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Feeding preference of the predatory larvae of genus *Lutzia* (Diptera: Culicidae).

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Abstract: Mosquitoes are classified under the family Culicidae and comprise a monophyletic taxon belonging to order Diptera. Genus *Lutzia* belongs to subfamily Culicinae. Mosquitoes play a major role as vectors of many pathogens. The larva of *Lutzia* is known as predators of other mosquito larvae. To obtain some understanding of the predatory potential of *Lutzia*on *Chironomous, Aedes* and *culex*this quantitative study was undertaken. The consumption pattern of *Lutzia* isstatistically significance ($p<0.05$) with hours of interval and the consumption percentages statistically significance ($p<0.05$) with different species. *Lutzia* gave high preference for *Chironomous* larvae, *Aedes* and *Culex* respectively.

Keywords: Consumption, Feeding preference, Instar, *Lutzia*, Predatory larva

Introduction

Mosquitoes are classified under the family Culicidae and comprise a monophyletic taxon (Wood and Borkeat, 1989; Miller *et al.*, 1997) belonging to order Diptera. They are classified into three subfamilies which contain Anophelinae, Culicinae and Toxorhynchitinae (Goma, 1996; Scholt and Holm, 1985). About 3490 species are currently recognized (Harbach and Howard, 2007). Mosquitoes are found throughout the world except in places that are permanently frozen. Three quarters of all mosquito species live in the humid tropics and subtropics, where the warm moist climate is favorable for rapid development and adult survival and the diversity of habitats permitted the evolution of many species (Clements, 1992).

Culicids exhibit complete metamorphosis. The adult lays eggs on water surface. The juvenilepasses through both larval and pupal stages and larvae are anatomically different from adult and feed on different types of food. About 95% of species are restricted to fresh water (Grueber and Bradley, 1994) and feed generally on aquatic micro organisms such as bacteria, diatoms and algae and detritus. But some larvae from subfamily Toxorhynchitine and genus *Lutzia* are predatory and feed on invertebrates and other mosquito larvae(Rajasekharan and Chowdaiah, 1972). The growing mosquito larva moults four times forming a pupa which is non feeding stage after the third molt. Adult male and female normally feed on plant juice for their energy need, but Culicine and Anopheline female feed on blood for their requirement for protein for egg development (Mellanby, 1963; Scholtz and Holm, 1985). Toxorhynchitine female feed only on plant juices. The life span of adult mosquitoes ranges from a few days to several weeks but in temperate regions it is longer.

Mosquitoes are host for variety of pathogens and parasites including viruses, bacteria, protoctistans and nematodes. Many mosquitoes are vectors of pathogens that cause diseases in human and domestic animals. Fewer than 150 species largely confine to *Anopheles, Aedes* and *Culex* is indirect cause of morbidity and mortality among human and other organism (Zhang and Shear, 2007). Mosquitoes are vectors of several considerably dangerous diseases including Malaria, Dengue, Filarioses, Yellow fever and Encephalitis (Roberts, 1996). They also can be a nuisance and cause allergic reactions in people when they bite. Therefore mosquito control is essential.

Normally mosquitoes are controlled by three ways which are physical, chemical and biological control. Physically mosquitoes are controlled by locating and eliminating the breeding sites. The

environmental sanitation is a good method to control mosquitoes. Chemical control targets the adult and larvae. Adulticides and larvicides are used in control programmes. The chemical control of mosquitoes is not an environment friendly method. It affects the nontargeted living organisms and the environment adversely and also forms the resistant varities. Dichloro Diphenyl T**r**ichloroethane (DDT) resistant mosquitoes have started to increase in numbers, especially in the tropics due to mutation and reducing the effectiveness of this chemical. These mutations can rapidly spread over vast areas if pesticides are applied indiscriminately (Chevillon *et al*., 1999).

Hence biological control is important in the management practices of mosquitoes. Predators are potentially a possibility for biological control of mosquitoes. Control of mosquito larvae by various biologic means has been the subject of considerable research. Larvivorous fish such as *Gambusia affinis* (Myers, 1965) and *Poecilia reticulata* (Sasa *et al.*, 1965) are widely used in mosquito control. The pathogenic agents such as virus, bacteria, fungi and protozoa are under the study. *Bacillus thuringiensis* (Bt) is an insecticide with unusual properties that make it useful for pest control in certain situations. Bt is a naturally occurring bacterium common in soils throughout the world. Several strains can infect and kill insects. Because of this property, Bt has been developed for insect control. At present, Bt is the only "microbial insecticide" in widespread use. This is now used in mosquito control.

