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Survey Data Conversions for Witch Flounder in Div. 2J, 3K and 3L from Comparative Fishing Trials
between the *Engel* Otter Trawl and the *Campelen 1800* Shrimp Trawl

by

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Introduction

During 1995 the Canadian Department of Fisheries and Oceans, Science Branch, Newfoundland Region replaced its *Engel* bottom otter trawl with bobbin footgear used in groundfish surveys with a *Campelen 1800* shrimp trawl using rockhopper footgear. In order to ensure an orderly transition and maintain continuity with the older data time series, comparative-fishing trials were conducted in 1995 and 1996 to develop conversion factors between the old *Engel* fishing gear and the new *Campelen 1800* survey gear. Surveys conducted in Div. 2J and 3K were carried out with a somewhat different *Engel* trawl and different vessel than in Div. 3L. Therefore, two sets of trials were carried out and conversion factors developed accordingly. Six target species were investigated (one being witch flounder) because of their commercial significance and management requirements.

A thorough description of the experimental design and mathematical determinations can be found in Warren et al. (1997) and thus will not be described in detail here. The purpose of this paper is to illustrate the results of the conversion factors and the impact on length and age distribution as well as trends in stock size using the newly converted data time series similar to that presented for witch in Div. 3NO by Bowering and Orr (1998) (this meeting).

Materials and Methods

Length frequencies, standardized for towing distance, for witch flounder in NAFO Divisions 2J, 3K and 3L were converted from *Engel* trawl catches to *Campelen 1800* trawl catch equivalents for the years beginning in 1977 for Div. 2J, 1978 for Div. 3K and 1984 for Div. 3L (the year the *Engel* trawl was introduced as the standard survey trawl in the respective areas). The data were converted from fall surveys up to 1995 when the new *Campelen* trawl was introduced as the standard survey gear.. All subsequent surveys were actually carried out using the *Campelen 1800* trawl. Conversion factors as presented in Warren et al. (1996) for witch flounder in Div. 2J and 3K and Warren et al (1997) for Div. 3L were applied using weighted least squares as follows:

For the converted length y_i

$$y_i = \beta * n_i$$

where

$$\beta = e^a X_i^b e^{cx_i}$$

n_i = number at length in the set
 x_i = midpoint of length class

For Div. 2J and 3K data
 $a = 13.234150$, $b = -3.949935$ and $c = 0.0367427$
 $\beta = 5.44$ for $x_i < 24$ and $\beta = 0.68$ for $x_i > 49$

and for Div. 3L data

$a = 23.209213$, $b = -7.475675$ and $c = 0.11559$

$\beta = 8.41$ for $x_i < 24$ and $\beta = 0.75$ for $x_i > 49$

Weights were applied as the number of fishing sets used to estimate the ratio for a given length class.

After the length frequencies were converted to *Campelen* trawl catch equivalents they were summed to provide total numbers of witch flounder caught per standard *Campelen* set (0.8 nautical mile tow distance in 15 minutes with a wing spread of 16.84 m). Using various combinations of length-weight relationships available from surveys during the 1990's, the converted length frequencies were adjusted also to provide the total weights caught per standard *Campelen* set. The mean number and weight (kg) per set by stratum and year for converted data only for Divisions 2J, 3K and 3L independently are presented for detailed information purposes showing the numbers of fishing stations in each stratum and year. For surveys conducted in Div. 2J, 3K and 3L the data are shown in Tables 1-2, 3-4 and 5-6, respectively. No adjustments have been made for differences in revisions to the stratum areas over time. Abundance at length (cm) for Div. 2J, 3K and 3L are shown in Tables 7-12 for both unconverted and converted data, respectively. Similar information is available for age composition in Tables 13-18, inclusive.

Results and Discussion

For illustration, a comparison of the abundance at length between the converted and unconverted data sets is presented in Fig. 1-3 for Div. 2J, 3K and 3L, respectively with the age comparisons for these data displayed in Figures 4-6. Very few fish were caught with the *Engel* trawl less than 30 cm for any division therefore conversions below this length are not available. In the range of about 40-60 cm where most fish were caught there was a considerable increase in the numbers of fish when converted to *Campelen* units. For fish over 55 cm the differences diminished substantially. Few witch flounder were caught less than 6 years old in either of Div. 2J or 3L but were well represented at 4 and 5 years old in Div. 3K and resulted in relatively high converted numbers compared to the other divisions. Very few fish were caught beyond 12 years old and because of the shape of the conversion curve both the converted and unconverted older fish would be about the same.

The lack of small fish therefore in the converted data is most likely an expression of the inability of the *Engel* trawl to catch small witch flounder and should not be interpreted as small fish not being available in the stock although there is no way of knowing for certain. It is prudent, nevertheless, to treat the absence of small witch flounder in the converted frequencies as an indicator of recruitment prospects with considerable scepticism. Any observations on recruitment probably should be reserved until the *Campelen* survey series is long enough to put some faith in pre-recruit estimates without reliance on the historic time series.

References

- Bowering, W.R., and D.C. Orr. 1998. Results of Data Conversions for Witch Flounder in Divisions 3NO from Comparative Fishing Trials Between the *Engel* Otter Trawl and the *Campelen 1800* Shrimp Trawl used on research Vessels on the Southern Grand Bank. NAFO SCR Doc. 98/50, Ser. No. N3041: 23p.
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- Warren, W., W. Brodie, D. Stansbury, S. Walsh, J. Morgan, and D. Orr. 1997. Analysis of the 1996 Comparative Fishing Trials between the *Alfred Needler* with the *Engel 145* trawl and the *Wilfred Templeman* with the *Campelen 1800* trawl. NAFO SCR Doc. 97/68, Ser. No. N2902: 12p.

Warren, W. 1996. Report on the Comparative Fishing Trial between the *Gadus Atlantica* with the Engel 145 trawl and the *Teleost*. NAFO SCR Doc. 96/28, Ser. No. N2701: 16 p.

Table 7. Estimated abundance (000's) at length (cm) of Witch flounder from surveys in Div. 2J during fall 1977-1994 by the Gadus Atlantica (Unconverted data).

Year	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	
Length (cm)																			
6.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28.5	22	0	0	0	0	0	0	0	0	57	13	0	146	31	61	0	0	0	0
30.5	0	0	25	0	0	0	0	0	12	44	14	0	39	157	104	11	21	0	48
34.5	12	0	16	111	0	0	0	17	0	135	55	124	181	188	286	186	75	25	25
36.5	67	21	8	0	0	11	0	0	0	141	12	217	165	343	236	125	43	62	62
38.5	283	33	91	47	67	54	27	28	38	216	76	99	298	515	265	79	26	56	56
40.5	610	183	126	284	83	240	151	108	156	293	108	351	135	697	366	65	35	9	9
42.5	568	215	277	384	185	586	467	391	276	777	320	114	165	426	428	183	59	55	55
44.5	377	164	177	282	321	694	578	378	433	825	356	150	367	350	242	112	45	19	19
46.5	646	94	152	463	357	671	538	340	493	832	241	162	223	155	171	57	107	23	23
48.5	330	123	270	367	338	661	538	393	478	763	281	148	197	201	103	36	0	0	0
50.5	321	42	248	214	215	326	456	203	322	402	176	161	198	129	79	42	14	5	5
52.5	320	60	175	149	125	272	235	142	111	511	102	135	43	219	49	51	14	5	5
54.5	179	63	173	179	71	174	112	103	104	141	12	35	87	60	59	9	17	0	0
56.5	120	37	16	104	109	80	93	32	43	106	28	0	27	35	18	0	0	0	0
58.5	201	18	45	82	34	101	16	26	52	47	12	0	22	16	27	25	0	0	0
60.5	77	8	29	68	59	40	18	31	0	0	0	10	12	0	0	0	0	0	0
62.5	13	0	0	0	0	40	0	0	15	0	0	0	0	0	0	0	0	0	0
64.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
66.5	13	0	0	0	19	0	0	0	0	0	0	0	10	0	0	0	0	0	0
68.5	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
70.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
72.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total (000's)	4175	1086	1828	2634	1983	3951	3228	2221	2533	5362	1835	1416	2371	3702	2888	1958	670	547	547

Table 8 Estimated abundance (000's) at length (cm) of Witch flounder from surveys in Div. 3K during fall 1978-1994 by the Gadius Atlantica (Unconverted data).

