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Sprat from Norwegian Waters

An Analysis of Vertebrae Counts

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Preface.

In the present report the results are given of vertebrae counts of sprat from Norwegian waters. Some parts of this material have previously been dealt with by PAUL BJERKAN and ALF DANNEVIG. It is, however, of importance to undertake a review of the total material now at hand.

Most of the samples from the Skagerak coast have kindly been placed at our disposal by Director ALF DANNEVIG. The Floedevig Sea Fish Hatchery, Arendal.

I wish to express my sincere thanks to those who have participated in the collection and preparation of the material and to my colleagues for their never failing willingness to discuss the problems. I am also greatly indebted to Dr. PER OTTESTAD for advice as to the statistical treatment of the material, and to secretary J. W. CHRISTENSEN for correcting the english text.

Bergen, September 1950.

Gunnar Dannevig.

Introduction.

The Norwegian sprat fishery mainly takes place in the Oslofjord and in the fjords of western Norway, whereas it is of less importance on the interjacent Skagerak coast. Most of the catch consists of immature fish between 1 and 2 years old. In certain districts, especially the Oslofjord, older age groups are of importance too.

Koefoed (1909), Sund (1911) and A. Dannevig (1930, 1940, 1945) have shown that the sprat is spawning in the coastel waters off the Norwegian Skagerak coast. The spawning generally takes place in the months of May and June. The sprat may also spawn in the Norwegian fjords on the Skagerak coast, but here at a somewhat earlier date. Eggs and larvae may be rather abundant in the middle of April and during the first days of May. — Høglund (1938) has shown that intense spawning takes place also off the west coast of Sweden and to the north of Jutland, especially during the months of May and June.

According to Sund (1911) and Bjerkan (1930) spawning may, to some extent, occur in the fjords and »skjærgård« (skerry guard) of western Norway. They assume, however, that the renewal of the sprat population of this district mainly is dependant on immigration from the Skagerak and adjacent waters.

Material and Methods.

The present material comprises 94 samples collected during the years 1927—1949. The localities from which they have been taken are shown on fig. 1 and fig. 2. In Tab. I (p. 20) is given the number of individuals, the average number of vertebrae, and the average size of the fish for each sample. In the table is also indicated whether the samples, as judged by the size of the fish, mainly contain sprat of the 0-group, or whether they contain several age groups (mixed samples). It has not been possible to carry out individual age determinations, as the sprat has very deciduous scales, which easily are scraped off when the samples are taken. During summer and autumn, when most of the samples have been collected, sprat of the 0-group are, with few exceptions,

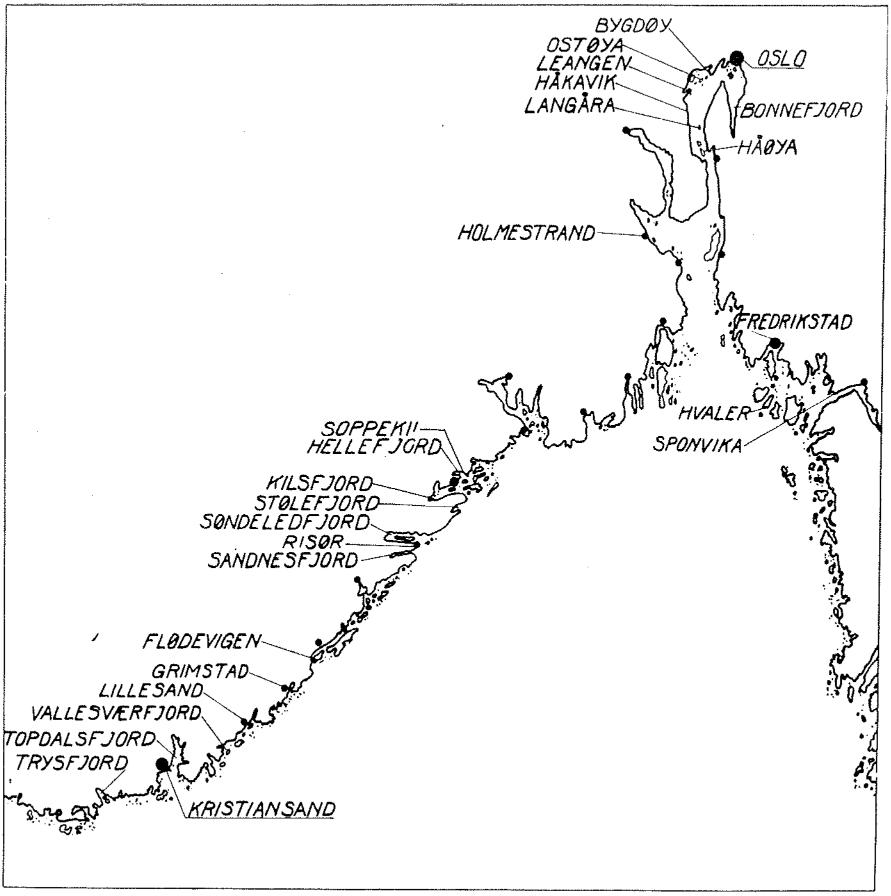

Fig. 1. South-Eastern Norway. The Localities from which the Samples have been taken.

definitely smaller than fish of older age groups. During that time of the year the size of the fish may therefore be used as a fairly good basis for separating sprat of the 0-group from older age groups.

