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Conversion factors for cod from Comparative Fishing Trials for Engel 145 Otter Trawl and
the Campelen 1800 Shrimp Trawl used on Research Vessels

by

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Introduction

In 1995 DFO Science Branch, Newfoundland Region acquired a new research vessel the *FRV Teleost*.
With the new vessel a new ground trawl, *Campelen 1800* shrimp trawl rigged with rockhopper footgear
was introduced. It was also decided to use the same trawl on the other large survey vessel *Wilfred
Templeman*.

To maintain continuity in the survey time series, a comparative fishing experiment was conducted between
the *FRV Gadus Atlantica* using the Engels 145 otter trawl with bobbin footgear and the *FRV Teleost*. A
total of 285 successful paired tows were conducted in the winter of 1995. Details of the fishing trials are
outlined in Warren (1996). A similar fishing experiment was conducted between the *FRV Wilfred
Templeman* using the *Campelen 1800* and her sister ship the *Alfred Needler* using the Engels 145 as it was
configured in surveys from 1983 to 1994. A total of 154 successful paired tows were conducted in the
winter of 1996 in which one or the other vessel caught cod. An analysis between the two vessel/gear
configurations for each experiment gave conversion factors for five groundfish species (Warren 1996,
1997). This paper illustrates the effect of the conversion from Engels to Campelen for Atlantic cod (*Gadus
morhua*) and produces a survey index in Campelen *equivalents* in NAFO Divisions 2J3KL from 1983 to
1994 and Divisions 3NO from 1984 to 1995. This paper has the corrected swept area used in the
abundance estimates from the surveys in Divisions 2J and 3K. (Stansbury 1996).

Methods

Standardized (for tow distance) length frequencies for cod from 1983 to spring 1995 in NAFO Divs.
2J3KLNO were converted to Campelen *equivalents*. Conversion factors as calculated by Warren (1996,
1997) were applied as follows.

The new numbers at 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 = length class midpoint

and $a = 10.857058$ b$= -2.654115$ c$=0.00307$ for *Gadus to Teleost* for all x_i and

a$= 17.508391$ b$= -5.172109$ c $= 0.059024$ for *Needler to Templeman* when $20 <= x_i <= 87$

and $\beta = 24.39$ for $x_i < 20$ and $\beta = .6345$ for $x_i > 87$

The new converted length frequencies are summed to give converted number of cod on a set by set bases. Annual and divisional length-weight regression parameters are applied to the converted length frequencies to give converted weights for each set. Tow distance wing spread and duration are set to 0.8 Nm, 55.25 ft and 15 minutes respectively for the Campelen trawl. It should be noted that in Stansbury (1996) parameters for STRAT1 and STRAT2 (Smith and Somerton 1981) where not changed to the Campelen values. This has now been corrected and used in the runs on the new converted set details and length frequency to calculate biomass and abundance estimates for 2J, 3KLNO. A multiplicative model is used to fill in missing strata.

Result

Mean number per tow (table 1-4) by age index as calculated from Strat1 show a skewness toward younger fish (Fig. 1 & 2). The abundance index at age 2 shows the greatest difference between the two gears with the Campelen/Engels ratio greater than 6 for some years in 2J3KL and as much as 16 in 1992 3NO (Fig. 3 & 4). The Campelen displays a greater variability over the time series. At age 6 the two indices show the same trends and the Campelen/Engels ratio is approximately 1.4 for 2J3KL and 1.25 for 3NO. At older ages (age 9) the Campelen/Engels ratio is less than 1 for both stocks indicating larger and older fish will not be sampled by the Campelen as well as they were in the past. The 1+ abundance index from the Campelen *equivalents* shows much greater variability in the eighties than the Engels (Fig. 5). The decline in survey abundance from 1989 to the present is well demonstrated by either survey trawl for the 2J3kl stock.

Discussion

A length based conversion between the Campelen and the Engels for five of the major groundfish species have been derived in an attempt to keep continuity between past and future groundfish bottom trawl surveys by Canada in the Northwest Atlantic.

From the conversion equations in Warren (1996) (*Gadus/Teleost*) the conversion factor for 16 cm cod is 35 and for 93 cm cod the conversion is 0.41, unity occurring at 64 cm. The conversion factor for the *Needler/Templeman* for a 16-cm cod is 24.39 and for a 93-cm cod is 0.63; unity is at 55 cm. Surveys that are dominated with small fish will show greater Campelen equivalent numbers. Such is the case in the 1988 3K and 1991 3NO surveys.

As age increases the discrepancy between the two gears decrease. At age 8 the two indices overlap and by age 9 the Campelen index is less than the Engels. While the new abundance index shows a greater variability at younger ages our perception of year class strength is not changed. The conversions are very sensitive to numbers at small sizes and there is no conversion for zero catches.

References

Stansbury D.E. 1996. Conversion factors from Comparative Fishing Trials for Engels 145 Otter Trawl on the FRV *Gadus Atlantica* and the Campelen 1800 shrimp Trawl on the FRV *Teleost*

Smith, S. J. and G. D. Somerton. 1981 . STRAP: A user-oriented computer analysis system for groundfish research trawl survey data. Can. Tech. Rep. Fish. Aquat. Sci. 1030: iv + 66p.

Warren, W. G. 1996. Report on the Comparative Fishing Trial Between the *Gadus Atlantica* and *Teleost*. NAFO SCR Doc. 96/28

Warren, W. G. et al. 1997. To be presented NAFO 97. Report on the Comparative Fishing Trial Between the *Wilfred Templeman* and the *Alfred Needler*. NAFO SCR Doc. 97/??.

