CHAPTER 2

ECOLOGY

2.1. INTRODUCTION

An aquatic ecosystem consists of a diverse assemblage of organisms, whose interaction with one another, between themselves and their physicochemical environment form an extremely complex nature of relationships. No organism can keep aloof from its environment and any change in the environment affects the organisms either directly or indirectly. Knowledge of the environment is of utmost importance to understand the distribution and colonization of most marine benthic organisms. In the coastal environments, study of hydrographical features such as rainfall, temperature, salinity and dissolved oxygen content are known to exert influence collectively on the distribution pattern of intertidal communities (Thorson, 1966). The environmental factors affecting the organization of communities on the intertidal rocky surfaces have received considerable attention, because of the easy access of physical characteristics like waves, tide and fresh water inflow into the intertidal areas and the relative sessile nature and great abundance of many of the organisms. On the contrary crustaceans like S. serrata may respond to changing environmental circumstances by movements where such response is
impossible for sessile species. So, recently the population of invertebrate organisms, ecology of mobile invertebrate organisms have received paramount attention. Environmental conditions also play an important role in promoting the occurrence and abundance of commercially exploitable marine resources (Ivelev, 1966). In many countries coastal and marine environs are under special jurisdiction and hence, it is imperative to know the inter relationships between the organisms and the environmental parameters in order to evaluate the suitability and function of ecosystem (Baskarasanjeevi, 2001).

The environmental conditions are governed by short term changes due to tides and seasonal changes from monsoonal cycle (Sankaranarayanan and Qasim, 1969). Hydrological parameters such as rainfall, temperature, salinity and the dissolved oxygen determine the distribution and survival of animals in estuaries, mangroves and in any other coastal environments. They directly or indirectly affect the life activities of each and every organisms at various levels of their life. Response of an animal to fluctuating environmental factors can be considered as adaptive strategies for survival. A knowledge of the environmental parameters of shallow water area is thus an essential prerequisite to understand the composition of animal inhabitants, their distribution, dispersal and relative zonal abundance within the vast and interior areas of coastal waters (Baskarasanjeevi, 2001).
Studies relating to the influence of environmental factors on intertidal communities have been well documented by Underwood (1979), Cantera et al. (1980), Stickle et al. (1985), Phil (1986), Silverberg et al. (1987), Stoner and Sandt (1991); Stoner et al. (1995). Locally and regionally the distribution of intertidal and other marine invertebrates is limited by complexity of interacting factors, of which temperature is important either directly or for its modifying effects on other factors (Kinne, 1970; Wolcott, 1973; Newell, 1979). Seasonal variations in salinity, dissolved oxygen and nutrient salts in the inshore waters of Gulf of Mannar and Palk Bay was observed by Jayaraman (1954), Prasad (1954, 1956 & 1958), Mahadevan and Nagappan Nayar (1967), Marichamy and Ponsirameetan (1985), Murugan et al. (1991) and Thilaga (2005).


Hill (1975) made a study on the breeding and growth of *S. serrata*. Kathirvel (1980), Hill *et al.* (1982), Frusher (1983) and Lee (1992) have studied the ecological distribution of the portunid crabs of Pulicat lake.

Ecological studies on *S. serrata* in Indian waters especially in the Gulf of Mannar are scanty, and hence the present work was designed to carry out a survey on the physico-chemical conditions along the Gulf of Mannar of Tuticorin coastal waters.

2.2. MATERIAL AND METHODS

Environmental survey samples on *S. serrata* were collected for a period from January 2000 to December 2001 from the Gulf of Mannar of Tuticorin coastal waters. The monthly rainfall data for the above period was collected from the meteorological department of Tuticorin Port. The atmospheric temperature was recorded using a thermometer °C with 0.1°C accuracy. The surface water was collected from the
collection area and the water temperature was measured by using a thermometer °C.

Salinity was determined through silver nitrate titration (Strickland and Parsons, 1972). The dissolved oxygen content was estimated through Winkler's method following the procedure of Strickland and Parsons (1972).

2.2.1. Statistical Treatment

Simple correlation coefficient was carried out to find out the relationship between population distribution and ecological parameters using the formula.

\[
\text{r} = \frac{\sum d_x d_y}{\sqrt{\sum d_x^2 \sum d_y^2}}
\]

Where,

\[d_x = \text{deviation of } x \text{ and } \bar{x}\]
\[d_y = \text{deviation of } y \text{ and } \bar{y}\]

\[d_x^2 \text{ and } d_y^2 = \text{squared values of } dx \text{ and } dy \text{ respectively.}\]

2.2.2. Population studies

For the present study the animals were collected by trawl operation. The collected population was examined to record the number of males and females.
2.3. RESULTS

2.3.1. Environmental parameters

(i) Rainfall

Rainfall in Tuticorin (East coast of India) is mainly due to North east monsoon (October to December). Monthly variations in the rainfall during the study period (January 2000 - December 2001) are presented in the Fig-2 (page 31). The maximum rainfall (216mm) was recorded during monsoon (December) and the minimum rainfall (2.1mm) was observed during summer (March) and no rainfall was recorded in summer (May) and pre-monsoon (July). Likewise during 2001 the maximum rainfall (201mm) was recorded in monsoon (December) and the minimum rainfall (1.3mm) was observed in pre-monsoon (September) and no rainfall was noticed during post-monsoon (March), summer (June) and pre-monsoon (August).

