effect of the seed shifting into germination mode and not vice versa. It is possible that a similar mechanism may be operating in mango varieties prone to ST formation, while the funiculus disconnection at hilum might be crucial in mango varieties free from spongy ST.

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Onset of sexual maturity in captive-reared endangered Indian seahorse, *Hippocampus kuda*

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The endangered Indian seahorse, *Hippocampus kuda* successfully reared in captive conditions for more than two years, repeatedly spawned and produced F_2 generations. In F_1 males, brood pouch started developing from 55 to 60 days of birth. The courtship behaviour was noted 30 days subsequently and males started receiving eggs in their pouch when their body length attained 101.0 ± 2.0 mm. Females started transferring eggs into the male brood pouch when their body length reached 110.0 ± 2.0 mm. The sexual maturity of male was earlier than that of female. Compared to the age (in days), the size was inferred as a reliable factor to predict the onset of maturity in this species.

Keywords: *Hippocampus*, Indian seahorse, sexual maturity.

THEORETICAL and experimental studies show that certain life-history characteristics make species more vulnerable to overexploitation[1,2]. Seahorse is an endangered fish and warrants replenishing the stock at least in selected marine habitats. In order to understand the impact of targeted fishing, by catch in trawlers and trade, knowledge of their biology along with population monitoring and fisheries management is required[3]. To a limited extent, attempts were made in this direction in understanding the behavioural and breeding patterns in *Hippocampus whitei*[4]. *H. zosterae* was reported to mature at three months[5]. *H. barbouri*, *H. fuscus*[6], *H. hippocampus* and *H. ingens*[3] reached maturity at four to five months, while many other species such as *H. kuda*[7], *H. spinosissimus*[7], *H. trimaculatus*[8], *H. capensis*[9], *H. erectus*[10] and *H. abdominalis*[11] were reported to initiate breeding behaviour after six to twelve months of birth. There is little attempt towards continuous monitoring for their first maturity and life history under captive condition, except for *H. zosterae*[5]. Considering the importance of conservation and the need to harness the brooder resources in India, breeding and lifecycle observations

Figure 1. Adult *Hippocampus kuda* [female (left) and male (right)].

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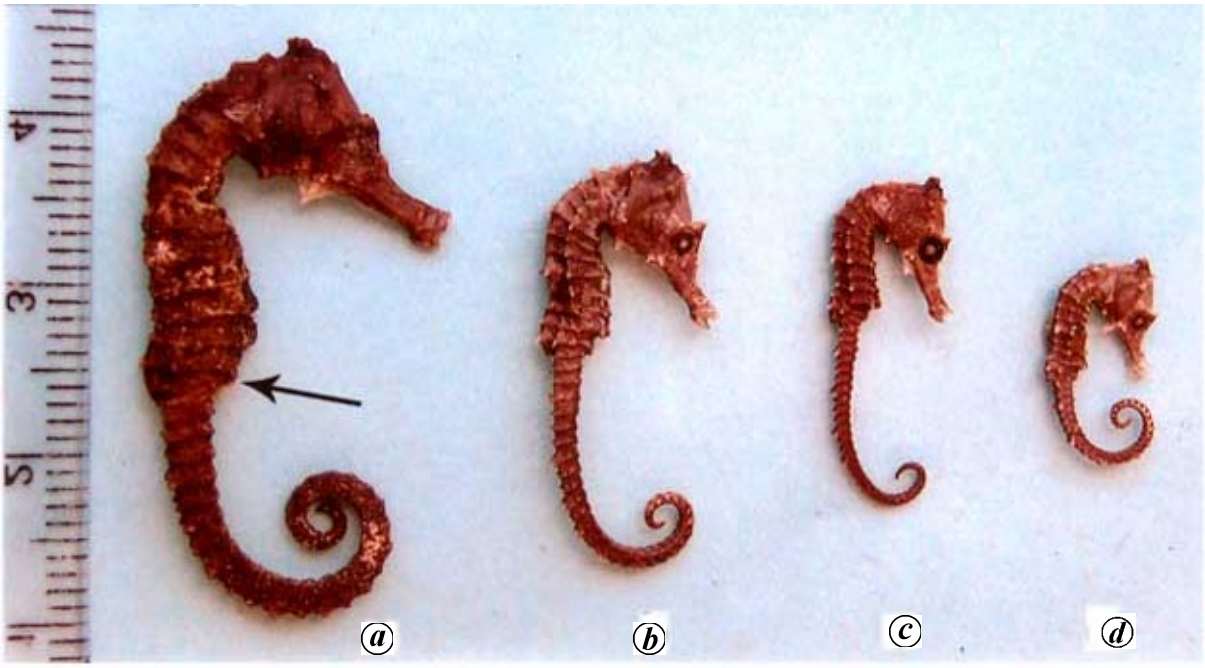

Figure 2. Photograph showing growth stages of *H. kuda* (***a***) Eight, (***b***) Six, (***c***) Four, (***d***) Two week olds. Arrow indicates initiation of brood pouch development.