Table 1. Mean number per tow of cod from autumn RV surveys in NAFO Divisions 2J3KL as calculated using the conversion from Warren 1996 and the catches from the Campelen 1800 in 1995 and 96.

Campelen [1]

2J3KL	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
1						26.49	7.85	0.58	3.23	4.44	18.12	13.75	8.44	0.73	0.25	0.09	0.11	1.58	0.38
2						58.68	52.62	9.81	14.81	12.42	19.41	66.33	16.98	10.22	2.48	3.05	0.51	0.97	1.37
3						41.65	53.05	29.73	20.48	8.02	14.48	33.08	48.74	14.80	5.89	2.03	0.71	0.74	0.85
4						24.08	31.67	32.81	55.20	9.25	7.51	21.96	29.59	41.55	4.54	1.72	0.31	0.30	0.41
5						15.93	19.82	16.18	62.23	22.83	8.67	12.16	13.54	18.47	4.52	0.51	0.12	0.12	0.15
6						4.67	10.93	10.25	30.82	17.22	15.21	9.74	6.93	4.58	1.75	0.31	0.03	0.06	0.04
7						2.67	2.37	4.76	13.08	5.05	13.51	10.34	4.29	1.29	0.39	0.06	0.02	0.01	0.03
8						5.48	1.35	0.86	5.77	2.97	2.82	5.44	4.12	0.54	0.04	0.01	0.01	0.00	0.00
9						2.77	1.93	0.71	1.31	1.41	1.58	1.44	1.60	0.35	0.02	0.00	0.00	0.00	0.00
10						1.20	1.12	0.61	0.51	0.31	0.77	0.73	0.50	0.15	0.01	0.00	0.00	0.00	0.00
11						0.27	0.41	0.33	0.57	0.13	0.13	0.33	0.19	0.04	0.00	0.00	0.00	0.00	0.00
12						0.07	0.16	0.12	0.36	0.15	0.08	0.10	0.10	0.02	0.01	0.00	0.00	0.00	0.00
13						0.02	0.04	0.03	0.09	0.08	0.07	0.04	0.03	0.00	0.00	0.00	0.00	0.00	0.00
1 plus						183.96	183.32	106.77	208.47	84.28	102.36	175.44	135.05	92.75	19.89	7.77	1.81	3.79	3.24

1 1983 to 1994 are Campelen equvilants

Table 2. Mean number per tow of cod from autumn RV surveys in NAFO Divisions 2J3KL using the original data from the Engels 145.

2J3KL	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
1	0.02	0.41	0.27	0.16	0.51	1.04	0.36	0.02	0.14	0.21	0.59	0.66	0.40	0.03	0.01	0.00	0.01
2	0.40	0.32	3.00	1.59	2.49	6.09	5.57	1.10	1.85	1.56	2.14	8.25	1.91	1.34	0.29	0.37	0.05
3	5.39	1.94	2.48	5.11	5.88	12.31	10.79	7.27	4.77	2.04	3.93	8.98	10.93	3.35	1.78	0.60	0.16
4	11.51	11.78	3.83	2.74	5.93	10.65	15.23	12.35	20.70	4.03	3.20	8.30	12.95	13.97	2.30	0.83	0.13
5	13.95	16.79	13.23	3.26	3.83	10.88	11.34	10.01	31.29	13.23	5.29	6.20	8.61	9.00	2.72	0.34	0.08
6	5.51	10.53	13.31	9.67	2.79	3.88	9.59	7.28	21.29	11.61	10.57	6.52	5.64	3.31	1.42	0.22	0.02
7	1.62	2.27	4.99	8.78	5.82	2.44	2.30	4.24	10.14	4.38	10.13	8.23	3.90	1.10	0.35	0.04	0.02
8	0.63	0.92	1.19	3.66	5.31	5.35	1.37	0.92	5.26	2.67	2.58	4.84	3.98	0.50	0.04	0.01	0.01
9	0.47	0.31	0.37	0.74	2.59	2.94	2.09	0.78	1.37	1.38	1.55	1.62	1.68	0.35	0.02	0.00	0.00
10	0.33	0.26	0.23	0.23	0.57	1.42	1.30	0.67	0.58	0.34	0.79	0.98	0.55	0.16	0.01	0.00	0.00
11	0.12	0.19	0.11	0.10	0.16	0.36	0.54	0.41	0.68	0.17	0.15	0.43	0.23	0.04	0.00	0.00	0.00
12	0.09	0.06	0.16	0.11	0.09	0.14	0.28	0.15	0.42	0.19	0.11	0.16	0.12	0.02	0.01	0.00	0.00
13	0.06	0.04	0.05	0.10	0.07	0.13	0.12	0.06	0.19	0.13	0.08	0.10	0.04	0.01	0.00	0.00	0.00
1 plus	40.11	45.80	43.21	36.23	36.03	57.63	60.87	45.25	98.68	41.96	41.11	55.29	50.93	33.18	8.96	2.41	0.48

Table 3. Mean number per tow of cod from spring RV surveys in NAFO Divisions 3NO as calculated using the conversion from Warren 1997.

