International Journal of Applied Engineering Research ISSN 0973-4562 Volume 15, Number 2 (2020) pp. 149-156


# Diversity and Distribution of Aquatic Entamo-fauna in Bonal Reservoir, Gulbarga District, Karnataka, India

**HalliAnjinappa[1] and K.Vijaykumar[2]**

*[1]Little Flower Science College, Kallahalli-583201, Sundor Road Hospet, Karnataka, India.*

*[2]Environmental Biology Research Unit, Department of Zoology, Gulbarga University, Gulbarga – 585106, Karnataka. India.*

**Abstract**

This study was conducted to assess the Bonal reservoiraquatic insects' communities and the health status through the determination of composition of insects' abundance, and water qualities of physico chemical parameters. This paper deals with biannual variability of aquatic entamo fauna were sampled systematically and randomly using standard protocols. The aquatic insects act as an pollution indicators depends upon the seasonal cycles. The study was conducted from October 1999 to September 2001 and water samples and insects were collected monthly and Insects were sampled using standard entomological methods, while water samples was analyzed using standard Winkler's titrimetric and APHA methods to determine the chemical properties. Water analyses and insects' identifications were conducted in the laboratory of Department of Zoology, Gulbarga University, and Karnataka State. The results show that only Dissolved oxygen and Phosphate-phosphorus had significant difference .Total of twenty one insects were noticed belongs to different orders like Hemiptera, Coleoptera, Diptera, Odonata and Ephemeroptera. These groups insects found in the water suggest that the water body is lightly polluted due to agro chemicals, Organic fertilizers, human activities near the reservoir and may be dangerous to the health of peoples, aquatic and terrestrial fauna around the reservoir.

**Keywords**: Water quality, Reservoir, Bio indicators, Diversity, Entomofauna,

## MATERIALS AND METHODS

Gulbarga is an important place in the northern part of Karnataka presenting a semiarid climatic condition typical to most area of the Deccan plateau. The Gulbarga district consists manyrivers, lakes, reservoirs, ponds. Bonal reservoir is shallow water bodies in northern part of Gulbarga district, Karnataka state, falls under $77^0$ - 45 ' E longitude and $16^0$ – 33' N latitude. This has natural hillocks that form a natural wall. The total catchment area of the reservoir is 40.96 sq. miles and maximum depth 12 ft. and minimum 4ft. The sampling was done in first week of every month at seven stations were selected to study the variations. The Water samples preserve in refrigerator at $4^0$ C which is most general accepted method .The water temperature and atmospheric temperature were recorded by digital centigrade thermometer in field .This is perennial nature and water level start rising in pre monsoon period and the level drop in summer seasons. The investigation is carried out for a period of 24 months from October 1999 to September 2001. The insect population study was carried out frequency by quadrat based on two stage sampling technique reported by Poole (1974).The aquatic entamo fauna were sampled systematically and randomly using standard protocols. In each selected station for the population study, the smaller units called quadrats were identified at seven different stations. At the first stage of sampling the quadrats were the primary units. In each of the chosen quadrats sample were netted seven times in the morning period using hand net fitted with units of mesh of 0.40 sq.mm and the random samples of individuals obtained were collected in a container. The collected individuals were separated stage wise and counted. Each collection was made of thirty second, which as an index of sampling effect. The individuals that were counted and released back in to the same habitat. The aquatic insects act as an indicator species to monitoring the environment pollution. The Dipterans were most divers and its presence indicative of good water quality and abundance of organic pollution causes human health. The physico chemical variations of water taken in to account for the study were found to be influencing the distribution of aquatic insects.

## RESULTS AND DISCUSSION

The monthly variation and diversity of aquatic insects population belonging to five orders like Hemiptera, coleoptera, Diptera, Odonata and Ephemeroptera groups of this reservoir for the period of two years from October 1999 to September 2001.The composition and percentage of aquatic insects are depicted in Table.6 and 7 found in the following order in this reservoir during study period. The Diptera >

