Eco. Env. & Cons. 28 (February Suppl. Issue) : 2022; pp. (S322-S327)
Copyright@ EM International
ISSN 0971–765X

DOI No.: http://doi.org/10.53550/EEC.2022.v28i02s.053

Hydrobiological Study of Lotic Water of Yamuna River at Yamuna Nagar, Haryana, India during 2018-2019

Babita and Sushil Kumar Upadhyay*

Department of Biotechnology, Maharishi Markandeshwar (Deemed to be University) Mullana-Ambala 133 207, Haryana, India

(Received 3 May, 2021; Accepted 24 July, 2021)

ABSTRACT

The current study deals with hydrobiological examination of lotic water of Yamuna river at Yamuna Nagar, Haryana, India to assess the oscillation in the physico-chemical parameters. The monitoring of water quality parameters was performed consecutively during; July, 2018 to June, 2019. The month wise onsite thermal examination, and titrimetric/ volumetric estimation of collected water samples showed seasonality biased pattern throughout the investigation. The mean value of water temperature (°C), dissolved oxygen (mg/l), pH, hardness (mg/l), alkalinity (mg/l) and acidity (mg/l) ranged between 11.9–29.5 °C, 3.4–7.0 mg/l, 6.3–7.6, 111.25–170.75 mg/l, 64.06–122.0 mg/l and 12.57–25.29 mg/l respectively. The monthly possible source of factors responsible for the spatial fluctuations in the hydrobiological parameters of riverine water was assessed through the advanced numerical tools. The observation reflected the requirement of urgent and systematic management strategies to overcome these invisible scarce and conserve the natural quality of incredible water resources.

Key words: *Lotic ecosystem, Yamuna river, Hydrobiological parameters, Physicochemical quality, Invaluable water resources.*

Introduction

The river Yamuna is an important perennial river of the Indo-Gangetic plains and largest tributary of river Ganges. The river Yamuna is a 1376km long river and runs from Yamunotri, Uttrakhand to river Ganga, Prayagraj, Uttar Pradesh. The lotic water river Yamuna get polluted due to wastes discharged from agricultural pesticide, domestic wastes area, detergents, sewage outlets, industrial effluents, etc. (Kulshrestha *et al.*, 1991; Srivastava *et al.*, 2003, 2009; Krishan *et al.*, 2016; Yadav *et al.*, 2016; Singh *et al.*, 2019). Therefore, riverine water in turns affect distribution, richness, biology, ecology, health, and survival of aquatic flora and fauna of the river along with human beings (Usha and Ramalingam, 2006; Hasan *et al.*, 2007; Upadhyay, 2012). Clean and wholesome water is required for several purposes for healthy living (Akhter and Brraich, 2020). Rivers are ideally considered as one of the important natural resource for the development of human civilization and is being polluted by various sources *e.g.* disposal of agricultural wastes, sewage, industrial waste etc., ultimately affecting its physico-chemical and microbiological quality (Malhotra *et al.*, 2009; Upadhyay *et al.*, 2013; Jaiswal *et al.*, 2014). River Yamuna has been well known as a holy river in Indian mythology and various pilgrimage centers e.g. Yamunotri (Uttaranchal), Paonta Sahib (Himachal Pradesh), Mathura (Uttar Pradesh), Vrindavan (Uttar Pradesh), and Prayagraj (Uttar Pradesh) are situated at the banks of this river (Upadhyay *et al.*, 2015; Kumar and Upadhyay, 2016; Rout, 2017; Upadhyay, 2017). Major urban centers *e.g.*, Yamuna