In New Orleans, Marten (1990) reported elimination of *Aedes albopictus* larvae from tire piles by introducing the copepod (*Macrocyclops albidus*). Other predators include dragonfly , which consume mosquito larvae in the breeding waters and adult , which eat adult mosquitoes.A few predacious mosquitoes are worthy of consideration at this stage. *Toxorhynchites* and *Lutzia* mosquitoes have obligatory predatory larvae but they have never been involved in disease transmission(Chow, 1972). However predators have specific ecological requirements and can only be used where their preferred living conditions are met. The life cycle of the predator is frequently not adapted to that of the target organism. So that it is unable on its own to bring about an effective reduction of the target population. Mass rearing and release of the predators or parasites is often expensive or impossible. This limits their large scale use in a number of specific habitats (Eilenberg and Hokkanen, 2006).). Mosquito larvae are mostly filter feeders but the larvae of genus *Lutzia* is known as predators of mosquito larvae for a long time (Rajasekharan and Chowdaiah, 1972).

Genus *Lutzia* belongs to subfamily Culicinae and it was earlier classified under sub genus *Culex Lutzia.* Presently it is classified as genus *Lutzia*. Sri Lanka has experience in dengue which is transmitted by vector mosquito. So this study mainly focuses on the use of mosquito genus *Lutzia* as a predator for other dipterans as biological control agentto over come the environmental hazards of chemical pesticides.

Materials and Methods

This study was conducted during the one year period from February 2009 to March 2010. The field study was conducted at the Eastern University premises at Vantharumoolai. The laboratory work was carried out at the special laboratory of Department of Zoology, Eastern University, Sri Lanka.

Preparation and maintenance of ovitraps

Plastic trays (29cm×24cm×6cm) with the capacity of 2500ml were used as artificial ovitraps. Two types of ovitraps were prepared. One was filled with straw soaked water and another one was filled with normal tap water. In these two ovitraps, water was poured more than ¾ volume of the tray and the water level was checked and maintained approximately in same level.

Fig.1:Photograph showing the two types of ovitraps

Sample collection

Sample collection was done from natural ponds and artificial ovitraps in the study area. Adult, egg raft, larvae and pupae were collected in the study area. Both types of ovitraps (Fig.1) were placed together in different localities under shadow place. These ovitraps were checked for *Lutzia* and prey larvae and sample was collected for laboratory study and the water was refilled for next round of collection.

Laboratory experiments

Fig.2: Photograph showing the larval rearing.

Fifteen plastic cups were filled with 70ml of filtered tap water. Then field collected healthy fifteen second/third instar of *Lutzia* larvae were placed in each cups individually and was starved for twenty four hours. Then each ten of same instar of genus *Culex* and *Aedes* larva and same size of *Chironomous* larva were provided as a prey for *Lutzia* larva. The cups were covered by mosquito net to prevent from other contamination of oviposition of flying organism. The total number of prey was thirty in each cup. Consumed prey larvae were counted every twenty four hours until all the predatory larvae were pupated and the surviving larvae of each three species were counted at morning time and eaten larva was replaced in each time to maintain the prey density as same. In this experiment twenty replicates were made.

Data analysis

Data were analyzed statistically using statistical package SAS 9.0 and Minitab 14.0. The data were subjected to one way analysis of variance (ANOVA) for prey preference and the differences among means were considered significant at a probability level of five percent ($P \leq 0.05$).

Results and Discussion

Two genera of mosquito such as *Culex* and *Aedes* and *Chironomous* were used in this experiment. In these three species *Culex* and *Aedes* are medically importance in disease transmission and*Chironomous* is pollution indicator. In this experiment filtered tab water was used to reduce the any food contamination with mosquito prey larvae.

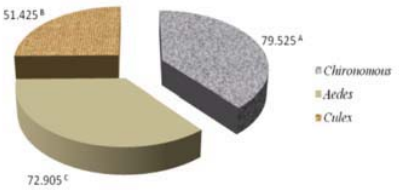
The results show the total percentage of the consumed number of each three of the prey larvae for consecutive of five days until the pupation of the predator *Lutzia* larvae and the average percentage of the each prey larvae for succeeding of five days in Table 1. *Lutzia* had the high preference for *Chironomous* larvae. One larva of *Lutzia* consumed 79.6% of *Chironomous*, 73.6% of *Aedes* and 51.2% of *Culex* from $2^{nd}/3^{rd}$ to pre pual stage in laboratory condition (Table 1). In each trial *Lutzia* shows same preference among three prey species.

Table 1: The total percentage of the consumed number of each three of the prey larvae until the pupation of the predator Lutzia larvae

		Percentage of prey larvae consumed by the predator from $2^{nd}/3^{rd}$ to pupation *		
Repeated No	Prey species	*Aedes*	*Culex*	*Chironomous*
1		73	51.2	78.5
2		69.1	49.9	77
3		75.2	51.7	81.1
4		72.8	48	78.8
5		78	55.1	82.5
	Total	368.1	255.9	397.9
	Average	73.6	51.2	79.6

* Average of 20 replicates in each trial.

