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Impact of Physico-Chemical Parameters of Water on Zooplankton Diversity in Nanjangud Industrial Area, India

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Abstract

Zooplanktons and macro invertebrate's samples were collected monthly from two sampling stations at River Kapila, Nanjangud, Karnataka State, India. Prior to sampling, temperature of surface water, pH, dissolved oxygen concentration etc were evaluated. Zooplanktons were sampled using plankton net. The result revealed that zooplankton was made up of, Rotifera (62.00%), Copepoda (12.00%), Cladocera (19.50%), Diptera (4.00%) and Nematoda (4.50%). The status of the River could said to be eutrophic as indicated by the diversity of zooplankton.

Keywords: Zooplankton, River Kapila, rotifera, cladocera.

Introduction

Zooplanktons are microscopic organisms that are suspended in water. Zooplankton includes many kinds of protozoans, micro-crustaceans and other micro invertebrates that are planktonic in water bodies[1]. These are heterotrophic planktonic animals which constitute an important food source for many species of aquatic organism[2]. It may serve as indicators of water quality. zooplankton to be rich in the essential amino and fatty acids, docosahexacnoic acid (DHA) and elcosaptaenoic acid (EPA)[3]. Zooplankton provides fish with nutrients since fish require proteins, fats, carbohydrates, mineral salts and water in the right proportion[2]. The freshwater forms of zooplankton are generally smaller in size and are represented by fewer animal phyla than their marine counterparts. Zooplankton study is of necessity in fisheries; aquaculture and paleolimnological research[2]. They are globally recognized as pollution indicator organisms in the aquatic environment[4].

A change in the physico-chemical aspect of a water body brings about a corresponding change in the relative composition and abundance of the organisms in that water. Biomonitoring (biological surveillance) is the systematic use of living organisms or their responses to determine the quality of the environment[5].

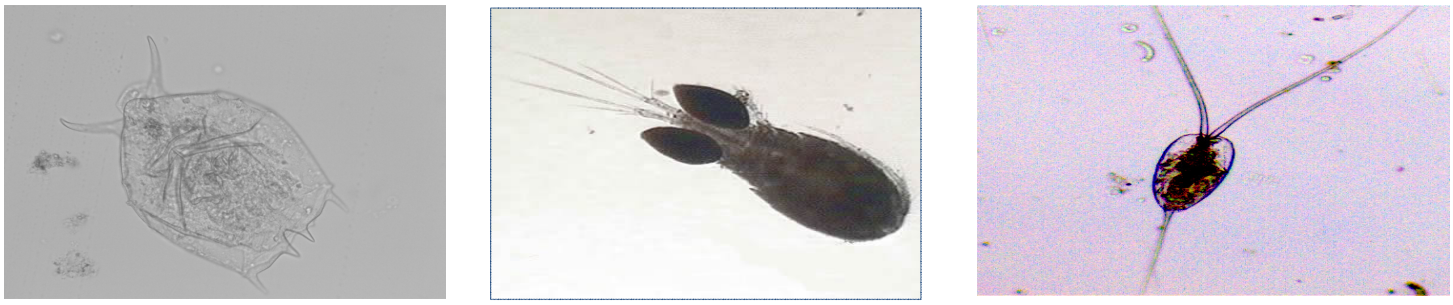
River Kapila plays important roles in the lives of the surrounding inhabitants. Fishing, bathing, washing/laundry, car washing, refuse disposal, industrial wastes disposal and other human activities are constantly going on within and around this river. This study was therefore conducted to evaluate the species distribution and surface water physico-chemical parameters of river Kapila.

Material and Methods

Study Site: The study area included two sampling sites of River Kapila flowing at Nanjangud. Nanjangud is a taluk in Mysore district in the Indian state of Karnataka (Figure-4). It is on the banks of the river Kapila (Kabini) tributaries of the Cauvery River, and lies at a distance of 23 km from the city of Mysore. It is located at 12°07′N 76°41′E/ 12.12°N 76.68°E. It has an average elevation of 657 meters (2155 feet). Nanjangud is also an important industrial and pilgrimage center of Mysore district. The River Kapila flows throughout the year providing adequate water for the domestic, agriculture and industrial purposes.

