SOUND PRODUCTION AND REPRODUCTIVE ECOLOGY OF STRONGLY ACOUSTIC FISH IN AFRICA: POLLIMYRUS ISIDORI, MORMYRIDAE

by

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Summary

We have studied the reproductive ecology and bioacoustic signals of weakly electric mormyrid fish in Africa in order to discover the natural conditions under which acoustic signals are used and to gain insight into the evolution of their acoustic behaviour and hearing. *Pollimyrus isidori* migrated from a tributary of the Niger River (Mali) into a shallow (2-3 m) flood plain during the onset of the flooding seasons (August, 1991 and 1994). The

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fish were fully primed for reproduction upon entering the plain, females were significantly larger than males, and the sex ratio was skewed toward males (about 2 males per female). Males established territories (d $\approx$ 1 m) within the roots of floating rafts of grasses, about 0.5 m below the water surface. Males produced conspicuous acoustic displays consisting of *Grunts* and *Moans* during the night (130 dB peak re 1 μPa at approximately 10 cm). These sounds had a fundamental of 340 Hz, but the band-width of the grunt extended to over 3 kHz. Experiments at the field site with captive animals showed that male sound production was stimulated by the presence of conspecific females. The *P. isidori* repertoire included 3 additional sounds. Analysis of environmental noise showed that these communication sounds fall within a distinct spectral window, thereby minimizing potential interference from other aquatic animals and abiotic noise sources. Waveform analyses showed that the sounds remained coherent over short distances (0.5 m) but lost amplitude more rapidly than would be predicted in a deep water free-field.

Keywords: animal communication, migration, electric fish, bioacoustics.

Introduction

The detection and analysis of acoustic communication signals are fundamental functions of auditory systems; communication with sounds is ubiquitous among terrestrial vertebrates and has been the subject of considerable research. From a comparative and evolutionary perspective, underwater hearing and sound communication in fishes are of great interest and promise insight into the biology of vertebrate communication generally. Nevertheless, detailed analyses of both hearing and communication have been carried out on only a relatively small number of marine (see Winn, 1964, 1967; Fish, 1970; Tavolga, 1971; Fish & Offutt, 1972; Fine, 1978, 1981; Myrberg, in press) and freshwater species (see Gerald, 1971; Ladich *et al.*, 1992).

Specializations of the inner ear for detecting sound pressure, including gas-filled bubbles within the ear and bony ossicles linking the swim bladder to the inner ear, have evolved in several distantly related fish groups (*e.g.* Cyprinidae, Clupeidae, Holocentridae and Mormyridae; reviewed by Schellart & Popper, 1992). Acoustic communication and hearing are of particular interest in these specialized fishes but have received little attention (but see von Frisch, 1938; Delco, 1960; Stout, 1963; Winn, 1964; Popper *et al.*, 1973). All of the African Mormyridae, well known as *weakly electric* fish (Moller, 1995), have a gas-filled bubble coupled to the sacculus in each ear (Heusinger, 1826; Stipetić, 1939; Orts, 1967; Taverne, 1973; Werns &