Northwest Atlantic Fisheries Organization

Serial No. N130

NAFO SCR Doc. 80/VI/77
(Revised)

SCIENTIFIC COUNCIL MEETING - JUNE 1980

The Wolffish Fishery at West Greenland

by

Erik Smidt
Grønlands Fiskeriundersøgelser
Charlottenlund, Denmark

Introduction

Three species of wolffish occur at West Greenland: spotted wolffish (Anarhichas minor), striped w. (A. lupus) and blue w. (A. latifrons). Only spotted and striped wolffish are of commercial interest, the blue wolffish being too watery. Although the spotted and the striped wolffish are easily distinguished from each other the fishing industry and the commercial statistics so far have made no distinction between them. Thus statistical data are difficult to use to analyze the species separately, which seems necessary for a detailed biological assessment, although some ovservations of the species composition have been made by research work. Also, age determination of wolffish is difficult and no good material is available at present to allow for a breakdown of samples into age groups at West Greenland. It is, therefore, not possible for the time being to come up with a detailed biological assessment of the two stocks. Biological analyses would have to include data from research vessels from many countries and may best be done in relevant working groups of NAFO and ICES. Management of the species will, therefore, for the time being, have to be based on simple catch data and history of the fishery, and on some biological considerations, but especially on economical and political considerations.

Fishery Trends

The annual catches of wolffish at West Greenland since World War II and their distribution on ICNAF/NAFO divisions are shown in Tables 1-2 and in Fig. 1 and 2. The catch figures 1945-59 are from ICES Bull. Stat. and from Beretninger vedr. Grønland while the figures from 1960 onwards are from ICNAF Stat. Bull. the catches by the Federal Republic of Germany in 1977-79 are estimated as 2% of the total German catches in the area, the species composition of nominal figures being regarded as dubious (see SCR Doc. 80/VI/72).

1. The Greenland fishery

The local fishery, mainly with long lines, on wolffish (nearly only spotted wolffish) was originally bases on production and export of skins while the meat was used locally (human consumption and food for sledge dogs). The fishery was started in 1938. No production of skins took place during the war, but it was resumed in 1945 until 1951. The skin production peaked in 1948 with a production of more than 100,000 skins corresponding to about 800 tons round, fresh fish, fished mainly in the northern part of West Greenland (Div. 1A-1B).

In 1951 a production of frozen fillets was started. It developed to an important production in the following years centered in the Sukkertoppen area (Div. 1C), but gradually also in other areas, especially the more northern (Div. 1A-1B). This fishery was also carried out by longlines as a directed fishery catching mainly spotted wolffish. The fishery reached a peak level in 1957 of 4,500 tons but decreased thereafter to a minimum of about 1,700 tons in 1962. In the following years the fishery fluctuated but with an increasing tendency to another peak of 3,800 tons in 1968, again followed by a decrease.

While the longline fishery for wolffish was mainly an inshore and coastal fishery, by-catches of wolffish in the offshore trawl fishery increased from 1972 to a peak level of about 3,200 tons in 1974-76 followed by a sharp decline. The increasing interest for wolffish was partly a consequence of the failing cod fishery and in some instances when the trawlers had to search for other resources. Wolffish was one of the target species. The increasing and economic better offshore shrimp fishery has meant that Greenland trawlers now switch between cod and shrimp as target species, and landings of wolffish is virtually only as by-catches on a small scale.

2. The fishery of other nations

From 1928 to World War II small catches of wolffish from Greenland waters were landed by British fishing vessels. After the war catches of wolffish were landed by vessels from several nations, especially by German trawlers. The fishery was at its highest from 1961 to 1967 when around 3,000 tons were landed annually, but at the end of the 1960's there was a decline due to decreasing effort as less vessels were fishing at Greenland because of the failing cod fishery.

The trawl catches on wolffish is located mainly in Div. 1D-1F. The catches seem to be by far dominated by the striped wolffish, especially on the shallow part of the fishing banks, whereas the spotted wolffish may constitute a greater part of the by-catches when fishing is carried out at greater depths.

