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Age and Growth of Silver Hake, *Merluccius bilinearis*,  
on the Scotian Shelf

by

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Introduction.-

The Silver hake, *Merluccius bilinearis*, is among the most important species of the bottom fauna on the Scotian Shelf (NAFO, Div. 4VWX). The population has been continuously studied since 1962 when the trawl fishery for silver hake began. In the last four years a considerable biological information were collected from the International Observer Program and it was possible to prepare age - length keys for assesment purpose.

The present paper summarizes the age-length key for the last four year obtained from the cuban commercial and research vessels samples.

Materials and Methods.-

Four samples of otoliths were collected, one during the summer 1977 on board the research vessel "Isla de la Juventud", and the others in 1978, 1979 and 1980, from the International Observer Program, all of them were stratified in size and sex. Once the otoliths were removed, they were kept in identified paper envelopes. The structures were broken through the nucleus and one half was polished at the surface for age determination. When the zones were not distinctly observed due to prolonged storing of otoliths, some HNO<sub>3</sub>(2 %) was added for a few minutes to the polished surface, attaining a considerable improvement for observation. The reading were carry out following Mari (1980) methodology.

The Von Bertalanffy growth equation was used to describe the growth of each sex and both combined.

Age and growth:

A sample of 306 Silver hake otoliths collected in july of 1977 were examined from wich 114 belonged to males and 192 to females.

The specimens used in the analysis ranged from 12-66 cm. The age-length key by sex derived from otoliths is presented in Table 1. These data indicated were defined age group 1 and 2 years for both males and females. Age 3 and older males (12.2) were poorly represented but females comprised 49.5 % of the sample. Females at age 3 showed a wide range in length (28-44 cm) wich might be attributed to the proportion mature at age 3 (Hunt, 1978).

The mean length-at-age shown in the Table 1 were used to calculated the Von Bertalanffy parameters and the resultants curve are shown in Fig. 2.

A total of 248 otoliths were employed in 1978, from wich 94 belonged to males and 154 to females. The age-length Key by sex derived from the individuals (14-60 cm) analysis is presented in Table 2. Females and males at age 2 were the most representatives with 25,3 % and 41,5 % respectively.

In July of 1979 a sample of 226 Silver hake otoliths were collected from which 80 belonged to males and 146 to females.

The age-length key by sex derived from the individual analyses is presented in Table 3. These data indicated well defined as in previous year age group 1 and 2 year for both males and female, with 47,5 and 34,2 % respectively.

The 1980 sample was the biggest one with females belonged to age 5 to 9 more representative. Females and males at age 1-2 were the most abundant with 39.7 and 71.5 % respectively (Table 4).

The Von Bertalanffy curves derived from tables 1-4 are shown in figure 1. The asymptotic length for all years analysed in this paper were higher than the values obtained by Hunt (1978) probably due to the lack of the older individuals in the sample (Table 5).

It was found that for each age group the females mean length exceeded the one of the males for the four years studied.

#### References.

- HUNT, J.J. (1978). Age growth and distribution of Silver hake, Merluccius bilinearis, on the Scotian Shelf. ICNAF Selected Papers N° 3, :33-44.
- MARÍ A. (1980). Distribution, age and growth of Silver hake (Merluccius bilinearis) on the Scotian Shelf. NAFO SCR Doc. 80/IX/117, Serial N° N186.

Table 1.- Age-length key for Silver hake in Div. 4W from otolith samples, 1977.

