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Results of Age Determination of Atlantic Wolffish (Anarhichas lupus)

Based on Otoliths and on Vertebrae

by

Frank Riget

Greenland Fisheries and Environment Research Institute
Tagensvej 135, Copenhagen N, Denmark

Introduction

In the reported statistics of wolffish catches at West Greenland no distinction is made between Atlantic wolffish and spotted wolffish. The two species have different patterns of distribution at West Greenland (Riget, 1986) and they are to some extent exploited by different fisheries. An inshore longline fishery catches mainly spotted wolffish while Atlantic wolffish occurs mainly as by-catch in the trawl fishery for cod (Smidt, 1980). Age determination of wolffish is difficult and no suitable age-length keys are available. This will give rise to problems if a proper assessment is to be made in future.

Different methods of age determination of wolffish have been used: otoliths, (Beese and Kändler, 1969, Jonsson ,1982), vertebrae (Østvedt, 1963) and scales (Sacno from Beese and Kändler, 1969). The present paper compares age determined from otoliths with age determined from vertebrae of Atlantic wolffish in an attempt to evaluate the use of either method for future assessment purposes. Furthermore, a von Bertalanffy growth curve is presented.

Materials and Methods

The material for this study consists of otoliths and vertebrae sampled from commercial landings, from bottom trawl surveys carried out by the Federal Republic of Germany and from shrimp trawl surveys carried out by the Greenland Fisheries and Environment Research Institute (Table 1). A total of 278 otoliths and 198 vertebrae were included in this study. In the sampling it was intended to cover the whole range of ages rather than to obtain uniformity with respect to season and locality. Both otoliths were sampled together with two or three anterior vertebraes.

The otoliths were examined in a mixture of alcohol and glycerin by reflected light. It was attempted to grind down single otoliths, but as this procedure did not improve readability, ages were determined without any special treatment of the otoliths. In 5 cases (2%) age determination was impossible. The vertebrae were examined in reflected light after a few days of drying. In 2 cases (1%), age could not be determined from the vertebrae. All age determinations were made by the same person.

Results

Precision of age determinations

An attempt was made to evaluate the precision of age determinations by reading the otoliths and the vertebrae twice; the second reading being made without knowning the result of the first reading. The results are shown in Table 2. Column 2 and 3 of Table 2 include only fish that had both otoliths and vertebrae sampled and which could therefore be compared directly. The precision seems to be higher when age is determined from otoliths than when it is determined from vertebrae. While the same result was obtained in 50.8% of the cases when age was determined from otoliths twice, this was only the case in 25.9% of the cases when age was determined from vertebrae.

Column 1 in Table 2 shows the results of all otolith determinations. In 51.7% of the cases the results of the first and the second determination were identical; In 33.6% of the cases the difference between the two age determinations was one year and in 14.7% of the cases the difference was more than one year.

Comparison of age determined from otoliths and vertebrae

A comparison between age-determination by otoliths and by vertebrae has been done for fish where both otoliths and vertebrae have been sampled (Fig. 1). Only the second determinations of either structure were compared and only cases in which the difference in age between the first and the second determination was less than 3 years were included. There is a substantial difference in age between the two methods; only in 25.5% of the cases are the determinations identical. The difference seems to be systematic - age determined from vertebrae generally being higher than age determined from otoliths.

Growth

Table 3 shows mean length at age, calculated from age determined from otoliths and vertebrae, together with the results from studies by Beese and Kändler (1969) and Jonsson (1982). From these data Bertalanffy growth curves have been constructed (Table 4). The calculations were based on the result of the second age determination, provided that the difference between this and the first age determination was less than three years. The difference between the two descriptions of growth based on otoliths and vertebrae is not great (Fig. 2).

In the present study the mean length at age for the younger age groups of Atlantic wolffish is greater than found by Beese and Kändler (1969), whereas for the older age groups the mean length at age is rather similar. Compared with samples from Iceland (Jonsson, 1982) the mean length at age for the younger age groups are much alike; however the Icelandic wolffish grow longer and older than the Greenland wolffish. The growth parameter (K) found in this study is much greater and the asymptotic length (L_{∞}) is much smaller than the values found in the studies by Beese and Kändler (1969) and Jonsson (1982).