Hemiptera >coleoptera> Odonata > Ephemeroptera are one of the important aspects of inland water study of regional biological diversity. Roy (1986) and Roy et al.,(1998) studied on the seasonal variation in the biomass production of aquatic fresh water pond Jakher (1987) distribution of benthic macro invertebrates in relation to physico chemical factors were studied in lake Balsamad, Jodhpur during 1976 and 1977 and emphasized that both diversities were increased during winter seasons at all the depths. Sinha (1990) studied with the seasonal variations in biomass and productivity of aquatic insects in two different fresh water bodies during the period from 1987 to 1988 and emphasized on the occurrence and production of the aquatic insect fauna in Derelict pond and managed fish pond of Manger were regulated by complex physico chemical and biological factors. Sharanappa (1995) studied in the common insects species available in fresh water bodies of Gulbarga area. Shivasharanappa (1996) worked on population dynamics of aquatic insects of Gulbarga. The Bonal reservoir water has a moderate multi directional current due to effect of wind. The physico-chemical parameter of the reservoir showed that the reservoir has a pH (Hydrogen ion concentration) range between 6.2 to 8.4, Oxygen ranged between 7.13 to 8.92 ppm, temperature ranged from 28.50$^{o}$C to 34.0$^{0}$C and the transparency ranged between 0.48 to 0.70cm. In Bonal reservoir much vegetation interspersed hydrophytes include *Camellias Gambia, Pistia stratiole, Marsilea quadrifolia, Cyprus sp* this result in changes in the physico-chemical properties of water like Temperature, Dissolved oxygen, Alkalinity, Phosphates, Nitrates and metal concentrations. The variations in these water properties greatly influence the distribution patterns of aquatic insects in the water, some of them are highly sensitive to pollution while others are some what tolerant or completely tolerant to pollution and environmental disturbances (Bauern feind and Moog 2000) Dudgeon et al., (1994, 2000) stresses the importance of bio monitoring and identifying areas of riverine biodiversity for long term conservation. Some insects are very sensitive to environmental degradation studied by Fore et al.,( 1996) Biological assessment of the freshwater habitats aims at characterizing and monitoring the conditions of the aquatic resources (Sivaramakrishnan, et al., 1996a). The reservoir is marked by two season's wet and dry seasons. The Rainy season occurs between April and October while the dry season is between November and March. The reservoir was created to serve for the purpose of water storage for domestic consumption, laboratory use, fish culture (Hassan, 1974). Temperature values recorded during the sampling period ranged from 24$^{0}$C to 29$^{0}$C. This value falls within the optimal range for tropical fresh waters. This was also corroborated (Tonapi 1980) but that tropical freshwaters had temperature values ranging from 21$^{0}$C to 32$^{0}$C. This temperature indicates a great impact on the abundance and distribution of aquatic insects as more species were collected at relatively high temperature than when there was a drop in low temperature. Ajao (1990) and Oben (2000), recorded similar observation during their studies. The analysis between insect abundance and water temperature showed that most of the species correlated positively with water temperature because some insect species are temperature dependent, this favors their rate of feeding and metabolism. Some other species like *Gyrinus sp., Tabanus sp., Culex sp., water flea, Gerris, Neopla sp.* and *Libellula sp* had positive correlation with temperature. These groups of insects increase in abundance with decreasing temperature because they prefer cooler waters for their feeding rate, metabolism and reproduction (Pennak, 1978). Aquatic Insects sampling and identification of overall insect composition, abundance, and distribution dissolved oxygen (DO) concentration in Bonal reservoir was inversely related to changes in temperature. Pearson's correlation coefficient (r) analysis confirmed an inverse relationship between Dissolved oxygen and water temperature. This observation agreed with findings that increase in water temperature brings about a decrease in Dissolved oxygen. This is because as water temperature increases, dissolved oxygen decreases; also it may be due to respiration and other processes such as breakdown of organic matters. The Diptera species group of diversity was highest in where the Dissolved oxygen was high. The low values of Dissolved oxygen concentration recorded is an indication of deterioration of the water quality as a result of various anthropogenic activities in these sites as observed and also attributed the low level of Dissolved oxygen in these points to human activities. Pearson correlation coefficient analysis showed a positive relationship of the insects and dissolved oxygen species like *Water flea, Libellula sp, Chironomus sp., Tabanus sp., Culex sp.,* correlated inversely with dissolved oxygen from the study. The Nutrients (Nitrate and Phosphates) correlated positively with insect species. It is likely that input of nutrients in the reservoir enhanced secondary production. The recorded higher values in nutrients (nitrates and phosphates) indicating significant input of organic discharges in this area was observed and finding consistent organic impacted areas, have low varieties of species and most of the species dominating such zones are tolerant to pollution. Dipterans like *Chironomus, Culex sp* are the most dominant and where organic wastes are discharged constantly into the reservoir. The most of the pollution tolerant species had inverse relationship with pH value obtained from this study ranged from slightly acidic to neutral. Most of the insects species such as *Chironomus sp*., Water boatmen, and Damsel flies are slightly affected by acidification, hence their abundance low varieties of species. The seasonal cycle and composition of Hemiptera group during north east monsoon season of 1999 to 2000 fluctuated between 95 to 136 numbers /quadrat (Table1 and6:Fig1 and 6). While for the same season of 2000 to 2001 fluctuated between 89 to 151 numbers /quadrat. The species *N.glauca, A.sardea, D.rusticum,* are dominant among Hemiptera group during north east monsoon season. While for the summer season of 2000 the Hemiptera population fluctuated between 79 to 98 numbers /quadrat and while for

