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An Evaluation of the Current Status and Historic Review of the Witch Flounder Resource in NAFO Divisions 3NO

by

W. R. Bowering and D. C. Orr

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

Landings and TAC Development

Reported catches in the 1960's peaked at 11,000-12,000 tons in 1967-68 and remained relatively high during the next several years(Table 1; Fig. 1). During the period 1971-84 catches ranged from a low of about 2,400 tons in 1980 and 1981 to as high as 15,000 tons in 1971 which is the highest recorded catch in the history of the fishery, however, from 1975-84 annual catches rarely exceeded 6,000 tons. It should be recognized, nevertheless, that species specific catch statistics for flatfish prior to 1973 were largely developed from breakdowns of unspecified flounders and are therefore may not be especially accurate.

As a result of a substantial increase in fishing 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 during this period. Catches remained relatively high in 1987 and 1988 at 7,600 and 7,300 tons respectively. During 1990-93 estimated catches were in the range of 4,200-5,000 tons. The estimated catch for 1994 was still in the order of 1,100 tons despite there being a moratorium introduced on fishing this stock (Table 1; Fig. 1). Since then annual catches have been estimated between 300-500 tons.

In the past, this fishery was carried out almost entirely by 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). Virtually no catch has been taken since then due to the moratorium. The increase in 1992 and 1993 was essentially the result of a quota transfer to Canada by 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 complete moratorium was introduced by the NAFO Fisheries Commission for directed fishing in 1995 and has continued through 1998.

Canadian 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 only surveyed to 366 meters. Since 1990, on the other hand, depth coverage was extended to 720 meters which should be more representative of the stock distribution. Nevertheless, this still may not cover the entire range of depth distribution of witch flounder when compared to its distribution observed in other stock areas during recent years. In addition to spring surveys, a time series of fall surveys was begun in 1990 to investigate seasonal variation in stock distribution and abundance of various groundfish species.

Beginning with the 1995 fall survey the survey gear was changed from an Engel groundfish trawl with steel bobbin footgear to a Campelen 1800 shrimp trawl with rockhopper footgear. The data from these surveys have now been converted from Engel trawl catches to Campelen 1800 trawl catch equivalents. The conversion exercise and impacts on the stock trends, size and age distributions are described in detail in Bowering and Orr (1998) (SCR Doc. 98/50 Ser. No. N3041, this meeting). For the purpose of this meeting both the unconverted and converted estimates of biomass and abundance from these surveys are presented here for comparison. In future, however, it is intended that with few exceptions only the converted data with the new Campelen survey data will be presented for review.

Survey Biomass and Abundance Indices

Biomass estimates by stratum are presented for the spring surveys in NAFO Division 3N and 3O, respectively in Tables 2 and 3 for unconverted data and in Tables 4 and 5 for converted data. Similar data are presented for abundance estimates from spring surveys in Tables 6-9, respectively. For the fall surveys results are shown in the same order as above for spring survey results in Tables 10-17, inclusive. Graphical plots to better illustrate the comparative trends in stock biomass and abundance by survey gear and season are presented by NAFO Divisions 3N and 3O separately and combined in figures 2-4, respectively.

Estimated biomass and abundance from spring surveys (which is the longer time series) in Div. 3N has been at very low levels throughout the period since 1984 and in most years trawlable stock size(converted data) was estimated to be less than 1,000 tons or 1 million fish (Fig. 2). For Div. 3O where most of the stock resides, estimates of stock size exhibited considerable annual fluctuations on average between 8,000 and 24,000 tons or 15-25 million fish (converted data) particularly in the late 1980's (Fig. 2). The several high spikes in the time series are believed to be related to distributional shifts between the deeper smaller strata and the more shallow large strata. This would have the effect of giving lower estimates when fish are distributed deeper and higher estimates when fish are distributed more in over the bank. Nevertheless, the data indicate an overall declining trend in stock size (Fig. 2 and 4) with the preliminary values for the

spring 1998 survey (just finished during the course of this meeting) at the lowest level observed since 1984. The previous estimate (1997) had been regarded with some optimism in the previous assessment with the relatively large increase from 1996, however, with the additional 1998 data included it appears that the 1997 values may be have been a spike in the data similar to those described above.

Results of the fall surveys for Div. 3N are similar to the spring in both stock size estimates which are very low and because of this there is no discernable trend (Fig. 3). The data trends for Div. 3O in the fall surveys are quite different than in the spring series (Fig. 3). There is an increasing trend for 1991-96, however, when the higher value for 1990 and the very low value for 1997 are included there is little in the way of trend at all (Fig. 3). Nonetheless, the estimates for each series is generally within the same numeric range. When considered together it is rather disconcerting that the most recent estimates are about the lowest observed in the periods examined. It should be emphasized as well that the more recent lower estimates are also based on more detailed survey coverage than in the earlier years. Consequently, in reality the declining trend may very well have been much steeper.

Current Resource Status

Although the view of the stock had not changed greatly, in last year's assessment there was a perception that the stock may have shown some indication of improvement. This was based on the most recent data points in both the spring and fall surveys which had increased from previous levels. With the addition of the 1997 fall and 1998 spring survey estimates it now appears that the resource remains at an all time low. The general trend in the longer survey series would in fact suggest that the stock may continue to decline despite the commercial fishing moratorium being in effect for several years. No aging data have been available since 1994 and are not expected to be available in the foreseeable future. Therefore, it is not possible to comment on any recruitment prospects for the resource.

Historic Evaluation for Reference Points

Commercial fishery data and aging data from all sources have not been available from this stock since 1992 and 1993, respectively. Nevertheless, some historic data (within the last 25 years) have been re-examined here in order allow for some review of potential reference points.

Catch Effort Data Analysis (CEDA)

A catch rate analysis was last presented for this stock in June 1993 (Bowering et al 1993) based on data mainly from the Canadian commercial fishery in Division 3O. The analysis was conducted using a multiplicative model (Gavaris 1980) to derive a standardized catch rate series for hours fished. The resultant data were used here in a biomass dynamic model analysis (surplus production) using CEDA software developed in the United Kingdom by the MRAG Ltd. (Holden et al 1995). A number of trial runs were carried out with Schaefer, Fox and Pella-Thomlinson models with various error structures. Given the large element of noise in the data none of the models performed

especially well. However, the best description of the data was demonstrated by the Schaefer model with a proportion to initial stock size of 0.5 and without a time lag. A plot of the analysis is illustrated in Figure 5. It was judged that the parameter most critical to the analysis was the choice of initial proportion. Therefore, a sensitivity analysis was carried out to evaluate the effect of varying initial proportions on estimates of MSY, intrinsic rate of growth (r), carrying capacity (K) and F_{msy}. The results are presented in Figure 6. Within the range 0.4-0.7 for initial proportion the various parameters appear relatively stable. Within this range the MSY is about 5,000 tons, F_{msy} around 0.25 and B_{msy} (K/2) approximately 20,000 tons.

Although the CPUE data are generally noisy they do exhibit a required degree of contrast for the model to work and show a generally similar trend as the spring survey index (unconverted) (Fig. 7). The stock appeared to be at a relatively low level during the late 1970's after a period of higher catches averaging about 7,000 tons. Catches declined to an annual catch of 3,000-4,000 tons and the stock improved. When catches escalated in the mid 1980's the stock declined again and does not appear to be recovering.

Yield and Spawner per Recruit Analysis

Yield, biomass and spawning stock biomass per recruit analyses were also carried out to give some idea of the general vicinity of the $F_{0.1}$ and F_{max} levels for witch flounder in Div. 3NO under the general exploitation pattern experienced during the years of the fishery. The partial recruitment pattern was estimated from the relationship between the Canadian spring survey age distribution (prior to conversion) and the commercial age distribution for 1984-92. The maturity rates were taken as knife edge with females at age 11 approximating age at M_{50} and sex ratios estimated from the survey age composition. The analysis presented used a natural mortality value of M=0.20 and a maximum age of 15 years old. The estimated parameters and the results of the yield per recruit analysis is presented in Figure 8. The results indicate an $F_{0.1}$ value at 0.30 and a F_{max} value at 0.631 although the flat topped nature of the Y/R curves would make F_{max} values generally unstable and are not usually considered for most flatfish stocks.

Based on aging data previous reviewed for this stock the maximum age observed has been much older than the current maximum (15 years) and M may have been considered to be somewhat lower. A sensitivity analysis was therefore performed for M=0.15 and 0.20 and maximum ages from 15 to 19 years old in order to examine the effect on the estimates of $F_{0.1}$ and F_{max}. The results are shown in Figure 9. As anticipated the lower the M with higher maximum age the lower the reference level estimates.

Conclusions

Attempts were made to investigate potential reference points by examining historic commercial catch-effort data from 1974-92 using **CEDA** (**C**atch **E**ffort **D**ata **A**nalysis) software (Holden, et al 1995). A range of trial runs were conducted to evaluate the sensitivity of the analysis to model choice, error structure and input parameters. It was concluded that under equiblibrium conditions the MSY may be in the order of about 5,000 tons with an associated F_{msy} of about 0.25. The MSY value was most robust in all analyses that were considered reasonable, however, other potential reference points were

much more sensitive to changes in the input parameters. It is proposed, therefore, that a more thorough examination of the data including survey trends as covariates be carried out before arriving at more firm conclusions on the values of reference points.

References

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Table 1 . Catches and TACs (t) of Witch Flounder in Div. 3NO from 1960-98.

Year	Canada	USSR (Russia)	Other	Total	TAC
1960	-	-	-	5799	-
1961	-	-	-	4627	-
1962	-	-	-	1228	-
1963	895	485	803	2183	-
1964	1055	-	11	1066	-
1965	1324	849	4	2177	-
1966	3644	3828	50	7522	-
1967	2863	8565	75	11503	-
1968	1503	9078	18	10599	-
1969	479	4215	6	4700	-
1970	723	6039	1	6763	-
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	2624	-	2223	4847	5000
1992	4328	-	632	4960	5000
1993	4337	3	250[b]	4414	5000
1994[a]	2	-	1117[b]	1119	3000
1995[a]	-	-	300[b]	300	0
1996[a]	64	-	294[b]	358	0
1997[a]	19	-	493[b]	512	0
1998	-	-	-	-	0

*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 Biomass (tons) of Witch flounder from surveys in Div. 3N during spring 1984-1995 using the Wilfred Templeman (Unconverted data)

