Effect of different diets on the body indices of Granite Ghost Dragonfly Nymph *Bradynopyga geminata*

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Abstract

The present experimental study was conducted on Granite Ghost Dragonfly nymph *Bradynopyga geminata*. The nymphs were fed with four different diets and their association with length and weight measurements was taken into account, before and after the experimental period of seven weeks. Diet of nymph consists of mosquito larva, chironomus larva, earthworm, mixed diet and control group was also maintained. The length of nymphs fed mosquito larva 1.6 cm, chironomus larva 1.6 cm rest of them earthworm, mixed diet and control group larval length reached 1.8 cm during the seventh week. The weight of nymph mosquito larva 0.17gm, chironomus larva 0.2 gm earthworm 0.24gm, control group 0.25 mixed diet 0.29 gm.

Index Terms - chironomus, dragonfly, earthworm, mosquito, nymph

I. INTRODUCTION

Species population and communities of organisms are often structured by abiotic and biotic factors (Mark and Peter, 1992). Natural enemies, symbionts, competitors, decomposers, resource quality and quantity, availability or proximity of water are among the known potential forces that determine structure and distribution of species population and community.

Aquatic insects are most abundant and diverse in fresh water habitats. Dragonflies are one of them, being the prey as well predator occupies an intermediate position in the food web (Johnson, 1991). In addition larval odonates are principal invertebrate predators in fresh water littoral zones. In general Odonate larvae called as nymphs or naiads. They are obligate predators, inhabit most shallow freshwater habitats, where they burrow into sediments, sprawl on substrates or climb within vegetation. The appearance of adult and nymphs reciprocal the adult looks benevolent whereas nymphs disgusting in nature.

Although dragonfly larvae are represented as the principal predaceous insects in the freshwater ecosystems, astonishingly little information is available concerning their population dynamics and their functional role. Dragonflies spend most of their life cycle as aquatic nymphs. Studies conducted in the ponds indicate up to 99%

mortality achieved during the nymph stage of dragonflies (Benke and Benke, 1975). The metamorphosis of dragon flies depends on species and varies from 9 to 14 larval instars which last few weeks to several years depending on temperature and food supply (Johnson, 1991). Larvae may enter diapause in response to environmental cues that regulate development and ensure that adults emerge in appropriate seasons.

II. METHODOLOGY

Collection of Dragonfly Nymph

Collection was made from 9.00 am to 12.00 pm. from the sites at four corners of pond. Larvae were collected by sweep sampling using a standard D-frame net usually used in limnological studies with mesh size of 1.5mm. The net was swept through the aquatic vegetation at the shore line and in the bottom sediment. down to water path of approximately 0.5m. The invertebrates which were buried in the sediments were sampled by placing the net into the substrate and disturbing the substrate directly upstream for 1 minutes. samples were flushed through the sieve in order to remove excess substrate.

All invertebrates sighted were placed into labeled jar and brought to the lab for further through identification and grouping. Diagnosis of each species was based on the examination of the species with naked eye or under 10X magnifier and 45X stereomicroscope with reference to colour photos of live insects, and by using the standard keys provided by published materials. The dragonfly nymph *Bradynopyga geminata* was selected as an experimental dragonfly species. The nymph were kept in the laboratory for three day for acclimation.

Experimental Procedure

Experimental feed were mosquito larva, chironomous larva earth worm and mixed feed consisting of all the species. Different diets were given to the nymphs in this experiment. The nymphs were divided into five groups with three individuals, each individual kept in a separate container to avoid cannibalism. The experiment was conducted for 49 days and container water were replaced daily. A separate control group of nymphs were maintained in separate cement tank. The nymphs in experimental setup containers were fed with Mosquito larva, Chironomus larva, Earth worm and Mixed (consisting of mosquito larva, chironomus and earthworm), The length and weight of nymphs were measured before and after experiment.

