Pauly, D. 1985. On improving operation and use of the ELEFAN programs. Part 1: avoiding "drift" of K toward low values. Fishbyte 3(3):13-14

ON IMPROVING OPERATION AND USE OF THE ELEFAN PROGRAMS. PART I: AVOIDING "DRIFT" OF K TOWARDS LOW VALUES

by

Daniel Pauly
ICLARM
P.O. Box 1501
Makati, Metro Manila
Philippines

At the Conference on the Theory and Application of Length-Based Methods in Stock Assessment (see Fishbyte Vol. 3(1): 5-12) held in Sicily, in February 1985, a number of suggestions were made for the improvement of the ELEFAN programs (particularly ELEFAN I) which neatly complement conclusions based on our own experience with these programs.

This article is the first of a planned series of contributions to appear in Fishbyte in which improvements for the programs will be proposed along with hints on how to use them for optimum output.

A basic understanding of the operation and terminology of the ELEFAN 0, I and II programs is assumed of the reader, who, by modifying their listings and use of the ELEFAN 0, I and II along the lines suggested in this series, will be able to upgrade their version of the ELEFAN program to what may be called "post-Sicily", or "second-generation" versions. A second generation, CP/M version, of ELEFAN 0, I and II, with detailed users guide will be soon issued at the Institut fuer Meereskunde, Kiel, Federal Republic of Germany; another such version is the graphics-oriented HP 86/87 programs developed by Saeger and Gayanilo (1985, see Fishbyte vol 3(2): 13-14).

This series with suggestions for upgrades appears necessary, because the "ELEFAN Book" we had planned to publish this year will be delayed, probably by about 1 year.

The first issue addressed in this series is a problem which should have been solved long ago. It concerns the feature, discussed in the user's instructions for ELEFAN I, that in some cases, the "best" estimates of the parameter K (of the von Bertalanffy growth equation) will "drift" toward lower and lower values, while the ESP/ASP ratio keeps increasing, up to and way beyond values of ESP/ASP = 1 (Fig. 1).

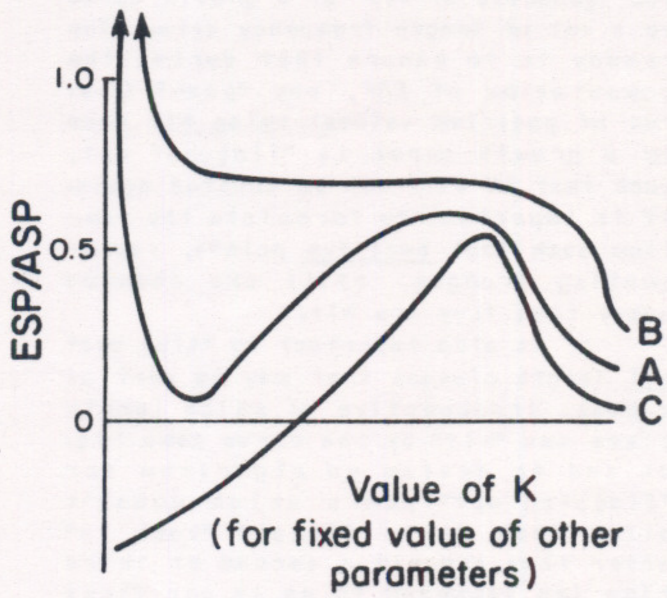

Fig. 1. Schematic representation of three types of response (= ESP/ASP values) obtained for given values of K, fixed values of the other parameters (L_∞, C, WP) and a given set of length-frequency data.

A) Response as usually obtained using unmodified ELEFAN I; note that (1) best estimate of K is obtained from local optimum of ESP/ASP, not from overall maximum, which occurs at very low values of K; (2) local optimum is flat-topped, and hence provide K estimate of low precision.

B) Response as obtained in some (too frequent) cases: maximum occurs at very low value of K, and there is no local optimum within the range of K value that would be considered reasonable. Hence, for most initial values of and step size for K, "best estimates" will drift toward unreasonably low values of K, and ESP/ASP will increase beyond unity.

C) Response after correction of routine for computation of ESP. Note that (1) ESP/ASP values will be generally lower, (2) very low values of K will always correspond to *negative* values of ESP/ASP, (3) "best estimates" of K will correspond to a peak that is better defined (sharper) than previously (4) which represent the system *maximum*. Note finally that (5) "best estimates" of K will be usually higher than in case A, and hence (partly) correct for a downward bias in K estimates.