Nagar, Sonepat, Delhi, Gautam Budh Nagar, Faridabad, Mathura, Agra etc. are also setup on its banks (Tiwari and Chauhan, 2006; Lavaniya *et al.*, 2015; Kumar *et al.*, 2016). The holy river Yamuna is subjected to many uses for community such as bathing, domestic water supply, irrigation, and disposal of sewage and industrial effluents (Rout, 2017; Upadhyay and Singh, 2018; Babita *et al.*, 2019). River ecosystems are most vulnerable habitats and likely to be altered by the anthropogenic inputs (Hasalam, 1991; Upadhyay, 2012; Lavaniya *et al.*, 2016; Upadhyay *et al.*, 2019). The physico-chemical analyses of river water provide a good indicator of the physical as well as chemical state of the river ecosystem (Chopra *et al.*, 2009; 2012; Upadhyay, 2012; Jaiswal *et al.*, 2014; Upadhyay, 2017). Therefore qualitative and quantitative analyses of different types of water quality parameters can be used to assess the pollution status (Jaiswal *et al.*, 2013; Singh *et al.*, 2019; Upadhyay *et al.*, 2020). Keeping this in view the study was under taken to assess the physico-chemical characteristics of lotic water in river Yamuna at three selected sites of district Yamuna Nagar (Haryana), India.

Materials and Methods

The present study was carried out during July, 2018 to June, 2019 with monthly collection of water sample from three selected sites (Near Yamuna bridge, Dadwa-Fatehpur and Dadupur) to study the hydrobiological parameters of Yamuna river, in district Yamuna Nagar, Haryana (Fig. 1). The water samples were collected weekly in sampling bottles and the date, time, and place recorded carefully to avoid mixing of samples from different sites. The onsite pH and temperature of river water was measured by using digital pen pH meter and thermometer respectively. The water samples for dissolved oxygen (DO) estimation were collected separately in DO sampling bottles (Upadhyay, 2012). The hydrobiological parameters including dissolved oxygen (modified Winkler's method), hardness, alkalinity, and acidity were estimated in Laboratory of Biotechnology Department, Maharishi Markandeshwar (Deemed to be University), Mullana-Ambala through titrimetric/ volumetric analysis after APHA (1998, 2001). The month wise oscillations in physico-chemical parameters of lotic water and its correlation were assessed using advanced numerical tools and SYSTAT-11.

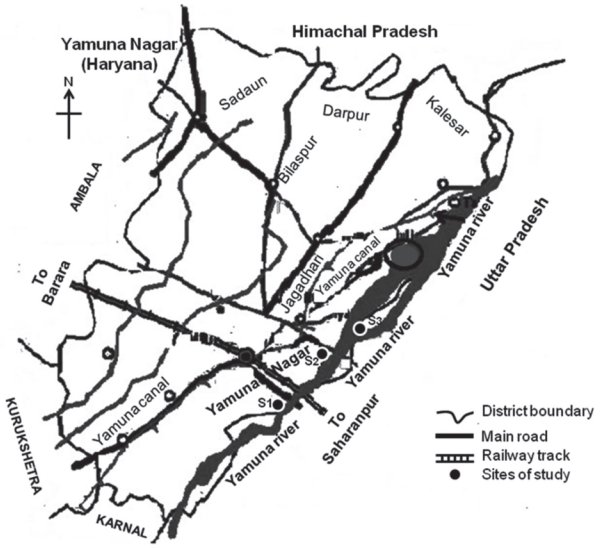

Fig. 1. The district map of Yamuna Nagar showing sites (S_1, Near Yamuna bridge; S_2, Dadwa-Fatehpur; S_3, Dadupur) of sample water collection from river Yamuna (*Map not to scale bar*).

Results and Discussion

The hydrobiological parameters worked out *in vitro* and *in situ* using standard protocol during investigation was provided in Table 1. The mean peak water temperature (29.5375±4.81°C) was recorded during late summer and early monsoon period. However, the maximum dissolved oxygen concentration (7.03±1.35mg/l) and abrupt decline (3.40± 1.52mg/l) was recorded during mid winter (January, 2019) period (Fig. 2). It was evident that the quality of an aquatic ecosystem not only depends upon physiochemical quality of water but also on biological diversity of the system (Ghavzan *et al.*, 2006a,b; Tiwari and Chauhan, 2006; Tas and Gonulol, 2007). It was noticed that the reduced dissolved oxygen concentrations inversely proportional to the organic matter suspended in the water reservoirs (Rim-Rukeh and Awatefe, 2006; Sharma *et al.*, 2016). According to Indian Council for Medical Research (ICMR) the recommended level of dissolved oxygen in river should be greater than 5.0 mg/l (ICMR, 1975; CPCB, 2000), however, Chopra *et al.* (2012) found the mean concentration of dissolved oxygen below 5.0 mg/l in river Yamuna. Thus the dissolved oxygen decreases and biochemical oxygen demand (BOD) increases by the addition of pollutants in river water due to organic matter decompo-