Year	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
6.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8.5	0	0	0	0	0	0	0	0	0	16	0	0	0	0	0	0	0
10.5	0	0	0	0	0	15	0	0	0	0	0	0	0	6	0	0	0
12.5	0	0	0	0	0	42	0	13	36	15	0	0	18	0	0	44	0
14.5	0	0	0	0	0	15	11	0	0	0	0	0	18	75	0	169	12
16.5	10	0	14	0	0	0	0	0	0	0	18	0	0	0	0	0	0
18.5	0	0	0	0	13	14	79	25	18	59	68	0	0	0	21	31	111
20.5	0	0	52	15	13	30	67	64	18	120	34	158	0	30	109	37	53
22.5	19	30	130	33	36	91	166	108	101	0	180	149	0	36	78	98	7
24.5	63	112	34	182	71	44	103	602	444	0	471	235	68	30	60	137	31
26.5	20	89	106	352	148	313	531	872	192	44	558	267	51	15	36	34	39
28.5	631	179	264	135	339	196	485	563	642	268	102	684	133	77	40	38	76
30.5	1182	356	296	360	467	388	505	1282	667	312	60	312	223	143	22	80	0
32.5	1523	1284	222	503	566	715	388	806	515	698	288	123	535	228	38	31	53
34.5	1844	2542	681	704	704	1240	818	460	339	713	397	193	555	257	81	107	33
36.5	1854	3097	2086	1136	764	1244	1325	686	201	733	699	102	515	291	10	126	72
38.5	1650	2922	3630	2011	1092	1432	1586	838	383	558	771	270	1107	137	131	58	37
40.5	3396	4050	3962	4502	2204	2445	2712	1936	755	817	541	222	1519	296	163	106	76
42.5	3603	5638	5541	6066	4100	4951	4948	3715	1656	1853	1122	502	1887	347	148	143	40
44.5	2192	5960	4116	4545	3912	6034	6201	5095	3422	2551	1735	873	1823	287	169	120	86
46.5	1840	4515	5074	4399	3636	5233	5762	4416	2591	2219	2073	670	1388	349	269	104	74
48.5	1658	3769	3529	4089	2992	4661	5162	3722	2051	2346	1688	828	1411	429	53	71	67
50.5	1332	2683	2735	2546	2301	3805	3995	2919	1707	1747	1566	647	1465	257	51	100	0
52.5	1314	2114	2062	2222	1343	3164	2638	1502	1324	1409	1069	539	860	267	157	7	33
54.5	935	1630	1629	1328	869	2100	1596	1015	712	869	512	354	812	154	51	27	27
56.5	885	1199	1133	1270	898	1617	1201	588	387	491	534	302	468	127	35	0	0
58.5	609	772	931	679	562	872	785	395	345	384	339	168	182	54	0	0	0
60.5	442	532	552	481	344	583	572	196	192	184	229	100	148	5	0	0	0
62.5	166	377	274	201	207	385	387	119	49	63	242	37	103	6	0	0	0
64.5	25	119	75	51	60	123	124	24	0	11	0	0	31	0	0	0	0
66.5	40	73	34	54	29	77	26	0	0	0	0	0	0	0	0	0	0
68.5	5	0	0	14	0	0	26	0	0	0	0	0	22	0	0	0	0
70.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
72.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total (000s)	27239	44041	39163	37879	27590	41827	42197	31958	18746	18479	15296	7734	15342	3904	1731	1668	924

Table 9 Abundance (000's) at length (cm) of Witch flounder from surveys in Div. 3L during fall 1984 - 1994 by the Wilfred Templeman and Alfred Needler (Unconverted data).											
Year	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
Length (cm)											
6.5	0	0	0	0	0	0	0	0	0	0	0
8.5	0	0	0	0	0	0	0	0	0	0	0
10.5	0	0	0	0	0	0	0	0	0	0	0
12.5	0	0	0	0	0	0	0	0	0	0	0
14.5	0	13	0	0	0	0	0	0	0	0	0
16.5	0	0	0	0	0	0	0	0	0	0	0
18.5	0	0	0	0	0	0	0	0	0	0	0
20.5	0	13	0	0	0	0	0	0	0	0	2
22.5	72	0	0	0	0	0	18	0	5	0	0
24.5	46	0	0	0	0	0	0	0	0	9	2
26.5	7	0	24	0	0	0	82	9	25	11	7
28.5	82	28	7	0	0	0	79	38	33	52	38
30.5	82	8	16	0	13	0	48	15	29	0	24
32.5	22	8	7	0	0	15	174	91	32	0	8
34.5	111	8	40	27	13	47	66	127	28	44	12
36.5	135	32	14	27	42	15	96	80	22	9	18
38.5	241	228	119	67	87	46	46	99	74	5	17
40.5	516	269	400	422	332	260	242	198	115	17	58
42.5	960	712	735	491	548	370	561	313	207	33	54
44.5	906	782	592	730	1023	817	740	331	314	57	69
46.5	943	810	1202	1427	1274	721	1120	686	314	68	49
48.5	934	741	1242	914	944	734	1177	549	436	79	43
50.5	902	752	954	681	914	542	834	383	261	90	53
52.5	770	520	837	441	587	380	801	354	216	26	27
54.5	653	172	538	363	201	175	428	204	118	29	26
56.5	527	181	181	413	189	186	249	91	26	0	2
58.5	290	43	163	123	83	111	146	50	28	12	2
60.5	151	56	91	18	85	47	90	53	9	0	0
62.5	87	36	71	0	55	32	39	9	0	7	0
64.5	36	0	27	0	0	0	0	0	0	0	0
66.5	10	12	0	0	0	0	0	0	0	0	0
68.5	0	0	0	0	15	0	0	0	0	0	0
70.5	0	0	0	0	0	0	0	12	0	0	0
72.5	0	0	0	0	0	0	0	0	0	0	0
Total (000s)	8481	5424	7260	6146	6406	4500	7037	3692	2291	547	510

Table 10 Abundance estimates (000s) of Witch Flounder (M+F) from surveys during fall 1977-1997 in Div. 2J by the research vessel Gadus Atlantica (Engel 145 data converted to Campelen Units for 1977-94)

