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BELGIAN MINISTRY OF TRANSPORT  
MARINE DEPARTMENT  
FISHERIES DIRECTION  
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FURTHER OBSERVATIONS ON SPENT HERRING CONCENTRATIONS  
ALONG THE BELGIAN AND FRENCH COASTS  
DURING THE PERIOD 1938-1945  
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OBSERVATIONS ABOUT THE ANNUAL SPENT HERRING-  
CONCENTRATIONS ALONG THE BELGIAN AND FRENCH  
COASTS.

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Since the winter 1930/1931 the Belgian Marine biological Institute has been studying with particular interest the spent herring concentrations, which settle down every winter along the Belgian and French coasts. These concentrations appear along our coast immediately after the breeding. It is highly probable that their spawning-grounds are situated in the extreme southern part of the North Sea and the Eastern Channel. When the concentration reaches the coast, all herrings - with the exception of a few - are spent. The development of eggs and milt goes together with a prejudicial reduction of mesenteric fat, their evacuation calling for an extremely hard physical effort on behalf of the herring, exhausted and grown thin by this strain. It does not feed whilst staying along the coast, but, as soon as the desire for food sharpens the concentration scatters and begins its search for food. The exact spot where the feeding-grounds are to be found have not yet been located with certainty. The following statements could be an indication for further explorations as to their location.

I At the end of March, and the beginning of April 1938, important quantities of herring (stage II) were landed by Belgian fishermen. They came from the "Silver-pit". The characteristics of those fishes were very much the same as those in the 1937-1938 concentration along the French coast. (See G. GILSON : Spent-Herring from the "Silver-pit", Rapp. et Proc.-verb. vol. CIX, III, n° 16, 1939).

II Prof. LE GALL and Dr. FURNESTIN draw our attention to the presence of "Bank-herring" on the Fladen-grounds, during the years 1929-1935. This herring as well as the Atlantic herring met in those grounds was in full feeding period (See J. FURNESTIN : Observations diverses sur les concentrations de harengs du "Fladen" (Mer du Nord) Rev. Trav. Off. des Pêch. Mar. Tom. III, Fasc. 1, 1936.)

The above mentioned points could make us draw the conclusion that part of the herring, spending a recovering stage along our coast during the winter months, makes for Northern waters to find its food.

The summary of the results of our studies on this matter were regularly sent to the International Council for the Exploration of the Sea, which incorporated it in its "Procès-Verbaux des Réunions". Due to war circumstances nothing more could be sent since 1939. However, the herring work was carried on, although an exception had to be made for 1940-1941, when war operations made all fishery and every experiment impossible.

Here follow the results since 1939 of the work continued according to the methods recommended in 1930 at Lowestoft.

The study material at our disposal consisted of 24 samples each of 25 herrings, totalling 600 individuals. All of them came from the French coast, between Gravelines and Boulogne.

I. Length.

The length of the analysed herrings fluctuated between 20 cm. and 29 cm.; the average length attaining 25,20 cm.

Frequency of the length-measures in cm.

Length	20	21	22	23	24	25	26	27	28	29
Number	3	17	43	100	97	90	114	92	40	4
%	0,5	2,8	7,2	16,7	16,2	15	19	15,3	6,7	0,7

II Weight.

Average weight of the individual : 114 gram.

Average number per Kgs : 8,8

III Sex.

Male : 294 or 49%

Female : 306 or 51%

IV Gonads.

Frequency for the different stades (Hjort scale, slightly altered)

Stades	I	V	VI	VII	VIII-II
Number	6	1	4	19	570
%	1,-	0,1	0,7	3,2	95,-

V Mesenteric fat.

Frequency of the mesenteric quantity of fat (Hjort scale)

Quantity	0	1	+	M
Number	118	440	38	3
%	19,7	73,3	6,5	0,5

VI Age.

24 out of the 600 individuals of which the study material consisted could not have their age determined, 551 were from 3 up to 10 years old, while the 25 remaining counted 11 and more years.

Frequency of age and year-class.

Age	3	4	5	6	7	8	9	10	+
Year-class.	1935	1934	1933	1932	1931	1930	1929	1928	Anterior
Number	47	224	55	79	62	8	72	4	25
%	8,2	28,9	9,5	13,7	10,8	1,4	12,5	0,7	4,3

The 4 youngest year-classes, 3,4,5 and 6 years-old individuals, amounted to a total of 70,3% of the concentration, which may be regarded as really promising for the coming campaign.

Length and age.

Average length of the herrings of the class	1935	:	22,29	cm.
" " " " " " " "	1934	:	23,67	cm.
" " " " " " " "	1933	:	25,33	cm.
" " " " " " " "	1932	:	26,25	cm.
" " " " " " " "	1931	:	26,45	cm.
" " " " " " " "	1930	:	27,50	cm.

VII Vertebrae.

Frequency of the number of vertebrae.

Number of vertebrae	54	55	56	57	58
Number of individuals	4	31	254	289	22
%	0,6	5,2	42,3	48,2	3,7

Monthly- and seasonal average of vertebrae.

December	January	February	Season
56,48	56,49	56,51	56,49

With the exception of the month of February, when the concentration was rather "Polyspondylic" the composition of the herring shoals was distinctly characterised by "Oligospondylic" which indicates that Northsea herring was preponderant in numbers.

