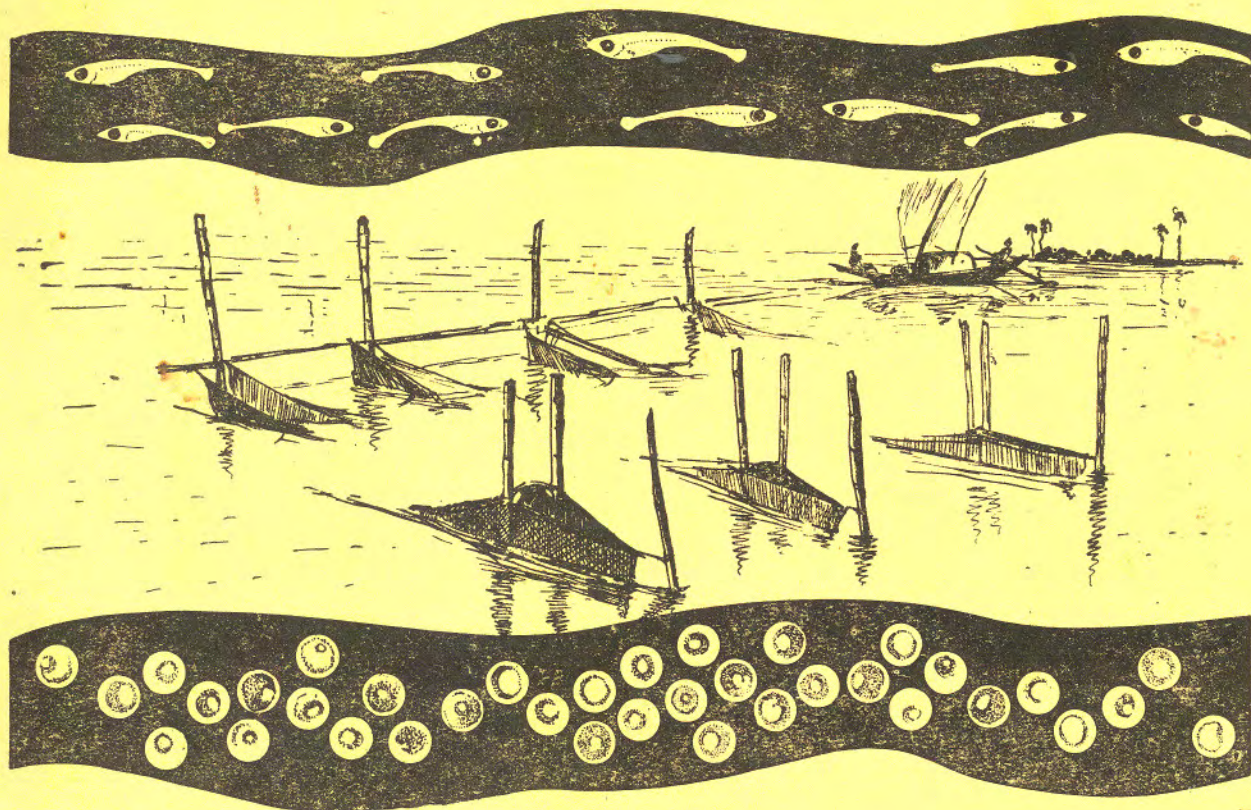


K. Venkateswara Rao
Gauhati

REPORT ON FISH SPAWN PROSPECTING INVESTIGATIONS, 1969

RAJASTHAN, UTTAR PRADESH, BIHAR, ASSAM, TAMILNADU AND MYSORE



Bulletin No. 16
December, 1971



CENTRAL INLAND FISHERIES RESEARCH INSTITUTE
(Indian Council of Agricultural Research)
BARRACKPORE, WEST BENGAL
INDIA

REPORT ON FISH SPAWN PROSPECTING INVESTIGATIONS, 1969
RAJASTHAN, UTTAR PRADESH, BIHAR,
ASSAM, TAMILNADU AND MYSORE

by

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FOREWARD

During the year 1969, the Riverine Division of the Institute carried out spawn prospecting investigations in the States of Rajasthan, Bihar, Assam, Tamil Nadu and Mysore, in response to the requests made by and in collaboration with the respective State Governments. In addition to the above, investigation with special emphasis on studies towards standardization of spawn collection nets, were also made by the Institute staff at Mahewapatti, near Allahabad, on River Yamuna. In Bihar, the State Government personnel investigated two sites, one each on the Ganga and the Son, as part of the overall investigations to assess the spawn yielding pattern and potentiality of River Son in collaboration with this Institute. The results of all these investigations are embodied in this report.

The investigations on spawn prospecting under Project 4.1 were conducted under the supervision and guidance of Shri H.P.C. Shetty, Officer-in-Charge, Allahabad Substation. The investigations under Project 4.2 connected with standardization and efficiency of nets were planned and executed under the guidance and supervision of Shri K.K. Ghosh at Mahewapatti on Jamuna and are included here.

The sectional reports were written by the staff of the respective field units, who collected and analysed the data. Shri Shetty edited these reports. The State personnel participated only in field work except in Bihar - where the State team also analysed the data and prepared the report for two centres in that State.

Shri R.K. Saxena of this Institute is responsible for the preparation of all the illustrations included in this report.

It is a pleasure to acknowledge here the active co-operation received from the Directors and other regional officers of the concerned State Governments.

V.G. Jhingran

(V.G. JHINGRAN)
DIRECTOR

Central Inland Fisheries
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1. INTRODUCTION

The continued acute shortage of fish seed in the country and the scanty coverage as yet of the riverine resources in a scientific manner as to their seed yielding potentiality, made it imperative to continue the spawn prospecting investigations, initiated in 1964 by the Central Inland Fisheries Research Institute, during 1969 as well. The earlier investigations have led to the location of several high yielding quality spawn collection centres in different parts of the country and have provided valuable clues to the selectivity and suitability of spawn collection nets of different types, sizes and mesh sizes under varying hydrographical conditions (Anon, 1965; Malhotra et al., 1966; Shetty, 1967; Shetty et al., MS.1, Shetty et al., MS.2). The results of investigations carried out by the Institute during 1969 in the States of Rajasthan, Uttar Pradesh, Bihar, Assam, Tamil Nadu and Mysore are embodied in this report.

The investigations during the year under report were carried out at eight centres spread over five States, as per details given in Table 1.

Table 1

Details of location of investigated centres

Sl. No.	Name of State	Name of river	Name of investigated centre
1.	Rajasthan	Gambhir (Utangan)	Baretha Barrier
2.	Uttar Pradesh	Yamuna	Mahewapatti
3.	Bihar	Son	Bahiara
4.	"	"	Tilauthu
5.	"	Ganga	Dighwara
6.	Assam	Brahmaputra	North Gauhati
7.	Tamil Nadu	Coleroon	Nirathanallur
8.	Mysore	Cauvery	Sosale

With the sole exception of the centre in Uttar Pradesh, all the other centres were chosen in response to the requests of the respective State Governments for locating lucrative spawn collection centres in particular regions of their States. Of the latter, all the centres except Tilauthu and Dighwara in Bihar were investigated jointly by the Institute and State Government staff. On the other

hand, the Tilauthu and Dighwara centres were manned entirely by the Bihar Government personnel. These two centres were investigated in addition to the joint centre at Bahiara, as part of the overall investigations to assess the spawn yielding pattern and potentiality of river Son and to ascertain the occurrence and extent of spawn drift from the Son into the Ganga.

The centre taken up in Uttar Pradesh, viz. Mahewapatti on R. Yamuna, was in continuation of the long term investigations initiated in 1968 for understanding in depth the occurrence and drift of spawn in relation to meteorological and hydrodynamical factors, and for studying the filtration and selection characteristics of spawn collection nets towards evolving optimum nets suitable for operation under different sets of hydrological conditions. This centre was manned entirely by the Institute staff.

The pattern of collaboration at all the joint centres was as in the previous years.

2 PREMONSOON SURVEY AND SELECTION OF SITES

On the basis of a detailed premonsoon survey of the river stretches suggested by the concerned State Governments as per their developmental needs, suitable stretches for prospecting and sites for detailed investigations were selected. The main criteria for selection of sites were the same as in the previous years.

Details of stretches surveyed and the probable sites examined are shown in Table 2, while the identity and approach details of all the sites selected for detailed investigations are given in Table 3. The geographical locations of the selected river stretches are shown in Fig.1.

3 MATERIAL AND METHODS

3.1 Gear used

As in the previous years, the provisional 'standard net' (1/8" meshed Midnapore-type spawn net) was employed at all centres, except at the two State operated centres in Bihar, for assessing their spawn yielding potentiality, in order to get comparable data over the years. The Bihar Government used at both their centres (Tilauthu and Dighwara) two kinds of Midnapore-type nets, one made of cotton netting

