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Stock Assessment of Georges Bank Haddock, 1931-1999

by

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A Report of the 3rd Transboundary Resources Assessment Committee Meeting

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ABSTRACT

The Georges Bank haddock stock experienced a 30-year period between 1931 and 1960 characterized by sustained annual yields of 40,000 to 60,000 mt supported by high levels of recruitment. In the 1960s, the stock collapsed as a result of high exploitation rates by distant water fisheries resulting in recruitment failure. With the exception of two strong year classes in the mid to late 1970s, the stock remained in a collapsed condition through the early 1990s. Since the mid-1990s, abundance and biomass have increased due to higher survivorship and improved recruitment.

In 1999, U.S. management actions included liberalized trip limit regulations relative to 1998. Liberalization of these regulations in conjunction with increased abundance of haddock resulted in a 51% increase in U.S. landings from 1,841 mt in 1998 to 2,775 mt in 1999, and a significant decline in reported discards. Canadian individual quota allocations remained stable at 3,900 mt between 1998 and 1999. Canadian landings increased by 9% from 3,371 mt in 1998 to 3,680 mt in 1999, as Canadian operators were able to harvest a greater share of their allocated quotas in 1999. The 1996 year class was partially recruited in 1999 and was well represented in both the U.S. and Canadian catch at age. Catch at age information continues to reflect increasing contributions of older age classes, suggesting broadening of the population age structure. U.S. and Canadian research vessel surveys suggest continued increases in abundance and biomass, while survey catch at age data indicate that the 1998 and 1999 year classes may be the largest since 1978.

Results of virtual population analysis (VPA) indicate that fishing mortality has been reduced from pre-1994 levels, and F_{1999} (0.16 or 13% exploitation) has remained consistent with relatively low levels observed since 1994. The population age structure continues to expand and age 4+ biomass is at its highest levels since 1982. Recruitment continues to improve with an increased frequency of large year classes relative to recent recruitment. Spawning stock biomass (SSB) in 1998 was estimated to be 48,500 mt, a 3-fold increase over levels estimated in 1993 but less than 50% of the B_{MSY} level of 105,000 mt established by U.S. harvest control rules. There is a high probability that SSB remains below both the threshold and target levels required to prosecute a directed fishery under U.S. harvest control rules.

INTRODUCTION

Haddock (*Melanogrammus aeglefinus*) resources within U.S. waters are assessed and managed as two separate stocks, one on Georges Bank and south (NAFO Division 5Z and Subarea 6 or statistical areas 521 and higher), and a second in the Gulf of Maine (NAFO Division 5Y or statistical areas 511-515; see Figure 1). These stock definitions are based on tagging studies, meristic data, age composition and growth data (see Clark et al. 1982 and Begg 1998). Haddock in Division 5Z and Subarea 6 comprise the Georges Bank stock (Figure 1), while haddock from Division 5Y represent the Gulf of Maine stock. The Georges Bank stock is a transboundary resource which is exploited by both U.S. and Canadian fisheries. The Department of Fisheries and Oceans (DFO) Canada, produces a separate stock assessment for the transboundary haddock resources in NAFO area 5Zj&m (Gavaris and Van Eeckhaute 1999). The Canadian assessment covers a subset of the U.S. Georges Bank assessment area, including area 5Zj&m, which approximately corresponds to U.S. statistical areas 551, 552, 561 and 562 (Figure 1).

Commercial fisheries for haddock on Georges Bank originated during the mid-1800s as a bycatch in the cod handline fishery (Jensen 1967). After an initial development period, yields from the fishery stabilized averaging approximately 46,000 mt from 1935 to 1960 (Clark et al. 1982; Figure 2). During the early 1960s, distant water fleets from the former Soviet Union, Spain and other countries began to direct fishing effort toward haddock on Georges Bank. Increased fishing effort corresponded with a large 1962 year class and an exceptionally large 1963 year class, resulted in yields in excess of 100,000 mt in 1965 and 1966 (Figure 2). By 1969, landings declined well below the 1935-1960 average landings, and continued to decline throughout mid 1970s (Figure 2). During the late 1970s and early 1980s, large 1975 and 1978 year classes resulted in a temporary increase in landings. During the 1980s, landings declined steadily from 27,000 mt to approximately 4,500 mt in 1989. With restrictive management measures implemented during the 1990s (Table 1), commercial landings reached a record low level of 2,300 mt in 1995, and have risen to approximately 6,500 mt 1999 (Figure 2).

The U.S. haddock fishery is currently managed under the Northeast Multispecies Fishery Management Plan administered by the New England Fishery Management Council. Commercial landings are the most significant form of fishery removals from this stock. Significant levels of regulatory discarding were produced by U.S. management regulations (minimum size limits, trip limits and quotas) in the mid-1970s to early 1980s and from 1994 to 1998. Recreational landings are generally insignificant relative to commercial landings and discards.

Management regulations have attempted to address the decline of Georges Bank haddock resources since the early 1970s (Table 1). Seasonal area closures were first established in 1970. Although the spatial and temporal configurations for these closures have changed numerous times over the past 25 years, a general pattern of spatial and temporal expansion of closures has occurred.

Recently, a series of significant management measures have been implemented by U.S. and Canadian management agencies resulting in significant changes in the haddock fishery. The U.S. Department of Commerce closed two large areas on Georges Bank on a year-round basis in

December 1994, and these areas remained closed to ground fishing through 1999. The Canadian Department of Fisheries and Oceans currently closes the Canadian waters of Georges Bank to directed ground fishing from January to early June. Both countries have increased the regulated mesh size in their respective fisheries. In January 1994, the NMFS implemented a 500 pound/trip landings limit to discourage targeting of haddock by the commercial fishery. This trip limit has been liberalized frequently since 1994, and was most recently raised to 5,000 pounds/day with a maximum of 50,000 pounds/trip on November 5, 1999. In addition, Days at Sea reductions have been implemented in the U.S. fishery to reduce overall groundfish effort.

Canada has managed Georges Bank haddock resources under an individual quota system since 1992. Restrictive quotas have been established annually to achieve fishing mortality rates approximately ½ of $F_{0.1}$ levels, and to generate a high probability of annual increases in stock biomass. In addition, prohibitions on discarding of haddock, high levels of sea sampling coverage, and mandatory dockside monitoring have increased the precision of estimates of Canadian fishery removals from this stock. The combined effect of U.S. and Canadian management measures has been to reduce the total fishery removals from the stock since the early 1990s.

The Georges Bank haddock stock was assessed in 1995 (O'Brien and Brown 1996), 1997 (NEFSC 1997), 1998 (NEFSC 1999), and 1999 (NDWG 2000). The current assessment represents an update of stock status through 1999 and was prepared by the Transboundary Assessment Working Group (TAWG) and the Transboundary Resource Assessment Committee (TRAC 2000) in April 2000. Canada conducts a separate stock assessment of the 5Zj&m area of Georges Bank which was reviewed during the same set of meetings (Gavaris and Van Eekhaute 2000).

THE FISHERY

U.S. Commercial Landings

The 1999 U.S. landings of haddock were prorated into stock areas using dealer and vessel trip report (VTR) data available at the time of assessment preparation (through March 2000). Since auditing and proration methodology development continue to evolve, U.S. landings data since 1994 are considered preliminary and subject to revision. The 1999 proration stratification design, which included species/market category, port group, gear group and quarter, is the same design employed since 1994 (Wigley et al. 1998).

U.S. landings increased by 51% from 1,841 mt in 1998 to 2,775 mt in 1999 (Table 2, Figure 2). Sharp increases in landings are related to significant liberalization of haddock trip limits and greater stock abundance, which resulted in both an increase in total catch and an increase in the proportion landed. Commercial landings of haddock by the U.S. fleet have traditionally been dominated by trawl gear, although other gears including hook gear, gill nets, scallop dredges, and other nets have also landed haddock historically (Table 3).

The spatial distribution of U.S. landings in 1999 indicates that the fishery continues to be concentrated in the western portion of the stock area (statistical areas 521-537; Figure 3). This trend has been evident since 1994 when the combination of days at sea restrictions and area closures excluded the U.S. fishery from seasonal haddock concentrations in eastern Georges Bank (statistical areas 551, 552, 561, 562) and resulted in a westward and inshore shift in fishing effort. In addition, temporal trends in landings through the calendar year indicated that the majority of U.S. landings occurred during the 3rd and 4th quarters of 1999 (Figure 4). This temporal pattern in landings has persisted since 1994, and is likely related to migration of adult haddock following spawning in the western portion of the bank and annual liberalization of trip limit regulations during the second half of each calendar year (Table 1).

Canadian Landings

Canadian landings are collected though a mandatory dockside monitoring program. Landings from Georges Bank are monitored by an independent observer, who verifies both the species identification and landings totals for each species. Increased at-sea monitoring and mandatory dockside monitoring of landings have resulted in relatively precise data on Canadian fishery effort and landings. Canadian landings increased by 9% from 3,371 mt in 1998 to 3,680 mt in 1999 (Table 2). The majority of Canadian landings are taken by otter trawlers and longliners < 65 feet (Table 3). Landings shares in the Canadian fishery remain relatively constant between gears recently because quota allocations have remained stable among gear sectors.

Total Landings

Total landings increased 23% from 5,212 mt in 1998 to 6,455 mt in 1999 (Table 2, Figure 2). The proportion of landings accounted for by the U.S. fishery averaged 13.8% between 1993 and 1997, but increased to 35.3% in 1998 and 43.0% in 1999, more closely reflecting the historical distribution of landings between countries.

Commercial Discards

Since the mid-1950s, discarding by the U.S. commercial fishery is believed to have occurred at a relatively low and constant level. Discard estimates have been added to catch at age periodically when resource conditions and management actions have resulted in the generation of levels of regulatory discard significantly higher than background levels. In 1974, 1977, 1978, and 1980, discarding increased sharply as three large year classes (1972, 1975, 1978) recruited to the fishery (Overholtz et al. 1983). The landings at age in each of these years was augmented by estimates of associated discard. More recently, catch at age was also augmented with estimates of discards from 1994 to 1998 to account for discard mortality generated in response to trip limit regulations in the U.S. fishery.

Discard sampling by the U.S. Sea Sampling program was limited with in 1999 with 15 otter trawl, 65 gill net, and 2 scallop dredge trips sampled that captured haddock on Georges Bank (Table 4). Discard ratios (discard weight/kept weight) were generally less than 0.04 indicating that discarding rates have declined to low levels (Table 4). The U.S. Department of Commerce

authorized a scallop exemption fishery inside Closed Area II beginning on June 15, 1999 and extending into autumn. During this fishery a total of 139 trips received observer coverage: 14 by regular sea sample observers and 125 by specially trained observers. The total reported haddock catch observed on these trips was 5 pounds on the 14 trips observed by regular observers and 0.5 pounds on the 125 trips observed by specially trained observers. Based on this information, haddock catch during the exemption scallop fishery was determined to be an insignificant source of mortality.

Reporting by industry operators in Vessel Trip Reports (VTR) provide an independent source for discard estimation. Discard reporting for otter trawl, gillnet, and hook (hand and long line) reported discard ratios that were generally less than 0.01, consistent with low discarding rates reported during sea sampled trips (Table 5).

Low discard rates reported in the Sea Sample and Vessel Trip Report databases are consistent with liberalized haddock trip limits that were in effect during 1999. These discarding rates are significantly less than the rates reported in the U.S. fishery during the 1994 to 1998 period, and appear to be representative of background discarding rates reported in the Sea Sampling database from 1989 to 1993. Based on these observations and the dearth of information available to characterize the size and age distribution of U.S. discards, estimates of U.S. discards were not included in 1999 catch at age.

U.S. Recreational Fishery

Offshore charter and party boats targeting cod on Georges Bank produce some bycatch landings of haddock. Reliable estimates of recreational landings are not available; however, total recreational landings appear to have been insignificant. Therefore, no estimates of recreational landings or discard were included in the catch at age matrix analyzed in this assessment.

U.S. Commercial Port Sampling

Length and age samples from U.S. commercial landings are collected through the Port Sampling program. U.S. commercial landings of haddock are sold and reported under market category determinations based primarily on size. Although haddock have been landed under as many as 6 different market categories historically, two market categories (large and scrod) account for greater than 95% of landings in recent years.

Traditionally, the Port Sampling program has produced length and age samples used to partition landings into a numerical catch at age. As landings in the U.S. fishery have declined, the availability of fish to port samplers has also declined. The implementation of trip limit regulations in 1994 resulted in a further reduction in landings, and resulting landings entered ports in small quantities that were quickly processed making it difficult to obtain samples. However, as landings have increase, the intensity and temporal coverage of the U.S. Port sampling program has remained poor. In 1999, a total of 28 samples were collected generating a total of 2,268 length measurements, and 595 age determinations (Table 6). By comparison, the Canadian sampling program obtained 48 port samples measuring 11,179 haddock, 48 samples

from their at-sea observer program measuring 67,890 haddock, and a total of 1,564 age determinations (Gavaris and Van Eekhaute 2000).

Landings of haddock from eastern Georges Bank continued to be low (355 mt), and sampling of these trips continued to be poor with only two large samples collected during 1999. Sampling of the scrod market category in western Georges Bank was poor during the first half of 1999 (one trip sampled), but improved during the 2nd half of the year (11 trips sampled). Port sampling coverage of U.S. haddock landings continues to be problematic, generating a significant source of uncertainty in the assessment.

Additional length and age samples are collected by the U.S. sea sampling program for both kept and discarded haddock (Table 7). Although in some quarters there were significant numbers of length samples available for haddock retained on otter trawl trips, these data were collected prior to sorting and could not be characterized relative to market category. Given the number of available samples, the potential gain of information through the utilization of these samples would not offset the loss in information resulting from elimination of market category stratification.

Estimation of U.S. Landings at Age

It is desirable to estimate landings at age separately from eastern and western Georges Bank to account for differences in growth rates between these areas. Pooling of samples from eastern and western Georges Bank has been necessary during the 1990s due to limited sampling of U.S. landings.

U.S. landings at age on western Georges Bank and south were estimated separately by market category using U.S. port sampling data. Sampling was sufficient to characterize western Georges Bank landings, but poor temporal distribution of samples made it necessary to use different temporal pooling for each of the two market categories. For the large haddock, samples were applied separately for quarters 1 and 2 and pooled for quarters 3 and 4. For scrod haddock, samples were pooled for quarters 1 and 2, and estimated separately for quarters 3 and 4.

U.S. port samples were insufficient to characterize U.S. landings from eastern Georges Bank (Table 6), but landings from this area comprise a relatively small portion of the U.S. and total landings in the assessment. Of the 2,775 mt of U.S. haddock landings from Georges Bank, 355 mt (12.8% of U.S. landings and 5.5% of total landings) occurred in eastern Georges Bank. Two options were considered for characterizing U.S. landings from eastern Georges Bank: 1) use Canadian length and age sampling to characterize the length and age characteristics of the U.S. fishery; or 2) use U.S. length frequency distributions by market category from western Georges Bank to characterize the length distribution of the eastern Georges Bank landings, and Canadian commercial age distributions from eastern Georges Bank to partition the landings at length into landings at age.

Use of both Canadian length and age samples was problematic because the selectivity pattern of the U.S. and Canadian fisheries differs due to different mesh size regulations and seasonal timing

of fisheries. Therefore, U.S. landings from eastern Georges Bank were partitioned using U.S. length samples by market category from western Georges Bank and Canadian survey ages (quarter 1) and Canadian commercial ages (quarters 2, 3 & 4). Length samples and landings were pooled identically to the analysis for western Georges Bank.

Catch at Age

The U.S. catch at age (landings and estimated discards as noted previously) time series from 1982 to 1999 is summarized in Table 8. The 1999 U.S. catch at age was dominated by age 3, 4, and 5 fish representing the 1996, 1995 and 1994 year classes. Catches of age 7, 8, and 9 year old fish (1992, 1991, and 1990 year classes) were the highest observed since 1986, indicating continued broadening of the age distribution of haddock represented in the commercial catch (Table 8). Mean lengths and weights fell within the range of values observed since 1982 (Table 8). Mean lengths and weights of age 2 catch increased between 1998 and 1999 due to the fact that discards were not included in the 1999 catch at age.

The Canadian landings at age time series for the 5Zj&m area from 1982 to 1997 is summarized in Table 9 (S. Gavaris and L. Van Eeckhaute, pers. comm.). Minor revisions to the Canadian landings at age for 1997 were incorporated into this assessment update. Comparison of the U.S. and Canadian catch at age indicates that the Canadian catch at age contains relatively stronger contributions of age 3 and age 6 fish (1993 and 1996 year classes) relative to the U.S. catch at age (Figure 5). Differences in the catch of age 2 and 3 haddock may be attributed to differences in gear selectivity between countries. Differences in catch of ages 6-8 may reflect spatial distributions patterns of the 1991-1993 year classes, which were primarily distributed on the eastern portion of the stock area. This area represents the area of operation of the Canadian fishery, but is only lightly exploited by the U.S. fishery.

The total catch at age for the Georges Bank stock including catch from all countries for the period 1963 to 1999 is summarized in Table 10. Several historically large year classes including the 1963, 1975, and 1978 year classes appear to track well through the catch at age matrix (Figure 6). Catch at age during the period from 1982-1999 has been dominated by the 1978, 1983, 1985, 1987, and 1992 and 1993 year classes (Table 10; Figure 6), although several recent year classes are contributing to catch across several years due to higher survivorship.

Mean lengths and weights of ages 3 through 7 haddock in 1999 indicate a declining trend since the early 1990s (Figure 7). Declines in mean size at age are negatively correlated with the approximately 4-fold increase in stock biomass observed since 1992, possibly indicating a density dependent growth response.

STOCK ABUNDANCE AND BIOMASS INDICES

U.S. Research Vessel Survey Abundance and Biomass Indices

U.S. research vessel survey indices of abundance (stratified mean number per tow) and biomass (stratified mean weight [kg] per tow) were estimated from both the NEFSC spring and autumn bottom trawl surveys from 1963 to 1999 (Table 11; Figure 8). Survey indices included catch data from stations occupied within NEFSC strata 01130-01250 and 01290-01300. The survey indices were adjusted for differences in fishing power of the Albatross IV and Delaware II, and for differences in the catchability of BMV doors (used before 1985) and the polyvalent doors introduced in 1985 (Forrester et al. 1997). Table 12 summarizes the factors applied to each survey. In the U.S. spring survey, a different net (Yankee 41 trawl) was used in the 1973-1981 surveys than in other years (Yankee 36 trawl). No survey adjustment factors were estimated for this gear adjustment (Sissenwine and Bowman 1978), and these 9 years are treated as an independent survey for the purposes of VPA calibration.

Spring and autumn indices of abundance and biomass exhibit similar trends throughout the time period (Figure 8). Indices declined from record high levels in the early 1960s to low levels in the early 1970s. Relatively strong 1975 and 1978 year classes are reflected by temporary increases in survey indices. Survey indices declined again in the early 1980s and remained a low levels until the early 1990s. Indices since 1994 suggest increases in haddock abundance and biomass (Figure 8).

Age disaggregated survey abundance indices (stratified mean number per tow) for ages 1 to 8 from the spring survey, and ages 0-8 from the autumn survey were available as tuning inputs in the stock assessment. The adjusted stratified mean catch/tow (numbers) are presented for the U.S. spring and autumn surveys in Tables 13 and 14, respectively. Large survey indices along diagonals in the U.S. spring (Figure 9) and U.S. autumn (Figure 10) surveys are indicative of the presence of strong year classes. Survey indices indicate the presence of strong year classes in 1963, 1972, 1975, 1978, 1983, 1985, 1987 and 1992. Patterns for recent year classes are occasionally obscured by year effects in the time series, where the survey indices for most or all ages are abnormally high or low relative to the rest of the time series. Examples of year effects include the 1996 U.S. spring survey (abnormally high for most ages) and 1994 autumn Survey (abnormally low for most ages; Tables 13 and 14; Figures 9 and 10).

Canadian Research Vessel Survey Abundance Indices

The Canadian Department of Fisheries and Oceans initiated a bottom trawl survey on Georges Bank in 1986. Indices of abundance at age for the Canadian spring research vessel survey from 1986 to 2000 are summarized in Table 15. Recent dominant year classes (1985, 1987, 1992) appear to track strongly through the age disaggregated matrix of Canadian spring survey abundance (Table 15; Figure 11). The two most recent surveys (1999 and 2000) indicate the highest aggregate abundance indices in the survey time series.

Canadian survey abundance indices in 1999 and 2000 have increased due to large catches of age 1 fish (1998 year class) in 1999, and large catches of age 1 and age 2 fish (1998 and 1999 year classes) in 2000. The 2000 survey index for age 2 haddock (68.60 age 2 haddock/tow) was than 3 fold higher than the next highest index at age value. The 2000 Canadian survey had a single large tow (set #55 in stratum 5Z8) which resulted in high stratified mean estimates for both the stratum (5Z8) and the entire survey. This tow occurred in the northeast corner of the stratum adjacent to areas with high haddock densities. The other two tows in this strata failed to capture a haddock. To assess the impact of this single tow on the age indices for this survey, the results of the tow were removed. Removal of set #55 from the analysis resulted in significantly lower stratified mean number at age indices for ages 1, 2, and 3, a minor reduction in the index for age 4, and no effect on the indices for ages 5 to 8 (Figure 12). Results of this exploratory analysis were used as inputs to virtual populations analysis (VPA) for the purpose of producing a sensitivity run to evaluate the potential effects of the large tow on assessment results.

Correspondence between Surveys

Age 0 and 1 indices from the U.S. autumn survey and age 1 indices from the U.S. and Canadian spring surveys provide an indication of strong year classes of haddock (Figure 13). The strong 1963, 1975, and 1978 year classes are readily apparent in age 0+ and age 1 indices (Figure 13), and track strongly through the age disaggregated matrix of survey abundance (Figures 9-11).

NATURAL MORTALITY AND MATURITY

Natural Mortality

As in previous assessments of this stock (O'Brien and Brown 1996, NEFSC 1997, DFO 1998, NDWG 1999, Gavaris and Van Eeckhaute 1999) the natural mortality rate was assumed to be 0.2. The presence of haddock in excess of 15 years of age in both the U.S. and Canadian research vessel surveys is consistent with this assumption for natural mortality.

Maturity Ogives

A logistic regression approach (O'Brien et al. 1993) was used to calculate maturity at age relationships for each year from 1985 to 1998. Maturity data from adjacent years with similar relationships were pooled, and logistic regressions were calculated for pooled time periods. Based on this approach, maturity relationships were calculated for four time periods 1985-1989, 1990-1992, 1993-1994, and 1995-1998. Because of the update nature of the current assessment, maturity ogives were not reanalyzed to incorporate 1999 survey maturity data. Table 16 summarizes percent maturity of female haddock at age for the time series used to estimate SSB in this assessment.

ESTIMATES OF STOCK SIZE AND FISHING MORTALITY

Virtual Population Analysis Formulation

Virtual population analysis (VPA) calibration (Parrack 1986; Gavaris 1988; Conser and Powers 1990) was used to estimate terminal stock abundance for ages 1 to 9+ and age-specific estimates of fishing mortality rates in 1999 and stock sizes at the beginning of 2000 using VPA calibation software in the Fisheries Assessment Computational Toolbox (FACT Version 1.2.3) software package. The VPA formulation was consistent with the approach used in the 1998 and 1999 assessments of the Georges Bank haddock stock (DFO 1998, NDWG 1999). The catch at age in the VPA was derived from combined U.S., Canadian, and distant water fleet landings from 1963 to 1999 for ages 1 to 8 with a 9+ age group. The indices used to calibrate the VPA included both U.S. and Canadian spring research vessel survey catch (numbers) at ages 1 to 8 and the U.S. autumn survey catch (numbers) at ages 0 to 6 lagged forward one age and one year. The U.S. spring survey from 1973 to 1981 (Yankee 41 years) was treated as a separate survey index for the purposes of VPA tuning.

Final assessments runs were made incorporating catch at age information from the 1931-1962 period from Clark et al. 1982 to estimate stock numbers, SSB, and fishing mortality from 1931-1999. No fishery independent tuning indices are available before 1963.

VPA Diagnostics

The diagnostics from the VPA calibration were similar to those from previous assessments conducted in 1994, 1997, 1998 and 1999 (Table 17; Appendix A). The coefficients of variation (CV's) on ages 1 and 2 are relatively high (0.61 and 0.39, respectively), but range from 0.26 to 0.31 for older age classes (Table 17). The maximum partial variance (2.433) occurs on the U.S. spring Yankee 41 age 1 index (years 1973-1981). The CV's on estimates of survey q's ranged from 0.14-0.35, and were generally inversely related to the length of the time series for each survey.

The number of survey residuals with absolute values greater than 2.0 (26) was similar to the values observed in previous years (Table 17). Residual patterns were generally random (Figure 14), although year effects across ages were apparent in some instances (e.g., 1996 U.S. spring Survey at all ages). Standardized residuals are positive for Canadian spring indices and negative for U.S. autumn survey indices for the 1998 and 1999 year classes (Figure 15).

VPA Results

VPA results indicate that stock numbers ranged between 350 and 725 million fish during the early 1960s but declined rapidly to 16 million fish by 1971 (Table 18). Improved recruitment from two strong year classes (1975, 1978) resulted in a temporary increase in stock numbers to 133 million fish in 1979, but stock numbers declined to less than 25 million by 1983. Stock numbers remained stable during the mid 1980s but declined to a record low of 15 million fish in 1991. Stock number increased again in the early 1990s and were estimated to have increased to

in excess of 100 million fish in 2000. Stock number estimates demonstrate a consistent trend of broadening of the age structure of the population since 1991 (Figure 16).

The two most recent year classes (1998 and 1999) were estimated at 48.8 million and 35.2 million fish at age 1 respectively, making them the largest estimated since 1978 (Table 18). The current estimate of year class size for the 1998 year class (48.8 million fish at age 1) represents a significant reduction from the estimate (61.9 million) generated by the 1999 stock assessment.

SSB was estimated to be in excess of 150,000 mt in the early to mid 1960s, but declined sharply reaching a low of 12,000 mt in 1973 (Table 19; Figure 17). SSB increased with improved recruitment in the 1970s reaching 69,000 mt in 1978, but declined to approximately 20,000 mt by the mid 1980s. SSB remained stable at this level until it began to decline in the early 1990s reaching record low levels of 11,000 mt in 1993. Since 1993, SSB has increased steadily, reaching 48,500 mt in 1999. This reflects both improved recruitment and broadening the size distribution of the adult stock. The age distribution of the adult stock has broadened by roughly one age per year since 1993 (Figure 16). Higher survivorship is largely responsible for the broader age distribution observed in the spawning stock.

Age 1+ mean biomass was estimated to exceed 200,000 mt in the mid-1960s, but declined rapidly to 25,000 mt by 1973. Mean biomass increased in the mid-1970s reaching 104,000 mt in 1977, but declined below 40,000 mt by 1983. During the mid-1980s to early 1990s, mean biomass declined gradually reaching an apparent all-time low level of 18,300 mt in 1992. Biomass has increased steadily since 1992, and was estimated at 86,500 mt in 1999.

Fishing mortality (average F, ages 4-7, unweighted) ranged between 0.33 and 0.62 during the 1960s and 1970s before declining below 0.10 in the mid 1970s (Table 20; Figure 18). Fishing mortality increased in the late 1970s and ranged between 0.31 and 0.46 from 1979 to 1993. Fishing mortality began to decline in 1994 and since 1995 has remained less than current estimates of $F_{0.1}$. The terminal year (1999) estimate is 0.16, which is within the probable measurement error of the fishing mortality rates observed between 1995 and 1998.

Stock Recruitment Relationship

With a 69 year time series, the stock recruitment relationship for Georges Bank haddock has been expressed over a range of stock conditions allowing for insights into recruitment dynamics. Between 1931 and 1961, SSB ranged between 80,000 and 120,000 mt and age 1 recruitment averaged 40 to 60 million fish annually, supporting a fishery with sustained annual landings averaging 46,000 mt (Figures 17-19). The recruitment of a large 1962 and an enormous 1963 year class was followed by the entrance of distant water fleets into the fishery, resulting in the collapse of the stock and destabilization of the stock recruitment relationship. Between 1966 and 1998, age 1 recruitment exceeded 20 million fish on only two occasions (the 1975 and 1978 year classes).

A key objective of U.S. and Canadian stock rebuilding efforts is to allow SSB to increase above a perceived threshold where significantly higher average recruitments have been observed

(Figure 19). Based on historical stock recruitment data, this threshold appears to occur between 50,000 and 100,000 mt of SSB for the 5Z haddock stock (Figure 19). Although there is still considerable uncertainty about the size of recent year classes, current estimates for the 1998 and 1999 cohorts appear to be significantly higher than others observed over the past two decades. This may be an indication that spawning stock levels may be approaching the threshold at which when significantly higher average recruitment is likely. Additional stock rebuilding is required to determine if this recruitment response will materialize.

Sensitivity VPA Run

To assess the relative sensitivity of the estimates of terminal year stock numbers to the large tow in the 2000 Canadian research vessel survey, a second VPA calibration was generated using adjusted 2000 Canadian survey indices that excluded data from this tow (set #55) from the analysis. Table 21 provides a comparison of key VPA diagnostics and results for the base run (Run 11) and the sensitivity run (Run 12). The sensitivity run had slightly lower sums of squares and mean squared residuals than the base run, but there were no appreciable differences in the coefficients of variations on the estimates of ages 1 to 8 between the calibrations.

Terminal year (1999) estimates of fully recruited fishing mortality and SSB were essentially identical between the VPA calibrations, but there were significant differences in the terminal year stock sizes for ages 1 and 2 (1999 and 1998 year classes). The sensitivity run with the adjusted Canadian survey resulted in significantly lower estimates of terminal year stock size of age 1 in 1999 and 2000 (1998 and 1999 year classes). However, even these lower estimates are the largest since recruitment of the 1978 year class.

Results of the sensitivity analysis provide an indication of the uncertainty of the relative strengths of the 1998 and 1999 year classes. A similar large tow in the terminal year of the 1999 stock assessment resulted in a relatively high estimate of 1998 year class at age 1 in 1999. This estimate has been revised downward significantly (from 61.9 million to 48.8 million) with the incorporation of additional survey information on this year class into the current assessment.

Precision of F and SSB Estimates

Uncertainty and potential bias of estimates were assessed through a bootstrap analysis of the VPA calibration. One thousand bootstrap realizations were produced by randomly resampling survey residuals produced by the original calibration. Bootstrapped abundance estimates had slightly larger CV's than the least squares estimates produced by the original calibration (Appendix B). Estimates of bias were large on ages 1 (8.3%), moderate on ages 2 (3.5%), 5 (3.0%) and 7 (3.1%), and less than 2% for ages 3, 4, 6, and 8. Estimates of survey q's were comparable with those produced in the original VPA calibration. Bias corrected estimates of stock size for ages 2-8 were well estimated with CV's ranging from 0.17 to 0.27; however, the CV for age 1 was relatively high (0.52). SSB was also well estimated with a CV of 0.09 and a bias estimate of 1.3%. Bootstrap distributions of fishing mortality, SSB, and age 1 recruitment were not bias corrected in this analysis.

The distribution of bootstrap realizations of SSB suggests that there is an 80% chance that 1999 SSB was between 43,800 mt and 54,500 mt (Figure 20). The distribution of bootstrap realizations of fishing mortality suggests that there is an 80% chance that F_{1999} was between 0.144 and 0.184 (Figure 20).

Retrospective Analysis

Retrospective analyses of the Georges Bank haddock VPA were performed from 1999 back to 1995. The FACT procedure was formulated to estimated ages 1-8 in the terminal year, and unweighted mean fishing mortality was estimated for ages 4-7.

Retrospective patterns for fishing mortality (Figure 21) were similar to those observed in the 1999 assessment of this stock, indicating that terminal year estimates of fishing mortality and SSB are relatively well estimated in the terminal year of the assessment. The alternating pattern of slightly overestimated and slightly underestimated terminal year estimates indicates that there is not a retrospective pattern in the terminal year estimates of these parameters.

Terminal year estimates of age 1 recruitment were more variable with a significant tendency to overestimate age 1 recruitment in some years (1995 year class in 1996, 1998 year class in 1999). The retrospective analysis of age 1 stock sizes reinforces the need for additional survey information on incoming recruitment before firm estimates of year class strength can be made.

BIOLOGICAL REFERENCE POINTS

Yield Per Recruit ($F_{0.1}$, F_{max})

A yield per recruit analysis (Thompson and Bell 1934) was performed during the 1997 assessment and has not been revised in the current assessment. Results of these analyses indicate that $F_{0.1} = 0.26$. Estimates of F_{max} are considered to be unreliable because of the asymptotic nature of the yield per recruit curve at high levels of fishing mortality.

Sustainable Fishery Act Reference Points

A harvest control rule based on proxies to MSY-based reference points was defined in Amendment 9 of the U.S. Northeast Multispecies FMP as follows:

> *"When SSB is greater than 105,000 mt (the 1931-1961 historical average), the overfishing limit is $F_{0.1}$ (0.26), and the target F is 75% of the F_{MSY} proxy (0.20; as proposed by Restrepo et al. 1998). To avoid low levels of recruitment, the limit F decreases linearly from 0.26 at 105,000 mt SSB to zero at 52,500 mt SSB (1/2 SSB_{MSY}), and the target F decreases linearly from 0.20 at 105,000 mt SSB to zero at 68,000 mt SSB."*

The 1999 estimates of SSB and F indicate that SSB was below the threshold and target levels indicating that the stock was overfished, and that F exceeds the rebuilding limit, indicating that overfishing was occurring (Figure 22).

Considering the bootstrap generated estimates of variability in SSB, there is a 78.3% chance that SSB was below the U.S. management threshold biomass level of 52,500 mt that allows for fishing mortality to exceed zero and a zero probability that SSB exceeded either the target SSB level or the B_{MSY} proxy of 105,000 mt of SSB. Based on the current point estimate of SSB and application of the Amendment 9 harvest control rule outlined in the U.S. Northeast Multispecies Fishery Management Plan, there is a 100% chance that F_{1999} exceeded the management target of F = 0.00.

CONCLUSIONS

The Georges Bank haddock stock remains in an overexploited condition based on the current low level of biomass in relation to management rebuilding thresholds and pre-collapse stock levels. The assessment indicates that fishing mortality has been reduced from pre-1994 levels, and fishing mortality remained stable at relatively low levels since 1994. F_{1999} was 0.16 (13% exploitation). The age structure of the population is continuing to expand and age 4+ biomass is at its highest level since 1982. Recruitment continues to improve and the 1998 and 1999 year classes are currently estimated to be the largest since 1978. There is considerable uncertainty about the absolute size of these year classes due to the influence of large tows that have a significant influence on available survey indices. Spawning stock biomass in 1999 was estimated to be 48,500 mt, a 3-fold increase over levels estimated in 1993 but less than 50% of the B_{MSY} level of 105,000 mt established by U.S. harvest control rules.

Observed increases in spawning stock biomass of Georges Bank haddock have resulted from conservation of a series of relatively weak year classes. This was a necessary first step in the stock rebuilding process. Spawning stock has been rebuilt and age structure has been restored to the point where recruitment appears to be improving significantly. If incoming recruitment from the 1998 and 1999 year classes is conserved, growth and maturation of these year classes will result in significant increases in spawning stock biomass. Based on historical stock recruitment relationships for this stock, as spawning stock biomass increases, the probability of additional strong recruitment events will be significantly enhanced. Maintenance of low fishing mortality rates to promote continuous rebuilding of spawning stock biomass is essential to achieving biomass rebuilding targets for this stock. Given the potential growth trajectories for this stock, maintenance of current low fishing mortality rates should still allow for significant increases in yield over the next several years.

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Table 1. Significant changes in management actions regulating the U.S. commercial fishery for haddock.

1953-1977		ICNAF Era
1953		Minimum mesh in body and codend - 4 1/2".
1970		Areas 1(A) and 2(B) closed during haddock spawning season: from March through April.
1972-1974		Areas 1(A) and 2(B) closure extended to March through May.
		Total Allowable Catch (TAC) regulations implemented for Subarea 5 haddock on an annual basis beginning in 1972; set at 6,000 t per year.
1975		Areas 1(A) and 2(B) closure extended to February through May; haddock TAC declared for incidental catches only
1977-Present		Extended Jurisdiction and National Management
1977		U.S. Fishery Conservation and Management Act of 1976 (FCMA) effective.
1977-1982		Fishery Management Plan (FMP) for Atlantic groundfish (cod, haddock and yellowtail fl.); mesh size of 5 1/8", seasonal spawning closure (areas 1 and 2), quotas established on annual, quarterly and vessel class basis, eventually leading to trip limits.
1982-1985		The "Interim Plan" for Atlantic groundfish; eliminated all catch controls, retained closed area and mesh size regulations, implemented minimum landings sizes.
1983		mesh size increased to 5 1/2 " minimum landing size - 17" commercial, 15" recreational.
1984	October	Implementation of the 'Hague' line establishing separate fishing zones for U.S. and Canada in the Gulf of Maine and on Georges Bank.
1985		Fishery Management Plan for the Northeast Multispecies Fishery.
		5 1/2" mesh size, areas 1 and 2 closed during February-May.
1991		Amendment 4 established overfishing definitions for haddock in terms of F_{med} ($F_{20\%}$) replacement levels.
1993		Area 2 closure in effect from Jan 1-June 30.
1994	January	Amendment 5 implemented - expanded Area 2, Area 1 closure not in effect.
	January 3	500 pound trip limit regulation implemented.
	May	6 inch mesh restriction implemented (delayed from March 1).
	December 8	Both Area 1,2 and Nantucket Lightship Area closed year-round.
1996	July 1	Amendment 7 implemented: additional Days-at-Sea restrictions, trip limit raised to 1,000 pounds.
1997	May 1	Additional scheduled Days-at-Sea restrictions from Amendment 7.
	September 1	Trip limit raised to 1,000 pounds/day, maximum of 10,000 pounds/trip.
1998	September 1	Trip limit raised to 3,000 pounds/day, maximum of 30,000 pounds/trip.

Table 1 (Cont). Significant changes in management actions regulating the U.S. commercial fishery for haddock.

1999	May 1	Trip limit lowered to 2,000 pounds/day, maximum of 20,000 pounds/trip. Mesh size increased to 6 ½" square, remains at 6" diamond.
	June 15	Scallop exemption fishery allows limited access to Closed Area II
	November 5	Trip limit raised to 5,000 pounds/day, maximum of 50,000 pounds/trip.
	November 15	Amendment 9 of the Northeast Multispecies Fishery Management Plan in effect. Establishes new overfishing definitions and harvest control rules to comply with the Sustainable Fisheries Act.
2000	May 1 (Proposed)	Additional one month closure on Georges Bank during May 2000. Blocks 109-114, 98-99) adjacent to Closed Area I.

Table 2. Commercial landings (mt) of haddock from Georges Bank and south (NAFO Division 5Z and Subarea 6), 1960-1999.[1]

Year	U.S.	Canada	USSR	Spain	Other	Total
1960	40800	77	0	0	0	40877
1961	46384	266	0	0	0	46650
1962	49409	3461	1134	0	0	54004
1963	44150	8379	2317	0	0	54846
1964	46512	11625	5483	2	464	64086
1965	52823	14889	81882	10	758	150362
1966	52918	18292	48409	1111	544	121274
1967	34728	13040	2316	1355	30	51469
1968	25469	9323	1397	3014	1720	40923
1969	16456	3990	65	1201	540	22252
1970	8415	1978	103	782	22	11300
1971	7306	1630	374	1310	242	10862
1972	3869	609	137	1098	20	5733
1973	2777	1563	602	386	3	5331
1974	2396	462	109	764	559	4290
1975	3989	1358	8	61	4	5420
1976	2904	1361	4	46	9	4324
1977	7934	2909	0	0	0	10843
1978	12160	10179	0	0	0	22339
1979	14279	5182	0	0	0	19461
1980	17470	10017	0	0	0	27487
1981	19176	5658	0	0	0	24834
1982	12625	4872	0	0	0	17497
1983	8682	3208	0	0	0	11890
1984	8807	1463	0	0	0	10270
1985	4273	3484	0	0	0	7757
1986	3339	3415	0	0	0	6754
1987	2156	4703	0	0	0	6859
1988	2492	4046[2]	0	0	0	6538
1989	1430	3059	0	0	0	4489
1990	2001	3340	0	0	0	5341
1991	1395	5446	0	0	0	6841
1992	2005	4061	0	0	0	6066
1993	687	3727	0	0	0	4414
1994	218[3]	2411	0	0	0	2629
1995	218[3]	2064	0	0	0	2282
1996	313[3]	3643	0	0	0	3956
1997	888[3]	2622	0	0	0	3510
1998	1841[3]	3371	0	0	0	5212
1999	2775[3]	3680	0	0	0	6455

[1]All landings 1960-1979 are from Clark et al. (1982); U.S. landings 1980-1981 are from Overholtz et al. (1983); U.S. landings 1982-1993 are from NMFS, NEFC Detailed Weighout Files and Canvas data; Canadian landings 1980-1998 from Gavaris and Van Eeckhaute (1999); Canadian landings 1999 from S. Gavaris (Personal Communication).

[2]1895 tons were excluded because of suspected misreporting (Gavaris and Van Eeckhaute 1995).

[3]U.S. landings from 1994-1999 are prorated using Vessel Trip Report data and are considered provisional.

Table 3. U.S. and Canadian commercial landings (mt) of haddock from Georges Bank and south (NAFO Division 5Z and Subarea 6) by major gear type, 1964-1999.

	United States				Canada			
	Otter Trawl	Long line	Other	Total	Otter Trawl	Long line	Other	Total
1964	45617	742	153	46512	11624	1	0	11625
1965	52034	716	73	52823	14862	22	5	14889
1966	51686	1127	105	52918	17905	63	324	18292
1967	33825	814	89	34728	12923	96	21	13040
1968	24930	495	44	25469	9201	111	11	9323
1969	15494	950	12	16456	3955	22	13	3990
1970	7979	430	6	8415	1900	76	2	1978
1971	7004	300	2	7306	1475	154	1	1630
1972	3674	190	5	3869	411	198	0	609
1973	2675	100	2	2777	1461	102	0	1358
1974	2308	80	8	2396	374	87	1	462
1975	3839	143	7	3989	1247	111	0	1358
1976	2840	51	13	2904	1192	154	15	1361
1977	7842	36	56	7934	2814	94	1	2909
1978	11962	63	135	12160	9716	171	292	10179
1979	14138	30	111	14279	4907	274	1	5182
1980	17170	30	270	17470	9510	590	1	10101
1981	19031	3	142	19176	4644	1015	0	5659
1982	12484	2	139	12625	4222	709	0	4931
1983	8588	35	59	8682	2396	813	3	3212
1984	8661	79	67	8807	624	838	1	1463
1985	4194	43	36	4273	2745	626	41	3484
1986	3298	24	17	3339	2734	594	35	3415
1987	2124	21	11	2156	3521	1046	89	4703
1988	2408	32	52	2492	3183	695	97	4046
1989	1356	24	50	1430	1976	977	106	3060
1990	1949	15	37	2001	2411	853	76	3340
1991	1340	28	27	1395	4028	1309	119	5456
1992	1974	17	14	2005	2583	1384	90	4058
1993	659	16	12	687	2489	1143	96	3727
1994	175	33	10	218	1597	714	100	2411
1995	144	59	15	218	1647	390	28	2065
1996	210	63	40	313	2689	947	26	3663
1997	754	76	58	888	1991	722	36	2749
1998	1692	55	94	1841	2422	921	27	3371
1999	2605	27	143	2775	2760	887	33	3680

Other includes: scallop dredge, handline, gillnet, midwater trawl, Danish seine.

Table 4. Number of trips, total discard, and total kept weight (mt) of sea sampled U.S. trawl trips catching haddock in the Georges Bank stock area in 1999. Many sea sampled trips fish in multiple stock areas. Discard, kept, and discard ratios are reported based on fishing activity occurring within the Georges Bank stock area. This table does not include scallop dredge trips conducted in Closed Area II during the exemption fishery where 139 observed trips sampled only 5.5 pounds of haddock.

Gear		Qtr 1	Qtr 2	Qtr 3	Qtr 4
Otter Trawl	Trips	1	6	3	6
	Discard (mt)	>0.01	0.04	0.04	0.10
	Kept (mt)	0	1.18	3.46	10.08
	Discard Ratio	∞	0.0360	0.0106	0.00971
Gillnet	Trips	13	23	26	3
	Discard (mt)	0.05	0.02	0.01	0.00
	Kept (mt)	1.28	1.43	0.96	0.06
	Discard Ratio	0.04171	0.0108	0.00564	0.0000
Scallop Dredge	Trips	0	0	1	1
	Discard (mt)	0	0	<0.01	<0.01
	Kept (mt)	0	0	0	0
	Discard Ratio	0.0000	0.0000	∞	∞

Table 5. Total discard weight (mt), total kept weight (mt), and discard ratio (discarded/kept) for Georges Bank haddock reported for U.S. trawl trips in the Vessel Trip Record database.

Gear		Qtr 1	Qtr 2	Qtr 3	Qtr 4	Total
Otter Trawl	Discard (mt)	0.5	0.4	3.9	5.4	10.3
	Kept (mt)	249.9	491.9	515.9	261.1	1518.9
	Discard Ratio	0.00206	0.00078	0.00757	0.02035	0.00670
Gillnet	Discard (mt)	0.5	0.2	0.2	0.0	0.9
	Kept (mt)	107.4	202.9	245.0	38.4	593.7
	Discard Ratio	0.00455	0.00103	0.00063	0.00118	0.00151
Hook	Discard (mt)	0.0	0.0	0.1	0.0	0.1
	Kept (mt)	0.4	13.8	12.1	0.9	27.2
	Discard Ratio	0.00438	0.00242	0.00930	0.0000	0.00544

Table 6. U.S. sampling of commercial haddock landings for length and age composition from Georges Bank and south (NAFO Division 5Z and Subarea 6), 1982-1999. Eastern Georges (statistical areas 561, 562, 523 and 524), Western Georges (521, 522, 525, 526, 537, 538, 539 and Subarea 6). Q1, Q2, Q3, Q4, denote quarters 1, 2, 3, and 4, respectively.

Number of Samples				Number of Samples by Market Category, Area, and Quarter																			Annual Sampling Intensity			
				Scrod										Large									No. of Tons Landed/Sample			
				Eastern Georges					Western Georges					Eastern Georges					Western Georges								
Year	No.	# Fish Meas.	# Fish Aged	Q1	Q2	Q3	Q4	∑	Q1	Q2	Q3	Q4	∑	Q1	Q2	Q3	Q4	∑	Q1	Q2	Q3	Q4	∑	East Scrod	West Scrod	East Large	West Large
1982	89	7851	1788	6	7	6	3	**22**	1	4	15	4	**24**	3	9	8	4	**24**	1	4	7	7	**19**	96	54	172	264
1983	104	8955	2000	3	9	4	4	**20**	2	5	8	2	**17**	7	9	6	5	**27**	2	12	17	5	**38**	54	35	139	95
1984	57	4762	1142	11	4	2	1	**18**	0	1	2	3	**6**	9	7	1	5	**22**	3	3	2	3	**11**	56	65	122	299
1985	32	2528	627	7	4	2	0	**13**	0	1	2	1	**4**	7	1	1	0	**9**	1	0	4	1	**6**	18	136	161	338
1986	30	2276	571	2	3	1	0	**6**	0	1	2	1	**4**	4	2	3	2	**11**	1	2	3	3	**9**	186	77	98	92
1987	36	2573	837	2	7	0	1	**10**	0	0	3	1	**4**	3	4	1	3	**11**	2	1	6	2	**11**	51	41	168	52
1988	34	2542	1096	2	4	2	4	**12**	1	2	2	0	**5**	5	4	1	4	**14**	1	1	1	0	**3**	61	47	69	186
1989	23	1548	856	4	1	1	1	**7**	0	1	7	1	**9**	2	2	0	1	**5**	1	1	0	0	**2**	50	29	87	189
1990	27	2001	945	5	5	1	2	**13**	1	1	1	1	**4**	1	5	0	1	**7**	2	0	1	0	**3**	46	77	84	167
1991	32	1065	439	3	3	0	3	**9**	0	0	7	0	**7**	0	9	0	3	**12**	4	0	0	0	**4**	56	48	35	31
1992	54	2456	922	7	10	5	0	**22**	3	4	0	0	**7**	3	8	2	0	**11**	3	4	5	0	**12**	46	38	56	9
1993	31	1140	533	3	3	0	0	**6**	2	3	3	2	**10**	0	11	0	0	**11**	0	0	2	2	**4**	30	27	13	20
1994	8	546	212	0	0	1	0	**1**	0	1	0	1	**2**	0	0	1	0	**1**	2	1	0	1	**4**	11	46	22	23
1995	3	198	58	0	0	0	0	**0**	2	1	0	0	**3**	0	0	0	0	**0**	0	0	0	0	**0**	∞	25	∞	∞
1996	6	524	191	0	0	1	0	**1**	0	0	0	1	**1**	0	0	0	0	**0**	0	0	1	3	**4**	6	30	∞	50
1997	34	3203	848	0	0	0	0	**0**	0	1	7	3	**10**	0	1	0	0	**1**	1	1	7	13	**22**	∞	22	33	10
1998	24	1692	686	0	0	0	0	**0**	7	2	1	2	**12**	1	0	0	0	**1**	3	3	3	2	**11**	∞	26	271	111
1999	28	2268	595	0	0	0	0	**0**	1	0	5	6	**12**	0	1	1	0	**2**	4	4	1	5	**14**	∞	60	131	122

Table 7. Summary of at-sea sampling of U.S. commercial trips and hauls from Georges Bank and south where haddock were measured in 1999. This table does not include observed scallop dredge trips conducted inside Closed Area II during the exemption fishery.