VIII Contents of stomach.

A rather important quantity of food was only to be found in 9 stomachs. It consisted mainly of copepod's rests, Temora longicornis.

IX Landed quantities and value.

The campaign started fairly early (18 December 1938) lacking sufficient catches however it was stopped at an early date (23 January 1939)

The total capture amounted to the weight of 2.658.320 Kgs and it was sold for the sum of 1.865.716 Fms, hardly 0,70 Fms per Kgs

CONCENTRATION 1939-40  
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Due to military operations in the English Channel and owing to a lack of herring along the Belgian Coast, only 4 samples of 25 herrings each, totalling 100 species could be analysed. They were coming from the French coast, between Gravelines and Calais.

I. Length.

The length of the examined herrings fluctuated between 21 cm. and 26 cm., the average-length reaching 24,64 cm.

Frequency of the lengthmeasures in cm.

Length	21	22	23	24	25	26	27	28
Number	8	8	18	17	22	8	14	5
%	8,-	8,-	18,-	17,-	22,-	8,-	14,-	5,-

II. Weight.

Average weight of the individual : 105 gr.

Average number per Kcs : 9,7

III Sex.

Male : 52 or 52%

Female : 48 or 48%

IV Gonads

Frequency of the different stades (Hjort scale slightly altered)

Stades	VII	VIII-II
Number	2	98
%	2	98,-

V Mesenteric fat.

Frequency of the quantity of fat. (scale Hjort)

Quantity	0	1	+
Number	28	69	3
%	28,-	69,-	3,-

VI Age.

The analysed herrings were 3 to 10 years old, the maximum being attained by the five-year old herrings.

Frequency of age and year-class.

Age	3	4	5	6	7	8	9	10
Year-class.	1936	1935	1934	1933	1932	1931	1930	1929
Number	16	22	30	7	10	8	1	6
%	16,-	22,-	30,-	7,-	10,-	8,-	1,-	6,-

The 4 youngest year classes gained in the 1939/40. concentration with 78% an up to now never reached percentage it being th a favourable omen for the abundance of coming concentrations.

Length and Age.

Average length of the herrings of the class	1936	: 22,37	cm.
" " " " " " " "	1935	: 23,68	cm.
" " " " " " " "	1934	: 24,97	cm.
" " " " " " " "	1933	: 26,64	cm.
" " " " " " " "	1932	: 26,90	cm.
" " " " " " " "	1931	: 27,-	cm.

VII Vertebrae.

Frequency of the number of vertebrae.

Number of ver- tebrae	55	56	57	58
Number of in- dividuals	5	35	55	5
%	5,-	35,-	55,-	5,-

Average of the season : 56,60 vertebrae.

As all samples had been collected during the month of January, and owing to the fairly high average of the vertebrae we may come to the conclusion that even that very month the Channelherring was already strongly represented.

VIII Contents of stomachs.

No food was to be found in any stomach. We may attribute this to the fact that the samples have been caught long before the concentration dispersed, on a moment when the longing for food had not yet been revived.

IX Landed quantities and value.

Because of military operations, the fishing activity during that period really met with great difficulties. On account of this, there was only fishing during the month of January. Belgium saw only 18 catches landed, totalling a weight of 60.880 Kgs and amounting to 110.570 Frs, thus an average price of 1,82 ~~frs~~ per Kgs

CONCENTRATION 1940-1941.

Owing to war operations and by want of herring along the Belgian coast, the study of the spent herring concentration could not be continued.

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CONCENTRATION 1941-42.  
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Although the spent herring had already made its appearance along the Belgian coast on the 9th of December 1941, the experiments could only be started on the 2d of February 1942. On this account the study material was limited to 9 samples each of 25 herrings, totalling 225 individuals.

I. Length.

The length of the examined herrings was from 20 cm. up to 29 cm. most of them attaining about 25 cm. The average length was 24,78 cm

Frequency of the lengthmeasures in cm.

Length	20	21	22	23	24	25	26	27	28	29
Number	1	5	22	29	25	60	53	20	8	2
%	0,4	2,2	9,8	12,9	11,1	26,6	23,6	8,9	3,6	0,9

II. Weight.

Average weight of the individual : 90 gr.

Average number per Kgs : 11,2

III Sex.

Male : 122 or 54%

Female : 103 or 46%

IV Gonads.

Frequency of the different stades (scale Hjort, slightly altered)

Stades	I	VI	VII	VIII-II
Number	2	2	5	216
%	0,9	0,9	2,2	96,-

V Mesenteric fat.

Frequency of the quantity of fat (scale Hjort)

Quantity	0	1	+	M
Number	109	107	6	3
%	48,4	47,5	2,7	1,3

VI Age.

Frequency of age and year-class.

Age	2	3	4	5	6	7	8	9	10	11	12
Year-class	1939	1938	1937	1936	1935	1934	1933	1932	1931	1930	1929
Number	2	51	24	74	31	24	11	3	2	1	2
%	0,9	22,7	10,7	32,9	13,8	10,7	4,9	1,3	0,9	0,4	0,9

The age fluctuated between 2 and 12 years. The 1936 year class, aged five years, appeared to be the strongest class present. The whole contingent, of the herrings, aged 3, 4, 5 and 6 years, attaining 80,1% was again present in extremely large numbers, so that the following year an abundant concentration could be expected.

