



COMPARISON OF MOUTHPARTS OF TWO FAMILIES OF AMPHIPODS OF PULICAT LAKE, TALITRIDAE AND GAMMARIDAE

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AUTHORS' CONTRIBUTIONS

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

Amphipods are tiny crustaceans that have adapted to diverse habits and habitats of different ecosystems. Found in freshwater, brackish water and a few in terrestrial ecosystems, these malacostracans play a pivotal role in the energetics of the lake. The mouthparts aid in the amphipods serving as detritivores, an important trophic level in the aquatic ecosystem and the modifications in the mouthparts for adaptation to different ecosystems. Of the eight families of amphipods in Pulicat lake, amphipods from two families, Talitridae, an intertidal group and Gammaridae an aquatic group were analysed of the mouthparts to detect the variation in the mouthpart to suit their habitats. It was found that the mouthparts varied with regard to the palps, size of the molars and the setae. There has been subtle modification amongst the genera to adapt to the type of food it feeds on. Significant among the differences are the absence of mandibular palp in Talitridae and densely setose maxilla in Gammaridae. It is found to correspond to the habit and food available in their respective habitats.

Keywords: Amphipods; setose maxilla; mandibular palp; detritivores.

1. INTRODUCTION

Amphipods are diverse group of crustaceans with diverse habits and habitats ranging from marine, freshwater, leaf litter, seaweeds and biofoulers [1]. The habit of the amphipods suits the habitat of the amphipods. Though most amphipods are aquatic,

amphipods of family Talitridae are unique for making it successful in the transition from the aquatic to the terrestrial habitat. They are successful and are found to live on vastly abundant materials like plant waste and algal fronds. In Pulicat lake, second largest brackish water lake in India, the amphipods are seen to inhabit a variety of habitats ranging from

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epibenthic to periphyton to terrestrial burrowing forms.

Members of Talitridae have mastered all levels during this transition from aquatic to terrestrial habitats, like the intertidal, sandy, freshwater, marine, estuarine and completely terrestrial [2]. They are found to inhabit moist habitats feeding on a variety of food. *Keratoides vulgaris* feeds on decayed forest leaf litter [3]. *Talorchestia marmorata* is abundant in piles of kelp [4]. *Talorchestia* sp. forage and feed on plants near the shore [4].

Members of the family Gammaridae are aquatic and found to live among the algae. These are diverse group of amphipods representing a dominant macro-invertebrate group, especially in terms of biomass in an aquatic ecosystem [5]. Gammarids are used as bioindicators, among the amphipods, extensively in marine, brackish and freshwater ecosystems [6].

This study has been designed to find any distinct difference between the two groups, Talitridae and Gammaridae. The members of Talitridae are terrestrial, living in the banks of the lake, in sand burrows or under the mulch or rotting algae, while the members of Gammaridae live associated with the algae and seagrasses.

Mouthparts have been used as an important taxonomic tool for identification of the amphipod species. The diversity in the mouthparts are due to the extensive adaptations seen in amphipods to the diverse habitat that these macro-invertebrates serve as the transmitters of energy from the lower trophic level to the higher trophic levels. The difference between these two groups, Talitridae and Gammaridae, is to understand the arrangement of the mouthparts and its adaptations to the change in habitat and in their habit.

2. MATERIALS AND METHODS

Amphipods from Talitridae and Gammaridae were collected from their habitats. In Pulicat lake two Talitrid amphipods, *Talitrus* sp and *Orchestia* sp. and two Gammarid amphipods, *Chaetogammarus* sp. and *Pectenogammarus* sp. were predominant. These species of the two families were collected from their habitats. The talitrid amphipods live under the decaying algal mass called ‘Mulch’ on the banks of the lake. The mulch was slowly disturbed and the amphipods were collected using a net.

The gammarid amphipods live associated with the algae and seagrasses in water. In Pulicat amphipods were found more in seaweed like *Gracillaria edulis*. The seaweed was transferred from water on to a

trough. It was slightly shaken and the amphipods were collected. Identification of the amphipods was done and about 10 specimen of each species were taken and were preserved in 4% formalin and the amphipods were carefully dissected. The animal was kept on a glass slide and using forceps and a needle, the mouthparts were intricately separated from each other and mounted on a slide for careful analyses. Dissection was done viewing through the Optika inverted microscope and Optika microscope-mounted camera was used to photograph the individual mouthparts.

3. RESULTS

The mouthparts of specimens from family Talitridae and Gammaridae were dissected and mounted on a glass slide for observation. The amphipod mouthparts generally comprises of the following.

3.1 General Structure of Mouthparts

3.1.1 Upper lip

The upper lip or Labrum is the anterior margin of the mouth. It is usually an unpaired flap-like structure, variable in size and shape among species and families, being bilobed or incised or rounded. The upper lip is not much of taxonomic importance.

