Northwest Atlantic Fisheries Organization

Serial No. N2420 NAFO SCR Doc. 94/49

SCIENTIFIC COUNCIL MEETING - JUNE 1994

Stock Status of Witch Flounder in NAFO Divisions 3NO

by

W. R. Bowering, D. Power and W. B. Brodie

Northwest Atlantic Fisheries Center
P.O. Box 5667
St. John's, Newfoundland
Canada, A1C 5X1

Catch history

Reported catches during the period 1971-84 ranged from a low of about 2,400 tons in 1980 and 1981 to as high as 15,000 tons in 1971 (Table 1; Fig. 1), however, from 1975-84 annual catches rarely exceeded 6,000 tons. With a substantial increase in effort in 1985 and 1986, especially by EU-Spain and EU-Portugal, catches rose rapidly to levels of 8,800 and 9,100 tons respectively. This increased effort was primarily concentrated on the "tail" of the Grand Bank in the NAFO Regulatory area of Division 3N. Non-Contracting parties such as South Korea, USA, Cayman Islands and Panama also contributed to increased catch levels. Catches remained relatively high in 1987 and 1988 at 7,600 and 7,300 tons respectively, declined to 3,700 tons in 1989 and remained stable at nearly 5,000 tons in 1991-92. The estimated catch for 1993 was 4,400 tons.

The main prosecutors of this fishery historically were Canada and the former Soviet Union. Canadian catches fluctuated from between 1,200 and 3,000 tons from 1985-91 but increased to about 4,300 tons in 1992 and 4,200 in 1993 (Table 1). This increase in 1992 and 1993 was essentially the result of a quota transfer between Canada and the Russian Federation. Catches by the USSR/Russian vessels declined from between 1,000 and 2,000 tons in the period 1982-88 to less than 100 tons in 1989-90 and no catch since then.

The first total allowable catch (TAC)for this resource was introduced by ICNAF in 1974 at a level of 10,000 tons largely based on average historical catches (Fig. 1). This level remained in effect until 1979 when it was reduced to 7,000 tons in consideration of declining commercial catch rates. It was further reduced to 5,000 tons in 1981 and remained at that level to 1993. The Scientific Council advised that for 1994 catches from this stock should not exceed 3,000 tons. A TAC of 3,000 tons was agreed by the NAFO Fisheries Commission, however, it was also agreed that no directed fishery would be conducted for witch flounder in 1994 due to the poor state of the stock and to allow for rebuilding. A comparison of annual catches and TAC's are presented in Figure 1.

Commercial Fishery Data

i) Catch and Effort

Catch and effort data from the directed fishery for the period 1974-90 were obtained from ICNAF/NAFO Statistical Bulletins and were combined with provisional 1991-92 NAFO data and preliminary Canadian data for 1992-93.

The catch and effort data were analyzed using a multiplicative model in order to derive a standardized catch rate series for hours fished. Effects included in the model were a combination country-gear-tonnage class category type (CGT), month, NAFO Division and year. Individual observations of catch or effort data less than 10 units were eliminated prior to the analysis as were categories where there were less than five samples in the database except within the year category type.

The regression was significant ($p<0.05$) explaining 76% of the variation in the catch rates (Table 2). The inclusion of CGT and division categories had no significant effect in explaining the variation in the catch rate data. The data available in the analysis are basically from the Canadian industry fishing in Division 3O. The analysis indicates very little in the way of trends (Table 2; Fig. 2). However, the most recent three data points are relatively stable at the lowest level in the time series. From the analysis in Table 2 it is evident that the best time of the year for fishing witch flounder is in the late winter and early spring as in fact has usually been done in the past. It must be recognized, however, that fishing during this time period on prespawning concentrations would represent catch rates when fish are highly aggregated and as such these catch rates might be more representative of density rather than stock size. Consequently, when catch rates are at a very low level such as those of recent years it may be an indication of a seriously depleted stock.

ii) **Catch at Age**

Catch at age data were available from the Canadian commercial fishery from 1979-93 (Table 3; Fig. 3). The data and catch at age composition from 1979-92 were taken from previous assessment documents. The 1993 Canadian catch is shown by month, division and gear in Table 4 with the sampling scheme and respective catch breakdown presented in Table 5. The results and associated statistics for 1993 are available in Table 6. The catch numbers at age, mean weights at age and catch weight at age for the entire time series are presented in Tables 3a, 3b and 3c respectively.

The age structure from the Canadian fishery (almost entirely in Div. 3O) has been relatively stable over the time series (Table 3a and 3d; Fig. 3) generally ranging from age 5 to age 14 with the bulk of the catch coming from within the age 9-12 category. There appears to be some slight increase in the younger ages in the more recent years. It was noted in the previous assessment that since historically the fishery occurred primarily in winter-spring on pre-spawning concentrations one may expect larger fish, whereas more recently the fishery has been spread throughout the year probably over a wider range of sizes.

iii) **Mean weights at age**

Mean weights at age from the Canadian commercial fishery were calculated for 1979-93. The results are shown in Figure 6 for ages 9-12 which comprise the major age groups represented in the fishery. It is difficult to reconcile the erratic trends in the earlier years but is likely related to poor sampling. Since the mid 1980's , however, there appears to be a declining trend up until 1991. From 1991 to 1993, on the other hand, the trend seems to have been reversed. This may be a result of the fishery recently being conducted throughout the year and therefore may be measuring some increase in annual growth.