			Quarter 1	Quarter 2	Quarter 3	Quarter 4	Total
Trawl	Kept	Trips	0	2	3	4	9
		Hauls	0	23	12	17	52
		Lengths	0	173	132	288	593
	Discard	Trips	1	4	2	6	13
		Hauls	1	7	10	17	35
		Lengths	1	18	24	92	135
Gillnet	Kept	Trips	7	5	3	1	16
		Hauls	15	6	5	1	27
		Lengths	130	6	30	1	167
	Discard	Trips	1	2	0	0	3
		Hauls	1	2	0	0	3
		Lengths	1	2	0	0	3
Scallop Dredge	Kept	Trips	0	0	0	0	0
		Hauls	0	0	0	0	0
		Lengths	0	0	0	0	0
	Discard	Trips	0	0	0	1	1
		Hauls	0	0	0	1	1
		Lengths	0	0	0	1	1

Table 8. Catch at age (000s), mean weight (kg) and mean length (cm) at age of U.S. commercial catches of haddock from Georges Bank and south (NAFO Division 5Z and Subarea 6), 1982-1999. Catch at age from 1982-1993 & 1999 includes only landings (discards assumed insignificant), while catch at age from 1994-1998 includes both landings and discards.

Year	1	2	3	4	5	6	7	8	9+	TOTAL
					U.S. Commercial Catch in Numbers (000's) at Age					
1982	1	852	1164	2333	298	463	924	97	105	6237
1983	0	53	454	432	1560	196	152	711	72	3630
1984	0	81	259	664	345	1310	173	234	439	3506
1985	0	384	245	80	372	173	439	56	90	1839
1986	0	16	1109	137	76	121	121	226	39	1845
1987	0	9	39	525	63	41	59	78	67	881
1988	0	1	506	53	541	96	48	48	20	1313
1989	0	131	18	254	79	156	33	20	8	699
1990	0	5	375	117	367	84	55	17	10	1030
1991	0	19	30	340	52	113	45	31	15	644
1992	0	17	83	70	507	97	111	24	8	917
1993	0	44	31	54	35	108	31	16	7	324
1994	1	59	107	33	17	36	44	30	6	334
1995	8	34	84	52	8	7	6	6	4	209
1996	5.0	26.7	97.6	95.4	52.1	9.1	4.7	2.8	8.5	301.8
1997	28.8	105.2	219.6	252.1	96.9	33.6	7.7	9.1	14.9	767.8
1998	0.0	43.9	149.8	262.8	191.6	118.3	47.4	10.6	10.4	834.9
1999	0.0	4.9	340.5	282.2	277.9	194.8	113.1	63.2	26.3	1303.0
					Commercial Catch in Weight (tons) at Age					
1982	0	794	1641	4325	708	1275	3063	389	430	12625
1983	0	53	611	794	3452	527	508	2423	308	8676
1984	0	75	338	1203	756	3483	515	801	1632	8803
1985	0	458	380	149	942	458	1323	219	342	4271
1986	0	14	1352	227	169	340	339	751	147	3339
1987	0	11	59	965	141	109	181	298	287	2051
1988	0	1	727	80	1043	244	143	175	79	2492
1989	0	154	29	459	174	393	113	76	31	1429
1990	0	5	571	212	719	218	163	68	42	1998
1991	0	21	44	579	121	304	143	114	63	1390
1992	0	23	125	128	1029	250	328	82	36	2000
1993	0	53	46	101	74	257	78	50	26	685
1994	1	55	164	70	43	109	135	119	26	722
1995	3	28	113	101	21	22	21	22	13	343
1996	2	31	174	213	135	26	17	11	32	641
1997	12	89	396	552	258	99	25	31	53	1515
1998	0	41	246	595	474	326	152	43	42	1919
1999	0	6	488	492	641	505	341	207	94	2775

Table 8 (Cont). Catch at age (000s), mean weight (kg) and mean length (cm) at age of U.S. commercial catches of haddock from Georges Bank and south (NAFO Division 5Z and Subarea 6), 1982-1996. Catch at age from 1982-1993 includes only landings (discards assumed insignificant), while catch at age from 1994-1998 includes both landings and discards.

Year	1	2	3	4	5	6	7	8	9+
				U.S. Commercial Catch Mean Weight (kg) at Age					
1982	0.225	0.932	1.410	1.854	2.375	2.753	3.315	4.015	4.091
1983	-	0.996	1.345	1.839	2.213	2.691	3.345	3.408	4.275
1984	-	0.924	1.305	1.812	2.191	2.659	2.979	3.425	3.718
1985	-	1.194	1.553	1.861	2.532	2.649	3.013	3.909	3.798
1986	-	0.846	1.219	1.656	2.230	2.807	2.798	3.325	3.781
1987	-	1.182	1.515	1.838	2.239	2.662	3.074	3.817	4.287
1988	-	1.065	1.436	1.510	1.927	2.545	2.972	3.643	3.963
1989	-	1.174	1.603	1.806	2.200	2.519	3.415	3.783	3.818
1990	-	0.981	1.523	1.809	1.959	2.597	2.960	4.005	4.164
1991	-	1.143	1.505	1.704	2.338	2.685	3.169	3.669	4.337
1992	-	1.336	1.503	1.833	2.030	2.584	2.947	3.458	4.267
1993	-	1.220	1.496	1.877	2.132	2.376	2.251	3.037	4.014
1994	0.447	0.942	1.529	2.103	2.595	3.007	3.075	3.924	4.546
1995	0.369	0.836	1.340	1.952	2.490	3.027	3.406	3.400	3.981
1996	0.453	1.175	1.778	2.223	2.574	2.924	3.799	3.964	3.807
1997	0.408	0.847	1.801	2.191	2.658	2.939	3.209	3.390	3.561
1998	-	0.940	1.641	2.263	2.476	2.751	3.214	4.087	3.994
1999	-	1.142	1.434	1.745	2.306	2.593	3.016	3.275	3.561
				U.S. Commercial Catch Mean Length (cm) at Age					
1982	27.0	44.4	51.5	56.8	61.9	65.3	69.7	74.8	74.8
1983	-	45.5	50.7	56.6	60.7	64.6	69.5	70.4	75.7
1984	-	44.7	50.3	56.1	60.4	64.4	67.7	70.5	72.7
1985	-	48.7	53.4	57.1	63.8	65.1	67.6	73.9	73.4
1986	-	43.5	49.3	54.5	60.5	65.7	66.1	70.2	73.1
1987	-	48.6	53.3	57.1	60.7	65.1	68.5	74.0	76.8
1988	-	46.8	51.9	53.3	58.3	64.2	67.9	72.5	74.3
1989	-	48.4	53.6	56.6	60.7	64.0	71.1	74.4	74.9
1990	-	44.9	52.4	56.9	58.6	64.7	67.8	75.4	76.4
1991	-	47.9	52.9	55.5	61.9	65.2	69.8	73.6	78.4
1992	-	49.6	53.1	57.1	59.1	64.8	68.0	72.3	77.6
1993	-	48.1	53.5	57.7	60.0	62.9	64.1	68.8	75.0
1994	34.6	44.7	52.4	58.2	62.6	65.4	66.1	71.4	75.0
1995	32.6	42.2	50.1	56.7	61.5	65.9	68.1	68.2	72.2
1996	35.0	47.5	54.6	59.0	62.2	65.2	71.1	72.1	71.1
1997	32.6	42.9	54.7	58.5	62.8	65.0	67.1	68.4	71.4
1998	-	44.3	53.4	59.5	61.4	63.7	67.0	72.3	71.7
1999	-	47.9	51.4	54.7	59.8	62.2	65.6	67.5	69.3

Table 9. Landings at age (000s) and mean weight (kg) at age of haddock landed in the Canadian fishery from Georges Bank and south (NAFO Division 5Z and Subarea6), 1982-1999. Data from Gavaris and Van Eeckhaute (1999) and S. Gavaris (pers. comm.).

Year	1	2	3	4	5	6	7	8	9+	TOTAL
				Canadian Commercial Landings in Numbers (000's) at Age						
1982	0	313	469	1400	93	106	195	9	5	2590
1983	0	161	359	258	679	76	34	89	4	1660
1984	0	12	38	63	52	172	61	33	104	535
1985	0	2022	305	114	89	55	87	22	62	2756
1986	6	38	1701	86	70	52	29	40	21	2043
1987	0	1986	90	1088	59	32	30	28	68	3381
1988	4	51	1878	81	390	53	7	16	86	2566
1989	0	1132	68	623	64	202	13	8	37	2147
1990	2	6	1070	55	501	14	122	29	34	1833
1991	6	429	62	1809	50	297	28	123	57	2861
1992	7	230	237	62	1020	14	212	3	86	1871
1993	7	246	319	245	69	551	7	143	69	1656
1994	0	210	703	137	49	33	107	13	37	1289
1995	1	56	512	405	52	24	2	50	15	1119
1996	0.1	27.0	472.0	850.5	411.5	59.2	17.3	2.6	70.6	1910
1997	0.8	69.6	65.7	503.0	450.1	178.5	11.2	6.7	24.7	1310
1998	0.0	153.3	265.9	237.7	500.5	408.7	101.6	10.7	30.6	1709
1999	0.9	34.9	721.6	300.1	220.0	315.1	222.0	79.5	14.6	1909
				Canadian Commercial Landings in Weight (mt) at Age						
1982	0	331	730	2681	218	297	567	31		
1983	0	166	503	470	1494	193	96	268		
1984	0	11	53	127	117	476	178	110		
1985	0	1917	386	236	193	162	286	71		
1986	3	37	2480	181	204	151	106	170		
1987	0	1652	125	2255	133	83	87	101		
1988	2	50	2470	145	871	120	21	49		
1989	0	975	99	1115	142	526	36	24		
1990	1	6	1563	94	1118	32	334	69		
1991	3	517	76	3325	101	781	66	356		
1992	4	267	400	105	2309	29	631	8		
1993	5	285	558	548	146	1475	21	448		
1994	0	240	1173	308	131	80	303	42		
1995	1	59	774	823	133	66	6	151		
1996	0	28	679	1527	944	147	57	8		
1997	1	85	88	879	955	435	34	23		
1998	0	173	418	332	992	945	291	31		
1999	1	38.2	1133	573	410	688	563	221		

Table 9 (Cont). Landings at age (000s), mean weight (kg) of haddock landed in the Canadian fishery from Georges Bank and south (NAFO Division 5Z and Statistical Area 6), 1982-1999. Data from Gavaris and Van Eeckhaute (1999) and S. Gavaris (pers. comm.).

Canadian Commercial Landings Mean Weight (kg) at Age

Year	1	2	3	4	5	6	7	8	9+	TOTAL
1982	-	1.056	1.556	1.915	2.348	2.801	2.909	3.414		
1983	-	1.031	1.401	1.822	2.200	2.543	2.821	3.007		
1984	-	0.883	1.401	2.010	2.257	2.770	2.918	3.326		
1985	-	0.948	1.264	2.068	2.169	2.942	3.289	3.238		
1986	0.452	0.981	1.458	2.104	2.913	2.899	3.646	4.248		
1987	-	0.832	1.391	2.073	2.253	2.598	2.906	3.623		
1988	0.421	0.974	1.315	1.787	2.234	2.264	2.978	3.036		
1989	-	0.861	1.449	1.789	2.215	2.604	2.795	3.014		
1990	0.639	0.956	1.461	1.711	2.232	2.281	2.736	2.396		
1991	0.581	1.204	1.220	1.838	2.023	2.63	2.341	2.891		
1992	0.538	1.163	1.687	1.694	2.264	2.073	2.977	2.633		
1993	0.659	1.160	1.750	2.236	2.113	2.677	2.987	3.133		
1994	0.405	1.135	1.661	2.235	2.639	2.422	2.831	3.223		
1995	0.797	1.055	1.511	2.033	2.550	2.755	2.908	3.010		
1996	0.576	1.022	1.439	1.795	2.294	2.485	3.322	3.032		
1997	0.685	1.215	1.336	1.747	2.120	2.476	3.034	3.365		
1998	0.568	1.131	1.573	1.697	1.983	2.312	2.864	3.395		
1999	0.678	1.095	1.570	1.910	1.865	2.182	2.535	2.773		

Table 10. Total catch at age (000's) and mean weight (kg) and mean length (cm) at age of commercial landings and discards of haddock from Georges Bank and south (NAFO Division 5Z and Statistical Area 6), 1982-1999.

Year	1	2	3	4	5	6	7	8	9+	TOTAL
					Total Commercial Catch in Numbers (000's) at Age					
1963	2910	4047	7418	11152	8198	2205	1405	721	1096	39152
1964	10101	15935	4554	4776	8722	5794	2082	1028	1332	54324
1965	9601	125818	44496	5356	4391	6690	3772	1094	1366	202584
1966	114	6843	100810	19167	2768	2591	2332	1268	867	136760
1967	1150	168	2891	20667	10338	1209	993	917	698	39031
1968	8	2994	709	1921	14519	3499	667	453	842	25612
1969	2	11	1698	448	654	5954	1574	225	570	11136
1970	46	158	16	570	186	214	2308	746	464	4708
1971	1	1375	223	40	289	246	285	1469	928	4856
1972	156	2	450	81	32	120	78	66	1236	2221
1973	2560	2075	3	386	53	30	77	15	447	5646
1974[2]	46	4320[2]	657	2	70	2	2	53	249	5401
1975	192	1034	1864	375	4	42	4	4	88	3607
1976	144	473	550	880	216	0	23	4	112	2402
1977[3]	1	19585[3]	187	680	515	357	4	39	111	21479
1978[4]	1	761	14395[4]	305	567	517	139	14	67	16766
1979	1	26	1726	7169	525	410	315	96	46	10314
1980[5]	8	31000[5]	347	975	6054	594	546	153	81	39758
1981	1	1743	10998	831	937	2572	331	158	94	17665
1982	1	1165	1633	3733	391	569	1119	106	110	8827
1983	0	214	813	690	2239	272	186	800	76	5290
1984	0	93	297	727	397	1482	234	267	543	4041
1985	0	2406	550	194	461	228	526	78	152	4596
1986	6	54	2810	223	146	173	150	266	60	3888
1987	0	1995	129	1613	122	73	89	106	135	4262
1988	4	52	2384	134	931	149	55	64	106	3879
1989	0	1263	86	877	143	358	46	28	45	2846
1990	2	11	1445	172	868	98	177	46	44	2863
1991	6	448	91	2149	102	410	73	154	72	3505
1992	7	247	320	132	1527	111	323	27	94	2788
1993	7	290	350	299	104	659	38	159	76	1980
1994[6]	1.2	268.9	810.4	170.3	65.6	69.3	150.8	43.4	42.7	1623
1995[6]	9.2	89.4	596.5	457.2	59.9	31.5	8.2	56.6	18.0	1327
1996[6]	5.1	53.6	569.6	946.0	463.6	68.2	21.9	5.4	7.9	2141
1997[6]	29.6	174.7	285.3	755.0	547.0	212.1	18.8	15.8	39.6	2078
1998[6]	1.0	198.9	414.6	501.1	691.6	526.0	148.5	21.1	41.0	2544
1999	0.9	39.7	1062.2	582.3	497.8	509.9	335.2	142.8	40.9	3211

Table 10 (Cont). Total catch at age (000's) and mean weight (kg) and mean length (cm) at age of commercial landings and discards of haddock from Georges Bank and south (NAFO Division 5Z and Statistical Area 6), 1982-1999.

Total Commercial Landings Mean Weight[1](kg) at Age

Year	1	2	3	4	5	6	7	8	9+
1963	0.57	0.87	1.18	1.47	1.68	2.15	2.35	3.04	3.10
1964	0.50	0.83	1.12	1.43	1.64	2.01	2.40	2.64	2.97
1965	0.58	0.69	1.03	1.35	1.67	1.99	2.26	2.66	3.11
1966	0.58	0.73	0.89	1.26	1.70	2.07	2.28	2.87	3.18
1967	0.66	0.70	0.95	1.18	1.42	2.05	2.31	2.66	3.10
1968	0.59	0.81	1.05	1.32	1.57	2.10	2.32	2.62	2.86
1969	0.52	0.78	1.10	1.69	1.75	1.99	2.52	2.99	3.63
1970	0.71	1.27	1.22	1.93	2.19	2.39	2.58	3.23	3.75
1971	(0.67)	1.03	1.31	1.74	2.39	2.81	2.92	3.10	3.72
1972	0.62	1.03	1.74	2.04	2.42	2.92	3.06	3.44	3.66
1973	0.60	1.03	1.58	2.13	2.41	3.29	3.42	3.86	3.94
1974	0.72	1.06	1.82	2.32	2.83	3.76	4.05	3.92	4.26
1975	0.62	0.98	1.63	2.21	2.20	2.94	4.00	4.05	4.33
1976	0.50	0.99	1.39	1.99	2.66	(3.08)	3.69	4.67	4.94
1977	(0.53)	1.07	1.44	2.17	2.73	3.21	4.15	4.00	4.99
1978	(0.53)	0.94	1.50	2.04	2.79	3.19	3.37	3.61	5.11
1979	(0.53)	1.00	1.28	2.02	2.51	3.14	3.78	3.79	4.87
1980	0.55	0.94	1.21	1.73	2.17	2.82	3.60	3.56	3.87
1981	0.39	0.87	1.24	1.83	2.30	2.72	3.71	4.04	4.44
1982	0.22	0.97	1.45	1.88	2.37	2.76	3.24	3.96	4.09
1983	(0.33)	1.02	1.37	1.83	2.21	2.65	3.25	3.36	4.27
1984	(0.33)	0.92	1.32	1.83	2.20	2.67	2.96	3.41	3.72
1985	(0.33)	0.99	1.39	1.98	2.46	2.72	3.06	3.72	3.80
1986	0.45	0.94	1.36	1.83	2.56	2.83	2.96	3.46	3.78
1987	(0.43)	0.83	1.43	2.00	2.25	2.63	3.02	3.77	4.29
1988	0.42	0.98	1.34	1.68	2.06	2.45	2.97	3.49	3.96
1989	(0.53)	0.89	1.48	1.79	2.21	2.57	3.24	3.56	3.82
1990	0.64	0.97	1.48	1.78	2.12	2.55	2.81	2.99	4.16
1991	0.581	1.201	1.311	1.817	2.183	2.645	2.852	3.048	4.337
1992	0.538	1.175	1.639	1.768	2.186	2.519	2.967	3.365	4.267
1993	0.659	1.169	1.728	2.171	2.119	2.628	2.649	3.123	4.014
1994	0.447	1.093	1.643	2.209	2.628	2.728	2.902	3.783	4.546
1995	0.429	0.967	1.489	2.025	2.542	2.815	3.275	3.091	3.981
1996	0.456	1.098	1.497	1.838	2.325	2.543	3.423	3.516	3.712
1997	0.416	0.998	1.690	1.891	2.213	2.547	3.1.4	3.380	3.655
1998	0.511	0.968	1.485	1.917	2.333	2.688	3.027	3.038	4.070
1999	0.678	1.101	1.527	1.830	2.111	2.339	2.697	2.973	3.682

1 Data 1963-1979 from Clark et al. (1982); Data 1980-1981 from Overholtz et al. (1983); Data 1982-1990 from Hayes and Buxton (1992); data from 1991-1994 from O'Brien and Brown (1996); data from 1995-1999 from current assessment, Gavaris and Van Eekhaute (1999), and S. Gavaris (personal communication).

2 Of this total, approximately 1.0 million fish were added to the catch at age to account for high discards in 1974.

3 Of this total, approximately 12.8 million fish were added to the catch at age to account for high discards in 1977.

4 Of this total, approximately 5.0 million fish were added to the catch at age to account for high discards in 1978.

5 Of this total, approximately 20.0 million fish were added to the catch at age to account for high discards in 1980.

6 Total includes discards resulting from trip limit regulations for most year classes.

Table 11. Mean number and mean weight (kg) per tow of haddock caught in U.S. spring and autumn research vessel surveys from 1963-1999.

	Spring Survey		Autumn Survey	
Year	Number/Tow	Weight (kg)/tow	Number/tow	Weight (kg)/tow
1963			145.01	79.77
1964			193.24	96.75
1965			101.69	72.78
1966			33.26	29.87
1967	*Spring survey initiated in 1968*		17.70	25.47
1968	13.84	20.55	7.51	15.40
1969	7.33	16.93	3.38	8.44
1970	6.00	17.12	7.70	13.50
1971	2.79	5.00	4.20	5.59
1972	6.38	7.37	11.35	8.47
1973	37.62	15.37	14.89	9.78
1974	19.01	17.70	4.05	3.99
1975	6.24	8.21	30.95	15.10
1976	83.19	15.72	71.07	35.76
1977	36.86	26.58	23.25	27.52
1978	19.41	31.27	25.29	18.06
1979	45.50	19.77	52.24	31.98
1980	60.06	53.92	30.54	21.98
1981	31.21	38.02	13.45	14.01
1982	8.60	13.11	4.96	7.34
1983	5.60	13.21	7.99	5.75
1984	6.24	7.45	5.38	4.48
1985	8.85	11.14	14.19	3.86
1986	5.85	5.86	6.81	5.10
1987	4.95	5.60	3.62	2.56
1988	3.38	3.43	5.35	5.57
1989	5.35	4.70	4.34	4.70
1990	7.68	7.57	2.92	2.62
1991	3.97	4.38	2.92	0.94
1992	1.18	1.41	6.06	3.17
1993	2.79	2.48	8.09	4.33
1994	4.99	3.63	3.58	2.93
1995	5.61	5.72	17.11	10.66
1996	23.40	25.73	4.47	4.11
1997	12.95	18.50	6.16	6.51
1998	7.28	6.12	11.07	5.75
1999	16.66	7.74	33.09	23.13

Table 12. Conversion factors used to account for differences in fishing power between research vessels and changes in doors used to conduct the U.S. research vessel bottom trawl surveys (Forrester et al. 1997). Coefficients of 0.82 (Delaware) and 1.49 (BMV door) were applied to numerical abundance indices, and 0.79 (Delaware) and 1.51 (BMV door) were applied to biomass indices.

		Spring		Autumn	
Years	Door	Vessel	Conversion	Vessel	Door
1963-1967	BMV	---	---	Albatross IV	1.490
1968-1976	BMV	Albatross IV	1.490	Albatross IV	1.490
1977-1980	BMV	Albatross IV	1.490	Delaware II	1.222
1981	BMV	Delaware II	1.222	Delaware II	1.222
1982	BMV	Delaware II	1.222	Albatross IV	1.490
1983-1984	BMV	Albatross IV	1.490	Albatross IV	1.490
1985-1988	Polyvalent	Albatross IV	1.000	Albatross IV	1.000
1989-1991	Polyvalent	Delaware II	0.820	Delaware II	0.820
1992	Polyvalent	Albatross IV	1.000	Albatross IV	1.000
1993	Polyvalent	Albatross IV	1.000	Delaware II	0.820
1994	Polyvalent	Delaware II	0.820	Albatross IV	1.000
1995-1999	Polyvalent	Albatross IV	1.000	Albatross IV	1.000

Table 13. Stratified mean catch per tow (numbers) for haddock in NEFSC offshore spring research vessel bottom trawl surveys on Georges Bank (Strata 01130-01250, 01290-01300), 1968-1999. Indices have been corrected to account for changes in catchability due to changes in research vessels and doors (Forester et al. 1997).

	Age Groups											
Year	0	1	2	3	4	5	6	7	8	9+	Total 1+	Total
1968	0.00	0.40	2.83	0.46	0.70	6.72	1.68	0.25	0.45	0.34	13.84	13.84
1969	0.00	0.00	0.07	0.58	0.25	0.42	4.23	1.03	0.28	0.46	7.33	7.33
1970	0.00	0.67	0.25	0.00	0.33	0.46	0.46	2.00	0.98	0.85	6.00	6.00
1971	0.00	0.00	1.16	0.25	0.00	0.12	0.12	0.09	0.82	0.22	2.79	2.79
1972	0.00	4.02	0.09	0.61	0.12	0.03	0.04	0.13	0.03	1.30	6.38	6.38
1973	0.00	30.68	4.84	0.00	0.54	0.09	0.00	0.18	0.01	1.28	37.62	37.62
1974	0.00	2.13	13.2	2.86	0.00	0.24	0.00	0.01	0.10	0.37	19.01	19.01
1975	0.00	0.94	0.97	3.32	0.63	0.00	0.13	0.09	0.01	0.15	6.24	6.24
1976	0.00	80.97	0.30	0.60	0.92	0.43	0.00	0.04	0.00	0.10	83.19	83.19
1977	0.00	0.61	33.3	0.42	1.22	0.60	0.45	0.00	0.04	0.12	36.86	36.86
1978	0.00	0.07	0.97	15.93	0.36	0.94	0.82	0.16	0.06	0.10	19.41	19.41
1979	0.00	36.12	1.58	1.13	5.71	0.33	0.16	0.37	0.06	0.04	45.50	45.50
1980	0.00	5.20	46.7	0.51	1.04	4.87	0.67	0.37	0.46	0.24	60.06	60.06
1981	0.00	3.30	3.29	19.49	2.19	0.76	1.78	0.24	0.11	0.05	31.21	31.21
1982	0.00	0.76	1.53	0.94	4.07	0.42	0.28	0.61	0.00	0.00	8.60	8.60
1983	0.00	0.43	0.55	0.58	0.22	2.41	0.01	0.04	1.16	0.18	5.60	5.60
1984	0.00	2.09	1.18	0.64	0.63	0.58	0.72	0.07	0.04	0.30	6.24	6.24
1985	0.00	0.00	4.96	0.76	0.40	0.87	0.34	1.17	0.10	0.25	8.85	8.85
1986	0.00	2.49	0.18	2.06	0.24	0.11	0.21	0.12	0.33	0.11	5.85	5.85
1987	0.00	0.00	3.62	0.06	0.81	0.08	0.10	0.05	0.22	0.01	4.95	4.95
1988	0.00	1.55	0.04	0.99	0.13	0.32	0.12	0.11	0.12	0.00	3.38	3.38
1989	0.00	0.02	3.49	0.45	0.71	0.14	0.41	0.06	0.05	0.01	5.35	5.35
1990	0.00	0.86	0.00	5.72	0.33	0.58	0.06	0.13	0.00	0.01	7.68	7.68
1991	0.00	0.54	1.07	0.24	1.85	0.09	0.10	0.02	0.04	0.02	3.97	3.97
1992	0.00	0.40	0.18	0.11	0.07	0.33	0.03	0.03	0.03	0.00	1.18	1.18
1993	0.00	1.17	0.65	0.18	0.14	0.12	0.37	0.06	0.02	0.02	2.73	2.73
1994	0.08	0.70	2.68	1.00	0.15	0.10	0.07	0.16	0.02	0.05	4.99	4.91
1995	0.00	0.50	1.29	2.32	0.91	0.17	0.11	0.03	0.18	0.09	5.61	5.61
1996	0.00	1.09	4.59	8.86	5.21	2.62	0.35	0.07	0.08	0.54	23.40	23.40
1997	0.00	1.79	1.02	3.35	3.66	2.01	0.89	0.13	0.07	0.02	12.95	12.95
1998	0.00	0.82	2.95	1.25	1.06	0.85	0.21	0.06	0.01	0.06	7.28	7.28
1999	0.00	10.21	2.03	2.14	0.72	0.64	0.51	0.20	0.20	0.02	16.66	16.66

Table 14. Stratified mean catch per tow (numbers) for haddock in NEFSC offshore autumn research vessel bottom trawl surveys on Georges Bank (Strata 01130-01250, 01290-01300), 1963-1999. Indices have been corrected to account for changes in catchability due to changes in research vessels and doors (Forrester et al. 1997).

	Age Groups											
Year	0	1	2	3	4	5	6	7	8	9+	Total	Total
1963	83.93	25.39	9.22	6.81	8.34	5.95	2.04	1.68	1.18	0.46	145.01	61.08
1964	2.37	112.8	63.74	5.83	1.79	3.81	1.56	0.69	0.25	0.33	193.24	190.8
1965	0.33	10.16	77.39	9.70	1.07	0.80	0.91	0.80	0.25	0.27	101.69	101.3
1966	6.14	0.95	2.89	18.39	3.35	0.52	0.49	0.33	0.12	0.07	33.26	27.12
1967	0.03	6.72	0.36	0.99	6.76	1.62	0.49	0.21	0.33	0.18	17.70	17.67
1968	0.09	0.06	0.95	0.13	0.33	3.86	1.27	0.27	0.16	0.39	7.51	7.42
1969	0.39	0.03	0.00	0.28	0.13	0.16	1.52	0.51	0.09	0.27	3.38	2.99
1970	0.04	4.13	0.21	0.01	0.28	0.27	0.51	1.37	0.48	0.40	7.70	7.66
1971	2.43	0.00	0.31	0.07	0.01	0.22	0.03	0.09	0.75	0.28	4.20	1.77
1972	6.75	2.52	0.00	0.52	0.09	0.00	0.09	0.06	0.03	1.30	11.35	4.60
1973	3.23	9.00	1.61	0.00	0.19	0.04	0.00	0.07	0.01	0.72	14.89	11.65
1974	0.75	1.77	0.98	0.31	0.00	0.01	0.00	0.00	0.00	0.22	4.05	3.31
1975	23.48	0.63	0.72	4.86	0.92	0.00	0.03	0.00	0.01	0.30	30.95	7.46
1976	4.32	64.17	0.52	0.54	0.82	0.30	0.00	0.04	0.10	0.25	71.07	66.75
1977	0.13	2.14	18.73	0.56	0.57	0.64	0.34	0.04	0.01	0.09	23.25	23.12
1978	13.22	0.84	1.04	9.27	0.18	0.26	0.45	0.01	0.00	0.01	25.30	12.07
1979	1.32	45.57	0.04	0.90	3.81	0.26	0.28	0.05	0.01	0.00	52.24	50.92
1980	11.68	2.71	12.72	0.45	0.18	1.70	0.48	0.46	0.09	0.06	30.54	18.86
1981	0.38	6.13	2.08	3.70	0.21	0.42	0.53	0.00	0.00	0.01	13.45	13.07
1982	1.37	0.00	1.33	0.34	1.40	0.13	0.07	0.21	0.01	0.10	4.96	3.61
1983	5.80	0.24	0.21	0.27	0.30	0.94	0.12	0.00	0.10	0.02	7.99	2.19
1984	0.03	3.32	0.88	0.24	0.28	0.06	0.45	0.00	0.00	0.12	5.38	5.35
1985	11.35	0.65	1.53	0.22	0.05	0.10	0.07	0.17	0.00	0.05	14.19	2.84
1986	0.00	5.11	0.09	1.21	0.06	0.13	0.13	0.02	0.03	0.03	6.81	6.81
1987	1.80	0.00	0.79	0.10	0.77	0.06	0.06	0.02	0.02	0.00	3.62	1.82
1988	0.07	3.02	0.18	1.30	0.12	0.40	0.12	0.11	0.00	0.03	5.35	5.28
1989	0.47	0.05	2.71	0.20	0.66	0.09	0.13	0.02	0.02	0.00	4.33	3.87
1990	0.78	0.67	0.03	1.19	0.05	0.17	0.04	0.00	0.00	0.00	2.92	2.15
1991	2.16	0.21	0.24	0.05	0.22	0.02	0.02	0.00	0.00	0.02	2.92	0.76
1992	2.85	2.08	0.23	0.24	0.00	0.47	0.02	0.08	0.03	0.06	6.06	3.21
1993	1.52	4.04	2.01	0.30	0.00	0.06	0.15	0.02	0.00	0.00	8.09	6.58
1994	0.91	0.77	0.81	0.67	0.12	0.05	0.02	0.17	0.06	0.00	3.58	2.67
1995	2.27	7.14	4.90	2.32	0.38	0.01	0.00	0.07	0.02	0.00	17.11	14.84
1996	1.31	0.54	0.93	1.04	0.49	0.14	0.01	0.01	0.00	0.01	4.47	3.16
1997	0.32	2.47	1.47	0.75	0.55	0.33	0.13	0.00	0.07	0.08	6.16	5.84
1998	4.32	2.79	2.47	0.72	0.41	0.18	0.16	0.02	0.00	0.01	11.07	6.75
1999	1.82	0.84	3.37	8.05	3.52	2.32	0.82	1.32	0.75	0.31	21.30	23.13

Table 15. Stratified mean catch per tow (numbers) for haddock in Canadian offshore research vessel bottom trawl surveys on Georges Bank, 1986-2000.[1] The Georges Bank strata set includes strata 5Z1-5Z8.

Year	Age group 0	1	2	3	4	5	6	7	8	9+	Total
1986	0.00	4.06	0.22	6.05	1.07	0.19	0.29	0.34	0.37	0.42	13.01
1987	0.00	0.03	3.04	0.69	2.51	0.67	0.08	0.30	0.10	0.86	8.28
1988	0.00	1.47	0.05	8.53	0.17	2.85	0.18	0.17	0.11	0.50	14.03
1989	0.00	0.03	5.34	0.72	2.12	0.19	0.42	0.03	0.03	0.23	9.11
1990	0.00	0.93	0.11	9.87	0.13	3.36	0.23	1.09	0.13	0.34	16.19
1991	0.00	0.75	1.67	0.14	8.99	0.11	1.60	0.09	0.44	0.21	14.00
1992	0.00	3.30	2.95	1.13	0.17	3.82	0.03	1.06	0.04	0.58	13.08
1993	0.00	3.96	2.16	0.55	0.45	0.04	1.28	0.02	0.32	0.16	8.94
1994	0.00	3.32	11.52	4.08	0.42	0.24	0.02	0.70	0.01	0.27	20.59
1995	0.00	1.94	2.62	4.30	2.22	0.56	0.28	0.00	0.48	0.66	13.06
1996	0.00	5.37	2.54	4.25	4.43	2.57	0.23	0.21	0.03	0.50	20.14
1997	0.00	1.74	1.15	0.81	2.36	2.47	1.77	0.24	0.09	0.59	11.22
1998	0.00	2.41	8.18	3.08	2.57	3.76	3.67	1.98	0.24	0.48	26.37
1999	0.00	19.75	3.41	7.16	2.21	1.40	1.35	1.26	0.33	0.13	37.00
2000	0.00	18.33	68.60	9.32	8.91	2.11	1.55	1.94	1.14	0.59	112.50

[1] S. Gavaris, personal communication.

Table 16. Percentage maturity of female Georges Bank haddock at age, 1963-1999.

	Age				
Year	1	2	3	4	Source
1963-1967	0	0	78	100	Clark (1959)
1968 - 1972	0	28	76	100	Livingstone (pers. comm., March 1980) as cited in Clark et al. (1982)
1973 - 1976	0	34	92	100	Livingstone (pers. comm., March 1980) as cited in Clark et al. (1982)
1977	0	61	100	100	Overholtz (1987)
1978	0	26	99	100	Overholtz (1987)
1979	0	8	71	100	Overholtz (1987)
1980	0	41	100	100	Overholtz (1987)
1981	0	52	94	100	Overholtz (1987)
1982	0	31	67	100	Overholtz (1987)
1983	0	11	39	100	Overholtz (1987)
1984	12	33	94	100	O'Brien (pers. comm.)
1985 - 1989	24	65	92	98	NEFSC (1997)
1990 - 1992	10	56	94	99	NEFSC (1997)
1993 - 1994	7	30	71	94	NEFSC (1997)
1995 - 1999	2	34	94	100	Current Assessment

Table 17. Virtual Population Analysis (VPA) run descriptions including a summary of key diagnostics and results from accepted VPA formulations from the previous four stock assessments and the current assessment.

VPA Run #	SARC-20	SARC-24	SARC-27	NDWG-1999	TRAC-2000
Terminal Year of Catch at Age	1994	1996	1997	1998	1999
Ages Estimated	1-6,8	1-8	1-8	1-8	1-8
Tuning Indices					
US Spring 1-8	Yes	Yes	Yes	Yes	Yes
US Spring 1973-1981 (Yankee 41 years) separate index	No	No	Yes	Yes	Yes
Canada Spring 1-8	Yes	Yes	Yes	Yes	Yes
US Autumn 0-5 Lagged	Yes	Yes	Yes	Yes	Yes
US Autumn 6-8 Lagged	Yes	Yes	No	No	No
Terminal Year US Spring Indices	No	No	No	Yes	No
Discards					
Post 1993 Discard Estimates Included	No	Yes	Yes	Yes	Yes
Diagnostics					
Sum of squares	319.791	398.655	338.164	352.199	375.251
Mean squared residuals	0.66485	0.72482	0.69581	0.68256	0.70802
CV n1	0.60	0.62	0.61	0.49	0.61
CV n2	0.38	0.40	0.39	0.35	0.39
CV n3	0.31	0.31	0.31	0.29	0.31
CV n4	0.31	0.29	0.27	0.27	0.29
CV n5	0.35	0.27	0.27	0.25	0.27
CV n6	0.39	0.26	0.25	0.26	0.26
CV n7	Not Estimated	0.33	0.27	0.25	0.30
CV n8	0.39	0.34	0.31	0.27	0.29
Min/Max CV q (US Spring)	0.16 - 0.17	0.16 - 0.17	N/A	N/A	N/A
Min/Max CV q (US Spring w/o	N/A	N/A	0.19 - 0.21	0.18 - 0.19	0.18 - 0.20
Min/Max CV q (US - Yankee 41)	N/A	N/A	0.28 - 0.34	0.28 - 0.34	0.28 - 0.35
Min/Max CV q (Can Spring)	0.26-0.28	0.25 - 0.26	0.24 - 0.25	0.23 - 0.24	0.22 - 0.23
Min/Max CV q (US Autumn)	0.15 - 0.17	0.15 - 0.17	0.15 - 0.15	0.14 - 0.15	0.14 - 0.15
Standardized Residuals > 2	22	21	25	28	26
Max Partial Variance - US Age 1 Y41	1.512	1.481	2.433	2.432	2.432

Table 18. Beginning year stock size (000s) of Georges Bank haddock estimated from VPA, 1963 to 2000.

	1963	1964	1965	1966	1967	1968	1969
1	190706	471885	33154	4137	12954	422	988
2	32266	153504	377207	18457	3284	9565	338
3	32743	22756	111260	194986	8920	2536	5122
4	45821	20096	14510	50830	68425	4687	1435
5	29031	27424	12131	7034	24273	37321	2099
6	9186	16351	14561	5959	3254	10519	17419
7	5595	5526	8144	5868	2535	1570	5446
8	2795	3309	2640	3255	2694	1177	682
9	4217	4251	3258	2201	2031	2163	1712
1+	352360	725101	576867	292727	128369	69961	35241

	1970	1971	1972	1973	1974	1975	1976
1	4661	369	8517	19418	10547	7661	103305
2	807	3774	301	6832	13582	8594	6098
3	267	518	1846	245	3716	7211	6100
4	2657	204	222	1104	198	2448	4217
5	770	1660	131	109	555	160	1665
6	1127	462	1097	78	41	391	127
7	8874	729	156	790	37	32	282
8	3035	5177	339	57	577	28	22
9	1875	3245	6311	1679	2702	622	623
1+	24071	16137	18919	30311	31954	27146	122441

	1977	1978	1979	1980	1981	1982	1983
1	13810	6073	83984	10137	7225	2480	3108
2	84449	11306	4971	68760	8292	5915	2029
3	4565	51420	8568	4046	28246	5212	3788
4	4497	3568	29074	5453	2999	13174	2789
5	2657	3066	2645	17317	3582	1703	7408
6	1168	1709	1997	1691	8700	2085	1041
7	104	633	931	1264	847	4796	1192
8	210	82	392	478	541	394	2914
9	594	390	187	251	319	406	275
1+	112054	78246	132750	109396	60751	36164	24545

	1984	1985	1986	1987	1988	1989	1990
1	17265	1761	14746	2103	16757	1087	2644
2	2544	14136	1442	12068	1722	13716	890
3	1468	1999	9396	1131	8075	1363	10087
4	2366	933	1139	5150	810	4454	1038
5	1659	1279	588	731	2757	542	2853
6	4039	999	630	350	488	1415	314
7	606	1966	612	360	220	265	835
8	808	284	1134	365	214	130	175
9	1628	550	254	461	351	208	166
1+	32384	23908	29941	22719	31393	23180	19002

Table 18 (Cont). Beginning year stock size (000s) of Georges Bank haddock estimated from VPA. 1963 to 2000.

	1991	1992	1993	1994	1995	1996	1997
1	2377	9306	15272	12448	10425	9908	19530
2	2163	1940	7613	12497	10190	8527	8107
3	719	1365	1365	5970	9989	8262	6933
4	6951	506	828	801	4155	7638	6249
5	694	3746	295	408	502	2988	5398
6	1551	476	1686	147	274	357	2027
7	168	899	289	784	58	196	230
8	523	72	443	202	505	40	141
9	243	247	210	198	160	58	356
1+	15388	18558	28001	33456	36258	37974	48971

	1998	1999	2000
1	11294	48760	35243
2	15963	9245	39921
3	6477	12890	7534
4	5415	4927	9592
5	4413	3980	3507
6	3906	2987	2808
7	1460	2722	1984
8	171	1061	1926
9	331	303	951
1+	49430	86877	103466

Table 19. Spawning stock biomass (mt) of Georges Bank haddock estimated from the VPA. 1963 to 1999.

	1963	1964	1965	1966	1967	1968	1969
1	00	00	00	00	00	00	00
2	00	00	00	00	00	1675	61
3	24233	15655	65996	91773	4934	1433	3119
4	56101	23010	14892	48128	60273	4294	1636
5	38629	36355	15691	8788	26351	41983	2731
6	16464	25247	20964	8946	5063	15410	26018
7	10877	10439	13799	10289	4575	2780	10823
8	6533	7059	5446	6850	5610	2397	1526
9	11435	10811	8271	5784	5324	5124	5278
1+	164273	128575	145060	180559	112131	75096	51190

	1970	1971	1972	1973	1974	1975	1976
1	00	00	00	00	00	00	00
2	164	756	67	1594	3142	2253	1510
3	185	411	1652	273	4216	7623	6069
4	3442	266	304	1789	359	4459	6767
5	1303	3215	236	189	1248	342	3694
6	2067	873	2671	183	116	1039	316
7	17573	1590	354	2308	126	113	863
8	7609	12676	962	170	1956	105	87
9	6177	10450	20679	5770	10659	2455	2771
1+	38520	30237	26924	12276	21822	18389	22076

	1977	1978	1979	1980	1981	1982	1983
1	00	00	00	00	00	00	00
2	17995	2458	1134	12825	1686	1074	293
3	4151	45760	6800	3345	20420	4055	3145
4	7098	5675	44468	7305	3874	17421	3991
5	5546	6779	5353	30529	6242	3137	12974
6	2927	4333	5274	3784	18209	4569	2279
7	351	1847	2737	3438	2262	12571	3240
8	725	286	1233	1494	1781	1315	8354
9	2664	1797	799	827	1224	1445	1019
1+	41458	68935	67797	63547	55698	45586	35294

	1984	1985	1986	1987	1988	1989	1990
1	376	79	1114	137	1105	97	117
2	436	4746	491	4335	685	5044	339
3	1429	1787	8534	1097	6681	1395	9917
4	3212	1317	1593	7119	1112	6049	1507
5	2933	2274	1163	1340	4738	911	4770
6	8196	2162	1446	808	983	2853	638
7	1405	4897	1526	923	540	672	1994
8	2283	820	3256	1054	597	377	476
9	5141	1817	848	1710	1197	708	603
1+	25411	19900	19971	18523	17638	18106	20361

Table 19 (Cont) Spawning stock biomass (mt) of Georges Bank haddock estimated from the VPA. 1963 to 1999.

	1991	1992	1993	1994	1995	1996	1997
1	92	323	521	252	53	58	96
2	947	822	1704	3010	2160	1888	1759
3	698	1589	1209	5366	11204	8713	8350
4	9669	666	1230	1309	6979	11583	9641
5	1244	6115	480	882	1092	5885	10037
6	3201	985	3336	281	686	812	4543
7	367	2109	683	1940	158	560	601
8	1319	185	1132	570	1392	124	440
9	907	878	706	800	586	198	1196
1+	18445	13674	11001	14409	24311	29823	36663

	1998	1999
1	75	569
2	3457	2240
3	7181	14483
4	8875	7744
5	8013	7212
6	8241	6006
7	3713	6366
8	535	2885
9	1178	1018
1+	41270	48522

Table 20. Estimated fishing mortality (F) at age and average F (ages 4-7, unweighted) for the Georges Bank haddock estimated from VPA, 1963 to 1999.

	1963	1964	1965	1966	1967	1968	1969
1	0.02	0.02	0.39	0.03	0.10	0.02	0.00
2	0.15	0.12	0.46	0.53	0.06	0.42	0.04
3	0.29	0.25	0.58	0.85	0.44	0.37	0.46
4	0.31	0.30	0.52	0.54	0.41	0.60	0.42
5	0.37	0.43	0.51	0.57	0.64	0.56	0.42
6	0.31	0.50	0.71	0.65	0.53	0.46	0.47
7	0.33	0.54	0.72	0.58	0.57	0.63	0.38
8	0.34	0.42	0.61	0.56	0.47	0.55	0.45
9	0.34	0.42	0.61	0.56	0.47	0.55	0.45
4-7	0.33	0.44	0.62	0.59	0.53	0.56	0.43

	1970	1971	1972	1973	1974	1975	1976
1	0.01	0.00	0.02	0.16	0.00	0.03	0.00
2	0.24	0.52	0.01	0.41	0.43	0.14	0.09
3	0.07	0.65	0.31	0.01	0.22	0.34	0.10
4	0.27	0.24	0.52	0.49	0.01	0.19	0.26
5	0.31	0.21	0.31	0.77	0.15	0.03	0.15
6	0.24	0.89	0.13	0.55	0.06	0.13	0.00
7	0.34	0.57	0.81	0.11	0.06	0.15	0.09
8	0.32	0.38	0.24	0.35	0.11	0.17	0.22
9	0.32	0.38	0.24	0.35	0.11	0.17	0.22
4-7	0.29	0.48	0.44	0.48	0.07	0.12	0.13

	1977	1978	1979	1980	1981	1982	1983
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.30	0.08	0.01	0.69	0.26	0.25	0.12
3	0.05	0.37	0.25	0.10	0.56	0.43	0.27
4	0.18	0.10	0.32	0.22	0.37	0.38	0.32
5	0.24	0.23	0.25	0.49	0.34	0.29	0.41
6	0.41	0.41	0.26	0.49	0.40	0.36	0.34
7	0.04	0.28	0.47	0.65	0.57	0.30	0.19
8	0.23	0.21	0.32	0.44	0.39	0.35	0.36
9	0.23	0.21	0.32	0.44	0.39	0.35	0.36
4-7	0.22	0.25	0.32	0.46	0.42	0.33	0.31

	1984	1985	1986	1987	1988	1989	1990
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.04	0.21	0.04	0.20	0.03	0.11	0.01
3	0.25	0.36	0.40	0.13	0.39	0.07	0.17
4	0.41	0.26	0.24	0.42	0.20	0.25	0.20
5	0.31	0.51	0.32	0.20	0.47	0.35	0.41
6	0.52	0.29	0.36	0.26	0.41	0.33	0.42
7	0.56	0.35	0.32	0.32	0.32	0.21	0.27
8	0.45	0.36	0.30	0.39	0.40	0.27	0.34
9	0.45	0.36	0.30	0.39	0.40	0.27	0.34
4-7	0.45	0.35	0.31	0.30	0.35	0.28	0.33

Table 20 (Cont). Estimated fishing mortality (F) at age and average F (ages 4-7, unweighted) for the Georges Bank haddock estimated from VPA, 1963 to 1999.

