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Density-Dependent Growth in Saithe

by

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1. Introduction

The major part of the Norwegian catch of saithe is taken with purse-seine from May to November in coastal waters. The purse-seine catches mainly consist of immature fish 3 to 5 years old, but large, mature fish are also taken in quantities, especially in the northernmost areas.

Variations in recruitment to the saithe stock are greatly affecting the yield of the purse-seine fisheries. During the most recent years the recruitment has evidently been exceptionally good as compared with the average for the 1950-ies, and the abundance of the saithe stock in Norwegian waters is high at present.

A reduced growth of young saithe was observed at the time the numerous 1950 year-class recruited the stock (Olsen, 1961), and changes in growth-rate during the more recent period are also quite evident. The present report is an attempt of comparing estimates of growth with the information available on stock size.

2. Variations in growth of young saithe

Since 1954 sampling has been carried out each year of commercial purse-seine catches taken in July/August at the Finmark coast. For some years data are also available from the Lofoten and Møre areas at slightly different times of the year. Comparable estimates of mean length at age are given in Tables la, -b and -c, together with estimates of percentage deviations from the overall mean for each age-group.

In both the Finmark and the Møre samples fluctuations of about  $\pm 10\%$  around the overall mean for each age-group are apparent, and there is a fair degree of parallelism in the trends both within the two localities and between them. Thus, during the period 1954 to 1957 mean lengths at age remained in general a few cm above the "normal" and this was also the case from 1960 to 1962. Data for 1959 are only few, but it seems that around that year mean lengths were low at the Finmark coast, and in 1958 also in the Møre area. In the most recent years, from 1963 to 1965, there was again a period with small fish, especially in 1964.

Estimates of annual length increments also show some variations, with low values for the periods 1958/59, 1961/62 and 1962/63. These variations, however, are too small to account for the large fluctuations in mean length at age. It would therefore seem likely that the greater part of these fluctuations is a result of changes in growth-rate in the pre-exploited phase, i.e. during the first two years of life.

3. Variations in abundance

During the years a gradual increase has probably taken place in effective fishing power of the individual saithe purse-seiners as a result of increased vessel size, improvements in gear, equipment and technique. The purse-seine fishery for saithe is, however, a traditional one, which is exploited to a large extent by the very same vessels each year, and it is reasonable to assume that no great year-to-year variations in total effort have occurred, although exact annual statistics of the number of vessels participating in this fishery are almost completely lacking.

It is evident from the output of the fishery, as well as from direct observations and analyses of the catch composition that great variations in abundance of young saithe do occur, mainly as a result of fluctuations in recruitment. Thus, when strong year-classes are recruiting the fishable stock

very large quantities of these small fish have been caught. This has usually created some market-problems, but prior to June 1965 when a complete ban on sale of saithe for reduction purposes was introduced, the surplus catch was sold to the fish-meal-and oil factories. It is therefore reasonable to assume that the commercial statistics of saithe landings do reflect the general trends in stock abundance.

From Table 2 which gives the total Norwegian landings of saithe taken during the purse-seine season and the corresponding figures for two of the main saithe-fishing districts, it is seen that yearly variations were rather small prior to 1961 for the Møre area, and prior to 1963 for the total landings and those from the coast of Finmark and Troms. The most recent years are characterized by a great increase of the catch in all areas, and there is no doubt that this is mainly caused by greater abundance of young saithe in all Norwegian waters, which is also evident from estimates for the years 1960 to 1963 of catch per seiner per week at the Finmark coast (Table 3).

Table 3. Catch/seiner/week (in tons),  
Finmark 1960-1963

Year	C.P.U.E.
1960	22.1
1961	11.6
1962	22.0
1963	34.4

Preliminary data suggest a further increase in C.P.U.E. in 1964.

#### 4. Discussion

Notwithstanding the scantiness of the material, particularly for some years, it seems to be demonstrated beyond any reasonable doubt that great variations do occur in the growth-rate of saithe at the Norwegian coast. Thus, during the last decade there are examples of fast-growing year-classes having a larger average length at the age of 2+ and 3+ than slow-growing year-classes when 3+ and 4+ years old. In terms of weight this means that the saithe of a fast-growing year-class may at the age of 3+ have attained a weight about twice that of 3-year old saithe of a slow-growing year-class.

