Morphologic features and feeding analysis of the black catfish Trachelyopterus lucenai Bertoletti, Pezzi da Silva & Pereira (Siluriformes, Auchenipteridae).

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ABSTRACT: Morphologic features and feeding analysis of the black catfish Trachelyopterus lucenai Bertoletti, Pezzi da Silva & Pereira, 1995 (Siluriformes, Auchenipteridae). Trachelyopterus lucenai was described for the Patos Lagoon complex and the basin of the River Uruguay (RS). Its occurrence was extended to the swamp region, close to the Taim Ecological Station and the Mirim and Mangueira coastal lagoons, in Rio Grande do Sul. Two hundred and thirty seven individuals were used in order to characterize the species' morphology, its strategy and feeding analysis. Trachelyopterus lucenai is a brown colored catfish, with a bulky body, and black spots over its body - more numerous in the dorsal region. In males the first rays of the anal fin were shown to have a projection that aids fecundation. The species has a generalist feeding behaviour, generally preying on insects and fish.
Key-words: Swamp, Taim, feeding, morphology.

RESUMO: Caracterização morfológica e análise alimentar do bagre negro, Trachelyopterus lucenai Bertoletti, Pezzi da Silva & Pereira, 1995 (Siluriformes, Auchenipteridae). Trachelyopterus lucenai foi descrita para o sistema da Lagoa dos Patos e bacia do Rio Uruguai, RS. Sua ocorrência foi ampliada para a região de banhados, junto a Estação Ecológica do Taim e lagoas costeiras Mirim e Mangueira, Rio Grande do Sul. Foram utilizados 237 indivíduos com o objetivo de caracterizar a morfologia da espécie, a estratégia e análise alimentar. Trachelyopterus lucenai é um bagre de corpo robusto, de coloração marrom com manchas pretas espalhadas por todo o corpo sendo estas mais densas na região dorsal. Nos machos os primeiros raios da nadadeira anal apresentam uma projeção que auxilia na fecundação. A espécie demonstrou um comportamento alimentar generalista, com tendências a predar insetos e peixes.
Palavras-chaves: Banhado, Taim, alimentação, morfologia.

Introduction

Trachelyopterus lucenai Bertoletti, Pezzi da Silva & Pereira (1995) belongs to the Auchenipteridae family, distinguishing itself from the others by a light stripe along the lateral line, by the well developed bone hooks on the anterior side of the dorsal fin, especially in males, and finally by a light coloured outline around the supraoccipital bone, forming a poligonal design in dorsal view (Bertoletti et al., 1995).

The species described for the Patos lagoon and Uruguay River basin systems is also captured relatively abundantly in the Taim swamp region, in the south of Rio Grande do Sul state. According to Bertoletti et al. (1992), migration may have occurred via the tributaries of these basins, by way of man made irrigation channels or the joining of the lagoons when there are floods.

The characteristics of the swamps, made up mostly of calm lagoons, streams and canals, together with the high availability of food, has favoured an increase in the T. lucenai population. This has led to a swift invasion and proliferation which is causing concern to the artisanal fishermen of this region.

So that this phenomenon of rapid invasion could be better understood, studies into the bioecology of the species were developed, helping to identify and differentiate this

group from others. Initially, the morphological chararacterization and feeding strategy were determined by analysing the stomach content, in order to find out about the fishes' behaviour in the environment and understand their ecological interaction with their surroundings and other species of fish. According to Rodrigues & Bemvenuti (2001), studies of the feeding composition of a species are fundamental to the understanding of the ecology and trophic structure to which a species belongs.

For Andrian & Barbieri (1996), it is essential to analyse the diet of a species if we want to understand its ecology and behaviour, as well as reproductive aspects, growth, mortality, birth rate and migration. Wootton (1990) also states that feeding is one of the most important functions of an organism, since growth, development and reproduction are the result of the quantity and quality of the food that a species ingests.

The aim of this study is to characterize the morphology, strategy and feeding analysis of T. lucenai, in order to understand its behaviour and proliferation in the coastal lagoon region and Taim swamps.

Material and methods

Sampling was carried out in the Flores, Nicola, Jacaré and Mangueira lagoons and the Taim swamps, between the Mirim Lagoon and the Atlantic Ocean, part of the municipalities of Santa Vitória do Palmar and Rio Grande, in Rio Grande do Sul state, Brazil. This study is part of the Brazilian Long Term Ecological Program (PELD – Site Taim).

