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## REVIBIOAS TO THE 4T HERRTIG CNTCH-AT-AGE MRNRICES

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#### Abstract

The catch-at-age matrices for spring- and fall-spawning herring in NAFO division $4 T$ were revised for the years 1974 to 1988 and the procedures used are documented here. Commercial samples were handled by three laboratories at various times during this period, resulting in inconsistent age or spawninggroup assignment between years and laboratories. Errors in data files were corrected and landings were updated before proceeding with the catch-at-age calculations. Fish sampled in 1985-1988 were reassigned to a spawning group by gonadal maturity stage or by visual inspection of otolith characteristics to be consistent with prior methodology.

The new catch-at-age differs slightly from previous matrices, the more notable differences being found at extreme ages. Despite the spawning-group reassignment applied to some years, the numbers-at-age for those years were not altered to any greater extent than those of other years.


## Résumé

Les matrices de capture à l'âge pour les géniteurs printemps et automne du hareng de la division 4 T de l'OPANO ont été reconstruites pour les années 1974-1988, et les méthodes employées pour ce faire sont présentées. Les échantillons tirés de la pêche commerciale ont été analysés par trois laboratoires differents au cours de cette période, ce qui a créé des différences dans la classification du type géniteur et de l'âge entre les laboratoires et au cours des années. Les erreurs découvertes dans les fichiers ont été corrigées et les prises ont été mises à jour avant de procéder à la révision des matrices. Le type géniteur des poissons échatillonnés entre 1985 et 1988 a été révisé en se servant soit du stade de maturité des gonades ou des caractères de l'otolithe, pour mieux se conformer aux méthodes employées par le passé.

Les nouvelles matrices different quelque peu des antécédentes, notamment pour les âges extrêmes. Les changements apportés à la méthode de classification du type géniteur pour les années 1985-1988 ne semblent guère avoir augmenté les différences entre les nouveaux et anciens chiffres de capture à l'âge.

The CAFSAC Advisory Document 86/19 (Anon., 1986) recommended that the catch- and weight-at-age matrices for 4 T herring be reconstructed. Several factors were suspected of having introduced inconsistencies in the matrices. The problems stemmed in part from successive transfers of responsibilities and information, lack of documentation about laboratory procedures, and differences in year-class and spawning-group assignment between laboratories and years. The 1974-1980 commercial samples for 4 T were processed in St. Andrews and aged in St. John's. The 1981 samples were processed in St. Andrews and aged in both St. Andrews and St. John's (the final ages on file were from St. Andrews). The 1982 samples were processed in St. Andrews up to September and from then on in Quebec. The St. Andrews samples were aged by the Gulf Region's ager (transferred from St. Andrews). Starting in 1983, 4 T samples were processed and aged in Moncton, and the data files were stored on site. Starting in 1984, sampling for detailed information switched from random to stratified subsampling (Ahrens, 1985b).

Many changes in methodology for calculating weights-at-age took place between 1971 and 1985 (Ahrens, 1985a). From 1971 to 1973, weights for 4 T herring were derived from samples drawn from the winter purse-seine fishery in Subdivision 3Pn. From 1974 to 1980, weights-at-age were estimated from the spring fishery along the Edge of the Laurentian Channel. When this fishery ended, weights were obtained from spring gillnet samples (1981 and 1982). For the 1983 and 1984 fisheries, weights were derived from the weighted averages of fish weights in all 4 f fisheries. Such inconsistencies yielded a weight-at-age matrix that did not match reported landings when multiplied by the catch-at-age matrix. In 1985, the weight matrix was revised by applying the observed average weights for each year between 1971 and 1976, and by averaging the 1981-to-1984 weights for the period 1977 to 1984. In subsequent assessments, no mention was made of the methodology used to derive weights-at-age, and previous symptoms in the matrices persisted.

Furthermore, changes in methodology used over the years to determine the spawning group of sampled individuals added to the mounting evidence against the reliability of the matrices. Starting with 1974, spawning group was assigned mainly by gonad maturity, using otolith type when maturity stage was ambiguous (Cleary et al., 1982). When the two methods gave different answers, the one that seemed most definite took precedence (the gonad-maturity schedule adopted by CAFSAC was followed, but the overwintering stages were considered less certain and were
therefore likely to be discarded in favour of a "clear-cut" otolith type. In 1985, the Gulf Region started using Discriminant Analysis of otolith morphometrics, which was meant to replace the ager's evaluation of otolith type when maturity stage was ambiguous. It was felt that using a Discriminant score would be an objective way of evaluating otolith morphology, not subject to within- and among- ager variability. The region was asked to document and justify this method. Messieh et al. (1989) have done so but provide little information on the selection of the classification data sets, which we know was inconsistent from year to year and often included the ager's opinion of otolith type (thus generating tautological classifications). The method was to be re-examined and documented here as well but this could not be done in the time available and had to be postponed. Instead, spawning group was reassigned for samples collected between 1985 and 1988 by a method more consistent with previous methodology, namely gonad ripeness in season or alternately otolith morphology as evaluated by the ager (see Methods below).

This document outlines the revisions to the previous (in effect up to 1989) catch- and weight-at-age matrices. Unexpected errors in the data files and in the landings were discovered and were edited before reconstructing the matrices. The effect of each revision step on the matrices is being documented with the revised 1989 assessment (Claytor and Dupuis, 1990).

## Methods

a) Catch data

The landings for particular gear types, fishing seasons and unit areas (or "cells") that had been used to generate the catch-at-age for the 4 T herring assessments up to 1989 rarely added up to the total landings for that year. The compilation method was not documented in the assessment documents. Landing statistics were therefore recompiled. Updated landing statistics for 4 T from 1974 to 1982 were drawn from McMillan et al. (1984). Quebec's 1982 statistics were not included in this report and were therefore obtained from Table 5 in the NAFO Statistical Bulletin (NAFO, 1984). Starting with 1983, Maritime landings were compiled from the Gulf Region's purchase slip files, to which Quebec totals were added. The latter were obtained either from Statistical Bulletins (1983-1985), NAFO data tape (1986) or ZIFF file (1987). Landings for 1987 and 1988 are preliminary.

Landings (round weight in kg ) for each gear, month, and unit area were pooled into "cells" defined by gear type (fixed and
mobile), fishing season (spring and fall), and aggregated statistical unit areas (431-435, 436, 437-439) for each year. They were later rounded off to the nearest metric tonne (MT). When the statistical unit area of a landing was unknown ('4Tu'), as sometimes occurred in the Maritimes or Quebec Region's reports, it was reallocated proportionally to specific $4 T$ pooled areas fished with the same gear and in the same season. In 1975 and 1977, there were no landings reported for fixed gear during any month, in any specific area, but such landings listed under '4Tu' were considerable. They were reallocated to specific pooled areas by calculating, for 1974, 1976 and 1978 , the average relative catches in the three areas and applying these proportions to the catch recorded for 4 Tu . The averages were based on only those years because the relative importance of the two fishing seasons and gear types shifted in subsequent years.

