



REPORT ON FISHERIES SURVEY OF THE RIVER GANDAK  
(NORTH BIHAR)

By

A. DAVID, D.Sc.

CENTRAL INLAND FISHERIES RESEARCH INSTITUTE,  
(ALLAHABAD SUB-STATION)

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Second Impression

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## INTRODUCTION

To ascertain the desirability or otherwise of providing fish passage and protection facilities at the proposed barrage on the Gandak at Bhaisalotan, two intensive surveys of a 115 mile stretch of the river (see map) (100 miles above and 15 miles below the barrage site) were conducted in November 1961 and March 1962 respectively. The periods of surveys were so selected as to correspond, approximately, with periods of high and low water levels respectively in the river. The following report embodies the results of these investigations and the recommendations made regarding provision of fish passage facilities at the proposed barrage.

## COMMERCIAL FISHERY AND FISH FAUNA IN THE GANDAK

No fishery of any significant commercial value exists in the Gandak system now surveyed. There are hardly a dozen families of fishermen in the entire 115 mile stretch surveyed, which depend entirely on fishing as a profession. Sporadic fishing by part-time fishermen is conducted and fish thus caught are marketed locally. Generally, cast nets, throw lines, long lines, bamboo-screens and harpoons are the fishing gear used in the area. In addition to the main river, fishing is done in inundated low lying areas and Jheels connected to the river.

Above the barrage site, Mahaseers and Bagarius bagarius contribute to the catches. In the stretch of the river between the barrage site at Bhaisalotan and Ratwal, Mystus spp., Glyptothorax sp., Bagarius bagarius, Clupisoma spp., Labeo gonius, Puntius spp., Colisa sp., Anabas sp., Mahseers (inclusive of Tor mosal, Tor tor

and Lissocheilus hexagonolepis) are represented in the catches. Major carps - Cirrhina mrigala, Labeo rohita and Catla catla, were first recorded occurring as stray individuals in the Ratwal region. Lower down the river, in the Gobindgunj and Haranadi regions, all the major Gangetic carps and even Hilsa ilisha are available. The probable reasons for the absence of a flourishing commercial fishing in the Gandak close to Bhaisalotan are:

1. Sparse habitations on both sides and consequently low density of settled communities of fishermen,
2. Lack of big towns along its banks to offer bigger markets for fish,
3. Long distances to be covered between streams, spills or inundable areas connected with the river and the settlements,
4. Absence of more economical forms of fishes in the river and uncertainties of their occurrence and
5. Inaccessibility of good fishing grounds.

A list of different species of fishes, collected in the river as well as from the connected spill areas and adjoining markets, is given in Appendix I. The relative importance of each species and the approximate maximum sizes attained by them are also indicated. In Appendix II are listed the species of fish, which by virtue of their abundance constitute fishes of some economic importance in the stretch of the river 10 miles above and 20 miles below the barrage site.

Only fourteen different species, of which eight are mountain stream forms, are found in large numbers near the barrage site. Besides these, Oxygaster spp., Garra spp., Puntius spp., Ompok spp., Glyptothorax spp., Clupisoma spp., and Mastacembelus sp. contributed to the fisheries occasionally. A sudden lowering of the river temperature from 17°C to 5°C on 5th March 1961 was observed to have caused large scale mortality of Gangetic major carps and Catfishes like Wallago attu, Mystus aor, M. seenghala, Cirrhina mrigala, Labeo gonius and Puntius sarana, whereas the cold water forms like Mahaseers and Bagarius bagarius remained unaffected, indicating that probably a temperature barrier restricts the distribution and causes a natural division in the fish fauna in this river.

### Migratory Forms

Long range migratory forms of fishes are not present in the Gandak river close to Bhaisalotan. Hilsa ilisha which is anadromous (migrant from the sea) stops 50-60 miles below Bhaisalotan, probably due to lower temperature of water at the time of migration during monsoon floods. Anguilla bengalensis, which is catadromous, though observed in the region, is not of any commercial value here. Probably this too may not occur naturally in the main river due to low temperature. The local migratory fishes are Tor spp., Lissocheilus sp., Barilius sp. and a few others, all of which can spawn and continue to thrive even a little distance below Bhaisalotan and very well in the rocky and bouldery shelters, upstream.

The natural division of fish fauna is very marked at Bhaisalotan as on the upstream side, consisting of torrential and rapid water forms. Of these, only Bagarius migrates downwards through the main river into the Ganga where specimens weighing 300 lbs and more are usually caught in July & August. Mahseers, mostly Tor spp. move downwards to a lesser extent.

