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Conversion factors from Comparative Fishing Trials for Engel 145 Otter Trawl on the  
FRV Gadus Atlantica and the Campelen 1800 shrimp Trawl on the FRV Teleost

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 foot gear was introduced.

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 foot gear and the *FRV Teleost*. A total of 285 successful paired tows were  
conducted in the winter of 1995. Detail of the fishing trials are outlined in Warren  
(1996). An analysis between the two vessel/gear configurations gave conversion factors  
for five groundfish species. This paper illustrates the effect of the conversion from  
Gadus/Engels to Teleost/Campelen *equivalents* for Atlantic cod (*Gadus morhua*) and  
Greenland halibut (*Reinhardtus hippoglassoides*) in NAFO Divs. 2J3K from 1978 to  
1994.

**Methods**

Two options were considered for applying the conversion factors:

1. Apply conversion factor to the population at length or
2. Apply conversion on the numbers at length on a set by set bases.

Under the first approach annual Atlantic cod and Greenland halibut abundance at length  
from autumn stratified random surveys were calculated for NAFO Divs. 2J, 3K, and 3L  
separately from years 1978 to 1994 in 2J3K and 1981 to 1994 in 3L. Conversion  
factors as calculated by Warren (1996) were applied to calculate Campelen *equivalents* as  
follows.

$$y = \beta * n_i$$

where

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

$n_i$  = population at length

$x_i$  = length class midpoint

and  $a = 10.857058$   $b = -2.654115$   $c = 0.00307$  for Atlantic cod and

$a = 14.123825$   $b = -4.850857$   $c = 0.0910797$  for Greenland halibut

when  $10 \leq x_i \leq 53.26$  and  $(\beta = 0.7347$  for  $x_i > 53.26$  and  $\beta = 47.7$  when  $x_i < 10$ ).

In the second approach Campelen *equivalents* were calculated by applying the conversion factor on a set by set bases to the length frequencies. Here  $n_i$  = number at length in the set. Population estimates can then be calculated at age using the annual age length keys for each NAFO division.

## Results

The ratio of annual population estimates from the Campelen *equivalents* to the Engels is negatively correlated with the mean length in the population for both species. This relationship is significant in divisions 2J and 3K but not in 3L for Atlantic cod (Fig 1a). The annual ratio is between 1 and 6 in 2J, 1 and 5 in 3K and around 3 in 3L. Greenland halibut also shows a negative relationship with mean length (Fig 1b). Reduction in mean length over time is evident in survey for both species.

Cumulative length distributions show a greater number at the smaller sizes for the Campelen (Fig. 2). This is most evident when a new, relatively strong year class was sampled by the Engel.

Population at age as calculated in the second approach also shows an increase in younger smaller fish, in years however, when the Engels sampled older Atlantic cod (>10) the conversion has substantially reduced them (Fig 3a) i.e. will not be sampled by the Campelen. This trend does not hold for Greenland halibut (Fig 3b,c). Both methods of applying the conversion equations, to the whole population or on a set by set basis, are consistent.

Annual abundance index for Atlantic cod and Greenland halibut show the same trend for both gears. The estimate for 1983 in 2J for Atlantic cod using the Campelen however is much higher than expected (Fig. 4 Table 1.). This is also reflected in the length frequency. The Campelen in 3K demonstrates a more rapid decline in cod from 1989 to 1992 than the Engels.

For Greenland halibut there is a divergence in the estimates of abundance from 1991 to 1994 in 2J between gears although both indices are increasing (Fig 4b Table 2). Campelen estimates in NAFO division 2J are more variable.

## 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) 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 a 10 cm Greenland halibut is 47.7 and for 53.36 cm and larger the conversion factor is 0.7347. Unity for Greenland halibut is at 36 cm. Surveys that are dominated with small fish will show a greater Campelen *equivalent*. Such is the case in the 90's for Greenland halibut.

The Teleost/Campelen to Gadus/Engels conversion cannot be applied to the *FRV Templeman*/Engels. The two Engels trawls differ in mesh size and rigging (McCallum and Walsh 1996). Comparative fishing will have to continue for the Templeman to obtain conversion factors.

Our perception of the historic time series of size and abundance at age in NAFO Divs. 2J3KL will change for both species when the data are converted to *Campelen equivalent* units. The conversions are very sensitive to number at small size. Also, older larger cod are poorly sampled with the Campelen gear.

## Acknowledgments

I like to acknowledge Mr. D. Orr for his efforts in the preparation of the data and to Dr. J. Morgan for her contributions.

**References:**

McCallum, B.R. and S. J. Walsh 1996. Groundfish survey trawls used at the Northwest Atlantic Fisheries Centre, 1971 - present. NAFO SCR Doc 96/50

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

**Atlantic cod**

YEAR	DIV						2J3KL	
	2J		3K		3L		ENGELS	CAMPELEN
	ENGELS	CAMPELEN	ENGELS	CAMPELEN	ENGELS	CAMPELEN		
	000's	000's	000's	000's	000's	000's	000's	000's
78	98,643	195,057	80,120	146,996	.	.	178,762	342,054
79	81,130	127,980	129,310	193,447	.	.	210,440	321,427
80	104,461	162,437	69,485	113,803	.	.	173,946	276,240
81	94,989	165,901	79,602	129,720	60,719	178,568	235,310	474,189
82	117,458	293,934	61,791	116,807	55,689	288,251	234,938	698,992
83	181,072	613,566	91,908	244,862	94,570	318,622	367,550	1177050
84	139,366	406,299	94,131	247,202	.	.	233,497	653,501
85	120,104	336,539	51,653	114,588	126,023	343,804	297,779	794,931
86	302,092	683,494	225,616	487,606	121,402	266,369	649,110	1437469
87	117,569	225,381	71,587	156,399	87,500	227,393	276,656	609,173
88	136,669	278,881	54,871	250,813	78,427	180,780	269,967	710,474
89	105,703	354,218	210,391	715,223	48,578	125,480	364,673	1194921
90	36,801	144,952	171,930	531,638	127,195	292,166	335,926	968,756
91	52,613	199,707	130,327	355,047	42,036	108,025	224,977	662,779
92	4,336	17,348	10,410	34,078	44,984	113,524	59,731	164,950
93	1,688	9,368	4,463	20,587	11,948	35,900	18,099	65,855
94	912	4,604	1,342	5,323	1,137	3,351	3,391	13,278

Table 1. Abundance estimates from NAFO Divs. 2J and 3K (1978-94) and 3L (1981-94).