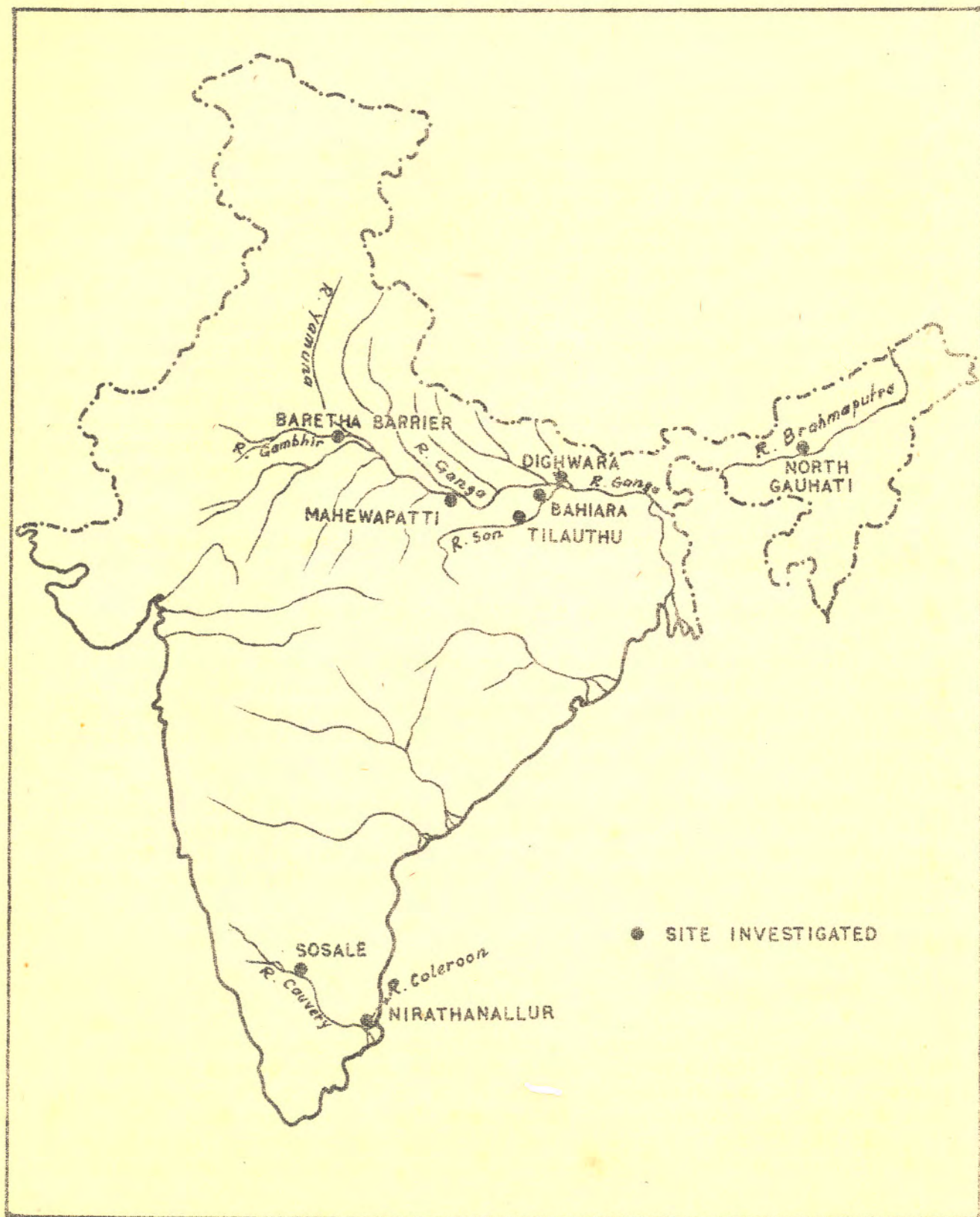


FIG. 1. MAP OF INDIA, SHOWING LOCATION OF SITES INVESTIGATED DURING FISH SPAWN PROSPECTING, 1969.

Table 2

Details of stretches and sites examined during the Premonsoon survey and of those selected for prospecting investigations

River	S U R V E Y E D							S E L E C T E D F O R P R O S P E C T I N G			
	S T R E T C H				S I T E S			S T R E T C H			
	From	To	Length in km	Bank	Name	Suitability S/US*	Justification for acceptance/rejection	From	To	Distance in km	Main site for investigation
1	2	3	4	5	6	7	8	9	10	11	12
Banas Dubbi	Rameswar		60	North	Billoli	S	Suitable for different flood levels upto 5-6 km above the summer level. Accessible only by rail.				
				West	Khandhar	US	Proper collection ground not available. Approach bad.				
Gambhir Rupbas Baretha (Utangan)			65	South	Rupbas	US	Collection ground very small. Rocky	Bayana Rajakheda		204	Baretha
				North	Baretha	S	Good collection ground & seed availability at the site promising.				
Son	Ram Dihra	Koelwar	120	West	Ram Dihra	S	Collection ground good & is being exploited by State Govt.	Sandesh	Koelwar	17	Bahiara
				West	Tilauthu	S	Suitable large area for operating nets. Approach good.				
				West	Indrapuri	US	Due to guide banks for Indrapuri Anicut the site has become unsuitable.				
				West	Dehri-on-Son	US	-do-				
				West	Amiaor	US	Steep bank and as a result no suitable collection ground.				

1	2	3	4	5	6	7	8	9	10	11	12
				West	Sahar	S	Exploited by State Govt.				
				West	Peur	US	Steep bank and during floods no transport and communication facilities.				
				West	Sandesh	US	Steep river bank & approach differing during floods.				
				West	Tirkaulghat	US	Approach to the site difficult during monsoons.				
				West	Saripur	US	-do-				
				West	Bishumpur	US	Steep bank & approach to the site difficult				
				West	Khangaon	US	-do-				
				West	Bahiara	S	Suitable collection ground & approach good.				
				West	Farangpur	US	Steep bank & operation of nets difficult during floods.				
				West	Dhandina	US	Steep bank & operation of nets difficult during high floods.				
				West	Koelwar	S	Well situated from the point of collection ground & transport of spawn. Exploited by State Govt.				
Brahmaputra	Kurwa	Hatimorah	80	North	Kurwa	US	Accessibility difficult during monsoons.	Saulkuchi	Barnaddi	North	Gauhati
	(Kamrup District)			North	North Gauhati	S	Sandy flat area. Operational area limited but otherwise suitable.				
				North	Ahoklanta Hill (Majgaon)	US	Steep bank				
				North	Amingaon	S	Good collection ground both above and below the bridge.				
				North	Saulkusi	US	Sandy flat area.				

1	2	3	4	5	6	7	8	9	10	11	12
				North	Bamundih	US	Collection ground not suitable for operation of nets.				
				North	Hatimorah	US	-do-				
Chandrapur	Nagarbera	130		South	Chandrapur	US	Not accessible during monsoons.				
				South	Pandu	US	Steep banks with hilly margins.				
				South	Sadilapur	S	Operational area limited.				
				South	Khanamuleh	S	Vast operational area with good collection ground.				
				South	Dharapur	US	Steep bank and deeper pools.				
				South	Bhatpara	US	-do-				
				South	Majargaon	US	Steep bank.				
				South	Chimnah	US	Inaccessible during monsoons.				
				South	Phaturi	US	Flat sandy bed. Approach difficult.				
				South	Nagarbera	US	River flow during monsoon very uncertain. Accessibility poor.				
Jogighopa	Kalapakani	120		North	Jogighopa	US	Unsuitable due to change of river course.				
(Goalpara District)				North	Chandradengha	US	Inaccessible during monsoons.				
				North	Bhasani-char	S	Operational area limited depending upon extent of floods.				
				North	Kalapakani	US	Accessible by river only.				
Dolgoma	Pancharatna	55		South	Dolgoma	S	Very good collection site				
				South	Goalpara	US	Steep hilly bank.				
				South	Pancharatna	US	-do-				
				South	Purorbhita	US	Approach by river route. Exploited by commercial parties.				

Contd.. Table 2

1	2	3	4	5	6	7	8	9	10	11	12
					South Buraburi	US	Approach by river route. Exploited by commercial parties.				
Cauvery	Krishnaraj-sagar	Hogaina-175	North Bunnur	US	No favourable current. Rocky and sandy terrain.			Chunchun-katte	Bunnur	107	Sosale
			North Sosale	S	Very good collection ground and accessibility also very good.						
			South T. Nar-sipur	US	Limited collection ground rendered unsuitable on account of confluence of two rivers at that point.						
			North Talkadu	S	Good collection ground & good accessibility.						
			Chikkay-lur	US	Extremely rocky terrain.						
			South Palar	US	Extremely difficult approach & precipitous bank.						
Coleroon	Grand Anicut	Lower Anicut	112 South Vilangudi	S	Very good approach & good collection ground.			Grand Anicut	Lower Anicut	112	Nirathanallur.
			South Nirathan-allur	S	Very good collection ground and good approach.						
			South Kachhapo-rumalna-than	S	Very good approach and good collection ground.						

* S = Suitable
US = Unsuitable

Table 3

The identity and approach details of the main sites selected for investigations along with the area available at each site for net operation

River	Gambhir (Utangan)	Son	Brahmaputra	Cauvery	Coleroon
Stretch (From-to)	Bayana to Rajakheda	Sandesh to Koelwar	Saulkuchi to Baruaddi	Chunchunkatte to Bunnur	Grand Anicut to Lower Anicut
Selected site	Baretha	Bahiara	North Gauhati	Sosale	Nirathanallur
Bank	North	West	North	North	South
Tehsil/Taluk/ Sub-division	Dholpur	Arrah Sadar	Gauhati	T. Narsipur	Kumbakonam
Police Station	Mania	Koelwar	North Gauhati	T. Narsipur	Kumbakonam
District/State	Bharatpur Rajasthan	Arrah Bihar	Kamrup Assam	Mysore Mysore	Thanjavur Tamil Nadu
Nearest Post Office	Baretha	Narhi Chandi	North Gauhati	T. Narsipur	Nirathanallur
Distance	1 km	1.5 km	1 km	5 km	3 km
Telegraph Office	Dholpur 19 km	Koelwar 9.5 km	Do	Do	Kumbakonam 36 km
Telephone	Dholpur 19 km	Koelwar 9.5 km	Do	Do	Do
Nearest all weather road at and distance	Baretha Barrier 0.25 km	Chandi 1.5 km	North Gauhati 1 km	Sosale 1 km	Nirathanallur 3 km
Nearest Railway Station/distance	Dholpur 19 km	Kulharia 9.5 km	Gauhati 7 km	Mysore 35 km	Thanjavur 33 km
Area available for nets at different flood levels.	Upto 5 M 5-10 nets	Upto 4.2 M 300-500 nets 4.5 M 100 nets 5.6 M Nil	Upto 5 M 100-150 nets	Upto 3 M 20-25 nets	75-100 nets throughout the period of floods.

and the other of synthetic netting. These nets differed in size, relative dimensions and mesh size from the standard net. The various dimensions of the two nets are shown in Table 4.

Table 4

Structural details of Bihar State nets
operated at Tialuthu and Dighwara.

Net type	Dimensions in cm					Mesh size
	Length of net	width at mouth	Height at mouth	Length of wing	Height diameter	
Cotton net	411	214	35	172	32	1/16"
Synthetic net	292	128	80	72	32	1/24"

In addition to the standard net, specially fabricated experimental nets of different meshes and sizes were operated at Mahewapatti on the Yamuna, to test the effect of mesh size and net size on catching efficiency. These consisted of standard-type 1/12" and 1/16" meshed nets of the same dimensions as the standard net, and the 6m, 14m and 18m standard-type nets described earlier by Shetty et al. (MS.). The 1/12" meshed standard-type net was also tested at North Gauhati on the Brahmaputra.

3.2 Techniques of collection and analyses of spawn and for determination of hydrographical and meteorological factors.

The techniques employed for the above were the same as those adopted since 1965 (Malhotra et al., 1966; Shetty, 1967). The frequency of observations was, likewise, the same.

4. DEFINITIONS

The definitions adopted for the investigations were the same as given by Shetty (1967).

5. OBSERVATIONS

5.1 Qualitative and quantitative spawn yielding potentiality of selected stretches.

5.1.1 Baretha stretch of river Gambhir (Utangan)

Participants

Shri D.V. Pahwa } Central Inland Fisheries
Shri A.G. Godbole } Research Institute, (I.C.A.R.)

Shri D.P.S. Chauhan - Govt. of Rajasthan.

River Gambhir (Utangan) originates in the hills of south Rajasthan and after meandering through the States of Rajasthan and Uttar Pradesh joins R. Yamuna near Agra. The Baretha Barrier site, where spawn prospecting investigations were carried out in 1969 is situated about 65 km upstream of the river's confluence with the Yamuna on the National High-way No.3 bordering the States of Rajasthan and Uttar Pradesh. The river at the site flows from west to east. Before joining the Yamuna, the river enters the State of U.P. a number of times and for a considerable distance it forms the boundary between the two States, as is shown in Fig. 2 & Fig. 3.