Table 1. Physico-chemical examination of lotic water of river Yamuna, Yamuna Nagar (HR) during July, 2018 to June, 2019 (Mean±SD).

Months, Year	Temperature (°C)	pH	DO (mg/L)	Hardness (mg/L)	Alkalinity (mg/L)	Acidity (mg/L)
July, 2018	29.6±4.8	6.29±0.14	5.19±0.22	138.13±4.58	72.63±13.02	12.57±1.99
August, 2018	27.3±4.7	6.39±0.12	7.03±1.35	128.50±15.84	93.75±22.64	13.29±1.50
September, 2018	25.7±4.5	6.59±0.10	6.90±1.06	118.88±12.36	82.50±17.53	17.86±4.10
October, 2018	25.6±2.7	6.71±0.11	5.65±0.81	130.50±12.47	109.38±17.41	20.57±2.99
November, 2018	22.7± 4.0	6.78±0.12	5.25±0.44	125.38±42.91	97.50±8.86	19.85±3.34
December, 2018	17.3±3.7	6.80±0.11	4.80±1.05	123.25±12.06	101.88±45.83	23.71±2.29
January, 2019	11.9±2.5	6.71±0.17	3.40±1.52	148.00±20.90	122.00±18.57	20.43±4.86
February, 2019	16.5±1.9	6.93±0.13	3.46±0.63	111.25±27.58	96.88±9.61	15.00±2.38
March, 2019	17.4±1.4	7.23±0.16	4.66±0.55	124.63±24.93	96.88±10.33	15.29±3.04
April, 2019	23.2±2.7	7.31±0.11	5.99±1.23	154.75±6.80	75.75±14.15	24.29±2.14
May, 2019	22.1±1.7	7.62±0.36	4.78±0.18	170.75±6.88	68.38±15.98	25.29±5.03
June, 2019	23.8±1.8	7.26±0.24	5.11±0.42	149.88±12.88	64.06±18.99	24.71±3.73

Where: SD, Standard Deviation; DO, Dissolved Oxygen; mg/L, Milligram per Liter

sition and vice versa by the self-purification process of river (Chopra *et al.*, 2012; Upadhyay, 2012). The dissolved oxygen showed negative correlation with free CO_2 and water temperature evident from the present investigation corroborated to the earlier findings (Upadhyay *et al.*, 2014; Jaiswal *et al.*, 2014; Upadhyay, 2017; Upadhyay *et al.*, 2020). The positive association in pH and dissolved oxygen was also evident during present investigation (Fig. 2). The pH was found to range between 6.1–8.2 (6.80±0.27) during whole study corroborated to Bhatnagar and Sanghwan (2009) who found that pH decline if there is discharge of waste into river and pH remains alkaline throughout their study period.

The hardness was estimated between 111.25–170.75 mg/l (148.63±11.51 mg/l) with single peak during May, 2019. The highest alkalinity 122.00± 18.57 mg/l was observed during the month of winter season (January, 2019). On contrary the acidity hit the highest point (25.29±5.03 mg/l) during summer period (May, 2019). The correlation among hardness, alkalinity and acidity worked out and showed remarkable contrast association to each other and well depicted (Fig. 3) (Ghosh *et al.*, 2000; Kaur *et al.*, 2001; Khaiwal *et al.*, 2003). According to Bhatnagar *et al.* (2009), hardness and alkalinity decrease during June (heavy monsoon) while increase during July (Bhatnagar and Garg, 1998). Variation in total hardness was observed by different workers which showed that total hardness amount was high in rainy season than summer season (Dalal and Arora, 2007; Deshmukh and Sonawane, 2007; Chopra *et al.*, 2012; Kumar *et al.*, 2016). It was evident that Ca and Mg amount is high during rainy season possibly positively influencing the total hardness well (Pandey and Soni, 1993; Usha and

