

THE HALIBUT GILLNET FISHERY IN WEST FINNMARK

Analysis of Landings Data from Øksfjord 1955–65

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INTRODUCTION

In 1936 gillnet fishing for halibut was started in Norway (DEVOLD 1938). One of the main localities for this autumn–early winter fishery is the deep parts of Altafjord in West Finnmark with its tributaries and entrances.

Detailed studies of the fishery and the stock of halibut in this area were carried out during the years 1956 to 1960 (OLSEN 1956, TJEMSLAND 1960, OLSEN and TJEMSLAND 1963, MATHISEN and OLSEN 1968). The findings of these investigations provided the main basis for revisions of existing regulations being in force for this fishery since 1937. The first revision was introduced in 1956 when the fishing time was increased to the end of December from, previously, December 15; and the second one in 1962, from which year the closed season started on January 21.

Estimates of mortality and the likely effects of the fishery on the stock were reported by MATHISEN and OLSEN (1968). The present data throws some further light on the dynamics of this stock of large mature halibut, which for most practical purposes can be considered as exploited by the gillnet fishery only during the short period of the year when these large fish penetrate into the deep fjords of Northern Norway to spawn.

MATERIAL AND METHODS

The Official Statistics of Norway give catch of halibut by months, but no published commercial statistics exist for the gillnet fishery alone or for the effort extended in this fishery.

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Table 1. Records of gillnet caught halibut landed in Øksfjord during the seasons 1955 to 1964-65.

Year	Month	Landings in kg	No. of men per vessel	No. of landings	No. of men times no. of landings	CPUE
1955	Oct.	1.580	3.5 ¹	90 ¹	315	5.0
	Nov.	5.782	3.8 ¹	100 ¹	380	15.2
	Dec. ²	7.768	4.1 ¹	60 ¹	410	18.8
	Nov.-Dec.	13.550	—	160 ¹	790	17.2
1956	Nov.	8.232	3.8 ¹	140 ¹	532	15.5
	Dec.	20.286	4.1 ¹	143	586	34.6
	Nov.-Dec.	28.518	—	283 ¹	1118	25.5
1957	Oct.	2.146	3.5 ¹	47	165	13.0
	Nov.	5.100	3.8 ¹	54	205	24.9
	Dec.	19.489	4.1 ¹	96	394	47.9
	Nov.-Dec.	24.589	—	150	599	41.1
1958	Oct.	2.369	3.5 ¹	35	123	19.3
	Nov.	3.039	3.8 ¹	38	144	21.1
	Dec.	13.523	4.1 ¹	53	217	62.3
	Nov.-Dec.	16.562	—	91	361	45.9
1959	Oct.	2.270	3.5 ¹	27	95	23.9
	Nov.	2.817	3.8 ¹	32	122	23.1
	Dec.	8.443	4.1 ¹	44	180	46.9
	Nov.-Dec.	11.260	—	76	302	37.3
1960	Oct.	1.576	3.5 ¹	37	130	12.1
	Nov.	4.172	3.8 ¹	35	133	31.4
	Dec.	5.691	4.1 ¹	42	172	33.1
	Nov.-Dec.	9.863	—	77	305	32.3
1961	Oct.	1.946	3.5 ¹	40	140	13.9
	Nov.	5.256	3.8 ¹	44	167	31.8
	Dec.	9.842	4.1 ¹	47	193	51.0
	Nov.-Dec.	15.098	—	91	360	41.9
1962	Nov.	3.128	3.8	18	68	46.0
	Dec.	12.969	4.1	46	187	69.3
1963	Jan.	9.310	4.6	31	143	65.1
1962	Nov.-Dec.	16.097	—	64	255	63.1
1963	Oct.	1.162	2.3	9	21	55.3
	Nov.	2.535	3.1	12	37	68.5
	Dec.	14.745	3.8	43	163	90.4
1964	Jan.	3.170	4.4	8	35	90.6
1963	Nov.-Dec.	17.280	—	65	200	86.4
1964	Oct.	2.064	2.9	13	37	55.7
	Nov.	5.039	3.0	20	59	85.4
	Dec.	7.748	3.5	36	126	61.5
1965	Jan.	489	2.8	5	14	34.9
1964	Nov.-Dec.	12.787	—	57	185	68.0

¹ Estimated figures. ² Closed season starting 15 December.

Table 2. Monthly weight distributions for gillnet caught halibut landed at Øksfjord.

