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RESEARCH ARTICLE

STUDY ON ZOOPLANKTONS AND WATER PRODUCTIVITY OF DIFFERENT LAKES IN JAMMU DIVISION, INDIA

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ABSTRACT

Introduction: Mansar and Surinsar Lake are the two important subtropical Lakes in Shivalik Hills of Jammu Province have been recognized as Ramsar Site owing to the rich diversity of both producer and consumers. The comparative study on water productivity of these two Lake had not been done yet. This study carried out to evaluate the productivity level of Mansar and Surinsar Lake as well as identification of different species of zooplankton. **Method:** Water samples are collected from both Lakes (Mansar and Surinsar) in the month of April in 2018 for productivity. The primary organic production of the river water was determined by 'light and dark bottle method'. The zooplankton was observed under a microscope with 400X magnification and their number could be countered by using Sedgewick rafter cell under a microscope. **Results:** The investigation showed that the collected sample of water from both the Lakes having the valve of NPP between the 50-250 mgl/m/hr. The value of NPP shows that the water of these two Lakes is coming under Oligotrophic i.e. Nutrients content is less. Few species of zooplanktons are found which comes under the group Protozoa (2 sps.), Rotifers (1 sps.), Cladocera (2 sps.), Copepoda (2 sps.) and Arthropoda (1 sp.). **Conclusion:** The productivity of these two Lakes is directly correlated with zooplanktons productions, which are less in number. Presence of less number of zooplankton might be due to the pollution level is higher. The environment of these Lakes are not suitable for the cultivation of fishes and therefore, some steps should be taken for up gradation of the Lakes water quality, so that, faunal community or biodiversity of the Lakes may sustain properly.

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INTRODUCTION

A Lake is an area filled with water, localized in a basin that is surrounded by land, apart from any river or another outlet that serves to feed or drain the Lake. The majority of Lakes on earth is fresh water, and most lies in the northern hemisphere at higher latitudes (Lehner and Doll, 2004). Study of basin bodies of water and their related ecosystem called limnology. Term Limnology classified the Lakes into three zones: the littoral zone, a slide area near to land; the photic or open-water zone, where there is more sunlight: and the deep-water profundal or benthic zone, where little sunlight found (Kalff, 2002). Based on the mode of their origin, they are either natural or man-made. The natural Lakes are in turn classified into Tectonic Lakes formed by tectonic activity of the earth; e.g. Lake Tso Moriri and Pangong Tso, Volcanic Lakes are formed by volcanic eruption, Glacial Lakes formed on the surface of glaciers, within glaciers, and in valleys blocked by glacial ice, many Lakes at high altitudes in the Himalayas region are glacial Lakes; e.g. Chandratal, Fluvial Lakes formed by the meandering of rivers; e.g. oxbow Lakes that may remain periodically connected with the river or may be completely separated; e.g. Kabar Tal, Surahatal. Among other types of Lakes, the Aeolian Lake is formed in depressions where surface flow checked by sediment brought by the wind; e.g. Sambhar Lake, Meteorite Lake is formed by the impact of meteorites; e.g. Lake Lonar. Tectonic, Volcanic and Glacial Lakes have many different forms (Gopal, 2010; Nie *et al*., 2013; Li *et al*., 2015; Worni *et al*., 2013). In India, most Lakes are found in the Himalayan region and in floodplains of Indus and Brahmaputra which are the natural Lake that is less in number (Kumar *et al.*, 2006; Chandrakiran and Sharma, 2013; Zubair and Ahrar, 2013). However, most of the water bodies have been made over millennia in the semi-arid and western and peninsular arid region of India. The very oldest man-made Lake in India, dating back to 300 B.C. was 'Sudarshan' in Gujarat's Girnar area. In the middle of 11th century, India's largest artificial Lake was constructed with embankment across two hills at Bhojpur, near Bhopal.

