Flatfish Statistics in the Gulf of St. Lawrence, with a Review of 4T White Hake

by

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ABSTRACT

Analytical assessments were not conducted for the flatfish stocks in NAFO divisions 4RST. Catch-at-age distribution is not accurate for American plaice due to the large number of discards and the unknown nature of these discards. Abundance indices indicate a possible decline in stock size. The winter flounder fishery is largely an inshore fishery, resulting in a lack of effort data and limited sampling information. Catch per unit effort data indicate a decreasing stock biomass, despite stable catches. The landings of the other flatfish stocks are small and comprise a very small portion of the Atlantic fishery. Catch-at-age information is not available for white hake and until 1982 this was an unregulated fishery. Research vessel survey data indicate a stable stock biomass. Analytical assessments on which to base management strategies will not be feasible for these fish stocks until more data are available. For the present, little can be done aside from data collection and biological monitoring.

RÉSUMÉ

Il n'y a pas eu d'évaluations analytiques de faites des stocks de poissons plats dans les div. 4RST de l'OPANO. La distribution des prises par âge de plie canadienne est imprécise à cause du grand nombre de poissons rejetés à la mer et du manque d'information sur la nature de ces rejets. Les indices d'abondance indiquent un déclin possible des effectifs de stock. La pêche de la plie rouge est en grande partie côtière. Comme résultat, on manque de données sur l'effort, et l'échantillonnage est limité. Les prises par unité d'effort indiquent une diminution de la biomasse de stock, malgré des prises stables. Les débarquements des autres stocks de poissons plats sont faibles et ne représentent qu'une petite fraction de la pêche dans l'Atlantique. Nous ne possédons pas de données sur les prises par âge de merluche blanche et, jusqu'en 1982, cette pêche était non réglementée. Les relevés par navires de recherche indiquent une biomasse de stock stable. On ne pourra faire des évaluations analytiques sur lesquelles fonder des stratégies de gestion pour ces stocks, tant qu'on n'aura pas plus de données. Pour le moment, on ne peut faire beaucoup plus que recueillir des données et exercer une surveillance biologique.

INTRODUCTION

Prior to 1982 the flatfish of the Gulf of St. Lawrence have been assessed by two research regions which in effect divided the Gulf into the southern (NAFO 4T) and northern (NAFO 4RS) research components . Most of the flatfish fisheries in the Gulf are by-catch, some having limited directed aspects. The major flatfish stocks investigated have included 4RS witch, 4RST Greenland halibut, 4T American plaice, and 4T winter flounder. The 4T white hake is a locally important stock in the southern Gulf.

STOCKS

YELLOWTAIL FLOUNDER

The Gulf yellowtail fishery is extremely small, having a mean catch of less than 45 tonnes over the last twenty years (Table 1). In most years the major portion is taken in NAFO division 4T. There is no seasonality in the distribution of the landings. The landings for 1982 were 6 tonnes.

ATLANTIC HALIBUT

Atlantic halibut is a commercially preferred fish, with declining landings over the last 20 years (Table 1). The landings have tended to be split somewhat equally over the 3 NAFO divisions of the Gulf. The landings for 1982 were 34 tonnes, down considerably from the 20 year average of 355 tonnes.

GREENLAND HALIBUT

This fishery was a by-catch of the northern shrimp fishery until 1978. Since that time increased biomass due to strong 1973 to 1975 year classes has lead to a dedicated gillnet fishery along the north shore (Quebec). The landings for this stock were fairly uniformly spread though NAFO divisions 4RST until 1973. Since that time there has been an increase in the 4S proportion of the landings, due mainly to fishing by gillnetters and shrimp trawlers. The landings have been declining in recent years (Table 1) to the 1982 level of 2264 tonnes.

Research vessel surveys do not indicate any strong new recruitment and the commercial catch per unit effort indicates a decline from 1978 to 1981/1982 from 23kg/hr to 5kg/hr. Due to the by-catch nature of the shrimp fishery component and the opportunistic nature of the directed gillnet component of the fishery, this fishery will be difficult to manage with a TAC. Catches should, however remain stable until 1985 or 1986.