Research Vessel Surveys

Stratified-random research vessel surveys have been carried out by Canada on the Grand Bank (including Div. 3NO) during spring since 1971 although during the early period coverage was limited and, in fact, for most years did not cover what may be considered an adequate depth range (survey maximum equal to 200 fathoms or 366 meters) to fully represent the distribution of witch flounder. Since 1990, on the other hand, depth coverage was extended to 400 fathoms or 720 meters which should be more representative but still not cover the entire range of depth distribution as observed in other areas in recent years. In addition to spring surveys, a time series of fall surveys was instituted in 1990 for seasonal comparisons. Total biomass estimates with confidence limits as well as biomass estimates by stratum for the spring surveys are presented in Tables 7 and 8 for Div. 3N and Div. 3O, respectively. A plot of the divisional biomass estimates is presented in Figure 4 for illustration.

i) **Biomass Estimates**

Estimated biomass in Div. 3N has been at very low levels throughout the time period and in most years was less than 1,000 tons (Tables 7; Fig. 4). For Div. 3O estimates of biomass showed considerable annual fluctuations on average between 6,000 and 12,000 tons particularly in the late 1980's considered to be related to distributional differences (Tables 8; Fig. 4). Nevertheless, the estimates illustrate a sharp decline in the last few years with the estimate for 1993 near the lowest observed. The most significant observation is that despite the fact that survey coverage during 1991-93 has been the most complete in the time series it indicates the a sharp systematic declining trend to levels as low as anything previously experienced. A preliminary estimate of biomass from the 1994 spring survey, on the other hand, estimated the biomass in Div. 3NO to be 6,800 tons largely as a result of good catches along the southwest slope of the Grand Bank in Div. 3O.

A comparison of biomass and abundance of spring versus fall surveys is shown in Table 9; Fig. 5. The series is too short to draw any firm conclusions as to significant seasonal comparisons. In 1990 the fall estimate was higher than in spring whereas for 1991 and 1992 the reverse was true. The 1993 shift is similar to that of 1990. The differences, however, especially for the 1991-93 surveys were not large and still put the biomass and abundance estimates in both instances among the lowest levels observed.

ii) **Catch at Age**

The age structure for the years 1984-93 from both the spring and fall surveys in Div. 3O is shown in Table 10 (data from Div. 3N insufficient). The age structure is quite similar to that previously described from the Canadian commercial fishery. It has been observed that the survey gear is not very proficient at capturing young fish and in fact appears to have much the same selection properties as the commercial gear. Based on previous observations in other areas it is possible that the younger age classes may not be in areas that are very accessible to fishing operations. The fall surveys show a decline in abundance since 1990 to the lowest level estimated in 1992 but increased again in 1993. Trends are less clear in the spring surveys except that the estimate for 1993 is the lowest in the time series.

Table 1. Catches and TACs (t) of Witch Flounder in Div. 3NO from 1971-94.

Year	Country			Total	TAC
	Canada	USSR	Other		
1971	178	14774	13	14965	
1972	3419	5738	20	9177	
1973	4943	1714	34	6691	
1974	2807	5235	3	8045	10000
1975	1137	5019	12	6168	10000
1976	3044	2991	-	6035	10000
1977	3013	2742	4	5759	10000
1978	1165	2275	33	3473	10000
1979	1193	1868	16	3077	7000
1980	425	1994	1	2420	7000
1981	381	2044	-	2425	5000
1982	1760	1969	3	3732	5000
1983	1674	1942	-	3616	5000
1984	834	1955	13	2802	5000
1985	2746	1908	4117	8771	5000
1986	2937	1724	4470	9131	5000
1987	2829	1425	3342	7596	5000
1988	1927	1037	4361	7325	5000
1989	1241	81	2366	3688	5000
1990	2654	9	1516	4179	5000
1991 a	2624	-	2223	4847	5000
1992 a	4316	-	600 b	4916	5000
1993 a	4164	-	250 b	4414	5000
*1994		-	-		3000

*Note: Although a TAC of 3000 tons was agreed by the FC, it was also agreed that no directed fishing be conducted in 1994 due to the poor state of the stock.

a = Provisional Data

b = Estimated

TABLE 2. ANOVA RESULTS AND REGRESSION COEFFICIENTS FROM A MULTIPLICATIVE MODEL UTILIZED TO DERIVE A STANDARDIZED CATCH RATE SERIES FOR WITCH FLOUNDER IN NAFO DIV. 3NO (1991-1993 BASED ON PRELIMINARY DATA).

REGRESSION OF MULTIPLICATIVE MODEL

MULTIPLE R..... 0.871
MULTIPLE R SQUARED..... 0.759

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SUMS OF SQUARES	MEAN SQUARES	F-VALUE	
INTERCEPT	1	2.050E2	2.050E2		
REGRESSION	28	2.913E1	1.040E0	10.712	
Country¦Gear¦TC (1)	1	1.319E-1	1.319E-1	1.359	(NS)
Month (2)	9	4.553E0	5.059E-1	5.210	
Division (3)	1	1.626E-1	1.626E-1	1.674	(NS)
Year (4)	17	1.579E1	9.287E-1	9.563	
RESIDUALS	95	9.226E0	9.711E-2		
TOTAL	124	2.434E2			

REGRESSION COEFFICIENTS

CATEGORY	CODE	VARIABLE	COEFFICIENT	STD. ERROR	NO. OBS.
Country¦Gear¦TC	3125	INTERCEPT	-1.163	0.127	124
Month	4				
Division	35				
Year	74				
(1)	3124	1	-0.096	0.082	22
(2)	1	2	-0.170	0.151	6
	2	3	0.020	0.099	19
	3	4	0.112	0.087	27
	5	5	-0.075	0.113	12
	6	6	-0.600	0.150	6
	7	7	-0.700	0.166	5
	10	8	-0.392	0.155	6
	11	9	-0.480	0.151	6
	12	10	-0.173	0.135	8
(3)	34	11	0.125	0.097	20
(4)	75	12	-0.141	0.178	6
	76	13	-0.248	0.147	10
	77	14	0.080	0.151	9
	78	15	-0.365	0.169	6
	81	16	0.009	0.251	2
	82	17	0.808	0.196	4
	83	18	0.112	0.157	8
	84	19	-0.170	0.214	3
	85	20	0.475	0.164	7
	86	21	0.350	0.150	9
	86	21	0.350	0.150	9
	87	22	0.188	0.180	5
	88	23	-0.105	0.163	7
	89	24	0.120	0.165	7
	90	25	0.685	0.176	6
(4)	91	26	-0.516	0.159	8
	92	27	-0.326	0.160	8
	93	28	-0.706	0.154	10

