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The growth and mortality of alewife (*Alosa pseudoharengus*) from the New England area

by

N.P. Puzhakov
AtlantNIRO
Kaliningrad, USSR

SUMMARY

The calculation of growth parameters by Bertalanfy's equation together with the assessment of the total instantaneous mortality rate for alewife are the main subjects of the presented paper. The growth parameters of alewife estimated according to Bertalanfy's equation are as follows:

L_{∞} = 32.42; K =0.21; t_o=-2.14 SD=±4.7% - for linear growth

W_{∞} = 373.25; K=0.23; t_o=-1.91 SD=± 7.2% - for wighted growth

Total instantaneous mortality rate (Z) = 0.50

INTRODUCTION

Though the fishery for alewife in the West Atlantic has a long history of about one hundred years the data on the dynamics of abundance of this species are rather scarce. General evidence on the biology and distribution of alewife is contained in the papers by Nitzel and Stanek (1966), Edsall (1970). In the present paper the calculation of growth parameters by Bertalanfy's equation and the assessment of the total instantaneous mortality rate of the species studied are given.

MATERIAL AND METHOD

For estimation of growth equation parameters according to Bertalanfy, the data on length-age composition of alewife cathes obtained in 1972 and 1973 were used. The data for these years are represented by monthly samples and clearly demostrate the dynamics of length-age composition of the stock. The volume of analysed material is given in table 1.

Table 1

The volume of analysed material

Years	Area	Specimen numbers	
		By length	By weight
1972	5	310	290
1973	5	1040	980

To estimate the linear and weighted growth parameters of the individuals with age the following growth equations of Bertalanfy were used:

$L_t = L_{\infty} (1 - e^{-K(t-t_o)})$ for linear growth,

$W_t = W_{\infty} (1 - e^{-K(t-t_o)})$ for weighted growth, where

L_t, W_t are the length and weight at age t, L_{∞}, W_{∞} are the mean theoretical maximum length and the weight which can be reached by the species in given conditions;

e - the base of natural logarithm;

K is a coefficient showing the growth rate;

t_o is the age at which the organism has a zero length, zero weight.

A comparative estimate of accuracy between the observed values and calculated ones was determined by:

$$SD = \pm \sqrt{\frac{\sum_{t=1}^{n} (D_t\%)^2}{n-2}} \quad \text{where}$$

D_t is the difference between the observed and calculated data for the year in percentage

n - the number of freedom degrees.

The parameters of growth equations were calculated according to Hohendorf (Hohendorf, 1966).

Total mortality rate was estimated by the formula of Beverton and Holt (Beverton and Holt, 1957)

$$Z = \frac{K\,(L_\infty - \bar{l}\,)}{\bar{l} - l'} \quad \text{where}$$

l' is the minimum length of the fish represented in the samples;

$\bar{l}$ is the mean length estimated for the fish of length l or greater.

Besides, the total mortality was determined by the formula of Tauti (Tauti, 1947) and Kurita (Kurita, 1948).

$$Z = \frac{1}{\bar{t} - t'} \quad \text{where}$$

t' is the youngest age represented in the samples taken from the catches, $\bar{t}$ is the mean age represented in the samples taken from the catches.

RESULTS OF STUDIES

Basing on the data on mean lengths of alewife, the parameters of growth equation were estimated (table 2). The substitution of those in Bertalanfy's equation gave:

$L_t = 32.42\ (1 - e - 0.21(t+2.14)$.

The calculation of theoretical values of linear growth and the comparison of those values with the observed data showed that the percentage of the mean error of estimated values (SD) was small and constituted 4.7%.

The weighted growth is given in table 2. The weight estimates calculated by Bertalanfy's equation agree with the observational data. The percentage of the mean error of the weight estimates like that of linear growth is also small - 7.2 %. The value of growth rate parameter (K= 0.21) confirms the mean growth rate of alewife. The parameter of weighted growth rate (K=0.23) is the value of the same order as that of linear growth.

The estimate of the mean theoretical maximum length (L_{∞} = 32.42), K, and of the mean length (l_{mean}) for the periods of 1972-1973, made it possible to assess the total instantaneous mortality rate of alewife by an integral method of Beverton and Holt, z = 0.50.

Table 2

Mean length and weight of alewife estimated from the observational and calculated data and the degree of accuracy of the latter

Age, years	length (cm)		weight (g)	
	observed	calculated	observed	calculated
1	16.8	15.6	48.4	43.9
2	20.3	18.8	86.2	76.8
3	22.6	21.4	129.0	117.6
4	23.8	23.3	148.6	151.4
5	25.0	25.3	181.4	191.1
6	26.1	26.6	222.4	221.4
7	27.0	27.6	253.8	245.3
8	28.0	28.5	280.1	272.1
9	29.2	29.2	299.0	290.1
10	30.7	29.8	324.0	310.3
Estimated parameters	L_{∞} = 32.42	K=0.21	W_{∞} = 373.25	K=0.23
	t_o=-2.14	SD=±4.7%	t_o=-1.91	SD=±7.2%

Total instantaneous mortality rate estimated from the data on age composition constitutes 0.56.

The composition of the estimates of total mortality rate obtained as a result of calculations using mean length (Z = 0.50) and mean age (Z=0.56) showed that the difference between the values is not considerable.

CONCLUSIONS

1. The equation of Bertalanfy reflects the regularities in the alewife growth with sufficient accuracy. The estimates obtained theoretically well agree with the observed data. The parameter of growth rate, K=0.21, confirms the mean growth rate of alewife.

2. The coefficient of total instantaneous mortality of alewife in the New England area in 1972-1973 appeared to be 0.50.

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