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Food preference of fairy shrimp *Streptocephalus dichotomus (*Baird) Crustacea: Anostraca

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ABSTRACT

Objective: To investigate and describe the feeding biology of fairy shrimp.

Methodology and results: The nature of food items and uptake of phyto and zooplankton were studied in three different size classes i.e. immature forms (6 – 9 mm), mature males (20 – 22 mm), and mature females (11 – 14 mm). The composition of food items and percentage composition of phyto and zooplankton in the gut contents of the shrimps were analyzed. The rate of uptake of phytoplankton by immature forms was 81.26%, 85.34% by adult males and 86.3% by the adult females. Zooplankton uptake by adult males was 14.36% and 13.69% by the adult females. Among phytoplankton, Chlorophyceae constitutes 11.39% in immature forms, 6% in males, and 7.10% in females; Bacillariophyceae constitutes 11.39% in immature forms, 6% in males and 7.10% in females; while Cyanophyceae constitutes 28.06% in immature forms, 62.01% in males and 48.92% in female animals.

Conclusion and application of findings: Immature fairy shrimps feed on smaller organisms especially phytoplankton while adults feed on both phyto and zooplanktonic forms which is dependent on their availability in the medium. Feed preference has a profound influence on fecundity and also the information will be helpful for mass production activities.

Key words: fairy shrimp, gut contents, food items, phytoplankton, zooplankton, mass production

INTRODUCTION

Fresh water anostracans (fairy shrimps) are of growing interest for various types of applications. Fairy shrimp, the freshwater relative of brine shrimp, may represent alternative food for larval and adult ornamental fishes, provided they are nutritionally adequate and can be mass produced. The potential of fairy shrimps as food for ornamental fish culture and freshwater aquaculture has been well documented (Velu & Munuswamy, 2003; Munuswamy, 2005; Ramasubramanian & Angayarkanni, 2007). To date, little basic information is available on the feeding habits and requirements of non- “cladoceran” branchiopods (“Phyllopods”) in general, and of fairy shrimps in particular (Brendonck, 1993). Feeding in anostracans appears to be a particle size, rather than particle-type, non-selective, filter feeding. The feeding is primarily aimed at collecting algal, bacterial and detrital material (Cannon, 1935; Reeve, 1963; Fryer, 1983).

Some large species of fairy shrimps have long been known to be raptorial predators (Fryer, 1966; White *et al*., 1969), but recent studies have confirmed that smaller fresh water anostracans

also readily feed on small invertebrate prey like ciliates and rotifers (Mertens *et al*., 1990) and other crustaceans, including their own naupliar stages (Brown & Carpelan, 1971). These studies were based on gut content analysis from field collected specimens (Bernice, 1971) and direct observations (Mertens *et al*., 1990).

Zooplankton such as cladocerans (*Daphnia, Moina*) copepods (*Metacyclops*, *Metadiaptomus*) and rotifers (*Asplanchna*, *Brachionus*, *Keratella*) (Bernice, 1971; Williams, 1985; Williams 1987) commonly occur in temporary pools. Their co-occurrence with anostracans sometimes shows an inverse relation ship (Mertens *et al*., 1990), suggesting a probable predatory interaction.

Earlier studies by Bernice (1971) in *Streptocephalus dichotomus* revealed the presence of rotifers in the gut content, constituting upto 45% of the animal diet. Furthermore, Mertens *et al*. (1990) observed lower populations of rotifers in temporary pools where *Streptocephalus* occur.

The present study investigated the feeding biology of the fairy shrimp *Streptocephalus dichotomus*. The nature of food, rate of uptake of phyto and zooplankton by adult male and female, and the immature animals were recorded.

MATERIALS AND METHODS

Streptocephalus dichotomus were collected from the Carp fish fingerling tank at the Government Department of Fisheries, Bhavani Sagar, Tamilnadu, India (1994 – 1997). A total of 90 animals (30 males, 30 females, 30 immature animals) were collected and washed in distilled water in order to remove adhering particles. Three different size classes of animals, i.e. immature specimens (6 – 9mm), mature male specimens (20 – 22mm) and mature female specimens (11 – 14mm) were sampled. In the laboratory, the alimentary canal was carefully dissected and removed from the animals. Each gut was placed on a counting slide with a few drops of distilled water and food items were identified and counted as described by Sridharan (1989). From this analysis the percentage of food composition was calculated.