The flow of water in this river is largely controlled by the earthen Augai Dam, which is located about 80 km upstream of the collection site. R. Parvati joins R. Gambhir, about 5 km above the collection site, while R. Khari joins R. Gambhir 22 km downstream of the collection site at Rajakheda. Both these tributaries are very much tamed by a number of earthen dams. The investigations at this site and stretch were carried out between 1.7.69 and 27.8.69.

Occurrence of spawn spurts: The river had only scattered patches of shallow water pools, leaving absolutely no current in them till 22 hrs of 8.7.69. A temporary rise in water level was observed thereafter, attaining the peak of 0.46 m at 18 hrs of 9.7.69 without yielding any spawn spurt.

The 1st flood, which commenced at 10 hrs on 19.7.69 with an abrupt rise in water level, attained its peak of 2.49 m at 22 hrs on 20.7.69. This flood yielded 135 ml of spawn and 500 ml of eggs in its receding phase. The spawn spurt was only of a short duration, from 2 hrs on 19.7.69 to 12 hrs on 20.7.69. During this short duration of spawn availability, the water level receded very fast, i.e. from 2.49 m at 22 hrs on 19.7.69 to 1.38 m at 12 hrs on 20.7.69. The current velocity at the place of collection was 2.25 km/hr, the average turbidity being 540 ppm and average air and water temperatures 30°C and 27°C respectively.

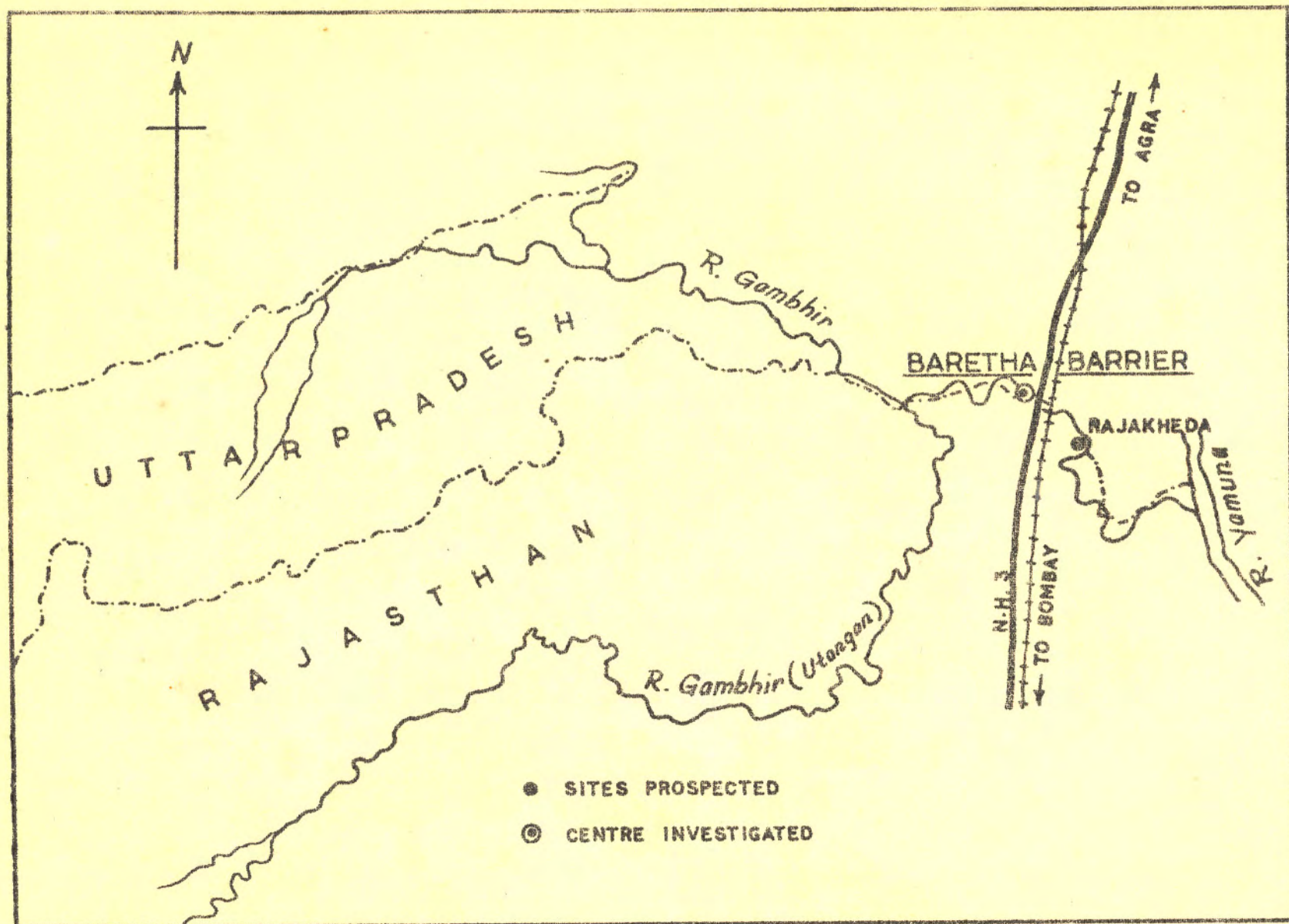


FIG. 2. BARETHA BARRIER STRETCH OF RIVER GAMBHIR (UTANGAN) SHOWING SITES PROSPECTED AND CENTRE INVESTIGATED.

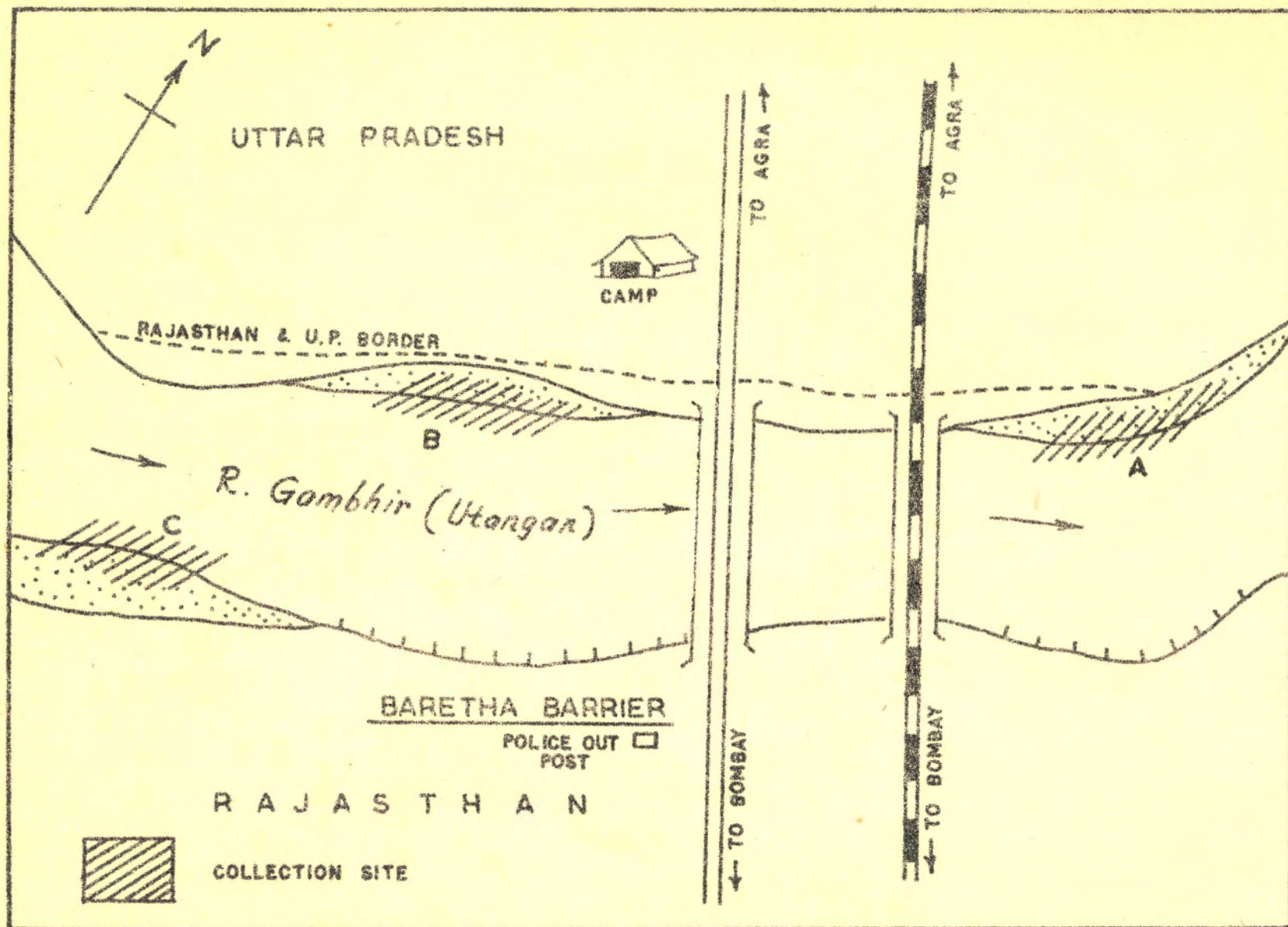


FIG. 3. THE RIVER COURSE, GENERAL TERRAIN AND TOPOGRAPHY OF RIVER GAMBHIR (UTANGAN) AT BARETHA BARRIER.

Before the appearance of the 12nd flood, a vacillatory phase was recorded, touching the peak level of 1.29 m at 10 hrs on 29.7.69, yielding no spawn. The 12nd flood appeared between 6.8.69 and 24.8.69, touching the peak level 5.81 m at 10 hrs on 14.8.69. This flood yielded only traces of spawn for about 20 hrs. The details of occurrence of floods and spawn availability are shown in Table 5.

Quality of fish seed collected : Spawn analysis as well as rearing experiments, revealed the complete absence of major carps in the spawn collected. The eggs collected were found to be mostly unfertilised.

Spawn availability at prospected sites : Rajakheda site, 79 km downstream and Bayana site, 125 km upstream of the site were prospected for their suitability. Both these sites did not yield any spawn.

Suitability of the investigated stretch for exploitation: The season's work unmistakably indicated the unsuitability of the entire investigated stretch for spawn exploitation. This could be attributed to the (i) large scale capture of breeders ascending from the Yamuna by erecting barricades across the river in its course through Uttar Pradesh territory and (2) the taming of the river and its tributaries by a series of earthen dams.

5.1.2 Mahewapatti on river Yamuna.

Participants

Shri K.K. Ghosh (Leader)	Central Inland Fisheries
Shri M. Sinha	Research Institute(I.C.A.R.)

