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ASSESSMENT OF GULF WHITE HAKE FROM NAFO DIVISION 4T IN 1988

by

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ABSTRACT

Since 1970 landings from this predominantly small vessel inshore fishery have ranged from 3,616 tonnes in 1974 to a high of 14,039 tonnes in 1981. The 1987 nominal landings (6,222 tonnes) increased by 1,600 tonnes (35%) from 1986. In 1982 the first precautionary TAC was set at 12,000 tonnes. A first analytical assessment carried out in 1985 indicated this level may have been too high.

Gillnet fishermen landed 37% of the total 1987 catch. Otter trawlers, seiners, and longliners are the other major gear categories (about 12%, 21%, and 25% respectively) in this fishery at present. Otter trawlers have had a significant drop in their share of the landings.

A commercial catch rate series was derived from landings per purchase slip (receipt) using all available data (1978 to 1987). Research vessel abundance indices were available, however only the commercial CPUE was used in calibration of the VPA model. The terminal F was estimated to be approximately 0.60. The Fo.1 falls below this value at 0.30.

The yield per recruit of 1.000 kg and the geometric mean recruitment from 1978 to 1984 (from a range of possible partial recruitment vectors) gives a long term equilibrium yield for this stock of 5,000 to 6,000 tonnes. Projections for the next 5 years at the Fo.1 level indicate a slowly recovering or stable stock with projected landings ranging from approximately 4,000 to 6,000 tonnes.

RESUME

Depuis 1970, les débarquements de cette flotte côtière constituée surtout de petits navires ont varié de 3 616 tonnes en 1974 à un sommet de 14 039 tonnes en 1981. Les débarquements nominaux de 1987 (6 222 tonnes) constituent une augmentation de 1 600 tonnes (35 %) par rapport à 1986. En 1982, le premier TPA préventif a été établi à 12 000 tonnes. D'après une première évaluation analytique effectuée en 1985, ce niveau pourrait être trop élevé.

Les pêcheurs au filet maillant ont débarqué 37 % de la prise totale de 1987. Le reste revient en gros aux chalutiers, aux senneurs et aux palangriers (respectivement 12 %, 21 % et 25 %), la part des premiers ayant chuté considérablement.

Une série de taux de captures commerciales a été établie à partir des débarquements consignés dans les bordereaux d'achat (reçus) à l'aide de toutes les données disponibles (1978 à 1987). Bien que l'on possédât des indices d'abondance établis par les navires de recherche, seules les CPUE commerciales ont été utilisées pour étalonner le modèle d'analyse des populations virtuelles. Le F de la dernière année a été estimé à 0,60. Le $F_{0,1}$ se situe sous cette valeur à 0,30.

Le rendement par recrue de 1,000 kg et le recrutement moyen géométrique de 1978 à 1984 (en fonction d'une gamme de vecteurs de recrutement partiel possible) donnent un rendement d'équilibre à long terme pour ce stock de 5 000 à 6 000 tonnes. Les projections pour les cinq prochaines années au niveau $F_{0,1}$ indiquent une lente récupération ou une certaine stabilité du stock compte tenu de débarquements prévus variant environ entre 4 000 et 6 000 tonnes.

INTRODUCTION

The fishery for white hake (Urophycis tenuis, Mitchill) in the southern Gulf of St. Lawrence usually does not commence until May when the last of the sea ice has dispersed. Landings then come to a peak between July and September and decline through October and November (Table 1). Landings have ranged from a low of 3,616 tonnes in 1974 to a high of 14,039 tonnes in 1981 (Table 2 and Figure 1).

This fishery is carried out mainly by small inshore vessels (tonnage class 0 and 1) making it dependent upon and susceptible to weather and local market conditions. Winter ice conditions preclude inshore fishing from December until April of most years. The majority of the fishery is carried out in the Northumberland Strait area, and on both the eastern and western ends of Prince Edward Island (P.E.I.). Two main gear types are used in this fishery, the first group uses gillnets and longlines in the summer and, if the weather permits, longlines in the fall. The second group, composed of vessels based in southeastern New Brunswick and Nova Scotia, uses small (<20m) draggers while those based in eastern P.E.I. use small draggers and seiners.

Gillnetters have maintained their dominant position in the fishery, longliners and seiners have increased their proportion of the catch while the proportion caught by the small draggers has declined (OTB tonnage class 0 and 1). This may be due to varying stock abundance at the different fishing locations utilized by these various gear types. Small draggers fish almost exclusively inshore, while the seiners, being larger vessels (tonnage class 2 & 3), fish the deeper waters between Cheticamp and Cape St. Lawrence as well as the slope waters along the southern edge of Cabot Strait.

Gillnetters and longliners catch larger fish than the draggers. The decrease in OTB tonnage class 0 and 1 landings to only 12% of the total is particularly confusing when anecdotal information indicates an increase in the proportion of small fish in the landings. A decrease in both mean size and age has also been observed in the commercial fishery samples.

The provisional nominal landings in 1987 (Table 1) totalled 6,222 tonnes, an increase of 35% from the 4,601 tonne catch of 1986 (Table 2). This is the first increase in landings since 1981. This increase may not be the result of increased abundance but may be the result of additional effort. This additional effort is probably due to the higher prices paid for hake in 1987 relative to the several preceding years and to the frequent closures of the 1987 Gulf cod fishery.

The stock was not managed by a TAC (Total Allowable Catch) until the precautionary quota of 12,000 tonnes was placed upon this stock in 1981 for the 1982 season. A first analytical assessment was carried out on this stock in 1985 (Clay et al., MS 1985a) and the long term harvesting level recommended at that

time was **no higher than** 8,000 to 9,000 tonnes annually. The second and third assessments (Clay et al., MS 1986, MS 1987) suggested long term yields in the range of 7,000 and 5,500 tonnes respectively. The TAC for 1987 was reduced to 9,400 tonnes and that of 1988 has been further reduced to 5,500 tonnes.

SAMPLING

Sampling was carried out in a similar manner to that of last year. Samples were obtained from 2 sources:-

1) the P.E.I. provincial Department of Fisheries and Labour provided 154 length frequency samples, and

2) the Department of Fisheries and Oceans (DFO) port samplers collected 58 length frequency samples with a total of 949 readable otoliths.

Much of the hake landed in the southeastern Gulf is gutted and beheaded at sea. Because of this, only 'sexes combined' samples are routinely collected. No sea sampling was carried out in 1987. The dorsal length (length from tip of tail to the anterior origin of the first dorsal fin) of beheaded fish was measured to the nearest cm and later converted to total length.

Prior to 1986 age determination was conducted by personnel under contract. During 1986 DFO staff were trained in age determination techniques for white hake. Analysis of the weight at age for those samples aged in 1986 indicated a bias of over one year. Subsequent additional training has rectified the problem and the otoliths from the 1986 commercial port samples and research vessel survey have been re-aged. Both these re-aged otoliths as well as those collected in 1987 provide growth estimates which match the historic series for size at age. Quality control tests were carried out after every 200 to 250 otoliths. Intra reader agreement and agreement with the past control (contract) reader ranged between 70 and 80% when reference trays (50 otoliths) and repeat samples were re-aged.

Low sampling intensity did not allow an area by area breakdown of the landings. Seven combinations of time and gear were chosen from the available samples for 1986 and eight combinations for 1987 (Table 3a and 3b). In order to have approximately 400 ages in each age-at-length key, these keys were combined by similar gear types for the entire year - all otter trawl and seiner (Scottish and Danish) samples were combined for age as were gillnet and longline samples. These two age-at-length keys were then used to determine the age composition of the length frequencies of landings in each of the seven time/gear combinations above. Although sexually dimorphic growth rates have been identified in our work, the landed form (gutted, head-off) and the low sampling intensity did not allow age-at-length keys or catch at age calculations to be conducted on sexed samples.

The catch at age and the weight at age were calculated for each key (Table 4 and 5) by the computer system AGELEN (ver 1.6) for sexes combined. These data were added together for the final catch numbers at age and a weighted average (by numbers in each age group) calculated for the weights at age.

LANDINGS: White hake by statistical district

Gulf hake are caught mainly by tonnage class 0 and 1 vessels. These vessels are not required to complete log books and therefore no estimate of landings or fishing effort by individual vessel is normally available. Trip landings are, however, recorded on the purchase slips for the inshore as well as other components of the fishing fleet. These data are available from the 'transaction files' of the DFO Statistics Branch of the Scotia-Fundy region (1978 - 1983) and the Gulf region (1984 and 1987). They have been transformed to 'NAFO Table 5' type format using a modification of the computer system NAFSYS. During this process the data were aggregated to biweekly intervals by Statistical Districts (Figure 2). This data base generally only includes 75 to 90% of the official landings. The balance of the landings are reported on Supplemental 'A' and 'B' slips - these have not been included in the present analysis as they do not represent individual vessel days of activity - but rather 'roll ups' of many vessels over various time periods.

CATCH PER EFFORT - COMMERCIAL

A commercial catch per unit of effort (CPUE) series can be used as an indicator of stock abundance. For the above catch and "effort" data set, each purchase slip is assumed to represent 1 day's fishing effort, generally 1 trip for the small vessels of the inshore fleet. Due to the variable nature of this fishery no single fleet component makes up a large enough percentage of the catch in all areas to be considered as representative of the entire stock (Table 2). A multiplicative model (Gavaris, 1980) was used to develop a standardized CPUE series based on all major fleet components of the fishery. The coded X-matrix (raw catch and effort data prepared for the multiplicative model) was generated using the computer system NAFSYS.

All individual daily purchase slips representing landings of 50 kg or less were excluded from the time series. This was done as fishermen often take small catches of hake home for personal use; this results in catches of less than 50 kg not being fully represented in the transaction file data set. As the Gulf region Statistics Branch has assumed (for some years) that all seiners in the Gulf are Danish, the Scottish and Danish seiners were combined for all years for this analysis. The summed fortnightly catch, from the remaining purchase slips, was expressed in hundreds of kg and rounded to the nearest hundred. The resulting standardized CPUE series indicates the highest level occurred in 1981 and the lowest level in 1987, marginally lower than 1986.

This model (Table 6) with standards for statistical

district, gear and time chosen as Cheticamp, gillnetters, May 15 to May 30, 1978 respectively, gives a correlation coefficient (r^2) 0.791 (Table 7), the residual plots indicate a normal non-biased distribution (Figure 4). In past years, observations with low effort had higher residuals. Weighting by the effort did improve the coefficient of correlation and the F levels of the regression from 0.232 to 0.791 and 21 to 266 respectively. However, the year to year trend did not change (Figure 5). The unweighted standardized CPUE and effort series were used for calibrating in the VPA runs (Figure 5).

The resulting standardized CPUE series is correlated with annual landings (r^2 = 0.69). This is what would be expected in an unregulated fishery (never limited by TAC) or a fishery with constant effort.

RESEARCH DATA

The September groundfish cruise in the southern Gulf of St. Lawrence in 1987 was conducted with similar survey protocols to those of previous years. This was the third year using the RV Lady Hammond. The data set for 1970 to 1985 (Clay, MS 1986) was extended to 1987 providing abundance estimates by numbers and weight; stratified CPUE (by tow) by numbers and weight. Data from this data set have been variable and the near four fold decrease in indicated stock size since the 1986 survey is no exception (Figure 6).

The research vessel population estimates, percent composition and weight at age are listed in Table 8. Weight at age from research vessel surveys are calculated for stratified 'detailed' samples only. Although this method is not statistically sound for population estimates, it is the only data currently available for white hake. It should have a minimal effect in the case of hake as in most years over 50% of all caught fish are sampled and since 1983 over 75% of the fish are sampled.

ESTIMATION OF PARAMETERS

Catch and Weights at age

The 1986 weights at age were re-calculated from 1986 length frequencies sampled from the commercial landings and the samples collected for age determination in 1986, the weight at length being calculated from the length/weight relationship taken from the 1986 research vessel survey data:-

$$W(g) = 0.00495 \times TL(cm)^{3.11}; \quad n = 2135 \quad r^2 = 0.98$$

Similarly the 1987 weights at age were from the respective length frequencies and age determination samples. The weight at length being calculated from the length/weight relationship taken from the 1987 research vessel survey data:-

$$W(g) = 0.003068 \times TL(cm)^{3.219}; \quad n = 823 \quad r^2 = 0.97$$

Weights at age for 1970 to 1982 were extremely

variable and unrealistic due to the sparse and thus non representative sampling data prior to 1983. With the better sampling since 1983, annual weights at age are possible. Thus, the weights at age for the commercial catch for all years prior to 1983 were taken as equal to the mean of 1983 to 1985 (Table 9).

The weights at age varied slightly between 1983 and 1985. However, the variation was not substantial except for the oldest ages. In 1986 and 1987 the weights of the younger age groups have decreased and in 1987 the percent composition of these younger groups has increased. There does not appear to be a corresponding decrease in weight at age in the population as measured by research surveys (Table 8). This implies one of two possible scenerios: first, smaller fish are being sought to compensate for low abundance, or; second, smaller fish that were discarded in the past are now being landed due to the higher price. Comments by fishermens representatives regarding large numbers of small fish being caught lead the assessment sub-committee to an alternate hypotheses that this was an indication of a very strong year class, possibly the strongest ever observed.

The starting catch-at-age matrix for the Gulf hake ages 3 to 13 from 1970 to 1985 was taken from Clay et al. (MS 1986). The 1986 (Table 4) and 1987 (Table 5) catch numbers at age were added to this earlier series. The interim catch at age for 1986 used in last years assessment (Clay, MS 1987) should be disregarded. Sampling data were limited in earlier years and thus 1970 to 1977 catch at age have been included only for historical perspective (Clay et al., MS 1985b).

The catch numbers-at-age matrix (Table 10a) was adjusted to match any changes reported in the statistical landings for 1985. This adjustment made the cross products of the catch-at-age and weight-at-age tables match the reported nominal landings.