Greenland halibut

YEAR	DIV					
	2J		3K		2J3K	
	ENGELS	CAMPELEN	ENGELS	CAMPELEN	ENGELS	CAMPELEN
	000's	000's	000's	000's	000's	000's
77	89,778	114,327			89,778	114,327
78	97,964	178,773	178,941	379,244	276,904	558,016
79	80,435	149,580	91,430	126,559	171,865	276,138
80	55,445	73,655	92,821	113,192	148,266	186,847
81	72,541	169,197	112,068	188,025	184,610	357,221
82	92,618	116,045	101,287	132,152	193,905	248,197
83	66,103	69,964	133,189	166,150	199,292	236,114
84	77,039	95,501	149,899	169,814	226,938	265,316
85	59,036	122,081	126,629	227,669	185,665	349,750
86	73,272	86,649	185,692	301,495	258,965	388,143
87	49,893	77,853	162,959	273,474	212,852	351,327
88	40,205	55,458	176,872	274,023	217,077	329,481
89	68,025	95,147	185,053	313,340	253,078	408,486
90	72,374	91,559	143,680	198,808	216,054	290,366
91	29,772	57,955	98,620	167,135	128,392	225,090
92	30,155	78,269	80,724	226,527	110,880	304,797
93	46,047	111,668	186,947	482,393	232,994	594,062
94	51,466	147,397	112,041	345,260	163,508	492,657

Table 2. Abundance estimates from NAFO Divs. 2J and 3K.

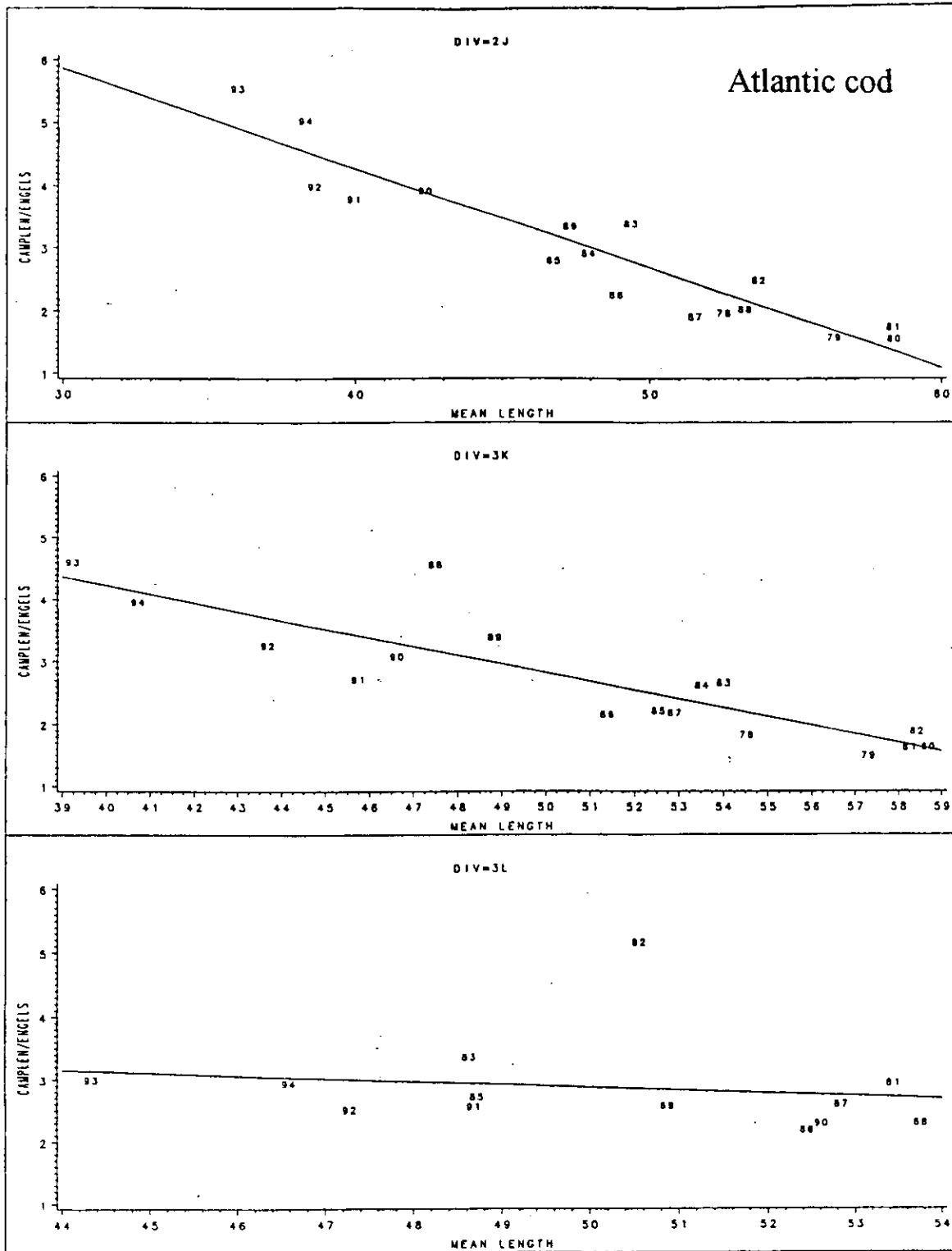


Fig. 1a Ratio of annual population estimates for Atlantic cod from Campelen and Engels vs. mean length of the population in NAFO Divs. 2J, 3K and 3L for 1978 to 1994.

