

**The 2005 assessment
of the Gulf of Maine
Atlantic cod stock**

by

Ralph K. Mayo and Laurel A. Col

March 2006

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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 2004 fishing mortality, spawning stock biomass and the survivors in 2005 are presented. Precision estimates of the 2004 fishing mortality and spawning stock biomass estimates for Gulf of Maine cod are also provided.

The 2005 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) sea sample 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 updates the analyses presented in the 2001 assessment of the Gulf of Maine cod stock reviewed at SAW 33 (NEFSC 2001a, b, Mayo *et al.* 2002) and those reviewed in 2002 at the Groundfish Assessment Review Meeting (GARM) (NEFSC 2002b). The analyses presented herein were recently reviewed at the 2005 GARM (NEFSC 2005).

Total landings of Gulf of Maine cod decreased from 4,156 metric tons (mt) in 1998 to 1,636 mt in 1999, increased to 3,730 mt in 2000 and have since remained between 3,800 and 4,400 mt. The sharp decline in landings between 1998 and 1999 and the subsequent increase in 2000 likely reflect the imposition of very low trip limits during 1999 and the subsequent relaxation of these limits in early 2000. It is probable that the extent of discarding increased sharply in 1999 in response to the reduced trip limits.

Commercial landings per unit of standardized effort declined steadily between 1982 and 1987, increased during 1988-1990, but declined sharply in 1992 and remained low in 1993. CPUE estimates have not been included in the assessment model since 1994 because of uncertainty in the effort units between the interview-based estimates and the VTR-based estimates as well as recent management initiatives including trip limits and closed areas imposed to control fishing mortality. 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 there are signs that the 2003 year class may be well above average.

Total stock biomass (ages 1+) declined from a peak of 41,966 mt in 1990 to 15,867 mt in 1997, but increased to 29,000 mt in 2001 and has remained at about that level through 2004. Spawning stock biomass (SSB) declined from over 24,200 mt in 1990 to a low of 11,128 mt in 1997; SSB increased to 25,369 mt in 2002 but declined to 20,549 mt in 2004 due to very low abundance of the poor 1999 and 2000 year classes. Fully recruited instantaneous fishing mortality (F , ages 4-5) remained close to or above 1.0 between 1983 and 1997, but declined to 0.35 by 2002 and has since increased to 0.58 in 2004. SSB_{msy} is now estimated to be 82,830 mt with a corresponding F_{msy} of 0.23, (fully recruited, ages 4+) (NEFSC 2002a). With respect to the age-structured MSY-based reference points, 2004 spawning stock biomass is well below $\frac{1}{2} SSB_{msy}$, and 2004 F is 2.5 times F_{msy} .

INTRODUCTION

Atlantic cod (*Gadus morhua*) in the Gulf of Maine region have been commercially exploited since the 17th century, and reliable landings statistics are available since 1893. Historically, the Gulf of Maine fishery can be separated into four periods (Figure 1): (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 1982-2004 based on analyses of commercial and recreational data through 2004 and research vessel survey data through spring 2005. 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 catch information obtained from the dealer. 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. Estimates of total catch by species and market category were derived from mandatory dealer reports submitted on a trip basis to NMFS. Catches (landed and discarded portions) by market category were allocated 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 catch 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 catch by stock, market category, calendar quarter, port group, and gear group in the full dealer database. 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).

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). The most recent peer review of this assessment (Mayo *et al.* 2002) occurred at the 33rd Northeast Regional Stock Assessment Workshop in June 2001 (NEFSC 2001b) and an updated assessment through 2001 was reviewed at the Groundfish Assessment Review Meeting in October 2002 (NEFSC 2002b, Mayo and Col 2002). The present assessment was reviewed at the second Groundfish Assessment Review Meeting in August 2005 (NEFSC 2005, Mayo and Col 2005).

THE FISHERY

Management History

Fishing for Gulf of Maine cod had been managed under international treaty prior to 1977 and by domestic management authority since 1977 (Appendix 1). 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 1). 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 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).

Commercial Fishery 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, 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). Beginning in 1994, landings estimates were derived from dealer reports prorated to stock based on the distribution of landed catch reported in fishing vessel logbooks as described above.

Total commercial landings in 2004 were 3,798 mt, slightly below those from 2001-2003 but approximately 132% greater than in 1999 (Table 1, Figure 1). Since 1977, the USA fishery has accounted for all of the commercial catch. 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. Although otter trawl catches account for most of the landings (averaging between 50 and 59% between 1993 and 2003), the otter trawl percentage has declined considerably compared to the period prior to 1993. Most of this change can be attributed to an increase in the percentage of cod taken by sink gillnets since 1993, although the percentage from combined handline and line trawls also increased substantially during the 1990s (Table 2). The percentage landed by otter trawls declined further in 2004 to 44%.

Commercial Fishery Discards

Discard rates have been routinely calculated for Gulf of Maine cod by quarter and gear from NEFSC sea sampling data collected since 1989 (Table 3). 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.

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 D/K ratios generally fluctuated between 0.002 and 0.155. In the shrimp trawl fishery, D/K ratios remained high during 1989-1991, but declined substantially in 1992 and remained negligible in 1993. Shrimp trawl sampling data for 1994-2004 were minimal; therefore, landings by this gear component were not distinguished from all other otter trawls in the proration scheme employed to derive the landings by stock for the present assessment. Consequently, discard estimates from both otter trawl and shrimp trawl gear were combined for the 1994-2004 period. D/K ratios from the sink gill net fishery remained relatively low between 1989 and 1998, generally in the range of 0.05 or so. 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 through 2000-early 2004 compared to pre-1999 ratios. Ratios declined in the second quarter of 2004 after trip limits were relaxed.

Discards of Gulf of Maine cod ranged from 154 mt in 1998 to 3,598 mt in 1990 (Table 3). Discards exceeded 1,000 mt in each year between 1989 and 1991 before declining steadily since

1992. The relatively high discard rates calculated for otter trawl and shrimp trawl gear during 1989-1991 coincide with recruitment of the strong 1987 year class to the small mesh shrimp trawl gear and then 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 2,630 mt, one of the highest in the data series, due to the imposition of low trip limits. Estimated discards declined to 1,170 mt in 2000 as trip limits were relaxed to 400 lbs/day in early 2000, and fluctuated between 1,500 and 2,000 mt between 2001 and 2003 before declining to about 575 mt in 2004 when the trip limit was increased to 800 lbs/day in the second quarter (Table 3).

To further evaluate discarding during 1999 - 2004 when low trip limits were imposed, all available vessel trip report (VTR) records were examined from trips reporting some catch of cod in the Gulf of Maine. All trips from vessels which never reported any discard were excluded from the discard analyses. The VTR data were treated in the same manner as the sea sample data. Comparisons between discard estimates based on Sea Sample and VTR data are provided in Tables 4 and 5.

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. Each method and data set has advantages and limitations. The sea sample data are less subjective since they are based on consistent interpretation by a small group of individuals. But these data have been sparse in some years, leading to considerable imprecision. The VTR data provide considerably more observations, which may increase precision, but these data may have been influenced by possible reporting bias in response to severe management actions beginning in 1999. Note that the discards estimated from the VTR data exceed the estimates derived from the Sea Sample data in 1999 and 2000, while the opposite is true from 2001-2004 (Tables 4 and 5).

There is no objective basis to select the results obtained from either data set. Thus, the SAW 33 SARC Panel concluded that both estimates could be used to derive annual estimates to the nearest 500 mt increment. This approach has continued in the present assessment and the results are given in Table 4 for the 1999-2004 period. While it is acknowledged that this approach is subjective, it has been accepted by the SAW33 SARC Panel and the 2 meetings of the GARM in 2002 (NEFSC 2002b) and 2005 (NEFSC 2005).

Commercial Fishery Sampling Intensity

A summary of USA length frequency and age sampling of Gulf of Maine cod landings during 1982-2000 is presented in Table 6. 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.

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 (scrod, market, and large). 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.

Beginning in 1998, the quality of commercial port sampling for Gulf of Maine cod declined considerably. 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 has diminished to the point that the representation of the older age groups may have been somewhat compromised. Sampling improved considerably in 2001, especially in the case of large market category cod as a result of augmented sampling effort from the Massachusetts Division of Marine Fisheries (DMF) samplers, and has remained high (less than 100 mt per sample).

Of the 201 samples collected in 2004, 46 were scrod samples (23%), 65 were market (32%), and 90 were large (45%). Compared with the 2004 market category landings distribution by weight (scrod: 3%; market: 41%; large: 53%) (Table 7), sampling in 2004 over-represented the scrod category and well represented the market and large categories.

As well, the seasonal distribution of samples became skewed for several years such that, although there appears to have been sufficient numbers of samples taken, there has been insufficient sampling in some quarters and half-years, requiring pooling of samples on an annual basis.

Commercial Landings Age Composition

The age composition of landings during 1982-1993 was estimated, by market category, from monthly 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:

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

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 8a).

Age composition of landings from 1994 through 2004 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 6). 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 2001 and continued through 2004.

Gulf of Maine cod landings have been generally dominated by age 3 and 4 fish in numbers 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. 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 have also been unusually low (Table 8a). Although this pattern may be partly a result of the poor sampling of 'Large' category cod, especially in recent years, a trend towards fewer older fish in the landings began in 1991.

More recently, the 1998 year class has dominated the landings at ages 3 through 6 in 2001 through 2004, respectively. As well, the proportion of cod older than age 7 has begun to increase. In 2004 ages 8 and older represented 15% of the landed weight, more than the 7-13% contribution during 1982-1984 and the very low 1% contribution in 2000. Although the fraction of age 8 and older fish has begun to increase, the period of low representation during the 1990s precludes the use of these older fish in the assessment model. Therefore, the age 7+ group was continued in the present assessment model (Table 9a and 9b).

Adjustment of the 1999 - 2004 Commercial Landings at Age

The fishery for Gulf of Maine cod was affected by management actions that began in 1999 and have continued into 2004. 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 1999-2004 estimated commercial landings at age presented in Tables 9 and 10 do not reflect the full extent of removals from the stock by the fishery. Therefore, prior to inclusion in the VPA, the 1999-2004 landings estimates had to be adjusted upwards at each age 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 most 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, the discards comprise the smaller, younger fish compared to those that are landed. However, where regulatory discards are generated as a result of extremely low trip limits (as occurred during 1999-2004), 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 Sea Sample 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 1999 commercial port samples. Therefore, the 1999 -2004 commercial landings at age estimates in Table 9 were multiplied by the discard adjustment factors in Table 4 before inclusion in the VPA catch at age matrix (see pages 3 and 4 for discard estimation procedures).

Commercial Landings Mean Weights at Age

Mean weights at age in the landings during 1982-2004 are given in Table 8b for ages 1-11+ and in Table 9b and Figure 2 for ages 2-7+. Based on landings patterns these are considered mid-year values. Mean weights of age 2 and 3 cod have increased since about 1992 and mean weights of age 4 cod have increased since 2000, reflecting reduced partial recruitment of younger fish to the fishery, while the average weights for age 5 and 6 cod have fluctuated without trend. Mean weights for ages 9 and older fluctuate considerably and are particularly sensitive to sampling variability. However, when the older ages are aggregated into a single age 7+ group, a marked decline is evident in mean weights during the 1990s, followed by an increase beginning in 2001. This likely reflects the decline of older fish in the landings during the 1990s and recent increases in the proportion of the stock ages 7 and older.

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.

Recreational Fishery Catches

Estimates of the recreational cod catch were derived from the Marine Recreational Fishery Statistics Survey (MRFSS), which has been conducted annually since 1979. Gulf of Maine cod catches were estimated assuming that catches of cod recorded in the intercept survey were removed from the ocean in statistical areas adjacent to the reported state or county of landing. The MRFSS database has been revised, resulting in adjusted catch estimates for the years 1981 through 1997. In addition, the Gulf of Maine cod catch from 1994 to 2004 were re-estimated using a revised port stratification scheme to better reflect sampling allocation in New England ports. Information on the catch prior to 1981, which has not been revised, is included in Table 10

to provide a longer-term perspective. 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 10.

The quantity of cod retained generally exceeded 80% of the total recreational catch during 1981 through 1991, but has averaged less than 40% since 1992. The estimated total cod catch (including those caught and released) declined from over 5,000 mt in 1980 and 1981 to less than 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 7,700 mt in 2003 before declining to 3,500 mt in 2004. Trends in the weight of cod retained were similar to the total catch, but the magnitude of the removals is considerably less, especially since 1992.

The fraction of the total landings (commercial and recreational) taken by the recreational sector (retained cod) generally ranged from 6 to 20% between 1981 and 1998. The recreational component increased to 35 percent in 1999 and has remained between 25 and 39 percent through 2004.

Recreational Fishery Sampling Intensity

Information on the length frequency sampling levels of Gulf of Maine cod taken in the recreational fishery is also provided in Table 10. Overall, sampling of cod taken by recreational gear is poor, averaging less than 1 sample per 1,000 mt removed. Sampling of the recreational fishery improved during the 1990s, but has been relatively low in recent years. The age composition of the 1982-1996 recreational landings was derived for the 1997 assessment (Mayo 1998) but, given the highly variable sampling, these data were not formally included in the VPA conducted in 1997 (NEFSC 1997; Mayo 1998). However, given the recent increase in the proportion of the total landings accounted by the retained recreational catch, the age composition of the recreational landings in 1997-2004 was estimated for the current assessment and the 1982-2004 recreational landings at age estimates were incorporated into the total catch at age.

Recreational Fishery Landings Age Composition

Given the limited sampling coverage in this 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 may not accurately reflect the size composition of the released cod. Age-length keys obtained from sampling the commercial landings, augmented by age samples from NEFSC bottom 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 11a).

During the 1980s, Gulf of Maine cod recreational landings in numbers were dominated by age 3 fish with age 2 fish next in importance. 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 from the commercial fishery with ages 3, 4 and 5 predominant (Tables 9a and 11a). 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.

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:

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

Mean lengths and weights at age of cod landed by the recreational sector (Table 11b) 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 and recent increase in the mean weight of the 7+ group fish.

Total Landings Age Composition

Estimates of the age composition of total cod landings (Table 12a) were derived by combining the separate age composition estimates obtained for the commercial (Table 9a) and recreational fisheries (Table 11a). 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. In general, ages 3, 4 and 5 have predominated; the 1987 year class dominated the total landings in 1990, 1991 and 1992, the 1992 year class can also be tracked between 1995 and 1999, and the 1998 year class dominates the period after 2000.

Total Landings Mean Weights at Age

Mean lengths and weights at age of cod landed by the combined commercial and recreational sectors (Table 12b) are intermediate to those obtained from the individual sectors. Mean weights at age are highly variable for the older ages due to the relatively poor sampling of fish at the larger sizes. Mean weights at age for calculating stock biomass at the beginning of the year are provided in Tables 13 and 14 for ages 1-11+ and 1-7+, respectively. The age 11+ values were derived from the commercial landings mean weight at age data (Table 9b) and the age 7+ values

were derived from the total (commercial and recreational) landings mean weight at age data (Table 12b) using procedures described by Rivard (1980, 1982).

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). Given the uncertainty in reported fishing effort since 1994, the 1994-1997 LPUE data 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 also make interpretation of 1997-2004 LPUE inconsistent with previous years. Until effort units are resolved in the commercial fishery database, no further treatment of the LPUE series after 1993 is meaningful.

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 updated standardized effort estimates to calculate a revised LPUE-at-age index. 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 1993 standardized fishing effort. Further details regarding data selection, preparation and estimation procedures are provided in Mayo *et al.* (1994).

Research Vessel Survey Indices

Indices of cod abundance (stratified mean catch per tow in numbers) and biomass (stratified mean weight per tow in kilograms) developed from NEFSC and Commonwealth of Massachusetts Division of Marine Fisheries (MADMF) research vessel bottom trawl survey data, have been used to monitor changes and assess trends in population size and recruitment of cod populations off New England. Offshore (> 27 m) stratified random NEFSC surveys have been conducted annually in the Gulf of Maine in autumn since 1963 and in spring since 1968. Inshore areas of the Gulf of Maine (< 27 m) have been sampled during spring and autumn NEFSC and MADMF inshore bottom trawl surveys since 1978. 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. Details on NEFSC survey sampling design and procedures are provided in Azarovitz (1981) and Clark (1981). The MADMF inshore bottom trawl sampling program is described in Howe *et al.* (1981). 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 15. Standardized mean catch-per-tow-at-age (number) indices are listed in Appendix 2: Tables 1 and 2, and catch-per-tow-at-age indices from DMF spring and autumn

surveys are listed in Appendix 2: Table 3. The entire series of spring and autumn abundance and biomass indices was re-estimated for this assessment to better account for vessel effects between RV Albatross IV and RV Delaware II. Although the only major difference during the 1982-2004 assessment period occurred in 1987, many minor changes to the indices occurred in most years. Therefore, the indices listed in Table 15 and Appendix 2: Tables 1 and 2 may differ slightly from those provided in previous assessments.

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 15, Figure 3). Number-per-tow indices declined during the mid- and late 1960s, but between 1972 and 1985 have fluctuated as a result of a series of recruitment pulses. 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 2: Table 2, Figure 4). 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 2: Table 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.

More recently, autumn biomass indices have shown a modest increase, but the large value in 2002 is the result of a single very large tow that unduly influenced the calculation of the mean. The 1998 year class is equivalent to the 1992 year class, and the 2003 year class appears to be the strongest since the 1987 year class. Biomass indices in 2003 and 2004 suggest the population biomass remains above the low level of the early 1990s.

Spring NEFSC number-per-tow indices have remained relatively low since 1985, below the 1981-1984 average (Table 15); spring weight-per-tow indices have also remained relatively low through 1991, but the index increased substantially in 1992, and remained relatively high in 1993, due to a large contribution from the 1987 year class (Appendix 2: Table 1). The index declined markedly in 1994, remained low in 1995, increased moderately in 1996 and remained essentially unchanged in 1997. Spring weight-per-tow indices increased in 2001 and 2002 and remained high in 2003; however, the 2004 and 2005 indices suggest that current biomass remains relatively low (Figure 3).

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 and at ages 0 and 1 in the MADMF autumn inshore surveys were nearly all record-high values (Appendix 2: Tables 1 and 3). Based on MADMF and NEFSC survey catch per tow indices, the 1992, 1998 and 2003 year classes appear to be of moderate strength; the intervening year classes of Gulf of Maine cod, particularly the 1993, 1994, 1995, 1996 and 2000 year classes have been well below average (Figures 4 and 5).

MORTALITY

Total Mortality Estimates

Estimates of instantaneous total mortality (Z) were calculated on an annual basis from 1964 through 2004. Total mortality was calculated from NEFSC survey catch per tow at age data (Appendix 2: Tables 1 and 2) for fully recruited age groups 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:

$$\begin{aligned} \text{Spring:} & \quad \ln \left(\frac{\sum \text{age 4+ for 1983}}{\sum \text{age 5+ for 1984}} \right) \\ \text{Autumn:} & \quad \ln \left(\frac{\sum \text{age 3+ for 1982}}{\sum \text{age 4+ for 1983}} \right) \end{aligned}$$

Different age groups were used in the spring and autumn analyses so that Z could be evaluated over the same year class within each year.

Values of Z derived from the spring surveys are generally comparable to those calculated from the autumn data (Figure 6). These values of Z exhibit considerable inter-annual variability due primarily to year effects in the surveys. When smoothed, however, the annual estimates suggest a pattern of increasing mortality during the 1980s, with mortality remaining close to 1.0 through the mid 1990s. Total mortality declined during the late 1990s, but the most recent estimates suggest an increase.

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).

ESTIMATION of FISHING MORTALITY RATES and STOCK SIZE

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 2004. As in previous assessments, age-disaggregated analyses were performed. Several comparative ADAPT calibrations were performed, each using the same NEFSC spring and autumn (ages 2-6) and MADMF spring (ages 2-4) and autumn (age 2) survey series. Due to uncertainty in the interpretation of effort units in the 1994-1997 VTR data, USA commercial LPUE abundance indices for ages 2-6 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 the previous assessment. As in the previous assessments (see Mayo *et al.* 1998), the USA commercial LPUE indices from 1982 through 1993 were 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).

The NEFSC and MADMF autumn indices were lagged forward by one age and one year whereby age 1-6 indices were related to age 2-7 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. The 1982-2004 commercial landings at age as provided in Table 8a include true ages 2-10 as well as the 11+ group. In recent years, however, fish beyond age 7 have been poorly represented. As reported by Mayo (1995), a calibration run employing an extended age complement (true ages 2-9) produced 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. Therefore, as in previous assessments of this stock (Mayo *et al.* 1993; Mayo 1995, Mayo 1998, Mayo *et al.* 1998, NEFSC 2000, NEFSC 2001, Mayo *et al.* 2001, Mayo and Col, 2002, 2005), all VPA formulations employed a reduced age range (ages 2-6 and 7+) (Table 9a).

Comparative VPA Calibrations

Recent changes to the VPA software and some revisions to the commercial and MRFSS data components were made in the intervening years between the current assessment and the previous assessment reviewed at the 2002 Groundfish Assessment Review Meeting (Mayo and Col 2002). These include:

- 1) A change in the software from the FACT package to the NFT package. The major change is in the estimation of F on the oldest age.
- 2) The discovery of additional commercial age samples for the years 2000 and 2001
- 3) Revision to the MRFSS catch estimates for the period back to 1994
- 4) Re-calculation of the NEFSC bottom trawl survey indices to better account for vessel effects between RV Albatross IV and RV Delaware II. Only minor differences occurred during the period of the VPA assessment.

To provide a bridge to the previous (2002) assessment, key results from six calibration runs with 2001 as the terminal year are compared in Table 16. The first set of results was taken directly from the 2002 assessment (Mayo and Col 2002) based on the FACT software package. The second set of results is based on running the NFT software on the 2002 assessment input file. The next 3 sets of results are also based on the NFT VPA software reflecting the following data changes: 1) re-estimated commercial catch at age for 2000 and 2001, 2) re-estimated recreational landings at age for 1994-2001, and 3) re-estimated NEFSC bottom trawl indices. The final set of results, also based on the NFT VPA software, incorporates all three data changes noted above.

In general, differences across all runs are minor (Table 16). The change in software did not produce a substantial change in the aggregate results (RSS, F and SSB), but there was a small difference in the estimated F at the fully recruited ages (4 and 5). Results from the remaining calibration runs incorporating the various data changes were very similar to the initial calibration run using the NFT software. Had these changes in software and data been in place in 2002, the results would have been very similar to what was obtained from the 2002 assessment. Based on these conclusions, the NFT software and the data revisions were carried forward with the updated catch and survey data for 2002-2004.

Final VPA Formulation

The ADAPT formulation employed in the final VPA calibration was the same as that used in the 2002 assessment except for the revisions to the software and data as noted above. This analysis provided direct stock size estimates for ages 2 through 6 in 2005 and corresponding estimates of F on ages 1 through 5 in 2004. Since the age at full recruitment was defined as 4 years in the input partial recruitment vector, the terminal year F on age 6 was estimated as the mean of the age 4 and 5 Fs; age 6 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 6) was determined from weighted estimates (by age group abundance, in numbers) of Z for ages 4 through 6. In all years, the age 6 F was applied to the 7+ group. Spawning stock biomass (SSB) was calculated at spawning time (March 1) by applying a series of period-specific maturity ogives. The present analysis used a maturity schedule which reflected earlier maturation beginning in 1994.

Residuals of the observed and predicted indices derived from the final VPA formulation (Figure 7) do not indicate any consistent trends over the period of the VPA, except for the MADMF age 2 autumn index.

Virtual Population Analysis Results

A complete listing of the final ADAPT VPA calibration is given in Appendix 3, and summary results, including age-specific estimates of instantaneous fishing mortality (F), stock size, mean biomass and spawning stock biomass, are presented in Table 17. All parameter estimates were significant (Appendix 3). Coefficients of variation on the stock size estimates at the beginning of 2005 ranged from 0.23 (age 4) to 0.36 (age 5), while CVs on the estimates of survey q s were between 0.03 and 0.17. Slopes of the abundance index-stock size relationships increased with age through age 6 for the NEFSC spring and autumn surveys and the USA commercial LPUE indices. The MADMF spring indices exhibited a decreasing trend in q between ages 2 and 4 (Appendix 3).

Average (ages 4-5, unweighted) fishing mortality fluctuated around 1.0 during the 1980s and early 1990s, but steadily declined thereafter to less than 0.4 in 2002 (Table 17, Figure 8). Fishing mortality in 2004 was estimated to be 0.58, an increase from 2002 and 2003. The increase in F in 2004 is notable because the two ages upon which the fully recruited average F is based (ages 4 and 5) represent the below-average 1999 and the very weak 2000 year classes. The spawning stock biomass of age 1 and older cod declined from 23,987 mt in 1982 to 15,302 mt in 1987. Following the recruitment and maturation of the strong 1987 year class, SSB increased to 24,261 mt in 1990 but declined to 10,797 mt in 1993, a 3-year reduction of 55% (Table 17, Figure 9). SSB increased to 14,996 mt in 1995 due to the growth and maturation of the 1992 year class, but declined again in 1996 and reached a record-low of 11,128 mt in 1997. SSB increased again beginning in 1998, reaching 25,369 mt in 2002, based primarily on growth and maturation of the 1998 year class (Table 17). Spawning stock biomass has since declined to 20,549 mt in 2004. Total stock size (ages 1+) has also declined sharply in recent years from 44.6 million fish in 1988 to an average of 14.0 million fish during 1996-1998 (Table 17), a decrease of 72%, but is

estimated to have increased to about 32.2 million fish in 2004 due in large part to an initial estimate of the strength of the 2003 year class.

Since 1982, recruitment at age 1 has ranged from less than 4 million fish (1993, 1994, 1995, 2000 and 2002 year classes) to 25.2 million fish (1987 year class). Over the 1982-2004 period, geometric mean recruitment for the 1981-2003 year classes was 6.3 million fish. The 1987 year class is the highest in the 1982-2004 series and about twice the size of the next strongest year class. The 1992, 1998 and 2001 year classes were of moderate strength. (Table 17, Figure 9), while the 1993-1995, 1999-2000 and 2002 year classes were weak. The initial estimate of the strength of the 2003 year class (22 million) is very close to that of the 1987 year class.

Precision of F and SSB

A bootstrap procedure (Efron 1982) was used to evaluate the precision of terminal year estimates, by generating 600 estimates of the 2004 fully recruited fishing mortality rate and spawning stock biomass. Summary statistics for the bootstrap analyses are provided in Appendix 4, and the distributions of the bootstrap estimates and the corresponding cumulative probability curves are shown in Figure 10. The cumulative probability expresses the likelihood that the fishing mortality rate was greater than a given level (Figure 10a) or the likelihood that spawning stock biomass was less than a given level (Figure 10b), when measurement error is considered.

Coefficients of variation for the 2005 stock size (numbers) estimates ranged from 0.24 (age 4) to 0.49 (age 2), and CVs for q_s among all indices ranged from 0.03 to 0.31 (Appendix 4). The fully-recruited fishing mortality in 2004 for ages 4+ was reasonably well estimated (CV = 0.20). The mean bootstrap estimate of F (0.60) was slightly higher than the point estimate (0.58) from the VPA. The 80% probability interval ranges from 0.46 to 0.76 (Figure 10a).

Although the abundance estimates for individual ages in 2005 had wide variances (CV = 0.24 to 0.49), the estimate of 2004 spawning stock biomass was robust (CV = 0.14). The bootstrap mean was 2.9% higher than the VPA point estimates (Appendix 4). The 80% probability interval for SSB ranges from 17,800 mt to 24,800 mt (Figure 10b). Despite this variability, current spawning stock biomass is estimated to have increased substantially from earlier record lows. In general, estimates of stock size and fishing mortality in the present assessment are estimated with about the same precision as in the previous assessment of this stock (Mayo and Col 2002).

Retrospective Analysis

The previous retrospective analysis for this stock was reported by Mayo *et al.* (2002). Although the formulation used in the present assessment is the same as in the previous assessment, changes in management measures for this stock during 2002-2004 may have imposed additional uncertainty in the interpretation of current stock status. Therefore, the retrospective analyses were conducted again, and the tabular results are given in Appendix 3.

Retrospective patterns with respect to terminal F are evident for Gulf of Maine cod in the most recent years (Figure 11), but the patterns are not consistent through time. Mean F (ages 4-5,

unweighted) in the terminal year was under-estimated in 1995 and 1996 by the ADAPT calibration. The retrospective analysis presented by Mayo *et al.* (1998) indicated the same pattern, but was able to detect the opposite pattern (slight over-estimate of F) prior to 1994. The retrospective pattern in F reversed between 1997 and 1998 revealing a tendency to over-estimate F in 2000 and 2001. Most recently, there appears to be a slight tendency to again under-estimate F in 2002 and 2003. Convergence of estimates is generally evident within 3 years, and often within 2 years, prior to any given terminal year. The retrospective analysis provides additional evidence that current fishing mortality on this stock, although somewhat lower than in the 1980s and 1990s, is showing a tendency to increase again. The retrospective patterns for SSB and age 1 recruits show the opposite patterns, with an indication of over-estimation in 2002 and 2003.

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 12a) was constructed over the period covering the 1982-2003 year classes. In addition, a survival ratio, expressed as recruits per unit of SSB (R/SSB) was also calculated for each year class (Figure 12b). The stock-recruitment trajectory indicates the position of the most recent levels of SSB and recruitment in the upper right corner of the plot illustrating the emergence of the 2003 year class from a relatively high spawning stock.

Survival ratios of pre-recruits up to age 1 are highest for the 1987, 1992, 1998 and 2003 year classes, the first two emerging from about average SSB, the 1998 year class from low SSB and the 2003 year class from relatively high 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 and 1998, declined thereafter and increased again in 2003.

BIOLOGICAL REFERENCE POINTS

Yield and Spawning Stock Biomass per Recruit Reference Points

Yield and spawning stock biomass biological reference points were not revised during the preparation of the current assessment. The following reference points were taken from Mayo *et al.* (2002) and are the same as those applied by the Working Group on Biological Reference Points (NEFSC 2002a) and in the 2002 and 2005 GARM assessments (NEFSC 2002b, 2005; Mayo and Col 2002, 2005). These are:

$$F_{0.1} = 0.15$$

$$F_{\max} = 0.27$$

$$F_{20\%} = 0.36$$

The yield per recruit reference points ($F_{0.1}$ and F_{\max}), and the SSB per recruit reference point ($F_{20\%}$) are slightly lower than those reported in the 1998 assessment (Mayo *et al.* 1998).

Age-Structured Production Model Reference Points

MSY-based reference points were not revised during the preparation of the current assessment. An age-structured production model (Sissenwine and Shepherd 1987) was developed and applied by the Working Group on Biological Reference Points (NEFSC 2002a) using data and results from the 2001 assessment (Mayo *et al.* 2002). A complete description of the approach is given in Mayo *et al.* (2002) and NEFSC (2002a). The MSY-based reference points calculated using this method are:

$$\text{MSY} = 16,600 \text{ mt}$$

$$\text{SSB}_{\text{MSY}} = 82,830 \text{ mt}$$

$$F_{\text{MSY}} = 0.23$$

CONCLUSIONS

Gulf of Maine cod spawning stock biomass has increased since the late 1990s from 15,900 mt in 1997 to 20,500 mt in 2004, but the stock remains low relative to SSB_{MSY} (82,830 mt). Fully recruited fishing mortality declined to about 0.35 in 2000 and 2001, but has since increased to 0.58 in 2004, indicating that F continues to remain very high relative to fully recruited F reference points ($F_{0.1} = 0.15$; $F_{\text{msy}} = 0.23$; $F_{\text{max}} = 0.27$). Thus, the stock remains in an overfished condition and overfishing continues to occur.

The 1987 year class is the strongest in the VPA assessment period (1982-2004). Subsequent year classes subsequent have been poor-to-average, except for the 1992, 1998, 2001 and 2003 cohorts. 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 year class.

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 under estimate fully recruited F and over estimate biomass in the terminal year.

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Table 1. Commercial landings (metric tons, live) of Atlantic cod from the Gulf of Maine (NAFO Division 5Y), 1960 - 2004.¹

Year	Gulf of Maine				Total
	USA	Canada	USSR	Other	
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*	7877	-	-	-	7877
1995*	6798	-	-	-	6798
1996*	7194	-	-	-	7194
1997*	5421	-	-	-	5421
1998*	4156	-	-	-	4156
1999*	1636	-	-	-	1636
2000*	3730	-	-	-	3730
2001*	4423	-	-	-	4423
2002*	4096	-	-	-	4096
2003*	4028	-	-	-	4028
2004*	3798	-	-	-	3798

* Provisional

¹ USA 1960-1993 landings from NMFS, NEFSC Detailed Weighout Files and Canvass data.

