

## Scientific Notes

### Local fish extinction in a small tropical lake in Brazil

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Lagoa Santa is a shallow permanent lake, located in Belo Horizonte metropolitan region, Brazil. In this study, the loss in fish diversity of the lake over the past 150 years is evaluated. Local extinction of almost 70% of the original fish fauna is described. Probably, the main causes of this richness loss were: obstruction of natural communication with rio das Velhas, non-native species introduction, change in the water level, organic pollution, and elimination of littoral and submerged vegetation.

Lagoa Santa é uma lagoa rasa e permanente, localizada na região metropolitana de Belo Horizonte, Brasil. Neste estudo, é avaliada a diminuição da diversidade de peixes na lagoa. Avaliações recentes indicam que cerca de 70% da ictiofauna nativa foi extinta na lagoa, durante os últimos 150 anos. As causas prováveis desta perda de espécies foram: obstrução da comunicação com o rio das Velhas, introdução de espécies exóticas, mudanças no nível da água, poluição orgânica e eliminação da vegetação marginal e submersa.

**Key words:** rio das Velhas, Lagoa Santa, urbanization, habitat destruction, species introduction, historical diversity loss.

The Central lake of Lagoa Santa city is locally known just as lagoa Santa. It is a shallow permanent lake located at 19°38' S and 43°53' W, 40 km to the north of the city of Belo Horizonte, in the rio das Velhas basin, Brazil. Lagoa Santa lake is relatively recent, formed between 6,100 and 5,000 years ago, when torrential rains caused a landslide that started obstructing the water outlet of the ancient valley. The present lake is exoreic and has a surface elevation of 740 m above the sea level, surface area of 1.31 km<sup>2</sup>, and catchment's area of 11.34 km<sup>2</sup> (Parizzi *et al.*, 1998).

The region of Lagoa Santa county is one of the most important and extensively explored karstic landscapes in Brazil. It has been studied since the 1850's, when many Danish naturalists traveled to the region after the paleontologist Peter W. Lund established himself in Lagoa Santa (Alves & Pompeu, 2001). Between 1850 and 1856, Johannes T. Reinhardt made fish collections in the rio das Velhas basin, including Lagoa Santa lake. At least 17 fish species were recorded (Lütken, 2001), including three taxa collected at that time and described later: *Characidium zebra*, *C. lagsantensis* and *Hyphessobrycon santae* (Eigenmann, 1918; Buckup, 1992). An additional species was described

for the area (*Neofundulus acutirostratus*), although its occurrence in this lake has been questioned (Costa, 1992).

Other five species (*Brycon orthotaenia*, *Parodon hilarii*, *Piabina argentea*, *Hypostomus lima* and *Stegophilus insidiosus*) were described from Lagoa Santa county, but according to Lütken (2001), these were found only in rio das Velhas and small streams of the region, such as Bebedouro stream, which drains the lake.

In the present study, we made an evaluation of the loss in fish diversity in Lagoa Santa lake over the past 150 years. Fish were collected in the lake in July and October/2001 and January/2002, using gill nets, seines and casting nets. Gillnets were 20 m long and consisted of panels with bar mesh sizes of 15, 20, 30, 35, 40, 50, 60, 70, and 80 mm between opposite knots.

Two hundred and eight specimens belonging to ten species were collected (Table 1), and had been deposited at the Fish Section of Museu de Zoologia da Universidade de São Paulo (MZUSP). These represent only 60% of the total richness recorded in the 19th century, even with the inclusion of four non-native species collected (*Hoplias lacerdae*, *Hoplosternum littorale*, *Cichla cf. monoculus* and *Tilapia rendalli*). In this

study, two more native species were recorded for the first time (*Pamphorichthys holandii* and *Serrapinnus heterodon*). Thus, the historical fish richness in Lagoa Santa lake reached at least 19 native species. Among these, only six (*Astyanax lacustris*, *S. heterodon*, *Hoplias malabaricus*, *Eigenmannia microstoma*, *Rhamdia quelen* and *P. hollandi*) can still be found in the lake, which means that almost 70% of the original fish fauna is now extinct.

The main factor that determines fish species richness in lakes is the balance between colonization and local extinction (Barbour & Brown, 1974). In Lagoa Santa lake, this balance has been upset by a number of negative environmental impacts, most of which resulting from the process of urbanization of the Belo Horizonte Metropolitan Region, capital of the state of Minas Gerais, starting in the 70's.

One source of impact was the obstruction of the natural communication between Lagoa Santa lake and the rio das Velhas, formerly provided by the Bebedouro stream. With this stream now canalized and heavily polluted, colonization, which used to occur during the flooding season, has been prevented. Also, migratory species, such as *Prochilodus costatus* and *Pimelodus maculatus*, can no longer swim between the river and the lake, as they did in the past (Lütken, 2001).

Another important change in the lake was the rise of the water level, causing the elimination of littoral (Cyperaceae) and submerged (Characeae) vegetation. Available spawning grounds, nursery and refuge areas at the littoral zone were probably greatly reduced.