	1991	1992	1993	1994	1995	1996	1997
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.26	0.15	0.04	0.02	0.01	0.01	0.02
3	0.15	0.30	0.33	0.16	0.07	0.08	0.05
4	0.42	0.34	0.51	0.27	0.13	0.15	0.15
5	0.18	0.60	0.49	0.20	0.14	0.19	0.12
6	0.35	0.30	0.57	0.73	0.14	0.24	0.13
7	0.65	0.51	0.16	0.24	0.17	0.13	0.10
8	0.39	0.54	0.50	0.27	0.13	0.16	0.14
9	0.39	0.54	0.50	0.27	0.13	0.16	0.14
4-7	0.40	0.44	0.43	0.36	0.14	0.18	0.12

	1998	1999
1	0.00	0.00
2	0.01	0.00
3	0.07	0.10
4	0.11	0.14
5	0.19	0.15
6	0.16	0.21
7	0.12	0.15
8	0.15	0.16
9	0.15	0.16
4-7	0.14	0.16

Table 21. Descriptions for 2000 assessment VPA calibrations including the base run and a sensitivity run with set #55 removed from the results of the 2000 Canadian research vessel survey indices.

VPA Run #	Base Run - Run 11	Dropped Tow - Run 12
Ages Estimated	1-8	1-8
Tuning Indices		
US Spring 1-8	Yes	Yes
US Spring 1973-1981 (Yankee 41 years) separate index	Yes	Yes
Canada Spring 1-8	Yes	Yes
US Autumn 0-5 Lagged	Yes	Yes
US Autumn 6-8 Lagged	No	No
2000 Canadian Survey Adjusted	No	Yes
Diagnostics		
Sum of squares	375.251	369.783
Mean squared residuals	0.70802	0.69770
CV n1	0.61	0.61
CV n2	0.39	0.39
CV n3	0.31	0.31
CV n4	0.29	0.28
CV n5	0.27	0.27
CV n6	0.26	0.26
CV n7	0.30	0.29
CV n8	0.29	0.28
Stock Numbers in 2000		
Age 1 (1999 Year Class)	35,243	22,458
Age 2 (1998 Year Class)	39,921	28,349
Age 3 (1997 Year Class)	7,534	7,178
Age 4 (1996 Year Class)	9,592	9,655
Fishing Mortality (4-7,u)	0.16	0.16
SSB (mt)	48,522	48,540

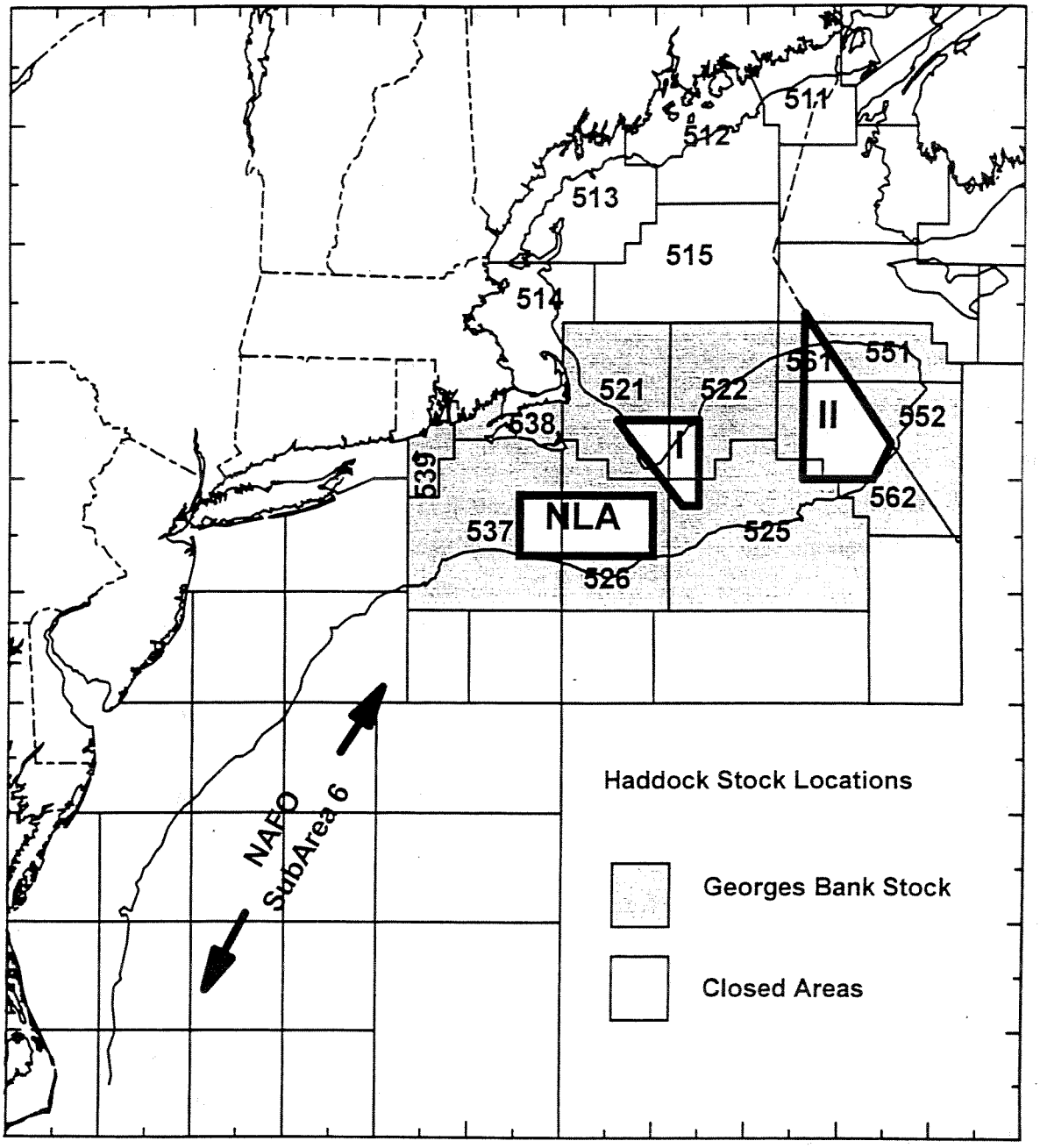

Figure 1. NEFSC statistical areas included in the Georges Bank haddock assessment. Shading indicates the area where 99% of catch occurs. For U.S. management purposes, a small amount of landings from subareas 5 and 6 south of the primary area of concentration are also included in the assessment.

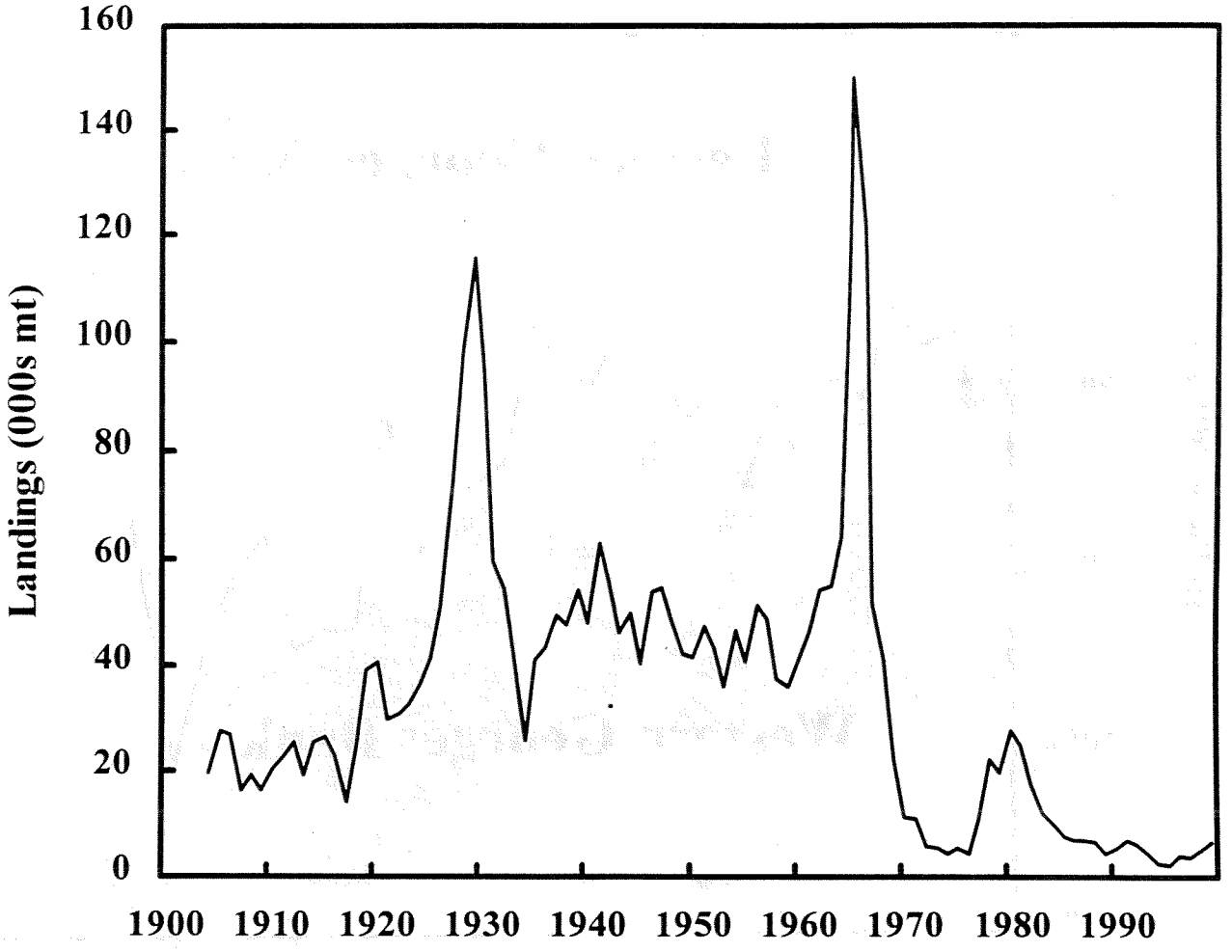

Figure 2. Total commercial landings (000s mt) of haddock from Georges Bank and south, 1904-1999.

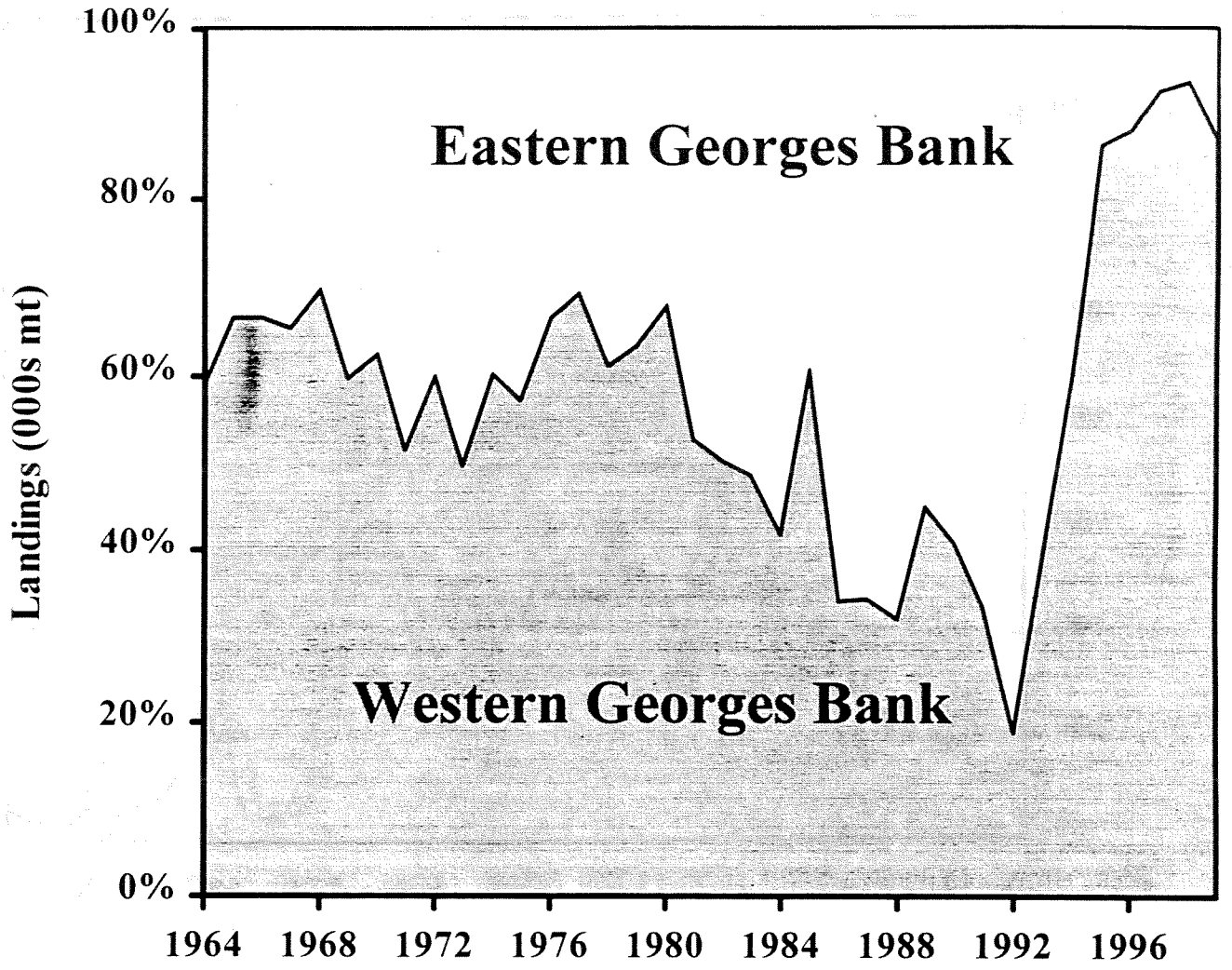

Figure 3. The proportion of U.S. haddockcatch occurring in eastern Georges Bank (U.S. statistical areas 551,552,561,562) and western Georges Bank (U.S. statistical areas 521, 522, 525, 526, 537, 538, 539, and south). U.S. landings have shifted from eastern to western Georges bank in response to U.S. management measures including closed areas and days at sea restrictions.

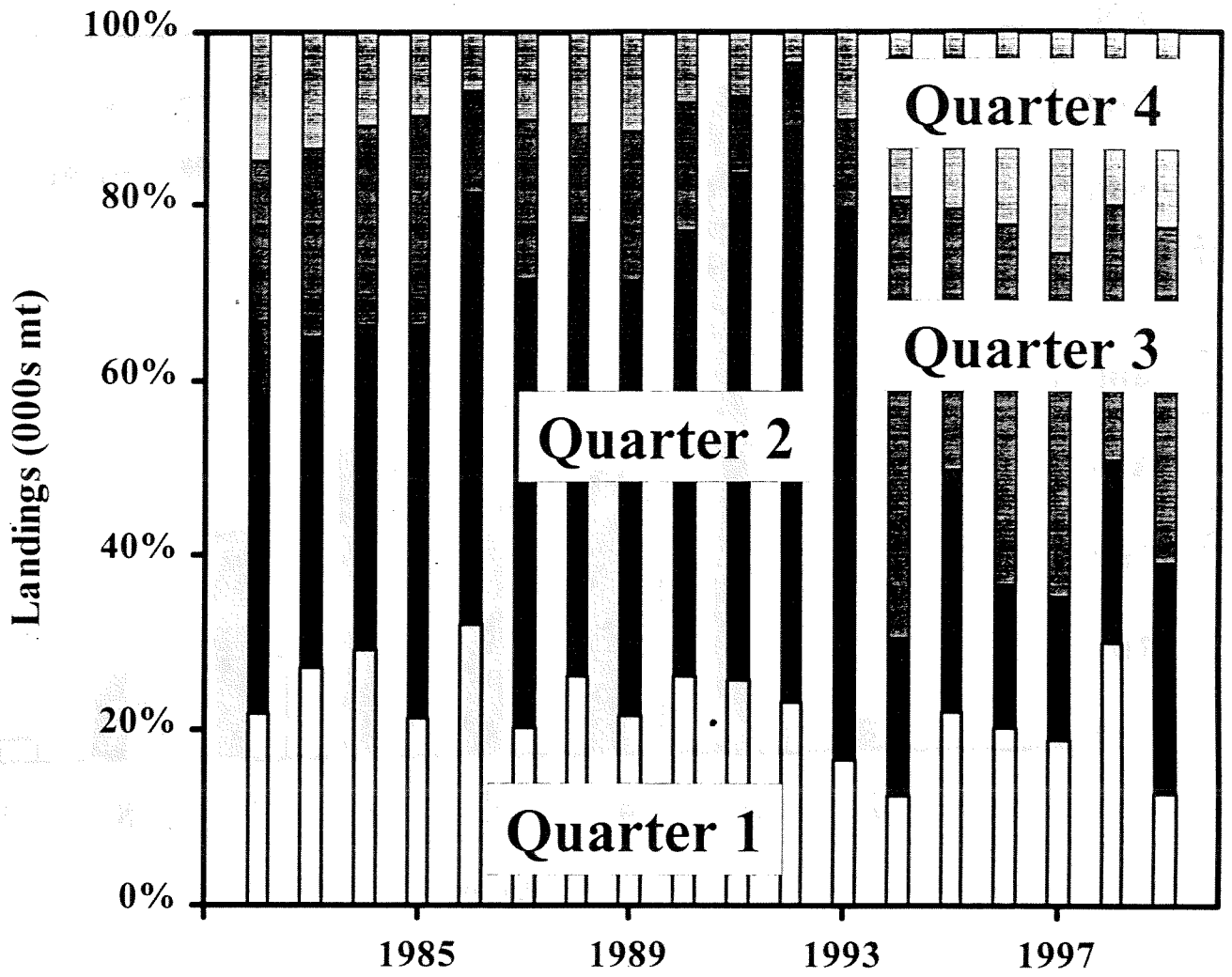

Figure 4. The proportion of U.S. haddock catch by quarter, 1982-1999. Since 1994, the proportion of U.S. catch occurring in the the 3rd and 4th quarters has increased relative to the 1st half of the year. U.S. trip limit regulations have been liberalized in the second half of the year in each of the last four years (1996-1999).

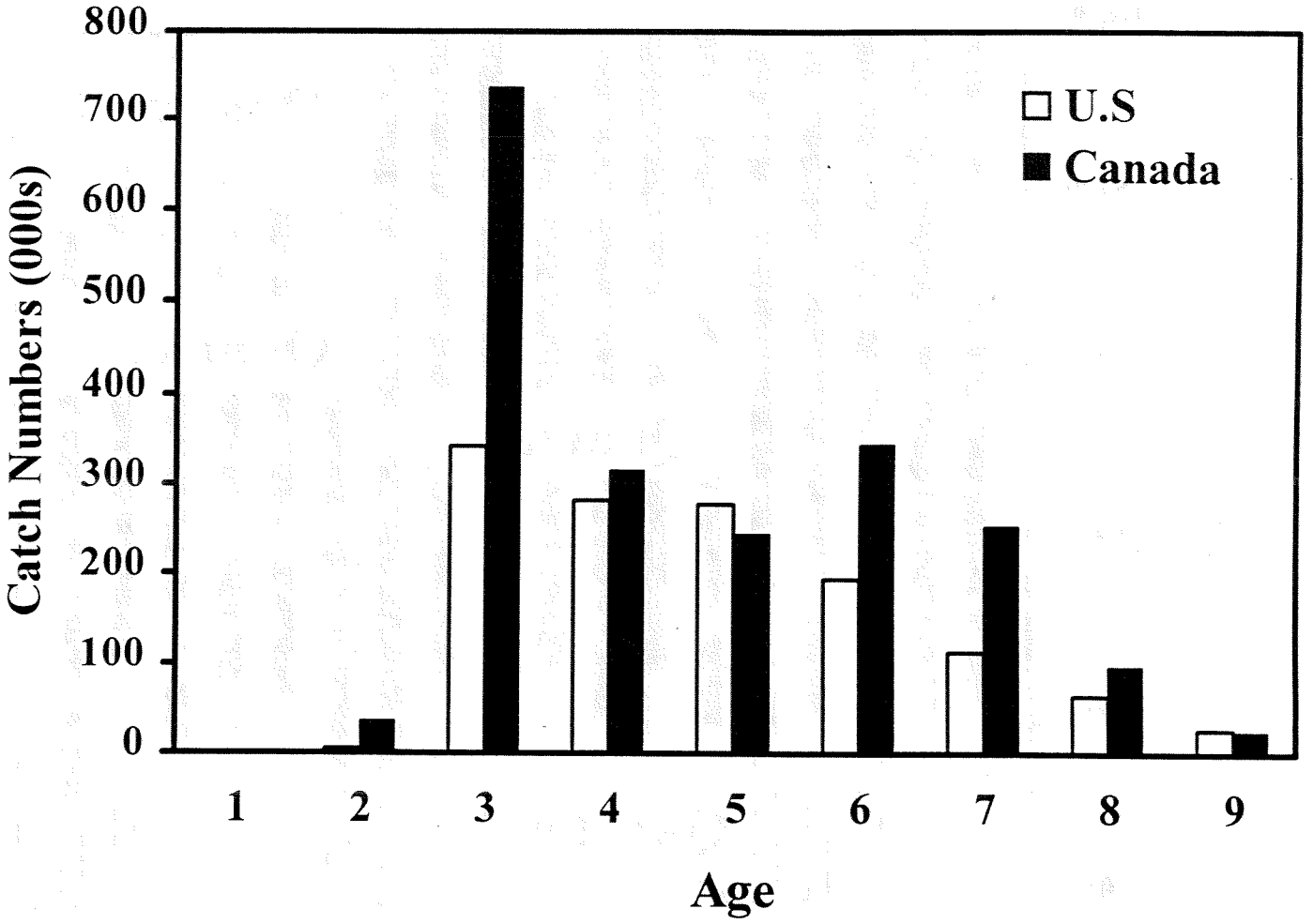

Figure 5. Comparison of the 1999 estimated catch at age in the U.S. and Canadian haddock fisheries on Georges Bank.

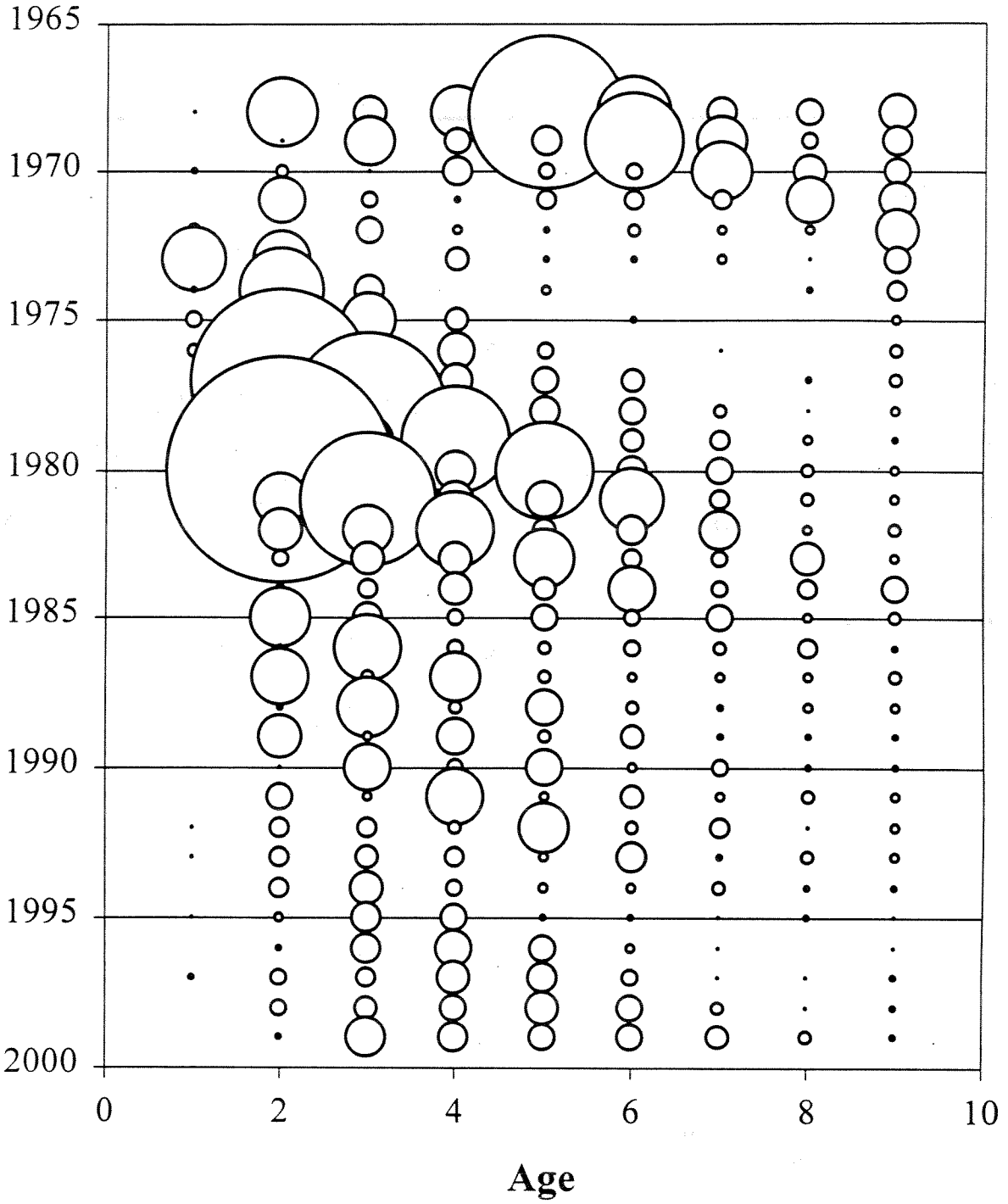

Figure 6. Estimated numerical catch at age of Georges Bank haddock from 1968 to 1999. Strong diagonals in the numerical catch at age are an indication of the presence of dominant year classes.

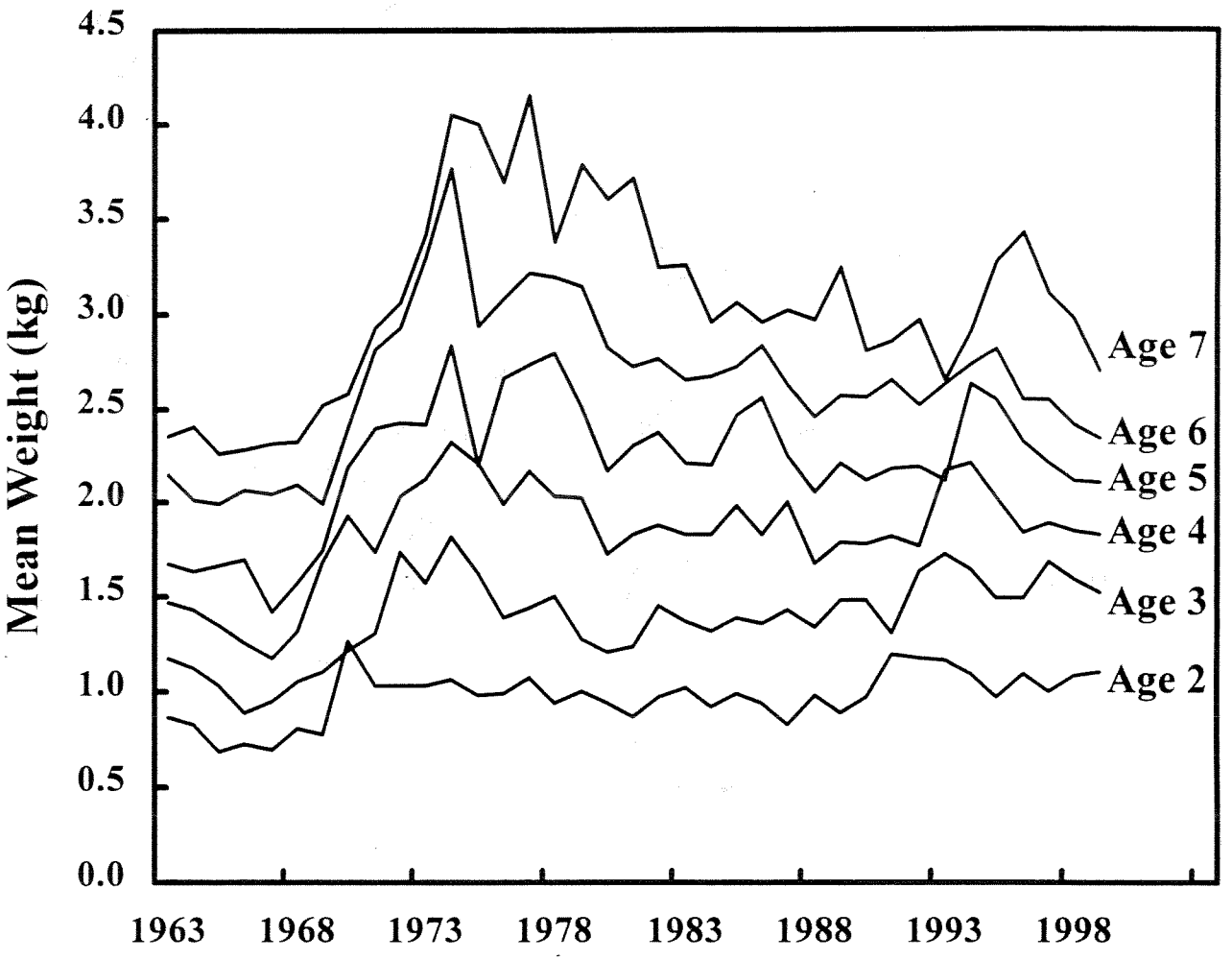

Figure 7. Trends in mean weight at age in the U.S. and Canadian catch of haddock from Georges Bank (Area 5Z).

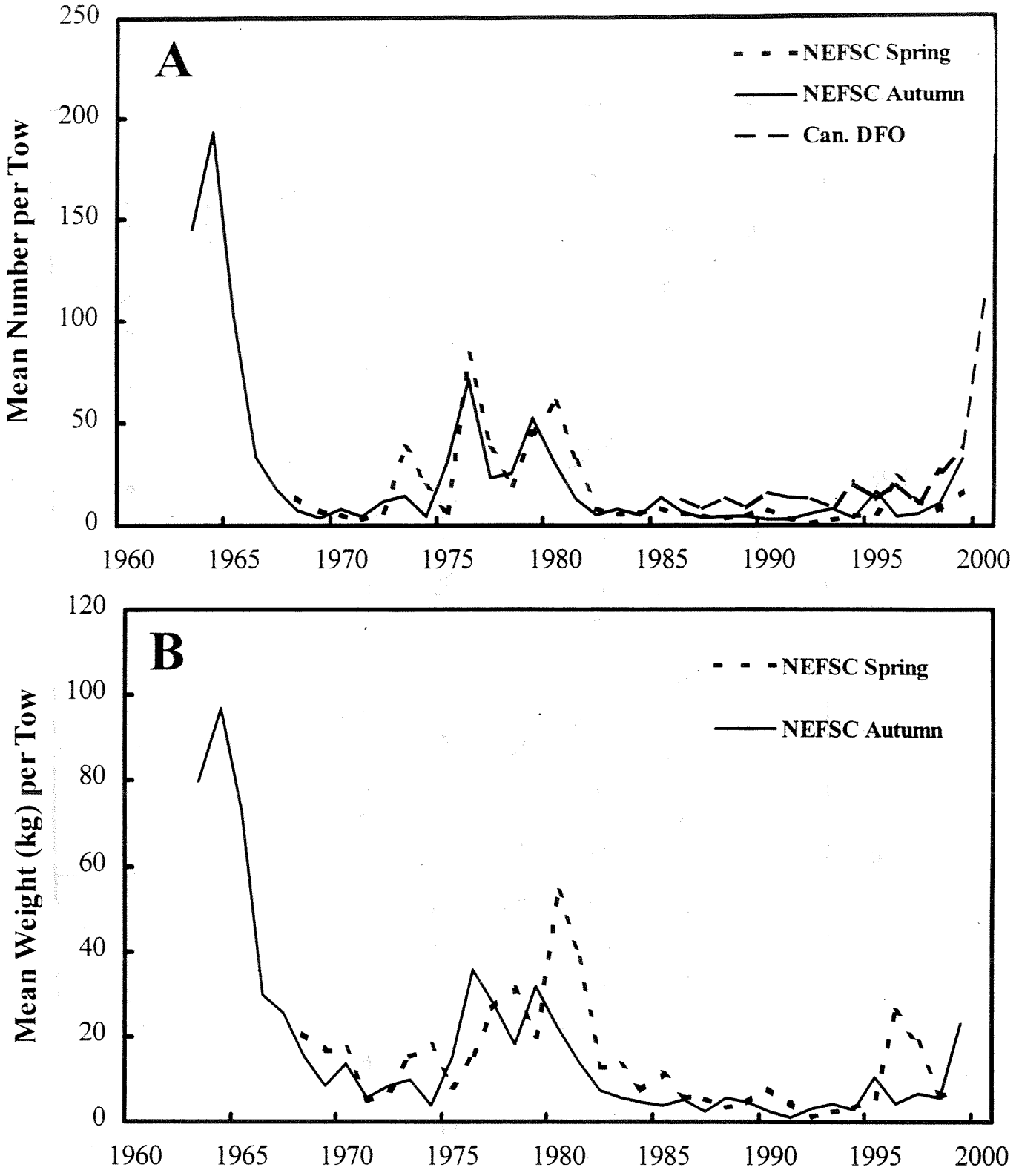

Figure 8. U.S. and Canadian research vessel survey abundance (stratified mean number per tow, Panel A) and biomass (kg per tow, Panel B) indices for Georges Bank haddock from 1963-1999. U.S. survey indices based on data for strata 01130-01250 and 01290-01300; Canadian survey indices include strata 5Z1-5Z8. Surveys have not been adjusted for catchabilities.

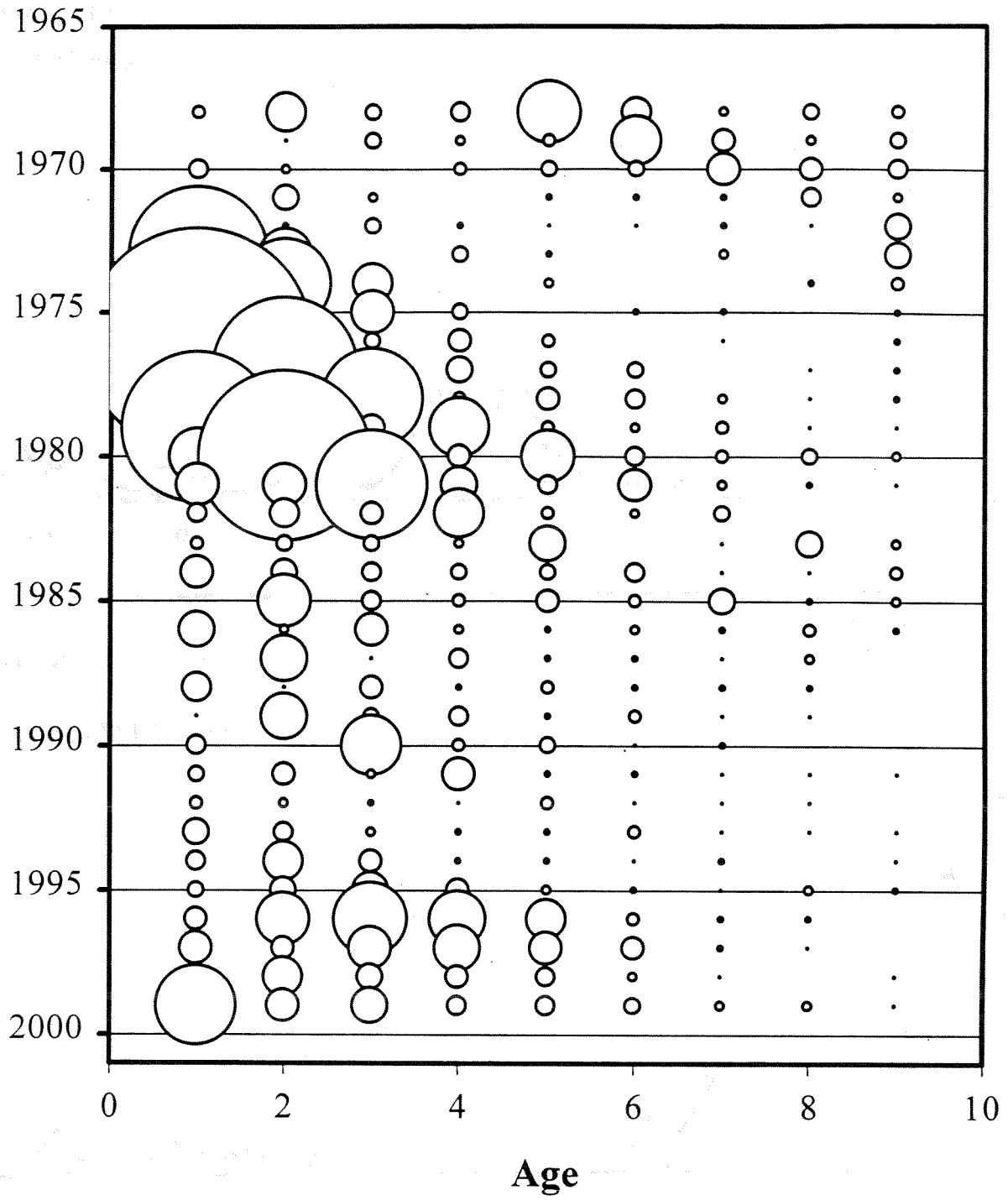

Figure 9. Numerical abundance indices at age for Georges Bank haddock in the U.S. spring research vessel survey from 1968 to 1999. Strong diagonals in the numerical catch at age are an indication of the presence of dominant year classes.

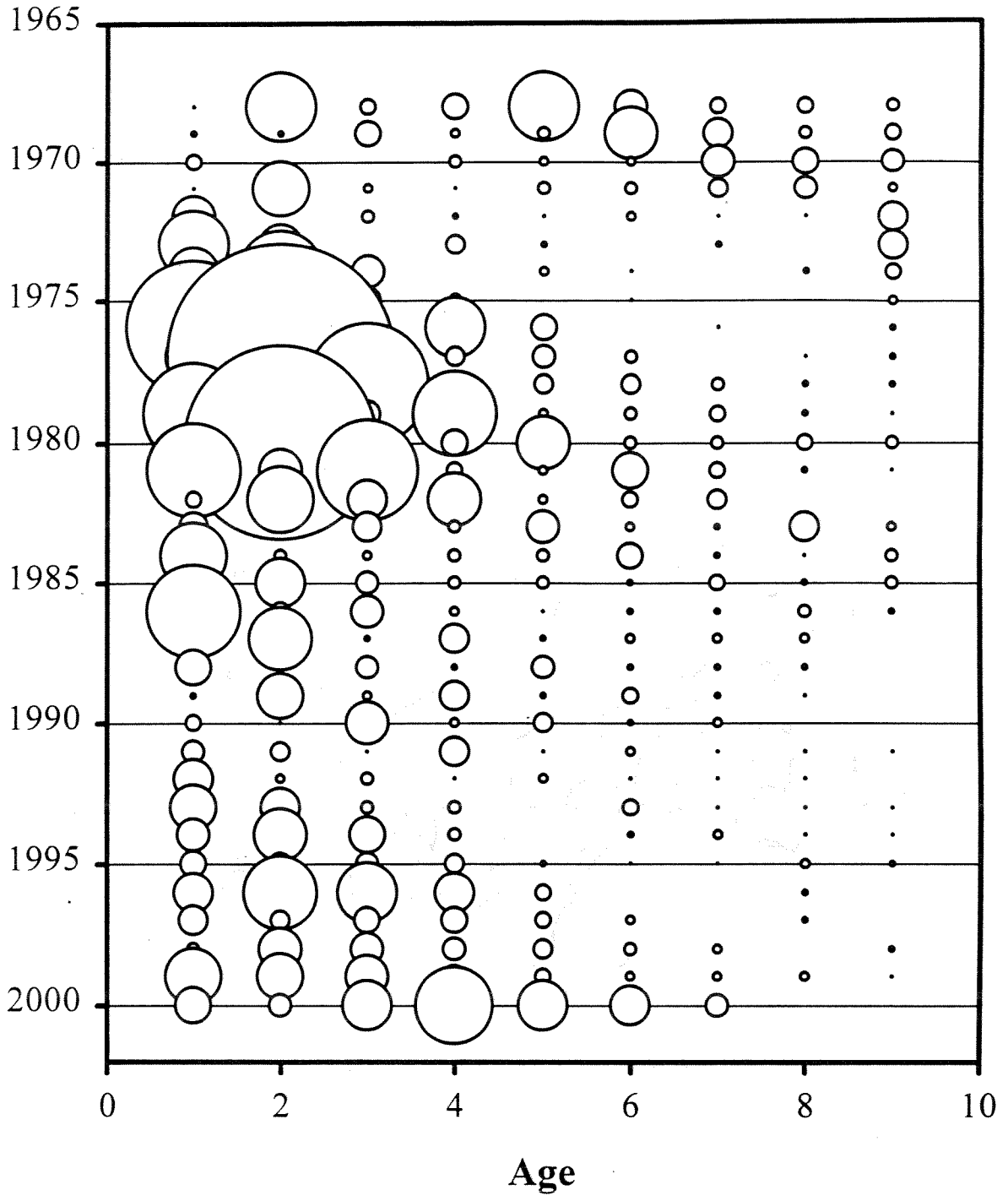

Figure 10. Numerical abundance indices at age for Georges Bank haddock in the U.S. autumn research vessel survey from 1968 to 1999. Survey indices have been lagged forward by one age and one year as they are used as inputs into virtual population analysis. Strong diagonals in the numerical catch at age are an indication of the presence of dominant year classes.

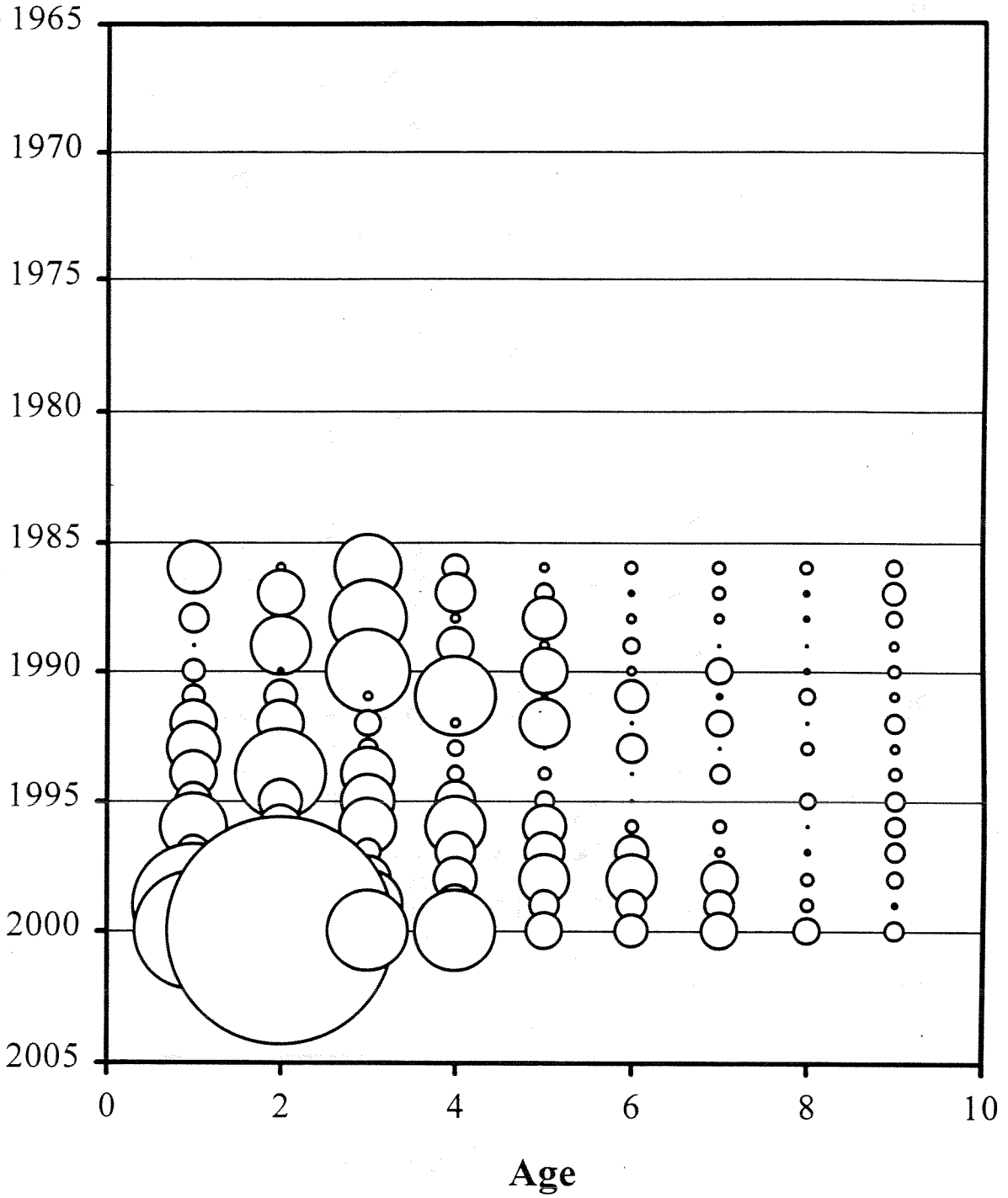

Figure 11. Numerical abundance indices at age for Georges Bank haddock in the Canadian spring research vessel survey from 1968 to 1999. Strong diagonals in the numerical catch at age are an indication of the presence of dominant year classes.