² USA 1994-2004 landings estimated by prorating NMFS, NEFSC Detailed Weighout data by Vessel Trip Reports.

Table 2. Distribution of USA commercial landings (metric tons, live) of Atlantic cod from the Gulf of Maine (Area 5Y), by gear type, 1965 - 2004. The percentage of total USA commercial landings of Atlantic cod from the Gulf of Maine, by gear type, is also presented for each year. Data only reflect Gulf of Maine cod landings that could be identified by gear type.

Year	Landings (metric tons, live)				Percentage of Annual Landings				
	Otter Trawl	Sink Gill Net	Line Trawl	Other Gear	Total	Otter Trawl	Sink Gill Net	Line Trawl	Other Gear
1965	2480	501	462	168	3612	68.7	13.9	12.8	4.6
1966	2549	830	308	150	3841	66.4	21.6	8.0	3.9
1967	4312	734	206	274	5526	78.0	13.3	3.7	5.0
1968	4143	1377	213	339	6076	68.2	22.7	3.5	5.6
1969	6553	851	258	162	7828	83.7	10.9	3.3	2.1
1970	5967	951	407	178	7512	79.4	12.7	5.4	0.1
1971	5117	1043	927	98	7193	71.1	14.5	12.9	1.4
1972	4004	1492	1234	54	6786	59.0	22.0	18.2	0.8
1973	3542	1182	1305	23	6061	58.4	19.5	21.5	0.2
1974	5056	1412	904	36	7425	68.1	19.0	12.2	0.5
1975	6255	1480	920	12	8675	72.1	17.1	10.6	0.1
1976	6701	2511	621	4	9878	67.8	25.4	6.3	0.1
1977	8415	2872	534	6	11993	70.2	23.9	4.5	1.4
1978	7958	3438	393	10	11890	66.9	28.9	3.3	0.1
1979	7567	2900	334	19	10987	68.9	26.4	3.0	0.2
1980	8420	3733	251	48	12513	67.3	29.8	2.0	0.4
1981	7937	4102	276	23	12383	64.1	33.1	2.2	0.4
1982	9758	3453	188	46	13479	72.4	25.6	1.4	0.3
1983	9975	3744	77	4	13867	71.9	27.0	0.6	0.5
1984	6646	3985	22	3	10725	62.0	37.2	0.2	0.6
1985	7119	3090	55	6	10596	67.2	29.1	0.5	0.1
1986	6664	2692	56	12	9604	69.4	28.0	0.6	0.1
1987	4356	2994	70	13	7501	58.1	39.9	0.9	0.2
1988	4513	3308	68	27	7938	56.9	41.7	0.8	0.3
1989	6152	4000	72	36	10379	59.3	38.5	0.7	0.4
1990	10420	4343	126	20	15095	69.0	28.8	0.8	0.1
1991	13049	4158	212	59	17744	73.5	23.4	1.2	0.3
1992	7344	3081	359	94	10891	67.4	28.3	3.3	0.9
1993	4876	3130	236	16	8287	58.8	37.8	2.8	0.2
1994	4205	3317	338	17	7877	53.4	42.1	4.3	0.2
1995	3450	3050	281	17	6798	50.8	44.9	4.1	0.3
1996	4012	2825	335	17	7194	55.8	39.3	4.7	0.3
1997	2798	2175	426	22	5421	51.6	40.1	7.9	0.4
1998	2329	1431	381	15	4156	56.0	34.4	9.2	0.4
1999	838	494	302	2	1630	51.2	30.2	18.5	0.1
2000	2007	1393	309	20	3730	53.8	37.4	8.3	0.5
2001	2554	1514	344	12	4424	57.7	34.2	7.8	0.3
2002	2282	1543	264	8	4096	55.7	37.7	6.4	0.2
2003	2013	1787	222	6	4028	50.0	44.4	5.5	0.2
2004	1682	1920	152	44	3798	44.3	50.6	4.0	1.2

[a] Of 166 mt landed, 107 mt were by mid-water pair trawl and 42 mt were by drift gill nets. [f] Of 199 mt landed, 75 mt were by longline and 27 mt were by Danish seine.
 [b] Of 91 mt landed, 56 mt were by Danish seine and 27 mt were by drifting gill nets. [g] Of 186 mt landed, 159 mt were by longline and 16 mt were by Danish sein.
 [c] Of 167 mt landed, 199 mt were by drifting gill nets and 38 mt were by Danish seine. [h] Of 266 mt landed, 245 mt were by longline and 9 mt were by Danish seine.
 [d] Of 326 mt landed, 268 mt were by longline and 37 mt were by Danish seine. [i] Handline and line trawl combined.
 [e] Of 181 mt landed, 152 mt were by longline and 23 mt were by Danish seine.

Table 3. Discard and total commercial catch estimates (metric tons, live) for Gulf of Maine cod by otter trawl, shrimp trawl, and sink gillnet gear derived from 1989-2004 NEFSC Sea Sample data.

Year	Discard Estimates					Total Discard	Total Catch
	Total Landings	Included Landings	Discard Estimate	Discard to Landings Ratio			
1989	10397	10182	1513	0.1486		1545	11942
1990	15154	14827	3521	0.2375		3598	18752
1991	17781	17374	1025	0.0590		1049	18830
1992	10891	10511	582	0.0554		603	11494
1993	8287	8058	320	0.0397		329	8616
1994	7877	7522	228	0.0303		239	8116
1995	6798	6500	408	0.0627		426	7224
1996	7194	6837	189	0.0277		199	7393
1997	5421	4974	164	0.0330		179	5600
1998	4156	3760	139	0.0370		154	4310
1999	1636	1332	2141	1.6074		2630	4266
2000	3730	3401	1067	0.3137		1170	4900
2001	4424	4068	1491	0.3665		1621	6045
2002	4096	3825	1821	0.4761		1950	6046
2003	4028	3799	1401	0.3688		1486	5514
2004	3798	3602	545	0.1513		575	4373

Table 4. Discard estimates (metric tons, live) for Gulf of Maine cod by otter trawl and sink gillnet gear derived from 1999-2004 NEFSC Sea Sample and VTR data.

Year	Discard Estimates				
	Commercial Landings	SS Discard Estimate	VTR Discard Estimate	Discard Quantity Included in VPA	Discard Raising Factor
1999	1636	2141	2760	2500	2.53
2000	3730	1067	2063	1000	1.27
2001	4424	1491	1201	1500	1.34
2002	4096	1821	1142	1500	1.37
2003	4028	1401	1030	1500	1.37
2004	3798	545	452	500	1.13

Table 5. Comparison of discard estimates and resulting total commercial catch based on NEFSC Sea Sample data and NERO VTR data for Gulf of Maine cod, 1999-2004

From NEFSC Sea Sample Data										SS-VTR Differences				
Year	Total Landings	Incl. Landings	Disc Estimate	D/K Ratio	Total Discard	Total Catch	Disc Estimate	D/K Ratio	Total Discard	Total Catch	Percent Change			
1999	1636	1332	2142	1.608108	2630.865	4266.865	-618	-0.46396	-759.045	-759.045	-15.1026			
2000	3730	3401	1067	0.313731	1170.218	4900.218	-996	-0.29286	-1092.35	-1092.35	-18.2284			
2001	4423	4068	1491	0.366519	1621.114	6044.114	290	0.071288	315.3073	315.3073	5.503891			
2002	4096	3825	1821	0.476078	1950.017	6046.017	679	0.196793	806.0623	806.0623	15.383			
2003	4028	3799	1401	0.368781	1485.451	5513.451	371	0.11269	453.9144	453.9144	8.971461			
2004	3798	3602	545	0.151305	574.6557	4372.656	93	0.0309	117.3579	117.3579	2.757925			

From NERO VTR Data									
Year	Total Landings	Incl. Landings	Disc Estimate	D/K Ratio	Total Discard	Total Catch			
1999	1636	1332	2760	2.072072	3389.91	5025.91			
2000	3730	3401	2063	0.606586	2262.567	5992.567			
2001	4423	4068	1201	0.295231	1305.807	5728.807			
2002	4096	4089	1142	0.279286	1143.955	5239.955			
2003	4028	4022	1030	0.256091	1031.537	5059.537			
2004	3798	3754	452	0.120405	457.2978	4255.298			

Table 6. USA sampling of commercial Atlantic cod landings from the Gulf of Maine cod stock (NAFO Division 5Y), 1982 - 2004.

Year	Number of Samples				Age Samples				Length Samples				Number of Samples, by Market Category & Quarter												Annual Sampling Intensity																	
	No. Measured		No. Fish Aged		No. Aged		No. Fish		No. Measured		No. Fish		No. Aged		No. Fish		Scrod				Large				Scrod		Market		Large		Σ											
	No.	No.	No.	No.	Q1	Q2	Q3	Q4	Σ	Q1	Q2	Q3	Q4	Σ	Q1	Q2	Q3	Q4	Σ	Q1	Q2	Q3	Q4	Σ	Q1	Q2	Q3	Q4	Σ	Q1	Q2	Q3	Q4	Σ	Q1	Q2	Q3	Q4	Σ			
1982	48	3848	48	866	6	7	6	6	25	4	3	7	4	18	0	2	1	2	5	134	348	792	266																			
1983	71	5241	67	1348	14	10	10	4	38	4	10	6	2	22	1	3	5	2	11	106	294	318	197																			
1984	55	3925	55	1224	7	5	6	7	25	4	3	5	6	18	1	6	3	2	12	85	319	245	193																			
1985	69	5426	66	1546	5	6	7	5	23	8	6	7	4	25	7	5	3	6	21	95	229	132	155																			
1986	53	3970	51	1160	5	5	6	3	19	5	6	8	2	21	1	5	4	3	13	124	242	170	182																			
1987	43	3184	42	939	4	4	3	4	15	5	5	3	5	18	4	2	3	1	10	83	224	225	175																			
1988	34	2669	33	741	4	3	4	4	15	1	5	3	5	14	1	2	2	0	5	147	271	391	234																			
1989	32	2668	32	714	3	3	3	3	12	4	1	5	4	14	2	2	1	1	6	209	430	311	325																			
1990	39	2982	38	789	3	7	3	5	18	4	7	4	3	18	0	2	1	0	3	300	378	966	387																			
1991	56	4519	56	1152	2	10	4	3	19	5	11	11	3	30	0	3	3	1	7	250	313	519	318																			
1992	51	4086	51	1002	2	8	6	3	19	6	7	7	3	23	3	1	1	4	9	104	232	375	214																			
1993	23	1753	23	447	3	3	3	1	10	1	2	4	1	8	1	1	2	1	5	177	453	527	360																			
1994	30	2696	33	665	0	2	2	4	8	1	4	4	6	15	0	2	3	2	7	180	284	272	263																			
1995	31	2568	32	662	4	2	2	4	12	2	7	1	2	12	0	5	0	2	7	133	300	202	219																			
1996	77	7027	71	1483	6	5	7	9	27	7	9	10	12	38	1	3	3	5	12	62	116	79	93																			
1997	78	6657	74	1521	7	10	3	9	29	11	9	9	7	36	1	8	2	2	13	37	91	71	69																			
1998	46	4205	46	912	4	7	0	3	14	8	9	9	3	29	0	0	2	1	3	53	81	321	90																			
1999	15	1305	16	350	6	0	1	0	7	4	2	0	0	6	2	0	0	0	2	36	144	245	109																			
2000	62	4881	62	1490	11	5	3	4	23	11	14	5	8	38	0	0	0	1	1	14	62	1131	61																			
2001	113	7326	105	2436	4	4	4	7	19	7	9	8	15	39	3	16	18	18	55	18	58	32	39																			
2002	137	5999	138	2800	4	4	0	2	10	16	5	8	4	33	53	9	15	17	94	17	64	19	30																			
2003	191	9043	234	5820	6	1	13	0	20	13	10	24	4	51	49	34	28	9	120	8	37	16	22																			
2004	201	10383	156	3375	11	9	6	20	46	16	20	15	14	65	35	19	11	25	90	2	24	22	19																			

Source: 1982-1985 from Serchuk and Wigley (1986); 1986-2004 from NEFSC files.

Table 7. Percentage (by weight) of USA commercial Atlantic cod landings from the Gulf of Maine (NAFO Division 5Y), by market category, 1964 - 2004.

Year	Gulf of Maine			Total [a]
	Large	Market	Scrod	
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	24	54	18	100
1995	21	53	23	100
1996	13	61	23	100
1997	17	60	20	100
1998	23	57	18	100
1999	29	53	16	100
2000	30	59	9	100
2001	40	51	8	100
2002	43	51	4	100
2003	48	46	4	100
2004	53	41	3	100

[a] Includes landings of 'mixed' cod.

Table 8a. Commercial landings at age (thousands of fish; metric tons) of Atlantic cod from the Gulf of Maine stock (NAFO Division 5Y), 1982 - 2004.

Year	Age											Total
	1	2	3	4	5	6	7	8	9	10	11+	
1982	30	1380	1633	1143	633	69	91	61	41	4	33	5118
1983	-	866	2357	1058	638	422	47	61	23	9	15	5496
1984	4	446	1240	1500	437	194	74	19	15	11	17	3957
1985	-	407	1445	991	630	128	78	32	4	11	11	3737
1986	-	84	2164	813	250	177	39	24	20	4	8	3583
1987	2	216	595	1109	277	66	51	9	8	8	3	2344
1988	-	160	1443	953	406	43	9	17	1	2	1	3035
1989	-	337	1583	1454	449	81	35	6	3	5	7	3960
1990	-	205	3425	2064	430	157	27	30	10	15	17	6380
1991	-	344	934	4161	851	143	41	30	6	1	1	6512
1992	-	313	530	484	2018	202	62	7	12	3	-	3631
1993	-	76	1487	641	129	457	28	6	2	-	-	2825
1994	-	29	1016	1135	288	72	54	17	13	1	1	2626
1995	-	218	880	1153	194	12	8	22	3	1	-	2491
1996	-	65	584	1738	347	45	5	2	3	-	-	2789
1997	-	53	438	435	832	68	4	1	1	1	1	1834
1998	-	94	390	542	165	193	8	1	1	1	-	1395
1999	-	-	178	192	90	27	28	6	2	-	-	523
2000	-	93	251	514	126	67	10	4	2	-	-	1067
2001	-	41	485	332	224	65	39	7	9	1	1	1203
2002	-	1	150	491	190	129	51	14	5	4	1	1036
2003	-	6	51	217	434	137	61	23	10	5	4	947
2004	-	1	146	135	229	179	54	28	15	8	2	795
Commercial Landings at Age in Numbers (000's)												
1982	24	1595	2717	3160	3019	461	813	608	531	41	613	13582
1983	-	1009	3913	2619	2410	2518	271	643	227	102	269	13981
1984	3	516	2071	4080	1607	1145	603	186	193	152	250	10816
1985	-	513	2523	2816	2814	705	615	363	51	141	152	10693
1986	-	110	3976	2375	1153	1072	296	243	253	54	132	9664
1987	2	283	1001	3641	1340	451	455	88	116	110	40	7527
1988	-	203	2715	2311	2097	295	85	191	11	36	14	7958
1989	-	420	2811	4351	1737	325	323	67	43	87	163	10397
1990	-	219	5794	4687	1834	1200	290	354	153	214	350	15095
1991	-	388	1463	10455	3520	1045	399	369	93	32	17	17781
1992	-	480	1019	1313	6175	1011	594	88	161	49	-	10891
1993	-	99	2809	1611	561	2819	281	79	27	-	-	8286
1994	-	43	1975	3576	991	442	451	218	156	20	6	7877
1995	-	361	1689	3200	997	96	92	291	45	27	-	6798
1996	-	110	1247	4131	1267	333	49	18	39	-	-	7194
1997	-	92	977	1308	2658	316	36	15	7	10	2	5421
1998	-	120	816	1614	693	812	67	13	12	13	-	4157
1999	-	-	315	520	361	155	203	54	28	-	-	1636
2000	-	137	625	1885	578	390	68	31	17	-	-	3730
2001	-	79	1222	1131	1112	430	295	59	86	10	7	4423
2002	-	2	368	1654	788	776	353	117	45	46	5	4096
2003	-	11	122	688	1824	733	439	195	103	60	51	4028
2004	-	1	375	490	959	1025	392	254	171	99	31	3798

Table 8b. Mean weight (kg) and mean length (cm) at age of commercial landings of Atlantic cod from the Gulf of Maine stock (NAFO Division 5Y), 1982 - 2004.

Year	Age											Average
	1	2	3	4	5	6	7	8	9	10	11+	
	Commercial Landings Mean Weight (kg) at Age											
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	-	1.450	1.943	3.151	3.444	6.132	8.321	12.628	12.052	21.532	19.369	3.000
1995	-	1.652	1.921	2.775	5.142	8.290	10.755	12.914	16.433	21.504	-	2.728
1996	-	1.687	2.136	2.376	3.648	7.376	10.440	11.928	13.471	-	-	2.580
1997	-	1.733	2.233	3.007	3.193	4.649	8.543	13.439	14.787	16.075	21.356	2.958
1998	-	1.277	2.089	2.979	4.191	4.211	8.538	11.747	19.369	20.847	-	2.980
1999	-	-	1.774	2.704	4.020	5.727	7.254	9.231	12.542	-	-	3.128
2000	-	1.479	2.491	3.664	4.589	5.795	6.748	7.833	10.297	-	-	3.496
2001	-	1.914	2.521	3.405	4.964	6.599	7.593	8.450	9.089	12.651	23.960	3.676
2002	-	1.371	2.459	3.367	4.153	6.002	6.896	8.663	9.712	10.074	13.877	3.955
2003	-	1.947	2.406	3.165	4.207	5.362	7.225	8.397	10.148	11.473	12.973	4.252
2004	-	1.529	2.576	3.628	4.182	5.741	7.257	9.239	11.583	12.631	16.410	4.778
	Commercial Landings Mean Length (cm) at Age											
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	97.7	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	-	52.4	57.2	66.6	68.1	82.7	92.0	106.4	104.9	127.3	123.0	64.4
1995	-	54.4	56.9	63.4	78.6	92.5	101.1	107.2	116.1	127.2	-	62.3
1996	-	54.6	58.8	60.7	69.3	88.9	99.9	104.8	108.7	-	-	61.8
1997	-	55.0	59.7	65.4	66.4	74.9	93.3	103.7	112.2	115.6	127.0	64.7
1998	-	50.1	58.4	65.1	72.9	72.7	92.9	102.2	123.0	126.0	-	64.4
1999	-	-	55.5	63.4	71.7	80.8	88.3	96.2	106.6	-	-	64.9
2000	-	52.5	61.5	70.2	75.8	82.2	86.5	91.2	100.0	-	-	68.3
2001	-	56.2	62.1	68.4	77.8	85.6	89.7	92.8	95.1	107.3	131.7	69.2
2002	-	51.6	61.5	68.3	72.8	82.8	86.6	93.6	97.3	98.1	108.9	71.1
2003	-	57.7	61.4	66.8	73.3	79.6	88.2	92.4	98.3	102.7	107.1	72.8
2004	-	53.5	62.9	70.3	73.4	81.4	88.2	95.8	103.4	106.6	115.0	75.5

Table 9a. Commercial landings at age (thousands of fish; metric tons) of Atlantic cod from the Gulf of Maine stock (NAFO Division 5Y), 1982 - 2004.
(Partial Input data for Virtual Population Analysis).

Year	Age							Total
	1	2	3	4	5	6	7+	
<u>Commercial Landings at Age in Numbers (000's)</u>								
1982	30	1380	1633	1143	633	69	230	5118
1983	-	866	2357	1058	638	422	155	5496
1984	4	446	1240	1500	437	194	136	3957
1985	-	407	1445	991	630	128	136	3737
1986	-	84	2164	813	250	177	95	3583
1987	2	216	595	1109	277	66	79	2344
1988	-	160	1443	953	406	43	30	3035
1989	-	337	1583	1454	449	81	56	3960
1990	-	205	3425	2064	430	157	99	6380
1991	-	344	934	4161	851	143	79	6512
1992	-	313	530	484	2018	202	84	3631
1993	-	76	1487	641	129	457	36	2825
1994	-	29	1016	1135	288	72	86	2626
1995	-	218	880	1153	194	12	34	2491
1996	-	65	584	1738	347	45	10	2789
1997	-	53	438	435	832	68	8	1834
1998	-	94	390	542	165	193	10	1395
1999	-	-	178	192	90	27	36	523
2000	-	93	251	514	126	67	16	1067
2001	-	41	485	332	224	65	57	1203
2002	-	1	150	491	190	129	74	1036
2003	-	6	51	217	434	137	103	947
2004	-	1	146	135	229	179	106	795
<u>Commercial Landings at Age in Weight (Tons)</u>								
1982	24	1595	2717	3160	3019	461	2606	13582
1983	-	1009	3913	2619	2410	2518	1512	13981
1984	3	516	2071	4080	1607	1145	1384	10816
1985	-	513	2523	2816	2814	705	1322	10693
1986	-	110	3976	2375	1153	1072	978	9664
1987	2	283	1001	3641	1340	451	809	7527
1988	-	203	2715	2311	2097	295	337	7958
1989	-	420	2811	4351	1737	325	683	10397
1990	-	219	5794	4687	1834	1200	1361	15095
1991	-	388	1463	10455	3520	1045	910	17781
1992	-	480	1019	1313	6175	1011	892	10891
1993	-	99	2809	1611	561	2819	387	8286
1994	-	43	1975	3576	991	442	851	7877
1995	-	361	1689	3200	997	96	455	6798
1996	-	110	1247	4131	1267	333	106	7194
1997	-	92	977	1308	2658	316	70	5421
1998	-	120	816	1614	693	812	104	4157
1999	-	-	315	520	361	155	285	1636
2000	-	137	625	1885	578	390	255	3730
2001	-	79	1222	1131	1112	430	458	4423
2002	-	2	368	1654	788	776	566	4096
2003	-	11	122	688	1824	733	848	4028
2004	-	1	375	490	959	1025	939	3798

Table 9b. Mean weight (kg) and mean length (cm) at age of commercial landings of Atlantic cod from the Gulf of Maine stock (NAFO Division 5Y), 1982 - 2004. (Partial Input data for Virtual Population Analysis)

Year	Age							Average
	1	2	3	4	5	6	7+	
<u>Commercial Landings Mean Weight (kg) at Age</u>								
1982	0.801	1.156	1.664	2.764	4.770	6.739	11.330	2.654
1983	-	1.164	1.660	2.475	3.778	5.962	9.755	2.544
1984	0.589	1.159	1.670	2.721	3.677	5.898	10.176	2.731
1985	-	1.260	1.746	2.840	4.466	5.525	9.721	2.861
1986	-	1.304	1.837	2.923	4.619	6.067	10.295	2.698
1987	1.028	1.313	1.684	3.283	4.831	6.824	10.241	3.212
1988	-	1.268	1.881	2.426	5.166	6.767	11.233	2.622
1989	-	1.247	1.776	2.993	3.864	4.872	12.200	2.626
1990	-	1.071	1.692	2.271	4.265	7.645	13.747	2.366
1991	-	1.130	1.568	2.512	4.136	7.309	11.449	2.731
1992	-	1.533	1.922	2.714	3.061	5.000	10.614	2.999
1993	-	1.293	1.889	2.513	4.353	6.174	11.063	2.933
1994	-	1.450	1.943	3.151	3.444	6.132	10.018	3.000
1995	-	1.652	1.921	2.775	5.142	8.290	12.969	2.728
1996	-	1.687	2.136	2.376	3.648	7.376	11.647	2.580
1997	-	1.733	2.233	3.007	3.193	4.649	12.479	2.958
1998	-	1.277	2.089	2.979	4.191	4.211	10.262	2.980
1999	-	-	1.774	2.704	4.020	5.727	7.901	3.128
2000	-	1.479	2.491	3.664	4.589	5.795	7.392	3.496
2001	-	1.914	2.521	3.405	4.964	6.599	8.110	3.676
2002	-	1.371	2.459	3.367	4.153	6.002	7.627	3.955
2003	-	1.947	2.406	3.165	4.207	5.362	8.212	4.252
2004	-	1.529	2.576	3.628	4.182	5.741	8.855	4.778
<u>Commercial Landings Mean Length (cm) at Age</u>								
1982	43.2	48.3	53.8	63.4	76.8	86.1	101.6	59.9
1983	-	48.6	53.8	61.4	70.8	82.4	95.1	59.8
1984	39.0	48.4	54.1	63.4	69.7	81.8	98.0	61.6
1985	-	49.8	55.1	64.6	74.9	80.3	96.7	62.8
1986	-	50.3	55.9	65.0	75.4	82.6	98.4	61.6
1987	47.0	50.4	54.4	67.8	76.9	86.5	98.4	65.4
1988	-	50.1	56.4	61.1	78.7	86.4	103.1	61.4
1989	-	49.8	55.5	65.7	71.5	76.7	103.6	61.7
1990	-	47.5	54.8	60.0	73.7	90.0	108.8	59.2
1991	-	47.7	52.6	61.8	72.6	88.6	102.2	62.2
1992	-	53.1	56.6	62.9	65.6	77.0	100.4	64.3
1993	-	50.5	56.8	61.7	74.2	83.7	101.6	63.5
1994	-	52.4	57.2	66.6	68.1	82.7	97.6	64.4
1995	-	54.4	56.9	63.4	78.6	92.5	107.1	62.3
1996	-	54.6	58.8	60.7	69.3	88.9	103.5	61.8
1997	-	55.0	59.7	65.4	66.4	74.9	104.6	64.7
1998	-	50.1	58.4	65.1	72.9	72.7	97.7	64.4
1999	-	-	55.5	63.4	71.7	80.8	90.7	64.9
2000	-	52.5	61.5	70.2	75.8	82.2	89.1	68.3
2001	-	56.2	62.1	68.4	77.8	85.6	91.4	69.2
2002	-	51.6	61.5	68.3	72.8	82.8	89.4	71.1
2003	-	57.7	61.4	66.8	73.3	79.6	91.6	72.8
2004	-	53.5	62.9	70.3	73.4	81.4	93.7	75.5

Table 10. Estimated number (000's) and weight (metric tons, live) of Atlantic cod caught by marine recreational fishermen from the Gulf of Maine stock, 1979 - 2004.¹

Year	Total Cod Caught		Total Cod Retained (excluding those caught and released)				
	No. of Cod (000's)	Wt. of Cod (mt)	No. of Cod (000's)	Wt. of Cod (mt)	Sample Mean Weight (kg)	Number Measured	Percent of Total Landings
1979	2698	3466	not estimated		-----	not estimated	-----
1980	2254	6860	not estimated		-----	not estimated	-----
1981	2933	5944	2738	5549	1.595	380	30.7
1982	1833	2138	1736	2025	1.554	377	13.0
1983	1455	1388	1237	1180	1.568	882	7.8
1984	1098	1705	905	1405	1.497	596	11.5
1985	1671	1964	1471	1729	1.263	295	13.9
1986	1114	967	993	862	2.871	75	8.2
1987	2625	2317	2054	1813	1.680	320	19.4
1988	1487	2114	1300	1848	1.497	407	18.8
1989	1769	2690	1193	1814	1.824	404	14.9
1990	1725	3882	1247	2806	1.838	206	15.6
1991	1770	3635	1419	2914	1.987	370	14.1
1992	585	1154	332	655	2.725	922	5.7
1993	1564	2378	772	1174	1.799	290	12.4
1994	VTR P/C 1599	3129	VTR P/C 651	1274	1.756	477	13.9
1995	393 1486	2156	247 632	917	1.736	928	11.9
1996	278 906	2348	174 395	1025	1.920	959	12.5
1997	208 585	1245	123 166	353	2.222	458	6.1
1998	299 782	3278	119 257	1077	2.416	508	20.6
1999	226 842	2642	143 284	891	3.054	117	35.3
2000	241 1615	4562	160 555	1567	2.337	89	29.6
2001	1880	6828	778	2826	2.692	68	39.0
2002	1421	4704	409	1354	3.885	70	24.8
2003	1389	7771	468	2619	4.017	300	39.4
2004	1041	3467	372	1239	2.954	493	24.6

¹ 1981-2004 from Revised Marine Recreational Fishery Statistics Survey database expanded catch estimates.

² VTR P/C are estimates of the number of cod caught and retained derived from VTR records of Part/Charter vessels.

³ 1994-2001 catches were re-estimated using a revised port stratification scheme to better reflect sampling allocation.

Table 11a. Recreational landings at age (thousands of fish; metric tons) of Atlantic cod from the Gulf of Maine stock (NAFO Division 5Y), 1982 - 2004. (Partial input data for Virtual Population Analysis)

Year	Age							Total
	1	2	3	4	5	6	7+	
<u>Recreational Landings at Age in Numbers (000's)</u>								
1982	58	615	717	243	84	6	12	1735
1983	14	471	539	126	47	26	14	1237
1984	20	367	332	136	32	11	6	904
1985	49	582	666	131	35	5	1	1469
1986	26	124	586	116	25	20	95	992
1987	39	691	823	416	53	13	18	2053
1988	6	360	697	196	28	8	4	1299
1989	5	193	701	244	36	10	5	1194
1990	7	89	770	309	58	10	6	1249
1991	5	103	415	787	95	8	6	1419
1992	-	37	70	42	166	14	2	331
1993	1	76	511	146	11	24	3	772
1994	1	20	472	123	31	2	2	651
1995	-	69	353	195	12	2	-	632
1996	-	24	132	217	21	1	1	395
1997	-	8	60	34	61	4	-	166
1998	-	18	115	85	17	21	1	257
1999	1	16	130	65	42	13	18	284
2000	-	76	222	204	38	12	2	555
2001	-	66	416	198	75	15	9	778
2002	-	1	71	192	74	38	34	409
2003	-	5	41	132	190	52	48	468
2004	-	1	119	74	113	47	19	372
<u>Recreational Landings at Age in Weight (Tons)</u>								
1982	26	556	1018	559	373	33	132	2697
1983	6	412	751	272	158	173	168	1940
1984	9	304	480	332	103	47	78	1353
1985	18	494	899	305	115	20	5	1856
1986	11	103	970	304	99	114	1247	2848
1987	11	634	1184	1111	224	96	189	3449
1988	1	310	1049	425	107	26	26	1944
1989	3	208	1111	628	124	61	43	2178
1990	1	80	1147	727	212	66	63	2296
1991	1	119	582	1749	287	48	34	2820
1992	-	56	130	119	509	69	19	902
1993	1	73	841	292	33	108	41	1389
1994	-	27	755	269	64	8	20	1143
1995	-	105	572	375	39	4	1	1096
1996	-	37	239	424	51	3	4	757
1997	-	13	120	80	146	10	1	369
1998	-	31	247	219	55	65	5	623
1999	-	19	254	198	202	77	121	872
2000	-	116	429	549	134	60	8	1295
2001	-	113	943	575	323	88	55	2097
2002	-	1	160	603	276	206	346	1591
2003	-	11	99	379	684	267	441	1880
2004	-	1	255	197	320	174	152	1099

¹ 1981-2004 from Revised Marine Recreational Fishery Statistics Survey database expanded catch estimates.

² 1994-2004 catches were re-estimated using a revised port stratification scheme to better reflect sampling allocation.