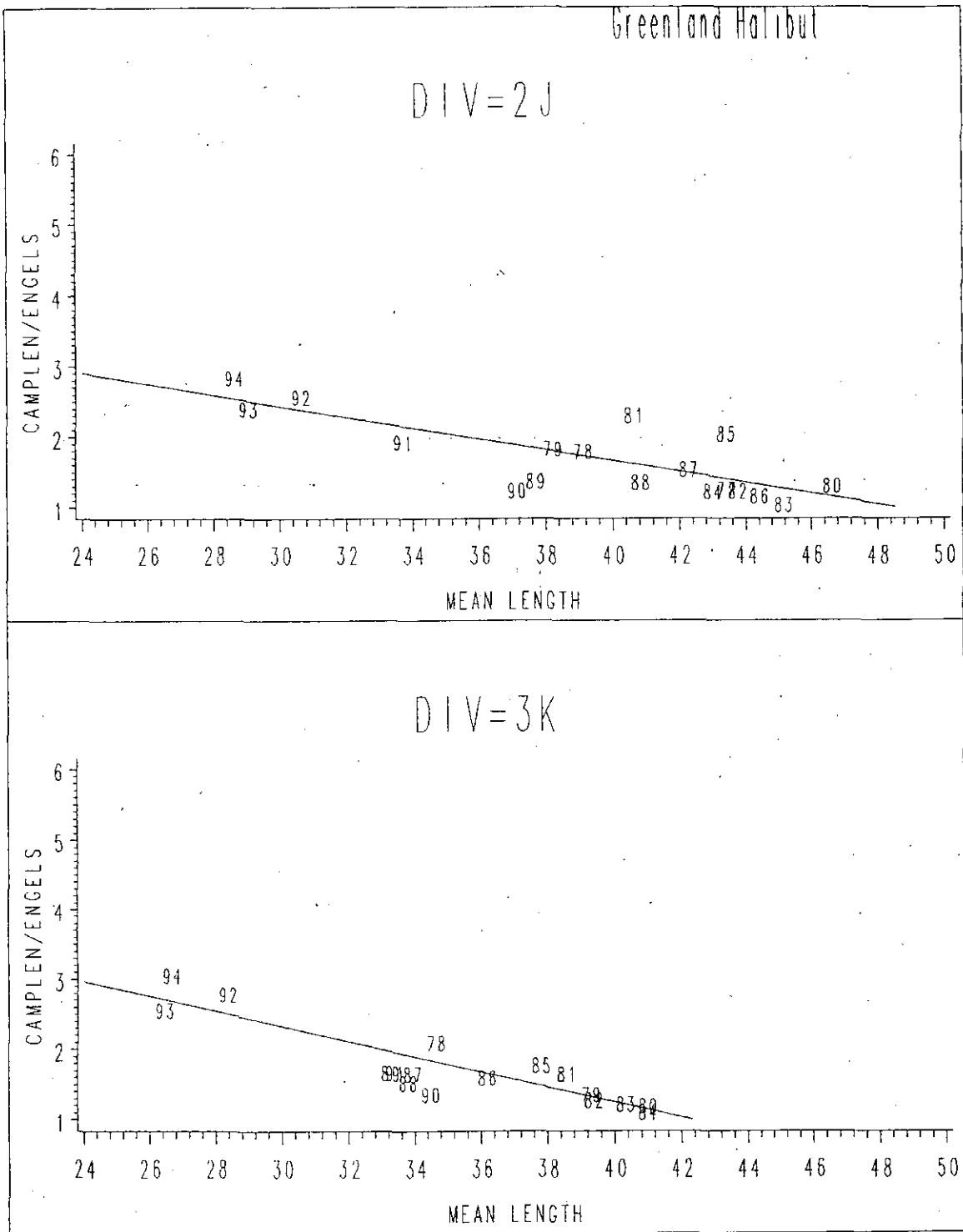


Fig. 1b Ratio of annual population estimates for Greenland halibut from Campelen and Engels vs. mean length of the population in NAFO Divs. 2J, 3K and 3L for 1978 to 1994.

Atlantic cod

CUMULATIVE PERCENT

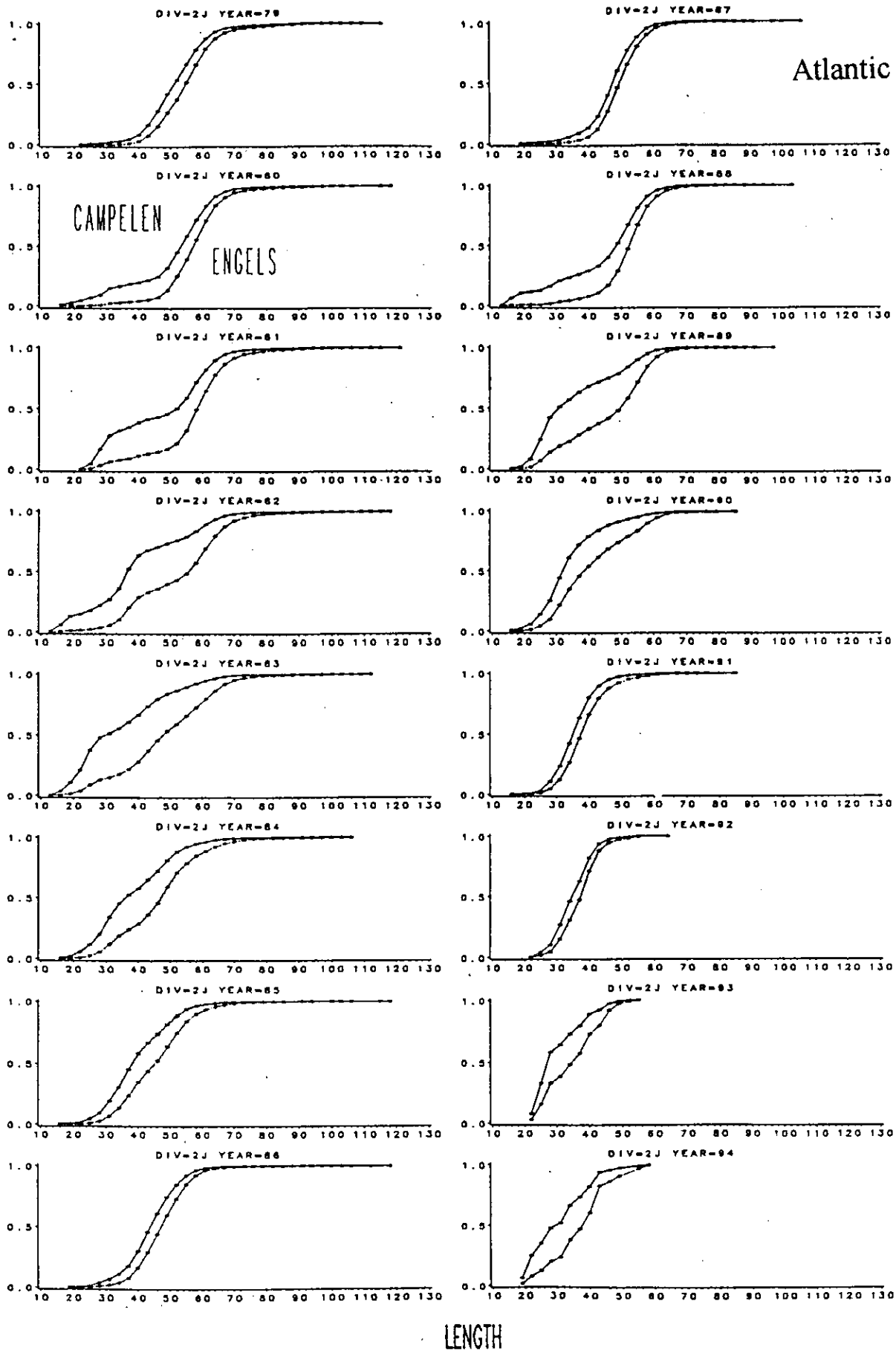


Fig 2a. Cumulative length distribution for Atlantic cod in NAFO division 2J from 1979-94