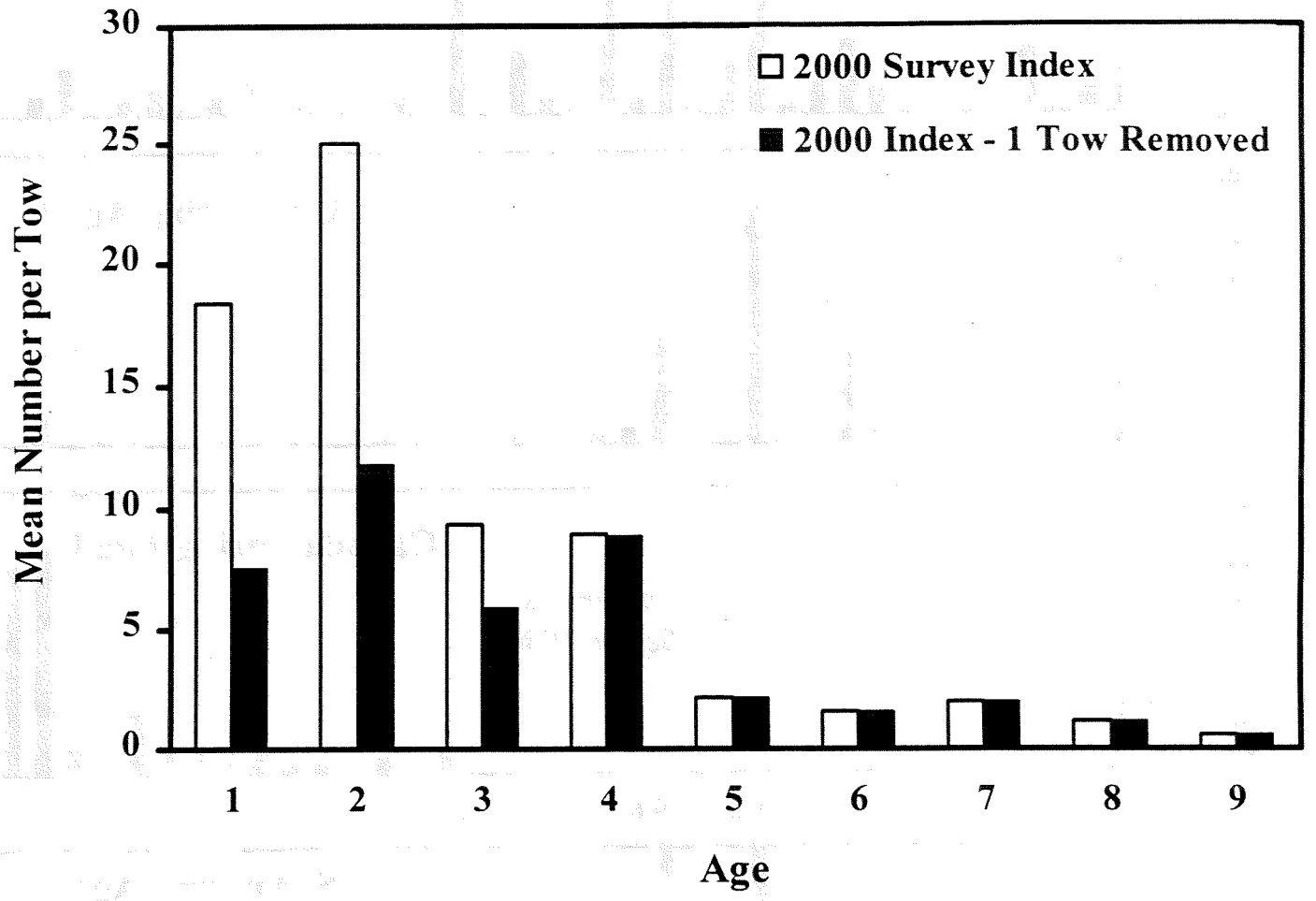

Figure 12. Stratified mean number per tow indices for Georges Bank haddock from the 2000 Canadian spring research vessel survey (strata 5Z1-5Z8). Results are presented for all sets completed on the survey, and adjusted indices that include all sets except for an exceptionally large tow in strata 5Z8 (set #55).

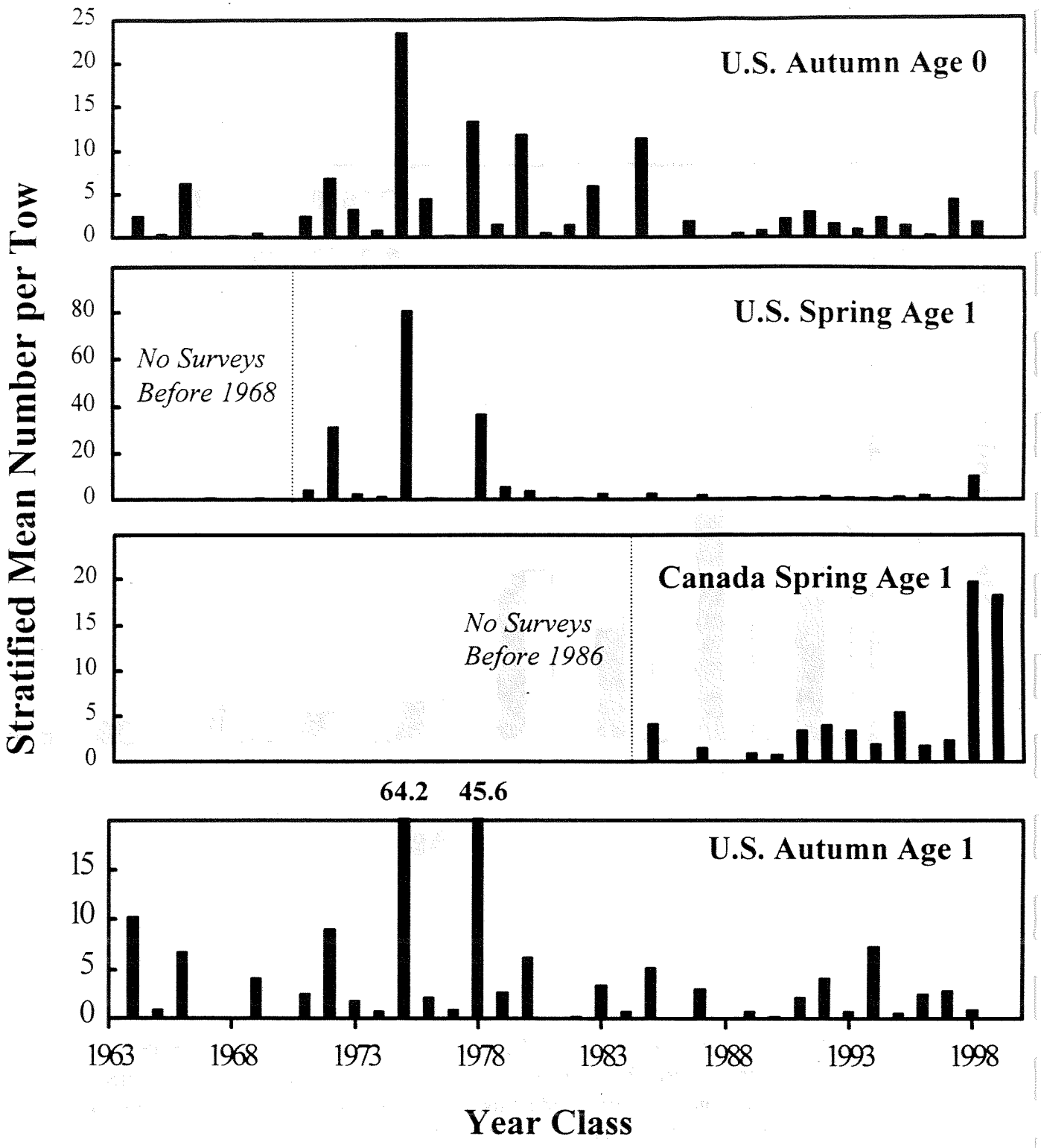

Figure 13. Stratified mean number per tow of age 0 and 1 haddock sampled during the U.S. spring, Canadian spring, and U.S. autumn research vessel surveys in the Georges Bank stock area (U.S. strata 01130-01250, 01290-01300; Canadian strata 5Z1-5Z8). Indices for the large 1963 year class are omitted for scaling purposes.

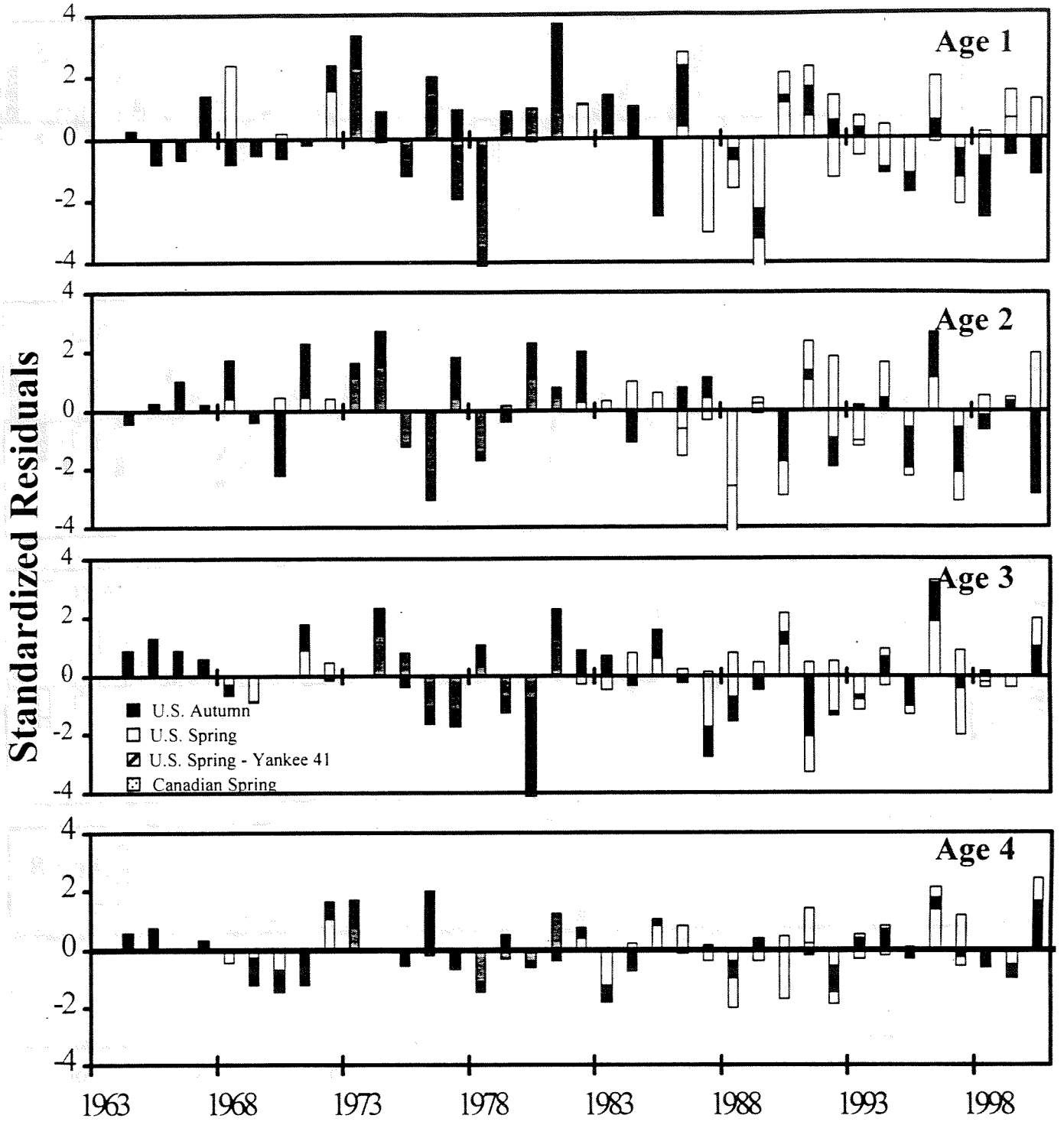

Figure 14. Standardized residuals for the ages 1 to 4 U.S. and Canadian research vessel survey indices used to tune the virtual population analysis for Georges Bank haddock.

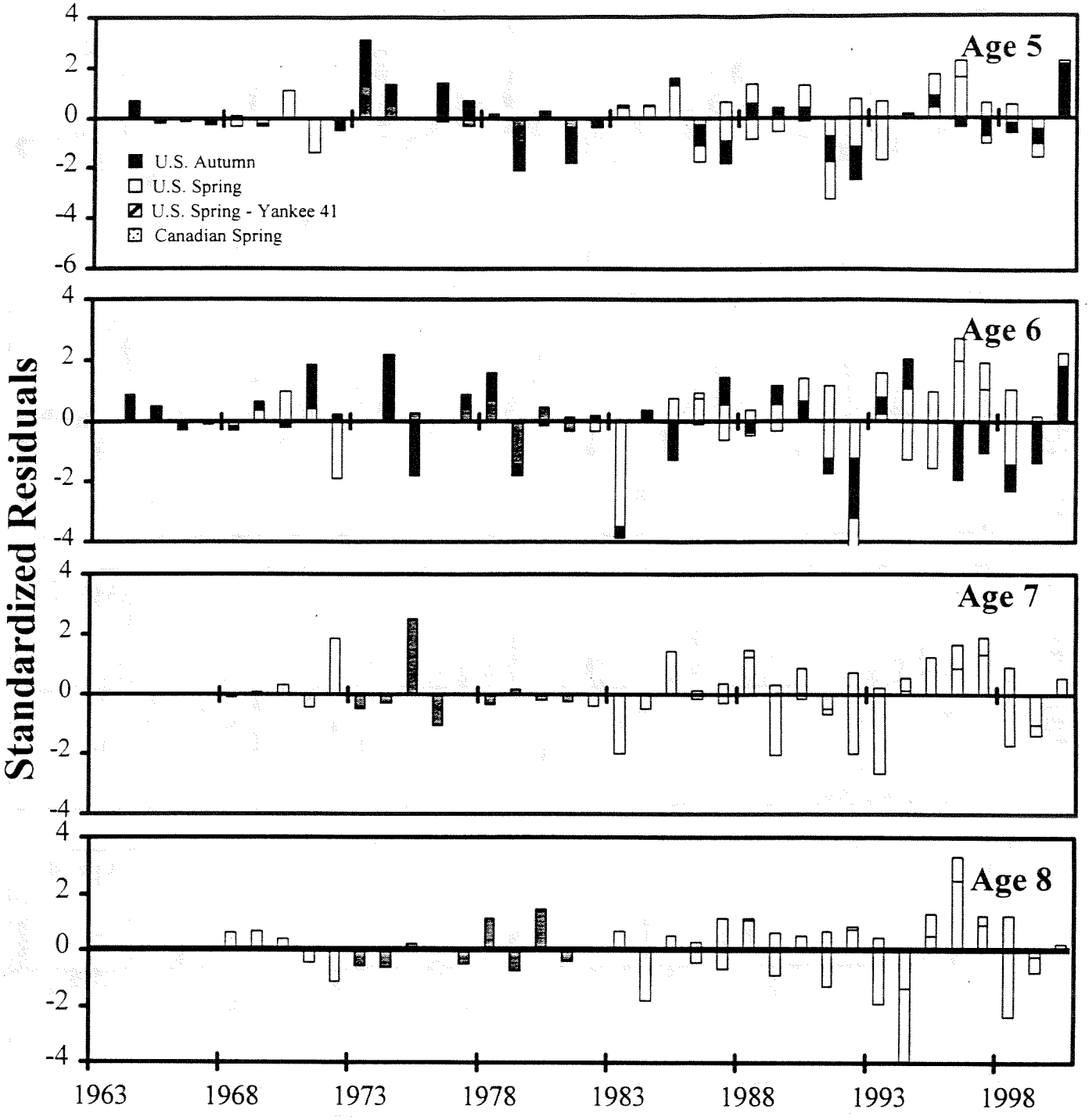

Figure 14 (Cont). Standardized residuals for the ages 1 to 4 U.S. and Canadian research vessel survey indices used to tune the virtual population analysis for Georges Bank haddock.

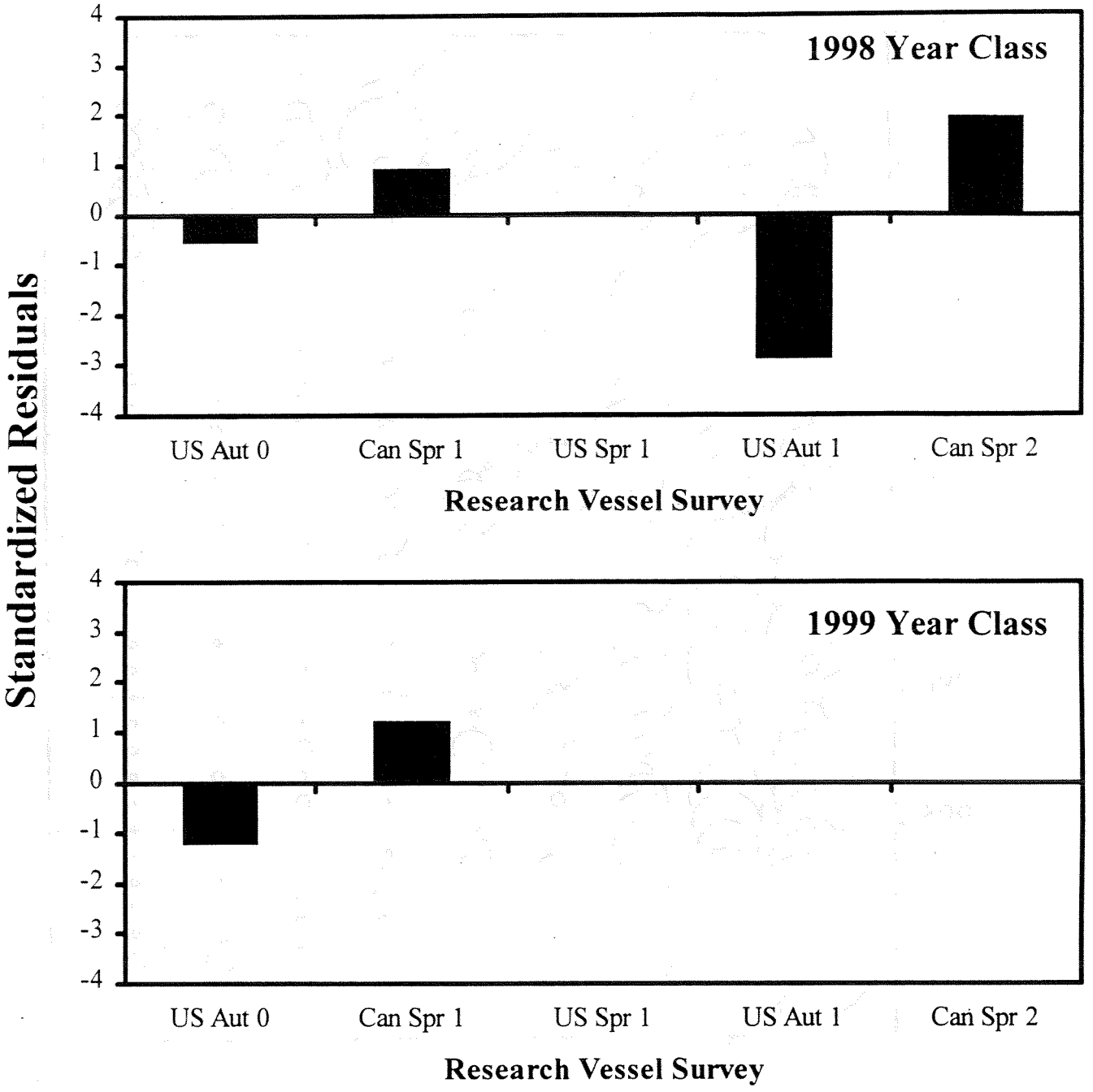

Figure 15. Standardized residuals for the U.S. and Canadian research vessel survey indices corresponding to the 1998 and 1999 year classes from virtual population analysis.

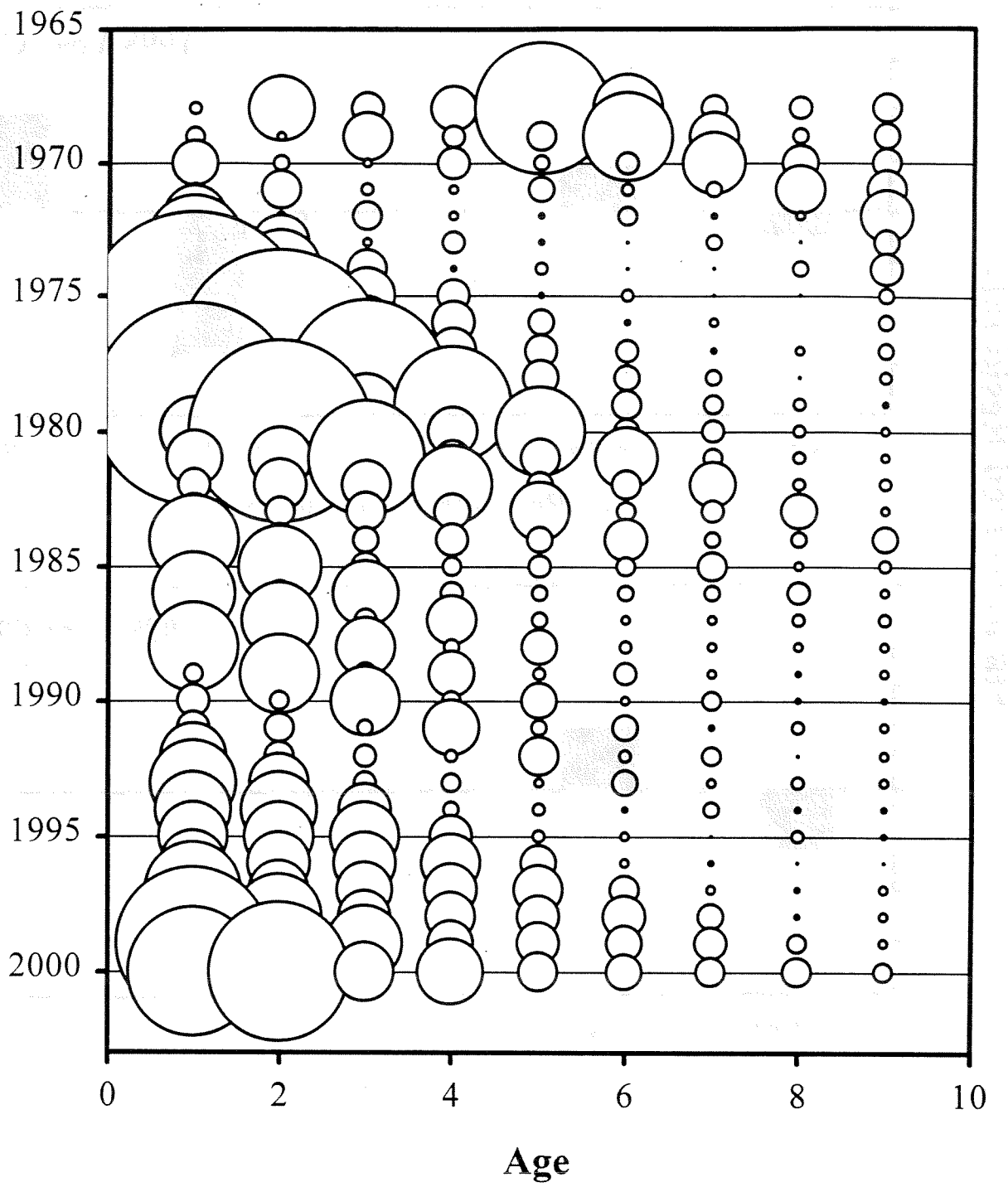

Figure 16. Estimates of stock size at age of Georges Bank haddock estimated through virtual population analysis. Stock size estimates since 1990 indicate broadening of the age structure of the stock and significantly improved recruitment.

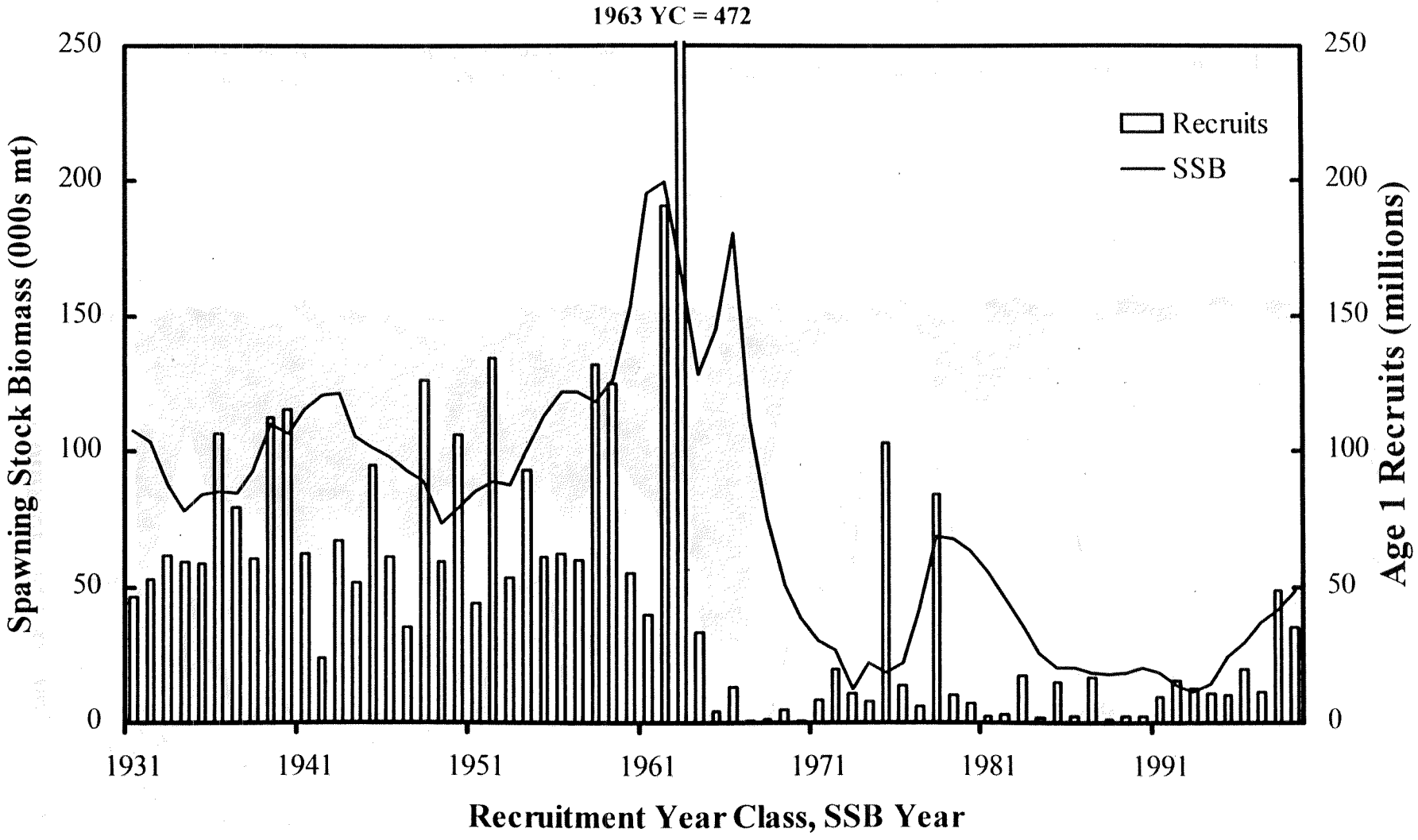

Figure 17. Trends in spawning stock biomass (line) and age 1 recruitment (bars) for Georges Bank haddock from 1931-1999.

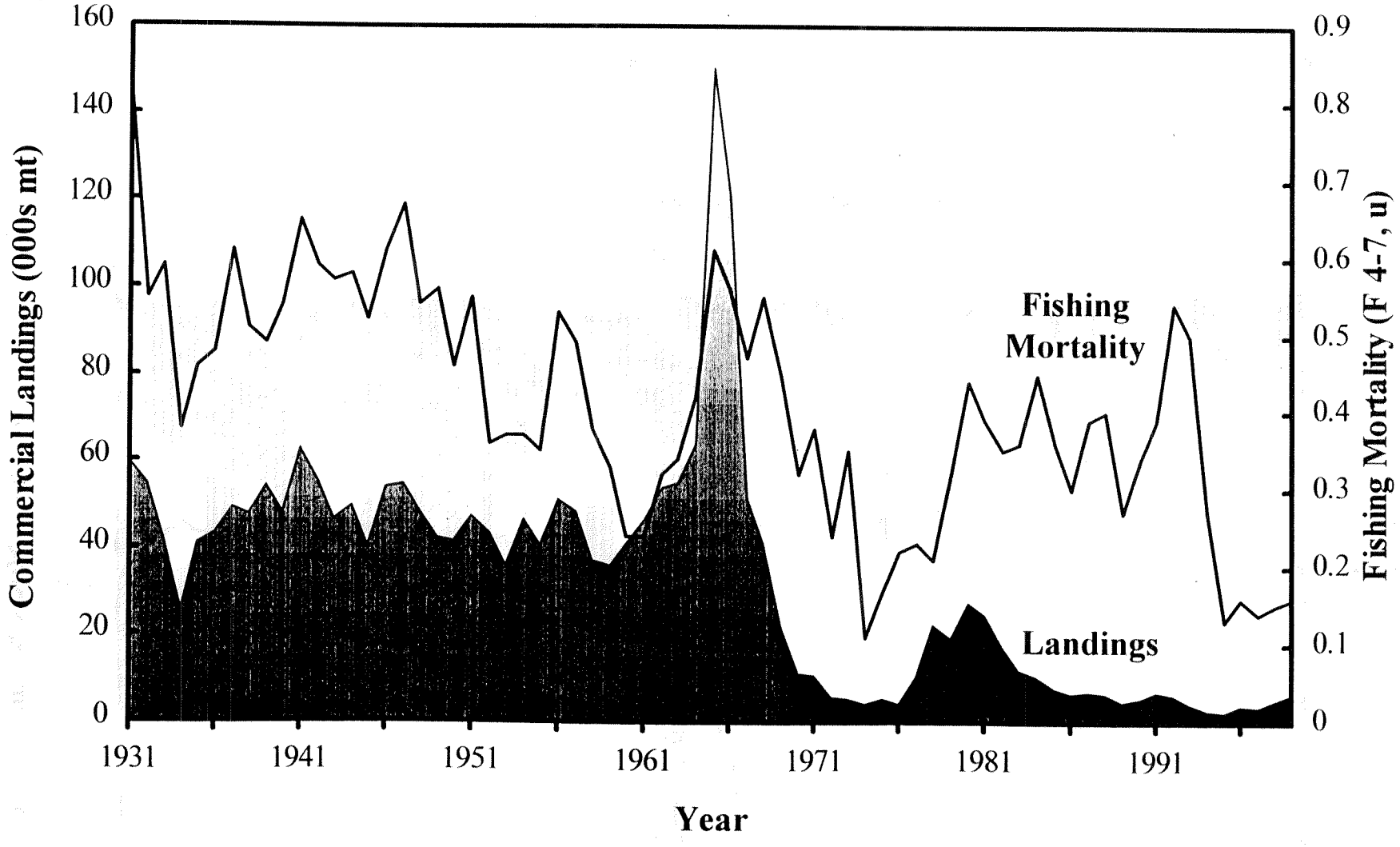

Figure 18. Trends in commercial landings (mt, live weight) and fully recruited fishing mortality (mean F, 4-7, unweighted) for Georges Bank haddock from 1931-1999.

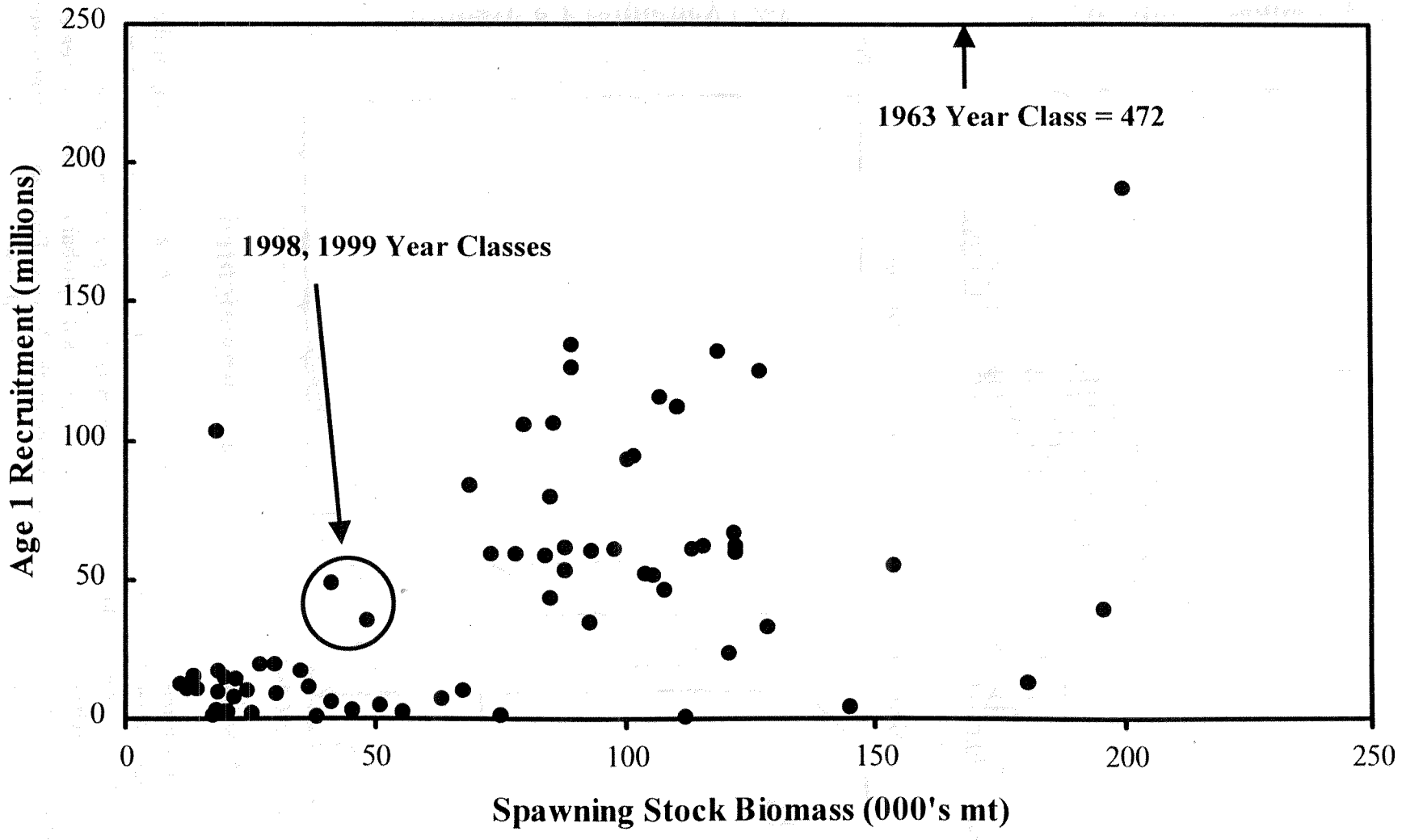

Figure 19. Spawning stock biomass and recruitment of Georges Bank haddock from 1931-1999.

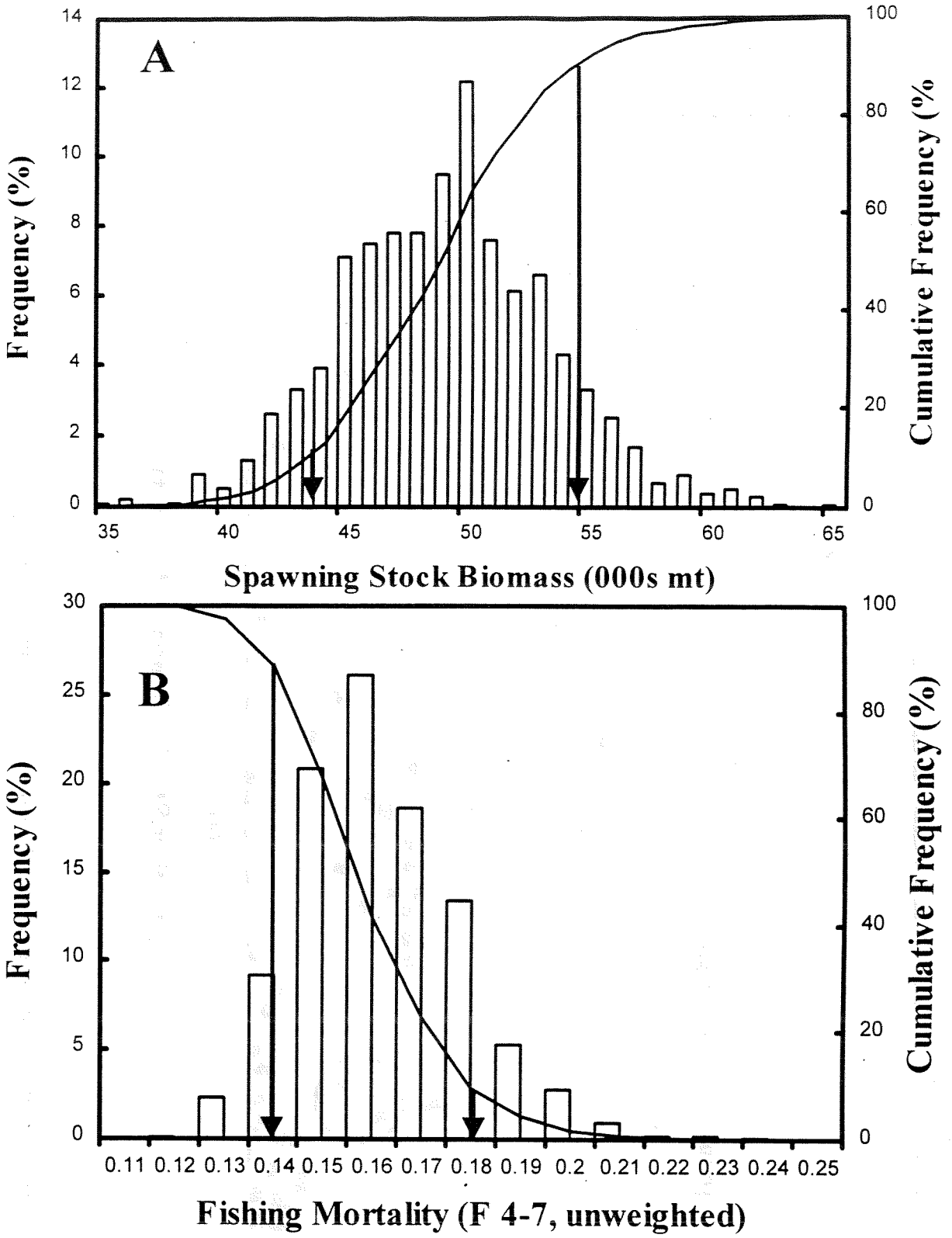

Figure 20. Precision of the estimates of spawning stock biomass (Panel A) at the beginning of the spawning season (April 1) and fishing mortality (Panel B) on the fully recruited ages (4-7) in 1999 for Georges Bank haddock. The vertical bars display and the probability of individual values within the range. The solid line gives the probability that F is greater than or SSB is less than the corresponding value on the X-axis. Precision estimates were derived from 1000 bootstrap realizations of the VPA formulation.

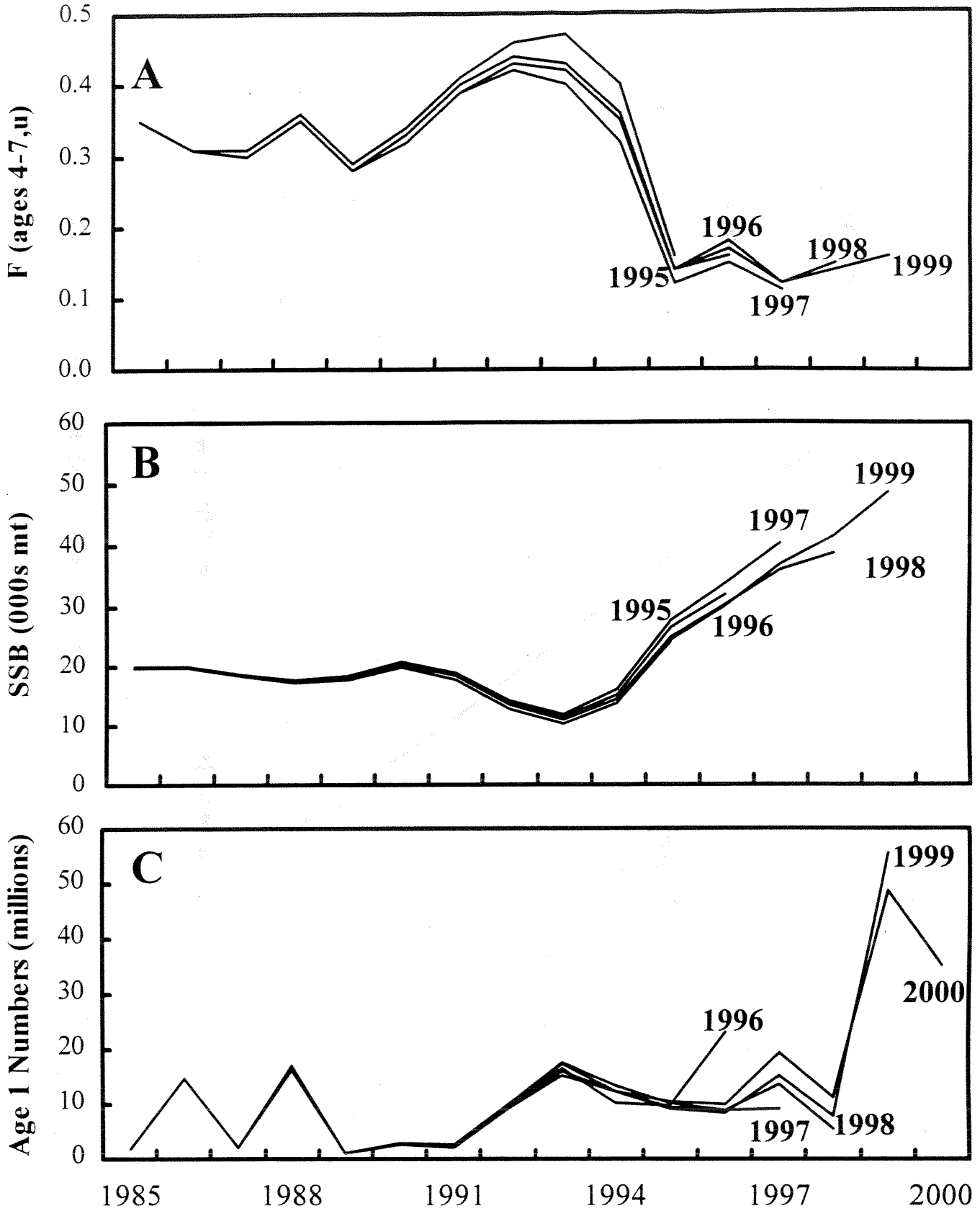

Figure 21. Retrospective analysis results of fishing mortality (Panel A), spawning stock biomass (Panel B) and age 1 stock size (Panel C) for the U.S. Georges Bank haddock assessment from 1999 to 1985.

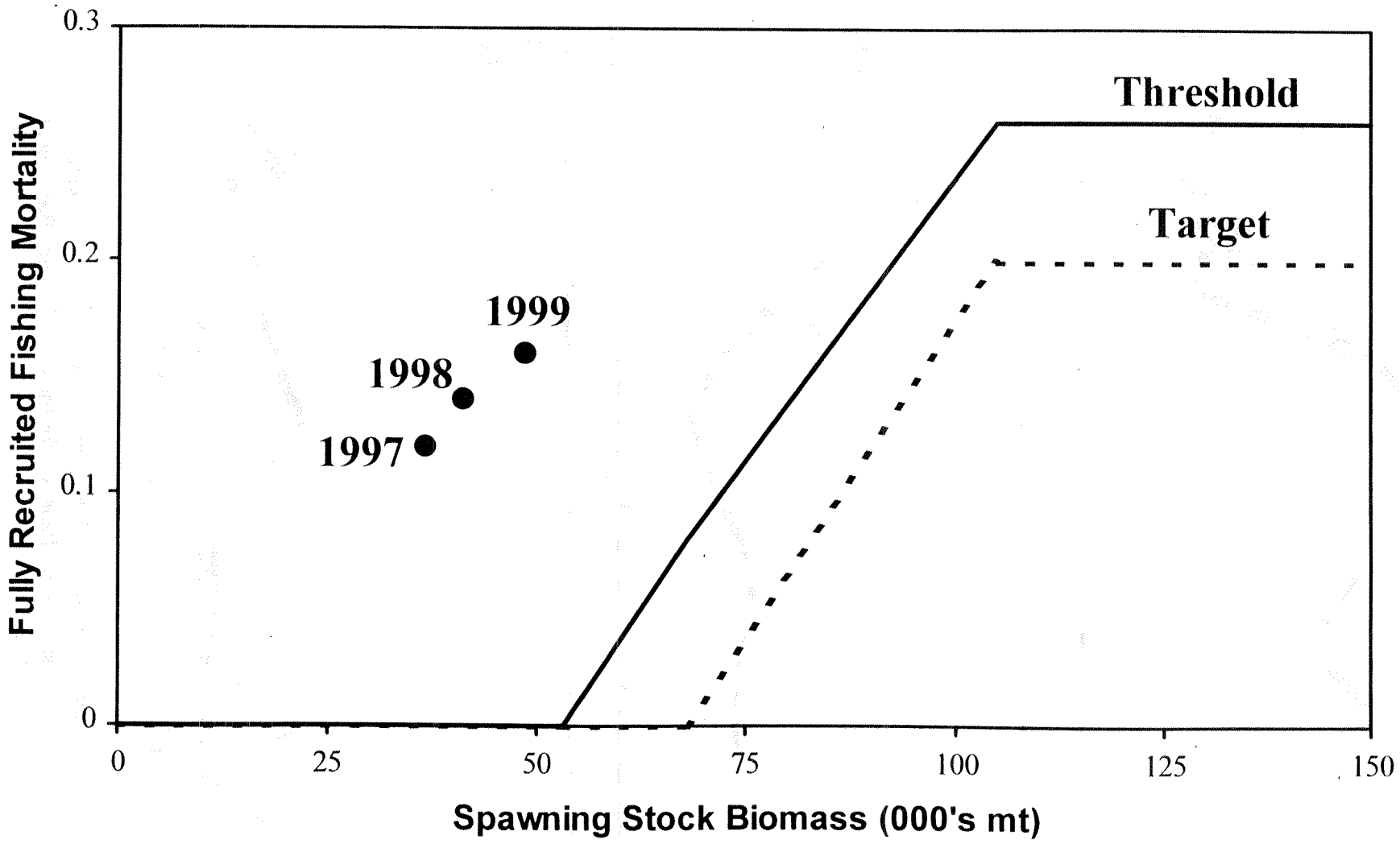

Figure 22. SFA harvest control rule for Georges Bank haddock based on proxies of MSY-based reference points and minimum biomass thresholds.