the same season of 2001 it varied between 80 to 102 numbers /quadrat only two species *N.glauca*, *D.rusticum* was dominant during summer season of the study period. The south west monsoon season of 2000, the Hemiptera population varied between 59 to 82 numbers /quadrat and during the same season of 2001 Hemipterans group varied from 82 to 91 numbers /quadrat and among Hemipterans during summer seasons two species *N.glauca, and S.pectoralis* are dominant. The coleopteran was in third position among the aquatic insects population observed in the Bonal reservoir. The coleopteran population fluctuated between 30 to 47 numbers /quadrat (Table 2 and 6 : Fig 2 and 6)during north east monsoon season of 1999 – 2000, and while for the same season of 2001 it varied between 23 to 39 numbers /quadrat. During summer season of 2000, the composition of Coleopteran group fluctuated between 20 to 41 numbers / quadrat and while for the same season the coleopteran varied between 17 to 20 numbers /quadrat in the Bonal reservoir. The south west monsoon season of 2000, the coleopteran population fluctuated between 17 to 30 numbers /quadrat and while for the same season the coleopteran varied between 18 to 45numbers/quadrat. The*C.lactobilis, H.olivaceous* and *Cybister limbatus* were dominant during the study period.During north east monsoon season of 1999 to 2000 the Diptera population varied between 561 to 772 numbers /quadrat. And While for the same season of 2001 it fluctuated from 509 to 771 numbers /quadrat.(Table 3 and 6: Fig 3 and 6) The species the summer season of 2000 the Diptera population fluctuated between 520 to 631 numbers / quadrat and while for the same season of 2001 it varied between 555 to 624 numbers /quadrat. During south west monsoon season of 2000, the Diptera population ranged between331 to 569 numbers /quadrat and during the same season of 2001, varied from 366 to 518 numbers /quadrat. However, *Chironomus javnus* and *Tanypus bilobatus* were dominant among Diptera during the present study.Maximum population was observed during north east monsoon and summer season, While minimum population was noticed during south west monsoon season and this group is occupy the first positionThe group Odonata formed fourth position in the aquatic insects during present study and it constituted about 2.57% (Table 4 and 6: Fig 4, 6 and 7) of the total aquatic insects. During north east monsoon season of 1999 – 2000, it varied between 15 to 32 numbers / quadrat and for the same season of 2000 – 2001 Odonata population varied between 18 to 28 numbers / quadrat. While during summer season of 2000, the Odonata population varied between 14 to 15 numbers / quadrat and for the same season of 2001,it fluctuated between 8 to 19 numbers / quadrat. The south west monsoon season of 2000 the Odonata population varied between 18 to 24 numbers / quadrat and during the same season of 2001 the Odonata population fluctuated between 9 to 21 numbers / quadrat. Among Odonata *Enallagma sp* was dominant during the study period.

**Table 1.** Population of Hemiptera (No/Quadrat)

| Months | *R.e* | *D.r* | *A.s* | *N.g* | *C.sp* | *L.f* | *L.r* | *L.i* | *S.p* |
|---|---|---|---|---|---|---|---|---|---|
| Oct99 | 09 | 12 | 14 | 20 | 12 | 11 | 04 | 03 | 10 |
| Nov | 18 | 24 | 12 | 26 | 16 | 09 | 03 | 02 | 14 |
| Dec | 21 | 18 | 11 | 28 | 19 | 16 | 04 | 03 | 16 |
| Jan00 | 17 | 15 | 13 | 41 | 21 | 10 | 02 | 04 | 11 |
| Feb | 15 | 12 | 10 | 26 | 10 | 12 | 03 | 04 | 06 |
| Mar | 10 | 08 | 14 | 18 | 12 | 09 | 02 | 03 | 05 |
| April | 11 | 07 | 13 | 15 | 11 | 08 | 04 | 02 | 09 |
| May | 08 | 12 | 10 | 17 | 10 | 04 | 03 | 04 | 11 |
| June | 06 | 04 | 09 | 13 | 09 | 05 | 02 | 03 | 08 |
| July | 09 | 07 | 05 | 18 | 08 | 10 | 02 | 02 | 07 |
| Aug | 07 | 03 | 10 | 14 | 10 | 13 | 03 | 04 | 05 |
| Sep | 10 | 03 | 12 | 17 | 12 | 16 | 04 | 02 | 06 |
| Oct | 13 | 07 | 09 | 18 | 10 | 12 | 03 | 04 | 13 |
| Nov | 19 | 15 | 12 | 21 | 10 | 11 | 06 | 05 | 21 |
| Dec | 26 | 21 | 13 | 26 | 16 | 18 | 04 | 03 | 24 |
| Jan01 | 23 | 19 | 06 | 28 | 13 | 02 | 02 | 02 | 37 |
| Feb | 20 | 17 | 05 | 21 | 10 | 06 | 04 | 05 | 14 |
| Mar | 12 | 14 | 03 | 18 | 12 | 03 | 02 | 04 | 12 |
| April | 16 | 13 | 10 | 13 | 17 | 04 | 03 | 02 | 18 |
| May | 12 | 10 | 12 | 16 | 10 | 12 | 02 | 02 | 10 |
| June | 10 | 08 | 10 | 12 | 12 | 08 | 05 | 01 | 12 |
| July | 09 | 06 | 13 | 14 | 10 | 07 | 04 | 01 | 16 |
| Aug | 12 | 10 | 08 | 16 | 21 | 08 | 04 | 02 | 10 |
| Sep | 11 | 09 | 06 | 21 | 14 | 09 | 02 | 03 | 07 |