The percent composition of the catch at age (Table 10b) indicates more small fish (4 year olds) than in the recent past. Other indications of higher than normal numbers of small fish is the decrease in mean age and in mean weight in each of the gear/time keys (Tables 4 and 5) in 1987 compared to 1986 and 1985.

Partial recruitment

The partial recruitment (PR) was estimated using two techniques. The first used the ratio of 1987 catch at age, estimated from commercial sampling, divided by the 1987 population at age, estimated from research vessel surveys. The smoothed (standardized to ages 5, 6 and 7) PR for 1987 indicates a flat topped vector for the older age groups (see 'cat/pop' in the text table below). The PR vector indicates the first fully recruited age group is 7 - the same as was observed in the 1986 data. This year has continued the trend away from the strong dome shaped PR observed in the first assessment (1985 data). This shift began when the longline component of the fishery increased

from 16 to 27% in 1986 and continued this year with the significant decrease in the small dragger component of the fishery.

The second method used was averaging of the yearly F table. However, as we feel 1987 may be somewhat different from preceding years this is of questionable value. This technique involves iterative averaging from 1982 to 1986 of standardized (to the mean of ages 6,7, and 8) F values for each age until little change was noted. This technique indicated full recruitment between the ages of 6 and 8 (Figure 7) with a slight dome shape (see 'year ave' below). (The assessment sub-committee favoured this latter technique standardized to ages 7, 8, and 9 weighted by population numbers and all values for ages over 7 set to 1 (Figure 7) (see 'selected' below).)

The PR values for the youngest ages appear similar for the first two methods, the major difference being in the older age groups. As these older age groups constitute a very small portion of the total landings there is little significance to the present calibration of the VPA which of the two PR vectors are chosen. We have selected the two flat topped vectors reflected in the catch over population method for all ages and the yearly averageing standardized to population numbers for the trial runs (Figure 7).

Partial Recruitment

AGE	3	4	5	6	7	8	9	10	11	12	13
cat/pop	.011	.15	.6	.9	1.0	1.0	1.0	1.0	1.0	1.0	1.0
year ave	.023	.18	.72	1.0	1.0	1.0	.95	.80	.75	.73	.73
selected	.009	.08	.33	.7	1.0	1.0	1.0	1.0	1.0	1.0	1.0

Mortality: Natural

The natural mortality (M) was assumed to be 0.2 as is the case with other gadoid stocks of the northwest Atlantic.

: Total

The total mortality (Z) was calculated from the CPUE at age (catch-at-age matrix divided by standardized effort (Figure 5). The mean (unweighted) Z for ages 7 through 10 for 1987 is 1.25. This indicates an F in the range of about 1. The low catch numbers for older fish introduce a high level of uncertainty for Z's calculated from catch curves.

: F oldest

The fishing mortality (F) on the oldest age group was chosen by the iterative technique 'AutoF' at age 9 (Rivard and Joly, MS 1984).

STARTING F oldest

70	71	72	73	74	75	76	77	78	79
0.58	0.63	0.67	0.88	0.64	0.80	0.58	0.53	0.42	0.60

80	81	82	83	84	85	86
0.69	0.77	0.73	0.79	0.71	0.95	1.24

The F oldest in the latest years is considerably higher than in last years assessment (Clay, MS 1987), possibly a further indication of a shift towards a more flat topped PR.

: F Terminal

Clay et al. (MS 1986) showed the RV CPUE and biomass to be highly variable and not correlated with the commercial CPUE series. Reviewing the biomass data (Figure 6) it is apparent that if 1974, 1981, and 1986 are considered anomalous for unknown reasons, the series is relatively stable between 10 and 20 thousand tonnes biomass. There was no relationship in the past between VPA population biomass and RV biomass. However removing the two anomalous points in the 1978 to 1987 series used in the calibrations changed the square of the correlation coefficient from under 10% to between 60 and 70%. Despite the improved relationship, this series was not used in the final calibration of the 1987 stock size estimates from VPA as the anomolous years could not be reconciled without variance estimates which were not available.

In last years assessment an attempt was made to identify possible recruitment indices using the research vessel numbers at age 1 and age 2 with VPA population numbers at age 3 in year + 2 and + 1 respectively. (Only the years from 1978 were used in this regression.) No significant relationship was found. In the 1987 survey no age zero fish were recorded and only 8 one year olds.

The biomass for the total and for ages 4,5 and 6 research vessel population (1981 and 1986 excluded) were regressed against the corresponding VPA population biomass. The correlation coefficients and the residuals indicate an F_t in the range of 0.3 to 0.4, however the intercepts indicate an F_t in the range of 0.65 to 0.75. Forcing the equation through the origin mimizes the mean square error at an F_t of 0.4 to 0.45. These calibrations were not considered due to the highly variable results.

Possible values of fully recruited or terminal F (F_t) were investigated by regressing the commercial standardized CPUE index against the exploitable 3+ VPA population biomass. The correlation coefficient had little discriminating power and for lower values of F_t was not significant, therefore the intercept value and the lowest residual(s) for the last three years were used as the main evaluation criteria. Regressions were also forced through the origin, in this case the minimum mean square error was the evaluation criteria. Residuals were standardized by dividing them by the square root of the mean square error (error sum of squares divided by the degrees of freedom). The relationship between 3+ exploitable VPA biomass (F table standardized over ages 7, 8, and 9 multiplied by the mid-year population biomass at age) and CPUE was selected from the above (Table 11). This series of VPA runs indicate an F_t in the range of 0.45 using the intercept and 0.65 to 0.75 evaluating by the correlation coefficient. Forcing the regression through the origin minimizes the mean square error at an F_t of 0.65.

The F weighted by population numbers regressed against standardized effort (Figure 5) did not give significant relationships this year.

This calibration process (with the commercial standardized CPUE) resulted in a final terminal F of 0.60 being investigated in more detail (Figure 8).

Yield per recruit

To provide a long term estimate of yield per recruit (YPR), calculations were carried out using the mean weight at age for 1983 to 1986 and the mean smoothed partial recruitment vector covering the period 1983 to 1986 with an M = 0.2 (Clay, MS 1987). The Fo.1 level was 0.30 and the Fmax was 1.16.

Fo.1 =	0.3039	Fo.1 YIELD =	1.000	kg	Ave Wt.	=	2.729 kg
Fmax =	1.1559	Fmax YIELD =	1.120	kg	Ave Wt.	=	2.005 kg

With a geometric mean (1978 to 1985) recruitment of 5.8 million fish the long term equilibrium yield would be slightly over 5,800 tonnes, 8 hundred tonnes below the average of the landings of the last 18 years - 6,533 tonnes (Table 2).

The annual average weight of a white hake landed can give an indication of the level of fishing mortality. The 1970 to 1986 mean weights have been under the mean weight expected when fishing at the Fo.1 level and above the mean weight of Fmax (Fig 9). The 1987 mean weight indicates an F in excess of Fmax.

ASSESSMENT RESULTS

Virtual population analysis (using the APL assessment workspace FISH - Watcom version, Rivard and Joly (MS 1984)) using the above data is shown in Appendix I.

The exploitable biomass (Table 12) was calculated from the VPA population numbers multiplied by the yearly partial recruitment (Table 13) calculated for each year by standardizing to the annual mean F between ages 7 to 9 and setting all values for ages over 7 to 1.0.

Using the PR selected by the assessment sub-committee, the population numbers (Appendix I.) indicate a high degree of variabilty in recruitment over the time series. The estimates from 1977 onwards are the only ones assumed to be representative of the fishery. The GM recruitment from 1978 to 1984 is approximately 6.2 million fish at age 3. Recruitment appears relatively strong in 1977 and 1978 (the 74 and 75 year classes) with a steady decline until 1983 with recovery to record high levels in 1985 and 1986. The range of recruitment values appears to vary by about a factor of 3. The major difference between the above PR and the other methods is shown in the recruitment

pattern over the last three years. The latter two methods indicate recruitment between 4 and 6 million fish at age 3 since 1981. This is relatively stable and about equal to the long term average. The PR selected by the assessment sub-committee indicates recruitment between 11 and 12 million fish at age 3, the highest in our 18 year series.

These divergent interpretations of the PR could be caused by some form of differential size specific mortality, possibly resulting from sexually dimorphic growth patterns. Interpretations such as these must be viewed critically, for as was pointed out by Clay et al. (MS 1985b), there is great variability in length frequency distribution between statistical unit areas and between months. Thus, inconsistent sampling could produce the illusion of strong or weak year classes from time to time. Unfortunately, the situation could have been further confounded in 1987 by the strong market and higher prices.

CATCH PROJECTIONS

Two series of catch projections were run. The first (output presented in Appendix II) used a catch level set at an Fo.1 of 0.30 - about 50% lower than recent fishing levels and the following input parameters:

AGE	WEIGHT(85-87) kg	PR(82-86)	POP(begin 88) ('000)
3	.892	0.009	6180
4	1.061	0.076	4392
5	1.596	0.333	8907
6	2.211	0.695	5277
7	2.825	1.0	1590
8	3.649	1.0	459
9	4.137	1.0	173
10	5.363	1.0	76
11	6.987	1.0	17
12	7.388	1.0	3
13	8.957	1.0	2

A geometric mean recruitment (1978 to 1984) of 6.2 million fish for age 3 in 1988 and 1989 was used. Using M = 0.2, a mean partial recruitment from 1982 to 1986 (run with the PR selected by the assessment sub-committee) and mean weights at age from 1985 to 1987 the projected catch for 1989 is about 6,700 tonnes. The 1983 year class accounts for 40% of this catch biomass. The population biomass appears relatively steady at about 38,000 tonnes (almost the highest on record). A catch equal to about the present TAC would be obtained if average recruitment were substituted for that of the 1983 year class.

The second scenario calibrating with the alternate PR averaged from the yearly F table resulted in a terminal F of 0.6 (the same as above). Using a mean recruitment of 6.0 million fish

and all other parameters as above results in a 1989 projected catch of 3,700 tonnes. The only apparent way for this stock to rebound quickly will be for it to receive 1 or 2 years of well above average recruitment.

These two very different scenario's (one with the highest recruitment ever in 1985 and 1986 and one with average recruitment - at one half this level) give projected catches differing by only 40%. This indicates the importance of the input recruitment in this stock. The long term equilibrium yield appears to be in the range of 5,000 to 6,000 tonnes. As this stock appears to be dependent on only 3 or 4 year classes - it is a fishery which is sensitive to annual fluctuations in recruitment.

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Table 1. Nominal landings (t) of white hake from NAFO division 4T in 1987 by gear and month. All data are provisional statistics.

MONTH	TRAWL	SEINE	LINE	GILLNET	OTHER	TOTAL
JANUARY	0	0	0	0	0	0
FEBRUARY	0	0	0	0	0	0
MARCH	0	0	0	0	0	0
APRIL	2.3	0	0	1.8	.2	4.3
MAY	17.0	85.6	38.9	55.8	8.0	205.3
JUNE	55.3	695.2	138.0	221.2	76.3	1186.0
JULY	225.3	190.7	363.0	598.2	52.5	1429.7
AUGUST	156.8	159.2	416.9	716.2	90.0	1539.1
SEPTEMBER	128.3	57.8	170.5	473.2	14.0	843.8
OCTOBER	186.8	108.5	247.7	176.5	5.0	724.5
NOVEMBER	23.3	38.8	136.0	48.9	17.8	264.8
DECEMBER	0	3.2	9.5	0	11.4	24.1
TOTAL	795.1	1339.0	1520.5	2291.8	275.2	6221.6
PERCENT	12.8	21.5	24.4	36.8	4.5	100

Table 2. Nominal landings (t) of white hake from NAFO division 4T by gear and year. All data from 1986 and 1987 are provisional.

:GEAR YEAR	TRAWL	SEINE	LINE	GILLNET	OTHER	TOTAL
1970	1463	382	385	2149	1289	5668
1971	1523	632	702	1622	1228	5707
1972	1140	863	1604	1190	960	5757
1973	2468	211	1045	1265	713	5702
1974	1454	305	345	1100	412	3616
1975	1576	306	324	1285	634	4125
1976	1429	398	183	1147	601	3758
1977	1227	408	231	1300	818	3984
1978	1303	729	456	1829	508	4825
1979	2826	912	479	3189	704	8110
1980	3430	1615	832	4831	1715	12423
1981	4733	1922	799	6174	411	14039
1982	2885	994	1027	4625	245	9776
1983	2141	906	753	2959	546	7305
1984	1614	592	674	3631	81	6592
1985	1639	1008	799	2480	88	6014
* 1986	847	735	992	1744	283	4601
* 1987	795	1339	1521	2292	275	6222
AVERAGE	1916	792	731	2490	640	6568
PERCENT	29	12	11	38	10	

* provisional

Table 3a. Keys selected in 1986 for gear/time combinations, these groupings produce age-at-length keys with at least 400 fish ages per key. The lower table indicates the keys and associated landings used for catch composition that were applied to the two age-at-length keys.

KEY	FISHERY/PERIOD	TYPE	SAMPLE SIZE	AGE/LENGTH KEY
1	OTB:Jan.- July	Length	653	
		Age	39	
2	OTB:Aug.- Dec.	Length	737	OTB/SNU:Jan.- Dec.
		Age	17	Lengths-5494
3	SNU:Jan.- July	Length	2884	Aged-434
		Age	340	
4	SNU:Aug.- Dec.	Length	1220	
		Age	38	
5	GN:Jan.- Jul.	Length	4971	
		Age	142	
6	GN:Aug.- Dec.	Length	4601	LL/GN:Jan.- Dec.
		Age	348	Lengths-11199
7	LL:Jun. - Dec.	Length	1627	Aged-795
		Age	305	

	....AL k e y.....		...LF c a t c h...		
KEY	DATE	GEAR	DATE	GEAR	TONNES
1	01/12	OTB/SNU	01/07	OTB	488
2	01/12	OTB/SNU	08/12	OTB	359
3	01/12	OTB/SNU	01/07	SNU	466
4	01/12	OTB/SNU	08/12	SNU	264
5	01/12	LL/GN	01/07	GN	939
6	01/12	LL/GN	08/12	GN	882
7	01/12	LL/GN	01/12	LL + LHP	1203
				TOTAL	4601

Table 3b. Keys selected in 1987 for gear/time combinations, these groupings produce age-at-length keys with at least 400 fish ages per key. The lower table indicates the keys and associated landings used for catch composition that were applied to the two age-at-length keys.

