



## Seasonal status of density of phytoplanktons and zooplanktons in Gomti river of Lucknow (U.P.), India

Preety Singh

Department of Zoology, BSNV PG College, Lucknow (U.P.), INDIA

E-mail: Preetysinghleo@gmail.com

Received: September 29, 2012; Revised received: January 28, 2013; Accepted: February 22, 2013

**Abstract:** Biodiversity of river Gomti is heavily affected by pollution. Planktons are important biological parameters to access the pollution level. Zooplanktons are the source of food for higher organism and phytoplankton play important role in biosynthesis of organic material and influence the river ecosystem, aquatic food chain and water characteristic. The biological productivity as ecological indicator to identify the ecological quality of river Gomti. The phytoplankton density fluctuated maximum in between the range of (140-900 ln/l) during monsoon season and minimum (40-140 ln/l) during winter season. Zooplanktons were reported to be highest (168-220 ln/l) during winter and lowest (114-155 ln/l) during summer season. During study period the total of phytoplanktons (17 sp.) and zooplanktons (10 sp.) were noticed during different seasons. Present study concluded that seasonal differences of planktons density will help in further planning of water management and their use for beneficial purpose like agricultural, drinking for mankind.

**Keywords:** Phytoplanktons, Plankton density, River Gomti, Zooplanktons

### INTRODUCTION

Planktons are the minute organism and are effective tools in environment bio-monitoring of aquatic ecosystem. Unplanned urbanization, rapid industrialization, indiscriminate use of artificial chemical in agriculture causing aquatic pollution, which deteriorating quality and depletion of aquatic biota (Yeole and Patil, 2005). Seasonal variation in planktons density are result of a complex interplay of physical, chemical and biological process, which indicate the diversity in ecological niches (Bansal *et al.*, 1989). Planktons diversity is controlled by seasonal changes as well as by the rate at which plant nutrients are supplied. Nitrogen, phosphorus and silica are three main nutrients needed for the phytoplanktons to grow at different times and in different ratio (Pilkaityte, 2003). Phytoplanktons are essential link in food chain of all aquatic animals include blue green algae, green algae, diatoms (Misra *et al.*, 2001). Planktons in the water body reflects existed ecological characteristics and so therefore, planktons organism may be used as indicators of water quality (Saha *et al.*, 2000, Angadi *et al.*, 2005). A considerable research work has been done in fresh water bodies in relation to phytoplanktons (Nautiyal, 1986, Bhatt *et al.* 1999, Calijuri *et al.*, 2002).

Therefore biological assessment is a significant alternative for assessing the ecological quality of aquatic ecosystem which influence the biological communities of rivers (Stevenson and Pan, 1999, Misra, 2000, Das and Panda, 2010). Species diversity indices when correlated

with ecological conditions provide one of the best way to evaluate influence of pollution on aquatic communities. The present study was conducted to examine the interaction of planktons density of river Gomti that may be influenced by the season.

### MATERIALS AND METHODS

**Study area:** The Gomti river is an important tributary of river Ganga and perennial river of Awadh plains run across the major part of U.P. covering nine districts and 940 Km stretch area. Five sampling sites from upstream to downstream were selected near Lucknow N (26° 52' 30'') and E (80° 52' 31'') in about 10 Km stretch.

For monitoring the river over a period of one year. Five sampling sites were chosen from upstream Gaughat (Site-A), Pakkapul (Site-B), Daliganj bridge (Site-C), Nishatganj bridge (Site-D) and Pipraghat (Site-E) respectively during monsoon (July-October), winter (November-February) and summer (March-June) season. All the sampling sites further divided as 1, 2, 3 for northern bank, midstream, southern bank respectively. The selection was based on the points where the communities most frequently collected water for drinking. For planktons estimation the method followed by Sheshodia (1988) was adopted. The planktons sample were collected by filtering about 25 litre of water through plankton net of bolting silk No. 25. The samples were preserved in 4% formaline solution. The samples were taken into Sedywick Rafter cell. Then placed the cell under microscope and counted all the

planktons present in the cell by moving it horizontally and vertically. Counting of phyto and zooplanktons was done by applying the following formula.

$$N = n \times v / V$$

Where: N- Total number of organism/litre of water filtered, n-Number of organism counted in 1ml of plankton sample v-Volume of concentrated plankton sample (ml), V- Volume of total water filtered

