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Canadian Atlantic Fisheries Scientific Advisory Committee

CAFSAC Research Document 89/ 49

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Comité scientifique consultatif des pêches canadiennes dans l'Atlantique

CSCPCA Document de recherche 89/ 49

# Assessment of Eastern Georges Bank Haddock

by

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## ABSTRACT

A new haddock management unit, defined as unit areas 5Zj and 5Zm, was identified to better reflect current understanding of stock structure and the fisheries on Georges Bank. Canadian haddock landings from unit areas 5Zj and 5Zm in 1988 decreased by 700 t to about 4000 t but still comprised about 70% of the total by all countries. Sequential population analysis was calibrated with the fall USA research survey results, as has been the practice previously. Results indicate that the exploitation rate has been high, with fishing mortality of 0.3 to 0.4, and few older fish (greater than 6 years of age) remain in the population. Abundance is near the lowest observed since 1963 and recruitment since the 1978 year-class has been variable and low.



## RESUME

Compte tenu des connaissances dont on dispose actuellement au sujet de la structure du stock et de la pêche de l'aiglefin sur le banc Georges, on a créé un nouvelle unité de gestion de cette espèce, composée des zones 5Zj et 5Zm. Quoique les débarquements canadiens d'aiglefin en provenance de ces zones aient diminué de 700 t en 1988, pour s'établir à environ 4 000 t, ils ont continué de représenter approximativement 70 % des débarquements totaux de tous les pays. Comme par le passé, on a étalonné l'analyse séquentielle de population d'après les données des relevés de recherche effectués en automne par les Etats-Unis. Les résultats révèlent que le taux d'exploitation a été élevé, la mortalité due à la pêche étant de 0,3 à 0,4, et que peu de vieux poissons (âgés de plus de six ans) demeurent dans la population. L'abondance approche de son niveau le plus bas depuis 1963, tandis que le recrutement s'est avéré irrégulier et faible depuis l'arrivée de la classe de 1978.

## MANAGEMENT UNITS FOR HADDOCK IN THE GULF OF MAINE AREA

Until 1989, the management units employed by Canada for haddock in the Gulf of Maine area were those established by the International Commission for the Northwest Atlantic Fisheries (ICNAF) in the early 1960'S. In 1985, the International Court of Justice defined a maritime boundary between Canada and USA in the Gulf of Maine which crossed several of the former management units (Fig. 1). In recognition of the split jurisdiction, a review was undertaken to identify management units which reflected current understanding of stock structure and the fisheries, thus enhancing conservation opportunities and long-term benefits to the Canadian fishery. Previous reviews (Bowen 1987, Clark et al. 1982, Grosslein 1962, Halliday et al. 1985) have concluded that there is little mixing of haddock between Georges Bank and areas to the east. Recent tagging results (unpublished) generally support this conclusion. The subsequent discussion will therefore be limited to evaluation of haddock stock definition in Subarea 5.

Based largely on analysis of tag returns, Grosslein (1962) tentatively concluded that there were three distinct stocks in Subarea 5. These were a coastal Grand Manan Bank/5Y stock, a Georges Bank stock east of the South Channel (about 68° or 69° W) and a coastal Nantucket Shoals/Jeffreys Ledge stock. Examination of fishing effort distribution during the period 1938-49 led Schuck (1952) to the observation that there were distinct haddock aggregations on Georges Bank and in the South Channel-Nantucket Shoals area. However, the maps of distribution would place the partition closer to 68° W. Though the existence of distinct Georges Bank and coastal Nantucket Shoals stocks was noted, since the early 1970s, analyses of stock dynamics have used the Division 5Z and Division 5Y boundary to separate stocks. This was due in part to the ease of summarizing statistics for these areas (Clark et al. 1982).

More recent data was considered to evaluate existing hypotheses. Examination of USA catch by unit area cannot be used to provide evidence of a discontinuity in the vicinity of the South Channel (5Zg, 5Zh) due to the coarseness of these statistics. USA research survey results show that haddock are broadly distributed over Georges Bank, however two areas of concentration were identifiable, the South Channel and the northeast edge and peak of Georges Bank. The extent of mixing

has not been re-evaluated since the results of tagging experiments were reported in the early 1960s which indicated that movement was limited.

In conclusion, past evidence for separating haddock into distinct Georges Bank and South Channel-Nantucket Shoals stocks appears to be supported or at least cannot be dismissed. The lack of more recent tagging experiments and the present low abundance do not permit more thorough evaluation. For practical considerations related to availability of catch statistics and commercial fishery samples, it is concluded that unit areas 5Zj and 5Zm would adequately approximate the Georges Bank stock.

## DESCRIPTION OF THE FISHERY

The haddock on Georges Bank have supported an important commercial fishery since the early 1920s (Clark et al. 1982). Canadian catches were not significant until the mid 1960s (Table 1) and have been almost entirely from unit areas 5Zj and 5Zm (Table 2). Since 1977, only Canada and USA have had haddock directed fisheries. The proportion of catch by USA on Georges Bank from unit areas 5Zj and 5Zm has varied around 45% but has increased since 1985 to about 65%. Landings from unit areas 5Zj and 5Zm were low in the early 1970s following the high exploitation of the strong 1963 year-class. Landings increased to about 23000 t in 1980, reflecting the strength of the 1975 and 1978 year-classes, and have since declined to about 6000 t.

Since 1970, seasonal spring closures have been in effect on eastern Georges Bank (Halliday 1988). The monthly distribution of catches by Canada reflect the closure (Table 3). The majority of the catch continues to be taken by otter trawls (Table 4) and in recent years, vessels in tonnage classes 2 and 3 have dominated (Table 5). The USA catch on Georges Bank has been more evenly distributed over the year and has been taken almost exclusively by vessels in tonnage classes 2 and 3 using otter trawl gear (W. Overholtz, pers. com.).

## DATA

### Catch and Weight at Age

Length frequencies for 1988 from the USA commercial fishery were supplied by National Marine Fisheries Service. In addition, age information for the first quarter was provided. Augmenting with Canadian age length keys for the remainder of the year, the samples were applied to the commercial catch as indicated in Table 6 to derive the catch at age for the USA fishery. Length

frequency and age information were collected for 29 samples from the Canadian commercial fishery in 1987. These samples were applied to the commercial catch as indicated in Table 7 to derive the catch at age for the Canadian fishery. Statistics by age (Table 8) were calculated according to the methods described by Gavaris and Gavaris (1983). The length weight relationship

$$\text{weight(kg)} = 0.0000158\ \text{length(cm)}^{2.91612}$$

derived from Canadian fishery samples (Waiwood and Neilson 1985), was used in these calculations. The 1985 year-class was dominant in the catch though the 1983 year class was still well represented (Table 9). The resulting weight at age was similar to values obtained in recent years.

Research Survey

Annual surveys have been conducted on Georges Bank by the Department of Fisheries and Oceans Canada during the spring of 1986-89 (Table 10) and by the National Marine Fisheries Service USA during the spring of 1968-89 (Table 11) and during the fall of 1963-88 (Table 12). A new type of otter trawl door was introduced to both spring and fall USA surveys in 1985, however the impact of this change on the abundance estimates has not been determined. The stratification scheme used for the Canadian survey is shown in Fig. 2.

Both the USA surveys and the Canadian survey have detected the relatively strong 1983, 1985, and 1987 year classes. Though the relative sizes of these three year classes in the surveys has not been entirely consistent, the 1985 year-class has generally appeared the largest.

## ESTIMATION OF STOCK SIZE

The available indices reflect abundance in Subdivision 5Ze. The data are currently being examined to determine the most appropriate way of deriving indices for unit areas 5Zj and 5Zm. There are indications that the abundance of haddock in the South Channel-Nantucket Shoals area have undergone a greater decrease than those on eastern Georges Bank. Though this difference would introduce bias in the estimate of the population size on eastern Georges Bank, the following results provide rough approximations of exploitation rate which could be compared to a target. The fall USA survey was used in the estimation of stock size as has been done in the past. For illustrative purposes, a preliminary analysis using all three survey indices was attempted. The results were similar but it was considered inappropriate to introduce these indices for the first time this

year since they will have to be modified to reflect the abundance on the eastern portion of Georges Bank subsequently.

The fall USA survey with the annual catch at age data (Table 13) was used in the adaptive framework described by Gavaris (1988) and Table 14 provides the average weight at age for the calculation of biomass. It was assumed that the error in the catch at age was negligible relative to the error in the abundance index. Based on previous results (Gavaris 1988), the survey results for ages 7 and older were not employed. The fall estimates were related to the beginning of year population estimates for the succeeding year. Based on these observations the survey was used to compile annual abundance indices for ages 1, 2, 3, and 4-6 aggregated.

As was done previously (Gavaris 1988) it was assumed that the fishing mortality on age 8 was equal to the total fishing mortality on ages 4 to 7 for all years, thereby only requiring estimates of population size at the beginning of 1989. The 1982 and 1979 year-classes could not be estimated well because of their low abundance. Their sizes were fixed at 170,000 and 40,000 respectively, at the beginning of 1989, corresponding to about the fully recruited fishing mortality rate for the other year classes. The formulation employed did not include intercepts in the relationships. Ln transformations were used to stabilize the variance of the survey results. The 1986 year-class estimate was based only on the 1988 survey because previous surveys did not capture any haddock of this year class. The resulting population matrix is shown in Table 15 and the fishing mortality is in Table 16. The calibration coefficients were 0.2, 0.35, 0.23 and 0.28 for the age groups 1 to 3 and 4-6 aggregated, respectively. The diagnostics examined (Figs. 3-7) did not uncover any problems with the fit of the model to the data.

## YIELD PER RECRUIT

A yield per recruit analysis was previously produced by Clark et al. (1982). Since then, the nature of the fishery has changed and this has an impact on the exploitation pattern, one of the input parameters of the analysis. Thus a review of yield per recruit was warranted.

Examination of the exploitation pattern from the fishing mortality table (Table 16) indicates that age 1 haddock are not exploited while age 3 haddock are generally fully recruited to the fishery. The recruitment of age 2 haddock to the fishery has been variable. Figure 8 shows that there is a tendency for the partial recruitment at age 2 to be greater when year-class size is large. Since we are concerned primarily about yield from

the more abundant year-classes, a value of 0.5 was considered appropriate. The following parameters were used for input to the yield per recruit analysis :

| Age | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PR | .0 | .5 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Wt | 0.60 | 0.93 | 1.36 | 1.88 | 2.30 | 2.73 | 3.15 | 3.58 | 3.80 | 3.90 | 4.00 | 4.10 | 4.20 | 4.30 |

The weight at age for ages 1 to 8 was obtained by taking the average for 1982-88. Weights for older ages are the result of subjectively smoothing observations for 1985-1988. The computed $F_{0.1}$ was 0.23 giving a yield of 0.756 kg per 1-year-old recruit and an average weight of harvested fish of 1.89 kg.