3NO	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
1	0.16	0.37	0.38	5.00	0.18	0.38	0.90	0.57	0.00	0.00	0.00	0.00
2	53.39	9.88	12.77	54.15	26.45	4.77	7.25	147.62	10.07	1.17	0.22	0.76
3	41.57	29.27	3.63	14.13	12.91	10.39	6.77	15.44	9.66	58.27	0.91	0.20
4	21.35	16.14	17.87	19.67	1.02	2.40	3.80	1.59	0.24	53.63	1.63	0.04
5	7.17	2.76	11.53	50.35	0.47	0.34	1.46	0.47	0.11	1.25	1.05	0.15
6	5.04	0.90	2.11	26.41	1.10	0.31	0.25	0.16	0.09	0.68	0.07	0.10
7	1.51	1.03	0.82	7.38	1.13	0.61	0.41	0.07	0.03	0.46	0.12	0.01
8	0.72	0.66	0.58	1.71	0.66	0.52	0.52	0.06	0.03	0.22	0.07	0.02
9	1.36	0.84	0.42	1.63	0.67	0.36	0.61	0.14	0.08	0.05	0.07	0.05
10	1.15	1.18	0.61	0.54	0.75	0.40	0.46	0.12	0.11	0.08	0.02	0.01
11	0.61	0.88	1.02	0.70	0.35	0.51	0.34	0.11	0.13	0.17	0.04	0.01
12	0.25	0.48	0.51	0.60	0.44	0.33	0.34	0.09	0.14	0.12	0.05	0.02
13	0.10	0.23	0.31	0.68	0.69	0.27	0.16	0.12	0.12	0.07	0.07	0.05
14+	0.255	0.380	0.404	0.592	1.070	0.894	1.275	0.530	0.354	0.240	0.093	0.057
1+	134.64	64.99	52.96	183.54	47.88	22.47	24.53	167.06	21.17	116.40	4.42	1.45

Table 4. Mean number per tow of cod from spring RV surveys in NAFO Divisions 3NO using the original data from the Engels 145.

