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The reproductive behaviour of the African catfish *Heterobranchus longifilis* (Siluriformes, Clariidae) in an aquarium – Preliminary results

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ABSTRACT. Aggressive and spawning behaviours of *Heterobranchus longifilis* were observed in aquaria under controlled environmental conditions. Reproductive behaviour was induced in 11 groups of two to six fish by means of a single injection of carp pituitary extract . Behavioural data were recorded by direct observation or with a camera system. Sexual behaviour was observed in six groups, but egg release was observed in only one, the responses to hormonal stimulation differing strongly. The complete spawning sequence was observed, including aggressive (lateral display, circling display, biting, and rapid swimming head against head) and spawning behaviours (swimming head against head, male folding his body around the head of the female, spawning and egg release, egg scattering).

KEY WORDS: catfish, reproductive behaviour.

INTRODUCTION

Some species of African catfish of the Clariidae family, such as *Clarias gariepinus* (Burchell, 1822), have been abundantly studied in most aspects of their biology (TEUGELS, 1982). The knowledge gained has been used to develop farming of these species (LEGENDRE & PROTEAU, 1996; MICHA, 1972).

Heterobranchus longifilis Valenciennes, 1840 is a member of the Clariidae family of great interest for aquaculture because it has one of the fastest growth rates among African catfish (LEGENDRE et al., 1992). Multidisciplinary research on this species has recently developed in Belgium. It has focused on morphology (ADRIAENS & VERRAES, 1994; VANDEWALLE et al., 1997), systematics (TEUGELS et al. 1990), genetics and phylogeny (TEUGELS *et al.*, 1992), ecology and behaviour (BARAS et al., 1998; BARAS, 1999). The reproductive cycle of *Heterobranchus longifilis* (FREUND et al., 1995) and the associated histological changes (NUNEZ RODRIGUEZ et al., 1995) have been studied, but the reproductive behaviour of this species has not been described in detail, in contrast to that of *Clarias gariepinus* (BRUTON, 1979; VAN DER WAAL, 1974). Here we focus on the various sexual behaviours of *Heterobranchus* longifilis and their temporal succession during mating in a large aquarium (5 m^3).

MATERIAL AND METHODS

The study was carried out between January and July 1997 in the Laboratory of Fish Ethology of the University of Liège, Belgium (PONCIN & RUWET, 1996). The fish, whose characteristics are listed in Table I, were from the Laboratory of Fish Demography and Aquaculture of the Tihange station where they were born and reared in captivity until reaching sexual maturity (BARAS et al., 1998).

The experiments were carried out in a 5-m^3 aquarium (3.5 m x 1.3 m x 1.2 m) connected to a 750-l biological filter equipped with two circulating pumps (2 x 3m^3/h). The lighting (two 70-W mercury vapour lamps) was maintained constant 12L/12D (7:00 AM – 19:00 PM). During mating, however, the lamps remained on even if mating continued into the night. The temperature of the water was maintained at 26°C. The bottom of the experimental aquarium was covered with artificial plants.

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Outside the experimental period, the fish were kept in a 1-m^3 tank with a separate filter.

Daily, the fish were fed pellets (Trouvit "Tilapia 4.5", 38% protein) and fresh fish ad libitum.

TABLE 1

Characteristics (total length and weight) of the fish of the 11 experimental batches.

Batch n°	Males		Females	
	Length (mm)	Weight (g)	Length (mm)	Weight (g)
1	320	234	350	290
	420	688	440	740
2	420	682	520	1437
	450	762		
3	485	841	510	1196
4	460	784	530	1449
5	530	1187	600	1882
6	480	741	580	1748
7	the same fish as in batch n° 6			
8	340	236	360	340
	390	365	360	343
	340	237	340	303
9	330	233	350	363
	390	373	400	500
	380	360	370	427
10	the same fish as in batch n° 9			
11	390	383	390	484
	410	432	380	455
	330	234	460	825

As we were unable to obtain spontaneous matings, 17 selected specimens received an injection of carp pituitary extract (6 mg/kg for females; 2 mg/kg for males) as described by WOYNAROVICH & HORVATH (1981), so as to induce and synchronise spawning. Eleven batches of two to six fish were thus hypophysised (Table 1). Some pituitary extract injections were done in the morning (between 4:00 AM and 9:00 AM) and others at night (between 19:00 and 0:30), as we did not know the response time of the fish.

The behavioural data (sexual and aggressive behaviours) were recorded with a video camera controlled from a room adjacent to the room housing the aquariums (Fig. 1). Females were identified from the males because they exhibited stoutness.