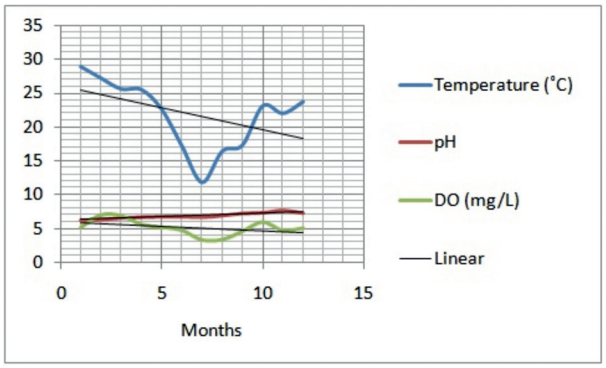

Fig. 2. Monthly variation patterns in water temperature (°C), pH and Dissolved Oxygen (mg/L) of river Yamuna, Yamuna Nagar (HR) during 2018-2019.

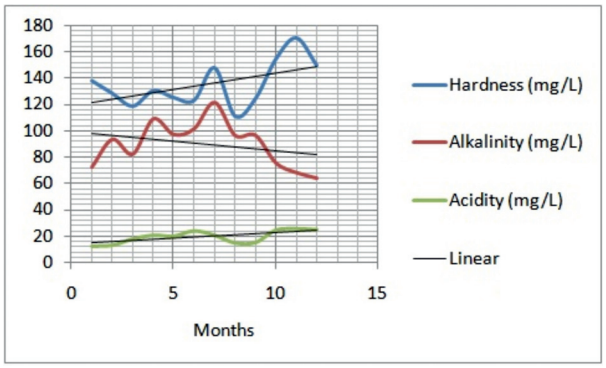

Fig. 3. Monthly variation patterns in Hardness (mg/L), Alkalinity (mg/L) and Acidity (mg/L) of river Yamuna, Yamuna Nagar (HR) during 2018-2019.

Ramalingam, 2006; Singh *et al.*, 2008; Bhatnagar *et al.*, 2009).

Conclusion

In the present study six physico-chemical water quality parameters of the river Yamuna at three different sampling locations of Yamuna Nagar (Haryana) were assessed during July, 2018 to June, 2019. The findings revealed that there was seasonality biased oscillation in hydrobiological quality parameters with fluctuation to the desired prescribed limit of BIS (Bureau of Indian Standards). The intensity of variability in the water quality increased as the river was subjected to sewage, agriculture sectors, industrial wastes etc. Therefore, the water of river Yamuna nearby Yamuna Nagar (Haryana) is unsafe for domestic consumption. The augmented awareness of relationships between aquatic fauna-water pollution and parasitic infra community-human health, is essential to carry out customary monitoring and surveillance of such important aquatic ecosystems.

Funding

This research received no external funding.

Acknowledgments

Authors are thankful to Dr. Anil K. Sharma, Profesoor & Head, Department of Biotechnology, Maharishi Markandeshwar (Deemed to be University), Mullana-Ambala (HR), India for encouragement to carry out such research.

Conflicts of Interest

The authors declare no conflict of interest.

References

Akhter, S. and Brraich, O.H. 2020. Spatial and temporal distribution of phytoplankton from Ropar wetland (Ramsar site) Punjab, India. *Applied Ecology and Environmental Sciences.* 8(1): 25–33. https://doi.org/10.12691/aees-8-1-4.

A.P.H.A. 2001. *Standard Methods for the Examination of Waste and Waste water.* 20th edition American Public Health Association. American *Water Works Association and Water Pollution Control Federation*, Washington DC. 581p.

A.P.H.A. 1998. *Standard Method for the Examination of Water and Waste Water.* 18th edition American Public Health Association. *American Water Works Association and Water Pollution Control Federation*, Washington DC. 1085p.