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There are many different types of man-made Lakes are found in some part of the country. For example, about 400 Lakes in Hyderabad and 645 water bodies within Ahmadabad urban development Area is present (Gopal, 2010; Alves *et al*., 2009; Thompson, 2010; Zhu *et al*., 2015). On the basis of water chemistry, Lakes are classified. They are freshwater, Brackish or saline Lakes. They may be as Oligotrophic (very low nutrients), Mesotrophic (moderate nutrients), Eutrophic (highly nutrients rich) on the basis of nutrient content. In India mostly Lakes are eutrophic or mesotrophic (Gopal, 2010). Also, the Lakes are also classified as on their geographic or climate of the region, they may be valley Lake, high altitude Lake, Forest Lake. Often Lakes are classified on the basis of a physiographic factor in India, they described as Himalayan Lake, Lake of arid and semi-arid regions, Lakes of Ganga Brahmaputra floodplain, Peninsular Lakes and coastal Lakes (Gopal, 2010). In Jammu and Kashmir state many Lakes, rivers, and ponds are present but we can profoundly focused on two Shiwalik Lakes of Jammu division which comes under the Udhampur district in Shivalik hill region. Lake Surinsar, an important subtropical Shiwalik Lake of the Udhampur district in Jammu division also along with other Lake Mansar has been recognized as Ramsar site known for its rich diversity of both autotrophs and heterotrophs (Slathia and Dutta, 2009). The Shiwalik Lakes are believed to have originated as many years ago (Zutshi and Khan, 1977). These both Shivalik Lakes are the lifeline for the civilized people of that area. The bottom sediments of the Lake are of the clayey sandy type with rich humus content. The Surinsar and Mansar Lake are oval to sub-oval in shape. They both are the non-drainage type. The Mansar and Surinsar Lakes are situated in the sub-tropical Himalayas region. The annual rainfall in the area is around near about 1500 mm (Singh *et al*., 2008). Surinsar and Mansar Lake are known for many aquatic life forms which diversely present in Lakes.

Study on zooplankton and water productivity of these two Lakes (Mansar and Surinsar) had not been done by any Ecologist yet. The water productivity parameter is making us know the overall productivity of these Lakes. Here, productivity is the total rate of production of biomass. By using wrinkler's method we can find out the productivity of water sample which we are taken from these two Lakes. Main objectives are under the comparative study of productivity of water of these two Lakes; identification of zooplankton from the water sample of both Lakes; and to know the ecological importance of both Lakes.

MATERIALS AND METHODS

Study Area: Lake Mansar, revered for being the seat of Sheshnag, is a sub-tropical, beautiful, rural Lake located between 7505′11.5″to 7505′12.5″E longitude and 32040′58.25″to 32040′59.25″N latitude at an elevation of 665 meters in the east of Jammu city. The Lake is a sub-oval in shaped, closed water system with no any surface channels flowing into it. The Lake receives freshwater from the subterranean springs and surface run-off. The Lake is surrounded by 700-800m tall hills forming an evergreen canopy of diverse plant and animal species (Kumar and Singh, 2006). Lake Surinsar (750 02’ 30″ E and 320 46’ 30″ N), the present area of study, is picturesque sweet water Lake and holds importance due to it's priceless historical, cultural and ecological possessions. Located about 23-25 Km north-east of Jammu city at an elevation of 605m above mean sea level, Lake is oval in shape with a deep notch towards its northwest. The main source of water being rain is also aided by the presence of natural springs within the Lake. The Lake presently is under tremendous biotic pressure and change due to increased human and cattle population in the catchment along with the increase in tourist influx which has resulted in changes in its physical, chemical and biological characteristics. The sample for productivity and study of zooplanktons are collected from these Lakes (Slathia and Dutta, 2013).

Water sampling analysis: Water samples are collected from both Lakes (Mansar and Surinsar) in the month of April, May in 2018 for productivity. Collection of samples for measuring the Dissolved Oxygen (DO) was taken in between from 6 A.M. to 10 A.M. from the surface of the pond water, depth 0.5m to 1 m containing no bubbles (Majumder *et al*., 2015). Samples are collected from two different sites i.e. from north and south direction of both the Lakes. The primary organic production of the river water was determined by ‘light and dark bottle method’ (Garder and Green, 1972). Water sample collects in three different bottles named as initial, light bottle (LB) and dark bottle (DB) having a 1-liter volume of each for productivity. Here, DB must be covered with dark cloth or polythene cover so sunlight not reached to water sample anymore and photosynthesis not occur in that sample.