Table 1. 4RST Landings Statistics 1960 - 1982 (Totals may not be exact due to roundings).

YEAR	YELLOW -TAIL	ATLANT HALIBUT	GREEN. HALIBUT	WITCH	WINTER FLOUNDER	PLAICE	TOTAL FLATFISH
1960	5	704	0	3341	929	11515	16494
1961	11	780	0	3506	1616	10793	16706
1962	3	621	0	3391	2331	6832	13178
1963	51	537	0	3637	2600	9411	16236
1964	48	615	0	2694	2645	9691	15693
1965	45	693	24	3033	3712	12089	19596
1966	108	612	365	2989	2444	13766	20284
1967	79	132	365	2714	2454	10478	16222
1968	12	444	686	3388	551	11911	16992
1969	268	94	801	4652	1710	10841	18366
1970	59	509	1112	4801	2694	13132	22307
1971	40	454	954	3821	2842	11765	19876
1972	3	310	681	2001	1911	9724	14630
1973	6	385	756	2224	2384	8007	13762
1974	27	418	1011	3247	1976	11261	17940
1975	3	272	1544	2722	2050	10177	16768
1976	37	196	2019	6875	2471	14265	25863
1977	30	150	3961	3039	1358	12665	21203
1978	13	135	6247	4510	1236	12375	24516
1979	69	132	8791	4561	1722	12943	28218
1980	46	202	7006	3527	2053	11115	23949
1981	14	95	3176	1912	2013	10210	17420
1982*	6	34	2264	1179	2327	7380	13190
AVERAGE	44	355	1898	3382	2140	10944	18766
PERCENT	0.2	1	10	18	11	58	100

* note: all references to 1982 data refer to provisional statistics

WITCH FLOUNDER

The witch (greysole) landings were distributed relatively evenly between NAFO divisions 4R and 4S in the Gulf until 1973, however since then there has been a shift in the landings to NAFO division 4R. There has been a steady decline since 1979 from 4500 tonnes to the present 1000 tonnes landed in 1982 (Table 1).

The CPUE index (Figure 1) from the multiplicative model (Gavaris, 1980) indicates a relatively stable level over the past four years. Comparing this index to the commercial CPUE used by Bowering (1981) there is reasonable agreement (Table 2), however there is little agreement between the R/V population estimate trend and the standardized CPUE.

Athough catches have decreased, recent commercial and research vessel abundance indices all indicate a stable stock. Due to the declining nature of the catch there has not been a research vessel survey for this stock since 1981 and little or no commercial sampling data are available. There is therefore little basis upon which to change the current TAC advice for the foreseeable future.

Table 2. Abundance indicies for 4RS witch from Bowering (1981) and the standardized CPUE index.

YEAR	CPUE	R/V	CPUE (Bowering)
1967	1.00		
1968	1.02		
1969	1.18		
1970	0.75		
1971	0.71		
1972	0.85		
1973	0.56		
1974	0.63		
1975	0.70		
1976	0.77		0.483 tonnes/hr
1977	0.57		0.201
1978	0.82	5837	0.455
1979	0.76	6594	0.343
1980	0.89	2538	0.132
1981	0.80	5910	

AMERICAN PLAICE in the Gulf of St. Lawrence

The American plaice landings in the Gulf are concentrated in NAFO division 4T. Although the catches in NAFO division 4R are only in the order of 2000 tonnes, they are larger than any of the other flatfish fisheries in that division. Plaice landing statistics have, in the past included up to 90% of the unspecified flounder catch. The 4T plaice catch for 1982 was 6180 tonnes, with and additional 1200 tonnes taken in 4RS for a total Gulf catch of 7380 tonnes.