If any mountainous forms - Glyptothorax spp., Sisor sp., Chaca sp., etc. are recorded near the barrage site, it is probably because stray individuals that may have washed downwards during monsoon months, or originated from eggs, larvae, or fry drifting downwards, remain in the stretch trapped in isolated pools, or try to migrate upstream to their original surroundings as they grow up. Economic value of these forms is negligible in the Gandak river. But academically, the zoogeographical aspects of certain species like Balitora brucei "Katli" Mahseer, some small minor cat-fishes, etc. have considerable importance, but such an account is beyond the scope of this report. Only one form of Himalayan fish of high ranges, Semiplotus semiplotus is represented in the collection by 2 specimens, ranging from 25 to 30 mm in total length.

### SPAWNING GROUNDS OF FISH

As some knowledge of the nature of spawning grounds of Indian river fishes, especially major carps within the Ganga river system, is now available by studies so far made in the Kosi and the Ganga below Hardwar, it is established from these surveys that major carps (Catla, Rohu and Mrigal) do not spawn at Bhaisalotan

region, even though the last two species do occur there in March. At least their occurrence is scarce in the main river itself for 40-50 miles below as they are found as stray individuals only. Since an extensive search was made for young fry or fingerlings of these species without success, their absence from any source well beyond Bagaha upwards indicates that they do not normally ascend even as far as 40 miles below the barrage site. They, however, spawn within the vast Gandak spills and minor streams and jheels connected with the river course below Sujurpur and Gobindgunj. Even though there appears to be a low population of major carps in the Gandak as a whole, it is not likely to be affected by the Barrage.

The mountainous or the rapid water forms require clear waters and, perhaps, clean pebbly and sandy areas for their habitats. Their spawning grounds, probably, are far above Bhaisalotan in higher altitudes. Even if some do spawn below the barrage site, construction of the barrage and the consequent rendering of the lower spawning grounds inaccessible, is not likely to appreciably affect the fisheries, since young ones from above can continue to drift down the barrage during floods.

Conditions for other fishes like Aspidoparia, Barilius, Oxygaster, Puntius and similar forms are more favourable for spawning below Bhaisalotan in the wide shallower stretches, rather than in deeper parts of the river.

#### Fish 'Seed' Resources

The Gandak valley in Champaran district does not show any perennial pools and fish culture in ponds is not very common. Some of the ponds are stocked by the Bihar Government's Fisheries Department with carp fry and fingerlings. The river itself is free from major carp fry, at least upto the Harhanadi (80 miles below Bhaisalotan). Probably lower Gandak in Muzaffarpur and Saran districts may yield some juvenile carps during monsoon floods. The species that enter the inundations and the few connecting jheels close to Bhaisalotan and for some miles below, are mainly species like Lebeo dero, L.dyocheilus and a few L.bata. (Cirrhina reba were mostly absent during November).

Larval stages of Tor spp. and fry of Lissocheilus (Katli) were obtained at Bhaisalotan in spawn nets operated in the main stream in November. There is reason to believe that good numbers of these forms may be obtained in the section, sufficient to stock

suitable ponds or streams for culture. Fry and fingerlings of major carps will have to be imported from lower reaches, but whether they can survive the colder temperatures of water attained in the canals etc. has first to be investigated.

### HYDROLOGICAL CONDITIONS

The flow of water into the Gandak below Bhaisalotan is not considerable, as there are only seasonal streams draining into it from parts of North Bihar to the East. Below Ratwal, the river is confined to its wide bed of 8-12 miles across by mud embankments (bundhs) on both sides to prevent its spilling across the plains of North Bihar while in floods. Close below Bhaisalotan, it floods both its banks, especially its right bank and has been depositing sand and silt in recent years with an increasing magnitude. Extensive inundations occur on both sides, but the soil being mainly sandy and unstable, perennial jheels and bheels and other depressions holding inundated water for considerable time are few, at least as far down as Motihari where due to silt-clay deposits, perennial jheels are present. Old beds of defunct channels, spills and tributary streams are common below Gobindgunj which either drain or bring spill waters from other rivers (from Sikrhna - Burhi Gandak). A number of 'chars' of raised silt and sand banks within the river bed are common in Muzaffarpur and Saran districts. But nearer Bhaisalotan and Bagaha, such 'chars' are smaller and few in numbers.

The river is quite deep, there being about 135 shoals less than 4 feet in depth in a length of 199 miles. There are a number of bundhs, and even above Ratwal the river is highly tortuous in course forming a number of streams. The current is fast (about 6-8 miles per hour) near Bhaisalotan (slope of 5-6 feet per mile) which slows down to 4-5 miles per hour some distance below.

### Physico-Chemical Characteristics

A survey, with a view to ascertain certain important physico-chemical characters of the river, was conducted in November, the results of which are given in table I. Figures given represent the average values of several determinations of samples taken from six different centres on the main river and one on Haranadi. The study is made with a view to ascertain; by subsequent studies after completion of the barrage, how its construction would effect the

physico-chemical characters of the residual river.

