Northwest Atlantic Fisheries Organization

Serial No. N5718 **NAFO SCR Doc. 09/057**

NAFO/ICES *PANDALUS* ASSESSMENT GROUP MEETING – OCTOBER 2009

Comparison of Northern Shrimp Age composition calculated from Length distributions in the EU Survey and from Commercial Samples in 3M Division

by

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Abstract

This document shows the results of Likelihood ratio test for the statistical comparison of northern shrimp growth curves built from length distribution in EU surveys and from commercial fisheries between the years 1994 and 2005 in 3M Division. Although the analysis showed growth differences in the oldest year classes between the two sources of samples, the absence of significant differences since 1994 in the growth curves estimated by EU survey and Commercial fishery would allow us to use the EU survey length distribution to estimate the age composition of the catches carried out by international fleet directed to shrimp fishery in 3M Division.

1. INTRODUCTION

Modal analysis (MacDonald and Pitcher, 1979) was usually conducted in the age assessment from northern shrimp in 3M Division on an individual month by month basis using each nation's catch, for weighting. This analysis provided the mean lengths and proportions at age and sex per month. The mean lengths were converted to mean weights using length weight relationships for the appropriate months to calculate the number caught (Skuladottir, 1997). An average length at age was after calculated for the whole period, weighted by number caught each month and by nation. The mean lengths were then converted to weights using the length weight relationship for April-June. This was said to be the average weight for that particular year at age and sex. However, since 2006, due to the lack of good information about length distributions from commercial fishery, the modal analysis was only conducted on length distributions estimated in the EU survey carried out in summer on Flemish Cap. In the same way, since 2006 the mean weights used in the calculations were estimated from the lengths-weight relationship obtained in the EU survey each year.

As response to NIPAG recommendation from SC Meeting in 2008, the age composition in the fishery calculated from length distribution in the UE survey and from commercial samples was compared when both were obtained.

2. MATERIAL AND METHODS

For the comparison the mean length by age estimated from UE surveys and from commercial fishery since 1994 to 2005 were used (Table 1). The mean length for age groups with low frequencies (age 1 and sometimes ages 2 and 7) were removed from the data set due to the high uncertainty of the estimated values. With the mean lengths by age estimated were built the Von Bertalanffy growth curves from the year class where the data were available (year classes 1991 to 1999) and they were compared by means of Likelihood ratio test following Kimura (1980).

Following Kimura, the general model (6 parameters; one L_∞, K, and t_0 for EU Surveys and Commercial Fishery) and four sub models are fitted to the length and age data using function nonlinear least squares function. The four sub models support the hypothesis where the parameters satisfy some set of linear constraints:

$$\mathbf{L\infty_1=L\infty_2}$$
$$\mathbf{K_1=K_2}$$
$$\mathbf{t_{01}=t_{02}}$$
$$\mathbf{L_{\infty1}=L_{\infty2},\ K_1=K_2,\ t_{01}=t_{02}}$$

For each general model-sub model comparison, likelihood ratios are calculated by using the residual sum-of-squares and are tested against chi-square statistics with the appropriate degrees of freedom. All the statistical analysis was made in R (www.flr-project.org).

3. RESULTS AND DISCUSSION

The table 2 list elements with the likelihood ratio tests comparing von Bertalanffy models. Results of Likelihood ratio test indicate that in 1993, 1994 and 1999 year classes there were significant differences in L_∞ whereas K and t_0 were significantly different in 1993 and 1999. When it was considered the hypothesis that L_∞, K and t_0 were equals in the two source of samples (EU survey and Commercial fishery) only the oldest year classes (1991, 1992 and 1993) show significative differences, a border line significant difference (α= 0.05) in 1994 and 1999 year classes and no significant difference in 1995-1998 year classes. The discrepancies in the 1991-1993 year classes could be due to deficiencies in the sampling and lack of experience of the scientific personal responsible in the first years to measure the shrimp in the UE survey.

These results show that in spite of growth differences found in the oldest year classes, the absence of significant differences since 1994 in the growth estimated by EU survey and Commercial fishery would allow to use the EU survey length distribution to estimate the age composition of the catches carried out by international fleet directed to shrimp fishery in 3M Division.

4. REFERENCES

Kimura, D.K. 1980. Likelihood methods for the von Bertalanffy growth curve. U.S. Fish. Bull. 77(4):765-776.

MacDonald P. D. M.. and T. J. Pitcher 1979. Age groups from size-frequency data: A versatile and efficient method of analysing distribution mixtures. . J.Fish. Res. Board Can. 36: 987-1011.

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Table 1 .- Average length at various ages of northern shrimp length distributions obtained from Commercial fishery and EU survey in 3M Division between 1994 and 2005 years.

Year class	Age	Commercial fishery	EU Survey
1991	3	20.40	17.45
	4	22.20	21.39
	5	26.60	25.25
	6	28.33	26.48
1992	3	20.30	16.58
	4	24.79	23.29
	5	25.56	24.64
	6	26.47	25.94
	7	29.57	28.66
1993	3	21.20	20.63
	4	23.58	22.85
	5	25.52	23.73
	6	26.42	26.09
	7	27.64	27.36
1994	2	15.25	14.44
	3	19.60	18.34
	4	22.64	21.61
	5	23.57	23.94
	6	26.32	25.02
	7	26.93	29.11
1995	3	18.66	18.75
	4	21.70	21.72
	5	23.46	22.77
	6	25.13	25.67
	7	28.25	27.37
1996	2	14.90	14.24
	3	17.91	18.87
	4	20.96	20.71
	5	23.01	23.12
	6	25.69	24.99
	7	27.88	28.72
1997	2	14.49	14.48
	3	17.83	17.70
	4	20.93	20.87
	5	23.58	23.72
	6	26.01	26.05
1998	2	13.16	14.43
	3	17.78	17.60
	4	21.02	21.30
	5	24.25	23.27
	6	26.45	26.69
	7	26.90	26.40
1999	2	15.23	14.19
	3	18.78	18.94
	4	21.40	21.07
	5	23.07	24.10
	6	26.24	24.04

Table 2.- Likelihood ratio tests comparing von Bertalanffy parameter estimates for EU survey samples (1) and commercial fishery (2) northern shrimp, based in table 1.

Year classes	$L_{\infty 1}=L_{\infty 2}$	$K_1=K_2$	$t_{01}=t_{02}$	$L_{\infty 1}=L_{\infty 2}$, $K_1=K_2$, $t_{01}=t_{02}$
1991	0.76	0.71	0.35	0.01
1992	0.43	0.40	0.20	0.03
1993	0.03	0.03	0.04	0.00
1994	0.04	0.06	0.21	0.05
1995	0.58	0.62	0.72	0.74
1996	0.92	1.00	1.00	0.97
1997	0.32	0.37	0.58	0.34
1998	0.69	0.47	0.24	0.42
1999	0.01	0.01	0.01	0.04