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Conversion of the Canadian Juvenile (Yankee trawl) Groundfish Survey Time Series for Yellowtail Flounder on the Grand Bank, NAFO Divisions 3LNO, into Campelen Trawl Units

by

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Abstract

Conversion of the Canadian juvenile (Yankee trawl) groundfish survey time series for yellowtail flounder on the Grand Bank, NAFO Divisions 3LNO, into Campelen trawl units. In 1998, Conversion of yellowtail flounder indices from the Canadian 1985-1994 fall juvenile groundfish surveys of the Grand Bank was based on the 1996 comparative fishing trials of the Yankee shrimp trawl and the Campelen shrimp trawl. STACFIS in 1998 reviewed the results of the comparative fishing and recommended that '*conversion factors be derived for re-calculating the Yankee trawl survey time series into Campelen trawl units*'. When the catch at length was adjusted for differences in swept area, i.e., 30 minute Yankee tow vs. 15 minute Campelen tow of the two trawls the analyses showed no difference in length selection and catching efficiency of the two trawls. Conversion of the time series from Yankee trawl units into Campelen trawl units was based solely on adjustment for the difference in swept area of the two trawls.

Introduction

Annual stratified-random fall juvenile groundfish surveys of the Grand Bank, NAFO Div. 3LNO (Fig. 1) by the Northwest Atlantic Fisheries Centre (NAFC), in Newfoundland, began in 1985. The objectives of these surveys were to provide information on trends in population size, distribution, and recruitment as well as biological data on size, growth, feeding of yellowtail flounder (*Limanda ferruginea*) and American plaice, *Hippoglossoides platessoides*, and Atlantic cod, *Gadus morhua*. From 1985 to 1988, the survey area incorporated the entire plateau of the bank inside the 91 m depth contour. In 1989 the survey was extended to 183 m depth contour and again in 1992 extended to the 274 m depth contour (see Walsh 1994 for details). The surveys were conducted from mid-August to mid-September from 1985-1994 with the exception of 1987 when a partial survey of Div. 3N was carried out in November due to mechanical problems with the survey vessel, CCG *Wilfred Templeman*. In all years the survey was carried out by the 50 m CCG *Wilfred Templeman*. The survey bottom trawl was a two bridle Yankee 41 shrimp trawl with a mesh size of 38 mm throughout, a 12.7mm stretched mesh liner in the codend and rigged with 30 cm rubber disk footgear (see McCallum and Walsh 1996 for detail description). The tows were 30 minutes duration and the gear was towed at 2.5 knots as measured by Doppler speed log and covered an average distance of 1.25 nm. An estimated sixteen hundred and eighty-two (1 682) successful sets were made during the combined period from 1985-1994.

In the fall of 1996, side-by-side comparative fishing trials were carried out between the *CCG Wilfred Templeman* using the "old standard" Yankee 41 shrimp trawl, and her sister ship the CCG *Alfred Needler* using the "new standard" survey trawl, a Campelen 1800 shrimp trawl. These trials were carried out on the southern Grand Bank, NAFO Div. 3NO during the regular fall survey (see Walsh and McCallum, 1998, for details). An analysis of the

catching efficiency and size selectivity of both shrimp trawls was presented in 1998 at the June meeting of STACFIS which showed that there was little differences in size selectivity of both trawls for yellowtail flounder and the differences in catching efficiency was related to differences in tow duration, i.e. 30 minutes for the Yankee and 15 minutes for the Campelen (Walsh and McCallum, 1998). In 1998, STACFIS recommended that '*conversion factors be derived for re-calculating the Yankee trawl survey time series into Campelen trawl units*' (NAFO, 1998).

This paper will present the conversion of the Yankee trawl indices into Campelen trawl units for the yellowtail flounder survey time series data from the 1985-94 Canadian juvenile groundfish surveys.

Materials and Methods

The comparative fishing trials were carried out while the CCG *Templeman* was conducting the annual autumn groundfish survey using the Campelen survey trawl in 1996. Details are given in Walsh and McCallum (1998) and a brief summary of some highlights have been duplicated here. Both ships fished at the same time and direction at each station, keeping within 0.5 nm of each other as described in Warren (1996) and Warren *et al*. (1997). The Campelen trawl was fished with the 'new standard time' of 15 minutes using a towing speed of 3.0 knots. The Yankee trawl was fished with the 'old standard time' of 30 minutes using a towing speed of 2.5 knots. The performance of both fishing gears was monitored using SCANMAR acoustic trawl instrumentation which measured door spread, wing spread, trawl opening, bottom contact and trawl depth.