Sample Analysis: Water samples were collected between 7.00am and 9.00am every month. The water samples were collected from two different points on the river namely: sampling site1 is River Kapila flowing through the Nanjangud temple. Sampling site 2 is River Kapila flowing through the Nanjangud industrial area. From each station, samples were collected for the analysis of zooplankton and physico-chemical properties such as temperature, pH and dissolved oxygen (DO2) were measured.

Zooplankton Sampling: The zooplanktons are collected using plankton net (60 microns mesh size). Plankton net acts as a filter, it is the most common method for collection of zooplanktons by the filtration of known amount of water sample. A mug of 500 ml capacity water was taken and about 25 times the river water was filtered out. The zooplankton trapped and collected in the containers of 30 ml capacity, inside net. This is the concentrated zooplanktons and later it is preserved. The concentrated zooplankton samples are carefully transferred to another container. To this 5 ml of 4% formalin is added. This solution is to be mixed using the pasture pipette. This solution is kept 24 hours undisturbed. Zooplanktons will settle down and this is the common method of preservation. Formalin acts as a fixative as well as preservative. Figure-1 Shows three samples of zooplanktons collected from the river.



a b c

Figure-1
a) Brachionus calyciflorus b) Filinia terminalis c) Eucyclops agilis

Identification of zooplankton: From the preserved sample, 1 ml of the sample was taken on the slide with the help of dropper and observed under the microscope. The important general manual for the identification of freshwater zooplankton are in[6-8]. The following are the specific volumes for identification of different groups of zooplankton- Rotifers[9]; Cladocerans[10-11]; Copepods[12-13].

Water quality parameters: Water samples were collected from two sampling sites and transported to laboratory for analysis. Temperature and pH were recorded immediately at study site itself. Water samples were analyzed for various physicochemical parameters using standard protocols as described in[14-15].

Results and Discussion

In the present study a total of 25 species of freshwater zooplanktons are identified. The study revealed the presence of 16 species of rotifers which included 13 different genera, 4 species of cladocerans belonged to 4 different genera, 3 species of copepods also belonged to 3 different genera, 1 species of dipterans and 1 species of nematodes in the study area. Physico-chemical parameters were recorded for the month of January, February, March, April and May are listed. Table 1 shows the sample of recorded results in March, April and May. The major groups of zooplankton found in the present study included rotifers, cladocerans, copepods, diptera and nematoda.

The knowledge of plankton species composition and distribution to time and space are of great value especially in running water system. The present study reveals some aspects of zooplanktonic dynamic to explain their relation with the physicochemical parameters of river water in the industrial area of Nanjangud. Fluctuation of abiotic factors i.e., concentration of dissolve oxygen, temperature, total alkalinity, total nitrogen, phosphate and pH can influence the growth of zooplankton. The predominance of rotifers over the other groups of zooplankton in the present study has also been reported earlier[16].

In the present study number of rotifers was highest, cladocera species and copepods followed respectively. This is in accordance with the study conducted by[17] which shows that size of the Rotifer community was the largest one, and showed a negative correlation with pH, dissolved oxygen and transparency. Abundance of Cladocera got second position among the total collection and showed negative correlation with pH, transparency and phosphate. Copepoda, the third dense community, exhibited negative correlation with water temperature, nitrate and phosphate.

Rotifers, the tiny wheel animalcules, are considered nature's water purifiers because they perform an important clean up services in the still or slow-moving waters they inhabit. The systematic and ecology of freshwater rotifers of west Bengal in India was reported earlier[18], but investigations on rotifers inhabiting industrial or municipal waste water of India are scant[19-24].

Temperature is one of the essential and changeable environmental factors, since it influence the growth and distribution of flora and fauna. Water temperature ranging between 13.5^0C and 32^0C is reported to be suitable for the development of the planktonic organisms[25]. From the above statement we can conclude that in the present study the increase in number of zooplanktons were in accordance with temperature of its habitat.

Rotifers were observed to grow when the pH was in the range of 7.0–7.19. Similar observation was done by[26] in their study. Species that reached large population sizes in the slightly acidic or near-neutral waters included: Asplanchna intermedia, A. brightwelli, Brachionus calyciflorus dorcas and Filinia longiseta[26]. In similar study the occurrence of A. priodonta, A.brightwelli and B. calyciflorus in acidic and neutral waters was highlighted[18]. B. calyciflorus dorcas f spinosa flourished in both acidic (pH 6.9) and alkaline (pH 8.6) conditions in the present study, thus exhibiting a wide range of pH tolerance. The alkaline preference of B. angularis, B. caudatus and B. calyciflorus, but in the present study they grew in the mean pH range of 7.0– 7.19[18].