PREDICTED CATCH RATE

YEAR	LN TRANSFORM MEAN	LN TRANSFORM S.E.	RETRANSFORMED MEAN	RETRANSFORMED S.E.	CATCH	EFFORT
1974	-1.1635	0.0161	0.325	0.041	2807	8625
1975	-1.3041	0.0223	0.282	0.042	1137	4034
1976	-1.4111	0.0159	0.254	0.032	3044	11981
1977	-1.0835	0.0161	0.353	0.045	3013	8546
1978	-1.5285	0.0197	0.226	0.032	1165	5166
1981	-1.1540	0.0528	0.323	0.074	381	1181
1982	-0.3552	0.0277	0.726	0.121	1760	2424
1983	-1.0510	0.0166	0.364	0.047	1674	4598
1984	-1.3339	0.0395	0.271	0.054	834	3075
1985	-0.6888	0.0187	0.523	0.071	2746	5255
1986	-0.8138	0.0158	0.462	0.058	2937	6361
1987	-0.9750	0.0229	0.392	0.059	2829	7224
1988	-1.2686	0.0177	0.293	0.039	1927	6583
1989	-1.0435	0.0189	0.366	0.050	1241	3387
1990	-0.4785	0.0224	0.644	0.096	2654	4124
1991	-1.6798	0.0169	0.194	0.025	2624	13517
1992	-1.4898	0.0172	0.235	0.031	4316	18389
1993	-1.8693	0.0164	0.161	0.021	4164	25920

AVERAGE C.V. FOR THE RETRANSFORMED MEAN: 0.145

LEGEND FOR AVOVA RESULTS:

CGT CODES: 3124 = Can(NFLD) TC 4 Bottom Trawl
3125 = " TC 5 "

DIVISION CODES: 34 = 3N, 35 = 3O

TABLE 3a. CATCH AT AGE OF WITCH FLOUNDER IN THE CANADIAN FISHERY IN DIV. 3NO.

Age	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
5	0	0	0	0	0	0	2	1	0	0	0	4	1	7	1
6	0	0	0	8	0	1	12	9	9	1	0	19	17	36	49
7	8	5	0	43	7	9	67	66	72	35	15	109	54	334	176
8	46	22	10	393	93	88	337	464	421	222	124	398	394	973	824
9	199	97	31	558	487	246	938	1184	1174	679	334	858	721	1314	2081
10	516	228	95	922	791	387	1254	1513	1270	1056	514	1115	717	1464	2532
11	664	177	149	630	740	431	1255	1231	1389	1079	650	1199	1324	1985	1664
12	280	35	143	431	452	183	960	649	755	457	468	969	1143	1318	849
13	81	10	109	293	74	38	222	122	129	105	138	285	374	491	224
14	24	0	29	55	17	5	36	10	7	15	10	31	32	55	14
15	0	0	0	11	4	0	0	0	0	0	0	4	0	5	
16	0	0	0	2	2	0	0	0	0	0	0	0	0	0	
5+	1818	574	566	3346	2667	1388	5083	5249	5226	3649	2253	4991	4777	7982	8414

TABLE 3b . WEIGHT AT AGE OF WITCH FLOUNDER IN THE CANADIAN FISHERY IN DIV. 3NO.

Age	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
5	0.000	0.000	0.000	0.000	0.000	0.000	0.090	0.115	0.000	0.000	0.000	0.135	0.049	0.071	0.078
6	0.000	0.000	0.000	0.216	0.000	0.166	0.133	0.160	0.147	0.185	0.000	0.164	0.143	0.163	0.131
7	0.187	0.249	0.000	0.240	0.228	0.248	0.209	0.230	0.212	0.231	0.208	0.213	0.170	0.234	0.201
8	0.272	0.332	0.267	0.359	0.345	0.343	0.293	0.330	0.299	0.323	0.280	0.296	0.250	0.300	0.265
9	0.345	0.445	0.315	0.422	0.431	0.444	0.390	0.425	0.409	0.402	0.378	0.385	0.344	0.380	0.365
10	0.498	0.662	0.423	0.517	0.526	0.547	0.479	0.533	0.501	0.494	0.466	0.477	0.424	0.489	0.482
11	0.717	0.905	0.531	0.613	0.706	0.670	0.610	0.664	0.628	0.594	0.570	0.580	0.563	0.605	0.647
12	0.903	1.264	0.716	0.717	0.920	0.830	0.763	0.839	0.805	0.741	0.703	0.704	0.729	0.751	0.837
13	1.141	1.485	0.883	0.804	1.170	1.051	1.006	0.992	1.011	0.958	0.904	0.873	0.937	0.928	1.036
14	1.239	1.752	1.136	1.067	1.328	1.229	1.189	1.289	1.214	1.153	1.318	1.180	1.182	1.213	1.425
15	1.434	0.000	0.000	1.342	1.499	1.552	0.000	0.000	0.000	0.000	0.000	1.427	1.971	1.511	0.000
16	0.000	0.000	0.000	1.752	1.916	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

TABLE 3c . CATCH WEIGHT (T) AT AGE OF WITCH FLOUNDER IN THE CANADIAN FISHERY IN DIV. 3NO.