## ASSESSMENT RESULTS

As noted previously, the caveats on this analysis limit interpretation. Consequently, these results should be viewed as rough values to compare against a target condition. The present population size is amongst the lowest since 1963, and is comprised primarily of the 1983, 1985, and 1987 year-classes. Fishing mortalities in the 1980s have generally been above 0.3 and often greater than 0.4 and recruitment in recent years has been low and variable. Exploitation of young haddock, age 2, is high, reaching up to 50% of the fully recruited fishing mortality rate. Given the low abundance of older haddock, this could result in reduced spawning potential. The low abundance of older haddock and the high exploitation rate on young haddock indicate that the stock is not in a healthy state. Management measures to reduce the capture of haddock younger than age 3 would contribute to the conservation and rebuilding of this resource.

The current fishing mortality rate and its associated catch of about 6000 t, are about 2 to 3 times greater than a harvest coinciding with $F_{0.1}$ management. The 1987 year-class will contribute approximately 30-50% of the catch biomass in 1989 and 1990, highlighting the dependence of this fishery on just a few age groups. An increase in mesh size to 152 mm would reduce the capture of 2 year old haddock allowing increased yield from growth and enhancing the reproductive potential of the stock. Recovery is not likely, or at least will be very slow if the present exploitation rate and pattern continue.

## ACKNOWLEDGMENTS

I thank T. Polacheck and other staff at NMFS, Woods Hole, MA, for providing the necessary USA statistics and reports.

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Table 1. Nominal catches(t) of haddock from NAFO Division 5Z. Data was obtained from ICNAF/NAFO for 1956-84 and from NMFS and DFO for 1985-88.

| Year | USA | Canada | USSR | Spain | Others | Total |
|---|---|---|---|---|---|---|
| 1956 | 51144 | 0 | 0 | 0 | 0 | 51144 |
| 1957 | 48561 | 0 | 0 | 0 | 0 | 48561 |
| 1958 | 37322 | 0 | 0 | 0 | 0 | 37322 |
| 1959 | 36051 | 0 | 0 | 0 | 0 | 36051 |
| 1960 | 40800 | 77 | 0 | 0 | 0 | 40877 |
| 1961 | 46384 | 266 | 0 | 0 | 0 | 46650 |
| 1962 | 49409 | 3461 | 1134 | 0 | 0 | 54004 |
| 1963 | 44150 | 8379 | 2317 | 0 | 0 | 54846 |
| 1964 | 46512 | 11625 | 5483 | 2 | 464 | 64086 |
| 1965 | 52823 | 14889 | 81882 | 10 | 758 | 150362 |
| 1966 | 52918 | 18292 | 48409 | 1111 | 544 | 121274 |
| 1967 | 34728 | 13040 | 2316 | 1355 | 30 | 51469 |
| 1968 | 25469 | 9223 | 1397 | 3014 | 1318 | 40421 |
| 1969 | 16456 | 3990 | 66 | 1201 | 470 | 22183 |
| 1970 | 8415 | 1978 | 103 | 782 | 7 | 11285 |
| 1971 | 7306 | 1630 | 374 | 1310 | 242 | 10862 |
| 1972 | 3869 | 609 | 137 | 1098 | 20 | 5733 |
| 1973 | 2777 | 1563 | 602 | 386 | 3 | 5331 |
| 1974 | 2396 | 462 | 109 | 764 | 559 | 4290* |
| 1975 | 3989 | 1358 | 8 | 61 | 4 | 5420 |
| 1976 | 2904 | 1361 | 4 | 46 | 9 | 4324 |
| 1977 | 7934 | 2909 | 0 | 0 | 0 | 10843* |
| 1978 | 12160 | 10179 | 0 | 0 | 0 | 22339* |
| 1979 | 14279 | 5182 | 0 | 0 | 0 | 19461 |
| 1980 | 17470 | 10101 | 0 | 0 | 0 | 27571* |
| 1981 | 19245 | 5659 | 0 | 0 | 3 | 24907 |
| 1982 | 12622 | 4931 | 0 | 0 | 0 | 17553 |
| 1983 | 8680 | 3212 | 0 | 0 | 0 | 11892 |
| 1984 | 8806 | 1463 | 0 | 0 | 0 | 10269 |
| 1985 | 4272 | 3485 | 0 | 0 | 0 | 7757 |
| 1986 | 3338 | 3415 | 0 | 0 | 0 | 6751 |
| 1987 | 2155 | 4703 | 0 | 0 | 0 | 6858 |
| 1988 | 2494 | 3990 | 0 | 0 | 0 | 6484 |

* Values adjusted for discards are 6190, 20531, 26281, and 51084 for 1974, 1977, 1978, and 1980 respectively.

Table 2. Nominal catches (t) of haddock from unit areas 5Zj and 5Zm. For "others" it was assumed that 50% catch was in 5Zj and 5Zm.

| YEAR | CANADA | USA | OTHERS | TOTAL |
|---|---|---|---|---|
| 1964 | 11625 | 19050 | 2974 | 33649 |
| 1965 | 14889 | 17636 | 41325 | 73850 |
| 1966 | 18292 | 17672 | 25032 | 60996 |
| 1967 | 13040 | 11998 | 1850 | 32888 |
| 1968 | 9223 | 7846 | 2864 | 19933 |
| 1969 | 3990 | 6621 | 868 | 11479 |
| 1970 | 1978 | 3154 | 446 | 5578 |
| 1971 | 1630 | 3533 | 963 | 6126 |
| 1972 | 609 | 1551 | 627 | 2787 |
| 1973 | 1563 | 1396 | 495 | 3454 |
| 1974 | 462 | 955 | 716 | 2893 |
| 1975 | 1358 | 1705 | 36 | 3099 |
| 1976 | 1361 | 974 | 29 | 2364 |
| 1977 | 2909 | 2428 | 0 | 8337 |
| 1978 | 10179 | 4725 | 0 | 16444 |
| 1979 | 5182 | 5212 | 0 | 10394 |
| 1980 | 10101 | 5615 | 0 | 23216 |
| 1981 | 5659 | 8934 | 0 | 14593 |
| 1982 | 4931 | 6279 | 0 | 11210 |
| 1983 | 3212 | 4453 | 0 | 7665 |
| 1984 | 1463 | 5120 | 0 | 6583 |
| 1985 | 3485 | 1683 | 0 | 5168 |
| 1986 | 3415 | 2201 | 0 | 5616 |
| 1987 | 4703 | 1418 | 0 | 6121 |
| 1988 | 3990 | 1695 | 0 | 5685 |

*Values augmented by 760, 3000, 1540 and 7500 in 1974, 1977, 1978 and 1980, respectively, to account for discards.

Table 3. Monthly catch(t) of haddock by Canada in unit areas 5Zj and 5Zm for 1968-1988.

| Year | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1968 | 337 | 510 | 990 | 2337 | 760 | 352 | 693 | 1240 | 941 | 904 | 120 | 139 | 9323 |
| 1969 | 106 | 73 | 6 | 291 | 587 | 691 | 559 | 607 | 553 | 364 | 119 | 34 | 3990 |
| 1970 | 10 | 105 | 0 | 1 | 576 | 345 | 104 | 456 | 241 | 103 | 25 | 12 | 1978 |
| 1971 | 0 | 9 | 2 | 0 | 400 | 153 | 283 | 279 | 97 | 246 | 140 | 21 | 1630 |
| 1972 | 0 | 118 | 2 | 0 | 4 | 112 | 87 | 116 | 91 | 70 | 9 | 0 | 609 |
| 1973 | 4 | 10 | 0 | 0 | 0 | 183 | 198 | 569 | 339 | 233 | 23 | 4 | 1563 |
| 1974 | 19 | 0 | 1 | 0 | 0 | 57 | 64 | 52 | 96 | 60 | 93 | 20 | 462 |
| 1975 | 5 | 14 | 0 | 0 | 0 | 167 | 257 | 482 | 104 | 167 | 117 | 45 | 1358 |
| 1976 | 0 | 8 | 61 | 68 | 61 | 595 | 152 | 188 | 186 | 26 | 9 | 7 | 1361 |
| 1977 | 102 | 176 | 6 | 0 | 23 | 519 | 1098 | 836 | 12 | 58 | 56 | 23 | 2909 |
| 1978 | 103 | 932 | 44 | 21 | 22 | 319 | 407 | 86 | 640 | 5605 | 2000 | 0 | 10179 |
| 1979 | 125 | 898 | 398 | 175 | 69 | 1393 | 905 | 395 | 488 | 261 | 53 | 22 | 5182 |
| 1980 | 39 | 134 | 13 | 33 | 225 | 2957 | 2299 | 963 | 1419 | 1739 | 103 | 177 | 10101 |
| 1981 | 38 | 482 | 568 | 4 | 254 | 1354 | 1242 | 727 | 292 | 82 | 378 | 238 | 5659 |
| 1982 | 131 | 309 | 1 | 12 | 45 | 1118 | 767 | 684 | 582 | 838 | 400 | 44 | 4931 |
| 1983 | 31 | 67 | 28 | 46 | 60 | 1288 | 386 | 489 | 527 | 194 | 90 | 6 | 3212 |
| 1984 | 3 | 5 | 80 | 89 | 73 | 433 | 218 | 255 | 212 | 70 | 25 | 0 | 1463 |
| 1985 | 1 | 11 | 33 | 99 | 26 | 354 | 392 | 1103 | 718 | 594 | 61 | 93 | 3485 |
| 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* | 39 | 80 | 67 | 79 | 15 | 1818 | 1360 | 315 | 118 | 62 | 13 | 24 | 3990 |

* Catches of 3, 1890, and 46 t for Jan., Feb., and Mar., respectively for otter trawlers were excluded because of suspected misreporting.