### RESULTS AND DISCUSSION

Rivers are the important source of natural water and provide life support ecosystem for existed aquatic life. Generally, planktons are heterogeneous minute organisms occurred in aquatic ecosystem and float on the wave action and movement of water. In the present study, the fluctuation of diversity of both phyto and zooplanktons at different sites and in different seasons in river Gomti indicated relation of particular variable for the growth of existing planktons in aquatic system. Seasonal density of phytoplanktons and zooplanktons are given in Table 1. The river comprises the maximum density of phytoplanktons during monsoon season (800 In/l), when turbidity and velocity of water were higher in their volume and minimum phytoplanktons (40 In/l) during winter ,when turbidity of water velocity was low in the river. Bwala *et al.* (2010) reported maximum count of planktons in Kainji reservoir of Nigeria during rainy season and winter season. Sharma *et al.* (2007) monitor phytoplankton diversity in the hill stream Chandrabhaga in Garhwal Himalayan and Misra and Ram (2007) also monitor comprehensive study of phytoplanktons community in polluted ponds of Janupur city.

At site-A (Gaughat) phytoplanktons concentration was recorded as 500-800 In/l in monsoon, 100-140 In/l in winter and 113-140 In/l in summer season. Bhowmick and Singh (1985) observed maximum density of phytoplanktons during summer and minimum in monsoon month. The low phytoplankton concentration (40-60 In/l) was

recorded at site-D (Nishatganj bridge) during winter season. The minimum range of phytoplankton was mainly due to anthropogenic activities like bathing, washing at site-D. The phytoplankton population decreased towards upstream site-A (Gaughat) to downstream at site-E (Pipraghat) during winter season. Decreased in biomass may be due to industrialization construction of buildings near by bank of river creating imbalance in low flow water velocity current. Sharma *et al.* (2007) reported that fluctuation in phytoplanktons diversity was due to seasonal alternation in physico-chemical characteristic of surface water in the hill stream. Further the planktonic community consists of the members of *Chlorophyceae* (7 sp.), *Bacillariophyceae*-diatoms (5 sp.), *Cynophyceae* (4 sp.) and *Euglenophyceae* ( 1 sp.) respectively (Table 2). Isabella *et al.* (2011) reported number of taxa of phytoplanktons during spring in north western Mediterranean sea.

The zooplankton population was observed maximum in between the range (158-215 In/l) at different sites during monsoon season, but it was low (114-155 In/l) in summer season. The zooplankton community comprised *Protozoa* (5 sp.), *Rotifera* (3 sp.), *Cladocera* (2 sp.) and *Copepoda* (1 sp.) (Table-2). These were identified from all sampling sites and their density showed low trend during summer season. Gautam and Gautam (2011) and Ahmed and Sharma (2009) reported the fluctuation in zooplanktons diversity and number of taxa due to seasonal change in Keetham lake at Agra and in river Gomti at Lucknow respectively. Ojha *et al.* (2007) reported that zooplanktons did not always follow the fluctuation of physico-chemical parameters. Shaikh *et al.* (2012) reported 10 spp. of fresh water protozoan from water bodies of Salim Ali lake, Aurangabad and according to him the distribution and population of protozoa was influenced with water temperature, light, pH, acidity, food availability and degree of adaptability of individual protozoa to various environmental changes.

**Table 1.** Variation in plankton density at different samping sites (1-3) in Gomti river of Lucknow during 2011-12.

Sites	Planktons	Monsoon season			Winter season			Summer season		
		1	2	3	1	2	3	1	2	3
Site-A (Gaughat)	Phytoplanktons	500	700	800	120	140	100	140	110	113
	Zooplanktons	210	205	200	176	170	168	127	130	135
Site-B (Pucca Pul)	Phytoplanktons	200	360	140	80	60	55	89	96	110
	Zooplanktons	178	176	190	180	183	185	136	135	120
Site-C (Daliganj bridge)	Phytoplanktons	900	500	600	140	80	60	129	130	125
	Zooplanktons	200	190	215	201	198	196	140	138	141
Site-D (Nishatganj-bridge)	Phytoplanktons	500	220	300	60	40	55	160	120	98
	Zooplanktons	170	179	210	220	219	203	150	155	120
Site-E (Pipraghat)	Phytoplanktons	600	520	370	80	60	40	145	130	120
	Zooplanktons	158	160	170	210	205	208	114	120	119

Values are mean of three values.

