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**Canadian Science Advisory Secretariat** | **Secrétariat canadien de consultation scientifique**

**Research Document 2003/076** | **Document de recherche 2003/076**



# Assessment of Haddock on Eastern Georges Bank

# Évaluation d'aiglefin sur l'est du banc Georges

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ISSN 1499-3848 (Printed)


Canada

# ABSTRACT

Haddock catches from eastern Georges Bank fluctuated around 5,000 t from 1985 to 1990. Under restrictive management measures, combined Canada/USA catches declined from over 6,400 t in 1991 to a low of about 2,100 t in 1995, fluctuated between about 3,000 t and 4,000 t until 1999 and have since increased to about 7,500 t.

Adult population biomass (ages 3+) has steadily increased from near an historical low of about 10,000 t in 1993 to about 78,000 t at the beginning of 2003 but remains below the average biomass during 1930-55. The recent increase was supported by improved recruitment in the 1990's. The 2000 year-class is estimated to be larger than the strong 1975 and 1978 year-classes. The fishing mortality rate for fully recruited ages 4+ has consistently been below the threshold reference target ($F_{ref}$) of 0.26 since 1995. Reduced fishing mortality and avoidance of small fish in the fisheries in recent years has resulted in increased survival of incoming year-classes and greater abundance at older ages.

With an assumed total catch of 8,000 t in 2003, a combined Canada/USA catch of 8,000 t in 2004 would result in a low probability that the fishing mortality rate in 2004 will exceed $F_{ref}$. At this yield, there is a negligible probability of achieving a 10% biomass increase from 2004 to 2005, due to the 2 weak incoming year-classes, 2001 and 2002, but there is a low probability that the biomass will fall below the median 2005 rebuilding biomass of 65,000 t. The population age structure shows good representation at all ages.



## RÉSUMÉ

Les prises d'aiglefin dans le secteur est du banc Georges ont fluctué autour de 5 000 t de 1985 à 1990. Sous le coup de mesures de gestion restrictives, les prises canado-américaines combinées ont chuté, passant de plus de 6 400 t en 1991 à un creux d'environ 2 100 t en 1995, puis ont fluctué entre quelque 3 000 à 4 000 t jusqu'en 1999 pour ensuite augmenter, se situant depuis à quelque 7 500 t.

La biomasse de la population d'adultes (3+ ans) a progressivement augmenté, pour passer d'un creux presque historique d'environ 10 000 t en 1993 à environ 78 000 t au début de 2003, bien qu'elle demeure inférieure à la biomasse moyenne de la période 1930-1955. Cette récente augmentation est imputable à l'amélioration du recrutement dans les années 1990. La classe d'âge 2000 est estimée comme étant plus abondante que les fortes classes 1975 et 1978. Depuis 1995, le taux de mortalité par pêche des classes de 4+ ans pleinement recrutées a régulièrement été inférieur au taux de référence cible ($F_{ref}$) de 0,26. Le taux réduit de mortalité par pêche et la protection des petits individus de la pêche dans les dernières années ont résulté en un taux de survie accru des classes d'âge en voie de recrutement et une plus forte abondance de poissons plus âgés.

À un niveau supposé de prises totales de 8 000 t en 2003, il est peu probable que des prises canado-américaines combinées de 8 000 t en 2004 résulteraient en un taux de mortalité par pêche supérieur à $F_{ref}$.cette année-là. À ce niveau de rendement, la probabilité que la biomasse augmente de 10 % entre 2004 et 2005 est négligeable parce que les deux classes d'âge en voie d'être recrutées, soit les classes 2001 et 2002, sont peu abondantes, mais il existe une faible probabilité que la biomasse diminuera, pour se situer en 2005 sous la biomasse médiane requise pour le rétablissement du stock, soit 65 000 t. La structure des âges dans la population révèle que ceux-ci sont tous bien représentés.

# Introduction

Since 1990, Canada has used eastern Georges Bank, statistical unit areas j and m in NAFO sub-division 5Ze (Figure 1), as the basis for a management unit (Gavaris 1989), referred to as 5Zjm for brevity. Canada and the USA jointly develop management measures for Georges Bank transboundary stocks including haddock. The 5Zjm management unit was adopted as the basis for a sharing allocation proposal (DFO 2002). This assessment applies the approach used by Gavaris and Van Eeckhaute (2002) using Canadian and USA fisheries information updated to 2003. Results from the Fisheries and Oceans Canada (DFO) survey, updated to 2003, and the USA National Marine Fisheries Service (NMFS) surveys in the spring, updated to 2002 and 2003, and fall, updated to 2002, were incorporated.

# The Fishery

### *Commercial Catches*

Haddock on Georges Bank have supported a commercial fishery since the early 1920s (Clark et al 1982). For details on the historical aspects of the Georges Bank haddock fishery see Gavaris and Van Eeckhaute (1998).

Under restrictive management measures, combined Canada/USA catches declined from over 6,400 t in 1991 to a low of about 2,100 t in 1995, fluctuated between about 3,000 t and 4,000 t until 1999 and has since increased to over 7,000 t (Table 1, Figure 2). Greater catches in the late 1970s and early 1980s, ranging up to about 23,000 t, were associated with good recruitment. Substantial quantities of small fish were discarded in those years (Overholtz et al 1983). Catches subsequently declined and fluctuated around 5,000 t during the mid to late 1980s.

Total catches during the 1930s to 1950s ranged between 15,000 t and 40,000 t (Figure 3), averaging about 25,000 t (Schuck 1951, R. Brown pers. com.). Records of catches by unit area for the early 1960s period have not been located, however, based on records for Subdivision 5Ze, catches probably attained record high levels of about 60,000 t during the early 1960s. Since the early 1970s, catches have been substantially lower, generally fluctuating between 5,000 t and 10,000 t.

Except for the year 2000, Canadian catches since 1995 were below the quota due to closure of some fleet sectors when the cod quotas were reached. The 2000 catch of 5,402 t was slightly above the Canadian quota of 5,400 t. The 2002 Canadian groundfishery catch was 6499 t. Since 1994, all Canadian groundfish fisheries on Georges Bank remained closed from January to early June.

Weight of all Canadian landings were monitored at dockside. At-sea observers monitored 10% of the haddock caught. In 2002, samples were collected by DFO, observers and by two industry groups, Scotia Fundy Mobile Gear Fishermen's Association and High Liner

Foods. Discarding and misreporting by the groundfishery have been considered negligible since 1992.

In recent years, the Canadian fishery has been primarily conducted by vessels using otter trawls and longlines with some handlines and gillnets. During 2002, all vessels over 65 ft operated on enterprise allocations, otter trawlers under 65 ft and fixed gear vessels 45-65 ft operated on individual quotas while fixed gear vessels under 45 ft operated on community quotas administered by local boards (Table 2). Most haddock were caught by otter trawlers and longliners in tonnage classes 2 and 3 vessels less than 65 ft in overall length (Table 3). The highest catches occurred in July (Table 4, Figure 4). The Canadian fishery management plan initial allocations by fleet sector (final allocations may differ due to transfer of quota between fleet sectors) and reported landings are shown below:

| Fishery Sector | 1998 | | 1999 | | 2000 | | 2001 | | 2002 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Quota | Catch | Quota | Catch | Quota | Catch | Quota | Catch | Quota | Catch |
| Fixed gear <65’ | 915 | 856 | 928 | 902 | 1271 | 1193 | 1731 | 1660 | 1644 | 1527 |
| Mobile gear <65' | 1984 | 1997 | 1972 | 1964 | 2743 | 2796 | 3465 | 3432 | 3367 | 3333 |
| Fixed gear 65'-100' | 39 | 39 | 39 | 8 | 54 | 51 | 70 | 2 | 0 | 0 |
| Mobile gear 65'-100' | 94 | 93 | 188 | 186 | 54 | 224 | 547 | 540 | 235 | 235 |
| Vessels >100' | 868 | 386 | 773 | 590 | 1278 | 1137 | 1176 | 1140 | 1494 | 1400 |
| Totals | 3900 | 3371 | 3900 | 3650 | 5400 | 5402 | 6989 | 6774 | 6740 | 6496 |

Source: Quota reports (will not match statistics exactly)

Since 1996 the Georges Bank scallop fishery has been prohibited from landing haddock and no estimates of haddock bycatch by this fishery have been available. In 2001-2002, a monitoring program was conducted by the Canadian offshore scallop industry to examine bycatch of several species, including haddock. Twelve observer deployments on offshore scallop vessels were conducted between May 2001 and April 2002 with most trips occurring in 5Zj. During each observed trip, approximately 80% of the scallop tows were monitored for bycatch. Since there is a seasonal component to the groundfish movements on the bank, haddock bycatch ratios (weighted averages) were calculated as a percentage of total scallop catch and total effort grouped by trimester. These ratios were then multiplied by the 2001 and 2002 offshore scallop catch and effort (for each trimester) and summed to provide estimates of total haddock bycatch for these two years. Since the offshore scallop fishery is under quota management, it was assumed that the effort-based calculations would be more reflective of haddock bycatch, although both methods yielded similar results. Discards from this fishery are estimated to be 19 t in 2002 and 22 t in 2001.

USA catches for 2002 were derived from logbooks coupled with dealer reports using the same procedures as for 1994-2001. Effort in the USA fishery was regulated using closed areas, days-at-sea limits, and trip limits (Table 2). Trip limits were introduced in 1994 and daily catch limits in 1996 to reduce targeting of haddock. Low trip limits resulted in an increase in discard rates. Trip limits have been adjusted periodically to reduce discarding of haddock. Since 1999, the maximum trip has been 50,000 pounds per trip with a daily limit of 5,000 pounds. The daily trip limit was suspended in July 2002 to reduce discards. The combination of area closures, effort restrictions, and trip limits has precluded most operators from making long trips to 5Zjm, with the result that USA catches from 5Zjm have been relatively low since 1993. While Area II remained closed in 2002, landings from 5Zjm, which come almost exclusively from tonnage classes 3 and 4 otter trawlers (Table 5), increased to 944.8 t and discards again were low because the day and trip possession

limits remained high. Catches by month have not been available since 1993 (Table 6) but quarterly landings totals in 2002 were: 165 t (17%), 605 t (64%), 99t (10%) and 76 t (8%) (Table 7). USA landings were evenly distributed between large 491 t (52%) and scrod 438 t (46%) market categories. A total of 15.8 t of unclassified haddock were apportioned to large and scrod market categories.

***Size and Age Composition***

The size and age composition of the 2002 Canadian fishery was characterised using port, at sea and industry samples from all principle gears and all seasons. Comparison of length frequencies from these sources did not reveal any persistent differences (Figure 5), therefore, all data was combined (Table 8, Figure 4). The size composition of catch in the Canadian fisheries peaked at 51 cm (20 in) for otter trawlers and at 58 cm (23 in) for longliners (Figure 6). Gill-netters caught few haddock but they were larger. Although haddock discard length sampling from the Canadian scallop fishery is available from the industry study that took place in 2001 and 2002, no data are available to weight the length measurements by numbers caught per set. Therefore, these discards are not included in the catch at age. The amount of discards estimated by the industry study is minimal and, in previous years, landings from this fishery were small so omitting landings from this source should not unduly impact the catch at age.

Length samples from USA 5Zjm landings were inadequate to characterise the fishery and were augmented by length samples from areas 521 (5Zg), 522 (5Zh) and 525 (5Zn). Age sampling was also inadequate and was augmented with 2002 DFO survey data for quarter 1 and with the 2002 Canadian commercial age length keys for quarters 2, 3 and 4 (Table 7). The size composition of the catch in the 2002 USA fisheries was 53% large, peaking at 60cm and 47% scrod, peaking at 53 cm. The scrod market category size composition samples did not contain any fish below 43 cm.

Ages of survey and commercial-caught haddock were separately assigned by DFO and NMFS age readers. For the DFO reader, intra-reader agreement tests were conducted in 2002 and indicated that DFO age interpretations were internally consistent. Results of between-reader comparisons were less consistent (68% agreement), especially for age-2 and age-3 fish. This led to concerns about a possible bias in age interpretations. (Appendix A). These concerns will be addressed at a joint NMFS-DFO ageing workshop scheduled for 2004. The NMFS ageing group is in the process of training a new haddock ager and this workshop will also help in establishing consistent age determinations with the new ager.

The 2002 catch at age by quarter for Canada and the USA (Table 9) and a revised 2001 catch at age was used to augment the 1969-2000 results (Gavaris and Van Eeckhaute, 2002). The 2001 catch at age was adjusted to reflect revised landings. Combined Canada/USA annual catch at age and average fishery weights at age are summarized in Tables 10 and 11 and Figure 7. The 1998 year-class (age 4) dominated the 2002 catch as it did in 2001. The 1996 year-class (age 6) contributed the next highest component. In comparison to the age composition of the catch during periods when year-classes were quickly fished down, the older age groups (ages 9+) continued to contribute significantly to the 2001 catch (Figure 8). The percentage of age 2 fish in 2002 was well below historical averages. The low percentage of younger ages in the recent catches has been due in part to

the type of gear used and to avoidance of areas with small fish. The age composition during the 1969 to 1974 period was dominated by the outstanding 1962 and 1963 year-classes which continued to contribute substantially as older fish and is not considered typical.

## Abundance Indices

### *Commercial Catch Rates*

Catch rates from the Canadian commercial fishery for selected trips (i.e., only those vessels which reported more than 1 t from 5Zjm during 1994 where cod, haddock and pollock comprised over 90% of the total catch) for tonnage classes 2 and 3 otter trawlers and longliners have generally increased since 1993 to 2000 but have leveled out since then (Figure 9). Changes to regulations, gear modifications and varying fishing practices in recent years make comparison of catch rates from year to year difficult to interpret. Therefore, these were not used as indices of abundance.

### *Research Surveys*

Surveys of Georges Bank have been conducted by DFO each year (February) since 1986 and by NMFS each fall (October) since 1963 and each spring (April) since 1968. All surveys used a stratified random design (Figures 10 and 11). For the NMFS surveys, two vessels have been employed and there was a change in the trawl door in 1985. Vessel and door type conversion factors (Table 12), derived experimentally from comparative fishing, have been applied to the survey results to make the series consistent. Additionally, two trawl nets were used on the NMFS spring survey, a modified Yankee 41 during 1973-81 and a Yankee 36 in other years, but no conversion factors are available for haddock (Forrester et al 1997).

The spatial distribution of catches for the most recent surveys of each series was similar to the distribution over the previous 5 year period (Figures 12, 13, 14 and 15). In winter/spring, adults (ages 3+) are more abundant on the Northern Edge but age 1 fish are distributed broadly over the bank. The 2000 year-class was well represented in all surveys, at age 2 in the 2002 NMFS spring and fall surveys and as age 3 in the 2003 DFO and NMFS spring surveys. All surveys had very low catches of the 2001 and 2002 year-classes. The distribution of ages 2 and 3+ in the NMFS 2002 survey was more evenly spread throughout the survey area and especially on the sourthern flank than is normally seen at this time of year. In fall, adult haddock are more concentrated in the deeper waters along the slopes of the Northeast Peak and the Northern Edge, however, age 1 fish remain somewhat more widespread.

Age specific abundance patterns from the three surveys track year-class strengths fairly well (Tables 13, 14 and 15; Figure 16). Some year effects are evident, for example, the low spring catches observed for both the 1997 DFO and NMFS surveys. The indices for ages 3-8 survey biomass peaked at record highs during the early 1960s (Figure 17). After declining to a record low in the early 1970s, they peaked again in the late 1970s, though at a lower level, and again during the mid to late 1980s at about half the level of the 1970s

peak. Biomass generally increased during the 1990s, and the most recent increase is due largely to the 2000 year-class. The NMFS 2002 fall survey abundance is at its highest level since 1976.

Survey recruitment indices for ages 0, 1 and 2 indicate that the abundance of the 2000 year-class is comparable to the good 1975 and 1978 year-classes, with the 1998 year-class being the second strongest since the 1978 (Figure 18). The 1996 and the 1999 year-classes were comparable to the moderate 1983, 1985, 1987 and 1992 year-classes. These year-classes were considerably smaller than the strong 1975 and 1978 year-classes and the exceptional 1963 year-classes. Early indications from survey results suggest that the 2001 and 2002 year-classes are weak.

Although fishery weights at age (Table 11, Figure 19) for ages 2 and 3 are higher since 1993/1994, reflecting the change in gear selectivity which occurred, there have been no persistent trends in population weight at age derived from the DFO surveys. The survey weights at age (Table 16, Figure 20) for 2002, while generally within the range of observation, were notably lower than for 2001 but several have increased in the most recent 2003 survey. Average weight at age of haddock from the 1989, 1990 and 1991 year-classes were higher than adjacent year-classes in both the surveys and the commercial fisheries, giving the false impression of a declining trend in recent years. The method of calculation of the weights at age from the DFO survey, which were used for beginning of year population weights, was given in Gavaris and Van Eeckhaute (1998) and were derived from weights observed during the survey, weighted by population numbers at length and age. Fishery weights at age are derived from a length-weight relationship (Waiwood and Neilson 1985). In some cases, the mean weight at age in the catch is larger than the population mean weight at age at the beginning of the following year for the same cohort. This feature was mostly attributable to bottom trawl gear changes which resulted in a change in partial recruitment since 1994 (Gavaris and Van Eeckhaute, 2000). However, some discrepancies in weights at age were more persistent and may be due to problems associated with the length weight equations and gutted to round weight conversion factors.

DFO survey weights at length were used as an indicator of condition and were calculated from observed lengths and weights. The average weights for 3 adjacent 2 cm length groupings exhibit no notable trends (Figure 21).

## Estimation of Stock Parameters

### *Calibration of Virtual Population Analysis (VPA)*

The adaptive framework, ADAPT, (Gavaris 1988) was used to calibrate the virtual population analysis with the research survey abundance information. An investigation of model formulations and model assumptions was conducted by Gavaris and Van Eeckhaute (1998) where details of model equations and the objective function are provided. The model formulation adopted assumed that the random error in the catch at age was negligible. The errors in the abundance indices were assumed independent and identically distributed after taking natural logarithms of the values. The annual natural mortality rate, M, was assumed constant and equal to 0.2. Similar model assumptions and methods were

applied to the updated information here. Minor differences in the handling of zero terminal catches for a year-class were implemented as a refinement to the software to afford more flexibility. The population abundance for the 9+ age group was calculated but not calibrated to the indices. In the first quarter of the first year, the 9+ abundance calculation was based on the assumption that the fishing mortality for the 9+ age group was equal to the population weighted fishing mortality for ages 4 - 8. In the first quarter of subsequent years, the 9+ abundance was calculated as the sum of the age 8 and age group 9+ abundances at the end of the last quarter of the previous year.

The VPA used quarterly catch at age, $C_{a,t}$, for ages $a$ = 0, 1, 2…8, 9+, and time $t$ = 1969.0, 1969.25, 1969.5, 1969.75, 1970.0…2002.75, 2003.00 where $t$ represents the beginning of the time interval during which the catch was taken. The VPA was calibrated to bottom trawl survey abundance indices, $I_{s,a,t}$, for

$s$ = DFO spring, ages $a$ = 1, 2, 3…8, time $t$ = 1986.16, 1987.16…2002.16, 2003.16

$s$ = NMFS spring (Yankee 36), ages $a$ = 1, 2, 3…8, time $t$ = 1969.29, 1970.29, 1971.29, 1972.29, 1982.29, 1983.29…2003.25

$s$ = NMFS spring (Yankee 41), ages $a$ = 1, 2, 3…8, time $t$ = 1973.29, 1974.29…1981.29

$s$ = NMFS fall, ages $a$ = 0, 1, 2…5, time $t$ = 1969.69, 1970.69…2002.69

A catch of 0 was assumed for the 1st quarter of 2003 and the population was calculated to the beginning of 2003.25. The NMFS spring survey in 2003 was designated as occurring at time 2003.25 instead of 2003.29. The NMFS fall survey captures young of the year and that information is included as 0 group, but older haddock appear less available during this season. Survey indices for older ages where catches were sparse and where there were frequent occurrences of zero catches were not included. Zero observations for abundance indices were treated as missing data as the logarithm of zero is not defined. During years when discarding was high, survey information was used along with interviews to obtain estimates of the USA catch. This lack of complete independence between catch and survey data does not influence population estimates but may deflate variance estimates marginally.

Statistical properties of estimators were obtained from model conditioned non-parametric bootstrap of the residuals (Efron and Tibshirani 1993) as described in Gavaris and Van Eeckhaute (1998). The population abundance estimates show a large relative error and substantial bias at ages 1 while the relative error for other ages is between about 27% and 41% and the bias is smaller (Table 17). The average magnitude of residuals is large and though several large residuals can be identified, the respective observations do not appear influential and should not impact parameter estimates of current abundance (Figures 22-26). Some patterns in the residuals (by cohort and by age) merit further investigation.

### *Retrospective Analysis*

Assessment results for several other stocks have identified a discrepancy between past and current estimates of stock status (retrospective pattern). This stock assessment does not suffer from a retrospective pattern. Successive estimates of year-class abundance at age are fairly stable (Figure 27) although there is sometimes a substantial change after the first estimate of a year-class when more data becomes available, as evidenced for the 1998 and

2000 year-classes. There were no trends of concern for adult biomass (ages 3-8) or for F (ages 4-8 weighted by population numbers) in the retrospective patterns (Figure 28).

## Stock Status

The results from the calibrated VPA were considered appropriate on which to base the status of the stock. For each cohort, the terminal population abundance estimates from ADAPT were adjusted for bias estimated from the bootstrap, and used to construct the history of stock status (Tables 18-19). This approach for bias adjustment, in the absence of an unbiased point estimator with optimal statistical properties, was considered preferable to using the biased point estimates (O'Boyle 1998). The weights at age from the DFO spring survey (Table 16) were used to calculate beginning of year population biomass (Table 20). A weight of 2.4 kg, which was midway between the age 6 and 8 weight for that cohort, was used for age 7 in 1995 as no data were available for that age group. For 1969-85, the 1986-95 average weight at each age was used.

Population biomass (ages 3+) has steadily increased from near an historical low of about 10,000 t in 1993 to about 78,000 t at the beginning of 2003 (Figure 29). Biomass is at the highest it has been in about 30 years and is now at the lower range of the 1930-1955 biomass. The recent increase has been due to more consistent and improved recruitment and was enhanced by increased survivorship and by reduced capture of small fish in the fisheries. Since the 1991 year-class, only the 2001 and 2002 year-classes have been below 4 million fish. Between the 1978 and 1991 year-classes, 7 of the 14 year-classes were below 4 million fish. The biomass increase is expected to be sustained by the 2000 year-class. Total biomass (ages 1+) trend is similar to the ages 3+ trend.

Population biomass during the late 1970s and early 1980s was about 50,000 t, due to recruitment of the strong 1975 and 1978 year-classes whose abundance was estimated at about 50 million. However, biomass declined rapidly in the early 1980s as subsequent recruitment was poor and these two year-classes were fished intensely at a young age.

Recruitment**,** estimated by the VPA, indicate that the 2000 year-class (77 million at age 1) is estimated to be larger than the good 1975 and 1978 year-classes (Figure 30). The 1998 year-class (29 million at age 1) is the second strongest since that of 1978. The 1996 and 1999 year-classes were estimated to be about 13 million, comparable to the 1983, 1985 and 1987 year-classes, which were the strongest 3 year-classes over about a 20 year time span.

Since 1995, fishing mortality rate on fully recruited ages 4+ has consistently been below that corresponding to the fishing mortality threshold reference established at $F_{ref} = 0.26$ ($F_{2002} = 0.19$: 80% Confidence Interval: 0.15 – 0.23),(exploitation rate = 0.21) (Figure 31). Historically, the fishing mortality rate has generally exceeded that corresponding to $F_{ref}$ and showed a marked increase between 1989 and 1993 to about 0.6 (41%), the highest observed. Reduced fishing mortality in recent years has resulted in increased survival of incoming year-classes. The number of haddock of the 1992 year-class surviving to age 8 was about four times that of the equally abundant 1983 year-class, and about the same as that of the 1975 or 1978 year-classes, which were more than 3 times as abundant (Figure 32). Fishery avoidance of small fish has resulted in the number of fish of the 1998 year-class surviving to age 3 to be almost as many as survived to age 3 of the 1978 year-class

which was twice as strong. In both absolute numbers and percent composition, the population structure displays a broad representation of age groups, reflecting improving recruitment and lower exploitation since 1995 (Figure 33).

Gains in fishable biomass may be partitioned into those associated with somatic growth of haddock, which have previously recruited to the fishery, and those associated with new recruitment to the fishery (Rivard 1980). We used age 2 as a convenient age of first recruitment to the fishery. Except for 1996 , since 1993 surplus production (biomass gains from growth and from recruitment, decremented by losses due to natural deaths) has exceeded the fishery harvest yield, resulting in net increase (Figure 34). Growth of fish is the dominant component of the biomass gain but recruitment accounts for significant portions when stronger year-classes enter the population. (Figure 35).

## Prognosis

The risk analysis is provided in terms of the possible consequences for alternative catch quotas in 2004 with respect to the harvest reference points. Uncertainty about year-class abundance generates uncertainty in forecast results. This uncertainty is expressed as the risk of exceeding $F_{ref} = 0.26$, the risk of not achieving a biomass increase and the risk that the biomass will decline below the median 2005 rebuilding biomass of 65,000 t.

Forcasts were done starting with population estimates at the beginning of the second quarter in 2003. The abundance of the 2003 and 2004 year-classes were assumed to be 10 million at age 0. For the forecast, partial recruitment to the fishery for ages 1, 2 and 3 and fishery weights at age were averaged over 1998 to 2002 while beginning of year population weights were those observed in 2003 (Table 21). With an assumed total catch of 8,000 t in 2003 and natural mortality assumed to be 0.2, a combined Canada/USA catch of 8,000 t in 2004 would result in a low probability that the fishing mortality rate in 2004 will exceed $F_{ref}$ (Figure 37). At this yield, there is a negligible probability of achieving a 10% biomass increase from 2004 to 2005, due to the 2 weak incoming year-classes, but there is a low probability that the biomass will fall below the median 2005 rebuilding biomass of 65,000 t (25% and 75% quartiles: 59,000 t – 76,000 t). The 2000 year-class (age 4) is expected to comprise the highest proportion of the total 2004 yield, accounting for about 60%.

These uncertainties are dependent on the model assumptions and data used in the analyses. Though these assumptions were deemed most suitable, there may be other plausible assumptions. These calculations do not include uncertainty due to variations in weight at age, partial recruitment to the fishery, natural mortality, systematic errors in data reporting or the possibility that the model may not reflect the stock dynamics closely enough. The risk profiles provide a general sense of the associated uncertainties and can assist in assessing the consequences of alternative actions.

## Management Considerations

Consistent management by Canada and the USA is required to ensure that conservation objectives are not compromised.

Recruitment of the strong 2000 year-class resulted in almost a doubling of the biomass for ages 3+ by the beginning of 2003. However, due to the subsequent weak incoming year-classes, a TAC greater than 8,000 t in 2004 has a greater than 50% chance of decreasing the adult biomass.

Data were available to approximate the age composition of the catch from unit areas 5Zj and 5Zm in order to reconstruct an illustrative population analysis for the period between 1930 and 1955 suitable for comparison of productivity. Total catches during the 1930s to 1950s ranged between 15,000 t and 40,000 t, averaging about 25,000 t. Catches probably attained record high levels of about 60,000 t during the early 1960s. Since the early 1970s, catches have been substantially lower, generally fluctuating between 5,000 t and 10,000 t. Although biomass has been increasing and is the highest it has been in about 30 years, sitting at the lower range of the 1930-55 levels, it remains below the average biomass during those years (Figure 38).

The pattern of recruitment indicates that the chance of a good year-class is significantly enhanced for adult biomass above about 40,000 t (Figure 39). Since 1969, only the 1975, 1978 and 2000 year-classes have been above the average abundance of year-classes observed during the period 1930-55. Examination of the recruits per adult biomass ratio suggests that survivorship to age 1, for several years during the 1980s, may have been lower than the norm (Figure 40). Except for the 2001 and 2002 year-classes, the present survivorship appears comparable to that of the 1930s to 1950s period, suggesting that higher recruitment might result if the biomass increases.

Fishing mortality rate and biomass can be used to compare consequences of alternative harvest yields. The projections above show those results. Other attributes like recruitment, age structure and spatial distribution reflect possible fluctuations in the productive potential and can be used to qualify reference points and acceptable risk. While conditions have improved, maintaining fishing mortality rate at current levels would enhance further rebuilding.

Cod and haddock are often caught together in Canadian groundfish fisheries. However, their catchabilities to the fisheries differ and they are not necessarily caught in proportion to their relative abundance. With current fishing practices, exploitation of haddock at $F_{ref}$ may compromise the achievement of rebuilding objectives for cod.

## Acknowledgements

G. Donaldson, E. Williams and several industry groups provided samples from the Canadian fishery. We thank members of the fishing industry who spent time to discuss their experiences in the fishery and Lei Harris for providing valuable comments during the review of the draft version.