Year	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997		
Length (cm)	6.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	8.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	10.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	12.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	14.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	16.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	18.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	20.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	22.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	24.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	26.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	28.5	127	0	0	0	0	0	0	0	312	71	0	778	168	337	0	0	0	0	0	170	11	0
	30.5	0	91	0	0	0	0	0	46	162	52	0	143	638	448	42	90	183	161	279	216	0	
	32.5	0	0	0	0	0	0	0	0	260	104	98	203	660	1426	194	201	51	36	183	289	0	
	34.5	46	0	58	39	0	0	61	0	440	203	425	599	610	895	576	236	90	38	63	204	0	
	36.5	125	39	15	0	19	0	0	0	325	23	425	318	836	592	245	91	131	100	68	25	0	
	38.5	583	60	196	86	124	50	70	69	468	162	197	675	1215	592	173	58	136	10	84	117	0	
	40.5	1186	348	231	521	152	440	276	306	568	198	63	247	1387	735	120	64	17	10	0	38	0	
	42.5	1052	394	508	704	339	1074	829	505	1424	587	208	303	781	785	335	108	102	13	84	153	0	
	44.5	657	300	323	517	588	1214	959	662	750	629	275	631	638	428	204	79	34	64	28	13	0	
	46.5	959	161	278	811	578	1052	792	566	1304	418	297	408	237	252	104	183	42	10	62	13	0	
	48.5	517	186	372	540	429	956	735	648	1081	377	255	326	258	147	67	0	17	0	0	0	0	
	50.5	444	76	310	338	307	487	604	446	501	254	264	295	189	99	78	26	9	0	0	50	0	
	52.5	442	110	275	235	183	440	355	158	715	163	174	63	306	45	94	26	9	0	0	0	0	
	54.5	257	116	193	271	130	262	176	168	196	23	48	143	95	80	16	27	0	0	0	0	0	
	56.5	197	34	29	181	155	110	124	79	169	52	0	49	64	16	0	0	0	0	0	0	0	
	58.5	329	33	82	134	62	181	29	95	56	23	0	41	29	33	46	0	0	0	0	0	0	
	60.5	119	15	53	126	108	73	33	57	0	0	19	23	0	0	0	0	0	0	0	0	0	
	62.5	25	0	0	0	0	56	0	28	0	0	0	0	0	0	0	0	0	0	0	0	0	
	64.5	0	0	0	0	0	0	56	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	66.5	18	0	0	0	35	0	0	0	0	0	0	19	0	0	0	0	0	0	0	0	0	
	68.5	25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	70.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	72.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Total (000's)	7106	1962	3016	4503	3190	6486	4963	3840	4089	9432	3337	2746	5263	8110	6941	2463	2588	2369	1808	1724	1890		

Table 11 Abundance estimates (000s) of Witch Flounder (M+F) collected during fall 1978-1997 in Div. 3K by the research vessel Gadus Atlantica (Engel 145 data converted to Campelen Units for 1978-94).

Year	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	
Length (cm)																					
6.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	53.6	0	0
8.5	0	0	0	0	0	0	0	0	0	239	0	0	0	0	0	0	0	0	0	0	0
10.5	0	0	0	0	0	217	0	0	0	0	0	0	0	91	0	0	0	0	41	50	20
12.5	0	0	0	0	0	612	0	186	521	217	0	0	261	0	0	650	0	218	131	577	
14.5	0	0	0	0	0	217	163	0	0	0	0	0	261	1096	0	2426	173	656	96	1141	
16.5	144	0	208	0	0	0	0	0	0	0	261	0	0	0	0	0	0	262	69	0	
18.5	0	0	0	0	186	199	1163	372	261	872	1002	0	0	0	304	460	1626	38	196	150	
20.5	0	0	761	217	186	434	977	934	261	1753	499	2292	0	441	1594	540	780	80	128	171	
22.5	212	326	1433	364	393	999	1804	1186	1077	0	1921	1585	0	399	855	1075	74	730	170	184	
24.5	481	822	252	1388	547	353	776	4811	3472	0	3650	1837	500	220	438	1007	224	354	406	151	
26.5	150	651	747	2431	1012	2157	3627	5801	1257	323	3754	1928	371	110	266	246	270	347	928	183	
28.5	3388	984	1453	742	1839	1077	2646	3023	3431	1471	558	3712	721	426	217	207	415	118	998	551	
30.5	4883	1414	1165	1490	1938	1555	2072	5394	2802	1186	220	1222	911	523	82	319	0	142	406	598	
32.5	5581	4708	813	1845	2073	2593	1422	2943	1858	2558	1055	450	1956	836	139	113	195	121	459	616	
34.5	5898	7991	2225	2244	1979	3846	2646	1593	1127	2242	1281	676	1804	815	278	367	121	34	272	364	
36.5	4635	7860	5186	2734	1858	2967	3126	1618	415	1800	1607	226	1165	635	19	256	149	0	265	163	
38.5	3859	6678	8434	4653	2446	3246	3603	1870	726	1244	1806	591	2602	270	303	130	67	29	156	93	
40.5	6659	7919	7813	8869	4320	4705	5206	3728	1472	1552	992	420	3027	543	299	196	138	101	83	185	
42.5	6585	10333	10096	11092	7511	9063	9068	6808	3045	3396	2045	921	3441	636	271	263	72	67	102	140	
44.5	3833	10033	7014	7573	6626	10159	10329	8611	5728	4368	2993	1457	2994	516	310	221	158	36	95	158	
46.5	2984	6929	7743	6715	5763	7905	8842	6745	4023	3467	3196	1110	2098	621	429	166	135	36	68	55	
48.5	2311	4924	4691	5569	4050	6226	6718	5055	2846	3344	2338	1147	1945	623	97	105	123	37	0	85	
50.5	1905	3586	3495	3478	3102	4710	5189	3854	2251	2359	2082	920	1887	294	93	135	0	0	0	104	
52.5	1741	3045	2736	2837	1849	4051	3455	2164	1745	1944	1465	760	1084	375	224	12	61	0	0	0	
54.5	1326	2330	2357	1862	1358	2790	2242	1547	1076	1209	738	569	1036	274	94	24	33	29	0	25	
56.5	1281	1697	1576	1692	1237	2292	1556	882	539	708	764	439	615	183	64	0	0	25	0	0	
58.5	842	1049	1248	1020	852	1128	1140	657	573	610	515	253	211	99	0	0	0	0	0	0	
60.5	689	746	812	654	520	859	851	362	318	310	335	152	202	9	0	0	0	0	4	0	
62.5	236	605	412	369	339	586	612	195	94	87	408	67	149	11	0	0	0	0	0	0	
64.5	47	190	138	94	110	202	227	44	0	20	0	0	57	0	0	0	0	0	0	0	
66.5	49	133	63	100	53	117	47	0	0	0	0	0	0	0	0	0	0	0	0	0	
68.5	9	0	0	26	0	0	47	0	0	0	0	0	40	0	0	0	0	0	0	0	
70.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
72.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Total (000s)	59729	84955	72872	70058	52146	75267	79553	70384	40917	37279	35486	22734	29338	10045	6377	8918	4815	3553	5081	5716	

Table 12 Abundance (000's) at length (cm) of Witch flounder (M+F) from surveys in Div. 3L during fall of 1984-1997 by the research vessels Alfred Needler and Wilfred Templeman (Engel data converted to Campelen units for 1984-94).