Water productivity calculation: Gross Primary productivity (GPP), the Net Primary Productivity (NPP) and Respiration were calculated in the following manner:

$$\text{Gross Primary Productivity} = \frac{\text{LB-DB}}{\text{T}} \times \frac{0.375}{\text{PQ}} \times 1000 \text{ mg/L/h}$$

$$\text{Net Primary Productivity} = \frac{\text{LB-IB}}{\text{T}} \times \frac{0.375}{\text{PQ}} \times 1000 \text{ mg/L/h}$$

$$\text{Respiration} = \frac{\text{IB-DB}}{\text{T}} \times \frac{0.375}{\text{RQ}} \times 1000 \text{ mg/L/h}$$

Where: LB = Light bottle, DB = Dark bottle, IB = Initial bottle, T = Time of incubation, PQ = Photosynthesis Quotient = 1.25, RQ = Respiratory Quotient =1 and the value 0.375 represents a constant to convert Oxygen value to Carbon Value (Thomas *et al.,* 1980).

Identification of Zooplankton: The sample for zooplanktons study from both Mansar and Surinsar Lakes are collected in two different bottles. Zooplankton samples were also collected in the months of April and May in the year of 2018. Samples were collected using thin net especially made for zooplankton collection about two feet in length with 64 µM mesh size. The net is slowly lowered down the water up to 5 meters sieving 706 L of water (Jose *et al*., 2015). The water sample is collected on plastic bottles in the lab for the identification of Zooplanktons. The zooplanktons were observed under a microscope with 400X magnification and their number could be countered by using Sedgewick rafter cell under a microscope (Jose *et al*., 2015).

RESULTS AND DISCUSSION

The productivity of fresh water of Mansar and Surinsar Lake of Himalayas hill region has been not done by any ecologist yet.