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Table 1. Nominal catches (t) of haddock from unit areas 5Zjm. For "Other" it was assumed that 40% of the total 5Z catch was in 5Zjm.

| | Landings | | | Discards | | |
|---|---|---|---|---|---|---|
| Year | Canada | USA | Other | Canada | USA | Total |
| 1969 | 3941 | 6622 | 695 | | | 11258 |
| 1970 | 1970 | 3153 | 357 | | | 5480 |
| 1971 | 1610 | 3534 | 770 | | | 5914 |
| 1972 | 609 | 1551 | 502 | | | 2662 |
| 1973 | 1565 | 1396 | 396 | | | 3357 |
| 1974 | 462 | 955 | 573 | | 757 | 2747 |
| 1975 | 1353 | 1705 | 29 | | | 3087 |
| 1976 | 1355 | 973 | 24 | | | 2352 |
| 1977 | 2871 | 2429 | | | 2966 | 8266 |
| 1978 | 9968 | 4724 | | | 1556 | 16248 |
| 1979 | 5080 | 5211 | | | | 10291 |
| 1980 | 10017 | 5615 | | | 7561 | 23193 |
| 1981 | 5658 | 9077 | | | | 14735 |
| 1982 | 4872 | 6280 | | | | 11152 |
| 1983 | 3208 | 4454 | | | | 7662 |
| 1984 | 1463 | 5121 | | | | 6584 |
| 1985 | 3484 | 1683 | | | | 5167 |
| 1986 | 3415 | 2200 | | | | 5615 |
| 1987 | 4703 | 1418 | | | | 6121 |
| 1988 | 4046* | 1693 | | | | 5739 |
| 1989 | 3060 | 787 | | | | 3847 |
| 1990 | 3340 | 1189 | | | | 4529 |
| 1991 | 5456 | 949 | | | | 6405 |
| 1992 | 4058 | 1629 | | | | 5687 |
| 1993 | 3727 | 421 | | | | 4148 |
| 1994 | 2411 | 33 | | | 258 | 2702 |
| 1995 | 2065 | 22 | | | 25 | 2112 |
| 1996 | 3663 | 36 | | | 41 | 3740 |
| 1997 | 2749 | 48 | | | 63 | 2859 |
| 1998 | 3371 | 311 | | | 14 | 3696 |
| 1999 | 3681 | 355 | | | | 4036 |
| 2000 | 5402 | 187 | | | | 5589 |
| 2001 | 6774 | 604 | | 22 | | 7400 |
| 2002 | 6499 | 945 | | 19 | | 7462 |

* 1895 t excluded because of suspected area misreporting.

Table 2. Regulatory measures implemented for the 5Z and 5Zjm fishery management units by the USA and Canada, respectively, from 1977, when jurisdiction was extended to 200 miles for coastal states, to the present.

| | **USA** | **Canada** |
|---|---|---|
| 1977-82 | **Mesh** size of 5 1/8" (140 mm), seasonal spawning closures, quotas and trip limits. | |
| 1982-85 | **All** catch controls eliminated, retained closed area and mesh size regulations, implemented minimum landings size (43 cm). | **First** 5Ze assessment in 1983. |
| 1984 Oct. | **Implementation of the 'Hague' line .** | |
| 1985 | **5 ½"** mesh size,.<br>**Areas** 1 and 2 closed during February-May. | |
| 1989 | | **Combined** cod-haddock-pollock quota for 4X-5Zc |
| 1990 | | **5Zjm** adopted as management unit.<br>**For** MG < 65 ft. – trip limits with a 30% by-catch of haddock to a maximum of 8 trips of 35,000 lbs per trip between June 1 and Oct. 31 and 130 mm square mesh required.<br>**Fixed** gear required to use large hooks until June |
| 1991 | **Established** overfishing definitions for haddock. | **MG** < 65 ft similar to 1990 but mesh size increased to 145 mm diamond. |
| 1992 | | **Introduction** of ITQs and dockside monitoring. |
| 1993 | **Area** 2 closure in effect from Jan 1-June30. | **OT** fishery permitted to operate in Jan. and Feb.<br>**Increase** in use square mesh. |
| 1994 | Jan.: **Expanded** Area 2 closure to include June and increased extent of area.<br>**Area** 1 closure not in effect.<br>**500** lb trip limit.<br>**Catch** data obtained from mandatory log books combined with dealer reports (replaces interview system).<br>May: **6**" mesh restriction.<br>Dec.: **Area** 1,2 closed year-round. | **Spawning** closure extended to Jan. 1 to May 31.<br>**Fixed** gear vessels must choose between 5Z or 4X for the period of June to September.<br>**Small** fish protocol.<br>**Increased** at sea monitoring.<br>**OT** > 65 could not begin fishng until July 1.<br>**Predominantly** square mesh by end of year. |
| 1995 | | **All** OT vessels using square mesh.<br>**Fixed** gear vessels with a history since 1990 of 25t or more for 3 years of cod, haddock pollock, hake or cusk combined can participate in 5Z fishery.<br>**ITQ** vessel require at least 2t of cod and 8t of haddock quota to fish Georges. |
| 1996 | July: **Additional** Days-at-Sea restrictions, trip limit raised to 1000 lbs. | **Fixed** gear history requirement dropped. |
| 1997 | May: **Additional** scheduled Days-at-sea restrictions.<br>September: **Trip** limit raised to 1000 lbs/day, maximum of 10,000 lbs/trip. | **Vessels** over 65 ft operated on enterprise allocations, otter trawlers under 65 ft on individual quotas, fixed gear vessels 45-65 ft on self-administered individual quotas and fixed gear vessels under 45 ft on community quotas administered by local boards. |
| 1998 | Sept. 1: **Trip** limit raised to 3000 lbs/day, maximum of 30,000 lbs/trip. | **Fixed** gear vessels 45-65 ft operated on individual quotas. |
| 1999 | May 1: Trip limit 2,000 lbs/day, max. 20,000 lbs/trip.<br>Square mesh size increased to 6.5" (diamond is 6").<br>June 15: Scallop exemption fishery in Closed Area II.<br>Nov. 5: Trip limit 5,000 lbs/day, max. 50,000 lbs/trip. | Same as 1997 and 1998. |
| 2000 | October: Daily trip limit suspended to April 2001but retained max. trip limit of 50,000 lbs/trip. | Same as 1999. |
| 2001 | Max. trip limit 50,000 lbs/trip; daily limit 5,000 lbs<br>November: Daily limit suspended through April 2002 | Same as 2000. |
| 2002 | Max. trip limit 50,000 lbs/trip; daily limit 5,000 lbs<br>July: Daily limit suspended through April 2003 | Same as 2001. |

Table 3. Canadian landings (t) of haddock in unit areas 5Zjm by gear category and tonnage class for principle gears.

| Year | Otter Trawl | | | | | | Longline | | | Other | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Side | Stern | | | | | | | | | |
| | | 2 | 3 | 4 | 5 | Total[1] | 2 | 3 | Total[1] | | |
| 1969 | 777 | 0 | 1 | 225 | 2902 | 3127 | 2 | 21 | 23 | 15 | 3941 |
| 1970 | 575 | 2 | 0 | 133 | 1179 | 1314 | 6 | 72 | 78 | 2 | 1970 |
| 1971 | 501 | 0 | 0 | 16 | 939 | 955 | 18 | 129 | 151 | 3 | 1610 |
| 1972 | 148 | 0 | 0 | 2 | 260 | 263 | 23 | 169 | 195 | 3 | 609 |
| 1973 | 633 | 0 | 0 | 60 | 766 | 826 | 23 | 80 | 105 | 0 | 1565 |
| 1974 | 27 | 0 | 6 | 8 | 332 | 346 | 29 | 59 | 88 | 1 | 462 |
| 1975 | 222 | 0 | 1 | 60 | 963 | 1024 | 25 | 81 | 107 | 0 | 1353 |
| 1976 | 217 | 0 | 2 | 59 | 905 | 967 | 48 | 108 | 156 | 15 | 1355 |
| 1977 | 370 | 92 | 243 | 18 | 2025 | 2378 | 43 | 51 | 94 | 28 | 2871 |
| 1978 | 2456 | 237 | 812 | 351 | 5639 | 7039 | 121 | 47 | 169 | 305 | 9968 |
| 1979 | 1622 | 136 | 858 | 627 | 1564 | 3185 | 190 | 80 | 271 | 2 | 5080 |
| 1980 | 1444 | 354 | 359 | 950 | 6254 | 7917 | 129 | 51 | 587 | 69 | 10017 |
| 1981 | 478 | 448 | 629 | 737 | 2344 | 4159 | 331 | 99 | 1019 | 2 | 5658 |
| 1982 | 115 | 189 | 318 | 187 | 3341 | 4045 | 497 | 187 | 712 | 0 | 4872 |
| 1983 | 106 | 615 | 431 | 107 | 1130 | 2283 | 593 | 195 | 815 | 4 | 3208 |
| 1984 | 5 | 180 | 269 | 21 | 149 | 620 | 614 | 192 | 835 | 3 | 1463 |
| 1985 | 72 | 840 | 1401 | 155 | 348 | 2745 | 562 | 33 | 626 | 41 | 3484 |
| 1986 | 51 | 829 | 1378 | 95 | 432 | 2734 | 475 | 98 | 594 | 35 | 3415 |
| 1987 | 48 | 782 | 1448 | 49 | 1241 | 3521 | 854 | 113 | 1046 | 89 | 4703 |
| 1988[2] | 72 | 1091 | 1456 | 186 | 398 | 3183 | 428 | 200 | 695 | 97 | 4046 |
| 1989 | 0 | 489 | 573 | 376 | 536 | 1976 | 713 | 175 | 977 | 106 | 3060 |
| 1990 | 0 | 928 | 890 | 116 | 471 | 2411 | 623 | 173 | 853 | 76 | 3340 |
| 1991 | 0 | 1610 | 1647 | 81 | 689 | 4028 | 900 | 271 | 1309 | 119 | 5456 |
| 1992 | 0 | 797 | 1084 | 56 | 645 | 2583 | 984 | 245 | 1384 | 90 | 4058 |
| 1993 | 0 | 535 | 1179 | 67 | 699 | 2489 | 794 | 156 | 1143 | 96 | 3727 |
| 1994 | 0 | 495 | 911 | 79 | 112 | 1597 | 498 | 47 | 714 | 100 | 2411 |
| 1995 | 0 | 523 | 896 | 14 | 214 | 1647 | 256 | 75 | 390 | 28 | 2065 |
| 1996 | 1 | 836 | 1405 | 166 | 270 | 2689 | 561 | 107 | 947 | 26 | 3663 |
| 1997 | 0 | 680 | 1123 | 91 | 96 | 1991 | 501 | 116 | 722 | 36 | 2749 |
| 1998 | 0 | 863 | 1340 | 98 | 71 | 2422 | 570 | 252 | 921 | 27 | 3371 |
| 1999 | 0 | 954 | 1471 | 174 | 145 | 2761 | 486 | 241 | 887 | 33 | 3680 |
| 2000 | 0 | 1313 | 2269 | 230 | 246 | 4146 | 619 | 258 | 1186 | 71 | 5402 |
| 2001 | 0 | 1564 | 2555 | 0 | 757 | 5112 | 754 | 302 | 1633 | 29 | 6774 |
| 2002 | 0 | 1217 | 2727 | 0 | 659 | 4960 | 891 | 151 | 1527 | 12 | 6499 |

[1] Total includes catches for tonnage classes which are not listed, only tonnage classes with substantial catches listed

[2] Catches of 26t, 776t, 1091t and 2t for side otter trawlers and stern otter trawlers tonnage classes 2, 3 and 5 respectively were excluded because of suspected area misreporting.

Table 4. Monthly landings (t) of haddock by Canada in unit areas 5Zjm.

| Year | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1969 | 105 | 74 | 6 | 291 | 588 | 691 | 559 | 580 | 551 | 360 | 102 | 34 | 3941 |
| 1970 | 2 | 105 | 0 | 1 | 574 | 345 | 103 | 456 | 242 | 103 | 26 | 12 | 1970 |
| 1971 | 0 | 9 | 1 | 0 | 400 | 132 | 283 | 278 | 97 | 246 | 141 | 21 | 1610 |
| 1972 | 0 | 119 | 2 | 0 | 2 | 111 | 84 | 116 | 98 | 68 | 7 | 2 | 609 |
| 1973 | 4 | 10 | 0 | 0 | 0 | 184 | 198 | 572 | 339 | 232 | 22 | 4 | 1565 |
| 1974 | 19 | 0 | 1 | 0 | 0 | 58 | 63 | 53 | 96 | 61 | 92 | 19 | 462 |
| 1975 | 4 | 14 | 0 | 0 | 0 | 166 | 256 | 482 | 100 | 166 | 118 | 45 | 1353 |
| 1976 | 0 | 7 | 62 | 68 | 60 | 587 | 152 | 190 | 186 | 26 | 9 | 7 | 1355 |
| 1977 | 102 | 177 | 7 | 0 | 23 | 519 | 1059 | 835 | 13 | 59 | 56 | 22 | 2871 |
| 1978 | 104 | 932 | 44 | 22 | 21 | 319 | 405 | 85 | 642 | 5433 | 1962 | 0 | 9968 |
| 1979 | 123 | 898 | 400 | 175 | 69 | 1393 | 885 | 396 | 406 | 261 | 53 | 22 | 5080 |
| 1980 | 38 | 134 | 14 | 29 | 223 | 2956 | 2300 | 965 | 1411 | 1668 | 104 | 176 | 10017 |
| 1981 | 38 | 481 | 568 | 4 | 254 | 1357 | 1241 | 726 | 292 | 82 | 378 | 239 | 5658 |
| 1982 | 129 | 309 | 1 | 11 | 46 | 1060 | 769 | 682 | 585 | 837 | 398 | 44 | 4872 |
| 1983 | 32 | 67 | 29 | 47 | 60 | 1288 | 387 | 483 | 526 | 195 | 88 | 6 | 3208 |
| 1984 | 3 | 5 | 81 | 88 | 73 | 433 | 219 | 254 | 211 | 71 | 25 | 0 | 1463 |
| 1985 | 1 | 11 | 33 | 99 | 26 | 354 | 392 | 1103 | 718 | 594 | 61 | 93 | 3484 |
| 1986 | 11 | 28 | 79 | 99 | 40 | 1339 | 1059 | 369 | 233 | 139 | 12 | 8 | 3415 |
| 1987 | 24 | 26 | 138 | 70 | 12 | 1762 | 1383 | 665 | 405 | 107 | 97 | 14 | 4703 |
| 1988[1] | 39 | 123 | 67 | 79 | 15 | 1816 | 1360 | 315 | 130 | 65 | 13 | 24 | 4046 |
| 1989 | 33 | 94 | 48 | 7 | 20 | 1398 | 356 | 566 | 141 | 272 | 108 | 18 | 3060 |
| 1990 | 35 | 14 | 50 | 0 | 7 | 1178 | 668 | 678 | 469 | 199 | 18 | 22 | 3340 |
| 1991 | 144 | 166 | 49 | 26 | 21 | 1938 | 1004 | 705 | 566 | 576 | 123 | 137 | 5456 |
| 1992 | 118 | 205 | 97 | 152 | 36 | 1381 | 619 | 414 | 398 | 401 | 209 | 28 | 4058 |
| 1993 | 468 | 690 | 96 | 78 | 25 | 723 | 505 | 329 | 202 | 198 | 230 | 183 | 3727 |
| 1994 | 3 | 3 | 1 | 2 | 0 | 398 | 693 | 373 | 375 | 220 | 211 | 133 | 2411 |
| 1995 | 5 | 1 | 1 | 1 | 0 | 762 | 327 | 290 | 281 | 109 | 197 | 93 | 2065 |
| 1996 | 0 | 0 | 0 | 0 | 0 | 1067 | 672 | 706 | 359 | 278 | 191 | 391 | 3663 |
| 1997 | 0 | 0 | 0 | 0 | 0 | 328 | 751 | 772 | 426 | 190 | 116 | 166 | 2749 |
| 1998 | 0 | 0 | 0 | 0 | 0 | 687 | 420 | 580 | 707 | 542 | 164 | 271 | 3371 |
| 1999 | 37 | 0 | 0 | 0 | 0 | 898 | 975 | 562 | 573 | 295 | 269 | 70 | 3681 |
| 2000 | 1 | 0 | 0 | 0 | 0 | 1368 | 1175 | 1026 | 848 | 658 | 175 | 150 | 5402 |
| 2001 | 0 | 0 | 0 | 0 | 0 | 971 | 1335 | 930 | 1267 | 1075 | 647 | 548 | 6774 |
| 2002 | 0 | 0 | 0 | 0 | 0 | 535 | 1619 | 1030 | 1352 | 870 | 555 | 537 | 6499 |

[1] Catches of 3t, 1846t and 46t for Jan., Feb., and Mar., respectively for otter trawlers were excluded because of suspected area misreporting

Table 5. USA landings (t) of haddock in unit areas 5Zjm by gear category and tonnage class. Details for 1994-2002 are not available because data are preliminary.

| Year | Otter Trawl | | | Other | Total |
|---|---|---|---|---|---|
| | 3 | 4 | Total | | |
| 1969 | 3010 | 3610 | 6621 | 0 | 6622 |
| 1970 | 1602 | 1551 | 3154 | 0 | 3153 |
| 1971 | 1760 | 1768 | 3533 | 0 | 3534 |
| 1972 | 861 | 690 | 1551 | 0 | 1551 |
| 1973 | 637 | 759 | 1396 | 0 | 1396 |
| 1974 | 443 | 512 | 955 | 0 | 955 |
| 1975 | 993 | 675 | 1668 | 36 | 1705 |
| 1976 | 671 | 302 | 972 | 2 | 973 |
| 1977 | 1721 | 700 | 2423 | 5 | 2429 |
| 1978 | 3140 | 1573 | 4713 | 11 | 4724 |
| 1979 | 3281 | 1927 | 5208 | 4 | 5211 |
| 1980 | 3654 | 2955 | 5611 | 4 | 5615 |
| 1981 | 3591 | 5408 | 9031 | 45 | 9077 |
| 1982 | 2585 | 3657 | 6242 | 37 | 6280 |
| 1983 | 1162 | 3261 | 4423 | 29 | 4454 |
| 1984 | 1854 | 3260 | 5115 | 5 | 5121 |
| 1985 | 856 | 823 | 1679 | 4 | 1683 |
| 1986 | 985 | 1207 | 2192 | 9 | 2200 |
| 1987 | 778 | 639 | 1417 | 1 | 1418 |
| 1988 | 920 | 768 | 1688 | 6 | 1693 |
| 1989 | 359 | 419 | 780 | 6 | 787 |
| 1990 | 486 | 688 | 1178 | 4 | 1189 |
| 1991 | 400 | 517 | 918 | 13 | 931 |
| 1992 | 597 | 740 | 1337 | 292 | 1629 |
| 1993 | 142 | 191 | 333 | 88 | 421 |
| 1994 | | | 32 | 0 | 33 |
| 1995 | | | 21 | 0 | 22 |
| 1996 | | | 36 | 0 | 36 |
| 1997 | | | 48 | 0 | 48 |
| 1998 | | | 311 | 0 | 311 |
| 1999 | | | 355 | 0 | 355 |
| 2000 | | | 187 | 0 | 187 |
| 2001 | | | 602 | 2 | 604 |
| 2002 | | | 944 | 1 | 945 |

Table 6. Monthly landings (t) of haddock by USA in unit areas 5Zjm. Details for 1994-2002 are not available because data is preliminary.

| Year | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1969 | 525 | 559 | 976 | 1825 | 670 | 809 | 204 | 219 | 249 | 226 | 203 | 157 | 6622 |
| 1970 | 169 | 219 | 242 | 375 | 608 | 374 | 324 | 333 | 179 | 219 | 61 | 50 | 3153 |
| 1971 | 155 | 361 | 436 | 483 | 668 | 503 | 338 | 152 | 147 | 165 | 58 | 68 | 3534 |
| 1972 | 150 | 196 | 91 | 90 | 239 | 261 | 97 | 164 | 84 | 63 | 52 | 64 | 1551 |
| 1973 | 90 | 111 | 77 | 85 | 138 | 365 | 217 | 196 | 37 | 3 | 22 | 55 | 1396 |
| 1974 | 135 | 70 | 47 | 70 | 122 | 160 | 165 | 43 | 27 | 6 | 19 | 91 | 955 |
| 1975 | 152 | 123 | 32 | 116 | 388 | 489 | 138 | 95 | 57 | 24 | 52 | 39 | 1705 |
| 1976 | 116 | 147 | 83 | 106 | 323 | 162 | 7 | 6 | 5 | 2 | 3 | 13 | 973 |
| 1977 | 75 | 211 | 121 | 154 | 374 | 372 | 434 | 191 | 73 | 52 | 146 | 226 | 2429 |
| 1978 | 336 | 437 | 263 | 584 | 752 | 750 | 467 | 221 | 245 | 426 | 194 | 49 | 4724 |
| 1979 | 274 | 329 | 352 | 548 | 766 | 816 | 588 | 659 | 224 | 202 | 281 | 172 | 5211 |
| 1980 | 632 | 1063 | 742 | 784 | 711 | 461 | 324 | 254 | 221 | 91 | 110 | 222 | 5615 |
| 1981 | 550 | 1850 | 634 | 627 | 882 | 1326 | 1233 | 873 | 321 | 284 | 242 | 255 | 9077 |
| 1982 | 425 | 754 | 502 | 347 | 718 | 1801 | 757 | 145 | 201 | 216 | 276 | 138 | 6280 |
| 1983 | 492 | 931 | 272 | 181 | 310 | 1145 | 231 | 178 | 187 | 110 | 227 | 190 | 4454 |
| 1984 | 540 | 961 | 366 | 281 | 627 | 1047 | 370 | 302 | 250 | 196 | 92 | 89 | 5121 |
| 1985 | 165 | 190 | 254 | 300 | 352 | 206 | 60 | 47 | 1 | 24 | 41 | 43 | 1683 |
| 1986 | 184 | 396 | 334 | 479 | 496 | 221 | 31 | 6 | 12 | 6 | 6 | 29 | 2200 |
| 1987 | 225 | 52 | 43 | 307 | 233 | 342 | 67 | 30 | 24 | 4 | 23 | 68 | 1418 |
| 1988 | 196 | 152 | 207 | 245 | 366 | 316 | 30 | 19 | 6 | 1 | 45 | 110 | 1693 |
| 1989 | 114 | 56 | 47 | 164 | 161 | 145 | 15 | 8 | 1 | 5 | 25 | 46 | 787 |
| 1990 | 148 | 21 | 155 | 274 | 214 | 306 | 23 | 3 | 5 | 5 | 16 | 19 | 1189 |
| 1991 | 105 | 28 | 76 | 133 | 89 | 434 | 1 | 20 | 6 | 0 | 19 | 19 | 931 |
| 1992 | 253 | 81 | 51 | 149 | 353 | 669 | 20 | 20 | 17 | 3 | 2 | 12 | 1629 |
| 1993 | 15 | 12 | 16 | 55 | 84 | 209 | 6 | 3 | 3 | 7 | 2 | 8 | 421 |
| 1994 | | | | | | | | | | | | | 33 |
| 1995 | | | | | | | | | | | | | 22 |
| 1996 | | | | | | | | | | | | | 36 |
| 1997 | | | | | | | | | | | | | 48 |
| 1998 | | | | | | | | | | | | | 311 |
| 1999 | | | | | | | | | | | | | 355 |
| 2000 | | | | | | | | | | | | | 187 |
| 2001 | | | | | | | | | | | | | 604 |
| 2002 | | | | | | | | | | | | | 945 |

Table 7. USA landings of haddock in 2002 by quarter and market category from unit areas 5Zjm and sampling intensity for lengths and ages.

| Market category | Large | Scrod | Unclassified | Total |
|---|---|---|---|---|
| | | Landings (t) | | |
| Quarter 1 | 96 | 68 | 1 | 165 |
| Quarter 2 | 291 | 300 | 14 | 605 |
| Quarter 3 | 56 | 43 | 0 | 99 |
| Quarter 4 | 48 | 27 | 1 | 76 |
| Total | 491 | 438 | 16 | 945 |
| | | Lengths per 100 t (Number measured) | | |
| Quarter 1 | 94 (91) | 0 (0) | NA | 55 (91) |
| Quarter 2 | 87 (258) | 43 (131) | NA | 64 (389) |
| Quarter 3 | 274 (153) | 0 (0) | NA | 155 (153) |
| Quarter 4 | 0 (0) | 0 (0) | NA | 0 (0) |
| Total | 102 (502) | 30 (131) | NA | 67 (633) |
| | | Ages per 100 t (Number aged) | | |
| Quarter 1 | 38 (37) | 0 (0) | NA | 22 (36) |
| Quarter 2 | 26 (74) | 16 (48) | NA | 21(127) |
| Quarter 3 | 64 (36) | 0 (0) | NA | 36 (36) |
| Quarter 4 | 0 (0) | 0 (0) | NA | 0 (0) |
| Total | 30 (147) | 11 (48) | NA | 21 (199) |

Table 8. Sampling for landings of the 2002 5Zjm Canadian haddock fishery.

| Qtr. | Gear | Month | Landings (kg) | Length Frequency Samples | | | | Ages | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Observer | | Port | | | |
| | | | | Trips | Measured | Samples | Measured | Observer | Port |
| 2 | OT IN | June | 472,408 | 11 | 5881 | 6 | 1326 | | |
| | OF OF | June | 58,579 | | | 2 | 400 | 116 | 215 |
| | LL IN | June | 3,3613 | | | | | | |
| | GN IN | June | 227 | | | | | | |
| 3 | OT IN | July | 1,170,046 | 9 | 6132 | 7 | 1651 | | |
| | | Aug | 517,108 | 5 | 2832 | 3 | 730 | | |
| | | Sept | 732,638 | 3 | 880 | 9 | 2038 | | |
| | OT OF | July | 150,706 | 1 | 795 | 3 | 600 | | |
| | | Aug | 53,855 | | | 1 | 200 | | |
| | | Sept | 251,285 | 1 | 1600 | | | | |
| | LL IN | July | 292,386 | 3 | 3157 | 1 | 220 | 4 | 454 |
| | | Aug | 456,196 | 5 | 4,581 | 5 | 1200 | | |
| | | Sept | 365,904 | 1 | 1165 | 3 | 699 | | |
| | Handline | July | 2 | Added to Q3 LL IN | | | | | |
| | | Aug | 3 | | | | | | |
| | GN IN | July | 6,328 | GN IN Dec | | | | | |
| | | Aug | 2,783 | | | | | | |
| | | Sept | 1,973 | | | | | | |
| 4 | OT IN | Oct | 621,451 | 2 | 734 | 9 | 1986 | | |
| | | Nov | 392,058 | | | 5 | 1211 | | |
| | | Dec | 394,441 | 3 | 1048 | 2 | 714 | | |
| | OT OF | Oct | 18,092 | | | | | | |
| | | Nov | 58,405 | | | 2 | 400 | | |
| | | Dec | 68,435 | | | 1 | 200 | 7 | 503 |
| | LL IN | Oct | 230,178 | 1 | 1148 | 7 | 1668 | | |
| | | Nov | 104,153 | | | 2 | 481 | | |
| | | Dec | 74,368 | 1 | 817 | 1 | 240 | | |
| | GN IN | Oct | 319 | | | | | | |
| | | Nov | 483 | | | | | | |
| | | Dec | 150 | | | 1 | 68 | | |
| Totals | | | 6,498,573 | 46 | 30770 | 70 | 16032 | 127 | 1172 |

OT=Otter Trawl Bottom, GN=Gill Net, LL=Longline, IN=Tonnage Class 0-3, OF=Tonnage Class 4-6

Table 9. Components of catch at age numbers of haddock from unit areas 5Zjm by quarter. Discards from the Canadian scallop fishery are not included.

| Quarter | Age Group | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9+ | 1+ |
| **Canada** | | | | | | | | | | |
| 2001 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2001.25 | 0 | 9962 | 291307 | 98979 | 117781 | 36310 | 27329 | 17640 | 10391 | 609699 |
| 2001.5 | 1726 | 24708 | 864109 | 258352 | 375614 | 102998 | 105214 | 89418 | 82723 | 1904863 |
| 2001.75 | 362 | 25523 | 471899 | 125224 | 261714 | 84241 | 44897 | 90244 | 58151 | 1162255 |
| Year total | 2088 | 60194 | 1627314 | 482555 | 755109 | 223548 | 177440 | 197302 | 151265 | 3676816 |
| **USA** | | | | | | | | | | |
| 2001 | 0 | 0 | 13197 | 16828 | 13158 | 14463 | 7960 | 6180 | 5173 | 76959 |
| 2001.25 | 0 | 0 | 24527 | 31274 | 24453 | 26879 | 14793 | 11486 | 9614 | 143026 |
| 2001.5 | 0 | 0 | 5162 | 6583 | 5147 | 5658 | 3114 | 2418 | 2023 | 30104 |
| 2001.75 | 0 | 0 | 5371 | 6849 | 5355 | 5886 | 3239 | 2515 | 2105 | 31321 |
| Year total | 0 | 0 | 48258 | 61533 | 48112 | 52886 | 29105 | 22599 | 18915 | 281409 |
| **Total** | | | | | | | | | | |
| 2001 | 0 | 0 | 13197 | 16828 | 13158 | 14463 | 7960 | 6180 | 5173 | 76959 |
| 2001.25 | 0 | 9962 | 315834 | 130253 | 142234 | 63189 | 42122 | 29126 | 20005 | 752724 |
| 2001.5 | 1726 | 24708 | 869271 | 264935 | 380761 | 108656 | 108328 | 91835 | 84746 | 1934967 |
| 2001.75 | 362 | 25523 | 477270 | 132072 | 267069 | 90127 | 48136 | 92760 | 60256 | 1193575 |
| Year total | 2088 | 60194 | 1675572 | 544088 | 803222 | 276435 | 206546 | 219901 | 170180 | 3958225 |
| | | | | | | | | | | |
| **Canada** | | | | | | | | | | |
| 2002 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2002.25 | 0 | 14178 | 10443 | 157663 | 42055 | 40913 | 6004 | 4987 | 13655 | 289897 |
| 2002.5 | 305 | 154290 | 130570 | 1007299 | 152606 | 368946 | 50520 | 60827 | 154784 | 2080146 |
| 2002.75 | 208 | 111201 | 51107 | 505302 | 120997 | 173254 | 26673 | 17675 | 48881 | 1055298 |
| Year total | 513 | 279669 | 192120 | 1670264 | 315658 | 583112 | 83196 | 83490 | 217319 | 3425341 |
| **USA** | | | | | | | | | | |
| 2002 | 0 | 0 | 3200 | 25300 | 9900 | 12800 | 4600 | 3600 | 17200 | 76800 |
| 2002.25 | 0 | 4400 | 7300 | 125900 | 38600 | 46200 | 19700 | 15000 | 33300 | 290500 |
| 2002.5 | 0 | 400 | 1400 | 19200 | 3100 | 9700 | 1500 | 2300 | 7000 | 44500 |
| 2002.75 | 0 | 1000 | 1100 | 14200 | 3700 | 8300 | 1700 | 1200 | 3600 | 34700 |
| Year total | 0 | 5800 | 13000 | 184600 | 55300 | 77000 | 27500 | 22100 | 61100 | 446500 |
| **Total** | | | | | | | | | | |
| 2002 | 0 | 0 | 3200 | 25300 | 9900 | 12800 | 4600 | 3600 | 17200 | 76800 |
| 2002.25 | 0 | 18578 | 17743 | 283563 | 80655 | 87113 | 25704 | 19987 | 46955 | 580397 |
| 2002.5 | 305 | 154690 | 131970 | 1026499 | 155706 | 378646 | 52020 | 63127 | 161784 | 2124646 |
| 2002.75 | 208 | 112201 | 52207 | 519502 | 124697 | 181554 | 28373 | 18875 | 52481 | 1089998 |
| Year total | 513 | 285469 | 205120 | 1854864 | 370958 | 660112 | 110696 | 105590 | 278419 | 3871841 |