## b) Commercial sampling

Data files, consisting of random length-frequency samples from which random detailed samples were drawn, were copied from the CYBER at BIO for 1974 to 1982, except for the years 19781981, which were obtained from the $S t$. Andrews magnetic tape collection. Data files generated before 1974 cannot be used because the errors, missing data and unreliable spawning-group and age assignments cannot be corrected.

Attempts to match length-frequency with detailed biological data revealed pervasive errors and missing information for identifying samples in these data files. Length-frequency and biological samples were therefore renumbered and obvious keypunching and coding errors were corrected by checking photocopies of data sheets filled out by samplers and laboratory technicians. For 1980 and 1981, several data sheets had not been keypunched or had been deleted, and therefore were restored. Once data files had been reorganized, length-weight regressions were executed to flag outliers. Such data points were examined in concert with gonad maturity and weight, and were either retained (if the length-weight relationship seemed plausible), edited (if a keypunching error was found), or deleted (if the error was untraceable).

There have been several changes in the procedures used to determine age and spawning-group affinity over the years, which reduce consistency across years. Thus the reconstruction of the catch-at-age matrices was based on the method most consistently applicable to all years, namely maturity stage if unambiguous (stages 5,6 and 7, with July 1 delineating the spring and fall spawning seasons), or alternately otolith type as evaluated by the ager (Cleary et al., 1982). This technique was applied to
the 1985-1988 samples to regenerate age and spawning-group data. In 1985, however, maturity stages were determined in part by unsupervised temporary helpers, with the result that maturity stages seemed unreliable and were deleted from the current file altogether. For 1985, therefore, all fish were assigned to a spawning group by the ager's evaluation of otolith type, whereas normally 50-80\% the fish sampled in a given year get classified according to maturity stage (weighted average for the 1980s, excluding 1985, is 63\%).

After editing the data files, the length-frequency samples were matched to their corresponding biological data to create a master data file, for each spawning group, of numbers aged at length in each sample. Samples were then pooled by area, fishing season and gear type (or "cells"). The corrections outlined above usually increased the effective sample sizes, but unfortunately did not rectify the sampling deficiency for certain cells (Table 1).

The detailed samples were used to construct age-length relationships specific to each cell (some of the fish that were used for regressing weight on length could not be aged, and were therefore subsequently excluded from the age-length key). When cell samples were missing or too small to be reliable (because of a low $r^{2}$ for the length-weight regression or very few length groups represented in the sample), other samples had to be substituted to construct the age-length key. The substitutions to be applied were determined by the considerations listed below.

1 - The unknown spawning-group composition (percentage by number) of the landings from one cell was estimated by taking the average (weighted by sample size) of the percentages in the equivalent cell for the two most recent and the two subsequent years available (Table 1). As an example, the South Spring Mobile catch in 1976 would be estimated by averaging the percentages observed in the equivalent cell in 1974, 1975, 1977 and 1978. Table 1 indicates, however, that there was no sampling in 1974 or 1977 , limiting the number of "most recent" cells to one (1975) and shifting the two "subsequent" available years to 1978 and 1979. The percentage estimate is required to adjust the numbers-at-age calculated with the substitute sample, as the latter is rarely composed of the same proportions of spring and fall spawners as those estimated for the missing sample. We assume that population composition for a cell is similar across years. This seems more likely than relying on a population from a different area, season or gear. For unit area 436 and unit areas 437-439, however, the Spring, Mobile-gear fishery was never sampled, preventing any estimation of spawning-group composition based on adjacent years (Table 1). In this instance the percentage of spring spawners in the catch had to be estimated
from the Southern samples collected sporadically over the years.
2 - The age-length key for an empty cell is preferably derived from the samples from another cell in that year, rather than from the equivalent cell in another year, to avoid the possibility of interdependent age or size shifts between years. The possible choices in selecting a substitute cell were:
a) the same season and gear in a different area,
b) the same season and area but different gear,
c) the same season but a different area and gear,
d) for mobile gear only, the same area and gear but a different season, or
e) the same season, gear, and area in a different year.

Because fixed and mobile gears usually targetted fish of different maturity stages within the same area, the order of preference for these choices was usually as listed above but was determined in each case by comparing the size distributions and the regression coefficients of length-weight relationships in the relevant cells from better-sampled years. The final choice of a substitute sample was therefore particular to that case and was affected by the similarities noted in other years.

3 - Partial substitutions were also required when a sample was available (and could therefore reveal spawning-group composition) but consisted almost exclusively of one group. In such cases, the sample size of the rare spawning-group was often inadequate for its age-length determination. The decision steps outlined in 2) above were followed and another subsample was substituted.

## c) Catch-at-age matrices

Length-weight regressions were computed with the SAS package for both spring and fall spawners in each cell. The percentages of spring and fall spawners at each length were also calculated. The options defining a particular cell (area, fishing season and gear type) selected the appropriate samples in the master file, which, along with the corresponding regression parameters, total landings, and percentages-at-length were input into the FORTRAN program 'AGELEN' (Wright, 1990). This set of programs calculates the catch-at-age from equations found in Gavaris and Gavaris (1983). It generated an age-length key for each spawning group and projected it onto the landings for that cell. The numbers-at-age thus obtained were then summed to yield corresponding annual totals for fixed, mobile and all gears.

Average weight-at-age was simultaneously computed by AGELEN
for each spawning group in each cell. Annual weight estimates for fixed, mobile and all gears combined were obtained by averaging the weights-at-age (weighted by their corresponding catch) from all appropriate cells.

## Results and Discussion

Updated landings for NAFO Division 4T are grouped by area, fishing season and gear type in Table 1, along with the revised spawning-group composition and size of the biological samples available for each cell. In most cases the landings have increased from those previously used, but some values, most often in the north, show a decline. The most probable explanation for such reductions is the '4Tu' landings, which may have been allocated to specific areas differently in the past (the procedures were not documented).

