Sorting.



Concentrations of Full Herring exploited by the Belgian Herring Trawlers in 1949.

The first full-herring catches taken by the Belgian herring trawlers were landed on 13. July and the last on 5. December 1949. During July and August, the catches came exclusively from the Fladen Ground, whereas from September onwards, many trawlers already fished south of this area, viz., on the Turbot Bank, Old Devil Hole, and Gut. In October, this fishery extended to Brucey's Garden and the SW. area of the Dogger Bank. In November, the whole fishery moved suddenly to the extreme south of the North Sea, where it was localised between the "Ruytingen", the "Sandettié", and the Straits of Dover. There the fishery ended on 5. December.

The effectiveness of the trawler fleet is shown by Tables 1—4.



Biological Scale of the Full-Herring Concentrations exploited by the Belgian Herring Trawlers during the years 1946—1949.

A. Activity of the Herring Trawlers and Results recorded during the Fishery.

Table 1. 1	Num	ber (	of tl	he Be	lgian	Herring
Trawlers	s (t),	and	of	their	Voya	jes (v).

Classes of Vessels													
	III (160- 200 H. P.)		III (160- 200 H. P.) IV (270- 300 H. P.)		V (400- 450 H. P.)		VI (550- 850 H. P.)		Tot	al			
t v t v t v t v t v													
<ul> <li>(a) According to Fladen</li> <li>Centr. Area<sup>1</sup>).</li> <li>South. Area<sup>2</sup>).</li> </ul>	o th	le fis	$\frac{1}{2}$	g gro 2 2 2	und 7 7 4	ls 36 38 7	13 9 1	52 26 1	22 16 13	90 64 18			
(b) According to	o th	e mo	onth	ly pe	erio	ds.							
July	_	-	<u> </u>		7	9	6	8	13	17			
August			<b>2</b>	<b>2</b>	7	19	13	27	22	48			
September	_	-			7	20	13	28	20	48			
October					7	20	5	12	12	32			
November	6	7	<b>2</b>	2	5	12	2	4	15	25			
December	1	1			1	1	_		<b>2</b>	$^{2}$			

<sup>1</sup>) Central Area of the North Sea, chiefly "Old Devil Hole", "Turbot Bank", "Gut", "Brucey's Garden" and S.W. area of the Dogger Bank.

Table 2. Number of Sea-Days (S.D.) and ofEffective Fishing Hours (F.H.).

Classes of Vessels												
	III IV V VI											
	S.D.	F.H.	S.D.	F. H.	S.D.	F.H.	S.D.	F.H.				
(a) According to the fishing grounds												
Fladen			29	300	391	3730	540	5337				
Centr. Area	_				338	2620	251	2139				
South. Area	62	747	17	206	48	446	4	20				
(b) Accordin	ng to	the mo	nthly	period	s							
July					103	1143	73	554				
August			29	300	195	1646	279	2676				
September.					203	1930	299	3272				
October					166	1267	111	802				
November.	60	737	17	206	105	780	33	192				

 $\mathbf{5}$ 

30

<sup>2</sup>) Southern Area of the North Sea, chiefly the area situated between the "Ruytingen", "Sandettié" and Straits of Dover.

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### Table 3. Number of H.P. developed (1000 H.P.) and of Landings (1000 Kg.) (L.).

December, 2

	III		IV		v		VI	
	H. P.	L.	H. P.	L.	H. P.	L.	H. P.	L.
Fladen			90	41	1528	1626	3966	3687
Centr. Area					1068	1790	1525	1429
Southern Area	128	36	57	12	178	125	11	49
July	());		-	-	472	308	389	358
August			90	41	674	951	1968	2101
September			1000	-	786	1017	2507	1943
October		_	S	1	519	984	531	619
November	126	36	57	12	312	277	107	143
December,	2	0.3	-		12	4	-	
%		0.4		0.6	100	40.3	-	58,7

## Table 4. Average Catch (1000 Kg.) per Voyage (C./V.), per Sea-Day (C./S.D.), and per Hour for 100 H.P. developed (C/H).

