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Preliminary Results on Growth and Age Determination of Pandalus borealis (Kröyer) in Periodiclaly Enclosed Fjord Populations

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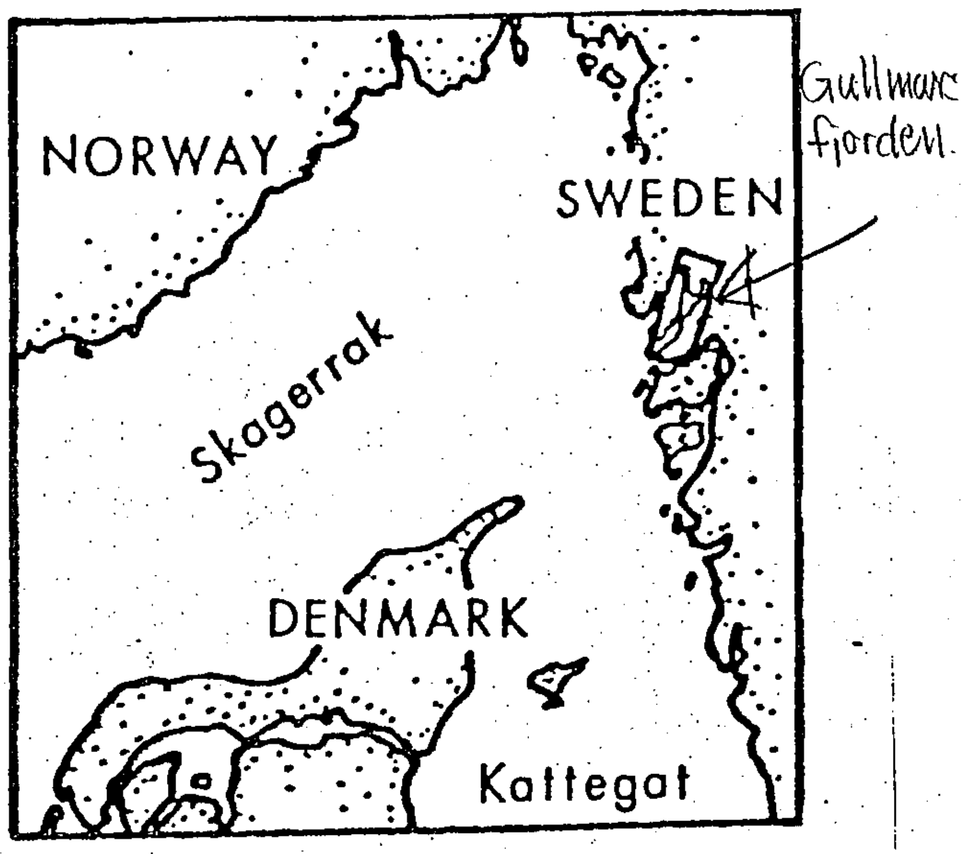
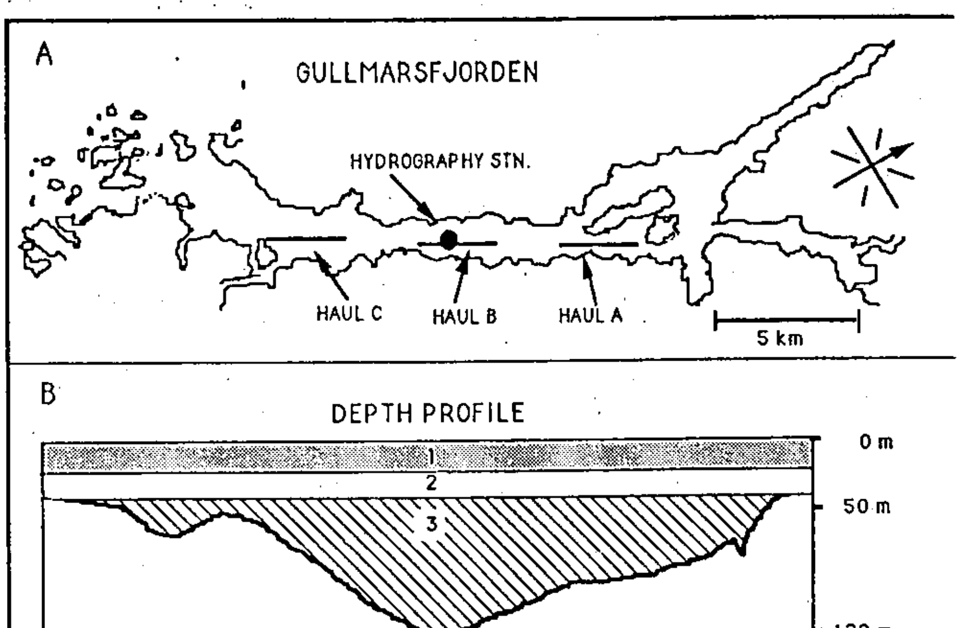
In the Gullmarfjord on the Swedish west coast a small stock of *Pandalus borealis* is found. This stock of shrimp seems to form true, albeit short-lived (8-12 months) populations during the yearly deep water stagnation periods in the fjord. These populations are enclosed by the combined effect of a stratified water-mass above sill depth, the environmental requirements of adult shrimp and fjord bottom topography. In the four studied years (1984-1988) variations in CPUE, sex ratios and size frequency distributions before and after the water exchange indicate that new demographic patterns is produced by migration over the sill area during the water renewal period (late winter-early spring) each year. The consequent stagnation populations develop without migratory contact with the neighbouring Skagerrak stock for 8-12 months until the next deep water exchange.