1. Collection of Mosquito Larvae

Mosquito larvae was collected from nearby stagnant water bodies in domestic settlements using a small D-frame nets. The collected larvae were sorted and left into 200ml plastic beaker. the larvae grown in laboratory was fed with powdered dog biscuits (Lukwa et al. 2009). The water in beakers changed daily to keep the larvae healthy. larvae were segregated as Aedes complex, Culicine aggregation and Anopheles life stages. Similarly, dragonfly nymphs were also kept under laboratory condition. Only live feeds were given to the nymphs throughout the experimental condition. For first week 0.561/mg per day, second week 0.0784/mg per day, third week 0.0896mg/day, fourth week

0.1008 mg / per day, fifth week 0.1124mg/day, sixth week 0.1232 mg/day, lastly for seventh week 0.1344 mg/day (Table 1)

2. Chironomus Larvae

The larva of chironomus were collected cement aquarium tank in the animal husbandry of zoology department of Scott Christian College, Nagarcoil. For the first week 0.0567 mg chironomus larvae per day were given to the Dragonfly larva likewise 0.0782 mg per day for second week, 0.0898 mg/day third week,0.1010mg/day fourth week,0.1122 mg/day fifth week,0.1235/day for sixth week, 0.1341mg/day for seventh week (Table 1).

3. Earthworm

Medium sized earthworm were collected from the vermicompost unit of zoology department. The earthworm was weighed and particular amount (according to the week) of earthworm was given to the individual dragonfly nymph. For the first of rearing week 0.0565 mg/day were provided to the dragonfly larva and increased second week 0.0786 mg/day, third week 0.0897 mg/day, fourth week 0.1007 mg/day, fifth week 0.1126/day, sixth week 0.1233/day and seventh week 0.1345 mg/day (Table 1) .

4. **Mixed food**

Mixed feed consists of three mosquito larvae, three Chironomus larvae, 0.0568 mg of earth worm per day were given for the first week and weekly increased four mosquito larvae, 4 chironomus larvae, earthworm 0.0792/mg day second week. Likewise 5 mosquito larvae, 5 chironomus larvae 0.0899mg of earthworm per day for third week. Mosquito 6, chironomus larva 6 and 0.1012mg/day for fourth week, Mosquito larva 7, chironomus larva 7 and 0.1290/mg of earthworm for fifth week, Mosquito larva 8, chironomus larva 8 and earthworm 0.12940mg/day for sixth week, finally 9 mosquito larva, 9 chironomus larva and 0.1347mg of earthworm for seventh week (Table 1).

Table 1. The quantity of different diet given to Granite Ghost Dragonfly Nymph *Bradynopyga geminata*

Week	Mosquito larvae	Chironomus larva	Earth worm	Mixed
1	0.0561	0.0567	0.0565	0.0568
2	0.0784	0.0782	0.0786	0.0792
3	0.0896	0.0898	0.0897	0.0899
4	0.1008	0.1010	0.1007	0.1012
5	0.1124	0.1122	0.1126	0.1129
6	0.1232	0.1235	0.1233	0.1240
7	0.1344	0.1341	0.1345	0.1347

III. RESULTS

In the present study of Granite Ghost Dragonfly Nymph *Bradynopyga geminata* fed with four different diets and their association with length and weight measurements were taken into account, before and after the experimental period of seven weeks. The nymph was fed with mosquito larva, chironomus larva, earthworm and mixed diet (consisting of mosquito larva, chironomus larva and earthworm). In addition, a control group was also maintained with natural condition (Table 2).

When the dragonfly nymphs were fed with mosquito larvae (Table 2) the length of nymphs was 1.16±0.04 cm and weight was 0.04±0.01mg/g in the third week the length was 1.56±0.04 cm and weight was 0.16±0.008 mg/g and fifth week. Likewise in the final week the nymph's length was 1.6±0.04 cm and weighed 0.17±0.009 mg/g (Table 2).

The body length and weight of nymph fed with chironomus larva 1.2±0.08 cm length and 0.08 ± 0.009 mg/g during the third week. In the fifth week the length was 1.56±0.04 cm and weight was 0.17±0.004 mg/g and fifth week. During the final week the larva grown 1.6±0.04 cm length and weighed 0.20±0.008 mg/g (Table 2).

Earthworm eaten by dragonfly nymph were 1.2±0.49 cm and weighed 0.07 ± 0.004 mg/g. During the fifth week grown upto 1.6±0.09 cm length and weighed 0.21±0.02 mg/g. Finally the nymph grown 1.8±0.08cm and weighed 0.24±0.01 mg/g at the end of seventh week (Table 2).

Nymph which were fed by the mixed items 1.5±0.04 cm and weighed 0.19 ± 0.004 mg/g during the beginning of third week. Fifth week showed 1.7± 0.004 cm and weighed 0.25 ± 0.004 mg/g. Seventh week showed 1.8±0.04cm and weighed 0.29±0.008 mg/g (Table 2).