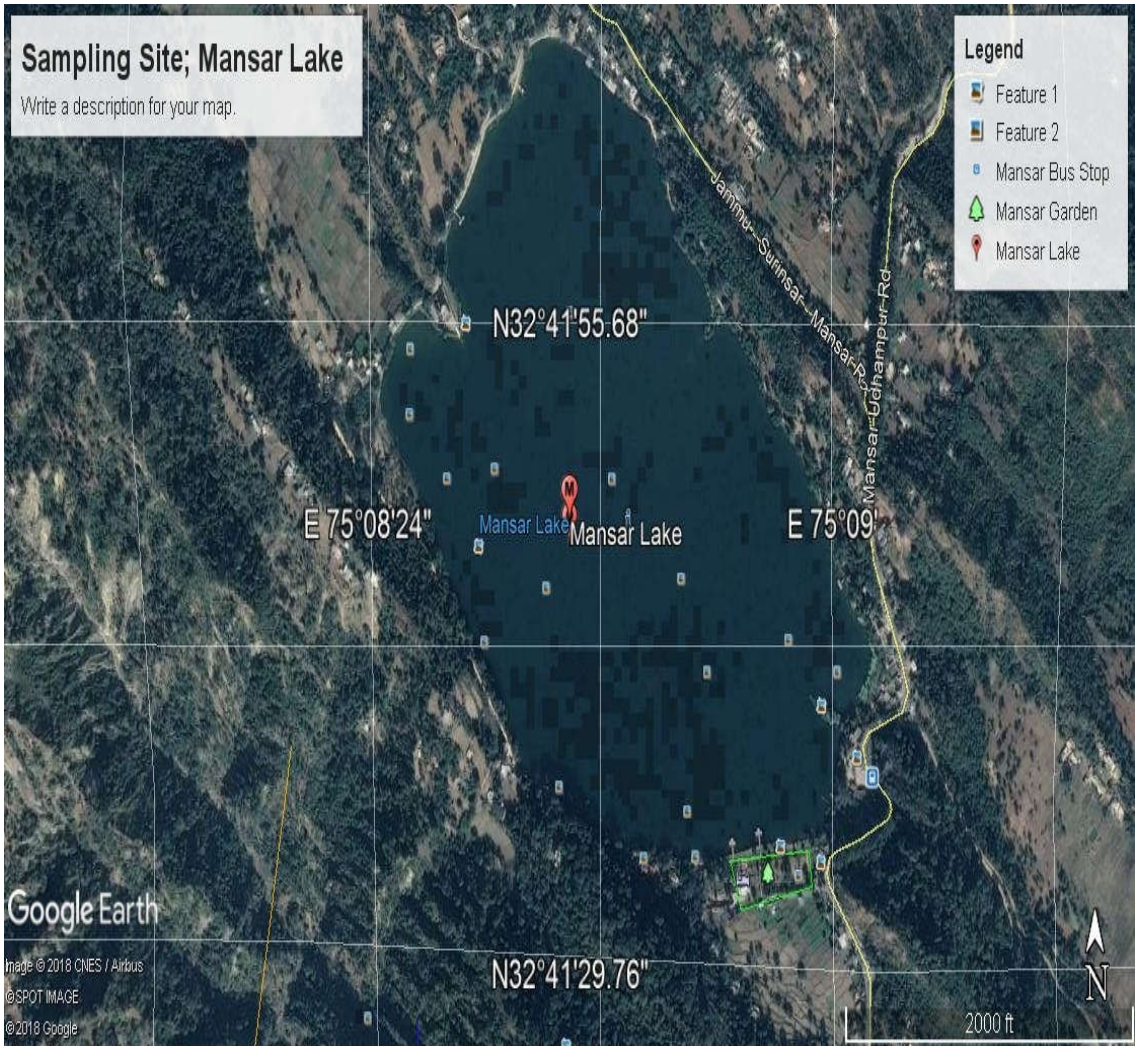

Figure 1. Sampling Map of Mansar Lake by Google 3D Earth Software

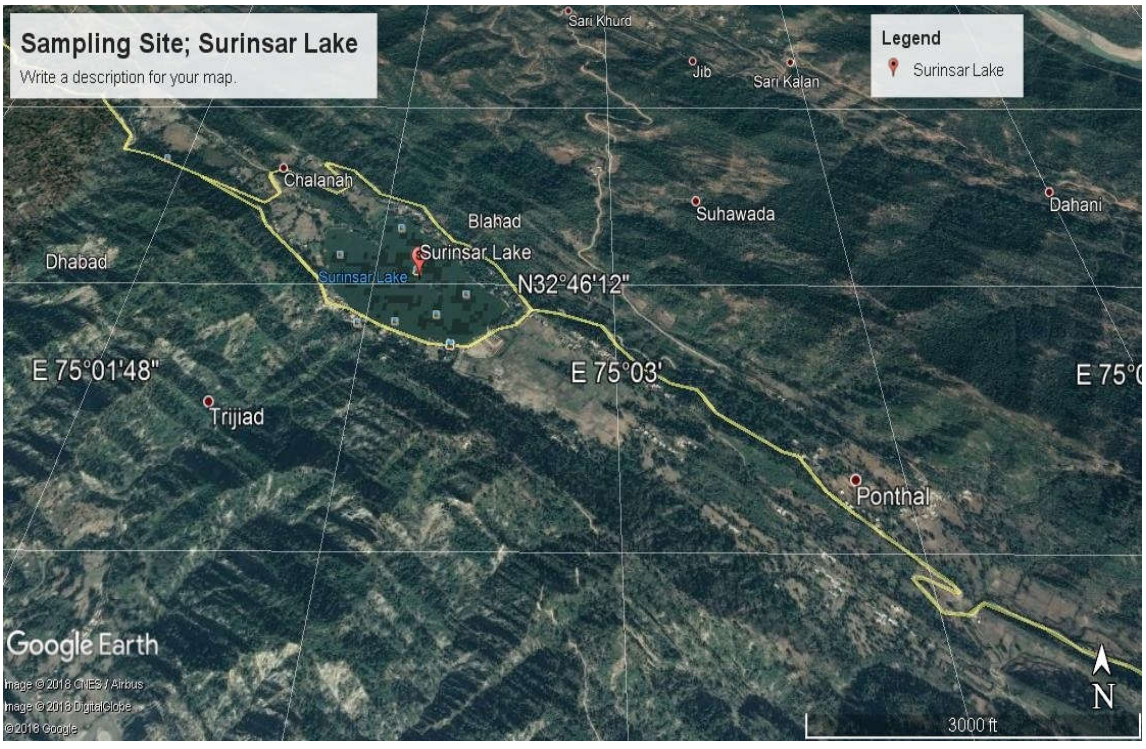

Figure 2. Sampling Map of Surinsar Lake by Google 3D Earth Software