Table 4. Canadian catch(t) of haddock in unit areas 5Zj and 5Zm by gear for 1968-1987.

| Year | OT | LL | MISC. | Total |
|---|---|---|---|---|
| 1968 | 9170 | 111 | 11 | 9292 |
| 1969 | 3955 | 22 | 13 | 3990 |
| 1970 | 1900 | 76 | 2 | 1978 |
| 1971 | 1475 | 154 | 1 | 1630 |
| 1972 | 411 | 198 | 0 | 609 |
| 1973 | 1461 | 102 | 0 | 1563 |
| 1974 | 374 | 87 | 1 | 462 |
| 1975 | 1247 | 111 | 0 | 1358 |
| 1976 | 1185 | 154 | 15 | 1354 |
| 1977 | 2814 | 94 | 1 | 2909 |
| 1978 | 9716 | 171 | 292 | 10179 |
| 1979 | 4907 | 274 | 1 | 5182 |
| 1980 | 9510 | 590 | 1 | 10101 |
| 1981 | 4644 | 1015 | 0 | 5659 |
| 1982 | 4222 | 709 | 0 | 4931 |
| 1983 | 2396 | 813 | 3 | 3212 |
| 1984 | 624 | 838 | 1 | 1463 |
| 1985 | 2817 | 626 | 42 | 3485 |
| 1986 | 2786 | 594 | 35 | 3415 |
| 1987 | 3569 | 1046 | 89 | 4703 |
| 1988* | 3257 | 681 | 52 | 3990 |

* see note in Table 3

Table 5. Canadian otter trawl catch(t) of haddock in unit areas 5Zj and 5Zm by tonnage class.

| Year | Side | | | | Stern | | | |
|---|---|---|---|---|---|---|---|---|
| | 2 | 3 | 4 | 5 | 2 | 3 | 4 | 5 |
| 1968 | 0 | 176 | 3463 | 0 | 0 | 0 | 580 | 5041 * |
| 1969 | 1 | 8 | 792 | 0 | 0 | 1 | 225 | 2928 |
| 1970 | 0 | 25 | 553 | 0 | 2 | 0 | 134 | 1186 |
| 1971 | 0 | 0 | 494 | 0 | 0 | 0 | 16 | 965 |
| 1972 | 0 | 0 | 0 | 0 | 0 | 0 | 148 | 263 |
| 1973 | 0 | 25 | 609 | 0 | 0 | 0 | 61 | 766 |
| 1974 | 0 | 0 | 26 | 0 | 0 | 6 | 8 | 334 |
| 1975 | 0 | 0 | 223 | 0 | 0 | 1 | 60 | 963 |
| 1976 | 0 | 1 | 192 | 23 | 0 | 0 | 61 | 908 |
| 1977 | 5 | 47 | 358 | 0 | 91 | 243 | 18 | 2052 |
| 1978 | 69 | 17 | 2485 | 0 | 238 | 822 | 351 | 5734 |
| 1979 | 12 | 116 | 1573 | 0 | 135 | 855 | 651 | 1565 |
| 1980 | 9 | 16 | 1426 | 1 | 354 | 365 | 1016 | 6323 |
| 1981 | 4 | 87 | 389 | 0 | 448 | 484 | 884 | 2348 |
| 1982 | 1 | 25 | 90 | 0 | 190 | 297 | 250 | 3359 |
| 1983 | 16 | 89 | 0 | 0 | 618 | 432 | 107 | 1134 |
| 1984 | 0 | 5 | 0 | 0 | 181 | 269 | 21 | 148 |
| 1985 | 0 | 72 | 0 | 0 | 840 | 1402 | 155 | 348 |
| 1986 | 4 | 48 | 0 | 0 | 829 | 1378 | 96 | 432 |
| 1987 | 6 | 41 | 0 | 0 | 782 | 1448 | 49 | 1241 |
| 1988** | 0 | 72 | 0 | 0 | 1161 | 1432 | 186 | 398 |

* 1165 t shown as stern tonnage class 2 in the Statistical Bulletin was included with tonnage class 5 pers. com. G. Moulton, NAFO

** see note in Table 3

Table 6. Length frequencies sampled from the 1988 USA commercial fishery for haddock in unit areas 5Zj and 5Zm were applied to the weight indicated. The manner in which statistics were pooled is shown by braces. The numbers in brackets are the numbers of age interpretations for age length keys.

| Gear | Month | Number measured | | Weight | | Combined | |
|---|---|---|---|---|---|---|---|
| | | Large | Scrod | Large | Scrod | | |
| ALL | Jan | 524 | 46 | 121.8 | 74.3 | | |
| | Feb | - | - | 90.9 | 61.5 | | |
| | Mar | - | 52 | 136.0 | 71.0 | - 555.5(275) | |
| | Apr | 102 | 50 | 128.4 | 116.6 | | |
| | May | 216 | 181 | 209.2 | 157.2 | | |
| | Jun | 112 | - | 192.2 | 124.3 | | |
| | Jul | - | - | 23.4 | 6.5 | | |
| | Aug | - | 50 | 14.9 | 4.2 | | |
| | Sep | - | - | 5.7 | 1.6 | | |
| | Oct | - | - | | | | |
| | Nov | - | - | | | | |
| | Dec | - | - | | | -1139.9(275) | -1695.3 |

Canadian age length key was used for Apr-Dec.
Sample information supplied by NMFS.

Table 7. Length frequencies sampled from the 1988 Canadian commercial fishery for haddock in unit areas 5Zj and 5Zm were applied to the weight indicated. The manner in which statistics were pooled is shown by braces. The numbers in brackets are the numbers of age interpretations for age length keys.

| Gear | Month | Number measured | Weight (t) | | | |
|---|---|---|---|---|---|---|
| OT | Jan | - | - | | | |
| | Feb | - | - | | | |
| | Mar | - | - | | | |
| | Apr | - | - | | | |
| | May | - | 5.9 | | | |
| | Jun | 2031 | 1730.3 | 1736.2 (275) | | |
| | Jul | 1055 | 1180.9 | | | |
| | Aug | 473 | 246.5 | | | |
| | Sep | 691 | 40.8 | | | |
| | Oct | 200 | 25.3 | | | |
| | Nov | 230 | 5.7 | | | |
| | Dec | - | 21.3 | 52.4 | 1520.5 (322) | |
| LL | Jan | - | 36.3 | | | |
| | Feb | - | 77.6 | | | |
| | Mar | | 65.0 | | | |
| | Apr | - | 75.7 | | | |
| | May | - | 5.8 | | | |
| | Jun | - | 74.6 | | | |
| | Jul | - | 162.9 | | | |
| | Aug | | 61.0 | | | |
| | Sep | 1702 | 75.9 | | | |
| | Oct | - | 37.0 | | | |
| | Nov | - | 7.2 | | | |
| | Dec | - | 2.0 | 681.1 (239) | | |
| Misc | | | | | 52.2 | 3990.2 |

Table 8. Age composition (000's) for components of the 1988 haddock fishery in unit areas 5Zj and 5Zm.

| AGE | A | B | C | D | E |
|---|---|---|---|---|---|
| 1 | | | 4 | | |
| 2 | | 37 | 12 | | 4 |
| 3 | 60 | 905 | 865 | 34 | 267 |
| 4 | 8 | 30 | 39 | 4 | 24 |
| 5 | 115 | 163 | 73 | 138 | 217 |
| 6 | 16 | 15 | 17 | 22 | 20 |
| 7 | 4 | 3 | 1 | 14 | 4 |
| 8 | 7 | 7 | 4 | 11 | 10 |
| 9 | 11 | 6 | 1 | 5 | 13 |
| 10 | 30 | 15 | 2 | 2 | 15 |
| 11 | 4 | 4 | 2 | | 4 |
| 12 | 3 | | | | |
| 13 | 16 | 2 | 1 | | 3 |
| 14 | 1 | | | | |

A. CAN LL JAN-DEC
B. CAN OT JAN-JUN
C. CAN OT JUL-DEC
D. USA JAN-MAR
E. USA APR-DEC

Table 9. Statistics by age for the 1988 haddock fishery in unit areas 5Zj and 5Zm.

CANADA

| AGE | AVERAGE WEIGHT | AVERAGE LENGTH | CATCH MEAN | CATCH STD ERR | CATCH CV |
|---|---|---|---|---|---|
| 1 | 0.421 | 32.836 | 4 | 1.312 | 0.333 |
| 2 | 0.974 | 43.665 | 50 | 19.551 | 0.390 |
| 3 | 1.314 | 48.434 | 1853 | 33.990 | 0.018 |
| 4 | 1.784 | 53.653 | 79 | 18.375 | 0.233 |
| 5 | 2.229 | 58.066 | 356 | 20.968 | 0.059 |
| 6 | 2.259 | 57.983 | 49 | 11.772 | 0.240 |
| 7 | 3.057 | 64.623 | 8 | 3.181 | 0.417 |
| 8 | 3.179 | 65.076 | 18 | 5.212 | 0.295 |
| 9 | 3.240 | 65.485 | 18 | 5.248 | 0.287 |
| 10 | 3.915 | 70.480 | 47 | 6.754 | 0.144 |
| 11 | 3.853 | 70.201 | 10 | 3.976 | 0.406 |
| 12 | 4.209 | 72.251 | 3 | 1.678 | 0.582 |
| 13 | 3.816 | 69.891 | 20 | 4.335 | 0.222 |
| 14 | 4.551 | 74.500 | 1 | 0.926 | 1.001 |

USA

| AGE | AVERAGE WEIGHT | AVERAGE LENGTH | CATCH MEAN | CATCH STD ERR | CATCH CV |
|---|---|---|---|---|---|
| 1 | | | | | |
| 2 | 1.099 | 45.741 | 4 | 2.402 | 0.685 |
| 3 | 1.454 | 50.192 | 301 | 18.192 | 0.060 |
| 4 | 1.963 | 55.509 | 28 | 9.579 | 0.344 |
| 5 | 2.258 | 58.351 | 355 | 19.440 | 0.055 |
| 6 | 2.666 | 61.637 | 42 | 8.275 | 0.198 |
| 7 | 3.266 | 66.148 | 18 | 4.403 | 0.243 |
| 8 | 3.442 | 67.195 | 21 | 6.290 | 0.296 |
| 9 | 3.356 | 66.597 | 18 | 6.498 | 0.356 |
| 10 | 3.900 | 70.438 | 18 | 5.183 | 0.294 |
| 11 | 3.621 | 68.715 | 4 | 2.334 | 0.620 |
| 12 | | | | | |
| 13 | 3.405 | 67.351 | 3 | 1.893 | 0.610 |