In general, the corrections made to the data files have altered sample sizes and spawning-group composition by only a small percentage, when compared with Table 2 in CAFSAC Res. Doc. 89/63 (Chadwick et al., 1989). Sample sizes increased substantially in 1980 and 1981 due to newly keypunched samples. Other notable changes were found in 1985 and 1986: a few samples originally allocated to 4 Tl or to 4 Tq in fact belonged to 4 Tj or 4 Tg respectively, thereby increasing the south's sample size by 200\%. The percentage of spring spawners in this area also changed from $100 \%$ to $80 \%$. This drop and the $10-15 \%$ differences observed in most cells of 1986 are the result of the spawninggroup reassignment. It was discovered while editing the biological files that the 1987 and 1988 results of the Discriminant Analyses were inadvertently omitted from the assignment process, such that the reassignment incorporated into the revised matrices affected the spawning-group composition of 1985 and 1986 samples only.

The catch-at-age matrices (Tables 2-4) begin with 1974, although it is apparent from Table 1 that many cells were not sampled that year and therefore several substitutions for agelength keys were required. Mean weights-at-age are found in Table 5-7. The unusual changes in weight observed as one follows some cohorts across the years are attributable either to a low sample size for that cohort in a given year, or to the cohort's poor fit with the length-weight relationships observed in a given year. The new catch-at-age for spring and fall-spawning herring differs somewhat from that found in previous $4 T$ herring assessments (Table 8), and the largest deviations tend to occur at extreme ages and represent minor catches. Despite the
reassignment of spawning group using a more traditional method instead of Discriminant Analysis on otolith morphometrics, the numbers-at-age for 1985 and 1986 have not been altered to any greater extent than those of other years.

The impact of edited data files, updated landings and spawning-group reassignment upon the revised catch-at-age matrices are being documented individually, in conjunction with the revised 1989 assessment (Claytor and Dupuis, 1990). In addition, otolith characteristics, the application of Discriminant Analysis to otolith morphometrics, and the GSI model (McQuinn, 1989) as methods of assigning spawning group are being compared by the Gulf Region. The method deemed most useful will be subject to CAFSAC approval before being applied retroactively to historical data sets.

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We thank Gloria Nielsen for compiling and updating landings from the Gulf Region's ZIFF and Purchase-slip data files, and John Wright for repeatedly editing the AGELEN program to suit our specific needs. Ross Claytor and David Cairns made valuable comments on an earlier draught.

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Table 1. Landings in metric tonnes (MT) for NAFO Division 4 T by area, fishing season and gear type. 1987 1988 landings are provisional. Spring fishing: January-June, Fall fishing: July-December. Most fixed gears are gillnets; mobile gears are mainly purse seines. \%P: Percentage (by numbers) of spring spawners (P) in biological samples; $N$ : sample size; NS: no sample available (*), or inadequate for one of the spawning group (A or P).


Table 1. (cont'd)

|  |  | SOUTH ( 4 Tf-4Tk) |  |  |  | MIDDLE (4T) |  |  |  | NORTH (4Tm-4TO) |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | SPRING |  | FALL |  | SPRING |  | fall |  | SPRING |  | FALL |  |
|  |  | FIXED | mobile | FIXED | mosile | FIXED | mobile | FIXED | mobile | FIXED | mobile | FIXED | mobile |
| 1981 | MT | 2,386 | 21 | 3,272 | 3,081 | 4,028 | 0 | 2,381 | 14 | 1,087 | 0 | 5,572 | 93 |
|  | \% | 97 | 27 | 1 | 39 | 84 | -- | 1 | 18 | 83 | -- | 3 | 16 |
|  | N | 3157 | * | 400 | * | 494 | -- | 694 | * | 1053 | -- | 2291 | 759 |
|  | NS |  | * | P | * |  |  | P | * |  |  |  |  |
| 1982 | MT | 2,015 | 0 | 5,241 | 0 | 2,836 | 0 | 1,105 | 9 | 1,072 | 62 | 6,636 | 2,569 |
|  | \% | 98 | -- | 0 | -- | 100 | -- | 0 | 18 | 99 | 27 | 2 | 12 |
|  | $N$ | 4069 | -- | 298 | -- | 397 | -- | 75 | * | 772 | * | 1867 | 798 |
|  | NS |  |  |  |  |  |  |  | * | A | * |  |  |
| 1983 | MT | 1,911 | 0 | 5,177 | 85 | 5,097 | 19 | 1,572 | 3,256 | 1,515 | 0 | 7,091 | 148 |
|  | \% | 97 | -- | 0 | 22 | 93 | 27 | 5 | 18 | 96 | -- | 1 | 49 |
|  | $N$ | * | -- | 743 | * | 683 | * | 175 | * | 114 | -- | 1151 | 1200 |
|  | NS | * |  |  | * |  | * | P | * | A |  | P |  |
| 1984 | MT | 663 | 3 | 7,939 | 0 | 4,192 | 1 | 1,338 | 114 | 427 | 0 | 6,697 | 2,164 |
|  | \% | 76 | 27 | 0 | -- | 96 | 27 | 1 | 18 | 85 | -- | 6 | 63 |
|  | $N$ | 157 | * | 446 | -- | * | * | 406 | * | 143 | -- | 925 | 992 |
|  | NS |  | * |  |  | * | * | P | * |  |  |  |  |
| 1985 | MT | 2,352 | 0 | 9,362 | 0 | 3,902 | 0 | 1,413 | 0 | 963 | 0 | 12,932 | 7,022 |
|  | \% | 80 | -- | 8 | -- | 99 | -- | 2 | -- | 65 | -- | 29 | 43 |
|  | $N$ | 240 | -- | 449 | -- | 70 | -- | * | -- | 77 | -- | 336 | 429 |
|  | NS |  |  |  |  | A |  | * |  |  |  |  |  |
| 1986 | MT | 3,336 | 0 | 12,265 | 44 | 3,389 | 0 | 1,570 | 0 | 1,825 | 0 | 26,056 | 10,871 |
|  | \% | 93 | -- | 0 | 22 | 100 | -- | 2 | -- | 85 | -- | 13 | 62 |
|  | $N$ | 192 | -- | 663 | 36 | 204 | -- | * | -- | 281 | -- | 578 | 693 |
|  | NS |  |  |  |  |  |  | * |  |  |  |  |  |
| 1987 | MT | 3,600 | 0 | 18,198 | 78 | 3,738 | 0 | 1,970 | 13 | 4,386 | 0 | 31,862 | 13,613 |
|  | \%P | 94 | -- | 0 | 22 | 100 | -- | 0 | 18 | 93 | -- | 6 | 49 |
|  | $N$ | 258 | -- | 1692 | * | 232 | -- | 32 | * | 325 | -- | 1309 | 445 |
|  | NS |  |  |  | * |  |  |  | * |  |  |  |  |
| 1988 | MT | 2,050 | 0 | 15,034 | 226 | 3,967 | 1 | 3,785 | 1 | 6,616 | 0 | 22,266 | 17,423 |
|  | \% | 93 | -- | 1 | 22 | 94 | 27 | 0 | 18 | 70 | -- | 14 | 48 |
|  | $N$ | 572 | -- | 685 | * | 425 | * | 95 | * | 527 | -- | 763 | 530 |
|  | NS |  |  | P | * |  | * |  | * |  |  |  |  |

Table 2. Annual catch-at-age (1000s) of spring and fall spawners in 4 T , all gears combined.

