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NOTA

RAPID SHIFT OF THE FISH ASSEMBLAGE UNDER CONTRASTING LIGHT INTENSITY SCENARIOS DURING TWILIGHT IN SANDY BEACHES OF URUGUAY RIVER (RÍO NEGRO, URUGUAY).

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ABSTRACT

A comparative study of fish assemblage in two contrasting light scenarios in sandy beaches of lower Uruguay River showed an increase in species richness and mean standard length during the night. *Bryconamericus stramineus* was the most abundant and also the smallest fish species, showing littoral diurnal habits.

Keywords: horizontal migrations, spatial distribution, monitoring, twilight changes

RESUMEN

Cambio rápido del ensamble de peces bajo escenarios contrastantes de intensidad de luz durante el atardecer en playas arenosas del Río Uruguay (Río Negro, Uruguay). Un análisis comparativo del ensamblaje de peces en dos escenarios contrastantes de luz en playas arenosas del Río Uruguay bajo, mostró un incremento en la riqueza y longitud estándar media durante la noche. La especie más abundante y de menor tamaño fue *Bryconamericus stramineus,* mostrando hábitos costeros diurnos.

Palabras Claves: migraciones horizontales, distribución espacial, monitoreo, cambios al atardecer.

The distribution of fish within an ecosystem is determined by a complex series of responses to both physical and biological environmental characteristics. These responses allow the individuals to select the habitats that offer the best combination of resource availability and predator avoidance. Light intensity is one of the abiotic factors that play an important role in fish behavior (Jonsson, 1991; De Robertis *et al*., 2003; Jacobsen *et al*., 2004; Pekcan-Hekim & Lappalainen, 2006, Gelós *et al*., 2010). Several studies arrayed in rivers of northern temperate regions, show an increase in abundance of small fishes in littoral zones at night, attributed to a predator avoidance behavior (Copp, 1992; Sandres 1992; Copp & Jurajda, 1993). In the same way, a comparative study carried out in five shallow lakes of Uruguay, demonstrates an increase

in the activity of small fishes during the night, also probably linked to a predator avoidance behavior (Gelós *et al.*, 2010). These works evidence important changes in the fish community under different light scenarios, probably reflecting an effect of light intensity on the ecosystem functioning. On the context of fish community monitoring programs or diversity surveys, it is extremely important to understand these changes to obtain representative samples of the study site. In lower Uruguay River, fish community studies are incipient (Errea *et al.*, 2008; Teixeira-de Mello *et al.*, 2009), and none of them about the variation in sandy beaches' fish assemblage due to changes in the light intensity that occurs during twilight. Thus, we developed a preliminary study to address changes in fish assemblage between day (complete clarity) and night (complete darkness) at the beginning and end of the twilight period in sandy beaches of the lower Uruguay River, in Río Negro County, Uruguay.

Sandy beaches were sampled on two consecutive years. On May 29-31, 2009, two sites were sampled: site A, a sandy beach located upstream from the mouth of Laureles stream (33°06'41''S, 58°12'37''W); and site B, a sandy beach between the mouths of M'Bopicua and De la Calera streams (33°06'40'' S, 58°10'10'' W). The second sampling was conducted two times in the same beach at Las Cañas (33°10'04''S, 58°21'27''W), on April 23-24, 2010 (site CI) and on April 30-May 01, 2010 (site CII). Each site was sampled on two contrasting light scenarios within the twilight period: one hour before (complete clarity, referred as "day" on the text) and one hour after (complete darkness, referred as "night") sunset; 17:00-17:30 hs and 19:30-20:00 hs, respectively. Fish were collected using a seine net 0.5 cm mesh size (5.5 m large, 1.0 m high). The fish sampling consisted in four seine drags during each light period in direction to the shore, with a drag distance of 20 m in a maximum depth of 1.5 m. Fish were sacrificed with 2-Phenoxi Ethanol (1ml l^{-1}) overdoses, classified to the lowest taxonomic level, and measured (standard length – Ls, 0.1 cm). The studied parameters used were: species richness, abundance (total number of individuals), and mean standard length. Differences in these parameters between day and night, sites, and the interaction of both factors were tested with a factorial design two way-ANOVA. Normality was analyzed using the Kolmogorov-Smirnov test and homogeneity of variance with the test of Levene (Sokal & Rohlf, 1981). Assumptions for ANOVA parametric test (Underwood, 1997) were accomplished by all the studied parameters.

A total of 213 individuals were collected, belonging to 14 species and four orders. The sites analyzed had a lower diversity than similar sites with aquatic vegetation from Uruguay River (Teixeira de Mello, unpublished data). The most represented order was Characiformes, and within this, the most abundant species was *Bryconamericus stramineus* (Table 1). This is the most abundant and frequent fish in the littoral zone of middle and lower Uruguay River (Errea *et al.*, 2008).

Species richness was significantly different among sites ($p<0.0001$) and higher at night- compared to day-time ($p=0.015$). Additionally, significant effects of the site-time interaction were found ($p=0.0009$), implying that the differences of day/night richness may depend on the studied site (Table 2).

However, the graph of richness *versus* sites (Fig. 1) clearly shows that, despite site-specific quantitative differences, the pattern of higher fish richness at night is strong and conspicuous to all studied sites. Moreover, the total richness (integrating specific composition from all replicates) *per* sampling time and site is clearly different between day and night (Lauereles 2 vs. 4; Bopicua 2 vs. 5; Las CañasI 1 vs. 12; Las CañasII 1 vs. 9; day and night respectively).

