Notas Científicas

Morphometric and allometric relations of cage-reared Iguaçu surubim

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Abstract – The objective of this work was to evaluate the morphometric and allometric relations of Iguaçu surubim (*Steindachneridion melanodermatum*) cultivated in net cages. One hundred and twenty specimens were cultivated at a density of 50 fish per square meter in three 6 m³ net cages. Fish were fed three times a day with commercial feed. Thirty fish were evaluated at 60, 120, 180, and 360 days of cultivation as to the variables: total body, head, clean trunk, viscera, skin, and fin weight; total, standard, and head length; and head and body height. The Iguaçu surubim shows later development of the clean trunk and early development of the other body parts.

Index terms: *Steindachneridion melanodermatun*, body weight, development, processing, weight class, yield.

Relações morfométricas e alométricas do surubim-do-iguaçu cultivado em tanques-rede

Resumo – O objetivo deste trabalho foi avaliar as relações morfométricas e alométricas do surubim-do-iguaçu (*Steindachneridion melanodermatum*) cultivado em tanques-rede. Cento e vinte espécimes foram cultivados em densidade de 50 peixes por metro quadrado, em três tanques-rede de 6 m³. Os peixes foram alimentados três vezes ao dia com ração comercial. Foram avaliados 30 peixes aos 60, 120, 180 e 360 dias de cultivo quanto às variáveis: peso total do corpo, da cabeça, do tronco limpo, das vísceras, da pele e das nadadeiras; comprimento total, padrão e da cabeça; e altura da cabeça e do corpo. O surubim-do-iguaçu apresenta desenvolvimento tardio de tronco limpo e precoce das demais partes corporais.

Termos para indexação: *Steindachneridion melanodermatun*, peso corporal, desenvolvimento, processamento, classe de peso, rendimento.

The Iguaçu surubim (*Steindachneridion melanodermatum*) was considered at risk of extinction for many years, which lead to repopulation programs in the region and to studies on the development of farming systems for this species (Feiden et al., 2006b). It has high growth potential, excellent meat quality, high market value, and is an interesting alternative to leverage the development of regional fish farming (Feiden et al., 2006a). However, its morphometric and allometric relations are still unknown.

According to Santos et al. (2001), allometric studies explain quantitative differences in the various animals life stages and can be used to assess body development traits. In addition, the morphometric variables of fish are useful to evaluate yield characteristics of different body parts (Meyer, 2009; Karachle & Stergiou, 2012) and can be used for the selection of species with potential for cultivation and processing for human consumption purposes (Cadrin, 2000; Kalayci et al., 2007). These parameters vary widely between different animals and are directly related to the size, shape, and dimensions of the body and to their respective relations throughout the developmental process (Santos et al., 2007).

The knowledge on the morphometric and allometric parameters of a species allows to elaborate new strategies on the industrialization and utilization of related residues and to improve the understanding of its biological characteristics.

The objective of this work was to evaluate the morphometric and allometric relations of Iguaçu surubim (*Steindachneridion melanodermatum*) cultivated in net cages.

The experiment was conducted at the Centro de Difusão de Desenvolvimento Tecnológico do Rio Iguaçu, which is a branch of the Grupo de Estudos de Manejo na Aquicultura (Gemaq), in the municipality of Boa Vista da Aparecida, PR, Brazil, from January to December, 2001.

A total of 900 Iguaçu surubim fingerlings, with approximately 60 days of age, average initial weight of 6.77±3.25 g, and average initial length of 8.34±1.63 cm, were distributed in three cages with volume capacity of 6 m³ at a density of 50 fish per square meter. The fish were fed ad libitum with commercial feed composed of different diets, offered at different time slots during the experiment. The diets contained: 48% crude protein (CP) and 4,000 kcal of gross energy (GE) per kg of animal feed during the first 60 days of cultivation; 40% CP between 60 and 180 days of cultivation; and 36% CP between 180 and 360 days of cultivation. This feed management was used due to the variation in the nutritional requirements of fish during development.

The averages of water physical and chemical properties, such as pH, electrical conductivity, dissolved oxygen, and transparency, were 7.78, 31.0 μS cm^{-1}, 8.7 mg L^{-1}, and 2.70 m, respectively. These parameters are suitable for tropical fish farming (Sipaúba-Tavares et al., 2003).

Thirty fish were collected and transported in rectangular containers, with 500 L capacity and constant aeration, to the laboratory at Gemaq, at 60, 120, 180, and 360 days of cultivation, for the evaluation of the morphometric and allometric relations. Fish were numbed in ice, and measurements of total weight, total length, head length, head height, head weight, body height, visceral weight, visceral fat weight, and clean trunk weight were recorded. These measurements were compared with fish total weight and total length to determine growth in the different body parts and their relations with fish body yield. Allometric evaluations between weight and length and the different body parts were performed according to Ricker (1973).

Data were subjected to homogeneity and normality tests, and to analysis of regression. When significant differences were observed, Tukey's multiple comparison test, at 1% probability, was applied. Data were analyzed using the SAS software (SAS Institute, Cary, NC, USA).

