

Fish diversity in the selected streams of Chakrata and Shiwalik Hills (District Dehradun, Uttaranchal), India

**DEVI PRASAD UNIYAL
ARUN KUMAR**



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Shiwalik hills, (District : Dehradun, Uttaranchal), India**

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INTRODUCTION

Animals had been studied since ages due to their economic value, the reference is found in epics and ancient literature, Hora (1948, 1950, & 1951). Among animals the fishes has been considered one of the most important creatures and being explored properly. Fishes can be defined as cold-blooded aquatic vertebrate which breath by means of gills and locomote with the help of fins namely, dorsal, caudal, pectoral, pelvic and anal fins named according to their position. It is an important feature for the taxonomical studies. In India the evidence of occurrence of fish reported dates back to three millennium B.C., Hora (1956). The remains of fishes were gathered during the excavations at Mohenjodero and Harappa of the Indus valley (2500 B.C.–1500 B.C.), Nath (1966). Somesvara, the son of King Vikramaditya-VI, who composed the book, *Manasoltara*, in 1127 A.D. was the first to record the common sport fishes of India. He grouped them into marine and freshwater. These reference clearly reveal that fishes were paid due attention in the past and reason for the same was their economic as well as biological value. Now fisheries science have developed tremendously and considered as an important industry. It is a chief source of economy in the country like Japan, Korea, China and many European countries. Yet in developing countries like India, Bangladesh, Myanmar, Nepal and Pakistan the industrial fisheries is in initial stage and expected to flourish in the coming years. In India fisheries have wide scope due to the diversified fish fauna *i.e.* Inland fishes, hill stream/river, estuarine, and marine fishes. In coastal area pesiculture have been taken seriously and it is attracting attention of farmers and big companies. Government is also encouraging the upcoming industries.

The fish fauna of India exhibits enormous diversity in their size, shape, colour and habitats. Fishes live in almost every possible aquatic habitat, they are reported from coast of Indian subcontinent, coastal lagoon, estuaries, coral reefs, back waters, rocks, sand, mud, dark caves, torrential streams/rivers, lakes and ponds. In India all these habitats are found and are responsible for the diversity of fish life. Fishes are adapted to adjust them self according to their habitat. Due to same reason fishes of marine water differ from fresh water and that of hillstream *e.g.* hillstream fishes have to bear the great amount of thrust so they develop an adhesive apparatus which help them to bear the fast moving current and attach them to the substratum, Whereas, marine fishes have to bear the tides and saline water so they develop big fins and other adaptive apparatus. Fishes constitute almost half of the total number of vertebrates. Out of 39,900 vertebrate species recognized the world over 21,723 are living species of fishes of which 8411 are of freshwater (excluding commonly diadromous that may have landlocked populations) and 11650 marine species. In the Indian region alone 2500 species were reported out of which 930 are freshwater inhabitants and 1570 are marine, Jayaram (1999).

Uttaranchal is rich in terms of fish diversity due to the two important perennial rivers of India *i.e.* River Ganga and Yamuna supported by many other tributaries. This new state has wide potential for fisheries especially in hill streams/rivers and their tributaries. Fishes can be propagated easily and can enhance the economy of this area. The state Government is taking ambitious steps to establish fish culture successfully in this region. It is essential to know the status of fish taxonomy, ecology and biology for further policy planning, management and conservation. Dehradun district remain an important research centre since past due to its geographical setup and availability of diversified fish fauna *i.e.* hill stream as well as warm water fishes. Geographically Dehradun can be divided into Eastern and Western Doon Valley. Both divisions are bestowed with rich perennial rivers. Eastern part, with Ganga river and its tributaries *viz.* Song, Suswa and Rawasan forming rich network. The western part is drained by Yamuna river system and its tributaries *viz.* Tons and Amlawa (originated from hilly area) and Asan River (originate from Shiwalik hills) with many seasonal nallas, Rao, Oggal, which form rich, network of water in Western Doon Valley.

Uttaranchal state was formed on the 19th November 2000 (separated from Uttar Pradesh state). Geographically Uttaranchal is divided into the two subdivisions Kumaon and Garhwal. The main work on fish fauna of Kumaon hills has been done by Hora (1937), Menon (1949, 1950, 1971), Chaudhary and Khandelwal, (1960), Pant (1970), Husain (1976, 1979, 1980), Das & Pathania (1978), Bhatt *et al.* (1984), Sunder (1990), Bhatt and Pathak (1992a,b), Joshi *et al.* (1993), Pathak & Bhatt (1993), Joshi (1999, 2000), Pathania & Rautela (2000), and Chawan (2000). While Garhwal hills were well explored by Atkinson (1884, 1974), Menon (1954, 1962, 1974, 1999), Hora (1952), Tilak (1969, 1970), Badola and Pant, (1973), Badola, (1975, 1979), Badola and Singh (1977a, 1977b, 1977c, 1981a, 1981b, 1982), Grover and Baloni (1977a,b,c), Singh and Badola (1979, 1978), Singh (1978), Baloni & Grover (1980, 1982, 1987), Dobriyal & Singh (1981, 1989), Sharma (1981, 1984, 1988, 1992), Singh and Dobriyal (1982), Singh *et al.* (1982, 1987, 1991), Tilak and Baloni (1984), Dobriyal (1985, 1991), Baloni and Tilak (1986), Khann & Badola (1987), Dobriyal & Kumar (1988), Nautiyal (1989, 1990, 1994, 1996, 2000, 2001), Juyal and Gusain (1990), Singh *et al.* (1991), Dobriyal *et al.* (1992), Nautiyal & Lal (1994), Joshi *et al.* (1993), Kumar & Dobriyal (1996), Husain (1997), Singh and Sharma (1998), Khanna *et al.* (1997), Badola & Badola (1999, 2000), Singh & Kumar (2000), Joshi (2000), Karmakar (2000), Khan (2000) and Joshi & Bist (2001) *etc.*

In past considerable work has been done by Ichthyologist in Doon Valley in the field of fish taxonomy, ecology, hydrobiology and conservation aspect by William (1874), Atkinson (1884), Fowler (1924), Hora and Mukherjee (1936), Das (1960), Lal (1962, 1963, 1971), Lal and Chatterjee (1963), Lal *et al.* (1964, 1966, 1979), Lal and Grover (1968), Singh (1964), Grover (1969, 1970, 1972, 1976a, 1976b, 1976 c, d, e, 1978 a -f, 1979 a-e), Tilak (1970), Tilak and Husain (1971, 1973, 1975, 1976, 1977a, 1977b, 1978, 1980, 1981, 1982, 1984), Husain (1975, 1976, 1979, 1980, 1985, 1987, 1995, 1996, 1997), Grover *et al.* (1979, 1994), Grover and Tripathi, (1979, 1983, 1985), Sharma and Grover (1982), Tilak & Jaffar (1982), Tilak & Sharma (1982), Prakash and Grover (1983), Chauhan and

Grover (1983), Tripathi (1983), Madwal *et al.* (1983), Kumar & Mathur (1985), Bist *et al.* (1989, 1990), Kumar *et al.* (1990), Husain and Tilak (1995), Pandey and Mishra (2000) Rauthan *et al.* (2000), Uniyal (2002) and Uniyal *et al.* (2001a, 2001b, 2002a, 2002b, 2005a, 2005b, 2005c, 2005d).

Most of the references in fisheries research in Doon Valley are on eastern part, whereas the western part of Doon valley remained neglected due to its topography. In Eastern Doon Valley it is easy to reach the river sites due to better road linkage and terrain. Whereas in western part of Doon Valley the river sites are not accessible due to poor road linkage. Beside that the main perennial river of Western Doon Valley originates from hill area (mainly from Jaunsar Bawar, Chakrata hills). So due to above mentioned limitations very less work has been done except Zoological Survey of India (ZSI, Dehradun) worked in some limited area. In the present study two important rivers of Western Doon Valley *i.e.* Amlawa river (Chakrata hills) and Asan river (foothills of Doon Valley) have been selected to study fish diversity and remote sensing in both the rivers, having different topographical and geographical setup.

In Western Doon Valley very scanty work has been done on fish taxonomy. The first report in Amlawa and Asan river was given by Singh (1964). He listed 8 species from Asan river and 4 species from Amlawa river. While Husain (1987) studied the selected sites of Amlawa river. Moreover ecological aspects like fishing methods, remote sensing and geographical information system and conservation of fish fauna have not been studied by any worker in Amlawa and Asan river. Hence for the first time an attempt has been made to fulfill the gap of knowledge in western part of Doon valley on following aspects :

- 1 A survey of Amlawa and Asan river was conducted to know the fish diversity in the remote tribal area (Chakrata hills) and foothills of Western Doon valley (Shiwalik hills).
2. Remote sensing and Geographical Information System (GIS) studies of the study area were carried out. However, encouraging results were not received due to the narrow and deep flow of river system within the rocky and bolder area especially in Amlawa river.
3. The fishing methods used in the Western Doon Valley were thoroughly observed and divided into scientific and unscientific methods. The ill effect of unscientific fishing methods on fish fauna has been highlighted.
4. The causes for depletion of fishes were observed and precautionary measures have been suggested to conserve and manage the fish diversity of Amlawa (Chakrata hills) and Asan river (Shiwalik hills) of Western Doon Valley.

In this project total two extensive surveys of seven days each and twenty five Intensive survey have been undertaken (2000-2002). It is expected that the present work will provide the baseline information for formulating the fisherie policies and for establishing fisheries in the remote tribal area of Chakrata hills and in foothills of Western Doon valley (Shiwalik hills). Thus, the results of present work have both academic as well as applied values.

MATERIAL AND METHODS

(i) Selection of collection site

The following sites were established on the basis of variation in altitude and longitude of Amlawa and Asan river of Western Doon Valley.

(a) Sites of Amlawa River : Amlawa river originates from Chakrata Hills (Deoban peaks) and travels through different terrain. Riverbed consists of different sized boulders, which acts as a breeding ground for the hillstream fishes. Sites selected on Amlawa river are: site A₁ Kalsi (Alt. 568.75 m, Lat. (N) 30°32' Long (E) 77°51'; site A₂ Seligothan (Alt. 1420.6 m, Lat. (N) 30°34' Long (E) 77°52'; site A₃ Sahiya (Alt. 1858.2 m, Lat. (N) 30°37' Long (E) 77°53' and site A₄ Chakrata (Alt. 2151.56 m, Lat. (N) 30°42' Long (E) 77°52'

(b) Sites of Asan River : Asan river originates from foothills of Shiwalik and travels through different villages which are situated at different altitudes these are: site A₁ Dhalipur (Alt. 422 m, Lat. (N) 30°26' Long (E) 77°41'; site A₂ Jhajra (Alt. 544 m, Lat. (N) 35°21' Long (E) 77°55'; site A₃ Badowala (Alt. 558.2 m, Lat. (N) 30°22' Long (E) 78°48' and site A₄ (Alt. 704.2 m, Lat. (N) 30°20' Long (E) 77°38'

Altitude was calculated with the help of Altimeter at different sampling sites. Whereas longitude was noted from the toposheet (By the permission of Director General of Survey of India).

(ii) Fish Collection

Monthly fish collection was made during day and night to get the maximum representation of fishes by using different sized fishing nets. However, some fishes were also procured from the local fishermen at different sampling sites e.g. Kalsi, Seligothan, Sahiya and Chakrata in Amlawa river and Dhalipur, Jhajra, Badowala, and Chandribani in Asan river.

The river Amlawa is a hillstream river and originates from the Chakrata Hills (Deoban Peaks). Geographically it traverses through Deoban forest, Chakrata Sahiya, Seligothen and finally merges with Yamuna at Kalsi village (near the famous Ashoka Pillar). In both the rivers lot of nallas, ogals (water oozing out from earth) merges and during rainy season a lot of rainwater drains to this river.

The fishes were collected from Asan river, which originates from the north-east of Shiwalik foothill which traverse through Chandribani, Ogalwala, Badowala, Harbajwala, Jhajra, Subhawala, Sahaspur, Dhalipur villages and finally merges with Yamuna river at Rampur Mandi near Asan barrage.

(iii) Fish Preservation

Fishes were examined in fresh as well as in preserved condition in the field and laboratory respectively. Before preservation a small cut/incision was given at abdominal region for better penetration of formaline solution in the internal organs of the fishes. Formaline injections were also given in some fresh fishes for better preservation and fixation of internal organs. For the maintenance of colour little amount of rectified spirit and Glycerine were also used. The fixed specimen were kept in glass, plastics Jars of different size with proper label containing date of collection, locality (site of collection), geographical/ecological note, number of examples and collector's name *etc.* The snout of the collected fishes were kept downward and the caudal fin upward in the jar to avoid damage to the soft parts of the fishes.

(iv) Fish Identification

The identification of the fishes was done by using various morphometry and merestimatic characters of the various species of fishes *viz.* general body shape, the structure of fins, fin count, body coloration, the length and count of barbels and distribution of scales on the body.

Measurements of different parts were taken in consideration for the formation of fin formula *viz.* (1) Total length (2) Standard length (3) Body depth (4) Ocular diameter (5) Snout length (6) Body length (7) Length from snout to dorsal fin (8) Length from snout to pectoral fin (9) Length from snout to pelvic fin (10) Length from snout to caudal fin (11) Length from snout to anal fin (12) Dorsal fin ray (14) Pelvic fin ray (15) Pectoral fin ray (16) Caudal fin ray (17) Anal fin ray and summarized in Fin Formula.

The fishes were classified according to Nelson (1984) with modification that of Talwar and Jhingran (1991) and Jayaram (1999). The macro identification of different fishes was done with the help of Day (1878), Srivastava (1968), Jhingran (1975), Jhingran & Seghal (1978), Dutta & Srivastava (1988), Talwar and Jhingran (1991) and Jayaram (1999).

(v) Physico-chemical study

Physico-chemical study was undertaken on the Amlawa and Asan river. The study is helpful to understand the suitability of water for the qualitative and quantitative analysis of fish fauna in two aquatic systems. The following physico-chemical parameters have been analysed by following standard methods of A.P.H.A. (1998) and Das (1989) to know the effect on the fish life in different seasons in the years (2000).

(a) Water and Air Temperature (°C) : The water and air temperature was calculated by the ordinary thermometer. Air temperature was recorded by keeping thermometer suspended in the air for 1 minute and the reading was recorded. The water temperature was taken from surface, mid and bottom. The thermometer was dipped in the water by tying with thread for 2 to 5 minutes from 3-5 different places on each site and then reading was recorded. The mean and standard deviation (SD) in temprature was calculated for every season from the different sampling sites of Amlawa and Asan rivers.

(b) Water current velocity (m sec⁻¹) by using Float Method : The speed of water was measured by Float Method. The rate of flow of the upper most water in both the rivers was measured by throwing a light piece of wood in different sampling sites in the river. Then the time taken by the wooden piece to cover the known distance (x distance) was recorded.

(c) Turbidity (NTU) : Turbidity was measured by Nephelometer (Elico Model CL-52) in the laboratory. The instrument was set at 100 with the 40 NTU standard suspension of hydrazine sulphate (NH₂)₂ H₂SO₄ and hexamethylene tetramine (CH₂)₆N₄. The sample, after shaking thoroughly, was put in the nephelometer sample tube and the values were directly seen in meter. More turbid samples (especially during monsoon) were diluted (to less than 40 NTU) by adding distilled water. The turbidity was expressed as Nephelometric Turbidity Unit (NTU) following the equation:

$$\text{Turbidity, NTU} = \text{Nephelometer reading} \times 0.4 \times \text{dilution factor.}$$

(d) Dissolved oxygen (mg l⁻¹) : “Winkler method” was followed to calculate the dissolved oxygen of river water. Water samples were taken from the sampling sites in BOD bottles of 350 ml, adding 1 ml, manganisum sulphate and 3 ml alkaline potassium iodide beneath the surface of water fixed the collected samples. The brown precipitate was allowed to settle down and then add 1 ml of concentrated sulphuric acid (Sp. gr. 1.83). This was done in field. Than 200 ml of the treated sample was transferred into a volumetric flask and than the sample was titrated with N/40 (0.025 N) sodium thiosulphate solution untill the pale straw colour appeared. Then 1 ml of starch solution was added which made the solution iodine coloured. The titration was continued over a white background until the blue colour disappeared. According to Welch (1952), “If a 200 c.c. sample is titrated the number of C.C. of the sodium thiosulphate solution used is numerically equal to the dissolved oxygen content in parts per million (ppm) and no additional calculation is necessary.”

(e) pH : The pH value of the river water was measured by pocket digital pH meter or some time by pH test paper. The water samples were brought to the laboratory where the final pH was examined by Elico pH meter.

PHYSIOGRAPHY OF THE STUDY AREA

Himalaya is the youngest mountain chain in the world. In India it begins from Karakoram and end up to the North East Himalaya. The newly formed Uttaranchal state lies in the western part of the Himalaya, which comprises of two subdivisions – Kumaun and Garhwal. Garhwal Himalaya lies in Lat 29°26' to 31°5' N and Long 78° to 88° E with an area of 30,090 km². Garhwal Himalaya includes six districts varying topographical and altitudinally (400 m-7,817). Garhwal Himalaya consists of diversified ecosystems resulting in rich floral and faunal diversity. Thus Garhwal Himalaya is considered as one of the hot spot of biodiversity in the country.

The study area falls in the Western part of district Dehradun which is the capital of Uttarakhand state. Dehradun is bounded by the district Uttarkashi (Uttarakhand) at the North and North-East, district of Tehri Garhwal (Uttarakhand) is situated at its East and district Saharanpur (Uttar Pradesh) at South. District Bijnor (Uttar Pradesh) touches its extreme southern part. The western part of district Dehradun is separated from Himachal Pradesh with the river Tons and river Yamuna. It is situated between the latitude of 29°57' and 31°2' North and Longitude of 77°35' and 78°20' East. The area of district is 2,455.9 Km²

Physiographically the district of Dehradun is divided into three zones viz. (i) The lesser Himalayan zone in North-West (ii) The Doon valley zone in the central part and (iii) Siwalik range zone in the south. The present study is conducted in the first and second zones i.e. the lesser Himalayan region (Chakrata hills) and the Doon valley (Plate-1).

LESSER HIMALAYAS

Chakrata tehsil popularly known as "Jaunsar-Bawar" lies in lesser Himalayas. It is situated at the latitude 30°30' and 31°2' N and longitude 77°42' and 78°5' E with an area of 700 Km². This is a tribal area. It is a mountainous region having deep gorges and poor accessibility. The study area of Amlawa river lies in Lesser Himalayas.

Amlawa river

Amlawa river arises from Deoban forest (high altitude) of Chakrata hills (lesser Himalaya). Popularly this area is called Jaunsar and it is the tribal area of Doon valley. River passes through tough mountainous terrain like Chakrata, Sahiya, Seligothan and Kalsi. The total catchment area is 46 km. River provides irrigation water, building material and faunal wealth (mainly fish), which is an alternative source of economy to the tribal people. River finally merges with Yamuna river at Kalsi near the world famous Ashoka pillar. The gradient falls of 6 km. In Amlawa river four sampling sites are selected (Plate-2; Plate-8, Fig.6) these are :

1. Kalsi (A1) : Kalsi lies at Lat. (N) 30°32' Long (E) 77°51'. It is famous for Ashoka's inscription (pillar), which was engraved by the emperor Ashoka in 250 B.C. At this site confluence of river Amlawa with river Yamuna takes place.

2. Seligothan (A2) : Seligothan lies at Lat. (N) 30°34' Long (E) 77°52'. It is a small village. Accessibility of this area is poor. River Amlawa flows through deep gorges in this area.

3. Sahiya (A3) : Sahiya lies at Lat. (N) 30°37' Long (E) 77°53'. It is an important township of Chakrata hills and acts as a connecting link for many villages. The river Amlawa flows through the plain area in this region.

4. Chakrata (A4) : Chakrata lies at Lat. (N) 30°42' Long (E) 77°52'. It is an important township of Jaunsar-Bawar area and is famous for its natural beauty. River flows through deep gorges and water level is less in this site. Origin of Amlawa takes place in Chakrata.)

Climate

In Chakrata hills four seasons were observed viz. summer (April, May and June), Monsoon (July, August and September), autumn (October, November and December) and winter (January, February and March). Maximum temperature of 34.5°C was recorded in summer and minimum temperature of 8°C was recorded in winter season.

DOON VALLEY

The outer Himalaya consists of a number of longitudinal valleys lying between the Siwalik and Himachal Pradesh, which are known as "Duns". Dehradun is the biggest valley it is popularly called Doon valley. The Doon valley is situated at latitude 29°58' and 30°32'N and longitude 77°35' and 78°20'E. The Doon valley is about 75 Km long and 25 Km wide with an area of 3088 km². Geographically the Doon valley is divided into Eastern and western Doon. The study area of Asan river falls in the Western part of Doon valley, which is having the Yamuna river basin whereas, Eastern Doon valley is having the Ganga river basin. The important drainage of district Dehradun is the Ganga river basin (Eastern Doon valley). It comprises the rivers Song, Suswa and Rawasan. Whereas on the other hand the Yamuna basin (falls in Western Doon valley) comprises of Asan, (Dehradun plain) Tons and Amlawa.

Asan River

The river Asan arises from foothills of Shiwalik hills near Chandribani temple. Previously its origin was near the Asarooriee forest, which is now shifted about 6km from its native origin. This 6 km is now dry river basin. The Asan river flows towards the Yamuna (western end of Doon valley) as an important tributary and merges with Yamuna at Dhalipur. Tons, Surna, Sitala Roa are the small tributaries of Asan river. The total river system of Asan is about 45 km from its origin to Yamuna confluence. The altitude of origin place of the river Asan is 700 mt msl, while the altitude of confluence is 400mt msl. The river is having very significant feature that it runs from east to west while most of the rivers flow from north to south or west to east in Himalayan region. In Asan river four sampling sites (Plate-3; Plate-8, Fig. 7) are selected these are :

1. Dhalipur (A₁): Dhalipur lies at Lat. (N) 30°26' Long (E) 77°41'. At this site confluence of Asan and Yamuna river takes place. River Asan forms a barrage before its confluence with Yamuna at Dhalipur, which is known as "Asan barrage" famous for migratory birds visiting during winter season.

2. Jhajra (A_2): Jhajra lies at, Lat. (N) 35°21' Long (E) 77°55' It is a big village with human habitation on both the banks of river. The riverbed is wide and shallow.

3. Badowala (A_3): Badowala lies at Lat.(N) 30°22' Long (E) 78°48' The bank of river is densely populated with big agricultural fields.

4. Chandribani (A_4): Chandribani lies at Lat. (N) 30°20' Long (E) 77°38' Asan river originates from this village from the pond of a temple (natural water oozing out). It is densely populated village.

Climate

In Doon valley four seasons were observed viz. Summer (April, May and June), Monsoon (July, August and September), Autumn (October, November and December) and Winter (January, February and March). Maximum temperature of 42°C was recorded in summer and minimum temperature of 16°C was recorded in winter season.

District Dehradun is having a good interstate and network of roads. The eastern part of Doon valley (plain) has good condition metaled roads and railway link. While western part

Table 1 : Physiographic details of Amlawa river of (Chakrata Hills) Western Doon valley.

Sl. No.	Site	Altitude (msl)	Distance between sites (Km)
1	A_1 Kalsi (Confluence)	568.75 m	0 Km
2.	A_2 Seligothan	1420.60 m	A_1 to A_2 - 10 Km
3.	A_3 Sahiya	1858.20 m	A_2 to A_3 - 15 Km
4.	A_4 Chakrata (Origin)	2151.56 m	A_3 to A_4 - 20 Km

Table 2 : Physiographic details of Asan river of (Shiwalik Hills) Western Doon valley.

Sl. No.	Site	Altitude (msl)	Distance between sites (Km)
1.	A_1 Dhalipur(Confluence)	422.00 m	0 Km
2.	A_2 Jhajra	544.00 m	A_1 to A_2 - 10 Km
3.	A_3 Badowala	558.20 m	A_2 to A_3 - 15 Km
4.	A_4 Chandribani (Origin)	704.20 m	A_3 to A_4 - 20 Km

PLATE-1

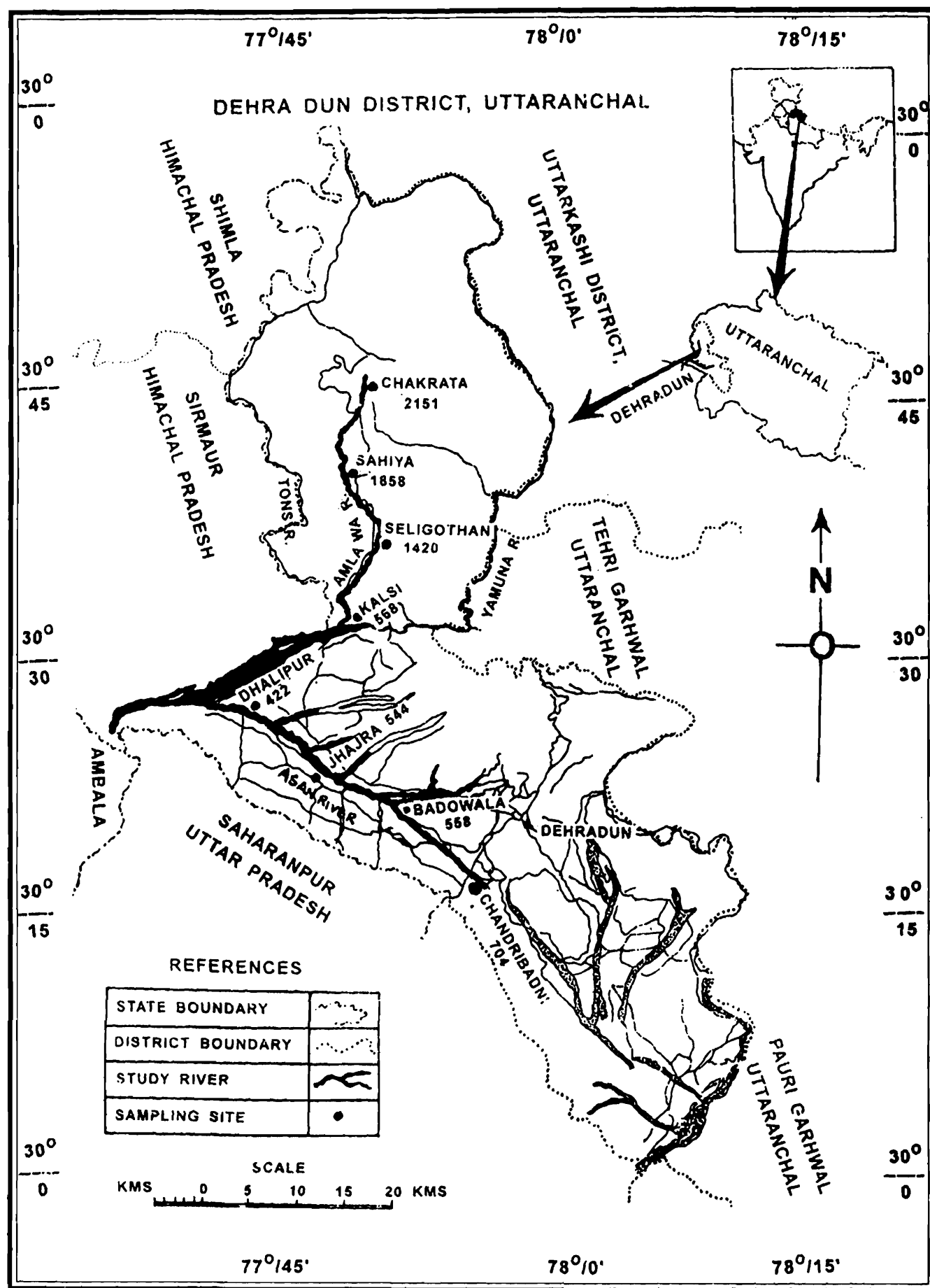


PLATE-2

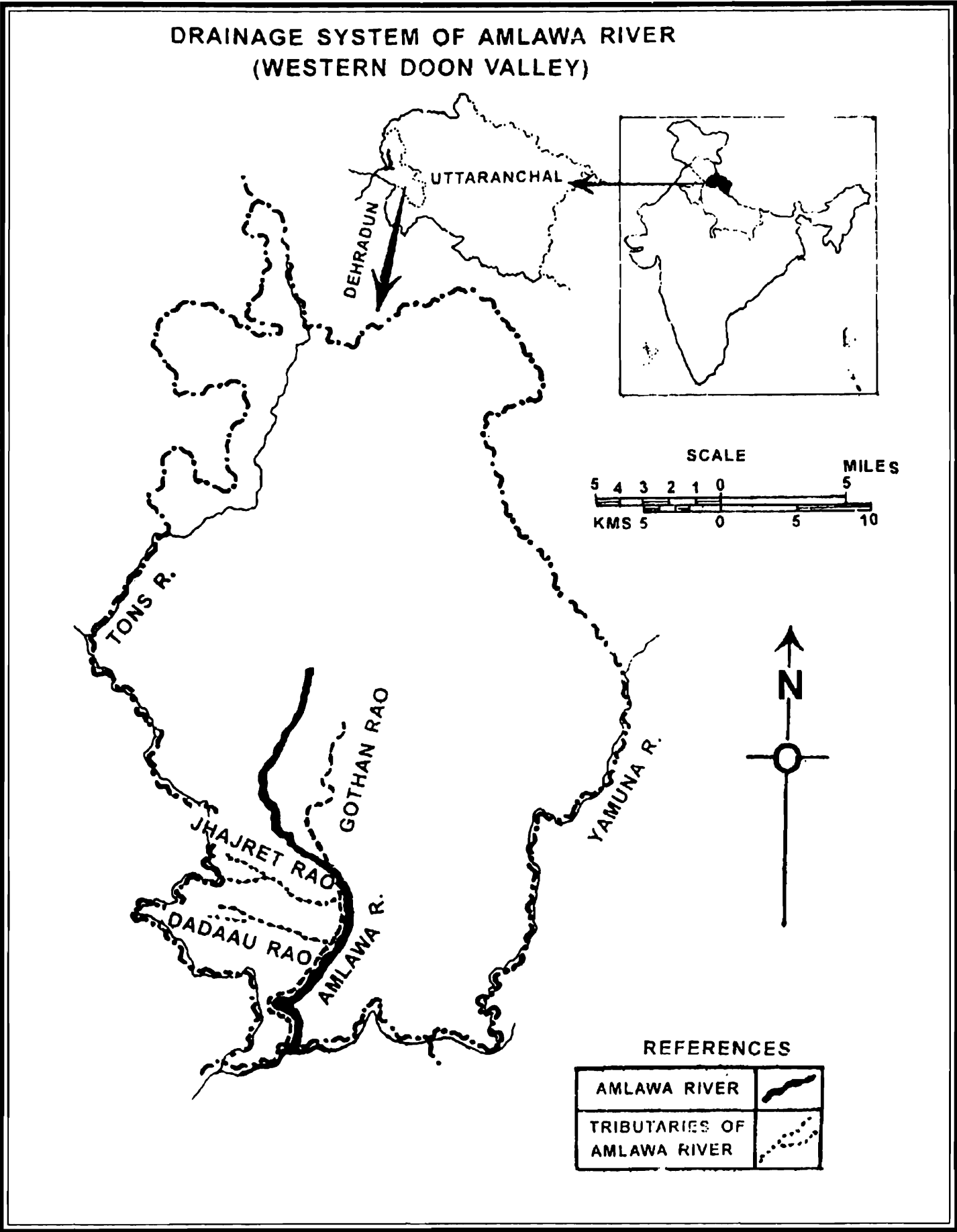
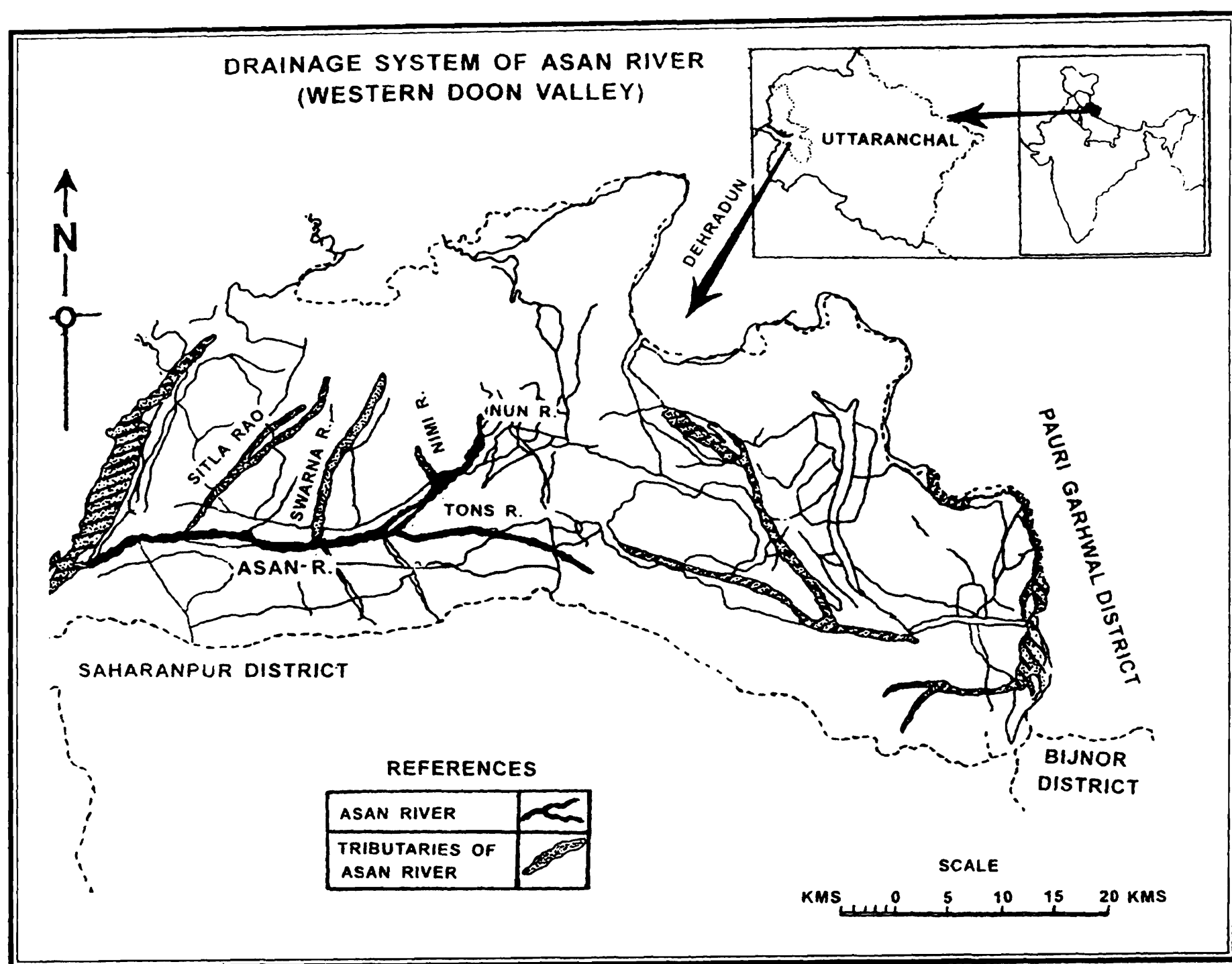


PLATE-3



have poor network especially in Chakrata hills. Due to natural climates, rain, snow the road block is quite common and it remains cut off from the neighbouring districts.

FISH DIVERSITY IN AMLAWA RIVER (CHAKRATA HILLS) AND ASAN RIVER (SHIWALIK HILLS) OF WESTERN DOON VALLEY

The freshwater resources of Dehradun district have good network of perennial rivers/hillstreams, pond, and reservoirs *etc.* Which provide an ideal habitat to flourish the diversified fish fauna. Doon valley act as a connective link between the plain and hillstream fishes. Hence, Ichthyologists and naturalists have carried out an important research work in this area especially in the field of taxonomy and ecology. During the British period Doon valley was famous for angling of the mighty game fish mahseer. Geographically Dehradun Distt. can be divided into Eastern and Western Doon valley. Eastern part is supported by Ganga drainage with number of tributaries, oggal (natural water oozing out from earth) and pond *i.e.* Song, Suswa and Rawasan *etc.* Whereas Western part is supported by Yamuna drainage with an important tributaries *i.e.* Amlawa, Asan, and Tons *etc.* However the Western part of Doon valley remained less explored as compared to Eastern Doon valley, as the accessibility in Western Doon valley *i.e.* Tons valley, Yamuna valley and Chakrata hills (Jaunsar-Bawar) is difficult due to poor road, transportation linkage and tough terrain.

The present chapter deals with fish diversity of Amlawa and Asan rivers of Western Doon Valley. The classification given by Nelson (1984), have been followed with slight modification that of Talwar and Jhingran (1991) and Jayram (1999).

The distribution of fish fauna of Amlawa and Asan river depicted in Table 3 and 4, showing the seasonal variation and diversity in different sampling station. Overall 45 species belonging to 31 genera 13 families and 4 orders was identified combine from both the rivers. In Amlawa 36 species belonging to 22 genera, 8 families and 3 orders and in Asan 41 species belonging to 28 genera, 12 families and 4 orders were identified. *Garra lamta*, *Nandus nandus* and *Colisa fasciatus* have been recorded for the first time from the Dehradun valley where as latter two are the new records from Garhwal Himalayas. The seasonal variation in fishes is mainly due to the physio-chemical parameters which are depicted in Table- 6 and Table. 7.

Amlawa River

Amlawa river is a hillstream and tributary of snowfed Yamuna river. Taxonomical study on the fish has been conducted to know the diversity in different season. The total river system has been divided in to four sampling sites (Table-1) for the collection of fish. Total of 36 species belonging to 22 genera 8 families and 3 orders were identified from Amlawa river, (Table-3). The famaliy-wise distribution of fish revealed that 23 species belongs to family Cyprinidae, 4 species from Cobitidae, 2 species each from Bagridae, Sisoridae, Channidae and 1 each from Amblyceptidae, Schilibidae and Mastacembelidae, (Plate-4, Fig. 1).

The seasonal difference in availability of fishes is due to the change in physico-chemical parameters, altitudinal and longitudinal variation in different sampling sites (Table-6, Plate-5, Fig.4). During autumn season highest fish diversity was recorded 30, 21, 19, and 10 from site A₁, A₂, A₃, and A₄, due to favourable conditions. In monsoon 31, 18, 12, and 9 species were recorded from site A₁, A₂, A₃, and A₄ respectively. In winter the availability of fishes was 26, 19, 13 and 9 from site A₁, A₂, A₃, and A₄ respectively and in summer season it was all most similar to winter season, 26, 19, 13 and 8 from site A₁, A₂, A₃, and A₄, respectively, it is due to the low and high water temp., which force the fishes to hide. Out of 36 species, 6 species were present in all four sampling sites of Amlawa river viz. *Garra gotyla gotyla*, *Schizothorax richardsonii*, *Nemacheilus botia*, *N. montanus*, *N. rupecola* and *Glyptothorax pectinopterus*. Most abundance species on the bases of catch percentage was *Schizothorax* sp., *Nemacheilus* Spp., and *Glyptothorax* sp. The four species was exclusively found in Amlawa river i.e. *Schizothoracichthys progastus*, *Clupisoma montana*, *Pseudechenesis sulcatus* and *Garra lamta*. *Garra lamta* is a new record from the district Dehradun.

Asan river

On the basis of altitudinal and longitudinal the Asan river system has been divided in to four sampling sites viz. Dhalipur (A₁), Jhajra (A₂), Badowala (A₃), and Chandribani (A₄) respectively. They are having different altitude and distance from the confluence to origin of river Asan, (Table-2).

Over all the 41 species belonging to 28 genera, 12 families and 4 orders have been identified from the Asan river (Table-4). Variation in availability of fish species has been recorded in different sites and season viz. in monsoon 39, 26, 19, and 20 from site A₁, A₂, A₃, and A₄ respectively. During winter the availability of fishes was 33, 26, 19 and 20 from site A₁, A₂, A₃, and A₄ respectively. The numbers of species were maximum in autumn and were 39, 33, 27, and 20 from A₁, A₂, A₃, and A₄ respectively. While species in summer were less 34, 24, 20 and 20 from at site A₁, A₂, A₃, and A₄ respectively, due to variation in physio-chemical parameters mainly temperature and oxygen (Table-7, Plate-6, Fig. 5)

During monsoon the mixing up of fish fauna was observed i.e. fishes from hillstream (high altitude, *Schizothorax richardsonii*) and plain water or warm water (*Nandus nandus* and *Colisa fasciatus*) was collected. It is due to the fast current and breeding period of fishes, which force them for upward and downward migration.

Among the identified fishes species 17 were found in all four sites in Asan river viz. *Barilius barna*, *B. bendelisis*, *B. vagra*, *Branchydanio rerio*, *Danio devario*, *Parluciosoma daniconius*, *Puntius ticto*, *P. conchoni*, *P. sophore*, *P. sarana sarana*, *P. chola*, *Garra gotyla gotyla*, *Lepidocephalus guntea*, *Amblyceps mangois*, *Channa gachus*, *C. pancatatus* and *Mastacembelus armatus*. The most abundant species (++) were *Barilius* Spp., *Puntius* spp., *Lepidocephalus* sp. in all four sites. While of 7 species was found exclusively in Asan

river only in single sites in different seasons. While, *Colisa fasciatus* and *Nandus nandus* is the new record for Garhwal Himalayas.

STATUS OF FISH FAUNA OF AMLAWA RIVER (CHAKRART HILLS) AND ASAN RIVER (SHIWALIK HILLS) OF WESTERN DOON VALLEY

A total of 45 species of fish belonging to 31 genera 13 families and 4 orders were reported combinily from Amlawa (Chakrara hills) and Asan river (Shiwalik hills) of Western Doon Valley. In this chapter the status were assigned to the fishes according to C.A.M.P. workshop (1994), on the guideline of I.U.C.N i.e. Endangered (En), Vulnerable (VU), Low-Risk near threatened, Low-Risk-least concern, Data dificent (D.D.) and Not Evulated (N.E.) and shown in (Table 5 and Plate-4, Fig. 3). As per analysis 6 species (13%) fall in endangered catagory (*Raiamas bola*, *Tor chelynoides*, *T. putitora*, *T. tor*, *N. montanus* and *Ompok padba*), 12 species (27%), fall in Vulnerable, (*B. vagra*, *Puntius chola*, *P. conchoni*, *P. sarana sarana*, *Labeo dero*, *L. dyocheilus* *Garra gotyla gotyla*, *Schizothorax richardsonii*, *Mystus bleekeri*, *M. vittatus*, *Heteropneutes fossils* and *Pseudechenesis sulcatus*), 18 species (41 %) in Low-Risk near threatened, (*Barilius barna*, *B. bendelisis*, *Brachydanio rerio*, *Danio devario*, *Parliuciosoma daniconius*, *P. sophore*, *P. ticto*, *Schizothoraichthys progastus*, *Nemacheilus botia*, *N. rupecola*, *Wallago attu*, *Amblyceps mangois*, *Glyptothorax pectinopterus*, *Xenentodon cancila*, *Colisa fasciatus*, *C. punctatus*, *Macrogathus panucalus* and *Clupisoma montana*) 1 species (2%) in Low-Risk-least concern, (*Esomus danricus*), 2 species (4%) in Data dificent (*Chagunius chagunio* and *Garra lamta*) and 6 species (13%) were in Not Evulated category (*Crossocheilus latius latius*, *Lepidocephalus guntea*, *Babis badis*, *Nandus nandus*, *Channa gauchua* and *Mastacembelus armatus*). It is inferred that the fish fauna of Amlawa ans Asan rivers required immediate conservation measures so that further their deplication can be checked. In this direction the concern department have to take action and public awarness is required. Beside this especial campian programm is to be launched to save the fishes which are in the category of endangered.

TAXONOMIC ACCOUNT OF FISH FAUNA OF AMLAWA (CHAKRATA HILLS) AND ASAN RIVER (SHIWALIK HILLS) OF WESTERN DOON VALLEY

The present chapter deals with taxonomy of fishes of Amlawa and Asan rivers of Western Doon Valley. The diagnostic characters of order, family, synonym in concise and specific characters of species, economic importance of genera, local name, the total length of biggest size fish (species) in collection and distribution of fishes in both the rivers and in country (including neighboring country) level have been mentioned, beside this key were also given for the identification of fishes. The classification given by Nelson (1984), have been followed with slight modification that of Srivastava (1968), Talwar and Jhingran (1991), and Jayram (1999). The coloured photographs (Plate 9-32) of fishes has been provided for better understanding.

Table 3 : Seasonal distribution of fish fauna of Amlawa river (Chakrata Hills) on the basis of altitude and longitude at sites A₁ , A₂ , A₃ and A₄ in the year 1999-2001.

