

On Improving the Resolution of the Recruitment Patterns of Fishes

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Abstract

It is proposed that the "recruitment pattern" routine of the ELEFAN II program can be modified to allow, in addition to length-frequency data, the use of "restructured" data files. An example, based on *Oreochromis niloticus* in Lake Itasy, Madagascar, is given to show that this results in recruitment patterns that have less temporal spread and hence better reflect the actual seasonality of recruitment.

Introduction

The concept of "recruitment pattern" for fish populations has been developed by Pauly (1982) to show that length-frequency (L/F) distributions can be used to obtain, via the ELEFAN II program, rough estimates of the relative proportion of a population which is recruited every month of the year, i.e., to provide information on the number and duration of breeding seasons.

To be most useful, however, these recruitment patterns should reflect (1) the breeding activity of fishes as assessed by conventional methods, e.g., monthly variations of the gonadosomatic index or direct field observations of breeding activity, etc., but (2) also take account of the fact that fish recruitment occurs (after a delay) over a period that is shorter than the spawning season.

Recruitment patterns are obtained by back-projecting, onto the time axis, by means of a single set of growth parameters (Pauly 1982) a set of length-frequency data. The problem here is that the individual fish of a given population always have different growth parameters, and that assuming the contrary leads to an exaggerated spread of the recruitment pattern (Fig. 1), a phenomenon also documented in detailed analyses of outputs of the ELEFAN II

program, which contains the routine in question (Isaac 1990).

Gonad studies, or field studies of the reproductive behavior of fish also suggest a longer recruitment season than actually occurs, albeit for a different reason: in this case, this is because survival of larvae hatched near the onset or near the end of the spawning season is much less than the survival of larvae hatched in the midst of that same spawning season (Philippart 1977; Moreau 1980, 1982).

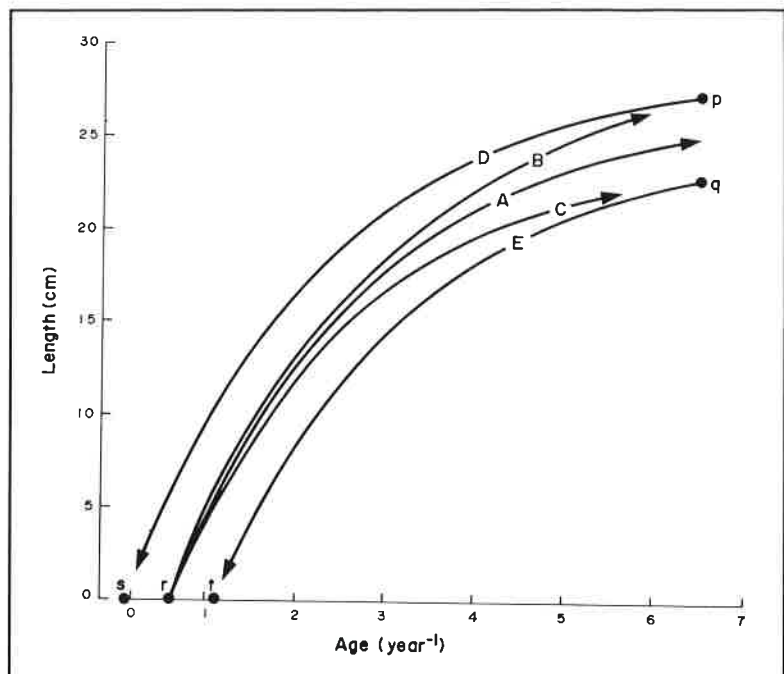


Fig. 1. An example of the process which generates the exaggerated spread of the recruitment pattern produced by ELEFAN II:

Curve A: $L_{\infty} = 27$ cm, $K = 0.45$ year⁻¹, projected forward from point r;

Curve B: $L_{\infty} = 30$ cm, $K = 0.40$ year⁻¹, projected forward from point r;

Curve C: $L_{\infty} = 34$ cm, $K = 0.50$ year⁻¹, projected forward from point r;

Curve D: same as A, but backprojected from point p;

Curve E: same as A, but backprojected from point q.

As might be seen, the backprojection of the length-frequency data generated by a mixture of growth types (A, B, C) will widen an apparent recruitment period (from points s to t) originally limited to a single point (r).