Year	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Length (cm)														
6.5	0	0	0	0	0	0	0	0	0	0	0	0	0	51
8.5	0	0	0	0	0	0	0	0	0	0	0	39	58	157
10.5	0	0	0	0	0	0	0	0	0	0	0	0	184	336
12.5	0	0	0	0	0	0	0	0	0	0	0	0	167	375
14.5	0	190	0	0	0	0	0	0	0	0	0	89	102	172
16.5	0	0	0	0	0	0	0	0	0	0	0	82	113	123
18.5	0	0	0	0	0	0	0	0	0	0	0	11	58	118
20.5	0	190	0	0	0	0	0	0	0	0	23	28	125	154
22.5	1059	0	0	0	0	0	263	0	79	0	0	94	192	65
24.5	675	0	0	0	0	0	0	0	0	128	23	72	278	180
26.5	75	0	278	0	0	0	907	95	274	124	77	58	448	169
28.5	622	206	60	0	0	0	618	294	245	381	286	44	479	114
30.5	471	45	88	0	71	0	264	84	161	0	133	26	410	312
32.5	122	45	36	0	0	84	892	455	177	0	45	27	235	478
34.5	407	30	147	99	48	172	241	463	101	163	44	0	326	262
36.5	473	115	48	74	155	56	321	255	81	32	65	21	247	151
38.5	519	552	329	122	159	84	84	225	145	9	31	26	285	163
40.5	1044	514	797	906	686	533	482	405	210	31	117	25	186	340
42.5	1799	1353	1403	934	1056	677	1062	602	379	60	99	33	219	89
44.5	1659	1434	1033	1338	1876	1497	1356	607	575	104	126	31	394	191
46.5	1703	1427	2008	2385	2155	1204	1901	1146	576	125	87	36	266	123
48.5	1519	1250	2004	1489	1549	1202	1873	879	675	124	79	94	149	83
50.5	1456	1249	1513	988	1416	848	1331	602	421	166	95	45	169	87
52.5	1298	908	1340	709	947	631	1250	584	335	39	46	67	119	12
54.5	1116	315	862	537	368	321	680	341	200	53	44	22	67	48
56.5	892	310	306	658	347	341	424	164	47	0	4	33	0	19
58.5	484	79	281	226	152	204	268	91	50	21	4	0	12	0
60.5	277	102	132	34	155	87	165	97	17	0	0	0	11	0
62.5	160	66	125	0	100	60	72	17	0	12	0	0	0	0
64.5	67	0	49	0	0	0	0	0	0	0	0	0	0	0
66.5	17	21	0	0	0	0	0	0	0	0	0	0	0	0
68.5	0	0	0	0	28	0	0	0	0	0	0	0	0	0
70.5	0	0	0	0	0	0	0	21	0	0	0	0	0	0
72.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total (000's)	17914	10401	12839	10500	11269	8002	14453	7428	4748	1572	1428	1004	5297	4373

Table 13 Abundance (000's) at age of Witch flounder from surveys in Div. 2J during fall 1977-1993 by the Gadus Atlantica (Unconverted data).

Year	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
Age 0	53	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	60
4	7	0	9	0	0	0	0	0	0	0	0	0	0	0	4	0	79
5	11	20	30	0	0	0	0	1	8	141	20	5	135	127	155	31	51
6	25	33	113	12	7	41	0	11	4	280	71	134	269	376	662	249	130
7	184	218	411	307	228	837	199	98	128	915	152	313	533	1179	668	227	62
8	585	295	346	739	653	1581	821	455	696	1667	476	229	504	903	632	254	98
9	836	181	353	643	583	898	1109	659	874	1348	549	245	439	418	347	104	74
10	595	136	328	471	300	384	731	552	509	686	354	246	262	332	210	77	41
11	850	101	168	248	132	195	310	282	225	277	150	182	153	254	131	62	46
12	518	66	51	132	58	11	45	106	76	39	55	58	66	94	67	44	14
13	237	23	13	70	18	0	7	48	9	4	3	0	6	14	6	6	9
14	99	4	0	7	0	0	2	4	0	0	1	0	0	0	0	0	0
15	91	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	77	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
unk	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total (000s)	4168	1079	1822	2629	1979	3947	3224	2216	2529	5357	1831	1412	2367	3697	2882	1054	664

Table 14 Abundance (000's) at age of Witch flounder from surveys in Div. 3K during fall 1978-1993 by the Gadus Atlantica (Unconverted data).

Year	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
Age																
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	35	0	0	0	17	0	0	213
2	0	0	0	0	0	71	0	12	17	16	0	0	17	80	0	31
3	19	52	230	14	19	13	145	78	58	0	0	0	0	15	75	142
4	597	456	202	605	476	155	370	469	565	179	235	341	45	85	191	130
5	3110	3768	371	996	1338	815	1440	2651	1588	442	1070	1152	391	187	91	128
6	3437	6579	1404	1774	1685	1795	1756	1971	873	1427	826	591	929	526	112	195
7	4937	10918	8592	8310	6592	4550	3157	2185	2222	1697	1574	551	2471	567	209	174
8	4922	8763	10388	11598	8763	9291	7593	8196	5256	3307	2444	1225	3399	542	343	224
9	2930	5184	7393	7447	4960	10847	10312	8269	4281	4403	2863	1371	2441	547	249	130
10	2519	3927	5396	4342	2173	7644	8850	4732	2311	3522	2630	1086	2279	594	181	104
11	2094	2499	2685	1831	1444	4639	5016	2349	1169	2152	2000	925	2029	482	143	111
12	1392	1334	1434	832	117	1492	2564	914	339	1128	1561	420	899	246	121	67
13	819	519	900	109	19	455	917	126	24	152	87	66	407	26	0	12
14	284	36	141	0	0	54	70	0	0	23	0	0	11	0	0	0
15	154	0	19	0	0	0	0	0	0	0	0	0	0	0	0	0
16	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
unk	0	0	0	14	0	0	0	0	0	25	0	0	0	0	0	0
Total (000s)	27232	44035	39155	37872	27586	41821	42190	31952	18738	18473	15290	7728	15335	3897	1715	1661

Table 15 Abundance at age (000's) of Witch flounder from surveys in Div. 3L during fall 1984-1993 by Wilfred Templeman and Alfred Needler (Unconverted data).										
Year	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
Age										
0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0
2	0	12	0	0	0	0	0	0	0	0
3	0	10	0	0	0	0	0	0	0	2
4	116	2	11	0	0	0	0	2	5	12
5	162	32	41	1	3	0	197	57	79	33
6	195	37	65	23	24	52	228	204	70	51
7	503	375	828	275	297	241	305	289	143	35
8	1318	1412	1880	1118	1232	1097	1100	506	426	65
9	1787	1586	2154	1776	1682	1289	1440	778	378	74
10	1790	1105	1325	1475	1514	893	1595	854	520	67
11	1406	590	692	955	1040	623	1354	637	443	98
12	894	220	215	451	586	260	588	301	215	71
13	284	35	45	54	23	40	198	59	6	16
14	21	0	0	12	0	0	9	0	0	11
15	0	0	0	0	0	0	0	0	0	6
16	0	0	0	0	0	0	0	0	0	0
unk	0	0	0	0	0	0	17	0	0	0
Total (000s)	8476	5416	7256	6140	6401	4495	7031	3687	2285	541