Length and Age.

Average length of the herrings of the year-class	1938	: 23,50	cm.
" " " " " " " "	1937	: 24,80	cm.
" " " " " " " "	1936	: 25,39	cm.
" " " " " " " "	1935	: 26,10	cm.
" " " " " " " "	1934	: 26,58	cm.
" " " " " " " "	1933	: 26,77	cm.

VII Vertebrae.

Frequency of the number of vertebrae.

Number of vertebrae	55	56	57	58	59
Number of individuals	16	90	99	19	1
%	7,1	40,-	44,-	8,4	0,5

Average of the season : 56,55

In February the average of vertebrae attained 56,44 characteristic of oligospondylie.

In March the average went up to 56,62 being fairly strongly characterised by polyspondylie.

The markedly higher proportion of this average explains the increasing richness of Channel-herring.

VIII Contents of stomachs.

Only 30 out of the 225 analysed stomachs contained some food, most of it being rests of copepods, i.e. Temora longicornis.

IX Landed quantities and value.

As foreseen in the season 1939/40 the herring concentration was particularly rich. The catches on the Belgian coast reached 5.030.928 Kgs, as to 4.975.863 Kgs in the French waters, amounting to the total sum of 10.006.791 Kgs. The capture per sea-hour and per developed H.P. in Belgian waters attained 21 Kgs; in French waters 19 Kgs.

The total catch was sold for a sum amounting to 80.054.328 Kgs at the average of 8 Kgs per Kg. The abundant catches in Belgian waters were really extraordinary, when we point to the fact that before 1941 Belgian fishermen were bound to fish the spent herring in French waters.



CONCENTRATION 1942-43.

The study material consisted of 21 samples each of 25 herrings, in other words 525 individuals. The concentration moved in preponderant number towards the Belgian coast, between Dunkirk and the Scheldt.

I. Length.

The length of the analysed herrings varied between 21 cm and 29 cm. most of them attaining a length of 26 cm. The average length was 25.43 cm.

Frequency of the length-measures in cm.

Length	21	22	23	24	25	26	27	28	29
Number	1	8	30	78	138	176	71	19	4
%	0,2	1,5	5,7	14,9	26,3	33,5	13,5	3,6	0,8

II Weight.

Average weight of the individual : 101 gr.

Average number per kg : 9,9

III Sex.

Male : 271. or 52%

Female : 254. or 48%

IV Stades of the Gonads.

Frequency of the different stades (Hjort scale, slightly altered.)

Stades	I	VI	VII	VIII-IX
Number	1	3	16	505
%	0,2	0,7	3,-	96,-

V Mesenteric fat.

Frequency of the quantity of fat (scale Hjort)

Quantity	0	1	+	M
Number	309	199	15	2
%	58,8	37,9	2,9	0,4

VI Age.

Frequency of age and year-class.

Age	3	4	5	6	7	8	9	10	11
Year-class	1939	1938	1937	1936	1935	1934	1933	1932	1931
Number	17	136	50	156	70	59	16	7	4
%	3,3	26,4	9,7	30,3	13,6	11,4	3,1	1,4	0,8

The herrings, whose age could be determined (515), were 3 to 11 years old. With 30,3% the year-class 1936, composed of six-year-old individuals was the most strongly represented contingent. The 1938 year-class as well as abundant (26,4%). On the contrary the year-classes 1939 (aged three) and 1937 (aged five, were with a respective percentage of 3,3% and 9,7% extremely poorly represented.

The percentage of the four youngest year-classes which attained 69,7% was sensibly lower than in 1941-42 when it attained 80,1% out of the concentration. If the 1943-44 catches were not disadvantaged on this account, this was solely due to the constant interruption of the Autumn-herring-fishery, at a distance from the coast.

Age and Length.

Average length of the herrings of the year-class 1939	:	22,62	cm.
" " " " " " " "	:	1938	: 24,90 cm.
" " " " " " " "	:	1937	: 25,84 cm.
" " " " " " " "	:	1936	: 25,90 cm.
" " " " " " " "	:	1935	: 26,57 cm.
" " " " " " " "	:	1934	: 26,86 cm.

VIII Vertebrae.

Frequency of the vertebrae.

Number of vertebrae	55	56	57	58
Number	11	235	251	28
%	2,1	44,8	47,8	5,3

Monthly and seasonal average.

December	January	February	March	Season
56,48	56,53	56,62	56,60	56,56

The seasonal average was 56,56. The 56,48 average it attained in December was rather low and makes us suppose that at that particular moment the concentration was exclusively composed of Channelherring. From January onwards the average number of vertebrae increases and attains 56,53, which is probably due to the appearance of channelherring. During the month of February the average number of vertebrae reached 56,62 and during March 56,60. This increase is an absolute proof of a strong penetration of Channelherring into the North Sea.

VIII Contents of the stomachs.

Only in 19 Stomachs a significant quantity of food was to be found. It consisted mainly of copepod's rests.

IX Landed quantities and value.