AMERICAN PLAICE in NAFO division 4T

Commercial (nominal) landings of American plaice in NAFO division 4T, the Gulf of St. Lawrence, stood at 6180 tonnes in 1982, down nearly 10% from 1981. This has continued the downward trend prevalent since 1976, resulting in a total drop of over 45% (Table 3). The majority of the landings is taken by mobile gear (OTB-1 and SNU) with the remaining 10% being taken by fixed gear (GN and LL).

Table 3. Nominal landings of 4T plaice in tonnes. These landings does not contain any of the unspecified flounder landings (the totals may not be exact due to roundings).

American plaice 4T landing statistics 1972 - 1982

YEAR::GEAR	TRAWL	SEINE	GILLNET	OTHER	TOTAL
1972	5135	2315	286	558	8294
1973	3558	2743	241	363	6905
1974	4131	3661	250	443	8485
1975	3989	3878	217	359	8443
1976	6962	3376	225	630	11193
1977	4634	4004	242	350	9230
1978	4540	3489	379	623	9031
1979	4523	3724	750	999	9996
1980	3887	3472	726	207	8292
1981	1671	3520	1057	541	6789
1982	1154	4124	767	135	6180
AVERAGE	4016	3482	467	473	8439
PERCENT	47	41	5	5	

A major problem in the sampling of American plaice is discarding at sea. Studies in 1959-61 (Jean, 1963), 1976 (MacLaren Atlantic, MS 1978) , and 1980 have shown levels of 30-60% discards by weight and 55-85% by number. All fish under 30cm and a decreasing percentage of each length interval above that size are discarded at sea. This poses a serious problem and requires either accurate on board sampling of 'catch', or faith in past discard studies and the assumption of a fleet with similiar discard habits. In the past, of necessity, we have accepted the latter.

The mean age and weight of fish in the catch has dramatically increased in the last two years over previous years (Table 4) This may be as a result of a strong year class moving into the older age groups and/or a poor recruitment in recent years or an increasing rate of discarding of small fish due to the abundance of cod. It is probable that the abundance of cod is making it both unnecessary and uneconomical to sort the relatively small and decreasing percentage of plaice in the catch. The mean weights of fish caught in the R/V surveys do not show the same marked trend - indicating the latter assumption is the more likely (Table 4).

Table 4. Mean weight and age of 4T plaice.

YEAR	MEAN AGE (catch)	MEAN WT (catch)	MEAN WT (R/V)
1964	8.63 yr	.41 tonnes	-
1965	8.63	.41	-
1966	8.63	.41	-
1967	8.63	.41	-
1968	8.63	.41	-
1969	8.63	.41	-
1970	9.69	.50	-
1971	9.69	.50	.17 kg
1972	9.69	.50	.19
1973	9.69	.50	.20
1974	9.69	.50	.14
1975	9.69	.50	.17
1976	9.20	.46	.19
1977	8.23	.37	.12
1978	8.54	.40	.19
1979	9.01	.43	.15
1980	10.69	.60	.19
1981	12.01	.74	.16
1982	11.77	.70	.21

The landings at age show a very marked relative drop in six and seven year old fish over the last three years. The disparity in six and seven year old fish is still present after weighting by the discard ogive to give the catch at age. As discussed above this is assumed to be the result of changing discard behavior of the fleet.

To investigate the possible interaction of the plaice and cod fisheries in the Gulf of St. Lawrence, the CPUE (standardized by the method of Gavaris (1980)) of the cod fishery was regressed against the CPUE (index) and the effort (standardized) of the plaice fishery (cod CPUE from Lever (Pers.Comm.)). The two CPUE series are highly correlated with a relationship of:

$$\text{PLAICE CPUE} = 0.37 + 1.12\ \text{COD CPUE} \ ;\ n=12\ ,\ r^2=0.91.$$

This implies the biomass abundance of the two fisheries are related, which is highly unlikely (Figure 2). The two CPUE series when normalized to their respective means (Figure 3) indicate a similar trend for both series until 1980 (or a cod CPUE level of 0.78) at which point they become diversent. The relationship of cod CPUE to effort expended on plaice may be more meaningful, this relationship is:

$$\text{PLAICE EFFORT} = 16044 - 12930\ \text{COD CPUE} \ ;\ n=12\ ,\ r^2=0.86.$$

This relationship implies the effort expended on the plaice fishery is inversely dependent upon the catch rate in the cod fishery (Figure 4).