The fish were captured using gill nets with different mesh sizes (15, 20, 30, 35 mm between knots). After the fish were taken out of the nets, they were labelled and placed in 10% formaldehyde in order to be sent to the laboratory where they were separated, identified and stored in 70% ethanol. Each individual was measured with a calliper (0.1mm of precision) and the values were put on biometry sheets and typed onto electronic spreadsheets using the Excel program. The measurements obtained were used to draw up a table of the morphometric characterization of the species.

The individuals were weighed on electronic scales and their stomachs extracted. The items were separated using a binocular stereomicroscope, identified to the lowest taxonomic level possible and quantified on four decimal place precision scales.

The food items of T. lucenai were typed onto Excel spreadsheets for feeding analysis, using the frequency of occurrence (FO) and importance in weight (G) of each item (Hyslop, 1980). Frequency of occurrence (FO) is the number of times that a food item occurs in the stomachs analyzed, divided by the total number of stomachs analyzed, minus the number of empty stomachs, expressed as a percentage. For gravimetric analysis, (G) is the total weight of an item expressed as a percentage of the total weight (TW) of all the items in the digestive tract. The index of specific abundance in weight (Pi-G%) was also calculated. This is defined as a percentage of the relative weight of a food item in relation to the total weight of food items in those stomachs which contained that item.

Food analysis was done using Amundsen graphic method (Amundsen et al., 1996), which compares frequency of occurrence (FO) with the index of specific abundance in weight (Pi-G%). The result indicates, through the distribution of the points, which food item is most important in the species´ diet and what food strategy it uses.

Results and discussion

Morphometric analysis

Two hundred and thirty-seven (237) indivividuals of sizes varying from 84.6 to 213 mm in standard length (SL) were sampled, and the morphometric characters were expressed as percentages of standard length (Tab. I). Of the individuals sampled, 136 were females and 101 males – a greater number of females was also found by Becker (1998), when analysing the food habits of this species in the Guaíba River.

The species is characterized by its bulky, brown body with black spots spread over its whole body, more densely so in the dorsal region (Fig. 1). The mouth is anterior, with an

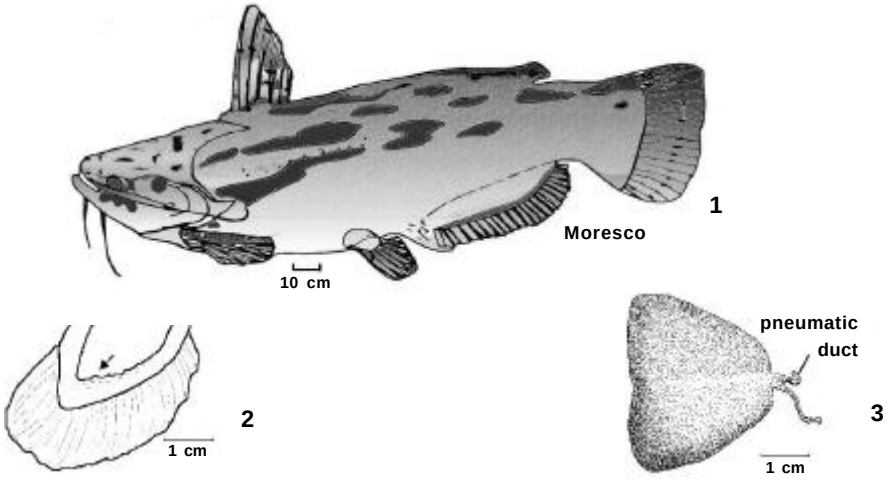
Table I: Morphometric data for 237 individuals of T. lucenai; percentages expressed as standard length; SD = standard deviation; CV= coefficient of variation.

Variable	max	min	mean	SD	CV
Standard length - SL (mm)	213.0	84.6	156.2	15.1	9.6
Head length	32.9	22.5	27.2	1.9	7.2
Head width	31.3	19.9	24.2	2.0	8.4
Snout length	15.4	7.0	8.5	0.7	8.4
Mouth width	23.6	8.2	15.0	1.2	8.0
Eye diameter	5.01	2.5	3.6	0.3	8.7
Interorbital distance	16.3	12.0	14.3	0.7	5.3
Predorsal distance	37.8	27.8	33.0	1.5	4.5
Prepectoral distance	28.1	20.6	23.7	1.3	5.7
Prepelvic distance	62.6	47.0	53.9	2.8	5.1
Preanal distance	77.6	53.4	65.1	3.7	5.6
Snout length	15.4	7.0	8.5	0.7	8.4

average width of 15% of SL and has several short, pointed teeth forming an upper plate and a lower one, which is divided in the middle. The width of the head, measured just behind the orbit, is slightly less than its length (Tab. I). The pectoral and dorsal fins have markedly serrated spine. The males were also seen to have a modification in the first rays of the anal fin, forming a projection, cited as an organ which aids internal fertilization in species of the Auchenipteridae family (Curran, 1989). This could explain the proliferation of the species, assuming that this modification allows for better utilization of the sperm.

