CHAPTER IV

GENERAL OBSERVATIONS AND HOST-PARASITE RELATIONSHIP

Studies on parasitic copepods are highly diversified with many disciplines. Initial studies were only on taxonomy of parasitic copepods with the description of many new species and genera. Parasitic copepods exceed any other group of parasites in number and abundance. Copepods are widely distributed and are found to be parasitising on almost all variety of fishes. They exhibit varying degrees of modification in their structural and functional morphology. The modifications may be simple on one hand and on the other hand it may be highly evolved which leads to the loss of all characteristic features.

The present study is mainly on the taxonomy of parasitic copepods on elasmobranch fishes and provides limited scope for a comprehensive discussion. Nevertheless, certain interesting observations on various aspects of copepod parasitism arising out of the present investigation are briefly dealt with in the following pages.
Copepods parasitic on fishes mainly belong to three groups viz. Poecilostomatoida, Cyclopoida and Siphonostomatoida. Poecilostomatoids are the least modified, whereas Siphonostomatoids are highly modified. Cyclopoids come in between the two. These groups exhibit a gradual transformation from nearly free living life to a sedentary parasitic mode of life.

It is difficult to find any convincing explanation for the way in which parasitic copepods find their host and the method of getting attached to the preferred site on the host. So one can only speculate that the infestation of copepods may occur at certain age or size of the host which is accessible to the infective stages of the parasite.

Chemoreception is considered to be a possible way of finding a specific host. Fryer (1966) observed that once a host is infested with a parasite, it may have a tendency to acquire more parasites. According to him, a chemical attractant is produced by the parasite, which gets attached initially. This will attract more parasites of the same species to the same host. Kabata (1974b) reported a chemoreceptive organ situated in the middle of the anterior margin of the dorsal shield of Caligus clemensi, C. curtus, and Lepeophtherius salmonis. Cressey
and Cressey (1979) reported the presence of a chemoreceptive structure in the genus *Abasia* Wilson. The authors described the sensitive area as 'Rugose' which appears to be similar to that described by Kabata. This increases the probability that all caligids might possess such chemo-receptive organs, which help the parasite to detect the host and find specific site of attachment. Many authors uphold the tactile sensation as another method adopted by the parasites to find its potential host. But this is still a hypothesis, for any report on direct observation in this regard is lacking.

Parasitic copepods are host specific, with varying degree of site specificity. Majority of copepod parasites encountered in the present study are ecto parasites. Members of genus *Penicillus* is observed to be host specific on the members of the genus *Eulamia*. All the parasites are collected from *E. ellioti* (Day), *E. melanoptera* (Quoy and Gaimard) and *E. dussumieri* (Muller and Henle).

According to Cressey (1967a), the copepods belonging to the family Pandaridae were specifically parasitic on elasmobranchs. Present study is also in confirmation with the view expressed by Cressey. All the Pandarid copepods collected during the study were from
various species of *Eulamia*.

Cressey (1967c) has reported that the genus *Gloipotes* were exclusively parasitic on members of the family *Istiophoridae*, and *Xiphidae*. In the present study, many species of *Gloipotes* were collected from elasmobranchs such as *Eulamia* spp. and *Scoliodon sorrakowah*. These are the new hosts for these parasites and it proves that the genus *Gloipotes* can also parasitise elasmobranch fishes. The genus *Echthrogaleus* parasitises only elasmobranch fishes (Cressey, 1967b). In the present study four species of *Echthrogaleus* were collected from elasmobranch fishes which confirm Cressey's observation.

It is well established that parasites frequently display an affinity for particular parts or region of their host body. In the case of gills of fishes, non random distribution of the parasites over the available sites of attachment are common, although the exact mechanism giving rise to such distributions are less clearly understood (Fryer, 1966). Most commonly, the force and direction of branchial ventilating currents are presumed to dictate the observed pattern of parasitic attachment (Hughes and Morgan, 1973). It is however believed that the existing pattern are susceptible to modifications due to influence of many external and
internal factors (Van den Broek, 1979).

It is also observed that irrespective of the host fishes, the same species of parasites show an affinity to a particular region of the host. All the species of Kroeyeria were collected from the anterior side of the fourth gill filament. The members of the new genus Penicillus were collected from three species of elasmobranchs. In all the cases, the parasites were found attached to the ventral side of the host. On dissection, the bulla of the parasites were found near the vicinity of the liver.

Kroeyeria is found only in the gill cavity of the host, whereas Echthrogaleus is found exclusively on the ventral body surface of the elasmobranchs. The members of the genus Alebion is found parasitic on the body surface of Sphyrna zygaena, Scoliodon sorra kowah and other elasmobranchs. Bomolochids and Taeniacanthids are found to be attached on the branchial cavity of the host. The members of the genus Caligus prefer mucus covered body surface and gill cavity. These are a few examples to support the site specificity exhibited by copepod parasites.

Morphological modifications exhibited by parasitic copepods are quiet astonishing and to a certain extent, it
is decided by the site of attachment. The parasites which attach on the body surface of the host are more exposed to the external environment and effective attachment is attained by the peculiar structure of cephalothorax and cephalic appendages. Such parasites are adhering to the surface of the host by the suction force produced by the cephalothorax along with the prehensile power of the second antenna. The suction is produced by pressing down the saucer shaped cephalothorax by muscles as suggested by Kabata (1979).

Members of the genus *Caligus* Muller, possess a sucker shaped cephalothorax with a circular sucking disc called lunules on their frontal plates. This structure acts as a powerful organ of attachment. *Caligus*, with the help of sternal fork, creates a vacuum by increasing the concavity of cephalothorax. In order to fill the gap found at the posterior margin of the carapace, the basipod of the third leg in *Caligus* is highly flattened and provided with marginal membranes.