Babita, Panwar, P. and Upadhyay, S.K. 2019. A review on ecosegregation and parasitocoenosis of helminthes: Perspective to health and sustainability. *Bulletin of Pure and Applied Sciences (Zoology)*. 38A(1): 40–51. https://doi.org/10.5958/2320-3188.2019.00005.6.

Bhatnagar, A. and Sanghwan, P. 2009. Impact of mass bathing on water quality. *International Journal of Environmental Research*. 3(2): 247–252.

Bhatnagar, A., Chopra, G. and Malhotra, P. 2009. Water quality indices and abiotic characteristics of wastern Yamuna canal in Yamunanagar, Haryana. *Journal of Applied and Natural Sciences.* 1(2): 149–154.

Bhatnagar, A. and Garg, S.K. 1998. Environmental impact assessment in river Ghaggar in Haryana. *Journal of Natural Conservation*. 10(2): 215–224.

Chopra, G., Bhatnagar, A. and Malhotra, P. 2012. Limnochemical characteristics of river Yamuna in Yamunanagar, Haryana, India. *International Journal of Water Research and Environmental Engineering*. 4(4): 97–104.

Chopra, G., Bhatnagar, A. and Malhotra, P. 2009. Planktonic community of the western Yamuna canal with special reference to industrial pollution. *Proceedings of 22nd National Symposium November 2008, Punjab Agriculture University, Ludhiana.*

C.P.C.B. 2000. Water quality status of Yamuna river. *ADSORBS/32/1999-2000, Annexure III*. 115p.

Dalal, A. and Arora, M.P. 2007. Seasonal physicochemical fluctuations of water quality of river Hindon. *Journal of Experimental Zoology India*. 11(1): 125–131.

Deshmukh, D.R. and Sonawane, S.R. 2007. Studies on seasonal variation in abiotic factors of Godawari river at Paithan. *Journal of Experimental Zoology India*. 11(1): 143–145.

Ghavzan, N.J., Gunale, V.R. and Trivedy, R.K. 2006a. Limnological evaluation of an urban fresh water river with special reference to phytoplankton. *Pollution Research*. 25(2): 259–268.

Ghavzan, N.J., Gunale, V.R., Mahajan, D.M. and Shirke, D.R. 2006b. Effect of environmental factors on ecology and distribution of aquatic macrophytes. *Asian Journal of Plant Sciences*. 5(5): 871–880. https://doi.org/10.3923/ajps.2006.871.880.

Ghosh, S., Chattopadhyay, G.N. and Garg, S.K. 2000. Environmental impact assessment in riverine ecosystem with special reference to Ganges. *Nature Conservators Publications.* 6: 271–289.

Hasalam, S.M. 1991. *River Pollution- An Ecological Perspective.* Belhaven Press, Great Britain.

Hasan, M.R., Hecht, T., De-Silva, S.S. and Tacon, A.G.J. 2007. Study and analysis of feeds and fertilizers for sustainable aquaculture development. *FAO Fisheries Technical Paper*, 497: 510p. http://www.fao.org/

docrep/011/a1444e/a1444e00.htm.

I.C.M.R. 1975. *Manal of Standards of Quality of Drinking Water Supplies* 2nd edition. *Special Series Report.* 44.

Jaiswal, N., Upadhyay, S.K., Malhotra, A. and Malhotra, S.K. 2014. Ecological morphotaxometry of trematodes of garfish (Teleostomi: Belonidae) from Gangetic riverine ecosystem in India. III. Principal Component Analysis for hydrobiological correlates to dynamics of infections by *Cephalogonimus yamunii* (Upadhyay, Jaiswal, Malhotra and Malhotra, 2012). *Journal of Parasitic Disease.* 38(2): 153–162. https://doi.org/10.1007/s12639-012-0200-6.

Jaiswal, N., Upadhyay, S.K., Malhotra, A. and Malhotra, S.K. 2013. Multifactorial etiology of infections by larvae of *Eustrongylides tubifex* (Nematoda: Dioctophymidae) in silver whiting of the central west coast of India at Goa. *Asian Journal of Biological Sciences*. 6(1): 21–39. https://doi.org/10.3923/ajbs.2013.21.39.