Mean standard length was significantly different among studied sites ($p=0.0289$), and significantly higher during the night ($p<0.0001$) (Table 3 and Fig. 2), and there was no interaction between site and time on this pattern (Table 3).

Table 1. Mean standard length of individuals collected; species composition and abundance variation between day and night samplings.

Order	Species \ Sites	Day	Abundance Night	Mean standard lenght (Day + Night)
Characiformes	*Apareiodon affinis*	4	9	8.5
	Astyanax abramis	-	14	7.1
	Astyanax sp.	-	33	7.3
	Bryconamericus stramineus	77	24	3.3
	Oligosarcus oligolepis	-	3	10
	Salminus brasiliensis	2	-	13.9
	Holothestes pequira	-	7	3.3
	Prochilodus lineatus	-	1	13.4
	Leporinus striatus	-	1	6.6
Siluriformes	*Homodiaetus sp.*	-	3	4.8
	Iheringhthys labrosus	-	3	6.4
Atheriniformes	*Odonthesthes aff perugiae*	-	15	10.8
	Pimelodella gracilis	-	16	5.9
Pleuronectiformes	*Catathyridium jenynsii*	-	1	7
	Total nº individuals	83	130	

Table 2. Two way factorial ANOVA results for richness.

Source	df	Mean Squares	F	Significance
site	3	4.28	4.24	<0.0001
time	1	81.28	80.44	0.0154
site*time	3	7.78	7.70	0.0009
error	24	1.01		
total	31			

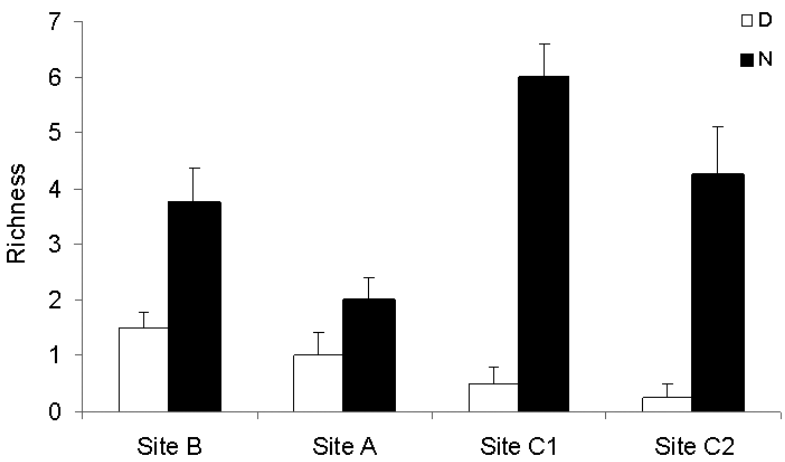

Fig. 1. Day-night richness variations for all studied sites; night values= black bars (N), day values= white bars (D).

Table 3. Two way factorial ANOVA results for mean standard length.

Source	df	Mean Squares	F	Significance
site	3	5.52	3.78	0.0289
time	1	54.97	37.64	<0.0001
site*time	3	0.56	0.38	0.765
error	18	1.46		
total	31			

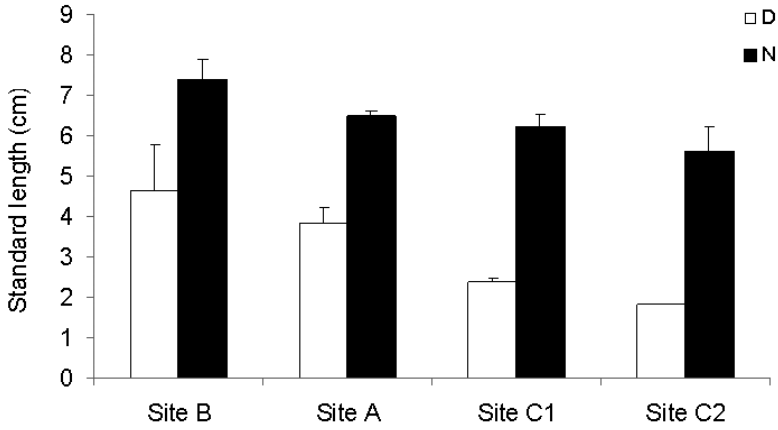

Fig. 2. Day/night mean length variation for the studied sites; night values= black bars (N), day values= white bars (D).

For the fish abundance, no significant differences were found between day and night, although the fish species composition was totally different between the two moments sampled (Table 1). At a species level, *B. stramineus* was the most abundant and the smallest species. This species inhabited the littoral zone mostly during the day, as well as *Apareiodon affinis* and *Salminus brasiliensis* juveniles, while the rest of the collected species used the river margin during the night (Table 1). Despite present study does not allow a conclusion about underlying mechanisms for this phenomenon, these differences in the use of littoral zones could be related to a predator avoidance behavior. Although different mechanisms could explain day-night difference in the use of spatial resources, Ross (1986) remarked an ancestral character of this resource partition, based on the fact that this partition is given to a family or order level many times. Therefore, the differences found may be due to historical causes rather than the current ecological interactions of the community (Ross, 1986).

During this study all fish collected were small sized, however, those collected during the day were the smallest. The observed species specific horizontal migrations could be indicating a combination of predator avoidance and feeding behaviors, current or historical. These preliminary results are the first obtained for sandy beach zones of lower Uruguay River, and clearly show fast changes in the fish assemblage at the beginning and end of twilight. Hense, the present study stresses the importance of including day and night samplings in these habitats (sandy beaches) during species diversity monitoring sampling campaigns. We thank

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