B2. GULF OF MAINE (GOM) WINTER FLOUNDER

TERMS OF REFERENCE

The following terms of reference were addressed for Gulf of Maine winter flounder stock:

1) Characterize status of GM winter flounder using the analytical tools that are most appropriate for available data. These may include sequential population analysis, surplus production, survey indices and relative exploitation indices, or length based models.

2) Where possible provide best estimates of exploitation rates (fishing mortality, relative exploitation), mean biomass, spawning stock biomass and characterize uncertainty associated with these estimates.

3) Develop yield per recruit and biological reference points.

4) Where possible, provide short-term and medium term projections of catch and stock size under status quo F and various proposed target fishing mortality rates (F20%, F25%, F30%, F40%, F0.01, Fmax, Fmsy) as appropriate.

5) Develop and recommend an overfishing definition for Gulf of Maine winter flounder that meets the standards of the Sustainable Fishery Act.

6) Develop research recommendations for improving assessment of winter flounder.

INTRODUCTION

The last assessment for Gulf of Maine winter flounder was an index based assessment reviewed at SARC 21 (NEFSC 1996). Low indices and the absence of large fish in the survey led SARC 21 to conclude that the stock was overexploited in the mid 1990s. The current benchmark assessment is based on a Virtual Population Analysis (VPA) with commercial/recreational landings and discard estimates from 1982-2001 and research survey abundance indices from 1982-2002.

Winter flounder (*Pleuronectes americanus*) is a demersal flatfish species commonly found in estuaries and on the continental shelf. The species is distributed between the Gulf of St. Lawrence and North Carolina, although it is not abundant south of Delaware Bay. Within the Gulf of Maine, winter flounder undergo migrations from estuaries, where spawning occurs in the late winter and spring, to offshore shelf areas of less than 60 fathoms. Winter flounder reach a maximum size of around 2.25 kg (5 pounds) and 65 cm, with the exception of Georges Bank where growth rate is higher and fish may reach a maximum weight up to 3.6 kg (8 pounds; Bigelow and Schroeder 1953).

Current fishery management is coordinated by the ASMFC in state waters and the NEFMC in federal waters. Winter flounder fisheries in state waters have been managed by Interstate Agreement under the auspices of the ASMFC Fishery Management Plan (FMP) for Inshore Stocks of Winter Flounder since approval in May, 1992. The plan includes states from Delaware to Maine, with Delaware granted *de minimus* status (habitat regulations applicable but fishery management not required). The Plan's goal is to rebuild spawning stock abundance and achieve a fishing mortality-based management target of $F_{40\%}$ (fishing rate that preserves 40% of the maximum spawning potential of the stock) in three steps: $F_{25\%}$ in 1993-1994, $F_{30\%}$ in 1995-1998, and $F_{40\%}$ in 1999 and later years through implementation of compatible, state-specific regulations.

Coastal states from New Jersey to New Hampshire have promulgated a broad suite of indirect catch and effort controls. State agencies have set or increased minimum size limits for recreationally and commercially landed flounder (10-12 in and 12 in, respectively); enacted limited recreational closures and bag limits; and instituted seasonal, areal, or state-wide commercial landings/gear restrictions. Minimum codend mesh regulations have been promulgated in directed winter flounder fisheries: 6 in MA. New Hampshire prohibits the use of mobile gear in state waters with the exception of small mesh trawling in the shrimp fishery.

Winter flounder in the Exclusive Economic Zone (EEZ) are managed under the Northeast Multispecies Fishery FMP developed by the NEFMC. The principle catch of winter flounder in the EEZ has recently occurred as bycatch in directed trawl fisheries for Atlantic cod, haddock, and yellowtail flounder. The management unit encompasses the multispecies finfish fishery that operates from eastern Maine through Southern New England (72° 30'). At least one offshore stock, on Georges Bank, has been identified. The FMP extends authority over vessels permitted under the FMP even while fishing in state waters if federal regulations are more restrictive than the state regulations.

The Multispecies FMP was implemented in September, 1986, imposing a codend minimum mesh size of 5.5 in (previously 5.1 in) in the large-mesh regulatory area of Georges Bank and the offshore portion of Gulf of Maine. There were closed areas and seasons for haddock and yellowtail flounder. In the western Gulf of Maine, vessels were required to enroll in an Exempted Fisheries Program in order to target small-mesh species such as shrimp, dogfish, or whiting. The bycatch restrictions specified area and season and limited groundfish bycatch to 25% of trip and 10% for the reporting period. In southern New England waters, the groundfish bycatch on vessels fishing with small mesh was not limited in any way. There was a 11 in minimum size for winter flounder which corresponded with the length at first capture (near zero percent retention) for 5.5 in diamond mesh. Although the Multispecies FMP was amended four times by 1991, it was widely recognized that many stocks, including winter flounder, were being overfished.

Time-specific stock rebuilding schedules were a part of Multispecies FMP Amendment 5 which took effect in May, 1994. The rebuilding target for winter flounder, a so-called "large-mesh" species, was $F_{20\%}$ within 10 years. Along with a moratorium on issuance of additional vessel permits, the cornerstone of Amendment 5 was an effort reduction program that required "large-mesh" groundfish vessels to limit days at sea, which would be reduced each year. There was an exemption from effort reduction requirements for groundfishing vessels less than 45 feet in length and for "day boats" (from 2:1 layover day ratio requirement). Draggers retaining more than the "possession limit" of groundfish (10%, by weight, up to 500 lbs) were required to fish with either 5.5 in diamond or square mesh in Southern New England or 6 in throughout the net in the regulated mesh area of Georges Bank/ Gulf of Maine, respectively. The possession limit was allowed when using small mesh within the western Gulf of Maine (except Jeffreys Ledge and Stellwagon Bank) and in Southern New England. Vessels fishing in the EEZ west of 72° 30' (the longitude of Shinnecock Inlet, NY) were required to abide by 5.5 in diamond or 6 in square codend mesh size restrictions consistent with the Summer Flounder FMP. The minimum landed size of winter flounder increased to 12 in, appropriate for the increased mesh size in order to reduce discards. There were many additional rules including time/area closures for sink gillnet vessels, seasonal netting closures of prime fishing areas on Georges Bank (Areas I and II), and on Nantucket Shoals to protect juvenile yellowtail flounder.

At the end of 1994, the NEFMC reacted to collapsed stocks of Atlantic cod, haddock, and yellowtail flounder on Georges Bank by recommending a number of emergency actions to tighten existing regulations reducing fishing mortality. Prime fishing areas on Georges Bank (Areas I & II), and the Nantucket Lightship Area were closed. The NEFMC also addressed expected re-direction of fishing effort into Gulf of Maine and Southern New England while, at the same time, developing Amendment 7 to the Multispecies FMP. Under Amendment 7, days-at-sea controls were extended, and any fishing by an EEZ-permitted vessel required use of not less than 6 in diamond or square mesh in Southern New England east of 72° 30'. Framework 27 in 1999 increased the square mesh minimum size to 6.5 in in the Gulf of Maine, Georges Bank, and Southern New England mesh areas. Amendment 9 revised the overfishing definitions for New England groundfish, and new overfishing definitions for SNE/MA winter flounder were recommended by SARC 28 (NEFSC 1999).

STOCK STRUCTURE

Although stock groups consist of an assemblage of adjacent estuarine spawning units, the ASMFC FMP originally defined three coastal management units based on similar growth, maturity and seasonal movement patterns: Gulf of Maine, Southern New England and the Mid-Atlantic. Boundaries for a total of four winter flounder stock units as originally defined in the ASMFC management plan (Howell et al., 1992) were:

Gulf of Maine: Coastal Maine, New Hampshire, and Massachusetts north of Cape Cod

Southern New England: Coastal Massachusetts east and south of Cape Cod, including Nantucket Sound, Vineyard Sound, Buzzards Bay, Narragansett Bay, Block Island Sound, Rhode Island Sound, Rhode Island coastal ponds and eastern Long Island Sound to the Connecticut River, including Fishers Island Sound, NY.

Mid-Atlantic: Long Island Sound west of the Connecticut River to Montauk Point, NY, including Gardiners and Peconic Bays, coastal Long Island, NY, coastal New Jersey and Delaware.

Georges Bank

In the current and previous assessments (e.g., NEFSC 1996, ASMFC 1998, NEFSC 1999) the Southern New England and Mid-Atlantic units have been combined into a single stock complex for assessment purposes. A review of tagging studies for winter flounder (Howell 1996) indicates dispersion (and hence mixing) has occurred between previously defined Southern New England and Mid-Atlantic units. Howell (1996) noted that differences in growth and maturity among samples from Southern New England to the Mid-Atlantic may reflect discrete sampling along a gradient of changing growth and maturity rates over the range of a stock complex. Differences in growth rates within the Mid-Atlantic units were observed to be greater than differences between Mid-Atlantic and Southern New England units (Howell, 1996). In offshore waters, the length structure of winter flounder caught in NEFSC research surveys is similar from Southern New England to New Jersey. Most commercial landings are obtained in these offshore regions (greater than 3 miles from shore).

Stock Boundaries and associated Statistical Areas

The Gulf of Maine stock complex extends along the coast of eastern Maine to Provincetown, MA, corresponding to NEFSC commercial fishery statistical division 51 (Figure B2.1). Recreational landings from Maine, New Hampshire and northern Massachusetts (northern half of Barnstable County and north to New Hampshire border) are associated with this stock complex.

The Southern New England/Mid-Atlantic stock complex extends from the coastal shelf east of Provincetown, MA southward along the Great South Channel (separating Nantucket Shoals and Georges Bank) to the southern geographic limits of winter flounder. NEFSC commercial fishery statistical areas within this boundary are 521 and 526, and statistical divisions 53, 61, 62, and 63. The corresponding recreational areas are southern Massachusetts (the southern half of Barnstable County; Dukes, Nantucket and Bristol counties), Rhode Island, Connecticut, New York, New Jersey, Delaware, Maryland and Virginia. NEFSC survey strata included for this stock extend from the waters of outer Cape Cod to the south and west.

The Georges Bank stock extends eastward of the Great South Channel, including statistical areas 522, 525, and 551-562.

FISHERY DATA

Landings

Commercial landings from 1964-1981 was taken directly from the SARC 21 assessment (NEFSC 1996). Landings from 1981-1993 was estimated from the weighout data and landings from 1994-2001 comes from a proration of dealer and vessel trip report (VTR) data (Table B2.1).

Commercial landings were near 1,000 mt from 1964 to the mid 1970s. Thereafter commercial landings increased to a peaked of 2,793 mt in 1982, and then steadily declined to a record low of 253 mt in 1999. Landings have remained near 500 mt since 1999 (Table B2.1, Figure B2.2). Otter trawl was the primary gear use during 1964-1985; > 95% of the landings (Table B2.2, Figure B2.2). Since 1985 the proportion of landings coming from gillnets has increased, and has averaged 25% since 1990. Over 95% of the landings came from Massachusetts since 1997 (Table B2.3, Figure B2.3). The proportion of winter flounder commercial landings taken in Maine has decrease from an average of 25 percent of the landings in the early 1980s to less than 5% of the landings from 1995-2001. Over 90% of the commercial landings came from statistical area 514 since 1996 (Table B2.4, Figure B2.4). Commercial landings are taken relatively constant over the year (Table B2.5, Figure B2.5). There has been a decrease in the proportion of the landings in the large market category in the last few years (Table B2.6, Figure B2.6).

Recreational landings reached a peak in 1981 of 2,554 mt but declined substantially thereafter (Table B2.7, Figure B2.7). Landings have been less than 100 mt since 1995, with the lowest estimated landings in 1998 of 30 mt. Landings in 2001 for the Gulf of Maine winter flounder were 43 mt. The proportion of recreational landings from Maine has decreased similarly to the commercial landings (Tables B2.8-9). The proportion of recreational landings taken by halfyear has fluctuated from 1981 to 2001 (Tables B2.10-11).

Landed Age Compositions

Commercial fishery

Length samples of winter flounder are available from both the commercial and recreational landings. In the commercial fishery, annual sampling intensity varied from 4 to 310 mt landed per sample during 1982-2001. Overall sampling intensity was adequate, however temporal and market category coverage in some years was poor (Table B2.12). Samples were pooled to halfyear when possible. In 1982 mediums were pooled with unclassified by halfyear; in 1985 and 1995 smalls were pooled with mediums; the large sample from 1998 was also used to characterize 1999; and the 2001 large samples were used to characterize the 1999 large market category. Sampling coverage may have been poor but length frequency samples appeared relatively constant over time and there was a substantial amount of overlap between market categories which helped justify the pooling used in the assessment. Length data from the obsever data was used to supplement length data of unclassified fish. The large number of lengths sampled in the observer data for gillnet trips were used to characterize the gillnet proportion of the landings from 1990-2001 (Table B2.13). There has been a slight shift in the commercial catch at length to larger fish since 1982. The total amount of fish aged in the commercial landings varied from 130 to 1,182 ages (Table B2.14).

Recreational fishery

Recreational landings at length were estimated seasonally (January-June and July-December) from 1982-2001 using the Marine Recreational Fisheries Statistics Survey (MRFSS). Recreational length sampling intensity varied from poorly sampled years in the beginning of the time series (1982-1987 average of 375 mt per 100 lengths) to relatively good sampling from the late 1980s to early 1990s (1988-1997 average of 109 mt per 100 lengths), and more recently

(1998-2001) the sampling intensity has decreased to an average of 179 mt per 100 lengths. Combined Massachusetts Division of Marine Fisheries (MADMF) spring and NEFSC spring surveys and the NEFSC fall survey were used to age recreational length frequencies by halfyear from 1982-2001.

Discard estimates and age compositions

Commercial fishery

Discards were estimated for the large mesh otter trawl (1982-2001), gillnet (1986-2001), and northern shrimp fishery (1982-2001; Table B2.15). Discard data for the small mesh trawl fishery was judged inadequate for estimating discards (Tables B2.15-16). Discard rates in the small mesh trawl fishery were assumed to be the same as for large mesh trawls and to have the same size distribution.

The survey culling ogive method was used in estimating both the discard magnitude and discard proportion at length for the large mesh trawl fishery on a yearly basis from 1982-1993 (Mayo et al. 1992). VTR data was used to estimate the discard magnitude from 1994-2001, and the survey method used to estimate only the discard proportion at length for these years (Table B2.17). Survey length frequency data (MADMF survey spring and fall) were smoothed using a three point moving average, then filtered through a mesh selection ogive (Simpson 1989) for 5 in mesh (1982), 5.5 in mesh (1983-1993), and a 6 in mesh (1994-2001). The 5.5 and 6 in mesh selection curve were calculated using the 5 inch curve adjusted to an L_{50} for 5.5 and 6 in mesh respectively. The choice of mesh sizes was based on sizes used in the American Plaice assessment for the Gulf of Maine (O'Brien and Esteves 2001). The mesh filtering process resulted in a survey length frequency of retained winter flounder. A logistic regression was used to model the percent discarded at length (culling ogive) from 1989-2000 observer data (Figures B2.8-9), and the resulting percentages at length were applied to the survey numbers at length data to produce the survey-based equivalent of commercial kept and discarded winter flounder. The 1989-1993 average percentage discard at length was applied to 1982-1993. The 1995-2000 average percentage discard at length was applied to 1994-2001. The survey numbers per tow at length "kept" were then regressed against commercial numbers landed at length. The linear relationship was calculated for those lengths common to both length frequencies and fitted with an intercept of zero. The slope of the regression provided a conversion factor to re-scale the survey "discard" numbers per tow at length to equivalent commercial numbers at length. The resulting vector of number of fish discarded at length was multiplied by a discard mortality rate of 50% (as averaged in Howell et al., 1992) to produce the vector of fish discarded dead at length per year. The number of dead discards at length was summed across lengths (and corresponding weight at length) to produce the annual total number and weight of commercial fishery discards for 1982-1993. NEFSC combined spring and fall survey age-length keys were applied to convert discard length frequencies to age.

The ASMFC Winter Flounder Technical Committee has considered NEFSC Fishery Observer data (OB), and NER Vessel Trip Report (VTR) data as sources of information to use in the estimation of commercial fishery discards (Tables B2.15-18). The Committee examined the characteristics of both the Fishery Observer and VTR discard data (number of trips/tows sampled, frequency distributions of discards to landings ratio per trip, mean and variance of annual/half-year discards to landings ratios), and concluded that the VTR sum discard to landed ratio aggregated over all trips provided the most reliable data from which to estimate large mesh trawl discards. VTR large mesh trawl gear discards to landings ratios were applied to the total commercial trawl fishery landings to estimate discards in weight from 1994 to 2001. The Fishery Observer length frequency samples were judged inadequate to characterize the proportion discarded at length for the trawl fishery and the length proportion from the survey method (described above) was used to characterize the size distribution of discarded fish (Table B2.16).

Fishery Observer discarded to landing ratios (annual total discards for all trips to annual total landings for all trips) were used for estimating gillnet discard rates, and observer discarded to days fished ratios (shrimp season total discards for all trips to total shrimp fishery days fished for all trips) were used for estimating shrimp discards, since landings of winter flounder in the shrimp fishery is prohibited (Table B2.18). Estimated annual total days fished in the shrimp fishery was calculated as in Wigley et al. 1999. Discard estimates in the shrimp fishery were based on a shrimp fishery season (December-April). The shrimp season catch at age was then adjusted to the appropriate calendar year and age using the proportion of calendar year landings. The average ratio for shrimp discards from 1989 to 1992 (before Nordmore grate requirement) was used for years (1982-1988) when observer data were not available. The 1989-1993 average gillnet ratios were used for 1986 to 1988.

The observer length frequency samples for gillnet and the northern shrimp fishery were used to characterize the proportion discarded at length. Total lengths from shrimp fishery observer discard data from 1989-1992 were used to characterize years 1982-1988 and total lengths from 1993-1997 were used for years 1998 to 2001. Total gillnet lengths from 1990-1993 were used to characterize years 1986 to 1989. Gillnet lengths in 1990 and 1992 were used to supplement lengths in 1991. The sample proportion at length, converted to weight, was used to convert the discard estimate in weight to numbers at length. As in the southern New England stock (NEFSC 1999), the resulting number of fish discarded at length was multiplied by a discard mortality rate of 50% (as averaged in Howell et al., 1992) to produce the number of fish discarded dead at length for all estimated commercial discard sources. Ages were determined using NEFSC/MADMF spring and NEFSC fall survey age-length keys.

Recreational fishery
A discard mortality of 15% was assumed for recreational discards (B2 category from MRFSS data), as assumed in Howell et al. (1992). Discard losses peaked in 1982 at 140,000 fish. Discards have since declined reaching a low in 1999 of 7,000 fish. In 2001, 15,000 fish were estimated to have been discarded (Table B2.7, Figure B2.7). Since 1997, irregular sampling of the recreational fisheries by state fisheries agencies has indicated that the discard is usually of fish below the minimum landing size of 12 inches (30 cm). For 1982-2001, the recreational discard has been assumed to have the same length frequency as the catch in the MADMF survey below the legal size and above an assumed hookable fish size (13 cm). When a size limit did not exist from 1982-1984 it was assumed that all fish discard were below 23 cm based on some length frequency information of discarded fish from the American Littoral Society tagging data. The recreational discard for 1982-2001 is aged using NEFSC/MADMF spring and NEFSC fall

survey age-length keys.

Mean Weights at Age in the Catch

Mean weights at age were determined for the landings and discards in the commercial and recreational fisheries (Figure B2.10). Length frequencies (cm) for each component were converted to weight (kg) using length-weight equations derived from NEFSC survey samples:

Spring surveys: $wt = 0.00000997 * length^{3.055236}$
Fall surveys: $wt = 0.00000925 * length^{3.095188}$

The equations from the spring and fall surveys were applied to catches during the corresponding time periods. The annual mean weights at age from the commercial and recreational fisheries were used in the virtual population analysis and yield per recruit calculations.

Total Catch

Estimates of the individual catch and mean weights at age components which made up the total catch are present in Tables B2.19 through B2.30 and Figure B2.11. The total catch during this period has varied from a high of 5,034 mt (14.2 million fish) in 1982 to a low of 300 mt (0.6 million fish) in 1999 (Tables B2.31-32). The total catch estimates include commercial and recreational landings and discards (Figure B2.12). Total catch and mean weights at age as aggregated for input to the VPA (ages 1-8+) are presented in Tables B2.33 and B2.34 (Figure B2.13). A summary of how the catch at age is was constructed can be seen in Table B2.35.

RESEARCH SURVEY ABUNDANCE AND BIOMASS INDICES

Research surveys

Mean weight and number per tow abundance indices were determined from spring (1979-2002) and fall (1979-2002) NEFSC and MADMF bottom trawl surveys (Table B2.36). Winter flounder are not found in the central Gulf of Maine and these strata (24, 28, 29, 37, and 36) were dropped from the index (Figures B2.14-15). Indices from the NEFSC spring and fall surveys were based on tows in offshore strata 26, 27, 38 to 40 and inshore strata 58 to 61, 65, and 66 (Figures B2.16-19). A longer spring (1968-2002) and fall (1963-2002) NEFSC survey index was also calculated which was limited to just offshore strata (26,27,38,39,40) since inshore strata were not sampled prior to 1979 in the Gulf of Maine (Figures B2.18-19). All MADMF strata sampled north of Cape Cod (25-36) were included in the index (Figures B2.20-21).

Survey trends by individual strata in the NEFSC survey suggests a decreasing trend in the northern part of the stock off the coast of Maine and an increasing trend in the southern stock component off Massachusetts which mirrors the trend seen in the landings by state and statistical area (Figures B2.16-17). Higher catches of winter flounder are seen in the MADMF survey with individual strata following similar trends. All of the indices generally dropped from the beginning of the time series in the early 1980s to a low point in the early to mid- 1990s, then increase slightly in the late 1990s (Table B2.36). All of the indices generally show increases during 1998 and 1999. Similar trends were seen between the inshore/offshore index and the index limited to just the offshore strata regardless of the increased variability in the offshore series due to less fish inhabiting the deeper waters of the offshore strata (Figures B2.18-19).

The Seabrook Nuclear Power Plant in New Hampshire has conducted a monthly bottom trawl survey at 3 fixed stations in Southern New Hampshire since 1975. Four replicate tows using a shrimp trawl were made at each station once per month from 1975-1983. Sampling changed to two replicate tows twice per month in 1985. Length data was collected from 1985-2001 with the exception of 1993. The monthly survey was broken down to a spring and fall survey. The Fall survey index was not used for tunning due to a lack of sampling in more recent years at one of the three stations because of the presence of lobster gear. In addition, appropriate age data in the fall does not exist for aging the smaller fish caught in this survey. MADMF spring survey ages were used to age the Seabrook spring index. This survey also shows an increase in the number of fish in the late 1990s (Figure B2.22).

MADMF catches a larger proportion of smaller fish than the NEFSC surveys. Survey numbers at age is summarized in Tables B2.37 through B2.41. No MADMF age data are currently available for the fall survey or for 2002 in the Spring. The NEFSC age data was used to age missing ages in the MADMF survey.

ESTIMATES OF MORTALITY AND STOCK SIZE

Natural Mortality

Instantaneous natural mortality (M) for winter flounder was assumed to be 0.20 and constant across ages as in the SNE winter flounder stock. Commercial catch at age included fish to age 13, under conditions of relatively high fishing mortality. If M = 0.25, less than 5% of the population would reach age 12 under conditions of no fishing mortality. Therefore, the SARC felt that M = 0.2, which represents a maximum age of 15, was representative of the stock.

Maturity

The VPA assessment uses the maturity schedule as published in O'Brien et al. (1993) for winter flounder north of Cape Cod, based on data from the MADMF spring trawl survey for strata 25-36 (state waters east and north of Boston and Cape Cod Bay) sampled during 1985-1989 (n = 215 males, n = 320 females). Those data provided estimates of lengths and ages of 50% maturity of 27.6 cm and 3.3 yr for males, and 29.7 cm and 3.5 yr for females, and estimated proportions mature at age as follows:

Age	1	2	3	4	5	6	7+
Males	0.00	0.04	0.34	0.87	0.99	1.00	1.00
Females	0.00	0.01	0.16	0.86	0.99	1.00	1.00

The female schedule (with the proportion at age 2 rounded down to 0.00 and the proportion at age 5 rounded up to 1.00) was used in the present VPA and YPR assessment.

The SARC has examined NEFSC spring trawl survey data over the 1981-2001 period in an attempt to better characterize the maturity characteristics of the Gulf of Maine winter flounder. Data were analyzed in 5-6 year blocks (1981-1985, 1986-1990, 1991-1995, and 1996-2001) and for the entire time period (1981-2001), for each sex and combined sexes (Tables B2.42-43). Observed proportions mature at age were tabulated, and from those data maturity ogives at length and age were calculated to provide estimated proportions mature at age.

In general, the NEFSC maturity data for the sexes combined indicated earlier maturity than the MADMF data, with L50% values ranging from 21-24 cm, rather than from 28-29 cm, and with 50% maturity for age 2.5 fish, rather than 50% maturity for age 3.3 fish (Table B2.42). To investigate the apparent inconsistency between the MADMF and NEFSC maturity data, the SARC compared the two data sets over the same time periods (1981-1985, 1986-1990, 1991-1995, 1996-2001, and 1981-2001) and area of survey coverage (MADMF strata 25-36; NEFSC inshore strata 58-66). For comparable time periods and geographic areas, the NEFSC maturity data still consistently indicated a smaller size and younger age of 50% maturity than the MADMF data. NEFSC L50% and A50% values range from 21-25 cm and about 2.5 yr, while the MADMF values range from 28-29 cm and about 3.3 yr (Table B2.44, Figure B2.23). The difference is still nearly a full age class difference at 50% maturity. These results are very similar to the differences seen between the MADMF and NEFSC surveys for the southern New England winter flounder stock.

Given that both length and age vary in the same direction, it seems unlikely that the differences could be attributed to aging differences between the two data sets. The comparison of MADMF and NEFSC maturity estimates over the same time period and location suggests the observed difference is not due to immature and mature fish in the 20 - 30 cm size-class being segregated by area e.g., mature fish in that size interval tending to occupy inshore areas during the spring with immature fish tending to remain offshore. The difference between MADMF and NEFSC surveys is consistent over time. The differences may be due to differences in interpretation of maturity stage for fish sizes between 20-30 cm between MADMF and NEFSC survey staff.

The SARC considered these data and analyses and the possible causes for the noted inconsistencies, and concluded that more detailed spatial and temporal analyses and/or a maturity workshop on the interpretation of maturity stages is needed before revisions to the maturity schedule can be adopted. Therefore, the maturity at age schedule published by O'Brien et al. 1993 was used for this assessment.

Virtual Population Analysis

Tuning

The Virtual Population Analysis (VPA) was tuned (calibrated) using the NEFSC Woods Hole Fisheries Assessment Compilation Toolbox (FACT) version 1.50 of the ADAPT VPA (Conser and Powers 1990). Abundance indices at age were available from several research surveys: NEFSC spring bottom trawl ages 1-8+, NEFSC fall ages 1-8+ (advanced to tune January 1 abundance of ages 2-8+), 1-5, Massachusetts spring ages 1-8+, Massachusetts fall ages 0-8+ (advanced to tune January 1 abundance of ages 1-8+), and Seabrook spring trawl survey ages 1-8+. Survey indices were selected for inclusion in VPA tuning based on consideration of the partial variance in a VPA trial run including all indices, residual error patterns from the various trail runs, and on the significance of the correlation among indices and with VPA abundance estimates from the trail run including all indices. A conditional non-parametric bootstrap procedure (Efron 1982) was used to evaluate the precision of fishing mortality and spawning stock biomass. A retrospective analysis was performed for terminal year fishing mortality, spawning stock biomass, and age 1 recruitment.

VPA diagnostics

The SARC considered 6 different configurations of tuning indices with the catch at age estimated to 8+ from 1982 to 2001. Run GOMWFS36_ALL was the initial trial including all indices. The results of the VPA were not sensitivity to the method used in estimating large mesh discards i.e. using the survey method only or using the survey method and vtr data to estimate discards (run GOMWFS36_survey). In addition, VPA result were not sensitivity to excluding all discards from the catch at age (GOMWFS36_no_dis). In general, tuning indices were excluded if they exhibited high partial variance (indicating a lack of fit within the VPA model) and low correlation with other indices with similar spatial and temporal characteristics and with the VPA estimates of stock size.

Run GOMWFS36_2 excluded six indices with high partial variance within the VPA and low correlation with other indices and/or the VPA estimates of stock size, resulting in improvements both in overall fit (Mean Square Residual (MSR) reduced by 25%) and in the precision of the stock size estimates. Run GOMWFS36_3 dropped an additional five indices from the GOMWFS36_2 configuration, resulting in some improvements in fit but this run also resulted in a decrease in the precision around age-1 stock numbers at age. Run GOMWFS36_no_age1 has the same survey indices as GOMWFS36_3, but did not estimate stock size at age 1, and provided virtually the same results. Therefore, GOMWFS36 _2 was the run adopted as final by the SARC, and is the basis for all further analyses (Table B2.45).

Fishing Mortality, Spawning Stock Biomass, and Recruitment

During 1982-1995, fishing mortality (fully recruited F, ages 5-6) has varied between 0.5 (1983) and 1.9 (1995). Fishing mortality has declined to a range of 0.06-0.14 during 1999-2001 (Figure B2.24). Accounting for the uncertainty of the 2001 estimate, there is an 80% probability that F in 2001 was between 0.12 and 0.16 (Table B2.46, Figure B2.25). Spawning stock biomass (SSB) declined from 4,790 mt in 1982 to a record low of 666 mt in 1995. SSB has increased since 1995 to 5,866 mt in 2001 (Figure B2.26). Accounting for the uncertainty of the 2001 estimate, there is an 80% probability that SSB in 2001 was between 5,203 mt and 6,581 mt (Figure B2.25). Recruitment declined continuously from 11.8 million age-1 fish in 1982 to 3.2 million in 1993. Recruitment then averaged 7.8 million fish during 1995-2002 (Figure B2.26).