3. The present fishery

The Greenland wolffish catches are now at a low level partly due to the steep decline in the trawl catches since 1976, but also because longline catches have declined to a level of little below 2,000 tons annually in the latest years. The distribution of the catches (tons) on trawl and longline since 1974 was as follows:

	1974	1975	1976	1977	1978	1979
Trawl	3273	3192	3297	1197	326	197
Longline	2474	2495	1626	1807	1831	1932

The total landings (tons) by month to The Royal Greenland Trade Departments fishery plants (nearly all landings in Greenland) and the trawler's landings by month in 1979 were as follows:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Total	32	22	31	14	40	188	331	374	240	351	269	123
Trawlers	19	23	47	23	29	5	-	-	4	17	9	21

It is seen that most of the total landings (mainly longline catches) took place in June-Decmeber, while most of the trawl catches were landed in December-May.

By-catches from the directed Greenland trawl fishery on wolffish during the latest years consist mainly of Greenland cod (Gadus ogac) in the northern regions (Div. 1B) and of cod in the southern regions (Div. 1D).

The weight composition (tons) of the trawl catches for wolffish in Div. 1B-1E in 1976-79 were as follows:

Years	Div.	Wolf-fish	Greenland cod	Cod	Others	Effort hours	Effort days fished
1976,78,79	1B	125	82	4	6	105	17
1976-79	1C	156	10	9	9	236	30
1976-79	1D	272	27	141	45	579	59
1977	1E	4	-	5	3	26	7

The annual landings by other nations (mainly Federal Republic of Germany) are estimated to be about 1,000 tons or more during the last three years.

Occurrence and Biology of the Species

While A. minor and A. latifrons are common from northern to southern W. Greenland (Div. 1A-1F), A. lupus is more southerly being nearly absent in the northern areas (Div. 1A). Fishing experiments (Table 3) have shown that A. minor was dominant in all inshore waters. A. lupus, which is rather common in shallower depths, was not represented in longline catches deeper than 200 m and was taken only in small numbers with the shrimp trawl (Smidt, 1968, p. 143-144).

In offshore trawl catches taken by research vessels of Federal Republic of Germany in 1955 and 1963 (Beese and Kändler, 1969) and by Greenland commercial trawlers in 1976 and 1980, A. lupus was absolutely dominant at southern W. Greenland, especially in shallow water on the fishing banks where it constituted nearly 100% of the wolffish catches (Table 3).

Trawling experiments at different depths (Beese and Kändler, 1969) showed that A. lupus is most frequent at depths less than 100 m while the two other species generally have a deeper range (Table 4).

It was shown by Beese and Kändler (1969) that A. lupus has a wide temperature tolerance from -1 to 10°C, and according with its more southerly geographical distribution it has a higher optimum, from 1 to 4°C, than the other species. A. minor has a range of tolerance from -1 to 7°C and an optimum of 0 to 2°C. A. latifrons has nearly the same range as A. minor and an optimum from 1 to 2°C.

Little is known concerning the propagation of the three species in Greenland waters. From other areas it is known that all three species deposit their eggs in lumps at considerable depths on the bottom. The pelagic larvae are found during the summer months in largest numbers along the slopes of the fishing banks and over the open sea, while they are rare in inshore waters, and it is remarkable that there is a concentration of larvae, especially of A. minor, off Sukkertoppen in Div. 1C (Hansen, 1968), where an important fishery on A. minor has been carried out during several years. The larvae of A. minor are carried by the current to nursery grounds in northern waters where they grow up and from where they seem to migrate to southern spawning grounds. Fishing experiments for A. minor have shown that individuals of small and medium size are common in catches in northern W. Greenland (Div. 1A) while these sizes are seldom by-catch in southern W. Greenland (Fig. 3). Tagging experiments, however, indicate that the fish is rather stationary.

According to Beese and Kändler (1969) and Østvedt (1963) the females of the striped and the spotted wolffish mature about one year earlier and at a smaller size than the males. The females of the striped wolffish mature at lengths of 31-46 cm and the males at 42-69 cm, while the females of spotted wolffish mature at 48-62 cm and the males at 53-71 cm.