Age	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
5	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
6	0	0	0	2	0	0	2	1	1	0	0	3	2	6	6
7	1	1	0	10	2	2	14	15	15	8	3	23	9	78	35
8	13	7	3	141	32	30	99	153	126	72	35	118	98	292	218
9	69	43	10	235	210	109	366	503	480	273	126	330	248	499	760
10	257	151	40	477	416	212	601	806	636	522	240	532	304	716	1220
11	476	160	79	386	522	289	766	817	872	641	370	695	745	1201	1077
12	253	44	102	309	416	152	732	545	608	339	329	682	833	990	711
13	92	15	96	236	87	40	223	121	130	101	125	249	350	456	232
14	30	0	33	59	23	6	43	13	8	17	13	37	38	67	20
15	0	0	0	15	6	0	0	0	0	0	0	6	0	8	0
16	0	0	0	4	4	0	0	0	0	0	0	0	0	0	0
5+	1191	421	363	1874	1718	840	2846	2974	2876	1973	1241	2676	2627	4313	4279.5

TABLE 3d . PERCENT CATCH AT AGE OF WITCH FLOUNDER IN THE CANADIAN FISHERY IN DIV. 3NO.

Age	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
7	0.00	0.01	0.00	0.01	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.04	0.02
8	0.03	0.04	0.02	0.12	0.03	0.06	0.07	0.09	0.08	0.06	0.06	0.08	0.08	0.12	0.10
9	0.11	0.17	0.05	0.17	0.18	0.18	0.18	0.23	0.22	0.19	0.15	0.17	0.15	0.16	0.25
10	0.28	0.40	0.17	0.28	0.30	0.28	0.25	0.29	0.24	0.29	0.23	0.22	0.15	0.18	0.30
11	0.37	0.31	0.26	0.19	0.28	0.31	0.25	0.23	0.27	0.30	0.29	0.24	0.28	0.25	0.20
12	0.15	0.06	0.25	0.13	0.17	0.13	0.19	0.12	0.14	0.13	0.21	0.19	0.24	0.17	0.10
13	0.04	0.02	0.19	0.09	0.03	0.03	0.04	0.02	0.02	0.03	0.06	0.06	0.08	0.06	0.03
14	0.01	0.00	0.05	0.02	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.00
15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 4. Breakdown of Canadian catches (tons) by division, month and gear of witch flounder in Div. 3NO, 1993.

Month	Div. 3N Otter trawl	Div. 3N Other gears	Div. 3O Otter trawl	Div. 3O Other gears	Total Catch (t)
Jan.	-	-	31	-	31
Feb.	-	-	4	-	4
Mar.	-	-	406	-	406
Apr.	-	-	428	42	470
May.	-	-	3	29	32
Jun.	-	-	426	38	464
Jul.	79	-	726	11	816
Aug.	53	-	336	1	390
Sep.	6	-	120	6	132
Oct.	1	-	321	12	334
Nov.	3	-	552	4	559
Dec.	-	-	665	3	668
	-	-	-	-	
Total Catch (t)	-	-	-	-	4306

Table 5. Samples used to calculate catch and weights at age for witch flounder in the Canadian fishery in Div. 3NO, 1993.

Age-length key	Length frequency	Catch (tons) Adjusted
Q1, Div. 3O, 233 Ages	OT, Mar., Div. 3O (1587)	441
Q2, Div. 3O, 240 Ages	OT, Apr., Div. 3O (576)	502
	OT, June, Div. 3O (1263)	464
Q3, Div. 3N, 72 Ages	OT, July, Div. 3N (341)	79
	OT, Aug., Div. 3N (320)	53
Q3, Div. 3O, 381 Ages	OT, July, Div. 3O (651)	737
	OT, Aug., Div. 3O (1256)	337
	OT, Sept., Div. 3O (970)	132
Q4, Div. 3O, 624 Ages	OT, Oct, Div. 3O (1012)	334
	OT, Nov, Div. 3O (2977)	559
	OT, Dec, Div. 3O (334)	668

Table 6. Catch numbers at age for Canadian catches of witch flounder in Div. 3NO in 1993.

Age	Mean weight (kg)	Mean length (cm)	Catch (000s)	Std. Err.	C.V.
5	0.078	25.519	1	0.01	0.01
6	0.131	29.424	49	6.90	0.14
7	0.201	33.164	176	18.59	0.11
8	0.265	35.799	824	44.78	0.05
9	0.365	39.100	2081	92.39	0.04
10	0.482	42.183	2532	107.05	0.04
11	0.647	45.819	1664	79.79	0.05
12	0.837	49.199	849	50.51	0.06
13	1.036	52.197	224	22.74	0.10
14	1.425	57.074	14	3.67	0.26

Table 7. Estimated biomass (tons) per stratum of witch flounder from research vessel surveys in Div. 3N from 1971-94.