Table 16 Abundance estimates (000's) for Witch flounder (M+F) at age collected during fall 1977 - 1993 in Division 2J by the research vessel Gadius Atlantica (Engel 145 data converted to Campelen units)

Year	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
Age 0	96	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	589
4	42	2	36	0	0	0	0	0	0	0	0	0	0	0	0	33	659
5	57	70	101	0	0	1	0	6	30	615	94	18	695	537	709	199	248
6	90	73	240	37	12	85	0	43	15	813	252	416	926	1332	2292	753	444
7	368	407	759	568	418	1529	357	199	244	1767	341	678	1168	2759	1558	501	135
8	1140	543	596	1327	1113	2583	1368	819	1211	2809	863	427	922	1734	1201	468	184
9	1537	312	495	1073	850	1351	1658	1124	1347	2004	905	439	755	710	586	190	131
10	963	226	440	743	443	595	1041	910	741	975	547	407	419	494	308	142	73
11	1269	177	237	398	211	322	449	455	347	385	234	272	246	369	163	113	80
12	744	104	83	216	105	16	71	184	133	52	89	86	116	146	80	82	25
13	362	33	24	123	33	0	11	88	17	7	5	0	12	24	7	11	15
14	160	6	0	12	0	0	3	7	0	0	1	0	0	1	0	0	0
15	145	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	127	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total (000's)	7100	1958	3011	4497	3185	6482	4958	3835	4085	9427	3331	2743	5259	8106	6937	2459	2583

Table 17 Estimates of abundance (000's) at age for Witch flounder (M+F) collected in Division 3K during fall 1978 - 1993 by the research vessel Gadus Atlantica (Engel data converted to Campelen units).

Year	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
Age																
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	521	0	0	0	260	0	0	3076
2	0	0	0	0	1045	0	186	260	238	238	0	0	260	1186	0	460
3	250	490	2653	217	279	199	2140	1150	691	0	0	0	0	220	1101	1549
4	3096	2535	1224	4222	3049	1673	3334	4121	4485	2624	2862	4105	333	867	2089	1079
5	12046	12458	1590	4027	5376	4279	7581	14741	7577	2119	7873	7065	1905	854	541	613
6	9903	16114	4415	4899	4322	6010	5415	6963	2853	4963	3216	2376	3305	1755	392	649
7	10161	20308	18851	16582	12515	9963	6846	4488	4104	4089	3625	1207	5702	1224	468	398
8	9101	14073	18485	19646	14163	16337	13624	14281	8602	5936	4439	2162	6148	993	628	424
9	4778	7192	11098	10612	6919	16452	16172	12651	6259	6963	4484	2134	3845	931	420	223
10	3650	5496	7267	5858	3145	10283	12654	6698	3255	5130	3777	1577	3178	875	303	172
11	2894	3515	3732	2516	2137	6164	6716	3421	1715	3047	2770	1361	2663	707	231	167
12	1986	1919	1980	1264	200	2107	3568	1465	552	1663	2294	640	1148	382	199	90
13	1183	784	1328	183	35	671	1387	213	37	228	141	102	572	46	0	12
14	425	66	213	0	0	78	111	0	0	35	0	0	13	0	0	0
15	225	0	29	0	0	0	0	0	0	0	0	0	0	0	0	0
16	25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total (000's)	59723	84950	72865	70026	52140	75261	79548	70378	40911	37035	35481	22729	29332	10040	6372	8912

Table 18 Estimated abundance (000's) at age for Witch flounder (M+F) collected in Division 3L during fall 1984 - 1993 by the research vessel Wilfred Templeman. (Engel data converted to Campelen units).										
Year	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
Age										
0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0
2	0	190	0	0	0	0	0	0	0	0
3	0	158	0	0	0	0	0	0	0	37
4	1689	31	126	0	0	0	0	23	79	158
5	1111	222	318	6	19	0	1611	425	634	247
6	806	167	230	74	107	217	1211	876	333	240
7	1147	825	1667	595	657	508	781	730	308	156
8	2513	2646	3271	2098	2307	2016	2030	969	782	126
9	3178	2783	3526	3007	2901	2186	2456	1335	682	130
10	3047	1893	2142	2385	2493	1462	2586	1395	853	119
11	2354	1024	1121	1491	1701	1065	2166	1047	702	170
12	1531	392	353	732	1036	469	975	515	360	123
13	496	64	81	87	42	74	351	108	12	28
14	36	0	0	21	0	0	16	0	0	21
15	0	0	0	0	0	0	0	0	0	12
16	0	0	0	0	0	0	0	0	0	0
unk	0	0	0	0	0	0	263	0	0	0
Total (000's)	17908	10395	12835	10496	11263	7997	14446	7423	4745	1567