Conclusion

The experience of age determination of wolffish is presently not very great at the institute, so the precision of age determinations can be expected to increase with the acquisition of greater experience. Age determinations based on otoliths seem to be more precise than age determinations based on vertebrae.

Age determined from otoliths and age determined from vertebrae do not correspond well, the former generally being lower than the latter. It has not been possible to validate age determinations by other methods (e.x. length composition analysis). With these results in mind determination of age from otoliths seems to be the method preferred in future work with Atlantic wolffish in West Greenland.

Although some discrepancies between results of age determined from otoliths and age determined from vertebrae were found in this study the difference between corresponding growth curves is not great. Compared with studies of growth of Atlantic wolffish at Greenland and in the Barents Sea combined (Beese and Käandler, 1969), the growth rate in this study is found to be much greater for the younger age groups. Mean length at age of Atlantic wolffish is much the same at Greenland and at Iceland (Jonsson, 1982) especially for the younger age groups. The Atlantic wolffish at Greenland does not seem to obtain as great a size as the Icelandic population, though.

References

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Table 1. List of material for the present study.

Gear	Area	Year	Material
long line commercial	West Greenland	Aug. 1985	166 fish otoliths and vertebrae
trawl research	West Greenland	Nov. 1984	80 fish otoliths
trawl research	East Greenland	Okt.-Nov. 1985	23 fish otoliths and vertebrae
shrimp trawl research	West Greenland	July 1986	9 fish otoliths and vertebrae

Table 2. The results of two independent age-readings of otoliths and vertebrae, respectively.

	Otoliths total material	Otoliths comparable material	Vertebrae comparable material
1. reading = 2. reading	51.7%	50.8%	25.9%
1. reading > 2. reading	23.9%	28.3%	34.2%
1. reading < 2. reading	24.4%	20.9%	39.9%
difference = 1 year	33.6%	37.5%	34.7%
difference > 1 year	14.7%	16.8%	39.9%

Table 3. Mean length at age of Atlantic wolffish based on age determined from otoliths and age determined from vertebrae compared with the results from Beese and Käandler (1969) and Jonsson (1982).

								B & K (1969)			Jonsson (1982)	
	Otoliths			Vertebrae			Greenland + Barent Sea			Iceland	
Age	Length	s.d.	n	Length	s.d.	n	Length		n	Length	n
0	9.7		3	9.0		1				10.5	6
1	11.3	5.9	6	10.2	2.6	6				13.6	94
2	16.4	3.0	16	15.4	2.4	15				18.0	330
3	21.4	3.2	14	19.3		3				21.9	471
4	26.8	6.3	11	22.0		1	21.8		8	25.8	534
5	29.9	11.7	10	-		0	24.2		13	30.8	344
6	39.0	6.7	17	38.5		2	28.6		17	35.6	274
7	46.3	6.3	27	44.5	5.3	8	36.7		79	44.9	338
8	49.1	7.3	25	45.6	3.1	13	42.4		21	56.8	789
9	55.4	6.7	34	51.5	6.5	10	45.5		22	61.7	1417
10	56.4	7.2	21	53.9	4.2	17	48.6		14	65.9	1606
11	61.4	5.5	26	55.8	5.1	18	55.7		6	69.6	1321
12	61.2	8.6	18	63.6	8.0	23	56.9		14	72.1	969
13	67.2	3.6	11	63.7	6.6	15	62.9		7	75.2	634
14	66.7	6.7	10	64.9	6.2	14	67.1		8	78.6	385
15	70.5		4	65.2	7.5	9	70.0		4	82.0	229
16	-		0	69.0	4.9	6	71.5		4	84.4	170
17	77.0		1	71.0		1	77.0		2	85.5	105
18	73.5		2	69.5		2	80.0		1	87.8	64
19	-		0	-		0				91.5	32
20	-		0	-		0				98.4	23
21	-		0	-		0				98.5	21

s.d. = standard deviation is given only when n>4.