Stratum	Depth (fath)	Area (sq. n.m.)	Units (000s)	Year 1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1982	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994a
375	<=30	1593	120	36	0	0	0	0	-	0	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0
376		1499	113	-	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	0	0	0	0	0	0
Total				36	0	0	0	0	0	0	11	0	0	0	0	0	0	7	0	0	0	0	0	0	0
360	31-50	2992	225	-	25	-	-	0	305	38	586	725	265	1316	1139	61	404	366	898	101	0	0	18	92	0
361		1853	139	0	0	0	0	203	0	63	0	19	70	24	83	0	0	21	36	0	13	0	0	0	0
362		2520	189	344	0	0	0	0	0	0	0	15	26	0	0	44	38	0	96	0	0	0	0	0	0
373		2520	189	0	0	0	0	-	0	0	59	15	0	0	0	0	0	0	0	0	0	0	0	0	0
374		931	70	0	0	0	0	0	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	37
383		674	51	34	0	0	-	-	0	0	0	0	0	0	0	34	0	21	0	0	0	0	0	0	0
Total				379	25	0	0	203	305	101	645	775	361	1340	1222	138	442	408	1031	101	13	0	18	103	37
359	51-100	421	32	-	268	660	-	-	1368	58	-	86	44	190	134	35	60	28	126	133	0	0	0	10	0
377		100	8	-	0	0	8	0	-	99	0	10	19	0	6	0	0	38	2	17	0	0	0	0	0
382		647	49	-	0	0	0	-	0	30	0	0	39	0	0	0	0	6	0	0	0	0	0	0	0
Total				0	268	660	8	0	1368	186	0	96	102	190	140	35	60	72	128	150	0	0	0	10	0
358	101-150	225	17	-	50	41	-	-	-	102	-	19	5	42	21	186	20	76	13	14	27	0	23	65	51
378		139	10	12	5	14	30	-	-	50	123	79	26	21	13	12	18	91	14	17	0	4	12	0	0
381		182	14	6	12	0	0	15	-	74	155	35	17	14	17	4	20	55	38	0	38	0	0	0	0
Total				18	67	55	30	15	0	226	278	133	48	77	51	202	58	222	64	31	65	4	34	65	51
357	151-200	164	12	-	-	15	-	-	-	89	-	80	25	105	4	52	66	86	3	20	9	0	14	31	47
379		106	8	-	-	5	14	-	-	114	38	45	22	12	19	7	14	88	21	11	27	2	9	0	1
380		116	9	-	48	18	17	-	-	59	-	37	12	-	2	28	0	83	17	4	5	0	0	0	0
Total				0	48	39	32	0	0	262	38	161	59	117	25	88	81	256	42	35	41	2	23	31	48
723	201-300	155	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	32	43	30	21
725		105	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	27	9	18	23
727		160	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	3	23	10
Total				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	59	56	71	54
724	301-400	124	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	112	71	93	19
726		72	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	38	13	16	13
728		156	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	48	11	59	13
Total				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	198	95	168	45
Biomass (tons)				432	408	754	70	218	1673	776	972	1165	570	1723	1438	462	641	965	1265	316	118	263	226	447	235
Lower limit				-3282	-449	-984	29	-123	-1305	421	-264	409	286	-974	453	-120	96	463	-567	-1040	-8	-734	84	229	UNK
Upper limit				4847	1316	2491	126	560	4652	1115	2211	1921	852	3306	2424	1044	1182	1313	3097	1671	174	1259	348	669	UNK

aPreliminary

Table 8. Estimated biomass (tons) per stratum of witch flounder from research vessel surveys in Division 3O from 1973-94.

				Year																		
Stratum	Depth (fath)	Area (sq. n. M.)	Units (ooos)	1973	1975	1976	1977	1978	1979	1980	1981	1982	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994a
330	31-50	2089	157	24	24	0	0	66	254	0	177	0	0	0	0	0	13	0	0	0	0	0	0
331		456	34	0	0	0	-	210	26	214	-	2	987	188	17	1	222	0	-	0	0	0	0
338		1898	142	1889	841	1530	517	20	46	627	-	40	100	4590	755	742	1728	1211	237	0	66	152	0
340		1716	129	-	0	282	0	73	406	0	52	9	17	82	0	14	0	0	5	0	75	0	0
351		2520	189	26	127	0	61	0	172	123	3689	74	422	165	303	163	613	140	62	0	0	0	0
352		2580	194	17	548	33	45	66	168	608	-	118	56	643	136	841	813	391	1021	23	58	35	0
353		1282	96	1806	714	1136	845	1093	153	722	-	2293	2406	802	741	1162	4205	1667	1035	0	144	122	0
Total				3763	2253	2981	1467	1528	1225	2294	3917	2536	3987	6470	1951	2923	7595	3409	2360	23	343	310	0
329	51-100	1721	129	0	-	3870	176	124	5	0	0	0	0	0	0	0	425	31	16	289	0	0	2501
332		1047	79	-	267	975	762	846	31	1218	-	5718	1493	4833	1218	1804	3181	813	2320	1390	1098	201	24
337		948	71	199	48	465	258	89	0	154	-	119	32	2113	825	894	539	877	971	892	349	278	27
339		585	44	130	0	-	-	130	106	-	296	20	176	0	4	149	80	0	0	0	0	0	0
354		474	36	797	-	501	81	-	42	302	9	267	285	71	605	151	231	17	141	74	73	463	0
Total				1126	316	5812	1276	1188	185	1675	305	6123	1986	7018	2653	2999	4457	1739	3447	2645	1511	941	2552
333	101-150	151	11	-	8	18	3	17	4	37	-	220	5	27	3	0	33	5	67	222	33	28	2285
336		121	9	6	11	144	62	14	3	114	-	136	5	5	18	12	23	0	22	226	680	40	455
355		103	8	2	21	39	-	-	3	21	15	99	31	101	20	37	1	47	47	54	10	14	55
Total				7	40	201	64	32	10	172	15	455	40	132	42	49	57	52	136	502	722	82	2796
334	151-200	92	7	-	-	9	1	9	3	12	-	63	0	22	17	0	6	11	13	12	53	8	344
335		58	4	0	-	20	-	3	0	31	-	10	0	53	8	0	27	11	44	21	566	24	51
356		61	5	4	-	-	-	-	3	126	4	-	2	40	10	10	3	13	33	18	57	23	33
Total				4	0	30	1	13	6	169	4	72	2	115	35	11	36	35	90	51	677	55	428
717	201-300	93	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	26	11	603
719		76	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	87	504	16	7
721		76	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	30	18	12	31
Total				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	121	547	38	641
718	301-400	111	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	8	26	52
720		105	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	125	59	43	27
722		93	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8	20	53	98
Total				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	139	88	122	177
Biomass (tons)				4900	2609	9023	2809	2761	1426	4310	4241	9186	6015	13736	4681	5982	12146	5234	6033	3481	3888	1548	6594
Lower limit				1960	1125	-24552	557	572	900	-434	-5549	-5569	3800	7922	2502	3632	4795	2955	280	1299	1936	625	UNK
Upper limit				7837	4093	42602	5059	4947	1951	9051	14030	23942	8228	19549	6848	8360	19555	7519	11781	5664	5833	2471	UNK

aPreliminery

Table 9. Comparison of results from spring and fall research vessel surveys in 1990-93 for witch flounder in Div. 3NO.