Year				1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Depth Range	Old Stratum Area (sq. n. mi.)	New Stratum Area (sq. n. mi.)	Stratum												
<=56	1593	1593	375	0	0	0	0	0	0	0	0	0	0	0	0
<=56	1499	1499	376	0	0	0	7	0	0	0	0	0	0	0	0
57 - 92	2992	2992	360	1139	60	399	367	898	100	0	0	18	93	0	0
57 - 92	1853	1853	361	83	0	0	21	36	0	12	0	0	0	0	21
57 - 92	2520	2520	362	0	44	39	9	96	0	0	0	0	0	0	0
57 - 92	2520	2520	373	0	0	0	0	0	0	0	0	0	0	0	0
57 - 92	931	931	374	0	0	0	0	0	0	0	0	0	10	24	0
57 - 92	674	674	383	0	34	0	21	0	0	0	0	0	0	0	0
93 - 183	421	421	359	134	35	60	28	126	133	0	0	0	10	0	0
93 - 183	100	100	377	6	0	0	38	2	17	0	0	0	0	0	0
93 - 183	647	647	382	0	0	0	6	0	0	0	0	0	0	0	0
184 - 274	225	225	358	21	186	20	76	13	14	27	0	23	65	51	2
184 - 274	139	139	378	13	12	18	91	14	17	0	4	12	0	0	0
184 - 274	182	182	381	11	4	21	55	38	0	19	0	0	0	0	0
275 - 366	164	164	357	4	52	66	.	3	20	9	0	14	31	47	10
275 - 366	106	106	379	19	7	15	88	21	11	13	2	9	0	1	0
275 - 366	116	116	380	2	28	0	83	17	4	3	0	0	0	0	0
367 - 549	155	155	723	.	.	.	.	.	.	.	32	43	30	21	26
367 - 549	105	105	725	.	.	.	.	.	.	.	27	.	18	23	0
367 - 549	160	160	727	.	.	.	.	.	.	.	0	3	23	10	0
550 - 731	124	124	724	.	.	.	.	.	.	.	112	71	93	19	12
550 - 731	72	72	726	.	.	.	.	.	.	.	38	13	16	13	2
550 - 731	156	156	728	.	.	.	.	.	.	.	48	11	59	12	115
732 - 914	.	134	752	.	.	.	.	.	.	.	.	.	.	14	.
732 - 914	.	106	756	.	.	.	.	.	.	.	.	.	.	15	.
732 - 914	.	154	760	.	.	.	.	.	.	.	.	.	.	13	.
915 -1097	.	138	753	.	.	.	.	.	.	.	.	.	.	.	.
915 -1097	.	102	757	.	.	.	.	.	.	.	.	.	.	.	.
915 -1097	.	171	761	.	.	.	.	.	.	.	.	.	.	.	.
1098 -1280	.	180	754	.	.	.	.	.	.	.	.	.	.	.	.
1098 -1280	.	99	758	.	.	.	.	.	.	.	.	.	.	.	.
1098 -1280	.	212	762	.	.	.	.	.	.	.	.	.	.	.	.
1281 -1463	.	385	755	.	.	.	.	.	.	.	.	.	.	.	.
1281 -1463	.	127	759	.	.	.	.	.	.	.	.	.	.	.	.
1281 -1463	.	261	763	.	.	.	.	.	.	.	.	.	.	.	.
Biomass (tons)				1433	462	639	888	1265	316	83	263	216	448	264	187

Table 3 Biomass (tons) of Witch flounder from surveys in Div. 3O during Spring 1984-95 using the Alfred Needler and Wilfred Templeman (Unconverted data)

Year				1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Depth Range (meters)	Old Stratum Area (sq. n. mi.)	New Stratum Area (sq. n. mi.)	Stratum												
57 - 92	2089	2089	330	0	0	0	0	12.2	0	0	0	0	0	0	0
57 - 92	456	456	331	987	188	17	10	222	0	.	0	0	0	0	0
57 - 92	1898	1898	338	100	4591	758	742	1728	1211	237	0	64	153	0	151
57 - 92	1716	1716	340	16	82	0	14	0	0	5	0	74	0	0	0
57 - 92	2520	2520	351	422	164	293	163	613	140	61	0	0	0	0	0
57 - 92	2580	2580	352	55	643	137	840	813	392	1020	23	58	35	21	40
57 - 92	1282	1282	353	2406	802	737	1163	4205	1668	1036	0	144	122	0	24
93 - 183	1721	1721	329	0	0	0	0	424	32	15	290	0	0	2501	61
93 - 183	1047	1047	332	1493	4833	1221	1805	3213	814	2320	1390	1088	201	23	885
93 - 183	948	948	337	32	2114	825	894	539	878	971	892	350	278	27	329
93 - 183	585	585	339	176	0	4	149	81	0	0	0	0	0	0	0
93 - 183	474	474	354	285	71	605	151	231	17	141	74	73	463	0	0
184 - 274	151	147	333	5	27	4	0	33	5	67	222	33	28	2244	68
184 - 274	121	121	336	5	5	18	12	23	0	22	226	680	40	455	30
184 - 274	103	103	355	31	101	20	37	1	47	47	54	9	14	55	20
275 - 366	92	96	334	0	22	17	5	6	11	13	12	53	8	359	7
275 - 366	58	58	335	0	53	8	0	27	11	44	21	566	24	51	20
275 - 366	61	61	356	2	40	9	10	3	13	33	18	57	23	33	31
367 - 549	93	166	717	.	.	.	.	.	.	.	4	26	11	1077	17
367 - 549	76	76	719	.	.	.	.	.	.	.	87	503	16	7	9
367 - 549	76	76	721	.	.	.	.	.	.	.	30	18	12	31	9
550 - 731	111	134	718	.	.	.	.	.	.	.	6	8	26	62	16
550 - 731	105	105	720	.	.	.	.	.	.	.	125	59	43	27	7
550 - 731	93	93	722	.	.	.	.	.	.	.	8	20	53	98	86
732 - 914	.	105	764	.	.	.	.	.	.	.	.	.	.	22	.
732 - 914	.	99	768	.	.	.	.	.	.	.	.	.	.	.	.
732 - 914	.	135	772	.	.	.	.	.	.	.	.	.	.	13	.
915 -1097	.	124	765	.	.	.	.	.	.	.	.	.	.	.	.
915 -1097	.	138	769	.	.	.	.	.	.	.	.	.	.	.	.
915 -1097	.	128	773	.	.	.	.	.	.	.	.	.	.	.	.
1098 -1280	.	144	766	.	.	.	.	.	.	.	.	.	.	.	.
1098 -1280	.	128	770	.	.	.	.	.	.	.	.	.	.	.	.
1098 -1280	.	135	774	.	.	.	.	.	.	.	.	.	.	.	.
1281 -1463	.	158	767	.	.	.	.	.	.	.	.	.	.	.	.
1281 -1463	.	175	771	.	.	.	.	.	.	.	.	.	.	.	.
1281 -1463	.	155	775	.	.	.	.	.	.	.	.	.	.	.	.
Biomass (tons)				6014	13735	4675	5996	12175	5237	6031	3482	3885	1548	7107	1808

Table 4 Biomass (tons) of Witch flounder from surveys in Div. 3N during spring 1984-1997 by the Wilfred Templeman (Engel data converted to Campelen units for 1984-95)

Year				1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Depth Range	Old Stratum	New Stratum	Stratum														
(meters)	Area (sq. n. mi.)	Area (sq. n. mi.)															
<=56	1593	1593	375	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<=56	1499	1499	376	0	0	0	19	0	0	0	0	0	0	0	0	0	0
57 - 92	2992	2992	360	1715	89	629	461	1519	175	0	0	29	165	0	0	0	115
57 - 92	1853	1853	361	119	0	0	39	50	0	20	0	0	0	0	39	0	0
57 - 92	2520	2520	362	0	82	23	18	147	0	0	0	0	0	0	0	0	0
57 - 92	2520	2520	373	0	0	43	0	0	0	0	0	0	0	0	0	0	0
57 - 92	931	931	374	0	0	0	0	0	0	0	0	0	18	34	0	0	0
57 - 92	674	674	383	0	57	0	37	0	0	0	0	0	0	0	0	0	0
93 - 183	421	421	359	231	47	99	43	306	121	0	0	0	19	0	0	0	0
93 - 183	100	100	377	8	0	0	72	3	32	0	0	0	0	0	0	0	0
93 - 183	647	647	382	0	0	0	12	0	0	0	0	0	0	0	0	0	0
184 - 274	225	225	358	40	308	42	137	20	29	57	0	44	132	106	7	51	49
184 - 274	139	139	378	22	19	32	155	31	42	0	0	29	0	0	0	0	3
184 - 274	182	182	381	21	7	32	101	69	0	28	0	0	0	0	0	0	0
275 - 366	164	164	357	8	87	154	.	4	60	21	0	31	49	81	20	36	12
275 - 366	106	106	379	36	12	23	173	44	20	35	3	18	0	4	0	0	9
275 - 366	116	116	380	6	53	0	134	24	7	4	0	0	0	0	0	0	0
367 - 549	155	155	723	.	.	.	.	.	.	.	90	102	79	36	51	16	25
367 - 549	105	105	725	.	.	.	.	.	.	.	62	.	40	44	0	5	28
367 - 549	160	160	727	.	.	.	.	.	.	.	0	5	38	17	0	0	3
550 - 731	124	124	724	.	.	.	.	.	.	.	327	181	218	51	36	29	157
550 - 731	72	72	726	.	.	.	.	.	.	.	81	25	22	28	3	12	42
550 - 731	156	156	728	.	.	.	.	.	.	.	92	19	82	22	152	21	.
732 - 914	.	134	752	.	.	.	.	.	.	.	.	.	.	27	.	.	.
732 - 914	.	106	756	.	.	.	.	.	.	.	.	.	.	33	.	.	.
732 - 914	.	154	760	.	.	.	.	.	.	.	.	.	.	26	.	.	.
915 -1097	.	138	753	.	.	.	.	.	.	.	.	.	.	.	.	.	.
915 -1097	.	102	757	.	.	.	.	.	.	.	.	.	.	.	.	.	.
915 -1097	.	171	761	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1098 -1280	.	180	754	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1098 -1280	.	99	758	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1098 -1280	.	212	762	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1281 -1463	.	385	755	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1281 -1463	.	127	759	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1281 -1463	.	261	763	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Biomass (tons)				2205	761	1078	1401	2217	485	164	655	484	862	510	308	170	443

Table 5 Biomass (tons) of Witch flounder from surveys in Div. 3O during spring 1984-1997 by the Wilfred Templeman (Engel data converted to Campelen units for 1984-95)

Year				1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Depth Range	Old Stratum	New Stratum	Stratum														
(meters)	Area (sq. n. mi.)	Area (sq. n. mi.)															
57 - 92	2089	2089	330	0	0	0	0	22	0	0	0	0	0	0	0	0	0.36
57 - 92	456	456	331	1912	302	36	18	444	0		0	0	0	0	0	74	0
57 - 92	1898	1898	338	134	7806	1108	1184	3075	1827	434	0	109	295	0	228	870	0
57 - 92	1716	1716	340	40	146	0	21	0	0	15	0	147	0	0	0	0	0
57 - 92	2520	2520	351	688	211	385	222	978	217	109	0	0	0	0	0	0	0
57 - 92	2580	2580	352	82	951	225	1275	1330	664	1427	40	105	60	40	63	59	100
57 - 92	1282	1282	353	4519	1122	1067	1609	7208	2486	1637	0	243	209	0	42	23	2
93 - 183	1721	1721	329	0	0	0	0	789	48	27	494	0	0	5071	193	0	11
93 - 183	1047	1047	332	3779	8589	2485	3367	6829	1485	4599	2426	2182	359	58	1791	1180	235
93 - 183	948	948	337	50	4129	1415	1506	1061	1543	1627	1581	580	675	50	654	330	163
93 - 183	585	585	339	335	0	16	223	136	0	0	0	0	0	0	0	1	0
93 - 183	474	474	354	495	105	1231	233	345	47	240	144	149	841	0	0	36	0
184 - 274	151	147	333	10	48	10	0	67	16	129	498	79	80	5196	162	7	109
184 - 274	121	121	336	12	7	43	25	63	0	53	492	1374	100	1057	62	180	293
184 - 274	103	103	355	45	181	38	71	0	97	126	136	16	34	129	43	86	48
275 - 366	92	96	334	0	42	42	18	22	23	26	20	108	20	860	15	150	362
275 - 366	58	58	335	0	98	18	2	51	22	92	42	1107	65	103	43	78	109
275 - 366	61	61	356	5	83	18	23	18	29	55	39	129	77	75	62	40	11
367 - 549	93	166	717								11	120	35	2375	53	465	4354
367 - 549	76	76	719								148	1024	49	14	18	137	601
367 - 549	76	76	721								76	48	31	72	18	16	19
550 - 731	111	134	718								35	29	104	221	80	71	37
550 - 731	105	105	720								217	134	182	95	15	21	150
550 - 731	93	93	722								18	49	150	217	206	89	87
732 - 914		105	764											60			
732 - 914		99	768														
732 - 914		135	772											75			
915 -1097		124	765														
915 -1097		138	769														
915 -1097		128	773														
1098 -1280		144	766														
1098 -1280		128	770														
1098 -1280		135	774														
1281 -1463		158	767														
1281 -1463		175	771														
1281 -1463		155	775														
Biomass (tons)				12108	23820	8136	9799	22438	8503	10594	6415	7734	3364	15769	3745	3915	6691