| 3NO	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
1	0.01	0.01	0.02	0.21	0.01	0.02	0.04	0.02	0.00	0.00	0.00	0.00
2	3.29	0.41	0.68	2.73	1.68	0.25	0.47	6.30	0.65	0.14	0.01	0.05
3	6.21	4.50	0.69	2.80	2.23	1.90	0.96	1.24	4.42	13.86	0.15	0.05
4	9.92	6.09	7.54	9.18	0.46	1.10	1.34	0.60	0.17	18.32	0.69	0.01
5	5.30	2.43	6.32	34.30	0.41	0.28	1.10	0.41	0.10	1.09	0.84	0.10
6	5.61	0.89	1.58	20.91	1.07	0.30	0.24	0.18	0.13	0.69	0.14	0.09
7	1.87	0.98	0.67	8.20	1.18	0.68	0.47	0.13	0.05	0.59	0.16	0.01
8	1.00	0.74	0.64	1.75	0.78	0.62	0.61	0.17	0.03	0.28	0.09	0.02
9	1.81	0.89	0.49	1.91	0.82	0.44	0.73	0.34	0.11	0.07	0.10	0.06
10	1.57	1.35	0.72	0.68	0.87	0.48	0.51	0.22	0.13	0.10	0.02	0.01
11	0.86	0.99	1.17	0.76	0.44	0.64	0.42	0.18	0.16	0.20	0.05	0.01
12	0.32	0.49	0.64	0.70	0.55	0.42	0.41	0.11	0.17	0.15	0.06	0.01
13	0.11	0.24	0.35	0.80	0.79	0.33	0.22	0.15	0.15	0.08	0.09	0.05