Sl. No.	Summer				Monsoon				Autumn				Winter			
	A ₁	A ₂	A ₃	A ₄	A ₁	A ₂	A ₃	A ₄	A ₁	A ₂	A ₃	A ₄	A ₁	A ₂	A ₃	A ₄
Phylum : CHORDATA Subphylum : VERTEBRATA Grade : PISCES Subgrade : TELEOSTOMI Subclass : ACTINOPTERYGII Infra division : EUTELEOSTEI Series : OTOPHYSI Order : CYPRINIFORMES Superfamily : CYPRINIODEA Family : CYPRINIDAE Subfamily : RASBORINAE Genus <i>Barilius</i> Ham.-Buch.																
1 <i>Barilius barna</i> (Ham.-Buch.)	++	+	-	-	++	+	-	-	++	++	-	-	++	+	-	-
2. <i>B. bendelisis</i> (Ham.-Buch.)	++	++	-	-	++	++	-	-	++	++	-	-	++	++	-	-
3. <i>B. vagra</i> (Ham.-Buch.)	++	+	-	-	++	++	-	-	++	+	-	-	++	+	-	-

Sl. Name of the species No.	Summer				Monsoon				Autumn				Winter			
	A ₁	A ₂	A ₃	A ₄	A ₁	A ₂	A ₃	A ₄	A ₁	A ₂	A ₃	A ₄	A ₁	A ₂	A ₃	A ₄
Genus <i>Raiamas</i> Jorden																
4. <i>Raiamas bola</i> (Ham.-Buch.)	-	-	+	+	-	-	+	+	-	-	+	+	-	-	+	+
Genus <i>Brachydanio</i> Weber & de Beaufort																
5. <i>Brachydanio rerio</i> (Ham.-Buch.)	+	-	-	-	+	-	-	-	+	-	-	-	+	-	-	-
Genus <i>Danio</i> Hamilton-Buchanan																
6. <i>Danio devario</i> (Ham.-Buch.)	+	-	-	-	+	-	-	-	+	-	-	-	+	-	-	-
Genus <i>Esomus</i> Swainson																
7. <i>Esomus danricus</i> (Ham.-Buch.)	-	-	-	-	+	-	-	-	+	-	-	-	-	-	-	-
Sub-family : CYPRININAE																
Genus <i>Chagunius</i> Smith																
8. <i>Chagunius chagunio</i> (Ham.-Buch.)	-	+	+	-	+	++	+	-	+	++	+	-	-	+	+	-
Genus <i>Puntius</i> Ham.-Buch.																
9. <i>Puntius chola</i> (Ham.-Buch.)	+	-	-	-	+	-	-	-	+	-	-	-	+	-	-	-
10. <i>P. conchoni</i> (Ham.-Buch.)	+	-	-	-	+	-	-	-	+	-	-	-	+	-	-	-
11. <i>P. sarana sarana</i> (Ham.-Buch.)	+	-	-	-	++	-	-	-	++	-	-	-	+	-	-	-
12. <i>P. sophore</i> (Ham.-Buch.)	+	-	-	-	+	-	-	-	+	-	-	-	+	-	-	-
13. <i>P. ticto</i> (Ham.-Buch.)	+	+	-	-	++	-	-	-	++	+	-	-	+	+	-	-
Genus <i>Tor</i> Gray																
14. <i>Tor chelynoides</i> (McClelland)	+	+	-	-	++	++	-	-	++	++	+	-	+	+	-	-
15. <i>T. putitora</i> (Ham.-Buch.)	+	+	-	-	++	+	-	-	++	+	+	-	+	+	-	-

Sl. Name of the species No.	Summer				Monsoon				Autumn				Winter			
	A ₁	A ₂	A ₃	A ₄	A ₁	A ₂	A ₃	A ₄	A ₁	A ₂	A ₃	A ₄	A ₁	A ₂	A ₃	A ₄
16. <i>T. tor</i> (Ham.-Buch.)	+	+	-	-	++	+	-	-	++	+	+	-	+	+	-	-
Genus <i>Labeo</i> Cuvier																
17. <i>Labeo dero</i> (Ham.-Buch.)	-	-	-	-	+	-	-	-	+	-	-	-	-	-	-	-
18. <i>L. dyocheilus</i> (McClelland)	-	-	-	-	+	-	-	-	+	-	-	-	-	-	-	-
Subfamily : GARRINAE																
Genus <i>Crossocheilus</i> Van Hasselt																
19. <i>Crossocheilus latius latius</i> (Ham.-Buch.)	-	+	+	-	+	+	+	-	-	+	++	+	-	+	+	-
Genus <i>Garra</i> Hamilton-Buchanan																
20. <i>Garra gotyla gotyla</i> (Gray)	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++
21. * <i>Garra lamta</i> (Ham.-Buch.)	-	-	+	-	-	-	-	-	-	-	+	-	-	-	-	-
Subfamily : SCHIZOTHORACINAE																
Genus <i>Schizothoraichthys</i> Mishra																
22. <i>Schizothoraichthys progastus</i> (McClelland)	-	++	++	-	-	++	++	-	-	++	++	-	-	++	++	++
Genus <i>Schizothorax</i> Heckle																
23. <i>Schizothorax richardsonii</i> (Gray)	+	++	++	++	+	++	++	++	+	++	++	++	+	++	++	++
Family : COBITIDAE																
Subfamily : COBITINAE																
Genus <i>Lepidocephalus</i> Bleeker																
24. <i>Lepidocephalus guntea</i> (Ham.-Buch.)	++	+	-	-	++	+	-	-	++	+	+	-	++	+	-	-

Sl. Name of the species No.	Summer				Monsoon				Autumn				Winter			
	A ₁	A ₂	A ₃	A ₄	A ₁	A ₂	A ₃	A ₄	A ₁	A ₂	A ₃	A ₄	A ₁	A ₂	A ₃	A ₄
Subfamily : NEMACHEILINAE																
Genus <i>Nemacheilus</i> Van Hasselt																
25. <i>Nemacheilus botia</i> (Ham.-Buch.)	+	++	++	++	+	++	++	++	+	++	++	++	+	++	++	++
26. <i>N. montanus</i> (McClelland)	+	++	++	++	+	++	++	++	+	++	++	++	+	++	++	++
27. <i>N. rupecola</i> (McClelland)	+	++	++	++	+	++	++	++	+	++	++	++	+	++	++	++
Order : SILURIFORMES																
Family : AMBLYCIPTIDAE																
Genus <i>Amblyceps</i> Blyth																
28. <i>Amblyceps mangois</i> (Ham.-Buch.)	+	-	-	-	+	-	-	-	+	-	-	-	+	-	-	-
Family : BAGARIDAE																
Genus <i>Mystus</i> Scopoli																
29. <i>Mystus bleekeri</i> (Day)	+	-	-	-	+	-	-	-	+	-	-	-	+	-	-	-
30. <i>M. vittatus</i> (Bloch)	+	-	-	-	+	-	-	-	+	-	-	-	+	-	-	-
Family : SCHILBIDAE																
Genus <i>Clupisoma</i> Swainson																
31. <i>Clupisoma montana</i> Hora	-	-	-	-	-	-	-	+	-	-	+	+	-	-	+	-
Family : SISORIDAE																
Genus <i>Glyptothorax</i> Blyth																
32. <i>Glyptothorax pectinopterus</i> (McClelland)	+	++	++	++	+	++	++	++	+	++	++	++	+	++	++	++

Sl. Name of the species No.	Summer				Monsoon				Autumn				Winter			
	A ₁	A ₂	A ₃	A ₄	A ₁	A ₂	A ₃	A ₄	A ₁	A ₂	A ₃	A ₄	A ₁	A ₂	A ₃	A ₄
Genus <i>Pseudechenesis</i> Blyth																
33. <i>Pseudechenesis sulcatus</i> (McClelland)	-	-	++	++	-	-	++	++	-	+	++	++	-	-	++	++
Order : PERCIFORMES																
Suborder : CHANNOIDEI																
Family : CHANNIDAE																
Genus <i>Channa</i> Bleeker																
34. <i>Channa gauchua</i> Hamilton.-Buchanan.	++	+	+	-	++	+	+	-	++	+	+	-	++	+	+	-
35. <i>C. punctatus</i> (Bloch)	+	+	-	-	+	+	-	-	+	+	+	-	+	+	-	-
Suborder : MASTACEMBELOIDEI																
Family : MASTACEMBELIDAE																
Genus <i>Macrognathus</i> Laceped																
36. <i>Macrognathus pancalus</i> Ham.-Buch	+	-	-	-	+	-	-	-	+	+	-	-	+	-	-	-
TOTAL SPECIES	26	19	13	8	31	18	12	9	30	21	19	10	26	19	13	9

++ : Abundant

+ : Common

- : Absent

* : New record

A₁ : Kalsi (Alt. 568.75 m)A₂ : Seligothan (Alt. 1420.6 m)A₃ : Sahiya (Alt. 1858.2 m)A₄ : Chakrata (Alt. 2151.56 m)

Sl. Name of the species No.	Summer				Monsoon				Autumn				Winter			
	A ₁	A ₂	A ₃	A ₄	A ₁	A ₂	A ₃	A ₄	A ₁	A ₂	A ₃	A ₄	A ₁	A ₂	A ₃	A ₄
Genus Danio Hamilton-Buchanan																
6. <i>Danio devario</i> (Ham.-Buch.)	+	+	++	++	+	+	++	++	+	+	++	++	+	+	++	++
Genus Esomus Swainson																
7. <i>Esomus danricus</i> (Ham.-Buch)	+	+	-	-	+	+	-	-	+	+	-	+	+	+	-	-
Genus Parliuciosoma Howes																
8. <i>Parliuciosoma daniconius</i> (Ham.-Buch)	+	+	++	++	+	+	++	++	+	+	++	++	+	+	++	++
Subfamily : CYPRININAE																
Genus Chagunius Smith																
9. <i>Chagunius chagunio</i> (Ham.-Buch.)	+	-	-	-	+	-	-	-	+	-	+	-	+	-	-	-
Genus Puntius Hamilton-Buchanan																
10. <i>Puntius chola</i> (Ham.-Buch.)	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++
11. <i>P. conchoni</i> (Ham.-Buch.)	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++
12. <i>P. sarana sarana</i> (Ham.-Buch.)	++	++	+	+	++	++	+	+	++	++	+	+	++	++	+	+
13. <i>P. sophore</i> (Ham.-Buch.)	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++
14. <i>P. ticto</i> (Ham.-Buch.)	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++
Genus Tor Gray																
15. <i>Tor chelynoides</i> (McClelland)	-	-	-	-	+	-	-	-	+	-	-	-	-	-	-	-
16. <i>T. putitora</i> (Ham.-Buch.)	++	+	-	-	++	+	-	-	++	++	-	-	++	+	-	-
17. <i>T. tor</i> (Ham.-Buch.)	+	-	-	-	+	-	-	-	++	+	-	-	+	-	-	-
Genus Labeo Cuvier																
18. <i>Labeo dero</i> (Ham.-Buch.)	+	-	-	-	+	-	-	-	+	+	+	-	+	-	-	-
19. <i>L. dyocheilus</i> (McClelland)	+	-	-	-	+	-	-	-	+	+	-	-	+	-	-	-

Sl. Name of the species No.	Summer				Monsoon				Autumn				Winter			
	A ₁	A ₂	A ₃	A ₄	A ₁	A ₂	A ₃	A ₄	A ₁	A ₂	A ₃	A ₄	A ₁	A ₂	A ₃	A ₄
Subfamily : GARRINAE																
Genus <i>Crossocheilus</i> Van Hasselt																
20. <i>Crossocheilus latius latius</i> (Ham.-Buch.)	+	-	-	-	+	-	-	-	+	-	+	-	+	-	-	-
Genus <i>Garra</i> Hamilton-Buchanan																
21. <i>Garra gotyla gotyla</i> (Gray)	++	++	+	+	++	++	+	+	++	++	+	+	++	++	+	+
Subfamily : SCHIZOTHORACINAE																
Genus <i>Schizothorax</i> Heckle																
22. <i>Schizothorax richardsonii</i> (Gray)	-	-	-	-	+	-	-	-	+	-	-	-	-	-	-	-
Family : COBITIDAE																
Subfamily : COBITINAE																
Genus : <i>Lepidocephalus</i> Bleeker																
23. <i>Lepidocephalus guntea</i> (Ham.-Buch.)	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++
Subfamily : NEMACHEILINAE																
Genus <i>Nemacheilus</i> Van Hasselt																
24. <i>Nemacheilus botia</i> (Ham.-Buch.)	++	+	-	-	++	+	-	-	++	+	+	-	++	+	-	-
25. <i>N. montanus</i> (McClelland)	++	+	-	-	++	+	-	-	++	+	+	-	++	+	-	-
26. <i>N. rupecola</i> (McClelland)	+	-	-	-	+	-	-	-	+	-	-	-	+	-	-	-
Order : SILIURIFORMES																
Family : SILURIDAE																
Genus <i>Ompok</i> Lacepede																
27. <i>Ompok padma</i> (Ham.-Buch.)	-	-	-	-	+	-	-	-	+	-	-	-	-	-	-	+
Genus <i>Wallago</i> Bleeker																
28. <i>Wallago attu</i> (Schneider)	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-

Sl. Name of the species No.	Summer				Monsoon				Autumn				Winter			
	A ₁	A ₂	A ₃	A ₄	A ₁	A ₂	A ₃	A ₄	A ₁	A ₂	A ₃	A ₄	A ₁	A ₂	A ₃	A ₄
Family Amblyciptidae																
Genus <i>Amblyceps</i> Blyth																
29. <i>Amblyceps mangois</i> (Ham.-Buch.)	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++
Family : BAGARIDAE																
Genus <i>Mystus</i> Scopoli																
30. <i>Mystus bleekeri</i> (Day)	++	-	-	+	+	-	-	+	+	+	+	+	+	-	-	+
31. <i>M. vittatus</i> (Bloch)	+	-	-	+	+	-	-	+	+	+	-	+	+	-	-	+
Family : HETEROPNEUSTIDAE																
Genus <i>Heteropneustes</i> (Muller)																
32. <i>Heteropneustes fossilis</i> (Bloch)	-	-	-	-	-	+	-	-	-	+	+	-	-	+	-	-
Family : SISORIDAE																
Genus <i>Glyptothorax</i> Blyth																
33. <i>Glyptothorax pectinopterus</i> (McClelland)	+	+	+	-	+	+	+	-	+	+	+	-	+	+	+	-
Order : BELONIFORMES																
Suborder : EXOCOETOIDEI																
Family : BELONIDAE																
Genus : <i>Xenentodon</i> Regan																
34. <i>Xenentodon cancila</i> (Ham.-Buch)	+	+	+	-	+	+	-	-	+	+	+	-	+	+	-	-
Order : PERCIFORMES																
Suborder : PERCOIDEI																
Family : NANDIDAE																
Subfamily : BADINAE																
Genus : <i>Badis</i> Bleeker																
35. <i>Badis badis</i> (Ham.-Buch.)	+	-	-	-	+	-	-	-	+	+	-	-	+	+	-	-

Table 5. Status of fish fauna of Amlawa river (Chakrata hills) and Asan river (Shiwalik hills), Western Doon Valley.

S. No.	Fish species	Local name	Common name	Status (Camp)
	Phylum : CHODRATA Subphylum : VERTEBRATEA Grade PISCES Subgrade TELEOSTOMI Subclass ACTINOPTERYGII Infra division EUTELEOSTEI Series OTOPHYSI Order CYPRINIFORMES Superfamily CYPRINIODEA Family CYPRINIDAE Subfamily RASBORINAE Genus <i>Barilius</i> Ham.-Buch.			
1.	<i>Barilius barna</i> (Hamilton-Buchanan)	Dhaur	—	LRnt
2.	<i>B. bendelisis</i> (Ham.-Buch.)	Chendra, Chilwa	—	LRnt
3.	<i>B. vagra</i> (Ham.-Buch.)	Popta, Dhaur	Hill trout	Vu
	Genus <i>Raiamas</i> Jordan			
4.	<i>Raiamas bola</i> (Ham.-Buch.)	Bhola, Balala	River Carp	En
	Genus <i>Brachydanio</i> Weber&de Beaufort			
5.	<i>Brachydanio rerio</i> (Ham.-Buch.)	Salari, Dharidar	India Trout	LRnt
	Genus <i>Danio</i> Hamilton-Buchanan			
6.	<i>Danio devario</i> (Ham.-Buch.)	Dhono, Chand	—	LRnt
	Genus <i>Esomus</i> Swainson			
7.	<i>Esomus danricus</i> (Ham.-Buch)	Chal	Flying barb	LRlc
	Genus <i>Parliuciosoma</i> Howes			
8.	<i>Parliuciosoma daniconius</i> (Ham-Buch)	Bhauri	—	LRnt
	Subfamily CYPRININAE			
	Genus <i>Chagunius</i> Smith			
9.	<i>Chagunius chagunio</i> (Ham.-Buch.)	Chhiban, Pathai	—	DD
	Genus <i>Puntius</i> Hamilton-Buchanan			
10.	<i>Puntius chola</i> (Ham.-Buch.)	Katcha, Phuthi	Green barb	Vu
11.	<i>P. conchoni</i> (Ham.-Buch.)	Phuti, Potto	Stigma barb	Vu

S. No.	Fish species	Local name	Common name	Status (Camp)
12.	<i>P. sarana sarana</i> (Ham.-Buch.)	Phaddar, Phuti	Oliver carp	Vu
13.	<i>P. sophore</i> (Ham.-Buch.)	Potto, Phuti	Stigma barb	LRnt
14.	<i>P. ticto</i> (Ham.-Buch.)	Bhuri, Phuti	—	LRnt
	Genus Tor Gray			
15.	<i>Tor chelynoides</i> (McClelland)	Kala-Mahseer	Black Mahseer	En
16.	<i>T. putitora</i> (Ham.-Buch.)	Sunari-Mahseer	Golden Mahseer	En
17.	<i>T. tor</i> (Ham.-Buch.)	Lal-Mahseer	Red-fined Mahseer	En
	Genus Labeo Cuvier			
18.	<i>Labeo dero</i> (Ham.-Buch.)	Kalbans, Moil	—	Vu
19.	<i>L. dyocheilus</i> (McClelland)	Doongri, Bolla	—	Vu
	Subfamily : GARRINAE			
	Genus Crossocheilus Van Hasselt			
20.	<i>Crossocheilus latius latius</i> (Ham.-Buch.)	Saknera, Dhanaura	—	NE
	Genus Garra Hamilton-Buchanan			
21.	<i>Garra gotyla gotyla</i> (Gray)	Gotla, Bhangnera	Stone sucker	Vu
22.	* <i>Garra lamta</i> (Ham.-Buch.)	Kali- Gotla	Stone sucker	DD
	Subfamily SCHIZOTHORACINAE			
	Genus Schizothoraichthys Mishra			
23.	<i>Schizothoraichthys progastus</i> (McClelland)	Dinnawha, Pahari	Snow Trout	LRnt
	Genus Schizothorax Heckle			
24.	<i>Schizothorax richardsonii</i> (Gray)	Asela, Sohal	Snow Trout	Vu
	Family COBITIDAE			
	Sub family COBITINAE			
	Genus Lepidocephalus Bleeker			
25.	<i>Lepidocephalus guntea</i> (Ham.-Buch.)	Gadera, Ghiwa	Loach	NE
	Subfamily NEMACHEILINAE			
	Genus Nemacheilus Van Hasselt			
26.	<i>Nemacheilus botia</i> (Ham.-Buch.)	Gadera, Bakati	Striped Loach	LRnt
27.	<i>N. montanus</i> (McClelland)	Gadera	Mountain Loach	En
28.	<i>N. rupecola</i> (McClelland)	Gadera	—	LRnt
	Order SILIURIFORMES			
	Family SILURIDAE			
	Genus Ompok Lacepede			

S. No.	Fish species	Local name	Common name	Status (Camp)
29.	<i>Ompok padma</i> (Ham.-Buch.) Genus <i>Wallago</i> Bleeker	—	—	En
30.	<i>Wallago attu</i> (Schneider) Family AMBLYCRIPTIDAE Genus <i>Amblyceps</i> Blyth	Lanchi	Butter Cat fish	LRnt
31.	<i>Amblyceps mangois</i> (Ham.-Buch.) Family BAGARIDAE Genus <i>Mystus</i> Scopoli	Singhi	—	LRnt
32.	<i>Mystus bleekeri</i> (Day)	Kater	Cat fish	Vu
33.	<i>M. vittatus</i> (Bloch) Family SCHILIBIDAE Genus <i>Clupisoma</i> Swainson	Fengan, Tengra	Striped cat fish	Vu
34.	<i>Clupisoma montana</i> Hora Family HETEROPNEUSTIDAE Genus <i>Heteropneustes</i> (Muller)	—	Bawla, Bachwa	Vu
35.	<i>Heteropneustes fossilis</i> (Bloch) Family SISORIDAE Genus <i>Glyptothorax</i> Blyth	Singhi	Stibging cat fish	Vu
36.	<i>Glyptothorax pectinopterus</i> (McClelland) Genus <i>Pseudechenesis</i> Blyth	Patharchat	Cat fish	LRnt
37.	<i>Pseudechenesis sulcatus</i> (McClelland) Order BELONIFORMES Suborder EXOCOETOIDEI Family BELONIDAE Genus <i>Xenentodon</i> Regan	Katharha	—	Vu
38.	<i>Xenentodon cancila</i> (Ham.-Buch.) Order PERCIFORMES Suborder PERCOIDEI Family NANDIDAE Subfamily BADINAE Genus <i>Badis</i> Bleeker	Saubam, Sooa	Needle fish	LRnt
39.	<i>Badis badis</i> (Ham.-Buch.) Subfamily NANDINAE Genus <i>Nandus</i> Valenciennes	Chiril, Kali	Badis	NE

S. No.	Fish species	Local name	Common name	Status (Camp)
40.	<i>*Nandus nandus</i> (Ham.-Buch.) Suborder ANANBANTOIDEI Family BELONTIDAE Subfamily TRICHOGASTERINAE Genus <i>Colisa</i> Cuvier	Saap Machhi	—	NE
41.	<i>*Colisa fasciatus</i> (Schneider) Suborder Channoidei Family Channidae Genus <i>Channa</i> Bleeker	Sunera	—	LRnt
42.	<i>Channa gauchua</i> Ham.-Buch.	Shovan, Dawla	Green snake-head	NE
43.	<i>C. punctatus</i> (Bloch.) Suborder MASTACEMBELOIDEI Family MASTACEMBELIDAE Genus <i>Macrogathus</i> Lacepede	Sewla, Suli	—	LRnt
44.	<i>Macrogathus panucalus</i> Ham.-Buch Genus <i>Mastacembelus</i> Scopoli	Bam, Gaj	Spinyeel	LRnt
45.	<i>Mastacembelus armatus</i> (Lacepede)	Bam, Gaj	Spinyeel	NE

EN: Endangered; VU: Vulnerable; LRnt: Low Risk-near threatened; LR-Ic: Low Risk-near-least concern; DD: Data deficient; NE: Not Evaluated

* New-Record

Table-6 : Physico-chemical parameters of Amlawa river (Chakrata Hills) of Western Doon Valley in the year 2000.

Season	Month	Station	Air Tem.	Water Temp.	Dissolved oxygen	pH	Turbidity	Water velocity
W	Jan.	A ₁	11.5	9.2	14.2	8.0	9.0	0.2
		A ₂	11.3	9.0	14.0	8.0	9.1	0.5
		A ₃	10.6	8.5	14.6	8.1	8.4	1.0
		A ₄	10.2	8.0	14.8	8.2	8.3	1.2
		M. Mean $\pm$ SD	10.9 $\pm$ 6.60	8.64 $\pm$ 0.53	14.4 $\pm$ 0.36	8.0 $\pm$ 0.9	8.7 $\pm$ 0.40	0.7 $\pm$ 0.45
I	Feb.	A ₁	12.7	10.5	13.8	8.0	9.1	0.1
		A ₂	12.9	10.9	13.6	8.0	9.5	0.4
		A ₃	11.6	9.7	14.5	8.0	8.5	1.0
		A ₄	11.4	9.3	14.7	8.2	8.6	1.2
		M. Mean $\pm$ SD	12.15 $\pm$ 0.75	10.1 $\pm$ 0.73	14.15 $\pm$ 0.53	8.0 $\pm$ 0.1	3.9 $\pm$ 0.46	0.6 $\pm$ 0.51
N	Mar.	A ₁	17.5	14.4	13.6	7.9	10.2	0.1
		A ₂	17.2	14.0	13.2	7.8	9.8	0.5
		A ₃	16.5	13.7	14.3	7.9	8.7	1.0
		A ₄	16.2	13.0	14.5	8.1	9.3	1.1
		M. Mean $\pm$ SD	16.8 $\pm$ 0.60	13.7 $\pm$ 0.59	13.9 $\pm$ 0.60	7.9 $\pm$ 0.12	9.5 $\pm$ 0.64	0.67 $\pm$ -0.46
T	Apr.	A ₁	13.6	10.8	14.1	7.9	9.0	0.6
		A ₂	13.4	10.5	13.9	7.8	8.9	0.5
		A ₃	13.2	10.3	13.7	7.9	8.8	0.4
		A ₄	13.0	10.1	13.5	8.0	8.7	0.3
		S. Mean $\pm$ SD	13.6 $\pm$ 3.10	10.8 $\pm$ 2.62	14.1 $\pm$ 0.25	7.9 $\pm$ 0.05	9.0 $\pm$ 0.41	0.61 $\pm$ 0.05
E	May	A ₁	14.5	11.5	14.2	8.0	9.0	0.2
		A ₂	14.3	11.3	14.0	8.0	9.1	0.5
		A ₃	14.1	11.1	13.8	8.1	8.4	1.0
		A ₄	13.9	10.9	13.6	8.2	8.3	1.2
		M. Mean $\pm$ SD	14.2 $\pm$ 0.4	11.2 $\pm$ 0.2	13.9 $\pm$ 0.2	8.0 $\pm$ 0.1	8.9 $\pm$ 0.2	0.7 $\pm$ 0.1
R	Jun.	A ₁	15.2	12.2	14.1	8.0	9.1	0.1
		A ₂	15.0	12.0	13.9	8.0	9.5	0.4
		A ₃	14.8	11.8	14.5	8.0	8.5	1.0
		A ₄	14.6	11.6	14.7	8.2	8.6	1.2
		M. Mean $\pm$ SD	15.2 $\pm$ 0.4	12.2 $\pm$ 0.2	14.1 $\pm$ 0.2	8.0 $\pm$ 0.1	9.3 $\pm$ 0.2	0.6 $\pm$ 0.1

S U	April	A ₁	22.4	17.9	8.5	7.7	17.2	0.2
		A ₂	21	17	8.9	7.7	17.4	0.5
		A ₃	20	15.2	9.2	7.8	16	1.0
		A ₄	19	15.1	9.8	7.9	16.2	1.2
		0.2	0.5	1.0	1.2			
M	M. Mean ± SD	20.6 ± 1.45	16.3 ± 1.37	9.1 ± 0.54	7.7 ± 0.09	16.7 ± 0.70	0.72 ± 0.45	
	M	May	A ₁	25	18.0	8.7	7.6	39.5
A ₂		24	18.3	8.9	7.5	40.1	0.3	
A ₃		23	16.7	9.9	7.8	38.1	1.2	
A ₄		20.5	16	10.2	7.8	36.9	1.4	
M. Mean ± SD		23.12 ± 1.93	17.2 ± 1.08	9.42 ± 0.73	7.6 ± 0.15	38.6 ± 1.43	0.8 ± 0.58	
E R	June	A ₁	33	20.5	8.6	7.5	55.9	0.5
		A ₂	32	20.2	8.8	7.5	54.2	1.0
		A ₃	28.5	19.8	9.5	7.7	50.6	1.5
		A ₄	25.6	19.6	9.0	7.7	51.2	1.8
		M. Mean ± SD	29.7 ± 3.38	20.0 ± 0.40	8.97 ± 0.38	7.6 ± 0.11	52.9 ± 2.50	1.2 ± 0.57
S. Mean ± SD		24.4 ± 4.69	17.8 ± 1.92	9.14 ± 0.26	7.6 ± 0.05	36.06 ± 18.23	0.90 ± 0.25	

M O N S O O N	July	A ₁	31.3	22.1	7.6	7.0	122.6	2.6
		A ₂	30.1	22.5	7.5	7.0	118.3	2.8
		A ₃	26.3	20.6	8.5	7.1	120.6	3.8
		A ₄	24.2	20.5	8.2	7.1	120.2	4.0
		M. Mean $\pm$ SD	27.9 $\pm$ 3.29	21.4 $\pm$ 1.02	7.9 $\pm$ 0.47	120.4 $\pm$ 1.76	3.3 $\pm$ 0.70	
	Aug.	A ₁	25.4	21.2	7.5	7.0	196.8	3
		A ₂	25.2	21.0	7.6	7.0	192.5	3.4
		A ₃	23.1	20.1	8.4	7.0	163.1	3.5
		A ₄	23.5	19.8	8.3	7.2	152.0	4.0
		M. Mean $\pm$ SD	24.3 $\pm$ 1.16	20.5 $\pm$ 0.68	7.9 $\pm$ 0.46	7.0 $\pm$ 21.96	3.47 $\pm$ 0.41	
	Sept.	A ₁	24.1	20	7.7	7.1	102.6	2.2
		A ₂	24.8	19.8	7.8	7.1	98.3	2.5
		A ₃	22.6	18.4	8.5	7.2	97.4	3.5
		A ₄	22	18.2	8.6	7.2	95.3	3.8
		M. Mean $\pm$ SD	23.3 $\pm$ 1.29	19.1 $\pm$ 0.93	8.1 $\pm$ 0.46	7.1 $\pm$ 0.05	98.4 $\pm$ 3.06	3.0 $\pm$ 0.77
	S. Mean $\pm$ SD		25.1 $\pm$ 2.41	20.3 $\pm$ 1.15	7.96 $\pm$ 0.11	7 $\pm$ 0.05	131.6 $\pm$ 40.04	3.25 $\pm$ 0.23

A	U	Oct.	A ₁	19.3	16.5	13.3	7.7	19.3	1.0
			A ₂	19.5	16.7	13.2	7.7	19.7	1.5
			A ₃	18.0	15.0	13.6	7.9	18.2	2.0
			A ₄	18.1	15.2	13.5	7.8	18.0	2.2
		M. Mean ± SD		18.7±0.78	15.8±0.87	13.4±0.18	7.7±0.09	18.8±0.82	1.6+-0.53
T	U	Nov.	A ₁	17.3	14.0	13.5	7.8	18.6	0.5
			A ₂	17.4	14.3	13.1	7.7	18.2	0.8
			A ₃	16.6	13.5	13.6	7.9	17.9	1.0
			A ₄	16.0	13.1	13.4	7.9	17.3	1.5
		M. Mean ± SD		16.8±0.65	13.7±0.53	13.4±0.21	7.8±0.09	18.0±0.54	0.9+-0.42
M	N	Dec.	A ₁	12.0	9.3	14.0	7.9	15.3	0.8
			A ₂	12.5	9.9	14.0	7.9	15.6	1.0
			A ₃	11.6	8.8	14.5	8.0	14.2	1.0
			A ₄	11.2	8.5	14.6	8.1	13.1	1.2
M. Mean ± SD		11.8±0.55	9.1±0.61	14.2±0.32	7.9±0.09	14.5±1.13	1.0+-0.1		
S. Mean ± SD		15.7±3.56	12.8±3.42	13.6±0.46	7.8±0.1	17.1±2.28	1.1+-0.37		

M = Monthly; S = Seasonal

Table-7 : Physico-chemical parameters of Asan river (Shiwalik Hills) of Western Doon Valley in the year 2000

Season	Month	Station	Air Tem. (°c)	Water Temp (°c)	Dissolved oxygen (mg l ⁻¹)	pH	Turbidity (NTU)	Water velocity (m sec ⁻¹)
W I N T E R	Jan.	A ₁	16.3	12.6	13.2	8.4	7.5	0.2
		A ₂	16.7	12.9	13.1	8.4	7.6	0.3
		A ₃	17.5	13.0	12.6	8.1	9.7	0.9
		A ₄	17.6	13.1	12.7	8.0	9.9	0.6
		M. Mean ± SD	17.0 ± 0.62	12.9 ± 0.21	12.9 ± 0.29	8.2 ± 0.20	8.6 ± 1.30	0.5 ± 0.31
	Feb.	A ₁	17.5	14.2	13.0	8.4	8.9	0.2
		A ₂	17.2	14.3	13.0	8.4	9.2	0.3
		A ₃	18.7	15.2	12.8	8.3	10.5	0.3
		A ₄	18.8	15.5	12.7	8.3	10.8	0.6
		M. Mean ± SD	18.0 ± 0.81	14.8 ± 0.64	12.8 ± 0.15	8.3 ± 0.05	9.85 ± 0.93	0.3 ± 0.17
	Mar.	A ₁	19.4	16.1	3.3	8.4	9.7	0.3
		A ₂	19.2	16.6	13.0	8.4	10.5	0.5
		A ₃	20.5	16.9	12.0	8.2	11.2	0.6
		A ₄	20.8	17.0	12.2	8.3	11.4	0.9
M. Mean ± SD			19.9 ± 0.79	16.6 ± 0.40	12.6 ± 0.62	8.3 ± 0.09	10.7 ± 0.77	0.5 ± 0.25
S. Mean ± SD			18.3 ± 1.47	14.7 ± 1.85	12.7 ± 0.15	8.2 ± 0.05	9.71 ± 1.05	0.4 ± 0.11

S	U	April	A ₁	24.5	19.3	8.7	7.7	17.6	0.2
			A ₂	24.1	19.6	8.9	7.6	17.2	0.3
			A ₃	25.6	20.1	7.9	7.5	18.5	0.8
			A ₄	25.7	20.8	8.0	7.5	19.6	0.6
		M. Mean $\pm$ SD		24.9 $\pm$ 0.79	19.9 $\pm$ 0.65	8.3 $\pm$ 0.49	7.5 $\pm$ 0.09	18.2 $\pm$ 1.06	0.47 $\pm$ 1.06
M	M	May	A ₁	27.4	20.3	9.0	7.65	44.5	0.3
			A ₂	27.5	20.6	9.1	7.6	43.1	0.7
			A ₃	28.6	21.8	8.0	7.4	43.0	0.9
			A ₄	28.9	21.5	8.2	7.4	43.1	1.1
		M. Mean $\pm$ SD		28.1 $\pm$ 0.76	21.05 $\pm$ 0.71	8.5 $\pm$ 0.55	7.5 $\pm$ 0.11	43.35 $\pm$ 0.56	0.75 $\pm$ 0.34
E	R	June	A ₁	34.6	24.2	8.3	7.5	65.2	0.5
			A ₂	34.2	24.6	8.8	7.6	66.2	0.9
			A ₃	36.5	25.7	7.7	7.4	66.9	1.2
			A ₄	36.4	25.9	8.0	7.4	67.8	1.2
		M. Mean $\pm$ SD		36.4 $\pm$ 1.19	25.1 $\pm$ 0.82	8.2 $\pm$ 0.46	7.4 $\pm$ 0.09	66.52 $\pm$ 1.09	0.95 $\pm$ 0.33
S. Mean $\pm$ SD		29.8 $\pm$ 5.93	22.0 $\pm$ 2.73	8.3 $\pm$ 0.15	7.4 $\pm$ 0.05	42.69 $\pm$ 24.16	0.72 $\pm$ 0.24		

M O N S O N	July	A ₁	33.4	25.3	7.0	7.3	126.3	1.6
		A ₂	33.6	25.6	7.1	7.3	122.4	1.2
		A ₃	34.8	26.8	6.5	7.3	126.3	1.9
		A ₄	34.9	26.9	6.2	7.3	127.5	1.8
		M. Mean $\pm$ SD	34.1 $\pm$ 0.78	26.1 $\pm$ 0.81	6.7 $\pm$ 0.42	7.3 $\pm$ 00	125.6 $\pm$ 2.22	1.6 $\pm$ 0.30
	Aug.	A ₁	28.5	23.6	6.4	7.4	213.3	2.3
		A ₂	28.9	23.7	6.6	7.4	207.8	2.6
		A ₃	29.6	24.8	6.0	7.3	209.8	2.5
		A ₄	29.8	24.1	6.0	7.3	230.0	2.9
		M. Mean $\pm$ SD	29.2 $\pm$ 0.60	24.0 $\pm$ 0.54	6.25 $\pm$ 0.3	7.3 $\pm$ 0.05	215.2 $\pm$ 10.1	2.5 $\pm$ 0.25
	Sept.	A ₁	27.4	21.4	7.2	7.5	101.5	1.8
		A ₂	27.6	21.3	7.3	7.4	110.1	1.9
		A ₃	28.9	33.5	7.1	7.3	117.8	1.7
		A ₄	28.5	22.7	7.2	7.3	120.1	1.4
		M. Mean $\pm$ SD	28.1 $\pm$ 0.71	21.9 $\pm$ 0.72	7.2 $\pm$ 0.08	7.3 $\pm$ 0.09	112.3 $\pm$ 8.41	1.7 $\pm$ 0.21
	S. Mean $\pm$ SD		30.4 $\pm$ 3.19	24.0 $\pm$ 2.1	6.71 $\pm$ 0.47	7.3 $\pm$ 0.0	151.0 $\pm$ 55.96	1.9 $\pm$ 0.49

A	U	Oct.	A ₁	22.1	19.3	12.0	7.5	23.1	0.5
			A ₂	22.6	19.2	12.1	7.7	23.5	1.1
			A ₃	23.4	20.6	11.2	7.4	26.2	1.2
			A ₄	23.5	20.5	11.0	7.4	26.3	1.1
		M. Mean $\pm$ SD		22.9 $\pm$ 0.60	19.9 $\pm$ 0.75	11.5 $\pm$ 0.55	7.5 $\pm$ 0.14	24.7 $\pm$ 1.71	0.9 $\pm$ 0.32
T	U	Nov.	A ₁	21.6	18.5	12.1	7.6	16.4	0.3
			A ₂	21.4	18.3	12.2	7.6	16.5	0.5
			A ₃	22.9	19.2	11.8	7.5	16.8	0.6
			A ₄	22.6	19.6	11.6	7.4	16.9	0.8
		M. Mean $\pm$ SD		22.1 $\pm$ 0.73	18.9 $\pm$ 0.60	11.9 $\pm$ 0.27	7.5 $\pm$ 0.09	16.6 $\pm$ 0.23	0.5 $\pm$ 0.20
M	N	Dec.	A ₁	19.3	15.8	12.7	7.7	12.2	0.2
			A ₂	19.6	15.2	12.8	7.8	12.3	0.6
			A ₃	20.0	15.9	12.0	7.6	12.4	0.3
			A ₄	20.9	15.7	12.5	7.6	12.1	0.6
M. Mean $\pm$ SD		19.9 $\pm$ 0.69	15.6 $\pm$ 0.31	12.5 $\pm$ 0.35	7.6 $\pm$ 0.09	12.2 $\pm$ 0.12	0.4 $\pm$ 0.20		
S. Mean $\pm$ SD		21.6 $\pm$ 1.55	18.1 $\pm$ 2.25	11.9 $\pm$ 0.50	7.5 $\pm$ 0.05	17.8 $\pm$ 6.34	0.6 $\pm$ 0.26		

M = Monthly; S = Seasonal

SYSTEMATIC ACCOUNT

Order CYPRINIFORMES

Body and head never covered with bony plates, covered with scale or base; webrain apparatus connecting the ear with the air bladder, further air bladder is connected by a duct with the alimentary canal; ventral fin, if present abdominal in position; mesocoracoid usually present; basisphenoid absent and orbit esphenoid always present; a vast order of fishes chiefly inhabiting in freshwater.

Family CYPRINIDAE

Body covered with scales; belly rounded and seldom keeled; no adipose fin; mouth bordered only by premaxillaries; barbels present or absent, if present one or two pairs; head scale less; eye never covered with skin; lower pharyngeal teeth large molariform, usually in several rows; largest otolith in lagina; gill opening wide and the gill membrane attached to the isthmus.

1. *Barilius barna* (Hamilton - Buchanan)

Cyprinus barna Hamilton 1822; Valenciennes 1842.

Barilius barna Gunter 1868; Day 1878; Menon, 1999; Singh 1964; Srivastava 1968; Talwar and Jhingran 1991; Jayram 1999; Khan 2000; Karmakar 2000.

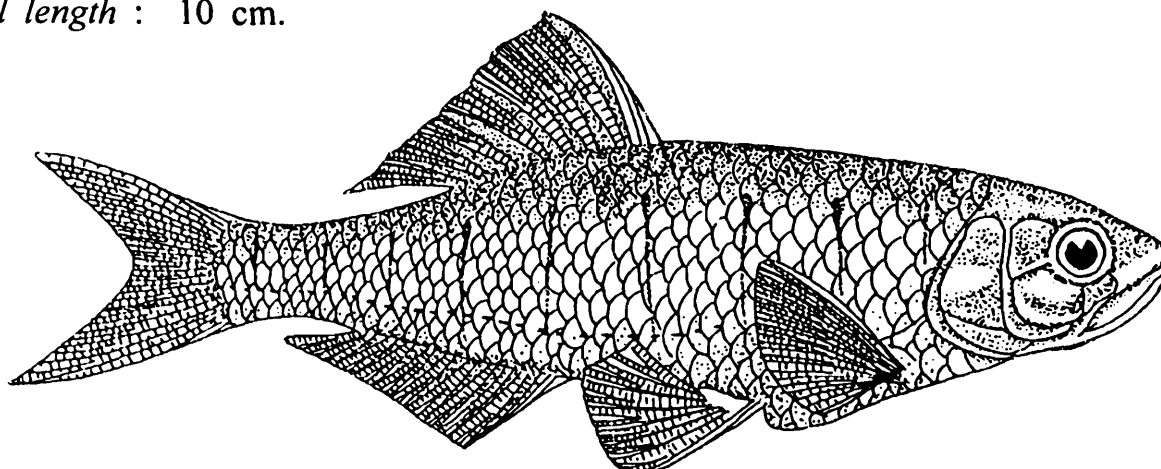
Local name Dhaur, Childi.

Material examined : 200 exs.

Collection Locality : Asan river : Confluence of Asan and Yamuna river, Dhalipur, Kunj grant near Asan Barrage, Dhalipur; 1 km towards North of Jhajra village, Badowala village near forest check post; Chanribani village near temple, Dehradun. Amlawa river : Kalsi village near confluence of Amlawa and Yamuna river, Kalsi; 1 km downstream from village Seligothan, Dehradun.

Fin formula : D. (2/7); P. 14-15; V. 9; A. (3/10); C.19. Ll 42-45; Ltr. 81.

Total length : 10 cm.



Specific characters : Length of head 4.6, of caudal 5 and height of body 4.22 in the total length; eye diameter 4.4 in the length of head, 1.5 from the end of snout in the interorbital width; body moderately elongated, compressed; head pointed and sharp; barbels absent; body colour is silvery with 9-11 blue bands on the side, dorsal and caudal fin with black tips.

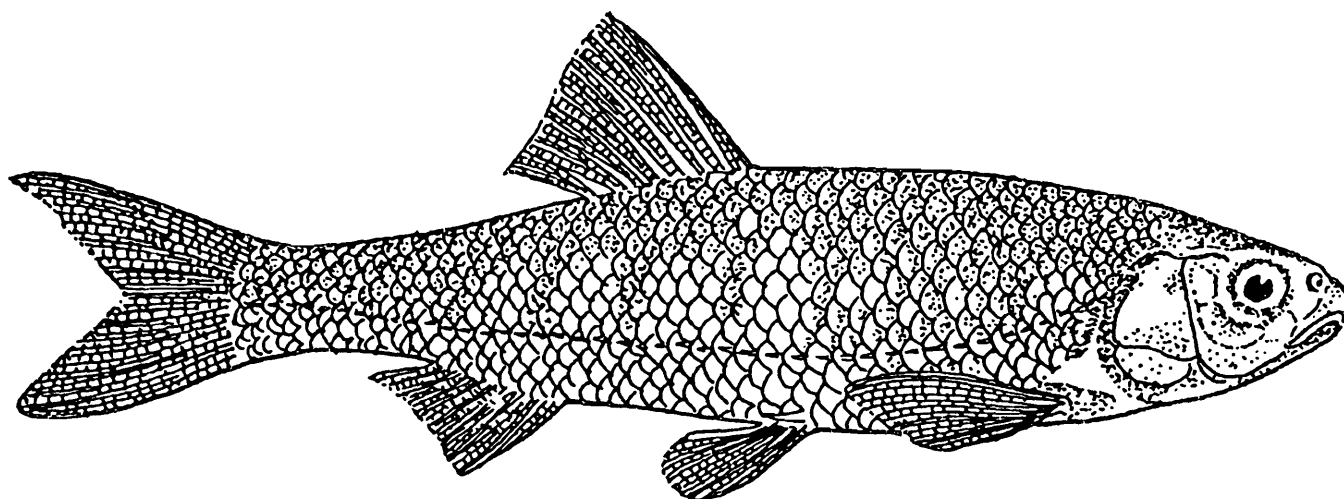
Distribution : India : Assam, Bengal, Bihar, Orissa and Uttaranchal.

Elsewhere : Pakistan.

2. *Barilius bendelisis* (Hamilton-Buchanan)

Cyprinus bendelisis Hamilton 1822; McClelland 1839.

Barilius bendelisis Day 1878; Mishra 1959; Menon 1999; Talwar and Jhingran 1991; Jayram 1999; Khan 2000; Karmakar 2000.



Local name : Cneudra, Chilwa.

Material examined : 295 exs.

Collection Locality : Asan river : Confluence of Asan and Yamuna river, Kunj Grant near Asan Barrage, Dhalipur; ½ NW of Jhajra village ; Badowala village near bridge; Chandribani village near Temple, Dehradun. Amlawa river : Confluenc of Amlawa and Yamuna river, Kalsi, Dehradun.

Fin formula : D. 9 (2/7); P. 15; V. 9; A. 10(2/8); C. 18; L.tr. 13 (8/5).

Total length : 12 cm.

Specific characters : Length of head 5.2, of caudal 4.95 and height of body 5.2 in the total length; eye diameter 4.5 in the length of head, 1.5 from the end of snout 1.7 in the interorbital width body profile; body moderately elongate, compressed, subcylindrical abdomen rounded; head sharply pointed, snout compressed, pointed mouth anterior or

obliquely directed upward, not protactile; dorsal fin inserted under space between pelvic and anal fin, dorsal higher than the length of its base, pectoral may or may not reach the ventral caudal forked; barbels generally short, four, rostral pair usually absent; lateral line complete, scale small 2 to 3 rows of scale between it and the base of ventral fin; 20 rows of predorsal scale present; colour silvery, back blackish with decending in complete bars towards the lateral line; tip of the fin blackish, each scale bearing a single black spot.