Regression analysis showed lower incorporation rate of fat and viscera and greater clean trunk weight in fish with 360 days of rearing than in those with 180 days (Table 1). At 60, 120, and 180 days of cultivation, there was a lower incorporation rate of fat and viscera and a larger clean trunk in fish subjected to a longer rearing period. The obtained results indicate that the growth of the Iguaçu surubim is slow and its productivity is low.

Morphometric parameters showed that the Iguaçu surubim has excellent characteristics for processing as a consumable product. Significant reductions were observed in head, viscera, and visceral fat weight, along with increases in clean trunk weight. The Iguaçu surubim presented early development of the head, visceral fat, viscera, and skin; however, a late growth of the trunk. Farmed fish with an early development of the trunk must be slaughtered earlier than fish with a later development, which must remain in cultivation for a longer period of time (Santos et al., 2007). This indicates that, to achieve high meat yields, the Iguaçu surubim should be slaughtered after a long cultivation period.

The proportional increase in weight and the percentage of the clean trunk in relation to fish development are desirable features in farmed fish (Silva et al., 2009) and are correlated to increased meat yield (Power et al., 2007). It was observed that, in this species, the development of the different body parts was proportional to the growth in weight; however, the development in length of these same body parts was smaller than the development in weight.

The instantaneous growth rate ranged from 1.42 to 0.10 in fish cultivated from 60 to 360 days, respectively. However, the regression equation of the allometric weight-length relation indicated annual growth rate of 0.95. Growth through the weight-length relation revealed that this species exhibits negative allometric development with a coefficient of 2.59. Similarly, the growth in weight of the different body parts of Iguaçu surubim, in the different phases of

the cultivation period, showed negative heterogonic growth (Figure 1), except for clean trunk weight, with heterogonic development. Since the negative heterogonic relationship of the different body parts presented by this species was directly correlated to the increase in weight in the clean trunk, which showed a positive heterogonic relationship during development, the Iguaçu surubim stands out as a potential species for cultivation, processing, and production of good quality fish meat.

The Iguaçu surubim shows later development of the clean trunk and early development of the head, viscera, and visceral fat. In general, it also presents excellent characteristics for cultivation and processing.

Table 1. Bodily parameters of Iguaçu surubim (*Steindachneridion melanodermatum*) cultivated in net cages[(1)].

Evaluated parameters	Evaluation time points				CV	p
	60 days	120 days	180 days	360 days	(%)	
Average total weight (g)	101.66d (±15.24)	238.97c (±34.08)	366.27b (±49.92)	441.53a (±59.13)	15.19	<0.0001
Average total length (cm)	18.89d (±0.98)	25.41c (±1.98)	29.29b (±1.30)	33.87a (±1.19)	5.76	<0.0001
Average standard length (cm)	16.55d (±0.78)	22.17c (±1.55)	25.96b (±1.72)	29.48a (±0.92)	5.84	<0.0001
Head height (cm)	2.00d (±0.30)	2.58c (±0.28)	2.94b (±0.22)	3.34a (±0.21)	10.26	<0.0001
Head length (cm)	4.99d (±0.31)	6.17c (±0.45)	6.77b (±0.46)	7.48a (±0.35)	6.48	<0.0001
Body height (cm)	3.59c (±0.49)	4.59b (±0.54)	5.57a (±0.62)	5.04ab (±0.74)	12.72	<0.0001
Head weight (g)	23.90d (±3.16)	43.47c (±6.37)	66.96b (±8.86)	85.57a (±11.75)	14.97	<0.0001
Viscera, skin, and fin weight (g)	25.87c (±4.03)	44.02b (±6.86)	68.64a (±13.84)	72.84a (±11.02)	18.30	<0.0001
Eviscerated body weight (g)	53.80d (±8.50)	134.68c (±27.29)	232.97b (±43.49)	274.27a (±37.89)	19.36	<0.0001
Visceral fat weight (g)	10.22c (±2.12)	21.71b (±4.81)	27.04a (±4.43)	23.55ab (±7.01)	23.33	<0.0001
Rate of length relative to weight (%)	18.88a (±2.13)	10.75b (±1.02)	8.08c (±0.76)	7.76c (±0.76)	11.49	<0.0001
Rate of head height relative to weight (%)	2.00a (±0.34)	1.10b (±0.15)	0.81c (±0.11)	0.77c (±0.09)	17.32	<0.0001
Rate of head height relative to length (%)	10.60 (±1.48)	10.20 (±1.09)	10.06 (±0.82)	9.87 (±0.67)	11.09	<0.1135
Rate of body height relative to weight (%)	3.56a (±0.35)	1.93b (±0.18)	1.53c (±0.12)	1.15d (±0.16)	10.72	<0.0001
Rate of body height relative to length (%)	18.98a (±2.03)	18.97a (±1.78)	18.06a (±1.57)	14.88b (±2.15)	10.49	<0.0033
Rate of head length relative to weight (%)	5.00a (±0.69)	2.61b (±0.27)	2.07c (±0.23)	1.55d (±0.14)	14.09	<0.0001
Rate of visceral weight relative to weight (%)	25.67a (±3.45)	18.45b (±1.70)	18.73b (±2.56)	16.58b (±2.06)	12.62	<0.0001
Rate of head weight relative to total weight (%)	23.68a (±2.29)	18.20b (±1.28)	18.43b (±2.42)	19.45b (±1.65)	9.61	<0.0001
Rate of the clean trunk relative to total weight (%)	52.91c (±2.38)	56.00bc (±6.69)	64.11a (±12.36)	62.14ab (±2.74)	11.94	<0.0007
Rate of visceral fat relative to total weight (%)	10.11a (±1.87)	9.04a (±1.31)	7.47b (±1.39)	5.32c (±1.32)	18.01	<0.0001
Daily growth (g)	1.69b (±0.25)	1.99a (±0.57)	2.03a (±0.83)	1.23c (±0.31)	14.46	<0.0001