Appendix A. Georges Bank Haddock Virtual Population Analysis Listing.

```
Fisheries Assessment Toolbox  GB Haddock 2000 Assessment  Run Number  11   4/12/00   10:43:35 PM
FACT Version 1.2.3
GB Haddock 2000 Assessment  1963 - 2000
Input Parameters and Options Selected
---------------------------------------
Natural mortality is a matrix below
Oldest age (not in the plus group) is  8
For all years prior to the terminal year ( 37 ), backcalculated
stock sizes for the following ages used to estimate
total mortality (Z) for age  8 : 4       5       6       7       8       9
This method for estimating F on the oldest age is generally used when a
flat-topped partial recruitment curve is thought to be characteristic of the stock.
F for age  9 + is then calculated from the following
ratios of F[age 9 +] to F[age 8 ]
          1963                1
          1964                1
          1965                1
          1966                1
          1967                1
          1968                1
          1969                1
          1970                1
          1971                1
          1972                1
          1973                1
          1974                1
          1975                1
          1976                1
          1977                1
          1978                1
          1979                1
          1980                1
          1981                1
          1982                1
          1983                1
          1984                1
          1985                1
          1986                1
          1987                1
          1988                1
          1989                1
          1990                1
          1991                1
          1992                1
          1993                1
          1994                1
          1995                1
          1996                1
          1997                1
          1998                1
          1999                1
Stock size of the  9 + group is then calculated using
the following method:  CATCH EQUATION
 Partial recruitment estimate for  2000
 1             0.001
 2             0.41
 3             0.84
 4             1
 5             1
 6             1
 7             1
 8             1
Objective function is Sum w*(LOG(OBS)-LOG(PRED))**2
 Indices normalized (by dividing by mean observed value)
before tuning to VPA stocksizes
Downweighting is None or Uniform
Biomass estimates (other than SSB) reflect mean stock sizes.
```

SSB calculated as in the NEFSC projection program
(see note below SSB table for description of the algorithm).
Initial estimates of parameters for the Marquardt algorithm
and lower and upper bounds on the parameter estimates:

Par.	Initial Est	Lower Bnd	Upper Bnd
N 1	3.80E+03	0.00E+00	1.00E+06
N 2	3.60E+03	0.00E+00	1.00E+06
N 3	2.00E+02	0.00E+00	1.00E+06
N 4	7.50E+03	0.00E+00	1.00E+06
N 5	2.00E+02	0.00E+00	1.00E+06
N 6	1.30E+03	0.00E+00	1.00E+06
N 7	1.00E+02	0.00E+00	1.00E+06
N 8	3.00E+02	0.00E+00	1.00E+06
q US_Sp1	1.00E-05	0.00E+00	1.00E+00
q US_Sp2	1.00E-05	0.00E+00	1.00E+00
q US_Sp3	1.00E-05	0.00E+00	1.00E+00
q US_Sp4	1.00E-05	0.00E+00	1.00E+00
q US_Sp5	1.00E-05	0.00E+00	1.00E+00
q US_Sp6	1.00E-05	0.00E+00	1.00E+00
q US_Sp7	1.00E-05	0.00E+00	1.00E+00
q US_Sp8	1.00E-05	0.00E+00	1.00E+00
q US_S411	1.00E-05	0.00E+00	1.00E+00
q US_S412	1.00E-05	0.00E+00	1.00E+00
q US_S413	1.00E-05	0.00E+00	1.00E+00
q US_S414	1.00E-05	0.00E+00	1.00E+00
q US_S415	1.00E-05	0.00E+00	1.00E+00
q US_S416	1.00E-05	0.00E+00	1.00E+00
q US_S417	1.00E-05	0.00E+00	1.00E+00
q US_S418	1.00E-05	0.00E+00	1.00E+00
q US_Au01	1.00E-05	0.00E+00	1.00E+00
q US_Au12	1.00E-05	0.00E+00	1.00E+00
q US_Au23	1.00E-05	0.00E+00	1.00E+00
q US_Au34	1.00E-05	0.00E+00	1.00E+00
q US_Au45	1.00E-05	0.00E+00	1.00E+00
q US_Au56	1.00E-05	0.00E+00	1.00E+00
q Can_Sp1	1.00E-05	0.00E+00	1.00E+00
q Can_Sp2	1.00E-05	0.00E+00	1.00E+00
q Can_Sp3	1.00E-05	0.00E+00	1.00E+00
q Can_Sp4	1.00E-05	0.00E+00	1.00E+00
q Can_Sp5	1.00E-05	0.00E+00	1.00E+00
q Can_Sp6	1.00E-05	0.00E+00	1.00E+00
q Can_Sp7	1.00E-05	0.00E+00	1.00E+00
q Can_Sp8	1.00E-05	0.00E+00	1.00E+00

The following indices of abundance are available

1	US_Sp1
2	US_Sp2
3	US_Sp3
4	US_Sp4
5	US_Sp5
6	US_Sp6
7	US_Sp7
8	US_Sp8
9	US_S411
10	US_S412
11	US_S413
12	US_S414
13	US_S415
14	US_S416
15	US_S417
16	US_S418
17	US_Au01
18	US_Au12
19	US_Au23
20	US_Au34
21	US_Au45
22	US_Au56
23	Can_Sp1
24	Can_Sp2
25	Can_Sp3
26	Can_Sp4
27	Can_Sp5
28	Can_Sp6
29	Can_Sp7
30	Can_Sp8

The Indices that will be used in this run are:

1	US_Sp1
2	US_Sp2
3	US_Sp3
4	US_Sp4
5	US_Sp5
6	US_Sp6
7	US_Sp7
8	US_Sp8
9	US_S411
10	US_S412
11	US_S413
12	US_S414
13	US_S415
14	US_S416
15	US_S417
16	US_S418
17	US_Au01
18	US_Au12
19	US_Au23
20	US_Au34
21	US_Au45
22	US_Au56
23	Can_Sp1
24	Can_Sp2
25	Can_Sp3
26	Can_Sp4
27	Can_Sp5
28	Can_Sp6
29	Can_Sp7
30	Can_Sp8

Obs Indices (before transformation) by index and year; with Index means

	1963	1964	1965	1966	1967	1968	1969
US_Sp1	0.00	0.00	0.00	0.00	0.00	0.40	0.00
US_Sp2	0.00	0.00	0.00	0.00	0.00	2.83	0.07
US_Sp3	0.00	0.00	0.00	0.00	0.00	0.46	0.58
US_Sp4	0.00	0.00	0.00	0.00	0.00	0.70	0.25
US_Sp5	0.00	0.00	0.00	0.00	0.00	6.72	0.42
US_Sp6	0.00	0.00	0.00	0.00	0.00	1.68	4.23
US_Sp7	0.00	0.00	0.00	0.00	0.00	0.25	1.03
US_Sp8	0.00	0.00	0.00	0.00	0.00	0.45	0.28
US_S411	0.00	0.00	0.00	0.00	0.00	0.00	0.00
US_S412	0.00	0.00	0.00	0.00	0.00	0.00	0.00
US_S413	0.00	0.00	0.00	0.00	0.00	0.00	0.00
US_S414	0.00	0.00	0.00	0.00	0.00	0.00	0.00
US_S415	0.00	0.00	0.00	0.00	0.00	0.00	0.00
US_S416	0.00	0.00	0.00	0.00	0.00	0.00	0.00
US_S417	0.00	0.00	0.00	0.00	0.00	0.00	0.00
US_S418	0.00	0.00	0.00	0.00	0.00	0.00	0.00
US_Au01	0.00	83.93	2.37	0.33	6.14	0.03	0.09
US_Au12	0.00	25.39	112.87	10.16	0.95	6.72	0.06
US_Au23	0.00	9.22	63.74	77.39	2.89	0.36	0.95
US_Au34	0.00	6.81	5.83	9.70	18.39	1.00	0.13
US_Au45	0.00	8.34	1.79	1.07	3.35	6.76	0.33
US_Au56	0.00	5.95	3.81	0.80	0.52	1.62	3.86
Can_Sp1	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Can_Sp2	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Can_Sp3	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Can_Sp4	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Can_Sp5	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Can_Sp6	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Can_Sp7	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Can_Sp8	0.00	0.00	0.00	0.00	0.00	0.00	0.00

	1970	1971	1972	1973	1974	1975	1976
US_Sp1	0.67	0.00	4.02	0.00	0.00	0.00	0.00
US_Sp2	0.25	1.16	0.09	0.00	0.00	0.00	0.00
US_Sp3	0.00	0.25	0.61	0.00	0.00	0.00	0.00
US_Sp4	0.33	0.00	0.12	0.00	0.00	0.00	0.00
US_Sp5	0.46	0.12	0.03	0.00	0.00	0.00	0.00
US_Sp6	0.46	0.12	0.04	0.00	0.00	0.00	0.00
US_Sp7	2.00	0.09	0.13	0.00	0.00	0.00	0.00
US_Sp8	0.98	0.82	0.03	0.00	0.00	0.00	0.00
US_S411	0.00	0.00	0.00	30.68	2.13	0.94	80.79
US_S412	0.00	0.00	0.00	4.84	13.29	0.97	0.30
US_S413	0.00	0.00	0.00	0.00	2.86	3.32	0.60
US_S414	0.00	0.00	0.00	0.54	0.00	0.63	0.92
US_S415	0.00	0.00	0.00	0.09	0.24	0.00	0.43
US_S416	0.00	0.00	0.00	0.00	0.00	0.13	0.00
US_S417	0.00	0.00	0.00	0.18	0.01	0.09	0.04
US_S418	0.00	0.00	0.00	0.01	0.10	0.01	0.00
US_Au01	0.39	0.04	2.43	6.75	3.23	0.75	23.48
US_Au12	0.03	4.13	0.00	2.52	9.00	1.77	0.63
US_Au23	0.00	0.21	0.31	0.00	1.61	0.98	0.72
US_Au34	0.28	0.01	0.07	0.52	0.00	0.31	4.86
US_Au45	0.13	0.28	0.01	0.09	0.19	0.00	0.92
US_Au56	0.16	0.27	0.22	0.00	0.04	0.01	0.00
Can_Sp1	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Can_Sp2	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Can_Sp3	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Can_Sp4	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Can_Sp5	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Can_Sp6	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Can_Sp7	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Can_Sp8	0.00	0.00	0.00	0.00	0.00	0.00	0.00

	1977	1978	1979	1980	1981	1982	1983
US_Sp1	0.00	0.00	0.00	0.00	0.00	0.76	0.43
US_Sp2	0.00	0.00	0.00	0.00	0.00	1.53	0.55
US_Sp3	0.00	0.00	0.00	0.00	0.00	0.94	0.58
US_Sp4	0.00	0.00	0.00	0.00	0.00	4.07	0.22
US_Sp5	0.00	0.00	0.00	0.00	0.00	0.42	2.41
US_Sp6	0.00	0.00	0.00	0.00	0.00	0.28	0.01
US_Sp7	0.00	0.00	0.00	0.00	0.00	0.61	0.04
US_Sp8	0.00	0.00	0.00	0.00	0.00	0.00	1.16
US_S411	0.61	0.07	36.12	5.20	3.30	0.00	0.00
US_S412	33.41	0.97	1.58	46.70	3.29	0.00	0.00
US_S413	0.42	15.93	1.13	0.51	19.49	0.00	0.00
US_S414	1.22	0.36	5.71	1.04	2.19	0.00	0.00
US_S415	0.60	0.94	0.33	4.87	0.76	0.00	0.00
US_S416	0.45	0.82	0.16	0.67	1.78	0.00	0.00
US_S417	0.00	0.16	0.37	0.37	0.24	0.00	0.00
US_S418	0.04	0.06	0.06	0.46	0.11	0.00	0.00
US_Au01	4.32	0.13	13.22	1.32	11.68	0.38	1.36
US_Au12	64.17	2.14	0.84	45.57	2.71	6.13	0.00
US_Au23	0.52	18.73	1.04	0.04	12.72	2.08	1.33
US_Au34	0.54	0.56	9.28	0.90	0.45	3.70	0.34
US_Au45	0.82	0.57	0.18	3.81	0.18	0.21	1.40
US_Au56	0.30	0.64	0.26	0.26	1.70	0.42	0.13
Can_Sp1	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Can_Sp2	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Can_Sp3	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Can_Sp4	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Can_Sp5	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Can_Sp6	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Can_Sp7	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Can_Sp8	0.00	0.00	0.00	0.00	0.00	0.00	0.00

	1984	1985	1986	1987	1988	1989	1990
US_Sp1	2.09	0.00	2.49	0.00	1.55	0.02	0.86
US_Sp2	1.18	4.96	0.18	3.62	0.04	3.49	0.00
US_Sp3	0.64	0.76	2.06	0.06	0.99	0.45	5.72
US_Sp4	0.63	0.40	0.24	0.81	0.13	0.71	0.33
US_Sp5	0.58	0.87	0.11	0.08	0.32	0.14	0.58
US_Sp6	0.72	0.34	0.21	0.10	0.12	0.41	0.06
US_Sp7	0.07	1.17	0.12	0.05	0.11	0.06	0.13
US_Sp8	0.04	0.10	0.33	0.22	0.12	0.05	0.00
US_S411	0.00	0.00	0.00	0.00	0.00	0.00	0.00
US_S412	0.00	0.00	0.00	0.00	0.00	0.00	0.00
US_S413	0.00	0.00	0.00	0.00	0.00	0.00	0.00
US_S414	0.00	0.00	0.00	0.00	0.00	0.00	0.00
US_S415	0.00	0.00	0.00	0.00	0.00	0.00	0.00
US_S416	0.00	0.00	0.00	0.00	0.00	0.00	0.00
US_S417	0.00	0.00	0.00	0.00	0.00	0.00	0.00
US_S418	0.00	0.00	0.00	0.00	0.00	0.00	0.00
US_Au01	5.80	0.03	11.35	0.00	1.80	0.07	0.47
US_Au12	0.24	3.32	0.65	5.11	0.00	3.02	0.05
US_Au23	0.21	0.88	1.53	0.09	0.79	0.18	2.71
US_Au34	0.27	0.24	0.22	1.21	0.10	1.30	0.20
US_Au45	0.30	0.28	0.05	0.06	0.77	0.12	0.66
US_Au56	0.94	0.06	0.10	0.13	0.06	0.40	0.09
Can_Sp1	0.00	0.00	4.06	0.03	1.47	0.03	0.93
Can_Sp2	0.00	0.00	0.22	3.04	0.05	5.34	0.11
Can_Sp3	0.00	0.00	6.05	0.69	8.53	0.72	9.87
Can_Sp4	0.00	0.00	1.07	2.51	0.17	2.12	0.13
Can_Sp5	0.00	0.00	0.19	0.67	2.85	0.19	3.36
Can_Sp6	0.00	0.00	0.29	0.08	0.18	0.42	0.23
Can_Sp7	0.00	0.00	0.34	0.30	0.17	0.03	1.09
Can_Sp8	0.00	0.00	0.37	0.10	0.11	0.03	0.13

	1991	1992	1993	1994	1995	1996	1997
US_Sp1	0.54	0.40	1.17	0.70	0.50	1.09	1.79
US_Sp2	1.07	0.18	0.65	2.68	1.29	4.59	1.02
US_Sp3	0.24	0.11	0.18	1.00	2.32	8.86	3.35
US_Sp4	1.85	0.07	0.14	0.15	0.91	5.21	3.66
US_Sp5	0.09	0.33	0.12	0.10	0.17	2.62	2.01
US_Sp6	0.10	0.03	0.37	0.07	0.11	0.35	0.89
US_Sp7	0.02	0.03	0.06	0.16	0.03	0.07	0.13
US_Sp8	0.04	0.03	0.02	0.02	0.18	0.08	0.07
US_S411	0.00	0.00	0.00	0.00	0.00	0.00	0.00
US_S412	0.00	0.00	0.00	0.00	0.00	0.00	0.00
US_S413	0.00	0.00	0.00	0.00	0.00	0.00	0.00
US_S414	0.00	0.00	0.00	0.00	0.00	0.00	0.00
US_S415	0.00	0.00	0.00	0.00	0.00	0.00	0.00
US_S416	0.00	0.00	0.00	0.00	0.00	0.00	0.00
US_S417	0.00	0.00	0.00	0.00	0.00	0.00	0.00
US_S418	0.00	0.00	0.00	0.00	0.00	0.00	0.00
US_Au01	0.77	2.16	2.85	1.52	0.91	2.27	1.31
US_Au12	0.67	0.21	2.08	4.04	0.77	7.14	0.54
US_Au23	0.02	0.24	0.23	2.01	0.81	4.90	0.93
US_Au34	1.19	0.05	0.24	0.30	0.67	2.32	1.04
US_Au45	0.05	0.22	0.00	0.00	0.12	0.38	0.49
US_Au56	0.17	0.02	0.47	0.06	0.05	0.01	0.14
Can_Sp1	0.75	3.30	3.96	3.32	1.94	6.11	1.74
Can_Sp2	1.67	2.95	2.16	11.52	2.62	2.89	1.16
Can_Sp3	0.14	1.13	0.55	4.08	4.30	4.84	0.99
Can_Sp4	8.99	0.17	0.45	0.42	2.22	5.04	2.34
Can_Sp5	0.11	3.82	0.04	0.24	0.56	2.92	2.37
Can_Sp6	1.60	0.03	1.28	0.02	0.03	0.26	1.70
Can_Sp7	0.09	1.06	0.02	0.70	0.00	0.24	0.23
Can_Sp8	0.44	0.04	0.32	0.01	0.48	0.04	0.09

	1998	1999	2000	Average
US_Sp1	0.82	10.21	0.00	1.606
US_Sp2	2.95	2.03	0.00	1.655
US_Sp3	1.25	2.14	0.00	1.525
US_Sp4	1.06	0.72	0.00	1.032
US_Sp5	0.85	0.64	0.00	0.878
US_Sp6	0.21	0.51	0.00	0.497
US_Sp7	0.06	0.20	0.00	0.288
US_Sp8	0.01	0.20	0.00	0.248
US_S411	0.00	0.00	0.00	17.760
US_S412	0.00	0.00	0.00	11.706
US_S413	0.00	0.00	0.00	5.533
US_S414	0.00	0.00	0.00	1.576
US_S415	0.00	0.00	0.00	1.033
US_S416	0.00	0.00	0.00	0.668
US_S417	0.00	0.00	0.00	0.183
US_S418	0.00	0.00	0.00	0.106
US_Au01	0.32	4.32	1.82	5.559
US_Au12	2.47	2.79	0.84	9.698
US_Au23	1.47	2.47	3.37	6.219
US_Au34	0.75	0.72	8.05	2.293
US_Au45	0.55	0.41	3.52	1.131
US_Au56	0.33	0.18	2.32	0.757
Can_Sp1	2.41	19.75	18.33	4.542
Can_Sp2	8.18	3.41	68.60	7.595
Can_Sp3	3.08	7.16	9.32	4.097
Can_Sp4	2.57	2.21	8.91	2.621
Can_Sp5	3.76	1.40	2.11	1.639
Can_Sp6	3.67	1.35	1.55	0.846
Can_Sp7	1.98	1.26	1.94	0.675
Can_Sp8	0.24	0.33	1.14	0.258

Catch at age (thousands) - C:\2000 Projects\2000 Haddock Assessment\2000_VPA_Run11_baserun.8

	1963	1964	1965	1966	1967	1968	1969
1	2910	10101	9601	114	1150	08	02
2	4047	15935	125818	6843	168	2994	11
3	7418	4554	44496	100810	2891	709	1698
4	11152	4776	5356	19167	20667	1921	448
5	8198	8722	4391	2768	10338	14519	654
6	2205	5794	6690	2591	1209	3499	5954
7	1405	2082	3772	2332	993	667	1574
8	721	1028	1094	1268	917	453	225
9	1096	1332	1366	867	698	842	570
1+	39152	54324	202584	136760	39031	25612	11136

	1970	1971	1972	1973	1974	1975	1976
1	46	01	156	2560	46	192	144
2	158	1375	02	2075	4320	1034	473
3	16	223	450	03	657	1864	550
4	570	40	81	386	02	375	880
5	186	289	32	53	70	04	216
6	214	246	120	30	02	42	00
7	2308	285	78	77	02	04	23
8	746	1469	66	15	53	04	04
9	464	928	1236	447	249	88	112
1+	4708	4856	2221	5646	5401	3607	2402

	1977	1978	1979	1980	1981	1982	1983
1	01	01	01	08	01	01	00
2	19585	761	26	31000	1743	1165	214
3	187	14395	1726	347	10998	1633	813
4	680	305	7169	975	831	3733	690
5	515	567	525	6054	937	391	2239
6	357	517	410	594	2572	569	272
7	04	139	315	546	331	1119	186
8	39	14	96	153	158	106	800
9	111	67	46	81	94	110	76
1+	21479	16766	10314	39758	17665	8827	5290

	1984	1985	1986	1987	1988	1989	1990
1	00	00	06	00	04	00	02
2	93	2406	54	1995	52	1263	11
3	297	550	2810	129	2384	86	1445
4	727	194	223	1613	134	877	172
5	397	461	146	122	931	143	868
6	1482	228	173	73	149	358	98
7	234	526	150	89	55	46	177
8	267	78	266	106	64	28	46
9	543	152	60	135	106	45	44
1+	4040	4595	3888	4262	3879	2846	2863

	1991	1992	1993	1994	1995	1996	1997
1	06	07	07	01	09	05	30
2	448	247	290	269	89	54	178
3	91	320	350	810	597	570	288
4	2149	132	299	170	457	946	777
5	102	1527	104	66	60	464	567
6	410	111	659	69	32	68	220
7	73	323	38	151	08	22	19
8	154	27	159	43	57	05	16
9	72	94	76	43	18	08	41
1+	3505	2788	1982	1623	1327	2141	2136

	1998	1999
1	01	01
2	199	40
3	415	1062
4	501	582
5	692	498
6	526	510
7	149	335
8	21	143
9	41	41
1+	2544	3212

CAA Summary for ages 4 - 9

1963	1964	1965	1966	1967	1968	1969
24777	23734	22669	28993	34822	21901	9425

1970	1971	1972	1973	1974	1975	1976
4488	3257	1613	1008	378	517	1235

1977	1978	1979	1980	1981	1982	1983
1706	1609	8561	8403	4923	6028	4263

1984	1985	1986	1987	1988	1989	1990
3650	1639	1018	2138	1439	1497	1405

1991	1992	1993	1994	1995	1996	1997
2960	2214	1335	542	631	1513	1641

1998	1999
1929	2109

Weight at age (mid year) in kg - C:\2000 Projects\2000 Haddock Assessment\2000_VPA_Run11_baserun.8

	1963	1964	1965	1966	1967	1968	1969
1	0.570	0.500	0.580	0.580	0.660	0.590	0.520
2	0.870	0.830	0.690	0.730	0.700	0.810	0.780
3	1.180	1.120	1.030	0.890	0.950	1.050	1.100
4	1.470	1.430	1.350	1.260	1.180	1.320	1.690
5	1.680	1.640	1.670	1.700	1.420	1.570	1.750
6	2.150	2.010	1.990	2.070	2.050	2.100	1.990
7	2.350	2.400	2.260	2.280	2.310	2.320	2.520
8	3.040	2.640	2.660	2.870	2.660	2.620	2.990
9	3.100	2.970	3.110	3.180	3.100	2.860	3.630

	1970	1971	1972	1973	1974	1975	1976
1	0.710	0.670	0.620	0.600	0.720	0.620	0.500
2	1.270	1.030	1.030	1.030	1.060	0.980	0.990
3	1.220	1.310	1.740	1.580	1.820	1.630	1.390
4	1.930	1.740	2.040	2.130	2.320	2.210	1.990
5	2.190	2.390	2.420	2.410	2.830	2.200	2.660
6	2.390	2.810	2.920	3.290	3.760	2.940	3.080
7	2.580	2.920	3.060	3.420	4.050	4.000	3.690
8	3.230	3.100	3.440	3.860	3.920	4.050	4.670
9	3.750	3.720	3.660	3.940	4.260	4.330	4.940

	1977	1978	1979	1980	1981	1982	1983
1	0.530	0.530	0.530	0.550	0.390	0.220	0.330
2	1.070	0.940	1.000	0.940	0.870	0.970	1.020
3	1.440	1.500	1.280	1.210	1.240	1.450	1.370
4	2.170	2.040	2.020	1.730	1.830	1.880	1.830
5	2.730	2.790	2.510	2.170	2.300	2.370	2.210
6	3.210	3.190	3.140	2.820	2.720	2.760	2.650
7	4.150	3.370	3.780	3.600	3.710	3.240	3.250
8	4.000	3.610	3.790	3.560	4.040	3.960	3.360
9	4.990	5.110	4.870	3.870	4.440	4.090	4.270

	1984	1985	1986	1987	1988	1989	1990
1	0.330	0.330	0.450	0.430	0.420	0.530	0.640
2	0.920	0.990	0.940	0.830	0.980	0.890	0.970
3	1.320	1.390	1.360	1.430	1.340	1.480	1.480
4	1.830	1.980	1.830	2.000	1.680	1.790	1.778
5	2.200	2.460	2.560	2.250	2.060	2.210	2.117
6	2.670	2.720	2.830	2.630	2.450	2.570	2.552
7	2.960	3.060	2.960	3.020	2.970	3.240	2.806
8	3.410	3.720	3.460	3.770	3.490	3.560	2.991
9	3.720	3.800	3.780	4.290	3.960	3.820	4.160

	1991	1992	1993	1994	1995	1996	1997
1	0.581	0.538	0.659	0.447	0.429	0.456	0.416
2	1.201	1.175	1.169	1.093	0.967	1.098	0.998
3	1.311	1.639	1.728	1.643	1.489	1.497	1.691
4	1.817	1.768	2.171	2.209	2.025	1.838	1.891
5	2.183	2.186	2.119	2.628	2.542	2.325	2.212
6	2.645	2.519	2.628	2.728	2.815	2.543	2.547
7	2.852	2.967	2.649	2.902	3.275	3.423	3.104
8	3.048	3.365	3.123	3.783	3.091	3.516	3.379
9	4.337	4.267	4.014	4.546	3.981	3.712	3.649

	1998	1999
1	0.511	0.678
2	1.084	1.101
3	1.599	1.527
4	1.852	1.830
5	2.120	2.111
6	2.411	2.339
7	2.978	2.697
8	3.752	2.973
9	3.883	3.682

January 1 Biomass Weights - C:\2000 Projects\2000 Haddock Assessment\2000_VPA_Run11_baserun.8

	1963	1964	1965	1966	1967	1968	1969
1	0.472	0.426	0.517	0.528	0.596	0.513	0.333
2	0.767	0.688	0.587	0.651	0.637	0.731	0.678
3	1.072	0.987	0.925	0.784	0.833	0.857	0.944
4	1.392	1.299	1.230	1.139	1.025	1.120	1.332
5	1.536	1.553	1.545	1.515	1.338	1.361	1.520
6	2.035	1.838	1.807	1.859	1.867	1.727	1.768
7	2.217	2.272	2.131	2.130	2.187	2.181	2.300
8	2.673	2.491	2.527	2.547	2.463	2.460	2.634
9	3.100	2.970	3.110	3.180	3.100	2.860	3.630

	1970	1971	1972	1973	1974	1975	1976
1	0.589	0.540	0.481	0.451	0.617	0.491	0.342
2	0.813	0.855	0.831	0.799	0.797	0.840	0.783
3	0.975	1.290	1.339	1.276	1.369	1.314	1.167
4	1.457	1.457	1.635	1.925	1.915	2.006	1.801
5	1.924	2.148	2.052	2.217	2.455	2.259	2.425
6	2.045	2.481	2.642	2.822	3.010	2.884	2.603
7	2.266	2.642	2.932	3.160	3.650	3.878	3.294
8	2.853	2.828	3.169	3.437	3.661	4.050	4.322
9	3.750	3.720	3.660	3.940	4.260	4.330	4.940

	1977	1978	1979	1980	1981	1982	1983
1	0.398	0.386	0.398	0.437	0.247	0.102	0.198
2	0.731	0.706	0.728	0.706	0.692	0.615	0.474
3	1.194	1.267	1.097	1.100	1.080	1.123	1.153
4	1.737	1.714	1.741	1.488	1.488	1.527	1.629
5	2.331	2.461	2.263	2.094	1.995	2.083	2.038
6	2.922	2.951	2.960	2.660	2.429	2.520	2.506
7	3.575	3.289	3.472	3.362	3.235	2.969	2.995
8	3.842	3.871	3.574	3.668	3.814	3.833	3.299
9	4.990	5.110	4.870	3.870	4.440	4.090	4.270

	1984	1985	1986	1987	1988	1989	1990
1	0.191	0.196	0.331	0.285	0.289	0.392	0.467
2	0.551	0.572	0.557	0.611	0.649	0.611	0.717
3	1.160	1.131	1.160	1.159	1.055	1.204	1.148
4	1.583	1.617	1.595	1.649	1.550	1.549	1.622
5	2.006	2.122	2.251	2.029	2.030	1.927	1.947
6	2.429	2.446	2.639	2.595	2.348	2.301	2.375
7	2.801	2.858	2.837	2.923	2.795	2.817	2.685
8	3.329	3.318	3.254	3.341	3.247	3.252	3.113
9	3.720	3.800	3.780	4.290	3.960	3.820	4.160

	1991	1992	1993	1994	1995	1996	1997
1	0.409	0.365	0.512	0.304	0.268	0.308	0.258
2	0.877	0.826	0.793	0.849	0.657	0.686	0.675
3	1.128	1.403	1.425	1.386	1.276	1.203	1.363
4	1.640	1.522	1.886	1.954	1.824	1.654	1.683
5	1.970	1.993	1.936	2.389	2.370	2.170	2.016
6	2.366	2.345	2.397	2.404	2.720	2.542	2.433
7	2.698	2.801	2.583	2.762	2.989	3.104	2.810
8	2.924	3.098	3.044	3.166	2.995	3.393	3.401
9	4.337	4.267	4.014	4.546	3.981	3.712	3.649

	1998	1999
1	0.348	0.613
2	0.672	0.750
3	1.263	1.287
4	1.770	1.711
5	2.002	1.977
6	2.309	2.227
7	2.754	2.550
8	3.413	2.975
9	3.883	3.682

SSB Weights - C:\2000 Projects\2000 Haddock Assessment\2000_VPA_Run11_baserun.8

	1963	1964	1965	1966	1967	1968	1969
1	0.472	0.426	0.517	0.528	0.596	0.513	0.333
2	0.767	0.688	0.587	0.651	0.637	0.731	0.678
3	1.072	0.987	0.925	0.784	0.833	0.857	0.944
4	1.392	1.299	1.230	1.139	1.025	1.120	1.332
5	1.536	1.553	1.545	1.515	1.338	1.361	1.520
6	2.035	1.838	1.807	1.859	1.867	1.727	1.768
7	2.217	2.272	2.131	2.130	2.187	2.181	2.300
8	2.673	2.491	2.527	2.547	2.463	2.460	2.634
9	3.100	2.970	3.110	3.180	3.100	2.860	3.630

	1970	1971	1972	1973	1974	1975	1976
1	0.589	0.540	0.481	0.451	0.617	0.491	0.342
2	0.813	0.855	0.831	0.799	0.797	0.840	0.783
3	0.975	1.290	1.339	1.276	1.369	1.314	1.167
4	1.457	1.457	1.635	1.925	1.915	2.006	1.801
5	1.924	2.148	2.052	2.217	2.455	2.259	2.425
6	2.045	2.481	2.642	2.822	3.010	2.884	2.603
7	2.266	2.642	2.932	3.160	3.650	3.878	3.294
8	2.853	2.828	3.169	3.437	3.661	4.050	4.322
9	3.750	3.720	3.660	3.940	4.260	4.330	4.940

	1977	1978	1979	1980	1981	1982	1983
1	0.398	0.386	0.398	0.437	0.247	0.102	0.198
2	0.731	0.706	0.728	0.706	0.692	0.615	0.474
3	1.194	1.267	1.097	1.100	1.080	1.123	1.153
4	1.737	1.714	1.741	1.488	1.488	1.527	1.629
5	2.331	2.461	2.263	2.094	1.995	2.083	2.038
6	2.922	2.951	2.960	2.660	2.429	2.520	2.506
7	3.575	3.289	3.472	3.362	3.235	2.969	2.995
8	3.842	3.871	3.574	3.668	3.814	3.833	3.299
9	4.990	5.110	4.870	3.870	4.440	4.090	4.270

	1984	1985	1986	1987	1988	1989	1990
1	0.191	0.196	0.331	0.285	0.289	0.392	0.467
2	0.551	0.572	0.557	0.611	0.649	0.611	0.717
3	1.160	1.131	1.160	1.159	1.055	1.204	1.148
4	1.583	1.617	1.595	1.649	1.550	1.549	1.622
5	2.006	2.122	2.251	2.029	2.030	1.927	1.947
6	2.429	2.446	2.639	2.595	2.348	2.301	2.375
7	2.801	2.858	2.837	2.923	2.795	2.817	2.685
8	3.329	3.318	3.254	3.341	3.247	3.252	3.113
9	3.720	3.800	3.780	4.290	3.960	3.820	4.160

	1991	1992	1993	1994	1995	1996	1997
1	0.409	0.365	0.512	0.304	0.268	0.308	0.258
2	0.877	0.826	0.793	0.849	0.657	0.686	0.675
3	1.128	1.403	1.425	1.386	1.276	1.203	1.363
4	1.640	1.522	1.886	1.954	1.824	1.654	1.683
5	1.970	1.993	1.936	2.389	2.370	2.170	2.016
6	2.366	2.345	2.397	2.404	2.720	2.542	2.433
7	2.698	2.801	2.583	2.762	2.989	3.104	2.810
8	2.924	3.098	3.044	3.166	2.995	3.393	3.401
9	4.337	4.267	4.014	4.546	3.981	3.712	3.649

	1998	1999
1	0.348	0.613
2	0.672	0.750
3	1.263	1.287
4	1.770	1.711
5	2.002	1.977
6	2.309	2.227
7	2.754	2.550
8	3.413	2.975
9	3.883	3.682

Computed (Rivard)from midyear weights: Jan 1 Weights - C:\2000 Projects\2000 Haddock Assessment\2000_VPA_Run11_baserun.8

	1963	1964	1965	1966	1967	1968	1969
1	0.472	0.426	0.517	0.528	0.596	0.513	0.333
2	0.767	0.688	0.587	0.651	0.637	0.731	0.678
3	1.072	0.987	0.925	0.784	0.833	0.857	0.944
4	1.392	1.299	1.230	1.139	1.025	1.120	1.332
5	1.536	1.553	1.545	1.515	1.338	1.361	1.520
6	2.035	1.838	1.807	1.859	1.867	1.727	1.768
7	2.217	2.272	2.131	2.130	2.187	2.181	2.300
8	2.673	2.491	2.527	2.547	2.463	2.460	2.634
9	3.100	2.970	3.110	3.180	3.100	2.860	3.630

	1970	1971	1972	1973	1974	1975	1976
1	0.589	0.540	0.481	0.451	0.617	0.491	0.342
2	0.813	0.855	0.831	0.799	0.797	0.840	0.783
3	0.975	1.290	1.339	1.276	1.369	1.314	1.167
4	1.457	1.457	1.635	1.925	1.915	2.006	1.801
5	1.924	2.148	2.052	2.217	2.455	2.259	2.425
6	2.045	2.481	2.642	2.822	3.010	2.884	2.603
7	2.266	2.642	2.932	3.160	3.650	3.878	3.294
8	2.853	2.828	3.169	3.437	3.661	4.050	4.322
9	3.750	3.720	3.660	3.940	4.260	4.330	4.940

	1977	1978	1979	1980	1981	1982	1983
1	0.398	0.386	0.398	0.437	0.247	0.102	0.198
2	0.731	0.706	0.728	0.706	0.692	0.615	0.474
3	1.194	1.267	1.097	1.100	1.080	1.123	1.153
4	1.737	1.714	1.741	1.488	1.488	1.527	1.629
5	2.331	2.461	2.263	2.094	1.995	2.083	2.038
6	2.922	2.951	2.960	2.660	2.429	2.520	2.506
7	3.575	3.289	3.472	3.362	3.235	2.969	2.995
8	3.842	3.871	3.574	3.668	3.814	3.833	3.299
9	4.990	5.110	4.870	3.870	4.440	4.090	4.270

	1984	1985	1986	1987	1988	1989	1990
1	0.191	0.196	0.331	0.285	0.289	0.392	0.467
2	0.551	0.572	0.557	0.611	0.649	0.611	0.717
3	1.160	1.131	1.160	1.159	1.055	1.204	1.148
4	1.583	1.617	1.595	1.649	1.550	1.549	1.622
5	2.006	2.122	2.251	2.029	2.030	1.927	1.947
6	2.429	2.446	2.639	2.595	2.348	2.301	2.375
7	2.801	2.858	2.837	2.923	2.795	2.817	2.685
8	3.329	3.318	3.254	3.341	3.247	3.252	3.113
9	3.720	3.800	3.780	4.290	3.960	3.820	4.160

	1991	1992	1993	1994	1995	1996	1997
1	0.409	0.365	0.512	0.304	0.268	0.308	0.258
2	0.877	0.826	0.793	0.849	0.657	0.686	0.675
3	1.128	1.403	1.425	1.386	1.276	1.203	1.363
4	1.640	1.522	1.886	1.954	1.824	1.654	1.683
5	1.970	1.993	1.936	2.389	2.370	2.170	2.016
6	2.366	2.345	2.397	2.404	2.720	2.542	2.433
7	2.698	2.801	2.583	2.762	2.989	3.104	2.810
8	2.924	3.098	3.044	3.166	2.995	3.393	3.401
9	4.337	4.267	4.014	4.546	3.981	3.712	3.649

	1998	1999	2000
1	0.348	0.613	0.370
2	0.672	0.750	0.750
3	1.263	1.287	1.616
4	1.770	1.711	1.812
5	2.002	1.977	1.958
6	2.309	2.227	2.254
7	2.754	2.550	2.457
8	3.413	2.975	2.852
9	3.883	3.682	3.682

Percent Mature (females)- C:\2000 Projects\2000 Haddock Assessment\2000_VPA_Run11_baserun.8

	1963	1964	1965	1966	1967	1968	1969
1	00	00	00	00	00	00	00
2	00	00	00	00	00	28	28
3	78	78	78	78	78	76	76
4	100	100	100	100	100	100	100
5	100	100	100	100	100	100	100
6	100	100	100	100	100	100	100
7	100	100	100	100	100	100	100
8	100	100	100	100	100	100	100
9	100	100	100	100	100	100	100

	1970	1971	1972	1973	1974	1975	1976
1	00	00	00	00	00	00	00
2	28	28	28	34	34	34	34
3	76	76	76	92	92	92	92
4	100	100	100	100	100	100	100
5	100	100	100	100	100	100	100
6	100	100	100	100	100	100	100
7	100	100	100	100	100	100	100
8	100	100	100	100	100	100	100
9	100	100	100	100	100	100	100

	1977	1978	1979	1980	1981	1982	1983
1	00	00	00	00	00	00	00
2	33	33	33	33	33	33	33
3	81	81	81	81	81	81	81
4	100	100	100	100	100	100	100
5	100	100	100	100	100	100	100
6	100	100	100	100	100	100	100
7	100	100	100	100	100	100	100
8	100	100	100	100	100	100	100
9	100	100	100	100	100	100	100

	1984	1985	1986	1987	1988	1989	1990
1	12	24	24	24	24	24	10
2	33	65	65	65	65	65	56
3	94	91	91	91	91	91	94
4	100	98	98	98	98	98	99
5	100	100	100	100	100	100	100
6	100	100	100	100	100	100	100
7	100	100	100	100	100	100	100
8	100	100	100	100	100	100	100
9	100	100	100	100	100	100	100

	1991	1992	1993	1994	1995	1996	1997
1	10	10	07	07	02	02	02
2	56	56	30	30	34	34	34
3	94	94	71	71	94	94	94
4	99	99	94	94	100	100	100
5	100	100	100	100	100	100	100
6	100	100	100	100	100	100	100
7	100	100	100	100	100	100	100
8	100	100	100	100	100	100	100
9	100	100	100	100	100	100	100

	1998	1999
1	02	02
2	34	34
3	94	94
4	100	100
5	100	100
6	100	100
7	100	100
8	100	100
9	100	100

Natural Mortality = 0.20 for all ages in all years.
Sex Ratio (Percent Female) = 0.50 for all ages in all years.

pF is 0.25
pM is 0.25

```
Residual Sum of Squares from Marquardt Algorithm
Number  1
RSS             6442.4063089014
Lambda         1.00E-02

Number  2
RSS             2278.71577686285
Lambda         1.00E-03

Number  3
RSS             773.599473966242
Lambda         1.00E-04

Number  4
RSS             424.408584041963
Lambda         1.00E-05

Number  5
RSS             377.856130949762
Lambda         1.00E-05

Number  6
RSS             375.274916660394
Lambda         1.00E-05

Number  7
RSS             375.251441680265
Lambda         1.00E-05

Number  8
RSS             375.25143920753
Lambda         1.00E-05

RESULTS
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Approximate Statistics Assuming Linearity Near Solution
Sum of Squares:  375.25143920753
Mean Square Residuals: 0.70802

                  PAR. EST.  STD. ERR.  T-STATISTIC C.V.
N  1              3.52E+04   2.16E+04   1.63E+00   0.61
N  2              3.99E+04   1.56E+04   2.57E+00   0.39
N  3              7.53E+03   2.33E+03   3.23E+00   0.31
N  4              9.59E+03   2.75E+03   3.49E+00   0.29
N  5              3.51E+03   9.61E+02   3.65E+00   0.27
N  6              2.81E+03   7.25E+02   3.88E+00   0.26
N  7              1.98E+03   5.90E+02   3.36E+00   0.30
N  8              1.93E+03   5.53E+02   3.48E+00   0.29
q US_Sp1          7.92E-05   1.57E-05   5.03E+00   0.20
q US_Sp2          1.27E-04   2.33E-05   5.46E+00   0.18
q US_Sp3          1.51E-04   2.76E-05   5.47E+00   0.18
q US_Sp4          2.14E-04   3.91E-05   5.48E+00   0.18
q US_Sp5          2.67E-04   4.78E-05   5.59E+00   0.18
q US_Sp6          3.67E-04   6.58E-05   5.58E+00   0.18
q US_Sp7          6.15E-04   1.10E-04   5.57E+00   0.18
q US_Sp8          9.27E-04   1.74E-04   5.34E+00   0.19
q US_S411         1.28E-05   3.60E-06   3.55E+00   0.28
q US_S412         2.41E-05   6.78E-06   3.55E+00   0.28
q US_S413         4.36E-05   1.30E-05   3.34E+00   0.30
q US_S414         1.65E-04   4.92E-05   3.34E+00   0.30
q US_S415         2.79E-04   8.35E-05   3.34E+00   0.30
q US_S416         4.06E-04   1.40E-04   2.90E+00   0.35
q US_S417         1.90E-03   5.67E-04   3.34E+00   0.30
q US_S418         2.69E-03   8.05E-04   3.34E+00   0.30
q US_Au01         2.59E-05   3.73E-06   6.94E+00   0.14
q US_Au12         2.46E-05   3.62E-06   6.80E+00   0.15
q US_Au23         3.12E-05   4.52E-06   6.92E+00   0.14
q US_Au34         9.08E-05   1.29E-05   7.02E+00   0.14
q US_Au45         1.52E-04   2.22E-05   6.83E+00   0.15
q US_Au56         2.30E-04   3.33E-05   6.90E+00   0.14
```

q Can_Sp1	4.12E-05	9.46E-06	4.35E+00	0.23
q Can_Sp2	4.38E-05	9.87E-06	4.43E+00	0.23
q Can_Sp3	1.33E-04	2.98E-05	4.47E+00	0.22
q Can_Sp4	1.84E-04	4.13E-05	4.47E+00	0.22
q Can_Sp5	3.38E-04	7.57E-05	4.46E+00	0.22
q Can_Sp6	4.67E-04	1.05E-04	4.44E+00	0.23
q Can_Sp7	9.33E-04	2.18E-04	4.27E+00	0.23
q Can_Sp8	1.89E-03	4.27E-04	4.42E+00	0.23

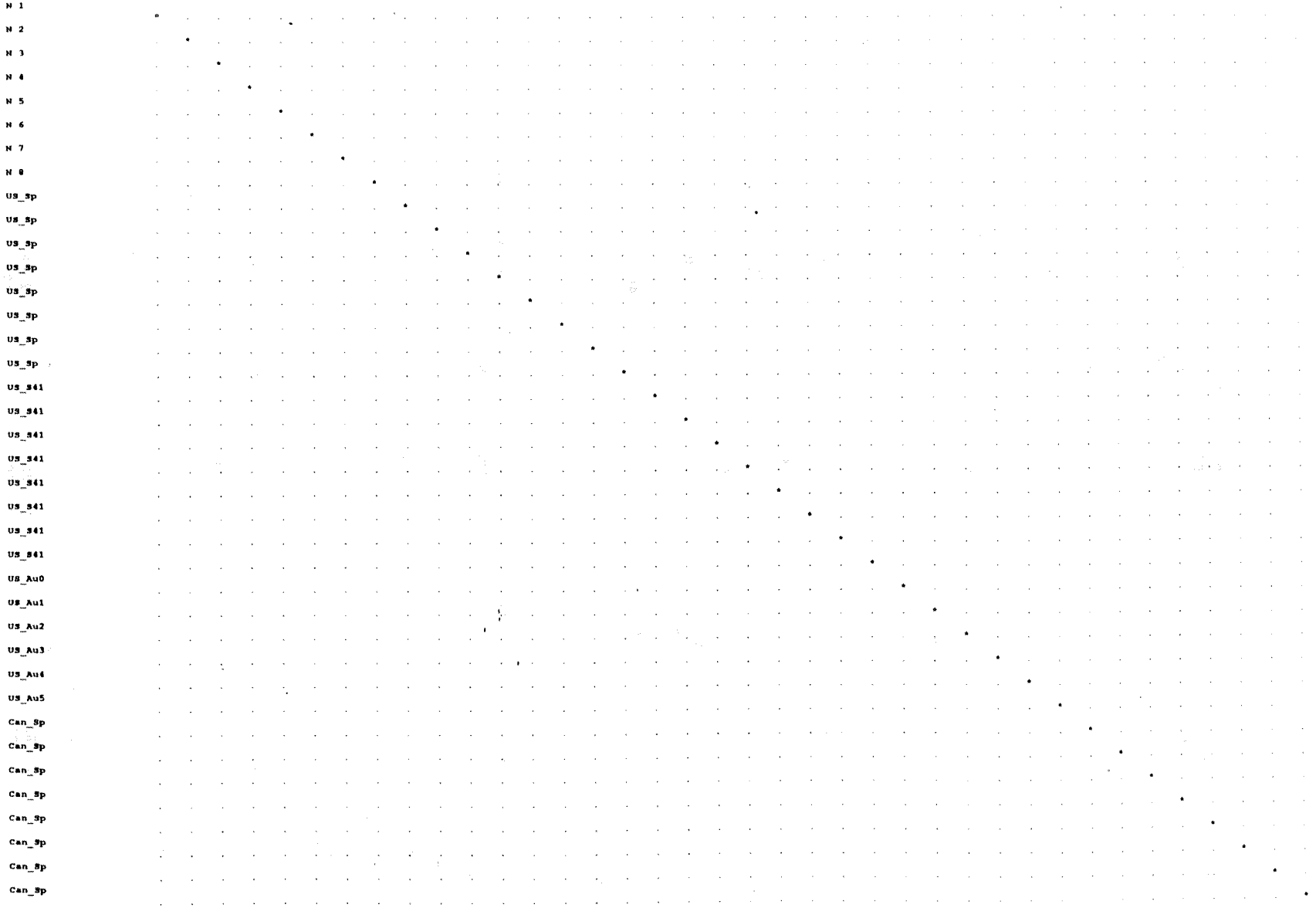
Catchability Estimates in Original Units

	Estimate	Std.Err.	C.V.
q US_Sp1	1.27E-04	2.53E-05	0.20
q US_Sp2	2.10E-04	3.86E-05	0.18
q US_Sp3	2.30E-04	4.20E-05	0.18
q US_Sp4	2.21E-04	4.04E-05	0.18
q US_Sp5	2.35E-04	4.19E-05	0.18
q US_Sp6	1.82E-04	3.27E-05	0.18
q US_Sp7	1.77E-04	3.17E-05	0.18
q US_Sp8	2.30E-04	4.31E-05	0.19
q US_S411	2.27E-04	6.39E-05	0.28
q US_S412	2.82E-04	7.94E-05	0.28
q US_S413	2.41E-04	7.21E-05	0.30
q US_S414	2.59E-04	7.76E-05	0.30
q US_S415	2.88E-04	8.62E-05	0.30
q US_S416	2.71E-04	9.37E-05	0.35
q US_S417	3.46E-04	1.04E-04	0.30
q US_S418	2.86E-04	8.56E-05	0.30
q US_Au01	1.44E-04	2.08E-05	0.14
q US_Au12	2.39E-04	3.51E-05	0.15
q US_Au23	1.94E-04	2.81E-05	0.14
q US_Au34	2.08E-04	2.97E-05	0.14
q US_Au45	1.71E-04	2.51E-05	0.15
q US_Au56	1.74E-04	2.52E-05	0.14
q Can_Sp1	1.87E-04	4.30E-05	0.23
q Can_Sp2	3.32E-04	7.50E-05	0.23
q Can_Sp3	5.45E-04	1.22E-04	0.22
q Can_Sp4	4.84E-04	1.08E-04	0.22
q Can_Sp5	5.54E-04	1.24E-04	0.22
q Can_Sp6	3.95E-04	8.89E-05	0.23
q Can_Sp7	6.30E-04	1.47E-04	0.23
q Can_Sp8	4.87E-04	1.10E-04	0.23

