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Age and Growth of Witch Flounder in Division 3K

by

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Abstract

Results of investigation of witch flounder growth rate in accordance with data obtained and results of back calculation by scales are given in the present paper. It is estimated that the greatest linear growth takes place during the first years of life. During these years males grow more rapidly than females, then their growth rate slackens which is related to earlier maturation. An accretion in fish of different generations varies by years depending on conditions of their existence.

Introduction

Witch flounder (*Glyptocephalus cynoglossus*) are spread in the Northwest Atlantic in a considerable range of depths (from 40 to 1300 m and deeper) and on a wide area. Length of individuals reaches 75 cm (Andriyashev, 1954; Leim, Scott, 1966). There wasn't a direct deep-water fishery on witch flounder before 1965. In March 1965 Murmansk scouting vessel "Neptun" found dense concentrations of witch flounder on the continental slope in Div. 2J and 3K. Catches reached 15-20 tons per hour trawling (Pechenik, Troyanovsky, 1970). The presence of dense spawning aggregations of witch flounder at depths 500-700 m in these divisions allowed the trawl fleet when ice conditions got worse to move to the continental slope and carry out witch flounder fishery instead of cod fishery. After 200-mile zone was introduced all the countries, members of ICNAF, beginning from 1974 got their quotas for witch flounder fisheries. In order to maintain rational fishery it is necessary to have special knowledge on age of fish and on regularities of their growth rate. This paper presents some results of our investigations concerning age and growth rate of witch flounder in Div. 3K. The main material was collected during a total trawl survey.

Material and methods

Total trawl surveys in the Northwest Atlantic have been carried out annually beginning from 1971 and approximately at the same sea-

son (April/August). Points of trawlings are permanent. Methods and main results of total trawl surveys are described by Konstantinov (1981). Every trawling lasts 1 hour, speed of vessel - 3.5 knots. Trawlings are carried out with bottom trawl having a fine-mesh incision in the codend, that is why we may judge of size composition of the whole population including small individuals. Water temperature measurements on standard depths are carried out before every trawling (sometimes after trawling).

All witch flounder taken were measured with indication of sex, their stomach content and maturity were analysed, part of fish were sampled for age composition analysis. Age of fish was estimated under microprojector. Totally 155 specimens were investigated for age. Age samples were taken in July 1981 from 2 trawl catches in Div. 3K.

Age and growth rate of witch flounder in Div. 3K

The Northwest Atlantic witch flounder reach maturity at age of 5-6 years (Andriyashev, 1954; Leim, Scott, 1966). Having analysed the material collected during the total trawl survey in 1981 in Div. 3K we may see that 60% of males (Table 1) reach maturity at age of 5-6 years. Females mature more slowly than males, they reach maturity at 8-12 years and length 39-50 cm. Similar conclusions on witch flounder maturation we may find in papers by Bowering (1976). According to our data length of witch flounder in Div. 3K fluctuates from 14 to 72 cm. While recalculating size distribution into age it seemed almost incredible that lengths of fish of the same age-group varied so widely (Table 2,3). Sometimes these variations reached 20 cm. Being of the same length fish may differ in age by 4-5 and even 8 years. Such variations were registered also for the Barents Sea flounder (Milinsky, 1938; Kovtsova, 1976).

We have recalculated length of witch flounder by their scales assuming that fish length and growth of scales are directly proportional. Doing this we used angular or variable scale by B.P. Aleyev (1937). The methods were described earlier by Chugunova (1959). Comparing data in Tables 4 and 5 we may see that during first years of life males grow a little bit faster than females, then they slacken their growth and lag behind in it, which is related to their earlier maturation. Average annual accretion in witch flounder during the first five years of life (Div. 3K) varies from 4.94 cm to 6.14 cm. During the following years they grow slower (1.63-4.41 cm per year).

Comparing the calculated ~~and~~ (Tables 4,5) and observed (Tables 2,3) data we see differences in age estimates which are named in literature "Lee's phenomenon". There are many reasons which cause these differences. There are many opinions on this subject as well. R. Lee (1926) noted that assuming of direct proportionality brings us to a fact that length of yearlings calculated by older fish scales measurements turns less than that calculated by younger

fish scales measurements. Investigating growth rate of witch flounder from Div. 3K we observed this "Lee's phenomenon" in our work as well. (Table 6).

The main mass of witch flounder in catches during total trawl survey are individuals at age 5-10 years but in some cases there may be fish at age of 18. Age composition of catches is presented on Fig.1. Having known mean annual accretion of length of witch flounder we may forecast the length of fish being exploited the next year; and having known mean length of every age-group we may indicate year-classes which enter the fishery. In 1981 in Div. 3K fish with length 30-46 cm (1971-1976 year-classes) were dominant in catches (total trawl survey data). In 1982 in Div. 3K fish of the same year-classes will dominate in catches by bottom trawls.

