# Diversity and species richness of insects in Nakane Lake near Dhule in Maharashtra

**Dr.RAMACHANDRA C G**
PG Department of Zoology
SSVP's Late KarmaveerDr. P R Ghogrey Science College,
Deopur, Dhule 424005 MS, India

**Abstract:**

Aquatic insects on account of their faculties of harsh environmental change endurance or heightened environmental stress sensitivity carry special significance freshwater ecosystem protection and conservation.The vital involvement of these invertebrate cohorts in aquatic ecosystemfood webs is documented. We probed the NakaneLake near Dhule city in North Maharashtra for its diversity of aquatic insects as well as for the insect diversity indices. Total 191 number of insect specimen were represented by 39 insect species. Higher species richness was documented for insects belonging to the orderColeoptera (25.64%), suborder Anisptera of order Odonata (25.4%) and Hemiptera (23.07%). This was followed by those belonging to Diptera (10.25%), and suborder Zygoptera of order Odonata (10.25%) with the maximum diversity (H = 3.66) and least dominance (D = 0.038) and minimum diversity (H = 3.43) and Evenness (E = 0.937).

**Keywords:**Aquatic insects,NakaneLake, diversity indices,species richness

## Introduction:

Anthropogenic sources inclusive of domestic and industrial activitiesas well as agricultural runoff account for mounting pollution and contamination of freshwater sources globally (Benetti and Garrido, 2010). The health or pollution status of a source can be indicated by the absence or presence of aquatic insects. Aquatic insect distribution, diversity and composition are impacted unfavourably by physico-chemical property alterations of water (Majumderet al,2013). Their extensive tolerance to environmental disturbances makes aquatic insects excellent water quality indicators (ArimoroandIkomi, 2008).Aquatic insects on account of their faculties of harsh environmental change endurance or heightened environmental stress sensitivity carry special significance freshwater ecosystem protection and conservation. A slew ofapproachesto employ aquatic insects to scrutinizewaterquality have been documentedinclusive of individual morphological and = physiological and morphological alterations to severalestimatesof community structure (Wallace, 1996).

Close to 7, 51,000 known species of insects that is nearly three-fourth known species of plantsand animals have been documented on earth. These are also the only invertebrates that can fly (Bybee et al, 2008). The vital functional involvement of aquatic insects among invertebrate assemblages in aquatic ecosystem food webs is known. Insect larvaeserve as the principal fauna for fishnutrition. As water beetles are crucialindicators of spatial and temporal alterationsin the environment, their use as habitat bio-indicators in research is known. This is inclusive of checking for potential pollutants, nutrient enrichment for habitat qualityand conservation area selection (Hufnagelet al, 1999; Sánchez- Fernándezet al, 2004). Aquatic insects with their abundance and diversity dominate wetlands including rivers and lakes. The pollution or health of a system can be revealed by the absence or presence of aquatic insects. Physico-chemical property alterations in water can adversely impact the composition, diversity, and distribution of aquatic insects (Majumderet al, 2013).

A study reported amaximum of 30 aquatic insect species and 1191 individuals in the vegetation rich Maharaja BirBikram College Lake while this was aminimum of 11 species and 215in the vegetation poor Laxminarayan Bari Lake (Agarwala et al, 2013). They assessed richness estimators as Chao 1 and Chao 2 for deriving the best predicted value of species richnessof which 3 species were reported for the first time in the study locationfrom the area. Sivaramkrishnan et al (2000) exploredthe distribution of aquatic insects (4533 individuals) belonging to 72 genera, 45 families and 10 orders that weresourcedfrom headwater stream riffles in the hills of south western India (from 17 localities). Sensitive and special taxa are favoured in such wetter and southern sites with lower human impacts. Correlations emerge for the ecological featuresacross the taxonomic gradient levels, viz. family, genus and species, which facilitatean inclusive and efficient catalogue compilationas well as monitoring right to the family level. Kulkarni and Zade (2020) documented the diversity and abundance of aquatic insects in theRamala reservoir in Chandrapur city inMaharashtra. A total of 16 resident species of insects belonging to 14 families and 4 orders were enumerated in and around this reservoir. They also reported season wise fluctuations in the population of insects.However, as the documentation of the aquatic insect fauna of Nakane Lake in North Maharashtra in India is lacking, the present investigation was undertaken.