CORRELATION BETWEEN PARAMETERS ESTIMATED

1	0.04	0.03	0.03	0.03	0.03	0.03	0.03	-0.07	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	0	0	0	0	0	0	0	0	-0.13	-0.01	-0.01	-0.01	-0.01	-0.01	-0.19	-0.02	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
0.04	1	0.05	0.04	0.04	0.04	0.04	0.04	-0.12	-0.02	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	0	0	0	0	0	0	0	0	-0.09	-0.09	-0.01	-0.01	-0.01	-0.01	-0.14	-0.14	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02
0.03	0.05	1	0.05	0.05	0.05	0.05	0.05	-0.1	-0.09	-0.02	-0.02	-0.01	-0.01	-0.02	-0.02	0	0	0	0	0	0	0	0	-0.08	-0.08	-0.07	-0.02	-0.01	-0.01	-0.12	-0.12	-0.11	-0.02	-0.02	-0.02	-0.02	-0.02
0.03	0.04	0.05	1	0.06	0.06	0.06	0.06	-0.09	-0.08	-0.08	-0.02	-0.02	-0.02	-0.02	-0.02	0	0	0	0	0	0	0	0	-0.07	-0.07	-0.07	-0.07	-0.02	-0.02	-0.11	-0.1	-0.1	-0.11	-0.03	-0.03	-0.03	-0.03
0.03	0.04	0.05	0.06	1	0.05	0.03	0.05	-0.09	-0.08	-0.08	-0.08	-0.03	-0.03	-0.04	-0.04	0	0	0	0	0	0	0	0	-0.07	-0.07	-0.06	-0.07	-0.07	-0.03	-0.1	-0.1	-0.1	-0.1	-0.11	-0.04	-0.05	-0.06
0.03	0.04	0.05	0.06	0.05	1	0.02	0.04	-0.08	-0.08	-0.08	-0.08	-0.09	-0.04	-0.06	-0.07	0	0	0	0	0	0	0	0	-0.06	-0.06	-0.06	-0.07	-0.07	-0.09	-0.1	-0.1	-0.1	-0.1	-0.11	-0.13	-0.07	-0.08
0.03	0.04	0.05	0.06	0.03	0.02	1	0.02	-0.08	-0.08	-0.08	-0.09	-0.1	-0.12	-0.09	-0.1	0	0	0	0	0	0	0	0	-0.06	-0.06	-0.07	-0.07	-0.07	-0.1	-0.1	-0.1	-0.1	-0.11	-0.13	-0.15	-0.19	-0.12
0.03	0.04	0.05	0.06	0.05	0.04	0.02	1	-0.08	-0.07	-0.08	-0.08	-0.1	-0.12	-0.16	-0.12	0	0	0	0	0	0	0	0	-0.06	-0.06	-0.06	-0.07	-0.07	-0.1	-0.1	-0.09	-0.1	-0.11	-0.13	-0.15	-0.16	-0.22
-0.07	-0.12	-0.1	-0.09	-0.09	-0.08	-0.08	-0.08	1	0.03	0.03	0.03	0.02	0.02	0.03	0.03	0	0	0	0	0	0	0	0	0.04	0.04	0.03	0.02	0.02	0.02	0.06	0.06	0.04	0.04	0.04	0.04	0.04	0.04
-0.01	-0.02	-0.09	-0.08	-0.08	-0.08	-0.08	-0.07	0.03	1	0.03	0.02	0.02	0.02	0.02	0.02	0	0	0	0	0	0	0	0	0.03	0.03	0.03	0.02	0.02	0.02	0.04	0.04	0.04	0.03	0.03	0.03	0.03	0.03
-0.01	-0.01	-0.02	-0.08	-0.08	-0.08	-0.08	-0.08	0.03	0.03	1	0.02	0.02	0.02	0.02	0.02	0	0	0	0	0	0	0	0	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
-0.01	-0.01	-0.02	-0.02	-0.08	-0.08	-0.09	-0.08	0.03	0.02	0.02	1	0.02	0.02	0.03	0.03	0	0	0	0	0	0	0	0	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.04	0.04	0.04	0.04
-0.01	-0.01	-0.01	-0.02	-0.03	-0.09	-0.1	-0.1	0.02	0.02	0.02	0.02	1	0.03	0.03	0.03	0	0	0	0	0	0	0	0	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.03	0.04	0.04	0.04	0.04
-0.01	-0.01	-0.01	-0.02	-0.03	-0.04	-0.12	-0.12	0.02	0.02	0.02	0.02	0.03	1	0.03	0.03	0	0	0	0	0	0	0	0	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.03	0.04	0.04	0.05	0.04
-0.01	-0.01	-0.02	-0.02	-0.04	-0.06	-0.09	-0.16	0.03	0.02	0.02	0.03	0.03	0.03	1	0.03	0	0	0	0	0	0	0	0	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.03	0.04	0.04	0.04	0.05
-0.01	-0.01	-0.02	-0.02	-0.04	-0.07	-0.1	-0.12	0.03	0.02	0.02	0.03	0.03	0.03	0.03	1	0	0	0	0	0	0	0	0	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.03	0.04	0.04	0.04	0.04
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.13	-0.09	-0.08	-0.07	-0.07	-0.06	-0.06	-0.06	0.04	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0	0	0	0	0	0	0	0	1	0.03	0.02	0.02	0.02	0.02	0.06	0.04	0.03	0.03	0.03	0.03	0.03	0.03
-0.01	-0.09	-0.08	-0.07	-0.07	-0.06	-0.06	-0.06	0.04	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0	0	0	0	0	0	0	0	0.03	1	0.02	0.02	0.02	0.02	0.04	0.04	0.03	0.03	0.03	0.03	0.03	0.03
-0.01	-0.01	-0.07	-0.07	-0.06	-0.06	-0.07	-0.06	0.03	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0	0	0	0	0	0	0	0	0.02	0.02	1	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
-0.01	-0.01	-0.02	-0.07	-0.07	-0.07	-0.07	-0.07	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0	0	0	0	0	0	0	0	0.02	0.02	0.02	1	0.02	0.02	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
-0.01	-0.01	-0.01	-0.02	-0.07	-0.07	-0.07	-0.07	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0	0	0	0	0	0	0	0	0.02	0.02	0.02	0.02	1	0.02	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
-0.01	-0.01	-0.01	-0.02	-0.03	-0.09	-0.1	-0.1	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0	0	0	0	0	0	0	0	0.02	0.02	0.02	0.02	0.02	1	0.03	0.03	0.03	0.03	0.03	0.04	0.04	0.04
-0.19	-0.14	-0.12	-0.11	-0.1	-0.1	-0.1	-0.1	0.06	0.04	0.03	0.03	0.03	0.03	0.03	0.03	0	0	0	0	0	0	0	0	0.06	0.04	0.03	0.03	0.03	0.03	1	0.06	0.05	0.04	0.04	0.04	0.04	0.04
-0.02	-0.14	-0.12	-0.1	-0.1	-0.1	-0.1	-0.09	0.06	0.04	0.03	0.03	0.03	0.03	0.03	0.03	0	0	0	0	0	0	0	0	0.04	0.04	0.03	0.03	0.03	0.03	0.06	1	0.05	0.04	0.04	0.04	0.04	0.04
-0.01	-0.02	-0.11	-0.1	-0.1	-0.1	-0.1	-0.1	0.04	0.04	0.03	0.03	0.03	0.03	0.03	0.03	0	0	0	0	0	0	0	0	0.03	0.03	0.03	0.03	0.03	0.03	0.05	0.05	1	0.04	0.04	0.04	0.04	0.04
-0.01	-0.02	-0.02	-0.11	-0.1	-0.1	-0.11	-0.11	0.04	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0	0	0	0	0	0	0	0	0.03	0.03	0.03	0.03	0.03	0.03	0.04	0.04	0.04	1	0.05	0.04	0.05	0.05
-0.01	-0.02	-0.02	-0.03	-0.11	-0.11	-0.13	-0.13	0.04	0.03	0.03	0.04	0.04	0.04	0.04	0.04	0	0	0	0	0	0	0	0	0.03	0.03	0.03	0.03	0.03	0.03	0.04	0.04	0.04	0.05	1	0.05	0.05	0.05
-0.01	-0.02	-0.02	-0.03	-0.04	-0.13	-0.15	-0.15	0.04	0.03	0.03	0.04	0.04	0.04	0.04	0.04	0	0	0	0	0	0	0	0	0.03	0.03	0.03	0.03	0.03	0.04	0.04	0.04	0.04	0.04	0.05	1	0.06	0.06
-0.01	-0.02	-0.02	-0.03	-0.05	-0.07	-0.19	-0.16	0.04	0.03	0.03	0.04	0.04	0.05	0.04	0.04	0	0	0	0	0	0	0	0	0.03	0.03	0.03	0.03	0.03	0.04	0.04	0.04	0.04	0.05	0.05	0.06	1	0.06
-0.01	-0.02	-0.02	-0.03	-0.06	-0.08	-0.12	-0.22	0.04	0.03	0.03	0.04	0.04	0.04	0.05	0.04	0	0	0	0	0	0	0	0	0.03	0.03	0.03	0.03	0.03	0.04	0.04	0.04	0.04	0.05	0.05	0.06	0.04	1

CORRELATION BETWEEN PARAMETERS ESTIMATED (SYMBOLIC FORM)



SYMBOLS:
= LARGE NEGATIVE CORRELATION whenever -1 <= R < -L
- MODERATE NEGATIVE CORRELATION whenever -L <= R < -M
. SMALL CORRELATION whenever -M <= R <= +M
+ MODERATE POSITIVE CORRELATION whenever +M < R <= +L
* LARGE POSITIVE CORRELATION whenever +L < R <= +1

Where R is the estimated correlation, M is, 0.25 and L is 0.5

Summary of Residuals
US_Sp
Tuned to: 1-Jan and number
For ages: 1

Year	Obs.	Pred.	Scd. Obs.	Scd. Pred.	Wt.	Wt. Res.	Std. Res.	Pred. Stk. Sze.
1963	0.000	0.000	0	0	1	0.000	0.000	00
1964	0.000	0.000	0	0	1	0.000	0.000	00
1965	0.000	0.000	0	0	1	0.000	0.000	00
1966	0.000	0.000	0	0	1	0.000	0.000	00
1967	0.000	0.000	0	0	1	0.000	0.000	00
1968	0.400	0.033	-1.390	-3.399	1	2.009	2.388	422
1969	0.000	0.000	0	0	1	0.000	0.000	00
1970	0.670	0.369	-0.874	-0.997	1	0.123	0.146	4661
1971	0.000	0.000	0	0	1	0.000	0.000	00
1972	4.020	0.674	0.918	-0.394	1	1.312	1.559	8517
1973	0.000	0.000	0	0	1	0.000	0.000	00
1974	0.000	0.000	0	0	1	0.000	0.000	00
1975	0.000	0.000	0	0	1	0.000	0.000	00
1976	0.000	0.000	0	0	1	0.000	0.000	00
1977	0.000	0.000	0	0	1	0.000	0.000	00
1978	0.000	0.000	0	0	1	0.000	0.000	00
1979	0.000	0.000	0	0	1	0.000	0.000	00
1980	0.000	0.000	0	0	1	0.000	0.000	00
1981	0.000	0.000	0	0	1	0.000	0.000	00
1982	0.760	0.196	-0.748	-1.628	1	0.880	1.046	2480
1983	0.430	0.246	-1.318	-1.402	1	0.085	0.101	3108
1984	2.090	1.367	0.263	0.313	1	-0.049	-0.058	17265
1985	0.000	0.000	0	0	1	0.000	0.000	00
1986	2.490	1.167	0.439	0.155	1	0.284	0.337	14746
1987	0.000	0.000	0	0	1	0.000	0.000	00
1988	1.550	1.327	-0.035	0.283	1	-0.318	-0.378	16757
1989	0.020	0.086	-4.386	-2.452	1	-1.933	-2.298	1087
1990	0.860	0.209	-0.625	-1.564	1	0.939	1.116	2644
1991	0.540	0.188	-1.090	-1.670	1	0.581	0.690	2377
1992	0.400	0.737	-1.390	-0.305	1	-1.085	-1.289	9306
1993	1.170	1.209	-0.317	0.190	1	-0.507	-0.602	15272
1994	0.699	0.985	-0.832	-0.015	1	-0.817	-0.971	12448
1995	0.501	0.825	-1.164	-0.192	1	-0.972	-1.156	10425
1996	1.086	0.784	-0.391	-0.243	1	-0.148	-0.176	9908
1997	1.795	1.546	0.111	0.436	1	-0.325	-0.386	19530
1998	0.824	0.894	-0.668	-0.112	1	-0.556	-0.661	11294
1999	10.209	3.860	1.850	1.351	1	0.499	0.593	48760
2000	0.000	0.000	0	0	0	0.000	0.000	00

Partial Variance: 0.87

US_Sp
Tuned to: 1-Jan and number
For ages: 2

Year	Obs.	Pred.	Scd. Obs.	Scd. Pred.	Wt.	Wt. Res.	Std. Res.	Pred. Stk. Sze.
1963	0.000	0.000	0	0	1	0.000	0.000	00
1964	0.000	0.000	0	0	1	0.000	0.000	00
1965	0.000	0.000	0	0	1	0.000	0.000	00
1966	0.000	0.000	0	0	1	0.000	0.000	00
1967	0.000	0.000	0	0	1	0.000	0.000	00
1968	2.830	1.216	0.536	0.196	1	0.341	0.405	9565
1969	0.070	0.043	-3.163	-3.146	1	-0.017	-0.020	338
1970	0.250	0.103	-1.890	-2.277	1	0.386	0.459	807
1971	1.160	0.480	-0.355	-0.734	1	0.379	0.450	3774
1972	0.090	0.038	-2.912	-3.262	1	0.350	0.416	301
1973	0.000	0.000	0	0	1	0.000	0.000	00
1974	0.000	0.000	0	0	1	0.000	0.000	00
1975	0.000	0.000	0	0	1	0.000	0.000	00
1976	0.000	0.000	0	0	1	0.000	0.000	00
1977	0.000	0.000	0	0	1	0.000	0.000	00
1978	0.000	0.000	0	0	1	0.000	0.000	00
1979	0.000	0.000	0	0	1	0.000	0.000	00
1980	0.000	0.000	0	0	1	0.000	0.000	00
1981	0.000	0.000	0	0	1	0.000	0.000	00
1982	1.530	0.752	-0.079	-0.285	1	0.206	0.245	5915
1983	0.550	0.258	-1.102	-1.355	1	0.253	0.301	2029
1984	1.180	0.324	-0.338	-1.129	1	0.790	0.939	2544
1985	4.960	1.797	1.098	0.586	1	0.511	0.608	14136
1986	0.180	0.183	-2.219	-1.697	1	-0.522	-0.620	1442
1987	3.620	1.534	0.783	0.428	1	0.354	0.421	12068
1988	0.040	0.219	-3.723	-1.519	1	-2.204	-2.619	1722
1989	3.490	1.744	0.746	0.556	1	0.190	0.226	13716
1990	0.000	0.000	0	0	1	0.000	0.000	00
1991	1.070	0.275	-0.436	-1.291	1	0.855	1.016	2163

1992	0.180	0.247	-2.219	-1.400	1	-0.819	-0.974	1940
1993	0.650	0.968	-0.935	-0.033	1	-0.902	-1.072	7613
1994	2.683	1.589	0.483	0.463	1	0.020	0.024	12497
1995	1.285	1.296	-0.253	0.259	1	-0.512	-0.608	10190
1996	4.593	1.084	1.021	0.081	1	0.940	1.117	8527
1997	1.023	1.031	-0.481	0.030	1	-0.512	-0.608	8107
1998	2.952	2.030	0.579	0.708	1	-0.129	-0.154	15963
1999	2.028	1.176	0.203	0.162	1	0.041	0.049	9245
2000	0.000	0.000	0	0	0	0.000	0.000	00

Partial Variance: 0.504

US_Sp
Tuned to: 1-Jan and number
For ages: 3

Year	Obs.	Pred.	Scd. Obs.	Scd. Pred.	Wt.	Wt. Res.	Std. Res.	Pred. Stk. Sze.
1963	0.000	0.000	0	0	1	0.000	0.000	00
1964	0.000	0.000	0	0	1	0.000	0.000	00
1965	0.000	0.000	0	0	1	0.000	0.000	00
1966	0.000	0.000	0	0	1	0.000	0.000	00
1967	0.000	0.000	0	0	1	0.000	0.000	00
1968	0.460	0.383	-1.199	-0.960	1	-0.238	-0.283	2536
1969	0.580	0.773	-0.967	-0.258	1	-0.709	-0.843	5122
1970	0.000	0.000	0	0	1	0.000	0.000	00
1971	0.250	0.078	-1.808	-2.549	1	0.741	0.881	518
1972	0.610	0.279	-0.916	-1.278	1	0.362	0.430	1846
1973	0.000	0.000	0	0	1	0.000	0.000	00
1974	0.000	0.000	0	0	1	0.000	0.000	00
1975	0.000	0.000	0	0	1	0.000	0.000	00
1976	0.000	0.000	0	0	1	0.000	0.000	00
1977	0.000	0.000	0	0	1	0.000	0.000	00
1978	0.000	0.000	0	0	1	0.000	0.000	00
1979	0.000	0.000	0	0	1	0.000	0.000	00
1980	0.000	0.000	0	0	1	0.000	0.000	00
1981	0.000	0.000	0	0	1	0.000	0.000	00
1982	0.940	0.786	-0.484	-0.240	1	-0.244	-0.290	5212
1983	0.580	0.572	-0.967	-0.559	1	-0.408	-0.484	3788
1984	0.640	0.221	-0.868	-1.507	1	0.639	0.760	1468
1985	0.760	0.302	-0.696	-1.199	1	0.502	0.597	1999
1986	2.060	1.418	0.301	0.349	1	-0.048	-0.058	9396
1987	0.060	0.171	-3.235	-1.768	1	-1.468	-1.744	1131
1988	0.990	1.219	-0.432	0.198	1	-0.630	-0.748	8075
1989	0.450	0.206	-1.221	-1.582	1	0.361	0.429	1363
1990	5.720	1.522	1.322	0.420	1	0.902	1.072	10087
1991	0.240	0.108	-1.849	-2.221	1	0.372	0.442	719
1992	0.110	0.206	-2.629	-1.580	1	-1.050	-1.247	1365
1993	0.180	0.206	-2.137	-1.580	1	-0.557	-0.662	1365
1994	1.003	0.901	-0.419	-0.104	1	-0.315	-0.374	5970
1995	2.319	1.507	0.419	0.410	1	0.009	0.011	9989
1996	8.856	1.247	1.759	0.221	1	1.539	1.828	8262
1997	3.354	1.046	0.788	0.045	1	0.743	0.883	6933
1998	1.247	0.977	-0.201	-0.023	1	-0.178	-0.212	6477
1999	2.141	1.945	0.339	0.665	1	-0.326	-0.387	12890
2000	0.000	0.000	0	0	0	0.000	0.000	00

Partial Variance: 0.498

US_Sp
Tuned to: 1-Jan and number
For ages: 4

Year	Obs.	Pred.	Scd. Obs.	Scd. Pred.	Wt.	Wt. Res.	Std. Res.	Pred. Stk. Sze.
1963	0.000	0.000	0	0	1	0.000	0.000	00
1964	0.000	0.000	0	0	1	0.000	0.000	00
1965	0.000	0.000	0	0	1	0.000	0.000	00
1966	0.000	0.000	0	0	1	0.000	0.000	00
1967	0.000	0.000	0	0	1	0.000	0.000	00
1968	0.700	1.004	-0.388	0.004	1	-0.392	-0.466	4687
1969	0.250	0.307	-1.418	-1.180	1	-0.238	-0.283	1435
1970	0.330	0.569	-1.140	-0.564	1	-0.576	-0.685	2657
1971	0.000	0.000	0	0	1	0.000	0.000	00
1972	0.120	0.048	-2.152	-3.045	1	0.894	1.062	222
1973	0.000	0.000	0	0	1	0.000	0.000	00
1974	0.000	0.000	0	0	1	0.000	0.000	00
1975	0.000	0.000	0	0	1	0.000	0.000	00
1976	0.000	0.000	0	0	1	0.000	0.000	00
1977	0.000	0.000	0	0	1	0.000	0.000	00
1978	0.000	0.000	0	0	1	0.000	0.000	00
1979	0.000	0.000	0	0	1	0.000	0.000	00
1980	0.000	0.000	0	0	1	0.000	0.000	00
1981	0.000	0.000	0	0	1	0.000	0.000	00

1982	4.070	2.821	1.372	1.037	1	0.335	0.398	13174
1983	0.220	0.597	-1.546	-0.515	1	-1.030	-1.224	2789
1984	0.630	0.507	-0.493	-0.680	1	0.186	0.222	2366
1985	0.400	0.200	-0.948	-1.610	1	0.663	0.788	933
1986	0.240	0.244	-1.459	-1.411	1	-0.048	-0.056	1139
1987	0.810	1.103	-0.242	0.098	1	-0.340	-0.404	5150
1988	0.130	0.173	-2.072	-1.752	1	-0.319	-0.379	810
1989	0.710	0.954	-0.374	-0.047	1	-0.327	-0.388	4454
1990	0.330	0.222	-1.140	-1.504	1	0.364	0.433	1038
1991	1.850	1.489	0.584	0.398	1	0.186	0.221	6951
1992	0.070	0.108	-2.691	-2.222	1	-0.469	-0.557	506
1993	0.140	0.177	-1.998	-1.729	1	-0.268	-0.319	828
1994	0.148	0.172	-1.941	-1.763	1	-0.178	-0.211	801
1995	0.915	0.890	-0.120	-0.117	1	-0.004	-0.004	4155
1996	5.205	1.636	1.618	0.492	1	1.126	1.338	7638
1997	3.657	1.338	1.265	0.291	1	0.974	1.158	6249
1998	1.059	1.160	0.026	0.148	1	-0.122	-0.145	5415
1999	0.717	1.055	-0.364	0.054	1	-0.418	-0.496	4927
2000	0.000	0.000	0	0	0	0.000	0.000	00

Partial Variance: 0.3

US_Sp
Tuned to: 1-Jan and number
For ages: 5

Year	Obs.	Pred.	Scd. Obs.	Scd. Pred.	Wt.	Wt. Res.	Std. Res.	Pred. Stk. Sze.
1963	0.000	0.000	0	0	1	0.000	0.000	00
1964	0.000	0.000	0	0	1	0.000	0.000	00
1965	0.000	0.000	0	0	1	0.000	0.000	00
1966	0.000	0.000	0	0	1	0.000	0.000	00
1967	0.000	0.000	0	0	1	0.000	0.000	00
1968	6.720	9.975	2.035	2.300	1	-0.265	-0.315	37321
1969	0.420	0.561	-0.737	-0.578	1	-0.159	-0.189	2099
1970	0.460	0.206	-0.646	-1.581	1	0.935	1.111	770
1971	0.120	0.444	-1.990	-0.813	1	-1.177	-1.399	1660
1972	0.030	0.035	-3.376	-3.353	1	-0.024	-0.028	131
1973	0.000	0.000	0	0	1	0.000	0.000	00
1974	0.000	0.000	0	0	1	0.000	0.000	00
1975	0.000	0.000	0	0	1	0.000	0.000	00
1976	0.000	0.000	0	0	1	0.000	0.000	00
1977	0.000	0.000	0	0	1	0.000	0.000	00
1978	0.000	0.000	0	0	1	0.000	0.000	00
1979	0.000	0.000	0	0	1	0.000	0.000	00
1980	0.000	0.000	0	0	1	0.000	0.000	00
1981	0.000	0.000	0	0	1	0.000	0.000	00
1982	0.420	0.455	-0.737	-0.787	1	0.050	0.059	1703
1983	2.410	1.980	1.010	0.683	1	0.327	0.388	7408
1984	0.580	0.444	-0.414	-0.813	1	0.398	0.474	1659
1985	0.870	0.342	-0.009	-1.073	1	1.064	1.265	1279
1986	0.110	0.157	-2.077	-1.850	1	-0.227	-0.270	588
1987	0.080	0.195	-2.395	-1.633	1	-0.762	-0.906	731
1988	0.320	0.737	-1.009	-0.305	1	-0.704	-0.837	2757
1989	0.140	0.145	-1.836	-1.933	1	0.097	0.115	542
1990	0.580	0.763	-0.414	-0.271	1	-0.143	-0.171	2853
1991	0.090	0.186	-2.278	-1.685	1	-0.593	-0.705	694
1992	0.330	1.001	-0.978	0.001	1	-0.980	-1.164	3746
1993	0.120	0.079	-1.990	-2.540	1	0.550	0.654	295
1994	0.102	0.109	-2.155	-2.217	1	0.062	0.074	408
1995	0.165	0.134	-1.670	-2.009	1	0.339	0.403	502
1996	2.618	0.799	1.093	-0.225	1	1.317	1.566	2988
1997	2.009	1.443	0.828	0.367	1	0.462	0.548	5398
1998	0.854	1.180	-0.027	0.165	1	-0.192	-0.228	4413
1999	0.642	1.064	-0.312	0.062	1	-0.374	-0.445	3980
2000	0.000	0.000	0	0	0	0.000	0.000	00

Partial Variance: 0.404

US_Sp
Tuned to: 1-Jan and number
For ages: 6

Year	Obs.	Pred.	Scd. Obs.	Scd. Pred.	Wt.	Wt. Res.	Std. Res.	Pred. Stk. Sze.
1963	0.000	0.000	0	0	1	0.000	0.000	00
1964	0.000	0.000	0	0	1	0.000	0.000	00
1965	0.000	0.000	0	0	1	0.000	0.000	00
1966	0.000	0.000	0	0	1	0.000	0.000	00
1967	0.000	0.000	0	0	1	0.000	0.000	00
1968	1.680	3.864	1.219	1.352	1	-0.133	-0.158	10519
1969	4.230	6.399	2.142	1.856	1	0.286	0.340	17419
1970	0.460	0.414	-0.076	-0.882	1	0.806	0.958	1127
1971	0.120	0.170	-1.420	-1.774	1	0.354	0.421	462

1972	0.040	0.403	-2.519	-0.908	1	-1.610	-1.914	1097
1973	0.000	0.000	0	0	1	0.000	0.000	00
1974	0.000	0.000	0	0	1	0.000	0.000	00
1975	0.000	0.000	0	0	1	0.000	0.000	00
1976	0.000	0.000	0	0	1	0.000	0.000	00
1977	0.000	0.000	0	0	1	0.000	0.000	00
1978	0.000	0.000	0	0	1	0.000	0.000	00
1979	0.000	0.000	0	0	1	0.000	0.000	00
1980	0.000	0.000	0	0	1	0.000	0.000	00
1981	0.000	0.000	0	0	1	0.000	0.000	00
1982	0.280	0.766	-0.573	-0.267	1	-0.306	-0.364	2085
1983	0.010	0.382	-3.905	-0.961	1	-2.944	-3.498	1041
1984	0.720	1.484	0.372	0.395	1	-0.023	-0.027	4039
1985	0.340	0.367	-0.379	-1.002	1	0.623	0.741	999
1986	0.210	0.232	-0.860	-1.463	1	0.602	0.716	630
1987	0.100	0.128	-1.602	-2.053	1	0.450	0.535	350
1988	0.120	0.179	-1.420	-1.719	1	0.299	0.355	488
1989	0.410	0.520	-0.191	-0.654	1	0.463	0.550	1415
1990	0.060	0.115	-2.113	-2.160	1	0.047	0.055	314
1991	0.100	0.570	-1.602	-0.563	1	-1.040	-1.236	1551
1992	0.030	0.175	-2.806	-1.744	1	-1.062	-1.263	476
1993	0.370	0.619	-0.294	-0.479	1	0.185	0.220	1686
1994	0.066	0.054	-2.021	-2.916	1	0.895	1.063	147
1995	0.114	0.101	-1.472	-2.295	1	0.822	0.977	274
1996	0.349	0.131	-0.353	-2.033	1	1.680	1.997	357
1997	0.889	0.745	0.583	-0.295	1	0.878	1.043	2027
1998	0.214	1.435	-0.840	0.361	1	-1.201	-1.427	3906
1999	0.507	1.097	0.021	0.093	1	-0.072	-0.085	2987
2000	0.000	0.000	0	0	0	0.000	0.000	00

Partial Variance: 1.024

US_Sp
Tuned to: 1-Jan and number
For ages: 7

Year	Obs.	Pred.	Scd. Obs.	Scd. Pred.	Wt.	Wt. Res.	Std. Res.	Pred. Stk. Sze.
1963	0.000	0.000	0	0	1	0.000	0.000	00
1964	0.000	0.000	0	0	1	0.000	0.000	00
1965	0.000	0.000	0	0	1	0.000	0.000	00
1966	0.000	0.000	0	0	1	0.000	0.000	00
1967	0.000	0.000	0	0	1	0.000	0.000	00
1968	0.250	0.966	-0.140	-0.035	1	-0.106	-0.125	1570
1969	1.030	3.350	1.275	1.209	1	0.067	0.079	5446
1970	2.000	5.457	1.939	1.697	1	0.242	0.288	8874
1971	0.090	0.448	-1.162	-0.802	1	-0.360	-0.428	729
1972	0.130	0.096	-0.794	-2.347	1	1.553	1.845	156
1973	0.000	0.000	0	0	1	0.000	0.000	00
1974	0.000	0.000	0	0	1	0.000	0.000	00
1975	0.000	0.000	0	0	1	0.000	0.000	00
1976	0.000	0.000	0	0	1	0.000	0.000	00
1977	0.000	0.000	0	0	1	0.000	0.000	00
1978	0.000	0.000	0	0	1	0.000	0.000	00
1979	0.000	0.000	0	0	1	0.000	0.000	00
1980	0.000	0.000	0	0	1	0.000	0.000	00
1981	0.000	0.000	0	0	1	0.000	0.000	00
1982	0.610	2.949	0.752	1.082	1	-0.330	-0.392	4796
1983	0.040	0.733	-1.973	-0.310	1	-1.663	-1.976	1192
1984	0.070	0.373	-1.413	-0.987	1	-0.427	-0.507	606
1985	1.170	1.209	1.403	0.190	1	1.213	1.441	1966
1986	0.120	0.376	-0.874	-0.977	1	0.103	0.122	612
1987	0.050	0.221	-1.750	-1.509	1	-0.241	-0.286	360
1988	0.110	0.135	-0.961	-2.000	1	1.038	1.234	220
1989	0.060	0.163	-1.568	-1.816	1	0.248	0.295	265
1990	0.130	0.513	-0.794	-0.667	1	-0.128	-0.152	835
1991	0.020	0.104	-2.666	-2.267	1	-0.399	-0.474	168
1992	0.030	0.553	-2.261	-0.593	1	-1.668	-1.982	899
1993	0.060	0.178	-1.568	-1.727	1	0.159	0.189	289
1994	0.155	0.482	-0.618	-0.730	1	0.112	0.133	784
1995	0.029	0.036	-2.309	-3.333	1	1.025	1.218	58
1996	0.073	0.121	-1.371	-2.115	1	0.743	0.883	196
1997	0.126	0.142	-0.826	-1.955	1	1.129	1.342	230
1998	0.060	0.898	-1.561	-0.107	1	-1.453	-1.727	1460
1999	0.204	1.674	-0.343	0.515	1	-0.858	-1.020	2722
2000	0.000	0.000	0	0	0	0.000	0.000	00

Partial Variance: 0.785

US_Sp
Tuned to: 1-Jan and number
For ages: 8

Year	Obs.	Pred.	Scd. Obs.	Scd. Pred.	Wt.	Wt. Res.	Std. Res.	Pred. Stk. Sze.
1963	0.000	0.000	0	0	1	0.000	0.000	00
1964	0.000	0.000	0	0	1	0.000	0.000	00
1965	0.000	0.000	0	0	1	0.000	0.000	00
1966	0.000	0.000	0	0	1	0.000	0.000	00
1967	0.000	0.000	0	0	1	0.000	0.000	00
1968	0.450	1.091	0.595	0.087	1	0.508	0.604	1177
1969	0.280	0.632	0.120	-0.459	1	0.579	0.688	682
1970	0.980	2.813	1.373	1.034	1	0.339	0.402	3035
1971	0.820	4.798	1.195	1.568	1	-0.374	-0.444	5177
1972	0.030	0.314	-2.114	-1.158	1	-0.956	-1.136	339
1973	0.000	0.000	0	0	1	0.000	0.000	00
1974	0.000	0.000	0	0	1	0.000	0.000	00
1975	0.000	0.000	0	0	1	0.000	0.000	00
1976	0.000	0.000	0	0	1	0.000	0.000	00
1977	0.000	0.000	0	0	1	0.000	0.000	00
1978	0.000	0.000	0	0	1	0.000	0.000	00
1979	0.000	0.000	0	0	1	0.000	0.000	00
1980	0.000	0.000	0	0	1	0.000	0.000	00
1981	0.000	0.000	0	0	1	0.000	0.000	00
1982	0.000	0.000	0	0	1	0.000	0.000	00
1983	1.160	2.701	1.541	0.994	1	0.548	0.651	2914
1984	0.040	0.749	-1.826	-0.289	1	-1.536	-1.826	808
1985	0.100	0.264	-0.910	-1.333	1	0.424	0.503	284
1986	0.330	1.051	0.284	0.050	1	0.235	0.279	1134
1987	0.220	0.339	-0.121	-1.083	1	0.962	1.143	365
1988	0.120	0.198	-0.727	-1.619	1	0.891	1.059	214
1989	0.050	0.121	-1.603	-2.113	1	0.510	0.606	130
1990	0.000	0.000	0	0	1	0.000	0.000	00
1991	0.040	0.485	-1.826	-0.724	1	-1.102	-1.310	523
1992	0.030	0.067	-2.114	-2.709	1	0.596	0.708	72
1993	0.020	0.411	-2.519	-0.889	1	-1.630	-1.937	443
1994	0.015	0.188	-2.800	-1.673	1	-1.127	-1.339	202
1995	0.178	0.468	-0.333	-0.759	1	0.426	0.506	505
1996	0.075	0.037	-1.197	-3.293	1	2.096	2.491	40
1997	0.070	0.130	-1.261	-2.036	1	0.776	0.922	141
1998	0.006	0.158	-3.810	-1.842	1	-1.968	-2.339	171
1999	0.201	0.984	-0.212	-0.017	1	-0.196	-0.233	1061
2000	0.000	0.000	0	0	0	0.000	0.000	00

Partial Variance: 1.075

US_S41
Tuned to: 1-Jan and number
For ages: 1

Year	Obs.	Pred.	Scd. Obs.	Scd. Pred.	Wt.	Wt. Res.	Std. Res.	Pred. Stk. Sze.
1973	30.680	0.248	0.547	-1.396	1	1.942	2.308	19418
1974	2.130	0.135	-2.121	-2.006	1	-0.115	-0.136	10547
1975	0.940	0.098	-2.939	-2.326	1	-0.613	-0.729	7661
1976	80.790	1.318	1.515	0.276	1	1.239	1.473	103305
1977	0.610	0.176	-3.371	-1.736	1	-1.635	-1.943	13810
1978	0.070	0.077	-5.536	-2.558	1	-2.978	-3.539	6073
1979	36.120	1.071	0.710	0.069	1	0.641	0.762	83984
1980	5.200	0.129	-1.228	-2.046	1	0.817	0.971	10137
1981	3.300	0.092	-1.683	-2.384	1	0.701	0.833	7225

Partial Variance: 2.432

US_S41
Tuned to: 1-Jan and number
For ages: 2

Year	Obs.	Pred.	Scd. Obs.	Scd. Pred.	Wt.	Wt. Res.	Std. Res.	Pred. Stk. Sze.
1973	4.840	0.164	-0.883	-1.805	1	0.922	1.096	6832
1974	13.290	0.327	0.127	-1.118	1	1.245	1.480	13582
1975	0.970	0.207	-2.491	-1.576	1	-0.915	-1.087	8594
1976	0.300	0.147	-3.664	-1.919	1	-1.745	-2.074	6098
1977	33.410	2.033	1.049	0.709	1	0.339	0.403	84449
1978	0.970	0.272	-2.491	-1.301	1	-1.189	-1.413	11306
1979	1.580	0.120	-2.003	-2.123	1	0.120	0.143	4971
1980	46.700	1.655	1.384	0.504	1	0.880	1.046	68760
1981	3.290	0.200	-1.269	-1.611	1	0.342	0.407	8292

Partial Variance: 1.127

US_S41
Tuned to: 1-Jan and number
For ages: 3

Year	Obs.	Pred.	Scd. Obs.	Scd. Pred.	Wt.	Wt. Res.	Std. Res.	Pred. Stk. Sze.
1974	2.860	0.162	-0.660	-1.821	1	1.161	1.380	3716
1975	3.320	0.314	-0.511	-1.158	1	0.647	0.769	7211
1976	0.600	0.266	-2.221	-1.325	1	-0.896	-1.065	6100
1977	0.420	0.199	-2.578	-1.615	1	-0.963	-1.145	4565
1978	15.930	2.240	1.058	0.807	1	0.251	0.298	51420
1979	1.130	0.373	-1.588	-0.985	1	-0.603	-0.717	8568
1980	0.510	0.176	-2.384	-1.736	1	-0.648	-0.771	4046
1981	19.490	1.231	1.259	0.208	1	1.052	1.250	28246

Partial Variance: 0.81

US_S41
Tuned to: 1-Jan and number
For ages: 4

Year	Obs.	Pred.	Scd. Obs.	Scd. Pred.	Wt.	Wt. Res.	Std. Res.	Pred. Stk. Sze.
1973	0.540	0.182	-1.071	-1.705	1	0.634	0.753	1104
1974	0.000	0.000	0	0	1	0.000	0.000	00
1975	0.630	0.403	-0.917	-0.909	1	-0.008	-0.010	2448
1976	0.920	0.694	-0.538	-0.365	1	-0.174	-0.206	4217
1977	1.220	0.740	-0.256	-0.301	1	0.045	0.053	4497
1978	0.360	0.587	-1.477	-0.532	1	-0.945	-1.123	3568
1979	5.710	4.786	1.287	1.566	1	-0.279	-0.331	29074
1980	1.040	0.898	-0.416	-0.108	1	-0.308	-0.366	5453
1981	2.190	0.494	0.329	-0.706	1	1.035	1.230	2999

Partial Variance: 0.382

US_S41
Tuned to: 1-Jan and number
For ages: 5

Year	Obs.	Pred.	Scd. Obs.	Scd. Pred.	Wt.	Wt. Res.	Std. Res.	Pred. Stk. Sze.
1973	0.090	0.030	-2.440	-3.496	1	1.056	1.255	109
1974	0.240	0.155	-1.459	-1.865	1	0.406	0.483	555
1975	0.000	0.000	0	0	1	0.000	0.000	00
1976	0.430	0.465	-0.876	-0.766	1	-0.110	-0.131	1665
1977	0.600	0.742	-0.543	-0.299	1	-0.244	-0.290	2657
1978	0.940	0.856	-0.094	-0.155	1	0.061	0.073	3066
1979	0.330	0.739	-1.141	-0.303	1	-0.838	-0.996	2645
1980	4.870	4.835	1.551	1.576	1	-0.025	-0.029	17317
1981	0.760	1.000	-0.306	0.000	1	-0.307	-0.364	3582

Partial Variance: 0.319

US_S41
Tuned to: 1-Jan and number
For ages: 6

Year	Obs.	Pred.	Scd. Obs.	Scd. Pred.	Wt.	Wt. Res.	Std. Res.	Pred. Stk. Sze.
1975	0.130	0.159	-1.637	-1.841	1	0.204	0.242	391
1976	0.000	0.000	0	0	1	0.000	0.000	00
1977	0.450	0.474	-0.396	-0.746	1	0.351	0.417	1168
1978	0.820	0.694	0.205	-0.365	1	0.570	0.677	1709
1979	0.160	0.811	-1.430	-0.209	1	-1.220	-1.450	1997
1980	0.670	0.687	0.002	-0.376	1	0.378	0.450	1691
1981	1.780	3.533	0.980	1.262	1	-0.282	-0.336	8700

Partial Variance: 0.465

US_S41
Tuned to: 1-Jan and number
For ages: 7

Year	Obs.	Pred.	Scd. Obs.	Scd. Pred.	Wt.	Wt. Res.	Std. Res.	Pred. Stk. Sze.
1973	0.180	1.499	-0.014	0.405	1	-0.419	-0.497	790
1974	0.010	0.070	-2.904	-2.659	1	-0.245	-0.291	37
1975	0.090	0.060	-0.707	-2.809	1	2.102	2.499	32
1976	0.040	0.535	-1.518	-0.625	1	-0.892	-1.061	282
1977	0.000	0.000	0	0	1	0.000	0.000	00
1978	0.160	1.201	-0.132	0.183	1	-0.315	-0.374	633
1979	0.370	1.768	0.707	0.570	1	0.137	0.163	931
1980	0.370	2.399	0.707	0.875	1	-0.168	-0.200	1264
1981	0.240	1.607	0.274	0.474	1	-0.201	-0.238	847

Partial Variance: 0.837

US_S41
Tuned to: 1-Jan and number
For ages: 8

Year	Obs.	Pred.	Scd. Obs.	Scd. Pred.	Wt.	Wt. Res.	Std. Res.	Pred. Stk. Sze.
1973	0.010	0.153	-2.363	-1.878	1	-0.485	-0.576	57
1974	0.100	1.554	-0.061	0.441	1	-0.502	-0.596	577
1975	0.010	0.076	-2.363	-2.571	1	0.208	0.247	28
1976	0.000	0.000	0	0	1	0.000	0.000	00
1977	0.040	0.566	-0.977	-0.570	1	-0.407	-0.484	210
1978	0.060	0.220	-0.571	-1.512	1	0.941	1.118	82
1979	0.060	1.057	-0.571	0.055	1	-0.627	-0.745	392
1980	0.460	1.286	1.465	0.252	1	1.214	1.442	478
1981	0.110	1.458	0.035	0.377	1	-0.342	-0.406	541

Partial Variance: 0.529

US_Au0
Tuned to: 1-Jan and number
For ages: 1

Year	Obs.	Pred.	Scd. Obs.	Scd. Pred.	Wt.	Wt. Res.	Std. Res.	Pred. Stk. Sze.
1963	0.000	0.000	0	0	1	0.000	0.000	00
1964	83.932	12.227	2.715	2.504	1	0.211	0.251	471885
1965	2.369	0.859	-0.853	-0.152	1	-0.701	-0.833	33154
1966	0.328	0.107	-2.831	-2.233	1	-0.598	-0.710	4137
1967	6.139	0.336	0.099	-1.092	1	1.191	1.415	12954
1968	0.030	0.011	-5.229	-4.516	1	-0.713	-0.847	422
1969	0.089	0.026	-4.130	-3.665	1	-0.465	-0.553	988
1970	0.387	0.121	-2.664	-2.114	1	-0.550	-0.653	4661
1971	0.045	0.010	-4.823	-4.650	1	-0.174	-0.206	369
1972	2.429	0.221	-0.828	-1.511	1	0.683	0.812	8517
1973	6.750	0.503	0.194	-0.687	1	0.881	1.047	19418
1974	3.233	0.273	-0.542	-1.297	1	0.755	0.898	10547
1975	0.745	0.198	-2.010	-1.617	1	-0.393	-0.467	7661
1976	23.482	2.677	1.441	0.985	1	0.456	0.542	103305
1977	4.321	0.358	-0.252	-1.028	1	0.776	0.922	13810
1978	0.134	0.157	-3.722	-1.849	1	-1.873	-2.226	6073
1979	13.222	2.176	0.866	0.778	1	0.089	0.106	83984
1980	1.320	0.263	-1.438	-1.337	1	-0.101	-0.120	10137
1981	11.682	0.187	0.743	-1.676	1	2.418	2.874	7225
1982	0.379	0.064	-2.686	-2.745	1	0.059	0.070	2480
1983	1.356	0.081	-1.411	-2.519	1	1.108	1.317	3108
1984	5.796	0.447	0.042	-0.804	1	0.846	1.006	17265
1985	0.030	0.046	-5.229	-3.087	1	-2.141	-2.545	1761
1986	11.350	0.382	0.714	-0.962	1	1.676	1.992	14746
1987	0.000	0.000	0	0	1	0.000	0.000	00
1988	1.800	0.434	-1.128	-0.834	1	-0.293	-0.349	16757
1989	0.070	0.028	-4.375	-3.569	1	-0.805	-0.957	1087
1990	0.467	0.069	-2.476	-2.681	1	0.205	0.243	2644
1991	0.771	0.062	-1.976	-2.787	1	0.812	0.965	2377
1992	2.157	0.241	-0.947	-1.422	1	0.475	0.565	9306
1993	2.850	0.396	-0.668	-0.927	1	0.259	0.308	15272
1994	1.517	0.323	-1.299	-1.132	1	-0.167	-0.199	12448
1995	0.910	0.270	-1.809	-1.309	1	-0.501	-0.595	10425
1996	2.273	0.257	-0.894	-1.360	1	0.465	0.553	9908
1997	1.311	0.506	-1.445	-0.681	1	-0.763	-0.907	19530
1998	0.323	0.293	-2.845	-1.229	1	-1.616	-1.921	11294
1999	4.316	1.263	-0.253	0.234	1	-0.487	-0.579	48760
2000	1.825	0.913	-1.114	-0.091	1	-1.023	-1.216	35243

Partial Variance: 0.909

US_Au1
Tuned to: 1-Jan and number
For ages: 2

Year	Obs.	Pred.	Scd. Obs.	Scd. Pred.	Wt.	Wt. Res.	Std. Res.	Pred. Stk. Sze.
1963	0.000	0.000	0	0	1	0.000	0.000	00
1964	25.390	3.777	0.962	1.329	1	-0.367	-0.436	153504
1965	112.868	9.281	2.454	2.228	1	0.226	0.269	377207
1966	10.162	0.454	0.047	-0.789	1	0.836	0.994	18457
1967	0.954	0.081	-2.319	-2.516	1	0.196	0.233	3284
1968	6.720	0.235	-0.367	-1.447	1	1.080	1.283	9565
1969	0.060	0.008	-5.092	-4.789	1	-0.303	-0.360	338
1970	0.030	0.020	-5.785	-3.919	1	-1.866	-2.218	807
1971	4.127	0.093	-0.854	-2.377	1	1.522	1.809	3774
1972	0.000	0.000	0	0	1	0.000	0.000	00
1973	2.518	0.168	-1.348	-1.783	1	0.435	0.517	6832
1974	9.000	0.334	-0.075	-1.096	1	1.021	1.214	13582
1975	1.773	0.211	-1.699	-1.554	1	-0.145	-0.173	8594
1976	0.626	0.150	-2.741	-1.897	1	-0.844	-1.003	6098
1977	64.174	2.078	1.890	0.731	1	1.158	1.377	84449
1978	2.138	0.278	-1.512	-1.280	1	-0.232	-0.276	11306
1979	0.843	0.122	-2.442	-2.101	1	-0.341	-0.406	4971
1980	45.568	1.692	1.547	0.526	1	1.021	1.214	68760
1981	2.713	0.204	-1.274	-1.590	1	0.316	0.375	8292
1982	6.134	0.146	-0.458	-1.927	1	1.469	1.746	5915
1983	0.000	0.000	0	0	1	0.000	0.000	00
1984	0.238	0.063	-3.706	-2.771	1	-0.935	-1.111	2544
1985	3.323	0.348	-1.071	-1.056	1	-0.015	-0.018	14136
1986	0.650	0.035	-2.703	-3.339	1	0.636	0.756	1442
1987	5.110	0.297	-0.641	-1.214	1	0.574	0.682	12068
1988	0.000	0.000	0	0	1	0.000	0.000	00
1989	3.020	0.337	-1.167	-1.086	1	-0.080	-0.096	13716
1990	0.049	0.022	-5.284	-3.821	1	-1.463	-1.738	890

1991	0.672	0.053	-2.669	-2.933	1	0.265	0.314	2163
1992	0.205	0.048	-3.857	-3.042	1	-0.815	-0.968	1940
1993	2.080	0.187	-1.540	-1.675	1	0.135	0.161	7613
1994	4.043	0.307	-0.875	-1.179	1	0.304	0.362	12497
1995	0.772	0.251	-2.531	-1.383	1	-1.147	-1.364	10190
1996	7.138	0.210	-0.306	-1.562	1	1.255	1.492	8527
1997	0.544	0.199	-2.881	-1.612	1	-1.269	-1.508	8107
1998	2.466	0.393	-1.369	-0.935	1	-0.435	-0.517	15963
1999	2.788	0.227	-1.246	-1.481	1	0.234	0.278	9245
2000	0.840	0.982	-2.446	-0.018	1	-2.428	-2.885	39921