The samples were preserved in formalin until the countings could be carried out. After having been washed in water, each specimen was measured, split up along the back bone, and allowed to dry for a few hours. The vertebrae were then counted under a low power binocular microscope.

When comparing the frequency distributions of number of vertebrae of the various samples, use has been made of the analysis of variance (Bonnier and Tedin (1940) and Ottestad (1947)). The mean squares

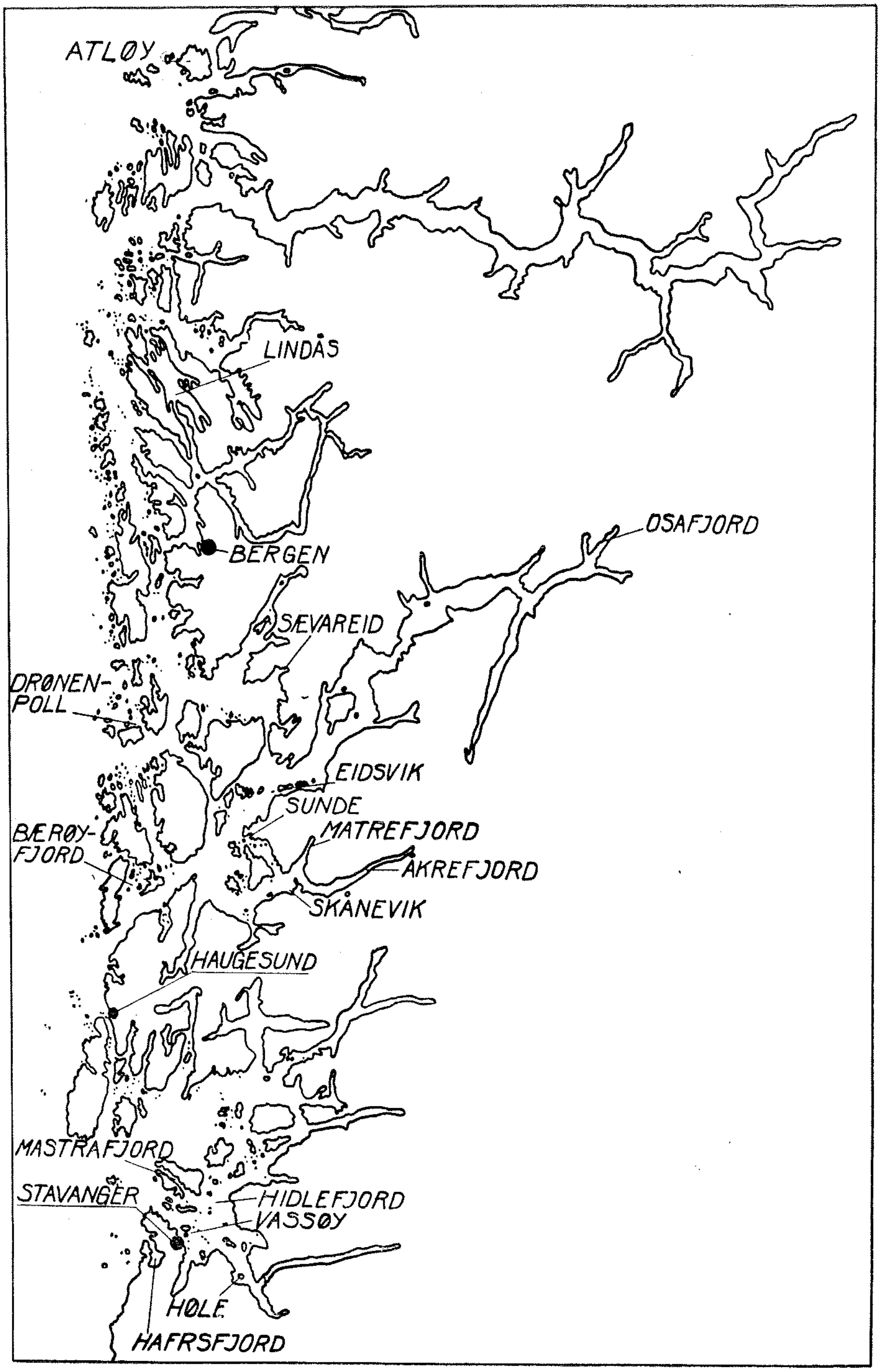

Fig. 2. Western Norway. The Localities from which the Samples have been taken.