**Materials and Methods**:

To assess the diversity of aquatic insects, live insect specimens were collected from Nakane Lake (20°88'51" N, 74°72'90" E) near Dhule city in North Maharashtra (Figure 1). All approaches entailed in this work adhered with the Laboratory Animal Management Principles of India. Approval was obtained for all experimental approaches from the institutional animal ethical committee of the college. Insectspecimens were photographed and identified on the basis of morphological traits using appropriate taxonomic keys and literature (Fraser 1943; Mitra 2006) and field-guides (Subramanian 2014, Andrew et al. 2008, Nair 2011).

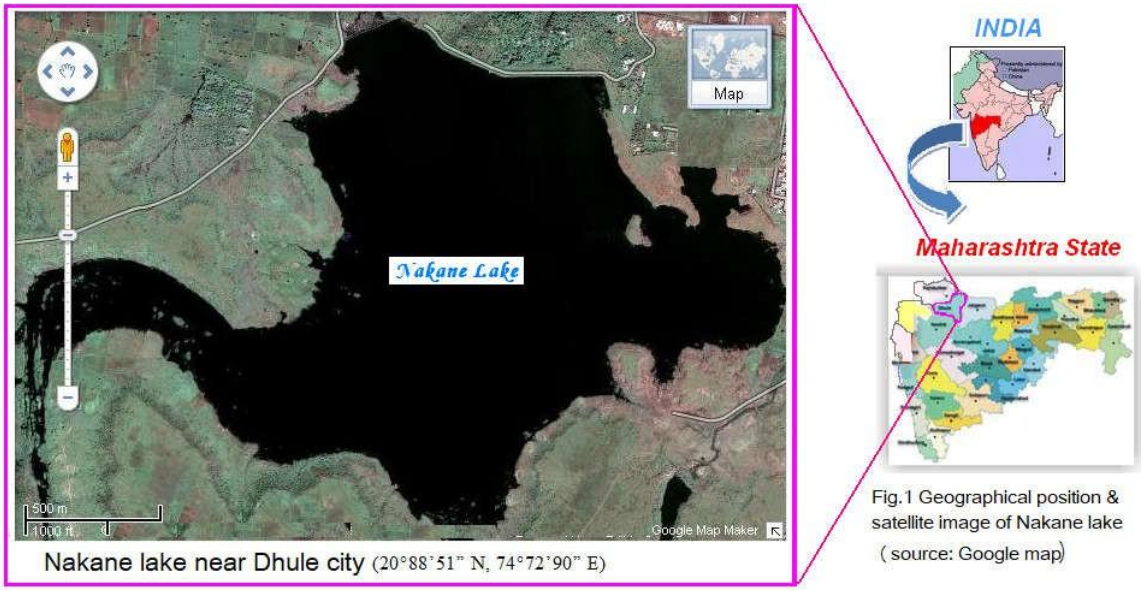


Fig.1 Geographical position & satellite image of Nakane lake ( source: Google map)

**Diversity Indices:**

The computation of diversity indices entailed the determination of the total numbers (each) of the species and individuals per sample along with thetotal number of individuals belonging toa species. The equations listed below were employed to compute the Shannon - Weiner Index (H), Simpson's Dominance Index (D), Simpson's Index of Diversity (1-D), and Pielou's evenness Index (J).

**1. Shannon - Weiner or Index (H):** It is contingenton the existing number of species and the abundance of each species.

$$H = \Sigma Pi (\ln Pi), Pi = A/T$$

Here: Pi is the proportion of each species

A is number of each species in the sample,

T is the total number of individuals of all species in the sample.

