GENERAL INTRODUCTION
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"Live alone and like it" is a slogan that no living thing can adopt. Every organism is subject to both living and non-living influences of its surroundings. Every individual depends upon its environment to supply it with vital materials and energy. Therefore, no study of living organisms would be complete without probing their relationship with environmental entities. Environment is the sum of many abiotic and biotic factors, interacting constantly. The organism not only exists in this dynamic, fluctuating complex but also it is a part and parcel of it. The environment is neither homogeneous nor unchanging. Certain minimum conditions such as sufficient warmth and oxygen are necessary for the continued existence of living organisms.

Caridina rajadhuri, a fresh water prawn, is no exception. Therefore, it is desired to stress the unity of ecology and the necessity for including the physical forces, as a part of the environment on this fresh-water prawn.

For the organism in a harsh environmental complex, mere survival is the minimal level of performance; but for the perpetuation of the species more highly integrated
processes leading to reproduction must be operational. Irrespective of the levels of performance demanded by an organism, a constant interchange of energy takes place between the organism and its ambient environment.

Fundamental needs of the organism which may be provided by the substratum are attachments, shelter and nourishment. A living organism is both structurally and functionally adjusted to the environment in which it is living. It must respond to external stresses in such a way that its internal environment is maintained in the optimum conditions for the continuance of its metabolic reactions. The animals in diverse environments are confronted with different problems; conversely, in the same environment different animals reacting to stress in different ways. The organism has to face a variety of environmental factors like water, inorganic ions, organic food, oxygen and carbon-dioxide, light of high and low frequency, currents, pressure, gravity, ionizing and other radiations and temperatures. The range of the species is determined through natural selection by its limits of tolerance. One environmental factor such as temperature may limit the distribution of one group, another factor such as salinity may limit another group over an ecological range; individuals may vary within limits set by the genotype while a phenotype results from the balance of genetic and environmental factors.
Three general time scales can be distinguished in response to an environmental alteration: (1) there are direct reactions to the environmental changes. These may be mediated by stimulation of sense organs which initiate chains of responses or there may be direct effect on metabolic reactions. Changes in ions, temperature, oxygen and foodstuffs may lead to alterations in enzymatic reaction rates. Frequently if the environmental change is abrupt or great, as with cooling or warming, the animal shows an initial overshoot or series of oscillatory metabolic reactions before settling down to a new stabilized rate. The time for the direct response or new rate is usually in minutes or hours; (2) the time period in the response of an organism to an environmental alteration may require days or weeks. This is a period of acclimation or compensation and the magnitude of the physiological adjustment varies with the amount of environmental change. In seasonal changes the compensatory alterations may develop gradually. Changes in hydrogen ion concentration in freshwater and seasonal changes in temperature may involve migration or changes in hormone balance in reproductive activity (3) a third type of response to environmental change is that of regulation of internal state with respect to environmental parameters.
The highest vital index for a population of a species occurs under ideal conditions in which the potential natality is highest possible and the potential mortality is the lowest. Maximum natality is determined by the largest number of viable progeny such as eggs and youngs and the frequency of reproduction. Minimum mortality is determined by the internal factors such as hormones, controlling survival when environmental factors are all completely favourable. The biotic potential is thus an innate characteristic of each species and widely differs from species to species. Harmful changes in climate result in migration to a favourable environment to release their larvae. Gravid females of a Danish population Carcinus maenas leave the intertidal zone during breeding season and move out into a deeper water of more saline (Rasmussen, 1953). Some sessile organisms such as barnacle, Balanus balanoides have an annual breeding cycle. Under optimal conditions of temperature, salinity and light, it is possible to shift the date at which egg masses are laid down by more than few weeks (Patel and Crisp, 1960). By manipulation of environmental factors the spawning can be continued throughout the year (Loosanoff and Davies, 1952). Reproductive processes generally occur over a narrow thermal range than many other physiological functions. Oviposition in boring gastropod, Uresalpinx cinerea does not take place until temperature
reaches 20°C (Stauber, 1950). American oyster, Crassostrea virginica, can feed and grow at temperature ranging from 8° - 31° C, but breeding does not occur until temperature is between 16° - 20° C, depending on geographical location (Loosanoff and Nomejko, 1951). In geographically separated populations the breeding season may vary over different parts of their range (Orton, 1920).