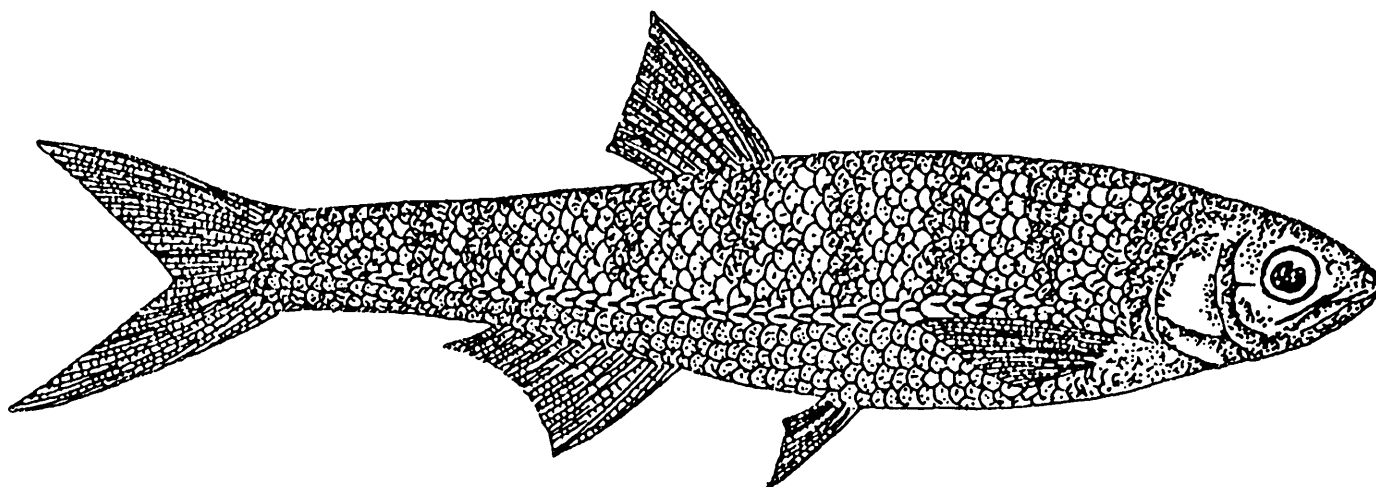
Distribution : Throughout India except Kerala.

Elsewhere : Nepal; Pakistan; Sri Lanka; Bangladesh and Myanmar.

3. *Barilius vagra* (Hamilton-Buchanan)

Cyprinus vagra Hamilton 1822.

Barilius vagra Day 1878; Menon 1949, 1999; Mishra 1959; Husain 1975, 1995; Jhingran and Sehgal 1978; Talwar and Jhingran 1991; Jayaram 1999; Khan 2000; Karmakar 2000.



Local name : Dharu, popota.

Material examined : 105 exs.

Collection Locality : Asan river : Kunj grant near Asan Barrage; Jhajra 2 km N-W of village; Badowala village 1.5 km from forest check post; Chanribani village near temple, Dehradun. Amlawa river : Upper Kalsi village, 1km N-W of town; seligothan 1 km down from village, Dehradun.

Fin formula : D. (2/7); P. 14-15; V 8; A.10-12 (2/3); C.15.

Total length : 13 cm.

Specific characters : Length of head 5.0; of caudal 4.80 and height of body 5.0 in the total length; eye diameter 4.2 in the length of head, 1.2 from the end of snout 1.7 in the interorbital width; body moderately elongated with rounded abdomen; barbels long and rostral

about half as the size of the head; caudal fin deeply forked; colour silvery with dark blue, 9-11 vertical bands extending below the lateral line.

Distribution : North India (Brahmaputra, Ganga, Indus, Yamuna river systems).

Elsewhere : Nepal; Pakistan and Sri Lanka.

Economic importance : This genus is represented by three species, which are quite common in Asan and low altitude of Amlawa rivers. It is liked as food and juice is given to weak person in the region.

4. *Raiamas bola* (Hamilton-Buchanan)

Cyprinus bola Hamilton 1822;

Barilius bola Day 1878; Menon 1949; Mishra 1959; Pant 1970

Raiamas bola Hora and Mukerji, 1936; Howes 1980; Jayaram 1981; Talwar and Jhingran 1991; Khan 2000.

Local name : Balala, Bhola.

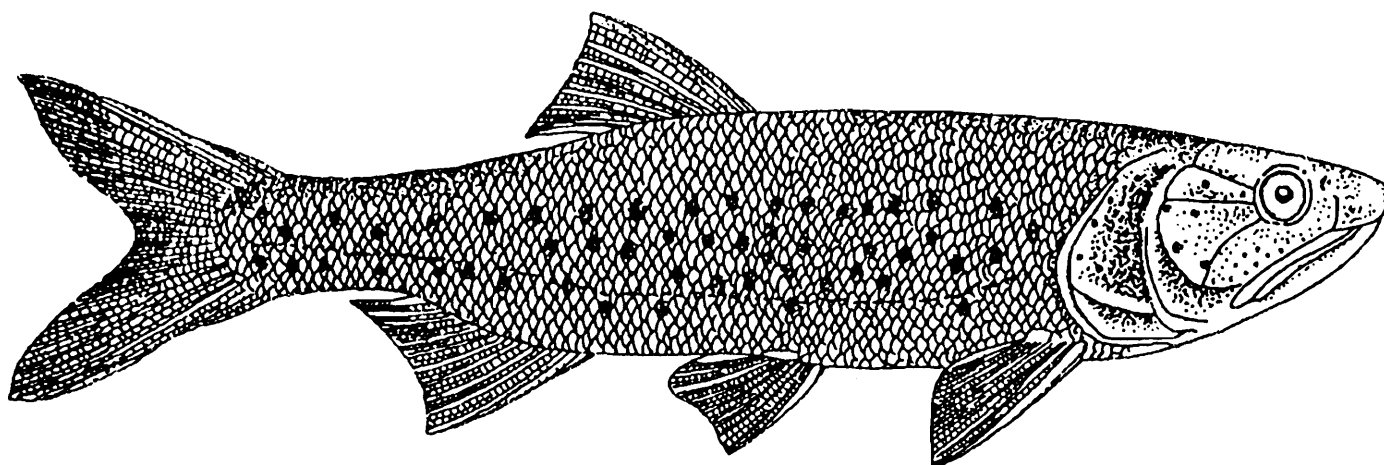
Material examined : 08 exs.

Collection Locality : Asan river : Confluence of Asan and Yamuna river, Dhalipur, Dehra Dun. Amlawa river : 3 km towards North from Sahiya town, nr bridge, Dehradun; 1 km down Alumandi, Chakrata, Dehradun.

Fin formula : D.7-8 (3); P. 12; V 8; A.10 (14).

Total length : 22 cm.

Specific characters : Length of head 5.4, of caudal, 5.6 and height of body 5.8 in the total length; eye diameter 5.0 the length of head, 1.6 from the end of snout and 1.8 in the interorbital width; body elongated and compressed; barbels absent; lower jaw larger than



combined length of snout and eyes; pectoral axillary scale elongated without a flesh border; in body two rows of spots; lateral line complete with 88-95 scales; body colour deep and bright with rounded spots arranged in rows, spots may extend to the operculum, preoperculum and suborbital.

Distribution : North India upto Orissa.

Elsewhere : Bangladesh; Myanmar and Nepal.

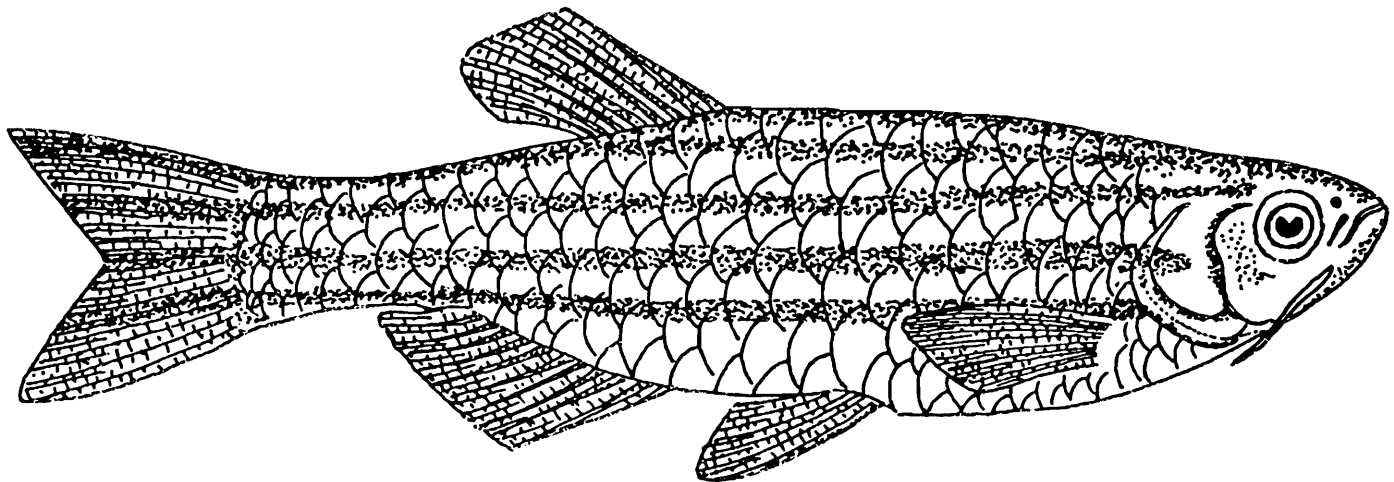
Economic Importance : The genus *Raiamas* represented by single species in my collection. It is liked by local people very much. But now its catch percentage is decreasing drastically and listed as endangered fish in Uttaranchal.

5. *Brachydanio rerio* (Hamilton-Buchanan)

Cyprinus rerio Hamilton 1822.

Danio rerio Day 1878; Menon 1949; Mishra 1959; Singh *et al.* 1987.

Brachydanio rerio Hora 1937; Menon 1962; Talwar and Jhingran 1991; Jayram 1999; Karmakar 2000.



Local name : Dhauridar, Salari.

Material Examined : 195 exs.

Collection Locality : Asan river : Kunj grant near Asan Barrage, Dhalipur; Jhajra village; Badowala village 200 m on either side of forest check post; Chanribani village ½ km toward north of temple, Dehradun. Amlawa river : Confluence of Amlawa and Yamuna river, Kalsi village, Dehradun.

Fin formula : D.7; P. 11-12; V 6; A.12 (2/10); C.

Total length : 5 cm.

Specific character : Length of head 4-8; of body depth 3.4 in the standard length; eye diameter 3.5 in the head length; body profile body elongated and strongly compressed;

caudal fin forked; barbels two pairs, well developed, rostral barbels considerably longer than eye diameter; lateral line usually absent or incomplete in case it often extends up to base of pelvic fins.

Distribution : Throughout India.

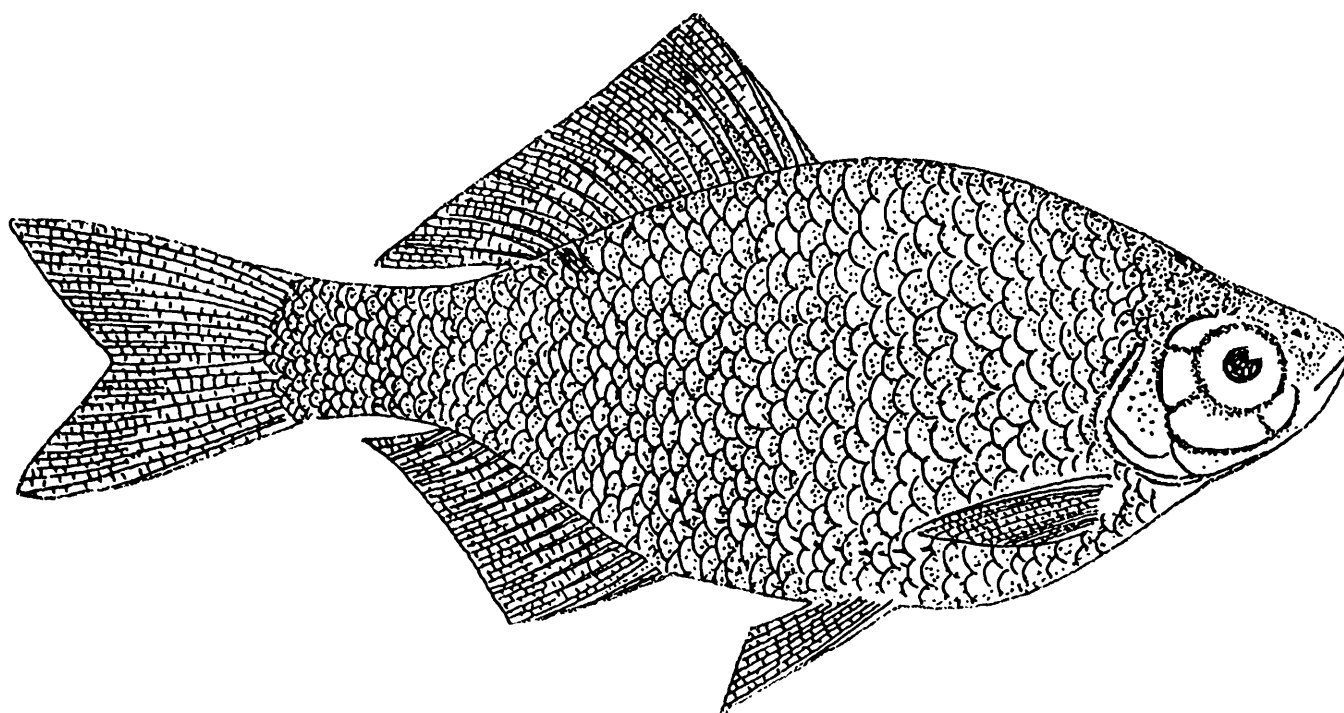
Elsewhere : Pakistan; Bangladesh and Nepal.

Economic importance : This genus represented by single species in my collection. It is a popular aquarium fish, but it carry no edibles value.

6. *Danio devario* (Hamilton-Buchanan)

Cyprinus devario Hamilton 1822.

Danio devario Day 1878; Mishra 1959; Menon 1999; Talwar and Jhingran 1991; Jayaram 1999, Khan 2000; Karmakar 2000.



Local name : Chand, Dhaur.

Material Examined : 140 exs.

Collection Locality : Asan river : confluence of Asan and Yamuna river, Dhalipur; Kunj grant near Asan Barrage, Dhalipur; Jhajra village, 1 km towards NW of village; Badowala village either side of forest check post; Chanribani village 1 km toward north of temple, Dehradun. Amlawa river : Upper Kalsi village, near temple, Confluence of Amlawa and Yamuna river Kalsi, Dehradun.

Fin formula : D.18 (2/16); P. 14; V 6; A.19 (3/16); C 19.

Total length : 8 cm.

Specific character : Length of head 5-1; of caudal 4.15 and height of body 3.45, in the total length, eye diameter 3 in the length of head 1.32 in the infraorbital width; head moderate, blunt snout obtuse mouth anterior, cleft of mouth shallow lip thin and simple; barbels absent; dorsal fin commences mid way between the anterior margin and the base of the caudal fin lunate; lateral line present, complete and concave; scales, moderate 2-1/2 rows between lateral line and the base of ventral fin; colour greenish above and dull white below.

Distribution : India (Northern India).

Elsewhere : Bangladesh; Pakistan and Nepal.

Economic importance : This genus represented by single species and found abundant in Asan as compare to Amlawa river. Local consumes them with great taste.

7. *Esomus danricus* (Hamilton-Buchanan)

Cyprinus danricus Hamilton 1822.

Nurla danrica Day 1878; Lal and Chatterjee 1962; Singh 1964.

Esomus danricus Bleekeri 1853; Husain 1995; Talwar and Jhingran 1991; Jayaram 1999; Khan 2000; Karmakar 2000.

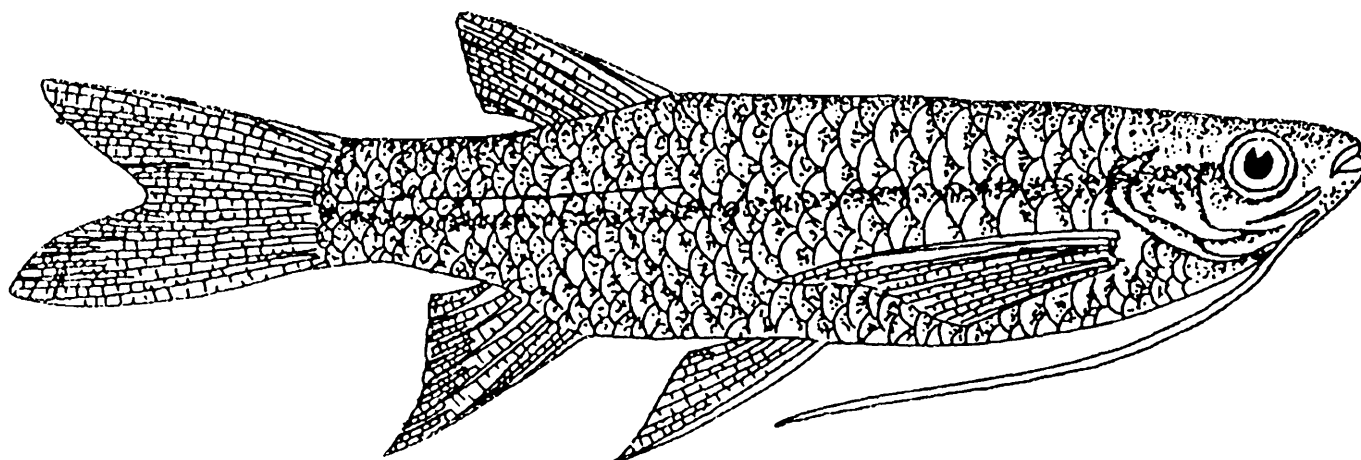
Local name : Chal.

Material Examined : 20 exs.

Collection Locality : Asan river : Confluence of Asan and Yamuna river, Dhalipur; ½ km toward N-W of Jhajra village; 1 km toward N of Chanribani village; Dehradun. Amlawa river : Confluence of Amlawa and Yamuna river, Kalsi, Dehradun.

Fin formula : D.8-9 (2/6-7); P. 11; V 8; A.9 (3/6); C 20.

Total length : 5 cm.



Specific character : Length of head 5.20; of caudal 4.25 and height of body 5.2, in the total length; eye diameter 3.8 in the length of head; body elongated, strongly compressed; head and snout blunt, lip thin; pharyngeal teeth in single row; barbels two pairs, rostral reach nearly the posterior part of orbit; dorsal fin originate near anal fin, pectoral fin extended beyond the base of ventral fin and the ventral extended nearly the base of the caudal fin forked; scales in two rows between lateral line the base of ventral fin; colour pale olive with broad black lateral band.

Distribution : Throughout India.

Elsewhere : Bangladesh; Nepal, Manyam, Srilanka and Pakistan.

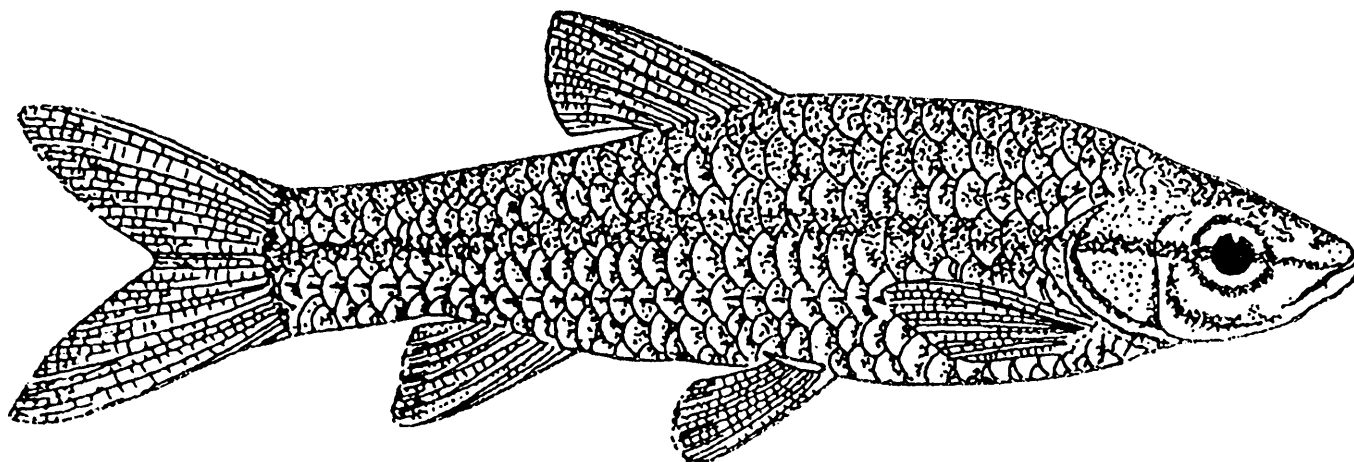
Economic Importance : In my collection represented by single species, not much liked by local people.

8. *Parluciosoma daniconius* (Hamilton-Buchanan)

Cyprinus daniconius Ham. 1822.

Rasbora daniconius Day 1878, Menon 1999; Mishra 1959; Jayaram 1999, Khan 2000; Karmakar 2000.

Parluciosoma daniconius Husain 1975; Hows 1980; Talwar and Jhingran 1991; Khan 2000.



Local name : Bhauri.

Material Examined : 55 exs.

Collection Locality : Asan river : Kunj grant near the Asan barrage, Dhalipur; Badowala village on either side of bridge; Chandribani village near temple, Dehradun.

Fin formula : D.9 (2/7); P. 14; V. 8; A.7 (2/5); C. 19.

Total length : 10 cm.

Specific character : Length of head 4.5 and height of body 5 in the total length; eye 3.5 in the length of head; body elongated, compressed, abdomen rounded; barbels absent;

dorsal fin commences rather near the origin of the ventral fin are very weak, caudal fin forked; lateral line concave and descended gradually with 2-1/2 rows of scale between the lateral line and the base of the ventral fin.

Distribution : Throughout India.

Elsewhere : Myanmar; Sri Lanka; Pakistan and Mekong.

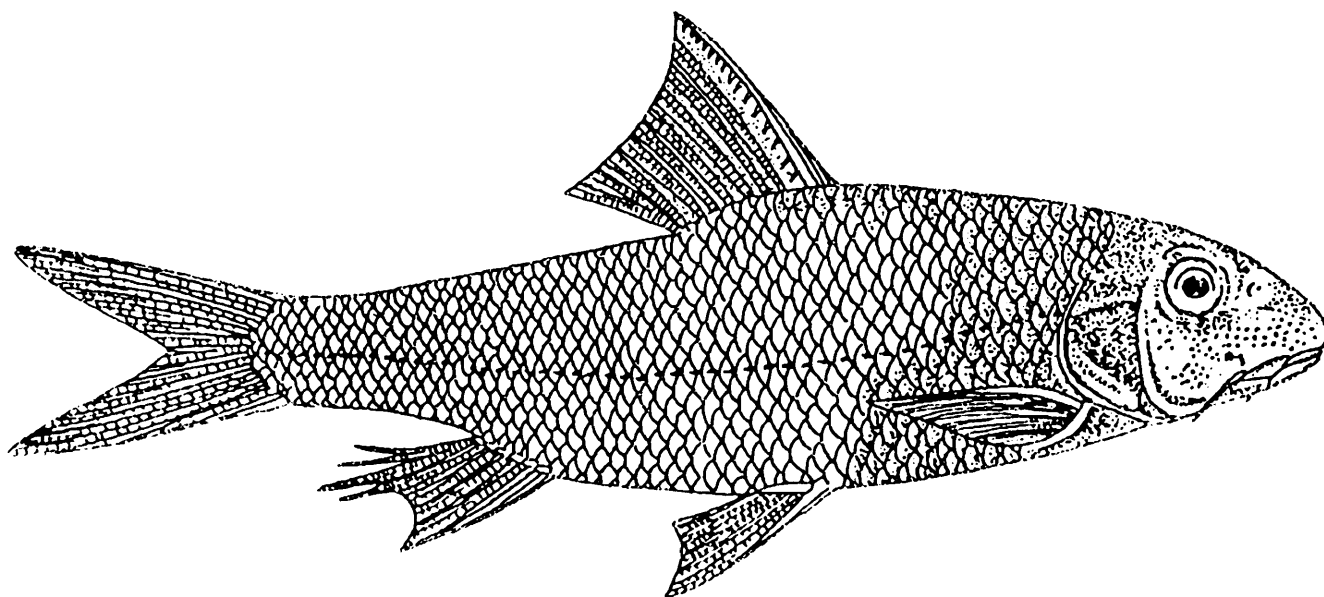
Economic importance : This genus represented by single species and is an aquarium fish, not much liked as food by locals.

9. *Chagunius chagunio* (Hamilton-Buchanan)

Cyprinus chagunio Hamilton 1822.

Barbus chagunio Day 1878; Singh 1964.

Chagunius chagunio Hora 1936; Menon 1999; Srivastava 1968; Talwar and Jhingran 1991; Jayaram 1999; Khan 2000; Karmakar 2000.



Local name : Chhibban, Pathali.

Material Examined : 28 exs.

Collection Locality : Asan river : Confluence of Asan and Yamuna river, Dhalipur; Badowala village near Forest check post, Dehradun. Amlawa river : Confluence of Amlawa and Yamuna river, Kalsi; Seligothan village ½ km down stream; Sango Ka Tallab, Sahiya village, Dehradun.

Fin formula : D. 11 (3/8); P.15; V.19; A8 (3/5); C. 19; Li: 44-46; Ltr. 11/9.

Total length : 10 cm.

Specific Character : Length of head 4.45, of caudal 5, and height of body 4.1 in total length; eye diameter 4.5 in length of head; body elongated, abdomen broadly rounded; head compressed, snout over hanging in male snout and check with short in female; lip thick, barbels two pairs each rostral and maxillary both longer than orbit; dorsal fin strong and serrated internally, anal fin long with three unbranched and fine complete; uniform silvery colour with pinkish tinge, black spots present at the base of each scale.

Distribution : India (Northern portion along base of Himalaya).

Elsewhere : Nepal; Pakistan; Bangladesh; Myanmar and Thailand.

Economic Importance : This genus is found in good number in Amlawa as compare to Asan river. Local consume it with great taste and its juice is given to prevent the cold in tribal area of Jaunsar-Bawar (Chakrata hills).

10. *Puntius chola* (Hamilton-Buchanan)

Cyprinus chola Ham. 1822.

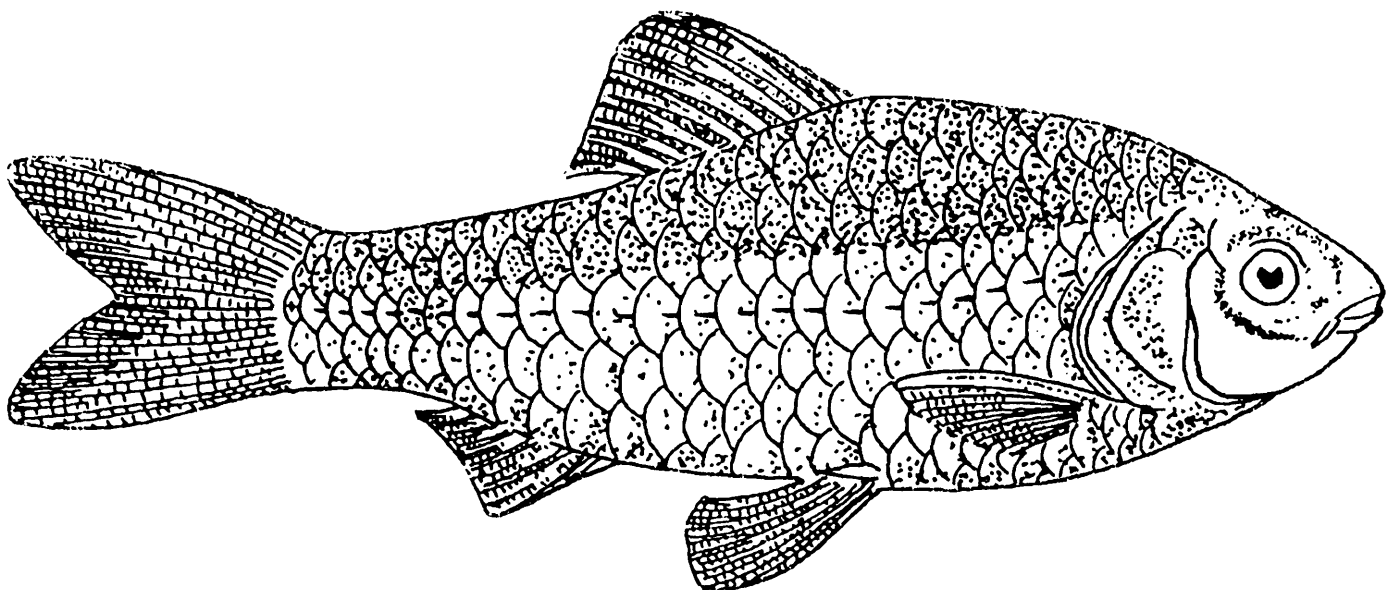
Barbus chola Day 1878; Singh 1963.

Puntius chola Chauhan and Ramakrishnan 1953; Menon 1962; Talwar and Jhingran 1991; Jayaram 1999; Khan 2000; Karmakar 2000.

Local name : Phuti, Phusi.

Material Examined : 160 exs.

Collection Locality : Asan river : Confluence of Asan and Yamuna river, Dhalipur, Kunj Grant village, Dhalipur; ½ N-W of Jhajra village; Badowala village near Forest check post; 1 km from temple, Chandribani village, Dehradun. Amlawa river : Confluence of Amlawa and Yamuna river, Kalsi, Viyas Nahar, Kalsi village, Dehradun.



Fin formula : D.11 (3/8); P. 14-15; V 9-8 (2/6); C 18.

Total length : 9 cm.

Specific character : Length of head 4.42, of caudal 4.44 and height of body 3.45 in the total length; eye diameter 3-8 in the total length of head, 1.54 in the interorbital width; body moderately elongated with rounded abdomen; head short, snout obtuse; barbels present, only one pair, maxillary which is shorter than the orbit; dorsal commence opposite to ventral fin, anal fin short, caudal forked; lateral line present and complete; body colour silvery, with a black blotch on 23rd and 24th scales along the lateral line.

Distribution : Throughout India.

Elsewhere : Pakistan; Nepal; Bangladesh; Myanmar and Sri Lanka.

11. *Puntius conchoni* (Hamilton-Buchanan)

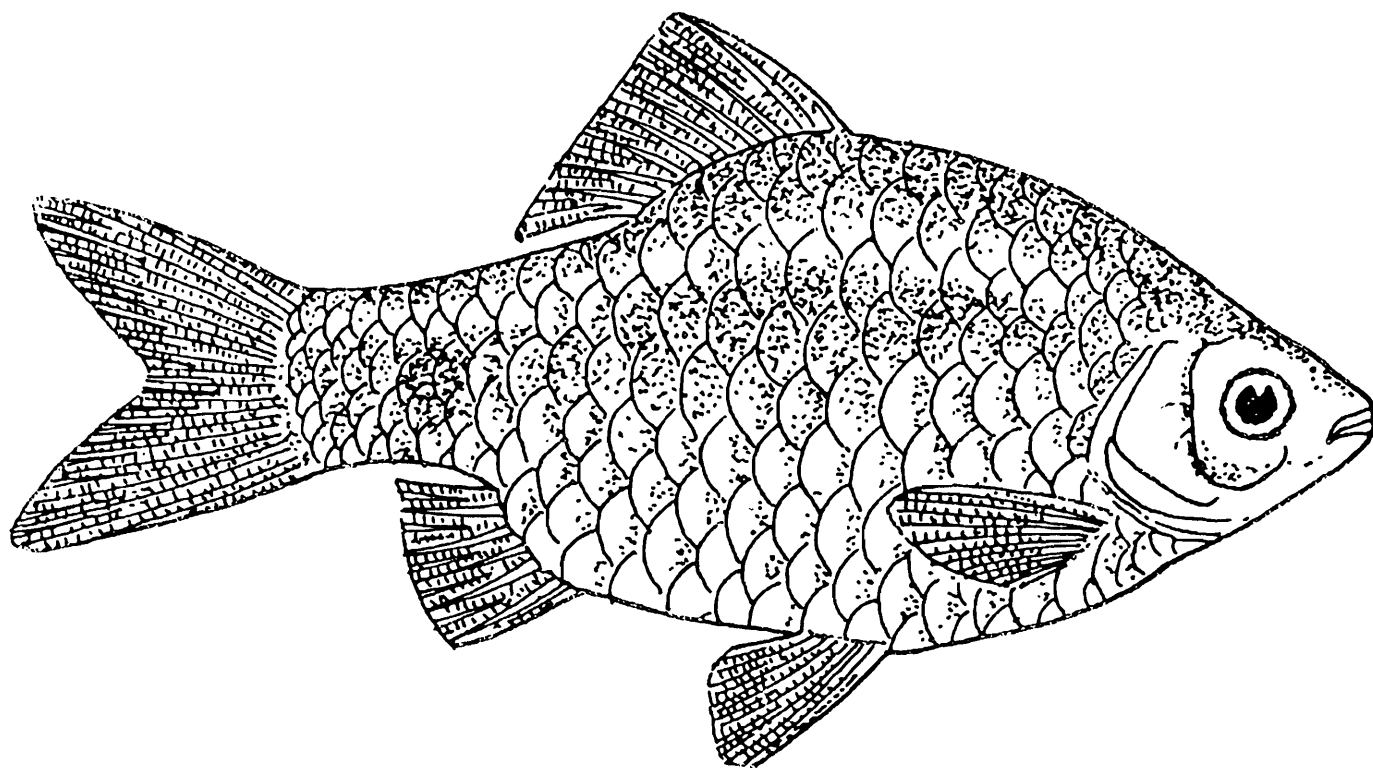
Cyprinus conchoni Hamilton 1822.

Barbus conchoni Day 1878 ; Shaw and Shebbeare 1937.

Puntius conchoni Chauhan and Ramakrishnan 1953; Mishra 1959; Talwar and Jhingran 1991; Jayaram 1999, Khan 2000; Karmakar 2000.

Local name : Phuti.

Material Examined : 210 exs.



Collection Locality : Asan river : Kunj Grant village, Dhalipur; ½ km N-W of Jhajra village; 1 km toward North of forest check post, Badowala village; near temple, Chandribani village, Dehradun. Amlawa river : Confluence of Amlawa and Yamuna river, Kalsi, Dehradun

Fin formula : D.11 (3/8); P. 15-16; V8- 9; A. 8 (3/5); C 19.

Total length : 5 cm.

Specific character : Length of head 4.85, of caudal 4.22, and height of body 2.85 in the total length; eye diameter 3.15 in the length of head, 1.0 from the end of snout and 1.35 in the interorbital width; body elongated, deep, compressed; head short, snout conical; barbel absent; dorsal fin commences just before the insertion of the ventral fin; caudal fin forked; lateral line incomplete, ceases after 10-13 scales; body colour greenish grey dorsally becoming silvery towards sides all scales with black base, black spot in between to 18th to 20th scales.

Distribution : India (Brahmaputra, Ganga, Mahauai river system in Assam, Bihar, Orissa, U.P., Uttaranchal, W. Bengal).

Elsewhere : Bangladesh; Nepal and Pakistan.

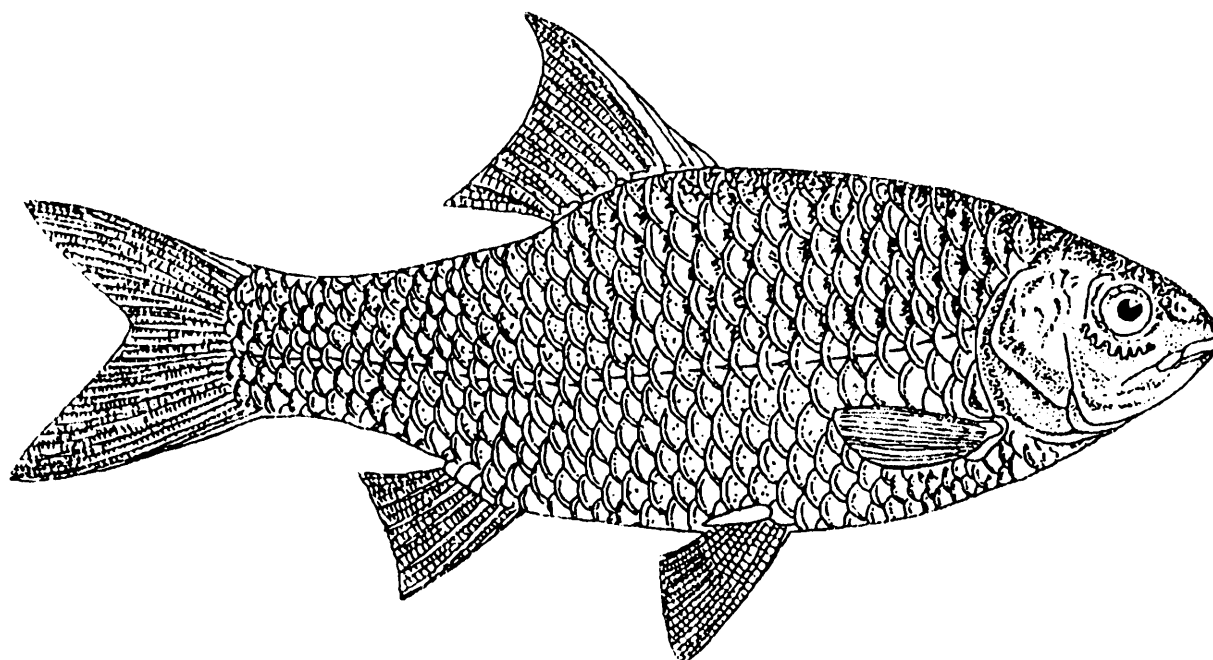
12. *Puntitus sarana sarana* (Hamilton-Buchanan)

Cyprinus sarana Hamilton 1822.

Barbus sarana Day 1878; Singh 1964.

Puntis sarana; Chauhan and Ramakrishnan 1953; Talwar and Jhingran 1991; Jayaram 1999; Khan 2000; Karmakar 2000.

Local name : Phuta, Chotti Machhi.



Material Examined : 50 exs.

Collection Locality : Asan river : Confluence of Asan and Yamuna river, Dhalipur; ½ km towards N.W. of Jhajra village; 1 km North from forest check post, Badowala village; near temple, Chandribani village, Dehradun. Amlawa river : Confluence of Amlawa and Yamuna river Kalsi, temple near forest check post Kalsi, Dehradun.

Fin formula : D.11-12 (3/8-9); P. 15-16; V. 8-9; A. 8 (3/5); C 19.

Total length : 12 cm.

Specific character : Length of head 4.90, of caudal 5.0 and height of body 3.60 in the total length; eye diameter 4.54 in the length of head, 1.25 from the end of snout and 2.0 in the interorbital width; head short, snout obtuse; barbels two pairs; dorsal fin start from snout caudal fin forked, pectoral do not hang over ventral; lateral line present and complete; body colour silvery, dorsal side black; dark spot behind the opercula horizontal figment band along the rows of scales in the upper half of the body.

Distribution : Throughout India (except South of Krishna river).

Elsewhere : Pakistan; Nepal; Bangladesh and Myanmar.

13. *Puntius sophore* (Hamilton-Buchanan)

Cyprinus sophore Hamilton 1822; McClelland 1839.

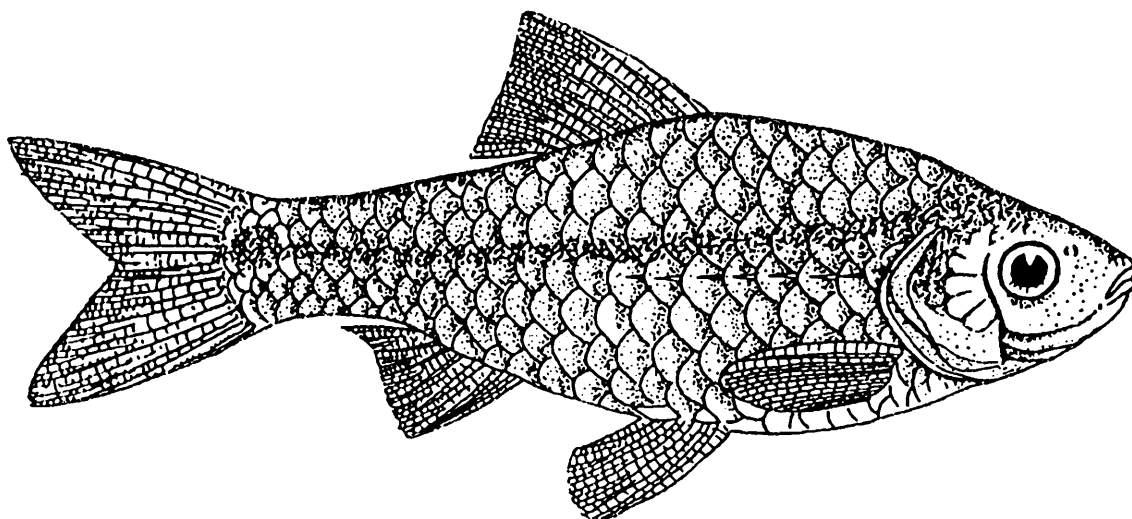
Barbus stigma Day 1878

Barbus sophore Chaudhari 1916; Hora 1938.

Puntius sophore Menon 1962; Talwar and Jhingran 1991; Jayaram 1999; Khan 2000; Karmakar 2000.

Local name : Phuti, Potto

Material Examined : 40 exs.



Collection Locality : Asan river : Kunj grant near the Asan barrage, confluence of Asan and Yamuna river, Dhalipur; Jhajra, 1km towards North of village; Badowala village near forest check post, Chanribani village near temple, Dehradun. Amlawa river : Kalsi village near temple confluence of Amlawa and Yamuna river, Kalsi, Dehradun.

Fin formula : D.11 (3/8); P. 15-16; V. 9; A. 8 (3/5); C. 19.

Total length : 7 cm.

Specific character : Length of head 4.45, of caudal 4.25 and height of body 3.5 in the total length; eye 3.5 in the length of head and moderate; dorso- lateral body elongate, compressed, abdomen rounded, head short, snout obtuse, barbel absent; dorsal fin inserted opposite the insertion of ventral, caudal fin forked; lateral line present and complete; colour silvery dark; sometime the caudal blotch is absent (in young form).

Distribution : Throughout India.

Elsewhere : Nepal; Bangladesh; Manyam and China.

14. *Puntius ticto* Hamilton

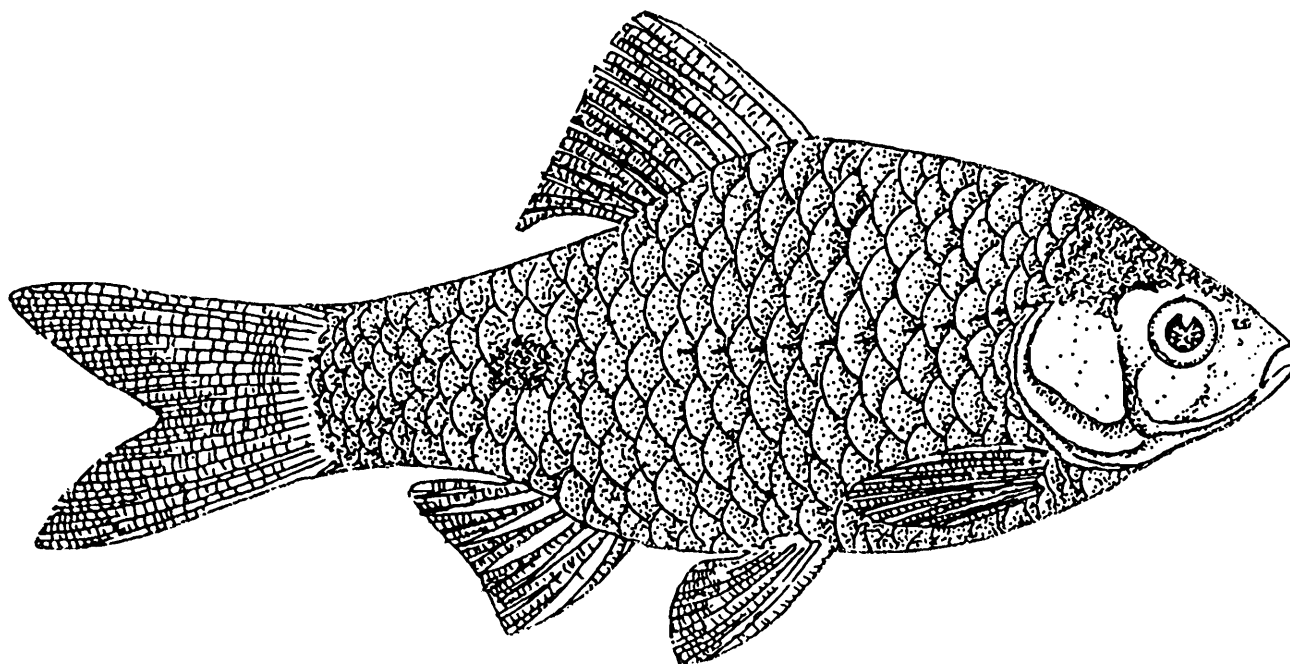
Cyprinus ticto Hamilton 1822.

Barbus ticto Day 1878; Menon 1962.

Puntius ticto Chauhan and Ramakrishan 1953; Srivastav 1968, Talwar and Jhingran 1991; Jayaram 1999; Khan 2000; Karmakar 2000.

Local name : Bhuri, Potto.

Material Examined : 280 exs.