LENGTH (cm)	AGE 1		AGE 2		AGE 3		AGE 4		AGE 5		AGE 6		AGE 7		AGE 8		AGE 9		TOTAL		
	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M+F
12	1	-																	1	-	1
13	5	3																	5	3	8
14	5	5																	5	5	10
15	5	5																	5	5	10
16	5	5																	5	5	10
17	5	5																	5	5	10
18	5	5																	5	5	10
19	5	5																	5	5	10
20	5	5																	5	5	10
21	5	5																	5	5	10
22	4	5	1	-															5	5	10
23	4	4	1	1															5	5	10
24	3	4	2	1															5	5	10
25	1	2	4	3															5	5	10
26	1	1	4	4															5	5	10
27	-	1	5	4															5	5	10
28			5	4	-	1													5	5	10
29			5	4	-	1													5	5	10
30			4	4	1	1													5	5	10
31			4	4	1	1													5	5	10
32			3	4	2	1													5	5	10
33			2	2	3	3													5	5	10
34			-	2	2	3	1	-											3	5	8
35			1	-	-	4	-	-											1	4	5
36					-	2	2	3											1	4	5
37					-	1	-	4	1	-									2	5	7
38					-	3	-	2	-	-									1	5	6
39					-	3	-	2	-	-									-	5	5
40					-	2	-	3	-	-									-	5	5
41					-	2	-	3	-	-									-	5	5
42					-	2	-	3	1	-									-	5	5
43					-	1	-	4	-	-									1	5	6
44					-	1	-	4	-	-									-	5	5
45							-	5	-	-									-	5	5
46							-	1	-	4									-	5	5
47							-	1	-	4									-	5	5
48							-	2	-	3									-	5	5
49									-	5									-	5	5
50										1	-	1							-	2	2
51										-	1	-	1						-	2	2
52										-	-	-	1						-	1	1
53										-	-	-	-						-	-	-
54										-	1	-	1						-	2	2
55										-	-	-	-						-	-	-
56										-	-	-	-						-	-	-
57										-	-	-	-						-	-	-
58										-	1								-	1	1
61																			-	1	1
66																			-	1	1
TOTAL	59	60	41	37	9	32	3	37	2	17	3	-	4	-	1	-	1	114	192	306	
MEAN (mm)	171	178	287	293	329	368	355	421	400	482	-	521	-	542	-	615	-	665			
%	52	31	36	19	8	17	3	19	2	9	-	2	-	2	-	+	-	+	37	63	

Table 2.- Age-length key for Silver hake in Div. 4W from otolith samples, 1978.

LENGTH (cm)	AGE 1		AGE 2		AGE 3		AGE 4		AGE 5		AGE 6		AGE 7		AGE 8		AGE 9		TOTAL		
	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M+F
14	1	-																	1	-	1
15	-	-																	-	-	-
16	-	1																	-	1	1
17	-	1																	-	1	1
18	2	3																	2	3	5
19	4	5	1	-															5	5	10
20	4	5	1	-															5	5	10
21	3	5	2	-															5	5	10
22	3	3	2	2															5	5	10
23	-	3	5	2															5	5	10
24	-	1	5	4															5	5	10
25			5	5															5	5	10
26			5	5															5	5	10
27			4	5	1	-													5	5	10
28			4	5	1	-													5	5	10
29			-	5	5	-													5	5	10
30			4	4	1	1													5	5	10
31			-	1	5	4													5	5	10
32			1	1	4	3	-	1											5	5	10
33					2	4	3	1											5	5	10
34					-	5	5	-											5	5	10
35					-	4	5	1											5	5	10
36					1	4	2	1											3	5	8
37					-	4	1	1											1	5	6
38					-	2	-	3											-	5	5
39							-	4	2	1									2	5	7
40								4	-	1									-	5	5
41								-	-	4	-	1							-	5	5
42								-	-	-	2	-	3						-	5	5
43								-	-	-	-	-	2						-	2	2
44								-	1	-	2	-	1	-	1				-	5	5
45								-	-	-	1	-	1	-	-				-	2	2
46								-	-	-	2	-	2	-	-				-	4	4
47								-	1	-	-	-	2	-	-				-	3	3
48										-	2	-	-	-	-				-	2	2
49										-	1	-	1	-	-				-	2	2
50											-	-	-	-	-				-	-	-
51												-	-	-	1				-	1	1
52												-	1	-	1				-	2	2
53												-	-	-	1				-	1	1
54												-	-	-	-				-	-	-
55												-	1	-	-				-	1	1
56												-	1	-	1				-	2	2
57																					
58																-	1		-	1	1
59																					
60																		-	1	-	1
TOTAL	17	27	39	39	20	31	16	18	2	16	-	16	-	5	-	1	-	1	94	154	248
MEAN (mm)	202	208	258	272	312	346	350	390	395	440	-	467	-	516	-	585	-	605			
%	18	18	42	25	21	20	17	12	2	10	-	10	-	3	-	1	-	1	38	62	

Table 3.- Age-length key for Silver hake in Div. 4W from otolith samples, 1979.