Survey	Index	Div. 3N	Div. 3O	Total
Spring 1990a	Abundance ('000)	145	9293	9438
	Biomass (t)	83	6031	6114
Fall 1990	Abundance	489	11351	11840
	Biomass	434	8955	9389
Spring 1991	Abundance	672	5880	6552
	Biomass	263	3482	3745
Fall 1991	Abundance	957	3212	4169
	Biomass	777	2106	2883
Spring 1992	Abundance	501	6982	7483
	Biomass	216	3885	4101
Fall 1992	Abundance	1700	6026	7726
	Biomass	1267	3536	4803
Spring 1993	Abundance	826	3214	4040
	Biomass	448	1548	1996
Fall 1993	Abundance	1463	6711	8174
	Biomass	774	4033	4807

a=No strata deeper than 200 fm surveyed.

Table 10. Mean number per set of witch flounder, by age, from Canadian research vessel surveys in Div. 3O during 1984-93 (S=spring, F=fall).

	Year													
Age	1984	1985	1986	1987	1988	1989	1990 (S)	1990 (F)	1991 (S)	1991 (F)	1992 (S)	1992 (F)	1993(S)	1993(F)
1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	-	-	-	-	-	-	0.04	-	-	-	-	-	-	-
3	-	-	-	-	0.01	-	-	0.01	-	-	-	-	-	-
4	-	0.01	0.02	-	-	-	-	-	-	-	-	-	-	-
5	-	0.10	0.01	0.01	0.01	-	-	0.01	0.02	0.01	0.04	-	0.07	0.01
6	0.06	0.08	0.06	0.07	0.02	-	0.01	0.01	0.06	0.01	0.04	0.03	0.15	0.08
7	0.12	1.22	0.26	0.22	0.12	0.02	0.19	0.11	0.15	0.07	0.19	0.27	0.33	0.39
8	0.94	5.88	0.66	0.50	0.97	0.07	0.56	0.44	0.36	0.25	0.56	0.74	0.57	0.76
9	1.59	5.44	1.09	1.59	1.85	0.25	0.67	0.89	0.45	0.29	0.88	1.04	0.52	1.43
10	1.70	2.58	0.90	1.60	2.93	0.59	1.13	1.66	0.69	0.41	1.05	0.80	0.34	0.97
11	2.51	0.47	1.00	1.23	4.48	1.39	1.94	2.34	1.24	0.75	1.13	1.00	0.22	0.61
12	1.14	0.04	0.52	0.96	3.52	1.89	1.64	1.81	0.88	0.51	0.76	0.49	0.10	0.47
13	0.26	-	0.13	0.25	1.19	1.00	0.81	1.06	0.32	0.05	0.33	0.07	0.02	0.10
14	0.16	-	0.01	-	0.11	0.18	0.11	0.10	0.08	-	0.01	0.06	-	-
15	-	-	-	-	-	0.02	-	-	-	-	-	-	-	-
Total	8.48	15.82	4.66	6.43	15.21	5.41	7.10	8.44	4.26	2.35	5.04	4.50	2.32	4.84

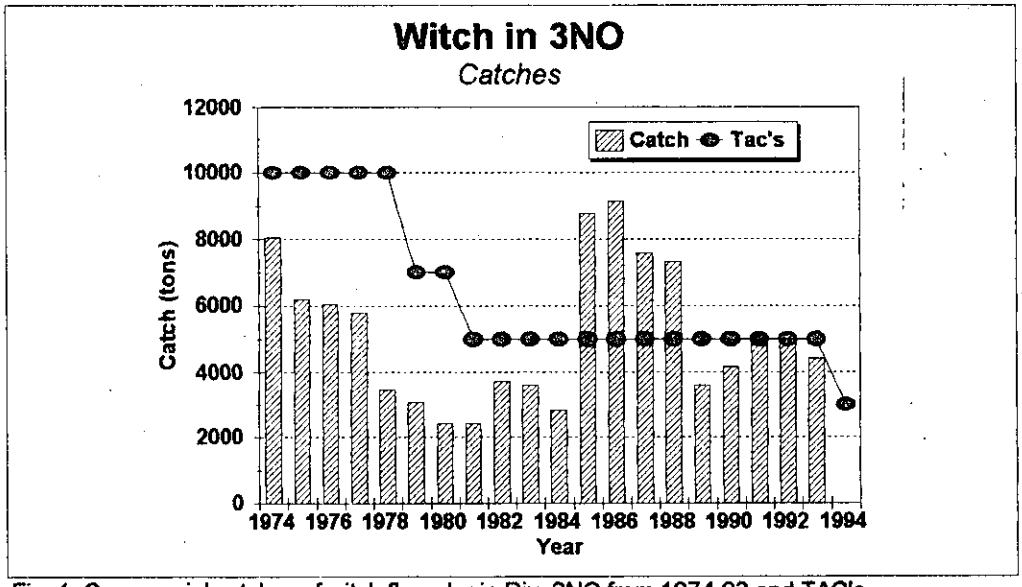

Fig. 1. Commercial catches of witch flounder in Div. 3NO from 1974-93 and TAC's 1974-94. The catch in recent years includes estimates of those non-reported.