Collection Locality : Asan river : Confluence of Asan and Yamuna river, Dhalipur, Kunj grant near the Asan barrage, Dhalipur; Jhajra, 1 km towards N-W of village; Badowala on either side of bridge; Chanribani 1 km towards North from village, Dehradun. Amlawa river : Confluence of Amlawa and Yamuna river, Kalsi village near temple, Viyas-Nahar, Kalsi, Seligothen 1 km downwards the stream, Dehradun.

Fin formula : D.11 (3/8); P. 13-15; V. 9; A. 9 (2/7); C. 19; Li 22-26; Ltr. 5 -1/2 / 6-1/2.

Total length : 6.5 cm.

Specific character : Length of head 4.5, of caudal 4.22 and height of body 3.25 in the total length; eye 3.5 in the length of head, eye moderate, dorso lateral in position body elongated, compressed, abdomen rounded, head short; mouth arched, lip thin covering jaw; barbel absent; dorsal fin origin midway between snout and caudal base, caudal fin forked; lateral line incomplete; colour silvery a black blotch, fins often black, sometime the caudal blotch is absent (in young form).

Distribution : Throughout India.

Elsewhere : Nepal; Pakistan; Srilanka; Bangladesh and Myanmar.

Economic Importance : This genus is abundant in throughout Asan river while in Amlawa river present in low altitude. Represented by 5 species in my collection. Economically less important due to their small size. Some time kept in aquarium also.

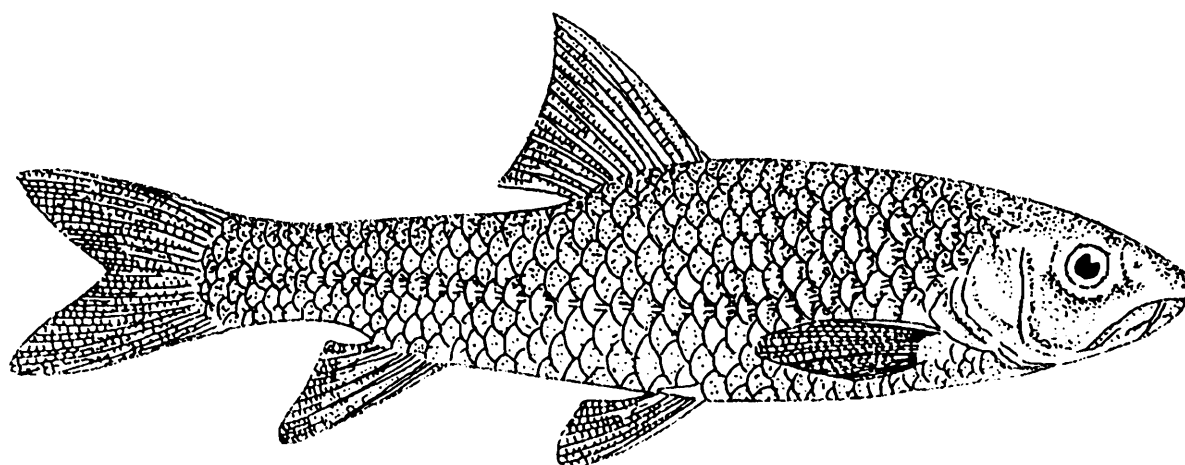
15. *Tor chelynoides* (McClelland)

Barbus chelynoides McClelland 1839; Singh. 1964.

Tor chelynoides Menon 1962; Husain 1975, Singh *et al.* 1987; Tilak and Husain 1995; Karmakar 2000.

Local name : Kali Mahseer.

Material examined : 50 exs.



Collection Locality : Asan river : Confluence of Asan and Yamuna river, Dhalipur, Dehradun. Amlawa river : Confluence of Amlawa and Yamuna river, Kalsi, near temple upper Kalsi; ½ km downstream, Seligothan village; near army camp, Sahiya town, Sango ka tallab, Sahiya village, Dehradun.

Fin formula : D. 12(2/10; P. 14-17; V. 9; A. 8(3/5); C. 19; Li. 32-35.

Total length : 12 cm.

Specific character : Length of head 4.2, of caudal 4.21 and height of body 3.60 in total length; eye diameter 2.5 to 5.2 in the length of head, 1.6 from the end of snout and 1.2 in the interorbital width; lower lip with an uninterrupted posterior groove, continues around corners of mouth; lateral line complete with scales 32-35; body elongate, compressed; body colour silver black, dark black single longitudinal passy near lateral line.

Distribution : India (along Himalaya).

Elsewhere : Pakistan.

16. *Tor putitora* (Hamilton-Buchanan)

Cyprinus putitora Hamilton 1822.

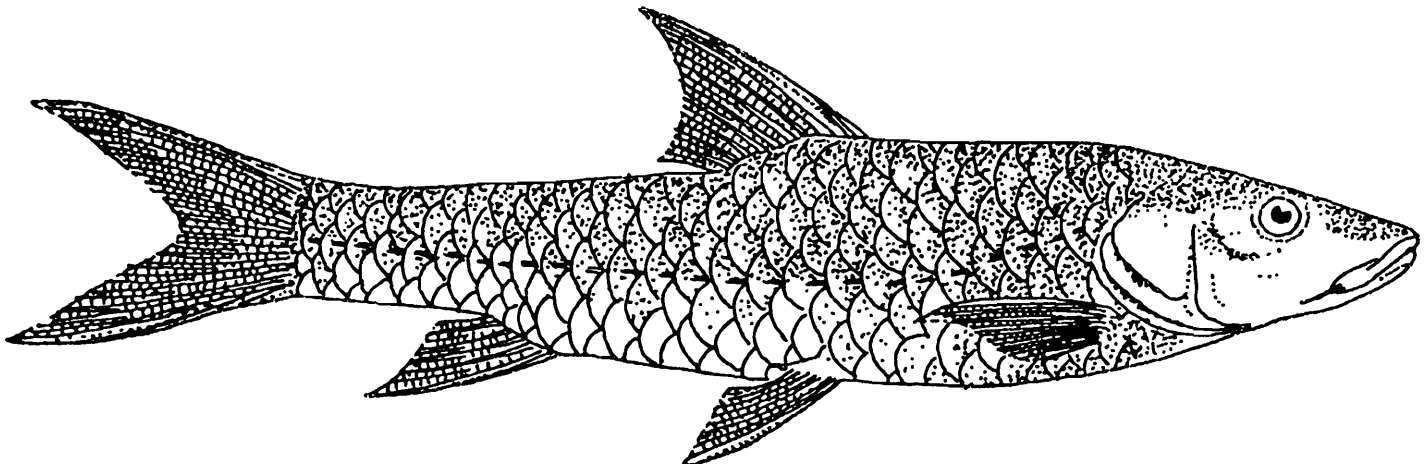
Barbus putitora Hora 1936; Hora and Mukerji 1936; Menon 1949.

Tor putitora Menon 1954, 1999; Badola 1975; Talwar and Jhingran 1991;; Jayaram 1999; Khan 2000; Karmakar 2000.

Local name : Pili Mahseer.

Material Examined : 50 exs.

Collection Locality : Asan river : Confluence of Asan and Yamuna river, Dhalipur; 1 km towards N-W of Jhajra village, Dehradun. Amlawa river : Confluence of Amlawa and Yamuna river, Kalsi, Viyas-Nahar, Ashoka pillar, Kalsi, 1.5 km down from the Seligothen village; Sango ka Talab, Sahiya village, Dehradun.



Fin formula : D.12 (3/9); P. 15-16; V. 9; A. 7 (2/5); C. 19. Ll. 25-28; L.tr. 4-1/2 / 2-1/2

Total length : 40 cm.

Specific character : Length of head 4.20, of caudal 4.26 and height of body 3.90 in the total length; eye diameter 2.8 to 5.3 in the length of head, 1.7 from the end of snout and 1.4 in the interorbital width; lips are fleshy and cartinous at the corner of mouth; two pairs of barbels of equal length; 25-28 scales along the lateral line; dorsal fin lies opposite to pelvic fin and mid way between tip of snout and base of caudal fin, pectoral fin are shorter than head, caudal fin sharply divided; body colour silvery white on belly width back reddish, below lateral line; the scales above the lateral line are marked by sap-green; pectoral, pelvic and caudal fins are peacock green colour.

Distribution : India (along Himalaya).

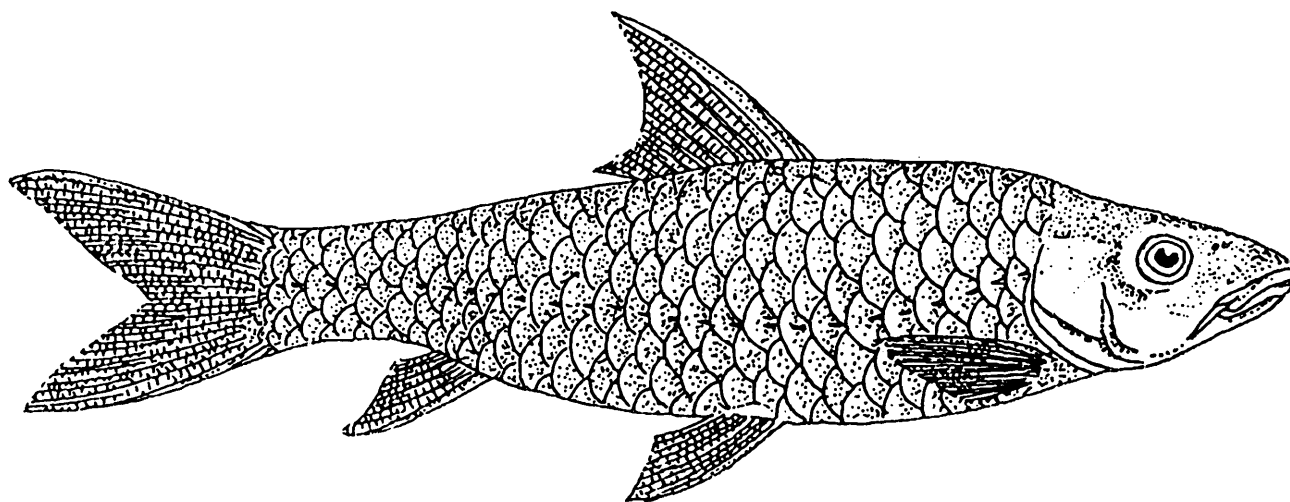
Elsewhere : Pakistan; Afghanistan; Nepal and Bangladesh.

17. *Tor tor* (Hamilton- Buchanan)

Cyprinus tor Hamilton 1822.

Barbus tor Day 1978; Hora and Mukerji 1936; Menon 1949.

Tor tor Menon 1954,1999, Badola 1975, Talwar and Jhingran 1991; Jayaram 1999; Khan 2000; Karmakar 2000.



Local name : Lal Mahseer, Ladhar.

Material Examined : 58 exs.

Collection Locality : Asan river : Confluence of Asan and Yamuna river, Dhalipur; 1.5 km towards N of Jhajra, village. Amlawa river : Confluence of Amlawa and Yamuna river, Kalsi, Viyas-Nahar, Ashoka pillar, Kalsi; 1 km down from the Seligothan village; Sahiya, near army camp, Dehradun.

Fin formula : D.12 (4/8); P. 15-18; V. 9; A.8 (3/5); C. 19. Ll. 22-27; Ltr. 4 -1/2 / 2-1/2.

Total length : 35 cm.

Specific character : Length of head 4.70; of caudal fin 4.3 and height of body is 4.7 in the total length; eye diameter 5.4 in the length of head and variable in size; lip are thick; barbels two pairs, maxillary and rostral; dorsal fin arise opposite the ventral fin, pectoral is long, anal fin not reach the base of caudal fin forked; lateral line complete colours silvery golden and fin reddish-yellow.

Distribution : Throughout India.

Elsewhere : Pakistan and Srilanka.

Economic Importance : In my collection three species were present. These are the largest fishes in length and chief source of protein, highly liked by locals, popularly called as anglers delight. These species are listed as endangered.

18. *Labeo dero* (Hamilton-Buchanan)

Cyprinus dero Hamilton 1822.

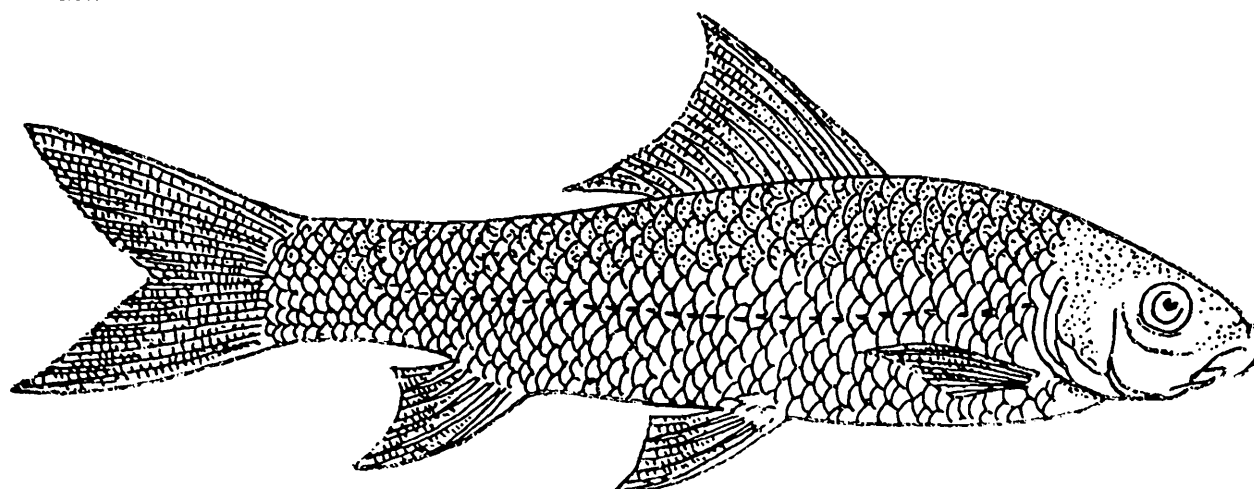
Labeo diplostomus Day 1878, 1889.

Labeo dero Hora and Mukharji 1936; Menon, 1974; Mishra 1959; Talwar and Jhingran 1991; Jayaram 1999; Khan 2000; Karmakar 2000.

Local name : Kalbas, Moil.

Material Examined : 20 exs.

Collection Locality : Asan river : Confluence of Asan and Yamuna river, Dhalipur; Kunj Grant, Asan Barrage, Dhalipur; towards NW from Jhajra village; Badowala village 1 km towards N of Dehradun. Amlawa river : Confluence of Amlawa and Yamuna river, Kalsi, Dehradun.



Fin formula : D.13 (3/10); P. 16-17; V. 9; A.7 (2/5); C. 19; Ll 43; Ltr 8/9.

Total length : 25 cm.

Special character : Length of head 4.5, of caudal fin 5.21 and height of body is 4.75 in the total length, eye diameter 4.5 in the length of head; body moderately elongated, abdomen rounded, head moderately large, snout overhanging the jaws, mouth rather narrow; inner surface of lower lip papillated; a small maxillary pair of barbels; pectoral fin not extending the ventral, caudal fin deeply forked with upper lobe slightly longer; colour greenish; scale raddish.

Distribution : India (All along the Himalayas, Assam, East Punjab, Uttar Pradesh, Uttaranchal, Bihar).

Elsewhere : Pakistan; China; Nepal and Mayanmar.

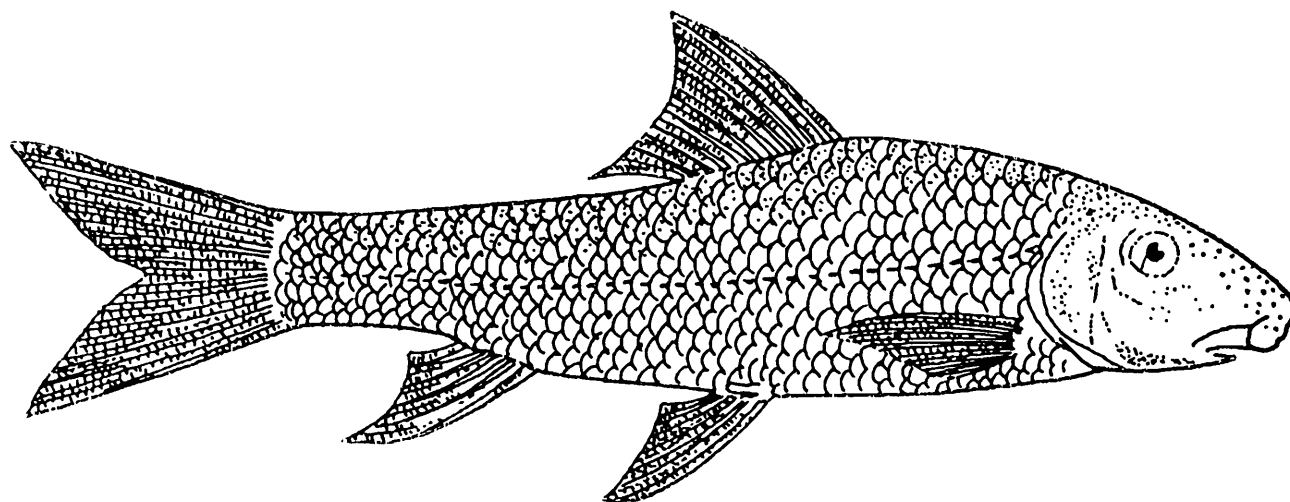
19. *Labeo dyocheilus* (McClelland)

Cyprinus dyocheilus McClelland 1839

Labeo dyocheilus Day 1878; Menon 1974; Talwar and Jhingran 1991; Jayaram 1999; Khan 2000; Karmakar 2000.

Local name : Balla, Doongri.

Material Examined : 10 exs (Procured from fishermen).



Collection Locality : Asan river : confluence of Asan and Yamuna river, Dhalipur; 1 km towards N of Jhajra village. Amlawa river : confluence of Amlawa and Yamuna river, Kalsi, Dehradun.

Fin formula : D.13 (2/11); P. 17; V 9; A.7 (2/5); C 19; Ll 43; Ltr7- 1/2.

Total length : 25 cm.

Special character : Length of head 4.2 of caudal 5.20 and height of body 4.70 in the total length; eye diameter 4.2 in the length of head; body elongated and compressed; lateral lobe distinct, thick; snout with groove in the adult; scales 19 to 23; pectoral fin small, caudal fin forked; body colour silvery greenish with reddish scales.

Distribution : India (along Himalaya, Madhya Pradesh, Rajasthan).

Elsewhere : Nepal; Bhutan and Bangladesh.

Economic importance : In my collection two species were present. These species are considered best food fishes, but very less in catch. These species can be cultured in water bodies of Doon valley.

20. *Crossocheilus latius latius* (Hamilton-Buchanan)

Cyprinus latius Hamilton 1822.

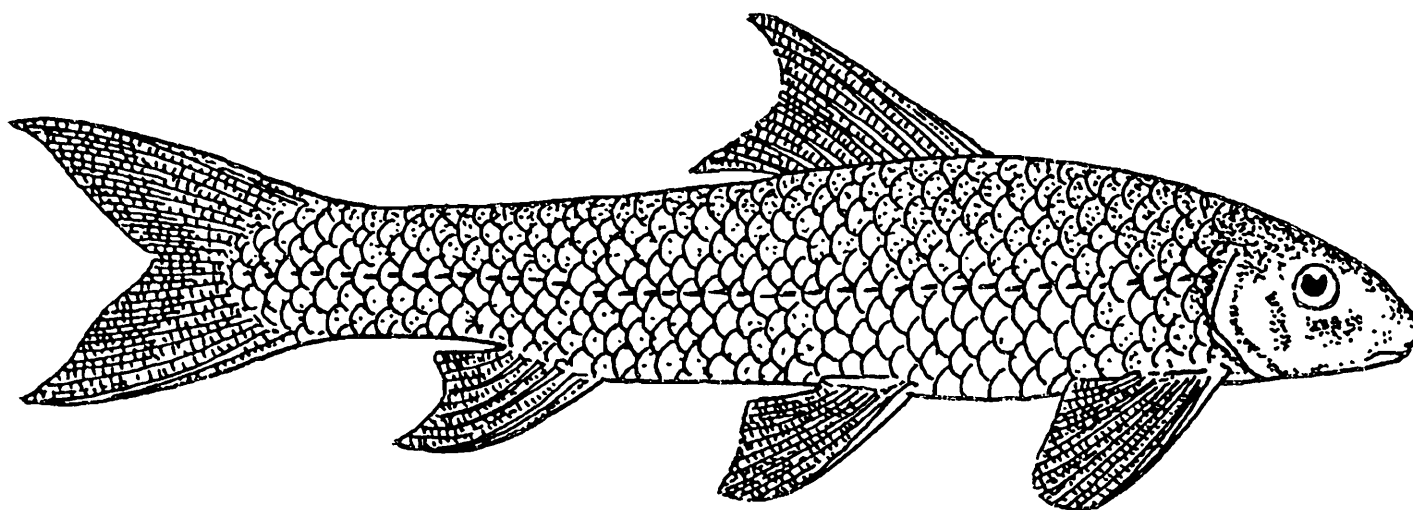
Cirrhina latia Day 1878, 1889.

Crossocheilus latius Hora and Mukherji 1936; Menon 1949; Srivastava 1968;

Crossochilus latius latius Menon 1974,; Talwar and Jhingran 1991; Jayaram 1999; Khan 2000; Karmakar 2000.

Local name : Dhanaura, Saknera.

Material Examined : 25 exs.



Collection Locality : Asan river : Confluence of Asan and Yamuna river, Dhalipur; Badowala village 1km towards N of bridge. Amlawa river : Seligotham 1.5 km down stream N of village; Sango ka Tallab, Sahiya; down stream ½ from Alu Mandi, Chakrata.

Fin formula : D.10 (3/7); P. 15; V 9; A.7 (2/5); C 19; Ll 38-39; Ltr 5-1/2 / 4-1/2.

Total length : 17 cm.

Special character : Length of head 4.82 of caudal 5 and height of body 5.2 in the total length; eye diameter 4.2 in the length of head 2.0 from the end of snout 3.0 in interorbital width; body elongated and compressed; snout overhanging the mouth, mouth, ventrally situated; pair of rostrum barbels; body colour brownish olive; scales golden and shining in fresh condition.

Distribution : India (Bhramaputra, Ganga river System, Deolali, Maharashtra).

Elsewhere : Bangladesh; Nepal and Pakistan.

Economic importance : This genus present in both the rivers. Moreover, it is much linked as a food in the region.

21. *Garra gotyla gotyla* (Gray)

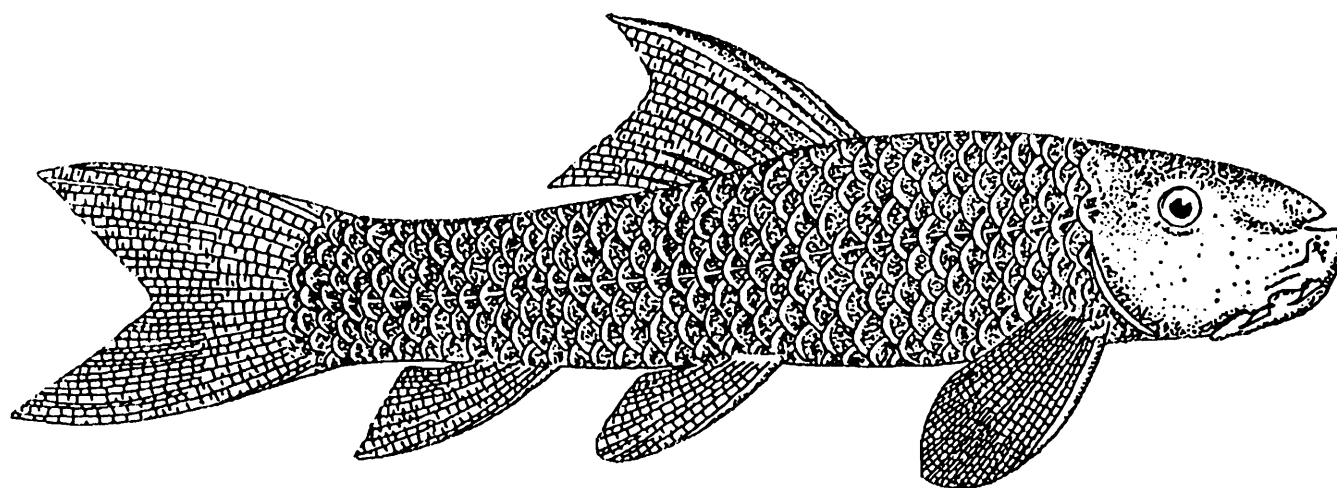
Cyprinus gotyla Gray 1832

Garra gotyla Hora and Mukherji 1936; Menon 1962; Karmakar 2000.

Garra gotyla gotyla Lal and Chatterjee 1962; Talwar and Jhingran 1991; Jayaram 1999; Khan 2000.

Local name : Gotyla, Bhangnera.

Material Examined : 110 exs.



Collection Locality : Asan river : Confluence of Asan and Yamuna river, Dhalipur, Kunj grant near Asan barrage, Dhalipur; ½ km towards NW of Jhajra village; Badowala village on either side of bridge; Chandribani village near temple, Dehradun. Amlawa river : Confluence of Amlawa and Yamuna river, Kalsi, ½ km down stream, Seligothan village; Sango ka Talab, Sahiya village; Sahiya town near army camp; Alumandi 1km downstream towards N, Chakrata, Kalina down stream 0.5 km from Army camp, Chakrata, Dehradun.

Fin formula : D.10-11(2/8-2/9); P. 15-16; V 9; A.8 (2/6); C 17; Ll 34; Ltr 4- 4-1/2.

Total length : 20 cm.

Special character : Length of head 4.80 of caudal fin 5.2 and height of body is 5.0 in the total length; eye diameter 4.5 in the length of head 2-2 from the end of snout and 3.1 in interorbital width; body elongated, abdomen rounded, head slightly depressed anteriorly; snout pointed and flattened, tuberculated with a transverse groove; upper lip bearing 28 fringes; pectoral fin bigger than head; caudal fin slightly lobed; chin containing a strong circular pad; colour blackish green.

Distribution : India (All along the Himalaya).

Elsewhere : Nepal; Bangladesh; Pakistan and Srilanka.

22. *Garra lamta** (Hamilton-Buchanan)

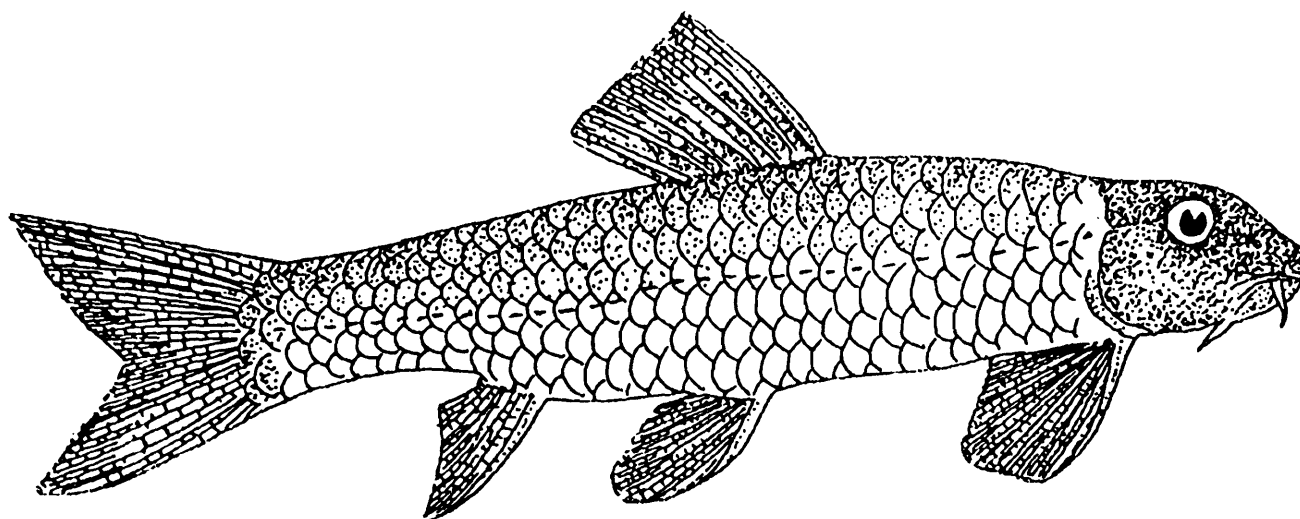
Cyprinus lamta Hamilton 1822.

Discognathus lamta Day 1878, 1889.

Garra lamta Hora 1937; Menon 1962; Talwar and Jhingran 1991; Jayaram 1999; Khan 2000; Karmakar 2000.

Local name : Gondal.

Material Examined : 02 exs.



Collection Locality : Amlawa river : Sango ka Talab Sahiya village, Sahiya town near army camp, Dehradun.

Fin formula : D.11(2/9); P. 15; V 9; A.6-7 (2/4, 2/5); C 17; Ll 35; Ltr 4-4-1/2.

Total length : 15 cm.

Specific character : Length of head 4.50, of caudal fin 5.5 and height of body is 5.1 in the total length; eye diameter 6.1 in the length of head 2.3 from the end of snout and 3.2 in interorbital width; body elongated, abdomen rounded, snout broad and flat; upper jaw fringed and overhanging the mouth; snout smooth and sometimes covered with tubercles;

pectoral and ventral fin horizontal, anal fin reaching the base of caudal fin, caudal fin slightly lobed; scales thick; small two dull pairs of barbels, dark brown bit greenish in colour in fresh specimen. It is a new record for district Dehradun. All the morphometric and merismatic characters were found same that of Badola (1979.)

Distribution : India (Darjeeling, Assam, Sikkim and Uttaranchal).

Elsewhere : Maymmar and Nepal.

Economically important : In my collection this genus represented by two species and present in good number in Amlawa river as compare to Asan river, local people consume although it is not very tasty and having large bony portion.

23. *Schizothoraichthys progastus* (McClelland)

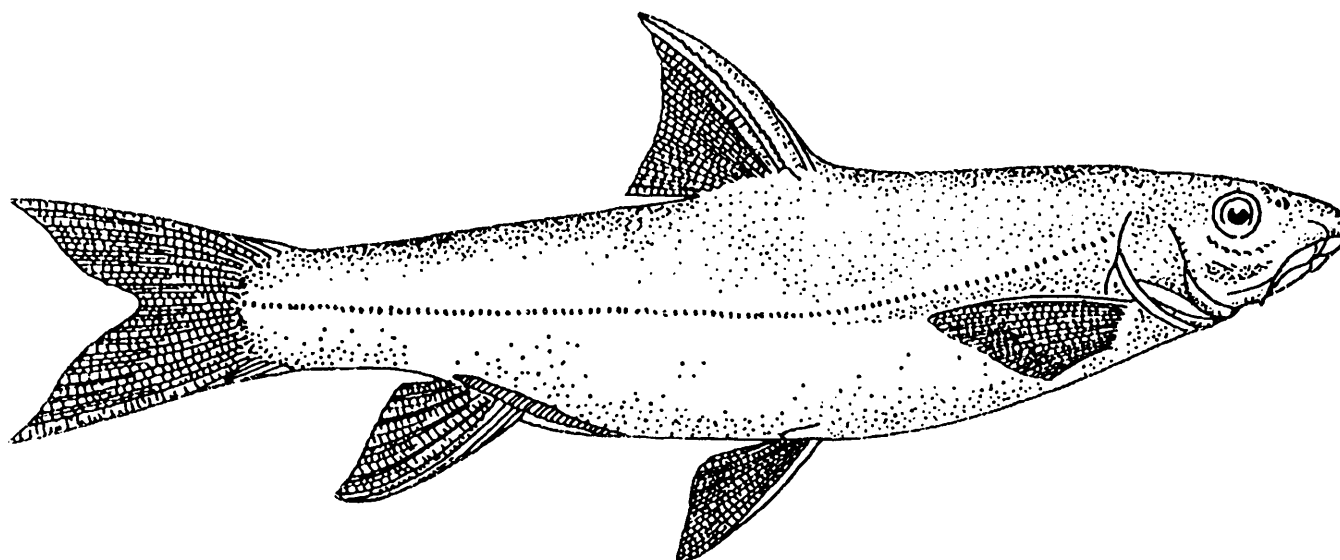
Cyprinus progastus McClelland 1839; Cuv and vale 1844.

Schizothorax progastus Day 1878; Badola 1975.

Schizothoraichthys progastus Mishra 1959; Menon 1962,; Jhingran 1975; Talwar and Jhingran 1991; Jayaram 1999; Karmakar 2000.

Local name : Pahari-machi, Dinnawh.

Material Examined : 60 exs.



Collection Locality : Amlawa river : Sango ka Talab, Sahiya village, Sahiya town near army camp; ½ km down stream from Seligothan village; Alumandi down stream 1 km N-W, Chakrata, Dehradun.

Fin formula : D.10 (2/8); P. 16-20; V11; A.7 (2/5); C 19; LI 150-160; Ltr4- 4-1/2.

Total length : 15 cm.

Specific character : Length of head 4.5, of caudal fin 4.2 and height of body is 4.0 in the total length; eye diameter 4.0 to 5.2 in the length of head; snout pointed and smooth; mouth terminal, lip thick and fleshy; lower labial fold uninterrupted; barbels two pair (maxillary and rostral); body elongated and abdomen rounded; dorsal fin inserted near to snout tip (or often midway) them base of caudal fin; dorsal spine strong and serrated; scales small; lateral width 150-160 scales; colour silvery often with a few fine spot on fins.

Distribution : India (Himalaya, from water of Ganga to Sadiya in Assam).

Elsewhere : Nepal.

24. *Schizothorax richardsonii* (Gray)

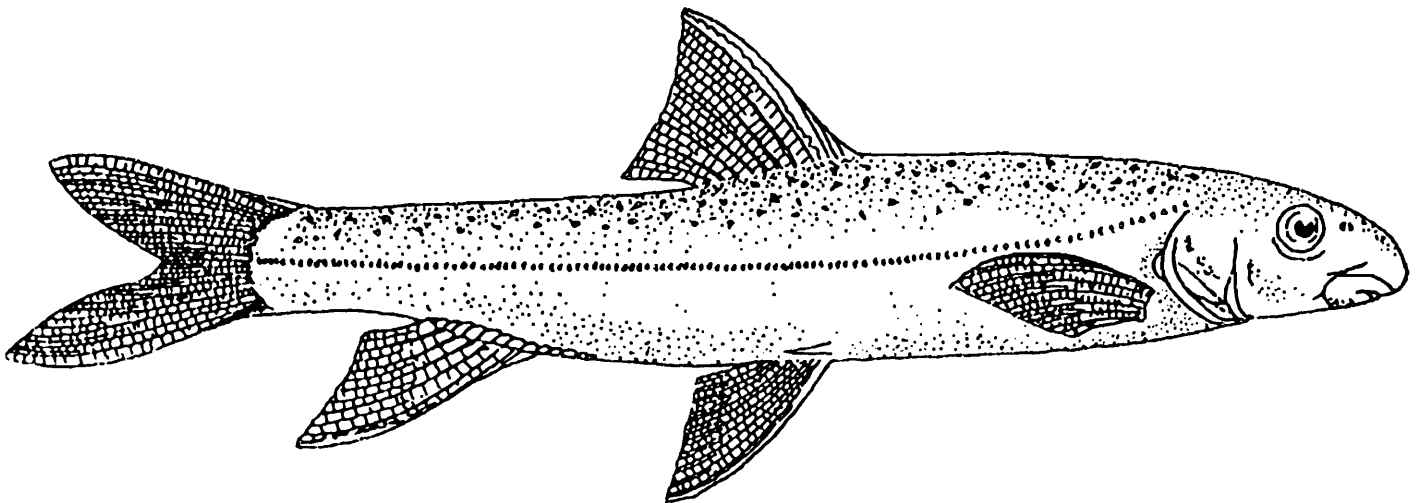
Cyprinus richardsonii Gray 1832.

Oreinus richardsonii Day 1878; Menon 1999.

Schizothorax richardsonii Menon 1962; Talwar and Jhingran 1991; Jayaram 1999; Karmakar 2000.

Local name : Asala, Sohal.

Material Examined : 250 exs.



Collection Locality : Asan river : Confluence of Asan and Yamuna river, Dhalipur, Dehradun. Amlawa river : Confluence of Amlawa and Yamuna river, Kalsi, viyas nahar, Kalsi village, temple near forest check post Kalsi; Seligothan ½ km down stream of village; Sahiya town near army camp, Sango ka Talab, Sahiya village, 1.5 km towards N-W of Sahiya town; Alumandi down stream ½ km Chakrata, Kalina 1 km down stream army camp, Chakrata, Dehradun

Fin formula : D.11 (3/8); P. 16-17; V10; A.7 (2/5); C 19; LI 95-100.

Total length : 25 cm.

Specific character : Length of head 5.6, of caudal fin 5.4 and height of body is 4.0 in the total length; eye diameter 4.0 to 5.4 in the length of head; snout overhanging the upper lip; upper lip hard; lower lip modified into a stony pad and laterally papillated; nasal barbel short and maxillary slightly big; dorsal fin ray with 12 serration, anal fin not reaching the base of caudal fin, caudal fin folded; blackish to brown and some black spots on the body. This species with black spot disease collected from Sahiya and Seligothan. This disease cause mass mortality among this species.

Distribution : India (Darjeeling, Himachal Pradesh, Jammu & Kashmir and Uttaranchal).

Elsewhere : Nepal and Bhutan.

Economic Importance : This genus is found in good numbers in Amlawa river and absent in Asan river. It is a medium sized fish; tribal people of Chakrata hills used its fats as pain reliever and also consume much due to its taste.

Family COBITIDAE

Head and body compressed; barbels 6 to 8; scales smaller or rudimentary embedded in Skin; mouth small inferior; eye sometimes covered with skin; whole or part of swim bladder enclosed in a bony capsule; pelvic fin with only one simple outer ray; largest otolith in utricles; orbitosphenoid present, maintaining contact with the mesethmoid; after a simple or bifid movable spine present in a groove before or below the eye.

25. *Lepidocephalus guntea* (Hamilton-Buchanan)

Cobidus guntea Hamilton 1822.

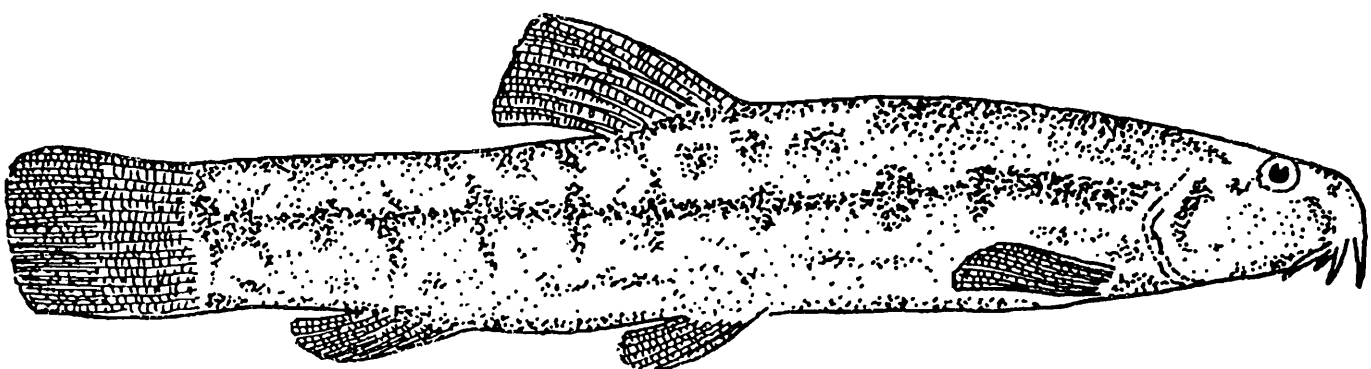
Lepidocephalichthys guntea Day 1878, 1889; Menon 1962; Srivastava 1968; Badola 1975.

Lepidocephalus (Lepidocaphalichdhys) guntea Husain 1987, 1995; Husain and Tilak 1995.

Lepidocephalus guntea Menon 1974; Talwar and Jhingran 1991; Jayram 1999; Khan 2000; Karmkar 2000.

Local name : Gadera, Ghiwa.

Material examined : 220 exs.



Collection Locality : Asan river : Confluence of Asan and Yamuna river, Dhalipur, Kunj Grant near Asan Barrage, Dhalipur; ½ km towards North of Jhajra village; Badowala village on either side of bridge; Chandribani village near temple, Chandribani 1/2 km toward N.W of temple, Dehradun. Amlawa river : Confluence of Amlawa and Yamuna river, Kalsi, Viyas Nahar, near Ashoka pillar, Kalsi, Kalsi temple, near Forest check post; Seligothan 1/2 km downstream from village; Shaiya village Sango ka tallab, Dehradun.

Fin Formula : D. 8 (2/6); P. 8; V. 7; A.7(2/5); C.16); L1. 115.

Total length : 8.5 cm.

Specific character : Length of head 5.1, of Caudal 5.0 and height of body 5.1 in the total length; eye diameter 3.7 in the length of head; body elongate and moderately compressed; abdomen rounded; barbels two pair rostral and one pair maxillary, all reaching the orbit caudal fin entire; lateral line absent; colour yellowish, a black transverse band along the lateral side, black ocellus above the middle of the base of the caudal fin, caudal and dorsal fin bearing a number of black spots.

Distribution : Throughout Northern India.

Elsewhere : Nepal and Bangladesh.

Economic importance : This genus is abundant in Asan river and in low altitude of Amlawa river. In my collection represented by one species. Local people eat it due to its taste and in tribal area of Chakrata its juice is given for curing fever.

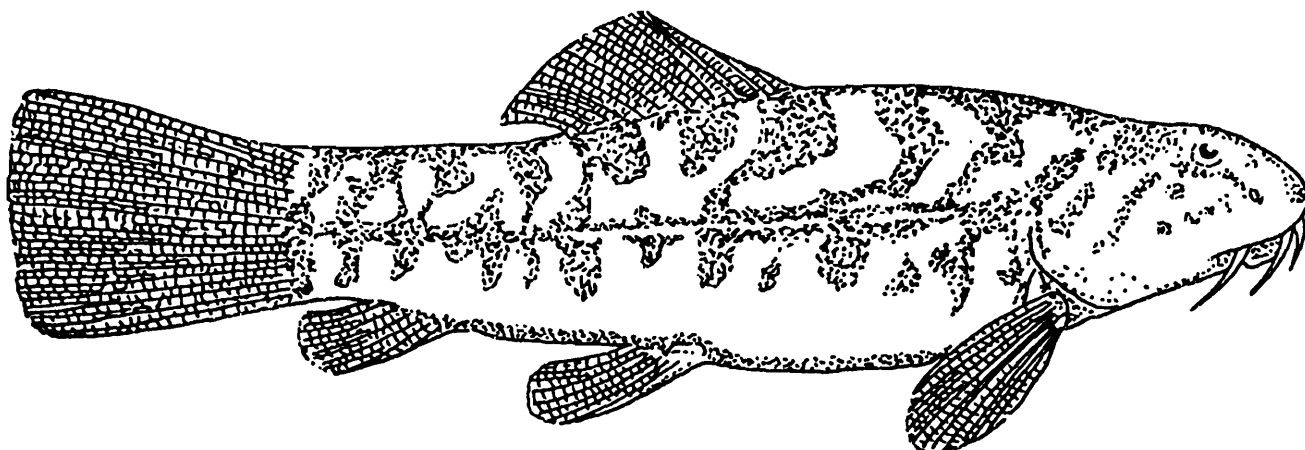
26. *Nemacheilus botia* (Hamilton-Buchanan)

Cobites botia Hamilton 1822.

Nemacheilus botia Day 1878; Hora and Mukerji 1936; Menon 1974; Talwar and Jhingran 1991; Khan 2000; Karmakar 2000.

Local name : Gadiyal, Gadera.

Material Examined : 210 exs.



Collection Locality : Asan river : Confluence of Asan and Yamuna river, Dhalipur, Kunj Grant, near Asan Barrage, Dhalipur; 1.5 km towards NW of Jhajra village; Badowala village or either side of bridge, Dehradun. Amlawa river : Confluence of Amlawa and Yamuna river, Kalsi, near Ashoka pillar, Kalsi; Seligothan $\frac{1}{2}$ down stream NW of village; Sango ka Tallab, Sahiya village; Sahiya town near Army camp; Alu mandi $\frac{1}{2}$ km down stream, Chakrata, Kalina 1 km. downstream near Army camp, Dehradun.

Fin Formula : D. 12 (2/10); P. 10-11; V. 8; A. 7 (2/5); C. 17.

Total length : 8.5 cm.

Specific Character Length of head 4.5, of caudal 5.0 and height of body 6.5 in total length; eye diameter 4.5 in length of head; body almost cylindrical, head cylindrical, pointed anteriorly, snout obtusely rounded; Jaw and palate without teeth; barbels long, maxillary pair reaching the posterior most extremity of the orbit; anal fin reaching the caudal fin, caudal fin entire or slightly emerginate; lateral line incomplete; colour brown, a number of irregular blotches above the lateral line; dorsal fin with black spots, caudal fin with 6-7 bar of > - shaped and with a black spot on the upper portion of the base.

Distribution : India (Assam, Bihar, Uttar Pradesh, Uttaranchal).

Elsewhere : Sri Lanka.