Trials were terminated early when the CCG *Templeman* developed mechanical problems. Twenty-eight comparative fishing sets were made of which 19 pairs were successful. A total of 18 successful paired tows, in which one or the other trawl caught yellowtail flounder were examined. Thirteen paired tows in Div 3N and 5 paired tows in Div. 3O were completed in a depth range of 42 to 209 m at bottom temperatures which ranged from 0.8 to 5.2^{0}C.

Measurements of average wing spread for Yankee and Campelen shrimp trawls for 18 paired tows

TRAWL	Wingspread (meters)	Distance Towed (nm)	Swept area m2
Yankee	13.49	1.25	31,229.35
Campelen	12.96	0.75	18,001.44

Since the selectivity and catching efficiency of bottom trawls are length dependent (Walsh, 1992; Godø and Walsh, 1992; Warren, 1996; Warren *et al*., 1997) then the derivation of conversion factors for the Yankee time series for yellowtail flounder focused on differences in catches in numbers (not weight) and length, and is an extension of the Walsh and McCallum (1998) analyses. For the comparative analysis, zero catches in one of the pair tows resulted in elimination of that pair according to the method of Warren (1996) and Warren *et al*. (1997) (see Table 1). Elimination of these small catches had no effect on the catch ratio. Warren (1996) and Warren et al. (1997) in their analyses of comparative fishing data to derive conversion factors (Engel trawl to Campelen trawl units) for Grand Bank yellowtail flounder and American plaice used the criteria of deleting (outliers) cases where it was felt that one trawl had encounter a high density of fish that the other trawl did not encounter. Using similar criteria here, only one outlier was detected in the yellowtail catches where the Yankee caught 27 times the amount of that caught by the Campelen. This outlier was deleted from the conversion analysis (Table 1).

Results

Selectivity and Catching efficiency

Catches of the yellowtail by gear type for the 18 paired sets are given in Table 1. The ratio of the catches in numbers of the Campelen to Yankee was 0.57 and after removal of 3 zero sets and one outlier the ratio increased to 0.60 for the remaining 14 paired tows. The average wing spread, as measured by Scanmar net monitoring instrumentation, of the Yankee trawl (13.49 m) was 0.53 m wider than the Campelen wing spread (12.96 m) at comparable depths in the comparative fishing tows. Wing spread and distance towed are two parameters needed to estimate swept area estimates of abundance and biomass. Table 1 gives the swept area estimates for both trawls using the wing spread of

the trawl times the standard tow distance. The ratio of the swept area difference for both trawls (Campelen/Yankee) based on the comparative fishing was 0.58 which was similar to the adjusted catch ratio of 0.60.

Length frequencies were available for 13 paired sets from the Campelen and the Yankee trawl catches (Table 2 and Fig. 2). There were some minor differences in length selectivity evident and a major difference in catching efficiency of the two trawls, i.e. in the 30 minute tow the Yankee trawl caught more fish than the 15 minute tow by the Campelen. A second Yankee length frequency is shown in Table 2 and Fig. 2 which is the Yankee catch-at-length adjusted by 0.58, the difference in swept area of the two trawls. After this adjustment, there is little difference in the catching efficiency or selectivity of both trawls (Fig. 2).

Conversion of the time series.

The difference in catching efficiency was assumed to be related to differences in swept area of the two trawls, i.e. the difference in standardized tow distance (0.75 nm *vs*. 1.25 nm; ratio of 0.60) for the Campelen and Yankee trawls and to a lesser extent the small difference in wing spread (12.96 m *vs*. 13.49 m) and towing speeds (3.0 *vs*. 2.5 knots). So based on the similarity in wing spread of the two trawls, the time series data for yellowtail flounder from the 1985-94 Yankee surveys were converted into Campelen trawl units by using the Campelen wing spread and tow distance in the standard swept area model that is used to derive the 1995-2004 Campelen trawl survey indices of the Grand Bank (see Walsh *et al*., 2004).

Tables 3-4 presents the converted time series of the Yankee trawl abundance and biomass of yellowtail flounder on the Grand Bank from 1985-1994 as Campelen trawl units. Noteworthy is that the 1987 covered only a portion of Div. 3N due to mechanical problems with the survey vessel. Table 5 and Fig. 4 presents a comparison of the unconverted and converted abundance and biomass of yellowtail flounder for the 1985-1994 series.

Converted population numbers at age from these surveys will be presented at a later date when the age resolution of yellowtail flounder is resolved.