,,between samples'' and ,,within samples'' are estimated from the data, and the quotient — ν^2 — between the greater and smaller value calculated. BONNIER and TEDIN (loc. cit.) give tables showing the ν^2 values for several probability limits and for various degrees of freedom.

The following abbrevations have been used:

N for Number of fish
$\bar{L}$ - average total length
$\bar{V}$ - average number of vertebrae
D - difference
S.S. - sum of squares
M.S. - mean square
D.f. - degrees of freedom
ν^2 - quotient between the greater and smaller mean square.

Correlation between Size of Fish and Number of Vertebrae.

BJERKAN (1939, 1940, 1944) and A. DANNEVIG (1947) have previously shown that, within the same samples of sprat of the 0-group, the larger individuals have often a somewhat higher number of vertebrae than the smaller ones. These authors, as well as MOLANDER (1940, 1942), have shown that a positive correlation between the size of the fish and the number of vertebrae may be found also when comparing different samples taken at approximately the same time of the year.

To elucidate this problem each 0-group sample has been divided into two subgroups, ,,large'' and ,,small'' fish. (3 samples have been excluded as most individuals were of nearly the same length.) The average number of vertebrae has then been calculated seperately for the ,,large'' and the ,,small'' fish of the same sample. In this way 72 have been examined. Tab. 1 shows the distribution of the samples according to the difference in the average number of vertebrae between ,,large'' and ,,small'' fish of the same sample. — A positive difference indicates that the larger fish have a greater number of vertebrae than the smaller ones. If the number of vertebrae were independent of the size of the fish, one should expect an equal number of positive and negative differences. Actually, there are 63 positive differences, and 9 negative differences. This is a significant deviation from expectation (x^2 = 40,5 with 1 degree of freedom, and $P < 0.001$).

Tab. 1. Distribution of Samples according to the Difference (D) between Average Number of Vertebrae of „large" and „small" Fish of the same Sample.

D	Number of samples	
	0-group	mainly I-group
Positive differences		
0.80— .89	1	
0.70— .79	—	
0.60— .69	1	
0.50— .59	—	
0.40— .49	3	1
0.30— .39	8	3
0.20— .29	14	1
0.10— .19	22	3
0.00— .09	14	3
Negative differences		
0.00— .09	3	2
0.10— .19	2	
0.20— .29	3	
0.30— .39	—	
0.40— .49	1	

The material as a whole, therefore, gives very strong indications that, within the same samples of the 0-group, the larger fish will generally have a somewhat higher number of vertebrae than the smaller ones. The positive differences are generally smaller than 0.40. — For comparison, 13 samples, (mainly of the 1-group) from western Norway, have been dealt with in the same way (tab. 1). Within these samples as well, the larger individuals have generally a higher number of vertebrae than the smaller ones.

Several theories have been put forward in order to explain this correlation. Bjerkan (1929, 1939, 1940), Molander (1942) and A. Dannevig (1947), assume that the external conditions prevailing during the early stages may influence the number of vertebrae, as has been shown for other species (Johs. Schmidt (1921), Vedel-Tåning (1944, 1950), A. Dannevig (1950)). According to Bjerkan's theory the larger sprat are somewhat older than the smaller ones, they have been hatched earlier in the season under lower temperatures, and therefore have a higher number of vertebrae.

In this connection BJERKAN (1939, 1940) has drawn attention to the fact that, in some samples, the size-distribution of the fish exhibits 2 modes. This — according to BJERKAN — indicates that the shoals have been formed of two different size groups originating from different spawning periods. Such bimodal frequency curves are shown in fig. 3

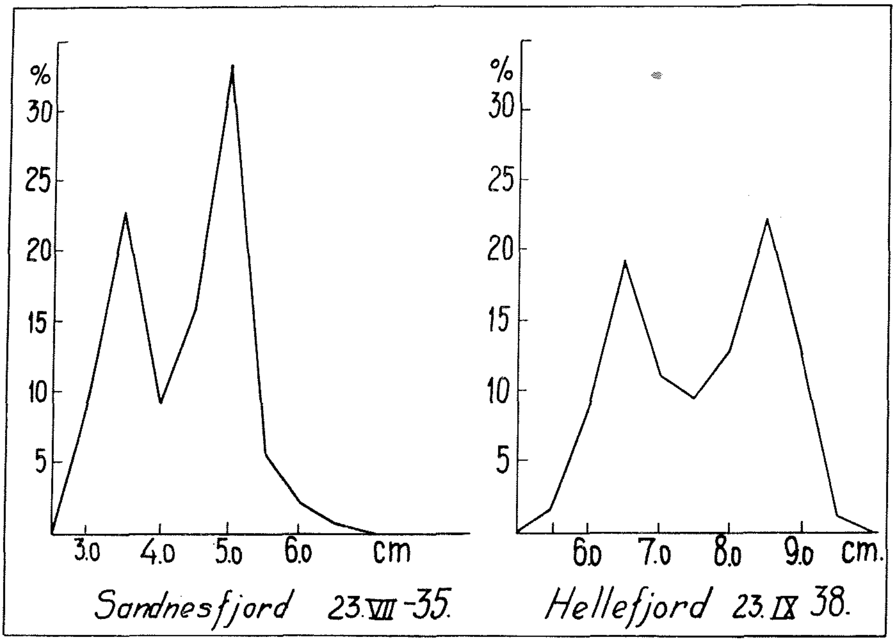

Fig. 3. Size-Distribution of two Samples of Sprat of the O-Group showing two Modes.