The catch per unit effort (CPUE) was standardized for this assessment using the (multiplicative) fishing power model (Gavaris, 1980) enhanced and modified from Robson (1966). The data for this model were prepared from Table 5 of the NAFO (ICNAF) "Statistical Bulletin's" 1967 to 1981 (tape provided by NAFO). The 1982 data were added from provisional data provided by DFO, Statistics Branch. These data were re-formatted into an 'X-matrix' composed of catch and effort data and dummy variables indicating presence or absence of 'category' variables. It was then analysed with the aid of an APL program (Gavaris, Pers. Comm.). The results show a similiar pattern irrespective of the manipulations made upon the data (ie. directed, by-catch, combining gears or tonnage classes, etc.). A strong drop in the index occurred in the mid 1970's followed by a steady rise in the relative CPUE until 1979/1980 with a subsequent drop in 1981 and 1982 (Table 5).

Table 5. Standardized CPUE and effort for 4T plaice.

YEAR	CPUE	EFFORT	CATCH	RVBIO
1967	1.00	7534	7534 tonnes	-
1968	1.15	6018	6921	-
1969	1.06	6211	6584	-
1970	.98	7776	7582	-
1971	.90	8474	7627	21.5
1972	.93	8966	8294	17.9
1973	.81	8525	6905	24.8
1974	.64	13258	8485	27.0
1975	.68	12416	8443	38.9
1976	.78	14350	11193	93.2
1977	1.02	9049	9230	65.2
1978	1.08	8362	9031	42.5
1979	1.35	7404	9996	62.4
1980	1.29	6428	8292	49.1
1981	1.28	5304	6789	43.8
1982	1.19	5215	6180	29.4

NOTE: RVBIO is an index of Research Vessel biomass based upon the number of fish per standard 30 minute tow
EFFORT is the 'standardized effort' calculated from the catch and the CPUE index.

It is difficult to estimate at what time in the future an analytical assessment of the 4T plaice stock will be feasible. There is indirect evidence of increased discards which makes any calculation of catch-at-age tables mere conjecture. Abundance as observed through catch and research vessel surveys indicate a falling population, however the standardized CPUE indicates a relatively stable state - upon this shakey basis it is not possible to recommend anything other than the status quo.

There are serious ramifications for the plaice fishery in view of the rising catch rate of 4TVn cod. Two options exist for the management of this groundfish fishery. The first is through catch and effort restrictions (F 0.1 fishing levels). As this is a by-catch fishery of a relatively uneconomical product, it is likely that discarding will continue and will be related to the catch rate of cod. This will continue to result in severe under reporting of juvenile catches and of the massive destruction of recruiting year classes. The catch/effort data are therefore inadequate for the very management that is supposed to control it.

The second management option is through the use of mesh size regulations. The very different mesh selection factors of flatfish compared to gadoids results in catches of juvenile plaice which must be discarded (without recording) at sea. The apparent 'availability' of juvenile plaice is inversely related to the catch rate of cod. Larger mesh sizes for a directed plaice fishery would result in increased yields of 6+ year old fish, and reduce the costs associated with sorting undersized fish. However, mesh size limits that would result in a less destructive directed plaice fishery would do little to ease the problem unless a way could be found to reduce the undersized by-catch of plaice in the cod fishery.

WINTER FLOUNDER

Over 95% of the landings of winter flounder are from the southern Gulf - NAFO division 4T. It is predominantly a small vessel, inshore, summer/autumn fishery. The mean landings over the last twenty years have been in excess of 2000 tonnes (Table 1). The major portion of the landings has been with small trawlers (tonnage class 1 & 2).

