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SHORT COMMUNICATION

Length-weight relationship of two fish species from a dryland intermittent river in northeastern Brazil

Relação peso-comprimento de duas espécies de peixes em um rio intermitente no nordeste do Brasil

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Abstract

Given the context of high hydrological uncertainties and stress in dryland streams, the evaluation of length-weight relationships and condition factors of fish becomes of chief concern for the understanding of these systems. Length-weight relationships were estimated for two fish species, *Astyanax fasciatus* (Cuvier 1819) and *Astyanax bimaculatus* (Linnaeus 1758), from temporary pools in a dry river bed. Length-weight relationship information was compared between dry and rainy seasons. Sampling was performed using gillnets, manual trawls and cast nets at different reaches of the river. Estimates for the values of *b* of the length-weight relationship were 2.63 for *A. fasciatus*, and 2.78 for *A. bimaculatus*, indicating a negative allometric growth. The condition factor ranged between 0.0180 and 0.0187 for both species, without significant difference between seasons, and meaning a greater investment in growth rather than weight gain. Results indicated that fishes tended to be larger during the rainy season, likely representing the result of a higher frequency of immature and smaller individuals during the previous dry season as a consequence of reproductive activity of adults.

Keywords: *Astyanax fasciatus, Astyanax bimaculatus,* temporary pools, condition factor.

Resumo

Dado o contexto de *stress* hídrico e alta variabilidade temporal em rios de regiões secas, o entendimento da relação peso-comprimento e fator de condição de peixes se apresenta como importante mecanismo para a compreensão desses sistemas. Relações peso-comprimento foram estimadas para duas espécies de peixes, *Astyanax fasciatus* (Cuvier 1819) e *Astyanax bimaculatus* (Linnaeus 1758), em poças temporárias de um rio intermitente. A relação peso-comprimento é comparada entre as estações seca e chuvosa. A amostragem foi realizada usando redes de espera, arrastos manuais e tarrafas em diferentes trechos do rio. Estimativas para os valores de *b* da relação peso-comprimento foram de 2,63 para *A. fasciatus* e 2,78 para *A. bimaculatus*, indicando crescimento alométrico negativo. O fator de condição variou entre 0,0180 e 0,0187 para ambas as espécies, não apresentando diferença sazonal significativa, dessa forma indicando maior investimento em crescimento em vez de ganho de peso. Os resultados indicaram que os peixes tendem a ser maiores durante a estação chuvosa, provavelmente decorrente de uma maior frequência de indivíduos juvenis e imaturos durante a estação seca precedente, causada por maior atividade reprodutiva dos adultos.

Palavras-chave: *Astyanax fasciatus, Astyanax bimaculatus,* poças temporárias, fator de condição.

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The intensification of water resource development is a threat to the natural flow patterns and the ecological integrity of rivers and streams in dry lands (Williams, 1999). Efforts to preserve natural patterns of fish diversity and their population dynamics in these systems are often hampered by limited scientific information on population structure and their responses to the high natural hydrological variability (Balcombe *et al.*, 2006).

The study of the length-weight relationship of fishes provides not only a measure of the expected weight change for the length of an individual or group of individuals but also an indication of the welfare or overall condition of an individual or population (Le Cren, 1951). Since fish nutritional status and/or spending reserves are a reflection of their relationship with the environment, length-weight relationships and condition factors of populations constrained in harsh habitats, such as temporary pools in dryland river beds, are of great importance (Medeiros and Maltchik, 2001).

Given the context of high hydrological uncertainties and stress presented by dryland intermittent streams, the evaluation of length-weight relationships and condition factors of fishes becomes of chief concern for the understanding of these systems, and the knowledge on fish population dynamics in intermittent streams. The present study estimates the length-weight relationship and condition factor of the species *Astyanax fasciatus* and *Astyanax bimaculatus* from temporary pools in a dry river bed.

This study was conducted in the Paraíba River basin, which is a dryland intermittent river in northeastern Brazil. The climate is semiarid (BS'*h* hot and dry) with temperature and annual precipitation averages of 26°C and 600 mm, respectively. Rivers and streams in this area are distinctive landscape features that cross a dry and shrubby deciduous open forest, the Caatinga. For much of the time there is a network of dry courses of sand and/or pebbles, with occasional strings of temporary and ephemeral pools scattered in the river bed (Maltchik and Medeiros, 2006).