of the present paper. These curves have, however, been selected only to illustrate the phenomenon. In most samples there are no distinct indications of more than one mode. A positive correlation between size and number of vertebrae is found in the latter cases too.

MOLANDER (1940) assumes, however, that the difference in size is due to a different rate of growth. He is of the opinion that the same external factor, or factors, which give rise to a higher number of vertebrae, should also give the fish and ability to quicker growth.

A. DANNEVIG (1941) points to the possibility that in addition to external factors also hereditary factors may be of importance. The correlation between size and number of vertebrae may partly be a constitutional genetic characteristic. In other words: greatcapability of growth is linked with a high number of vertebrae. — For the sprat, we have, however, no experimental evidence which may elucidate these problems.

Variations in Number of Vertebrae.

The fact that there is generally a correlation between the size of the fish and the number of vertebrae makes our analysis of the vertebrae counts rather complicated. The sprat usually occur in shoals, and fish of approximately the same size may have a tendency to keep together. Our samples may well be representative of the shoals from which they are taken, but it is doubtful whether a single shoal is representative of the total stock within a certain locality: And unless the samples are representative as to the size of the fish, we cannot expect them to be representative as to the number of vertebrae.

A. DANNEVIG (1947) has already shown that samples, taken at the same locality within a short space of time, may differ considerably as to the average number of vertebrae. The material from Floedevigen forming the basis of this conclusion, is included in tab. 2 and 3 of the present paper.

In 1933 three samples were taken between August 11th and 16th (tab. 2). The mean number of vertebrae increased from 47.59 to 48.08.

Tab. 2.

Flødevigen 1933	$\overline{V}$	$\overline{L}$
August 11th	47.59	3.2 cm
August 15th	47.88	4.3 -
August 16th	48.08	5.1 -
S.S.	D.f.	M.S.
Between samples 13.54	2	6.77
Within samples 226.43	357	0.63
$\nu^2 = \frac{6.77}{0.63} =$	10.68	$P < 0.001$

As pointed out by A. DANNEVIG (1947), also the mean size of the fish increased from 3.3 to 5.1 cm, indicating a positive correlation between the size of the fish and the number of vertebrae. — Our calculations show that there are significant differences between the samples, ($P < 0.001$), and it is therefore not likely that they have been taken from the same population. Also between the 4 samples taken in 1934 there are significant differences.

At present it seems problematic to consider the vertebrae counts of a single sample as being representative of more than the shoal from

Tab. 3.

Flødevigen 1934	$\bar{V}$	$\bar{L}$
August 17th	48.11	6.5 cm
August 24th	47.82	5.7 -
August 27th	47.97	6.2 -
August 28th	47.84	6.5 -
S.S.	D.f.	M.S.
Between samples 9.52	3	3.17
Within samples 316.36	704	0.449
$\nu^2 = \frac{3.17}{0.449} =$	7.06	$P < 0.001$

which it has been taken. For this reason little attention is paid in the following to the particular fjords from which the material has been obtained.

The diagram, fig. 4, shows the average number of vertebrae for each sample for all years in which material has been obtained. Different symbols have been used for the samples from southeastern and western Norway, as well as for the 0-group and for the mixed samples.

We will first discuss the 0-group samples from south-eastern Norway. — In most years the average number of vertebrae varies considerably from one sample to another, thus, in 1933, between 47.59 and 48.26. In order to test the significance of the differences between samples, use has been made of the analysis of variance. The results are given in tab. 4 for all years in which 3 or more samples were taken. The mean square ,,between samples'' is always greater than the mean square ,,within samples''. In all years but one (1947) there are significant differences between the samples as to the frequency distribution for number of vertebrae ($P < 0.001$). Therefore the shoals of sprat occurring in the coastal waters of south-eastern Norway, can not all belong to the same population.