The investigations at Mahewapatti on the Yamuna were spread out over the period 1st July to 29th August, 1969. The details of location and topographical details of the site have already been described by Shetty et al. (MS.2)

Occurrence of spawn spurts : Table 6 presents the details of occurrence, duration, quantity and quality of spawn spurts at Mahewapatti throughout the season. The river experienced four floods during the season. The peak levels touched were respectively 75.48 m, 79.17 m, 82.44 m and 83.11 m above MSL, corresponding to 3.28 m, 6.97 m, 10.24 m and 10.91 m above the summer level. The first three of these yielded sizeable spawn spurts during their receding phases. The first spurt

Table 5

Flood-phase-wise occurrence, duration, desirability and magnitude of spawn spurts recorded at Baretha Barrier on R. Gambhir in 1969

FLOOD DETAILS								SPAWN		SPURT		DETAILS	
Flood No.	Phase	Commencement Date	Hour	Duration in days	Peak Date	Hour	Level in m	Spurt No.	Commencement Date	Hour	Duration in hrs.	Desirability (D/UD)+	Total catch in ml
IX	Rising	15.7.69	6	4½	19.7.69	22	2.49						
	Receding	19.7.69	2	3½				S ₁	19.7.69	2	12	UD	135(spawn) [+ 500 ml of eggs]
II	Rising	6.8.69	22	7	14.8.69	10	5.81	-	-	-	-	-	-
	Receding	14.8.69	14	10									

x : Before the first flood attained its peak, there were two temporary recessions in its level.

+ : D = Desirable.

UD = Undesirable.

Table 6

Occurrence, duration, quantity and quality of spawn
spurts at Mahewapatti on R. Yamuna during 1969.

Spawn spurt No.	Flood			Spurts' commencement				Spurt's end			Dura- tion in hrs.	Desir- abili- ty (D/UD) ^x	Spawn catch in ml		Spawn By spawn analysis			quality By rearing		
	No.	Phase	Peak level above M.S.L. in m	Date	Hour	Flood level above M.S.L. in m	No. of hours after touch- ing peak level	Date	Hour	level above M.S.L. in m			Total	Per- net hour	Major carps %	Minor carps %	Others	Major carps %	Minor carps %	Others %
1	I	Rece- ding	75.48	15/7	14	75.45	12	16/7	4	75.45	16 40	UD ^x UDII	3850 2510	125 312.5	1 0	80 0	19 100 ^{xx}	Not reared		
2	II	Rece- ding	79.17	25/7	10	78.78	28	26/7	14	78.00	28	UD	145	4.03	9	63	18	65.7	33.6	0.7
				26/7	14	78.00		28/7	10	77.10	44	D	1280	23.2	26	51	23			
3	III	Rece- ding	82.44	10/8	6	82.06	24	12/8	18	80.41	60	D	930	5.4	47	51	2	31.5	68.5	0.0

Pooled % of major carps in reared spawn = 52.2%
 " " minor carps " " = 47.4%
 " " others " " = 0.4%

^x This catch contained 550 ml of desirable spawn (11% of major carp caught between 20-22 hrs of 15/7

^{xx} Prawns only.

which commenced 12 hours after the 1st flood started receding, yielded predominantly minor carp spawn for 16 hrs, at the rate of 125 ml/standard net/hour, and thereafter only prawn hatchlings for another 40 hours. The second spurt of spawn came during the receding phase of flood II and yielded undesirable spawn at a low rate of about 4 ml/net/hour for 28 hours. Thereafter, the quality and abundance of spawn improved to yield 1280 ml of spawn in the next 44 hours, at the rate of about 23 ml/standard net/hour. The third flood during its receding phase yielded the last spawn spurt of the season, comprising high quality desirable spawn. This last spurt lasted for 60 hours and yielded spawn at a very low rate of only about 5 ml/standard net/hour.

In addition to the above, small quantities of spawn were also collected for short durations during the rising phases of floods II and III.

Quality of fish seed collected : The quality of spawn was determined through microscopical analysis, as well as by rearing in a ditch near the site. The entire catch of the 1st spurt was found to be undesirable under microscopical analysis and was hence not reared. The desirable segment of the II spurt was found to contain 26% of major carps on spawn analysis, while the rearing of a composite sample gave a major carp content of 65.7%. This consisted of 59.1% mrigal, 5.3% of rohu and 1.3% kalbasu. The major carp content of the IIIrd spurt was found to be 47% and 31.5% respectively by spawn analysis and rearing. This spurt was dominated by catla (15.4%), followed by rohu (13.5). Mrigal formed only 2.6%. In another experiment dealing with rearing of every two hourly catch during a 24 hr. period in this spurt done in chetty pots, mrigal dominated the survivors with its percentage ranging from 21.5 to 42.3%. Catla which was the most dominant major carp in the ditch was altogether absent. This suggests that the overall quality of the third spurt was probably better than 31.5% as found from ditch rearing.

The seasonal indices of spawn quantity and quality for the Mahewapatti centre worked out to 1098 ml and 52.2% respectively.

5.1.3 Bahiara Stretch of river Son

Participants(a) Bahiara Centre

Shri V.R. Desai (Leader)	Central Inland Fisheries
" S.D. Gupta	Research Institute
" J.N. Sinha	(I.C.A.R.)
" Krishnachandra Singh	Govt. of Bihar

(b) Tilauthu and Dighwara Centres

Dr. Prem Shankar Prasad (Overall-in-Charge)	Govt. of Bihar
Shri S.K. Tewari (Leader, Tilauthu Centre)	
Shri Devendra Prasad (Leader, Dighwara Centre)	

The spawn yielding potentiality of the lower stretch of R. Son is already well known, as is evident from its commercial exploitation by the Bihar Fisheries, as well as private parties. However, at the instance of the Bihar Fisheries Department, investigations were taken up in the lower stretch of R. Son and the adjoining stretch of R. Ganga with certain specific objectives, in addition to those of the normal spawn prospecting investigations. These additional objectives are :

1. To determine the causative factors responsible for the reported depletion of spawn, in regard to both quantity and quality, in river Son and the adjoining stretch of the Ganga.
2. To ascertain the extent of migration of major carps from river Ganga up the river Son for breeding, and the effect of Indrapuri Anicut on fish migration and spawn flow.
3. To know the role of flood in river Son on the availability of spawn in river Ganga at Dighwara.

The Son joins the Ganga in Bihar, with the confluence having Saran district on its north, Shahabad district on its west and Patna district on the east. (Fig. 4) About 150 km upstream of the confluence,

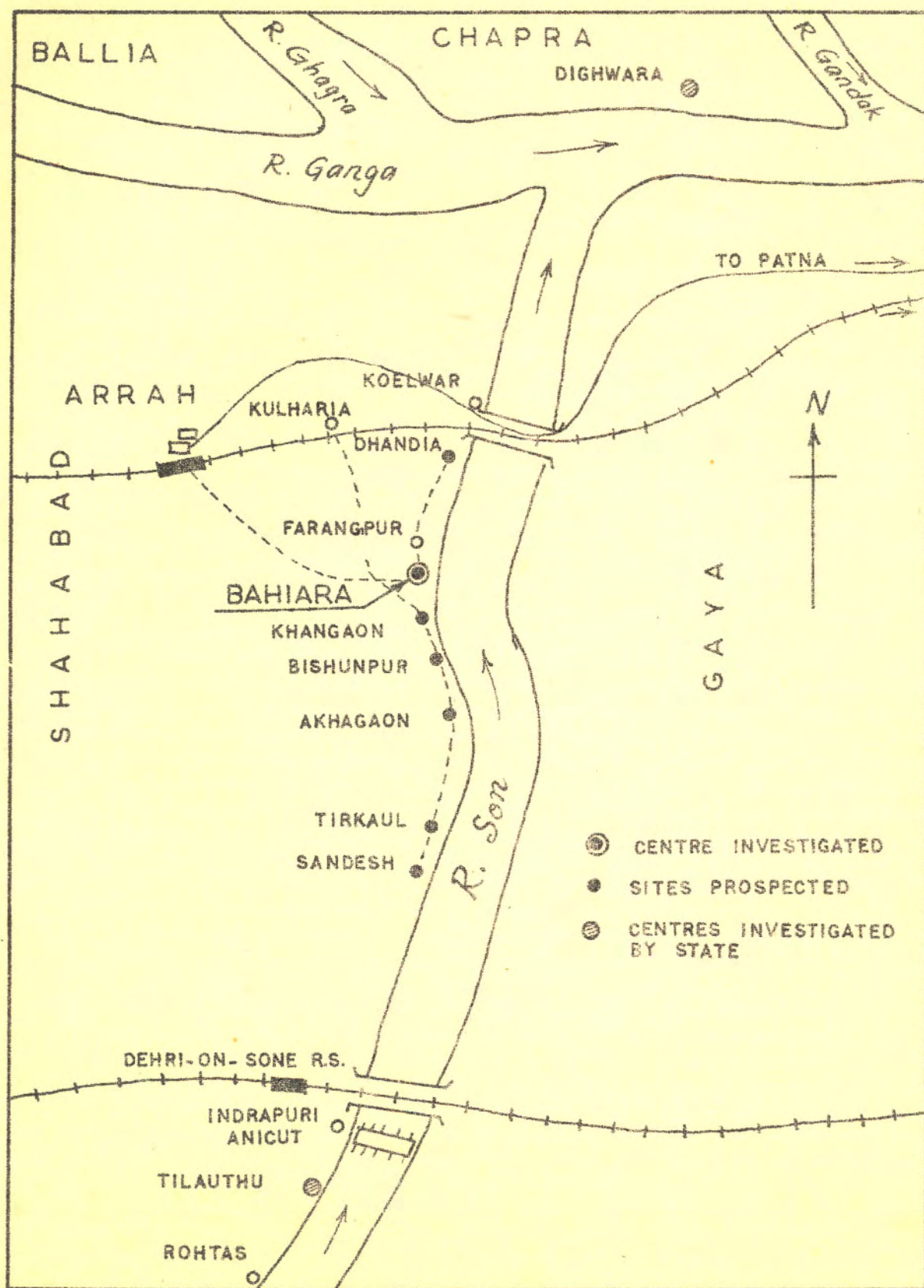


FIG. 4. BAHIARA STRETCH OF RIVER SON SHOWING SITES PROSPECTED AND CENTRE INVESTIGATED.

there is an anicut across the Son at Indrapuri. The flood water of the Son is characteristically red in colour, and is, therefore, easily distinguishable from the milky flood waters of the Ganga, when the former drains into the latter. It is the experience and belief of the fishermen on the Ganga near the confluence that spawn appears in the Ganga when its water turns red. It is, therefore, presumed that the spawn is brought down into the Ganga from the Son alongwith its red flood waters.

With the above mentioned objective in view, the lowermost stretch of the Son from the Koelwar Bridge upto Ram Dihra, about 5 km upstream of the Indrapuri Anicut, was surveyed, and two sites were selected for detailed investigations, one at Bahiara below the Indrapuri Anicut and the other at Tilauthu above the Anicut (Fig. 4). A third centre was chosen on the Ganga at Dighwara, about 10 km below the confluence. While the Bahiara centre was investigated by ICAR staff in collaboration with the staff of Bihar Fisheries, the Tilauthu and Dighwara centres were manned entire by the State staff.

