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Scientific Note

Radiotelemetry of a female jaú, *Zungaro jahu* (Ihering, 1898) (Siluriformes: Pimelodidae), passed upstream of Funil Dam, rio Grande, Brazil

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Jaú, *Zungaro jahu* (Ihering, 1898), a large migratory catfish endemic to the rio da Prata basin, has a fragile conservation status and its ecology is poorly known. We radio-tracked a female jaú with a total length of 1.5 m that was passed upstream of Funil Dam, rio Grande, to describe its migratory movements, habitat use, linear home range, and diel activity. To track the fish, we made five tracking trips in the period from April, 2003 to January, 2004. In addition to the main body of Funil Reservoir, the fish also used a reservoir-river transition zone located in a branch of Funil Reservoir that flooded part of rio das Mortes. Most of the times, we found the fish in the former beds of streams flooded by the reservoir, at depths that ranged from 8-9 m in the reservoir-river transition zone to 18-21 m in Funil Reservoir. Linear home range of the fish was 31.4 km. The onset of activity occurred early in the evening, but we also detected daytime activity. The conclusion from our study was that the passed adult female jaú used reservoir habitats, migrated between the main body and the reservoir-river transition zone, preferred deep habitats, showed a relatively short home range, and had diurnal and nocturnal activities.

O jaú, *Zungaro jahu* (Ihering, 1898), é um bagre migrador de grande porte endêmico da bacia do rio da Prata, possui frágil *status* de conservação e sua ecologia é pouco conhecida. Nós rastreamos uma fêmea adulta de 1,5 m de comprimento total transposta para montante da barragem de Funil, rio Grande, para descrever movimentos migratórios, uso do hábitat, área de vida e atividade circadiana. Fizemos cinco viagens, de abril de 2003 a janeiro de 2004, para localização do peixe marcado. O indivíduo utilizou a zona de transição reservatório-rio, localizada no braço do reservatório de Funil que alagou parte do rio das Mortes. O peixe também utilizou o corpo principal do reservatório. Nós o encontramos principalmente nos antigos leitos dos rios que foram alagados em profundidades que variaram de 8-9 m, na zona de transição reservatório-rio, a 18-21 m, no corpo principal do reservatório de Funil. A área de vida linear foi de 31,4 km. O período de atividade ocorreu no início da noite mas também encontramos atividade durante o dia. Concluindo, este estudo demonstrou que a fêmea adulta de jaú transposta usou hábitats do reservatório, migrando entre o corpo principal e a zona de transição reservatório-rio, preferiu ambientes profundos, apresentou área de vida pequena, e mostrou atividade diurna e noturna.

Key words: Catfish, Endangered species, Migration, Home range, Habitat use.

Jaú, *Zungaro jahu* (Ihering, 1898), is endemic to the rivers that form the rio da Plata basin (in rio Paraná, rio Paraguay and rio Uruguay), occurring in Argentina, Bolivia, Brazil, and Paraguay (Lundberg & Littmann, 2003; Zaniboni Filho & Schulz, 2003). Jaú is one of the largest Neotropical catfishes and may reach a weight of up to 150 kg (Ihering, 1929). It is a main stem migratory species (Agostinho *et al.*, 2003, Resende, 2003), but its migratory movements are poorly known. Jaú reaches maturity at 70 cm (total length) and spawns from December to February in the upper rio Paraná (Agostinho *et al.,* 2003). Jaú is nocturnal and piscivorous, and adults prefer deeper habitats in large rivers (Agostinho *et al.*, 2003; Resende, 2003). It is an important commercial and sport fish, and substantial commercial landings still occur in long, free-flowing river stretches (Mateus *et al*., 2004). However, jaú has been overexploited in rio Paraguay and rio Paraná (Agostinho *et al.,* 2003; Resende, 2003). Also, it has practically disappeared in the southern part of its distribution area (Quirós, 1993). It used to

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be abundant in rio Grande (Azevedo, 1965), but now occurs in only a few places (Godinho, 1998). In addition to the fragile conservation status of jaú, its biology and ecology are poorly known (Agostinho *et al.*, 2003; Resende, 2003).