Conclusions

1. Length of witch flounder of the same year-class varies considerably.
2. The greatest accretion is observed during the first 5 years of life (4.94-6.14 cm in average).
3. During first years of life males of witch flounder grow more rapidly than females and after reaching maturity - more slowly.
4. In 1982 in Div. 3K witch flounder of 1971-1976 year-classes will be dominant in catches by bottom trawls.

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Table I

- 4 -

Ratio of mature and immature individuals of witch flounder (%) in Division 3 K, July 1981

Sex	Maturity	Age, years									
		2	3	4	5	6	7	8	9	10	11
Males	Mature	-	-	16,7	60,0	100,0	84,6	100,0	100,0	100,0	100,0
	Immature	100,0	100,0	83,3	40,0	-	15,4	-	-	-	-
Females	Mature	-	-	-	-	7,1	-	40,0	60,0	64,3	60,0
	Immature	100,0	100,0	100,0	100,0	92,9	100,0	60,0	40,0	35,7	40,0

Sex	Maturity								Number of specimens
		I2	I3	I4	I5	I6	I7	I8	
Males	Mature	100,0	100,0	-	-	-	-	-	36
	Immature	-	-	-	-	-	-	-	12
Females	Mature	77,8	100,0	100,0	75,0	100,0	100,0	100,0	48
	Immature	22,2	-	-	25,0	-	-	-	60

Table 2

- 5 -

Size distribution of witch flounder males reduced to their age (Division 3 K, July 1981)

Age, years	Length, cm											
	20-21	22-23	24-25	26-27	28-29	30-31	32-33	34-35	36-37	38-39	40-41	42-43
2	3											
3		2	10									
4			9		10	7	15					
5				2		12		6				
6										2	7	
7								11	5	12	7	
8									2	6	7	
9									3			8
10										2		
11												
12												9
13												
	3	2	19	2	10	19	15	17	10	22	21	17
%	0,5	0,3	3,0	0,3	1,5	3,0	2,3	2,6	1,5	3,4	3,2	2,6

Age, years	44-45	46-47	48-49	50-51	52-53	54-55	56-57	Number of specimens	Per cent	Mean length, cm
2								3	0,5	20,5
3								12	1,8	24,17
4								41	6,3	29,43
5								20	3,1	31,30
6								9	1,4	40,06
7								35	5,4	37,36
8	2							17	2,5	39,66
9	4							15	2,3	41,83
10								2	0,5	38,55
11	2	6						8	1,2	46,05
12			3	1		2		15	2,3	45,83
13					2		1	3	0,5	53,83
	8	6	3	1	2	2	1	180		35,83
%	1,2	0,9	0,5	0,2	0,3	0,3	0,2		27,8	

Table 3

- 6 -

Size composition of witch flounder females reduced to their age (Division 3 K, July 1981)

Age, years	Length, cm															
	18- 19	20- 21	22- 23	24- 25	26- 27	28- 29	30- 31	32- 33	34- 35	36- 37	38- 39	40- 41	42- 43	44- 45	46- 47	
2	I	I	6													
3				I4	6	5										
4						I2	I9									
5						5	I9	8	I9							
6						5			7	I0	8	I6		5		
7					6			8	3		8	6	4	I1		
8									7			3	4	3		
9						5					5	6	I7	I1	4	
I0									3			3	4	3	I9	
I1														8	8	
I2															8	
I3																
I4																
I5																
I6																
I7																
I8																
	I	I	6	I4	I2	32	38	I6	39	I3	2I	34	29	4I	39	
%	0,2	0,2	0,9	2,2	I,8	4,9	5,9	2,5	6,0	2,0	3,2	5,2	4,5	6,3	6,0	

TABLE 3. (Continued).

Age, years	48- 49	50- 51	52- 53	54- 55	56- 57	58- 59	60- 61	62- 63	64- 65	66- 67	68- 69	70- 71	72- 73	Number of spec.	Per cent	Mean length, cm
2														8	1,2	21,75
3														25	3,9	25,78
4														31	4,8	29,73
5														51	7,9	32,11
6														54	8,3	37,72
7														46	7,0	37,67
8														17	2,6	39,21
9	7													55	8,5	42,10
10	11	6												49	7,6	45,89
11	11	3			4									34	5,3	48,21
12	7	10	4	3										32	4,9	49,69
13	3	6	4											13	2,0	50,65
14				9										9	1,4	54,50
15			4	3		17								24	3,7	57,00
16	3				3		2	1						9	1,4	55,39
17							3	1	1					5	0,8	61,70
18							3	1		1			1	6	0,9	64,17
	42	25	12	15	7	17	8	3	1	1			1	468		41,27
%	6,5	3,8	1,8	2,3	1,1	2,6	1,2	0,5	0,2	0,2			0,2		72,2	