ALL GEARS - SPRING SPAWNERS

| AGE | 1974 | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 |  |
| ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 1 | 107 | 0 | 35 | 1131 | 1434 | 6787 | 701 | 85 | 7 | 0 | 0 | 190 | 47 | 0 | 2467 |  |
| 2 | 2616 | 1058 | 16335 | 3541 | 16542 | 15870 | 12366 | 1674 | 772 | 305 | 237 | 1587 | 1639 | 306 | 5697 |  |
| 3 | 4932 | 20105 | 6679 | 58151 | 13469 | 14435 | 24371 | 12588 | 24424 | 16343 | 5366 | 8782 | 5379 | 2360 | 5797 |  |
| 4 | 4081 | 10670 | 36486 | 8676 | 52354 | 10846 | 11445 | 8131 | 4339 | 26786 | 16610 | 19159 | 24684 | 9357 | 10883 |  |
| 5 | 1978 | 2053 | 5117 | 8359 | 3736 | 37186 | 6957 | 2044 | 1063 | 2017 | 9884 | 16581 | 16783 | 29599 | 11132 |  |
| 6 | 22693 | 11944 | 1528 | 888 | 5814 | 5795 | 19340 | 1921 | 465 | 492 | 702 | 5804 | 17456 | 16648 | 19027 |  |
| 7 | 7646 | 21774 | 204 | 2569 | 1401 | 4393 | 9782 | 3258 | 350 | 64 | 86 | 1693 | 3561 | 14614 | 12458 |  |
| 8 | 4209 | 3082 | 7439 | 315 | 1123 | 1817 | 4482 | 1160 | 348 | 23 | 50 | 779 | 818 | 5572 | 7878 |  |
| 9 | 4968 | 3314 | 860 | 3584 | 181 | 772 | 2649 | 699 | 126 | 5 | 17 | 260 | 245 | 750 | 2544 |  |
| 10 | 605 | 4802 | 480 | 3873 | 4125 | 772 | 1185 | 512 | 91 | 0 | 5 | 4 | 131 | 509 | 196 |  |
| $11+$ | 5363 | 5837 | 3736 | 3459 | 2070 | 3125 | 1142 | 763 | 587 | 0 | 0 | 155 | 197 | 202 | 1878 |  |

ALL GEARS - FALL SPAWNERS

| AGE | 1974 | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 |  |
| ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: |
|  |  |  | 101 | 0 | 0 | 0 | 0 | 1115 | 148 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 | 2421 | 23 | 71 | 195 | 1512 | 2747 | 2364 | 358 | 203 | 210 | 36 | 264 | 557 | 62 | 3984 |  |
| 2 | 4478 | 4149 | 164 | 6995 | 23044 | 7010 | 39878 | 10107 | 7606 | 6850 | 1127 | 4353 | 2510 | 9090 | 3714 |  |
| 3 | 26000 | 5110 | 1976 | 10091 | 29774 | 38935 | 18275 | 30067 | 18424 | 26606 | 26157 | 16904 | 35492 | 39403 | 23612 |  |
| 4 | 9632 | 30464 | 5872 | 19178 | 15160 | 26002 | 23878 | 7476 | 21118 | 11157 | 14436 | 30191 | 20940 | 33195 | 43538 |  |
| 5 | 5032 | 8896 | 17483 | 8318 | 4672 | 12342 | 7705 | 3255 | 5488 | 14225 | 8892 | 13562 | 40368 | 25761 | 24846 |  |
| 6 | 18672 | 4122 | 4491 | 14338 | 5452 | 3392 | 4648 | 1585 | 2703 | 2152 | 6526 | 8188 | 21094 | 41792 | 22950 |  |
| 7 | 974 | 7228 | 3022 | 6408 | 19244 | 3374 | 1482 | 882 | 1118 | 1753 | 1588 | 3594 | 10967 | 18992 | 20477 |  |
| 8 | 4621 | 3049 | 5327 | 2484 | 1847 | 6294 | 1726 | 236 | 492 | 548 | 541 | 823 | 4185 | 10713 | 11800 |  |
| 9 | 3082 | 4490 | 1181 | 4884 | 2377 | 1282 | 1202 | 241 | 225 | 149 | 211 | 894 | 562 | 4526 | 4338 |  |
| 10 | 3962 | 19984 | 33949 | 19963 | 16893 | 9695 | 358 | 309 | 181 | 194 | 75 | 295 | 870 | 1778 | 3054 |  |

Table 3. Annual catch-at-age (1000s) for spring and fall spawners in fixed gear.

FIXED GEAR - SPRING SPAWNERS

| AGE | 1974 | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 |
| ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 1 | 1 | 0 | 0 | 17 | 0 | 105 | 0 | 85 | 7 | 0 | 0 | 0 | 0 | 0 | 57 |
| 2 | 107 | 51 | 0 | 40 | 4 | 17 | 205 | 947 | 52 | 73 | 11 | 360 | 50 | 150 | 487 |
| 3 | 3454 | 14335 | 1410 | 18158 | 5544 | 5974 | 11194 | 11285 | 23679 | 14226 | 3549 | 6085 | 3026 | 1325 | 3972 |
| 4 | 3160 | 3189 | 16902 | 2901 | 25449 | 2292 | 7078 | 7363 | 4246 | 25857 | 14001 | 16610 | 17926 | 7697 | 8942 |
| 5 | 1352 | 926 | 2610 | 4121 | 1142 | 17595 | 2693 | 2041 | 1057 | 1892 | 8501 | 15127 | 11485 | 22395 | 9895 |
| 6 | 15869 | 1737 | 528 | 489 | 1631 | 552 | 9204 | 1385 | 461 | 474 | 462 | 5145 | 11994 | 10559 | 13598 |
| 7 | 2674 | 6581 | 114 | 90 | 227 | 1214 | 1869 | 2929 | 331 | 54 | 44 | 1418 | 1675 | 9722 | 7842 |
| 8 | 2952 | 1360 | 3737 | 117 | 257 | 180 | 892 | 480 | 331 | 5 | 31 | 643 | 383 | 3504 | 5807 |
| 9 | 2951 | 1043 | 505 | 1082 | 88 | 131 | 764 | 459 | 125 | 1 | 2 | 75 | 24 | 681 | 1385 |
| 10 | 332 | 1497 | 300 | 22 | 1379 | 303 | 456 | 187 | 91 | 0 | 5 | 4 | 117 | 441 | 196 |
| $11+$ | 541 | 1211 | 2632 | 803 | 764 | 1266 | 683 | 761 | 583 | 0 | 0 | 9 | 137 | 169 | 598 |