LENGTH (cm)	AGE 1		AGE 2		AGE 3		AGE 4		AGE 5		AGE 6		AGE 7		AGE 8		AGE 9		TOTAL				
	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M+F		
16	1	-																			1	1	
17	-	-																			-	-	
18	2	1																			2	1	3
19	1	2																			1	2	3
20	4	3																			4	3	7
21	1	3	-	-																	1	3	4
22	5	4	-	1																	5	5	10
23	2	2	-	3																	2	5	7
24	1	2	4	3																	5	5	10
25	1	2	4	3																	5	5	10
26	2	-	3	5																	5	5	10
27	-	-	5	5																	5	5	10
28	-	-	5	5																	5	5	10
29	-	-	5	5																	5	5	10
30	-	1	4	3	1	1															5	5	10
31			3	4	2	1															5	5	10
32			2	3	3	2															5	5	10
33			2	2	3	1															5	5	10
34			1	1	3	2	1	-													5	5	10
35			-	-	5	2	-	1													5	5	10
36			-	-	1	2	1	2	1	-											3	5	8
37					-	3	-	1	1	1											1	5	6
38					-	1	-	2	-	2											-	5	5
39										3	-	2									-	5	5
40										-	2	-	2	-	1						-	5	5
41										-	2	-	2	-	1						-	5	5
42										-	2	-	2	-	1						-	5	5
43										-	2	-	3	-	-						-	5	5
44												-	1	-	3						-	4	4
45												-	4	-	1						-	5	5
46												-	1	-	1						-	2	2
47												-	1	-	2						-	3	3
48												-	-	-	1						-	1	1
49												-	1	-	-						-	1	1
50												-	1	-	1						-	2	2
51													-	-	-	1					-	1	1
52													-	-	-	-					-	-	-
53													-	1	-	-					-	1	1
54														-	-	-	1				-	1	1
55															-	1	-	1			-	2	2
56																-	2	-	1		-	3	3
57																	-	1	-		-	1	1
58																							
TOTAL	20	20	38	50	18	15	2	6	2	14	-	20	-	13	-	4	-	4	80	146	226		
MEAN (mm)	219	225	286	292	337	349	354	371	369	405	-	439	-	459	-	549	-	559	--	--			
%	250	137	475	342	225	103	25	41	25	96	-	137	-	90	-	27	-	27	354	646			

Table 4.- Age-length key for Silver hake in Div. 4W from otolith samples, 1980.

LENGTH (cm)	AGE 1		AGE 2		AGE 3		AGE 4		AGE 5		AGE 6		AGE 7		AGE 8		AGE 9		TOTAL		
	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M+F
13	5	3																	5	3	8
14	5	5																	5	5	10
15	5	5																	5	5	10
16	5	5																	5	5	10
17	5	5																	5	5	10
18	5	5																	5	5	10
19	5	5																	5	5	10
20	4	5	1	-															5	5	10
21	5	5	-	-															5	5	10
22	1	1	4	4															5	5	10
23	1	3	4	2															5	5	10
24		3	5	2															5	5	10
25		3	5	2															5	5	10
26			5	5															5	5	10
27			4	4	1	1													5	5	10
28			5	4	-	1													5	5	10
29			5	5	-	-													5	5	10
30			3	4	2	1													5	5	10
31			1	2	4	3													5	5	10
32				2	1	3	3	-	1	-									5	5	10
33				3	5	2	2	-	-	-									5	5	10
34				2	5	3	3	-	-	-									5	5	10
35				3	3	2	3	-	-	-									5	5	10
36					2	5	3	-	-	-									5	5	10
37					3	1	2	-	-	-									1	5	6
38						-	4	1	1										1	5	6
39							-	-	1	4	-	1							1	5	6
40									-	2	-	3							-	5	5
41									-	1	-	-							-	5	5
42									-	4	-	1							-	5	5
43									-	4	-	1							-	5	5
44									-	1	-	3							-	4	4
45									-	2	-	1							-	3	3
46									-	-	-	3							-	3	3
47									-	-	-	4	-	1					-	5	5
48									-	-	-	2	-	3					-	5	5
49								-	1	-	-	2	-	1					-	4	4
50									-	-	-	2	-	1					-	3	3
51									-	2	-	-	-	3					-	5	5
52									-	-	-	2	-	3					-	5	5
53									-	-	-	-	2	-	1				-	3	3
54									-	2	-	-	3	-	-				-	5	5
55									-	1	-	3	-	1	-				-	5	5
56									-	1	-	1	-	-	-				-	2	2
57										-	1	-	3	-	1				-	5	5
58												-	5	-	-				-	5	5
59													1	-	1				-	2	2
60													-	-	2	-	2		-	4	4
61													-	1	-	-	-		-	1	1
62																			-	1	1
63																			-	1	1
TOTAL	46	53	42	36	16	27	16	24	3	28	-	22	-	25	-	5	-	4	123	224	347
MEAN (mm)	176	188	263	274	326	336	348	405	367	452	-	491	-	548	-	582	-	617			
%	374	237	341	160	130	121	130	107	24	125	-	98	-	112	-	22	-	18	35	65	

