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Effect of temperature on the population density of aquatic insects

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Abstract : The population growth of *Cybister confusus*, an aquatic insect in a pond was studied with emphasis on water temperature. Population of the *Cybister confusus* was examined in relation to degree-days. This measure accounts for time and the minimum temperature necessary for insect growth and reproduction to enhance population size. Result showed highest population density at about 17.6°C temperature. Studies demonstrated that the population of insects is directly proportional to change in seasonal temperature cycle

Keywords:- ***Cybister confusus*, population, Madhepura, temperature**

INTRODUCTION

The most diverse and prominent order of the insect, Coleoptera includes about 3.87 lakhs described species from the entire world representing about 38% of insect species (10.2 lakhs species) of all the orders[1]. Out of these, 12,604 species belong to aquatic beetles pertaining to at least eighteen families[2]. Even though the insects are terrestrial in origin, a large number of species belonging to several orders have adapted to aquatic mode of life. Despite a lot of fresh water bodies in India, the information on these aquatic beetles in several states is still lacking. The catalogues and review work on aquatic beetles of world are published by Schenkling (1910-40)[3], Knisch (1924)[4], Wewalka (1975 & 1979)[5,6], Brancucci (1983)[7], Pederzani (1995)[8], Miller (2002)[9], Andrew and Martin (2011)[10], Nilsson (2011)[11] (palcat.) & 2013 (world cat.)[12], Fery (2003)[13], Toledo (2009)[14]. The information on aquatic beetles of India is known through the works of D'Orchymout (1928)[15] and Vazirani (1969a, 1969b, 1977, 1984)[16-19] where in the species from Central India was also included. Subsequently, Chandra *et.al.* (2010)[20] and Ghosh & Nilsson (2012)[21] reported total seventy two aquatic beetle species from Madhya Pradesh.

However, study on the aquatic beetle fauna from Bihar state and particularly in Madhepura districts insufficient. Hence the present work was undertaken. The present study, "Effect of temperature on the population density of aquatic insects" is a part of the work to investigate the impact of environmental stress in the form of temperature on an aquatic insect- *Cybister confusus* in terms of population. *Cybister confusus* belongs to the class-insecta, order-coleoptera, family-dytiscidae, sub-family-dytiscinae and genus-cybister.

It was hypothesized that two factors, temperature and time, would be sufficient for predicting the aquatic

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insect populations. Previous studies have demonstrated the degree-day dependence of insects' growth[22-24]. Few, however, have examined the extent to which the degree-day relationship holds within a given habitat. Harper (1973)[25] notes that differing temperature regimes, within the habitable range of an organism, can yield differences in growth patterns of stoneflies. Studies with *Assellus* spp. show very definite growth-temperature relationships using the degree-day concept[23, 24].

Water beetles can be used to control water plants that have become pests. Species of Dytiscidae are aquatic predators and may play an important role in controlling mosquitoes. Dytiscids cause considerable harm to fish fry but there were few actual studies on that subject, and more research would be needed to assess potential harm as well as benefits of water beetles to aquaculture[26]. The earlier knowledge and scientific contribution on aquatic beetles are noteworthy to understand the present fauna[19,27,28]. Besides thisa number of other workers contributed greatly[2,5]. The major studies on aquatic Coleoptera also includes the works from Andhra Pradesh (Mukhopadhyaya, 2007)[28], West Bengal, (Biswas &Mukhopadhyay, 1995)[29], Sikkim (Mukhopadyaya & Ghosh, 2003)[28-30].

MATERIALS AND METHODS

A pond at Babhangama village was selected in Bihariganj block of Madhepura district (Bihar) to study the aquatic insect- *Cybister confusus* population for a period of 12 months from May, 2017 to April, 2018. Monthly collections were made for the entire period of study in three stations in the pond. Pond has an area of about 30,000 Sq. ft. with an average depth of five ft.

Description of Stations

Station-I: Dense with floating and submerged vegetation.

Station-II: Open water area completely devoid of vegetation and used as a bathing ghat.

