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## Variation in population density of aquatic coleopteran in a freshwater body of Ranchi District, Jharkhand with special reference to pH, temperature and dissolved oxygen

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**Abstract :** Present work deals with the variation in population of aquatic coleoptera species in a freshwater body, i.e. the Joda Talab of Bariatu area in Ranchi, Jharkhand on account of changes in physico-chemical parameters such as pH, temperature and dissolved oxygen. The study was conducted from October-2019 to February 2020 i.e. the post monsoon to winter season. During the study period total 3 families of order coleopteran i.e. Gyrinidae, Dytiscidae and Hydrophilidae were recorded from the two sites of the Talab. Among these families, *Gyrinus* species of Gyrinidae was found in high number at both the sites as they prefer cooler environment for breeding and development. Except these, species of other families declined from October to December and then increased till February. Site 1 with greater number of individual was recorded with low pH values. Similarly decline in temperature from October to January was seen with rise in DO values which was accompanied with increase in number of insect species. Whereas site 2 with high pH, low dissolved oxygen and seasonal changes of temperature, was accompanied with less number of individuals. Thus the study revealed that pH, temperature and DO play an important role in difference of population density of aquatic insects.

**Keywords :** Aquatic coleoptera, freshwater pond, physico-chemical parameters, variation in population

### INTRODUCTION

Aquatic insects belonging to group of Arthropods, spend their life in water bodies and about 45,000 species are known to inhabit diverse freshwater ecosystems.<sup>1</sup> In order to maintain the stability of aquatic ecosystem its aquatic biodiversity is very essential.<sup>2</sup> These insects form an important component of food chain and energy flow pathway in the aquatic ecosystem.<sup>3</sup> The presence or absence of aquatic insects indicates that a particular water body is healthy or polluted. Some of them are very sensitive

to pollution and prefer good water quality.<sup>4</sup> Hence these insects are considered as good indicator of water quality.<sup>5</sup> The changes in the physico-chemical properties of water, adversely affect the diversity and distribution of aquatic insects.<sup>6</sup> Thus these are used for water quality assessment to provide appropriate information in regard to the state and quality of water bodies. Physico-chemical parameters such as pH, Temperature, Dissolved oxygen etc have been widely used to assess the quality of water.<sup>7</sup> The aquatic beetle communities are also affected by these factors. However the vegetation and size of the water body also affect the population.

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Thus the present study was undertaken with an aim to investigate the changes and fluctuations in the population of aquatic beetle families in a pond of Ranchi in context of these parameters.

**MATERIALS & METHODS**

**Study Area:**

For this research work the Joda Talab of Bariatu area in Ranchi is taken. This Talab is situated in a densely populated area and is also subjected to various anthropogenic interferences. Two sites were selected from the pond, one which is rich in vegetation and the other site which is disturbed by the domestic uses.

**Sampling Method:**

Present study was conducted during the post monsoon & winter season i.e. from October 2019 to February 2020. Water and insect samples were collected from both the sites of the pond. The insects were collected by using hand operated nets. At each site at least three drags were made as they constituted a sample.<sup>8</sup> Collected insects were sorted and taken to the laboratory. They were preserved in 70% ethyl alcohol. Each of them was later

identified with the help of standard keys of Imms<sup>9</sup>, Mani (1994)<sup>10</sup>, Borror and Delong (2005)<sup>11</sup>. Water samples from each site was also collected and brought to the laboratory. All these collections were made during early hours of the day between 8 to 11 a.m. as the insects migrate to deeper water during late hours of the day.

**Water-Parameter Analysis:**

Physico-chemical parameters such as temperature, pH and dissolved oxygen were analyzed by standard titrimetric methods.<sup>12</sup>

**Data Analysis:**

Species diversity index was calculated using Shanon-Weiner diversity index to understand the aquatic community of insects at both the sites.

**RESULTS**

During the study period of 5 months, i.e. from October 2019 to February 2020, monthly data of water parameters and insects availability was recorded from both the sites. The monthly water parameter data is shown in Table 1.

**Table 1. Water quality parameters at the two sites of Joda Talab, Ranchi**

Sl. No.	Parameters	Site 1					Site 2				
		Oct	Nov	Dec	Jan	Feb	Oct	Nov	Dec	Jan	Feb
1.	pH	7.79	7.84	7.92	7.22	7.32	8.32	8.20	7.89	7.58	7.94
2.	Water temperature (°C)	27.2	25.2	21.4	19.2	25.9	27.8	25.9	21.9	19.3	26.1
3.	Dissolved Oxygen (mg/l)	4.91	5.21	5.39	5.46	5.31	4.62	4.88	4.91	5.02	4.93

Variation in pH and Temperature of water was seen at both the sites during the study period. Highest temperature was recorded in the month of October. It was 27.2°C, 27.8°C respectively at both the sites. Whereas, the lowest temperature was recorded in the month of January i.e. 19.21°C & 19.88°C respectively at both sites.

pH at both sites, ranged between 7.22 to 8.32. The maximum pH was recorded in the month of October and minimum in the month of January at both the sites. Dissolved oxygen is also an important physico-chemical parameter in water quality studies. High DO value indicated good aquatic life.<sup>13</sup> The amount of dissolved oxygen recorded in site 1 of Joda Talab ranged between 4.9mg/l to 5.4mg/l. Maximum value was recorded in the month of January (5.46 mg/l) and minimum was recorded in the month of October (4.91 mg/l) at site 1. Similarly, highest dissolved oxygen was seen in the month of January

(5.02 mg/l) and lowest value was in the month of October (4.62 mg/l) at site 2.