As had been forecast in 1941-42 the catches were particularly abundant. Weight and value reached fabulous figures: 51.894.746 Kgs and 352.533.995 Rs i.e. an average of 6,66 per Kgs. The average capture per sea-hour and per developed H.P. amounted to a weight of 22 Kgs.

CONCENTRATION 1943-44

The study material collected consisted of 28 samples, each of 25 herrings, totalling 700 individuals, all of them coming from the Belgian coast.

I Length.

The length of the examined herrings fluctuated between 20 cm. and 33 cm. At an average they measured 25,76 cm.

Frequency of the lengthmeasures in cm.

Length	20	21	22	23	24	25	26	27	28	29	30 +
Number	1	2	25	31	28	157	246	140	51	7	2
%	0,1	0,3	3,6	4,4	5,4	22,4	35,1	20,-	7,3	1,-	0,3

II Weight.

Average weight of the individual : 101 gr.

Average number per Kes : 9,9

III Sex.

Male : 384 or 54,9%

Female : 316 or 45,1%

IV Gonads.

Frequency of the different stades (Hjort scale, slightly altered).

Stades	I	V	VI	VII	VIII-II
Number	2	2	1	9	686
%	0,3	0,3	0,1	1,3	98,-

V Mesenteric fat.

Frequency of the quantity of fat. (scale Hjort)

Quantity	0	1	+	M
Number	436	245	16	3
%	62,3	35,-	2,3	0,4

VI Age.

Frequency of age and year-class.

Age	3	4	5	6	7	8	9	10	11 +
Year-class	1940	1939	1938	1937	1936	1935	1934	1933	Anterior
Number	66	22	124	61	217	99	78	15	15
%	9,5	3,2	17,8	8,8	31,1	14,2	11,1	2,1	2,1

In the concentration 1943-44 ten different year-classes were represented : 1940 to 1931, i.e. 3- to 12-year-old herrings, with the greater part in the 1936 year-class, in other words seven-year-old individuals.

The four youngest classes, 3-, 4-, 5, and 6-year-old herrings were as a whole, with 39,3%, very poorly represented, which in case the fishery for Autumn-herring would take place at a distance from the coast, could highly have ~~disadvantaged~~ the richness of coming concentrations. The fabulous catches nevertheless realised, are in a very large part the consequence of the above-mentioned fishery.

Age and Length.

Average length of the herring of the year-class 1940	:	23,38	cm.
" " " " " " " "	:	1939	: 24,91 cm.
" " " " " " " "	:	1938	: 25,65 cm.
" " " " " " " "	:	1937	: 26,71 cm.
" " " " " " " "	:	1936	: 26,44 cm.
" " " " " " " "	:	1935	: 27,02 cm.

VII Vertebrae.

Frequency of the number of vertebrae.

Number of vertebrae	55	56	57	58
Number	11	235	251	28
%	2,1	44,8	47,8	5,3

Monthly and seasonal average.

December	January	February	March	Season
56,44	56,54	56,53	56,60	56,51

The seasonal average attained 56,51 vertebrae. In December : 56,44, which might indicate that during that period the concentration was exclusively composed of North Sea-herring. From January onwards the vertebrae-characteristic becomes Polyspondylic with a percentage of 56,54 plainly proving that henceforth Channelherring joined the concentration. In March the average attains 56,60 making us believe in a stronger Channelherring penetration into the North Sea.

VIII Contents of stomachs.

Of the 700 analysed stomachs only 8 were found to be containing some food, nearly all of it being copepod's rests. Temora Longicornis.

IX Landed quantities and Value.

During the 1943-44 campaign the spent herring never touched the French coast but moved along the Belgian coast between Dunkirk and the Scheldt.

Weight : 58.119.500 Kgs; value : 304.954.647 frs  
i.e. 5,25 frs per Kgs. The capture per sea-hour and per developed H.P. was 27 Kgs

CONCENTRATION 1944-45

The study material consisted of 22 samples each of 25 herrings, totalling 550 individuals having all been collected along the Belgian coast.

I. Length.

The length of the analysed herrings fluctuated between 20 cm. and 29 cm.: in most cases the length attaining 26 cm, The average length attained 25,20 cm.

Frequency of the length-measures.

Length	20	21	22	23	24	25	26	27	28	29
Number	4	16	25	27	62	145	177	74	19	1
%	0,7	2,9	4,5	4,9	11,3	26,4	32,2	13,5	3,4	0,2

II. Weight.

Average weight of the individual : 100 gr.

Average number per Kes : 10

III. Sex.

Male : 287 or 52%

Female : 263 or 48%

IV. Gonads.

Frequency of the different stades (scale Hjort, slightly altered).

Stades	VI	VII	VIII - II
Number	1	1	548
%	0,2	0,2	99,6

V. Mesenteric fat.

Frequency of the quantity of fat.

Quantity	0	1	+	M
Number	275	272	1	1
%	50,3	49,3	0,2	0,2

VI. Age.

Frequency of age and year-class.

