

Age and Growth of *Pimelodella pappenheimi* (Siluriformes, Pimelodidae) from an Atlantic Forest Stream in Southern Brazil

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ABSTRACT

Studies were performed to determine the growth curves in length and weight for *Pimelodella pappenheimi* in the “das Pombas” stream, a coastal stream susceptible to the flash flood phenomenon. Samples were collected from September-95 to February-97, monthly, using electric fishing. The fishes were measured in total length and weight. A total of 156 pairs of otoliths were taken for ring reading. The Ford-Walford transformation allowed the use of von Bertalanffy expression. The pale ring formation was annual, and it occurred during the summer and the autumn. This species grows in length according to $L_t = 15.86 (1 - e^{-0.57(t+0.1551)})$ equation and in weight according to $W_t = 24.23 (1 - e^{-0.57(t+0.1551)})^{3.12}$. The increase in length was faster until the second year of life, whereas the increase in weight was more noticeable between the first and fourth years of life.

Key word: Growth, Coastal Stream, Pimelodidae.

INTRODUCTION

The variable conditions of freshwater streams must have played a decisive role in the selection of flexible features, like fecundity, age at first maturation, and longevity, for example, so that the populations that live in those systems could be adjusted to the instability of the habitat (Mann *et al.*, 1984). This heterogeneity makes these environments excellent models of studies in populations' life histories and are useful for the understanding of the adaptative mechanisms to different environmental conditions.

The life histories of fish are strongly influenced by biotic and abiotic features of the environment. Several authors have demonstrated the capacity of the fish assemblage in adapting its population dynamic to the local conditions (*e.g.* Kramer, 1978; Lobon-Cervia *et al.*, 1991). Considering the life history that characterises the ecology of fish, the study of growth can aid a lot in the understanding of the population structure and dynamic as a whole.

The rate of an individual's growth depends on the energy obtained by it and how this energy is used. The periods in which growth is slow are registered in some bony structures, as opaque rings, that are a result of a larger deposition of minerals. The periods in which growth is more accelerated correspond to hyaline areas in these structures. The periodicity of the ring formation is generally associated to seasonable factors, being the temperature a factor of larger prominence (*e.g.* Lagler *et al.*, 1962), or as a result of internal and external processes simultaneously (*e.g.* Nikolsky, 1963). In tropical areas, where temperature variations are less strong, it has been more difficult to identify the responsible factors for the periodicity of ring formation. In these situations, it is important to study the possible parameters that should be acting in the formation of rings in these populations. Lagler *et al.* (1962) mentioned the droughts as main factors of the periodicity of growth in tropical waters. Other authors related the formation of rings with the spawning (*e.g.* Gurgel & Barbieri, 1991).

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There are few studies related with the growth of Pimelodidae fishes. Gurgel & Barbieri (1991), defined the age and growth for *Rhamdia branneri*; Fenerich *et al.* (1975) worked with *Pimelodus maculatus*, Nomura *et al.* (1972) with *Pimelodus clarias*, and Trajano (1991) with a troglobitic catfish *Pimelodella kronei*. The biology of *Pimelodella pappenheimi* was studied in relation to the feeding and space occupation (Aranha *et al.*, *in press*) and to the reproductive strategy (Amaral *et al.*, *in press*).

This paper aimed at of estimating the growth of *Pimelodella pappenheimi* in the “das Pombas” stream. More specifically, the objectives were to define the length-weight relationship and estimate the growth in length and in weight, defining its growth curves.

MATERIALS AND METHODS

In the “das Pombas” stream (Basin of the “Guaraguaçu” river, Municipal district of Paranaguá-PR, Fig 1), monthly samples were collected between September/95 and February/97, with electric fishing. Approximately 15 fishes a month of *P. pappenheimi* were measured in total length (centimeters), weighed (milligrams) and dissected.

In laboratory, we chose individuals of various sizes to remove the Lapillus otoliths pair.

The length-weight relationship was initially obtained for males and females separately, by the expression $W_t = a \cdot L_t^b$, by the minima square method. The straight lines estimated for males and females were compared to each other by the interval of confidence of the straight line (95% of confidence) estimated for all the contained data. These straight lines were obtained by the logarithmic transformation of the data. Using this methodology analysis was made if the straight lines obtained for males and females separately were contained in the interval of confidence for the straight line obtained for both sexes together. In case they were contained, it was considered that there were no differences between the equations of the straight lines of males and females. Otherwise, the sexes should necessarily be analysed separate.