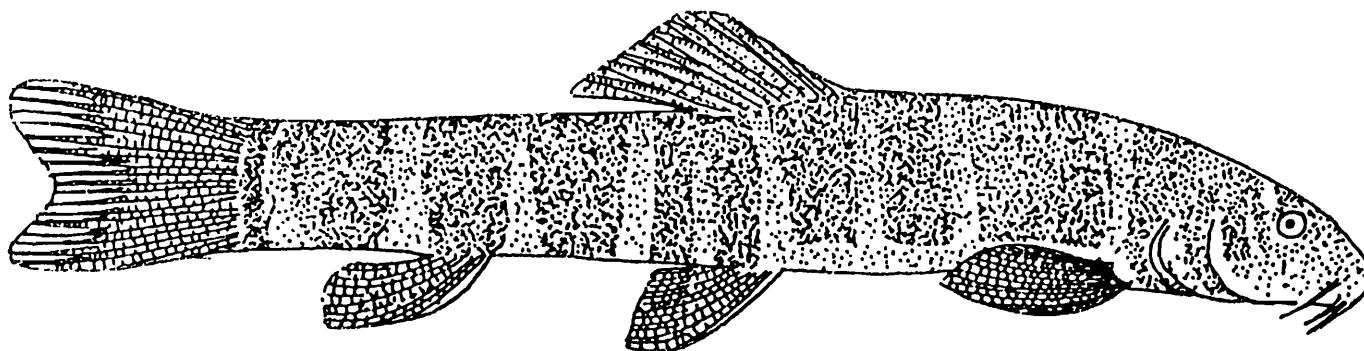
27. *Nemacheilus montanus* (McClelland)

Schistura montanus McClelland 1839.

Nemacheilus montanus Day 1878, 1889; Menon 1975; Talwar and Jhingran 1991; Karmakar 2000.

Local name : Gadiyal, Gadera.

Material examined : 60 exs.



Collection Locality : Asan river : Confluence of Asan and Yamuna river, Dhalipur; Kunj Grant near, Asan Barrage, Dhalipur; Jhajra 1 km. toward N-W of village; Badowala village 1 km. N. from Forest check post, Dehradun. Amlawa river : Confluence of Amlawa and Yamuna river, Kalsi, Viyas Nahar near Ashoka Pillar, Kalsi; Seligothan $\frac{1}{2}$ km down stream toward NW of village; Sahiya town near Army camp, Sango ka Tallab, Sahiya village,

Sahiya village near Inter-college; Alu mandi 1 km down stream towards NW, Chakrata, Dehradun.

Fin formula : D. 9 (2/7); P. 9-10; V.7.; C.19.

Total length : 8 cm.

Specific character : Length of head 6.5, of caudal 5.5 and height of body 6.0 in the total length; eye diameter 5 in the length of head, body elongated, snout pointed; preorbital spine projected, maxillary barbel comparatively long and thick, reaching the middle of the orbit; caudal fin with rounded lobes; colour reddish, 12 vertical dark band wider than interspace, dark black streak on the base of the caudal fin, all fins provided with black spot.

Distribution : India (Bihar, Himachal Pradesh, and Uttaranchal).

Elsewhere : Nepal and Bangladesh.

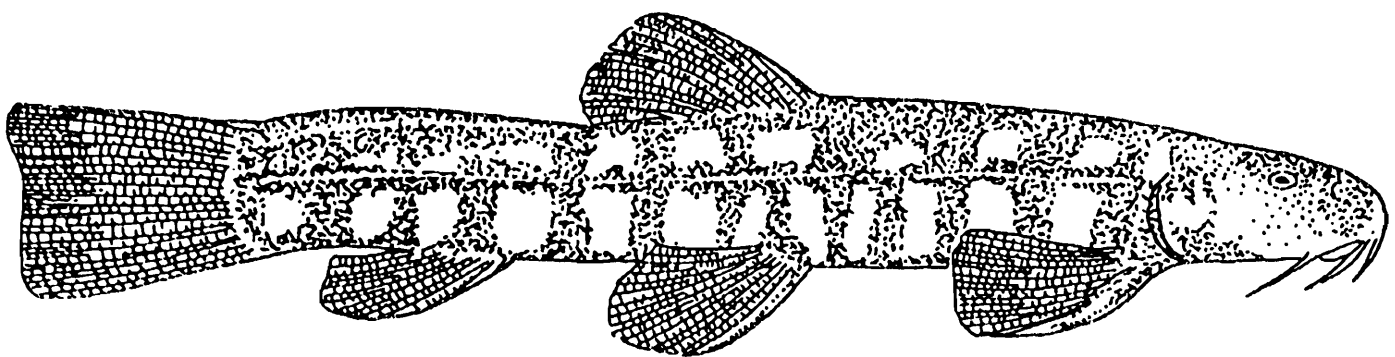
28. *Nemacheilus rupecola* (McClelland)

Schistura rupecola McClelland 1839; Jayram 1999.

Nemacheilus rupecola Day 1878, 1889; Menon 1962; Badola 1975; Talwar and Jhingran 1991; Khan 2000; Karmkar 2000.

Local name : Ghidiyala, Gaderi.

Material examined : 140 exs.



Collection Locality : Asan river : Confluence of Asan and Yamuna river, Dhalipur, Dehradun. Amlawa river : Confluence of Amlawa and Yamuna river, Kalsi, Kalsi village near. temple, Kalsi; Seligothan $\frac{1}{2}$ km down stream NW of village; Sangoka ka tallab, Sahiya village, 1.5 km toward N-W of Sahiya town; Alu mandi $\frac{1}{2}$ km down stream, Chakrata, Kalina 1 km down stream near Army camp, Dehradun.

Fin Formula : D.9 (2/7); P.9-10; V.8; A7 (2/5); C.18.

Total length : 11 cm.

Specific Character : Length of head 5.5, of caudal 5.2 and height of body 5.3 is the total length; eye diameter 4.0 m the length of head, 1.50 from the end of snout and 1.50 from the interorbital width; body elongated; head as wide as long. Caudal fin emarginated; lateral line complete; colour blackish, 16-17 vertical brown band which are narrow band ground colour; dorsal fin containing several rows of spots.

Distribution : India : (Jammu and Kashmir, Himachal Pradesh and Uttaranchal).

Elsewhere : Nepal.

Economic importance : This genus represented by four species in my collection. There abundance is good in both the rivers. These fish very much liked in the region and in Chakrata hills the Juice is advice to patients after illness for speedy recovery.

Order SILURIFORMES

Body elongate and compressed, either naked (without scales) or covered with bone plate; eye mainly small, maxilla usually rudimentary and serve as support for a barbel; spine often present at the front of the dorsal and pectoral fin; if present, only a single spine in each fin, no pelvic fin spine, adipose dorsal fin usually present, pectoral fin low, caudal fin ray 18 or less presence of barbels is the prominent character and extended from each side of upper jaw; some also have on the lower jaw.

Family SILURIDAE

Body elongated and compressed with large size nostrils separated from each other by short distance; anterior tubular on tip of snout, posterior valved and situated before anterior broader eye; barbels 4 to 6 well develop; gill opening wide; dorsal fin short without spine, adipose dorsal fin absent, pectoral fin with strong spine, anal fin long, caudal fin round forked; lateral line straight and complete, air bladder large and attach to second to fourth vertebrae.

29. *Ompok pabda* (Hamilton-Buchanan)

Silurus pabda Hamilton 1822.

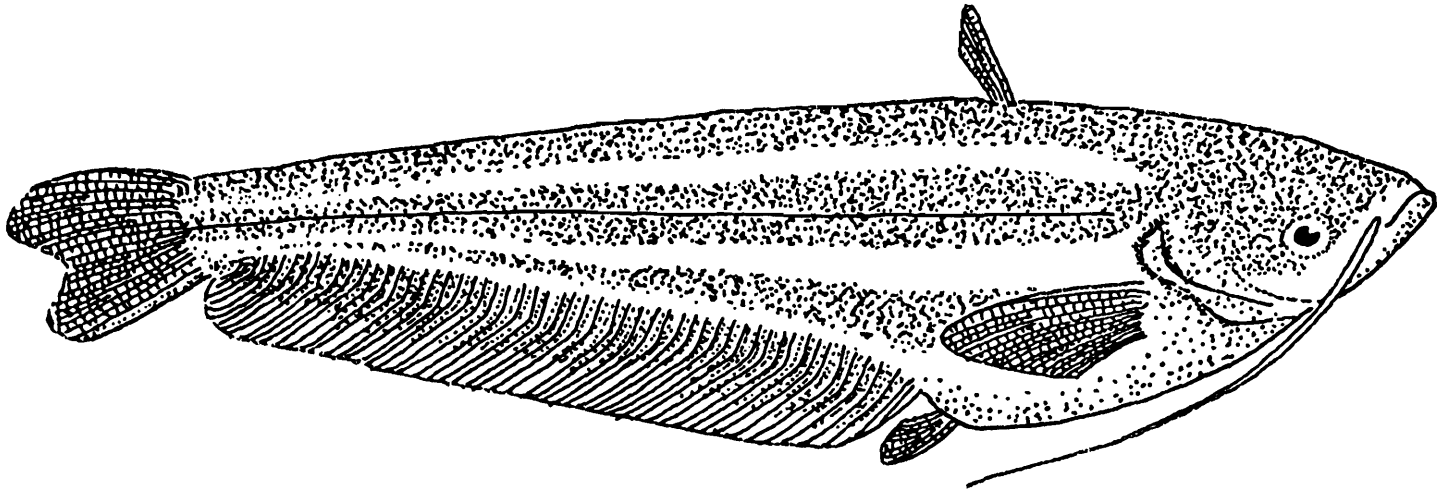
Callichrous pabda Day 1878, 1889.

Ompok pabda Parameswaran *et al.* 1967; Talwar and Jhingran 1991; Jayram 1999.

Local name : Pabda.

Material examined : 2 exs.

Collection Locality : Asan river : Confluence of Asan and Yamuna river, Dhalipur, Dehradun.



Ompok pabda (Hamilton-Buchanan)

Fin formula : D. 4-5; P. 12-14; V. 8; A. 65(2/63); barbels two pairs.

Total length : 16.5 cm.

Specific characters : Length of head 5.2, of caudal 9.2, and height of body 5.0 in the total length; eye diameter 5.2 in the length of head; 2.0 from the end of snout and 4.2 in the interorbital width; body elongated, compressed; head small, broad; teeth uniformly villiform; dorsal fin short, pelvic fin reaching anal fin, origin anal fin insertion opposite to or one eye diameter, distance behind last dorsal fin ray; body colour silvery but varies with habitat.

Distribution : India (Brahmaputra, Ganga and Yamuna river system).

Elsewhere : Bangladesh; Myanmar and Pakistan.

Economic importance : In my collection represented by single species. Rare in catch, local people consume it with taste.

30. *Wallago attu* (Schneider)

Silurus attu Schneider 1801.

Wallago attu Day 1878, 1889; Hora 1939; Talwar and Jhingran 1991; Jayram 1999; Khan 2000.

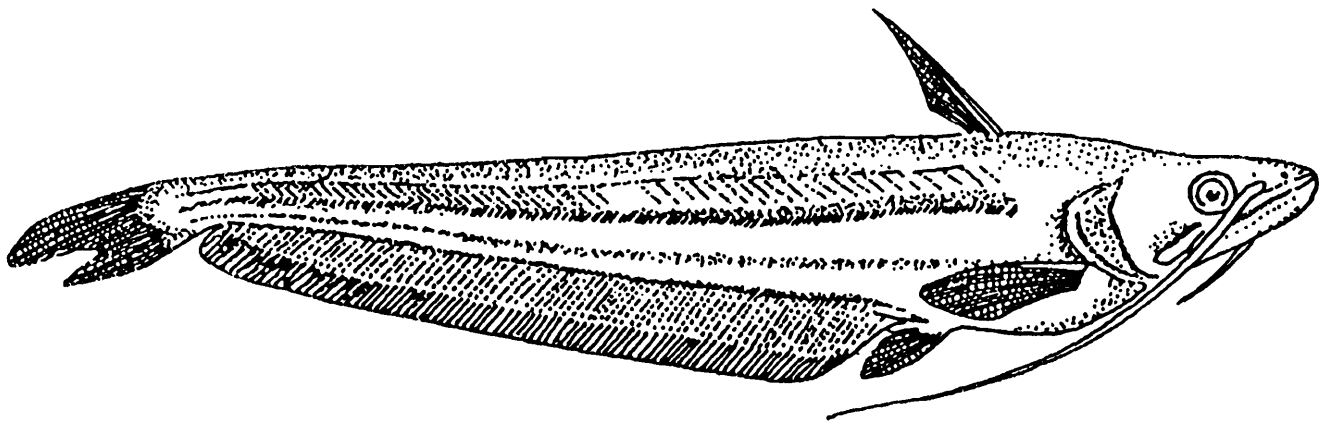
Local name : Lanchi, Lahgu.

Material Examined : 1 ex.

Collection Locality : Asan river : Jhajra 1 km towards N.W. of village, Dehradun.

Fin Formula : D. 5; P. 15-16 (1/14-15); V. 9-10; A. 86-88 (4/82-84); C. 17; barbels two pairs.

Total length : 30 cm.



Wallago attu (Schneider)

Specific characters : Length of head 5.0, of caudal 6.2 and height of body 6.75 in the total length; eye diameter 8.03 in the length of head, 3.0 from the end of snout and 3.63 in the interorbital width, body elongated, compressed, abdomen rounded; head large depressed; lip thin, teeth villiform; barbels two pairs, maxillary and mandibular; dorsal fin short, spineless, inserted above or a little in front of pelvic fin or above half of pectoral, adipose dorsal fin absent, pectoral spine moderate, caudal fin forked; lateral line complete; colour, usually white with grey, yellowish along dorsal back.

Distribution : Throughout India.

Elsewhere : Pakistan; Myanmar; Bangladesh; Sri Lanka and China.

Economic Importance : In my collection represented by single genus. Catch is very rare and local consume it with taste.

Family AMBLYCIPITIDAE

Long, cylindrical compressed body, head broad out depressed; nostrils close together, separated by barbel; mouth terminal; villiform teeth; barbels four pair, gill-opening wide, extending very far forward; gill membranes united with each other, but free from isthmus; dorsal fin covered by thick skin; inserted above pectoral fins, anal fin base short, pectoral fin with one weak spine and 7 soft ray; skin smooth; no lateral line, air bladder greatly reduced divided into two lateral chambers, partially enclosed in bone.

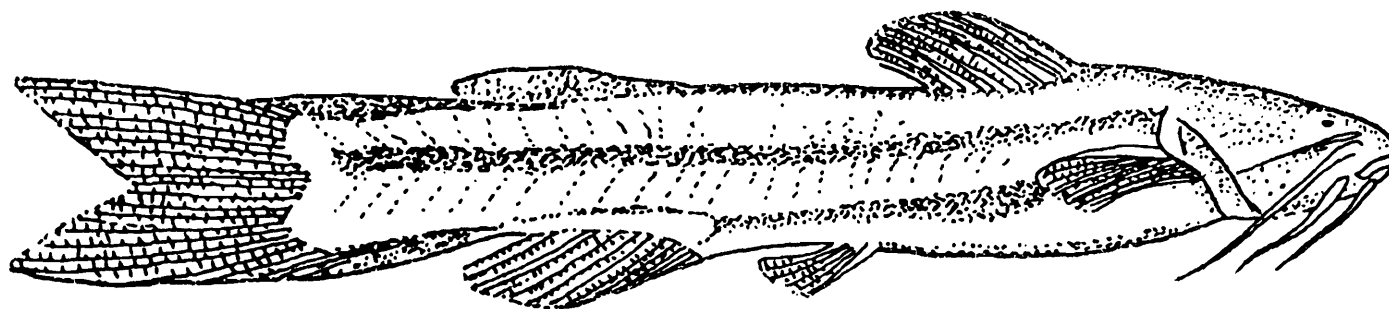
31. *Amblyceps mangois* (Hamilton-Buchanan)

Pimelodus mangois Hamilton 1822

Amblyceps mangois Day 1877, 1889; Talwar and Jhingran 1941; Jayram 1999; Khan 2000; Karmakar 2000.

Local name : Singhi.

Material examined : 130 exs.



Amblyceps mangois (Hamilton-Buchanan)

Collection Locality : Asan River : Confluence of Asan and Yamuna river, Dhalipur, Kunj Grant near Asan Barrage, Dhalipur; Jhajra 1 km towards N.W. of village; Badowala on either side of bridge; Chandrbani village near temple, Dehradun. Amlawa river : Confluence of Amlawa and Yamuna river, Kalsi, Kalsi village near Kali temple, Dehradun.

Fin formula : D. 5-6; P. 7; A 8 (2/6); barbels 4 pair.

Total length : 6.5 cm.

Specific character : Length of head 5.2, of caudal 4.0 and height of body 5.2 in total length; eye diameters 3.2 in head length from the end of snout; body elongated, compressed, rounded abdomen; head small and broad with thick skin, snout broadly rounded; teeth small villiform; barbels four pairs, one pair each of maxillary, nasal, two of mandibular, maxillary barbels with broad bases; dorsal fin rayed, pectoral with five or six ray, adipose dorsal fin, pelvic fin with six rays, anal fin with 8 to 11 rays, caudal fin truncate; lateral line absent; body colour dark brown or sometime light brown.

Distribution : India (along the foothills of the Himalaya from Kangra valley in Punjab to Assam).

Elsewhere : Myanmar; Nepal; Pakistan and Thailand.

Economic importance : In my collection represented by single species and abundant in Asan and low altitude of Amlawa river not much like by the people of the region.

Family BAGRIDAE

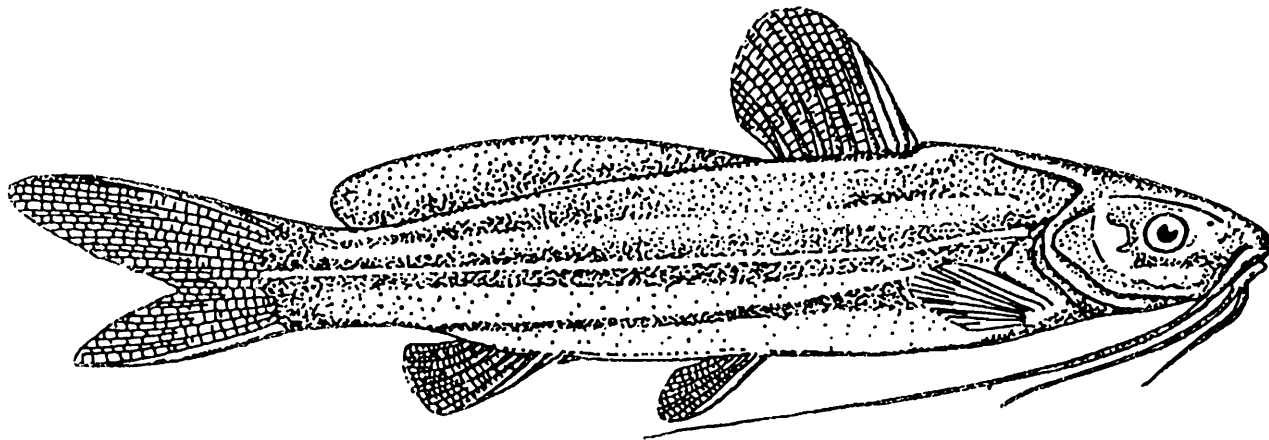
Generally large sized, body elongated and compressed, teeth on pre maxillaries, mandible and prevomer present nostrils widely separated, above the angle of mouth anterior tubular on tip of snout, posterior nearer eye than tip of snout; barbels eight or six generally well developed; gill opening wide, extending to above base of pectoral fin, gill membrane free; eye with free orbital margin; dorsal fin short with 6-8 rays and spine, adipose dorsal fin smooth and confluent with either rayed dorsal or with caudal paired fin inserted horizontally, pectoral fin with strong spine, anal fin short of moderately long; caudal fin forked, lateral line generally complete air bladder large.

32. *Mystus bleekeri* (Day)

Macrones bleekeri Day 1878, 1889.

Mystus bleekeri Hora and Mukerji 1935; Menon 1962; Srivastava 1968; Talwar and Jhingran 1991; Jayram 1999; Karmakar 2000.

Local name : Kutera, Trikenda.



Collection Locality : Asan river : Confluence of Asan and Yamuna river, Dhalipur; 1/2 km toward N.W. of Jhajra village; Badowala 1 km toward W. of forest check post; Chandribani village near temple, Dehradun. Amlawa river : Confluence of Amlawa and Yamuna river, Kalsi, Kalsi village near Kali temple, Kalsi; Seligothan 1/2 km downstream toward N.E. of village, Dehradun.

Fin formula : D. 7; P. 9-10; A. 9-10 (3/6-7); C. 17; barbels 4 pair.

Total length : 12.5 cm.

Specific characters : Length of head 5.6, of caudal 4.3 and height of body 5.6 in total length; eye diameter 3.4 in head length from the end of snout and 1.17 in the interorbital width; body moderately elongated, compressed with abdomen rounded; head moderate in size and compressed; occipitus process is not groove but has rigid line; uniform villiform; barbels eight in number maxillary barbels (one pair).

Distribution : Throughout India.

Elsewhere : Pakistan; Bangladesh; Nepal and Srilanka.

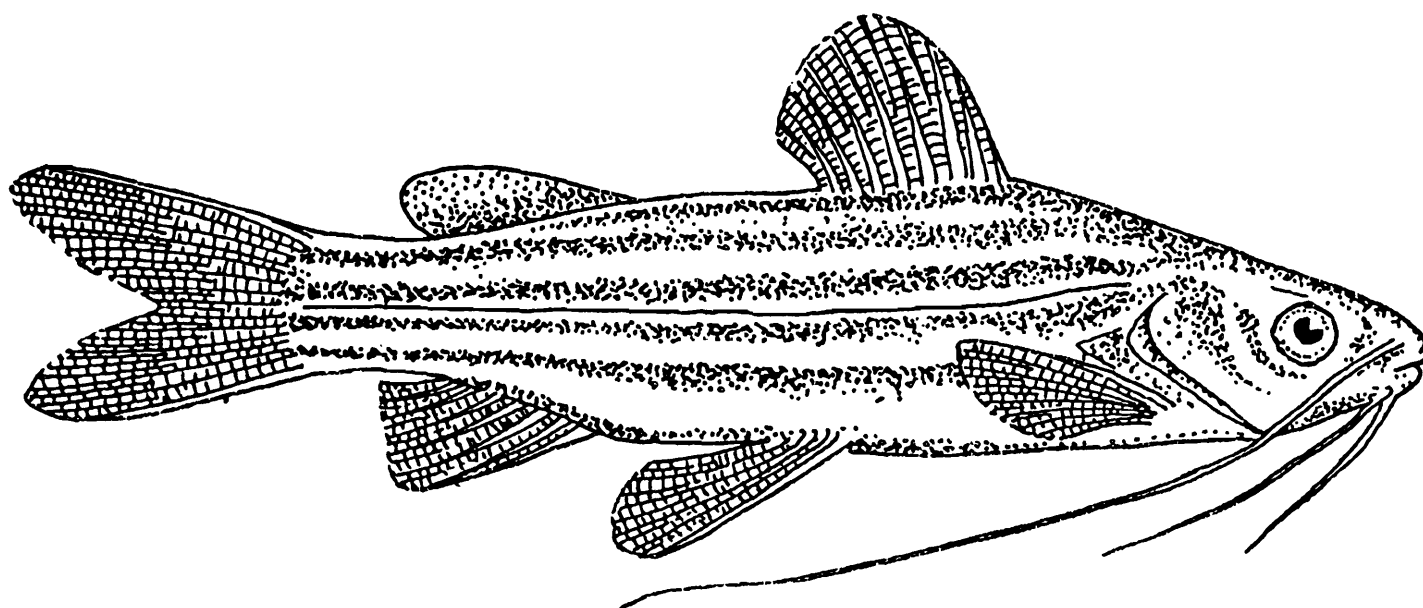
33. *Mystus vittatus* (Bloch)

Silurus vittatus Bloch, 1797.

Pimelodus carico Hamilton. 1822.

Macrones vittatus Day 1878, 1889; Lal and Chatterjee 1962.

Mystus vittatus Hora 1937; Menon 1962, 1999; Talwar and Jhingran 1991; Jayram 1999; Khan 2000; Karmakar 2000.



Mystus vittatus (Bloch)

Local name : Tangra.

Material examined : 51 exs.

Collection Locality : Asan river : Confluence of Asan and Yamuna river, Dhalipur; 1 km toward N.W. of Jhajra village, Chandrabani village near temple, Dehradun. Amlawa river : Confluence of Amlawa and Yamuna river, Kalsi, Dehradun.

Fin Formula : D. 7; P. 8; V. 6; A. 11 (2/9); C. 17; barbels 4 pairs.

Total length : 9.5 cm.

Specific characters : Length of head 4.65, of caudal 4.6 and the height of body 5 in the total length; eye diameter 5.12 in the length of head, 1.6 from the end of snout and 1-8 in the interorbital width; body elongated and compressed, barbels four pairs, maxillary barbel extended slightly behind the ventral, the nasal ones reach little behind the posterior margins of eye; the external mandibulars of each the middle or even beyond the middle of the pectoral spine and the internal one is short and reaches nearly the base of the pectoral spine, dorsal spine weak, finely serrated on its inner edge; adipose fin small inserted much behind rayed, dorsal fin but in advance of anal fin, caudal fin forked; colour variable as per growth grey-silvery sometimes light golden with black longitudinal band.

Distribution : Throughout India.

Elsewhere : Pakistan; Bangladesh; Nepal; Sri Lanka; Myanmar and Thailand.

Economic importance : In my collection represented by two species, not much liked by local people.

Family SCHILBIDAE

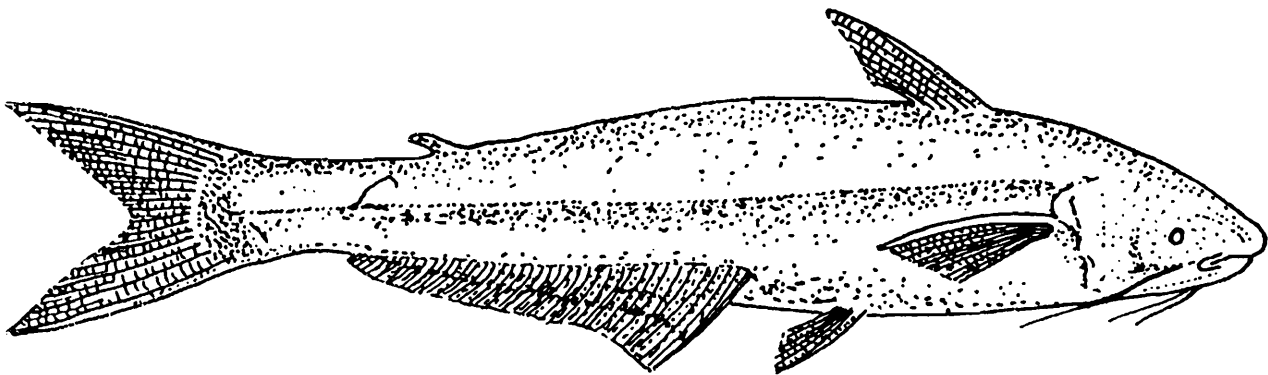
Elongated and compressed body; teeth generally villiform; nostrils widely separated, anterior wide, along front border of snout; barbels two, four or eight, fairly well develop; gill opening very wide, extending up to lateral line; dorsal fin when present short, with 5 to 7 rays, adipose dorsal fin generally present may be absent, paired fins inserted laterally, pectoral fin with strong spine, usually serrates anal fin very long, not confluent with caudal fin, caudal fin forked; lateral line generally complete, simple.

34. *Clupisoma montana* Hora

Clupisoma montana Hora 1937; Menon 1962, 1999; Talwar and Jhingran 1991; Jayram 1999; Karmakar 2000.

Local name : Bawla, Bachwa.

Material examined : 4 exs.



Collection Locality : Sahiya town, near Army camp; Alumandi $\frac{1}{2}$ km downstream towards N.W., Chakrata, Kalina, 1 km downstream near Army camp, Chakrata, Dehradun.

Fin formula : D. 6-7; A. 38; P. 12; V. 5

Total length : 20 cm.

Specific character : Length of head 5.6, of caudal 4.2 and height of the body 6.4 in the total length; eye diameter 4.0 in the length of head 1.5' from the end of the snout and 2.4 in the interorbital width; body elongated and compressed with abdominal edge rounded, head short, mouth inferior; teeth villiform; barbels four pair, nasal pair extend beyond front edge of orbit, maxillary pair do not extend beyond base of pectoral fin; and the outer and inner mandibular barbels much shorter than head; dorsal spine rather feeble; adipose dorsal fin small but distinctly well marked.

Distribution : India : Darjeeling, West Bengal and Uttaranchal.

Elsewhere : Nepal.

Economic importance : In my collection represented by single species, not much liked by local people, absent in Asan river.

Family HETEROPNEUSTIDAE

Moderate sized elongated fishes with a compressed body; teeth on premaxillaries, mandible and vomer, nostrils sidely separated, anterior produced into a short tube, on tip of snout, posterior slit-like behind nasal barbels; barbels eight well developed; gill openings wide extending to above base of pectoral fin; a long air-sac extends posteriorly from gill chamber though muscles of back to tail branchiostegal rays seven rayed; dorsal fin short and without any spine, pectoral adipose dorsal fin absent or represented by a low ridge, pectoral fin with a strong spine, serrated, anal fin long, just reaching or united with caudal, caudal fin almost rounded; lateral line present, complete.

35. *Heteropneustes fossilis* (Bloch)

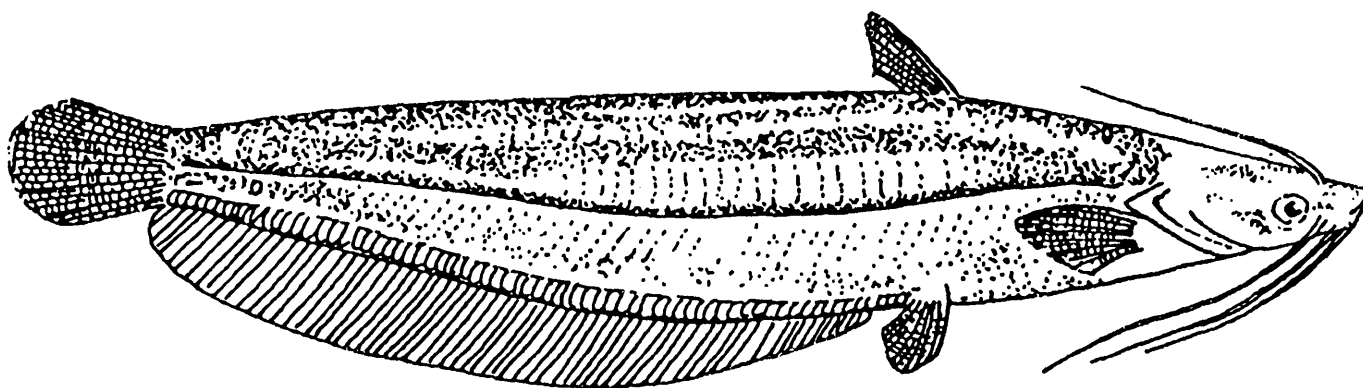
Silurus fossilis Bloch 1785.

Saccorbranchus fossilis Day 1878, 1889.

Heteropneustes fossilis Shaw and Shebbeare 1937; Menon 1962; Jayram 1999; Karmakar 2000; Khan 2000.

Local name : Singhi.

Material examined : 2 exs.



Collection Locality : Asan river : 1 km towards N.W. of Jhajra village; Badowala village near Forest check post, Dehradun.

Fin formula : D. 6; P. 1/7; V. 6; A. 63-74; C. 19; barbels four pairs.

Total length : 14.5 cm.

Specific characters : Length of head 6.2, of caudal 9.92, and height of body 7.14 in the total length; height of body varies due to food and season; eye diameter 8.04 in the length of head, 2.44 from the end of snout and 4.14 in the interorbital width; body elongated, compressed, abdomen rounded; head moderate sized; teeth, villiform in broad bands as jaws and in two oval patches on palate; barbels four pairs, one pair each maxillary, nasal and two of manibular; rayed dorsal short, inserted above tip of pectoral fin, adipose, dorsal fin absent, pectoral fin with a strong spine serrated along inner edge with a few

serrations at its anterior end. It is $\frac{2}{3}$ as long as head ventral fins reaches upto the third or fourth anal rays, anal fin long, anal and caudal fins are separated by a distinct notch, caudal fin rounded; lateral line complete and simple; air-bladder greatly reduced, consisting of two thin walled pyriform sac enclosed in incomplete basal capsules; colour dark leaden brown.

Distribution : India : Punjab, U.P, Uttaranchal, Bihar, Darjeeling distt. West Bengal, Orissa and Madhya Pradesh.

Elsewhere : Pakistan; Nepal; Sri Lanka; Bangladesh; Thailand and Laos.

Economic importance : In my collection represent by single species. Catch is very rare and local consume it with taste.

Family SISORIDAE

Head and body ventrally flattened; dorsal fin with a spine pectoral and ventral fin horizontal; barbels present between the nares; branchiostegal membranes attached to the interbranchial space; nares close together; eye covered with a thin transparent skin.

36. *Glyptothorax pectinopterus* (McClelland)

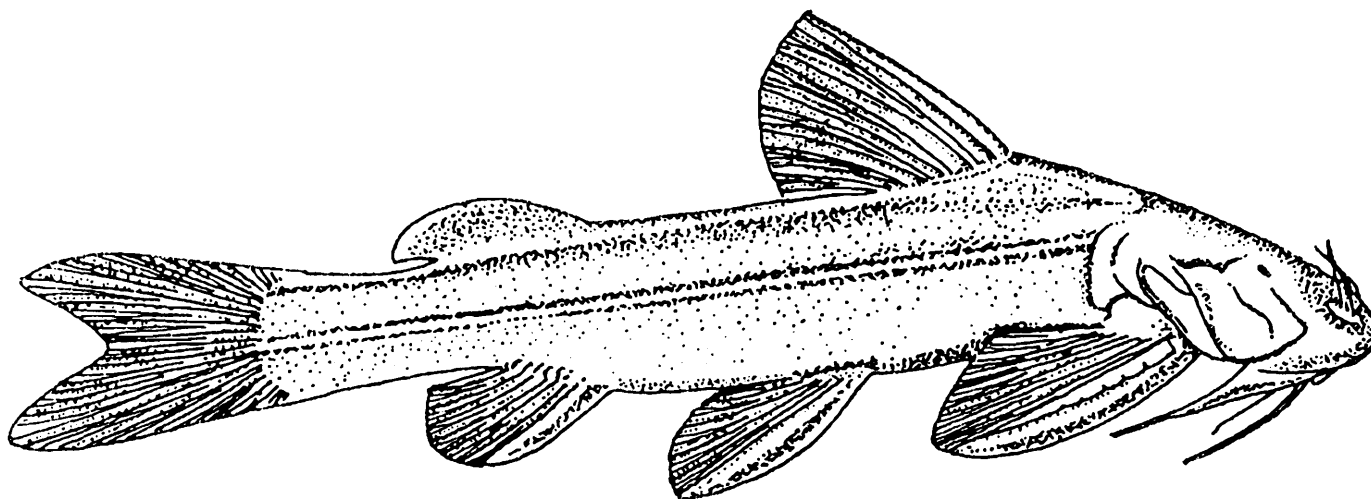
Glyptosternum pectinopterus McClelland 1842.

Glyptothorax pectinopterus Hora 1936; Menon 1949; Jayaram 1999; Khan 2000, Karmakar 2000.

Local name : Patharchat.

Material Examined : 75 exs.

Collection Locality : Asan river : Confluence of Asan and Yamuna river, Dhalipur; 1 km towards N.W of Jhajra village; Badowala village near forest check post, Dehradun. Amlawa river : Confluence of Amlawa and Yamuna river, Kalsi, Viyas Nahar near Ashoka



pillar, Kalsi; ½ Km downstream toward NW of Seligothen village, Sahiya town near Army camp, Sango ka Tallab, Sahiya village; Alu mandi 1 km downstream Chakrata, Dehradun.

Fin Formula : D. 7(1/6); P. 9 (1/8); V. 6; A.9 (2/7); C. 17.

Total length : 10 cm.

Specific characters : Length of head 5.2, of caudal 5.56, and height of the body 7.43 in the total length; eye diameter 13.5 in the length of head, 6.9 from the end of snout; body elongate moderately depressed, body smooth or rough with granules or tubercles; head small covered with thick skin, lip thick; upper lip slightly papillated or fringed; snout; conical but not pointed; mouth inferior, transverse narrow, nostril separated from snout, teeth villiform upper jaw longer; barbels 4 pairs, maxillary barbels reaching nearly middle of the pectoral fin, nasal barbels reaching middle of the orbit; outer mandibular extending upto the base of pectoral fin, ventral fin not reaching the anal fin, caudal fin forked the lower lobe longer, pectoral ray spinous internally; colour brown to blackish, tip of the fins blackish, adhesive apparatus elongated, having internal U- shaped gap.

Distribution : India : Punjab, Himachal, Bihar and Uttaranchal.

Elsewhere : Pakistan and Nepal.

Economic importance : This genus comprises single species in my collection and found in good number in both the river. The fish have high nutrition and taste, hence local consumes it with great taste. Tribes used the fat of this genus for curing the wounds.

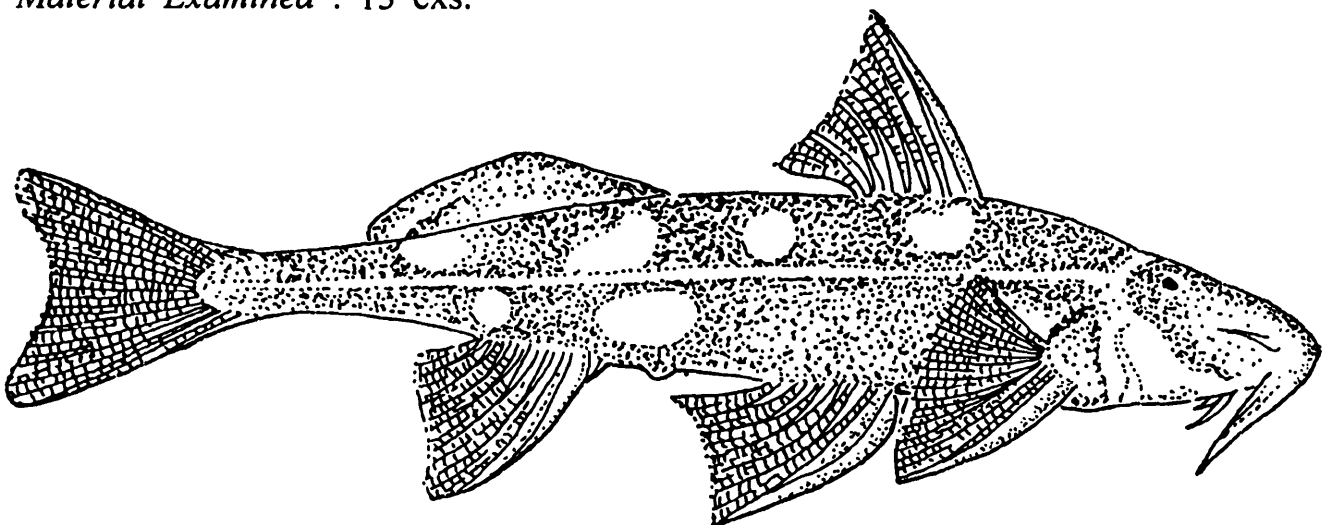
37. *Pseudechenesis sulcatus* (McClelland)

Glyptosternum sulcatus McClelland 1839.

Pseudechenesis sulcatus Day, 1878; 1936; Menon 1962; Jayram 1999; Karmakar 2000.

Local name : Katharna.

Material Examined : 15 exs.



Collection Locality : Amlawa river : 1/2 km downstream of village seligothan; Sahiya town near Army camp, Sango ka Tallab, Sahiya village; Alu mandi, 1 km downstream Chakrata, Dehradun.

Fin Formula : D. 7. (1/6); P. 14 (1/13); V. 6.; A. 11 (2/9); C. 17.

Total length : 10 cm.

Specific character : Length of head 5.2 of caudal 5.54 and height of the body 7.40 in the total length; eye diameter 12.5 with the length of head 6.5, from the end of snout; body cylindrical and anteriorly flattened, mouth surrounded by a large number of papillae; nasal barbel smaller, maxillary and mandibular pair with a broad base and not reaching the adhesive apparatus, dorsal spine broad, non-serrated and bearing large number of lamellae, adipose fin, caudal fin emerginate with lower lobe; colour brownish to blackish with irregular blotches on the body, fin bearing black bands, adhesive apparatus quite large with about 17 lamellae.

Distribution : India : Darjeeling, Khasi hills and Uttaranchal.

Elsewhere : Nepal and Bangladesh.

Economic importance : This species found mostly in hill stream (Amlawa river) and absent in Asan river. As food this fish is considered best and like by local.

Order BELONIFORMES

Body elongated, compressed with scales; head with scale; fins are devoid of spine, ventral fin with six rays while pectoral are inserted high up; orbitosphenoid and mesocoracoid are absent and the lower pharyngeals are completely fused, caudal fin with thirteen branched ray; scale cycloid; lateral line running low; branchiostegals are 9 to 15 in number; lower and upper ribs are attached to transverse processes

Family BELONIDAE

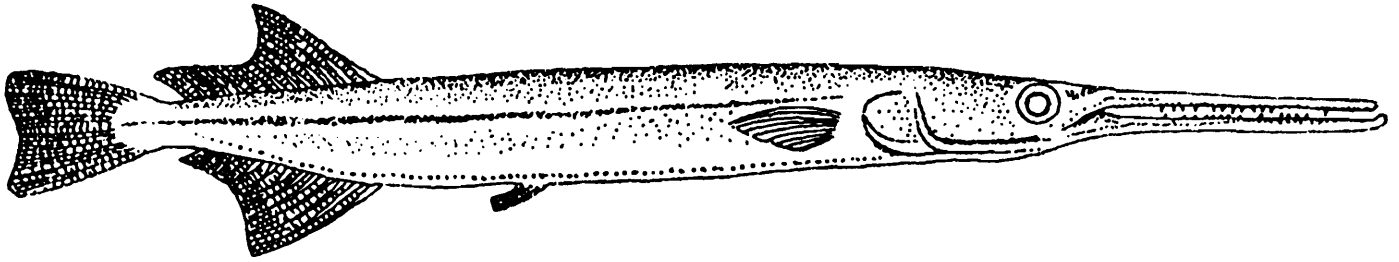
Body elongated, head with scales; teeth on jaws; branchiostegal rays 12 to 15; gill opening wide; nasal large; dorsal fin without spines, pectoral fin short with 10-12 rays, pelvic fin abdominal with six rays; lateral line on free portion of tail with or without a keel scales cycloid.

38. *Xenentodon cancila* (Hamilton-Buchanan)

Esox cancila Ham, 1822.

Belone cancila Day, 1878, 1889.

Xenentodon cancila Hora and Mukerji 1936; Mishra; Menon 1962; Singh 1964; Srivastava 1968; Grover 1972; Singh *et al.* 1987; Talwar and Jhingran 1991; Husain 1995; Tilak and Husain 1995; Jayram 1999; Khan 2000; Karmkar 2000.



Xenentodon cancila (Hamilton-Buchanan)

Local name : Sooa Bam.

Material examined : 30 exs.

Collection Locality : Asam river : Confluence of Asan and Yamuna river, Dhalipur, Kunj Grant village, Dhalipur; 1/2 km Nw of Jhajra village; Badowala village near forest check post, Dehradun.

Fin formula : D. 15-17; P. 11; V. 6; A. 16-17; C. 15.

Total length : 25 cm.

Specific character : Length of head 2.70, of caudal 11.15 and height of body 12.80 in the total length; eye diameter 10.15 in head length, 2.80 from the hind edge of operculum and 1.02 in the interorbital width; body elongated with rounded abdomen; head and snout pointed; teeth villiform; dorsal fin inserted opposite to anal at a distance at least twice as far from front border of eye; caudal fin truncate, pelvic origin nearer to caudal base, than to hind border of eye; scales small irregularly arranged; lateral line present without a keel; body colour greenish grey with dark margin most of the body marked with closely set fine black dots, often 3, 4 to 5, 6 black lateral rounded blotch between pectoral and anal bases present.

Distribution : Throughtout India.

Elsewhere : Bangladesh; Myanmar; Nepal and Pakistan.

Economic importance : In my collection represented by single species. Local people consume it with great taste.

Order PERCIFORMES

Skin with scales, commonly cenoid; fins are usually with spines, with two dorsal fins the first being spine; ventral fin usually thoracic, with not more than 6 rays, pelvic bones are usually directly attached to due cleithra; eye and skull are symmetrical; maxillary is usually quite excluded from the gape; caudal fin is never with more than 17 principal rays; mesocoracoid and orbitosphenoid are absent while the mesethmoid is present; weberian apparatus is absent and the first vertebra is free; lower and upper ribs are present, but

intermuscular bone are absent; cutaneous vascular system is normal past-temporal bone is usually forked; lateral line present continuous; air bladder physoclistic.

Family NANDIDAE

Body oblong, elevated, compressed with moderate sized ctenoid scale; head covered with scales; teeth on jaws and palate, feeble, but dentition is more or less complete; branchiostegals are five or six in number, operculum armed with a spine, a single dorsal fin, the base of spinous portion is longer than that of the soft portion or is equal to it; anal fin with three spine; lateral line is innerrupted or absent and the suprabranchial organ is also present; air bladder is present.

39. *Badis badis* (Hamilton-Buchanan)

Labrus badis Ham., 1822.

Badis buchanani Day, 1878, 1889.

Badis badis Shaw and Shebbeare 1937; Menon 1962, 1999; Srivastava 1968; Jayaram 1999; Khan 2000; Karmakar 2000.