Based on the size frequency distribution in monthly trawl samples from these stagnation populations, von Bertalanffy growth curves have been calculated for the year-classes 82-85 . Estimates of size at age were generally made from the two or in a few cases, three first cohorts in sample size frequency distributions.
Cohorts were separated with the aid of the ELEFAN I computer programme developed by Pauly & David (1981), plotting of cumulative frequencies on probability paper (Cassie 1954), and common sense.
Fitting of the growth curves were done graphically with the aid of the Excel programme on a Macintosh PC. The resemblance of calculated sizes at age and the empirically found mean sizes were tested with the aid of a two sample chi^2 test. The calculated values are all significant on the 1% level. Based on these von Bertalanffy growth curves (9 sets of data) mean k (0,3896±0,0500, (99%)), and L_∞ (34,920±0,403 mm (99%)) was determined. When comparing the resulting average growth curve with empirical sizes at age the sizes of the youngest cohorts all fall within the confidence level but above the mean curve, while the sizes at age from the older cohorts all fall slightly below the mean growth curve. Sex differentiated growth might be the cause of this difference in growth rate. From the empirical sizes at age it is also apparent that seasonal variations in growth seems to be the rule in the Gullmarfjord. Future work will focus on among other things sex-differentiated growth and the attachment of a sinus function to the von Bertalanffy growth equation in order to describe the seasonal variations in growth.