The catch per unit effort (CPUE) of winter flounder was calculated with the aid of the multiplicative model (Gavaris,1980). Their appears to be a decreasing trend over the last 20 years (Figure 5). The high CPUE of 1979 does not appear to be reflected in the landings.

Research vessel length frequencies for 1982 sexes combined are presented in Table 6. The modal lengths for males and females separately are 1 cm less than the respective modal lengths from the 1981 hake/winter flounder charter off N. E. PEI.

Table 6. Research vessel length frequencies for 1982 for white hake (WH RV LF) and winter flounder (WF RV LF)

cm	WH RV LF	LGTH DIST
19	12	0.0015
22	49	0.0065
25	33	0.0043
28	0	0.0000
31	43	0.0057
34	130	0.0172
37	298	0.0395
40	500	0.0663
43	415	0.0550
46	456	0.0605
49	704	0.0934
52	656	0.0870
55	676	0.0897
58	971	0.1288
61	843	0.1118
64	690	0.0915
67	462	0.0613
70	318	0.0421
73	85	0.0112
76	103	0.0136
79	76	0.0100
82	0	0.0000
85	16	0.0021
sum	7536	

cm	WF RV LF	LGTH DIST
14	17	0.0005
15	0	0.0000
16	49	0.0015
17	34	0.0011
18	80	0.0026
19	234	0.0076
20	280	0.0091
21	540	0.0175
22	1098	0.0357
23	1280	0.0416
24	2154	0.0700
25	2794	0.0909
26	3697	0.1202
27	3877	0.1261
28	3475	0.1130
29	3103	0.1009
30	2707	0.0880
31	1926	0.0626
32	1166	0.0379
33	845	0.0274
34	525	0.0170
35	243	0.0079
36	349	0.0113
37	16	0.0005
38	87	0.0028
39	33	0.0010
40	0	0.0000
41	40	0.0013
42	40	0.0013
43	0	0.0000
44	43	0.0013
sum	30732	

WHITE HAKE

White hake is a localized fishery with a variable catch history. The peak landings (1981) was 13572 tonnes while the landings for 1982 were 9170 tonnes. Gillnets take the major portion of the catch with otter trawlers taking nearly as much (Table 7). The research vessel length frequency for 1982 (Table 6) has the modal length about 3-5 cm below that of the hake/winter flounder 1981 charter off N. E. PEI.

The white hake landings statistics were not suitable for analysis by the multiplicative model. The R/V abundance is presented in Table 8. The 1982 level, although down from the 1981 level, is close to the mean of 6.2. This may not be significant in light of the inshore nature of the fishery and the offshore nature of the survey.

Table 7. White hake 4T landings 1972 - 1982 (totals may not appear correct due to roundings).

YEAR::GEAR	TRAWL	SEINE	LINE	GILLNET	OTHER	TOTAL
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	1265	606	419	1689	582	4561
1979	2819	890	469	2337	725	7240
1980	3378	1432	834	4459	1521	11624
1981	4713	1916	660	6142	141	13572
1982	2849	997	977	4317	30	9170
AVERAGE	2210	757	644	2384	648	6646
PERCENT	33	11	9	35	9	

Table 8. Abundance indices of 4T white hake

YEAR	R/V # per tow
1970	.59
1971	2.68
1972	1.52
1973	5.92
1974	10.45
1975	8.39
1976	7.06
1977	3.50
1978	9.95
1979	7.46
1980	6.85
1981	12.30
1982	6.98

