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A note concerning ICNAF Res.Doc. 75/12 "A note on a possible source of bias in the estimation of mean length at age"

by

W.G. Doubleday
Environment Canada
Biological Station
Fisheries and Marine Service
St. Andrews, N.B., Canada

Introduction:

ICNAF Res. Doc. 75/12, A note on a possible source of bias in the estimation of mean length at age, by M. D. Nicholson and D. W. Armstrong discusses a simulation study showing that the mean length at age of fish in a sample stratified by length may differ from the corresponding mean length at age in the catch sampled. This bias can be removed if the sampling fractions for the length strata (i.e. the number of fish of length i on the stratified sample/ the number of fish at length i in the random sample) are taken into consideration in the estimates.

Analysis:

Consider a landing of N fish with X_{ij} fish having length i and age j. Then the mean length of age j fish in the landing is

$$\bar{L}_j = \frac{\sum_i i X_{ij}}{\sum_i X_{ij}}. \text{ If a simple random sample of } n \text{ fish is taken from the}$$

landing with n_i fish of length i and a stratified subsample of k_i fish is taken from each length group i , let the number of fish in the stratified sample at length i and age j be y_{ij} .

Then $\hat{L}_j = \frac{\sum_i n_i y_{ij}/k_i}{\sum_i n_i Y_{ij}/k_i}$ is almost unbiased estimate of

\bar{L}_j . Observe that the mean length at age j , $\hat{L}_{j\text{ran}}$ in the random sample is an unbiased estimator of \bar{L}_j . The expected numerator of \hat{L}_j , for given random sample is $\hat{L}_{j\text{ran}}$ times the number of fish at age j in the random sample. The expected value of the denominator is the number of fish at age j in the random sample. For a given random sample, \hat{L}_j , therefore has a slight positive bias in estimating the mean length at age j $\hat{L}_{j\text{ran}}$ in the random sample, because \hat{L}_j is a ratio estimator (Cochran 1963). It follows that \hat{L}_j is an almost unbiased estimator of \bar{L}_j over all random samples.

References:

Cochran, W. G. 1963. Sampling Techniques, second edition.

Wiley, New York.

Nicholson, M. D. and D. W. Armstrong, MS, 1975. A note on possible source of bias in the estimation of mean length at age

ICNAF Res. Doc. 75/12.