Age	2	3	4	5	6	7	8	9	10	11	13	14
Year-class	1942	1941	1940	1939	1938	1937	1936	1935	1934	1933	1931	1930
Number	1	54	58	9	106	42	168	64	35	8	2	1
%	0,2	9,8	10,7	1,6	19,4	7,6	30,7	11,6	6,4	1,4	0,4	0,2

The concentration 1944-45 was composed out of 12 different year-classes, herrings from 2 to 14 years old. The old 1936 year-class, eight-year-old individuals once more claimed an exceptionally high proportion (30,7), which inevitably caused a decrease in the percentage of the other year-classes, especially for the herrings aged 3, 4, 5- and 6 years, which as a whole in the recent concentration claimed an extraordinary low percentage. It was forecast that if an eventual Autumn-herringfishery on the open sea should take place even before the oncoming spent-herringseason, the abundance of the next concentration would strongly decrease.

Age and Length.

Average length of the herring of the year-class 1941	:	22,57	cm.
" " " " " " " "	:	1940	: 23,88 cm.
" " " " " " " "	:	1939	: 25,50 cm.
" " " " " " " "	:	1938	: 25,62 cm.
" " " " " " " "	:	1937	: 26,38 cm.
" " " " " " " "	:	1936	: 26,40 cm.

VII Vertebrae.

Frequency of the number of vertebrae.

Number of vertebrae	55	56	57	58
Number	25	216	272	30
%	4,5	39,6	50,4	5,3

Monthly and seasonal average.

December	January	February	March	Season
56,48	56,35	56,62	56,63	56,57

The average number of vertebrae for the season was brought to 56,57. In December it attained 56,35 which is particularly low and indicates that the concentration, during that very period, was exclusively composed of North sea-herring.

During January, on the contrary, the average of vertebrae greatly increased, indicating a strong increase of Channel herring.

VIII Contents of the stomachs.

Not one stomach was to be found with a quantity of food that was worth-mentioning.

IX Landed quantities and value.

In 1944-45 the spent-herringconcentration moved once more exclusively along the coast between Dunkirk and the Scheldt.

3.840 catches were landed, amounting to a total weight of 31.846.604 Kgs i.e. at an average of 8.189 Kgs for one day's capture. The average capture per hour of absence from the harbour per developed H.P. attained 27 Kgs

The total weight of the landed quantities was sold for the sum of 167.044.272, thus at an average of 5,25 Kgs

CONCENTRATION 1945-46

Once more were all herringsamples caught along the Belgian coast. The study material consisted of 28 samples each of 25 herrings making a total of 700 individuals analysed.

I Length.

The length of the examined herrings was from 20 cm. to 29 cm., mostly attaining a 27 cm. length. At an average they measured 25,41 cm.

Frequency of the lengthmeasures.

Length	20	21	22	23	24	25	26	27	28	29
Number	8	21	69	67	57	60	117	213	83	5
%	1,1	3,-	9,9	9,6	8,1	8,6	16,7	30,4	11,9	0,7

II Weight.

Average weight of the individual : 107 gr.

Average number per Ks : 9,4

III Sex.

Male : 371 or 53%

Female : 329 or 47%

IV Gonads

Frequency of the different stades (scale Hjort, slightly altered).

Stades	I	VI	VII	VIII-II
Number	4	1	36	659
%	0,6	0,1	5,1	94,2

V Mesenteric fat.

Frequency of the quantity of fat(scale Hjort)

Quantity	0	1	+	M
Number	196	485	18	1
%	28	69,3	2,6	0,1

VI. Age.

Frequency of age and year-class.

Age	2	3	4	5	6	7	8	9	10	11+
Year-class	1943	1942	1941	1940	1939	1938	1937	1936	1935	Anterior
Number	1	168	89	50	19	115	40	131	52	33
%	0,1	24,-	12,7	7,1	2,7	16,5	5,7	18,7	7,2	4,7

The concentration 1945-46 was composed out of 13 different year-classes, herrings aged 2 to 15 years. This time the 3-year-old herrings, which participating for the first time in the spawning and attaining a percentage of 24, are represented in the concentration with the highest proportion, followed by the 9-year-old (1936 class), with a percentage of 18,7. The herrings aged 3-, 4-, 5-, and 6 years were once more, with a total percentage of 43,8, represented far below the normal average. This time also it is a bad omen for the results of the coming spent herring season.

Age and length.

Average length of the herring of the class	1942	: 22,92 cm.
" " " " " " " "	1941	: 24,83 cm.
" " " " " " " "	1940	: 26, - cm.
" " " " " " " "	1939	: 26,61 cm.
" " " " " " " "	1938	: 26,41 cm.
" " " " " " " "	1937	: 27,30 cm.

VII Vertebrae.

Frequency of the number of vertebrae.

Number of vertebrae	54	55	56	57	58	59
Number	1	18	271	359	50	1
%	0,1	2,6	38,7	31,3	7,1	0,1

Monthly and seasonal average.

December	January	February	March	Season
56,53	56,67	56,71	56,59	56,63

From the beginning the concentration was characterised by polyspondylic (56,53). With a percentage of 56,63 the seasonal average attained a high proportion making us conclude that the Channelherring had a strong participation in the composition of the concentration.

VIII Contents of stomachs.

98,3% of the stomachs were empty; only from March onwards some food was to be found, mainly consisting of rests of copepods..

IX Landed quantities and value.