The branchial openings are small and the gill rakers are short and few in number (Fig 2). According to Wooton (1990), observing the branchial gill rakers can give us a good idea of the fish´s diet, since these organs possess adaptations which are directly related to the size of the preferred food. Fish which feed on small particles usually have numerous, long and thin gill rakers, aiding the retention of food. Fish which prey on large particles, on the other hand, have short, rounded and less numerous gill rakers, as with T. lucenai, which because it catches large food does not need large and numerous branchial gill rakers to retain its food.

The swimming bladder is a bag with soft walls, which is full of gas, located in the upper part of a fish's abdominal cavity, under the vertebral column. Its main function is to control the fish´s buoyancy, and also emit sounds and aid breathing, occurring in most freshwater fish (Schmidt-Nielsen, 1999). In this species, the swimming bladder has the outer shape of a heart and is divided longitudinally in two chambers, connected to the digestive tube by the pneumatic duct (physostomous) (Fig. 3).



Figures 1-3: (1) Trachelyopterus lucenai, 196 mm standard length (SL), Taim swamp, Rio Grande, RS, March 2003; (2) branchial arch, arrow indicates small gill rakers; (3) swimming bladder.

Feeding analysis

The diversity of the food items found in the diet of T. lucenai, and their respective weight and frequency of occurrence percentages are shown in Tab. II.

The most abundant food items present in the species´ diet were insects and fish, as well as mollusks, crustaceans and other less important items.

Table II: Principal items found in diet of T. lucenai; (G%) = weight percentage; (FO)= frequency of occurrence.

Items	G%	FO
MOLUSCA		
Gastropoda		
Pomacea sp	3.60	21.63
Heleobia sp	0.37	22.12
Bivalvia	0.34	0.48
ANELIDA		
Hirudinea	0.003	0.48
ARTROPODA		
Chelicerata		
Araneae	0.01	0.96
Crustacea		
Decapoda		
Shrimps	0.31	5.29
Aegla sp	1.52	14.42
Isopoda	0.17	3.85
Amphipoda	0.07	5.77
INSECTA		
Ephemeroptera	52.77	45.67
Odonata	0.90	10.58
Hemiptera	1.51	6.25
Coleoptera	1.16	12.50
Diptera	0.01	1.44
Hymenoptera	0.004	0.48
Not identified	2.73	9.62
REPTILIA		
Amphysbaena darwinii	0.53	0.48
PISCES		
Siluriformes	0.84	2.40
Phalloceros caudimaculatus	0.01	0.48
Astyanax spp	6.51	5.29
Oligosarcus jenynsii	3.25	2.40
Characidium rachovii	0.03	0.48
Scale	1.55	28.85
Viscera	3.97	5.29
Not identified	5.36	16.83
ORGANIC MATERIAL	9.80	25.48
PLANTS	0.98	11.06

The insect group was made up of the following orders: Ephemeroptera, Coleoptera, Odonata, Hemiptera, Diptera, Orthoptera and Hymenoptera. Among the fish groups recorded were the "dentudo" Oligosarcus jenynsii (Günther,1864), the "barrigudinho" Phalloceros caudimaculatus (Hensel, 1868) and Characidium rachovii Regan, 1913. The "lambaris" were grouped into Astyanax spp. Pimelodella australis Eigenmann, 1917, Corydoras paleatus (Jenyns, 1842), Loricariichthys anus (Valenciennes, 1836) and Hisonotus taimensis (Buckup, 1981) were grouped into Siluriform. Fish scales, remains and guts were also included in the fish group.

In the mollusk group, there were Pomacea sp, Heleobia sp and bivalves. The crustaceans were composed of Aegla sp., amphipods, isopods and shrimps. Other items recorded were arachnids, a reptile, annelids, plants and an unidentifiable part, which was considered organic material. The reptile was an Amphisbaena darwinii (Duméril & Bibron, 1839) "cobra-cega" and the annelid was a leech.

The digestive tracts analysed were also separated by seasons and by content into those containing items and those with no items - empty (Tab. III). Comparing the seasons of the year, it could be seen that in spring the percentage of empty stomachs was higher than in autumn.

Table III: Presence or absence of food items in stomachs of T. lucenai, related to seasons of the year.