A third factor that had also directly contributed to local fish fauna extinction in Lagoa Santa lake was the introduction of non-native species. Although there is no official record of such introductions, *Tilapia rendalli* is known to be present at least since 1980's decade (Buckup, 1990). In general, introduced non-native species cause dramatic changes in host communities, such as removal of vegetation, degradation of water quality, introduction of parasites and diseases, trophic changes (Courtenay & Stauffer, 1984), genetic changes (Ferguson, 1990), and species extinction (Zaret & Paine, 1973; Barel *et al.*, 1985; Miller, 1989). The predatory pressure of two large-size piscivorous species (*Cichla cf. monoculus* and *Hoplias lacerdae*) may be related to the extinction of many small fish species, a dominant component of the original community in Lagoa Santa lake (Table I). The most dramatic example is the elimination of *C. lagosantensis*, which type locality is the lake (Travassos, 1947). This is one of the three species officially considered threatened of extinction in Minas Gerais State (Machado *et al.*, 1998), based on IUCN criteria.

However, rehabilitation initiatives, such as reestablishment of the communication with rio das Velhas and control of the water quality in the lake, can greatly improve the chances of recovery of its fish fauna diversity over the medium term.

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**Table 1.** Historical and current fish fauna in Lagoa Santa lake, with some biological attributes of the species listed. Valid names according to Eigenmann (1918), Buckup (1992), Mago-Leccia (1994), Britski (2001). Size: small = adults smaller than 15 cm; medium = between 15 and 30 cm; large = larger than 30 cm total length. MZUSP: catalog numbers of voucher specimens.

Original citation (Lütken, 2001)	Valid name	Historical records	Current records	Exotic species	Migratory species	Size	MZUSP
<i>Xiphorhamphus lacustris</i> Rhdt. Ltk.	<i>Acestrorhynchus lacustris</i> (Lütken, 1875)	•				Medium	
<i>Tetragonopterus Cuvieri</i> Ltk.	<i>Astyanax fasciatus</i> (Cuvier, 1819)	•				Small	
<i>Characidium fasciatum</i> Rhdt.	<i>Characidium zebra</i> Eigenmann, 1909	•				Small	
<i>Characidium fasciatum</i> Rhdt.	<i>Characidium lagosantensis</i> Travassos, 1947	•				Small	
<i>Carapus fasciatus</i> Pall.	<i>Gymnotus carapo</i> Linnaeus, 1758	•				Medium	
<i>Tetragonopterus nanus</i> Rhdt. Ltk.	<i>Hasemania nana</i> (Lütken, 1875)	•				Small	
<i>Tetragonopterus gracilis</i> Rhdt. Ltk.	<i>Hyphessobrycon gracilis</i> (Lütken, 1875)	•				Small	
<i>Tetragonopterus rivularis (interrupta)</i> Ltk.	<i>Hyphessobrycon santae</i> (Eigenmann, 1907)	•				Small	
<i>Leporinus Reinhardti</i> Ltk.	<i>Leporinus reinhardti</i> Lütken, 1875	•			•	Medium	
<i>Auchenipterus lacustris</i> Rhdt. Ltk.	<i>Parauchenipterus galeatus</i> (Linnaeus, 1766)	•				Medium	
<i>Pimelodus maculatus</i> Lac.	<i>Pimelodus maculatus</i> Lacépède, 1803	•			•	Large	
<i>Prochilodus affinis</i> Rhdt. Ltk.	<i>Prochilodus costatus</i> Valenciennes 1850	•			•	Large	
<i>Serrasalmo Brandti</i>	<i>Serrasalmus brandtii</i> Lütken, 1875	•				Medium	
<i>Tetragonopterus lacustris</i> Rhdt. Ltk.	<i>Astyanax lacustris</i> (Linnaeus, 1758)	•	•			Small	73764
<i>Sternopygus virescens</i> Val.	<i>Eigenmannia microstoma</i> (Reinhardt, 1852)	•	•			Medium	73765
<i>Macrodon trahira</i> Sp.	<i>Hoplias malabaricus</i> (Bloch, 1794)	•	•			Medium	73838
<i>Rhamdia Hilarii</i> Val.	<i>Rhamdia quelen</i> (Quoy & Gaimard, 1824)	•	•			Medium	73769
	<i>Pamphorichthys hollandi</i> (Henn, 1916)		•			Small	-
	<i>Serrapinnus heterodon</i> (Eigenmann, 1915)		•			Small	73774
	<i>Cichla cf. monoculus</i> Agassiz, 1831		•	•		Large	73767
	<i>Hoplias lacerdae</i> Ribeiro, 1908		•	•		Large	73772
	<i>Hoplosternum littorale</i> (Hancock, 1828)		•	•		Medium	73766
	<i>Tilapia rendalli</i> (Boulenger 1877)		•	•		Medium	73768
	Total	17	10	4	3	-	-

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