Where*asR.e=R.elongata,D.r=D.rusticumA.s=A.sardeaN.g=N. glaucaC.sp=Corisa.spL.f=L.fluvirurmL.r=L.ruber L.i=L.indiicus S.p=S.pectoralis*

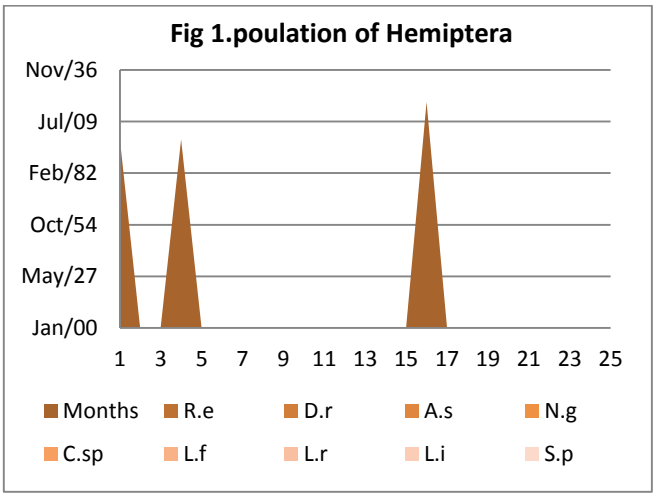


**Table 2.** Population of coleoptera (No/Quadrat)

| Months | *C.l* | *H.o* | *C.l* | *R.a* |
|---|---|---|---|---|
| Oct99 | 12 | 08 | 06 | 04 |
| Nov | 09 | 05 | 12 | 03 |
| Dec | 26 | 06 | 11 | 04 |
| Jan00 | 14 | 09 | 06 | 02 |
| Feb | 18 | 05 | 18 | 01 |
| Mar | 13 | 03 | 12 | 01 |
| April | 06 | 02 | 08 | 04 |
| May | 08 | 04 | 05 | 03 |
| June | 05 | 03 | 06 | 03 |
| July | 13 | 02 | 04 | 02 |
| Aug | 19 | 03 | 13 | 01 |
| Sep | 17 | 04 | 04 | 05 |
| Oct | 09 | 05 | 08 | 04 |
| Nov | 05 | 07 | 12 | 03 |
| Dec | 06 | 11 | 16 | 06 |
| Jan01 | 04 | 10 | 07 | 02 |
| Feb | 07 | 08 | 03 | 02 |
| Mar | 05 | 06 | 05 | 03 |
| April | 06 | 03 | 04 | 04 |
| May | 03 | 04 | 06 | 06 |
| June | 12 | 02 | 03 | 01 |
| July | 16 | 06 | 05 | 03 |
| Aug | 14 | 04 | 12 | 06 |
| Sep | 21 | 12 | 08 | 04 |

WhereasC.l=*C.lactobilis,*H.o=*H.olivacieous,*C.l=*C.limbatus,* R.a=*R.attenuat*

The Ephemeroptera groups was in the fifth position (Table.5,6 and 7:Fig 5,6 and 7) among the aquatic insects population observed in the Bonal reservoir .TheEphemeroptera population fluctuated between 9 to 17 numbers / quadrat during north east monsoon season of 1999 – 2000. While for the same season of 2001, it varied between 23 to 31 numbers / quadrat .While for the summer season of 2000, the Ephemeroptera fluctuated between 5 to 12 numbers / quadrat and for the same season of 2001 the Ephemeroptera varied between 10 to 21 numbers / quadrat. During the south west monsoon season of 2000, the Ephemeroptera ranged between 15 to 23 numbers / quadrat and while for the same season of 2001, it varied between 7 to 22 numbers / quadrat (Table.6). *Baetix sp* and *Cloen sp* both species were dominant in the present study.