KEY	FISHERY/PERIOD	TYPE	SAMPLE SIZE	AGE/LENGTH KEY
1	OTB:Jan.- July	Length	866	
		Age	29	
2	OTB:Aug.- Dec.	Length	1880	OTB/SNU:Jan.- Dec.
		Age	0	Lengths-10294
3	SNU:Jan.- July	Length	5444	Aged-524
		Age	495	
4	SNU:Aug.- Dec.	Length	2104	
		Age	0	
5	GN:Jan.- Jul.	Length	5428	
		Age	37	
6	GN:Aug.- Dec.	Length	2856	LL/GN:Jan.- Dec.
		Age	155	Lengths-11503
7	LL:Jan. - Jul.	Length	832	Aged-425
		Age	0	
8	LL:Aug. - Dec.	Length	2387	
		Age	233	

	....AL k e y.....		...LF c a t c h...		
KEY	DATE	GEAR	DATE	GEAR	TONNES
1	01/12	OTB/SNU	01/07	OTB	299
2	01/12	OTB/SNU	08/12	OTB	495
3	01/12	OTB/SNU	01/08	SNU	972
4	01/12	OTB/SNU	08/12	SNU	368
5	01/12	LL/GN	01/07	GN	877
6	01/12	LL/GN	08/12	GN	1415
7	01/12	LL/GN	01/07	LL + LHP	677
8	01/12	LL/GN	08/12	LL + LHP	1119
				TOTAL	6222

Table 4. Catch at age and weight at age of white hake in NAFO
1986 division 4T as estimated from dockside sampling of the commercial fisheries. The seven keys refer to the keys of Table 3a.

White Hake:Catch Numbers at Age (000's)

Age	Key 1	Key 2	Key 3	Key 4	Key 5	Key 6	Key 7	Sum	C.V
1	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0
3	0	0	0	0	1	0	0	1	0
4	15	79	10	48	4	7	12	175	106
5	70	121	41	95	43	63	47	480	264
6	62	40	61	28	109	119	64	483	254
7	34	18	37	13	93	78	53	326	183
8	21	6	25	6	65	50	62	235	113
9	9	3	9	2	13	14	30	80	30
10	7	2	7	1	3	4	23	47	13
11	1	0	1	0	3	2	16	23	3
12	2	0	2	0	0	0	8	12	1
13	0	0	0	0	1	1	4	6	0
14	0	0	0	0	0	1	1	2	0
Sum (From Keys)	221	269	193	193	335	339	320	1870	190
# LF	653	737	2884	1220	4971	4601	1627		
# Aged	434	434	434	434	795	795	795		
Mean Age	6.22	5.15	6.54	5.20	6.73	6.53	7.44		

Average Weight at Age (kg)

Age	Key 1	Key 2	Key 3	Key 4	Key 5	Key 6	Key 7	Weighted Ave.
1	.00	.00	.00	.00	.00	.00	.00	.00
2	.00	.00	.93	.00	.98	.00	.00	.00
3	.00	.00	.00	.00	.97	1.05	.98	.99
4	1.02	.87	.99	.90	1.73	1.59	1.21	.97
5	1.38	1.18	1.44	1.18	2.20	1.91	1.73	1.47
6	1.99	1.79	2.16	1.78	2.53	2.28	2.34	2.22
7	2.50	2.18	2.69	2.34	2.88	2.78	3.15	2.78
8	3.53	3.55	3.27	3.27	3.33	3.45	4.60	3.71
9	4.02	3.34	4.01	3.60	3.60	3.63	5.58	4.43
10	4.73	3.08	3.97	3.80	4.46	4.90	6.88	5.59
11	7.58	3.32	6.50	5.55	3.94	5.05	7.19	6.57
12	5.74	2.91	4.48	3.34	7.31	6.96	8.52	7.15
13	8.95	8.95	10.12	.00	4.15	4.52	8.45	7.74
14	8.17	.00	8.90	.00	8.17	10.03	9.31	9.28
Ave. Len	64.07	55.03	66.40	55.43	70.90	68.81	76.79	
Mean Wt. (From Keys)	2.21	1.34	2.42	1.37	2.81	2.61	3.94	

Table 5. *1987* Catch at age and weight at age of white hake in NAFO division 4T as estimated from dockside sampling of the commercial fisheries. The eight keys refer to the keys of Table 3b.

White Hake:Catch Numbers at Age (000's)

Age	Key 1	Key 2	Key 3	Key 4	Key 5	Key 6	Key 7	Key 8	Sum	C.V.
1	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0
3	0	1	1	12	2	1	2	9	28	17
4	47	57	49	143	20	13	29	98	456	234
5	105	177	221	135	110	102	157	284	1291	647
6	31	59	130	29	143	233	123	165	913	751
7	9	21	53	9	82	153	41	53	421	415
8	5	11	29	3	27	52	11	19	157	122
9	4	6	23	3	8	10	5	12	71	65
10	1	0	5	1	1	4	1	3	16	8
11	0	1	1	0	0	0	0	1	3	0
12	1	0	1	0	0	0	0	0	2	0
13	0	0	0	0	0	0	0	1	1	0
14	0	0	0	0	0	0	0	2	2	0
Sum (From Keys)	203	331	512	335	394	570	369	645	3361	321
# LF	866	1880	5444	2104	5428	2856	832	2387		
# Aged	524	524	524	524	425	425	0	425		
Mean Age	5.24	5.30	5.78	4.72	6.02	6.31	5.63	5.46		

Average Weight at Age (kg)

Age	Key 1	Key 2	Key 3	Key 4	Key 5	Key 6	Key 7	Key 8	Weighted Ave.
1	.00	.00	.00	.00	.00	.00	.00	.00	.00
2	.00	.00	.00	.00	.00	.00	.00	.00	.00
3	.52	.50	.51	.48	.85	.67	.85	.78	.63
4	.86	.83	.87	.73	.96	.84	.91	.85	.82
5	1.19	1.26	1.30	1.14	1.36	1.59	1.37	1.30	1.30
6	1.89	1.85	2.01	1.84	2.17	2.21	1.97	1.91	2.04
7	2.40	2.42	2.71	2.48	2.95	3.09	2.71	2.83	2.88
8	3.79	3.61	3.52	3.28	3.99	3.67	4.20	4.23	3.79
9	4.16	3.80	3.89	3.97	4.39	3.41	4.92	5.73	4.27
10	7.16	7.16	5.80	6.41	6.08	3.98	8.99	6.67	5.90
11	6.22	6.85	8.26	9.57	7.95	7.86	7.89	8.59	8.10
12	7.44	9.50	9.35	7.55	.00	10.15	10.15	10.15	8.67
13	7.63	10.78	9.75	10.49	.00	.00	.00	10.42	10.41
14	8.68	.00	10.66	9.54	.00	10.46	.00	11.09	9.75
Ave Len	56.33	57.14	61.13	51.63	64.72	67.40	60.95	59.24	
Mean Wt (From Keys)	1.47	1.49	1.90	1.10	2.23	2.48	1.84	1.73	

Table 6. Three of the category types and their associated categories used to run a multiplicative model for the Gulf hake using commercial catch and effort data from 1978 to 1987. (Note: fourth category type is years.)

STATISTICAL DISTRICT		GEAR		TIME PERIODS	
CODE	AREA	CODE	NAME	CODE	PERIOD
2(88)	*CHETICAMP	41	*GN	0	JAN 1-MAY 14
3	EAST ST GEORGES BAY	11	OTB-1	1	*MAY 15-MAY 31
12(13)	PICTOU	12	OTB-2	2	JUN 1-JUN 14
13	WEST ST GEORGES BAY	21(22)	SDN	3(4)	JUN 15-JUN 30
65	CARAQUET	22	SSC	4	JUL 1-JUL 14
66	MISCOU/SHIPPAGAN			5	JUL 15-JUL 31
67(75)	TRACADIE, N.B.			6	AUG 1-AUG 14
75	RICHIBUCTO			7(8)	AUG 15-AUG 31
76(80)	BOUCTOUCHE			8	SPT 1-SPT 14
{77	SHEDIAC}			9(10)	SPT 15-SPT 30
80	CAPE TORMENTINE			10	OCT 1-OCT 14
82	TIGNISH			11	OCT 15-OCT 31
87	MURRAY HARBOUR			12	NOV 1-DEC 31
88	SOURIS				
92(93)	COW POND				
93(95)	MALPEQUE				
95	TRACADIE, P.E.I.				

* standard category
( ) combined category
{ } reduced category

Table 7. Analysis of variance and parameter estimation for catch rate standardization of Gulf hake from 1978 to 1987. See Table 6 for category types and codes.

REGRESSION OF MULTIPLICATIVE MODEL

MULTIPLE R..... .483
MULTIPLE R SQUARED..... .233

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SUMS OF SQUARES	MEAN SQUARES	F-VALUE
INTERCEPT	1	4.992E0003	4.992E0003	
REGRESSION	30	5.722E0002	1.907E0001	21.542
TYPE 1	9	3.152E0002	3.502E0001	39.534
TYPE 2	3	1.105E0001	3.684E0000	4.161
TYPE 3	9	1.198E0002	1.331E0001	15.038
TYPE 4	9	6.850E0001	7.611E0000	8.596
RESIDUALS	2127	1.383E0003	8.854E-001	
TOTAL	2158	7.447E0003		

PREDICTED CATCH RATE

STANDARDS USED VARIABLE NUMBERS: 2 41 1

YEAR	TOTAL CATCH	PROP.	CATCH RATE MEAN	S.E.	EFFORT
78	48250	0.407	7.424	0.977	6499
79	81100	0.341	7.654	0.986	10596
80	124230	0.435	9.302	1.262	12674
81	140390	0.530	9.751	1.225	14397
82	97760	0.473	8.803	1.113	11105
83	73050	0.436	7.826	1.036	9334
84	70500	0.686	7.519	0.957	9376
85	60140	0.765	7.744	0.975	7766
86	46010	0.565	5.743	0.736	8012
87	62220	0.361	5.327	0.707	11681

AVERAGE C.V. FOR THE MEAN: .129

REGRESSION COEFFICIENTS

CATEGORY	CODE	VARIABLE	COEFFICIENT	STD. ERROR	NO. OBS.
1	2	INTERCEPT	1.571	0.132	2158
2	41				
3	1				
4	78				
1	3	1	-0.582	0.080	212
	12	2	-0.227	0.090	160
	65	3	-0.761	0.091	145
	66	4	-0.195	0.077	229
	67	5	-0.396	0.078	223
	76	6	0.481	0.126	68
	82	7	-0.576	0.089	153
	87	8	0.516	0.081	204
	92	9	-0.701	0.072	307
2	11	10	0.162	0.106	92
	12	11	-0.146	0.068	302
	21	12	0.085	0.050	699
3	0	13	-0.603	0.180	41
	2	14	-0.019	0.129	152
	3	15	0.195	0.115	422
	5	16	0.074	0.122	236
	6	17	-0.032	0.124	211
	7	18	0.062	0.116	385
	9	19	0.328	0.117	347
	11	20	0.539	0.128	159
	12	21	0.780	0.134	122
4	79	22	0.030	0.098	208
	80	23	0.278	0.100	191
	81	24	0.272	0.096	226
	82	25	0.170	0.098	207
	83	26	0.053	0.103	170
	84	27	0.012	0.095	257
	85	28	0.042	0.094	275
	86	29	-0.257	0.096	242
	87	30	-0.332	0.100	213

Table 8a.The Gulf hake population-at-age matrix estimated from research vessel surveys in the southern Gulf of St. Lawrence (NAFO division 4T).