Table - I

Physico-Chemical Characteristics of the Gandak river

(Figures within brackets refer to values before rains/and hailstorms hit Bhaisalotan region on 5.4.1962)

Characters	Khairkola 5 miles	Bhaisalotan 0 miles	Narain- pur (Bagaha) 35 miles	Ratwal 50 miles	Sujur -pur 85 miles	Gobin -dga- nj 110 miles	Harha- nadi 80 miles
1	2	3	4	5	6	7	8
<u>Water</u>							
Temperature (°C)	20.7°C	21.1°	19.5°	22.5°	22.9°	21.9°	23.5°C
Colour		NO	CHARACTERISTIC	COLOUR			
Turbidity			Clear	Water			
Dissolved Oxygen(ppm)	7.2	7.2(8.2)	7.4	7.2	6.2	6.6	4.47
Conductivity	233	233(290)	243	325	223	215	437
Alkalinity	84	92(116)	95	104	144	104	220
Chloride	8.4	4.2(7.5)	6.2	5.0	5.4	8.8	4.0
Consumed Oxygen	2.6	4.0(8.0)	3.0	8.0	16.8	10.8	10.8
Nitrates	0.16	0.11	0.16	0.04	0.06	0.04	0.08
Phosphates	Trace	Trace	0.18	0.08	0.01	0.09	0.09
Si <sup>02</sup>	0.44	0.44	1.20	1.60	1.60	2.00	55.4
Calcium	65	78.7	29.5	35.5	33.3	29.8	55.4
Iron	0.32	0.32	Trace	Trace	Trace	Trace	Trace
Hardness	100	100	92	100	114	104	136

	1	2	3	4	5	6	7
<u>SOIL</u>							
Carbon %	0.3006	0.1998	0.2268	0.2271	0.3720	0.1914	0.7206
Nitrogen %	0.0168	0.0118	0.0118	0.0151	0.0134	0.112	0.0857
C/N Ratio	17	16	19	15	20	17	8.4

Average water temperature (3 hourly) ranged only between 19.5 and 22.9°C in the main river. These temperatures refer to conditions in November when uniformly low temperatures prevailed, the water having little chance to show a rise in temperature as in summer. The temperature, however, showed a tendency to rise lower down towards Sujurpur even in November, while air temperatures were low due to onset of winter conditions. During hot months a total rise in temperature of 8-10°C should normally occur in a length of 60-70 miles from the upper to lower reaches as the snow-melt water gradually absorbs heat. There was no appreciable deviation in water temperature in March 1962, when a maximum of 23.6°C was recorded in Gobindganj. This natural division in temperature, along with hydro-graphical conditions above and below Bhaisalotan is noteworthy.

Colour and turbidity were not significant factors during November. But in March 1962 due to heavy rains and hailstorms, the water became abnormally turbid, a very unusual feature in the region for the month of March.

A uniformly high dissolved oxygen content in water (6.2-7.4 ppm) was observed in November 1961. D.O. (dissolved oxygen) values do not show a diurnal fluctuation (3 hourly samples were analysed), which indicates that there were no organisms (especially phyto-plankton) in sufficient numbers, to cause discernible changes in dissolved oxygen content. But at Bhaisalotan itself (before the hailstorms and rains), a diurnal fluctuation ranging between 7.4 and 9.6 ppm was observed due to the presence of algae (mainly Spirogyra) attached to the bottom boulders and rubble.

Oxygen consumption ( $\frac{1}{2}$  hour  $KMnO_4$ ) values rose at Sujurpur and Gobindgunj perceptibly, indicating some addition of organic matter into the river. In the absence of a large town or factory

which may throw its wastes into the river, this increasing value, (from 2.6 to 16.8 ppm) is probably attributable to a decay of vegetation - grasses, and deposition and disintegration of drifting vegetable matter in the shallower, exposed, quieter pools. These values do not indicate any river pollution, but are very much lower than in other rivers, like the Ganga, in their middle reaches.

Fairly alkaline conditions prevail in the river, with the water being sufficiently hard. It is rich in minerals like calcium, but poor in iron, while sulphates, chlorides, etc. are negligible as evidenced by almost uniform values of total alkalinity and total hardness (Table 1). Phosphate and silicates show an inverse relationship with iron and nitrate nitrogen. It is to be concluded that very little unsaturated organic matter is present in the river stretch now studied, a condition expected of any river flowing mainly through a rocky substratum. Incidentally carbonate values also go up by dissolution of calcareous rocks. More cations are exchanged lower down (as reflected by lowering of Ca-values).

In short, there was little humic and organic matter in the river during November, which could contribute to a dense growth of aquatic organisms, but by March 1962 an improvement in density of food organisms was noted.

