The information on the natural history observations and biology of the brachyuran crab *Barystelphusa jacquemontii* (Rathbun), along with its habitat features and limnology, as detailed in the foregoing chapters of the thesis, permits an analysis on the life pattern of this crab and an overview on the ecophysiology of the species.

Amongst the two true crabs available in and around Bangalore, *Barystelphusa jacquemontii* is more aquatic and less widely distributed than *Oziotelphusa senex* and by virtue of being larger in size, the former species is also a commercially important. Out of the fortyone local freshwater habitats surveyed for crab resources, *B. jacquemontii* maximally inhabited the canal and nullah systems of Byramangala reservoir. The striking feature of these nullahs is the presence of slow continuous flow of water all through the year. Apart from this, with the peripheral characteristic 'algal-mat ecosystem complex', which regularly appears and disappears during a predictable time of each year (May through December), is propitiously colonised by the "young of the year" crabs. This unique algal-mat ecosystem appears to provide the suitable kind of a habitat for the survival and growth of the newly recruited crablings. Algal-mat, with its rich invertebrate biota (many species of which form the food of young crabs), has enabled *B. jacquemontii* to colonise successfully. Chironoids are the common inhabitants of polluted waters rich in nutrients and poor
in oxygen content (Dutta and Malhotra, 1986). Being more aquatic than *O. senex*, it is understandable that *B. jacquemontii* has chosen this lotic system. Further, as adults, *B. jacquemontii* tends to be solitary and highly territorial and also requires a typical rocky/clayey shores, to elaborate it's burrowing habit, as well as to successfully complete it's moulting and reproduction events (both of which are believed to be achieved when the crab lives in hiding, away from predators and also from conspecific competitors. Non-availability of post-moult (=soft) adult crabs of either sex, in the population and the difficulty in locating and collecting ovigerous/brooding females, provide support to these observations.

The result on the limnology of nullah water suggests that rainfall as also the inflow of sewage into the Byramangala reservoir play a dominant role in regulating the physico-chemical characteristics of water and sediments in the nullahs. Turbidity, conductivity, phosphate-phosphorus and silica content of water are considerably influenced by the rainfall and concentration of sewage. The influence of rainfall and sewage on physico-chemical condition of water has been reported for several freshwater habitats (Ponnuchamy et al., 1980; Sutchiffe et al., 1982).

In the nullahs, throughout the annual cycle, the air and water temperatures did not differ significantly. Lack of depth and morphometric features of the nullah favour the existence of
uniform conditions. Further, the water or bottom sediment temperatures never exceeded 30 °C thus suggesting that the temperature of the nullah systems is highly suitable for the survival of crabs.

The dissolved oxygen concentration although remained low, the continuous flow of water has enabled it to be far from being a limiting factor. The low levels of this gas in the water could be attributed to the high concentrations of dissolved organic matter. While the level at which nitrates become toxic to crabs is largely unknown, natural waters containing less than 4.2 mg l$^{-1}$ are believed to support aquatic fauna (Stickney, 1979). Since the concentration of the water remained low, it is evident that the survival and growth of crab is promoted in this habitat.

Bottom sediments play a vital role as a reservoir of nutrients and in regulating the eutrophication of freshwater habitats (Hendricks and Silvey, 1973). The alkaline nature of the sediment and fairly good calcium carbonate-phosphorus system may suggest the release of nutrients fairly.

Despite the fact that Byramangala reservoir system receives drainage of undesirable effluents (of both domestic and industrial origin) from the Bangalore city, the main reservoir as such appears to function as a large oxidation pond and its system of perennial nullahs which allow slow flow of reservoir water for
Irrigation perhaps permits natural water-quality improvement, thereby rendering the canal and nullahs congenial for the support of crab abundance.

As mentioned earlier, seasonality in the climate of Bangalore, largely determined by the two major factors - temperature and rainfall, is known to be fairly accurately predictable over an annual cycle (Singh, 1964) as follows:

- a. March through May ........ Hot-dry season
- b. June through September .......... Hot-wet season
- c. October through November ........ Cool-wet season
- d. December through February ........ Cool-dry season

The profiles of changes in the monthly rainfall, temperature and sunshine hours, at the Byramangala region, in relation to the above four seasons, are presented in Figures 66 and 67. The corresponding seasonal changes in the reproductive indices of males and females of *B. jacquemontii* are depicted in Figures 68 and 69 respectively. A correlative analyses of these four figures project interesting facts:

Unlike in the other tropical aquatic thermoconformers (see Peter and Hontela, 1978; Rao, 1983), due to its peculiar reproductive habit, in *B. jacquemontii* (as also perhaps the other brachyuran crabs), the reproductive events of males and females do not appear to be synchronous. The males show an overt gonadal activity during hot-dry and hot-wet seasons, in time to copulate with the soft post-moult females during the hot-
FIG. 66

Data on rainfall (mm) and sunshine period (hrs/month)

July 1988 to September 1989

Rainfall  Sunshine period
FIG. 67
Data on air and water temperatures (centigrade)

Air temp. (minimum)  Water temperature  Air temp. (maximum)

July 1988 to September 1989

Hot-wet  Cool-wet  Cool-dry  Cool-dry  Hot-dry  Hot-wet
Season-related variations in the reproductive indices of males

**FIG. 68**

July 1988 to September 1989
FIG. 69
Season-related variations in the reproductive indices of females

July 1988 to September 1989

GSSI (%)  GSI (%)  SSI (%)
wet/cool-wet seasons. Therefore, the reproductive indices of the males were realised to be highest during hot-dry and hot-wet seasons, showing declines thereafter. Correlative to this, the spermathecal somatic index of the females was highest during the hot-wet and cool-wet seasons (i.e. immediately after the event of copulation). The dip in the reproductive indices of the females is significant during February (i.e. the latter part of the cool-dry season), suggesting a depletion of the ovaries, spermathecae and the oviducts, consequent to fertilisation, spawning and oviposition. Appearance of egg-bearing females during March-April and the juvenile-bearing females during May of each year, confirms the above and further suggests that egg-incubation and juvenile brooding in this species, lasts for two to three months. Therefore, the 'free-crabs' recruited into the population, appear in significant numbers in the population, during June and July each year. That the juveniles of *B. jacquemontii* are retained in the brood pouch for nearly a month also suggests that these juveniles may be osmoregulatorily insufficiently adapted immediately after hatching from the eggs.

The once in a year moulting phenomenon of *B. jacquemontii* (especially that of the females) appears to be restricted to the hot-wet/cool-wet seasons, thus permitting successful copulation thereafter, between a post-moult, soft female and a hard inter-moult male of the species. Similar observation has also been reported in *Paratelphusa hydrodromous* (see Adiyodi and Subramoniam, 1983; Adiyodi and Anilkumar, 1988). That mating in
**B. jacquemontii** is restricted to this season is also apparent from the histological analysis of the generative system of the females where, spermatophore deposition in the oviducts was noticed only in this season. Further, as indirectly gathered from the histological data on the oviducts and the spermathecae, mating in females of **B. jacquemontii** appears to occur when the females are quite small in size (10 to 50 mm in CW), at the time when the ovaries contain avitellogenic oocytes. The smallest ovigerous female of **B. jacquemontii** collected during the present studies was 60 mm CW. This suggests that the ovarian cycle of the females may be initiated only after first mating to surmise that mating is a prerequisite to initiate the first ovarian cycle of the female. Such a phenomenon is well known in the insects (Gillott, 1988) and is indicated in another brachyuran, *Paratelphusa hydrodromous* (Krishnakumar, 1985).

A coitus-induced initiation of vitellogenesis in **B. jacquemontii** could be a response either to a mechanical filling of the spermathecae during copulation or to active components contained in the semen (= spermathecal factor ?). Once induced, the process of vitellogenesis progresses rapidly to permit females that have reached 60 mm CW to spawn during the next cool-dry season. Considering 5 mm CW as the size of the young of the year of **B. jacquemontii** and taking the average monthly growth rate of the crabs as 5 mm, it is understandable that the females breed after one year of their age. Further, the continuous presence of sperms in the spermathecae of the females, even after
spawning/brooding, also suggests that once mated, the females are capable of producing two to three broods and that the females need not mate, each time spawning is to be realised (see also Morgan et al., 1983). Retention of viable sperms in the spermathecae also appears to be aided through tanning of the distal regions of the spermatophores held in the oviducts, thereby perhaps blocking the loss of spermatophores as well as preventing further copulation with the male. Perhaps the female-biased sex-ratio of the adults of this species, calls for such a strategy.

On the whole, it is apparent that the endocrine mechanism of B. jacquemontii are in fitness to the resource availability and requirement of an optimal energy expenditure for the processes of moulting and reproduction. The observation on the habitat characteristics, population structure through space and time, food and feeding habits and histomorphology of the generative system as presented in the thesis thus project the ecophysiological bonitation of the species.