Retrospective analysis
A retrospective analysis of the VPA was conducted back to a terminal catch year of 1995 (Table B2.45b, Figure B2.27). The Gulf of Maine winter flounder VPA does exhibit a retrospective pattern in F from 1993 to 1998. Retrospective fishing mortality rates underestimate the current values by an average of 56% from 1993-1998. The most likely cause of this pattern is a combination of factors including under-reporting of the landings, mis-classification of the landings by stock area, and underestimation of the discards. There is a tendency for an overestimation of SSB during the late 1990s. For 1993-1998, retrospective SSB levels overestimate current values by an average of 92%.

Precision of Stock Size, F, and SSB estimates
The precision of the 2002 stock size, fishing mortality at age in 2001, and SSB estimates from VPA was evaluated using bootstrap techniques (Efron 1982). Five hundred bootstrap iterations were realized in which errors (differences between predicted and observed survey values) were resampled. Bootstrap estimates of stock size at age indicate a bias of less than 5% for age 1-2 and a bias less than 4% for ages 3-8+. Bootstrap standard errors provide stock size CVs ranging from 16% at age 7 to 48% at age 1 (Table B2.46).

Bootstrapped estimates of spawning stock biomass indicate a CV of 9%, with low bias (bootstrap mean estimate of spawning stock biomass of 5,945 mt compared with VPA estimate of 5,866 mt). There is an 80% probability that spawning stock in 2001 was between 5,203 mt and 6,581 mt (Figure B2.25).

The bootstrap estimates of standard error associated with fishing mortality rates at age indicate good precision. Coefficients of variation for F estimates ranged from 16% at age 7 to 37% at ages 1. There is an 80% probability that fully recruited F for ages 5-6 in 2001 was between 0.12 and 0.16 (Figure B2.25).

BIOLOGICAL REFERENCE POINTS

The ASMFC Winter Flounder Technical Committee followed the parametric modeling approach done for SNE winter flounder by the NEFSC Working Group on the Re-Evaluation of Biological Reference Points for New England Groundfish (RPWG; NEFSC 2002) in estimating biological reference points for Gulf of Maine winter flounder. The RPWG (NEFSC 2002) estimated biological reference points using yield and SSB per recruit (Thompson and Bell 1934) and Beverton-Holt/Ricker stock-recruitment models (Beverton and Holt 1957, Brodziak et al. 2001, Mace and Doonan 1988).

Yield and Spawning Stock Biomass per Recruit

The yield and SSB per recruit analyses was estimated by the Technical Committee for Gulf of Maine winter flounder. Natural mortality was assumed to be 0.2. The proportion mature was taken from O'Brien et. al (1993). The average partial recruitment pattern form 1999-2001 was used for ages 1 to 4. Full recruitment was assumed for 5 and older. The average catch weight from 1999-2001 was used for ages 1 to 7 and the Rivard weights were used for the stock weights for ages 1 to 7. An estimated von bertalanffy model for female Gulf of Maine winter flounder using MADMF data from Witherell and Burnett (1993) was used to estimate catch and stock weights for ages 8 to 15. The von Bertalanffy model for females was used since survey data indicates a skewed sex ratio for older ages. The yield and SSB per recruit analyses indicate that $F_{40\%}$ and $F_{0.1}$ = 0.26 (Table B2.47, Figure B2.28). F_{max} was estimated to be 0.69.

Empirical Nonparametric approach

If $F_{40\%}$ is assumed to be an adequate proxy for Fmsy, then the fishing mortality threshold is 0.26. This fishing mortality rate produces 0.8333 kg of spawning stock biomass per recruit and 0.1977 kg of yield per recruit (including discards). Since the VPA estimates of recruitment does not increase greatly with increasing spawning stock size, the mean of the time-series of recruitments (1982-2001) is assumed to be representative of recruitment levels expected at maximum sustainable yield (MSY). Thus, recruitment of 6.705 million fish results in an estimate of 5,587 mt of spawning stock biomass (SSBmsy proxy) and 1,326 mt of MSY.

Parametric Model Approach

Maximum likelihood fits of the 10 parametric stock-recruitment models to the Gulf of Maine winter flounder VPA estimates for 1982-2001 are listed below (Table B2.48). The model acronyms are: BH = Beverton-Holt, ABH = Beverton-Holt with autoregressive errors, PBH = Beverton-Holt with steepness prior, PABH = Beverton-Holt with steepness prior and autoregressive errors, PRBH = Beverton-Holt with recruitment prior, PRABH = Beverton-Holt with recruitment prior and autoregressive errors, RK = Ricker, ARK = Ricker with autoregressive errors, PRK = Ricker with slope at the origin prior, PARK = Ricker with slope at the origin prior and autoregressive errors. The six hierarchical criteria are applied to each of the models to determine the set of candidate models (NEFSC 2002).

1. Parameter estimates must not lie on the boundary of their feasible range of values.
2. The estimate of MSY lies within the range of observed landings.
3. The estimate of S_{msy} is not substantially greater than the nonparametric proxy estimate.
4. The estimate of F_{msy} is not substantially greater than the value of F_{max}.
5. The dominant frequencies for the autoregressive parameter, if applicable, lie within the range of one-half of the length of the stock-recruitment time series.
6. The estimate of recruitment at S_{max}, the maximum spawning stock size proxy input to the stock-recruitment model, is consistent with the value of recruitment used to compute the nonparametric proxy estimate of S_{msy}.

The fifth criterion is not satisfied by the ABH, PABH, PRABH, ARK, and PARK models. The RK, and ARK models do not satisfy criterion 4. The stock-recruitment data does not support overcompensatory effects at SSB predicted by the PRK model (Ricker model with slope at the origin prior). The three remaining models are BH, PBH, and PRBH. All three models estimated a high steepness parameter. The AIC assigns the greastest probability to the BH model (Figure B2.29). However similar point estimates of MSY, F_{msy}, and S_{msy} are estimated by all three models. The standardized residual plot of the fit of the BH model to the stock-recruitment data shows that the standardized residuals generally lie within $\pm$ two standard deviations of zero.

The SARC selected the parametric Berverton-Holt (BH) model for estimating biological reference points for Gulf of Maine winter flounder; MSY = 1,543 mt, F_{msy} = 0.43, SSB_{msy} = 4,104 mt. The SARC concluded that the high steepness estimates from the Beverton-Holt models were within the feasible biological range and therefore estimating F_{msy} using the (BH) parametric approach was preferred over assuming $F_{msy} = F_{40\%}$ in the empirical nonparametric approach. The high steepness estimate also likely resulted in similar estimates of SSB_{msy} between the empirical and parametric approach.

PROJECTIONS FOR 2002-20012

Stochastic projections were made based on 500 bootstrapped VPA realizations of stock size in numbers at age in 2002. The stochastic forecasts only incorporate uncertainty in 2002 stock sizes due to survey variability and assume current discard to landings proportions. Partial recruitment to the fishery and percentage discarded were estimated as the mean of VPA estimates for 1999-2001. For consistency with the partial recruitment averages, mean weights at age in the stock, landings, and discards were similarly estimated as the weighted (by number landed) geometric mean weight at age from 1999-2001.

Parametric approach

Assuming F in 2002 will be equal to F in 2001 (F2002 = 0.14), landings are expected to be about 961 mt in 2002. At this status quo F, spawning stock biomass is projected to continue to increase to 7,623 mt in 2002. If fishing mortality rate is increased to F_{msy} = 0.43 in 2003 spawning stock will decrease to 4,258 mt by 2013 with 50% probability which is slightly above the B_{msy} = 4,104 mt estimate (Table B2.49).

If F in 2002 is assumed to be 15% less than F in 2001 (F2002 = 0.12), due to the impact of management measures implemented in response to court orders during 2002, then landings are expected to be about 831 mt in 2002. At this reduced F, spawning stock biomass is projected to continue to increase to 7,655 mt in 2002. If fishing mortality rate is increased to F_{msy} = 0.43 in 2003 spawning stock will decrease to 4,260 mt by 2013 with 50% probability which is slightly above the B_{msy} = 4,104 mt estimate (Table B2.49, Figure B2.30).

CONCLUSIONS

The Gulf of Maine winter flounder stock is not overfished and overfishing is not occurring (Figure B2.31). Fully recruited fishing mortality in 2001 was 0.14 (exploitation rate = 12%), about 67% below F_{msy} = 0.43. There is an 80% chance that the 2001 F was between 0.12 and

0.16. Spawning stock biomass was estimated to be 5,900 mt in 2001, about 44% above B_{msy} = 4,100 mt. There is an 80% chance that the spawning stock biomass was between 5,200 mt and 6,600 mt in 2001.

Spawning stock biomass declined substantially from 4,800 mt in 1982 to700 mt in 1995, but has increased to about 5,900 mt in 2001 due to reduced fishing mortality rates since 1996. Recruitment to the stock has been near or above average since 1995.

For 1993-1998 retrospective fishing mortality rates underestimate the current values by an average of 56%. The most likely cause of this pattern is a combination of factors including under-reporting of the landings, mis-classification of the landings by stock area, and underestimation of the discards. For 1993-1998, retrospective SSB levels overestimate current values by an average of 92%. While the GOM winter flounder VPA provides uncertain estimates of current F and SSB, it provides a better determination of stock status than reliance on survey indices alone. However, recent spatial distribution of both commercial landings and survey catches indicates that most of the recent stock rebuilding has taken place off the Massachusetts coast, with little evidence of rebuilding off the Maine coast.

Biological reference points for Gulf of Maine winter flounder were estimated using empirical, non-parametric and parametric stock-recruit modeling approaches. The yield and SSB per recruit analyses indicate that $F_{40\%}$ = $F_{0.1}$ = 0.26 and F_{max} = 0.69. A parametric Beverton-Holt stock-recruitment model estimated values of F_{msy} = 0.43, B_{msy} = 4,100, and MSY = 1,500 mt. The SARC recommends that the parametric model reference points be adopted as the basis for the ASMFC and NEFMC FMP overfishing definitions.

SARC COMMENTS

The SARC noted that a single survey length-weight relationship has been used for SNE-MA, GOM and GB winter flounder stocks, and suggested stock-specific parameters be explored in the next assessment.

The VPA indicates substantial rebuilding of the stock since 1995. The stock status of GOM winter flounder is somewhat unique among GOM groundfish stocks, as it is currently at a relatively high stock biomass and apparently subject to relatively low fishing mortality. The recent spatial distribution of commercial landings and survey catches indicates that most of the recent stock rebuilding has taken place off the Massachusetts coast, with little evidence of rebuilding off the Maine coast. This situation may be attributed to the restrictive regulations imposed in recent years in the areas where much of the current biomass is concentrated (e.g. area closures and gear and vessel restrictions in statistical areas 513 and 514).

The GOM winter flounder VPA, like the SNE-MA analysis, exhibits a retrospective pattern of underestimating fishing mortality (averaging 56%) and overestimating SSB (averaging 92%) during the period 1993-1998. The observed retrospective pattern is likely caused by under-reporting or under-estimating the catch. The SARC concluded that, while the GOM winter flounder VPA provides uncertain estimates of current F and SSB, it provides a better determination of stock status than would reliance on survey indices alone.

As this is a new, benchmark analytical assessment for GOM winter flounder, biological reference points based on the analytical results have been estimated for the first time. The SARC discussed options for the analyses to be used as the basis for defining overfishing. It was noted that the ASMFC Winter Flounder Technical Committee preferred the empirical non-parametric approach, based on concerns over the relatively high stock resilience (i.e. relatively high estimates of the model steepness parameter, and therefore the estimated F_{MSY}) of the stock inferred from the stock-recruitment models. The SARC agreed with the Technical Committee's conclusion to reject the Ricker stock-recruitment model estimates of reference points, based on: 1) the lack of evidence of population dynamics (e.g. cannibalism, high degree of spatial interference among adults and recruits) that would justify a high degree of density-dependent compensation in recruitment; and 2) the lack of VPA or hindcast stock-recruitment estimates at biomass levels where there might be such compensation. The SARC concluded that the Beverton-Holt stock-recruitment model provided reasonable reference points for the stock, and recommended that they be adopted as the basis for the ASMFC and NEFSC FMP overfishing definitions.

SOURCES OF UNCERTAINTY

1) Stock-specific landings data for 1994 and later are derived by proration from Vessel Trip Report data and are considered provisional.

2) The lack of a long time series of survey coverage in inshore New Hampshire and Maine waters, where winter flounder are abundant, is a source of uncertainty. The small number of survey tows in inshore Massachusetts strata in the NEFSC survey results in uncertainty in the index.

3) Length frequency sampling intensity of the commercial and recreational fishery landings has been low in some recent years, and likely increases the uncertainty of the estimated landings at age.

4) Observer sampling intensity of the commercial trawl fishery has been low. Shrimp fishery discard sampling has been discontinued in recent years. Commercial fishery discard estimates are based on rates provided by fishers in the Vessel Trip Reports, owing to inadequate Fishery Observer sampling.

5) Scales and otoliths collected by the MADMF fall survey are not aged. In addition, the MADMF 2002 spring survey scales and otoliths were not aged, which likely resulted in an underestimation of the high incoming recruitment evident from the length frequency distributions in the Fall 2000 and Spring 2002 surveys.

6) Differences in the age at maturity between the MADMF and NEFSC spring surveys are a source of uncertainty.

7) The Gulf of Maine winter flounder VPA exhibits a retrospective pattern of underestimating F from 1993 to 1998 and overestimating SSB during the late 1990s.

RESEARCH RECOMMENDATIONS

New

1) The MADMF fall survey does collect winter flounder otoliths and scales, so ageing such material should be undertaken.

2) Increase the number of tows and/or consistently sample inshore strata in the NEFSC bottom trawl survey.

3) Increase MRFSS length sampling intensity in the recreational fishery.

4) Increase temporal and market category coverage of length sampling in the commercial landings.

5) Increase the intensity of observer sampling especially with small- and large-mesh trawl gear.

6) Examine the sources of discrepancy between NEFSC and MA survey maturity estimates.

7) Initiate periodic maturity staging workshops, involving State and NEFSC trawl survey staff.

8) Incorporate the results from the MEDMR research trawl survey (begun in 2001) into the assessment as they become available.

9) Investigate derivation of stock-specific parameters for the next assessment.

10) Attempt use of a forward projection (statistical catch at age model) in the next assessment.

Old

1) Examine the implications of anthropogenic mortalities caused by pollution and power plant entrainment in estimating yield per recruit, if feasible.

2) Examine growth variations within the Gulf of Maine, using results from the Gulf of Maine Biological Sampling Survey (1993-1994).

3) Further examine the stock boundaries to determine if Bay of Fundy winter flounder should be included in the Gulf of Maine stock complex.

Old: completed

1) Process archived age samples from NEFSC surveys and commercial landings, and develop an analytical age based assessment.

2) Estimate biological reference points for Gulf of Maine winter flounder.

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Table B2.1. Winter flounder commercial landings (metric tons) for the Gulf of Maine stock (U.S. statistical reporting areas 512 to 515). Landings from 1964-1981 is taken directly from SARC 21, 1982-1993 is re-estimated from the wodets, data and 1994-2001 is estimated using prorated dealer and VTR data.

Year	metric tons
1964	1,081
1965	665
1966	785
1967	803
1968	864
1969	975
1970	1,092
1971	1,113
1972	1,085
1973	1,080
1974	885
1975	1,181
1976	1,465
1977	2,161
1978	2,194
1979	2,021
1980	2,437
1981	2,406
1982	2,793
1983	2,096
1984	1,699
1985	1,582
1986	1,188
1987	1,140
1988	1,250
1989	1,253
1990	1,116
1991	1,008
1992	825
1993	611
1994	552
1995	796
1996	600
1997	618
1998	637
1999	253
2000	382
2001	571

Table B2.2. Percent commercial landings by gear for Gulf of Maine winter flounder.

Year	otter trawl	shrimp trawl	gillnet	other
1964	96%		1%	3%
1965	95%	-	2%	3%
1966	98%	-	1%	2%
1967	99%	-	-	1%
1968	98%	-	-	2%
1969	99%	-	-	1%
1970	99%	-	1%	-
1971	95%	-	4%	1%
1972	95%	-	4%	1%
1973	97%	-	2%	-
1974	95%	-	5%	-
1975	92%	4%	1%	3%
1976	87%	2%	6%	5%
1977	93%	1%	3%	3%
1978	89%	-	3%	9%
1979	94%	-	1%	5%
1980	95%	-	1%	4%
1981	92%	3%	1%	3%
1982	89%	5%	2%	4%
1983	87%	7%	3%	4%
1984	85%	8%	2%	6%
1985	91%	4%	1%	4%
1986	77%	6%	14%	4%
1987	74%	8%	12%	5%
1988	81%	5%	13%	1%
1989	80%	5%	11%	4%
1990	77%	2%	19%	2%
1991	86%	2%	9%	2%
1992	77%	2%	19%	2%
1993	75%	-	23%	2%
1994	78%	-	21%	1%
1995	66%	-	32%	3%
1996	72%	-	27%	1%
1997	72%	-	27%	1%
1998	73%	-	27%	1%
1999	65%	-	33%	1%
2000	73%	-	26%	1%
2001	77%	-	22%	1%

Table B2.3. Percent commercial landings by state for Gulf of Maine winter flounder.

Year	ME	NH	MA	RI
1964	3%	-	97%	-
1965	7%	-	93%	-
1966	6%	-	94%	-
1967	6%	-	94%	-
1968	3%	-	97%	-
1969	4%	-	96%	-
1970	13%	-	87%	-
1971	6%	-	93%	1%
1972	12%	-	88%	-
1973	9%	-	91%	-
1974	13%	-	87%	-
1975	20%	-	80%	-
1976	12%	-	88%	-
1977	9%	-	91%	-
1978	14%	-	86%	-
1979	21%	-	79%	-
1980	23%	-	77%	-
1981	27%	2%	71%	-
1982	32%	4%	64%	-
1983	31%	4%	65%	-
1984	23%	6%	71%	-
1985	21%	5%	74%	1%
1986	22%	4%	73%	-
1987	19%	8%	72%	1%
1988	22%	9%	69%	-
1989	18%	9%	72%	-
1990	14%	7%	78%	-
1991	16%	7%	76%	-
1992	14%	7%	79%	-
1993	8%	6%	86%	-
1994	5%	7%	88%	-
1995	3%	4%	93%	-
1996	1%	5%	94%	-
1997	3%	2%	95%	-
1998	1%	2%	97%	-
1999	-	3%	97%	-
2000	-	4%	95%	1%
2001	1%	3%	96%	-

Table B2.4. Percent commercial landings by statistical area for Gulf of Maine winter flounder.

Year	511	512	513	514	515
1964	-	2%	1%	96%	-
1965	-	1%	6%	92%	1%
1966	-	2%	7%	90%	-
1967	-	1%	6%	94%	-
1968	-	2%	1%	97%	-
1969	-	1%	4%	95%	-
1970	-	1%	12%	87%	-
1971	-	1%	6%	93%	-
1972	-	1%	12%	87%	-
1973	-	1%	8%	91%	-
1974	-	2%	11%	87%	-
1975	1%	2%	18%	79%	-
1976	-	1%	13%	86%	-
1977	-	2%	9%	89%	-
1978	-	3%	13%	83%	-
1979	2%	4%	18%	77%	-
1980	1%	3%	20%	76%	1%
1981	-	3%	27%	69%	1%
1982	3%	5%	27%	62%	2%
1983	2%	4%	29%	64%	1%
1984	1%	3%	27%	68%	1%
1985	4%	2%	21%	70%	2%
1986	4%	5%	26%	64%	2%
1987	2%	3%	25%	69%	1%
1988	4%	6%	22%	67%	1%
1989	1%	5%	24%	69%	2%
1990	4%	3%	21%	71%	1%
1991	2%	1%	23%	68%	5%
1992	1%	3%	21%	73%	3%
1993	1%	-	17%	81%	2%
1994	-	2%	14%	81%	2%
1995	2%	9%	8%	80%	1%
1996	-	-	9%	90%	1%
1997	-	-	9%	90%	1%
1998	-	-	4%	96%	-
1999	-	-	3%	94%	2%
2000	1%	-	5%	94%	-
2001	-	-	4%	95%	-

Table B2.5. Percent commercial landings by quarter for Gulf of Maine winter flounder.

year	1	2	3	4
1964	21%	31%	22%	27%
1965	22%	27%	11%	40%
1966	21%	23%	8%	48%
1967	15%	35%	8%	42%
1968	12%	39%	17%	32%
1969	23%	37%	15%	26%
1970	19%	40%	11%	30%
1971	25%	33%	19%	22%
1972	23%	34%	18%	25%
1973	24%	27%	16%	33%
1974	22%	30%	7%	41%
1975	18%	25%	17%	40%
1976	22%	18%	18%	42%
1977	24%	19%	13%	44%
1978	21%	32%	12%	35%
1979	13%	28%	17%	42%
1980	17%	30%	16%	37%
1981	23%	28%	14%	34%
1982	24%	28%	9%	38%
1983	28%	31%	12%	30%
1984	29%	27%	8%	36%
1985	26%	31%	10%	33%
1986	33%	32%	7%	29%
1987	29%	34%	7%	30%
1988	30%	29%	7%	34%
1989	27%	39%	8%	27%
1990	27%	38%	10%	26%
1991	26%	32%	9%	32%
1992	26%	36%	7%	32%
1993	18%	37%	11%	34%
1994	13%	38%	11%	38%
1995	22%	38%	15%	25%
1996	20%	38%	10%	32%
1997	18%	34%	16%	31%
1998	16%	44%	13%	28%
1999	13%	44%	17%	25%
2000	15%	39%	17%	29%
2001	9%	41%	17%	32%

Table B2.6. Percent commercial landings by market category for Gulf of Maine winter flounder.

year	unclassified	small	medium	large
1964	77%	-	-	23%
1965	66%	-	-	34%
1966	68%	-	-	32%
1967	78%	-	-	22%
1968	70%	-	-	30%
1969	71%	-	-	29%
1970	75%	-	-	25%
1971	71%	-	-	29%
1972	64%	-	-	36%
1973	-	40%	-	60%
1974	-	38%	-	62%
1975	-	31%	-	69%
1976	-	42%	-	58%
1977	-	53%	-	47%
1978	-	50%	-	50%
1979	-	51%	-	49%
1980	-	49%	-	50%
1981	3%	47%	-	50%
1982	12%	41%	2%	44%
1983	15%	48%	3%	35%
1984	15%	46%	7%	33%
1985	11%	41%	17%	31%
1986	17%	39%	16%	29%
1987	22%	36%	20%	23%
1988	19%	42%	17%	22%
1989	20%	35%	20%	25%
1990	22%	34%	15%	29%
1991	15%	34%	22%	29%
1992	16%	33%	23%	29%
1993	14%	32%	29%	25%
1994	14%	33%	28%	26%
1995	12%	46%	18%	25%
1996	10%	56%	17%	18%
1997	10%	46%	25%	20%
1998	29%	44%	18%	9%
1999	42%	32%	18%	7%
2000	36%	41%	14%	9%
2001	36%	30%	28%	6%

Table B2.7. Estimated number (000's) and weight (mt) of winter flounder caught, landed, and discarded in the recreational fishery, Gulf of Maine stock.

	Numbers (000's)				Metric Tons
Year	Catch A+B1+B2	Landed A+B1	Released B2	15 % Release Mortality	Landed A+B2
1981	6,200	5,433	767	115	2,554
1982	8,207	7,274	933	140	1,876
1983	2,169	1,988	181	27	868
1984	2,477	2,285	191	29	1,300
1985	3,694	3,220	474	71	1,896
1986	946	691	255	38	523
1987	3,070	2,391	679	102	1,809
1988	953	841	111	17	345
1989	1,971	1,678	294	44	620
1990	786	652	134	20	370
1991	213	154	59	9	91
1992	186	137	48	7	90
1993	396	249	147	22	140
1994	232	145	87	13	83
1995	150	82	68	10	39
1996	184	98	86	13	56
1997	192	64	129	19	43
1998	109	65	44	7	30
1999	115	67	48	7	34
2000	177	75	102	15	42
2001	172	72	100	15	43

Table B2.8. Gulf of Maine winter flounder recreational landings (mt) by state.

Year	ME	NH	MA	total
1981	45	55	2,455	2,554
1982	2	20	1,855	1,876
1983	11	36	821	868
1984	5	68	1,227	1,300
1985	4	28	1,864	1,896
1986	112	21	390	523
1987	1	12	1,796	1,809
1988	0	15	329	345
1989	197	20	402	620
1990	265	5	100	370
1991	23	0	68	91
1992	16	13	61	90
1993	37	9	94	140
1994	2	12	68	83
1995	0	4	35	39
1996	0	5	51	56
1997	17	6	20	43
1998	1	12	18	30
1999	0	6	27	34
2000	0	4	37	42
2001	1	7	36	43

Table B2.9. Percent Gulf of Maine winter flounder recreational landings (mt) by state.

Year	ME	NH	MA
1981	2%	2%	96%
1982	0%	1%	99%
1983	1%	4%	95%
1984	0%	5%	94%
1985	0%	1%	98%
1986	21%	4%	75%
1987	0%	1%	99%
1988	0%	4%	95%
1989	32%	3%	65%
1990	72%	1%	27%
1991	25%	0%	75%
1992	18%	14%	67%
1993	27%	6%	67%
1994	3%	15%	82%
1995	0%	11%	89%
1996	0%	9%	91%
1997	40%	13%	46%
1998	2%	38%	60%
1999	0%	19%	81%
2000	0%	10%	90%
2001	1%	15%	83%

Table B2.10. Gulf of Maine winter flounder recreational landing (mt) by halfyear.

Year	halfyear 1	halfyear 2	total
1981	1,407	1,148	2,554
1982	517	1,359	1,876
1983	455	413	868
1984	599	701	1,300
1985	1,742	154	1,896
1986	485	39	523
1987	415	1,393	1,809
1988	211	134	345
1989	127	493	620
1990	52	318	370
1991	39	52	91
1992	24	66	90
1993	50	91	140
1994	38	45	83
1995	27	13	39
1996	39	17	56
1997	32	11	43
1998	15	15	30
1999	23	11	34
2000	14	28	42
2001	26	17	43

Table B2.11. Percent Gulf of Maine winter flounder recreational landing by halfyear.

year	halfyear 1	halfyear 2
1981	55%	45%
1982	28%	72%
1983	52%	48%
1984	46%	54%
1985	92%	8%
1986	93%	7%
1987	23%	77%
1988	61%	39%
1989	20%	80%
1990	14%	86%
1991	43%	57%
1992	27%	73%
1993	36%	64%
1994	46%	54%
1995	68%	32%
1996	69%	31%
1997	74%	26%
1998	50%	50%
1999	67%	33%
2000	33%	67%
2001	60%	40%

Table B2.12. Number of lengths, samples, and metric tons per sample for Gulf of Maine winter flounder. Number of samples and calculations of metric tons per samples does not include observer data or gillnet landings from 1990-2001. * = redistributed according to market category and halfyear proportions. Bold are lengths from observer trawl data.

		Number of lengths.					Number of samples					mt/samples				
year	Qtr	lg	sm	med	un	total	lg	sm	Med	un	total	lg	sm	med	un	total
1982	1				296					3						
	2	102	101		159		1	1		1		838	453		46	
	3	84	81		106		1	1		1						
	4					929					9	396	691		231	310
1983	1	80		99			1		1							
	2	300	100		407		3	1		4		120	510		53	
	3	108	388				1	3								
	4	107	956		106	2651	1	8		1	24	125	44	64	95	87
1984	1	201	209				2	2								
	2	237	294		221		3	2		2		74	95			
	3		123					1								
	4	126	690	100		2201	1	5	1		19	189	67	114	124	89
1985	1	273	565				3	3								
	2	392	170				3	2				54				
	3	105					1									
	4	116			80	1701	1			1	14	87		182	176	113
1986	1				266					3						
	2	237	109	109			3	1	1				242	126	48	
	3		111	86				1	1							
	4		389	107	89	1503		5	1	1	17	113	37	31	56	70
1987	1				113					1						
	2															
	3		95					1								
	4	47	156	272		683	1	2	3		8	257	137	75	249	143
1988	1		258	311				3	3							
	2	102		395*			1		4*				108	23		
	3															
	4		169	107*		1342		2	1*		14	340	164	96		89
1989	1				100					1						
	2	113		91	**134**		1		1					168		
	3		95	120	**32**			1	1							
	4			100		785			1		6	313	435	42	254	209
1990	1	328	301				3	4								
	2				102					1		64	48			
	3															
	4	117	197	97		1142	1	2	1		12	83	90	138	118	75

Table B2.12 Continued.

Year	qtr	Number of lengths. lg	sm	med	un	total	Number of samples lg	sm	med	un	total	mt/samples lg	sm	med	un	total
1991	1	100	51	105	101		1	1	1	1						
	2	88	203	100	**42**		1	2	1			92	72			
	3		95					1								
	4	236	254			1375	3	3			15	32	47	95	115	65
1992	1	110			**107**		1									
	2	136	100	93			2	1	1			47	119	84		
	3															
	4	57	74	253		930	1	1	3		10	75	134	19		67
1993	1	100					1									
	2			288					3			83		16		
	3		55		**91**			1								
	4	80		157	**51**	822	1		2		8	47	177	30		59
1994	1															
	2		71	92	102			1	1	1				75		
	3															
	4	94		235		594	1		3		7	112	143	15	60	62
1995	1	101		175	**63**		1		2							
	2			299					3					37		
	3			414					4							
	4				**609**	1661					10	134		42		55
1996	1		77					1								
	2		231					2					44			
	3		355	252				2	3							
	4	84	440	86	**112**	1637	1	5	1		15	80	16	18		29
1997	1		204					2								
	2		127	75*				2	1*				28	66		
	3		220	218				2	3							
	4	307	502	56*		1709	4	8	1*		23	25	11	14		19
1998	1		148	79				2	1							
	2		151	201*				3	2*				34	29		
	3		583					7								
	4	69	163	110*		1504	1	2	1*		19	65	14	30		25
		↑					↑									
1999	1			104					1							
	2			171					2							
	3		28					1								
	4		52		**408**	763		1			5		26	10		34

Table B2.12. Continued.