RV population matrix of> gulf hake > nafo 4t 29/ 4/88

:	70	71	72	73	74	75	76	77
3 :	.	2013	303	1166	3502	4609	4290	2088
4 :	.	987	547	3571	4924	2138	1669	2422
5 :	.	830	525	3913	3597	1397	935	934
6 :	.	94	469	1382	2751	700	400	303
7 :	.	199	156	512	1716	292	146	322
8 :	.	66	245	123	470	79	32	84
9 :	.	45	147	72	85	1	1	102
10 :	.	82	89	56	245	58	44	27
11 :	.	37	35	40	112	120	51	31
12 :	.	1	42	58	188	1	1	104
13 :	.	1	1	19	5	1	1	45

:	78	79	80	81	82	83	84	85	86	87
3 :	2826	3521	1889	3667	1180	1390	2602	6780	13267	2903
4 :	4931	3515	3548	6631	1672	1452	3070	4029	14618	3662
5 :	4223	3407	4466	6183	2318	858	2544	1238	7060	2601
6 :	1853	2686	1715	4496	817	545	1151	675	1966	1189
7 :	602	997	830	1258	714	288	591	493	794	339
8 :	111	344	445	812	211	130	359	258	436	90
9 :	44	33	156	202	194	139	120	272	202	45
10 :	139	40	189	62	1	17	127	162	58	43
11 :	1	54	31	27	27	1	23	50	44	1
12 :	37	129	1	104	43	1	23	65	30	46
13 :	1	1	28	93	1	1	1	49	32	1

Table 8b. Composition of the population at age of Gulf hake estimated from research vessel surveys of the southern Gulf of St. Lawrence (NAFO division 4T).

composition of RV population matrix of> gulf hake > nafo 4t 29/ 4/88

:	70	71	72	73	74	75	76	77
3 :	0.085	0.462	0.118	0.107	0.199	0.491	0.567	0.323
4 :	0.119	0.227	0.214	0.327	0.280	0.228	0.220	0.375
5 :	0.301	0.191	0.205	0.359	0.204	0.149	0.124	0.145
6 :	0.117	0.022	0.183	0.127	0.156	0.074	0.053	0.047
7 :	0.080	0.046	0.061	0.047	0.098	0.031	0.019	0.050
8 :	0.031	0.015	0.096	0.011	0.027	0.008	0.004	0.013
9 :	0.076	0.010	0.057	0.007	0.005	0.000	0.000	0.016
10 :	0.092	0.019	0.035	0.005	0.014	0.006	0.006	0.004
11 :	0.096	0.008	0.014	0.004	0.006	0.013	0.007	0.005
12 :	0.002	0.000	0.016	0.005	0.011	0.000	0.000	0.016
13 :	0.002	0.000	0.000	0.002	0.000	0.000	0.000	0.007

:	78	79	80	81	82	83	84	85	86	87
3 :	0.191	0.239	0.142	0.156	0.164	0.288	0.245	0.482	0.345	0.266
4 :	0.334	0.239	0.267	0.282	0.233	0.301	0.289	0.286	0.380	0.335
5 :	0.286	0.231	0.336	0.263	0.323	0.178	0.240	0.088	0.183	0.238
6 :	0.125	0.182	0.129	0.191	0.114	0.113	0.108	0.048	0.051	0.109
7 :	0.041	0.068	0.062	0.053	0.099	0.060	0.056	0.035	0.021	0.031
8 :	0.008	0.023	0.033	0.035	0.029	0.027	0.034	0.018	0.011	0.008
9 :	0.003	0.002	0.012	0.009	0.027	0.029	0.011	0.019	0.005	0.004
10 :	0.009	0.003	0.014	0.003	0.000	0.004	0.012	0.012	0.002	0.004
11 :	0.000	0.004	0.002	0.001	0.004	0.000	0.002	0.004	0.001	0.000
12 :	0.003	0.009	0.000	0.004	0.006	0.000	0.002	0.005	0.001	0.004
13 :	0.000	0.000	0.002	0.004	0.000	0.000	0.000	0.003	0.001	0.000

Table 8c. The weight-at-age matrix (Kg) of Gulf hake from research surveys of NAFO division 4T. Samples collected from stratified samples (see text).

RV weight at age matrix of> gulf hake > nafo 4t 29/ 4/88

	70	71	72	73	74	75	76	77
1	0.152	0.152	0.175	0.325	0.325	0.242	0.242	0.088
2	0.312	0.312	0.355	0.270	0.270	0.322	0.322	0.267
3	0.387	0.387	0.684	0.388	0.388	0.535	0.535	0.511
4	0.608	0.608	0.896	1.058	1.058	0.954	0.954	0.730
5	1.506	1.506	1.858	1.448	1.448	1.419	1.419	1.288
6	2.313	2.313	2.308	2.288	2.288	1.675	1.675	1.648
7	2.650	2.650	2.520	2.725	2.725	2.514	2.514	1.685
8	2.150	2.150	3.014	4.675	4.675	2.500	2.500	2.467
9	3.300	3.300	3.133	5.733	5.733	3.600	3.600	4.333
10	2.625	2.625	6.275	3.400	3.400	3.100	3.100	1.800
11	9.500	9.500	3.175	4.800	4.800	4.767	4.767	9.800
12	6.000	6.000	3.400	3.150	3.150	6.000	6.000	4.500
13	8.000	8.000	4.200	4.000	4.000	10.000	10.000	8.000

	78	79	80	81	82	83	84	85	86	87
1	0.106	0.152	0.250	0.075	0.075	0.114	0.183	0.086	0.135	0.107
2	0.207	0.325	0.349	0.317	0.302	0.352	0.283	0.207	0.241	0.195
3	0.427	0.527	0.488	0.574	0.544	0.685	0.556	0.436	0.455	0.420
4	1.036	0.860	0.950	1.233	0.976	1.126	0.978	0.789	0.776	0.686
5	1.480	1.427	1.373	1.664	1.506	1.868	1.521	1.310	1.245	1.234
6	1.911	1.903	1.845	2.302	2.035	2.131	2.223	1.823	1.949	2.006
7	2.662	2.250	2.462	2.916	2.598	2.989	2.657	2.329	3.004	3.206
8	3.625	2.686	3.242	3.208	2.525	4.900	3.477	2.646	3.620	4.206
9	2.000	3.200	3.408	3.275	3.167	3.900	3.054	3.542	5.261	6.479
10	2.067	3.925	5.540	2.500	3.600	6.000	5.140	3.632	8.321	7.000
11	5.200	5.100	3.800	3.400	2.400	5.200	3.467	4.125	8.767	8.000
12	7.200	2.617	11.000	10.267	3.150	5.800	5.475	10.250	10.100	9.570
13	8.000	8.000	8.000	9.500	9.000	8.000	8.000	9.600	10.750	10.000

Table 9. The commercial weight-at-age (grams) of Gulf hake from NAFO division 4T. Prior to 1983 the weights at age are an average of data from 1983 to 1985 (see text).

weight at age matrix of> gulf hake > nafo 4t 29/ 4/88

:	70	71	72	73	74	75	76	77
3 :	1050	1050	1050	1050	1050	1050	1050	1050
4 :	1343	1343	1343	1343	1343	1343	1343	1343
5 :	1863	1863	1863	1863	1863	1863	1863	1863
6 :	2267	2267	2267	2267	2267	2267	2267	2267
7 :	2767	2767	2767	2767	2767	2767	2767	2767
8 :	3297	3297	3297	3297	3297	3297	3297	3297
9 :	3567	3567	3567	3567	3567	3567	3567	3567
10 :	4483	4483	4483	4483	4483	4483	4483	4483
11 :	5850	5850	5850	5850	5850	5850	5850	5850
12 :	6900	6900	6900	6900	6900	6900	6900	6900
13 :	9493	9493	9493	9493	9493	9493	9493	9493

:	78	79	80	81	82	83	84	85	86	87
3 :	1050	1050	1050	1050	1050	1060	1040	1050	993	632
4 :	1343	1343	1343	1343	1343	1350	1290	1390	971	821
5 :	1863	1863	1863	1863	1863	1910	1670	2010	1473	1305
6 :	2267	2267	2267	2267	2267	2220	2210	2370	2222	2042
7 :	2767	2767	2767	2767	2767	2810	2680	2810	2779	2885
8 :	3297	3297	3297	3297	3297	3210	3230	3450	3705	3792
9 :	3567	3567	3567	3567	3567	3470	3530	3700	4435	4276
10 :	4483	4483	4483	4483	4483	4460	4390	4600	5595	5895
11 :	5850	5850	5850	5850	5850	6670	4590	6290	6567	8103
12 :	6900	6900	6900	6900	6900	8350	6010	6340	7153	8672
13 :	9493	9493	9493	9493	9493	10730	9030	8720	7744	10407

Table 10a. The catch-at-age matrix ('000) of Gulf hake from NAFO division 4T.

catch matrix of> gulf hake > nafo 4t 29/ 4/88

:	70	71	72	73	74	75	76	77
3 :	86	84	91	80	49	56	81	86
4 :	708	715	633	499	250	214	298	332
5 :	798	798	747	664	380	390	433	471
6 :	456	448	485	461	297	344	333	361
7 :	373	378	403	454	313	380	291	302
8 :	144	144	165	191	136	171	132	136
9 :	74	77	84	108	78	99	67	66
10 :	42	43	44	50	33	42	28	29
11 :	12	14	12	13	8	8	5	5
12 :	7	8	8	9	5	7	9	8
13 :	3	3	4	4	3	3	2	2

:	78	79	80	81	82	83	84	85	86	87
3 :	79	90	91	66	5	57	60	82	1	27
4 :	354	470	452	427	113	128	423	212	174	457
5 :	579	833	1028	1075	546	595	793	572	475	1296
6 :	545	972	1661	1976	1136	787	862	572	479	917
7 :	345	672	1196	1391	1104	609	523	408	322	422
8 :	172	315	540	604	551	398	265	262	233	159
9 :	61	101	137	154	149	233	158	121	79	70
10 :	26	47	75	94	79	71	53	54	47	16
11 :	4	8	7	4	21	5	20	19	23	3
12 :	8	11	6	1	9	4	10	31	14	2
13 :	2	4	5	8	9	1	1	7	6	1

Table 10b. Composition of the catch at age of Gulf hake from NAFO division 4T.

composition of catch matrix of> gulf hake > nafo 4t 29/ 4/88

:	70	71	72	73	74	75	76	77
3 :	0.032	0.031	0.034	0.032	0.032	0.033	0.048	0.048
4 :	0.262	0.263	0.236	0.197	0.161	0.125	0.178	0.185
5 :	0.295	0.294	0.279	0.262	0.245	0.228	0.258	0.262
6 :	0.169	0.165	0.181	0.182	0.191	0.201	0.198	0.201
7 :	0.138	0.139	0.151	0.179	0.202	0.222	0.174	0.168
8 :	0.053	0.053	0.062	0.076	0.088	0.100	0.079	0.076
9 :	0.027	0.029	0.031	0.043	0.050	0.058	0.040	0.037
10 :	0.016	0.016	0.016	0.020	0.021	0.024	0.017	0.016
11 :	0.005	0.005	0.005	0.005	0.005	0.005	0.003	0.003
12 :	0.002	0.003	0.003	0.003	0.003	0.004	0.005	0.004
13 :	0.001	0.001	0.001	0.002	0.002	0.002	0.001	0.001

:	78	79	80	81	82	83	84	85	86	87
3 :	0.037	0.026	0.017	0.011	0.001	0.020	0.019	0.035	0.001	0.008
4 :	0.163	0.133	0.087	0.074	0.030	0.044	0.134	0.091	0.094	0.136
5 :	0.266	0.236	0.198	0.185	0.147	0.206	0.250	0.244	0.256	0.385
6 :	0.250	0.276	0.320	0.341	0.305	0.272	0.272	0.244	0.259	0.272
7 :	0.158	0.191	0.230	0.240	0.297	0.211	0.165	0.174	0.174	0.125
8 :	0.079	0.090	0.104	0.104	0.148	0.138	0.084	0.112	0.126	0.047
9 :	0.028	0.029	0.026	0.027	0.040	0.081	0.050	0.052	0.043	0.021
10 :	0.012	0.013	0.014	0.016	0.021	0.025	0.017	0.023	0.025	0.005
11 :	0.002	0.002	0.001	0.001	0.006	0.002	0.006	0.008	0.012	0.001
12 :	0.004	0.003	0.001	0.000	0.002	0.001	0.003	0.013	0.007	0.001
13 :	0.001	0.001	0.001	0.001	0.002	0.000	0.000	0.003	0.003	0.000

Table 11. VPA calibration results for NAFO division 4T white hake. The intercept, correlation coefficient, and residuals for the last 3 years were used as selection criteria for selected terminal F levels.

cpue vs 3+ exploitable vpa biomass, reg>origin > standardized residuals

term f	int	slope	r2	res85	res86	res87	mean squ error
0.30	0.0	1627.7	0.896	@0.798	@0.165	2.503	23649952
0.35	0.0	1581.0	0.920	@1.001	@0.346	2.314	16713454
0.40	0.0	1546.0	0.935	@1.182	@0.520	2.065	12925913
0.45	0.0	1518.8	0.943	@1.329	@0.676	1.776	10818305
0.50	0.0	1497.1	0.947	@1.437	@0.807	1.472	9660078
0.55	0.0	1479.3	0.949	@1.510	@0.911	1.176	9061164
0.60	0.0	1464.5	0.950	@1.554	@0.989	0.901	8801542
0.65	0.0	1452.0	0.949	@1.577	@1.047	0.657	8751636
0.70	0.0	1441.3	0.948	@1.585	@1.089	0.442	8832476
0.75	0.0	1432.0	0.946	@1.584	@1.120	0.257	8994606
0.80	0.0	1423.9	0.944	@1.577	@1.141	0.097	9206385
0.85	0.0	1416.8	0.943	@1.567	@1.157	@0.041	9447243
0.90	0.0	1410.4	0.941	@1.555	@1.168	@0.161	9703655
0.95	0.0	1404.8	0.939	@1.542	@1.175	@0.264	9966670
1.00	0.0	1399.7	0.937	@1.528	@1.181	@0.355	10230360

Table 12. The fishable or exploitable population biomass (t) of Gulf hake from NAFO division 4T calculated from the historical partial recruitment (Table 13) and the VPA population biomass (Appendix I).

exploitable biomass: tonnes 22/ 8/88

:	70	71	72	73	74	75	76	77	78	79
3 :	156	156	159	115	95	85	158	191	210	180
4 :	1639	1697	1421	920	615	414	745	937	1197	1196
5 :	2563	2628	2325	1696	1295	1046	1499	1841	2716	2939
6 :	1783	1795	1836	1432	1231	1121	1402	1719	3107	4174
7 :	1690	1797	1820	1722	1586	1511	1499	1752	2399	3522
8 :	816	841	911	865	822	811	808	889	1136	1645
9 :	453	456	472	445	427	420	402	417	487	579
10 :	269	263	231	219	205	206	206	232	256	280
11 :	125	148	121	100	83	65	52	59	56	85
12 :	75	93	81	80	61	59	67	73	99	117
13 :	49	45	57	44	45	36	33	36	46	63
3+:	9619	9919	9434	7637	6464	5773	6872	8146	11709	14780

