CHAPTER 1

INTRODUCTION AND REVIEW OF LITERATURE
The class Crustacea of the phylum Arthropoda is characterised with multiplicity of species as well as with a feature that most species are represented in few subgroups. In as far as the species richness is considered, the class Crustacea has a significant wealth of over 26,000 species, out of which nearly 70% are included in the subclass Malacostraca. Within Malacostraca again, the order Decapoda (which includes crabs, shrimps and lobsters) has the most number of species (nearly 8,500). The suborder Reptantia under Decapoda which includes the crabs is divided into "true crabs" (infra order: Brachyura) and the "other crabs" (infra order: Anomura) and it is one of the largest groups of crustacea in terms of the number of species represented. The Brachyura includes a variety of true crabs, represented in marine, brackishwater, freshwater and terrestrial habitats. Evolutionarily, this order is considered to be an excellent example wherein the individuals exhibit adaptive radiation (Warner, 1977). Naturally, the extant species included under the Brachyura show diverse and interesting life history patterns.

Crabs have been favourite animals associated with man for a long time. Apart from featuring in the Zodiac (as 'Cancer') and their use by man as sporting/recreational animals, the crabs have also been associated with disease transmission and biological magnification of pollutants. Of course, the main use that man
makes of crabs is to eat them. The rich nutritional quality of crab meat, with a protein content as high as 20% and a mineral content as high as 1-2% along with a desirable low contents of total lipids and carbohydrates, has given the crab meat, the pride of place both in local and export markets. Naturally, since a long time, international fishery practices for both capture and culture of crabs has been attempted (Bardach et al., 1972; Adiyodi, 1985). Since, at least some crabs reach enormous body proportions (eg. Japanese spider crab, Pseudo carcinus gigas, South Australian crab; Indian brackishwater crab Scylla serrata, there has been a concerned effort at improving crab fishery and management. Although the large edible crabs are restricted to the brackishwater and marine habitats, even the small and medium sized crabs represented in freshwaters (Family: Potamonidae) and terrestrial habitats (Family: Gecarcinidae) are candidate species for intensional farming. According to Bott (1970), the freshwater crabs that are represented in India, East Indies, and Australia, are known to be included in the super family: Parathelphusoidea. Within the confines of the freshwater and terrestrial habitats of our subcontinent, a number of crabs have been known to exist and these are included in four genera, Paratelphusa, Barytelphusa, Oziotelphusa and Potamon.

A literature survey on species belonging to the above four genera of inland brachyurans of India indicates that, from time to time, there has been a growing interest on several aspects of their biology, covering the following:
1. **Taxonomy**:

The earliest diagnosis of species and varieties of freshwater crabs of India have been detailed by Alcock (1909a and b). This diagnosis was largely based on the earlier contributions of Ortmann (1897) and Rathbun (1904). According to Alcock (1909a and b), all the freshwater crabs are included under the family Potamonidae, the three principal genera being *Potamon*, *Paratelphusa*, and *Gecarcinus*. This classification of Potamonidae was dealt in further detail by Alcock (1909a) and the accepted taxonomic key of freshwater crabs of India is due to the catalogue of Alcock (1909b). Much of the further contributions in conformations of the above are detailed in Chuensri (1974).

2. **Natural history observations**:

Most of the early information on the natural history of freshwater crabs of India, emanated due to the fact that crabs were considered as agricultural pests. Shroff (1917), Ghosh (1919) and Wagle (1924) considered these crabs as pests hindering paddy cultivation. It was only in 1923 that the first note on the biology of *Paratelphusa hydrodromous* was published by Ramachandra Rao (1923) and thereafter, Mecan (1937) recorded the observations on *Paratelphusa* (*Barytelphusa*) *querini*. Further Chacko and Thiagarajan (1952) recorded parental care in *Paratelphusa* *jacquemontii* and Ali (1955) recorded his observations on *Paratelphusa querini*. Chhapgar (1956) documented the breeding habitats and larval stages of some
Thereafter, the emphasis on scientific studies of freshwater crabs of India appears to have drifted from natural history observations to various other experimental aspects.

Experimental physiology related to metabolism:

Between 1969 to date, considerable work on metabolic patterns and physiology of two species of freshwater crabs Paratelphusa hydrodromus and Oziotelphusa senex senex have been documented in relation to various aspects (Adiyodi, 1969; Krishnamurthy and Srihari, 1973; Ramamurthy, and Sainathjanak, 1973; Ramamurthy and Veerabhadraachari, 1974; Rashan, 1976; Rashan and George, 1977; Raghavaiah et al., 1980; Purushotham et al., 1981; Venkataramanaiah, 1981; Ramamurthi and Venkataramanaiah, 1982; Subramaniam and Krishnamurthy, 1983; Raghupathi et al., 1983; Sreenivasula Reddy et al., 1983; Reddy et al., 1983; 1984; Kulkarni and Tankar 1984; Kurup and Adiyodi, 1984; Ramamurthy et al., 1985; Sreenivasula Reddy et al., 1986; Jawale, 1986; Appaswamy Pillai et al., 1986; Bradley et al., 1986; Ramamohan Rao et al., 1986; Laxminarayana and Kutty, 1986; Sreenivasala Reddy et al., 1986; Jayasundaramma and Ramamurthy, 1988a and b). All these papers on the physiology and metabolism of Indian freshwater crabs is based on short-term experimental studies on field collected samples.