Partial Variance: 0.916

US_Au2
Tuned to: 1-Jan and number
For ages: 3

Year	Obs.	Pred.	Scd. Obs.	Scd. Pred.	Wt.	Wt. Res.	Std. Res.	Pred. Stk. Sze.
1963	0.000	0.000	0	0	1	0.000	0.000	00
1964	9.223	0.711	0.394	-0.341	1	0.735	0.874	22756
1965	63.742	3.477	2.327	1.246	1	1.081	1.285	111260
1966	77.391	6.093	2.521	1.807	1	0.714	0.849	194986
1967	2.891	0.279	-0.766	-1.278	1	0.511	0.608	8920
1968	0.358	0.079	-2.856	-2.535	1	-0.321	-0.381	2536
1969	0.954	0.160	-1.875	-1.832	1	-0.043	-0.051	5122
1970	0.000	0.000	0	0	1	0.000	0.000	00
1971	0.209	0.016	-3.395	-4.124	1	0.729	0.866	518
1972	0.313	0.058	-2.990	-2.853	1	-0.137	-0.162	1846
1973	0.000	0.000	0	0	1	0.000	0.000	00
1974	1.609	0.116	-1.352	-2.153	1	0.801	0.952	3716
1975	0.983	0.225	-1.844	-1.490	1	-0.354	-0.421	7211
1976	0.715	0.191	-2.163	-1.657	1	-0.505	-0.601	6100
1977	0.522	0.143	-2.479	-1.947	1	-0.531	-0.631	4565
1978	18.733	1.607	1.103	0.474	1	0.628	0.747	51420
1979	1.039	0.268	-1.790	-1.318	1	-0.472	-0.561	8568
1980	0.037	0.126	-5.133	-2.068	1	-3.065	-3.642	4046
1981	12.721	0.883	0.716	-0.125	1	0.840	0.999	28246
1982	2.077	0.163	-1.097	-1.815	1	0.718	0.854	5212
1983	1.326	0.118	-1.545	-2.134	1	0.588	0.699	3788
1984	0.209	0.046	-3.395	-3.082	1	-0.313	-0.372	1468
1985	0.879	0.062	-1.957	-2.773	1	0.817	0.971	1999
1986	1.530	0.294	-1.402	-1.225	1	-0.177	-0.210	9396
1987	0.090	0.035	-4.236	-3.342	1	-0.893	-1.062	1131
1988	0.790	0.252	-2.063	-1.377	1	-0.686	-0.816	8075
1989	0.180	0.043	-3.542	-3.156	1	-0.386	-0.459	1363
1990	2.706	0.315	-0.832	-1.155	1	0.322	0.383	10087
1991	0.025	0.022	-5.533	-3.796	1	-1.737	-2.064	719
1992	0.238	0.043	-3.264	-3.154	1	-0.110	-0.130	1365
1993	0.230	0.043	-3.297	-3.155	1	-0.143	-0.170	1365
1994	2.009	0.187	-1.130	-1.679	1	0.549	0.652	5970
1995	0.808	0.312	-2.041	-1.164	1	-0.877	-1.042	9989
1996	4.904	0.258	-0.238	-1.354	1	1.116	1.327	8262
1997	0.926	0.217	-1.905	-1.530	1	-0.375	-0.446	6933
1998	1.467	0.202	-1.444	-1.598	1	0.153	0.182	6477
1999	2.473	0.403	-0.922	-0.909	1	-0.013	-0.015	12890
2000	3.369	0.235	-0.613	-1.446	1	0.833	0.990	7534

Partial Variance: 0.728

US_Au3
Tuned to: 1-Jan and number
For ages: 4

Year	Obs.	Pred.	Scd. Obs.	Scd. Pred.	Wt.	Wt. Res.	Std. Res.	Pred. Stk. Sze.
1963	0.000	0.000	0	0	1	0.000	0.000	00
1964	6.809	1.825	1.088	0.602	1	0.487	0.579	20096
1965	5.826	1.318	0.932	0.276	1	0.656	0.780	14510
1966	9.700	4.616	1.442	1.530	1	-0.087	-0.104	50830
1967	18.387	6.214	2.082	1.827	1	0.255	0.303	68425
1968	0.998	0.426	-0.832	-0.854	1	0.023	0.027	4687
1969	0.134	0.130	-2.839	-2.038	1	-0.801	-0.952	1435
1970	0.283	0.241	-2.092	-1.422	1	-0.670	-0.797	2657
1971	0.015	0.019	-5.036	-3.988	1	-1.048	-1.246	204
1972	0.074	0.020	-3.427	-3.903	1	0.476	0.566	222
1973	0.522	0.100	-1.481	-2.300	1	0.819	0.973	1104
1974	0.000	0.000	0	0	1	0.000	0.000	00
1975	0.313	0.222	-1.992	-1.504	1	-0.488	-0.580	2448
1976	4.857	0.383	0.751	-0.960	1	1.710	2.033	4217
1977	0.536	0.408	-1.453	-0.896	1	-0.557	-0.662	4497
1978	0.562	0.324	-1.406	-1.127	1	-0.279	-0.332	3568

1979	9.275	2.640	1.397	0.971	1	0.426	0.507	29074
1980	0.904	0.495	-0.931	-0.703	1	-0.228	-0.271	5453
1981	0.452	0.272	-1.624	-1.301	1	-0.323	-0.384	2999
1982	3.703	1.196	0.479	0.179	1	0.300	0.356	13174
1983	0.343	0.253	-1.901	-1.373	1	-0.528	-0.627	2789
1984	0.268	0.215	-2.146	-1.538	1	-0.608	-0.723	2366
1985	0.238	0.085	-2.264	-2.468	1	0.205	0.243	933
1986	0.220	0.103	-2.344	-2.269	1	-0.075	-0.089	1139
1987	1.210	0.468	-0.639	-0.760	1	0.121	0.143	5150
1988	0.100	0.074	-3.133	-2.610	1	-0.522	-0.621	810
1989	1.300	0.405	-0.568	-0.905	1	0.338	0.401	4454
1990	0.197	0.094	-2.455	-2.362	1	-0.094	-0.111	1038
1991	1.189	0.631	-0.657	-0.460	1	-0.197	-0.234	6951
1992	0.049	0.046	-3.842	-3.080	1	-0.762	-0.906	506
1993	0.240	0.075	-2.257	-2.587	1	0.330	0.392	828
1994	0.303	0.073	-2.023	-2.621	1	0.598	0.711	801
1995	0.667	0.377	-1.234	-0.975	1	-0.260	-0.309	4155
1996	2.317	0.694	0.010	-0.366	1	0.376	0.447	7638
1997	1.038	0.568	-0.792	-0.566	1	-0.226	-0.269	6249
1998	0.749	0.492	-1.119	-0.710	1	-0.409	-0.486	5415
1999	0.723	0.447	-1.154	-0.804	1	-0.350	-0.416	4927
2000	8.051	0.871	1.256	-0.138	1	1.394	1.656	9592

Partial Variance: 0.36

US_Au4
Tuned to: 1-Jan and number
For ages: 5

Year	Obs.	Pred.	Scd. Obs.	Scd. Pred.	Wt.	Wt. Res.	Std. Res.	Pred. Stk. Sze.
1963	0.000	0.000	0	0	1	0.000	0.000	00
1964	8.344	4.157	1.998	1.425	1	0.574	0.682	27424
1965	1.788	1.839	0.458	0.609	1	-0.151	-0.180	12131
1966	1.073	1.066	-0.053	0.064	1	-0.117	-0.139	7034
1967	3.352	3.679	1.087	1.303	1	-0.216	-0.257	24273
1968	6.765	5.657	1.789	1.733	1	0.056	0.066	37321
1969	0.328	0.318	-1.238	-1.145	1	-0.093	-0.111	2099
1970	0.134	0.117	-2.132	-2.149	1	0.016	0.019	770
1971	0.283	0.252	-1.385	-1.380	1	-0.005	-0.006	1660
1972	0.015	0.020	-4.330	-3.920	1	-0.409	-0.487	131
1973	0.089	0.016	-2.538	-4.107	1	1.569	1.864	109
1974	0.194	0.084	-1.765	-2.476	1	0.712	0.846	555
1975	0.000	0.000	0	0	1	0.000	0.000	00
1976	0.924	0.252	-0.202	-1.377	1	1.175	1.396	1665
1977	0.820	0.403	-0.322	-0.910	1	0.588	0.698	2657
1978	0.574	0.465	-0.678	-0.766	1	0.089	0.105	3066
1979	0.183	0.401	-1.820	-0.914	1	-0.906	-1.077	2645
1980	3.813	2.625	1.215	0.965	1	0.250	0.297	17317
1981	0.183	0.543	-1.820	-0.611	1	-1.209	-1.437	3582
1982	0.208	0.258	-1.695	-1.354	1	-0.341	-0.405	1703
1983	1.401	1.123	0.214	0.116	1	0.098	0.116	7408
1984	0.298	0.252	-1.334	-1.380	1	0.046	0.055	1659
1985	0.283	0.194	-1.385	-1.640	1	0.255	0.303	1279
1986	0.050	0.089	-3.119	-2.417	1	-0.702	-0.834	588
1987	0.060	0.111	-2.937	-2.200	1	-0.736	-0.875	731
1988	0.770	0.418	-0.384	-0.872	1	0.488	0.580	2757
1989	0.120	0.082	-2.243	-2.500	1	0.257	0.305	542
1990	0.664	0.432	-0.532	-0.838	1	0.306	0.364	2853
1991	0.049	0.105	-3.135	-2.252	1	-0.883	-1.049	694
1992	0.221	0.568	-1.631	-0.566	1	-1.065	-1.266	3746
1993	0.000	0.000	0	0	1	0.000	0.000	00
1994	0.000	0.000	0	0	1	0.000	0.000	00
1995	0.124	0.076	-2.212	-2.577	1	0.364	0.433	502
1996	0.376	0.453	-1.100	-0.792	1	-0.308	-0.366	2988
1997	0.488	0.818	-0.841	-0.201	1	-0.641	-0.761	5398
1998	0.547	0.669	-0.726	-0.402	1	-0.323	-0.384	4413
1999	0.412	0.603	-1.010	-0.505	1	-0.504	-0.599	3980
2000	3.521	0.532	1.136	-0.632	1	1.768	2.101	3507

Partial Variance: 0.467

US_Au5
Tuned to: 1-Jan and number
For ages: 6

Year	Obs.	Pred.	Scd. Obs.	Scd. Pred.	Wt.	Wt. Res.	Std. Res.	Pred. Stk. Sze.
1963	0.000	0.000	0	0	1	0.000	0.000	00
1964	5.945	3.753	2.061	1.322	1	0.738	0.878	16351
1965	3.814	3.342	1.617	1.207	1	0.411	0.488	14561
1966	0.805	1.368	0.061	0.313	1	-0.252	-0.300	5959

1967	0.522	0.747	-0.373	-0.292	1	-0.081	-0.096	3254
1968	1.624	2.414	0.763	0.881	1	-0.118	-0.140	10519
1969	3.859	3.998	1.629	1.386	1	0.243	0.289	17419
1970	0.164	0.259	-1.530	-1.352	1	-0.178	-0.211	1127
1971	0.268	0.106	-1.038	-2.244	1	1.207	1.434	462
1972	0.224	0.252	-1.220	-1.379	1	0.159	0.189	1097
1973	0.000	0.000	0	0	1	0.000	0.000	00
1974	0.045	0.009	-2.829	-4.666	1	1.837	2.183	41
1975	0.015	0.090	-3.928	-2.411	1	-1.517	-1.802	391
1976	0.000	0.000	0	0	1	0.000	0.000	00
1977	0.298	0.268	-0.932	-1.317	1	0.385	0.457	1168
1978	0.635	0.392	-0.175	-0.936	1	0.761	0.904	1709
1979	0.257	0.458	-1.082	-0.780	1	-0.302	-0.359	1997
1980	0.257	0.388	-1.082	-0.947	1	-0.135	-0.161	1691
1981	1.699	1.997	0.808	0.692	1	0.117	0.139	8700
1982	0.416	0.479	-0.600	-0.737	1	0.137	0.163	2085
1983	0.134	0.239	-1.731	-1.432	1	-0.299	-0.355	1041
1984	0.939	0.927	0.215	-0.076	1	0.291	0.346	4039
1985	0.060	0.229	-2.542	-1.472	1	-1.069	-1.271	999
1986	0.100	0.145	-2.024	-1.933	1	-0.091	-0.108	630
1987	0.130	0.080	-1.762	-2.523	1	0.761	0.905	350
1988	0.060	0.112	-2.535	-2.190	1	-0.345	-0.411	488
1989	0.400	0.325	-0.638	-1.125	1	0.487	0.578	1415
1990	0.090	0.072	-2.127	-2.630	1	0.503	0.597	314
1991	0.172	0.356	-1.481	-1.033	1	-0.448	-0.532	1551
1992	0.016	0.109	-3.832	-2.214	1	-1.618	-1.923	476
1993	0.470	0.387	-0.477	-0.950	1	0.473	0.562	1686
1994	0.057	0.034	-2.579	-3.386	1	0.807	0.959	147
1995	0.045	0.063	-2.816	-2.765	1	-0.051	-0.061	274
1996	0.012	0.082	-4.153	-2.503	1	-1.650	-1.961	357
1997	0.143	0.465	-1.669	-0.765	1	-0.904	-1.074	2027
1998	0.326	0.897	-0.844	-0.109	1	-0.735	-0.873	3906
1999	0.176	0.686	-1.459	-0.377	1	-1.082	-1.286	2987
2000	2.322	0.645	1.121	-0.439	1	1.560	1.854	2808

Partial Variance: 0.676

Can_Sp
Tuned to: 1-Jan and number
For ages: 1

Year	Obs.	Pred.	Scd. Obs.	Scd. Pred.	Wt.	Wt. Res.	Std. Res.	Pred. Stk. Sze.
1986	4.060	0.607	-0.112	-0.499	1	0.387	0.460	14746
1987	0.030	0.087	-5.020	-2.447	1	-2.573	-3.058	2103
1988	1.470	0.690	-1.128	-0.372	1	-0.757	-0.899	16757
1989	0.030	0.045	-5.020	-3.107	1	-1.913	-2.274	1087
1990	0.930	0.109	-1.586	-2.218	1	0.632	0.751	2644
1991	0.750	0.098	-1.801	-2.325	1	0.524	0.622	2377
1992	3.300	0.383	-0.319	-0.960	1	0.640	0.761	9306
1993	3.960	0.629	-0.137	-0.464	1	0.327	0.389	15272
1994	3.320	0.512	-0.313	-0.669	1	0.355	0.422	12448
1995	1.940	0.429	-0.851	-0.846	1	-0.005	-0.005	10425
1996	6.110	0.408	0.297	-0.897	1	1.194	1.419	9908
1997	1.740	0.804	-0.959	-0.218	1	-0.741	-0.881	19530
1998	2.410	0.465	-0.634	-0.766	1	0.132	0.157	11294
1999	19.750	2.007	1.470	0.697	1	0.773	0.919	48760
2000	18.330	1.451	1.395	0.372	1	1.023	1.216	35243

Partial Variance: 1.162

Can_Sp
Tuned to: 1-Jan and number
For ages: 2

Year	Obs.	Pred.	Scd. Obs.	Scd. Pred.	Wt.	Wt. Res.	Std. Res.	Pred. Stk. Sze.
1986	0.220	0.063	-3.542	-2.763	1	-0.778	-0.925	1442
1987	3.040	0.528	-0.916	-0.638	1	-0.277	-0.329	12068
1988	0.050	0.075	-5.023	-2.586	1	-2.438	-2.897	1722
1989	5.340	0.600	-0.352	-0.510	1	0.158	0.188	13716
1990	0.110	0.039	-4.235	-3.245	1	-0.990	-1.176	890
1991	1.670	0.095	-1.515	-2.357	1	0.843	1.002	2163
1992	2.950	0.085	-0.946	-2.466	1	1.520	1.807	1940
1993	2.160	0.333	-1.257	-1.099	1	-0.158	-0.188	7613
1994	11.520	0.547	0.417	-0.603	1	1.020	1.212	12497
1995	2.620	0.446	-1.064	-0.807	1	-0.257	-0.305	10190
1996	2.890	0.373	-0.966	-0.986	1	0.020	0.023	8527
1997	1.160	0.355	-1.879	-1.036	1	-0.843	-1.002	8107
1998	8.180	0.699	0.074	-0.359	1	0.433	0.514	15963
1999	3.410	0.405	-0.801	-0.905	1	0.104	0.124	9245
2000	68.600	1.747	2.201	0.558	1	1.643	1.952	39921

Partial Variance: 1.121

Can_Sp
Tuned to: 1-Jan and number
For ages: 3

Year	Obs.	Pred.	Scd. Obs.	Scd. Pred.	Wt.	Wt. Res.	Std. Res.	Pred. Stk. Sze.
1986	6.050	1.251	0.390	0.224	1	0.166	0.198	9396
1987	0.690	0.151	-1.781	-1.893	1	0.112	0.133	1131
1988	8.530	1.075	0.733	0.072	1	0.661	0.786	8075
1989	0.720	0.181	-1.739	-1.707	1	-0.031	-0.037	1363
1990	9.870	1.343	0.879	0.295	1	0.585	0.695	10087
1991	0.140	0.096	-3.376	-2.347	1	-1.030	-1.224	719
1992	1.130	0.182	-1.288	-1.705	1	0.417	0.496	1365
1993	0.550	0.182	-2.008	-1.705	1	-0.303	-0.360	1365
1994	4.080	0.795	-0.004	-0.230	1	0.226	0.268	5970
1995	4.300	1.330	0.048	0.285	1	-0.236	-0.281	9989
1996	4.840	1.100	0.167	0.095	1	0.072	0.085	8262
1997	0.990	0.923	-1.420	-0.080	1	-1.340	-1.592	6933
1998	3.080	0.862	-0.285	-0.148	1	-0.137	-0.163	6477
1999	7.160	1.716	0.558	0.540	1	0.019	0.022	12890
2000	9.320	1.003	0.822	0.003	1	0.819	0.974	7534

Partial Variance: 0.345

Can_Sp
Tuned to: 1-Jan and number
For ages: 4

Year	Obs.	Pred.	Scd. Obs.	Scd. Pred.	Wt.	Wt. Res.	Std. Res.	Pred. Stk. Sze.
1986	1.070	0.210	-0.896	-1.560	1	0.664	0.789	1139
1987	2.510	0.950	-0.043	-0.051	1	0.008	0.009	5150
1988	0.170	0.149	-2.736	-1.901	1	-0.834	-0.991	810
1989	2.120	0.822	-0.212	-0.196	1	-0.016	-0.019	4454
1990	0.130	0.191	-3.004	-1.653	1	-1.351	-1.605	1038
1991	8.990	1.282	1.232	0.249	1	0.984	1.169	6951
1992	0.170	0.093	-2.736	-2.371	1	-0.365	-0.433	506
1993	0.450	0.153	-1.762	-1.878	1	0.116	0.138	828
1994	0.420	0.148	-1.831	-1.912	1	0.081	0.096	801
1995	2.220	0.767	-0.166	-0.266	1	0.100	0.118	4155
1996	5.040	1.409	0.654	0.343	1	0.311	0.369	7638
1997	2.340	1.153	-0.114	0.142	1	-0.256	-0.304	6249
1998	2.570	0.999	-0.020	-0.001	1	-0.019	-0.022	5415
1999	2.210	0.909	-0.171	-0.095	1	-0.075	-0.090	4927
2000	8.910	1.770	1.223	0.571	1	0.653	0.776	9592

Partial Variance: 0.341

Can_Sp
Tuned to: 1-Jan and number
For ages: 5

Year	Obs.	Pred.	Scd. Obs.	Scd. Pred.	Wt.	Wt. Res.	Std. Res.	Pred. Stk. Sze.
1986	0.190	0.199	-2.155	-1.616	1	-0.539	-0.641	588
1987	0.670	0.247	-0.895	-1.399	1	0.504	0.600	731
1988	2.850	0.931	0.553	-0.071	1	0.624	0.742	2757
1989	0.190	0.183	-2.155	-1.699	1	-0.456	-0.542	542
1990	3.360	0.964	0.718	-0.037	1	0.755	0.897	2853
1991	0.110	0.234	-2.702	-1.451	1	-1.251	-1.487	694
1992	3.820	1.265	0.846	0.235	1	0.611	0.726	3746
1993	0.040	0.100	-3.713	-2.306	1	-1.407	-1.672	295
1994	0.240	0.138	-1.921	-1.983	1	0.061	0.073	408
1995	0.560	0.169	-1.074	-1.775	1	0.701	0.833	502
1996	2.920	1.009	0.577	0.009	1	0.568	0.675	2988
1997	2.370	1.823	0.369	0.601	1	-0.232	-0.276	5398
1998	3.760	1.490	0.830	0.399	1	0.431	0.512	4413
1999	1.400	1.344	-0.158	0.296	1	-0.454	-0.539	3980
2000	2.110	1.185	0.252	0.169	1	0.083	0.099	3507

Partial Variance: 0.502

Can_Sp
Tuned to: 1-Jan and number
For ages: 6

Year	Obs.	Pred.	Scd. Obs.	Scd. Pred.	Wt.	Wt. Res.	Std. Res.	Pred. Stk. Sze.
1986	0.290	0.294	-1.071	-1.223	1	0.153	0.181	630
1987	0.080	0.163	-2.358	-1.813	1	-0.546	-0.648	350
1988	0.180	0.228	-1.548	-1.480	1	-0.068	-0.081	488
1989	0.420	0.661	-0.700	-0.415	1	-0.286	-0.339	1415
1990	0.230	0.147	-1.302	-1.920	1	0.618	0.734	314
1991	1.600	0.724	0.637	-0.323	1	0.960	1.141	1551
1992	0.030	0.222	-3.339	-1.504	1	-1.835	-2.181	476
1993	1.280	0.787	0.414	-0.240	1	0.654	0.777	1686
1994	0.020	0.069	-3.745	-2.676	1	-1.069	-1.270	147
1995	0.030	0.128	-3.339	-2.055	1	-1.284	-1.526	274

1996	0.260	0.166	-1.180	-1.793	1	0.613	0.729	357
1997	1.700	0.946	0.698	-0.055	1	0.753	0.895	2027
1998	3.670	1.824	1.467	0.601	1	0.867	1.030	3906
1999	1.350	1.394	0.467	0.333	1	0.135	0.160	2987
2000	1.550	1.311	0.605	0.271	1	0.335	0.398	2808

Partial Variance: 0.737

Can_Sp
Tuned to: 1-Jan and number
For ages: 7

Year	Obs.	Pred.	Scd. Obs.	Scd. Pred.	Wt.	Wt. Res.	Std. Res.	Pred. Stk. Sze.
1986	0.340	0.571	-0.686	-0.560	1	-0.126	-0.149	612
1987	0.300	0.336	-0.811	-1.092	1	0.281	0.334	360
1988	0.170	0.205	-1.379	-1.583	1	0.204	0.242	220
1989	0.030	0.247	-3.114	-1.399	1	-1.715	-2.038	265
1990	1.090	0.779	0.479	-0.250	1	0.729	0.867	835
1991	0.090	0.157	-2.015	-1.850	1	-0.164	-0.195	168
1992	1.060	0.839	0.451	-0.176	1	0.627	0.746	899
1993	0.020	0.270	-3.519	-1.310	1	-2.209	-2.626	289
1994	0.700	0.731	0.036	-0.313	1	0.349	0.415	784
1995	0.000	0.000	0	0	1	0.000	0.000	00
1996	0.240	0.183	-1.034	-1.698	1	0.664	0.789	196
1997	0.230	0.215	-1.077	-1.538	1	0.461	0.548	230
1998	1.980	1.363	1.076	0.309	1	0.767	0.911	1460
1999	1.260	2.541	0.624	0.932	1	-0.308	-0.366	2722
2000	1.940	1.852	1.056	0.616	1	0.440	0.522	1984

Partial Variance: 0.829

Can_Sp
Tuned to: 1-Jan and number
For ages: 8

Year	Obs.	Pred.	Scd. Obs.	Scd. Pred.	Wt.	Wt. Res.	Std. Res.	Pred. Stk. Sze.
1986	0.370	2.140	0.361	0.761	1	-0.400	-0.476	1134
1987	0.100	0.689	-0.948	-0.372	1	-0.576	-0.685	365
1988	0.110	0.404	-0.852	-0.907	1	0.055	0.065	214
1989	0.030	0.246	-2.152	-1.402	1	-0.750	-0.892	130
1990	0.130	0.330	-0.685	-1.108	1	0.422	0.502	175
1991	0.440	0.987	0.534	-0.013	1	0.546	0.649	523
1992	0.040	0.136	-1.864	-1.998	1	0.134	0.159	72
1993	0.320	0.837	0.215	-0.178	1	0.393	0.468	443
1994	0.010	0.382	-3.250	-0.962	1	-2.288	-2.719	202
1995	0.480	0.954	0.621	-0.048	1	0.668	0.794	505
1996	0.040	0.076	-1.864	-2.582	1	0.718	0.853	40
1997	0.090	0.266	-1.053	-1.325	1	0.272	0.323	141
1998	0.240	0.323	-0.072	-1.131	1	1.059	1.258	171
1999	0.330	2.003	0.246	0.695	1	-0.448	-0.533	1061
2000	1.140	3.634	1.486	1.290	1	0.195	0.232	1926

Partial Variance: 0.68

Partial variance (and proportion of total) by index

Index	Partial Variance	Proportion
US_Sp 1	0.87	0.039
US_Sp 2	0.504	0.023
US_Sp 3	0.498	0.023
US_Sp 4	0.3	0.014
US_Sp 5	0.404	0.018
US_Sp 6	1.024	0.046
US_Sp 7	0.785	0.035
US_Sp 8	1.075	0.049
US_S41 1	2.432	0.11
US_S41 2	1.127	0.051
US_S41 3	0.81	0.037
US_S41 4	0.382	0.017
US_S41 5	0.319	0.014
US_S41 6	0.465	0.021
US_S41 7	0.837	0.038
US_S41 8	0.529	0.024
US_Au0 1	0.909	0.041
US_Au1 2	0.916	0.041
US_Au2 3	0.728	0.033
US_Au3 4	0.36	0.016
US_Au4 5	0.467	0.021
US_Au5 6	0.676	0.031
Can_Sp 1	1.162	0.052
Can_Sp 2	1.121	0.051
Can_Sp 3	0.345	0.016
Can_Sp 4	0.341	0.015
Can_Sp 5	0.502	0.023
Can_Sp 6	0.737	0.033
Can_Sp 7	0.829	0.037
Can_Sp 8	0.68	0.031

Standardized residuals by index and year; with row/column/grand means

	1963	1964	1965	1966	1967	1968	1969
US_Sp1	0.000	0.000	0.000	0.000	0.000	2.388	0.000
US_Sp2	0.000	0.000	0.000	0.000	0.000	0.405	-0.020
US_Sp3	0.000	0.000	0.000	0.000	0.000	-0.283	-0.843
US_Sp4	0.000	0.000	0.000	0.000	0.000	-0.466	-0.283
US_Sp5	0.000	0.000	0.000	0.000	0.000	-0.315	-0.189
US_Sp6	0.000	0.000	0.000	0.000	0.000	-0.158	0.340
US_Sp7	0.000	0.000	0.000	0.000	0.000	-0.125	0.079
US_Sp8	0.000	0.000	0.000	0.000	0.000	0.604	0.688
US_S411	0.000	0.000	0.000	0.000	0.000	0.000	0.000
US_S412	0.000	0.000	0.000	0.000	0.000	0.000	0.000
US_S413	0.000	0.000	0.000	0.000	0.000	0.000	0.000
US_S414	0.000	0.000	0.000	0.000	0.000	0.000	0.000
US_S415	0.000	0.000	0.000	0.000	0.000	0.000	0.000
US_S416	0.000	0.000	0.000	0.000	0.000	0.000	0.000
US_S417	0.000	0.000	0.000	0.000	0.000	0.000	0.000
US_S418	0.000	0.000	0.000	0.000	0.000	0.000	0.000
US_Au01	0.000	0.251	-0.833	-0.710	1.415	-0.847	-0.553
US_Au12	0.000	-0.436	0.269	0.994	0.233	1.283	-0.360
US_Au23	0.000	0.874	1.285	0.849	0.608	-0.381	-0.051
US_Au34	0.000	0.579	0.780	-0.104	0.303	0.027	-0.952
US_Au45	0.000	0.682	-0.180	-0.139	-0.257	0.066	-0.111
US_Au56	0.000	0.878	0.488	-0.300	-0.096	-0.140	0.289
Can_Sp1	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Can_Sp2	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Can_Sp3	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Can_Sp4	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Can_Sp5	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Can_Sp6	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Can_Sp7	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Can_Sp8	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Col Avg	0.000	0.471	0.302	0.098	0.368	0.147	-0.151

	1970	1971	1972	1973	1974	1975	1976
US_Sp1	0.146	0.000	1.559	0.000	0.000	0.000	0.000
US_Sp2	0.459	0.450	0.416	0.000	0.000	0.000	0.000
US_Sp3	0.000	0.881	0.430	0.000	0.000	0.000	0.000
US_Sp4	-0.685	0.000	1.062	0.000	0.000	0.000	0.000
US_Sp5	1.111	-1.399	-0.028	0.000	0.000	0.000	0.000
US_Sp6	0.958	0.421	-1.914	0.000	0.000	0.000	0.000
US_Sp7	0.288	-0.428	1.845	0.000	0.000	0.000	0.000
US_Sp8	0.402	-0.444	-1.136	0.000	0.000	0.000	0.000
US_S411	0.000	0.000	0.000	2.308	-0.136	-0.729	1.473
US_S412	0.000	0.000	0.000	1.096	1.480	-1.087	-2.074
US_S413	0.000	0.000	0.000	0.000	1.380	0.769	-1.065
US_S414	0.000	0.000	0.000	0.753	0.000	-0.010	-0.206
US_S415	0.000	0.000	0.000	1.255	0.483	0.000	-0.131
US_S416	0.000	0.000	0.000	0.000	0.000	0.242	0.000
US_S417	0.000	0.000	0.000	-0.497	-0.291	2.499	-1.061
US_S418	0.000	0.000	0.000	-0.576	-0.596	0.247	0.000
US_Au01	-0.653	-0.206	0.812	1.047	0.898	-0.467	0.542
US_Au12	-2.218	1.809	0.000	0.517	1.214	-0.173	-1.003
US_Au23	0.000	0.866	-0.162	0.000	0.952	-0.421	-0.601
US_Au34	-0.797	-1.246	0.566	0.973	0.000	-0.580	2.033
US_Au45	0.019	-0.006	-0.487	1.864	0.846	0.000	1.396
US_Au56	-0.211	1.434	0.189	0.000	2.183	-1.802	0.000
Can_Sp1	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Can_Sp2	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Can_Sp3	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Can_Sp4	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Can_Sp5	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Can_Sp6	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Can_Sp7	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Can_Sp8	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Col Avg	-0.098	0.178	0.242	0.874	0.765	-0.126	-0.063

	1977	1978	1979	1980	1981	1982	1983
US_Sp1	0.000	0.000	0.000	0.000	0.000	1.046	0.101
US_Sp2	0.000	0.000	0.000	0.000	0.000	0.245	0.301
US_Sp3	0.000	0.000	0.000	0.000	0.000	-0.290	-0.484
US_Sp4	0.000	0.000	0.000	0.000	0.000	0.398	-1.224
US_Sp5	0.000	0.000	0.000	0.000	0.000	0.059	0.388
US_Sp6	0.000	0.000	0.000	0.000	0.000	-0.364	-3.498
US_Sp7	0.000	0.000	0.000	0.000	0.000	-0.392	-1.976
US_Sp8	0.000	0.000	0.000	0.000	0.000	0.000	0.651
US_S411	-1.943	-3.539	0.762	0.971	0.833	0.000	0.000
US_S412	0.403	-1.413	0.143	1.046	0.407	0.000	0.000
US_S413	-1.145	0.298	-0.717	-0.771	1.250	0.000	0.000
US_S414	0.053	-1.123	-0.331	-0.366	1.230	0.000	0.000
US_S415	-0.290	0.073	-0.996	-0.029	-0.364	0.000	0.000
US_S416	0.417	0.677	-1.450	0.450	-0.336	0.000	0.000
US_S417	0.000	-0.374	0.163	-0.200	-0.238	0.000	0.000
US_S418	-0.484	1.118	-0.745	1.442	-0.406	0.000	0.000
US_Au01	0.922	-2.226	0.106	-0.120	2.874	0.070	1.317
US_Au12	1.377	-0.276	-0.406	1.214	0.375	1.746	0.000
US_Au23	-0.631	0.747	-0.561	-3.642	0.999	0.854	0.699
US_Au34	-0.662	-0.332	0.507	-0.271	-0.384	0.356	-0.627
US_Au45	0.698	0.105	-1.077	0.297	-1.437	-0.405	0.116
US_Au56	0.457	0.904	-0.359	-0.161	0.139	0.163	-0.355
Can_Sp1	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Can_Sp2	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Can_Sp3	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Can_Sp4	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Can_Sp5	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Can_Sp6	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Can_Sp7	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Can_Sp8	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Col Avg	-0.064	-0.383	-0.354	-0.010	0.353	0.268	-0.353

	1984	1985	1986	1987	1988	1989	1990
US_Sp1	-0.058	0.000	0.337	0.000	-0.378	-2.298	1.116
US_Sp2	0.939	0.608	-0.620	0.421	-2.619	0.226	0.000
US_Sp3	0.760	0.597	-0.058	-1.744	-0.748	0.429	1.072
US_Sp4	0.222	0.788	-0.056	-0.404	-0.379	-0.388	0.433
US_Sp5	0.474	1.265	-0.270	-0.906	-0.837	0.115	-0.171
US_Sp6	-0.027	0.741	0.716	0.535	0.355	0.550	0.055
US_Sp7	-0.507	1.441	0.122	-0.286	1.234	0.295	-0.152
US_Sp8	-1.826	0.503	0.279	1.143	1.059	0.606	0.000
US_S411	0.000	0.000	0.000	0.000	0.000	0.000	0.000
US_S412	0.000	0.000	0.000	0.000	0.000	0.000	0.000
US_S413	0.000	0.000	0.000	0.000	0.000	0.000	0.000
US_S414	0.000	0.000	0.000	0.000	0.000	0.000	0.000
US_S415	0.000	0.000	0.000	0.000	0.000	0.000	0.000
US_S416	0.000	0.000	0.000	0.000	0.000	0.000	0.000
US_S417	0.000	0.000	0.000	0.000	0.000	0.000	0.000
US_S418	0.000	0.000	0.000	0.000	0.000	0.000	0.000
US_Au01	1.006	-2.545	1.992	0.000	-0.349	-0.957	0.243
US_Au12	-1.111	-0.018	0.756	0.682	0.000	-0.096	-1.738
US_Au23	-0.372	0.971	-0.210	-1.062	-0.816	-0.459	0.383
US_Au34	-0.723	0.243	-0.089	0.143	-0.621	0.401	-0.111
US_Au45	0.055	0.303	-0.834	-0.875	0.580	0.305	0.364
US_Au56	0.346	-1.271	-0.108	0.905	-0.411	0.578	0.597
Can_Sp1	0.000	0.000	0.460	-3.058	-0.899	-2.274	0.751
Can_Sp2	0.000	0.000	-0.925	-0.329	-2.897	0.188	-1.176
Can_Sp3	0.000	0.000	0.198	0.133	0.786	-0.037	0.695
Can_Sp4	0.000	0.000	0.789	0.009	-0.991	-0.019	-1.605
Can_Sp5	0.000	0.000	-0.641	0.600	0.742	-0.542	0.897
Can_Sp6	0.000	0.000	0.181	-0.648	-0.081	-0.339	0.734
Can_Sp7	0.000	0.000	-0.149	0.334	0.242	-2.038	0.867
Can_Sp8	0.000	0.000	-0.476	-0.685	0.065	-0.892	0.502
Col Avg	-0.059	0.279	0.063	-0.255	-0.332	-0.302	0.188

	1991	1992	1993	1994	1995	1996	1997
US_Sp1	0.690	-1.289	-0.602	-0.971	-1.156	-0.176	-0.386
US_Sp2	1.016	-0.974	-1.072	0.024	-0.608	1.117	-0.608
US_Sp3	0.442	-1.247	-0.662	-0.374	0.011	1.828	0.883
US_Sp4	0.221	-0.557	-0.319	-0.211	-0.004	1.338	1.158
US_Sp5	-0.705	-1.164	0.654	0.074	0.403	1.566	0.548
US_Sp6	-1.236	-1.263	0.220	1.063	0.977	1.997	1.043
US_Sp7	-0.474	-1.982	0.189	0.133	1.218	0.883	1.342
US_Sp8	-1.310	0.708	-1.937	-1.339	0.506	2.491	0.922
US_S411	0.000	0.000	0.000	0.000	0.000	0.000	0.000
US_S412	0.000	0.000	0.000	0.000	0.000	0.000	0.000
US_S413	0.000	0.000	0.000	0.000	0.000	0.000	0.000
US_S414	0.000	0.000	0.000	0.000	0.000	0.000	0.000
US_S415	0.000	0.000	0.000	0.000	0.000	0.000	0.000
US_S416	0.000	0.000	0.000	0.000	0.000	0.000	0.000
US_S417	0.000	0.000	0.000	0.000	0.000	0.000	0.000
US_S418	0.000	0.000	0.000	0.000	0.000	0.000	0.000
US_Au01	0.965	0.565	0.308	-0.199	-0.595	0.553	-0.907
US_Au12	0.314	-0.968	0.161	0.362	-1.364	1.492	-1.508
US_Au23	-2.064	-0.130	-0.170	0.652	-1.042	1.327	-0.446
US_Au34	-0.234	-0.906	0.392	0.711	-0.309	0.447	-0.269
US_Au45	-1.049	-1.266	0.000	0.000	0.433	-0.366	-0.761
US_Au56	-0.532	-1.923	0.562	0.959	-0.061	-1.961	-1.074
Can_Sp1	0.622	0.761	0.389	0.422	-0.005	1.419	-0.881
Can_Sp2	1.002	1.807	-0.188	1.212	-0.305	0.023	-1.002
Can_Sp3	-1.224	0.496	-0.360	0.268	-0.281	0.085	-1.592
Can_Sp4	1.169	-0.433	0.138	0.096	0.118	0.369	-0.304
Can_Sp5	-1.487	0.726	-1.672	0.073	0.833	0.675	-0.276
Can_Sp6	1.141	-2.181	0.777	-1.270	-1.526	0.729	0.895
Can_Sp7	-0.195	0.746	-2.626	0.415	0.000	0.789	0.548
Can_Sp8	0.649	0.159	0.468	-2.719	0.794	0.853	0.323
Col Avg	-0.104	-0.469	-0.255	-0.029	-0.093	0.794	-0.107

	1998	1999	2000
US_Sp1	-0.661	0.593	0.000
US_Sp2	-0.154	0.049	0.000
US_Sp3	-0.212	-0.387	0.000
US_Sp4	-0.145	-0.496	0.000
US_Sp5	-0.228	-0.445	0.000
US_Sp6	-1.427	-0.085	0.000
US_Sp7	-1.727	-1.020	0.000
US_Sp8	-2.339	-0.233	0.000
US_S411	0.000	0.000	0.000
US_S412	0.000	0.000	0.000
US_S413	0.000	0.000	0.000
US_S414	0.000	0.000	0.000
US_S415	0.000	0.000	0.000
US_S416	0.000	0.000	0.000
US_S417	0.000	0.000	0.000
US_S418	0.000	0.000	0.000
US_Au01	-1.921	-0.579	-1.216
US_Au12	-0.517	0.278	-2.885
US_Au23	0.182	-0.015	0.990
US_Au34	-0.486	-0.416	1.656
US_Au45	-0.384	-0.599	2.101
US_Au56	-0.873	-1.286	1.854
Can_Sp1	0.157	0.919	1.216
Can_Sp2	0.514	0.124	1.952
Can_Sp3	-0.163	0.022	0.974
Can_Sp4	-0.022	-0.090	0.776
Can_Sp5	0.512	-0.539	0.099
Can_Sp6	1.030	0.160	0.398
Can_Sp7	0.911	-0.366	0.522
Can_Sp8	1.258	-0.533	0.232
Col Avg	-0.304	-0.225	0.619

Percent of total sum of squares by index and year; with row/column sums

	1963	1964	1965	1966	1967	1968	1969
US_Sp1	0.000	0.000	0.000	0.000	0.000	1.076	0.000
US_Sp2	0.000	0.000	0.000	0.000	0.000	0.031	0.000
US_Sp3	0.000	0.000	0.000	0.000	0.000	0.015	0.134
US_Sp4	0.000	0.000	0.000	0.000	0.000	0.041	0.015
US_Sp5	0.000	0.000	0.000	0.000	0.000	0.019	0.007
US_Sp6	0.000	0.000	0.000	0.000	0.000	0.005	0.022
US_Sp7	0.000	0.000	0.000	0.000	0.000	0.003	0.001
US_Sp8	0.000	0.000	0.000	0.000	0.000	0.069	0.089
US_S411	0.000	0.000	0.000	0.000	0.000	0.000	0.000
US_S412	0.000	0.000	0.000	0.000	0.000	0.000	0.000
US_S413	0.000	0.000	0.000	0.000	0.000	0.000	0.000
US_S414	0.000	0.000	0.000	0.000	0.000	0.000	0.000
US_S415	0.000	0.000	0.000	0.000	0.000	0.000	0.000
US_S416	0.000	0.000	0.000	0.000	0.000	0.000	0.000
US_S417	0.000	0.000	0.000	0.000	0.000	0.000	0.000
US_S418	0.000	0.000	0.000	0.000	0.000	0.000	0.000
US_Au01	0.000	0.012	0.131	0.095	0.378	0.135	0.058
US_Au12	0.000	0.036	0.014	0.186	0.010	0.311	0.024
US_Au23	0.000	0.144	0.311	0.136	0.070	0.027	0.000
US_Au34	0.000	0.063	0.115	0.002	0.017	0.000	0.171
US_Au45	0.000	0.088	0.006	0.004	0.012	0.001	0.002
US_Au56	0.000	0.145	0.045	0.017	0.002	0.004	0.016
Can_Sp1	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Can_Sp2	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Can_Sp3	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Can_Sp4	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Can_Sp5	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Can_Sp6	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Can_Sp7	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Can_Sp8	0.000	0.000	0.000	0.000	0.000	0.000	0.000
++	0.000	0.488	0.622	0.440	0.489	1.736	0.540

	1970	1971	1972	1973	1974	1975	1976
US_Sp1	0.004	0.000	0.458	0.000	0.000	0.000	0.000
US_Sp2	0.040	0.038	0.033	0.000	0.000	0.000	0.000
US_Sp3	0.000	0.146	0.035	0.000	0.000	0.000	0.000
US_Sp4	0.088	0.000	0.213	0.000	0.000	0.000	0.000
US_Sp5	0.233	0.369	0.000	0.000	0.000	0.000	0.000
US_Sp6	0.173	0.033	0.691	0.000	0.000	0.000	0.000
US_Sp7	0.016	0.035	0.642	0.000	0.000	0.000	0.000
US_Sp8	0.031	0.037	0.243	0.000	0.000	0.000	0.000
US_S411	0.000	0.000	0.000	1.005	0.004	0.100	0.409
US_S412	0.000	0.000	0.000	0.227	0.413	0.223	0.812
US_S413	0.000	0.000	0.000	0.000	0.359	0.112	0.214
US_S414	0.000	0.000	0.000	0.107	0.000	0.000	0.008
US_S415	0.000	0.000	0.000	0.297	0.044	0.000	0.003
US_S416	0.000	0.000	0.000	0.000	0.000	0.011	0.000
US_S417	0.000	0.000	0.000	0.047	0.016	1.178	0.212
US_S418	0.000	0.000	0.000	0.063	0.067	0.011	0.000
US_Au01	0.081	0.008	0.124	0.207	0.152	0.041	0.055
US_Au12	0.928	0.618	0.000	0.050	0.278	0.006	0.190
US_Au23	0.000	0.142	0.005	0.000	0.171	0.033	0.068
US_Au34	0.120	0.293	0.060	0.179	0.000	0.063	0.780
US_Au45	0.000	0.000	0.045	0.656	0.135	0.000	0.368
US_Au56	0.008	0.388	0.007	0.000	0.899	0.613	0.000
Can_Sp1	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Can_Sp2	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Can_Sp3	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Can_Sp4	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Can_Sp5	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Can_Sp6	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Can_Sp7	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Can_Sp8	0.000	0.000	0.000	0.000	0.000	0.000	0.000
++	1.721	2.107	2.557	2.837	2.538	2.392	3.119

	1977	1978	1979	1980	1981	1982	1983
US_Sp1	0.000	0.000	0.000	0.000	0.000	0.206	0.002
US_Sp2	0.000	0.000	0.000	0.000	0.000	0.011	0.017
US_Sp3	0.000	0.000	0.000	0.000	0.000	0.016	0.044
US_Sp4	0.000	0.000	0.000	0.000	0.000	0.030	0.283
US_Sp5	0.000	0.000	0.000	0.000	0.000	0.001	0.028
US_Sp6	0.000	0.000	0.000	0.000	0.000	0.025	2.309
US_Sp7	0.000	0.000	0.000	0.000	0.000	0.029	0.737
US_Sp8	0.000	0.000	0.000	0.000	0.000	0.000	0.080
US_S411	0.712	2.364	0.110	0.178	0.131	0.000	0.000
US_S412	0.031	0.377	0.004	0.206	0.031	0.000	0.000
US_S413	0.247	0.017	0.097	0.112	0.295	0.000	0.000
US_S414	0.001	0.238	0.021	0.025	0.285	0.000	0.000
US_S415	0.016	0.001	0.187	0.000	0.025	0.000	0.000
US_S416	0.033	0.087	0.397	0.038	0.021	0.000	0.000
US_S417	0.000	0.026	0.005	0.008	0.011	0.000	0.000
US_S418	0.044	0.236	0.105	0.393	0.031	0.000	0.000
US_Au01	0.160	0.935	0.002	0.003	1.558	0.001	0.327
US_Au12	0.358	0.014	0.031	0.278	0.027	0.575	0.000
US_Au23	0.075	0.105	0.059	2.503	0.188	0.137	0.092
US_Au34	0.083	0.021	0.048	0.014	0.028	0.024	0.074
US_Au45	0.092	0.002	0.219	0.017	0.390	0.031	0.003
US_Au56	0.039	0.154	0.024	0.005	0.004	0.005	0.024
Can_Sp1	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Can_Sp2	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Can_Sp3	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Can_Sp4	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Can_Sp5	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Can_Sp6	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Can_Sp7	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Can_Sp8	0.000	0.000	0.000	0.000	0.000	0.000	0.000
++	1.891	4.577	1.308	3.779	3.024	1.092	4.021

	1984	1985	1986	1987	1988	1989	1990
US_Sp1	0.001	0.000	0.021	0.000	0.027	0.996	0.235
US_Sp2	0.166	0.070	0.073	0.033	1.294	0.010	0.000
US_Sp3	0.109	0.067	0.001	0.574	0.106	0.035	0.217
US_Sp4	0.009	0.117	0.001	0.031	0.027	0.028	0.035
US_Sp5	0.042	0.302	0.014	0.155	0.132	0.002	0.005
US_Sp6	0.000	0.104	0.097	0.054	0.024	0.057	0.001
US_Sp7	0.048	0.392	0.003	0.015	0.287	0.016	0.004
US_Sp8	0.629	0.048	0.015	0.247	0.212	0.069	0.000
US_S411	0.000	0.000	0.000	0.000	0.000	0.000	0.000
US_S412	0.000	0.000	0.000	0.000	0.000	0.000	0.000
US_S413	0.000	0.000	0.000	0.000	0.000	0.000	0.000
US_S414	0.000	0.000	0.000	0.000	0.000	0.000	0.000
US_S415	0.000	0.000	0.000	0.000	0.000	0.000	0.000
US_S416	0.000	0.000	0.000	0.000	0.000	0.000	0.000
US_S417	0.000	0.000	0.000	0.000	0.000	0.000	0.000
US_S418	0.000	0.000	0.000	0.000	0.000	0.000	0.000
US_Au01	0.191	1.222	0.748	0.000	0.023	0.173	0.011
US_Au12	0.233	0.000	0.108	0.088	0.000	0.002	0.570
US_Au23	0.026	0.178	0.008	0.213	0.126	0.040	0.028
US_Au34	0.099	0.011	0.002	0.004	0.073	0.030	0.002
US_Au45	0.001	0.017	0.131	0.144	0.063	0.018	0.025
US_Au56	0.023	0.305	0.002	0.154	0.032	0.063	0.067
Can_Sp1	0.000	0.000	0.040	1.764	0.153	0.976	0.106
Can_Sp2	0.000	0.000	0.161	0.020	1.583	0.007	0.261
Can_Sp3	0.000	0.000	0.007	0.003	0.117	0.000	0.091
Can_Sp4	0.000	0.000	0.118	0.000	0.185	0.000	0.486
Can_Sp5	0.000	0.000	0.077	0.068	0.104	0.055	0.152
Can_Sp6	0.000	0.000	0.006	0.079	0.001	0.022	0.102
Can_Sp7	0.000	0.000	0.004	0.021	0.011	0.784	0.142
Can_Sp8	0.000	0.000	0.043	0.088	0.001	0.150	0.048
++	1.577	2.832	1.680	3.757	4.580	3.533	2.589