14+	0.22	0.39	0.51	0.76	1.25	1.00	1.65	0.72	0.13	0.08	0.02	0.10
1+	38.10	20.40	22.02	85.69	12.53	8.46	9.16	10.77	6.40	35.65	2.42	0.57
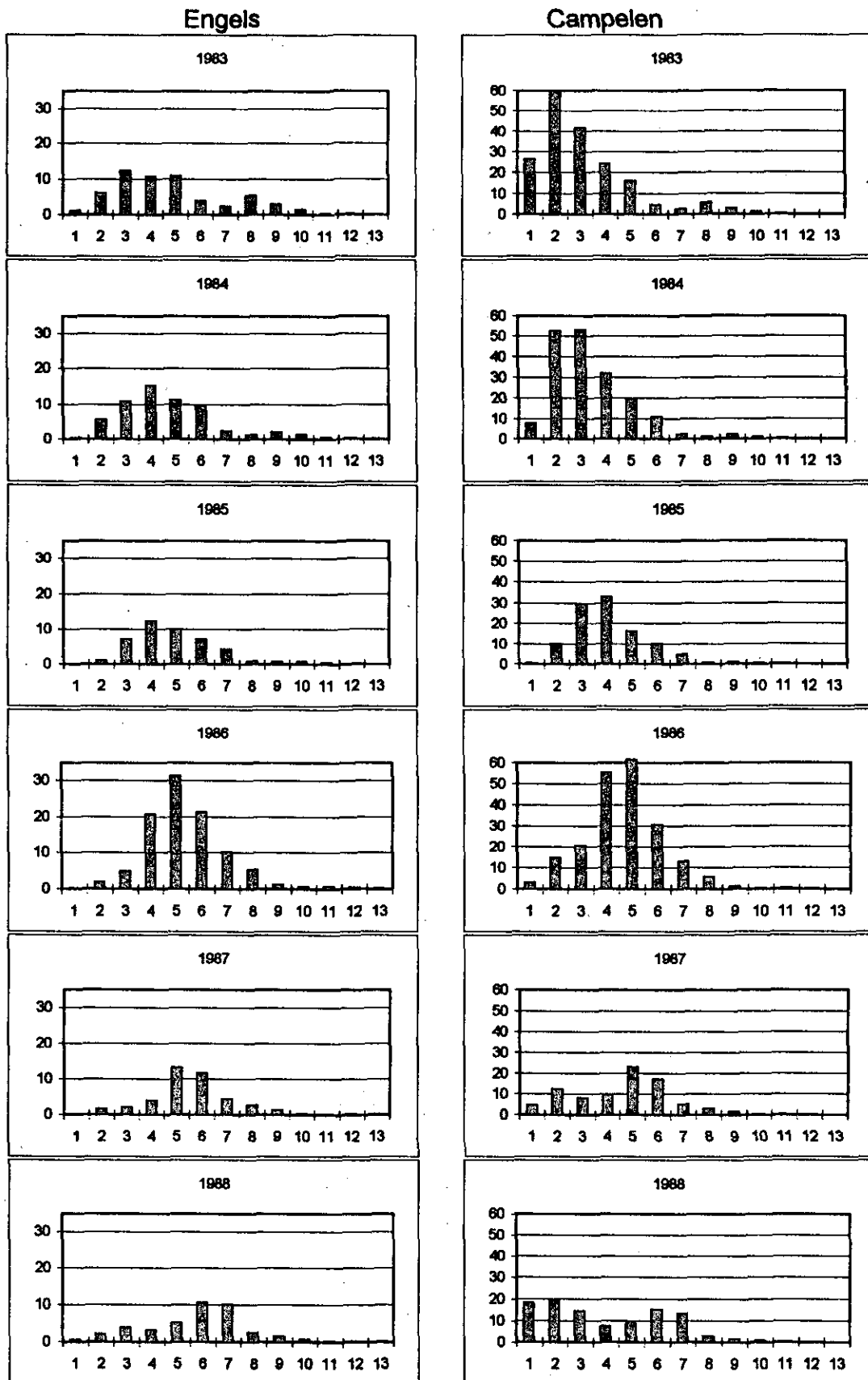
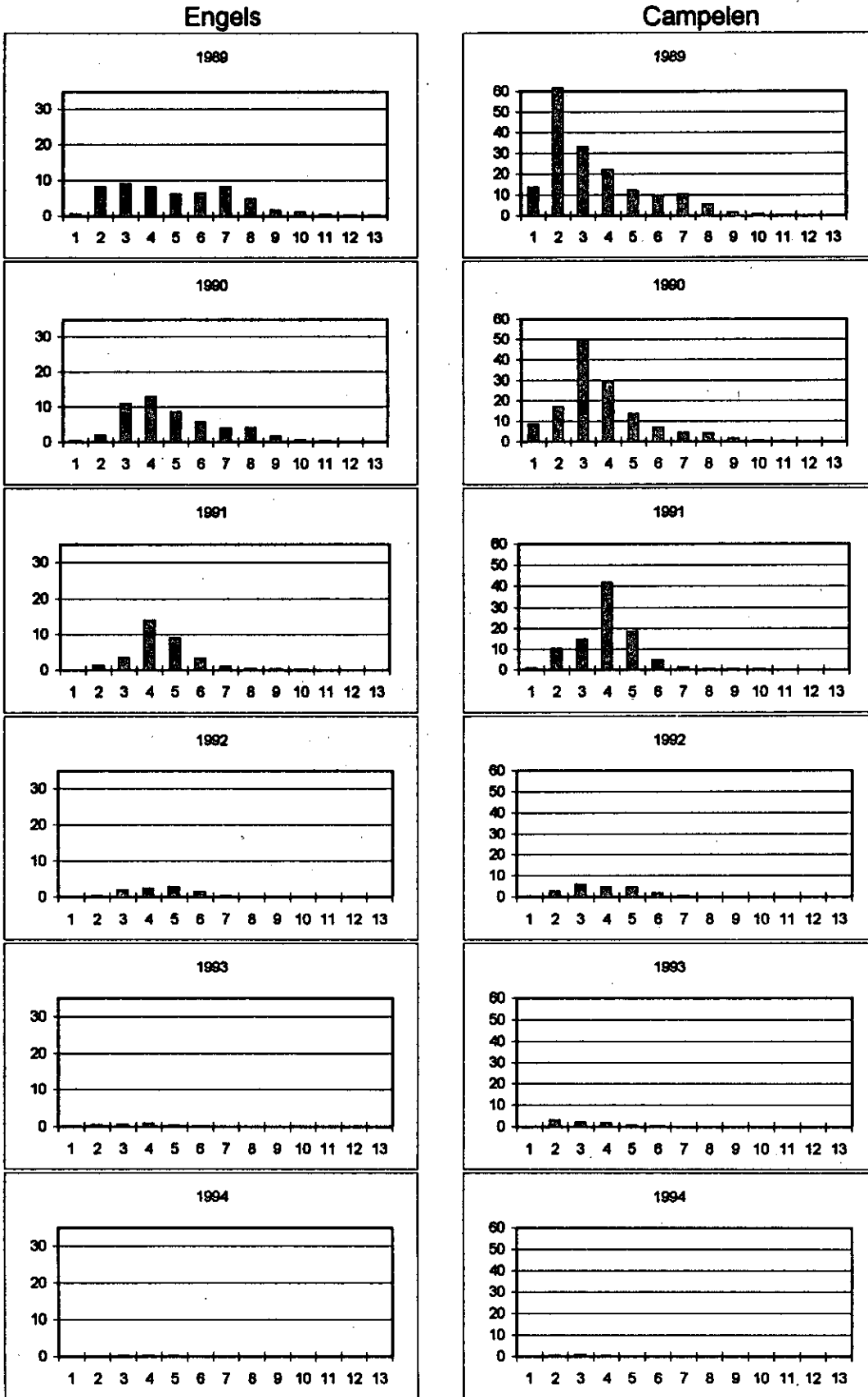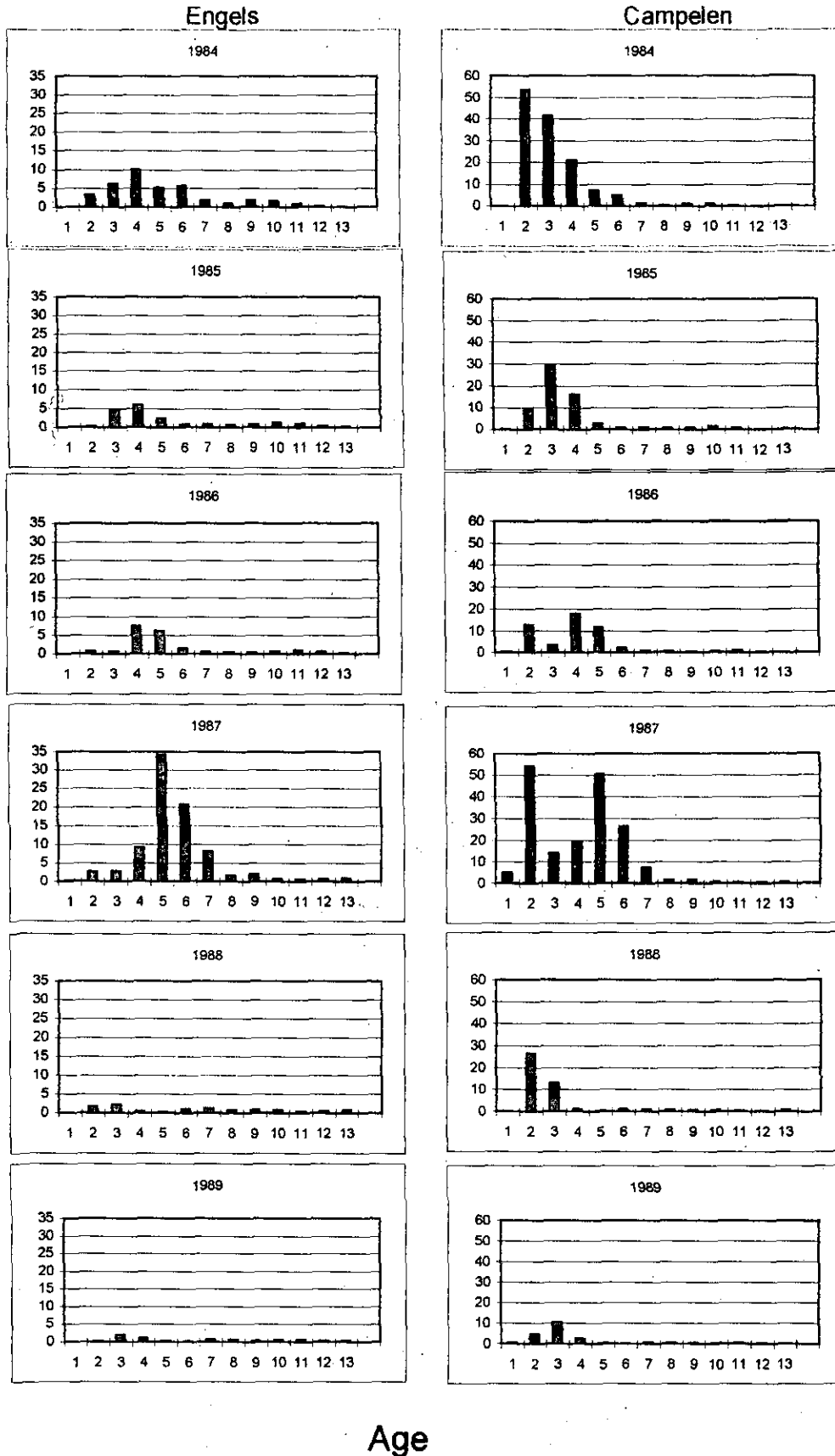Fig 1. Age frequency histograms by year in 2J3KL for the original data (Engels) and converted (Campelen) 1983-1994.
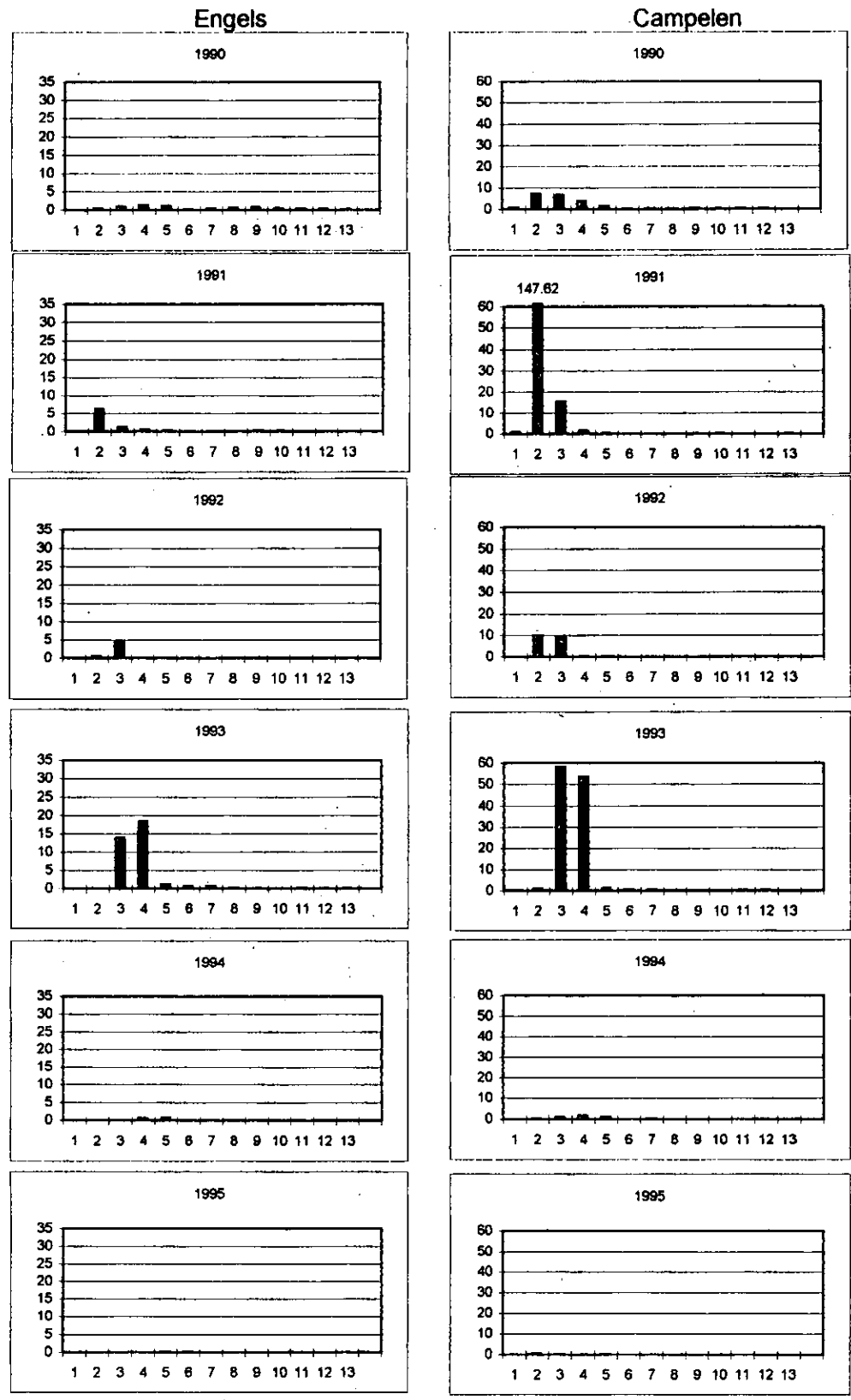
Fig. 1. (continued)