TOTAL

| AGE | AVERAGE WEIGHT | AVERAGE LENGTH | CATCH MEAN | CATCH STD ERR | CATCH CV |
|---|---|---|---|---|---|
| 1 | 0.421 | 32.836 | 4 | 1.312 | 0.333 |
| 2 | 0.982 | 43.800 | 54 | 19.698 | 0.367 |
| 3 | 1.333 | 48.680 | 2154 | 38.552 | 0.018 |
| 4 | 1.831 | 54.139 | 107 | 20.722 | 0.194 |
| 5 | 2.243 | 58.208 | 711 | 28.594 | 0.040 |
| 6 | 2.446 | 59.662 | 91 | 14.390 | 0.158 |
| 7 | 3.204 | 65.697 | 26 | 5.432 | 0.211 |
| 8 | 3.322 | 66.233 | 39 | 8.169 | 0.210 |
| 9 | 3.298 | 66.040 | 37 | 8.352 | 0.229 |
| 10 | 3.911 | 70.469 | 65 | 8.513 | 0.132 |
| 11 | 3.789 | 69.788 | 14 | 4.610 | 0.340 |
| 12 | 4.209 | 72.251 | 3 | 1.678 | 0.582 |
| 13 | 3.760 | 69.543 | 23 | 4.730 | 0.209 |
| 14 | 4.551 | 74.500 | 1 | 0.926 | 1.001 |

Table 10. Stratified mean catch per tow at age (numbers) for haddock in NAFO Division 5Z from the Canadian surveys in spring.

| Year | Age Group | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9+ | 1-9+ | 4-6 |
| 1986 | 4.11 | 0.22 | 6.01 | 1.06 | 0.18 | 0.27 | 0.30 | 0.33 | 0.40 | 12.88 | 1.51 |
| 1987 | 0.03 | 3.04 | 0.69 | 2.50 | 0.66 | 0.08 | 0.30 | 0.10 | 0.86 | 8.26 | 3.24 |
| 1988 | 1.47 | 0.05 | 8.53 | 0.17 | 2.85 | 0.18 | 0.17 | 0.11 | 0.50 | 14.03 | 3.20 |
| 1989 | 0.03 | 5.07 | 0.68 | 1.99 | 0.18 | 0.42 | 0.03 | 0.03 | 0.23 | 8.69 | 2.59 |

Table 11. Stratified mean catch per tow at age(numbers) for haddock on Georges Bank from the spring USA surveys. From 1973-81 a 41 Yankee trawl was used while a 36 Yankee was used in other years.

| Year | Age Group | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9+ | 1-9+ | 4-6 |
| 1968 | 0.27 | 1.90 | 0.31 | 0.47 | 4.51 | 1.13 | 0.17 | 0.30 | 0.23 | 9.29 | 6.11 |
| 1969 | 0.00 | 0.05 | 0.39 | 0.17 | 0.28 | 2.84 | 0.69 | 0.19 | 0.31 | 4.92 | 3.29 |
| 1970 | 0.45 | 0.17 | 0.00 | 0.22 | 0.31 | 0.31 | 1.34 | 0.66 | 0.57 | 4.03 | 0.84 |
| 1971 | 0.00 | 0.78 | 0.17 | 0.00 | 0.08 | 0.08 | 0.06 | 0.55 | 0.15 | 1.87 | 0.16 |
| 1972 | 2.70 | 0.06 | 0.41 | 0.08 | 0.02 | 0.03 | 0.09 | 0.02 | 0.87 | 4.28 | 0.13 |
| 1973 | 20.59 | 3.25 | 0.00 | 0.36 | 0.06 | 0.00 | 0.12 | 0.01 | 0.86 | 25.25 | 0.42 |
| 1974 | 1.43 | 8.92 | 1.92 | 0.00 | 0.16 | 0.00 | 0.01 | 0.07 | 0.25 | 12.76 | 0.16 |
| 1975 | 0.63 | 0.65 | 2.23 | 0.42 | 0.00 | 0.09 | 0.06 | 0.01 | 0.10 | 4.19 | 0.51 |
| 1976 | 54.22 | 0.20 | 0.40 | 0.62 | 0.29 | 0.00 | 0.03 | 0.00 | 0.07 | 55.83 | 0.91 |
| 1977 | 0.41 | 22.42 | 0.28 | 0.82 | 0.40 | 0.30 | 0.00 | 0.03 | 0.08 | 24.74 | 1.52 |
| 1978 | 0.05 | 0.65 | 10.69 | 0.24 | 0.63 | 0.55 | 0.11 | 0.04 | 0.07 | 13.03 | 1.42 |
| 1979 | 24.24 | 1.06 | 0.76 | 3.83 | 0.22 | 0.11 | 0.25 | 0.04 | 0.03 | 30.54 | 4.16 |
| 1980 | 3.49 | 31.34 | 0.34 | 0.70 | 3.27 | 0.45 | 0.25 | 0.31 | 0.16 | 40.31 | 4.42 |
| 1981 | 2.70 | 2.69 | 15.95 | 1.79 | 0.62 | 1.46 | 0.20 | 0.09 | 0.04 | 25.54 | 3.87 |
| 1982 | 0.62 | 1.25 | 0.77 | 3.33 | 0.34 | 0.23 | 0.50 | 0.00 | 0.00 | 7.04 | 3.90 |
| 1983 | 0.29 | 0.37 | 0.39 | 0.15 | 1.62 | 0.01 | 0.03 | 0.78 | 0.12 | 3.76 | 1.78 |
| 1984 | 1.40 | 0.79 | 0.43 | 0.42 | 0.39 | 0.48 | 0.05 | 0.03 | 0.20 | 4.19 | 1.29 |
| 1985 | 0.00 | 4.96 | 0.76 | 0.40 | 0.87 | 0.34 | 1.17 | 0.10 | 0.25 | 8.85 | 1.61 |
| 1986 | 2.49 | 0.17 | 2.06 | 0.24 | 0.11 | 0.21 | 0.12 | 0.33 | 0.11 | 5.84 | 0.56 |
| 1987 | 0.00 | 3.62 | 0.06 | 0.81 | 0.08 | 0.10 | 0.05 | 0.22 | 0.01 | 4.95 | 0.99 |
| 1988 | 1.55 | 0.04 | 0.99 | 0.13 | 0.32 | 0.12 | 0.09 | 0.09 | 0.00 | 3.37 | 0.57 |

modified from Overholtz et. al. 1983
data for 1983-86 supplied by W. J. Overholtz
data for 1987-88 supplied by T. Polacheck

Table 12. Stratified mean catch per tow at age (numbers) for haddock on Georges Bank from the fall USA survey.

| Year | Age Group | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8+ | 0-8+ | 3-5 |
| 1963 | 56.33 | 17.04 | 6.19 | 4.57 | 5.60 | 3.99 | 1.37 | 1.13 | 1.10 | 97.32 | 14.16 |
| 1964 | 1.59 | 75.75 | 42.78 | 3.91 | 1.20 | 2.56 | 1.05 | 0.46 | 0.39 | 129.69 | 7.67 |
| 1965 | 0.22 | 6.82 | 51.94 | 6.51 | 0.72 | 0.54 | 0.61 | 0.54 | 0.35 | 68.25 | 7.77 |
| 1966 | 4.12 | 0.64 | 1.94 | 12.34 | 2.25 | 0.35 | 0.33 | 0.22 | 0.13 | 22.32 | 14.94 |
| 1967 | 0.02 | 4.51 | 0.24 | 0.67 | 4.54 | 1.09 | 0.33 | 0.14 | 0.34 | 11.88 | 6.30 |
| 1968 | 0.06 | 0.04 | 0.64 | 0.09 | 0.22 | 2.59 | 0.85 | 0.18 | 0.37 | 5.04 | 2.90 |
| 1969 | 0.26 | 0.02 | 0.00 | 0.19 | 0.09 | 0.11 | 1.02 | 0.34 | 0.24 | 2.27 | 0.39 |
| 1970 | 0.03 | 2.77 | 0.14 | 0.01 | 0.19 | 0.18 | 0.34 | 0.92 | 0.59 | 5.17 | 0.38 |
| 1971 | 1.63 | 0.00 | 0.21 | 0.05 | 0.01 | 0.15 | 0.02 | 0.06 | 0.69 | 2.82 | 0.21 |
| 1972 | 4.53 | 1.69 | 0.00 | 0.35 | 0.06 | 0.00 | 0.06 | 0.04 | 0.89 | 7.62 | 0.41 |
| 1973 | 2.17 | 6.04 | 1.08 | 0.00 | 0.13 | 0.03 | 0.00 | 0.05 | 0.49 | 9.99 | 0.16 |
| 1974 | 0.50 | 1.19 | 0.66 | 0.21 | 0.00 | 0.01 | 0.00 | 0.00 | 0.15 | 2.72 | 0.22 |
| 1975 | 15.76 | 0.42 | 0.48 | 3.26 | 0.62 | 0.00 | 0.02 | 0.00 | 0.21 | 20.77 | 3.88 |
| 1976 | 2.90 | 43.07 | 0.35 | 0.36 | 0.55 | 0.20 | 0.00 | 0.03 | 0.24 | 47.70 | 1.11 |
| 1977 | 0.11 | 1.75 | 15.33 | 0.46 | 0.47 | 0.52 | 0.28 | 0.03 | 0.08 | 19.03 | 1.45 |
| 1978 | 10.82 | 0.69 | 0.85 | 7.59 | 0.15 | 0.21 | 0.37 | 0.01 | 0.01 | 20.70 | 7.95 |
| 1979 | 1.08 | 37.29 | 0.03 | 0.74 | 3.12 | 0.21 | 0.23 | 0.04 | 0.01 | 42.75 | 4.07 |
| 1980 | 9.56 | 2.22 | 10.41 | 0.37 | 0.25 | 1.39 | 0.39 | 0.38 | 0.12 | 25.09 | 2.01 |
| 1981 | 0.31 | 5.02 | 1.70 | 3.03 | 0.17 | 0.34 | 0.43 | 0.00 | 0.01 | 11.01 | 3.54 |
| 1982 | 0.89 | 0.00 | 0.74 | 0.32 | 1.27 | 0.13 | 0.07 | 0.19 | 0.06 | 3.67 | 1.72 |
| 1983 | 3.89 | 0.16 | 0.14 | 0.18 | 0.20 | 0.63 | 0.08 | 0.00 | 0.08 | 5.36 | 1.01 |
| 1984 | 0.02 | 2.23 | 0.59 | 0.16 | 0.19 | 0.04 | 0.30 | 0.00 | 0.08 | 3.61 | 0.39 |
| 1985 | 11.35 | 0.65 | 1.53 | 0.22 | 0.05 | 0.10 | 0.01 | 0.17 | 0.05 | 14.13 | 0.37 |
| 1986 | 0.00 | 5.11 | 0.09 | 1.21 | 0.06 | 0.13 | 0.13 | 0.02 | 0.07 | 6.82 | 1.40 |
| 1987 | 1.80 | 0.00 | 0.79 | 0.10 | 0.77 | 0.06 | 0.06 | 0.02 | 0.02 | 3.62 | 0.93 |
| 1988 | 0.07 | 3.02 | 0.18 | 1.30 | 0.12 | 0.40 | 0.12 | 0.10 | 0.03 | 5.35 | 1.82 |

modified from Overholtz et. al. 1983
data for 1983-86 supplied by W. J. Overholtz
data for 1987-88 supplied by T. Polacheck

