Northwest Atlantic ⬛ Fisheries Organization

SCIENTIFIC COUNCIL MEETING - JUNE 1989

The Question of Optimum Numbers of Ageing the Scotian Shelf Silver Hake

by

V. A. Rikhter and V. V. Peteropsh

Atlantic Scientific Research Institute of Marine Fisheries and Oceanography (AtlantNIRO)
5 Dmitry Donskoy Street, Kaliningrad, 236000, USSR

ABSTRACT

An attempt has been made to more strictly estimate the
number of specimens of each size group of the Scotian Shelf silver
hake to be collected on a mouthly basis for ageing with desirable
accuracy. In this context, the method of selection of optimum
numbers of specimens for ageing suggested by Baird (1983) was used.
The calculations showed that at the given accuracy level (20% CV),
a stratification scheme adopted in the AtlantNIRO may be considered
satisfactory for males at the age of 1-3 and females at the age
of 1-4. As to older fish, the greater number of specimens must be
sampled from each age group.

1. INTRODUCTION

Sampling of the silver hake for ageing is made in the
AtlantNIRO using a stratified approach recommended by NAFO (NAFO
Secretariat, 1986). However, the practice of collecting specimens
from each size group for ageing is of arbitrary nature and dis-
regards the estimate of diserable accuracy of ageing data. The
size of age sample thus collected had been considered to be quite
sufficient to obtain reliable information on silver hake age com-
position in commercial catches.

In the present paper on attempt is made to more strictly
estimate the number of apecimens of each size group to be collected
on a monthly basis for ageing with desirable accuracy.

2. MATERIALS AND METHODS

The "length-age" keys and size composition of the silver
hake for July 1986 were used as an initial data (tables 1, 2).
The males and females were examined separately according to NAFO
demands (NAFO Secretariat, 1986). The total silver hake catch
in July 1986 has been taken to be 20 thous. tons. As to males, the
stratification scheme adopted in the AtlantNIRO for silver hake
sampling for ageing provides that 5 pairs of otoliths are selected
from each size group below 25 cm in length, 10 pairs of otoliths
from the 26 to 30 cm length group and 5 pairs from the length
group of 31 cm on. The pattern is almost similar for the females:
5 pairs of otoliths from the size group below 25 cm in length,
10 pairs from the 26 to 31 cm length group and 5 pairs from the
length group of 32 cm on.

The method used in this paper (Baird, 1983) is based on
calculating the coefficient of variation for catch by age.

Definitions:

N_i - catch in numbers by age group;

n_i - number of specimens collected for ageing by age
group;

P_i - ratio of size groups for the given age;

$n_i P_i$- number of specimens of each size group relative to
the given age;

$N_i P_i$- catch by size group for the given age.

The calculation procesure given below is completely adopted
from the above-mentioned paper. It should be noted, however, that
in the numerator of the formula for calculating the coefficient
of variation (CV) given in the paper of Baird, the square root of
variation of the total number of the caught fish of all ages must
be written.

3. RESULTS AND DISCUSSION

Selected results of calculating the coefficients of variation (CV)
by age separately for the males and females are presented in tables
3 and 4. It was assumed that the volume of initial information
(tables 1,2) ensured the required accuracy of the results. The

calculations make it possible to determine which size group is
subject to the greatest variation. Introduction of amendments into
the stratified scheme for one or the other size group may result
in achievement of the desirable CV level. However a question arises
then: what accuracy level must be sought? If, as in the Baird's
paper, 10% CV is used as a criterion then, conformably to the
silver hake, the achievement of such an accuracy may require collec-
tion of samples of a considerably greater size, especially so for
older ages. Therefore, in the given case, it has been decided to
select 20% CV as a criterion of acceptable accuracy. Actually all
values of CV for all age groups of the males and females are con-
tained in table 5.

From the comparison between the data given in table 5 and
the selected criterion of accuracy it is obvious that the number
of males at the age of 4-5 and females at the age of 6 sampled for
ageing must be decreased. The amended results (the numbers corres-
ponding to the initial stratification are given in brackets) are
presented in tables 6 and 7.

