Biolife AN INTERNATIONAL QUARTERLY JOURNAL OF BIOLOGY & LIFE SCIENCES 2(3):825-833

ISSN (online): 2320-4257
www.biolifejournal.com

BIOLIFE RESEARCH ARTICLE

POPULATION DYNAMICS OF MALACO FAUNAL ASSEMBLAGE

Sanindhar Shreedhar Gaikwad[1]* and Nitin Anandrao Kamble[2]

[1,2] *Department of Zoology, Shivaji University, Kolhapur- 416 004, (MS) India*

E-mail: sanindhargaikwad@rediffmail.com

ABSTRACT

Malaco fauna is the second largest and richest fauna after insect. It is globally distributed and acquired every possible niche of the planet earth except aerial one. It has numerous economic characteristics, amongst which bioindication is remarkdly important. Numbers of molluscan species were utilized world widely as biomonitoring agents, because of its sedentary and sessile nature. The present investigation aimed to describe the population dynamics of the molluscan fauna along with contamination level of the region. In order to describe the ecological conditions and its impact over the spatial distribution assessments of different physicochemical parameters were carried out. We conclude eight molluscan species representing six families. Species richness, abundance and evenness were evaluated in order to elucidate the diversity profile of the malaco fauna at the region. Physicochemical parameters were noted with significant variations and showed its remarked impact over the spatial and temporal distribution of the molluscs.

Key words: Molluscs, Species richness, Species abundance, Pollution indices.

INTRODUCTION

Invertebrates are a ubiquitous and diverse group of long-lived species that react strongly and often predictable to human influences in aquatic ecosystem. Most of them are sedentary; therefore, their body burden reflects local conditions, allowing for detection of a variety of perturbations in a range of aquatic habitats (Rosenberg, 1993). Benthic invertebrates are important and integral part of any aquatic ecosystem, as they form the basis of the tropic level. Any negative effects caused by aquatic contamination in the community structure can in turn affects tropic relationships among the species.

Invertebrates are biological elements required for the classification of biological status of the water body (Timm, 2008). Community studies, among invertebrate provides the standard for assessment and alteration in community occurrence (Champman, 2005). The abundance of benthic fauna greatly depends upon physical and chemical properties of substratum. Invertebrate communities changes in response to habitat alteration and physicochemical factors. The biotic structure and water quality of river reflects on ecological integration. Molluscs are common, highly visible and commercially important group of animals. Worldwide about 50,000 living and 60,000 fossilized molluscan species were recorded (Bursca, 1990). Members of phylum mollusca found abundantly in freshwater, marine water and on land (Barnes, 1980). Water quality has major influence over molluscan composition, abundance and distribution (Boesh *et al*., 2004, Karnkowska, 2011 and Filippenko, 2011).

Molluscs became prime model to use as biomonitoring agents, b'coz of its sedentary and sessile life style, along with benefit of quick assessment of biological resources to obtain the pollution indices (Miserendino, 2001 & Ikomi *et al*., 2005). In addition, aquatic invertebrates have ability to clean river water as they utilizing the organic and detritus matter from food chain.

Figure-1. Location of the sampling stations from Panchganga river, Kolhapur, Maharashatra, India.
(Sampling statrions:1-Prayag-Chikhali, 2- Shivaji bridge, 3- Rukdi, 4- Narsobawadi, 5- Ichalkaranji).

According to Carlisle *et al*. (2007), population of macro-invertebrate in rivers gives an opportunity for the assessment of pollution status of aquatic body.

Due to easy availability with clear differentiation of molluscan fauna throughout the world, animals belonging to phylum mollusca were grossly studied for evaluation of water quality. Indian subquantinants includes four major riverine systems as North, South, East and West, including major rivers Ganga, Yamuna, Brahmaputra, Krishna, and Kaveri etc., enriched by floral and faunal diversity. River Panchganga, Kolhapur, Maharashtra, India is lifeline and important resource for providing water for agricultural and industrial development. However, the river receives untreated effluents from many urban settlements and industrial discharges, so now it is badly polluted. As a result, life of aquatic flora and fauna is under threat so, there is need of assessment of pollution to prevent the extinction of the species within short period.

By considering present status of river, investigation has carried out for the contamination evaluation and its impact over the molluscan diversity, species richness, abundance, evenness from study region.