Soil (Table 1) appeared to be low in carbon and nitrogen content. The onset of cold season soon after the heavy floods and when water continually goes down in its level, does not augur well for enrichment of the bottom soil, but in comparison to the main Ganga river at Allahabad, the values are very poor. Such conditions do not help a high degree of microbial activity in the river bottom.

### RECOMMENDATIONS

#### On Fish Pass

Fish passes of proper design are provided in a dam or barrage to enable the migratory species to negotiate the barrier in order to complete their life cycle. The necessity for their incorporation in a barrier depends upon the type of fish which inhabit or frequent the river concerned. Since the long range migratory species of fish of the Ganga system viz. the Hilsa and Pangasius are not known to naturally occur in the vicinity of the Barrage site, the question of making a provision of a fish pass in the Gandak Barrage at Bhaisalotan does not arise. It is true that there are local migrations of endemic species for breeding and feeding

but such fish are not known to be adversely affected by the construction of barrage.

### On Fishery Management

There is a likelihood of fish congregation below the Barrage gates almost throughout the year. Examples of such congregations are furnished below anicuts in rivers of Peninsular India, barrages in the Punjab and the Sukkur Barrage in Sind (now in Pakistan), and elsewhere and below all the high dams which now exist. These fishes should not be destroyed indiscriminately. Carefully planned restrictive measures have to be imposed to avoid any slaughter. The canal heads also have to be similarly guarded. If the canals are stocked with suitable fishes, these are apt to congregate at the regulator heads, becoming easy prey.

Gear regulation, such as restricted modes of fishing, protected areas where fish can thrive without any hindrance by man, or closed seasons for some varieties, and banning of capture of the young or breeders are some well known measures which may be adopted, after proper evaluation of the situation for individual species.

### On Development of Fisheries

The following developmental measures are provisionally suggested:

#### 1) Main River Course

After the diversion of water into channels (of a total magnitude of nearly 20,000 cusecs at the site of the barrage) the course below the Barrage will result in a reduction in the residual river flow. This will reduce the wetted perimeter as well as the depth at places and may result in the improvement of conditions for capturing fish in the main river during the dry periods of the year. These areas may also hold more varieties of fish as more exposed shallows might result in an increase of temperature and production of fish-food organisms. As the minimum flow of the river is 7000-8000 cusecs in February-March, it may be necessary to see that the main channel below the barrage is not entirely dried up; in such an event, deep pools should harbour some adult fishes for spawning. There is little doubt that diversion of so much water into the canals will affect the ecological picture of the river below. But what direction these changes will take, is difficult to anticipate now. No specific protection measures are required during monsoon, as the river will fill its older channels during this period.

However, in the past-monsoon months a reduction in flow and consequently depth of the river, will necessitate measures to guard against indiscriminate fishing. There is every reason to believe that erection of the barrage will increase the fishery value, as well as fishing activity of the entire Gandak river in Bihar.

### ii) Impounded Water

The pond level of about 30 feet above barrage (between 347 and 367 feet R.L.) between Bhaisalotan and Tribeni ghat, and entrance of water into the Sonapancha, can be exploited by deep water fishing methods. No artificial stocking may be necessary as the Mahseers, Bagarius, etc. are expected to thrive in it and in the vicinity of the smaller streams just above. Fishing by rod and line for sport can be developed by resorting to artificial feeding of Mahseers in some locations, thereby inducing them to concentrate there for easier capture. Since it is observed that normally major carps like Rohu and Mrigal can withstand temperatures as low as 19-20°C, stocking fry or fingerlings of the carps in the impounded area above the Barrage might enhance the fish production above the barrage including the streams of the Nawalpur Valley of Nepal, provided very adverse temperature conditions do not develop.

### iii) Canals

The total canal lengths of 195 (main) and 335 (branch) miles and thousands of miles of major and minor distributaries connected with the project can be stocked with several varieties of fishes. In the existing Tribeni canal, there are no economical forms like the Gangetic major carps, as their young cannot get into it at the regulator head for the reason that they are not abundant there. Some investigations will be necessary to recommend the measures needed for making these channels useful for fish culture, even if it is only for a short season. The defunct Tribeni canal portion for three miles, can perhaps be converted into a fish farm, to augment the 'seed' by induced breeding. Also some ponds may be experimentally stocked with Mahseer for game fishing activities, and for biological control of Malaria and other water-borne diseases, which usually follow in the wake of water logging. Some nearby streams can also be utilised for experimental stocking of suitable varieties of fishes. Possibilities of Mahseers or even Trout thriving in such streams cannot be excluded and in ponds, culture of common carp (Cyprinus carpio) may be quite a success.

Details of developmental and fishery management measures can best be formulated after the construction of the barrage. It will

be highly desirable to appoint a Fishery Biologist on the staff of the Project to help the Project administration in solving fishery development problems as they arise from time to time. It is beyond the scope of the present survey to submit the details of developmental measures which will require extensive surveys than were undertaken in the present brief study. However, on the basis of the present survey an attempt has been made to furnish a general idea of the possible trends of future development.