However it would not be wise to make definite conclusions
from the given data without a clear idea of the influence of the
volume of initial information on the accuracy of the obtained
results. Remember the above-stated assumption. Thus a necessity
arose to supplement the analysis by the assessment of confidence
intervals (spread) of CV for each age group in conformity with
the used volume of information (tables 1,2). The results of the
new calculations are presented in table 8.

As is evident from the comparison between the newly calcu-
lated data and the adopted criterion of accuracy, the number of
males at the age of 1-3 and females at the age 1-4 sampled for
ageing according to the selected stratification scheme basically
ensures the predetermined accuracy. Amended results for the males
at the age of 4-5 and females at the age of 5-6 are given in table 9.

The tabulated data show that even a marked increase of the
number of specimens that are to be sampled for ageing (40 from
each size group instead of 5) will not provide a desirable accura-
cy in ageing 5 year old males and 6 year old females.

4. CONCLUSION

The results of application of the Baird's methods to the
Scotian shelf silver hake showed that the stratification scheme
adopted in the AtlantNIRO may be considered satisfactory for the
1-3 year old males and 1-4 year old females at the given accuracy
level (20% CV). The ageing of the older fish requires a certain
correction consisting in an increase of the number of specimens
to be sampled from each size group. However if such a correction
is real enough for the 4 year old males and 5 year old females,
the ageing of the older fish will require such an increase of
sampling which seems to be impracticable.

REFERENCES

BAIRD J.W. 1983. A method to select optimum numbers of ageing
in a stratified approach. Can Spec. Publ. and Aquat. Sci.,
66, p. 161-164.

NAFO Secretariat 1986. Notes on NAFO Sampling Program. NAFO SCS
Doc. 86/23, p. 8.

Table 1 "Length-age" key and age composition of silver hake males, 4W, July 1986

Length, cm	Size composition of commercial catch	No. of specimens by age group and length					
		1	2	3	4	5	6
15							
6	+	5					
7	2	5					
8	4	5					
9	7	4					
20	1	5					
1	6	6					
2	6	5	2				
3	4	1	6				
4	4		5				
5	7		6				
6	23		11				
7	45		5	7			
8	67		5	6			
9	88			10			
30	97			10			
1	58			3	2		
2	23			1	5	1	
3	9				6	–	
4	2				3	1	
5	1				1	2	2
6	+						1
Total	460	36	40	37	17	2	3

10988	No. of fish measured	
158	Mean weight of fish, g	

Table 2

"Length-age" key and size composition of silver hake females,

4W, July 1986

Length, cm	Size composition of commercial catch, %	No. of specimens by age group and length							
		1	2	3	4	5	6	7	8
15									
6	1	7							
7	3	6							
8	5	5							
9	5	5							
20	8	5							
1	6	4							
2	5	7							
3	4	3	5						
4	3	1	5						
5	2		6						
6	3		6						
7	7		12	1					
8	17		5	5					
9	34		1	9					
30	71		1	7					
1	95			10	1				
2	102			-	7				
3	78			3	4				
4	41			1	5				
5	22				1	4			
6	14				1	2			
7	6					4			
8	4					7	1		
9	2					2	1	1	
40	1					4	1	-	
1	1					1	4	-	
2	+						-	3	
3	+						2	2	
4	+						-	1	
5	+								
6	+						1		1
7	+								-
8	+								-
9	+								1
50	+								1
Total	540	43	41	36	19	24	11	7	3

