Sound production in four species of the Loricariidae family

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Received September 4, 2012 – Accepted September 17, 2012 – Distributed August 31, 2013

Many fish species use acoustic signals for a variety of purposes (Lobel, 2002). One application of bioacoustics is the use of passive acoustic technology to record temporal and spatial patterns of fish reproduction by detecting sounds associated with spawning (Lobel & Mann, 1995) and other behaviors associated with disturbance (Tellechea et al., 2011).

This paper documents, for the first time, sound production by four species, *Hypostomus commersoni* (n = 3), *Hypostomus derbyi* (n = 2), *Paraloricaria vetula* (n = 2) and *Ricola macrops* (n = 2) from the Uruguay River in Uruguay, South America. To our knowledge, there are no studies in the region on sound production by Loricariidae fish species. This family of catfish (Order Siluriformes), typical of South American freshwater habitats (Nelson, 2006), consists of almost 700 species and new species are described every year.

Fish were collected with a multi-mesh net in April 2008 at three sites on the Lower Uruguay River, Uruguay. The specimens were maintained live in 300 L tanks with river water at a temperature ranging from 15 to 17 °C, as measured at the collection site. Each fish was captured with a hand net and placed at a 1 m distance from the underwater hydrophone in a separate 50 L tank for recording. After each recording, fish were sacrificed with an overdose of anesthesia (solution of 2-Phenoxy-Ethanol, 1 mL L^{-1}). Total length (TL) in cm and sex were also determined.

Recordings were made with a hydrophone built in the laboratory (sensitivity-40 dB re: 1 µPa and linear from 20 Hz and 60 kHz) on a digital recorder TASCAM HD-P2, with a sampling frequency of 44.1 kHz. Sound analysis was performed using Audacity free software, version 1.2.3. Power spectra were calculated using a 1024-point Fast Fourier Transform (FFT) with a Hanning window. The four species emitted sound, as a disturbance call produced by the teeth, when fishes were immobilized underwater with the hand or outside the water.

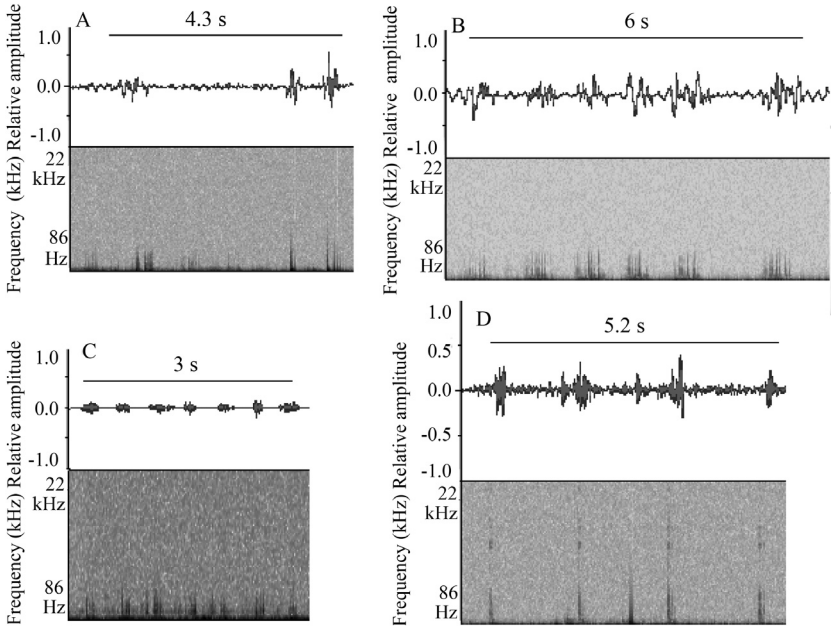

Figure 1 - Oscillogram and sonograms using the hamming window function and an FFT size of 1024 points (Audacity software). A) *H. commersoni* dominant frequency, DF 348 Hz. B) *H. derbyi*, DF 292 Hz. C) *P. vetula*, DF 389 Hz. D) *R. macrops*, DF 200 Hz.

H. commersoni produced a series of 5 to 10 pulses, with a duration of 26 ± 0.95 ms, interval and dominant frequency of 350 ± 5.10 Hz (Figure 1a). *H. derbyi* produced a series of a series of 4 to 8 pulses, with a duration of 28 ± 2.02 ms and a dominant frequency of 29 ± 4.64 Hz (Figure 1b). *P. vetula* also produced a series of pulses of 5 to 14 pulses with a duration of 30 ± 0.22 ms and a dominant frequency of 390 ± 3.23 Hz (Figure 1c). The third species *R. macrops* produced a series of 3 to 11 pulses, with a duration and dominant frequency of 20 ± 0.12 ms and 200 ± 6.08 Hz, respectively (Figure 1d).

Disturbance calls produced by fish in the Sciaenid family appear to indicate fright, alarm, pain, distress, or a similar state (Fish & Mowbray, 1970; Fine et al., 2004). Sorensen (1895) hypothesized that pectoral stridulation in South American catfishes could alert predators to the spine, and therefore Kaatz (1999) suggested that these sounds may have an aposematic function (Tellechea et al., 2011). The same behavior may be displayed by these species studied here as they have spines on their plates. This implies that disturbance calls could provide some evolutionary advantage as well. Disturbance calls in this family may have evolved as a behavior for defense or as an agony call to warn of danger. Future studies on the behavior of these species are necessary to understand the role of sound production.

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