It should be pointed out, however, that in some years the high value for the mean square ,,between samples'' is due mainly to one single sample deviating strongly from all the other ones. As can be seen from fig. 3, 7 of the 8 samples from 1946 have approximately the same average number of vertebrae, whereas one sample (from Kilsfjord) has a much higher average number. Excluding this from our calculations we find the following results for the remaining samples:

mean square between samples 0.543
— — within — 0.431
$\nu^2 = 1.26$

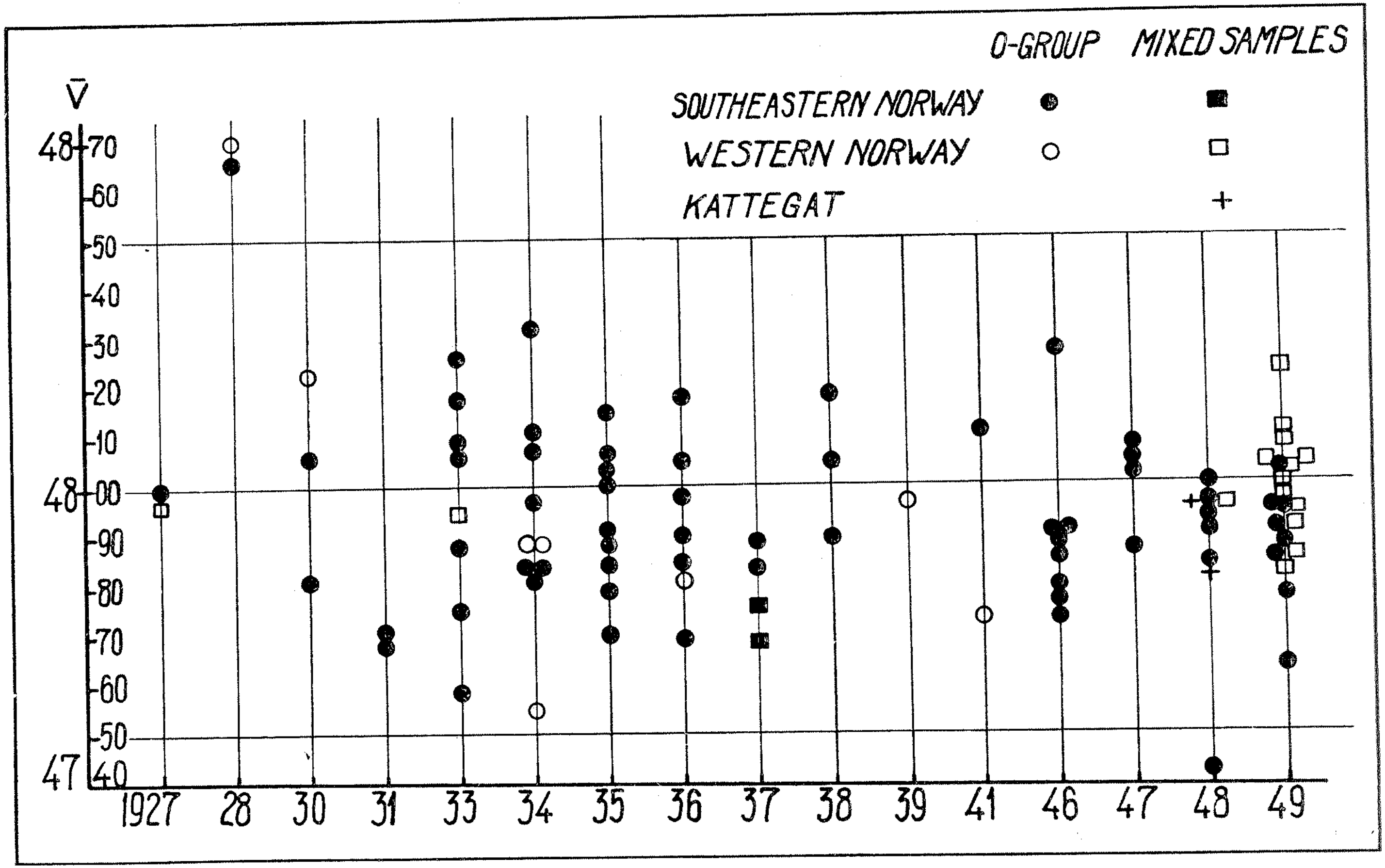

Fig. 4. The average Number of Vertebrae of each Sample.

Tab. 4. Samples of O-groups of sprat from South-eastern Norway.

	S. S.		D. F.	M. S.	ν^2	P
1933	Between samples	38.432	6	6.405		
7 samples	Within —	444.623	775	0.574	11.16	< 0.001
1934	Between samples	26.432	6	4.405		
7 samples	Within —	561.341	1207	0.465	9.47	< 0.001
1935	Between samples	19.904	8	2.488		
9 samples	Within —	582.989	1084	0.538	4.62	< 0.001
1936	Between sampes	24.10	5	4.82		
6 samples	Within —	544.28	1085	0.502	9.60	< 0.001
1938	Between samples	7.638	2	3.819		
3 samples	Within —	226.886	528	0.431	8.86	< 0.001
1946	Between samples	23.082	7	3.297		
8 samples	Within —	413.292	952	0.434	7.60	< 0.001
1947	Between samples	3.316	3	1.105		
4 samples	Within —	230.651	476	0.485	2.28	$0.05 < P < 0.2$
1948	Between samples	28.218	5	5.64		
6 samples	Within —	368.772	820	0.45	12.53	< 0.001
1949	Between samples	12.780	7	1.826		
8 samples	Within —	479.683	952	0.504	3.62	ca. 0.001

The deviations between the 7 samples are, therefore, not outside the sampling limits for *random samples* from the same population. In this case, however, the samples have been selected according to the numerical results obtained, and no estimates of the probability limits can be made directly.