DO (0.1 to 6.0 mg l-1) showed little effect on the rotiferan community in the study done by[26]. The present study is in accordance with the above statement. Important physico-chemical factors influenced the microcrustacean population fluctuation, including DO, conductivity, chloride, nitrite (NO^{2-}), S^{2}-, Cu and Mg[26]. The similar physico-chemical parameters were studied in the present study in relation to the zooplankton population. The total alkalinity affects the primary production and the other metabolic process of aquatic organisms[27]. It was reported earlier that during summer and winter water was alkaline, which is helpful for maximum population dynamics of planktons[28]. The present study was carried out in summer, hence, relatively high populations of zooplankton species were observed during the study period. Tiny microbes and plankton are instrumental in turning wastes into wealth, with the support of the strong solar radiation, and a myriad of physico-chemical interactions and transformations.

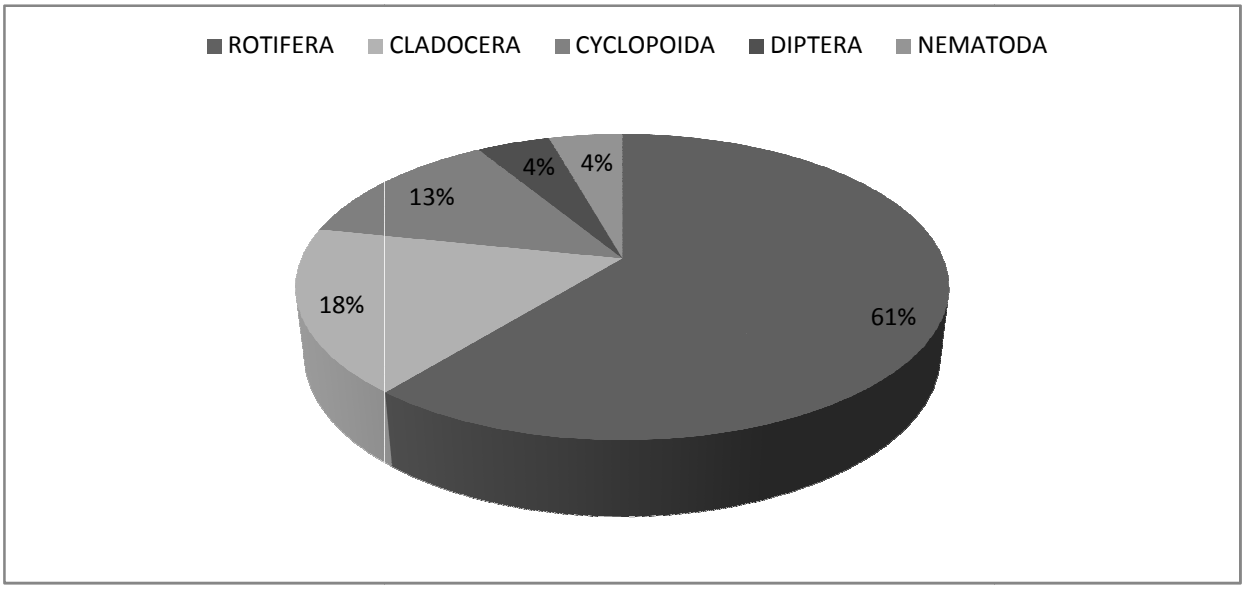


Figure-2
Distribution of zooplankton groups in station 1

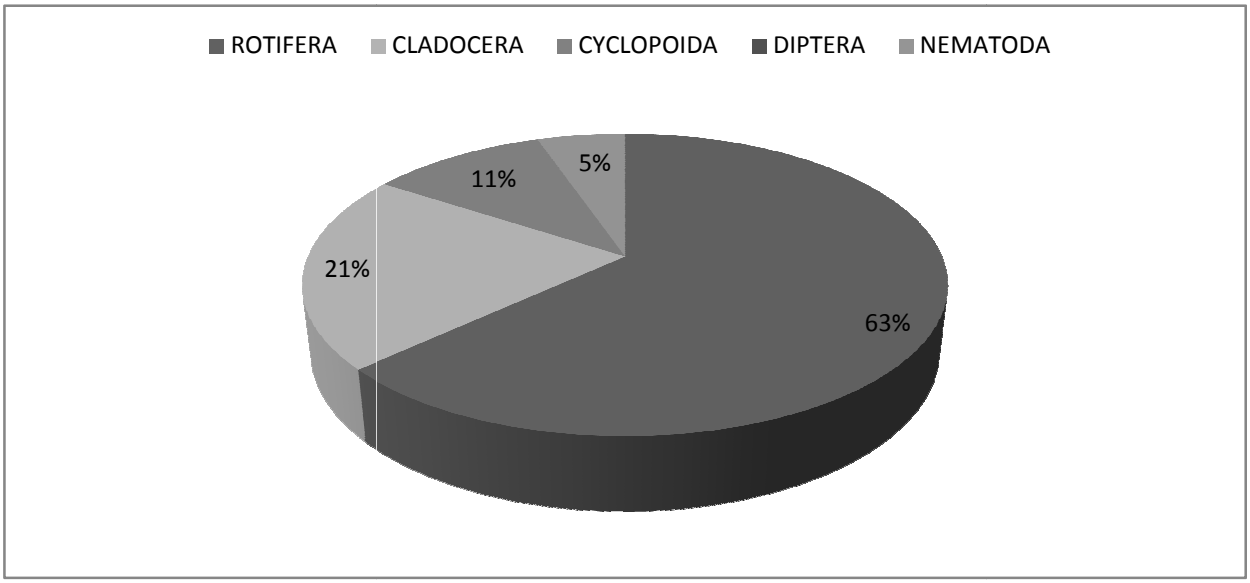


Figure-3
Distribution of zooplankton groups in station 2

Table-1
Physico-Chemical Characteristics of water samples in Nanjangud Industrial area (River Kapila)

Parameters	Unit	March	April	May			
		Sample1	Sample2	Sample1	Sample2	Sample1	Sample2
Color	Hazen	<5	<5	<5	<5	<5	<5
Odour	-----	Un objectionable	Un objectionable	Un objectionable	Un objectionable	Un objectionable	Un objectionable
Taste rating	-----	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
Turbidity	NTU	1	1	1	1	1	1
Temperature	^{0}C	25	27	25.20	26	28	27
pH value	mg/l	7.12	7.01	7.19	7.07	7.16	7.06
Total Dissolved salts	mg/l	134	97	138	98	135.8	100