***Note: Although a TAC of 3000 tons was agreed by the FC, it was also agreed that no directed fishing be conducted in 1994 due to the poor state of the stock.**

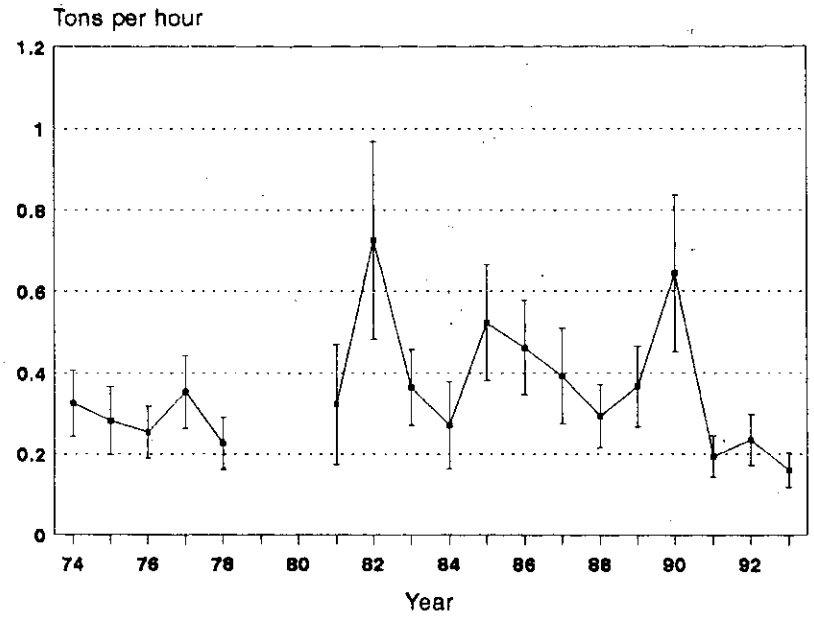

Fig. 2 Standardized CPUE with approximate 95% confidence intervals for Witch flounder in Div. 3NO from 1974-1993.

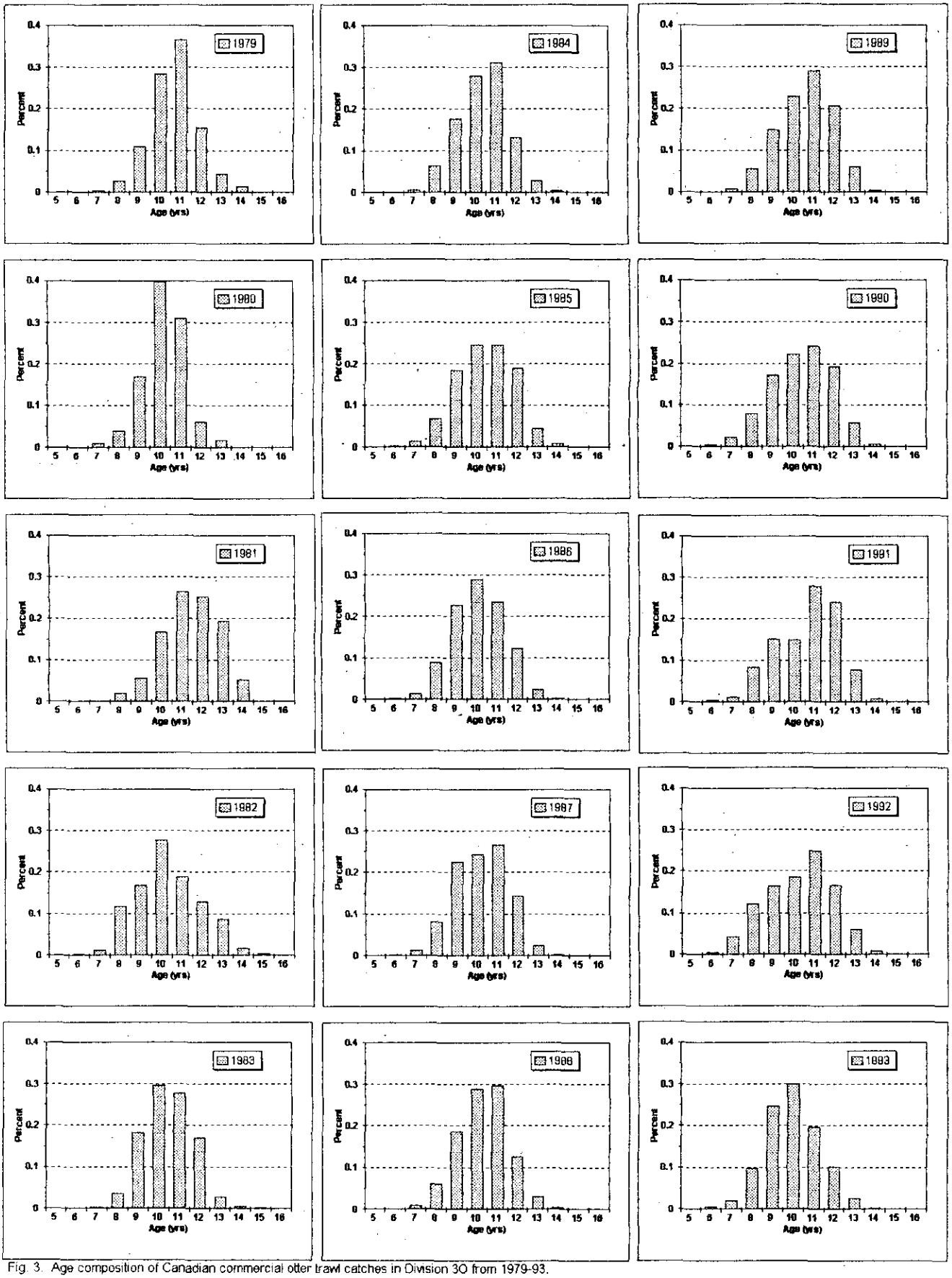

Fig. 3. Age composition of Canadian commercial otter trawl catches in Division 3O from 1979-93.