MATERIALS AND METHODS

Study area:
River Panchganga originated at Prayag Sangam-Chikhli, Kolhapur, Maharashtra, India- 16 º 31' N and 74 º 36'E selected as study area for present investigation. Stretch of river is of 81 km (50 mi.), from which five sampling stations were selected viz. Prayag-Chikhli, Shivaji bridge, Rukdi, Narsobawadi and Ichalkaranji (Figure- 1).

Quantitative analysis:
Molluscan species were collected by simple hand picking method, from all along the marginal area and sandy substratum. Samplings were carried out up to depth of 1 to 2 meters from water level. Stratified random quadrate sampling method was applied for quantitative assessment of molluscan fauna at selected sampling stations (Christian, 2005). However, five replicates at each sampling stations were performed to overcome the problem of random sampling. All the species were carried to laboratory, cleaned neatly and used for identification by referring standard published photographs, literature etc. (Zoological Survey of India, 1989).

Analysis of pollution status:
Water samples were collected monthly from selected sampling stations. Environmental variables in the water column as pH, Temperature, Total Solids (TS), Total Suspended Solids (TDS), Dissolved Oxygen (DO), Free Carbon Dioxide (CO_2), Total Alkalinity (TA), Total Hardness (TH), Total Chlorides (TC), Inorganic Phosphate (IP) and Nitrates were analyzed during the period of June, 2010 to May, 2011. Fluctuations in the environmental variables were interpreted for describing its correlation with faunal diversity, richness and abundance, from selected sampling stations.

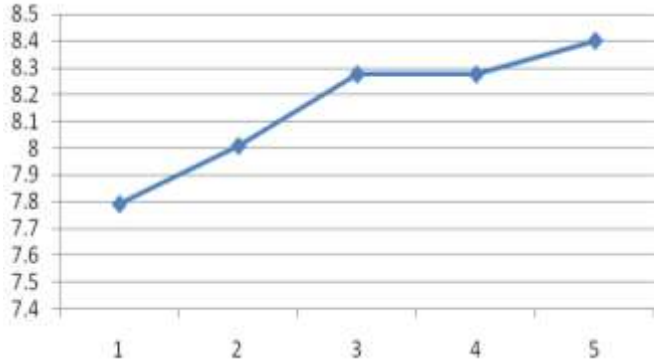
Statistical analysis:
Statistical analysis of quantified data was carried out by calculating various index as Shannon-Weaver Index (1963), Simpson Index (1949) and Evenness Method (Pielu, 1969) to interpret species richness, species abundance. All the variables were statistically analyzed and graphically interpreted.

RESULTS

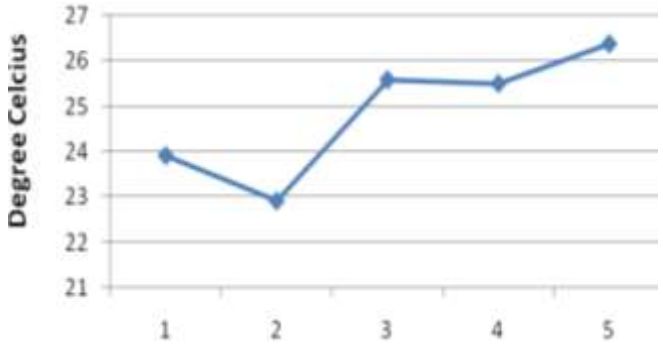
Present investigation provides overall assessment of different sampling area and effect of anthropogenic activities on molluscan fauna from different catchment area of river Panchganga. Seasonal variations with abundance of molluscan fauna by the effect of physicochemical parameters were observed**.** During the present investigation, the average range of alkaline pH varied between minimum of 7.7 to maximum of 8.4 was noted. The seasonal fluctuation in temperature was recorded as minimum of 23 ^{0}C to maximum of 26 ^{0}C.

Figure-2(a-d): Average environmental variables of water column from five sampling stations of Panchganga river.