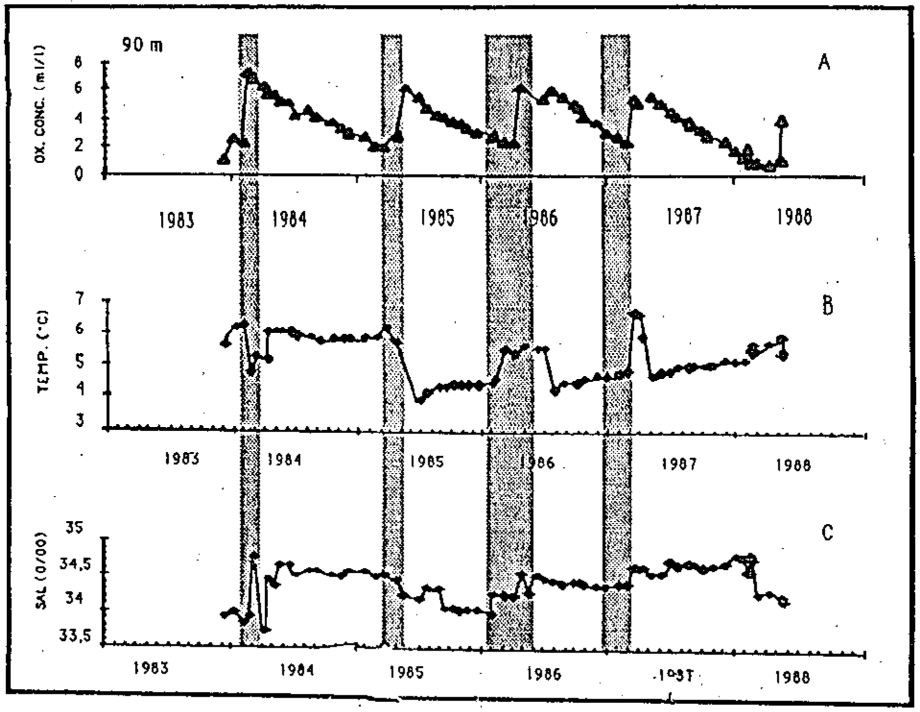




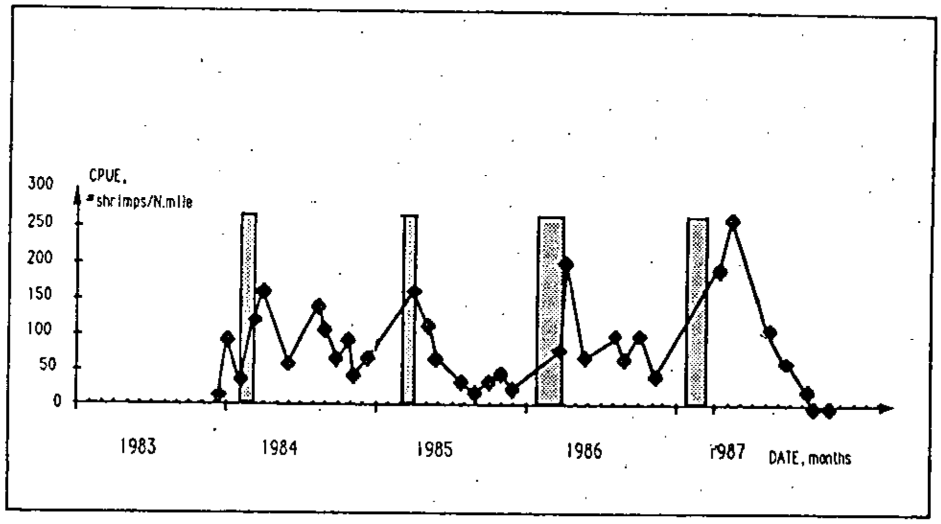
1. WATER WITH LOW AND VARIABLE SALINITY (18-20 0/00) AND VARIABLE TEMPERATURE (-0.2-17 °C)

2. WATER WITH INTERMEDIATE SALINITY (30-34 0/00) AND VARIABLE TEMPERATURE (2-13 °C)

3. WATER OF OCEANIC ORIGIN, SALINITY >34.5 0/00 AND TEMPERATURES BETWEEN 4-6 °C. THE WATER BODY REMAINS STAGNANT FOR 8-12 MONTHS BETWEEN RENEWALS, WHICH OCCUR IN FEB-APRIL.



HYDROGRAPHY AT 90 METERS OF DEPTH IN THE CENTRAL GULLMARFJORD.WATER RENEWAL PERIODS ARE INDICATED BY INCREASES IN OXYGEN CONCENTRATIONS.



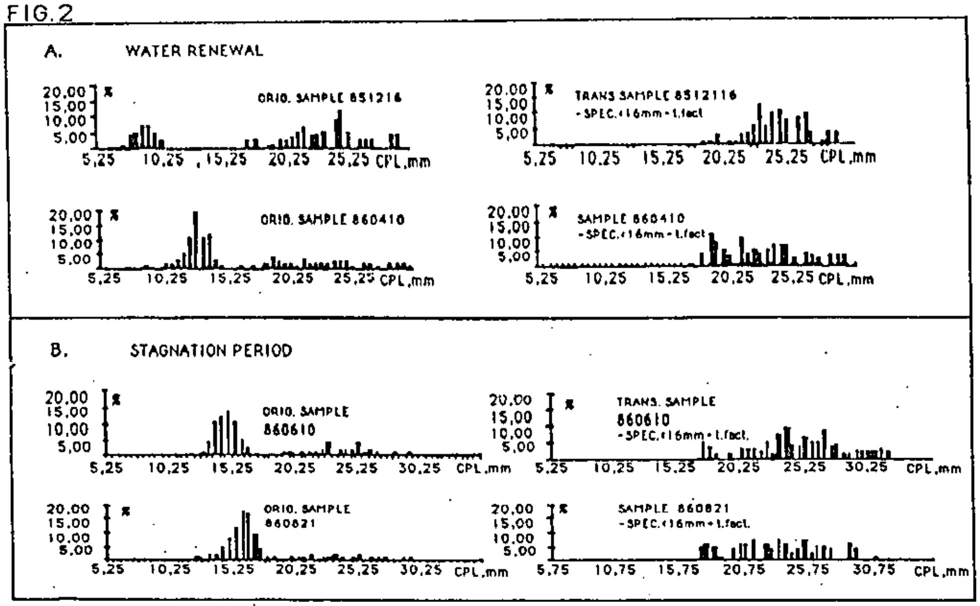
CPUE IN ORIGINAL SAMPLES DECREASE DURING THE STAGNATION PERIODS, BUT INCREASE AFTER EACH WATER RENEWAL.

TABLE II
Total catch of shrimps and CPUE of shrimps in original and translated samples.