Zungaro jahu and *Z. zungaro* are the two valid species of the genus *Zungaro*. The Amazonian species, *Z. zungaro,* is listed as "overexploited or endangered by overexploitation" in Brazil (MMA, 2004). Inclusion of *Z. zungaro* in this list, instead of *Z. jahu,* was an error that urgently needs to be amended. Jaú (*Z. jahu*) is listed as being vulnerable in two Brazilian states, *i.e.*, Minas Gerais and Paraná (Machado *et al.*, 1998; Mikich & Bérnils, 2004). The Minas Gerais list has recently been revised, but has not yet been published. Jaú will be listed as critically endangered in the new Minas Gerais list.

In this 10-month study, we radio-tracked a jaú specimen that was passed upstream of Funil Dam, rio Grande, to describe its migratory movements, habitat use, linear home range and diel activity. This is the first biotelemetry study on jaú conducted in Brazil.

Rio Grande, located in the upper rio Paraná basin, is a medium-size Brazilian river with an approximate length of 1,250 km. Rio Grande joins rio Paranaíba to form rio Paraná on the border between the states of Minas Gerais, São Paulo, and Mato Grosso do Sul. Rio Grande is today a cascade of 12 reservoirs. Funil Dam (21°08' 38" S 45°02' 11" W), the last one to be constructed, was built in 2000-2002, a few kilometers downstream of a famous fishing spot ("Ponte do Funil"). It is located in the upper rio Grande, 950 km from its mouth, in the stretch between Furnas Reservoir and Itutinga Dam. This section of rio Grande used to be one of its longest free-flowing remnants. Of the 12 dams on rio Grande, only the Igarapava and Funil dams have fishways. Almost 90% of the 1,486 mm annual rainfall in the study area occurs from October to March.

In March, 2003, a specimen of jaú was caught with a cast net just downstream of Funil Dam, transferred to a 2,500-liter holding tank, and radiotagged about 8 h later. We tagged the fish with a Lotek coded tag (frequency = 149.780 MHz; tag weight in air = 170 g; burst rate = 5 s), using the surgical method described by Godinho *et al*. (in press). We immobilized the fish in a 150-liter tank using electronarcosis with non-pulsed 25–60 V DC. During the surgery, we added LabProtect® to the water in the tank, to aid fish recovery. We inserted the tag into the body cavity of the fish through an incision along its ventral middle line and extended the antenna laterally to the body wall and outside the fish. Sex and gonadal stage were determined during surgery through macroscopic inspection of the organ. The fish, a female (most likely an adult) in resting reproductive stage, measured 1.5 m (total length) and weighed 43 kg. Soon after the surgery was finished, we released the fish in Funil Reservoir, 2.3 km upstream of the dam.

To locate the tagged fish, we conducted five tracking trips in the period from April, 2003 to January, 2004. Using a SRX_400 Lotek receiver, we tracked for the fish by boat in Funil Reservoir, in the navigable stretch of rio Grande, and in two major tributaries of rio Grande (rio das Mortes and rio Capivari). To detect the tag signal, we used two 3-element Yagi antennas set at an angle of 90° and set the receiver gain at a high value. After the tag signal had been detected, we reduced the receiver gain in order to locate the fish within < 20 m. At each fish location, we determined the coordinates with a GPS, and used a fishfinder to determine depth at the fish location and the depth profile of the transversal section of the water body. We determined the linear distance to Funil Dam for each fish location and then determined the fish linear home range as being the distance between the most up- and downstream location of the fish. In September, 2003, we radio-tracked the fish every 30 min during a 12-h period to detect the onset of activity. We also tracked the jaú continually on three other occasions, for 1 to 6 hours, to detect daytime movements.

