveys were accomplished with a '36 Yankee' trawl. No adjustments have been made to the catch per tow data for these differences.

[e] During 1963-1984, BMV oval doors were used in the spring and autumn surveys; since 1985, Portuguese polyvalent doors have been used in both surveys. Adjustments have been made to the 1963-1984 catch per tow data to standardize these data to polyvalent door equivalents. Conversion coefficients of 1.56 (numbers) and 1.62 (weight) were used in this standardization (NESFC 1991).

[f] In the Gulf of Maine, spring surveys during 1980-1982, 1989-1991, 1994 and 2003, were conducted aboard R/V DELAWARE II; in all other years, the surveys were conducted aboard R/V ALBATROSS IV except in 1979 and 1987 when both vessels were deployed on portions of the survey. Adjustments have been made to the R/V DELAWARE II catch per tow data to standardize these to R/V ALBATROSS IV equivalents. Conversion coefficients of 0.79 (numbers) and 0.67 (weight) were used in this standardization (NEFSC 1991).

[g] In the Gulf of Maine, autumn surveys during 1977-1978, 1980, 1989-1991 and 1993 were conducted aboard R/V DELAWARE II; in all other years, the surveys were conducted aboard R/V ALBATROSS IV except in 1979 when both vessels were deployed on portions of the survey. Adjustments have been made to the R/V DELAWARE II catch per tow data to standardize these to R/V ALBATROSS IV equivalents. Conversion coefficients of 0.79 (numbers) and 0.67 (weight) were used in this standardization (NEFSC 1991).

Appendix B: Tables 3 and 4. Massachusetts DMF spring and autumn bottom trawl survey stratified mean number per tow at age for Gulf of Maine cod, regions 4 and 5 (strata 28-36), 1978-2007.

Appendix B: Table 1. Stratified mean number per tow at age and aggregate mean weight (kg) per tow for Gulf of Maine cod[1] based on NEFSC spring bottom trawl surveys, 1968-2008

NEFSC Spring survey stratified mean number per tow

	Age Group															Totals				Mean wgt/tow (kg)
Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14+	0+	4+	5+	6+	
1968	0.128	0.613	1.234	1.407	0.846	0.538	0.207	0.129	0.111	0.059	0.165	-	-	-		5.438	2.056	1.211	0.673	18.200
1969	0	0	0.036	0.307	0.88	0.807	0.633	0.256	0.144	0.089	0.101	-	-	-		3.253	2.909	2.03	1.223	13.190
1970	0	0.159	0.124	0.053	0.091	0.271	0.465	0.611	0.094	0.059	0.098	0.1	0.042	0.012	0.012	2.191	1.855	1.764	1.494	11.080
1971	0	0.026	0.151	0.105	0.286	0.048	0.084	0.3	0.206	0.154	0.058	0.013	0	0	0	1.429	1.148	0.862	0.814	7.000
1972	0	0.371	0.135	0.521	0.195	0.181	0.044	0.124	0.093	0.229	0.056	0.056	0.034	0	0.017	2.057	1.03	0.835	0.653	8.030
1973	0	0.035	4.25	0.89	0.632	0.348	0.194	0.096	0.221	0.261	0.198	0.075	0.106	0.132	0.088	7.525	2.35	1.718	1.37	18.810
1974	0	0.475	0.103	1.503	0.172	0.235	0.075	0.028	0.057	0.033	0.045	0.043	0.081	0	0.051	2.902	0.82	0.648	0.413	7.420
1975	0.006	0.096	0.686	0.131	1.105	0.269	0.079	0	0.006	0.018	0.028	0.026	0.062	0	0	2.512	1.593	0.488	0.219	6.040
1976	0	0.051	0.265	1.104	0.137	0.902	0.09	0.095	0.027	0	0.011	0	0.074	0.027	0	2.782	1.362	1.225	0.323	7.560
1977	0	0.025	0.297	0.553	1.925	0.111	0.831	0.011	0.083	0	0	0	0	0	0.038	3.872	2.998	1.073	0.962	8.540
1978	0	0.048	0.11	0.308	0.351	0.744	0.095	0.252	0.013	0.107	0	0.022	0	0	0	2.05	1.584	1.233	0.488	7.700
1979	0.044	0.484	1.63	0.219	0.449	0.299	0.587	0.102	0.112	0.013	0.031	0	0	0	0.025	3.993	1.617	1.168	0.869	8.360
1980	0.07	0.037	0.423	0.492	0.138	0.238	0.304	0.317	0	0.122	0.014	0	0	0	0	2.155	1.133	0.994	0.756	6.230
1981	0	1.075	0.644	0.841	1.342	0.331	0.264	0.116	0.121	0.1	0	0	0	0	0	4.832	2.272	0.93	0.6	10.650
1982	0.014	0.359	1.007	0.476	0.655	0.988	0.087	0.112	0	0.026	0.039	0	0	0	0	3.763	1.907	1.251	0.264	8.620
1983	0.013	0.632	0.949	0.997	0.465	0.404	0.212	0.068	0.016	0.071	0.018	0.008	0.03	0	0.03	3.912	1.322	0.857	0.453	10.960
1984	0	0.151	1.312	1.023	0.823	0.212	0.047	0.1	0	0	0	0	0	0	0	3.667	1.182	0.359	0.147	6.140
1985	0	0.029	0.231	0.662	0.663	0.662	0.103	0.091	0.052	0	0.026	0	0	0	0	2.517	1.596	0.933	0.272	7.650
1986	0	0.537	0.248	0.754	0.237	0.091	0.035	0.038	0	0	0	0	0.018	0	0	1.957	0.419	0.182	0.090	3.480
1987	0	0.03	0.46	0.199	0.231	0.074	0	0.066	0.008	0	0	0	0	0	0.015	1.083	0.394	0.163	0.088	1.980
1988	0.029	0.717	0.923	0.823	0.218	0.254	0.092	0.065	0	0.007	0	0	0	0	0	3.127	0.635	0.417	0.163	3.600
1989	0	0.017	0.605	0.723	0.6	0.091	0.063	0.014	0	0	0	0	0	0	0	2.112	0.768	0.168	0.077	2.420
1990	0	0	0.208	1.365	0.637	0.102	0.032	0.018	0	0	0	0	0	0	0	2.362	0.789	0.152	0.050	3.080
1991	0	0.038	0.068	0.234	1.717	0.299	0.02	0.018	0	0	0	0	0	0	0	2.393	2.054	0.337	0.038	2.890
1992	0	0.05	0.226	0.242	0.282	1.328	0.226	0.069	0	0.012	0	0	0	0	0	2.435	1.917	1.635	0.307	8.630
1993	0	0.201	0.497	0.799	0.334	0.091	0.484	0.055	0.023	0	0	0.023	0	0	0	2.507	1.010	0.676	0.585	5.880
1994	0	0.015	0.316	0.388	0.215	0.094	0.049	0.127	0.027	0.022	0.018	0	0	0	0	1.271	0.553	0.338	0.244	2.430
1995	0	0.05	0.179	1.116	0.372	0.145	0.028	0	0.011	0	0	0	0	0.028	0	1.930	0.585	0.213	0.068	2.430
1996	0	0.057	0.022	0.593	1.331	0.403	0.059	0	0	0	0	0	0	0	0	2.465	1.793	0.463	0.059	5.430
1997	0	0.159	0.132	0.399	0.264	0.876	0.242	0.12	0	0	0	0	0	0	0	2.192	1.502	1.238	0.362	5.620
1998	0	0.018	0.224	0.33	0.517	0.142	0.421	0.023	0.037	0	0	0	0	0	0	1.710	1.139	0.622	0.481	4.180
1999	0	0.166	0.344	0.713	0.345	0.315	0.134	0.273	0	0	0	0	0	0.011	0	2.301	1.078	0.733	0.418	5.090
2000	0.026	1.184	0.725	0.439	0.457	0.107	0.101	0.024	0.022	0	0	0	0	0	0	3.083	0.710	0.253	0.146	3.210
2001	0	0.029	0.323	0.716	0.497	0.354	0.064	0.098	0.055	0	0.011	0	0	0	0	2.146	1.078	0.581	0.227	6.220
2002	0	0.34	0.045	0.524	1.601	0.614	0.362	0.164	0.057	0.016	0	0	0	0	0	3.724	2.814	1.213	0.598	10.930
2003	0	0.069	0.831	0.063	0.708	1.089	0.395	0.321	0.103	0.073	0.027	0	0	0	0	3.677	2.715	2.007	0.918	9.500
2004	0	0.136	0.045	0.221	0.118	0.191	0.232	0.014	0.014	0.01	0	0	0	0	0	0.981	0.579	0.461	0.270	2.410
2005	0	0.02	0.7265	0.1014	0.6076	0.0154	0.1498	0.1297	0.0142	0	0	0	0	0	0	1.765	0.917	0.309	0.294	2.700
2006	0.0284	0.1858	0.2272	0.4344	0.0595	0.1892	0.021	0.1314	0.0729	0	0.013	0	0	0	0	1.363	0.487	0.428	0.238	2.702
2007	0	0.092	3.4799	2.89	4.3461	0.5376	0.9437	0.0652	0.0384	0	0	0	0	0	0	12.393	5.931	1.585	1.047	15.811
2008	0	0.0661	1.0986	3.2112	1.3566	0.9393	0.0584	0.0806	0	0	0	0	0	0	0	6.811	2.435	1.078	0.139	9.386

1. Strata 01260-01300 and 01360-01400.

Appendix B: Table 2. Stratified mean number per tow at age and aggregate mean weight (kg) per tow for Gulf of Maine cod[1] based on NEFSC autumn bottom trawl surveys, 1963-2007.

NEFSC Autumn stratified mean number per tow

	Age Group															Totals				Mean wgt/tow (kg)
Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14+	0+	3+	4+	5+	
1963	0.05	0.649	1.349	1.253	0.849	0.579	0.537	0.3	0.183	0.095	0.075	-	-	-		5.917	3.869	2.616	1.767	17.950
1964	0	0.092	0.122	0.417	0.856	0.853	0.783	0.373	0.237	0.114	0.101	-	-	-		4.003	3.789	3.318	2.462	22.800
1965	0.002	0.85	0.88	0.824	0.75	0.496	0.374	0.17	0.08	0.044	0.025	-	-	-		4.494	2.763	1.939	1.189	12.010
1966	0.17	0.204	0.64	0.697	0.718	0.558	0.441	0.192	0.078	0.048	0.036	-	-	-		3.783	2.769	2.072	1.354	12.920
1967	0.012	0.129	0.215	0.574	0.671	0.384	0.268	0.162	0.07	0.041	0.034	-	-	-		2.562	2.204	1.630	0.959	9.230
1968	0.012	0.036	0.179	0.719	1.256	0.973	0.627	0.261	0.156	0.072	0.095	-	-	-		4.387	4.159	3.440	2.184	19.440
1969	0.016	0.059	0.123	0.354	0.63	0.552	0.466	0.22	0.145	0.129	0.062	-	-	-		2.758	2.560	2.206	1.576	15.370
1970	0.802	0.883	0.26	0.538	0.329	0.486	0.425	0.811	0.132	0.094	0.036	0.037	0.073	0	0	4.905	2.960	2.422	2.093	16.440
1971	1.319	0.179	0.276	0.219	0.578	0.478	0.455	0.236	0.298	0.163	0.066	0.034	0.061	0	0	4.361	2.588	2.368	1.790	16.530
1972	0.031	5.578	1.215	1.528	0.233	0.09	0.14	0.07	0.138	0.262	0	0	0	0	0.016	9.301	2.477	0.949	0.716	12.990
1973	0.638	0.329	2.17	0.139	0.507	0.213	0.077	0.027	0.051	0.183	0.102	0	0	0.016	0	4.452	1.315	1.176	0.669	8.760
1974	0.283	1.134	0.266	1.876	0.167	0.274	0.051	0.046	0.036	0.033	0.033	0.098	0	0	0.033	4.328	2.646	0.770	0.603	8.960
1975	0.047	0.177	3.045	0.138	2.333	0.259	0.109	0.017	0.006	0	0	0.006	0.006	0	0	6.143	2.874	2.736	0.403	8.620
1976	0	0.23	0.221	0.633	0.077	0.773	0.052	0.132	0	0	0.031	0	0	0	0	2.148	1.697	1.064	0.988	6.740
1977	0	0.042	0.416	0.465	1.157	0.114	0.629	0.044	0.09	0.022	0.032	0	0.044	0.019	0	3.073	2.615	2.150	0.994	10.200
1978	0.248	1.373	0.378	1.135	0.658	1.426	0.109	0.31	0.005	0.083	0.007	0.013	0	0.028	0	5.773	3.773	2.638	1.980	12.900
1979	0.002	0.381	0.588	0.145	0.708	0.337	0.688	0.044	0.181	0	0.053	0	0	0	0.018	3.142	2.172	2.027	1.319	13.930
1980	0.027	1.321	2.52	1.78	0.492	0.194	0.36	0.207	0.036	0.025	0	0.036	0	0.014	0.022	7.034	3.165	1.385	0.894	14.200
1981	0.01	0.618	0.419	0.539	0.405	0.121	0.076	0.029	0.09	0	0.043	0	0	0	0	2.349	1.302	0.763	0.358	7.530
1982	0	0.843	3.353	2.275	1.089	0.209	0	0	0	0	0	0	0	0	0	7.769	3.573	1.298	0.209	15.920
1983	0	0.317	0.916	0.828	0.197	0.227	0.21	0	0	0	0.027	0.028	0.037	0	0	2.786	1.553	0.726	0.529	8.420
1984	0.022	0.432	0.426	0.631	0.387	0.214	0.163	0.079	0	0.03	0	0	0.03	0.035	0	2.449	1.569	0.938	0.551	8.740
1985	0.121	0.526	0.957	0.609	0.248	0.182	0.075	0	0.034	0.021	0.01	0	0.01	0	0.029	2.821	1.218	0.609	0.361	8.260
1986	0	0.392	0.401	0.657	0.342	0.073	0.041	0	0.011	0.034	0	0	0	0	0	1.950	1.157	0.501	0.159	4.720
1987	0.128	0.578	1.38	0.592	0.243	0.075	0	0	0	0	0	0	0	0	0	2.996	0.910	0.318	0.075	3.390
1988	0	1.938	2.313	0.99	0.443	0.099	0.065	0.033	0.011	0.011	0	0	0	0	0	5.903	1.652	0.662	0.219	6.620
1989	0	0.15	2.407	1.502	0.293	0.161	0.033	0	0	0	0.009	0	0	0	0	4.553	1.997	0.495	0.202	4.540
1990	0.006	0.045	0.187	1.829	0.598	0.259	0.052	0.01	0	0	0	0	0	0	0	2.986	2.748	0.919	0.321	4.910
1991	0.009	0.144	0.139	0.223	0.633	0.081	0	0.023	0	0	0	0	0	0	0	1.252	0.960	0.737	0.104	2.780
1992	0.059	0.291	0.446	0.14	0.036	0.35	0.104	0.008	0	0	0	0	0	0	0	1.433	0.638	0.498	0.462	2.450
1993	0.043	0.198	0.568	0.36	0.034	0	0.03	0	0	0	0	0	0	0	0	1.232	0.424	0.064	0.030	1.000
1994	0.032	0.207	0.883	0.826	0.085	0.051	0	0.045	0	0	0	0	0	0	0	2.130	1.008	0.182	0.096	2.740
1995	0.008	0.068	0.285	1.228	0.325	0.082	0.011	0	0	0	0	0	0	0	0	2.008	1.647	0.419	0.093	3.670
1996	0.029	0.124	0.383	0.188	0.542	0.062	0	0	0	0	0	0	0	0	0	1.327	0.792	0.604	0.062	2.350
1997	0	0.297	0.086	0.177	0.173	0.14	0	0	0	0	0	0	0	0	0	0.872	0.490	0.313	0.140	1.870
1998	0.05	0.097	0.32	0.115	0.192	0.039	0.031	0	0	0	0	0	0	0	0	0.843	0.376	0.262	0.069	1.500
1999	0.025	0.431	0.367	0.586	0.243	0.132	0.016	0.006	0	0	0	0	0	0	0	1.807	0.984	0.398	0.155	3.510
2000	0.008	0.533	0.984	0.394	0.507	0.134	0.01	0	0.011	0.023	0	0	0	0	0	2.604	1.079	0.686	0.178	4.650
2001	0.018	0.034	0.141	0.752	0.469	0.337	0.122	0.084	0	0.023	0	0	0	0	0	1.980	1.788	1.035	0.566	7.330
2002	0	0.269	0.081	0.364	2.797	1.096	0.627	0.051	0.043	0	0	0	0	0	0	5.328	4.979	4.615	1.818	24.660
2003	0.542	0.455	0.198	0.185	0.529	0.45	0.073	0.077	0	0.011	0	0.011	0	0	0	2.529	1.335	1.150	0.622	5.990
2004	1.38	0.651	0.168	0.581	0.231	0.253	0.168	0.068	0.011	0.01	0.011	0	0	0	0	3.533	1.334	0.753	0.522	4.900
2005	0.034	0.1533	0.3806	0.0796	0.4495	0.0221	0.0923	0.0824	0.0227	0.0214	0	0	0	0	0	1.338	0.690	0.241	0.219	2.897
2006	0.0638	1.2514	0.5802	1.0331	0.2475	0.2857	0.0339	0.0496	0.0296	0	0.0057	0.0137	0	0	0	3.594	0.666	0.418	0.133	4.229
2007	0.0113	0.1456	0.831	0.384	0.5283	0.0226	0.069	0	0	0	0	0	0	0	0	1.992	0.620	0.092	0.069	2.714

1. Strata 01260-01300 and 01360-01400.

Appendix B: Table 3. Stratified mean number per tow at age and aggregate mean weight (kg) per tow for Gulf of Maine cod[1] based on Massachusetts DMF spring inshore bottom trawl surveys, 1978-2007.

MADMF Spring stratified mean number per tow																					
	Age Group															Totals					Stratified Mean
Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Total	0+	1+	2+	3+	Wgt/tow(kg)
1978	31.43	6.33	2.59	3.61	2.00	1.76	0.07	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	47.89	47.87	16.44	10.11	7.52	11.05
1979	69.49	19.62	2.07	0.56	2.41	1.02	1.27	0.02	0.11	0.00	0.00	0.00	0.00	0.00	0.00	96.56	96.57	27.08	7.46	5.39	14.28
1980	9.03	42.81	10.45	1.80	0.22	0.89	0.40	0.35	0.00	0.04	0.00	0.00	0.00	0.00	0.00	65.98	65.99	56.96	14.15	3.70	14.51
1981	26.48	23.01	12.52	6.15	0.96	0.15	0.02	0.00	0.12	0.00	0.00	0.00	0.00	0.00	0.00	69.41	69.41	42.93	19.92	7.40	18.69
1982	1.71	13.29	7.17	2.41	0.87	0.22	0.08	0.04	0.05	0.00	0.00	0.00	0.00	0.00	0.00	25.84	25.84	24.13	10.84	3.67	12.16
1983	0.77	34.75	14.61	2.86	1.50	0.25	0.03	0.04	0.03	0.00	0.00	0.00	0.00	0.00	0.00	54.85	54.84	54.07	19.32	4.71	18.75
1984	0.26	1.96	5.15	2.07	0.70	0.05	0.05	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.33	10.32	10.06	8.10	2.95	7.24
1985	1.09	1.79	2.77	2.27	0.45	0.05	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.46	8.45	7.36	5.57	2.80	4.77
1986	1.14	9.26	11.68	1.23	0.68	0.07	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	24.09	24.09	22.95	13.69	2.01	7.84
1987	0.78	8.29	4.71	2.96	0.22	0.09	0.06	0.03	0.00	0.07	0.00	0.00	0.00	0.00	0.00	17.21	17.21	16.43	8.14	3.43	7.87
1988	1.88	10.05	6.35	2.45	1.45	0.01	0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	22.24	22.25	20.37	10.32	3.97	7.70
1989	0.18	21.59	20.51	8.76	1.06	0.10	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	52.24	52.24	52.06	30.47	9.96	16.82
1990	4.92	4.63	5.45	14.75	2.31	0.31	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	32.41	32.41	27.49	22.86	17.41	15.88
1991	0.35	5.01	2.69	1.57	3.66	0.40	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	13.70	13.69	13.34	8.33	5.64	8.73
1992	1.51	4.50	5.13	3.67	0.75	1.26	0.09	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	16.92	16.93	15.42	10.92	5.79	8.77
1993	79.84	2.99	6.11	2.55	0.90	0.09	0.17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	92.66	92.65	12.81	9.82	3.71	5.86
1994	4.63	4.79	4.07	1.75	0.49	0.16	0.01	0.03	0.00	0.01	0.00	0.00	0.00	0.00	0.00	15.96	15.94	11.31	6.52	2.45	3.89
1995	12.03	5.83	1.92	2.76	0.78	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	23.36	23.37	11.34	5.51	3.59	3.99
1996	8.94	0.64	0.52	1.08	1.49	0.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	12.96	12.97	4.03	3.39	2.87	3.15
1997	12.47	2.88	0.98	0.93	0.17	0.42	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	17.89	17.90	5.43	2.55	1.57	2.50
1998	23.48	1.49	0.83	0.70	0.75	0.06	0.24	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	27.57	27.56	4.08	2.59	1.76	3.25
1999	143.00	11.68	2.39	2.31	0.78	0.64	0.07	0.18	0.01	0.00	0.00	0.00	0.00	0.00	0.00	161.06	161.06	18.06	6.38	3.99	9.00
2000	2.15	35.14	7.02	2.89	2.20	0.71	0.49	0.09	0.08	0.00	0.00	0.00	0.00	0.00	0.00	50.77	50.77	48.62	13.48	6.46	20.60
2001	25.99	0.08	4.50	4.97	3.52	2.07	0.42	0.26	0.03	0.00	0.00	0.00	0.00	0.00	0.00	41.84	41.84	15.85	15.77	11.27	26.45
2002	0.92	19.29	0.26	1.23	1.41	0.56	0.30	0.16	0.13	0.03	0.03	0.00	0.01	0.00	0.00	24.34	24.33	23.41	4.12	3.86	11.16
2003	1097.97	6.20	12.70	0.28	1.43	1.33	0.29	0.13	0.04	0.00	0.00	0.00	0.00	0.00	0.00	1120.37	1120.37	22.40	16.20	3.50	10.98
2004	116.15	9.21	1.56	2.58	0.46	0.90	0.64	0.04	0.04	0.01	0.00	0.00	0.00	0.00	0.00	131.59	131.59	15.44	6.23	4.67	8.15
2005	180.85	1.06	7.15	0.57	2.07	0.18	0.95	0.35	0.08	0.00	0.00	0.00	0.00	0.00	0.00	193.26	193.26	12.41	11.35	4.20	10.40
2006	1053.70	14.89	3.67	3.38	0.54	0.69	0.01	0.06	0.07	0.00	0.00	0.00	0.00	0.00	0.00	1077.03	1077.01	23.31	8.42	4.75	9.18
2007	49.35	4.37	3.36	1.84	1.75	0.32	0.54	0.04	0.01	0.00	0.00	0.00	0.00	0.00	0.00	61.58	61.58	12.23	7.86	4.50	8.43

1. Mass. Regions 4 and 5 (strata 25-36)

Appendix B: Table 4. Stratified mean number per tow at age and aggregate mean weight (kg) per tow for Gulf of Maine cod[1] based on Massachusetts DMF autumn inshore bottom trawl surveys, 1978-2007.