Table 10. Total annual commercial catch at age numbers (000's) of haddock from unit areas 5Zjm.

| Year | Age Group | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9+ | 1+ |
| 1969 | 0 | 0 | 18 | 1441 | 260 | 331 | 2885 | 819 | 89 | 279 | 6123 |
| 1970 | 0 | 25 | 82 | 7 | 347 | 147 | 126 | 1140 | 364 | 189 | 2425 |
| 1971 | 0 | 0 | 1182 | 247 | 31 | 246 | 157 | 159 | 756 | 407 | 3185 |
| 1972 | 0 | 259 | 1 | 376 | 71 | 21 | 92 | 37 | 16 | 431 | 1303 |
| 1973 | 0 | 1015 | 1722 | 6 | 358 | 37 | 10 | 37 | 8 | 163 | 3358 |
| 1974 | 0 | 17 | 2105 | 247 | 0 | 31 | 3 | 0 | 29 | 57 | 2488 |
| 1975 | 0 | 0 | 270 | 1428 | 201 | 5 | 34 | 1 | 2 | 28 | 1969 |
| 1976 | 0 | 73 | 149 | 166 | 814 | 125 | 0 | 19 | 0 | 17 | 1363 |
| 1977 | 0 | 0 | 7836 | 64 | 178 | 303 | 162 | 0 | 15 | 14 | 8571 |
| 1978 | 0 | 1 | 285 | 9831 | 161 | 169 | 302 | 80 | 10 | 9 | 10848 |
| 1979 | 0 | 0 | 15 | 199 | 4250 | 362 | 201 | 215 | 43 | 14 | 5300 |
| 1980 | 0 | 3 | 17561 | 342 | 299 | 2407 | 191 | 129 | 51 | 12 | 20995 |
| 1981 | 0 | 0 | 660 | 6687 | 393 | 494 | 1234 | 119 | 33 | 7 | 9627 |
| 1982 | 0 | 0 | 713 | 1048 | 2799 | 201 | 377 | 723 | 62 | 65 | 5988 |
| 1983 | 0 | 0 | 140 | 648 | 546 | 1629 | 207 | 104 | 402 | 34 | 3710 |
| 1984 | 0 | 0 | 76 | 249 | 341 | 264 | 1120 | 186 | 165 | 314 | 2716 |
| 1985 | 0 | 0 | 2063 | 374 | 176 | 189 | 123 | 371 | 53 | 114 | 3463 |
| 1986 | 0 | 6 | 38 | 2557 | 173 | 142 | 122 | 118 | 173 | 41 | 3369 |
| 1987 | 0 | 0 | 1990 | 127 | 1515 | 96 | 56 | 82 | 68 | 108 | 4042 |
| 1988 | 0 | 4 | 51 | 2145 | 121 | 877 | 109 | 36 | 46 | 98 | 3487 |
| 1989 | 0 | 0 | 1153 | 78 | 734 | 129 | 320 | 31 | 20 | 45 | 2510 |
| 1990 | 0 | 2 | 7 | 1265 | 126 | 743 | 68 | 163 | 42 | 42 | 2457 |
| 1991 | 0 | 6 | 441 | 89 | 2041 | 88 | 389 | 72 | 145 | 61 | 3332 |
| 1992 | 0 | 7 | 230 | 311 | 127 | 1446 | 89 | 315 | 26 | 90 | 2640 |
| 1993 | 0 | 7 | 247 | 343 | 279 | 85 | 635 | 34 | 153 | 74 | 1856 |
| 1994 | 0 | 1 | 241 | 737 | 148 | 54 | 48 | 125 | 29 | 39 | 1423 |
| 1995 | 0 | 2 | 60 | 525 | 414 | 53 | 25 | 3 | 51 | 16 | 1149 |
| 1996 | 0 | 1 | 29 | 481 | 862 | 419 | 61 | 18 | 3 | 72 | 1946 |
| 1997 | 0 | 2 | 81 | 80 | 542 | 483 | 194 | 13 | 8 | 34 | 1438 |
| 1998 | 0 | 1 | 163 | 282 | 258 | 539 | 446 | 114 | 12 | 35 | 1851 |
| 1999 | 0 | 1 | 35 | 737 | 315 | 244 | 344 | 253 | 97 | 25 | 2052 |
| 2000 | 0 | 0 | 309 | 437 | 1245 | 249 | 200 | 209 | 182 | 65 | 2896 |
| 2001 | 0 | 2 | 60 | 1676 | 544 | 803 | 276 | 207 | 220 | 170 | 3958 |
| 2002 | 0 | 1 | 285 | 205 | 1855 | 371 | 660 | 111 | 106 | 278 | 3872 |

Table 11. Average weight at age (kg) of haddock from the commercial fishery in unit areas 5Zjm. The 1989 to 1991 year-classes (shaded) grew faster than adjacent year-classes.

| Year | Age Group | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| 1969 | 0.600 | 0.763 | 1.282 | 1.531 | 1.649 | 1.836 | 2.298 | 2.879 |
| 1970 | 0.721 | 1.067 | 0.812 | 1.653 | 1.886 | 2.124 | 2.199 | 2.841 |
| 1971 | 0.600 | 0.928 | 1.059 | 1.272 | 2.011 | 2.255 | 2.262 | 2.613 |
| 1972 | 0.759 | 1.000 | 1.562 | 1.750 | 2.147 | 2.505 | 2.411 | 2.514 |
| 1973 | 0.683 | 1.002 | 1.367 | 1.804 | 2.202 | 1.631 | 2.885 | 3.295 |
| 1974 | 0.600 | 0.970 | 1.418 | 1.800 | 1.984 | 3.760 | 2.700 | 3.128 |
| 1975 | 0.600 | 0.872 | 1.524 | 2.062 | 1.997 | 2.422 | 4.114 | 3.557 |
| 1976 | 0.596 | 0.956 | 1.293 | 1.857 | 2.417 | 2.700 | 2.702 | 3.000 |
| 1977 | 0.600 | 0.970 | 1.442 | 1.809 | 2.337 | 2.809 | 2.700 | 3.095 |
| 1978 | 0.619 | 1.151 | 1.433 | 2.055 | 2.623 | 2.919 | 2.972 | 2.829 |
| 1979 | 0.600 | 0.987 | 1.298 | 1.805 | 2.206 | 2.806 | 3.219 | 3.277 |
| 1980 | 0.405 | 0.892 | 1.034 | 1.705 | 2.115 | 2.593 | 3.535 | 3.608 |
| 1981 | 0.600 | 0.890 | 1.262 | 1.592 | 2.270 | 2.611 | 3.505 | 4.009 |
| 1982 | 0.600 | 0.965 | 1.363 | 1.786 | 2.327 | 2.557 | 2.958 | 3.531 |
| 1983 | 0.600 | 1.024 | 1.341 | 1.750 | 2.118 | 2.509 | 2.879 | 3.104 |
| 1984 | 0.600 | 0.876 | 1.354 | 1.838 | 2.159 | 2.605 | 2.856 | 3.134 |
| 1985 | 0.600 | 0.950 | 1.230 | 1.915 | 2.227 | 2.702 | 2.872 | 3.180 |
| 1986 | 0.452 | 0.981 | 1.352 | 1.866 | 2.367 | 2.712 | 2.969 | 3.570 |
| 1987 | 0.600 | 0.833 | 1.431 | 1.984 | 2.148 | 2.594 | 2.953 | 3.646 |
| 1988 | 0.421 | 0.974 | 1.305 | 1.708 | 2.042 | 2.350 | 3.011 | 3.305 |
| 1989 | 0.600 | 0.868 | 1.450 | 1.777 | 2.183 | 2.522 | 3.012 | 3.411 |
| 1990 | 0.639 | 0.999 | 1.419 | 1.787 | 2.141 | 2.509 | 2.807 | 3.002 |
| 1991 | 0.581 | 1.197 | 1.241 | 1.802 | 2.087 | 2.596 | 2.918 | 3.012 |
| 1992 | 0.538 | 1.163 | 1.622 | 1.654 | 2.171 | 2.491 | 2.988 | 3.388 |
| 1993 | 0.659 | 1.160 | 1.724 | 2.181 | 2.047 | 2.623 | 2.386 | 3.112 |
| 1994 | 0.405 | 1.135 | 1.661 | 2.235 | 2.639 | 2.422 | 2.831 | 3.223 |
| 1995 | 0.797 | 1.055 | 1.511 | 2.033 | 2.550 | 2.755 | 2.908 | 3.010 |
| 1996 | 0.576 | 1.022 | 1.439 | 1.795 | 2.294 | 2.485 | 3.322 | 2.032 |
| 1997 | 0.685 | 1.215 | 1.336 | 1.747 | 2.120 | 2.476 | 3.034 | 3.365 |
| 1998 | 0.568 | 1.131 | 1.573 | 1.697 | 1.983 | 2.312 | 2.864 | 3.395 |
| 1999 | 0.678 | 1.095 | 1.570 | 1.910 | 1.865 | 2.182 | 2.535 | 2.773 |
| 2000 | 0.664 | 1.103 | 1.470 | 1.920 | 2.242 | 2.098 | 2.497 | 2.816 |
| 2001 | 0.394 | 1.102 | 1.471 | 1.755 | 2.107 | 2.367 | 2.186 | 2.522 |
| 2002 | 0.405 | 1.009 | 1.418 | 1.763 | 1.941 | 2.343 | 2.660 | 2.382 |
| Low | 0.394 | 0.763 | 0.812 | 1.272 | 1.649 | 1.631 | 2.186 | 2.032 |
| High | 0.797 | 1.215 | 1.724 | 2.235 | 2.639 | 3.760 | 4.114 | 4.009 |
| Median | 0.600 | 1.000 | 1.418 | 1.798 | 2.148 | 2.509 | 2.876 | 3.120 |
| Average | 0.590 | 1.009 | 1.384 | 1.812 | 2.165 | 2.505 | 2.851 | 3.105 |

Table 12. Conversion factors used to adjust for changes in door type and survey vessel in the NMFS surveys.

| | | Spring | | Fall | |
|---|---|---|---|---|---|
| Year | Door | Vessel | Conversion | Vessel | Conversion |
| 1968 | BMV | Albatross IV | 1.49 | Albatross IV | 1.49 |
| 1969 | BMV | Albatross IV | 1.49 | Albatross IV | 1.49 |
| 1970 | BMV | Albatross IV | 1.49 | Albatross IV | 1.49 |
| 1971 | BMV | Albatross IV | 1.49 | Albatross IV | 1.49 |
| 1972 | BMV | Albatross IV | 1.49 | Albatross IV | 1.49 |
| 1973 | BMV | Albatross IV | 1.49 | Albatross IV | 1.49 |
| 1974 | BMV | Albatross IV | 1.49 | Albatross IV | 1.49 |
| 1975 | BMV | Albatross IV | 1.49 | Albatross IV | 1.49 |
| 1976 | BMV | Albatross IV | 1.49 | Albatross IV | 1.49 |
| 1977 | BMV | Albatross IV | 1.49 | Delaware II | 1.2218 |
| 1978 | BMV | Albatross IV | 1.49 | Delaware II | 1.2218 |
| 1979 | BMV | Albatross IV | 1.49 | Delaware II | 1.2218 |
| 1980 | BMV | Albatross IV | 1.49 | Delaware II | 1.2218 |
| 1981 | BMV | Delaware II | 1.2218 | Delaware II | 1.2218 |
| 1982 | BMV | Delaware II | 1.2218 | Albatross IV | 1.49 |
| 1983 | BMV | Albatross IV | 1.49 | Albatross IV | 1.49 |
| 1984 | BMV | Albatross IV | 1.49 | Albatross IV | 1.49 |
| 1985 | Polyvalent | Albatross IV | 1 | Albatross IV | 1 |
| 1986 | Polyvalent | Albatross IV | 1 | Albatross IV | 1 |
| 1987 | Polyvalent | Albatross IV | 1 | Albatross IV | 1 |
| 1988 | Polyvalent | Albatross IV | 1 | Albatross IV | 1 |
| 1989 | Polyvalent | Delaware II | 0.82 | Delaware II | 0.82 |
| 1990 | Polyvalent | Delaware II | 0.82 | Delaware II | 0.82 |
| 1991 | Polyvalent | Delaware II | 0.82 | Delaware II | 0.82 |
| 1992 | Polyvalent | Albatross IV | 1 | Albatross IV | 1 |
| 1993 | Polyvalent | Albatross IV | 1 | Delaware II | 0.82 |
| 1994 | Polyvalent | Delaware II | 0.82 | Albatross IV | 1 |
| 1995 | Polyvalent | Albatross IV | 1 | Albatross IV | 1 |
| 1996 | Polyvalent | Albatross IV | 1 | Albatross IV | 1 |
| 1997 | Polyvalent | Albatross IV | 1 | Albatross IV | 1 |
| 1998 | Polyvalent | Albatross IV | 1 | Albatross IV | 1 |
| 1999 | Polyvalent | Albatross IV | 1 | Albatross IV | 1 |
| 2000 | Polyvalent | Albatross IV | 1 | Albatross IV | 1 |
| 2001 | Polyvalent | Albatross IV | 1 | Albatross IV | 1 |
| 2002 | Polyvalent | Albatross IV | 1 | Albatross IV | 1 |
| 2003 | Polyvalent | Delaware II | 0.82 | | |

Table 13. Total estimated abundance at age (numbers in 000's) of haddock for unit areas 5Zjm from DFO spring surveys.

| Year | Age Group | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9+ | Total |
| 1986 | 5057 | 306 | 8176 | 997 | 189 | 348 | 305 | 425 | 401 | 16205 |
| 1987 | 46 | 4286 | 929 | 3450 | 653 | 81 | 387 | 135 | 1132 | 11099 |
| 1988 | 971 | 49 | 12714 | 257 | 4345 | 274 | 244 | 130 | 686 | 19670 |
| 1989 | 48 | 6664 | 991 | 2910 | 245 | 526 | 40 | 34 | 265 | 11724 |
| 1990 | 726 | 108 | 12300 | 168 | 4466 | 299 | 1370 | 144 | 389 | 19968 |
| 1991 | 383 | 2163 | 134 | 10819 | 114 | 1909 | 117 | 505 | 225 | 16368 |
| 1992 | 1914 | 3879 | 1423 | 221 | 4810 | 18 | 1277 | 52 | 656 | 14249 |
| 1993 | 3448 | 1759 | 545 | 431 | 34 | 1186 | 19 | 281 | 147 | 7849 |
| 1994 | 4197 | 15163 | 5332 | 549 | 314 | 20 | 915 | 18 | 356 | 26864 |
| 1995 | 1231 | 3224 | 6236 | 3034 | 720 | 398 | 0 | 729 | 849 | 16422 |
| 1996 | 1455 | 2290 | 4784 | 5305 | 3113 | 303 | 274 | 38 | 684 | 18247 |
| 1997 | 1033 | 1550 | 1222 | 2742 | 2559 | 1397 | 150 | 65 | 372 | 11090 |
| 1998 | 2379 | 10626 | 5348 | 3190 | 5312 | 5028 | 2248 | 348 | 601 | 35080 |
| 1999 | 24593 | 4787 | 10067 | 3104 | 1963 | 1880 | 1764 | 448 | 174 | 48780 |
| 2000 | 3177 | 15865 | 7679 | 12108 | 2900 | 2074 | 2726 | 1591 | 813 | 48932 |
| 2001 | 23026 | 3519 | 14633 | 4255 | 5608 | 1808 | 1426 | 1963 | 2299 | 58536 |
| 2002 | 732 | 28174 | 5977 | 12659 | 2980 | 2644 | 647 | 528 | 2420 | 56760 |
| 2003 | 1682 | 1503 | 82161 | 5533 | 15105 | 3675 | 2355 | 1106 | 1986 | 115107 |

Table 14. Total estimated abundance at age (numbers in 000's) of haddock for unit areas 5Zjm from NMFS spring surveys. From 1973-81, a 41 Yankee trawl was used while a 36 Yankee trawl was used in other years. Conversion factors to adjust for changes in door type and survey vessel were applied.

| Year | Age Group | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9+ | Total |
| 1968 | 0 | 3254 | 68 | 679 | 4853 | 2045 | 240 | 123 | 234 | 11496 |
| 1969 | 17 | 35 | 614 | 235 | 523 | 3232 | 1220 | 358 | 489 | 6724 |
| 1970 | 478 | 190 | 0 | 560 | 998 | 441 | 3165 | 2491 | 769 | 9092 |
| 1971 | 0 | 655 | 261 | 0 | 144 | 102 | 58 | 1159 | 271 | 2650 |
| 1972 | 2594 | 0 | 771 | 132 | 25 | 47 | 211 | 27 | 1214 | 5020 |
| 1973 | 2455 | 5639 | 0 | 1032 | 154 | 0 | 276 | 0 | 1208 | 10763 |
| 1974 | 1323 | 20596 | 4084 | 0 | 354 | 0 | 43 | 72 | 322 | 26795 |
| 1975 | 528 | 567 | 6016 | 1063 | 0 | 218 | 127 | 45 | 208 | 8773 |
| 1976 | 8228 | 402 | 424 | 1127 | 532 | 0 | 0 | 0 | 22 | 10735 |
| 1977 | 126 | 26003 | 262 | 912 | 732 | 568 | 0 | 22 | 102 | 28727 |
| 1978 | 0 | 743 | 20859 | 641 | 880 | 1163 | 89 | 23 | 116 | 24516 |
| 1979 | 10496 | 441 | 1313 | 9764 | 475 | 72 | 445 | 42 | 9 | 23056 |
| 1980 | 4355 | 66450 | 1108 | 1086 | 5761 | 613 | 371 | 693 | 360 | 80797 |
| 1981 | 3281 | 2823 | 27085 | 2906 | 751 | 2455 | 347 | 56 | 21 | 39725 |
| 1982 | 584 | 3703 | 1658 | 7802 | 767 | 455 | 697 | 0 | 0 | 15666 |
| 1983 | 238 | 770 | 686 | 359 | 2591 | 30 | 0 | 798 | 58 | 5529 |
| 1984 | 1366 | 1414 | 1046 | 910 | 847 | 1189 | 133 | 73 | 490 | 7469 |
| 1985 | 40 | 8911 | 1396 | 674 | 1496 | 588 | 1995 | 127 | 483 | 15709 |
| 1986 | 3334 | 280 | 3597 | 246 | 210 | 333 | 235 | 560 | 159 | 8953 |
| 1987 | 122 | 5480 | 144 | 1394 | 157 | 231 | 116 | 370 | 0 | 8013 |
| 1988 | 305 | 61 | 1868 | 235 | 611 | 203 | 218 | 178 | 0 | 3678 |
| 1989 | 84 | 6665 | 619 | 1343 | 267 | 791 | 58 | 92 | 47 | 9966 |
| 1990 | 1654 | 70 | 10338 | 598 | 1042 | 110 | 182 | 0 | 0 | 13995 |
| 1991 | 740 | 2071 | 432 | 3381 | 192 | 203 | 66 | 87 | 25 | 7198 |
| 1992 | 529 | 287 | 205 | 158 | 602 | 32 | 46 | 46 | 0 | 1905 |
| 1993 | 1870 | 1116 | 197 | 232 | 195 | 717 | 77 | 35 | 43 | 4480 |
| 1994 | 1025 | 4272 | 1487 | 269 | 184 | 118 | 278 | 28 | 84 | 7745 |
| 1995 | 921 | 2312 | 4184 | 1727 | 265 | 152 | 51 | 272 | 214 | 10099 |
| 1996 | 912 | 1365 | 3789 | 3190 | 1905 | 237 | 36 | 0 | 496 | 11931 |
| 1997 | 1635 | 1226 | 380 | 595 | 470 | 343 | 24 | 44 | 20 | 4736 |
| 1998 | 549 | 6046 | 2005 | 1281 | 1184 | 303 | 58 | 15 | 122 | 11562 |
| 1999 | 6286 | 1914 | 3655 | 661 | 1128 | 1062 | 468 | 476 | 46 | 15696 |
| 2000 | 2675 | 2131 | 3399 | 1624 | 636 | 564 | 438 | 305 | 165 | 11938 |
| 2001 | 10503 | 1186 | 3304 | 1232 | 374 | 294 | 113 | 20 | 20 | 17047 |
| 2002 | 231 | 40432 | 10938 | 4044 | 1492 | 473 | 287 | 229 | 236 | 58362 |
| 2003 | 125 | 1105 | 16915 | 2245 | 3773 | 476 | 200 | 82 | 286 | 25206 |

Table 15. Total estimated abundance at age (numbers in 000's) of haddock for unit areas 5Zjm from NMFS fall surveys. Conversion factors to adjust for changes in door type and survey vessel were applied.

| Year | Age Group | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8+ | Total |
| 1963 | 105993 | 40995 | 10314 | 3378 | 5040 | 4136 | 1477 | 451 | 276 | 172061 |
| 1964 | 1178 | 123976 | 46705 | 4358 | 807 | 1865 | 477 | 211 | 167 | 179742 |
| 1965 | 259 | 1503 | 51338 | 8538 | 479 | 302 | 142 | 148 | 208 | 62918 |
| 1966 | 9325 | 751 | 1742 | 20323 | 3631 | 671 | 138 | 133 | 84 | 36798 |
| 1967 | 0 | 3998 | 73 | 327 | 1844 | 675 | 141 | 88 | 88 | 7233 |
| 1968 | 55 | 113 | 800 | 28 | 37 | 2223 | 547 | 177 | 313 | 4293 |
| 1969 | 356 | 0 | 0 | 509 | 62 | 30 | 739 | 453 | 108 | 2257 |
| 1970 | 0 | 6400 | 336 | 16 | 415 | 337 | 500 | 902 | 578 | 9483 |
| 1971 | 2626 | 0 | 788 | 97 | 0 | 265 | 27 | 73 | 594 | 4471 |
| 1972 | 4747 | 2396 | 0 | 232 | 0 | 0 | 53 | 0 | 275 | 7702 |
| 1973 | 1223 | 16797 | 1598 | 0 | 168 | 0 | 0 | 8 | 16 | 19809 |
| 1974 | 151 | 234 | 961 | 169 | 0 | 6 | 0 | 0 | 70 | 1589 |
| 1975 | 30365 | 664 | 192 | 1042 | 239 | 0 | 0 | 0 | 28 | 32530 |
| 1976 | 738 | 121717 | 431 | 25 | 484 | 71 | 0 | 17 | 37 | 123521 |
| 1977 | 47 | 238 | 26323 | 445 | 125 | 211 | 84 | 4 | 4 | 27480 |
| 1978 | 14642 | 547 | 530 | 7706 | 56 | 42 | 94 | 0 | 0 | 23617 |
| 1979 | 1598 | 21605 | 14 | 335 | 1489 | 45 | 12 | 0 | 0 | 25098 |
| 1980 | 3556 | 2788 | 5829 | 0 | 101 | 1081 | 108 | 25 | 4 | 13492 |
| 1981 | 596 | 4617 | 2585 | 2748 | 89 | 136 | 318 | 0 | 15 | 11103 |
| 1982 | 62 | 0 | 673 | 465 | 2508 | 153 | 97 | 528 | 42 | 4527 |
| 1983 | 3609 | 444 | 236 | 501 | 289 | 402 | 17 | 12 | 86 | 5598 |
| 1984 | 45 | 3775 | 856 | 233 | 194 | 45 | 262 | 0 | 41 | 5451 |
| 1985 | 12148 | 381 | 1646 | 199 | 70 | 68 | 46 | 30 | 21 | 14611 |
| 1986 | 30 | 7471 | 109 | 961 | 52 | 50 | 72 | 24 | 23 | 8793 |
| 1987 | 508 | 0 | 843 | 28 | 152 | 38 | 22 | 0 | 0 | 1592 |
| 1988 | 122 | 3983 | 184 | 2348 | 155 | 400 | 142 | 140 | 38 | 7513 |
| 1989 | 167 | 83 | 2645 | 112 | 509 | 68 | 73 | 0 | 0 | 3656 |
| 1990 | 1217 | 1041 | 36 | 1456 | 65 | 196 | 24 | 5 | 0 | 4040 |
| 1991 | 705 | 331 | 267 | 52 | 289 | 25 | 10 | 0 | 0 | 1679 |
| 1992 | 3484 | 1052 | 172 | 110 | 0 | 95 | 0 | 18 | 18 | 4948 |
| 1993 | 652 | 6656 | 3601 | 585 | 0 | 87 | 96 | 30 | 0 | 11707 |
| 1994 | 625 | 782 | 927 | 419 | 96 | 32 | 0 | 24 | 0 | 2905 |
| 1995 | 892 | 1436 | 5993 | 3683 | 550 | 30 | 0 | 0 | 53 | 12637 |
| 1996 | 1742 | 453 | 570 | 2302 | 963 | 167 | 0 | 0 | 0 | 6196 |
| 1997 | 217 | 5738 | 3368 | 592 | 690 | 385 | 0 | 0 | 13 | 11004 |
| 1998 | 2566 | 2966 | 4214 | 1085 | 705 | 526 | 722 | 0 | 0 | 12784 |
| 1999 | 3268 | 1236 | 5364 | 5060 | 837 | 2825 | 148 | 1150 | 991 | 20879 |
| 2000 | 1368 | 5284 | 6226 | 3712 | 622 | 229 | 0 | 146 | 97 | 17684 |
| 2001 | 659 | 16626 | 1382 | 6939 | 3000 | 1586 | 306 | 127 | 58 | 30684 |
| 2002 | 172 | 1864 | 44602 | 6040 | 5120 | 1660 | 863 | 457 | 354 | 61131 |

Table 16. Average weight at age (kg) from DFO spring surveys used to represent beginning of year weights.

| Year | Age Group | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9+ |
| 1986 | 0.135 | 0.451 | 0.974 | 1.445 | 3.044 | 2.848 | 3.598 | 3.376 | 3.918 |
| 1987 | 0.150 | 0.500 | 0.716 | 1.672 | 2.012 | 2.550 | 3.148 | 3.151 | 3.629 |
| 1988 | 0.097 | 0.465 | 0.931 | 1.795 | 1.816 | 1.918 | 2.724 | 3.264 | 3.871 |
| 1989 | 0.062 | 0.474 | 0.650 | 1.392 | 1.995 | 2.527 | 2.158 | 2.859 | 3.141 |
| 1990 | 0.149 | 0.525 | 0.924 | 1.181 | 1.862 | 2.073 | 2.507 | 2.815 | 3.472 |
| 1991 | 0.120 | 0.685 | 0.800 | 1.512 | 1.695 | 2.434 | 2.105 | 3.122 | 3.432 |
| 1992 | 0.122 | 0.602 | 1.118 | 1.061 | 2.078 | 2.165 | 2.709 | 2.284 | 3.440 |
| 1993 | 0.122 | 0.481 | 1.227 | 1.803 | 1.274 | 2.332 | 2.343 | 2.739 | 3.280 |
| 1994 | 0.107 | 0.469 | 1.047 | 1.621 | 1.927 | 2.154 | 3.154 | 2.688 | 3.084 |
| 1995 | 0.086 | 0.493 | 0.963 | 1.556 | 2.222 | 2.445 | | 2.991 | 3.184 |
| 1996 | 0.139 | 0.495 | 0.919 | 1.320 | 1.932 | 2.555 | 2.902 | 2.611 | 3.588 |
| 1997 | 0.132 | 0.506 | 0.782 | 1.205 | 1.664 | 2.176 | 2.454 | 2.577 | 3.158 |
| 1998 | 0.107 | 0.535 | 1.035 | 1.161 | 1.570 | 1.954 | 2.609 | 3.559 | 3.462 |
| 1999 | 0.130 | 0.474 | 0.911 | 1.290 | 1.259 | 1.869 | 2.131 | 2.722 | 2.992 |
| 2000 | 0.116 | 0.543 | 0.949 | 1.478 | 1.871 | 1.789 | 2.298 | 2.508 | 2.901 |
| 2001 | 0.093 | 0.524 | 1.005 | 1.371 | 1.798 | 2.165 | 2.250 | 2.593 | 2.928 |
| 2002 | 0.096 | 0.332 | 0.778 | 1.138 | 1.494 | 1.965 | 2.177 | 2.206 | 2.707 |
| 2003 | 0.080 | 0.369 | 0.846 | 1.063 | 1.477 | 1.645 | 2.208 | 2.229 | 2.487 |
| Low | 0.062 | 0.332 | 0.650 | 1.061 | 1.259 | 1.645 | 2.105 | 2.206 | 2.487 |
| High | 0.150 | 0.685 | 1.227 | 1.803 | 3.044 | 2.848 | 3.598 | 3.559 | 3.918 |
| Median | 0.118 | 0.494 | 0.927 | 1.382 | 1.839 | 2.165 | 2.454 | 2.730 | 3.232 |
| Average | 0.113 | 0.496 | 0.921 | 1.393 | 1.833 | 2.198 | 2.557 | 2.794 | 3.260 |