3.1.2 Lower lip

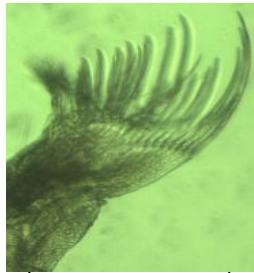
The lower lip or Labium is the posterior end of the mouth of an amphipod. The structure of the lower lip is relatively complex when compared to the upper lip. It consists of a pair of outer lobes enclosing a pair of inner lobes. The outer lobes end with a mandibular lobe. It lies in front of maxillae 1 and behind the mandibles.



Labium

3.1.3 Maxilla 1

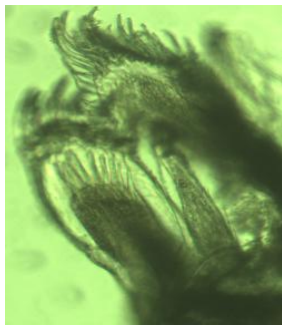
Maxilla 1 is biramous and consists of an inner plate, an outer plate and a palp. The outer plate is with spines while the inner plate is distended to the outer plate. Palp is reduced or absent.



Maxilla 1

3.1.4 Maxilla 2

Maxilla 2 is the smallest of the mouthparts and is biramous comprising of two plates with setae. Palp is absent. Maxilla 2 is of least taxonomic importance.



Maxilla 2

3.1.5 Mandibles

The mandibles are on either side of the mouth opening and along with the upper and the lower lip surround the mouth. The mandible consists of a median molar, toothed and chitinised incisors, a small accessory part lacinia mobilis, and between the lacinia mobilis and the molar is the spine row. The outer margin of the mandible has an extended part called the mandibular palp which is of taxonomic importance. Except a few families most amphipods have the mandibular palp which can be easily spotted between the antennal peduncle.

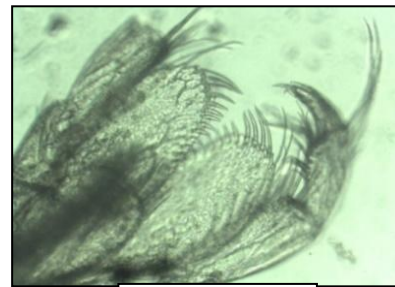


Mandible

3.1.6 Maxillipede

The Maxillipede consists of two branches each contains an inner plate and an outer plate with a palp. The two branches are fused at the base. The palp is usually of four articles and some reduced to three. This is the largest of the mouthparts of amphipods. The maxillipede is part of the first thoracic segment and not a part of the head region.

The mouthparts of members of Talitridae and Gammaridae were taken and carefully dissected to study the mouthparts. The mouthparts are very minute and needs a higher magnification microscope for clear viewing and for photographs.



Maxillipede

3.1.7 Talitridae

Mandibles are without palp, molar well developed, about 3-7 apical spine teeth are seen in the inner plate of the maxillipede (Fig. 1). The outer plate is broad and rounded. The setal arrangement is in the outer plate and it has a single row of short simple setae. The palp is long and prominent, usually 4-articulate. Maxilla I lie anterior to maxilla II. Margins with apical setae and the outer plate bears a small short palp. Gnathopod variable in size.

The *Orchestia* and *Talitrus* specimen were found to have similar type of mouthparts. Similarity in the mouthparts were seen in almost all the parts except a small difference in the palp in the maxillipede. The maxillipede palp is absent or vestigial in *Orchestia* sp., while it is short and broad in *Talitrus* sp.

- Labrum – unpaired, rounded
- Mandible – paired, consists of incisors and molar
 - Incisors – five teeth
 - Molar – oval and with spinous ridges, left molar is concave and right is convex
 - Mandibular palp absent
- Maxilla 1 palp is small about 2-articulate

- Maxillipede palp vestigial or absent in *Orchestia* sp. and short and broad in *Talitrus* sp.

3.1.8 Gammaridae

Upper lip rounded, inner lobes of lower lip absent or weakly developed (Fig. 2). Mandibles with large molars. Mandibular palp elongate 4-articulate. Maxilla 1 palp 2-articulate, inner plates larger, densely setose, outer spine with numerous apical spines. Maxilla 2 is basic and densely setose, Maxillipede is robust, palp elongate, 4-articulate. Gnathopod robustly subchelate and gnathopod 2 slightly larger.

***Chaetogammarus* sp.:** Maxilla 1 & 2 inner plate setose, gnathopods subchelate, gnathopod 2 larger than gnathopod. I

***Pectenogammarus* sp.:** Maxilla 1 and Maxilla 2 are setose.

4. DISCUSSION

Amphipods are known to inhabit many habitats like the sand, sand burrows in the banks of the rivers or on the beach, cracks and crevices of the oysters and barnacles, along the algae and seagrasses. They are diverse in habitat [2].

The habitat of the amphipods also determines the habit of the amphipods and the adaptation or specialization of the mouthparts become important for the survival of the animal. Working on the amphipods, Watling [7] pointed out that there is a change in the morphology of the mandible on prolonged use in a particular habit. The mandibles have become elongated and the incisors have become vertical in amphipods that cut the tissues of animals. Barnes [8] observed that the antennae are used to hold the food in place for the marine filter feeding amphipods and the gnathopods help in wiping the antennae.