	DATE	N.o	N.t.	N.t./N.o	(CPUE o.s.) (#/n. mile)	(CPUE t s) (#/n. mile)
PRE WR	840131	395	323	0,82	94	76,9
1984						
POST WR	840426	645	522	0,81	161,3	130,5
PRE WR	850116	269	267	0,99	65,6	65,1
1985						
POST WR	850424	594	522	0,88	160,5	141,1
PRE WR	851216	92	83	0,90	24,5	22,1
1986						
POST WR	860410	311	100	0,32	77,5	25
PRE WR	861126	162	121	0,75	41,5	30,6
1987						
POST WR	870421	725	398	0,55	190,8	104,7

CPUE IN TRANSFORMED SAMPLES (EXCLUDING THE NEW YEAR CLASS) INCREASE WITH FACTORS 1.8 (84), 2.2 (85), 1.1 (86), AND 3.4 (87).

FIG.2



WATER RENEWALS	Prob. for Ho SFDPRE - SFDPOST	Max. Diff
1984	p-0,0001	0,24
1985	p-0,0011	0,25
1986	p-0,0106	0,38
1987	p-0,0297	0,23

Comparison of SFD.before (PRE) and after (POST) the deep water renewal by K-S test. Similarity can be rejected at the 95% level of confi-

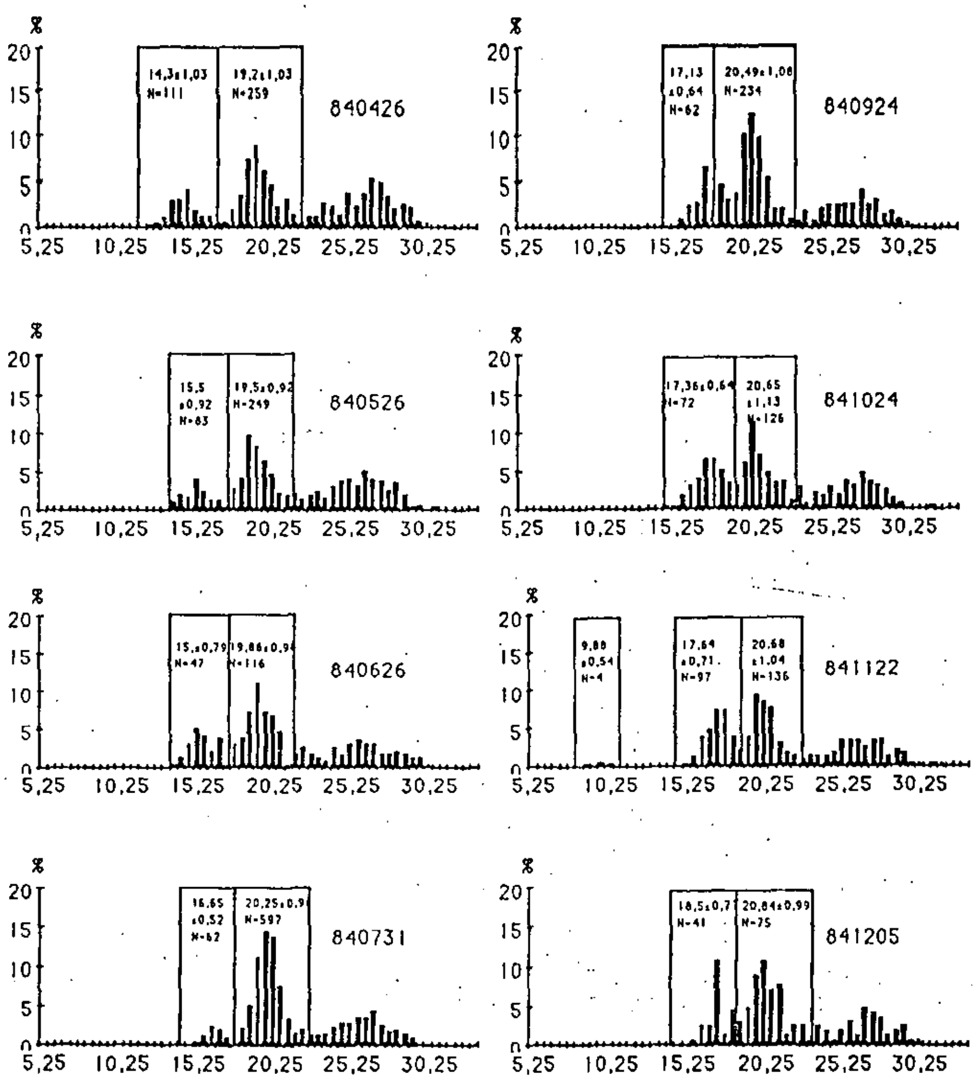
YEAR	DATE	Prob. for Ho (SFDA- SFDB)	Max. Diff
1984	0426-0524	p-0.2031	0.08
	0910-0924	p-0.16	0.09
1985	0528-0617	p-0.41	0.11
	1120-1216	p-0.35	0.15
1986	0610-0821	p-0.22	0.18
	0911-1022	p-0,16	0,18
1987	0421-0526	p-0,26	0,06
	0526-0819	p-0,18	0,09