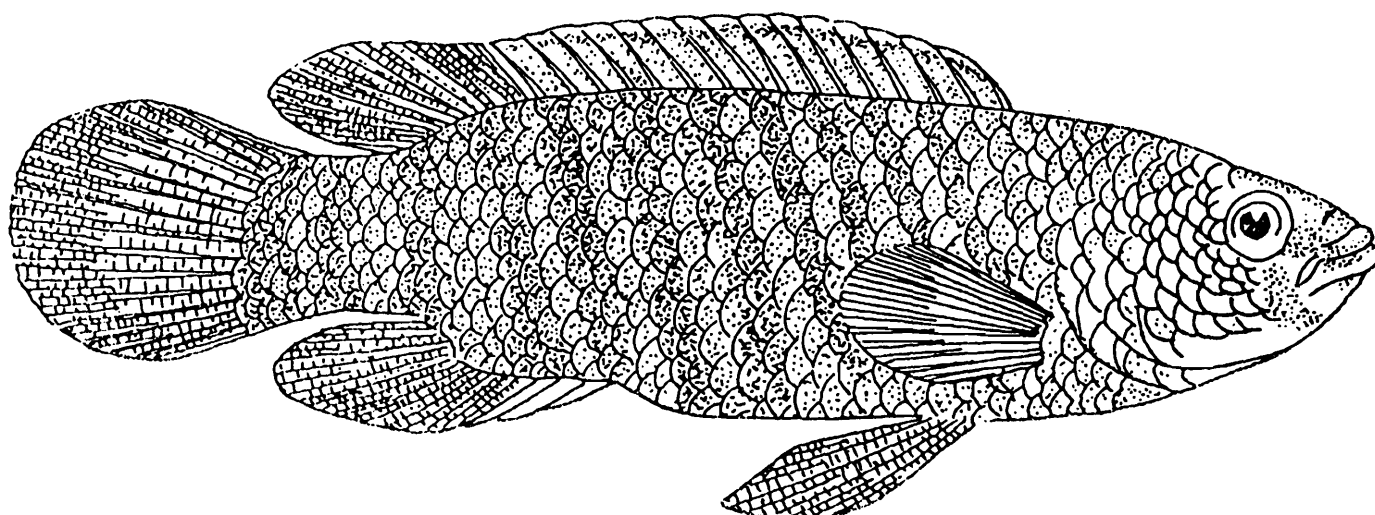
Local name : Kali.

Material examined : 25 exs.

Collection Locality : Asan river : Confluence of Asan and Yamuna river, Dhalipur, Kunj grant, Dhalipur; ½ towards NW direction of Jhajra village; Badowala village near forest check post, Dehradun.

Fin formula : D. 13/12-13; P. 15-16; V. 1/5; A.3/7; C. 15; L.1. 46-38, Ltr. 6/17-20.

Total length : 4 cm.



Specific character Length of head is 3.1, of caudal 5.5, and height of body 3.6 in the total length; eye diameter 5.05 in the length of head, 1.17 from the end of snout and 1.05 in the interorbital width; body oblong, compressed and abdomen rounded; head large, compressed, snout pointed, mouth terminal, lip thin, jaw subequal, lower jaw longer; teeth villiform; dorsal fin inserted above pectoral base, dorsal spine are strong and their bases are lodged in a groove, anal fin rounded and anal spine strong, second and the third is longest, caudal fin is rounded or square shaped; lateral line present interrupted between 34-36th scales; scales strongly ctenoid air bladder large and simple; body colour greenish brown or greyish with three wavy band a fourth short band with a black blotch-cross the free portion of the tail, narrow bands or spots across the fin.

Distribution : Throughout India.

Elsewhere : Bangladesh; Nepal; Pakistan; Malaya and Thailand.

Economic importance : In my collection represented by single species. It is an aquarium fish and not consume by local.

40. *Nandus nandus** (Hamilton-Buchanan)

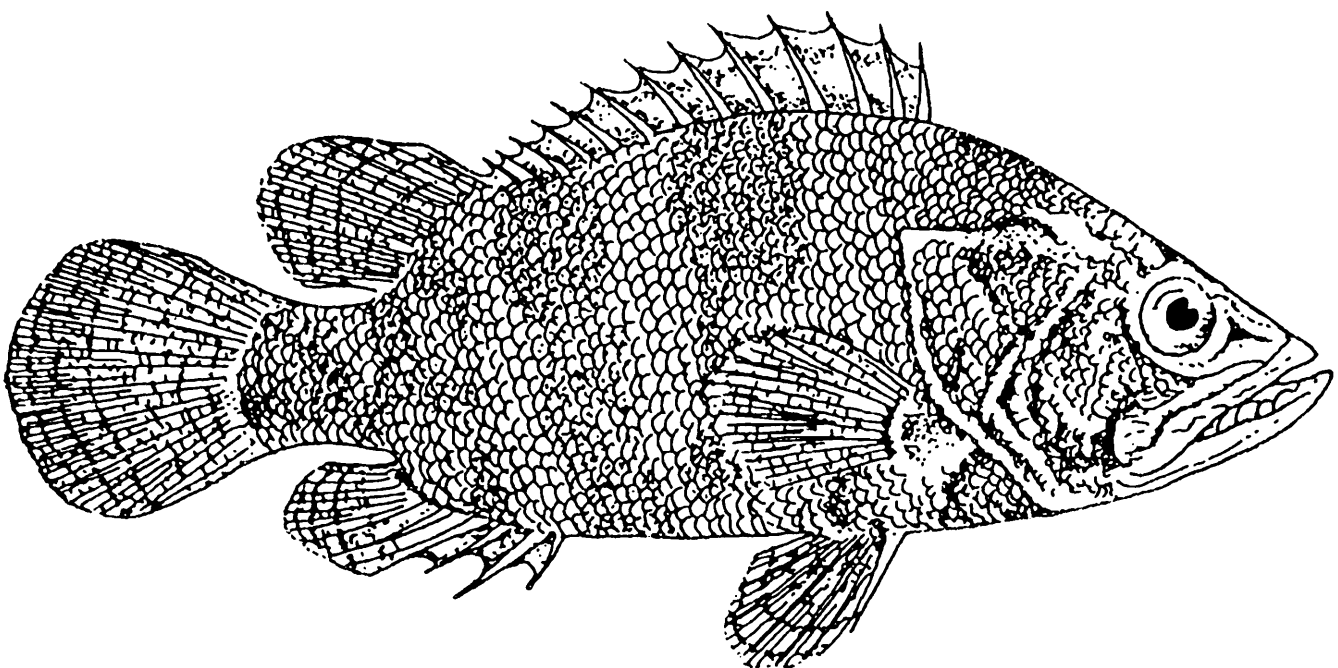
Gobius nandus Hamilton, 1822.

Nandus marmoratus Day, 1878, 1889.

Nandus nandus Shaw and Shebbeare 1937; Menon 1999; Talwar and Jhingran 1991; Jayaram 1999; Khan 2000; Karmakar 2000.

Local name : Kali Machli.

Material examined : 2 exs.



Collection Locality : Asan river : Confluence of Asan and Yamuna river, Dhalipur, Dehradun. *Nandus nandus* is a new record from Garhwal Himalaya.

Fin formula : D. 16, P. 12-15; V. 1/5; A. 3/7; L. 1. 31; Ltr. 2½/8½.

Total length : 7 cm.

Specific character : Length of head 4.15, of caudal 4.56 and height of body 4.15 in the total length; eye, diameter 3.4 in the length of head, 0.8 from the end of snout and 1.0 in the interorbital width; body moderately elongated, oval and the sides are compressed, abdomen rounded, head large, compressed, snout bluntly rounded; teeth villiform, vomer and palatines; single dorsal fin, inserted above base of pectoral fin, dorsal spine some what slender, anal spines are short, caudal fin is wedge shaped; length of pectoral is 5.2 in the total length; lateral line present but interrupted; scales ctenoid, air-bladder large and simple; colour brownish with a black spot located behind the opercle and above the pectoral fin; another spot behind the eye and a faint and large black spot is situated at the base of the caudal fin, body spotted with irregular black spot.

Distribution : Throughout freshwater of India.

Elsewhere : Pakistan; Nepal; Bangladesh and Myanmar.

Economic importance : In my collection this genus comprises single species; which is a new record from Garhwal Himalaya. This is an aquarium fish, local do not consume it.

Family BELONTIDAE

Body short, compressed; head and body covered with ctenoid scales; teeth on jaws, none on palate; pseudobranchiae rudimentary or absent; branchio-stegal ray five or six, gill opening rather narrow and interopercle not serrated; a single dorsal fin with spines and soft ray, first ray of pelvic fins modified into a filiform ray, or with few rays; pelvic fin inserted behind base of pectoral fin, anal fin very long; lateral line vestigial, or absent; air bladder present or absent.

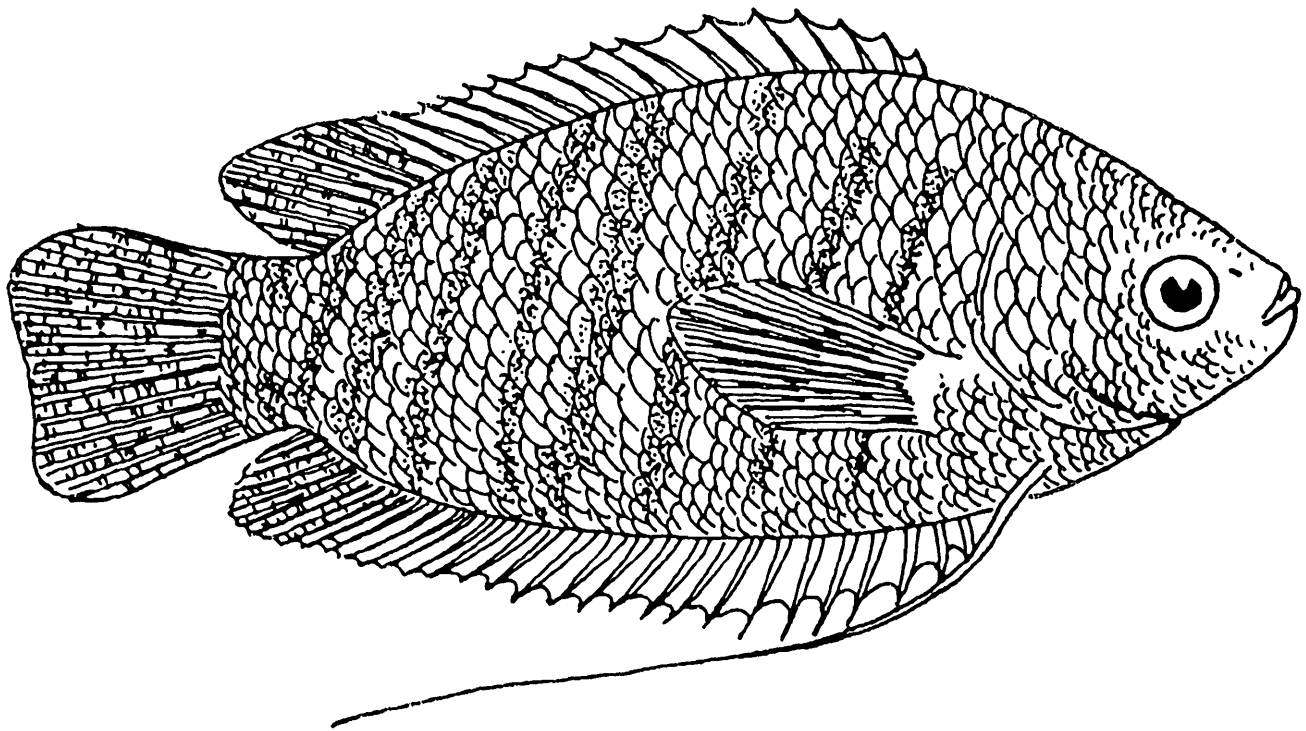
41. *Colisa fasciatus** (Schneider)

Trichogaster fasciatus Bloch and Schn. 1801; Day 1878, 1889.

Colisa fasciatus Menon 1949; Talwar and Jhingran 1991; Husain 1995; Jayaram 1999; Khan 2000; Karmakar 2000.

Local name : Chamki.

Material examined : 4 exs.



Colisa fasciatus (Schneider)

Collection Locality : Asan river : Confluence of Asan and Yamuna river, Dhalipur; ½ km N-W of Jhajra village, Dehradun. *Colisa fasciatus* is a new record from Garhwal Himalaya.

Fin formula : D. 15-17/10-11; P. 10; V. 1; A. 15-17/15-17; C. 15-16; L. 1; 19-31; Ltr. 5½/11-12.

Total length : 4.5 cm.

Specific characters : Length of head 3.82, of caudal 4.29 and height of body 2.71 in the total length; eye diameter 3.33 from the end of snout and 1.98 in the interorbital width; body elevated, compressed head moderate in size, snout blunt; teeth, small villiform; small dorsal fin commencing above near pectoral base, last dorsal spine is the largest, soft anal fin, caudal fin is truncate; lateral line present, interrupted between 15th to 17th scale; air bladder present; body colour, greenish blue above, dirty white below with bluish black spot on the gill cover 14 orange colored oblique band.

Distribution : India : Fresh and Estuarine water.

Elsewhere : Pakistan and Myanmar.

Economic importance : In my collection represented by single species. It is a new record for Garhwal Himalayas and is an aquarium fish, local doesn't prefer to eat it.

Family CHANNIDAE

Body elongate, cylindrical with large scale; head with plate like scales; teeth on jaws; branchiostegal rays five; gill membranes connected beneath isthmus; dorsal and anal fin large spineless, both free from caudal fin; lateral line abruptly curved or almost interrupted; air-bladder present, pyloric appendages when present are few in number.

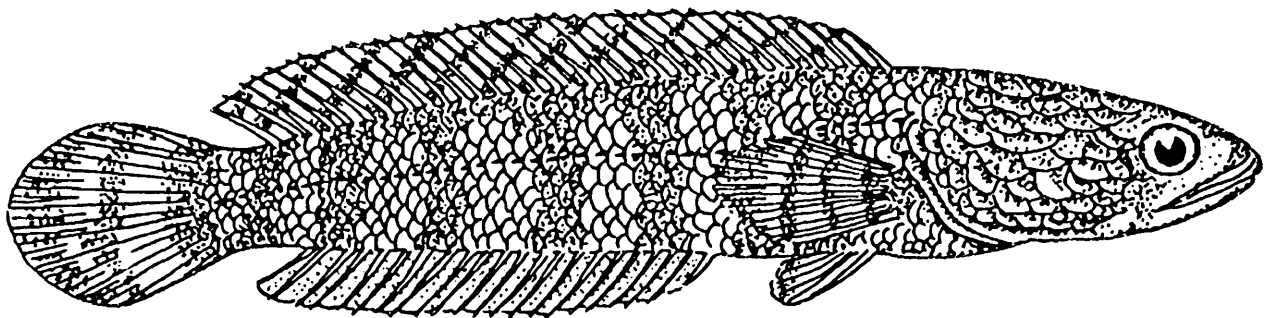
42. *Channa gachua* (Hamilton-Buchanan)

Ophicephalus gachua Hamilton 1822; Day 1878; Menon 1949; Tilak and Husain 1995.

Channa gachua Menon 1954; Talwar and Jhingran 1991; Jayram 1999; Khan 2000; Karmakar 2000.

Local name : Dawla

Material examined : 70 exs.



Collection Locality : Asan river : Confluence of Asan and Yamuna river, Dhalipur; 1.5 km toward NW of Jhajra village; Badowala village near forest Check post; Near temple, Chandribani village, Dehradun. Amlawa river : Confluence of Amlawa and Yamuna river, Kalsi; 1 km downstream village seligothan; Sango ka Tallab, Sahiya village, Dehradun.

Fin formula : D. 32-37; P. 16; V. 6; A. 21-23; C. 12; L.I. 42-44; L. tr. 4/7.

Total length : 15.0 cm.

Specific character : Length of head 3.81, of caudal 6.15, and height of body 6.2 in the total length; eyes diameter 6.25 in length of head, 1.30 from the end of snout, and 1.7 in the interorbital width; body elongated subcylindrical with rounded abdomen; head depressed with plate like scale, snout obtuse up moderate and jaws equal; dorsal fin long, inserted almost above pectoral without spine, anal fin long but shorter than dorsal, caudal fin rounded, ventral fin 2/5 of pectoral length; lateral line complete; body colour brown sometime blackish, pectoral fin black base and bearing black transverse stripe, dorsal and caudal fin spotted.

Distribution : Throughout India.

Elsewhere : Afghanistan; Bangladesh; Myanmar; Nepal; Pakistan; Sri Lanka and Thailand.

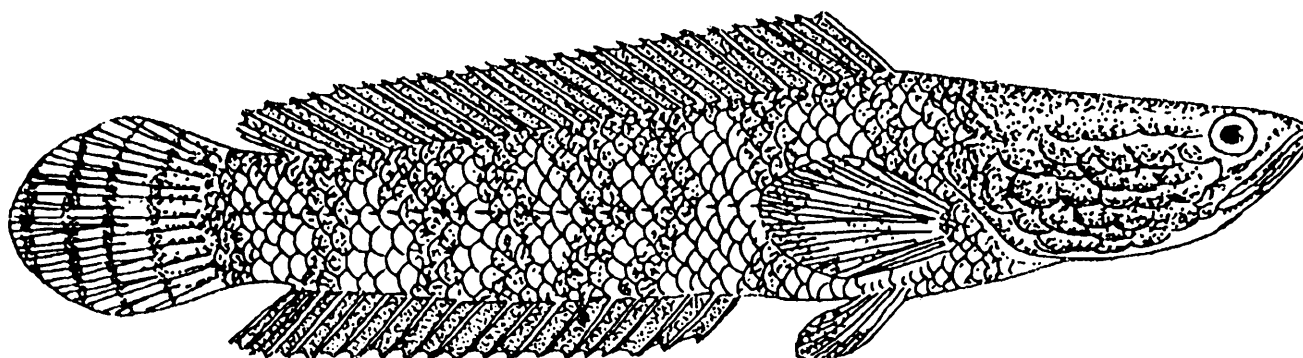
43. *Channa punctatus* (Bloch)

Ophicephalus puntatus Bloch 1793; Day 1878; Shaw and Shebbeare 1937; Menon 1949; Husain and Tilak 1995.

Channa punctatus Menon, 1954, 1999; Talwar and Jhingran 1991; Grover *et al.* 1994; Jayram 1999; Khan 2000; Karmakar 2000.

Local name : Suli.

Material examined : 50 exs.



Collection Locality : Asan river : Confluence of Asan and Yamuna river, Dhalipur, village kunj Grant, ½ km from Asan Barrage, Dhalipur ½ km N.W. of Jhajra village; Badowala village near forest check post; 1 km from Chandrbani temple, Dehradun. Amlawa river : Confluence of Amlawa and Yamuna river Kalsi; Kali temple near forest check post, Kalsi; ½ km downstream village, Seligothan; Sango ka tallab, Sahiya village, near Army Camp, Sahiya town, Dehradun.

Fin formula : D. 29-30; P. 13; V. 6; A. 20-22; C. 12; L.I. 35-39; L.tr. 4-5/7-8.

Total length : 25 cm.

Specific character : Length of head 3-25, of caudal 5.80 and height of body 5.92 in the total length; eyes diameter 7.1 in the length of head, 1.26 from the end of snout and 1.55 in the interorbital width, body elongated, abdomen rounded; head depressed with plate-like scales, snout obtuse, lip moderate; gill opening wide, accessory respiratory organ in the form of a thin bary laminate present in a cavity in gill chamber; dorsal fin long; anal fin shorter than dorsal; pectoral fin may reach origin of anal, caudal fin rounded; lateral line present complete; body colour dark or dark grey with several bands pass from the dorsum of the body, fins are spotted.

Distribution : Throughout India.

Elsewhere : Pakistan and Nepal.

Economic importance : In my collection represented by two species. It is found in foothill and low altitude. Local people do not consume it due to its appearance like snake-head.

Family MASTACEMBELIDAE

Body elongated and eel shaped covered with minute scales; pseudobranchiae are absent; gills are four and the gill-opening are in the form of a slit on the side of the head; humeral arch is not suspended from the skull; lower jaw longer, not capable of much movement; a single long dorsal fin, anal fin with three spines, soft dorsal and anal fin of similar extent, ventral fin absent; air bladder present.

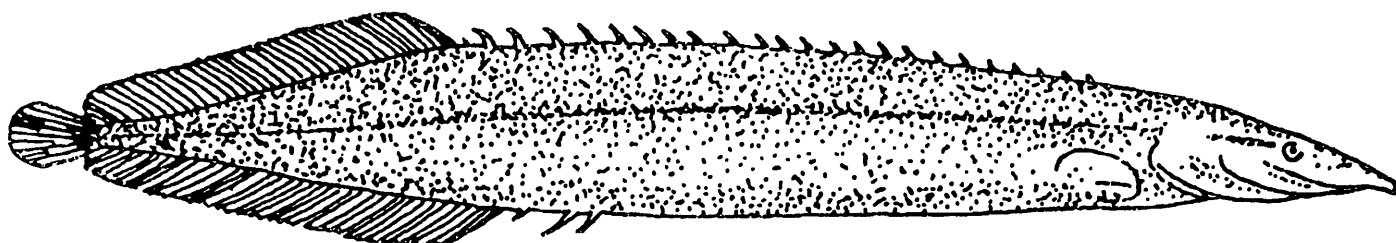
44. *Macrogathus pancalus* Hamilton-Buchnan

Macrogathus pancalus Hamilton, 1822; Talwar and Jhingran 1991; Jayram 1999; Karmakar 2000.

Mastacembelus pancalus Day 1878, 1889; Srivastava 1968; Menon 1974; Khan 2000.

Local name : Bam.

Material examined : 08 exs.



Collection Locality : Asan river : Confluence of Asan and Yamuna river, Dhalipur; ½ km N.W. of Jhajra village; Badowala village near forest check post; near temple, Chandribani village, Dehradun. Amlawa river : Confluence of Amlawa and Yamuna river, Kalsi, Viyas Nahar, Kalsi village; ½ km downstream, Seligothan village, Dehradun.

Fin formula : D. 24-26; /30-42; P. 19; A. 3/30-40; C. 12.

Total length : 10 cm.

Specific character : Length of head 5.3, of caudal and the height of body is 7.2 in the total length; eye diameter 9.0 in length of head, 3.2 from the end of snout and 1.0 in the interorbital width; body long and eel shaped; head long pointed; teeth minute on jaws and plate present; dorsal fin with 24-26 spaces; anal spine three, ventral fin absent, caudal fin short and rounded; lateral line present and simple; scale cycloid; air bladder present and elongated; body colour greenish oliver along black, yellowish beneath, sometime yellowish, white spot over the side of the body, soft dorsal, pectoral, caudal and anal fin with black spot.

Distribution : Throughout India.

Elsewhere : Pakistan; Nepal; China and Myanmar.

Economic importance : Local consumes it with great taste.

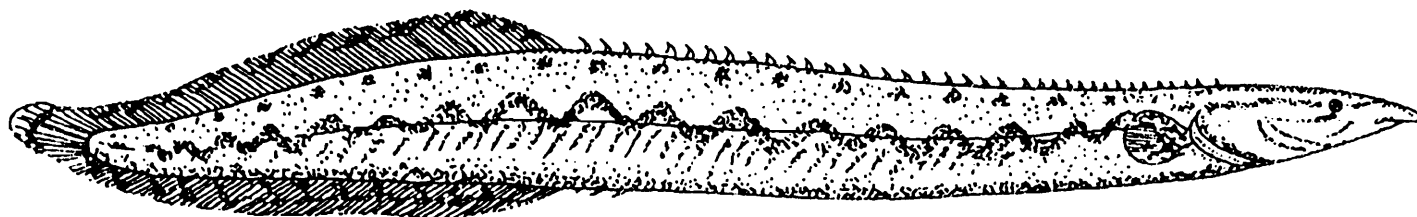
45. *Masterambelus armatus* (Lacepede)

Macrogmathus armatus Lacepede 1800.

Mastacembelus armatus Gunter 1861; Day 1878, 1889; Talwar and Jhingran 1991; Jayaram 1999; Khan 2000; Karmakar 2000.

Local name : Bam

Material examined : 30 exs.



Collection Locality : Asan river : Confluence of Asan and Yamuna river, Dhalipur, Kunj Grant village, Dhalipur; ½ km N-W of Jhajra village; Badowala village on either side of forest check post; 1 km from temple chandribani village, Dehradun.

Fin formula : D. 32-39/74-90; P. 23; A. 75-80; C. 20.

Specific characters : Length of head 6-12, and the height of body is 11.52 in the total length; eye diameter 11-22 in the total length of head, 4.0 diameter from the end of snout and 1.0 in the interorbital width; body elongated, eel-like head long, pointed, lip thin; teeth minute on jaw and or palate; dorsal spines commence over the middle of the pectoral fin; ventral and anal fin fused with the caudal, caudal fin rounded; scales very minutes; colour brown; dorsally body undulated by black spot bands, black spots along the dorsal fin.

Distribution : Throughout India.

Elsewhere : Bangladesh; China; Malaya; Myanmar; Nepal; Pakistan and Sri Lanka.

Economic importance : This genus found in foothill not in torrential stream. It is liked by the local people due to its taste and its juice is given to the patients.

**KEY TO THE IDENTIFICATION OF FISHES OF AMLAWA (CHAKRATA HILLS)
AND ASAN RIVER (SHIWALIK HILLS) OF WESTERN DOON VALLEY**

- 1 Anterior vertebrae modified to form the weberian apparatus(2)
 - Anterior vertebrae not modified to form the weberian apparatus(40)
2. Body covered with scales (usually cycloid) (CYPRINIFORMES) (3)
 - Body not covered with scales (SILURIFORMES) (31)
3. Barbels 1-2 pairs or absent; mouth terminal or inferior; scales usually large; no subocular spine; gill-openings wide; eyes not covered with skin (CYPRINIDAE) (4)
 - Barbels 3-4 pairs; mouth inferior, scales small or rudimentary; sometime a simple or bifid movable spine present in a groove before or below the eye; gill-openings small or moderate; eyes sometimes covered with skin (COBITIDIDAE) (27)
4. Origin of dorsal fin nearly opposite the pelvic fin or a little before(13)
 - Origin of dorsal fin clearly behind the pelvic fin(5)
5. Dorsal fin does not extend to above the anal fin; anal fin with 5-11 branched rays(6)
 - Dorsal fin generally extending over the anal fin which has 7-33 branched rays..(8)
6. A symphyseal knob present in the lower jaw, fitting into the upper jaw; mouth oblique; with lips present(8)
 - A symphyseal knob in the lower jaw absent; upper and lower lip not continuous; lower lip without a suckorial disc *Crossocheilus latius latius* (Hamilton-Buchanan)
7. Barbels present, maxillary barbels very long *Esomus danricus* (Hamilton-Buchanan)
 - Barbels absent*Parluciosoma daniconius* (Hamilton-Buchanan)
8. Suborbital ring of bone distinctly broad and prominent; cleft of mouth extending to anterior margin of eye(9)
 - Suborbital ring of bone not broad; cleft of mouth extending beyond anterior margin of eye(10)
9. Dorsal fin with 7 branched rays; anal fin with 11 branched rays, barbels present *Brachydanio rerio* (Hamilton-Buchanan)
 - Dorsal fin with 15 branched rays; anal fin with 16 branched rays, barbels absent *Danio devario* (Hamilton-Buchanan)

10. Cleft of the mouth extending beyond the postorbital margin; lateral line scales 87-90 *Raiamas bola* (Hamilton-Buchanan)
 - Cleft of the mouth not extended beyond the postorbital margin; lateral line scales less than 61 (11)
11. Anal fin with 8 branched rays *Barilius bendelisis* (Hamilton- Buchanan)
 - Anal fin with more than 8 branched rays (12)
12. Barbels moderately long; predorsal scales 19-20; lateral line scales 43-44 *Barilius vagra* Hamilton-Buchanan
 - Barbels minute; predorsal scales 15-16; lateral line scales 40 *Barilius barna* Hamilton- Buchanan
13. Upper lip separated from the skin of snout by a deep groove; lower lip without a. suctorial disc (15)
 - Upper lip continuous with the skin of snout; lower lip with or without a suctorial disc (14)
14. Upper and lower lips continuous at angle of jaws; lower lip with a suctorial disc *Garra gotyla gotyla* (Gray)
 - Upper and lower lips continuous at angle of jaws; lower lip with a suctorial disc *Garra lamta* (Hamilton-Buchanan)
15. Anal opening lined on both sides by a sheath of enlarged scales; lateral line scales. more than 94 (16)
 - Anal opening not lined by enlarged scales; lateral line scales less than 94 (17)
16. A plate of hardened skin presents across the lower lip; groove postlabial groove absent *Schizothorax richardsonii* (Gray)
 - Hardened plate across lower lip absent; lower lip fleshy, postlabial groove continuous, forming a central lobe *Schizothoraichthyes progastus* (McClelland)
17. Mouth inferior; lower lip with an inner transverse fold; dorsal fin with 10 branched rays (18)
 - Mouth terminal or subterminal; lower lip with or without an inner transverse fold; dorsal fin with less than 10 branched rays (19)
18. Margin of lower lip finely fimbriated; its inner surface studded with nodular tubercles *Labeo dero* (Hamilton- Buchanan)
 - Margin of lower lip tuberculated; its inner surface with a series of ridges which are finely striated *Labeo dyecheilus* (McClelland)

19. Lower lip with an uninterrupted posterior groove; continuous around corners of mouth (20)
 - Lower lip with posterior groove interrupted (22)
20. Length of head shorter than depth of body *Tor tor* (Hamilton- Buchanan)
 - Length of head greater than depth of body (21)
21. Lateral line scales 32-35 *Tor chilionides* (McClelland)
 - Lateral line scales 26-27 *Tor putitora* (Hamilton-Buchanan)
22. Snout with a medium and lateral lobes; snout and cheeks covered with horney tubercles; gill rakers a few, triangular *Changunius changunio* (Hamilton-Buchanan)
 - Snout entire; snout and cheeks without horney tubercles; gill rakers numerous, usually lanceolate (23)
23. Barbels present (24)
 - Barbels absent (25)
24. With 4 barbels; last undivided ray of dorsal osseous and serrated *Puntius sarana* (Hamilton-Buchanan)
 - With 2 barbels; last undivided ray of dorsal osseous and smooth *Puntius chola* Hamilton-Buchanan
25. Last undivided ray of dorsal osseous and smooth *Puntius sophore* Hamilton-Buchanan
 - Last undivided ray of dorsal spine stained dark nor anal base bears spot (26)
26. Dorsal fin with 2 rows of dark spots; a black spot on 4- 5 th lateral line scale.... *Puntius ticto* Hamilton-Buchanan
 - Dorsal fin without dark spots; tip of dorsal fin black in male; no black spot on anterior scales of lateral line *Puntius conchoni* Hamilton- Buchanan
27. An erectile spine present near the orbit (28)
 - Without an erectile spine near the orbit (29)
28. Caudal fin convex, truncate or slightly emarginated with rounded corners; no whited-edged black spot at the margin *Lepidocephalus guntea* (Hamilton-Buchanan)
29. Dorsal fin with 10 – 11 branched rays; a black spot at upper half of caudal base present *Noemachilus botia* (Hamilton-Buchanan)

- Dorsal fin with less than 10 branched rays; vertical band with indistinct outline, post dorsal bands generally not encircling body caudal fin emarginated(30)
- 30. Head broad; depressed; caudal fin deeply emarginated with its upper lobes prominent; dorsal fin marked with 2-3 oblique rows of dark dots
.....*Noemacheilus rupecula* (McClelland)
- Head narrow; slightly compressed; caudal fin slightly emarginated with its lower lobe longer; dorsal fin marked with an oblique dark band across its centre
.....*Noemacheilus montanus* (McClelland)
- 31 Anal fin long (more than 40 rays)(32)
- Anal fin shorter or moderate (less than 40 rays)(47)
- 32. Accessory respiratory organ present(33)
- Accessory respiratory organ absent(34)
- 33. Dorsal fin short (with 7 rays) spineless *Heteropneustes fossilis* (Bloch)
- Dorsal fin long (with 60 rays) spineless *Clarias batrachus* (Linnaeus)
- 34. Two pairs of barbells, nasal barbels absent(35)
- Four pairs of barbells, nasal barbells present(36)
- 35. Eyes with a free suborbital margin and lie above the level of the corner of the mouth and not visible from inside of the head; cleft of mouth oblique and reaching to or beyond posterior margin of eye; anal fin with 82-89 branched rays
..... *Wallago attu* (Schneider)
- Eyes susutanecous lie posterior to level of corner of mouth and visible from underside of head, cleft of mouth not reaching anterior margin of eye; anal fin with 53 branched rays..... *Ompok pabda* (Hamilton-Buchanan)
- 36. Adipose fin rudimentary; anal fin long; body herring shaped
..... *Clupisoma montane* Hora
- Adipose fin well developed; anal fin short; body loach- like
..... *Amblyceps mangois* (Hamilton-Buchanan)
- 37. Adhesive thoracic apparatus present(39)
- Adhesive thoracic apparatus absent(38)
- 38. Occipital process 1.5-2.0 times as long as wide at the base; dorsal spine smooth; adipose fin long *Mystus bleekeri* (Day)
- Occipital process more than 2.0 times as long as wide at the base; dorsal spine serrated on both edges near the tip; adipose fin short *Mystus vittatus* (Bloch)

39. Adhesive thoracic apparatus formed of transverse fold of skin; pelvic fin situated below the dorsal fin; pectoral fin with a weak and articulated spine
..... *Pseudechenesis sulcatus* (McClelland)
- Adhesive thoracic apparatus reduced; under surface of pectoral spine and outer pelvic ray plaited *Glyptothorax pectinopterns* (McClelland)
40. Branchiostegal rays 10; jaws prolonged in the form of a beak; opercular bone unarmed; caudal fin emarginated or truncate
..... *Xenentodon cancila* (Hamilton-Buchanan)
- Branchiostegal rays less than 10; jaws not prolonged; opercular bones armed; caudal fin rounded or convex (41)
41. Head snake-like; suprabranchial organ present; only one elongated dorsal fin present (42)
- Head not snake-like; suprabranchial organ absent; a 2nd dorsal fin present (43)
42. Pelvic fin less than half the length of pectoral fin; dorsal fin with 34-36 rays; pectoral fin with vertical bands; no bands on body *Channa gachua* Hamilton-Buchanan
- Pelvic fin more than half the length of pectoral fin; dorsal fin with 29-32 rays; pectoral fin without bands; body with bands or patches *Channa punctatus* Bloch
43. Body oblong, compressed; mouth terminal, very protractile, its cleaf very wide, dorsal fin insertated above pectoral fin base, with 12 to 14 spines and 11 to 13 rays
..... *Nandus nandus* (Hamilton-Buchanan)
- Body elevated, compressed; mouth upturned, terminal cleft small; a single dorsal fin commencing above from near pectoral base, with 15-18 spines
..... *Colisa fasciatus* (Schneider)
44. Body cylindrical and elongated; spinous dorsal with numerous (23-37) spines .. (45)
- Body neither cylindrical nor elongated; spinous dorsal formed of 16 spines
..... *Badis badis* (Hamilton-Buchanan)
45. Anal and dorsal fins confluent with the caudal ... *Mastacemblus armatus* (Lacepede)
- Anal and dorsal fins distinct from the caudal
..... *Macrognaathus panucalus* Hamilton-Buchanan

REMOTE SENSING AND GEOGRAPHICAL INFORMATION STUDY APPROACH IN AMLAWA RIVER (CHAKRATA HILLS) AND ASAN RIVER (SHIWALIK HILLS) OF WESTERN DOON VALLEY

Remote sensing and Geographical information study (GIS) is a modern technique to study the micro details of a particular area for accurate results. Half-decade back it attracted the attention of scientist for its application in various fields. Its use opened the new horizon for the planners, militarians, engineers, geographers, cartographer, botanist, zoologists and wild lifers. In zoological study, remote sensing and geographical information system is used to analyse the suitability of an area for a particular species in an ecosystem, Dwivedi *et al.* (1998). Yet this new science is on the way of expansion, which can give more strength to the advance research in above mentioned field. However, the work on aquatic diversity by using remote sensing and geographical information system has been done only in ocean to know the vegetation and species pattern. While, in the field of fishes work is concentrated only in oceans, Nath (1993), due to the large area of ocean it is easy to interpret different attributes for the detailed study *i.e.* vegetation, PFZ (Potential fishing zone) and riparian zone *etc.* Whereas, in small water bodies including hillstream the length and width of the water body remain very narrow and flow through the deep gorges, which does not allow the sensors to penetrate the water body or give the details due to which very less work has been done on the freshwater rivers mainly in hilly area, Srivastava and Ponniah (1997). However, in future the satellite sensors of high spatial and spectral resolution will give the accuracy and it will help the scientists working on freshwater bodies to explore the freshwater biota in more detail.

In present study an effort has been made to study the different attributes *i.e.* biological parameters of Asan (Shiwalik hills, Western Doon valley) and Amlawa river (Chakrata hills) of western part of Doon valley but due to the above mentioned limitations of remote sensing and geographical information system the better results could not be achieved. However, the satellite imagery of district Dehradun showing the catchment area of both the rivers has been given (Plate-7).

FISHING METHODS OBSERVED IN AMLAWA RIVER (CHAKRATA HILLS) AND ASAN RIVER (SHIWALIK HILLS) OF WESTERN DOON VALLEY

Fishes have always attracted the attention of human beings since ages for food and as the chief source of vitamin A and D. Man have evolved different types of methods for fish collection. The fishing methods depend upon the topography and geographical setup of the region. In plain areas where the volume of water is more, the fishermen use big nets for fishing. However, in hill streams where the water current is very high and volume is less, small nets are used for the fishing. Fishing methods have their own history of evolution and reference is found in the Mahabharata epic and other old literature, Hora (1951). The tribal people of the Andaman and Nicobar Island do fishing with the help of bow and arrows even now. The fishing methods are developed more scientifically in different regions

and the old crude methods has been replaced by scientific methods, Sehgal (1987). Countries like U.S.A., China, Japan and Korea etc use highly commercialized methods now days.

In the Western Doon Valley fishing is not practiced as a profession and people do fishing for animal protein nutrition. People of this region use many crude fishing methods even today. Reference to fishing of the tribal region is found in the books and magazine on fishing festival called "Maund", Nauriyal (1998) and Uniyal (2002). In this festival, males of the nearby villages gather on the bank of rivers and throw powder of "Timur" plant (*Zanthoxylum armatum*). The toxic effect of the powder make the fishes unconscious and are collected by the people, this festival is celebrated in Jaunsar-Bawar and in parts of the Garhwal. Author observed the same in Amlawa river only in Western Doon valley. Author conducted a wide survey from 1999 to 2001 and found that the people of western Doon valley commonly use 20 methods, of which 15 are scientific while the remaining 5 are unscientific methods. The fishing in the small and moderate tributaries of Yamuna river in different seasons and comparison of fishing method used in Amlawa and Asan river is given in tabular form (Table-8) for easy understanding.

In the Garhwal region the fishing methods were reported by Badola and Singh (1977a) they observed 15 fishing methods in that region. Rautala *et al.*, (1993), described fishing methods used in Khoh river at Kotdwar. Dobriyal *et al.*, (1992) and Nautiyal and Lal (1994) reported fishing method from Nayar river (Garhwal). Joshi *et al.* (1993) reported fishing methods commonly used in Gori Ganga river (Kumaon).

There is very little information available on the fishing methods of western Doon Valley recently author published detailed account on fishing methods of Jaunsar-Bawar, Bahuguna *et al.* (2001) and Uniyal *et al.* (2005d). Hence an attempt has been made in present study to observe the different fishing methods used in Amlawa (Chakrata hills) and Asan river (Shiwalik hills, Dun Valley). Most of the fishing methods observed was photographed on the spot.

OBSERVATIONS

Fishing Methods have been classified into two parts, viz., (i) Scientific and (ii) unscientific.

Scientific Methods

Scientific methods for fish collection involve only required numbers and size of fishes so that sufficient population of fishes remains balance in the nature.

(1) **Cast net or Jaal** : Jaal is conical or umbrella shaped. It is approximately 130-160 cm. in the length having the surface area of 250-300 cm². It is made up of nylon thread with different mist size (0.5 to 1.5 cm). The rim contains around 100 to 110 sinkers. During operation the cord of the net remains in one hand of the fisherman and the rim in the other hand. As the net is thrown in the river, the rim quickly sinks to the bottom with

Table 8 : Fishing methods practised in Amlawa (Chakrata Hills) and Asan rivers (Shiwalik Hills) of Western Doon Valley.

Sl. No.	Fishing Method	Amlawa River	Asan River	Remarks
Scientific Fishing Method				
1	Pattari Fishing Method	Present	Present	Used throughout the year, observed in every Survey in both the rivers.
2.	Cast net Fishing Method	Present	Present	- do -
3.	Scoop net Fishing Method	Present	Present	Used in Monsoon season observed in both the rivers.
4.	Angling or Kanta Fishing Method	Present	Present	Used throughout the year, observed in every survey in both rivers.
5.	Side Water Diversion or Dam formation Fishing Method	Present	Present	Used in Summer and winter in both in the rivers
6.	Mosquito Net or Cloth Fishing Method	Present	Present	- do -
7.	Hand Picking Fishing Method	Present	Present	Used throughout the year in both rivers.
8.	Gowda trap Fishing Method	Present	Absent	Used in monsoon season, Observed in Sahiya & Seligothan in Amlawa river
9.	Patti Fishing Method	Present	Absent	Used in winter and summer. observed in Kalsi, confluence of Amlawa and Yamuna river.
10.	Katori Fishing Method	Present	Present	- do -
11.	Fundi Fishing Method	Present	Present	- do -
12.	Bori Fishing Method	Present	Present	- do -

Sl. Fishing Method No.	Amlawa River	Asan River	Remarks
13. Jali Fishing Method	Absent	Present	Used throughout the year in Asan river
14. Char (Rod). Fishing Method	Present	Present	Used throughout the year in both rivers
15. Jali Fundi Fishing Method	Present	Absent	Used throughout the in Amlawa river
Unscientific Fishing Method			
1 Dynamiting Fishing Method	Present	Present	Used throughout the year and more common in Amlawa river.
2. Electric current Fishing Method	Present	Present	Used throughout the year, badly effect fish fauna and risky for human as well as domestic cattle life.
3. Hammering Fishing Method	Present	Present	Used in summer & winter, badly effects the juvenile and bottom feeder fishes
4. Ichthyotoxic Plant Fishing Method	Present	Absent	Used in monsoon season, observed very common in Amlawa river during the fishing festival called "Maund" Plants found in hill region only.
5. Bleaching powder Fishing Method	Present	Present	Used throughout the year. It is a menace for fishes as well aquatic biota. Frequently used in both rivers and cause skin diseases.

the help of the iron sinkers. The rim forms a bag like structure in which fishes get trapped, then the net is slowly dragged out and fishes are taken out by hands. Single fisherman operates the jaal and this method is used in the shallow water throughout the year. This is a popular method in Amlawa and Asan river of Western Doon Valley, (Plate-33, Fig. 55).

(2) Pattari : This is a very common method for fishing in the Western Doon region. Single man operates it. The net used is triangular in form, joined by two bamboo sticks parallel at upper region about 120 cm long and 50 to 60 sinkers are attached to the rim of its neck which help the net to settle down in the water. Cotton cloth or bori is attached to its rim. During the operation the fishermen stand inside the water. The net is placed inside the water, while holding the bamboo sticks in the hand the fisherman disturbs the fishes, which get trapped inside the net. The net remains open from one side during the operation, which act as a gateway for fishes. This type of net is used in the streams or in less water throughout the year in Amlawa and Asan river of the region, (Plate- 33, Fig. 56).

(3) Karonchor or Scoop net : Karnochor net is used for fishing from distance. It is made up of nylon or cotton threads. It is circular or semicircular in shape. The average height of the net is around 60 to 90cm. The net is open like a spoon having a rim of bamboo sticks or iron, which is further attached to a 3 to 4 meter long bamboo rod. This method is usually used in monsoon season when water is more in the river. The net is operated on the bank of river by free movement on either side, the fishes get trapped inside and unable to escape. By this method, medium sized of fishes *i.e.* *Barilius* spp., *Schizothorax* sp. and *Channa* sp., etc. are trapped, (Plate-34, Fig. 57).

(4) Kanta (Angling) : “Kanta” is an old popular method for fishing of big fishes. It is commonly used in the Tons and Yamuna river of the Jaunsar - Bawar tribal area. In this device, a copper or iron angle and usually “J” shaped hooks are used which vary in size, (Plate-34, Fig. 58). It is tied to a thread (Cotton or Nylon), which is further connected to a bamboo stick at the other end. The bait (usually flour or earthworm) is put on the tip of the hook, which is then thrown into the river/stream. Fishes get attracted by the bait and caught by the hook usually at the gill or buccal cavity region. Angling is becoming a popular sport. In Amlawa and Asan river the fishing of Mahseer and catfishes is done by this method, (Plate-35, Fig. 59).

(5) Side water Diversion or Dam formation : In this method the main flow of the stream is turned to the other side, thus the main stream faces the scarcity of water and fishes present in the stream come out from the hidden places can be collected with the help of hand. This method is used in the small rivers. It is commonly used in the Amlawa and Asan river of Western Doon valley.

(6) Mosquito Net or Cloth This is a popular method of fishing used in the tribal area of the Amlawa and Asan river. In this method usually three fishermen are required. Two of them hold the two ends of the cloth while the third one stands in opposite direction. Then both the fishermen drag the cloth or net slowly while the third man disturbs the fishes and

tries to direct them towards the net or cloth with the help of rod or stick. As a result, fishes move into the net or cloth. After sometime fishermen immediately lift up the cloth and collect the fishes. This method is quite successful in shallow or in stagnant water. By this method some small fishes can be collected *i.e.* *Barilius* sp., *Puntius* sp., and *Nemachilus* sp., *etc.*, (Plate-35, Fig. 60).

(7) Hand Picking : This method is also very much common in the Amlawa & Asan river where the level of water is less. In this method fishermen simply insert their hand under the rock and boulders from where they catch the fish like *Schizothorax* sp., *Torchelyinoides*, *Glyptothorax* sp., *Pseudechenesis sulcatus*, *Nemachilus* sp. *etc.*, (Plate-36, Fig. 61).