(ii) Atmospheric temperature

The atmospheric temperature recorded during the study period is given in Fig-3 (page 32). The monthly mean atmospheric temperature during 2000 fluctuated seasonally and high temperature (36°C) was recorded during summer (May) and low temperature (27°C) in monsoon season (November). During 2001, the atmospheric temperature (37°C) was recorded in summer (May) and low temperature (27°C) was during monsoon (November and December).
(iii) Water surface temperature

The temperature fluctuation in surface water in this study are is given in Fig-3 (page 32). The surface water temperature ranged from 26°C to 33°C. The maximum temperature (33°C) was recorded in summer (May) and the minimum temperature (26°C) in monsoon (November) during 2000. In the second year of study (2001) the surface water temperature varied from 26°C to 33°C. The high temperature (33°C) was recorded in summer (May) and the low temperature (26°C) was in monsoon (November and December).

(iv) Dissolved oxygen

Monthly variations in oxygen values are presented in Fig-4 (page 33). The dissolved oxygen content ranged from 3.13 ml/l to 4.56 ml/l. The maximum oxygen concentration (4.56 ml/l) was recorded during monsoon (October and November) and minimum (3.13 ml/l) was observed during summer (April and June) in the first year of study (2000).

Likewise during 2001, the dissolved oxygen content varied between 3.63 and 4.73 ml/l. The maximum dissolved oxygen content was noticed (4.73 mlO₂/l) during monsoon (October and November) and the minimum (3.63 mlO₂/l) was during summer (April and June).
(v) Salinity

The salinity variations during the study period of 2000 to 2001 were given in Fig-5 (page 32). During 2000, salinity values ranged from 28.5% to 36.7%. Maximum salinity (36.7%) was observed during summer (May) and the minimum salinity (28.5%) was observed during monsoon (November and December). Likewise during 2001, salinity varied between 36.2% and 28%. Maximum salinity (36.2%) was recorded during summer (April and May) and the minimum salinity (28%) was observed during monsoon (December).

(vi) Population density

The number of study animals collected by trawl operation from January 2000 to December 2001 are recorded and given in Fig-6 a & b (page 35). The total number of S. serrata collected during the entire period of study was 1311 and it comprised of 278 females and 295 males in the first year of study (2000) and 393 females and 345 males in the second year (2001).

The maximum number of males (39) of S. serrata was recorded in monsoon (November) and the minimum number (21) during post-monsoon (March) in the first year of study. During the second year (2001) the maximum number (37) was recorded in summer (April) and the minimum number (25) in post-monsoon (January).
The maximum (39) females of *S. serrata* was recorded in monsoon (November) and the minimum number (19) during post-monsoon season (January) in the first year of study (2000). In the second year (2001) of the study the maximum number (41) was recorded in monsoon (November) and the minimum number (29) in pre-monsoon (July). Total population and environmental characters showed insignificant correlation Table- 1 (page 30).

2.4. DISCUSSION

Both the years the bulk of rainfall was recorded during monsoon season (December) due to the North East monsoon which is predominant in the East coast of peninsular of India. Thilaga (2005) also reported maximum rainfall in Tuticorin coastal areas during the North East monsoon season (October to December).

Of the many physical and chemical parameters that characterize different environments, temperature of water is one of the factors if not the most important to determine, and its analyses often provides a satisfactory description of the main features of the environmental situation (Boely et al., 1990). Temperature is commonly considered the most important single ecological parameter in the distribution of marine animals (Gunter, 1957). The fluctuation in the climatic conditions, microbial activities, influx of fresh and saline water, solar radiation, tidal currents and atmospheric changes bring about
temperature variation (Alvarez Borrego and Alvarez Borrego, 1982). The occurrence of maximum temperature during summer may be due to the high intensity of solar radiation and evaporation. The rise in water temperature may be due to the entry of hot waste water discharged from Thermal power plant of Tuticorin. The minimum temperature during the monsoon and post-monsoon season was due to high humidity and high water level caused by the fresh water input. The lower water temperature in the aquatic body in the monsoon season may also be due to the influx of upwelling water. The present observation is in agreement with the finding of Baskarasanjeevi (2001) and Thilaga (2005) from the Gulf of Mannar of Tuticorin coastal waters. In the westcoast also maximum water temperature during summer and minimum in monsoon and postmonsoon season was reported by Nair et al. (1983) in Ashtamudi backwaters, Bijoy Nandan, (1991) in Kadinamkulam backwaters.