:	80	81	82	83	84	85	86	87
3 :	131	88	6	78	82	114	1	29
4 :	836	729	194	223	720	392	247	625
5 :	2634	2542	1304	1468	1746	1526	1025	2819
6 :	5180	5682	3298	2255	2512	1799	1560	3123
7 :	4550	4881	3760	2211	1849	1521	1313	2027
8 :	1967	2232	2303	1593	1111	896	1082	1002
9 :	672	696	683	839	617	431	340	501
10 :	226	324	330	410	309	262	138	158
11 :	54	29	95	41	121	159	92	41
12 :	55	8	39	35	79	143	137	29
13 :	65	97	110	14	13	62	38	83
3+:	16369	17308	12120	9166	9160	7307	5973	10436

Table 13. The yearly partial recruitment for Gulf hake from NAFO division 4T calculated by standardizing to the mean of the F values at ages 7,8, and 9 and setting all values for all ages over 7 to 1.

yearly partial recruitment: standard ages 7 8 9 22/ 8/88

:	70	71	72	73	74	75	76	77	78	79
3 :	0.033	0.037	0.044	0.032	0.022	0.013	0.018	0.017	0.020	0.025
4 :	0.337	0.384	0.359	0.273	0.176	0.094	0.117	0.104	0.106	0.112
5 :	0.617	0.621	0.617	0.501	0.419	0.306	0.338	0.280	0.287	0.250
6 :	0.626	0.618	0.625	0.563	0.505	0.481	0.526	0.476	0.567	0.537
7 :	1.000	1.000	1.000	0.995	0.998	0.978	0.981	0.939	0.884	0.903
8 :	0.905	0.898	0.917	0.923	0.912	0.948	0.992	1.000	1.000	1.000
9 :	0.946	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
10 :	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
11 :	0.786	0.972	0.807	0.873	0.760	0.520	0.439	0.408	0.327	0.445
12 :	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
13 :	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

:	80	81	82	83	84	85	86	87
3 :	0.025	0.018	0.001	0.017	0.013	0.010	0.000	0.009
4 :	0.115	0.139	0.039	0.051	0.169	0.060	0.029	0.075
5 :	0.243	0.370	0.256	0.284	0.478	0.338	0.199	0.333
6 :	0.577	0.758	0.731	0.632	0.748	0.644	0.515	0.695
7 :	0.925	0.958	1.000	0.903	0.943	0.773	0.821	1.000
8 :	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
9 :	0.866	0.914	0.737	1.000	1.000	1.000	1.000	1.000
10 :	1.000	1.000	1.000	0.777	0.804	1.000	1.000	1.000
11 :	0.305	0.316	1.000	0.200	0.441	0.610	1.000	1.000
12 :	0.383	0.057	1.000	1.000	0.735	1.000	1.000	1.000
13 :	0.955	0.982	0.928	1.000	0.930	1.000	1.000	1.000

Figure 1. Nominal landings by gear and year of NAFO division 4T Gulf white hake.

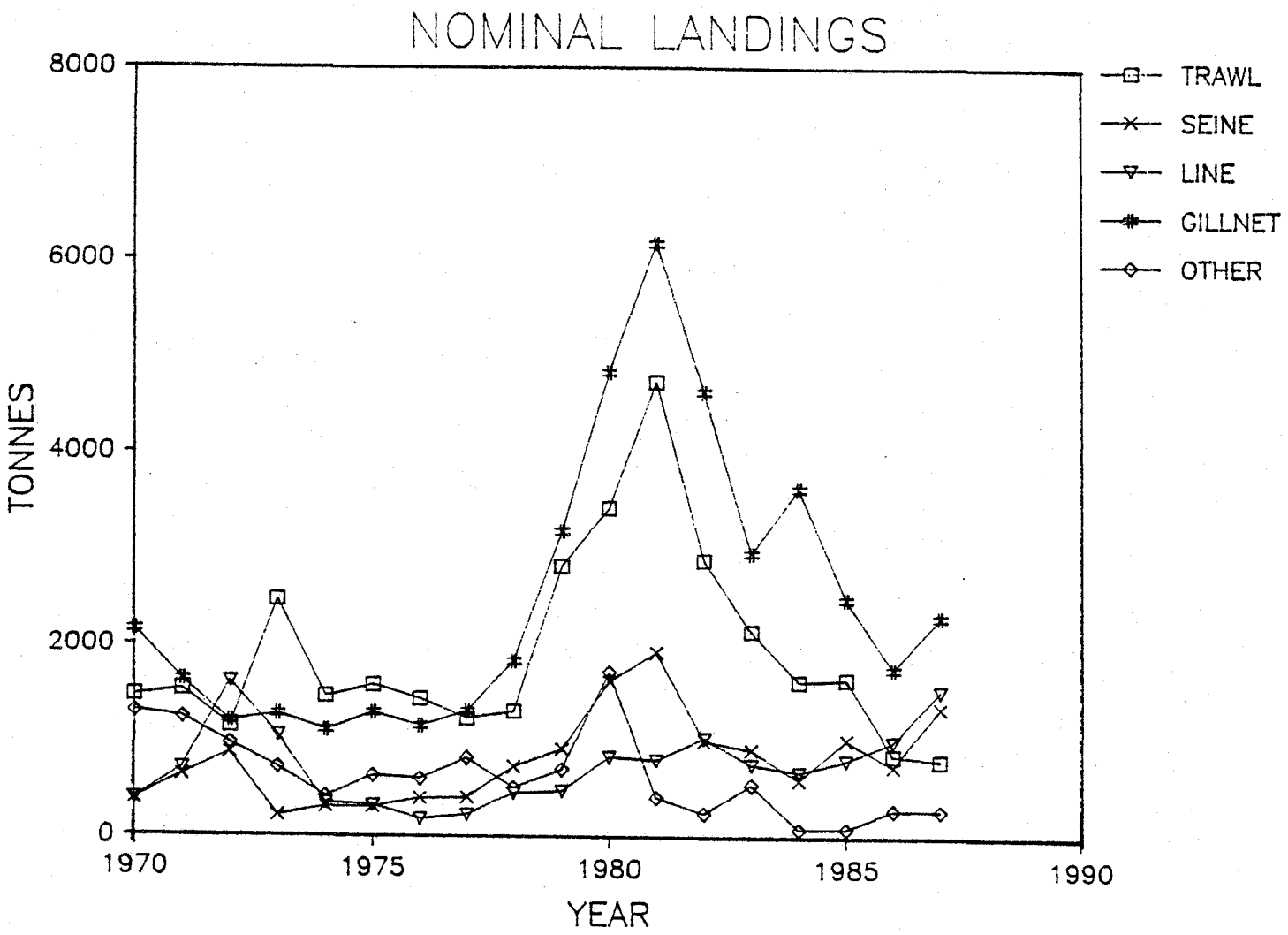


Figure 2. Statistical Districts of the southern Gulf of St. Lawrence used in aggregation of commercial landings per trip data.

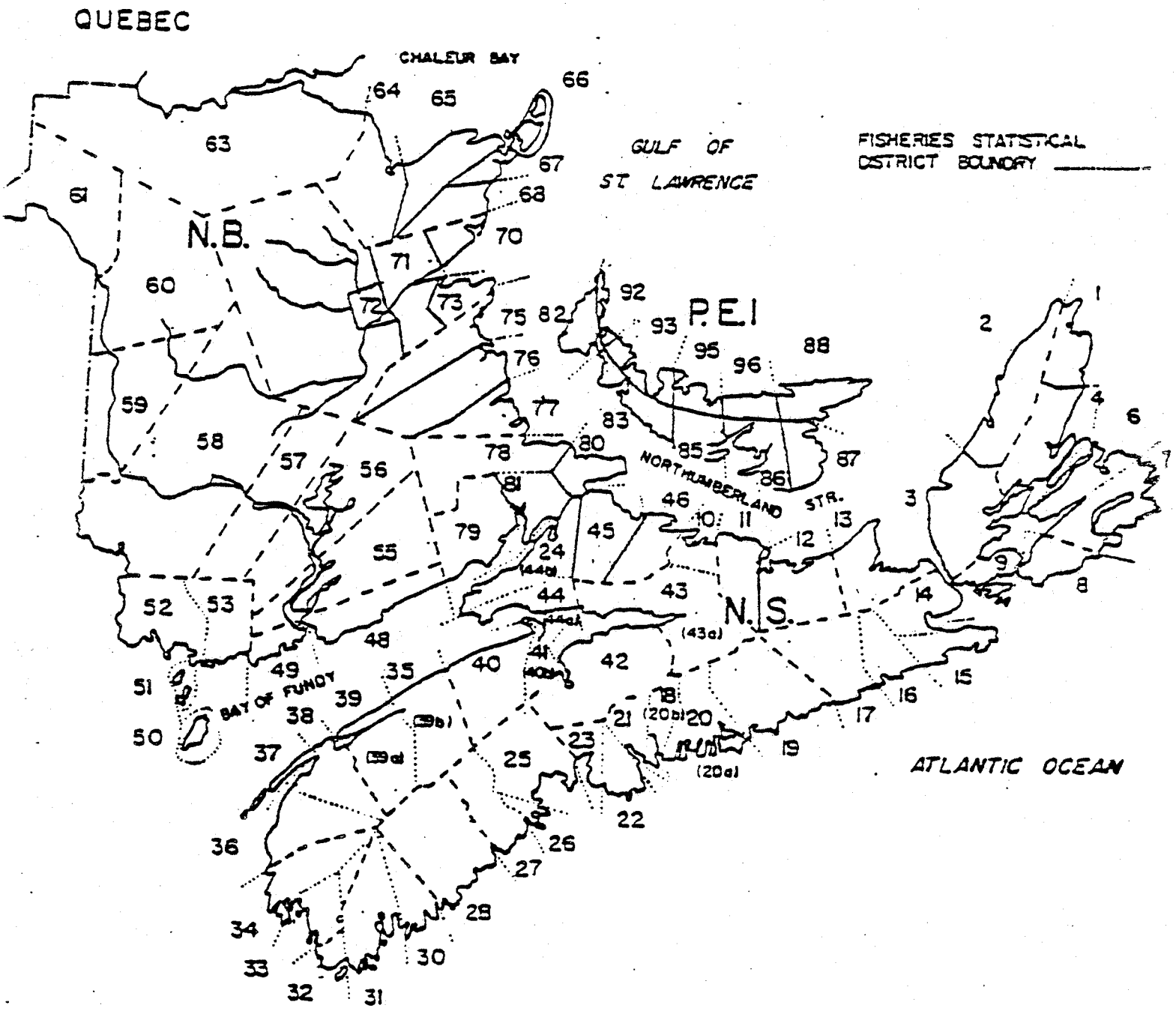
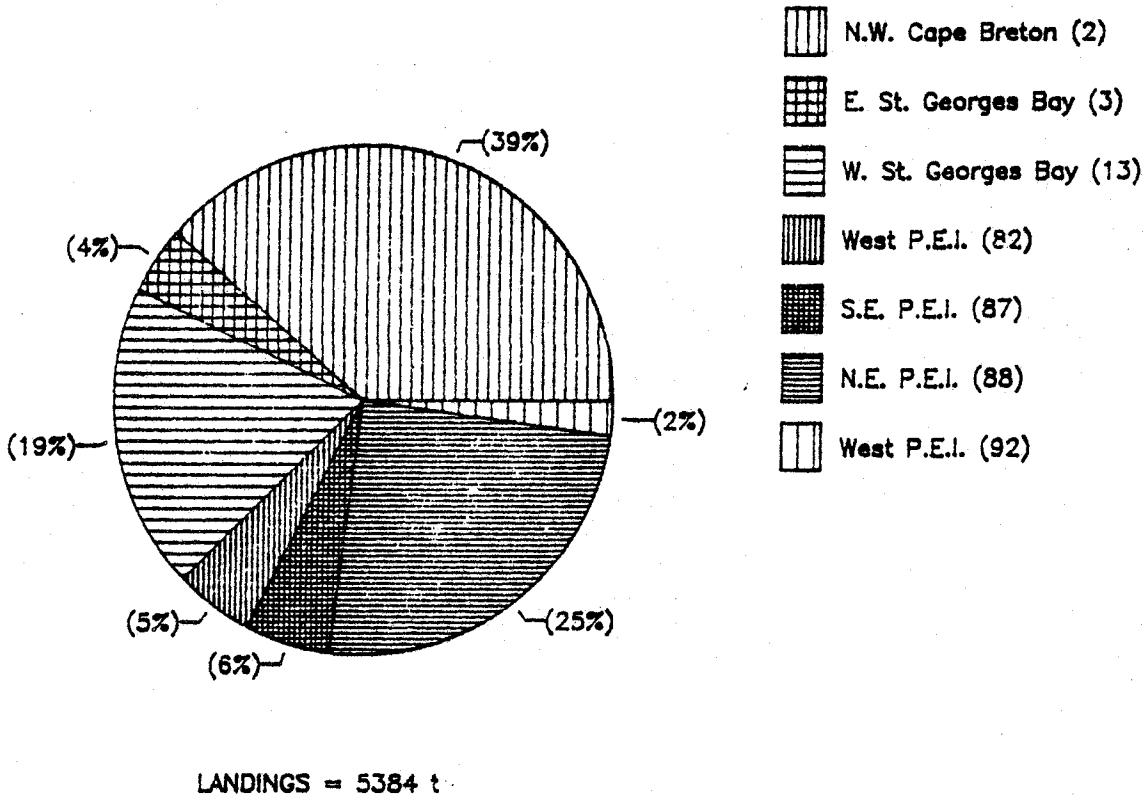


Figure 3. Distribution of 1987 landings by statistical district and gear of Gulf hake in NAFO division 4T as derived from 'Purchase Slips'.