#### ACKNOWLEDGEMENTS

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APPENDIX IFISHES OF THE RIVER GANDAK

Stray	- x	Common	- x 5
Rare	- x 2	Very common	- x 6
Infrequent	- x 3	Abundant	- x 7
Fairly common	- x 4	Economically important species	- //

Scientific Name	Appr. Maximum size	Nature of occurrence	Remarks
1	2	3	4
Family CLUPEIDAE			
1. <u>Gadusia chapra</u> (Ham.)	9"	x 2	Frequent in inundated ponds and jheels but not in the main river.
2. <u>Gonialosa manminna</u> (Ham.)	8"	x 2	
3. <u>Hilsa ilisha</u> (Ham.)	20"	x	Recorded close to Bettiah. ABSENT close to Bhisalotan.
4. <u>Setipinna phasa</u> (Ham.)	15"	x	Recorded 30 miles below Bhisalotan in the main river.
Family NOTOPTERIDAE			
5. <u>Notopterus chitala</u> (Ham.)	48"	x 2	Recorded from jheel collections and the main river 25 miles below Bhisalotan.
6. <u>Notopterus notopterus</u> (Pallas)	24"	x 2	
Family CYPRINAE (Cyprinidae)			
Subfamily Abramidinae			
7. <u>Chela atpar</u> (Ham.)	2½"	x 4	Distributed equally well in the main river, tributaries and jheels.
8. <u>Chela laubuca</u> (Ham.)	2½"	x 4	

1	2	3	4
9. <u>Oxygaster bacaila</u> (Ham.)	7"	X 5	Mostly in the main river, tributaries and the Tribeni canal.
10. <u>Oxygaster gora</u> (Ham.)	12"	X 5	
Subfamily <u>Rasborinae</u>			
11. <u>Barilius barila</u> (Ham.)	5"	X 4	These are all stream forms occurring within the main river, tributaries and the Tribeni canal, sometimes together constituting bulk quantities.
12. <u>Barilius bendelisis</u> (Ham.)	6"	X 5	
13. <u>Barilius shacra</u> (Ham.)	5"	X 3	
14. <u>Barilius tileo</u> (Ham.)	7"	X 2	
15. <u>Barilius vagra</u> (Ham.)	5"	X 2	
16. <u>Brachydanio rerio</u> (Ham.)	1½"	X 2	
17. <u>Danio dangila</u> (Ham.)	4"	X 4	Mostly obtained from small tributaries. <u>D.dangila</u> enters jheels and grows well.
18. <u>Danio devario</u> (Ham.)	3"	X 4	
19. <u>Esomus danricus</u> (Ham.)	3"	X 5	Well distributed.
20. <u>Raiamus bola</u> (Ham.)	14"	X 4	Occurs in the main and tributary streams as well as in the Tribeni canal.
21. <u>Rasbora daniconius</u> (Ham.)	6"	X 5	Well distributed but grow better contributing to some extent to the fishery value of the jheels.
22. <u>Rasbora elanga</u> (Ham.)	8"	X 5	
Subfamily <u>Cyprininae</u>			
23. <u>Amblypharyngodon mola</u> (Ham.)	4"	X 2	Recorded from stagnant pools.
24. <u>Aspidoparia morar</u> (Ham.)	5"	X 7	This is the most ABUNDANT species in the river for 100 miles at the time of survey.

1	2	3	4
25. <u>Catla catla</u> (Ham.)	48"	X	These MAJOR CARPS of the Ganga river system do not occur commercially in the Gandak river for 50-60 miles below Bhaissalotan. <u>C. mrigala</u> was recorded during March only, but no <u>Catla catla</u> was recorded upto Bettiah both times.
26. <u>Cirrhina mrigala</u> (Ham.)	48"	X	
27. <u>Cirrhina reba</u> (Ham.)	12"	X 3	Recorded from the Tribeni canal and the main river below Bagaha during the survey.
28. <u>Crossocheilus latius</u> (Ham.)	7"	X 5	Recorded during November in large numbers in the main river and its tributaries.
29. <u>Garra gotyla</u> (Gray)	6"	X 3	Restricted mainly to the boulderstrewn lengths of the main river and tributaries. Only juveniles recorded.
30. <u>Garra</u> sp. •	..	X 4	
31. <u>Garra</u> sp.	..	X 4	
32. <u>Labeo bata</u> (Ham.)	17"	X 3	These occur in larger numbers below Bagaha.
33. <u>Labeo boga</u> (Ham.)	15"	X 2	Recorded at Bhaissalotan from the Tribeni canal does not seem to occur in the main river, except below Bagaha.
34. <u>Labeo calbasu</u> (Ham.)	25"	X 2	
35. <u>Labeo dero</u> (Ham.)	14"	X 6	Very common close to Bhaissalotan in the river, enters inundated pools and