Table 11b. Mean weight (kg) and mean length (cm) at age of recreational landings of Atlantic cod from the Gulf of Maine stock (NAFO Division 5Y), 1982 - 2004. (Partial input data for Virtual Population Analysis)

Year	Age							Average
	1	2	3	4	5	6	7+	
<u>Recreational Landings Mean Weight (kg) at Age</u>								
1982	0.452	0.904	1.420	2.297	4.417	5.542	10.872	1.554
1983	0.410	0.874	1.394	2.159	3.350	6.635	12.136	1.568
1984	0.450	0.827	1.447	2.432	3.236	4.215	11.892	1.497
1985	0.371	0.848	1.349	2.330	3.298	3.780	5.2091	1.263
1986	0.413	0.832	1.655	2.630	3.884	5.600	12.995	2.871
1987	0.269	0.918	1.439	2.672	4.252	7.134	10.283	1.680
1988	0.184	0.860	1.504	2.165	3.816	3.443	6.067	1.497
1989	0.615	1.081	1.586	2.575	3.498	6.285	7.851	1.824
1990	0.148	0.900	1.489	2.354	3.640	6.587	13.783	1.838
1991	0.171	1.156	1.403	2.223	3.013	5.696	5.696	1.987
1992	0.456	1.495	1.858	2.832	3.074	4.820	7.221	2.725
1993	0.582	0.959	1.645	2.001	3.131	4.566	11.797	1.799
1994	0.131	1.342	1.601	2.182	2.086	4.300	8.644	1.756
1995	0.482	1.523	1.620	1.924	3.120	1.798	5.833	1.736
1996	0.582	1.524	1.808	1.952	2.387	8.127	12.664	1.920
1997	-	1.733	1.992	2.381	2.388	2.806	6.365	2.222
1998	0.456	1.718	2.151	2.570	3.332	3.140	3.489	2.416
1999	0.334	1.253	1.958	3.048	4.820	6.032	6.853	3.054
2000	-	1.521	1.929	2.688	3.543	4.898	3.491	2.337
2001	-	1.716	2.266	2.912	4.308	6.000	6.288	2.692
2002	-	1.381	2.265	3.147	3.716	5.357	10.316	3.885
2003	-	2.093	2.414	2.864	3.606	5.156	9.470	4.017
2004	-	1.571	2.147	2.657	2.822	3.733	8.468	2.954
<u>Recreational Landings Mean Length (cm) at Age</u>								
1982	33.9	42.9	50.2	59.0	74.1	79.9	98.4	49.9
1983	33.5	42.9	50.1	57.9	67.1	84.5	101.2	49.9
1984	34.2	42.0	50.5	60.1	66.1	71.0	100.1	49.3
1985	32.0	42.4	49.3	60.0	67.0	70.1	78.9	47.5
1986	33.7	41.6	53.3	62.0	70.8	80.4	113.4	59.1
1987	27.8	43.4	50.5	62.5	72.3	86.0	98.6	51.3
1988	26.2	42.8	51.3	58.2	69.9	66.2	81.3	50.5
1989	38.4	46.2	52.5	61.6	67.8	83.9	97.5	54.2
1990	23.7	43.1	51.1	59.8	69.7	84.4	110.0	53.9
1991	24.9	47.0	50.4	58.5	64.5	80.0	80.9	55.8
1992	35.0	51.3	54.7	63.1	64.9	75.4	86.6	61.6
1993	38.0	44.3	53.2	56.6	64.9	72.8	103.1	53.9
1994	23.6	49.3	52.9	58.1	57.4	70.9	93.5	54.1
1995	36.0	52.1	53.1	55.9	65.5	54.6	83.0	54.0
1996	38.0	52.3	55.0	56.4	60.0	62.8	85.4	55.8
1997	-	54.5	57.0	60.1	60.0	62.8	85.4	55.8
1998	35.0	54.2	58.4	61.7	66.9	65.3	68.3	60.5
1999	33.0	47.9	56.4	65.0	75.6	81.5	85.5	63.9
2000	-	52.1	56.1	62.3	68.2	76.3	67.6	59.1
2001	-	54.1	59.2	64.0	73.6	82.6	83.8	62.2
2002	-	51.1	59.2	66.1	69.6	79.0	96.5	69.3
2003	-	58.1	60.7	64.0	68.5	76.9	95.1	70.2
2004	-	53.0	58.6	62.7	63.7	68.9	90.1	63.9

Table 12a. Total (commercial and recreational) landings at age (thousands of fish; metric tons) of Atlantic cod from the Gulf of Maine stock (NAFO Division 5Y), 1982 - 2004. (Input data for Virtual Population Analysis)

Year	Age							Total
	1	2	3	4	5	6	7+	
<u>Total Landings at Age in Numbers (000's)</u>								
1982	88	1995	2350	1386	717	75	242	6853
1983	14	1337	2896	1184	685	448	169	6733
1984	24	813	1572	1636	469	205	142	4861
1985	49	989	2111	1122	665	133	137	5206
1986	26	208	2750	929	275	197	190	4575
1987	41	907	1418	1525	330	79	97	4397
1988	6	520	2140	1149	434	51	34	4334
1989	5	530	2284	1698	485	91	61	5154
1990	7	294	4195	2373	488	167	105	7629
1991	5	447	1349	4948	946	151	85	7931
1992	-	350	600	526	2184	218	86	3962
1993	1	152	1998	787	140	481	39	3597
1994	1	49	1488	1258	319	74	88	3277
1995	-	287	1233	1348	206	14	34	3123
1996	-	89	716	1955	368	45	10	3184
1997	-	61	498	469	893	72	8	2000
1998	-	112	505	627	182	214	11	1652
1999 ¹	1	16	580	550	270	81	109	1606
2000 ²	-	194	540	856	198	97	23	1908
2001 ³	-	121	1065	643	375	102	84	2389
2002 ⁴	-	2	276	863	334	214	135	1824
2003 ⁵	-	14	111	430	786	240	189	1768
2004 ⁶	-	1	284	227	372	250	139	1272
<u>Total Landings at Age in Weight (Tons)</u>								
1982	50	2151	3735	3719	3392	494	2738	16279
1983	6	1421	4664	2891	2568	2691	1680	15921
1984	12	820	2551	4412	1710	1192	1462	12169
1985	18	1007	3442	3121	2929	725	1327	12549
1986	11	213	4946	2679	1252	1186	2225	12512
1987	13	917	2185	4752	1564	547	998	10976
1988	1	513	3764	2736	2204	321	363	9902
1989	3	628	3922	4979	1861	386	726	12575
1990	1	299	6941	5414	2046	1266	1424	17391
1991	1	507	2045	12204	3807	1093	944	20601
1992	-	536	1149	1432	6684	1080	911	11793
1993	1	172	3650	1903	594	2927	428	9675
1994	-	70	2730	3845	1055	450	871	9020
1995	-	466	2261	3575	1036	100	455	7894
1996	-	147	1486	4555	1318	336	110	7951
1997	-	105	1097	1388	2804	326	70	5790
1998	-	151	1063	1833	748	877	109	4780
1999 ¹	-	19	1052	1511	1117	468	840	5008
2000 ²	-	290	1222	2937	867	552	158	6025
2001 ³	-	218	2580	2089	1812	663	663	8019
2002 ⁴	-	3	659	2838	1348	1262	1139	7195
2003 ⁵	-	27	267	1322	3190	1275	1643	7406
2004 ⁶	-	2	681	751	1404	1337	1214	5398

1. Includes 2,500 mt of estimated discards.
 2. Includes 1,000 mt of estimated discards.
 3. Includes 1,500 mt of estimated discards.

4. Includes 1,500 mt of estimated discards.
 5. Includes 1,500 mt of estimated discards.
 6. Includes 500 mt of estimated discards.

Table 12b. Mean weight (kg) and mean length (cm) at age of total landings (commercial and recreational) of Atlantic cod from the Gulf of Maine stock (NAFO Division 5Y), 1982 - 2004. (Input data for Virtual Population Analysis)

Year	Age							Average
	1	2	3	4	5	6	7+	
<u>Total Landings Mean Weight (kg) at Age</u>								
1982	0.568	1.078	1.589	2.683	4.731	6.587	11.314	2.375
1983	0.429	1.063	1.610	2.442	3.749	6.007	9.941	2.365
1984	0.500	1.009	1.623	2.697	3.646	5.815	10.296	2.503
1985	0.367	1.018	1.621	2.782	4.405	5.451	9.686	2.410
1986	0.423	1.024	1.799	2.884	4.553	6.020	11.711	2.735
1987	0.317	1.011	1.541	3.116	4.739	6.924	10.289	2.496
1988	0.167	0.987	1.759	2.381	5.078	6.294	10.676	2.285
1989	0.600	1.185	1.717	2.932	3.837	4.242	11.902	2.440
1990	0.143	1.017	1.655	2.282	4.193	7.581	13.562	2.280
1991	0.171	1.134	1.516	2.466	4.024	7.238	11.106	2.598
1992	0.390	1.531	1.915	2.722	3.060	5.000	10.593	2.977
1993	0.390	1.132	1.627	2.418	4.243	6.085	10.974	2.690
1994	0.390	1.429	1.835	3.056	3.307	6.081	9.898	2.753
1995	0.390	1.624	1.834	2.652	5.029	7.143	13.687	2.528
1996	0.390	1.662	2.075	2.330	3.582	7.412	10.657	2.497
1997	0.390	1.736	2.203	2.959	3.140	4.553	8.738	2.895
1998	0.625	1.348	2.105	2.923	4.110	4.098	9.528	2.893
1999	0.346	1.188	1.814	2.744	4.143	5.758	7.706	3.118
2000	0.390	1.498	2.261	3.432	4.385	5.691	6.994	3.158
2001	0.390	1.804	2.422	3.251	4.833	6.496	7.891	3.357
2002	0.390	1.360	2.389	3.289	4.041	5.888	8.427	3.944
2003	0.390	1.968	2.409	3.075	4.060	5.313	8.676	4.190
2004	0.390	1.525	2.395	3.313	3.772	5.357	8.738	4.245
<u>Total Landings Mean Length (cm) at Age</u>								
1982	37.1	46.6	52.7	62.6	76.5	85.6	101.4	57.4
1983	33.5	46.6	53.1	61.0	70.5	82.5	95.6	58.0
1984	28.5	45.5	53.3	63.1	69.5	81.2	98.1	59.3
1985	32.0	45.4	53.3	64.1	74.5	79.9	96.6	58.5
1986	33.7	45.1	55.3	64.6	75.0	82.4	105.9	61.1
1987	26.4	45.1	52.1	66.4	76.2	86.4	98.4	58.8
1988	26.2	45.0	54.7	60.6	78.1	83.2	100.5	58.1
1989	38.4	48.5	54.6	65.1	71.2	77.5	103.1	60.0
1990	23.7	46.2	54.1	60.0	73.2	89.7	108.9	58.3
1991	24.9	47.5	51.9	61.3	71.8	88.1	100.7	61.1
1992	31.3	52.9	56.4	62.9	65.5	76.9	100.1	64.1
1993	38.0	47.4	55.9	60.8	73.5	83.2	101.7	61.4
1994	30.8	53.3	57.1	66.0	67.3	82.2	97.3	63.3
1995	30.8	54.4	57.3	63.2	77.9	88.6	107.0	61.9
1996	30.8	52.8	58.4	61.2	69.7	88.8	103.0	62.1
1997	30.8	54.6	59.3	65.2	66.5	75.0	104.5	64.2
1998	30.8	50.7	58.6	65.0	73.0	73.7	96.0	64.1
1999	30.8	51.1	56.3	63.7	71.4	80.5	91.7	65.7
2000	30.8	52.3	59.3	68.3	74.3	81.5	86.9	65.6
2001	30.8	55.1	61.0	67.0	77.0	85.2	90.6	66.9
2002	30.8	51.4	60.8	67.7	72.0	82.1	91.2	70.7
2003	30.8	57.9	61.1	65.9	72.1	79.0	92.5	72.1
2004	30.8	53.4	61.1	67.8	70.5	79.0	93.2	72.1

Table 13. Mean weight at age (kg) at the beginning of the year (January 1) for Atlantic cod from the Gulf of Maine stock (NAFO Division 5Y), 1982 - 2004. Values derived from commercial landings mean weight-at-age data (mid-year) using procedures described by Rivard (1980).

	Age										
	1	2	3	4	5	6	7	8	9	10	11+
1982	0.665	0.965	1.364	2.364	4.267	7.259	8.246	9.853	14.071	11.714	18.456
1983	0.672	0.966	1.385	2.029	3.232	5.333	6.256	9.701	10.010	11.867	17.813
1984	0.403	0.967	1.394	2.125	3.017	4.720	6.957	7.465	11.646	11.864	15.028
1985	0.634	0.862	1.423	2.178	3.486	4.507	6.826	9.544	10.468	13.135	14.523
1986	0.632	1.025	1.521	2.259	3.622	5.205	6.509	8.902	11.824	12.141	16.554
1987	0.926	1.029	1.482	2.456	3.758	5.614	7.339	8.767	11.745	13.553	14.596
1988	0.648	1.142	1.572	2.021	4.118	5.718	8.233	9.939	12.245	14.723	20.356
1989	0.699	1.003	1.501	2.373	3.062	5.017	7.919	10.889	12.835	16.499	21.521
1990	0.681	0.929	1.453	2.008	3.573	5.435	7.232	10.439	13.388	14.795	20.295
1991	0.584	0.954	1.296	2.062	3.065	5.583	8.586	11.501	13.520	19.112	21.885
1992	0.636	1.112	1.474	2.063	2.773	4.548	8.362	10.962	12.873	16.080	18.170
1993	0.601	1.021	1.702	2.198	3.438	4.347	7.071	11.518	14.786	14.469	18.170
1994	0.563	1.081	1.585	2.440	2.942	5.168	7.168	11.237	12.929	19.436	19.369
1995	0.557	1.154	1.669	2.322	4.025	5.343	8.121	10.366	14.405	16.099	18.170
1996	0.550	1.166	1.879	2.136	3.182	6.159	9.303	11.326	13.190	15.994	18.170
1997	0.640	1.182	1.941	2.534	2.754	4.118	7.938	11.845	13.281	14.716	21.356
1998	0.611	1.015	1.903	2.579	3.550	3.667	6.300	10.018	16.134	17.558	18.170
1999	0.595	1.063	1.505	2.377	3.461	4.899	5.527	8.878	12.138	17.364	18.170
2000	0.523	1.092	1.868	2.550	3.523	4.827	6.217	7.538	9.749	13.973	18.170
2001	0.618	1.242	1.931	2.912	4.265	5.503	6.633	7.551	8.438	11.414	23.960
2002	0.519	1.051	2.170	2.914	3.760	5.458	6.746	8.110	9.059	9.569	13.877
2003	0.585	1.253	1.816	2.790	3.764	4.719	6.585	7.610	9.376	10.556	12.973
2004	0.585	1.110	2.240	2.955	3.638	4.915	6.238	8.170	9.862	11.322	16.410
2005	0.563	1.138	2.075	2.886	3.721	5.031	6.523	7.963	9.433	10.482	14.420
Avg 1982-2004	0.614	1.048	1.592	2.299	3.456	5.149	7.337	9.912	12.484	14.825	18.645
Avg 2000-2004	0.566	1.121	1.907	2.417	3.162	4.648	7.847	11.063	14.201	16.089	19.232

Table 14. Mean weight at age (kg) at the beginning of the year (January 1) for Atlantic cod from the Gulf of Maine stock (NAFO Division 5Y), 1982 - 2004. Values derived from total (commercial and recreational landings mean weight-at-age data (mid-year) using procedures described by Rivard (1980).

	Age						
	1	2	3	4	5	6	7+
1982	0.4152	0.8821	1.2818	2.2697	4.1986	5.5824	11.314
1983	0.2797	0.777	1.3174	1.9699	3.1715	5.331	9.941
1984	0.3504	0.6579	1.3135	2.0838	2.9839	4.6691	10.296
1985	0.2197	0.7134	1.2789	2.1249	3.4468	4.4581	9.686
1986	0.2736	0.613	1.3533	2.1622	3.559	5.1496	11.711
1987	0.1797	0.654	1.2562	2.3676	3.6969	5.6147	10.289
1988	0.0627	0.5594	1.3335	1.9155	3.9778	5.4614	10.676
1989	0.4609	0.4449	1.3018	2.271	3.0226	4.6412	11.902
1990	0.0508	0.7812	1.4004	1.9794	3.5063	5.3934	13.562
1991	0.0723	0.4027	1.2417	2.0202	3.0303	5.509	11.106
1992	0.2293	0.5534	1.4736	2.0314	2.747	4.4855	10.593
1993	0.2041	0.6648	1.6725	2.1519	3.3984	4.3151	10.974
1994	0.1914	0.7469	1.4413	2.3629	2.8278	5.0795	9.898
1995	0.1898	0.7962	1.6189	2.206	3.9203	4.8602	13.367
1996	0.1851	0.8031	1.8357	2.0672	3.0821	6.1053	10.657
1997	0.2101	0.8232	1.9077	2.4779	2.7048	4.0384	8.738
1998	0.4533	0.7254	1.9116	2.5376	3.4873	3.5872	9.528
1999	0.1663	0.8617	1.5637	2.4034	3.4799	4.8647	7.706
2000	0.1816	0.7199	1.6389	2.4951	3.4688	4.8557	6.994
2001	0.2092	0.8392	1.9048	2.7112	4.0727	5.3371	7.891
2002	0.1739	0.7287	2.0834	2.8344	3.6326	5.3386	8.412
2003	0.1975	0.8765	1.81	2.72	3.6697	4.6439	8.678
2004	0.1975	0.7716	2.176	2.8349	3.4197	4.678	8.749
2005	0.1896	0.7923	2.0231	2.7964	3.574	4.8868	8.613
Avg 1982-2004	0.224	0.713	1.570	2.304	3.413	4.956	10.116
Avg 2000-2004	0.192	0.787	1.923	2.719	3.653	4.971	8.145

Table 15. Standardized stratified mean catch per tow in numbers and weight (kg) for Atlantic cod from NEFSC offshore spring and autumn research vessel bottom trawl surveys in the Gulf of Maine NEFSC strata 01260-01300 and 01360-01400), 1963 - 2005 [a,b,c].

Year	Spring		Autumn	
	no/tow (kg)	wt/tow (kg)	no/tow (kg)	wt/tow (kg)
1963	No Survey Conducted		5.914	17.95
1964	No Survey Conducted		4.015	22.799
1965	No Survey Conducted		4.5	12.005
1966	No Survey Conducted		3.784	12.916
1967	No Survey Conducted		2.56	9.225
1968	5.583	18.195	4.374	19.437
1969	3.247	13.194	2.758	15.368
1970	2.191	11.077	4.905	16.442
1971	1.429	6.996	4.361	16.527
1972	2.057	8.029	9.301	12.988
1973	7.525	18.807	4.452	8.758
1974	2.902	7.418	4.328	8.959
1975	2.512	6.039	6.143	8.619
1976	2.782	7.556	2.148	6.74
1977	3.872	8.541	3.073	10.199
1978	2.05	7.697	5.773	12.899
1979	3.993	8.363	3.142	13.927
1980	2.154	6.232	7.034	14.202
1981	4.831	10.65	2.349	7.533
1982	3.763	8.616	7.768	15.919
1983	3.912	10.962	2.786	8.416
1984	3.667	6.143	2.449	8.735
1985	2.517	7.645	2.821	8.264
1986	1.957	3.476	1.95	4.715
1987	1.083	1.976	2.996	3.394
1988	3.127	3.603	5.903	6.616
1989	2.112	2.424	4.553	4.535
1990	2.362	3.076	2.986	4.912
1991	2.393	2.891	1.252	2.781
1992	2.435	8.626	1.433	2.448
1993	2.507	5.875	1.232	1.002
1994	1.271	2.427	2.13	2.737
1995	1.93	2.431	2.008	3.665
1996	2.465	5.427	1.327	2.351
1997	2.192	5.615	0.872	1.872
1998	1.71	4.18	0.843	1.5
1999	2.301	5.089	1.807	3.505
2000	3.083	3.211	2.604	4.652
2001	2.147	6.216	1.98	7.325
2002	3.724	10.933	5.328	24.659
2003	3.677	9.495	2.529	5.993
2004	0.981	2.414	3.53	4.90
2005	1.765	2.703		

- [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 16. Comparative Results from ADAPT/VPA runs incorporating data and software updates since the 2002 GARM.

Terminal Year	GARM/FACT		GARM/NFT		NewAges/NFT ¹		Rev. MRFSS/NFT ¹		Rev. Indices/NFT All Rev/NFT ¹	
	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001
RSS	139.865	140.169	139.992	140.117	139.346	139.219				
N t+1 age 2 (cv)	463 (0.40)	463 (0.38)	463 (0.38)	466 (0.38)	523 (0.33)	526 (0.33)				
N t+1 age 3 (cv)	3009 (0.26)	3007 (0.25)	3002 (0.25)	2990 (0.26)	3022 (0.25)	3004 (0.26)				
N t+1 age 4 (cv)	4554 (0.25)	4551 (0.24)	4533 (0.24)	4531 (0.24)	4704 (0.24)	4685 (0.24)				
N t+1 age 5 (cv)	1362 (0.28)	1211 (0.27)	1207 (0.27)	1221 (0.27)	1257 (0.26)	1267 (0.26)				
N t+1 age 6 (cv)	437 (0.36)	492 (0.35)	492 (0.35)	496 (0.35)	506 (0.34)	510 (0.34)				
F age 1	0.00	0.0000	0.0000	0.0000	0.0000	0.0000				
F age 2	0.02	0.0167	0.0179	0.0348	0.0178	0.0358				
F age 3	0.18	0.1814	0.1811	0.1937	0.1752	0.1872				
F age 4	0.37	0.4039	0.4039	0.3906	0.3906	0.3779				
F age 5	0.57	0.5190	0.5227	0.5180	0.5109	0.5100				
F age 6	0.47	0.4614	0.4663	0.4543	0.4507	0.4439				
F (ages 4-5)	0.47	0.46	0.46	0.45	0.45	0.44				
SSB (mt)	22,040	21,937	24,328	24,228	25,003	24,801				

1. Revised mean weights at age in 2000 and 2001

Table 17 Estimation Results from the Final Formulation of the
Gulf of Maine cod VPA ADAPT Calibration

JAN-1 Population Numbers					
AGE	1982	1983	1984	1985	1986
1	7769.	7539.	10464.	7004.	10162.
2	10891.	6281.	6160.	8545.	5690.
3	5359.	7112.	3933.	4307.	6101.
4	3026.	2262.	3202.	1797.	1616.
5	1796.	1223.	780.	1142.	456.
6	170.	822.	382.	214.	333.
7	548.	310.	264.	221.	321.
Total	29559.	25548.	25185.	23231.	24680.
AGE	1987	1988	1989	1990	1991
1	12538.	25205.	4301.	4031.	7056.
2	8296.	10228.	20630.	3517.	3294.
3	4471.	5972.	7904.	16411.	2613.
4	2507.	2377.	2953.	4404.	9640.
5	483.	673.	907.	881.	1459.
6	125.	97.	158.	303.	280.
7	153.	64.	106.	191.	158.
Total	28573.	44616.	36958.	29738.	24500.
AGE	1992	1993	1994	1995	1996
1	6657.	9624.	3515.	3686.	3504.
2	5773.	5451.	7878.	2877.	3018.
3	2292.	4410.	4325.	6406.	2096.
4	919.	1334.	1802.	2195.	4129.
5	3416.	276.	380.	337.	577.
6	338.	820.	100.	22.	90.
7	135.	67.	119.	54.	20.
Total	19530.	21981.	18119.	15578.	13433.
AGE	1997	1998	1999	2000	2001
1	5906.	5096.	7785.	4404.	1030.
2	2868.	4836.	4172.	6373.	3606.
3	2390.	2293.	3858.	3401.	5042.
4	1068.	1506.	1421.	2634.	2296.
5	1612.	450.	666.	665.	1382.
6	140.	511.	204.	301.	366.
7	16.	26.	274.	71.	301.
Total	14000.	14719.	18380.	17850.	14022.
AGE	2002	2003	2004	2005	
1	7042.	3063.	22048.	6306.	
2	843.	5766.	2508.	18051.	
3	2843.	688.	4708.	2052.	
4	3165.	2078.	463.	3597.	
5	1298.	1810.	1312.	174.	
6	792.	761.	771.	737.	
7	500.	599.	346.	513.	
Total	16482.	14764.	32155.	31431.	

Table 17 (Continued)

Fishing Mortality Calculated

AGE	1982	1983	1984	1985	1986
1	0.0126	0.0021	0.0025	0.0078	0.0028
2	0.2262	0.2682	0.1577	0.1369	0.0412
3	0.6628	0.5979	0.5830	0.7801	0.6894
4	0.7057	0.8642	0.8315	1.1709	1.0083
5	0.5819	0.9646	1.0915	1.0322	1.0968
6	0.6578	0.8983	0.8774	1.1147	1.0271
7	0.6578	0.8983	0.8774	1.1147	1.0271
AGE	1987	1988	1989	1990	1991
1	0.0036	0.0003	0.0013	0.0019	0.0008
2	0.1288	0.0578	0.0288	0.0969	0.1625
3	0.4316	0.5043	0.3847	0.3320	0.8451
4	1.1156	0.7639	1.0093	0.9050	0.8376
5	1.4077	1.2483	0.8945	0.9471	1.2611
6	1.1573	0.8524	0.9812	0.9119	0.8840
7	1.1573	0.8524	0.9812	0.9119	0.8840
AGE	1992	1993	1994	1995	1996
1	0.0000	0.0001	0.0003	0.0000	0.0000
2	0.0694	0.0313	0.0069	0.1168	0.0331
3	0.3415	0.6947	0.4784	0.2392	0.4741
4	1.0012	1.0559	1.4756	1.1357	0.7408
5	1.2263	0.8202	2.6326	1.1232	1.2198
6	1.1742	1.0113	1.6027	1.1341	0.7886
7	1.1742	1.0113	1.6027	1.1341	0.7886
AGE	1997	1998	1999	2000	2001
1	0.0000	0.0000	0.0001	0.0000	0.0000
2	0.0238	0.0259	0.0042	0.0342	0.0378
3	0.2617	0.2789	0.1817	0.1929	0.2658
4	0.6641	0.6162	0.5584	0.4451	0.3703
5	0.9477	0.5922	0.5943	0.3987	0.3566
6	0.8249	0.6106	0.5697	0.4355	0.3651
7	0.8249	0.6106	0.5697	0.4355	0.3651
AGE	2002	2003	2004		
1	0.0000	0.0000	0.0000		
2	0.0026	0.0027	0.0004		
3	0.1135	0.1963	0.0690		
4	0.3587	0.2597	0.7801		
5	0.3346	0.6537	0.3760		
6	0.3516	0.4242	0.5781		
7	0.3516	0.4242	0.5781		

Table 17 (Continued)

JAN-1 Biomass

AGE	1982	1983	1984	1985	1986
1	3226.	2109.	3666.	1539.	2780.
2	9607.	4880.	4052.	6096.	3488.
3	6870.	9369.	5165.	5509.	8257.
4	6868.	4455.	6673.	3819.	3495.
5	7541.	3880.	2328.	3935.	1624.
6	948.	4381.	1782.	956.	1715.
7	6200.	3082.	2722.	2140.	3761.
Total	41259.	32155.	26390.	23994.	25120.
AGE	1987	1988	1989	1990	1991
1	2253.	1580.	1982.	205.	510.
2	5426.	5722.	9178.	2747.	1326.
3	5616.	7963.	10289.	22982.	3245.
4	5936.	4554.	6706.	8718.	19476.
5	1785.	2676.	2740.	3089.	4421.
6	700.	528.	734.	1637.	1541.
7	1576.	688.	1261.	2587.	1749.
Total	23292.	23711.	32891.	41966.	32269.
AGE	1992	1993	1994	1995	1996
1	1527.	1964.	673.	700.	649.
2	3195.	3624.	5884.	2291.	2424.
3	3378.	7375.	6234.	10371.	3847.
4	1867.	2870.	4259.	4841.	8536.
5	9383.	940.	1074.	1323.	1779.
6	1518.	3540.	506.	109.	549.
7	1427.	730.	1173.	726.	213.
Total	22294.	21043.	19803.	20360.	17995.
AGE	1997	1998	1999	2000	2001
1	1241.	2310.	1295.	800.	215.
2	2361.	3508.	3595.	4588.	3026.
3	4560.	4384.	6032.	5575.	9604.
4	2647.	3822.	3414.	6571.	6226.
5	4359.	1570.	2317.	2308.	5627.
6	563.	1835.	992.	1461.	1952.
7	135.	251.	2114.	499.	2376.
Total	15867.	17679.	19759.	21802.	29026.
AGE	2002	2003	2004	2005	
1	1225.	605.	4354.	1196.	
2	614.	5054.	1935.	14302.	
3	5922.	1246.	10221.	4148.	
4	8970.	5651.	1308.	10048.	
5	4716.	6642.	4468.	620.	
6	4228.	3532.	3595.	3600.	
7	4202.	5198.	3023.	4416.	
Total	29876.	27928.	28904.	38331.	

Table 17 (Continued)

Spawning Stock Biomass

AGE	1982	1983	1984	1985	1986
1	218.	143.	248.	59.	108.
2	2327.	1174.	993.	2766.	1608.
3	3629.	5004.	2765.	4444.	6763.
4	5197.	3283.	4945.	3039.	2858.
5	6421.	3099.	1821.	3204.	1308.
6	822.	3648.	1489.	768.	1397.
7	5374.	2566.	2275.	1719.	3065.
Total	23987.	18916.	14536.	16000.	17107.
AGE	1987	1988	1989	1990	1991
1	87.	61.	77.	22.	54.
2	2465.	2631.	4241.	732.	350.
3	4802.	6727.	8867.	11778.	1527.
4	4767.	3878.	5481.	5874.	13270.
5	1365.	2102.	2283.	2373.	3223.
6	559.	443.	602.	1333.	1261.
7	1257.	578.	1036.	2150.	1460.
Total	15302.	16419.	22587.	24261.	21144.
AGE	1992	1993	1994	1995	1996
1	162.	209.	26.	27.	25.
2	855.	976.	2160.	826.	886.
3	1728.	3558.	4955.	8578.	3060.
4	1238.	1886.	3189.	3836.	7224.
5	6880.	737.	670.	1061.	1404.
6	1183.	2835.	375.	87.	465.
7	1135.	597.	869.	581.	180.
Total	13182.	10797.	12243.	14996.	13244.
AGE	1997	1998	1999	2000	2001
1	48.	89.	50.	31.	8.
2	864.	1284.	1320.	1677.	1105.
3	3758.	3602.	5038.	4647.	7909.
4	2269.	3303.	2979.	5842.	5604.
5	3600.	1376.	2030.	2089.	5128.
6	475.	1603.	872.	1314.	1776.
7	114.	219.	1859.	449.	2163.
Total	11128.	11475.	14149.	16049.	23694.
AGE	2002	2003	2004		
1	47.	23.	168.		
2	226.	1857.	711.		
3	5002.	1038.	8697.		
4	8090.	5182.	1100.		
5	4314.	5761.	4059.		
6	3856.	3183.	3157.		
7	3833.	4685.	2656.		
Total	25369.	21729.	20549.		

Gulf of Maine Cod
Total Commercial Landings

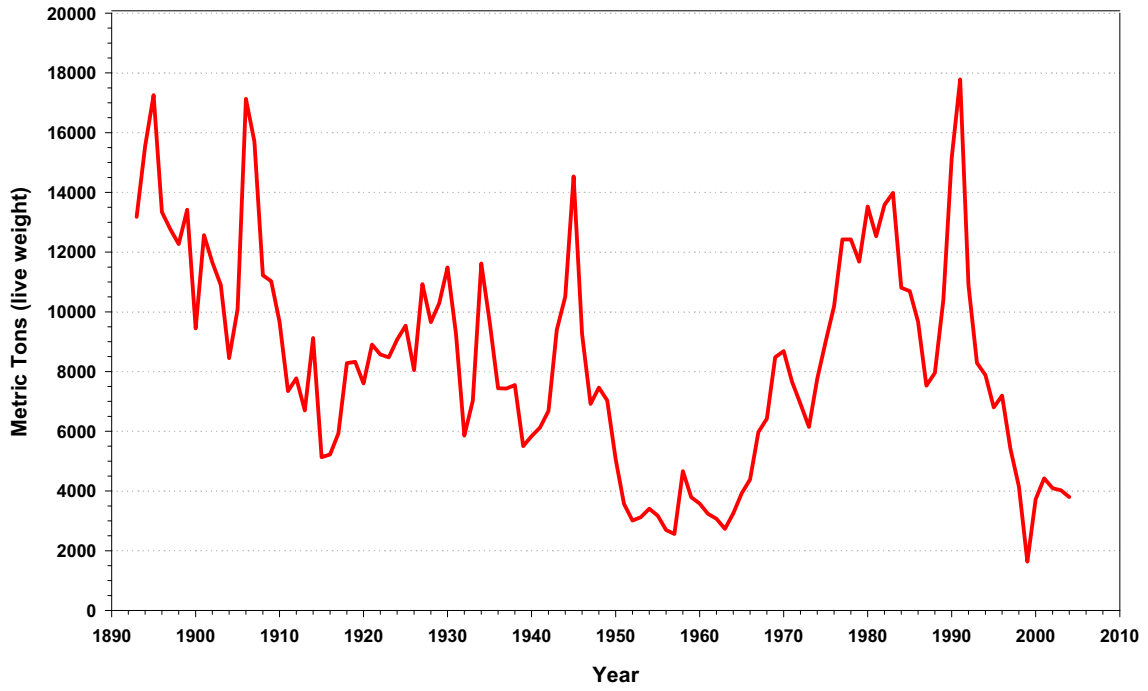


Figure 1. Total commercial landings of Gulf of Maine cod (NAFO Div. 5Y), 1893-2004.

