



## Water and Fishery Resources of Kumaun Central Himalaya, India

**Rakesh Verma**

Fisheries Research and Development Laboratory (FRDL), Department of Zoology, P.G. College Pithoragarh, Uttarakhand, India

### Publication History

Received: 23 October 2013

Accepted: 22 November 2013

Published: 1 December 2013

### Citation

Rakesh Verma. Water and Fishery Resources of Kumaun Central Himalaya, India. *Discovery*, 2013, 8(19), 8(19), 7-12

### Publication License



© The Author(s) 2013. Open Access. This article is licensed under a [Creative Commons Attribution License 4.0 \(CC BY 4.0\)](https://creativecommons.org/licenses/by/4.0/).

### General Note

Article is recommended to print as color digital version in recycled paper.

### ABSTRACT

This paper deals with water resources and fisheries resources of Kumaun region of state Uttarakhand. Rivers, streams, lakes, reservoirs and ponds are the main water resources. Moreover Western Ramganga, Saryu, Kali, Kosi, Gomati, Gori, Dhauri and Eastern Ramganga were the eight major river systems which also show annual physico-chemical fluctuation. Nainital, Bhimtal, Khurpatal, Sattal, Naukuchiatal and Shymalatal are main lakes of the region which also shows annual physico-chemical variations. Tumaria, Haripura, Baur, Nanaksagar, Bagul and Dhaura are major reservoir of the region which was also the subject of the study. This paper also emphasis on the district wise fish diversity, altitudinal variations in fish distribution and diversity in culture fishery.

**Key words:** fishery, water resources, Kumaun Central Himalaya.

### 1. INTRODUCTION

The state of Uttarakhand situated between 77°34'-81°02' E longitudes and 23°53'-31°27' N latitudes in the north of the India, is a region of great physical diversities (Figure 1). Covering an area of approx 53484 Km<sup>2</sup> the state has two divisions i.e. the Garhwal region and the Kumaun region. *Kumaun region* is a glittering jewel in the *Himalayan* necklace which lies between 28 °51' to 30 °49' N latitude and 77°43' to 80°31' E longitude, covers total 21000 Km<sup>2</sup> area of six districts viz. Almora, Bageshwar, Champawat, Nainital, Pithoragarh and Udam Singh Nagar, with total 35,64,068 people residing in this region (Census, 2011).

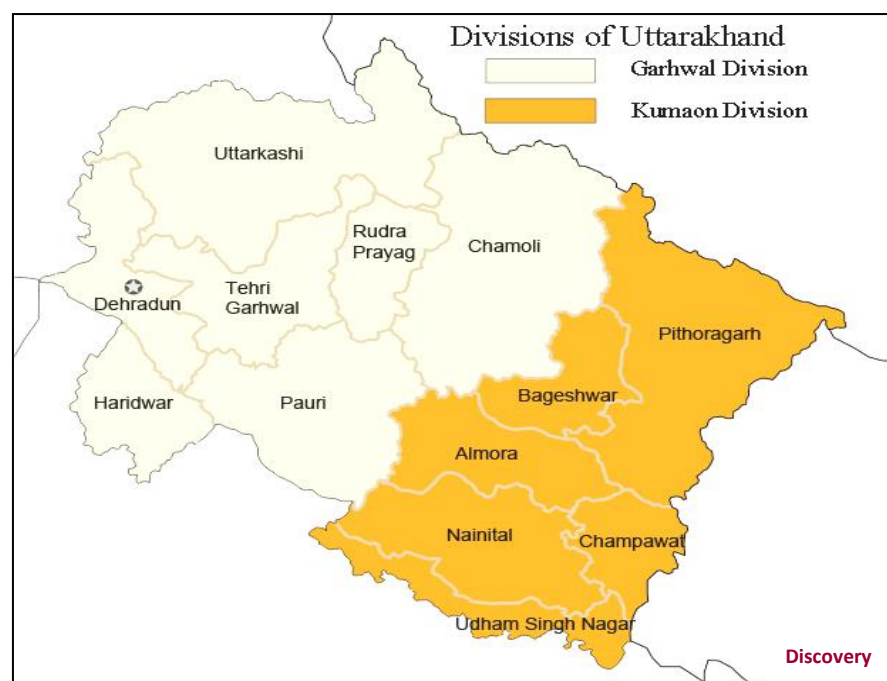
The Kumaun region has broadly three surface features viz.(a) Pahari; mountainous region in the north-Himalaya, (b) a narrow foot hill belt of Tarai and (c) Bhabar. Pahari zone is 4/5 of the total Kumaun region and lies between 560m -7817 m asl and Bhabar

zone lies between 300m -560m asl while Tarai is situated west to Bhabar and most fertile area than Bhabar and Pahari zone. The Kumaun region is blessed with splendour, varied natural water resources such as of snow fed rivers and upland lakes which serve as potential fishery resources of Cold water fish species.