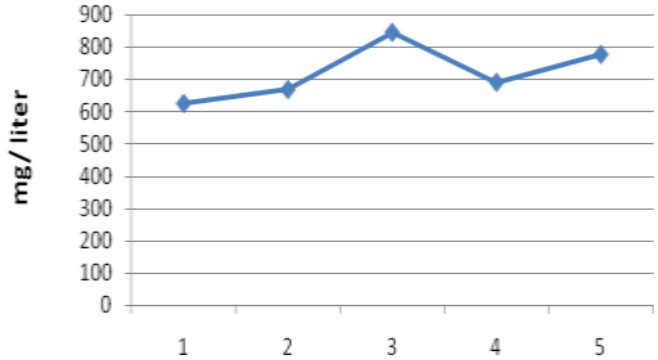
a-pH



b-Temperature



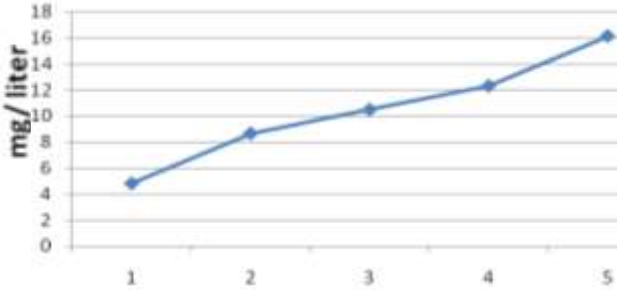
c-Total Solids



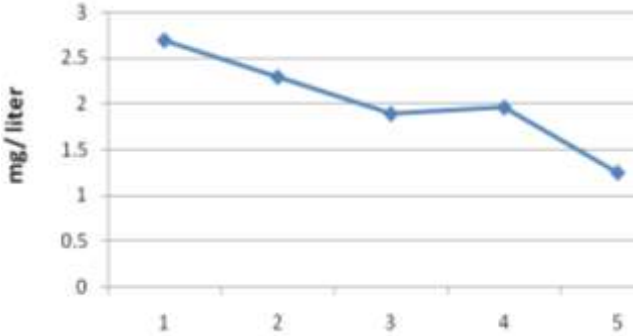
d-Total Dissolved Solids

Figure-2(e-h): Average environmental variables of water column from five sampling stations of Panchganga river.

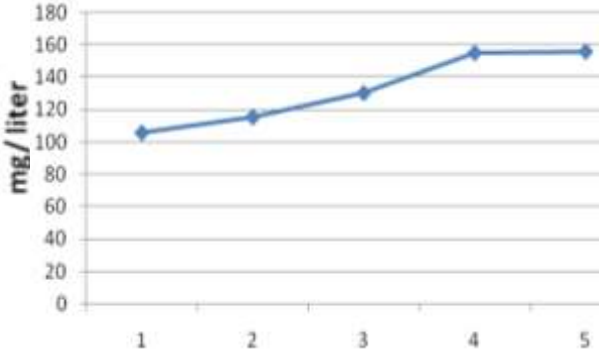
e-Dissolved Oxygen



f-Free Carbon Dioxide



g-Total Hardness



h-Total Alkalanity

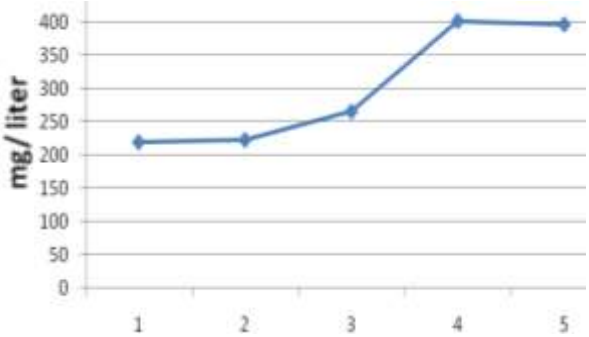
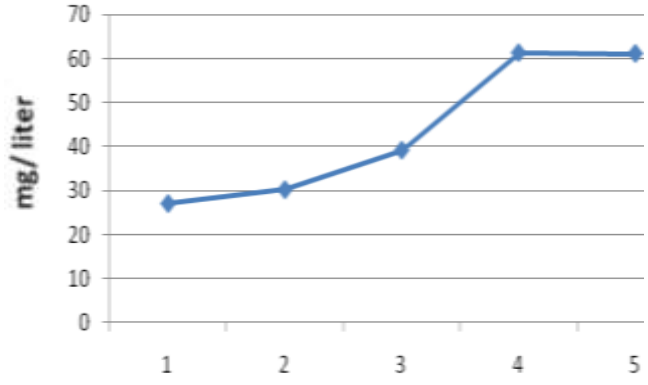
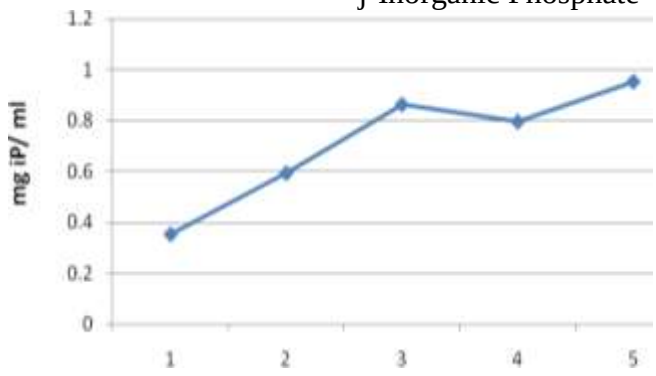