MADMF Autumn stratified mean number per tow																					
	Age Group															Totals					Stratified Mean
Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Total	0+	1+	2+	3+	Wgt/tow(kg)
1978	151.81	3.95	0.02	0.07	0.01	0.09	0.02	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	156.06	156.06	4.25	0.30	0.28	1.51
1979	5.72	2.93	0.20	0.00	0.04	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.92	8.92	3.20	0.27	0.07	1.05
1980	6.00	5.46	1.06	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	12.53	12.54	6.54	1.08	0.02	1.28
1981	1.45	6.20	1.25	0.36	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.29	9.28	7.83	1.63	0.38	3.64
1982	4.59	1.14	0.31	0.04	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.12	6.12	1.53	0.39	0.08	0.66
1983	1.27	0.28	0.10	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.68	1.68	0.41	0.13	0.03	0.09
1984	10.30	0.16	0.07	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.55	10.54	0.24	0.08	0.01	0.13
1985	2.65	0.19	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.87	2.87	0.22	0.03	0.01	0.07
1986	1.80	0.55	0.37	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.75	2.75	0.95	0.40	0.03	0.25
1987	311.72	1.40	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	313.15	313.14	1.42	0.02	0.00	0.35
1988	5.53	3.10	0.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.87	8.87	3.34	0.24	0.00	0.37
1989	3.94	0.02	0.10	0.07	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.15	4.15	0.21	0.19	0.09	0.22
1990	7.81	4.22	0.31	0.32	0.02	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	12.71	12.71	4.90	0.68	0.37	0.76
1991	5.04	2.00	0.36	0.02	0.05	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.48	7.49	2.45	0.45	0.09	0.48
1992	26.42	0.99	0.04	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	27.50	27.49	1.07	0.08	0.04	0.27
1993	49.43	1.53	0.36	0.17	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	51.50	51.51	2.08	0.55	0.19	1.35
1994	40.01	5.36	3.45	0.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	49.00	49.01	9.00	3.64	0.19	2.00
1995	2.93	0.80	0.41	0.49	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.66	4.65	1.72	0.92	0.51	0.81
1996	6.90	0.08	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.01	7.01	0.11	0.03	0.02	0.08
1997	1.43	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.46	1.46	0.03	0.00	0.00	0.01
1998	3.27	0.64	0.32	0.04	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.33	4.32	1.05	0.41	0.09	0.36
1999	7.33	0.59	0.07	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.01	8.00	0.67	0.08	0.01	0.31
2000	0.05	0.40	0.17	0.04	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.68	0.68	0.63	0.23	0.06	0.27
2001	49.19	0.01	0.13	0.13	0.04	0.05	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	49.55	49.56	0.37	0.36	0.23	0.76
2002	0.96	1.09	0.13	0.25	0.36	0.44	0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.30	3.29	2.33	1.24	1.11	3.99
2003	120.17	1.60	0.14	0.05	0.20	0.11	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	122.28	122.28	2.11	0.51	0.37	1.85
2004	44.67	9.94	0.92	1.19	0.19	0.45	0.25	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	57.62	57.62	12.95	3.01	2.09	5.58
2005	39.47	0.61	0.24	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	40.35	40.35	0.88	0.27	0.03	0.21
2006	2.08	4.35	0.42	0.48	0.06	0.08	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.50	7.50	5.42	1.07	0.65	1.94
2007	7.61	0.16	0.13	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.92	7.91	0.30	0.14	0.01	2.94

1 Mass. Regions 4 and 5 (strata 25-36)

Appendix C:

Table 1: Base VPA Results for Gulf of Maine Cod, 1982-2007.

Table 2: Bootstrap Results from the Base VPA for Gulf of Maine Cod.

Table 3: Retrospective Analyses from the Base VPA for Gulf of Maine Cod, 2000-2007

Appendix C: Table 1. Base VPA Output Results for Gulf of Maine Cod

VPA Version 2.7.1

Model ID: GoM Cod 2008 VPA Update GARMIII TY2007 11+

Input File: C:\ALLWORK\ASSESS\GARMIIIAUG2008WG\ASSMT_MTG\GOMCOD\VPA\FINALS\GMCOD2008_GARMIII
Date of Run: 17-JUL-2008 Time of Run: 13:23

Levenburg-Marquardt Algorithm Completed 21 Iterations
Residual Sum of Squares = 279.707

Number of Residuals = 508
Number of Parameters = 9
Degrees of Freedom = 499
Mean Squared Residual = 0.560535
Standard Deviation = 0.748689

Number of Years = 26
Number of Ages = 11
First Year = 1982
Youngest Age = 1
Oldest True Age = 10

Number of Survey Indices Available = 25
Number of Survey Indices Used in Estimate = 23

VPA Classic Method - Auto Estimated Q's

Stock Numbers Predicted in Terminal Year Plus One (2008)

Age	Stock Predicted	Std. Error	CV
2	3936.752	0.173583E+04	0.440929E+00
3	16020.398	0.499998E+04	0.312101E+00
4	3542.738	0.930299E+03	0.262593E+00
5	3970.448	0.103469E+04	0.260597E+00
6	201.340	0.776978E+02	0.385903E+00
7	251.280	0.110401E+03	0.439357E+00
8	29.920	0.163265E+02	0.545679E+00
9	46.873	0.324104E+02	0.691456E+00
10	71.277	0.516470E+02	0.724592E+00

Catchability Values for Each Survey Used in Estimate

INDEX	Catchability	Std. Error	CV
1	0.639060E-04	0.988283E-05	0.154646E+00
2	0.131940E-03	0.141520E-04	0.107261E+00
3	0.225008E-03	0.228294E-04	0.101460E+00
4	0.293998E-03	0.386906E-04	0.131602E+00
5	0.382779E-03	0.641901E-04	0.167695E+00
6	0.566609E-03	0.109588E-03	0.193411E+00
7	0.511812E-03	0.139644E-03	0.272843E+00
8	0.533836E-04	0.687041E-05	0.128699E+00
9	0.113582E-03	0.128656E-04	0.113272E+00
10	0.223833E-03	0.225992E-04	0.100965E+00
11	0.370258E-03	0.463840E-04	0.125275E+00
12	0.478237E-03	0.565335E-04	0.118212E+00
13	0.451154E-03	0.836411E-04	0.185394E+00
14	0.566767E-03	0.129170E-03	0.227906E+00
15	0.710558E-03	0.107424E-03	0.151183E+00
16	0.544643E-03	0.474923E-04	0.871988E-01
17	0.453706E-03	0.562280E-04	0.123930E+00
19	0.122958E-03	0.367937E-04	0.299238E+00
21	0.245830E-05	0.690050E-06	0.280702E+00
22	0.140563E-04	0.164576E-05	0.117084E+00
23	0.231650E-04	0.128111E-05	0.553035E-01
24	0.229116E-04	0.123947E-05	0.540979E-01
25	0.218712E-04	0.246650E-05	0.112774E+00

-- Non-Linear Least Squares Fit --

Default Tolerances Used

Scaled Gradient Tolerance = 6.055454E-06
Scaled Step Tolerance = 3.666853E-11
Relative Function Tolerance = 3.666853E-11
Absolute Function Tolerance = 4.930381E-32

VPA Method Options

- Catchability Values Estimated as an Analytic Function of N
- Pope Approximation Used in Cohort Solution
- Plus Group Backward Calculation Method Used
- Rivard Weights Used for JAN-1 Biomass
- Rivard Weights Used for SSB Biomass
- Rivard Weights Calculation Used 3 Years for Terminal Year Plus One

- Heincke Rule Used in F-Oldest Calculation
- F-Oldest Calculation in Years Prior to Terminal Year
  Uses Stock Sizes in Ages 5 to 9
- Calculation of Population of Age 1 In Year 2008
  = Set to Zero

Stock Estimates

Age 2
Age 3
Age 4
Age 5
Age 6
Age 7
Age 8
Age 9
Age 10

Full F in Terminal Year = 0.6492
F in Oldest True Age in Terminal Year = 0.4888

Full F Calculated Using Classic Method

Age	Input Partial Recruitment	Calc Partial Recruitment	Fishing Mortality	Used In Full F	Comments
1	0.000	0.000	0.0000	NO	Stock Estimate in T+1
2	0.002	0.001	0.0004	NO	Stock Estimate in T+1
3	0.162	0.060	0.0388	NO	Stock Estimate in T+1
4	0.682	0.290	0.1880	NO	Stock Estimate in T+1
5	0.900	0.754	0.4892	NO	Stock Estimate in T+1
6	1.000	1.000	0.6492	YES	Stock Estimate in T+1
7	0.826	0.352	0.2288	NO	Stock Estimate in T+1
8	0.733	0.572	0.3714	NO	Stock Estimate in T+1
9	0.772	0.229	0.1484	NO	Stock Estimate in T+1
10	0.753	0.753	0.4888		Input PR * Full F

Catch at Age - Input Data

AGE	1982	1983	1984	1985	1986
1	71.4	11.3	24.7	44.3	12.8
2	1980.9	1324.4	801.5	1064.5	186.0
3	2420.3	2917.6	1581.5	2187.8	2756.8
4	1422.1	1189.0	1636.5	1137.1	929.6
5	747.1	687.2	470.1	667.5	277.0
6	77.1	452.6	207.6	133.2	199.9
7	97.7	50.0	78.4	78.5	45.7
8	65.6	65.4	19.3	32.1	30.2
9	41.0	25.2	15.0	4.0	35.6
10	4.0	11.8	11.6	11.0	8.0
11	33.0	19.4	18.4	11.0	59.5

AGE	1987	1988	1989	1990	1991
1	96.3	2.4	3.8	0.0	0.0
2	889.6	549.1	519.5	253.6	438.5
3	1321.0	2128.0	2280.6	4125.6	1341.1
4	1505.8	1117.1	1715.7	2455.9	4910.7
5	346.4	428.8	488.0	523.3	930.6
6	91.5	49.3	92.8	176.6	158.8
7	83.7	11.2	41.2	27.0	46.8
8	13.9	17.9	6.4	30.0	30.0
9	13.6	1.0	3.0	10.0	7.9
10	10.3	2.0	5.0	15.0	1.3
11	3.0	1.0	7.0	17.0	1.0

AGE	1992	1993	1994	1995	1996
1	0.0	0.0	0.9	18.1	0.0
2	338.3	127.8	54.0	277.0	90.0
3	587.1	2031.8	1488.2	1169.9	630.7
4	531.9	783.0	1216.6	1192.0	1936.7
5	2188.4	139.4	330.9	232.5	384.3
6	219.1	473.8	71.0	28.6	36.9
7	65.3	29.2	85.7	13.9	4.5
8	7.4	6.0	29.5	18.4	0.5
9	12.0	2.0	6.7	0.8	1.3
10	3.0	0.0	0.6	1.6	0.0
11	0.0	0.0	1.2	0.2	0.0

AGE	1997	1998	1999	2000	2001
1	0.0	0.0	1.2	0.0	0.0
2	85.4	107.5	22.1	201.1	147.2
3	495.2	482.4	647.2	534.0	1183.5
4	455.5	594.8	568.0	828.3	685.5
5	852.4	158.7	272.6	190.3	378.0
6	71.4	191.4	58.0	98.9	109.1
7	5.0	26.2	79.2	16.1	59.8
8	2.6	3.9	7.9	7.1	8.9
9	0.3	0.4	0.0	0.0	13.3
10	0.7	1.1	4.4	0.0	1.2
11	0.1	0.4	0.0	0.0	0.5

AGE	2002	2003	2004	2005	2006
1	0.0	0.0	0.0	0.0	0.0
2	3.0	16.4	0.9	7.5	1.6
3	259.5	118.6	357.8	134.1	177.4
4	884.3	442.9	249.9	813.8	281.3
5	346.0	766.1	409.6	95.2	449.3
6	203.5	231.4	266.0	265.3	32.5
7	81.0	103.3	74.6	120.9	97.2
8	35.5	39.9	36.9	32.5	48.0
9	9.5	21.7	19.3	19.2	18.2
10	9.4	9.9	11.3	8.1	10.8
11	0.6	7.4	3.5	8.3	8.8

AGE	2007
1	0.0
2	7.9
3	154.8
4	907.5
5	140.4
6	253.8
7	8.5
8	23.3
9	12.6
10	6.7
11	7.5

Catch Weights at Age - Input Data

AGE	1982	1983	1984	1985	1986
1	0.6440	0.4460	0.5060	0.4660	0.3990
2	1.1110	1.0620	1.0200	0.9950	1.1220
3	1.6190	1.6100	1.6130	1.6010	1.7960
4	2.6980	2.4400	2.6980	2.7750	2.8860
5	4.7180	3.7510	3.6600	4.3850	4.5540
6	6.5770	6.0250	5.8080	5.4240	6.0200
7	8.7400	5.7750	8.0700	7.8590	8.1200
8	9.7630	10.3910	9.7410	11.3120	10.8450
9	12.9510	9.9510	12.8450	12.7500	13.5720
10	10.2500	12.8550	13.9870	12.8180	13.6400
11	18.5760	18.1250	14.9620	13.8180	19.5780

AGE	1987	1988	1989	1990	1991
1	0.2060	0.3180	0.6800	0.4160	0.4160
2	0.9520	0.9640	1.1990	1.0820	1.1820
3	1.5460	1.7380	1.7220	1.6860	1.5420
4	3.1310	2.3780	2.9340	2.3000	2.4330
5	4.8110	5.0970	3.8440	4.1870	4.0060
6	7.1610	6.4500	4.3090	7.4070	7.4210
7	9.5210	8.9190	9.0180	10.7410	9.6890
8	10.0530	11.0220	11.0340	11.8000	12.3000
9	13.1950	11.0000	14.3330	15.3000	14.0030
10	13.1320	18.0000	17.4000	14.2670	25.6720
11	13.3330	14.0000	23.2860	20.5880	17.0000

AGE	1992	1993	1994	1995	1996
1	0.4160	0.4160	0.1320	0.2740	0.5880
2	1.5540	1.1890	1.3830	1.4150	1.5430
3	1.9500	1.8210	1.8080	1.7970	2.1430
4	2.7410	2.3980	2.9620	2.6620	2.3100
5	3.0800	4.2250	3.3470	5.0510	3.4860
6	4.9910	6.0990	6.2800	5.5780	7.3530
7	9.4890	10.0220	7.1850	10.7600	10.4260
8	12.0270	13.1670	10.4480	11.4920	13.9120
9	13.4170	13.5000	10.3310	18.8930	14.7240
10	16.3330	14.7850	18.5420	20.0640	14.7850
11	17.5760	17.5760	20.6370	20.3470	17.5760

AGE	1997	1998	1999	2000	2001
1	0.4160	0.4170	0.3340	0.4160	0.4160
2	1.7740	1.3730	1.3410	1.6190	1.7680
3	2.2160	2.0720	1.8350	2.2840	2.3870
4	3.0460	2.8460	2.5650	3.4230	3.1940
5	3.1240	4.1350	3.8430	4.4320	4.7320
6	4.7910	4.2240	5.7730	5.7070	6.2960
7	8.4050	5.1770	7.2010	6.0130	7.2660
8	11.5470	11.3130	9.9150	8.5210	8.3510
9	14.7260	18.8930	12.8700	12.8700	8.6430
10	15.8140	14.9530	13.4020	14.7850	12.4140
11	21.8740	20.3470	17.5760	17.5760	24.4180

AGE	2002	2003	2004	2005	2006
1	0.4160	0.4160	0.4160	0.4160	0.4160
2	1.3570	1.9290	1.4740	1.5740	2.3030
3	2.4580	2.4090	2.3400	2.0580	2.4250
4	3.2690	3.0580	3.2240	2.8330	3.2610
5	4.0260	3.9980	3.6470	4.3070	3.7510

6	5.8860	5.2890	5.2590	4.5090	4.8450
7	6.7020	7.5220	6.8890	6.2390	5.5140
8	11.5140	8.7600	9.3960	7.8350	7.6100
9	10.1740	10.8340	11.7750	10.4400	9.6540
10	10.6620	12.2690	12.9440	13.4280	12.1620
11	14.3330	13.0740	13.2600	14.3820	15.6640

AGE	2007
1	0.4160
2	2.0270
3	2.5260
4	3.2220
5	3.9270
6	4.7940
7	6.3620
8	7.0750
9	10.1060
10	11.7210
11	14.3140

JAN-1 Weights at Age - Input Data

AGE	1982	1983	1984	1985	1986
1	0.5015	0.2949	0.3608	0.3003	0.2583
2	0.9229	0.8270	0.6745	0.7096	0.7231
3	1.3188	1.3374	1.3088	1.2779	1.3368
4	2.2882	1.9876	2.0842	2.1157	2.1495
5	4.1750	3.1812	2.9884	3.4396	3.5549
6	7.0188	5.3316	4.6675	4.4555	5.1379
7	8.0156	6.1630	6.9729	6.7561	6.6365
8	9.6703	9.5298	7.5003	9.5545	9.2321
9	12.9993	9.8566	11.5530	11.1444	12.3906
10	11.5216	12.9029	11.7977	12.8315	13.1875
11	18.5760	18.1250	14.9620	13.8180	19.5780

AGE	1987	1988	1989	1990	1991
1	0.0952	0.1638	0.5391	0.2468	0.2152
2	0.6163	0.4456	0.6175	0.8578	0.7012
3	1.3170	1.2863	1.2884	1.4218	1.2917
4	2.3713	1.9174	2.2582	1.9901	2.0253
5	3.7262	3.9948	3.0234	3.5049	3.0354
6	5.7106	5.5705	4.6865	5.3360	5.5742
7	7.5708	7.9918	7.6267	6.8032	8.4715
8	9.0350	10.2441	9.9203	10.3156	11.4941
9	11.9624	10.5159	12.5689	12.9931	12.8544
10	13.3502	15.4114	13.8347	14.3000	19.8187
11	13.3330	14.0000	23.2860	20.5880	17.0000

AGE	1992	1993	1994	1995	1996
1	0.2461	0.2282	0.0403	0.1155	0.3385
2	0.8040	0.7033	0.7585	0.4322	0.6502
3	1.5182	1.6822	1.4662	1.5765	1.7414
4	2.0559	2.1624	2.3225	2.1938	2.0374
5	2.7375	3.4030	2.8330	3.8680	3.0463
6	4.4715	4.3342	5.1510	4.3208	6.0943
7	8.3915	7.0725	6.6198	8.2203	7.6260
8	10.7949	11.1777	10.2328	9.0868	12.2349
9	12.8464	12.7422	11.6631	14.0497	13.0080
10	15.1232	14.0844	15.8214	14.3973	16.7133
11	17.5760	17.5760	20.6370	20.3470	17.5760

AGE	1997	1998	1999	2000	2001
1	0.2290	0.2325	0.1517	0.2018	0.2303
2	1.0213	0.7558	0.7478	0.7354	0.8576
3	1.8491	1.9172	1.5873	1.7501	1.9658
4	2.5549	2.5113	2.3054	2.5062	2.7009
5	2.6863	3.5490	3.3071	3.3717	4.0246
6	4.0867	3.6326	4.8858	4.6832	5.2824
7	7.8614	4.9803	5.5152	5.8918	6.4395
8	10.9722	9.7512	7.1645	7.8332	7.0862
9	14.3132	14.7702	12.0664	11.2963	8.5818
10	15.2593	14.8391	15.9124	13.7943	12.6399
11	21.8740	20.3470	17.5760	17.5760	24.4180

AGE	2002	2003	2004	2005	2006

1	0.1932	0.2210	0.2139	0.1768	0.1885
2	0.7513	0.8958	0.7831	0.8092	0.9788
3	2.0846	1.8080	2.1246	1.7417	1.9537
4	2.7934	2.7416	2.7869	2.5747	2.5906
5	3.5860	3.6152	3.3395	3.7264	3.2598
6	5.2776	4.6145	4.5854	4.0552	4.5681
7	6.4958	6.6539	6.0362	5.7281	4.9862
8	9.1466	7.6622	8.4069	7.3468	6.8905
9	9.2175	11.1688	10.1562	9.9043	8.6971
10	9.5996	11.1725	11.8421	12.5744	11.2682
11	14.3330	13.0740	13.2600	14.3820	15.6640

AGE	2007	2008
1	0.1885	0.1846
2	0.9183	0.9021
3	2.4119	2.0358
4	2.7952	2.6535
5	3.5785	3.5216
6	4.2406	4.2879
7	5.5519	5.4221
8	6.2459	6.8277
9	8.7696	9.1237
10	10.6374	11.4933
11	14.3140	14.7867

SSB Weights at Age - Input Data

AGE	1982	1983	1984	1985	1986
1	0.5015	0.2949	0.3608	0.3003	0.2583
2	0.9229	0.8270	0.6745	0.7096	0.7231
3	1.3188	1.3374	1.3088	1.2779	1.3368
4	2.2882	1.9876	2.0842	2.1157	2.1495
5	4.1750	3.1812	2.9884	3.4396	3.5549
6	7.0188	5.3316	4.6675	4.4555	5.1379
7	8.0156	6.1630	6.9729	6.7561	6.6365
8	9.6703	9.5298	7.5003	9.5545	9.2321
9	12.9993	9.8566	11.5530	11.1444	12.3906
10	11.5216	12.9029	11.7977	12.8315	13.1875
11	18.5760	18.1250	14.9620	13.8180	19.5780

AGE	1987	1988	1989	1990	1991
1	0.0952	0.1638	0.5391	0.2468	0.2152
2	0.6163	0.4456	0.6175	0.8578	0.7012
3	1.3170	1.2863	1.2884	1.4218	1.2917
4	2.3713	1.9174	2.2582	1.9901	2.0253
5	3.7262	3.9948	3.0234	3.5049	3.0354
6	5.7106	5.5705	4.6865	5.3360	5.5742
7	7.5708	7.9918	7.6267	6.8032	8.4715
8	9.0350	10.2441	9.9203	10.3156	11.4941
9	11.9624	10.5159	12.5689	12.9931	12.8544
10	13.3502	15.4114	13.8347	14.3000	19.8187
11	13.3330	14.0000	23.2860	20.5880	17.0000

AGE	1992	1993	1994	1995	1996
1	0.2461	0.2282	0.0403	0.1155	0.3385
2	0.8040	0.7033	0.7585	0.4322	0.6502
3	1.5182	1.6822	1.4662	1.5765	1.7414
4	2.0559	2.1624	2.3225	2.1938	2.0374
5	2.7375	3.4030	2.8330	3.8680	3.0463
6	4.4715	4.3342	5.1510	4.3208	6.0943
7	8.3915	7.0725	6.6198	8.2203	7.6260
8	10.7949	11.1777	10.2328	9.0868	12.2349
9	12.8464	12.7422	11.6631	14.0497	13.0080
10	15.1232	14.0844	15.8214	14.3973	16.7133
11	17.5760	17.5760	20.6370	20.3470	17.5760

AGE	1997	1998	1999	2000	2001
1	0.2290	0.2325	0.1517	0.2018	0.2303
2	1.0213	0.7558	0.7478	0.7354	0.8576
3	1.8491	1.9172	1.5873	1.7501	1.9658
4	2.5549	2.5113	2.3054	2.5062	2.7009
5	2.6863	3.5490	3.3071	3.3717	4.0246
6	4.0867	3.6326	4.8858	4.6832	5.2824

7	7.8614	4.9803	5.5152	5.8918	6.4395
8	10.9722	9.7512	7.1645	7.8332	7.0862
9	14.3132	14.7702	12.0664	11.2963	8.5818
10	15.2593	14.8391	15.9124	13.7943	12.6399
11	21.8740	20.3470	17.5760	17.5760	24.4180