12879	No. of fish measured
211	Mean weight of fish, g

Table 3 Coefficients of variation calculated for silver hake

males at the age of 3 and 5

Length, cm	Age 3					Length, cm	Age 5				
	N_i	n_i	n_ip_i	N_iP_i	$VarN_iP_i$		N_i	n_i	n_ip_i	N_iP_i	$VarN_iP_i$
27	4813	10	6	2840	555959	32	2460	5	1	344	145238
28	7166	10	5	3941	1283789	33	963	5	–	–	–
29	9412	10	10	9412	0	34	214	5	1	51	1649
30	10374	10	10	10374	0	35	107	5	2	43	549
31	6203	5	6	3783	1846906						
32	2460	5	1	344	145238						

$$\sum N_ip_i = 30694 \qquad\qquad \sum N_ip_i = 438$$

$$\text{Total variance} = 3831892 \qquad \text{Total variance} = 147436$$

$$\text{CV} = 6.4\% \qquad\qquad \text{CV} = 87.7\%$$

Table 4 Coefficients of variation calculated for silver hake females at the age of 3 and 6

Length, cm	Age 3					Length, cm	Age 6				
	N_i	n_i	$n_i p$	$N_i P_i'$	$VarN_i P_i$		N_i	n_i	$n_i p$	$N_i P_i$	$VarN_i P_i$
27	749	10	1	60	3927	36	1497	5	1	374	82917
28	1818	10	5	909	82628	37	-	-	-	-	-
29	3636	10	9	3272	118984	38	428	5	1	56	4213
30	7595	10	9	6684	576840	39	214	5	1	54	1694
31	10160	10	9	9246	825805	40	107	5	1	21	366
32	10909	5	-	-	-	41	107	5	4	86	366
33	8342	5	2	3587	3409859						
34	4385	5	1	745	538390						

$$\sum N_i P_i = 24503$$

Total variance = 5556433

CV = 9.6%

$$\sum N_i P_i = 591$$

Total variance = 89556

CV = 50.6%

Table 5 Coefficients of variation for catch in numbers

by age calculated according to the above-stated

stratification scheme

Age	Males		Females	
	Number caught	CV (%)	Number caught	CV (%)
1	3304	4.4	3749	2.8
2	9383	14.3	3939	22.6
3	30694	6.4	24503	9.6
4	5337	27.1	21062	13.0
5	438	87.7	3858	14.1
6			591	50.6

Table 6 Amended coefficients of variation for silver hake

males at the age of 4 and 5

Length, cm	Age 4				Length, cm	Age 5			
	N_i	n_i	N_iP_i	$VarN_iP_i$		N_i	n_i	N_iP_i	$VarN_iP_i$
31	6203	15(5)	2419	615635	32	2460	40(5)	344	18155
32	2460	15(5)	1771	78671	33	963	40(5)	-	-
33	963	15(5)	963	0	34	214	40(5)	51	206
34	214	15(5)	163	55	35	107	40(5)	43	69
35	107	15(5)	21	123					

$\sum N_iP_i = 5337$ $\sum N_iP_i = 438$

Total variance = 694484   Total variance = 18430

CV = 15.6%   CV = 31.0%

Table 7 Amended coefficients of variation for silver hake
females at the age.

L e n g t h , cm	N_i	n_i	N_iP_i	Var N_iP_i
36	1497	15(5)	374	26892
37	–	–	–	–
38	428	15(5)	56	1374
39	214	15(5)	54	572
40	107	15(5)	21	126
41	107	15(5)	86	126

$$\sum N_iP_i = 591$$

Total variance = 29090

CV = 28.8%

Table 8 Range of coefficients of variation for each age group

of silver hake males and females at used volume

Age	Males		Females	
	No. in catch	CV (%)	No.in catch	CV (%)
1	1954-3614	3.2-16.3	2023-4021	2.8-16.1
2	5098-12989	9.4-22.6	1558-8389	16.0-22.9
3	19273-36452	3.8-12.2	14175-32015	5.8-17.0
4	1973-8607	13.0-48.0	10861-28885	6.3-27.2
5	27-1382	39.9-346.0	1533-5041	4,5-36.8
6				18.6-130.0

Table 9 Range of amended coefficients of variation for

4-5 year old males and 5-6 year old females

Age	Males		Females	
	n_i	CV (%)	n_i	CV (%)
4	15(5)	7.4-27.7	-	-
5	40(5)	13.8-120.0	15(5)	2.6-21.3
6			40(5)	6.6-45.9