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A SIMPLE METHOD FOR COMPARING THE GROWTH OF FISHES AND INVERTEBRATES

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When studying the growth of tropical fishes and invertebrates, the question of validation of growth parameters estimates often arises, due to the lack of reliability of some of the methods used in obtaining such estimates.

One possible approach is the comparative approach, which has the additional advantage of allowing, in certain cases, for inferences on the growth of the fish or invertebrates of a given stock, given the growth characteristics of closely related animals.

In fishes and invertebrates whose growth can be described by the von Bertalanffy growth function (VBGF), the comparison of growth performance is facilitated by the feature, demonstrated empirically and on theoretical grounds by Pauly (1979) that for related animals, double logarithmic plots of the coefficient of growth, K, against the asymptotic weight, W_∞ are linear with a slope of 2/3. Thus,

$$\log_{10} K = \phi - 0.67 \log_{10} W_\infty \qquad 1)$$

and hence

$$\phi = \log_{10} K + 0.67 \log_{10} W_\infty \qquad 2)$$

The implication of the constant slope (0.67) is that the differences in the growth performance of different organisms are reflected solely in the value of the y-axis intercept, ϕ, which may be viewed as the (theoretical) value of K that would occur in fishes and invertebrates with a W_∞ value of 1 unit of mass (Munro, in press).

Fig. 1 shows the frequency distribution of values of ϕ for different stocks of a number of species of fishes (for which W_∞ is expressed in grams). As can be seen, the use of equation (2) to estimate ϕ from published growth parameters for various stocks of the species produces distributions of ϕ values that are essentially normal (bell-shaped), and rather sharply peaked, suggesting that equation (1) indeed describes the interrelationship of K and W_∞ in those fishes whose growth can be described by the von Bertalanffy growth function (VBGF).

The relationship expressed in (1) and (2) can also be used to characterize the animals of a given family. Figure 2 shows examples of the frequency distributions of ϕ for species of mesopelagic Myctophids, penaeid prawns, reef dwelling serranids and tropical scombrids. Here too, the distributions are quite sharply peaked and cover a relatively narrow range which immediately suggests that the growth parameter estimates which produce the values of ϕ at the upper or lower limits of the distributions should be checked (e.g., the single estimate of ϕ = 3.3 in the Scombridae).

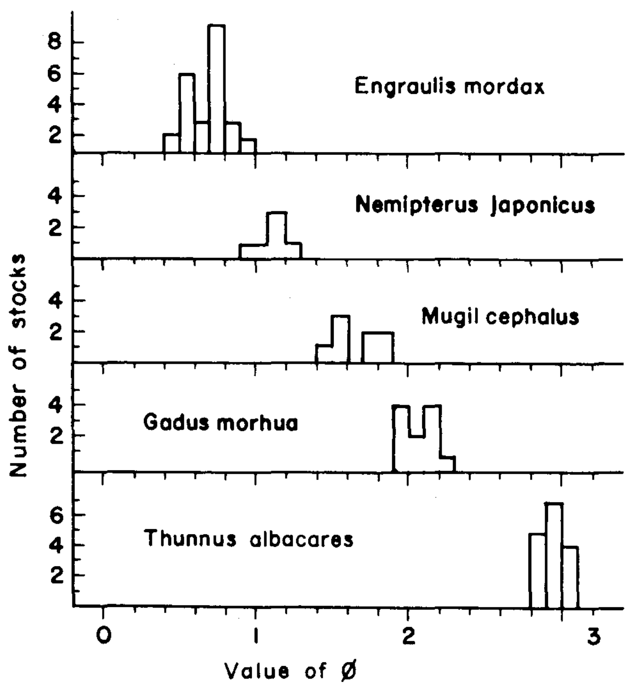

Fig. 1. Frequency distributions of values of ϕ for species for which growth parameter estimates are available for a number of stocks (based on data in Pauly 1979, and Huang and Yang 1974).

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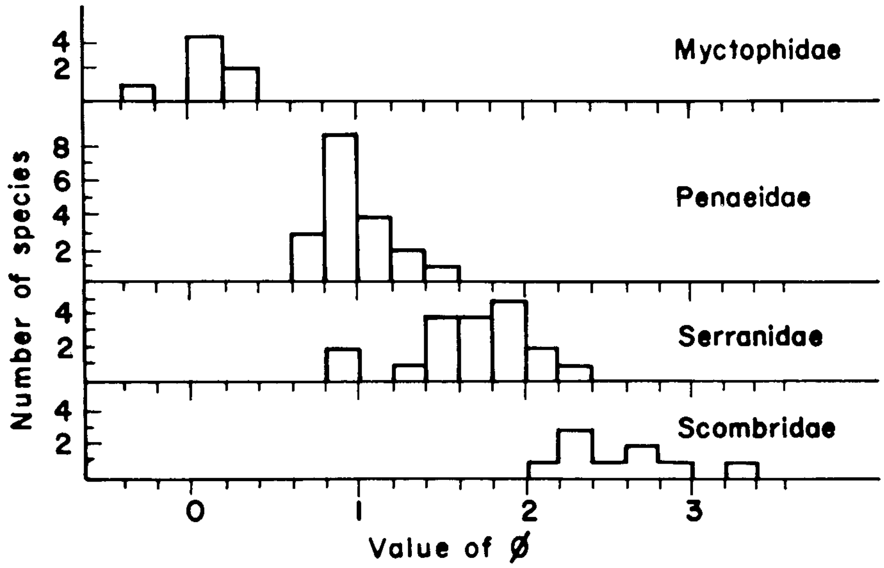

Fig. 2. Frequency distributions of values of ø for species of meso-pelagic Myctophidae, benthic Penaeidae, reef-dwelling Serranidae and tropical pelagic Scombridae (based on data in Pauly (1980), Pauly et al. (in press) and Munro (in press).

It also appears to be possible to obtain estimates of K in those species or families whose range of ø values is known, if the asymptotic weight can be estimated. (One way of estimating W_∞ is to use the relationship

$$W_{max}/0.86 = W_{(\infty)} \qquad 3)$$

in which W_{max} is the largest animal observed in a given stock and $W_{(\infty)}$ distinguishes a preliminary estimate of asymptotic length from one (coded W_∞) which was obtained by fitting the VBGF to growth data).

For example, applying equation (1) to tropical scombrids, which have an overall ø range of 2 to 3, the median value of ø = 2.5 in conjunction with equation (1) will provide a value of K = 1.08 for an asymptotic weight of 5,000 g and of K = 0.233 for an asymptotic weight of 50,000 g.

Finally, it is likely that the value of ø represents and quantifies the energetics of a given habitat or niche because ø is directly related to growth performance and hence metabolism and food consumption.

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