FIXED GEAR - FALL SPAWNERS

| AGE | 1974 | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 |
| ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 1 | 0 | 0 | 0 | 0 | 0 | 903 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2 | 0 | 0 | 0 | 0 | 80 | 6 | 91 | 281 | 0 | 0 | 0 | 31 | 403 | 15 | 0 |
| 3 | 157 | 0 | 8 | 434 | 3520 | 532 | 8149 | 5406 | 2492 | 993 | 920 | 1966 | 1606 | 8166 | 1401 |
| 4 | 5577 | 1437 | 344 | 3164 | 5608 | 10754 | 5460 | 25698 | 15876 | 22006 | 25228 | 14054 | 33820 | 38450 | 21118 |
| 5 | 1764 | 6601 | 1845 | 480 | 3593 | 5789 | 6285 | 7187 | 18618 | 10225 | 13303 | 25547 | 17678 | 30658 | 40919 |
| 6 | 534 | 968 | 5052 | 384 | 904 | 2672 | 1023 | 3142 | 5152 | 12739 | 8235 | 10342 | 35098 | 20148 | 21742 |
| 7 | 2125 | 634 | 625 | 4013 | 958 | 907 | 1244 | 1457 | 2586 | 1927 | 6162 | 6622 | 18454 | 36671 | 14437 |
| 8 | 145 | 605 | 221 | 222 | 5103 | 1068 | 269 | 863 | 1048 | 1690 | 1529 | 2829 | 9483 | 14711 | 14841 |
| 9 | 1635 | 435 | 573 | 92 | 117 | 958 | 293 | 152 | 389 | 524 | 517 | 541 | 3402 | 9517 | 7868 |
| 10 | 383 | 475 | 72 | 664 | 521 | 265 | 302 | 240 | 114 | 108 | 211 | 481 | 362 | 4340 | 2832 |
| $11+\mid$ | 2582 | 1671 | 2500 | 1000 | 2589 | 710 | 52 | 309 | 58 | 162 | 74 | 27 | 745 | 1764 | 1475 |

Table 4. Annual catch-at-age (1000s) for spring and fall spawners in mobile gear.

MOBILE GEAR - SPRING SPAWNERS

| AGE | 1974 | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 |  |
| ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 1 | 2506 | 1114 | 1434 | 6681 | 701 | 0 | 0 | 0 | 0 | 190 | 47 | 0 | 2410 |  |  |  |
| 2 | 2508 | 1007 | 16335 | 3501 | 16538 | 15853 | 12161 | 727 | 720 | 232 | 226 | 1227 | 1589 | 155 | 5210 |  |
| 3 | 1478 | 5771 | 5269 | 39993 | 7925 | 8461 | 13177 | 1303 | 745 | 2117 | 1818 | 2697 | 2353 | 1035 | 1825 |  |
| 4 | 921 | 7481 | 19584 | 5775 | 26905 | 8555 | 4366 | 768 | 93 | 928 | 2609 | 2549 | 6758 | 1659 | 1941 |  |
| 5 | 627 | 1127 | 2507 | 4238 | 2594 | 19591 | 4265 | 3 | 6 | 125 | 1383 | 1454 | 5298 | 7204 | 1237 |  |
| 6 | 6824 | 10207 | 1000 | 400 | 4184 | 5243 | 10136 | 536 | 3 | 18 | 240 | 659 | 5463 | 6089 | 5429 |  |
| 7 | 4971 | 15193 | 90 | 2479 | 1174 | 3179 | 7913 | 329 | 19 | 10 | 42 | 275 | 1886 | 4892 | 4616 |  |
| 8 | 1257 | 1722 | 3702 | 199 | 866 | 1637 | 3590 | 679 | 17 | 17 | 19 | 136 | 435 | 2068 | 2070 |  |
| 9 | 2017 | 2271 | 355 | 2501 | 93 | 641 | 1885 | 239 | 1 | 4 | 14 | 185 | 220 | 69 | 1159 |  |
| 10 | 273 | 3305 | 179 | 3851 | 2746 | 469 | 729 | 326 | 1 | 0 | 0 | 0 | 14 | 68 | 0 |  |
| $11+$ | 4822 | 4625 | 1104 | 2656 | 1306 | 1859 | 459 | 2 | 5 | 0 | 0 | 146 | 59 | 32 | 1280 |  |

MOBILE GEAR - FALL SPAWNERS

| AGE | 1974 | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 |
| ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: |
| - |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 1 | 101 | 0 | 0 | 0 | 0 | 212 | 148 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 66 |
| 1 | 2421 | 23 | 71 | 195 | 1432 | 2741 | 2273 | 77 | 203 | 210 | 36 | 233 | 154 | 47 | 3984 |
| 3 | 4320 | 4149 | 155 | 6561 | 19524 | 6478 | 31729 | 4702 | 5114 | 5857 | 207 | 2387 | 903 | 924 | 2313 |
| 4 | 20423 | 3673 | 1632 | 6927 | 24166 | 28182 | 12815 | 4369 | 2548 | 4600 | 929 | 2850 | 1672 | 954 | 2494 |
| 5 | 7868 | 23863 | 4027 | 18698 | 11567 | 20212 | 17593 | 289 | 2500 | 933 | 1133 | 4644 | 3262 | 2537 | 2619 |
| 6 | 4498 | 7928 | 12431 | 7934 | 3767 | 9670 | 6682 | 112 | 336 | 1486 | 657 | 3220 | 5271 | 5613 | 3104 |
| 7 | 16547 | 3488 | 3866 | 10325 | 4494 | 2485 | 3404 | 129 | 116 | 225 | 364 | 1566 | 2640 | 5121 | 8514 |
| 8 | 829 | 6623 | 2801 | 6185 | 14142 | 2306 | 1213 | 19 | 70 | 62 | 60 | 765 | 1485 | 4281 | 5635 |
| 9 | 2985 | 2614 | 4754 | 2392 | 1730 | 5336 | 1433 | 84 | 103 | 23 | 25 | 282 | 783 | 1197 | 3932 |
| 10 | 2699 | 4015 | 1110 | 4220 | 1856 | 1017 | 900 | 1 | 111 | 42 | 0 | 413 | 200 | 186 | 1506 |
| $11+$ | 6380 | 18314 | 31449 | 18963 | 14305 | 8986 | 305 | 0 | 123 | 32 | 1 | 268 | 125 | 13 | 1580 |

Table 5. Mean weight-at-age (kg) of spring and fall spawners caught in 4 T , all gears combined.