Age readings have been made on otoliths from all species (Beese and Kändler, 1969), and on vertebrae from A. minor (Østvedt, 1963). Figures on length and age distribution for A. lupus and A. minor in subarctic seas (Greenland waters and Barents Sea) are given in Table 5 (after Beese and Kändler, 1969), and it is seen that the growth rate is much lower for the striped than for the spotted wolffish. Therefore, there is a great difference in size between the two species in the catches. Length frequencies of both species from longline catches (Div. 1B-1D, 1956) and from trawl catches (Div. 1D, 1980) are shown in Fig. 4 and 5. When recruited to the fishery (about 50 cm) the striped wolffish is about 10 years old and the spotted about 7 years old. The length-weight relationships for both the spotted and the striped wolffish are shown in Fig. 6 (trawl catches, Div. 1D, 1980).

General Conclusions

The fisheries on wolffish at Greenland are two different fisheries on two different species, a local longline fishery mainly on spotted wolffish and in international trawl fishery for the major groundfish (cod and redfish) in which by-catch of striped wolffish occurs. On some occasions hand trawlers fished directly for wolffish, but only when catches of the major species were extremely low or restricted. The two species must be studied separately for assessment purposes.

The local fishery on spotted wolffish was originally mainly a directed fishery, later by-catches from other longline fisheries seem to constitute an essential part of the landings. The fishery culminated in the mid 1950's with landings of about 4,000 tons annually and decreased thereafter possibly due to overexploitation. In the 1960's the landings fluctuated around 3,000 tons annually, and in the 1970's the landings were at a level of around 2,000 tons with a slight decreasing tendency due to decreasing effort.

The international trawl fishery showed its highest catch of striped wolffish in the 1960's with a level of about 3,000 tons annually, but thereafter the fishery decreased due to decreasing effort. In the middle of the 1970's there was a second peak of about 4,000 tons annually, mainly landings from the Greenland trawlers, which was again followed by a decline.

An assessment of the wolffish stocks is not possible before better biological data are at hand and it seems also necessary to separate the species in the fishery statistics. The historical fishery data indicate that it is reasonable to estimate a sustainable yield of spotted wolffish to 2,000-3,000 tons annually and of striped wolffish to about 3,000 tons annually. As the longline fishery is normally a moderate fishery there seems to be no need at present for a regulation of that fishery, whereas it may be advisable to regulate a trawl fishery should such a fishery develop.

References

Beese, G., and R. Kändler. 1969. Beiträge zur Biologie der drei nordatlantischen Katfischenarten Anarhichas lupus L., A. minor Olafs. und A. denticulatus.- Ber. Deutsch. Wiss. Komm. Meeresforsch, N. F. 20: 21-59.

Hansen, P. M. 1958. Spotted Wolffish (Anarhichas minor) and Striped Wolffish (Anarhichas lupus). Ann. Biol. Cons. int. Explor. Mer (1956) 13: 53.

1959. Spotted Wolffish (Anarhichas minor). Ann. Biol. Cons. int. Explor. Mer (1957) 14: 40.

1968. Report on Wolffish Larvae in West Greenland Waters. ICNAF Spec. Publ. No. 7. NORWESTLANT Part 1: 127-137.

Smidt, E. L. B. 1969. The Greenland Halibut, Reinhardtius hippoglossoides (Walb.), biology and exploitation in Greenland waters. Meddr. Danm. Fisk. og Havunders. N. S. 6: 79-148.

Østvedt, O. J. 1963. On the life history of the spotted catfish (Anarhichas minor Olafsen). Rep. Norw. Fish. Mar. Invest. 13 (6): 54-72.

Table 1. Catches at West Greenland of wolffish (tons fresh fish) by country.
Figures in brackets are estimates (see text).