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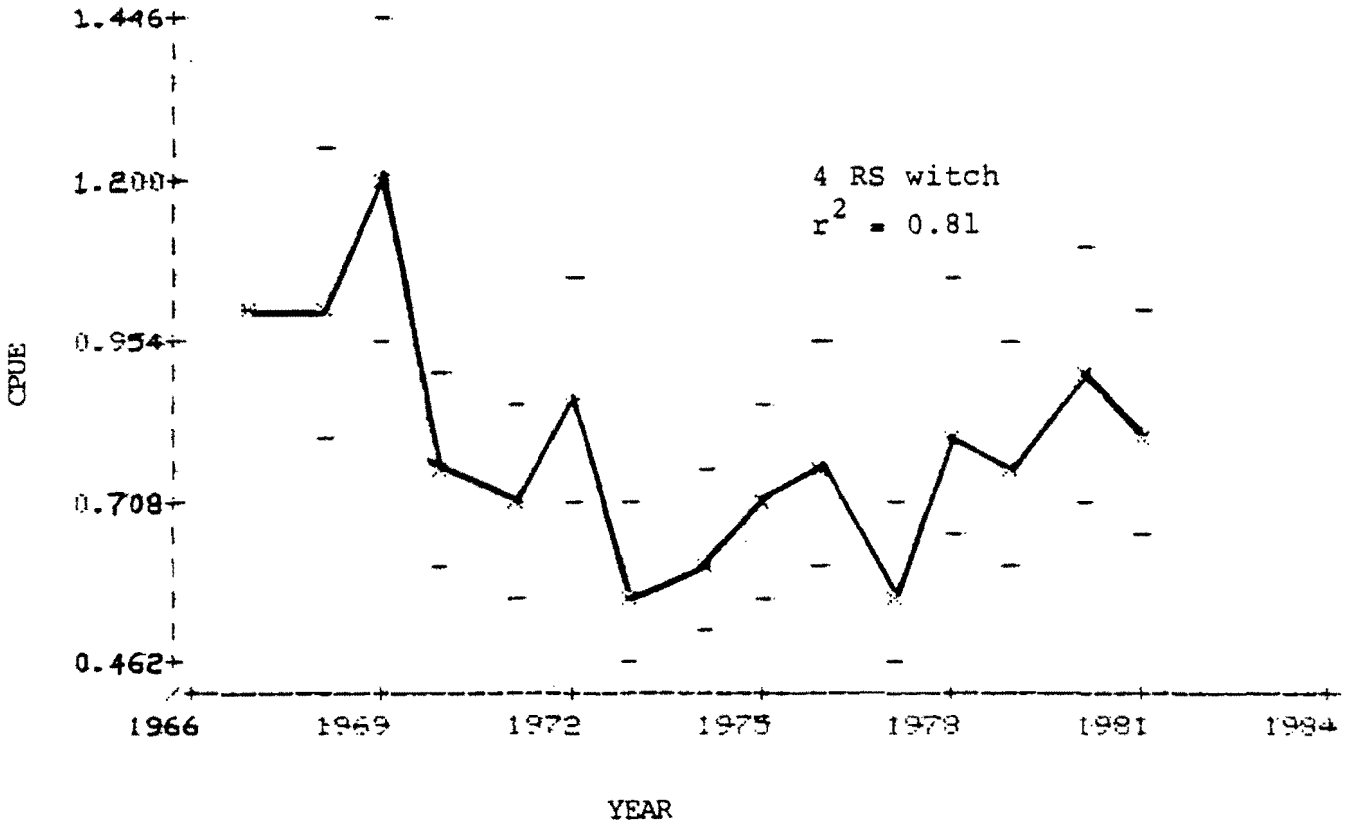


Figure 1. Standardized CPUE for 4RS witch as calculated from the multiplicative model (see text).