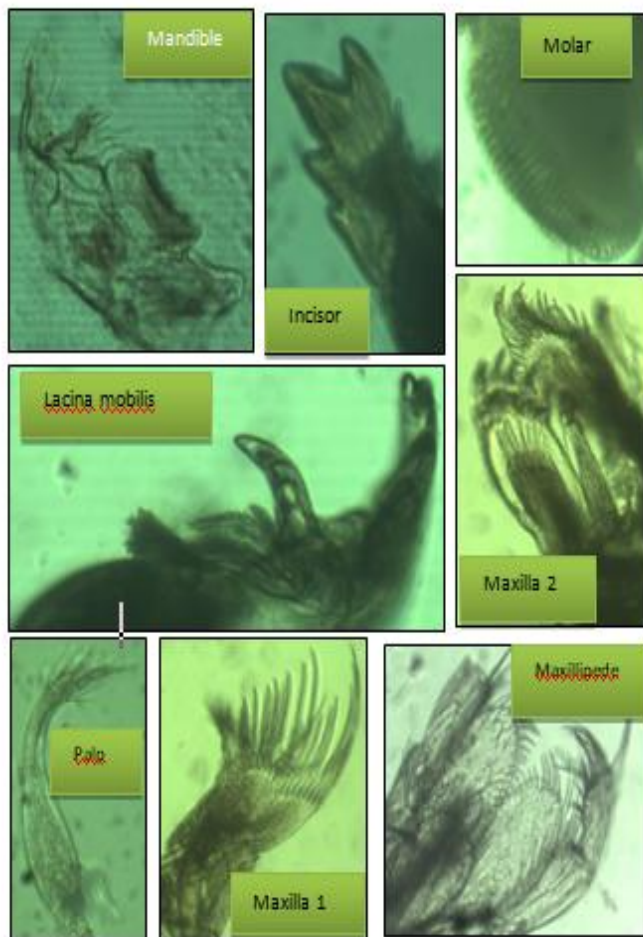


Fig. 1. Mouthparts of Talitridae

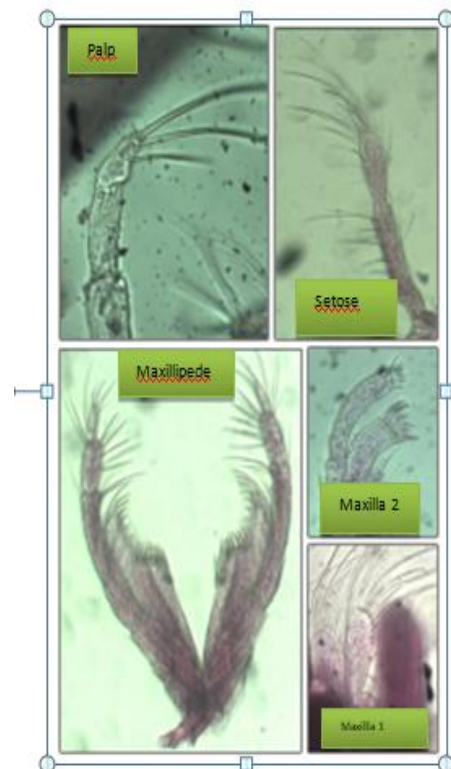


Fig. 2. Mouthparts of Gammaridae

Arems [9] observed that the amphipods living in the streams feeding on the algae capture the food particles from the sediments and these particles are cleaned by comb and broom-like structures. Wagner and Blin [10] complemented this view saying that the maxillae 1 have comb-like structures on the setae that trap these particles.

The amphipods that were studied were talitrids and they are terrestrial amphipods living predominantly in the intertidal zone. Richardson and Swain declared that talitrids are translittoral species. In the case of *T. saltator* and *Macarorchestia remyi*, Pavesi and Olesen [11] identified that the structural differences in their mouthparts are in accordance to the habitat of the two talitrid amphipods. Coleman [12] suggested that the size of the mandible, among all mouthparts, adapt to suit the feeding habit of the amphipod in different habitats consuming from different food sources. The modifications could be reduction in the size or loss of molars, reduction in the size of the incisors, loss of ridges on the molar, etc... Watling confirms that the molars become reduced in case of amphipods feeding on softer food materials. Johnston et al. [2] established that the spinous ridges in the triturative area of the molar is increased in case of amphipods that are used to grind their food materials as seen in *Talorchestia* sp. Gammarid amphipods are predominantly aquatic seen amongst the seaweeds and seagrasses. The mouthparts are more adapted to the nibbling and rasping on the leaves of the seagrasses. The mouthparts of the gammarid amphipods were like that of the basic type of amphipod mouthparts [13]. The modification of the incisors and the molars are suited for the type of food they feed on [14]. Coelho and Rodrigues [15] observed that the setal arrangement varied in the feeding appendages of two shrimps depending on the feeding mode of the shrimps.

5. CONCLUSION

The mouth parts of the two species of Talitridae had the same structures of mouthparts except the presence of maxilliped palp in *Talitrus* sp. The Gammarid species were also identical in their structure. The difference between the families is that the gammarid amphipods are more setose than the Talitrid amphipods.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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