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Hamilton Buchanan (1822) recorded the species *Labeo gonius* in the river Ganges. The *Labeo gonius* is a commercially important minor carp with a wide distribution over India, Pakistan, Nepal, and Bangladesh (Talwar and Jhingran, 1991). As this species is a minor carp, study on the species has been comparatively less. Moreover, the fish species has high market value in different parts of the country, which prompted the study of the biology and its favourable environmental conditions so that this fish species can be cultured in different areas of the Northeastern region, in general and Meghalaya, in particular.

The North-Eastern part of India, comprises of seven states, viz., Assam, Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland, and Tripura, is a part of Eastern Himalayan region and one of the global hotspots for flora and fauna biodiversity. Each state has its unique topography, diverse geographical features and varied watershed patterns. The region is fed by the Brahmaputra river system and its various tributaries crisscross different states and ultimately join the Brahmaputra. These make the area a favourable site for development of fisheries and fish biology studies. Innumerable hill streams, rivers, wetlands and perennial water sources abound in the area. In Meghalaya, diverse climatic conditions make it conducive for its floral and faunal wealth. The entire region mostly depends upon capture fisheries. There are more than 126 species of fish in the Brahmaputra river systems (Jhingran, 1985). The state abounds in numerous man-made water bodies, which have not been adequately exploited for its fishery potential. Vast lentic water bodies could be utilized for fish production catering to the needs of
increasing demand of fish protein in the state. For cultivation of fish at high altitude area, detailed information about the ecobiology of the species is essential.

Culture of fish in backyard ponds is a traditional practice in India, particularly in the North-Eastern region from time immemorial. Earlier, fish seed was collected from riverine sources and it was a mixture of major carps and minor carps. But presently, the well developed technology of composite fish culture, has led to the entire fish culture system to take a new turn and concentrate on only major carp culture that grow well. With the introduction of exotic carps and development of composite fish culture, minor carps do not get any place in the fish culture system. As a result the minor carp population is slowly becoming rare and some of them are on the verge of extinction. *Labeo gonius* is one such Indian minor carp, which according to CAMP (1997) report is a lower risk-near threatened species. However, the species, which is known as “Khaski” in the local Khasi language, has very good market value in North-East India in general and Meghalaya in particular.

Culture of the fishes has always been considered as a useful practice, since fishes are the most efficient organisms among animals in converting feed into nutritious protein food but the main constraints facing the inland culture fisheries is non utilization and under utilization of the readily available water and this problem arises basically because of the lack of knowledge of culture technique among the fishermen, who catch fish from rivers and ponds, are ignorant about fish culture techniques. This results in over exploitation of the natural source of fishes, leading to a drastic change in their numbers, with little effort being made to restock the natural systems with fish seed. This also acts as a hindrance for
pisciculture practices, since most of the farmers have to procure fingerlings from other places, which often proves to be uneconomical for them.

There are different ecological niches of freshwater bodies in the varied altitude of the state of Meghalaya that are not suitable for major carp culture but minor carps can be effectively utilized in these water bodies for culture, hence fish production as well as extra income may be generated from them. *Labeo gonius* may be cultured along with major carps wherever major carps can be grown and in other places the species may be cultured in individual ponds, paddy fields or low lying water logged areas, which provide additional production of fish strengthening the economics further. *Labeo gonius* like *Labeo bata* and *Cirrhinus reba* fetch high market price even at a very smaller size. Therefore, introduction of *Labeo gonius* as a culturable species in the state will increase the fishery potential and there is a probability of increasing per capita income.

In the Indian scenario, inland fish culture practices have taken tremendous strides in the last three decades. The introduction of exotic fish like grass carp and silver carp and success to induce them to breed in captivity (Alikunhi *et al.*, 1963) has boosted the production of fish. This national achievement has improved due to already established induced breeding technique through hypophysation of Indian Major Carps (Chaudhuri and Alikunhi, 1957), which assured the supply of quality fish seed for major carps and some minor carps in the plains of India. In contrast to this achievement, Meghalaya is still lagging behind in such endeavours. However, the dearth of quality seed is one of the constraints in aquaculture of Meghalaya and aquaculture is often considered as a high-risk bioindustry due to prevailing environmental conditions in this state of the country. There are several
components involved in raising fish seed and temperature plays a major role in success of induced breeding of fish. Since research on environment related aspects of induced breeding is still in its early stages in most countries, therefore a detailed study of induced breeding of this species and its nursery rearing in relation to the agro-climatic conditions of Shillong becomes essential.

However, as a pre-requisite to such an endeavour, it is essential to understand the ecobiology of a fish species in a particular environment. The study also helps in breeding, culture and conservation of the species in particular conditions. For well-organized fish culture of any particular fish species in a high altitudinal region, some information regarding its eco-biology, gonadal development, breeding behaviour and histological and ultra structural study of gonads in relation to physico-chemical conditions of water bodies are of utmost necessity.