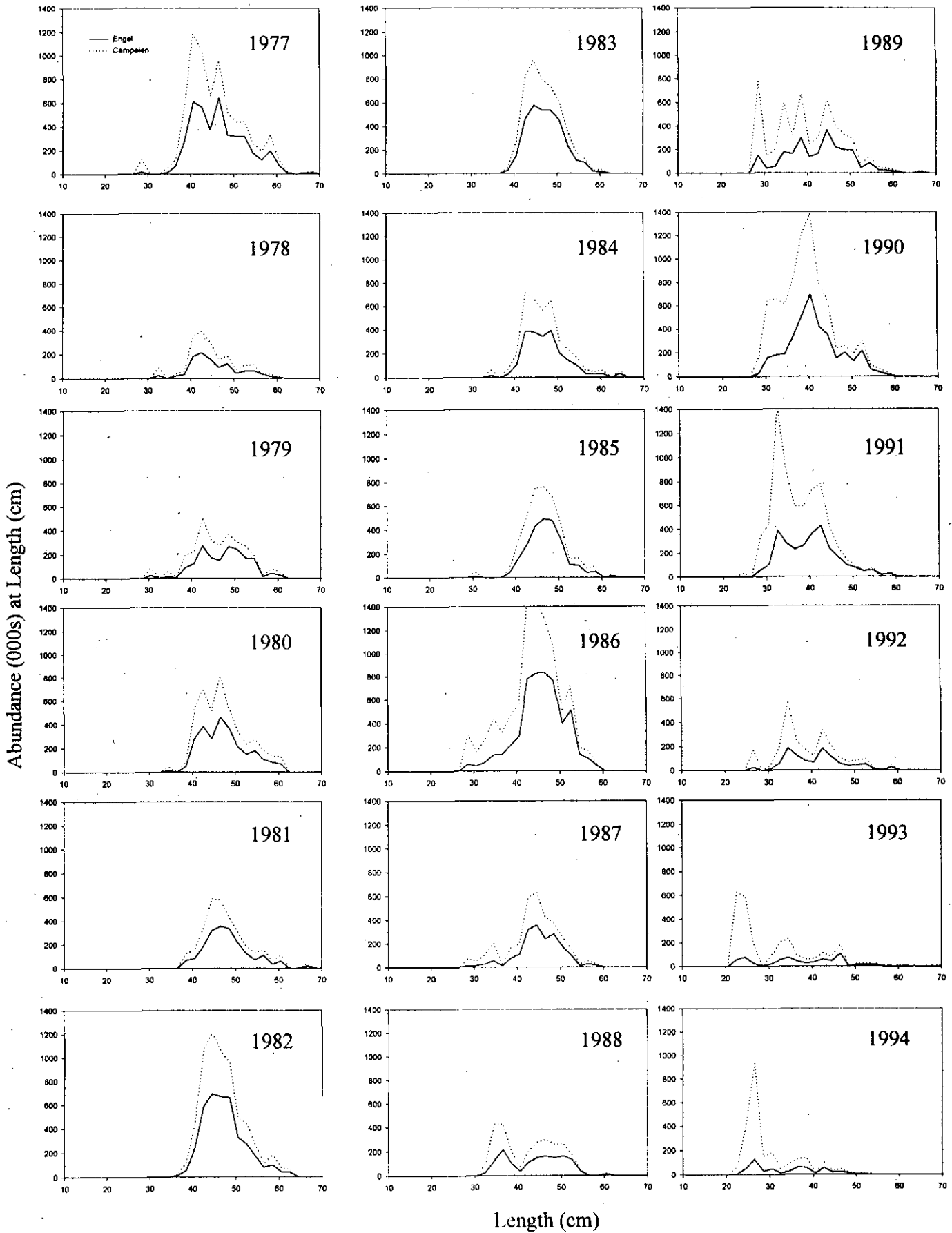


Fig. 1 Comparative length distributions (cm) between Engel trawl catches and Campelen trawl catch equivalents of witch flounder from Canadian fall surveys in Div. 2J during 1977-94.

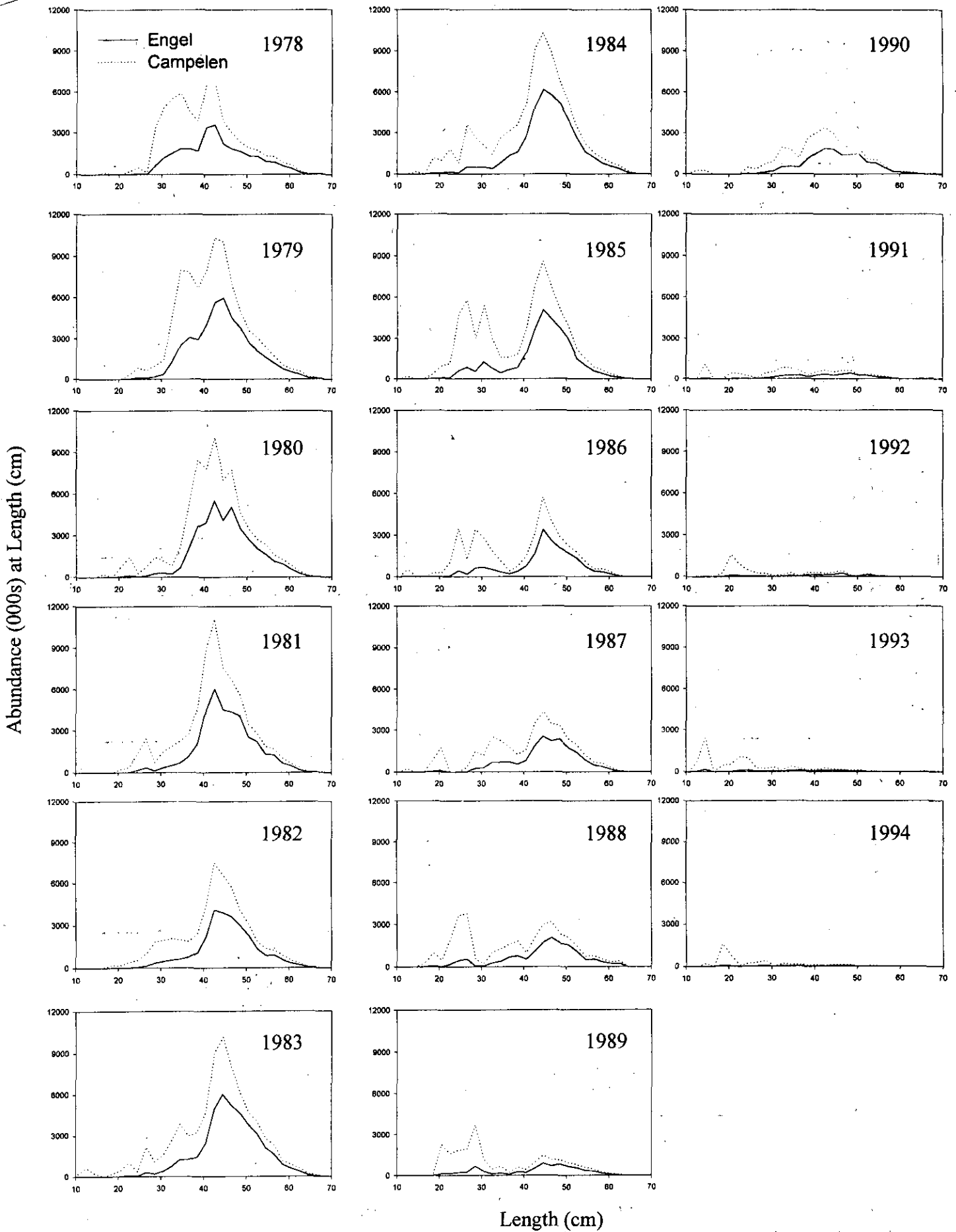


Fig. 2 Comparative length distributions (cm) between Engel trawl catches and Campelen trawl catch equivalents of witch flounder from Canadian fall surveys in Div. 3K during 1978-94.