Table 6 Abundance (000's) of Witch flounder from surveys in Div. 3N during spring 1984-1995 by the Wilfred Templeman (Unconverted data)

Year				1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Depth Range	Old Stratum	New Stratum	Stratum												
(meters)	Area (sq. n. mi.)	Area (sq. n. mi.)													
<=56	1593	1593	375	0	0	0	0	0	0	0	0	0	0	0	0
<=56	1499	1499	376	0	0	0	14	0	0	0	0	0	0	0	0
57 - 92	2992	2992	360	1251	56	397	374	1348	105	0	0	32	123	0	0
57 - 92	1853	1853	361	83	0	0	17	20	0	15	0	0	0	0	20
57 - 92	2520	2520	362	0	52	41	15	95	0	0	0	0	0	0	0
57 - 92	2520	2520	373	0	0	0	0	0	0	0	0	0	0	0	0
57 - 92	931	931	374	0	0	0	0	0	0	0	0	0	23	23	0
57 - 92	674	674	383	0	34	0	17	0	0	0	0	0	0	0	0
93 - 183	421	421	359	190	32	95	32	300	111	0	0	0	16	0	0
93 - 183	100	100	377	8	0	0	71	4	34	0	0	0	0	0	0
93 - 183	647	647	382	0	0	0	16	0	0	0	0	0	0	0	0
184 - 274	225	225	358	34	262	34	135	17	25	51	0	42	127	93	8
184 - 274	139	139	378	21	16	26	146	31	42	0	3	37	0	0	0
184 - 274	182	182	381	14	7	23	82	41	0	14	0	0	0	0	0
275 - 366	164	164	357	12	74	176	.	6	62	25	0	37	49	55	12
275 - 366	106	106	379	32	12	32	163	44	20	36	4	20	0	4	0
275 - 366	116	116	380	4	44	0	122	17	4	4	0	0	0	0	0
367 - 549	155	155	723	.	.	.	.	.	.	.	93	93	87	29	47
367 - 549	105	105	725	.	.	.	.	.	.	.	63	.	39	35	0
367 - 549	160	160	727	.	.	.	.	.	.	.	0	6	30	12	0
550 - 731	124	124	724	.	.	.	.	.	.	.	337	195	228	56	37
550 - 731	72	72	726	.	.	.	.	.	.	.	89	27	22	35	3
550 - 731	156	156	728	.	.	.	.	.	.	.	82	12	83	16	120
732 - 914	.	134	752	.	.	.	.	.	.	.	.	.	.	20	.
732 - 914	.	106	756	.	.	.	.	.	.	.	.	.	.	32	.
732 - 914	.	154	760	.	.	.	.	.	.	.	.	.	.	19	.
915 -1097	.	138	753	.	.	.	.	.	.	.	.	.	.	.	.
915 -1097	.	102	757	.	.	.	.	.	.	.	.	.	.	.	.
915 -1097	.	171	761	.	.	.	.	.	.	.	.	.	.	.	.
1098 -1280	.	180	754	.	.	.	.	.	.	.	.	.	.	.	.
1098 -1280	.	99	758	.	.	.	.	.	.	.	.	.	.	.	.
1098 -1280	.	212	762	.	.	.	.	.	.	.	.	.	.	.	.
1281 -1463	.	385	755	.	.	.	.	.	.	.	.	.	.	.	.
1281 -1463	.	127	759	.	.	.	.	.	.	.	.	.	.	.	.
1281 -1463	.	261	763	.	.	.	.	.	.	.	.	.	.	.	.
Total (000's)				1649	587	823	1204	1923	402	145	672	501	826	429	247

Table 7 Abundance (000's) of Witch flounder from surveys in Div. 3O during spring 1984-1995 by the Wilfred Templeman (Unconverted data)

Year				1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Depth_Range	Old Stratum	New Stratum	Stratum												
(meters)	Area (sq. n. mi.)	Area (sq. n. mi.)													
57 - 92	2089	2089	330	0	0	0	0	17	0	0	0	0	0	0	0
57 - 92	456	456	331	1791	217	43	17	394	0	.	0	0	0	0	0
57 - 92	1898	1898	338	114	6665	886	1013	2422	1453	321	0	71	237	0	166
57 - 92	1716	1716	340	32	115	0	14	0	0	14	0	77	0	0	0
57 - 92	2520	2520	351	504	147	311	160	813	146	63	0	0	0	0	0
57 - 92	2580	2580	352	55	810	194	983	1039	492	1102	28	48	28	24	39
57 - 92	1282	1282	353	4138	722	894	1283	6582	2172	1283	0	144	192	0	19
93 - 183	1721	1721	329	0	0	0	0	664	29	18	416	0	0	4754	181
93 - 183	1047	1047	332	3890	8048	2463	3238	6700	1399	4480	2174	2075	275	79	1670
93 - 183	948	948	337	71	3985	1267	1423	1014	1366	1352	1509	427	712	47	587
93 - 183	585	585	339	242	0	15	146	73	0	0	0	0	0	0	0
93 - 183	474	474	354	480	95	1222	231	302	53	196	119	107	818	0	0
184 - 274	151	147	333	11	57	11	0	68	17	130	493	74	85	5136	166
184 - 274	121	121	336	9	9	41	23	50	0	55	486	1317	100	1045	55
184 - 274	103	103	355	43	174	35	62	8	97	128	116	15	31	124	46
275 - 366	92	96	334	0	38	45	17	25	21	21	21	100	24	850	18
275 - 366	58	58	335	0	87	18	2	48	20	79	41	1036	71	96	41
275 - 366	61	61	356	5	76	16	21	18	27	51	39	119	80	78	55
367 - 549	93	166	717	.	.	.	.	.	.	.	10	126	35	2312	56
367 - 549	76	76	719	.	.	.	.	.	.	.	120	990	48	15	17
367 - 549	76	76	721	.	.	.	.	.	.	.	74	46	34	66	17
550 - 731	111	134	718	.	.	.	.	.	.	.	37	29	112	251	86
550 - 731	105	105	720	.	.	.	.	.	.	.	179	134	185	99	16
550 - 731	93	93	722	.	.	.	.	.	.	.	17	46	145	192	195
732 - 914	.	105	764	.	.	.	.	.	.	.	.	.	.	59	.
732 - 914	.	99	768	.	.	.	.	.	.	.	.	.	.	.	.
732 - 914	.	135	772	.	.	.	.	.	.	.	.	.	.	78	.
915 -1097	.	124	765	.	.	.	.	.	.	.	.	.	.	.	.
915 -1097	.	138	769	.	.	.	.	.	.	.	.	.	.	.	.
915 -1097	.	128	773	.	.	.	.	.	.	.	.	.	.	.	.
1098 -1280	.	144	766	.	.	.	.	.	.	.	.	.	.	.	.
1098 -1280	.	128	770	.	.	.	.	.	.	.	.	.	.	.	.
1098 -1280	.	135	774	.	.	.	.	.	.	.	.	.	.	.	.
1281 -1463	.	158	767	.	.	.	.	.	.	.	.	.	.	.	.
1281 -1463	.	175	771	.	.	.	.	.	.	.	.	.	.	.	.
1281 -1463	.	155	775	.	.	.	.	.	.	.	.	.	.	.	.
Total (000's)				11386	21243	7459	8634	20239	7291	9293	5880	6982	3214	15304	3430

Table 8 Abundance (000's) of Witch flounder from surveys in Div. 3N during spring of 1984-1997 by the Wilfred Templeman (Engel data converted to Campelen units for 1984-95)

Year				1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Depth Range	Old Stratum	New Stratum	Stratum														
(meters)	Area (sq. n. mi.)	Area (sq. n. mi.)															
<=56	1593	1593	375	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<=56	1499	1499	376	0	0	0	26	0	0	0	0	0	0	0	0	0	0
57 - 92	2992	2992	360	2234	129	728	741	2641	220	0	0	59	225	0	0	0	132
57 - 92	1853	1853	361	153	0	0	32	36	0	28	0	0	0	0	36	0	0
57 - 92	2520	2520	362	0	95	25	27	173	0	0	0	0	0	0	0	0	0
57 - 92	2520	2520	373	0	0	50	0	0	0	0	0	0	0	0	0	0	0
57 - 92	931	931	374	0	0	0	0	0	0	0	0	0	43	43	0	0	0
57 - 92	674	674	383	0	62	0	31	0	0	0	0	0	0	0	0	0	0
93 - 183	421	421	359	405	58	232	58	985	203	0	0	0	29	0	0	0	0
93 - 183	100	100	377	14	0	0	186	7	83	0	0	0	0	0	0	0	0
93 - 183	647	647	382	0	0	0	30	0	0	0	0	0	0	0	0	0	0
184 - 274	225	225	358	77	557	93	279	31	46	93	0	93	294	232	31	77	83
184 - 274	139	139	378	48	29	48	354	86	115	0	0	96	0	0	0	0	9
184 - 274	182	182	381	25	13	42	163	75	0	25	0	0	0	0	0	0	0
275 - 366	164	164	357	23	180	553	.	11	237	56	0	90	124	102	23	40	30
275 - 366	106	106	379	66	36	68	423	102	44	109	7	44	0	22	0	0	18
275 - 366	116	116	380	8	88	0	247	32	8	8	0	0	0	0	0	0	0
367 - 549	155	155	723	.	.	.	.	.	.	.	288	341	256	53	181	45	51
367 - 549	105	105	725	.	.	.	.	.	.	.	166	.	101	87	0	13	235
367 - 549	160	160	727	.	.	.	.	.	.	.	0	11	55	22	0	0	11
550 - 731	124	124	724	.	.	.	.	.	.	.	1134	580	597	188	119	128	432
550 - 731	72	72	726	.	.	.	.	.	.	.	213	59	30	114	5	33	183
550 - 731	156	156	728	.	.	.	.	.	.	.	182	21	139	29	172	134	.
732 - 914	.	134	752	.	.	.	.	.	.	.	.	.	.	37	.	.	.
732 - 914	.	106	756	.	.	.	.	.	.	.	.	.	.	87	.	.	.
732 - 914	.	154	760	.	.	.	.	.	.	.	.	.	.	95	.	.	.
915 -1097	.	138	753	.	.	.	.	.	.	.	.	.	.	.	.	.	.
915 -1097	.	102	757	.	.	.	.	.	.	.	.	.	.	.	.	.	.
915 -1097	.	171	761	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1098 -1280	.	180	754	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1098 -1280	.	99	758	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1098 -1280	.	212	762	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1281 -1463	.	385	755	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1281 -1463	.	127	759	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1281 -1463	.	261	763	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Total (000's)				3053	1246	1837	2595	4180	955	320	1991	1394	1892	1110	567	470	1184