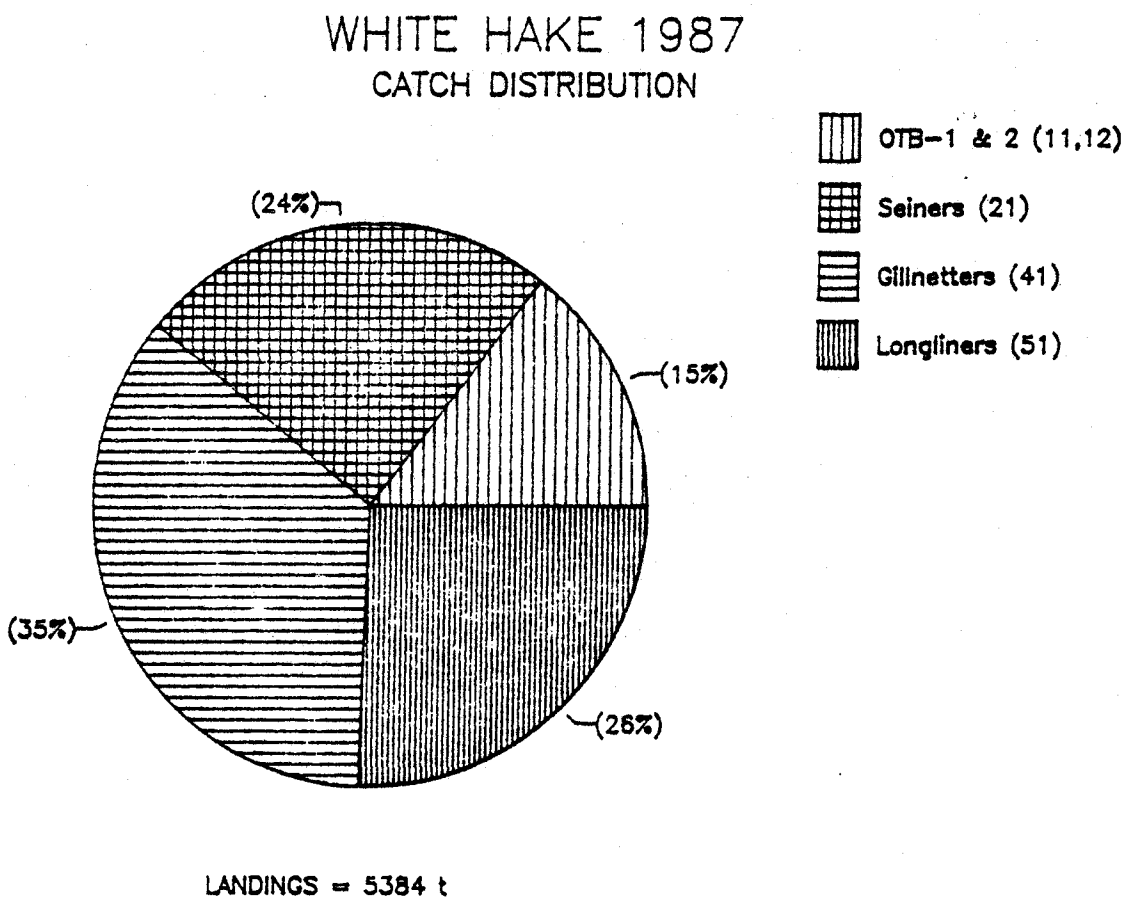


Figure 4. Residuals at successive CPUE levels in the last run of the Gavaris multiplicative model.

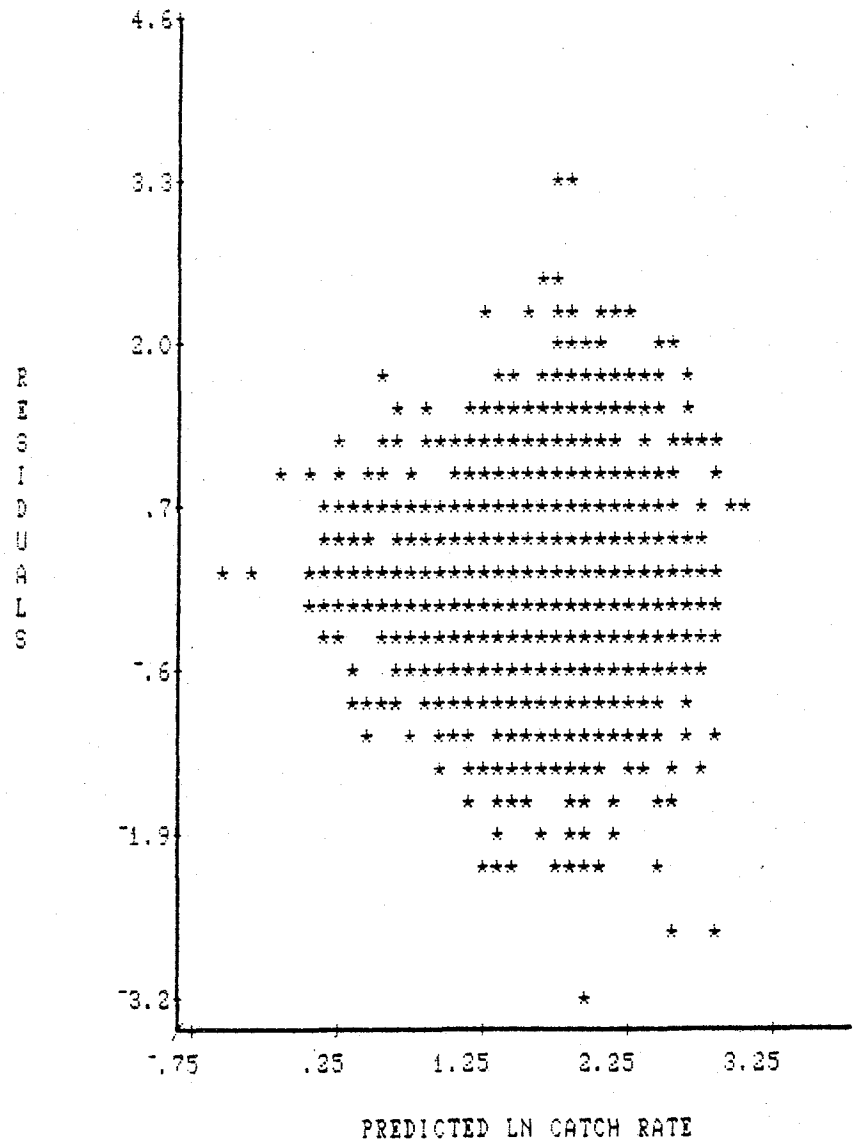
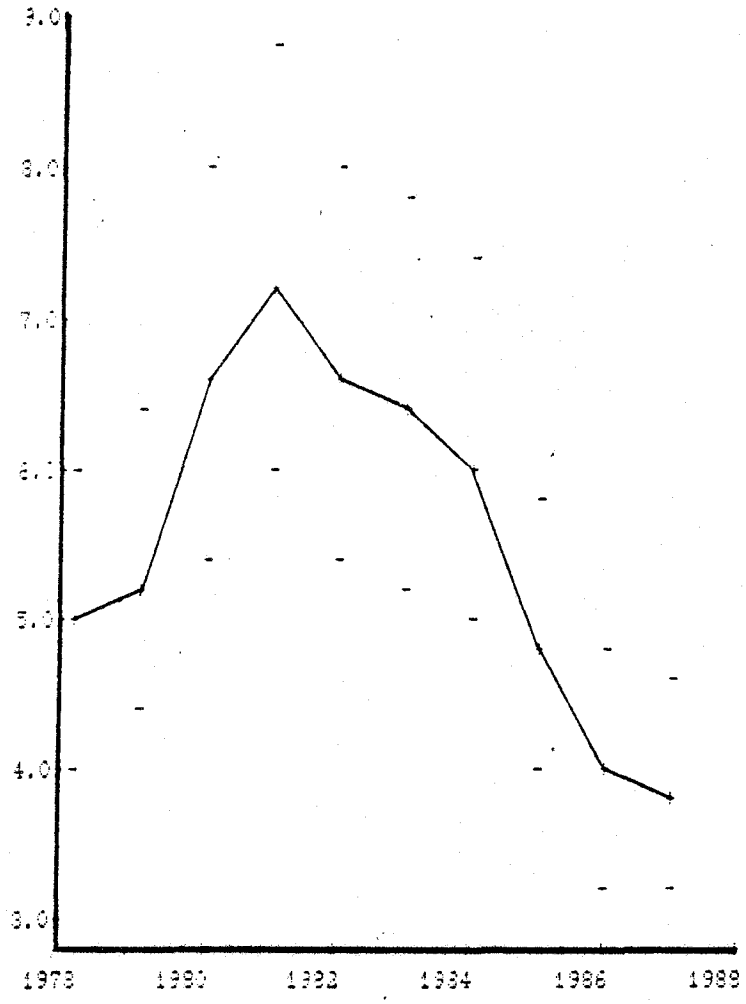


Figure 5. Standardized catch rates for Gulf hake in NAFO division 4T. All catches are expressed in hundred's of kg.



PREDICTED CATCH RATE

STANDARDS USED VARIABLE NUMBERS: 2 41 1

YEAR	TOTAL CATCH	PROP.	CATCH RATE MEAN	S.E.	EFFORT
78	48250	0.407	4.906	0.603	9836
79	81100	0.341	5.293	0.640	15321
80	124230	0.435	6.648	0.788	18686
81	140390	0.410	7.280	0.855	19285
82	97760	0.473	6.599	0.773	14815
83	73050	0.428	6.403	0.763	11409
84	70500	0.608	6.035	0.712	11682
85	60140	0.671	4.795	0.570	12543
86	46010	0.565	3.909	0.464	11772
87	62220	0.361	3.780	0.454	16460

Figure 6. Research vessel biomass estimates of Gulf hake from surveys of the southern Gulf of St. Lawrence in September of each year. The values are tonnes.

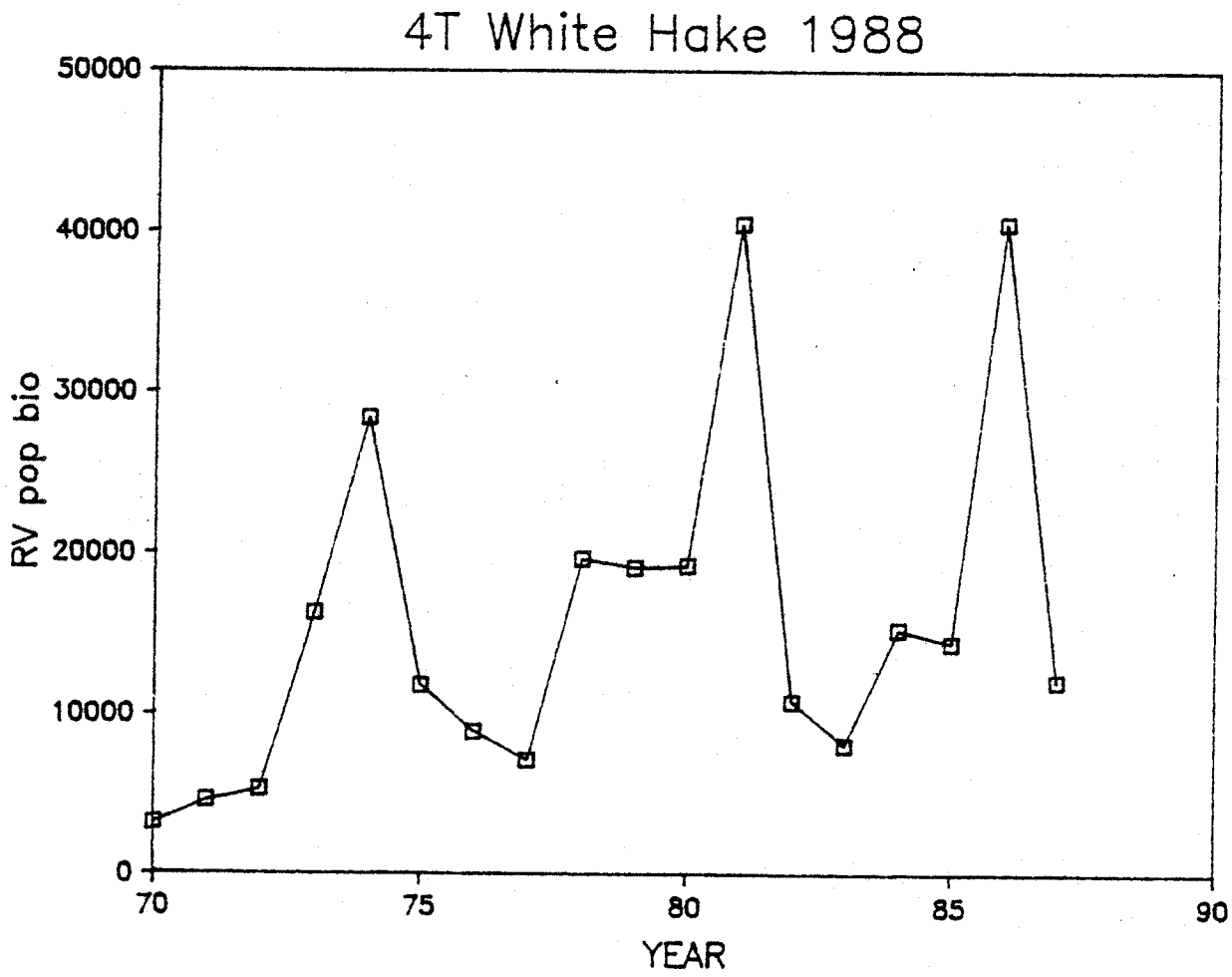


Figure 7a. Partial recruitment calculated by three different methods (see text).