Commercial Landings Mean Weights (kg) at Age

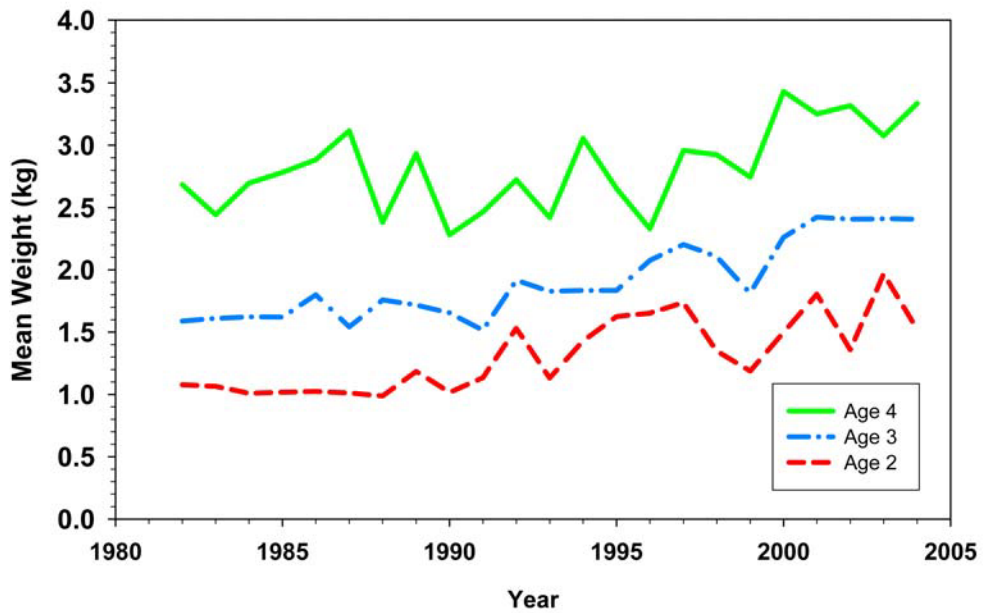
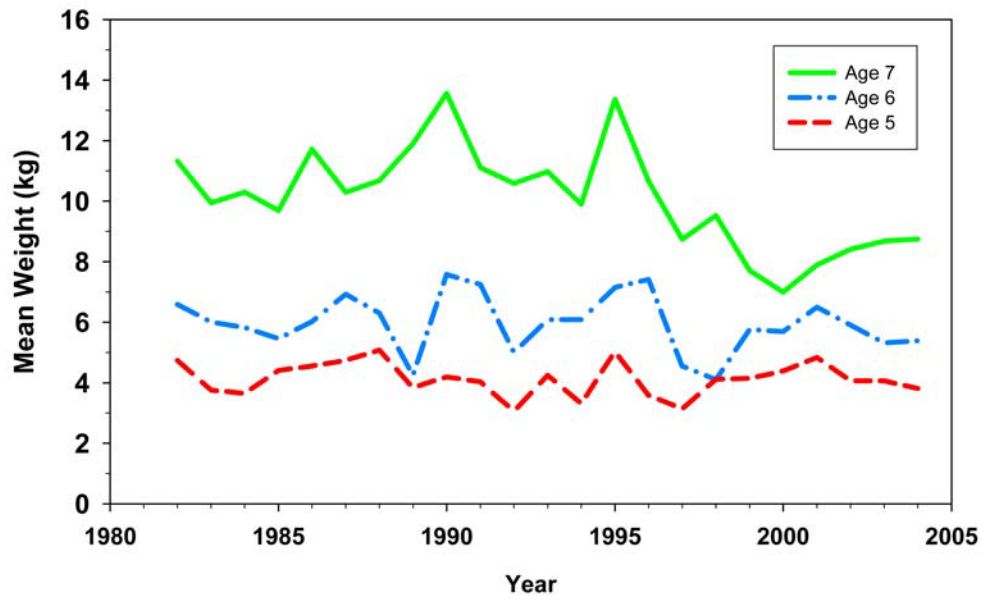


Figure 2. Commercial landings mean weights (kg) at age for Gulf of Maine cod, 1982-2004

Gulf of Maine Cod NEFSC Spring and Autumn Biomass Indices

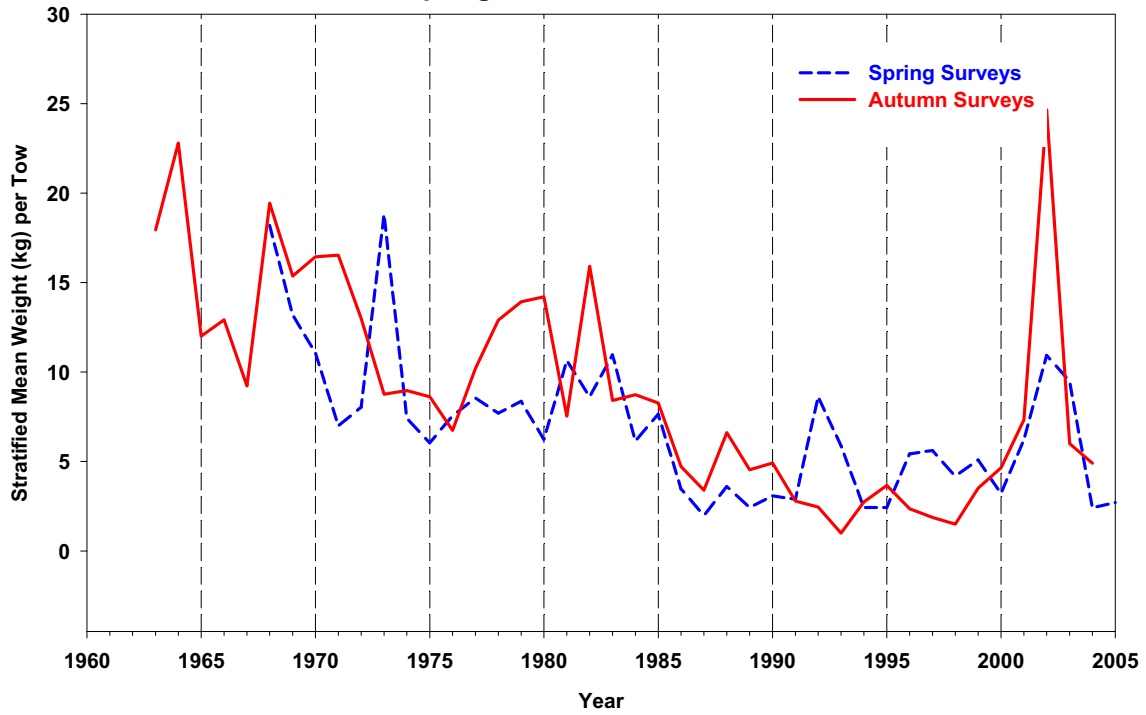
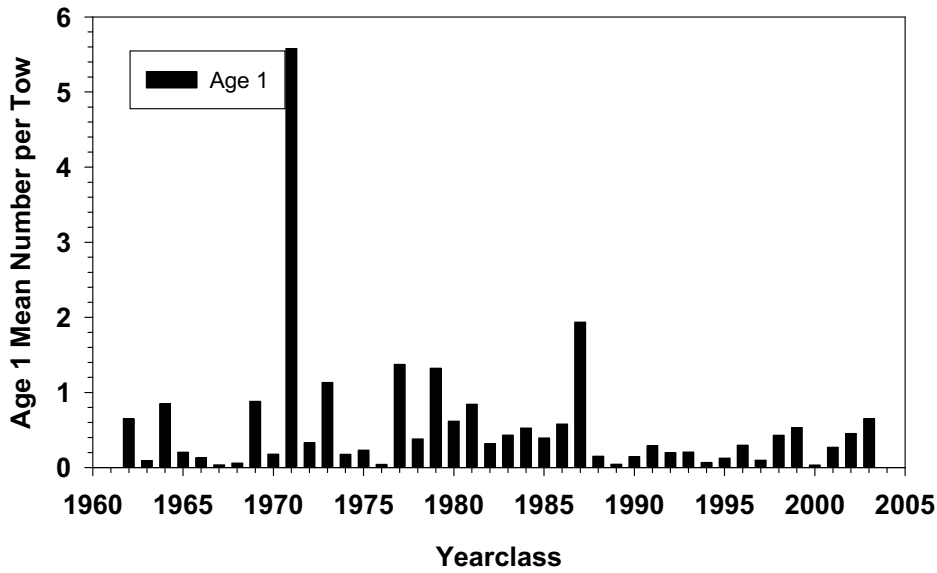


Figure 3. Biomass indices (stratified mean weight per tow) for Gulf of Maine cod from NEFSC autumn bottom trawl surveys.

NEFSC Autumn Survey: Yearclass Strength at Age 1



NEFSC Autumn Survey: Yearclass Strength at Age 2

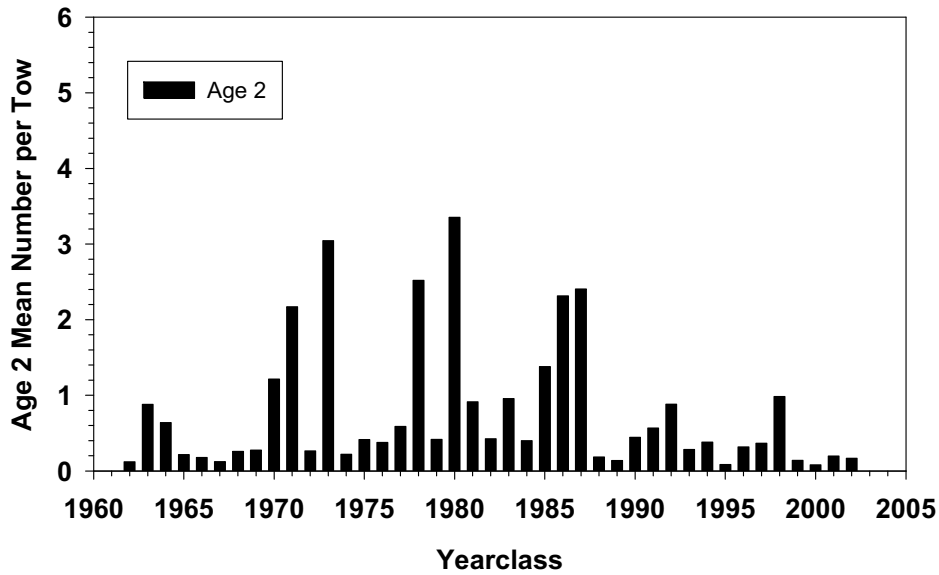
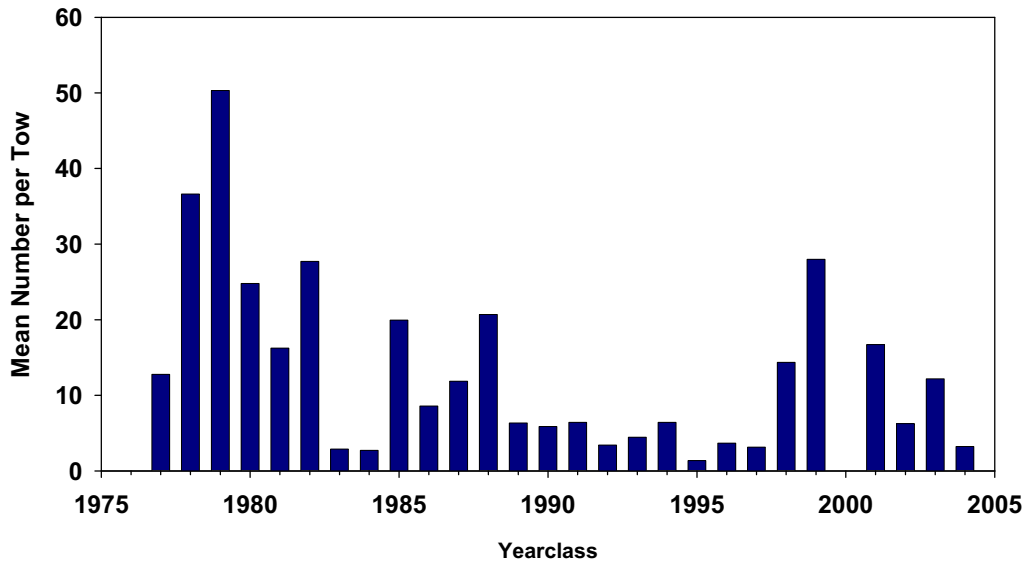


Figure 4. Recruitment indices at age 1 and 2 for Gulf of Maine cod from NEFSC autumn bottom trawl surveys.

Mass Spring Survey: Yearclass Strength at Age 1



Mass Spring Survey: Yearclass Strength at Age 2

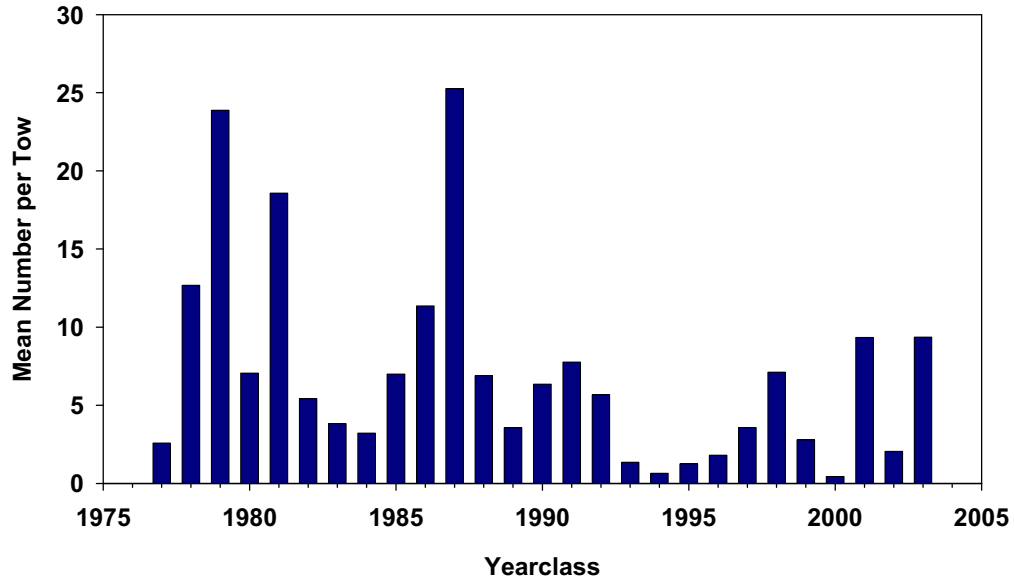
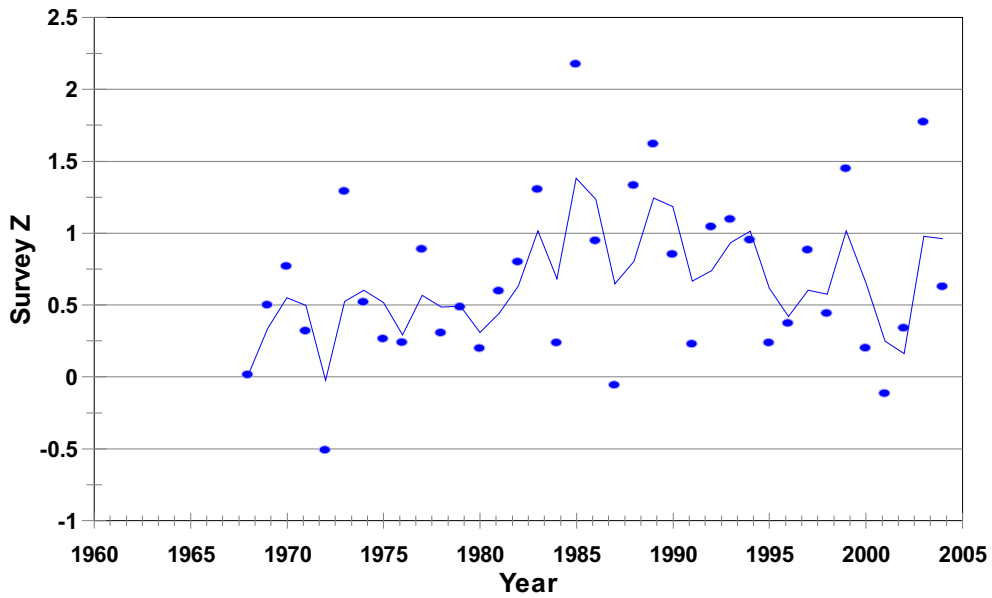


Figure 5. Recruitment indices at age 1 and 2 for Gulf of Maine cod from MA DMF autumn bottom trawl surveys.

Gulf of Maine Cod Surveys Zs - Spring



Gulf of Maine Cod Surveys Zs - Autumn

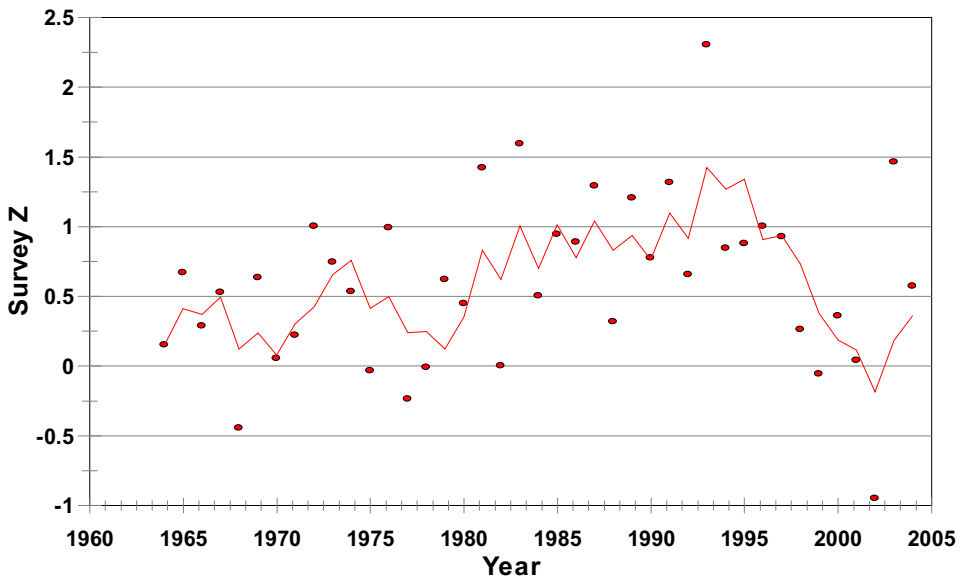


Figure 6. Estimates of total instantaneous mortality (Z) for Gulf of Maine cod based on NEFSC spring (ages 5+/4+) and autumn (ages 4+/3+) stratified mean number per tow at age.

Gulf of Maine Cod Calculated VPA Residuals

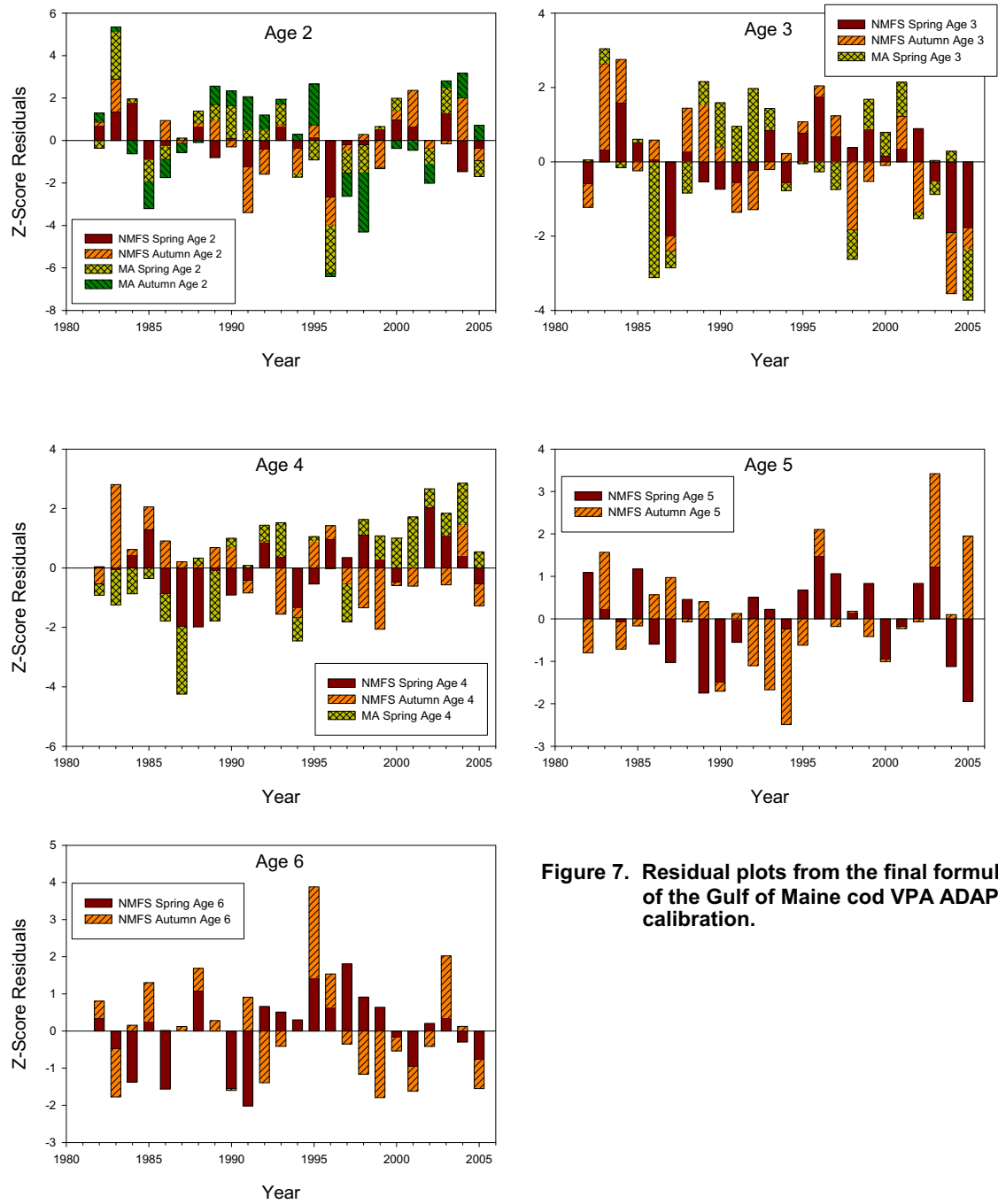


Figure 7. Residual plots from the final formulation of the Gulf of Maine cod VPA ADAPT calibration.

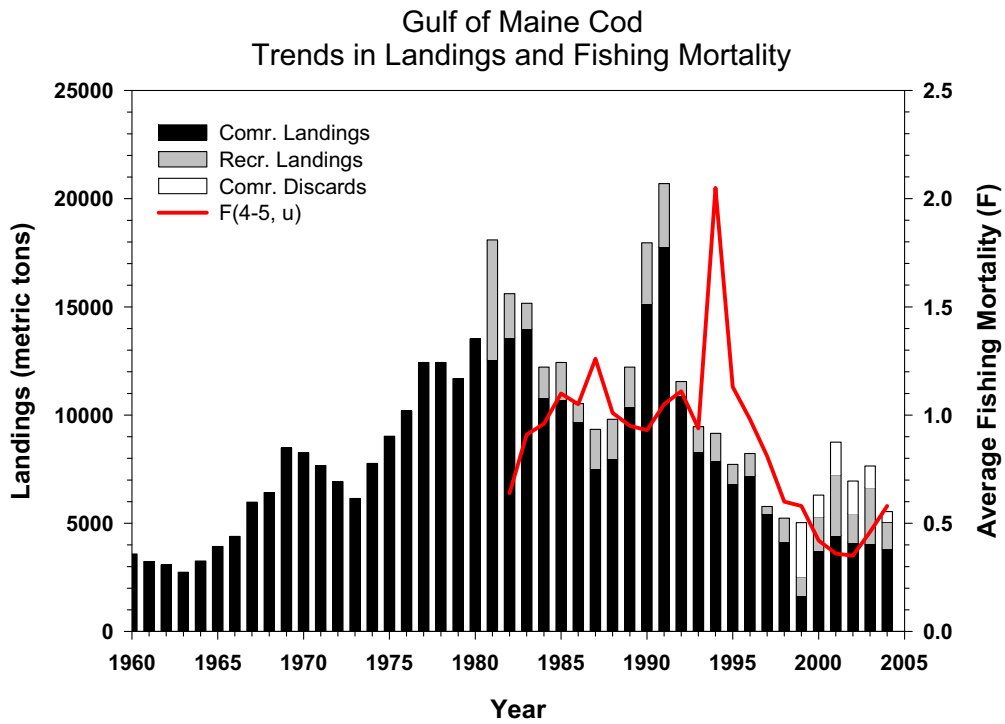


Figure 8. Trends in landings and fishing mortality for Gulf of Maine cod.

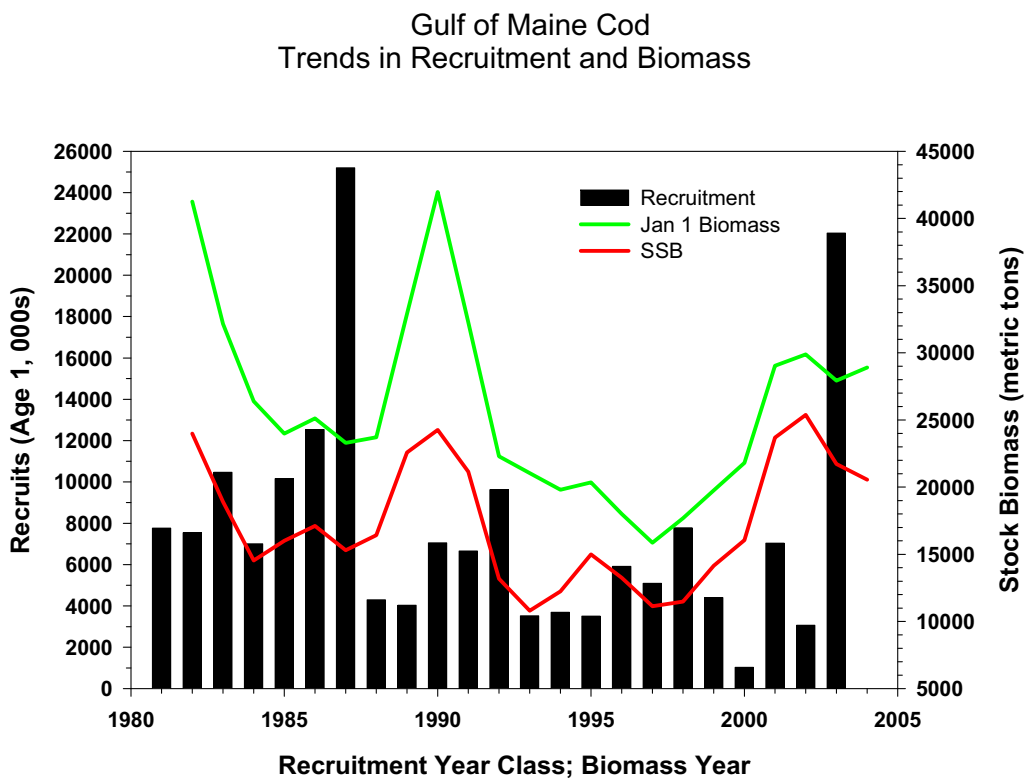
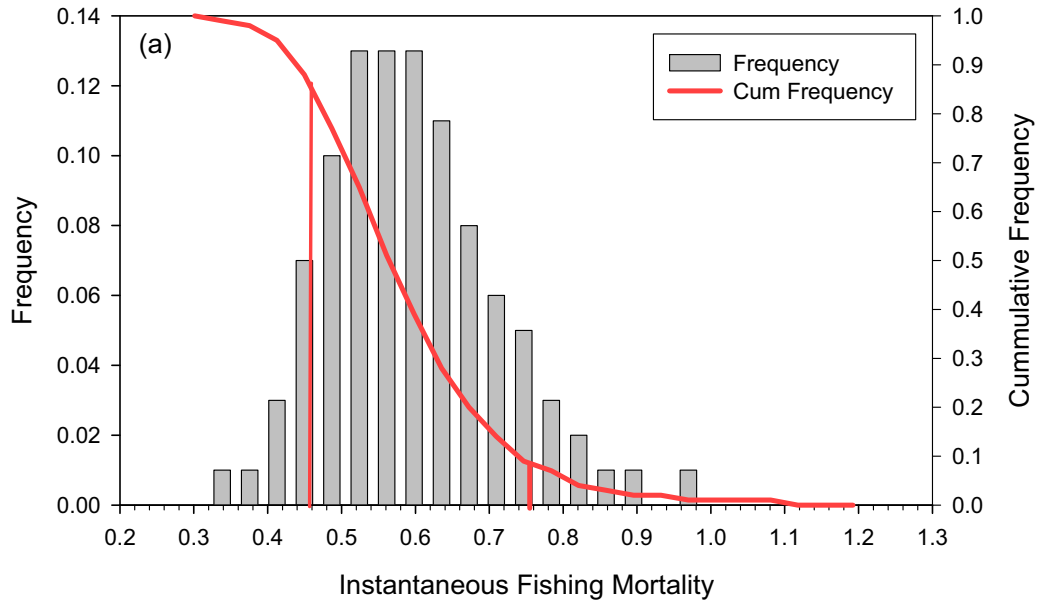


Figure 9. Trends in recruitment (age 1) and biomass for Gulf of Maine cod.

2004 Fully Recruited Fishing Mortality



2004 Spawning Stock Biomass

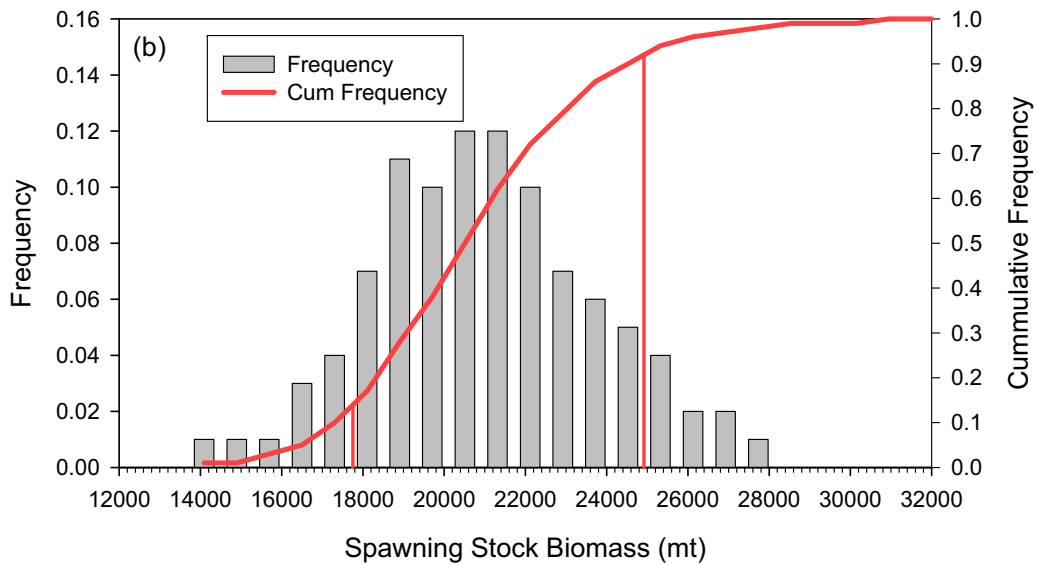


Figure 10. Bootstrap estimates of 2004 F (a) and SSB (b) for Gulf of Maine cod.