Table 13. Catch numbers at age (000's) from the commercial fishery for haddock in unit areas 5Zj and 5Zm.

| Year | Age Group | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9+ | 1-9+ |
| 1964 | 5304 | 8367 | 2391 | 2508 | 4580 | 3042 | 1093 | 540 | 699 | 28523 |
| 1965 | 4716 | 61795 | 21854 | 2631 | 2157 | 3286 | 1853 | 537 | 671 | 99499 |
| 1966 | 57 | 3442 | 50703 | 9640 | 1392 | 1303 | 1173 | 638 | 436 | 68785 |
| 1967 | 735 | 107 | 1847 | 13206 | 6606 | 773 | 635 | 586 | 446 | 24940 |
| 1968 | 4 | 1476 | 350 | 947 | 7160 | 1725 | 334 | 223 | 415 | 12635 |
| 1969 | 1 | 6 | 879 | 232 | 338 | 3081 | 814 | 116 | 295 | 5763 |
| 1970 | 23 | 78 | 8 | 282 | 92 | 106 | 1141 | 369 | 229 | 2327 |
| 1971 | 0 | 775 | 126 | 23 | 163 | 139 | 161 | 828 | 523 | 2738 |
| 1972 | 76 | 1 | 219 | 39 | 16 | 58 | 38 | 32 | 601 | 1080 |
| 1973 | 1659 | 1333 | 2 | 250 | 34 | 19 | 50 | 10 | 290 | 3646 |
| 1974 | 21 | 2019 | 307 | 1 | 33 | 1 | 1 | 25 | 116 | 2524 |
| 1975 | 110 | 591 | 1066 | 214 | 2 | 24 | 2 | 2 | 50 | 2062 |
| 1976 | 79 | 259 | 301 | 481 | 118 | 1 | 13 | 2 | 61 | 1314 |
| 1977 | 0 | 7953 | 76 | 276 | 209 | 145 | 2 | 16 | 45 | 8722 |
| 1978 | 0 | 476 | 9007 | 191 | 355 | 323 | 87 | 9 | 42 | 10490 |
| 1979 | 0 | 14 | 922 | 3829 | 280 | 219 | 168 | 51 | 25 | 5508 |
| 1980 | 4 | 14088 | 158 | 443 | 2751 | 270 | 248 | 70 | 37 | 18069 |
| 1981 | 0 | 973 | 5595 | 442 | 410 | 1335 | 180 | 81 | 47 | 9063 |
| 1982 | 50 | 909 | 1044 | 1849 | 214 | 412 | 886 | 83 | 76 | 5522 |
| 1983 | 0 | 56 | 482 | 457 | 1239 | 172 | 143 | 564 | 62 | 3176 |
| 1984 | 0 | 60 | 215 | 463 | 235 | 982 | 128 | 208 | 292 | 2583 |
| 1985 | 0 | 1551 | 380 | 150 | 209 | 117 | 437 | 61 | 118 | 3023 |
| 1986 | 5 | 38 | 2314 | 176 | 140 | 134 | 131 | 226 | 37 | 3201 |
| 1987 | 0 | 1868 | 115 | 1493 | 105 | 59 | 85 | 70 | 126 | 3921 |
| 1988 | 4 | 54 | 2154 | 107 | 711 | 91 | 26 | 39 | 143 | 3329 |

modified from Overholtz et. al. 1983
USA data for 1983-86 supplied by W. J. Overholtz
USA data for 1987 supplied by T. Polacheck

Table 14. Average weight(kg) at age of haddock caught by the commercial fishery in unit areas 5Zj and 5Zm.

| Year | Age Group | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9+ | Avg |
| 1964 | 0.50 | 0.83 | 1.12 | 1.43 | 1.64 | 2.01 | 2.40 | 2.64 | 2.97 | 1.25 |
| 1965 | 0.58 | 0.69 | 1.03 | 1.35 | 1.67 | 1.99 | 2.26 | 2.66 | 3.11 | 0.90 |
| 1966 | 0.58 | 0.73 | 0.89 | 1.26 | 1.70 | 2.07 | 2.28 | 2.87 | 3.18 | 1.03 |
| 1967 | 0.66 | 0.70 | 0.95 | 1.18 | 1.42 | 2.05 | 2.31 | 2.66 | 3.10 | 1.33 |
| 1968 | 0.59 | 0.81 | 1.05 | 1.32 | 1.57 | 2.10 | 2.32 | 2.62 | 2.86 | 1.60 |
| 1969 | 0.52 | 0.78 | 1.10 | 1.69 | 1.75 | 1.99 | 2.52 | 2.99 | 3.63 | 2.01 |
| 1970 | 0.71 | 1.27 | 1.22 | 1.93 | 2.19 | 2.39 | 2.58 | 3.23 | 3.75 | 2.63 |
| 1971 | 0.60 | 1.03 | 1.31 | 1.74 | 2.39 | 2.81 | 2.92 | 3.10 | 3.72 | 2.47 |
| 1972 | 0.62 | 1.03 | 1.74 | 2.04 | 2.42 | 2.92 | 3.06 | 3.44 | 3.66 | 2.91 |
| 1973 | 0.60 | 1.03 | 1.58 | 2.13 | 2.41 | 3.29 | 3.42 | 3.86 | 3.94 | 1.21 |
| 1974 | 0.72 | 1.06 | 1.82 | 2.32 | 2.83 | 3.76 | 4.05 | 3.92 | 4.26 | 1.35 |
| 1975 | 0.62 | 0.98 | 1.63 | 2.21 | 2.20 | 2.94 | 4.00 | 4.05 | 4.33 | 1.54 |
| 1976 | 0.60 | 0.99 | 1.39 | 1.99 | 2.66 | 2.63 | 3.69 | 4.67 | 4.94 | 1.79 |
| 1977 | 0.60 | 1.07 | 1.44 | 2.17 | 2.73 | 3.21 | 4.15 | 4.00 | 4.99 | 1.21 |
| 1978 | 0.60 | 0.94 | 1.50 | 2.04 | 2.79 | 3.19 | 3.37 | 3.61 | 5.11 | 1.61 |
| 1979 | 0.60 | 1.00 | 1.28 | 2.02 | 2.51 | 3.14 | 3.78 | 3.79 | 4.87 | 2.05 |
| 1980 | 0.60 | 0.72 | 1.20 | 1.93 | 2.30 | 2.94 | 3.86 | 4.13 | 4.83 | 1.09 |
| 1981 | 0.60 | 0.91 | 1.24 | 1.80 | 2.40 | 2.80 | 3.73 | 4.44 | 4.04 | 1.61 |
| 1982 | 0.60 | 0.92 | 1.41 | 1.94 | 2.44 | 2.83 | 3.35 | 4.00 | 3.73 | 2.03 |
| 1983 | 0.60 | 1.00 | 1.43 | 1.94 | 2.31 | 2.80 | 3.38 | 3.59 | 3.89 | 2.43 |
| 1984 | 0.60 | 0.86 | 1.31 | 1.74 | 2.17 | 2.67 | 2.98 | 3.39 | 3.62 | 2.48 |
| 1985 | 0.60 | 0.98 | 1.26 | 1.91 | 2.39 | 2.86 | 3.03 | 3.53 | 3.92 | 1.69 |
| 1986 | 0.60 | 0.95 | 1.38 | 1.84 | 2.42 | 2.86 | 3.04 | 3.54 | 4.08 | 1.76 |
| 1987 | 0.60 | 0.85 | 1.39 | 1.98 | 2.15 | 2.66 | 3.06 | 3.71 | 4.10 | 1.56 |
| 1988 | 0.42 | 0.98 | 1.33 | 1.83 | 2.24 | 2.45 | 3.20 | 3.32 | 3.73 | 1.71 |

modified from Clark et. al. 1982
USA data for 1980-86 supplied by W. J. Overholtz
USA data for 1987 supplied by T. Polacheck

Table 15. Estimated population numbers (000's) at the beginning of the year for haddock in unit areas 5Zj and 5Zm.

| YEAR | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 1-8 |
|---|---|---|---|---|---|---|---|---|---|
| 1964 | 243567 | 80962 | 11869 | 10519 | 14258 | 8563 | 2932 | 1762 | 374431 |
| 1965 | 17462 | 194617 | 58715 | 7554 | 6343 | 7530 | 4258 | 1411 | 297890 |
| 1966 | 2130 | 10030 | 103424 | 28298 | 3804 | 3242 | 3192 | 1810 | 155930 |
| 1967 | 6856 | 1692 | 5098 | 38798 | 14445 | 1855 | 1475 | 1552 | 71771 |
| 1968 | 233 | 4948 | 1288 | 2502 | 19816 | 5850 | 820 | 634 | 36091 |
| 1969 | 538 | 187 | 2715 | 738 | 1191 | 9745 | 3228 | 369 | 18713 |
| 1970 | 2601 | 439 | 148 | 1428 | 395 | 669 | 5191 | 1906 | 12777 |
| 1971 | 223 | 2109 | 289 | 114 | 914 | 240 | 452 | 3218 | 7560 |
| 1972 | 4800 | 183 | 1025 | 123 | 73 | 601 | 71 | 225 | 7100 |
| 1973 | 10586 | 3861 | 149 | 641 | 65 | 46 | 439 | 24 | 15811 |
| 1974 | 5851 | 7166 | 1955 | 120 | 299 | 22 | 20 | 315 | 15748 |
| 1975 | 4588 | 4771 | 4040 | 1323 | 97 | 215 | 17 | 15 | 15067 |
| 1976 | 56278 | 3657 | 3371 | 2344 | 889 | 78 | 154 | 12 | 66782 |
| 1977 | 8459 | 46005 | 2760 | 2488 | 1483 | 621 | 63 | 115 | 61994 |
| 1978 | 3691 | 6926 | 30470 | 2191 | 1787 | 1025 | 377 | 50 | 46517 |
| 1979 | 42713 | 3022 | 5239 | 16797 | 1621 | 1142 | 547 | 230 | 71311 |
| 1980 | 6198 | 34970 | 2461 | 3456 | 10287 | 1074 | 737 | 295 | 59478 |
| 1981 | 4659 | 5071 | 15884 | 1872 | 2428 | 5933 | 635 | 379 | 36861 |
| 1982 | 1565 | 3814 | 3271 | 7941 | 1133 | 1617 | 3650 | 356 | 23349 |
| 1983 | 2101 | 1236 | 2300 | 1734 | 4829 | 734 | 952 | 2187 | 16072 |
| 1984 | 13721 | 1720 | 961 | 1447 | 1006 | 2832 | 445 | 650 | 22783 |
| 1985 | 835 | 11234 | 1354 | 593 | 766 | 611 | 1430 | 249 | 17072 |
| 1986 | 16396 | 684 | 7794 | 764 | 350 | 438 | 394 | 775 | 27596 |
| 1987 | 1217 | 13420 | 525 | 4287 | 467 | 160 | 238 | 204 | 20518 |
| 1988 | 9627 | 996 | 9297 | 326 | 2159 | 287 | 78 | 118 | 22888 |
| 1989 | 348 | 7879 | 767 | 5663 | 170 | 1124 | 152 | 40 | 16143 |