**Table 2.** Diversity and seasonal abundance of phytoplanktons and zooplanktons in river Gomti during 2011-12

Taxon	Monsoon season	Winter season	Summer season
<b>Phytoplanktons</b>			
<b>Chlorophyceae</b>			
<i>Ulothrix</i>	+++	+	++
<i>Oedogonium</i>	++	+	+++
<i>Spirogyra</i>	+++	++	+
<i>Microspora</i>	+	++	+
<i>Cladophora</i>	+++	+	++
<i>Volvox</i>	++	+	+++
<i>Hydrodictyon</i>	+	++	+
<b>Bacillariophyceae</b>			
Diatoms-			
<i>Navicula-viridula</i>	+++	++	+++
<i>Pleurasigma normanni sp.</i>	++	+++	+
<i>Nitzschia palea</i>	++	+++	+
<i>Synedra</i>	++	+	+
<i>Achnanthes exigua</i>	+	-	+
<b>Cynophyceae</b>			
<i>Nostoc</i>	+	++	+++
<i>Oscillatiria</i>	++	+++	+
<i>Anabena sp.</i>	++	++	+
<i>Spirulina</i>	+	-	+
<b>Euglenophyceae</b>			
<i>Euglena</i>	+++	+++	++
<b>Zooplanktons</b>			
<b>Protozoa</b>			
<i>Euglena viridis</i>	+++	+	++
<i>Euglena acus</i>	++	-	+
<i>Paramecium caudatum</i>	+++	-	+
<i>Amphileptus</i>	+	+	+
<i>Vorticella sp.</i>	+++	++	+
<b>Rotifera</b>			
<i>Brachionus</i>	-	+	-
<i>Rotaria sp.</i>	+	+	+
<i>Philodina sp.</i>	++	-	+
<b>Cladocera</b>			
<i>Daphnia sp.</i>	+	+	-
<i>Simocephalis sp.</i>	++	+	-
<b>Copepoda</b>			
<i>Cyclops sp.</i>	+++	-	-

Note: Abundant (+++); Rare ( ++); Common (+); Absent (-)

The occurrence of *Chlorophyceae* was observed dominant group during monsoon season. *Ulothrix*, *Oedogonium*, *Spirogyra* and *Cladophora* were the dominating species during monsoon season at each site in Gomti river. Diatoms-*Navicula-viridula sp.* were maximum in monsoon and *Pleurasigma normanni sp.* and *Nitzschia palea sp.* were maximum in winter season.

The *N.viridula sp.*, *P. normanni sp.*, *Synedra*, *Achnanthes exigua* were commonly observed in summer season. Mrutyunjay *et al.* (2006) reported 78 taxa of bacillariophyceae from different fresh water habitates of Orissa and its neighbouring regions . Rashmi *et al.* (2011) reported four spp. of diatoms in Galta Kund, Jaipur, concluded that the diatoms attains maximum growth

during the winter season and gradually declines in summer to reach its minimum during the rainy season. *Oscillatoria* was observed as dominating species in winter season and members of *Cynophyceae* as *Nostoc*, *Anabena*, *Spirulina* commonly observed in summer and monsoon season respectively. *Oscillatoria* was rare in monsoon season.

In the present study planktons diversity was recorded higher range at upstream (Gaughat) and low at downstream (Pipraghat). Minimum productivity of phytoplanktons were observed at site-D (Nishatganj bridge) that may be due to maximum anthropogenic activities like disposal of solid waste, bathing, washing. The minimum count of phytoplanktons may be due to low content of nutrients. At site-D, diversity of zooplanktons was reported maximum. During the present study a varied fluctuation of zoo- and phytoplanktons density in different season were observed. Almost similar finding were noted by Saha *et al.* (2000) in sewage pollution, Calijuri *et al.* (2002) in a tropical and eutrophic reservoir, Pathani and Mathar (2006) in river Suyal of Uttranchal, Sharma *et al.* (2007) in hill stream Chandrabhaga of Garhwal Himalaya.