Yet this time did the spent herring concentration move in preponderant number between Dunkirk and the Scheldt. The landed quantities amounted to 6.559 catches, weighing 26.353.658 Kgs i.c. an average of 4.030 Kgs for one day's capture. The mean catch per hour's absence from the harbour per developed H.P. was 11,3 Kgs.

If compared with the average catches booked during the four previous spent herring campaigns this means a decrease of 50% to 60%.



This immense depression is largely due to the renewal in 1945 of the Autumn-herring fishery in the Southern North Sea and the Eastern Channel. The rich catches this fishery provided, undoubtedly meant an important previous thinning of the spent-herring concentration of 1945-46

The landed quantities were sold for the sum of 69.694.108 Ffs, i.e. at an average of 2,64 Ffs per Kgs.

Recapitulation of the results during the  
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 period 1938-1945.  
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The study material implies 7 spent herring-seasons and contains 132 samples, each of 25 herrings, totalling thus 3.400 individuals.

I Length.

Table I. Frequency of the length-measures in percentage.

Length in cm.	20	21	22	23	24	25	26	27	28	29	30+	Average Length
1938-39	0,5	2,8	7,2	16,7	16,2	15,-	19,-	15,3	6,7	0,7	-	25,10
1939-40	-	8,-	8,-	18,-	17,-	22,-	8,-	14,-	5,-	-	-	27,64
1941-42	0,4	2,2	9,8	12,9	11,-	26,6	23,3	8,9	3,6	0,9	-	24,78
1942-43	-	0,2	1,5	5,7	14,9	26,3	33,5	13,5	3,6	0,8	-	25,43
1943-44	0,1	0,3	3,6	4,4	5,4	22,4	35,1	20,-	7,3	1,-	0,3	25,76
1944-45	0,7	2,9	4,5	4,9	11,3	26,4	32,2	13,5	3,4	0,2	-	25,20
1945-46	1,1	3,-	9,9	9,6	8,1	8,6	16,7	30,4	11,9	0,7	-	25,43
General average	0,5	2,-	5,9	8,9	11,-	19,8	26,2	18,3	6,6	0,7	0,1	25,33

Among the 3.400 herrings that were examined in the 7 latest concentrations, the length varied between 20 cm. and 33 cm., the greater number attaining 26 cm. (26,2%). The annual length-average fluctuated between 24,64 cm. (1939/40) and 25,76 cm. (1943/44)

The general average of the length for the 7 considered concentrations was 25,33 cm.

II Weight.

Table 2. Average weight and number of individuals in a Kgs.

Concentrations	Average weight of the individual (gr.)	Number of herrings per kilogram.
1938-39	114	8,8
1939-40	103	9,7
1941-42	90	11,2
1942-43	101	9,9
1943-44	108	9,3
1944-45	100	10,-
1945-46	107	9,3
General average	105	9,5

The total weight of the 3.400 analysed herrings amounted to 357.964 gr. i.e. an average of 105 gr. or 9,5 individuals per kilogram. The average weight attained its maximum in 1938-39, with 114 gr. or 8,8 individuals per kilogram, and its minimum, in 1941-42 with 90 gr. or 11,2 individuals per kilogram.

III Sex.

Table 3. Frequency of the sex in percentage.

Concentration	Male		Female	
	Number	%	Number	%
1938-39	294	49,-	306	51,-
1939-40	52	52,-	48	48,-
1941-42	122	54,-	103	46,-
1942-43	271	52,-	254	48,-
1945-44	384	55,-	316	45,-
1944-45	287	52,-	263	48,-
1945-46	371	53,-	329	47,-
General result	1.781	52,-	1.619	48,-

The males were, with a percentage of 48, a minority in the concentration 1938-39, while they booked a major proportion in the 6 remaining concentrations. Among the 3.400 analysed herrings there were counted : 1.781 males, an average of 52% and 1.619 females, i.e. 48%

IV Gonads.

Table 4. Frequency of the stades in percentage.  
(scale Hjort, slightly altered)

Concentration	I	V	VI	VII	VIII-II
1938-39	1,-	0,1	0,7	3,2	95,-
1939-40	-	-	-	2,-	98,-
1941-42	0,9	-	0,9	2,2	96,-
1942-43	0,3	-	0,7	3,-	96,-
1943-44	0,3	0,3	0,1	1,3	98,-
1944-45	-	-	0,2	0,2	99,6
1945-46	0,6	-	0,1	5,1	94,2
General result	0,4	0,1	0,3	2,6	96,5

According to the frequency of the stades of the gonads, where stade VIII-II, with 96,5%, was found to be nearly always represented, we are undoubtedly in the presence of a composition of herrings which spawned recently in grounds not far distant from the Belgian and French coast.

The presence of the stades V, VI and VII, asserts this point of view.

V. Mesenteric fat.

Table 5 frequency of the quantity of fat in percentage (scale Ejort)

quantity of fat	0	1	+	M
1938-39	19,7	73,3	6,5	0,5
1939-40	28,-	69,-	3,-	-
1941-42	48,4	47,5	2,7	1,3
1942-43	58,8	37,9	2,9	0,4
1943-44	62,3	35,-	2,3	0,4
1944-45	50,4	49,4	0,1	0,1
1945-46	28,-	69,3	2,6	0,1
General average	43,3	53,4	2,9	0,4

The concentrations were, with 96,7%, composed of herrings with no or very little fat in stock, thus explaining their thinness and consequently having not long ago passed their breeding period.