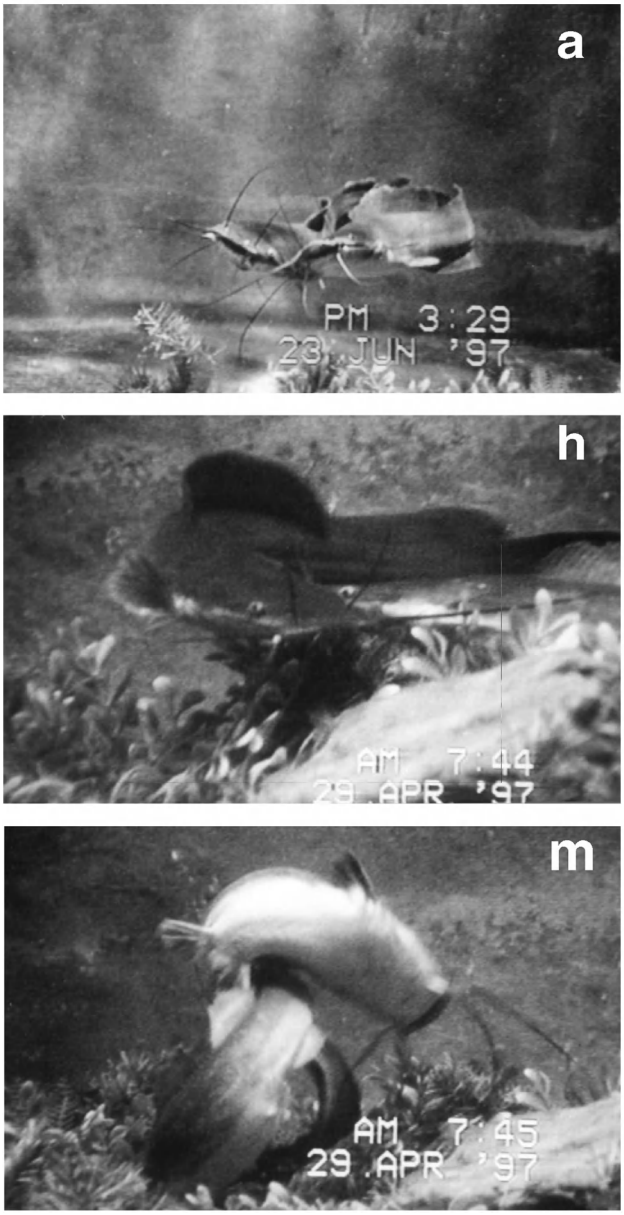

Fig. 1. – Aggressive and spawning behaviour of *H. longifilis* in aquarium. "a", "h" and "m" are related to the same items of Fig. 2. See the text for explanations.

RESULTS

Aggressive behaviours

Various aggressive behaviours were observed in *H. longifilis* with or without hormonal treatment. Both sexes displayed them indifferently. These behaviours were (Fig. 2): lateral display (a), during which both partners advanced slowly side by side with all their fins spread out, executing swimming movements with a seemingly exaggerated amplitude and giving each other powerful tail blows; head-to-tail display (b), a variant of the previous behaviour; carried out by two fish passing each other slowly, it was often followed by a circular motion (c) during which the fish, head to tail, circled in place, effecting a lateral display and biting (d) each other on the tail and side until the dominated individual fled; rapid swimming of the two opponents head against head (e). Neither the aggressive nor the sexual behaviours were associated with any actual colour patterns (the coloration was uniform), but we did observe a darkening of colour in dominant males and during male sexual displays. Dominated individuals were lighter in colour than dominant fish. These changes were rather slight.

Sexual display

The first sexual behaviours began about three hours post-injection (3 hours at 26°C =78 degree-hours). First we observed following (f) (Fig. 2), during which the male accompanied the female, swimming with his head against her sides and abdomen. This following was interspersed with periods of inactivity or solitary swimming. Male and