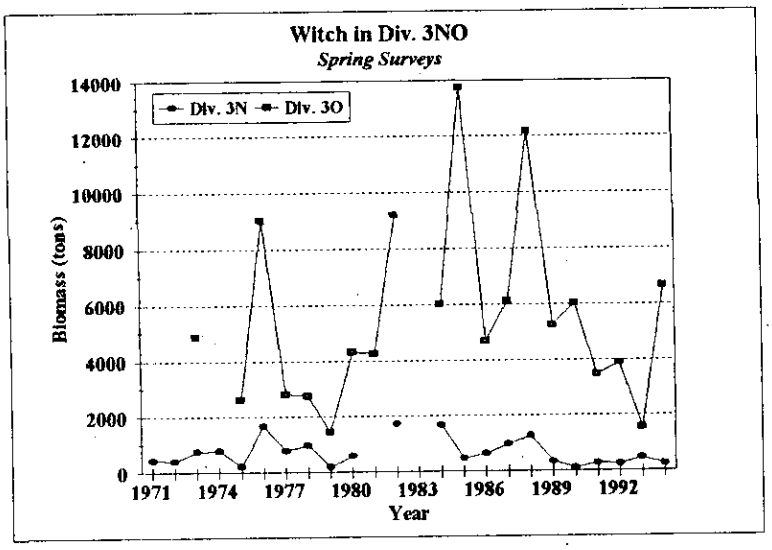

Fig.4. Biomass estimates of witch flounder in Div. 3NO from Canadian spring surveys during 1971-94.

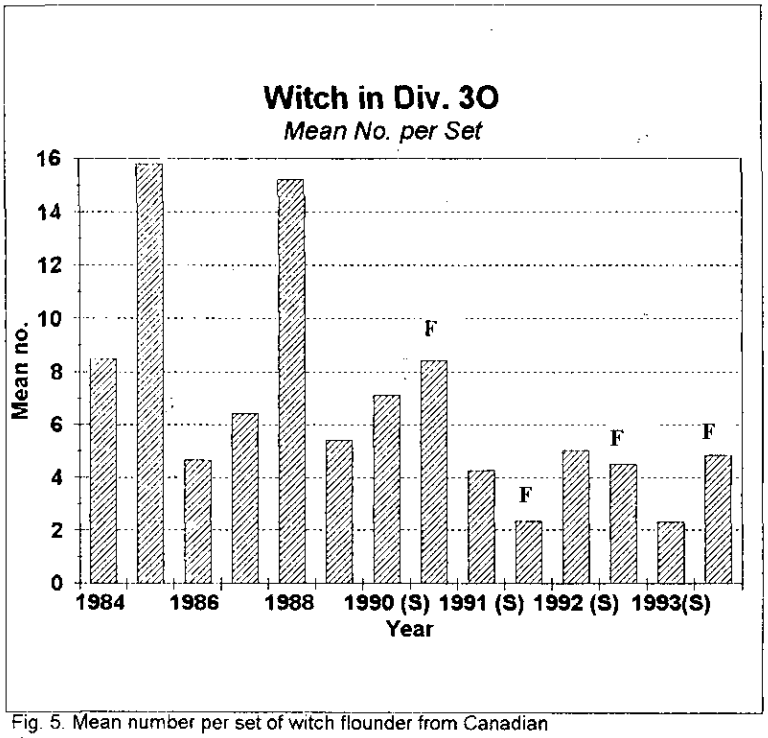

Fig. 5. Mean number per set of witch flounder from Canadian research vessel surveys in Div. 3O during 1984-93 (S=spring, F=fall).

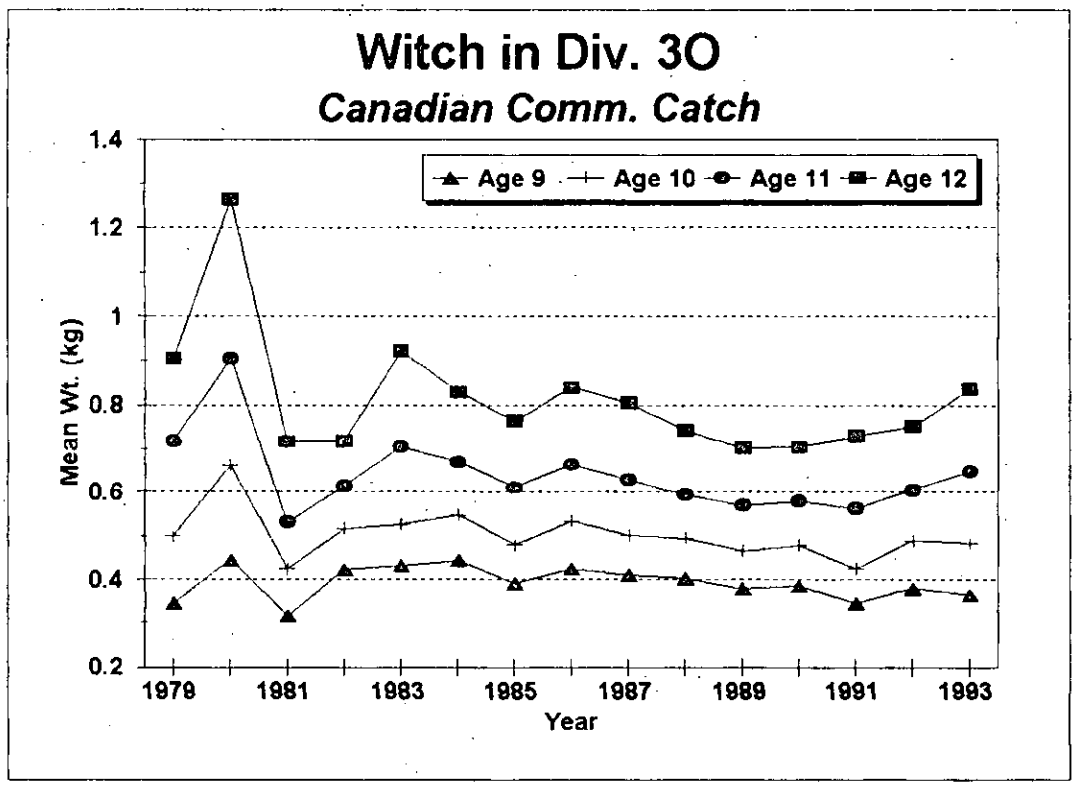

Fig. 6. Mean weight at age of witch flounder in Division 3O from Canadian commercial bottom trawl catches from 1979-93.