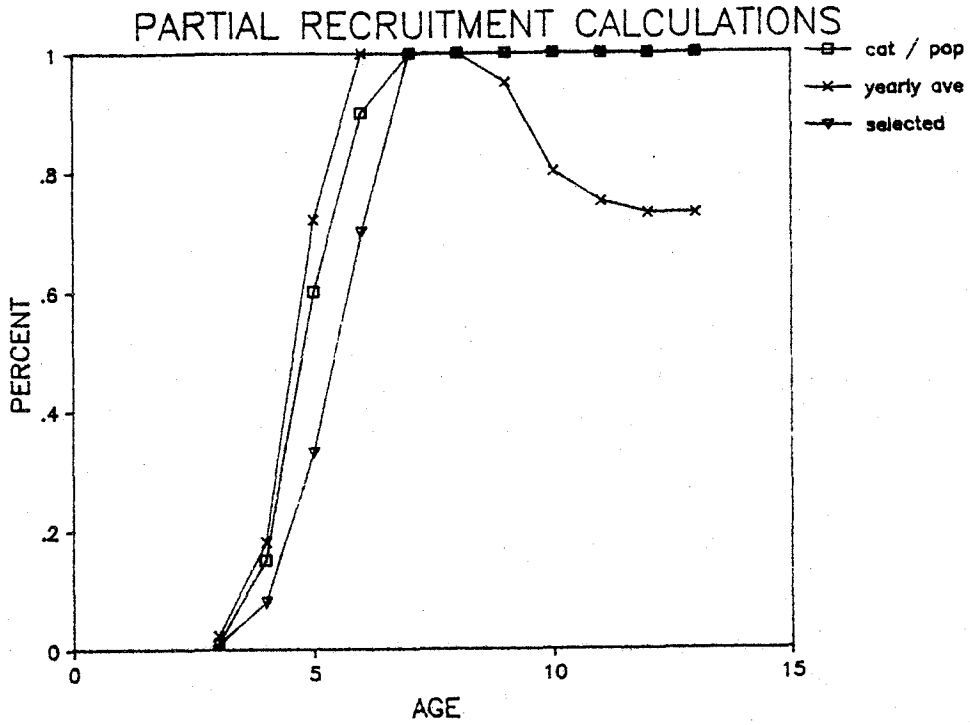


Figure 7b. The partial recruitment used in the 1986 and 1987 assessments (Clay et al., MS 1986, MS 1897) compared to that chosen for the 1988 assessment.

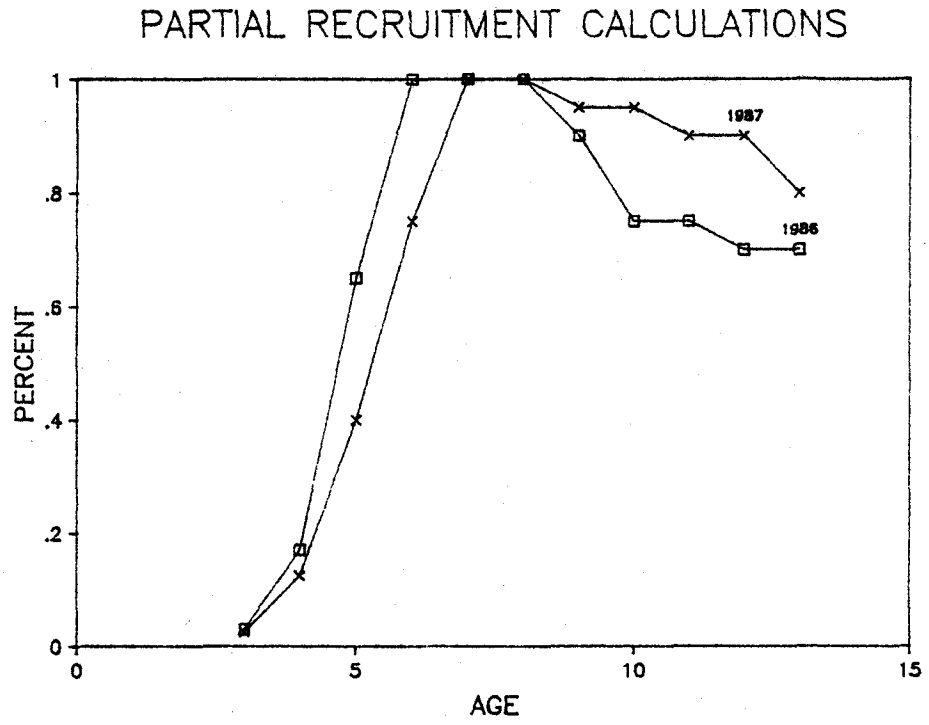


Figure 8. Calibration plots at F<u>t</u> of 0.6 for the 3+ exploitable population biomass as estimated by VPA against the commercial CPUE index from a multiplicative model.

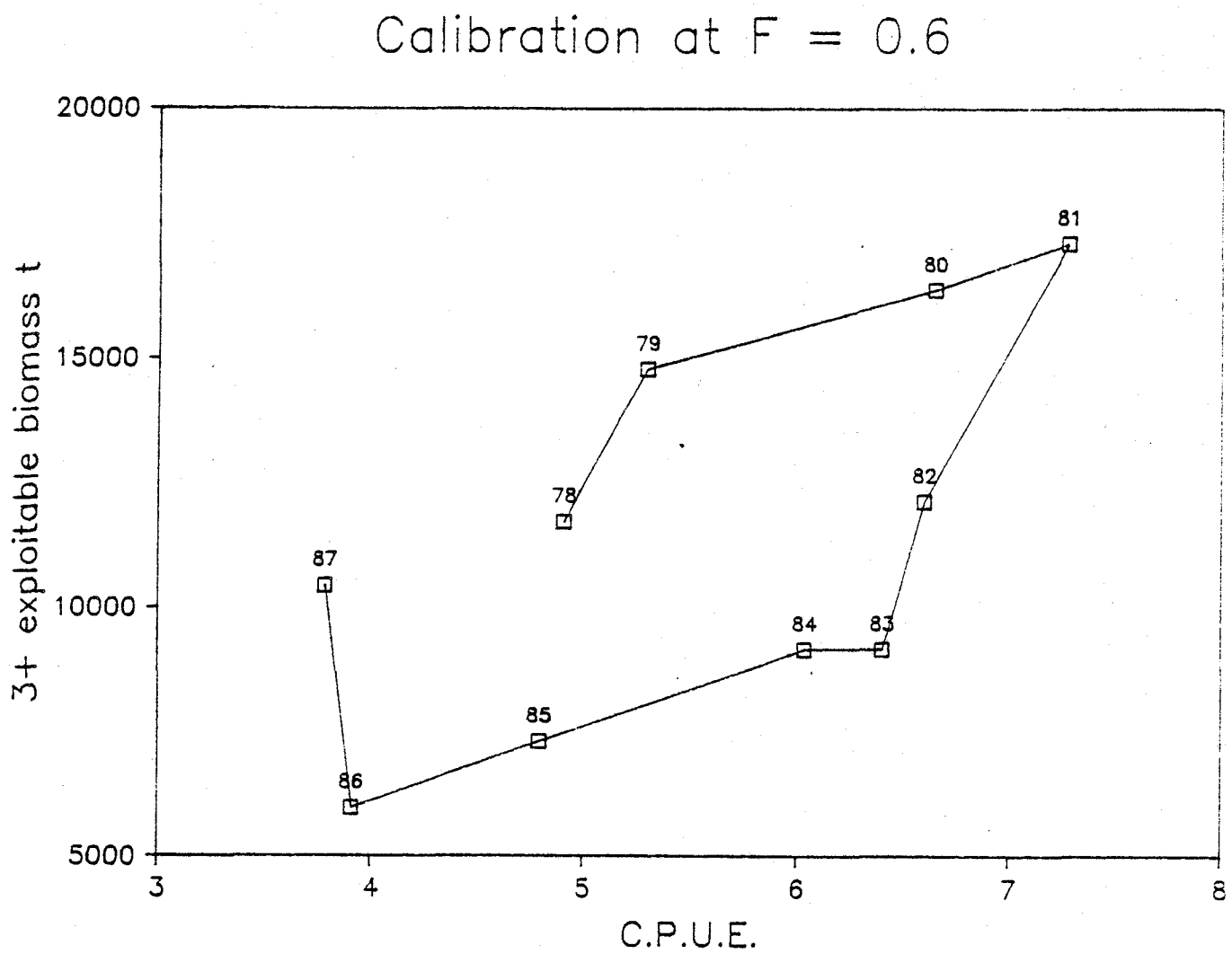
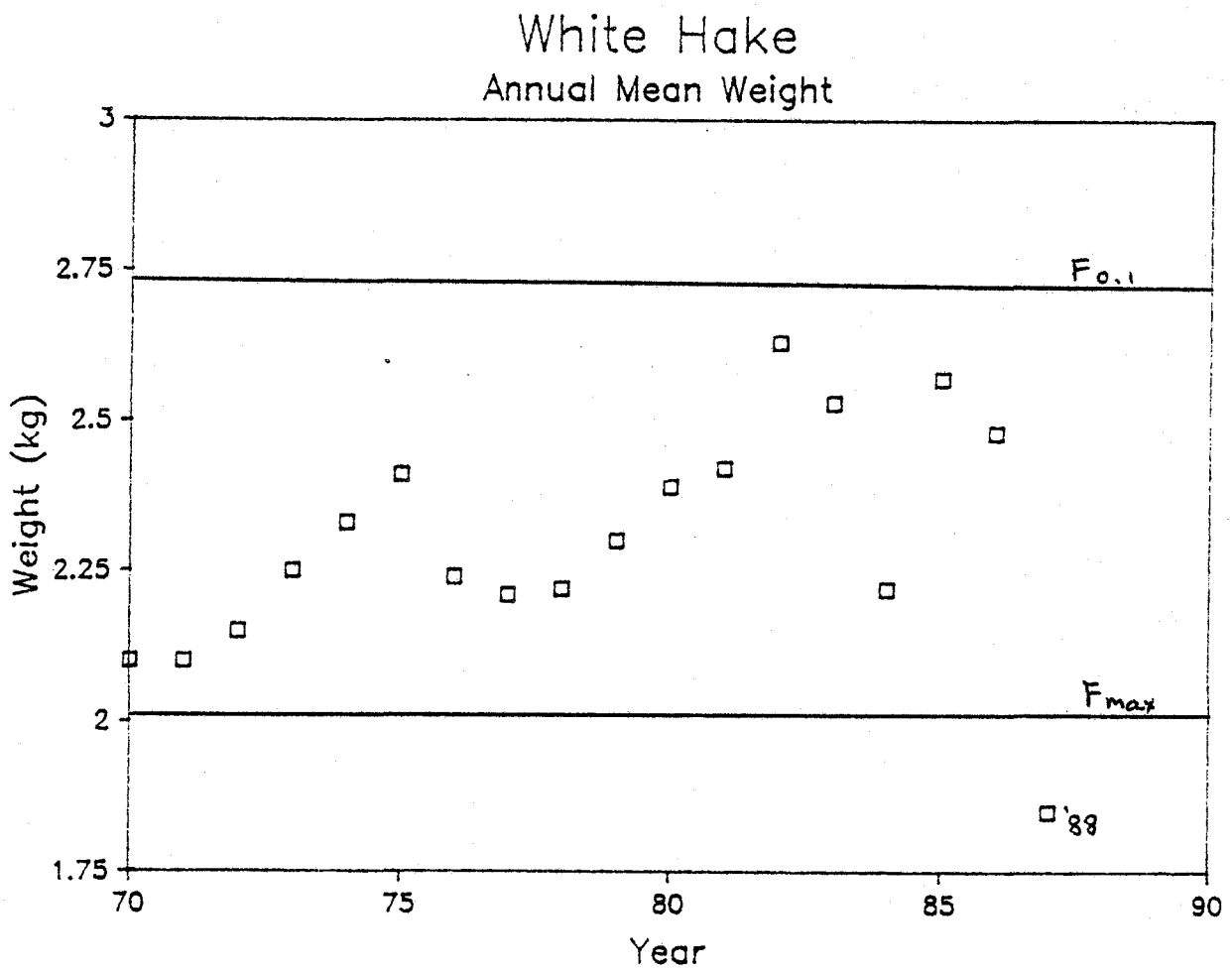


Figure 9. Mean weights by year for the NAFO division 4T Gulf hake as compared to the mean weights estimated if fishing at Fo.1 and Fmax.



