GENERAL INTRODUCTION

Continuous increase in the demand for shrimps worldwide has put an ever increasing pressure on producer countries to increase their supply with the result that, most major shrimp fisheries are at present harvested to full or near full capacity (Palomares, 1985). This resulted in an increase in the prawn cultivation in captivity all over the world. Presently most of the shrimp culture is centred around penaeid prawns and very little attention is being given towards palaemonid prawns, specially of the genus Macrobrachium. The culture of Macrobrachium prawn has a recent origin and is restricted to the Indo-Pacific countries (Ling, 1969a; Fujimura, 1974; Aquacop, 1979).

The members of the family Palaemonidae belong to the class Crustacea, order Caridae. Many species of this group are of high economic importance, both as items of food (source of protein) as well as cash crop, as they bring good prices both in local and in foreign markets. Most of the species are inhabitants of freshwater areas, but a few are capable of migrating or living in brackishwaters. They vary in sizes from a few centimetres long, weighing in milligrams to big ones of 20 to 30 cm weighing 200 to 300 g. They are hardy and easily occupy a variety of ecological niches. Most of the palaemonids have become table delicacies
in several parts of the world. They are widely distributed in tropical, subtropical and temperate zones, with different species dominating in specific geographic zones, or the areas (Rabanal, 1982). In India the two species of Macrobrachium namely M. malcolmsonii and M. rosenbergii contribute to the major caridean shrimp fisheries (Raman, 1967).

Biological information pertaining to Macrobrachium species is widespread in the literature, but is not very deep or thorough. The available information is almost exclusively on taxonomy, ecology and distribution of the genus. In India very little work has been done on Macrobrachium spp. Raman (1967) reported the statistics of M. rosenbergii fisheries from Vembanad Lake in Kerala. No account on the fisheries statistics of M. idella is available. However, Pillai and Mohamed (1973) have reported this species to be supporting a subsistence fishery of some importance in Cochin backwaters and the canal system associated with it.

At present the literature available on the different culture aspects of Macrobrachium is concentrated singularly on M. rosenbergii and freshwater prawn culture is almost synonymous with this giant prawn. Ling and Merican (1961) for the first time attempted successfully the rearing of larval stages of this species. Thus the pioneering work of Ling and Merican (1961) indicated the possibility
of commercial culture of this species and several other related prawns in confined water. Since then several workers have studied the various aspects of larval rearing and farming of _M. rosenbergii_ (Ling, 1962; Fujimura and Okamoto, 1970; Wickins, 1972; Dugan _et al._, 1975; Goodwin and Hansen, 1975; Aquacop, 1977b; Guerrero and Guerrero, 1979; Lee, 1982 and Sankolli _et al._, 1982).

Today freshwater prawn industry has become a well established industry of the Indo-Pacific region. In Thailand, _Macrobrachium_ culture has become a booming industry, and at present there are 44 hatcheries producing the seed on commercial scale and about 455 farms spread over an area of 375 ha are engaged in freshwater prawn culture (New _et al._, 1982). Similarly in Hawaii 126 ha pond area is under _Macrobrachium_ culture (Rabanal, 1982). In Taiwan, the _Macrobrachium_ industry has grown to more than 30 farms comprising of 165 ha (Liao and Chao, 1982). Whereas in Philippines (Padilla, 1982) and Sri Lanka (Ferdinando and Manawadu, 1982) _Macrobrachium_ culture is in experimental stage only.

In India only limited investigations have been carried out with respect to _Macrobrachium_ culture. The cultivation trials of _M. rosenbergii_ in cement pond and earthen ponds were attempted by Panikkar and Kadri (1978). Report about the growth trials of
M. rosenbergii from five different and distant water bodies in Maharashtra is available in the AGRESCO annual report (1981). Subrahmanyam (1981) reported the influence of stocking density, stocking size, environmental conditions and supplementary feeds on the growth of M. rosenbergii.

There is little doubt about the suitability of M. rosenbergii as animal for extensive culture but the possibility always remains that some other species might prove to be even better. Encouraged by the successful larval rearing attempts of M. rosenbergii by Ling and Merican (1961) and Fujimura (1966), several researchers studied the life history and culture potential of other Macrobrachium species, viz. M. carcinus (Lewis, 1961; Choudhary, 1971; Dugan and Frakes, 1972), M. lanchesteri (Johnson, 1968), M. ohione and M. olfersii (Holothuis and Provenzano, 1970), M. idella (Pillai and Mohamed, 1973) and M. malcolmsonii (Sankolli and Shenoy, 1978). Researchers have also suggested a great potency and suitability of M. amazonicum for culture purposes owing to its hardiness, fast growth rate and easy breeding in captivity. Guerrero and Guerrero (1979) have advocated the culture of M. lanchesteri over M. rosenbergii because of its high value and contribution to rural nutrition. In Venezuela possibilities are being tapped whether M. amazonicum could be cultivated and used as a food for carnivorous fishes (Romero, 1982).
Thus _Macrobrachium_ prawns other than _M. rosenbergii_ have been also advocated as culturable ones. In India, Pillai and Mohamed (1973) have recommened _M. idella_ as a species having sufficient culture potential, especially in the backwaters of Kerala.

In India, _M. idella_ has been reported from Tentuliah River, Piali River, Uttarbhag and Hooghly Rivers near Calcutta in Gangetic West Bengal (Tiwari, 1951). It appears to have a common occurrence along the West Coast of India in Kerala, Karnataka and Maharashtra states (Henderson and Matthai, 1910 and Jalihal et al., 1988).