Figure-2(i-k): Average environmental variables of water column from five sampling stations of Panchganga river.

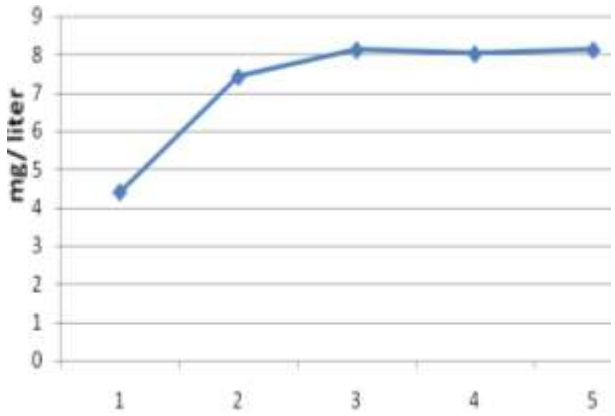
i-Total Chlorides



j-Inorganic Phosphate



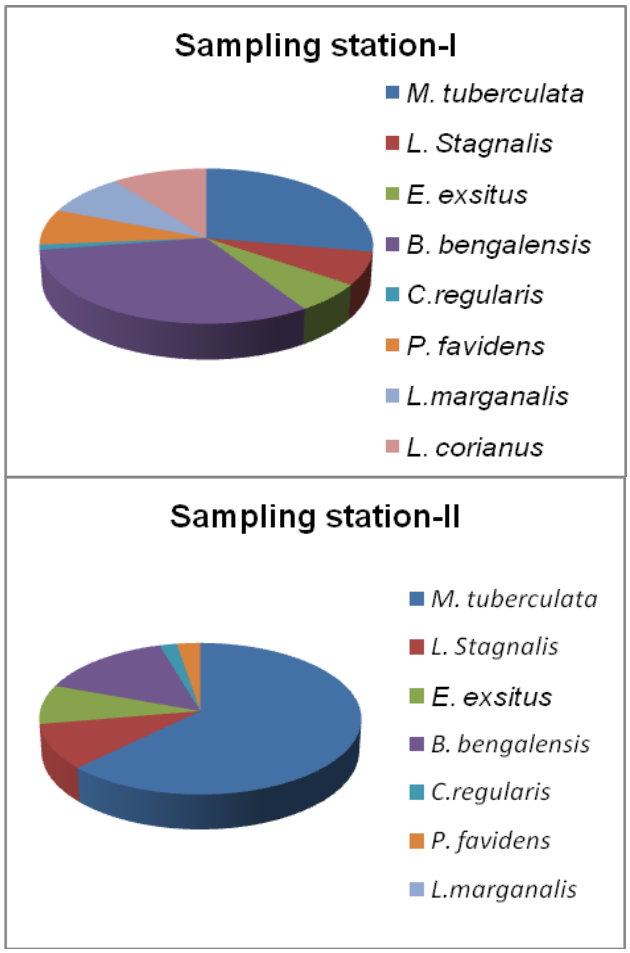
k-Nitrates

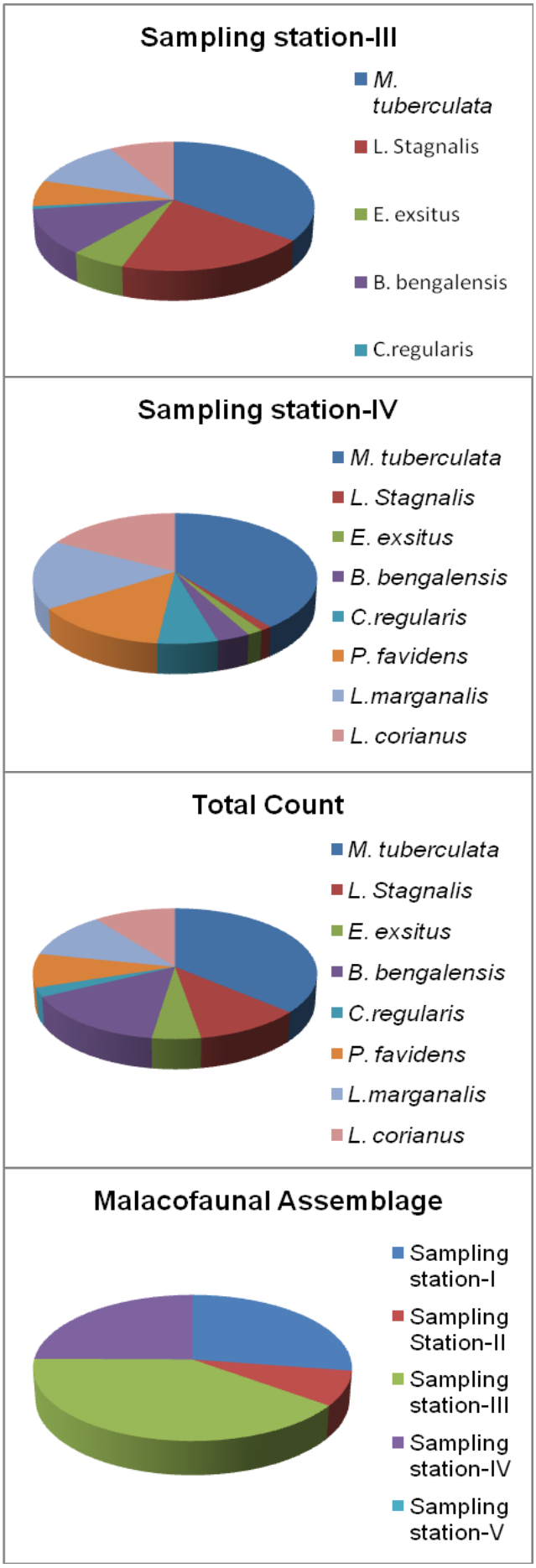


Seasonally varied TS and TDS were recorded as minimum of 626 mg/ liter, 845 mg/ liter and maximum of 478 mg/ liter, 386 mg/ liter respectively. Suitable factor DO was noted with minimum of 1.8 mg/ liter to maximum of 2.6 mg/ liter. Regulating factor CO_2 was characterized by minimum of 4.8 mg/ liter to 16.1 mg/ liter. TH was observed with minimal level of 106 mg/ liter to maximum of 155 mg/ liter. TA was recorded with minimum of 219 mg/ liter to maximum of 400 mg/ liter. Parameters like TC, IP and Nitrates marked with seasonal variations with minimum of 27 mg/ liter, 4.4 mg ip/ ml, 4.4 mg/ liter and maximum of 61 mg/ liter, 0.95 mg ip/ ml, 8.1 mg/ liter respectively (Figure-2,a-k).

During the assessment period of June, 2010 to May, 2011, total 2003 (two thousand three) individuals belonging to six different families were identified (Figure-3).

Figure-3 : Average population dynamics measured with Simpson Index, Shannon Index and Evenness at selected sampling stations of Panchganga river.





Melanoides tuberculata (Family- Tharidae) was noted as dominant species throughout the sampling stations with abundance of 43.33 %. *Lymnea stagnalis* (Family- Lymnidae) was also noted with higher dominance after *Melanoides tuberculata* and with abundance of 10 %. All other molluscan species- *Endoplanorbis exsitus* (Family- Planorbidae), *Bellemya bengalensis* (Family- Viviparidae), *Parreysia favidens* (Family- Uninoidae), *Lamellidens marginalis*