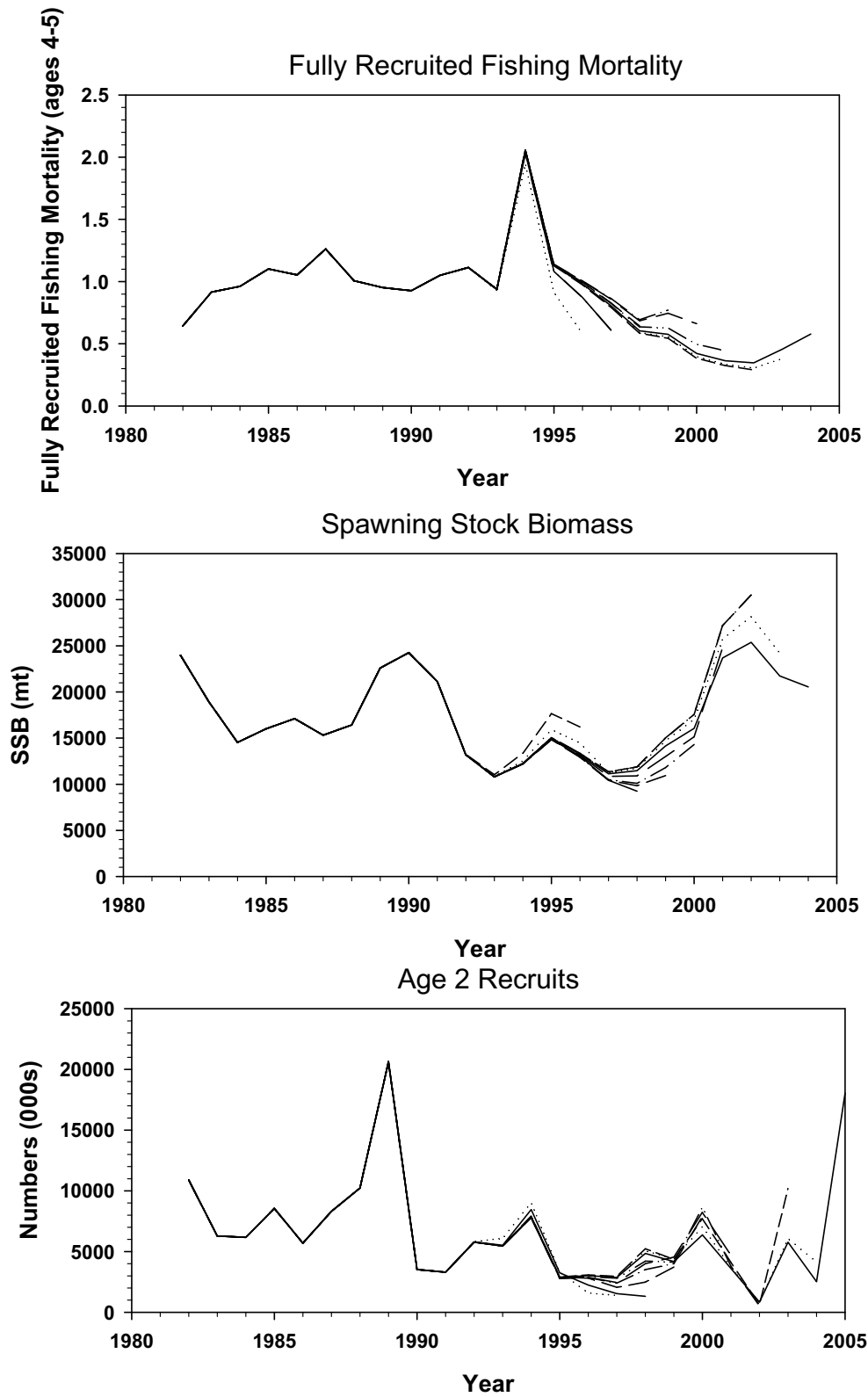
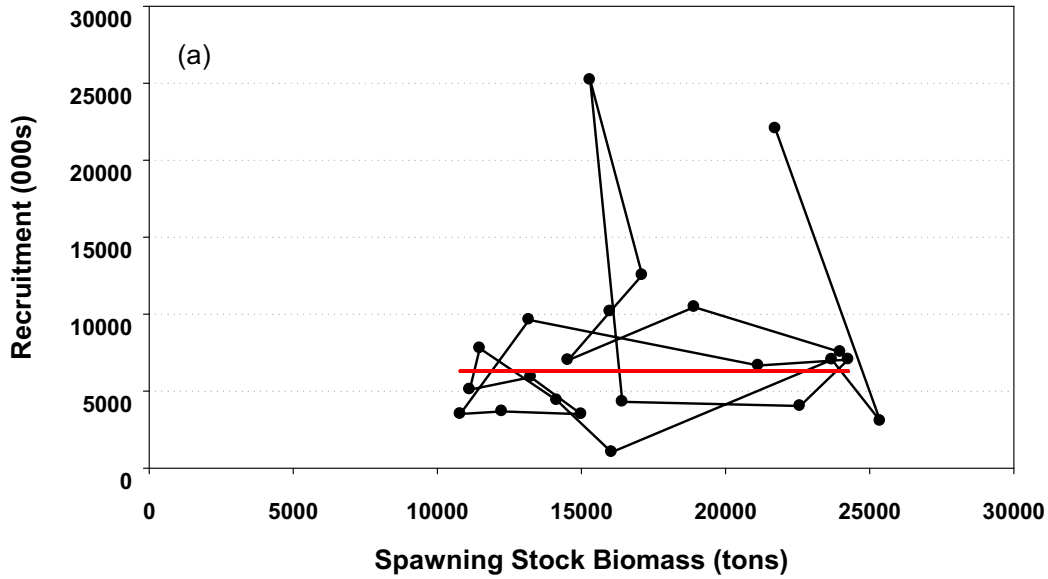


Figure 11. Retrospective Analysis for Gulf of Maine cod

**Gulf of Maine Cod
Stock-Recruitment Plot**



**Gulf of Maine Cod
R/S Survival Ratios**



Figure 12. (a) Spawning stock-recruitment scatterplot for Gulf of Maine cod. The solid horizontal line represents the geometric mean recruitment, and (b) Trends in survival ratios (R/SSB) for Gulf of Maine cod.

Appendix 1. Management History of Gulf of Maine Cod.

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

Table 2. Recent Management Measures affecting New England Groundfish Stocks, 2002-2004.

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 ½" (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 "Interim" 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 ½" (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 1: 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.

Appendix 1: Table 1 (Continued).

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.

Appendix 1: Table 2. Recent Management Measures affecting New England Groundfish Stocks, 2002-2004.

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 1: 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 <u>Recreational</u> : 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. <u>DAS</u> : 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). <u>Minimum Size</u> : No change from emergency rule <u>Gear</u> : <i>Trawl</i> : No change from emergency rule. <i>Gillnet</i> : 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. mesh/75 nets. <i>Hook</i> : GOM: 2,000 hooks. GB: 3,600 hooks <u>Closures</u> : 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. <u>Possession limits</u> : 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. <u>Special Management Programs</u> : 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. <u>Exempted Fisheries</u> : 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 1: Table 2 (Continued)

	<p>----</p> <p>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.</p>
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 <i>Closed Area I Haddock SAP</i> Access to small area of CAI to target haddock using longlines. Limited to 1,000 mt haddock TAC. Season ends December 31. <i>Eastern US/CA Area Haddock SAP Pilot Program</i> 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. <i>Category B (regular) DAS Pilot Program</i> 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.

Appendix 2. Age-specific bottom trawl survey abundance indices for Gulf of Maine cod.

Table 1. Standardized [for both door and gear changes] stratified mean number per tow at age and standardized stratified mean weight (kg) per tow of Atlantic cod in NEFSC offshore spring research vessel bottom trawl surveys in the Gulf of Maine, 1968-2005.

Table 2. Standardized [for both door and gear changes] stratified mean number per tow at age and standardized stratified mean weight (kg) per tow of Atlantic cod in NEFSC offshore autumn research vessel bottom trawl surveys in the Gulf of Maine, 1963-2004.

Table 3. Stratified mean catch per tow in numbers and weight (kg) of Atlantic cod in State of Massachusetts inshore spring and autumn bottom trawl surveys in territorial waters adjacent to the Georges Bank area (Mass. Regions 1-3) and in the Gulf of Maine (Mass. Regions 4-5), 1978 - 2005.

Appendix 2: Table 1. Standardized [for both door and gear changes] stratified mean number per tow at age and standardized stratified mean weight (kg) per tow of Atlantic cod in NEFSC offshore spring research vessel bottom trawl surveys in the Gulf of Maine (Strata 26-30 and 36-40), 1968-2005. [a,b]

Year [c,d,e]	Age Group																	Totals				Standardized Mean Wt./Tow (kg)
	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	18.20		
1969	0.000	0.000	0.036	0.307	0.880	0.807	0.633	0.256	0.144	0.089	0.101	-	-	-	-	3.253	2.909	2.030	1.223	13.19		
1970	0.000	0.159	0.124	0.053	0.091	0.271	0.465	0.611	0.094	0.059	0.098	0.100	0.042	0.012	0.012	2.191	1.855	1.764	1.494	11.08		
1971	0.000	0.026	0.151	0.105	0.286	0.048	0.084	0.300	0.206	0.154	0.058	0.013	0.000	0.000	0.000	1.429	1.148	0.862	0.814	7.00		
1972	0.000	0.371	0.135	0.521	0.195	0.181	0.044	0.124	0.093	0.229	0.056	0.056	0.034	0.000	0.017	2.057	1.030	0.835	0.653	8.03		
1973	0.000	0.035	4.250	0.890	0.632	0.348	0.194	0.096	0.221	0.261	0.198	0.075	0.106	0.132	0.088	7.525	2.350	1.718	1.370	18.81		
1974	0.000	0.475	1.031	1.503	0.172	0.235	0.075	0.028	0.057	0.043	0.045	0.043	0.081	0.051	0.202	2.902	0.820	0.648	0.413	7.42		
1975	0.006	0.096	0.686	0.131	1.105	0.269	0.079	0.000	0.006	0.018	0.028	0.026	0.062	0.000	0.000	2.512	1.593	0.488	0.219	6.04		
1976	0.000	0.051	1.104	0.265	0.137	0.902	0.090	0.095	0.027	0.000	0.011	0.000	0.074	0.027	0.000	2.782	1.362	1.225	0.323	7.56		
1977	0.000	0.025	0.297	0.553	1.925	1.111	0.831	0.011	0.083	0.000	0.000	0.000	0.000	0.038	0.038	3.872	2.998	1.073	0.962	8.54		
1978	0.000	0.048	0.110	0.308	0.351	0.744	0.095	0.252	0.013	0.107	0.000	0.022	0.000	0.000	0.000	2.050	1.584	1.233	0.488	7.70		
1979	0.044	0.484	1.630	0.219	0.449	0.299	0.587	0.102	0.112	0.013	0.031	0.000	0.000	0.025	0.025	3.993	1.617	1.168	0.869	8.36		
1980	0.070	0.037	0.423	0.492	0.138	0.304	0.317	0.038	0.014	0.122	0.014	0.000	0.000	0.000	0.000	2.155	1.133	0.994	0.756	6.23		
1981	0.000	1.075	0.644	0.841	1.342	0.331	0.264	0.116	0.121	0.100	0.000	0.000	0.000	0.000	0.000	4.832	2.272	0.930	0.600	10.65		
1982	0.014	0.359	1.007	0.476	0.655	0.988	0.087	0.112	0.000	0.026	0.039	0.000	0.000	0.000	0.000	3.763	1.907	1.251	0.264	8.62		
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	0.030	0.030	0.030	3.667	1.322	0.857	0.453	10.96		
1984	0.000	0.151	1.312	1.023	0.823	0.212	0.047	0.100	0.000	0.000	0.000	0.000	0.000	0.000	0.000	3.667	1.182	0.359	0.147	6.14		
1985	0.000	0.029	0.231	0.662	0.663	0.662	0.103	0.091	0.052	0.000	0.026	0.000	0.000	0.000	0.000	2.517	1.596	0.933	0.272	7.65		
1986	0.000	0.537	0.248	0.754	0.237	0.091	0.035	0.038	0.000	0.000	0.000	0.000	0.018	0.000	0.000	1.957	0.419	0.182	0.090	3.48		
1987	0.074	0.030	0.460	0.199	0.231	0.074	0.000	0.066	0.008	0.000	0.000	0.000	0.000	0.015	0.015	1.083	0.394	0.163	0.088	1.98		
1988	0.029	0.717	0.923	0.823	0.218	0.254	0.092	0.065	0.000	0.007	0.000	0.000	0.000	0.000	0.000	3.127	0.635	0.417	0.163	3.60		
1989	0.000	0.017	0.605	0.723	0.600	0.091	0.063	0.014	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.112	0.768	0.168	0.077	2.42		
1990	0.000	0.000	0.208	0.068	0.637	0.102	0.032	0.018	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.362	0.789	0.152	0.050	3.08		
1991	0.000	0.038	0.068	0.234	1.717	0.299	0.020	0.018	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.393	2.054	0.337	0.038	2.89		
1992	0.000	0.050	0.226	0.242	0.282	1.328	0.226	0.069	0.000	0.012	0.000	0.000	0.000	0.000	0.000	2.435	1.917	1.635	0.307	8.63		
1993	0.000	0.201	0.497	0.799	0.334	0.091	0.484	0.055	0.023	0.000	0.023	0.023	0.000	0.000	0.000	2.507	1.010	0.378	0.585	5.88		
1994	0.000	0.015	0.316	0.388	0.215	0.094	0.049	0.127	0.027	0.022	0.018	0.000	0.000	0.000	0.000	1.271	0.553	0.336	0.244	2.43		
1995	0.000	0.050	0.179	1.116	0.372	0.145	0.028	0.000	0.011	0.000	0.000	0.000	0.000	0.028	0.000	1.930	0.585	0.213	0.068	2.43		
1996	0.000	0.057	0.022	0.593	1.331	0.403	0.059	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.465	1.793	0.463	0.059	5.43		
1997	0.000	0.159	0.132	0.399	0.264	0.876	0.242	0.120	0.024	0.022	0.000	0.000	0.000	0.000	0.000	2.192	1.502	1.238	0.362	5.62		
1998	0.000	0.184	0.224	0.330	0.517	1.142	0.421	0.023	0.037	0.000	0.000	0.000	0.000	0.011	0.000	2.301	1.139	0.622	0.481	4.18		
1999	0.000	1.166	0.344	0.713	0.345	0.315	0.134	0.273	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.011	1.078	0.733	0.418	5.09		
2000	0.000	0.026	1.184	0.725	0.439	0.457	0.107	0.101	0.024	0.022	0.000	0.000	0.000	0.000	0.000	3.083	0.710	0.253	0.146	3.21		
2001	0.000	0.029	0.323	0.716	0.497	0.354	0.064	0.098	0.055	0.000	0.011	0.000	0.000	0.000	0.000	2.146	1.078	0.581	0.227	6.22		
2002	0.000	0.340	0.045	0.524	1.601	0.614	0.362	0.164	0.057	0.016	0.000	0.000	0.000	0.000	0.000	3.724	2.814	1.213	0.598	10.93		
2003	0.000	0.069	0.831	0.063	0.708	1.089	0.395	0.321	0.103	0.073	0.027	0.000	0.000	0.000	0.000	3.677	2.715	2.007	0.918	9.50		
2004	0.000	0.136	0.045	0.221	0.118	0.191	0.232	0.014	0.014	0.010	0.000	0.000	0.000	0.000	0.000	0.981	0.579	0.461	0.270	2.41		
2005	0.000	0.020	0.726	0.101	0.608	0.015	0.145	0.130	0.014	0.000	0.000	0.000	0.000	0.000	0.000	1.765	0.917	0.309	0.294	2.70		

[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] 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.

[d] During 1963-1984, BMW 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 (NEFSC 1991).

[e] 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).

Appendix 2: Table 2. Standardized [for both door and gear changes] stratified mean number per tow at age and standardized stratified mean weight (kg) per tow of Atlantic cod in NEFSC offshore autumn research vessel bottom trawl surveys in the Gulf of Maine (Strata 26-30 and 36-40), 1963-2004. [a,b]

Year [c,d]	Age Group																				Totals					Standardized Mean Wt./Cov (Kg)
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14+	0+	3+	4+	5+							
1963	0.050	0.649	1.349	1.253	0.849	0.579	0.537	0.300	0.183	0.095	0.075	-	-	-	-	5.917	3.869	2.616	1.767	17.95						
1964	0.000	0.092	0.122	0.417	0.856	0.493	0.783	0.373	0.237	0.114	0.101	-	-	-	-	4.003	3.789	3.318	2.462	22.80						
1965	0.002	0.850	0.880	0.824	0.750	0.496	0.374	0.170	0.080	0.044	0.025	-	-	-	-	4.494	2.763	1.939	1.189	12.01						
1966	0.170	0.204	0.640	0.697	0.718	0.558	0.441	0.192	0.078	0.048	0.036	-	-	-	-	3.783	2.769	2.072	1.354	12.92						
1967	0.012	0.129	0.215	0.574	0.671	0.384	0.268	0.162	0.070	0.041	0.034	-	-	-	-	2.562	2.204	1.630	0.959	9.23						
1968	0.012	0.036	0.179	0.719	1.256	0.719	0.627	0.261	0.156	0.072	0.095	-	-	-	-	4.387	4.159	3.440	2.184	19.44						
1969	0.016	0.059	0.123	0.354	0.630	0.552	0.466	0.220	0.145	0.129	0.062	-	-	-	-	2.758	2.560	2.206	1.576	15.37						
1970	0.802	0.883	0.260	0.538	0.329	0.486	0.425	0.811	0.132	0.094	0.036	0.037	0.073	0.000	0.000	4.905	2.960	2.422	2.093	16.44						
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	0.000	0.000	4.361	2.588	2.368	1.790	16.53						
1972	0.031	5.578	1.215	1.528	0.233	0.090	0.140	0.070	0.138	0.262	0.000	0.000	0.000	0.016	0.000	9.301	2.477	0.949	0.716	12.99						
1973	0.638	0.329	2.170	0.139	0.507	0.213	0.077	0.027	0.051	0.183	0.102	0.000	0.000	0.016	0.000	4.452	1.315	1.176	0.669	8.76						
1974	0.283	1.134	0.266	1.876	0.167	0.274	0.051	0.046	0.033	0.033	0.033	0.098	0.000	0.000	0.033	4.328	2.646	0.770	0.603	8.96						
1975	0.047	0.177	3.045	0.138	2.333	0.259	0.109	0.017	0.006	0.000	0.000	0.006	0.000	0.000	0.000	6.143	2.874	2.736	0.403	8.62						
1976	0.000	0.230	0.221	0.633	0.077	0.773	0.052	0.132	0.000	0.000	0.031	0.000	0.000	0.000	0.000	2.148	1.697	1.064	0.988	6.74						
1977	0.000	0.042	0.416	0.465	1.157	0.114	0.629	0.044	0.090	0.022	0.032	0.000	0.044	0.019	0.000	3.073	2.615	2.150	0.994	10.20						
1978	0.248	1.373	0.378	1.135	0.658	1.426	0.109	0.310	0.005	0.083	0.007	0.013	0.000	0.028	0.000	5.773	3.773	2.638	1.980	12.90						
1979	0.002	0.381	0.588	0.145	0.708	0.337	0.688	0.044	0.181	0.000	0.053	0.000	0.000	0.000	0.018	3.142	2.172	2.027	1.319	13.93						
1980	0.027	1.321	2.520	1.780	0.492	0.194	0.360	0.207	0.036	0.025	0.000	0.036	0.000	0.014	0.022	7.034	3.165	1.385	0.894	14.20						
1981	0.010	0.618	0.419	0.539	0.405	0.029	0.076	0.029	0.000	0.000	0.043	0.000	0.000	0.000	0.000	2.349	1.302	0.768	0.358	7.53						
1982	0.000	0.843	3.353	2.275	1.089	0.209	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	7.769	3.573	1.298	0.209	15.92						
1983	0.000	0.317	0.916	0.828	0.197	0.227	0.210	0.000	0.000	0.000	0.027	0.028	0.000	0.000	0.000	2.786	1.553	0.726	0.529	8.42						
1984	0.121	0.526	0.957	0.609	0.248	0.182	0.075	0.000	0.034	0.021	0.010	0.000	0.030	0.035	0.000	2.449	1.569	0.938	0.551	8.74						
1985	0.000	0.392	0.401	0.657	0.342	0.073	0.041	0.000	0.011	0.034	0.000	0.000	0.000	0.000	0.000	1.950	1.157	0.501	0.159	4.72						
1987	0.128	0.578	1.380	0.592	0.243	0.075	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.996	2.960	0.318	0.075	3.39						
1988	0.000	1.938	2.313	0.990	0.443	0.099	0.065	0.033	0.011	0.011	0.000	0.000	0.000	0.000	0.000	5.903	1.652	0.662	0.219	6.62						
1989	0.000	0.150	2.407	1.502	0.293	0.161	0.033	0.000	0.000	0.000	0.009	0.000	0.000	0.000	0.000	4.553	1.997	0.495	0.202	4.54						
1990	0.006	0.045	0.187	1.829	0.598	0.259	0.052	0.010	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.986	2.748	0.919	0.321	4.91						
1991	0.009	0.144	0.139	0.223	0.633	0.081	0.000	0.023	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.252	0.960	0.737	0.104	2.78						
1992	0.059	0.291	0.446	0.140	0.036	0.350	0.104	0.008	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.433	0.638	0.498	0.462	2.45						
1993	0.043	0.198	0.568	0.360	0.034	0.000	0.030	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.232	0.424	0.064	0.030	1.00						
1994	0.032	0.207	0.883	0.826	0.085	0.051	0.000	0.045	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.130	1.008	0.182	0.096	2.74						
1995	0.008	0.068	0.285	1.228	0.325	0.082	0.011	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.008	1.647	0.419	0.093	3.67						
1996	0.029	0.124	0.383	0.188	0.542	0.062	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.327	0.792	0.604	0.062	2.35						
1997	0.000	0.297	0.086	0.177	0.173	0.140	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.872	0.490	0.313	0.140	1.87						
1998	0.050	0.097	0.320	0.115	0.192	0.039	0.031	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.843	0.376	0.262	0.069	1.50						
1999	0.025	0.431	0.367	0.586	0.243	0.132	0.016	0.006	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.807	0.984	0.398	0.155	3.51						
2000	0.008	0.533	0.984	0.394	0.507	0.134	0.010	0.000	0.011	0.023	0.000	0.000	0.000	0.000	0.000	2.604	1.079	0.686	0.178	4.65						
2001	0.018	0.034	0.141	0.752	0.469	0.337	0.122	0.084	0.000	0.023	0.000	0.000	0.000	0.000	0.000	1.980	1.788	1.035	0.566	7.33						
2002	0.000	0.269	0.081	0.364	2.797	1.096	0.627	0.051	0.043	0.000	0.000	0.000	0.000	0.000	0.000	5.328	4.979	4.615	1.818	24.66						
2003	0.542	0.455	0.198	0.185	0.529	0.450	0.073	0.077	0.000	0.011	0.000	0.011	0.000	0.000	0.000	2.529	1.335	1.150	0.622	5.99						
2004	1.380	0.651	0.168	0.581	0.231	0.253	0.168	0.068	0.011	0.010	0.011	0.000	0.000	0.000	0.000	3.533	1.334	0.753	0.522	4.90						

[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.

[b] 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+.

[c] During 1963-1984, EMV 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.

[d] 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 2: Table 3. Stratified mean catch per tow in numbers and weight (kg) of Atlantic cod in State of Massachusetts inshore spring and autumn bottom trawl surveys in territorial waters adjacent to the Gulf of Maine (Mass. Regions 4-5), 1978 - 2005. [a]

Year	Age Group											Totals	Stratified Mean Weight/tow (kg)				
	0	1	2	3	4	5	6	7	8	9	10+			0+	1+	2+	3+
Spring																	
1978	21.965	12.784	4.162	4.572	0.872	1.028	0.000	0.000	0.000	0.000	0.000	0.000	45.406	23.441	10.657	6.495	12.16
1979	56.393	36.630	2.581	1.533	4.659	1.995	0.183	0.000	0.000	0.000	0.000	0.000	104.043	47.650	11.020	8.439	20.53
1980	8.156	50.311	12.679	0.971	0.745	0.737	0.080	0.000	0.000	0.000	0.000	0.000	73.918	65.762	15.451	17.71	17.71
1981	19.753	24.794	23.884	3.122	1.279	0.041	0.146	0.022	0.000	0.000	0.000	0.000	73.063	53.310	28.516	4.632	21.79
1982	1.489	16.235	7.060	3.418	1.147	0.232	0.011	0.057	0.000	0.000	0.000	0.000	29.694	28.205	11.970	4.910	13.42
1983	0.453	27.703	18.572	5.331	0.501	1.221	0.142	0.022	0.000	0.000	0.000	0.000	53.945	53.482	25.789	7.217	19.77
1984	0.206	2.896	5.408	2.271	0.865	0.138	0.162	0.000	0.000	0.000	0.000	0.000	11.946	11.740	8.844	3.436	8.63
1985	0.793	2.711	3.822	2.794	0.692	0.000	0.000	0.000	0.000	0.000	0.000	0.000	10.812	10.019	7.308	3.486	6.42
1986	0.957	19.960	3.222	0.887	0.426	0.090	0.019	0.000	0.000	0.000	0.000	0.000	25.561	24.604	4.644	1.422	7.77
1987	0.659	8.590	6.997	2.268	0.257	0.147	0.048	0.000	0.000	0.000	0.000	0.000	19.053	18.394	9.804	2.807	9.59
1988	1.595	11.841	11.356	2.511	1.370	0.000	0.039	0.000	0.000	0.000	0.000	0.000	28.712	27.117	15.276	3.920	9.66
1989	0.157	20.679	25.260	6.580	0.458	0.106	0.124	0.000	0.000	0.000	0.000	0.000	53.364	53.207	32.528	7.268	18.26
1990	4.10	6.33	6.89	17.77	2.64	0.18	0.05	0.02	0.000	0.000	0.000	0.000	37.980	33.88	27.55	20.66	19.51
1991	0.32	5.88	3.56	2.54	5.03	0.36	0.000	0.000	0.000	0.000	0.000	0.000	17.69	17.37	11.49	7.93	11.37
1992	1.36	6.42	6.35	3.58	0.65	1.37	0.12	0.04	0.00	0.00	0.00	0.00	19.88	18.53	12.11	5.76	10.10
1993	69.03	3.40	7.76	3.60	1.45	0.05	0.30	0.00	0.00	0.00	0.00	0.00	85.59	16.56	13.16	5.40	7.63
1994	3.90	4.45	5.67	2.46	0.52	0.23	0.03	0.06	0.00	0.00	0.00	0.00	17.35	13.45	9.00	3.33	4.83
1995	9.84	6.41	1.36	3.89	1.20	0.09	0.00	0.00	0.00	0.00	0.00	0.00	22.79	12.95	6.54	5.18	4.49
1996	6.39	1.37	0.65	1.15	2.00	0.38	0.00	0.00	0.00	0.00	0.00	0.00	11.96	5.57	4.20	3.55	4.06
1997	10.40	3.66	1.25	1.05	0.22	0.50	0.03	0.00	0.00	0.00	0.00	0.00	28.30	6.69	3.03	1.78	2.97
1998	20.72	3.15	1.80	0.99	1.06	0.08	0.46	0.04	0.00	0.00	0.00	0.00	17.09	7.58	4.43	2.63	5.76
1999	116.22	14.36	3.57	3.46	1.20	1.08	0.06	0.22	0.04	0.00	0.00	0.00	140.08	23.84	9.48	5.91	14.19
2000	1.83	27.99	7.12	2.85	2.60	0.78	0.77	0.06	0.13	0.00	0.00	0.00	44.16	42.33	14.34	7.22	22.36
2001	19.00	0.08	2.78	4.81	3.63	1.86	0.41	0.16	0.00	0.00	0.00	0.00	32.74	13.74	13.66	10.88	22.33
2002	0.82	16.71	0.441	1.642	2.379	0.879	0.615	0.37	0.286	0.178	0.000	0.286	24.11	23.29	6.58	6.14	19.51
2003	801.27	6.247	9.338	0.366	1.714	1.638	0.365	0.20	0.018	0.000	0.000	0.000	821.16	19.89	13.64	4.30	12.32
2004	100.62	12.177	2.049	3.350	0.608	1.310	0.891	0.056	0.097	0.067	0.000	0.000	121.22	20.60	8.42	6.37	12.18
2005	145.59	3.236	9.363	0.675	2.575	0.250	1.313	0.474	0.077	0.000	0.000	0.000	163.53	17.94	14.70	5.34	13.05
Autumn																	
1978	151.533	2.082	0.000	0.120	0.140	0.318	0.000	0.080	0.000	0.000	0.000	0.000	154.273	2.740	0.658	0.658	3.02
1979	4.933	3.430	0.042	0.000	0.026	0.000	0.000	0.000	0.000	0.000	0.000	0.000	8.431	3.498	0.068	0.026	0.99
1980	5.680	8.834	0.052	0.000	0.050	0.000	0.000	0.000	0.000	0.000	0.000	0.000	14.616	8.936	0.102	0.050	1.57
1981	2.018	5.652	7.290	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	15.689	13.671	8.019	0.729	6.65
1982	4.667	2.346	1.005	0.060	0.050	0.000	0.000	0.000	0.000	0.000	0.000	0.000	8.128	3.461	1.115	0.110	1.35
1983	1.308	0.651	0.100	0.013	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.072	0.764	0.113	0.013	0.18
1984	12.296	0.344	0.022	0.013	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	12.675	0.379	0.035	0.013	0.18
1985	2.832	0.419	0.018	0.010	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	3.279	0.447	0.028	0.010	0.09
1986	2.478	1.150	0.833	0.000	0.067	0.000	0.000	0.000	0.000	0.000	0.000	0.000	4.528	2.050	0.900	0.067	0.55
1987	389.584	2.386	0.020	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	391.990	2.406	0.020	0.000	0.45
1988	4.571	20.490	0.679	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	25.740	21.169	0.679	0.000	1.57
1989	2.971	2.700	0.350	0.210	0.185	0.000	0.000	0.000	0.000	0.000	0.000	0.000	6.416	3.445	0.745	0.395	1.27
1990	9.37	9.13	1.74	0.31	0.06	0.03	0.000	0.000	0.000	0.000	0.000	0.000	20.638	11.27	2.14	0.40	1.56
1991	4.65	4.20	0.81	0.03	0.05	0.01	0.00	0.00	0.00	0.00	0.00	0.00	9.74	5.09	0.89	0.08	0.80
1992	24.30	2.01	0.11	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00	26.48	2.18	0.17	0.06	0.42
1993	49.92	3.32	0.61	0.33	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	54.21	4.29	0.97	0.36	1.97
1994	33.49	14.13	6.37	0.26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	54.26	20.77	6.64	0.27	4.47
1995	2.56	0.64	0.54	0.79	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.55	1.99	1.35	0.81	0.74
1996	7.59	0.15	0.02	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.78	0.19	0.04	0.03	0.09
1997	2.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.04	0.02	0.00	0.00	0.02
1998	2.61	1.04	0.62	0.08	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.46	1.85	0.19	0.19	0.56
1999	6.34	0.98	0.28	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.65	1.31	0.33	0.05	0.43
2000	0.04	0.54	0.27	0.02	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.91	0.87	0.33	0.06	0.34
2001	44.52	0.06	0.30	0.15	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	45.22	0.70	0.64	0.34	1.00
2002	0.99	2.50	0.30	0.55	0.77	0.91	0.08	0.00	0.00	0.00	0.00	0.00	6.17	5.18	2.68	2.38	8.66
2003	112.79	3.66	0.33	0.12	0.47	0.15	0.02	0.00	0.00	0.00	0.00	0.00	117.54	4.75	1.09	0.76	3.13
2004	39.22	14.38	1.50	2.03	0.33	0.77	0.38	0.01	0.00	0.00	0.00	0.00	58.62	19.40	5.02	3.52	8.77

[a] Massachusetts sampling strata 25-36.