Table 4

- 8 -

Average length of witch flounder males in Div. 3K according to recalculations by Alejev's scale

Year-classes	Age, years	Number of fish	Length, cm							
			I	2	3	4	5	6	7	8
1979	2	1	7,5	18,0						
1978	3	2	9,0	17,0	25,0					
1977	4	6	9,1	15,9	23,1	28,5				
1976	5	5	8,3	14,9	23,5	26,4	31,0			
1975	6	3	7,0	14,0	22,3	28,3	33,5	37,8		
1974	7	13	7,9	13,9	19,6	24,9	29,4	33,8	37,8	
1973	8	6	7,3	12,8	19,0	24,2	28,8	33,3	36,8	39,7
1972	9	4	8,8	11,7	20,7	24,5	29,0	32,8	36,0	39,2
1971	10	1	5,0	10,0	16,0	20,0	22,0	26,5	30,0	33,0
1970	11	3	8,0	13,0	17,7	22,6	26,3	29,8	34,0	38,0
1969	12	2	7,3	12,0	16,5	21,5	26,0	30,0	33,0	36,7
1968	13	2	5,0	10,0	13,7	18,3	22,7	26,5	32,5	36,8
Average length, cm			7,85	14,02	20,09	24,94	30,4	32,7	35,9	38,27

Year-classes	Age, years	Number of fish	Length, cm				
			9	10	11	12	13
1979	2	1					
1978	3	2					
1977	4	6					
1976	5	5					
1975	6	3					
1974	7	13					
1973	8	6					
1972	9	4	41,8				
1971	10	1	36,0	38,0			
1970	11	3	40,7	43,7	46,0		
1969	12	2	39,5	42,0	44,5	47,8	
1968	13	2	41,5	45,0	47,5	50,5	53,0
Average length, cm			40,58	42,87	46,0	49,1	53,0

Table 5

Average length of witch flounder females in Div. 3K according to recalculations by Alejev's scale

Year-class	Age, years	Number of fish	Length, cm									
			I	2	3	4	5	6	7	8	9	10
I979	2	I	9,5	I9,0								
I978	3	2	9,5	I7,5	25,5							
I977	4	3	7,3	I5,7	24,5	29,0						
I976	5	8	7,8	I4,7	I8,8	27,2	32,6					
I975	6	I3	8,7	I5,2	2I,6	28,3	34,2	38,8				
I974	7	I2	8,2	I4,I	20,7	26,I	3I,3	35,2	38,8			
I973	8	5	8,2	I3,8	I9,2	24,2	28,7	32,5	36,4	39,8		
I972	9	I5	7,I	I2,9	I8,I	23,4	28,6	32,3	36,2	39,4	42,5	
I97I	I0	I4	7,3	I3,8	I9,0	24,8	29,3	33,8	37,5	40,6	43,I	45,8
I970	II	I0	7,2	I2,8	I8,6	24,I	29,I	33,0	36,7	39,8	42,9	45,6
I969	I2	9	6,7	II,7	I6,7	I9,3	26,0	30,3	34,I	37,9	4I,8	44,7
I968	I3	4	6,9	II,9	I6,9	2I,5	26,3	30,8	34,0	37,8	4I,0	44,4
I967	I4	3	5,7	I0,5	I4,7	I9,2	24,7	29,0	33,0	37,5	4I,3	44,7
I966	I5	4	5,8	I0,6	I5,5	I9,9	25,0	28,8	32,5	35,2	40,2	42,9
I965	I6	2	5,8	I0,2	I5,0	I8,5	22,0	25,0	28,0	3I,0	34,2	37,0
I964	I7	I	6,0	II,0	I5,0	I9,0	25,0	29,0	34,0	37,0	39,0	43,0
I963	I8	I	7,0	I4,0	20,0	27,0	3I,0	35,0	38,0	4I,0	45,0	47,0
Average length, cm			7,28	I3,47	I9,20	24,02	29,66	33,5	36,07	38,74	4I,9	44,73

TABLE 5. (Continued).

Year-class	Age, years	Number of fish	I1	I2	I3	I4	I5	I6	I7	I8
I979	2	I								
I978	3	2								
I977	4	3								
I976	5	8								
I975	6	I3								
I974	7	I2								
I973	8	5								
I972	9	I5								
I97I	I0	I4								
I970	II	I0	48,0							
I969	I2	9	47,3	49,8						
I968	I3	4	46,8	48,8	5I,0					
I967	I4	3	46,8	49,3	5I,7	54,0				
I966	I5	4	46,2	49,0	5I,4	54,I	56,2			
I965	I6	2	40,5	43,0	45,0	47,5	50,0	52,0		
I964	I7	I	46,0	49,0	5I,0	54,0	57,0	6I,0	64,0	
I963	I8	I	5I,0	54,0	56,0	59,0	6I,0	63,0	64,0	66,00
Average length, cm			47,00	49,I0	50,96	53,50	55,37	57,00	64,00	66,00