The findings at the three centres are detailed below.

5.1.3.1 Bahiara on R. Son

The village Bahiara is situated on the West bank of R. Son in Shahabad district of Bihar, about 25 km upstream of its confluence with the Ganga and about 125 km downstream of the Indrapuri Anicut. The Koelwar bridge is located about 7 km downstream of the site. The availability of extensive suitable operational area at Koelwar draws numerous parties of fishermen for commercial exploitation of spawn from this centre, and on account of its location on the main line, a good number of hundies of spawn are booked from Koelwar during July-August. Besides the spawn collected at Koelwar, the collection from the villages of upper reaches, viz. Sandesh, Tirkaul, Akhagaon, Bishnupur, Khangaon and Bahiara is also booked from the Koelwar railway station. Arrah, the district headquarters, is only 13 km away from Bahiara and is connected with it by an all weather metalled road.

The course, general terrain and topography of river Son near Bahiara are shown in Fig. 5. The river in this stretch flows from south to North. The site selected for detailed round the clock investigations is located opposite village Farangpur, situated only 1 km downstream of Bahiara. The flat gradually sloping sand bar from

Bahiara to Farangpur is an ideal spot for large scale operation of shooting nets and as much as 400 to 500 nets were seen being operated by commercial fishermen in the stretch. Prior to the initiation of observation the river was in summer condition, with the main current flowing almost along the east bank, leaving extensive sand bars along the west bank. With the advent of the first flood, the river water started flowing along the west bank as well, thereby making available suitable sites for spawn collection. Round the clock observations on spawn availability and other related factors were recorded at Bahiara from 3.7.69 to 5.9.69.

Occurrence of spawn spurts : During the period of observation extending over 65 days, the river experienced five floods at Bahiara, when a total of 3120 ml of spawn was collected by operating 1-5 standard and state nets. Of the total catch, 1690 ml of spawn were collected by standard nets and 1,430 ml by State nets. The flooding in this stretch of the river Bahiara is determined by the release of water from the Indrapuri Anicut, where the flood water of river Koel is diverted for irrigation purposes and the surplus water released down according to the magnitude of flood. Details of occurrence, duration, desirability and magnitude of the spawn spurts are shown in Table 7.

Even though five floods were encountered, bulk appearance of spawn was observed only during the first two floods, with the remaining floods yielding only traces of spawn. The first flood, which yielded the major portion of the season's catch, commenced on 5.7.69 and reached its peak level of 3.23 m on 8.7.69, with its rising and receding phases lasting 96 and 120 respectively. This flood yielded desirable spawn both during its rising and receding phases, in three spurts. The I spurt occurred briefly for only 6 hours towards the end of the rising phase, just before the flood attained its peak and yielded only 45 ml of desirable spawn in 1-5 standard nets. The II spurt, which happened to be the major spurt of the season, occurred during the receding phase of this flood during 9th and 10th July, yielding in all 1,390 ml of desirable spawn in 1-5 standard nets. The concentration of spawn was maximum from 18.00 to 4.00 hour on 9.7.69, when the catch per net-hour amounted to 15 ml. The III spurt of 8 hours' duration also occurred during the same receding phase on 11.7.71 and yielded only 100 ml of desirable spawn in 5 standard nets. As such, the I flood yielded a total of 1535 ml of high quality desirable spawn which constituted a little over 90% of the season's total spawn catch at the site by standard nets. The simultaneous

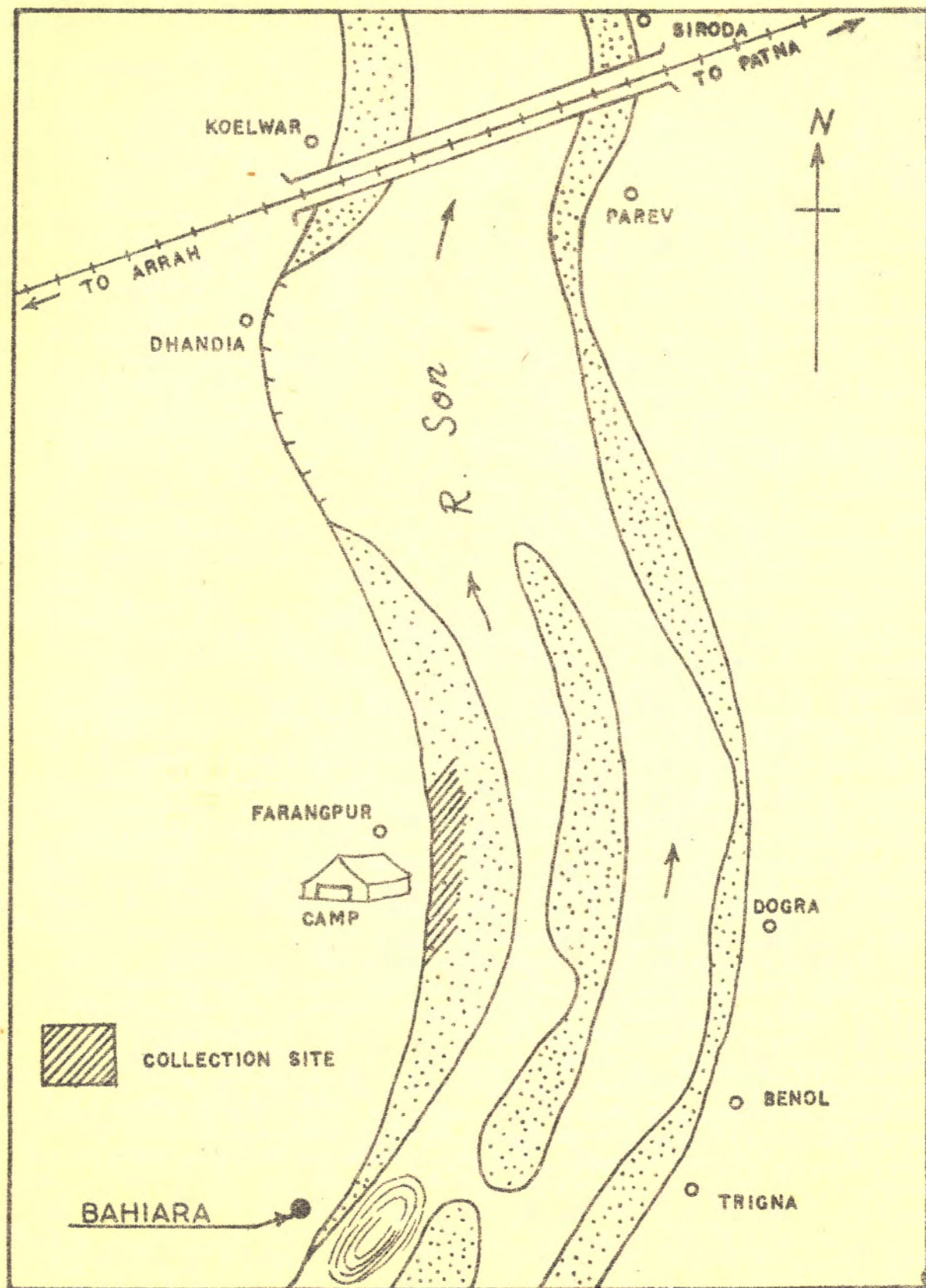


FIG. 5. THE RIVER COURSE, GENERAL TERRAIN AND TOPOGRAPHY OF RIVER SON AT BAHIARA.

Occurrence, duration, desirability and magnitude of spawn spurts at Bahiara

Flood details					Spawn spurt details								
Flood No.	Phase	Commencement		Duration in days	Peak flood level			Spurt No.	Commencement		Duration in hours	Spawn desirability	Total catch in ml
		Date	Hour		Date	Hour	Flood level m		Date	Hour			
I	Rising	5.7.69	6	4	8.7.69	18	3.23	1	8.7.69	10	6	D	45
	Receding	8.7.69	22	5				2	9.7.69	6	36	D	1390
	Vacillation phase between I & II floods		15.7.69	6	5				3	11.7.69	18	8	D
II	Rising	19.7.69	6	3	21.7.69	2	3.65	-	-	-	-	-	-
	Receding	22.7.69	6	5				4	24.7.69	6	6	D	135
III	Rising	27.7.69	2	3	30.7.69	2	4.18	5	24.7.69	20	2	D	20
	Receding	31.7.69	6	4									Traces
	Vacillation phase between III & IV floods		4.8.69	10	5								
IV	Rising	9.8.69	10	1	10.8.69	10	4.63						
	Receding	10.8.69	14	2									
Vacillation phase between IV & V floods		12.8.69	14	2½									Traces
V	Rising	15.8.69	14	2	16.8.69	2	5.63						
	Receding	17.8.69	10	12									Traces
													1690

operation of 3-6 State nets yielded another 1310 ml of spawn.

The 4th spawn spurt occurred during the receding phase of the II flood on 24.7.69 and lasted only 6 hours, yielding in all 135 ml of desirable spawn. After a break of 10 hours, there was a brief 5th spurt, lasting only 2 hours, and yielding just 20 ml of desirable spawn. Thus the II flood yielded a total of only 155 ml of spawn in 1-5 standard nets, the catch per net-hour being 4 ml. An additional 120 ml of spawn was also collected during this flood through the operation of eight State nets.

The progressively higher three subsequent floods yielded only traces of desirable spawn. The availability of spawn in traces throughout the III flood was in continuity to the 5th spawn spurt during the II flood. As such, spawn appeared at the site continuously for about 15 days from 24.7.69 to 8.8.69, even though it was mostly in traces. This, however, indicates prolonged breeding of major carps in this region.

The limited quantity of spawn available could be due either to the restricted breeding of a few fishes only or to the drifting of spawn elsewhere away from the site.

Quality of spawn : Details of spurt-wise quality of spawn, as revealed by microscopical analysis of spawn samples and nursery rearings, are given in Table 8. However, nursery rearing was confined to only spurts 2 and 4. As can be seen from the table, spawn analyses revealed quality of the spawn to be uniformly high throughout the season. It was over 65% during the first two spurts. The quality was high (above 50%) even when spawn was available only in traces during the III, IV and V floods. The nursery rearing of a sample from the 2nd spurt showed a major carp content of 87.4%, with mrigal dominating, the others being rohu and kalbasu. Similar rearing of a sample from the 4th spurt, in Beniganj Fish Farm in Madhya Pradesh, yielded 100% major carps at fingerling stage, consisting mainly of catla, the others being mrigal and rohu. From the above it appears that catla spawn becomes available only later in the season in late July, while kalbasu occurs only during the earlier part of the season.

The seasonal indices of spawn quantity and quality were found to be 252.0 ml and 33.5% respectively.