Table 9 Abundance (000's) of Witch flounder from surveys in Div. 3O during spring 1984-1997 by the Alfred Needler and Wilfred Templeman (Engel data converted to Campelen units for 1984-95)

Year				1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Depth Range (meters)	Old Stratum Area (sq. n. mi.)	New Stratum Area (sq. n. mi.)	Stratum														
57 - 92	2089	2089	330	0	0	0	0	32	0	0	0	0	0	0	0	0	73
57 - 92	456	456	331	3555	376	94	31	1004	0		0	0	0	0	0	63	0
57 - 92	1898	1898	338	209	11894	1509	1944	5418	2480	587	0	131	479	0	305	1417	0
57 - 92	1716	1716	340	59	210	0	26	0	0	52	0	142	0	0	0	0	0
57 - 92	2520	2520	351	924	231	495	267	1317	240	116	0	0	0	0	0	0	0
57 - 92	2580	2580	352	101	1807	431	2048	1839	928	1775	51	89	51	44	71	79	197
57 - 92	1282	1282	353	9347	1235	1713	2146	13050	3880	2910	0	265	353	0	35	35	265
93 - 183	1721	1721	329	0	0	0	0	1454	53	34	763	0	0	12263	521	0	35
93 - 183	1047	1047	332	11018	16592	6529	7230	16023	2852	10572	4513	5761	504	432	3925	2927	5665
93 - 183	948	948	337	130	9181	2634	3543	2641	2556	2608	3182	815	2087	87	1239	826	469
93 - 183	585	585	339	443	0	80	268	134	0	0	0	0	0	0	0	161	36
93 - 183	474	474	354	1174	239	3282	456	619	196	359	261	261	1663	0	0	98	33
184 - 274	151	147	333	21	156	35	0	145	52	332	1361	187	301	13447	425	30	277
184 - 274	121	121	336	25	17	175	67	208	0	158	1365	3287	266	3029	125	432	682
184 - 274	103	103	355	92	418	128	135	0	383	510	340	28	99	340	99	168	195
275 - 366	92	96	334	0	95	165	63	95	44	51	38	272	63	2238	40	462	880
275 - 366	58	58	335	0	203	40	8	148	68	331	109	2340	223	215	108	192	243
275 - 366	61	61	356	17	214	38	55	109	80	126	92	348	319	189	126	88	40
367 - 549	93	166	717								32	371	166	5960	228	1363	11566
367 - 549	76	76	719								288	2535	267	37	42	364	1161
367 - 549	76	76	721								235	209	94	193	42	42	63
550 - 731	111	134	718								282	122	512	1161	535	518	507
550 - 731	105	105	720								361	376	1026	498	43	101	518
550 - 731	93	93	722								45	166	512	518	601	274	819
732 - 914		105	764											217			
732 - 914		99	768														
732 - 914		135	772											501			
915 -1097		124	765														
915 -1097		138	769														
915 -1097		128	773														
1098 -1280		144	766														
1098 -1280		128	770														
1098 -1280		135	774														
1281 -1463		158	767														
1281 -1463		175	771														
1281 -1463		155	775														
Total (000's)				27114	42867	17347	18286	44236	13811	20521	13317	17705	8983	41371	8508	9639	23725

Table 10 Biomass (tons) by stratum of Witch flounder from surveys in Div. 3N during fall 1990-1994 by the Wilfred Templeman (Unconverted data).

Year				1990	1991	1992	1993	1994
Depth Range (meters)	Old Stratum Area (sq. n. mi.)	New Stratum Area (sq. n. mi.)	Stratum					
<=56	1593	1593	375	0	43		0	0
<=56	1499	1499	376	0	0	0	0	0
57 - 92	2992	2992	360	148	95	734	79	52
57 - 92	1853	1853	361	15	274	282	0	20
57 - 92	2520	2520	362	269	129	54	0	0
57 - 92	2520	2520	373	0	0	0	0	0
57 - 92	931	931	374	0	0		0	0
57 - 92	674	674	383	0	0		0	0
93 - 183	421	421	359	0	0	136	0	0
93 - 183	100	100	377	0		0	0	5
93 - 183	647	647	382	0	0	0	0	0
184 - 274	225	225	358	0	11	40	13	0
184 - 274	139	139	378	0	16	8	0	0
184 - 274	182	182	381		0		0	0
275 - 366	164	164	357	0	116	6	95	18
275 - 366	106	106	379	2		1	0	0
275 - 366	116	116	380		0		0	0
367 - 549	155	155	723		24		83	87
367 - 549	105	105	725			8	192	18
367 - 549	160	160	727				0	21
550 - 731	124	124	724		69		163	73
550 - 731	72	72	726				149	27
550 - 731	156	156	728					88
732 - 914		134	752					
732 - 914		106	756					
732 - 914		154	760					
915 -1097		138	753					
915 -1097		102	757					
915 -1097		171	761					
1098 -1280		180	754					
1098 -1280		99	758					
1098 -1280		212	762					
1281 -1463		385	755					
1281 -1463		127	759					
1281 -1463		261	763					
Biomass (tons)				434	777	1267	774	407

Table 11 Biomass (tons) by stratum of Witch flounder from surveys in Div. 3O during fall 1990-1994 by the Wilfred Templeman (Unconverted data).

Year				1990	1991	1992	1993	1994
Depth Range (meters)	Old Stratum Area (sq. n. mi.)	New Stratum Area (sq. n. mi.)	Stratum					
57 - 92	2089	2089	330	65	31	47	0	0
57 - 92	456	456	331	12	161	84	0	0
57 - 92	1898	1898	338	1347	244	450	2144	1065
57 - 92	1716	1716	340	106	155	37	0	0
57 - 92	2520	2520	351	1029	161	43	0	0
57 - 92	2580	2580	352	926	515	863	559	136
57 - 92	1282	1282	353	1795	183	301	0	419
93 - 183	1721	1721	329	57	46	0	11	0
93 - 183	1047	1047	332	1118	72	659	372	127
93 - 183	948	948	337	721	91	422	310	934
93 - 183	585	585	339	708	128	390	65	506
93 - 183	474	474	354	775	14	158	39	109
184 - 274	151	147	333	88	4	6	13	33
184 - 274	121	121	336	34	59	29	133	5
184 - 274	103	103	355		213	35	46	11
275 - 366	92	96	334	10	5	0	5	6
275 - 366	58	58	335	97	8	9	14	6
275 - 366	61	61	356		6	3	166	44
367 - 549	93	166	717	12			0	21
367 - 549	76	76	719	57	0		25	3
367 - 549	76	76	721		7		73	28
550 - 731	111	134	718				6	19
550 - 731	105	105	720				23	0
550 - 731	93	93	722		3		31	8
732 - 914		105	764					
732 - 914		99	768					
732 - 914		135	772					
915 -1097		124	765					
915 -1097		138	769					
915 -1097		128	773					
1098 -1280		144	766					
1098 -1280		128	770					
1098 -1280		135	774					
1281 -1463		158	767					
1281 -1463		175	771					
1281 -1463		155	775					
Biomass (tons)				8955	2106	3536	4034	3480

Table 12 Biomass (tons) of Witch flounder from surveys in Div. 3N during fall 1990-1997 by the Wilfred Templeman, Alfred Needler and Teleost (Engel data converted to Campelen units for 1990-94).

Year				1990	1991	1992	1993	1994	1995	1996	1997
Depth Range (meters)	Old Stratum Area (sq. n. mi.)	New Stratum Area (sq. n. mi.)	Stratum								
<=56	1593	1593	375	0	73	.	0	0	0	0	0
<=56	1499	1499	376	0	0	0	0	0	14	0	22
57 - 92	2992	2992	360	265	171	1297	173	75	888	23	427
57 - 92	1853	1853	361	28	467	463	0	32	0	0	14
57 - 92	2520	2520	362	400	221	87	0	0	0	0	0
57 - 92	2520	2520	373	0	0	0	0	0	0	0	0
57 - 92	931	931	374	0	0	.	0	0	0	0	0
57 - 92	674	674	383	0	0	.	0	0	0	0	0
93 - 183	421	421	359	0	0	278	0	0	22	0	0
93 - 183	100	100	377	0	.	0	0	8	0	0	0
93 - 183	647	647	382	0	0	0	0	0	0	0	0
184 - 274	225	225	358	0	20	66	24	0	74	0	11
184 - 274	139	139	378	0	41	15	0	0	0	0	1
184 - 274	182	182	381	.	0	.	0	0	0	0	1
275 - 366	164	164	357	0	234	9	187	43	85	0	27
275 - 366	106	106	379	4	.	4	0	0	0	1	7
275 - 366	116	116	380	.	0	.	0	0	0	0	0
367 - 549	155	155	723	.	41	.	163	180	57	15	28
367 - 549	105	105	725	.	.	15	376	46	19	0	135
367 - 549	160	160	727	.	.	.	0	38	0	0	29
550 - 731	124	124	724	.	172	.	414	180	104	60	197
550 - 731	72	72	726	.	.	.	310	54	48	40	21
550 - 731	156	156	728	.	.	.	.	153	35	21	76
732 - 914	.	134	752	.	.	.	.	.	.	.	.
732 - 914	.	106	756	.	.	.	.	.	.	.	.
732 - 914	.	154	760	.	.	.	.	.	.	.	.
915 -1097	.	138	753	.	.	.	.	.	.	.	.
915 -1097	.	102	757	.	.	.	.	.	.	.	.
915 -1097	.	171	761	.	.	.	.	.	.	.	.
1098 -1280	.	180	754	.	.	.	.	.	.	.	.
1098 -1280	.	99	758	.	.	.	.	.	.	.	.
1098 -1280	.	212	762	.	.	.	.	.	.	.	.
1281 -1463	.	385	755	.	.	.	.	.	.	.	.
1281 -1463	.	127	759	.	.	.	.	.	.	.	.
1281 -1463	.	261	763	.	.	.	.	.	.	.	.
Biomass (tons)				696	1441	2235	1647	808	1346	160	993

Table 13 Biomass (tons) of Witch flounder from surveys in Div. 3O during fall 1990-1997 by the Wilfred Templeman, Alfred Needler and Teleost (Engel data converted to Campelen units for 1990-94).

Year				1990	1991	1992	1993	1994	1995	1996	1997
Depth Range	Old Stratum	New Stratum	Stratum								
(meters)	Area (sq. n. mi.)	Area (sq. n. mi.)									
57 - 92	2089	2089	330	122	67	79	0	0	247	0	72
57 - 92	456	456	331	22	315	134	0	0	108	0	0
57 - 92	1898	1898	338	2226	438	837	3966	2193	4685	503	1329
57 - 92	1716	1716	340	173	280	63	0	0	204	0	22
57 - 92	2520	2520	351	1690	284	72	0	0	0	0	0
57 - 92	2580	2580	352	1415	896	1352	946	228	379	273	573
57 - 92	1282	1282	353	2405	343	477	0	732	538	789	168
93 - 183	1721	1721	329	99	85	0	18	0	417	0	173
93 - 183	1047	1047	332	2102	155	1724	813	321	1114	4569	190
93 - 183	948	948	337	1333	188	954	563	2132	421	492	322
93 - 183	585	585	339	1132	224	651	119	742	1911	0	481
93 - 183	474	474	354	1291	23	316	75	210	191	4647	215
184 - 274	151	147	333	221	11	22	30	92	26		4
184 - 274	121	121	336	82	151	76	298	13	35	32	19
184 - 274	103	103	355		497	93	120	25	16	343	6
275 - 366	92	96	334	24	16	0	9	17	4		5
275 - 366	58	58	335	194	25	25	30	18	1	23	0
275 - 366	61	61	356		11	7	430	98	7	60	3
367 - 549	93	166	717	30			0	32	37		12
367 - 549	76	76	719	110	2		65	6	1	226	19
367 - 549	76	76	721		18		169	67	21	54	6
550 - 731	111	134	718				22	68	8		68
550 - 731	105	105	720				73	0	13	68	
550 - 731	93	93	722		9		81	21	14	39	12
732 - 914		105	764								
732 - 914		99	768								
732 - 914		135	772								
915 -1097		124	765								
915 -1097		138	769								
915 -1097		128	773								
1098 -1280		144	766								
1098 -1280		128	770								
1098 -1280		135	774								
1281 -1463		158	767								
1281 -1463		175	771								
1281 -1463		155	775								
Biomass (tons)				14671	4036	6884	7827	7013	10397	12117	3698

Table 14 Abundance (000s) by stratum of Witch flounder from surveys in Div. 3N during fall 1990-1994 by the Wilfred Templeman (Unconverted data).