APPENDIX I

VPA run with the parameters from the text and a terminal F of 0.6.

population numbers (000's) 22/ 8/88

:	70	71	72	73	74	75	76	77	78	79
3 :	5008	4491	3811	3769	4617	6645	9363	11619	11149	7672
4 :	4388	4023	3601	3038	3013	3735	5390	7593	9435	9056
5 :	2910	2955	2650	2378	2038	2242	2865	4144	5916	7405
6 :	1644	1666	1703	1500	1351	1327	1484	1956	2968	4322
7 :	892	937	961	959	814	840	778	916	1276	1940
8 :	384	396	428	426	380	387	348	376	479	735
9 :	191	186	195	203	178	189	164	167	185	238
10 :	91	90	83	85	70	76	67	74	78	97
11 :	37	37	35	29	25	28	25	30	35	40
12 :	16	19	18	18	13	13	16	16	20	25
13 :	7	7	9	7	7	6	5	5	6	10
3+:	15569	14807	13495	12412	12506	15487	20504	26896	31548	31539
4+:	10561	10316	9684	8644	7890	8842	11141	15277	20399	23867
5+:	6173	6293	6083	5605	4876	5107	5752	7684	10964	14811
6+:	3263	3338	3433	3227	2838	2866	2887	3540	5048	7406

:	80	81	82	83	84	85	86	87
3 :	5626	5164	4444	4799	6504	12066	13904	5395
4 :	6200	4524	4169	3635	3878	5271	9805	11383
5 :	6990	4668	3319	3311	2860	2793	4124	7871
6 :	5312	4797	2855	2225	2176	1630	1772	2948
7 :	2664	2859	2161	1321	1117	1010	821	1021
8 :	986	1113	1100	785	538	447	462	384
9 :	320	326	373	409	289	204	134	170
10 :	105	140	130	172	128	96	59	39
11 :	37	19	31	36	77	57	30	7
12 :	26	24	12	7	26	45	29	5
13 :	11	16	19	2	2	12	9	12
3+:	28276	23651	18613	16703	17593	23630	31149	29234
4+:	22650	18487	14169	11904	11089	11564	17245	23839
5+:	16450	13963	10000	8270	7212	6293	7440	12456
6+:	9460	9295	6682	4958	4351	3500	3317	4586

mid-year population biomass: tonnes 22/ 8/88

:	70	71	72	73	74	75	76	77	78	79
3 :	4722	4231	3581	3546	4368	6295	8869	11014	10570	7255
4 :	4869	4418	3959	3365	3504	4407	6367	9027	11256	10718
5 :	4156	4233	3765	3385	3088	3423	4437	6565	9461	11740
6 :	2850	2904	2937	2544	2437	2330	2668	3608	5480	7766
7 :	1690	1797	1820	1731	1588	1545	1529	1865	2714	3899
8 :	901	937	994	937	902	855	814	889	1136	1645
9 :	479	456	472	445	427	420	402	417	487	579
10 :	269	263	231	219	205	206	206	232	256	280
11 :	160	152	150	115	109	125	119	145	173	192
12 :	75	93	81	80	61	59	67	73	99	117
13 :	49	45	57	44	45	36	33	36	46	63
3+:	20221	19530	18048	16410	16735	19701	25512	33870	41675	44254
4+:	15499	15299	14467	12865	12366	13405	16643	22857	31105	36998
5+:	10630	10881	10507	9499	8862	8998	10276	13830	19850	26280
6+:	6474	6648	6742	6114	5774	5576	5839	7264	10389	14541

:	80	81	82	83	84	85	86	87
3 :	5308	4881	4227	4581	6100	11441	12514	3082
4 :	7251	5226	5002	4363	4265	6497	8547	8288
5 :	10854	6871	5097	5164	3653	4511	5160	8467
6 :	8975	7493	4512	3570	3357	2796	3027	4492
7 :	4917	5094	3760	2450	1961	1968	1599	2027
8 :	1967	2232	2303	1593	1111	896	1082	1002
9 :	775	761	926	839	617	431	340	501
10 :	226	324	330	527	384	262	138	158
11 :	178	91	95	205	274	261	92	41
12 :	144	150	39	35	108	143	137	29
13 :	69	98	119	14	14	62	38	83
3+:	40662	33222	26410	23340	21844	29269	32673	28169
4+:	35354	28341	22182	18758	15744	17828	20159	25087
5+:	28104	23115	17181	14395	11479	11331	11612	16800
6+:	17249	16243	12083	9231	7826	6820	6452	8333

catch biomass: tonnes 22/ 8/88

:	70	71	72	73	74	75	76	77	78	79
3 :	90	88	95	84	52	59	85	91	83	95
4 :	951	960	850	671	336	288	400	447	476	632
5 :	1487	1487	1391	1237	707	727	806	877	1080	1552
6 :	1035	1016	1099	1044	672	779	754	819	1235	2204
7 :	1032	1047	1116	1256	866	1050	806	835	954	1860
8 :	473	476	545	631	449	564	434	450	568	1040
9 :	263	276	300	384	279	351	240	236	219	360
10 :	189	193	197	224	147	186	125	129	116	211
11 :	73	84	73	73	45	45	28	28	22	45
12 :	46	53	53	60	33	47	60	53	53	73
13 :	29	29	38	38	29	29	19	19	19	38
3+:	5668	5707	5757	5702	3616	4125	3758	3984	4825	8110
4+:	5578	5619	5662	5618	3564	4066	3673	3893	4742	8015
5+:	4626	4659	4812	4948	3228	3778	3273	3447	4266	7383
6+:	3139	3172	3420	3711	2521	3051	2466	2569	3186	5831

:	80	81	82	83	84	85	86	87
3 :	95	69	5	60	62	86	1	17
4 :	607	574	151	173	546	295	169	375
5 :	1915	2004	1018	1136	1325	1150	700	1691
6 :	3765	4478	2574	1746	1905	1356	1064	1874
7 :	3308	3847	3053	1712	1402	1147	896	1216
8 :	1780	1992	1816	1276	858	904	864	601
9 :	488	548	533	810	557	449	352	300
10 :	337	421	353	317	234	248	261	95
11 :	39	23	123	32	92	120	150	24
12 :	40	7	63	32	60	200	99	17
13 :	48	76	86	11	10	59	46	10
3+:	12423	14039	9776	7305	7050	6014	4601	6222
4+:	12328	13970	9771	7245	6988	5928	4600	6205
5+:	11720	13396	9620	7072	6442	5633	4431	5830
6+:	9805	11392	8602	5935	5117	4482	3732	4139

mean weight of individuals in catch: kg 22/ 8/88

:	70	71	72	73	74	75	76	77	78	79
:	2.10	2.10	2.15	2.25	2.33	2.41	2.24	2.21	2.22	2.30

:	80	81	82	83	84	85	86	87
:	2.39	2.42	2.63	2.53	2.22	2.57	2.48	1.85

production 22/ 8/88

source	:	70	71	72	73	74	75
recruitment biomass	:	4649	4169	3538	3498	4286	6168
growth	:	4796	4729	4332	3937	3998	4795
total production	:	9445	8898	7870	7435	8283	10963
loss through fishing	:	5668	5707	5757	5702	3616	4125
surplus production	:	5401	4992	4260	4153	4936	7023
net production	:	-267	-715	-1497	-1549	1320	2898

source	:	76	77	78	79	80	81
recruitment biomass	:	8692	10786	10350	7122	5222	4794
growth	:	6301	8424	10313	10757	9636	7751
total production	:	14993	19210	20662	17879	14858	12545
loss through fishing	:	3758	3984	4825	8110	12423	14039
surplus production	:	9891	12436	12327	9029	6726	5901
net production	:	6133	8452	7502	919	-5697	-8138

source	:	82	83	84	85	86	87
recruitment biomass	:	4126	4444	6249	10854	15182	5891
growth	:	6185	5015	5209	5744	751	-263
total production	:	10311	9459	11458	16599	15933	5628
loss through fishing	:	9776	7305	7050	6014	4601	6222
surplus production	:	5029	4791	7089	10745	9398	-6
net production	:	-4747	-2514	39	4731	4797	-6228

production/biomass ratio 22/ 8/88

:	70	71	72	73	74	75	76	77	78	79	80
:	0.47	0.46	0.44	0.45	0.49	0.56	0.59	0.57	0.50	0.40	0.37

:	81	82	83	84	85	86	87
:	0.38	0.39	0.41	0.52	0.57	0.49	0.20

fishing mortality 22/ 8/88

:	70	71	72	73	74	75	76	77	78	79
3 :	0.019	0.021	0.027	0.024	0.012	0.009	0.010	0.008	0.008	0.013
4 :	0.195	0.217	0.215	0.199	0.096	0.065	0.063	0.049	0.042	0.059
5 :	0.358	0.351	0.369	0.365	0.229	0.212	0.182	0.134	0.114	0.132
6 :	0.363	0.350	0.374	0.411	0.276	0.334	0.283	0.227	0.225	0.284
7 :	0.611	0.582	0.613	0.726	0.545	0.680	0.527	0.448	0.351	0.477
8 :	0.525	0.508	0.549	0.673	0.498	0.659	0.533	0.506	0.500	0.632
9 :	0.549	0.605	0.635	0.864	0.653	0.837	0.596	0.567	0.449	0.623
10 :	0.700	0.733	0.855	1.023	0.718	0.905	0.606	0.557	0.453	0.755
11 :	0.456	0.550	0.483	0.637	0.415	0.362	0.236	0.194	0.130	0.235
12 :	0.616	0.567	0.648	0.747	0.546	0.791	0.894	0.726	0.536	0.624
13 :	0.581	0.630	0.669	0.877	0.641	0.801	0.576	0.529	0.416	0.604
6+:	0.473	0.462	0.493	0.588	0.421	0.531	0.408	0.339	0.296	0.387

:	80	81	82	83	84	85	86	87
3 :	0.018	0.014	0.001	0.013	0.010	0.008	0.000	0.006
4 :	0.084	0.110	0.030	0.040	0.128	0.045	0.020	0.045
5 :	0.176	0.292	0.200	0.220	0.363	0.255	0.136	0.200
6 :	0.420	0.598	0.570	0.489	0.568	0.485	0.352	0.417
7 :	0.673	0.755	0.812	0.699	0.715	0.583	0.560	0.600
8 :	0.905	0.893	0.789	0.801	0.772	1.009	0.798	0.600
9 :	0.630	0.721	0.575	0.966	0.902	1.041	1.034	0.600
10 :	1.492	1.296	1.071	0.602	0.610	0.946	1.888	0.600
11 :	0.222	0.249	1.305	0.155	0.335	0.460	1.635	0.600
12 :	0.278	0.045	1.619	0.902	0.557	1.393	0.726	0.600
13 :	0.694	0.774	0.724	0.791	0.705	0.944	1.209	0.600
6+:	0.560	0.694	0.700	0.636	0.650	0.638	0.538	0.482

APPENDIX II.

Projections run with the parameters listed in the text fishing the full quota of 5,500 tonnes for 1988 and the $F_{0.1}$ for 1989 to 1992.

population numbers (000's) 22/ 8/88

:	87	88	89	90	91	92
3 :	5395	6180	6180	6180	6180	6180
4 :	11383	4392	5043	5045	5045	5045
5 :	7871	8907	3507	4035	4036	4036
6 :	2948	5277	6541	2598	2989	2990
7 :	1021	1590	3442	4346	1726	1986
8 :	384	459	940	2088	2636	1047
9 :	170	173	271	570	1266	1599
10 :	39	76	102	164	346	768
11 :	7	17	45	62	100	210
12 :	5	3	10	27	38	60
13 :	12	2	2	6	17	23
3+:	29234	27078	26084	25121	24378	23943
4+:	23839	20898	19904	18941	18198	17763
5+:	12456	16506	14861	13897	13153	12719
6+:	4586	7598	11354	9861	9117	8683

mid-year population biomass: tonnes 22/ 8/88

:	87	88	89	90	91	92
3 :	4348.07	4986.55	4987.19	4987.19	4987.19	4987.19
4 :	10707.15	4171.84	4794.77	4796.02	4796.02	4796.02
5 :	10354.44	12231.16	4836.03	5563.93	5565.38	5565.38
6 :	4864.54	9496.76	11872.27	4715.72	5425.51	5426.93
7 :	1984.83	3493.20	7651.61	9659.43	3836.77	4414.27
8 :	964.58	1301.44	2698.40	5995.32	7568.52	3006.25
9 :	484.50	555.07	882.30	1855.54	4122.65	5204.46
10 :	143.57	318.81	430.30	693.77	1459.06	3241.74
11 :	35.07	94.93	248.34	339.98	548.16	1152.82
12 :	24.72	18.82	60.03	159.29	218.07	351.59
13 :	89.91	15.21	13.64	44.14	117.12	160.35
3+:	34001.37	36683.80	38474.88	38810.34	38644.46	38307.00
4+:	29653.30	31697.25	33487.69	33823.15	33657.27	33319.82
5+:	18946.16	27525.41	28692.92	29027.13	28861.25	28523.79
6+:	8591.71	15294.25	23856.89	23463.20	23295.87	22958.41

catch biomass 22/ 8/88

:	87	88	89	90	91	92
3 :	24	16	15	15	15	15
4 :	484	104	110	110	110	110
5 :	2068	1330	484	556	557	557
6 :	2029	2158	2481	986	1134	1134
7 :	1191	1140	2295	2898	1151	1324
8 :	579	425	810	1799	2271	902
9 :	291	181	265	557	1237	1561
10 :	86	104	129	208	438	973
11 :	21	31	75	102	164	346
12 :	15	6	18	48	65	105
13 :	9	5	4	13	35	48
3+:	6797	5500	6686	7291	7177	7075
4+:	6773	5484	6671	7277	7162	7061
5+:	6289	5379	6560	7166	7052	6950
6+:	4220	4049	6077	6610	6495	6394

fishing mortality 22/ 8/88

:	87	88	89	90	91	92
3 :	0.006	0.003	0.003	0.003	0.003	0.003
4 :	0.045	0.025	0.023	0.023	0.023	0.023
5 :	0.200	0.109	0.100	0.100	0.100	0.100
6 :	0.417	0.227	0.209	0.209	0.209	0.209
7 :	0.600	0.326	0.300	0.300	0.300	0.300
8 :	0.600	0.326	0.300	0.300	0.300	0.300
9 :	0.600	0.326	0.300	0.300	0.300	0.300
10 :	0.600	0.326	0.300	0.300	0.300	0.300
11 :	0.600	0.326	0.300	0.300	0.300	0.300
12 :	0.600	0.326	0.300	0.300	0.300	0.300
13 :	0.100	0.326	0.300	0.300	0.300	0.300
3+:	0.148	0.113	0.126	0.130	0.123	0.120

production 22/ 8/88

source	:	87	88	89	90	91	92
recruitment biomass	:	4410	5052	5052	5052	5052	5052
growth	:	10022	10672	10279	9935	9671	9694
total production	:	14432	15725	15332	14988	14724	14746
loss through fishing	:	6797	5500	6686	7291	7177	7075
surplus production	:	7632	8388	7637	7226	6995	7085
net production	:	835	2888	951	-66	-182	9

production/biomass ratio 22/ 8/88

:	87	88	89	90	91	92
:	0.42	0.43	0.40	0.39	0.38	0.38

summary of projections 22/ 8/88

year	:	87	88	89	90
population numbers	:	29234.03	27078.00	26084.33	25121.28
population biomass	:	34001.37	36683.80	38474.88	38810.34
catch	:	6797.17	5500.00	6685.54	7291.49
f or quota	:	6797.17	5500.00	0.30	0.30

year	:	91	92
population numbers	:	24377.84	23943.38
population biomass	:	38644.46	38307.00
catch	:	7176.85	7075.48
f or quota	:	0.30	0.30

age groups considered>3+