3		III			IV			V			VI	
	C./V.	C./S.D.	C./H.	C./V.	C./S.D.	C./H.	C./V.	C./S.D.	C./H.	C./V.	C./S.D.	C./H.
Fladen		-	_	20	1.4	45	45	4.2	106	71	6.8	93
Centr. Area						-	47	5.3	167	55	5.7	94
Southern Area.	4	0.6	<b>28</b>	6	0.7	22	18	2.6	70	49	12.2	427
July		1	1000	1000			<b>34</b>	3.0	65	45	4.9	92
August			-	<b>20</b>	1.4	45	50	4.9	141	78	7.5	107
September			_				51	5.0	129	69	6.5	77
October							49	5.9	189	52	5.6	117
November	5.1	0.6	<b>28</b>	6	0.7	<b>22</b>	<b>23</b>	2.6	89	36	4.3	134
December.	0.3	0.1	14				4	0.7	30		_	_
Total	4.5	0.6	<b>28</b>	13	1.2	36	44	4.6	128	65	6.5	<b>94</b>

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	Q				-							
	Classes			Campaigns								
Details	OI				_							
	Vessels	194	16	1947		194	18	194	.9			
		t	v	t	v	t	v	t	v			
Number of Herring Trawlers in	III	8	12	4	5	16	33	6	8			
Activity (t), and Number of Voyages (v)	IV	26	156	} 37	169	$\left.\right\}$ 42	161	$\frac{4}{7}$	4 81			
5 6 ( )	VI	12	89	19	141	22	138	13	79			
	Total	46	257	60	315	80	332	30	172			
Number of effective fishing	III	793		312		1,183	-	747				
Hours	IV)	1 100		10 055		1 10 040		506				
	V	1,102		} 10,000		10,040		6,796	-			
	VI	6,812	-	14,339	-	12,376		7,496				
	Total	18,707	-	33,306	-	30,199		15,545				
Number of 1000 H.P.	III	155	-	56		199		128				
developed	IV)	0.050		] = 405		1 5 9 1 5		147				
1	v	2,958		} 0,480	A	} 3,315		2,774				
	VI	4,301		9,126	-	8,080		5,502				
	Total .	7.414		14.667		13.594	_	8.551	-			

# Table 5. Recapitulation of the Activity of the Herring Trawlers during the Full-HerringCampaigns 1946 to 1949.

## Table 6. Weight of Full-Herring landed during the Years 1946-1949.

Dotaila	Classes		Year	S	
Details	Vessels III	$\begin{array}{c} 1946 \\ 230 \end{array}$	1947 44	$\begin{array}{r} 1948\\ 307 \end{array}$	$\begin{array}{r} 1949 \\ 36 \end{array}$
Weight landed (1000 Kg.)	$\left. \begin{array}{c} \mathrm{IV} \dots \\ \mathrm{V} \dots \end{array} \right\}$	4,726 }	4,560 }	4,040	53 3,541
	VI Total	5,985 10,941	9,761 14,365	9,784 14,131	5,164 8,794
Average Weight per catch		19	9	9	4
(1000 kg.)	V	30 }	27 }	25	44
	VI Total	67 43	$\frac{69}{45}$	$\begin{array}{c} 71 \\ 43 \end{array}$	$\begin{array}{c} 65\\51\end{array}$
Average Catch per Hour and	III	148	80	154	28
per 100 HP. (Kg.)	$\left. \begin{array}{c} \mathbf{IV} \dots \dots \\ \mathbf{V} \dots \dots \end{array} \right\}$	160 }	84 }	76	36 128
	VI Total	139 147	107 98	121 104	94 103
	10000 101000	* * *		201	200

### Table 7. Seasonal Values recorded for the Years 1946 to 1949 (1000 Frs.).

Classes of Vessels										
Years	III	IV	v	VI	Total	per Kg.				
1946	513	18	,437	27,241	46,191	4.22				
1947	278	16	,987	38,703	55,968	3.97				
1948	784	13	,158	32,335	46,277	3.27				
1949	223	162	9,511	12,658	22,555	2.56				