		Number of lengths.					Number of samples					mt/samples				
year	qtr	lg	sm	med	un	total	lg	sm	med	un	total	lg	sm	med	un	total
2000	1		866	143	**480**			12	2							
	2		3441	51	**554**			45	1				1			
	3		102		**50**			2								
	4		114		**26**	5827		2			64		12	13		4
2001	1			187	**172**				2							
	2	99	157	189	**630**		1	2	3				37	10		
	3		100	52	**399**			1	1							
	4		154	198	**1307**	3644		2	2		14	26	21	24		32

Table B2.13. Number of kept observer lengths, trips, and gillnet metric tons landed per 100 lengths sampled for Gulf of Maine winter flounder.

Year	half	lengths	trips	gillnet landings (mt)	mt/100 lengths
1990	1	539	90	184	
	2	78	1	29	
		617	91	214	35
1991	1	126	6	81	
	2	30	8	13	
		156	14	94	60
1992	1	1950	39	134	
	2	172	25	26	
		2122	64	160	8
1993	1	2004	63	96	
	2	375	20	42	
		2379	83	138	6
1994	1	330	22	101	
	2	206	10	15	
		536	32	115	21
1995	1	1116	20	217	
	2	306	23	35	
		1422	43	253	18
1996	1	1275	26	146	
	2	118	17	19	
		1393	43	164	12
1997	1	793	18	139	
	2	42	4	27	
		835	22	166	20
1998	1	1162	19	141	
	2	431	8	32	
		1593	27	173	11
1999	1	747	5	78	
	2	526	12	7	
		1273	17	85	7
2000	1	911	8	85	
	2	261	4	15	
		1172	12	100	9
2001	1	862	15	94	
	2	42	2	32	
		904	17	126	14

Table B2.14. Gulf of Maine winter flounder numbers of fish aged.

	NEFSC			MA DMF	
Year	Commercial landings	Spring	Fall	Spring	Fall
1982	483	68	94	133	
1983	1182	150	104	159	
1984	908	63	150	139	
1985	318	135	160	97	
1986	344	84	62	57	
1987	130	118	67	125	
1988	249	127	68	104	7
1989	148	60	88	320	
1990	241	122	111	224	
1991	262	174	179	333	
1992	270	144	148	362	
1993	183	91	107	172	
1994	139	122	134	253	149
1995	248	170	55	213	221
1996	246	97	181	324	
1997	295	103	189	286	
1998	341	122	75	135	
1999	149	171	194	146	
2000	883	176	216	160	
2001	246	154	118	166	

Table B2.15. Gulf of Maine winter flounder discard ratios and number of trips/tows in the observer and VTR data for the large mesh, small mesh and gillnet fishery.

		Large Mesh Otter Trawl					Small Mesh Otter Trawl					Gillnet				
Year	Half-year	# trips	#tows	SS ratio	VTR trips	VTR ratio	# trips	#tows	SS ratio	VTR trips	VTR ratio	# trips	#tows	SS ratio	VTR trips	VTR ratio
1989	Jan-Jun	15	44	0.130			2	3	0.200							
	Jul-Dec	7	16	0.071			10	25	0.290			26	62	**0.084**		
1990	Jan-Jun	5	6	0.167								50	164	**0.166**		
	Jul-Dec	6	14	0.287			2	3	0.333			33	63	**0.223**		
1991	Jan-Jun	8	25	0.072			4	14	0.029			73	164	**0.164**		
	Jul-Dec	23	103	0.055			8	18	1.152			321	618	**0.142**		
1992	Jan-Jun	21	48	0.098			1	1	0.000			257	617	**0.130**		
	Jul-Dec	6	22	0.039			3	11	0.068			224	397	**0.114**		
1993	Jan-Jun	1	1	0.600								196	576	**0.150**		
	Jul-Dec	4	12	0.080			3	10	0.153			97	198	**0.107**		
1994	Jan-Jun	1	1	0.000	445	**0.053**				23	0.151	43	101	**0.174**	249	0.229
	Jul-Dec				1422	**0.062**				524	0.092	15	35	**0.103**	648	0.091
1995	Jan-Jun	4	15	1.101	2417	**0.048**				229	0.217	18	54	**0.285**	907	0.150
	Jul-Dec	3	52	0.011	1149	**0.037**	22	57		123	0.322	19	52	**0.201**	548	0.388
1996	Jan-Jun	2	5	0.068	2196	**0.044**	1	1		60	0.254	17	62	**0.128**	589	0.159
	Jul-Dec	2	19	0.013	1227	**0.035**	26	93	3.344	219	1.807	18	39	**0.066**	364	0.553
1997	Jan-Jun	3	13	0.231	1700	**0.034**	1	4	0.218	22	0.064	18	56	**0.245**	470	0.112
	Jul-Dec				887	**0.023**				149	0.136	10	22	**0.272**	291	0.087
1998	Jan-Jun	5	16	0.233	1809	**0.046**				17	0.046	27	87	**0.109**	543	0.144
	Jul-Dec				939	**0.030**				129	0.024	35	66	**0.049**	329	0.117
1999	Jan-Jun				942	**0.038**				15	0.034	14	41	**0.141**	285	0.136
	Jul-Dec	15	35	0.015	1148	**0.038**	13	35		123	0.516	23	60	**0.100**	359	0.090
2000	Jan-Jun	35	78	0.041	1240	**0.060**	7	10	0.123	28	0.192	27	74	**0.137**	378	0.094
	Jul-Dec	6	8	0.000	1418	**0.032**	6	13	0.170	52	0.165	18	39	**0.098**	472	0.088
2001	Jan-Jun	27	61	0.100	1289	**0.029**				3	0.054	13	27	**0.061**	340	0.095
	Jul-Dec	51	129	0.037	1272	**0.045**	2	3	0.000	88	0.052	9	21	**0.101**	523	0.107

Table B2.16. Gulf of Maine winter flounder discard lengths from observer data. MADMF observer length data in the small mesh otter trawl was also added to the table (6 tows, 2 trips, and 213 lengths in 1994; 55 tows, 20 trips, and 891 lengths in 1999; 20 tows, 8 trips, and 637 lengths in 2000).

		large-mesh trawl			small mesh otter trawl			shrimp fishery			gillnet		
YEAR		H1	H2		H1	H2		H1	H2		H1	H2	
1989	tows	13		13		7	7	12	2	14		1	1
	trips	9		9		4	4	6	1	7		1	1
	lengths	116		116		239	239	347	79	426		2	2
1990	tows			0			0	3		3	20	1	21
	trips			0			0	3		3	10	1	11
	lengths			0			0	126		126	313	18	331
1991	tows	1		1			0	32		32	3	2	5
	trips	1		1			0	15		15	3	1	4
	lengths	9		9			0	1144		1144	20	2	22
1992	tows		1	1			0	72		72	39	9	48
	trips		1	1			0	24		24	30	7	37
	lengths		18	18			0	1026		1026	352	32	384
1993	tows		2	2		3	3	132	2	134	35	20	55
	trips		2	2		2	2	53	1	54	20	14	34
	lengths		12	12		43	43	1685	2	1687	400	38	438
1994	tows			0		6	6	106	3	109	18	4	22
	trips			0		2	2	49	3	52	10	3	13
	lengths			0		213	213	1002	5	1007	136	6	142
1995	tows	2	9	11		21	21	85	13	98	23	12	35
	trips	1	2	3		12	12	45	7	52	14	8	22
	lengths	28	18	46		264	264	1118	34	1152	377	38	415
1996	tows		2	2	1	59	60	36	6	42	16	2	18
	trips		1	1	1	21	22	17	3	20	7	2	9
	lengths		5	5	1	250	251	197	105	302	89	2	91
1997	tows	1		1			0	13		13	9		9
	trips	1		1			0	7		7	3		3
	lengths	2		2			0	155		155	67		67
1998	tows			0			0			0	17	2	19
	trips			0			0			0	9	2	11
	lengths			0			0			0	70	5	75
1999	tows			0		71	71			0	10	15	25
	trips			0		30	30			0	5	7	12
	lengths			0		1195	1195			0	163	53	216
2000	tows	5		5	3	21	24			0	11	1	12
	trips	3		3	3	9	12			0	6	1	7
	lengths	90		90	9	640	649			0	219	1	220
2001	tows	1	9	10			0			0	5		5
	trips	1	4	5			0			0	3		3
	lengths	8	184	192			0			0	42		42

Table B2.17. Discard ratios and estimated discards (mt) for large mesh trawl VTR data and gillnet observer data. A 50% mortality rate was applied to the total discard estimate. Discard estimates using the survey method for otter trawl is also shown for comparison. Gillnet ratio from 1986-1988 is the average from 1989-1993.

year	large mesh trawl vtr ratio	vtr trawl discards (mt)	survey trawl discards (mt)	observer Gillnet ratio	gillnet discards (mt)
1982	-	-	343	-	-
1983	-	-	112	-	-
1984	-	-	67	-	-
1985	-	-	93	-	-
1986	-	-	63	*0.136*	11
1987	-	-	81	*0.136*	9
1988	-	-	106	*0.136*	11
1989	-	-	86	0.084	6
1990	-	-	81	0.173	18
1991	-	-	84	0.152	7
1992	-	-	56	0.129	10
1993	-	-	11	0.144	10
1994	0.061	13	65	0.165	9
1995	0.043	11	100	0.257	32
1996	0.040	8	72	0.119	10
1997	0.028	6	62	0.247	20
1998	0.038	9	53	0.100	8
1999	0.038	3	13	0.127	5
2000	0.041	6	19	0.133	7
2001	0.036	8	39	0.065	4

Table B2.18. Gulf of Maine winter flounder estimated discard ratios in the shrimp fishery (total discard kg / total days fished estimated from NEFSC and MA Observer data by shrimp season). Ratio for 1982-1988 is the average ratio from 1989-1992. Total shrimp fishery days fished estimated by Wigley et al 1999 and estimated discards are also shown. A 50% mortality is used for estimating dead discards. Dotted line indicates the introduction of the Nordmore grate.

Year	trips	tows	ratio	Shrimp df	discard wt (mt)	dead discards (mt)
1982			*22.225*	970.1	22	11
1983			*22.225*	1156.9	26	13
1984			*22.225*	1754.0	39	19
1985			*22.225*	2081.4	46	23
1986			*22.225*	2395.1	53	27
1987			*22.225*	3708.2	82	41
1988			*22.225*	2815.2	63	31
1989	12	24	13.361	2839.5	38	19
1990	25	53	24.070	3204.6	77	39
1991	38	94	27.720	2587.7	72	36
1992	72	225	23.749	2313.3	55	27
1993	63	178	10.730	1902.2	20	10
1994	63	183	7.320	1982.3	15	7
1995	58	136	7.382	3375.7	25	12
1996	40	92	6.290	3242.9	20	10
1997	21	55	12.511	3661.2	46	23
1998	3	6	10.559	2204.0	23	12
1999	4	5	5.645	1217.4	7	3
2000	4	10	10.927	792.9	9	4
2001	3	6	9.749	672.8	7	3

Table B2.19. Gulf of Maine winter flounder commercial numbers (000’s) at age.

Year	1	2	3	4	5	6	7	8	9	10	11	12	13
1982		550	2,025	1,288	733	482	181	22					
1983	5	366	1,026	1,311	632	282	109	68	21	13	7	2	1
1984		599	1,512	982	384	235	152	76	44	7			1
1985		25	573	1,164	759	263	82	64	26	5	5		
1986		310	629	512	303	199	58	28	12	4	1		
1987		283	821	422	356	141	25	35	2	0			
1988		327	745	725	217	94	49	46	5	1			
1989		37	840	733	602	102	8	7					
1990		102	478	690	446	145	43	11	5	2			
1991		175	735	519	191	104	45	28	1				
1992		188	609	511	174	57	20	7	2				
1993	2	105	605	545	77	46	4						
1994		4	386	557	130	31	7						
1995		8	267	680	456	162	21	14	2				
1996		107	693	347	61	11	1	2	1				
1997		93	512	455	105	27	4	2					
1998		25	217	458	321	105	34	4	1				
1999			49	158	143	59	19	5	4				
2000		1	57	212	173	50	14	7		1			
2001		2	27	287	390	175	63	26	6	3			

Table B2.20. Gulf of Maine winter flounder commercial weight (kg) at age.

Year	1	2	3	4	5	6	7	8	9	10	11	12	13
1982		0.351	0.454	0.502	0.617	0.817	0.901	1.087	1.330				
1983	0.293	0.281	0.403	0.528	0.667	0.814	0.970	1.062	1.238	1.415	1.467	1.224	1.422
1984		0.294	0.301	0.392	0.550	0.763	0.971	1.124	1.124	1.275			1.578
1985		0.307	0.366	0.449	0.572	0.802	1.020	1.121	1.183	1.071	1.462		
1986		0.412	0.470	0.534	0.699	0.842	0.940	1.231	1.387	0.479	2.996		
1987		0.380	0.437	0.586	0.650	0.843	1.107	1.272	1.684				
1988		0.510	0.524	0.530	0.669	0.620	0.976	1.082	1.132	2.338	1.619		
1989		0.286	0.434	0.542	0.592	1.034	1.155	1.264					
1990		0.435	0.482	0.541	0.646	0.780	1.039	1.261	1.214	1.310			
1991		0.393	0.487	0.626	0.624	0.725	0.741	0.896	1.810				
1992		0.364	0.447	0.569	0.653	0.787	1.075	1.461	1.745				
1993	0.125	0.336	0.396	0.457	0.701	0.607	1.331						
1994		0.274	0.402	0.489	0.669	0.829	1.324	1.558					
1995		0.305	0.369	0.437	0.552	0.653	1.030	1.181	1.447	2.572			
1996		0.387	0.451	0.546	0.634	0.915	1.452	1.694	2.177	2.663			
1997		0.412	0.451	0.540	0.701	0.847	0.998	1.479					
1998		0.371	0.426	0.482	0.598	0.750	0.991	1.709	2.149	2.459			
1999			0.431	0.503	0.564	0.735	0.962	1.102	1.236	2.941			
2000		0.449	0.400	0.480	0.560	0.711	0.930	1.178	1.467	1.555			
2001		0.175	0.373	0.468	0.546	0.693	0.869	0.953	1.215	1.562			

Table B2.21. Gulf of Maine winter flounder recreational numbers (000's) at age.

Year	1	2	3	4	5	6	7	8	9	10	11	12	13
1982	40	1,546	2,526	2,180	669	135	95	22	38	6	5	7	3
1983	89	381	654	488	224	80	49	12	4		6		
1984	12	166	423	847	468	112	159	50	37		10		
1985		112	762	875	1,163	136	136	37					
1986		18	102	301	56	154	44	18					
1987		28	805	739	436	170	113	37	52	9			
1988	2	10	103	320	142	153	75	30	3			3	
1989		124	469	729	172	110	43	21	7	2			
1990		111	228	236	37	25	5	5	3	2	1		
1991		9	31	47	34	12	9	7	3	1			
1992		10	29	50	26	9	5	1	3	3			
1993		21	54	79	66	20	5		3				
1994		4	32	55	30	13	7	5					
1995		2	22	27	19	8	3	2					
1996			17	40	17	11	7	5		1			
1997			8	20	18	5	5	5	3	1			
1998		2	19	32	8	4							
1999			8	23	17	11	4	5	1				
2000			10	23	26	11	4		1	1			
2001			8	22	16	14	12						

Table B2.22. Gulf of Maine winter flounder recreational mean weights (kg) at age.

Year	1	2	3	4	5	6	7	8	9	10	11	12	13
1982	0.109	0.197	0.339	0.479	0.571	0.746	1.025	1.522	1.929	2.801	3.431	3.963	5.187
1983	0.131	0.258	0.331	0.444	0.578	0.730	0.893	0.959	1.395		1.365		
1984	0.098	0.256	0.349	0.419	0.539	0.594	0.745	1.073	0.932		1.784		
1985		0.196	0.293	0.456	0.592	0.823	0.872	1.047					
1986		0.201	0.312	0.497	0.563	0.776	1.090	1.187					
1987		0.138	0.417	0.510	0.724	0.871	1.062	1.195	1.252	1.784			
1988	0.098	0.254	0.372	0.464	0.620	0.838	1.053	1.359	1.600	0.000		0.976	
1989		0.277	0.432	0.630	0.762	0.981	1.179	1.298	1.781	1.547	0.000		
1990		0.268	0.425	0.644	0.642	0.770	0.678	1.317	1.078	1.257	1.199		
1991		0.360	0.375	0.460	0.569	0.708	0.916	0.993	1.307	0.616			
1992		0.224	0.358	0.466	0.636	0.886	1.013	1.199	1.576	1.365			
1993		0.282	0.381	0.482	0.626	0.848	0.997		1.453				
1994		0.275	0.386	0.477	0.558	0.701	0.908	1.009					
1995		0.284	0.393	0.446	0.552	0.621	0.644	0.872					
1996		0.317	0.398	0.434	0.516	0.616	0.766	0.958	0.000	1.744			
1997		0.271	0.428	0.426	0.471	0.545	0.619	0.690	0.765	0.869			
1998		0.293	0.325	0.419	0.572	0.753							
1999			0.383	0.446	0.520	0.595	0.666	0.922	0.669				
2000			0.449	0.496	0.529	0.567	0.668	0.616	0.983	1.047			
2001			0.347	0.405	0.521	0.640	0.689						

Table B2.23. Gulf of Maine winter flounder recreational discards (000's) at age.

Year	1	2	3	4	5	6	7	8	9	10	11	12	13
1982	25	105	9										
1983	17	7	3										
1984	5	14	10										
1985	12	30	28	1									
1986	20	13	4	1									
1987	29	39	32	2									
1988	3	6	7	1									
1989	13	23	7	1									
1990	3	14	4										
1991	2	4	3	1									
1992	3	2	1										
1993	5	12	4	1									
1994	2	7	3	1									
1995	2	4	3	1									
1996	3	5	3	1									
1997	2	9	6	2									
1998	2	3	2										
1999	2	3	2	1									
2000	4	6	4	2									
2001	3	4	5	3	1								

Table B2.24. Gulf of Maine winter flounder recreational discards (kg) at age.

Year	1	2	3	3	4	5	6	7	8	9	11	12	13
1982	0.041	0.084	0.116										
1983	0.071	0.087	0.128										
1984	0.072	0.072	0.117										
1985	0.041	0.083	0.171	0.210									
1986	0.078	0.161	0.209	0.258	0.295								
1987	0.043	0.088	0.216	0.307									
1988	0.059	0.120	0.177	0.279									
1989	0.055	0.158	0.228	0.285	0.325								
1990	0.043	0.123	0.199	0.259	0.325								
1991	0.055	0.108	0.210	0.288	0.325								
1992	0.048	0.132	0.236	0.277	0.307								
1993	0.048	0.108	0.184	0.286	0.293								
1994	0.059	0.111	0.201	0.251	0.299								
1995	0.055	0.127	0.207	0.239	0.325								
1996	0.046	0.117	0.217	0.268	0.271								
1997	0.042	0.092	0.170	0.247	0.287								
1998	0.037	0.114	0.190	0.269	0.325								
1999	0.051	0.103	0.207	0.245	0.314								
2000	0.074	0.158	0.211	0.272	0.297								
2001	0.042	0.098	0.208	0.261	0.285								

Table B2.25. Gulf of Maine winter flounder commercial large mesh trawl discards (000's) at age using vtr ratios.

Year	1	2	3	4	5	6	7	8	9	10	11	12	13
1982	40	642	697	18									
1983	18	124	249	36									
1984	3	87	97	59	3								
1985	4	59	196	77	3								
1986	1	77	143	23	9								
1987	1	20	236	49	1								
1988	3	61	233	107	3	1							
1989	2	118	105	71	19	6							
1990	1	86	162	49	17								
1991	5	70	147	89	5								
1992	2	56	105	45	8								
1993	1	14	20	9	2								
1994	1	10	22	13	4								
1995	1	5	21	14	1								
1996	2	7	12	8	1								
1997		5	9	6	2								
1998		7	14	9	3								
1999		2	5	3	1								
2000	0	3	7	5	3	1							
2001		2	8	10	4	2							

Table B2.26. Gulf of Maine winter flounder commercial large mesh trawl discards weight (kg) at age using vtr ratios.

Year	1	2	3	4	5	6	7	8	9	10	11	12	13
1982	0.095	0.212	0.282	0.368	0.560	0.640	0.943	1.259	1.625	2.284			
1983	0.122	0.247	0.264	0.370	0.514	0.458	0.648	1.252			1.422		
1984	0.091	0.223	0.278	0.322	0.350	0.595	0.699	0.954	1.014				
1985	0.114	0.221	0.273	0.318	0.414	0.595	0.761	1.093	1.713				
1986	0.038	0.182	0.275	0.317	0.301	0.508	0.815	1.014	1.422				
1987	0.045	0.125	0.260	0.324	0.424	0.699	1.038	1.362	1.612				
1988	0.068	0.210	0.249	0.314	0.388	0.410	0.768	1.029	1.432	1.619			
1989	0.056	0.229	0.280	0.289	0.351	0.336	0.594	1.249	0.000				
1990	0.040	0.216	0.254	0.300	0.353	0.468	0.949	1.178	0.949	1.248			
1991	0.101	0.220	0.264	0.305	0.379	0.411	0.589	0.876	1.349	1.746			
1992	0.067	0.202	0.264	0.315	0.332	0.419	0.824	1.258	1.617				
1993	0.069	0.202	0.243	0.306	0.348	0.494	0.751	1.377	1.533				
1994	0.060	0.160	0.255	0.320	0.345	0.518	0.956						
1995	0.045	0.152	0.249	0.319	0.390	0.499	0.249	1.351	1.515				
1996	0.077	0.214	0.286	0.333	0.359	0.507	0.642	1.176					
1997	0.046	0.174	0.277	0.312	0.346	0.514	0.538	0.751					
1998	0.030	0.146	0.261	0.328	0.363	0.542	0.890	1.106					
1999	0.061	0.157	0.280	0.339	0.395	0.481	1.033	1.195	1.457				
2000	0.094	0.205	0.270	0.309	0.367	0.382	0.468		0.878	1.105			
2001	0.038	0.159	0.292	0.329	0.354	0.368	0.527	0.592	0.813	1.333			

Table B2.27. Gulf of Maine winter flounder gillnet discards (000's) at age.

Year	1	2	3	4	5	6	7	8	9	10	11	12	13
1986		3	26	9	3								
1987			27	6									
1988			27	13									
1989			14	7									
1990		1	39	28	2								
1991		2	17	7	1								
1992		3	28	6									
1993		1	25	10	1								
1994		1	22	11	2								
1995		6	37	23	12	5	3	1					
1996		2	21	10	2								
1997		1	26	30	13								
1998		3	14	8	2		1						
1999			2	2	1	2	1	1					
2000		1	8	7	4	1							
2001			4	5	2	1							

Table B2.28. Gulf of Maine winter flounder gillnet discard weight (kg) at age.

Year	1	2	3	4	5	6	7	8	9	10	11	12	13
1986		0.182	0.276	0.294	0.274	0.593							
1987		0.154	0.265	0.306	0.503	0.693							
1988		0.106	0.261	0.292	0.476	0.543							
1989		0.122	0.259	0.295	0.363	0.346	0.693						
1990		0.143	0.249	0.278	0.338								
1991		0.200	0.269	0.298	0.341								
1992		0.196	0.283	0.311	0.360	0.409							
1993		0.174	0.264	0.287	0.307	0.631							
1994		0.172	0.246	0.295	0.313	0.538							
1995	0.112	0.246	0.285	0.358	0.546	0.636	0.600	0.824					
1996		0.207	0.268	0.286	0.309	0.793	0.812						
1997		0.222	0.265	0.299	0.333								
1998		0.172	0.232	0.305	0.475	0.568	0.761	0.693					
1999		0.184	0.277	0.372	0.540	0.684	0.793	0.786	1.132	1.484			
2000		0.185	0.260	0.296	0.363	0.403	0.607	0.837	0.789				
2001			0.267	0.315	0.323	0.401	0.812		0.812	0.812			

Table B2.29. Gulf of Maine winter flounder commercial shrimp fishery discards (000's) at age.

Year	1	2	3	4	5	6	7	8	9	10	11	12	13
1982	13	65	16	1									
1983	17	62	37	4									
1984	15	83	55	19	1								
1985	39	94	57	7									
1986	62	137	32	8	2								
1987	48	182	110	7									
1988	44	103	101	13									
1989	42	136	45	4									
1990	35	53	86	33	7								
1991	36	145	62	12	1								
1992	46	177	30	3									
1993	38	67	17	4	1								
1994	30	73	11	1									
1995	41	70	19	4									
1996	52	52	13	5	1								
1997	34	171	44	7									
1998	41	61	16	3	1								
1999	16	18	4	1									
2000	19	22	11	2	1								
2001	17	16	5	2									

Table B2.30. Gulf of Maine winter flounder shrimp fishery weight (kg) at age.

Year	1	2	3	4	5	6	7	8	9	10	11	12	13
1982	0.025	0.093	0.212	0.341	0.429								
1983	0.023	0.074	0.183	0.322	0.505	0.400		0.522					
1984	0.016	0.067	0.151	0.273	0.357	0.502	0.453						
1985	0.034	0.094	0.188	0.293	0.470	0.000							
1986	0.035	0.107	0.234	0.308	0.316	0.469							
1987	0.028	0.081	0.197	0.343	0.470	0.519							
1988	0.028	0.078	0.170	0.291	0.400	0.353							
1989	0.029	0.079	0.191	0.277	0.393								
1990	0.039	0.093	0.201	0.316	0.397	0.442							
1991	0.040	0.106	0.208	0.297	0.336	0.460							
1992	0.028	0.097	0.217	0.296	0.361	0.076							
1993	0.025	0.064	0.187	0.295	0.427	0.621	0.953						
1994	0.026	0.066	0.145	0.286	0.413	0.603	0.767						
1995	0.042	0.091	0.186	0.224	0.579	0.426	0.221	0.795					
1996	0.029	0.084	0.214	0.299	0.277	0.377							
1997	0.043	0.076	0.155	0.245	0.329	0.117	0.170						
1998	0.037	0.088	0.162	0.299	0.440	0.568	0.687	0.974					
1999	0.033	0.078	0.196	0.219	0.400	0.569	0.866	0.810	0.933				
2000	0.031	0.065	0.122	0.258	0.355	0.424	0.633	0.937	0.943				
2001	0.032	0.068	0.163	0.240	0.300	0.431	0.683	0.931	0.751	0.920			

Table B2.31. Gulf of Maine winter flounder composition of the catch by number.

	Landings		Discards				
year	recreational	commercial	recreational	gillnet	lg mesh	shrimp	Total
1982	7,274	5,282	140	0	1,397	96	14,188
1983	1,988	3,842	27	0	428	120	6,406
1984	2,285	3,992	29	0	249	174	6,729
1985	3,220	2,965	71	0	340	197	6,793
1986	691	2,055	38	41	253	240	3,318
1987	2,391	2,086	102	34	308	346	5,266
1988	841	2,210	17	40	406	262	3,775
1989	1,678	2,329	44	21	321	227	4,620
1990	652	1,922	20	70	315	214	3,193
1991	154	1,799	9	26	315	257	2,559
1992	137	1,567	7	36	216	256	2,220
1993	249	1,384	22	36	45	127	1,863
1994	145	1,116	13	36	49	116	1,475
1995	82	1,609	10	85	42	134	1,963
1996	98	1,224	13	35	31	123	1,524
1997	64	1,198	19	70	23	257	1,630
1998	65	1,166	7	29	33	123	1,423
1999	67	437	7	9	11	39	571
2000	75	516	15	22	20	54	701
2001	72	980	15	13	26	41	1,146

Table B2.32. Gulf of Maine winter flounder composition of the catch by weight (mt).

	Landings		Discards				
year	recreational	commercial	recreational	gillnet	lg mesh	shrimp	Total
1982	1,876	2,793	11		343	11	5,034
1983	868	2,096	2		112	13	3,091
1984	1,300	1,699	2		67	19	3,089
1985	1,896	1,582	8		93	23	3,602
1986	523	1,188	5	11	63	27	1,817
1987	1,809	1,140	12	9	81	41	3,091
1988	345	1,250	2	11	106	31	1,745
1989	620	1,253	6	6	86	19	1,989
1990	370	1,116	3	18	81	39	1,626
1991	91	1,008	1	7	84	36	1,227
1992	90	825	1	10	56	27	1,009
1993	140	611	3	10	11	10	785
1994	83	552	2	9	13	7	666
1995	39	796	1	32	11	12	892
1996	56	600	2	10	8	10	686
1997	43	618	2	20	6	23	712
1998	30	637	1	8	9	12	697
1999	34	253	1	5	3	3	300
2000	42	382	2	7	6	4	443
2001	43	571	2	4	8	3	632

Table B2.33. Gulf of Maine winter flounder total catch at age (000's).