	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962
DEN-F																	39	
DEN-G	60	50	500	800	780	730	620	760	2100	2434	3520	3500	4500	4000	3100	2822	2302	1712
FRG								12	21	17	446	1090	721	479	469	813	2616	2545
ICE					6		46	66	103			79	235	50	64		247	164
NOR										75			24	20				
USSR											53							
UK		+	+	155	318	12	220	550	510	278	20	22	122	330	275	652	419	520
Non-m																		
TOTAL	60	50	500	955	1104	742	886	1388	2734	2804	4039	4691	5602	4879	3908	4287	5623	4941

	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
DEN-F	5								152	57	13						
DEN-G	2466	2085	3274	2478	2700	3812	3356	2702	2613	3464	4186	5747	5687	4923	3004	2154	2129
FRG	2806	1588	1854	1541	1777	582	199	208	132	555	489	136	400	659	(1000)	(800)	(1400)
ICE	107	71	80	96													
NOR		25	29	40	10	120	204		36		108	210	177	183	50	16	
USSR			7			3					89	80	102	321	56		
UK	774	1109	535	897	558	65		83	99	71	16	117	12	19			
Non-m				339	88	97											
TOTAL	6158	4878	5779	5391	5133	4679	3759	2993	3032	4147	4901	6290	6378	6105	(4210)	(2970)	(3529)

Table 2. Catches at West Greenland of wolffish (tons fresh fish), and their distribution (as percentage of total catch) on ICNAF/NAFO divisions. + less than 1 %.

	Div	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962
GREENLAND	A		65	75	72	81	85	70	7	-	1	1	9	13	16	12	11	16	14
	B		32	18	15	12	10	24	50	6	-	4	11	12	22	26	39	31	31
	C		1	-	2	2	1	+	43	94	99	93	80	74	62	62	50	53	53
	D		2	-	1	-	2	2	-	-	-	2	1	1	-	+	-	-	-
	E		+	3	3	2	2	1	-	-	-	-	-	-	-	-	+	+	-
	F		-	4	8	3	2	3	-	-	-	+	-	-	-	+	+	+	2
	NK		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	TOT	60	50	500	800	780	730	620	760	2100	2434	3520	3500	4500	4000	3100	2822	2302	1712
OTHERS	A																-	+	+
	B																4	5	10
	C																6	18	21
	D																37	35	25
	E																23	20	26
	F																30	20	17
	NK																-	2	-
	TOT				155	324	12	266	628	634	370	519	1191	1102	879	808	1465	3321	3229
ALL NATIONS	A																7	7	5
	B																27	16	17
	C																35	32	32
	D																13	20	17
	E																8	12	17
	F																10	12	12
	NK																-	-	-
	TOT	60	50	500	955	1104	742	886	1388	2734	2804	4039	4691	5602	4879	3908	4287	5623	4941

	Div	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
GREENLAND	A	21	23	15	12	15	15	19	24	20	15	18	9	9	9	15	21	15
	B	22	29	26	23	39	37	31	36	32	26	24	21	24	13	21	35	45
	C	51	34	47	51	36	37	42	28	28	20	25	23	25	36	33	35	32
	D	4	10	7	5	5	4	5	1	4	14	20	34	35	29	19	6	3
	E	-	+	1	-	1	1	1	1	1	+	9	11	6	12	9	3	3
	F	2	4	4	8	4	6	1	1	1	+	3	2	1	1	3	+	2
	NK	-	-	-	-	-	-	+	8	14	25	-	-	-	-	-	-	-
	TOT	2466	2085	3274	2478	2700	3812	3356	2702	2613	3464	4186	5747	5687	4923	3004	2154	2129
OTHERS	A	-	+	1	-	2	-	-	-	-	-	-	-	-	-			
	B	9	8	12	15	8	-	-	-	-	-	-	1	1	11			
	C	18	16	21	9	14	27	3	1	1	8	6	20	30	18			
	D	30	24	29	27	41	26	13	19	20	30	37	35	13	26			
	E	25	29	16	23	18	13	13	33	9	50	41	36	30	22			
	F	18	23	20	25	16	20	21	47	34	12	13	9	27	23			
	NK	+	+	-	+	+	14	50	-	36	-	3	-	-	-			
	TOT	3692	2793	2505	2913	2433	867	403	291	419	683	715	543	691	1182	(1000)	(800)	(1400)
ALL NATIONS	A	9	10	9	5	9	13	17	22	17	12	16	8	8	7			
	B	14	17	20	19	24	30	28	33	28	22	20	19	21	13			
	C	31	23	36	29	26	35	37	26	24	18	22	23	26	32			
	D	19	18	17	18	23	8	6	3	6	17	22	34	32	28			
	E	15	17	7	12	9	4	2	4	2	8	14	14	9	14			
	F	12	15	11	17	10	8	3	5	6	2	5	2	4	6			
	NK	+	+	-	+	+	2	6	7	17	21	+	-	-	-			
	TOT	6158	4878	5779	5391	5133	4679	3759	2993	3032	4147	4901	6290	6378	6105	(4210)	(2970)	(3529)