In Figure 1 the combined estimates of the deviations in  $\bar{l}_t$  from the overall means are plotted for each year. For the Finmark area (A) these were calculated from all available data for the age-groups II, III and IV, for the Møre coast (B) only the age-groups II and III were included. For comparison, the deviations in annual landings during the same period are shown. With the exception of the data for 1958 for the Møre coast and for 1959 for the Finmark area both the curves for catch and  $\bar{l}_t$  deviations show the same general trend. Thus, it appears that in years with above-average catches the saithe have been of a smaller than average length at age and vice versa, and the few estimates of C.P.U.E. which are available suggest that the variations in growth are indeed paralleled with fluctuations in stock abundance.

The very young saithe (0- and I-groups) are distributed mainly in the littoral zone of the Norwegian coast, and it is conceivable that the stock density may have a great impact on the growth of these young fish. Beyond the age of recruitment to the exploited stock there is only very slight evidence of any density effect on the growth-rate. Little is known, however, about the fishing-mortality rate of 2- and 3-year old saithe, except that for the rich year-classes it might in the past have been considerably higher than for the poor ones. This could have had the effect of reducing the density of young saithe, in years when rich year-classes recruited the fishable stock, to such an extent that the growth-rate of the surviving fish became larger than it would otherwise have been. Consequently, it should not be concluded that density-dependent factors affecting the growth-rate of saithe may only be of significance during the pre-exploited phase.

#### Reference

- Olsen, Steinar            1961            "An account of the Norwegian coalfish investigations with special reference to the tagging experiments". ICES, C.M. 1961. Doc.No. 125.

Table 1a. Mean length at age and percentage deviation from overall mean (in brackets), Finmark Coast July/August.

Year-class	Age-group			
	II	III	IV	V
1949				70.6 (4.6)
1950			61.8 (6.2)	68.1 (0.9)
1951			59.1 (1.5)	69.0 (2.2)
1952	36.6 (0.3)			65.8 (-2.5)
1953		49.7 (6.0)	59.7 (2.6)	68.9 (2.1)
1954		48.1 (2.6)	60.3 (3.6)	
1955		51.5 (9.8)		66.3 (-1.8)
1956		43.4 (-7.5)	59.4 (2.1)	71.1 (5.3)
1957		50.2 (7.0)	60.6 (4.1)	70.2 (4.0)
1958	38.6 (5.8)	49.0 (4.5)	58.6 (0.7)	68.2 (1.0)
1959	39.7 (8.8)	45.6 (-2.8)	56.1 (-3.6)	60.6 (-10.2)
1960	36.5 (0.0)	42.0 (-10.4)	50.4 (-13.4)	63.2 (-6.4)
1961	32.5 (-11.0)	43.3 (-7.7)	56.4 (-3.1)	
1962	34.6 (-5.2)	45.8 (-2.3)		
1963	37.0 (1.4)			
Overall mean	36.5	46.9	58.2	67.5

Table 1b. Mean length at age and percentage deviation from overall mean (in brackets), Lofoten area, June/July

Year-class	Age-group			
	II	III	IV	V
1957				60.0 (-7.1)
1958			53.9 (0.2)	69.2 (7.1)
1959		49.3 (5.6)	54.0 (0.0)	
1960	38.3 (5.5)	47.0 (0.6)		
1961	33.8 (-6.9)			
1962		43.9 (-6.0)		
1963	36.9 (1.7)			
Overall mean	36.3	46.7	54.0	64.6

Table 1c. Mean length at age and percentage deviation from overall mean (in brackets), Møre coast May/June.

Year-class	Age-group			
	II	III	IV	V
1952		43.9 (4.3)	53.4 (-0.9)	
1953	39.2 (10.4)	46.2 (9.7)		54.3 (-11.3)
1954	37.0 (4.2)	43.6 (3.6)	48.3 (-10.4)	
1955	38.0 (7.0)	38.3 (-9.0)		
1956	32.6 (-8.2)			
1957				68.0 (11.1)
1958			62.0 (15.0)	
1959		43.9 (4.3)	52.0 (-3.5)	
1960	37.3 (5.1)	41.8 (-0.7)		
1961	32.1 (-9.6)			
1962		37.0 (-12.1)		
1963	32.6 (-8.2)			
Overall mean	35.5	42.1	53.9	61.2

Table 2. Total Norwegian landings of saithe during main purse-seine season and corresponding figures for Finmark + Troms and Møre.