Year	1	2	3	4	5	6	7	8+
1982	118	2,909	5,274	3,487	1,402	617	276	104
1983	146	941	1,970	1,839	857	362	158	133
1984	36	949	2,097	1,907	856	348	312	225
1985	54	320	1,617	2,124	1,925	398	218	136
1986	83	557	936	852	373	353	102	62
1987	78	553	2,031	1,224	794	311	138	136
1988	52	507	1,215	1,179	361	248	123	89
1989	56	439	1,480	1,545	793	218	51	38
1990	39	366	997	1,037	509	170	48	29
1991	43	405	995	674	232	116	55	40
1992	52	436	802	615	208	67	24	16
1993	46	220	725	647	147	66	9	3
1994	33	98	477	638	166	44	14	5
1995	43	95	367	749	488	174	27	18
1996	57	174	758	413	83	23	8	9
1997	37	279	605	519	139	32	9	11
1998	44	100	283	511	335	109	36	5
1999	18	23	70	188	162	71	24	16
2000	23	33	97	251	206	62	18	11
2001	20	24	58	329	412	192	76	35

Table B2.34. Gulf of Maine winter flounder mean weight at age (kg).

Year	1	2	3	4	5	6	7	8+
1982	0.081	0.223	0.375	0.487	0.595	0.802	0.943	2.037
1983	0.115	0.252	0.357	0.502	0.644	0.795	0.946	1.164
1984	0.059	0.257	0.305	0.400	0.543	0.708	0.855	1.115
1985	0.041	0.169	0.311	0.447	0.584	0.809	0.927	1.122
1986	0.045	0.291	0.408	0.510	0.664	0.813	1.005	1.221
1987	0.034	0.240	0.390	0.527	0.690	0.858	1.070	1.284
1988	0.034	0.376	0.421	0.487	0.648	0.753	1.022	1.204
1989	0.036	0.197	0.412	0.570	0.623	0.989	1.175	1.397
1990	0.040	0.271	0.398	0.538	0.631	0.778	1.003	1.247
1991	0.048	0.256	0.429	0.563	0.609	0.722	0.771	0.965
1992	0.031	0.229	0.405	0.539	0.638	0.799	1.064	1.468
1993	0.031	0.226	0.380	0.454	0.658	0.680	1.148	1.453
1994	0.029	0.096	0.379	0.481	0.637	0.790	1.128	1.052
1995	0.043	0.127	0.345	0.431	0.552	0.651	0.929	1.186
1996	0.029	0.279	0.437	0.520	0.593	0.768	0.851	1.381
1997	0.043	0.191	0.415	0.514	0.630	0.802	0.798	0.859
1998	0.036	0.170	0.384	0.471	0.594	0.749	0.984	1.814
1999	0.035	0.088	0.391	0.490	0.559	0.713	0.907	1.062
2000	0.039	0.108	0.345	0.470	0.549	0.676	0.869	1.187
2001	0.033	0.090	0.317	0.454	0.542	0.685	0.840	1.055

Table B2.35. Gulf of Maine winter flounder catch at age construction summary.

Catch at age component	years	halfyear	length data	age data
Trawl and other commercial landings	82-01	mix	commercial and observer (unclassified)	commercial
gillnet commercial Landings	90-01	whole year	observer (kept)	commercial
recreational Landings	82-01	halfyear	MRFSS	combine NEFSC and MA DMF ages by halfyear
recreational Discards	82-01	halfyear	spr & fall MA DMF	combine NEFSC and MA DMF ages by halfyear
Large mesh trawl discards (survey)	82-93	whole year	survey method (spr & fall MA DMF)	combine NEFSC spr & fall survey
Large mesh trawl discards (vtr/survey)	94-01	whole year	survey method (spr & fall MA DMF)	combine NEFSC spr & fall survey
gillnet discards	86-01	whole year	observer (discards)	combine spr NEFSC and MA DMF ages
shrimp discards	82-01	shrimp season	observer (discards)	combine spr NEFSC and MA DMF ages

Table B2.36. NEFSC and MADMF stratified mean survey indices of abundance for Gulf of Maine winter flounder. NEFSC indices use offshore strata (26,27,38-40) and inshore strata (58-61,65,66). NEFSC indices are calculated with trawl door conversion factors where appropriate. MADMF uses strata 25-36.

	NEFSC spring		NEFSC fall		MADMF spring		MADMF fall	
year	number	weight	number	weight	number	weight	number	weight
1978					86.805	18.373	43.360	9.887
1979	9.063	3.218	6.003	2.602	64.952	14.407	119.506	28.978
1980	11.284	4.447	13.141	6.553	66.231	17.494	74.684	15.940
1981	13.051	3.946	4.179	3.029	100.569	28.370	47.342	13.228
1982	7.670	3.022	4.201	1.924	60.719	14.687	106.053	23.635
1983	12.367	5.653	10.304	3.519	108.508	27.233	88.143	15.772
1984	5.155	1.979	7.732	3.106	66.271	15.977	35.956	10.817
1985	3.469	1.418	7.638	2.324	48.651	13.594	44.564	7.381
1986	2.343	0.998	2.502	0.938	62.356	14.724	41.914	6.603
1987	5.609	1.503	1.605	0.488	83.171	17.648	50.426	7.227
1988	6.897	1.649	3.000	1.031	52.733	10.617	33.063	7.173
1989	3.717	1.316	6.402	2.013	63.595	13.317	33.983	7.462
1990	5.415	2.252	3.527	1.177	74.131	12.966	67.874	13.452
1991	4.517	1.436	7.035	1.467	49.265	11.587	88.777	15.473
1992	3.933	1.160	10.447	3.096	74.146	13.938	77.350	13.471
1993	1.556	0.353	7.559	1.859	80.133	12.390	92.476	14.996
1994	3.481	0.891	4.870	1.319	71.710	10.036	67.351	13.560
1995	12.185	3.149	4.765	1.446	87.848	14.560	84.768	17.250
1996	2.736	0.732	10.099	3.116	77.249	12.823	74.295	13.031
1997	2.806	0.664	10.008	2.950	95.918	14.796	74.347	14.316
1998	2.001	0.528	3.218	0.987	91.466	15.756	93.889	14.934
1999	6.510	1.982	10.921	3.269	77.941	14.198	117.648	22.672
2000	10.383	2.885	12.705	5.065	169.291	35.453	101.633	25.693
2001	5.242	1.666	8.786	3.131	90.153	23.891	80.978	18.367
2002	12.066	3.693	10.691	4.003	87.376	21.404		

Table B2.37. NEFSC spring stratified mean number per tow at age for Gulf of Maine winter flounder (offshore strata 26,27,38-40 and inshore 58-61,65,66).

Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	total
1980		0.10	3.28	4.73	1.79	0.96	0.31	0.06	0.05							11.28
1981		1.05	5.36	2.05	3.14	0.92	0.39	0.09	0.04							13.05
1982		0.16	1.92	3.40	0.85	1.00	0.11	0.06	0.10		0.03					7.67
1983		0.42	0.88	3.65	3.06	1.88	1.00	1.21	0.23	0.02		0.02				12.37
1984		0.23	1.13	1.37	1.17	0.61	0.08	0.35	0.03	0.16		0.02				5.15
1985		0.01	0.53	1.41	0.65	0.57	0.10	0.14	0.04		0.01					3.47
1986		0.03	0.75	0.42	0.58	0.14	0.31	0.10	0.02							2.34
1987		0.19	1.58	2.65	0.61	0.23	0.14	0.12	0.05	0.03						5.61
1988		0.65	1.36	3.04	1.42	0.26	0.11	0.03	0.03							6.90
1989		0.06	0.49	1.39	1.13	0.31	0.13	0.10	0.11							3.72
1990		0.04	0.61	1.63	1.54	0.78	0.34	0.04	0.17	0.14	0.14					5.42
1991		0.09	1.26	1.52	1.01	0.47	0.10	0.04	0.01	0.01	0.01					4.52
1992		0.31	1.16	1.01	0.96	0.34	0.10	0.03	0.01	0.01						3.93
1993		0.01	0.53	0.59	0.28	0.11	0.02	0.01								1.56
1994		0.02	1.00	1.28	0.78	0.29	0.08	0.01	0.01							3.48
1995		0.59	2.89	5.45	2.20	0.68	0.20	0.14	0.02							12.19
1996		0.05	0.59	1.05	0.74	0.23	0.06	0.01								2.74
1997		0.04	0.69	0.81	0.71	0.41	0.09	0.04	0.01							2.81
1998		0.10	0.59	0.60	0.48	0.21	0.01			0.01						2.00
1999		0.31	1.17	2.28	1.68	0.71	0.36									6.51
2000		0.16	1.50	3.76	2.41	1.56	0.75	0.17		0.04	0.02					10.38
2001		0.07	0.52	1.41	1.49	0.83	0.60	0.22	0.09	0.02						5.24
2002		0.20	1.59	2.98	3.57	2.29	0.92	0.34	0.11	0.07						12.07

Table B2.38. NEFSC fall stratified mean number per tow at age for Gulf of Maine winter flounder (offshore strata 26,27,38-40 and inshore 58-61,65,66).

year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	total
1980		0.57	4.36	5.34	1.85	0.74	0.18			0.05		0.05				13.14
1981		0.07	0.71	1.76	0.78	0.12	0.37	0.08	0.12	0.08			0.41		0.04	4.18
1982		0.30	1.21	1.68	0.40	0.32	0.08	0.21								4.20
1983		2.14	3.60	3.12	1.01	0.27	0.11	0.07								10.30
1984		0.45	2.34	1.67	2.17	0.59	0.22	0.17	0.11							7.73
1985		1.30	2.74	1.92	1.15	0.33	0.10	0.10								7.64
1986		0.02	0.73	1.15	0.49	0.05	0.02	0.01	0.02							2.50
1987		0.08	0.46	0.84	0.19	0.03				0.01						1.61
1988		0.49	0.96	0.60	0.71	0.15	0.06	0.03								3.00
1989		0.46	3.60	1.42	0.77	0.08	0.07			0.01						6.40
1990		0.10	1.86	1.09	0.41	0.04	0.02	0.02								3.53
1991	0.03	2.60	2.83	1.09	0.39	0.03	0.05	0.03								7.04
1992		1.92	3.70	2.40	1.63	0.75	0.01	0.03								10.45
1993		1.66	3.16	1.82	0.69	0.23	0.01									7.56
1994		0.43	2.32	1.29	0.65	0.12	0.03	0.03								4.87
1995		0.47	1.83	1.51	0.63	0.19	0.14									4.77
1996	0.01	1.77	2.37	2.57	2.63	0.60	0.13	0.01								10.10
1997		0.41	4.32	3.19	1.47	0.57	0.03									10.01
1998		0.19	0.92	1.13	0.78	0.14	0.06									3.22
1999		0.81	2.77	3.65	2.85	0.68	0.15	0.01								10.92
2000		0.62	2.03	4.00	3.54	1.41	0.96	0.15								12.70
2001		0.36	1.66	2.59	2.80	0.96	0.36	0.04	0.01							8.79

Table B2.39. MADMF spring stratified mean number per tow at age for Gulf of Maine winter flounder (strata 25-36).

year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	total
1982		7.51	30.59	8.96	8.80	2.57	0.90	1.33	0.02	0.04						60.72
1983	0.07	14.01	32.31	30.65	18.11	8.82	2.36	1.02	0.84	0.28					0.02	108.51
1984		5.80	26.27	16.96	11.65	3.94	0.38	0.83	0.08	0.31		0.04				66.27
1985		9.47	7.29	15.34	11.28	3.57	1.39	0.25	0.03	0.03						48.65
1986		9.35	19.78	20.97	10.29	1.22	0.46	0.06	0.04	0.19						62.36
1987		16.93	18.71	32.69	11.54	0.72	1.74	0.33	0.02	0.49						83.17
1988	0.08	7.47	15.76	18.87	9.37	0.61	0.38	0.00	0.04	0.10				0.05		52.73
1989		9.15	23.03	17.39	9.10	3.72	0.71	0.13	0.23	0.15						63.59
1990		14.31	18.33	27.47	10.04	2.04	1.35	0.39	0.08	0.08	0.02	0.04				74.13
1991		4.82	19.21	13.00	7.84	3.17	0.50	0.24	0.17	0.11	0.15	0.04				49.27
1992		19.96	32.12	12.31	6.70	1.97	0.69	0.16	0.07	0.08	0.07					74.15
1993		17.86	37.10	15.09	6.46	2.03	1.09	0.34	0.02	0.11	0.04					80.13
1994		14.33	36.11	15.44	4.66	0.79	0.12	0.17	0.08		0.02					71.71
1995	0.06	20.76	36.25	22.59	6.02	1.33	0.54	0.15	0.11	0.02	0.02					87.85
1996		14.96	34.59	17.79	7.04	1.88	0.73	0.19	0.08							77.25
1997		15.04	39.94	22.78	10.72	5.34	1.08	0.58	0.26	0.09	0.06	0.03				95.92
1998		10.23	32.61	29.11	13.26	4.12	1.15	0.81	0.17							91.47
1999		14.31	25.96	21.79	9.02	4.66	1.14	0.57	0.44	0.05						77.94
2000		28.67	69.85	33.39	18.16	11.00	5.83	1.79	0.37	0.22						169.29
2001		14.37	11.22	29.56	19.47	7.23	4.79	2.34	0.68	0.33	0.16					90.15
2002		9.59	23.85	19.60	19.52	7.59	4.97	1.64	0.25	0.27	0.09					87.38

Table B2.40. MADMF fall stratified mean number per tow at age for Gulf of Maine winter flounder (strata 25-36).

year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	total
1980	0.13	27.26	31.13	14.18	1.54	0.38	0.01	0.04								74.68
1981	0.13	13.05	21.14	11.46	1.31	0.02	0.19	0.04								47.34
1982	0.44	42.30	39.70	19.00	3.62	0.63	0.30	0.04	0.02							106.05
1983	0.00	49.19	23.26	11.70	2.80	1.11	0.07	0.01								88.14
1984	0.06	8.29	11.63	6.41	6.89	1.80	0.59	0.25	0.02							35.96
1985	0.28	22.32	12.36	6.14	2.66	0.54	0.21	0.05								44.56
1986	0.23	16.68	14.78	8.44	1.46	0.24	0.00	0.04	0.04							41.91
1987	0.50	17.29	19.40	11.68	1.34	0.10	0.11	0.02								50.43
1988	0.16	11.96	12.69	3.87	3.09	0.80	0.34	0.11	0.04							33.06
1989		12.17	14.59	5.29	1.41	0.31	0.19	0.03								33.98
1990		8.35	45.03	11.72	2.54	0.18	0.03	0.03								67.87
1991	2.41	40.54	23.35	16.65	4.92	0.58	0.22	0.12								88.78
1992	0.65	38.61	18.43	10.65	5.87	2.58	0.11	0.44								77.35
1993	0.32	34.29	38.90	13.55	3.82	1.37	0.17	0.06								92.48
1994	0.12	17.93	28.24	14.66	5.00	1.08	0.14	0.14	0.05							67.35
1995	0.29	29.32	30.17	17.27	6.04	0.91	0.49	0.22	0.05							84.77
1996	1.01	33.45	16.23	13.19	8.53	1.51	0.37									74.30
1997	0.47	20.04	29.06	17.89	5.25	1.54	0.10									74.35
1998	0.34	38.17	28.88	16.86	7.30	1.71	0.63									93.89
1999	1.17	30.34	42.82	23.00	15.01	4.10	1.15	0.06								117.65
2000	0.30	25.54	30.64	23.79	13.65	4.34	2.43	0.94								101.63
2001	0.20	27.85	17.67	14.22	14.96	4.13	1.71	0.22	0.01							80.98

Table B2.41. Seabrook spring mean number per tow at age for Gulf of Maine winter flounder.

year	1	2	3	4	5	6	7	8	9	10	11	total
1985	1.16	0.49	0.40	0.21	0.08	0.04	0.02					2.39
1986	1.65	1.06	0.52	0.23	0.06	0.01						3.53
1987	1.60	1.47	1.08	0.15	0.01	0.08	0.03		0.01			4.43
1988	0.88	1.18	1.52	0.31	0.02	0.02						3.92
1989	3.73	1.30	1.35	0.37	0.06	0.03	0.01					6.85
1990	1.63	1.06	0.93	0.40	0.08	0.02					0.01	4.14
1991	2.66	1.19	1.19	0.37	0.12	0.02						5.55
1992	0.58	1.00	0.34	0.16	0.02							2.11
1993												
1994	0.81	1.16	0.32	0.05								2.33
1995	0.97	0.97	0.38	0.09	0.02	0.01						2.44
1996	1.38	1.35	0.63	0.11	0.03	0.01						3.51
1997	0.94	1.29	0.59	0.21	0.08	0.02	0.01	0.01				3.15
1998	1.39	2.62	1.67	0.56	0.17	0.04	0.01	0.01	0.02			6.50
1999	3.13	3.94	2.49	0.39	0.12	0.02	0.01	0.03				10.14
2000	3.32	6.72	1.53	0.38	0.23	0.10	0.03	0.01	0.01			12.31
2001	2.74	0.97	1.76	0.32	0.06	0.03	0.02					5.91

Table B2.42. Age and length at 50% maturity for Gulf of Maine winter flounder in the spring NEFSC, MADMF, and combined surveys with the sexes combined.

	NEFSC			MADMF			Both		
time period	total N	L50	A50	total N	L50	A50	total N	L50	A50
81-85	456	23.7	2.5	479	29.1	3.5	935	26.6	2.9
86-90	510	21.3	2.3	763	28.5	3.4	1,273	25.4	3.0
91-95	700	24.2	2.8	1,312	28.4	3.2	2,012	26.8	3.0
96-01	823	22.8	2.6	1,212	27.7	3.3	2,035	25.3	3.0
81-01	2,489	23.1	2.6	3,766	28.3	3.3	6,255	26.0	3.0

Table B2.43. Age at 50% maturity by sex and sexes combined for Gulf of Maine winter flounder in the Spring NEFSC, MADMF, and combined surveys.

		NEFSC		MADMF		Both	
time period	sex	total N	A50	total N	A50	total N	A50
81-01	male	948	2.5	1,406	3.3	2,354	2.9
	female	1,601	2.6	2,533	3.4	4,134	3.1
	Combined	2,489	2.6	3,766	3.3	6,255	3.0

Table B2.44. Comparison of length and age at 50% maturity for Gulf of Maine winter flounder in the spring NEFSC and MADMF surveys with the sexes combined. NEFSC data was limited to inshore Gulf of Maine Massachusetts strata (58-66) which overlap with the MADMF survey (25-36).

	NEFSC			MADMF		
time period	total N	L50	A50	total N	L50	A50
81-85	209	24.0	2.4	479	29.1	3.5
86-90	248	21.0	2.1	763	28.5	3.4
91-95	493	25.0	2.8	1,312	28.4	3.2
96-01	577	23.0	2.5	1,212	27.7	3.3
81-01	1,527	23.5	2.5	3,766	28.3	3.3

Table B2.45. Virtual Population Analysis for Gulf of Maine winter flounder, 1982-2001.

```
Fisheries Assessment Toolbox  gom wf total catch  Run Number  1   12/3/2002   12:55:40 PM
FACT Version 1.5.0
gom wf total catch  1982 - 2002
Input Parameters and Options Selected
---------------------------------------
Natural mortality is a matrix below
Oldest age (not in the plus group) is  7
For all years prior to the terminal year ( 20 ), backcalculated
stock sizes for the following ages used to estimate
total mortality (Z) for age  7 : 5 6 7
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  8 + is then calculated from the following
ratios of F[age 8 +] to F[age 7 ]
          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
          2000               1
          2001               1
Stock size of the  8 + group is then calculated using
the following method:  CATCH EQUATION
 Partial recruitment estimate for  2002
 1             0.02
 2             0.04
 3             0.15
 4             0.57
 5             1
 6             1
 7             1
 The Indices that will be used in this run are:
 1            NEC_S11
 2            NEC_S22
 3            NEC_S33
 4            NEC_S44
 5            NEC_S55
 6            NEC_S66
 7            NEC_S77
 8            NEC_S88
 9            NEC_F23
 10           NEC_F34
 11           NEC_F45
 12           NEC_F56
 13           NEC_F67
 14           MA_S11
 15           MA_S22
 16           MA_S33
 17           MA_S44
 18           MA_S55
 19           MA_S66
 20           MA_S77
 21           MA_S88
 22           MA_F01
 23           MA_F12
 24           MA_F23
 25           MA_F34
 26           MA_F45
 27           SEA_S11
 28           SEA_S22
 29           SEA_S33
 30           SEA_S44
 31           SEA_S55
 32           SEA_S66
 33           SEA_S77
```

Table B2.45. Continued.

STOCK NUMBERS (Jan 1) in thousands

	1982	1983	1984	1985	1986	1987	1988
1	11761	8778	6269	9277	7686	6125	4482
2	14415	9522	7055	5100	7547	6218	4944
3	11100	9170	6945	4917	3886	5675	4590
4	6207	4316	5725	3788	2563	2334	2808
5	3058	1927	1869	2962	1180	1327	804
6	1177	1235	802	756	683	628	368
7	571	405	683	342	259	240	233
8	212	337	486	209	156	232	166
1+	48500	35690	29834	27351	23959	22779	18395

	1989	1990	1991	1992	1993	1994	1995
1	4043	4242	4542	3322	3240	4519	7503
2	3622	3259	3438	3680	2673	2611	3670
3	3589	2569	2337	2448	2618	1989	2049
4	2659	1599	1201	1013	1279	1488	1197
5	1232	779	371	373	273	461	641
6	331	291	177	94	117	91	228
7	77	74	85	40	16	36	34
8	56	44	60	26	05	13	22
1+	15610	12857	12211	10996	10221	11208	15343

	1996	1997	1998	1999	2000	2001	2002
1	7588	7249	8967	10080	7474	7391	6274
2	6104	6161	5902	7301	8237	6099	6033
3	2919	4840	4792	4742	5957	6714	4971
4	1345	1704	3415	3667	3819	4789	5444
5	302	728	925	2334	2832	2899	3624
6	83	172	470	454	1764	2132	2001
7	29	47	112	286	308	1388	1572
8	32	57	15	190	188	638	1558
1+	18402	20958	24598	29055	30578	32050	31477

Table B2.45. Continued.

FISHING MORTALITY

	1982	1983	1984	1985	1986	1987	1988
1	0.01	0.02	0.01	0.01	0.01	0.01	0.01
2	0.25	0.12	0.16	0.07	0.09	0.10	0.12
3	0.74	0.27	0.41	0.45	0.31	0.50	0.35
4	0.97	0.64	0.46	0.97	0.46	0.87	0.62
5	0.71	0.68	0.71	1.27	0.43	1.08	0.69
6	0.87	0.39	0.65	0.87	0.85	0.79	1.36
7	0.76	0.56	0.70	1.22	0.57	1.01	0.88
8	0.76	0.56	0.70	1.22	0.57	1.01	0.88

	1989	1990	1991	1992	1993	1994	1995
1	0.02	0.01	0.01	0.02	0.02	0.01	0.01
2	0.14	0.13	0.14	0.14	0.10	0.04	0.03
3	0.61	0.56	0.64	0.45	0.37	0.31	0.22
4	1.03	1.26	0.97	1.11	0.82	0.64	1.18
5	1.24	1.28	1.17	0.96	0.90	0.51	1.84
6	1.30	1.03	1.29	1.56	0.97	0.77	1.87
7	1.31	1.26	1.26	1.09	0.95	0.55	2.03
8	1.31	1.26	1.26	1.09	0.95	0.55	2.03

	1996	1997	1998	1999	2000	2001
1	0.01	0.01	0.01	0.00	0.00	0.00
2	0.03	0.05	0.02	0.00	0.00	0.00
3	0.34	0.15	0.07	0.02	0.02	0.01
4	0.41	0.41	0.18	0.06	0.08	0.08
5	0.36	0.24	0.51	0.08	0.08	0.17
6	0.37	0.23	0.30	0.19	0.04	0.10
7	0.37	0.24	0.44	0.10	0.07	0.06
8	0.37	0.24	0.44	0.10	0.07	0.06

5,6
Average F for 5,6

	1982	1983	1984	1985	1986	1987	1988
5,6	0.79	0.53	0.68	1.07	0.64	0.94	1.02

	1989	1990	1991	1992	1993	1994	1995
5,6	1.27	1.16	1.23	1.26	0.94	0.64	1.85

	1996	1997	1998	1999	2000	2001
5,6	0.36	0.23	0.40	0.13	0.06	0.14

Biomass Weighted F

1982	1983	1984	1985	1986	1987	1988
0.60	0.33	0.42	0.70	0.30	0.55	0.40

1989	1990	1991	1992	1993	1994	1995
0.74	0.64	0.54	0.49	0.41	0.39	0.51

1996	1997	1998	1999	2000	2001
0.20	0.17	0.14	0.05	0.05	0.07

Table B2.45. Continued.

BACKCALCULATED PARTIAL RECRUITMENT

	1982	1983	1984	1985	1986	1987	1988
1	0.01	0.03	0.01	0.01	0.01	0.01	0.01
2	0.26	0.17	0.23	0.06	0.10	0.10	0.09
3	0.77	0.40	0.58	0.36	0.37	0.47	0.25
4	1.00	0.94	0.65	0.76	0.54	0.80	0.46
5	0.73	1.00	1.00	1.00	0.51	1.00	0.50
6	0.89	0.58	0.93	0.69	1.00	0.73	1.00
7	0.79	0.83	1.00	0.96	0.68	0.93	0.64
8	0.79	0.83	1.00	0.96	0.68	0.93	0.64

	1989	1990	1991	1992	1993	1994	1995
1	0.01	0.01	0.01	0.01	0.02	0.01	0.00
2	0.11	0.10	0.11	0.09	0.10	0.06	0.01
3	0.46	0.44	0.49	0.29	0.38	0.40	0.11
4	0.78	0.98	0.75	0.71	0.84	0.83	0.58
5	0.95	1.00	0.91	0.62	0.93	0.66	0.91
6	0.99	0.81	1.00	1.00	1.00	1.00	0.92
7	1.00	0.98	0.98	0.70	0.98	0.72	1.00
8	1.00	0.98	0.98	0.70	0.98	0.72	1.00

	1996	1997	1998	1999	2000	2001
1	0.02	0.01	0.01	0.01	0.04	0.02
2	0.08	0.13	0.04	0.02	0.05	0.03
3	0.82	0.36	0.13	0.09	0.22	0.06
4	1.00	1.00	0.35	0.31	0.90	0.46
5	0.87	0.58	1.00	0.42	1.00	1.00
6	0.88	0.56	0.58	1.00	0.47	0.61
7	0.88	0.58	0.86	0.51	0.80	0.37
8	0.88	0.58	0.86	0.51	0.80	0.37

MEAN BIOMASS (using catch mean weights at age)

	1982	1983	1984	1985	1986	1987	1988
1	859	907	334	344	312	188	137
2	2586	2058	1522	755	1911	1287	1591
3	2693	2611	1588	1124	1242	1589	1489
4	1782	1468	1677	1000	958	757	932
5	1196	826	668	907	581	516	346
6	581	741	382	375	344	342	140
7	345	268	385	169	181	149	146
8	277	275	357	125	132	173	122
1+	10319	9153	6914	4798	5662	5000	4903

	1989	1990	1991	1992	1993	1994	1995
1	131	153	197	93	90	118	292
2	604	751	746	714	523	223	417
3	1014	716	680	729	760	591	577
4	873	452	399	304	364	484	280
5	407	256	123	141	109	211	151
6	170	130	67	35	47	46	63
7	47	39	34	24	11	29	13
8	41	29	31	22	05	10	11
1+	3285	2527	2275	2062	1909	1710	1802

	1996	1997	1998	1999	2000	2001	
1	199	282	292	320	264	221	
2	1520	1041	901	581	805	496	
3	986	1696	1615	1667	1847	1920	
4	523	656	1338	1584	1569	1898	
5	137	371	393	1138	1354	1313	
6	49	112	278	268	1060	1259	
7	19	31	82	225	235	1026	
8	34	40	21	175	196	592	
1+	3466	4228	4918	5957	7328	8724	00

Table B2.45. Continued.

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

	1982	1983	1984	1985	1986	1987	1988
1	00	00	00	00	00	00	00
2	00	00	00	00	00	00	00
3	454	368	265	189	144	257	204
4	1685	1307	1578	898	744	714	857
5	1255	867	778	991	549	571	376
6	665	733	437	383	362	370	180
7	390	292	449	194	193	165	167
8	339	325	433	164	157	220	153
1+	4790	3890	3941	2820	2149	2298	1936

	1989	1990	1991	1992	1993	1994	1995
1	00	00	00	00	00	00	00
2	00	00	00	00	00	00	00
3	185	95	103	107	107	82	54
4	824	450	365	302	366	444	295
5	474	323	151	167	124	208	198
6	183	149	82	42	58	51	87
7	50	51	46	25	12	26	17
8	54	38	40	28	06	11	15
1+	1769	1106	787	672	672	823	666

	1996	1997	1998	1999	2000	2001
1	00	00	00	00	00	00
2	00	00	00	00	00	00
3	96	241	194	185	157	189
4	421	596	1180	1283	1315	1521
5	133	373	428	1116	1369	1335
6	47	107	285	268	1022	1211
7	19	33	85	219	227	980
8	39	44	24	188	208	630
1+	754	1395	2197	3260	4298	5866

Table B2.45b. VPA retrospective analysis for Gulf of Maine winter flounder.