W kg	1961-62					1962-63					1963-64					1964-65				
	O	N	D	J	Σ	O	N	D	J	Σ	O	N	D	J	Σ	O	N	D	J	Σ
5-9	2	4	2	35	43	—	1	14	16	31	35	64	34	10	143	—	2	29	44	75
10-14	3	11	13	72	99	4	3	28	49	84	30	37	61	26	154	2	7	42	72	123
15-19	9	8	14	90	121	2	6	20	36	64	20	17	59	17	113	2	8	31	62	103
20-24	5	13	11	54	83	2	7	33	17	59	19	10	61	21	111	5	14	28	46	93
25-29	11	23	28	44	106	3	11	60	29	103	12	20	70	20	122	11	43	67	43	164
30-34	11	23	28	29	91	1	19	59	22	108	18	22	97	16	153	17	56	83	22	178
35-39	10	22	27	23	82	5	26	56	13	100	7	20	54	13	94	10	25	43	21	99
40-44	2	19	16	13	50	4	11	19	11	45	4	10	29	8	51	10	18	32	20	80
45-49	5	5	10	18	38	—	1	11	6	18	1	1	14	5	21	6	8	13	8	35
50-54	—	2	5	15	22	2	—	11	3	16	3	1	14	3	21	1	1	8	7	17
55-59	—	4	1	10	15	—	3	2	3	8	—	—	5	5	10	1	2	5	2	10
60-64	1	—	2	8	11	1	—	—	3	4	1	—	6	—	7	—	1	5	7	13
65-69		3	—	10	13	—	—	—	4	4	—	—	2	1	3	—	—	2	5	7
70-74		1	1	8	10	—	—	—	1	1	—	—	6	1	7	—	—	2	2	4
75-79		1	—	6	7	—	1	3	2	6	1	—	2	—	3	—	—	—	3	3
80-84		—	1	5	6	1	—	2	3	6	—	—	1	1	2	—	—	2	3	5
85-89		1	—	7	8		1	1	2	4		2	—	2	4		—	2	3	5
90-94		1	1	2	4		—	1	—	1		—	2	1	3		—	2	4	6
95-99							1	1	2	4		—	2	3	5	2		1	3	6
100-104								1		1		—	—	3	3			3	1	4
105-109												—	3	2	5			3	4	7
110-114												—	1	2	3			1	3	4
≥115												1	1	5	7			7	4	11
Total	59	141	160	448	808	25	90	322	222	659	151	205	524	165	1045	67	185	411	389	1059
\bar{W}	29.5	33.5	32.6	29.3	30.7	33.5	34.1	29.4	27.6	30.5	21.0	20.7	29.8	35.9	27.7	36.1	31.5	33.3	29.5	31.2

Through the courtesy of Njord Handels og Industri A/S, the only fish packing and processing company in Øksfjord, where a fair proportion of all gillnet caught halibut in West Finnmark is landed, a series of detailed landing statistics for this fishery was compiled for the period 1955–1965 (Table 1). Some data on relative effort were also collected and the material thus comprises monthly (since 1961 also weekly) records of all landings of gillnet caught halibut; the number of landings made, and since 1962 also the number of men, and some information on the amount of gear in relation to vessel size and number of men. For the four last seasons data are available on the size distribution of the landings in terms of weight (Table 2).

Records are available of the number of landings from 1957 onwards and for the last three seasons also of the number of men for each vessel and landing. These data show quite clearly that the average number of men per vessel increases from October to December–January, probably because the larger vessels do not start halibut fishing until the latter part of the season when catches are best.

For the season of 1962–63 there are also data on the amount of gear used, and these reveal a nearly linear relationship (Table 3) between number of nets and number of men per vessel. Thus the effective effort is directly proportional to the number of men per vessel, and the landing data have to be corrected for the seasonal change in vessel size, or average number of men per vessel, to facilitate unbiased estimates of catch per unit of effort (CPUE). In recent years there has been a continuous trend of reducing the number of men required to operate these fishing vessels, and the monthly estimates of average number of men per vessel for 1962 were therefore used as weighting factors for all previous years.

Table 3. No. of men and average no. of nets used for 11 vessels in the 1962–63 season.