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Table 1 Catches of yellowtail flounder by gear from 1996 comparative fishing between Campelen 1800 shrimp trawl and Yankee 41 shrimp trawl from 18 pair tows.

set no.	Numbers Campelen	Weight	Numbers Yankee	Weight	Numbers Ratio Y/C All sets	Numbers_Ratio Y/C Minus 0s/set 38
37	638	160.8	656	103.9	0.97	1.03
38	29	4.5	776	135.4	26.76	
40	380	124.7	676	221.7	1.78	1.78
50	0	0.0	5	0.1		
51	304	9.9	167	23.2	0.55	0.55
56	1973	278.8	1922	277.9	0.97	0.97
57	1256	140.0	2133	270.4	1.70	1.70
58	2442	380.0	3725	620.4	1.53	1.53
59	989	138.1	3094	239.8	3.13	3.13
60	923	105.0	1623	313.0	1.76	1.76
61	1084	163.8	2759	379.6	2.55	2.55
62	0	0.0	3	0.4		
85	1	0.4	6	3.8	6.00	6.00
86	5	2.5	34	22.1	6.80	6.80
87	46	24.1	15	8.5	0.33	0.33
88	94	45.6	166	89.8	1.77	1.77
89	9	5.9	80	52.7	8.89	8.89
93	0	0.0	28	8.5		
Total	**10173**	**1583.9**	**17868**	**2770.9**		
Ratio						
Numbers (Y/C)	**1.76**					
Numbers (C/Y)	**0.57**					

After removals of sets 38, 50, 62, & 93		
Numbers	**10144**	**17056**

Ratio of adjusted catches (numbers) Yankee to Campelen = 1.68
Ratio of adjusted catches (numbers) Campelen to Yankee = 0.60

Ratio of swept areas of Yankee/Campelen from comparative fishing is 31,229.35/18,001.44 m2 = 1.74
Ratio of swept areas of Campelen/Yankee from comparative fishing is 18,001.44/31,229.35m2 = 0.58

Table 2. Length frequency of yellowtail flounder by Campelen and Yankee shrimp trawls showing revised 13* pair tows and adjusted Yankee length frequency (Y2).

LENGTH	Yankee	Yankee*0.58	Campelen	Ratio C/Y2
8	12	6	0	0.00
9	41	22	0	0.00
10	40	22	47	2.18
11	51	28	69	2.51
12	65	35	56	1.60
13	115	62	58	0.93
14	138	75	95	1.27
15	236	127	143	1.12
16	221	119	134	1.12
17	276	149	168	1.13
18	379	205	249	1.22
19	607	328	260	0.79
20	1059	572	562	0.98
21	1252	676	618	0.91
22	1296	700	711	1.02
23	1497	808	689	0.85
24	1223	660	540	0.82
25	1155	624	596	0.96
26	1093	590	462	0.78
27	915	494	566	1.15
28	786	424	458	1.08
29	627	339	368	1.09
30	429	232	235	1.01
31	273	147	222	1.51
32	277	150	119	0.80
33	203	110	121	1.10
34	108	58	92	1.58
35	185	100	87	0.87
36	157	85	103	1.21
37	170	92	95	1.03
38	110	59	85	1.43
39	100	54	90	1.67
40	85	46	78	1.70
41	54	29	37	1.27
42	48	26	36	1.39
43	50	27	17	0.63
44	39	21	10	0.47
45	16	9	4	0.46
46	28	15	16	1.06
47	13	7	4	0.57
48	10	5	3	0.56
49	5	3	2	0.74
50	1	1	3	5.56
TOTAL	**15445**	**8340**	**8308**	

Sets 38, 50, 62 and 93 deleted.
* No length data available for set 60.
Adjustment factor of 0.58 is the ratio of Campelen/Yankee swept areas

Table 3. Converted abundance (millions) of yellowtail flounder by stratum, Div 3LN0, from Yankee trawl units to Campelen trawl units for the 1985-94 juvenile groundfish time series.