We found the jaú in all tracking trips (Table 1). After released, we spotted the fish in April in a reservoir-river transition zone (RRTS) located in a branch of Funil Reservoir that flooded part of rio das Mortes (Fig. 1). Water velocity at the fish location was noticeable. In June and September, we found the fish at two locations separated by a distance of only 0.7 km in the still water of the main body of Funil Reservoir. In November, we again located the tagged jaú in the same RRTS in which it had been in April. The distance between the two locations in the RRTS was only (1.2 km). In January, we found the fish once again in the main body of Funil Reservoir.

The tagged jaú was in the RRTS at the end of the rainy season and at the beginning of the next rainy season (Fig. 2). The fish preferred to migrate towards the more turbid, free-flowing waters of rio das Mortes rather than towards the regulated rio Grande or the smaller rio Capivari. Preference for rio das Mortes could be the dominant behavior among local jaús, as rio das Mortes is the best river for jaú fishing, according to local fishers.

The jaú location depths were 8-9 m in the RRTS and 18-21 m in the main body of Funil Reservoir (Table 1). Most of the times, the fish was found in the former beds of streams that were flooded by the reservoir. This habit of remaining in deep areas is identical to that described by Agostinho *et al.* (2003) and Resende (2003).

Linear home range was 31.4 km, which is relatively short. Though very few linear home ranges have been determined for adults of large migratory Neotropical catfishes, they are believed to vary considerably. The linear home range of surubim females (*Pseudoplatystoma corruscans*), for example, range from 1–210 km (Godinho *et al*., *in press*), whereas the linear home range of piramutaba (*Brachyplatystoma vaillantii*) in the rio Amazonas basin is several thousand kilometers (Barthem & Golding, 1997). We never located the tagged jaú close to the dam, but it could have gone there and this movement may have gone unnoticed. Also, the fish could have moved further upstream of the RRTS. Jaú is known to occur 70 km upstream the RRTS (Pompeu, pers. comm.) and there is no barrier for fish migration in rio das Mortes upstream of the RRTS. Thus, we suspect that linear home range of the tagged jaú may be greater than 31.4 km. The fact that