Fig 2. Age frequency histograms by year in 3NO for the original data (Engels) and converted (Campelen) 1983-1994 .
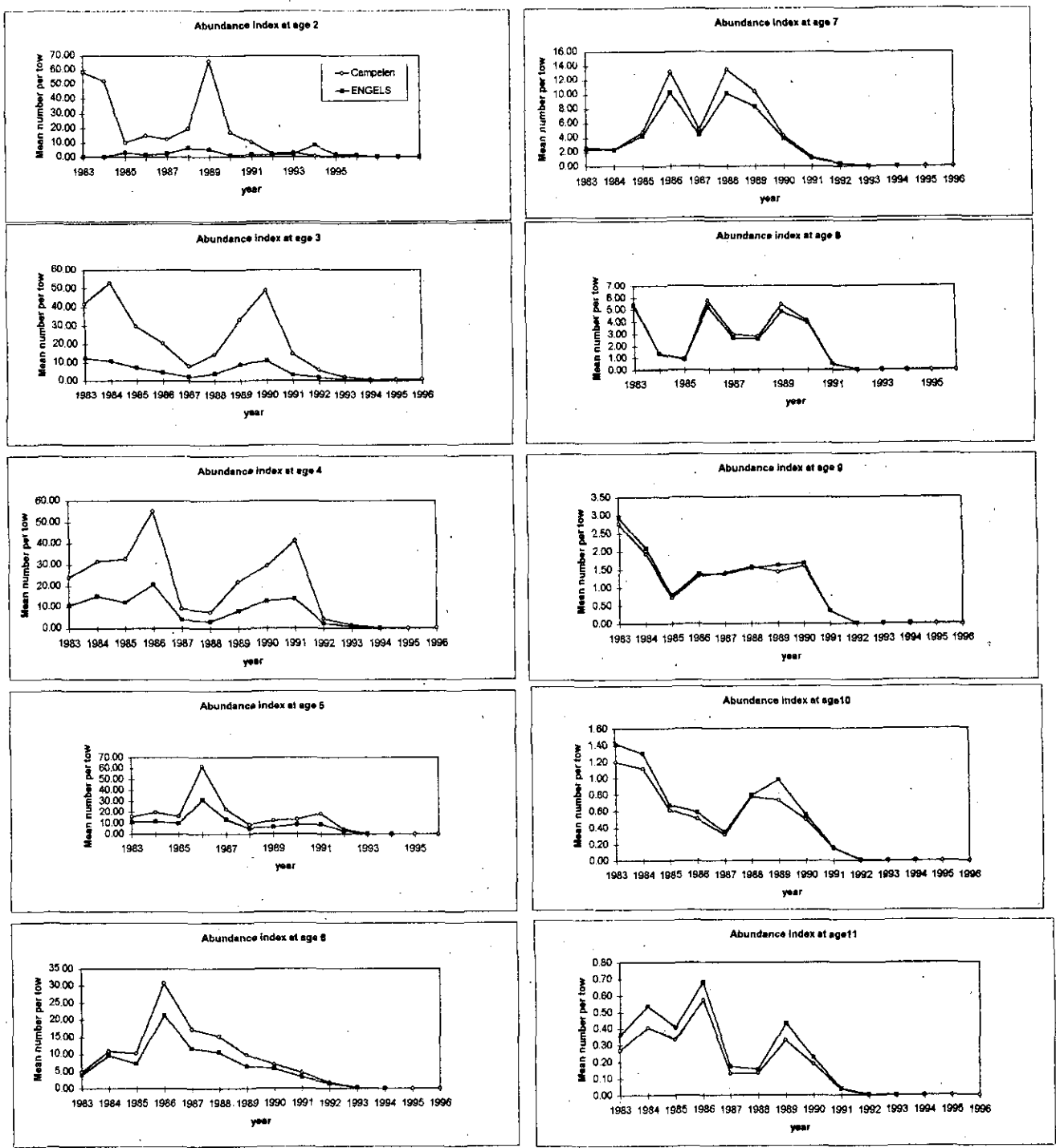
Fig. 2. (continued)