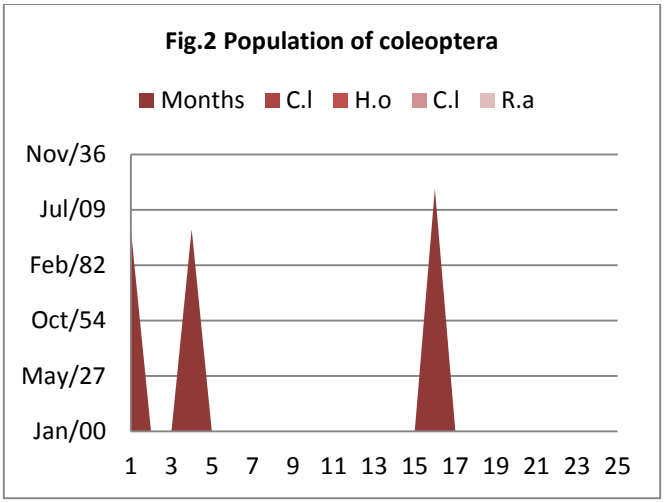
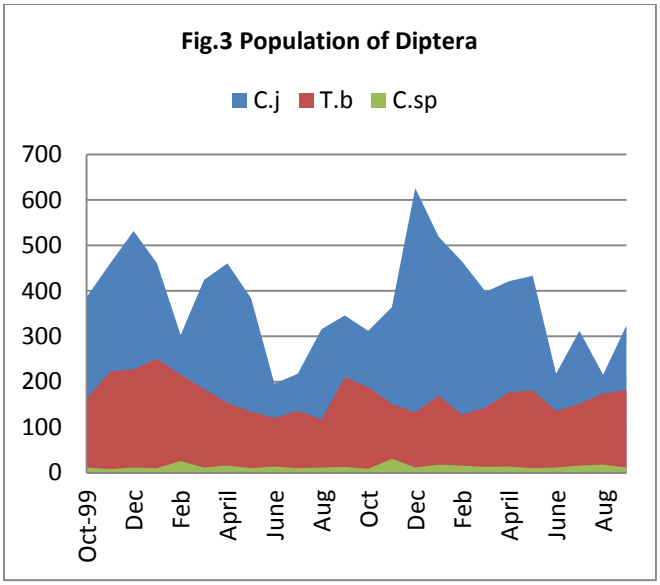



**Table 3:** Population of Diptera (No/Quadrat)

| Months | *C.j* | *T.b* | *C.sp* |
|---|---|---|---|
| Oct99 | 386 | 163 | 12 |
| Nov | 461 | 223 | 08 |
| Dec | 532 | 228 | 12 |
| Jan00 | 461 | 251 | 10 |
| Feb | 303 | 216 | 26 |
| Mar | 424 | 184 | 12 |
| April | 461 | 154 | 16 |
| May | 384 | 134 | 10 |
| June | 196 | 121 | 14 |
| July | 218 | 136 | 10 |
| Aug | 316 | 118 | 12 |
| Sep | 346 | 210 | 13 |
| Oct | 312 | 188 | 09 |
| Nov | 364 | 151 | 31 |
| Dec | 626 | 133 | 12 |
| Jan01 | 519 | 169 | 18 |
| Feb | 464 | 128 | 16 |
| Mar | 398 | 144 | 13 |
| April | 421 | 177 | 14 |
| May | 433 | 181 | 10 |
| June | 218 | 136 | 12 |
| July | 312 | 152 | 16 |
| Aug | 216 | 174 | 18 |
| Sep | 324 | 182 | 12 |