Depth Range (m)	Stratum	No. of trawlable Units	1985 *WT 35*	1986 *WT 51*	1987 *WT 66*	1988 *WT 75*	1989 *WT 84,85*	1990 *WT 99,100*	1991 *WT 110,111*	1992 *WT 124-126*	1993 *WT 141,142*	1994 *WT 158,159*
<=56	375-3N	219,134.8	30.8	31.9	55.0	19.8	38.8	36.0	64.7	61.8	21.2	128.3
	376-3N	206,204.1	18.8	41.3	128.9	46.2	116.3	191.0	210.2	60.6	88.9	376.2
	784-3L	36,866.4										
TOTAL			**49.6**	**73.2**	**183.9**	**66.0**	**155.0**	**227.0**	**274.8**	**122.4**	**110.1**	**504.5**
57-92	330-3O	287,365.1				1.9	1.2	6.6	0.1	9.4	0.6	2.9
	331-3O	62,727.9				0.0	0.5	0.7	0.1	0.2	0.1	0.2
	338-3O	261,090.9		13.9		3.1	7.8	1.5	1.6	5.4	13.0	4.5
	340-3O	236,054.8				0.8	4.9	1.0	4.2	1.4	0.6	5.8
	350-3L	284,889.0	10.3	1.4		1.3	0.2	0.0	0.2	0.1	0.1	0.1
	351-3O	346,653.9	35.4	37.5		18.3	14.8	21.0	8.8	13.6	15.7	12.3
	352-3O	354,907.6		46.0		36.0	45.2	21.2	50.7	55.0	100.0	100.5
	353-3O	17.6353.31		12.8		2.1	2.4	34.7	9.4	0.7	0.8	0.1
	360-3N	411,582.8	14.6	65.2	48.7	28.5	94.5	99.3	115.8	84.2	116.0	82.0
	361-3N	254,900.7	15.7	29.6	62.8	25.5	44.9	58.5	81.9	67.7	112.1	178.3
	362-3N	346,653.9	35.6	23.3	8.1	27.6	22.0	16.9	62.5	8.6	15.2	41.1
	363-3L	244,858.7	8.1	7.4		6.4	2.1	1.1	2.4	2.0	2.6	2.2
	371-3L	154,206.0	0.2			0.1	0.6	0.4		0.1	0.0	0.1
	372-3L	338,400.3	19.4	21.0		13.5	8.5	16.4	12.1	7.2	1.2	1.5
	373-3N	346,653.9	34.3	24.1		6.4	6.9	3.2	0.2	0.2	1.6	0.0
	374-3N	128,069.4	1.3	0.9		0.4	0.0	0.1	0.0	0.6	0.0	0.0
	383-3N	92,716.2	0.0			0.0	0.0	0.0	0.0		0.0	0.0
	384-3L	154,068.4	3.3			0.0	0.0	0.0	0.0		0.1	0.0
	785-3L	63,965.9										
TOTAL			**178.2**	**283.1**	**119.6**	**172.1**	**256.4**	**282.5**	**350.3**	**256.4**	**379.7**	**431.7**
93-183	328-3L	208,955.3					0.0		0.0	0.0	0.0	0.0
	329-3O	236,742.6					0.0		0.0	0.4	0.0	0.0
	332-3O	144,026.5					0.6	0.6	2.5	0.0	0.3	0.4
	337-3O	130,407.9					0.0	0.9	0.1	0.1	1.2	0.1
	339-3O	80,473.2					0.0	0.0	0.2	0.0	0.0	0.0
	341-3L	216,521.2					0.0	0.0	0.0	0.0	0.0	0.0
	342-3L	80,473.2					0.0			0.0	0.0	0.0
	343-3L	72,219.6					0.0		0.0	0.0	0.0	0.0
	348-3L	291,629.5					0.0	0.0	0.0	0.0	0.0	0.0
	349-3L	290,804.1					0.0	0.0	0.0	0.0	0.0	0.0
	354-3O	65,204.0					0.0	0.0	0.0	0.0	0.0	0.0
	359-3N	57,913.2					0.0	0.0	0.0	0.0	0.0	0.0
	364-3L	387,509.6					0.0	0.0	0.0	0.0	0.0	0.0
	365-3L	143,201.1					0.0	0.0	0.0	0.0	0.0	0.0
	370-3L	181,580.6					0.0	0.0	0.9	0.0	0.0	0.0
	377-3N	13,756.1									0.0	0.0
	382-3N	89,002.0					0.0		0.0	0.0	0.0	0.0
	385-3L	324,093.9					0.0	0.0	0.0	0.0	0.0	0.0
	390-3L	203,728.0					0.0	0.0	0.0	0.0	0.0	0.0
	786-3L	11,555.1										
	787-3L	84,325.0										
TOTAL							**0.6**	**1.5**	**3.7**	**0.5**	**1.6**	**0.5**
184-274	333-3O	20,771.7									0.0	
	336-3O	16,644.9									0.0	
	344-3L	205,516.3								0.0	0.0	0.0
	347-3L	135,222.6								0.0	0.0	0.0
	355-3O	14,168.8										0.0
	358-3N	30,951.2								0.0		
	366-3L	191,760.2								0.0	0.0	0.0
	369-3L	132,196.2								0.0	0.0	0.0
	378-3N	19,121.0										0.0
	381-3N	25,036.1									0.0	0.0
	386-3L	135,222.6								0.0	0.0	0.0
	389-3L	112,937.7								0.0	0.0	0.0
	391-3L	38,792.2								0.0	0.0	0.0
TOTAL										**0.0**	**0.0**	**0.0**
Abundance (millions)			**227.9**	**356.4**	**303.5**	**238.1**	**490.0**	**490.0**	**628.8**	**380.0**	**491.4**	**939.1**
Upper C.I.			**303.9**	**467.4**	**490.1**	**309.3**	**622.4**	**622.4**	**800.6**	**503.3**	**668.7**	**1,375.7**
Lower C.I.			**151.8**	**245.4**	**116.9**	**166.8**	**357.5**	**357.5**	**457.1**	**256.7**	**314.1**	**502.5**

Note: the 1987 survey was incomplete and covered only a portion of Div. 3N.