One problem of animal life is to maintain inside the organism just a proper amount of water not too much, not too little. The salinity fluctuations are not very much in fresh water; and fresh water animals must exclude water to prevent self-dilution. Since the water in natural environments contains a varying amount of dissolved materials and usually a different amount from the fluids of the organism, the resulting differences in osmotic pressure raise a problem in regard to water exchange. Hard fresh-water contains more dissolved salts than soft fresh water; particularly with respect to calcium and carbonate ions. In typical soft fresh-water the calcium and carbonate ions are relatively less concentrated than sodium and chloride (Baldwin, 1948). Since osmotic pressure is determined by the total concentrations of molecules and ions in solution, values for the aquatic medium will vary according to the total salt content of the water. Dissolved materials in
soft fresh-water vary in amount from practically zero to about 65 parts per million and ponds with hard water exhibit a variety of higher values for salt content (Clarke, 1954). The salt content of the water in alkali soils may be even greater. Animals and plants living in saline soils are, therefore, surrounded by liquids having very high osmotic pressure. Aquatic organisms, therefore, face osmotic problems because net diffusion of water molecules will take place between the body fluid and external aqueous environment, the direction and extent depending upon the relative concentrations of the two solutions. The environmental range with respect to water from fresh-water through sea water to salt lakes is far greater than the tolerated range of concentrations of body fluids; hence animals must have a variety of mechanisms for regulating their osmotic balance.

Usually prolonged periods of thermal extremes, both high and low temperature, have resulted in the mass mortality of marine organisms. The following example will demonstrate the extent of this widespread phenomenon. At the northern limit of their distribution in Florida many tropical fishes have been killed by severe cold spells (Storey and Cudger, 1936); in Great Britain the severe winter of 1962-63 caused great mortality of its marine fauna (Crisp, 1964). Irregular thermal variations, as
well as regular high summer and low winter temperature fluctuations in given region, may act to limit the distribution of animals. When the water currents are favourable to the larvae of the Mytilus edulis, they are carried southwards from north to Cape Hatteras where they get settled and grow. As soon as summer temperature reaches 20°C, all these mussels die (Wells and Gray, 1960). Tropical animals are thought to osmoregulate with greater ease at high temperature (Pannikkar, 1940).

Majority of living organisms live in an environment where temperature fluctuates both diurnally and seasonally. Temperature is the most important environmental factor limiting the distribution of the living organisms. The rate of chemical reaction increases as the temperature rises. Generally speaking, organisms acclimated to low temperature (water condition and/or latitudes) have a higher metabolic rate than similar organisms acclimated to a higher temperature (summer conditions or an equatorial latitude). Not only can acclimatization compensate for changes occurring within viable limits, but they can also extend this limit of resistance of extreme temperatures. This form of compensation is usually called resistance adaptation.

An organism is exposed to a range of intensities of a given environmental gradients. The zone of lethality or
the zone of resistance adaptation is the extreme of the gradient, which results in the organism's death. The environmental range of an environmental gradient where the organism can survive is called zone of capacity adaptation. Intraspecific difference in the position of those zones along an environmental gradient may correlate with different ecological requirements of each individual species. The position of these zones may change during the life cycle of a single species and may reflect ontogenetic differences in environmental requirement of an organism.

The normal low winter temperatures found in higher latitudes are known to be lethal to tropical species. Few species which have wide geographical limits were able to shift their lethal limits by seasonal acclimation. Similar general trends were exhibited by larval crustaceans. Zoaceae of warm adapted species were less resistant to both low temperature and salinity than cold adapted species (Vernberg and Vernberg, 1970).