1	2	3	4
			jheels as fry and is caught in abundance during October-November. Declines in fishery value below Bagaha.
# 36. <u>Labeo dyocheilus</u> (McCl.)	36"	X 5	Common, but not so frequently caught as <u>L. dero</u> . Larger though showing similar trends in distribution.
37. <u>Labeo gonius</u> (Ham.)	25"	X 3	Recorded in the Tribeni canal and is fairly common at Bhaisalotan and below.
38. <u>Labeo rohita</u> (Ham.)	48"	X	Recorded below Bettiah in November and close to Bhaisalotan in March 1962 in stray numbers.
# 39. <u>Lissocheilus hexagonolepis</u> (McCl.) = <u>Barbus dukai</u> Day?	40"	X 5	Fry, juveniles and adults recorded from the tributaries, main stream and Tribeni canal. (This is the 'Katli' Mahseer).
40. <u>Oreochthys cosuatus</u> (Ham.)	1½"	X	Recorded in turbid lower pools of tributaries.
41. <u>Osteobrama cotio</u> (Ham.)	3"	X 4	Increases in frequency of occurrence below Bagaha.
42. <u>Puntius ambassis</u> (Day) = <u>P. guganio</u> (Ham.)	2½"	X 2	
# 43. <u>Puntius</u> sp.			

1	2	3	4
43. <u>Puntius chagunio</u> (Ham.)	12"	X 4	Peculiar to rapid waters of the main and tributary streams of the Gandak. Declines lower down.
44. <u>Puntius chola</u> (Ham.)	5"	X 3	All these forms are of wide distribution and were recorded equally well in the main river, tributaries, Tribeni canal and inundated low lying pools and jheels. Several species occurring together often yield considerable catches.
45. <u>Puntius conchonius</u> (Ham.)	3"	X 3	
46. <u>Puntius gelius</u> (Ham.)	2½"	X 2	
47. <u>Puntius sarana</u> (Ham.)	15"	X 2	
48. <u>Puntius sophore</u> (Ham.)	4"	X 4	
49. <u>Puntius ticta</u> (Ham.)	3"	X 3	
50. <u>Semiplotus semiplotus</u> (McCl.)	12"	X 2	Early fingerlings obtained above Bhaissalotan in streams. Peculiar to colder upper waters only.
51. <u>Tor mosal</u> (Ham.)	56"	X 5	These are the 'true' Mahseers. During the survey adults were not captured, but larvae, fry, fingerlings and juveniles were extensively obtained from the main river and its upper tributaries. These are peculiar to rapid streams with boulder or rocky bottom.
52. <u>Tor tor</u> (Ham.)	50"	X 5	
Family HOMALORTERIDAE			
53. <u>Balitora brucei</u> Gray	6"	X 2	Recorded by very young specimens from the main stream at

1	2	3	4
			Bhaisalotan; obviously they had drifted from upper reaches.
Family COBITIDAE			
54. <u>Botia dayi</u> Hora	3½"	X 3	Obtained only from running streams during the survey.
55. <u>Lepidocephalus annandalei</u> Choudhury ?	4"	X 4	Widely distributed in the river and tributaries; <u>Lepidocephalus</u> spp. also common in stagnant jheels and tanks.
56. <u>Lepidocephalus guntea</u> (Ham.)	4"	X 4	
57. <u>Nemachilus beavani</u> Gunther	3"	X 4	
58. <u>Nemachilus botia</u> (Ham.)	3"	X 4	
59. <u>Nemachilus corica</u> (Ham.)	3"	X 4	
Family SILURIDAE			
60. <u>Ompok bimaculatus</u> (Bloch)	16"	X 3	All three species have occurred both in the streams, as well as jheels. <u>Wallago attu</u> was found abundantly in the Tribeni canal and reported to be a commercially important form in the main river.
61. <u>Ompok pabo</u> (Ham.)	16"	X 3	
62. <u>Wallago attu</u> (Bl. & Schn.)	60"	X 5	
Family BAGRIDAE			
63. <u>Batasio batasio</u> (Ham.)	4"	X 2	Recorded from upper streams.
64. <u>Mystus aor</u> (Ham.)	48"	X 6	Several species of these <u>Mystus</u> occur together in the main river and its tributaries and also in the Tribeni canal. Of these <u>M. aor</u> <u>M. seenghala</u> are restricted to flowing waters.
65. <u>Mystus bleekeri</u> (Day)	6"	X 6	
66. <u>Mystus cavasius</u> (Ham.)	12"	X 5	
67. <u>Mystus menoda</u> (Day)	18"	X 2	
68. <u>Mystus seenghala</u> (Sykes)	48"	X 6	
69. <u>Mystus vittatus</u> (Bloch)	7"	X 3	

