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Research Paper

AMPHIPOD (MALACOSTRACA: CRUSTACEA), AN IMPORTANT TROPHIC LEVEL IN THE LAKE ENERGETICS OF PULICAT LAKE, TAMILNADU, INDIA

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Abstract

Amphipods are benthic organisms which play a vital role in the energetics of any aquatic ecosystem as they involve in the remineralization of organic matter. Amphipods are predominantly detritus feeders, though a few are herbivores feeding on seagrasses and seaweeds and a few carnivores feeding on bacteria, they are an important food source for fish species. In Pulicat lake, amphipods are found in abundance and do play a pivotal role in the distribution and abundance of the biodiversity in the lake. Amphipods, being an important and compulsive converter of biomass of the sediments in the ecosystem, also play a crucial role in the cleaning up of the lake of its dead as they help in the degradation and disintegration of organic matter in the benthos adding to the nutrient pool of the ecosystem. Gut content analysis of the fishes around the preferred habitats of amphipods were done and were found to have had semi-digested parts of amphipods in their gut confirming the role of amphipods in the food chain and food web of the lake contributing greatly to the energetics of the lake. The incidence of wading birds in the vicinity of the amphipod infested seagrasses and seaweeds also indicate that amphipods could be their source of food making them an integral part of the lake energetics and conserving them is imperative for the conservation of the lake and its biodiversity.

Key words: Amphipods, Energetics, benthic, detritus, Pulicat lake.

INTRODUCTION

Pulicat Lake, the second largest brackishwater lake in India, is spread between two states, Andhra Pradesh and Tamilnadu with a water spread area of about 365 sq. kms. The intertidal zone and the benthos of any aquatic ecosystem is very productive with a variety of organisms which form the life-line of the ecosystem. The organisms that are associated with the sediments of an aquatic habitat are called benthic organisms or termed as benthos. They are identified as organisms living in or on the bottom of any waterbody [1]. The benthos constitutes a rich supplement of flora and fauna. Most of the benthic organisms live attached to hard substratum while a few are free living and a very few are planktonic forms. The position of the benthos in the sediment and their size determines whether they could be called as "infauna" or "epifauna". Those organisms which inhabit the interstitial spaces within the sediments are called infauna and those that are attached or move on the sediments are called epifauna. Amphipods (Fig. 1) are small, delicate and fragile macrobenthic organisms found both in terrestrial and aquatic ecosystems. They are detritus feeders and are a very important constituent in the energy cycle of the lake. The presence of Amphipods in the ecosystem effects a major change in the energetics of the lake.

There are three types of feeding associated with the macrobenthic organisms *viz*., filter feeders, browsers and deposit feeders. Amphipods come under browser category, where it feeds on a variety of algae and sea grasses. The abundance and diversity is dependent on the physicochemical factors and the incidence of other organisms in the ecosystem.

Physicochemical factors include region, climate, temperature, salinity, water current, tidal exposure, depth, substratum, dissolved oxygen and nutrient contents. The biological factors encompass the food availability and feeding activities, prey-predator relationship, reproduction and dispersal, growth and mortality.

Macrofauna serve as a major source of food for the demersal fishes [2]. The amphipods exhibit diversity in feeding habits. They are detritus feeders though few are herbivores and few carnivores feeding on bacteria [3]. The role of amphipods in the lake energetics is vital. The small compact and compressed body of the amphipods, their feeding diversity, their high population make amphipods an important and compulsive converter of biomass of the sediments in the ecosystem. They play an important role in the cleaning up of the lake of its dead, from various habitats.

Benthos is important in maintaining the ecological balance in an estuarine ecosystem. The various benthic groups play a crucial role in the food chain and food web of the estuary. The high primary productivity of any estuary is maintained because of the nutrients through remineralization of organic matter which is efficiently done by the benthic organisms. The wealth of fishery in an estuary reflects on the distribution and abundance of the benthic organisms in the ecosystem. The estuaries have a very productive benthos when compared to any other water body because of the food availability and the depth of the estuary.

Unlike the nektons, the benthos does not get translocated from the ecosystem and are hence a very reliable indicator of the water quality. They can be identified as good ecological indicators of the lake because of their differential tolerance to ecological pressures and changes. The presence or absence of a certain group of benthic organism would indicate shortage in supply of a specific food material. The benthos would be the first group of estuarine fauna to exhibit a weakening ecosystem.

MATERIALS AND METHOD

Fishes were collected in and around the amphipod infested habitat like the algal beds, oyster beds and near decaying algae. About 276 fishes were caught over a period of time across different amphipod habitats. Fishes were identified and analyzed to ensure their feeding habit, whether they were herbivores or carnivores or detritivores. During subsequent collections, care was taken to release the herbivores back into the lake. Carnivorous fishes were isolated and were sacrificed. The fishes were dissected to analyze the gut content. The digestive system was opened and the gut contents were taken in a glass slide and were observed under a microscope and the contents were recorded and photographs were taken.