Table 1. Range of hydrological parameters during rearing of *Hippocampus kuda*

Parameter	Range
Temperature (°C)	26.5–28.0
pH	7.8–8.3
DO (ppm)	5.0–5.5
Salinity (ppt)	36.5–37.0

were made in *H. kuda* and the observations are summarized here.

Adult *H. kuda* (21 males and 21 females) were collected from Tuticorin coast, Gulf of Mannar, Tamil Nadu as by-catch specimens (Figure 1) and maintained in the wet laboratory of Tuticorin Research Centre of CMFRI, Tuticorin. The length of adults ranged from 129 to 175 mm. They were maintained in 1000 l FRP tanks supplied with filtered sea water at a photoperiod of 12:12 h L/D. The ranges of hydrological parameters are given in Table 1. Conditioned dead corals and old nylon nets were provided as hold-fast for juveniles. The bottom of the brood stock/rearing tanks was cleaned with 25.0% water exchange daily and the tanks were drained and cleaned every week.

Six batches of juveniles were obtained during August to November 2003. The mean juveniles per brood was 262.00 ± 59.00 (range 162 to 317). Their mean length and the wet weight was 7.83 ± 0.35 mm and 1.17 ± 0.03 mg respectively. The juveniles were fed *ad libitum* with *Artemia* and *Mysids*. From 31 to 90 days, the juveniles grew faster and from 60 to 65 days, development of brood pouch was noted in males (Figure 2). At this stage, the average length of the brood pouch was 3.0 mm and juvenile length was 50.0 mm. As the juveniles grew to 101.0 mm, the brood pouch was five times longer. The average size of brood pouch in relation to their body size is given in Table 2. When the juveniles attained 101.0 ± 2.0 mm length, their wet weight was 2.530 ± 0.250 g.

Males matured earlier than females and showed courtship signs from the age of 85 to 90 days. The brood pouch index at this stage was 0.14 (Table 2). Pair bonding, approaching the females with coloration and postural changes were observed. The females reciprocated when they attained 110.0 ± 2.0 mm in length. After 21 to 24 days from the date of mating, males produced the F_2 generation in captive rearing conditions. Initially the brood was ranging from 30 to 65 with normal babies. Although variation was noted in body length (± 10 mm) within individuals of the same brood during the active growth phase, variation was minimum (± 2 mm) with the onset of maturity.

In teleosts and elasmobranchs, fish length is considered as a better indicator of the first maturity stage[12,13]. However in seahorses, the size at first maturity was not given much importance in the *in situ* studies[3]. The presence of a fully developed brood pouch in the males was only regarded as the best indicator of maturity, although it did not provide any clue or exact detail of its first maturity[6,14,15]. Prediction of maturity by observing 'berried male' has its own limitations as males may mature earlier than they mate with the females, especially where low seahorse

Table 2. Average growth rate and size of brood pouch in relation to body size of *H. kuda*

Age (in weeks)	Juvenile length (mm ± SD)	Juvenile weight (g ± SD)	Average length and width of brood pouch (mm)	
8	42 ± 0.5	0.140 ± 0.005	Developing	
9	50 ± 0.5	0.370 ± 0.050	3	1
10	69 ± 1.5	0.715 ± 0.050	6	2
11	80 ± 1.5	1.040 ± 0.075	8	3
12	92 ± 1.5	1.510 ± 0.150	9.5	4.2
13	96 ± 2.0	1.940 ± 0.150	12	5.7
14	101 ± 2.0	2.530 ± 0.250	15	7.8*

*Brood pouch index at the time of egg-receiving: 0.14 (based on ten individuals/batch of six cycles).

density or a skewed sex ratio reduces the mating opportunities. Such observations may not give a clear picture on the size at onset of maturity[3]. Few reports on sex-specific length at first maturity assumed that both sexes mature at the same size[16]. But the present observation indicated that males attained maturity at 101.0 ± 2.0 mm length compared to the females at 110.0 ± 2.0 mm in the captive rearing conditions. Thus it is possible to infer that the males mature faster than the females.

The onset of maturity in seahorse in nature as well as in captive rearing conditions can be influenced by a number of stock-specific, environmental and behavioural factors including sex-ratio alterations. It is not clear whether the seahorses in the natural conditions mature at same size as noted in the captive rearing conditions. The present observations suggest the exact size and age of the Indian seahorse, *H. kuda* at which it attains maturity in its life cycle.

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