Whereas C.j=*C.javanus*,T.b=*T.bilobatus*C.sp=*Culex.sp*



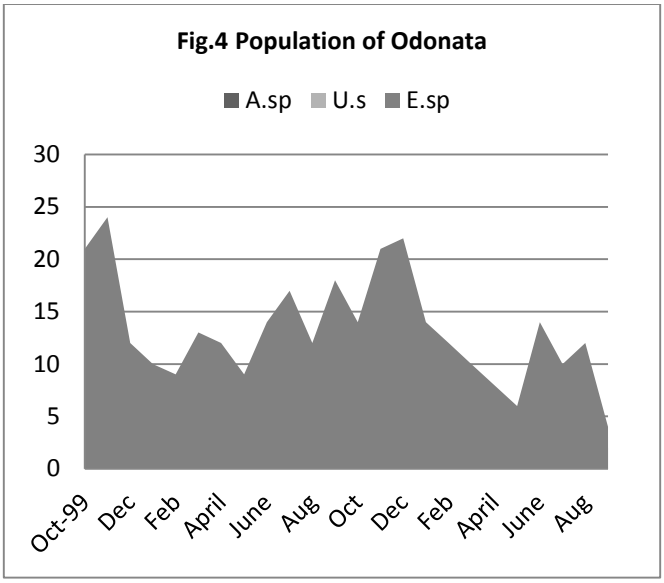




**Table 4:** Population of Odonata (No/Quadrat)

| Months | *A.sp* | *U.s* | *E.sp* |
|---|---|---|---|
| Oct 1999 | 01 | 02 | 21 |
| Nov | 05 | 03 | 24 |
| Dec | 06 | 04 | 12 |
| Jan 2000 | 03 | 02 | 10 |
| Feb | 04 | 01 | 09 |
| Mar | 02 | - | 13 |
| April | - | 02 | 12 |
| May | 03 | 03 | 09 |
| June | 02 | 02 | 14 |
| July | - | 04 | 17 |
| Aug | 04 | 05 | 12 |
| Sep | 03 | 03 | 18 |
| Oct | 02 | 02 | 14 |
| Nov | 03 | 04 | 21 |
| Dec | 04 | 02 | 22 |
| Jan 2001 | 04 | 05 | 14 |
| Feb | 03 | 04 | 12 |
| Mar | 04 | 03 | 10 |
| April | 01 | 02 | 08 |
| May | - | 02 | 06 |
| June | 02 | 05 | 14 |
| July | 03 | 02 | 10 |
| Aug | 03 | 01 | 12 |
| Sep | 02 | 03 | 04 |

Whereas

A.sp=*Anaxsp*,U.s=*U.signata*,E.sp=*Enallagmasp*

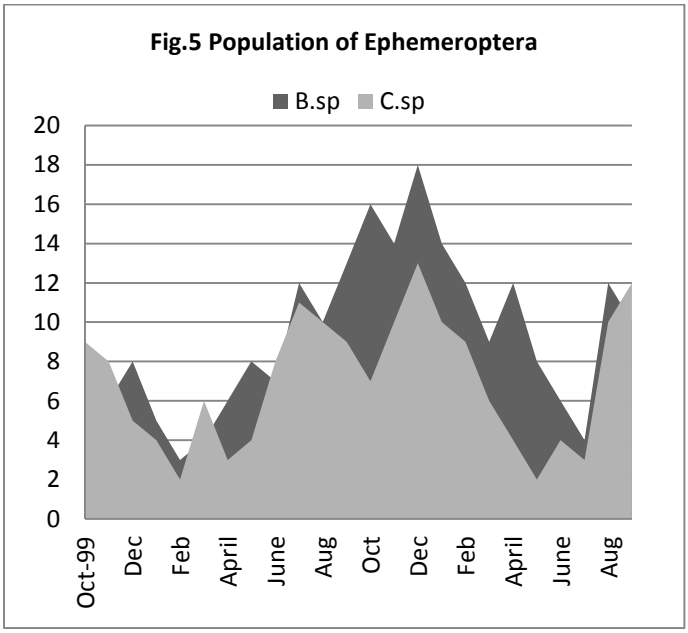
**Table 5:** Population ofEphemeroptera (No/Quadrat)

| Months | *B.sp* | *C.sp* |
|---|---|---|
| Oct99 | 08 | 09 |
| Nov | 06 | 08 |
| Dec | 08 | 05 |
| Jan00 | 05 | 04 |
| Feb | 03 | 02 |
| Mar | 04 | 06 |
| April | 06 | 03 |
| May | 08 | 04 |
| June | 07 | 08 |
| July | 12 | 11 |
| Aug | 10 | 10 |
| Sep | 13 | 09 |
| Oct | 16 | 07 |
| Nov | 14 | 10 |
| Dec | 18 | 13 |
| Jan01 | 14 | 10 |
| Feb | 12 | 09 |
| Mar | 09 | 06 |
| April | 12 | 04 |
| May | 08 | 02 |
| June | 06 | 04 |
| July | 04 | 03 |
| Aug | 12 | 10 |
| Sep | 10 | 12 |

Where as

B.sp= *Baetix sp*, C.sp= *Cloensp* (May fly)

Aquatic insects can thrive under varied ecological conditions in fresh water and occupy almost all conceivable habitats, having wide range habitats. The aquatic insects are important component of food web in an ecosystem and they are valuable indicators of water quality. The composition and dominance ( Table 6 and 7: Fig 6 and 7) of total aquatic insects of Diptera 77.61 %, Hemiptera 13.27 %, coleopteran 4.25 %, Odonata 2.57 %, Ephemeroptera 2.26 % during present study.




The dipteran are formed the largest group among the aquatic insects constitute 77.61 % of the total aquatic entamo fauna. Among aquatic weeds an *Ottelia alismoides* and *Ipomea aquatica* are two dominant plant species occurred throughout the reservoir and provide good floating and shelter for various insects. The physico chemical parameters influence the aquatic entamo fauna are naturally occupied in the Bonal reservoir. The high abundance and distribution of pollutiontolerant orders of aquatic insects and the bio monitoring of the reservoir using benthic macro invertebrates in standing water is an effective tool for food web in different organisms.