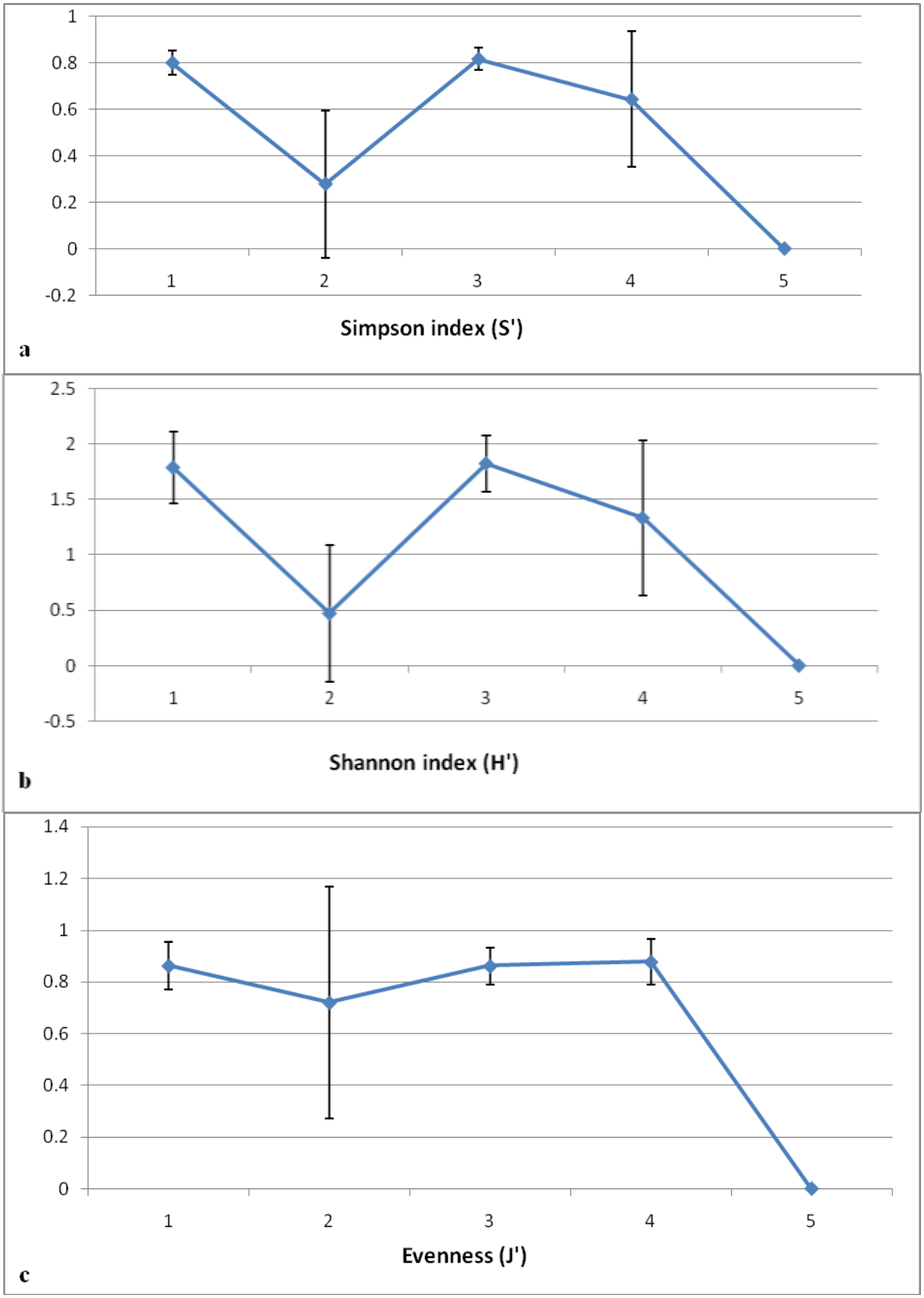
(Family- Uninoidae) and *Lamellidens* corrianus (Family- Uninoidae) were recorded with average dominance and abundance of 7.33 %, 8.66 %, 8.33 %, 8.33 % and 7.33 % respectively. *Corbicula regularis* was observed as least abundant species with abundance of 6.66 % during the study period (Figure-3).

Faunal diversity of Prayag-Chikhali and Narsobawadi was noted with average Simpson Index as 0.8, 0.6 with evenness of 0.8, representing its average diversity and uniform distribution. As per Shannon Index, species abundance at Prayag-Chikhli and Narsobawadi was 1.7 and 1.3 respectively. Sampling station Rukdi observed with maximum Simpson Index as 0.8, Shannon Index as 1.8 and Evenness of 0.8, presenting it as richest molluscan diversity station, with higher abundance and distribution. Shivaji bridge was observed, with minimum count of Simpson Index, Shannon Index and Evenness as 0.2, 0.4 and 0.7 respectively, representing it's least species composition. Ichalkaranji noted as unfavorable for species availability due to its grossly polluted water (Figure-4 a,b and c).