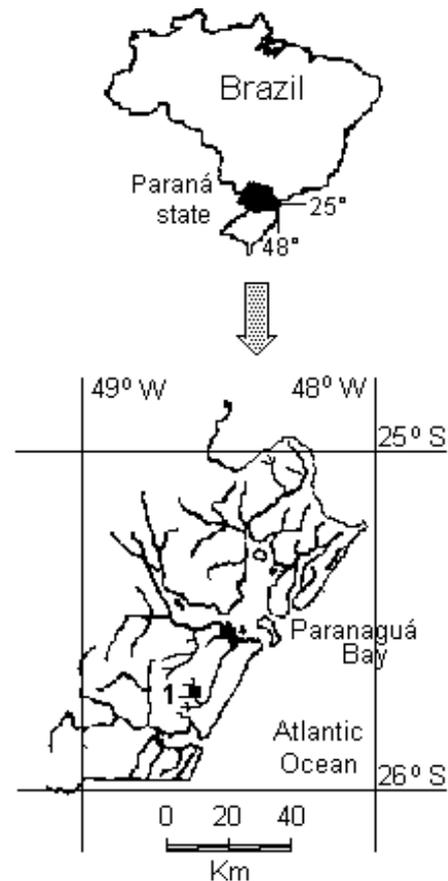


Figure 1. Map of Paraná coast showing “das Pombas” stream (1).

Otoliths from small, medium and large size fishes were washed with water and detergent. These were immersed in xylene for clarification and observed in glycerine in order to read the rings. The material was observed on dark bottom, under stereoscopic microscope with reflected light. The reading of the rings was made according to Jones & Hynes (1950). The graphic of the segments was built according to the methodology proposed in Vazzoler (1981). The data were grouped in quarters and the number of rings was determined considering the formation of opaque rings. The Ford-Walford transformation was used according to Vazzoler (1981). The growth curve in length was obtained by the von Bertalanffy expression $L_t = L_\infty [1 - e^{-k(t-t_0)}]$. The growth curve in weight was obtained from the length-weight relationship associated to the expression of the curve of the growth in length $W_t = W_\infty [1 - e^{-k(t-t_0)}]^b$.

RESULTS

The length of males ranged from 3.6 cm to 14.8 cm; and for females it ranged from 4.4 cm to 15.0 cm. The minimum and maximum values of total weight for the males were respectively 0.299 g and 16.853 g whereas for females, 0.388 g and 21.450 g.

The analysis of the length-weight relationship for males and females did not present differences, as the straight lines were in the same interval of confidence (Table I). This made it possible to analyse of the length-weight relationship for both sexes together, as represented in Figure 2.

We took out 156 pairs of otoliths: 35 with zero opaque rings, 56 with one ring, 61 with two rings, and 4 with three rings. The formation of the ring was annual, occurring between summer and autumn.

The Ford-Walford transformation ($r^2=0.97$) allowed the use of von Bertalanffy model. The individuals grew in length according to the expression $Lt = 15.86 [1 - e^{-0.5782(t+0.1551)}]$ represented graphically in Figure 3. The growth in weight was according to the expression $Wt = 24.23 [1 - e^{-0.5782(t+0.1551)}]^{3.12}$, represented in Figure 4.

Table I. Minimum and maximum weight values (Ln Wt) of the interval of confidence of the length-weight relationships for both sexes together, and the values obtained by the length-weight relationship for each sexes. (Min.= Minimum; Max.= Maximum)

Ln Lt	Both Sexes		Alone Sexes	
	Min.	Max.	Female	Male
1.0	-2.2503	-2.3686	-2.3301	-2.2955
1.2	-1.6352	-1.7337	-1.7026	-1.6727
1.4	-1.0198	-1.0989	-1.0743	-1.0499
1.6	-0.4041	-0.4646	-0.4461	-0.4270
1.8	0.2125	0.1689	0.1821	0.1958
2.0	0.8314	0.8001	0.8103	0.8186
2.2	1.4558	1.4258	1.4385	1.4414
2.4	2.0863	2.0454	2.0667	2.0642
2.6	2.7195	2.6623	2.6950	2.6871
2.8	3.3538	3.2781	3.3232	3.3099

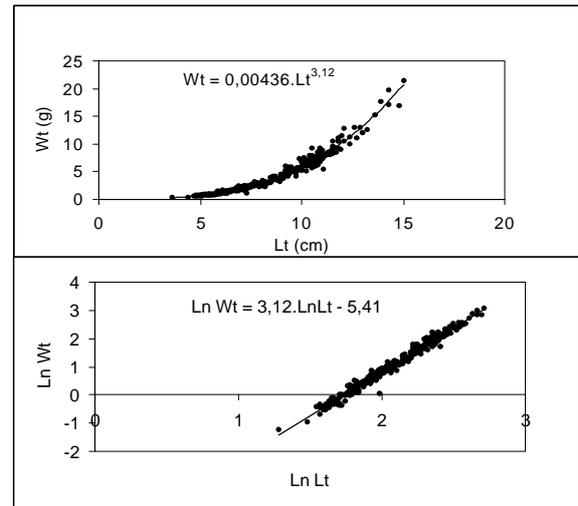


Figure 2. Length-weight relationship of *Pimelodella pappenheimi* in the “das Pombas” stream. Above, empirical data of weight and length values, and under it, straight line obtained by logarithmic transformation of the data.