No. of men	Average no. of nets
2	23.3
3	24.5
3	26.4
4	31.5
4	31.8
4	38.6
4	45.0
5	36.0
6	72.0
6	77.0
7	88.3

The estimates for November and December of CPUE were applied to the official statistics of total catch of halibut in Finnmark during the last quarter of each year to calculate the total effort required to catch an equivalent quantity of halibut if fishing with gillnets only (Table 4). Since halibut landings in October are always relatively small the bias introduced by using the combined CPUE estimates for November–December only is probably not very significant.

SIZE DISTRIBUTION

Table 2 gives the monthly weight distribution in 5 kg groups of all gillnet caught halibut landed in Øksfjord during the fishing seasons 1961–62 through 1964–65. Frequency distributions for the total material, October–November–December combined and for January respectively are plotted for each year on Fig. 1. The bimodal type of distribution is probably caused by the great sex difference in growth rate.

In all seasons except 1963–64 the halibut caught during October–December were generally larger than those taken in January. This is in keeping with previous findings from the detailed investigations of 1956 to 1960 (OLSEN 1956, TJEMSLAND 1960) that the older fish which have spawned earlier generally arrive on the spawning grounds before the first time spawners; which for halibut in the Altafjord area usually do not appear before some time in January.

However, in the 1963–64 season the spawning run apparently occurred earlier than normal and many relatively small-sized halibut were caught before Christmas. When January came catches were declining and most of the season was presumably over by then.

The figure shows no general trend of decreasing fish size over the years. If anything, there was a slight increase in the relative numbers of medium sized fish and the proportion of large halibut, over 50 kg say, remained fairly constant. This size distribution is very similar to that established for the period 1956 to 1960, and although it is known that a gradual increase from 16" to 18" mesh size of the halibut nets did take place in recent years, it is nevertheless safely concluded that no dramatic change in size composition has occurred from the first to the second five-year period.

CATCH AND EFFORT

On the top of Fig. 2 are plotted the landings in Øksfjord during October–November–December, of all gillnet caught halibut and the corresponding total landings of halibut in the county of Finnmark. These also include a quantity taken with longlines and trawl (mainly immature fish).