Fig 3. Campelen and Engels mean number per tow by age for the 2J3KL cod stock.

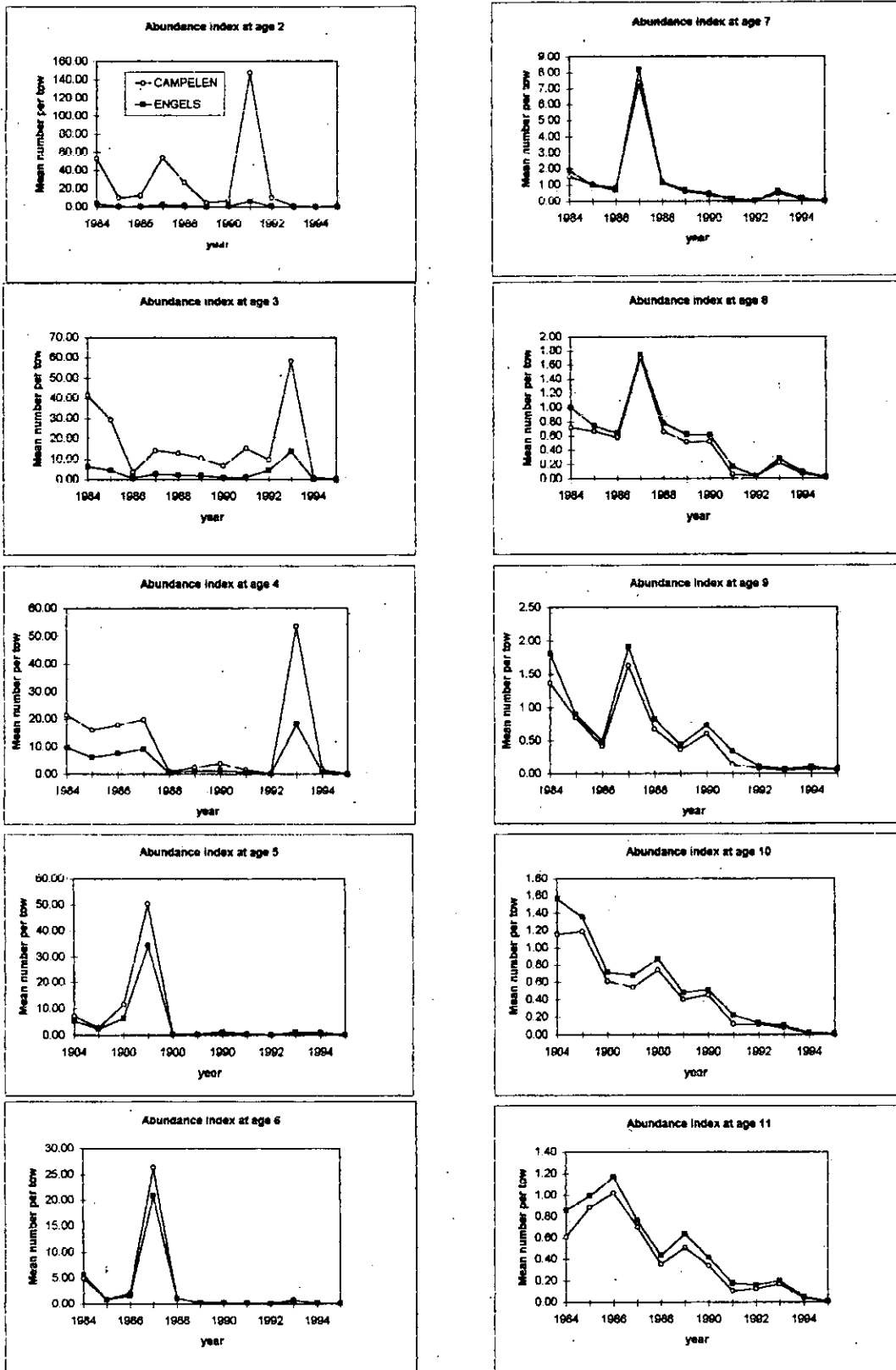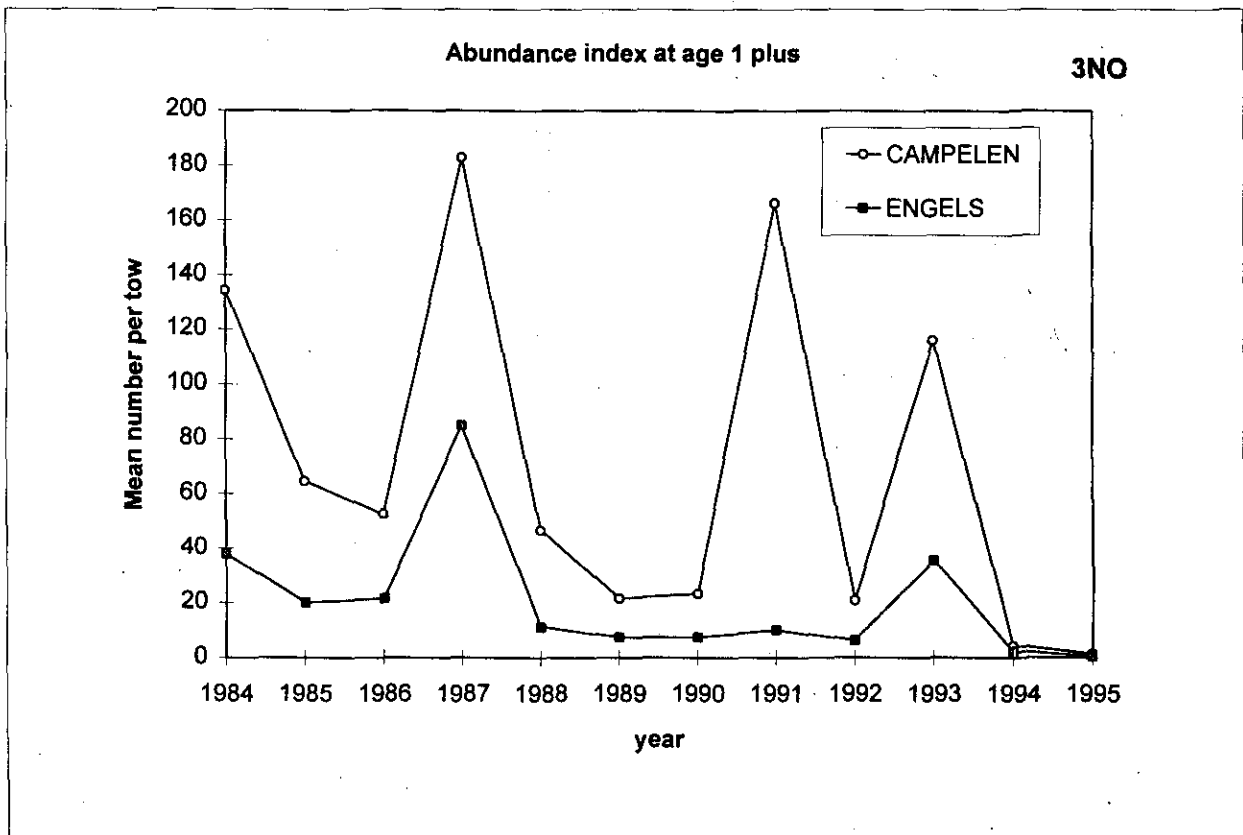Fig 4. Campelen and Engels mean number per tow by age for the 3NO cod stock
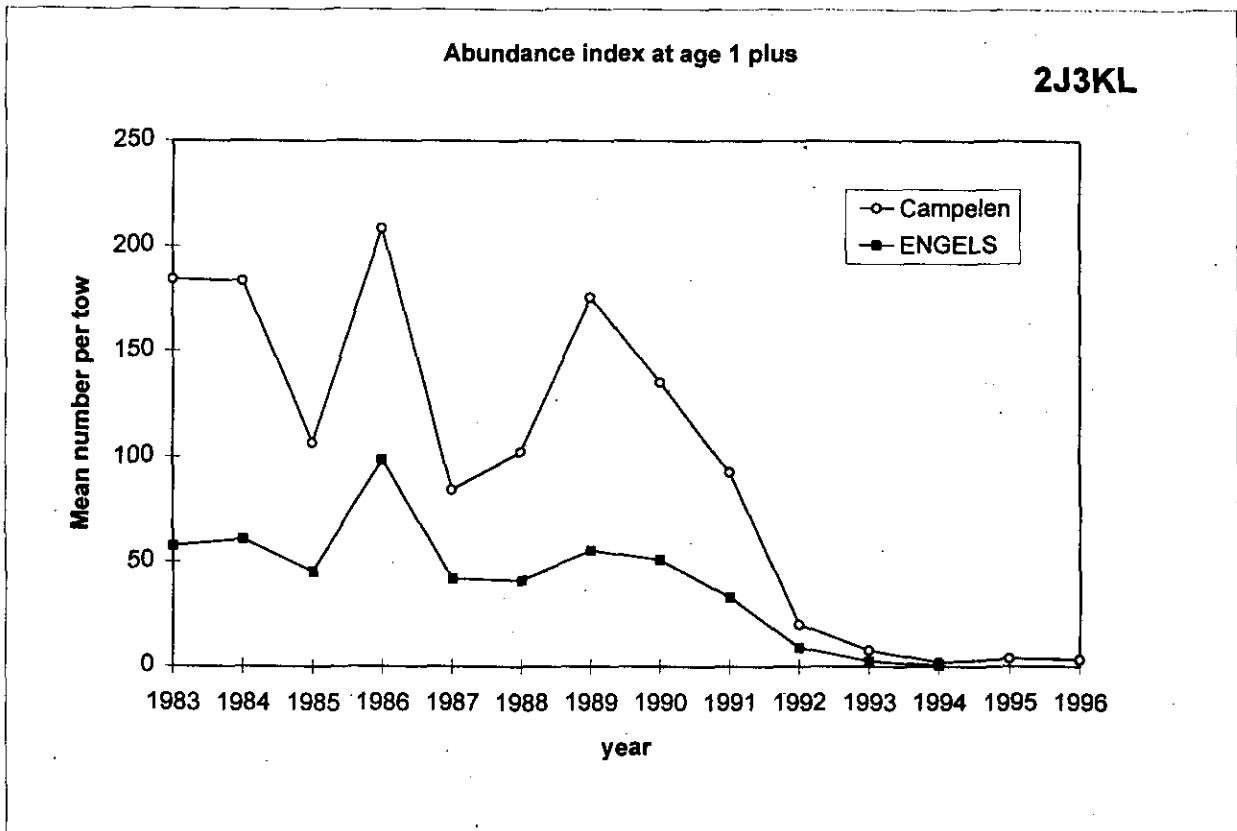
Fig 5.   Abundance index at age 1+ for cod stock s in Divisions 2J3KL and 3NO.