CUMULATIVE PERCENT

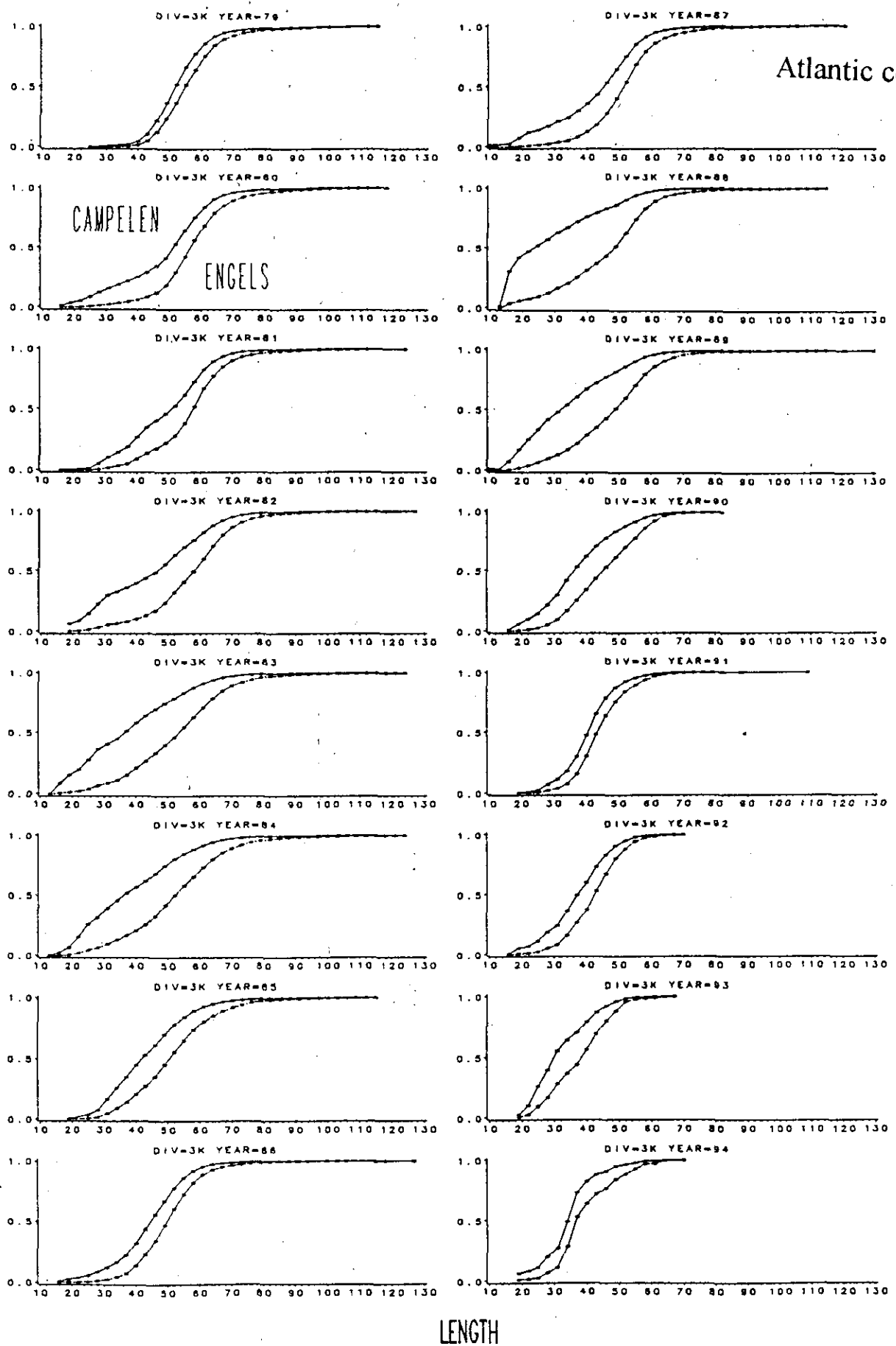


Fig 2b. Cumulative length distribution for Atlantic cod in NAFO division 3K from 1979-94