**2. Simpson's Dominance Index (D):** It is derived as below.

$$D = \frac{n_1 (n_1 - 1) + n_2 (n_2 - 2) + \text{---------} + n_{20} (n_{20} - 1)}{N (N - 1)}$$

Here: n is the overallnumber of individuals of anindividualspecies and

N is the netcountof all individuals inall species.

**3. Simpson's Index of Diversity** = 1- D

Here: D is the Simpson's Dominance Index

**4. Pielou's evenness Index (J) = H /ln S**

Here: H is the Shannon - Weiner Index and

S is the speciesnumber

**Results and Discussion:**

The results of the assessment of Nakane Lake with reference to the diversity and species richness of aquatic insects indicated the presence of total 39 species (Table 1 and 2), of which 10 species of aquatic insects belonging to order Coleoptera (25.64%), 10 species belonging to suborder Anisptera of order Odonata (25.64%) and 9 species belonging to order Hemiptera (23.07%). These three orders showed higher species richness indicating that the Nakane lake is still not polluted. Lake also had 4 species of aquatic insects belonging to orderDiptera (10.25%) and in same proportion to suborder Zygoptera of order Odonata (10.25%). Insect order Dermaptera and Orthoptera were represented by single species (2.56%) in the insect samples collected form the study site.The number of species in a sample indicates the richness and the abundance of different species makes the wetland rich and even in number of species.It was recorded that insect *Dysdercuscingulatus*of the family Pyrrhocoridaee and *Aquarius paludum*of the familyGerridae, both included in order Hemiptera were found more in number (19 and 15, respectively) as compared to other insect species, thus indicated the dominance of the species. Whereas, the insect species *Acroleucusbrevicollis, Bembidionfoveolatum*, *Catantopshumalaris*,*Ischnuraaurora*were the lowest in number at the study site (Table 3).

A vital element of diversity indices is the evenness, which is a measure of the relative abundance of different species making up the richness of an area (Ghani and Maalik, 2020). Theuniformdistribution of the individuals among different species is signified by the evenness. Significant results regarding Shannon -Weiner Index (H =3.43), Simpson's Index

(D= 0.038), Species Richness (R=2.82) Pielou's evenness Index (J=0.936), Maximum Diversity possible ($H_{max}$=3.66) and Evenness (E = 0.937) and Simpson's Index (D= 0.038) of insect fauna sampled at Nakane Lake during February 2021 to March 2022were recorded (Table 3).

Table 1. Insect species belonging to 5 different orders found in the vicinity of Nakane Lake

| **Order** | **Family** | ***Scientific name*** |
|---|---|---|
| Coleoptera (10 species) | Carabidae | *Bembidionfoveolatum*<br>*Harpalusrubripes*<br>*Chlaeniuscordicollis* |
| | Staphylindae | *Paederidusruficollis*<br>*Olophrumlathrimaeum* |
| | Phalacridae | *Phalacruspolitus* |
| | Gyrinidae | *Dineutusindicus* |
| | Hydrophilidae | *Cercyonpractextatus* |
| | Dytiscidae | *Sandracottusdejeani*<br>*Aciliussculcatus* |
| Diptera (4 species) | Chironomidae | *Chironomusjavanus*<br>*Chironomuscircumdatus* |
| | Culicidae | *Aedesageypti*<br>*Aedesalbopictus* |
| Dermaptera (1 species) | Forficulidae | *Forcipulalurida* |
| Hemiptera (9 species) | Gerridae | *Aquariuspaludum*<br>*Gerrisfabricus* |
| | Tetranychidae | *Diplonychusrusticus* |
| | Notonectidae | *Notonectareuteri* |
| | Lygaeidae | *Acroleucusbrevicollis* |
| | Coxidae | *Micronectascutellaris* |
| | Nepidae | *Laccotrephesgriseus* |
| | Pyrrhocoridaee | *Dysdercuscingulatus* |
| | Reduviidae | *Reduviiuspersonatus* |
| Orthoptera (1 species) | Acrididae | *Catantopshumalaris* |