During the present investigation, study of eco-biology of the fish, *Labeo gonius*, at high altitude has been carried out to perceive the effect of temperature and altitude on the growth and development of the fish. The investigation includes the study of length-weight relationship, annual gonadal cycle, maturity stages of gonads food and feeding behaviour under the agro-climatic condition of the study area.

Knowledge of the different factors influencing the suitability of any aquatic system is of significance for aquaculture. Physico-chemical parameters of water are very important as they play a major role in the life of an aquatic animal. So, in order to ascertain the ability of water to support aquatic life especially, among fish for its existence and growth in pond condition, analysis of various physical and chemical parameters is of great significance in aquaculture.
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In the present investigation, various physico-chemical parameters of the pond water where fishes were stocked have been analyzed. The study helped to understand the effect of physico-parameters on the fish during culture of the fish at higher altitude.

Several authors have worked on different aspects of eco-biology and breeding biology on different species of the genus *Labeo* (Mookerjee and Ganguly, 1949; Motwani *et al.*, 1962; Hora and pillay, 1962; Bhatnagar and Karamchandani, 1970; Bhatnagar, 1972; Parameswaran *et al.*, 1974; Chatterjee *et al.*, 1976; Pathak and Jhingran, 1977; Bhatnagar *et al.*, 1989; Chatterji, 1992). Moreover, from the available literature it has been found that most of the work on the *Labeo* species has been done in its natural habitat and in riverine conditions. There are also reports of induced breeding of the carp, at lower altitude area though it is scanty (Sharma *et al.*, 1986; Joshi, 1987). However, review of literature revealed no report about the eco-biology, reproductive biology or induced breeding of *Labeo gonius* at the mid and high altitude area. Hence, research is necessary to study the eco-biology of the species and standardize techniques for artificial propagation of the fish. The standardization of pituitary dose for induced breeding of fish at places located in the high altitude area can be used to help conserve the threatened species through captive breeding programs and also to generate new employment opportunities for rural people.

In the present investigation, induced breeding experiment has been successfully completed leading to the large-scale production of quality seed of *Labeo gonius* in a new environment set up. Pituitary dose has been standardized for this new environment set up under the climatic condition of the area. The
results have paved the way for commercialization of seed production and conservation of the fish in Meghalaya.

Along with induced breeding, it is important to study the embryonic development and ontogeny of the fish to see its adaptability, survival and growth rate in the particular environment. Various environmental factors effect the embryonic and post-embryonic development of fish. The embryonic development is a complex process and it progresses at different rates (Ojanguren and Brana, 2003). The organogenesis and somatic growth are controlled by enzymatic actions and are dependent on genetic expressions and temperature of the surroundings. The inverse relationship between the length of hatching period and temperature has been described in *Ammodytes personatus* (Yamashita and Aoyama, 1985), *Thymallus thymallus* (Humpesch, 1985).

To understand the effect of temperature and other environmental conditions of the study area on propagation of the fish through induced breeding, a deeper understanding about the structural changes at histological and ultra structural level at the particular agro-climatic conditions seems necessary. This would enhance knowledge about the fish, increase aquatic resources and improve efficiency of the present culture methods. Various reports are available on the histological and electron microscopical studies of gonads in different fish species such as *Labeo gonius* (Joshi and Khanna, 1980), *Channa guchua* (Sanwal and Khanna, 1972), *Cyprinus carpio* (Guraya and Kaur, 1979), *Mugil capito* (Zaki et al., 1994), *Tilapia Zillii, T. aurea* (Kamel and Fathalla, 1995).

The sustainable utilization of genetic resources, including fish, plays a pivotal role in improving the standard of living in a populous country like India. Concern
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over declining harvests and an obvious reduction in population of the *Labeo gonius* from the natural habitat has led to a holistic approach to study its ecobiology, the effect of temperature on the breeding behaviour including embryological development in the cold climatic condition.

In the present investigation, histological study of gonads during gonadal cycle has been carried out. Simultaneous to histological study, ultra structural study of both ovary and testes have been carried out with scanning and transmission electron microscopy to examine the effect of temperature on the development of gonads at higher altitude. Surface ultra structural study also carried out on hatchlings with SEM. The histological and ultra structural observation help to understand the effect of climatic variation especially temperature on the maturity stages of gonads and verify the spawning season of the fish under the prevalent climatic condition of the study area.

In Shillong usually water temperature ranges between 14° to 22°C. For proper commercial utilization of this species in Meghalaya, study of detailed ecobiology of the species at prevailing low temperature condition is very much essential. Thus, the present investigations have been taken up to make a detailed study of the fish and its induced breeding possibilities, which is indispensable for taking up conservation of the fish. Detailed study of ecobiology, induced breeding, standardization of pituitary dose, study of spawning behaviour of the fish are major achievements of the present investigation. Quality seeds have been successfully produced that were supplied to the local fish farmers. The findings will help in culture and conservation of *Labeo gonius* in Meghalaya in particular and North East India in general.
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The present research effort is a logical initial step towards developing sustainable aquaculture in the region. This effort will benefit the entire region by providing pertinent information on ecobiology, gonadal development in terms of morphological and ultrastructural level, artificial reproduction and conservation of the species.