INTRODUCTION

The air-breathing fishes are usually distinguished by the possession of an accessory respiratory (air-breathing) organ, which enables them to survive for quite sometimes out of water, or for a longer duration in oxygen deficient waters or even in moist and muddy pond bottom. The species is adopted for the situations of low dissolved oxygen contents, high organic load as well as salinity up to 10 ppt. Usually they are considered to be a very hardy with respect to variations in all other environmental parameters and are best suited for culture in shallow and derelict waters. A number of species of air-breathing fishes are considered to be delicacies in various parts of India notably among them are *Clarias, Heteropneustes* and *Anabas*. These species are relished in the North-Eastern states including murrels but murrels are...
considered to the choicest fresh water fish in peninsular India, especially in Andhra Pradesh, Tamil Nadu and Karnataka. Simultaneously, above all the species fetches a higher market price than carps, marketed in live conditions in pots or baskets and hence known as live fishes. Anabas flesh is tasty and has medicinal and therapeutic values as it contains iron, copper, vitamins and unsaturated fatty acids in sufficient quantities which help in augmenting blood content. It is prescribed to convalescing and lactating mothers. Moreover, the flesh has very good digestibility which is one of the reason for which it is recommended to patients for consumption. The fish has a wide range of distribution in the freshwater and is prevalent in the derelict and swampy areas.

Because of the reduced abundance in the wild, the species is presently categorized as Vulnerable (Vn) as per International Union of Conservation of Nature and Natural Resources (IUCN). Although culture, breeding and larval rearing technology of the major carps has been developed in India, other species having commercial importance have been neglected. Now Anabas testudineus is considered as one of the potential and candidate species for aquaculture in the swampy and derelict water bodies for revitalization of the fishery.

A. testudineus is bisexual. Sexual dimorphism is generally observed with the approach of breeding season. Mookherjee and Majumder (1946) marked the sexual differences on the basis of body and fin colouration. Dehadrai et al. (1992), marked out the colour of the mature males of Bihar stocks as reddish hue on the body, particularly on the pectoral and ventral fins, while females do not show reddish hue. Banerjee and Prasad (1974) reported that the ripe or near ripe female become somewhat pot-bellied anteriorly. As a result, the ventral designed between the pectorals is relatively larger in females than in males. The study on the relative condition factor for the species indicates that the male and females attain their first sexual maturity when they grow to 11.3 and 12.2 g in weight and 8.0 and 8.2 cm length, respectively. The species is considered as a low fecund fish. Studies conducted on the fecundity indicate that, the specimens of same weight and length reared under laboratory and natural condition showed a varied level of fecundity which accounts to 4,590 and 9,934, respectively (Mookharjee and Majumdar, 1946). Specimens measuring 99 to 169 mm in total length showed a variation in the fecundity from 10,002 to 36,477 numbers of eggs per individual, respectively (Khan and Mukhopadhyya, 1975). Further it was also reported that, the fecundity for the species varies with respect to the habitat, agro-climatic conditions as well as variations in the total length of the fish (Sarkar et al., 2005).

The spawning season of the fish generally varies from pre monsoon to post monsoon season with a peak during monsoon months extending from June to September. Under controlled conditions, it can be bred at any desired time of the day by manipulating the environmental conditions as well as the time of administration of the hormones. Dehadrai et al. (1992) studied the breeding behaviour, sexual dimorphism under controlled conditions. The assessment of captive breeding of Anabas testudineus with synthetic hormone-Ovaprim, ovatide and wova-FH have been well documented (Bhattacharyya and Momehchurlhury, 2009).

Mahmood (2006) attempted to study the comparison between single and double injection of pituitary gland on induced breeding performance of the climbing perch, Anabas testudineus. The results demonstrated that, splitting pituitary gland dose (double injection) has no additional advantages on breeding performance of Anabas testudineus. Pituitary gland extract at a rate of 10-12 mg/kg body weight of female was the best with respect of fertilization and hatching rate.

Realizing the cultural importance of the species, its adaptability in derelict water bodies, suitability for inclusion under mono and polyculture as an alternate candidate species to boost the fresh water fish production of the country an attempt has been made to induced breed the species, to evaluate the efficacy of inducing agent ovaprim, wova-FH and larval rearing for Anabas testudineus.

