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Mushtaq Ahmad Ganie
Department of Environmental Sciences and Limnology, Barkatullah University, Bhopal, Madhya Pradesh, India

Hilal Ahmad Bhat
Department of Environmental Sciences and Limnology, Barkatullah University, Bhopal, Madhya Pradesh, India

Abhilasha Bhawsar
Department of Environmental Sciences and Limnology, Barkatullah University, Bhopal, Madhya Pradesh, India

Corresponding Author:
Mushtaq Ahmad Ganie
Department of Environmental Sciences and Limnology, Barkatullah University, Bhopal, Madhya Pradesh, India

Kolar River in the focus of physical habitat assessment with its catchment

Mushtaq Ahmad Ganie, Hilal Ahmad Bhat and Abhilasha Bhawsar

Abstract
The present survey was conducted to assess the habitat quality of Kolar River, which is one of the right bank tributaries of Narmada River. The various physical habitat parameters *viz*., epifaunal substrate, embeddedness, velocity/depth regime, sediment deposition, channel flow status, channel alterations, frequency of riffles (or bends), bank stability, bank vegetative protection and riparian vegetative zone width were analysed at different selected locations in order to evaluate the physical habitat conditions of the Kolar River. The present observations of the study area shows that some of the selected locations ranges from marginal to poor quality which represents strong alterations due to anthropogenic pressure whereas, some of the selected locations fall under optimal to suboptimal condition which represents less to moderate alterations due to minimum intervention of human beings.

Keywords: Physical habitat assessment, Kolar, riparian

Introduction
Stream habitat forms an essential component of river 'health' [5] that can be used to evaluate the overall ecological integrity of a river system [8]. The conditions of local stream habitat, otherwise known as the habitat templet, influences the structure and group of biological community. The term habitat is used to designate the local physical, chemical and biological features that provide an environment for the biota [4]. Physical habitat in streams includes all those physical characteristics that impact or provide sustenance to organisms within the stream. The physical habitat of stream varies naturally, as do biological characteristics. Physical habitat assessment is the evaluation of habitat quality which is directly associated with the ecology of any water body. Physical habitat assessment aims to depict the physical realm and to explain the physical processes involved in creating spatial heterogeneity and in particular physical features of the streams [1, 7]. The reformation of structure and function of physical habitat which affects the quality of water and its community [2]. Physical habitat features control the structure and composition of fluvial biological communities and play an important role in defining fluvial ecosystem functioning [3, 6]. The methods involved in characterizing river habitats are becoming more important for the success of river restoration projects and understanding the river ecosystem functioning. High quality physical habitat and riparian habitats provide niche for aquatic organisms to reproduce, to feed, and take protection from both predators as well as natural high flow events [5]. The present study was conducted in order to assess the physical habitat conditions of different selected locations to analyze the prevailing ecological conditions of Kolar River.

Study area
The present study was conducted on Kolar River which is a right bank tributary of the Narmada River. Kolar River flows for a total length of 101 km, all of which is in the state of Madhya Pradesh. Kolar river is located at 21^0 14' N 79^0 10'E which arises in the Vindhya Range of Sehore district and flows in a south westerly direction to meet the Narmada near Nasrullahganj in the Sehore district of Madhya Pradesh. Its total drainage area is of 1,347 km^2. is spread across the two districts. The upper part of the river basin lies at an elevation of 350 to 600 meters and much of it is under tropical deciduous forest. The river debouches into the plains near Jholiapur.

Much of the upper basin has poor soils and agriculture here is largely of wheat and gram. The lower basin has better soils and a flatter slope and has been used extensively bundled allowing for impounding water during the monsoons.