Table 6 Linear accretion of witch flounder males and females during the first year of life calculated during investigation of individuals of different age (1981, Div. 3K)

Catch by age, years	Accretion, cm		Number of specimens
	Males	Females	
2	$\frac{7,5}{7,5}$	$\frac{9,5}{9,5}$	2
3	$\frac{7,0-11,0}{9}$	$\frac{9,0-10,0}{9,5}$	4
4	$\frac{7,5-11,0}{9,08}$	$\frac{6,0-9,0}{7,3}$	9
5	$\frac{7,0-10,5}{8,3}$	$\frac{6,0-10,0}{7,8}$	13
6	$\frac{6,0-7,5}{7,0}$	$\frac{6,5-10,5}{8,7}$	16
7	$\frac{6,0-9,0}{7,9}$	$\frac{6,0-12,0}{8,2}$	25
8	$\frac{6,0-8,5}{7,3}$	$\frac{5,0-11,0}{8,2}$	11
9	$\frac{8,0-9,0}{8,8}$	$\frac{6,0-9,0}{7,1}$	19
10	$\frac{5,0}{5,0}$	$\frac{6,5-10,0}{7,3}$	15
11	$\frac{7,0-9,0}{8,0}$	$\frac{6,0-9,0}{7,2}$	13
12	$\frac{7,0-7,5}{7,3}$	$\frac{6,0-9,0}{6,7}$	11
13	$\frac{5,0}{5,0}$	$\frac{5,5-9,0}{6,9}$	6
14		$\frac{4,5-7,5}{5,7}$	3
15		$\frac{4,0-7,5}{5,8}$	4
16		$\frac{5,0-6,5}{5,8}$	2
17		$\frac{6,0}{6,0}$	1
18		$\frac{7,0}{7,0}$	1

Note: numerator - limits of variations
denominator - average values

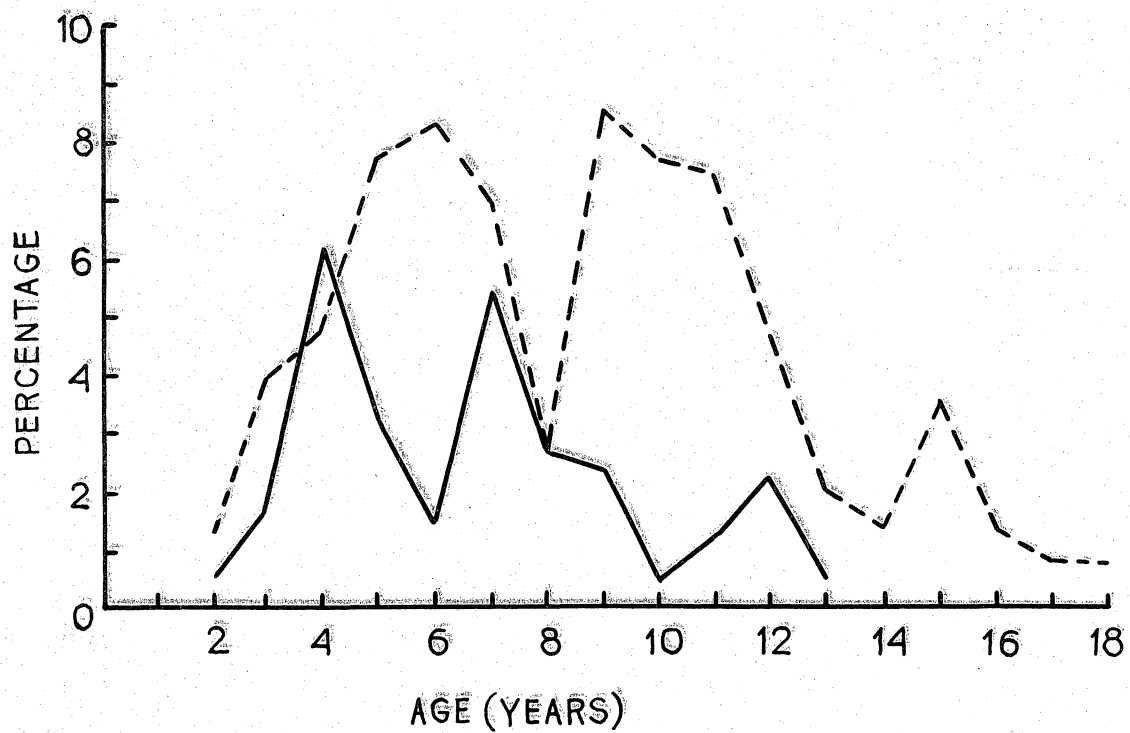


Fig. 1. Age composition of witch flounder in Div. 3K.

full line - males

dot line - females