Table 17. Statistical properties of estimates of population abundance (numbers in 000's) at time 2003.25 and survey calibration constants (unitless, survey:population) for haddock in unit areas 5Zjm obtained from a bootstrap with 1000 replications.

| Age | Estimate | Standard Error | Relative Error | Bias | Relative Bias |
|---|---|---|---|---|---|
| | | Population Abundance (000's) | | | |
| 1 | 2109 | 1518 | 0.720 | 382 | 0.181 |
| 2 | 3087 | 1272 | 0.412 | 211 | 0.068 |
| 3 | 51176 | 16008 | 0.313 | 2488 | 0.049 |
| 4 | 7517 | 2186 | 0.291 | 324 | 0.043 |
| 5 | 9635 | 2742 | 0.285 | 256 | 0.027 |
| 6 | 2297 | 615 | 0.268 | 24 | 0.010 |
| 7 | 1129 | 445 | 0.394 | 32 | 0.028 |
| 8 | 480 | 180 | 0.376 | 21 | 0.044 |
| | | Survey Calibration Constants | | | |
| *DFO Spring Survey* | | | | | |
| 1 | 0.224 | 0.052 | 0.232 | 0.006 | 0.026 |
| 2 | 0.482 | 0.107 | 0.223 | 0.014 | 0.029 |
| 3 | 0.949 | 0.206 | 0.217 | 0.031 | 0.033 |
| 4 | 0.875 | 0.186 | 0.212 | 0.021 | 0.024 |
| 5 | 1.064 | 0.242 | 0.228 | 0.030 | 0.028 |
| 6 | 0.903 | 0.197 | 0.218 | 0.020 | 0.023 |
| 7 | 1.186 | 0.276 | 0.233 | 0.031 | 0.026 |
| 8 | 1.180 | 0.248 | 0.210 | 0.001 | 0.001 |
| *NMFS Spring Survey – Yankee 36 – 1969-72/1982-2003* | | | | | |
| 1 | 0.126 | 0.023 | 0.186 | 0.002 | 0.016 |
| 2 | 0.328 | 0.063 | 0.191 | 0.003 | 0.011 |
| 3 | 0.450 | 0.089 | 0.197 | 0.007 | 0.015 |
| 4 | 0.432 | 0.083 | 0.193 | 0.007 | 0.017 |
| 5 | 0.507 | 0.093 | 0.184 | 0.010 | 0.019 |
| 6 | 0.408 | 0.073 | 0.180 | 0.005 | 0.013 |
| 7 | 0.448 | 0.083 | 0.186 | 0.008 | 0.017 |
| 8 | 0.501 | 0.099 | 0.197 | 0.008 | 0.016 |
| *NMFS Spring Survey – Yankee 41 – 1973-81* | | | | | |
| 1 | 0.225 | 0.078 | 0.349 | 0.013 | 0.059 |
| 2 | 0.511 | 0.160 | 0.313 | 0.021 | 0.042 |
| 3 | 0.639 | 0.207 | 0.325 | 0.022 | 0.035 |
| 4 | 0.793 | 0.265 | 0.334 | 0.034 | 0.043 |
| 5 | 0.964 | 0.318 | 0.330 | 0.037 | 0.038 |
| 6 | 0.887 | 0.346 | 0.390 | 0.055 | 0.062 |
| 7 | 1.595 | 0.617 | 0.387 | 0.106 | 0.066 |
| 8 | 0.633 | 0.232 | 0.367 | 0.034 | 0.054 |
| *NMFS Fall Survey* | | | | | |
| 0 | 0.119 | 0.019 | 0.157 | 0.001 | 0.004 |
| 1 | 0.318 | 0.053 | 0.168 | 0.002 | 0.005 |
| 2 | 0.244 | 0.040 | 0.165 | 0.003 | 0.013 |
| 3 | 0.243 | 0.040 | 0.163 | 0.004 | 0.018 |
| 4 | 0.182 | 0.031 | 0.169 | 0.002 | 0.013 |
| 5 | 0.168 | 0.029 | 0.174 | 0.002 | 0.014 |

Table 18. Beginning of year population abundance (numbers in 000's) for haddock in unit areas 5Zjm from a virtual population analysis using the bootstrap bias adjusted population abundance at the beginning of 2003.

| Year | Age Group | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9+ | 1+ | 2+ | 3+ |
| 1969 | 768 | 189 | 4375 | 853 | 905 | 8990 | 3021 | 185 | 809 | 20095 | 19327 | 19138 |
| 1970 | 3349 | 629 | 138 | 2295 | 465 | 448 | 4796 | 1745 | 486 | 14351 | 11003 | 10374 |
| 1971 | 456 | 2715 | 439 | 107 | 1569 | 249 | 253 | 2904 | 1335 | 10027 | 9571 | 6857 |
| 1972 | 5375 | 373 | 1128 | 138 | 61 | 1064 | 64 | 67 | 2441 | 10711 | 5336 | 4963 |
| 1973 | 11030 | 4152 | 305 | 587 | 49 | 31 | 792 | 19 | 1661 | 18626 | 7596 | 3444 |
| 1974 | 3342 | 8121 | 1827 | 244 | 153 | 7 | 17 | 614 | 1224 | 15550 | 12208 | 4086 |
| 1975 | 3222 | 2718 | 4750 | 1279 | 200 | 99 | 4 | 14 | 1430 | 13715 | 10493 | 7775 |
| 1976 | 53927 | 2633 | 1972 | 2593 | 868 | 159 | 51 | 2 | 1156 | 63362 | 9435 | 6802 |
| 1977 | 5899 | 43960 | 2022 | 1467 | 1403 | 599 | 131 | 25 | 933 | 56438 | 50539 | 6579 |
| 1978 | 4205 | 4830 | 28838 | 1599 | 1043 | 885 | 349 | 107 | 759 | 42614 | 38409 | 33579 |
| 1979 | 51913 | 3437 | 3680 | 14522 | 1160 | 703 | 457 | 213 | 692 | 76776 | 24864 | 21427 |
| 1980 | 6635 | 42502 | 2799 | 2831 | 8088 | 625 | 400 | 185 | 690 | 64756 | 58120 | 15618 |
| 1981 | 5116 | 5423 | 18952 | 1988 | 2051 | 4507 | 342 | 216 | 661 | 39256 | 34140 | 28717 |
| 1982 | 1710 | 4188 | 3832 | 9539 | 1279 | 1239 | 2605 | 176 | 683 | 25252 | 23542 | 19353 |
| 1983 | 2529 | 1400 | 2766 | 2194 | 5287 | 864 | 679 | 1487 | 592 | 17798 | 15269 | 13869 |
| 1984 | 14879 | 2070 | 1015 | 1674 | 1305 | 2883 | 522 | 462 | 1318 | 26128 | 11249 | 9179 |
| 1985 | 1550 | 12182 | 1625 | 607 | 1064 | 835 | 1370 | 264 | 1034 | 20532 | 18982 | 6799 |
| 1986 | 13226 | 1266 | 8035 | 984 | 338 | 702 | 574 | 795 | 914 | 26833 | 13607 | 12341 |
| 1987 | 1272 | 10795 | 1001 | 4293 | 654 | 150 | 466 | 367 | 1212 | 20211 | 18939 | 8144 |
| 1988 | 14969 | 1042 | 7036 | 706 | 2153 | 449 | 73 | 308 | 1134 | 27870 | 12900 | 11858 |
| 1989 | 787 | 12222 | 807 | 3823 | 469 | 989 | 271 | 28 | 1053 | 20449 | 19662 | 7440 |
| 1990 | 2359 | 644 | 8959 | 589 | 2467 | 268 | 524 | 195 | 827 | 16832 | 14473 | 13829 |
| 1991 | 1793 | 1927 | 521 | 6188 | 370 | 1351 | 159 | 283 | 762 | 13353 | 11560 | 9633 |
| 1992 | 7622 | 1460 | 1174 | 347 | 3212 | 223 | 756 | 66 | 670 | 15530 | 7908 | 6448 |
| 1993 | 10366 | 6226 | 983 | 680 | 171 | 1334 | 105 | 337 | 500 | 20701 | 10335 | 4109 |
| 1994 | 11981 | 8474 | 4857 | 492 | 308 | 65 | 530 | 56 | 486 | 27250 | 15269 | 6795 |
| 1995 | 4730 | 9785 | 6707 | 3286 | 266 | 202 | 8 | 319 | 381 | 25684 | 20954 | 11168 |
| 1996 | 5104 | 3862 | 7947 | 5004 | 2310 | 169 | 143 | 4 | 512 | 25055 | 19951 | 16089 |
| 1997 | 12021 | 4170 | 3131 | 6058 | 3300 | 1502 | 82 | 100 | 353 | 30718 | 18697 | 14527 |
| 1998 | 9366 | 9817 | 3336 | 2489 | 4455 | 2253 | 1050 | 55 | 332 | 33153 | 23787 | 13970 |
| 1999 | 29117 | 7659 | 7874 | 2464 | 1797 | 3143 | 1431 | 756 | 275 | 54514 | 25397 | 17739 |
| 2000 | 14241 | 23810 | 6231 | 5754 | 1727 | 1247 | 2259 | 940 | 733 | 56941 | 42700 | 18891 |
| 2001 | 76905 | 11653 | 19209 | 4694 | 3556 | 1186 | 835 | 1656 | 1143 | 120837 | 43932 | 32280 |
| 2002 | 3697 | 62888 | 9478 | 14158 | 3340 | 2161 | 714 | 493 | 1926 | 98855 | 95158 | 32270 |
| 2003 | 1816 | 3023 | 51184 | 7562 | 9859 | 2389 | 1154 | 482 | 1625 | 79095 | 77279 | 74256 |

Table 19. Fishing mortality rate for haddock in unit areas 5Zjm from a virtual population analysis using the bootstrap bias adjusted population abundance at the beginning of 2002. The rate for ages 4+ is weighted by population numbers and is also shown as exploitation rate (%).

| Year | Age Group | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9+ | 4+ | 4+ (%) |
| 1969 | 0.000 | 0.112 | 0.445 | 0.407 | 0.504 | 0.428 | 0.349 | 0.737 | 0.470 | 0.422 | 31 |
| 1970 | 0.010 | 0.159 | 0.057 | 0.180 | 0.425 | 0.371 | 0.302 | 0.258 | 0.543 | 0.287 | 23 |
| 1971 | 0.000 | 0.678 | 0.956 | 0.367 | 0.188 | 1.164 | 1.131 | 0.332 | 0.397 | 0.375 | 29 |
| 1972 | 0.058 | 0.003 | 0.453 | 0.832 | 0.467 | 0.096 | 0.993 | 0.288 | 0.210 | 0.219 | 18 |
| 1973 | 0.106 | 0.621 | 0.022 | 1.143 | 1.738 | 0.413 | 0.054 | 0.641 | 0.112 | 0.322 | 25 |
| 1974 | 0.007 | 0.336 | 0.156 | 0.000 | 0.242 | 0.491 | 0.003 | 0.051 | 0.050 | 0.059 | 5 |
| 1975 | 0.002 | 0.121 | 0.405 | 0.188 | 0.025 | 0.460 | 0.336 | 0.172 | 0.021 | 0.108 | 9 |
| 1976 | 0.004 | 0.064 | 0.096 | 0.414 | 0.171 | 0.000 | 0.522 | 0.000 | 0.016 | 0.262 | 21 |
| 1977 | 0.000 | 0.222 | 0.035 | 0.141 | 0.261 | 0.339 | 0.000 | 1.007 | 0.017 | 0.180 | 15 |
| 1978 | 0.002 | 0.072 | 0.486 | 0.121 | 0.194 | 0.460 | 0.293 | 0.107 | 0.013 | 0.195 | 16 |
| 1979 | 0.000 | 0.005 | 0.062 | 0.385 | 0.419 | 0.363 | 0.704 | 0.249 | 0.022 | 0.379 | 29 |
| 1980 | 0.002 | 0.608 | 0.142 | 0.122 | 0.385 | 0.402 | 0.416 | 0.346 | 0.019 | 0.309 | 24 |
| 1981 | 0.000 | 0.147 | 0.486 | 0.241 | 0.304 | 0.348 | 0.465 | 0.178 | 0.012 | 0.295 | 23 |
| 1982 | 0.000 | 0.215 | 0.358 | 0.390 | 0.192 | 0.401 | 0.361 | 0.481 | 0.107 | 0.358 | 27 |
| 1983 | 0.000 | 0.121 | 0.302 | 0.320 | 0.407 | 0.304 | 0.185 | 0.343 | 0.065 | 0.341 | 26 |
| 1984 | 0.000 | 0.042 | 0.314 | 0.253 | 0.246 | 0.544 | 0.482 | 0.486 | 0.298 | 0.390 | 29 |
| 1985 | 0.002 | 0.216 | 0.302 | 0.387 | 0.216 | 0.175 | 0.345 | 0.246 | 0.128 | 0.247 | 20 |
| 1986 | 0.003 | 0.035 | 0.427 | 0.208 | 0.610 | 0.209 | 0.246 | 0.263 | 0.049 | 0.221 | 18 |
| 1987 | 0.000 | 0.228 | 0.150 | 0.490 | 0.177 | 0.527 | 0.214 | 0.229 | 0.104 | 0.365 | 28 |
| 1988 | 0.003 | 0.056 | 0.410 | 0.209 | 0.578 | 0.305 | 0.759 | 0.174 | 0.099 | 0.363 | 28 |
| 1989 | 0.000 | 0.111 | 0.114 | 0.238 | 0.359 | 0.436 | 0.130 | 1.606 | 0.047 | 0.247 | 20 |
| 1990 | 0.002 | 0.013 | 0.170 | 0.265 | 0.402 | 0.321 | 0.417 | 0.269 | 0.057 | 0.319 | 25 |
| 1991 | 0.005 | 0.295 | 0.207 | 0.456 | 0.307 | 0.381 | 0.675 | 0.825 | 0.092 | 0.423 | 32 |
| 1992 | 0.002 | 0.195 | 0.347 | 0.507 | 0.679 | 0.556 | 0.609 | 0.544 | 0.159 | 0.584 | 41 |
| 1993 | 0.002 | 0.048 | 0.492 | 0.591 | 0.770 | 0.723 | 0.428 | 0.667 | 0.171 | 0.593 | 41 |
| 1994 | 0.002 | 0.034 | 0.191 | 0.416 | 0.222 | 1.885 | 0.308 | 0.886 | 0.095 | 0.338 | 26 |
| 1995 | 0.003 | 0.008 | 0.093 | 0.153 | 0.252 | 0.147 | 0.506 | 0.197 | 0.047 | 0.153 | 13 |
| 1996 | 0.002 | 0.010 | 0.071 | 0.216 | 0.230 | 0.527 | 0.154 | 2.122 | 0.174 | 0.224 | 18 |
| 1997 | 0.003 | 0.023 | 0.030 | 0.107 | 0.182 | 0.158 | 0.195 | 0.092 | 0.114 | 0.136 | 12 |
| 1998 | 0.001 | 0.021 | 0.103 | 0.126 | 0.149 | 0.254 | 0.129 | 0.273 | 0.123 | 0.164 | 14 |
| 1999 | 0.001 | 0.006 | 0.114 | 0.155 | 0.165 | 0.130 | 0.220 | 0.154 | 0.104 | 0.157 | 13 |
| 2000 | 0.001 | 0.015 | 0.083 | 0.281 | 0.176 | 0.200 | 0.110 | 0.244 | 0.106 | 0.216 | 18 |
| 2001 | 0.001 | 0.007 | 0.105 | 0.140 | 0.298 | 0.307 | 0.328 | 0.164 | 0.189 | 0.218 | 18 |
| 2002 | 0.001 | 0.006 | 0.026 | 0.162 | 0.135 | 0.428 | 0.193 | 0.275 | 0.179 | 0.188 | 16 |

Table 20. Beginning of year biomass (tonnes in 000's) for haddock in unit areas 5Zjm from a virtual population analysis using the bootstrap bias adjusted population abundance at the beginning of 2003.

| Year | Age Group | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9+ | 1+ | 2+ | 3+ |
| 1969 | 88 | 97 | 4091 | 1283 | 1803 | 21079 | 8204 | 541 | 2788 | 39975 | 39886 | 39789 |
| 1970 | 385 | 324 | 129 | 3451 | 926 | 1049 | 13027 | 5111 | 1676 | 26079 | 25694 | 25371 |
| 1971 | 52 | 1397 | 411 | 161 | 3127 | 583 | 687 | 8505 | 4600 | 19523 | 19471 | 18074 |
| 1972 | 618 | 192 | 1055 | 208 | 121 | 2495 | 173 | 196 | 8409 | 13466 | 12848 | 12656 |
| 1973 | 1268 | 2136 | 285 | 884 | 98 | 73 | 2150 | 56 | 5722 | 12672 | 11404 | 9268 |
| 1974 | 384 | 4179 | 1708 | 367 | 306 | 17 | 46 | 1799 | 4217 | 13021 | 12637 | 8458 |
| 1975 | 370 | 1398 | 4441 | 1924 | 398 | 231 | 10 | 40 | 4928 | 13740 | 13370 | 11971 |
| 1976 | 6199 | 1355 | 1844 | 3900 | 1729 | 374 | 138 | 6 | 3983 | 19527 | 13328 | 11973 |
| 1977 | 678 | 22618 | 1890 | 2206 | 2796 | 1404 | 355 | 73 | 3214 | 35234 | 34556 | 11938 |
| 1978 | 483 | 2485 | 26962 | 2404 | 2077 | 2074 | 949 | 313 | 2613 | 40361 | 39878 | 37393 |
| 1979 | 5968 | 1768 | 3441 | 21839 | 2310 | 1648 | 1242 | 625 | 2383 | 41224 | 35257 | 33488 |
| 1980 | 763 | 21869 | 2617 | 4258 | 16115 | 1464 | 1087 | 543 | 2377 | 51092 | 50329 | 28461 |
| 1981 | 588 | 2790 | 17719 | 2990 | 4086 | 10567 | 929 | 633 | 2278 | 42580 | 41992 | 39202 |
| 1982 | 197 | 2155 | 3583 | 14346 | 2549 | 2905 | 7076 | 515 | 2353 | 35678 | 35481 | 33326 |
| 1983 | 291 | 720 | 2586 | 3300 | 10534 | 2026 | 1844 | 4354 | 2038 | 27694 | 27403 | 26682 |
| 1984 | 1710 | 1065 | 949 | 2518 | 2600 | 6759 | 1418 | 1353 | 4540 | 22912 | 21202 | 20136 |
| 1985 | 178 | 6268 | 1520 | 913 | 2120 | 1959 | 3720 | 773 | 3561 | 21013 | 20835 | 14567 |
| 1986 | 1781 | 572 | 7829 | 1421 | 1028 | 1999 | 2065 | 2682 | 3581 | 22957 | 21176 | 20604 |
| 1987 | 191 | 5393 | 717 | 7179 | 1316 | 383 | 1468 | 1158 | 4399 | 22203 | 22012 | 16619 |
| 1988 | 1456 | 484 | 6547 | 1267 | 3911 | 861 | 198 | 1006 | 4389 | 20118 | 18662 | 18178 |
| 1989 | 49 | 5795 | 524 | 5324 | 935 | 2500 | 584 | 80 | 3308 | 19099 | 19050 | 13255 |
| 1990 | 351 | 338 | 8280 | 696 | 4594 | 555 | 1313 | 548 | 2872 | 19547 | 19196 | 18858 |
| 1991 | 214 | 1320 | 416 | 9353 | 627 | 3290 | 335 | 882 | 2614 | 19051 | 18836 | 17517 |
| 1992 | 932 | 880 | 1312 | 368 | 6675 | 482 | 2048 | 151 | 2306 | 15154 | 14222 | 13342 |
| 1993 | 1265 | 2996 | 1207 | 1226 | 218 | 3111 | 245 | 922 | 1639 | 12828 | 11563 | 8568 |
| 1994 | 1278 | 3976 | 5084 | 798 | 594 | 139 | 1672 | 150 | 1500 | 15192 | 13914 | 9938 |
| 1995 | 408 | 4828 | 6459 | 5113 | 591 | 494 | 19 | 954 | 1213 | 20079 | 19672 | 14843 |
| 1996 | 707 | 1911 | 7303 | 6606 | 4461 | 432 | 414 | 10 | 1837 | 23683 | 22976 | 21065 |
| 1997 | 1589 | 2112 | 2448 | 7302 | 5492 | 3269 | 201 | 258 | 1114 | 23784 | 22195 | 20083 |
| 1998 | 1005 | 5255 | 3453 | 2891 | 6993 | 4403 | 2741 | 196 | 1151 | 28088 | 27083 | 21827 |
| 1999 | 3775 | 3628 | 7171 | 3177 | 2262 | 5875 | 3049 | 2056 | 823 | 31815 | 28040 | 24413 |
| 2000 | 1648 | 12937 | 5912 | 8506 | 3230 | 2231 | 5192 | 2358 | 2127 | 44141 | 42492 | 29556 |
| 2001 | 7180 | 6101 | 19311 | 6436 | 6391 | 2568 | 1880 | 4295 | 3347 | 57509 | 50329 | 44228 |
| 2002 | 354 | 20852 | 7374 | 16108 | 4989 | 4246 | 1555 | 1087 | 5214 | 61779 | 61425 | 40573 |
| 2003 | 146 | 1117 | 43305 | 8037 | 14563 | 3930 | 2548 | 1076 | 4043 | 78763 | 78617 | 77501 |

Table 21. Risk projection input for haddock in unit areas 5Zjm. A catch of 8000t in 2003, 10 million recruits for the 2003 and 2004 year-classes and M = 0.2 were assumed for the forecasts.

| Year | Age Group | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9+ |
| *Population Numbers (000s)* | | | | | | | | | |
| 2003.25 | 2109 | 3087 | 51176 | 7517 | 9635 | 2297 | 1129 | 480 | 1576 |
| *Partial Recruitment to the Fishery*[1] | | | | | | | | | |
| 2003.25 | 0 | 0.09 | 0.5 | 1 | 1 | 1 | 1 | 1 | 1 |
| 2004 | 0 | 0.09 | 0.5 | 1 | 1 | 1 | 1 | 1 | 1 |
| *Weight at beginning of year for population (kg)*[2] | | | | | | | | | |
| 2003.25 | 0.08 | 0.37 | 0.85 | 1.06 | 1.48 | 1.64 | 2.21 | 2.23 | 2.49 |
| 2004 | 0.08 | 0.37 | 0.85 | 1.06 | 1.48 | 1.64 | 2.21 | 2.23 | 2.49 |
| 2005 | 0.08 | 0.37 | 0.85 | 1.06 | 1.48 | 1.64 | 2.21 | 2.23 | 2.49 |
| *Weight at age for catch (kg)*[3] | | | | | | | | | |
| 2003.25 | 0.54 | 1.09 | 1.5 | 1.81 | 2.03 | 2.26 | 2.55 | 2.78 | 3.67 |
| 2004 | 0.54 | 1.09 | 1.5 | 1.81 | 2.03 | 2.26 | 2.55 | 2.78 | 3.67 |

[1]Average of 1997 – 2001.
[2]Equal to 2003 from DFO survey.
[3]Average of 1998 – 2002 from fishery.

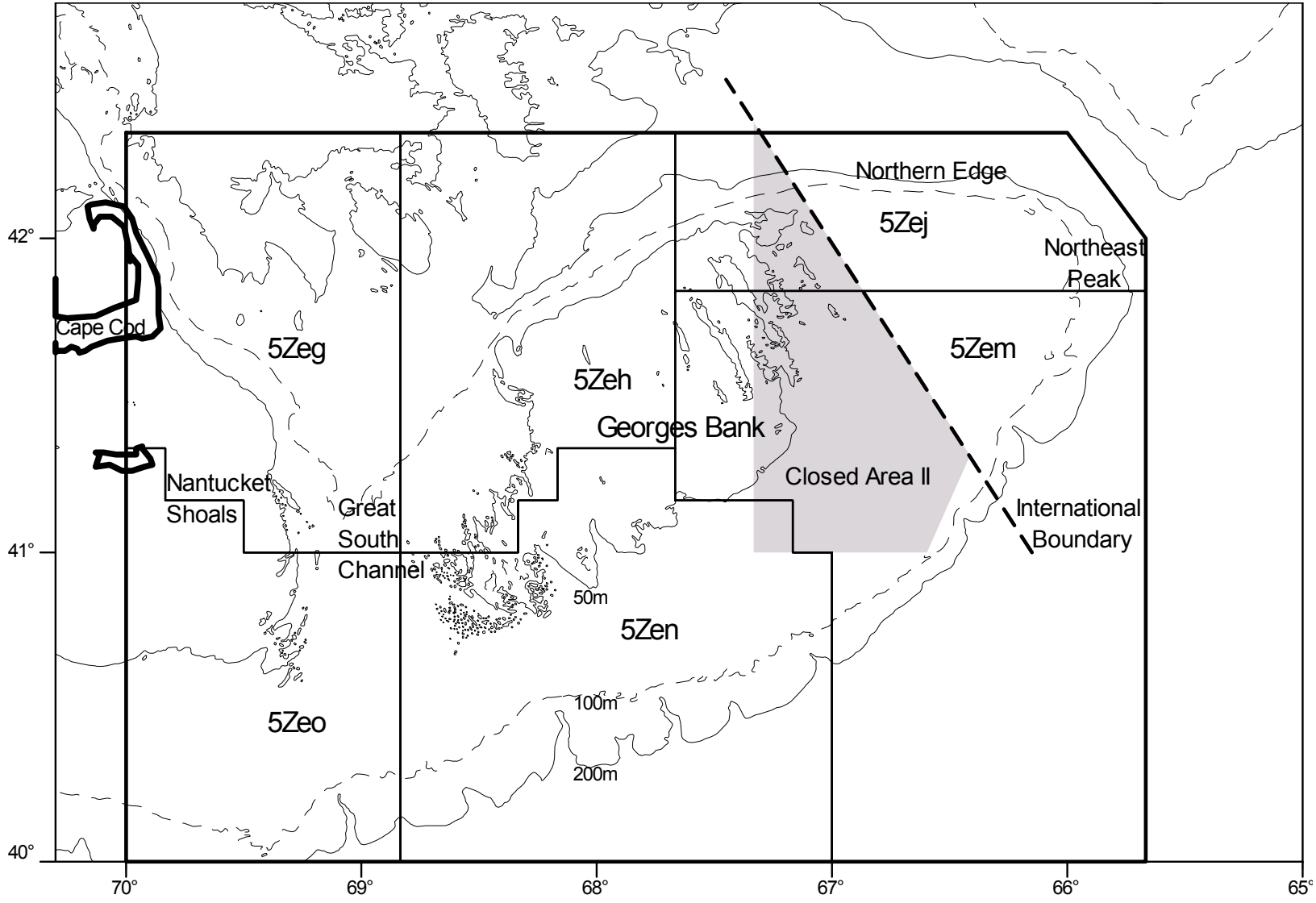


Figure 1. Fisheries statistical unit areas in NAFO Subdivision 5Ze.

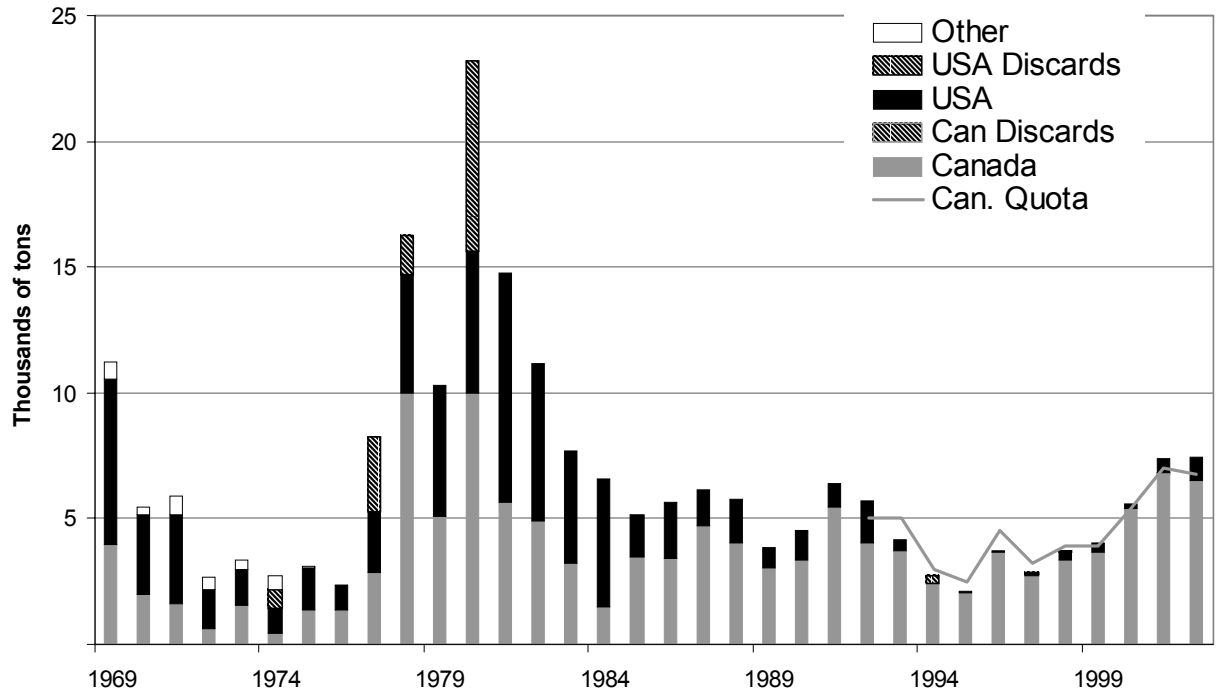


Figure 2. Nominal catch of haddock in unit areas 5Zjm.