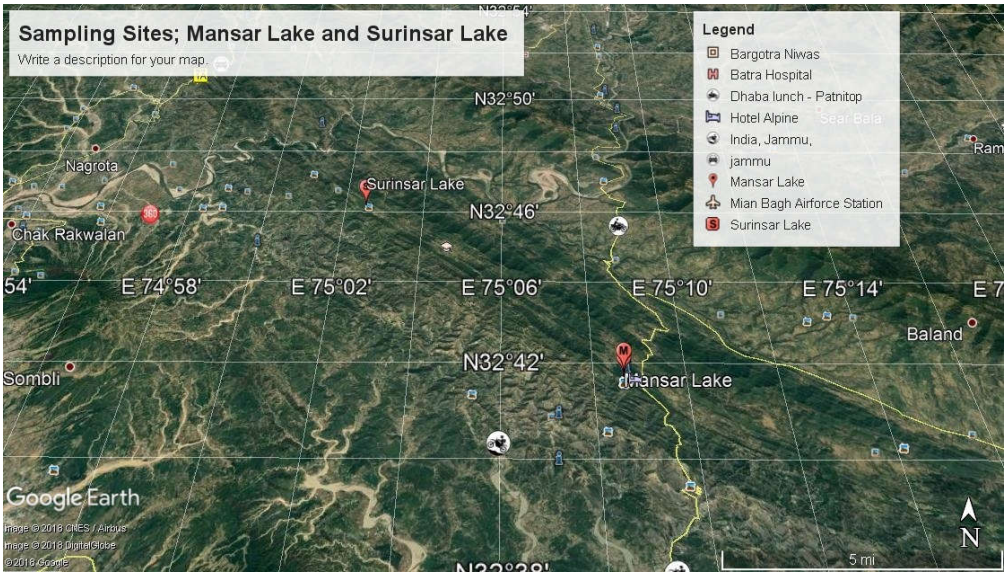

Figure 3. Sampling Map of Mansar and Surinsar Lake by Google 3D Earth Software

Table 1. Water Sample Analysis for measurement of productivity after taking the initial and final readings