Table 8

Spurt-wise quality of spawn collected
at Bahiara on R. Son in 1969

Spurt No.	Desir-ability (D/UD)*	Spawn quality in percentage								
		By spawn analysis			By rearing					
		Major carps	Minor carps	Others	Major carps				Minor carps	Others
					Rohu	Mrigal	Catla	Kalbasu	Total	
1	D	65.3	23.0	11.7	-	-	-	-	-	-
2	D	65.7	30.0	4.3	32.4	53.6	-	1.4	87.4	12.6
3	D	53.0	44.0	3.0	-	-	-	-	-	-
4	D	51.4	48.0	0.6	15.5	23.0	61.5	-	100	-
5	D	44.0	49.0	7.0	-	-	-	-	-	-

* D = Desirable

UD = Undesirable

Spawn availability at prospected sites : Occasional prospecting was done at six sites located between Koelwar Bridge and the Indrapuri Anicut, viz. Bishnupur, Akhagaon, Tirkaul and Sandesh (Fig. 4). All these sites were found to be unsuitable, in that operational area was not available under flooded conditions. As such, the stretch between the villages Bahiara and Farangpur appears to be the only suitable site for commercial exploitation in this stretch of R. Son.

5.1.3.2 Tilauthu on R. Son

Tilauthu is a small village situated on the west bank of R. Son, about 16 km south-west of Dehri in Shahabad district and about 3 km upstream of the Indrapuri Anicut (Fig. 4). The course, general topography and terrain of the river in the vicinity of Tilauthu are depicted in Fig. 6. The river bank at the site is gradually sloping, offering extensive area for the operation of a large number of nets. At some points, upto as many as 20 nets could be operated in a single row perpendicular to the bank. Apart from the investigation under report, a good number of private fishermen and State Fisheries staff were commercially exploiting this site.

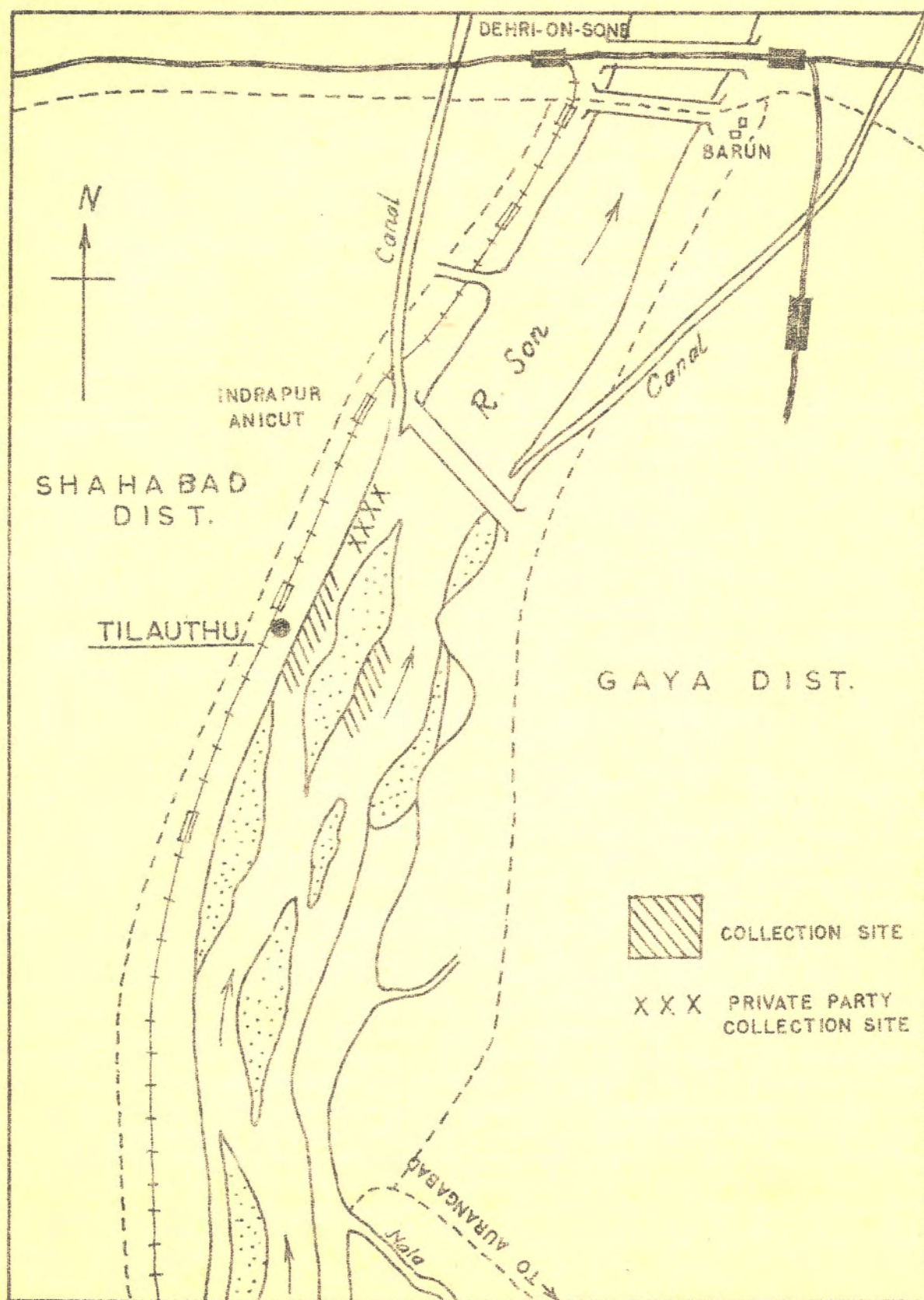


FIG. 6. THE RIVER COURSE, GENERAL TERRAIN AND TOPOGRAPHY OF RIVER SON AT TILAUTHU.

Occurrence, magnitude and quality of spawn spurts : The observations at the site lasted from 2nd July to 20th August, during which period the river experienced five floods. The season's entire catch of 900 ml of spawn was obtained during the first two floods (7/7 to 23/7) in 1-6 experimental nets, with the remaining floods (29/7 to 18/8) yielding only traces of spawn. This pattern is similar to that observed at Bahiara. Likewise, there was prolonged appearance of spawn in traces only during the III flood as at Bahiara and quick vacillations in water level appeared to have adversely affected the bulk availability of spawn.

Table 9

Flood-wise occurrence, duration, magnitude and quality of spawn spurts at Tilauthu on R. Son in 1969

Flood		Spawn spurt details								
No.	Peak level in m	Spurt No.	Duration	Catch in ml	Quality in % (by rearing					Minor carps
					Major carps					
					Rohu	Mrigal	Catla	Kalbasu	Total	
I	1.08	1	7/7 to 9/7	400	54	20	2	4	80	20
II	0.75	2	21/7 to 23/7	500	4	68	5	2	79	21
III	1.00	-	29/7 to 2/8	Traces	-	-	-	-	-	-
IV	1.10	-	9/8 to 11/8	Traces	-	-	-	-	-	-
V	2.50	-	16/8 to 18/8	Traces	-	-	-	-	-	-

Details of flood-wise occurrence, magnitude and quality of spawn spurts are given in Table 9. There were only two spawn spurts, one each during the I and II floods, yielding in all 400 ml and 500 ml respectively. The average rate of spawn catch during both the spurts was 1.66 ml per net-hour. The 1st spurt was encountered during early July (7/7 to 9/7), while the 2nd occurred during early fourth week of July (21/7 to 23/7).

Both the spurts yielded high quality desirable spawn, their major carp content, as revealed by nursery rearing being 80% and 79% respectively. While rohu dominated the first spurt, mrigal similarly dominated the 2nd spurt. Catla and Calbasu were available during both the spurts in small numbers only.

5.1.3.3 Dighwara on R. Ganga

Observations similar to those made at Tilauthu were also recorded at Dighwara on the Ganga (Fig. 4), about 10 km below its confluence with R. Son, in order to study the influence of major carp breeding in river Son and the subsequent spawn flow on spawn availability in the adjoining stretch of the Ganga (vide supra).

Dighwara is situated on the north bank of the Ganga in Saran district and is commonly exploited by commercial parties. The spawn collection site is spread over three villages, viz. Basantpore, Dighwara and Ami. R. Ghaghara joins the Ganga on its northern side, a little to the west of R. Son's confluence with the Ganga. The spawn collection activity at Dighwara is spread out over a stretch of 6 km along the northern bank of the Ganga. The course, general topography and terrain of the site are depicted in Fig.7. The bank at the site is gradually sloping and allows the operation of only 3-4 nets abreast in a row. Due to the inflow nearly of two rivers, one from each bank, a huge island is formed almost every year early in the season, when the main current drifts along the south and of the island, which forms the main collection spot during the first flood.

Occurrence, magnitude and quality of spawn spurts : Five floods were encountered during the period of observations, lasting from 1.7.69 to 15.8.69, when a total of 2806 ml of spawn could be collected in 1-5 experimental nets. However, bulk of the catch was obtained during the I flood, when the spawn occurred continuously for about 70 hours, yielding in all 2400 ml, which formed 85.2% of the season's total catch at the site. The average rate of spawn catch during this spurt was 6.66 ml per net-hour. In addition to the catch by the experimental nets, commercial fishermen parties operating at the site collected an additional quantity of 9260 ml of spawn during the I and III floods.

In Table 10 are shown the details of flood-wise occurrence, magnitude and quality of spawn catches made at the site.