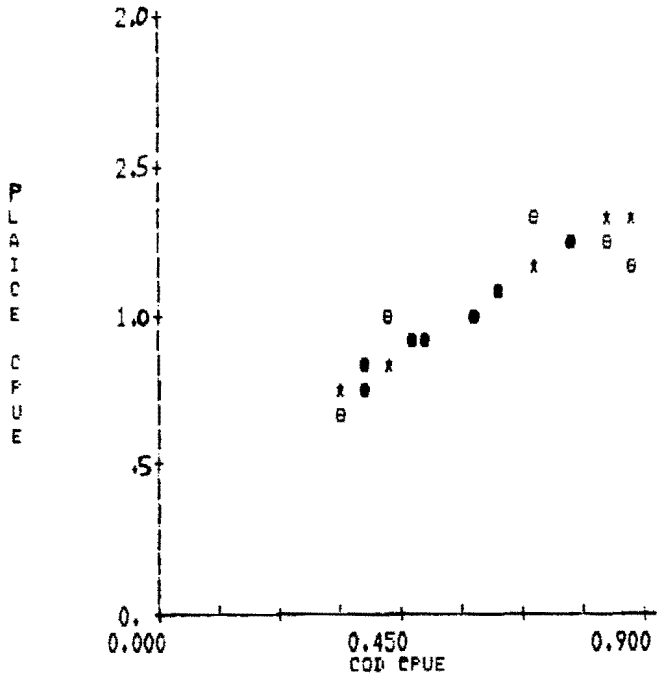


Figure 2. CPUE indices of 4TVn cod and 4T plaice. * = cod
o = plaice

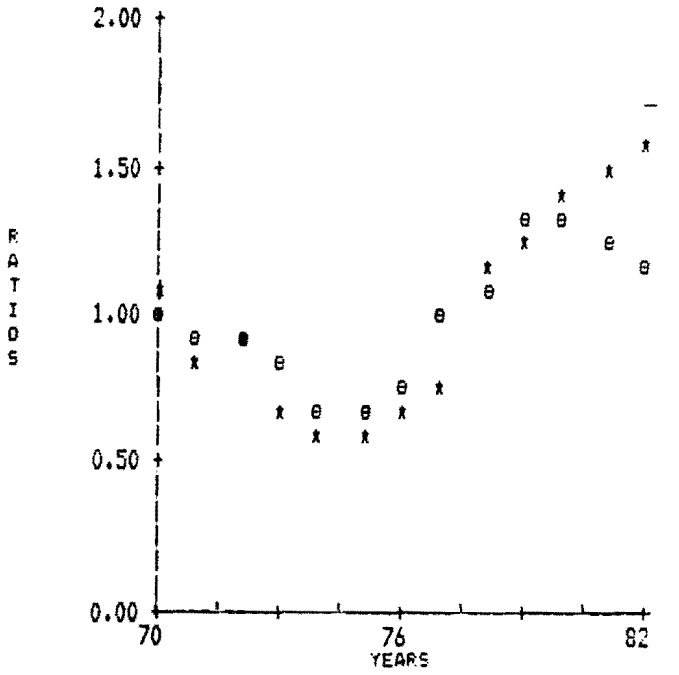
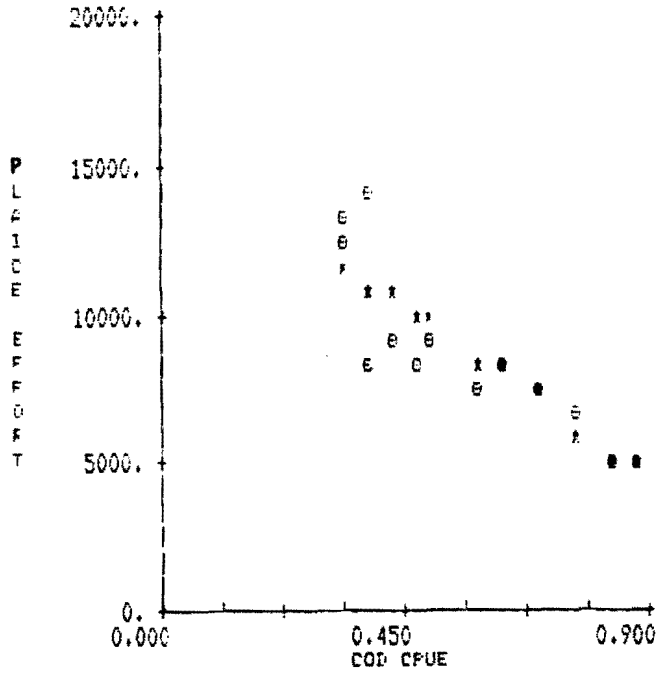


Figure 3. Two indices of Fig.2 normalized to their respective means. The *=cod and the o=plaice.