Sampling was performed in three temporary pools at different reaches of the Paraíba river (P1: 7°23'0"S; 36°34'24.4"W, P2: 7°43'29.7"S; 36°34'9.3"W and P3: 7°31'20.8"S; 36°1'29.8"W) (Figure 1), during the rainy (June) and dry (October) seasons of 2010. During the study period, these pools were not connected to each other since there was no major flooding in the catchment basin. Despite decreasing in size between June and October, these pools did not dry out during the study period. Sampling occurred at the same pools on both seasons. Samples were taken during daylight hours, using different sampling gear (gillnets 10 m long, mesh sizes 25, 35 and 45 mm), manual trawls (20 m long, 2.5 m height, mesh size 10 mm; and 4 m long, 2 m high, mesh size 5 mm), and cast nets (2 m height, mesh sizes 12 mm) according to the methodology used by Medeiros *et al.* (2010). Fishes were treated with 4% neutral formalin and transferred to the laboratory for biological measurements after being preserved in 70% ethanol. Fishes were collected under license no. 23348-1 IBAMA/SISBIO. Representative specimens of populations of each species are deposited at the Ichthyological Collection of Universidade Federal da Paraíba under the numbers UFPB 5972; 6016; 6029; 6060; 6178 (*A. bimaculatus*), and UFPB 5721; 5726; 5734; 5772; 5796 (*A. fasciatus*).

Total weight (TW) and total length (TL) were determined for each specimen. TL was measured to the nearest millimeter and TW determined with 0.01 g accuracy. The length-weight relationship (LWR) was expressed according to the mathematical equation $TW=aTL^b$, where: TW is the total weight of the individual; TL is the total length; *a* is the linear coefficient and *b* is the angular coefficient (Froese, 2006). Subse-

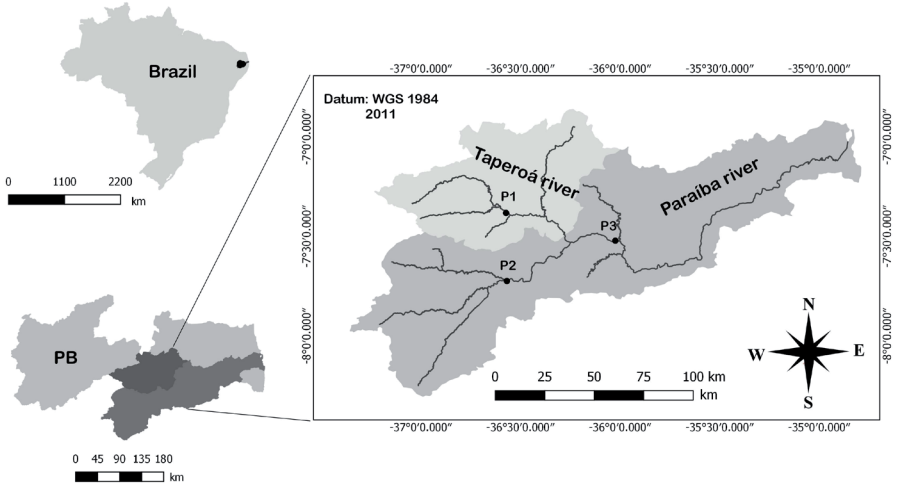

Figure 1. Study area and location of sampled pools in the Paraíba river basin, Paraíba, northeastern Brazil.

quently, the confidence level (95% CL) for the *b* parameter was determined. The condition factor (K) was obtained by the expression $K=W/L^b$ (allometric condition factor), where *b* is estimated by LWR after logarithmic transformation and setting by the method of least squares (Bolger and Connolly, 1989). Significance of differences in K or fish size between species or seasons were tested using student's t-test ($\alpha=0.05$) for equality of variances not assumed by the log-transformed data (Sheridan and Lyndall, 2001).

In this survey, 1650 individuals of two species were examined for calculation of the LWR (Table 1), *A. fasciatus* being more abundant with 65.9% of the fish caught. The range of lengths analyzed during the present study was usually below minimum and maximum values reported in other works, indicating greater frequency of larger individuals, commonly above 6 cm SL (Benedito-Cecilio *et al.*, 1997; Oliva-Paterna *et al.*, 2009; Gaspar *et al.*, 2012). Shorter overall length in the present study is likely the result of reproductive activity and spawning in the pools (Medeiros and Maltchik, 2000) rather than recruitment from other areas since there was no connection between the study pools and other river reaches due to lack of flooding. There were significant differences in length between seasons (t-test, $t_{A.bimaculatus}= 4.2$;d.f.= 519.7;$p<0.001$, $t_{A.fasciatus}= 3.8$;d.f.= 150.1;$p<0.001$), with individuals being larger during the rainy season on average. This is in accordance with other studies for intermittent streams that report a higher frequency of immature and smaller individuals during the dry season. These pools have been recognized as important breeding sites for several species (Medeiros and Maltchik, 2000), where reproductive activity seems to be triggered by flooding during the previous wet phase (Alkins-Koo, 2000). Despite that, predation cannot be disregarded as another factor limiting greater length in the study species since larger predator fishes, such as *Hoplias malabaricus* (Bloch 1794), have been reported for drainages in semi-arid Brazil (Silva *et al.*, 2010).