**RESEARCH METHODS**

Altogether 100 numbers of yearlings were reared for brood stock rising in two cement cisterns having dimension of 2.0 × 1.0 × 1.5 m without being sexually segregated by adopting recommended pre-stocking and post-stocking management steps. As the species is a bottom dweller the base of the cement cisterns were provided with soil base up to a height of 1.5 to 2 inches. The stocked yearlings were fed with boiled fish mince and rice polish at a ratio of 9:1 fortified with vitamin and mineral premix at the rate of 10 per cent of their total biomass initially in two split doses. The quantity of feed
was adjusted at every fortnight intervals with respect to gain in weight by the biomass. The feeding rate was gradually reduced from 10 to 4 per cent from the month of March onwards. 20-30 per cent of the water from the cement cisterns was replenished at every alternative day to maintain good, hygienic condition of the water.

The test animals were sexually segregated from the month of April depending up on the secondary sexual characters to achieve more sexual urge in the brood stock for better spawning response. To ascertain the maturity status of females few samples of ova were taken out by use of a simple catheter. The ova thus obtained were exposed to modified Gilson’s fluid solution in order to ascertain the migration of germinal vesicles in it. The ova collected from the female brooders exhibiting the germinal vesicle migration to the peripheral regions considered to be the best for artificial fertilizations as well as spawning success.

Unlike that of carps the formation of a proper breeding set is a pre-requisite for achieving better spawning response in terms of rate of fertilization and hatching percentage. For *Anabas testudineus* a breeding set comprises of one female and two males. The quantities of milt produced by two males are adequate for fertilizing the eggs released by a single female. Therefore in present investigation the male: female ratio was maintained at the rate of 2:1 throughout the breeding process.

The inducing agents like Ovaprim and Wova-FH were tried on *Anabas testudineus* for inducing spawning as well as to determine the efficacy of the inducing agents. Ovaprim (0.2, 0.3, 0.4 ml/kg body weight for female and 0.2 ml/kg body weight for male) and Wova-FH (0.2, 0.3, 0.4 ml/kg body weight for female and 0.2 ml/kg body weight for male) were administered on the spawners to determine the breeding response, latency period, quantity of eggs released, fertilization and hatching rate with respect to each of the inducing agents.

**RESEARCH FINDINGS AND ANALYSIS**

In the present investigation, the temperature varied between 27.0 to 31.0°C, pH values fluctuated between 7.5 to 8.0, dissolved oxygen content of the experimental units varied between 6.50 to 8.50 mg/l, total alkalinity of the water in the experimental containers ranged between 120 mg CaCO$_3$/l to 130 mg CaCO$_3$/l. The data obtained in the present investigation for the physico-chemical parameters indicates that, they are at the optimal level without much variation (Table 1).

The ovulatory response of *Anabas testudineus* in terms of number of eggs laid, percentage of fertilisation, percentage of hatching, number of spawn produced and the latency period with respect to administration of ovaprim and Wova-FH are presented in Table 2 and 3. It was reported that, the female brooders injected with 0.2 and 0.3 ml of ova prim per kg body weight resulted with partial spawning after a latency period of 11 to 15 hrs, whereas the female brooders injected with 0.4 ml per kg body weight resulted with complete spawning with in a latency period of 8.33 hrs. Further, the abdomen of the female spawner injected with 0.4 ml of ovaprim was fully distended with oozing out of ova indicating appropriate gonad hydration. High rate of fertilisation (93%) and high rate of hatching (91%) was reported with the brooders injected with 0.4 ml of ovaprim per kg body weight.