VI. Age.

Table 6. Frequency of age and year-class in percentage.

Age	3	4	5	6	7	8	9	10
1938-39	1935 8,2	1934 38,9	1933 9,5	1932 13,7	1931 10,8	1930 1,4	1929 12,5	1928 0,7
1939-40	1936 16,-	1935 22,-	1934 30,-	1933 7,-	1932 10,-	1931 8,-	1930 1,-	1929 6,-
1941-42	1938 22,7	1937 10,7	1936 32,9	1935 13,8	1934 10,7	1933 4,9	1932 1,3	1931 0,9
1942-43	1939 3,3	1938 26,4	1937 9,7	1936 30,3	1935 13,6	1934 11,4	1933 3,1	1932 1,4
1943-44	1940 9,5	1939 3,2	1938 17,8	1937 8,8	1936 31,1	1935 14,2	1934 11,2	1933 2,1
1944-45	1941 9,8	1940 10,7	1939 1,6	1938 19,4	1937 7,6	1936 30,7	1935 11,6	1934 6,4
1945-46	1942 24,-	1941 12,7	1940 7,1	1939 2,7	1938 16,5	1937 5,7	1936 18,7	1935 7,4
General average	12,5	17,1	11,7	13,7	16,1	11,7	10,9	3,6

Only the percentage of the three- to ten-year-old individuals is noted in table 6. The percentage attained by the two-year-old or the older classes, is as a rule insignificant.

Considering the first column where the percentage of the three-year-old herrings are noted, in other words at the very moment they make their first appearance in the concentration, it is made plain that their contingent is far from being constant. The percentage of the three-year-old individuals varies between 3,3% (1939 class) and 24% (class 1942) (see diagram I). On the other hand it is established that in the columns of the herrings aged four and more years the year-classes having been strongly represented from the beginning, keep so in the next concentrations, and reversely, that the classes that were poor at their first appearance, afterwards remain deficient. So we have rich and poor year-classes.

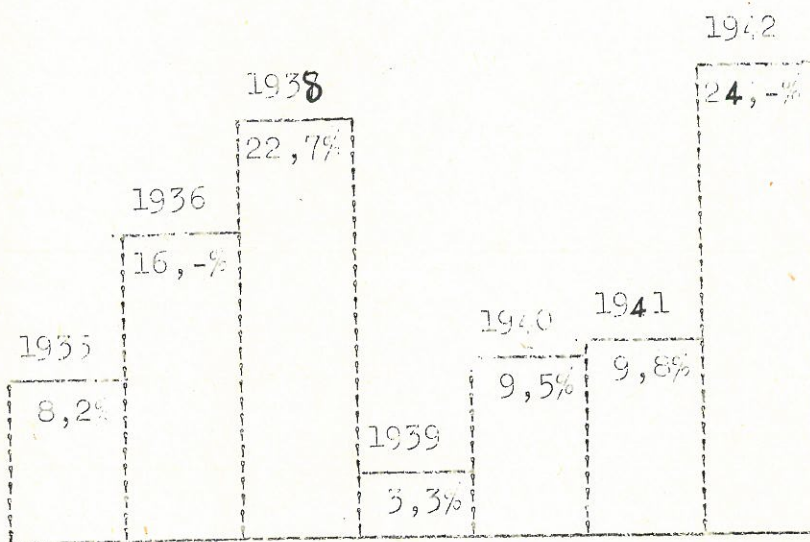


Diagram : Fluctuation at first appearance of 3-year-old recruits.

Among the year-classes which have been met in the 7 latest concentrations, there should be distinguished two extremely rich classes : 1929 and 1936; five less abundant but still considered good classes : 1931, 1932, 1934, 1935 and 1938, and 7 poor ones 1928, 1930, 1933, 1937, 1939, 1940 and 1941, among which the 1939 class may be reckoned as the poorest ever.

It is mostly at the age of four that a year-class is most strongly represented in the composition of the spent-herring concentrations. At the age of five there is already a slight decrease in the number of the year-classes and from the age of six onward the decrease is significant.

In the latest concentrations this line of conduct was not exactly to be kept to, as in the above mentioned concentrations the old-year-classes generally attained a higher proportion than the younger ones. When looking at the general result we make out that the six- and seven-year-old herrings claimed a higher percentage than the ones aged five years. This abnormal result may largely originate in the poor representation of the youngest year-classes and especially of the 1939-1940 and 1941 classes, on account of which the percentage of the older year-classes instead of decreasing, rather remained at the same level or even slightly decreased.

Age and length.

Table 7. Average length 1 cm. by three to eight years of age.

Concentration	Age					
	3	4	5	6	7	8
1938-39	22,29	23,67	25,33	26,25	26,45	27,50
1939-40	22,37	23,68	24,97	26,64	26,90	27,-
1941-42	23,50	24,80	25,39	26,10	26,58	26,77
1942-43	22,62	24,90	25,84	25,90	26,57	26,86
1943-44	23,38	24,91	25,65	26,71	26,44	27,02
1944-45	22,57	23,88	25,50	25,62	26,38	26,40
1945-46	22,92	24,83	26,-	26,61	26,41	27,30
General results	23,03	24,49	25,64	26,21	26,52	26,77

VII Vertebrae.