Table 4. Values of the parameters in the von Bertalanffy growth equation :
$\text{Length} = L_\infty (1 - \exp(-K(t - t_0)))$

Present study	L_∞	K	t_0
Otoliths	105.5	0.070	-0.69
Vertebraes	100.3	0.069	-0.73
Beese and Käandler (1969)			
Barent Sea + Greenland	192.5	0.035	0.57
Jonsson (1982)			
Iceland	187.5	0.035	-1.25

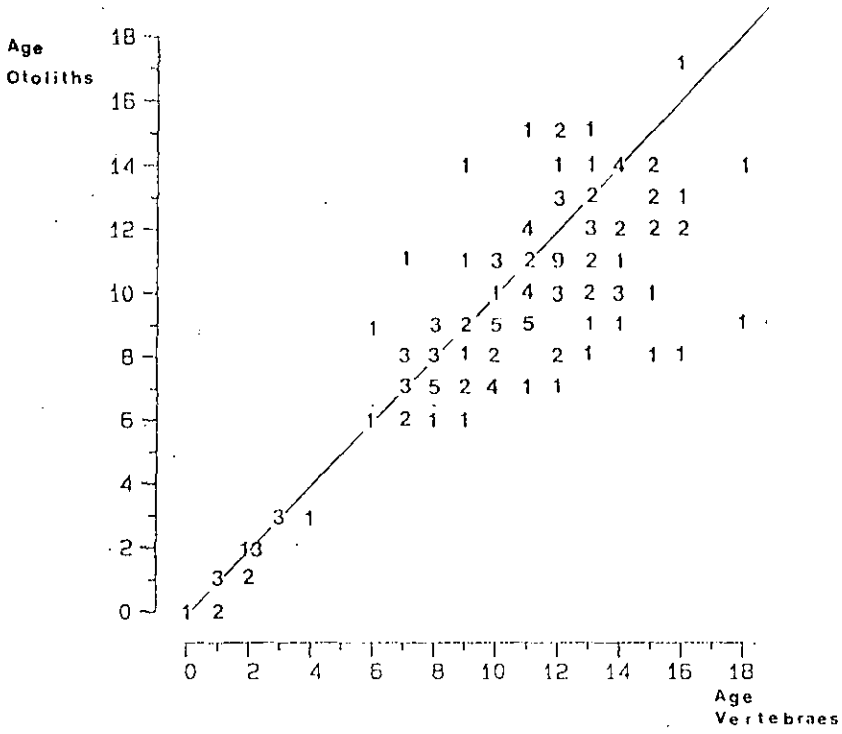

Fig 1. Comparision between results of age determined from otoliths and age dertermined from vertebrae.

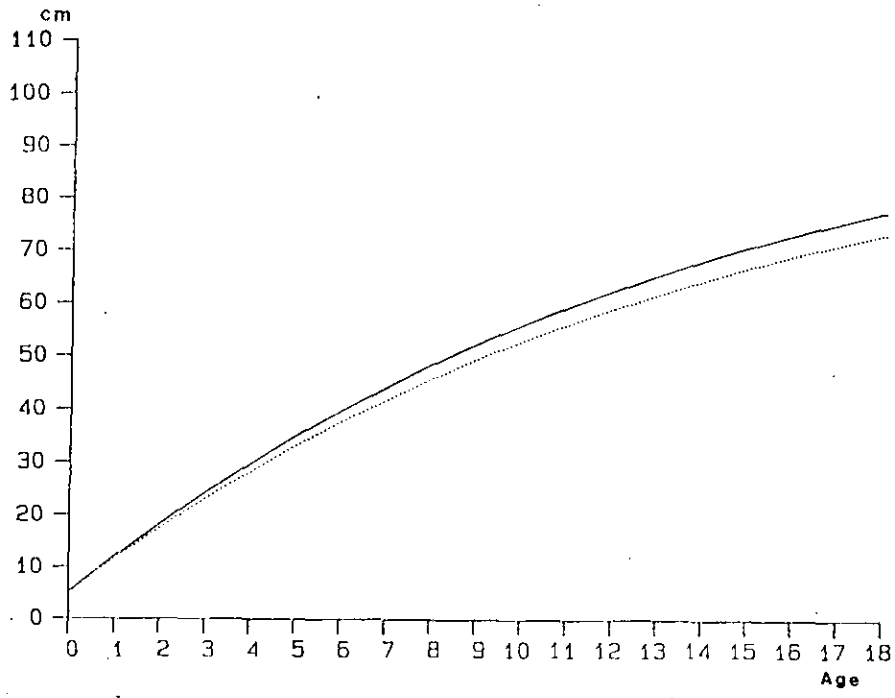

Fig 2. von Bertalanffy growth curves based on age determined from otoliths (solid line) and age determined from vertebrae (spotted line).