TECHNICAL REPORT

PIRACEMA CANAL TECHNICAL VISIT

Itaipu Dam, Brazil, January 14th – 19th, 2004

Lisiane Hahn
University of Maringá

EVALUATION OF MIGRATORY FISH CAPACITY TO USE THE PIRACEMA CHANNEL AT ITAIPU DAM USING RADIOTELEMETRY TECHNIQUES

ITAIPU RADIOTELEMETRY PRELIMINARY TESTS

FIRST REPORT- JANUARY 2004

Itaipu Binacional

UEM- Nupélia

WFT

LGL

by

Lisiane Hahn, Karl K. English, Joachim Carolsfeld and Angelo Antonio Agostinho

Introduction

The Itaipu reservoir, formed in November 1982, has an area of 1,460 km^2, 835 km^2 of which are in Brazil and 625 km^2 of which are in Paraguay (Agostinho *et al*., 1992). The Itaipu dam has interrupted the natural migratory routes of the reophilic fish of the Paraná River. A decrease in the migratory fish population has been observed downstream of the dam due factors such as the loss of spawning areas and spillway impact that compromise egg and larval survival.

One possible option to mitigate the impacts of dams is the use of side channels, which lead migratory fish toward spawning areas (Borghetti *et al*., 1994). This measure was taken at the Itaipu dam, with the construction of the Piracema side channel. This channel was built in the hope of diminishing the impacts caused by the interruption of the river course by promoting the relocation of migratory fish up and downstream of the dam.

In January 2004 the project "Evaluation of migratory fish capacity to use the Piracema Channel at Itaipu dam using radiotelemetry techniques" was initiated, with the goal of evaluate the channel's efficiency of fish transposition. The project was developed in partnership with Núcleo de Pesquisas em Limnologia, Ictiologia e Aqüicultura (Nupélia) - Universidade Estadual de Maringá, and Itaipu Binacional, with the support of World Fisheries Trust and LGL Environmental Research Associates.

Several tests were performed on the channel between January 13th and 22nd, 2004 to establish the location of the fixed radiotelemetry stations and fish capture sites, to determine optimal frequencies, and to identify possible noise sources, among others. This report presents the results of these tests, as well as the procedures used to achieve them.

1. Study Area

The Piracema channel is approximately 10 km in length and connects the Itaipu reservoir to a natural stretch of the Bela Vista River. The Bela Vista River connects with the Paraná River approximately 1,500 meters downstream of the Itaipu spillway.

2. Methods

2.1. Study Area

Three fixed-stations were installed along the channel to monitor fish migration. Station locations are:

Station 1: First section of the ladder, upstream of the main channel's lake (1).

Station 2: First section of the ladder, immediately upstream of Grevilhas Pond (2).

Station 3: Regulation dyke, downstream of the channel gate (3).

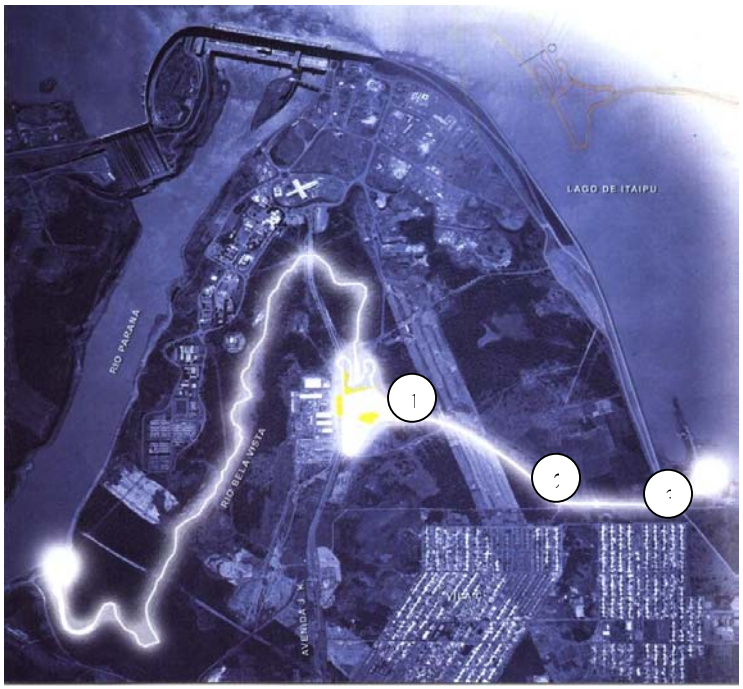

Figure 1. Piracema channel at Itaipu dam (numbered dots indicate fixed-stations)

2.2. Telemetry Equipment

Radiotelemetry equipment installed at each fixed stations included: a SRX 400 W31 Lotek receiver, two Yagi model ASP antennas with three elements (Grant Systems Engineering Inc.), an external 12 V battery and other accessories (connectors and cables).