Year				1990	1991	1992	1993	1994
Depth Range (meters)	Old Stratum Area (sq. n. mi.)	New Stratum Area (sq. n. mi.)	Stratum					
<=56	1593	1593	375	0	30		0	0
<=56	1499	1499	376	0	0	0	0	0
57 - 92	2992	2992	360	193	112	898	125	56
57 - 92	1853	1853	361	17	232	383	0	23
57 - 92	2520	2520	362	275	151	63	0	0
57 - 92	2520	2520	373	0	0	0	0	0
57 - 92	931	931	374	0	0		0	0
57 - 92	674	674	383	0	0		0	0
93 - 183	421	421	359	0	0	253	0	0
93 - 183	100	100	377	0		0	0	4
93 - 183	647	647	382	0	0	0	0	0
184 - 274	225	225	358	0	25	59	17	0
184 - 274	139	139	378	0	42	10	0	0
184 - 274	182	182	381		0		0	0
275 - 366	164	164	357	0	179	12	154	43
275 - 366	106	106	379	4		4	0	0
275 - 366	116	116	380		0		0	0
367 - 549	155	155	723		29		151	163
367 - 549	105	105	725			18	327	47
367 - 549	160	160	727				0	24
550 - 731	124	124	724		157		400	182
550 - 731	72	72	726				289	51
550 - 731	156	156	728					130
732 - 914		134	752					
732 - 914		106	756					
732 - 914		154	760					
915 -1097		138	753					
915 -1097		102	757					
915 -1097		171	761					
1098 -1280		180	754					
1098 -1280		99	758					
1098 -1280		212	762					
1281 -1463		385	755					
1281 -1463		127	759					
1281 -1463		261	763					
Total (000s)				489	957	1701	1463	724

Table 15 Abundance (000s) by stratum of Witch flounder from surveys in Div. 3O during fall 1990-1994 by the Wilfred Templeman (Unconverted data).

Year				1990	1991	1992	1993	1994
Depth Range (meters)	Old Stratum Area (sq. n. mi.)	New Stratum Area (sq. n. mi.)	Stratum					
57 - 92	2089	2089	330	71	59	39	0	0
57 - 92	456	456	331	23	274	68	0	0
57 - 92	1898	1898	338	1728	342	712	3419	2102
57 - 92	1716	1716	340	143	180	64	0	0
57 - 92	2520	2520	351	1078	189	32	0	0
57 - 92	2580	2580	352	968	678	1097	609	194
57 - 92	1282	1282	353	1780	241	417	0	626
93 - 183	1721	1721	329	72	55	0	26	0
93 - 183	1047	1047	332	1821	157	1755	760	341
93 - 183	948	948	337	1110	178	890	498	1957
93 - 183	585	585	339	878	132	417	66	571
93 - 183	474	474	354	1050	18	302	71	196
184 - 274	151	147	333	221	11	23	23	88
184 - 274	121	121	336	76	150	82	272	14
184 - 274	103	103	355		468	97	112	27
275 - 366	92	96	334	28	17	0	9	18
275 - 366	58	58	335	174	24	26	30	15
275 - 366	61	61	356		11	5	412	98
367 - 549	93	166	717	31			0	50
367 - 549	76	76	719	99	3		68	6
367 - 549	76	76	721		14		163	68
550 - 731	111	134	718				25	86
550 - 731	105	105	720				75	0
550 - 731	93	93	722		10		73	21
732 - 914		105	764					
732 - 914		99	768					
732 - 914		135	772					
915 -1097		124	765					
915 -1097		138	769					
915 -1097		128	773					
1098 -1280		144	766					
1098 -1280		128	770					
1098 -1280		135	774					
1281 -1463		158	767					
1281 -1463		175	771					
1281 -1463		155	775					
Total (000s)				11351	3212	6026	6711	6476

Table 16 Abundance (000s) of Witch flounder from surveys in Div. 3N during fall 1990-1997 by the Wilfred Templeman, Alfred Needler and Teleost (Engel data converted to Campelen units for 1990-94).

Year				1990	1991	1992	1993	1994	1995	1996	1997
Depth Range	Old Stratum	New Stratum	Stratum								
(meters)	Area (sq. n. mi.)	Area (sq. n. mi.)									
<=56	1593	1593	375	0	55	.	0	0	0	0	0
<=56	1499	1499	376	0	0	0	0	0	23	0	19
57 - 92	2992	2992	360	382	206	1646	320	103	1232	41	672
57 - 92	1853	1853	361	32	425	701	0	42	0	0	23
57 - 92	2520	2520	362	441	277	116	0	0	0	0	0
57 - 92	2520	2520	373	0	0	0	0	0	0	0	0
57 - 92	931	931	374	0	0	.	0	0	0	0	0
57 - 92	674	674	383	0	0	.	0	0	0	0	0
93 - 183	421	421	359	0	0	608	0	0	87	0	0
93 - 183	100	100	377	0	.	0	0	7	0	0	0
93 - 183	647	647	382	0	0	0	0	0	0	0	0
184 - 274	225	225	358	0	46	108	31	0	234	0	31
184 - 274	139	139	378	0	105	19	0	0	0	0	9
184 - 274	182	182	381	.	0	.	0	0	0	0	7
275 - 366	164	164	357	0	384	23	338	135	180	0	60
275 - 366	106	106	379	7	.	15	0	0	0	19	22
275 - 366	116	116	380	.	0	.	0	0	0	0	0
367 - 549	155	155	723	.	53	.	330	394	117	21	88
367 - 549	105	105	725	.	.	36	701	173	49	0	237
367 - 549	160	160	727	.	.	.	0	44	11	0	55
550 - 731	124	124	724	.	444	.	1126	512	223	178	571
550 - 731	72	72	726	.	.	.	669	114	119	99	40
550 - 731	156	156	728	.	.	.	.	268	195	129	212
732 - 914	.	134	752	.	.	.	.	.	.	.	.
732 - 914	.	106	756	.	.	.	.	.	.	.	.
732 - 914	.	154	760	.	.	.	.	.	.	.	.
915 -1097	.	138	753	.	.	.	.	.	.	.	.
915 -1097	.	102	757	.	.	.	.	.	.	.	.
915 -1097	.	171	761	.	.	.	.	.	.	.	.
1098 -1280	.	180	754	.	.	.	.	.	.	.	.
1098 -1280	.	99	758	.	.	.	.	.	.	.	.
1098 -1280	.	212	762	.	.	.	.	.	.	.	.
1281 -1463	.	385	755	.	.	.	.	.	.	.	.
1281 -1463	.	127	759	.	.	.	.	.	.	.	.
1281 -1463	.	261	763	.	.	.	.	.	.	.	.
Total (000s)				863	1995	3272	3515	1793	2470	488	2046

Table 17 Abundance (000s) of Witch flounder from surveys in Div. 3O during fall 1990-1997 by the Wilfred Templeman, Alfred Needler and Teleost (Engel data converted to Campelen units for 1990-94).

Year				1990	1991	1992	1993	1994	1995	1996	1997
Depth Range	Old Stratum	New Stratum	Stratum								
(meter)	Area (sq. n. mi.)	Area (sq. n. mi.)									
57 - 92	2089	2089	330	131	144	72	0	0	517	0	96
57 - 92	456	456	331	42	502	125	0	0	408	0	0
57 - 92	1898	1898	338	3264	627	1436	6893	4700	8459	522	2872
57 - 92	1716	1716	340	262	330	118	0	0	295	0	47
57 - 92	2520	2520	351	1837	347	58	0	0	0	0	0
57 - 92	2580	2580	352	1597	1242	2011	1115	355	371	355	1141
57 - 92	1282	1282	353	2822	485	941	0	1176	999	882	573
93 - 183	1721	1721	329	132	101	0	47	0	663	0	616
93 - 183	1047	1047	332	3625	396	5281	2064	960	5233	11954	1248
93 - 183	948	948	337	2347	424	2347	1043	5216	1435	717	1130
93 - 183	585	585	339	1556	241	724	121	966	2776	0	1086
93 - 183	474	474	354	1891	33	685	359	424	489	8955	489
184 - 274	151	147	333	582	52	83	62	312	187		192
184 - 274	121	121	336	222	466	216	633	42	549	208	100
184 - 274	103	103	355		1459	298	425	85	63	768	28
275 - 366	92	96	334	76	70	0	21	57	56		33
275 - 366	58	58	335	371	100	112	68	52	64	64	4
275 - 366	61	61	356		25	8	1255	252	40	113	13
367 - 549	93	166	717	122			0	96	703		46
367 - 549	76	76	719	209	42		277	10	52	612	183
367 - 549	76	76	721		47		444	183	102	131	17
550 - 731	111	134	718				107	428	164		535
550 - 731	105	105	720				339	0	105	316	
550 - 731	93	93	722		26		243	58	64	134	51
732 - 914		105	764								
732 - 914		99	768								
732 - 914		135	772								
915 -1097		124	765								
915 -1097		138	769								
915 -1097		128	773								
1098 -1280		144	766								
1098 -1280		128	770								
1098 -1280		135	774								
1281 -1463		158	767								
1281 -1463		175	771								
1281 -1463		155	775								
Total (000s)				21086	7158	14515	15517	15369	23795	25731	10499