## ALL GEARS - SPRING SPAWNERS

| AGE ${ }^{\text {\| }}$ | 1974 | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1 | 0.0537 | 0 | 0.064 | 0.101 | 0.0779 | 0.0953 | 0.1361 | 0.1128 | 0.0316 | 0 | 0 | 0.0872 | 0.089 | 0 | 0.0834 |
| 2 | 0.125 | 0.086 | 0.1405 | 0.1401 | 0.1307 | 0.1654 | 0.1629 | 0.1573 | 0.142 | 0.1376 | 0.1481 | 0.1702 | 0.1404 | 0.1408 | 0.116 |
| 3 | 0.1606 | 0.1526 | 0.1626 | 0.1832 | 0.1704 | 0.1483 | 0.1658 | 0.1834 | 0.1747 | 0.1556 | 0.1809 | 0.1886 | 0.1796 | 0.1982 | 0.1716 |
| 4 | 0.2084 | 0.1742 | 0.1888 | 0.1965 | 0.2268 | 0.1665 | 0.1852 | 0.2338 | 0.2077 | 0.2099 | 0.1991 | 0.2231 | 0.2137 | 0.1990 | 0.2168 |
| 5 | 0.2299 | 0.2091 | 0.2108 | 0.2347 | 0.245 | 0.243 | 0.2342 | 0.2636 | 0.2624 | 0.2386 | 0.2179 | 0.2492 | 0.2498 | 0.2348 | 0.2401 |
| 6 | 0.2537 | 0.2026 | 0.2301 | 0.2638 | 0.2789 | 0.2349 | 0.2662 | 0.3288 | 0.3175 | 0.2738 | 0.3011 | 0.2803 | 0.2771 | 0.2748 | 0.2837 |
| 7 | 0.2818 | 0.2547 | 0.2674 | 0.2847 | 0.3103 | 0.2859 | 0.2555 | 0.326 | 0.3816 | 0.3326 | 0.373 | 0.3379 | 0.3156 | 0.2928 | 0.3058 |
| 8 | 0.2864 | 0.2937 | 0.2963 | 0.2786 | 0.3439 | 0.3018 | 0.2728 | 0.3016 | 0.3801 | 0.2528 | 0.4025 | 0.3767 | 0.3466 | 0.3052 | 0.3209 |
| 9 | 0.2963 | 0.3212 | 0.3169 | 0.311 | 0.3311 | 0.3231 | 0.3095 | 0.3411 | 0.4028 | 0.426 | 0.3401 | 0.4793 | 0.3152 | 0.3158 | 0.3609 |
| 10 | 0.3077 | 0.3176 | 0.3185 | 0.3238 | 0.3563 | 0.328 | 0.3546 | 0.3279 | 0.4058 | 0 | 0.3818 | 0.386 | 0.3143 | 0.3287 | 0.3959 |
| $11+1$ | 0.3429 | 0.3623 | 0.3189 | 0.3468 | 0.3876 | 0.3793 | 0.394 | 0.3973 | 0.4445 | 0 | 0 | 0.3262 | 0.4046 | 0.4163 | 0.3922 |

ALL GEARS - FALL SPAWNERS

| AGE | 1974 | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1 | 0.0498 | 0 | 0 | 0 | 0 | 0.0311 | 0.0318 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0726 |
| 2 | 0.0665 | 0.0566 | 0.0887 | 0.1178 | 0.0972 | 0.1128 | 0.1023 | 0.1284 | 0.0949 | 0.1073 | 0.1047 | 0.1176 | 0.1558 | 0.1408 | 0.0934 |
| 3 | 0.1352 | 0.1103 | 0.1802 | 0.138 | 0.1458 | 0.1218 | 0.1596 | 0.1931 | 0.1819 | 0.1742 | 0.2208 | 0.2242 | 0.1845 | 0.2313 | 0.1981 |
| 4 | 0.1968 | 0.2 | 0.1866 | 0.214 | 0.2208 | 0.1984 | 0.2036 | 0.2425 | 0.2486 | 0.2439 | 0.2455 | 0.2647 | 0.2476 | 0.2469 | 0.2608 |
| 5 | 0.2333 | 0.2388 | 0.2219 | 0.2249 | 0.2634 | 0.2368 | 0.2676 | 0.3065 | 0.2729 | 0.2816 | 0.2824 | 0.2928 | 0.2867 | 0.2810 | 0.2909 |
| 6 | 0.2637 | 0.2662 | 0.2722 | 0.2583 | 0.2793 | 0.2697 | 0.2921 | 0.3601 | 0.3175 | 0.3126 | 0.3182 | 0.3224 | 0.3206 | 0.3145 | 0.3244 |
| 7 | 0.2629 | 0.2994 | 0.2875 | 0.2974 | 0.2949 | 0.3095 | 0.309 | 0.3873 | 0.3659 | 0.3453 | 0.3443 | 0.3548 | 0.3588 | 0.3414 | 0.3404 |
| 8 | 0.316 | 0.3028 | 0.3192 | 0.2995 | 0.3351 | 0.3426 | 0.3281 | 0.4054 | 0.3677 | 0.3636 | 0.3924 | 0.3737 | 0.3759 | 0.3663 | 0.3676 |
| 9 | 0.314 | 0.3269 | 0.328 | 0.3203 | 0.3173 | 0.355 | 0.3455 | 0.3809 | 0.3594 | 0.3701 | 0.4079 | 0.3972 | 0.3892 | 0.3793 | 0.3925 |
| 10 | 0.3071 | 0.3337 | 0.3551 | 0.328 | 0.3194 | 0.3673 | 0.3836 | 0.472 | 0.3386 | 0.3929 | 0.3918 | 0.3938 | 0.4027 | 0.3889 | 0.4008 |
| 11+\| | 0.352 | 0.3653 | 0.3812 | 0.3545 | 0.386 | 0.3824 | 0.4155 | 0.4246 | 0.4236 | 0.4311 | 0.4869 | 0.4597 | 0.4138 | 0.4305 | 0.43 |

Table 6. Mean weight-at-age (kg) of spring and fall spawners caught in 4 T with fixed gear.

