



Scientific Note

Absence of metazoan gill parasites on *Potamotrygon falkneri* (Potamotrygonidae) and its ecological implications in the upper Paraná River floodplain, Brazil

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Abstract. Specimens of *Potamotrygon falkneri* were analyzed for metazoan parasites on the gills, and none of them was parasitized. This species was translocated to the studied region, and the unusual result is explained by some hypothesis.

Keywords: Stingrays, elasmobranch, ectoparasites, translocated species.

Resumo. Ausência de metazoários parasitas branquiais em *Potamotrygon falkneri* (Potamotrygonidae) e suas implicações ecológicas na planície alagável do alto rio Paraná, Brazil. Espécimes de *Potamotrygon falkneri* foram analisados em busca de metazoários parasitas de brânquias e nenhum deles estava parasitado. Esta espécie não é nativa da região de estudo e o resultado incomum é explicado por algumas hipóteses.

Palavras-chave: Raias, elasmobrânquios, ectoparasitos, espécies translocadas.

The Paraná River is the most important river of the La Plata basin and the tenth largest in discharge in the world (Paiva 1982). Before the creation of the reservoir of the Itaipu hydroelectric power plant, the Sete Quedas Falls served as a natural barrier against the dispersion of numerous species of fish, including stingrays, from the lower and middle portions of the Paraná River to the upper Paraná River. With the construction of the Itaipu dam, this natural barrier was moved about 150 km upstream, and allowed some species to be translocated to this new environment, including *Potamotrygon falkneri* Castex & Maciel 1963, which was restricted to the lower and middle portions of the Paraná River (Agostinho *et al.* 2004a).

Family Potamotrygonidae Garman, 1877 includes the only group of elasmobranchs completely adapted to life in freshwater habitats (Compagno & Cook 1995). Within this family, there

are three valid genera, but the vast majority belong to the genus *Potamotrygon* Garman 1877 (Carvalho *et al.* 2003). Only in the Paraguay-Paraná basin around seven species occur, and this number can vary with the occurrence of synonyms and/or undescribed species (Rosa 1985, Carvalho *et al.* 2003).

Potamotrygonids have features similar to their marine relatives, such as low fecundity, late maturity and slow growth, making them very vulnerable (Compagno & Cook 1995). Moreover, they are very sensitive to the lack of oxygen in the water, being the first to rise to the surface when the oxygen is scarce (Achenbach & Achenbach 1976, Araújo 1998). They also have low tolerance to environmental and anthropogenic impacts (Compagno & Cook 1995, Marques 1996).

Potamotrygon falkneri has predominantly benthic habits and is found preferably in places from two to four meters deep, with highly variable flow

and substrate (Neto *et al.* 2007). It exerts an important role in the food chain, since it is positioned at the top. Its diet consists mainly of fish and mollusks (Lonardon *et al.* 2006).

Studies on the parasitic fauna of *P. falkneri* have been made, but regarding endoparasites (Brooks & Amato 1992, Campbell 1999, Ivanov 2005, Lacerda *et al.* 2008, 2009). Only one species of ectoparasite was described from the gills of *P. falkneri*, the monogenean *Potamotrygonocotyle euryptomaxenus* Domingues & Marques 2007. This species also parasitizes other species of potamotrygonids: *Potamotrygon motoro* (Müller & Henle 1841), *P. castexi* Castello & Yagolkowski 1969 and *P. hystrix* (Müller & Henle 1841) (Domingues & Marques 2007).

Studies on gill parasites have great importance because they can be very pathogenic to

the host (Whittington & Chisholm 2008). As the studied species was translocated and is well adapted to the new environment, further studies are necessary to investigate if it was infested by new species of gill parasites, or brought its native parasites with them. This study aimed to investigate the fauna of metazoan gill parasites in *Potamotrygon falkneri* in the floodplain of the upper Paraná River.

Stingrays were collected quarterly from March 2005 to September 2006, using fishing rods and nets exposed for 24 hours in different locations of the upper Paraná River floodplain (Fig. 1). In the field, gills were removed with the aid of a scalpel and fixated in 5% formalin. The branchial arches were separated and analyzed for metazoan parasites (especially monogeneans) in the laboratory, under an Olympus SZ40 stereomicroscope with 4.0 zoom. Methodology was according to Eiras *et al.* (2006).