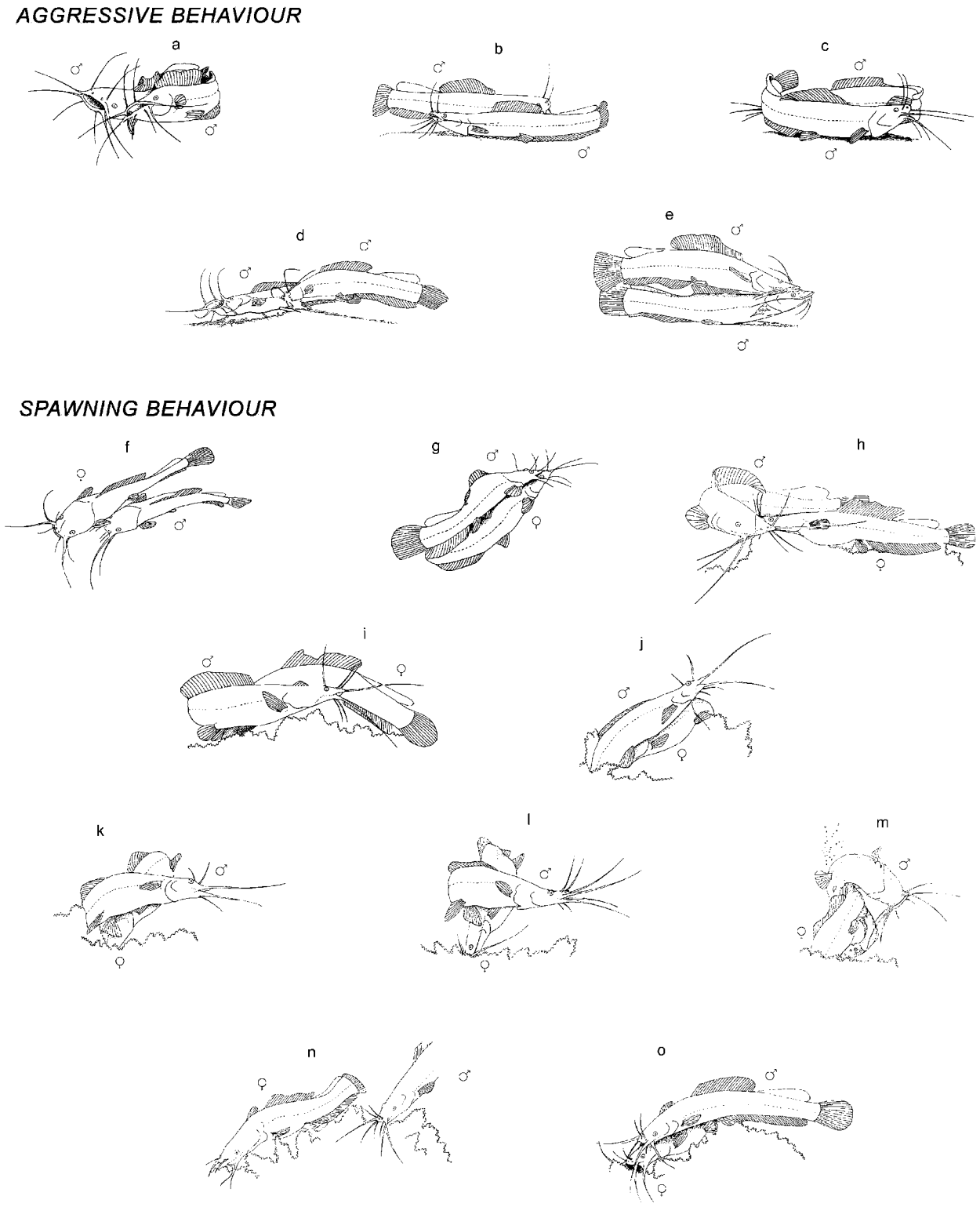

Fig. 2. – Aggressive and spawning behaviours in *Heterobranchus longifilis*: a, b: lateral display; c: circling display; d: biting; e and g: swimming head against head; f: male following female; h and i: male folds his body around the head of female; j, k, l, m: spawning act in which male folds his body around the body of female. Ova, sperm, and bubbles are released; n and o: female pushes her head into the substrate (vegetation) and beats her tail vigorously, mixing sperm and ova and distributing them over the substrate. The behaviours 'a', 'h' & 'm' are also illustrated by the plates with similar references.

female next swam head against head (g) while the male, located above his partner during a slow, calm swim, pressed his head against hers. This behaviour was similar to aggressive behaviour (e), rapid swimming head against head. When the female was ready to spawn, she effected a few burrowing movements in the artificial aquatic plants. The male, his body trembling, then encircled the female's head (Fig. 2: h, i, and j). He tightened his body around his partner's head while exerting pressure on her abdomen until the pair was immobilised by the surrounding vegetation. This amplexus was maintained for about ten seconds. In most batches observed, sexual display did not go beyond this stage. There was only one 'batch' of fish that spawned completely. When mating did continue, the male further tightened his grip and slid along the female's back as she positioned herself almost vertically, her head buried in the substrate (k and l). Then, when the partners' genital papillae were close to each other, she released a batch of eggs often followed by few bubbles of gas escaping from the genital pore or from the female's gills (m); presumably the male released his sperm at this time, but this was not seen. The male then moved away briefly, as the female, jaws anchored to the substrate, beat her tail to disperse the eggs (n and o). The eggs yielded larvae a few days later. Detailed monitoring of the frequency and duration of the main sexual behaviours was carried out on the only pair (in batch n°8) where spawning was observed (Fig. 3). Noteworthy was the high frequency of pursuit behaviour and enfolding behaviour associated with spawning acts.