AGE	2002	2003	2004	2005	2006
1	0.1932	0.2210	0.2139	0.1768	0.1885
2	0.7513	0.8958	0.7831	0.8092	0.9788
3	2.0846	1.8080	2.1246	1.7417	1.9537
4	2.7934	2.7416	2.7869	2.5747	2.5906
5	3.5860	3.6152	3.3395	3.7264	3.2598
6	5.2776	4.6145	4.5854	4.0552	4.5681
7	6.4958	6.6539	6.0362	5.7281	4.9862
8	9.1466	7.6622	8.4069	7.3468	6.8905
9	9.2175	11.1688	10.1562	9.9043	8.6971
10	9.5996	11.1725	11.8421	12.5744	11.2682
11	14.3330	13.0740	13.2600	14.3820	15.6640

AGE	2007
1	0.1885
2	0.9183
3	2.4119
4	2.7952
5	3.5785
6	4.2406
7	5.5519
8	6.2459
9	8.7696
10	10.6374
11	14.3140

Natural Mortality - Input Data

AGE	1982	1983	1984	1985	1986
1	0.2000	0.2000	0.2000	0.2000	0.2000
2	0.2000	0.2000	0.2000	0.2000	0.2000
3	0.2000	0.2000	0.2000	0.2000	0.2000
4	0.2000	0.2000	0.2000	0.2000	0.2000
5	0.2000	0.2000	0.2000	0.2000	0.2000
6	0.2000	0.2000	0.2000	0.2000	0.2000
7	0.2000	0.2000	0.2000	0.2000	0.2000
8	0.2000	0.2000	0.2000	0.2000	0.2000
9	0.2000	0.2000	0.2000	0.2000	0.2000
10	0.2000	0.2000	0.2000	0.2000	0.2000
11	0.2000	0.2000	0.2000	0.2000	0.2000

AGE	1987	1988	1989	1990	1991
1	0.2000	0.2000	0.2000	0.2000	0.2000
2	0.2000	0.2000	0.2000	0.2000	0.2000
3	0.2000	0.2000	0.2000	0.2000	0.2000
4	0.2000	0.2000	0.2000	0.2000	0.2000
5	0.2000	0.2000	0.2000	0.2000	0.2000
6	0.2000	0.2000	0.2000	0.2000	0.2000
7	0.2000	0.2000	0.2000	0.2000	0.2000
8	0.2000	0.2000	0.2000	0.2000	0.2000
9	0.2000	0.2000	0.2000	0.2000	0.2000
10	0.2000	0.2000	0.2000	0.2000	0.2000
11	0.2000	0.2000	0.2000	0.2000	0.2000

AGE	1992	1993	1994	1995	1996
1	0.2000	0.2000	0.2000	0.2000	0.2000
2	0.2000	0.2000	0.2000	0.2000	0.2000
3	0.2000	0.2000	0.2000	0.2000	0.2000
4	0.2000	0.2000	0.2000	0.2000	0.2000
5	0.2000	0.2000	0.2000	0.2000	0.2000
6	0.2000	0.2000	0.2000	0.2000	0.2000
7	0.2000	0.2000	0.2000	0.2000	0.2000
8	0.2000	0.2000	0.2000	0.2000	0.2000
9	0.2000	0.2000	0.2000	0.2000	0.2000
10	0.2000	0.2000	0.2000	0.2000	0.2000
11	0.2000	0.2000	0.2000	0.2000	0.2000

AGE	1997	1998	1999	2000	2001

1	0.2000	0.2000	0.2000	0.2000	0.2000
2	0.2000	0.2000	0.2000	0.2000	0.2000
3	0.2000	0.2000	0.2000	0.2000	0.2000
4	0.2000	0.2000	0.2000	0.2000	0.2000
5	0.2000	0.2000	0.2000	0.2000	0.2000
6	0.2000	0.2000	0.2000	0.2000	0.2000
7	0.2000	0.2000	0.2000	0.2000	0.2000
8	0.2000	0.2000	0.2000	0.2000	0.2000
9	0.2000	0.2000	0.2000	0.2000	0.2000
10	0.2000	0.2000	0.2000	0.2000	0.2000
11	0.2000	0.2000	0.2000	0.2000	0.2000

AGE	2002	2003	2004	2005	2006
1	0.2000	0.2000	0.2000	0.2000	0.2000
2	0.2000	0.2000	0.2000	0.2000	0.2000
3	0.2000	0.2000	0.2000	0.2000	0.2000
4	0.2000	0.2000	0.2000	0.2000	0.2000
5	0.2000	0.2000	0.2000	0.2000	0.2000
6	0.2000	0.2000	0.2000	0.2000	0.2000
7	0.2000	0.2000	0.2000	0.2000	0.2000
8	0.2000	0.2000	0.2000	0.2000	0.2000
9	0.2000	0.2000	0.2000	0.2000	0.2000
10	0.2000	0.2000	0.2000	0.2000	0.2000
11	0.2000	0.2000	0.2000	0.2000	0.2000

AGE	2007
1	0.2000
2	0.2000
3	0.2000
4	0.2000
5	0.2000
6	0.2000
7	0.2000
8	0.2000
9	0.2000
10	0.2000
11	0.2000

Proportion of Natural Mortality Before Spawning = 0.1667
Proportion of Fishing Mortality Before Spawning = 0.1667

Maturity - Input Data

AGE	1982	1983	1984	1985	1986
1	0.1100	0.0700	0.0100	0.0100	0.0700
2	0.3200	0.2600	0.2100	0.3600	0.5900
3	0.6400	0.6100	0.8500	0.9600	0.9700
4	0.8700	0.8800	0.9900	1.0000	1.0000
5	0.9600	0.9700	1.0000	1.0000	1.0000
6	0.9900	0.9900	1.0000	1.0000	1.0000
7	1.0000	1.0000	1.0000	1.0000	1.0000
8	1.0000	1.0000	1.0000	1.0000	1.0000
9	1.0000	1.0000	1.0000	1.0000	1.0000
10	1.0000	1.0000	1.0000	1.0000	1.0000
11	1.0000	1.0000	1.0000	1.0000	1.0000

AGE	1987	1988	1989	1990	1991
1	0.0300	0.0400	0.0700	0.3000	0.1000
2	0.3900	0.4200	0.3500	0.5100	0.2600
3	0.9300	0.9200	0.8100	0.7200	0.5300
4	1.0000	0.9900	0.9700	0.8600	0.7900
5	1.0000	1.0000	1.0000	0.9400	0.9200
6	1.0000	1.0000	1.0000	0.9700	0.9700
7	1.0000	1.0000	1.0000	0.9900	0.9900
8	1.0000	1.0000	1.0000	1.0000	1.0000
9	1.0000	1.0000	1.0000	1.0000	1.0000
10	1.0000	1.0000	1.0000	1.0000	1.0000
11	1.0000	1.0000	1.0000	1.0000	1.0000

AGE	1992	1993	1994	1995	1996
1	0.0600	0.0600	0.0100	0.0000	0.0300
2	0.1900	0.2200	0.1900	0.1500	0.3300
3	0.4700	0.5700	0.8200	0.9300	0.9000
4	0.7800	0.8700	0.9900	1.0000	0.9900
5	0.9300	0.9700	1.0000	1.0000	1.0000

6	0.9800	0.9900	1.0000	1.0000	1.0000
7	0.9900	1.0000	1.0000	1.0000	1.0000
8	1.0000	1.0000	1.0000	1.0000	1.0000
9	1.0000	1.0000	1.0000	1.0000	1.0000
10	1.0000	1.0000	1.0000	1.0000	1.0000
11	1.0000	1.0000	1.0000	1.0000	1.0000

AGE	1997	1998	1999	2000	2001
1	0.0100	0.0600	0.0900	0.1400	0.0900
2	0.1600	0.3600	0.3400	0.3900	0.2800
3	0.7900	0.8200	0.7200	0.7100	0.6100
4	0.9900	0.9700	0.9300	0.9100	0.8600
5	1.0000	1.0000	0.9800	0.9700	0.9600
6	1.0000	1.0000	1.0000	0.9900	0.9900
7	1.0000	1.0000	1.0000	1.0000	1.0000
8	1.0000	1.0000	1.0000	1.0000	1.0000
9	1.0000	1.0000	1.0000	1.0000	1.0000
10	1.0000	1.0000	1.0000	1.0000	1.0000
11	1.0000	1.0000	1.0000	1.0000	1.0000

AGE	2002	2003	2004	2005	2006
1	0.1900	0.1500	0.1300	0.0300	0.1200
2	0.4100	0.3800	0.3000	0.1100	0.3200
3	0.6800	0.6700	0.5500	0.3400	0.6300
4	0.8600	0.8700	0.7700	0.6900	0.8600
5	0.9500	0.9600	0.9000	0.9000	0.9600
6	0.9800	0.9900	0.9600	0.9800	0.9900
7	0.9900	1.0000	0.9900	0.9900	1.0000
8	1.0000	1.0000	1.0000	1.0000	1.0000
9	1.0000	1.0000	1.0000	1.0000	1.0000
10	1.0000	1.0000	1.0000	1.0000	1.0000
11	1.0000	1.0000	1.0000	1.0000	1.0000

AGE	2007
1	0.0800
2	0.3400
3	0.7600
4	0.9500
5	0.9900
6	1.0000
7	1.0000
8	1.0000
9	1.0000
10	1.0000
11	1.0000

Input Partial Recruitment

AGE	
1	0.0000
2	0.0021
3	0.1618
4	0.6821
5	0.9004
6	1.0000
7	0.8264
8	0.7333
9	0.7720
10	0.7530

Input F-Plus Ratio

YEAR	
1982	1.0000
1983	1.0000
1984	1.0000
1985	1.0000
1986	1.0000
1987	1.0000
1988	1.0000

1989	1.0000
1990	1.0000
1991	1.0000
1992	1.0000
1993	1.0000
1994	1.0000
1995	1.0000
1996	1.0000
1997	1.0000
1998	1.0000
1999	1.0000
2000	1.0000
2001	1.0000
2002	1.0000
2003	1.0000
2004	1.0000
2005	1.0000
2006	1.0000
2007	1.0000

`

SURVEY - INPUT DATA

INDEX	1	2	3	4	5
SURVEY TAG	WHSpr	WHSpr	WHSpr	WHSpr	WHSpr
AGE	2	3	4	5	6
TIME	JAN-1	JAN-1	JAN-1	JAN-1	JAN-1
TYPE	NUMBERS	NUMBERS	NUMBERS	NUMBERS	NUMBERS
RETRO FLAG	1	1	1	1	1
1982	1.0065	0.4764	0.6554	0.9877	0.0873
1983	0.9486	0.9968	0.4647	0.4042	0.2118
1984	1.3120	1.0226	0.8233	0.2118	0.0467
1985	0.2308	0.6617	0.6625	0.6617	0.1031
1986	0.2478	0.7540	0.2369	0.0912	0.0349
1987	0.4602	0.1991	0.2307	0.0744	0.0000
1988	0.9234	0.8229	0.2179	0.2535	0.0915
1989	0.6048	0.7230	0.6001	0.0908	0.0627
1990	0.2076	1.3654	0.6370	0.1020	0.0321
1991	0.0678	0.2339	1.7167	0.2993	0.0200
1992	0.2255	0.2424	0.2819	1.3281	0.2264
1993	0.4965	0.7993	0.3343	0.0906	0.4842
1994	0.3156	0.3875	0.2150	0.0942	0.0493
1995	0.1792	1.1161	0.3717	0.1454	0.0283
1996	0.0215	0.5927	1.3307	0.4032	0.0593
1997	0.1316	0.3991	0.2643	0.8756	0.2424
1998	0.2236	0.3301	0.5166	0.1415	0.4210
1999	0.3443	0.7133	0.3445	0.3150	0.1337
2000	0.7247	0.4385	0.4570	0.1071	0.1006
2001	0.3234	0.7161	0.4972	0.3539	0.0635
2002	0.0453	0.5244	1.6012	0.6142	0.3619
2003	0.8305	0.0630	0.7077	1.0889	0.3946
2004	0.0446	0.2213	0.1181	0.1908	0.2316
2005	0.7265	0.1014	0.6076	0.0154	0.1498
2006	0.2300	0.4300	0.0600	0.2000	0.0200
2007	3.4500	2.9300	4.4800	0.5000	0.8400
2008	1.0986	3.2112	1.3566	0.9393	0.0584

INDEX	6	7	8	9	10
SURVEY TAG	WHSpr	WHSpr	WHAut	WHAut	WHAut
AGE	7	8	2	3	4
TIME	JAN-1	JAN-1	JAN-1	JAN-1	JAN-1
TYPE	NUMBERS	NUMBERS	NUMBERS	NUMBERS	NUMBERS
RETRO FLAG	1	1	1	1	1
1982	0.1120	0.0000	0.6179	0.4188	0.5394

1983	0.0680	0.0160	0.8426	3.3527	2.2748
1984	0.1000	0.0000	0.3168	0.9155	0.8277
1985	0.0910	0.0520	0.4323	0.4258	0.6307
1986	0.0380	0.0000	0.5256	0.9567	0.6094
1987	0.0660	0.0080	0.3920	0.4010	0.6565
1988	0.0650	0.0000	0.5782	1.3796	0.5921
1989	0.0140	0.0000	1.9375	2.3134	0.9896
1990	0.0180	0.0000	0.1495	2.4065	1.5017
1991	0.0180	0.0000	0.0447	0.1868	1.8293
1992	0.0690	0.0000	0.1435	0.1390	0.2233
1993	0.0550	0.0230	0.2910	0.4458	0.1400
1994	0.1270	0.0270	0.1977	0.5678	0.3602
1995	0.0000	0.0110	0.2071	0.8831	0.8260
1996	0.0000	0.0000	0.0680	0.2845	1.2284
1997	0.1200	0.0000	0.1242	0.3826	0.1883
1998	0.0230	0.0370	0.2968	0.0855	0.1769
1999	0.2730	0.0000	0.0966	0.3203	0.1147
2000	0.0240	0.0220	0.4307	0.3672	0.5857
2001	0.0980	0.0550	0.5326	0.9837	0.3936
2002	0.1640	0.0570	0.0340	0.1410	0.7524
2003	0.3210	0.1030	0.2691	0.0805	0.3637
2004	0.0140	0.0140	0.4546	0.1976	0.1848
2005	0.1297	0.0142	0.5700	0.1700	0.5400
2006	0.1314	0.0729	0.1533	0.3806	0.0796
2007	0.0652	0.0384	1.2514	0.5802	1.0331
2008	0.0806	0.0000	0.1456	0.8310	0.3840

SURVEY - INPUT DATA

INDEX	11	12	13	14	15
SURVEY TAG	WHAut	WHAut	WHAut	WHAut	MASpr
AGE	5	6	7	8	2
TIME	JAN-1	JAN-1	JAN-1	JAN-1	JAN-1
TYPE	NUMBERS	NUMBERS	NUMBERS	NUMBERS	NUMBERS
RETRO FLAG	1	1	1	1	1

1982	0.4047	0.1205	0.0760	0.0290	7.1700
1983	1.0892	0.2092	0.0000	0.0000	14.6100
1984	0.1970	0.2270	0.2100	0.0000	5.1500
1985	0.3871	0.2140	0.1630	0.0790	2.7700
1986	0.2482	0.1820	0.0750	0.0000	11.6800
1987	0.3417	0.0727	0.0410	0.0000	4.7100
1988	0.2429	0.0751	0.0000	0.0000	6.3500
1989	0.4434	0.0990	0.0650	0.0330	20.5100
1990	0.2926	0.1605	0.0330	0.0000	5.4500
1991	0.5978	0.2589	0.0520	0.0100	2.6900
1992	0.6334	0.0811	0.0000	0.0230	5.1300
1993	0.0355	0.3498	0.1040	0.0080	6.1100
1994	0.0336	0.0000	0.0300	0.0000	4.0700
1995	0.0854	0.0511	0.0000	0.0450	1.9200
1996	0.3252	0.0821	0.0110	0.0000	0.5200
1997	0.5421	0.0616	0.0000	0.0000	0.9800
1998	0.1728	0.1402	0.0000	0.0000	0.8300
1999	0.1923	0.0387	0.0310	0.0000	2.3900
2000	0.2433	0.1320	0.0160	0.0060	7.0200
2001	0.5071	0.1343	0.0100	0.0000	4.5000
2002	0.4690	0.3368	0.1220	0.0840	0.2600
2003	2.7972	1.0958	0.6270	0.0510	12.7000
2004	0.5287	0.4498	0.0730	0.0770	1.5600
2005	0.2400	0.2500	0.1680	0.0680	7.1500
2006	0.4495	0.0221	0.0923	0.0824	3.6700
2007	0.2475	0.2857	0.0339	0.0496	3.3600
2008	0.5283	0.0226	0.0690	0.0000	0.0000

INDEX	16	17	18	19	20
SURVEY TAG	MASpr	MASpr	MAAut	MAAut	MAAut

AGE	3	4	1	2	3
TIME	JAN-1	JAN-1	JAN-1	JAN-1	JAN-1
TYPE	NUMBERS	NUMBERS	NUMBERS	NUMBERS	NUMBERS
RETRO FLAG	1	1	1	1	1
1982	2.4100	0.8700	1.4500	6.2000	1.2500
1983	2.8600	1.5000	4.5900	1.1400	0.3100
1984	2.0700	0.7000	1.2700	0.2800	0.1000
1985	2.2700	0.4500	10.3000	0.1600	0.0700
1986	1.2300	0.6800	2.6500	0.1900	0.0200
1987	2.9600	0.2200	1.8000	0.5500	0.3700
1988	2.4500	1.4500	311.7200	1.4000	0.0200
1989	8.7600	1.0600	5.5300	3.1000	0.2400
1990	14.7500	2.3100	3.9400	0.0200	0.1000
1991	1.5700	3.6600	7.8100	4.2200	0.3100
1992	3.6700	0.7500	5.0400	2.0000	0.3600
1993	2.5500	0.9000	26.4200	0.9900	0.0400
1994	1.7500	0.4900	49.4300	1.5300	0.3600
1995	2.7600	0.7800	40.0100	5.3600	3.4500
1996	1.0800	1.4900	2.9300	0.8000	0.4100
1997	0.9300	0.1700	6.9000	0.0800	0.0100
1998	0.7000	0.7500	1.4300	0.0300	0.0000
1999	2.3100	0.7800	3.2700	0.6400	0.3200
2000	2.8900	2.2000	7.3300	0.5900	0.0700
2001	4.9700	3.5200	0.0500	0.4000	0.1700
2002	1.2300	1.4100	49.1900	0.0100	0.1300
2003	0.2800	1.4300	0.9600	1.0900	0.1300
2004	2.5800	0.4600	120.1700	1.6000	0.1400
2005	0.5700	2.0700	44.6700	9.9400	0.9200
2006	3.3800	0.5400	39.4700	0.6100	0.2400
2007	1.8400	1.7500	2.0800	4.3500	0.4200
2008	0.0000	0.0000	7.6100	0.1600	0.1300

SURVEY - INPUT DATA

INDEX	21	22	23	24	25
SURVEY TAG	CM_CPE	CM_CPE	CM_CPE	CM_CPE	CM_CPE
AGE	2	3	4	5	6
TIME	MEAN	MEAN	MEAN	MEAN	MEAN
TYPE	NUMBERS	NUMBERS	NUMBERS	NUMBERS	NUMBERS
RETRO FLAG	0	0	0	0	0
1982	0.0743	0.0738	0.0450	0.0217	0.0027
1983	0.0477	0.1099	0.0422	0.0209	0.0123
1984	0.0331	0.0448	0.0442	0.0118	0.0055
1985	0.0137	0.0423	0.0289	0.0179	0.0036
1986	0.0041	0.0688	0.0226	0.0066	0.0043
1987	0.0074	0.0186	0.0260	0.0057	0.0018
1988	0.0146	0.0492	0.0242	0.0093	0.0015
1989	0.0170	0.0637	0.0397	0.0106	0.0023
1990	0.0110	0.1595	0.0782	0.0122	0.0051
1991	0.0194	0.0404	0.1355	0.0217	0.0039
1992	0.0149	0.0173	0.0138	0.0515	0.0052
1993	0.0027	0.0500	0.0232	0.0041	0.0140
1994	0.0000	0.0000	0.0000	0.0000	0.0000
1995	0.0000	0.0000	0.0000	0.0000	0.0000
1996	0.0000	0.0000	0.0000	0.0000	0.0000
1997	0.0000	0.0000	0.0000	0.0000	0.0000
1998	0.0000	0.0000	0.0000	0.0000	0.0000
1999	0.0000	0.0000	0.0000	0.0000	0.0000
2000	0.0000	0.0000	0.0000	0.0000	0.0000
2001	0.0000	0.0000	0.0000	0.0000	0.0000
2002	0.0000	0.0000	0.0000	0.0000	0.0000
2003	0.0000	0.0000	0.0000	0.0000	0.0000
2004	0.0000	0.0000	0.0000	0.0000	0.0000
2005	0.0000	0.0000	0.0000	0.0000	0.0000

2006	0.0000	0.0000	0.0000	0.0000	0.0000
2007	0.0000	0.0000	0.0000	0.0000	0.0000
2008	0.0000	0.0000	0.0000	0.0000	0.0000

Additional Output Files

```
Population File C:\ALLWORK\ASSESS\GARMIIIAUG2008WG\ASSMT_MTG\GOMCOD\VPA\FINALS\G
Auxilliary File C:\ALLWORK\ASSESS\GARMIIIAUG2008WG\ASSMT_MTG\GOMCOD\VPA\FINALS\G
Covariance File C:\ALLWORK\ASSESS\GARMIIIAUG2008WG\ASSMT_MTG\GOMCOD\VPA\FINALS\G
Residuals File  C:\ALLWORK\ASSESS\GARMIIIAUG2008WG\ASSMT_MTG\GOMCOD\VPA\FINALS\G
Log File        C:\ALLWORK\ASSESS\GARMIIIAUG2008WG\ASSMT_MTG\GOMCOD\VPA\FINALS\G
```

Estimation Results JAN-1 Population Numbers

AGE	1982	1983	1984	1985	1986
1	7857.	7929.	10674.	6679.	10260.
2	11123.	6368.	6481.	8717.	5428.
3	5520.	7314.	4015.	4581.	6174.
4	3128.	2329.	3348.	1856.	1771.
5	1767.	1274.	831.	1261.	491.
6	226.	771.	421.	255.	428.
7	260.	116.	222.	157.	88.
8	140.	124.	49.	111.	58.
9	71.	55.	42.	23.	62.
10	10.	21.	22.	21.	15.
11	79.	35.	36.	21.	113.
Total	30180.	26336.	26143.	23683.	24888.

AGE	1987	1988	1989	1990	1991
1	12744.	24612.	4254.	4135.	6975.
2	8388.	10347.	20148.	3480.	3386.
3	4276.	6063.	7974.	16026.	2620.
4	2560.	2306.	3038.	4465.	9388.
5	609.	734.	877.	935.	1434.
6	151.	185.	213.	276.	292.
7	170.	41.	107.	90.	66.
8	31.	63.	24.	50.	49.
9	20.	13.	35.	14.	14.
10	18.	4.	10.	26.	2.
11	5.	2.	13.	30.	2.
Total	28973.	44369.	36694.	29528.	24228.

AGE	1992	1993	1994	1995	1996
1	6340.	9123.	3180.	3805.	3545.
2	5711.	5191.	7469.	2603.	3099.
3	2375.	4369.	4134.	6066.	1880.
4	931.	1414.	1739.	2038.	3908.
5	3243.	281.	449.	323.	590.
6	332.	675.	104.	68.	54.
7	96.	73.	124.	21.	30.
8	12.	19.	34.	24.	5.
9	13.	3.	10.	1.	3.
10	4.	0.	1.	2.	0.
11	0.	0.	2.	0.	0.
Total	19057.	21148.	17245.	14951.	13113.