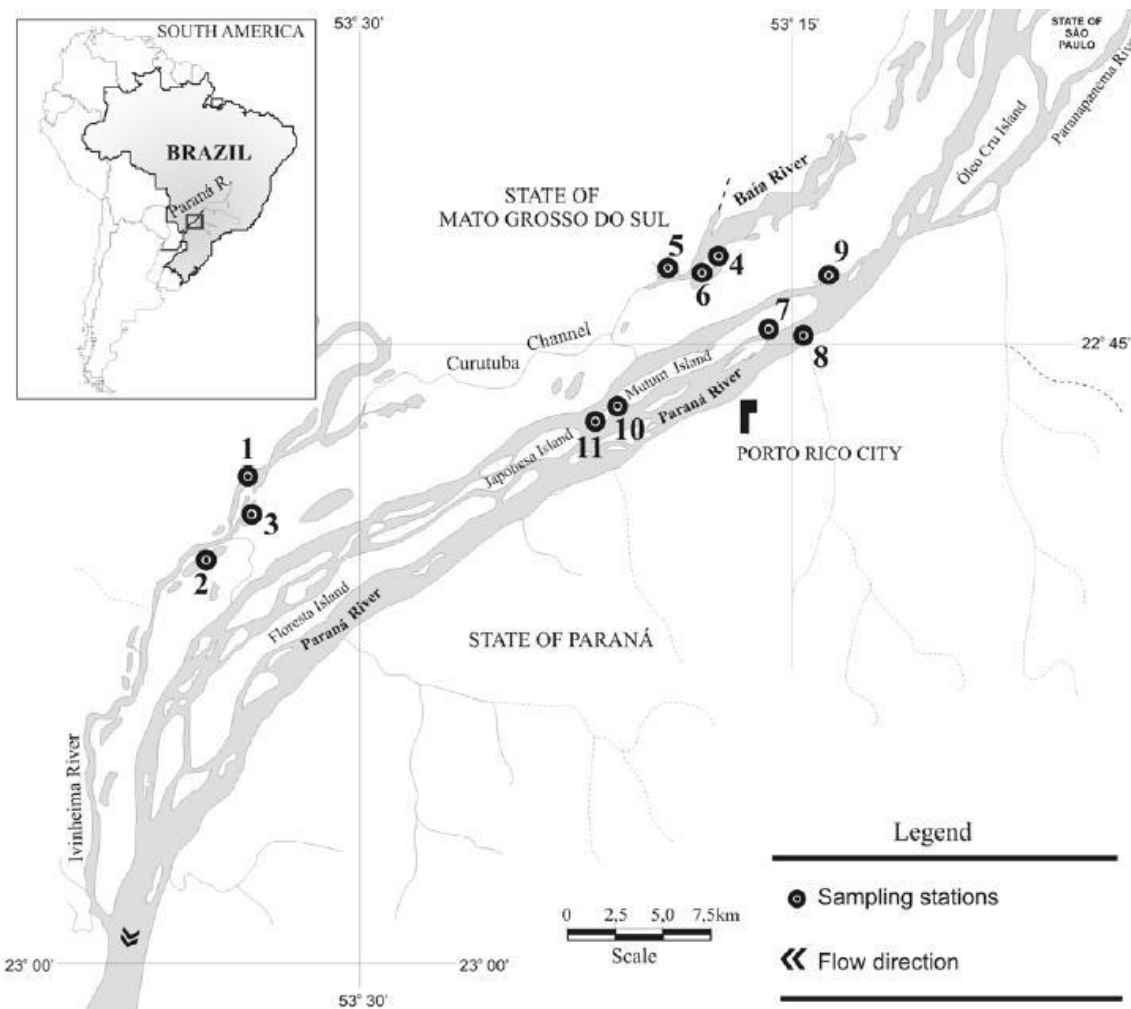


Figure 1. Upper Paraná River floodplain. Sampling stations: 1-Ivinheima River; 2-Ventura Lagoon; 3-Patos Lagoon; 4-Fechada Lagoon; 5-Guaraná Lagoon; 6-Baía River; 7-Pau Vêio Backwater; 8-Paraná River; 9-Garças Lagoon; 10-Osmar Lagoon; 11-Mutum Island.