1	2	3	4
70. <u>Rita rita</u> (Ham.)	30"	X 2	Restricted to flowing waters; more frequent below Bettiah.
Family AMBLYCEPIDAE			
71. <u>Amblyceps mangois</u> (Ham.)	3"	X 2	Recorded from clear stream beds.
Family SISORIDAE			
72. <u>Bagarius bagarius</u> (Ham.)	73"	X 4	Though rated only as 'fairly common' on the basis of numerical abundance it constitutes an economically important species.
73. <u>Gagata gagata</u> (Ham.) <u>Gagata cenia</u> (Ham.)	6"	? X 4	These forms are 'torrential' - water inhabitants of the upper waters; their young appear to get grapped within inundated jheels and sometimes are caught in considerable numbers.
74. <u>Gagata punctata</u> ?	..	X 3	
75. <u>Glyptothorax cavia</u> (Ham.)	12"	X 4	These were mostly recorded from the Tribeni canal; restricted to fast currents over boulders and rocks.
76. <u>Glyptothorax horai</u> Shaw & Shebbeare			
77. <u>Glyptothorax ribeiroi</u> (Hora) = <u>Laguvia ribeiroi</u> (Hora)	4"	X 2	Recorded from the main stream at Bhaisalotan in the Gandak; obviously drifted from upper waters.
78. <u>Glyptothorax telchitta</u> (Ham.)	6"	X 2	All these are rapid or torrential stream fishes; mostly young that drift into the region from upper
79. <u>Hara hara</u> (Ham.) = <u>Erithestes hara</u> (Ham.)	6"	X 2	

1	2	3	2
80. <u>Rama rama</u> (Ham.) = <u>Leiocassis rama</u> (Ham.)	3"	X 3	waters; occasionally seem to grow within suitable shelters. Most of these forms are of academic interest, but fishes like <u>Rama rama</u> were observed in fish markets in large numbers having been collected from receding streams.
81. <u>Sisor rhabdophorus</u> (Ham.)	10"	X	
Family SCHILBEIDAE			
82. <u>Ailia coila</u> (Ham.)	6"	X 3	These species were recorded in fairly common numbers within the Tribeni canal. <u>Clupisoma montana</u> predominating, it being a cold water form unlike the rest, which are common within the Ganga river system over the plains.
83. <u>Ailia</u> sp.	7"	X 3	
84. <u>Ailichthys punctatus</u> (Ham.)	5"	X 3	
85. <u>Clupisoma garua</u> (Ham.)	16"	X 3	
86. <u>Clupisoma montana</u> Hora	10"	X 3	
87. <u>Eutropiichthys vacha</u> (Ham.)	20"	X 2	Occurs only below Bettiah.
88. <u>Pangasius pangasius</u> (Ham.)	52"	X	
89. <u>Pseudeutropius atherinoides</u> (Bloch)	3"	X 2	Very small catfish of no economical value anywhere.
90. <u>Silonia silondia</u> (Ham.)	56"	X	Recorded only below Bettiah; its occurrence above Bagaha is doubtful.

1	2	3	4
Family CHACIDAE			
91. <u>Chaca chaca</u> (Ham.)	12"	X	This torrential river fish of the upper reaches (a poisonous variety) was obtained in a muddy tributary below Bhaisalotan.
Family HETEROPNEUSTIDAE			
92. <u>Heteropneustes fossilis</u> (Bloch)	16"	X 2	Uncommon in the main river and tributaries where it is also recorded; a tank and jheel form where it may be available in large numbers.
Family CLARIIDAE			
93. <u>Clarias batrachus</u> (Linn.)	20"	X 2	Uncommon in the main river and tributaries where it is also recorded; a tank and jheel form where it may be available in large numbers.
Family ANGUILLIDAE			
94. <u>Anguilla bengalensis</u> (Gray)	60"	X 2	Recorded during the survey within the Tribeni canal. This is a long distance migrant going to the sea for spawning ('Catadromous') from its rocky shelters and crevices in the rivers. Its occurrence is doubtful in the colder main stream of the Gandak close to Bhaisalotan.