AGE	1997	1998	1999	2000	2001
1	5245.	4458.	7847.	4016.	1187.
2	2902.	4294.	3650.	6424.	3288.
3	2455.	2299.	3419.	2969.	5077.
4	969.	1562.	1446.	2213.	1947.
5	1447.	381.	741.	670.	1063.
6	135.	414.	168.	360.	376.
7	11.	46.	166.	85.	205.
8	20.	4.	14.	64.	55.
9	3.	14.	0.	4.	46.
10	1.	2.	11.	0.	4.
11	0.	1.	0.	0.	2.
Total	13190.	13477.	17462.	16805.	13250.

AGE	2002	2003	2004	2005	2006

1	4953.	1681.	10966.	6713.	23910.
2	972.	4055.	1377.	8979.	5496.
3	2559.	793.	3305.	1126.	7344.
4	3086.	1860.	542.	2382.	801.
5	974.	1726.	1122.	218.	1214.
6	528.	484.	720.	548.	92.
7	209.	248.	187.	349.	209.
8	114.	98.	110.	86.	176.
9	37.	61.	44.	56.	41.
10	25.	22.	30.	19.	29.
11	2.	16.	9.	19.	23.
Total	13459.	11046.	18414.	20495.	39336.

AGE	2007	2008
1	4808.	0.
2	19576.	3937.
3	4498.	16020.
4	5852.	3543.
5	401.	3970.
6	587.	201.
7	46.	251.
8	83.	30.
9	101.	47.
10	17.	71.
11	21.	19.
Total	35992.	28090.

Fishing Mortality Calculated

AGE	1982	1983	1984	1985	1986
1	0.0101	0.0016	0.0026	0.0074	0.0014
2	0.2192	0.2612	0.1470	0.1450	0.0386
3	0.6628	0.5814	0.5714	0.7503	0.6802
4	0.6981	0.8305	0.7769	1.1299	0.8676
5	0.6295	0.9064	0.9811	0.8800	0.9766
6	0.4723	1.0461	0.7862	0.8605	0.7259
7	0.5377	0.6505	0.4954	0.8028	0.8481
8	0.7294	0.8727	0.5657	0.3866	0.8646
9	1.0140	0.7010	0.4948	0.2139	1.0200
10	0.6088	0.9342	0.8265	0.8317	0.8523
11	0.6088	0.9342	0.8265	0.8317	0.8523

AGE	1987	1988	1989	1990	1991
1	0.0084	0.0001	0.0010	0.0000	0.0000
2	0.1247	0.0604	0.0289	0.0840	0.1545
3	0.4177	0.4909	0.3799	0.3348	0.8343
4	1.0499	0.7667	0.9783	0.9361	0.8630
5	0.9906	1.0384	0.9547	0.9634	1.2635
6	1.1023	0.3485	0.6584	1.2250	0.9179
7	0.7884	0.3576	0.5545	0.4021	1.5057
8	0.6852	0.3761	0.3568	1.0760	1.1140
9	1.4099	0.0904	0.0981	1.7050	0.9720
10	0.9568	0.7939	0.8422	0.9642	1.2033
11	0.9568	0.7939	0.8422	0.9642	1.2033

AGE	1992	1993	1994	1995	1996
1	0.0000	0.0000	0.0003	0.0053	0.0000
2	0.0677	0.0276	0.0080	0.1251	0.0326
3	0.3191	0.7214	0.5072	0.2397	0.4631
4	0.9977	0.9473	1.4838	1.0395	0.7934
5	1.3696	0.7941	1.6866	1.5888	1.2721
6	1.3085	1.4954	1.4035	0.6248	1.4090
7	1.4079	0.5791	1.4467	1.3241	0.1825
8	1.1311	0.4254	3.4380	1.9107	0.1292
9	8.8324	1.1807	1.2844	6.1427	0.6870
10	1.3641	1.1501	1.6321	1.3635	1.1851
11	1.3641	1.1501	1.6321	1.3635	1.1851

AGE	1997	1998	1999	2000	2001
1	0.0000	0.0000	0.0002	0.0000	0.0000
2	0.0331	0.0281	0.0067	0.0352	0.0507
3	0.2522	0.2638	0.2347	0.2216	0.2979
4	0.7331	0.5461	0.5695	0.5337	0.4927
5	1.0524	0.6167	0.5220	0.3769	0.4994

6	0.8742	0.7161	0.4791	0.3620	0.3864
7	0.7168	0.9838	0.7526	0.2337	0.3888
8	0.1523	6.4333	0.9591	0.1311	0.1957
9	0.1066	0.0314	0.2164	0.0002	0.3866
10	1.0156	0.6873	0.5515	0.3465	0.4486
11	1.0156	0.6873	0.5515	0.3465	0.4486

AGE	2002	2003	2004	2005	2006
1	0.0000	0.0000	0.0000	0.0000	0.0000
2	0.0034	0.0045	0.0007	0.0009	0.0003
3	0.1189	0.1807	0.1274	0.1411	0.0271
4	0.3808	0.3053	0.7125	0.4741	0.4914
5	0.4985	0.6741	0.5164	0.6606	0.5260
6	0.5550	0.7507	0.5245	0.7653	0.4948
7	0.5582	0.6163	0.5806	0.4825	0.7225
8	0.4224	0.5975	0.4648	0.5426	0.3577
9	0.3310	0.4983	0.6597	0.4716	0.6789
10	0.5163	0.6793	0.5218	0.6406	0.5272
11	0.5163	0.6793	0.5218	0.6406	0.5272

AGE	2007
1	0.0000
2	0.0004
3	0.0388
4	0.1880
5	0.4892
6	0.6492
7	0.2288
8	0.3714
9	0.1484
10	0.4888
11	0.4888

Average Fishing Mortality For Ages 5 - 7

Year	Average F	N Weighted	Biomass Wtd	Catch Wtd
1982	0.5465	0.6031	0.5896	0.6066
1983	0.8677	0.9426	0.9506	0.9488
1984	0.7543	0.8523	0.7919	0.8772
1985	0.8478	0.8698	0.8641	0.8702
1986	0.8502	0.8588	0.8383	0.8695
1987	0.9605	0.9719	0.9537	0.9778
1988	0.5815	0.8761	0.8204	0.9533
1989	0.7225	0.8662	0.8154	0.8839
1990	0.8635	0.9800	0.9711	1.0061
1991	1.2290	1.2161	1.1983	1.2252
1992	1.3620	1.3651	1.3643	1.3652
1993	0.9562	1.2385	1.2349	1.3016
1994	1.5123	1.5992	1.5540	1.6032
1995	1.1792	1.4161	1.3970	1.4752
1996	0.9545	1.2348	1.1860	1.2724
1997	0.8811	1.0350	1.0243	1.0369
1998	0.7722	0.6858	0.6925	0.6928
1999	0.5846	0.5508	0.5638	0.5605
2000	0.3242	0.3611	0.3550	0.3645
2001	0.4249	0.4598	0.4506	0.4648
2002	0.5373	0.5233	0.5298	0.5244
2003	0.6804	0.6834	0.6816	0.6848
2004	0.5405	0.5252	0.5285	0.5256
2005	0.6362	0.6564	0.6361	0.6736
2006	0.5811	0.5512	0.5613	0.5572
2007	0.4557	0.5685	0.5686	0.5845

Back Calculated Partial Recruitment

AGE	1982	1983	1984	1985	1986
1	0.0100	0.0015	0.0026	0.0065	0.0014
2	0.2162	0.2497	0.1498	0.1283	0.0378
3	0.6537	0.5557	0.5824	0.6641	0.6669
4	0.6884	0.7939	0.7918	1.0000	0.8506
5	0.6208	0.8665	1.0000	0.7789	0.9575
6	0.4658	1.0000	0.8013	0.7616	0.7116
7	0.5303	0.6218	0.5050	0.7105	0.8314
8	0.7194	0.8342	0.5766	0.3422	0.8477
9	1.0000	0.6700	0.5043	0.1893	1.0000
10	0.6004	0.8930	0.8424	0.7361	0.8356
11	0.6004	0.8930	0.8424	0.7361	0.8356

AGE	1987	1988	1989	1990	1991
1	0.0059	0.0001	0.0010	0.0000	0.0000
2	0.0884	0.0582	0.0296	0.0493	0.1026
3	0.2962	0.4727	0.3883	0.1964	0.5541
4	0.7446	0.7384	1.0000	0.5490	0.5731
5	0.7026	1.0000	0.9758	0.5650	0.8392
6	0.7818	0.3356	0.6730	0.7185	0.6096
7	0.5592	0.3444	0.5668	0.2358	1.0000
8	0.4860	0.3622	0.3647	0.6311	0.7399
9	1.0000	0.0871	0.1003	1.0000	0.6455
10	0.6786	0.7645	0.8608	0.5655	0.7992
11	0.6786	0.7645	0.8608	0.5655	0.7992

AGE	1992	1993	1994	1995	1996
1	0.0000	0.0000	0.0001	0.0009	0.0000
2	0.0077	0.0184	0.0023	0.0204	0.0232
3	0.0361	0.4824	0.1475	0.0390	0.3287
4	0.1130	0.6335	0.4316	0.1692	0.5631
5	0.1551	0.5310	0.4906	0.2587	0.9028
6	0.1481	1.0000	0.4082	0.1017	1.0000
7	0.1594	0.3872	0.4208	0.2156	0.1295
8	0.1281	0.2845	1.0000	0.3111	0.0917
9	1.0000	0.7896	0.3736	1.0000	0.4875
10	0.1544	0.7691	0.4747	0.2220	0.8411
11	0.1544	0.7691	0.4747	0.2220	0.8411

AGE	1997	1998	1999	2000	2001
1	0.0000	0.0000	0.0002	0.0000	0.0000
2	0.0314	0.0044	0.0070	0.0660	0.1016
3	0.2396	0.0410	0.2448	0.4153	0.5965
4	0.6966	0.0849	0.5938	1.0000	0.9866
5	1.0000	0.0959	0.5442	0.7062	1.0000
6	0.8307	0.1113	0.4995	0.6782	0.7738
7	0.6812	0.1529	0.7847	0.4378	0.7784
8	0.1447	1.0000	1.0000	0.2457	0.3918
9	0.1013	0.0049	0.2256	0.0005	0.7741
10	0.9651	0.1068	0.5751	0.6493	0.8982
11	0.9651	0.1068	0.5751	0.6493	0.8982

AGE	2002	2003	2004	2005	2006
1	0.0000	0.0000	0.0000	0.0000	0.0000
2	0.0061	0.0060	0.0010	0.0012	0.0004
3	0.2129	0.2407	0.1788	0.1844	0.0374
4	0.6822	0.4067	1.0000	0.6195	0.6801
5	0.8931	0.8980	0.7248	0.8632	0.7280
6	0.9943	1.0000	0.7361	1.0000	0.6848
7	1.0000	0.8209	0.8148	0.6305	1.0000
8	0.7566	0.7959	0.6523	0.7090	0.4951
9	0.5929	0.6637	0.9258	0.6162	0.9396
10	0.9249	0.9049	0.7324	0.8370	0.7296
11	0.9249	0.9049	0.7324	0.8370	0.7296

AGE	2007
1	0.0000
2	0.0007
3	0.0597
4	0.2896
5	0.7536
6	1.0000

7	0.3524
8	0.5722
9	0.2286
10	0.7530
11	0.7530

JAN-1 Biomass

AGE	1982	1983	1984	1985	1986
1	3940.	2338.	3851.	2006.	2650.
2	10265.	5266.	4372.	6186.	3925.
3	7279.	9782.	5255.	5854.	8253.
4	7157.	4629.	6978.	3928.	3807.
5	7379.	4053.	2484.	4336.	1746.
6	1589.	4111.	1967.	1137.	2199.
7	2081.	712.	1546.	1062.	586.
8	1354.	1183.	370.	1057.	532.
9	924.	545.	491.	256.	762.
10	110.	273.	265.	272.	200.
11	1468.	629.	533.	293.	2210.
Total	43548.	33522.	28112.	26386.	26871.

AGE	1987	1988	1989	1990	1991
1	1213.	4031.	2294.	1021.	1501.
2	5170.	4611.	12442.	2985.	2374.
3	5631.	7799.	10274.	22786.	3384.
4	6071.	4421.	6861.	8887.	19014.
5	2269.	2931.	2651.	3278.	4352.
6	865.	1031.	997.	1475.	1629.
7	1284.	329.	816.	613.	563.
8	280.	647.	234.	519.	567.
9	238.	134.	446.	175.	181.
10	243.	61.	132.	377.	40.
11	71.	28.	312.	614.	26.
Total	23334.	26023.	37458.	42729.	33630.

AGE	1992	1993	1994	1995	1996
1	1560.	2082.	128.	439.	1200.
2	4591.	3651.	5665.	1125.	2015.
3	3606.	7350.	6061.	9564.	3274.
4	1914.	3057.	4039.	4471.	7962.
5	8877.	957.	1271.	1249.	1798.
6	1484.	2925.	536.	294.	329.
7	802.	519.	820.	172.	227.
8	130.	214.	345.	217.	56.
9	170.	41.	119.	12.	38.
10	66.	0.	13.	33.	0.
11	0.	0.	33.	6.	0.
Total	23202.	20795.	19031.	17583.	16899.

AGE	1997	1998	1999	2000	2001
1	1201.	1037.	1190.	810.	273.
2	2964.	3246.	2730.	4724.	2820.
3	4540.	4408.	5426.	5195.	9981.
4	2475.	3923.	3333.	5547.	5259.
5	3888.	1352.	2450.	2258.	4277.
6	553.	1503.	823.	1686.	1987.
7	85.	230.	913.	503.	1321.
8	223.	42.	101.	500.	392.
9	47.	211.	0.	50.	393.
10	18.	36.	181.	0.	46.
11	4.	18.	0.	0.	37.
Total	15999.	16006.	17147.	21274.	26787.

AGE	2002	2003	2004	2005	2006
1	957.	372.	2346.	1187.	4507.
2	730.	3632.	1078.	7265.	5379.
3	5334.	1434.	7022.	1962.	14348.
4	8620.	5100.	1510.	6133.	2074.
5	3493.	6242.	3748.	811.	3957.
6	2787.	2235.	3303.	2223.	420.
7	1359.	1651.	1130.	1999.	1041.
8	1042.	751.	922.	630.	1215.
9	343.	683.	449.	559.	355.
10	245.	245.	360.	235.	325.

11	23.	214.	125.	276.	368.
Total	24934.	22558.	21993.	23280.	33992.

AGE	2007	2008
1	906.	0.
2	17977.	3551.
3	10849.	32614.
4	16359.	9401.
5	1435.	13982.
6	2491.	863.
7	255.	1362.
8	518.	204.
9	886.	428.
10	180.	819.
11	304.	283.
Total	52161.	63509.

Mean Biomass

AGE	1982	1983	1984	1985	1986
1	4564.	3203.	4889.	2811.	3708.
2	10094.	5418.	5586.	7336.	5418.
3	5987.	8172.	4514.	4734.	7373.
4	5569.	3547.	5766.	2849.	3142.
5	5667.	2891.	1785.	3380.	1315.
6	1084.	2656.	1556.	853.	1681.
7	1605.	449.	1290.	780.	444.
8	890.	791.	336.	947.	385.
9	533.	363.	393.	240.	482.
10	67.	162.	196.	170.	128.
11	1007.	376.	333.	183.	1367.
Total	37067.	28028.	26644.	24281.	25443.

AGE	1987	1988	1989	1990	1991
1	2370.	7093.	2621.	1559.	2630.
2	6819.	8781.	21592.	3278.	3370.
3	4932.	7609.	10420.	20928.	2517.
4	4576.	3514.	5237.	6138.	14065.
5	1713.	2144.	1999.	2314.	3016.
6	606.	919.	615.	1091.	1306.
7	1026.	281.	677.	727.	309.
8	207.	529.	199.	335.	338.
9	130.	122.	440.	92.	116.
10	141.	45.	103.	222.	28.
11	42.	18.	194.	363.	14.
Total	22561.	31056.	44098.	37048.	27708.

AGE	1992	1993	1994	1995	1996
1	2390.	3440.	380.	942.	1889.
2	7786.	5520.	9326.	3144.	4266.
3	3613.	5199.	5358.	8820.	2946.
4	1488.	2016.	2491.	3110.	5723.
5	5039.	753.	675.	759.	1077.
6	855.	1982.	325.	258.	197.
7	451.	511.	436.	116.	258.
8	80.	187.	94.	114.	54.
9	20.	23.	55.	3.	28.
10	36.	0.	7.	24.	0.
11	0.	0.	15.	3.	0.
Total	21758.	19631.	19164.	17294.	16438.

AGE	1997	1998	1999	2000	2001
1	1978.	1685.	2375.	1514.	448.
2	4593.	5272.	4422.	9267.	5142.
3	4377.	3812.	5088.	5532.	9546.
4	1919.	3133.	2587.	5368.	4487.
5	2578.	1077.	2028.	2256.	3617.
6	398.	1144.	706.	1571.	1792.
7	59.	140.	768.	417.	1127.
8	198.	7.	83.	463.	382.
9	42.	241.	0.	52.	300.
10	11.	24.	107.	0.	33.
11	2.	12.	0.	0.	27.
Total	16154.	16548.	18164.	26440.	26901.

AGE	2002	2003	2004	2005	2006

1	1867.	634.	4135.	2531.	9015.
2	1193.	7074.	1838.	12803.	11470.
3	5386.	1589.	6595.	1964.	15933.
4	7652.	4466.	1146.	4910.	1885.
5	2822.	4602.	2922.	628.	3238.
6	2182.	1653.	2695.	1585.	321.
7	983.	1276.	895.	1578.	752.
8	976.	592.	753.	474.	1029.
9	294.	477.	349.	429.	262.
10	194.	179.	280.	170.	249.
11	17.	142.	89.	186.	261.
Total	23566.	22683.	21698.	27259.	44415.

AGE	2007
1	1813.
2	35957.
3	10108.
4	15629.
5	1138.
6	1898.
7	238.
8	447.
9	862.
10	144.
11	220.
Total	68452.

Spawning Stock Biomass

AGE	1982	1983	1984	1985	1986
1	419.	158.	37.	19.	179.
2	3063.	1268.	866.	2102.	2226.
3	4035.	5238.	3928.	4797.	6913.
4	5361.	3431.	5870.	3147.	3186.
5	6169.	3270.	2040.	3621.	1435.
6	1406.	3307.	1669.	952.	1885.
7	1840.	618.	1377.	898.	492.
8	1160.	989.	326.	959.	446.
9	755.	469.	437.	239.	622.
10	96.	226.	223.	229.	168.
11	1283.	521.	449.	247.	1854.
Total	25587.	19494.	17223.	17211.	19406.

AGE	1987	1988	1989	1990	1991
1	35.	156.	155.	296.	145.
2	1910.	1854.	4192.	1452.	582.
3	4725.	6394.	7555.	15007.	1509.
4	4929.	3725.	5469.	6324.	12582.
5	1861.	2384.	2187.	2538.	3137.
6	696.	941.	864.	1128.	1311.
7	1089.	300.	719.	549.	420.
8	241.	587.	213.	420.	456.
9	182.	128.	424.	128.	148.
10	200.	52.	111.	310.	32.
11	58.	24.	262.	506.	21.
Total	15926.	16546.	22151.	28657.	20342.

AGE	1992	1993	1994	1995	1996
1	91.	121.	1.	0.	35.
2	834.	773.	1040.	160.	640.
3	1554.	3593.	4418.	8266.	2639.
4	1223.	2196.	3020.	3637.	6680.
5	6355.	786.	928.	927.	1406.
6	1131.	2183.	410.	256.	252.
7	607.	456.	623.	133.	213.
8	104.	193.	188.	153.	53.
9	38.	32.	93.	4.	32.
10	51.	0.	9.	26.	0.
11	0.	0.	24.	5.	0.
Total	11988.	10334.	10755.	13566.	11949.

AGE	1997	1998	1999	2000	2001
1	12.	60.	104.	110.	24.
2	456.	1125.	897.	1771.	757.
3	3326.	3345.	3634.	3438.	5603.
4	2098.	3361.	2727.	4467.	4030.

5	3155.	1180.	2129.	1990.	3654.
6	463.	1290.	735.	1519.	1784.
7	73.	189.	779.	468.	1198.
8	210.	14.	84.	473.	367.
9	45.	203.	0.	49.	357.
10	15.	31.	159.	0.	41.
11	3.	15.	0.	0.	33.
Total	9856.	10814.	11246.	14285.	17848.

AGE	2002	2003	2004	2005	2006
1	176.	54.	295.	34.	523.
2	289.	1334.	313.	773.	1665.
3	3440.	902.	3657.	630.	8704.
4	6729.	4079.	999.	3782.	1590.
5	2953.	5179.	2993.	632.	3366.
6	2408.	1889.	2810.	1855.	371.
7	1186.	1441.	982.	1767.	893.
8	939.	658.	826.	557.	1108.
9	314.	608.	389.	500.	307.
10	217.	211.	319.	204.	288.
11	21.	185.	111.	239.	326.
Total	18673.	16539.	13693.	10974.	19139.

AGE	2007
1	70.
2	5911.
3	7924.
4	14568.
5	1267.
6	2162.
7	237.
8	471.
9	836.
10	161.
11	271.
Total	33877.

Catch Biomass

AGE	1982	1983	1984	1985	1986
1	46.	5.	12.	21.	5.
2	2201.	1407.	818.	1059.	209.
3	3918.	4697.	2551.	3503.	4951.
4	3837.	2901.	4415.	3155.	2683.
5	3525.	2578.	1721.	2927.	1261.
6	507.	2727.	1206.	722.	1203.
7	854.	289.	633.	617.	371.
8	640.	680.	188.	363.	328.
9	531.	251.	193.	51.	483.
10	41.	152.	162.	141.	109.
11	613.	352.	275.	152.	1165.
Total	16713.	16037.	12173.	12711.	12768.

AGE	1987	1988	1989	1990	1991
1	20.	1.	3.	0.	0.
2	847.	529.	623.	274.	518.
3	2042.	3698.	3927.	6956.	2068.
4	4715.	2656.	5034.	5649.	11948.
5	1667.	2186.	1876.	2191.	3728.
6	655.	318.	400.	1308.	1178.
7	797.	100.	372.	290.	453.
8	140.	197.	71.	354.	369.
9	179.	11.	43.	153.	111.
10	135.	36.	87.	214.	33.
11	40.	14.	163.	350.	17.
Total	11237.	9747.	12597.	17739.	20424.

AGE	1992	1993	1994	1995	1996
1	0.	0.	0.	5.	0.
2	526.	152.	75.	392.	139.
3	1145.	3700.	2691.	2102.	1352.
4	1458.	1878.	3604.	3173.	4474.
5	6740.	589.	1108.	1174.	1340.
6	1094.	2890.	446.	160.	271.
7	620.	293.	616.	150.	47.
8	89.	79.	308.	211.	7.

9	161.	27.	69.	15.	19.
10	49.	0.	11.	32.	0.
11	0.	0.	25.	4.	0.
Total	11881.	9607.	8952.	7419.	7648.

AGE	1997	1998	1999	2000	2001
1	0.	0.	0.	0.	0.
2	151.	148.	30.	326.	260.
3	1097.	1000.	1188.	1220.	2825.
4	1387.	1693.	1457.	2835.	2189.
5	2663.	656.	1048.	843.	1789.
6	342.	808.	335.	564.	687.
7	42.	136.	570.	97.	435.
8	30.	44.	78.	60.	74.
9	4.	8.	0.	0.	115.
10	11.	16.	59.	0.	15.
11	2.	8.	0.	0.	12.
Total	5731.	4517.	4765.	5946.	8401.