RESULT AND DISCUSSION

On repeated fishing in the habitats which had more aggregation of amphipods, about 276 fishes were caught. Herbivorous fishes were released back into the lake and the carnivorous fishes were taken to the laboratory for analysis. The fishes were identified as *Therapon jarbua, Therapon puta, Siganus cannaliculatus, Lutjanus argentimaculatus, Etroplus suratensis, Oreochromis mosambicus* and *Secutor reconius*.

The gut content of the carnivorous fishes collected from the vicinity of the amphipod habitat and habit was analyzed and recorded. (Fig. 2)

About 176 fishes belonging to these seven species were dissected and the gut contents were analyzed. About 72% of the fishes had remnants of amphipods in their alimentary canal. The position of the remnants in the alimentary canal exhibits the condition of the remnant. If found in the foregut, the remnant would be almost full or small pieces of the amphipod (Fig. 3). If found in the midgut, it would be semi-digested and in the hindgut it is usually very hard to identify as a remnant of a particular species.

The most prominent parts to be seen among the gut contents are the spines and the dactylus. These relatively hard parts of amphipods are helpful in identifying that the remnant in the alimentary canal is an amphipod.

Out of the 176 fishes taken for gut content analyses, 127 fishes were found to have had an amphipod meal before being caught while 54 fishes did not show any trace of amphipod remnants in their gut. Out of these 176 fishes caught from the amphipod habitat, *Etroplus suratensis* was found to be dominant with about 58 fishes followed by *Therapon jarbua* (29 fishes) and *Epinephelus malabaricus* (25 fishes) followed by other fishes.

On careful analyses of the gut content under the microscope, it was found to contain amphipod parts partly eaten, partly digested and bits of spines and dactylus. The presence of the amphipod parts in the gut determines the condition of the remnant. The incidence of amphipods in the gut of fishes caught from the amphipod habitats shows that the amphipods do play an important role in the food chain and food web of the Pulicat lake ecosystem. In any ecosystem the structure of the food chain and food web indicates the stability and carrying capacity of the ecosystem [4, 5].

Amphipods being a browser and a detritus feeder help in the degradation or disintegration of the organic matter in the sediments adding to the nutrient pool of the ecosystem. Benthic fauna in estuaries and coastal ecosystems have direct access to their food source that being the detritus [6]. The small fishes that feed on amphipods fall prey to bigger fishes and birds, thereby completing a food chain and interlinking with other such food chains to form the food web in the lake.

There are many wading birds in the Pulicat lake which are seen very close to the algal beds and seaweeds where the amphipods inhabit. There could be a possibility that the amphipods would be food for these waders like the painted stork, flamingoes, cormorants, stilts and others. Though proof is not possible because of the inability to sacrifice the birds as they are protected by the Wildlife Protection Act 1972, it is assumed that these birds prey on the amphipods.

The microphytobenthos that inhabit the intertidal sediments have a very high productivity as it is exposed directly to sunlight [7]. The importance of amphipods as a nutritional resource appears to be due to the combined secondary production of several co-inhabiting species [8].

The fishes that were dissected showed incidence of semi-digested amphipods which shows that amphipods do play an important role in the food chain and food web of Pulicat lake ecosystem. About 17 out of 38 fishes, on analyses of the gut content were found to prey on the hyperid amphipod, *Themisto gaudichaudi* [9]. A small group of hyperid amphipods are important prey for the birds of the sea [10].

Amphipods being browsers and detritus feeders help in the degradation and disintegration of organic matter in the benthos adding to the nutrient pool of the ecosystem. The density and distribution of amphipods is also dependent on the fish predation pressure. The small fishes that feed on amphipods fall prey to bigger fishes and birds and thereby completing a food chain and linking with other food chains to form food web. There are many wading birds in Pulicat lake which are seen very close to the algal beds and seaweeds that usually harbours amphipods. Amphipods, which are versatile omnivore community, establish itself as an important trophic level adapting to the constantly drifting food sources [11, 12]. The population of amphipods vary drastically across seasons [13] also impacts the distribution of organisms.

There is a possibility that these amphipods would have formed as food for waders like the painted stork, flamingoes, cormorants, stilts and other birds. Though proof is not possible because we are not permitted to analyze the gut content of the birds in the vicinity as they are protected under the Wildlife Protection Act, it was assumed that these birds prey on amphipods.

Amphipods are considered the most efficient scavengers of the sea bottom and shores, probably cleaning up and recycling more organic shore debris than any other organism in the aquatic ecosystem [14]. Talitrid amphipods were seen under the seagrasses which are washed ashore and they seem to be responsible in the degradation and disintegration of the mulch on the shore [15] who described the contribution of *Talorchestia capernis* in the curing of beached kelp in South African coast.

Amphipods that live in soft sediments help in inverting or mixing the sediments. Even in Arctic region the pelagic amphipods are responsible for the transferring of energy from the herbivores to the carnivores thereby maintaining a strong marine food web [16].

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Fig. 1 Amphipod

Fig. 2. Fishes for gut content analysis

Fig.3. Amphipod meal in the gut content