Thirty specimens of *Potamotrygon falkneri* were analyzed, 18 males and 22 females, with total length ranging from 40.0 to 80.0 cm (52.2 ± 10.2) and disc length from 21.6 to 50.0 cm (29.9 ± 6.9). None of them was parasitized by metazoans. This result is very unusual in nature, leading us to elaborate some hypothesis to explain it.

Recent studies show the importance of parasites within the community and their relationship as indicators of the ecosystem health (Marcogliese 2005). Parasites present a great variety of life cycles and adaptations for survival, inside and outside their hosts (Thatcher 1991) and the ectoparasitic fauna can provide answers regarding the host's behavioral habits and environment (Yamada *et al.* 2008).

For example, many helminthes have a complex life cycle, with hosts ranging from invertebrates to vertebrates. The absence of only one organism or host within that process would mean the interruption of their life cycles, and the end of their disposal in the environment (Thatcher 1981).

According to Almeida *et al.* (2009), stingrays exhibit distinct environment occupation and habitat use patterns, that may lead to spatial segregation processes. *Potamotrygon falkneri* was translocated to the floodplain of the upper Paraná River. This species went through a process of moving from its place of origin to a new habitat. In this process, the stingrays could have gained, or lost, forms of parasitism. Biological invasions are a big problem for the world's biodiversity and parasites may have a key role in modifying the environment (Prenter *et al.* 2004).

The absence of ectoparasites in *P. falkneri* in the floodplain of the upper Paraná River is somewhat intriguing. One species of gill parasite was described from *P. falkneri*, *Potamotrygonocotyle eurypotamoxenus*, but in another area (Salobra River, District of Salobra, Municipality of Miranda, Mato Grosso do Sul, Brazil) (Domingues & Marques 2007). The same authors recorded other species of monogeneans in the La Plata basin (Corrientes, Argentina), downstream the upper Paraná River floodplain. This fact may indicate that these stingrays had these parasites prior to the translocation. We suggest that maybe these parasites were lost during the change of habitat as the stingray reached new environments after the flooding of the Sete Quedas Falls, with the construction of the Itaipu hydroelectric power plant.

This hypothesis is supported by some studies showing that invasive species can have fewer parasites than if they were in their place of origin, because of the typical aggregate distribution and the

“bottleneck” effect (Mitchell 2003, Torchin *et al.* 2003, Prenter *et al.* 2004). Individuals that are not parasitized, especially on the gills, which are related to gas exchange and movement, should have advantage over parasitized ones. Maybe non-parasitized fish had advantage colonizing the new environment. A second possible scenario would be the loss of parasites during the translocation from the place of origin (lower and middle Paraná River), to the upper Paraná River.

Another factor that cannot be forgotten when we consider the difference in the parasitic fauna between the two observed locations, is the contrast of anthropogenic impacts between the two regions. Pollution is a major factor in the change of the parasite's population and community (Kennedy 1997). The region of the upper Paraná River is probably less impacted than the region of Itaipu when we consider the construction of dams, as it is the largest stretch of the river without them (Agostinho *et al.* 2004b). Nevertheless, it may have limnological characteristics that did not encourage the establishment of ectoparasites on stingrays present in this region. In addition, this new environment for the stingrays is constantly being changed in relation to the transparency of water due to the construction of the Porto Primavera dam, placed upstream from this portion of the river (Universidade Estadual de Maringá. Nupélia/PELD/CNPq 2000).

The higher probability of success in the invasion of specimens with few or no parasites may increase their advantages in the competition with native species that suffer the negative effects from parasites (enemy release hypothesis, see Colautti *et al.* 2004).