AGE	2002	2003	2004	2005	2006
1	0.	0.	0.	0.	0.
2	4.	32.	1.	12.	4.
3	638.	286.	837.	276.	430.
4	2891.	1354.	806.	2305.	917.
5	1393.	3063.	1494.	410.	1685.
6	1198.	1224.	1399.	1196.	157.
7	543.	777.	514.	754.	536.
8	409.	350.	347.	255.	365.
9	97.	235.	227.	200.	176.
10	100.	121.	146.	109.	131.
11	9.	97.	46.	119.	138.
Total	7281.	7538.	5818.	5637.	4540.

AGE	2007
1	0.
2	16.
3	391.
4	2924.
5	551.
6	1217.
7	54.
8	165.
9	127.
10	79.
11	107.
Total	5631.

Catch Numbers

AGE	1982	1983	1984	1985	1986
1	71.4	11.3	24.7	44.3	12.8
2	1980.9	1324.4	801.5	1064.5	186.0
3	2420.3	2917.6	1581.5	2187.8	2756.8
4	1422.1	1189.0	1636.5	1137.1	929.6
5	747.1	687.2	470.1	667.5	277.0
6	77.1	452.6	207.6	133.2	199.9
7	97.7	50.0	78.4	78.5	45.7
8	65.6	65.4	19.3	32.1	30.2
9	41.0	25.2	15.0	4.0	35.6
10	4.0	11.8	11.6	11.0	8.0
11	33.0	19.4	18.4	11.0	59.5
Total	6960.2	6753.9	4864.6	5371.0	4541.1

AGE	1987	1988	1989	1990	1991
1	96.3	2.4	3.8	0.0	0.0
2	889.6	549.1	519.5	253.6	438.5
3	1321.0	2128.0	2280.6	4125.6	1341.1
4	1505.8	1117.1	1715.7	2455.9	4910.7
5	346.4	428.8	488.0	523.3	930.6
6	91.5	49.3	92.8	176.6	158.8
7	83.7	11.2	41.2	27.0	46.8
8	13.9	17.9	6.4	30.0	30.0
9	13.6	1.0	3.0	10.0	7.9
10	10.3	2.0	5.0	15.0	1.3
11	3.0	1.0	7.0	17.0	1.0
Total	4375.1	4307.8	5163.0	7634.0	7866.7

AGE	1992	1993	1994	1995	1996
1	0.0	0.0	0.9	18.1	0.0
2	338.3	127.8	54.0	277.0	90.0
3	587.1	2031.8	1488.2	1169.9	630.7
4	531.9	783.0	1216.6	1192.0	1936.7
5	2188.4	139.4	330.9	232.5	384.3
6	219.1	473.8	71.0	28.6	36.9
7	65.3	29.2	85.7	13.9	4.5
8	7.4	6.0	29.5	18.4	0.5
9	12.0	2.0	6.7	0.8	1.3
10	3.0	0.0	0.6	1.6	0.0
11	0.0	0.0	1.2	0.2	0.0
Total	3952.5	3593.0	3285.3	2953.0	3084.9

AGE	1997	1998	1999	2000	2001
1	0.0	0.0	1.2	0.0	0.0
2	85.4	107.5	22.1	201.1	147.2
3	495.2	482.4	647.2	534.0	1183.5
4	455.5	594.8	568.0	828.3	685.5
5	852.4	158.7	272.6	190.3	378.0
6	71.4	191.4	58.0	98.9	109.1
7	5.0	26.2	79.2	16.1	59.8
8	2.6	3.9	7.9	7.1	8.9
9	0.3	0.4	0.0	0.0	13.3
10	0.7	1.1	4.4	0.0	1.2
11	0.1	0.4	0.0	0.0	0.5
Total	1968.6	1566.8	1660.6	1875.8	2587.0

AGE	2002	2003	2004	2005	2006
1	0.0	0.0	0.0	0.0	0.0
2	3.0	16.4	0.9	7.5	1.6
3	259.5	118.6	357.8	134.1	177.4
4	884.3	442.9	249.9	813.8	281.3
5	346.0	766.1	409.6	95.2	449.3
6	203.5	231.4	266.0	265.3	32.5
7	81.0	103.3	74.6	120.9	97.2
8	35.5	39.9	36.9	32.5	48.0
9	9.5	21.7	19.3	19.2	18.2
10	9.4	9.9	11.3	8.1	10.8
11	0.6	7.4	3.5	8.3	8.8
Total	1832.3	1757.6	1429.8	1504.9	1125.1

AGE	2007
1	0.0
2	7.9
3	154.8
4	907.5
5	140.4
6	253.8
7	8.5
8	23.3
9	12.6
10	6.7
11	7.5
Total	1523.0

Surplus Production

Average Adjustment Factor (Delta) = 1.0000

Year	Biomass	Delta Biomass	Catch Biomass	Surplus Production
1982	43548.026	-10025.750	16713.307	6687.557
1983	33522.276	-5409.948	16037.051	10627.104
1984	28112.328	-1726.717	12173.486	10446.769
1985	26385.612	485.726	12711.449	13197.175
1986	26871.338	-3537.308	12768.471	9231.163
1987	23334.030	2688.560	11236.780	13925.340
1988	26022.590	11435.443	9746.789	21182.231
1989	37458.032	5271.009	12597.429	17868.438
1990	42729.041	-9098.808	17738.869	8640.060

1991	33630.233	-10428.550	20423.898	9995.348
1992	23201.683	-2406.842	11880.954	9474.111
1993	20794.841	-1764.240	9606.844	7842.605
1994	19030.601	-1447.956	8951.516	7503.559
1995	17582.645	-683.721	7418.520	6734.799
1996	16898.923	-899.757	7648.280	6748.523
1997	15999.167	6.556	5731.013	5737.569
1998	16005.723	1141.654	4516.532	5658.186
1999	17147.377	4126.627	4764.652	8891.279
2000	21274.004	5513.172	5945.694	11458.866
2001	26787.176	-1853.416	8401.230	6547.813
2002	24933.760	-2375.296	7280.581	4905.285
2003	22558.464	-565.860	7538.329	6972.469
2004	21992.604	1287.872	5817.528	7105.401
2005	23280.477	10711.086	5637.061	16348.146
2006	33991.562	18168.941	4540.123	22709.064
2007	52160.503	11348.568	5631.217	16979.785
2008	63509.071			

Summary of Survey Indices Used in the Estimate

INDEX	Survey Tag	Age	Time	Type	Catchability	Std. Error	CV
1	WHSpr	2	JAN-1	NUMBER	0.6391E-04	0.9883E-05	0.1546E+00
2	WHSpr	3	JAN-1	NUMBER	0.1319E-03	0.1415E-04	0.1073E+00
3	WHSpr	4	JAN-1	NUMBER	0.2250E-03	0.2283E-04	0.1015E+00
4	WHSpr	5	JAN-1	NUMBER	0.2940E-03	0.3869E-04	0.1316E+00
5	WHSpr	6	JAN-1	NUMBER	0.3828E-03	0.6419E-04	0.1677E+00
6	WHSpr	7	JAN-1	NUMBER	0.5666E-03	0.1096E-03	0.1934E+00
7	WHSpr	8	JAN-1	NUMBER	0.5118E-03	0.1396E-03	0.2728E+00
8	WHAut	2	JAN-1	NUMBER	0.5338E-04	0.6870E-05	0.1287E+00
9	WHAut	3	JAN-1	NUMBER	0.1136E-03	0.1287E-04	0.1133E+00
10	WHAut	4	JAN-1	NUMBER	0.2238E-03	0.2260E-04	0.1010E+00
11	WHAut	5	JAN-1	NUMBER	0.3703E-03	0.4638E-04	0.1253E+00
12	WHAut	6	JAN-1	NUMBER	0.4782E-03	0.5653E-04	0.1182E+00
13	WHAut	7	JAN-1	NUMBER	0.4512E-03	0.8364E-04	0.1854E+00
14	WHAut	8	JAN-1	NUMBER	0.5668E-03	0.1292E-03	0.2279E+00
15	MASpr	2	JAN-1	NUMBER	0.7106E-03	0.1074E-03	0.1512E+00
16	MASpr	3	JAN-1	NUMBER	0.5446E-03	0.4749E-04	0.8720E-01
17	MASpr	4	JAN-1	NUMBER	0.4537E-03	0.5623E-04	0.1239E+00
19	MAAut	2	JAN-1	NUMBER	0.1230E-03	0.3679E-04	0.2992E+00
21	CM_CPE	2	MEAN	NUMBER	0.2458E-05	0.6900E-06	0.2807E+00
22	CM_CPE	3	MEAN	NUMBER	0.1406E-04	0.1646E-05	0.1171E+00
23	CM_CPE	4	MEAN	NUMBER	0.2317E-04	0.1281E-05	0.5530E-01
24	CM_CPE	5	MEAN	NUMBER	0.2291E-04	0.1239E-05	0.5410E-01
25	CM_CPE	6	MEAN	NUMBER	0.2187E-04	0.2466E-05	0.1128E+00

Survey Index: 1 Tag: WHSpr AGE = 2
Time = JAN-1 Type = NUMBER
Catchability = 0.639060E-04 % Variance Contribution = 6.0022
Residual = LN(Observed) - LN(Predicted)

Year	Observed	Predicted	Residual
1982	0.100650E+01	0.710799E+00	0.347845E+00
1983	0.948600E+00	0.406955E+00	0.846285E+00
1984	0.131200E+01	0.414194E+00	0.115297E+01
1985	0.230800E+00	0.557076E+00	-0.881151E+00
1986	0.247800E+00	0.346899E+00	-0.336413E+00
1987	0.460200E+00	0.536073E+00	-0.152610E+00
1988	0.923400E+00	0.661229E+00	0.333963E+00
1989	0.604800E+00	0.128761E+01	-0.755643E+00
1990	0.207600E+00	0.222378E+00	-0.687655E-01
1991	0.678000E-01	0.216374E+00	-0.116045E+01
1992	0.225500E+00	0.364946E+00	-0.481430E+00

1993	0.496500E+00	0.331710E+00	0.403323E+00
1994	0.315600E+00	0.477323E+00	-0.413717E+00
1995	0.179200E+00	0.166337E+00	0.744872E-01
1996	0.215000E-01	0.198014E+00	-0.222029E+01
1997	0.131600E+00	0.185482E+00	-0.343192E+00
1998	0.223600E+00	0.274436E+00	-0.204860E+00
1999	0.344300E+00	0.233272E+00	0.389310E+00
2000	0.724700E+00	0.410507E+00	0.568365E+00
2001	0.323400E+00	0.210131E+00	0.431157E+00
2002	0.453000E-01	0.621130E-01	-0.315648E+00
2003	0.830500E+00	0.259133E+00	0.116469E+01
2004	0.446000E-01	0.879742E-01	-0.679310E+00
2005	0.726500E+00	0.573787E+00	0.235981E+00
2006	0.230000E+00	0.351219E+00	-0.423332E+00
2007	0.345000E+01	0.125103E+01	0.101441E+01
2008	0.109860E+01	0.251582E+00	0.147402E+01

Survey Index: 2 Tag: WHSpr AGE = 3
Time = JAN-1 Type = NUMBER
Catchability = 0.131940E-03 % Variance Contribution = 2.8875
Residual = LN(Observed) - LN(Predicted)

Year	Observed	Predicted	Residual
1982	0.476400E+00	0.728272E+00	-0.424417E+00
1983	0.996800E+00	0.965009E+00	0.324129E-01
1984	0.102260E+01	0.529782E+00	0.657637E+00
1985	0.661700E+00	0.604445E+00	0.905019E-01
1986	0.754000E+00	0.814568E+00	-0.772658E-01
1987	0.199100E+00	0.564175E+00	-0.104156E+01
1988	0.822900E+00	0.799946E+00	0.282904E-01
1989	0.723000E+00	0.105215E+01	-0.375184E+00
1990	0.136540E+01	0.211448E+01	-0.437363E+00
1991	0.233900E+00	0.345620E+00	-0.390447E+00
1992	0.242400E+00	0.313398E+00	-0.256884E+00
1993	0.799300E+00	0.576498E+00	0.326764E+00
1994	0.387500E+00	0.545448E+00	-0.341891E+00
1995	0.111610E+01	0.800395E+00	0.332491E+00
1996	0.592700E+00	0.248098E+00	0.870866E+00
1997	0.399100E+00	0.323968E+00	0.208567E+00
1998	0.330100E+00	0.303334E+00	0.845609E-01
1999	0.713300E+00	0.451059E+00	0.458304E+00
2000	0.438500E+00	0.391672E+00	0.112936E+00
2001	0.716100E+00	0.669891E+00	0.667046E-01
2002	0.524400E+00	0.337622E+00	0.440328E+00
2003	0.630000E-01	0.104634E+00	-0.507337E+00
2004	0.221300E+00	0.436067E+00	-0.678277E+00
2005	0.101400E+00	0.148600E+00	-0.382182E+00
2006	0.430000E+00	0.969003E+00	-0.812483E+00
2007	0.293000E+01	0.593492E+00	0.159673E+01
2008	0.321120E+01	0.211373E+01	0.418189E+00

Survey Index: 3 Tag: WHSpr AGE = 4
Time = JAN-1 Type = NUMBER
Catchability = 0.225008E-03 % Variance Contribution = 2.5836
Residual = LN(Observed) - LN(Predicted)

Year	Observed	Predicted	Residual
1982	0.655400E+00	0.703819E+00	-0.712760E-01
1983	0.464700E+00	0.524085E+00	-0.120261E+00
1984	0.823300E+00	0.753380E+00	0.887512E-01
1985	0.662500E+00	0.417720E+00	0.461208E+00
1986	0.236900E+00	0.398528E+00	-0.520139E+00
1987	0.230700E+00	0.576066E+00	-0.915104E+00
1988	0.217900E+00	0.518778E+00	-0.867439E+00

1989	0.600100E+00	0.683671E+00	-0.130380E+00
1990	0.637000E+00	0.100474E+01	-0.455718E+00
1991	0.171670E+01	0.211239E+01	-0.207415E+00
1992	0.281900E+00	0.209529E+00	0.296690E+00
1993	0.334300E+00	0.318050E+00	0.498311E-01
1994	0.215000E+00	0.391268E+00	-0.598755E+00
1995	0.371700E+00	0.458588E+00	-0.210066E+00
1996	0.133070E+01	0.879362E+00	0.414264E+00
1997	0.264300E+00	0.217998E+00	0.192599E+00
1998	0.516600E+00	0.351519E+00	0.385006E+00
1999	0.344500E+00	0.325315E+00	0.573012E-01
2000	0.457000E+00	0.498022E+00	-0.859616E-01
2001	0.497200E+00	0.438150E+00	0.126431E+00
2002	0.160120E+01	0.694378E+00	0.835492E+00
2003	0.707700E+00	0.418570E+00	0.525175E+00
2004	0.118100E+00	0.121949E+00	-0.320709E-01
2005	0.607600E+00	0.536011E+00	0.125362E+00
2006	0.600000E-01	0.180179E+00	-0.109961E+01
2007	0.448000E+01	0.131685E+01	0.122438E+01
2008	0.135660E+01	0.797144E+00	0.531701E+00

Survey Index: 4 Tag: WHSpr AGE = 5
Time = JAN-1 Type = NUMBER
Catchability = 0.293998E-03 % Variance Contribution = 4.3467
Residual = LN(Observed) - LN(Predicted)

Year	Observed	Predicted	Residual
1982	0.987700E+00	0.519630E+00	0.642261E+00
1983	0.404200E+00	0.374612E+00	0.760188E-01
1984	0.211800E+00	0.244348E+00	-0.142951E+00
1985	0.661700E+00	0.370595E+00	0.579702E+00
1986	0.912000E-01	0.144370E+00	-0.459325E+00
1987	0.744000E-01	0.179037E+00	-0.878139E+00
1988	0.253500E+00	0.215680E+00	0.161567E+00
1989	0.908000E-01	0.257798E+00	-0.104352E+01
1990	0.102000E+00	0.274954E+00	-0.991631E+00
1991	0.299300E+00	0.421518E+00	-0.342417E+00
1992	0.132810E+01	0.953406E+00	0.331464E+00
1993	0.906000E-01	0.826501E-01	0.918379E-01
1994	0.942000E-01	0.131944E+00	-0.336956E+00
1995	0.145400E+00	0.949236E-01	0.426416E+00
1996	0.403200E+00	0.173484E+00	0.843345E+00
1997	0.875600E+00	0.425507E+00	0.721628E+00
1998	0.141500E+00	0.112034E+00	0.233500E+00
1999	0.315000E+00	0.217813E+00	0.368937E+00
2000	0.107100E+00	0.196910E+00	-0.608983E+00
2001	0.353900E+00	0.312421E+00	0.124663E+00
2002	0.614200E+00	0.286360E+00	0.763072E+00
2003	0.108890E+01	0.507578E+00	0.763274E+00
2004	0.190800E+00	0.329950E+00	-0.547717E+00
2005	0.154000E-01	0.639780E-01	-0.142417E+01
2006	0.200000E+00	0.356917E+00	-0.579186E+00
2007	0.500000E+00	0.117918E+00	0.144462E+01
2008	0.939300E+00	0.116730E+01	-0.217316E+00

Survey Index: 5 Tag: WHSpr AGE = 6
Time = JAN-1 Type = NUMBER
Catchability = 0.382779E-03 % Variance Contribution = 6.5351
Residual = LN(Observed) - LN(Predicted)

Year	Observed	Predicted	Residual
1982	0.873000E-01	0.866418E-01	0.756783E-02
1983	0.211800E+00	0.295150E+00	-0.331842E+00

1984	0.467000E-01	0.161312E+00	-0.123959E+01
1985	0.103100E+00	0.976474E-01	0.543368E-01
1986	0.349000E-01	0.163853E+00	-0.154648E+01
1987	N/A	0.579545E-01	N/A
1988	0.915000E-01	0.708719E-01	0.255464E+00
1989	0.627000E-01	0.813926E-01	-0.260923E+00
1990	0.321000E-01	0.105784E+00	-0.119255E+01
1991	0.200000E-01	0.111846E+00	-0.172139E+01
1992	0.226400E+00	0.127010E+00	0.578037E+00
1993	0.484200E+00	0.258344E+00	0.628205E+00
1994	0.493000E-01	0.398210E-01	0.213530E+00
1995	0.283000E-01	0.260400E-01	0.832277E-01
1996	0.593000E-01	0.206587E-01	0.105447E+01
1997	0.242400E+00	0.518259E-01	0.154270E+01
1998	0.421000E+00	0.158347E+00	0.977847E+00
1999	0.133700E+00	0.644584E-01	0.729578E+00
2000	0.100600E+00	0.137766E+00	-0.314404E+00
2001	0.635000E-01	0.143989E+00	-0.818698E+00
2002	0.361900E+00	0.202110E+00	0.582556E+00
2003	0.394600E+00	0.185413E+00	0.755288E+00
2004	0.231600E+00	0.275722E+00	-0.174380E+00
2005	0.149800E+00	0.209851E+00	-0.337097E+00
2006	0.200000E-01	0.352258E-01	-0.566047E+00
2007	0.840000E+00	0.224846E+00	0.131798E+01
2008	0.584000E-01	0.770687E-01	-0.277382E+00

Survey Index: 6 Tag: WHSpr AGE = 7
Time = JAN-1 Type = NUMBER
Catchability = 0.566609E-03 % Variance Contribution = 8.0244
Residual = LN(Observed) - LN(Predicted)

Year	Observed	Predicted	Residual
1982	0.112000E+00	0.147101E+00	-0.272622E+00
1983	0.680000E-01	0.654754E-01	0.378336E-01
1984	0.100000E+00	0.125658E+00	-0.228392E+00
1985	0.910000E-01	0.890640E-01	0.215047E-01
1986	0.380000E-01	0.500514E-01	-0.275465E+00
1987	0.660000E-01	0.960915E-01	-0.375647E+00
1988	0.650000E-01	0.233256E-01	0.102484E+01
1989	0.140000E-01	0.606162E-01	-0.146550E+01
1990	0.180000E-01	0.510645E-01	-0.104272E+01
1991	0.180000E-01	0.376623E-01	-0.738287E+00
1992	0.690000E-01	0.541349E-01	0.242628E+00
1993	0.550000E-01	0.415969E-01	0.279308E+00
1994	0.127000E+00	0.701825E-01	0.593088E+00
1995	N/A	0.118593E-01	N/A
1996	N/A	0.168957E-01	N/A
1997	0.120000E+00	0.611869E-02	0.297614E+01
1998	0.230000E-01	0.262033E-01	-0.130392E+00
1999	0.273000E+00	0.937761E-01	0.106856E+01
2000	0.240000E-01	0.483830E-01	-0.701095E+00
2001	0.980000E-01	0.116258E+00	-0.170841E+00
2002	0.164000E+00	0.118570E+00	0.324362E+00
2003	0.321000E+00	0.140611E+00	0.825446E+00
2004	0.140000E-01	0.106071E+00	-0.202505E+01
2005	0.129700E+00	0.197780E+00	-0.421929E+00
2006	0.131400E+00	0.118308E+00	0.104954E+00
2007	0.652000E-01	0.260288E-01	0.918257E+00
2008	0.806000E-01	0.142377E+00	-0.568982E+00

Survey Index: 7 Tag: WHSpr AGE = 8
Time = JAN-1 Type = NUMBER
Catchability = 0.511812E-03 % Variance Contribution = 5.5891
Residual = LN(Observed) - LN(Predicted)

Year	Observed	Predicted	Residual
1982	N/A	0.716573E-01	N/A
1983	0.160000E-01	0.635433E-01	-0.137913E+01
1984	N/A	0.252670E-01	N/A
1985	0.520000E-01	0.566227E-01	-0.851666E-01
1986	N/A	0.295134E-01	N/A
1987	0.800000E-02	0.158516E-01	-0.683828E+00
1988	N/A	0.323025E-01	N/A
1989	N/A	0.120637E-01	N/A
1990	N/A	0.257487E-01	N/A
1991	N/A	0.252609E-01	N/A
1992	N/A	0.617975E-02	N/A
1993	0.230000E-01	0.979461E-02	0.853662E+00
1994	0.270000E-01	0.172403E-01	0.448589E+00
1995	0.110000E-01	0.122153E-01	-0.104793E+00
1996	N/A	0.233333E-02	N/A
1997	N/A	0.104113E-01	N/A
1998	0.370000E-01	0.220955E-02	0.281813E+01
1999	N/A	0.724529E-02	N/A
2000	0.220000E-01	0.326741E-01	-0.395540E+00
2001	0.550000E-01	0.283257E-01	0.663565E+00
2002	0.570000E-01	0.582846E-01	-0.222870E-01
2003	0.103000E+00	0.501770E-01	0.719173E+00
2004	0.140000E-01	0.561498E-01	-0.138897E+01
2005	0.142000E-01	0.438969E-01	-0.112860E+01
2006	0.729000E-01	0.902784E-01	-0.213810E+00
2007	0.384000E-01	0.424809E-01	-0.100996E+00
2008	N/A	0.153132E-01	N/A

Survey Index: 8 Tag: WHAut AGE = 2
Time = JAN-1 Type = NUMBER
Catchability = 0.533836E-04 % Variance Contribution = 4.1570
Residual = LN(Observed) - LN(Predicted)