## Table 8. Percentage Distribution of each Centimetre Class, Mean Length (cm), Average Weight, and Percentage of Males.

cm. N. Area. C. Area.	$\frac{21}{1.1}$	$22 \\ 0.2 \\ 3.2$	$23 \\ 1.0 \\ 8.9$	$24 \\ 1.7 \\ 10.5$	$25 \\ 5.9 \\ 11.7$	$26 \\ 15.5 \\ 14.6$	27 30.2 <b>28.9</b>	28 <b>34.2</b> 17.1	29 10.0 3.8	$30 \\ 1.3 \\ 0.2$	Mean 27.6 26.4	Aver. weight 165 gr. 142 »	% males 55.5 52.0
August September October Total.	0.7 0.9 0.5	$0.4 \\ 4.2 \\ 1.6$	3.6 10.4 4.8	$0.7 \\ 4.2 \\ 12.5 \\ 5.9$	9.0 3.3 13.8 8.7	$18.6 \\ 12.0 \\ 14.9 \\ 15.1$	30.2 31.3 <b>27.1</b> <b>29.5</b>	<b>31.2</b> <b>33.1</b> 14.2 26.1	8.6 10.7 2.0 7.0	1.7 0.7 0.8	27.5 27.5 26.2 27.0	165 » 160 » 136 » 154 »	57.6 47.3 56.7 53.8

-	1	86	

Table 9. Perc	entage	Dist	ribution	of	each Stage	of	Maturity,	and of	Quant	ity of	Mese	enteric	Fat.
Stage of Maturity	1	[	II	III	IV	V	VI	VII	VIII-II	Fat 0	1	+	М
Northern Area	. (	).1	1.2	6.1	16.4	54.4	20.3	0.7	0.9	<b>24</b>	50	10	16
Central Area	(	).2	1.1	1,3	3.7	16.2	67.6	4.1	5.9	46	46	4	õ
August	0	.2	1.7	7,4	22.6	62.4	5.0	0.7		14	49	14	22
September	(	).4	1.3	4.2	9,1	38.0	42.0	1.3	3.6	36	46	7	10
October			0.4			9.8	78.9	4.9	6.0	52	47	0.4	0.4
Total %	(	).2	1.1	3.8	10.3	36.1	42.8	2.4	3.3	34	48	7	11
D					fatin ( 1st	grou	p, maturities	I-III.			2	21	77
Percen	tage dis	ributio	on or mese	nter	$10^{10}$ 1 at 111 $2$ nd	gro	up, maturitie	s IV-VIII	(II)	38	52	6	5

 Table 10. Percentage Distribution of each Year-Class observed and Number (No.) of readable Scales, and Age-Groups of total catch compared for 1946—49.

Winter rings	2	3	4	5	6	7	8	9		No.
Age (Years) Year-Classes in	3	4	5	6	7	8	9	10	+	
1949 catch.	1946	1945	1944	1943	1942	1941	1940	1939	before 1939	•
Northern Area	1.1	3.4	11.3	12.8	18.5	20.8	19.2	9.1	3.8	265
Central Area	8.0	15.1	13.2	10.0	19.9	7.9	13.5	6.4	6.0	251
August		2.6	13.5	12.9	20.2	21.8	17.1	8.3	3.6	193
September	3.1	4.6	10.1	9.3	19.4	16.3	20.9	10.1	6.2	129
October	9.8	18.6	12.4	11.3	18.0	6.2	12.9	5.7	5.1	194
1946	4.4	9,5	11.5	23.9	14.3	10.7	11.3	7.4	4.8	
1947	5.3	8.7	17.2	13.7	18.7	11.9	10.9	4.4	9.1	
1948	1.1	16.7	9.4	17.6	15.3	16.7	9.7	4.5	8.7	
1949	4.5	9,1	12.2	11.4	19.2	14.5	16.5	7.7	4.9	