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References

- Achenbach, G. M. & Achenbach, S. V. M. 1976. Notas acerca de algunas especies de “raya fluvial” (Batoidei, Potamotrygonidae) que frecuentan el sistema hidrográfico del río Paraná medio en el departamento La Capital (Santa Fé – Argentina). **Comunicaciones del Museo Provincial de Ciencias Naturales**

- Florentino Ameghino**, 8: 1-34.
- Agostinho, A. A., Bini, L. M., Gomes, L. C., Júlio Júnior, H. F., Pavanelli, C. S. & Agostinho, C. S. 2004a. Fish Assemblages. Pp 223-246. *In*: Agostinho, A. A., Thomaz, S. M. & Hahn, N. S. (Eds.). **The Upper Paraná River and its floodplain: physical aspects, ecology and conservation**. Backhuys Publishers, Netherlands, Leiden, 393 p.
- Agostinho, A. A., Gomes, L. C., Thomaz, S. M. & Hahn, N. S. 2004b. The upper Paraná River and its floodplain: main characteristics and perspectives for management and conservation. Pp. 381-393. *In*: Agostinho, A. A., Thomaz, S. M. & Hahn, N. S. (Eds.). **The Upper Paraná River and its floodplain: physical aspects, ecology and conservation**. Backhuys Publishers, Netherlands, Leiden, 393 p.
- Almeida, M. P., Barthem, R. B., Viana, A. S. & Charvet-Almeida, P. 2009. Factors affecting the distribution and abundance of freshwater stingrays (Chondrichthyes: Potamotrygonidae) at Marajó Island, mouth of the Amazonas River. **Pan-American Journal of Aquatic Sciences**, 4(1): 1-11.
- Araújo, M. L. G. 1998. Biologia reprodutiva e pesca de *Potamotrygon* sp. (Chondrichthyes: Potamotrygonidae), no Médio Rio Negro, Amazonas. **Master Dissertation**. Instituto Nacional de Pesquisas da Amazonia & Universidade do Amazonas, Manaus, Brazil, 171 p.
- Brooks, D. R. & Amato, F. R. 1992. Cestodes Parasites in *Potamotrygon motoro* (Natterer) (Chondrichthyes: Potamotrygonidae) from Southwestern Brazil, including *Rhinebothroides mclennanae* n. sp. (Tetraphyllidea: Phyllobothriidae), and a revised host-parasite checklist for helminths inhabiting neotropical freshwater stingrays. **Journal of Parasitology**, 78(3): 393-398.
- Campbell, R. A., Marques, F. & Ivanov, V. A. 1999. *Paroncomegas araya* (Woodland, 1934) n. gen. et comb. (Cestoda: Trypanorhyncha: Eutetrarhynchidae) from the freshwater stingray *Potamotrygon motoro* in South America. **Journal of Parasitology**, 85(2): 313-320.
- Carvalho, M. R., Lovejoy, N. R. & Rosa, R. S. 2003. Family Potamotrygonidae (river stingrays). Pp 22-28. *In*: Reis, R. E., Kullander, S. O. & Ferrari Jr, C. J. (Orgs.) . **Check List of the Freshwater Fishes of South and Central America**. EDIPUCRS, Porto Alegre, 742 p.
- Colautti, R. I., Ricciardi, A., Grigorovich, I. A. & MacIsaac, H. J. 2004. Is invasion success explained by the enemy release hypothesis? **Ecology Letters**, 7: 721-733.
- Compagno, L. J. V. & Cook S. F. 1995. The exploitation and conservation of freshwater elasmobranchs: status of taxa and prospects for the future. **Journal of Aquaculture & Aquatic Sciences**, 7: 62-90.
- Domingues, M. V. & Marques, F. P. L. 2007. Revision of *Potamotrygonocotyle* Mayes, Brooks & Thorson, 1981 (Platyhelminthes: Monogeneoidea: Monocotylidae), with descriptions of four new species from the gills of the freshwater stingrays *Potamotrygon* spp. (Rajiformes: Potamotrygonidae) from the La Plata river basin. **Systematic Parasitology**, 67: 157-174.
- Eiras, J. C., Takemoto, R. M. & Pavanelli, G. C. 2006. **Métodos de estudo e técnicas laboratoriais em parasitologia de peixes**. Eduem, Maringá, 199 p.
- Ivanov, V. A. 2005. A new species of *Acanthobothrium* (Cestoda: Tetraphyllidea: Onchobothriidae) from the ocellate river stingray, *Potamotrygon motoro* (Chondrichthyes: Potamotrygonidae), in Argentina. **Journal of Parasitology**, 91(2): 390-396.
- Kennedy, C. R. 1997. Freshwater fish parasites and environmental quality: an overview and caution. **Parasitologia**, 39: 249-254.
- Lacerda, A. C. F., Takemoto, R. M. & Pavanelli, G. C. 2008. Digenea, Nematoda, Cestoda and Acanthocephala, parasites in Potamotrygonidae (Chondrichthyes) from the upper Paraná River floodplain, states of Paraná and Mato Grosso do Sul, Brazil. **Check List**, 4(2): 115-122.
- Lacerda, A. C. F., Takemoto, R. M. & Pavanelli, G. C. 2009. Ecology of endoparasites of the fluvial stingray *Potamotrygon falkneri* (Chondrichthyes: Potamotrygonidae) from the upper Paraná River, Brazil. **Brazilian Journal of Biology**, 69(2): 297-303.
- Lonardoní, A. P., Goulart, E., Oliveira, E. F. & Abelha, M. C. F. 2006. Hábitos alimentares e sobreposição trófica das raias *Potamotrygon falkneri* e *Potamotrygon motoro* (Chondrichthyes: Potamotrygonidae) na planície alagável do rio Paraná, Brasil. **Acta Scientiarum Biological Sciences**, 28(3): 195-202.
- Marcogliese, D. J. 2005. Parasites of the