Fishing Mortality

Terminal year

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
1995	0.79	0.53	0.68	1.07	0.64	0.94	1.02	1.26	1.14	1.17	1.05	0.59	0.29	0.72						
1996	0.79	0.53	0.68	1.07	0.64	0.94	1.02	1.27	1.15	1.22	1.21	0.85	0.52	1.05	0.07					
1997	0.79	0.53	0.68	1.07	0.64	0.94	1.02	1.27	1.15	1.22	1.22	0.87	0.55	1.19	0.14	0.09				
1998	0.79	0.53	0.68	1.07	0.64	0.94	1.02	1.27	1.16	1.22	1.23	0.88	0.56	1.27	0.16	0.09	0.23			
1999	0.79	0.53	0.68	1.07	0.64	0.94	1.02	1.27	1.16	1.23	1.25	0.91	0.6	1.54	0.23	0.13	0.21	0.09		
2000	0.79	0.53	0.68	1.07	0.64	0.94	1.02	1.27	1.16	1.23	1.25	0.93	0.63	1.73	0.30	0.19	0.27	0.08	0.06	
2001	0.79	0.53	0.68	1.07	0.64	0.94	1.02	1.27	1.16	1.23	1.26	0.94	0.64	1.85	0.36	0.23	0.40	0.13	0.06	0.14

Spawning Stock Biomass

Terminal year

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
1995	4790	3890	3941	2821	2150	2299	1939	1776	1121	831	804	910	1283	1759						
1996	4790	3890	3941	2820	2149	2298	1937	1770	1108	795	695	735	1080	1373	2108					
1997	4790	3890	3941	2820	2149	2298	1937	1770	1108	794	690	722	957	1046	1510	2530				
1998	4790	3890	3941	2820	2149	2298	1936	1770	1108	793	688	715	934	1008	1417	2274	2956			
1999	4790	3890	3941	2820	2149	2298	1936	1769	1106	789	678	688	868	799	1137	2082	2799	4038		
2000	4790	3890	3941	2820	2149	2298	1936	1769	1106	788	674	678	839	719	873	1753	2616	3601	4808	
2001	4790	3890	3941	2820	2149	2298	1936	1769	1106	787	672	672	823	666	754	1395	2197	3260	4298	5866

Population Numbers Age1:

Terminal year

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
1995	11762	8779	6271	9285	7698	6150	4556	4377	4717	5296	6200	6700	6302	8273	6222						
1996	11761	8778	6269	9278	7688	6129	4496	4096	4336	5330	5327	6547	6324	7084	6987	6895					
1997	11761	8778	6269	9278	7688	6127	4499	4067	4390	4811	4419	4909	6072	7098	7490	7043	7090				
1998	11761	8778	6269	9278	7688	6127	4497	4061	4380	4723	4402	4662	5446	6768	7060	7347	8617	11412			
1999	11761	8778	6269	9277	7687	6126	4487	4052	4283	4657	3598	4474	5794	7011	7774	7883	9687	13335	16197		
2000	11761	8778	6269	9277	7686	6125	4484	4045	4262	4567	3482	3425	5692	7749	7257	7352	9106	10817	8113	6990	
2001	11761	8778	6269	9277	7686	6125	4482	4043	4242	4542	3322	3240	4519	7503	7588	7249	8967	10080	7474	7391	6274

Table B2.46. VPA Bootstrap results: precision of estimates.

The number of bootstraps: 500

Bootstrap Output Variable: N hat

	NLLS ESTIMATE	BOOTSTRAP MEAN	BOOTSTRAP StdError	C.V. FOR NLLS SOLN
N 1	6274	6578	2984	0.48
N 2	6033	6313	1951	0.32
N 3	4971	5148	1277	0.26
N 4	5444	5544	1043	0.19
N 5	3624	3711	674	0.19
N 6	2001	2043	394	0.20
N 7	1572	1576	273	0.17
N 8	1068	1077	170	0.16

	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	304	133	4.85	5969	0.499901	3546	11460
N 2	280	87	4.65	5752	0.339112	3677	8478
N 3	177	57	3.56	4794	0.266440	3559	6826
N 4	100	47	1.83	5344	0.195187	4245	6919
N 5	88	30	2.42	3536	0.190486	2818	4483
N 6	42	18	2.11	1959	0.201157	1523	2548
N 7	04	12	0.27	1568	0.173815	1286	1984
N 8	10	08	0.90	1058	0.160299	874	1312

Bootstrap Output Variable: F t

	NLLS ESTIMATE	BOOTSTRAP MEAN	BOOTSTRAP StdError	C.V. FOR NLLS SOLN
Age 1	0.0030	0.0032	0.0011	0.37
Age 2	0.0044	0.0045	0.0011	0.25
Age 3	0.0096	0.0097	0.0018	0.19
Age 4	0.0790	0.0795	0.0139	0.18
Age 5	0.1708	0.1730	0.0311	0.18
Age 6	0.1048	0.1074	0.0180	0.17
Age 7	0.0624	0.0633	0.0098	0.16
Age 8	0.0624	0.0633	0.0098	0.16

	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	0.0001690	0.0000491	5.641	0.0028262	0.39	0.0021	0.0048
Age 2	0.0001079	0.0000490	2.477	0.0042508	0.26	0.0032	0.0061
Age 3	0.0001559	0.0000812	1.625	0.0094377	0.19	0.0075	0.0122
Age 4	0.0005479	0.0006197	0.694	0.0784051	0.18	0.0640	0.0998
Age 5	0.0021128	0.0013886	1.237	0.1687286	0.18	0.1359	0.2178
Age 6	0.0025929	0.0008055	2.474	0.1022216	0.18	0.0836	0.1266
Age 7	0.0009146	0.0004373	1.465	0.0614994	0.16	0.0506	0.0752
Age 8	0.0009146	0.0004373	1.465	0.0614994	0.16	0.0506	0.0752

Bootstrap Output Variable: Mean Biomass

NLLS ESTIMATE	BOOTSTRAP MEAN	BOOTSTRAP StdError	C.V. FOR NLLS SOLN
8723.9106	8873.3264	775.7433	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
149.4158	34.6923	1.71	8574.4947	0.09	7730.5482	9603.4137

Bootstrap Output Variable: SSB spawn t

NLLS ESTIMATE	BOOTSTRAP MEAN	BOOTSTRAP StdError	C.V. FOR NLLS SOLN
5865.7415	5945.3298	554.7207	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
79.59	24.81	1.36	5786.15	0.10	5203.0726	6580.6435

Table B2.47. Yield Per Recruit analysis for Gulf of Maine winter flounder.

The NEFC Yield and Stock Size per Recruit Program - PDBYPRC
PC Ver.2.0 [Method of Thompson and Bell (1934)] 1-Jan-1999

Run Date: 3-10-2002; Time: 12:05:35.00
gulf of Maine Winter Flounder - 1999-01 PR, Mean Weights at Age from

Proportion of F before spawning: 0.2500
Proportion of M before spawning: 0.2500
Natural Mortality is Constant at: 0.200
Initial age is: 1; Last age is: 15
Last age is a TRUE Age;
Original age-specific PRs, Mats, and Mean Wts from file:
==> C:\Program Files\FACT\wv\ypr\gomwfy3.dat

Age-specific Input data for Yield per Recruit Analysis

Age	Fish Mort Pattern	Nat Mort Pattern	Proportion Mature	Average Weights Catch	Average Weights Stock
1	0.0300	1.0000	0.0000	0.036	0.021
2	0.0400	1.0000	0.0000	0.095	0.059
3	0.1300	1.0000	0.1600	0.351	0.206
4	0.5700	1.0000	0.8600	0.471	0.420
5	1.0000	1.0000	1.0000	0.550	0.512
6	1.0000	1.0000	1.0000	0.691	0.626
7	1.0000	1.0000	1.0000	0.872	0.788
8	1.0000	1.0000	1.0000	0.993	0.993
9	1.0000	1.0000	1.0000	1.091	1.091
10	1.0000	1.0000	1.0000	1.171	1.171
11	1.0000	1.0000	1.0000	1.234	1.234
12	1.0000	1.0000	1.0000	1.284	1.284
13	1.0000	1.0000	1.0000	1.323	1.323
14	1.0000	1.0000	1.0000	1.353	1.353
15	1.0000	1.0000	1.0000	1.377	1.377

Summary of Yield per Recruit Analysis:

Slope of the Yield/Recruit Curve at F=0.00: --> 2.0105
F level at slope=1/10 of the above slope (F0.1): -----> 0.258
Yield/Recruit corresponding to F0.1: -----> 0.1970
F level to produce Maximum Yield/Recruit (Fmax): -----> 0.687
Yield/Recruit corresponding to Fmax: -----> 0.2201
F level at 40 % of Max Spawning Potential (F40): -----> 0.261
SSB/Recruit corresponding to F40: --------> 0.8333

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Listing of Yield per Recruit Results for:

	FMORT	TOTCTHN	TOTCTHW	TOTSTKN	TOTSTKW	SPNSTKN	SPNSTKW	% MSP
	0.00	0.00000	0.00000	5.2420	2.4078	2.6476	2.0834	100.00
	0.10	0.17406	0.12996	4.5658	1.6980	1.9691	1.3773	66.11
	0.20	0.26851	0.18214	4.1562	1.3009	1.5634	0.9877	47.41
F0.1	0.26	0.30487	0.19700	3.9894	1.1500	1.4000	0.8411	40.37
F40%	0.26	0.30682	0.19770	3.9802	1.1419	1.3911	0.8333	40.00
	0.30	0.32662	0.20421	3.8874	1.0616	1.3007	0.7557	36.27
	0.40	0.36623	0.21387	3.6983	0.9070	1.1185	0.6074	29.16
	0.50	0.39537	0.21807	3.5575	0.8010	0.9848	0.5067	24.32
	0.60	0.41803	0.21972	3.4476	0.7243	0.8823	0.4345	20.85
Fmax	0.69	0.43413	0.22009	3.3697	0.6733	0.8108	0.3869	18.57
	0.70	0.43638	0.22010	3.3588	0.6664	0.8009	0.3805	18.26
	0.80	0.45170	0.21982	3.2847	0.6211	0.7343	0.3387	16.26
	0.90	0.46481	0.21920	3.2215	0.5846	0.6787	0.3053	14.66
	1.00	0.47624	0.21839	3.1666	0.5544	0.6314	0.2781	13.35
	1.10	0.48637	0.21747	3.1180	0.5288	0.5905	0.2553	12.25
	1.20	0.49545	0.21650	3.0745	0.5069	0.5547	0.2359	11.32
	1.30	0.50368	0.21549	3.0352	0.4878	0.5230	0.2193	10.52
	1.40	0.51121	0.21446	2.9992	0.4708	0.4947	0.2047	9.83
	1.50	0.51816	0.21343	2.9660	0.4557	0.4693	0.1919	9.21
	1.60	0.52462	0.21238	2.9352	0.4421	0.4463	0.1805	8.67
	1.70	0.53064	0.21134	2.9065	0.4297	0.4253	0.1703	8.18
	1.80	0.53630	0.21029	2.8795	0.4183	0.4060	0.1611	7.73
	1.90	0.54163	0.20924	2.8541	0.4078	0.3883	0.1527	7.33
	2.00	0.54668	0.20819	2.8300	0.3981	0.3719	0.1451	6.96

Table B2.48. Stock-recruitment model comparison for Gulf of Maine winter flounder.

	Prior	Prior	Prior	Prior	Prior	Prior	Prior	Prior	Prior	Prior
	1	0	1	0	1	0	0	0	0	0
	BH	ABH	PBH	PABH	PRBH	PRABH	RK	ARK	PRK	PARK
Posterior Probability	0.36	0.00	0.32	0.00	0.31	0.00	0.00	0.00	0.00	0.00
Odds Ratio for Most Likely Model	1.00		1.12		1.16					
Normalized Likelihood	0.363	0.000	0.323	0.000	0.313	0.000	0.000	0.000	0.000	0.000
Model AIC Ratio	1.160	0	1.033	0	1.000	0	0	0	0	0

	BH	**ABH**	**PBH**	**PABH**	**PRBH**	**PRABH**	**RK**	**ARK**	**PRK**	**PARK**
Number_of_data_points	20	20	20	20	20	20	20	20	20	20
Number_of_parameters	3	4	3	4	3	4	3	4	3	4
Fit_negloglikelihood	41.146	33.566	41.263	33.724	41.295	33.732	43.534	34.926	52.285	37.530
Penalty_steepness	0	0	-0.810	-1.087	0	0	0	0	0	0
Penalty_slope	0	0	0	0	0	0	0	0	3.160	-0.774
Penalty_unfished_R	0	0	0	0	2.085	1.809	0	0	0	0
Negative_loglikelihood	41.146	33.566	40.452	32.637	43.380	35.541	43.534	34.926	55.445	36.756
Bias-corrected_AIC	89.792	77.799	90.025	78.115	90.090	78.130	94.568	80.519	112.070	85.726
Diagnostic Comments	**Most likely parametric model**	Power spectrum dominant frequency exceeds 1/2 time series length		Power spectrum dominant frequency exceeds 1/2 time series length		Power spectrum dominant frequency exceeds 1/2 time series length	Fmsy>> Fmax	Fmsy>> Fmax	no stock recruit data at SSB where density dependence is predicted	Power spectrum dominant frequency exceeds 1/2 time series length

Table B2.48. Continued.

Parameter Point_Estimate	BH	ABH	PBH	PABH	PRBH	PRABH	RK	ARK	PRK	PARK
MSY	1.543	1.587	1.596	1.623	1.640	1.771	1.753	1.836	2.153	0.568
FMSY	0.430	0.415	0.405	0.380	0.410	0.395	0.745	0.705	0.375	0.240
SMSY	4.104	4.359	4.484	4.830	4.554	5.087	2.871	3.154	6.485	2.594
Alpha	7.706	8.051	8.167	8.579	8.365	9.161	2.043	1.982	1.296	0.828
expected_alpha	8.084	8.422	8.574	8.998	8.783	9.612	2.171	2.097	1.500	1.431
Beta	0.387	0.473	0.516	0.698	0.516	0.636	-0.359	-0.323	-0.134	-0.281
Steepness	0.923	0.911	0.905	0.881	0.907	0.896				
R_at_input_SMAX	7.302	7.542	7.606	7.800	7.791	8.398	4.388	5.310	10.032	2.233
expected_R_at_input_SMAX	7.661	7.889	7.985	8.182	8.180	8.811	4.663	5.618	11.611	3.862
unfished_S	18.138	18.883	19.118	19.925	19.594	21.389	8.144	8.863	16.247	6.058
unfished_R	7.544	7.855	7.952	8.288	8.150	8.897	3.387	3.686	6.758	2.520
Sigma	0.310	0.300	0.312	0.309	0.312	0.310	0.349	0.336	0.541	1.047
Phi		0.720		0.734		0.736		0.749		0.973
Sigmaw		0.208		0.210		0.210		0.222		0.240
last_residual_R		-1.177		-1.392		-1.991		-0.141		3.699
last_logresidual_R		-0.172		-0.200		-0.276		-0.022		0.890
expected_lognormal_error_term	1.049	1.046	1.050	1.049	1.050	1.049	1.063	1.058	1.157	1.729
prior_mean_steepness			0.80	0.80						
prior_se_steepness			0.09	0.09						
prior_mean_slope									0.79	0.79
prior_se_slope									0.18	0.18
prior_mean_unfished_R					10.09	10.09				
prior_se_unfished_R					2.06	2.06				

Table B2.49. Input parameters and stochastic projection results for Gulf of Maine winter flounder using recruitment predicted from the Beverton-Holt stock-recruitment model and an estimated Fmsy = 0.43.

Age	Stock Size on 1 Jan 2002 (000s)	Fishing Mortality Pattern	Proportion Landed	Proportion mature	Mean Weights Spawning Stock	Mean Weights Landings	Mean Weights Discards
1	6274	0.030	0.000	0.000	0.021	0.000	0.036
2	6033	0.040	0.040	0.000	0.059	0.000	0.089
3	4971	0.130	0.710	0.160	0.203	0.399	0.229
4	5444	0.570	0.940	0.860	0.419	0.480	0.306
5	3624	1.000	0.980	1.000	0.512	0.553	0.389
6	2001	1.000	0.980	1.000	0.626	0.696	0.468
7	1572	1.000	0.990	1.000	0.788	0.875	0.694
8+	1558	1.000	0.990	1.000	1.100	1.105	0.867

F2002 is assumed equal to F2001; F during 2003-2013 = F_{msy} = 0.43.

Forecast Medians (50% probability level)

000s Metric tons

2002				2003				2013			
F	Land	Disc	SSB	F	Land	Disc	SSB	F	Land	Disc	SSB
0.14	0.9	<0.1	7.6	Fmsy=0.43	2.9	0.1	7.8	Fmsy=0.43	1.5	0.1	4.3

F2002 is assumed 0.85*F2001 (15% decrease in F from 2001 to 2002); F during 2003-2013 = F_{msy} = 0.43.

Forecast Medians (50% probability level)

000s Metric tons

2002				2003				2013			
F	Land	Disc	SSB	F	Land	Disc	SSB	F	Land	Disc	SSB
0.12	0.8	<0.1	7.7	Fmsy=0.43	2.9	0.1	7.9	Fmsy=0.43	1.6	0.1	4.3

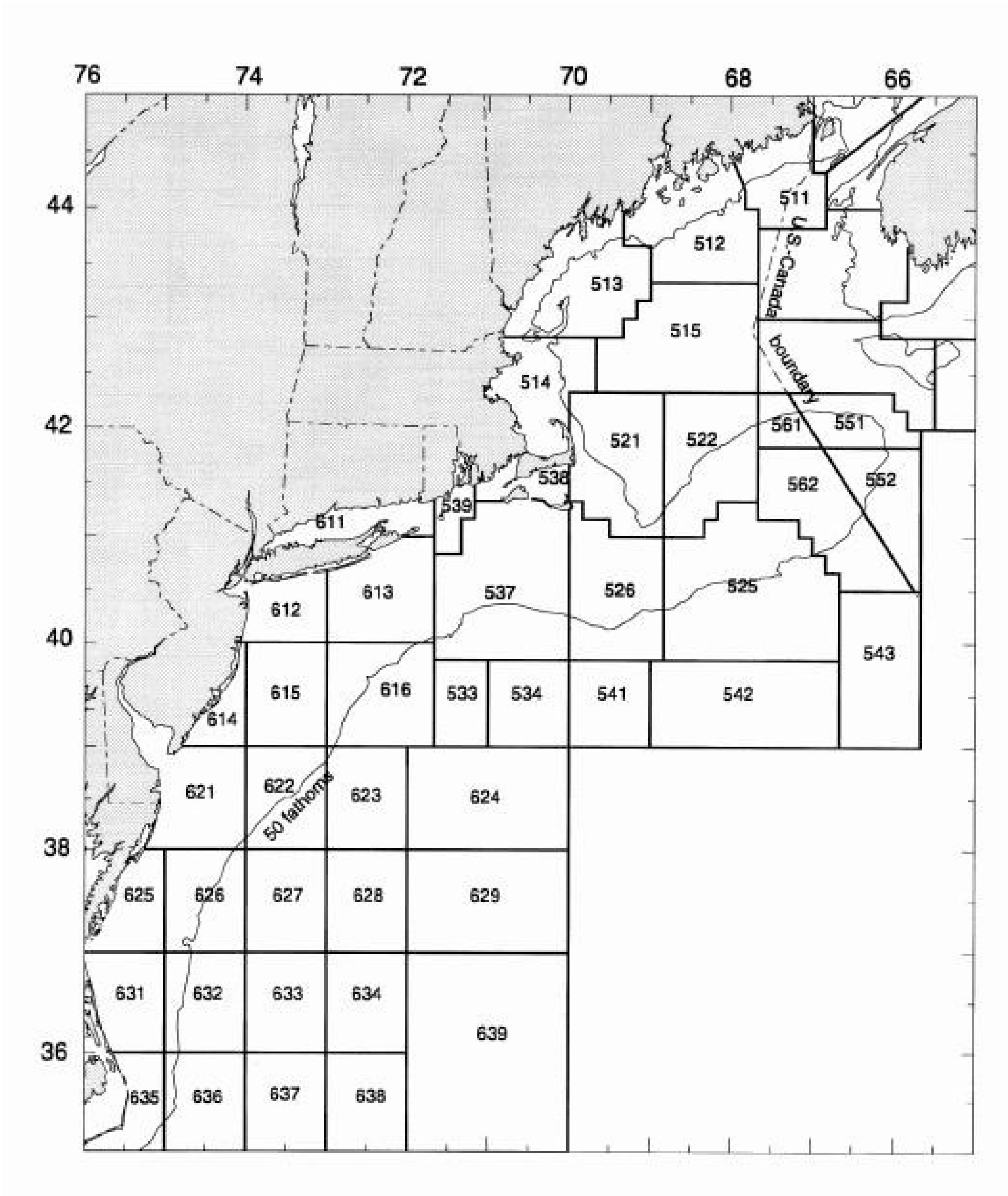

Figure B2.1. Statistical areas for reporting landings in the northwest Atlantic ocean.

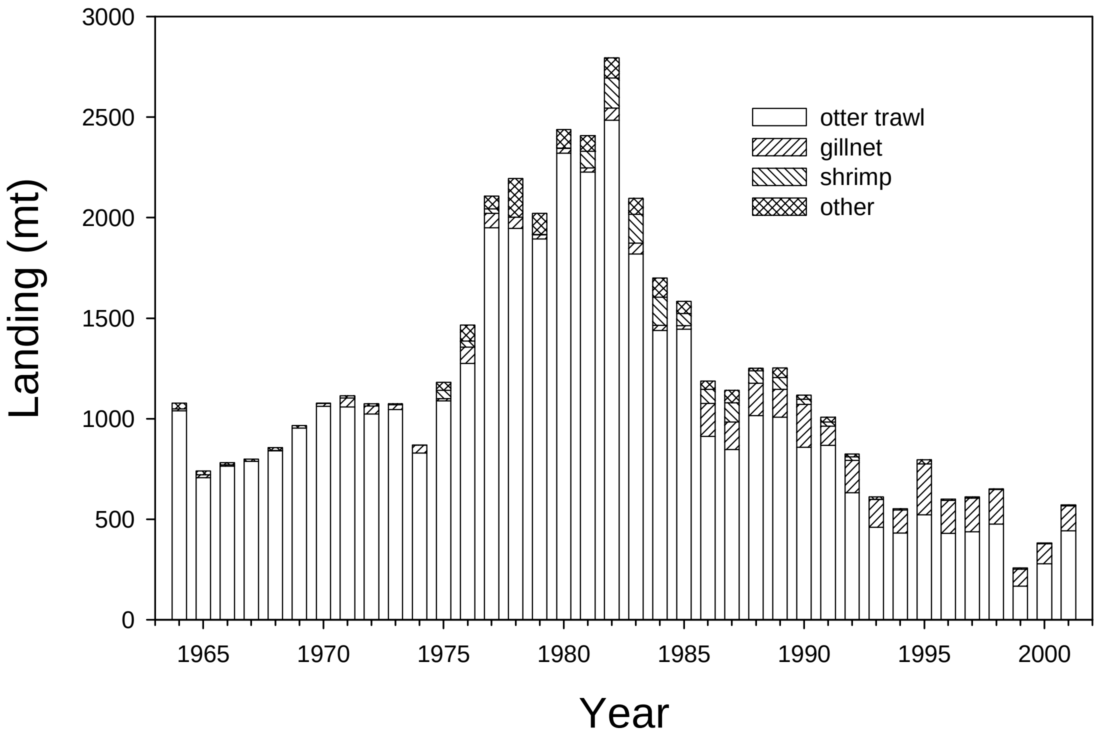

Figure B2.2. Gulf of Maine winter flounder commercial landings by gear from 1964-2001.

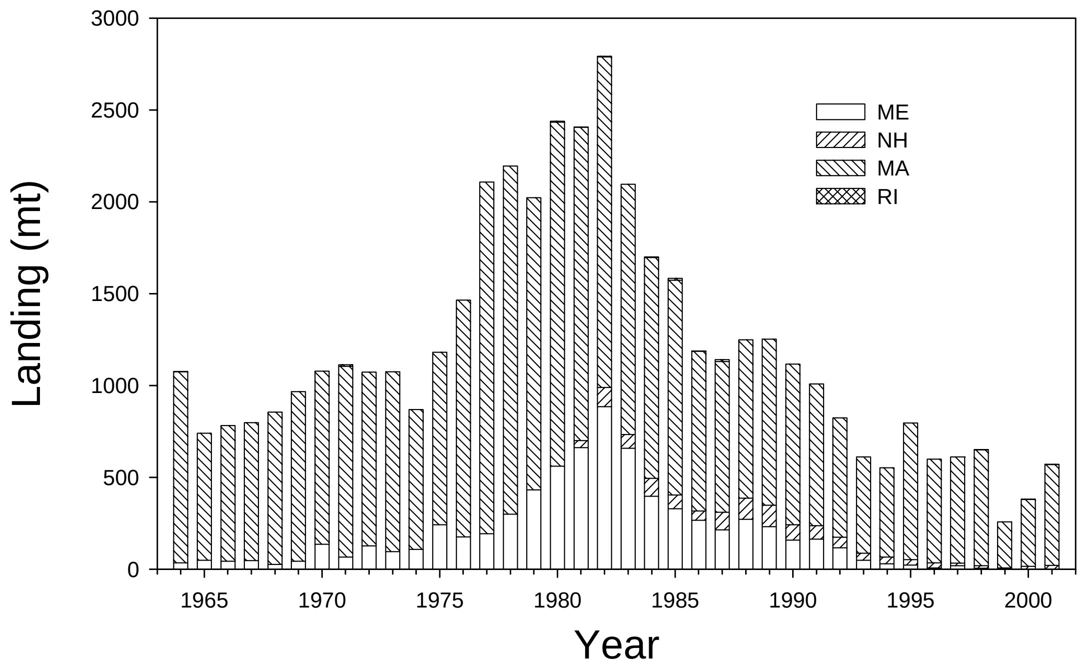

Figure B2.3. Gulf of Maine winter flounder commercial landings by state from 1964-2001.

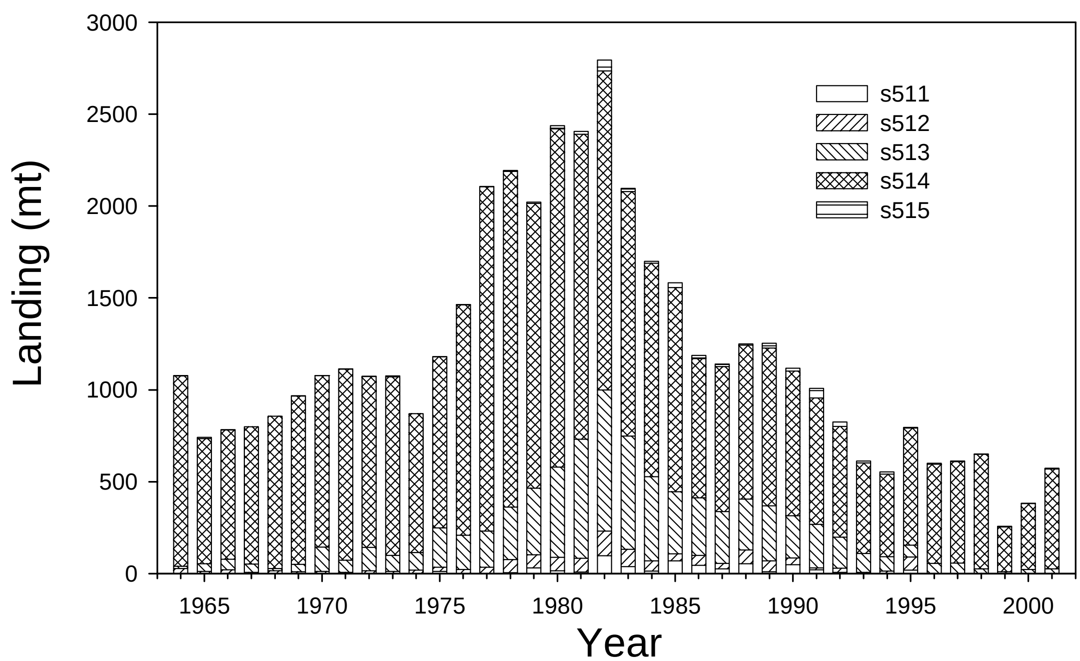

Figure B2.4. Gulf of Maine winter flounder commercial landings by statistical area from 1964-2001.

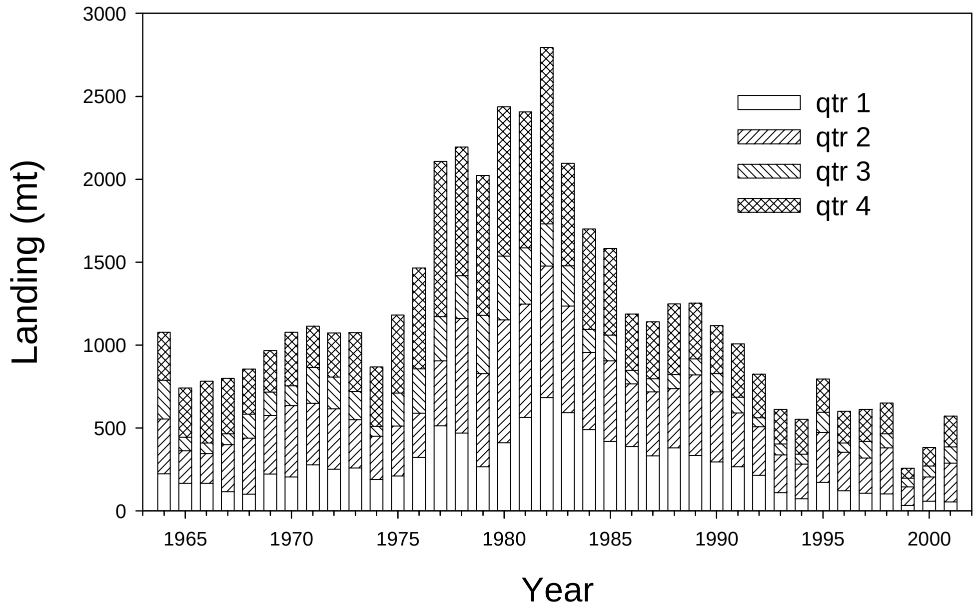

Figure B2.5. Gulf of Maine winter flounder commercial landings by quarter from 1964-2001.