Table 16. Estimated fishing mortality rate for haddock in unit areas 5Zj and 5Zm. Fishing mortality for age 8 is set equal to the aggregate mortality rte for age groups 4 to 7.

| YEAR | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| 1964 | 0.02 | 0.12 | 0.25 | 0.31 | 0.44 | 0.50 | 0.53 | 0.41 |
| 1965 | 0.35 | 0.43 | 0.53 | 0.49 | 0.47 | 0.66 | 0.66 | 0.55 |
| 1966 | 0.03 | 0.48 | 0.78 | 0.47 | 0.52 | 0.59 | 0.52 | 0.49 |
| 1967 | 0.13 | 0.07 | 0.51 | 0.47 | 0.70 | 0.62 | 0.64 | 0.54 |
| 1968 | 0.02 | 0.40 | 0.36 | 0.54 | 0.51 | 0.39 | 0.60 | 0.49 |
| 1969 | 0.00 | 0.03 | 0.44 | 0.43 | 0.38 | 0.43 | 0.33 | 0.43 |
| 1970 | 0.01 | 0.22 | 0.06 | 0.25 | 0.30 | 0.19 | 0.28 | 0.24 |
| 1971 | 0.00 | 0.52 | 0.66 | 0.25 | 0.22 | 1.02 | 0.50 | 0.33 |
| 1972 | 0.02 | 0.01 | 0.27 | 0.44 | 0.27 | 0.11 | 0.89 | 0.17 |
| 1973 | 0.19 | 0.48 | 0.01 | 0.56 | 0.88 | 0.63 | 0.13 | 0.60 |
| 1974 | 0.00 | 0.37 | 0.19 | 0.01 | 0.13 | 0.05 | 0.05 | 0.09 |
| 1975 | 0.03 | 0.15 | 0.34 | 0.20 | 0.03 | 0.13 | 0.16 | 0.18 |
| 1976 | 0.00 | 0.08 | 0.10 | 0.26 | 0.16 | 0.01 | 0.09 | 0.22 |
| 1977 | 0.00 | 0.21 | 0.03 | 0.13 | 0.17 | 0.30 | 0.03 | 0.17 |
| 1978 | 0.00 | 0.08 | 0.40 | 0.10 | 0.25 | 0.43 | 0.29 | 0.21 |
| 1979 | 0.00 | 0.01 | 0.22 | 0.29 | 0.21 | 0.24 | 0.42 | 0.28 |
| 1980 | 0.00 | 0.59 | 0.07 | 0.15 | 0.35 | 0.33 | 0.47 | 0.30 |
| 1981 | 0.00 | 0.24 | 0.49 | 0.30 | 0.21 | 0.29 | 0.38 | 0.27 |
| 1982 | 0.04 | 0.31 | 0.43 | 0.30 | 0.23 | 0.33 | 0.31 | 0.30 |
| 1983 | 0.00 | 0.05 | 0.26 | 0.34 | 0.33 | 0.30 | 0.18 | 0.34 |
| 1984 | 0.00 | 0.04 | 0.28 | 0.44 | 0.30 | 0.48 | 0.38 | 0.44 |
| 1985 | 0.00 | 0.17 | 0.37 | 0.33 | 0.36 | 0.24 | 0.41 | 0.31 |
| 1986 | 0.00 | 0.06 | 0.40 | 0.29 | 0.58 | 0.41 | 0.46 | 0.39 |
| 1987 | 0.00 | 0.17 | 0.28 | 0.49 | 0.29 | 0.52 | 0.50 | 0.47 |
| 1988 | 0.00 | 0.06 | 0.30 | 0.45 | 0.45 | 0.43 | 0.46 | 0.46 |

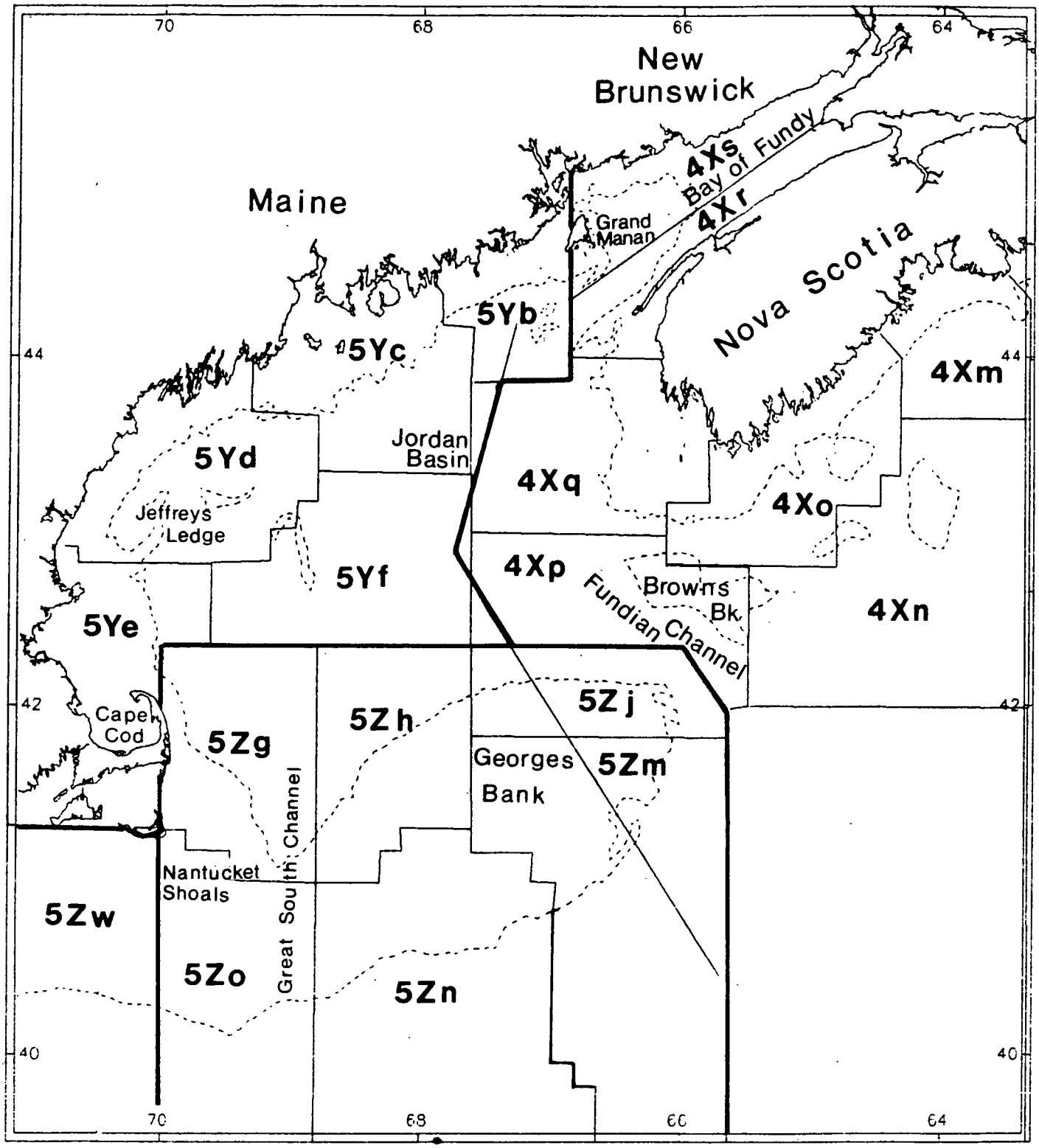


Fig. 1. Map of the Gulf of Maine area showing unit areas.