	Absence of food items	**Presence of food items**	**Total of stomachs**
Spring	16	113	129
Summer	3	48	51
Autumn	9	47	56
Winter	0	1	1
Total	28	209	237

Only one individual was captured in winter. This low occurrence of the species in the winter catches suggests a behaviour not yet known. It can be deduced that the species remains hidden in burrow or under stones when the temperature decreases. However, in the months before the winter period, a great accumulation of fat was observed close to the viscera and attached to the visceral cavity. This fat is used as an energy reserve so that the fish does not need to go out and catch food, which may explain the low occurrence of the species.

In spring the empty stomachs occurred in a lower percentage, with an average of one empty stomach for every 16 full ones. Among the stomachs analysed, 28 (11.8%) were empty and the items in the others varied in weight between 0.34g and 24.35g. However, the large quantity of full stomachs highlighted the species' voracious nature, as mentioned by Braga (1990) for another auchenipteride, Parauchenipterus galeatus (Linnaeus, 1766), in the Tocantins River.

In Fig. 4, the specific abundance of the prey (Pi- G%) is compared using the frequency of occurrence (FO) in order to determine the food strategy and preference of the species according to the distribution of the points on the graph. According to Amundsen et al. (1996), when a point, each of which represents a particular prey, is above the 75% isoline (high Pi-G% and FO), a predator has a generalist feeding strategy, which can be generalist-opportunist when most of the points are located in the top left corner (high Pi-G% and low FO) and generalist-generalist when most of the points are found in the bottom right corner (low Pi-G% and high FO). The points located below the hypothetical dominance isoline (100/S, where S is the sum of the different prey) are considered occacionals items.

In this analysis, insects were the most abundant diet item. This dominance is due to the large number of individuals caught in spring, a time which coincides with a great eclosion of ephemeroptera, an insect which dies a few hours after reaching its final stage (adult). This eclosion almost always happens at the same time, generally shortly after sunset. The insects fall in the water almost immediately afterwards, becoming easy and abundant prey for T. lucenai. The fact that the fish is nocturnal was proved by the sampling carried out for the project and the observations made in aquariums where the species moves little during the day, spending most of the time camouflaged in vegetation. This also happens with other Auchenipterids which live hidden in burrow or in any other substrate, leaving them at night to catch food (Andrian et al., 1994).

The fish items were also found to be of great importance in the diet, with most of them the result of the discard by local fishermen, who clean their fish on the banks of the lagoons, throwing away guts and fish which are of little commercial interest to them.

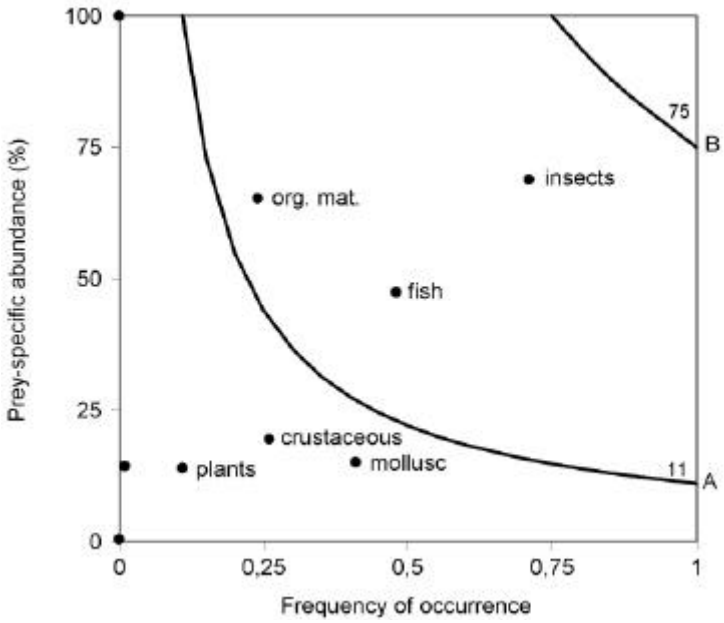


Figure 4: Diet of Trachelyopterus lucenai; feeding strategy in weight; Pi-G% = specífic abundance of prey in weight; FO= Frequency of Occurrence. The isolines represent the different values of prey abundances: A= isolines hypothetical of dominance 100/S, where S= total number of prey found in contents; B= isolines of the 75%.

The mollusk and crustacean groups appear with an average frequency of occurrence - the lowest specific abundance of prey (Pi-G%) - and are considered a complementary food of the species. The arachnid, plant, reptile and annelid items were poorly represented.