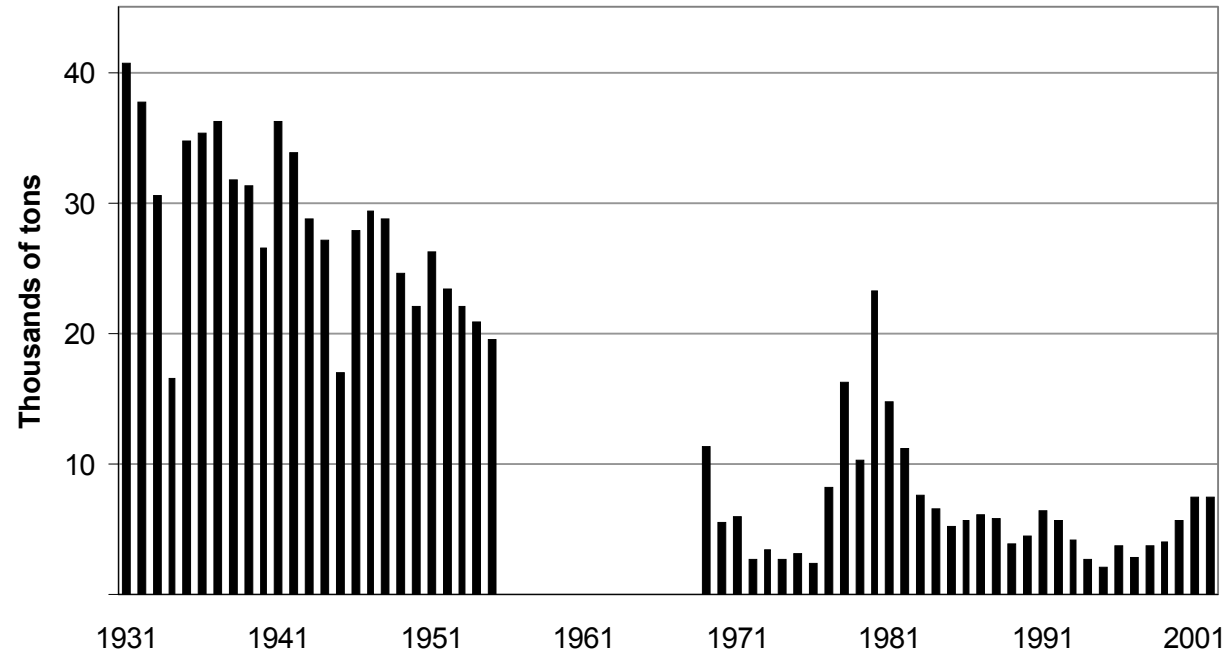


Figure 3. Historical catch of haddock in 5Zjm compared to recent catches.

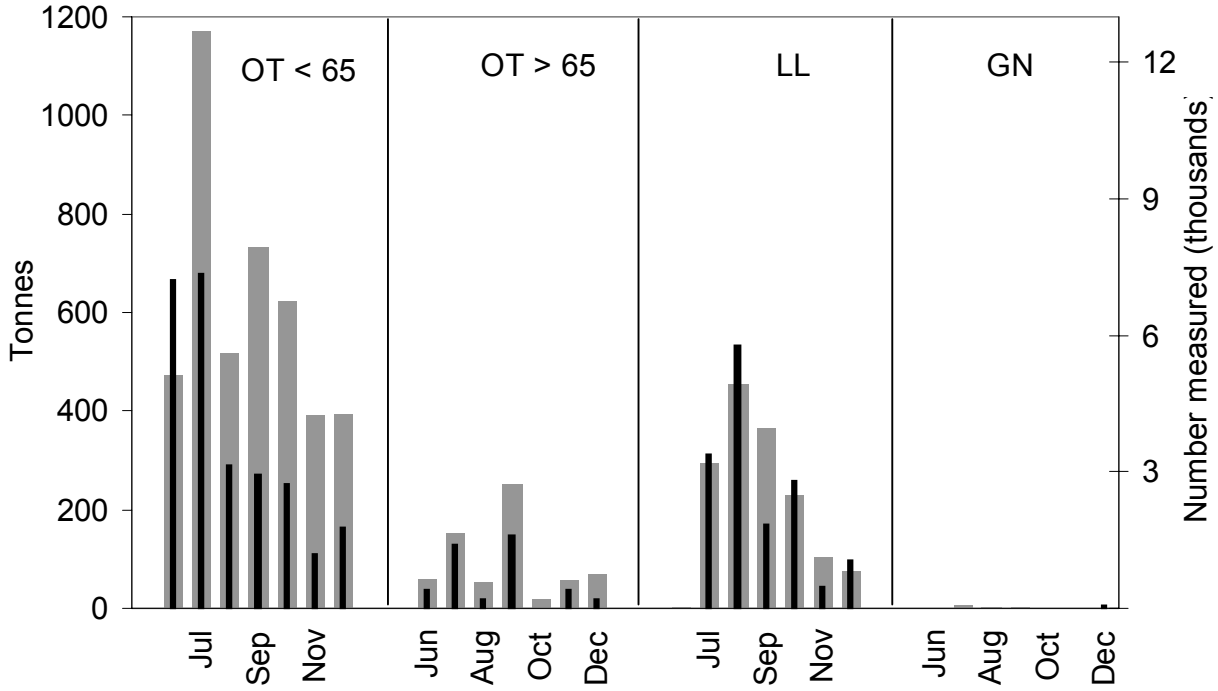


Figure 4. Haddock catches in 5Zjm by month and gear for the Canadian commercial fishery in 2002 (wide gray bars) with sampling levels (narrow black bars).

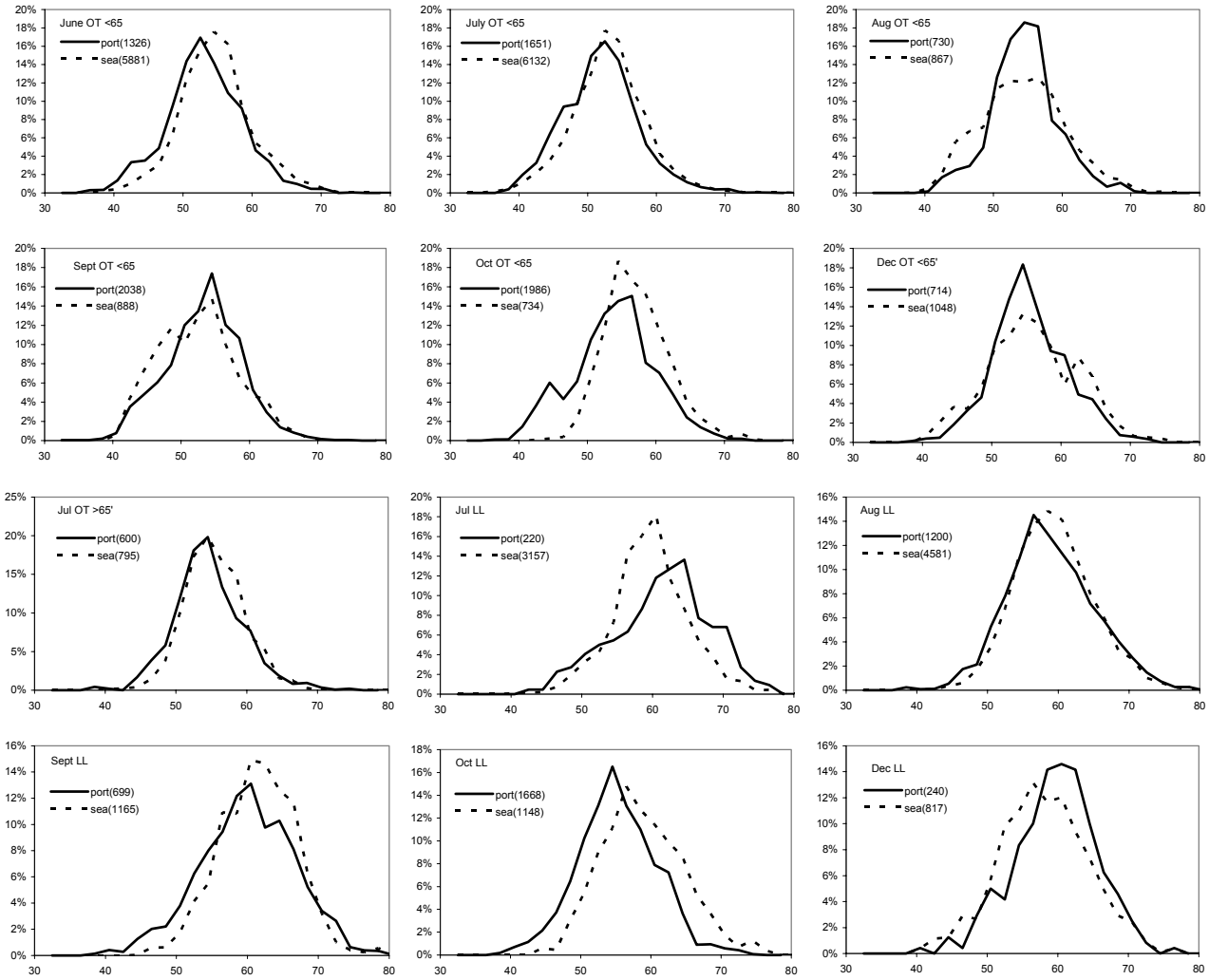


Figure 5. Comparison of length frequencies obtained at port and at sea from the Georges Bank commerical fishery in 2002. The number of fish measured is shown in brackets.

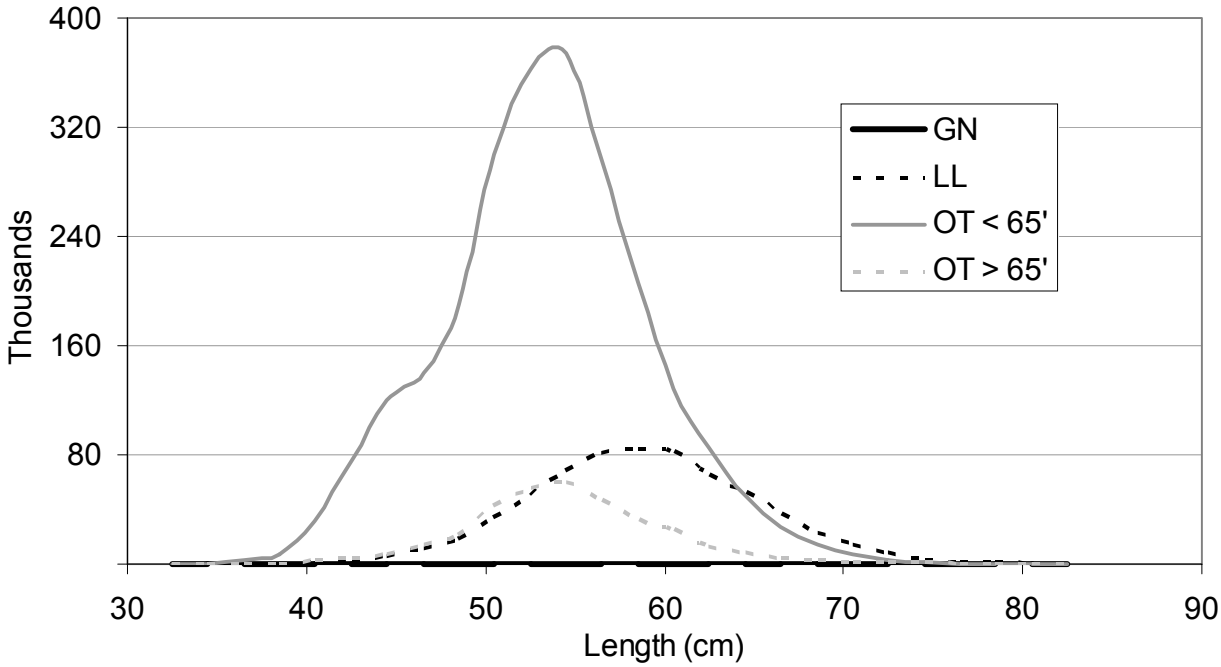


Figure 6. Catch at length by the principal Canadian 5Zjm commercial haddock fisheries in 2002.

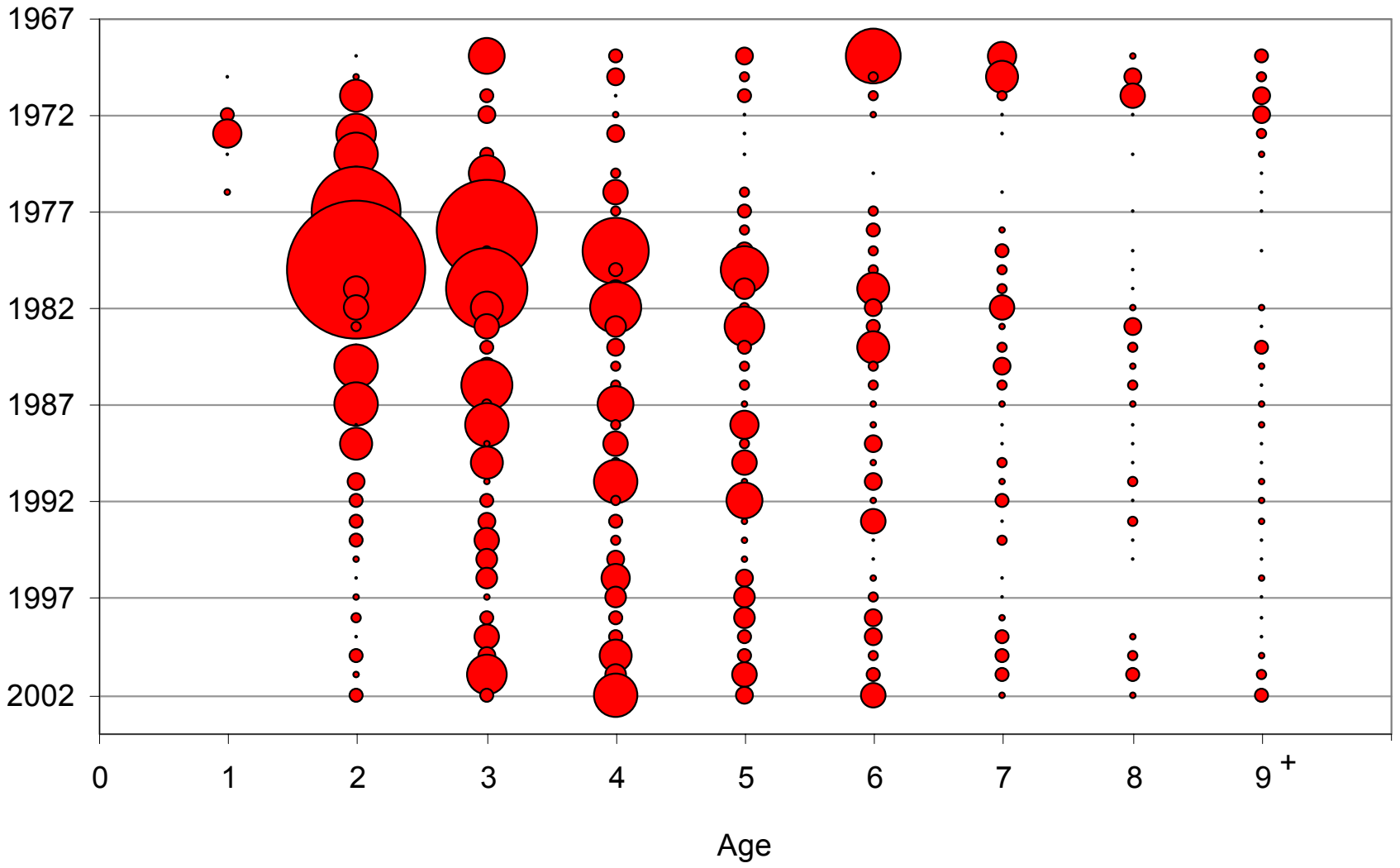


Figure 7. Total commercial catch at age (numbers) of haddock from unit areas 5Zjm. The bubble area is proportional to magnitude (see Table 9).

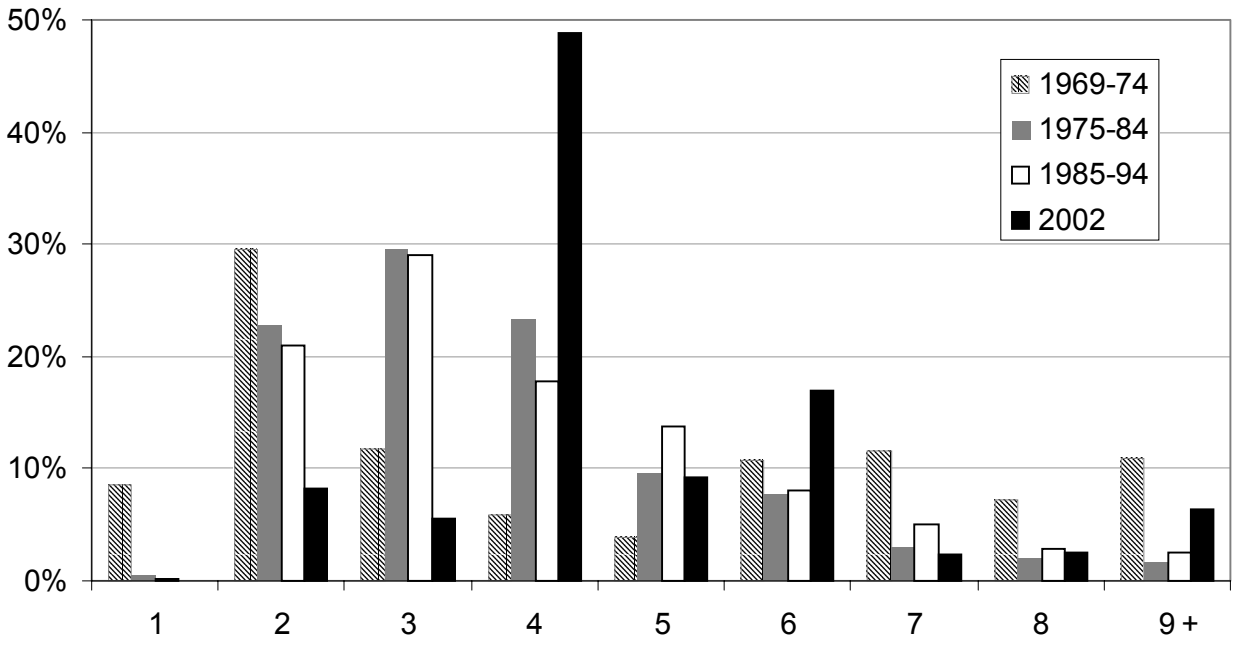


Figure 8. Age composition of the haddock catch for the Canadian 5Zjm commercial fishery in 2002 compared to the average age composition for the total catch of all fisheries during three earlier periods.

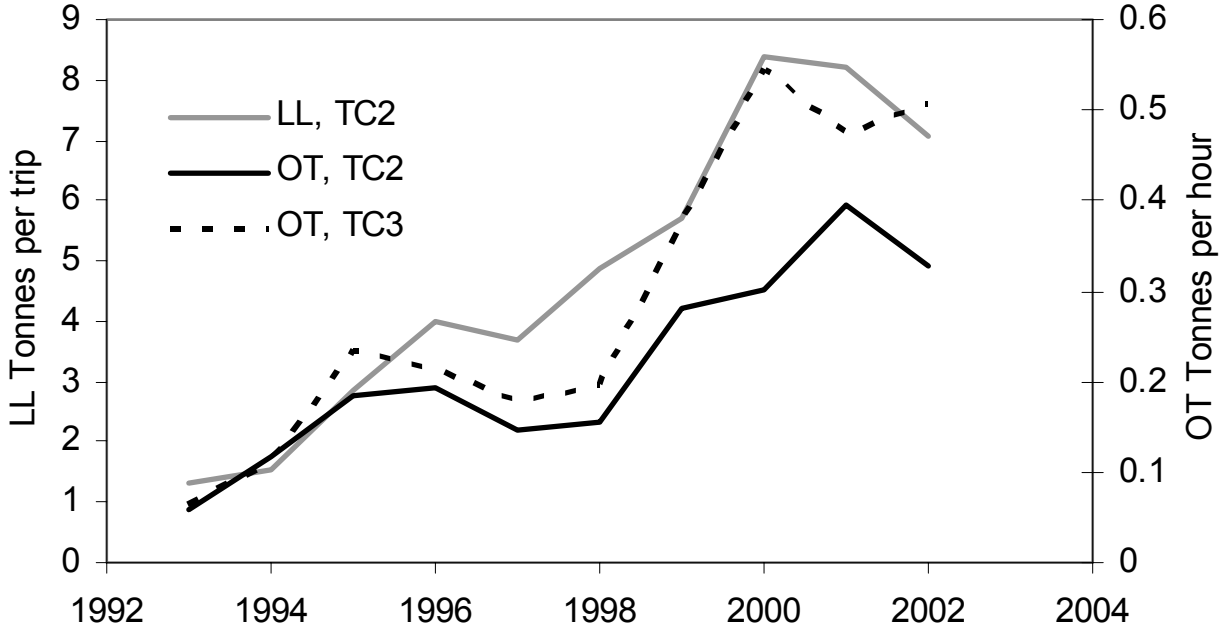


Figure 9. Catch rates for haddock from the Canadian commercial fishery in 5Zjm. (LL = longline, OT = otter trawl, TC = tonnage class).

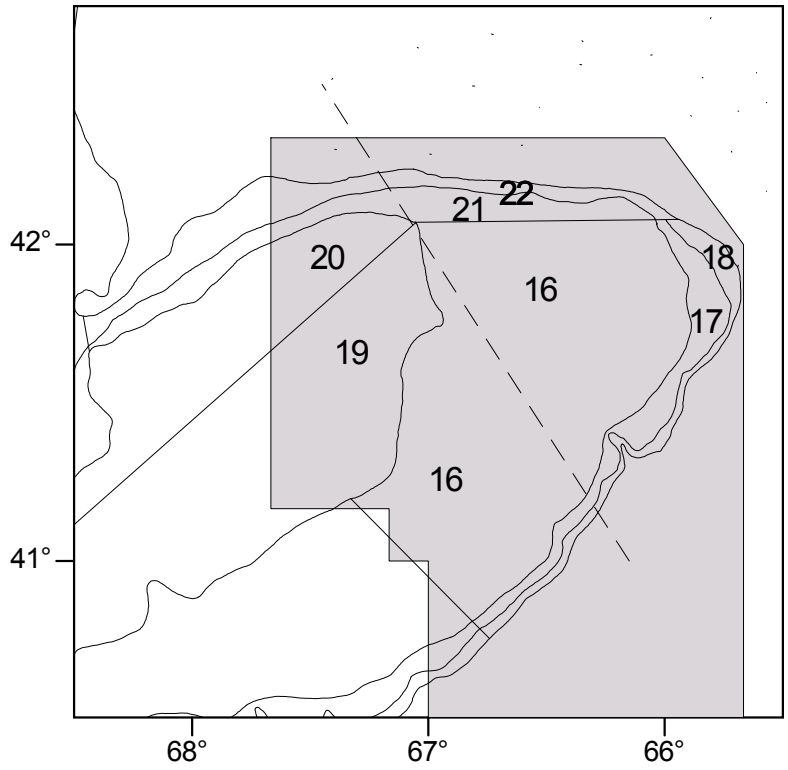


Figure 10. Stratification scheme used for NMFS surveys. The 5Zjm management area is indicated by shading.

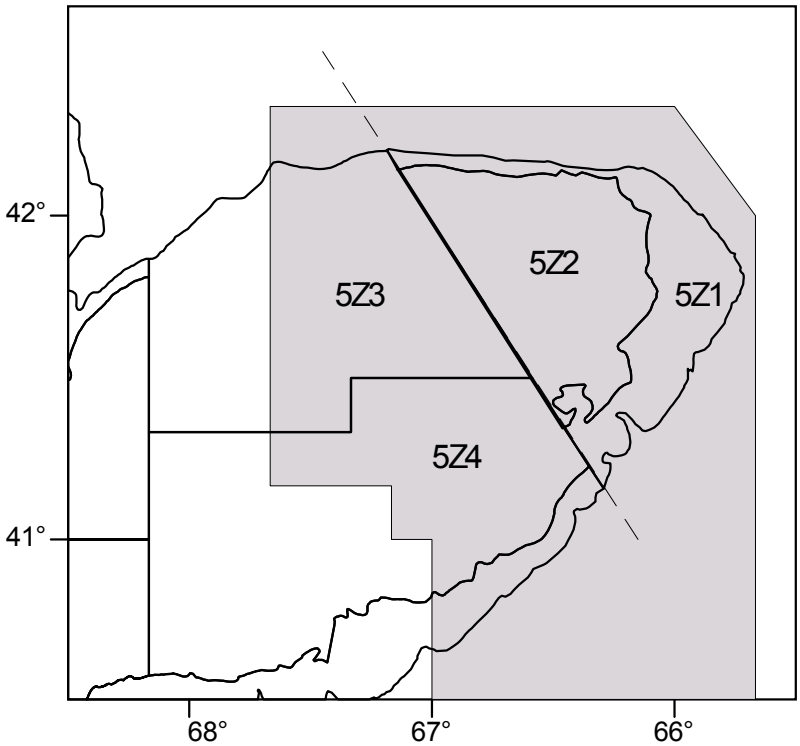


Figure 11. Stratification scheme used for the DFO survey. The 5Zjm management area is indicated by shading.

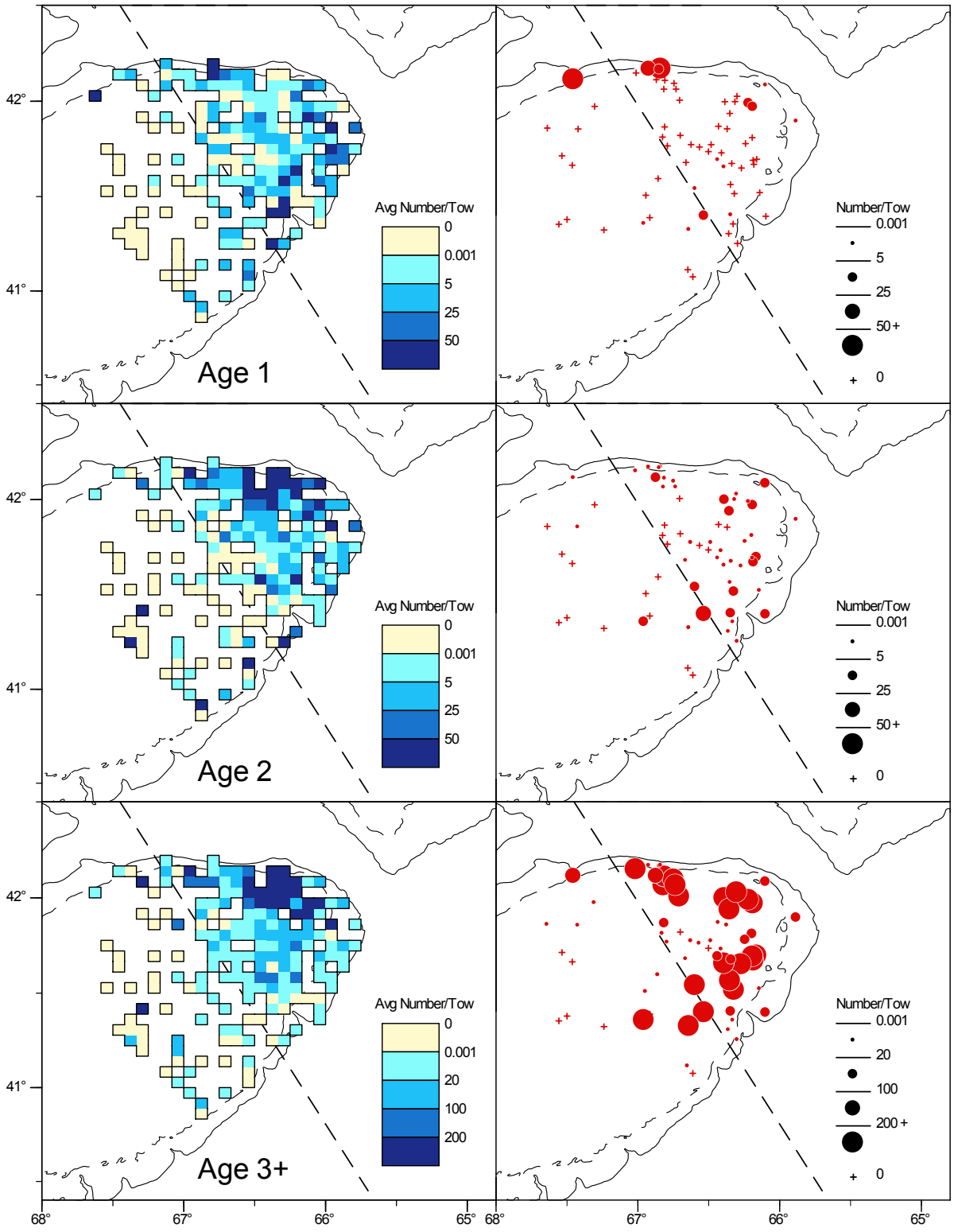


Figure 12. Distribution of 5Zjm haddock abundance (number/tow) as observed from the **DFO** survey. The squares (left panels) are shaded relative to the average catch for 1998 to 2002. The expanding symbols (right panels) represent the **2003** survey catches.