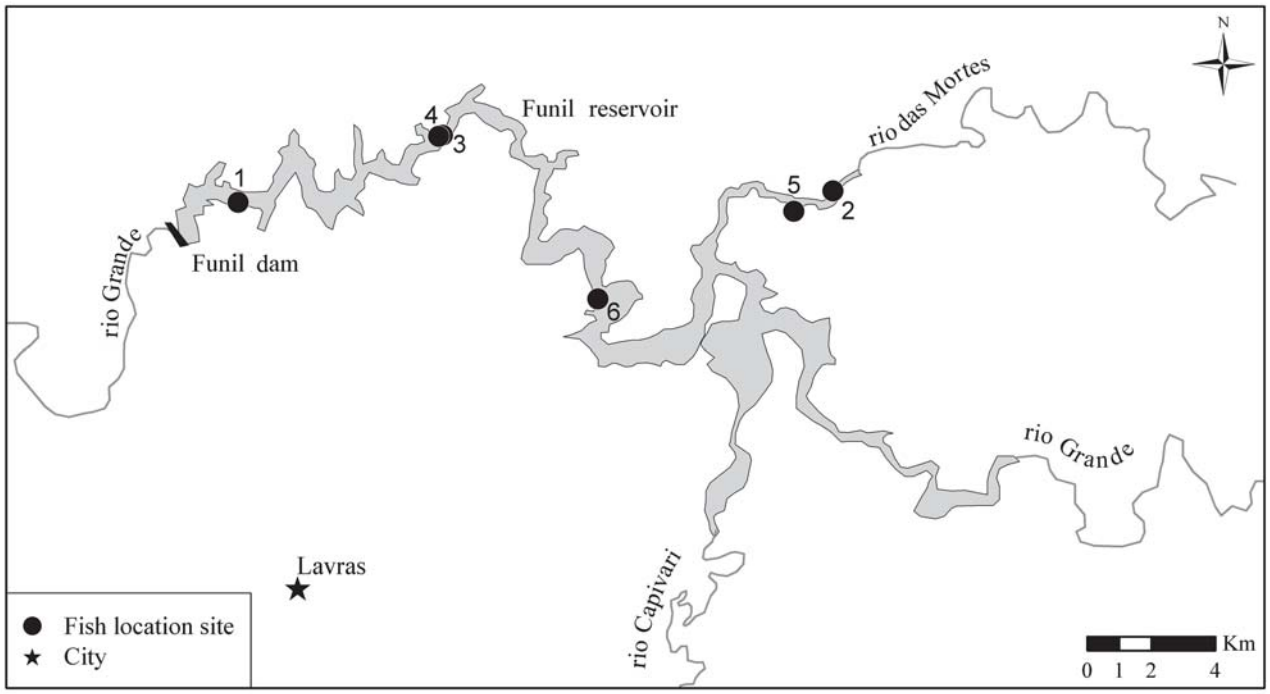

Fig. 1. Map of Funil Reservoir showing locations (%) of the tagged jaú. Location numbers as in Table 1.

we did not find the tagged jaú near the dam suggests that passed adult jaú specimens may not want to return downstream. If this is so, a downstream fishway for adult jaú would be unnecessary at Funil Dam. However, this finding needs to be tested for more individuals, including juveniles, to be validated.

In September, we located the fish at 10:50 h in the main body of Funil Reservoir where in the past there was a rapid (Itapecerica Rapid) that used to be a fishing site for jaú. Until early evening, the fish had moved only 100 m (linear distance). At 19:46 h, the fish moved and, 24 min later, we found it 360 m (linear distance) away. The fish stayed still until 20:48 h, when it moved again. We then searched for the fish for two hours, but could not find it. This indicates that the onset of jaú activity was early in the evening (local sunset time = 17:52 h). However, the tagged jaú also showed day-time activity. We detected the fish moving at noon, covering a distance of 764 m in 30 min, on one day, and 328 m in 2 h, on another day. Although the onset of activity in the evening corroborates the nocturnal habits of jaú described elsewhere (Agostinho *et al.*, 2003; Resende, 2003), our data indicate that jaú also displays diurnal activity.

We found in this study that the passed adult female jaú used reservoir habitats, migrated between the main body of the reservoir and the reservoir-river transition zone, preferred deep habitats, had a relatively short home range, and showed both diurnal and nocturnal activities.

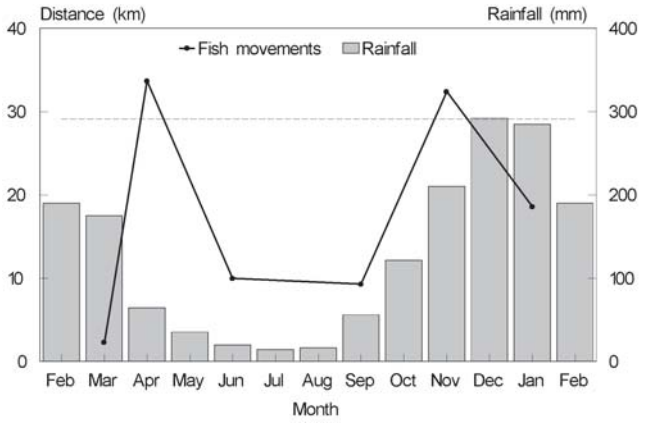

Fig. 2. Movements of jaú in Funil Reservoir, rio Grande, and rainfall in rio das Mortes. The y-axis on the left shows distances to Funil Dam. The horizontal dashed line indicates the location of the rio das Mortes mouth before it was flooded.

Table 1. Number, coordinates, and depth of locations of the tagged jaú in Funil Reservoir, rio Grande (MG, Brazil). * Released date.

Date	Fish location		
	Number	Coordinates	Depth (meters)
March, 2003*	1	21º 08' 07 S 45º 01 04 W	-
April, 2003	2	21º 08' 09 S 44º 50 22 W	8
June, 2003	3	21º 07' 03 S 44º 57 24 W	21
September, 2003	4	21º 07' 04 S 44º 57 28 W	18
November, 2003	5	21º 08' 12 S 44º 51 02 W	9
January, 2004	6	21º 09' 49 S 44º 54 36 W	-

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