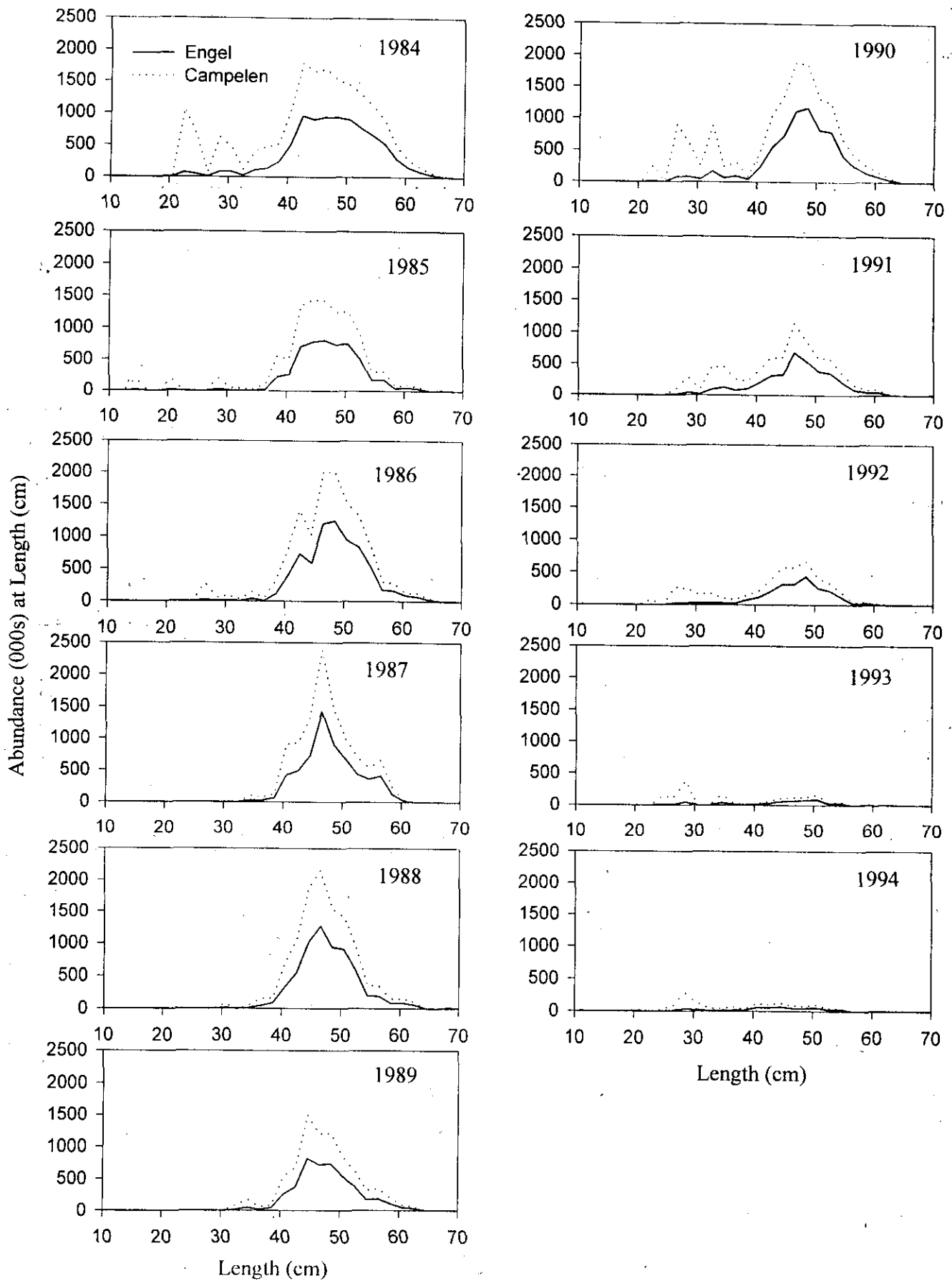


Fig. 3 Comparative abundance (000s) at length (cm) of witch flounder from Canadian fall surveys in Div. 3L between the Engel trawl and Campelen trawl catch equivalents during 1984-94.

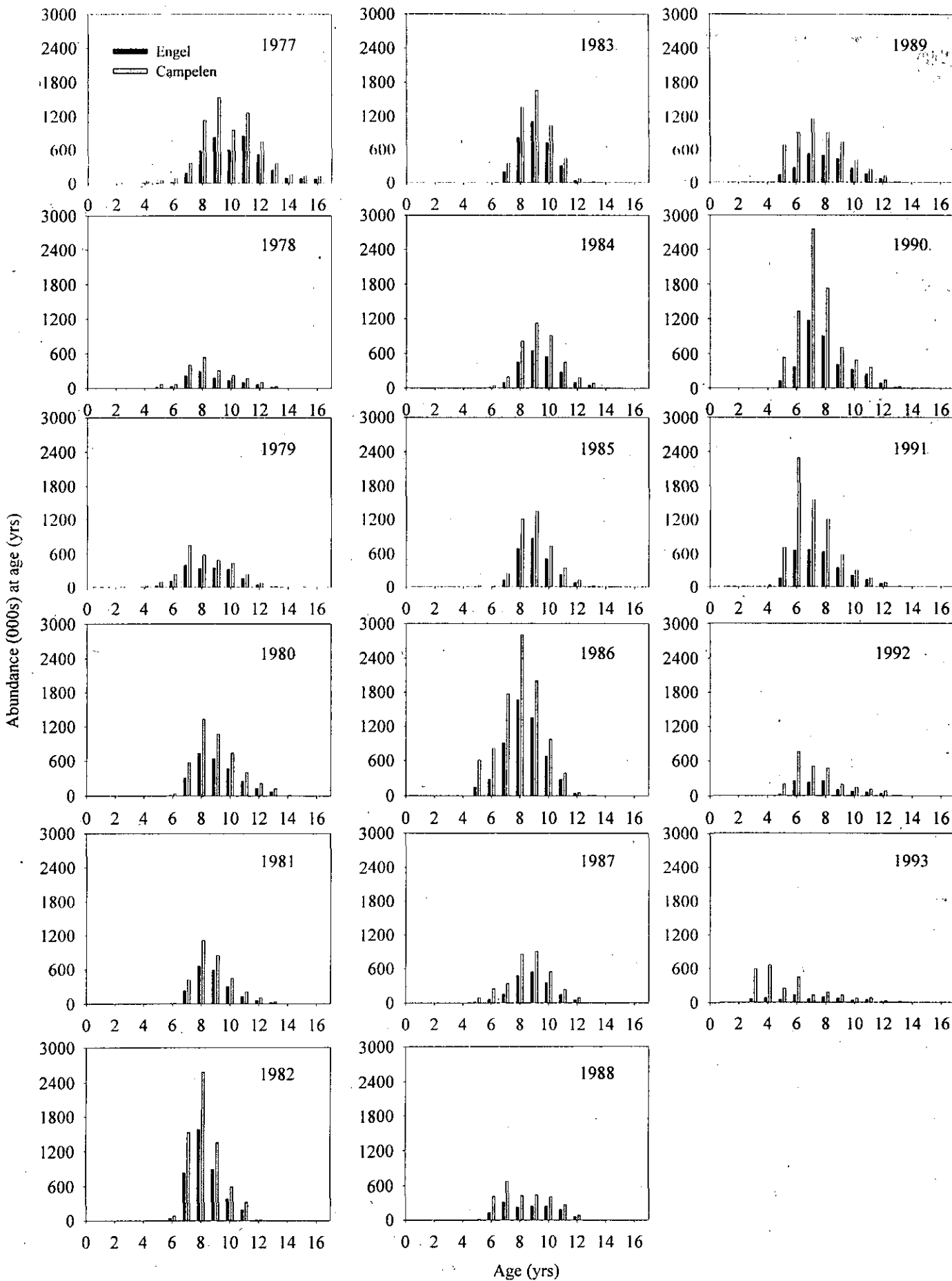


Fig. 4 Comparative abundance (000s) at age (yrs) of witch flounder from Canadian surveys in Div. 2J between Engel trawl catches and Campelen trawl catch equivalents during 1977-93.