# Table 11. Average Size (cm.) observed for<br/>each Year-Class.

# Table 12. Average Value of L<sub>1</sub> (mm.) of each Year-Class.

		Ori	gin	Mont	hly P	eriods		Year-Classes								
Herrings	Age	Are	as	Aug.	Sept	. Oct.	Total	Areas	1946	1945	1944	1943	1942	1941	1940	1939
born in	(Years)	North.	Centr					Northern	133	109	113	115	115	118	119	120
1946	3	23.6	23.3		24.1	23.2	23.3	Central	123	109	109	113	113	112	115	118
1945	4	25.4	24.9	25.9	24.9	24.9	25.0	Total	124	109	111	114	114	117	117	119
1944	5	26.9	26.1	26.9	27.0	25.8	26.5									
1943	6	27.0	26.7	27.0	26.9	26.7	26.9	General Avera	ige val	lue of	$L_1$ :					
1942	7	27.6	27.3	27.6	27.5	27.1	27.5	Norther	n Area	a: 116	mm.,	Augu	st	: 116	mm,	
1941	8	28.0	27.5	28.0	28.2	27.7	28.0	Central	Area	: 113	mm.	; Sept	ember	: 119	mm.	
1940	9	28.3	27.9	28.0	28.4	27.8	28.1	Total		: 115	mm.	; Octo	ber	: 110	mm.	
1939	10	28.4	28.2	28.6	28.2	28.2	28.3									

## Table 13. Percentage Distribution of the Number of Vertebrae and the vertebral Average.

Number of vertebrae	55	56	57	58	59	Total	Ave	rages
							1st group	2nd group
Northern Area.	2.5	46.8	45.3	5.0	0.4	56,541	56.73	56.53
Central Area	3.4	45.5	46.4	4.5	0.2	56,525	56.73	56.52
Total	2.9	46.2	45.8	4.8	0.3	56,533		
August	2.2	48.2	44.6	4.3	0.7	56,532	56.69	56.52
September	0.2	44.3	47.5	5.7	2.3	56,573	56.77	56.57
October	4.3	46.2	45.2	4.3		56,495	56.50	56.50
Total	2.9	46.2	45.8	4.8	0.3	56,533	56.74	56.52
1st group	0.9	34.9	54.7	8.5	0.9	56,735		
2nd group	3.1	47.2	45.0	4.5	0.2	56,515		

Herring North Sea

#### Table 14. Percentage Distribution of the Number of cervical Vertebrae and the cervical vertebral Average.

Numb, C. Ver.	21	22	23	<b>24</b>	25	26	27	28	Total	Aver	ages
							<u> </u>	0.0	1	st group 2	and group
Northern Area	0.2	2.4	29.4	46.5	17.9	2.9	0.4	0.3	23.92	23.96	23.91
Central Area	1	1.8	29.5	46.5	16.0	4.7	1.3	0.2	23.96	24.20	23.96
August	0.2	3.6	29.0	49.6	14.4	2.6	0.2	0.2	23.84	23.90	23.84
September	_	0.9	29.4	43.4	20.5	3.9	1.6	0.2	24.03	24.08	24.02
October		1.8	29.9	46.6	16.1	4.7	0.7	0.2	23.95	23.50	23.95
Total	0.1	2.1	29.4	46.5	17.0	3.9	0.8	0.2	23.94	24.00	23.94
1st group	-	2.8	20,7	55.7	17.0	1.9	1.9	_	24.00		
2nd group	0.1	2.0	30.2	45.7	17.0	4.0	0.8	0.2	23.94		

### Table 15. Average Number of cervical Vertebrae for each Total Number of Vertebrae.

Total number of vertebrae	55	56	57	58	59	Total
Number of spines observed	38	598	593	62	• 4	1295
Average number of cerv. vert	23.29	23.77	24.11	24.44	23.75	23.94

#### Table 16. Percentage Distribution of the keeled Scales $(K_2)$ .

Number of K <sub>2</sub>	12	13	14	15	16	17	18	Total	Aver	ages
-									1st group	2nd group
Northern Area		5,9	33.7	41.4	16.5	2.3	0.2	14.76	14,59	14.77
Central Area	0.3	4.3	28.9	45.3	18.3	2.2	0.7	14.86	14.65	14.87
Total	0.1	5.2	31.4	43.2	17.4	2.3	0.4	14.81	10	
August		5.5	31.7	43.8	16.9	1.9	0.2	14.79	14.64	14.80
September	0.2	5.6	34.8	39.6	16.9	2.7	0.2	14.76	14.53	14.81
October	0.2	4.5	27.8	46.3	18.3	2.2	0.7	14.87	15.00	14.87
Total	0.1	5.2	31,4	43.2	17.4	2.3	0.4	14.81	14.58	14.83
1st group	0.9	8.3	40.4	36.7	10.1	3.7		14.58		
2nd group	0.1	4.9	30.6	43.8	18.0	2.2	0.4	14.83		

## B. Some Considerations about the Exploitation of the Full-Herring Shoals and on the Results obtained.

In 1949, the herring trawlers were less active than usual. The number of trawlers as well as of voyages decreased (see Table 5); the same applies to the number of sea-days, the hours of effective fishing and the number of H.P. developed.