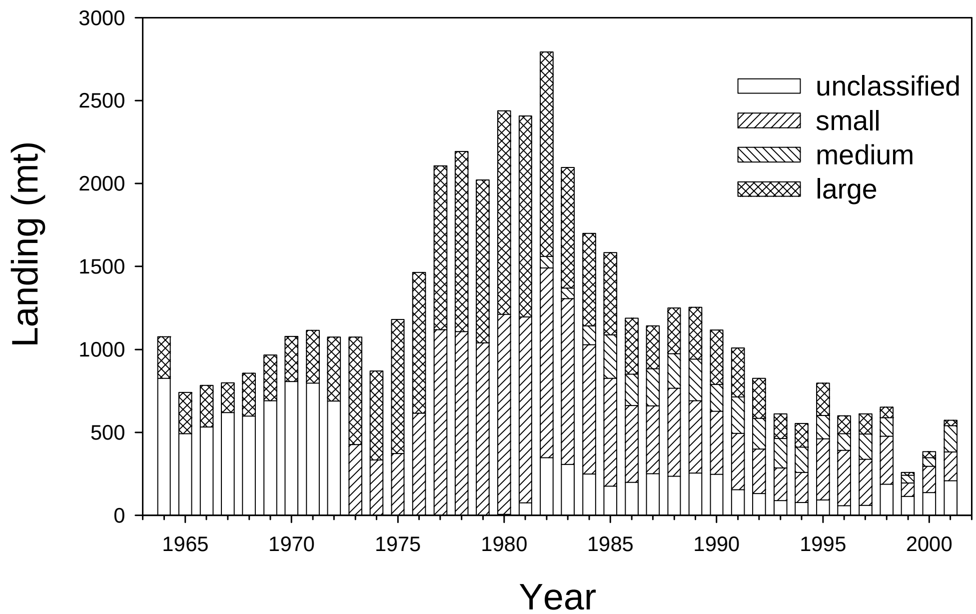

Figure B2.6. Gulf of Maine winter flounder commercial landings by market category from 1964-2001.

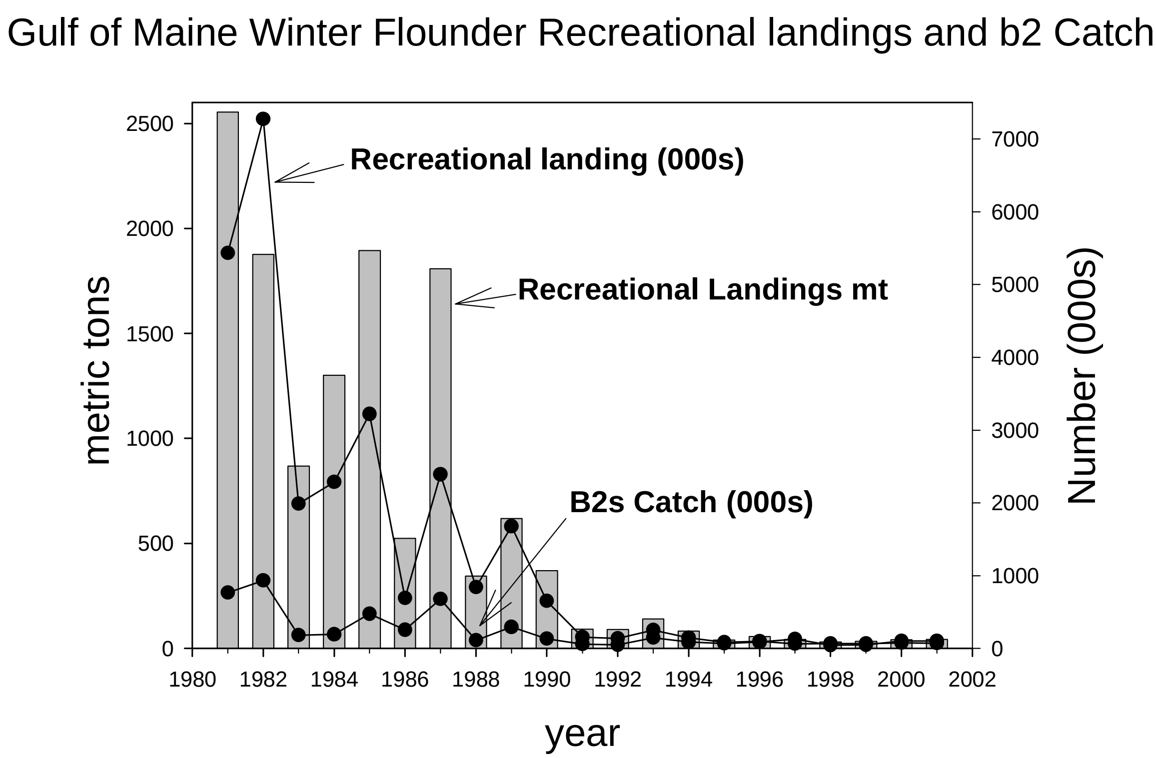

Figure B2.7. Recreational landings in numbers and metric tons for Gulf of Maine winter flounder. B2 catch in numbers is also shown.

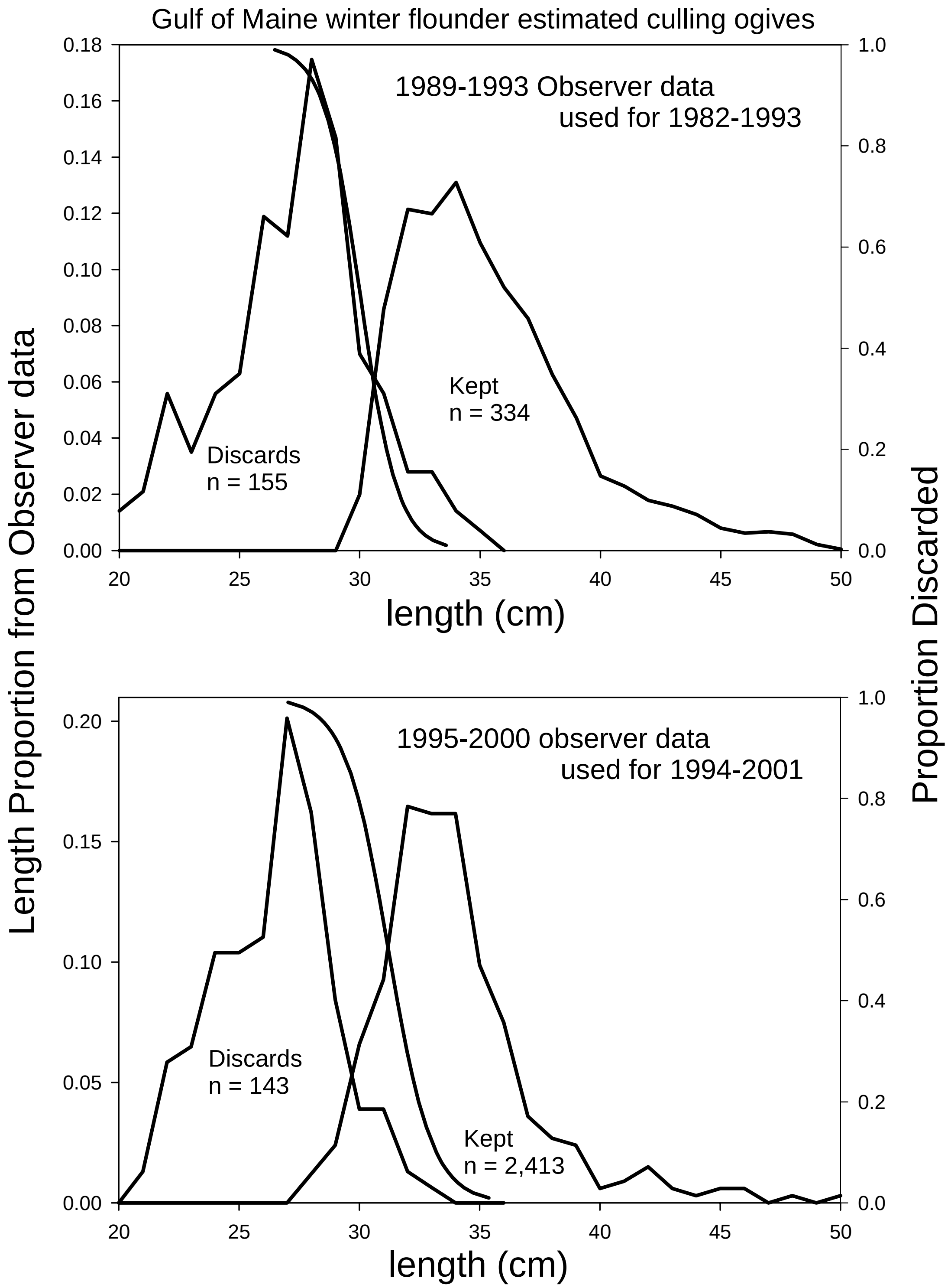

Figure B2.8. Gulf of Maine winter flounder estimated culling ogive from Observer data for estimating trawl discards in the survey method.

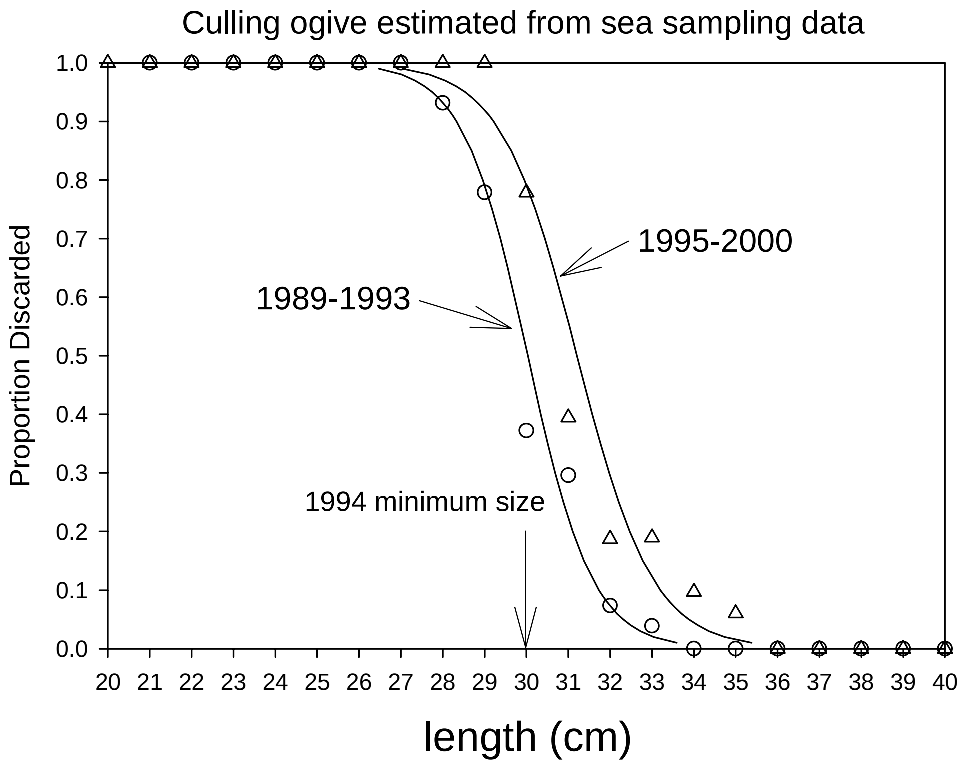

Figure B2.9. Gulf of Maine winter flounder estimated culling ogive. Observer data from 1989-1993 was used to estimate an ogive used for years 1982-1993. Observer data from 1995-2000 was used to estimate an ogive used for years 1994-2001.

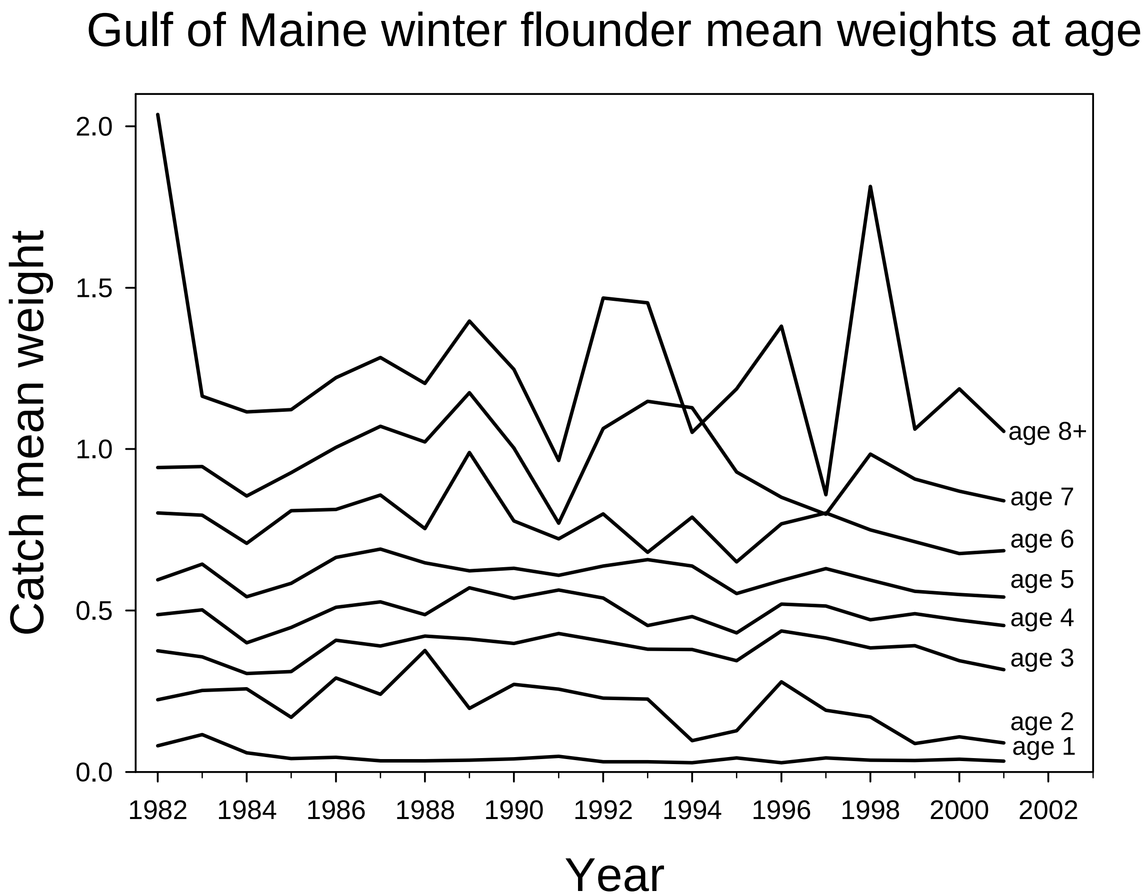

Figure B2.10. Gulf of Maine winter flounder VPA mean weights at age.

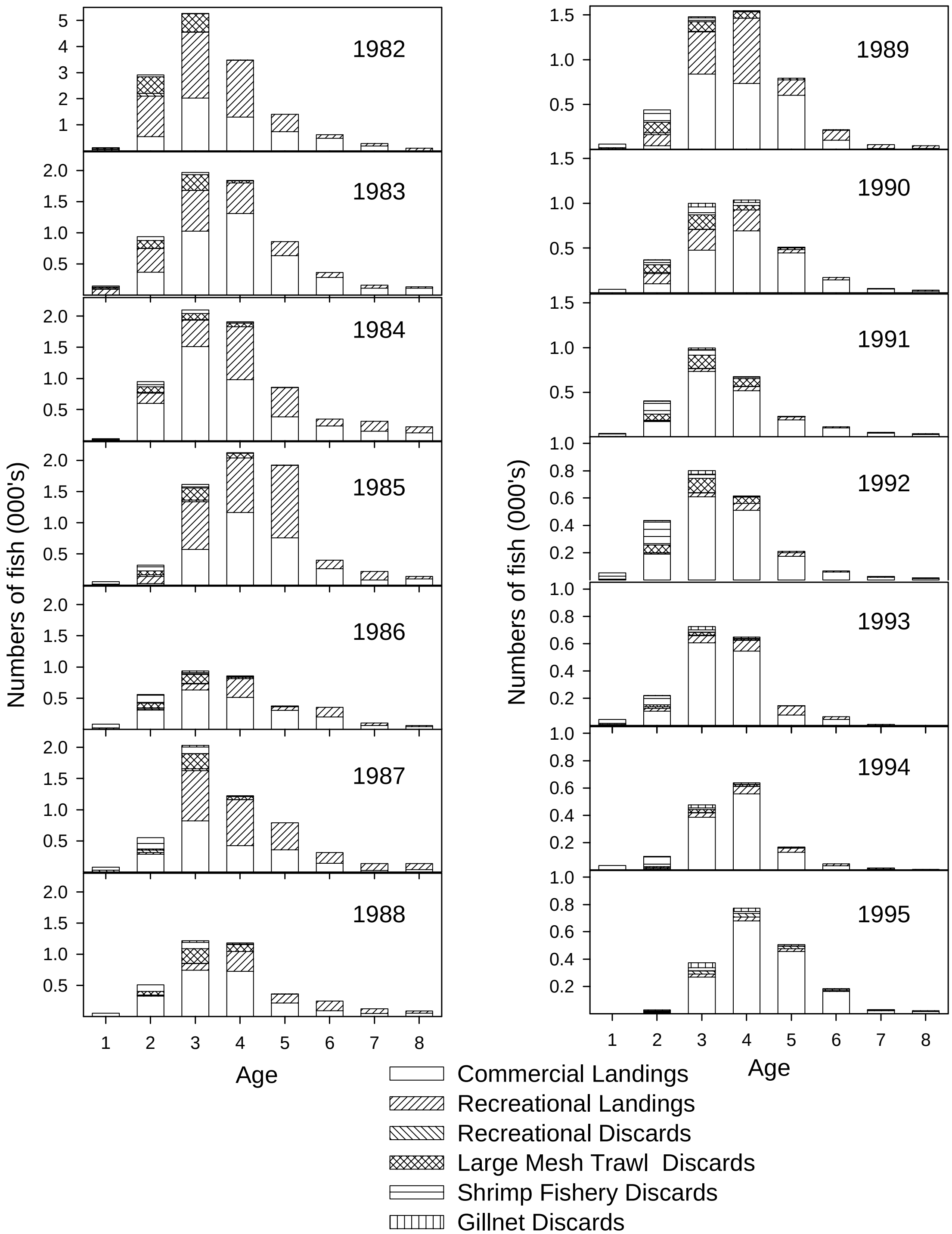

Figure B2.11. Gulf of Maine winter flounder catch at age composition in numbers from 1982-2001.

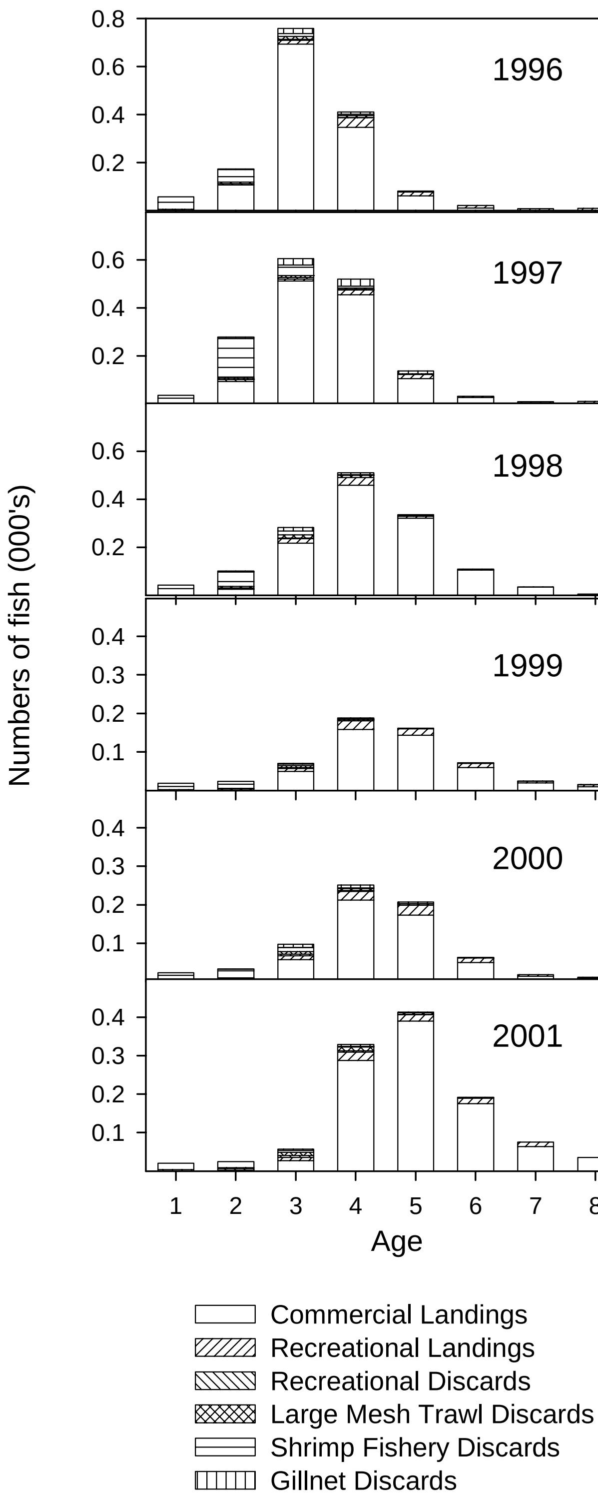

Figure B2.11. Continued.

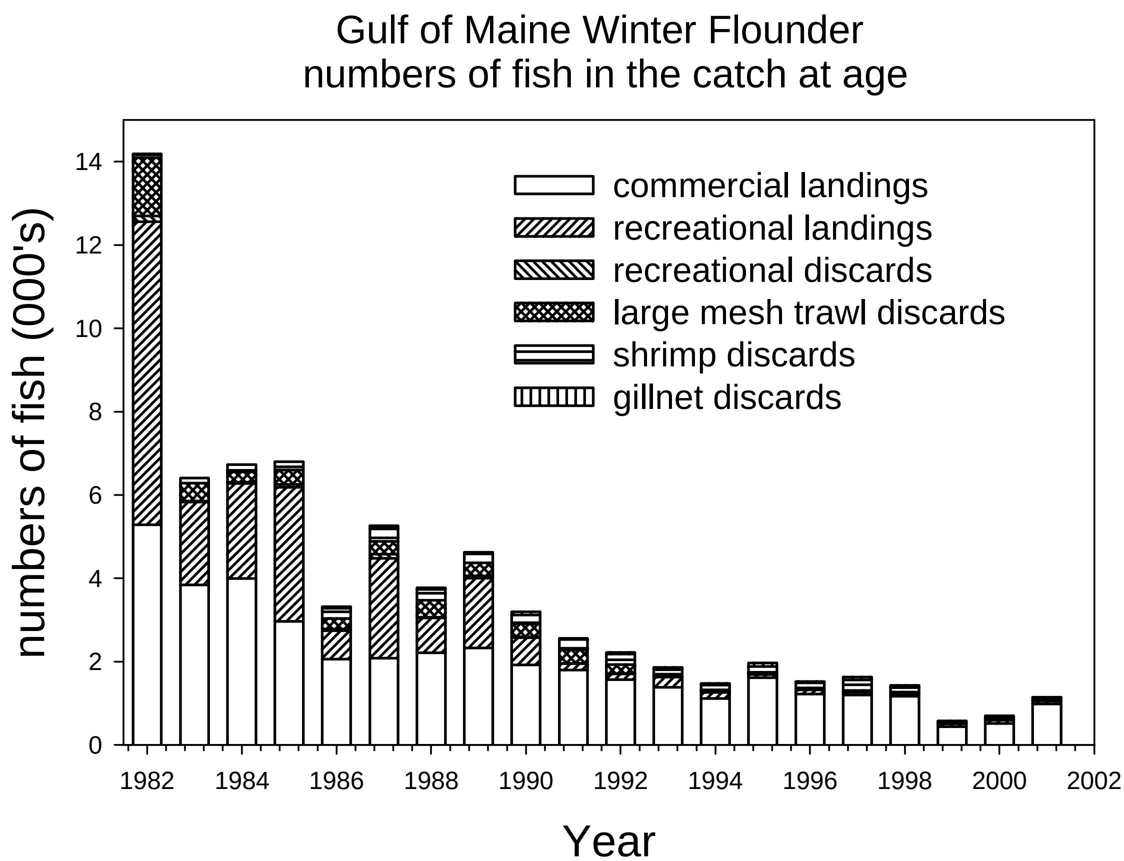

Figure B2.12. Gulf of Maine winter flounder catch composition in numbers

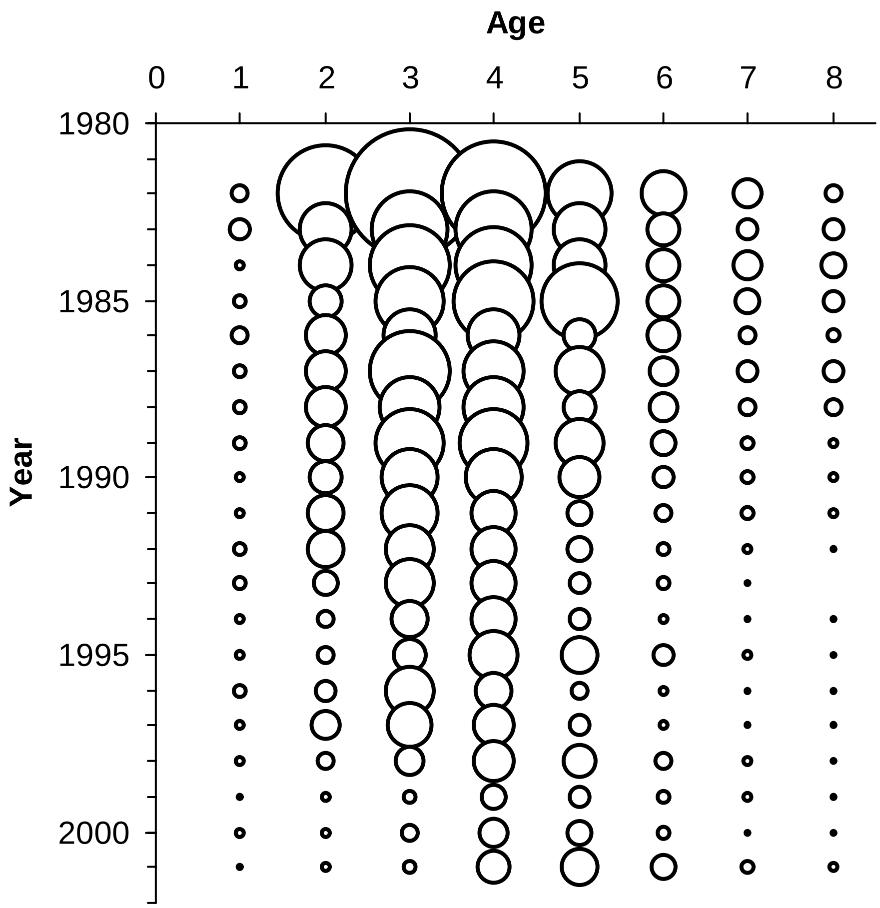

Figure B2.13. Total Gulf of Maine winter flounder catch at age.

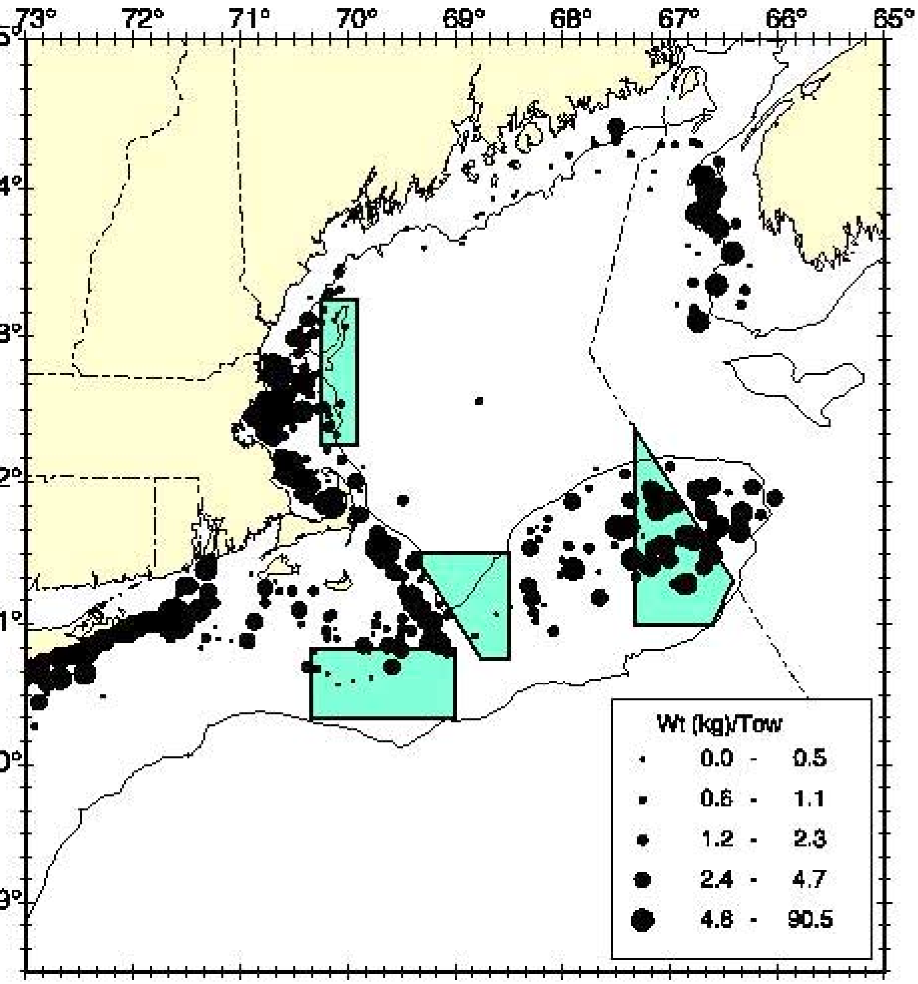

Figure B2.14. Distribution of winter flounder during the NEFSC spring bottom trawl surveys from 1995-1999.