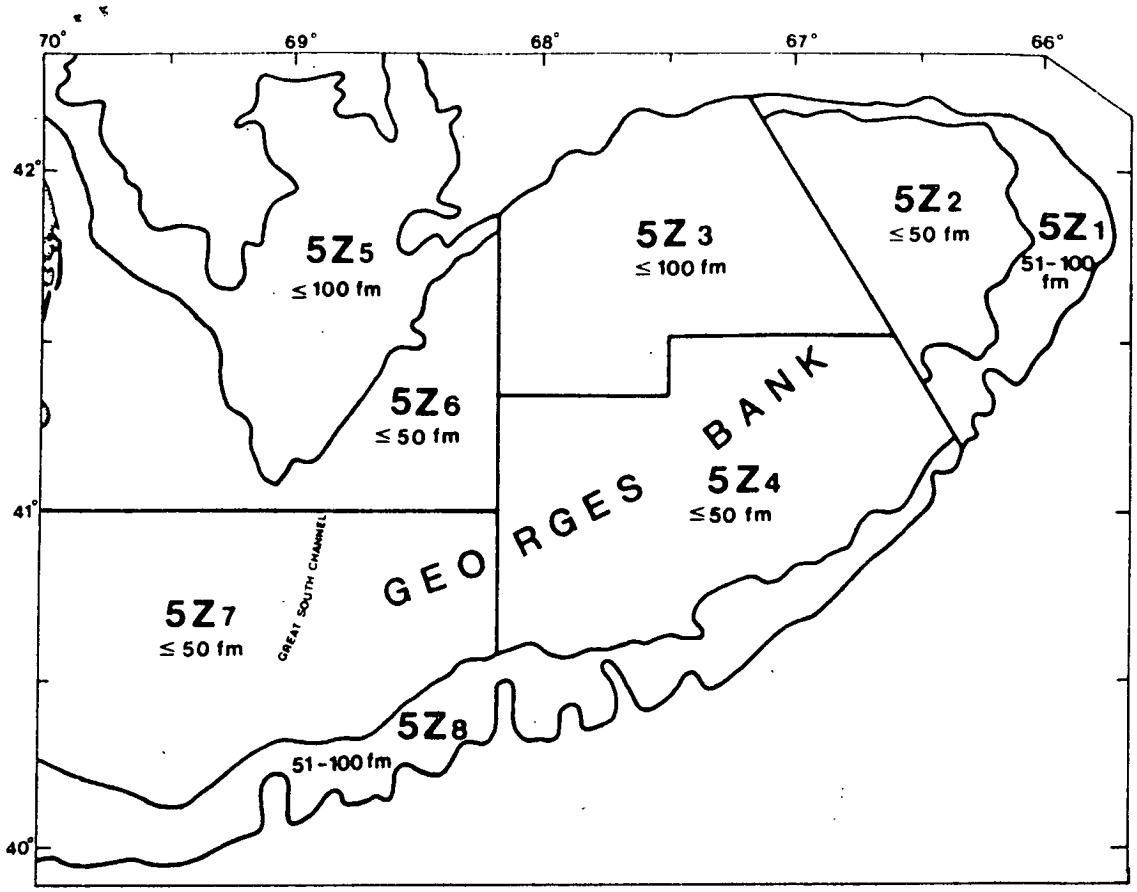


Fig. 2 Stratification scheme used for the Canadian survey of Georges Bank since 1987.

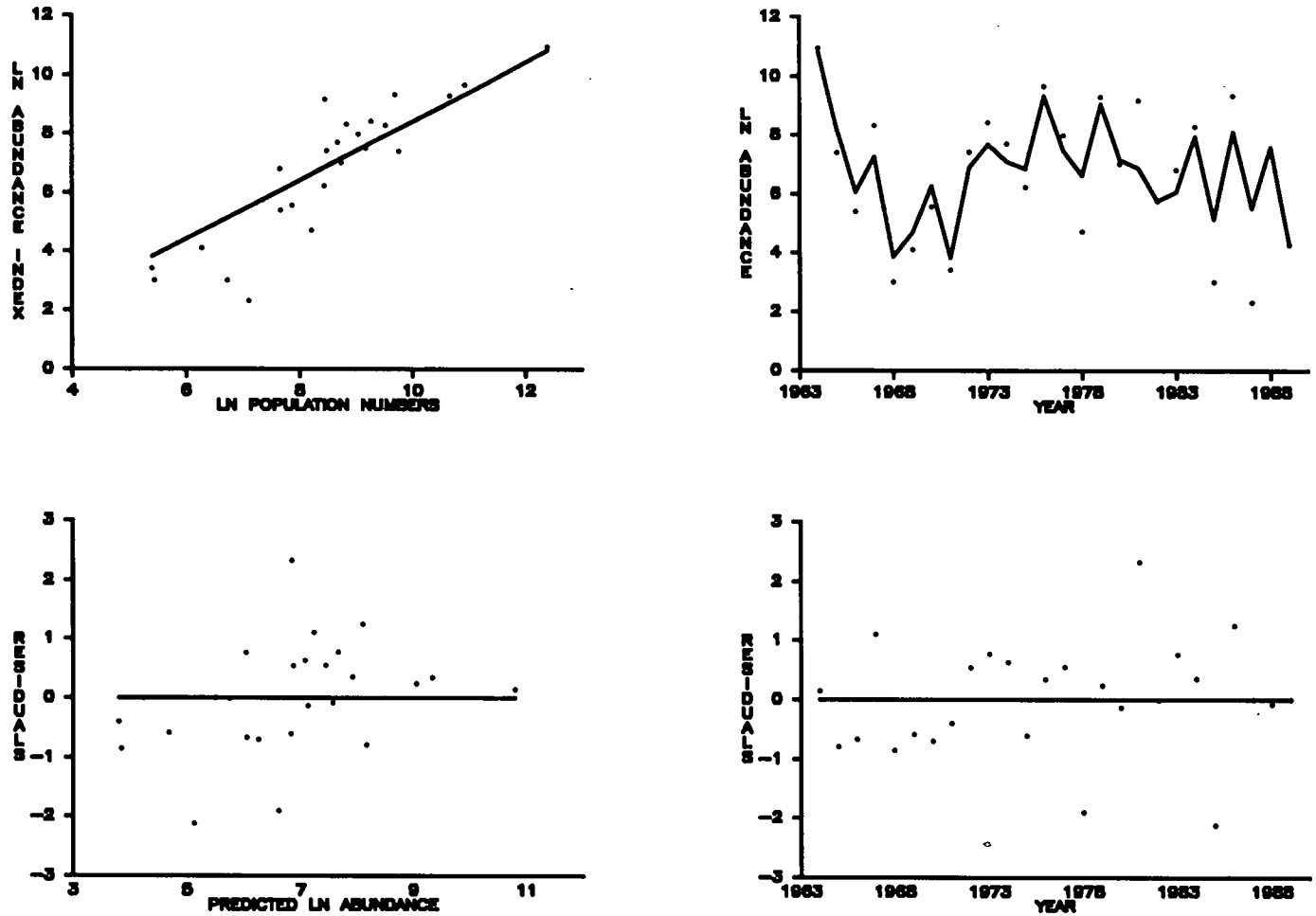


Fig. 3 Diagnostics for age 1 haddock in unit areas 5Zj and 5Zm.

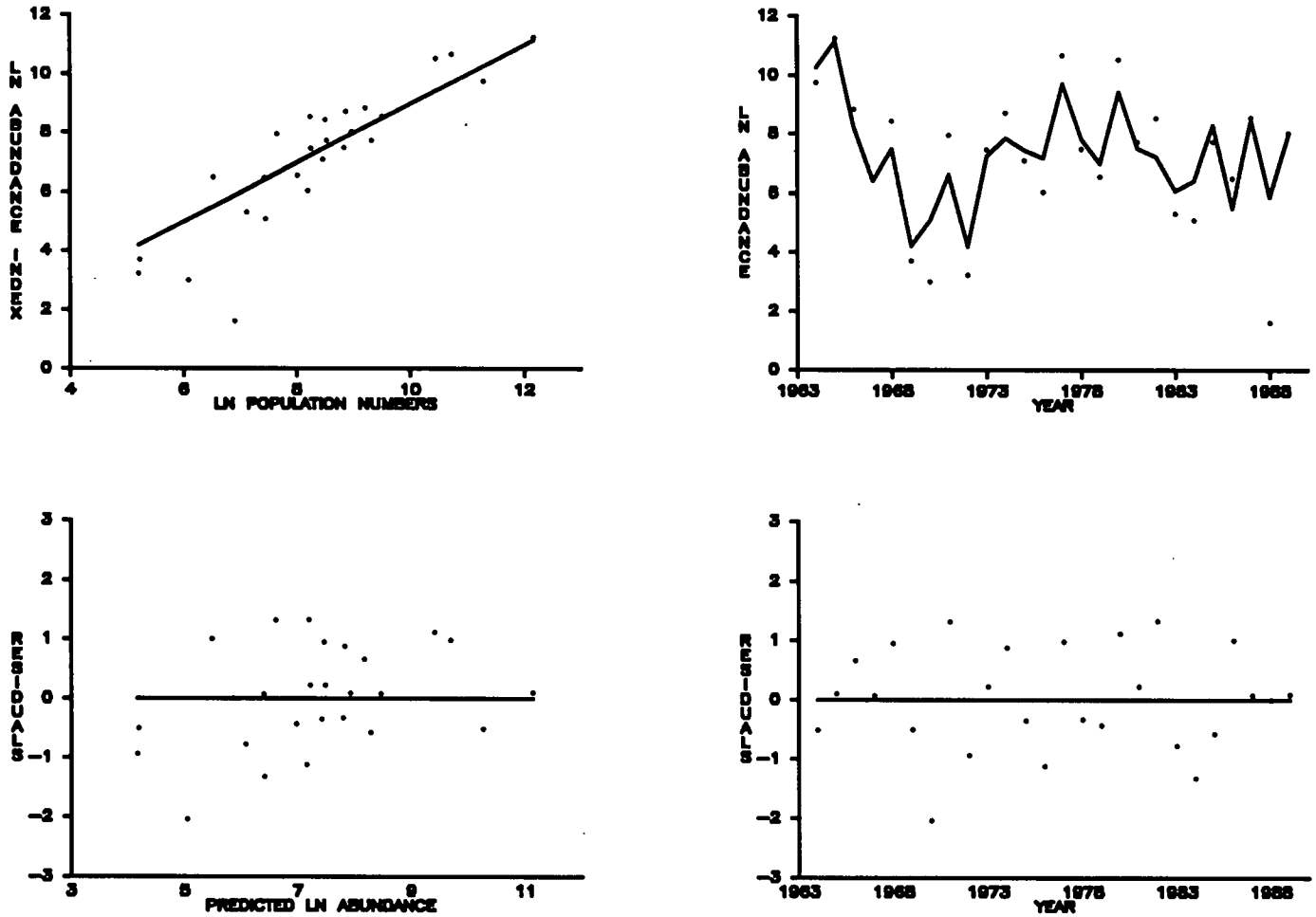


Fig. 4 Diagnostics for age 2 haddock in unit areas 5Zj and 5Zm.