Figure 4. Plaice effort (standardized) and 4TVn cod CPUE.



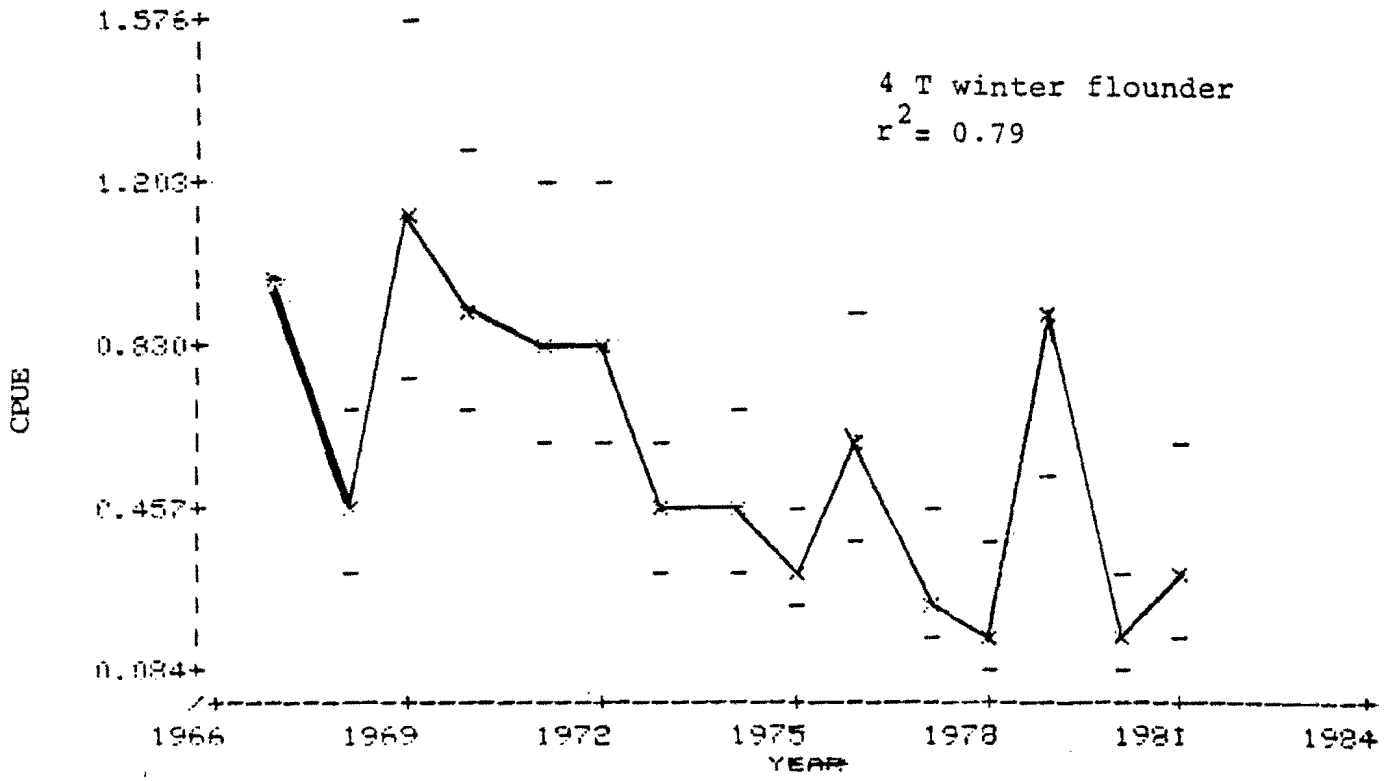


Figure 5. Standardized CPUE for 4T winter flounder as calculated from the multiplicative model (see text).