The famous Himalayan snow-trouts, mahseers, barils and cheetals are found in these aquatic resources. Many exotic fishes like chinese carps, golden carps and trouts have also been introduced in fresh waters of Kumaun to enhance fish production and also to boost the eco-tourism through angling etc. Although the area has numerous aquatic resources to be exploited for fishery purpose still fish production is below their capacity. The developmental efforts for these aquatic resources of the region as well as the state, initiated during last two decades of 20<sup>th</sup> century. Thus present article besides giving a concise account of the aquatic resources also describes the fishery potential of the Kumaun region including the efforts being made to educate local masses for adopting fish culture to enhance their income for better social status.

## 2. MATERIAL AND METHODS

The physicochemical factors are water temperature, turbidity of water, pH, dissolved oxygen, total alkalinity and total hardness of water. Study of physicochemical factors was carried out by using standard methods APHA (1998). For the qualitative estimation Safe water quality standards were used by Boyd and Tucker, (1998), Ali et al., (1999). Standard chemical analysis of waters for pond was done by Swingle (1967). Some of information was taken from Census (2001). Fishes were preserved into 5% formalin solution and identified with the help of keys provided by Day (1878), Talwar and Jhingran (1991) and Jayram (2002).



**Figure 1**

Map of the study area

Dhaulti, Gori, Kali, Ramganga eastern, Panar, Pindar, Pungar, Gomati, Saryu, Gagas, Ramganga western, Suyal, Kosi, and Ladhiya. Besides many rivulets and tributary streams in the Himalayan region, various perennial streams drain the southern slopes of Siwaliks or outer Himalayas and Tarai region. The important streams of this region are Dabka, Dhaura, Gaula, Bhakra, Kailash etc. The total stream length of the flowing waters in the state is approx 1090 Km. within thermal regime of 8.0°C-32.0°C, these resources generally reflect different type of habitats, temperate, subtropical and tropical. These waters are mostly alkaline with pH ranging 6.5-8.8. Because of low thermal regime of the streams during most part of the year, the dissolved oxygen content is quite high (7.2-12.0 mg/l). This result is supported by findings of Bhatt et al. (1984), and Shukh, (1996). As the biotic strata of these streams is concern, they are not very rich in planktonic biomass, however they do have plenty of periphytic organisms and aquatic insects to serve as the food of the fishes. Result supported by a study Moghraby and Rahman 1984, Odum, 1971. A concise description of the rivers and streams is given in Table 2.

## 3. RESULTS AND DISCUSSION

### 3.1. Water resources

The Kumaun region of the state of Uttarakhand has rich and diversified aquatic resources in the form of glacial rivers, spring fed streams, natural lakes, man-made reservoirs, barrages, small and medium sized ponds, fish farms and hatcheries. These aquatic resources are broadly divided into capture and culture fisheries resources. The rivers, streams and lakes are included under the capture fisheries where as the culture fishery mainly is exercised in the ponds, fish farms and hatcheries (Table 1).

#### 3.1.1. Rivers and streams

With major rivers like Kali and Ramganga with their numerous tributaries, the whole of Kumaun region is drained finally by a single river system, the Ganges. The important rivers draining in the system include the rivers- Kuti,

**Table 1**

Approximate area and stream length of fishery resources in Kumaun

S.No.	Resource	Area/stream length	Number
1.	Rivers/streams	1090 Km.	Eight major river + many rivulets & stream
2.	Lakes	225.0 hac.	Six longer lakes + smaller lakes
3.	Reservoirs	14120 hac.	Six Tarai reservoirs
4.	Ponds	465 hac.	1350 Nos (ponds + tanks)
5.	Farms/hatcheries	17 hac.	11 Nos.