Dissolved Oxygen	mg/l	4.0	4.2	3.9	4.9	3.8	5.12
Total hardness as $CaCO_3$	mg/l	89	63.4	96	64	95	66
Calcium as Ca	mg/l	20.50	13.00	20.80	12.80	20.85	13.07
Magnesium as Mg	mg/l	10.47	7.72	10.56	7.68	10.59	7.64
Total alkalinity	mg/l	195	199	205	197	189	194
Chloride as Cl	mg/l	12.10	7.9	12	8	11.9	7.7
Sulphates as SO_4	mg/l	4.15	3.6	4	3	3.73	3.4
Nitrates as NO_3	mg/l	BDL	BDL	BDL	BDL	BDL	BDL
Iron as Fe	mg/l	0.085	0.11	0.095	0.10	0.088	0.10
Fluoride as F	mg/l	0.11	0.10	0.10	0.10	0.10	0.10
Cyanide as CN	mg/l	BDL	BDL	BDL	BDL	BDL	BDL
Copper Cu	mg/l	BDL	BDL	BDL	BDL	BDL	BDL
Manganese as Mn	mg/l	BDL	BDL	BDL	BDL	BDL	BDL
Mercury as Hg	mg/l	BDL	BDL	BDL	BDL	BDL	BDL
Cadmium as Cd	mg/l	BDL	BDL	BDL	BDL	BDL	BDL
Selenium as Se	mg/l	BDL	BDL	BDL	BDL	BDL	BDL
Arsenic as As	mg/l	BDL	BDL	BDL	BDL	BDL	BDL
Lead as Pb	mg/l	BDL	BDL	BDL	BDL	BDL	BDL
Zinc as Zn	mg/l	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Chromium	mg/l	BDL	BDL	BDL	BDL	BDL	BDL
Residual free Chlorine	mg/l	BDL	BDL	BDL	BDL	BDL	BDL

Conclusion

The study revealed the values of different physico- chemical conditions and metal loads from the two sites: Site 1- River Kapila flowing through the Nanjangud temple; Site 2- River Kapila flowing through the Nanjangud industrial area. The values did not exceed the desirable limit of IS 10500-1993 specifications. The increase in number of zooplanktons was in accordance with temperature of its habitat. The study also showed that zooplankton species survive in the neutral condition. Thus the status of the River could said to be eutrophic as indicated by the diversity of zooplankton. Physico-chemical conditions of River Kapila can be changed because of industrial effluents which release to the water. Therefore, conducting further studies in this area is essential to measuring the diversity of zooplanktons.