Monthly insect collection is shown in Table 2. A total of 71 insects of order coleopteran were collected from site 1. Among these, highest number was seen in month of October which was followed by February. December and January were seen with few individuals. Total 42 insects were collected from site 2. October was seen with highest number of insects. Throughout the study period Gyrinus species of family Gyrinidae was collected in highest number from both the sites. Insects belonging to Hydrophilidae were found least. Two taxa of family Dytiscidae were recorded from both sites with highest number in month of October and least in December. Shanon-Weiner diversity index of different species were determined for each site and is shown in Table 3.

**Table 2. List of Coleopteron species found at each site during October 2019 to February 2020 at Joda Talab, Ranchi.**

Sl.No.	Months	Site 1						Site 2						
		Oct	Nov	Dec	Jan	Feb	Total	Oct	Nov	Dec	Jan	Feb	Total	
	<b>Gyrinidae</b>													
1.	<i>Gyrinus</i>	7	4	2	5	7	25	5	4	3	3	5	20	
	<b>Dytiscidae</b>													
2.	<i>Cybister</i>	5	1	-	1	3	10	4	1	-	-	3	8	
3.	<i>Dytiscus</i>	6	4	-	2	6	18	4	2	-	-	4	10	
	<b>Hydrophilidae</b>													
4.	<i>Hydrophilus</i>	6	4	1	2	5	18	2	1	-	-	1	4	
<b>Total number of Insects at Site 1 = 71</b>								<b>Total number of Insects at Site 2 = 42</b>						

**Table 3: Shannon-Weiner Diversity Index**

Sl.no.	Species	Site 1	Site 2
1.	<i>Gyrinus</i>	0.1516	0.1534
2.	<i>Cybister</i>	0.1198	0.1371
3.	<i>Dytiscus</i>	0.1510	0.1483
4.	<i>Hydrophilus</i>	0.1510	0.0972

## DISCUSSION

Present study on aquatic coleopteran at the two sites of Joda Talab showed that the population of aquatic insects is greatly regulated by biotic and abiotic factors. Abiotic factors such as water temperature, dissolved oxygen and pH seem to be responsible for the variation seen in the aquatic coleopteran population at the two sites.

The number of insects declined from October to December and after that increased till February. The minimum and maximum numbers of Coleoptera were recorded in the month of December and February respectively. Fewer individuals were available in December which might be due to hibernation or due to low temperature which might have affected the development process of insects. Total collection comprised mainly of 3 families i.e., Gyrinidae, Dytiscidae and Hydrophilidae. Out of these, individuals of Gyrinidae were abundant as this group of insects increase in abundance with decreasing temperature because they prefer cooler water for their feeding rate, metabolism and reproduction. However, population of species of Dytiscidae & Hydrophilidae decreased with decreased temperature. More individuals were collected at relatively high temperature than when there was a drop in temperature. Ajao (1990)<sup>14</sup> and Oben (2000)<sup>15</sup> recorded similar observation during their studies. But at site 2 less number of individuals of Gyrinidae was

recorded even in winter season. Site 1 showed high number of individuals which might be also due to presence of luxuriant vegetation which provided better environment for the growth of insects. Similar readings have also been recorded by Korkeamaki and Subomen (2000)<sup>16</sup>.

The variation in pH values at both the sites has been found to affect the population of aquatic insects. However, in India, water bodies are generally alkaline in nature. Lower number of insects was seen at site 2, as high value of pH was recorded there, where as greater number of insects were recorded at site 1 having low value of pH. The factors like photosynthesis, respiratory activity, temperature, exposure to air, disposal of wastes etc. bring out changes in the pH.

Dissolved oxygen showed an inverse relationship with water temperature. This observation agreed with Arimoro and Ikomi (2008)<sup>5</sup> findings, who reported that increase in water temperature brings about a decrease in dissolved oxygen and it may be due to respiration and other process such as breakdown of organic matters. More population was seen at site 1 where DO values were high. The low values of DO at site 2 indicated deterioration of water quality as a result of anthropogenic activities in this site as observed. Similar findings were seen by Yakub (2004)<sup>17</sup>.

Shanon-Weiner diversity Index helps to know the relative species abundance. The diversity of entamofauna at site 1 was higher than in site 2. Out of the three families of order Coleoptera, Gyrinidae was dominant family at both the sites.

## CONCLUSION

The result obtained during the study revealed that the physico-chemical parameters greatly influenced the

aquatic coleopteran species composition and abundance. The result also showed that temperature and dissolved oxygen had strongest influence on the community structure at both the sites of Joda Talab. The lower values of Shannon-Weiner diversity index at site 2 pointed towards the disturbances, caused due to anthropogenic activities. Low vegetation was also a reason for lower number of aquatic insects at this site.

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