# Greenland Halibut

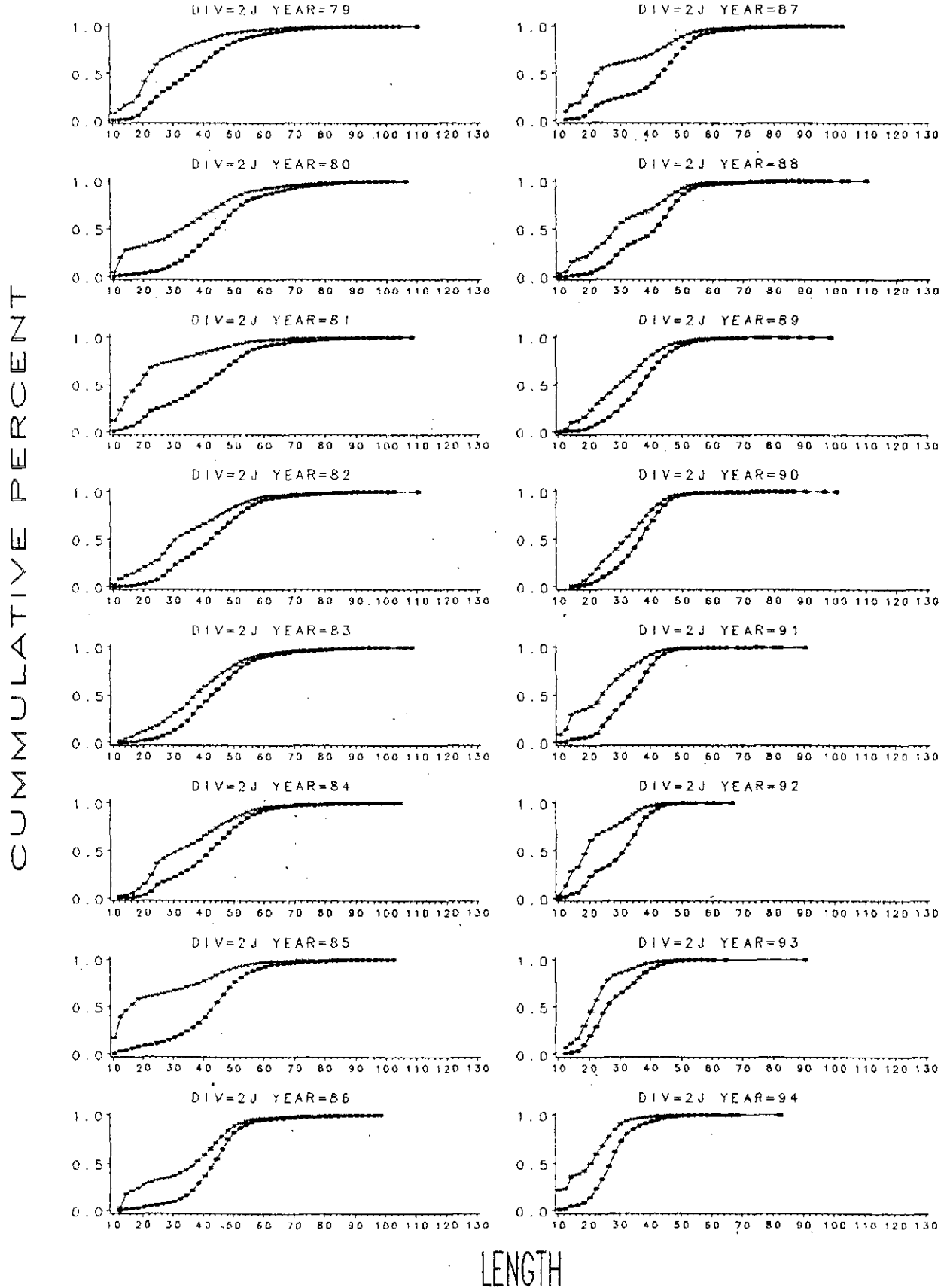


Fig 2c. Cumulative length distribution for Greenland halibut in NAFO division 2J from 1979-94.

# Greenland Halibut

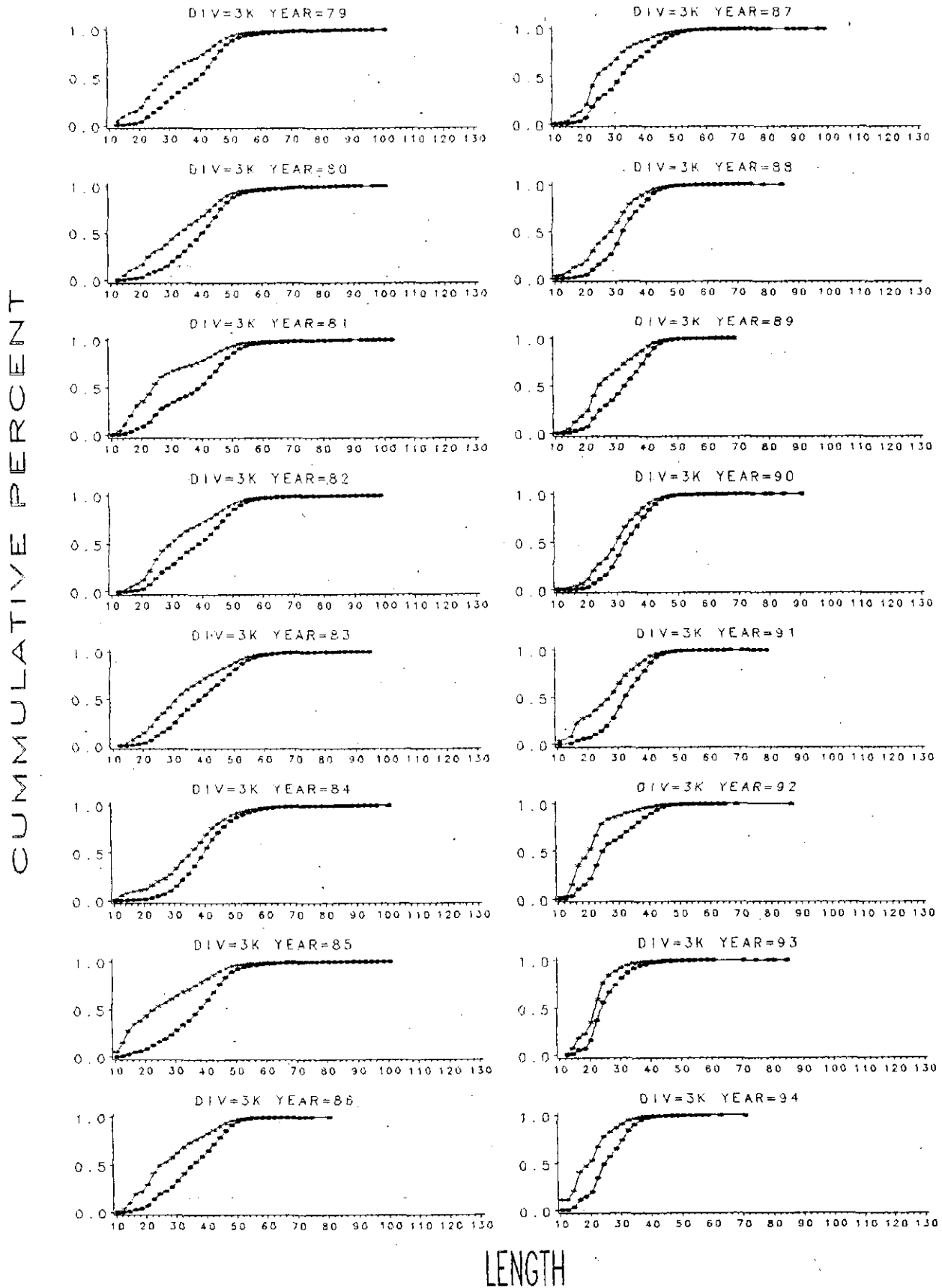


Fig 2d. Cumulative length distribution for Greenland halibut in NAFO division 3K from 1979-94.