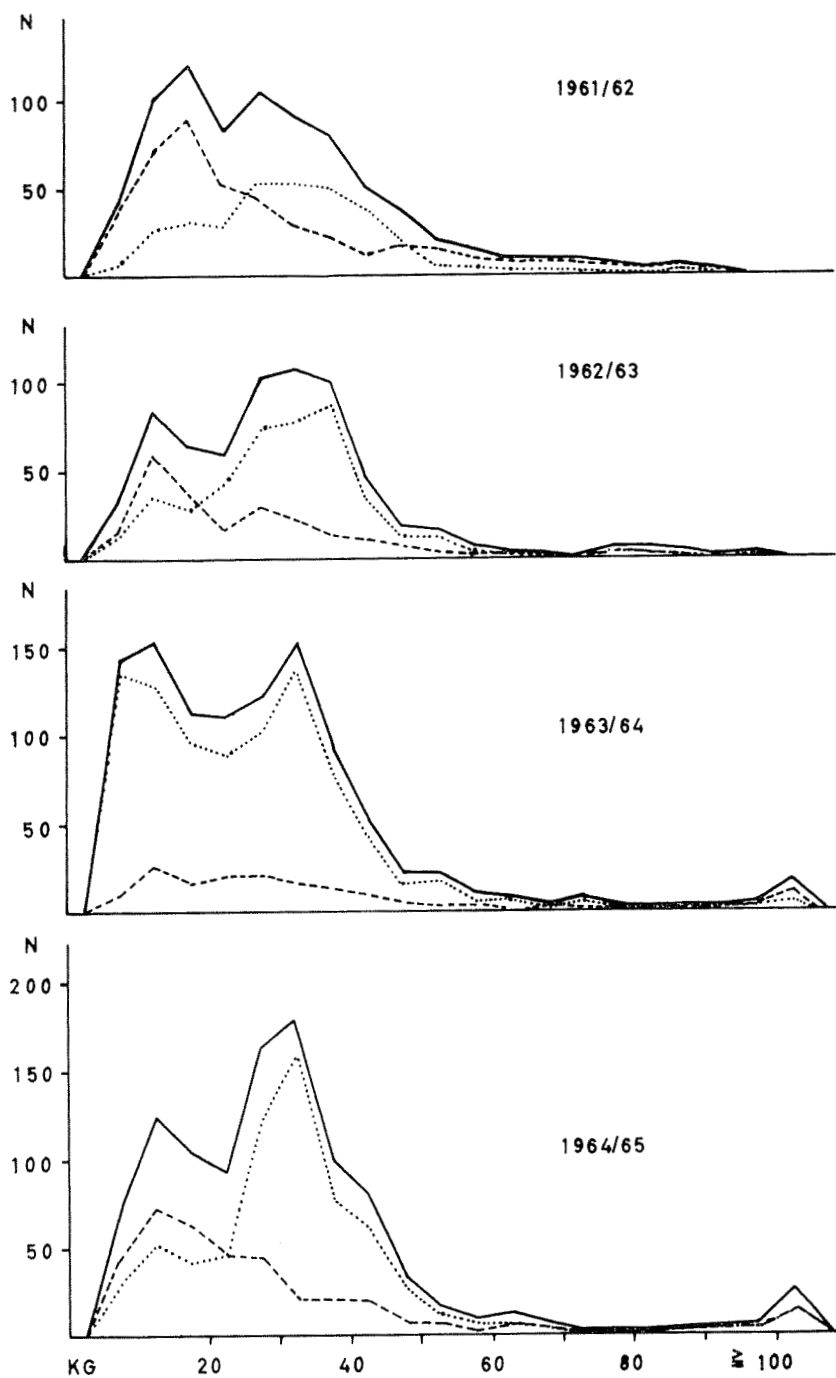


Fig. 1. Size distributions of gillnet caught halibut landed at Øksfjord. Solid line: total. Dotted line: October/November/December. Broken line: January.