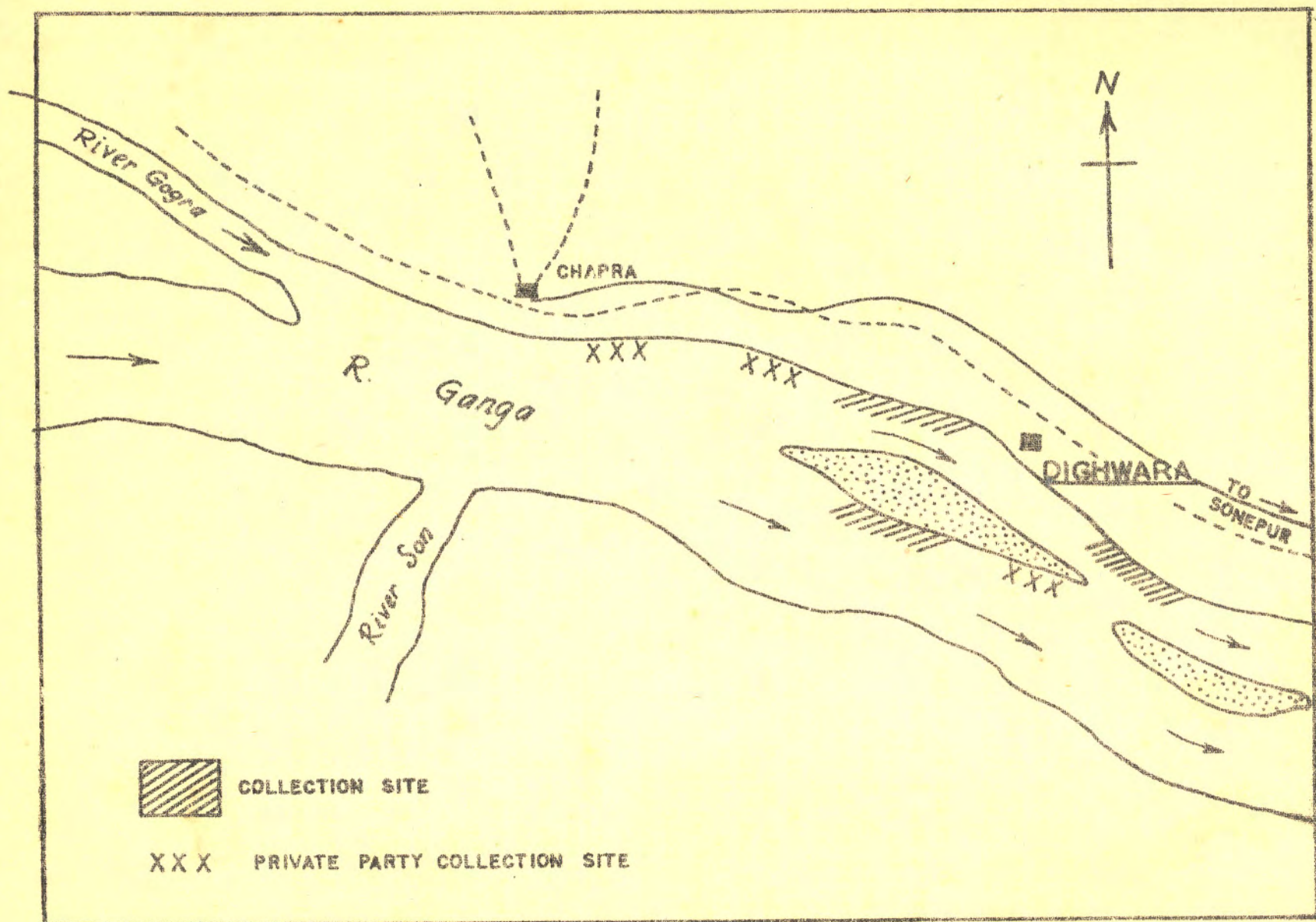


FIG. 7. THE RIVER COURSE, GENERAL TERRAIN AND TOPOGRAPHY OF RIVER GANGA AT DIGHWARA.

Table 10

Flood-wise occurrence, duration, magnitude and quality of spawn catches at Dighwara on R. Ganga in 1969

No.	Flood		Spawn catch details				
	Average level in cm.	Duration in hrs	Quantity in ml	Period of catch	Quality in % (by rearing)		
					Major carps	Minor carps	Others
I	2.93	72	2,400	8/7 to 11/7	82	18	-
II	2.84	72	18	16/7 to 18/7	80	16	4
III	3.54	120	243	21/7 to 25/7	75	20	5
IV	3.91	168	53	28/7 to 3/8	60	35	5
V	4.63	144	92	7/8 to 11/8	62	36	2

From the above table it is evident that except during the flood, spawn was available mostly in traces during the rest of the season. The quality of the catches was quite high, specially during the I flood, when the major carp content consisted mainly of rohu (52%), the others being catla and mrigal (15% each). Flood levels above 3.5 m and frequent quick vacillation appear to have come in the way of better collection during the subsequent floods.

5.1.3.4 Inter-relationship between the rivers Son and Ganga in regard to spawn availability

A perusal of the data presented in this section, reveals the close similarity of period and floods of occurrence and quality of the spawn spurts at Tilauthu, Bahiara and Dighwara. The earlier floods, specially the first, yielded the bulk of the season's catch at all the centre. Likewise, the major carp content was quite high (about 80% or above) at all the centres, with mrigal and rohu dominating. Catla was also present at all the centres in small numbers, while Calbasu was absent only at Dighwara. It is reported by the State Fisheries that an upstream site below the confluence of R. Koel with R. Son, about 50 km south-west of Tilauthu, gave excellent results to private parties, even though its accessibility was quite poor. Even though the catches were of much greater magnitude at this site, their quality was reported to be similar to those obtained at the downstream centres.

The construction of Rihand Dam appears to have adversely affected the spawn yielding potentiality of the Son, in that the flowing down of water is greatly restricted, thereby affecting the flooding pattern of the river and consequently the breeding grounds, breeding opportunities and spawn drift. The higher magnitude of spawn availability near the confluence of R. Koel with R. Son appears to be due to the discharge received from R. Koel.

Enquiries from local fishermen and State Fisheries Officials revealed that major carps do not form a regular fishery in R. Son, but are encountered in commercial catches only during the monsoon and post-monsoon months, while they form a regular commercial fishery in the adjoining Ganga almost throughout. As such, the availability of major carp seed in R. Son may be attributed to the breeding migration of major carps from the Ganga into the Son during the monsoon months. The availability of major carp seed in appreciable quantities in the lower stretch of R. Son below the Indrapuri Anicut indicates profuse breeding of the ascending Ganga major carps in this stretch of R. Son. The absence of any nala or rivulet between Indrapuri and Bahiara suggests that breeding must be taking place in the shallow marginal areas of the main river itself. The comparatively poor yield at Tilauthu above the Indrapuri Anicut indicates a very limited migration, if any, of major carps above the anicut which, therefore, appears to have adversely affected the spawn yielding potentiality of the stretch immediately above the anicut.

Spawn availability at Dighwara appears to be dependent on the inflow of spawn from the Son. This is evident from the fact that spawn appears at Dighwara only when the red flood waters of the Son enter the Ganga. As such, the floods in R. Son play a vital role in spawn availability in the Ganga and the Son.

5.1.4 North Gauhati stretch of R. Brahmaputra

Participants

Shri K. Venkateswara Rao (Leader)	{ Central Inland
" S.C. Pathak	{ Fisheries Research
	{ Institute(I.C.A.R.)
Shri Nagen Gogoi (28.5.69 to 15.6.69)	{ Govt. of Assam.
" S.K. Pathak (15.6.69 to 10.7.69)	{

The Brahmaputra traverses through ravinous terrain in Kamrup district, with hilly margin and precipitous banks, resulting

in a tortuous course and torrential flow. The pattern and direction of the current are often found to change.

On the basis of the premonsoon survey carried out in March, 1969, Khanamukh on the south bank, about 16 km west of Gauhati, had been chosen for detailed investigations, with Amingaon and north Gauhati, both on the north bank, as the sites for periodical prospecting. However, at the time of initiation of the monsoon investigation, it was found that the Khanamukh site had since become unsuitable for operation during the initial floods due to heavy erosion during the early April floods. A fresh survey was, therefore, undertaken and North Gauhati on the north bank, 11 km upstream of Saraighat Bridge and 25 km by road from Gauhati, was selected for detailed investigations. The stretch selected for prospecting is shown in Fig. 8, while the topographical features of the investigation site are depicted in Fig. 9.

The river bank is steep at the top and forms a narrow canal, followed by another sharp slope for about 40 m. This is succeeded by an extensive stretch of gradually sloping low-lying area extending for over 200 m towards the water's edge. This wide expanse of sandy operational area was available over a distance of 1.5 km. The sites selected for occasional prospecting were Saulkuchi and Bar Naddi mouth, both on the north bank, while commercial fishermen from W. Bengal were exploiting the sites at Khanamukh, and Palasbari on the south bank and Bamundi on the north bank, under agreement with the State Fisheries Department. The latter sites were also visited by the prospecting team for examining their catch and general suitability. The State Government operated centre at Dolgoma on the south bank was also visited.

The observations at the North Gauhati lasted from 21.5.69 to 9.7.69.

Occurrence of spawn spurts : Three floods were encountered at the site during the period of observations, out of which only the first two yielded a total of 1,223 ml of undesirable spawn in six spurts. The details of occurrence, duration, magnitude and desirability of the various spawn spurts are shown in Table 11.

Of the six spawn spurts, the first five occurred during the I flood. The 1st spawn spurt appeared on 22nd May at the fagend of the rising phase of the I flood and continued for 4 hours in the receding

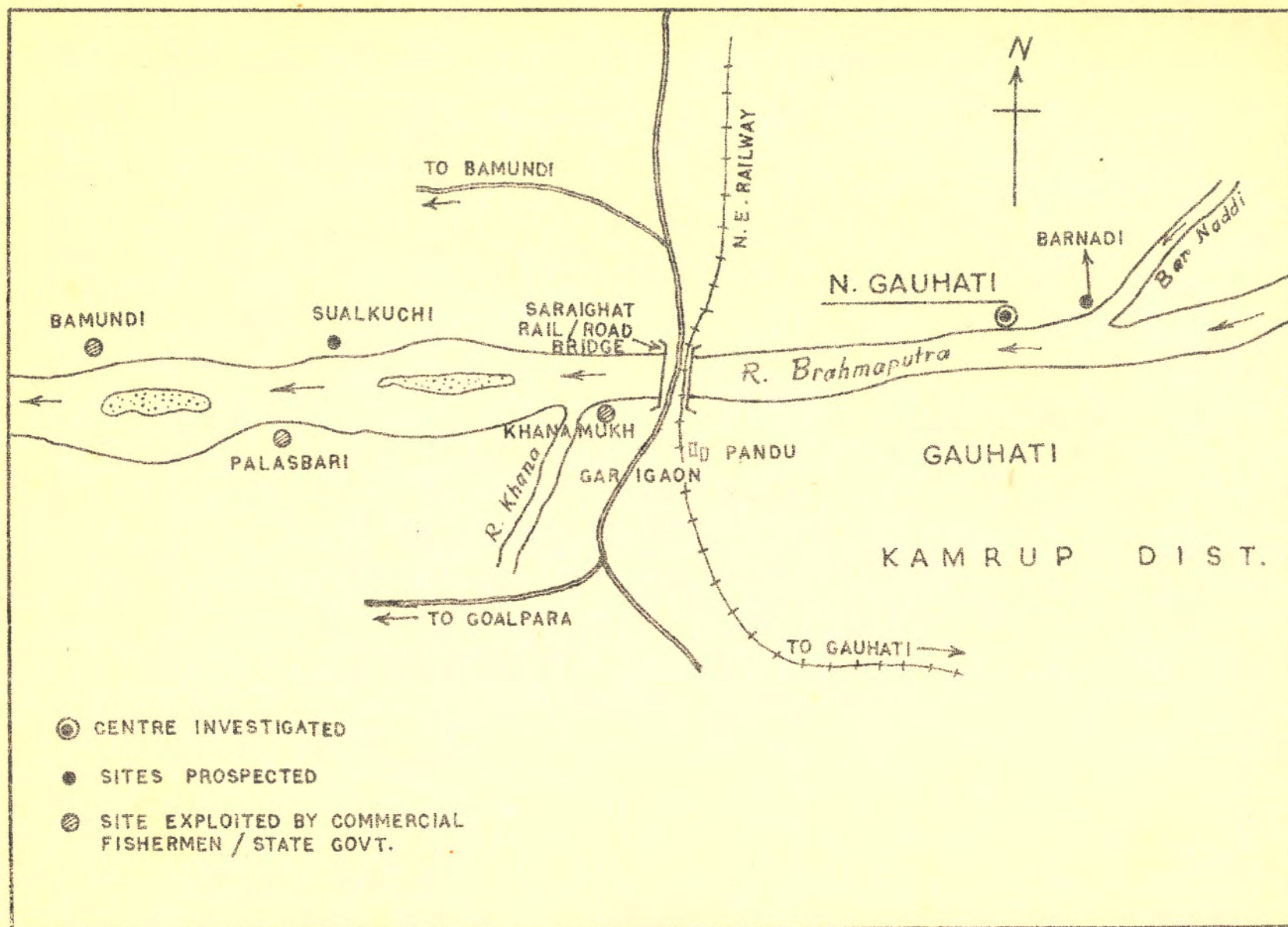


FIG. 8. NORTH GAUHATI STRETCH OF RIVER BRAHMAPUTRA SHOWING SITES PROSPECTED AND CENTRE INVESTIGATED.