RESULTS

A variety of food items were identified from the gut contents of *Streptocephalus dichotomus* (Table 1 & 2). Among the phytoplanktons, Chlorophyceae and Bacillariophyceae were more numerous in the immature shrimps with 41.3 and 11.39%, respectively, than in the mature females and males. More Cyanophyceae were present in males (62%) than in females (48%), while more Chlorophyceae were present in females (30%) than in males (17%). The Bacillariophyceae were present in about the same ratio of 6 – 7% in males and females (Table 1). Among the zooplankton, none were present in the guts of immature shrimps. In the mature females and males, the different types of food items were distributed in about the same ratios (Table 1).Regarding zooplankton, both male and female mature animals gut contents consisted of solitary and colonial ciliates, *Pompholux sulcata*, *Brachionus* sp., *Filinia* sp. (Rotifer forms), *Miona* sp, *Rhinediaptomus indicus*, anostracan and copepod remnants. In addition, nauplii forms (Crustaceans) and eggs of copepod, cladoceran and rotifers were observed. In male animals, ciliates constituted 1%, rotifers 2.69%, crustaceans 2.35%, crustacean remains 5.27% and eggs 3.05%. In females, ciliates were 1.29%, rotifers 2.09%, crustaceans 1.98%, crustacean remains 5.40% and eggs 3.01%.

DISCUSSION

Anostracan thoracic appendages are multifunctional phyllopods that are used not only for locomotion, but also for food collection, either by particle filtration as in the majority of anostracans (Barlow & Sleigh, 1980: Schrehardt, 1987), by scraping (Daborn, 1979) or by predation *Branchinecta gigas* (Fryer, 1966: White *et al*., 1969) and large adult *Branchinecta ferox* (Fryer, 1983).

The setae on the margins of the basal thoracopodal endites are generally considered to be the main filtatory structures. Some suspension feeding organisms are capable of retaining much smaller particles than predicted from intersetular distance (Rubenstein & Koehl, 1977). The distinct preference for particle size in different size classes of *S. proboscideus* is probably determined by structural

constrains in the thoracic appendages, mouth parts, food grooves and by the size of the oral aperture (determining the maximum particle size) rather by active selection. According to Mertens *et al*., (1990, 1991), the intersetular distance in adult *S. proboscideus* is about 3.5 µm. Therefore, the smallest glass spheres (±5 µrn) were still larger than necessary to reveal the minimum particle size that can be retained.

Table 1: Percentage composition of food in the gut of *Streptocephalus dichotomus.*

Major food items	Male	Female	Immature
Phytoplankton			
Chlorophyceae	17.33	30.28	41.33
Bacillariophyceae	6.00	7.10	11.39
Cyanophyceae	62.01	48.72	28.67
Zooplankton			
Ciliates	1.00	1.29	--
Rotifers	2.69	2.09	--
Crustaceans	2.35	1.98	--
Crustacean remains	5.27	5.40	--
Eggs	3.05	3.01	--

Table 2: Types of Zooplankters identified from the gut contents of *Streptocephalus dichotomus*.

Cillates	Rotifera	Crustaceans	Eggs
Solitary ciliates	*Pompholux sulcata*	Nauplii	Copepod eggs
Colonial ciliates	*Brachionus*	*Miona* sp.	Rotifer eggs
	Filinia sp.	Copepod ramnant	Cladoceran eggs.
		Anostracan ramnant	
		Rhinediaptomus indicus	

Table 3: Occurrence of Phytoplanktersfrom the gut contents of *Streptocephalus dichotomus*.

