PANAMJAS
Pan-American Journal of Aquatic Sciences

First records of Sigmodontinae (Mammalia) predation by *Oligosarcus hepsetus* (Cuvier, 1829) (Characiformes, Characidae) in Atlantic Rain Forest rivers of southern Brazil

JEAN RICARDO SIMÕES VITULE[1,4], MATHEUS OLIVEIRA FREITAS[2,4], VANESSA MARIA RIBEIRO[1,4] & HUGO BORNATOWSKI [3*]

[1] *Laboratório de Ecologia e Conservação, Departamento de Engenharia Ambiental, Setor de Tecnologia, Universidade Federal do Paraná, Campus Centro Politécnico, Avenida Coronel Francisco Heráclito dos Santos, CEP 81530-000, Curitiba – PR, Brazil*
[2] *GPIc – Grupo de Pesquisas em Ictiofauna, Museu de História Natural Capão da Imbuia, Curitiba – PR, Brazil*
[3] *Instituto de Pesca, Avenida Bartolomeu de Gusmão, 192, Santos - São Paulo postal code:11030-906*
[4] *Programa de Pós Graduação em Ecologia e Conservação, Universidade Federal do Paraná, Campus Centro Politécnico, Avenida Coronel Francisco Heráclito dos Santos, CEP 81530-000, Curitiba – PR, Brazil*
** Corresponding author: anequim.bio@gmail.com*

Abstract. Two Sigmodontinae were found in the stomachs of two individuals of saicanga, *Oligosarcus hepsetus*, in different rivers located in the southern Brazilian Atlantic Rain Forest, in March and November 2010. These were the first records of this species feeding on mammals.

Key words: Fish diet; *Akodon*, *Oligoryzomys*; freshwater; Neotropical rivers.

Resumo. Primeiros registros de predação de Sigmodontinae (Mammalia) por *Oligosarcus hepsetus* (Cuvier, 1892) (Characiformes, Characidae) em rios da Floresta Atlântica, sul do Brasil. Dois roedores foram encontrados nos estômagos de dois indivíduos de *Oligosarcus hepsetus*, em diferentes rios localizados na Floresta Atlântica brasileira, em março e novembro de 2010. Esses foram os primeiros registros desta espécie se alimentando de mamíferos.

Palavras-chave: Dieta de peixes; *Oligoryzomys*; *Akodon*; água doce; rios Neotropicais

Predation, in the sense of an organism eating another for nutritional purposes, is probably as old as life itself and has originated many times during the history of life and predator-prey interactions may result in different ecological effects (Bengtson 2002). Fishes are important components of food webs, and display great variability in trophic behavior at all levels (Winemiller & Jepsen 1998, Braga *et al.* 2012). The predatory fish effects on prey populations may alter structure and energy flow within aquatic ecosystems (Estes *et al.* 2011, Cucherousset *et al.* 2012, Ritchie *et al.* 2012).

The characid genus *Oligosarcus* (Günther 1864) is represented by 20 described species (Ribeiro & Menezes 2015) distributed throughout most South American river basins below 14º latitude (Menezes 1988). The saicanga *Oligosarcus hepsetus* (Cuvier 1829) is a medium-sized fish (250 mm of maximum total length, TL) occurring widely in most freshwater ecosystems in southeastern Brazil (Botelho *et al.* 2007). Saicanga inhabits shallow, densely vegetated microhabitats in small streams or along the banks of larger rivers (Araújo *et al.* 2005).

Most species of the genus feed mainly on insects, crustaceans and small fishes (e.g. Lowe-McConnell 1975, Casatti 2002, Araújo *et al.* 2005, Botelho *et al.* 2007, Novakowski et al. 2007, Corrêa & Piedras 2009), being *O. hepsetus* the species with the highest trophic level of the genus (trophic level 4.2 ± 0.79) (Froese & Pauly 2014),

which characterizes it as a secondary or tertiary consumer with carnivorous feeding habits.

However, the occurrence of small mammals in the species diet was not yet recorded. In this context, the goal of the present paper is to report two independent occurrences of rodents in stomachs of *O. hepsetus* in two rivers located in the Brazilian Atlantic Rain Forest (BARF; henceforth).