Kaur, H., Syal, H. and Dhilon, S.S. 2001. Water quality index of the river Satluz. *Pollution Research*. 20(2): 199–204.

Khaiwal, R., Ameena, Meenakshi, Monika, Rani and Kaushik, A. 2003. Seasonal variations in physico-chemical characterististics of river Yamuna in Haryana and its ecological best designated use. *Journal of Environmental Monitoring*. 5: 419–426.

Kulshrestha, S.K., Adholia, U.N. and Bhatnagar, A. 1991. Zooplankton community of river Chambal and its tridutatries with special reference to industrial pollution. *Journal of Environmental Studies*. 40: 207–216.

Kumar, M., Khare, P.K. and Singh, R. 2016. Hydrobiological study of Yamuna river at Kalpi, District Jalaun, Uttar Pradesh, India. *Hydrobiology of Nepal.* 18: 41–46.

Kumar, S. and Upadhyay, S.K. 2016. Pathogenesis of *Flavobacterium colunare* in fish of fresh water riverine ecosystem from eastern region of Uttar Pradesh, India. *International Journal of Recent Scientific Research*. *7*(10): 13676–13679.

Lavaniya, A., Divakar, R.P. and Rout, C. 2015. Assessment of water quality of the Yamuna river in rural and semi-urban settings of Agra, India. *International Journal of Earth Sciences and Engineering*. 8(4): 1661–1666.

Malhotra, A., Jaiswal, N., Upadhyay, S.K., Kumar, S. and Malhotra, S.K. 2009. Parasite stress response in zoonoses of *Cephalogonimus* sp. *Indian Journal of Helminthology (N.S.)*. 27: 73–80.

Panday, D.K. and Soni, P. 1993. Physico-chemical quality of Naukuchiyatal lake water Indian. *Journal of Environment Protectection*. 13: 726–728.

Rim-Rukeh, A and Awatefe, J.K. 2006. Investigation of soil corrosivity in the corrosion of low carbon steel pipe in soil. *Journal of Applied Sciences Research*. 2(8): 466–469.

Rout, C. 2017. Assessment of water quality: A case study of river Yamuna. *International Journal of Earth Sciences and Engineering.* 10(2): 398–403. https://doi.org/10.21276/ijee.2017.10.0239.

Sharma, R.C., Singh, N. and Chauhan, A. 2016. The influence of physico-chemical parameters on phytoplankton distribution in a head water stream of Garhwal Himalayas: A case study. *The Egyptian Journal of Aquatic Research.* 42(1): 11–21. https://doi.org/10.1016/j.ejar.2015.11.004.

Krishan, G., Singh, S., Gurjar, G., Kumar, C.P. and Ghosh, N.C. 2016. Water quality assessment in terms of water quality index (WQI) using GIS in Ballia district, Uttar Pradesh, India. *Journal of Environmental Analysis and Toxicology*. 6: 366p. https://doi.org/10.4172/2161-0525.1000366.

Singh, S., Ghosh, N.C., Krishan, G., Kumar, S., Gurjar, S. and Sharma M.K. 2019. Development of indices for surface and groundwater quality assessment and characterization for Indian conditions. *Environmental Monitoring and Assessment*. 191: 182p. https://doi.org/10.1007/s10661-019-7276-8.

Singh, J., Agrawal, D.K. and Panwar, S. 2008. Seasonal variations in different physico- chemical characteristics of Yamuna river water quality in proposed Lakhwar hydropower project influence area. *International Journal of Applied Environmental Sciences*. 3: 107–117.

Singh, M., Yadav, M., Singh, R., Kumar, V., Sehrawat, N. and Upadhyay, S.K. 2019. Development of water quality criteria for *Fenneropenaeus indicus* against arsenic by flow-through system in the central west coast of India at Goa. *Bulletin of Pure and Applied Sciences (Zoology)*. 38A(2): 144–149. https://doi.org/10.5958/2320-3188.2019.00021.4.