The task, thus, when only length-frequency data are available, is to modify the recruitment pattern routine of ELEFAN II such that it generates recruitment patterns that are narrower than those produced using the original routine. This is the aim of this note.

Materials and Methods

The information used on the seasonal pattern of gametogenesis in both sexes of *Oreochromis niloticus* in Lake Itasy, Madagascar, was taken from Moreau (1979), who also provided the relevant growth parameter estimates: $L_{\infty} = 46.4$ cm, $K = 0.181$ year⁻¹, $t_0 = -0.81$ year. Simultaneous L/F data were obtained by beach seining at different times of the year. They are available on request from the first author.

Computations of recruitment patterns have been performed using the version of ELEFAN II included in the package of Brey and Pauly (1986), both in its original version and after modifications and additions, as follows:

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203 : IF LEFT $(D2$, 3) = "SXY" THEN GOTO 5 000
550 FOR I2 = 1 TO N2 IF A0 (I1, I2) < 0 THEN A0 (I1, I2) = 0
5000 INPUT # 1, N1, N2, M1, M2, S1, NA, Ng, NC
5010 FOR I1 = 1 TO N1 : INPUT # 1, AM (I1), AD (I1)
5020 FOR I2 = 1 TO N2 : INPUT # 1, AM (I1, I2) : NEXT : NEXT
5030 GOTO 250.
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This modification allows use of "restructured" files (see Pauly and David 1981) instead of the original L/F data when constructing a recruitment pattern.

Results and Discussion

Fig. 2 presents a typical set of results. As might be seen, the recruitment pattern obtained after restructuring is narrower than that based on the original length-frequency data. This is due to *negative* values in the restructured files (corresponding to troughs in the original L/F data) being added to the months outside of the recruitment season. However, this change generates a pattern which is not as narrow as the seasonal pattern of change of "breeding activity", i.e., the percentage of females laying eggs spontaneously when handled.

Still, using a set of restructured L/F data allows one to obtain a picture of the recruitment pattern which is narrower than without restructuring. Thus, this picture will describe the annual recruitment pattern in a way that will generally be in better agreement with information on the reproduction cycle of the studied fish than the original recruitment pattern routine. Since

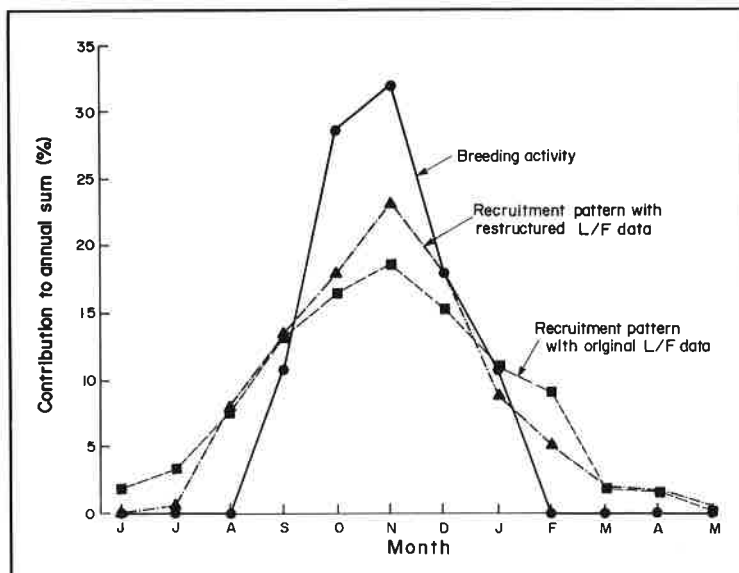


Fig. 2. Showing the match between three methods for documenting the seasonality of reproduction in fishes (here *Oreochromis niloticus* in Lake Itasy, Madagascar). Note that both types of recruitment patterns are less "peaked" than the variations of "breeding activity" (= percentage of females laying eggs spontaneously when handled) but that construction of the recruitment pattern with restructured length-frequency (L/F) data leads to a better resolution than when using the original L/F data.

this improvement, however slight, can be achieved without additional data having to be available, it is proposed that the option be provided in future versions of the Compleat ELEFAN, and/or in FiSAT^a, to select an original file or a restructured file for the construction of recruitment patterns.

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^aSee p. 47 for a brief presentation of FiSAT.