Table 2. Insect species belonging to **order Odonata** found in the vicinity of Nakane Lake

| **Suborder** | **Family** | ***Scientific name*** |
|---|---|---|
| Suborder: Anisoptera (10 species) | Aeshnidae | *Anaciaeschnajaspidea*<br>*Hemianaxephippiger* |
| | Gomphidae | *Ictinogomphusrapax*<br>*Paragomphuslineatus* |
| | Libellulidae | *Acisomapanorpoides*<br>*Aethriamantabrevipennis*<br>*Crocothemisservilia*<br>*Lathrecistaasiatica*<br>*Neurothemisfulvia*<br>*Neurothemisintermedia* |
| Zygoptera | Chlorocyphidae | *Libellagolineata* |

| | | |
|---|---|---|
| (4 species) | Coenagrionidae | *Ceriagrioncoromandelianum*<br>*Ischnura aurora* |
| | Platycnemididae | *Coperamarginipes* |

Ourresults were in line with that ofAgarwala et al (2013) who reported ahigher species richness for insects of Hemiptera (32.26%) and Odonata (32.25%) orders followed by those belonging to Coleoptera (25.81%) and Diptera (9.68%). At Maharaja BirBikram College Lake, maximum diversity (H = 3.03) and least dominance (D = 0.06) of aquatic insects were revealed while Laxminarayan s Bari Lakedocumented minimum diversity (H = 1.50) and maximum s dominance (D = 0.06). Lower pollution of urban lakes of Tripura is suggested by the predominance of hemipteran and coleopteran insects.Membere et al (2021) noted the insectabundance and diversity in a mangrove ecosystem with the highest species diversity documented in Dipteran insects with Shanon H' of 2.00.

Table 3. Diversity indices of aquatic insects in association of Nakane Lake, near Dhule, MS