Table 4. Converted biomass estimates ('000t) of yellowtail flounder by stratum, Div 3LN0, from Yankee trawl units to Campelen trawl units for the 1985-94 juvenile groundfish time series.

Depth Range (m)	Stratum	No. of trawlable Units	1985 *WT 35*	1986 *WT 51*	1987 *WT 66*	1988 *WT 75*	1989 *WT 84,85*	1990 *WT 99,100*	1991 *WT 110,111*	1992 *WT 124-126*	1993 *WT 141,142*	1994 *WT 158,159*
<=56	375-3N	219,134.8	14.0	15.5	5.8	3.2	12.0	9.9	19.5	22.8	11.4	34.7
	376-3N	206,204.1	6.1	19.1	7.4	4.9	20.3	26.2	20.3	7.4	16.1	65.5
	784-3L	36,866.4										
TOTAL			**20.1**	**34.6**	**13.3**	**8.1**	**32.3**	**36.0**	**39.9**	**30.2**	**27.6**	**100.2**
57-92	330-3O	287,365.1				1.0	0.6	3.2	0.0	5.2	0.2	1.5
	331-3O	62,727.9				0.0	0.3	0.4	0.1	0.1	0.0	0.1
	338-3O	261,090.9		6.6		1.5	3.2	0.6	0.7	2.9	5.7	1.0
	340-3O	236,054.8				0.4	2.2	0.5	1.7	0.5	0.3	2.6
	350-3L	284,889.0	4.5	0.6		0.6	0.1	0.0	0.1	0.0	0.0	0.0
	351-3O	346,653.9	13.6	14.1		6.1	6.3	9.4	4.0	5.9	7.0	5.2
	352-3O	354,907.6		16.1		12.9	16.9	14.4	17.5	21.3	34.0	35.1
	353-3O	17.6353.31		7.5		1.0	1.1	0.0	4.1	0.3	0.4	0.1
	360-3N	411,582.8	6.8	5.1	3.2	5.8	11.7	14.8	19.1	15.2	22.6	15.8
	361-3N	254,900.7	6.1	9.7	27.4	9.8	16.9	20.9	27.1	24.6	41.8	65.6
	362-3N	346,653.9	12.7	9.2	3.6	12.3	9.7	8.6	27.1	3.9	7.2	17.0
	363-3L	244,858.7	3.2	3.4		3.0	1.1	0.5	1.2	1.0	1.3	1.1
	371-3L	154,206.0	0.2			0.1	0.4	0.2		0.1	0.0	0.1
	372-3L	338,400.3	8.2	10.0		7.1	4.2	8.4	5.7	1.9	0.6	0.8
	373-3N	346,653.9	16.1	10.6		3.4	3.3	1.9	0.2	0.1	0.8	1.2
	374-3N	128,069.4	0.6	0.5		0.3	0.0	0.0	0.0	0.3	0.0	0.0
	383-3N	92,716.2	0.0			0.0	0.0	0.0	0.0	0.0	0.0	0.0
	384-3L	154,068.4	2.2				0.0	0.0	0.0	0.0	0.0	0.0
	785-3L	63,965.9										
TOTAL			**74.0**	**93.4**	**34.2**	**65.3**	**78.1**	**83.8**	**108.7**	**83.2**	**122.1**	**146.9**
93-183	328-3L	208,955.3					0.0		0.0	0.0	0.0	0.0
	329-3O	236,742.6					0.0		0.0	0.1	0.0	0.0
	332-3O	144,026.5					0.3	0.2	1.1	0.0	0.1	0.2
	337-3O	130,407.9					0.0	0.2	0.0	0.0	0.5	0.0
	339-3O	80,473.2					0.0	0.0	0.1	0.0	0.0	0.0
	341-3L	216,521.2					0.0	0.0	0.0	0.0	0.0	0.0
	342-3L	80,473.2					0.0			0.0	0.0	0.0
	343-3L	72,219.6					0.0		0.0	0.0	0.0	0.0
	348-3L	291,629.5					0.0	0.0	0.0	0.0	0.0	0.0
	349-3L	290,804.1					0.0	0.0	0.0	0.0	0.0	0.0
	354-3O	65,204.0					0.0	0.0	0.0	0.0	0.0	0.0
	359-3N	57,913.2					0.0	0.0	0.0	0.0	0.0	0.0
	364-3L	387,509.6					0.0	0.0	0.0	0.0	0.0	0.0
	365-3L	143,201.1					0.0	0.0	0.0	0.0	0.0	0.0
	370-3L	181,580.6					0.0	0.0	0.0	0.0	0.0	0.0
	377-3N	13,756.1									0.0	0.0
	382-3N	89,002.0					0.0	0.0	0.0	0.0	0.0	0.0
	385-3L	324,093.9					0.0	0.0	0.0	0.0	0.0	0.0
	390-3L	203,728.0					0.0	0.0	0.0	0.0	0.0	0.0
	786-3L	11,555.1										
	787-3L	84,325.0										
TOTAL							**0.3**	**0.4**	**1.3**	**0.2**	**0.6**	**0.2**
184-274	333-3O	20,771.7									0.0	
	336-3O	16,644.9									0.0	
	344-3L	205,516.3								0.0	0.0	0.0
	347-3L	135,222.6								0.0	0.0	0.0
	355-3O	14,168.8										0.0
	358-3N	30,951.2								0.0		
	366-3L	191,760.2								0.0	0.0	0.0
	369-3L	132,196.2								0.0	0.0	0.0
	378-3N	19,121.0										0.0
	381-3N	25,036.1									0.0	0.0
	386-3L	135,222.6								0.0	0.0	0.0
	389-3L	112,937.7								0.0	0.0	0.0
	391-3L	38,792.2								0.0	0.0	0.0
TOTAL										**0.0**	**0.0**	**0.0**
Biomass ('000t)			**94.1**	**128.0**	**47.4**	**73.7**	**110.7**	**120.2**	**149.8**	**113.7**	**150.3**	**247.3**
Upper C.I.			**124.3**	**178.3**	**67.0**	**92.5**	**134.5**	**146.6**	**182.6**	**142.8**	**187.8**	**331.1**
Lower C.I.			**64.0**	**77.7**	**27.9**	**54.9**	**86.8**	**93.8**	**117.1**	**84.6**	**112.7**	**163.5**