Table 3. Some observations on the composition of wolffish catches at West Greenland by Greenland and Federal Republic of Germany (Beese and Kändler, 1969).

Year	ICNAF/ NAFO Div.	Depth in m.	Gear	% of spotted by nos.	% of spotted by weight	% of striped by nos.	% of striped by weight	Total nos. observed.
1956	1B	70-260	longlines research	69	93	31	7	810
1956	1D	c.20-300	longlines research	89	99	13	3	586
1957	1A	25-300	longlines comm.	99	>99	1	<1	6126
1957	1B	30-400	longlines comm.	98	99	2	1	4368
1960	1A	250-600	longlines research	100	100	-	-	83
1976	1C	70-90	otter trawl comm.	1	<1	99	99-100	c.2000
1980	1D	300-500	otter trawl landed	18	42	82	58	802
1955 and 1963	1A-1F	100-500	otter trawl research Fed. Rep. Germany	20	c.40	80	c.60	?

Table 4. Vertical distribution of the three wolffish species at W. and E.Greenland. Individual numbers per hour in trawl catches.(After Beese and Kändler,1969).

Depths in m.	Nos. of individuals per hour striped	spotted	blue
<100	29.7	3.2	8.2
100-200	6.5	3.8	4.5
200-300	12.1	1.8	1.6
300-400	7.8	1.7	1.8
400-500	0.8	1.4	1.5
500-600	-	-	2.0
600-700	-	-	-
700-800	-	-	1.5
>800	-	-	1.0

Table 5. Age (years) and length (cm) of spotted and striped wolffish in subarctic waters. Specimen numbers in brackets. (After Beese and Kändler, 1969.)

Age	5	6	7	8	9	10	11	12	13	14	15	16	17
Spotted wolfffish	34.7 (10)	41.3 (7)	51.0 (11)	59.8 (13)	66.8 (13)	70.9 (11)	81.2 (9)	86.3 (15)	90.4 (18)	97.6 (13)	101.0 (5)	107.5 (4)	108.0 (1)
Striped wolffish	24.2 (13)	28.6 (12)	36.7 (24)	42.4 (21)	45.5 (22)	48.6 (14)	55.7 (6)	56.9 (14)	62.9 (7)	67.1 (8)	70.0 (4)	71.5 (4)	77.0 (2)