FIXED GEAR - SPRING SPAWNERS

| AGE | 1974 | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 |  |
| :---: | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 1 | 0.0537 | 0 | 0 | 0.101 | 0 | 0.0194 | 0 | 0.1128 | 0.0316 | 0 | 0 | 0 | 0 | 0 | 0.0386 |  |
| 2 | 0.1129 | 0.1146 | 0 | 0.16 | 0.0798 | 0.1171 | 0.2265 | 0.1511 | 0.1762 | 0.1376 | 0.1123 | 0.2193 | 0.1811 | 0.0906 | 0.0818 |  |
| 3 | 0.1573 | 0.1536 | 0.1594 | 0.1562 | 0.149 | 0.1673 | 0.1573 | 0.1812 | 0.1735 | 0.151 | 0.1684 | 0.184 | 0.1575 | 0.1752 | 0.1663 |  |
| 4 | 0.2057 | 0.1941 | 0.1854 | 0.1882 | 0.1852 | 0.1997 | 0.1719 | 0.231 | 0.2072 | 0.2093 | 0.1939 | 0.2209 | 0.2007 | 0.1883 | 0.2073 |  |
| 5 | 0.2254 | 0.2292 | 0.2177 | 0.2217 | 0.2038 | 0.2319 | 0.2182 | 0.2636 | 0.2623 | 0.2367 | 0.2128 | 0.2472 | 0.2389 | 0.2159 | 0.236 |  |
| 6 | 0.2507 | 0.2493 | 0.2488 | 0.2611 | 0.2449 | 0.235 | 0.2664 | 0.3106 | 0.3175 | 0.2716 | 0.3032 | 0.2774 | 0.2645 | 0.2463 | 0.2622 |  |
| 7 | 0.2735 | 0.2773 | 0.2587 | 0.2629 | 0.2912 | 0.3047 | 0.2933 | 0.3304 | 0.3768 | 0.3358 | 0.3937 | 0.3384 | 0.3001 | 0.2703 | 0.2849 |  |
| 8 | 0.2849 | 0.2893 | 0.2868 | 0.274 | 0.299 | 0.3404 | 0.3268 | 0.3412 | 0.3833 | 0.2528 | 0.4444 | 0.3647 | 0.3448 | 0.2744 | 0.299 |  |
| 9 | 0.2937 | 0.3022 | 0.3087 | 0.2969 | 0.3271 | 0.345 | 0.3653 | 0.3725 | 0.4027 | 0.426 | 0.3903 | 0.4283 | 0.3285 | 0.3028 | 0.3347 |  |
| 10 | 0.3043 | 0.3115 | 0.2965 | 0.2998 | 0.3199 | 0.318 | 0.3723 | 0.3946 | 0.4057 | 0 | 0.3819 | 0.386 | 0.2981 | 0.3060 | 0.3959 |  |
| $11+$ | 0.3281 | 0.3383 | 0.3115 | 0.3239 | 0.3614 | 0.3507 | 0.3845 | 0.3973 | 0.4445 | 0 | 0 | 0.3414 | 0.4169 | 0.3991 | 0.3177 |  |

## FIXED GEAR - FALL SPAWNERS

| AGE | 1974 | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 |
| :---: | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 1 | 0 | 0 | 0 | 0 | 0 | 0.0231 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2 | 0 | 0 | 0 | 0 | 0.0808 | 0.1003 | 0.1922 | 0.1325 | 0 | 0 | 0 | 0.2332 | 0.1745 | 0.1405 | 0 |
| 3 | 0.1669 | 0 | 0.2134 | 0.1705 | 0.1378 | 0.2027 | 0.2072 | 0.2087 | 0.2094 | 0.1863 | 0.234 | 0.2629 | 0.2007 | 0.2345 | 0.2454 |
| 4 | 0.2227 | 0.2383 | 0.2609 | 0.2375 | 0.2373 | 0.2547 | 0.2565 | 0.246 | 0.255 | 0.2492 | 0.2466 | 0.2733 | 0.2488 | 0.2469 | 0.2647 |
| 5 | 0.2696 | 0.2772 | 0.2898 | 0.2791 | 0.2825 | 0.2945 | 0.3113 | 0.3087 | 0.2748 | 0.2844 | 0.2852 | 0.2988 | 0.292 | 0.2805 | 0.2921 |
| 6 | 0.2972 | 0.3155 | 0.3142 | 0.2873 | 0.306 | 0.3239 | 0.3597 | 0.3627 | 0.3201 | 0.3156 | 0.3217 | 0.3322 | 0.3263 | 0.3192 | 0.3247 |
| 7 | 0.3089 | 0.3341 | 0.3429 | 0.3222 | 0.3153 | 0.3583 | 0.3575 | 0.3906 | 0.3658 | 0.3488 | 0.3466 | 0.364 | 0.3665 | 0.3439 | 0.3512 |
| 8 | 0.3363 | 0.3436 | 0.3489 | 0.3375 | 0.3642 | 0.3992 | 0.3857 | 0.409 | 0.3694 | 0.3637 | 0.3953 | 0.3824 | 0.3849 | 0.3729 | 0.3774 |
| 9 | 0.3501 | 0.3732 | 0.3775 | 0.3598 | 0.3734 | 0.4143 | 0.4082 | 0.4482 | 0.374 | 0.3683 | 0.4104 | 0.4005 | 0.4001 | 0.3814 | 0.4013 |
| 10 | 0.3381 | 0.3783 | 0.3604 | 0.3699 | 0.3382 | 0.4288 | 0.4474 | 0.4712 | 0.3495 | 0.4588 | 0.3918 | 0.383 | 0.4488 | 0.3878 | 0.3973 |
| $11+$ | 0.3753 | 0.4007 | 0.4074 | 0.3927 | 0.4195 | 0.4201 | 0.4677 | 0.4246 | 0.388 | 0.427 | 0.4884 | 0.4741 | 0.4157 | 0.4306 | 0.4504 |