The reason for this deficiency of the original version of ELEFAN I is simple; it is due to the fact that "peaks" (i.e. positive point values in the restructured samples) are counted more than once during the computation of ESP, which may happen a very large number of times, depending on the structure of the available length frequency data.

Correcting this is straightforward, as is also the redefinition of the ESP/ASP as an improved measure of the "goodness of fit" of a growth curve to a set of length frequency data. The remedy is to ensure that during the computation of ESP, any "peak" (i.e. run of positive values) being hit once by a growth curve is "flagged" out, such that it will not be counted again. It is important to formulate the routine such that negative points, representing troughs, still are counted every time they are hit.

It is also important to "flag out" all length classes that may be part of a peak, irrespective of which length class was "hit" by the curve (see Fig. 2) and to devise an algorithm for "flagging out" peaks which doesn't allow them to be flagged "back in" after they are hit a second or third time (as happened to us in our first attempt to implement this modification).

Implementing this suggestion in your version of ELEFAN I will have the following effects on its output:

i) The value of ESP/ASP, now being properly defined will never exceed unity (in fact it will usually be lower than before the change), and will be extremely low (i.e. negative) when unrealistically low values of K are entered.

ii) Optimum values of K (i.e. values associated with highest ESP/ASP ratio) will be easier to identify.

iii) The value of K estimated in (ii) will usually be higher than estimated without the improvement, thus compensating (at least in part) for the tendency of ELEFAN I to underestimate K (and overestimate L_∞, see below).

Two papers based on simulation studies presented by A. Rosenberg and J. Beddington, and by J. Hampton and J. Majkowski at the abovementioned conference showed that ELEFAN I has a tendency to underestimate K and overestimate L_∞. The modification of the ELEFAN I program suggested here helps alleviate the downward bias in K estimates.

In the next issue of Fishbyte various approaches by which overestimation of L_∞ can be countered will be presented. The third contribution in this series will show how to account for gear selection and again help toward reducing (or eliminating) the downward bias in the estimation of K.

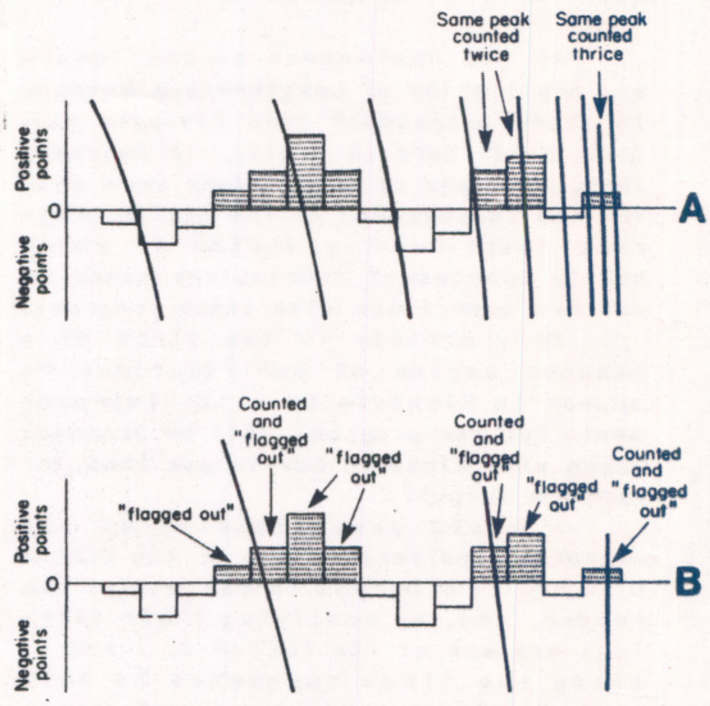

Fig. 2. Schematic representation, for a given "restructured" length-frequency sample of length classes counted and/or "flagged out" in computation of ESP (solid lines represent hypothetical growth curves).

A) Uncorrected version: peaks can be counted repeatedly, which results in low value of K (i.e., numerous "year classes" are presumed to exist).

B) Corrected version: peaks can be counted only once, which results in higher value of K (i.e., each peak is assumed to represent one year class and is not counted again if it indeed consists of more than one year class).