Year	Observed	Predicted	Residual
1982	0.617900E+00	0.593763E+00	0.398469E-01
1983	0.842600E+00	0.339948E+00	0.907700E+00
1984	0.316800E+00	0.345995E+00	-0.881533E-01
1985	0.432300E+00	0.465351E+00	-0.736728E-01
1986	0.525600E+00	0.289781E+00	0.595416E+00
1987	0.392000E+00	0.447806E+00	-0.133099E+00
1988	0.578200E+00	0.552354E+00	0.457300E-01
1989	0.193750E+01	0.107560E+01	0.588523E+00
1990	0.149500E+00	0.185762E+00	-0.217172E+00
1991	0.447000E-01	0.180747E+00	-0.139713E+01
1992	0.143500E+00	0.304856E+00	-0.753505E+00
1993	0.291000E+00	0.277092E+00	0.489726E-01
1994	0.197700E+00	0.398729E+00	-0.701532E+00
1995	0.207100E+00	0.138949E+00	0.399096E+00
1996	0.680000E-01	0.165410E+00	-0.888921E+00
1997	0.124200E+00	0.154942E+00	-0.221156E+00
1998	0.296800E+00	0.229249E+00	0.258249E+00
1999	0.966000E-01	0.194862E+00	-0.701715E+00
2000	0.430700E+00	0.342915E+00	0.227929E+00
2001	0.532600E+00	0.175532E+00	0.110995E+01
2002	0.340000E-01	0.518858E-01	-0.422685E+00
2003	0.269100E+00	0.216466E+00	0.217651E+00
2004	0.454600E+00	0.734888E-01	0.182228E+01
2005	0.570000E+00	0.479310E+00	0.173289E+00

2006	0.153300E+00	0.293389E+00	-0.649104E+00
2007	0.125140E+01	0.104504E+01	0.180205E+00
2008	0.145600E+00	0.210158E+00	-0.366997E+00

Survey Index: 9 Tag: WHAut AGE = 3
Time = JAN-1 Type = NUMBER
Catchability = 0.113582E-03 % Variance Contribution = 3.2202
Residual = LN(Observed) - LN(Predicted)

Year	Observed	Predicted	Residual
1982	0.418800E+00	0.626938E+00	-0.403454E+00
1983	0.335270E+01	0.830735E+00	0.139521E+01
1984	0.915500E+00	0.456067E+00	0.696831E+00
1985	0.425800E+00	0.520341E+00	-0.200514E+00
1986	0.956700E+00	0.701227E+00	0.310658E+00
1987	0.401000E+00	0.485674E+00	-0.191576E+00
1988	0.137960E+01	0.688639E+00	0.694831E+00
1989	0.231340E+01	0.905753E+00	0.937707E+00
1990	0.240650E+01	0.182027E+01	0.279189E+00
1991	0.186800E+00	0.297530E+00	-0.465475E+00
1992	0.139000E+00	0.269791E+00	-0.663173E+00
1993	0.445800E+00	0.496283E+00	-0.107275E+00
1994	0.567800E+00	0.469552E+00	0.189989E+00
1995	0.883100E+00	0.689026E+00	0.248160E+00
1996	0.284500E+00	0.213577E+00	0.286737E+00
1997	0.382600E+00	0.278890E+00	0.316172E+00
1998	0.855000E-01	0.261127E+00	-0.111649E+01
1999	0.320300E+00	0.388297E+00	-0.192513E+00
2000	0.367200E+00	0.337173E+00	0.853095E-01
2001	0.983700E+00	0.576681E+00	0.534032E+00
2002	0.141000E+00	0.290644E+00	-0.723340E+00
2003	0.805000E-01	0.900753E-01	-0.112388E+00
2004	0.197600E+00	0.375392E+00	-0.641725E+00
2005	0.170000E+00	0.127923E+00	0.284370E+00
2006	0.380600E+00	0.834173E+00	-0.784692E+00
2007	0.580200E+00	0.510912E+00	0.127176E+00
2008	0.831000E+00	0.181962E+01	-0.783754E+00

Survey Index: 10 Tag: WHAut AGE = 4
Time = JAN-1 Type = NUMBER
Catchability = 0.223833E-03 % Variance Contribution = 2.5584
Residual = LN(Observed) - LN(Predicted)

Year	Observed	Predicted	Residual
1982	0.539400E+00	0.700144E+00	-0.260829E+00
1983	0.227480E+01	0.521348E+00	0.147323E+01
1984	0.827700E+00	0.749446E+00	0.993165E-01
1985	0.630700E+00	0.415539E+00	0.417253E+00
1986	0.609400E+00	0.396447E+00	0.429933E+00
1987	0.656500E+00	0.573058E+00	0.135936E+00
1988	0.592100E+00	0.516069E+00	0.137435E+00
1989	0.989600E+00	0.680101E+00	0.375060E+00
1990	0.150170E+01	0.999498E+00	0.407100E+00
1991	0.182930E+01	0.210136E+01	-0.138650E+00
1992	0.223300E+00	0.208435E+00	0.688890E-01
1993	0.140000E+00	0.316389E+00	-0.815330E+00
1994	0.360200E+00	0.389225E+00	-0.774982E-01
1995	0.826000E+00	0.456194E+00	0.593677E+00
1996	0.122840E+01	0.874770E+00	0.339506E+00
1997	0.188300E+00	0.216860E+00	-0.141214E+00
1998	0.176900E+00	0.349683E+00	-0.681443E+00
1999	0.114700E+00	0.323616E+00	-0.103724E+01
2000	0.585700E+00	0.495422E+00	0.167398E+00

2001	0.393600E+00	0.435862E+00	-0.101991E+00
2002	0.752400E+00	0.690752E+00	0.854870E-01
2003	0.363700E+00	0.416385E+00	-0.135280E+00
2004	0.184800E+00	0.121312E+00	0.420907E+00
2005	0.540000E+00	0.533212E+00	0.126500E-01
2006	0.796000E-01	0.179239E+00	-0.811704E+00
2007	0.103310E+01	0.130997E+01	-0.237443E+00
2008	0.384000E+00	0.792982E+00	-0.725158E+00

Survey Index: 11 Tag: WHAut AGE = 5
Time = JAN-1 Type = NUMBER
Catchability = 0.370258E-03 % Variance Contribution = 3.9388
Residual = LN(Observed) - LN(Predicted)

Year	Observed	Predicted	Residual
1982	0.404700E+00	0.654418E+00	-0.480600E+00
1983	0.108920E+01	0.471783E+00	0.836679E+00
1984	0.197000E+00	0.307730E+00	-0.446019E+00
1985	0.387100E+00	0.466724E+00	-0.187056E+00
1986	0.248200E+00	0.181818E+00	0.311227E+00
1987	0.341700E+00	0.225478E+00	0.415710E+00
1988	0.242900E+00	0.271626E+00	-0.111776E+00
1989	0.443400E+00	0.324668E+00	0.311669E+00
1990	0.292600E+00	0.346275E+00	-0.168426E+00
1991	0.597800E+00	0.530856E+00	0.118765E+00
1992	0.633400E+00	0.120071E+01	-0.639567E+00
1993	0.355000E-01	0.104089E+00	-0.107571E+01
1994	0.336000E-01	0.166169E+00	-0.159848E+01
1995	0.854000E-01	0.119546E+00	-0.336355E+00
1996	0.325200E+00	0.218485E+00	0.397724E+00
1997	0.542100E+00	0.535880E+00	0.115407E-01
1998	0.172800E+00	0.141094E+00	0.202706E+00
1999	0.192300E+00	0.274311E+00	-0.355207E+00
2000	0.243300E+00	0.247987E+00	-0.190795E-01
2001	0.507100E+00	0.393460E+00	0.253728E+00
2002	0.469000E+00	0.360639E+00	0.262726E+00
2003	0.279720E+01	0.639239E+00	0.147610E+01
2004	0.528700E+00	0.415537E+00	0.240850E+00
2005	0.240000E+00	0.805733E-01	0.109147E+01
2006	0.449500E+00	0.449498E+00	0.419220E-05
2007	0.247500E+00	0.148504E+00	0.510796E+00
2008	0.528300E+00	0.147009E+01	-0.102342E+01

Survey Index: 12 Tag: WHAut AGE = 6
Time = JAN-1 Type = NUMBER
Catchability = 0.478237E-03 % Variance Contribution = 3.2474
Residual = LN(Observed) - LN(Predicted)

Year	Observed	Predicted	Residual
1982	0.120500E+00	0.108249E+00	0.107218E+00
1983	0.209200E+00	0.368755E+00	-0.566843E+00
1984	0.227000E+00	0.201540E+00	0.118962E+00
1985	0.214000E+00	0.121999E+00	0.561964E+00
1986	0.182000E+00	0.204715E+00	-0.117612E+00
1987	0.727000E-01	0.724073E-01	0.403470E-02
1988	0.751000E-01	0.885462E-01	-0.164703E+00
1989	0.990000E-01	0.101691E+00	-0.268141E-01
1990	0.160500E+00	0.132165E+00	0.194241E+00
1991	0.258900E+00	0.139739E+00	0.616666E+00
1992	0.811000E-01	0.158684E+00	-0.671232E+00
1993	0.349800E+00	0.322771E+00	0.804195E-01
1994	N/A	0.497516E-01	N/A
1995	0.511000E-01	0.325339E-01	0.451501E+00

1996	0.821000E-01	0.258107E-01	0.115715E+01
1997	0.616000E-01	0.647504E-01	-0.498781E-01
1998	0.140200E+00	0.197835E+00	-0.344366E+00
1999	0.387000E-01	0.805332E-01	-0.732830E+00
2000	0.132000E+00	0.172122E+00	-0.265404E+00
2001	0.134300E+00	0.179897E+00	-0.292311E+00
2002	0.336800E+00	0.252513E+00	0.288028E+00
2003	0.109580E+01	0.231651E+00	0.155401E+01
2004	0.449800E+00	0.344482E+00	0.266762E+00
2005	0.250000E+00	0.262184E+00	-0.475867E-01
2006	0.221000E-01	0.440105E-01	-0.688851E+00
2007	0.285700E+00	0.280919E+00	0.168753E-01
2008	0.226000E-01	0.962883E-01	-0.144940E+01

Survey Index: 13 Tag: WHAut AGE = 7
Time = JAN-1 Type = NUMBER
Catchability = 0.451154E-03 % Variance Contribution = 5.1610
Residual = LN(Observed) - LN(Predicted)

Year	Observed	Predicted	Residual
1982	0.760000E-01	0.117127E+00	-0.432526E+00
1983	N/A	0.521337E-01	N/A
1984	0.210000E+00	0.100053E+00	0.741407E+00
1985	0.163000E+00	0.709158E-01	0.832257E+00
1986	0.750000E-01	0.398527E-01	0.632299E+00
1987	0.410000E-01	0.765114E-01	-0.623868E+00
1988	N/A	0.185726E-01	N/A
1989	0.650000E-01	0.482647E-01	0.297687E+00
1990	0.330000E-01	0.406593E-01	-0.208720E+00
1991	0.520000E-01	0.299880E-01	0.550447E+00
1992	N/A	0.431041E-01	N/A
1993	0.104000E+00	0.331209E-01	0.114423E+01
1994	0.300000E-01	0.558817E-01	-0.622040E+00
1995	N/A	0.944275E-02	N/A
1996	0.110000E-01	0.134530E-01	-0.201304E+00
1997	N/A	0.487191E-02	N/A
1998	N/A	0.208640E-01	N/A
1999	0.310000E-01	0.746677E-01	-0.879061E+00
2000	0.160000E-01	0.385242E-01	-0.878698E+00
2001	0.100000E-01	0.925683E-01	-0.222536E+01
2002	0.122000E+00	0.944096E-01	0.256378E+00
2003	0.627000E+00	0.111959E+00	0.172281E+01
2004	0.730000E-01	0.844571E-01	-0.145784E+00
2005	0.168000E+00	0.157479E+00	0.646722E-01
2006	0.923000E-01	0.942010E-01	-0.203867E-01
2007	0.339000E-01	0.207250E-01	0.492075E+00
2008	0.690000E-01	0.113366E+00	-0.496513E+00

Survey Index: 14 Tag: WHAut AGE = 8
Time = JAN-1 Type = NUMBER
Catchability = 0.566767E-03 % Variance Contribution = 3.3797
Residual = LN(Observed) - LN(Predicted)

Year	Observed	Predicted	Residual
1982	0.290000E-01	0.793514E-01	-0.100659E+01
1983	N/A	0.703661E-01	N/A
1984	N/A	0.279800E-01	N/A
1985	0.790000E-01	0.627025E-01	0.231047E+00
1986	N/A	0.326824E-01	N/A
1987	N/A	0.175536E-01	N/A
1988	N/A	0.357710E-01	N/A
1989	0.330000E-01	0.133590E-01	0.904319E+00
1990	N/A	0.285135E-01	N/A
1991	0.100000E-01	0.279732E-01	-0.102866E+01

1992	0.230000E-01	0.684329E-02	0.121223E+01
1993	0.800000E-02	0.108463E-01	-0.304381E+00
1994	N/A	0.190914E-01	N/A
1995	0.450000E-01	0.135269E-01	0.120198E+01
1996	N/A	0.258387E-02	N/A
1997	N/A	0.115292E-01	N/A
1998	N/A	0.244679E-02	N/A
1999	N/A	0.802324E-02	N/A
2000	0.600000E-02	0.361824E-01	-0.179681E+01
2001	N/A	0.313671E-01	N/A
2002	0.840000E-01	0.645428E-01	0.263488E+00
2003	0.510000E-01	0.555646E-01	-0.857210E-01
2004	0.770000E-01	0.621788E-01	0.213791E+00
2005	0.680000E-01	0.486102E-01	0.335674E+00
2006	0.824000E-01	0.999719E-01	-0.193304E+00
2007	0.496000E-01	0.470422E-01	0.529461E-01
2008	N/A	0.169574E-01	N/A

Survey Index: 15 Tag: MASpr AGE = 2
Time = JAN-1 Type = NUMBER
Catchability = 0.710558E-03 % Variance Contribution = 5.3115
Residual = LN(Observed) - LN(Predicted)

Year	Observed	Predicted	Residual
1982	0.717000E+01	0.790323E+01	-0.973656E-01
1983	0.146100E+02	0.452485E+01	0.117212E+01
1984	0.515000E+01	0.460534E+01	0.111781E+00
1985	0.277000E+01	0.619402E+01	-0.804737E+00
1986	0.116800E+02	0.385710E+01	0.110796E+01
1987	0.471000E+01	0.596049E+01	-0.235465E+00
1988	0.635000E+01	0.735207E+01	-0.146526E+00
1989	0.205100E+02	0.143166E+02	0.359490E+00
1990	0.545000E+01	0.247258E+01	0.790355E+00
1991	0.269000E+01	0.240582E+01	0.111650E+00
1992	0.513000E+01	0.405776E+01	0.234474E+00
1993	0.611000E+01	0.368821E+01	0.504785E+00
1994	0.407000E+01	0.530725E+01	-0.265432E+00
1995	0.192000E+01	0.184947E+01	0.374282E-01
1996	0.520000E+00	0.220168E+01	-0.144315E+01
1997	0.980000E+00	0.206234E+01	-0.744044E+00
1998	0.830000E+00	0.305140E+01	-0.130193E+01
1999	0.239000E+01	0.259370E+01	-0.817915E-01
2000	0.702000E+01	0.456434E+01	0.430489E+00
2001	0.450000E+01	0.233641E+01	0.655462E+00
2002	0.260000E+00	0.690622E+00	-0.976910E+00
2003	0.127000E+02	0.288125E+01	0.148338E+01
2004	0.156000E+01	0.978167E+00	0.466761E+00
2005	0.715000E+01	0.637981E+01	0.113973E+00
2006	0.367000E+01	0.390514E+01	-0.621009E-01
2007	0.336000E+01	0.139099E+02	-0.142066E+01
2008	N/A	0.279729E+01	N/A

Survey Index: 16 Tag: MASpr AGE = 3
Time = JAN-1 Type = NUMBER
Catchability = 0.544643E-03 % Variance Contribution = 1.7670
Residual = LN(Observed) - LN(Predicted)

Year	Observed	Predicted	Residual
1982	0.241000E+01	0.300628E+01	-0.221075E+00
1983	0.286000E+01	0.398352E+01	-0.331343E+00
1984	0.207000E+01	0.218692E+01	-0.549455E-01
1985	0.227000E+01	0.249512E+01	-0.945583E-01
1986	0.123000E+01	0.336250E+01	-0.100567E+01

1987	0.296000E+01	0.232889E+01	0.239797E+00
1988	0.245000E+01	0.330214E+01	-0.298484E+00
1989	0.876000E+01	0.434324E+01	0.701575E+00
1990	0.147500E+02	0.872850E+01	0.524649E+00
1991	0.157000E+01	0.142671E+01	0.957073E-01
1992	0.367000E+01	0.129369E+01	0.104269E+01
1993	0.255000E+01	0.237976E+01	0.690935E-01
1994	0.175000E+01	0.225159E+01	-0.252019E+00
1995	0.276000E+01	0.330400E+01	-0.179902E+00
1996	0.108000E+01	0.102414E+01	0.531105E-01
1997	0.930000E+00	0.133733E+01	-0.363243E+00
1998	0.700000E+00	0.125215E+01	-0.581537E+00
1999	0.231000E+01	0.186195E+01	0.215622E+00
2000	0.289000E+01	0.161680E+01	0.580805E+00
2001	0.497000E+01	0.276528E+01	0.586277E+00
2002	0.123000E+01	0.139369E+01	-0.124940E+00
2003	0.280000E+00	0.431926E+00	-0.433466E+00
2004	0.258000E+01	0.180007E+01	0.359965E+00
2005	0.570000E+00	0.613413E+00	-0.734015E-01
2006	0.338000E+01	0.400001E+01	-0.168420E+00
2007	0.184000E+01	0.244991E+01	-0.286285E+00
2008	N/A	0.872540E+01	N/A

Survey Index: 17 Tag: MASpr AGE = 4
Time = JAN-1 Type = NUMBER
Catchability = 0.453706E-03 % Variance Contribution = 3.5692
Residual = LN(Observed) - LN(Predicted)

Year	Observed	Predicted	Residual
1982	0.870000E+00	0.141918E+01	-0.489343E+00
1983	0.150000E+01	0.105676E+01	0.350253E+00
1984	0.700000E+00	0.151912E+01	-0.774803E+00
1985	0.450000E+00	0.842292E+00	-0.626879E+00
1986	0.680000E+00	0.803591E+00	-0.166998E+00
1987	0.220000E+00	0.116158E+01	-0.166391E+01
1988	0.145000E+01	0.104606E+01	0.326529E+00
1989	0.106000E+01	0.137855E+01	-0.262766E+00
1990	0.231000E+01	0.202597E+01	0.131201E+00
1991	0.366000E+01	0.425942E+01	-0.151669E+00
1992	0.750000E+00	0.422495E+00	0.573897E+00
1993	0.900000E+00	0.641316E+00	0.338873E+00
1994	0.490000E+00	0.788953E+00	-0.476302E+00
1995	0.780000E+00	0.924698E+00	-0.170173E+00
1996	0.149000E+01	0.177315E+01	-0.173979E+00
1997	0.170000E+00	0.439571E+00	-0.950001E+00
1998	0.750000E+00	0.708803E+00	0.564961E-01
1999	0.780000E+00	0.655965E+00	0.173187E+00
2000	0.220000E+01	0.100421E+01	0.784254E+00
2001	0.352000E+01	0.883486E+00	0.138234E+01
2002	0.141000E+01	0.140014E+01	0.701462E-02
2003	0.143000E+01	0.844005E+00	0.527271E+00
2004	0.460000E+00	0.245898E+00	0.626310E+00
2005	0.207000E+01	0.108081E+01	0.649835E+00
2006	0.540000E+00	0.363314E+00	0.396302E+00
2007	0.175000E+01	0.265530E+01	-0.416941E+00
2008	N/A	0.160736E+01	N/A

Survey Index: 19 Tag: MAAut AGE = 2
Time = JAN-1 Type = NUMBER
Catchability = 0.122958E-03 % Variance Contribution = 22.4734
Residual = LN(Observed) - LN(Predicted)

Year	Observed	Predicted	Residual
1982	0.620000E+01	0.136761E+01	0.151149E+01
1983	0.114000E+01	0.782999E+00	0.375653E+00
1984	0.280000E+00	0.796927E+00	-0.104597E+01
1985	0.160000E+00	0.107184E+01	-0.190196E+01
1986	0.190000E+00	0.667449E+00	-0.125644E+01
1987	0.550000E+00	0.103143E+01	-0.628782E+00
1988	0.140000E+01	0.127223E+01	0.956991E-01
1989	0.310000E+01	0.247741E+01	0.224188E+00
1990	0.200000E-01	0.427865E+00	-0.306308E+01
1991	0.422000E+01	0.416314E+00	0.231615E+01
1992	0.200000E+01	0.702172E+00	0.104672E+01
1993	0.990000E+00	0.638224E+00	0.439016E+00
1994	0.153000E+01	0.918390E+00	0.510401E+00
1995	0.536000E+01	0.320039E+00	0.281828E+01
1996	0.800000E+00	0.380988E+00	0.741845E+00
1997	0.800000E-01	0.356876E+00	-0.149536E+01
1998	0.300000E-01	0.528027E+00	-0.286795E+01
1999	0.640000E+00	0.448825E+00	0.354836E+00
2000	0.590000E+00	0.789833E+00	-0.291699E+00
2001	0.400000E+00	0.404302E+00	-0.106976E-01
2002	0.100000E-01	0.119508E+00	-0.248080E+01
2003	0.109000E+01	0.498583E+00	0.782162E+00
2004	0.160000E+01	0.169266E+00	0.224629E+01
2005	0.994000E+01	0.110399E+01	0.219764E+01
2006	0.610000E+00	0.675761E+00	-0.102381E+00
2007	0.435000E+01	0.240704E+01	0.591780E+00
2008	0.160000E+00	0.484055E+00	-0.110702E+01

Survey Index: 21 Tag: CM_CPE AGE = 2
Time = MEAN Type = NUMBER
Catchability = 0.245830E-05 % Variance Contribution = 3.7184
Residual = LN(Observed) - LN(Predicted)

Year	Observed	Predicted	Residual
1982	0.743000E-01	0.223352E-01	0.120195E+01
1983	0.477000E-01	0.125412E-01	0.133591E+01
1984	0.331000E-01	0.134627E-01	0.899610E+00
1985	0.137000E-01	0.181238E-01	-0.279829E+00
1986	0.410000E-02	0.118717E-01	-0.106317E+01
1987	0.740000E-02	0.176086E-01	-0.866906E+00
1988	0.146000E-01	0.223933E-01	-0.427740E+00
1989	0.170000E-01	0.442708E-01	-0.957113E+00
1990	0.110000E-01	0.744697E-02	0.390088E+00
1991	0.194000E-01	0.700807E-02	0.101821E+01
1992	0.149000E-01	0.123165E-01	0.190425E+00
1993	0.270000E-02	0.114122E-01	-0.144143E+01
1994	N/A	0.165774E-01	N/A
1995	N/A	0.546252E-02	N/A
1996	N/A	0.679601E-02	N/A
1997	N/A	0.636459E-02	N/A
1998	N/A	0.943961E-02	N/A
1999	N/A	0.810664E-02	N/A
2000	N/A	0.140715E-01	N/A
2001	N/A	0.714947E-02	N/A
2002	N/A	0.216199E-02	N/A
2003	N/A	0.901510E-02	N/A
2004	N/A	0.306613E-02	N/A

2005	N/A	0.199960E-01	N/A
2006	N/A	0.122433E-01	N/A
2007	N/A	0.436076E-01	N/A
2008	N/A	0.000000E+00	N/A

Survey Index: 22 Tag: CM_CPE AGE = 3
Time = MEAN Type = NUMBER
Catchability = 0.140563E-04 % Variance Contribution = 0.6469
Residual = LN(Observed) - LN(Predicted)