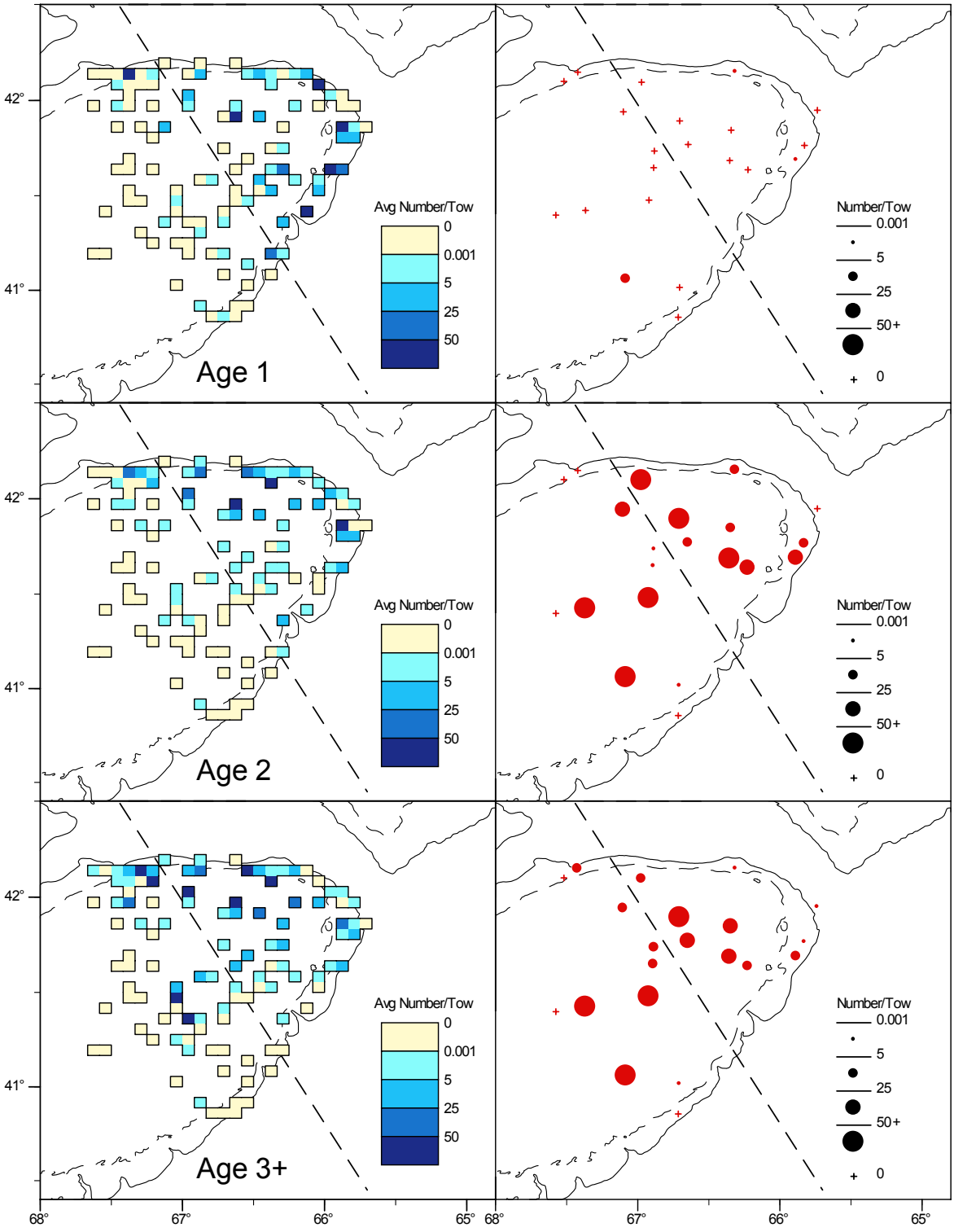


Figure 13. Distribution of 5Zjm haddock abundance (number/tow) as observed from the **NMFS spring** survey. The squares (left panels) are shaded relative to the average catch for 1997 to 2001. The expanding symbols (right panels) represent the **2002** survey catches.

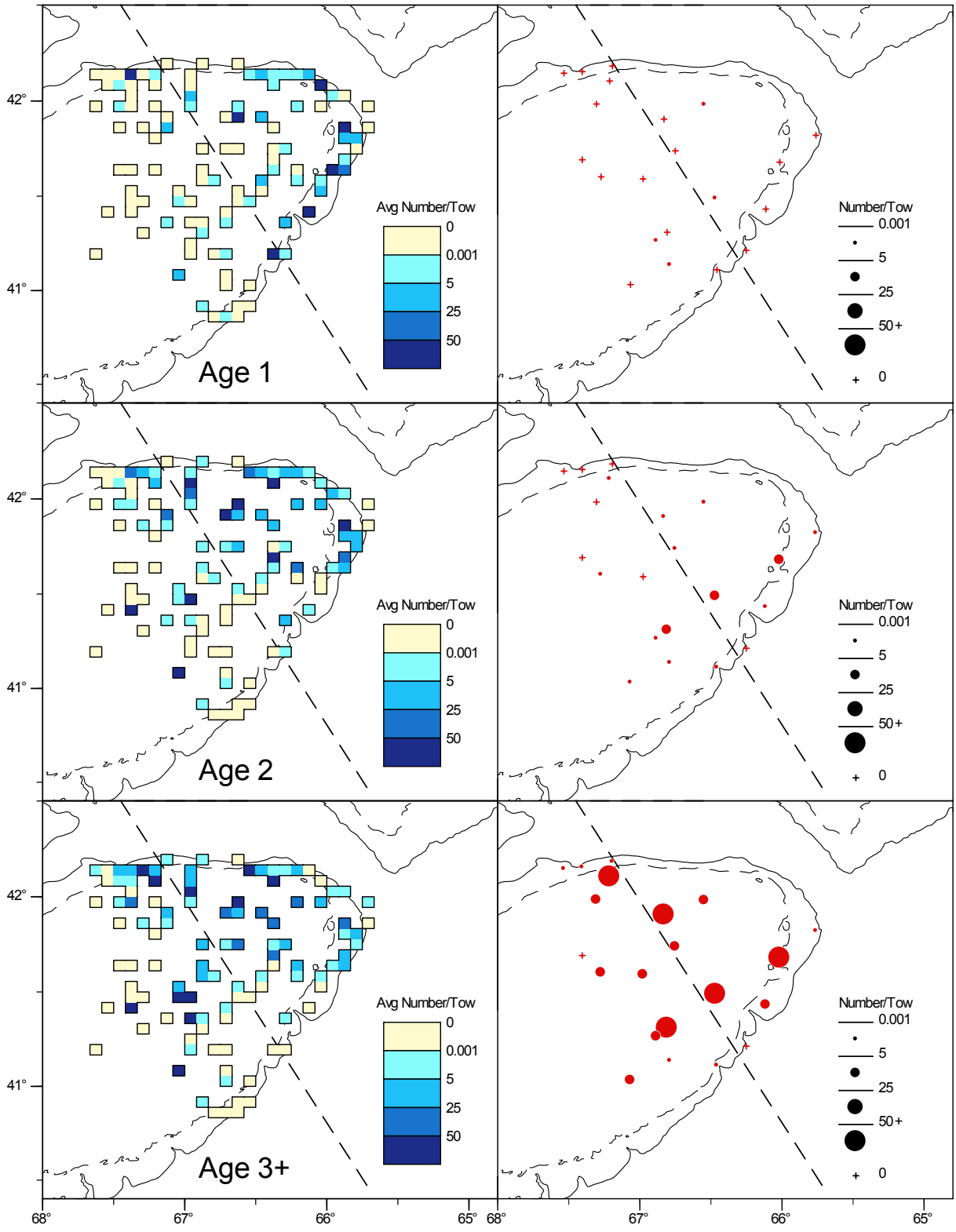


Figure 14. Distribution of 5Zjm haddock abundance (number/tow) as observed from the **NMFS spring** survey. The squares (left panels) are shaded relative to the average catch for 1998 to 2002. The expanding symbols (right panels) represent the **2003** survey catches.

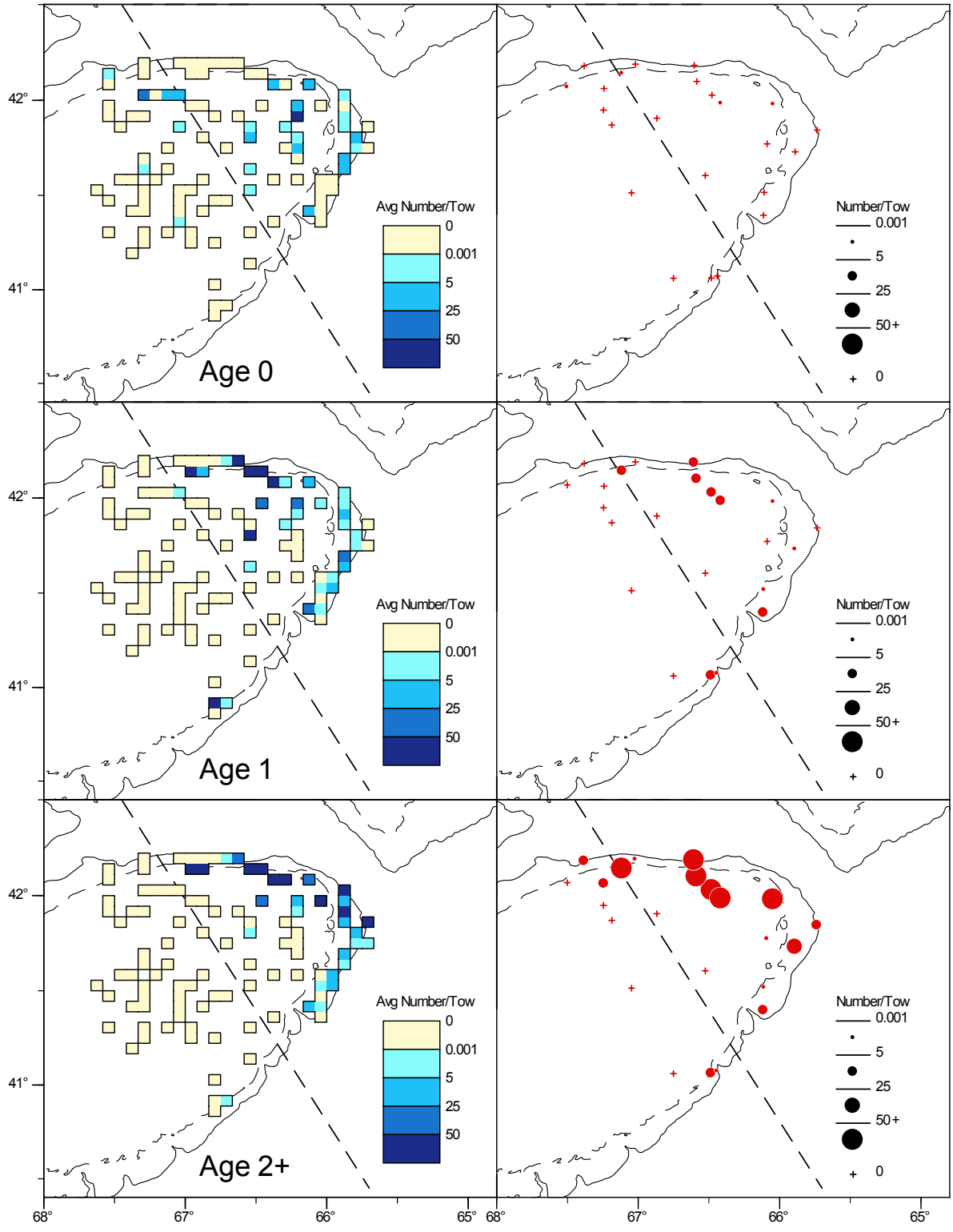


Figure 15. Distribution of 5Zjm haddock abundance (number/tow) as observed from the **NMFS fall** survey. The squares (left panels) are shaded relative to the average catch for 1997 to 2001. The expanding symbols (right panels) represent the **2002** survey catches.

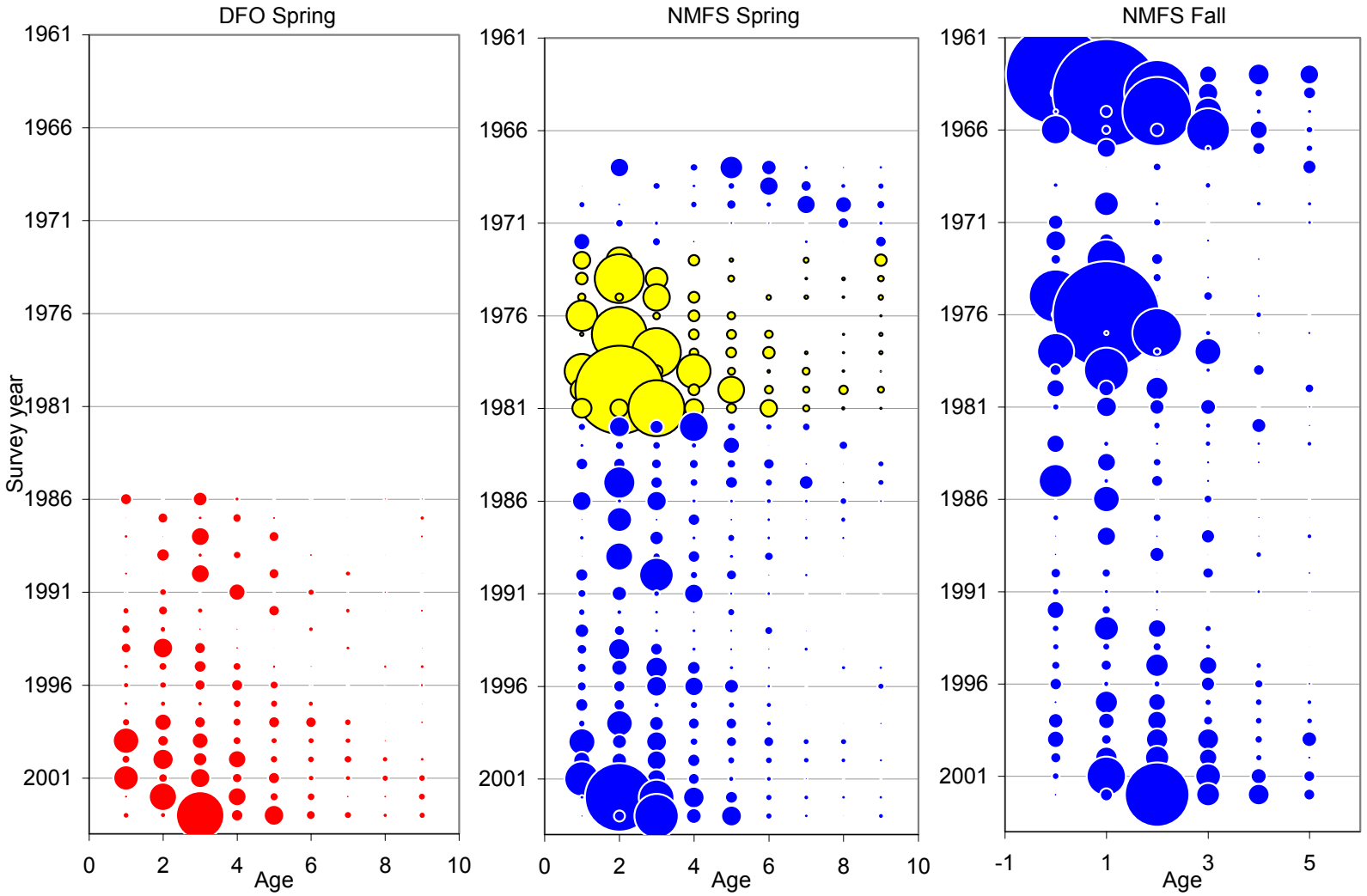


Figure 16. Estimated abundance at age (numbers in 000's) of haddock for the DFO and NMFS spring surveys and the NMFS fall survey. Bubble area is proportional to magnitude (see Tables 12-14). Conversion factors to adjust for changes in door type and survey vessel were applied to the NMFS surveys. From 1973-81 (pale circles), a 41 Yankee trawl was used for the NMFS spring survey while a 36 Yankee was used in the other years. Symbol size has not been adjusted between surveys for the catchability of the survey.

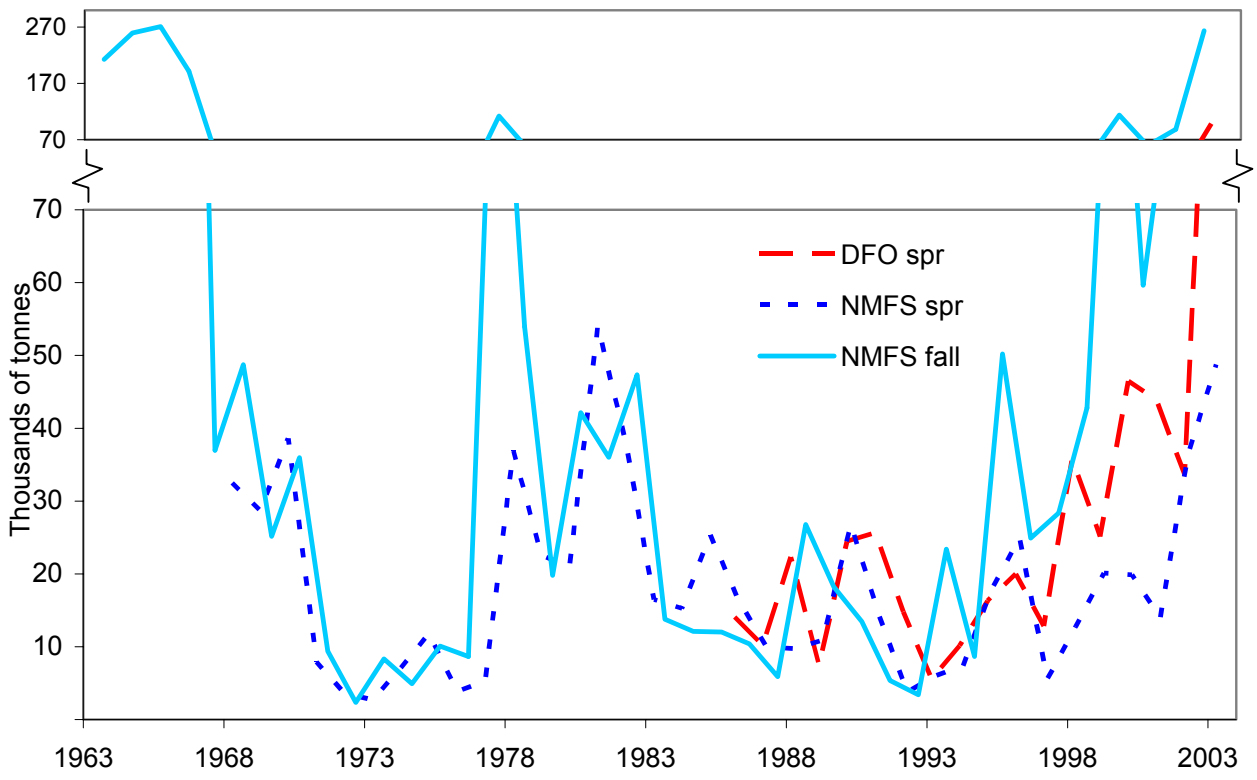


Figure 17. Biomass from NMFS fall (ages 2-8), NMFS spring (ages 3-8) and DFO (ages 3-8) research surveys (scaled by calibration constants, Table 16) for haddock in unit areas 5Zjm..

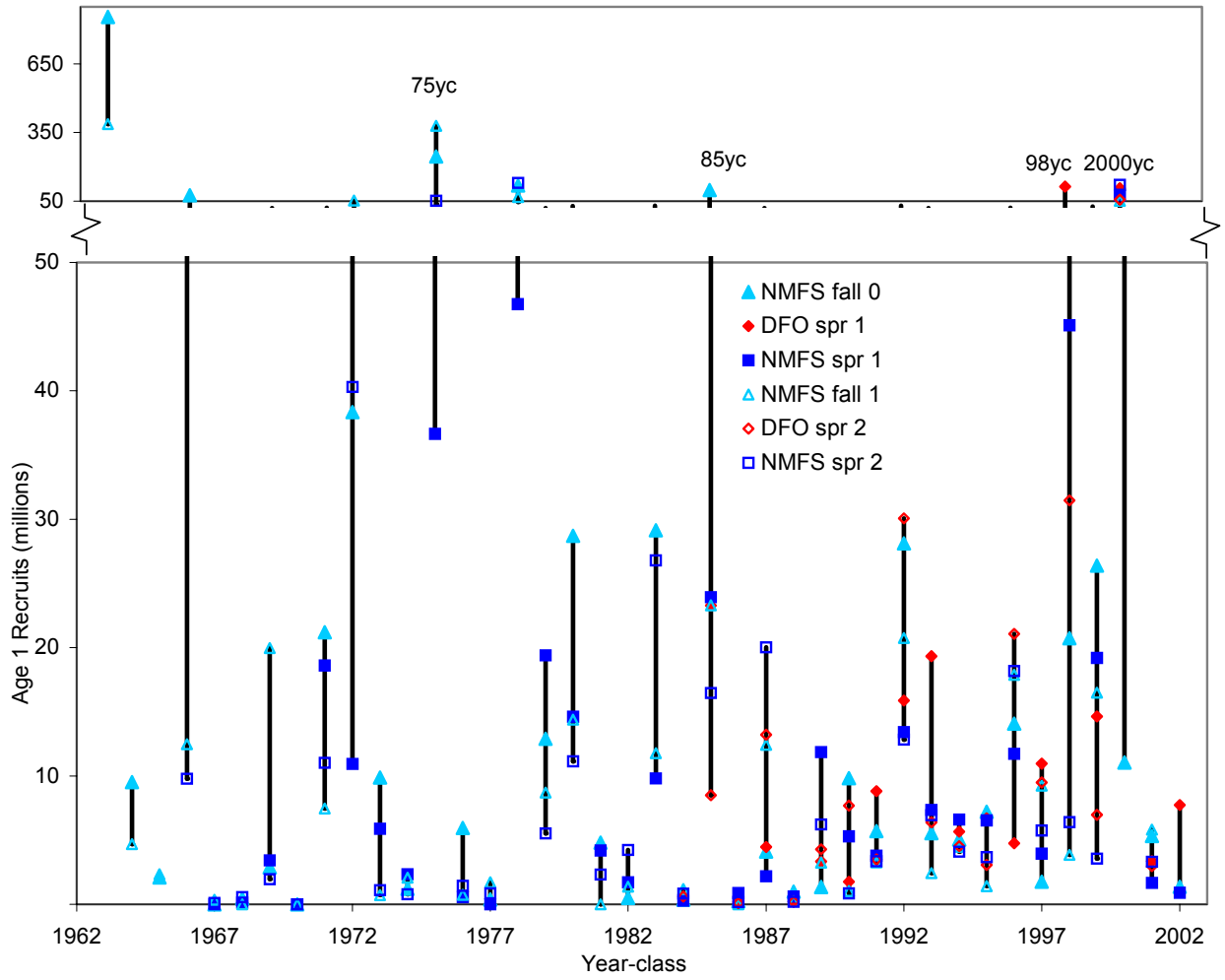


Figure 18. Year-class abundance for ages 0 and 1 from the NMFS fall and ages 1 and 2 from the NMFS and DFO spring research surveys (scaled by calibration constants, Table 16) for haddock in unit areas 5Zjm.

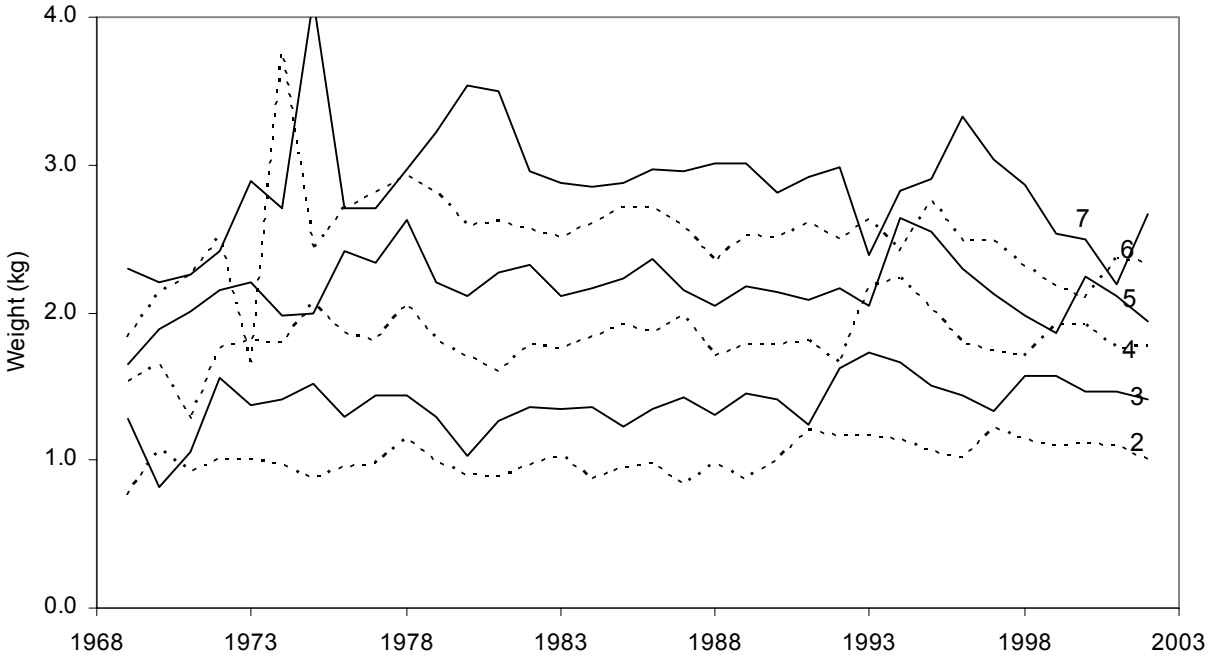


Figure 19. Weight at age for haddock in unit areas 5Zjm derived from the commercial fisheries.


Figure 20. Weight at age for haddock in unit areas 5Zjm derived from the DFO spring surveys.

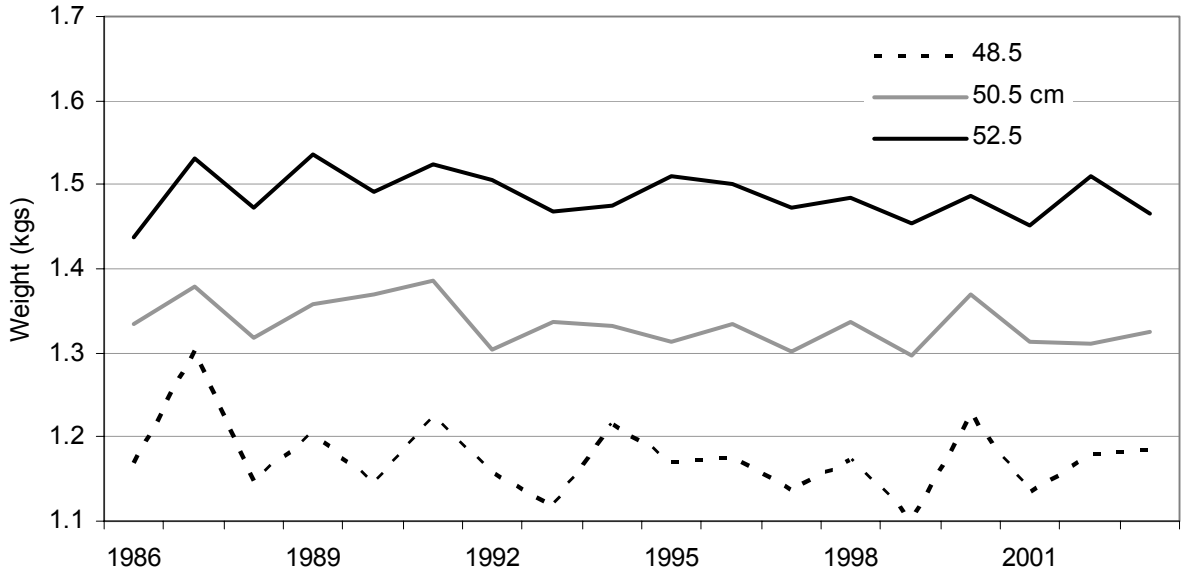


Figure 21. Weights at lengths for haddock in 5Zjm for 3 adjacent 2cm length groupings indicate that there are no alarming trends in condition.