[(1)]Means±SD followed by equal letters, in the rows, do not differ by Tukey's test, at 1% probability.

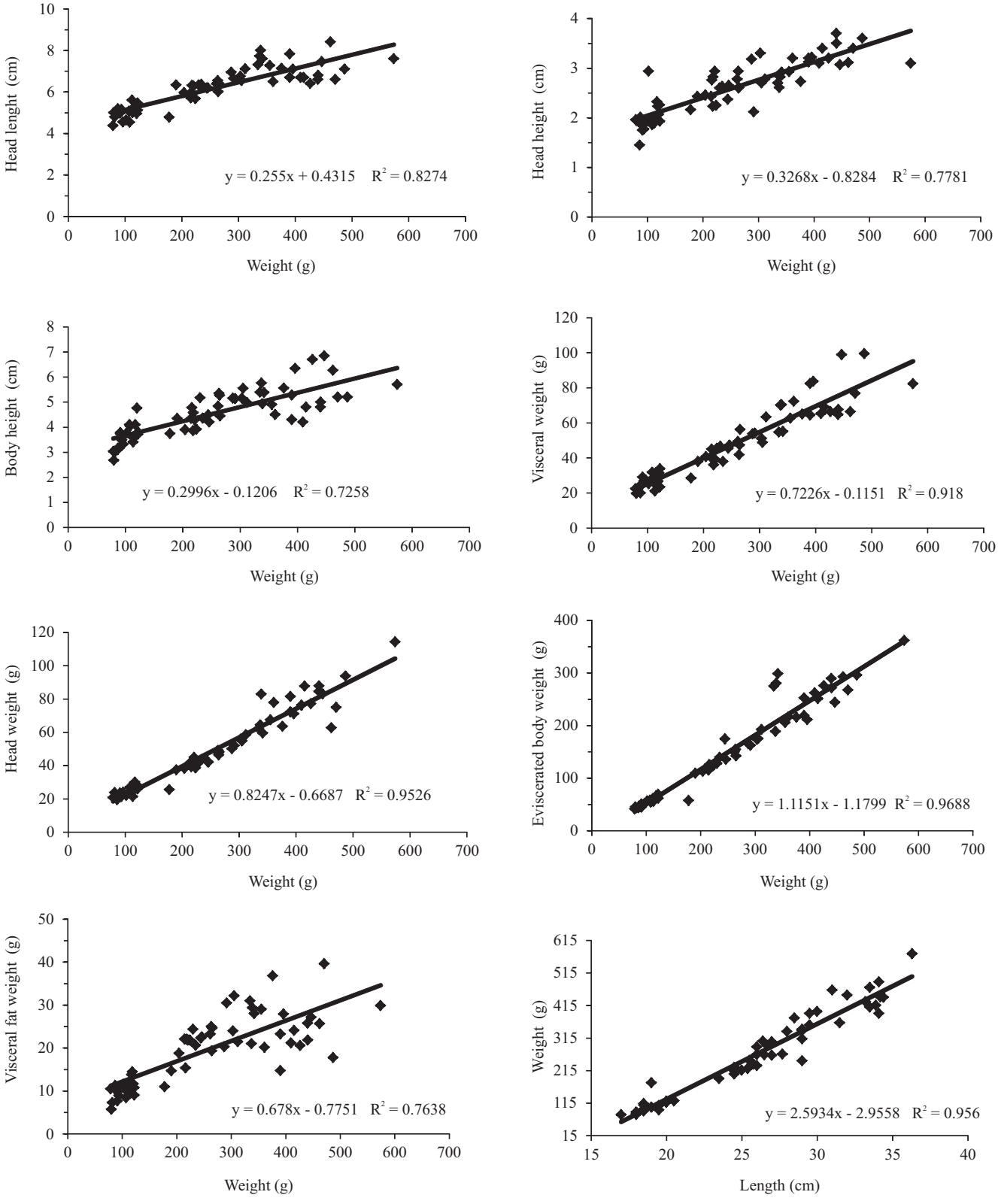

Figure 1. Allometric relations of Iguaçu surubim (*Steindachneridion melanodermatum*) cultivated in net cage systems during one year.

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