There was not much variation in the range of atmospheric and water surface temperature. The factors that influence the water temperature are under water current, rainfall and subsequent river run-off. The surface water temperature was always lower than that of atmospheric temperature, and atmospheric and surface water temperatures vary in different seasons. This observation is in agreement with that of Jagadeesan(1974),
Mc Lusky et al. (1975), Rajendran (1995) and Thilaga (2005). In the present study the temperature was not found to influence the distribution of the crab *S. serrata* and it is evident from the insignificant correlation obtained between total population and surface temperature.

The high salinity reported could be due to the higher rate of evaporation and the absence of fresh water inflow. The minimum salinity could be mainly due to the large influence of land run off, maximum influence of fresh water run off as well as heavy rainfall during monsoon season. Ajmalkhan and Natarajan (1981) have stated that in tropical waters, salinity is known to play a key role in the distribution of marine organisms in near shore and estuarine regions, where fluctuations in salinity are well pronounced. However, the changes in salinity was not conspicuous in the present study. In Indian coastal waters, the seasonal changes in the intertidal area are not much (Baskarasanjeevi, 2001). Salinity changes do not bring major fluctuations in the animal population (Ansell et al., 1972). According to Kinne (1970) *S. serrata* is an euryhaline animal, and able to survive unfavourable salinities for short periods. In the present study salinity might not be a factor affecting the distribution of *S. serrata* and it is evident from the insignificant correlation obtained between total population and salinity.

The dissolved oxygen content depends upon the nature and abundance of plankton, photosynthetic activity and monsoonal rainfall. In the present study
higher oxygen content was observed in the pre-monsoon, monsoon and low value in the summer season. High dissolved oxygen associated with high pH values along the coastal system during the study period suggested, the abundant growth of phytoplankton and related zooplankton leading to high biological activity and which might contribute to the oxygen budget of the aquatic body. High dissolved oxygen concentration coincided with low salinity and low temperature in water. Low temperature also influence oxygen solubility, Red field (1948) and Dutt et al (1954). The low level of oxygen may be due to the rich organic content from land drainage, sewage discharge, aquatic weeds with utilization of oxygen for bio-degradation of organic matter in the water. The decomposition of organic matter also reflect the low dissolved oxygen content (Vijayalakshmi, 1973; Qasim and Sengupta, 1981; Thilaga, 2005).

The first year (2000) of study showed the dominance of males in the catches. Similar observations were also reported by Mohanty (1973) in Chilika lake, Shanmugam and Bensam (1980) in the inshore and mud flat areas of Tuticorin coast. The present observation showed the dominance of female in the catches in the second year of study (2001). In confirmation with the present study (Srinivasagam, 1975) in Killai backwaters, (Ram and Chandramohan, 1978) in Netravati estuary, (Kathirvel, 1981) in Cochin backwaters, (Lalitha Devi, 1985) in the inshore and estuarine areas of Kakinada region, (Srinivasagam and Raman, 1985) in Pulicat lake also showed the evidence of the
dominance of females in the catches. However, the dominance of males in 2000 and females in 2001 could not be pinpointed since it was a natural phenomenon due to some unknown environmental conditions. The occurrence of large number of females in the monsoon season may be due to the migration of females from the sea to the inshore areas for breeding (Pillai and Nair, 1973; Joel and Sanjeevaraj, 1982; Lalitha Devi, 1985). It was evident from the present finding that the physico-chemical parameters were not found to be governing the distribution of the study animal from the Gulf of Mannar region.
Table 1. Shows the analysis of correlation co-efficient between total population and ecological parameters.

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Total population vs Ecological Parameters</th>
<th>Correlation value</th>
<th>Significant Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Tp Vs Rainfall</td>
<td>(0.01)</td>
<td>P &gt; 0.01</td>
</tr>
<tr>
<td>2</td>
<td>Tp Vs Atmospheric temperature</td>
<td>(0.20)</td>
<td>P &gt; 0.001</td>
</tr>
<tr>
<td>3</td>
<td>Tp Vs Surface water temperature</td>
<td>(0.23)</td>
<td>P &gt; 0.01</td>
</tr>
<tr>
<td>4</td>
<td>Tp Vs Oxygen</td>
<td>(0.61)</td>
<td>P &gt; 0.001</td>
</tr>
<tr>
<td>5</td>
<td>Tp Vs Salinity (%)</td>
<td>(0.11)</td>
<td>P &gt; 0.001</td>
</tr>
</tbody>
</table>
Figure 2. Rate of rainfall during the study period (2000-2001)
Figure 3. Temperature distribution during the study period (2000-2001)
Fig. 6. Seasonal abundance of *S. serrata* for the year 2000 and 2001.