Respiration is that phase of metabolic process involved in exchange of oxygen and carbon dioxide between organism and its environment. The rate at which organisms consume oxygen is modified by many factors, some environmental, other intra-organismic. All animals are not influenced in the same manner. The factors are: oxygen tension, temperature, salinity, light, food, carbon dioxide
and cyclic changes in environmental parameters acting independently, or in various combinations, may influence the rate of oxygen utilization.

Apparent differences in respiration rates of populations of copepod *Acartia clausi* from England and Land Island have been reported. The forms from the English waters had statistically higher metabolic rate during the colder months of the year. Therefore, it was suggested that the American form had the greater capacity for control of metabolism under varying thermal conditions (Conover, 1959).

Diversity in metabolic temperature response has been reported for latitudinally separated populations of the coastal hermit crab, *Pagurus longicarpus* (Vernberg, 1962). The metabolic temperature curves for the three northern populations demonstrated a common adaptational response, for the cold acclimated animals consumed oxygen faster than warm acclimated animals.

Comparison of absolute metabolic rate of these geographically separated populations rather than the pattern of response, reveals certain generalities. Warm acclimated hermit crabs from Florida exhibit higher metabolic rate at elevated temperature than the northern populations. But at lower temperature, the cold water populations tended to have the higher rates. Since northern animals normally experience
lower temperature, their relatively higher metabolic rate at lower temperature would have adaptive significance.

Supply of oxygen in the aquatic environment varies over the complete range from super saturation to total exhaustion, but that even when saturated water contains a much lower concentration of oxygen than the atmosphere. Some fresh-water organisms have hit upon certain dodges by which they can live in the aquatic medium and still breathe air, either by coming to the surface or by boring into the stems and roots of emergent hydrophytes and obtain oxygen from the internal air spaces of the plants. Most aquatic animals, however, must get along with the relatively meager supply of oxygen dissolved in the water.

Inhabitants of water environment display a wide variety of adaptations that serve to obtain a sufficient supply of oxygen from the medium. The relation oxygen consumption by animals to the tension of oxygen in the environment follows two general patterns: (1) non-regulatory type in which consumption is highly dependent upon tension, as seen in certain arthropods (Homarus, Limulus and Callinectes) and (2) the regulatory type in which consumption is independent of oxygen pressure over a wide range as seen in certain crustaceans (Astacus, Caridina) and Molluscs (Anlydia, Eladon). In the latter type, the harmful effects of insufficient oxygen appear rather suddenly when the oxygen drops below the critical tension for the species concerned (Prosser, 1950).
Arthropods are the most successful animals in terms of evolution and adaptation to numerous environments and largest phylum in respect to number of species. Crustaceans species occur in fresh-water as well as in marine waters. The tremendous importance of these animals rests upon their indispensable position in the food web and energy relationships in streams, river, lakes and estuaries and the sea. An important concept, therefore, is that for practically every major type found in fresh waters, there is a ecological counterpart, often similar in appearance inhibiting the sea; many of these meet in the estuary (Ried, 1961).

The goal of the present study in physiological ecology is to investigate the interrelations of the freshwater prawn, *Caridina rajadhari*, to biotic and abiotic factors of the environment. This Caridian prawn embraces an ecologically important group of small animals characteristically associated with the debris or vegetation. Laboratory tests were mainly used to study the reactions of these prawns to understand their actual and possible behaviour under natural conditions. Hence to observe the influence of habitat on *Caridina rajadhari*, both physical features and biological influences were investigated. The present probe was carried out on the following lines: (1) Breeding behaviour and Development, (2) Reproductive Biology, (3) Physiology of moulting, (4) Osmotic behaviour, (5) Temperature tolerance, and (6) Respiratory metabolism.