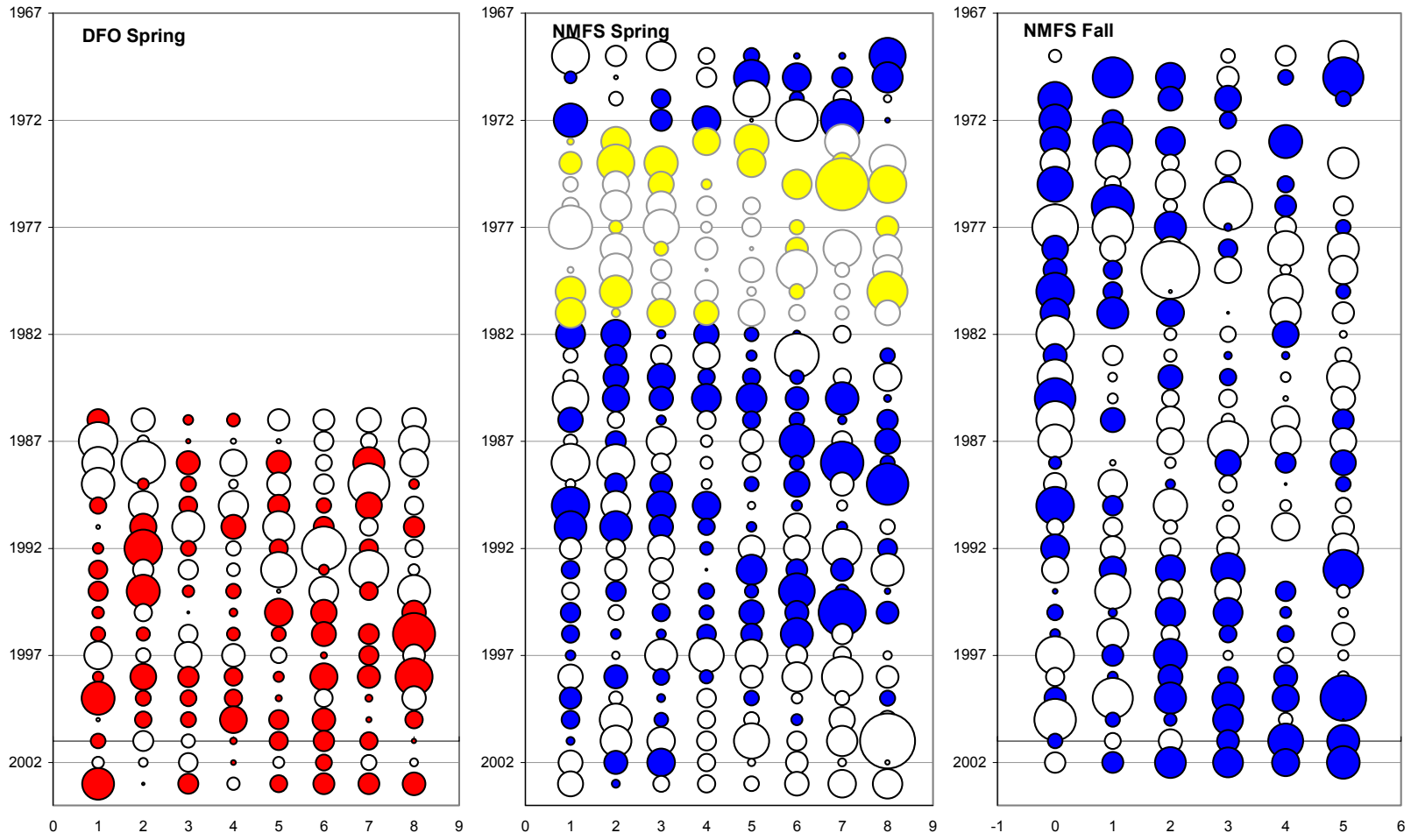


Figure 22. Residuals by year and age group for each research survey index. Solid symbols indicate positive values, open symbols indicate negative values. Bubble area is proportional to magnitude. From 1973-81 (pale circles), a 41 Yankee trawl was used for the NMFS spring survey while a 36 Yankee was used in the other years.

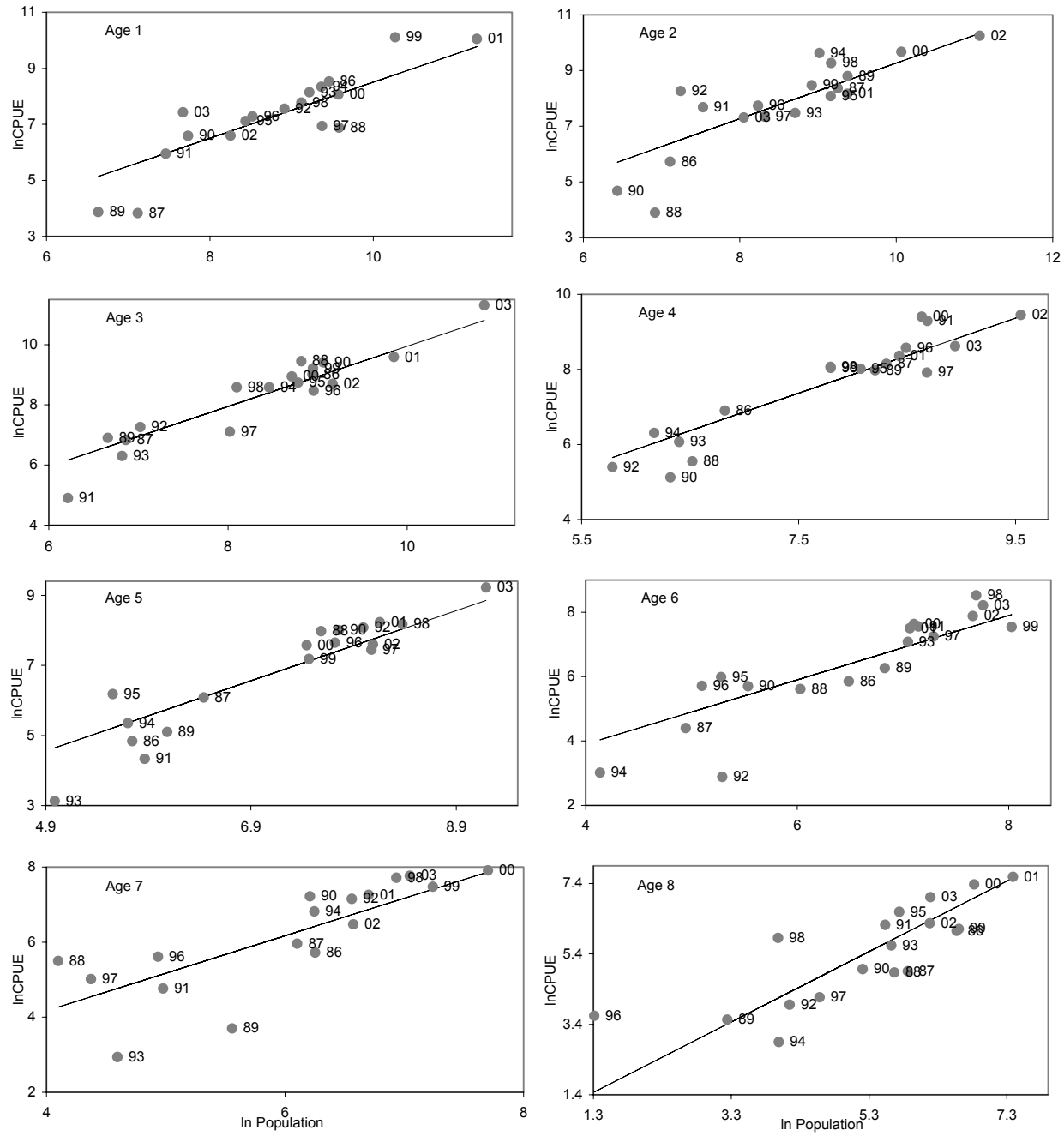


Figure 23. Age by age plots of the observed and predicted ln abundance index versus ln population numbers for haddock in unit areas 5Zj and 5Zm from the **DFO** survey.

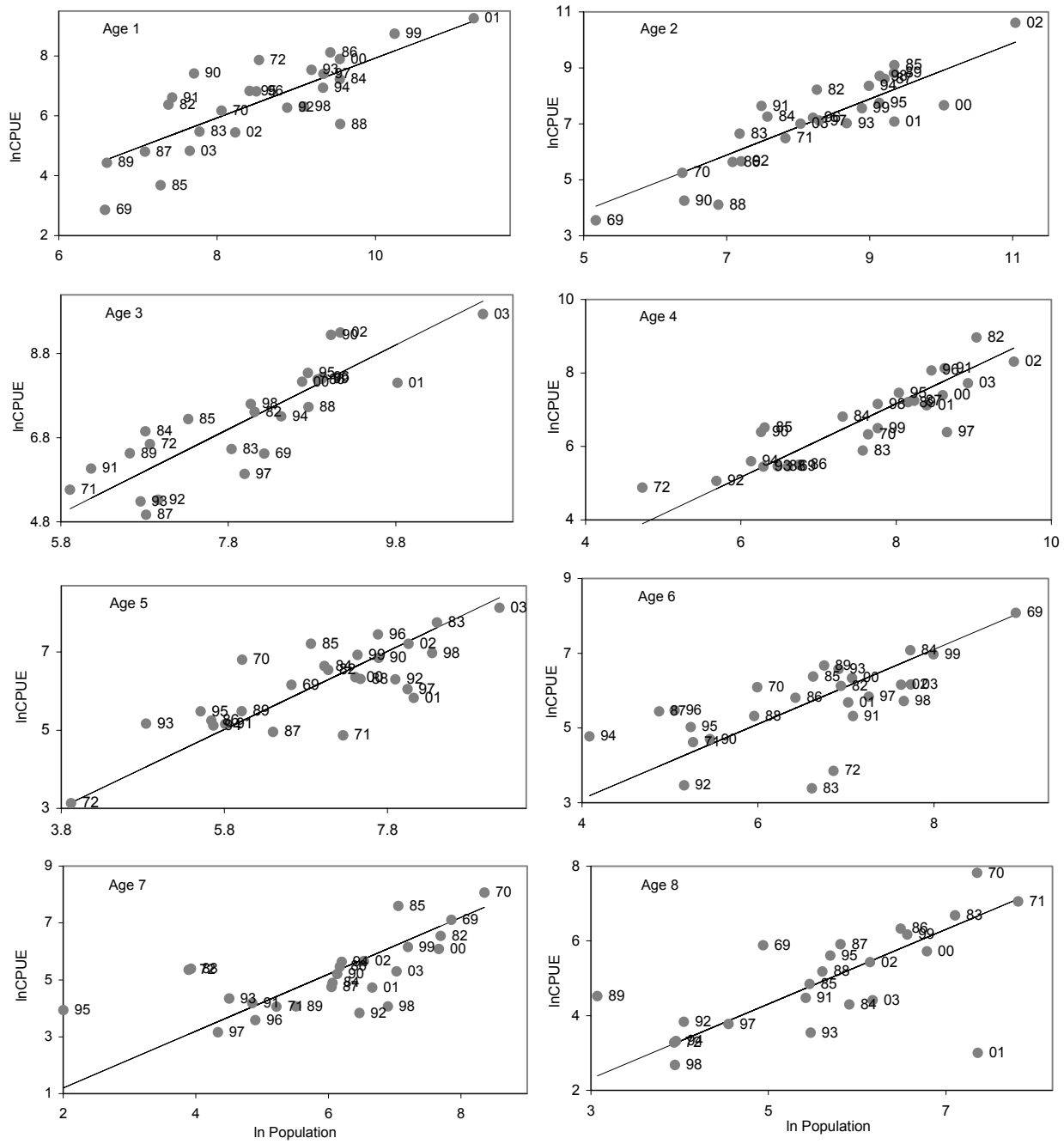


Figure 24. Age by age plots of the observed and predicted ln abundance index versus ln population numbers for haddock in unit areas 5Zj and 5Zm from the **NMFS spring** survey with a Yankee 36 net.

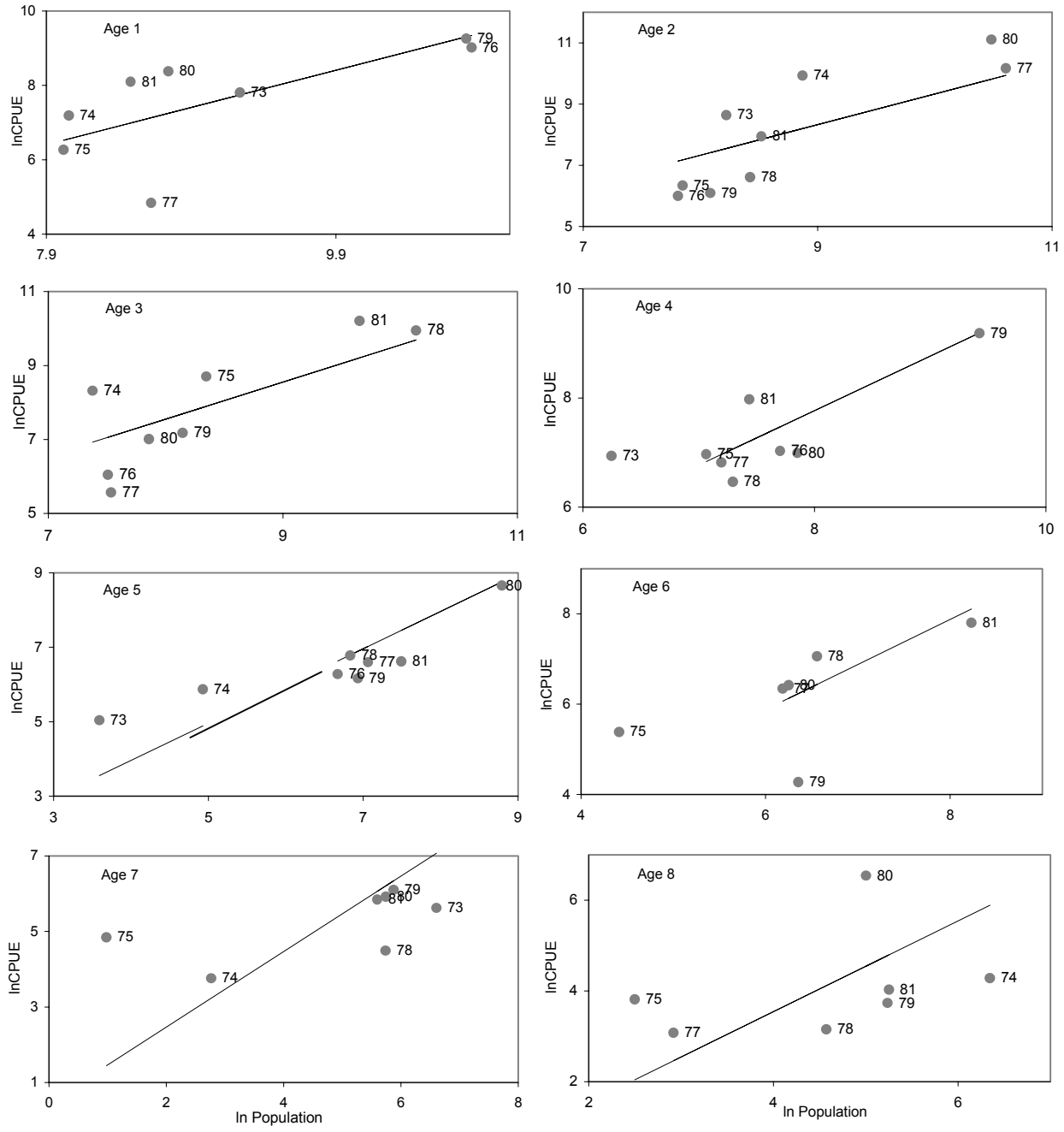


Figure 25. Age by age plots of the observed and predicted ln abundance index versus ln population numbers for haddock in unit areas 5Zj and 5Zm from the **NMFS spring** survey with a Yankee 41 net.

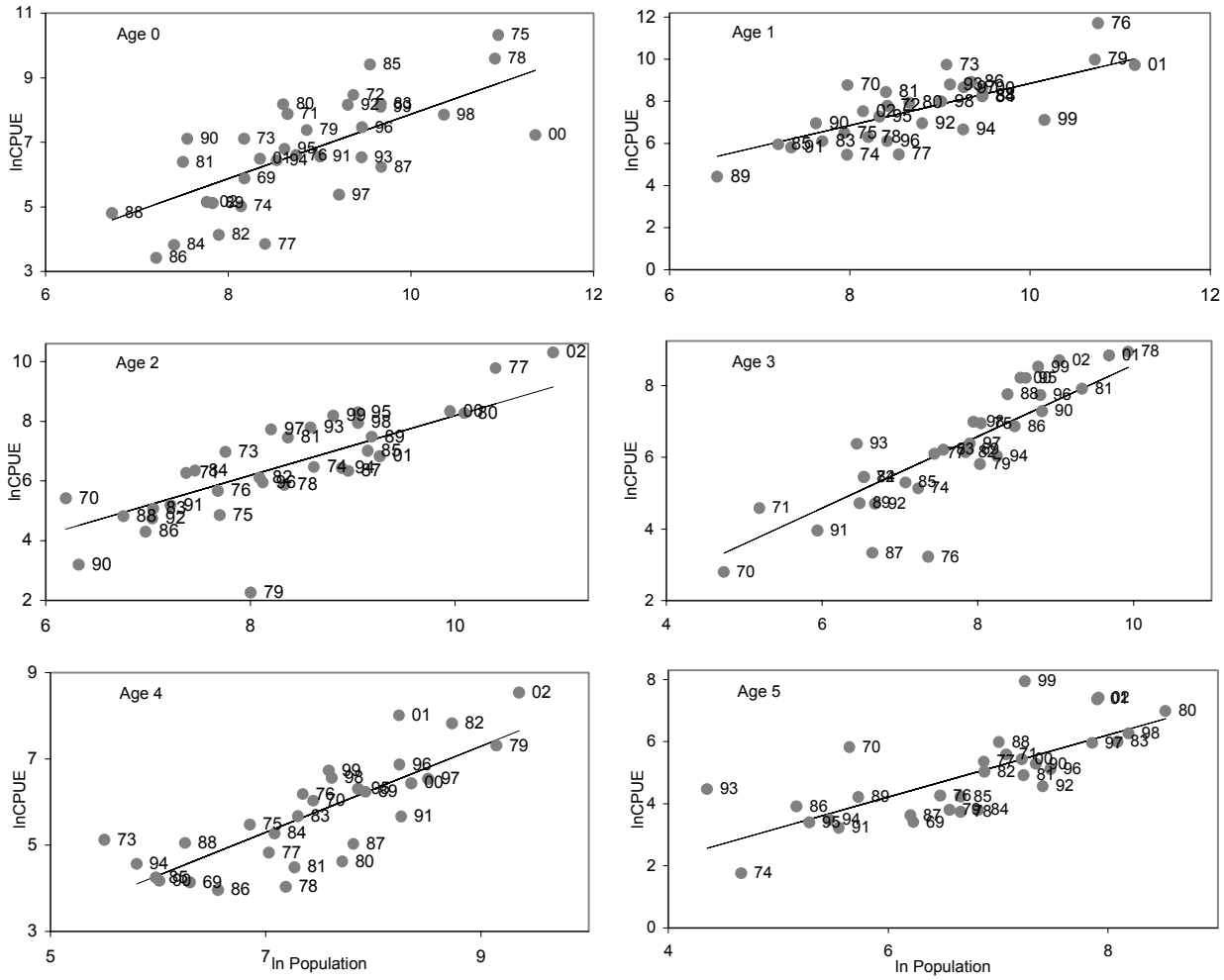


Figure 26. Age by age plots of the observed and predicted ln abundance index versus ln population numbers for haddock in unit areas 5Zj and 5Zm from the **NMFS fall** survey.

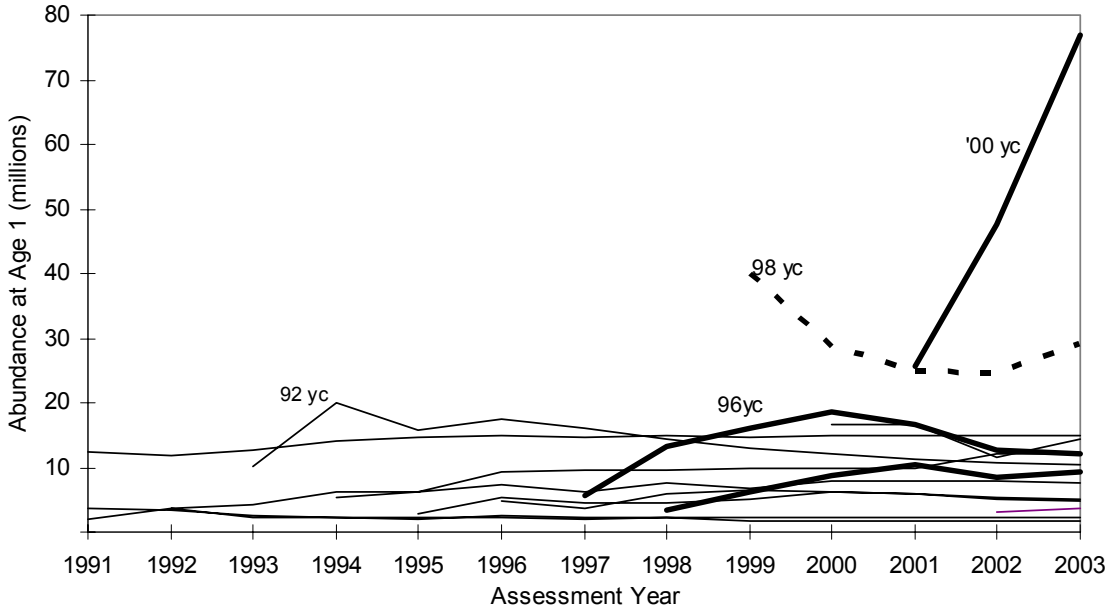


Figure 27. Successive estimates of 5Zjm haddock year-class abundance as additional years of data were included in the assessment did not display any persistent trends.

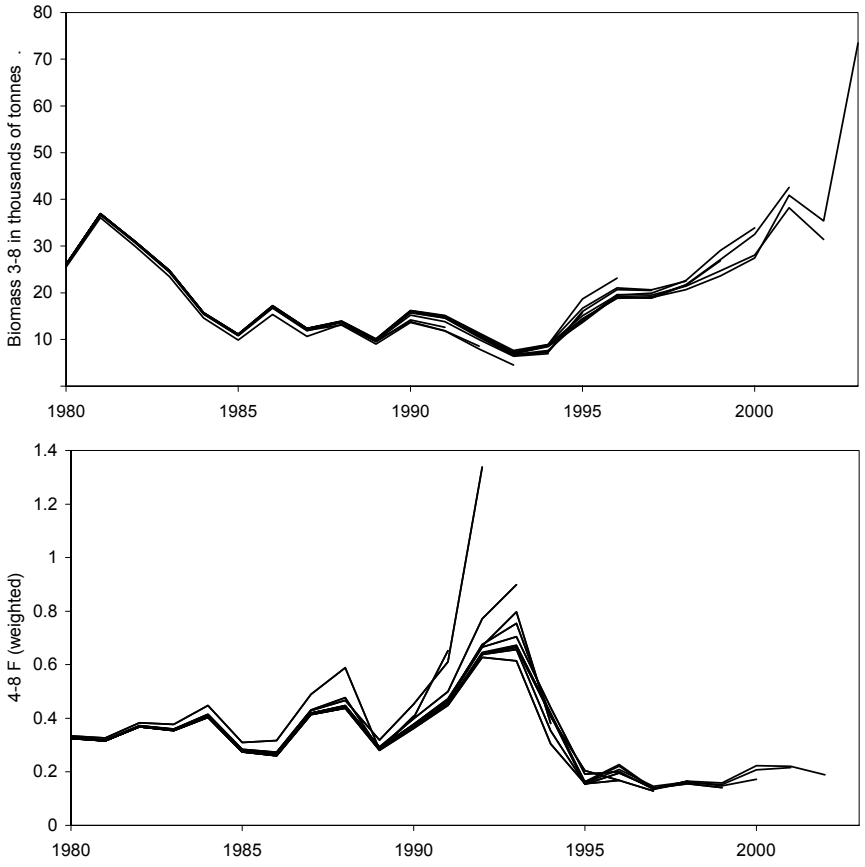


Figure 28. Retrospective estimates from VPA of 5Zjm haddock biomass and fishing mortality did not display any persistent trends for over or under estimation as successive years of data were excluded in the assessment.

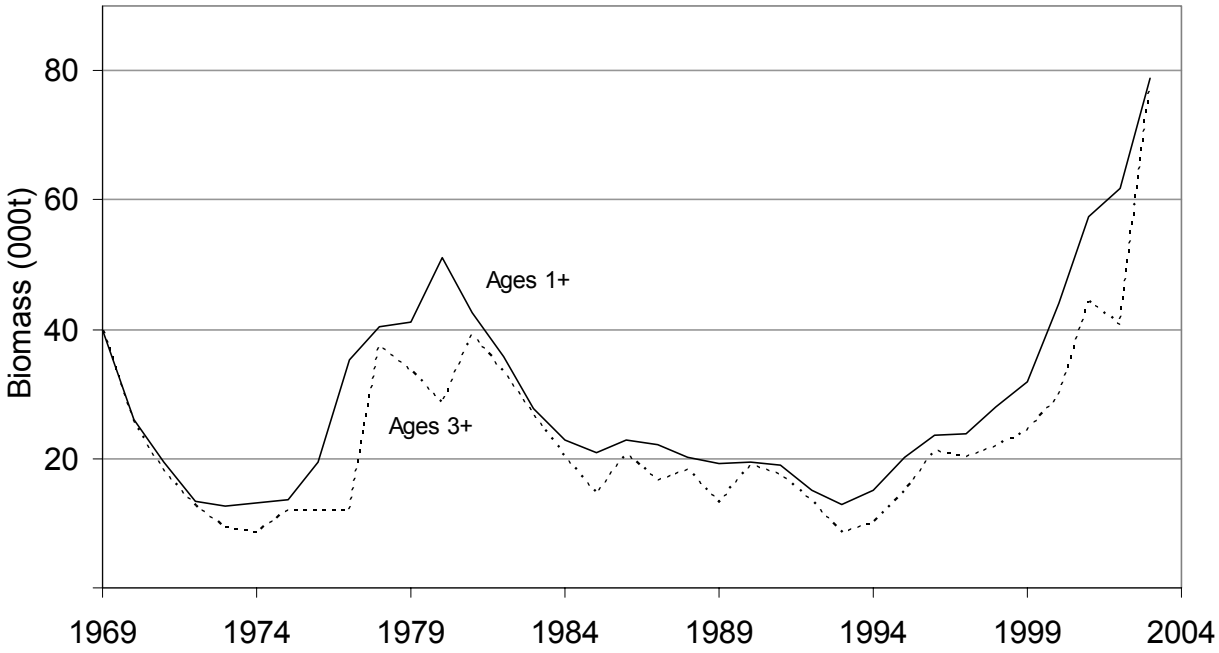


Figure 29. Beginning of year total (1+) and adult (3+) biomass for haddock in unit areas 5Zjm.

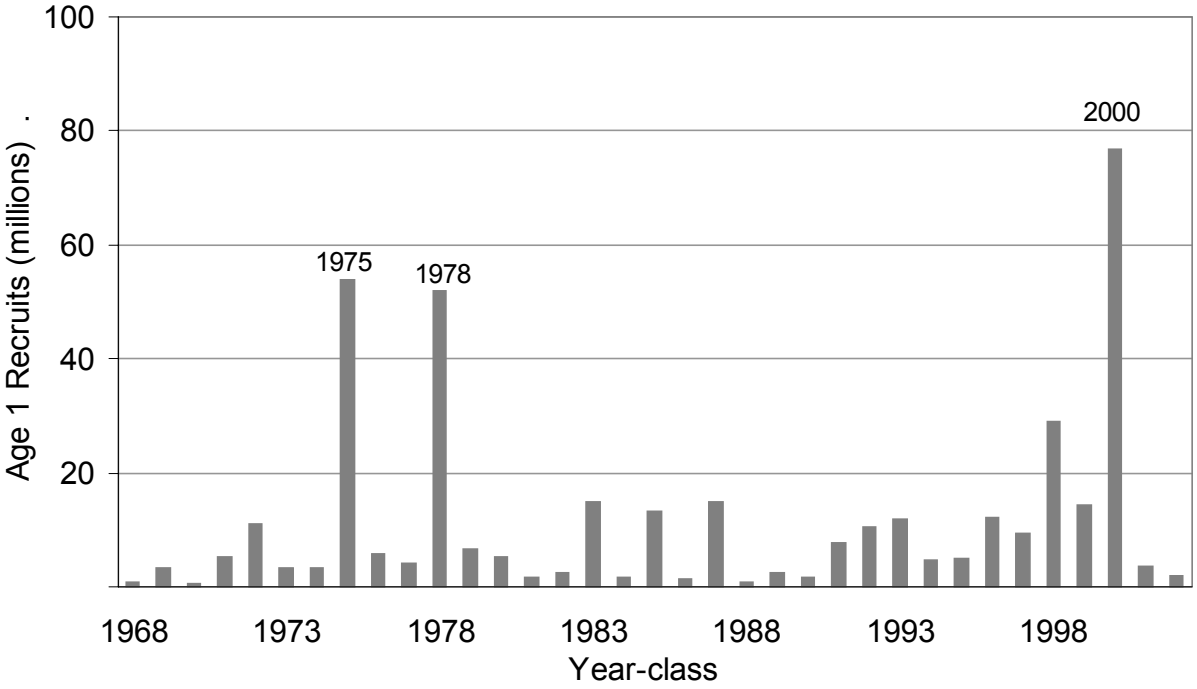


Figure 30. Number of age 1 recruits for haddock in unit areas 5Zjm.