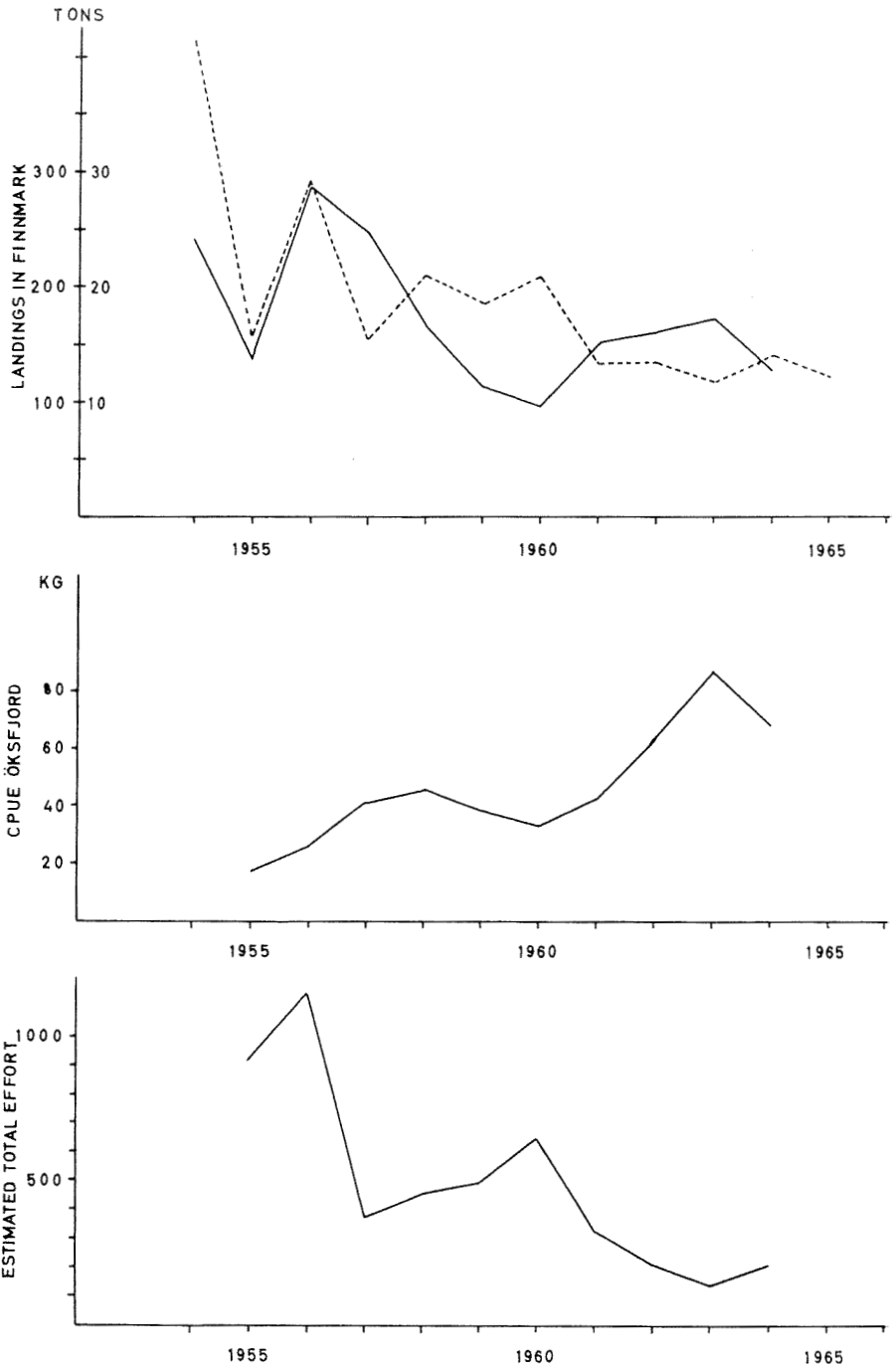


Fig. 2. Top, solid line: gill net caught halibut landed at Øksfjord in November/December. Broken line: total halibut landings in Finnmark during October/November/December. Middle: catch per unit of effort (CPUE) estimated from statistics of landings at Øksfjord in November/December. Bottom: estimated total effort of the halibut fishery in Finnmark during last quarter of the year.

The figure confirms that Øksfjord is a main landing place for the halibut gillnet fishery in the area and accounts for about 10 per cent of all halibut landed in Finnmark. Thus, there is good reason to assume that any trend in the halibut stock of the area would be manifest in the fishery out of this port.

The landing statistics for 1955 to 1965 shows a general trend of decreasing halibut landings in the last quarter of the year both for the whole county and for the gillnet fishery out of Øksfjord.

This decrease has taken place at the same time as a marked increase in CPUE has been experienced (Fig. 2, middle) and, consequently, the estimated total effort of the fishery has decreased to about one-fifth of the level in the mid-1950's (Fig. 2, bottom, Table 4).

The rise in CPUE has been most spectacular and continuous for the month of November, but also for December and October a great increase was apparent (Table 1), and on an average for November and December combined, CPUE more than tripled during the ten-year period studied.

DISCUSSION

There may be several reasons for the spectacular rise in CPUE during the period covered by this study. For December there was at first a great increase in the years 1956, 1957 and 1958. This was most probably a direct result of the new regulations extending the season to the end of December and the changeover from hemp to nylon nets, which took place gradually during these years. This gear innovation was followed by a gradual increase in mesh size from the usual 16" nets to 18", and even

Table 4. Total catch of halibut landed in Finnmark during October/November/December and estimated total effort for the same period.

Year	CPUE Nov./Dec.	Catch in Finnmark Oct./Nov./Dec.	Estimated total effort
1955	17.2	157	913
1956	25.5	292	1145
1957	41.1	153	372
1958	45.9	210	457
1959	37.3	184	493
1960	32.3	209	647
1961	41.9	136	324
1962	63.1	134	211
1963	86.4	119	137
1964	68.0	142	209

Table 5. Records of catch and effort in 1962/63 for 12 vessels using nets of different mesh sizes.

Week No.	16" and 18" mesh			18" and 20" mesh			All nets		
	Catch kg	No. of nets	kg/net	Catch kg	No. of nets	kg/net	Catch kg	No. of nets	kg/net
46	320	186	1.7	644	215	3.0	964	401	2.4
47	469	204	2.3	31	30	1.0	500	234	2.1
48	421	165	2.6	409	220	1.9	830	385	2.2
49	1719	556	3.1	1944	400	4.9	3663	956	3.8
50	1264	392	3.2	549	205	2.7	1813	597	3.1
51	1714	485	3.5	1595	320	5.0	3309	805	4.1
52	169	70	2.4	—	—	—	169	70	2.4
1	199	60	3.3	179	30	6.0	378	90	4.2
2	1761	248	7.1	2887	355	8.1	4648	603	7.7
3	2451	332	7.4	1118	105	10.6	3569	437	8.2
4	337	55	6.1	3101	270	11.5	3438	325	10.6
45-48 (Nov.)	1469	627	2.3	1084	465	2.3	2549	1092	2.3
49-52 (Dec.)	4866	1503	3.2	4088	925	4.4	8954	2428	3.7
1-4 (Jan.)	4748	695	7.0	7285	750	9.7	12033	1445	8.3
Total	11183	2825	4.0	12457	2130	5.8	23540	4955	4.8

20" used by some vessels, while the dimensions of the nets themselves remained unchanged. It is interesting to note that the shift to larger mesh sizes was already started voluntarily before the 18" mesh was prescribed by the new regulation in 1961 as a direct result of the successful experiments with large meshed nets carried out by the Institute of Marine Research from 1957 to 1960.