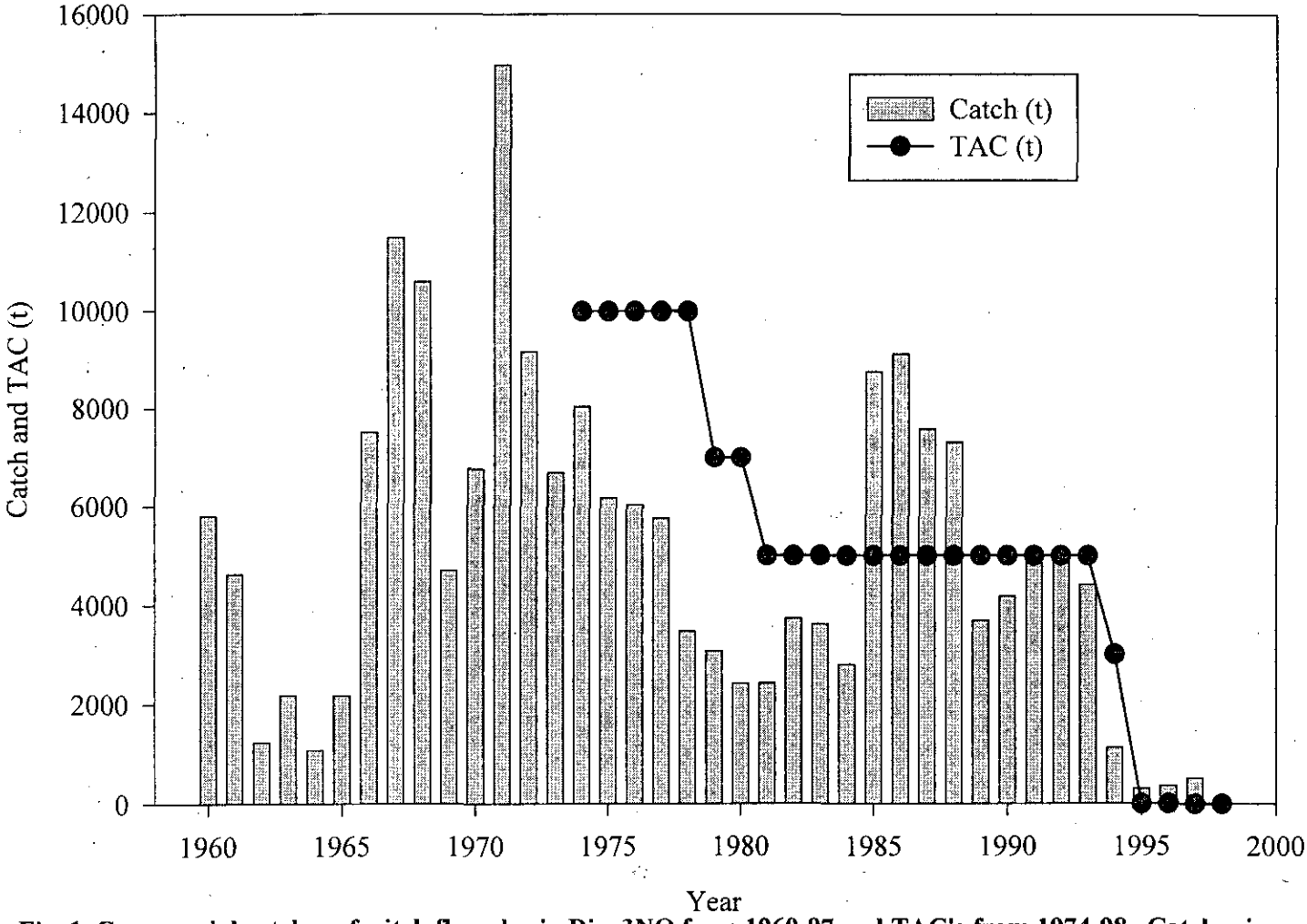


Fig. 1 Commercial catches of witch flounder in Div. 3NO from 1960-97 and TAC's from 1974-98. Catches in recent years include estimates of those not reported.

***Note: Although a TAC of 3000 tons was agreed by the Fisheries Commission, it was also agreed that no directed fishing on witch flounder in Div. 3NO take place during 1994 due to the poor state of the stock.**

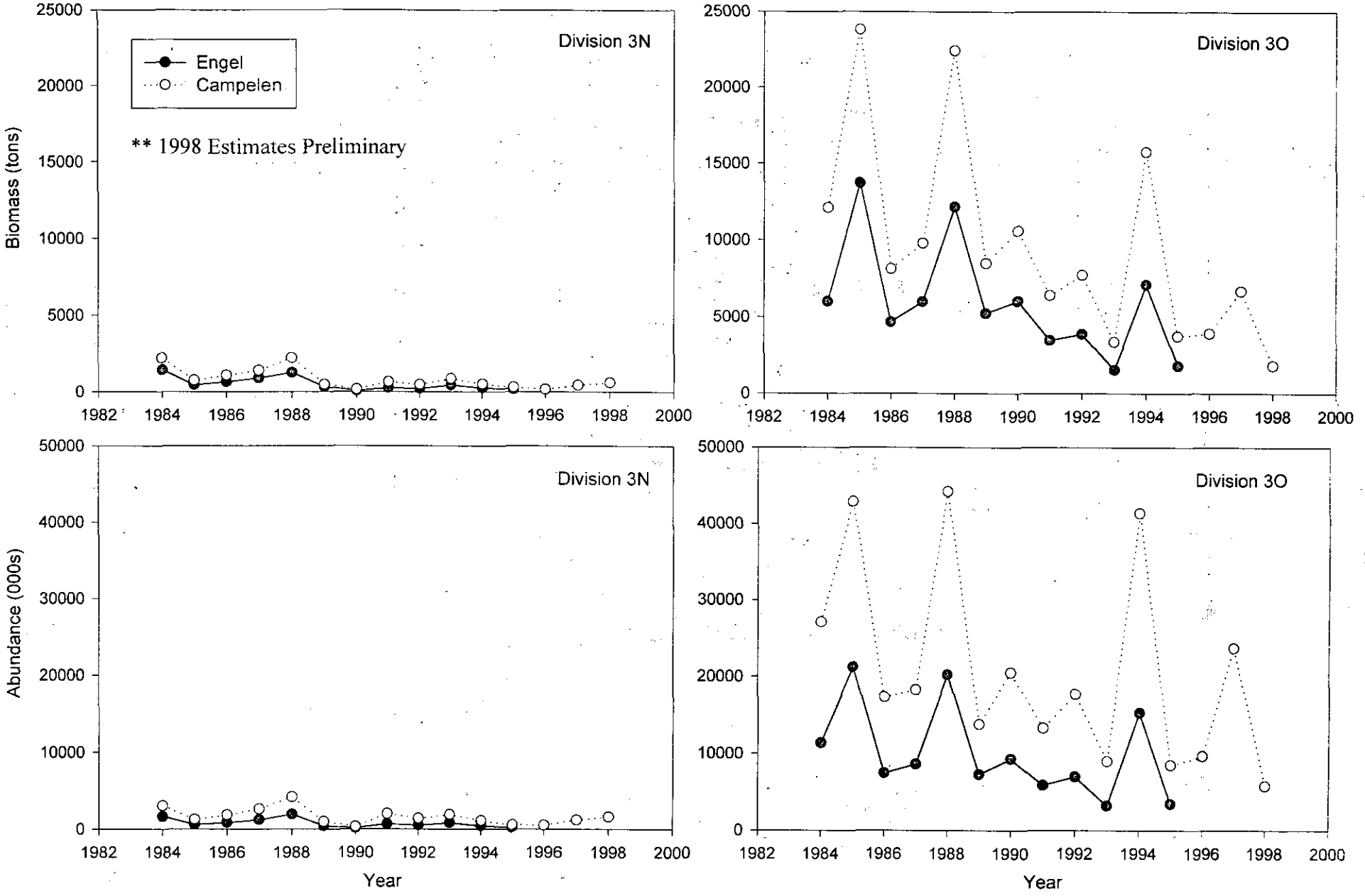


Fig. 2 Comparison of biomass (tons) and abundance estimates (000s) of witch flounder from Canadian spring surveys in Div. 3N and 3O during 1984-98

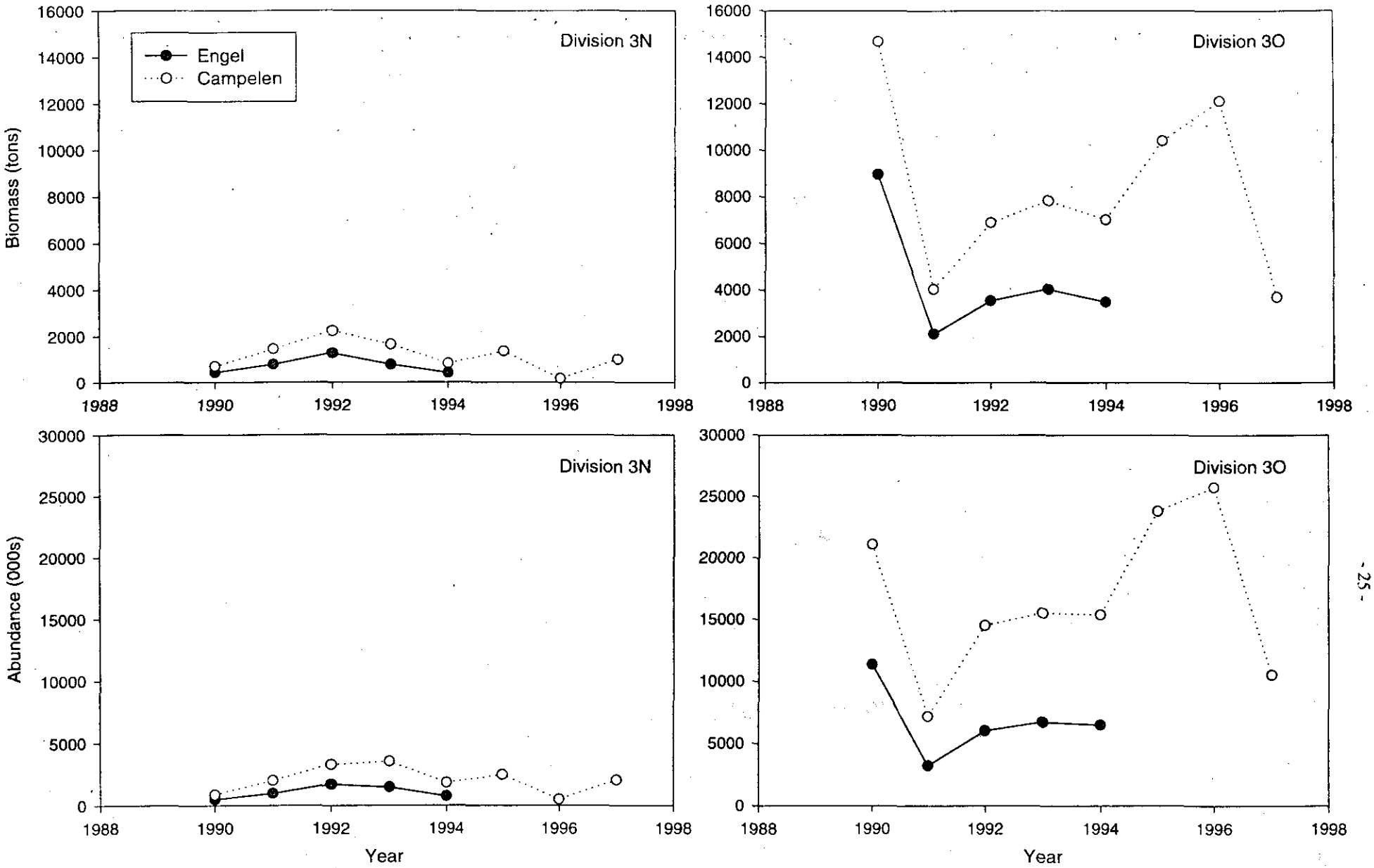


Fig. 3 Comparison of biomass (tons) and abundance estimates (000s) of witch flounder from Canadian fall surveys in Div. 3N and 3O during 1990-97.