**3.1.2. Lakes and reservoirs**

The Kumaun lakes-Nainital, Bhimtal, Naukuchiatal, Sattal, Khurpatal, Garurtal and Shymlat are bigger than 4.0 hac. Whereas there are many small lakes less than 4.0 ha in area and do not harbour any important fishery. The lakes of lesser Himalayas in Kumaun

hills, however support commercial fishery of Chinese carps, Indian major carps, Schizothoracids and Mahseers. Their temperature regime is (5.0 °C -28.2 °C) quite moderate for supporting the fishery of the food fishes and is favourable for the growth of biota too. Similar findings by Sharma et al. (1990), Kumar et al., (2006). There is prolific growth of plankton and benthos (Table 3).

There are 6 reservoirs situated in Tarai region of Kumaun in district UdhamSingh Nagar. The total area of these reservoirs is approx 14120 ha., all the reservoirs have the congenial water qualities supportive to the tropical fishery of Indian major carps, medium carps, Chinese carps and cat fishes like *Wallago* sp., *Mystus* sp., *Channa* sp.etc. The average temperature of these reservoirs always remains above 20°C and hence suitable to harbor all the tropical fishes. Ali et al., (2006) also done similar research and support our results. The important reservoirs in the Tarai region of Kumaun are Tumaria, Nanaksagar, Baur Bagul, Dhaura and Haripura (Table 4).

**Table 2**

Important Rivers of the region showing stream length and water quality

S.No.	Name of the river	Stream length (Km.)	Water temp (°C)	pH	Dissolved Oxygen (mg/l)
1.	Ramganga (W)	197	11.0-28.0	7.2-8.2	7.2-10.1
2.	Saryu	120	10.0-29.0	7.2-8.0	9.7-11.5
3.	Kali	220	12.0-22.5	7.6-8.2	6.5-10.5
4.	Kosi	150	8.5-29.6	7.0-8.5	7.8-13.8
5.	Gomati	49	11.5-20.0	7.2-8.4	8.6-12.4
6.	Gori	100	8.0-19.8	8.2-11.6	7.5-11.4
7.	Dhauri	170	8.5-17.2	7.2-8.0	5.8-10.2
8.	Ramganga (E)	85	10.2-29.0	7.4-7.8	7.8-12.0

**Table 3**

Lakes of Kumaun with elevation, area and water quality

S.No	Name of the lake	Elevation (m)	Area (ha)	Water temperature (°C)	pH	Dissolved Oxygen (mg/l)
1.	Nainital	1937	48.2	0.8-16.0	7.2-7.8	4.2-12.0
2.	Bhimtal	1331	72.2	4.6-28.8	7.0-8.2	6.2-10.0
3.	Khurpatal	1600	13.0	4.8-26.2	8.1-8.7	7.6-09.9
4.	Sattal	1286	43.0	5.2-28.2	6.8-8.0	6.8-09.8
5.	Naukuchiatal	1220	44.6	1.8-29.0	7.2-8.0	4.0-11.5
6.	Shymalatal	1390	3.5	6.0-28.8	7.0-8.0	6.6-11.2

**3.1.3. Ponds and fish farms**

There is approximately 1350 Nos. of small and medium sized ponds in the Kumaun region with covered area of approx 465 ha. These ponds are normally in the size range of 100 sq. m-500 sq. m in the hills and 400-1000 sq. m in Tarai which are used to culture the carp fishes. Some of the ponds in sub-tropical areas of this area are used for growing snow-trout and mahseer fishes. In Kumaun region there are 11 hatcheries/fish farms and most of them are used for seed production of carp fishes. The trout, a famous exotic game fish, is being cultured at Chirapani farm of Champawat district of Kumaun region, while mahseer culture is done in Bhimtal

**Table 4**

Main reservoirs of the region

S.N.	Name	Area (ha)	Average water temp. (°C)	pH	Dissolved Oxygen (mg/l)
1.	Tumaria	2681	25.1	7.8	9.4
2.	Haripura	1168	23.2	7.9	8.6
3.	Baur	1320	21.6	7.8	9.9
4.	Nanaksagar	4662	27.0	7.8	9.2
5.	Bagul	2995	22.9	7.7	8.8
6.	Dhaura	1295	24.8	7.8	11.2

and Pantnagar. Besides the fishfarms/hatcheries of state Government, NRC on Cold water fisheries, Bhimtal, Pantnagar University and six fish farms of private sector at Udham Singh Nagar are also producing fish seed.

Table 5 gives the details of fish farms/hatcheries in Kumaun. Besides the lakes, rivers and reservoirs, a few tanks, barrages and river pools are also available in Kumaun for fisheries. Among these, Naldamyanti tal in district Nainital and Bajinath pool in river Gomti in district Bageshwar are good resource for mahseer fishery. This study is similar as by Singh et al., (2000), Boyd and Tucker (1998).