Station-III: Open water area with sparse vegetation and the deepest area of the pond.

Collection and calculation Methods

Preliminary sampling was initiated in May, 2017. Regular sampling, at 30 days intervals, was begun after that. According to Menke (1979)[31] the aquatic bugs in particular are to be collected differently according to their behaviours and dragged through the organic debris, floating vegetation, tangled roots and other objects. Insects clinging on the vegetation were handpicked. Some insects were collected by splashing water on the bank toflush them out of the crevices and small insects that hide in mosses and floating vegetation were exposed by pressing the plant under water. The aquatic insects in open area were collected with the help of a pond net.

During the course of study, surface floating/ swimming insects were collected with small circular nets made of finely meshed polyester mosquito curtain cloth. The design and operation of the net was roughly based on those described by Junk (1977)[32]. The insects were collected by filtering forty litres of water randomly from each station with the help of a boat and pond net.

Habitat sampling of the insects and water were made during early hours of the day (7 am-10 am) since many aquatic insects migrate to deeper water during late hours of the day. The adult insects collected were sorted out for *Cybister confusus* after identification with the aid of standard literature on the group, kept proper record of the identified population. After proper record keeping insects were released in same pond. Along with sample collection temperature also measured every time with the help of laboratory thermometer.

RESULTS AND DISCUSSION

Dissolved oxygen, which is inversely correlated to temperature, decreases with increasing temperature and increases with decreasing temperature[33]. In this case, the dissolved oxygen values are expected to be high in the winter months. The relationship was clearly seen in present study. While the lowest temperature value of the pond water was measured as 11.8°C in January 2018 and the highest temperature value was measured as 35.9°C in July 2017 (Table-1).

As per the change in temperature of the pond water population statistics also changed. There was a strong negative relationship between temperature values and population of the species. This data show us that high temperatures are not suitable for aquatic insects particularly, *Cybister confususn* and as the temperature approaches the upper limit, the population of species was decreased. However, the highest population density value was seen at 17.6°C in March 2018.

Table-1: Population of *Cybister confusus* in a pond at Babhangama village, Bihariganj block of Madhepura district (Bihar)

Sl. No.	Month	Station-I		Station-II		Station- III		Mean value	
		Temp. (in °C)	No. of individual (in 40 L)	Temp. (in °C)	No. of individual (in 40 L)	Temp. (in °C)	No. of individual (in 40 L)	Temp. (in °C)	No. of individual (in 40 L)
1	May,17	28.5	134	26.3	44	27.5	195	27.4	243
2	Jun, 17	32.8	122	31.7	32	30.4	172	31.6	109
3	Jul, 17	34.8	94	36.8	22	36.2	122	35.9	157
4	Aug,17	32.2	85	35.8	21	34.2	103	34.1	140
5	Sep, 17	31.9	92	34.0	18	32.2	95	32.7	142
6	Oct, 17	28.9	88	31.5	07	29.4	106	29.9	130
7	Nov,17	22.4	105	25.2	19	23.1	128	23.6	167
8	Dec, 17	18.1	117	20.4	36	17.1	133	18.5	197
9	Jan, 18	11.1	152	13.2	42	11.2	137	11.8	240
10	Feb, 18	15.4	174	15.2	49	15.6	179	15.4	283
11	Mar, 18	17.9	193	17.3	57	17.5	216	17.6	322
12	Apr, 18	23.3	184	21.6	49	22.8	191	22.6	297

Fig. 1- Pond at Babhangama village, Bihariganj block of Madhepura district (Bihar)

CONCLUSION

To study population and temperature relationships, it is necessary to determine whether or not a minimum critical temperature for a species is reached in the water bodies. Below this temperature, population is either very low or non-existent[34]. In present study critical temperature was found about 17.6°C. This temperature minimum is difficult to evaluate with field data, but an approximation is possible. Further studies aiming to improve our knowledge on water insects should focus on collecting in little known areas, revision of the still unstudied material from additional families and filling the large gaps in our

knowledge regarding the diversity of water beetles in some specific habitats.

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