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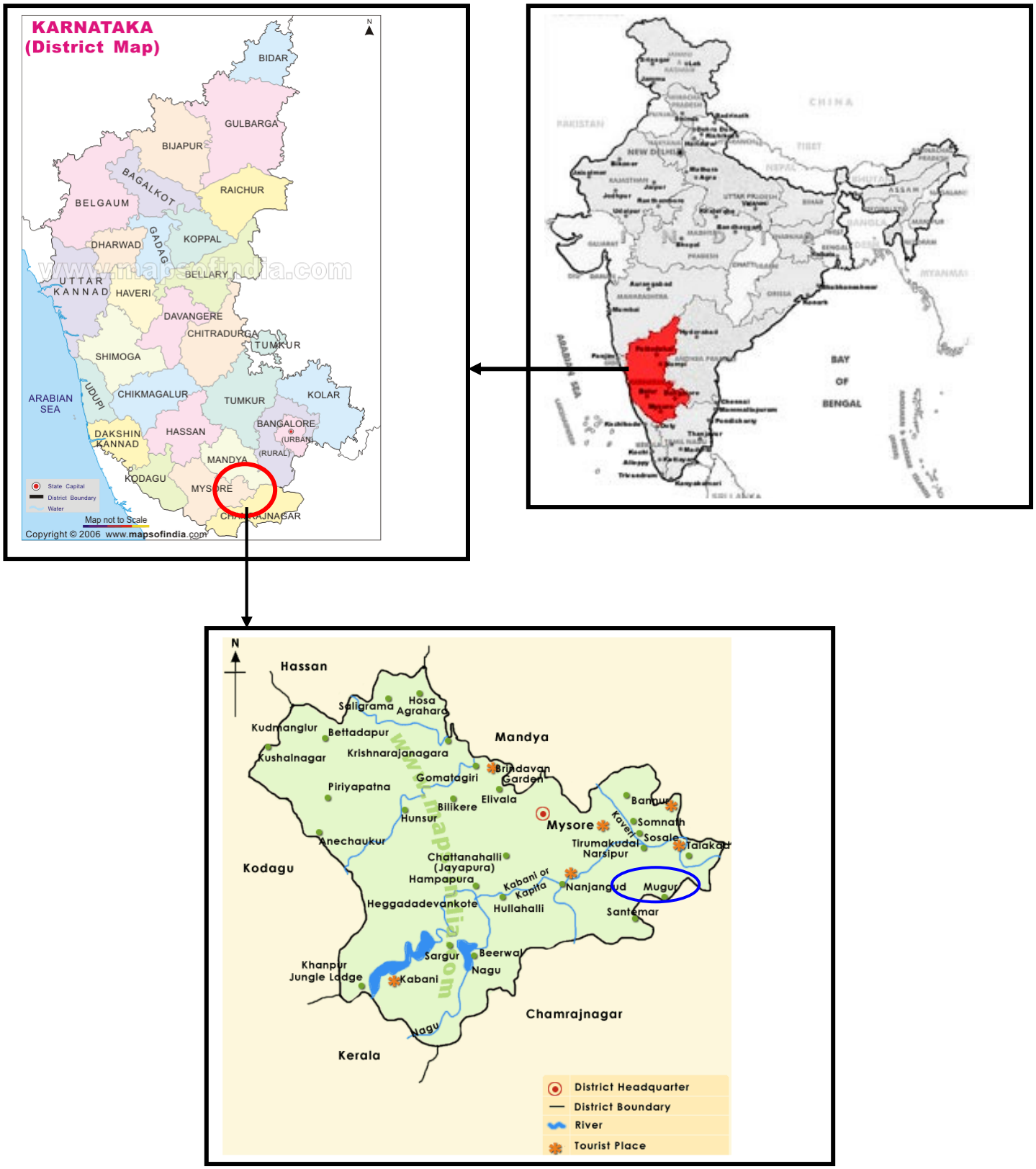

Figure-4
Location of selecting study area.