Table 5.- Growth parameters for 1977, 1978, 1979 and 1980.

1977	♀+♂	♂	♀
K	0.1453	0.5695	0.1563
$t_0$	-0.5250	0.0515	-0.3889
$L_{\infty}$	87.8	42.0	84.9
1978			
K	0.0912	0.2485	0.1113
$t_0$	-1.518	-1.288	-1.390
$L_{\infty}$	95.8	47.3	86.2
1979			
K	0.1031	0.5316	0.1125
$t_0$	-1.9799	-0.5904	-1.9112
$L_{\infty}$	81.3	38.9	77.8
1980			
K	0.1152	0.5438	0.1283
$t_0$	0.9505	0.1077	0.9062
$L_{\infty}$	90.2	39.2	85.4

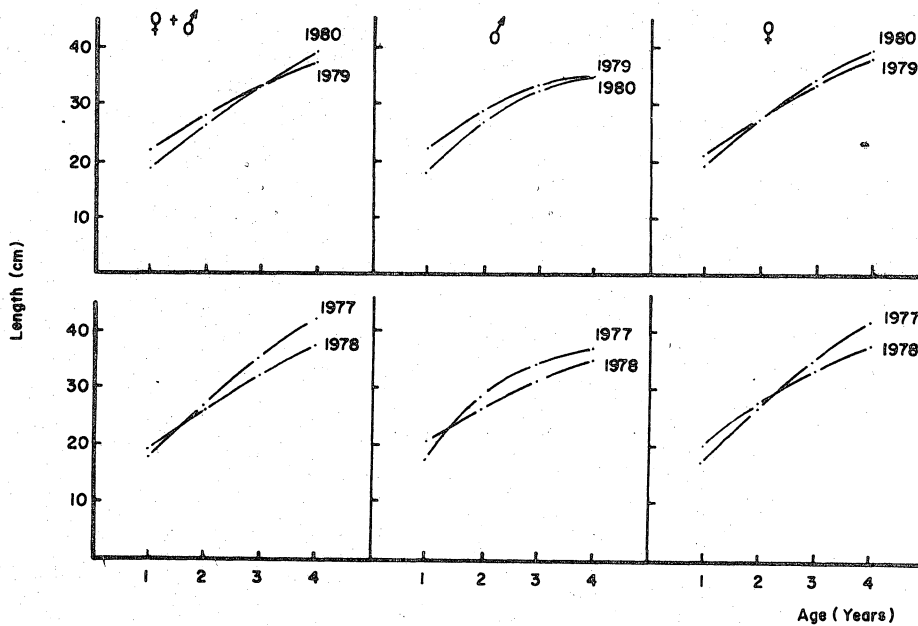


Fig.1-Bertalanffy growth curves for silver hake on the Scotian shelf.