Appendix 3. Full VPA Output for Gulf of Maine Cod

VPA Version 2.3.1

Model ID: GoM Cod 2005 VPA Update GARMII w/Rev Survey Indices Run

Input File: C:\ALLWORK\ASSESS\AUG2005WG\GOMCOD\UPDATEVPA\GMCOD2005_REC3.DAT

Date of Run: 08-NOV-2005

Time of Run: 13:49

Levenburg-Marquardt Algorithm Completed 6 Iterations
Residual Sum of Squares = 165.848

Number of Residuals = 382
Number of Parameters = 5
Degrees of Freedom = 377
Mean Squared Residual = 0.439914
Standard Deviation = 0.663260

Number of Years = 23
Number of Ages = 7
First Year = 1982
Youngest Age = 1
Oldest True Age = 6

Number of Survey Indices Available = 21
Number of Survey Indices Used in Estimate = 18

VPA Classic Method - Auto Estimated Q's

Stock Numbers Predicted in Terminal Year Plus One (2005)

Age	Stock Predicted	Std. Error	CV
2	18051.358	0.612618E+04	0.339375E+00
3	2052.179	0.527079E+03	0.256839E+00
4	3597.430	0.811616E+03	0.225610E+00
5	173.805	0.621311E+02	0.357476E+00
6	737.451	0.193160E+03	0.261929E+00

Catchability Values for Each Survey Used in Estimate

INDEX	Catchability	Std. Error	CV
1	0.540727E-04	0.837665E-05	0.154915E+00
2	0.119324E-03	0.119116E-04	0.998256E-01
3	0.213271E-03	0.185151E-04	0.868151E-01
4	0.286265E-03	0.351416E-04	0.122759E+00
5	0.385326E-03	0.668847E-04	0.173579E+00
6	0.512569E-04	0.653308E-05	0.127458E+00
7	0.114621E-03	0.142845E-04	0.124624E+00
8	0.235486E-03	0.249146E-04	0.105801E+00
9	0.377789E-03	0.497063E-04	0.131572E+00
10	0.542803E-03	0.663712E-04	0.122275E+00
11	0.802556E-03	0.953070E-04	0.118754E+00
12	0.622564E-03	0.592625E-04	0.951910E-01
13	0.493316E-03	0.696618E-04	0.141211E+00
15	0.269618E-03	0.827514E-04	0.306920E+00
18	0.142705E-04	0.171375E-05	0.120090E+00
19	0.241124E-04	0.141021E-05	0.584847E-01
20	0.246504E-04	0.112758E-05	0.457428E-01
21	0.256380E-04	0.743155E-06	0.289865E-01

-- 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 4 to 6
- Calculation of Population of Age 1 In Year 2005
= Geometric Mean of First Age Populations
Year Range Applied = 1982 to 2004

Stock Estimates

Age 2
Age 3
Age 4
Age 5
Age 6

Full F in Terminal Year = 0.5781

F in Oldest True Age in Terminal Year = 0.5781

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	0.053	0.001	0.0004	NO	Stock Estimate in T+1
3	0.421	0.088	0.0690	NO	Stock Estimate in T+1
4	1.000	1.000	0.7801	YES	Stock Estimate in T+1
5	1.000	0.482	0.3760	YES	Stock Estimate in T+1
6	1.000	0.741	0.5781		Input PR * Full F

Catch At Age - Input Data

AGE	1982	1983	1984	1985	1986
1	88.0	14.0	24.0	49.0	26.0
2	1995.0	1337.0	813.0	989.0	208.0
3	2350.0	2896.0	1572.0	2111.0	2750.0
4	1386.0	1184.0	1636.0	1122.0	929.0
5	717.0	685.0	469.0	665.0	275.0
6	75.0	448.0	205.0	133.0	197.0
7	242.0	169.0	142.0	137.0	190.0
AGE	1987	1988	1989	1990	1991
1	41.0	6.0	5.0	7.0	5.0
2	907.0	520.0	530.0	294.0	447.0
3	1418.0	2140.0	2284.0	4195.0	1349.0
4	1525.0	1149.0	1698.0	2373.0	4948.0
5	330.0	434.0	485.0	488.0	946.0
6	79.0	51.0	91.0	167.0	151.0
7	97.0	34.0	61.0	105.0	85.0
AGE	1992	1993	1994	1995	1996
1	0.0	1.0	1.0	0.0	0.0
2	350.0	152.0	49.0	287.0	89.0
3	600.0	1998.0	1488.0	1233.0	716.0
4	526.0	787.0	1258.0	1348.0	1955.0
5	2184.0	140.0	319.0	206.0	368.0
6	216.0	481.0	74.0	14.0	45.0
7	86.0	39.0	88.0	34.0	10.0
AGE	1997	1998	1999	2000	2001
1	0.0	0.0	1.0	0.0	0.0
2	61.0	112.0	16.0	194.0	121.0
3	498.0	505.0	580.0	540.0	1065.0
4	469.0	627.0	550.0	856.0	643.0
5	893.0	182.0	270.0	198.0	375.0
6	72.0	214.0	81.0	97.0	102.0
7	8.0	11.0	109.0	23.0	84.0
AGE	2002	2003	2004		
1	0.0	0.0	0.0		
2	2.0	14.0	1.0		
3	276.0	111.0	284.0		
4	863.0	430.0	227.0		
5	334.0	786.0	372.0		
6	214.0	240.0	250.0		
7	135.0	189.0	139.0		

Weight At Age - Input Data

AGE	1982	1983	1984	1985	1986
1	0.5680	0.4290	0.5000	0.3670	0.4230
2	1.0780	1.0630	1.0090	1.0180	1.0240
3	1.5890	1.6100	1.6230	1.6210	1.7990
4	2.6830	2.4420	2.6970	2.7820	2.8840
5	4.7310	3.7490	3.6460	4.4050	4.5530
6	6.5870	6.0070	5.8150	5.4510	6.0200
7	11.3140	9.9410	10.2960	9.6860	11.7110
AGE	1987	1988	1989	1990	1991
1	0.3170	0.1670	0.6000	0.1430	0.2000
2	1.0110	0.9870	1.1850	1.0170	1.1340
3	1.5410	1.7590	1.7170	1.6550	1.5160
4	3.1160	2.3810	2.9320	2.2820	2.4660
5	4.7390	5.0780	3.8370	4.1930	4.0240
6	6.9240	6.2940	4.2420	7.5810	7.2380
7	10.2890	10.6760	11.9020	13.5620	11.1060
AGE	1992	1993	1994	1995	1996
1	0.3904	0.3904	0.3904	0.3904	0.3904
2	1.5310	1.1320	1.4290	1.6240	1.6520
3	1.9150	1.8270	1.8350	1.8340	2.0750
4	2.7220	2.4180	3.0560	2.6520	2.3300
5	3.0600	4.2430	3.3070	5.0290	3.5820
6	5.0000	6.0850	6.0810	7.1430	7.4120
7	10.5930	10.9740	9.8980	13.3670	10.6570
AGE	1997	1998	1999	2000	2001
1	0.3904	0.6250	0.3460	0.3904	0.3904
2	1.7360	1.3480	1.1880	1.4980	1.8040
3	2.2030	2.1050	1.8140	2.2610	2.4220
4	2.9590	2.9230	2.7440	3.4320	3.2510
5	3.1400	4.1100	4.1430	4.3850	4.8330
6	4.5530	4.0980	5.7580	5.6910	6.4960
7	8.7380	9.5280	7.7060	6.9940	7.8910
AGE	2002	2003	2004		
1	0.3904	0.3904	0.3904		
2	1.3600	1.9680	1.5250		
3	2.4060	2.4090	2.3950		
4	3.3170	3.0750	3.3130		
5	4.0590	4.0600	3.7720		
6	5.8970	5.3130	5.3570		
7	8.4120	8.6780	8.7380		

JAN-1 Weights at Age - Input Data

AGE	1982	1983	1984	1985	1986
1	0.4152	0.2797	0.3504	0.2197	0.2736
2	0.8821	0.7770	0.6579	0.7134	0.6130
3	1.2818	1.3174	1.3135	1.2789	1.3533
4	2.2697	1.9699	2.0838	2.1249	2.1622
5	4.1986	3.1715	2.9839	3.4468	3.5590
6	5.5824	5.3310	4.6691	4.4581	5.1496
7	11.3140	9.9410	10.2960	9.6860	11.7110
AGE	1987	1988	1989	1990	1991
1	0.1797	0.0627	0.4609	0.0508	0.0723
2	0.6540	0.5594	0.4449	0.7812	0.4027
3	1.2562	1.3335	1.3018	1.4004	1.2417
4	2.3676	1.9155	2.2710	1.9794	2.0202
5	3.6969	3.9778	3.0226	3.5063	3.0303
6	5.6147	5.4614	4.6412	5.3934	5.5090
7	10.2890	10.6760	11.9020	13.5620	11.1060
AGE	1992	1993	1994	1995	1996
1	0.2293	0.2041	0.1914	0.1898	0.1851
2	0.5534	0.6648	0.7469	0.7962	0.8031
3	1.4736	1.6725	1.4413	1.6189	1.8357
4	2.0314	2.1519	2.3629	2.2060	2.0672
5	2.7470	3.3984	2.8278	3.9203	3.0821
6	4.4855	4.3151	5.0795	4.8602	6.1053
7	10.5930	10.9740	9.8980	13.3670	10.6570
AGE	1997	1998	1999	2000	2001
1	0.2101	0.4533	0.1663	0.1816	0.2092
2	0.8232	0.7254	0.8617	0.7199	0.8392
3	1.9077	1.9116	1.5637	1.6389	1.9048
4	2.4779	2.5376	2.4034	2.4951	2.7112
5	2.7048	3.4873	3.4799	3.4688	4.0727
6	4.0384	3.5872	4.8647	4.8557	5.3371
7	8.7380	9.5280	7.7060	6.9940	7.8910
AGE	2002	2003	2004	2005	
1	0.1739	0.1975	0.1975	0.1896	
2	0.7287	0.8765	0.7716	0.7923	
3	2.0834	1.8100	2.1710	2.0215	
4	2.8344	2.7200	2.8251	2.7932	
5	3.6326	3.6697	3.4057	3.5694	
6	5.3386	4.6439	4.6636	4.8820	
7	8.4120	8.6780	8.7380	8.6093	

SSB Weight At Age - Input Data

AGE	1982	1983	1984	1985	1986
1	0.4152	0.2797	0.3504	0.2197	0.2736
2	0.8821	0.7770	0.6579	0.7134	0.6130
3	1.2818	1.3174	1.3135	1.2789	1.3533
4	2.2697	1.9699	2.0838	2.1249	2.1622
5	4.1986	3.1715	2.9839	3.4468	3.5590
6	5.5824	5.3310	4.6691	4.4581	5.1496
7	11.3140	9.9410	10.2960	9.6860	11.7110
AGE	1987	1988	1989	1990	1991
1	0.1797	0.0627	0.4609	0.0508	0.0723
2	0.6540	0.5594	0.4449	0.7812	0.4027
3	1.2562	1.3335	1.3018	1.4004	1.2417
4	2.3676	1.9155	2.2710	1.9794	2.0202
5	3.6969	3.9778	3.0226	3.5063	3.0303
6	5.6147	5.4614	4.6412	5.3934	5.5090
7	10.2890	10.6760	11.9020	13.5620	11.1060
AGE	1992	1993	1994	1995	1996
1	0.2293	0.2041	0.1914	0.1898	0.1851
2	0.5534	0.6648	0.7469	0.7962	0.8031
3	1.4736	1.6725	1.4413	1.6189	1.8357
4	2.0314	2.1519	2.3629	2.2060	2.0672
5	2.7470	3.3984	2.8278	3.9203	3.0821
6	4.4855	4.3151	5.0795	4.8602	6.1053
7	10.5930	10.9740	9.8980	13.3670	10.6570
AGE	1997	1998	1999	2000	2001
1	0.2101	0.4533	0.1663	0.1816	0.2092
2	0.8232	0.7254	0.8617	0.7199	0.8392
3	1.9077	1.9116	1.5637	1.6389	1.9048
4	2.4779	2.5376	2.4034	2.4951	2.7112
5	2.7048	3.4873	3.4799	3.4688	4.0727
6	4.0384	3.5872	4.8647	4.8557	5.3371
7	8.7380	9.5280	7.7060	6.9940	7.8910
AGE	2002	2003	2004		
1	0.1739	0.1975	0.1975		
2	0.7287	0.8765	0.7716		
3	2.0834	1.8100	2.1710		
4	2.8344	2.7200	2.8251		
5	3.6326	3.6697	3.4057		
6	5.3386	4.6439	4.6636		
7	8.4120	8.6780	8.7380		

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
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
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
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
AGE	2002	2003	2004		
1	0.2000	0.2000	0.2000		
2	0.2000	0.2000	0.2000		
3	0.2000	0.2000	0.2000		
4	0.2000	0.2000	0.2000		
5	0.2000	0.2000	0.2000		
6	0.2000	0.2000	0.2000		
7	0.2000	0.2000	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	0.0700	0.0700	0.0700	0.0400	0.0400
2	0.2600	0.2600	0.2600	0.4800	0.4800
3	0.6100	0.6100	0.6100	0.9500	0.9500
4	0.8800	0.8800	0.8800	1.0000	1.0000
5	0.9700	0.9700	0.9700	1.0000	1.0000
6	1.0000	1.0000	1.0000	1.0000	1.0000
7	1.0000	1.0000	1.0000	1.0000	1.0000
AGE	1987	1988	1989	1990	1991
1	0.0400	0.0400	0.0400	0.1100	0.1100
2	0.4800	0.4800	0.4800	0.2800	0.2800
3	0.9500	0.9500	0.9500	0.5600	0.5600
4	1.0000	1.0000	1.0000	0.8100	0.8100
5	1.0000	1.0000	1.0000	0.9300	0.9300
6	1.0000	1.0000	1.0000	0.9800	0.9800
7	1.0000	1.0000	1.0000	1.0000	1.0000
AGE	1992	1993	1994	1995	1996
1	0.1100	0.1100	0.0400	0.0400	0.0400
2	0.2800	0.2800	0.3800	0.3800	0.3800
3	0.5600	0.5600	0.8900	0.8900	0.8900
4	0.8100	0.8100	0.9900	0.9900	0.9900
5	0.9300	0.9300	1.0000	1.0000	1.0000
6	0.9800	0.9800	1.0000	1.0000	1.0000
7	1.0000	1.0000	1.0000	1.0000	1.0000
AGE	1997	1998	1999	2000	2001
1	0.0400	0.0400	0.0400	0.0400	0.0400
2	0.3800	0.3800	0.3800	0.3800	0.3800
3	0.8900	0.8900	0.8900	0.8900	0.8900
4	0.9900	0.9900	0.9900	0.9900	0.9900
5	1.0000	1.0000	1.0000	1.0000	1.0000
6	1.0000	1.0000	1.0000	1.0000	1.0000
7	1.0000	1.0000	1.0000	1.0000	1.0000
AGE	2002	2003	2004		
1	0.0400	0.0400	0.0400		
2	0.3800	0.3800	0.3800		
3	0.8900	0.8900	0.8900		
4	0.9900	0.9900	0.9900		
5	1.0000	1.0000	1.0000		
6	1.0000	1.0000	1.0000		
7	1.0000	1.0000	1.0000		

Input Partial Recruitment

AGE

1	0.0000
2	0.0530
3	0.4210
4	1.0000
5	1.0000
6	1.0000

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

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

SURVEY - INPUT DATA

INDEX	6	7	8	9	10
SURVEY TAG	WHAut	WHAut	WHAut	WHAut	WHAut
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	0.6179	0.4188	0.5394	0.4047	0.1205
1983	0.8426	3.3527	2.2748	1.0892	0.2092
1984	0.3168	0.9155	0.8277	0.1970	0.2270
1985	0.4323	0.4258	0.6307	0.3871	0.2140
1986	0.5256	0.9567	0.6094	0.2482	0.1820
1987	0.3920	0.4010	0.6565	0.3417	0.0727
1988	0.5782	1.3796	0.5921	0.2429	0.0751
1989	1.9375	2.3134	0.9896	0.4434	0.0990
1990	0.1495	2.4065	1.5017	0.2926	0.1605
1991	0.0447	0.1868	1.8293	0.5978	0.2589
1992	0.1435	0.1390	0.2233	0.6334	0.0811
1993	0.2910	0.4458	0.1400	0.0355	0.3498
1994	0.1977	0.5678	0.3602	0.0336	0.0000
1995	0.2071	0.8831	0.8260	0.0854	0.0511
1996	0.0680	0.2845	1.2284	0.3252	0.0821
1997	0.1242	0.3826	0.1883	0.5421	0.0616
1998	0.2968	0.0855	0.1769	0.1728	0.1402
1999	0.0966	0.3203	0.1147	0.1923	0.0387
2000	0.4307	0.3672	0.5857	0.2433	0.1320
2001	0.5326	0.9837	0.3936	0.5071	0.1343
2002	0.0340	0.1410	0.7524	0.4690	0.3368
2003	0.2691	0.0805	0.3637	2.7972	1.0958
2004	0.4546	0.1976	0.1848	0.5287	0.4498
2005	0.6513	0.1678	0.5809	0.2311	0.2534

SURVEY - INPUT DATA

INDEX	11	12	13	14	15
SURVEY TAG	MASpr	MASpr	MASpr	MAAut	MAAut
AGE	2	3	4	1	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	7.0600	3.4180	1.1470	2.0180	5.6520
1983	18.5720	5.3310	0.5010	4.6670	2.3460
1984	5.4080	2.2710	0.8650	1.3080	0.6510
1985	3.8220	2.7940	0.6920	12.2960	0.3440
1986	3.2220	0.8870	0.4260	2.8320	0.4190
1987	6.9970	2.2680	0.2570	2.4780	1.1500
1988	11.3560	2.5110	1.3700	389.5840	2.3860
1989	25.2600	6.5800	0.4580	4.5710	20.4900
1990	6.8900	17.7700	2.6400	2.9710	2.7000
1991	3.5600	2.5400	5.0300	9.3700	9.1300
1992	6.3500	3.5800	0.6500	4.6500	4.2000
1993	7.7600	3.6000	1.4500	24.3000	2.0100
1994	5.6700	2.4600	0.5200	49.9200	3.3200
1995	1.3600	3.8900	1.2000	33.4900	14.1300
1996	0.6500	1.1500	2.0000	2.5600	0.6400
1997	1.2500	1.0500	0.2200	7.5900	0.1500
1998	1.8000	0.9900	1.0600	2.0200	0.0200
1999	3.5700	3.4600	1.2000	2.6100	1.0400
2000	7.1200	2.8500	2.6000	6.3400	0.9800
2001	2.7800	4.8100	3.6300	0.0400	0.5400
2002	0.4410	1.6420	2.3790	44.5200	0.0600
2003	9.3380	0.3660	1.7140	0.9900	2.5000
2004	2.0490	3.3500	0.6080	112.7900	3.6600
2005	9.3633	0.6751	2.5750	39.2200	14.3800

SURVEY - INPUT DATA

INDEX	16	17	18	19	20
SURVEY TAG	MAAut	CM_CPE	CM_CPE	CM_CPE	CM_CPE
AGE	3	2	3	4	5
TIME	JAN-1	MEAN	MEAN	MEAN	MEAN
TYPE	NUMBERS	NUMBERS	NUMBERS	NUMBERS	NUMBERS
RETRO FLAG	1	0	0	0	0
1982	7.2900	0.0743	0.0738	0.0450	0.0217
1983	1.0050	0.0477	0.1099	0.0422	0.0209
1984	0.1000	0.0331	0.0448	0.0442	0.0118
1985	0.0220	0.0137	0.0423	0.0289	0.0179
1986	0.0180	0.0041	0.0688	0.0226	0.0066
1987	0.8330	0.0074	0.0186	0.0260	0.0057
1988	0.0200	0.0146	0.0492	0.0242	0.0093
1989	0.6790	0.0170	0.0637	0.0397	0.0106
1990	0.3500	0.0110	0.1595	0.0782	0.0122
1991	1.7400	0.0194	0.0404	0.1355	0.0217
1992	0.8100	0.0149	0.0173	0.0138	0.0515
1993	0.1100	0.0027	0.0500	0.0232	0.0041
1994	0.6100	0.0000	0.0000	0.0000	0.0000
1995	6.3700	0.0000	0.0000	0.0000	0.0000
1996	0.5400	0.0000	0.0000	0.0000	0.0000
1997	0.0200	0.0000	0.0000	0.0000	0.0000
1998	0.0000	0.0000	0.0000	0.0000	0.0000
1999	0.6200	0.0000	0.0000	0.0000	0.0000
2000	0.2800	0.0000	0.0000	0.0000	0.0000
2001	0.2700	0.0000	0.0000	0.0000	0.0000
2002	0.3000	0.0000	0.0000	0.0000	0.0000
2003	0.3000	0.0000	0.0000	0.0000	0.0000
2004	0.3300	0.0000	0.0000	0.0000	0.0000
2005	1.5000	0.0000	0.0000	0.0000	0.0000

INDEX	21				
SURVEY TAG	CM_CPE				
AGE	6	NUMBERS	NUMBERS	NUMBERS	NUMBERS
TIME	MEAN	NUMBERS	NUMBERS	NUMBERS	NUMBERS
TYPE	NUMBERS	NUMBERS	NUMBERS	NUMBERS	NUMBERS
RETRO FLAG	0				

1982	0.0027
1983	0.0123
1984	0.0055
1985	0.0036
1986	0.0043
1987	0.0018
1988	0.0015
1989	0.0023
1990	0.0051
1991	0.0039
1992	0.0052
1993	0.0140
1994	0.0000
1995	0.0000
1996	0.0000
1997	0.0000
1998	0.0000
1999	0.0000
2000	0.0000
2001	0.0000
2002	0.0000
2003	0.0000
2004	0.0000
2005	0.0000

Additional Output Files

Population File C:\ALLWORK\ASSESS\AUG2005WG\GOMCOD\UPDATEVPA\GMCOD2005_RECR_3.PP
 Auxilliary File C:\ALLWORK\ASSESS\AUG2005WG\GOMCOD\UPDATEVPA\GMCOD2005_RECR_3.AU
 Covariance File C:\ALLWORK\ASSESS\AUG2005WG\GOMCOD\UPDATEVPA\GMCOD2005_RECR_3.CV
 Residuals File C:\ALLWORK\ASSESS\AUG2005WG\GOMCOD\UPDATEVPA\GMCOD2005_RECR_3.RS
 Log File C:\ALLWORK\ASSESS\AUG2005WG\GOMCOD\UPDATEVPA\GMCOD2005_RECR_3.LO

Bootstrap Files

Bootstrap Stock Numbers
 C:\ALLWORK\ASSESS\AUG2005WG\GOMCOD\UPDATEVPA\GMCOD2005_RECR_3.BS
 Bootstrap Fishing Mortality
 C:\ALLWORK\ASSESS\AUG2005WG\GOMCOD\UPDATEVPA\GMCOD2005_RECR_3.BS
 Bootstrap Biomass
 C:\ALLWORK\ASSESS\AUG2005WG\GOMCOD\UPDATEVPA\GMCOD2005_RECR_3.BS
 Bootstrap Catchability
 C:\ALLWORK\ASSESS\AUG2005WG\GOMCOD\UPDATEVPA\GMCOD2005_RECR_3.BS

Estimation Results

JAN-1 Population Numbers

AGE	1982	1983	1984	1985	1986
1	7769.	7539.	10464.	7004.	10162.
2	10891.	6281.	6160.	8545.	5690.
3	5359.	7112.	3933.	4307.	6101.
4	3026.	2262.	3202.	1797.	1616.
5	1796.	1223.	780.	1142.	456.
6	170.	822.	382.	214.	333.
7	548.	310.	264.	221.	321.
=====					
Total	29559.	25548.	25185.	23231.	24680.
=====					
AGE	1987	1988	1989	1990	1991
1	12538.	25205.	4301.	4031.	7056.
2	8296.	10228.	20630.	3517.	3294.
3	4471.	5972.	7904.	16411.	2613.
4	2507.	2377.	2953.	4404.	9640.
5	483.	673.	907.	881.	1459.
6	125.	97.	158.	303.	280.
7	153.	64.	106.	191.	158.
=====					
Total	28573.	44616.	36958.	29738.	24500.
=====					
AGE	1992	1993	1994	1995	1996
1	6657.	9624.	3515.	3686.	3504.
2	5773.	5451.	7878.	2877.	3018.
3	2292.	4410.	4325.	6406.	2096.
4	919.	1334.	1802.	2195.	4129.
5	3416.	276.	380.	337.	577.
6	338.	820.	100.	22.	90.
7	135.	67.	119.	54.	20.
=====					
Total	19530.	21981.	18119.	15578.	13433.
=====					
AGE	1997	1998	1999	2000	2001
1	5906.	5096.	7785.	4404.	1030.
2	2868.	4836.	4172.	6373.	3606.
3	2390.	2293.	3858.	3401.	5042.
4	1068.	1506.	1421.	2634.	2296.
5	1612.	450.	666.	665.	1382.
6	140.	511.	204.	301.	366.
7	16.	26.	274.	71.	301.
=====					
Total	14000.	14719.	18380.	17850.	14022.
=====					
AGE	2002	2003	2004	2005	
1	7042.	3063.	22048.	6306.	
2	843.	5766.	2508.	18051.	
3	2843.	688.	4708.	2052.	
4	3165.	2078.	463.	3597.	
5	1298.	1810.	1312.	174.	
6	792.	761.	771.	737.	
7	500.	599.	346.	513.	
=====					
Total	16482.	14764.	32155.	31431.	

Fishing Mortality Calculated

AGE	1982	1983	1984	1985	1986
1	0.0126	0.0021	0.0025	0.0078	0.0028
2	0.2262	0.2682	0.1577	0.1369	0.0412
3	0.6628	0.5979	0.5830	0.7801	0.6894
4	0.7057	0.8642	0.8315	1.1709	1.0083
5	0.5819	0.9646	1.0915	1.0322	1.0968
6	0.6578	0.8983	0.8774	1.1147	1.0271
7	0.6578	0.8983	0.8774	1.1147	1.0271
AGE	1987	1988	1989	1990	1991
1	0.0036	0.0003	0.0013	0.0019	0.0008
2	0.1288	0.0578	0.0288	0.0969	0.1625
3	0.4316	0.5043	0.3847	0.3320	0.8451
4	1.1156	0.7639	1.0093	0.9050	0.8376
5	1.4077	1.2483	0.8945	0.9471	1.2611
6	1.1573	0.8524	0.9812	0.9119	0.8840
7	1.1573	0.8524	0.9812	0.9119	0.8840
AGE	1992	1993	1994	1995	1996
1	0.0000	0.0001	0.0003	0.0000	0.0000
2	0.0694	0.0313	0.0069	0.1168	0.0331
3	0.3415	0.6947	0.4784	0.2392	0.4741
4	1.0012	1.0559	1.4756	1.1357	0.7408
5	1.2263	0.8202	2.6326	1.1232	1.2198
6	1.1742	1.0113	1.6027	1.1341	0.7886
7	1.1742	1.0113	1.6027	1.1341	0.7886
AGE	1997	1998	1999	2000	2001
1	0.0000	0.0000	0.0001	0.0000	0.0000
2	0.0238	0.0259	0.0042	0.0342	0.0378
3	0.2617	0.2789	0.1817	0.1929	0.2658
4	0.6641	0.6162	0.5584	0.4451	0.3703
5	0.9477	0.5922	0.5943	0.3987	0.3566
6	0.8249	0.6106	0.5697	0.4355	0.3651
7	0.8249	0.6106	0.5697	0.4355	0.3651
AGE	2002	2003	2004		
1	0.0000	0.0000	0.0000		
2	0.0026	0.0027	0.0004		
3	0.1135	0.1963	0.0690		
4	0.3587	0.2597	0.7801		
5	0.3346	0.6537	0.3760		
6	0.3516	0.4242	0.5781		
7	0.3516	0.4242	0.5781		

Average Fishing Mortality For Ages 4- 5

Year	Average F	N Weighted	Biomass Wtd	Catch Wtd
1982	0.6438	0.6596	0.6409	0.6635
1983	0.9144	0.8994	0.9109	0.9010
1984	0.9615	0.8824	0.8987	0.8894
1985	1.1015	1.1170	1.1005	1.1193
1986	1.0525	1.0278	1.0364	1.0285
1987	1.2616	1.1627	1.1831	1.1675
1988	1.0061	0.8708	0.9432	0.8967
1989	0.9519	0.9824	0.9760	0.9838
1990	0.9260	0.9120	0.9160	0.9121
1991	1.0493	0.8932	0.9159	0.9055
1992	1.1138	1.1786	1.1890	1.1826
1993	0.9381	1.0155	0.9978	1.0203
1994	2.0541	1.6770	1.7086	1.7096
1995	1.1295	1.1341	1.1330	1.1341
1996	0.9803	0.7995	0.8234	0.8167
1997	0.8059	0.8347	0.8406	0.8500
1998	0.6042	0.6107	0.6092	0.6108
1999	0.5764	0.5699	0.5729	0.5702
2000	0.4219	0.4357	0.4330	0.4364
2001	0.3635	0.3652	0.3638	0.3653
2002	0.3466	0.3516	0.3503	0.3519
2003	0.4567	0.4432	0.4726	0.5144
2004	0.5781	0.4814	0.4675	0.5291

Back Calculated Partial Recruitment

AGE	1982	1983	1984	1985	1986
1	0.0179	0.0021	0.0023	0.0066	0.0026
2	0.3205	0.2780	0.1445	0.1169	0.0376
3	0.9392	0.6198	0.5341	0.6662	0.6286
4	1.0000	0.8958	0.7617	1.0000	0.9193
5	0.8246	1.0000	1.0000	0.8815	1.0000
6	0.9321	0.9312	0.8038	0.9520	0.9365
7	0.9321	0.9312	0.8038	0.9520	0.9365
AGE	1987	1988	1989	1990	1991
1	0.0026	0.0002	0.0013	0.0020	0.0006
2	0.0915	0.0463	0.0285	0.1024	0.1289
3	0.3066	0.4040	0.3812	0.3505	0.6701
4	0.7924	0.6120	1.0000	0.9555	0.6642
5	1.0000	1.0000	0.8863	1.0000	1.0000
6	0.8221	0.6829	0.9721	0.9628	0.7010
7	0.8221	0.6829	0.9721	0.9628	0.7010
AGE	1992	1993	1994	1995	1996
1	0.0000	0.0001	0.0001	0.0000	0.0000
2	0.0566	0.0296	0.0026	0.1028	0.0272
3	0.2785	0.6579	0.1817	0.2106	0.3887
4	0.8165	1.0000	0.5605	1.0000	0.6073
5	1.0000	0.7768	1.0000	0.9890	1.0000
6	0.9575	0.9577	0.6088	0.9985	0.6465
7	0.9575	0.9577	0.6088	0.9985	0.6465
AGE	1997	1998	1999	2000	2001
1	0.0000	0.0000	0.0002	0.0000	0.0000
2	0.0251	0.0421	0.0071	0.0769	0.1021
3	0.2761	0.4526	0.3057	0.4335	0.7179
4	0.7008	1.0000	0.9395	1.0000	1.0000
5	1.0000	0.9609	1.0000	0.8959	0.9630
6	0.8704	0.9909	0.9586	0.9786	0.9861
7	0.8704	0.9909	0.9586	0.9786	0.9861
AGE	2002	2003	2004		
1	0.0000	0.0000	0.0000		
2	0.0073	0.0041	0.0006		
3	0.3165	0.3002	0.0884		
4	1.0000	0.3973	1.0000		
5	0.9328	1.0000	0.4820		
6	0.9803	0.6488	0.7410		
7	0.9803	0.6488	0.7410		

JAN-1 Biomass

AGE	1982	1983	1984	1985	1986
1	3226.	2109.	3666.	1539.	2780.
2	9607.	4880.	4052.	6096.	3488.
3	6870.	9369.	5165.	5509.	8257.
4	6868.	4455.	6673.	3819.	3495.
5	7541.	3880.	2328.	3935.	1624.
6	948.	4381.	1782.	956.	1715.
7	6200.	3082.	2722.	2140.	3761.
Total	41259.	32155.	26390.	23994.	25120.
AGE	1987	1988	1989	1990	1991
1	2253.	1580.	1982.	205.	510.
2	5426.	5722.	9178.	2747.	1326.
3	5616.	7963.	10289.	22982.	3245.
4	5936.	4554.	6706.	8718.	19476.
5	1785.	2676.	2740.	3089.	4421.
6	700.	528.	734.	1637.	1541.
7	1576.	688.	1261.	2587.	1749.
Total	23292.	23711.	32891.	41966.	32269.
AGE	1992	1993	1994	1995	1996
1	1527.	1964.	673.	700.	649.
2	3195.	3624.	5884.	2291.	2424.
3	3378.	7375.	6234.	10371.	3847.
4	1867.	2870.	4259.	4841.	8536.
5	9383.	940.	1074.	1323.	1779.
6	1518.	3540.	506.	109.	549.
7	1427.	730.	1173.	726.	213.
Total	22294.	21043.	19803.	20360.	17995.
AGE	1997	1998	1999	2000	2001
1	1241.	2310.	1295.	800.	215.
2	2361.	3508.	3595.	4588.	3026.
3	4560.	4384.	6032.	5575.	9604.
4	2647.	3822.	3414.	6571.	6226.
5	4359.	1570.	2317.	2308.	5627.
6	563.	1835.	992.	1461.	1952.
7	135.	251.	2114.	499.	2376.
Total	15867.	17679.	19759.	21802.	29026.
AGE	2002	2003	2004	2005	
1	1225.	605.	4354.	1196.	
2	614.	5054.	1935.	14302.	
3	5922.	1246.	10221.	4148.	
4	8970.	5651.	1308.	10048.	
5	4716.	6642.	4468.	620.	
6	4228.	3532.	3595.	3600.	
7	4202.	5198.	3023.	4416.	
Total	29876.	27928.	28904.	38331.	