Comparison of SFD by K-S test in randomly choosen sample pairs from the stagnation periods. Similarity can not be rejected on the 95 % level in any of the cases

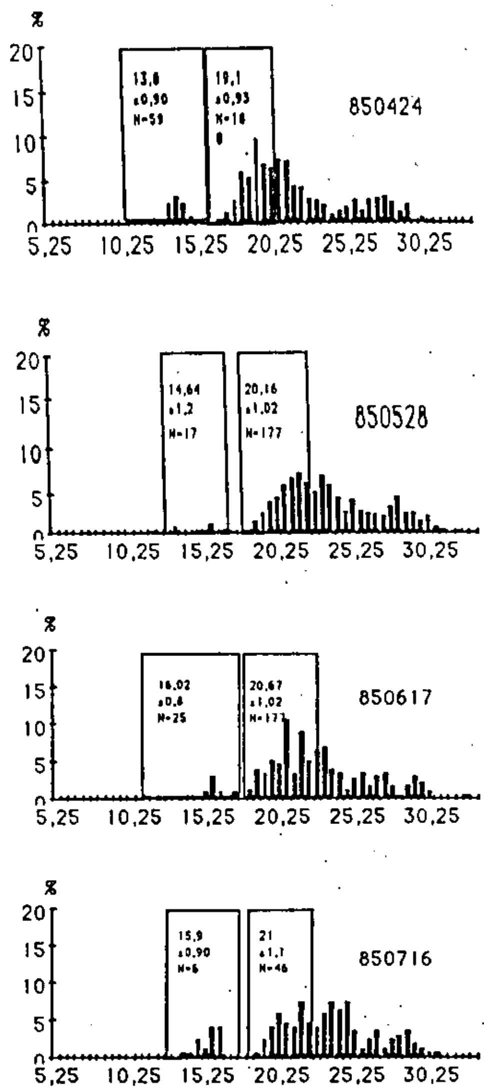
	Date	males.o./N.o.	i.sex.o./N.o.	females.o./N.o.
Pre	840131	0,71	0,12	0,17
1984				
Post	840426	0,49	0,06	0,45
Pre	850116	0,49	0,18	0,33
1985				
Post	850424	0,55	0,07	0,38
Pre	851216	0,87	0	0,13
1986				
Post	860410	0,74	0,05	0,21
Pre	861126	0,57	0	0,40
1987				
Post	870421	0,68	0,04	0,28

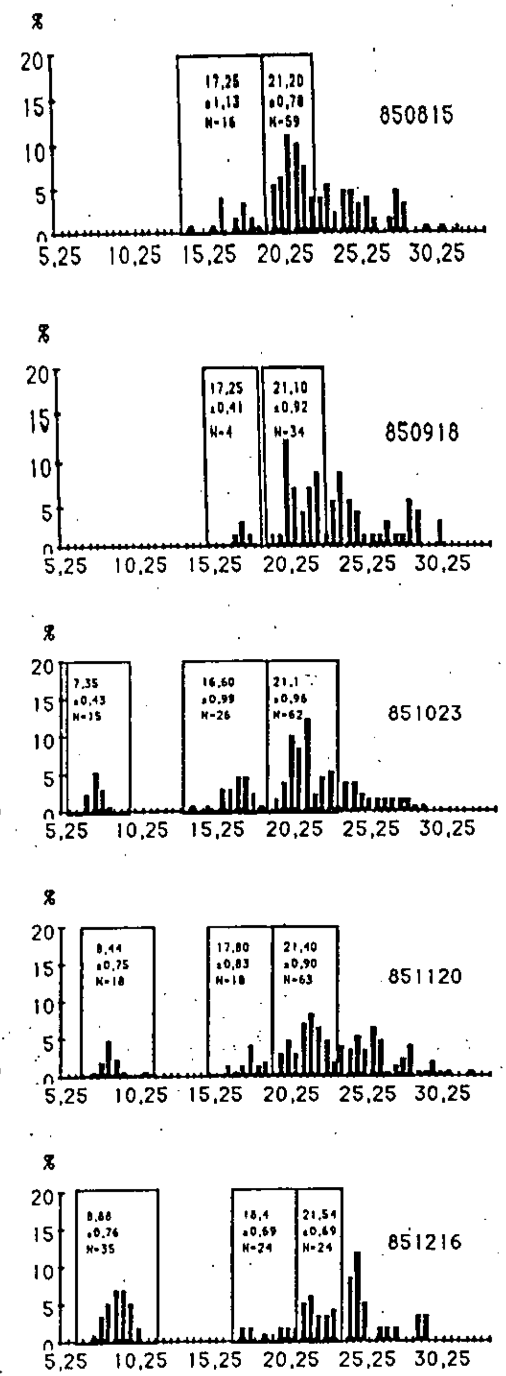
Relative frequencies of males, intersexuals and females before and after water renewals 1984-1987.