This mesh increase was probably partly responsible for the more than doubling of CPUE which occurred after 1961 and which was apparent throughout the season. Some data from 1962-63 (Table 5) of catch rates for 16" and 18" nets compared with 18" and 20" nets suggest that the immediate effect of the mesh size increase would be of the order of 40% to 50%. Any long term effects of increasing the exploitation age, as discussed by MATHISEN and OLSEN (1968) would not take effect immediately, and hence, the rising CPUE must also have been caused by other factors than the use of larger meshed nets.

There is no evidence suggesting that the rise in CPUE estimates could be related to increased effective fishing time of the nets in recent years; in fact, any trend here would be towards decreasing fishing time when nylon nets were introduced because the fish die quickly in such nets and the quality then deteriorates.

One possible cause is the increase in the minimum landing size of halibut from 50 cm to 65 cm introduced in 1956. This regulation certainly reduced the fishery for small, immature halibut at the Finnmark coast, and any effects of the reduced fishing mortality of these age groups (3-5 years) would not be felt in the gillnet fishery for mature halibut until at least 6-7 years later.

Finally, one should consider the apparent fall in total effort of the Finnmark halibut fishery, which in itself is probably related to a gradual change during the same period in the structure of the fishing fleet and the overall reduction in the number of fishermen. In Fig. 3 CPUE is plotted against the two years sum of estimated total effort. This indicates a direct relationship between CPUE and effort which for the range in total effort experienced during the 1955-65 period could well account for the observed increase in CPUE.

This relationship might be composed of two components. Firstly, it could reflect a true density change resulting from variations in fishing mortality. However, it is also likely that the reduced and low participation in this fishery in recent years, which is conducted in fairly restricted localities, has had a direct and immediate effect on the efficiency of the operations for the individual vessels, allowing more careful selection of the fishing places for the nets and practically eliminating any chance of entangling or conflict between different vessels.

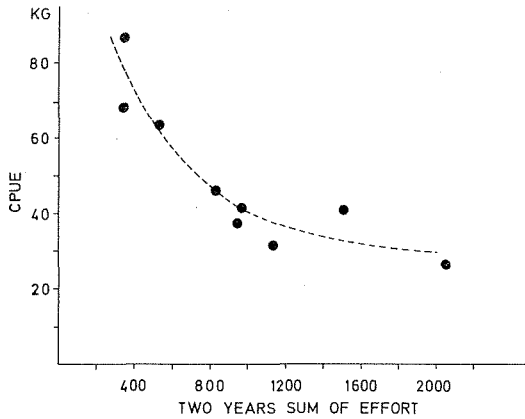


Fig. 3. Estimates of catch per unit effort (CPUE) at Øksfjord for November/December plotted against two year sums of estimated total effort for the county of Finnmark during October/November/December.

The present data have thus demonstrated that the trend of decrease in the halibut landings in Finnmark from 1955 onwards was most likely caused by reduced fishing effort, while in the gillnet fishery for mature halibut the CPUE increased greatly. This increase was partly caused by more efficient nets and less competition on the fishing grounds, but it also reflects a real increase in fish density resulting from the lower fishing mortality in the mature stock, the increased exploitation age, and possibly improved recruitment to the mature stock resulting from the raising of the minimum landing size introduced in 1956.

SUMMARY

1. This study was based on statistics of gill net caught halibut landed at Øksfjord, West Finnmark from 1955 to 1965. For the most recent years some data on relative effort and weight distribution of the catches were also available.
2. Small annual fluctuations in size distribution of the catches occurred, but no consistent trend over the years were apparent.
3. During the 10 year period studied, halibut landings in the last quarter of the year decreased markedly both in the county of Finnmark as a whole and at Øksfjord. However, during the same period catch per unit of effort in the gill net fishery increased greatly, and consequently, the estimated total effort was very much reduced.

4. It is concluded that the reduced landings resulted mainly from reduced fishing effort while the increase in catch per unit of effort was partly caused by improved fishing nets and less competition on the fishing grounds, but was also reflecting a real increase in fish density.

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Received 28 May 1969

Printed 10 November 1969