- superorganism: are they indicators of ecosystem health? **International Journal for Parasitology**, 35: 705-716.
- Marques, J. F. B. 1996. Regulação de Amônia e Uréia de *Potamotrygon* sp (Chondrichthyes: Potamotrygonidae) em águas Amazônicas. **Master Dissertation**. Instituto Nacional de Pesquisas da Amazônia & Universidade do Amazonas, Manaus, Brazil, 120 p.
- Mitchell, C. E. & Power, A. G. 2003. Release of invasive plants from fungal and viral pathogens. **Nature**, 421: 625-627.
- Neto, D. G., Haddad, V. J., Vilela, M. J. A. & Uieda, V. S. 2007. Registro de ocorrência de duas espécies de potamotrygonídeos na região do Alto Rio Paraná e algumas considerações sobre sua biologia. **Biota Neotropica**, 7(1): 1-4.
- Paiva, M. P. 1982. **Grandes Represas do Brasil**. Editerra, Brasília, 292 p.
- Prenter, J., Macneil, C., Dick, J. T. A. & Dunn, A. M. 2004. Roles of Parasites in animal invasions. **Trends in Ecology and Evolution**, 19(7): 385-390.
- Rosa, R. S. 1985. A systematic revision of the South American freshwater stingrays (Chondrichthyes: Potamotrygonidae). **PhD. Thesis**. The College of William and Mary, Williamsburg, United States, 523 p.
- Thatcher, V. E. 1981. Patologia de peixes da Amazônia Brasileira, 1. Aspectos gerais. **Acta Amazonica**, 11(1): 125-140.
- Thatcher, V. E. 1991. Amazon fish parasites. **Amazoniana**, 11(3/4): 263-571.
- Torchin, M. E., Lafferty, K. D. & Kuris, A. M. 2003. Parasites and Marine invasions. **Nature**, 421: 137-151.
- Universidade Estadual de Maringá. Nupélia/PELD/CNPq. **2000. A planície alagável do alto rio Paraná: estruturas e processos ambientais: Site 6 PELD/CNPq: Annual Report (2000)**. Agostinho, A. A., Thomaz, S. M. & Nakatani, K. (Coords). Accessible at <http://www.peld.uem.br/Relat2000/apresent2000.htm>. (Accessed 25/09/2008).
- Whittington, I. D. & Chisholm, L. A. 2008. Diseases Caused by Monogenea. Pp 683-816. *In*: Eiras, J. C., Segner, H., Wahli, T. & Kapoor, B. G. (Eds.). **Fish Diseases**. Volume 2. Science Publishers, Enfield, 1312 p.
- Yamada, F. H., Takemoto, R. M. & Pavanelli, G. C. 2008. Relação entre fator de condição relativo (Kn) e abundância de ectoparasitos de brânquias em duas espécies de ciclídeos da bacia do rio Paraná, Brasil. **Acta Scientiarum Biological Sciences**, 30: 213-217.

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