(8) Gowda trap : Gowda is like a conical or cylindrical structure with circular mouth made up of bamboo sticks. It is about 45-65 cm in height with variable diameter. It looks like a basket. Gowda is kept in such a place where the water current is fast and falling down in the form of a fall. Fishes during the downward migration are trapped inside the Gowda. It is kept under water overnight and in the morning the fishes can be collected. It is successful during rainy season, when the water is turbid and current is fast. This method was observed in Amlawa river but absent in Asan river.

(9) Patti Net : This is a popular method of fishing in Tons and Yamuna river but rarely seen in Amlawa river. Patti is made up of nylon threads and at the upper region the rope is passed to hang the net having mesh size of 2.5 inches and a width ranging from 2.5-4.5 meters according to the requirement. At the lower portion small stones are attached which act like sinkers to balance the net in fast current. Patti net is tied with some tree or rod from both the ends. Net is put across the river and left for five to six hours. The fishes during the upward and downward movement get trapped in the net. This method is mostly applied during the winter season mainly to catch the average and big sized fishes *i.e.* *Tor* sp., *Labeo* sp., *Clarius* sp. and *Wallago* sp., *etc.* The fishing method is not seen in Asan river, (Plate-36, Fig. 62).

(10) Katori : In this method mainly iron, copper or earthen pot can be used. The upper portion of the pot is covered by cloth having a small hole at center in the cloth. The bait (flour or earthworm) is kept in the pot. Katori is kept around the shallow water where fishes are abundant. After 4-5 hours the pot can be taken out to collect the fishes. This method is commonly used in Amlawa and Asan river during summer and winter season to collect the small fishes *i.e.* *Puntius* sp., *Barilius* sp. and *Nemachilus* sp., *etc.*, (Plate-37, Fig. 63).

(11) Fandi : Fandi method is based on the principle of "Kanta" with slight modification. Fandi is made with the help of nylon cord or a string, which is approximately 10-20 m. In the main nylon cord or a string, the large numbers of small fiber loops (Bangle shaped) are joined together after a regular interval. These loops are made in such a way that knot of loop can easily slip away from the main cord towards the inner side. Stones are tied after

10 loops, which act as a sinker. Fandi is thrown and kept for 5-6 hours in the water. Fishes get trapped in the loops or fandi. By this method many fishes can be caught at the same time. This method is very common in Amlawa and Asan river for catching the medium sized fishes *i.e.* *Barilius* spp., *Puntius* sp., *Garra* sp. and *Tor* sp., *etc.* (Plate-37, Fig. 64).

(12) Bori : It is also a popular method of fish collection in Amlawa and Asan river. In this method holes are made in a jute cloth (Bori) at 3-5 places and then it is dipped in the river where the fishes are abundant then suddenly fishermens picks up the cloth (Bori) and collect the fishes trapped in it. By this method mainly small fishes are collected *i.e.* *Barilius* sp., *Puntius* sp. and *Nemachilus* sp. *etc.*

(13) Jali : Jali method is based on the principal of Scoopnet or Karonchor with Slight modification In this medhodo the jali used in window pan were used. In conical rim jali form bag like structure. The fisherman simply inserts the Jali where fishes are abundant and picked up quickly and collect the fishs. This method is common in Asan river while it was absent in Amlawa river.

(14) Char (Rod) : Char fishing method is modified form of Kaanta method. Char consists of a bamboo stick 4-6 meter long in which nylon thread is attached from base to top. At the base hook is fixed for placing bait to lure fish. The stick is placed in between stones to trap the fishes of *Mastacembelus* sp., *Glyptothorax* sp. and *Garra* sp. *etc.*

(15) Jali-fandi : This method of fishing was reported from Sahiya (Chakrata hills) in Amlawa river. This method was developed by children of 10-12 years by using their crafty and innovative ideas. In this method a net of small mesh size genrally used for keeping medicine bottles is used in which a thread is passed on its upper rim in circular form and thread remain free from both the ends of the rim. It can be easily operated by placing a stone as a sinker along with bait. Net is thrown in the river and placed for 10-20 minutes as soon as the fish enters the thread is tightened from both the ends and net is pulled out, fishes like *Shizothorax* sp., *Glyptothorax* sp., *Garra* sp. can be trapped using this method.

Unscientific Methods

Unscientific method of fishing means indiscriminate killing of large number of fishes (Juvenile as well as brooder fishes), which affects the population of the fishes as well as the water quality of the river. In the Western Doon Valley following unscientific methods of fishing were observed during the survey in different tributaries of Yamuna river *i.e.* Amlawa, Tons & Asan river.

(1) Dynamiting : Dynamite explosive was most common unscientific method used in this area. It is just thrown in the stream or river before it bursts. Due to its terrific sound of explosives large number of fishes come on the surface and float with their bellies upward from where they are easily collected. By this method all sort of fishes (all sized) are killed in large number. This is common practice during summer and winter where the

water level is very high (in pools, near the rocks), in Amlawa and Asan river. The dynamiting affects the fish balancing system and so they die and float.

(2) Electric Current : This is also an ill unscientific and dangerous method of fishing where electric phase wire is dipped into the stream water and due to the electric shock a large number of fishes of all the size die.

(3) Ghan or Hammering : In this method a big iron hammer is used. The fishermen notice the movement of fishes and locates their hiding ground, (usually stones) and then they hammer on that stone with full strength. As a result of hammering a large number of all sized fishes are killed, which come out with the running water then they are collected. This is another popular unscientific method in Amlawa river during summer and winter season, when the level of water is less (Plate-38, Fig. 65).

(4) Ichthyotoxic plants : In the tribal area of Jaunsar - Bawar the plants are freely used for fishing in Amlawa river only. This popular fishing method is especially used during the "Maund" fishing festival. The festival takes place during the monsoon season, Nauriyal (1998). The commonly used toxic plant is "Timrue" (*Zanthoxylum armatum*). The bark of the tree, branches, fruits and leaves are crushed together to form powder, which is thrown in the river/stream from the height. As the powder get mixed with water, a large number of fishes die due to the toxic effect. Beside fishes it also kills other aquatic fauna. Some other Ichthyotoxic plants commonly used are Rambans (*Yacca* sp.) Khinnha (*Sapium* sp.) and Akhrot (*Juglans regia*) etc.

(5) Bleaching powder : This is another popular unscientific method used in this region. Bleaching powder is mixed in the sides pools of the river or stagnant water. Due to the toxic effect a large number of Juvenile fishes are killed. It also affects other aquatic flora and fauna. The author done detailed survey to know the affects of bleaching powder on fish fauna in Amlawa and Asan river of Western Doon Valley, Uniyal *et al.* (2001a).

DISCUSSION

The various types of fishing methods are used in India and abroad which generally depend upon the topographic and geographical setup of the area. Earlier reports on this aspect was given by Faruqui and Sahai (1943), MacDonald (1955), Anon.(1963), Badola and Singh(1977a), Brundt (1972), Singh (1974), Yadav *et al.* (1981), Sharma and Grover (1982), Tilak and Sharma (1982), Dobriyal *et al.* (1992), Rautela *et al.*, (1993), Joshi *et al.* (1993), Nautiyal and Lal (1994) Bahuguna *et al.* (2001),Uniyal *et al.* (2001a, 2001b, 2002b) and Uniyal (2002).

It was observed that the aquatic fauna especially the fish population of this region is badly affected due to the frequent use of unscientific methods *i.e.* Dynamiting, Electric current, Ghan or Hammering, Ichthyotoxic plants and Bleaching powder. It is necessary to check use of this method strictly and proper management should be done to save the

endemic fishes of this region. Out of given total 20 methods during the summer and winter season. Mosquito net, Bori, Patti, Katori, Ghan or Hammering, Fundi and Dam formation are common. While the methods used in monsoon season Scoop net, Gowda and Ichthyotoxic plants while, some methods used throughout the year including Cast net, Pattari, Kanta, Bleaching Powder, Electric current, Dynamiting, Hand picking, Jali and Char (Rod). The present observation is agreement with the finding of above workers.

It is important to study the fishing method of concerned area as it gives clear-cut picture regarding the anthropogenic pressure on river. If more unscientific methods will be used in the river/water bodies then it will face more pressure, scarcity/indiscriminate killing of fishes and aquatic fauna. It will also increase the water pollution. For the effective fish management and by making good policies the above baseline data will be quite helpful in checking the unscientific methods and to balance the fish yield.

CONSERVATION AND MANAGEMENT OF FISH DIVERSITY OF AMLAWA (CHAKRATA HILLS) AND ASAN RIVER (SHIWALIK HILLS) OF WESTERN DOON VALLEY

Conservation and management is an important tool to preserve the nature for maintaining the ecological balance, which is foremost essential for the survival of human kind. In past, the reference of animal and plant conservation is found in Vedas and linked with Hindu religion and culture. The Elephant (*Elephas maximus*) were assigned an important position in the pantheon of Hindu deities. Lord Ganesha or Ganapati is mentioned as the elephant-God with the prehensile trunk. Nags or snake spirits (*Naja naja*) too are very ancient object of worship, like wise some plants were also worshipped like Banyan (*Ficus palmata*), Mango (*Mangifera indica*), Ficus (*Ficus palmata*), Bel (*Eugenia jambol*) and Tulsi (*Ocimum tenuiflorum*). These are the device to save nature and their component by giving religious motivation to the people for the conservation of animal and plants. The Emperor Ashoka also conserved fishes and the second pillar edit dated back (250 B.C.) shows that he had given clear guideline for the conservation of wild animals Krishna (2000).

Even today many communities conserve the wildlife viz. Bisnoi community of Jodhpur conserve Chinkara (*Gazella bennetti*). Kinnorie tribe of Himachal Pradesh use to conserve the fishes in Koti temple and in Renuka Lake. In Punjab the water birds are conserved in wetlands. In some part of Himalaya Musk deer (*Moschus chrysogaster*) hunting is prohibited by locals. But unfortunately for the last half-century human beings have disturbed the natural ecosystem for their food, fun, game, shelter and medicine. The number of wild animals is decreasing at alarming rate due to destruction in their natural habitat and increasing anthropogenic pressure. Once the forest cover was 33% of the country land mass but at present it is 12% only. Now this indicates the destruction caused by human beings in the name of development. For the last one decade the natural imbalance is adversely effecting the life globally i.e. ozone layer depletion, global warming, atmospheric pollution, extinction of many plant and animals and many of them are on the verge of extinction. These factors

are forcing the naturalists and the scientific community to think about the future of our earth. In this regard, on October 1991 an international meeting was held at Bayreuth (German) on biodiversity and its conservation. Again in 1992 a step was taken in this direction in Rio de Janeiro, (Brazil), where 150 countries including India agreed to sign on the memo to save the precious biodiversity at global level by protecting Nature and Natural resources in wild. The convention is popularly called "Convention on Biological Diversity" (CBD-1992).

Indian Government also followed the same and decided to formulate "National Biodiversity Strategy and Action Plan" (NBSAP). The main aim of NBSAP is the conservation of national biodiversity and sustainable use of biological resources and equity in using and benefiting from the natural resources by involving people in the state, district and village level as the problem can be tackled in grass root level Kothari (2001) and Sharan (2001).

Now for proper Biodiversity Conservation, it is necessary to know the status of flora and fauna which will give the exact knowledge of species, which species is endangered, required immediate protection. Status survey should be conducted at country and state level and checklist should be made on the basis of IUCN guidance (1994), (Extinct, Critically Endangered, Vulnerable, and Rare). For this, we have to conduct status survey in each group otherwise without information no plan can be checkout.

Recently, Gadgil *et al.*, (2001) published a popular article in which they stated that even today fishes have not been given the status of Wildlife and critically endangered, endangered fishes have not been included in the wildlife protection Act-1972, Amended 1991, and Fisheries Act of India-1897, modified (1959). The Fishes are the important component of aquatic life. Menon (1996) has given a list of 24 species out of them 22 species are endangered. National Bureau of Fish Genetic Resources (NBFGR), Lucknow tentatively identified 4 endangered, 21 vulnerable, 2 rare and 52 indeterminate species from different ecosystems of the country, Kapoor *et al.* (1998). Singh and Sharma (1998) also identified 2 fish species as endangered while 7 species as vulnerable from the Garhwal Himalaya of Uttaranchal. Unfortunately these fishes have not been given any status in the fisheries Act of India 1897, Wildlife Protection Act 1972, Amended-1991, and Red Data Book of Zoological Survey of India, 1994, Uniyal *et al.* (2001b). Now it is urgently required to revive all these acts and include the fishes in the list of endangered, so that nation wide programmes can be launched to protect them in their natural state.

Author conducted survey of Western Doon valley for the period of three years (1999, 2000, 2001) and observed the fish species such as *Tor* spp., *Raiamas bola*, *Labeo* sp. *etc.* their catch percentage, length, weight and diameter is decreasing drastically, which is an alarming situation. The protection and conservation of fish fauna in remote area of Garhwal Himalaya is required. In Garhwal Himalaya scanty work has been done on the conservation of fish fauna by Sharma (1983), Sunder (1985), Nautiyal (1989) and Singh and Sharma (1998). In Doon Valley also little work has been done by Prakash and Grover (1983), Das and Nath (1988), Bahuguna *et al.* (2001), Uniyal *et al.* (2001a, 2001b, 2002a, 2002b). Author observed and concluded the following point, which are responsible for fish depletion.

Causes of depletion of fish fauna in Amlawa (Chakrata hills) and Asan river (Shiwalik hills) of Western Doon Valley

1. Over exploitation of fish fauna : It was observed that main reason of over exploitation of fishes is extensive use of unscientific methods of fishing in Amlawa and Asan river *i.e.* Dynamiting, hammering, bleaching powder and Ichthyotoxic plants (used exclusively in Amlawa river). These methods adversely effect the population of Juvenile as well as brooder fishes, aquatic biota, water quality and human health (by consuming polluted water and fish). Now the situation is alarming as the catch percentage, size and diameter of fishes is decreasing drastically. These methods are also affecting the breeding of fishes, which are resulting the decreasing fecundity rate.

2. Lack of policy/law implementation : In Eastern part of Doon Valley, fishing is well organised and time to time checking is also done but in Western part of Doon Valley, there is no well organised fishing *i.e.* in Amlawa and Asan river, no license were issued to the villagers, and law is not strictly followed which result in the destruction of fish and their habitat. There is no check on daily catch, size of fish and mesh size of nets, by which even the Juvenile fishes get killed which adversely effect the population of both the rivers.

3. Deforestation : Due to excessive deforestation on the bank of Amlawa and Asan river the problem of soil erosion and siltation is increasing (mainly in Asan river) as a result water level is decreasing, which adversely effect the fish population.

4. Destruction of spawning ground : Usually the game fishes *i.e.* *Tor* spp. and *Labeo* spp. *etc.* migrate into the small stream or tributary for breeding purpose so that young ones can grow in safe place. Big boulder or pebbles act as a breeding ground for them, but building material contractors, extract them indiscriminately as well as big logs thrown in the river result destruction of breeding ground which adversely effect the population and create a threat for future generation (Plate-38, Fig. 66).

5. Pollution : Pollution in Asan river is much as compared to Amlawa river. The rate of pollution is increasing day by day in the form of Industrial waste (Miniature bulb, Pharmaceutical products, Plastic Industries, *etc.*), domestic garbage, solid waste, sewage disposal, pesticides and insecticides used in agriculture fields. All these waste carry non-biodegradable component, which result in the decreased oxygen percentage and cause mass mortality of fishes, which is another serious threat to the fish fauna of both the rivers (Plate-39, Fig. 67).

6. Weed infestation : The weed infestation is more in Asan river as compared to Amlawa river. The infested area in Asan river is Chandrabani (A_4), Badowala village (A_3), which are surrounded by thick in habitation and the weeds are commonly reported (*Typha*, *Ipomea*, *Eichnornia*, *Azola* and *Algae*). In Amlawa river the most infested area is Kalsi (A_1), in low altitude, surrounded by thick human population. In rest of the stations river is

clean. The weed infestation increases the turbidity and decreases the oxygen percentage of the river, resulting in the fish mass mortality.

7. Introduction of the exotic species : The exotic fishes (fishes introduced from outside the country) are introduced for various purposes. Usually exotic species grow faster than native species and adversely effect their population and growth.

8. Construction of dams : The construction of dam adversely effect the migration of fishes which result in destruction in breeding and spawning. In Asan river the dam was constructed to fulfill the irrigation demand of Doon Valley. Das and Nath (1988) reported abundant numbers of the *Tor* spp. and *Labeo* spp. in the whole river. Now, in the present study, very less specimen of *Tor* spp. was collected from station Chandribani A₄ and Badowal A₃. In Amlawa river also the effect can be seen clearly. These dams also result in destruction of habitat of fishes.

9. The fishing festival-Maund : Maund-fishing festival celebrated in Jaunsar and Garhwal Himalaya. It is celebrated onset of monsoon when fishes migrate for breeding. In this festival male of near by villages gather on the bank of river and throw quintals of "Timur powder" (*Zanthoxylum armatum*) which carry toxic substance, Bhatt and Fraswan (1992) in the river and kill number of fishes (Juvenile and brooders) aquatic insect and plants. It is practised in Amlawa river and every year lot of fishes die which is great threat to the fish fauna of Amlawa river, (Plate-39, Fig. 68).

10. Unawareness among masses : The most important cause of destruction of fishes of Asan and Amlawa river is unawareness among masses. Villagers don't understand the importance of conservation and they do fishing in unplanned manner.

The above-mentioned points are the important factors for the destruction of fish fauna of Amlawa and Asan River of Western Doon Valley. Author attempted to know the remedial way to protect the fish fauna of both the rivers, so that population, growth and diversity can be increased which can uplift the economic status of the people. The important points are as follows :

Remedies and management for the conservation of fish fauna in Asan and Amlawa river of Western Doon Valley

1. Strict law : Now as the new state Uttaranchal is formed, it is necessary to frame out the policies/laws for the conservation of fishes, the laws made previously were ineffective. It is important to make strict laws by state fishery department/Forest department and their implementation should be done seriously so that people may not dare to do illegal fishing. Daily catch should be fixed along with the size of fish and nets (traps) so that indiscriminate killing of fishes can be stopped in both the rivers of Doon Valley.

2. Fishery status : For proper planning and management, it is foremost important to know the fishery status of concerned area on the bases of IUCN guidelines (1994), (extinct,

critically endangered, vulnerable, rare, low risk, data deficit) so that action plan can be prepared to check the depletion of fishes which are falling in the list of these categories and can be included in state fishery act. In this way fishes of both the rivers and Doon Valley can be protected. Author observed that catch percentage, size, length, weight and diameter of *Tor* spp., *Labeo* spp., *Raiamas bola* etc. are decreasing at alarming rate, now it is necessary to check the status of these species.

3. Fishes should be included in Acts : Conservation programmes can not be successful if endangered fishes are not included in the acts *i.e.* Wildlife Protection Act 1972, Amended 1995, Fishery Act of India 1897 (Modified 1957) and Red Data Book (ZSI, 1994). Fishes are not included in any of the acts. For conservation fishes on the verge of extinction, they should be included, in the acts so that nation wide campaign can be launched to check there further depletion.

4. Unscientific methods should be banned : All unscientific methods of fishing *i.e.* (indiscriminate killing of large number of fishes, Juvenile as well as brooder fish, adversely effect the population of fish as well as water quality), Dynamiting, Ichthyotoxic plant, Electric current, Hammering, Bleaching powder, (Plate-41, Fig. 71), should be banned and fine should be imposed on the guilty.

5. Paddy culture or sera culture : In Garhwal hills the paddy fields are called “sera”, these are situated on the bank of river/hillstream and receive constant water supply. In these seras fish fauna can be cultured. It can be an alternative source of economy to the tribal people of Chakrata. It is possible in Amlawa river (Chakrata hills) of Western Doon Valley, (Plate-40, Fig. 69).

6. Afforestation : Afforestation should be done on the river banks, so that problem of soil erosion, siltation can be solved. Trees like *Oak*, *Rhododendron*, *Shoria*, *Dalbergia* etc. having high water retaining capacity should be planted, so that water level, oxygen level can be increased and provide an ideal habitat for fishes to flourish. It is urgently required in Asan river.

7. Conservation of spawning ground : For the development of fishery it is important to protect the spawning ground of fishes, so that fish can breed freely. Constant vigilance should be done for its protection by Fishery department/Forest department by deputing guard.

8. Weed control : Another important aspect for fish conservation is to control the weed (unwanted plants), which cause mass mortality. A routine cleaning of different water bodies *i.e.* Asan river, (Asan reservoir) and Amlawa river at Kalsi is required, so that fishes may grow.

9. Pathology center : Author came across fish *i.e.* *Schizothorax richardsonii* suffering from “Black spot” diseases (Amlawa river) two-three times, which shows the presence of disease among fishes (Plate-40, Fig. 70). It is important to monitor the fish stock time to

time so that mass mortality may not occur. Fish pathology center should be established for monitoring Yamuna, Asan, Tons and Amlawa river of Western Doon Valley.

10. Introduction of exotic fishes : Exotic fishes should be introduced only after thorough assessment. If found suitable with minimum ecological risk, then only it should be introduced otherwise exotic fishes grow at faster rate than native species and adversely effect their abundance.

11. Close season : During breeding season, fishery should be banned (July-October) so that fishes can breed freely and the brooder fish can be protected.

12. Fish ladder in dams : Before constructing the dam it is necessary to know its impact on fish migration. So proper fish path/ladder should be made so that fishes can migrate freely.

13. Establishment of hatcheries and training : For economic development of newly formed state Uttaranchal and Doon Valley, it is necessary to exploit the fishery resources, which can generate employment for people of the region. For this it is foremost important to establish the hatcheries and trained the people about new methods of fish culture.

14. *In situ* conservation : It refers to conserve the animals and plants in their natural habitat by providing ideal habitat to grow. In case of fishes *in situ* conservation can be done by establishing fish sanctuaries/reserve area. In Western Doon Valley the sanctuary can be established in Yamuna river from Kalsi to Dakpathar, where fish abundance is more. By this way fishes can be saved at large scale.

15. *Ex situ* conservation : It refers to conservation of plants and animal in laboratory by storing genetical material by establishing "Gene Bank" The methods adopted for this is cryopreservation of sperms, eggs or embryos and storage of cells cultures. In Uttaranchal, presently, Cold Water Fishery Research Institute, Bhimtal has done on endangered fish Mahseer and good results have been achieved. Such laboratory can also, be established in Doon valley.

16. Mass awareness : The most effective way to conserve the fish fauna of both the rivers is to educate the masses at different level *i.e.* village, block, school, College etc. by organising seminars, video show, distributing poster, sticker with slogan for conservation, folks songs and excursion. So that they can understand the importance of fish conservation.

SUMMARY

The present work has been completed in more than three years and summaries as follows.

1 A brief historical resume of the work done on, Uttaranchal (Kumaon and Garhwal) mainly on Dehradun District on Taxonomy, ecology, fishing methods, physico-chemical and conservation aspect have been given.

2. A brief information on the physiography of the study area *i.e.* Amlawa river of a tribal area of Chakrata hills (Jaunsar-Bawar) and Asan river (Shiwalik hills) of foothill area of Western Doon valley along with maps showing the latitude, longitude and altitude of all the sampling sites have been mentioned.

3. Extensive survey has been conducted on the the river Amlawa and Asan of Western Doon valley. Species variation in both the rivers has been studied. As a result of this survey total 45 species of fishes belonging to 31 Genera, 13 families 4 orders have been reported. During the present study three new records were identified one for district Dehradun and 2 were for Garhwal Himalaya. In Amlawa river 36 fish species belonging to 22 genera, 8 family and 3 orders were identified. While in Asan river 41 fish species belonging to 28 genera, 12 family and 4 orders have been recorded. Beside this seasonal variation and impact of physico-chemical parameters on fishes distribution in Amlawa and Asan river were discussed. It is concluded that quantity and quality of fish species decreased as we moved from low to higher altitude. This is due to decrease in water level or volume at high altitude. Only the fishes having high adaptation for hillstream environment were found at high altitude in Amlawa river. These fishes are: *Garra* sp., *Schizothorax* sp., *Glyptothorax* sp. and *Pseudecheneis*, etc. While the common species inhabiting the lower altitude of Amlawa and foothills of river Asan were: *Barilius* spp., *Puntius* spp., *Channa* spp., *Danio* sp. etc. *Garra lamta*, *Nandus nandus* and *Colisa fasciatus* have been recorded for the first time from the Dehra Dun Valley where as latter two are the new records from Garhwal Himalayas. The status of fishes of Amlawa (Chakrata hills) and Asan river (Shiwalik hills) were assigned according to C.A.M.P. workshop (1994), on the guideline of I.U.C.N *i.e.* Endangered (En), Vulnerable (VU), Low-Risk near threatened, Low-Risk-least concern, Data deficient (D.D.) and Not Evaluated (N.E.). As per analysis 6 species (13%) fall in endangered category (*Raiamas bola*, *Tor chelynooides*, *T. putitora*, *T. tor*, *N. montanus* and *Ompok padma*), 12 species (27%), fall in Vulnerable, (*B. vagra*, *Puntius chola*, *P. conchoniis*, *P. sarana sarana* , *Labeo dero*, *L. dyocheilus* , *Garra gotyla gotyla*, *Schizothorax richardsonii*, *Mystus bleekeri* ,*M. vittatus*, *Heteropneustes fossilis* and *Pseudecheneis sulcatus*), 18 species (41%) in Low-Risk near threatened, (*Barilius barna*, *B. bendelisis*, *Brachydanio rerio*, *Danio devario*, *Parliuciosoma daniconius*, *P. sophore*, *P. ticto*, *Schizothorachichthys progastus*, *Nemacheilus botia*, *N. rupecola*, *Wallago attu*, *Amblyceps mangois*, *Glyptothorax pectinopterus*, *Xenentodon cancila*, *Colisa fasciatus*, *C.punctatus*, *Macrognathus panucalus* and *Clupisoma Montana*) 1 species (2%) in Low-Risk-least concern, (*Esomus danricus*), 2 species (4%) in Data deficient (*Chagunius chagunio*, *Garra lamta*) and 6 species (13%) were in Not Evaluated category (*Crossocheilus latius latius*, *Lepidocephalus guntea*, *Babibadis*, *Nandus nandus*, *Channa gauchua* and *Mastacembelus armatus*). It is inferred that the fish fauna of Amlawa and Asan rivers required immediate conservation measures so that further their depication can be checked. Taxonomic account of all fishes were given along with distribution, identification key and supported by line diagram and actually photographs.

4. An account of fishing methods employed in Amlawa and Asan River by local fisherman has been observed. The study was divided in to two parts (i) Scientific fishing methods and (ii) Unscientific fishing methods. A total of 20 fishing methods were observed in the tribal area of Chakrata hills (Jaunsar-Bawar) and Shiwalik hills, foothill of Doon valley. Out of which 19 methods were used in Amlawa river whereas 16 methods were observed in Asan river. Over all 15 methods were scientific, which do not disturb the fish diversity in nature but 5 methods were unscientific and they disturbed the fish diversity. The total 10 methods were to practised throughout the year while, 3 methods were practised during monsoon months. Seven other methods were applied during summer and winter generally when water level is low. This study is aimed to know the causes and remedy for the conservation of fish fauna of Western Doon valley. As unscientific methods are more harmful than the scientific fishing methods so it is needed to make aware the local people.

5. Remote sensing and Geographical Information System (GIS) technique was proposed to study the physico-chemical and biological parameters of Amlawa and Asan river which were already done by routine methods as stated in point 8 and 9, but no inference was detected as the river width is very less specially in Amlawa river which flows through deep gorges. The sensor penetration was not possible in this terrain due to less resolution power of satellite. In future with the help of high penetration sensors it will be possible to conduct the studies in freshwater rivers and it will open new horizon for freshwater biologists.

6. Fish conservation aspect of Amlawa and Asan river was highlighted after the observation of 3 years. The causes of fish degradation have been pointed out as follows :

(a) In the tribal area of Chakrata hills and foothill of western part of Doon valley there is no organised fishing and no law has been followed as in Eastern Doon valley where the Gram Panchyat issues the annual license or permit for local fishing.

(b) People of the western Doon valley use many unscientific fishing methods i.e. dynamite, electric current, hammering, Ichthyotoxic plants (Timaru, Akhrot, Rambans) and bleaching powder extensively in both the rivers. Due to which brooders, juvenile as well as other biota is completely wiped out and adversely affect the water quality. This indiscriminate killing of fishes should be checked immediately.

(c) Deforestation, weed infestation and pollution in both the rivers adversely effect the water level and quality, which decreases the oxygen percentage, resulting in mass mortality among the fishes which is another important cause of sharp decline of fishes in the region.

(d) Spawning ground of the fishes is adversely affected by indiscriminate extraction of pebbles or boulders and logs through in the Amlawa river which destroy the eggs and spawning sites.

(e) There is no law to check the fish size, weight and mesh size of fishermen nets, which is the main factor for destruction of juvenile in these rivers.

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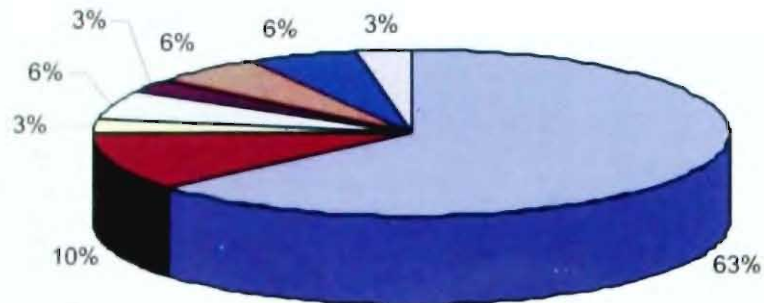
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PLATES : 4-41

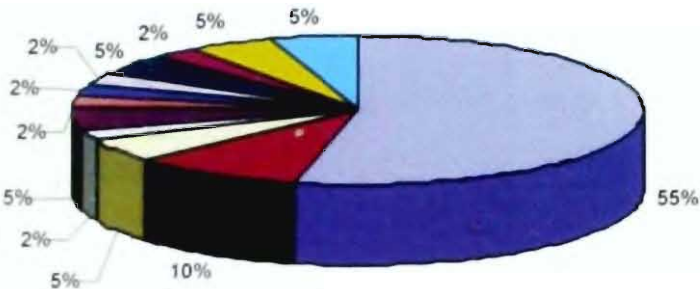
PLATE - 4

Fig.1. Fish diversity (family-wise) in Amlawa river



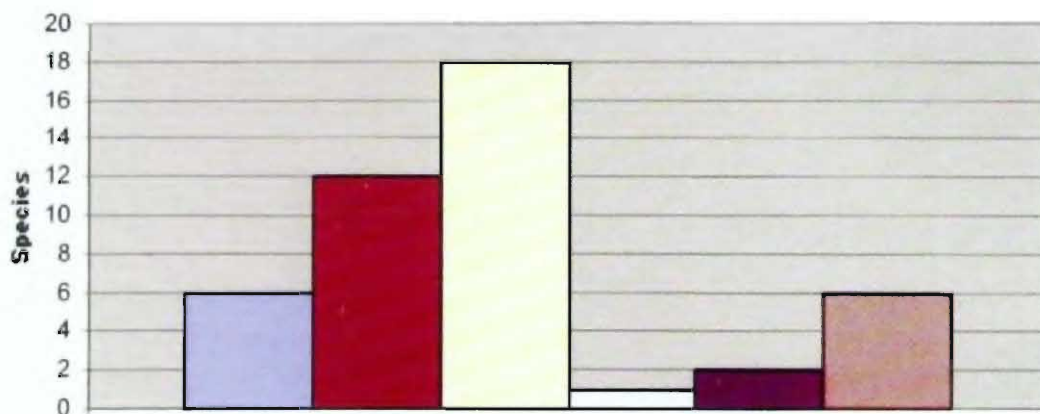
■ Cyprinidae ■ Cobitidae □ Amblycypidae □ Bagaridae ■ Schilbidae ■ Sisoridae ■ Channidae □ Mastacembelidae

Fig.2. Fish diversity (family-wise) in Asan river



■ Cyprinidae ■ Cobitidae □ Siluridae □ Amblycypidae
 ■ Bagaridae ■ Heteropneustidae ■ Sisoridae □ Belonidae
 ■ Nanidae ■ Belontiidae ■ Channidae □ Mastacembelidae

Fig.3. Status of fish fauna of Amlawa and Asan rivers



■ Endangered (EN) ■ Vulnerable (VU)
 □ Low Risk -near threatened (LRnt) □ Low Risk -least concern(LR-lc)
 ■ Data deficient (DD) ■ Not Evaluated (NE)

PLATE - 5

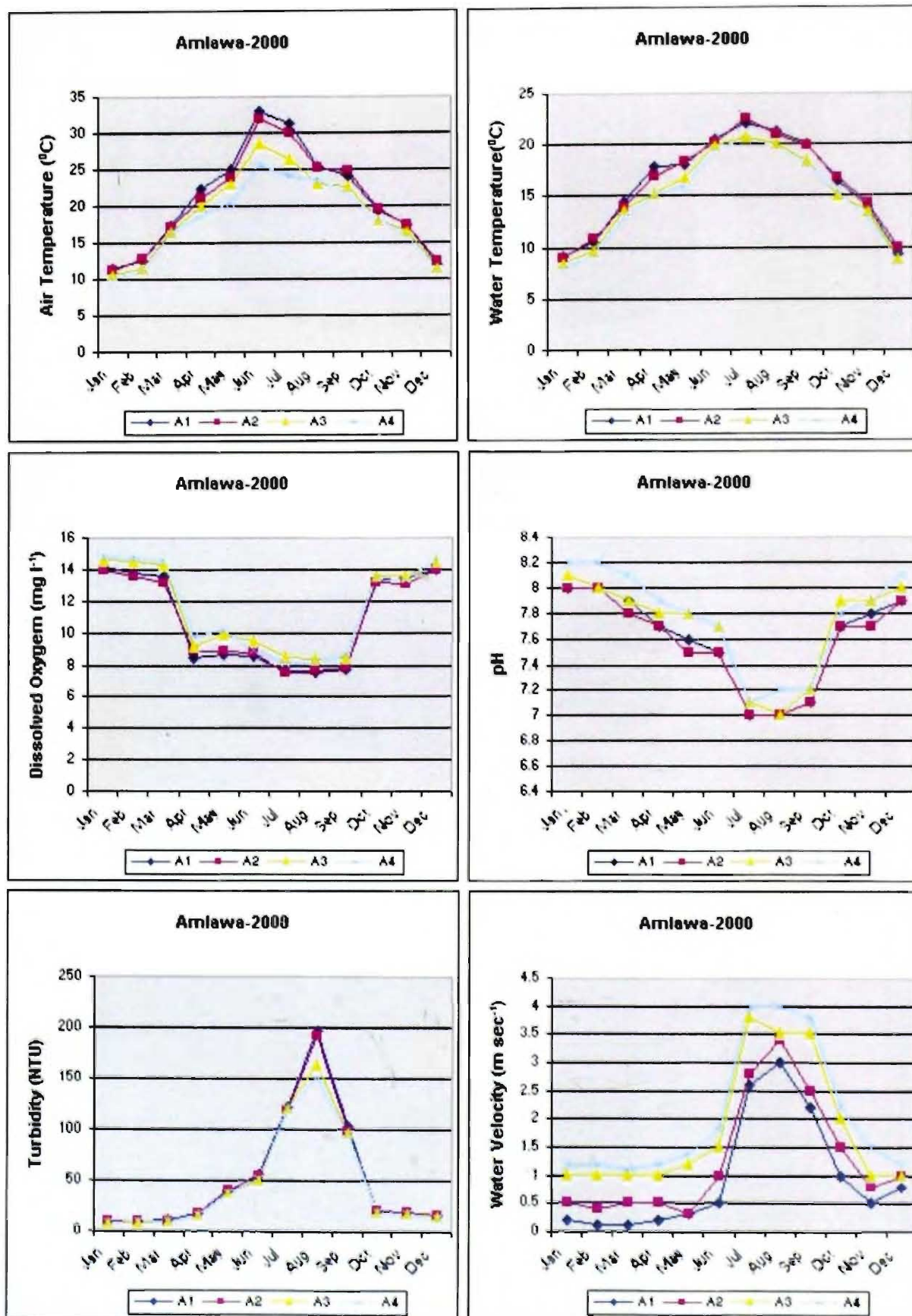


Fig. 4. Phyco-chemical parameters of Amlawa river (Shiwalik Hills) of Western Doon Valley for the year 2000

PLATE - 6

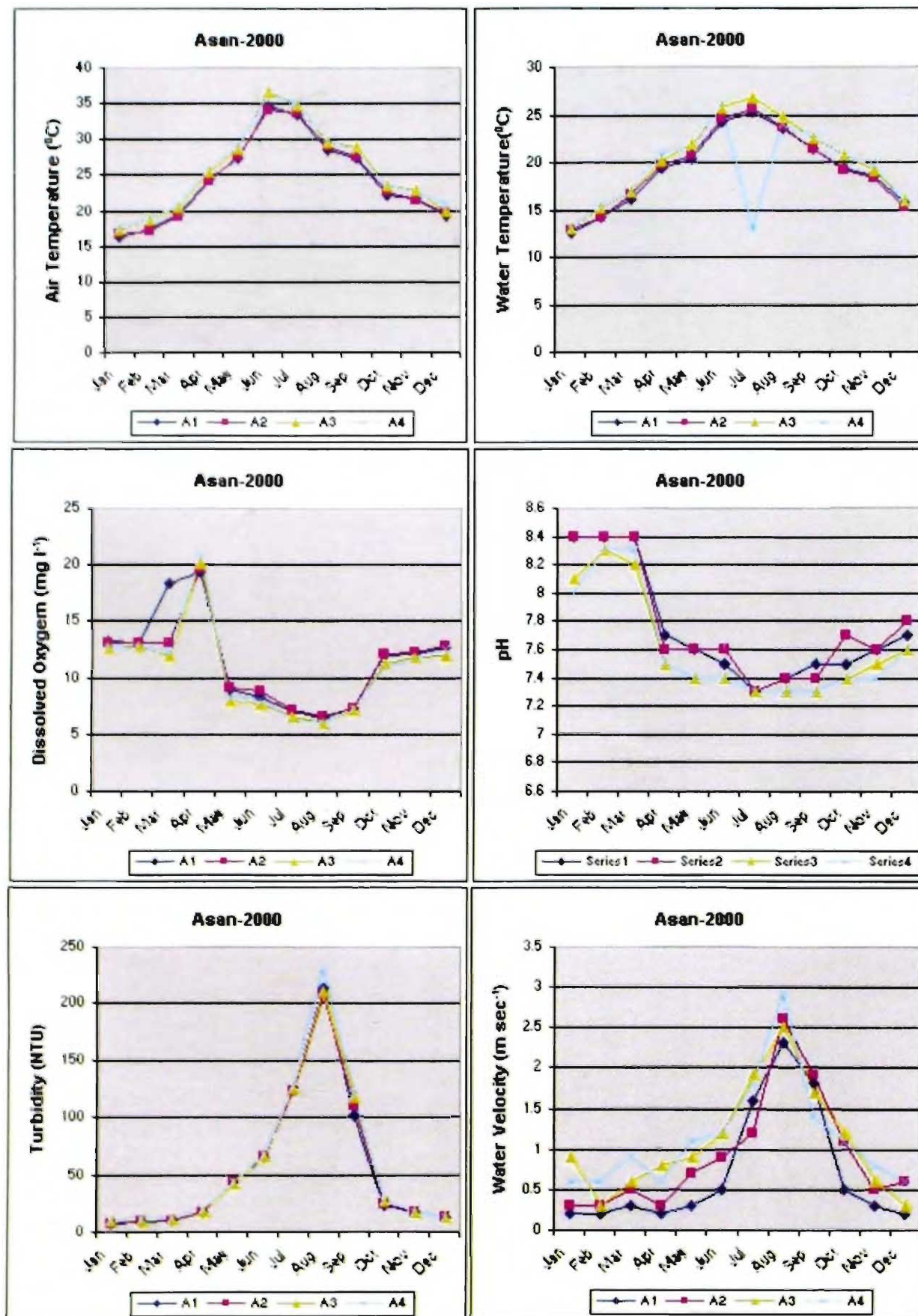


Fig. 5. Phyco-chemical parameters of Asan river (Chakrata Hills) of Western Doon Valley for the year 2000

PLATE - 7



PLATE - 8

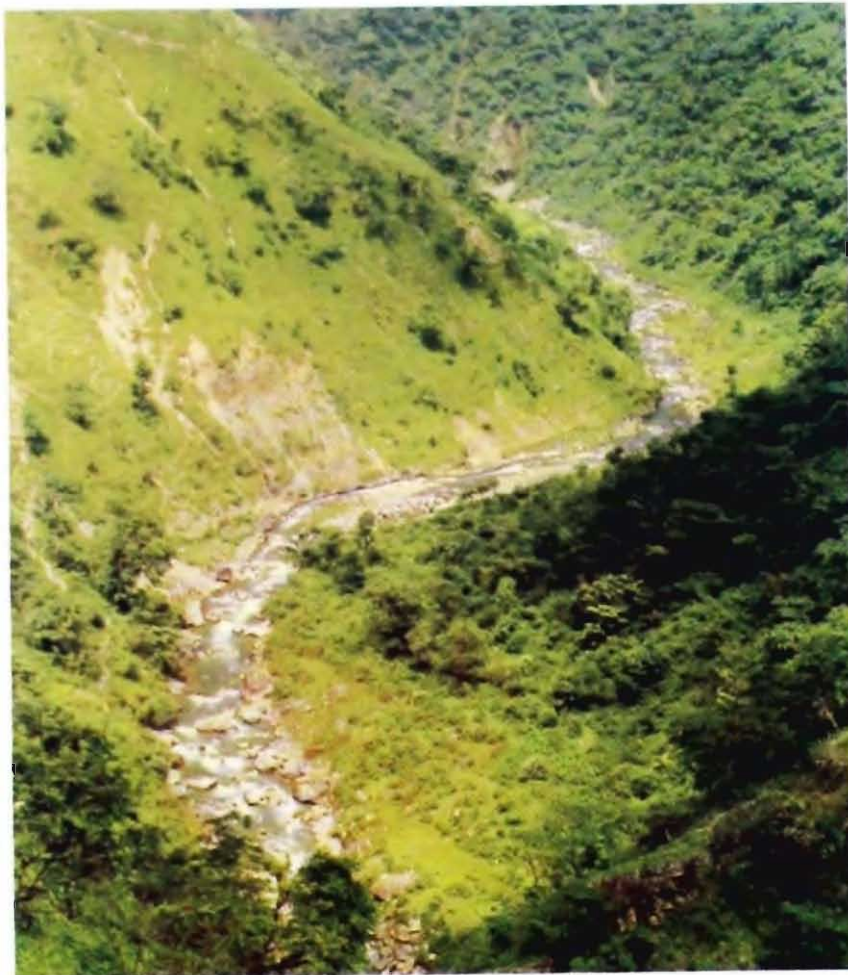


Fig. 6. View of Amlawa river (Chakrata Hills)



Fig. 7. View of Asan river (Western Doon Valley)

PLATE - 9



Fig. 8. *Barilius barna* (Hamilton-Buchanan)

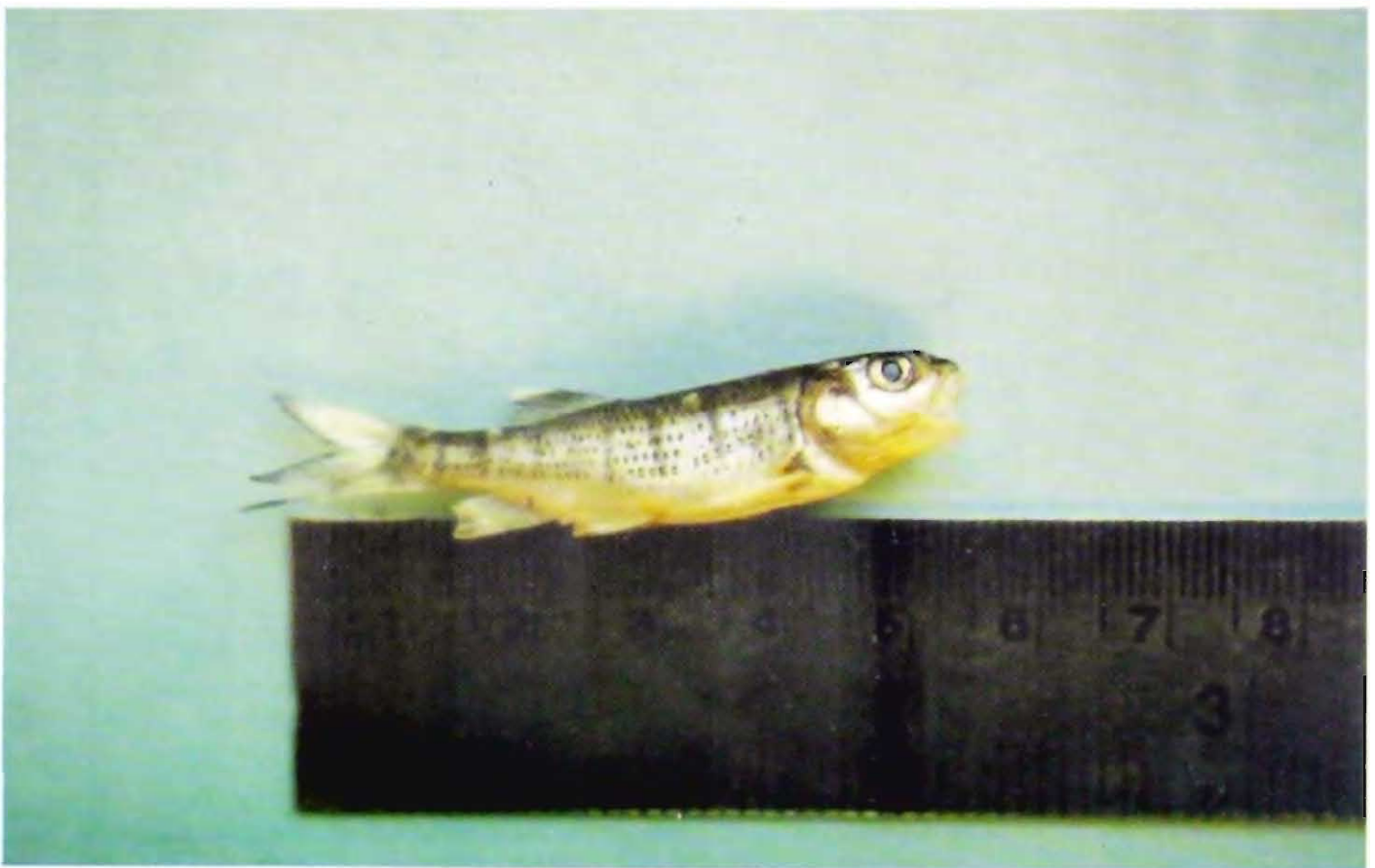


Fig. 9. *Barilius bendelisis* (Hamilton-Buchanan)

PLATE - 10



Fig. 10. *Barilius vagra* (Hamilton-Buchanan)



Fig. 11. *Raiamas bola* (Hamilton-Buchanan)

PLATE - 11



Fig. 12. *Brachydanio rerio* (Hamilton-Buchanan)



Fig. 13. *Danio devario* (Hamilton-Buchanan)

PLATE - 12



Fig. 14. *Esomus danricus* (Hamilton-Buchanan)



Fig. 15. *Parulciosoma daniconius* (Hamilton-Buchanan)

PLATE - 13

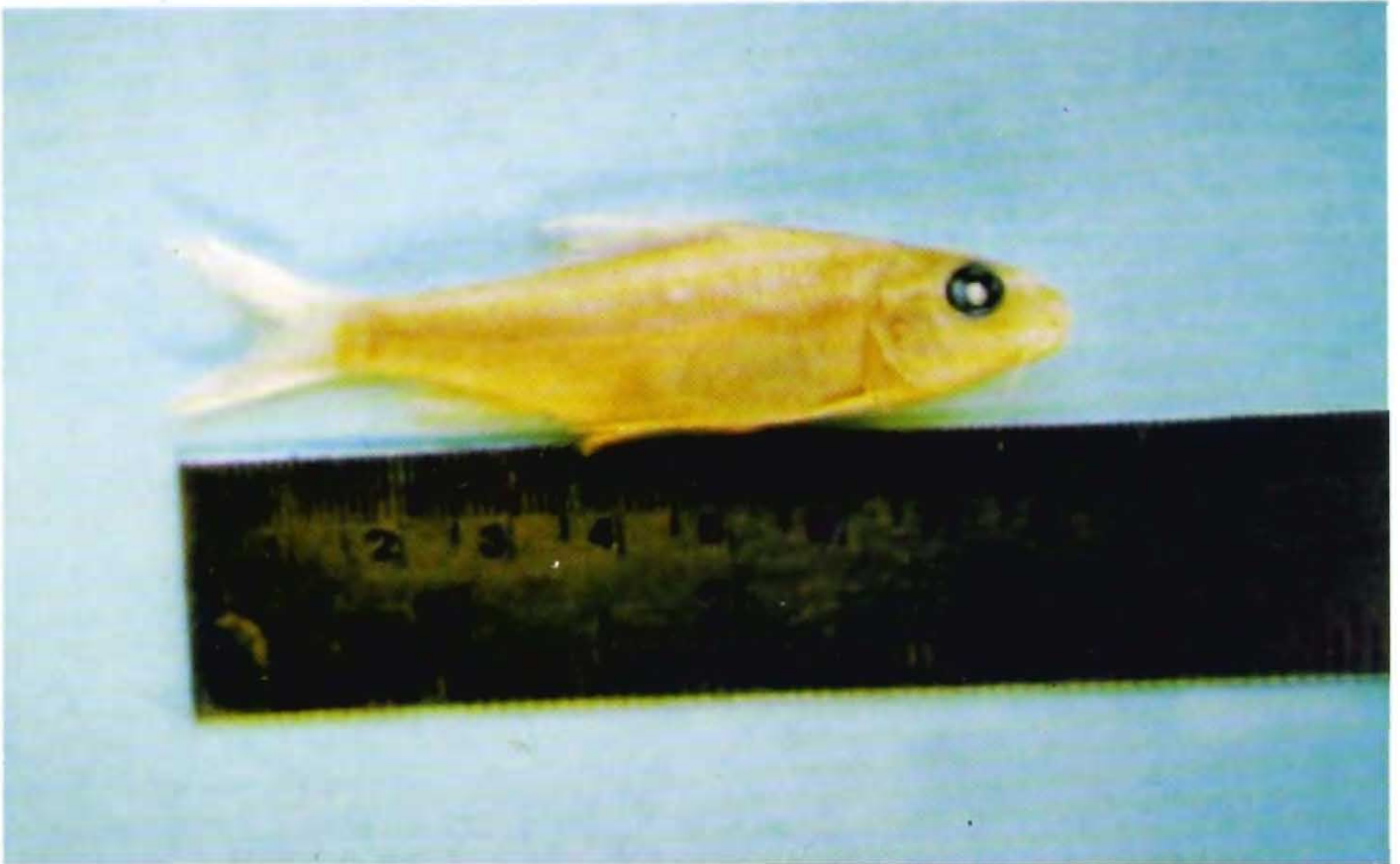


Fig. 16. *Chagunius chagunio* (Hamilton-Buchanan)



Fig. 17. *Puntius chola* (Hamilton-Buchanan)

PLATE - 14



Fig. 18. *Puntius conchoni* (Hamilton-Buchanan)



Fig. 19. *Puntius sarana sarana* (Hamilton-Buchanan)

PLATE - 15



Fig. 20. *Puntius sophore* (Hamilton-Buchanan)



Fig. 21. *Puntius ticto* (Hamilton-Buchanan)

PLATE - 16



Fig. 22. *Tor chelynoides* (McClelland)



Fig. 23. *Tor putitora* (Hamilton-Buchanan)

PLATE - 17



Fig. 24. *Tor tor* (Hamilton-Buchanan)



Fig. 25. *Labeo dero* (Hamilton-Buchanan)

PLATE - 18



Fig. 26. *Labeo dyocheilus* (McClelland)



Fig. 27. *Crossocheilus latius latius* (Hamilton-Buchanan)

PLATE - 19



Fig. 28. *Garra gotyla gotyla* (Gray)



Fig. 29. *Garra lamta* (Hamilton-Buchanan)

PLATE - 20



Fig. 30. Adhesive organ of *Garra* spp.