**Table 5**

list of foremost Fish farms and hatcheries in Kumaun

S.No.	District	Location	Area(ha)	Fish species
1	Nainital	Bhimtal	1.20	Common carp, gold fish
		Bhowali	0.20	C. carpio, gold fish
2	Almora	Manan	0.20	C. carpio, mahseer
3	Pithoragarh	Naini-saini	0.10	Common carp
		Panda	1.0	C. carpio, Chinese carp, IMC
4	Champawat	Chirapani	4.50	C. carp, trout, chinease carp, mahseer, schizothorax
5	USNagar	Pantnagar	—	C. carp, chinease carp, IMC
		Dhaura	4.40	IMC, C. carp
		Baur	—	IMC, C. carp
		Tumaria	2.83	IMC, C. carp
		Hempur	—	IMC, C. carp

**Table 6**

Various fish species related to different altitude

S.No.	Altitudes (m)	Dominant fish species
1.	> 2400	No fish
2.	1800-2000	Sisorids (Glyptothoracids)
3.	1200-1800	Snow-trouts (Schizothoracid)
4.	600-1200	Mahseers (Tor species)
5.	300-600	Crossocheilus spp.

### 3.2. Fish and fishery

#### 3.2.1. Natural fisheries

Fish fauna of Kumaun is rich and diversified. Of the total 203 fish species enumerated from Himalayan waters (including J.K., Himachal Pradesh and North-east hill states) 78 species are identified from Kumaun region including 8 exotic fish species and 3 introduced fish species.

Occurrence and distribution of fishes is governed by mainly the geo-physical features of the region, thermal regime, trophic status and water qualities of the resources. Because of great variation of climate there are large differences in the taxa and population density of fishes. Fish fauna in upper Himalayan region is very poor as compared to middle Himalayas. Lower Himalaya and Tarai waters have quite rich fish fauna. Above the elevation of 2400 mt. fishes are not available. In middle Himalayan resources, 42 fish species have been identified, while from lower Himalayan and Tarai region 78 species are recorded. The occurrence of mahseer is normally observed at low altitudes (600-1200 m) while snow-trouts population dominates in the waters at higher altitudes (1200-1800 m). *Glyptothorax* and *Pseudoechinus* species are available on much higher altitudes (1800-2400 m). At the lower altitudes (300-600 m) most common taxa is *Crossocheilus* spp. Above results similar as with the research findings of Rautela et al., (2006), Sahu et al., (2007), Kumar et al., (2006). The occurrence of various fish species in related to the altitudes is given in Table 6.

As the distribution of fish taxa is concern, district Udham Singh Nagar has maximum number of fish species (78) with respect to 30 species from other districts of Kumaun. This difference in the occurrence of fish species is mainly related to the temperature, as the stream and rivers in hill district has low thermal regime as compared to Tarai region (Table 7).

**Table 7**

The number of fish species available in various district of Kumaun

S.No.	District	No. of fish species	Thermal Zone
1.	Pithoragarh	34	Temperature & coldwater Zone
2.	Almora	30	Cold water & subtropical Zone
3.	Champawat	30	
4.	Bageshwar	30	
5.	Nainital	35*	Tropical Zone
6.	Udhamsingh Nagar	78	

\* Part included in tropical zone

**Table 8**

Important Culturable Fishes of the region

S.No.	Fish species	Common name
1.	<i>Tor putitora</i>	Mahseer
2.	<i>Tor tor</i>	Mahseer
3.	<i>Cyprinus carpio</i> sp	Common carp
4.	<i>Ctenopharyngodon idella</i>	Grass carp
5.	<i>Hypophthalmichthys</i>	Silver carp
6.	<i>molitrix</i>	Snow trout
7.	<i>Schizothorax richardsoni</i>	Brown trout
8.	<i>Salmo trutta fario</i>	Rainbow trout
9.	<i>Onchorynchus mykiss</i>	Golden carp
10.	<i>Carassius carassius</i>	Rohu
11.	<i>Labeo rohita</i>	Nain
12.	<i>Cirrhinus mrigala</i>	Katla
	<i>Catla catla</i>	

stretches are famous for their sports fisheries. Bhimtal, Naucuchiatal and Sattal lakes are famous for mahseer sports where as Nainital lake is important for carp fisheries. Among river stretches Pancheswar in River Kali, Chalthi in River Ladhiya and Hawalbag in River Kosi are few important spots for fishing and angling of mahseer. These results are supported by findings of Rautela et al., (2006), Sahu et al., (2007), Kumar et al., (2006), Hynes, (1974), Rafique et al., (2002).

