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NOTA

REAPPEARANCE AND DIET OF JUVENILE ARMADO CATFISH (*Pterodoras granulosus*) IN LOWER URUGUAY RIVER, (RIO NEGRO, URUGUAY).

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ABSTRACT

The Armado catfish (*Pterodoras granulosus*) abundance status and diet of juveniles was studied for the first time in lower Uruguay River. This work report juvenile's reappearance (after 2004 mortality event) and their diet based on vegetal and mollusks. This fish was classified as generalist with certain selectivity for a free-floating macrophyte.

Key words: *Pterodoras granulosus*, diet, feeding strategy, lower Uruguay River;

RESUMEN

Reaparición y dieta de juveniles de bagre Armado (*Pterodoras granulosus*) en el Río Uruguay bajo (Rio Negro, Uruguay). El estado de abundancia y la dieta de juveniles de Armado (*Pterodoras granulosus*) fue estudiado por primera vez para el Río Uruguay bajo. Este trabajo reporta la re-aparición de juveniles (luego de un evento de mortandad en 2004) y su dieta basada en material vegetal y moluscos. Este pez fue clasificado como generalista con cierta selectividad por una macrófita flotante.

Palabras clave: Dieta, *Pterodoras granulosus*, estrategia alimenticia, Río Uruguay bajo

The Armado catfish (*Pterodoras granulosus*) is a migratory species from the Amazon and Rio de la Plata basins (Makrakis *et al*., 2007). Migrating distances of 100-200 km have been commonly recorded for the Parana River (Bonetto *et al*., 1971; Makrakis *et al*., 2007). These migrations represent reproductive and feeding strategies in which juveniles migrate along with the adults (Makrakis *et al*., 2007).

In the Rio de la Plata basin, *P.granulosus* represents an important fisheries resource, being among the most abundant catches of the Parana River (particularly in the Itaipú reservoir) (Agostinho *et al*., 2003). According to reports from governmental fisheries institution (DINARA) during the 90' decade the Armado catfish represented one of the most important catches in Uruguay River and Río de la Plata fisheries (INAPE, 1999). However, reports from Comisión Administradora del Río Uruguay (CARU) note that this species had faced a drastically mortality event on 2004 in the region. This is probably the reason for the decrease in the number of catches of this species observed in the last years in fisheries of lower Uruguay River (Spinetti & Espinach Ros, 2008). Despite the commercial importance of this species, its biology in the Río de la Plata basin has been scarcely studied (only for Paraná River basin). The extant diet studies (for Paraná, and the Amazon River basins (Hahn *et al.*, 1992; Gaspar da Luz *et al.*, 2002; Agostinho *et al.*, 2009) did not focus on aspects of the feeding strategy as the between-within-phenotypic component of niche width, of great importance to understand fish feeding ecology (Amundsen *et al.*, 1996).

Feeding ecology studies of this fish agree in classifying it as an omnivore, eating mainly vegetal material (with an important terrestrial component) and mollusks (Hahn *et al.*, 1992; Gaspar da Luz *et al.*, 2002; Agostinho *et al.*, 2009). The aim of this work is to report *P. granulosus* abundance status and its feeding ecology in lower Uruguay River.