Nafeesa Begum *et al.* (2010) reported the seasonal study of phytoplanktons diversity and pollution indicator in Bathi pond. Ahmed *et al.* (2010) also observed seasonal variation of planktons density in Gomti river and concluded that the zooplankton and phytoplankton population increased during monsoon and post monsoon season due to high nutrient flow. The present study indicate that highest phytoplanktons population in monsoon season (800 In/l) due to velocity of water high in rainy season. It has been monitored during the study time the water current above the moderate speed is usually directly inhibitory to plankton development. Malik and Bharti (2012) reported the status of plankton diversity of Sahastradhara stream at Uttarakhand. It appeared that phytoplanktons was found to dominant over zooplankton. Chakraborty *et al.* (1959) and Pahwa and Mehrotra (1966) reported maximum density of phytoplanktons. The fluctuation in occurrence of planktons and abundance can be a major indicator of the environmental status of any water body like planktons. Almost many scientist reported this type of finding in various habitats. Rout and Gaur (1994) in a forest stream at Shillong, Cantonati *et al.* (2001) in Nanda Devi Biosphere reserve India. The present study revealed that population density of different biotic community including phyto- and zooplanktons in river Gomti were affected with the variations of abiotic factors either directly or indirectly.

#### ACKNOWLEDGEMENTS

The authors are highly grateful to University Grant

Commission, New Delhi for financial support to carry out the present research work and also thankful to Supervisor, Dr. Sanjive Shukla & Head, Brijendra Singh PG Department of Zoology, BSNVPG College Lucknow for providing necessary laboratory facilities.

#### REFERENCES

- Ahmad, T. and Sharma, A.K. (2009). A study of fresh water protozoans with special reference to their abundance and ecology. *Journal of Applied and Natural Sciences*, 1(2): 166-169.
- Ahmad T., Paul, N. and Sharma, A.K. (2010). Seasonal variations of zooplankton and phytoplankton density in Gomti river and ponds of Lucknow. *Aquacult.*, 11(2): 207-213.
- Angadi, S.B., Shiddamallayya, N. and Patil, P.C. (2005). Limnological studies of papnash pond, Bidar (Karnataka). *J. Environ Biol.*, 26: 213-216.
- Bansal, N.R., Naokarni, V.B. and Gourder, B.Y.M. (1989). Ecology of zooplankton of supra reservoir of Kalirner during the filling phase, Karnataka. *J. Fresh water Biol.*, 1(1): 15-23.
- Bhatt, L.R., Lacoul, P., Lekhal, H.D. and Jha, P. K. (1999). Physico-chemical characteristic and phytoplanktons for Taudha lake, Kathmandu. *Poll Res.*, 18(4): 353-358.
- Bhowmick, B.N. and Singh, A.K. (1985). Phytoplanktons population in relation to physico-chemical factors of river Ganga at Patna. *Indian J. Ecol.*, 12 (2): 360-364.
- Bwala, R.L., Soloman, I. O., Olarewaju, A. and Abdullahi, H. (2010). Preliminary study on the limnology and plankton abundance in relation to fish production in some Niffi reservoirs. *Report and Opinion*. 2(6): 9-15.
- Calijuri, M.C., Santos, D.O.S. and Jati, S. (2002). Temporal changes in the phytoplanktons community structure in a tropical and eutrophic reservoir. (Barra Bonita, S.P. Brazil). *J. of Plankton Research*, 24: 617-634.
- Cantonati, M., Corradini, G. and Singh, D. (2001). Aquatic macroinvertebrate diversity in Nanda Devi Biosphere Reserve India. *Environmentalist*, 24: 211-221.
- Chakraborty, R.D., Roy, P. and Singh, S.B. (1959). A quantitative study of plankton and the physico-chemical condition of the river Yamuna at Allahabad in 1954-55. *Indian J. Fish.*, 61: 186-208.
- Das, M. and Panda, T. (2010). Water quality and phytoplankton population in sewage fed river of Mahanadi, Orissa. *India. J. Life Sci.*, 2(2): 81-85.
- Gautam R. and Gautam, R.K., (2011). Zooplanktons diversity at sursarovar (Keetham) lake, Agra. *Aquacult.*, 12 (1): 73-77.
- Isabella Percopo, Raffaello Siano, Federica Cerino, Diana and Adriana Zingone (2011). Phytoplankton diversity during the spring bloom in the North Western Medirerranean sea. *Botanica Marina*, 54: 243-267.
- Malik, D.S. and Bharti, U. (2012). Status of plankton diversity and biological productivity of Sahastradhara stream at Uttarakhand, India. *Journal of Applied and Natural Science*, 4 (1): 96-103.
- Misra, K.N. and Ram, S. (2007). Comprehensive study of phytoplanktonic community growing in polluted ponds of Janupur city (U.P.). *J. Phytol Res.*, 20(2): 317-320.
- Misra, S.M., Pani, S., Bajpai, A. and Bajpai, A. K. (2001).