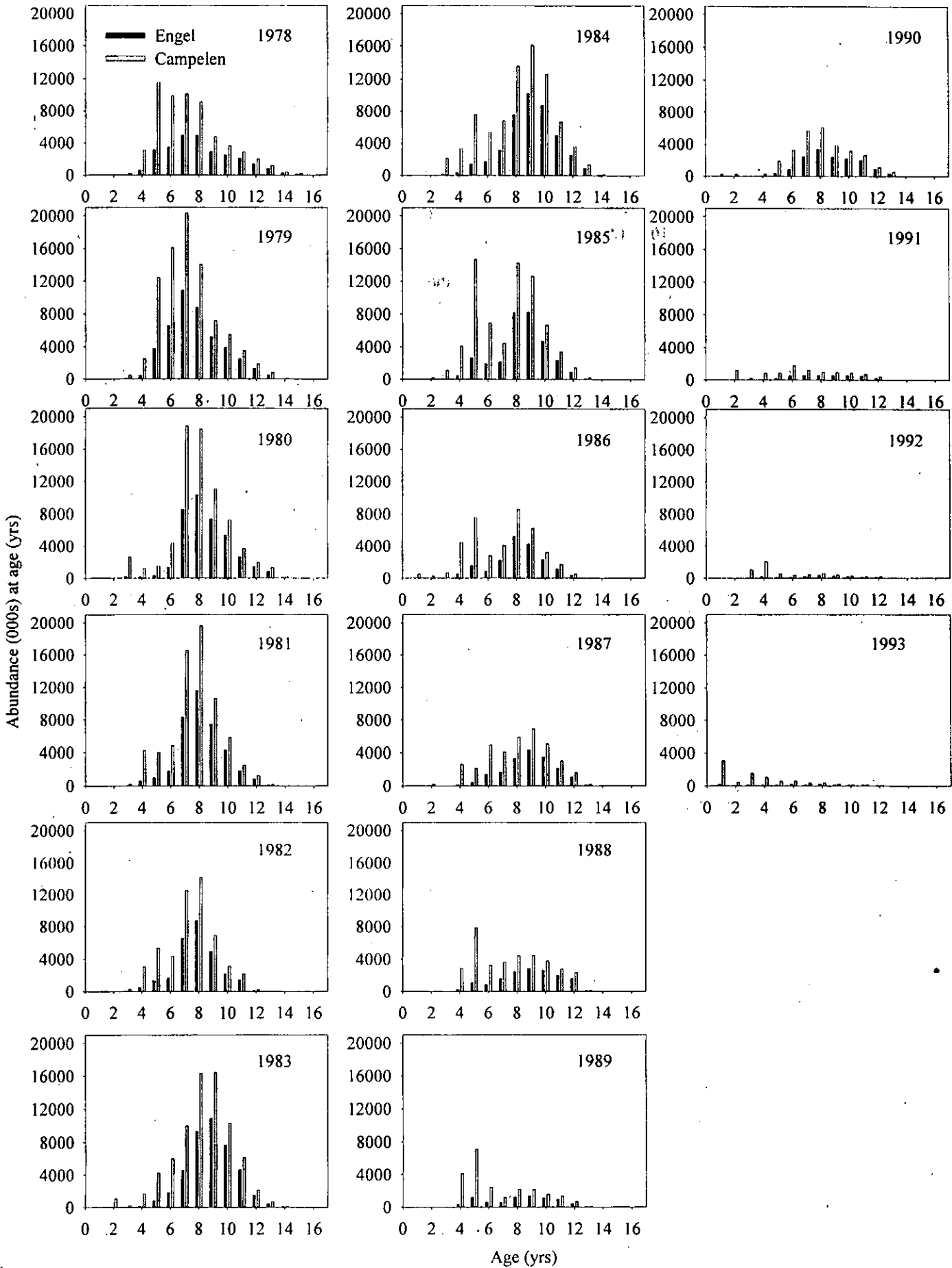


Fig. 5 Comparative abundance (000s) at age (yrs) of witch flounder from Canadian surveys in Div. 3K between Engel trawl catches and Campelen trawl catch equivalents during 1978-93.

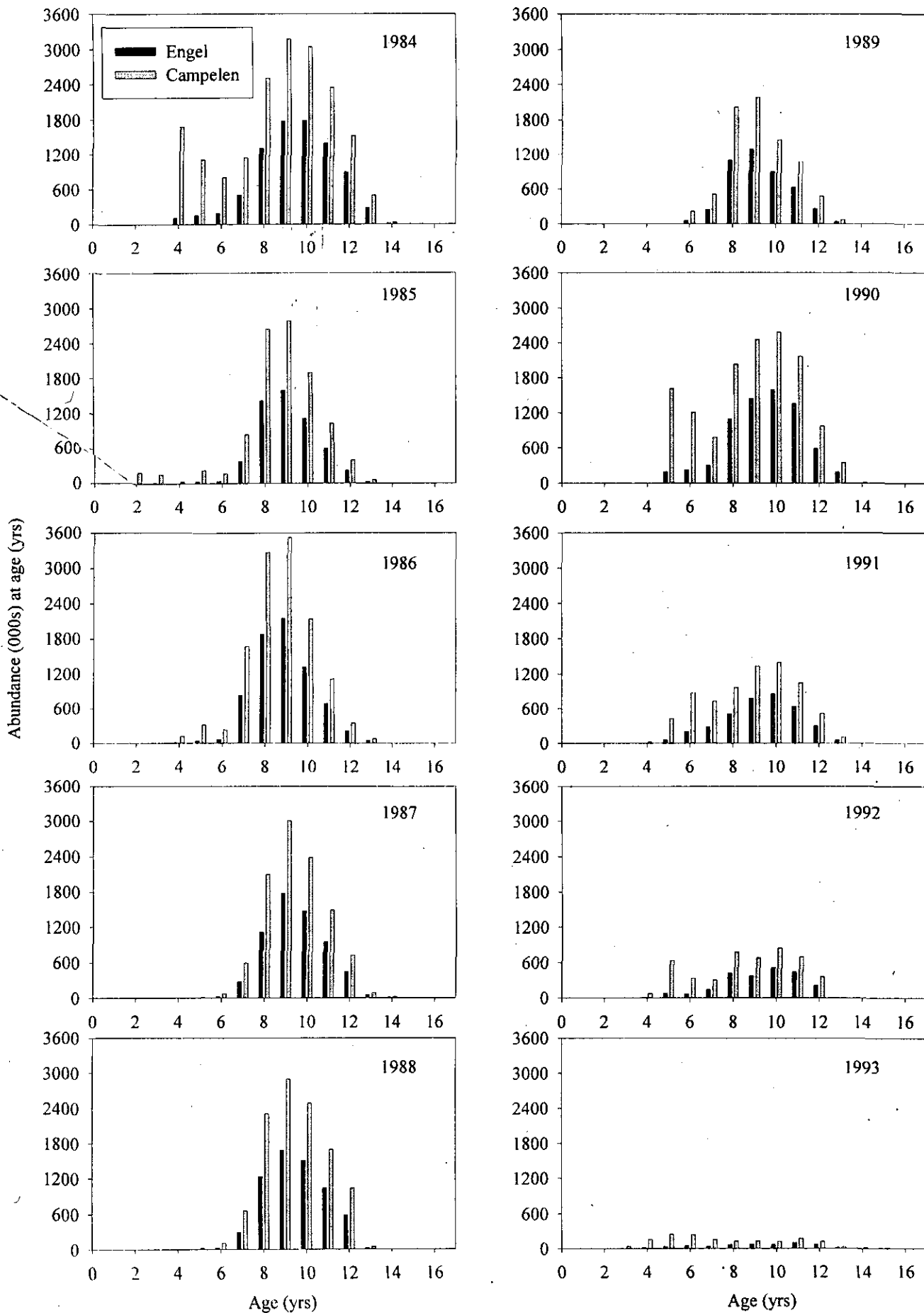


Fig. 6 Comparative abundance (000s) at age (yrs) for witch flounder from Canadian fall surveys in Div. 3L between Engel trawl catches and Campelen trawl catch equivalents.