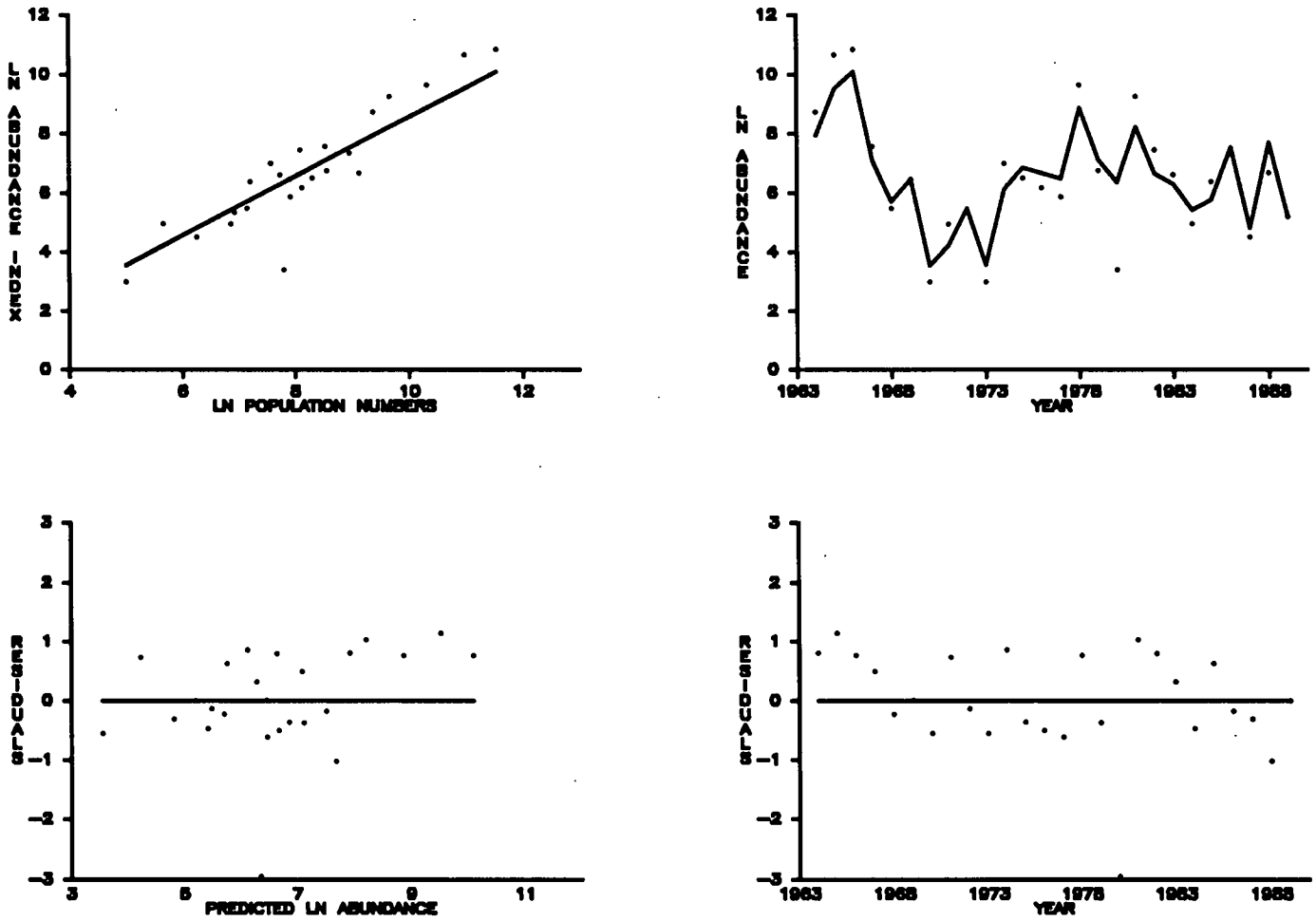


Fig. 5 Diagnostics for age 3 haddock in unit areas 5Zj and 5Zm.

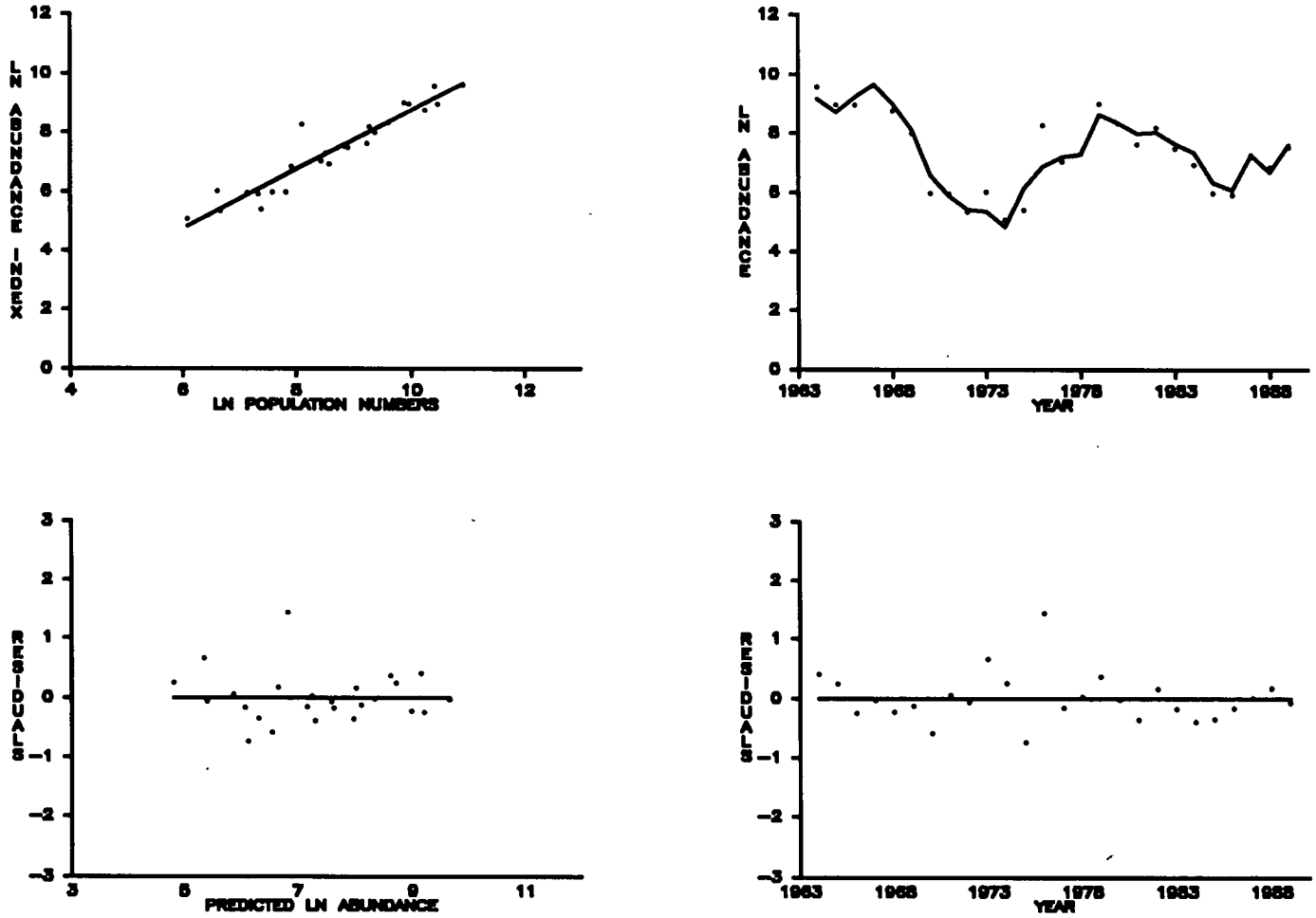


Fig. 6 Diagnostics for ages 4—6 haddock in unit areas 5Zj and 5Zm.

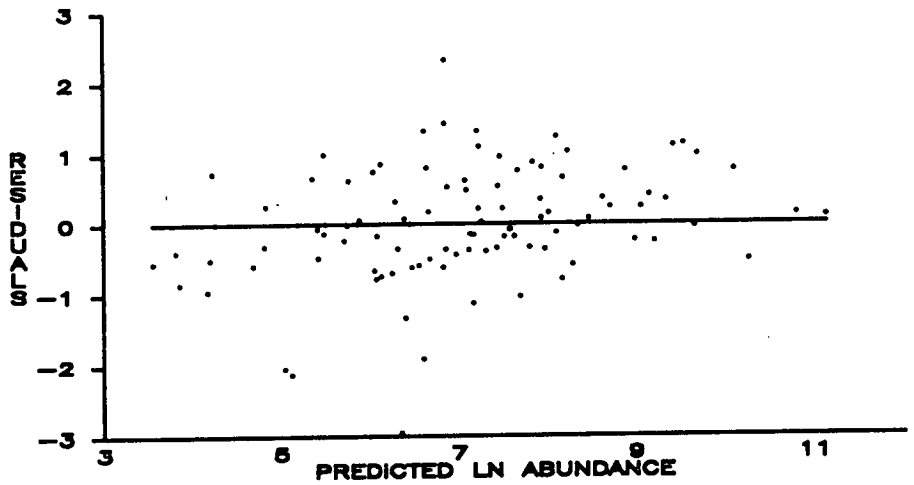


Fig. 7 Plot of residuals for all ages of haddock in unit areas 5Zj and 5Zm.

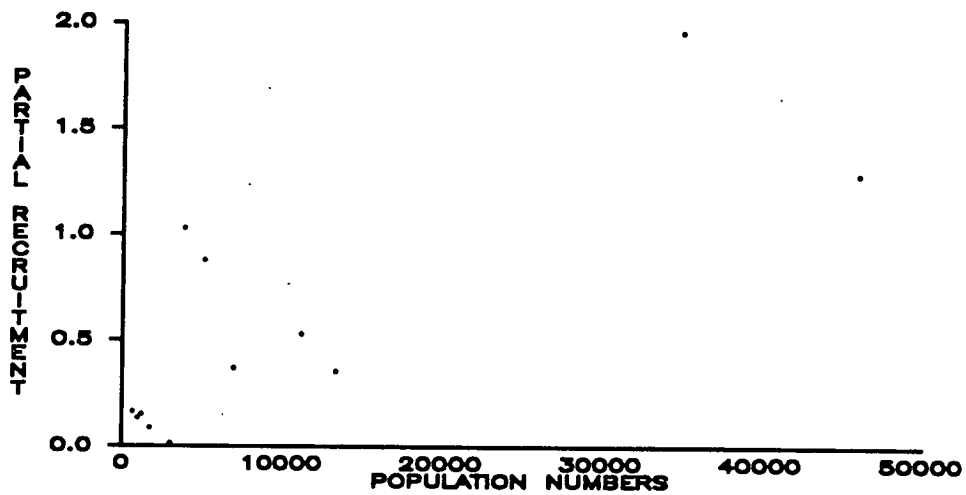


Fig. 8 Relationship between partial recruitment and population size at age 2 for haddock in unit areas 5Zj and 5Zm.