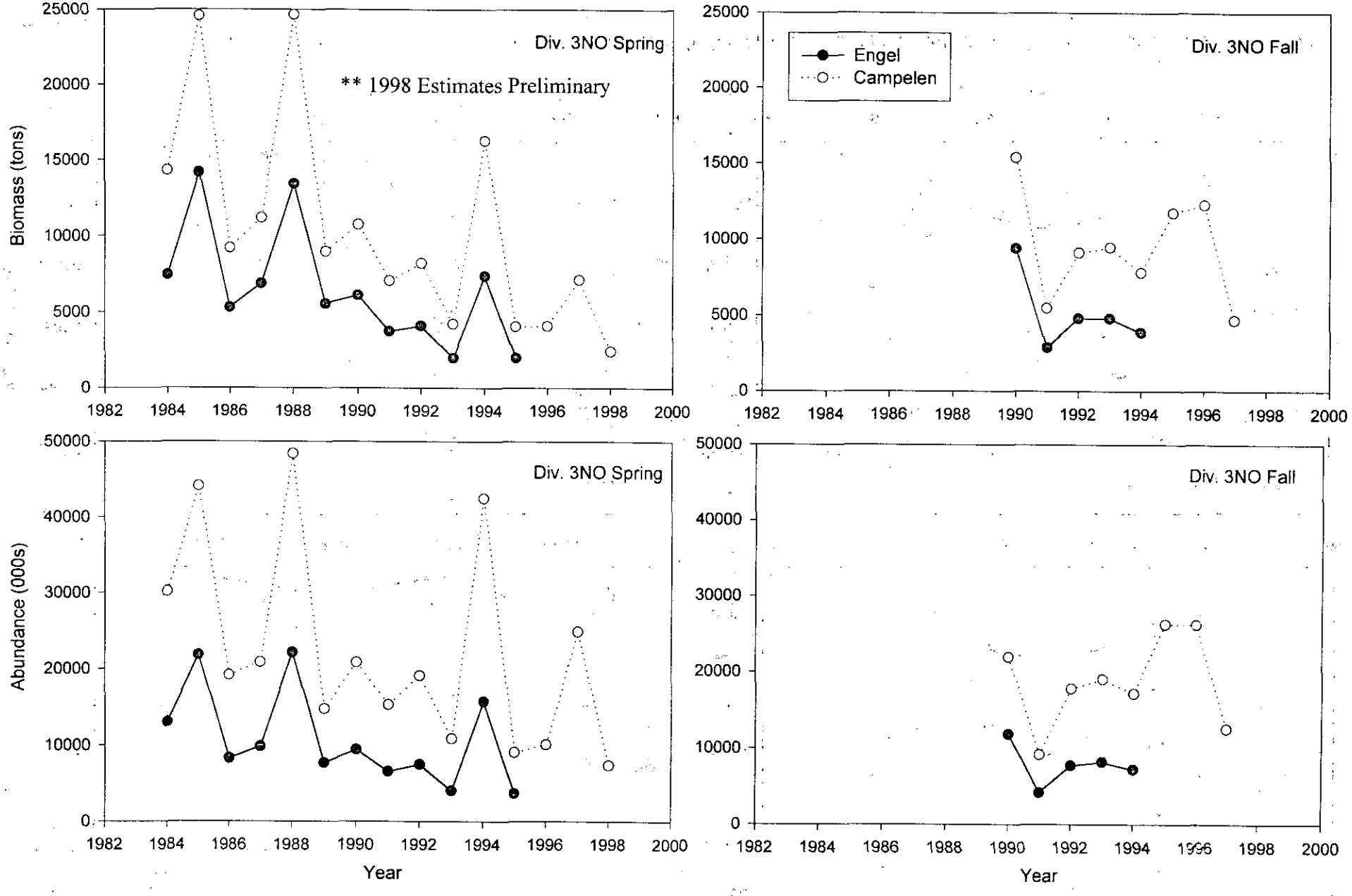


Fig. 4 Comparison of biomass (tons) and abundance estimates (000s) of witch flounder for converted versus unconverted data from Canadian spring (1984-98) and fall (1990-97) surveys in Div. 3NO combined..

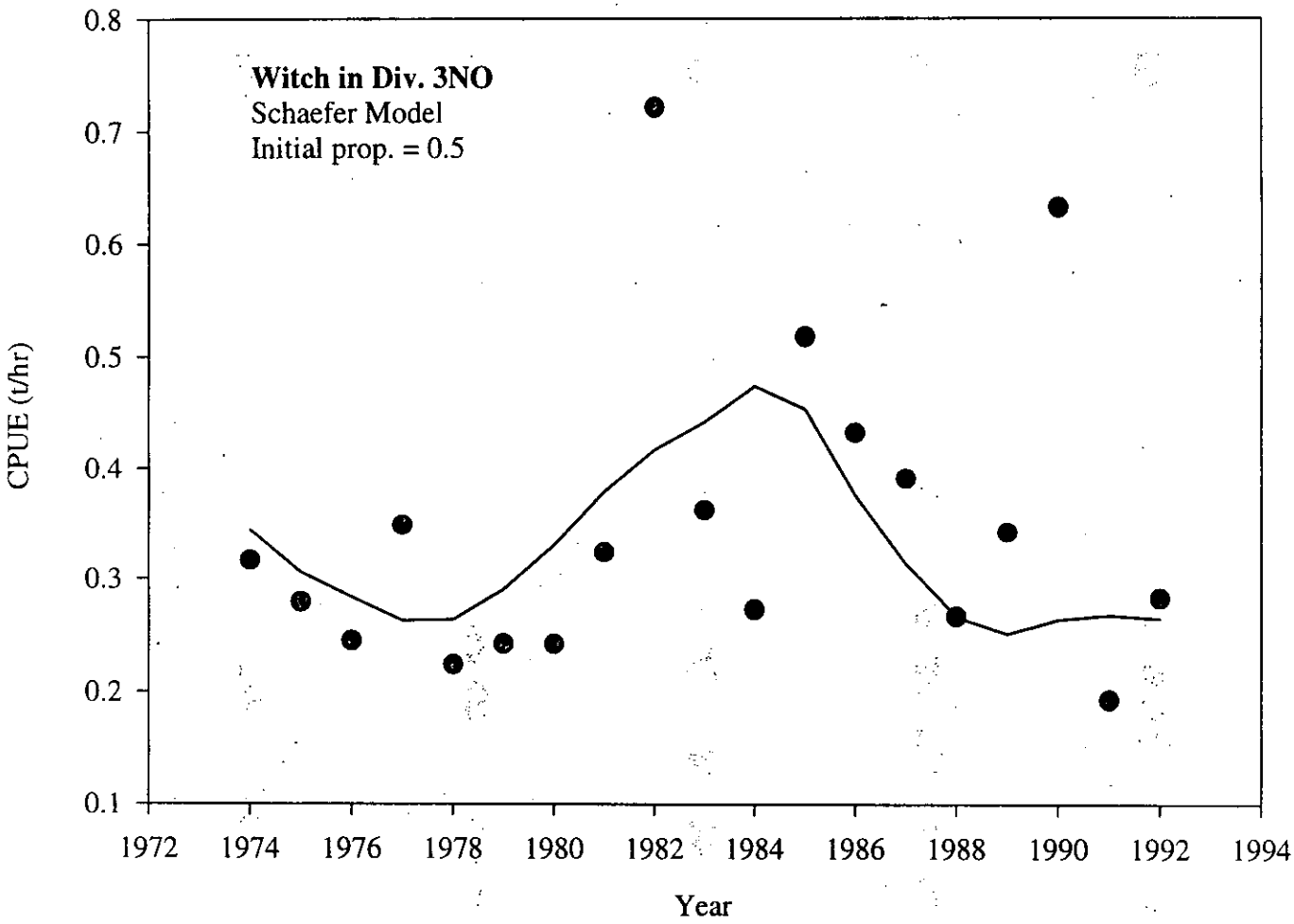


Fig. 5 Schaefer general production analysis using non linear least squares analysis for commercial standardized CPUE of witch flounder in Div. 3NO from 1974-92.

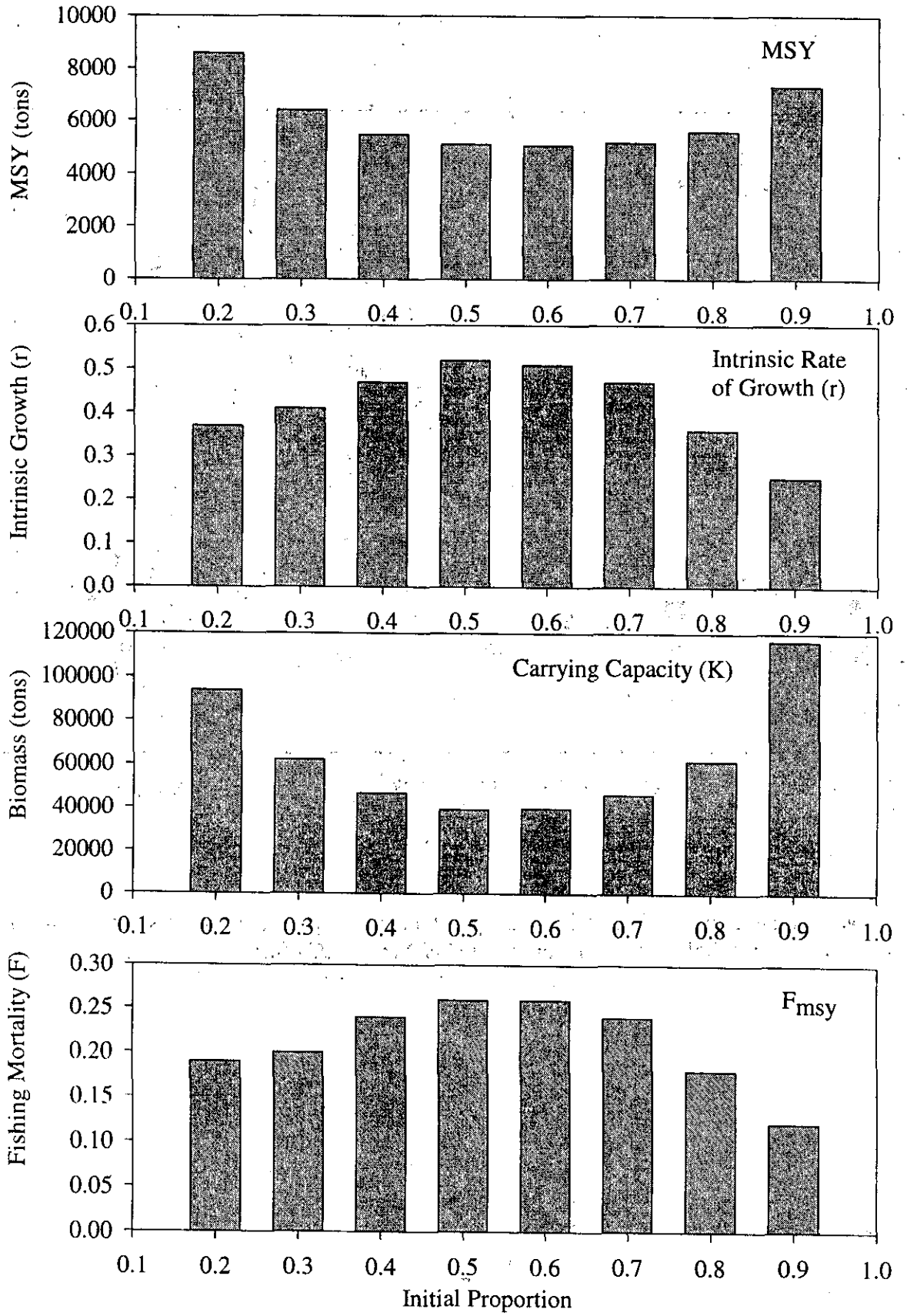


Fig. 6 Sensitivity analysis of the initial proportion parameter for Schaefer general production analysis on commercial catch rates of Div. 3NO witch flounder during 1974-92.