THE DRAMATIC INCREASE OF FEMALES IN 84 CAN ONLY BE EXPLAINED BY SEX DIFFERENTIATED IMMIGRATION. IT IS LIKELY THAT SMALLER DIS- PROPORTIONATE FEMALE IMMIGRATIONS ALSO TOOK PLACE IN 85, AND 86. IN 87 RECRUITMENT OF YOUNGER YEAR CLASSES (MOSTLY MALES) DOMINATE THE PICTURE.

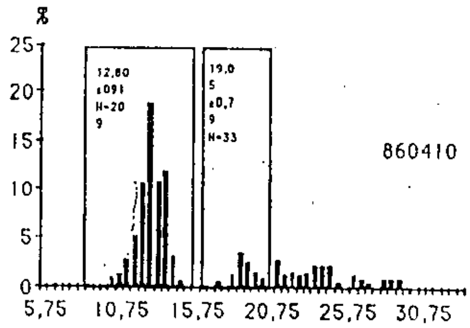


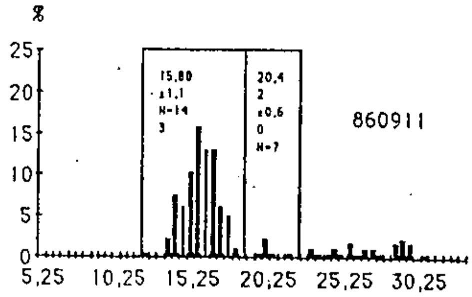
SIZE FREQUENCY DISTRIBUTIONS *P.borealis*,

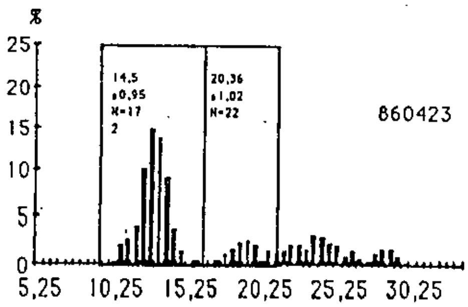


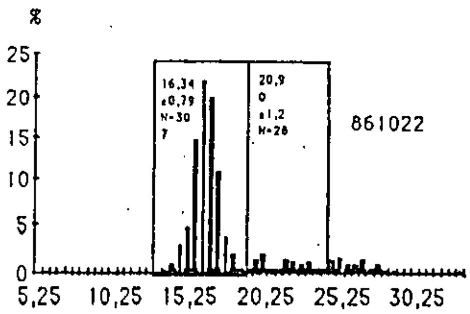


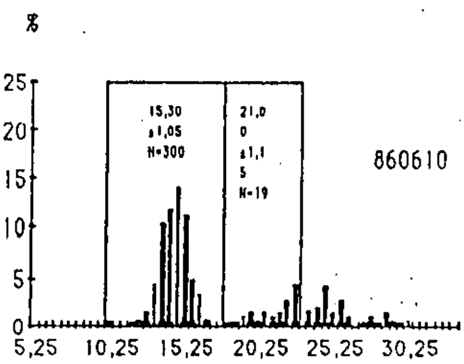
SIZE FREQUENCY
DISTRIBUTIONS. *P. borealis*
GULLMARN,STAGNATION
POPULATION 1985