Note: the 1987 survey was incomplete and covered only a portion of Div. 3N.

Table 5 Comparison of the unconverted & converted Yankee trawl abundance and biomass estimates of yellowtail flounder from annual fall juvenile groundfish surveys in Div. 3LNO. Converted series are in Campelen trawl units, 1985-1994.

YEAR	**BIOMASS (000t)**		YEAR	**Abundance (millions)**	
	Unconverted	Converted		Unconverted	Converted
1985	118.2	**94.1**	**1985**	286.4	**227.9**
1986	155.5	**128.0**	**1986**	448.1	**356.4**
1987	59.6	**47.4**	**1987**	381.1	**303.5**
1988	98.5	**73.7**	**1988**	299.0	**238.1**
1989	138.9	**110.7**	**1989**	516.9	**412.0**
1990	150.9	**120.2**	**1990**	616.6	**490.0**
1991	188.2	**149.8**	**1991**	785.1	**628.8**
1992	157.5	**113.7**	**1992**	476.5	**380.0**
1993	188.6	**150.3**	**1993**	616.8	**491.4**
1994	300.6	**247.3**	**1994**	1115.2	**939.1**

Note 1987 survey covered a limited portion of Div. 3N with no survey in Div. 3L and 3O

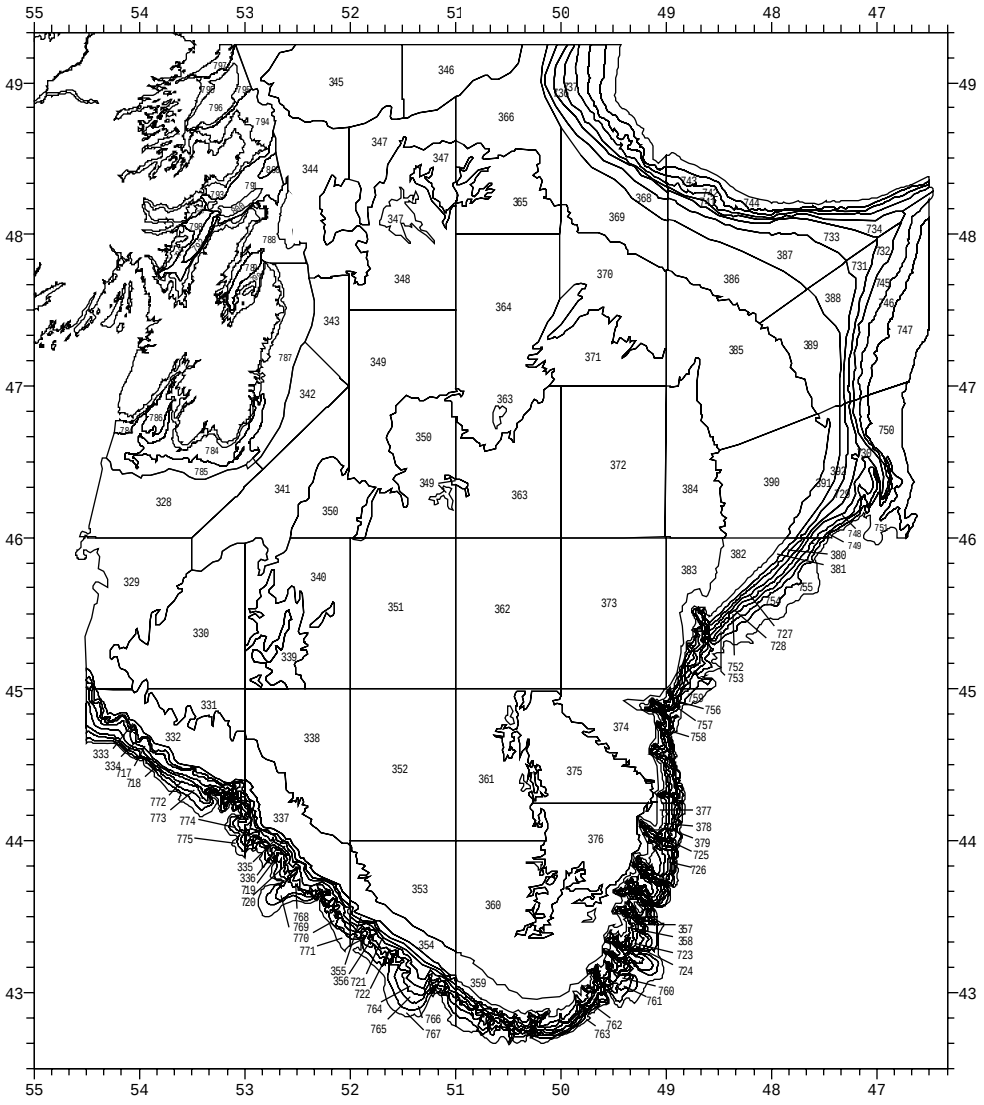

Fig 1. Stratification chart of the Grand Bank for the 1985-1994 juvenile groundfish surveys and the 1995-2004 Campelen groundfish surveys.