The material from 1948 exhibits much the same features, a single sample from the Bonnefjord having a considerably smaller number of vertebrae than all the other samples, which all have approximately the same average number of vertebrae. Excluding this sample from the Bonnefjord, we find the mean square „between" and „within samples" to be respectively 0.389 and 0.424.

There are at least indications that, in some years there are smaller differences between the majority of the samples than in other years. For 7 of the 8 samples from 1946 the average values of number of vertebrae varies within narrow limits, in spite of the fact that the samples have been taken at widely separated localities between Oslofjord and

Trysfjord (to the west of Kristiansand), see tab. I and fig. 1. This different „variability" of the number of vertebrae may perhaps be related to whether the shoals occurring in the fjords are the results of local spawning, or whether they originate from the more important spawning areas in the open waters of Skagerak. In the latter case, one should expect to find less differences between the shoals than in the former case.

The sprat population of western Norway is, according to theory, mainly maintained by immigration from the Skagerak and adjacent waters. In 1949 we got 12 samples from this district, and also these ex-exhibit significant differences as to number of vertebrae (tab. 5 and

Tab. 5. 1949 12 Samples of Sprat from Western Norway.

	S. S.	D. F.	M. S.
Between samples	14.064	11	1.279
Within —	544.929	1364	0.40

$$\nu^2 = \frac{1.279}{0.40} = 3.20 \qquad P < 0.01 \ (P = \text{ca. } 0.001).$$

fig. 4). The samples consisted mainly of 1 year old sprat. There was, perhaps, a varying admixture of older sprat, but it has not been possible to ascertain whether this is the reason for the differences between the samples. It may be that also here the various shoals of 1 year old sprat are of somewhat different origin. At certain localities local spawning may be of importance to the recruitment of the stock.

Owing to the great differences between samples from the same year, it is very difficult to ascertain if there are any variations from one year to another. The two 0-group samples from the year 1928 have, however, a much higher number of vertebrae than any of the other samples (48.63 and 48.70). They were obtained from two widely separated localities, viz. the Sandnesfjord, southeastern Norway, and Bærøyfjord in western Norway.

Tab. 6 gives a summary of the vertebrae counts from southeastern Norway, Kattegatt and western Norway. Within each district the average number of vertebrae fluctuates within very wide limits. There are no distinct indications of any prevailing difference between the various districts.

Tab. 6. Distribution of Samples from the various Districts according to Average Number of Vertebrae.

Average Number of Vertebrae	South-eastern Norway	Kattegatt	Western Norway
48.70— .79			1
.60— .69	1		—
.50— .49	—		—
.40— .49	—		—
.30— .39	1		—
.20— .29	2		2
.10— .19	6		1
48.00— .09	15		5
47.90— .99	14	1	6
.80— .89	16	1	5
.70— .79	10		1
.60— .69	3		—
.50— .59	1		1
47.40— .49	1		
Total Number of Samples	70	2	22

Summary.

The present report gives a review of some results of the vertebrae counts of sprat from the years 1927—1949.

Within each sample of sprat of the 0-group there is generally a positive correlation between the size of the fish and the number of vertebrae. The positive differences between the average number of vertebrae of „large" and „small" fish of the same sample is generally smaller than 0.40.

It has been shown that samples taken at the same locailty within a short space of time may differ significantly as to the frequency distribution for number of vertebrae. It is therefore difficult to obtain representative samples from a certain locality. For this reason a comparison with respect to number of vertebrae of sprat from different year classes, and from different waters, may be of doubtful value. Our samples can not be considered representative of more than the shoals from which they have been taken.

In each year there may be significant differences between the samples as to the average number of vertebrae, indicating that the shoals from which they have been taken are of somewhat different origin.

List of References.

1929. BJERKAN, PAUL: On the validity of the „Race-Characters" of the Food-Fishes. *Rap. et Proc. Verb. Vol. LIV.*

1930. — Fluctuations in the Stock of Young Sprat off the West Coast of Norway and its Relation to the Sprat Population as a whole. Ibidem vol. LXV.

1939. — Sprat Investigations in 1938. Rep. Norw. Fish. and Mar. Invest. Vol. VI. No. 1.

1940. — Sprat Investigations in 1939. Ibidem Vol. VI. No. 4.

1944. — Sprat Investigations in 1941. Ibidem Vol. VII. No. 4.