1	2	3	4
Family CYPRINODONTIDAE			
95. <u>Panchax panchax</u> (Ham.)	2½"	X 2	Recorded from the muddier tributaries below Bhaisalotan.
Family MUGILIDAE			
96. <u>Mugil corsula</u> (Ham.)	16"	X 2	Recorded only below Bettiah.
Family BELONIDAE			
97. <u>Xenentodon cancila</u> (Ham.)	15"	X 3	Stray close to Bhaisalotan but fairly common below Bettiah.
Family OPHICEPHALIDAE			
98. <u>Channa gachua</u> (Ham.)	10"	X 3	Though mostly are of considerable fishery value in tanks and jheels, these have occurred also in the main river stream and its tributaries occasionally, <u>C. gachua</u> being more frequent.
99. <u>Channa marulius</u> (Ham.)	36"	X 2	
100. <u>Channa punctatus</u> (Bloch)	14"	X 3	
101. <u>Channa striatus</u> (Bloch)	30"	X 3	
Family CENTROPOMIDAE			
102. <u>Ambassis nama</u> (Ham.)	3"	X 3	These are not of much value even if they occur in larger numbers from tanks or jheels on account of their slimy nature and spines.
103. <u>Ambassis ranga</u> (Ham.)	3"	X 3	
Family NANDIDAE			
104. <u>Badis badis</u> (Ham.)	3"	X	Recorded from jheel and tank collections and in muddy portions of the main river; <u>B. badis</u> also has occurred in clear upper tributaries.
105. <u>Nandus nandus</u> (Ham.)	5"	X 2	

1	2	3	4
Family ANABANTIDAE			
106. <u>Anabas testudineus</u> (Bloch)	7"	X 3	Sold in markets, having been fished from jheels near Bhaisa-logan.
Family OSPHRONEMIDAE			
107. <u>Colisa chuno</u> (Ham.)	3"	X 2	These are recorded from the jheels, tanks and tributaries connected with the Gandak.
108. <u>Colisa fasciatus</u> (Bloch & Schneider)	4"	X 2	
109. <u>Colisa lalius</u> (Ham.)			
Family GOBIIDAE			
110. <u>Glossogobius giuris</u> (Ham.)	18"	X 2	Obtained from the jheels and tributaries.
Family MASTACEMBELIDAE			
111. <u>Mastacembelus armatus</u> (Lacepede)	24"	X 3	These 'Spiny' eels were recorded from the tributaries and Tribeni canal; Shelter in rocky crevices or muddy holes.
112. <u>Mastacembelus pancalus</u> (Ham.)	24"	X 3	
113. <u>Macrogathus aculeata</u> (Bloch)	24"	X 3	

NOTES ON ECONOMICALLY IMPORTANT SPECIES AND MIGRATORY FORMSEconomically Important Forms

Economically important forms in the Bhaisalotan region of the Gandak and for about 20 miles below and 10 miles above, are listed below separately for reasons mentioned against each. As species abundance depends upon seasonal conditions, some more species may have to be supplemented to this list at a later stage.

I. Small Fishes upto 6-7"Aspidoparia morar

"Chapua"

Occurs in abundance,  
especially in cast  
nets and "Chilwan"  
fishing.

Barilius spp.

"Chapua"

May occur all round  
the year.

Crossocheilus latius

- -

These may be only sea-  
sonal; large numbers  
were, however, obser-  
ved during November,  
but may decrease in  
the ensuing months.

Mustus spp.

"Tangra"

About three species  
together contribute  
to the fishery.

II. Medium Sized Fishes upto 14"Labeo deroPuntius chagunio

These are medium sized  
fishes found in rapid  
waters. Small sizes  
of upto 5" were  
common in November.

III. Large species - 36 - 73%Labeo dyocheilusLissocheilus hexagonolepisTor mosalTor torBagarius bagarius

"Mansaar"

"Mansaar"

"Mansaar"

"Goonch"

These are mainly mountain stream forms, the sizes attained being considerable. (Goonch is the largest fish in Indian freshwaters and the Mahseers are no less important). All these forms offer a good fishery yield in this region. Their number decreases lower down from the barrage site in the wide silty river. Both young and adults occur in large number.

Mystus aorMystus seenghalaWallago attu

"Tangra"

"Tangra"

"Gallari"

These are of very wide distribution in the Gangetic river system their occurrence in the main stream at Bhaisalotan probably is seasonal and they appear to enter the Tribeni canal as juveniles and also plant themselves in inundated depressions.

KALI GANDAKI MARSYANDI BURI GANDAKI  
NAWALPUR VALLY  
TRISULI

NOT TO SCALE

NEPAL

ANDHARI KHOLA  
KHAIR KHOLA  
TRIBENI GHAT

KANHA  
EMANHA  
SONAPANCHA  
BHAILOTAN  
R. ROHUA  
R. RAUA

TRIBENI CANAL

BAGHA  
RATWAL  
R. HARAHA  
SUJURPUR  
BETTIAH

UTTAR PRADESH

CHAMPARAN DT.  
BIHAR

GORAKHPUR DT.

SARAN DT.

MUZAFFARPUR DT.

SAMPLING STATION	●
INDO NEPAL BORDER	-----
STATE BORDER	- - - - -
DISTRICT BORDER	- - - - -
EMBANKMENT	▲▲▲