Whereas, males administered with Wova-FH at a rate of 0.2 ml per kg. body weight and females were administered with 0.2 ml, 0.3 ml and 0.4 ml per kg resulted with partial spawning with release of ova in clusters indicating improper hydration of gonad. The latency period was comparatively more with the brooders injected with 0.2 ml and 0.3 ml of Wova-FH ranging from 16 to 19 hrs. The latency period was reported to be

<table>
<thead>
<tr>
<th>Table 1 : Average value of physico-chemical parameters of water during seed production and larval rearing of <em>Anabas testudineus</em></th>
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</thead>
<tbody>
<tr>
<td><strong>Water parameter</strong></td>
</tr>
<tr>
<td>Temperature</td>
</tr>
<tr>
<td>pH</td>
</tr>
<tr>
<td>Dissolved oxygen (ppm)</td>
</tr>
<tr>
<td>Hardness (ppm)</td>
</tr>
<tr>
<td>Carbon dioxide (ppm)</td>
</tr>
<tr>
<td>Free ammonia (ppm)</td>
</tr>
<tr>
<td>Hydrogen sulphide (ppm)</td>
</tr>
<tr>
<td>Nitrite (ppm)</td>
</tr>
</tbody>
</table>
10.66 hrs in case where the brooders were administered with 0.4 ml of Wova-FH per kg body weight of female. The study also indicates a lower rate of fertilization as well as hatching with the brooders injected with lower doses of WOVA-FH with respect to the brooders administered with 0.4 ml of WOVA-FH per kg body weight. The rate of fertilization and hatching were reported to be highest with the brooders injected with 0.4 ml of Wova-FH.

The study also indicates a lower rate of fertilization as well as hatching with the brooders injected with lower doses of WOVA-FH with respect to the brooders administered with 0.4 ml of WOVA-FH per kg body weight. The rate of fertilization and hatching were reported to be highest with the brooders injected with 0.4 ml of Wova-FH.

The data thus gathered during the present investigation with respect to concentration of hormone against the latency period, fertilization rate, egg output, hatching rate and spawn recovery are subjected to correlation co-efficient analysis by employing statistical methods. The study indicates a strong correlation to exist between the doses of ovaprim with egg output (+0.99), fertilization rate (+0.99), hatching rate (+0.99), spawn production (+0.99). A negative correlation was reported to exist between the doses of ovaprim with latency period (-0.99) and hatching time (-0.90) which indicates that, with increase in the concentration of ovaprim the latency period and hatching time decreases.

Similar trend also reported when the brooders of *Anabas testudineus* administered with the hormone Wova-FH. The study indicates a strong correlation to exist between the doses of Wova-FH with egg output (+0.96), fertilization rate (+0.96), hatching rate (+0.96), spawn production (+0.95). A negative correlation was reported to exist between the doses of Wova-FH with latency period (-0.96) and hatching time (-0.98) which indicates that, with increase in the concentration of Wova-FH the latency period and hatching time decreases.

Khan and Mukhopadhya (1975) observed the fecundity of *Anabas testudineus* to range between 10,002 to 36,477 in the size range of 99 to 169 mm. However, Banerjee and Prasad (1974) reported fecundity of the same species to range from 4,588 to 34,933 in Bihar region at a size range of 73.0 to 182 mm in a weight range of 8.40 to 100.20 g. Banerjee and Thakur (1981) reported shading of 2,000 to 13,000 eggs in seven sets of induced bred *Anabas testudineus* weighing 24.8 to 40.1 g. The study conducted on captive breeding of climbing perch *Anabas testudineus* with Wova-FH for conservation and aquaculture reveals a very high

### Table 2 : Showing details of breeders, injections, spawning and hatching of *Anabas testudineus* administered with Ovaprim