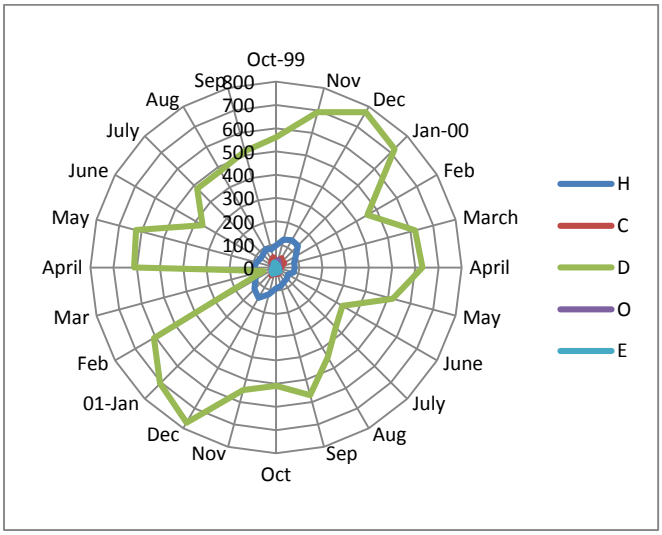



**Fig 6:** Composition of Entamofauna

**Table 6:** Composition of Enamofauna

| Months | H | C | D | O | E |
|---|---|---|---|---|---|
| Oct99 | 95 | 30 | 561 | 23 | 17 |
| Nov | 124 | 29 | 692 | 33 | 14 |
| Dec | 136 | 47 | 772 | 22 | 13 |
| Jan00 | 134 | 31 | 722 | 15 | 09 |
| Feb | 98 | 41 | 454 | 14 | 05 |
| March | 81 | 28 | 620 | 15 | 10 |
| April | 80 | 20 | 631 | 14 | 09 |
| May | 79 | 20 | 520 | 15 | 12 |
| June | 59 | 17 | 331 | 18 | 15 |
| July | 68 | 21 | 364 | 21 | 23 |
| Aug | 69 | 26 | 446 | 21 | 20 |
| Sep | 82 | 30 | 569 | 24 | 22 |
| Oct | 89 | 26 | 509 | 18 | 23 |
| Nov | 120 | 27 | 546 | 28 | 24 |
| Dec | 151 | 39 | 771 | 28 | 31 |
| Jan01 | 132 | 23 | 706 | 23 | 24 |
| Feb | 102 | 20 | 608 | 19 | 21 |
| Mar | 80 | 19 | 55 | 17 | 15 |
| April | 96 | 17 | 612 | 11 | 16 |
| May | 86 | 19 | 624 | 08 | 10 |
| June | 77 | 18 | 366 | 21 | 10 |
| July | 79 | 30 | 480 | 15 | 07 |
| Aug | 91 | 36 | 480 | 04 | 22 |
| Sep | 82 | 45 | 518 | 09 | 22 |

Whereas

H=Hemiptera,C=Coleopter,D=Diptera,
O=Odonata,E=Ephemeroptera

**Table 7:** Total Percentage of aquatic Entomfauna

| Orders | Percentage |
|---|---|
| Hemiptera | 13.27 |
| Coleoptera | 04.25 |
| Diptera | 77.61 |
| Odonata | 02.57 |
| Ephemeroptera | 02.26 |

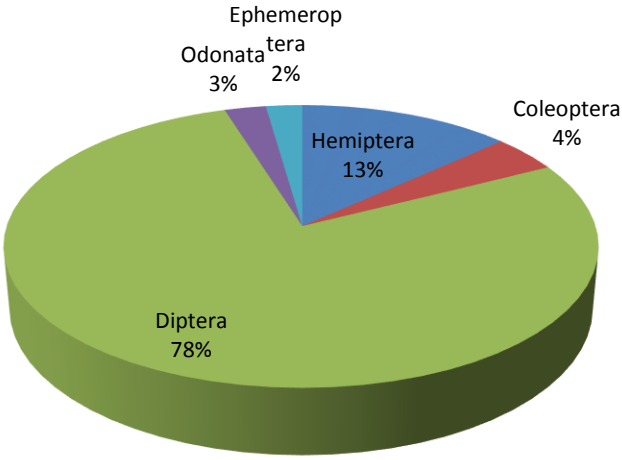



**Fig.7 Total Percentage Entamo fauna**

## CONCLUSION

In conclusion, Thus the study reveals water quality plays a vital role in the distribution and diversity of aquatic entamo fauna .The richness of Dipterans population indicate are the evidence showed that the Bonal reservoir water body is lightly polluted due to human activities, entry of agro chemicals, and organic fertilizers around the reservoir areas and may be dangerous to the aquatic and terrestrial fauna in and around the reservoir. It is imperative that there should be strict adherence to adequate conservation measure like sewage, organicfertilizers, agrochemicals should be treat before discharge in to this reservoir to improve the quality of water, healthy ecosystem as well as public health.