The LWR was significant ($p<0.05$) for both species and seasons (Figure 2), with an angular coefficient (*b*) of 2.6 for *A. fasciatus* and 2.8 for *A. bimaculatus*. According to Froese (2006), the values of *b* are expected to range between 2.5 and 3.5 with the values observed in the present study indicating a negative allometric growth ($b<3$) for both species. This means a greater investment in growth rather than in weight gain. A negative allometric growth has been attributed to young individuals (Nomura, 1975; Vazzoler, 1996; Carvalho *et al.*, 2008), as is the case of the present study. None of the species showed significant statistical difference in condition factor between the seasons (t-test, $t_{A.bimaculatus}= 4.5$; d.f.= 558.5; $p=0.651$, $t_{A.fasciatus}= 1.3$; d.f.= 182.2; $p=0.195$). Since most fishes evaluated in this study were below the expected size of first maturity (Agostinho *et al.*, 1984; Fontoura *et al.*, 2009), seasonal variation in the condition factor should be minimal.

This study provides important LWR on two congeneric species of fishes in a highly variable ecosystem, subject to various degrees of natural disturbances and human management. This information is useful to managers and conservationists as comparison with perennial or other temporary environments and helps further understanding the population dynamics of the study species.

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Table 1. Length-weight relationship and statistical parameters for two species of fishes from a dryland intermittent river, Paraíba River, northeastern Brazil.

	Total length (cm)				Total weight (g)			*Regression parameters*				
Species	**N**	**Min**	**Max**	**Average±SD**	**Min**	**Max**	**Average±SD**	***a***	***b***	**95% CL *b***	***R²***	K
A. fasciatus	1088	1.3	9.3	2.80±1.00	0.06	8.68	0.38±0.69	0.032	2.632	2.579-2.686	0.898	0.0181
Dry season	951	1.3	8.2	2.74±0.89	0.06	8.68	0.34±0.55	0.031	2.591	2.532-2.657	0.886	0.0180
Rainy season	137	1.7	9.3	3.24±1.51	0.06	4.68	0.69±1.26	0.040	2.723	2.619-2.829	0.933	0.0187
A. bimaculatus	562	1.2	9.0	3.28±1.29	0.03	8.86	0.74±1.07	0.035	2.784	2.741-2.829	0.932	0.0186
Dry season	327	1.5	9.0	3.10±1.30	0.07	8.86	0.66±1.01	0.031	2.781	2.723-2.844	0.928	0.0186
Rainy season	235	1.2	8.2	3.55±1.23	0.03	7.52	0.86±1.15	0.047	2.777	2.716-2.848	0.951	0.0185

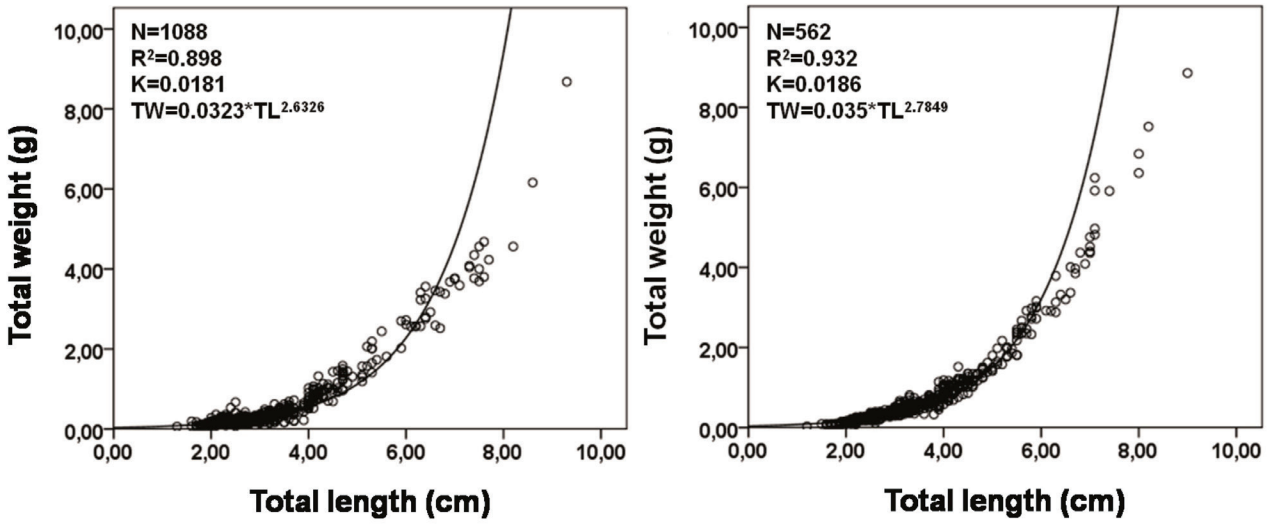

Figure 2. Length-weight relationship of *A. fasciatus* (left) and *A. bimaculatus* (right) from a dryland intermittent river, Paraíba River, northeastern Brazil.

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