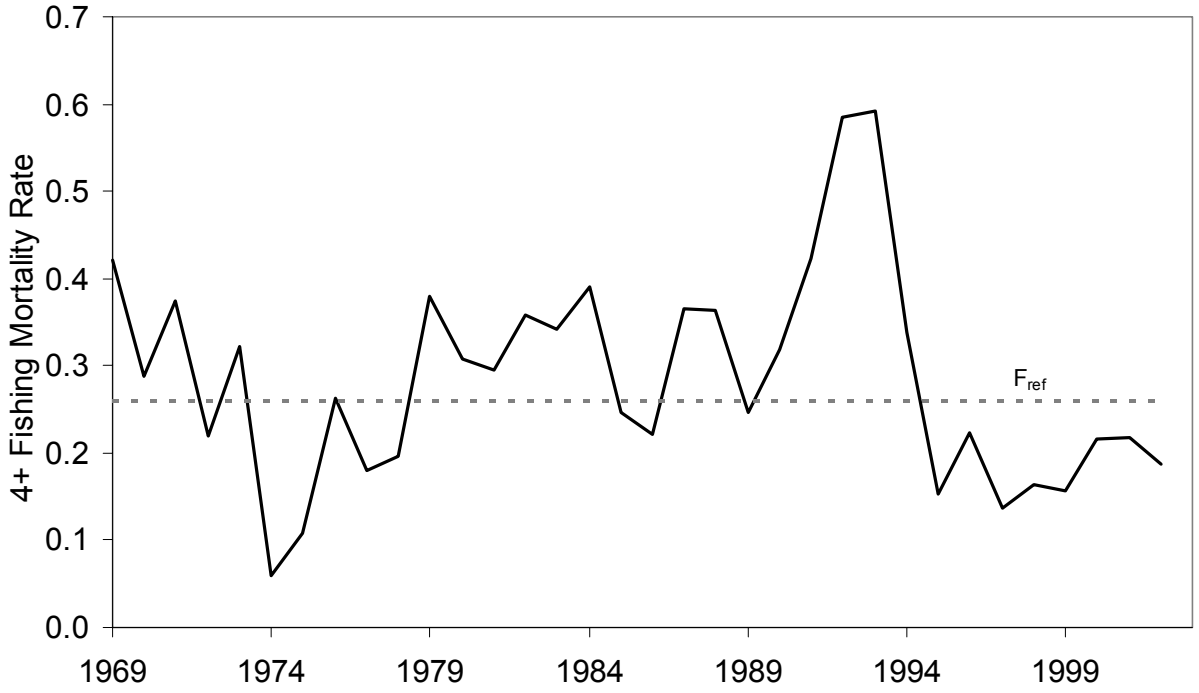


Figure 31. Fishing mortality rate for haddock ages 4+ in unit areas 5Zjm and the fishing mortality threshold reference established at $F_{ref} = 0.26$.

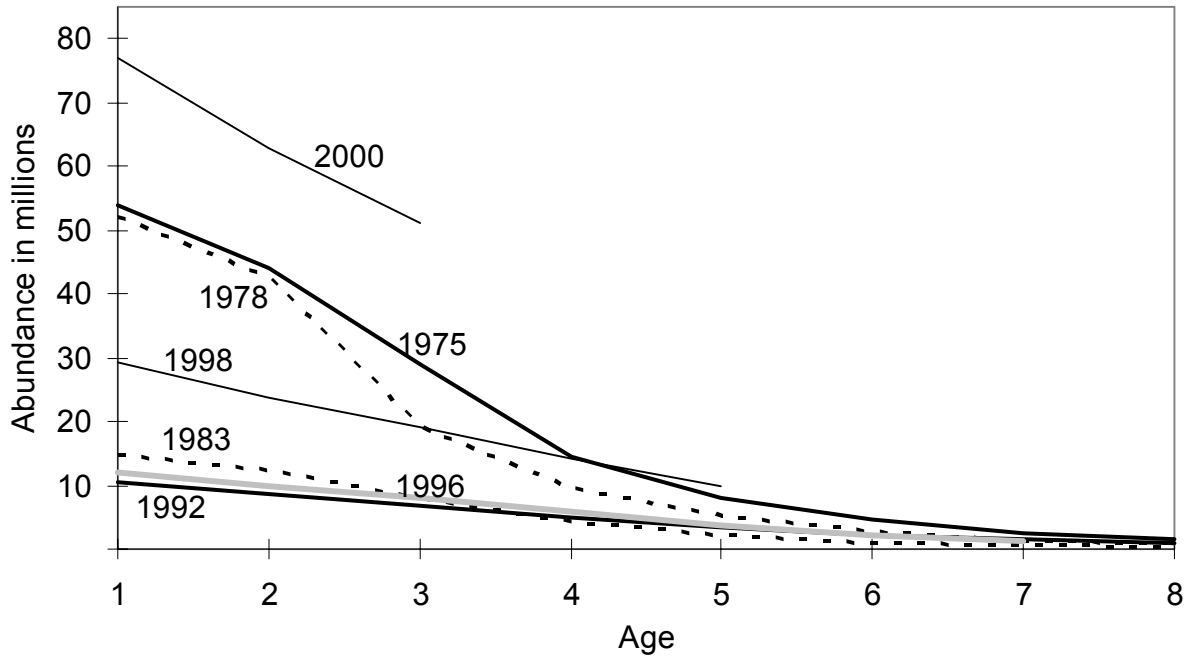


Figure 32. Decay of selected year-classes of the 5Zjm haddock population.

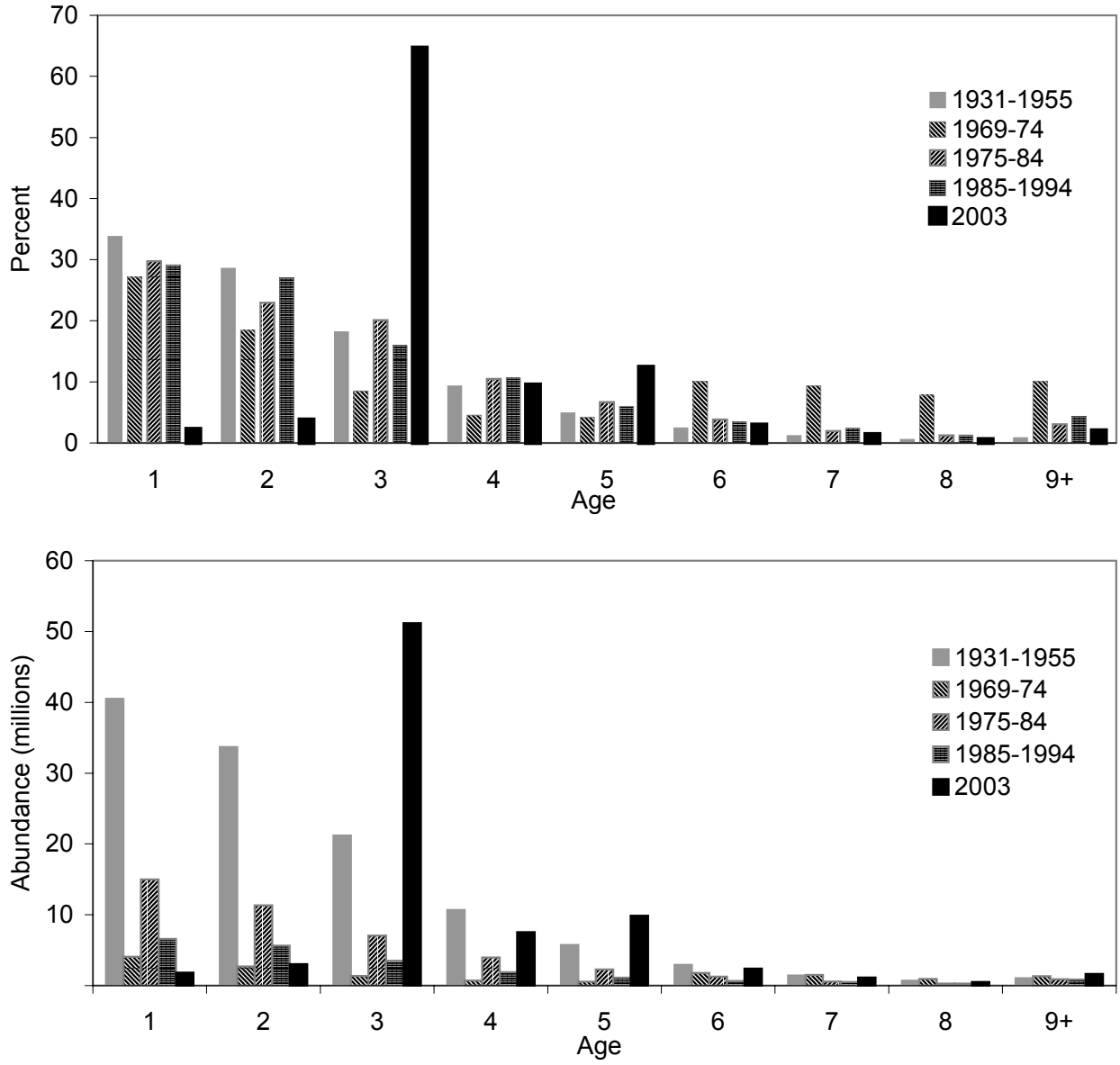


Figure 33. The age composition and absolute abundance at age of the 5Zjm haddock population in 2003 compared to earlier periods.

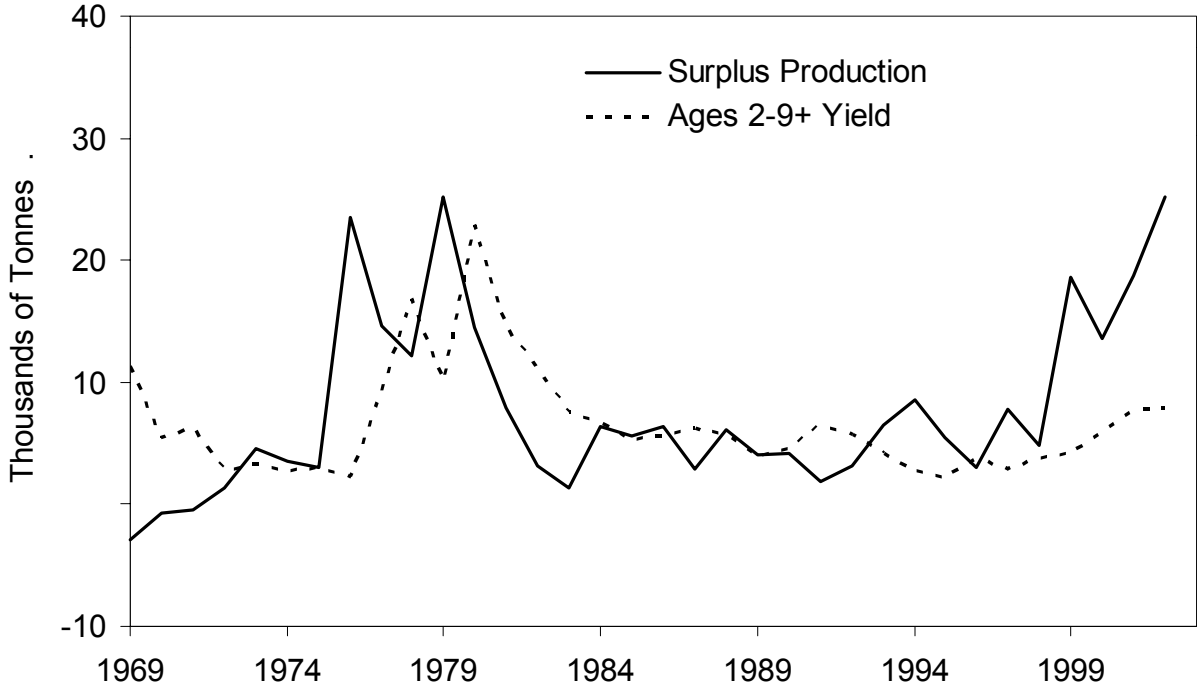


Figure 34. Surplus production of 5Zjm haddock available to the commercial fishery compared to the harvested yield.

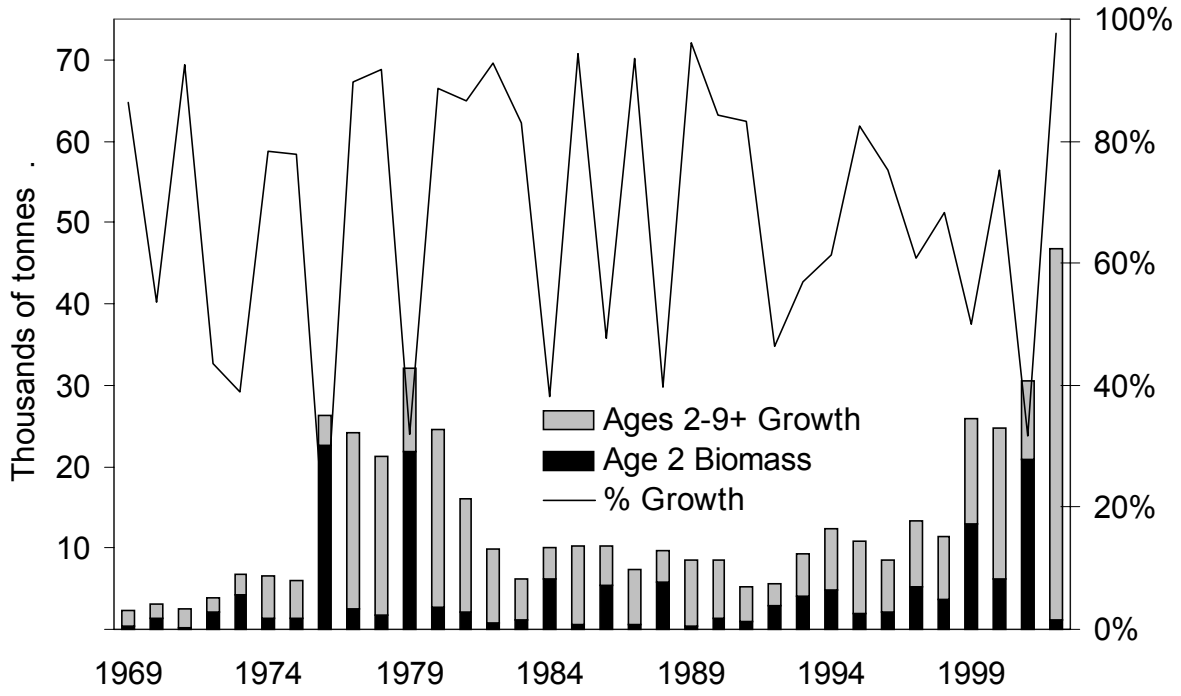


Figure 35. Amount of productivity attributible to growth (ages 2 to 9+) of 5Zjm haddock and the amount contributed by recruitment (age 2).

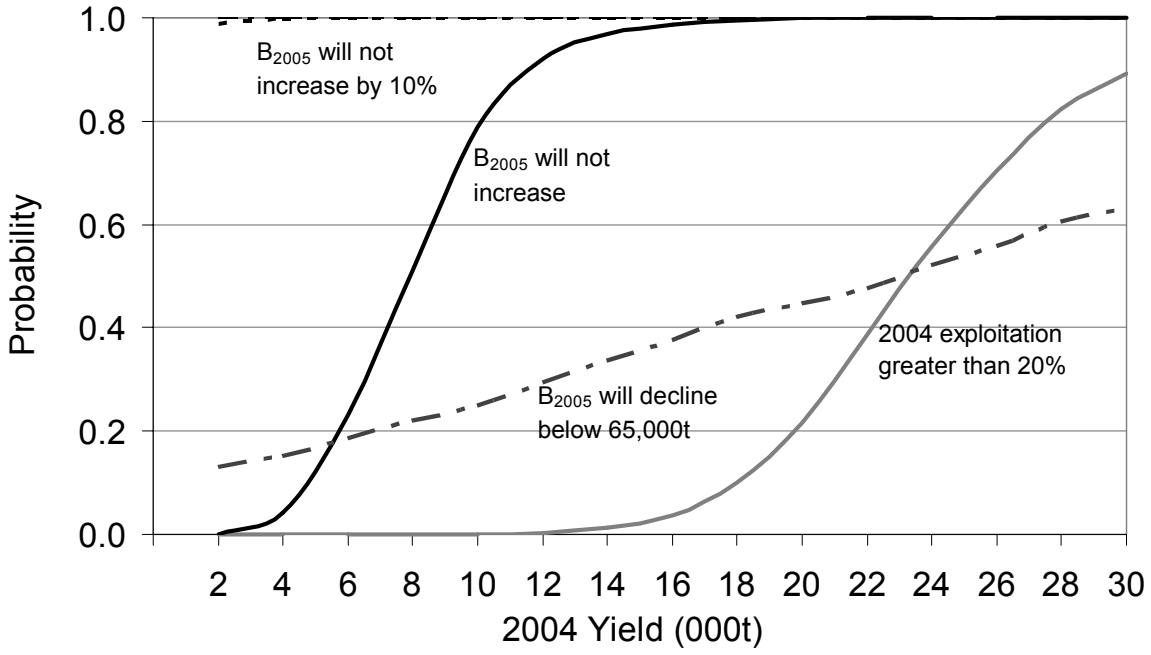


Figure 36. Probability of 2004 explopitation rate exceeding 20%, the $F_{0.1}$ reference level, and of the 2005 ages 3+ biomass being less than the 2004 biomass by 0%, 10% and 20% for 5Zjm haddock at various quotas.

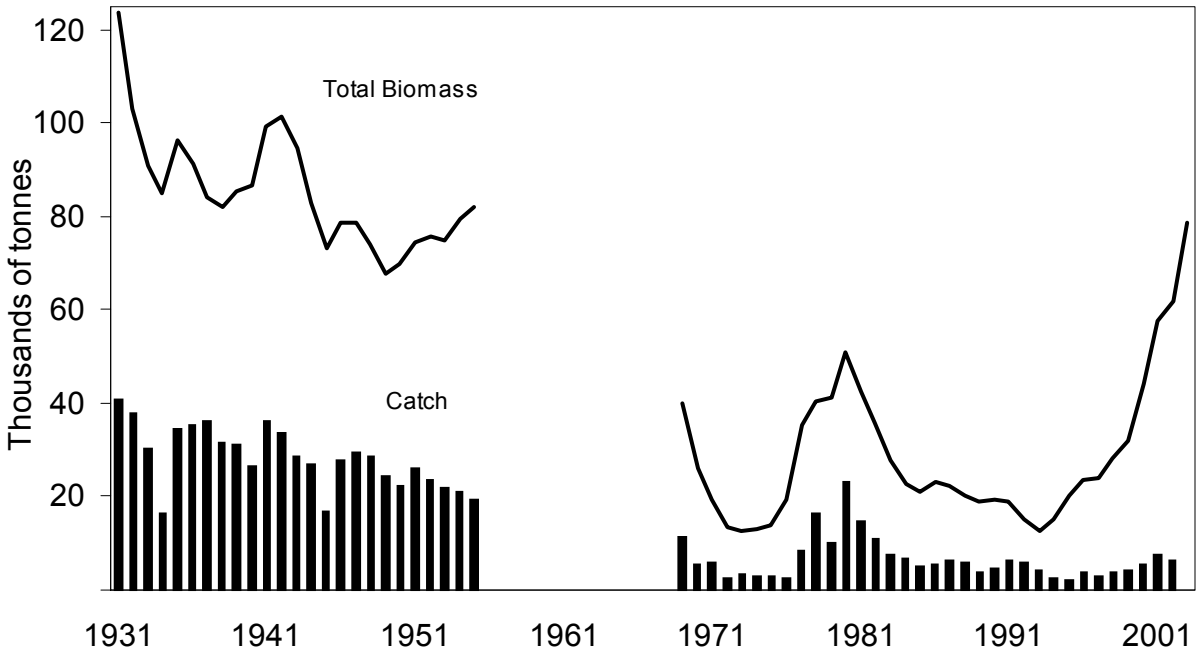


Figure 37. Historical catch and total biomass of haddock in 5Zjm compared to recent catches and biomass.

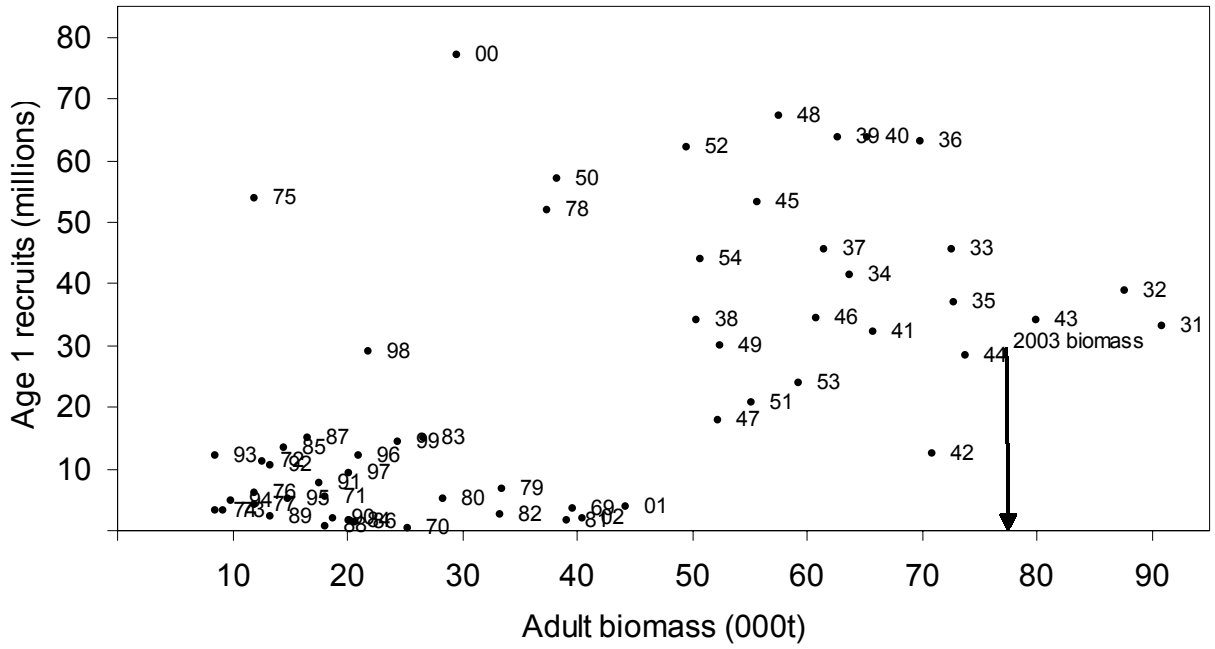


Figure 38. Relationship between adult (ages 3+) 5Zjm haddock biomass and recruits at age 1 from 1931 to 1955 and 1969 to 2001.

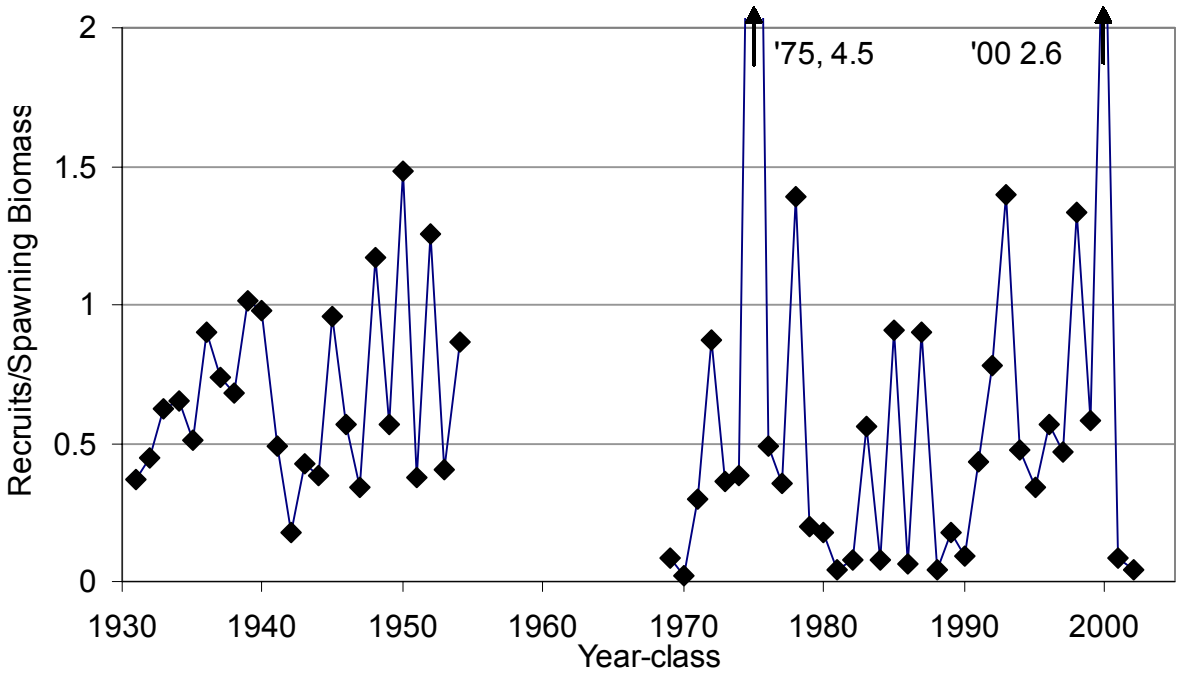


Figure 39. Ratio of recruits (numbers at age 1) to spawning biomass (kg) for 5Zjm haddock suggests that, except for 2001, present survivorship appears comparable to that of the 1930s to 1950s.

# Appendix A

Table A1. Intra-reader ageing agreement matrices for the DFO haddock ager, L. Van Eeckhaute (LVE), using haddock ageing material from the 2002 DFO spring survey and the 2000 Canadian fishery in 5Zjm.

DFO 2002 Georges Bank Spring Survey (NED2002002) Agreement = **96%**

| Test Age (LVE) | Production Age (LVE) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | Total |
| 1 | 15 | | | | | | | | | | | | 15 |
| 2 | | 20 | 1 | | | | | | | | | | 21 |
| 3 | | | 9 | | | | | | | | | | 9 |
| 4 | | | | 15 | | | | | | | | | 15 |
| 5 | | | | | 5 | | | | | | | | 5 |
| 6 | | | | | | 9 | | | | | | | 9 |
| 7 | | | | | | | 2 | | | | | | 2 |
| 8 | | | | | | | | 5 | | | | | 5 |
| 9 | | | | | | | | | 5 | | | | 5 |
| 10 | | | | | | | | | 2 | 5 | | | 7 |
| 11 | | | | | | | | | | | 5 | | 5 |
| 12 | | | | | | | | | | | 1 | 1 | 2 |
| Total | 15 | 20 | 10 | 15 | 5 | 9 | 2 | 5 | 7 | 5 | 6 | 1 | 100 |

2000 Commercial Samples Agreement = **89%**

| Test Age (LVE) | Production Age (LVE) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 13 | Total |
| 1 | 1 | 1 | | | | | | | | | | | 2 |
| 2 | | 21 | 2 | | | | | | | | | | 23 |
| 3 | | | 4 | | | | | | | | | | 4 |
| 4 | | | | 21 | 1 | | | | | | | | 22 |
| 5 | | | | | 6 | | 1 | | | | | | 7 |
| 6 | | | | | | 6 | | | | | | | 6 |
| 7 | | | | | | | 7 | | | | | | 7 |
| 8 | | | | | | | 1 | 7 | | | | | 8 |
| 9 | | | | | | | | 3 | 5 | 1 | | | 9 |
| 10 | | | | | | | | 1 | | 4 | | | 5 |
| 11 | | | | | | | | | | | 1 | | 1 |
| 13 | | | | | | | | | | | | 5 | 5 |
| Omitted | | | | | | | | 1 | | | | | 1 |
| Total | 1 | 22 | 6 | 21 | 7 | 6 | 9 | 12 | 5 | 5 | 1 | 5 | 100 |

Table A2. Inter-reader ageing agreement matrix for the DFO haddock ager, L. Van Eeckhaute (LVE), and the NMFS haddock ager, N. Munroe (NM), using haddock ageing material from the 2001 NMFS Georges Bank spring survey.

| NMFS 2001 Spring Survey | | | | | | | | | | | | Agreement = **68%** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DFO Reader (LVE) | NMFS Reader (NM) | | | | | | | | | | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | Missing | Omitted | Total |
| 1 | 9 | 1 | | | | | | | | | | 10 |
| 2 | 1 | 16 | 16 | | | | | | | | | 33 |
| 3 | | | 11 | 1 | | | | | | | | 12 |
| 4 | | | 1 | 15 | 2 | | | | | 1 | | 19 |
| 5 | | | | 2 | 7 | 1 | | | | | | 10 |
| 6 | | | | | | 4 | 2 | 1 | | | | 7 |
| 7 | | | | | | 1 | 3 | 1 | | | | 5 |
| 8 | | | | | | | | 1 | 1 | | | 2 |
| 9 | | | | | | | | | 1 | | | 1 |
| Omitted | | | 1 | 1 | 1 | | | | | | | 3 |
| Total | 10 | 17 | 29 | 19 | 10 | 6 | 5 | 3 | 2 | 1 | | 102 |