| **Sr No.** | **Insect species** | **$n_1$** | **$n_1$-1** | **$n_1$ ($n_1$-1)** | **pi** | **In (pi)** | **pi [in(pi)]** |
|---|---|---|---|---|---|---|---|
| 1 | *Aciliussculcatus* | 8 | 7 | 56 | 0.0418 | -3.17 | -0.13 |
| 2 | *Acisomapanorpoides* | 5 | 4 | 20 | 0.0262 | -3.64 | -0.10 |
| 3 | *Acroleucusbrevicollis* | 1 | 0 | 0 | 0.0052 | -5.25 | -0.03 |
| 4 | *Aedesageypti* | 3 | 2 | 6 | 0.0157 | -4.15 | -0.07 |
| 5 | *Aedesalbopictus* | 4 | 3 | 12 | 0.0209 | -3.87 | -0.08 |
| 6 | *Aethriamantabrevipennis* | 2 | 1 | 2 | 0.0105 | -4.56 | -0.05 |
| 7 | *Anaciaeschnajaspidea* | 7 | 6 | 42 | 0.0366 | -3.31 | -0.12 |
| 8 | *Aquarius paludum* | 15 | 14 | 210 | 0.0785 | -2.54 | -0.20 |
| 9 | *Bembidionfoveolatum* | 1 | 0 | 0 | 0.0052 | -5.25 | -0.03 |
| 10 | *Catantopshumalaris* | 1 | 0 | 0 | 0.0052 | -5.25 | -0.03 |
| 11 | *Cercyonpractextatus* | 2 | 1 | 2 | 0.0105 | -4.56 | -0.05 |
| 12 | *Ceriagrioncoromandelianum* | 3 | 2 | 6 | 0.0157 | -4.15 | -0.07 |
| 13 | *Chironomuscircumdatus* | 11 | 10 | 110 | 0.0576 | -2.85 | -0.16 |
| 14 | *Chironomusjavanus* | 9 | 8 | 72 | 0.0471 | -3.06 | -0.14 |
| 15 | *Chlaeniuscordicollis* | 8 | 7 | 56 | 0.0419 | -3.17 | -0.13 |
| 16 | *Coperamarginipes* | 2 | 1 | 2 | 0.0105 | -4.56 | -0.05 |
| 17 | *Crocothemisservilia* | 2 | 1 | 2 | 0.0105 | -4.56 | -0.05 |
| 18 | *Dineutusindicus* | 9 | 8 | 72 | 0.0471 | -3.06 | -0.14 |
| 19 | *Diplonychusrusticus* | 3 | 2 | 6 | 0.0157 | -4.15 | -0.07 |
| 20 | *Dysdercuscingulatus* | 19 | 18 | 342 | 0.0995 | -2.31 | -0.23 |
| 21 | *Forcipulalurida* | 2 | 1 | 2 | 0.0105 | -4.56 | -0.05 |
| 22 | *Gerrisfabricus* | 3 | 2 | 6 | 0.0157 | -4.15 | -0.07 |
| 23 | *Harpalusrubripes* | 4 | 3 | 12 | 0.0209 | -3.87 | -0.08 |
| 24 | *Hemianaxephippiger* | 2 | 1 | 2 | 0.0105 | -4.56 | -0.05 |
| 25 | *Ictinogomphusrapax* | 4 | 3 | 12 | 0.0209 | -3.87 | -0.08 |
| 26 | *Ischnura aurora* | 1 | 0 | 0 | 0.0052 | -5.25 | -0.03 |
| 27 | *Laccotrephesgriseus* | 12 | 11 | 132 | 0.0628 | -2.77 | -0.17 |
| 28 | *Lathrecistaasiatica* | 2 | 1 | 2 | 0.0105 | -4.56 | -0.05 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 29 | *Libellagolineata* | 3 | 2 | 6 | 0.0157 | -4.15 | -0.07 |
| 30 | *Micronectascutellaris* | 8 | 7 | 56 | 0.0419 | -3.17 | -0.13 |
| 31 | *Neurothemisfulvia* | 3 | 2 | 6 | 0.0157 | -4.15 | -0.07 |
| 32 | *Neurothemisintermedia* | 2 | 1 | 2 | 0.0105 | -4.56 | -0.05 |
| 33 | *Notonectareuteri* | 7 | 6 | 42 | 0.0366 | -3.31 | -0.12 |
| 34 | *Olophrumlathrimaeum* | 6 | 5 | 30 | 0.0314 | -3.46 | -0.11 |
| 35 | *Paederidusruficollis* | 5 | 4 | 20 | 0.0262 | -3.64 | -0.10 |
| 36 | *Paragomphuslineatus* | 3 | 2 | 6 | 0.0157 | -4.15 | -0.07 |
| 37 | *Phalacruspolitus* | 3 | 2 | 6 | 0.0157 | -4.15 | -0.07 |
| 38 | *Reduviiuspersonatus* | 2 | 1 | 2 | 0.0105 | -4.56 | -0.05 |
| 39 | *Sandracottusdejeani* | 4 | 3 | 12 | 0.0209 | -3.87 | -0.08 |
| | Total | 191 | 152 | 1374 | | | -3.43 |

| | |
|---|---|
| Total no. of organisms in all species (N) | 191 |
| N(N-1) | 29032 |
| Shannon – Weiner Index (H) | H = -Σ Pi x (ln Pi) = H = -(-3.43) = 3.43 |
| Simpson's Index (D) | 1374 / (191 x 190)= 0.038 |
| Simpson's Index of Diversity (1- D) | 0.962 |
| Simpson's Reciprocal Index (1/D) | 26.315 |
| No.of species found in sample (S) | 39 |
| Species Richness (Menhinick's Index) R= S/√N | 2.82 |
| Pielou's evenness Index (J) = H /ln S | 0.936 |
| Maximum Diversity possible ($H_{max}$) = ln S | 3.66 |
| Evenness (E)=H/ $H_{max}$ | 0.937 |

Here, n=total number of organisms in a distinctspecies; pi=proportion of the total sample illustratedby species i. Divide the no. individuals of species (i) by total number of all species. S= species number.