Year	Total Norwegian landings May-Oct.		Landings in Finmark + Troms June-Oct.		Landings in Møre May-Oct.	
	Tons	Dev. from mean	Tons	Dev. from mean	Tons	Dev. from mean
1954	42.153	-15.550	15.790	-7.172		
1955	39.924	-17.779	17.636	-5.326	5.460	- 476
1956	47.294	-10.409	18.756	-4.206	5.184	- 752
1957	53.952	- 3.751	21.916	-1.046	5.877	- 59
1958	46.888	-10.815	13.765	-9.197	5.033	- 906
1959	57.789	86	18.157	-4.805	5.224	- 712
1960	45.139	-12.564	20.014	-2.948	4.213	-1.723
1961	47.928	- 9.775	19.590	-3.372	2.141	-3.795
1962	50.487	- 7.216	18.771	-4.191	3.282	-2.654
1963	68.526	10.823	26.718	3.756	9.289	3.353
1964	104.379	46.676	55.170	32.208	7.386	1.450
1965	87.981	30.278	29.260	6.298	12.232	6.296

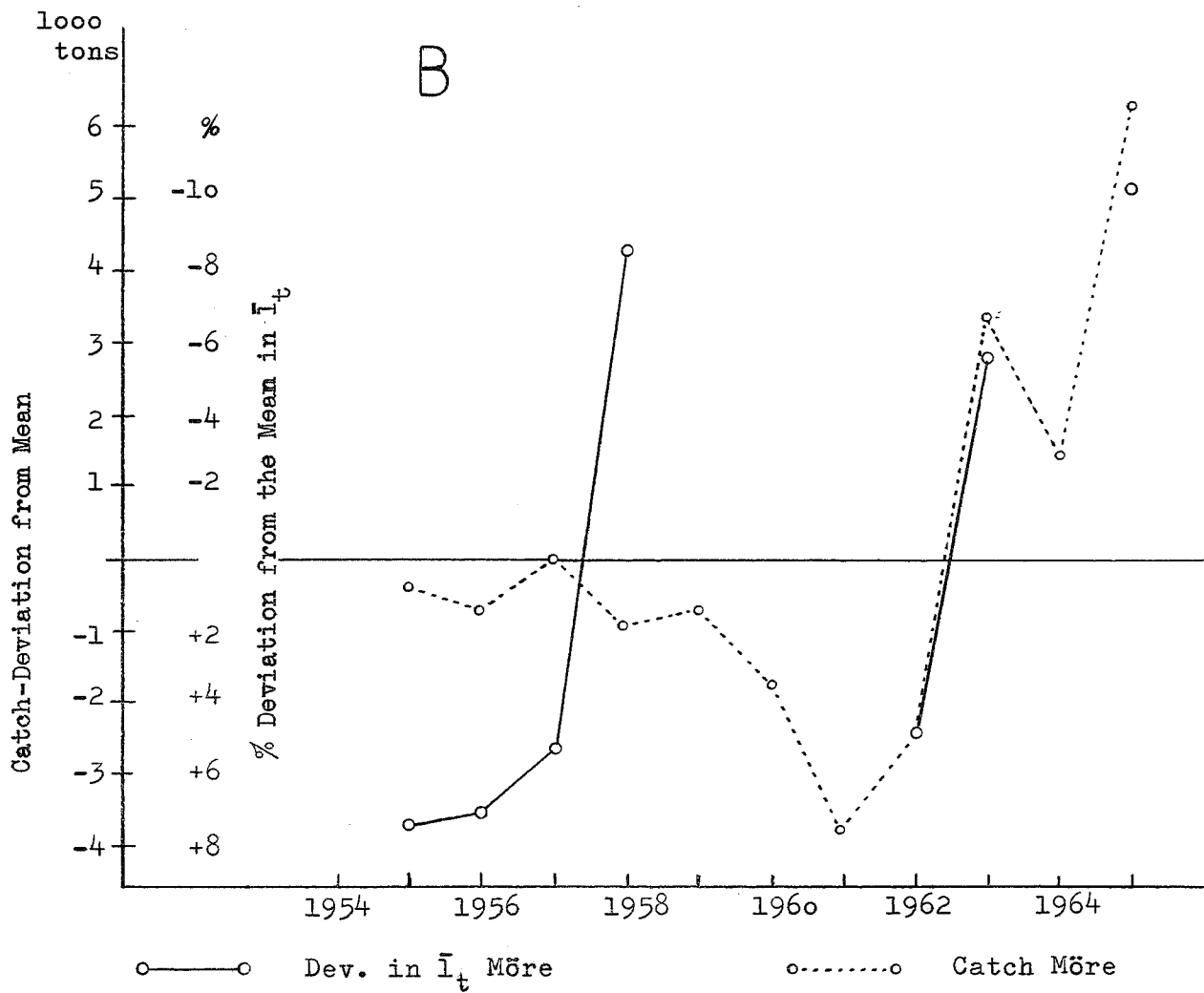
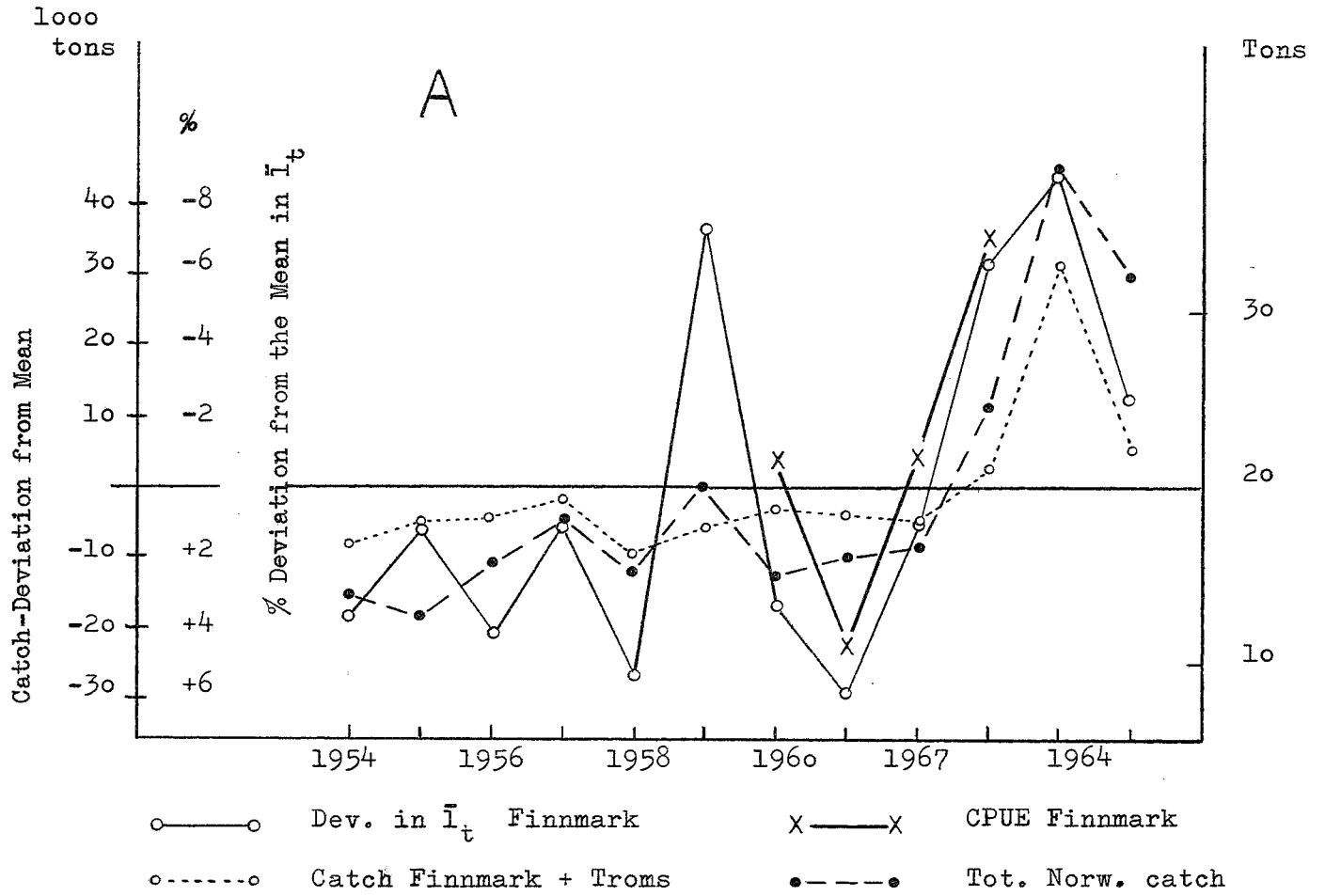


Figure 1. Variations in catch and mean length at age.  
For further explanation, see text.