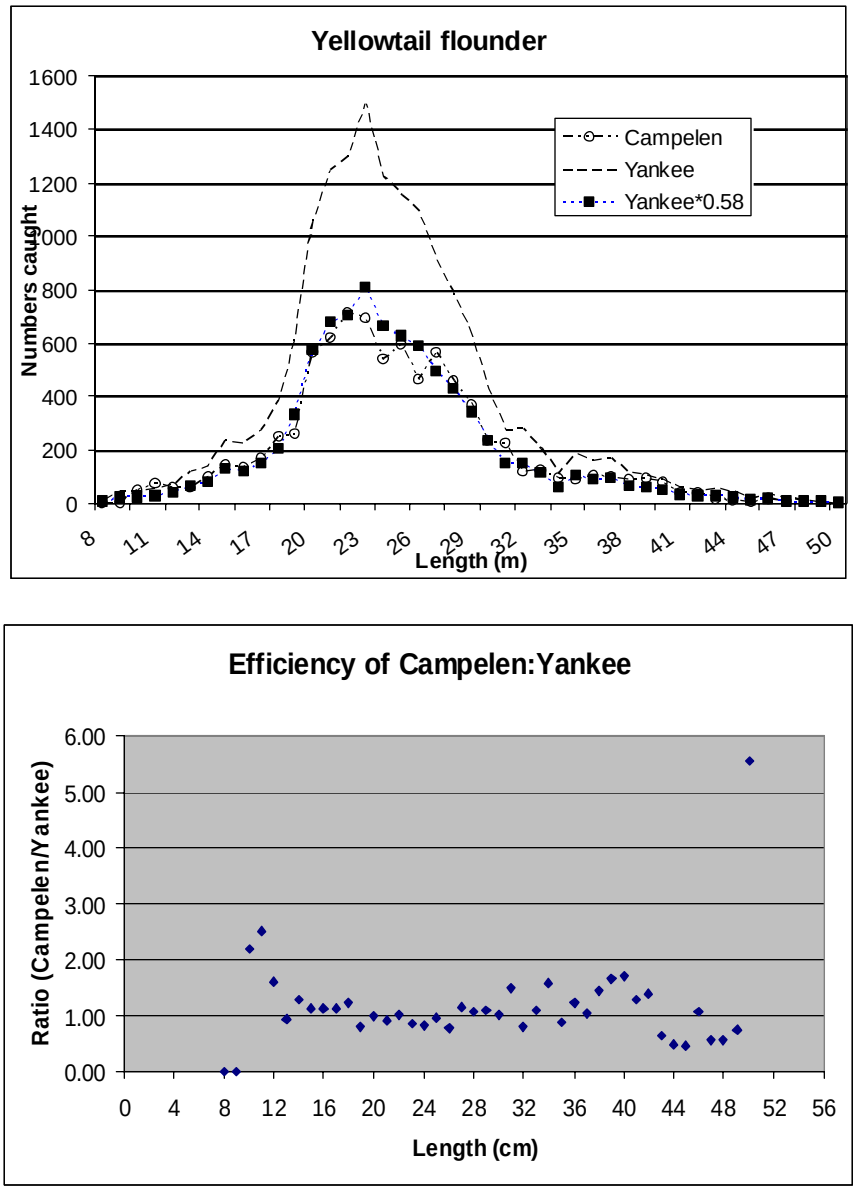

Fig 2. Length frequency of yellowtail flounder from the 1996 comparative fishing between the Yankee and Campelen shrimp trawls. Top Panel: Numbers caught in 13 paired tows with Campelen and Yankee trawls and the numbers-at-length of the Yankee catches adjusted for differences in