## REFERENCES

[1] APHA 1985: Slandered methods for the examination of water and waste water ,17thEd.public health Association ,Washington ,D.C. standardized by American Public Health Association.

[2] Bisht R.S and S.M Das.1980.Certain aspects habitatecologyof aquatic entamo fauna in Two cold water Kurnaon lakes.India.J.Eco.7 (2): 237 – 245.

[3] Daly, H V, 1996. General classified key to the orders of aquatic and semi aquatic insects In: An introduction to the aquatic insects of North America (Eds. MerritR.W.and Cummins, K.W) Kendall Hunt, Iowa, USA. 101-112.

[4] Fore, L S, Karr, J R, Wisseman,RW, 1996. Assessing invertebrate response to human activities:evaluating alternative approaches .Journal of NorthAmericaBenthol. Soc.,15: 212-231.

[5] Jakher G.R 1987: Species diversity of macro Benthic fauna in tropical lake.Comp.Phyiol.Ecol.11 (4):217 – 225.

[6] Poole.1974: Sampling and estimation of population parameters In an introduction to quantitative ecology. McGraw.

Hill.Kogakush.Ltd.Tokiyo: 293 – 303.

[7] Roy S.P 1986: Studies on seasonal variations in the biomass and production of aquatic insects in fresh water pond.Biol.Bull.India. 8 :169 – 173.

[8] Roy S.P ., V.Kumar, H.S.Pathak and U.P.Sharma 1989:Estimation of secondary productivity of aquatic insects in fresh water pond.J.Fresh water Biol.1 (2): 109 – 112.

[9] Merrit, R W, and Cummins, K W, 1988. An Introduction to the aquatic insects of North America (2nd Edn.) Kendall. Hunt Publication Company, Dubuque, Iowa: 722.

[10] Timm, H,1997: Ephemeroptera and Plecoptera larvae as environmental indicators in running waters of Estonia.

[11] Trivedy, R K and Goel, P K, 1985.(Eds). Current Pollution Researches in India.Environmedia.

Karad, M.P: 344.

[12] Sharanappa B.G1995 : Common insects of fresh water pond of Gulbarga. M.Phil. dissertation, GulbargaUniversity, Gulbarga.

[13] TonapiG.T.1959 : Studies on the aquatic insects fauna of Poona aquatic Heteroptera proc.Nat.Inst.Sci.India.25 B (6):321 - 332.

[14] Tonapi G.T.1980: Fresh water animals of India ( An Ecological Approach) Oxford and IBH Publishing Co.NewDelhi.India

[15] Sinha K.K AND D.K.Sinha1990 : Seasonal variations in Biomass and production of aquatic insects in a Derelict pond and a managed fish pond of Munger,Bihar.Environ and Ecol.8 (4): 1231- 1234

[16] Shivasharanappa J.1996: Population dynamics of aquatic insects in fresh water bodies of Gulbarga, M.Phil.Dissertation, GulbargaUniversity, Gulbarga.

[17] Ali, A., R. Lobinske, J. Frouz and R.J. Leckel, 2003.Spatial and temporal influence of environmental conditions on benthic macro invertebrates in North east Lake Jessup; Central Florida. Florida Sci., 66(2): 69-83.

[18] Ajao, E.A., 1990. The influence of domestic and industrial effluents on the population of sessile and benthic organisms in Lagos lagoon. Ph.D. Thesis, University of Ibadan, Ibadan, pp.: 411.

[19] Pennak, R.W., 1978. Freshwater invertebrates of the United States. 2nd Edn., John Wiley and Sons, NewYork, pp: 810.

[20] Yakub, A.S., 2004. Assessment of water Quality and Plankton of Effluent receiving lower Awba stream and Reservoir, Ibadan. Afr. J. Appl. Zool. Environ.Biol., 6: 107-110.

[21] Zabbey, N. and A.Z. Hart, 2006. Influence of somephysicochemical parameters on the composition and distribution of benthic fauna in Woji Creek, NigerDelta, Nigeria. Global J. Pure Appl. Sci., 12(1): 1-5

[22] Subramanian, K.A. and Sivaramakrishnan, K.G. (2007).Aquatic Insects for Bio monitoring Freshwater Ecosystems-A Methodology Manual.Ashoka Trust for Ecology and Environment (ATREE), Bangalore, India. 31pp.

[23] Sivaramakrishnan, K.G, Hannaford, J Morgan and Resh H Vincent. (1996). Biological Assessment of theKaveri River Catchment, South India, and Using Benthic Macro invertebrates: Applicability of Water Quality Monitoring Approaches Developed in Other Countries.Int. J. Eco.andEnv.Sci.32: 113-132