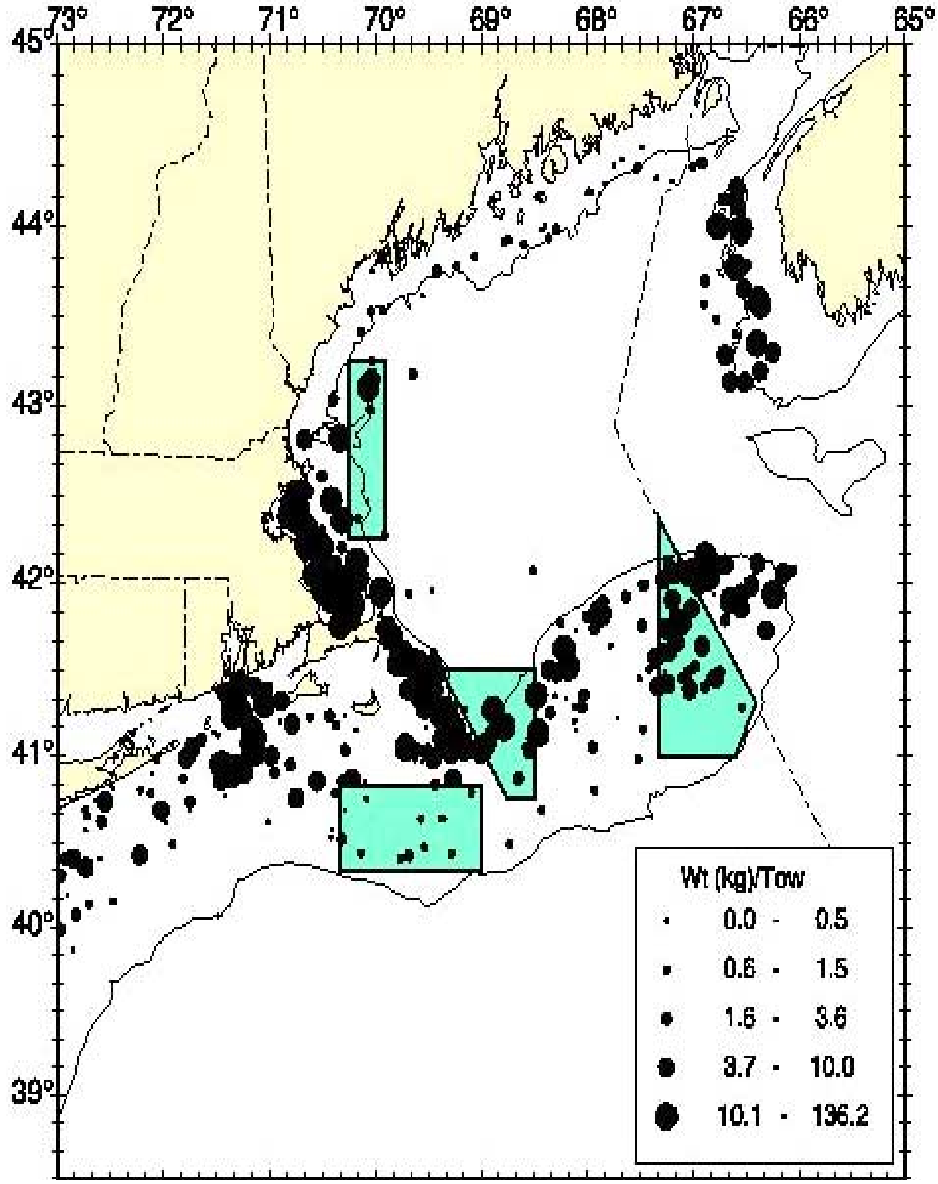

Figure B2.15. Distribution of winter flounder during the NEFSC fall bottom trawl surveys from 1995-1999.

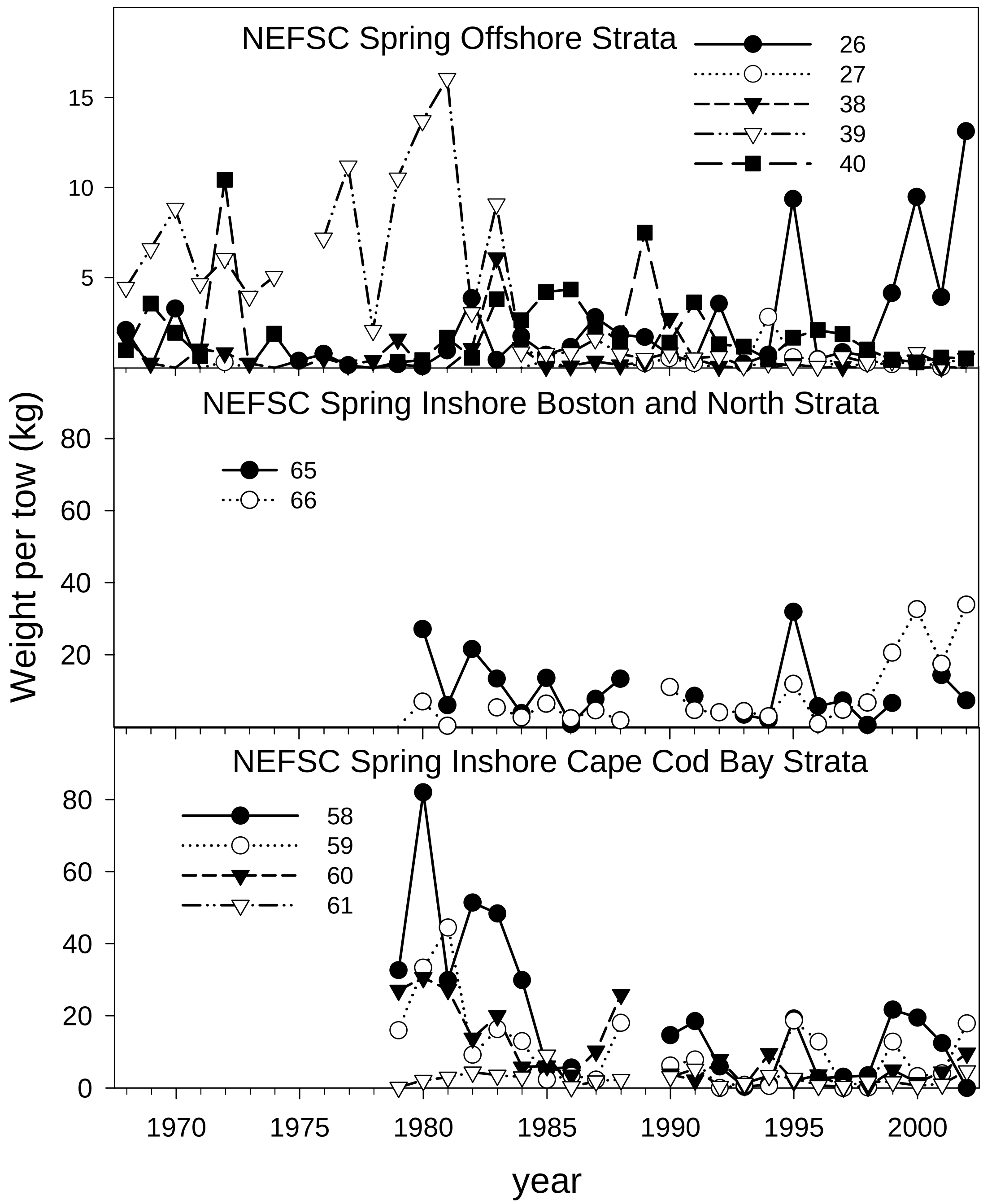

Figure B2.16. NEFCS spring Gulf of Maine winter flounder weight per tow trends among strata.

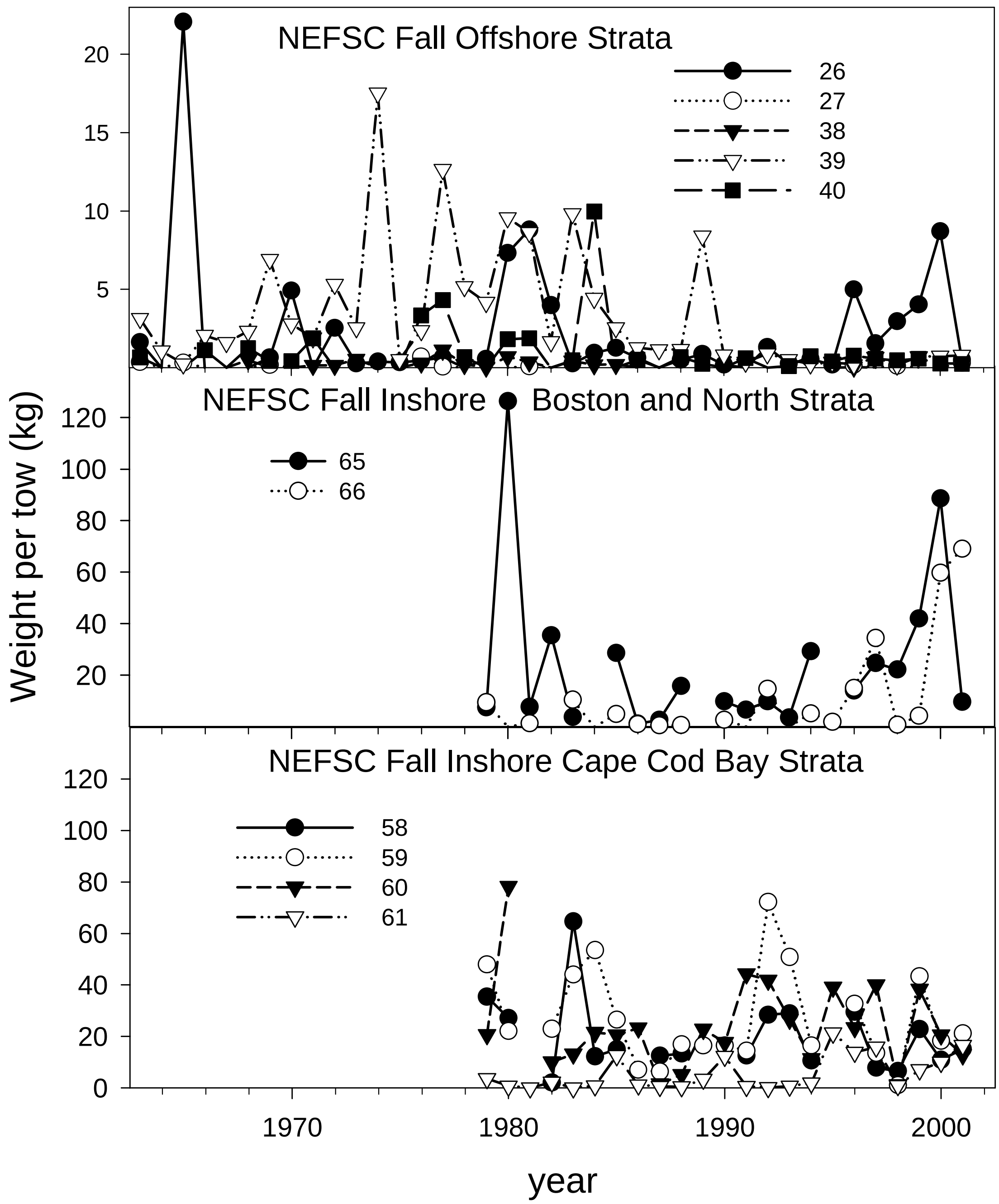

Figure B2.17. NEFCS fall Gulf of Maine winter flounder weight per tow trends among strata.

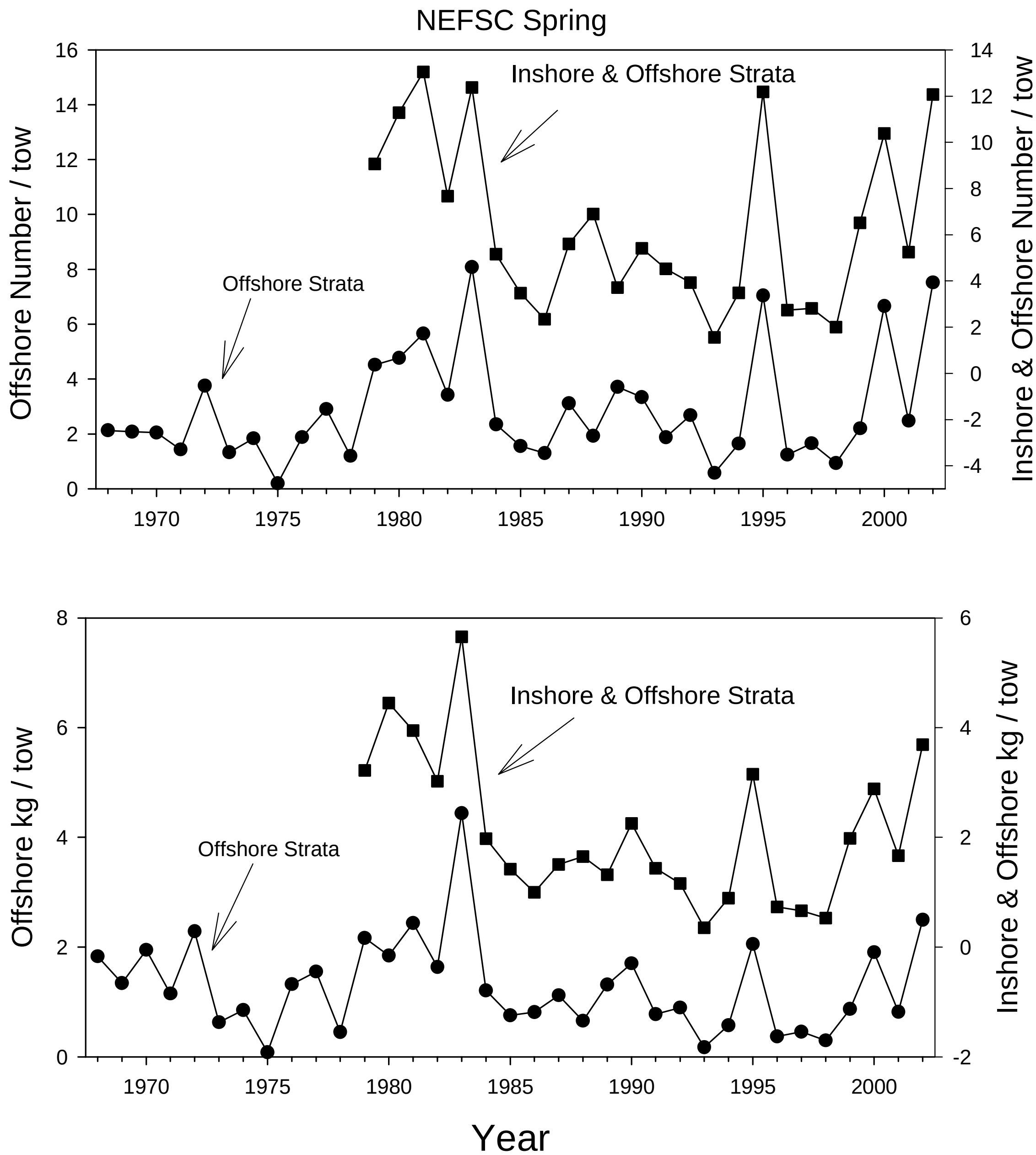

Figure B2.18. NEFSC spring offshore and inshore/offshore survey stratified mean number and mean weight (kg) per tow for Gulf of Maine winter flounder. Trawl door conversion factors are use where appropriate.

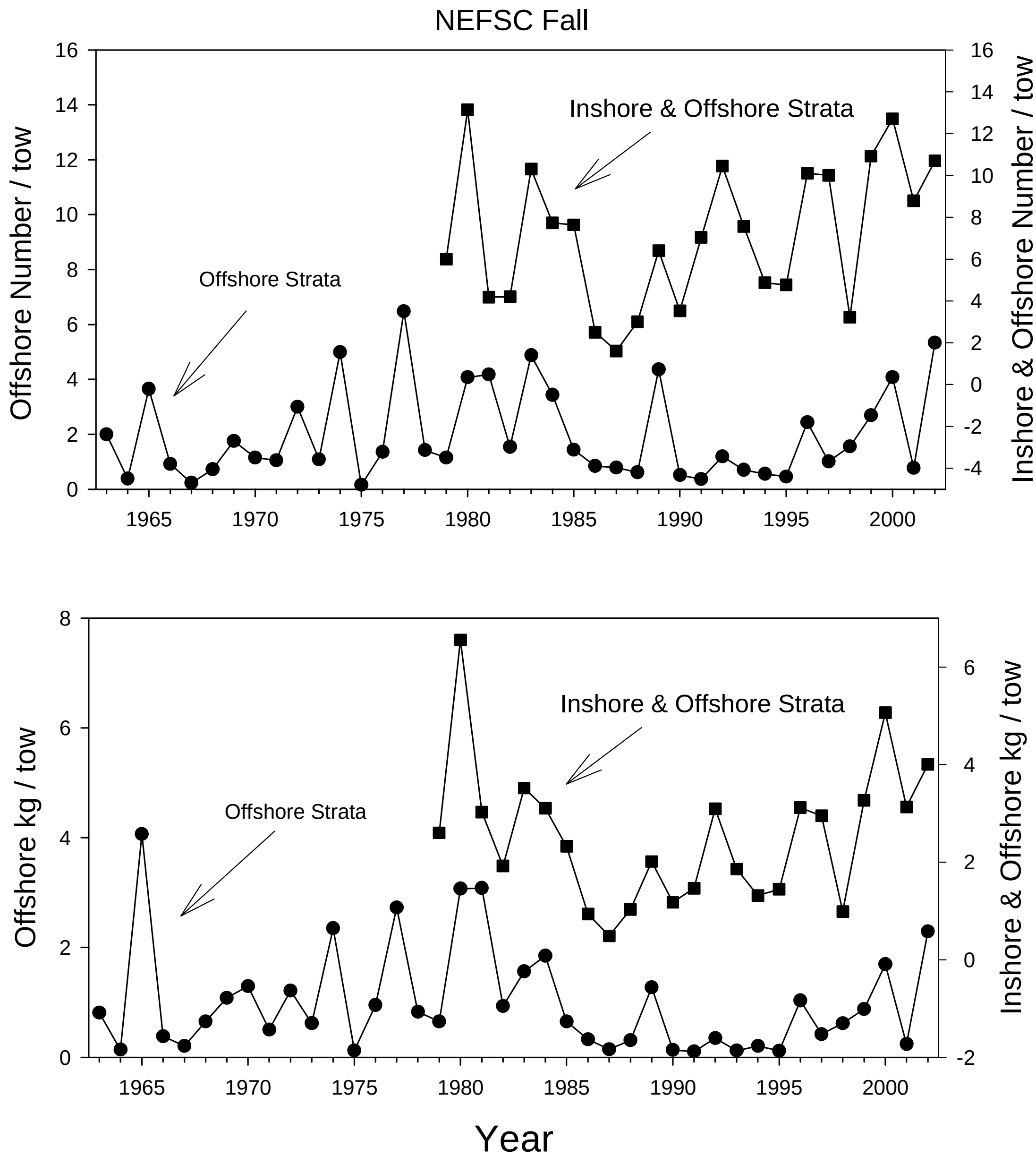

Figure B2.19. NEFSC Fall offshore and inshore/offshore survey stratified mean numbers and mean weight (kg) per tow for Gulf of Maine winter flounder. Trawl door conversion factors are use where appropriate. Data for 2002 is preliminary.

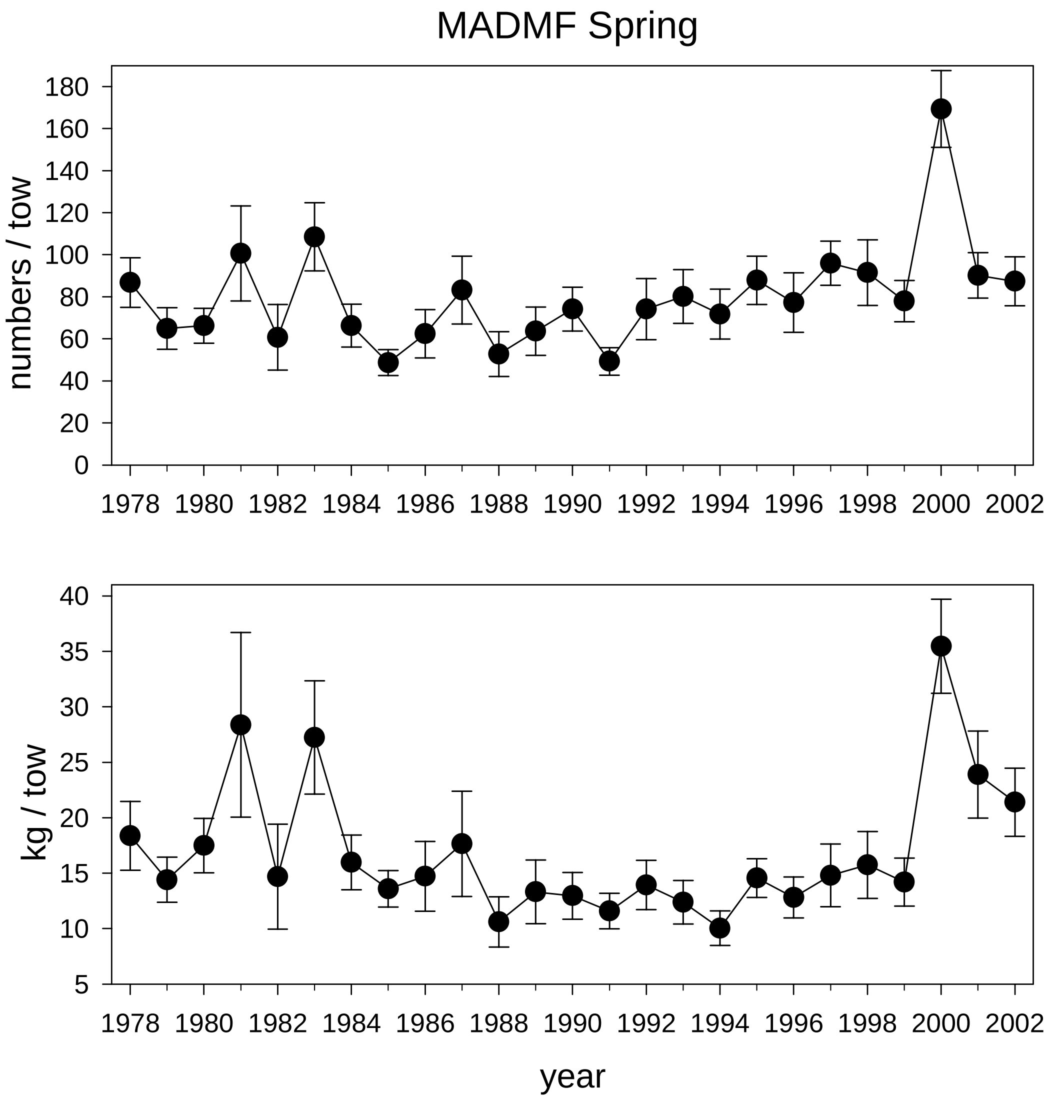

Figure B2.20. Massachusetts Division of Marine Fisheries (MADMF) spring survey stratified mean numbers and mean weight (kg) per tow for Gulf of Maine winter flounder.

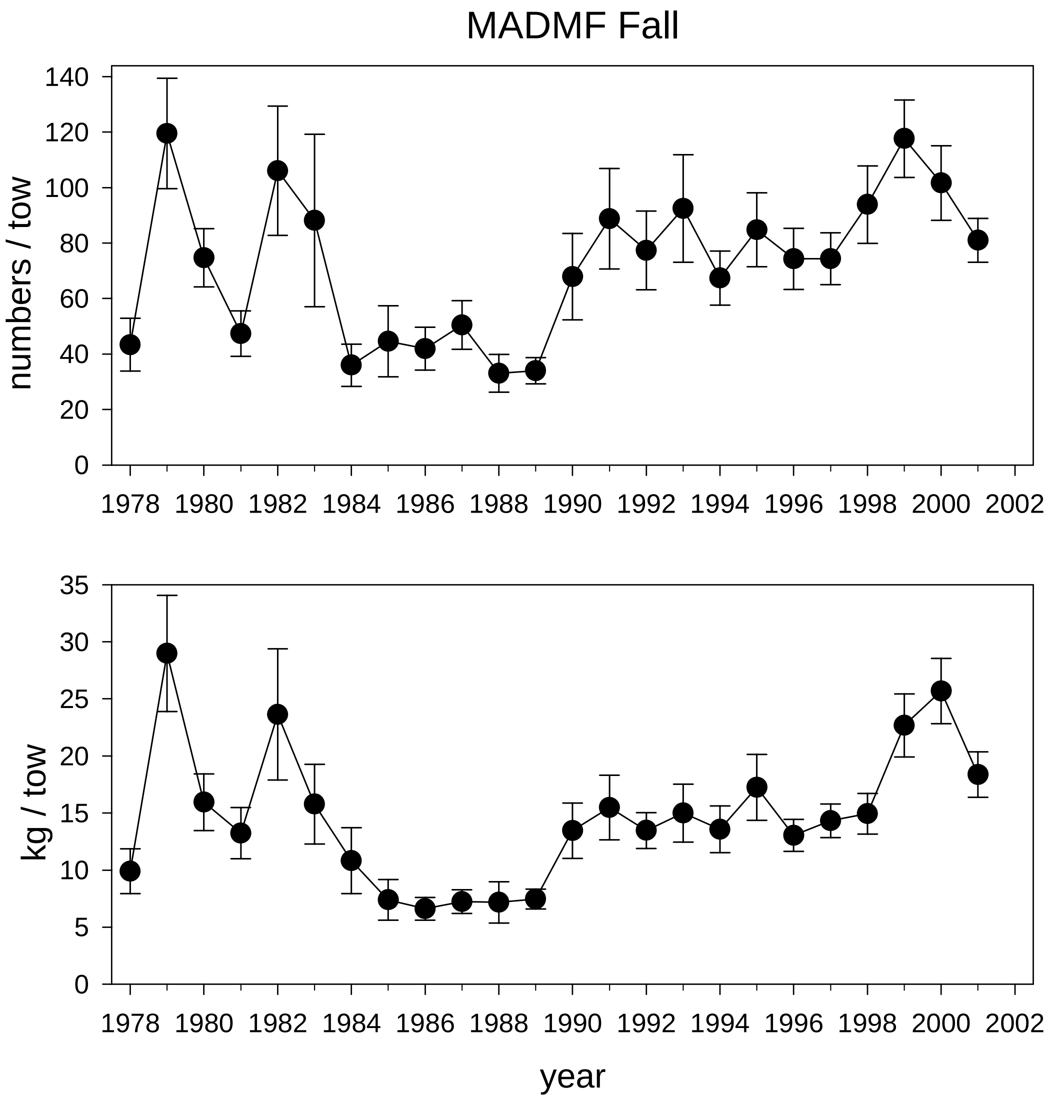

Figure B2.21. Massachusetts Division of Marine Fisheries (MDMF) fall survey stratified mean numbers and mean weight (kg) per tow for Gulf of Maine winter flounder.

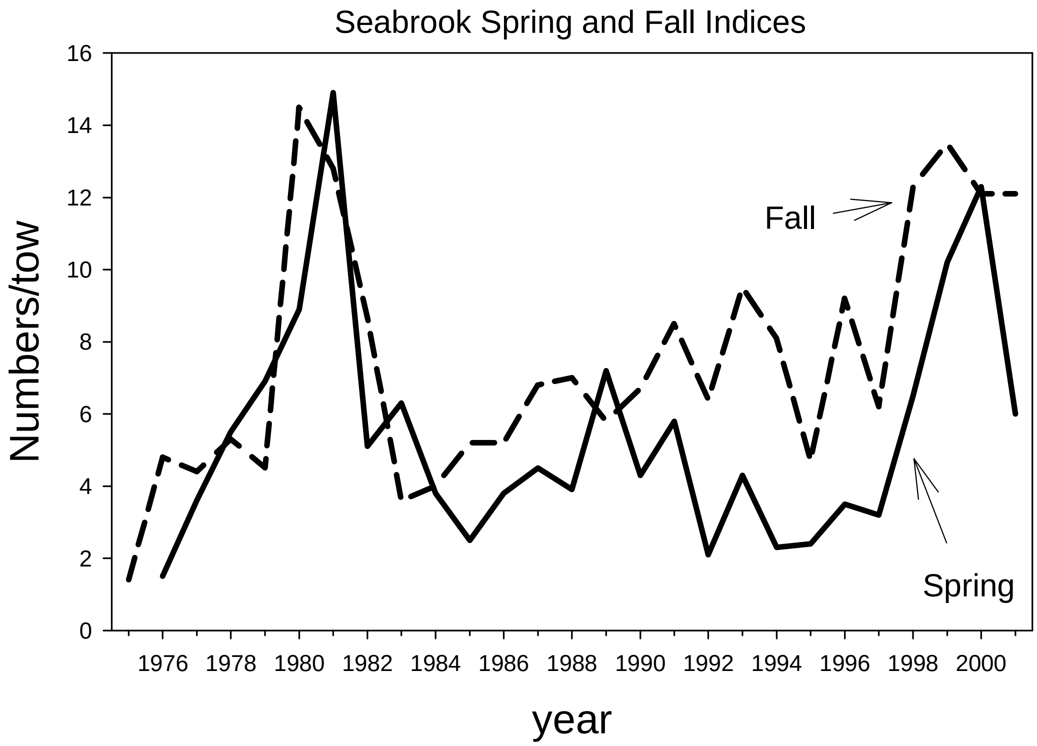

Figure B2.22. Seabrook Nuclear Power Plant in New Hampshire spring and fall survey mean numbers per tow for Gulf of Maine winter flounder. No length data exists from 1975 to 1984 and 1993.