Sample	Number of Readings	Initial readings	Final readings	Volume used (ml)
Surinsar Spot 1	Initial bottle			
	1	0	0.9	0.9
	2	0.9	1.6	0.7
	3	1.6	2.4	0.8
	Light bottle			
	1	2.4	3.5	1.1
	2	3.5	4.4	0.9
	3	4.4	5.6	1.2
	Dark bottle			
	1	5.6	6.4	0.8
	2	6.4	7.0	0.6
	3	7.0	7.5	0.5
Surinsar Spot 2	Initial bottle			
	1	0	0.6	0.6
	2	0.6	1.3	0.7
	3	1.3	1.8	0.6
	Light bottle			
	1	1.8	2.8	1.0
	2	2.8	3.7	0.9
	3	3.7	4.5	0.8
	Dark bottle			
	1	4.5	5.0	0.5
	2	5.0	6.1	0.6
	3	6.1	6.6	0.5
Mansar Spot 1	Initial bottle			
	1	6.6	7.5	0.9
	2	7.5	8.3	0.8
	3	8.3	9.2	0.9
	Light bottle			
	1	9.2	10.4	1.2
	2	10.4	11.7	1.3
	3	11.7	12.7	1.0
	Dark bottle			
	1	12.7	13.4	1.2
	2	13.4	14.0	1.3
	3	14.0	14.6	1.0
Mansar Spot 2	Initial bottle			
	1	14.6	15.2	0.6
	2	15.2	16.1	0.9
	3	16.1	16.9	0.8
	Light bottle			
	1	16.9	17.8	0.9
	2	17.8	19.4	1.4
	3	19.4	20.5	1.1
	Dark bottle			
	1	20.5	21.0	0.5
	2	21.0	21.6	0.6
	3	21.6	22.1	0.5

Table 2. Level of GPP, NPP and R of different sites of two lakes

S. No.	Samples	GPP	NPP	R
1	Mansar spot 1	156.25mgl/m^3/hr	75mgl/m^3/hr	l97.5mgl/m^3/hr
2	Mansar spot 2	187.5mgl/m^3/hr	125mgl/m^3/hr	75mgl/m^3/hr
3	Surinsar spot 1	143.75mgl/m^3/hr	81.25mgl/m^3/hr	75mgl/m^3/hr
4	Surinsar spot 2	125mgl/m^3/hr	93.75mgl/m^3/hr	37.5mgl/m^3/hr

Table 3. Level of Zooplanktons in two lakes

Zooplankton Species	Mansar Lake	Surinsar Lake
Protozoans		
Amoeba sp.	Present	Present
Vorticella sp.	Absent	Present
Rotifers		
Branchinous sp.	Present	Present
Cladocera		
Daphnia sp.	Present	Absent
Bosmina sp.	Present	Present
Copepoda		
Ectocyclops sp.	Present	Present
Mesocyclops sp.	Present	Present
Arthopoda		
Nauplius	Present	Absent

The valve for the productivity of water from Surinsar, spot 1 areas GPP=143.75 mgl/m^3/hr, NPP= 81.25 mgl/m^3/hr, and R=75 mgl/m^3/hr. The valve of NPP ranges between 50-250 mgl/m^3/hr which shows that it comes under Oligotrophic. Similarly, the value of spot 2 are as GPP=125 mgl/m^3/hr, NPP=93.75 mgl/m^3/hr, R=37.5 mgl/m^3/hr, which again comes under Oligotrophic. The value of productivity from Mansar Lake, at spot 1 GPP=156.25 mgl/m^3/hr, NPP=75 mgl/m^3/hr, R=97.5 mgl/m^3/hr, which comes under Oligotrophic nutrition. At spot 2, the value of GPP=187.5 mgl/m^3/hr, NPP=125 mgl/m^3/hr, R=75 mgl/m^3/hr that comes under Oligotrophic. Some of the studies were supported by the findings of this work. A number of studies have been reported in the area Lake investigations (Zutshi, 1989). Zutshi *et al*. (1980) reported that the Lakes of Jammu and Kashmir are different in their quality of water. Physical, chemical and biological features of Mansar Lake have been studied by Zutshi (1980), and Gupta (2009). Rai *et al*. (2001) performed studies on bathymetry, sedimentation rate and water quality of the Mansar (Singh and Jain, 2013).