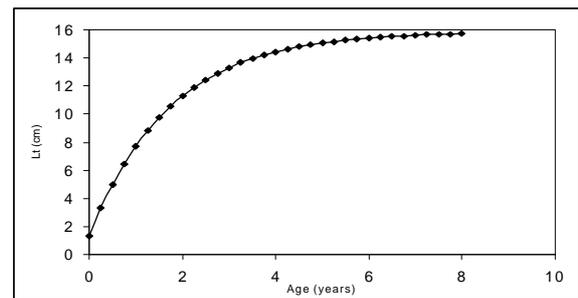


Figure 3. Growth curve in length of *Pimelodella pappenheimi* in the “das Pombas” stream.

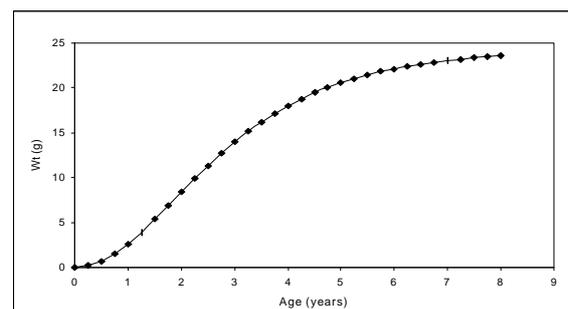


Figure 4. Growth curve in weight of *Pimelodella pappenheimi* in the “das Pombas” stream.

DISCUSSION

Pimelodella pappenheimi in the “das Pombas” stream, did not present difference in the length-weight relationship for males and females. For

this reason, the data of *P. pappenheimi* were analysed considering the sexes together, differing from the analysis of the *Rhamdia branneri* data (Gurgel & Barbieri, 1991), in which the sexes were analysed separately.

Even though analysed only 156 pairs of otholits, (against 977 pairs of otholits by Gurgel & Barbieri, 1991 and 1321 vertebrae by Agostinho *et al.*, 1991). Even so, we obtained a high value for the coefficient of determination (r^2), which was a strong evidence that the data were representative, and this allowed the application of von Bertalanffy expression. Besides that, collected samples in streams must be certainly smaller than those obtained in large rivers, as in the researches mentioned above. In streams, the populations are smaller and the individuals' excessive capture could be harmful for the whole community.

The period of formation of the rings coincides with the end of the reproductive period of the species (Amaral *et al.*, *in press*). However, we believe that the strong environmental changes at the end of the summer, as flash floods changing the assemblage and the food availability, should be determining the formation of rings.

The growth curves demonstrated that *P. pappenheimi* grew faster than *Rhamdia branneri*, whose growth was verified by Gurgel & Barbieri (1991). *P. pappenheimi* presented rate of growth of 0.57, whereas in *Rhamdia branneri*, it was 0.21 for females and 0.28 for males. It was observed that the growth in length of *P. pappenheimi* was more accentuated until the second year of life, becoming slower in the following years, while the growth in weight was more accentuated between the first and the fourth years of life.

The values obtained for L_{∞} and W_{∞} were very close to the values found for the biggest fishes collected in the "das Pombas" stream. It is a reason for reliability in the data.

Vazzoler (1971), reported that there was a relationship between the values of K, longevity, and L_{∞} . The individuals in which the growth was faster (K is high), the longevity was shorter and the maximum lengths reached were smaller too.

This can be verified when *P. pappenheimi* was compared with the troglotic *Pimelodella kronei* (Trajano, 1991). *P. pappenheimi*, presented $K=0.57$, its asymptotic length was 15.86 cm and the species lived until approximately four years. *P. kronei*, whose $K=0.0898$; presented $L_{\infty}= 15.4$ cm and lived approximately from 10 to 15 years.

In unstable environment, it was important that the species develop tactics to survive and to leave offspring. *Pimelodella pappenheimi* presented fast growth and development. These tactics were of great importance for species with a short life period. The fast development leads to facts as, for example, a great swimming capacity in young, and precocious reproduction. The species in subject reproduced early, its length at the sexual maturation was 6.3cm (Amaral *et al.*, *in press*), which corresponded to individuals of approximately one year of life.

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RESUMO

O crescimento de uma espécie é um mecanismo adaptativo da população em relação às características e às variações do meio ambiente. Este trabalho visa determinar as curvas de crescimento em comprimento e peso de *Pimelodella pappenheimi* no rio das Pombas, um rio costeiro sujeito a trombas d'água frequentemente. As coletas foram mensais de setembro/95 a fevereiro/97 usando pesca elétrica. Os peixes foram medidos no comprimento e peso total. Foram retirados 156 pares de otólitos para leitura dos anéis de crescimento e foi utilizada a expressão de von Bertalanffy. A formação dos anéis é anual e ocorre entre o verão e o outono. *P. pappenheimi* cresce em comprimento de acordo com a expressão $L_t=15.86 (1-e^{-0.57(t+0.1551)})$ e em peso

conforme a expressão $W_t = 24.23 (1 - e^{-0.57(t+0.1551)})^{3.12}$. O aumento no comprimento é maior até o segundo ano de vida enquanto o aumento em peso é maior entre o primeiro e o quarto ano de vida.

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