swept area (0.58). Bottom Panel: Ratio of numbers-at-length of the Campelen and adjusted Yankee.

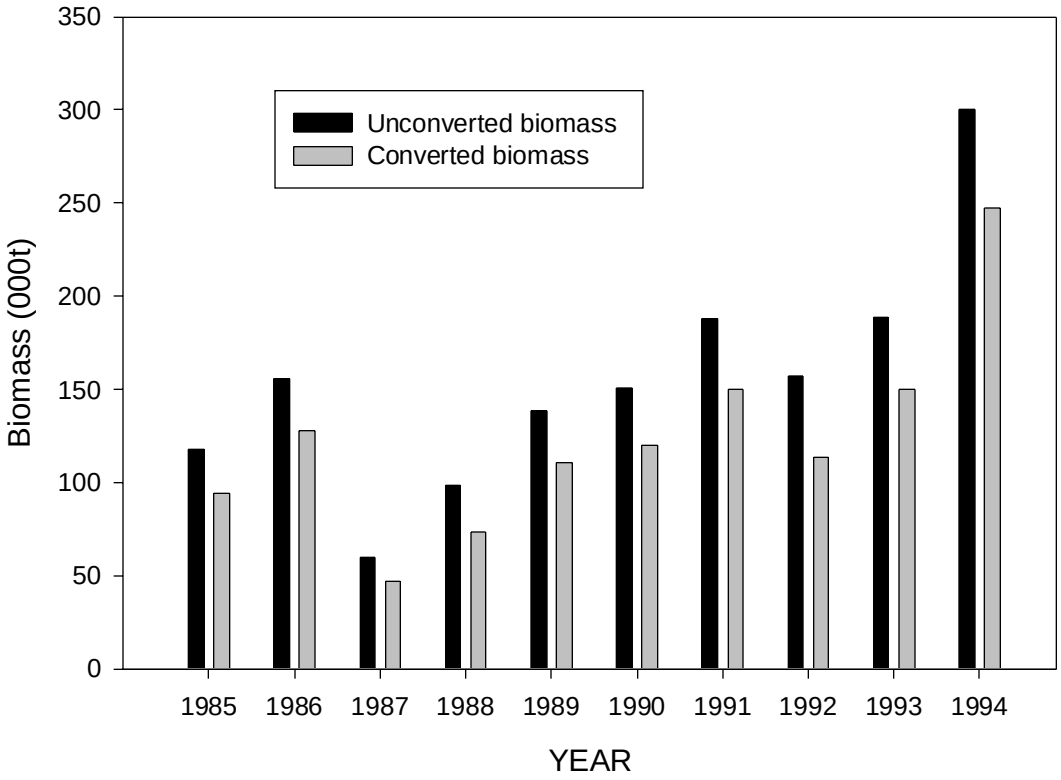

Fig. 4. Biomass of yellowtail flounder in Yankee trawl units (unconverted) and Campelen trawl units (converted) for the 1985-1994 Canadian juvenile groundfish surveys of the Grand Bank.