Table 1. Receiver channels and frequencies used to monitor radio tags (preliminary tests)

Channel	Codes
03	025; 050; 100
05	001; 002; 003; 004; 005
09	007; 010; 014; 015
17	039; 104

2.3. Fish collection

Fish were collected using a 10 mm mesh size cast net at various locations on the channel. *Cichla ocelarus* were captured in Grevilhas Pond (also the release site - see map), *Prochilodus lineatus* were captured near the fish lab just downstream of the artificial section of the canal, *Leporinus friderici* and *Schizodon borellii* were also captured here and in the adjacent down-river sections, *Pseudoplatystoma fasciatum* were captured just upstream of Itaipu's road bridge across the canal close to the confluence with Bela Vista River, and *Pterodoras granulosas* were captured further downstream in the flood-plain reach of the Bela Vista River.

2.4. Tagging

Transmitters were inserted into the stomach or peritoneal cavity using a surgical procedure based on methods outlined in Adams *et al.* (1998) and described by Jepsen *et al.* (2002): "*The fish was placed in the anesthetic bath until operculum rate became slow and irregular (2- 4 min). The fish was then placed in a V-shaped surgical table and the transmitter was inserted into the body cavity through a mid-ventral incision, posterior to the pelvic girdle. The antenna was run through a hole from the body cavity, pierced with a blunt needle. The incision was closed with absorbable separate sutures. The duration of the operation was between 5 and 15 min. Recovery time was 1-4 min*".

Fish were anesthetized using either Clove oil (1ml diluted in 40 liters of water) or with electro-immobilization. Fish were immobilized electrically in a plastic box filled with approximately 40 liters of water. Two zinc plates, placed on either sides of the box, were connected to a 30-volt electrical current. Although the total 30 volts were required to cause complete immobilization of the fish, only 18 volts were used during surgery. Fish recovered approximately 5 seconds after the current was turned off.

External "LEA" hydrostatic tags were used to mark radiotagged fish. Each external tag included a message instructing fishermen to return tags and transmitter to the project.

2.5. Release Procedures

Tagged fish were released at Grevilhas Pond (see map). Fish were kept up to 3 days in the lab before release. Fish were transferred from the lab to the pond using a "Transfish" transport tank and were released using a dip net.

2.6. Data Management

2.6.1. Tagging and Release data:

The tagging and release data were recorded in an Excel spreadsheet (See Table 2).

2.6.2. Download Protocol:

Receiver data were downloaded and the general conditions of the fixed stations were checked (battery voltage, memory status and accuracy of the internal clock) a minimum of three times per week.

2.6.3. Data management and processing:

Data logged by the receivers were downloaded to a laptop as hex-encoded files, which were converted to standard ASCII format using software developed by LGL Limited (SRX400.EXE). Data analyses were performed using Telemetry Manager Version 2.8.

3. Results

3.1. Tagging

Between January 15th and January 21st, 16 fish were tagged and released into the Itaipu Piracema channel. The tagged fish belong to six species: *Leporinus friderici, Prochilodus lineatus,*

Schizodon borellii, Pterodoras granulosus, Pseudoplatystoma fasciatum and *Cichla monoculus* (table 2).

Transmitters were inserted non-surgically into the stomachs of four fish: *P. lineatus* (two specimens, one of which died), *L. friderici* (one specimen) and *C. monoculus* (one specimen). The transmitter was removed from the *C. monoculus* specimen after release, as it was causing high levels of stress in the animal.

Transmitters were inserted surgically into the peritoneal cavities of twelve fish. Two of these were immobilized electrically for surgery (individuals of *L. friderici* and *Pterodoras granulosus*) and ten were anesthetized with clove oil. One of those anesthetized with clove oil died after surgery because too high a concentration of clove oil was used. The other nine fish anesthetized with clove oil survived surgery.