Srivastava, N., Harit, G. and Srivastava, R. 2009. A study of physico-chemical characteristics of lakes around Jaipur, India. *Journal of Environmental Biology*. 30(5): 889–894. https://pubmed.ncbi.nlm.nih.gov/20143724/.

Srivastava, N., Agrawal, M. and Tyagi, A. 2003. Study of physico-chemical characteristics of water bodies around jaipur. *Journal of Environmental Biology*. 24(2): 177–180. https://pubmed.ncbi.nlm.nih.gov/12974460/.

Tas, B. and Gonulol, A. 2007. An ecological and taxonomic study on phytoplankton of a shallow lake, Turkey. *Journal of Environmental Biology*. 28: 439–445. https://doi.org/10.1.1.1 077.9281&rep=rep1&type=pdf.

Tiwari, A. and Chauhan, S.V.S. 2006. Seasonal phytoplanktonic diversity of Kitham Lake, Agra. *Journal of Environmental Biology*. 27: 35–38.

Upadhyay, S.K. 2017. Environmental impact on helminth parasites of fresh water garfish from river Yamuna at Allahabad, Uttar Pradesh, India. *Proceedings of the Zoological Society of India.* 16(02): 63–75.

Upadhyay, S.K. 2012. *Transmission dynamics ad environmen-*

tal influence on food borne parasitic helmin-thes of the Gangetic plains and central west coast of India. Unpubl. D.Phil Thesis, University of Allahabad, India. 400p.

Upadhyay, S.K., Babita and Singh, R. 2019. The diversity and bioecology of cestodes in freshwater snakehead fish *Channa* sp. (Bloch) with a checklist of tapeworms previously reported from this fish in India. *In: Parasitology Taxonomy and Bioecology* (ed. Upadhyay, S.K.). Write and Print Publ., New Delhi. pp.17–37.

Upadhyay, S.K., Jaiswal, N., Malhotra, A. and Malhotra, S.K. 2013. Ecological morphotaxometry of trematodes of garfish (Teleostomi: Belonidae) from Gangetic riverine ecosystem in India. II. Correlation of seasonality and host biology with distribution pattern of *Cephalogonimus yamunii* n.sp. *Journal of Parasitic Diseases.* 37(2): 211–217. https://doi.org/10.1007/s12639-012-0168-2.

Upadhyay, S.K. and Singh, R. 2018. Polyfactorial etiology on demography of parasitic allocreodoidean trematodes in the Gangetic ecosystem. *AASCIT American Journal of Biomedical Science and Engineering*. 04(02): 17–23.

Upadhyay, S.K., Singh, R., Babita, Panwar, P., Singh, D.P., Rani, K. and Yadav, D. 2020. Population ecology of parasitic helminthes *Oncodiscus* Yamaguti, 1934 (Cestoda: Bothriocephalidae) in Greater lizardfish *Saurida tumbil* Bloch (Aulopiformes: Synodontidae) from the coast of Visakhapatnam, Bay of Bengal. *Bulletin of Pure and Applied Sciences (Zoology)*. 39A(2): 379–386. https://doi.org/10.5958/2320-3188.2020.00042.X.

Upadhyay, S.K., Yadav, D. and Pathak, R.K. 2015. The impact of water quality on the population distribution pattern of cephalogonimid trematodes *Cephalogonimus yamunii* in fresh water fish *Heteropneustes fossilis* at Allahabad, Uttar Pradesh. *Journal of Kalash Science.* 3(2): 11–17.

Usha, R. and Ramalingam, U.D. 2006. Bharathi Ramjan: Freshwater lakes- A potential source for aquaculture activities- a Model study on Perumal lake, Cuddalore, Tamil Nadu. *Journal of Environmental Biology*. 27: 713–722.

Yadav, A., Rajhas, K.P., Ramteke, S., Sahu, B.L., Patel, K.S. and Blazhev, B. 2016. Contamination of industrial waste in central India. *Journal of Environmental Protection*. 7(01). https://doi.org/10.4236/jep.2016.71007.