The first record occurred in a river located in the Capivari river (Ribeira river basin, 24º 59' 49 S and 48º 35' 44 W, Paraná state, Brazil). A female (315 mm total length - TL, 260 mm standard length - SL, 349 g total mass - Wt) was captured on March 2010 during an ecological survey (license nº 24779, SISBIO) using a gillnet (30 mm between consecutive knots). An entire native cricetid rodent *Akodon* sp. (Meyen 1833) (Sigmodontinae, Akodontini) was registered in the stomach, with 160 mm TL, 25.4 g Wt. The second record, comprised a female (290 mm TL, 235 mm SL, 306.8 g Wt) (Figure 1) collected by angling on November 2010, in the Pardo river (Ribeira de Iguape river basin, 24º 49' 51 S and 48º 33' 44 W, Paraná, Brazil). This specimen had a live rodent in its stomach, an adult pygmy rice rat *Oligoryzomys nigripes* (Olfers 1818) (Sigmodontinae, Oryzomyni), with 190 mm TL and 23.1 g Wt (Figure 1).

In the second occasional record the *O. hepsetus* individual attacked an artificial plug bait (fish approximately 50 mm). At the moment of capture, the *O. nigripes* was alive in the fish's stomach (tail partially out of its mouth), indicating a recent predation. The mouse occupied 100% of the stomach cavity (Figure 2).

Figure 1: A pygmy rice rat *Oligoryzomys nigripes* (190 mm total length) found in a saicanga *Oligosarcus hepsetus* (290 mm total length) stomach.

Figure 2: *Oligosarcus hepsetus* female (290 mm total length) with a pigmy rice rat *Oligoryzomys nigripes* in its stomach. See the rat tail outside the fish's mouth, and the body occupying the whole stomach.

Oligosarcus species have a large mouth aperture, permitting the ingestion of the whole prey in a single bite (Casatti *et al.* 2001). Ontogenetic variation was observed in *Oligosarcus* species, in which juveniles consume crustaceans, mollusks, and insects (Araújo *et al.* 2005, Botelho *et al.* 2007, Corrêa & Piedras 2009), while adults basically feed on fishes (Casatti 2002, Araújo *et al.* 2005, Botelho *et al.* 2007, Novakowski *et al.* 2007, Corrêa & Piedras 2009). Therefore, the large size of the two *O. hepsetus* individuals registered here allow them to explore and eat large preys, for example, small

rodents.

Rodent predation by fish is uncommon; however, an occurrence of pygmy rice rat in the stomach of piraputanga *Brycon opalinus* (Cuvier 1819) was registered also in a BARF river (Gomiero *et al.* 2006). The two rodent species found in this paper occupy different habitats. *Oligoryzomys nigripes* is scansorial, so maybe wind disturbance may have caused the fall of the mice from vegetation. *Akodon*, on the other hand, is mostly terrestrial, and maybe an intensive rain may have caused an inundation of marginal areas. The hypotheses of the consumption of small mammals could be associated to opportunistic behavior. These records highlight the importance of the marginal forest of the BARF biome on the feeding habits of Neotropical stream fishes (see Abilhoa *et al.* 2011 and references therein).

Predation is important in modulating ecosystems (Estes *et al.* 2011, Cucherousset *et al.* 2012, Ritchie *et al.* 2012), with important role in the ecology of Atlantic Rain Forest freshwater fishes. Many fishes are piscivorous, and virtually all fishes are vulnerable to predation at some point in their lives. Piscivorous fishes have their diets based on the pursuit (e.g. *Oligosarcus* spp.) or ambush (e.g. *Hoplias malabaricus*) of prey, although they may complement their diets with allochthonous items (mainly terrestrial insects, Abilhoa *et al.* 2011).

The two independent records reported here may contribute to the knowledge on trophic ecology, energy transfer between ecosystems (terrestrial and aquatic) and diet breadth of *O. hepsetus*, highlighting the need for further investigation in order to identify patterns and possible relationships between resource availability and environmental effects that could trigger these predatory events.

Acknowledgements

We thank the National Council for Scientific and Technological Development (CNPq) for research grants to JRSV and MOF, the Coordination for the Improvement of Higher Education Personnel (CAPES) for research grants to VR, and the São Paulo Research Foundation (FAPESP) for grants to HB.

References

Abilhoa, V., Braga, R. R., Bornatowski, H. & Vitule, J. R. S. 2011. Fishes of the Atlantic Rain Forest streams: ecological patterns and conservation. In*:* Grillo, O. Ed. **Changing diversity in changing environment**. InTech, p. 259-282.