Mean Biomass

AGE	1982	1983	1984	1985	1986
1	3975.	2928.	4736.	2321.	3890.
2	9560.	5331.	5225.	7385.	5177.
3	5705.	7889.	4426.	4451.	7270.
4	5340.	3399.	5389.	2721.	2706.
5	5895.	2709.	1597.	2891.	1164.
6	751.	2996.	1359.	650.	1155.
7	4162.	1870.	1666.	1190.	2166.
Total	35389.	27123.	24398.	21610.	23529.
AGE	1987	1988	1989	1990	1991
1	3596.	3814.	2337.	522.	1279.
2	7148.	8899.	21852.	3094.	3133.
3	5108.	7540.	10275.	21063.	2458.
4	4345.	3632.	5023.	6083.	14794.
5	1138.	1804.	2115.	2198.	3086.
6	473.	377.	393.	1388.	1236.
7	862.	426.	740.	1562.	1068.
Total	22670.	26492.	42735.	35911.	27054.
AGE	1992	1993	1994	1995	1996
1	2356.	3405.	1244.	1304.	1240.
2	7748.	5509.	10170.	4005.	4447.
3	3389.	5324.	5763.	9508.	3164.
4	1456.	1836.	2672.	3212.	6235.
5	5568.	735.	417.	941.	1104.
6	920.	2894.	281.	88.	423.
7	776.	423.	543.	401.	135.
Total	22212.	20127.	21090.	19458.	16747.
AGE	1997	1998	1999	2000	2001
1	2090.	2887.	2441.	1558.	364.
2	4462.	5834.	4483.	8511.	5789.
3	4217.	3836.	5817.	6360.	9763.
4	2116.	3010.	2732.	6661.	5689.
5	3010.	1278.	1904.	2196.	5121.
6	397.	1436.	819.	1267.	1815.
7	85.	172.	1474.	369.	1815.
Total	16377.	18452.	19671.	26922.	30356.
AGE	2002	2003	2004		
1	2492.	1084.	7801.		
2	1038.	10271.	3465.		
3	5871.	1369.	9886.		
4	8042.	5121.	978.		
5	4082.	4943.	3762.		
6	3589.	3006.	2869.		
7	3230.	3867.	2101.		
Total	28344.	29660.	30863.		

Spawning Stock Biomass

AGE	1982	1983	1984	1985	1986
1	218.	143.	248.	59.	108.
2	2327.	1174.	993.	2766.	1608.
3	3629.	5004.	2765.	4444.	6763.
4	5197.	3283.	4945.	3039.	2858.
5	6421.	3099.	1821.	3204.	1308.
6	822.	3648.	1489.	768.	1397.
7	5374.	2566.	2275.	1719.	3065.
Total	23987.	18916.	14536.	16000.	17107.
AGE	1987	1988	1989	1990	1991
1	87.	61.	77.	22.	54.
2	2465.	2631.	4241.	732.	350.
3	4802.	6727.	8867.	11778.	1527.
4	4767.	3878.	5481.	5874.	13270.
5	1365.	2102.	2283.	2373.	3223.
6	559.	443.	602.	1333.	1261.
7	1257.	578.	1036.	2150.	1460.
Total	15302.	16419.	22587.	24261.	21144.
AGE	1992	1993	1994	1995	1996
1	162.	209.	26.	27.	25.
2	855.	976.	2160.	826.	886.
3	1728.	3558.	4955.	8578.	3060.
4	1238.	1886.	3189.	3836.	7224.
5	6880.	737.	670.	1061.	1404.
6	1183.	2835.	375.	87.	465.
7	1135.	597.	869.	581.	180.
Total	13182.	10797.	12243.	14996.	13244.
AGE	1997	1998	1999	2000	2001
1	48.	89.	50.	31.	8.
2	864.	1284.	1320.	1677.	1105.
3	3758.	3602.	5038.	4647.	7909.
4	2269.	3303.	2979.	5842.	5604.
5	3600.	1376.	2030.	2089.	5128.
6	475.	1603.	872.	1314.	1776.
7	114.	219.	1859.	449.	2163.
Total	11128.	11475.	14149.	16049.	23694.
AGE	2002	2003	2004		
1	47.	23.	168.		
2	226.	1857.	711.		
3	5002.	1038.	8697.		
4	8090.	5182.	1100.		
5	4314.	5761.	4059.		
6	3856.	3183.	3157.		
7	3833.	4685.	2656.		
Total	25369.	21729.	20549.		

Catch Biomass

AGE	1982	1983	1984	1985	1986
1	50.	6.	12.	18.	11.
2	2151.	1421.	820.	1007.	213.
3	3734.	4663.	2551.	3422.	4947.
4	3719.	2891.	4412.	3121.	2679.
5	3392.	2568.	1710.	2929.	1252.
6	494.	2691.	1192.	725.	1186.
7	2738.	1680.	1462.	1327.	2225.
Total	16278.	15920.	12160.	12549.	12514.
AGE	1987	1988	1989	1990	1991
1	13.	1.	3.	1.	1.
2	917.	513.	628.	299.	507.
3	2185.	3764.	3922.	6943.	2045.
4	4752.	2736.	4979.	5415.	12202.
5	1564.	2204.	1861.	2046.	3807.
6	547.	321.	386.	1266.	1093.
7	998.	363.	726.	1424.	944.
Total	10976.	9902.	12504.	17394.	20598.
AGE	1992	1993	1994	1995	1996
1	0.	0.	0.	0.	0.
2	536.	172.	70.	466.	147.
3	1149.	3650.	2730.	2261.	1486.
4	1432.	1903.	3844.	3575.	4555.
5	6683.	594.	1055.	1036.	1318.
6	1080.	2927.	450.	100.	334.
7	911.	428.	871.	454.	107.
Total	11791.	9675.	9021.	7893.	7946.
AGE	1997	1998	1999	2000	2001
1	0.	0.	0.	0.	0.
2	106.	151.	19.	291.	218.
3	1097.	1063.	1052.	1221.	2579.
4	1388.	1833.	1509.	2938.	2090.
5	2804.	748.	1119.	868.	1812.
6	328.	877.	466.	552.	663.
7	70.	105.	840.	161.	663.
Total	5793.	4777.	5006.	6030.	8026.
AGE	2002	2003	2004		
1	0.	0.	0.		
2	3.	28.	2.		
3	664.	267.	680.		
4	2863.	1322.	752.		
5	1356.	3191.	1403.		
6	1262.	1275.	1339.		
7	1136.	1640.	1215.		
Total	7283.	7724.	5391.		

Catch Numbers

AGE	1982	1983	1984	1985	1986
1	88.0	14.0	24.0	49.0	26.0
2	1995.0	1337.0	813.0	989.0	208.0
3	2350.0	2896.0	1572.0	2111.0	2750.0
4	1386.0	1184.0	1636.0	1122.0	929.0
5	717.0	685.0	469.0	665.0	275.0
6	75.0	448.0	205.0	133.0	197.0
7	242.0	169.0	142.0	137.0	190.0
Total	6853.0	6733.0	4861.0	5206.0	4575.0
AGE	1987	1988	1989	1990	1991
1	41.0	6.0	5.0	7.0	5.0
2	907.0	520.0	530.0	294.0	447.0
3	1418.0	2140.0	2284.0	4195.0	1349.0
4	1525.0	1149.0	1698.0	2373.0	4948.0
5	330.0	434.0	485.0	488.0	946.0
6	79.0	51.0	91.0	167.0	151.0
7	97.0	34.0	61.0	105.0	85.0
Total	4397.0	4334.0	5154.0	7629.0	7931.0
AGE	1992	1993	1994	1995	1996
1	0.0	1.0	1.0	0.0	0.0
2	350.0	152.0	49.0	287.0	89.0
3	600.0	1998.0	1488.0	1233.0	716.0
4	526.0	787.0	1258.0	1348.0	1955.0
5	2184.0	140.0	319.0	206.0	368.0
6	216.0	481.0	74.0	14.0	45.0
7	86.0	39.0	88.0	34.0	10.0
Total	3962.0	3598.0	3277.0	3122.0	3183.0
AGE	1997	1998	1999	2000	2001
1	0.0	0.0	1.0	0.0	0.0
2	61.0	112.0	16.0	194.0	121.0
3	498.0	505.0	580.0	540.0	1065.0
4	469.0	627.0	550.0	856.0	643.0
5	893.0	182.0	270.0	198.0	375.0
6	72.0	214.0	81.0	97.0	102.0
7	8.0	11.0	109.0	23.0	84.0
Total	2001.0	1651.0	1607.0	1908.0	2390.0
AGE	2002	2003	2004		
1	0.0	0.0	0.0		
2	2.0	14.0	1.0		
3	276.0	111.0	284.0		
4	863.0	430.0	227.0		
5	334.0	786.0	372.0		
6	214.0	240.0	250.0		
7	135.0	189.0	139.0		
Total	1824.0	1770.0	1273.0		

Surplus Production

Average Adjustment Factor (Delta) = 1.0000

Year	Biomass	Delta Biomass	Catch Biomass	Surplus Production
1982	41259.363	-9104.261	16277.522	7173.261
1983	32155.101	-5764.971	15920.355	10155.384
1984	26390.130	-2396.578	12160.046	9763.468
1985	23993.552	1126.324	12549.410	13675.734
1986	25119.875	-1827.772	12513.581	10685.809
1987	23292.104	419.261	10975.911	11395.172
1988	23711.365	9179.238	9902.101	19081.339
1989	32890.602	9075.122	12504.203	21579.325
1990	41965.724	-9697.121	17394.131	7697.010
1991	32268.604	-9974.321	20598.402	10624.081
1992	22294.283	-1251.467	11790.660	10539.193
1993	21042.815	-1239.488	9674.657	8435.169
1994	19803.327	556.214	9021.290	9577.505
1995	20359.541	-2364.386	7892.760	5528.374
1996	17995.155	-2128.399	7946.164	5817.766
1997	15866.756	1812.271	5792.501	7604.773
1998	17679.028	2080.334	4776.532	6856.866
1999	19759.362	2042.608	5005.636	7048.244
2000	21801.970	7224.358	6030.463	13254.821
2001	29026.328	850.122	8025.918	8876.040
2002	29876.450	-1948.180	7282.631	5334.451
2003	27928.270	975.937	7723.623	8699.561
2004	28904.207	9426.874	5390.772	14817.646
2005	38331.081			

Summary of Survey Indices Used in the Estimate

INDEX	Survey Tag	Age	Time	Type	Catchability	Std. Error	CV
1	WHSpr	2	JAN-1	NUMBER	0.5407E-04	0.8377E-05	0.1549E+00
2	WHSpr	3	JAN-1	NUMBER	0.1193E-03	0.1191E-04	0.9983E-01
3	WHSpr	4	JAN-1	NUMBER	0.2133E-03	0.1852E-04	0.8682E-01
4	WHSpr	5	JAN-1	NUMBER	0.2863E-03	0.3514E-04	0.1228E+00
5	WHSpr	6	JAN-1	NUMBER	0.3853E-03	0.6688E-04	0.1736E+00
6	WHAut	2	JAN-1	NUMBER	0.5126E-04	0.6533E-05	0.1275E+00
7	WHAut	3	JAN-1	NUMBER	0.1146E-03	0.1428E-04	0.1246E+00
8	WHAut	4	JAN-1	NUMBER	0.2355E-03	0.2491E-04	0.1058E+00
9	WHAut	5	JAN-1	NUMBER	0.3778E-03	0.4971E-04	0.1316E+00
10	WHAut	6	JAN-1	NUMBER	0.5428E-03	0.6637E-04	0.1223E+00
11	MASpr	2	JAN-1	NUMBER	0.8026E-03	0.9531E-04	0.1188E+00
12	MASpr	3	JAN-1	NUMBER	0.6226E-03	0.5926E-04	0.9519E-01
13	MASpr	4	JAN-1	NUMBER	0.4933E-03	0.6966E-04	0.1412E+00
15	MAAut	2	JAN-1	NUMBER	0.2696E-03	0.8275E-04	0.3069E+00
18	CM_CPE	3	MEAN	NUMBER	0.1427E-04	0.1714E-05	0.1201E+00
19	CM_CPE	4	MEAN	NUMBER	0.2411E-04	0.1410E-05	0.5848E-01
20	CM_CPE	5	MEAN	NUMBER	0.2465E-04	0.1128E-05	0.4574E-01
21	CM_CPE	6	MEAN	NUMBER	0.2564E-04	0.7432E-06	0.2899E-01

Survey Index: 1 Tag: WHSpr AGE = 2
 Time = JAN-1 Type = NUMBER
 Catchability = 0.540727E-04 % Variance Contribution = 7.9876
 Residual = LN(Observed) - LN(Predicted)

Year	Observed	Predicted	Residual
1982	0.100650E+01	0.588932E+00	0.535923E+00
1983	0.948600E+00	0.339625E+00	0.102715E+01
1984	0.131200E+01	0.333063E+00	0.137098E+01
1985	0.230800E+00	0.462060E+00	-0.694144E+00
1986	0.247800E+00	0.307693E+00	-0.216481E+00
1987	0.460200E+00	0.448589E+00	0.255534E-01
1988	0.923400E+00	0.553076E+00	0.512567E+00
1989	0.604800E+00	0.111553E+01	-0.612191E+00
1990	0.207600E+00	0.190165E+00	0.877210E-01
1991	0.678000E-01	0.178095E+00	-0.965753E+00
1992	0.225500E+00	0.312145E+00	-0.325149E+00
1993	0.496500E+00	0.294730E+00	0.521523E+00
1994	0.315600E+00	0.426006E+00	-0.299978E+00
1995	0.179200E+00	0.155572E+00	0.141391E+00
1996	0.215000E-01	0.163179E+00	-0.202680E+01
1997	0.131600E+00	0.155104E+00	-0.164331E+00
1998	0.223600E+00	0.261472E+00	-0.156467E+00
1999	0.344300E+00	0.225601E+00	0.422746E+00
2000	0.724700E+00	0.344607E+00	0.743353E+00
2001	0.323400E+00	0.194963E+00	0.506078E+00
2002	0.453000E-01	0.455832E-01	-0.623149E-02
2003	0.830500E+00	0.311760E+00	0.979795E+00
2004	0.446000E-01	0.135595E+00	-0.111194E+01
2005	0.726500E+00	0.976085E+00	-0.295312E+00

Survey Index: 2 Tag: WHSpr AGE = 3
 Time = JAN-1 Type = NUMBER
 Catchability = 0.119324E-03 % Variance Contribution = 3.3168
 Residual = LN(Observed) - LN(Predicted)

Year	Observed	Predicted	Residual
1982	0.476400E+00	0.639506E+00	-0.294438E+00
1983	0.996800E+00	0.848640E+00	0.160915E+00
1984	0.102260E+01	0.469254E+00	0.778960E+00
1985	0.661700E+00	0.513974E+00	0.252639E+00
1986	0.754000E+00	0.728034E+00	0.350450E-01
1987	0.199100E+00	0.533459E+00	-0.985575E+00
1988	0.822900E+00	0.712549E+00	0.143986E+00
1989	0.723000E+00	0.943112E+00	-0.265776E+00
1990	0.136540E+01	0.195824E+01	-0.360598E+00
1991	0.233900E+00	0.311833E+00	-0.287573E+00
1992	0.242400E+00	0.273506E+00	-0.120733E+00
1993	0.799300E+00	0.526172E+00	0.418109E+00
1994	0.387500E+00	0.516085E+00	-0.286555E+00
1995	0.111610E+01	0.764385E+00	0.378525E+00
1996	0.592700E+00	0.250089E+00	0.862870E+00
1997	0.399100E+00	0.285211E+00	0.335983E+00
1998	0.330100E+00	0.273645E+00	0.187565E+00
1999	0.713300E+00	0.460314E+00	0.437992E+00
2000	0.438500E+00	0.405871E+00	0.773246E-01
2001	0.716100E+00	0.601664E+00	0.174121E+00
2002	0.524400E+00	0.339181E+00	0.435722E+00
2003	0.630000E-01	0.821403E-01	-0.265294E+00
2004	0.221300E+00	0.561752E+00	-0.931541E+00
2005	0.101400E+00	0.244875E+00	-0.881673E+00

Survey Index: 3 Tag: WHSpr AGE = 4
 Time = JAN-1 Type = NUMBER
 Catchability = 0.213271E-03 % Variance Contribution = 2.5085
 Residual = LN(Observed) - LN(Predicted)

Year	Observed	Predicted	Residual
1982	0.655400E+00	0.645324E+00	0.154926E-01
1983	0.464700E+00	0.482320E+00	-0.372160E-01
1984	0.823300E+00	0.682988E+00	0.186843E+00
1985	0.662500E+00	0.383318E+00	0.547155E+00
1986	0.236900E+00	0.344746E+00	-0.375170E+00
1987	0.230700E+00	0.534676E+00	-0.840542E+00
1988	0.217900E+00	0.506991E+00	-0.844456E+00
1989	0.600100E+00	0.629732E+00	-0.481973E-01
1990	0.637000E+00	0.939334E+00	-0.388402E+00
1991	0.171670E+01	0.205603E+01	-0.180374E+00
1992	0.281900E+00	0.195992E+00	0.363477E+00
1993	0.334300E+00	0.284446E+00	0.161496E+00
1994	0.215000E+00	0.384401E+00	-0.581048E+00
1995	0.371700E+00	0.468058E+00	-0.230505E+00
1996	0.133070E+01	0.880613E+00	0.412842E+00
1997	0.264300E+00	0.227794E+00	0.148641E+00
1998	0.516600E+00	0.321258E+00	0.475025E+00
1999	0.344500E+00	0.302982E+00	0.128422E+00
2000	0.457000E+00	0.561669E+00	-0.206229E+00
2001	0.497200E+00	0.489719E+00	0.151606E-01
2002	0.160120E+01	0.674917E+00	0.863918E+00
2003	0.707700E+00	0.443074E+00	0.468283E+00
2004	0.118100E+00	0.987786E-01	0.178651E+00
2005	0.607600E+00	0.767227E+00	-0.233266E+00

Survey Index: 4 Tag: WHSpr AGE = 5
 Time = JAN-1 Type = NUMBER
 Catchability = 0.286265E-03 % Variance Contribution = 5.0158
 Residual = LN(Observed) - LN(Predicted)

Year	Observed	Predicted	Residual
1982	0.987700E+00	0.514157E+00	0.652851E+00
1983	0.404200E+00	0.350172E+00	0.143485E+00
1984	0.211800E+00	0.223362E+00	-0.531492E-01
1985	0.661700E+00	0.326807E+00	0.705442E+00
1986	0.912000E-01	0.130623E+00	-0.359262E+00
1987	0.744000E-01	0.138226E+00	-0.619431E+00
1988	0.253500E+00	0.192571E+00	0.274900E+00
1989	0.908000E-01	0.259539E+00	-0.105025E+01
1990	0.102000E+00	0.252221E+00	-0.905334E+00
1991	0.299300E+00	0.417618E+00	-0.333121E+00
1992	0.132810E+01	0.977825E+00	0.306173E+00
1993	0.906000E-01	0.791392E-01	0.135245E+00
1994	0.942000E-01	0.108740E+00	-0.143539E+00
1995	0.145400E+00	0.965857E-01	0.409057E+00
1996	0.403200E+00	0.165209E+00	0.892224E+00
1997	0.875600E+00	0.461358E+00	0.640734E+00
1998	0.141500E+00	0.128853E+00	0.936312E-01
1999	0.315000E+00	0.190638E+00	0.502195E+00
2000	0.107100E+00	0.190498E+00	-0.575881E+00
2001	0.353900E+00	0.395521E+00	-0.111191E+00
2002	0.614200E+00	0.371624E+00	0.502438E+00
2003	0.108890E+01	0.518162E+00	0.742635E+00
2004	0.190800E+00	0.375536E+00	-0.677128E+00
2005	0.154000E-01	0.497543E-01	-0.117273E+01

Survey Index: 5 Tag: WHSpr AGE = 6
 Time = JAN-1 Type = NUMBER
 Catchability = 0.385326E-03 % Variance Contribution = 9.1926
 Residual = LN(Observed) - LN(Predicted)

Year	Observed	Predicted	Residual
1982	0.873000E-01	0.654394E-01	0.288225E+00
1983	0.211800E+00	0.316640E+00	-0.402123E+00
1984	0.467000E-01	0.147077E+00	-0.114721E+01
1985	0.103100E+00	0.826356E-01	0.221259E+00
1986	0.349000E-01	0.128301E+00	-0.130189E+01
1987	N/A	0.480727E-01	N/A
1988	0.915000E-01	0.372748E-01	0.898022E+00
1989	0.627000E-01	0.609055E-01	0.290376E-01
1990	0.321000E-01	0.116926E+00	-0.129269E+01
1991	0.200000E-01	0.107816E+00	-0.168469E+01
1992	0.226400E+00	0.130407E+00	0.551644E+00
1993	0.484200E+00	0.316146E+00	0.426294E+00
1994	0.493000E-01	0.384035E-01	0.249776E+00
1995	0.283000E-01	0.861526E-02	0.118933E+01
1996	0.593000E-01	0.346190E-01	0.538206E+00
1997	0.242400E+00	0.537624E-01	0.150602E+01
1998	0.421000E+00	0.197090E+00	0.758975E+00
1999	0.133700E+00	0.785465E-01	0.531908E+00
2000	0.100600E+00	0.115956E+00	-0.142057E+00
2001	0.635000E-01	0.140905E+00	-0.797045E+00
2002	0.361900E+00	0.305139E+00	0.170602E+00
2003	0.394600E+00	0.293097E+00	0.297368E+00
2004	0.231600E+00	0.296997E+00	-0.248710E+00
2005	0.149800E+00	0.284159E+00	-0.640234E+00

Survey Index: 6 Tag: WHAut AGE = 2
 Time = JAN-1 Type = NUMBER
 Catchability = 0.512569E-04 % Variance Contribution = 5.4071
 Residual = LN(Observed) - LN(Predicted)

Year	Observed	Predicted	Residual
1982	0.617900E+00	0.558264E+00	0.101495E+00
1983	0.842600E+00	0.321939E+00	0.962131E+00
1984	0.316800E+00	0.315719E+00	0.341819E-02
1985	0.432300E+00	0.437999E+00	-0.130957E-01
1986	0.525600E+00	0.291670E+00	0.588917E+00
1987	0.392000E+00	0.425229E+00	-0.813664E-01
1988	0.578200E+00	0.524275E+00	0.979035E-01
1989	0.193750E+01	0.105744E+01	0.605544E+00
1990	0.149500E+00	0.180262E+00	-0.187116E+00
1991	0.447000E-01	0.168820E+00	-0.132886E+01
1992	0.143500E+00	0.295891E+00	-0.723655E+00
1993	0.291000E+00	0.279382E+00	0.407426E-01
1994	0.197700E+00	0.403822E+00	-0.714223E+00
1995	0.207100E+00	0.147471E+00	0.339570E+00
1996	0.680000E-01	0.154682E+00	-0.821863E+00
1997	0.124200E+00	0.147027E+00	-0.168725E+00
1998	0.296800E+00	0.247856E+00	0.180213E+00
1999	0.966000E-01	0.213853E+00	-0.794709E+00
2000	0.430700E+00	0.326662E+00	0.276487E+00
2001	0.532600E+00	0.184811E+00	0.105844E+01
2002	0.340000E-01	0.432094E-01	-0.239698E+00
2003	0.269100E+00	0.295525E+00	-0.936700E-01
2004	0.454600E+00	0.128534E+00	0.126323E+01
2005	0.651300E+00	0.925256E+00	-0.351100E+00

Survey Index: 7 Tag: WHAut AGE = 3
 Time = JAN-1 Type = NUMBER
 Catchability = 0.114621E-03 % Variance Contribution = 5.1693
 Residual = LN(Observed) - LN(Predicted)

Year	Observed	Predicted	Residual
1982	0.418800E+00	0.614299E+00	-0.383088E+00
1983	0.335270E+01	0.815189E+00	0.141410E+01
1984	0.915500E+00	0.450757E+00	0.708542E+00
1985	0.425800E+00	0.493715E+00	-0.147989E+00
1986	0.956700E+00	0.699337E+00	0.313357E+00
1987	0.401000E+00	0.512432E+00	-0.245206E+00
1988	0.137960E+01	0.684463E+00	0.700915E+00
1989	0.231340E+01	0.905938E+00	0.937503E+00
1990	0.240650E+01	0.188105E+01	0.246342E+00
1991	0.186800E+00	0.299541E+00	-0.472214E+00
1992	0.139000E+00	0.262725E+00	-0.636634E+00
1993	0.445800E+00	0.505432E+00	-0.125542E+00
1994	0.567800E+00	0.495742E+00	0.135713E+00
1995	0.883100E+00	0.734255E+00	0.184582E+00
1996	0.284500E+00	0.240232E+00	0.169130E+00
1997	0.382600E+00	0.273969E+00	0.333975E+00
1998	0.855000E-01	0.262858E+00	-0.112310E+01
1999	0.320300E+00	0.442170E+00	-0.322437E+00
2000	0.367200E+00	0.389873E+00	-0.599138E-01
2001	0.983700E+00	0.577948E+00	0.531837E+00
2002	0.141000E+00	0.325811E+00	-0.837558E+00
2003	0.805000E-01	0.789025E-01	0.200436E-01
2004	0.197600E+00	0.539610E+00	-0.100460E+01
2005	0.167800E+00	0.235222E+00	-0.337759E+00

Survey Index: 8 Tag: WHAut AGE = 4
 Time = JAN-1 Type = NUMBER
 Catchability = 0.235486E-03 % Variance Contribution = 3.7257
 Residual = LN(Observed) - LN(Predicted)

Year	Observed	Predicted	Residual
1982	0.539400E+00	0.712544E+00	-0.278385E+00
1983	0.227480E+01	0.532561E+00	0.145195E+01
1984	0.827700E+00	0.754132E+00	0.930835E-01
1985	0.630700E+00	0.423247E+00	0.398875E+00
1986	0.609400E+00	0.380656E+00	0.470578E+00
1987	0.656500E+00	0.590370E+00	0.106173E+00
1988	0.592100E+00	0.559801E+00	0.560940E-01
1989	0.989600E+00	0.695327E+00	0.352918E+00
1990	0.150170E+01	0.103718E+01	0.370092E+00
1991	0.182930E+01	0.227020E+01	-0.215933E+00
1992	0.223300E+00	0.216408E+00	0.313516E-01
1993	0.140000E+00	0.314075E+00	-0.807989E+00
1994	0.360200E+00	0.424442E+00	-0.164116E+00
1995	0.826000E+00	0.516813E+00	0.468913E+00
1996	0.122840E+01	0.972342E+00	0.233760E+00
1997	0.188300E+00	0.251523E+00	-0.289497E+00
1998	0.176900E+00	0.354722E+00	-0.695749E+00
1999	0.114700E+00	0.334542E+00	-0.107044E+01
2000	0.585700E+00	0.620175E+00	-0.571944E-01
2001	0.393600E+00	0.540730E+00	-0.317586E+00
2002	0.752400E+00	0.745220E+00	0.958863E-02
2003	0.363700E+00	0.489227E+00	-0.296497E+00
2004	0.184800E+00	0.109068E+00	0.527304E+00
2005	0.580900E+00	0.847145E+00	-0.377294E+00

Survey Index: 9 Tag: WHAut AGE = 5
 Time = JAN-1 Type = NUMBER
 Catchability = 0.377789E-03 % Variance Contribution = 5.7618
 Residual = LN(Observed) - LN(Predicted)

Year	Observed	Predicted	Residual
1982	0.404700E+00	0.678542E+00	-0.516800E+00
1983	0.108920E+01	0.462128E+00	0.857356E+00
1984	0.197000E+00	0.294774E+00	-0.403006E+00
1985	0.387100E+00	0.431293E+00	-0.108106E+00
1986	0.248200E+00	0.172386E+00	0.364500E+00
1987	0.341700E+00	0.182419E+00	0.627628E+00
1988	0.242900E+00	0.254139E+00	-0.452317E-01
1989	0.443400E+00	0.342518E+00	0.258148E+00
1990	0.292600E+00	0.332861E+00	-0.128918E+00
1991	0.597800E+00	0.551138E+00	0.812705E-01
1992	0.633400E+00	0.129045E+01	-0.711647E+00
1993	0.355000E-01	0.104441E+00	-0.107909E+01
1994	0.336000E-01	0.143506E+00	-0.145185E+01
1995	0.854000E-01	0.127466E+00	-0.400503E+00
1996	0.325200E+00	0.218029E+00	0.399814E+00
1997	0.542100E+00	0.608863E+00	-0.116142E+00
1998	0.172800E+00	0.170049E+00	0.160483E-01
1999	0.192300E+00	0.251589E+00	-0.268739E+00
2000	0.243300E+00	0.251404E+00	-0.327665E-01
2001	0.507100E+00	0.521977E+00	-0.289149E-01
2002	0.469000E+00	0.490439E+00	-0.446977E-01
2003	0.279720E+01	0.683828E+00	0.140867E+01
2004	0.528700E+00	0.495601E+00	0.646495E-01
2005	0.231100E+00	0.656616E-01	0.125834E+01

Survey Index: 10 Tag: WHAut AGE = 6
 Time = JAN-1 Type = NUMBER
 Catchability = 0.542803E-03 % Variance Contribution = 4.5616
 Residual = LN(Observed) - LN(Predicted)

Year	Observed	Predicted	Residual
1982	0.120500E+00	0.921834E-01	0.267870E+00
1983	0.209200E+00	0.446045E+00	-0.757130E+00
1984	0.227000E+00	0.207185E+00	0.913361E-01
1985	0.214000E+00	0.116407E+00	0.608881E+00
1986	0.182000E+00	0.180736E+00	0.697072E-02
1987	0.727000E-01	0.677191E-01	0.709727E-01
1988	0.751000E-01	0.525083E-01	0.357848E+00
1989	0.990000E-01	0.857966E-01	0.143141E+00
1990	0.160500E+00	0.164712E+00	-0.259052E-01
1991	0.258900E+00	0.151878E+00	0.533361E+00
1992	0.811000E-01	0.183702E+00	-0.817631E+00
1993	0.349800E+00	0.445350E+00	-0.241498E+00
1994	N/A	0.540983E-01	N/A
1995	0.511000E-01	0.121362E-01	0.143759E+01
1996	0.821000E-01	0.487672E-01	0.520880E+00
1997	0.616000E-01	0.757341E-01	-0.206567E+00
1998	0.140200E+00	0.277637E+00	-0.683243E+00
1999	0.387000E-01	0.110647E+00	-0.105051E+01
2000	0.132000E+00	0.163345E+00	-0.213062E+00
2001	0.134300E+00	0.198490E+00	-0.390664E+00
2002	0.336800E+00	0.429844E+00	-0.243932E+00
2003	0.109580E+01	0.412881E+00	0.976080E+00
2004	0.449800E+00	0.418374E+00	0.724263E-01
2005	0.253400E+00	0.400290E+00	-0.457221E+00

Survey Index: 11 Tag: MASpr AGE = 2
 Time = JAN-1 Type = NUMBER
 Catchability = 0.802556E-03 % Variance Contribution = 4.6938
 Residual = LN(Observed) - LN(Predicted)

Year	Observed	Predicted	Residual
1982	0.706000E+01	0.874104E+01	-0.213584E+00
1983	0.185720E+02	0.504077E+01	0.130410E+01
1984	0.540800E+01	0.494338E+01	0.898297E-01
1985	0.382200E+01	0.685798E+01	-0.584639E+00
1986	0.322200E+01	0.456683E+01	-0.348818E+00
1987	0.699700E+01	0.665804E+01	0.496561E-01
1988	0.113560E+02	0.820886E+01	0.324533E+00
1989	0.252600E+02	0.165570E+02	0.422415E+00
1990	0.689000E+01	0.282246E+01	0.892461E+00
1991	0.356000E+01	0.264331E+01	0.297728E+00
1992	0.635000E+01	0.463292E+01	0.315268E+00
1993	0.776000E+01	0.437444E+01	0.573204E+00
1994	0.567000E+01	0.632286E+01	-0.108982E+00
1995	0.136000E+01	0.230903E+01	-0.529345E+00
1996	0.650000E+00	0.242194E+01	-0.131535E+01
1997	0.125000E+01	0.230209E+01	-0.610672E+00
1998	0.180000E+01	0.388081E+01	-0.768257E+00
1999	0.357000E+01	0.334841E+01	0.640807E-01
2000	0.712000E+01	0.511472E+01	0.330786E+00
2001	0.278000E+01	0.289368E+01	-0.400783E-01
2002	0.441000E+00	0.676553E+00	-0.427967E+00
2003	0.933800E+01	0.462719E+01	0.702142E+00
2004	0.204900E+01	0.201252E+01	0.179622E-01
2005	0.936330E+01	0.144872E+02	-0.436470E+00