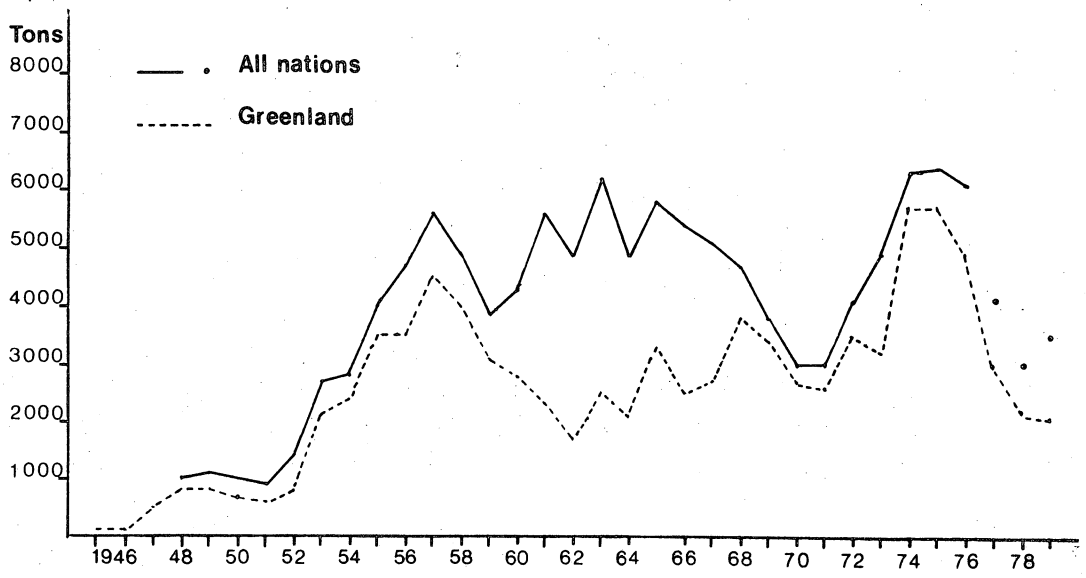

Fig. 1. Annual landings (tonnes) of wolffish (both species) by Greenland and by other nations.

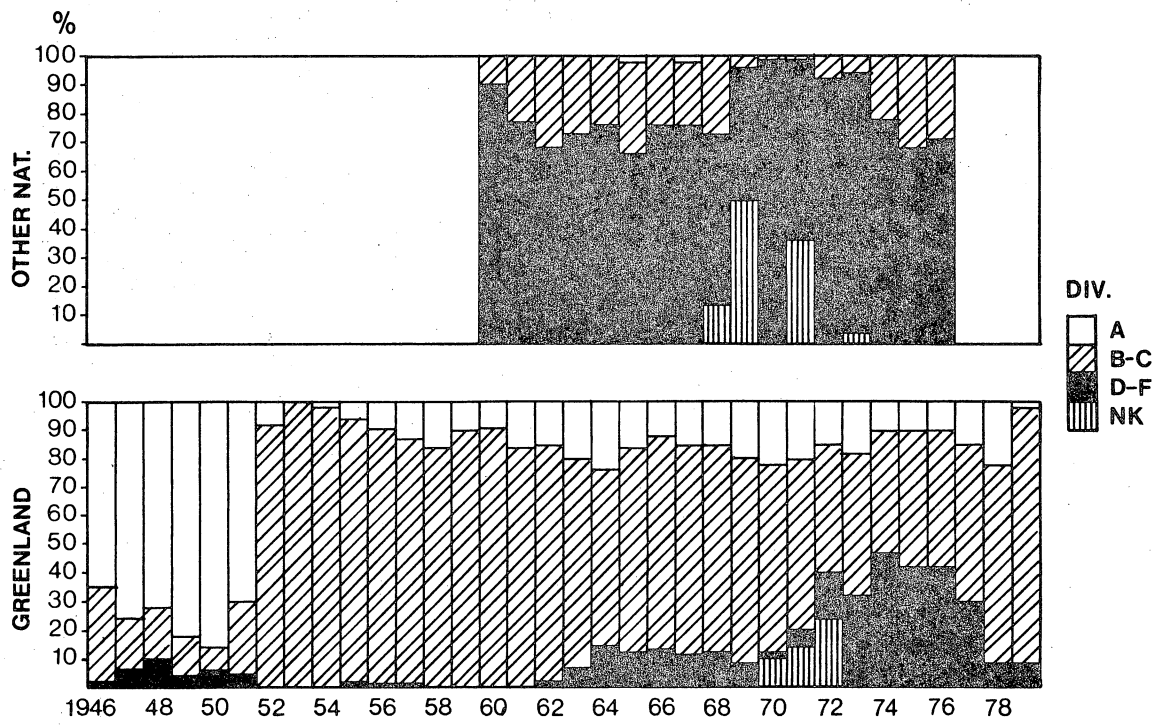

Fig. 2. Distribution (percent of annual catch) on ICNAF/NAFO divisions of wolffish (both species) landed by Greenland and by other nations.