Table 7. Mean weight-at-age (kg) of spring and fall spawners caught in 4 T with mobile gear.
mobile gear - spring spahners

| AGE | 1974 | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |$|$

mobile gear - fall spawners

| AGE | 1974 | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| - |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 1 | 0.0498 | 0 | 0 | 0 | 0 | 0.0652 | 0.0318 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0726 |
| 2 | 0.0665 | 0.0566 | 0.0887 | 0.1178 | 0.0981 | 0.1129 | 0.0987 | 0.1133 | 0.0949 | 0.1073 | 0.1047 | 0.1024 | 0.107 | 0.1409 | 0.0934 |
| 3 | 0.134 | 0.1103 | 0.1784 | 0.1358 | 0.1473 | 0.1152 | 0.1473 | 0.1751 | 0.1685 | 0.1722 | 0.1617 | 0.1923 | 0.1558 | 0.2032 | 0.1694 |
| 4 | 0.1897 | 0.185 | 0.1709 | 0.2033 | 0.217 | 0.177 | 0.181 | 0.2218 | 0.2082 | 0.2186 | 0.2168 | 0.222 | 0.2234 | 0.2493 | 0.2278 |
| 5 | 0.2252 | 0.2281 | 0.1908 | 0.2235 | 0.2575 | 0.2202 | 0.252 | 0.2516 | 0.2584 | 0.2507 | 0.2484 | 0.2598 | 0.2575 | 0.2869 | 0.2725 |
| 6 | 0.2597 | 0.2602 | 0.251 | 0.2569 | 0.273 | 0.2547 | 0.2818 | 0.2872 | 0.2775 | 0.2875 | 0.2736 | 0.2909 | 0.2833 | 0.2974 | 0.3223 |
| 7 | 0.257 | 0.2931 | 0.2786 | 0.2878 | 0.2905 | 0.2918 | 0.2913 | 0.3497 | 0.3684 | 0.3161 | 0.3053 | 0.3157 | 0.3053 | 0.3238 | 0.3219 |
| 8 | 0.3125 | 0.299 | 0.3169 | 0.2981 | 0.3246 | 0.3163 | 0.3153 | 0.2383 | 0.3407 | 0.3618 | 0.3163 | 0.3417 | 0.3188 | 0.3436 | 0.3418 |
| 9 | 0.2942 | 0.3192 | 0.322 | 0.3188 | 0.3135 | 0.3444 | 0.3326 | 0.2583 | 0.3043 | 0.4101 | 0.3558 | 0.391 | 0.3417 | 0.3623 | 0.3748 |
| 10 | 0.3027 | 0.3284 | 0.3548 | 0.3214 | 0.3141 | 0.3513 | 0.3622 | 0.6919 | 0.3275 | 0.2231 | 0 | 0.4064 | 0.3192 | 0.4143 | 0.4072 |
| $11+$ | 0.3426 | 0.362 | 0.3791 | 0.3525 | 0.3799 | 0.3794 | 0.4065 | 0 | 0.4404 | 0.4518 | 0.4143 | 0.4583 | 0.403 | 0.417 | 0.4109 |

Table 8. Ratio of new annual catch-at-age numbers to old catch-at-age (see CAFSAC Res. Doc. 89/63).

SPRING SPAWNERS - ALL GEARS

| AGE | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 |
| ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: |
|  |  |  |  |  |  |  |  |  |  |  |  |
| 2 | 1.1460 | .7300 | .5783 | .2726 | .8355 | .7193 | 1.1449 | 12.6960 | 5.2032 | 1.1250 | 13.0068 |
| 3 | .9538 | 1.0545 | .5724 | .7082 | .7316 | 1.5103 | 1.5437 | 1.0365 | 1.0713 | 1.0328 | 1.2199 |
| 4 | .8017 | 1.8521 | 2.0118 | .9856 | .6997 | .8584 | 1.5055 | 1.6910 | 1.4297 | 1.1118 | .7379 |
| 5 | .7962 | 1.0952 | 2.2471 | 1.5675 | .7202 | .5127 | .7143 | 1.4163 | .8127 | 1.0171 | .7898 |
| 6 | .8358 | 2.7207 | 1.2265 | 2.2131 | 1.3798 | .4457 | .4652 | 1.0812 | 1.0877 | .9523 | .9267 |
| 7 | 1.0971 | 1.4300 | 2.9924 | .7331 | 1.6129 | .9143 | .7414 | .8315 | .6143 | .9736 | 1.1663 |
| 8 | .9501 | 2.5700 | 2.2046 | 1.5364 | 1.0265 | .4600 | 4.5455 | 2.1401 | .4907 | .9556 | .9692 |
| 9 | .9476 | 3.8030 | 3.5797 | .9246 | 1.1053 | .2941 | 1.5455 | 1.0442 | .4554 | 1.0260 | 1.2272 |
| 10 | 1.1509 | 1.0752 | 3.7031 | 4.7407 | 45.4998 | .0000 | .2273 | 4.0000 | 1.1197 | 1.1114 | .4516 |
| $11+$ | 1.0392 | .8959 | .3924 | .6369 | 5.3364 | .0000 | .0000 | 154.9985 | .4273 | 1.0306 | 1.1804 |

FALL SPAWNERS - ALL GEARS

| AGE | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 |
| ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: |
| 2 |  | .9987 | .9453 | 1.7268 | 3.2844 | 1.1033 | 6.0000 | 4.0000 | 8.8000 | 1.6828 | 1.0877 |
| 2 | 1.1910 | 1.1276 | 1.2297 | 1.0032 | .8202 | 1.4325 | .9930 | 1.1651 | .5741 | .9709 | 2.3869 |
| 4 | 1.0875 | 1.1114 | 1.8284 | .9055 | .8559 | 1.1142 | .9505 | .9554 | .9879 | .9942 | .8696 |
| 5 | 1.0758 | .9411 | 1.0258 | 1.2521 | .8077 | 1.0170 | .8885 | 1.2542 | .7973 | 1.0004 | .8290 |
| 6 | 1.1759 | 1.1110 | .9235 | 1.2490 | .9691 | 1.0427 | .6855 | 1.0742 | 1.1523 | .9975 | .9522 |
| 7 | 1.5734 | 1.4602 | 1.1254 | 1.6207 | 1.1532 | .8933 | .9714 | 1.4122 | 1.0506 | 1.0076 | 1.1922 |
| 8 | 1.3892 | 1.0786 | 2.3265 | .9028 | 1.1135 | .9389 | 1.1457 | 1.6763 | 1.0812 | 0.9971 | 1.1158 |
| 9 | 1.1501 | 1.2007 | 2.0354 | 1.0926 | .7676 | .8796 | 1.1271 | 1.9095 | 1.2651 | 1.0059 | 1.1585 |
| 10 | 2.6708 | 1.8262 | 3.7562 | 2.2315 | 1.7045 | 1.3070 | 1.3701 | 4.4039 | 1.0505 | 0.9725 | 1.4407 |
| $11+1$ | 1.0390 | .9335 | .1207 | .3544 | 1.1173 | .6278 | .4310 | 294.9971 | 1.3043 | 1.0131 | 1.3794 |