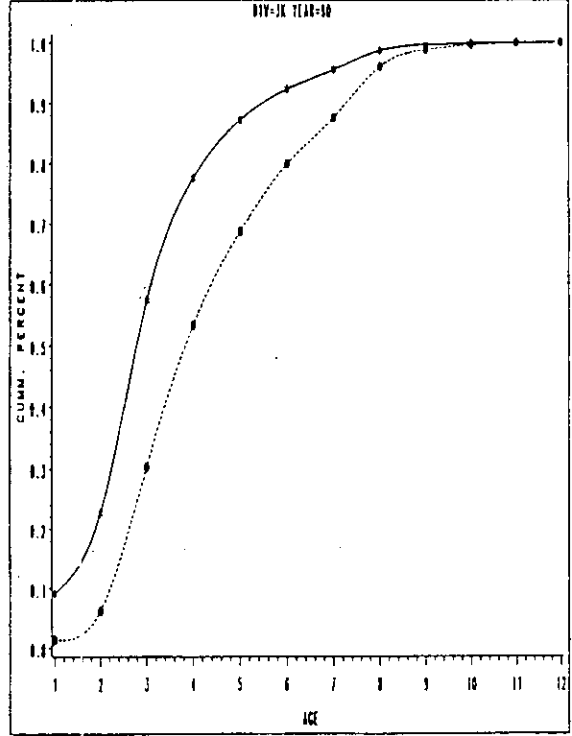
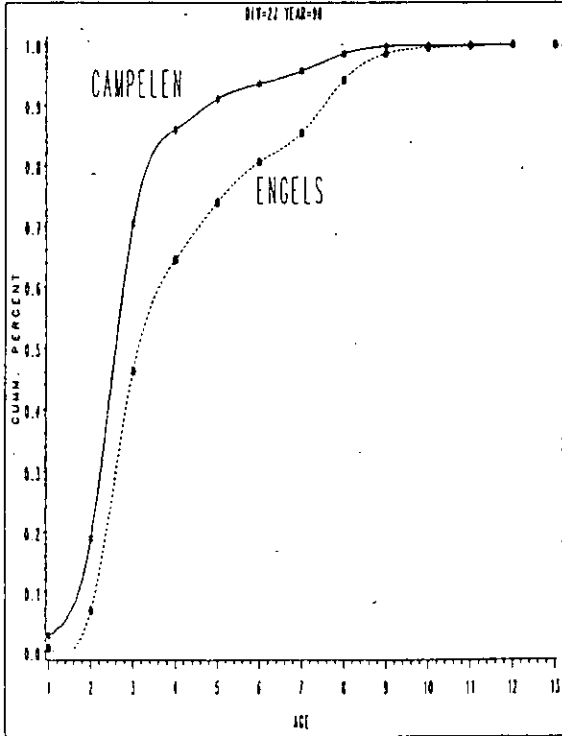
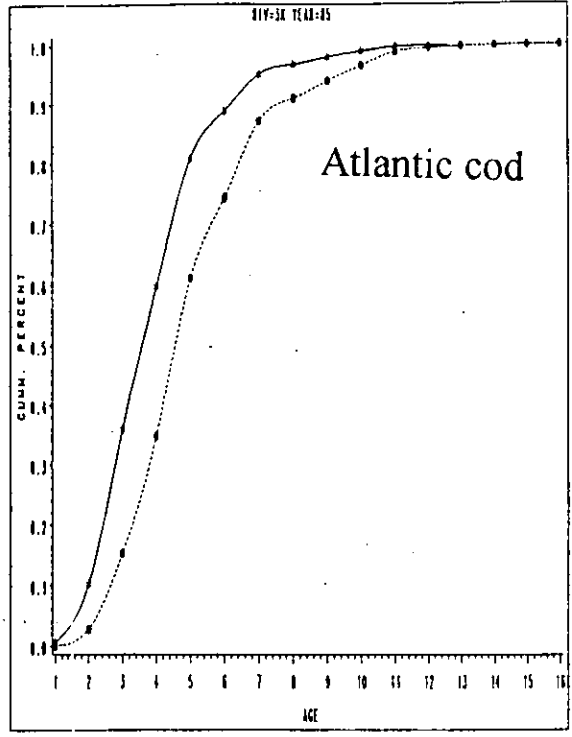
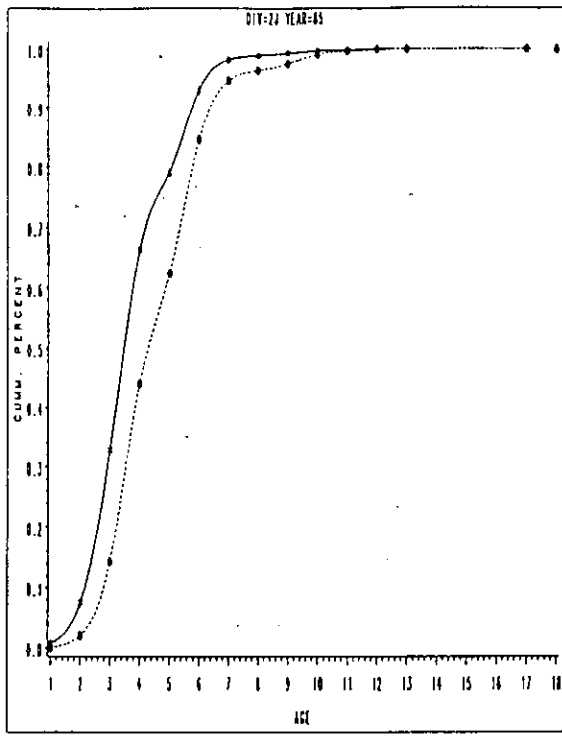


Fig 3a. Cumulative age distribution for Atlantic cod in NAFO division 2J and 3K in 1985 and 1990.