DISCUSSION

Molluscs are likely to be affected by direct physical stress and unavailability of habitat with ample amount of food. Quantitative assessment showed that, among mollusca *Melanoides tuberculata* was dominant species, due to its rigid nature for tolerating wide range of pH and hardness. These adaptations made it capable to occupy all niche as previously mentioned by Clement (2005). Our results for diversity profile with Simpson Index, Shannon Index and

Fig. 4 : Average species composition of malacofauna at selected sampling stations from Panchganga river.



Evenness found resembling with molluscan diversity profiles made by Umeozov (1994), Ansa (2005), Zabbey (2002) and Sikoki (2006) from some rivers. It astonishes that, common availability of bivalve species *Corbicula regularis* was least recorded during the assessment period. The most common reason for decline of *Corbicula regularis* may be competition within species, lack of host fish species and intolerance to seasonal variations with anthropogenic activities. We feel that, due to unavailable conditions this species reaches towards extinction gradient from the river basin. Freshwater molluscan snails *Bellemya bengalensis* and *Lymnea stagnalis* were noted with average dominance and abundance 10% and 8.66% respectively of overall population. These species were noted as rigid species as found able to tolerate wide range of fluctuation in environmental parameters. Bullnid snail *Endoplanorbis exsitus* and Uninoid bivalves' *Parreysia favidens, Lamellidens marginalis, Lamellidens corrianus* showed least dominance, with average percent abundance. Sampling stations Prayag-Chikhli, Rukdi and Narsobawadi were recorded suitable sampling stations due to its higher quantified diversity and species abundance.

Whereas, Shivaji bridge was noted as unsuitable sampling station for faunal diversity and abundance. Molluscan fauna was not found at Ichalkaranji. Recorded information relate with non-random pattern of distribution of molluscan fauna, which is common in nature as previously mentioned by Wright (1992), Saronia et al (2013), Wright el al., (1998) and Cook (1995).

Species diversity, richness and abundance of molluscan fauna in the study region compared with environmental variables found greatly affected by Temperature, pH and Hardness. Average temperature ranges between 24 ^{o}C to 27 ^{o}C was noted as suitable for the development and enrichment of molluscan fauna. Average alkaline pH ranges between 7.8 to 8.4 were observed suitable for flourishing the molluscs. Maximum hardness ranges between 100 to 160 mg/liter as $CaCO_3$ was recorded, found suitable for ideal development of molluscan fauna as previously mentioned by Okland (1982). Higher hardness was described as most favorable environmental parameter as it provides large amount of calcium content, which helps molluscs to mature and reproduce faster (Clement, 2005). Dissolved Oxygen and Free Carbon dioxide was noted as regulating factors, due to its vice versa mechanism. Higher DO and less CO_2 was noticed as favorable, whereas higher CO_2 and less DO was noted as limiting factor, for the development of molluscs. TS, TDS, TA, TC, IP and Nitrate were recorded with very little or no impact on species composition. Prayag-Chikhli and Shivaji bridge were observed with less pH, Temperature, TS, TDS, CO_2, TH, TA, TC, IP and Nitrates along with high amount of DO. Hence, noticed unpolluted with average species composition. Rukdi and Narsobawadi were noted with average pH, Temperature, TS, TDS, CO_2, TH, TA, TC, IP, Nitrates and DO. So, it was noted as most suitable sampling station with moderate amount of pollution. Whereas, Ichalkaranji was remarked with higher pH, Temperature, TS, TDS, CO_2, TH, TA, TC, IP and Nitrates along with less amount of DO, which implies its maximum pollution status and hence became unsuitable for availability of molluscan fauna.

Seasonal variations in the physicochemical parameters along with population dynamics of molluscan fauna indicates that, Panchganga river basin at all sampling stations recorded to be polluting or polluted and became unsuitable for availability and survivality of molluscan fauna. Increasing pollution status of river, imbalances the aquatic food chain. Therefore, it is the correct time to take efforts towards minimization of water contamination and conservation of faunal diversity in the study region. The work is in progress.