Chlorophyceae	IM	M	F	Bacillariophyceae	IM	M	F	Cyanophyceae	IM	M	F
Chlorococcum humicola	+	+	+	*Gomphonema elegans*	+	-	+	*Microcystis aeruginosa*	+	+	+
Coelastrum microporum	+	+	+	*Navicula longicephala,*	+	+	+	*Aphanocapsa grevilleri*	+	+	+
Selanastrum westii	-	-	+	*N. gracilis*	+	-	+	*. Holopedium irregulare*	+	+	+
Closterium lanceolatum.	-	-	+	*Amphora ovalis*	-	+	+	*Tetrapedia sp.*	+	-	-
Oedogonium sp.	+	+	-	*Fragillaria vaucheriae*	+	+	+	*Oscillotoria formosa,*	+	+	+
Ankistrodesmus falculatus	+	+	+	*Stephenodiscus biserialis*	+	-	+	*Microcoelus vaginatus*	+	+	+
Crucigenia quadrata	+	+	-	*Cyclotella striata*	-	+	-	*Anabena flos-aquae*	+	+	+
Mougeotia genu-flexu	-	+	+	*Synedra ulna*	-	+	-		+	+	+
Peridinium cinetum	-	+	+								
Pediastrum boryanum	+	+	+								
P. simple	+	+	+								
Mesotaenium sp.	-	+	-								

However, Brendonck (1993) observed maximum sizes of ingested glass spheres to be 17.2 µm in larvae and 67.l µm in adults. Further observations showed that Pome (type of feed from agro-industrial waste) and Pea / corn particle were both 79.4 µm in adults of *S. proboscideus,* and are more representative of the maximum particle size that can be filtered from the water and transported along the ventral food-groove to the mouth. It can be expected that, in contrast to glass spheres, large sized edible particles are first ground by the mandibles before ingestion. Mertens *et al.* (1990) found from indirect observations that rotifers exceeding 510µm are eaten by *S. proboscideus.*

In the present study, the gut contents of *S. dichotomus* were observed to contain phytoplankton, zooplankton, crustacean remains and mud. Of these, the most dominant food item appears to be phytoplankton as it formed the major food item in all three size classes namely: adult males, 85.34% adult females, 86.30% and immature animals 81.26%.

Among the phytoplankton, Cyanophyceae form the bulk feed (in males 62.01%, in females 48.92% and 28.60% in immature animals). After phytoplankton, zooplankton supply 14.36% of food in males and 13.69% in females (Table 1). The composition of food in *S. dichotomus* has clearly indicated that the phytoplankton predominate the gut contents, followed by crustacean remains, zooplankton and mud.

The presence of various food items in the gut is more dependent on their availability in the medium than on other factors. The contents found in the gut and feacal pellets demonstrate that *S. dichotomus* is a non-selective filter feeder, mainly based on the food availability and the order of abundance (Bernice, 1971).

The experimental data so far available on the feeding habits of fairy shrimp suggest a phytoplanktivorous detrivorous diet, although gut contents of field collected *Streptocephalus* are known to include animal prey e.g. ciliates, rotifers and crustaceans (Bernice, 1971). In the present work, zooplankton form 14.36% of the food items in male animals, and 13.69% in females. However, like other aquatic invertebrate predators *Streptocephalus* might have size-related feeding modes (Pastorok, 1981; Stream, 1994).

From the present study it is inferred that immature forms of *Streptocephalus* feed on smaller organisms such as bacteria and phytoplankton, while the adult feed on both the plankters which is dependent on their availability in the medium. Gut content analysis of *Streptocephalus dichotomus* revealed that the main source of food is phytoplankton since it is found abundant in the medium. In phytoplankton, cyanophyceae is predominant in the gut of male and female animals, followed by chlorophyceae and bacillariophyceae. *S. dichotomus* is a non-selective filter feeder, taking in all the food items carried in the feeding currents and passed through the mid-ventral groove. The feeding currents are produced by thoracic limbs that facilitate the gathered food to pass in a unidirectional way.

Since adult fairy shrimp, larvae and its cysts have the potential to be used as a live food for commercial as well as ornamental fish industry; its continuous, cost effective mass production requires feeding biology information. From the present study it is concluded that fairy shrimp feed on the available food item which is present in the medium.

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