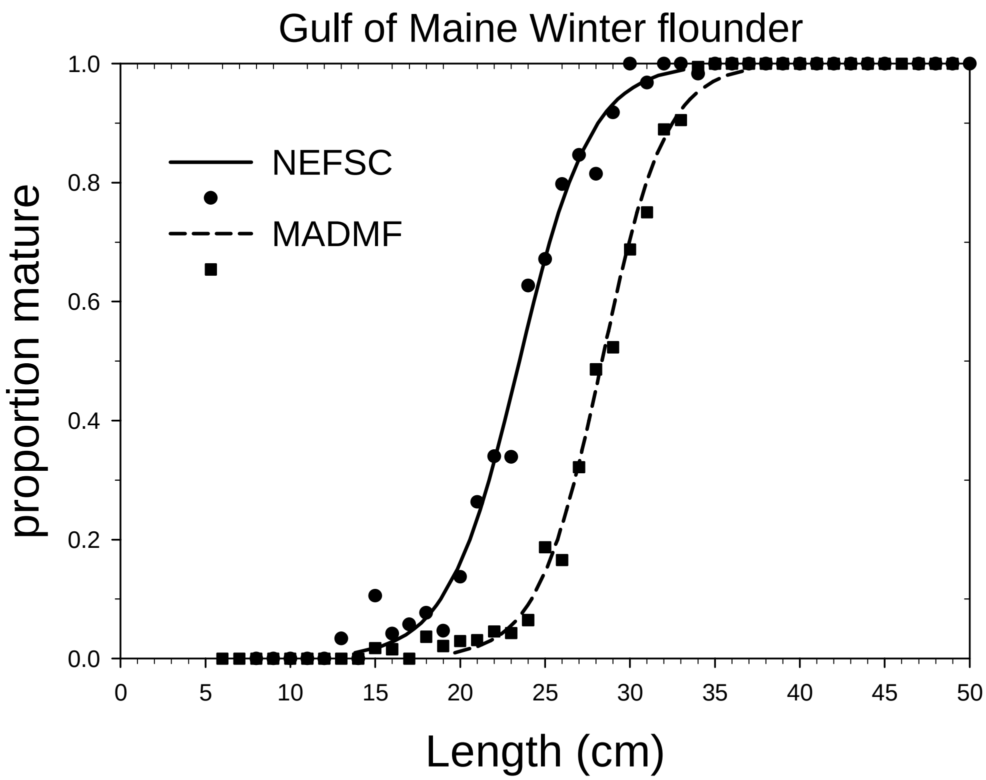

Figure B2.23. Comparison of Gulf of Maine winter flounder maturity ogives (sexes combined) estimated from the MADMF spring survey (strata 25-36) and the spring NEFSC survey data limited in inshore MA strata 58-66.

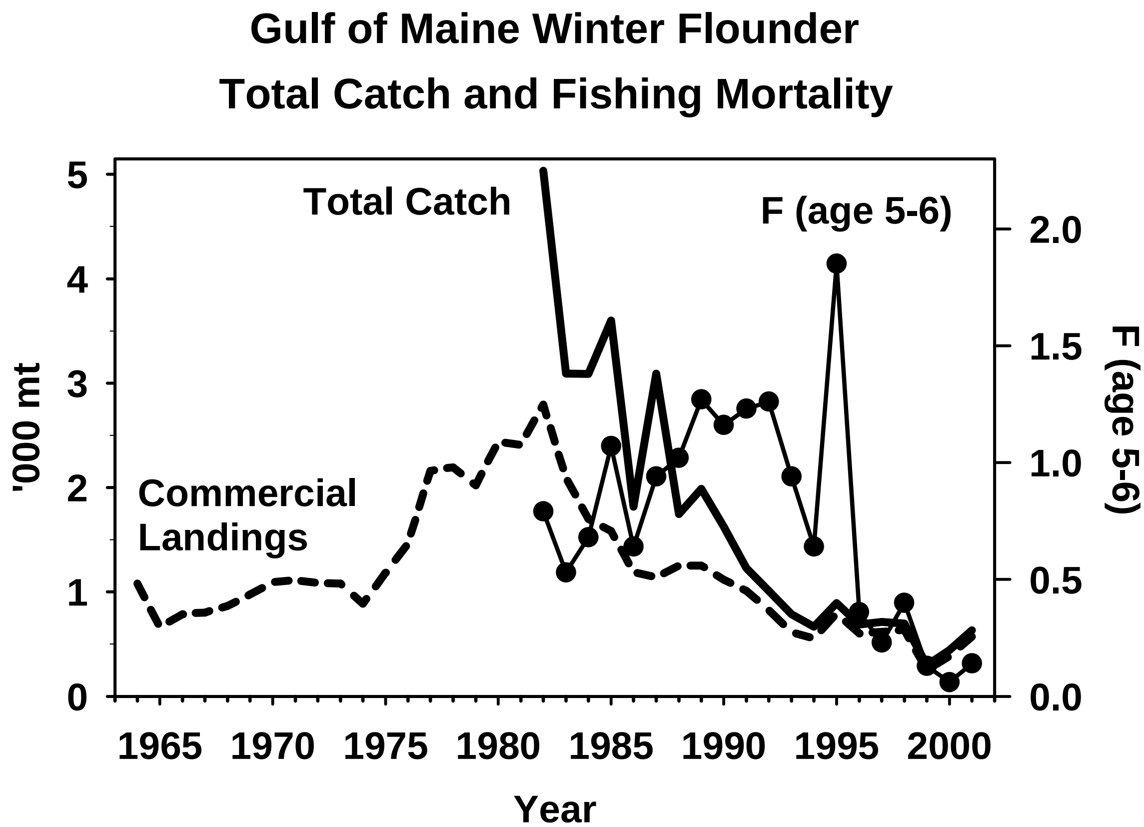

Figure B2.24. Total catch (landings and discards, '000 mt), commercial landings ('000 mt), and fishing mortality rate (F, ages 5-6, unweighted) for Gulf of Maine winter flounder.

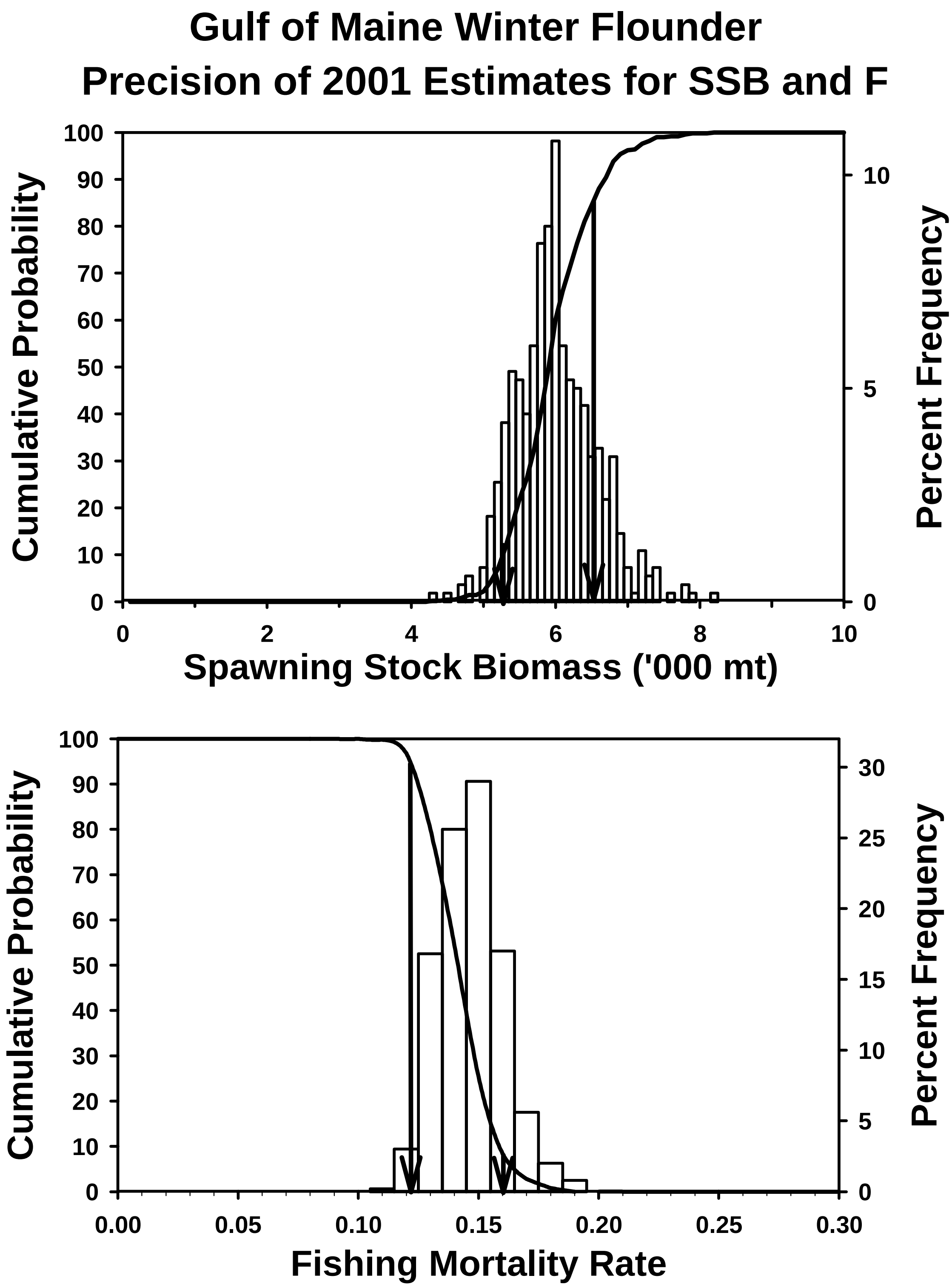

Figure B2.25. Precision of estimates of spawning stock biomass ('000 mt) and fishing mortality rate (F, ages 5-6, unweighted) in 2001 for Gulf of Maine winter flounder. Vertical bars display the range of the bootstrap estimates and the probability of individual values in the range. The solid curve gives the probability of SSB that is less or fishing mortality that is greater than any value along the X axis.

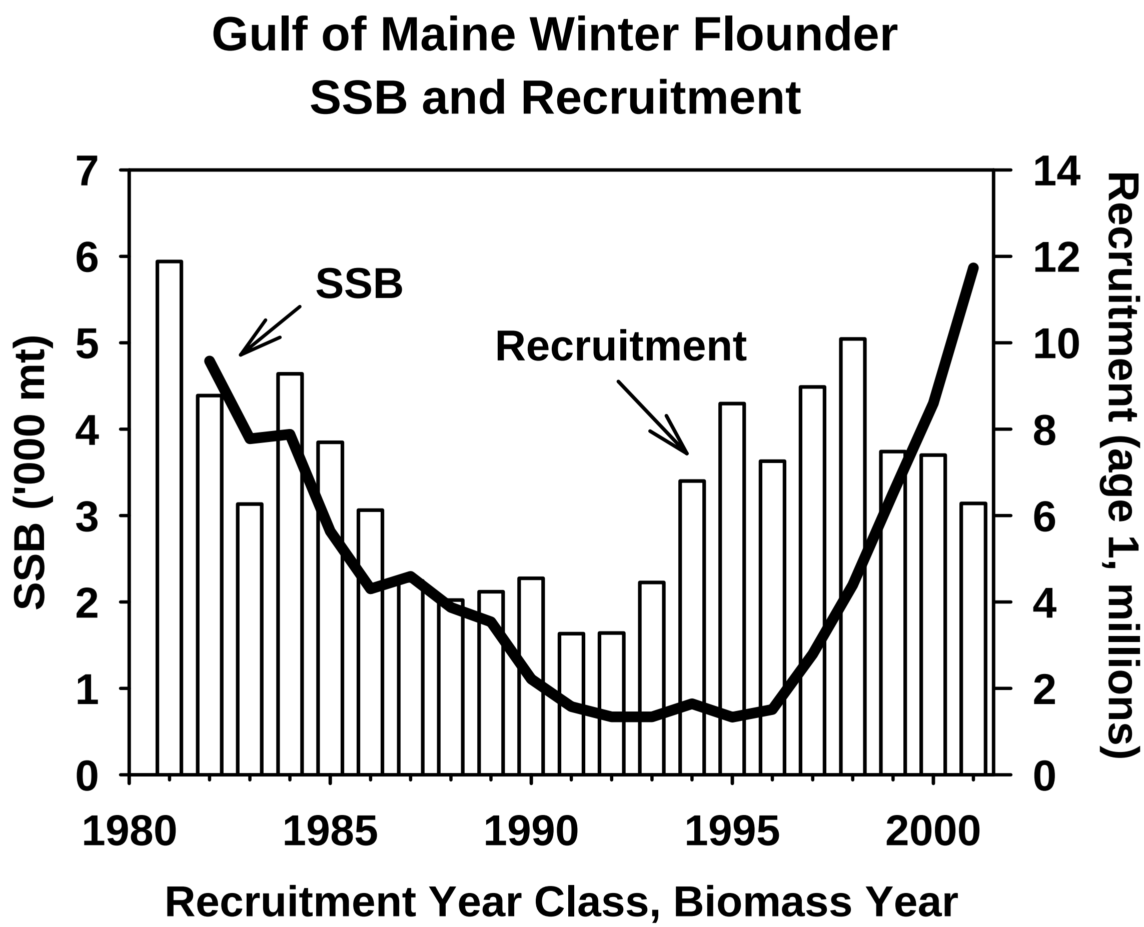

Figure B2.26. Spawning stock biomass (SSB, '000 mt) and recruitment (millions of fish at age-1) for Gulf of Maine winter flounder.

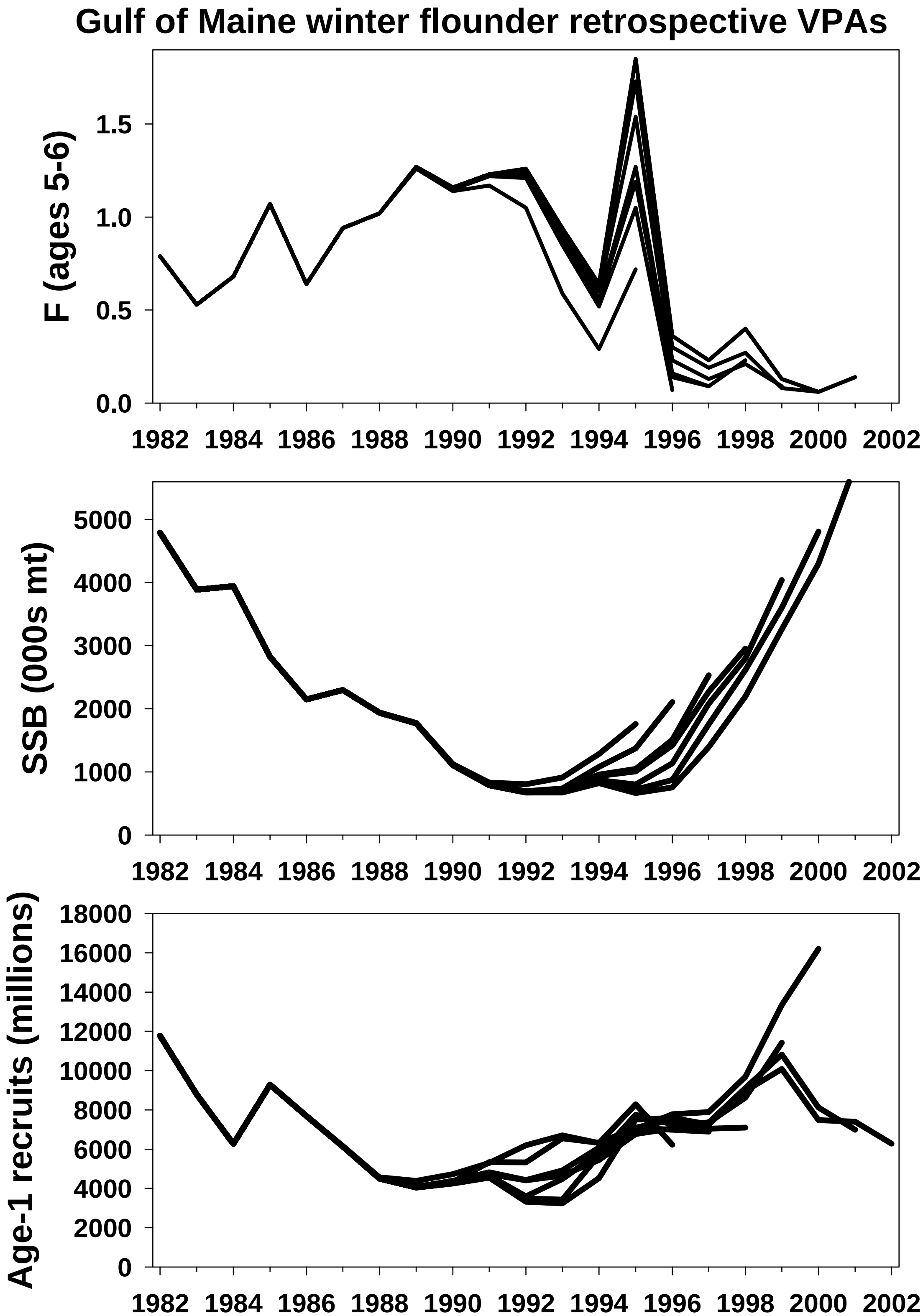

Figure B2.27. Retrospective VPAs for Gulf of Maine winter flounder.

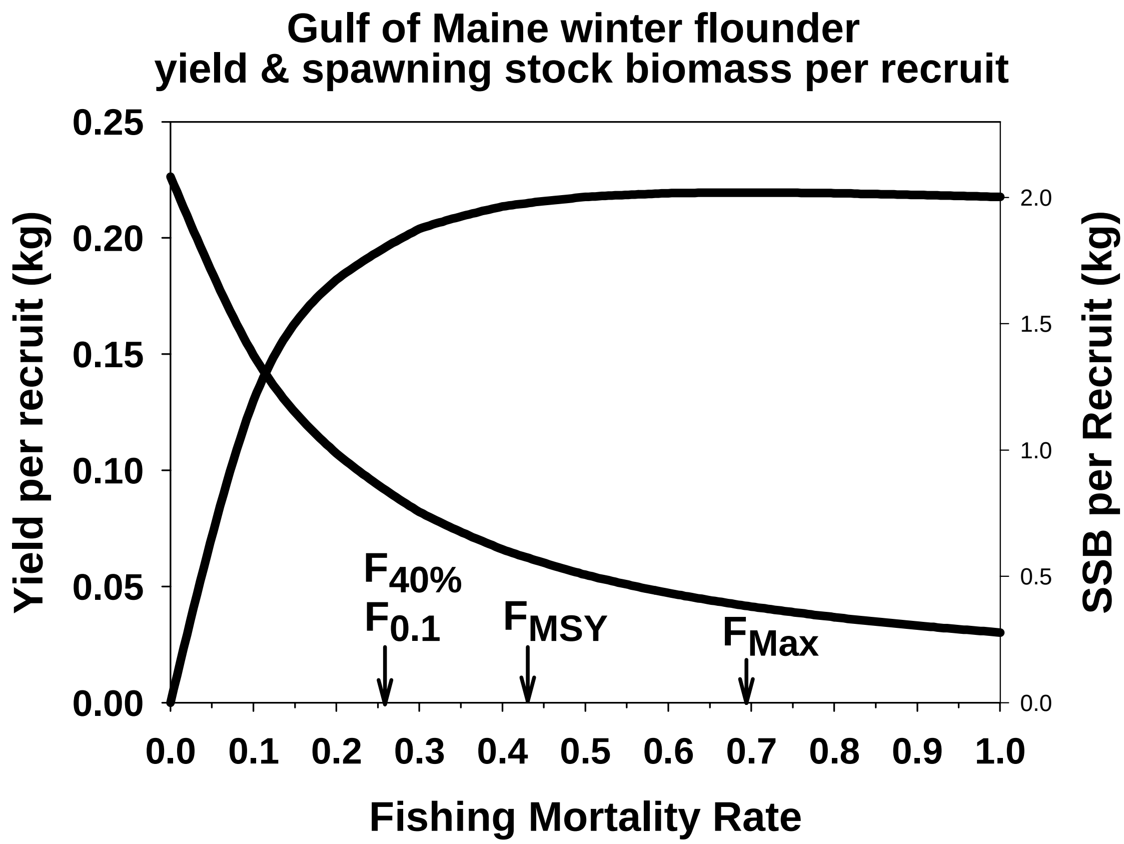

Figure B2.28. Yield and spawning stock biomass per recruit estimates for Gulf of Maine winter flounder.

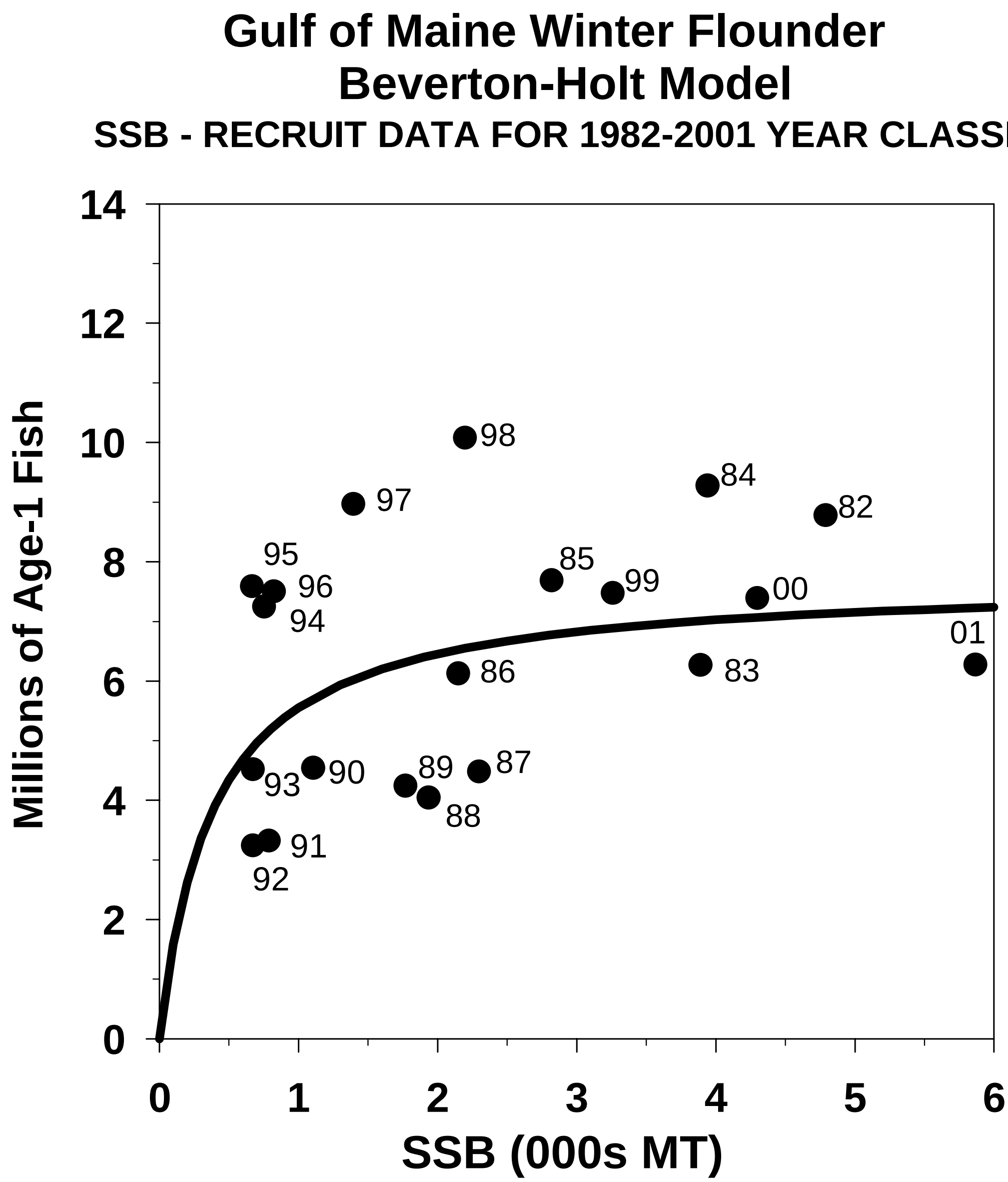

Figure B2.29. Beverton-Holt stock-recruitment model for Gulf of Maine winter flounder.

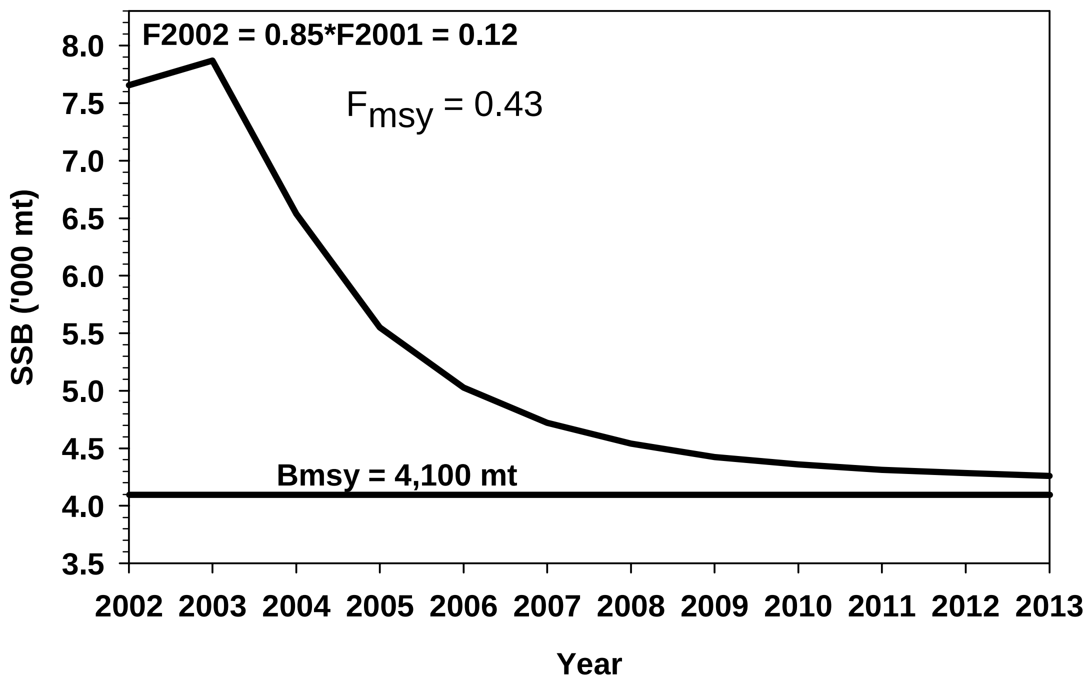

Figure B2.30. Median (50% probability) of forecast spawning stock biomass (SSB, mt) for Gulf of Maine winter flounder assuming F2002 = 0.85*F2001 = 0.12 and Fmsy fishing mortality rates during 2003-2013.

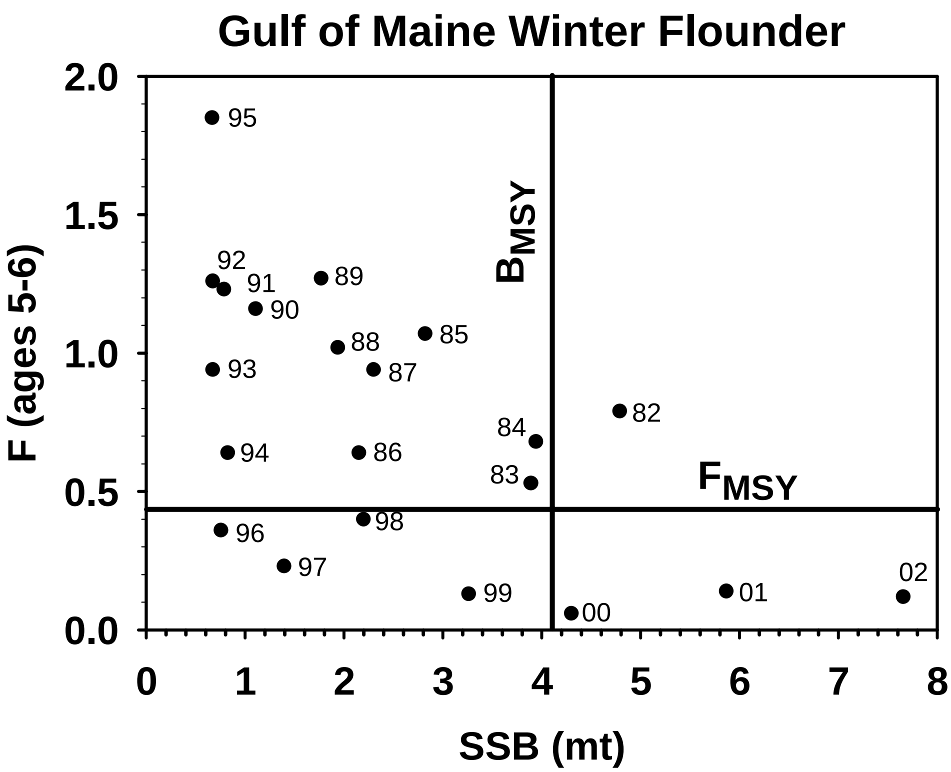

Figure B2.31. SSB and F (ages 5-6) for Gulf of Maine winter flounder. Biological reference points calculated from the Beverton-Holt model are also shown.