Some species of zooplankton are also identified which are mostly protozoan and crustacean. At Mansar Lake few species of zooplanktonic fauna are found on which species of *amoeba* sp*., Daphnia* sp., and *Vorticella sp.* are identified in their collected samples. This finding is similar to the results of other studies (Kinne, 1997). Sehgal (1980) also observed two species viz*. Difflugia* sp. and *Centropyris* sp. from Lake Surinsar. The overall zooplankton population was very low in these two Lakes and it might be due to the lower productivity level of Lakes (Sosnovsky, 2007). Zooplanktons studies on the Lakes of Himalayas region (Mansar and Surinsar) showed that few species of protozoan, identified in Lake Surinsar, have shown the qualitative dominance of class Sarcodina. Zooplankton also is known as the bio-indicator of water body. Zooplankton (consumer) depends upon phytoplankton that is known as produce. These are found less in number in Mansar Lake as it is affected by pollution. Zooplankton plays a major role in the functioning and the productivity of aquatic ecosystems through its impact on the nutrient dynamics and its key position in the food webs (Ismail and Adnan, 2016; Trishala *et al*., 2016; Yang *et al*., 2017; Gianuca *et al*., 2016; D'Alelio *et al*., 2016).

Conclusion

Water sample which is collected from these two Lakes for finding productivity of water shows that water of these both Lakes comes under the Oligotrophic i.e. value of NPP lies between 50-250 mg/m^3/hr, which shows that nutrition level of these Lakes is very less. Mostly Oligotrophic Lakes are clear, deep and have large algae blooms. Though beautiful, they are low in nutrients and do not supports fish populations in large quantity but fishes in Mansar Lake, where mostly carps which are found in large number. Though, oligotrophic Lakes are capable to develop a food chain process for sustaining a very desirable fishery of large game fish. So, this shows that water from these two Lakes is less usable for drinking purpose by near civilized people.

Mansar Lake and Surinsar Lake in NW Himalayas are also the sources of fresh water to support the civilization and biodiversity of that area. Thus, the contamination in the water or imbalance in the chemistry of the Lake and pond has been always proved as the main source of epidemics in the area. Besides drinking facility, the Lake provides a heavy flush of water for the agriculture practice and livestock of the area. This study indicates that the productivity level of both Lakes is very critical level. The environment of these Lakes are not suitable for the cultivation of fishes and therefore, some steps should be taken for up gradation of the Lakes water quality, so that, faunal community or biodiversity of the Lakes and ponds may sustain properly.

Conflict of Interest: The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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REFERENCES

Alves RR, Mendonça LE, Confessor MV, Vieira WL, Lopez LC. 2009. Hunting strategies used in the semi-arid region of northeastern Brazil. *J Ethnobiol Ethnomed.*, 5: 12.

Chandrakiran KK. Sharma, R. Sharma School of Natural Resources, University of Nebraska Lincoln- Lincoln, NE-68503, United States Department of Zoology, Faculty of Life sciences, University of Jammu, JandK, INDIA-180006, India

D'Alelio D, Libralato S, Wyatt T, Ribera d'Alcalà M. 2016. Ecological-network models link diversity, structure and function in the plankton food-web. *Sci Rep.*, *6:* 21806.

Garder TG and Green HH. 1927. Investigation of the production of plankton in the Osio Ford. Rapp. *Process-Reunions council pernt.Intern.Exploration.*, 42: 1-48.

Gianuca AT, Pantel JH, De Meester L. 2016. Disentangling the effect of body size and phylogenetic distances on zooplankton top-down control of algae. *Proc Royal Society B: Biol Sci.*, 283: 20160487.

Gopal B. 2010. Ex-professor, Jawaharlal Nehru University, New Delhi, M. Sengupta (former advisior), R.Dalwani (Director), S.K. Shrivastava (Dy Director), Ministry of environment and forest, New Delhi.

Gupta P, Vishwakarma M, Rawtani PM. 2009. Assesment of water quality parameters of Kerwa dam for drinking suitability. *Int J Theoretical and Appl Sci,* 1: 53-55.

Ismail AH and Adnan AAM. 2016. Zooplankton Composition and Abundance as Indicators of Eutrophication in Two Small Man-made Lakes. *Trop Life Sci Res.*, 27: 31–38.

Jose EC, Furio EF, Borja VM, Gatdula NC, Santos MD. 2015. Zooplankton Composition and Abundance and its Relationship with Physicochemical Parameters in Manila Bay. *Oceanography*, 3: 136.