	1991	1992	1993	1994	1995	1996	1997
US_Sp1	0.090	0.313	0.068	0.178	0.252	0.006	0.028
US_Sp2	0.195	0.179	0.217	0.000	0.070	0.235	0.070
US_Sp3	0.037	0.294	0.083	0.026	0.000	0.631	0.147
US_Sp4	0.009	0.059	0.019	0.008	0.000	0.338	0.253
US_Sp5	0.094	0.256	0.081	0.001	0.031	0.463	0.057
US_Sp6	0.288	0.301	0.009	0.213	0.180	0.752	0.205
US_Sp7	0.042	0.741	0.007	0.003	0.280	0.147	0.340
US_Sp8	0.324	0.095	0.708	0.338	0.048	1.170	0.160
US_S411	0.000	0.000	0.000	0.000	0.000	0.000	0.000
US_S412	0.000	0.000	0.000	0.000	0.000	0.000	0.000
US_S413	0.000	0.000	0.000	0.000	0.000	0.000	0.000
US_S414	0.000	0.000	0.000	0.000	0.000	0.000	0.000
US_S415	0.000	0.000	0.000	0.000	0.000	0.000	0.000
US_S416	0.000	0.000	0.000	0.000	0.000	0.000	0.000
US_S417	0.000	0.000	0.000	0.000	0.000	0.000	0.000
US_S418	0.000	0.000	0.000	0.000	0.000	0.000	0.000
US_Au01	0.176	0.060	0.018	0.007	0.067	0.058	0.155
US_Au12	0.019	0.177	0.005	0.025	0.351	0.420	0.429
US_Au23	0.804	0.003	0.005	0.080	0.205	0.332	0.037
US_Au34	0.010	0.155	0.029	0.095	0.018	0.038	0.014
US_Au45	0.208	0.302	0.000	0.000	0.035	0.025	0.109
US_Au56	0.053	0.697	0.060	0.173	0.001	0.725	0.218
Can_Sp1	0.073	0.109	0.029	0.034	0.000	0.380	0.146
Can_Sp2	0.189	0.616	0.007	0.277	0.018	0.000	0.189
Can_Sp3	0.282	0.046	0.024	0.014	0.015	0.001	0.478
Can_Sp4	0.258	0.035	0.004	0.002	0.003	0.026	0.017
Can_Sp5	0.417	0.099	0.528	0.001	0.131	0.086	0.014
Can_Sp6	0.246	0.897	0.114	0.304	0.440	0.100	0.151
Can_Sp7	0.007	0.105	1.301	0.033	0.000	0.117	0.057
Can_Sp8	0.080	0.005	0.041	1.395	0.119	0.137	0.020
++	3.900	5.545	3.355	3.209	2.262	6.188	3.296

	1998	1999	2000	++
US_Sp1	0.082	0.066	0.000	4.111
US_Sp2	0.004	0.000	0.000	2.786
US_Sp3	0.008	0.028	0.000	2.753
US_Sp4	0.004	0.046	0.000	1.655
US_Sp5	0.010	0.037	0.000	2.338
US_Sp6	0.384	0.001	0.000	5.929
US_Sp7	0.563	0.196	0.000	4.549
US_Sp8	1.032	0.010	0.000	5.654
US_S411	0.000	0.000	0.000	5.013
US_S412	0.000	0.000	0.000	2.323
US_S413	0.000	0.000	0.000	1.453
US_S414	0.000	0.000	0.000	0.685
US_S415	0.000	0.000	0.000	0.573
US_S416	0.000	0.000	0.000	0.587
US_S417	0.000	0.000	0.000	1.503
US_S418	0.000	0.000	0.000	0.950
US_Au01	0.696	0.063	0.279	8.411
US_Au12	0.050	0.015	1.571	7.994
US_Au23	0.006	0.000	0.185	6.545
US_Au34	0.045	0.033	0.518	3.329
US_Au45	0.028	0.068	0.833	4.076
US_Au56	0.144	0.312	0.648	6.077
Can_Sp1	0.005	0.159	0.279	4.252
Can_Sp2	0.050	0.003	0.719	4.101
Can_Sp3	0.005	0.000	0.179	1.264
Can_Sp4	0.000	0.002	0.114	1.249
Can_Sp5	0.050	0.055	0.002	1.839
Can_Sp6	0.200	0.005	0.030	2.697
Can_Sp7	0.157	0.025	0.051	2.815
Can_Sp8	0.299	0.054	0.010	2.489
++	3.822	1.179	5.418	100.000

STOCK NUMBERS (Jan 1) in thousands - C:\2000 Projects\2000 Haddock Assessment\2000_VPA_Run11_baserun.8

	1963	1964	1965	1966	1967	1968	1969
1	190706	471885	33154	4137	12954	422	988
2	32266	153504	377207	18457	3284	9565	338
3	32743	22756	111260	194986	8920	2536	5122
4	45821	20096	14510	50830	68425	4687	1435
5	29031	27424	12131	7034	24273	37321	2099
6	9186	16351	14561	5959	3254	10519	17419
7	5595	5526	8144	5868	2535	1570	5446
8	2795	3309	2640	3255	2694	1177	682
9	4217	4251	3258	2201	2031	2163	1712
1+	352360	725101	576867	292727	128369	69961	35241

	1970	1971	1972	1973	1974	1975	1976
1	4661	369	8517	19418	10547	7661	103305
2	807	3774	301	6832	13582	8594	6098
3	267	518	1846	245	3716	7211	6100
4	2657	204	222	1104	198	2448	4217
5	770	1660	131	109	555	160	1665
6	1127	462	1097	78	41	391	127
7	8874	729	156	790	37	32	282
8	3035	5177	339	57	577	28	22
9	1875	3245	6311	1679	2702	622	623
1+	24071	16137	18919	30311	31954	27146	122441

	1977	1978	1979	1980	1981	1982	1983
1	13810	6073	83984	10137	7225	2480	3108
2	84449	11306	4971	68760	8292	5915	2029
3	4565	51420	8568	4046	28246	5212	3788
4	4497	3568	29074	5453	2999	13174	2789
5	2657	3066	2645	17317	3582	1703	7408
6	1168	1709	1997	1691	8700	2085	1041
7	104	633	931	1264	847	4796	1192
8	210	82	392	478	541	394	2914
9	594	390	187	251	319	406	275
1+	112054	78246	132750	109396	60751	36164	24545

	1984	1985	1986	1987	1988	1989	1990
1	17265	1761	14746	2103	16757	1087	2644
2	2544	14136	1442	12068	1722	13716	890
3	1468	1999	9396	1131	8075	1363	10087
4	2366	933	1139	5150	810	4454	1038
5	1659	1279	588	731	2757	542	2853
6	4039	999	630	350	488	1415	314
7	606	1966	612	360	220	265	835
8	808	284	1134	365	214	130	175
9	1628	550	254	461	351	208	166
1+	32384	23908	29941	22719	31393	23180	19002

	1991	1992	1993	1994	1995	1996	1997
1	2377	9306	15272	12448	10425	9908	19530
2	2163	1940	7613	12497	10190	8527	8107
3	719	1365	1365	5970	9989	8262	6933
4	6951	506	828	801	4155	7638	6249
5	694	3746	295	408	502	2988	5398
6	1551	476	1686	147	274	357	2027
7	168	899	289	784	58	196	230
8	523	72	443	202	505	40	141
9	243	247	210	198	160	58	356
1+	15388	18558	28001	33456	36258	37974	48971

	1998	1999	2000
1	11294	48760	35243
2	15963	9245	39921
3	6477	12890	7534
4	5415	4927	9592
5	4413	3980	3507
6	3906	2987	2808
7	1460	2722	1984
8	171	1061	1926
9	331	303	951
1+	49430	86877	103466

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	1963	1964	1965	1966	1967	1968	1969
1	0.02	0.02	0.39	0.03	0.10	0.02	0.00
2	0.15	0.12	0.46	0.53	0.06	0.42	0.04
3	0.29	0.25	0.58	0.85	0.44	0.37	0.46
4	0.31	0.30	0.52	0.54	0.41	0.60	0.42
5	0.37	0.43	0.51	0.57	0.64	0.56	0.42
6	0.31	0.50	0.71	0.65	0.53	0.46	0.47
7	0.33	0.54	0.72	0.58	0.57	0.63	0.38
8	0.34	0.42	0.61	0.56	0.47	0.55	0.45
9	0.34	0.42	0.61	0.56	0.47	0.55	0.45

	1970	1971	1972	1973	1974	1975	1976
1	0.01	0.00	0.02	0.16	0.00	0.03	0.00
2	0.24	0.52	0.01	0.41	0.43	0.14	0.09
3	0.07	0.65	0.31	0.01	0.22	0.34	0.10
4	0.27	0.24	0.52	0.49	0.01	0.19	0.26
5	0.31	0.21	0.31	0.77	0.15	0.03	0.15
6	0.24	0.89	0.13	0.55	0.06	0.13	0.00
7	0.34	0.57	0.81	0.11	0.06	0.15	0.09
8	0.32	0.38	0.24	0.35	0.11	0.17	0.22
9	0.32	0.38	0.24	0.35	0.11	0.17	0.22

	1977	1978	1979	1980	1981	1982	1983
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.30	0.08	0.01	0.69	0.26	0.25	0.12
3	0.05	0.37	0.25	0.10	0.56	0.43	0.27
4	0.18	0.10	0.32	0.22	0.37	0.38	0.32
5	0.24	0.23	0.25	0.49	0.34	0.29	0.41
6	0.41	0.41	0.26	0.49	0.40	0.36	0.34
7	0.04	0.28	0.47	0.65	0.57	0.30	0.19
8	0.23	0.21	0.32	0.44	0.39	0.35	0.36
9	0.23	0.21	0.32	0.44	0.39	0.35	0.36

	1984	1985	1986	1987	1988	1989	1990
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.04	0.21	0.04	0.20	0.03	0.11	0.01
3	0.25	0.36	0.40	0.13	0.39	0.07	0.17
4	0.41	0.26	0.24	0.42	0.20	0.25	0.20
5	0.31	0.51	0.32	0.20	0.47	0.35	0.41
6	0.52	0.29	0.36	0.26	0.41	0.33	0.42
7	0.56	0.35	0.32	0.32	0.32	0.21	0.27
8	0.45	0.36	0.30	0.39	0.40	0.27	0.34
9	0.45	0.36	0.30	0.39	0.40	0.27	0.34

	1991	1992	1993	1994	1995	1996	1997
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.26	0.15	0.04	0.02	0.01	0.01	0.02
3	0.15	0.30	0.33	0.16	0.07	0.08	0.05
4	0.42	0.34	0.51	0.27	0.13	0.15	0.15
5	0.18	0.60	0.49	0.20	0.14	0.19	0.12
6	0.35	0.30	0.57	0.73	0.14	0.24	0.13
7	0.65	0.51	0.16	0.24	0.17	0.13	0.10
8	0.39	0.54	0.50	0.27	0.13	0.16	0.14
9	0.39	0.54	0.50	0.27	0.13	0.16	0.14

	1998	1999
1	0.00	0.00
2	0.01	0.00
3	0.07	0.10
4	0.11	0.14
5	0.19	0.15
6	0.16	0.21
7	0.12	0.15
8	0.15	0.16
9	0.15	0.16

Average F for 4,7

	1963	1964	1965	1966	1967	1968	1969
4,7	0.33	0.44	0.62	0.59	0.53	0.56	0.43

	1970	1971	1972	1973	1974	1975	1976
4,7	0.29	0.48	0.44	0.48	0.07	0.12	0.13

	1977	1978	1979	1980	1981	1982	1983
4,7	0.22	0.25	0.32	0.46	0.42	0.33	0.31

	1984	1985	1986	1987	1988	1989	1990
4,7	0.45	0.35	0.31	0.30	0.35	0.28	0.33

	1991	1992	1993	1994	1995	1996	1997
4,7	0.40	0.44	0.43	0.36	0.14	0.18	0.12

	1998	1999
4,7	0.14	0.16

Average F weighted by N for 4,7

	1963	1964	1965	1966	1967	1968	1969
4,7	0.33	0.42	0.61	0.56	0.47	0.55	0.45

	1970	1971	1972	1973	1974	1975	1976
4,7	0.32	0.40	0.26	0.36	0.11	0.17	0.22

	1977	1978	1979	1980	1981	1982	1983
4,7	0.23	0.21	0.31	0.44	0.39	0.35	0.36

	1984	1985	1986	1987	1988	1989	1990
4,7	0.45	0.36	0.30	0.39	0.40	0.27	0.34

	1991	1992	1993	1994	1995	1996	1997
4,7	0.39	0.54	0.51	0.28	0.13	0.16	0.13

	1998	1999
4,7	0.15	0.16

Average F for weighted by Catch for 4,7

	1963	1964	1965	1966	1967	1968	1969
4,7	0.34	0.43	0.62	0.56	0.49	0.55	0.45

	1970	1971	1972	1973	1974	1975	1976
4,7	0.32	0.52	0.42	0.47	0.14	0.18	0.24

	1977	1978	1979	1980	1981	1982	1983
4,7	0.25	0.27	0.32	0.47	0.39	0.35	0.37

	1984	1985	1986	1987	1988	1989	1990
4,7	0.47	0.38	0.31	0.40	0.43	0.28	0.36

	1991	1992	1993	1994	1995	1996	1997
4,7	0.40	0.55	0.53	0.32	0.13	0.16	0.14

	1998	1999
4,7	0.15	0.16

Biomass Weighted F

1963	1964	1965	1966	1967	1968	1969
0.20	0.15	0.52	0.71	0.44	0.53	0.44

1970	1971	1972	1973	1974	1975	1976
0.29	0.39	0.21	0.27	0.20	0.19	0.06

1977	1978	1979	1980	1981	1982	1983
0.25	0.30	0.19	0.52	0.43	0.34	0.33

1984	1985	1986	1987	1988	1989	1990
0.34	0.29	0.26	0.29	0.27	0.18	0.22

1991	1992	1993	1994	1995	1996	1997
0.34	0.34	0.17	0.10	0.07	0.09	0.08

1998	1999
0.09	0.07

BACKCALCULATED PARTIAL RECRUITMENT

	1963	1964	1965	1966	1967	1968	1969
1	0.05	0.04	0.54	0.04	0.16	0.03	0.00
2	0.40	0.23	0.64	0.62	0.09	0.67	0.08
3	0.77	0.46	0.81	1.00	0.70	0.58	0.96
4	0.84	0.57	0.73	0.64	0.64	0.95	0.89
5	1.00	0.80	0.71	0.67	1.00	0.89	0.89
6	0.82	0.92	0.99	0.77	0.83	0.72	1.00
7	0.87	1.00	1.00	0.68	0.89	1.00	0.81
8	0.90	0.78	0.85	0.66	0.74	0.87	0.96
9	0.90	0.78	0.85	0.66	0.74	0.87	0.96

	1970	1971	1972	1973	1974	1975	1976
1	0.03	0.00	0.03	0.20	0.01	0.08	0.01
2	0.72	0.58	0.01	0.53	1.00	0.42	0.34
3	0.20	0.73	0.39	0.02	0.50	1.00	0.40
4	0.80	0.27	0.64	0.63	0.03	0.55	1.00
5	0.92	0.24	0.39	1.00	0.35	0.08	0.59
6	0.70	1.00	0.16	0.71	0.13	0.38	0.00
7	1.00	0.64	1.00	0.15	0.14	0.45	0.36
8	0.94	0.42	0.30	0.45	0.25	0.50	0.84
9	0.94	0.42	0.30	0.45	0.25	0.50	0.84

	1977	1978	1979	1980	1981	1982	1983
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.72	0.19	0.01	1.00	0.47	0.58	0.30
3	0.11	0.91	0.54	0.14	0.99	1.00	0.67
4	0.44	0.24	0.68	0.32	0.65	0.88	0.79
5	0.58	0.56	0.53	0.71	0.60	0.69	1.00
6	1.00	1.00	0.55	0.71	0.70	0.84	0.84
7	0.10	0.68	1.00	0.94	1.00	0.70	0.47
8	0.56	0.52	0.67	0.63	0.69	0.83	0.89
9	0.56	0.52	0.67	0.63	0.69	0.83	0.89

	1984	1985	1986	1987	1988	1989	1990
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.07	0.41	0.11	0.47	0.07	0.31	0.03
3	0.45	0.71	1.00	0.32	0.85	0.21	0.41
4	0.75	0.51	0.61	1.00	0.43	0.71	0.48
5	0.55	1.00	0.80	0.48	1.00	1.00	0.97
6	0.93	0.57	0.90	0.62	0.88	0.95	1.00
7	1.00	0.69	0.79	0.75	0.69	0.62	0.63
8	0.82	0.71	0.75	0.91	0.86	0.78	0.81
9	0.82	0.71	0.75	0.91	0.86	0.78	0.81

	1991	1992	1993	1994	1995	1996	1997
1	0.00	0.00	0.00	0.00	0.01	0.00	0.01
2	0.40	0.25	0.08	0.03	0.06	0.03	0.17
3	0.23	0.50	0.59	0.22	0.40	0.33	0.32
4	0.64	0.57	0.90	0.37	0.76	0.62	1.00
5	0.27	1.00	0.87	0.27	0.83	0.79	0.83
6	0.53	0.50	1.00	1.00	0.80	1.00	0.86
7	1.00	0.85	0.28	0.33	1.00	0.55	0.66
8	0.60	0.90	0.89	0.37	0.78	0.68	0.91
9	0.60	0.90	0.89	0.37	0.78	0.68	0.91

	1998	1999
1	0.00	0.00
2	0.07	0.02
3	0.39	0.46
4	0.57	0.67
5	1.00	0.71
6	0.85	1.00
7	0.63	0.70
8	0.77	0.77
9	0.77	0.77

MEAN BIOMASS (using catch mean weights at age)

	1963	1964	1965	1966	1967	1968	1969
1	97717	211391	14554	2142	7375	223	465
2	23694	108938	190543	9574	2026	5762	235
3	30570	20524	79454	107563	6249	2031	4131
4	52683	22565	13938	45273	60547	4252	1805
5	37107	33322	14500	8336	23357	41005	2735
6	15484	23667	19034	8292	4737	16183	25212
7	10228	9378	12048	9296	4088	2471	10392
8	6577	6509	4809	6534	5219	2165	1497
9	10122	9407	6938	4896	4586	4345	4563
1+	284182	445700	355818	201907	118183	78438	51035

	1970	1971	1972	1973	1974	1975	1976
1	2983	224	4739	9796	6867	4247	46780
2	828	2777	280	5270	10666	7130	5242
3	286	458	2511	348	5529	9097	7308
4	4091	287	324	1700	414	4489	6720
5	1320	3249	248	167	1324	315	3728
6	2183	791	2731	181	136	980	356
7	17699	1487	300	2318	132	107	901
8	7654	12198	942	169	1948	96	85
9	5489	9174	18665	5098	9910	2252	2513
1+	42532	30643	30740	25047	36925	28713	73634

	1977	1978	1979	1980	1981	1982	1983
1	6634	2917	40343	5051	2554	494	930
2	71235	9281	4493	42806	5771	4630	1768
3	5826	58786	8824	4231	24504	5619	4140
4	8107	6291	45834	7702	4192	18830	3982
5	5864	6958	5353	27164	6363	3188	12276
6	2803	4087	5034	3442	17830	4408	2131
7	384	1695	2568	3068	2195	12237	3210
8	683	242	1162	1257	1652	1198	7491
9	2411	1633	711	717	1071	1275	898
1+	103947	91891	114321	95439	66131	51880	36824

	1984	1985	1986	1987	1988	1989	1990
1	5164	527	6013	820	6378	522	1533
2	2080	11489	1203	8249	1505	10509	778
3	1558	2125	9604	1375	8155	1765	12464
4	3234	1480	1683	7660	1120	6434	1519
5	2864	2256	1174	1353	4145	923	4522
6	7688	2149	1365	736	894	2826	596
7	1259	4627	1415	847	509	702	1871
8	2021	810	3087	1042	561	370	404
9	4444	1600	756	1498	1045	635	533
1+	30312	27062	26301	23578	24312	24687	24221

	1991	1992	1993	1994	1995	1996	1997
1	1250	4536	9120	5043	4052	4094	7358
2	2082	1922	7901	12238	8889	8457	7247
3	795	1761	1828	8228	13045	10792	10387
4	9420	692	1288	1413	7168	11861	9980
5	1262	5640	451	885	1080	5758	10202
6	3161	944	3095	262	656	734	4402
7	323	1912	644	1841	159	572	618
8	1203	171	994	611	1329	118	404
9	794	747	605	718	542	182	1105
1+	20290	18326	25925	31237	36919	42567	51703

	1998	1999
1	5230	29963
2	15579	9205
3	9061	17041
4	8632	7644
5	7746	7093
6	7905	5734
7	3723	6206
8	542	2648
9	1086	935
1+	59505	86470

Summaries for ages 4,7

	1963	1964	1965	1966	1967	1968	1969
4,7	115502	88931	59520	71197	92729	63912	40144

	1970	1971	1972	1973	1974	1975	1976
4,7	25293	5813	3602	4367	2005	5891	11705

	1977	1978	1979	1980	1981	1982	1983
4,7	17159	19031	58789	41377	30580	38664	21598

	1984	1985	1986	1987	1988	1989	1990
4,7	15045	10511	5637	10595	6668	10884	8509

	1991	1992	1993	1994	1995	1996	1997
4,7	14167	9188	5478	4400	9063	18925	25202

	1998	1999
4,7	28006	26678

Catch BIOMASS (using catch mean weights)

	1963	1964	1965	1966	1967	1968	1969
1	1662	5061	5614	66	762	05	01
2	3536	13275	87624	5048	118	2446	09
3	8810	5130	46352	91127	2771	750	1885
4	16506	6876	7306	24407	24593	2565	764
5	13882	14431	7408	4758	14860	23046	1155
6	4773	11762	13492	5431	2504	7416	11962
7	3325	5050	8640	5377	2319	1566	3999
8	2208	2738	2945	3679	2462	1200	679
9	3398	3956	4248	2757	2164	2408	2069
1+	58099	68278	183627	142650	52553	41403	22521

	1970	1971	1972	1973	1974	1975	1976
1	33	01	97	1543	33	119	72
2	202	1431	02	2155	4620	1017	470
3	20	296	788	05	1202	3060	767
4	1107	70	167	830	05	833	1762
5	410	694	78	130	199	09	577
6	514	703	352	100	08	124	00
7	5998	841	242	264	08	16	85
8	2426	4590	228	58	209	16	19
9	1740	3452	4524	1761	1061	381	553
1+	12450	12078	6478	6846	7344	5576	4305

	1977	1978	1979	1980	1981	1982	1983
1	01	01	01	04	00	00	00
2	21094	718	26	29522	1526	1137	219
3	270	21762	2222	421	13788	2389	1121
4	1483	624	14582	1696	1533	7074	1272
5	1414	1591	1325	13266	2171	933	4990
6	1156	1663	1295	1692	7054	1583	726
7	17	471	1202	1990	1242	3650	607
8	157	51	366	550	644	423	2709
9	554	342	224	314	417	450	325
1+	26145	27222	21244	49454	28374	17637	11968

	1984	1985	1986	1987	1988	1989	1990
1	00	00	03	00	02	00	01
2	86	2394	51	1664	51	1128	11
3	394	770	3854	185	3221	128	2148
4	1342	386	410	3254	226	1579	307
5	879	1146	376	276	1936	318	1853
6	3998	624	493	193	368	927	252
7	700	1622	447	271	165	150	500
8	919	292	927	403	225	100	139
9	2020	578	227	579	420	172	183
1+	10338	7812	6788	6825	6614	4502	5394

	1991	1992	1993	1994	1995	1996	1997
1	04	04	05	01	04	02	12
2	541	291	340	295	87	59	178
3	120	528	609	1337	891	855	489
4	3938	235	656	379	929	1746	1476
5	224	3377	223	173	153	1083	1258
6	1093	282	1751	192	89	174	563
7	211	968	101	440	27	75	60
8	473	92	502	165	176	19	55
9	312	401	305	194	72	29	149
1+	6916	6178	4491	3175	2427	4044	4240

	1998	1999
1	01	01
2	216	44
3	665	1627
4	931	1070
5	1473	1055
6	1274	1199
7	444	908
8	80	426
9	159	151
1+	5242	6480

Summaries for ages 4,7

	1963	1964	1965	1966	1967	1968	1969
4,7	38486	38118	36845	39973	44276	34594	17878

	1970	1971	1972	1973	1974	1975	1976
4,7	8030	2308	839	1324	219	982	2424

	1977	1978	1979	1980	1981	1982	1983
4,7	4069	4349	18405	18643	11999	13239	7595

	1984	1985	1986	1987	1988	1989	1990
4,7	6919	3778	1727	3994	2695	2974	2913

	1991	1992	1993	1994	1995	1996	1997
4,7	5465	4861	2730	1184	1198	3079	3358

	1998	1999
4,7	4122	4232

Jan 1 BIOMASS (using Jan 1 mean weights)

	1963	1964	1965	1966	1967	1968	1969
1	90013	201023	17141	2184	7720	217	329
2	24748	105611	221421	12016	2092	6992	229
3	35101	22460	102915	152869	7430	2174	4835
4	63782	26104	17847	57896	70135	5249	1912
5	44591	42589	18743	10656	32478	50794	3191
6	18694	30052	26311	11078	6075	18166	30796
7	12403	12555	17355	12499	5543	3425	12526
8	7470	8243	6673	8290	6636	2895	1797
9	13074	12625	10134	7000	6298	6188	6215
1+	309877	461263	438540	274487	144407	96098	61830

	1970	1971	1972	1973	1974	1975	1976
1	2745	199	4097	8758	6508	3761	35331
2	656	3227	250	5459	10825	7219	4775
3	260	668	2472	313	5087	9475	7119
4	3872	297	363	2125	379	4910	7595
5	1481	3565	269	241	1362	362	4037
6	2304	1146	2899	221	123	1127	332
7	20108	1926	456	2496	135	123	929
8	8658	14640	1074	195	2113	115	97
9	7030	12070	23097	6614	11509	2693	3078
1+	47114	37738	34977	26420	38039	29785	63292

	1977	1978	1979	1980	1981	1982	1983
1	5496	2344	33426	4430	1785	253	615
2	61732	7982	3619	48544	5738	3638	962
3	5451	65149	9399	4451	30505	5853	4368
4	7811	6116	50618	8114	4463	20117	4544
5	6193	7546	5987	36262	7147	3548	15098
6	3412	5043	5913	4498	21132	5254	2608
7	373	2082	3234	4251	2740	14238	3571
8	807	317	1402	1752	2064	1510	9613
9	2967	1991	909	970	1418	1659	1173
1+	94241	98569	114506	113271	76991	56070	42552

	1984	1985	1986	1987	1988	1989	1990
1	3298	345	4881	599	4843	426	1235
2	1402	8086	803	7373	1117	8380	638
3	1703	2261	10900	1311	8519	1641	11580
4	3746	1509	1817	8493	1255	6900	1683
5	3329	2715	1324	1483	5597	1044	5555
6	9812	2445	1663	907	1146	3256	746
7	1698	5620	1736	1051	615	745	2241
8	2689	944	3690	1221	694	424	545
9	6056	2091	960	1980	1391	796	691
1+	33731	26013	27774	24418	25177	23612	24914

	1991	1992	1993	1994	1995	1996	1997
1	972	3397	7819	3784	2794	3052	5039
2	1897	1603	6037	10610	6695	5849	5472
3	811	1916	1945	8275	12746	9939	9449
4	11399	771	1562	1565	7579	12634	10517
5	1367	7466	571	974	1189	6484	10882
6	3669	1116	4040	355	746	906	4932
7	454	2517	747	2165	173	609	647
8	1530	223	1350	641	1513	136	479
9	1052	1056	842	900	637	217	1300
1+	23151	20063	24914	29268	34072	39826	48717

	1998	1999
1	3930	29890
2	10727	6934
3	8180	16589
4	9585	8431
5	8835	7869
6	9020	6652
7	4022	6942
8	584	3157
9	1285	1114
1+	56167	87579

Summaries for ages 4,7

	1963	1964	1965	1966	1967	1968	1969
4,7	139471	111301	80257	92129	114231	77634	48425

	1970	1971	1972	1973	1974	1975	1976
4,7	27765	6934	3987	5083	1998	6522	12893

	1977	1978	1979	1980	1981	1982	1983
4,7	17788	20787	65751	53124	35481	43158	25821

	1984	1985	1986	1987	1988	1989	1990
4,7	18584	12288	6540	11933	8613	11945	10225

	1991	1992	1993	1994	1995	1996	1997
4,7	16890	11870	6921	5058	9687	20633	26977

	1998	1999
4,7	31461	29894

SSB AT THE START OF THE SPAWNING SEASON -MALES AND FEMALES (MT) (using SSB mean weights)

	1963	1964	1965	1966	1967	1968	1969
1	00	00	00	00	00	00	00
2	00	00	00	00	00	1675	61
3	24233	15655	65996	91773	4934	1433	3119
4	56101	23010	14892	48128	60273	4294	1636
5	38629	36355	15691	8788	26351	41983	2731
6	16464	25247	20964	8946	5063	15410	26018
7	10877	10439	13799	10289	4575	2780	10823
8	6533	7059	5446	6850	5610	2397	1526
9	11435	10811	8271	5784	5324	5124	5278
1+	164273	128575	145060	180559	112131	75096	51190

	1970	1971	1972	1973	1974	1975	1976
1	00	00	00	00	00	00	00
2	164	756	67	1594	3142	2253	1510
3	185	411	1652	273	4216	7623	6069
4	3442	266	304	1789	359	4459	6767
5	1303	3215	236	189	1248	342	3694
6	2067	873	2671	183	116	1039	316
7	17573	1590	354	2308	126	113	863
8	7609	12676	962	170	1956	105	87
9	6177	10450	20679	5770	10659	2455	2771
1+	38520	30237	26924	12276	21822	18389	22076

	1977	1978	1979	1980	1981	1982	1983
1	00	00	00	00	00	00	00
2	17995	2458	1134	12825	1686	1074	293
3	4151	45760	6800	3345	20420	4055	3145
4	7098	5675	44468	7305	3874	17421	3991
5	5546	6779	5353	30529	6242	3137	12974
6	2927	4333	5274	3784	18209	4569	2279
7	351	1847	2737	3438	2262	12571	3240
8	725	286	1233	1494	1781	1315	8354
9	2664	1797	799	827	1224	1445	1019
1+	41458	68935	67797	63547	55698	45586	35294

	1984	1985	1986	1987	1988	1989	1990
1	376	79	1114	137	1105	97	117
2	436	4746	491	4335	685	5044	339
3	1429	1787	8534	1097	6681	1395	9917
4	3212	1317	1593	7119	1112	6049	1507
5	2933	2274	1163	1340	4738	911	4770
6	8196	2162	1446	808	983	2853	638
7	1405	4897	1526	923	540	672	1994
8	2283	820	3256	1054	597	377	476
9	5141	1817	848	1710	1197	708	603
1+	25411	19900	19971	18523	17638	18106	20361

	1991	1992	1993	1994	1995	1996	1997
1	92	323	521	252	53	58	96
2	947	822	1704	3010	2160	1888	1759
3	698	1589	1209	5366	11204	8713	8350
4	9669	666	1230	1309	6979	11583	9641
5	1244	6115	480	882	1092	5885	10037
6	3201	985	3336	281	686	812	4543
7	367	2109	683	1940	158	560	601
8	1319	185	1132	570	1392	124	440
9	907	878	706	800	586	198	1196
1+	18445	13674	11001	14409	24311	29823	36663

	1998	1999
1	75	569
2	3457	2240
3	7181	14483
4	8875	7744
5	8013	7212
6	8241	6006
7	3713	6366
8	535	2885
9	1178	1018
1+	41270	48522

Appendix B. Results of 1000 Bootstrap realizations of the Virtual Population Analysis calibration of the Georges Bank haddock assessment (Run 11).

The number of bootstraps: 1000
Bootstrap Output Variable: N hat

	NLLS ESTIMATE	BOOTSTRAP MEAN	BOOTSTRAP StdError	C.V. FOR NLLS SOLN
N 1	35243	38355	16818	0.48
N 2	39921	41328	10370	0.26
N 3	7534	7648	1606	0.21
N 4	9592	9708	1869	0.19
N 5	3507	3612	679	0.19
N 6	2808	2828	484	0.17
N 7	1984	2046	421	0.21
N 8	1926	1939	357	0.19

	BIAS ESTIMATE	BIAS STD ERROR	PERCENT BIAS	NLLS EST CORRECTED FOR BIAS	C.V. FOR CORRECTED ESTIMATE	LOWER 80%CI	UPPER 80%CI
N 1	3111	532	8.83	32132	0.523401	21321	56519
N 2	1408	328	3.53	38513	0.269249	27122	51639
N 3	115	51	1.52	7419	0.216438	5660	9604
N 4	116	59	1.21	9476	0.197243	7333	12017
N 5	105	21	2.98	3403	0.199671	2647	4267
N 6	19	15	0.69	2789	0.173396	2187	3407
N 7	61	13	3.09	1923	0.218693	1445	2449
N 8	13	11	0.69	1912	0.186670	1442	2331

Bootstrap Output Variable: Q_unscaled

	NLLS ESTIMATE	BOOTSTRAP MEAN	BOOTSTRAP StdError	C.V. FOR NLLS SOLN
q US_Sp1	0.0001271	0.0001287	0.0000172	0.14
q US_Sp2	0.0002105	0.0002120	0.0000255	0.12
q US_Sp3	0.0002301	0.0002324	0.0000283	0.12
q US_Sp4	0.0002210	0.0002232	0.0000280	0.13
q US_Sp5	0.0002346	0.0002361	0.0000285	0.12
q US_Sp6	0.0001824	0.0001827	0.0000217	0.12
q US_Sp7	0.0001769	0.0001775	0.0000205	0.12
q US_Sp8	0.0002302	0.0002329	0.0000291	0.13
q US_S411	0.0002265	0.0002296	0.0000445	0.20
q US_S412	0.0002818	0.0002876	0.0000528	0.19
q US_S413	0.0002410	0.0002468	0.0000498	0.21
q US_S414	0.0002595	0.0002644	0.0000549	0.21
q US_S415	0.0002883	0.0002974	0.0000626	0.22
q US_S416	0.0002714	0.0002791	0.0000649	0.24
q US_S417	0.0003463	0.0003519	0.0000693	0.20
q US_S418	0.0002862	0.0002896	0.0000569	0.20
q US_Au01	0.0001440	0.0001450	0.0000140	0.10
q US_Au12	0.0002386	0.0002398	0.0000236	0.10
q US_Au23	0.0001943	0.0001959	0.0000187	0.10
q US_Au34	0.0002083	0.0002084	0.0000202	0.10
q US_Au45	0.0001714	0.0001720	0.0000168	0.10
q US_Au56	0.0001737	0.0001757	0.0000171	0.10
q Can_Sp1	0.0001869	0.0001883	0.0000292	0.16
q Can_Sp2	0.0003324	0.0003362	0.0000520	0.16
q Can_Sp3	0.0005453	0.0005521	0.0000818	0.15
q Can_Sp4	0.0004836	0.0004881	0.0000724	0.15
q Can_Sp5	0.0005537	0.0005606	0.0000850	0.15
q Can_Sp6	0.0003949	0.0003968	0.0000608	0.15
q Can_Sp7	0.0006299	0.0006394	0.0000967	0.15
q Can_Sp8	0.0004870	0.0004931	0.0000728	0.15

	BIAS ESTIMATE	BIAS STD ERROR	PERCENT BIAS	NLLS EST CORRECTED FOR BIAS	C.V. FOR CORRECTED ESTIMATE	LOWER 80%CI	UPPER 80%CI
q US_Sp1	0.00000151	0.000000545	1.188	0.000125638	0.14	0.0001065	0.0001500
q US_Sp2	0.00000159	0.000000807	0.756	0.000208862	0.12	0.0001776	0.0002427
q US_Sp3	0.00000232	0.000000894	1.007	0.000227806	0.12	0.0001909	0.0002623
q US_Sp4	0.00000225	0.000000885	1.016	0.000218736	0.13	0.0001849	0.0002552
q US_Sp5	0.00000150	0.000000901	0.640	0.000233145	0.12	0.0002018	0.0002740
q US_Sp6	0.00000026	0.000000687	0.143	0.000182132	0.12	0.0001562	0.0002109
q US_Sp7	0.00000060	0.000000648	0.339	0.000176345	0.12	0.0001483	0.0002010
q US_Sp8	0.00000277	0.000000921	1.204	0.000227385	0.13	0.0001928	0.0002655
q US_S411	0.00000304	0.000001407	1.341	0.000223494	0.20	0.0001746	0.0002852
q US_S412	0.00000585	0.000001670	2.075	0.000275910	0.19	0.0002181	0.0003489
q US_S413	0.00000575	0.000001574	2.386	0.000235290	0.21	0.0001804	0.0003024
q US_S414	0.00000487	0.000001735	1.877	0.000254626	0.22	0.0001952	0.0003335
q US_S415	0.00000913	0.000001978	3.166	0.000279163	0.22	0.0002097	0.0003574
q US_S416	0.00000773	0.000002051	2.849	0.000263655	0.25	0.0001983	0.0003619
q US_S417	0.00000554	0.000002190	1.600	0.000340777	0.20	0.0002664	0.0004379
q US_S418	0.00000341	0.000001799	1.190	0.000282756	0.20	0.0002181	0.0003579
q US_Au01	0.00000091	0.000000444	0.633	0.000143136	0.10	0.0001252	0.0001600
q US_Au12	0.00000122	0.000000748	0.512	0.000237398	0.10	0.0002108	0.0002720
q US_Au23	0.00000155	0.000000590	0.796	0.000192802	0.10	0.0001694	0.0002175
q US_Au34	0.00000015	0.000000640	0.072	0.000208103	0.10	0.0001825	0.0002332
q US_Au45	0.00000056	0.000000532	0.327	0.000170865	0.10	0.0001511	0.0001931
q US_Au56	0.00000190	0.000000542	1.096	0.000171843	0.10	0.0001532	0.0001979
q Can_Sp1	0.00000138	0.000000923	0.739	0.000185554	0.16	0.0001520	0.0002268
q Can_Sp2	0.00000384	0.000001646	1.154	0.000328550	0.16	0.0002656	0.0003937
q Can_Sp3	0.00000681	0.000002588	1.249	0.000538464	0.15	0.0004336	0.0006432
q Can_Sp4	0.00000451	0.000002290	0.933	0.000479099	0.15	0.0003873	0.0005722
q Can_Sp5	0.00000696	0.000002689	1.258	0.000546713	0.16	0.0004451	0.0006657
q Can_Sp6	0.00000187	0.000001921	0.474	0.000393056	0.15	0.0003130	0.0004662
q Can_Sp7	0.00000950	0.000003057	1.507	0.000620407	0.16	0.0005163	0.0007541
q Can_Sp8	0.00000612	0.000002304	1.256	0.000480836	0.15	0.0003903	0.0005733

Bootstrap Output Variable: N t1

	NLLS ESTIMATE	BOOTSTRAP MEAN	BOOTSTRAP StdError	C.V. FOR NLLS SOLN
Age 1	35243.3	38354.8	16817.9	0.4772
Age 2	39920.9	41328.4	10369.7	0.2598
Age 3	7533.6	7648.1	1605.8	0.2131
Age 4	9592.0	9707.6	1869.1	0.1949
Age 5	3507.3	3611.9	679.4	0.1937
Age 6	2808.2	2827.6	483.6	0.1722
Age 7	1984.3	2045.7	420.5	0.2119
Age 8	1925.6	1938.9	357.0	0.1854
Age 9	950.5	946.1	99.3	0.1044

	BIAS ESTIMATE	BIAS STD ERROR	PERCENT BIAS	NLLS EST CORRECTED FOR BIAS	C.V. FOR CORRECTED ESTIMATE	LOWER 80%CI	UPPER 80%CI
Age 1	3111.42	531.83	8.828	32131.91	0.52	21321.2	56518.7
Age 2	1407.51	327.92	3.526	38513.38	0.27	27122.4	51639.1
Age 3	114.51	50.78	1.520	7419.11	0.22	5659.8	9603.5
Age 4	115.64	59.11	1.206	9476.35	0.20	7332.8	12017.1
Age 5	104.61	21.49	2.982	3402.73	0.20	2647.1	4267.3
Age 6	19.32	15.29	0.688	2788.93	0.17	2186.7	3407.5
Age 7	61.34	13.30	3.091	1922.98	0.22	1445.3	2448.6
Age 8	13.28	11.29	0.689	1912.33	0.19	1442.2	2330.9
Age 9	-4.40	3.14	-0.463	954.95	0.10	823.3	1078.0

Bootstrap Output Variable: F t

	NLLS ESTIMATE	BOOTSTRAP MEAN	BOOTSTRAP StdError	C.V. FOR NLLS SOLN
Age 1	0.0000	0.0000	0.0000	0.28
Age 2	0.0048	0.0049	0.0011	0.22
Age 3	0.0955	0.0978	0.0192	0.20
Age 4	0.1400	0.1405	0.0255	0.18
Age 5	0.1488	0.1517	0.0249	0.17
Age 6	0.2091	0.2109	0.0425	0.20
Age 7	0.1463	0.1500	0.0279	0.19
Age 8	0.1610	0.1633	0.0162	0.10
Age 9	0.1610	0.1633	0.0162	0.10

	BIAS ESTIMATE	BIAS STD ERROR	PERCENT BIAS	NLLS EST CORRECTED FOR BIAS	C.V. FOR CORRECTED ESTIMATE	LOWER 80%CI	UPPER 80%CI
Age 1	0.0000006	0.0000002	3.004	0.0000198	0.29	0.0000	0.0000
Age 2	0.0001400	0.0000336	2.943	0.0046169	0.23	0.0037	0.0063
Age 3	0.0023118	0.0006085	2.421	0.0931802	0.21	0.0768	0.1227
Age 4	0.0005418	0.0008051	0.387	0.1394151	0.18	0.1161	0.1813
Age 5	0.0029112	0.0007862	1.957	0.1458490	0.17	0.1239	0.1870
Age 6	0.0018457	0.0013433	0.883	0.2072083	0.21	0.1724	0.2759
Age 7	0.0036832	0.0008820	2.518	0.1425874	0.20	0.1221	0.1907
Age 8	0.0022455	0.0005119	1.395	0.1587649	0.10	0.1430	0.1836
Age 9	0.0022455	0.0005119	1.395	0.1587649	0.10	0.1430	0.1836

Bootstrap Output Variable: F full t

NLLS ESTIMATE	BOOTSTRAP MEAN	BOOTSTRAP StdError	C.V. FOR NLLS SOLN
0.1610	0.1633	0.0162	0.10

BIAS ESTIMATE	BIAS STD ERROR	PERCENT BIAS	NLLS EST CORRECTED FOR BIAS	C.V. FOR CORRECTED ESTIMATE	LOWER 80%CI	UPPER 80%CI
0.00225	0.00051	1.39	0.15876	0.10	0.1430	0.1836

Bootstrap Output Variable: PR t

	NLLS ESTIMATE	BOOTSTRAP MEAN	BOOTSTRAP StdError	C.V. FOR NLLS SOLN
Age 1	0.0001	0.0001	0.0000	0.32
Age 2	0.0228	0.0234	0.0060	0.26
Age 3	0.4568	0.4672	0.1143	0.25
Age 4	0.6695	0.6716	0.1544	0.23
Age 5	0.7116	0.7247	0.1550	0.22
Age 6	1.0000	0.9802	0.0559	0.06
Age 7	0.6997	0.7160	0.1605	0.23
Age 8	0.7702	0.7731	0.0893	0.12
Age 9	0.7702	0.7731	0.0893	0.12

	BIAS ESTIMATE	BIAS STD ERROR	PERCENT BIAS	NLLS EST CORRECTED FOR BIAS	C.V. FOR CORRECTED ESTIMATE	LOWER 80%CI	UPPER 80%CI
Age 1	0.00000	0.000001	2.95	0.00009470	0.33	0.0001	0.0001
Age 2	0.00062	0.000190	2.73	0.02213421	0.27	0.0165	0.0308
Age 3	0.01044	0.003614	2.29	0.44634150	0.26	0.3435	0.6333
Age 4	0.00209	0.004882	0.31	0.66739249	0.23	0.4967	0.9154
Age 5	0.01314	0.004902	1.85	0.69844299	0.22	0.5259	0.9604
Age 6	-0.01984	0.001768	-1.98	1.01984223	0.05	0.5875	1.0000
Age 7	0.01628	0.005075	2.33	0.68339628	0.23	0.5046	0.9645
Age 8	0.00292	0.002825	0.38	0.76726850	0.12	0.6495	0.8840
Age 9	0.00292	0.002825	0.38	0.76726850	0.12	0.6495	0.8840

Bootstrap Output Variable: PR mean

	NLLS ESTIMATE	BOOTSTRAP MEAN	BOOTSTRAP StdError	C.V. FOR NLLS SOLN
Age 1	0.0008	0.0008	0.0001	0.18
Age 2	0.0650	0.0651	0.0107	0.17
Age 3	0.3827	0.3822	0.0613	0.16
Age 4	0.7241	0.7154	0.0857	0.12
Age 5	0.8404	0.8333	0.0830	0.10
Age 6	0.9015	0.8924	0.0644	0.07
Age 7	0.6606	0.6588	0.0764	0.12
Age 8	0.8155	0.8070	0.0707	0.09
Age 9	0.8155	0.8070	0.0707	0.09

	BIAS ESTIMATE	BIAS STD ERROR	PERCENT BIAS	NLLS EST CORRECTED FOR BIAS	C.V. FOR CORRECTED ESTIMATE	LOWER 80%CI	UPPER 80%CI
Age 1	0.00000	0.0000047	0.50	0.0008255	0.18	0.0007	0.0010
Age 2	0.00001	0.0003396	0.01	0.0650390	0.17	0.0537	0.0820
Age 3	-0.00048	0.0019382	-0.13	0.3831539	0.16	0.3141	0.4702
Age 4	-0.00872	0.0027098	-1.20	0.7328696	0.12	0.6295	0.8449
Age 5	-0.00711	0.0026236	-0.85	0.8474766	0.10	0.7187	0.9418
Age 6	-0.00902	0.0020370	-1.00	0.9104869	0.07	0.8075	0.9714
Age 7	-0.00180	0.0024160	-0.27	0.6624462	0.12	0.5393	0.7477
Age 8	-0.00846	0.0022354	-1.04	0.8239338	0.09	0.7105	0.8972
Age 9	-0.00846	0.0022354	-1.04	0.8239338	0.09	0.7105	0.8972

Bootstrap Output Variable: Mean Biomass

NLLS ESTIMATE	BOOTSTRAP MEAN	BOOTSTRAP StdError	C.V. FOR NLLS SOLN
86470.4110	88300.9767	9802.1871	0.11

BIAS ESTIMATE	BIAS STD ERROR	PERCENT BIAS	NLLS EST CORRECTED FOR BIAS	C.V. FOR CORRECTED ESTIMATE	LOWER 80%CI	UPPER 80%CI
1830.5657	309.9724	2.12	84639.8453	0.12	74157.0951	97037.2701

Bootstrap Output Variable: SSB f mean

NLLS ESTIMATE	BOOTSTRAP MEAN	BOOTSTRAP StdError	C.V. FOR NLLS SOLN
22438.8578	25350.1969	2318.2074	0.10

BIAS ESTIMATE	BIAS STD ERROR	PERCENT BIAS	NLLS EST CORRECTED FOR BIAS	C.V. FOR CORRECTED ESTIMATE	LOWER 80%CI	UPPER 80%CI
2911.339	73.308	12.97	19527.519	0.12	17865.2734	22431.9018

Bootstrap Output Variable: SSB spawn t

NLLS ESTIMATE	BOOTSTRAP MEAN	BOOTSTRAP StdError	C.V. FOR NLLS SOLN
48522.2992	49171.8381	4315.3779	0.09

BIAS ESTIMATE	BIAS STD ERROR	PERCENT BIAS	NLLS EST CORRECTED FOR BIAS	C.V. FOR CORRECTED ESTIMATE	LOWER 80%CI	UPPER 80%CI
649.54	136.46	1.34	47872.76	0.09	42196.7278	53155.6340

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Publications and Reports of the Northeast Fisheries Science Center

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