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Sounds produced by the longsnout seahorse: a study of their structure and functions

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Abstract

Seahorses are known to produce sounds in different behavioural contexts, but information on the sound production in this fish group is scarce. Here we examined the acoustic behaviour of the longsnout seahorse *Hippocampus reidi* by analysing sound production when fish were introduced to a new environment and during feeding, handling and courtship. We show that males and females produce two distinct sound types: 'clicks' (main energy between 50 and 800 Hz) during feeding and courtship, and previously undescribed 'growls' (main energy concentrated below 200 Hz). The latter consists of series of sound pulses uttered in stress situations when the animals were handheld. Growls were accompanied by body vibrations, and may constitute an additional escape mechanism in seahorses, which might startle predators. During reproductive behaviour, clicks were most abundant on the third (last) day of courtship; they were particularly associated with the males' pouch-pumping behaviour, suggesting synchronization between sound production and courtship behaviour. This is consistent with the biology of *Hippocampus* species, which are mostly monogamous and form pair bonds. Thus, a courtship call may be used to signal readiness to mate.

Introduction

Fishes produce sounds in a wide range of contexts, such as during territorial defence, in disturbance situations, during feeding, territory advertisement, mate attraction, courtship and spawning (for a review, see Ladich & Myrberg, 2006; Myrberg & Lugli, 2006; Kasumyan, 2009; Luczkovich, Sprague & Krahforst, 2011). Bony fishes possess the largest diversity of sound-producing mechanisms of all vertebrate classes (Ladich & Fine, 2006). The majority of vocal species studied so far produce low-frequency sounds by vibrating their swim bladders via intrinsic or extrinsic drumming muscles. Some taxa such as catfish generate broadband stridulatory sounds by rubbing pectoral spines in grooves of the shoulder girdle (Fine & Ladich, 2003; Ladich & Fine, 2006; Parmentier *et al*., 2010; Ladich & Bass, 2011).

Sound production in seahorses (*Hippocampus* spp.) has been mentioned in several ecological and behavioural studies, mainly during feeding events (e.g. Bergert & Wainwright, 1997; Felício *et al*., 2006; Anderson, 2009). The most conspicuous sounds emitted by those fish are broadband clicking sounds, which are generated by a skull stridulatory mechanism (Colson *et al*., 1998). Additionally, seahorses reportedly vocalize when introduced to new environments, in stress situations (i.e. when handheld) and during courtship (Dufossé, 1874; Fish, 1953; Fish & Mowbray, 1970; Colson *et al*., 1998; Anderson, 2009; Anderson *et al*., 2011).

The first probable record of sound production by seahorses dates from the nineteenth century (Dufossé, 1874). Nonetheless, until recently, specific studies have been rare and limited to a few species (*H. hippocampus*: Dufossé, 1874; *H. erectus*: Fish, 1953; Fish & Mowbray, 1970; Colson *et al*., 1998; Anderson, 2009; Anderson *et al*., 2011; *H. zosterae*: Colson *et al*., 1998; *H. kuda*: Chakraborty *et al*., 2014).

Besides sound production, seahorses exhibit complex behaviours and life histories, such as low mobility, small home ranges, mate fidelity (in most species studied), a complex courtship behaviour and male 'pregnancy' (Foster & Vincent, 2004). Therefore, seahorses provide an opportunity to assess fish acoustic communication from a unique perspective. The present study investigated the sound repertoire and sound