### 3.2.3. Culture Fisheries

Fish breeding, nourishing fry, rearing fingerlings and raising brooders are the important component of culture fishery. In Kumaun, 11 fish farms and about 1350 fish ponds are the important culture fishery resources. The important culturable fishes in the state are mainly the carps, mahseers and trouts. The culture of schizothoracids, however is being attempted in some spots. A list of culturable fishes in Kumaun is given Table 8.

The culture fishery in Kuamun is mainly dominated by the Chinease carps and Indian major carps in the foot hills and lower Himalayans ponds while in upper Himalayan region where the temperature is quite low culture of exotic carps and trouts is in practice. The mahseer culture is being done at Bhimtal and Pantnagar fish farms along with other carp. The culture of *Schizothorax* sp. is in the beginning stage and being attempted at Chirapani fish farm and by few fish farmers in Pithoragarh district. Besides growing brooders, fish seed is produced and distributed by the farms/hatcheries.

In trout culture two exotic species, brown trout (*Salmo trutta fario*) and rainbow trout (*Onchorynchus mykiss*) is practiced only at Chirapani fish farm in Kumaun. These fishes normally breed during winter months at low temperature and hence their incubation and hatching period is quite prolonged (28-62 days).

### 3.2.2. Capture Fishery

The rivers, streams, lakes and reservoirs are the capture fishery resources in the region. In riverine fishery fish catches from the rivers and streams comprise the running water fishery. Among the fishes inhabiting in these resources mahseers, snow-trouts, medium carps, barils, sisorids, loaches are important. Mahseer fishery is dominant in the lower reaches of Saryu, Kali, West Ramganga, East Ramganga and Ladhiya. Where as upper reaches of these rivers harbour a rich fishery of *Schizothorax* sp. Gori, Kali, Dhauli, East Ramganga are the important rivers known for snow trout fishery but trout fishery is not predominant in the region.

In lacustrine fishery common carps, chinease carps, indian major carps, snow trouts and Mahseers are the important component of lake fisheries in Kumaun region. Except Nainital lake in Kumaun, Bhimtal, Sattal, Nankuchiatal, Khurpatal, Nal-Damyantital situated between the elevation 1220 mt and 1600 mt asl are known for mahseer fishery. In Nanital lake mahseer was a prominent fishery earlier but due to pollution and other factors, its fishery has declined sharply and the fish has lost its existence in this lake. Recently in the Nanital lake has been undertaken for aeration to increase the dissolved oxygen content of the lake to lower the consequences of pollution and mass mortality of inhabiting fauna in winters.

The fisheries of Tarai reservoirs were restricted to tropical fishes only. The main fishery in these water bodies comprised by Indian major carp i.e. Rohu, Cattla and Mrigal, Common carp, medium carp-Labeo species and Cat fishes i.e. Wallago, Mystus & Channa species etc. Stray specimens of mahseer are also caught casually near the mouth of the feeding channels during monsoons.

In sports fishery Mahaseers and trouts are world famous fishes known for the excitement and for angling. Though there are number of fishes available under the group game fishes like *Raimus* bola, a few varieties of carp fishes and some silurids (Cat fishes). They inhabits in both capture and culture fisheries resources. Kumaun lakes and river

In Mahseer cultrue the seed of mahseer (*Tor putitora*) is produced in the fish farms at Bhimtal. They have prolonged breeding season existing from April-September, while peak breeding season for these fishes was observed during the monsoon months (July-Aug). The incubation of mahseer eggs takes absent 72-110 hrs and yolk absorption is completed within 7-14 days. The tiny fry are then reared in nursery ponds. When they grow to the fingerlings stage they are stocked in bigger water bodies.

In ornamental fish culture there are varieties of ornamental fishes available in the region and are cultured in aquariums and small nursery ponds. A few fishes of the groups Barbus, Barils, Loaches and small cat fishes are included in this group. At present the culture of ornamental fishes is being done at Pantnagar and Bhimtal. The culture of golden carp, an ornamental fish is being done in the state fisheries farms at Bhimtal and Bhowali. This work gets similar as with Jhingran, (1965), Alikunhi, (1957), Boyd and Tucker, (1998).