On the context of UPM Fray Bentos (formerly BOTNIA) pulp mill impact assessment, three sites have been monitored over a four years period (2006-2010) in lower Uruguay River. The study sites were: Nuevo Berlin, (32°58'52" S, 58°04'06" W, situated 12 Km upstream the mill), Yaguareté bay, Fray Bentos (33°06'35" S, 58°16'39" W, near the mill), and Las Cañas (33º09'48" S, 58°21'43" W, 12 Km downstream from the mill). Fish were collected by two different monitoring strategies in the period from autumn 2006 to autumn 2010. First, we analyzed data obtained from artisanal fisheries census (each fishing day during the four years period) from the three zones in order to assess the abundance variability of this species. The artisanal fishermen used 2.5 m high and 50 m long nets, with mesh size of 70 mm knot to knot. Finally,the second method was arrayed twice per year (late spring and autumn), using eight standard Nordic gill nets, each one 1.5 m height and 30 m large, with 12 different mesh sizes (5.0, 6.25, 8.0, 10.0, 12.5, 15.5, 19.5, 24, 29, 35, 43 y 55 mm knot to knot respectively, each mesh: 2.5 m long). Four nets were placed on littoral areas and four on the pelagic region, for a 12 hours period (from sunset to sunrise) in each study site. Sampling was repeated twice (after a week period), within each sampling season (two in autumn and two in late spring; 48 total net sets per year). Fish from artisanal fisheries were counted and weighted; and fish collected with the standard Nordic gill nets sampling were counted, measured (mm), weighted (0.1 g) and it's digestive tract was extracted and weighted. Voucher specimens were preserved in 10 % formalin and donated to the Fish Collection of Facultad de Ciencias, Universidad de la República (acronym ZVC-P). Each prey item was classified at the lower taxonomic level possible and its fresh weight was determined (0.1 g). Repletion index (R_i=digestive tract content weight x body weight^{-1}) was estimated to determine feeding activity. Length and weight measures were used to describe length-weight relationship in the studies individuals. Calculation of relative weight contribution of every diet item to the collected individual's diet was estimated (sum of every item weight/ total diet items weight, expressed in percentage). The graphical method of Amundsen (1996) was used to describe prey importance, the feeding strategy, and the between-within-phenotypic component in niche width. This method consists in plotting the prey specific weight (percent of weight of a prey taxon considering all guts in which this prey is present) against the frequency of occurrence of the item (F.O.: number of stomachs in which a prey occurs, expressed as a frequency of the total number of stomachs with content). In this graph, the vertical axis evidence feeding strategy: specialist species will have their food items on the upper part of the graph (higher prey specific weight) and generalists on the lower part (lower prey specific weight). Diagonals indicates the prey importance (dominant in upper right and rare in lower left of the graph), as well as evidence if the between or within-phenotypic component (upper left margin or lower right margin of the graph, respectively), contributes more to species niche breadth. This information is important to determine if niche breadth is given by diverse food sources consumed by every individual, or caused by specialist individuals, but more diverse food sources given by phenotypic differences in diet.

Fisheries census revealed that adult *P. granulosus* were caught only twice during the entire period: at Nuevo Berlin in January 2007 (32 individuals, 1.23±0.07 kg), and at Las Cañas on March-April 2007 (5 individuals, 2.17±0.29 kg). This abundances are considered very low, given the high fishing effort (2972 nets in 321 fishing days at Nuevo Berlin; 950 nets in 425 fishing days at Fray Bentos; and 4884 nets on 606 fishing days at Las Cañas). In the standard Nordic gill nets sampling, a single adult (3.5 kg of body weight) was captured on December 2008 at Nuevo Berlin and 23 juveniles (11 females, 4 males and 8 unidentified) on April 2010.

Because only one adult was obtained during the whole study period (containing 100% of *Pistia stratiotes* in gut; data not shown in Table 1), we will focus on the juveniles captured in April 2010 to analyze length weight relationship and dietary aspects.

Standard length, mean weight, means repletion index and diet components of juveniles are shown in Table 1. Length-weight relationship is described by the following equation: Log P= Log -3.82 + 3.17xLog (standard length); R^2=0.83, p<0.001 (n=16). When eviscerated weight is considered, the linear equation adjustment improves: Log P_{evi}= Log -3.60 + 2.92xLog (standard. length); R^2=0.93, p<0.001 (n=20). The difference in length weight equation using total or eviscerated weight is probably related with the high variability of repletion index (12-50% of total weight). Besides, this high index reflects the inflated belly aspect of this fish, probably due to a feeding strategy to maximize ingestion. This is particulary important when this fish feeds on free floating macrophytes which represent a voluminous food due the high air content in tissues. Main diet ítems were *P. stratiotes* (free-floating macrophyte), the gastropod *Potamolithus sp.*, the exotic invasive bivalves *Corbicula fluminea* and *Limnoperna fortunei,* and terrestrial vegetal remains (fruits and leaves). Minor importance items were coarse sediment (sand and stones) and terrestrial insect (Orthoptera). Amundsen diagram (Fig.1) showed that most prey items have low F.O and low prey specific weight. The results suggest that this *P. granulosus* juveniles feeding strategy is generalist. There were only two items with relatively high prey specific weight (*P. stratiotes* and *Potamolithus* sp.), however only *P. stratiotes* had high F.O. This former, represent the only item for which this fish showed a high degree of predilection. The Amundsen's diagram evidenced the importance of between-phenotypic component of trophic niche breadth in this species.

Pterodoras granulosus mortality event on 2004 cited above is the most likely reason to explain the low abundance observed during this study. This is supported by the fact that in 2000-2003 period *P. granulosus* larvae were among the most abundant of the river; however, in 2004-2006 period this fish larvae were almost absent from the annually fish larvae survey taken over by CARU (Spinetti & Espinach Ros, 2008). The reappearance of some juveniles on April 2010 may be related with the great flood event recorded in the Uruguay River during spring-summer 2009.This flood contacted the river with floodplain lakes and wetlands that may have functioned as optimal nursery and breeding areas. Additionally the flood event may have drifted larvae from upstream sections. Despite this recent increase in juvenile's abundances, the abundance status of this species is critical, and a re-appearance would only be confirmed with continuous monitoring.