3.2. Migration

Pseudoplatystoma fasciatum:

Of the three *P. fasciatum* specimens, two remained at the release site (for 7 and 10 days) before moving past the upstream station and leaving the channel. The other swan approximately 2km downstream until it reached the main lake, were it remained until the last data was download on February 18th).

Pterodoras granulosus:

All three *P. granulosus* specimens were detected near Station 1 until February 2nd, after which only one was detected (still near Station 1). No further data was collected for the remaining two specimens.

Schizodon borelli:

Of the two *S. borelli* specimens, one remained in the mid-canal pond until February 13th (last download from that station), while the other was last recorded at Station 1 in the last week of January.

Leporinus friderici:

Both *L. friderici* individuals were last detected in the mid-canal pond on February 13th.

Prochilodus lineatus:

Both specimens were recorded leaving the canal, the first 55 hours after release and the second 25 days after release.

Cichla ocelaris:

Both *C. ocelaris* (tucunaré) individuals were last detected downstream of Station 1.

4. References

ADAMS, N. S., RONDORF, D. W., EVANS, S. D. & KELLY, J. E. 1998. Effects of surgically and gastrically implanted radio transmitters on growth and feeding behavior of juvenile Chinook salmon. *Trans. Amer. Fish. Soc.* 127 (1): 128-13.

AGOSTINHO, A. A., JÚLIO Jr., H. F. & BORGHETTI, J.R. 1992. Considerações sobre os impactos dos represamentos na ictiofauna e medidas para sua atenuação. Um estudo de caso: reservatório de Itaipu. Rev. *UNIMAR*, 14(Suplemento), p.89-107.

BORGETTI, J.R., NOGUEIRA, V.S.G., BORGHETTI, N.R.B. & CANZI, C. 1994. The fish ladder at the Itaipu Binacional Hydroelectric complex on the Parana River, Brazil. *Regulated Rivers: Research & Management*, V.9, p.127-130.

JEPSEN, N., KOED, A., THORSTAD, E. B. & BARAS, E. 2002. *Surgical implantation of telemetry transmitters in fish: how much have we learned?* Hydrobiology, 483:239-248.

Table 2. Tagging Data

Tag	LEA #	Code	Chan.	Species	Tl	Sl	Wt	Freq.	Time In	Time Out	Tag Date	Release Date	Release Time	Implant	Anest.
1	34208	5	5	P. lineatus	---	55	---	148,400	20:45	---	15/01	18/01	12:47:50	Stomach	
2	32021	15	9	L. friderici	39.8	35	10.5	148,800	---	---	15/01	18/01	12:00:40	Stomach	
3	32299	4	5	L. friderici	36	29.2	550	148,400	14:15	14:30	16/01	18/01	12:13:16		
4	32549	104	17	P. lineatus	57.9	49.2	3.3	150,640	14:41	15:04	15/01	18/01	11:58:11	Surgery	Clove Oil
5	32070	10	9	S. borelli	42.5	27	850	148,480	15:30	15:42	17/01	18/01	12:02:30	Surgery	Clove Oil
6	33671	3	5	S. borelli	39	34	550	148,400	12:25	12:52	18/01	18/01	12:04:10	Surgery	Clove Oil
7	33995	50	3	P. granulosus	54	48	2050	150,360	13:14	13:42	18/01	18/01	12:12:19	Surgery	Clove Oil
8	33825	39	17	P. granulosus	64	40	1850	150,640	13:49	14:28	18/01	18/01	12:09:40	Surgery	Electroshock
9	[1]	14	9	P. fasciatum	77	66.5	2.9	148,480	15:06	15:26	18/01	18/01	14:43:50	Surgery	Clove Oil
10	31691	7	9	P. fasciatum	75	68	2.8	148,480	15:32	15:52	18/01	18/01	12:47:10	Surgery	Clove Oil
11	33836	100	3	C. ocelaris	49	42	1.5	150,360	17:25	17:49	19/01	20/01	18:00:00	Surgery[2]	Clove Oil
12	31952	2	5	C. ocelaris	41	35.5	800	148,400	10:20	10:40	21/01	21/01	12:27:00	Surgery	Clove Oil
13	32022	25	3	P. fasciatum	86	77	4.7	150,360	11:20	11:47	18/01	21/01	12:25:00	Surgery	Clove Oil
14		25	24	P. granulosus								22/01	16:21:00		

[1] External tag was removed
[2] Norberto, Lisiane and Domingo participated in the surgery