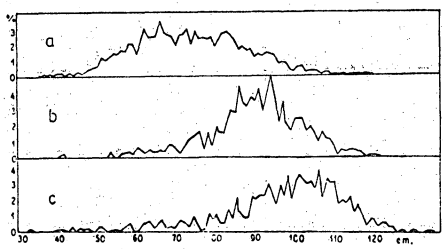

Fig. 3. Length frequencies of spotted wolffish from northern and southern W. Greenland localities.- a. Søndre Upernavik, Div. 1A north (72°08'N, July 1957, 2694 specimens).- b. Disko Fjord, Div. 1A south (69°28'N, August 1957, 746 specimens).- c. Div. 1B-1C (August 1956, 786 specimens). (Hansen, 1959).

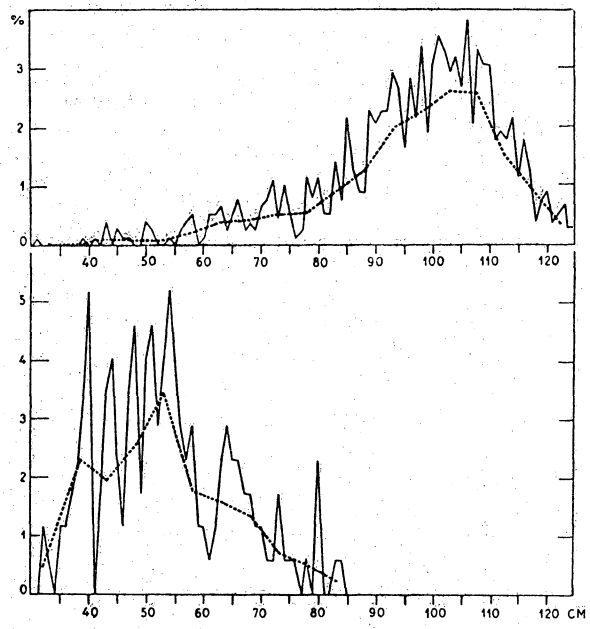

Fig. 4. Length frequencies of spotted wolffish (top, 786 specimens) and striped wolffish (bottom, 174 specimens) from long line catches, Div. 1B-1D, 1956. The dotted lines show length frequencies in 5 cm groups. (Hansen, 1958).