1940. BONNIER, G. and O. TEDIN: 1940. Biologisk Variationsanalys Stockholm.

1930. DANNEVIG, ALF: The Propagation of Our Common Fishes During the Cold Winter 1924. Rep. Norw. Fish. and Mar. Invest. Vol. III, No. 10.

1940. — The propagation of the Common Food Fishes on the Norwegian Skager Rack Coast. Ibidem Vol. VI, No. 3.

1941. — Kan hvirveltallet hos ørreten benyttes som et mål for dens anlegg til god eller dårlig vekst? Norsk Jeger- og Fiskerforbunds Tidsskrift hefte 2, 1941.

1945. — Undersøkelser i Oslofjorden 1936—1940. Rep. Norw. Fish. and Mar. Invest. Vol. VIII, No. 4.

1947. — The Number of Vertebrae and Rays of the second dorsal Fin of Fishes from the Norwegian Skagerak Coast, Annales Biologiques. Vol. II.

1950. — The influence of the Environment on Number of Vertebrae in Plaice. Rep. Norw. Fish. and Mar. Invest. Vol. IX. No. 9.

1938. HØGLUND, HANS: Über die horizontale und vertikale Verteilung der Eier und Larven des Sprotts (Clupea Sprattus L) im Skagerak—Kattegatgebiet. Svenska Hydrografisk-Biologiska Kommissionens Skrifter. N. S. Biologi Band II.

1909. KOEFOED, E.: The Sprat. Rep. Norw. Fish. and Mar. Invest. Vol. II, Part I.

1940. MOLANDER, ARVID R.: A Research upon the Sprat of the West Coast of Sweden. L. Svenska Hydrografisk-Biologiska Kommissionens Skrifter. N. S. Biologi. B. II.

1942. — A Research upon the Sprat of the West Coast of Sweden II. Ibidem B II.

1947. OTTESTAD, PER: Forelesninger over Matematikk og Statistikk ved Norges Landbrukshøgskole.

1921. SCHMIDT, JOHS.: Racial Investigations VII. Annual Fluctuations of Racial Characters in Zoarces Viviparus L. Comptes — Rendus des Travaux du Laboratoire Carlsberg. Vol. 14, No. 15.

1911. SUND, OSCAR: Undersøkelser over brislingen i norske farvand. Årsberetning vedk. Norges Fiskerier.

1944. TÅNING, Å. VEDEL: Experiments on Meristic and other Characters in Fishes. I. Med. fra Kom. for Danmarks Fiskeri og Havundersøgelser. Serie: Fiskeri. Bind XI.

1950. — Influence of the Environment on Number of Vertebrae in Teleostian Fishes. Nature, Vol. 165, p. 28, January 7.

TABLE I.

Year	Date	Locality	N	$\bar{V}$	$\bar{L}$
1927	5/10	Flødevigen	0-gr 99	48.00	6.2 cm
	17/10	Drønenpollen	mixed 66	47.96	13.9 -
1928	22/9	Sandnesfjord	0-gr 944	48.66	4.8 -
	24/11	Bærøyfjord	0-gr 102	48.70	7.2 -
1930	15/1	Hvaler	0-gr 192	48.06	7.8 -
	28/8	Søndeledfjord	0-gr 560	47.81	5.3 -
	7/11	Sunde	0-gr 200	48.23	9.0 -
1931	15/9	Soppekil	0-gr 90	47.71	5.1 -
	17/9	Søndeledfjord	0-gr 118	47.70	5.9 -
1933	27/9	Soppekil	0-gr 84	48.18	8.3 -
	28/9	Hellefjord	0-gr 115	48.07	7.1 -
	11/8	Flødevigen	0-gr 116	47.59	3.2 -
	15/8	—	0-gr 137	47.88	4.3 -
	16/8	—	0-gr 107	48.08	5.1 -
	2/9	Vallesværfjord.............	0-gr 123	47.75	5.6 -
	5/9	Topdalsfjord	0-gr 100	48.26	7.4 -
	4/4	Vassøy	1-gr 236	47.95	8.1 -
1934	19/9	Soppekil	0-gr 231	47.84	6.4 -
	18/9	Hellefjord	0-gr 203	48.08	8.5 -
	17/8	Flødevigen	0-gr 170	48.11	6.5 -
	24/8	—	0-gr 183	47.82	5.7 -
	27/8	—	0-gr 149	47.97	6.2 -
	28/8	—	0-gr 206	47.84	6.5 -
	10/9	Topdalsfjord	0-gr 72	48.32	8.0 -
	19/9	Høle	0-gr 102	47.89	6.0 -
	17/9	Matrefjord	0-gr 101	47.55	3.3 -
	26/9	Lindås	0-gr 103	47.89	6.6 -
1935	24/7	Kilsfjord	0-gr 104	48.00	4.1 -
	24/9	Søndeledfjord	0-gr 136	48.04	8.2 -
	23/7	Risør.....................	0-gr 97	47.90	3.5 -
	23/7	Sandnesfjord (innerpart)	0-gr 143	48.05	4.4 -
	23/7	— (outer part)	0-gr 103	47.84	2.5 -
	15/7	Flødevigen	0-gr 108	47.70	2.7 -
	18/7	—	0-gr 117	47.79	2.4 -
	18/9	Topdalsfjord	0-gr 131	48.16	7.4 -
	17/9	Trysfjord	0-gr 154	47.89	5.9 -
1936	4/8	Fredrikstad	0-gr 124	48.18	4.9 -
	16/10	Langåra, Oslofjord	0-gr 298	47.90	7.2 -
	16/10	Håkavik, Oslofjord	0-gr 167	48.05	8.4 -
	23/9	Hellefjord	0-gr 205	47.69	5.9 -
	24/9	Stølefjord	0-gr 124	47.98	7.1 -
	22/9	Søndeledfjord	0-gr 173	47.83	5.7 -
	24/9	Lindås	0-gr 120	47.82	5.6 -