### Greenland Halibut

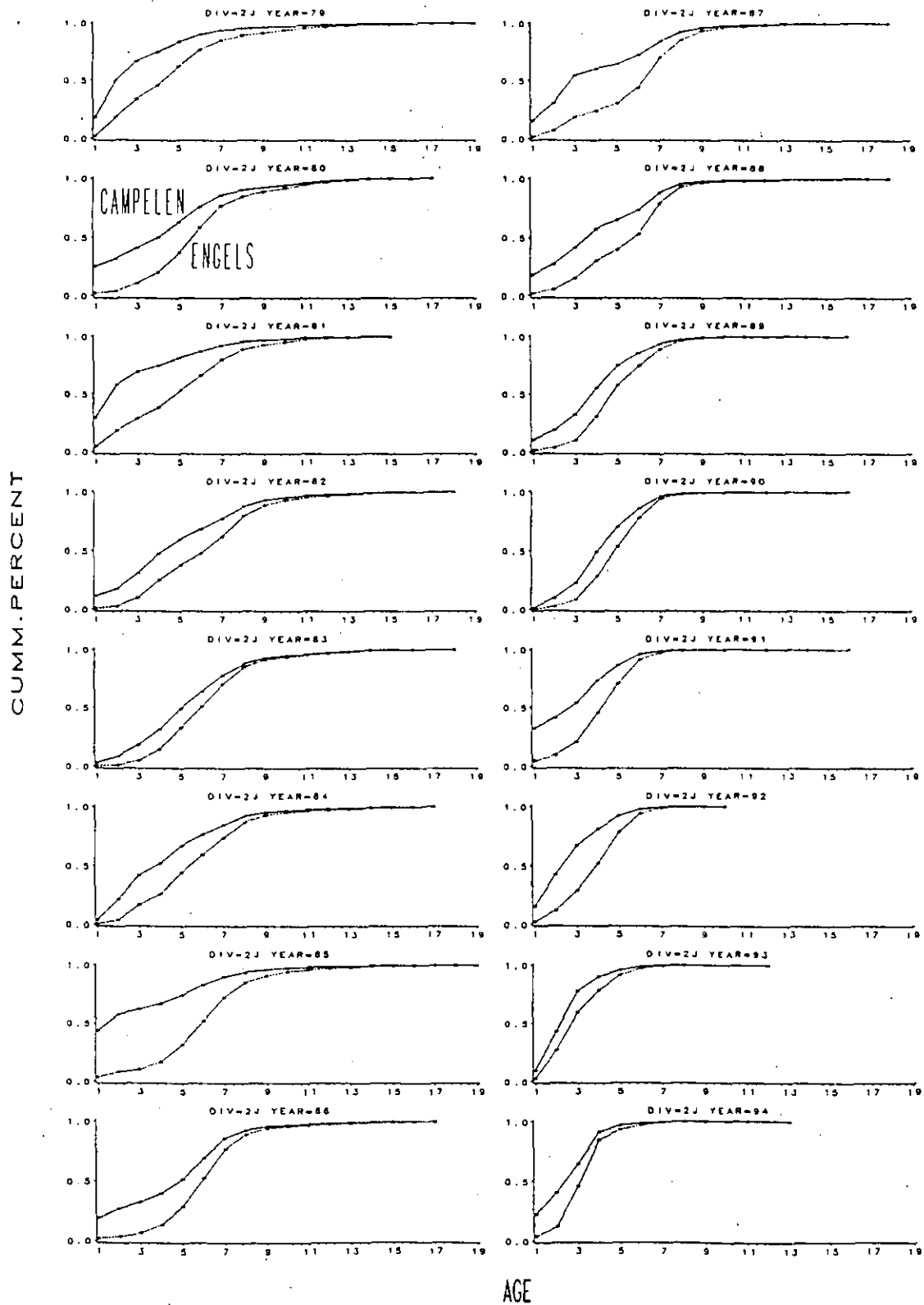


Fig 3b. Cumulative age distribution for Greenland halibut in NAFO division 2J from 1979-94.

### Greenland Halibut

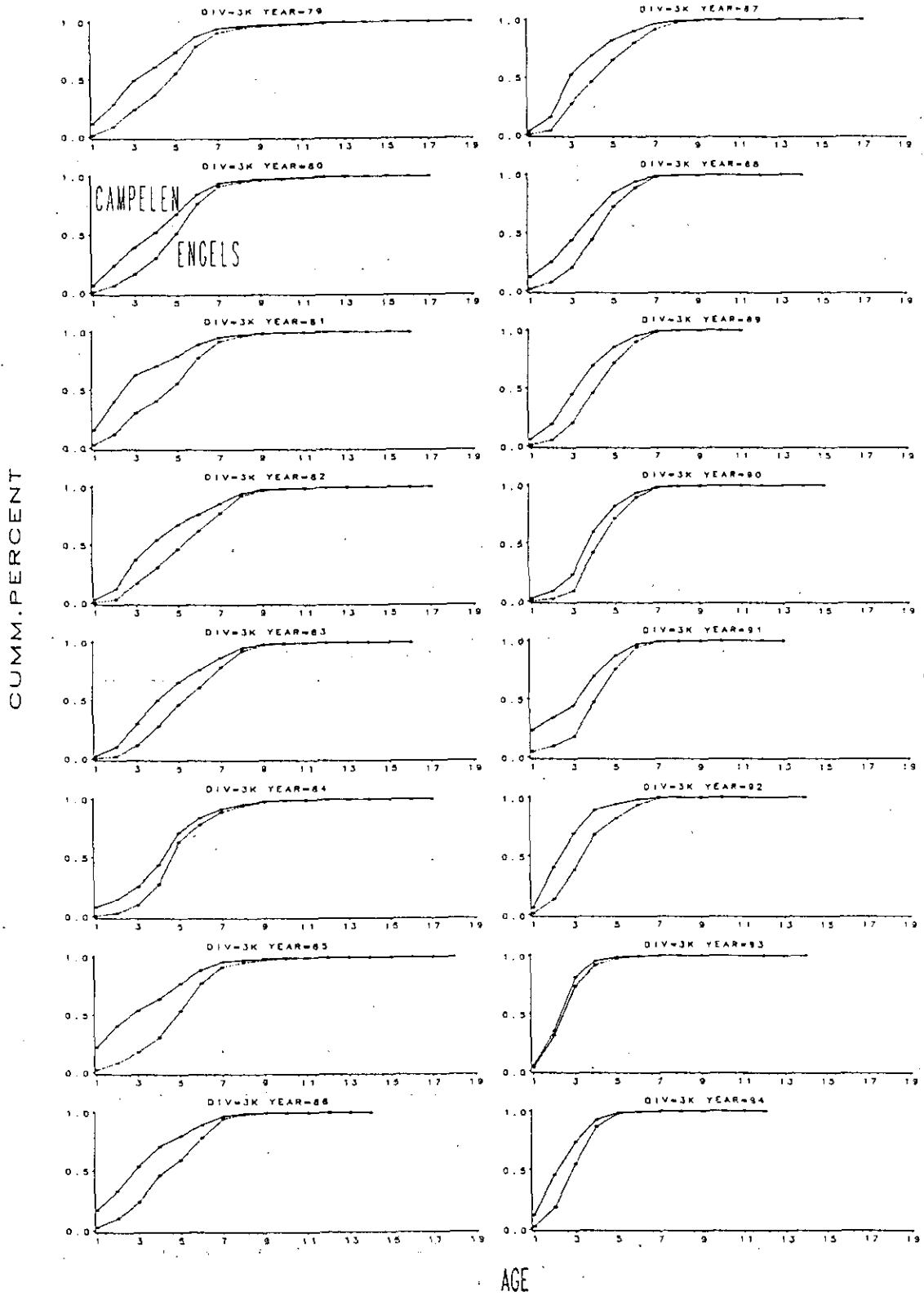


Fig 3c. Cumulative age distribution for Greenland halibut in NAFO division 3k from 1979-94.