## Conclusion:

The insect range in Nakane Lake near Dhule city in North Maharashtra is vast adding to thebiodiversity records. More intensive study would surely result in identifying more species of insectfauna. The ensuing ecosystem conservation and management is the need of the hour.

## References:


- Agarwala, Basant&Majumder, Joydeb& Das, Rajib&Majumder, Prasanta& Ghosh, Durgadas&Agarwala, B. (2013) Aquatic Insect Fauna and Diversity in Urban Fresh Water Lakes of Tripura, Northeast India. *Middle East J of Sci Res*. 13. 25-32. 10.5829/idosi.mejsr.2013.13.1.66123.
- Arimoro FO, Ikomi RB. (2008) Ecological integrity of upper Warri River, Niger Delta using aquatic insects as bioindicators.*EcolIndicators*. 395:1-7.
- Benetti CJ, Garrido J (2010) The influence of stream habitat and water quality on water beetles assemblages in two rivers in northwest Spain. *Vie et milieu*, 60(1): 53-63.

- Bybee S. M.Ogden T. H.Branham M. A. Whiting M. F.(2008) Molecules, morphology and fossils: a comprehensive approach to odonate phylogeny and the evolution of the odonate wing *Cladistics* 24:477–514.
- Fraser F. C. (1943)New oriental odonatelarvae.*Proc. Royal Entomol. Soc. London (B)*12:81– 93
- Ghani A. and S. Maalik (2020) Assessment of diversity and relative abundance of insect fauna associated with *Triticumaestivum* from district Sialkot, Pakistan, J of King Saud Uni- Sci. Vol 32 (1) Pages 986-95
- Hufnagel, L., Bakonyi, G. &Vásárhelyi, T. (1999) New approach for habitat characterization based on species lists of aquatic and semiaquatic bugs. Environ Monit Assess 58, 305–316.
- Kulkarni, R. R., and Zade, S. (2020). Role of aquatic insects in the enhancement of biodiversity of a freshwater reservoir, Ramala, Chandrapur, Maharashtra. *Envir.Conser. J.*, *21*(3), 89–92.
- Majumder J, Das K, Majumder P, Ghosh D, AgarwalaBK.(2013) Aquatic Insect fauna and diversity in urban freshwater lakes of Tripura, Northeast India.*Middle-East Jof Sci Res.* 13(1):25-32.
- Membere O., D.D.S. Bawo, J. Onwuteaka, A.P. Ugbomeh, O.R. Nwosu, (2021) Abundance and diversity of insects associated with Rhizophora mangle and Avicenniagerminans in Bundu-Ama mangrove ecosystem of the Niger Delta, Nigeria, *Scientific African*,Vol.14(2):229-35
- Mitra T. R. (2006) Handbook of common Indian dragonflies (Insecta: Odonata)Zoological Survey of India.Kolkata, West Bengal, India pp.124
- Nair M. V.(2011) Dragonflies and damselflies of Orissa and Eastern IndiaWildlife Organization,Forest and Environment Department, Government of Orissa, OS, India
- Sánchez-Fernández D, Abellán P, Velasco J, Millán A. (2004) Selecting areas to protect the biodiversity of aquatic ecosystems in a semiarid Mediterranean region using water beetles. *Aquat. Conserv. Mar. Freshw. Ecosyst.* **14**, 465–479.
- Sivaramakrishnan, K &Venkataraman, K. &Moorthy, R.K. & Subramanian, K.A. &Ghate, Utkarsh. (2000) Aquatic insect diversity and ubiquity of the streams of the Western Ghats, India. Journal of the Indian Institute of Science. 80. 537-552.
- Subramanian K. A. (2014)*A checklist of Odonata (Insecta) of India.* Zoological survey of India,Kolkata, WB

- Wallace JB (1996) Biotic indices and stream ecosystem processes: results from an experimental study. EcolAppl 6:140–151