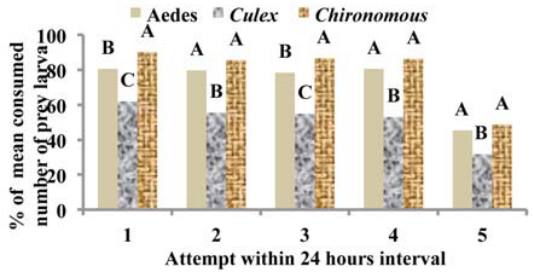
The results indicated that the total consumption percentage for the succeeding of five days until the pupation of predatory larva statistically significance ($P<0.05$) between three species of the prey which were used in this experiment. This will be clearly seen in the Fig.3. Total numbers consumed shows that the predator of *Lutzia* larva consumed higher percentage of *Chironomous* larvae between three species of treatment. Secondly *Lutzia* consumed *Aedes* in higher percentage than *Culex*. In this treatment consumption percentage of *Culex* species was very low compared to other two prey species.



A, B and C denote the statistical significance

Fig.3: Mean percentage of consumed number of different prey by the predator from the 2nd/3rd instar to pupation

In this experimental study, reading was taken at twenty four hours intervals until the pupation of the *Lutzia* larva. Graph in Fig.4 shows that the consumption pattern of *Lutzia* statistically significance ($p<0.05$) with hours of interval and the consumption percentages statistically significance ($p<0.05$) between the different treatment of preference. There is no statistically significance ($p>0.05$) between prey species and hours. That is in each and every hours consumption pattern of predator *Lutzia* did not change. Each 24 hours of reading *Lutzia* prefer *Chironomous* in higher percentage and then it prefers *Aedes* and finally prefers the *Culex* larvae in lower percentage compared to others. Analytical studies shows that in first and third twenty four hours there is a significant difference in consumption pattern between three prey species but there is no significant difference in consumption of *Chironomous* and *Aedes* in rest of the twenty four hours interval but there is a significance in consumption of *Culex* in that hours (Fig.4). During the last twenty four hours that is pre pupation time consumption pattern in three species of predator become very low.



*A, B and C denote the statistical significance

Fig. 4:Comparison of the mean % of consumed number of prey larvae by *Lutzia* to different prey until the pupation of predator

The colour of the *Chironomous* larvae effects in the predation by the predatory larvae of *Lutzia*. MacGregor (1924a) had reference to *Lutzia tigrips* eating *Chironomous* larvae. Haddow (1942) also observed that the *Lutzia* attack larvae and pupae of Chironomidae under natural conditions. Jin *et al*., (2004) also stated that the *Chironomous* larvae found in the gut content of 78.6% of *Lutzia fuscanus* larvae and mosquitoes remains in 2.5% of *Lutzia fuscanus* larvae.

If we concern about *Aedes* larvae apparently moved more frequently in the water than the others and this was confirmed by studying both the spontaneous movements and the movements induced after stimulation, of *Aedes* and *Culex sp., Aedes ganlbiue* and *Lutzia tigripes* larvae by Jackson, (1953). It was demonstrated from the experiment by Jackson, (1953) *Aedes aegypti* larvae were more active than any other groups of *Culex* and *Anopheles* larvae. In the case of *Aedes* and *Culex sp.* these two species may be particularly sensitive to some external stimuli such as the vibration caused by opening and closing the laboratory door or by the shadow of the observer walking past the basins. Due to these stimuli the duration of spontaneous movement of *Aedes* larvae was found to be significantly longer than that of the *Culex* larvae. Stimulated *Lutzia* larvae move spontaneously shorter periods than *Aedes* but longer than that of *Culex* species.Stimulated *Lutzia* will show more movement, but when no stimulation is given it will remain motionless more frequently than either *Culex sp*. It seems probable that this increase in amount of movement after stimulation can be accounted for the predaceous habit of the *Lutzia* larva. When a stationary *Lutzia* larva is approached or touched by its prey, it will continue to be active for several seconds afterwards (Jackson, 1953). So the *Lutzia* consumed lower number of *Culex* than *Chironomous* and *Aedes*. In this experiment the size of the prey species are approximately same in the each stage of them. So the size cannot effect in this experiment.

Conclusion

Among the three prey species such as *Culex* larva, *Aedes* larva and *Chironomous* larva, the consumption of *Lutzia* is statistically significance ($p<0.05$) with 24 hours interval and the consumption percentages are statistically significance ($p<0.05$) with the different

species. There is no significant ($p>0.05$) interaction effect between prey species and hours of interval. Larva of *Lutzia* prefer the *Chironomous* and *Aedes*higher than *Culex*.

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