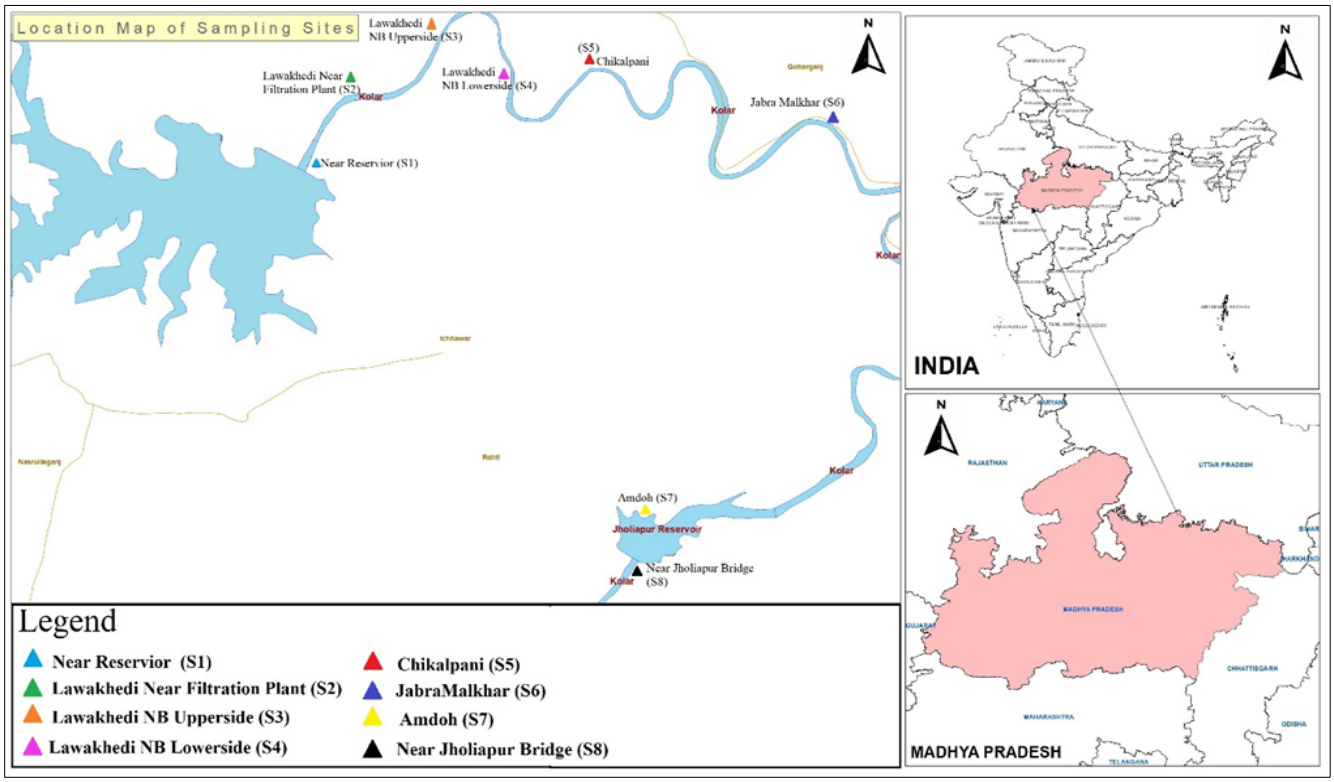

Fig 1: Showing location map of sampling sites of Kolar River

Methodology

The total length of the river has been divided into 5 sections (locations/sites) *viz*; S1, S2, S3, S4 and S5. During the study the physical habitat characterisation were evaluated by numeric measurement. Several parameters such as epifaunal substrate, embeddedness, velocity/depth regime, sediment deposition, Channel flow status, channel alterations, frequency of riffles (or bends), bank stability, bank vegetative protection and riparian vegetative zone width were scored on the basis of scoring system. Each of the parameters was classified as optimal, suboptimal, marginal or poor as per the used protocol. The locations with a high score on this portion of the assessment likely provides a suitable habitat whereas, low score shows anthropogenic pressure. The physical habitat assessment was followed from rapid bio assessment protocol [2].

Results and Discussion

During the present study various physical habitat parameters of the Kolar River were assessed (Table 1). The epifaunal substrate at site 1 was found to be in marginal range as it shows habitat availability less than desirable; the substrate is mostly disturbed by the anthropogenic stress. Whereas, site 2 and site 5 was found to be in suboptimal range as habitat was well suited for full colonization potential; It represents adequate habitat for maintenance of populations. The epifaunal substrate at site 3 fall under poor range as it represents strong disturbances by human beings caused unstable substrate and lack of habitat is obvious. Whereas, the epifaunal substrate at site 4 falls under optimal range which reflects the favourable substrate for epifaunal colonization and fish cover; mixture of snags, submerged logs, undercut banks because of minimum disturbance. The embeddedness at sites 1, 2 and 5 showed optimal range. A mixture of gravel, cobbles and boulders were surrounded by a very little amount of fine sediment whereas, embeddedness at site 3 showed in poor range. The boulders and cobbles were covered by fine sediments besides mud. Embeddedness at site 4 fall under suboptimal range which determines 25-50% of gravel, cobble and boulder particles surrounded by fine particles. The velocity/depth regime parameter at sites 1, 2 and 3 showed marginal category with having only two of the four habitat regimes present. Whereas, sites 4 and 5 fall under suboptimal having three of the four regimes present. The another parameter sediment deposition at sites 1, 2 and 5 showed optimal category having little deposition of sand, gravel was found with bottom almost unaffected. Site 3 fall under marginal category with moderate amount of sand, gravel, fine sediment depositions were present and increased amount of bar development had resulted in substantial amount of the bottom affected, hence, it falls under marginal range for sediment deposition. Whereas, site 4 showed suboptimal category with having some new bar formation, mostly due to gravel, sand or fine sediment, bottom less affected. Channel flow status at sites 1, 2, 4 and 5 was found to be in suboptimal range. The water fills about 75% of available channel with almost less than 25% of channel substrate is exposed. Channel flow status at S3 was found in marginal range water fills 25- 75% of available channel and riffle substrates are mostly exposed. The channel alteration at sites 1, 4 and 5 fall under optimal category as per the physical habitat assessment protocol the stream trend was in normal conditions with no channelization. Whereas, site 2 and 3 comes under marginal category due to the extensive channelization with shoring structures present on both the