In the control group nymph reached 1.5±0.04 cm and weighed 0.16 ± 0.004 mg/g during the third week. Fifth and Final week the nymph grown 1.7± 0.04 cm and 1.8±0.04 cm respectively and weighed gained were 0.22 ± 0.008 mg/g and 0.29±0.004 mg/g (Table 2). The above results indicated the nymph growth and weight achieved by feeding them with mosquito larva, chironomus larva, earthworm, mixed diet and natural feed in 49 days of experimental period. Overall the length smallest 1.6 cm in fed mosquito and chironomus larva whereas largest length of 1.8 cm achieved earthworm, mixed and control group nymphs. Likewise, weight of the nymph fed with mosquito reached maximum 0.29 mg/g followed by chironomus 0.20 mg/g, earthworm 0.24 mg/g control and 0.25 mg/g and mosquito larva 0.17 mg/g. There is small variation in the length of nymph fed with different diets however there was a negligible variation in the weight. However, both measurements taken were statistically insignificant.

Table 2. Week-wise variation of Length and weight of Granite Ghost Dragonfly Nymph *Bradynopyga geminata* fed with mosquito larva, chironomus larva, earthworm, mixed and control group.

	Week	Length		Weight	
		Initial	Final	Initial	Final
Mosquito larva	1	0.76 ± 0.04	0.93 ± 0.12	0.03 ± 0.004	0.04 ± 0.01
	2	0.93 ± 0.12	1.16 ± 0.04	0.04 ± 0.01	0.08 ± 0.008
	3	1.16 ± 0.04	1.33 ± 0.18	0.04 ± 0.01	0.08 ± 0.008
	4	1.33 ± 0.18	1.53 ± 0.04	0.10 ± 0.02	0.15 ± 0.008
	5	1.53 ± 0.04	1.56 ± 0.04	0.15 ± 0.008	0.16 ± 0.008
	6	1.56 ± 0.04	1.56 ± 0.04	0.16 ± 0.008	0.16 ± 0.009
	7	1.56 ± 0.04	**1.60 ± 0.04**	0.16 ± 0.009	**0.17 ± 0.009**
Chironomus larva	1	0.83 ± 0.04	1 ± 0.08	0.03 ± 0.004	0.05 ± 0.008
	2	1 ± 0.08	1.2 ± 0.08	0.05 ± 0.008	0.08 ± 0.009
	3	1.2 ± 0.08	1.4 ± 0.04	0.08 ± 0.009	0.14 ± 0.01
	4	1.4 ± 0.04	1.5 ± 0.04	0.14 ± 0.01	0.14 ± 0.01
	5	1.5 ± 0.04	1.56 ± 0.04	0.14 ± 0.01	0.17 ± 0.004
	6	1.5 ± 0.04	1.6 ± 0.04	0.17 ± 0.004	0.18 ± 0.009
	7	1.6 ± 0.04	**1.6 ± 0.04**	0.18 ± 0.009	**0.2 ± 0.008**
Earthworm	1	0.8 ± 0.08	0.9 ± 0.08	0.03 ± 0.008	0.05 ± 0.01
	2	0.9 ± 0.08	1.2 ± 0.49	0.05 ± 0.01	0.07 ± 0.004
	3	1.2 ± 0.49	1.3 ± 0.04	0.07 ± 0.004	0.11 ± 0.01
	4	1.3 ± 0.04	1.5 ± 0.04	0.11 ± 0.01	0.16 ± 0.03
	5	1.53 ± 0.04	1.6 ± 0.09	0.16 ± 0.03	0.21 ± 0.02
	6	1.6. ± 0.09	1.7 ± 0.04	0.21 ± 0.02	0.23 ± 0.01
	7	1.7 ± 0.04	**1.8 ± 0.08**	0.23 ± 0.01	**0.24 ± 0.01**
Mixed food	1	1 ± 0.0	1 ± 0.0	0.06 ± 0.004	0.05 ± 0.01
	2	1.1 ± 0.0	1.5 ± 0.04	0.08 ± 0.004	0.16 ± 0.004
	3	1.5 ± 0.04	1.6 ± 0.04	0.16 ± 0.004	0.19 ± 0.008
	4	1.6 ± 0.04	1.6 ± 0.04	0.19 ± 0.008	0.21 ± 0.01
	5	1.6 ± 0.04	1.7 ± 0.04	0.21 ± 0.01	0.25 ± 0.004
	6	1.7 ± 0.04	1.8 ± 0.04	0.25 ± 0.004	0.27 ± 0.004
	7	1.8 ± 0.04	**1.8 ± 0.04**	0.27 ± 0.004	**0.29 ± 0.008**
Control Group	1	1 ± 0.0	1.16 ± 0.04	0.07 ± 0.004	0.08 ± 0.004
	2	1.16 ± 0.04	1.4 ± 0.04	0.08 ± 0.004	0.15 ± 0.008
	3	1.4 ± 0.04	1.5 ± 0.04	0.15 ± 0.008	0.16 ± 0.004
	4	1.5± 0.04	1.5 ± 0.04	0.16 ± 0.004	0.20 ± 0.004
	5	1.5± 0.04	1.7 ± 0.08	0.20 ± 0.004	0.22 ± 0.008
	6	1.7 ± 0.08	1.7 ± 0.04	0.22 ± 0.008	0.24 ± 0.01
	7	1.7 ± 0.04	**1.8 ± 0.04**	0.24 ± 0.01	**0.25 ± 0.004**