Kalff J. 2002. Limnology: Inland Water Ecosystems. Upper Saddle River, NJ: Prentice-Hall.

Kinne O. 1997. Ethics and eco-ethics. M*ar Eccol Progr Ser.,* 153: 1-3.

Kumar V, Rai SP, Singh O. 2006. Water Quantity and Quality of Mansar lake in the Himalayan Foothills, India. *Int J Lake Res Manag.,* 22: 191-198.

Lehner B and Doll P. 2004. Development and validation of a global database of lakes, reservoirs and wetlands. *J Hydrol.,* 296: 1–22.

Li Z, Fan K, Tian L, Shi B, Zhang S, Zhang J. 2015. Response of Glacier and Lake Dynamics in Four Inland Basins to Climate Change at the Transition Zone between the Karakorum and Himalayas. *PLoS ONE*, *10:* e0144696.

Majumder S, Patra A, Dutta TA, Goswami R. 2014. Physico-chemical parameter influenced Zooplankton diversity in some ponds of south western part of Bankura town of WB, India. *Int J Adv Res.,* 2: 1146-1157.

Nie Y, Liu Q, Liu S. 2013. Glacial Lake Expansion in the Central Himalayas by Landsat Images, 1990–2010. *PLoS ONE*, *8:* e83973.

Rai SP, Kumar V, Singh O, Kumar B, Jain SK. 2001. Limnological Study of the Mansar Lake, District Udhampur, JandK. Final Project Report, NIH, WHRC, Jammu Cantt.

Sehgal HS. 1980. Limnology of Lake Surinsar, Jammu, with reference to Zooplankton and fishery prospects. Ph.D. Thesis submitted to Deptt. of Biosciences. University of Jammu, Jammu.

Slathia D and Dutta SPS. 2009. Limnology of Lake Surinsar, Jammu, JandK: Part I – Protozoa. *J Appl Nat Sci.,* 1: 141-148.

Sosnovsky A. 2007. Factores que determinan la estructura del zooplancton en pequeños cuerpos de agua de la Región Pampeana. Ph.D. Dissertation, Universidad de Buenos Aires, Buenos Aires, Argentina

Thomas PA, Abraham T, Abraham KG. 1980. Observation on the primary productivity of Sasthamkotta lake. In: Alexender KM*etal. (eds.) J Environ Biol Trivandram, 1-7.*

Thompson LG. 2010. Climate Change: The Evidence and Our Options. *The Behavior Analyst*, *33:* 153–170.

Trishala KP, Deepak R, Agrawal YK. 2016. Bioindicators: the natural indicator of environmental pollution. *Frontiers in Life Sci.,* 9: 110-118.

Worni R, Huggel C, Stoffel M. 2013. Glacial lakes in the Indian Himalayas--from an area-wide glacial lake inventory to on-site and modeling based risk assessment of critical glacial lakes. *Sci Total Environ.,* 1: 468-469.

Yang J, Zhang X, Xie Y, Song C, Zhang Y, Yu H, Burton GA. 2017. Zooplankton Community Profiling in a Eutrophic Freshwater Ecosystem-Lake Tai Basin by DNA Metabarcoding. *Sci Rep.*, 7: 1773.

Zhu L, Lü X, Wang J, Peng P, Kasper T, Daut G, Mäusbacher R. 2015. Climate change on the Tibetan Plateau in response to shifting atmospheric circulation since the LGM. *Sci Rep.*, 5: 13318.

Zubair SM and Ahrar AH. 2013. Characterization of Abiotic Status of Lake Mansar at Surinsar- Mansar Ramsar Site In The NW Himalayas". *Int J Sci Technol Res.,* 2: 50-65.

Zutshi DP and Khan MA. 1977. Limnological investigation of two subtropical lakes. *Geobios.,* 4: 45-48.

Zutshi DP, Subia, A, Khan, MA, Wanganeo W. 1980. Comparative limnology of nine lakes of Jammu and Kashmir Himalayas. *Hydrobiologia.,* 72: 10l-1I2.

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