Survey Index: 12 Tag: MASpr AGE = 3
 Time = JAN-1 Type = NUMBER
 Catchability = 0.622564E-03 % Variance Contribution = 3.0159
 Residual = LN(Observed) - LN(Predicted)

Year	Observed	Predicted	Residual
1982	0.341800E+01	0.333657E+01	0.241128E-01
1983	0.533100E+01	0.442771E+01	0.185657E+00
1984	0.227100E+01	0.244829E+01	-0.751697E-01
1985	0.279400E+01	0.268162E+01	0.410543E-01
1986	0.887000E+00	0.379845E+01	-0.145450E+01
1987	0.226800E+01	0.278328E+01	-0.204730E+00
1988	0.251100E+01	0.371766E+01	-0.392414E+00
1989	0.658000E+01	0.492061E+01	0.290603E+00
1990	0.177700E+02	0.102169E+02	0.553464E+00
1991	0.254000E+01	0.162696E+01	0.445450E+00
1992	0.358000E+01	0.142699E+01	0.919793E+00
1993	0.360000E+01	0.274525E+01	0.271060E+00
1994	0.246000E+01	0.269263E+01	-0.903563E-01
1995	0.389000E+01	0.398811E+01	-0.249087E-01
1996	0.115000E+01	0.130482E+01	-0.126303E+00
1997	0.105000E+01	0.148806E+01	-0.348686E+00
1998	0.990000E+00	0.142772E+01	-0.366127E+00
1999	0.346000E+01	0.240165E+01	0.365112E+00
2000	0.285000E+01	0.211760E+01	0.297037E+00
2001	0.481000E+01	0.313913E+01	0.426752E+00
2002	0.164200E+01	0.176965E+01	-0.748646E-01
2003	0.366000E+00	0.428560E+00	-0.157797E+00
2004	0.335000E+01	0.293089E+01	0.133653E+00
2005	0.675100E+00	0.127761E+01	-0.637888E+00

Survey Index: 13 Tag: MASpr AGE = 4
 Time = JAN-1 Type = NUMBER
 Catchability = 0.493316E-03 % Variance Contribution = 6.6369
 Residual = LN(Observed) - LN(Predicted)

Year	Observed	Predicted	Residual
1982	0.114700E+01	0.149270E+01	-0.263435E+00
1983	0.501000E+00	0.111565E+01	-0.800589E+00
1984	0.865000E+00	0.157982E+01	-0.602336E+00
1985	0.692000E+00	0.886653E+00	-0.247867E+00
1986	0.426000E+00	0.797431E+00	-0.626956E+00
1987	0.257000E+00	0.123676E+01	-0.157117E+01
1988	0.137000E+01	0.117272E+01	0.155486E+00
1989	0.458000E+00	0.145663E+01	-0.115701E+01
1990	0.264000E+01	0.217277E+01	0.194775E+00
1991	0.503000E+01	0.475580E+01	0.560553E-01
1992	0.650000E+00	0.453349E+00	0.360310E+00
1993	0.145000E+01	0.657950E+00	0.790189E+00
1994	0.520000E+00	0.889157E+00	-0.536445E+00
1995	0.120000E+01	0.108266E+01	0.102897E+00
1996	0.200000E+01	0.203694E+01	-0.183034E-01
1997	0.220000E+00	0.526911E+00	-0.873404E+00
1998	0.106000E+01	0.743101E+00	0.355193E+00
1999	0.120000E+01	0.700826E+00	0.537818E+00
2000	0.260000E+01	0.129920E+01	0.693767E+00
2001	0.363000E+01	0.113277E+01	0.116457E+01
2002	0.237900E+01	0.156115E+01	0.421258E+00
2003	0.171400E+01	0.102487E+01	0.514260E+00
2004	0.608000E+00	0.228484E+00	0.978707E+00
2005	0.257500E+01	0.177467E+01	0.372234E+00

Survey Index: 15 Tag: MAAut AGE = 2
 Time = JAN-1 Type = NUMBER
 Catchability = 0.269618E-03 % Variance Contribution = 31.3532
 Residual = LN(Observed) - LN(Predicted)

Year	Observed	Predicted	Residual
1982	0.565200E+01	0.293655E+01	0.654775E+00
1983	0.234600E+01	0.169344E+01	0.325947E+00
1984	0.651000E+00	0.166073E+01	-0.936501E+00
1985	0.344000E+00	0.230393E+01	-0.190173E+01
1986	0.419000E+00	0.153423E+01	-0.129791E+01
1987	0.115000E+01	0.223677E+01	-0.665269E+00
1988	0.238600E+01	0.275776E+01	-0.144801E+00
1989	0.204900E+02	0.556230E+01	0.130392E+01
1990	0.270000E+01	0.948205E+00	0.104644E+01
1991	0.913000E+01	0.888019E+00	0.233033E+01
1992	0.420000E+01	0.155643E+01	0.992692E+00
1993	0.201000E+01	0.146959E+01	0.313151E+00
1994	0.332000E+01	0.212416E+01	0.446588E+00
1995	0.141300E+02	0.775719E+00	0.290227E+01
1996	0.640000E+00	0.813649E+00	-0.240061E+00
1997	0.150000E+00	0.773385E+00	-0.164014E+01
1998	0.200000E-01	0.130375E+01	-0.417727E+01
1999	0.104000E+01	0.112490E+01	-0.784695E-01
2000	0.980000E+00	0.171829E+01	-0.561530E+00
2001	0.540000E+00	0.972130E+00	-0.587921E+00
2002	0.600000E-01	0.227288E+00	-0.133187E+01
2003	0.250000E+01	0.155450E+01	0.475135E+00
2004	0.366000E+01	0.676106E+00	0.168887E+01
2005	0.143800E+02	0.486698E+01	0.108337E+01

Survey Index: 18 Tag: CM_CPE AGE = 3
 Time = MEAN Type = NUMBER
 Catchability = 0.142705E-04 % Variance Contribution = 1.1478
 Residual = LN(Observed) - LN(Predicted)

Year	Observed	Predicted	Residual
1982	0.738000E-01	0.512376E-01	0.364885E+00
1983	0.109900E+00	0.699259E-01	0.452135E+00
1984	0.448000E-01	0.389163E-01	0.140794E+00
1985	0.423000E-01	0.391810E-01	0.765948E-01
1986	0.688000E-01	0.576703E-01	0.176461E+00
1987	0.186000E-01	0.472994E-01	-0.933336E+00
1988	0.492000E-01	0.611694E-01	-0.217753E+00
1989	0.637000E-01	0.854027E-01	-0.293194E+00
1990	0.159500E+00	0.181622E+00	-0.129881E+00
1991	0.404000E-01	0.231355E-01	0.557461E+00
1992	0.173000E-01	0.252573E-01	-0.378408E+00
1993	0.500000E-01	0.415867E-01	0.184242E+00
1994	N/A	0.448143E-01	N/A
1995	N/A	0.739850E-01	N/A
1996	N/A	0.217581E-01	N/A
1997	N/A	0.273194E-01	N/A
1998	N/A	0.260048E-01	N/A
1999	N/A	0.457627E-01	N/A
2000	N/A	0.401391E-01	N/A
2001	N/A	0.575218E-01	N/A
2002	N/A	0.348210E-01	N/A
2003	N/A	0.811069E-02	N/A
2004	N/A	0.589052E-01	N/A
2005	N/A	0.000000E+00	N/A

Survey Index: 19 Tag: CM_CPE AGE = 4
 Time = MEAN Type = NUMBER
 Catchability = 0.241124E-04 % Variance Contribution = 0.2722
 Residual = LN(Observed) - LN(Predicted)

Year	Observed	Predicted	Residual
1982	0.450000E-01	0.479914E-01	-0.643601E-01
1983	0.422000E-01	0.335634E-01	0.228985E+00
1984	0.442000E-01	0.481757E-01	-0.861294E-01
1985	0.289000E-01	0.235870E-01	0.203147E+00
1986	0.226000E-01	0.226224E-01	-0.991411E-03
1987	0.260000E-01	0.336209E-01	-0.257051E+00
1988	0.242000E-01	0.367856E-01	-0.418754E+00
1989	0.397000E-01	0.413056E-01	-0.396474E-01
1990	0.782000E-01	0.642782E-01	0.196049E+00
1991	0.135500E+00	0.144659E+00	-0.654064E-01
1992	0.138000E-01	0.128976E-01	0.676245E-01
1993	0.232000E-01	0.183131E-01	0.236534E+00
1994	N/A	0.210818E-01	N/A
1995	N/A	0.291996E-01	N/A
1996	N/A	0.645212E-01	N/A
1997	N/A	0.172440E-01	N/A
1998	N/A	0.248263E-01	N/A
1999	N/A	0.240106E-01	N/A
2000	N/A	0.467972E-01	N/A
2001	N/A	0.421974E-01	N/A
2002	N/A	0.584631E-01	N/A
2003	N/A	0.401581E-01	N/A
2004	N/A	0.711843E-02	N/A
2005	N/A	0.000000E+00	N/A

Survey Index: 20 Tag: CM_CPE AGE = 5
 Time = MEAN Type = NUMBER
 Catchability = 0.246504E-04 % Variance Contribution = 0.1665
 Residual = LN(Observed) - LN(Predicted)

Year	Observed	Predicted	Residual
1982	0.217000E-01	0.307160E-01	-0.347470E+00
1983	0.209000E-01	0.178120E-01	0.159879E+00
1984	0.118000E-01	0.107991E-01	0.886351E-01
1985	0.179000E-01	0.161778E-01	0.101159E+00
1986	0.660000E-02	0.630230E-02	0.461550E-01
1987	0.570000E-02	0.592016E-02	-0.378968E-01
1988	0.930000E-02	0.875919E-02	0.599108E-01
1989	0.106000E-01	0.135847E-01	-0.248087E+00
1990	0.122000E-01	0.129214E-01	-0.574517E-01
1991	0.217000E-01	0.189030E-01	0.137993E+00
1992	0.515000E-01	0.448547E-01	0.138154E+00
1993	0.410000E-02	0.427151E-02	-0.409796E-01
1994	N/A	0.311110E-02	N/A
1995	N/A	0.461182E-02	N/A
1996	N/A	0.759740E-02	N/A
1997	N/A	0.236295E-01	N/A
1998	N/A	0.766357E-02	N/A
1999	N/A	0.113275E-01	N/A
2000	N/A	0.123425E-01	N/A
2001	N/A	0.261187E-01	N/A
2002	N/A	0.247880E-01	N/A
2003	N/A	0.300085E-01	N/A
2004	N/A	0.245821E-01	N/A
2005	N/A	0.000000E+00	N/A

Survey Index: 21 Tag: CM_CPE AGE = 6
 Time = MEAN Type = NUMBER
 Catchability = 0.256380E-04 % Variance Contribution = 0.0669
 Residual = LN(Observed) - LN(Predicted)

Year	Observed	Predicted	Residual
1982	0.270000E-02	0.292324E-02	-0.794400E-01
1983	0.123000E-01	0.127862E-01	-0.387668E-01
1984	0.550000E-02	0.599045E-02	-0.854185E-01
1985	0.360000E-02	0.305898E-02	0.162851E+00
1986	0.430000E-02	0.491745E-02	-0.134174E+00
1987	0.180000E-02	0.175006E-02	0.281341E-01
1988	0.150000E-02	0.153392E-02	-0.223584E-01
1989	0.230000E-02	0.237785E-02	-0.332886E-01
1990	0.510000E-02	0.469544E-02	0.826492E-01
1991	0.390000E-02	0.437936E-02	-0.115925E+00
1992	0.520000E-02	0.471637E-02	0.976202E-01
1993	0.140000E-01	0.121939E-01	0.138118E+00
1994	N/A	0.118377E-02	N/A
1995	N/A	0.316503E-03	N/A
1996	N/A	0.146300E-02	N/A
1997	N/A	0.223784E-02	N/A
1998	N/A	0.898503E-02	N/A
1999	N/A	0.364509E-02	N/A
2000	N/A	0.570987E-02	N/A
2001	N/A	0.716189E-02	N/A
2002	N/A	0.156052E-01	N/A
2003	N/A	0.145064E-01	N/A
2004	N/A	0.137326E-01	N/A
2005	N/A	0.000000E+00	N/A

Retrospective Summary

Average Fishing Mortality
Ages = 4 - 5

	1982	1983	1984	1985	1986
1996	0.6438	0.9144	0.9615	1.1015	1.0525
1997	0.6438	0.9144	0.9615	1.1015	1.0525
1998	0.6438	0.9144	0.9615	1.1015	1.0525
1999	0.6438	0.9144	0.9615	1.1015	1.0525
2000	0.6438	0.9144	0.9615	1.1015	1.0525
2001	0.6438	0.9144	0.9615	1.1015	1.0525
2002	0.6438	0.9144	0.9615	1.1015	1.0525
2003	0.6438	0.9144	0.9615	1.1015	1.0525
2004	0.6438	0.9144	0.9615	1.1015	1.0525
	1987	1988	1989	1990	1991
1996	1.2616	1.0061	0.9518	0.9256	1.0482
1997	1.2616	1.0061	0.9519	0.9259	1.0491
1998	1.2616	1.0061	0.9519	0.9260	1.0494
1999	1.2616	1.0061	0.9519	0.9260	1.0494
2000	1.2616	1.0061	0.9519	0.9260	1.0494
2001	1.2616	1.0061	0.9519	0.9260	1.0493
2002	1.2616	1.0061	0.9519	0.9260	1.0493
2003	1.2616	1.0061	0.9519	0.9260	1.0493
2004	1.2616	1.0061	0.9519	0.9260	1.0493
	1992	1993	1994	1995	1996
1996	1.1094	0.9289	1.9486	0.9135	0.5827
1997	1.1126	0.9359	2.0331	1.0809	0.8719
1998	1.1139	0.9384	2.0568	1.1358	0.9942
1999	1.1140	0.9385	2.0580	1.1390	1.0046
2000	1.1140	0.9385	2.0578	1.1383	1.0027
2001	1.1139	0.9383	2.0557	1.1334	0.9898
2002	1.1137	0.9380	2.0529	1.1267	0.9736
2003	1.1137	0.9380	2.0534	1.1277	0.9761
2004	1.1138	0.9381	2.0541	1.1295	0.9803
	1997	1998	1999	2000	2001
1996					
1997	0.6107				
1998	0.8272	0.6429			
1999	0.8630	0.6929	0.7697		
2000	0.8575	0.6844	0.7457	0.6610	
2001	0.8252	0.6350	0.6263	0.4951	0.4440
2002	0.7923	0.5838	0.5441	0.3827	0.3244
2003	0.7972	0.5912	0.5549	0.3963	0.3344
2004	0.8059	0.6042	0.5764	0.4219	0.3635
	2002	2003	2004		
1996					
1997					
1998					
1999					
2000					
2001					
2002	0.2883				
2003	0.3054	0.3797			
2004	0.3466	0.4567	0.5781		

Spawning Stock Biomass

	1982	1983	1984	1985	1986
1996	23987.	18916.	14536.	16000.	17107.
1997	23987.	18916.	14536.	16000.	17107.
1998	23987.	18916.	14536.	16000.	17107.
1999	23987.	18916.	14536.	16000.	17107.
2000	23987.	18916.	14536.	16000.	17107.
2001	23987.	18916.	14536.	16000.	17107.
2002	23987.	18916.	14536.	16000.	17107.
2003	23987.	18916.	14536.	16000.	17107.
2004	23987.	18916.	14536.	16000.	17107.
	1987	1988	1989	1990	1991
1996	15303.	16421.	22592.	24271.	21163.
1997	15302.	16420.	22588.	24263.	21148.
1998	15302.	16419.	22587.	24260.	21143.
1999	15302.	16419.	22587.	24260.	21143.
2000	15302.	16419.	22587.	24260.	21143.
2001	15302.	16419.	22587.	24260.	21143.
2002	15302.	16419.	22587.	24261.	21144.
2003	15302.	16419.	22587.	24261.	21144.
2004	15302.	16419.	22587.	24261.	21144.
	1992	1993	1994	1995	1996
1996	13239.	11019.	13357.	17646.	16193.
1997	13193.	10846.	12519.	15914.	14457.
1998	13180.	10791.	12205.	14876.	13048.
1999	13180.	10789.	12194.	14828.	12903.
2000	13180.	10789.	12198.	14840.	12929.
2001	13181.	10794.	12222.	14925.	13109.
2002	13182.	10800.	12258.	15047.	13341.
2003	13182.	10799.	12252.	15027.	13305.
2004	13182.	10797.	12243.	14996.	13244.
	1997	1998	1999	2000	2001
1996					
1997	11252.				
1998	10436.	9241.			
1999	10419.	9834.	10942.		
2000	10476.	10094.	11802.	14309.	
2001	10852.	10918.	12998.	15144.	24799.
2002	11326.	11884.	15018.	17569.	27189.
2003	11252.	11735.	14707.	17026.	25752.
2004	11128.	11475.	14149.	16049.	23694.
	2002	2003	2004		
1996					
1997					
1998					
1999					
2000					
2001					
2002	30524.				
2003	28157.	24211.			
2004	25369.	21729.	20549.		

Total Population Numbers

	1982	1983	1984	1985	1986
1996	29559.	25548.	25185.	23231.	24681.
1997	29559.	25548.	25185.	23231.	24680.
1998	29559.	25548.	25185.	23231.	24680.
1999	29559.	25548.	25185.	23231.	24680.
2000	29559.	25548.	25185.	23231.	24680.
2001	29559.	25548.	25185.	23231.	24680.
2002	29559.	25548.	25185.	23231.	24680.
2003	29559.	25548.	25185.	23231.	24680.
2004	29559.	25548.	25185.	23231.	24680.
	1987	1988	1989	1990	1991
1996	28575.	44629.	36974.	29762.	24578.
1997	28573.	44618.	36962.	29743.	24526.
1998	28573.	44615.	36958.	29738.	24496.
1999	28573.	44615.	36958.	29737.	24496.
2000	28573.	44615.	36958.	29737.	24496.
2001	28573.	44615.	36958.	29738.	24498.
2002	28573.	44616.	36959.	29738.	24501.
2003	28573.	44616.	36959.	29738.	24501.
2004	28573.	44616.	36958.	29738.	24500.
	1992	1993	1994	1995	1996
1996	20357.	24061.	20322.	15640.	11657.
1997	19629.	22764.	19200.	15517.	11756.
1998	19521.	21859.	18042.	15249.	12161.
1999	19510.	21851.	17898.	15201.	12525.
2000	19512.	21858.	17918.	15222.	12618.
2001	19523.	21920.	18041.	15398.	13193.
2002	19536.	22023.	18176.	15702.	13626.
2003	19534.	22007.	18156.	15653.	13564.
2004	19530.	21981.	18119.	15578.	13433.
	1997	1998	1999	2000	2001
1996	13233.				
1997	8324.	11124.			
1998	10082.	10970.	13850.		
1999	11644.	12581.	18447.	20352.	
2000	12305.	13782.	19856.	20451.	21776.
2001	13036.	13861.	20451.	19796.	15227.
2002	14645.	15455.	20598.	20276.	15717.
2003	14377.	15268.	19649.	19001.	14950.
2004	14000.	14719.	18380.	17850.	14022.
	2002	2003	2004	2005	
1996					
1997					
1998					
1999					
2000					
2001	16305.				
2002	23327.	23811.			
2003	17627.	17606.	18986.		
2004	16482.	14764.	32155.	31431.	

Age 2 Population

	1982	1983	1984	1985	1986
1996	10891.	6281.	6160.	8545.	5691.
1997	10891.	6281.	6160.	8545.	5690.
1998	10891.	6281.	6160.	8545.	5690.
1999	10891.	6281.	6160.	8545.	5690.
2000	10891.	6281.	6160.	8545.	5690.
2001	10891.	6281.	6160.	8545.	5690.
2002	10891.	6281.	6160.	8545.	5690.
2003	10891.	6281.	6160.	8545.	5690.
2004	10891.	6281.	6160.	8545.	5690.
	1987	1988	1989	1990	1991
1996	8296.	10230.	20640.	3521.	3303.
1997	8296.	10229.	20632.	3518.	3295.
1998	8296.	10228.	20630.	3517.	3294.
1999	8296.	10228.	20630.	3517.	3293.
2000	8296.	10228.	20630.	3517.	3293.
2001	8296.	10228.	20630.	3517.	3294.
2002	8296.	10228.	20630.	3517.	3294.
2003	8296.	10228.	20630.	3517.	3294.
2004	8296.	10228.	20630.	3517.	3294.
	1992	1993	1994	1995	1996
1996	5821.	6075.	9027.	3288.	1587.
1997	5791.	5514.	8453.	3238.	2243.
1998	5770.	5446.	7784.	2896.	2800.
1999	5770.	5437.	7785.	2783.	2858.
2000	5770.	5438.	7790.	2795.	2861.
2001	5771.	5446.	7834.	2854.	2923.
2002	5774.	5454.	7909.	2896.	3081.
2003	5773.	5453.	7897.	2890.	3055.
2004	5773.	5451.	7878.	2877.	3018.
	1997	1998	1999	2000	2001
1996	1377.				
1997	1536.	1316.			
1998	2047.	2480.	3728.		
1999	2377.	3515.	3998.	7875.	
2000	2439.	3994.	4539.	8222.	4704.
2001	2792.	4208.	4115.	8641.	3802.
2002	2943.	5235.	4343.	7696.	4113.
2003	2925.	5057.	4369.	7044.	3703.
2004	2868.	4836.	4172.	6373.	3606.
	2002	2003	2004	2005	
1996					
1997					
1998					
1999					
2000					
2001	526.				
2002	605.	10199.			
2003	827.	6061.	4129.		
2004	843.	5766.	2508.	18051.	

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

18	CM_CPE	3
19	CM_CPE	4
20	CM_CPE	5
21	CM_CPE	6

Plus Group Diagnostic Report

Calculation Method Selected = Backward

Year	Population Backward	Population Forward	F Forward	F Backward	Ratio
1982	548.	548.	0.657781	0.657781	1.000000
1983	310.	304.	0.924619	0.898299	0.971535
1984	264.	373.	0.538636	0.877362	1.628860
1985	221.	308.	0.664082	1.114702	1.678562
1986	321.	232.	2.078124	1.027096	0.494242
1987	153.	99.	5.000000	1.157331	0.231466
1988	64.	42.	2.078124	0.852419	0.410187
1989	106.	75.	2.078124	0.981163	0.472139
1990	191.	128.	2.078124	0.911853	0.438787
1991	158.	101.	2.310247	0.883999	0.382642
1992	135.	103.	2.226390	1.174176	0.527390
1993	67.	95.	0.597492	1.011323	1.692614
1994	119.	287.	0.409493	1.602830	3.914180
1995	54.	172.	0.244175	1.134386	4.645782
1996	20.	116.	0.099334	0.789256	7.945450
1997	15.	120.	0.076470	0.826884	10.813197
1998	26.	141.	0.090062	0.613165	6.808252
1999	272.	331.	0.446613	0.575490	1.288564
2000	71.	267.	0.099790	0.440404	4.413326
2001	294.	355.	0.300927	0.375241	1.246950
2002	492.	416.	0.439039	0.358456	0.816457
2003	564.	665.	0.373193	0.457262	1.225270
2004	422.	746.	0.229082	0.446782	1.950315
2005	619.	884.	N/A	N/A	

Appendix 4. Bootstrap Output for Gulf of Maine Cod

Bootstrap Summary Report

Number of Bootstrap Repetitions Requested = 1000
 Number of Bootstrap Repetitions Completed = 1000
 Bootstrap Output Variable: Stock Estimates (2005)

	NLS Estimate	Bootstrap Mean	Bootstrap Std Error	C.V. For NLS Soln.
N 2	18051.	19801.	9675.	0.4886
N 3	2052.	2161.	673.	0.3115
N 4	3597.	3743.	886.	0.2368
N 5	174.	183.	66.	0.3625
N 6	737.	756.	208.	0.2748

	Bias Estimate	Bias Std. Error	Per Cent Bias	NLS Estimate Corrected For Bias	C.V. For Corrected Estimate
N 2	1749.	311.	9.6916	16302.	0.5935
N 3	109.	22.	5.2931	1944.	0.3463
N 4	146.	28.	4.0501	3452.	0.2568
N 5	10.	2.	5.5365	164.	0.4050
N 6	19.	7.	2.5377	719.	0.2891

	LOWER 80. % CI	UPPER 80. % CI
N 2	9440.	31891.
N 3	1376.	3049.
N 4	2727.	4909.
N 5	104.	272.
N 6	513.	1023.

Bootstrap Output Variable: Catchability Estimates

	NLLS Estimate	Bootstrap Mean	Bootstrap Std Error	C.V. For NLLS Soln.
Q 1	0.540727E-04	0.545956E-04	0.827388E-05	0.1515
Q 2	0.119324E-03	0.120012E-03	0.120371E-04	0.1003
Q 3	0.213271E-03	0.212844E-03	0.189102E-04	0.0888
Q 4	0.286265E-03	0.287855E-03	0.358489E-04	0.1245
Q 5	0.385326E-03	0.387728E-03	0.679215E-04	0.1752
Q 6	0.512569E-04	0.512655E-04	0.657115E-05	0.1282
Q 7	0.114621E-03	0.114339E-03	0.147188E-04	0.1287
Q 8	0.235486E-03	0.235978E-03	0.251229E-04	0.1065
Q 9	0.377789E-03	0.382567E-03	0.528013E-04	0.1380
Q 10	0.542803E-03	0.547428E-03	0.679780E-04	0.1242
Q 11	0.802556E-03	0.802377E-03	0.962255E-04	0.1199
Q 12	0.622564E-03	0.622083E-03	0.574202E-04	0.0923
Q 13	0.493316E-03	0.498635E-03	0.656052E-04	0.1316
Q 15	0.269618E-03	0.283644E-03	0.875370E-04	0.3086
Q 18	0.142705E-04	0.144301E-04	0.170770E-05	0.1183
Q 19	0.241124E-04	0.242120E-04	0.140148E-05	0.0579
Q 20	0.246504E-04	0.246868E-04	0.108934E-05	0.0441
Q 21	0.256380E-04	0.256148E-04	0.710634E-06	0.0277

	Bias Estimate	Bias Std. Error	Per Cent Bias	NLLS Estimate Corrected For Bias	C.V. For Corrected Estimate
Q 1	0.5229E-06	0.2622E-06	0.9671	0.5355E-04	0.1545
Q 2	0.6878E-06	0.3813E-06	0.5764	0.1186E-03	0.1015
Q 3	-0.4265E-06	0.5981E-06	-0.2000	0.2137E-03	0.0885
Q 4	0.1590E-05	0.1135E-05	0.5555	0.2847E-03	0.1259
Q 5	0.2401E-05	0.2149E-05	0.6232	0.3829E-03	0.1774
Q 6	0.8607E-08	0.2078E-06	0.0168	0.5125E-04	0.1282
Q 7	-0.2822E-06	0.4655E-06	-0.2462	0.1149E-03	0.1281
Q 8	0.4918E-06	0.7946E-06	0.2088	0.2350E-03	0.1069
Q 9	0.4778E-05	0.1677E-05	1.2648	0.3730E-03	0.1416
Q 10	0.4625E-05	0.2155E-05	0.8520	0.5382E-03	0.1263
Q 11	-0.1789E-06	0.3043E-05	-0.0223	0.8027E-03	0.1199
Q 12	-0.4808E-06	0.1816E-05	-0.0772	0.6230E-03	0.0922
Q 13	0.5319E-05	0.2081E-05	1.0782	0.4880E-03	0.1344
Q 15	0.1403E-04	0.2804E-05	5.2021	0.2556E-03	0.3425
Q 18	0.1595E-06	0.5424E-07	1.1179	0.1411E-04	0.1210
Q 19	0.9953E-07	0.4443E-07	0.4128	0.2401E-04	0.0584
Q 20	0.3645E-07	0.3447E-07	0.1479	0.2461E-04	0.0443
Q 21	-0.2326E-07	0.2248E-07	-0.0907	0.2566E-04	0.0277

	LOWER 80. % CI	UPPER 80. % CI
Q 1	0.443115E-04	0.652195E-04
Q 2	0.104895E-03	0.135329E-03
Q 3	0.189258E-03	0.237830E-03
Q 4	0.243205E-03	0.334172E-03
Q 5	0.302247E-03	0.472936E-03
Q 6	0.434941E-04	0.596438E-04
Q 7	0.956714E-04	0.133125E-03
Q 8	0.205385E-03	0.268675E-03
Q 9	0.319952E-03	0.449477E-03
Q 10	0.462585E-03	0.637418E-03
Q 11	0.680870E-03	0.927766E-03
Q 12	0.554410E-03	0.698540E-03
Q 13	0.416928E-03	0.586342E-03
Q 15	0.183680E-03	0.397477E-03
Q 18	0.123328E-04	0.166984E-04
Q 19	0.223536E-04	0.259625E-04
Q 20	0.232452E-04	0.261059E-04
Q 21	0.247162E-04	0.264931E-04

Bootstrap Output Variable: Fishing Mortality (2004)

	NLLS Estimate	Bootstrap Mean	Bootstrap Std Error	C.V. For NLLS Soln.
AGE 1	0.0000	0.0000	0.000000	0.5352
AGE 2	0.0004	0.0005	0.000146	0.3170
AGE 3	0.0690	0.0698	0.015871	0.2273
AGE 4	0.7801	0.8043	0.212510	0.2642
AGE 5	0.3760	0.3896	0.098774	0.2535
AGE 6	0.5781	0.5969	0.122221	0.2047
AGE 7	0.5781	0.5969	0.122221	0.2047

	Bias Estimate	Bias Std. Error	Per Cent Bias	NLLS Estimate Corrected For Bias	C.V. For Corrected Estimate
AGE 1	0.000000	0.000000	14.8487	0.0000	0.7218
AGE 2	0.000019	0.000005	4.3820	0.0004	0.3461
AGE 3	0.000832	0.000503	1.2054	0.0682	0.2328
AGE 4	0.024150	0.006763	3.0957	0.7560	0.2811
AGE 5	0.013606	0.003153	3.6188	0.3624	0.2726
AGE 6	0.018878	0.003911	3.2658	0.5592	0.2186
AGE 7	0.018878	0.003911	3.2658	0.5592	0.2186

	LOWER 80. % CI	UPPER 80. % CI
AGE 1	0.000000	0.000000
AGE 2	0.000296	0.000657
AGE 3	0.050983	0.089993
AGE 4	0.561080	1.087988
AGE 5	0.284153	0.502891
AGE 6	0.455558	0.755217
AGE 7	0.455558	0.755217

Bootstrap Output Variable: Average F (2004) AGES 4 - 5

	NLLS Estimate	Bootstrap Mean	Bootstrap Std Error	C.V. For NLLS Soln.
AVG F	0.5781	0.5969	0.122221	0.2047
N WTD	0.4814	0.4910	0.098450	0.2005
B WTD	0.4675	0.4775	0.097484	0.2042
C WTD	0.5291	0.5468	0.106708	0.1952

	Bias Estimate	Bias Std. Error	Per Cent Bias	NLLS Estimate Corrected For Bias	C.V. For Corrected Estimate
AVG F	0.018878	0.003911	3.2658	0.5592	0.2186
N WTD	0.009593	0.003128	1.9926	0.4719	0.2086
B WTD	0.009957	0.003099	2.1296	0.4576	0.2130
C WTD	0.017602	0.003420	3.3265	0.5115	0.2086

	LOWER 80. % CI	UPPER 80. % CI
AVG F	0.455558	0.755217
N WTD	0.379037	0.617081
B WTD	0.367838	0.598736
C WTD	0.421293	0.683605

Bootstrap Output Variable: Biomass

JAN-1 Biomass (2005) Mean Biomass & SSB (2004)

	NLLS Estimate	Bootstrap Mean	Bootstrap Std Error	C.V. For NLLS Soln.	
JAN-1	38331.	40563.	8769.	0.2162	
MEAN	30863.	32385.	5554.	0.1715	
SSB	20549.	21135.	2892.	0.1368	
	Bias Estimate	Bias Std. Error	Per Cent Bias	NLLS Estimate Corrected For Bias	C.V. For Corrected Estimate
JAN-1	2232.	286.	5.8223	36099.	0.2429
MEAN	1522.	182.	4.9316	29341.	0.1893
SSB	586.	93.	2.8525	19963.	0.1449
	LOWER 80. % CI	UPPER 80. % CI			
JAN-1	30807.	51619.			
MEAN	25887.	39668.			
SSB	17809.	24840.			

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