Year	Observed	Predicted	Residual
1982	0.738000E-01	0.519778E-01	0.350541E+00
1983	0.109900E+00	0.713423E-01	0.432082E+00
1984	0.448000E-01	0.393360E-01	0.130068E+00
1985	0.423000E-01	0.415634E-01	0.175677E-01
1986	0.688000E-01	0.577049E-01	0.175861E+00
1987	0.186000E-01	0.448396E-01	-0.879930E+00
1988	0.492000E-01	0.615373E-01	-0.223750E+00
1989	0.637000E-01	0.850584E-01	-0.289154E+00
1990	0.159500E+00	0.174475E+00	-0.897392E-01
1991	0.404000E-01	0.229452E-01	0.565723E+00
1992	0.173000E-01	0.260461E-01	-0.409160E+00
1993	0.500000E-01	0.401303E-01	0.219891E+00
1994	N/A	0.416566E-01	N/A
1995	N/A	0.689939E-01	N/A
1996	N/A	0.193218E-01	N/A
1997	N/A	0.277652E-01	N/A
1998	N/A	0.258572E-01	N/A
1999	N/A	0.389707E-01	N/A
2000	N/A	0.340461E-01	N/A
2001	N/A	0.562158E-01	N/A
2002	N/A	0.307978E-01	N/A
2003	N/A	0.927102E-02	N/A
2004	N/A	0.396172E-01	N/A
2005	N/A	0.134136E-01	N/A
2006	N/A	0.923518E-01	N/A
2007	N/A	0.562457E-01	N/A
2008	N/A	0.000000E+00	N/A

Survey Index: 23 Tag: CM_CPE AGE = 4
Time = MEAN Type = NUMBER
Catchability = 0.231650E-04 % Variance Contribution = 0.1443
Residual = LN(Observed) - LN(Predicted)

Year	Observed	Predicted	Residual
1982	0.450000E-01	0.478168E-01	-0.607149E-01
1983	0.422000E-01	0.336756E-01	0.225646E+00
1984	0.442000E-01	0.495054E-01	-0.113356E+00
1985	0.289000E-01	0.237841E-01	0.194823E+00
1986	0.226000E-01	0.252171E-01	-0.109574E+00
1987	0.260000E-01	0.338541E-01	-0.263964E+00
1988	0.242000E-01	0.342353E-01	-0.346903E+00
1989	0.397000E-01	0.413480E-01	-0.406733E-01
1990	0.782000E-01	0.618167E-01	0.235096E+00
1991	0.135500E+00	0.133920E+00	0.117317E-01
1992	0.138000E-01	0.125736E-01	0.930706E-01
1993	0.232000E-01	0.194789E-01	0.174818E+00
1994	N/A	0.194817E-01	N/A
1995	N/A	0.270618E-01	N/A
1996	N/A	0.573865E-01	N/A
1997	N/A	0.145917E-01	N/A
1998	N/A	0.255037E-01	N/A
1999	N/A	0.233620E-01	N/A
2000	N/A	0.363291E-01	N/A

2001	N/A	0.325446E-01	N/A
2002	N/A	0.542248E-01	N/A
2003	N/A	0.338284E-01	N/A
2004	N/A	0.823436E-02	N/A
2005	N/A	0.401443E-01	N/A
2006	N/A	0.133912E-01	N/A
2007	N/A	0.112368E+00	N/A
2008	N/A	0.000000E+00	N/A

Survey Index: 24 Tag: CM_CPE AGE = 5
Time = MEAN Type = NUMBER
Catchability = 0.229116E-04 % Variance Contribution = 0.1381
Residual = LN(Observed) - LN(Predicted)

Year	Observed	Predicted	Residual
1982	0.217000E-01	0.275207E-01	-0.237626E+00
1983	0.209000E-01	0.176589E-01	0.168507E+00
1984	0.118000E-01	0.111738E-01	0.545269E-01
1985	0.179000E-01	0.176601E-01	0.134932E-01
1986	0.660000E-02	0.661394E-02	-0.211032E-02
1987	0.570000E-02	0.815593E-02	-0.358279E+00
1988	0.930000E-02	0.963858E-02	-0.357593E-01
1989	0.106000E-01	0.119158E-01	-0.117011E+00
1990	0.122000E-01	0.126640E-01	-0.373282E-01
1991	0.217000E-01	0.172514E-01	0.229419E+00
1992	0.515000E-01	0.374843E-01	0.317659E+00
1993	0.410000E-02	0.408155E-02	0.450955E-02
1994	N/A	0.462407E-02	N/A
1995	N/A	0.344415E-02	N/A
1996	N/A	0.707689E-02	N/A
1997	N/A	0.189098E-01	N/A
1998	N/A	0.596659E-02	N/A
1999	N/A	0.120896E-01	N/A
2000	N/A	0.116604E-01	N/A
2001	N/A	0.175142E-01	N/A
2002	N/A	0.160594E-01	N/A
2003	N/A	0.263716E-01	N/A
2004	N/A	0.183585E-01	N/A
2005	N/A	0.334331E-02	N/A
2006	N/A	0.197757E-01	N/A
2007	N/A	0.664047E-02	N/A
2008	N/A	0.000000E+00	N/A

Survey Index: 25 Tag: CM_CPE AGE = 6
Time = MEAN Type = NUMBER
Catchability = 0.218712E-04 % Variance Contribution = 0.6002
Residual = LN(Observed) - LN(Predicted)

Year	Observed	Predicted	Residual
1982	0.270000E-02	0.360420E-02	-0.288849E+00
1983	0.123000E-01	0.964092E-02	0.243583E+00
1984	0.550000E-02	0.586004E-02	-0.634079E-01
1985	0.360000E-02	0.343923E-02	0.456871E-01
1986	0.430000E-02	0.610563E-02	-0.350596E+00
1987	0.180000E-02	0.185134E-02	-0.281215E-01
1988	0.150000E-02	0.311688E-02	-0.731367E+00
1989	0.230000E-02	0.312149E-02	-0.305403E+00
1990	0.510000E-02	0.322153E-02	0.459384E+00
1991	0.390000E-02	0.384759E-02	0.135296E-01
1992	0.520000E-02	0.374652E-02	0.327830E+00
1993	0.140000E-01	0.710875E-02	0.677731E+00
1994	N/A	0.113347E-02	N/A
1995	N/A	0.101323E-02	N/A
1996	N/A	0.586834E-03	N/A

1997	N/A	0.181507E-02	N/A
1998	N/A	0.592501E-02	N/A
1999	N/A	0.267336E-02	N/A
2000	N/A	0.602197E-02	N/A
2001	N/A	0.622466E-02	N/A
2002	N/A	0.810640E-02	N/A
2003	N/A	0.683689E-02	N/A
2004	N/A	0.112083E-01	N/A
2005	N/A	0.769048E-02	N/A
2006	N/A	0.145083E-02	N/A
2007	N/A	0.865748E-02	N/A
2008	N/A	0.000000E+00	N/A

Plus Group Diagnostic Report

Calculation Method Selected = Backward

Year	Population Backward	Population Forward	F Forward	F Backward	Ratio
1982	79.	79.	0.608762	0.608767	1.000008
1983	35.	39.	0.766578	0.934198	1.218659
1984	36.	22.	2.291808	0.826495	0.360630
1985	21.	13.	2.078124	0.831755	0.400243
1986	113.	73.	2.078124	0.852354	0.410155
1987	5.	6.	0.850480	0.956793	1.125004
1988	2.	8.	0.154090	0.793893	5.152153
1989	13.	9.	2.078124	0.842203	0.405271
1990	30.	21.	2.078124	0.964334	0.464041
1991	2.	8.	0.141677	1.203395	8.493906
1992	0.	6.	0.000172	1.364201	7931.037707
1993	0.	6.	0.000179	1.151373	6429.218887
1994	2.	5.	0.302683	1.679343	5.548194
1995	0.	3.	0.072010	1.408175	19.555209
1996	0.	3.	0.000384	1.075723	2801.841399
1997	0.	2.	0.047990	1.074636	22.392985
1998	1.	2.	0.227801	0.769676	3.378726
1999	0.	2.	0.000490	0.810592	1655.235816
2000	0.	5.	0.000221	0.640350	2892.159780
2001	0.	4.	N/A	N/A	

Warning **** Infeasible Mass Balance in Plus Group
Year = 1986
Year = 1989
Year = 1990
Year = 1994
Year = 1997

Appendix C: Table 2. Bootstrap Summary Report for Gulf of Maine Cod

Number of Bootstrap Repetitions Requested = 1000
Number of Bootstrap Repetitions Completed = 1000

Bootstrap Output Variable: Stock Estimates (2008)

	NLLS Estimate	Bootstrap Mean	Bootstrap Std Error	C.V. For NLLS Soln.
N 2	3937.	4778.	3549.	0.7428
N 3	16020.	17071.	6345.	0.3717
N 4	3543.	3648.	986.	0.2703
N 5	3970.	4078.	1050.	0.2575
N 6	201.	214.	80.	0.3741
N 7	251.	270.	126.	0.4652
N 8	30.	34.	19.	0.5717
N 9	47.	56.	45.	0.7909
N 10	71.	86.	70.	0.8079

	Bias Estimate	Bias Std. Error	Per Cent Bias	NLLS Estimate Corrected For Bias	C.V. For Corrected Estimate
N 2	841.	115.	21.3697	3095.	1.1466
N 3	1050.	203.	6.5570	14970.	0.4239
N 4	105.	31.	2.9687	3438.	0.2868
N 5	107.	33.	2.6968	3863.	0.2718
N 6	13.	3.	6.5231	188.	0.4263
N 7	19.	4.	7.4963	232.	0.5406
N 8	4.	1.	13.6268	26.	0.7521
N 9	9.	1.	20.1704	37.	1.1906
N 10	15.	2.	21.1718	56.	1.2418

	LOWER 80. % CI	UPPER 80. % CI
N 2	1677.	8603.
N 3	10069.	25149.
N 4	2521.	4978.
N 5	2832.	5454.
N 6	124.	328.
N 7	121.	439.
N 8	12.	60.
N 9	9.	110.
N 10	8.	179.

Bootstrap Output Variable: Catchability Estimates

	NLLS Estimate	Bootstrap Mean	Bootstrap Std Error	C.V. For NLLS Soln.
Q 1	0.639060E-04	0.647586E-04	0.101782E-04	0.1572
Q 2	0.131940E-03	0.133998E-03	0.145121E-04	0.1083
Q 3	0.225008E-03	0.225360E-03	0.233256E-04	0.1035
Q 4	0.293998E-03	0.295308E-03	0.383110E-04	0.1297
Q 5	0.382779E-03	0.386695E-03	0.603680E-04	0.1561
Q 6	0.566609E-03	0.571598E-03	0.110028E-03	0.1925
Q 7	0.511812E-03	0.524087E-03	0.139158E-03	0.2655
Q 8	0.533836E-04	0.535169E-04	0.726587E-05	0.1358
Q 9	0.113582E-03	0.114677E-03	0.129450E-04	0.1129
Q 10	0.223833E-03	0.223325E-03	0.225948E-04	0.1012
Q 11	0.370258E-03	0.372882E-03	0.441525E-04	0.1184
Q 12	0.478237E-03	0.480790E-03	0.575817E-04	0.1198
Q 13	0.451154E-03	0.460422E-03	0.853109E-04	0.1853
Q 14	0.566767E-03	0.586741E-03	0.137955E-03	0.2351
Q 15	0.710558E-03	0.715248E-03	0.110880E-03	0.1550
Q 16	0.544643E-03	0.546052E-03	0.476591E-04	0.0873
Q 17	0.453706E-03	0.455707E-03	0.552238E-04	0.1212
Q 19	0.122958E-03	0.128903E-03	0.390116E-04	0.3026
Q 21	0.245830E-05	0.251662E-05	0.718337E-06	0.2854
Q 22	0.140563E-04	0.141456E-04	0.162997E-05	0.1152
Q 23	0.231650E-04	0.232271E-04	0.126746E-05	0.0546
Q 24	0.229116E-04	0.229085E-04	0.120903E-05	0.0528
Q 25	0.218712E-04	0.220098E-04	0.250055E-05	0.1136

	Bias Estimate	Bias Std. Error	Per Cent Bias	NLLS Estimate Corrected For Bias	C.V. For Corrected Estimate
Q 1	0.8525E-06	0.3230E-06	1.3340	0.6305E-04	0.1614
Q 2	0.2058E-05	0.4635E-06	1.5600	0.1299E-03	0.1117
Q 3	0.3524E-06	0.7377E-06	0.1566	0.2247E-03	0.1038
Q 4	0.1310E-05	0.1212E-05	0.4455	0.2927E-03	0.1309
Q 5	0.3917E-05	0.1913E-05	1.0232	0.3789E-03	0.1593
Q 6	0.4988E-05	0.3483E-05	0.8803	0.5616E-03	0.1959
Q 7	0.1227E-04	0.4418E-05	2.3983	0.4995E-03	0.2786
Q 8	0.1332E-06	0.2298E-06	0.2496	0.5325E-04	0.1364
Q 9	0.1096E-05	0.4108E-06	0.9645	0.1125E-03	0.1151
Q 10	-0.5082E-06	0.7147E-06	-0.2270	0.2243E-03	0.1007
Q 11	0.2624E-05	0.1399E-05	0.7086	0.3676E-03	0.1201
Q 12	0.2554E-05	0.1823E-05	0.5339	0.4757E-03	0.1211
Q 13	0.9268E-05	0.2714E-05	2.0543	0.4419E-03	0.1931
Q 14	0.1997E-04	0.4408E-05	3.5242	0.5468E-03	0.2523
Q 15	0.4690E-05	0.3509E-05	0.6600	0.7059E-03	0.1571
Q 16	0.1409E-05	0.1508E-05	0.2587	0.5432E-03	0.0877
Q 17	0.2001E-05	0.1747E-05	0.4410	0.4517E-03	0.1223
Q 19	0.5945E-05	0.1248E-05	4.8350	0.1170E-03	0.3334
Q 21	0.5832E-07	0.2279E-07	2.3723	0.2400E-05	0.2993
Q 22	0.8937E-07	0.5162E-07	0.6358	0.1397E-04	0.1167
Q 23	0.6213E-07	0.4013E-07	0.2682	0.2310E-04	0.0549
Q 24	-0.3153E-08	0.3823E-07	-0.0138	0.2291E-04	0.0528
Q 25	0.1386E-06	0.7920E-07	0.6336	0.2173E-04	0.1151

	LOWER 80. % CI	UPPER 80. % CI
Q 1	0.528038E-04	0.777431E-04
Q 2	0.116065E-03	0.153541E-03
Q 3	0.195847E-03	0.256823E-03
Q 4	0.251091E-03	0.347007E-03
Q 5	0.311452E-03	0.463932E-03
Q 6	0.435944E-03	0.713003E-03
Q 7	0.363137E-03	0.705006E-03
Q 8	0.448692E-04	0.627867E-04
Q 9	0.991114E-04	0.131147E-03
Q 10	0.195500E-03	0.251712E-03
Q 11	0.317280E-03	0.430807E-03
Q 12	0.407507E-03	0.551218E-03
Q 13	0.359008E-03	0.576648E-03
Q 14	0.425972E-03	0.768331E-03
Q 15	0.581905E-03	0.849728E-03
Q 16	0.486698E-03	0.606425E-03
Q 17	0.386956E-03	0.528414E-03
Q 19	0.842248E-04	0.174946E-03
Q 21	0.167670E-05	0.346849E-05
Q 22	0.121995E-04	0.162474E-04
Q 23	0.216791E-04	0.248333E-04

Q 24	0.213895E-04	0.245191E-04
Q 25	0.190392E-04	0.252692E-04

Bootstrap Output Variable: Fishing Mortality (2007)

	NLLS Estimate	Bootstrap Mean	Bootstrap Std Error	C.V. For NLLS Soln.
AGE 1	0.0000	0.0000	0.000000	0.7193
AGE 2	0.0004	0.0005	0.000180	0.3776
AGE 3	0.0388	0.0403	0.010717	0.2657
AGE 4	0.1880	0.1940	0.047462	0.2446
AGE 5	0.4892	0.5077	0.151260	0.2979
AGE 6	0.6492	0.7011	0.268324	0.3827
AGE 7	0.2288	0.2890	0.246963	0.8546
AGE 8	0.3714	0.5913	0.645212	1.0911
AGE 9	0.1484	0.3630	0.603834	1.6637
AGE 10	0.4888	0.5279	0.202048	0.3827
AGE 11	0.4888	0.5279	0.202048	0.3827

	Bias Estimate	Bias Std. Error	Per Cent Bias	NLLS Estimate Corrected For Bias	C.V. For Corrected Estimate
AGE 1	0.000000	0.000000	25.9547	0.0000	1.2235
AGE 2	0.000031	0.000006	6.9738	0.0004	0.4343
AGE 3	0.001556	0.000342	4.0140	0.0372	0.2880
AGE 4	0.006058	0.001513	3.2227	0.1819	0.2609
AGE 5	0.018527	0.004819	3.7875	0.4706	0.3214
AGE 6	0.051977	0.008643	8.0070	0.5972	0.4493
AGE 7	0.060197	0.008039	26.3126	0.1686	1.4650
AGE 8	0.219925	0.021557	59.2126	0.1515	4.2591
AGE 9	0.214574	0.020266	144.6129	-0.0662	-9.1219
AGE 10	0.039139	0.006508	8.0070	0.4497	0.4493
AGE 11	0.039139	0.006508	8.0070	0.4497	0.4493

	LOWER 80. % CI	UPPER 80. % CI
AGE 1	0.000000	0.000001
AGE 2	0.000284	0.000710
AGE 3	0.027715	0.053995
AGE 4	0.140155	0.254509
AGE 5	0.325552	0.702242
AGE 6	0.420262	1.058058
AGE 7	0.120909	0.499303
AGE 8	0.174605	1.208743
AGE 9	0.061730	0.855144
AGE 10	0.316457	0.796718
AGE 11	0.316457	0.796718

Bootstrap Output Variable: Average F (2007) AGES 5 - 7

	NLLS Estimate	Bootstrap Mean	Bootstrap Std Error	C.V. For NLLS Soln.
AVG F	0.4557	0.4993	0.136083	0.2726
N WTD	0.5685	0.5810	0.147049	0.2531
B WTD	0.5686	0.5816	0.150324	0.2584
C WTD	0.5845	0.6250	0.178702	0.2859

	Bias Estimate	Bias Std. Error	Per Cent Bias	NLLS Estimate Corrected For Bias	C.V. For Corrected Estimate
AVG F	0.043567	0.004519	9.5605	0.4121	0.3302
N WTD	0.012503	0.004667	2.1994	0.5560	0.2645
B WTD	0.013043	0.004772	2.2939	0.5556	0.2706
C WTD	0.040489	0.005794	6.9270	0.5440	0.3285

	LOWER 80. % CI	UPPER 80. % CI
AVG F	0.355693	0.669985
N WTD	0.411017	0.781374
B WTD	0.408325	0.786745
C WTD	0.428986	0.863827

Bootstrap Output Variable: Biomass

JAN-1 Biomass (2008) Mean Biomass & SSB (2007)

	NLLS Estimate	Bootstrap Mean	Bootstrap Std Error	C.V. For NLLS Soln.
JAN-1	64636.	68657.	14733.	0.2146
MEAN	68452.	72310.	15634.	0.2162
SSB	33877.	35256.	5061.	0.1435

	Bias Estimate	Bias Std. Error	Per Cent Bias	NLLS Estimate Corrected For Bias	C.V. For Corrected Estimate
JAN-1	4021.	483.	6.2205	60615.	0.2431
MEAN	3857.	509.	5.6350	64595.	0.2420
SSB	1379.	166.	4.0692	32499.	0.1557

	LOWER 80. % CI	UPPER 80. % CI
JAN-1	51410.	87543.
MEAN	54179.	91739.
SSB	29133.	41747.

Appendix C: Table 3. Retrospective Summary for Gulf of Maine Cod

Average Fishing Mortality
Ages = 5 – 7

	1982	1983	1984	1985	1986
2000	0.5465	0.8677	0.7543	0.8478	0.8502
2001	0.5465	0.8677	0.7543	0.8478	0.8502
2002	0.5465	0.8677	0.7543	0.8478	0.8502
2003	0.5465	0.8677	0.7543	0.8478	0.8502
2004	0.5465	0.8677	0.7543	0.8478	0.8502
2005	0.5465	0.8677	0.7543	0.8478	0.8502
2006	0.5465	0.8677	0.7543	0.8478	0.8502
2007	0.5465	0.8677	0.7543	0.8478	0.8502

	1987	1988	1989	1990	1991
2000	0.9605	0.5815	0.7225	0.8636	1.2294
2001	0.9605	0.5815	0.7225	0.8636	1.2293
2002	0.9605	0.5815	0.7225	0.8635	1.2291
2003	0.9605	0.5815	0.7225	0.8635	1.2291
2004	0.9605	0.5815	0.7225	0.8635	1.2290
2005	0.9605	0.5815	0.7225	0.8635	1.2290
2006	0.9605	0.5815	0.7225	0.8635	1.2290
2007	0.9605	0.5815	0.7225	0.8635	1.2290

	1992	1993	1994	1995	1996
2000	1.3627	0.9571	1.5425	1.2239	0.9161
2001	1.3625	0.9573	1.5339	1.2157	0.9634
2002	1.3622	0.9561	1.5204	1.1878	0.9567
2003	1.3622	0.9560	1.5177	1.1824	0.9581
2004	1.3620	0.9562	1.5125	1.1795	0.9547
2005	1.3620	0.9562	1.5129	1.1805	0.9547
2006	1.3620	0.9562	1.5126	1.1798	0.9544
2007	1.3620	0.9562	1.5123	1.1792	0.9545

	1997	1998	1999	2000	2001
2000	0.8377	0.7034	0.9794	0.6104	
2001	0.9143	0.8529	0.8262	0.4132	0.5330
2002	0.8658	0.7592	0.6060	0.3896	0.4672
2003	0.8847	0.7648	0.6037	0.3519	0.4961
2004	0.8827	0.7733	0.5875	0.3281	0.4329
2005	0.8822	0.7751	0.5902	0.3273	0.4269
2006	0.8812	0.7724	0.5870	0.3253	0.4212
2007	0.8811	0.7722	0.5846	0.3242	0.4249

	2002	2003	2004	2005	2006	2007
2000						
2001						
2002	0.4124					
2003	0.5813	0.6681				
2004	0.5697	0.7016	0.5905			
2005	0.5559	0.7256	0.6259	0.7789		
2006	0.5399	0.6962	0.5950	0.6406	0.5204	
2007	0.5373	0.6804	0.5405	0.6362	0.5811	0.4557

Spawning Stock Biomass (mt)

	1982	1983	1984	1985	1986
2000	25587.	19494.	17223.	17211.	19406.
2001	25587.	19494.	17223.	17211.	19406.
2002	25587.	19494.	17223.	17211.	19406.
2003	25587.	19494.	17223.	17211.	19406.
2004	25587.	19494.	17223.	17211.	19406.
2005	25587.	19494.	17223.	17211.	19406.
2006	25587.	19494.	17223.	17211.	19406.
2007	25587.	19494.	17223.	17211.	19406.

	1987	1988	1989	1990	1991
2000	15926.	16545.	22151.	28655.	20339.
2001	15926.	16545.	22151.	28655.	20340.
2002	15926.	16545.	22151.	28657.	20341.
2003	15926.	16546.	22151.	28657.	20342.
2004	15926.	16546.	22151.	28657.	20342.
2005	15926.	16546.	22151.	28657.	20342.
2006	15926.	16546.	22151.	28657.	20342.
2007	15926.	16546.	22151.	28657.	20342.