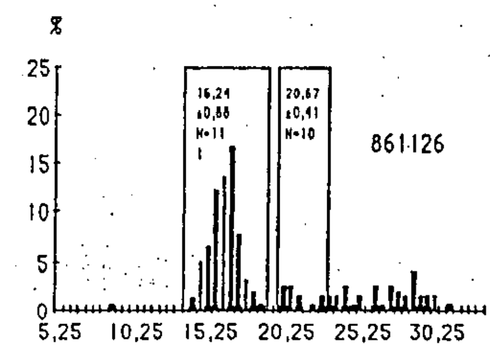


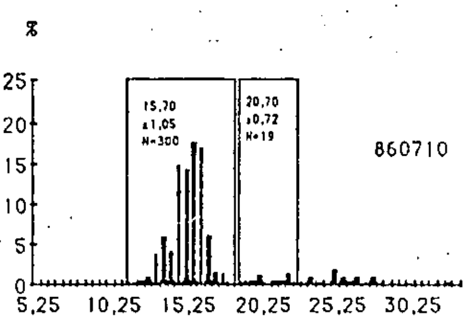




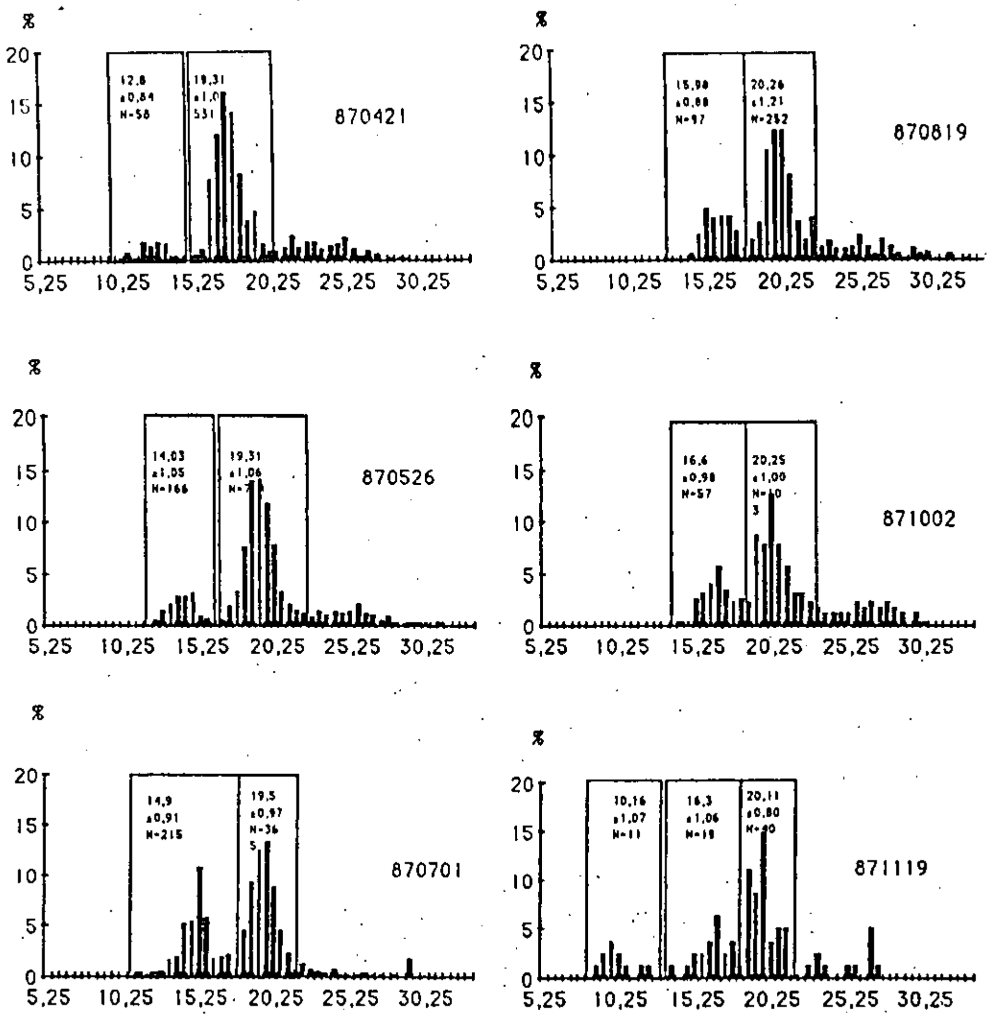








SIZE FREQUENCY.
DISTRIBUTION *P.borealis*,
GULLMARN, STAGNATION
POPULATION 1986



SIZE FREQUENCY DISTRIBUTION.
P.borealis,
GULLMARN, STAGNATION
POPULATION, 1987

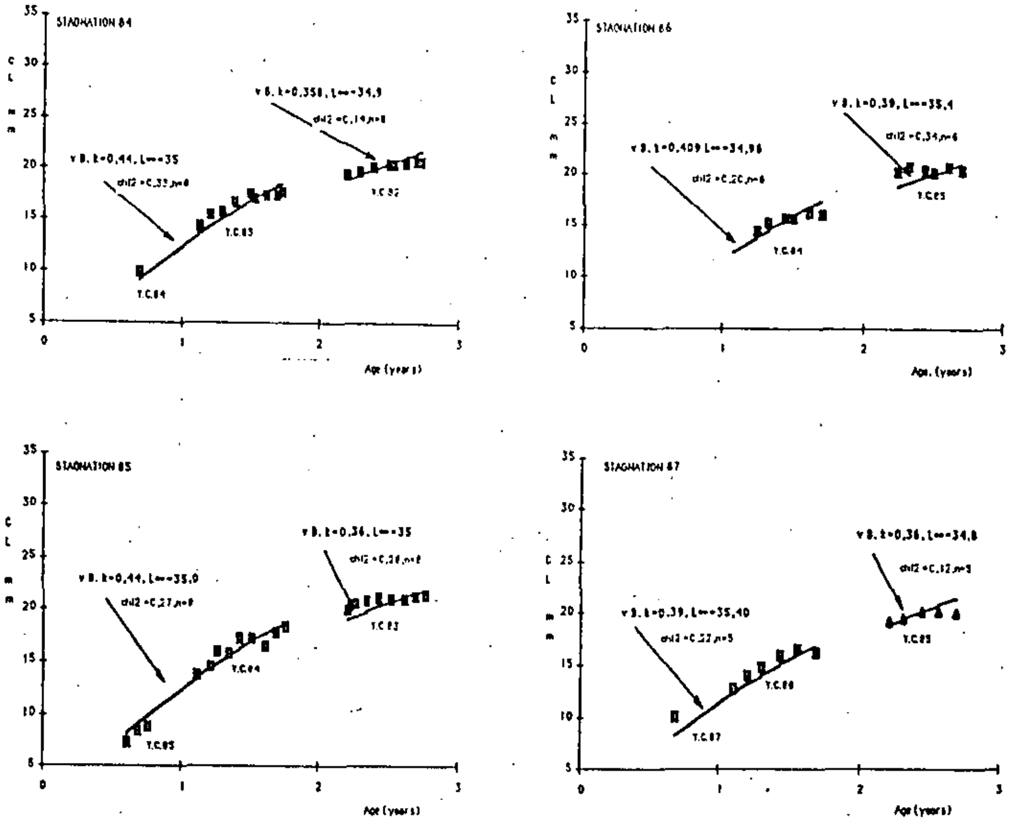
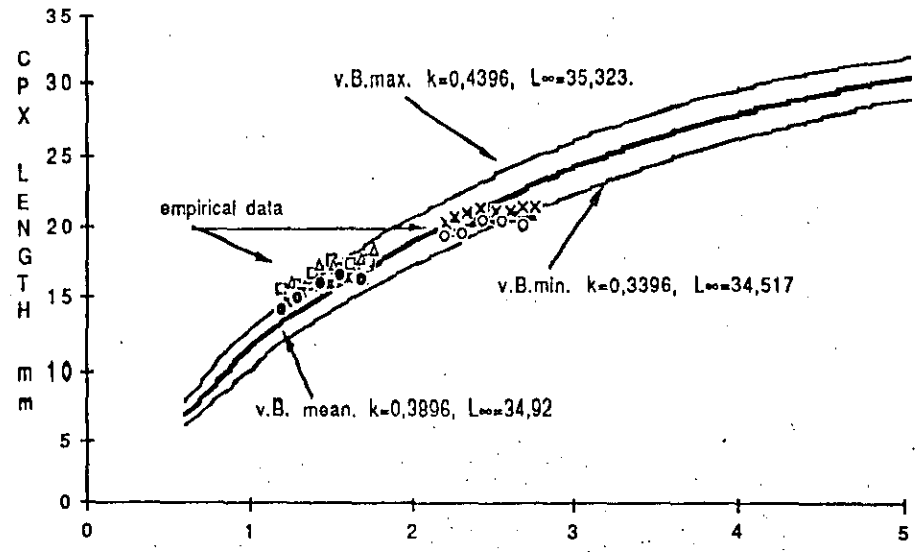


TABLE I v. Bertalanffy constants

Stagnation period	Year class.	k	L_∞
1984-85	83	0,44	35,00
	82	0,358	34,90
1985-86	84	0,44	35,0
	83	0,36	35,00
1986-87	85	0,409	34,96
	84	0,36	34,30
1987-88	86	0,39	35,40
	85	0,36	34.80

$K_{95\%}=0{,}3896\pm0{,}032$ $L_{\infty\,95\%}=34{,}92\pm0{,}273$ (mm)
$K_{99\%}=0{,}3896\pm0{,}o5$ $L_{\infty\,99\%}=34{,}92\pm0{,}403$ (mm)



Mean von Bertalanffy growth curve with 99% conf. int. for P.borelis in the Gullmarfjord based on y.c.82-85 in stagnation populations 84-87.