Problems in Estimating Growth Parameters of the Wahoo *Acanthocybium solandri* (Scombridae) Using the ELEFAN I Program

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Abstract

Plots of R_n, the goodness-of-fit index of the ELEFAN I program *versus* K can be used jointly with fixed values of the other growth parameters to identify "optimum values" of K. This is here illustrated using data on wahoo (*Acanthocybium solandri*, Fam. Scombridae) from St. Lucia, West Indies.

Introduction

The ELEFAN system of programs was developed in response to the need for robust methods of length-frequency analysis as well as the availability of cheap microcomputers (Pauly 1987). It is claimed (Gayanilo et al. 1988) that if properly used, "with well-sampled data, this package can be used to perform, reliably, most types of assessments for which length-frequency data are needed".

In St. Lucia, there is a cycle of landings of the wahoo *Acanthocybium solandri* (Scombridae) (Fig. 1), with the season extending from mid-November to the end of the following July (Murray 1989). This species, during the pelagic season, is landed at most of the fish landing sites around St. Lucia and sold in quantity to the St. Lucia Fish Marketing Corporation (FMC) through its outlets at the major landing sites. The landings of wahoo represent some 14% of total estimated fish landings during 1988.

This paper, which follows up on Murray and Sarvay (1987), considers a specific approach which can be used in conjunction with the Compleat ELEFAN program package of Gayanilo et al. (1988) for estimating von Bertalanffy growth parameters in cases where the available length-frequency data do not cover the young, fast-growing fishes. A subsidiary aim was to reassess previous otolith-based estimates of growth parameters in *A. solandri* (Murray 1989) now thought to be erroneous.

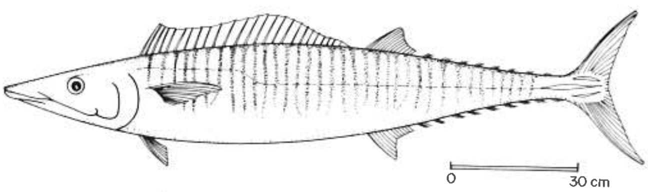

Fig. 1. *Acanthocybium solandri* (Cuvier 1831), after Collette (1984).

Methods

Length-frequency data were collected at the FMC during 1987 and 1988 (Murray 1989), and by Department of Fisheries (DOF) data collectors at Dennery between December 1988 and mid-June 1989. The data were arranged in 4 cm class intervals on a monthly basis and pooled to form an "artificial year" (Table 1).

The average of the estimates of L_∞ and K presented by Murray and Sarvay (1987), i.e., L_∞ = 158.5 cm (fork length) and K = 0.35 $year^{-1}$, were used to derive a preliminary length-converted catch curve, from which probabilities of capture were estimated which were used to correct the data in Table 1 for the effect of gear selection and/or incomplete recruitment.

The data in Table 1 lack the young fishes from which growth parameters can be securely inferred and we thus opted to estimate only one growth parameter (K) from these data, leaving L_∞ fixed at 158.5 cm, and setting C = 0 (i.e., ignoring seasonal growth oscillation).

Further, to illustrate the uncertainties involved in the analysis of such data, we opted to scan, in small

Table 1. Length-frequencies of wahoo *(Acanthocybium solandri)* from St. Lucia used for determination of growth parameters. (Data from December 1988 to June 1989).