banks. Another parameter frequency of riffles or bends at sites 1and 2 fall under poor category with shallow bends generally all flat water having poor habitat. Whereas, sites 3, 4 and 5 was found under marginal category showing occasional bends bottom contours provide some habitat. The sites 1, 2, 4 and 5 showed suboptimal range for bank stability. The banks of the river were moderately stable infrequent, small areas of erosion were found mostly healed over. Little human involvements in degradation of banks were found and it was also found less than 30% banks were affected. At site 3 bank stability showed marginal range. Banks were found moderately unstable due to agricultural activities from one side and deforestation from other side of the bank. No rocks, boulders found near the banks which are susceptible to soil degradation during energetic flow of rainy season. The vegetative protection was found to be in optimal range at sites 1, 4 and 5. These sites are mostly surrounded by forested area. The vegetative disruption through human interference was little with almost native vegetation unaffected. The vegetative protection at site 2 was found to be in marginal range. The forested vegetation was found but the vegetative disruption through human activities was evident. The vegetative protection at site 3 fall under poor category with less than 50% of streambank surfaces covered by vegetation; disruption of vegetation is high because of more anthropogenic stress. The riparian vegetation zone width at sites 1, 2 4 and 5 showed in optimal range. The human activities were found to have no impact on the width of natural vegetation along the stream banks. An abundance of tree cover was found along both sides of the banks. The forests growth in riparian corridor makes the stream more pristine. On the contrary, the riparian vegetative zone width at site 3 comes in marginal range due to the influence of human activities *viz*., agricultural activities and human settlement in riparian zone. The actual habitat assessment process involves rating the 10 parameters as optimal, suboptimal, marginal, or poor based on the criteria included on the Habitat Assessment Field Data Sheets. Some state programs, such as Florida Department of Environmental Protection and Mid-Atlantic Coastal Streams Workgroup have adapted this approach. Temporal variability of rapid physical habitat assessment (rPHA) indices can be assessed at various intervals [9].

Table 1: Variations in physical habitat assessment score at selected locations of Kolar River

Habitat Parameters	Physical habitat assessment score				
	S1	**S2**	**S3**	**S4**	**S5**
Epifaunal Substrate	10	11	5	18	15
Embeddedness	18	16	4	14	18
Velocity/Depth Regime	8	9	7	11	14
Sediment Deposition	19	18	7	15	17
Chanel Flow Status	14	13	6	12	12
Channel Alteration	16	9	8	19	17
Frequency of Riffles (or Bends),	5	5	7	9	10
Bank Stability	LB 8 RB 8	LB 8 RB 7	LB 5 RB 4	LB 8 RB 7	LB 8 RB 8
Bank Vegetative Protection	LB 9 RB 9	LB 6 RB 7	LB 5 RB 5	LB 9 RB 8	LB 9 RB 9
Riparian Vegetative Zone Width	LB 9 RB 9	LB 10 RB 10	LB 4 RB 5	LB 10 RB 9	LB 9 RB 9

Here: LB=left bank, RB=right bank

Conclusion

The primary aim of the study was to evaluate variation associated with the measurement of physical habitat assessment of sampling stations of Kolar River during the study period, inequalities among the parameters of physical habitat assessment between sampling locations were clearly observed. The physical habitat assessment at sites 1, 2, 4 and 5 comes under optimal or sub optimal category which shows that these sites are in better ecological conditions with minimum disturbances. On the contrary, at site 3, the status of physical habitat comes under marginal or poor condition due to agricultural land use and human interferences which shows that this site is polluted and need immediate control measures. Thus, the study clearly predicted that the physical habitat condition, riparian condition and land use pattern have profound effect in assessing overall ecological health of the water bodies. Therefore, government should categorise observed area as protected area and give necessary attention towards its restoration and well planning for maintaining the ecological health of Kolar River. Moreover, proper management and policies should be framed for the settlement of human habitation along the buffer zones of the river network which will help in saving the ecological health as well as aesthetic nature of Kolar River.

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