Araújo, F. G. Andrade, C. C. Santos, R. N. Santos, A. F. G. N. & Santos, L. N. 2005. Spatial and seasonal changes in the diet of *Oligosarcus hepsetus* (Characiformes, Characidae) in a brazilian reservoir. **Brazilian Journal of Biology**, 65: 1-8.

Bengtson, S. 2002. Origins and early evolution of predation. In*:* Kowalewski, M. & Kelley, P. H. Eds. **The fossil record of predation**. 8 ed. New Haven: The Paleontological Society Papers, p. 289-317.

Botelho, M. L. L. A., Gomiero, L. M. & Braga, F. M. S. 2007. Feeding of *Oligosarcus hepsetus* (Cuvier, 1829) (Characiformes) in the Serra do Mar State Park - Santa Virginia Unit, São Paulo, Brazil. **Brazilian Journal of Biology**, 67: 741-748.

Braga, R. R., Bornatowski, H. & Vitule J. R. S. 2012. Feeding ecology of fishes: an overview of worldwide publications. **Reviews in Fish Biology and Fisheries**, 22: 915-929.

Casatti, L. 2002. Alimentação dos peixes em um riacho do Parque Estadual Morro do Diabo, bacia do Alto Rio Paraná, sudeste do Brasil. **Biota Neotropica**, 2: 1-14.

Casatti, L., Langeani, F. & Castro, R. M. C. 2001. Peixes de riacho do Parque Estadual Morro do Diabo, Bacia do alto Rio Paraná, SP. **Biota Neotropica**, São Paulo, 1: 1-15.

Corrêa, F. & Piedras, S. R. N. 2009. Alimentação de *Hoplias* aff. *malabaricus* (Bloch, 1794) e *Oligosarcus robustus* Menezes, 1969 em uma lagoa sob influência estuarina, Pelotas, RS. **Biotemas**, 22: 121-128.

Cucherousset, J., Blanchet, S. & Olden, J. D. 2012. Non-native species promote trophic dispersion of food webs. **Frontiers in Ecology and the Environment**, 10: 406-408.

Estes, J. A., Terborgh, J., Brashares, J. S., Power, M. E., Berger, J., Bond, W. J., Carpenter, S. R., Essington, T. E., Holt, R. D., Jackson, J. B. C., Marquis, R. J., Oksanen, L., Oksanen, T., Paine, R. T., Pikitch, E. K., Ripple, W. J., Sandin, S. A., Scheffer, M., Schoener, T. W., Shurin, J. B., Sinclair, A. R. E., Soulé, M. E., Virtanen, R. & Wardle, D. A. 2011. Trophic Downgrading of Planet Earth. **Science**, 333: 301-306.

Froese, R. & Pauly, D. 2014. **FishBase**. Available at <http://www.fishbase.org>. Accessed in: July 20, 2014.

Gomiero, L. M., Briani, D. C. & Giassa, L. O. M.

2006. Vertebrados consumidos por *Brycon opalinus* (Pisces, Characidae) em rios do Parque Estadual da Serra do Mar, SP. **Biota Neotropica**, 6: 1-5.

Lowe-McConnell, R. H. L. 1975. **Fish communities in tropical freshwaters**. London: Longman, 337 p.

Menezes, N. A. 1988. Implications of the distribution patterns of the species of *Oligosarcus* (Teleostei, Characidae) from central and southern South America. In: Vanzolini, P. E., Heyer, W. R. 1988. **Proceedings of a Workshop on Neotropical Distribution Patterns**. Rio de Janeiro: Academia Brasileira de Ciências, p. 295-304.

Novakowski, G. C., Hahn, N. S. & Fugi, R. 2007. Feeding of piscivorous fish before and after the filling of the Salto Caxias Reservoir, Parana State, Brazil. **Biota Neotropica**, 7: 149-154.

Ribeiro, A.C. & Menezes, N.A. 2015. Phylogenetic relationships of the species and biogeography of the characid genus *Oligosarcus* Günther, 1864 (Ostariophysi, Characiformes, Characidae). **Zootaxa**, 3494(1):041-081.

Ritchie, E. G., Elmhagen, B., Glen, A. S., Letnic, M., Ludwig, G. & Mcdonald, R. A. 2012. Ecosystem restoration with teeth: What role for predators? **Trends in Ecology & Evolution**, 27: 265-271.

Winemiller, K. O. & Jepsen, D. B. 1998. Effects of seasonality and fish movement on tropical river food webs. **Journal of Fish Biology**, 53: p. 267-296.

Received: May 2015
Accepted: November 2015
Published: January 2016