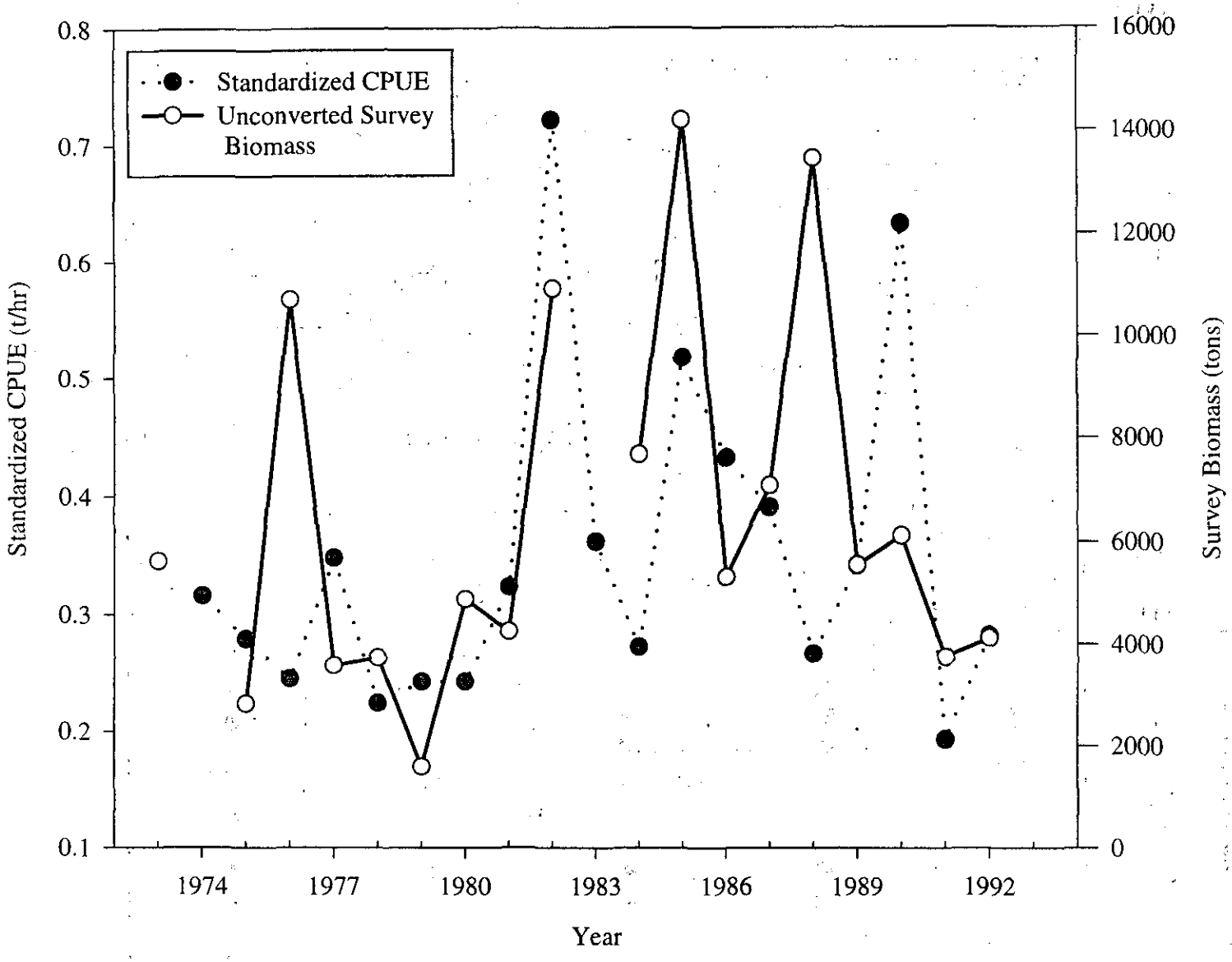
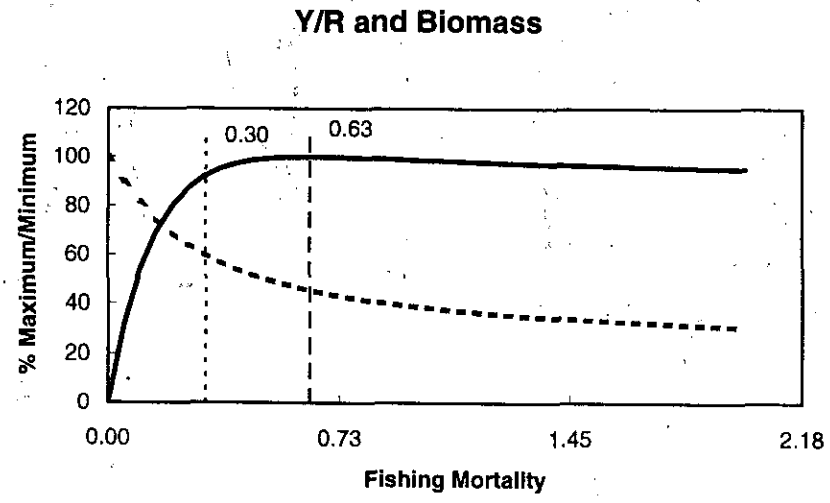


Fig. 7 A comparison of standardized commercial CPUE and unconverted biomass indices from the Canadian spring surveys in Div. 3NO during 1973-92.

Age	PR	Jan 1 Wt	MY Wt	Maturity	Sex Ratio
5	0.00	0.09	0.09	0.00	0.50
6	0.03	0.12	0.16	0.00	0.50
7	0.09	0.18	0.21	0.00	0.51
8	0.32	0.24	0.28	0.00	0.52
9	0.58	0.33	0.37	0.00	0.54
10	0.85	0.42	0.46	0.00	0.53
11	1.00	0.52	0.58	0.50	0.54
12	1.00	0.66	0.73	1.00	0.53
13	1.00	0.82	0.91	1.00	0.52
14	1.00	1.05	1.19	1.00	0.56
15	1.00	1.41	1.64	1.00	0.50



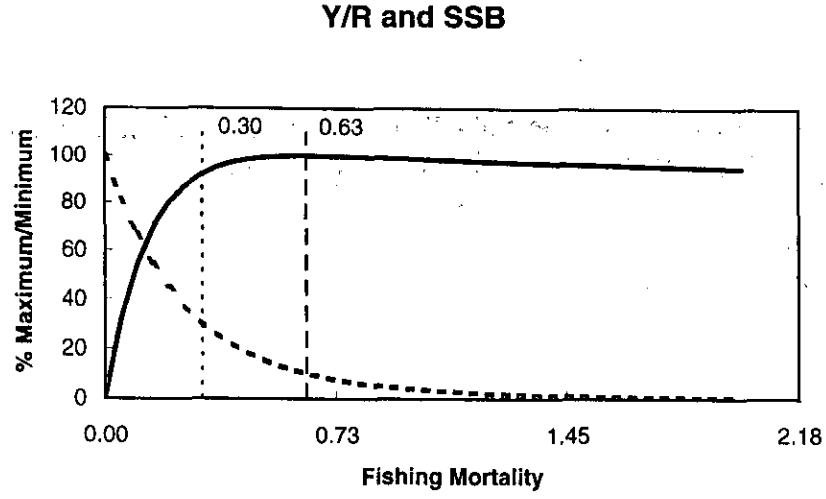


Fig. 8 Thompson and Bell yield per recruit analysis for witch flounder in Divisions 3NO. Variable estimates used in the analysis are shown in the text table above.

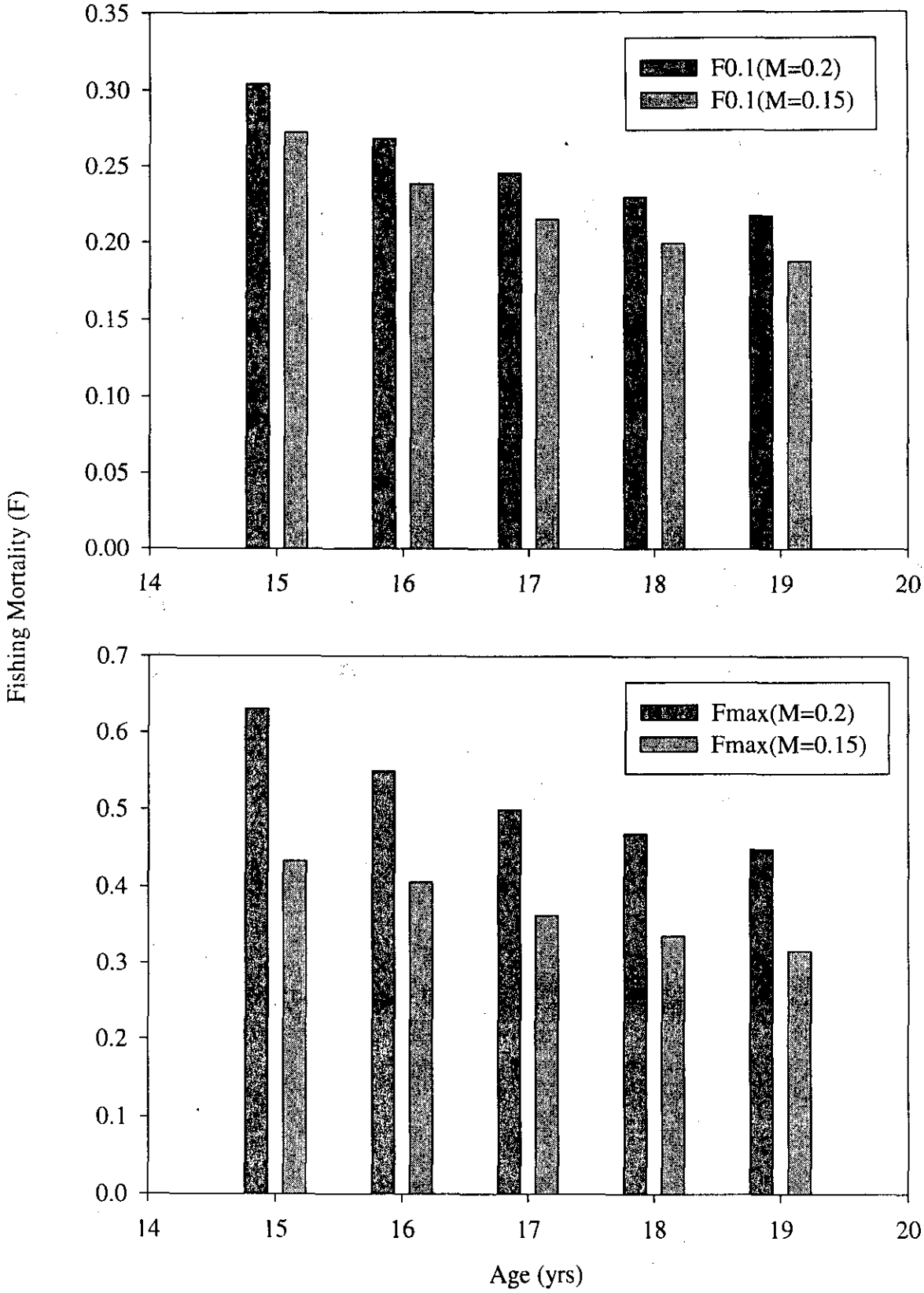


Fig. 9 Sensitivity analysis in yield per recruit for witch flounder in Div. 3NO by varying natural mortality (M) and maximum age.