IV. CONCLUSION

Our experiment on length-weight relationship of Granite Ghost Dragonfly Nymph *Bradynopyga geminata* fed with mosquito larva, chironomus larva, earthworm, mixed and control group on for even week period proved only slight variation. It is generally known that length-weight relationship provides information on growth pattern and growth of animals. However, in natural environment predators exploit the prey indiscriminately however but feed more or less selectively on a subset of prey they encounter the mechanisms and consequences of selective predation elucidated in the concept of optimal foraging theory (Emlen, 1966, MacArthur,and Pianka, 1966) supported by Beckerman et al (2006).

Optimal foraging theory where the predators should prefer prey which provides the highest amount of energy per unit time. However, even in the control group also there is no significant variation in size of nymphs observed although they were fed as their own. Moreover, Dudová et al (2019) in his experiments on prey selectivity and the effect of diet on growth and development of a dragonfly, *Sympetrum sanguineum* found when the dragonfly larvae *S. sanguineum* conditioned with *Daphnia magna* and *Chironomus* species. The larvae comparatively less and avoided eating *Chironomus.* In addition *S. sanguineum* larvae fed only with *Chironomus* had higher mortality and slower growth rate. In the present study there was no death of *B. geminata* were recorded and growth rate was slightly lower than mixed diet, control and earthworm where as negligibly higher than weight of nymph that were fed by mosquito larva.

According to Boggs (1981) many of the species of insects possess complex life cycles (egg to mature) many of the animals feed during the immature and mature stage. Thus, the life history is important in determining both resource allocation at metamorphosis and dynamics of reproductive utilization of larval derived nutrient and adult derived nutrients or energy. Dudová et al (2019) observed growth rate and survival rate was highest with mixed diet provided to dragonfly larve *S. sanguineum* this suggest the superiority of mixed diet over other diets. Our present study also followed the same pattern that the nymph of Granite Ghost Dragonfly *Bradynopyga geminata* fed with mixed diet showed highest weight gain than other diet during the experimental period.

In general, Population tend to increase and decrease or even extinct according to favorable and unfavorable condition (Soloman, 1949). Buskirk and Sherman (1985) pointed out that individuals of dragonflies spend few weeks as adults in their life time. Biotic interaction aquatic communities are dominated chiefly by predation and the distribution of food chain strength in aquatic food webs which critically impacts their dynamics and stability (Wallace and Webster 1996,Boukal, 2014). In the case of insects population density is primarily designed by the effects of weather condition during their development and survival (Johnson,1991). Generally 85 to 90% of mortality in the early stages and later by the predator (Solomon, 1949 and references therein, Benke and Benke, 1975) in the case of dragonflies mortality achieved even 99% . In the present experimental period none of the nymphs died in the laboratory condition.

How the various predator population influences the prey population is of interest practical and theoretical point of view equally (Murdogh, 1971). Studying the effect of predation natural population (field method) and observing the prey with predator population kept in the laboratory. These two approaches have their own advantages and disadvantages one over the other. Field studies suffer inaccuracy, separating the interacting factors, problem with size of animal, previous population history etc. even the whole population may eradicate the whole population by density-independent factor (Solomon, 1949). In laboratory work suffers from the typical defects of maintaining more or less unrealistic situations. Whereas, in the laboratory approach predation can be break down the process of into components, to study the variation in the components among different kinds of predators and over a wide range of situations, and to integrate the results obtained so that the potential for predation can be predicted in a rather general way for all the kinds of predators studied (Murdogh, 1971). Although, the essence of predation by laboratory theoretically satisfying in reality varying factors complex communities have overriding importance and subsequent field work for supporting the ground truth.

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