Fig. 31. *Schizothoracichthys progastus* (McClelland)

PLATE - 21



Fig. 32. *Schizothorax richardsonii* (Gray)



Fig. 33. *Lepidocephalus guntea* (Hamilton-Buchanan)

PLATE - 22

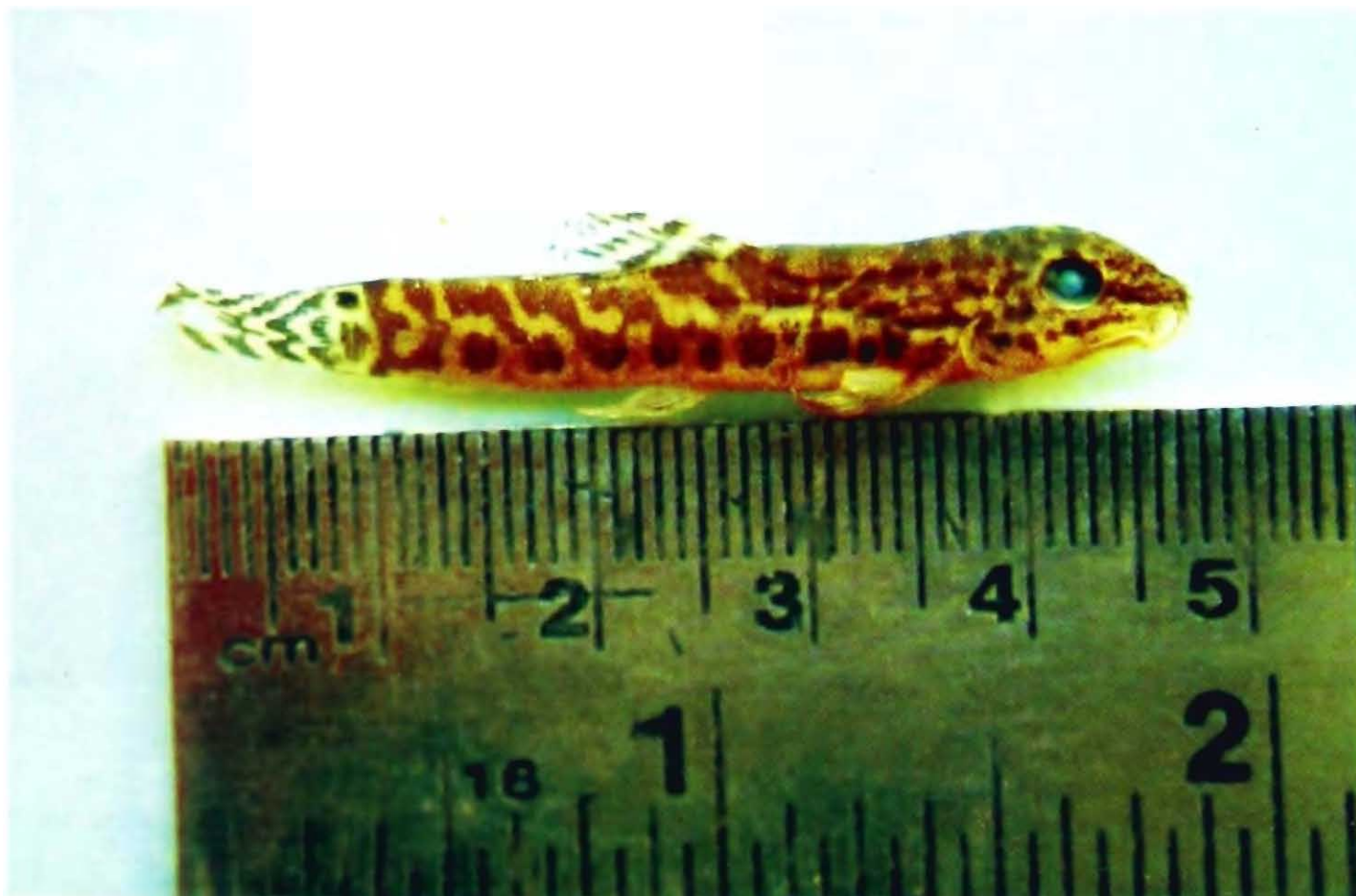


Fig. 34. *Nemacheilus botia* (Hamilton-Buchanan)



Fig. 35. *Nemacheilus montanus* (McClelland)

PLATE - 23



Fig. 36. *Nemacheilus rupecola* (McClelland)



Fig. 37. *Ompok pabda* (Hamilton-Buchanan)

PLATE - 24



Fig. 38. *Wallago attu* (Schneider)



Fig. 39. *Amblyceps mangois* (Hamilton-Buchanan)

PLATE - 25



Fig. 40. *Mystus bleekeri* (Day)



Fig. 41. *Mystus vittatus* (Bloch)

PLATE - 26



Fig. 42. *Clupisoma montana* Hora



Fig. 43. *Heteropneustes fossilis* (Bloch)

PLATE - 27

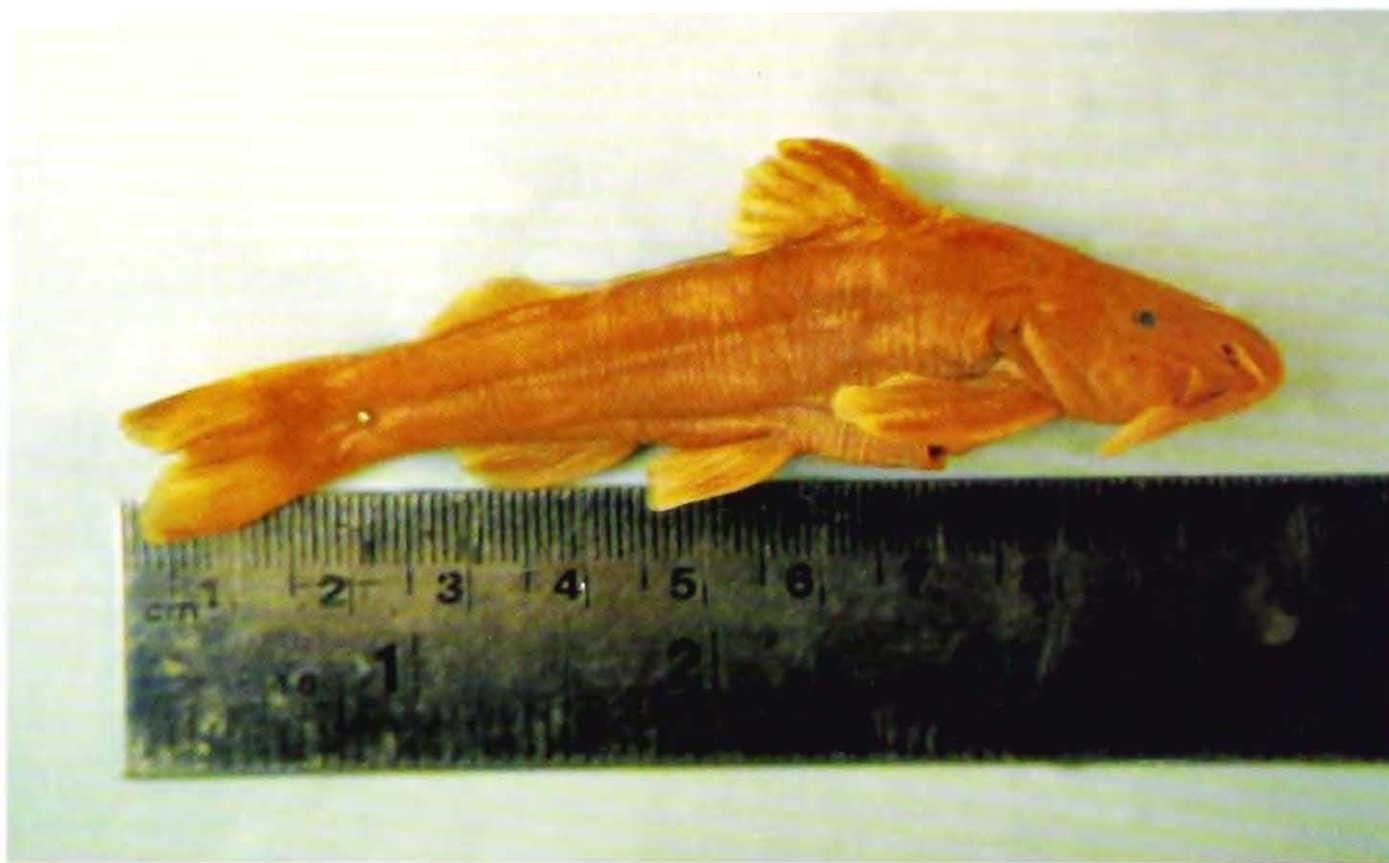


Fig. 44. *Glyptothorax pectinopterus* (McClelland)



Fig. 45. *Pseudechenesis sulcatus* (McClelland)

PLATE - 28



Fig. 46. Adhesive organ of *Pseudechenesis sulcatus* (McClelland)



Fig. 47. *Xenentodon cancila* (Hamilton-Buchanan)

PLATE - 29



Fig. 48. *Badis badis* (Hamilton-Buchanan)



Fig. 49. *Nandus nandus* (Hamilton-Buchanan)

PLATE - 30



Fig. 50. *Colisa fasciatus* (Schneider)



Fig. 51. *Channa gachua* Hamilton-Buchanan

PLATE - 31



Fig. 52. *Channa punctatus* (Bloch)



Fig. 53. *Macrognathus pancalus* Hamilton-Buchanan

PLATE - 32



Fig. 54. *Mastacembelus armatus* (Lacepede)

PLATE - 33



Fig. 55. Cast net or Jal, fishing method

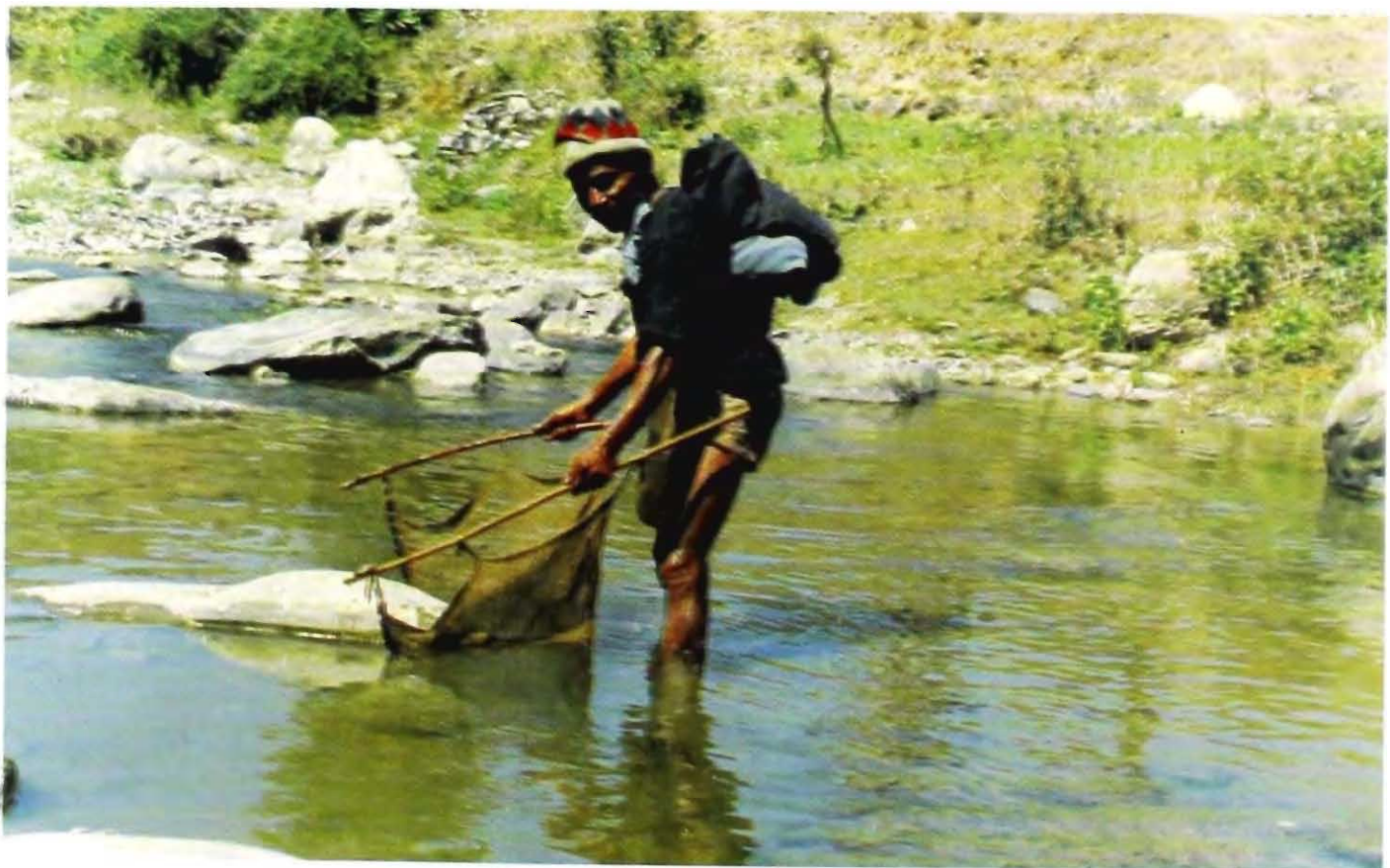


Fig. 56. Pattari fishing method

PLATE - 34

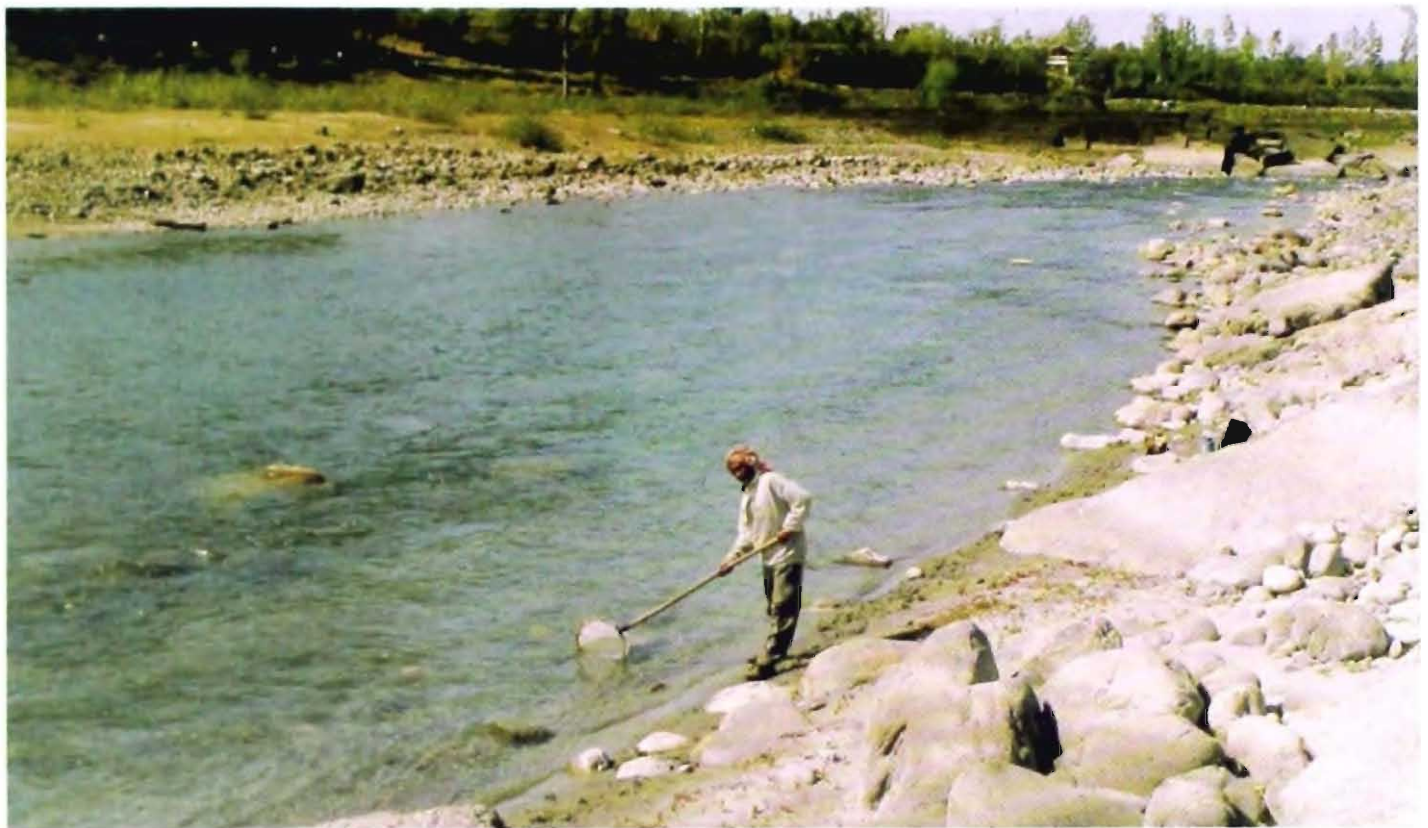


Fig. 57. Karonchor or Scoop net fishing method

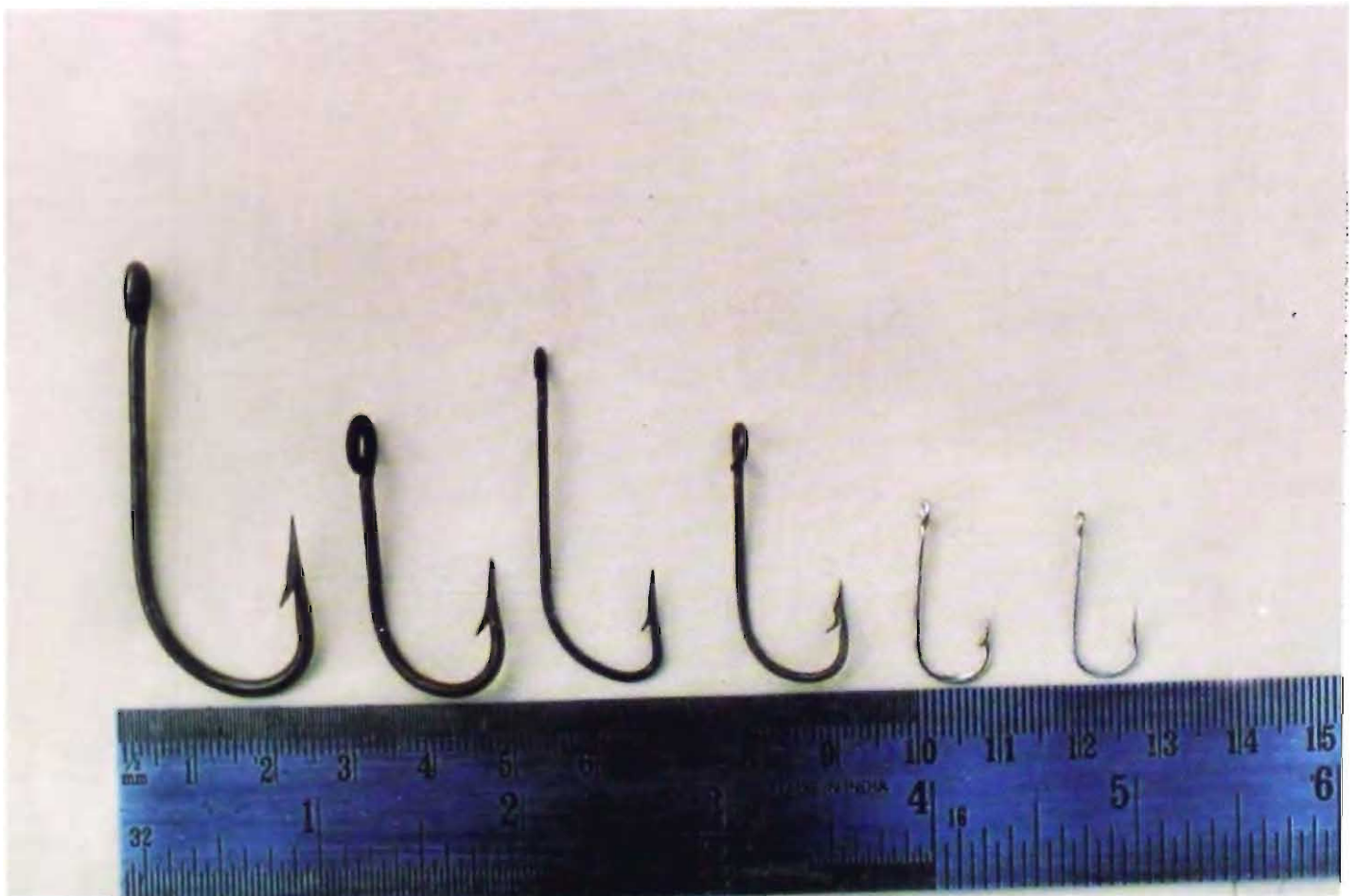


Fig. 58. Fishing hooks of various size

PLATE - 35



Fig. 59. Kanta or Angling fishing method



Fig. 60. Mosquito net or cloth fishing method

PLATE - 36

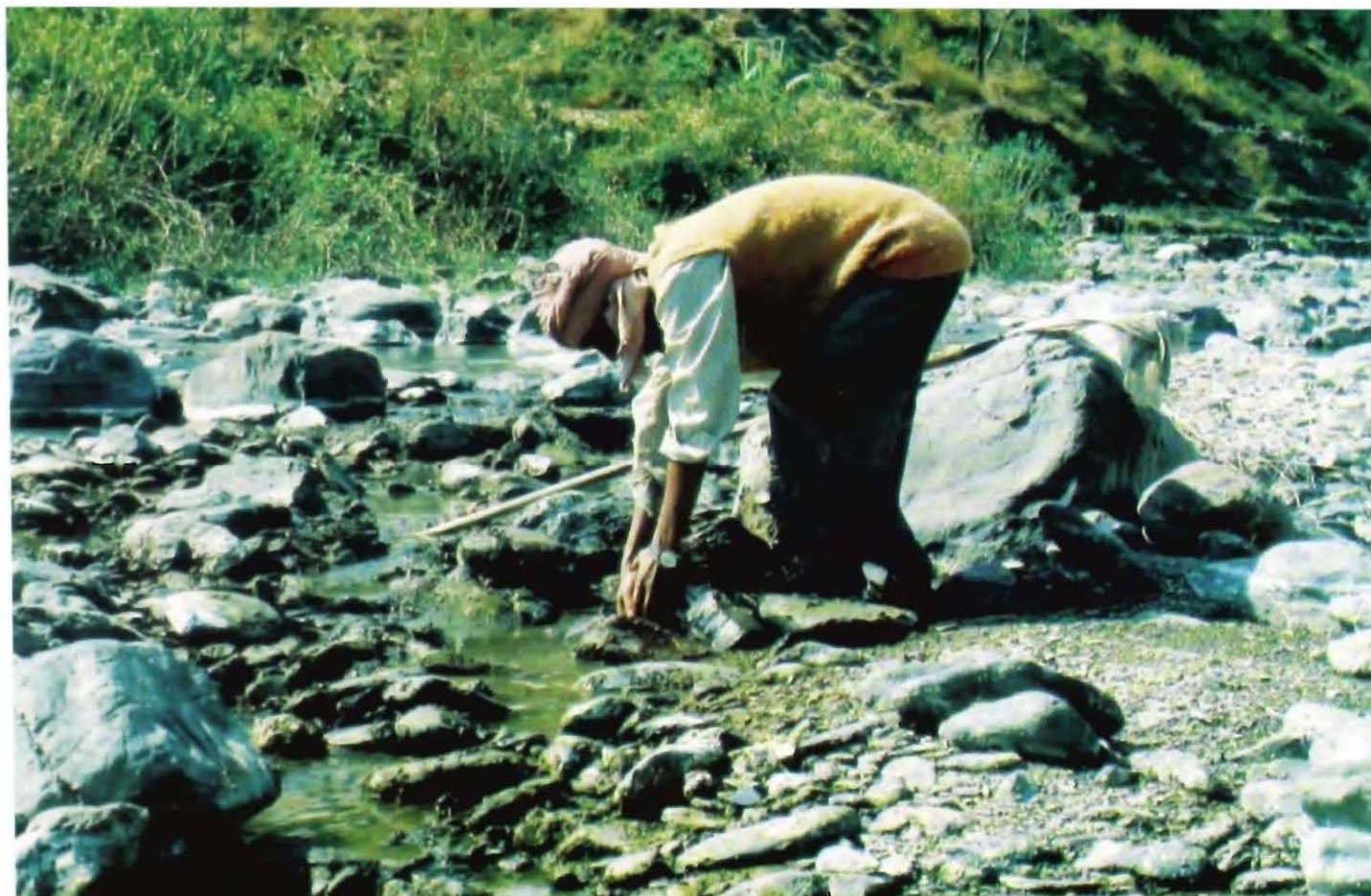


Fig. 61. Hand picking fishing method

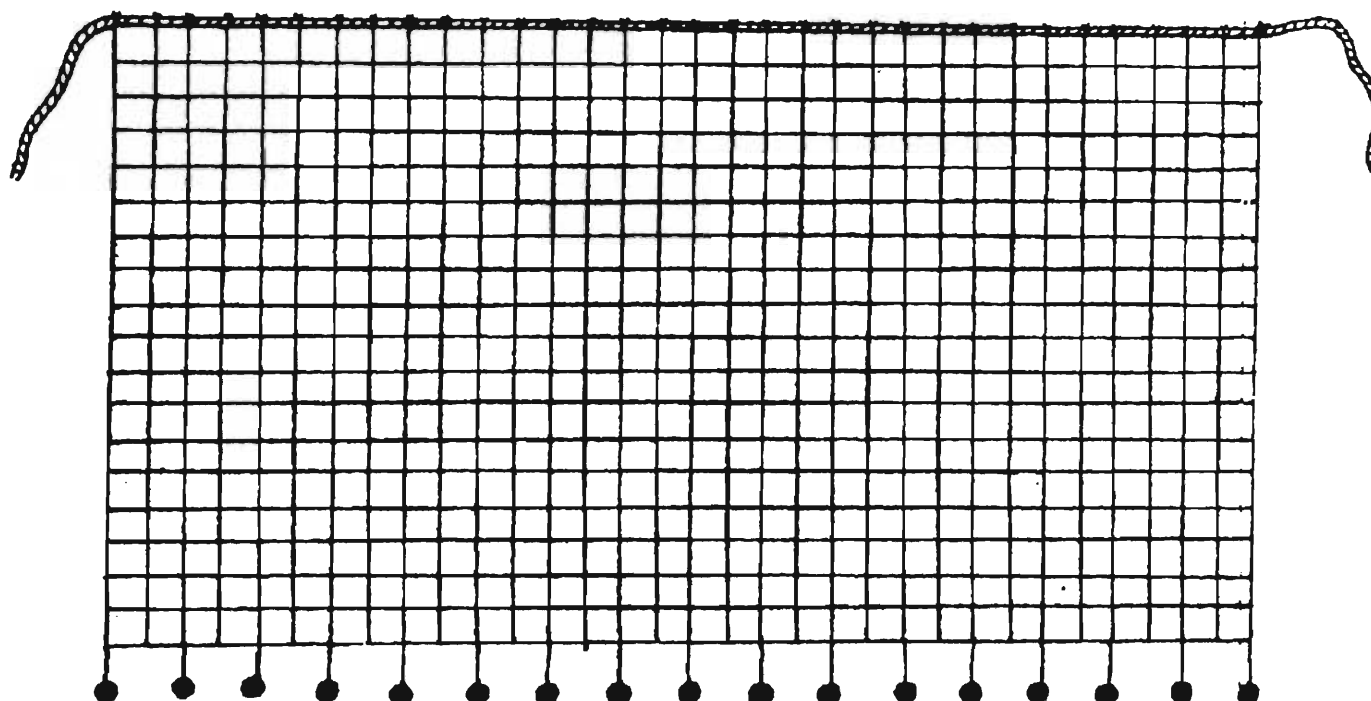


Fig. 62. Patti-net fishing method

PLATE - 37

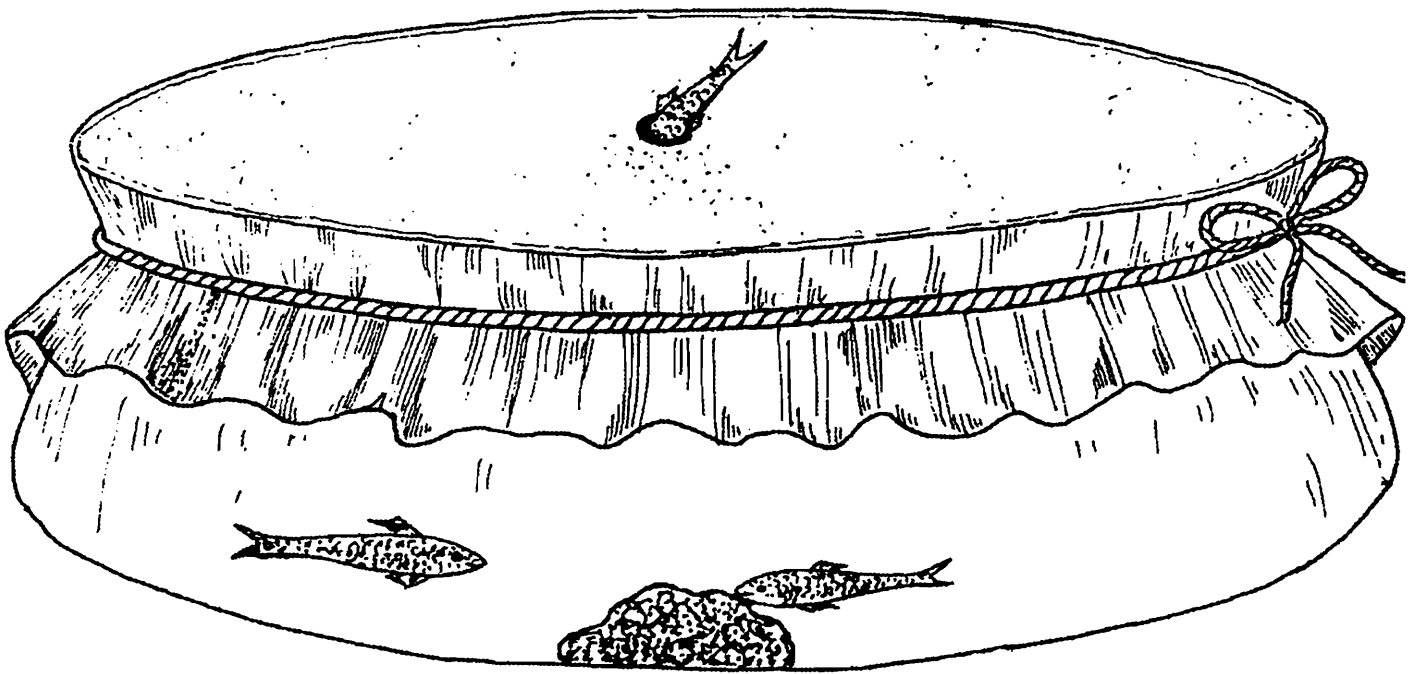


Fig. 63. Katori or Pot fishing method

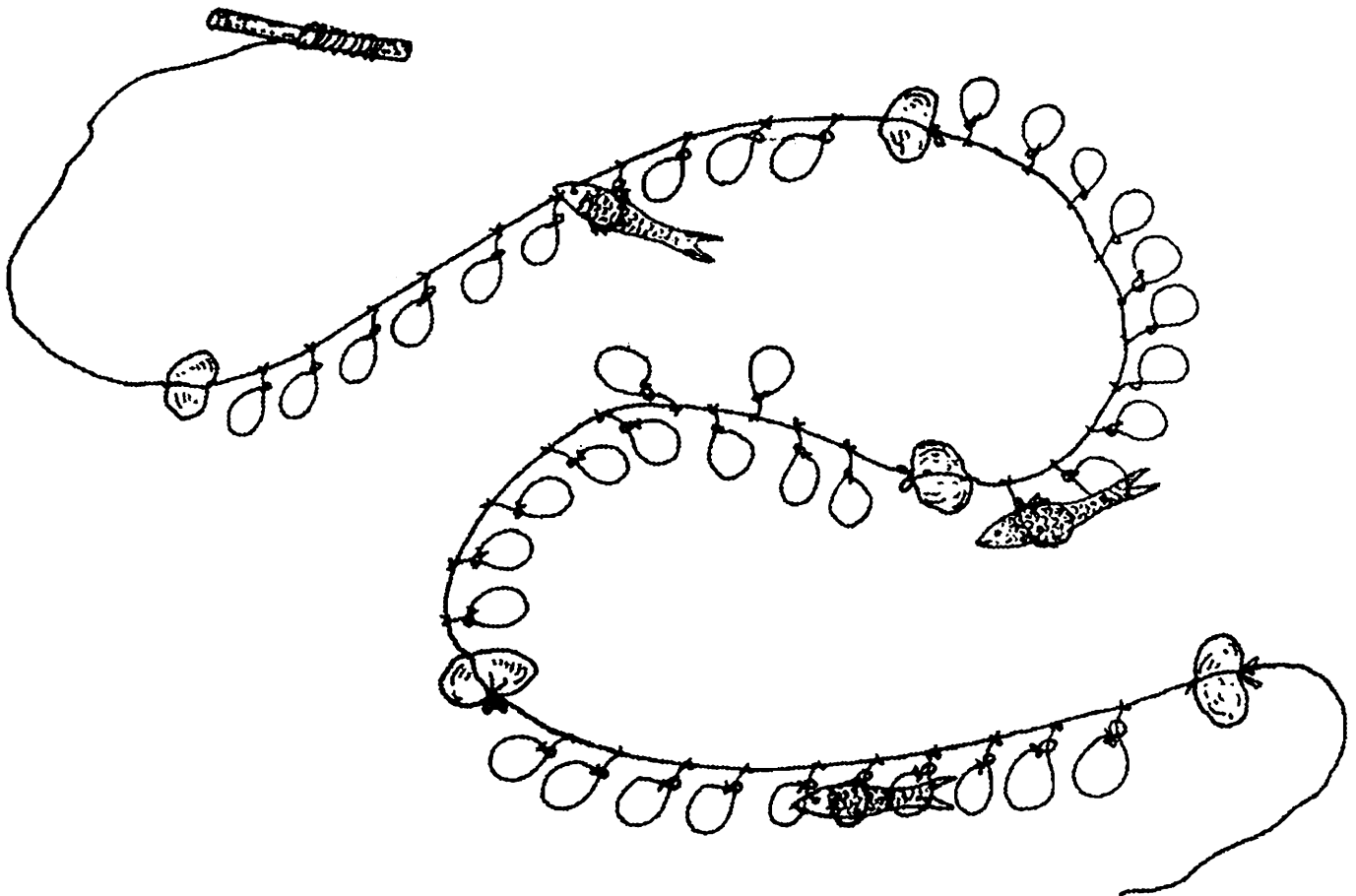


Fig. 64. Fandi fishing method

PLATE - 38

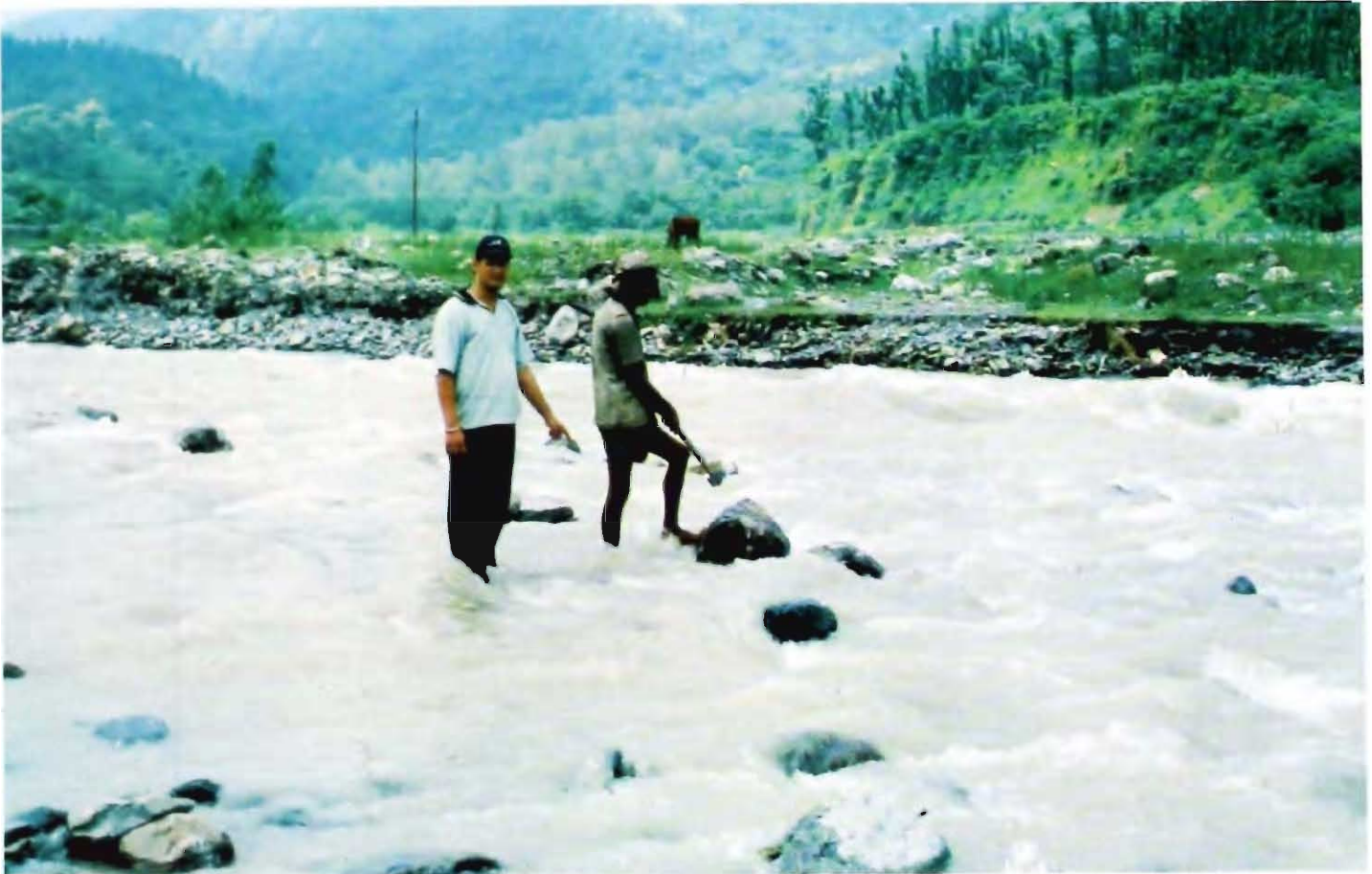


Fig. 65. Ghan or Hammering fishing method



Fig. 66. Destruction of spawning ground

PLATE - 39



Fig. 67. Dumping of solid waste



Fig. 68. Maund community fishing festival (Chakrata Hills)

PLATE - 40



Fig. 69. Paddy culture or sera culture



Fig. 70. *Schizothorax richardsonii* (Gray) suffering from Black spot disease

PLATE - 41



Fig. 71. Fish mortality due to Bleaching powder