Regarding diet, we found that *P. granulosus* is an omnivorous species, that feeds on vegetal and animal preys. Similar patterns have been previously reported (e. g. Gaspar da Luz *et al.*, 2002, Agostinho *et al.,* 2009).However, as a difference with previous studies, vegetal matter in this study was mainly represented by the free-floating macrophyte *P. stratiotes* instead of

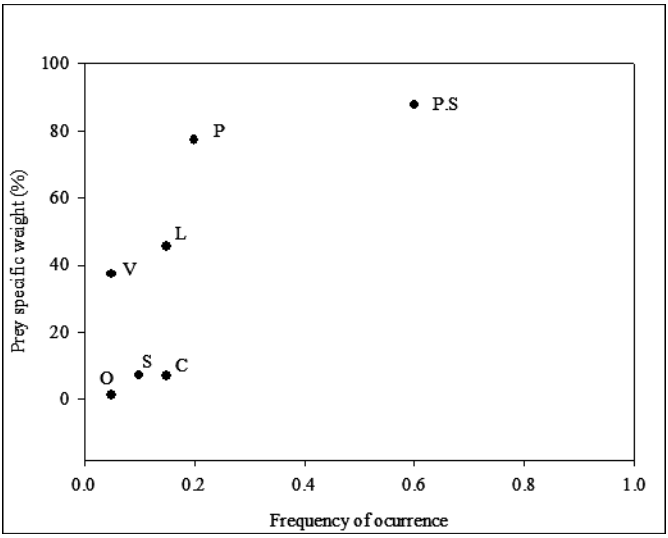

Fig 1. Amundsen diagram: Prey specific weight vs. Frequency of occurrence of food items found in juvenile *P. granulosus*; P.S: *Pistia stratiotes*; P: *Potamolithus* sp.; L: *Limnoperna fortunei*; C: *Corbicula fluminea*; V: Terrestrial vegetation; S: Sediment; O: Orthoptera.

terrestrial vegetation. Besides, Agostinho *et al.* (2009) evidenced an ontogenic dietary shift, with smaller individuals (6-22.5 cm) including a greater proportion of detritus in the diet when compared to the bigger ones (22.5-60.2 cm). On the same way they describe a habitat change after this size range, being epipelagic dwellers later in their life. Even though the size range here studied is within that one (12-19 cm), we did not find detritus on diet, and vegetal matter was the most important diet item. Differences observed with Agostinho *et al.* (2009) in diet of *P. granulosus* could respond to the different ecosystem type (reservoir and river) and thus, difference in food availability. The high occurrence of free-floating macrophyte in diet, as well as benthic mollusks, suggest that this fish use the entire water column, both benthic and epipelagic

Table 1. Collected fish descriptive and diet parameters: Weight, Length and Repletion index showing Mean ± Standard Deviation and data Range between brackets. Diet parameters: Frequency of occurrence and Relative contribution to diet (expressed as % of diet weight), for all found items.

Weight (g)	**Standard length (cm.)**	**Repletion index (% of total weight)**
164.6 ± 64 (61.8-266)	16.3 ± 2 (12-19)	31.2 ± 11.8 (12-50)
Food Items	**F.O (%)**	**% of diet weight.**
Pistia stratiotes	60	82.6
Corbicula fluminea	15	0.3
Potamolithus sp.	20	11.2
Coarse sediment	10	0.4
Terrestrial vegetation	10	2.0
Limnoperna fortunei	15	3.4
Ortoptera	5	<0.1

habitats. Amundsen´s method showed that *P. stratiotes* may be specifically selected when available. Besides, the importance of the between-phenotypic component suggests this population niche width could be given by different individual strategies more than by a high diversity of items within each individual. It is possible that two diet items with higher frequency of occurrence (*P.stratiotes* and *Potamlithus sp*.) reflect two different more specialist feeding strategies; however we cannot test this due to the low n number and narrow size range of juveniles. Further work considering wider size range will aim at testing this aspect and would reveal if the observed dietary strategy is present in younger specimens and adults, allowing a better comparison with other systems studied.

This work represents, as far as we know, the first study reporting abundance status of this formerly important fish resource in lower Uruguay River and their feeding ecology. It is also, the first in exploring their feeding strategies by Amundsen's method. This survey enhances the need of ecological studies of this species to evaluate and apply management policies to preserve this important fisheries resource. We greatly thank Diego Larrea; Jukka Tana; Gervasio González as well as the artisanal fishermen Elbio Russo, Vicente Rodriguez and Angel Rosano for providing vital information for this report.

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