## ACKNOWLEDGMENTS

The author acknowledges the LSRB-DRDO (R&D) New Delhi organization for financial assist and FRDL for Laboratory as well technical support.

## REFERENCE

1. Ali A, Bhatti MN, Khan N and Rehman MH. Role of soil and water chemistry in aquaculture. *Proceedings of International conference on solving problems of Freshwater Fish Farming in Pakistan*. 2006, 139-141
2. Ali SS. Freshwater Fishery Biology. 1st Ed. Naseem Book Depot, Hyderabad, Pakistan. 1999, 108 14
3. Alikunhi KH. Fish culture in India. *Bull. Indian Coun. Agri. Res.* 1957, 20, 144
4. APHA-AWWA-WEF. Standard methods for the examination of water and wastewater, 20th edition. Washington DC, USA: American Public Health Association. 1998
5. Bhatt SD, Bisht Y, Negi U. Ecology of the limmofauna in the river Kosi of the Kumaun Humalaya. *Proc. Indian Matn. Sci. Acad.* 1984, 50, 395-405.
6. Boyd CE, Tucker CS. Pond aquaculture and water quality management. Kluwer Academic Pub., London. 1998, 44-48
7. Boyd CE, Tucker, CS. Pond aquaculture and water quality management. Kluwer Academic Pub., London. 1998, 44-48
8. Day F. The fishes of India: being a Natural History of the Fishes known to inhabit the seas and Fresh waters of India, Burma and Ceylon. Reproduced in 1958. London: Willian Dawon and Sons
9. Hynes HBN. Further studies on the distribution of stream animals within the substratum. *Limmol. Oceanogr.*, 1974, 19, 92-99
10. Jayaram KC. Fundamentals of fish Taxonomy. *Narendra Publishing House, Delhi*. 2002
11. Jhingran. Report on inland fisheries research and management and fish culture in the U.S.S.R. Misc. contr. Cent. Int. Fish. Res. Inst, Barrackpore. 1965, 5-27
12. Kumar K, Rautela KK, Bisht KL, Joshi VD, Rautela AS, Dobriyal AK. Ecological studies on the Biodiversity of river Khoh in the foothills of Garhwal Himalaya. *Journal of Natcon.* 2006, 18, 71-80
13. Moghraby A, Rahman A. Food and feeding habits of *Labeo niloticus* (Pisces: Cyprinidae) in Jebel Aulia Reservoir, Sudan. *Hydrobiologia*, 1984, 110, 327-332.
14. Odum EP. Fundamentals of Ecology. 3rd Ed. Toppan Company, Ltd., Japan. 1971, 278-84
15. Rafique RM, Hussain N, Mahboob S. Limnological variation in river Jhelum at Dulahi Muzaffarabad. *J. Nat. Sci.*, 2003, 1, 107-112
16. Rautela K, Bisht K, Joshi KL, Negi VD, KS, Rautela AS, Dobriyal AK. Ecological studies on the biodiversity of river Khoh in the foot hills of Garhwal Himalaya. *Aquaculture*, 2006, 7, 277-283
17. Sahu PK, Jena JK, Das P, Mondal C, Das R. Production performance of *Labeo calbasu* (Hamilton) in polyculture with three Indian major carps *Catla catla* (Hamilton), *Labeo rohita* (Hamilton) and *Cirrhinus mrigala* (Hamilton) with provisions of fertilizers, feed and periphytic substrate as varied inputs. *Aquaculture*, 2007, 262, 333-339
18. Sharma RC, Gusain OP, Juyal CP. High Altitude river Bhilingana of Garhwal Himalaya . In: *River pollution in India*. Ed. Trivedy, R.K. (ed). Ashish publication House, New Delhi. 1990
19. Shukh R. Comparative studies of physic-chemical characteristics of water quality of river Betwa. Kolar dam and upper Lake of Bhopal. Thesis of Ph.D. (Chemistry) Barkatullah University Bhopal. 1996
20. Singh P, Jee C, Pandey BN, Singh BK. Study of Variation Range of Different Physico-chemical Parameters in Relation to Fish Productivity and Health. *Advan. In. Zool. Environmental-degradation, biodiversity*. 2000, 4, 213-217
21. Swingle. Standardization of chemical analysis for waters of pond mud. *FAO Fish. Rep.* 1967, 4, 397-421
22. Talwar PK, Jhingran AG. Inland fishes of India and adjacent countries. *New Delhi, Oxford and IBH Publishing Co Pvt. Ltd.* 1991