Using the Amundsen method to analyze the distribution of the points, T. lucenai is shown to have a generalist-opportunist feeding strategy, with a tendency towards fish and insect items. The organic material items were the result of some individuals with full stomachs, which remained caught in the gill nets for a long time before being fixed in formaldehyde, thus increasing the degree of digestion and making it more difficult to identify the items. The points on the graph which represent the arachnid, reptile and plant items were below the hypothetical dominance isoline (100/S) and are therefore considered occacionals items.

Previous studies of this species, in the Guaíba river, showed a diet made up of fish, crustaceans, land arthropods, plants, water insects and mollusks, with fish being the highest frequency of occurrence item (Becker, 1998). According to Andrian & Barbieri (1996), the most important items in the diet of P. galeatus´ in the Itaipu reservoir were Coleoptera and Hymenoptera in almost all the seasons of the year.

When the FO and the Pi-% G were compared for each season (Fig. 5), it could be observed that in spring the species developed a specialist strategy for insect item. In summer its behaviour became generalist-opportunist for insect and fish items, with a high FO and Pi-% G, respectively. In autumn, fish were the most important items, followed by insects, thus inverting the food preference. As several items had high Pi-G% and low FO, the food strategy can be characterized as generalist-opportunist.

Species were considered as opportunist in its capture of prey due to the wide variability in food and inversion of item's abundance throughout the year. The use of the Amundsen method made it possible to suggest that the species has generalist-opportunist behaviour, capturing whatever food is available in the environment, as mentioned by Becker (1998). In addition, because of the different prey present, it was possible to deduce that the species catches its food throughout the water column, though more intensely at the surface.

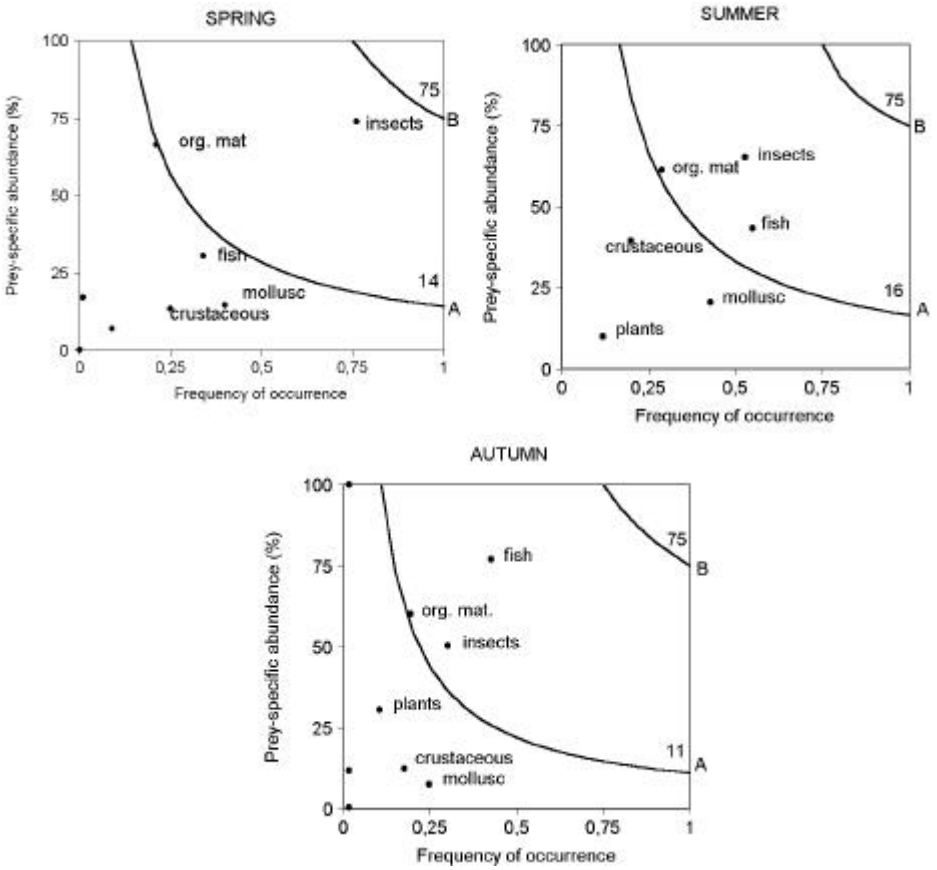


Figure 5: Diet of Trachelyopterus lucenai; feeding strategy in weight, analyzed by season of the year; Pi-G% =; específic abundance of prey in weight; FO= Frequency of Occurrence. The isolines represent the different values of prey abundances: A= isolines hypothetical of dominance 100/S, where S= total number of prey found in contents; B= isolines of the 75%.

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