This smaller activity of the herring fleet entailed inevitably a marked diminution in the total weight landed (see Table 6). As a set-off, the average weight per catch shows a large increase with reference to the averages recorded in previous years. In comparison with 1948 and 1947, the average catch per hour's effective fishing stayed rather stationary, whereas a maximum was attained in 1946.

Looking at Table 7, we ascertain a formidable regression in the value in reference with previous years. This deficit must for the greater part be attributed to the diminution of the total weight landed and to the average price paid for the herring, which was rather derisory. A comparison of the activity displayed by the herring trawlers with the results achieved during the post-war years, permits us to infer that the quantities landed in 1949 are in relation to the effort furnished by the herring fleet. Moreover, since 1947, the average catch per hour's effective fishing for 100 H.P. developed, seems to stay around 100 Kg.

If this level could be maintained in the future, the question of overfishing the herring stock of the North Sea would not be raised and the yield of the fishery would be sufficient to guarantee a lucrative exploitation, on condition however, that the prices offered be reasonable.

#### C. Biological Statistics.

(Material collected during August, September and October 1949).

In 1946, the results were distributed according to the origin of the material, namely Fladen and Gut. But as the information regarding the samples was later found not always

_		4				-		1		-		-
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1		1	<b>‡</b> ‡‡	++++	+++;	Ling Ban	RE	2	1	Za		w
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Fishing Grounds exploited by Belgian Herring Trawlers in 1949.

		Maturity	
	Periods	Observed Stages	Mode
+ + +	July-August-Sept.	I to VI	V
11.1	September	I to VII	V
000	SeptOctober	I to VIII-II	v
	October	V to VIII-II	VI
CONTRACT.	November	V to VIII-II	VI

to be very trustworthy, we have given in 1947 and 1948, the distribution in monthly periods, viz. August, September and October.

However in 1949, we have been able to cover this deficiency, and therefore, in this present study, the results are distributed according to the origin as well as according to the periods.

Besides, we have proceeded with a third distribution, the one covering the most important racial characters (average of the total number of vertebrae, of the cervical vertebrae and of the keeled scales) for each stage of maturity. The results obtained reveal once more the presence of two very distinct groups or populations: a first group, made up by spring spawners in maturity stage I, II and III, with a relatively high average of vertebrae (ca. 56.70) and a second group made up by "autumn spawners" in maturity stage IV to VIII—II with a remarkably inferior average

of vertebrae (ca. 56.50). The material comprises 22 samples from 50 to 90 herrings each, forming a total of 1320 herrings: 690 herrings from the northern area, chiefly the Fladen Ground (August-September), and 630 herrings from the central area, chiefly Turbot Bank, Old Devil Hole, Gut, Dogger Bank and Bruceys Garden (September-October).

The census for the vertebrae covered 1320 spines, of which there were 25 spines or 1.89 % with fused vertebrae. These spines have been eliminated from our material.

#### **Stomachal Contents.**

Among the 1320 stomachs examined 73 or only 5.53% were found to have any contents: 6 full and 67 half full. The contents observed consisted for the greater part of copepods and smaller quantities of schizopods. Besides, stomachs have been found to contain eggs and keeled scales of herrings, which have most probably been swallowed during the trawling or during the winding up of the nets.

## D. A few Considerations on the Biological Values observed.

The fishing grounds according to the various months have been given under A, p. 183. A comparison of the monthly results shows that the material collected in August and September differs hardly or not at all, whereas the results concerning the material assembled in October

## Table 17. Values observed during the PeriodsAugust-October.

Characters observed	Material assembled in:						
	August	Sept.	October				
Average size in mm	275	275	262				
Average weight in gr	165	160	136				
Quantity of Fat 0 %	14.1	36.0	51.9				
1 %	49.3	46.7	47.3				
+%	14.3	6.9	0.4				
М %	22.3	10.4	0.4				
Maturity stages (I to III) %	9.3	5.9	0.4				
Maturity stages (IV to VIII-II) %	90.7	94.1	99.6				
Most frequent year-class	1941	1942	1945				
	(8 years)	) (7 years)	) (4 years)				
Vertebral average	56.53	56.57	56.49				
Average of the keeled scales K.	14.79	14.76	14.87				

Table 18. Cervical Vertebral Average observed for each Total Number of Vertebrae.