ACKNOWLEDGEMENT

The authors are thankful to Science and Engineering Research Board, New Delhi for providing the financial support under Young Scientist Fast track Major Research Project. The authors are also thankful to Head Department of Zoology, Shivaji University, Kolhapur for

providing infrastructural facilities for the progress of work.

REFERENCES

1. Ansa E. J., 2005. Studies of the benthic macro fauna of the Andoni flats in the Niger Delta Area of Nigeria. Ph.D. Thesis University of Port Harcourt, Port Harcourt, Nigeria, 2-42.
2. APHA , 1998. Standard methods of examination of water and wastewater. 20th Edn. American Public Health Association, AWWA and WPCF, Washington DC, USA., 1213.
3. Barnes R. D., 1980. Invertebrate Zoology, Fifth Edition. Saunders College Publishing. New York, New York, 342-464.
4. Boesh G, et al., 2004. Composition and distribution of benthic molluscs on intertidal flats of Paranagua Bay (Parana, Brazil). Scientia Marina 68 (4): 537-543.
5. Bursca R.C. and Brusca G.J., 1990. Invertebrates Sinauer Associates, Inc. Sunderland, Massachusetts.
6. Carlisle D. M. et al., 2007. Estimation and application of indicator values for common macroinvertebrate. Ecol. Indicators, 7: 22-33.
7. Chapman P. M. and Anderson J., 2005. Integrated Environmental Assessment and Management 1: 163-173.
8. Christian A.D. and Harris J. L., 2005. Development and assessment of a sampling design for mussel assemblages in large streams. American Midland Naturalist. 153: 284-92.
9. Clements G. R. and Li D., 2005. Occurrence and distribution of Primary Freshwater Molluscs in Singapore.
10. Cook R.F. and Quinn J. F., 1995. The influence of colonization in nested species subsets. Oecologia 102: 413-424.
11. Filippenko D., 2011. Fauna of gastropod molluscs in the Curonian Lagoon Littoral biotopes. Malacologia 10: 79-83.
12. Ikomi,R. B. et al., 2005. Composition, distribution and abundance of macro invertebrates of the upper reaches of River Ethiope Delta State, Nigeria. The Zoologist 3: 68-81.
13. Karnkowska E. J., 2011. Effect of habitat conditions on the diversity and abundance of molluscs in floodplain water bodies of different permanence of flooding. Polish Journal of Ecology 59(1): 165-178.
14. Miserendino M. L., 2001. Ecologia Austral (Argentina) 11: 3-8.
15. Okland J., 1982. Factors regulating the distribution of freshwater snails in Norway, Malacologia 22: 277-288.
16. Pielu E.U., 1969. An introduction to mathematical ecology. Wiley, New York.
17. Rosenberg D. and Resh V., 1993. Freshwater Biomonitoring and Benthic macro invertebrates. Chapman hall publication.
18. Saroniya, D. N. Saksena and N. S. Nagpure. 2013. The morphometric and meristic analysis of some *puntius* species from central India. Biolife. 1(3), 144-154.
19. Shannon C.E. and Weaver W., 1963. The Mathematical Theory of Communication. University of Illinois, Urban Press, Illinois, 177.
20. Sikoki F.D. and Zabbey N., 2006. Environmental gradients and benthic community of the middle reaches of Imo River, South-Eastern Nigeria. Environmental Ecology 24 (1): 32-36.
21. Simpson E.H., 1949. Nature 163, 688.
22. Timm H., 2008. Verh. International Verein. Limnology 30: 138-148.
23. Umeozor O.C., 1995. Benthic fauna of New Calabar River, Nigeria. Tropical Freshwater Biology 4: 41-51.
24. Wright D. H., 1992. Reeves On the meaning and measurement of nestedness of species assemblages. Oecologia 92: 416-428.
25. Wright D. H., et al., 1998. Comparative analysis of nested subset pattern of species composition. Oecologia 113: 1-20.
26. Zabbey N., 2002. An ecological survey of benthic macro invertebrates of Woji Creek, of the Bonny River System Rivers State. M.Sc. Thesis, University of Port Harcourt, 102.

DOI: http://dx.doi.org/10.17812/blj2317
Received: 5 July 2014;
Accepted; 17 August 2014;
Available online : 6 September 2014