<table>
<thead>
<tr>
<th>Weight of females (g)</th>
<th>Weight of males (g)</th>
<th>Dose of ovaprim (ml/kg) to females</th>
<th>Dose of ovaprim (ml/kg) to males</th>
<th>Latency period (h)</th>
<th>No. of eggs released</th>
<th>Fertilization rate (%)</th>
<th>Hatching time (h)</th>
<th>Hatching rate (%)</th>
<th>No. of spawn produced</th>
</tr>
</thead>
<tbody>
<tr>
<td>68.36 (0.49)</td>
<td>64.66 (3.05)</td>
<td>Nil</td>
<td>Nil</td>
<td>Nil</td>
<td>No breeding</td>
<td>22.600</td>
<td>42.66 (3.05)</td>
<td>18.66 (1.15)</td>
<td>40.00 (2.00)</td>
</tr>
<tr>
<td>76.83 (4.67)</td>
<td>72.78 (2.72)</td>
<td>0.2</td>
<td>0.2</td>
<td>15.00 (1.00)</td>
<td>(Partial spawning)</td>
<td>28.200</td>
<td>72.00 (2.00)</td>
<td>18.00 (2.00)</td>
<td>62.66 (4.61)</td>
</tr>
<tr>
<td>77.83 (6.16)</td>
<td>70.43 (4.20)</td>
<td>0.3</td>
<td>0.2</td>
<td>11.00 (1.00)</td>
<td>(Partial spawning)</td>
<td>53,200</td>
<td>93.33 (3.05)</td>
<td>12.33 (1.52)</td>
<td>91.00 (1.00)</td>
</tr>
<tr>
<td>85.93 (2.03)</td>
<td>75.26 (2.73)</td>
<td>0.4</td>
<td>0.2</td>
<td>8.33 (0.57)</td>
<td>(Complete spawning)</td>
<td>70.30 (2.00)</td>
<td>65.56 (2.46)</td>
<td>76.56 (3.05)</td>
<td>70.43 (4.20)</td>
</tr>
</tbody>
</table>

### Table 3 : Showing details of breeders, injections, spawning and hatching of *Anabas testudineus* administered with WOVA-FH

<table>
<thead>
<tr>
<th>Weight of females (g)</th>
<th>Weight of males (g)</th>
<th>Dose of WOVA-FH (ml/kg) to females</th>
<th>Dose of WOVA-FH (ml/kg) to males</th>
<th>Latency period (h)</th>
<th>No. of eggs released</th>
<th>Fertilization rate (%)</th>
<th>Hatching time (h)</th>
<th>Hatching rate (%)</th>
<th>No. of spawn produced</th>
</tr>
</thead>
<tbody>
<tr>
<td>70.30 (2.00)</td>
<td>65.56 (2.46)</td>
<td>Nil</td>
<td>Nil</td>
<td>Nil</td>
<td>No breeding</td>
<td>13,600</td>
<td>28.00 (2.00)</td>
<td>22.00 (2.00)</td>
<td>850</td>
</tr>
<tr>
<td>76.56 (5.14)</td>
<td>69.15 (3.85)</td>
<td>0.2</td>
<td>0.2</td>
<td>19.00 (1.00)</td>
<td>(Partial spawning)</td>
<td>17,650</td>
<td>62.00 (2.00)</td>
<td>24.00 (2.00)</td>
<td>46.33 (1.52)</td>
</tr>
<tr>
<td>78.81 (3.70)</td>
<td>64.89 (1.22)</td>
<td>0.3</td>
<td>0.2</td>
<td>16.66 (1.15)</td>
<td>(Partial spawning)</td>
<td>29,000</td>
<td>74.33 (2.00)</td>
<td>16.00 (2.00)</td>
<td>54.66 (3.05)</td>
</tr>
<tr>
<td>84.46 (1.76)</td>
<td>71.22 (2.97)</td>
<td>0.4</td>
<td>0.2</td>
<td>10.66 (1.52)</td>
<td>(Complete spawning)</td>
<td>70.30 (2.00)</td>
<td>65.56 (2.46)</td>
<td>76.56 (3.05)</td>
<td>70.43 (4.20)</td>
</tr>
</tbody>
</table>

Figures in parentheses indicate standard deviation.
fecundity for the species. The number of eggs released by the female ranged from 52,000 to 1,30,000. The results obtained in the present investigation are well within the range of the findings of earlier author. Ovaprim is a composite mixture of SGnRH-A with dopamine antagonist “Dom” dissolved in non-toxic calibrated amount of organic solvent. Peter et al. (1986) reported that, over mammalian LH-RH-A, the Ovaprim was found to be 17 times more potent. The increased effectiveness of SGnRH-A is attributed to its higher affinity for the binding site of pituitary.

The statistical analysis in the present investigation reveals a significant difference between the hormones used on latency period (h), number of egg released, fertilization rate (%), hatching time (h), hatching rate (%) and number of spawn produced. Better spawning response was reported from the group of fishes administered with ovaprim.

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**LITERATURE CITED**