Concentr	ations		Total number of vertebrae									
		54	55	56	57	58	59	61	spines obs.			
Full Herring	number .	4	32	- 301	273	33	-		643			
1946	average	22.8	23.4	23.6	24.0	24.2	1		• .			
Spent Herring	number	1	8	157	200	32	1	1	400			
1946-47	average	24.0	23.9	23.8	24.1	24.4	25.0	28.0				
Full Herring	number	3	45	440	449	60	3	Vicini	1.000			
1947	average	23.0	23.3	23.8	24.1	24.6	24.7	_				
Spent Herring	number	$^{2}$	47	425	517	58	1		1,050			
194748	average	23.5	23.0	23.7	24.0	24.7	24.0	-	<i>6</i> .			
Full Herring	number	4	39	400	483	71	3	10000	1,000			
1948	average	22.5	23.4	23.7	24.1	24.2	25.0					
Spent Herring	number	5	58	434	512	88	3		1,100			
1948-49	average	22.4	23.4	23.7	24.1	24.4	25.0					
Full Herring	number	1. march 1	38	598	593	62	4	1	1,295			
1949	average		23.3	23.8	24.1	<b>24.4</b>	23.8	1000 C				
Total	number	19	267	2755	3027	404	15	1	6,488			
	average	22.8	23.3	23.8	24,1	24.4	24.5	28.0				

deviate remarkably from those observed the previous months (see Table 17).

The figures in Table 17 are very instructive on this point and they indicate that the extreme values observed are always found in August and October, except the vertebral average, which attained its maximum value in September, month in which the other values approach those of August. Nevertheless they constitute intermediary values between August and October.

From this we infer that from October onwards, the full-herring concentrations exploited by the Belgian trawlers in the central area of the North Sea had already undergone a rather extensive modification in their composition and that the critical moment of this change takes place in the second fortnight of September or in the areas south of  $55^{\circ}$  or  $56^{\circ}$  L. N.

Note also, that the proportion of herrings of the first group (maturities I, II and III) was very poorly represented this year, viz. 5.1%against 28.7% in 1948, 22.1% in 1947 and 11.2% in 1946. As in previous years, this group is missing in our samples from October.

It is also interesting to note, that for the period August-September, the year-class 1945 (4-year-old herrings) barely reaches 3.4% of the total number of individuals observed, whereas in October it is the best represented year-class with 18.6%. This same year-class was also abundantly represented in the "Spent-Herring Concentration" on the Belgian coast during the Winter 1949—50.

The vertebral average, which was 56.57 in September, decreases suddenly to 56.49 in October.

For the spring spawners (1st group), this average is 56.735, for the autumn spawners (2nd group) 56.515 and together 56.533.

At the time of the Herring Experts Meeting at Edinburgh, we have insisted on the relation existing between the total number of vertebrae and the total number of cervical vertebrae, that is to say, that the spines constituted of a large number of vertebrae also have a relatively high proportion of cervical vertebrae.

Thus, the cervical vertebral average of a lot of spines with 56 vertebrae, will inevitably be higher than the one with spines of 55 vertebrae. Again, the cervical vertebral average of spines with 57 vertebrae will be superior to the one with spines of 56 vertebrae, etc.

This point of view is again confirmed in this present study.

Table 18 gives a recapitulation of the cervical vertebral averages observed for each total number of vertebrae of the years 1946—49 for the "Full-Herring Concentrations" of the northern and central areas of the North Sea as well as for the "Spent-Herring Concentrations" on the Belgian coast.

The results unquestionably show, that an increase in the total number of vertebrae entails also an increase of the number of cervical vertebrae.

Therefore, the latter value seems to be of little interest for the study of the different populations, which may be met with in the future, and we suggest not to take any more notice of it in our ulterior studies.

CH. GILIS.