Cont.

Year	Date	Locality	N	$\overline{V}$	$\overline{L}$
1937	4/10	Bygdøy	0-gr 101	47.89	6.6 cm
	5/10	Håkavik	mixed 35	47.69	
	7/10	Holmestrand	0-gr 122	47.84	5.8 -
	23/9	Stølefjord	mixed 66	47.76	10.6 -
1938	1/10	Bonnefjord	0-gr 167	48.05	8.4 -
	30/9	Håkavik	0-gr 195	48.19	8.3 -
	23/9	Hellefjord	0-gr 169	47.90	7.5 -
1939	16/9	Bergen	0-gr 95	47.97	5.6 -
1941	1/10	Flødevigen	0-gr 283	48.11	7.6 -
	5/9	Bergen	0-gr 61	47.74	4.2 -
1946	4/10	Bygdøy, Oslofjord	0-gr 120	47.88	6.7 -
	4/10	Leangen, Oslofjord	0-gr 120	47.74	7.6 -
	27/9	Kilsfjord	0-gr 120	48.28	7.2 -
	26/9	Søndeledfjord	0-gr 120	47.87	6.6 -
	7/11	Flødevigen	0-gr 120	47.91	7.8 -
	21/9	Grimstad	0-gr 120	47.91	7.3 -
	20/9	Lillesand	0-gr 120	47.78	6.5 -
	17/9	Trysfjord	0-gr 120	47.79	6.5 -
1947	4/10	Bonnefjord	0-gr 120	48.04	6.8 -
	6/10	Bygdøy	0-gr 120	47.87	5.7 -
	6/10	Ostøya	0-gr 120	48.08	7.6 -
	26/9	Soppekil	0-gr 120	48.06	7.5 -
1948	28/9	Bonnefjord	0-gr 120	47.43	7.7 -
	28/9	Bonnefjord (Blylaget)	0-gr 120	48.00	8.7 -
	29/9	Bygdøy	0-gr 120	47.85	7.5 -
	29/9	Ostøya	0-gr 120	47.91	9.3 -
	2/10	Holmestrand	0-gr 226	47.95	6.7 -
	22/9	Søndeledfjord	0-gr 120	47.96	6.8 -
	3/11	Sponvika	mixed 116	47.97	12.9 -
	1/11	Kattegat	mixed 120	47.97	12.1 -
	2/11	—	mixed 120	47.84	11.6 -
1949	3/10	Bonnefjord (Bogenbukta)	0-gr 120	47.78	7.4 -
	3/10	— (Breivik)	0-gr 120	47.64	7.4 -
	3/10	— (Blylaget)	0-gr 120	47.96	8.4 -
	3/10	Bygdøy	0-gr 120	47.86	6.7 -
	30/9	Håøya	0-gr 120	47.89	7.5 -
	22/9	Kilsfjord	0-gr 120	48.04	7.0 -
	22/9	Stølefjord	0-gr 120	47.96	7.2 -
	20/9	Sandnesfjord	0-gr 120	47.92	7.5 -
	16/6	Hafrsfjord (mainly)	1-gr 120	48.11	9.6 -
	14/6	Hidlefjord —	120	48.05	8.8 -
	31/5	Mastrafjord —	120	47.92	8.5 -
	13/6	— —	120	48.00	9.0 -

Cont.

Year	Date	Locality	N	V	L
	15/6	— ....(mainly)	120	47.83	8.5 cm
	30/5	Skånevik .... —	120	48.04	8.8 -
	10/6	Åkrefjord .... —	120	47.96	8.3 -
	3/6	Matrefjord .... —	120	48.08	8.7 -
	7/6	Eidsvik............ —	110	48.05	8.9 -
	3/6	Sævareid .... —	120	47.98	8.8 -
	7/7	Osafjord .... —	120	47.86	8.8 -
	22/5	Atløy .... —	66	48.24	10.3 -