The prawn _M. idella_ finds a ready local market, but the catches are too insignificant to meet the demand. This species is being able to grow in varied types of freshwater and brackishwater bodies and has potential of developing into a suitable species for cultivation purposes owing to following reasons:

1. It is a continuous breeder therefore, uninterrupted seed production is possible if the technique of breeding in captivity is perfected.

2. There is no competition from established fisheries.

3. These shrimps are delicious and fetch good market value.
4. The species is very hardy, can tolerate a wide range of salinity from 0% to 18%.

In India reports are scanty regarding seed stocks of caridean prawns from freshwater/brackish water bodies, except the report of Pande (1984) on the availability of *M. rosenbergii* seed from rivers near Bombay and of Natarajan and Sambandam (1987) on 9 species of *Macrobrachium* from Tamilnadu. Attempts to produce the seed of *M. rosenbergii* artificially in hatcheries, were made, but on large scale production still success could not be achieved.

For successful breeding of the animal in captivity a sound knowledge of reproductive physiology of the animal is very much essential. It was felt that the changes in the reproductive effort of animal are attributed to changes in the biochemical components as well as hormonal quantum during subsequent breeding. Therefore, it was decided to investigate in detail these aspects.

Our present knowledge regarding neuroendocrine control of reproduction in *Macrobrachium* prawns is very scanty and is restricted to three species viz. *M. kistensis* (Nagabhushanam et al., 1979), *M. lanchesteri* (Rao et al., 1981b) and *M. rosenbergii* (Dietz, 1982). Therefore, it is very important to know about the
neuroendocrine centres, and how the neurosecretory components of these prawns react during maturation.

The endocrine manipulation has so far been synonymous with eyestalk ablation — a technique with far reaching impact on crustacean aquaculture. Accelerated ovarian growth following eyestalk ablation has been reported in many crustaceans viz. the crab *Barytelphusa cunicularis* (Nagabhushanam and Diwan, 1974), the prawn *Penaeus duorarum* (Caillouet, 1972), *P. japonicus* (Aquacop, 1975 and Lumare, 1981), *P. indicus* (Muthu and Laxminarayana, 1977), *P. merguiensis* (Aquacop, 1975 and 1983), *P. monodon* (Muthu and Laxminarayana, 1984), *P. indicus* (Sunilkumar, 1989). On the contrary in *Macrobrachium*, the only available report of induced breeding after eyestalk ablation is that of Dietz (1982) on *M. rosenbergii*.

The *Macrobrachium* spp. are prolific breeders, in which maturation of ovary, moultng, mating, spawning and hatching of eggs are almost a continuous process. Only a few reports are available on these aspects in some species, particularly *M. rosenbergii* (Sandifer and Smith, 1979), *M. nobilii* (Pandian and Balsundaram, 1980), and *M. lanchesteri* (Rao et al., 1981a).

Due to the multiple breeding characteristic during the process of reproduction, utilization of large amount of energy will be necessitated.
This energy is either made available from the food or is channelled through the organic reserves of body stored in tissues like hepatopancreas and haemolymph. Thus during the process of maturation, there is tremendous change in the biochemical components, not only of the ovary, but also of hepatopancreas, haemolymph and to a lesser extent muscular tissue. So as to understand the complete spectrum of reproduction, it becomes essential to know thoroughly the changes taking place in the various tissues at biochemical levels and the research work related to this field is very limited in *Macrobrachium* spp. (Rao et al., 1981a; Dietz, 1982; Sarojini et al., 1988).

Shrimp culture is progressing to the point where genetic programming can be useful to increase production. To produce fast growing individuals, it is necessary that parents should be fast growing. In scientifically sound breeding programme it is often necessary to produce and identify full-sib families and/or half-sib families and to distinguish all parents (Malecha, 1977). The technique of artificial insemination makes the desirable genetic manipulation possible. In the penaeids this technique is being applied successfully in improving hatchery products (Bray et al., 1982; Muthu and Laxminarayana, 1984). The technique of artificial insemination has been successfully applied for *M. rosenbergii* and some other caridean prawns (Sandifer and Smith, 1979). The technique of electro-
ejaculation of spermatophore has simplified artificial insemination further (Sandifer and Lynn, 1980). The possibility of using refrigerated spermatophore for artificial insemination was tapped in *M. rosenbergii* by Sandifer and Lynn (1980) and Chow (1982). Similarly the cryopreservation of spermatophores of the same species was attempted by Chow et al. (1985). But work on artificial insemination of palaemonid prawns is still in infancy and there is lot of scope for improvement.

Thus an assessment of the literature shows paucity of scientific knowledge on the genus regarding its reproductive physiology. The information on culture aspects, that too for one species, *M. rosenbergii*, is available while information on culture aspects as well as on physiological functions is extremely scanty in other species.

In the present study an attempt is made to investigate some aspects of physiology of reproduction of the female *M. idella* which includes the biology of breeding of females with regard to sex composition, maturity stages, gonadosomatic and hepatosomatic index, ova diameter changes, histology of ovary, female reproductive cycle and fecundity. The biochemical changes of the organic reserves in various tissues viz. haemolymph, ovary, hepatopancreas and muscle during different maturity stages through the annual reproductive cycle are investigated.
The changes in the neurosecretory components of the neuroendocrine organs like eyestalk complex, cerebral (brain) thoracic and abdominal ganglia during different maturity stages are investigated.

The impact of eyestalk ablation, eyestalk extract injection, as well as brain and thoracic ganglia extract injection on the process of maturation is also studied.

Attempts are also made on artificial insemination of the prawn adopting electroejaculation technique for extrusion of spermatophores.

The knowledge and understanding gained on the reproductive physiology of the species through this investigation will not only form a significant advancement over that of the past, but would also form the base-line information for management of reproduction of the species for controlled seed production and culture.