4. Moulting regeneration and reproduction and their control mechanisms:

Parallel to the work on general physiology of crabs as
mentioned above, a magnitude of documentation on the neuroendocrines and their control of moulting, regeneration and reproduction of freshwater crabs has been there between 1932 to date (Nath, 1932; Iyer Muthuswamy, 1933; Parameswaran, 1956; Otsu, 1963; Gomez, 1965; Gomez and Nayar, 1965; Adiyodi, 1967; Adiyodi, 1968a,b and c; Adiyodi, 1969; Adiyodi and Adiyodi, 1971; Vasisth and Relan, 1971; Adiyodi, 1972; Rajula et al., 1973; Diwan and Nagabhushanam, 1975; Anilkumar and Adiyodi, 1977; Anilkumar and Adiyodi, 1978; Gangotri et al., 1978; Raman and Adiyodi, 1980; 1981; Reddy et al., 1982; Chandran et al., 1982; Ramamurthy and Sreenivasula Reddy et al., 1985; Ramamurthy et al., 1986; Joshi and Khanna 1987; Joshi, 1989). Most of the above work has also been extensively reviewed from time to time (Nayar, 1977; Adiyodi and Adiyodi, 1983a and b; Adiyodi, 1985; Adiyodi and Adiyodi, 1988).

5. **Histology and biology in relation to reproduction:**

Simultaneous to the work on moulting and reproduction requisite histological and biochemical studies on the freshwater crabs has also been published from time to time (Adiyodi, 1969; Adiyodi and Adiyodi, 1970a and b; Diwan and Nagabhushanam, 1974; Joshi and Khanna, 1982a and b; Rashan et al., 1983; Bhagyalakshmi et al., 1984).

6. **Physiological ecology related to development:**

In recent years, valuable contributions in the field of physiological ecology in relation to development of Indian freshwater crabs have been made (Pillai, 1981; Narasimha Rao et
Appreciating the work so far carried out by earlier workers, it is evident that, while much of the experimental work on one or the other aspect of the physiology of freshwater crabs is well documented, field-oriented studies on their biology covering particular aspects like their habitat features, occurrence and distribution through seasons, population structure through time, biometric analysis, food and feeding habits and reproductive cycle etc., have not been studied to the extent required.

When the commercial importance of crabs has been realised and international farming of suitable species is advocated (Bardach et al., 1972; Adiyodi, 1985), it is imminent that the biological performance of crabs in their natural populations be understood clearly. Notable progress on these lines has been made in respect of temperate country crabs (marine/brackishwater/freshwater; see Warner, 1977; Jones, 1978). Considerable progress has also been achieved in respect of Indian marine/brackishwater crabs (Rahaman, 1967; Rayan, 1967; Chandran, 1968; Rangnekar et al., 1968; Subramaniam, 1969; Teshima and Kanazawa, 1971; Fielder and Eales, 1972; Hartnoll, 1974; Gupta and Chatterji, 1976; Johns and Sivadas 1979; Subramaniam, 1979; Uma and Subramoniam, 1979; Babu et al., 1980; Ezhilarasi and Subramoniam, 1982; Nagabhushanam and Kulkarni, 1982; Uma and Subramoniam, 1982; Nagabhushanam and Farroqui 1984;
Hilarasi and Subramoniam, 1984; Kulkarni, 1984; Subramoniam, 1984; Haesman et al., 1985; Prasad, 1987; Nagarajalingam and Subramoniam, 1987; Sambasiva Rao, 1987; Krishnan and Kannupandi, 1987; 1990). However, only a few papers on freshwater crabs of India (Anilkumar, 1980; Joshi and Khanna, 1982; Pillai and Subramoniam, 1984; Ramamurthi et al., 1986) are known. In view of this, it was planned to undertake detail studies on a natural population of one of the locally available freshwater brachyuran crabs.

Hitherto, limnology of several lentic and lotic freshwater habitats of Bangalore district have been investigated to relate the same with biology and ecology of prawns (Anantha Raman, 1982; Narasimha Rao, 1983), fishes (Purushothama, 1985) and plankton (Ayyappan, 1987; Chakrapani, 1988; Sukumaran, 1989). There is no record of the limnology of the lotic habitats particularly those of nullahs in relation to biology of crabs inhabiting these systems. The only report is that of the limnology of Neeru nullah from Jammu (Malhotra et al., 1987). Nullahs are excellent examples of temporary lotic habitats and form the fundamental links between canals and temporary lentic systems (paddy fields; Reddy and Pandian, 1974). To-date, no specific scientifically based conceptions have been elaborated for the nullahs, although they are found to harbour a variety of invertebrates and small fishes.
Hence, after a survey of the lentic and lotic systems of Bangalore district for the occurrence and distribution of crabs, detail studies on a natural population of *Barytelphusa Jacquemontii*, the larger of the two species of locally available brachyuran crabs (see Srivathsa *et al*., 1989) and inhabiting the canal and nullah systems of the Byramangala reservoir was undertaken.

The information on the biology and ecophysiology of *Barytelphusa Jacquemontii* as presented in this thesis is arranged as follows :-

The first chapter on general introduction and review of literature and also highlights the aims and objectives of the present work, is followed by chapter two, describing the survey of freshwater habitats of Bangalore to determine the crab resources and their distribution. Chapter three details the material used methods adopted during the studies. Chapter four, describes the physico-chemical features of the chosen habitat where long term data on catch composition and population structure of *B. Jacquemontii* were collected. In chapter five, the population characteristics, biology and ecophysiology of the crab have been detailed. In each of the three, four and five chapters, the observations made and results obtained are also discussed in the light of relevant literature in the respective fields. The above five chapters are followed by an overview (Chapter Six), where the biological findings on the crab are correlated with the climatic features of the area,
determine the ecophysiological fitness of the species. 

After, a summary is included to outline the salient findings 
the thesis, followed by an alphabetical list of literature