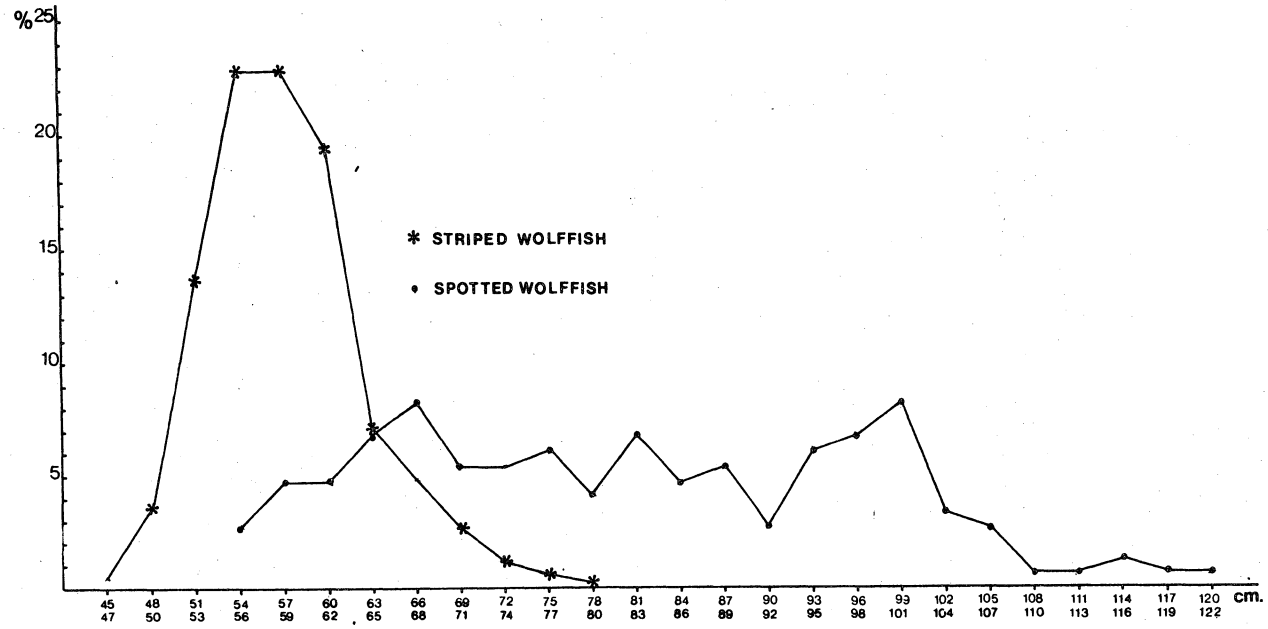

Fig. 5. Length frequencies in 3 cm groups of spotted wolffish (146 specimens) and striped wolffish (656 specimens). Landings by trawlers from Div. 1D (March 1980).

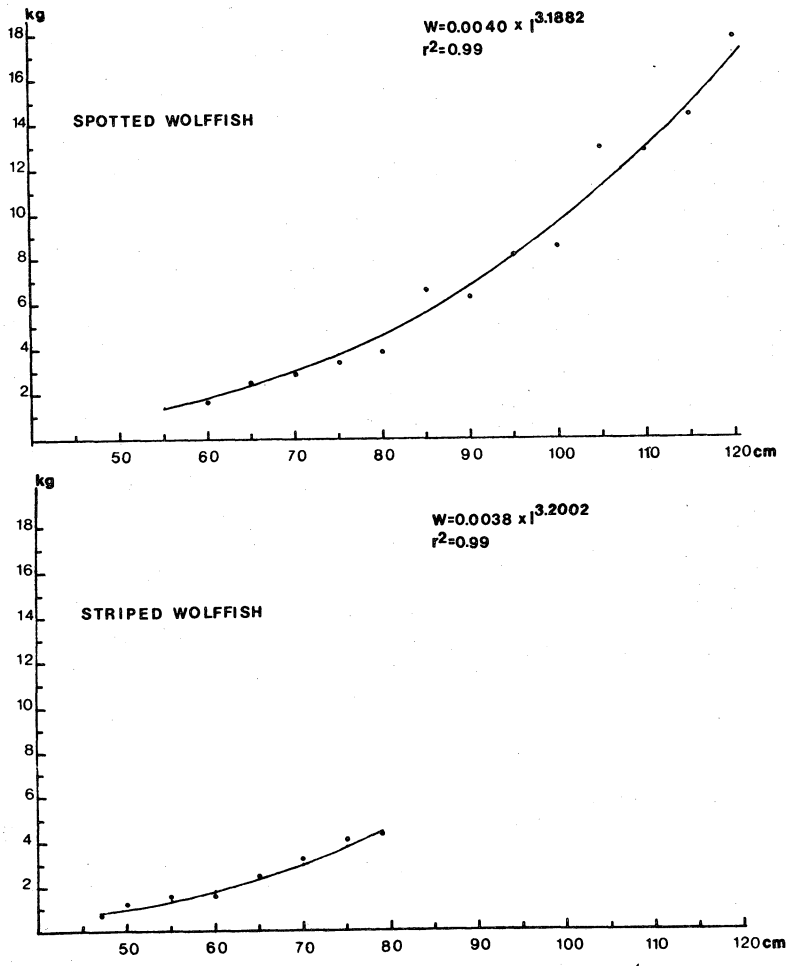

Fig. 6. Length-weight relationships of spotted wolffish (146 specimens) and striped wolffish (233 specimens). Landings by trawlers from Div. 1D (March 1980).