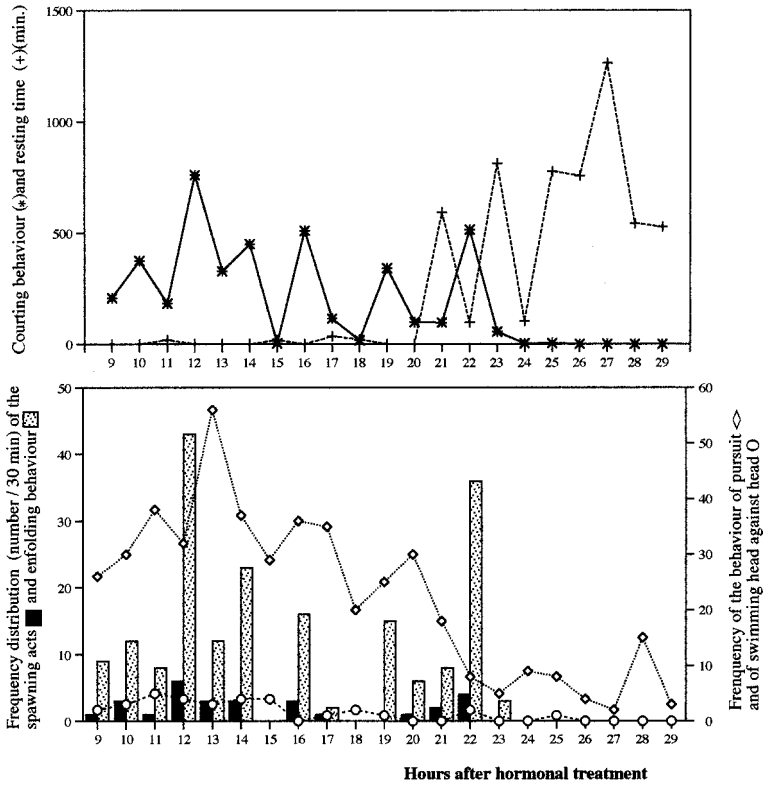

Fig. 3. – Duration of courtship and resting behaviours and frequency distribution of spawning acts, enfolding of the female by the male and pursuit., in a pair of *Heterobranchus longifilis* specimens (batch n° 8, in which egg release was observed).

DISCUSSION

This is the first detailed description of reproductive behaviour in *Heterobranchus longifilis*. This behaviour is quite similar to that of *Clarias gariepinus*, described by BRUTON (1979) and VAN DER WAAL (1974), and *Heteropneustes fossilis* (Heteropneustidae; a family closely related to the Clariidae) (ROY & PAL, 1986). It should be mentioned, however, that swimming head against head was not described by BRUTON (1979) for *Clarias gariepinus* in natural conditions (Lake Sibaya). Despite these differences, given the sympatric distribution of *H. longifilis* and *Cl. gariepinus* in some regions of Africa (MICHA, 1972) and their use of comparable spawning sites (flooded grounds) (GOSSE, 1963), it seems that extremely rare natural hybridisation might occur between these species (TEUGELS, pers. comm.). Moreover, by artificial fertilisation it is possible to obtain hybrids between Clariidae species (NA-NAKORN, 1995), and some hybrids are fertile (LEGENDRE et al., 1992; TEUGELS et al., 1992). However, AGUIGWO (1993) failed to obtain any hybrids of *H. longifilis* and *Clarias albopunctatus*, two genetically and morphologically distant species (AGNÈSE & TEUGELS, 2001). Factors such as morphological features, sound production, and pheromones could be important in bringing male and female catfish together (VAN WEERD, 1990).

Hormonal induction of spawning has been used previously to observe the reproductive behaviour of several fish species when spontaneous mating is hard to obtain in captivity. The similarity between the induced behaviours and those reported in the field (e.g. in *Clarias gariepinus*; BRUTON, 1979; VAN DER WAAL, 1974) indicated that this method does not influence qualitatively the behaviours expressed. To obtain spontaneous spawning (without hormonal stimulation) would require better knowledge of the role of environmental factors (water physico-chemistry, pluviosity, water-level variations,...) in controlling the seasonality of *H. longifilis* reproduction. This has already been investigated in *Clarias gariepinus* (HOGENDOORN, 1979; RICHTER et al., 1987; VAN WEERD, 1990).

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