Table 8. Frequency of the vertebra number in percentage.

Number of vertebrae							Average of vertebrae.
	54	55	56	57	58	59	
1938-39	0,6	5,2	42,3	<u>48,2</u>	3,7	-	56,49
1939-40	-	5,-	35,-	<u>55,-</u>	5,-	-	56,60
1941-42	-	7,1	40,-	<u>44,-</u>	8,4	0,5	56,55
1942-43	-	2,1	44,8	<u>47,8</u>	5,6	-	56,56
1943-44	-	4,1	<u>46,2</u>	<u>44,4</u>	5,3	-	56,51
1944-45	-	4,5	39,6	<u>50,4</u>	5,5	-	56,57
1945-46	0,1	2,6	38,7	<u>51,3</u>	7,1	0,1	56,63
General results	0,14	4,-	41,9	<u>48,3</u>	5,6	0,06	56,55

The number of vertebrae 57, with a percentage of 48,3 appeared mostly in the seven latest concentrations, followed by the number of vertebrae 56, with 41,9%; the number of vertebrae 58, with 5,6%; the number of vertebrae 55, with 4,-%; the number of vertebrae 54, with 0,14% and the number of vertebrae 59, with 0,06%.

The seasonal average of the number of vertebrae varied between 56,49 (1938-39) and 56,53 (1945-46). The low average of vertebrae in the concentrations of 1938-39, points to a want of Channel-herring, while the higher average of vertebrae of the concentration 1945-46, on the contrary, makes us believe in a strong massing of Channelherring.

The average of vertebrae calculated for the seven concentrations and which attained 56,55 indicates that generally the spent-herring concentrations were composed of North Sea and Channel-herring nevertheless with a majority of North Sea herring.

Table 9. Monthly fluctuations of the average of vertebrae.

Season	December	January	February	March.
1938-39	56,48	56,49	56,51	-
1939-40	-	56,60	-	-
1941-42	-	-	56,41	56,62
1942-43	56,48	56,53	56,62	56,60
1943-44	56,44	56,54	56,53	56,60
1944-45	56,35	56,62	56,63	-
1945-46	56,53	56,67	56,71	56,59
General Average	56,47	56,57	56,59	56,60

During the spent-herring campaign the average of vertebrae was subjected to important fluctuations. As a general rule, the later in the season, the higher the average of vertebrae.

In December, when the spent-herring concentration makes its appearance on the coast, the average of vertebrae is usually the lowest, being characterised by oligospondylie, calling to draw the conclusion that at this moment the concentration is exclusively composed of North Sea herring.

But from January onwards, the average of vertebrae increases markedly and goes over to polyspondylie, indicating a greater number of Channelherring.

In February and March the average of vertebrae increases, and consequently the Channelherring as well.

The absence of Channel-herring in December can easily be understood, as the herring is in full spawning-season, while the North-Sea-herring mostly breeds in November; for this reason drawing close to the coast one month earlier.

#### VIII Contents of stomachs.

Of the 3.400 analysed stomachs, only 78, i.e. 2,3%, contained a significant quantity of food, proving that the spentherring abstains itself from food during its visit to our coast.

As a matter of fact does the concentration leave the coast as soon as the longing for food has been revived, which means that the end of the spent herringfishery has come.

IX. Landed quantities and value

Table 10. Average weight of one catch per sea-hour for a developed H.P. and average price per kilogram.

Season	Weight in Kgs			Value in Frgs	
	Total	Average per catch	per sea hour & per developed H.P.	Total	per Kgs
1938-39	2.658.320	-	-	1.865.716	0,70
1939-40	60.880	3.382	-	110.570	1,82
1941-42	10.006.791	4.119	20	80.054.328	8,-
1942-43	51.894.716	5.662	27	352.533.995	6,66
1943-44	58.119.500	6.197	22	304.954.647	5,25
1944-45	31.846.602	8.189	27	167.044.272	5,25
1945-46	26.383.638	4.030	11	69.694.108	2,64

The small landed quantities booked in 1938-39, were due to the low price, an average of 0,70 Frgs per kilogram, which was offered for the herring. Discouraged on this account, only a small number of boats set out for the fishery and it was stopped altogether at an early date.

The poor result of 1939-40, can be explained by the war operations on sea, making active fishery impossible.

The stupendous catches made in the period 1941-45 may be attributed on one hand to the unusual appearance of spent herringshoals along the Belgian coast, coming thus in close range of the smallest fishing-smacks, i.e. shrimp-boats, which landed 50% of the capture, on the other hand, to the strong density of the concentration which fluctuated between 20 Kgs and 27 Kgs per sea-hour and per developed H.P.

The extremely high density most probably originates in the interruption, since 1940, of the Autumn-herring fishery, off the English coast and in the approaches of the Straits of Dover. This fishery may cause an important decrease in density of the next herring-concentrations which settle down after breeding along the French and Belgian coasts. The strong decrease in the average weight per sea-hour for each developed H.P. booked in 1945-46, is indeed a consequence of the above mentioned fishery.

Ostend, the 1rst of June 1946.