- Assessment of tropical status by using Nygaard index with reference to Bhoj wetland. *Pollution Res.*, 20(2): 147-153.
- Misra, V.C. (2000). Ecological investigation of river Gomti under the influence of municipal wastes of Jaunpur city. *Ph.D. thesis, Jaunpur* : VBS. Purvanchal University.
- Mrutyunjay, J., Ratha, S. K. and Adikary, S. P. (2006). Diatoms (Bacillariophyceae) from Orissa state and neighbouring regions, India. *Algae*, 21(4): 377-392.
- Nafeesa Begum, Narayana, J. and Sayeswara, H.A. (2010). A seasonal study of phytolanktons diversity of pollution indicators of Bathi pond near Davangere city, Karnataka (India). *Environment conservation Journal*, 11(3): 75-80.
- Nautiyal, P. (1986). Studies on the riverine ecology of the torrential waters in Indian uplands of Garhwal region. Floristic faunistic survey. *Trop.Ecol.*, 27: 157-165.
- Ojha, P., Mandloi, A.K. and Dube, K.K. (2007). Diel variations of physicochemical parameters influences zooplanktons fluctuations in a small irrigation reservoir. Bamoo (Jabalpur,MP). *J. Natcon*, 19(2): 375-385.
- Pahwa, D.V. and Mehrotra, S.(1966). Observation in the abundance of plankton in relation to certain hydrobiological condition of river Ganga. *Proc. Natl. Acad Sci.* 36 (2): 157-89.
- Pathani, S.S. and Mathar, S. (2006). A study of population of planktons in river Suyal of Uttranchal, India. *Flora and Fauna*, 11(2): 250-256.
- Pilkaityte, R.(2003). Phytoplanktons seasonal sucession and abundance in the eutophic estuarine lagoons. *Doctoral dissertation thesis, Klaipeda*.pp 97.
- Rashmi, P., Singh,G.P. and Singh, R. (2011). Some fresh water diatoms of Galta Kund,Jaipur, India. *Journal of Soil Sciences and Enviromental Management*, 2 (4): 110-116.
- Rout, J. and Gaur, J.P.( 1994). Composition of dynamics of epilithic algae in a forest stream at Shillong (India). *Hydrobiologia*, 291 : 61-74.
- Saha, S.B. ,Bhattacharya, S.B. and Choudhary, A. (2000). Diversity of phytoplanktons of a sewage pollution brackish water tidal ecosystem. *J.Env.Biol.*, 21(1): 9-14.
- Shaikh, J.D., Shaikh, T.T., Kamble, U.P., Jadha,T.J. and Malik Kazim (2012). Studies on some free living protozoan from Salim Ali Lake,Aurangabad. *International Multidisciplinary Research Journal*, 2 (6):27-29.
- Sharma, A. , Sharma, R.C. and Anthwal, A. (2007). Monitoring phytoplankton diversity in the hill stream chandrabhaga of Garhwal Himalaya. *Life Science Journal*, 4:80-84.
- Shishodia, S.K. (1988). Ecological studies of upper Ganga. Identification and representation of the state of the river. Ph.D. Thesis submitted to the University of Roorkee, India.
- Stevenson, R.J. and Pan, Y. (1999). Assessing environmental conditions in river and streams using diatoms In: Stoermer E.F. and Smol, J.P.(eds.). *The diatoms applications for the environmental and earth Sciences*, Cambridge, University Press, Cambridge, University Press, Cambridge :11-40.
- Yeole,S.M. and Patil, G.P. (2005). Physicochemical status of Yedshi lake in relation to water pollution. *J.Aqsua.Biol*, 20:41-45.