The second antenna is the most important prehensile organ by which the parasite is firmly attached to its host. This is effected by virtue of the shape of the second antenna, which is either sharply pointed or chelate. With the aid of these structures, the parasite
anchor itself to the host. The second antenna with pointed claw is found in the members of the genus Caligus, Gloiopotes and Alebion. While the members of the genus Kroyeria and Eudactyлина possess chelate second antennae by which it holds on to the host tissue.

The members of the new genus Penicillus, collected during the present study, was found attached to the host with their anterior half buried in the tissues and this makes them invariably mesoparasites.

Parasites belonging to the family Pandaridae such as Pandarus, Perissopus and Echthrogaleus collected during this study have fairly prominent denticiform outgrowths, with grooved surfaces. These are usually seen situated at the postero-medial position to the base of maxillipeds and other appendages. These rugose area are termed adhesion pads, whose function is to provide an extra grip to the parasite on the host. According to Kabata (1979) the exact function of these pads are not known. But taking into account of the fact that the members of the family Pandardidae have less suction effect on cephalothorax and poorly developed blunt claw of the second antenna, one could only justify the part played by the adhesion pads as supplementary organs for attachment.
All the species of *Kroyeria* collected during the study possess posteriorly directed dagger-like process of hard cuticle connected with their interpodal base. They are also equipped with a pair of stylets situated in the posterior side of the dorsal shield. These organs are believed to be the prehensile organs of the parasite which aid the second antenna for attachment with host.

Another interesting observation which is made in the present study is that old and large elasmobranchs bear larger number of parasitic fauna than its smaller counterparts. This is evident from the collection of large numbers of *Pandarus cranchii*, *P. bicolor* and *Gloipotes watsoni* from the body surfaces of *Eulamia elliottii*, *E. melanoptera*, *Scoliodon sorракowah* etc. Cressey and Collette (1970) found that the specialised groups of parasites which are permanently attached on the host increase in number with the increase in size of the host. This is attributed to the availability of large area of attachment with the increase in size of the host. Heavy infestation may also be due to the adaptability of free living stages of parasites to the habitat of the host (Boxshall 1974). It is also found that in the case where large number of parasitic assemblage is found, the possibility of finding large parasites is also higher. In the present study, specimens of *Pandarus cranchii*, upto
15 mm in length were collected. In another collection of parasites belonging to the family Pennellidae, specimens up to the length of 156 mm were collected from three species of *Eulamia*.

It is observed that cephalon of the genus *Gloipotes* becomes shorter with the increase in length. But the length of the genital segments becomes proportionally longer as the length increases. This observation is in confirmation with that of Cressey (1967b). He attributed the increase in length of genital segment to the production and distribution of eggs within the body of the parasite. Several numbers of copulating stages of *Gloipotes* were collected during the present investigation. The females were attached to the host in the usual manner and the males were attached to the ventral side of the female by its ventral side. A detailed study in this line is highly essential.

The distribution of parasitic copepods usually follow the distribution of their specific host. Even though elasmobranchs enjoy a cosmopolitan distribution their parasites do not have the continuity in their distribution. *Gloipotes buttoni*, *G. watsoni*, *Alebion carchariae* are distributed in Indian and Japanese waters. This has been confirmed by the collection of these
species during the present study.

It is interesting to note that a copepod parasite Entephereus laminipes, which was initially described by Bere in 1936 from Madagascar and subsequently reported by Benz and Doots in 1988, from American waters is at present recorded from Indian waters. This has confirmed that this parasite enjoys cosmopolitan distribution. The earlier two reports were based on the collections from Mobula spp. whereas the present collection is from Dasyatis marginatus. This is a new host record of Entephereus laminipes.

Gloipotes ornatus, enjoys a wide distribution in Southern Indian Ocean, North Atlantic and Arabian sea. Gloipotes huttoni is reported from Indian ocean and Western Pacific Ocean, whereas G. watsoni is seen only in Indian Ocean. G. hygromianus is distributed in Pacific, Atlantic and Indian Ocean. Pandarus cranchii is reported from North Atlantic, Pacific Ocean and Indian Ocean. P. niger is seen only in Indian Ocean. P. bicolor is a common parasite on elasmobranchs in Pacific, North Atlantic and Indian Ocean. The genus Echthrogaleus is restricted to larger pelagic sharks. During the present investigation, four species of the genus Echthrogaleus were collected from elasmobranch fishes. This is the first
record of the genus from Indian waters. *Echthrogaleus
coleoptratus* enjoys a wide distribution in North West
Atlantic, North Pacific and Indian Ocean. The range of
*E. denticulatus* is now extended to Indian waters, which
was formerly seen only in Pacific ocean and eastern Indian
Ocean.

It is evident from the above that most of the
copepods, parasitic on elasmobranchs are common in Indian,
Australian, African and American waters. It is clear from
the present study that the elasmobranchs of Indo-Pacific
region harbours a vast variety of parasitic copepod fauna.

An appraisal of the earlier works on parasitic
copepods reveal that so far major emphasis was given only
on taxonomic studies. Except for a few works of Kabata,
Cressey etc., no attempts have been made to study the
biology, ecology and functional morphology of marine
copepod parasites. A number of works on evolution and
phylogenetic relationship of parasites and hosts are
attempted recently. But the effect of parasites on the
physiology of the host is still unknown except for few
fresh water parasites. In this regard, a detailed
investigation is highly essential for further studies.