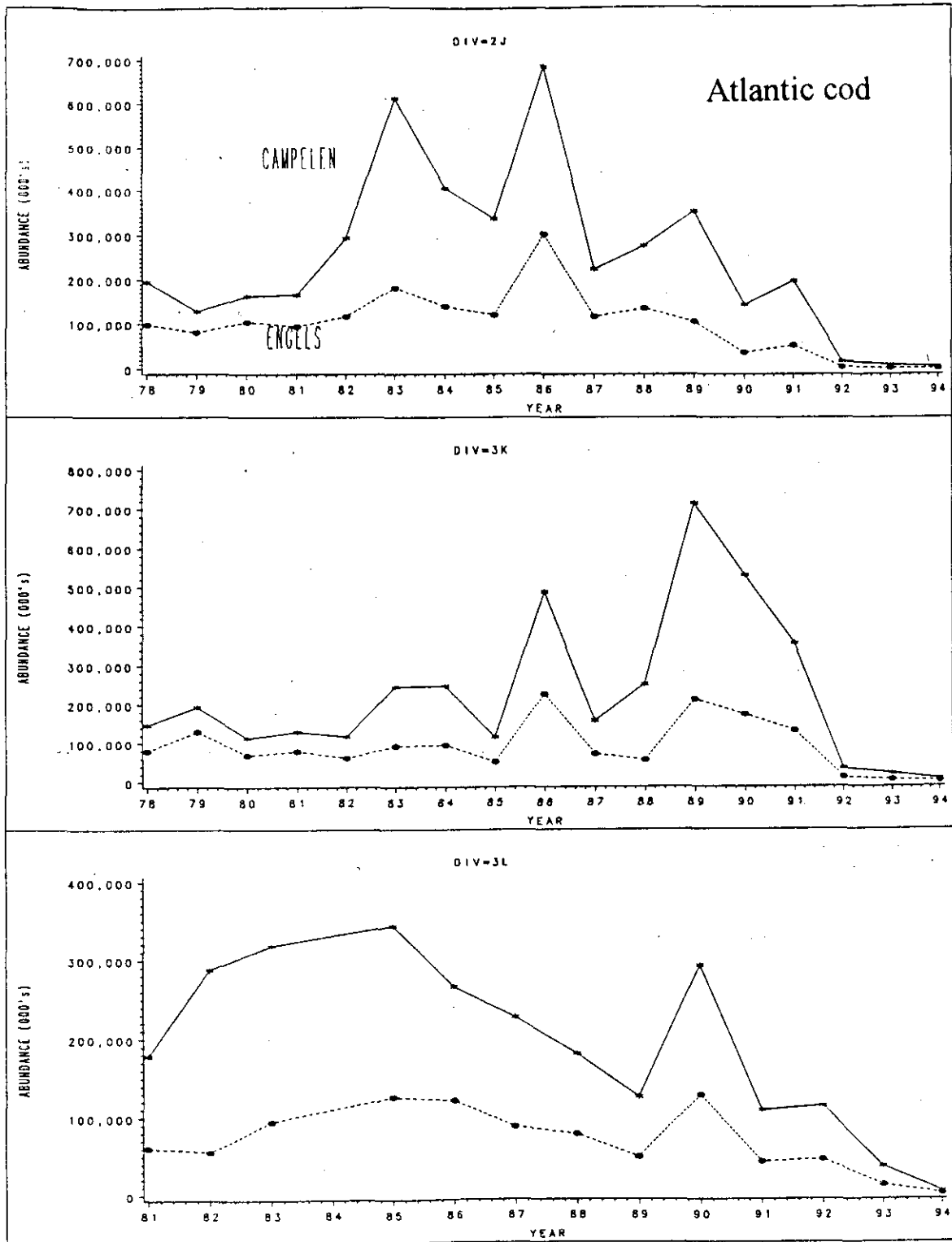


Fig 4a. Campelen and Engels estimates of abundance from the NAFO Divs. 2J and 3K (1978-94) and 3L (1981-94) for Atlantic cod.

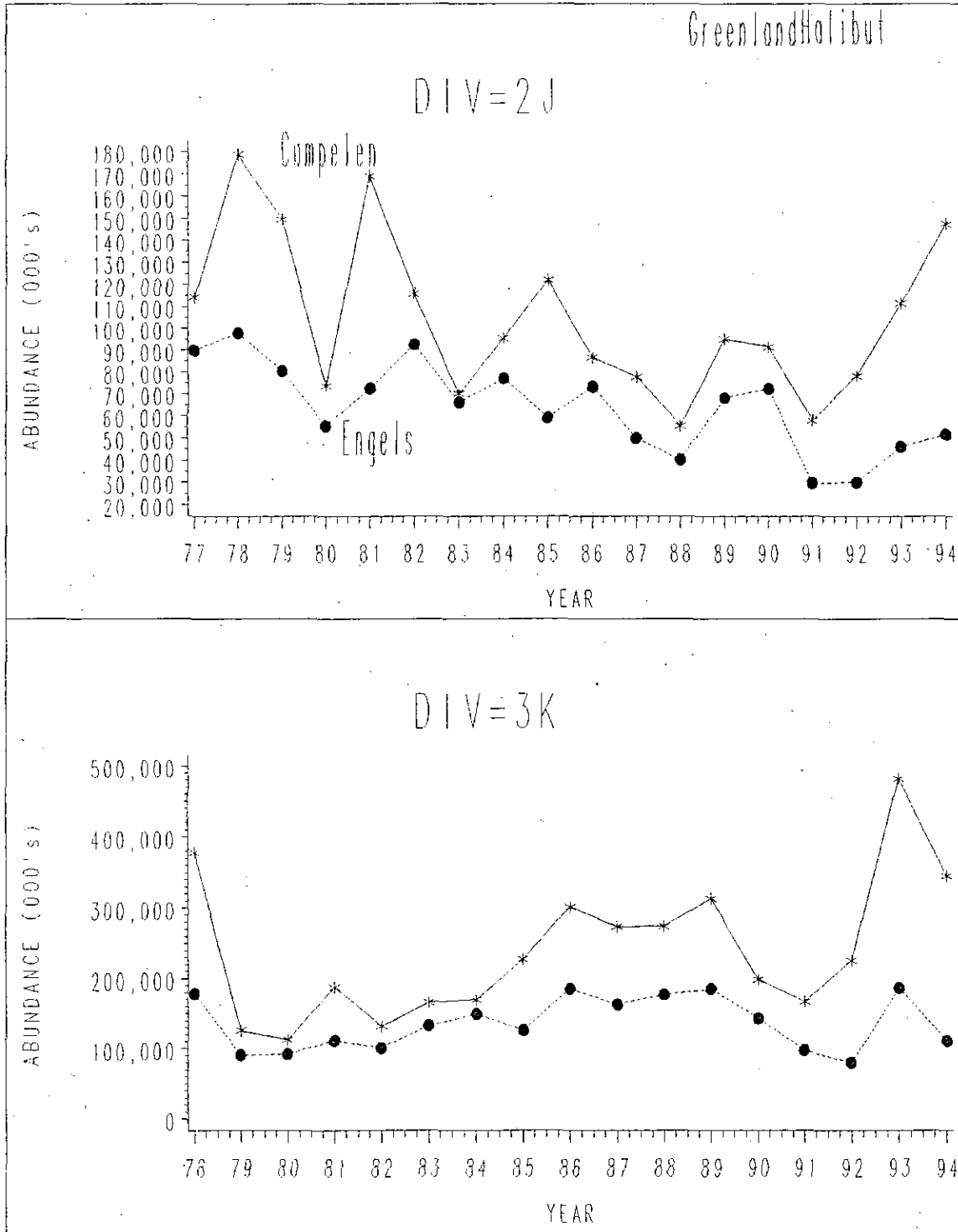


Fig. 4b. Campelen and Engels estimates of abundance from the NAFO Divs. 2J and 3K (1978-94) for Greenland halibut.