FL (cm)	Jan	Feb	Mar	Apr	May	Jun	Dec
44	0	0	0	0	0	0	1
48	3	0	0	0	0	0	1
52	0	0	0	0	0	0	2
56	0	0	0	0	0	0	2
60	5	0	0	0	0	0	4
64	10	3	0	0	0	0	14
68	6	5	0	0	0	0	5
72	0	3	0	0	0	0	1
76	24	7	1	0	0	0	6
80	6	12	9	0	0	0	1
84	16	18	10	1	2	2	2
88	31	52	99	48	18	5	4
92	8	23	55	9	10	0	0
96	9	34	107	19	15	3	4
100	5	32	85	12	13	3	2
104	1	18	62	7	37	1	0
108	5	10	41	20	51	1	1
112	0	10	23	7	19	1	1
116	3	9	12	3	4	1	0
120	0	2	12	1	4	0	0
124	0	2	6	0	0	0	0
128	1	1	5	2	1	0	0
132	0	1	4	1	1	0	1
136	0	1	1	0	1	1	0
140	0	1	0	0	0	0	0
144	0	0	1	0	0	0	0
148	0	0	0	0	0	0	0
152	0	0	0	0	0	0	0
156	0	0	0	1	0	0	0

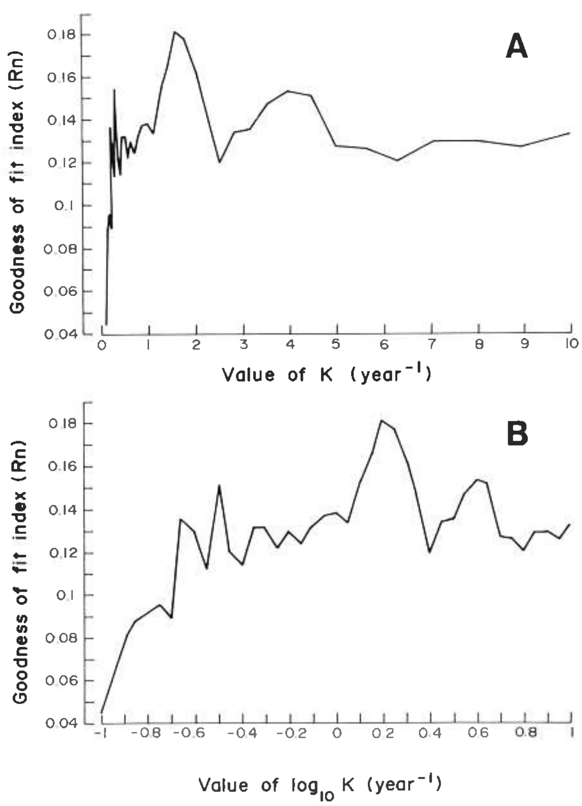

Fig. 2. Plots of R_n *vs* the corresponding value of K (for $L_\infty = 158.5$, C = 0 and data of Table 1). A. Linear scale of K (note difficulty in interpreting left half of curve). B. Log scale of K (note ease of identifying peaks).

steps, a wide range of values of K, such as to identify the value of K associated with the highest value (peak) of the goodness of fit index R_n, as well as a number of subpeaks.

Results and Discussion

Fig. 2A shows the plot of R_n *vs* K obtained here, while Fig. 2B shows essentially the same plot, but with a $\log_{10}$ scale for K.

As might be seen, these plots show that the maximum R_n value is associated with $K \approx 1.6$, while secondary peaks are associated with K = 0.22, 0.32 and 4 $year^{-1}$.

The logic of ELEFAN I implies that one should pick from such graphs the value of K associated with the highest R_n value. However, this logic assumes that the highest R_n value, being based on well-sampled, representative data, is part of a well-defined, *unique* peak. The low quality of the data analyzed here - especially the lack of small, fast-growing fishes in Table 1 - led, however, to a number of peaks, from which no reliable inference can be made.

However, one of the peaks identified here suggests a value of K = 0.32 $year^{-1}$, close to the values of K = 0.34-0.37 $year^{-1}$ reported in Murray and Sarvay (1987). If this range included the "real" value of K, this would confirm the study of Rosenberg and Beddington (1987) which pointed out that "ELEFAN I has the potential to produce accurate estimates because the scoring function often (but not always) contains a *local maximum* near the true value" (emphasis added).

However, this doesn't imply that accurate growth parameter estimates for wahoo are now available. Rather, this contribution points out the need to obtain better data on this species, both in terms of otolith readings and in terms of length-frequency distribution.

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