	1992	1993	1994	1995	1996
2000	11980.	10322.	10777.	13478.	11705.
2001	11981.	10317.	10715.	13398.	11662.
2002	11986.	10329.	10755.	13618.	11931.
2003	11986.	10329.	10746.	13549.	11943.
2004	11988.	10333.	10754.	13559.	11945.
2005	11988.	10333.	10754.	13560.	11938.
2006	11988.	10334.	10754.	13563.	11945.
2007	11988.	10334.	10755.	13566.	11949.

	1997	1998	1999	2000	2001
2000	9131.	9363.	9755.	14042.	
2001	9324.	10068.	10821.	15431.	21475.
2002	9657.	10652.	11773.	16946.	24018.
2003	9717.	10561.	10951.	14173.	18544.
2004	9843.	10759.	11163.	14180.	17858.
2005	9838.	10781.	11189.	14139.	17624.
2006	9848.	10813.	11253.	14254.	17787.
2007	9856.	10814.	11246.	14285.	17848.

	2002	2003	2004	2005	2006	2007
2000						
2001						
2002	28693.					
2003	20609.	19609.				
2004	18896.	17307.	15989.			
2005	18427.	16431.	14089.	11691.		
2006	18623.	16760.	14633.	12359.	23403.	
2007	18673.	16539.	13693.	10974.	19139.	33877.

Total Population Numbers (000s)

	1982	1983	1984	1985	1986
2000	30180.	26336.	26143.	23683.	24887.
2001	30180.	26336.	26143.	23683.	24888.
2002	30180.	26336.	26143.	23683.	24888.
2003	30180.	26336.	26143.	23683.	24888.
2004	30180.	26336.	26143.	23683.	24888.
2005	30180.	26336.	26143.	23683.	24888.
2006	30180.	26336.	26143.	23683.	24888.
2007	30180.	26336.	26143.	23683.	24888.

	1987	1988	1989	1990	1991
2000	28973.	44369.	36693.	29511.	24213.
2001	28973.	44369.	36692.	29517.	24218.
2002	28973.	44369.	36694.	29523.	24223.
2003	28973.	44369.	36694.	29524.	24224.
2004	28973.	44369.	36694.	29528.	24228.
2005	28973.	44369.	36694.	29528.	24228.
2006	28973.	44369.	36694.	29528.	24228.
2007	28973.	44369.	36694.	29528.	24228.

	1992	1993	1994	1995	1996
2000	19138.	21034.	17098.	14371.	12093.
2001	19048.	20992.	17068.	14585.	12614.
2002	19056.	21210.	17252.	14746.	12884.
2003	19053.	21133.	17279.	14801.	12935.
2004	19057.	21141.	17245.	14946.	13064.
2005	19057.	21143.	17237.	14941.	13090.
2006	19057.	21146.	17242.	14946.	13107.
2007	19057.	21148.	17245.	14951.	13113.

	1997	1998	1999	2000	2001
2000	12119.	13858.	20971.	23393.	17455.
2001	13018.	14774.	21508.	21509.	16376.
2002	13744.	15306.	23309.	23087.	17810.
2003	13035.	13170.	18732.	18600.	14407.
2004	13154.	13306.	17668.	17029.	13255.
2005	13184.	13334.	17312.	16718.	13046.
2006	13237.	13419.	17396.	16748.	13203.
2007	13190.	13477.	17462.	16805.	13250.

	2002	2003	2004	2005	2006	2007	2008
2000							
2001	11067.						
2002	26285.	19865.					
2003	17077.	17114.	12418.				
2004	15583.	14068.	32769.	25539.			
2005	14224.	12041.	21034.	20889.	15743.		
2006	14567.	12623.	21874.	23736.	45200.	35989.	
2007	13459.	11046.	18414.	20495.	39336.	35992.	28090.

Age 1 Recruitment Population Numbers (000s)

	1982	1983	1984	1985	1986
2000	7857.	7929.	10674.	6679.	10260.
2001	7857.	7929.	10674.	6679.	10260.
2002	7857.	7929.	10674.	6679.	10260.
2003	7857.	7929.	10674.	6679.	10260.
2004	7857.	7929.	10674.	6679.	10260.
2005	7857.	7929.	10674.	6679.	10260.
2006	7857.	7929.	10674.	6679.	10260.
2007	7857.	7929.	10674.	6679.	10260.

	1987	1988	1989	1990	1991
2000	12744.	24612.	4253.	4119.	6975.
2001	12744.	24612.	4253.	4125.	6975.
2002	12744.	24612.	4254.	4130.	6975.
2003	12744.	24612.	4255.	4131.	6975.
2004	12744.	24612.	4254.	4135.	6975.
2005	12744.	24612.	4254.	4135.	6975.
2006	12744.	24612.	4254.	4135.	6975.
2007	12744.	24612.	4254.	4135.	6975.

	1992	1993	1994	1995	1996
2000	6432.	8943.	3126.	3345.	3000.
2001	6338.	8975.	3131.	3583.	3345.
2002	6343.	9185.	3137.	3593.	3484.
2003	6339.	9110.	3227.	3627.	3490.
2004	6340.	9116.	3185.	3800.	3500.
2005	6340.	9117.	3177.	3802.	3529.
2006	6340.	9121.	3179.	3802.	3542.
2007	6340.	9123.	3180.	3805.	3545.

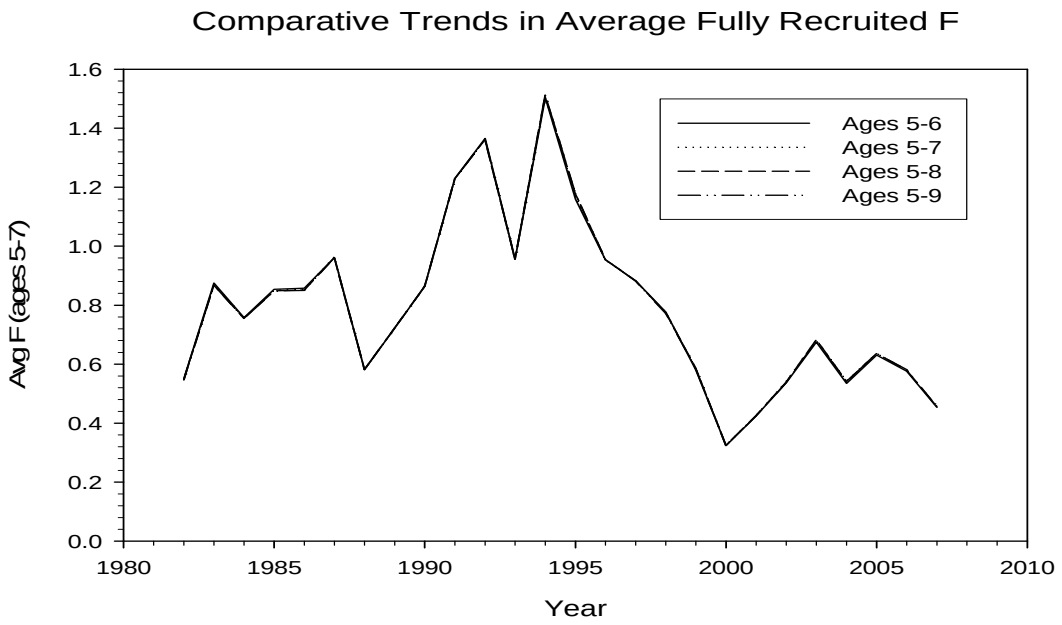
	1997	1998	1999	2000	2001
2000	5009.	5716.	11044.	7729.	0.
2001	5482.	5896.	10831.	5406.	461.
2002	5987.	5834.	12196.	5510.	603.
2003	5236.	4278.	9369.	4770.	875.
2004	5249.	4317.	8193.	4071.	1008.
2005	5258.	4321.	7814.	4052.	1054.
2006	5298.	4362.	7828.	4013.	1187.
2007	5245.	4458.	7847.	4016.	1187.

	2002	2003	2004	2005	2006	2007	2008
2000							
2001	0.						
2002	14045.	0.					
2003	7623.	4786.	0.				
2004	7073.	2963.	22845.	0.			
2005	5884.	2050.	12772.	4959.	0.		
2006	6099.	2351.	13136.	7120.	27113.	0.	
2007	4953.	1681.	10966.	6713.	23910.	4808.	0.

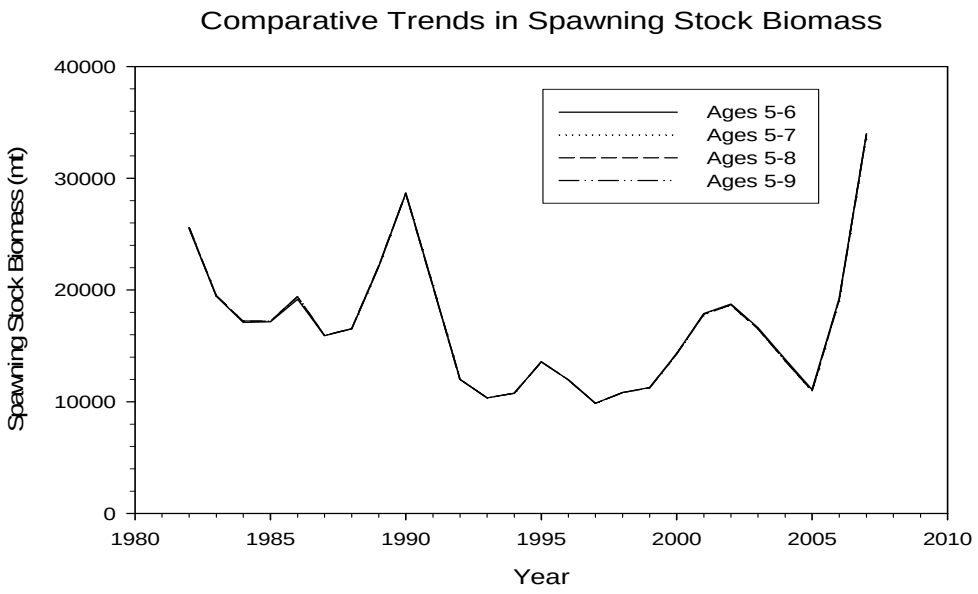
In the Retrospective Analysis
The Following Survey Indices Have Predicted
Index Value Set to Zero in Terminal Year + 1

21	CM_CPE	2
22	CM_CPE	3
23	CM_CPE	4
24	CM_CPE	5
25	CM_CPE	6

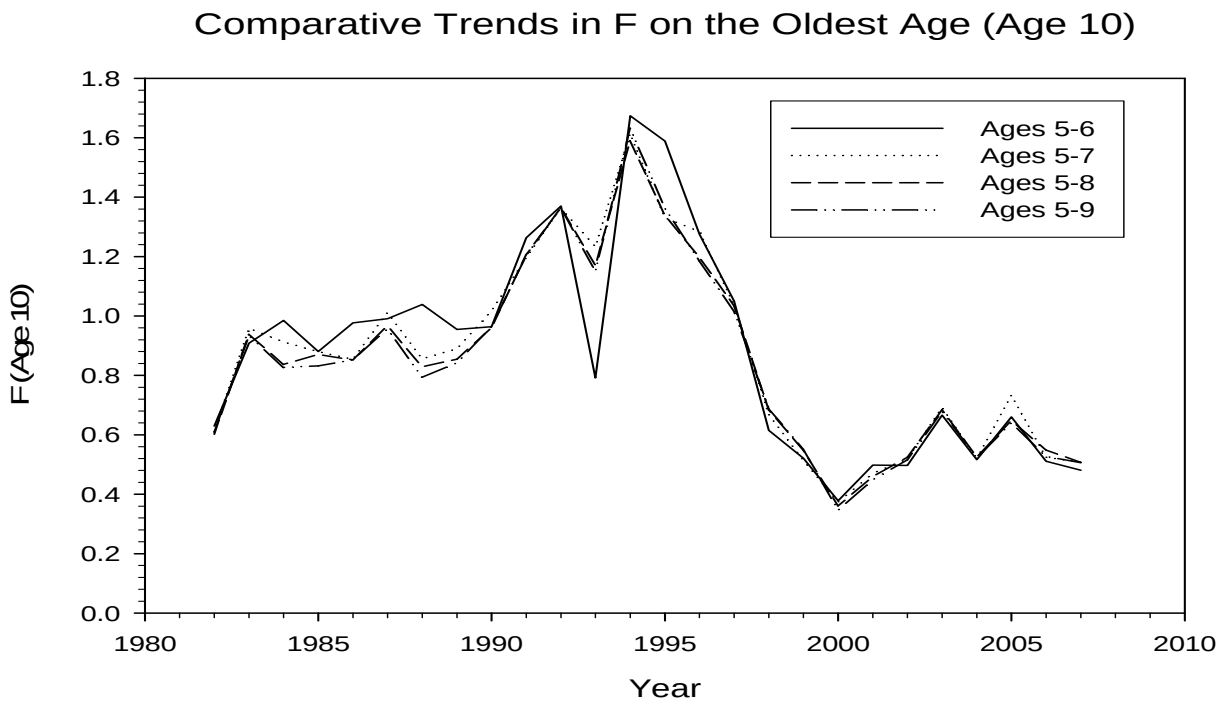
Appendix D: F on oldest true age explorations for the Gulf of Maine stock of Atlantic cod. .



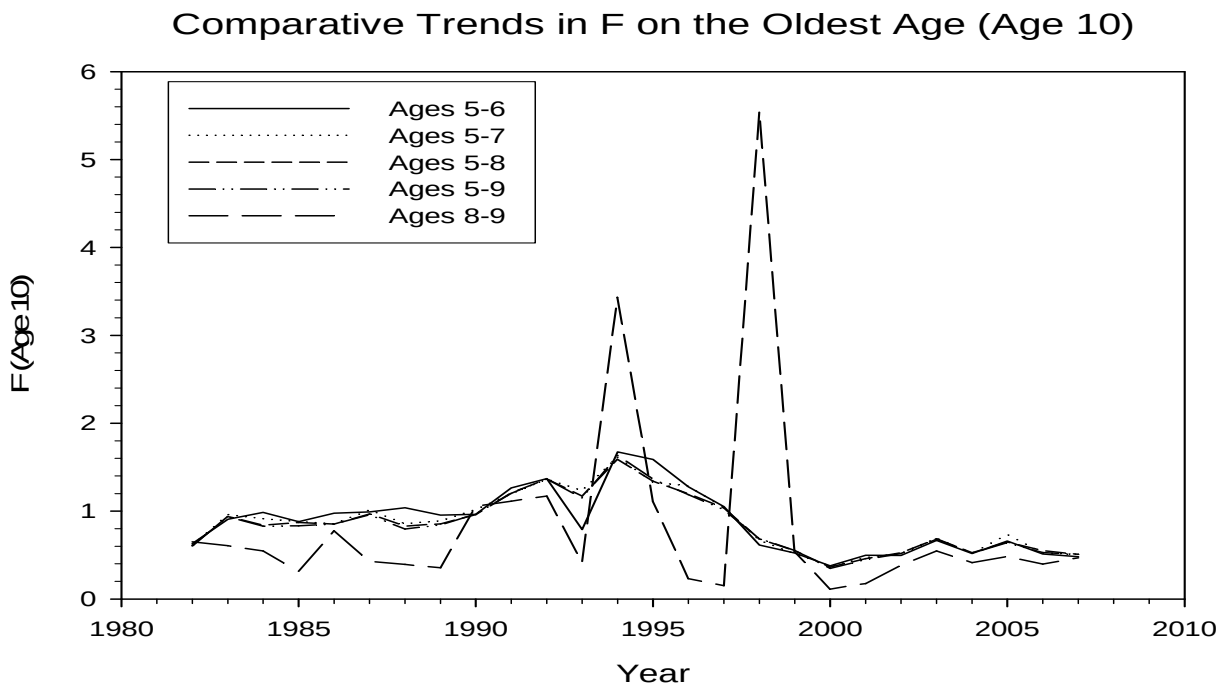
In the 11 plus VPA formulation, F on the oldest true age (age 10) was estimated in a series of trial VPAs using ages 5-6, 5-7, 5-8, and 5-9 as a basis for computing F on age 10. An additional exploration was conducted using ages 8-9. The following graphics show the impact on the average F (ages 5-7), spawning stock biomass, and F on age 10.



In each trial, the average F on the fully recruited ages (5-7) and the spawning stock biomass were not appreciably affected by the choice of age range.



The F on the oldest (age 10), however, was directly affected by the choice of age range. The age 5-6 range caused F to deviate from the other ranges, especially in 1993. Overall, the age range did not substantially affect the estimate of F on the oldest true age.



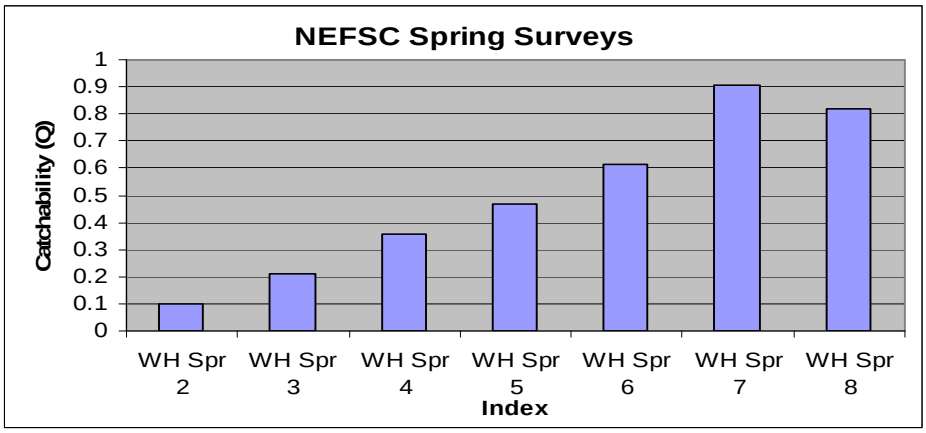
When ages 8-9 were included in the analysis, the estimate of F on age 10 was generally lower than the estimates obtained from the other age ranges, sometimes as much as 80-90% lower (1996 and 1997). In other cases (1994 and 1998), the estimates are as much as 2-6 times higher. The estimates of F on ages 8 and 9 are highly variable, especially during the 1990s.

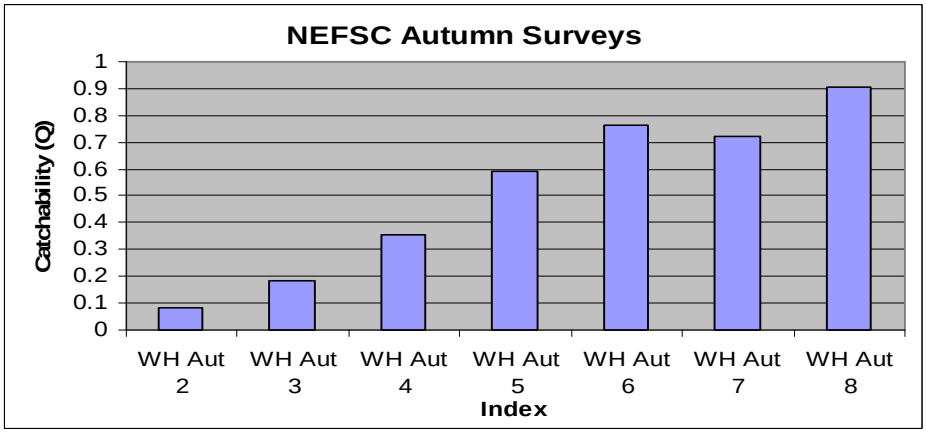
Appendix E. Swept area survey Q analyses for the Gulf of Maine stock of Atlantic cod.

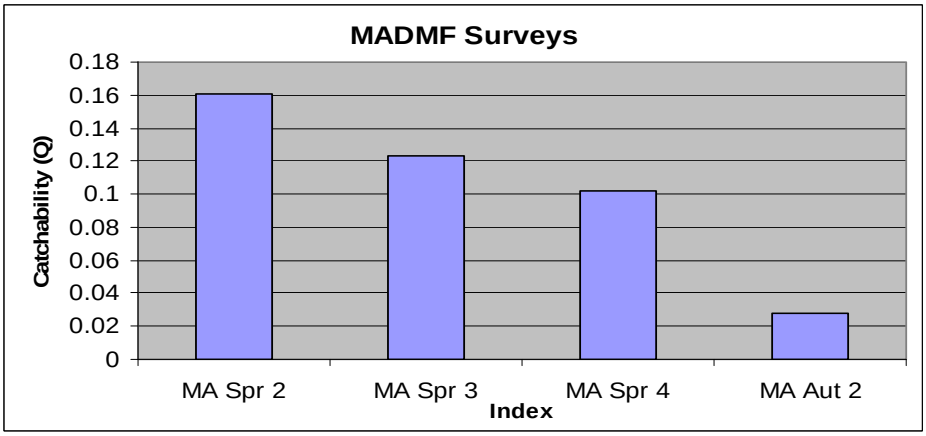
Index	Index #	q	se	Q	CV	2 Std
WH Spr2	1	0.000064	0.1547	0.10224	0.1547	0.031633
WH Spr3	2	0.000132	0.1065	0.21087	0.1065	0.044915
WH Spr4	3	0.000225	0.1026	0.359438	0.1026	0.073757
WH Spr5	4	0.000293	0.1308	0.468068	0.1308	0.122446
WH Spr6	5	0.000378	0.1666	0.603855	0.1666	0.201204
WH Spr7	6	0.000557	0.1964	0.889808	0.1964	0.349516
WH Spr8	7	0.000491	0.2765	0.784373	0.2765	0.433758
WH Aut2	8	0.000053	0.1286	0.084668	0.1286	0.021776
WH Aut3	9	0.000113	0.1128	0.180518	0.1128	0.040725
WH Aut4	10	0.000224	0.1012	0.35784	0.1012	0.072427
WH Aut5	11	0.000369	0.1239	0.589478	0.1239	0.146073
WH Aut6	12	0.000473	0.1185	0.755618	0.1185	0.179081
WH Aut7	13	0.000442	0.1875	0.706095	0.1875	0.264786
WH Aut8	14	0.000545	0.2305	0.870638	0.2305	0.401364
MA Spr2	15	0.00071	0.1511	0.160257	0.1511	0.04843
MA Spr3	16	0.000544	0.0868	0.122789	0.0868	0.021316
MA Spr4	17	0.000453	0.1231	0.102249	0.1231	0.025174
MA Aut2	19	0.000123	0.2996	0.027763	0.2996	0.016636

NEFSC	
Area (sq mi) A	17892
Area Swept a	0.0112
Exp Fact	1597500
Exp Fact (1000s)	1597.5
MADMF	
Area (sq mi) A	869
Area Swept a	0.00385
Exp Fact	225714.3
Exp Fact (1000s)	225.7143

Survey catchabilities (q) obtained from the VPA (calibrated with number/per tow at age) were expanded on the basis of minimum swept area population numbers using the area of the strata used in the assessment (A = 17,892 sq mi) and the footprint of a standard tow (a = 0.0112 sq mi) for the NEFSC survey and the strata used in the assessment (A = 869 sq mi) and the footprint of a standard tow (a = 0.00385 sq mi) for the MA DMF survey. The expansion factor: (A/a *1/1000) converts a survey q from a kg/tow basis to a swept area basis (Q).







As the figures above show, the NEFSC survey Qs start at about 10% at age 2, increase through age 5 or 6 and then level off at about 70-90%. The MADMF spring Qs show a continuously declining trend from age 2 to age 4, reflecting the movement of fish out of the survey area as they grow older.

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