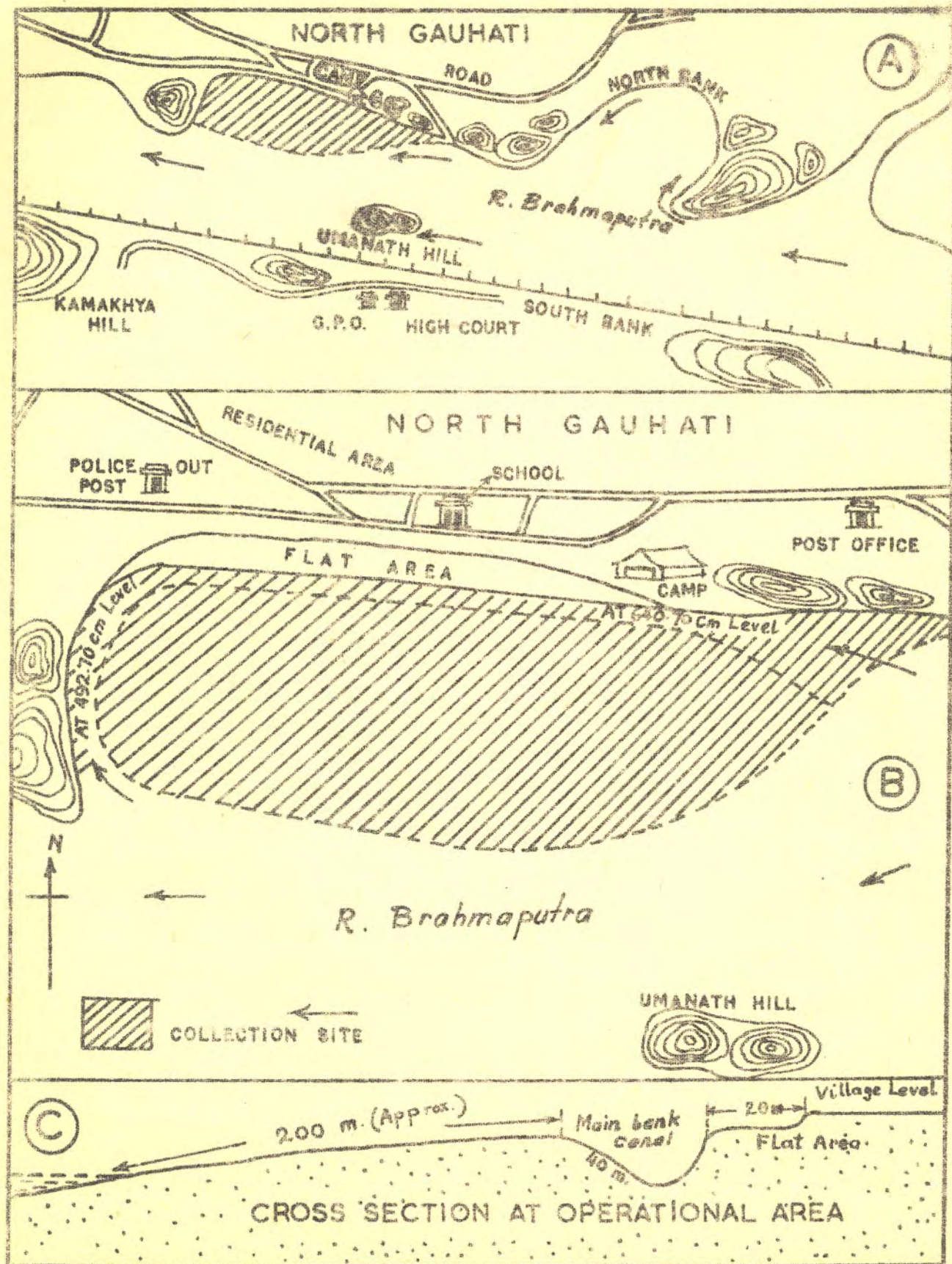


FIG. 9. THE RIVER COURSE, GENERAL TERRAIN AND TOPOGRAPHY OF RIVER BRAHMAPUTRA AT NORTH GAUHATI.

Table 11

Flood-phase-wise occurrence, duration, desirability and magnitude of spawn spurts
at North Gauhati on R. Brahmaputra in 1969

FLOOD DETAILS						SPAWN SPURT DETAILS						
Flood No.	Phase	Duration	Peak			Spurt No.	Commencement		Duration in hrs	Desirability (D/UD) +	Total catch in ml	Catch in numbers per net-hour
			Date	Hour	Level in m*		Date	Hour				
I	Rising	18/5 to 22/5	22/5	22	4.45	1	22/5	18	10	UD	39	670
	Receding	22/5 to 5/6	-	-	-	1 (Contd.)						
						2	23/5	21	9	UD	515	5365
						3	25/5	4	2	UD	52	13,000
						4	25/5	18	12	UD	253	2875
						5	31/5	22	4	UD	4	500
II	Rising	6/6 to 14/6	14/6	14	7.11	6	9/6	21	7	UD	360	4735
	Receding	14/6 to 21/6	-	-	-	Traces	-	-	-	D	-	-
	Rising	22/6 to 26/6	26/6	6	7.43	-	-	-	-	-	-	-
III	Receding	26/6 to 2/7	-	-	-	Traces	-	-	-	D	-	-

* Height above the summer level

+ D = Desirable

UD = Undesirable

phase as well. This spurt yielded only 39 ml of spawn in 5 standard nets. The next four spurts occurred during the receding phase of the same flood, at intervals ranging from 12-136 hrs, over the period 23rd May to 1st June, i.e., (spurts 2-5) lasted for 9, 2, 12 and 4 hours respectively. Of these, only the 2nd and 4th spurts yielded somewhat sizable quantities of spawn. All the collections during the four spurts of the receding phase were made during night hours.

The 6th and last spurt of the season was obtained during the rising phase of the II flood on 9th June and yielded 360 ml of spawn in 5 standard nets. No further spawn spurt occurred during the rest of the season, even though spawn was available in traces during the receding phases of the II and III floods on 15/6, 16/6 and 17/6, and 30/6 respectively.

Thus, the first flood constituted 70.56% of the season's catch, while the II flood accounted for only 29.44%. The 2nd spurt occurring in the last week of May accounted for 42.11% of the season's total catch. The average catches per net-hour were 3,400 and 4,735 numbers of spawn for the I and II floods respectively, while the average for the season was 3,580. The rate was highest during the 3rd spurt, when a single net landed 13,000 spawn per hour; but this spurt lasted for only two hours.

Quality of spawn collected : Details of quality as obtained by spawn analysis and nursery rearing are given in Table 12. All the spawn spurts were of undesirable type, with the percentage of major carps ranging between nil and 9.58%, as made out on the basis of spawn analysis. Nursery rearing yielded the maximum major carp content of only 9.80%, consisting entirely of rohu. Minor carps constituted the bulk of the catch during all the spurts, with their percentage varying from about 85 to 95. Labeo bata constituted more than 64% of the minor carps.

Table 12

Spurt-wise quality of spawn collected at North Gauhati on R. Brahmaputra in 1969

Spurt No.	Desirability (D/UD)*	SPAWN QUALITY IN PERCENTAGE																
		By spawn analysis			By rearing in													
					Nursery pits					State Govt. nurseries								
		Major carps	Minor carps	Others	Major carps					Minor carps	Others	Major carps					Minor carps	Others
Catla	Rohu				Mrigal	Cal-basu	Total	Catla	Rohu			Mrigal	Cal-basu	Total				
1	UD	5.87	87.65	6.48														
2	UD	9.58	84.74	5.68														
3	UD	5.30	89.40	5.30	-	7.44	-	-	7.44	92.56	-	-	9.80	-	-	9.80	90.20	-
4	UD	6.00	92.45	1.55														
5	UD	-	95.17	4.83														
Pooled average for I flood		6.82	88.40	4.78														
6	UD	9.27	88.47	2.26	-	8.33	-	-	8.33	91.67	-	No results obtained due to accidental mixing up of fry from different sources.						

* D = Desirable
UD = Undesirable

The spawn obtained in traces only during the receding phase of floods II and III in the second fortnight of June were also analysed for their quality, since parties of commercial fishermen were reported to have made heavy catches of spawn at Khanamukh on the south bank during the receding phase of the II flood. The analyses revealed the collections to be desirable, with their major carp content varying from 12.50-20.00% during the receding phase of II flood, while it was 11.90-18.66% during the III flood.

It thus appears that the quality of spawn available in the Brahmaputra in this stretch is low early in the season, while it improves subsequently in the later floods. As such, sites suitable for operation under higher flood levels of the later floods are only likely to yield desirable spawn in appreciable quantities. The North Gauhati site remains suitable for net operation only during the earlier floods.

The seasonal index of quality for the site worked out to only 8.62%, while that of quantity was nil since the entire catch in spurts happened to be undesirable and only traces of desirable spawn could be obtained later in the season.

Spawn availability at prospected sites : Due to the steepness of the banks over a greater portion of the selected stretch, very few suitable sites were available for occasional prospecting. Lack of suitable transport facilities further cramped this programme, while 3 of the suitable sites were being exploited by private parties through Government lease. As such, prospecting was restricted to Saulkuchi and near the confluence of Bar Naddi with Brahmaputra. However, visits were also made to the State leased centres, viz. Khanamukh, Palasbari and Bamundi, to examine their suitability and the quality of spawn collected there.

At Saulkuchi, located about 30 km downstream of North Gauhati on the northern bank, the current pattern and direction were found to undergo frequent changes, due to the presence of a long narrow protection into the river about a kilometre upstream of the site. The limited operational area at the site was rendered unsuitable during the II flood, when it became a shadow zone due to changed current direction. However, it appears that the site is suitable for operation during the I flood. All the same, the inconsistent current pattern at the site makes it unsuitable for large scale exploitation.

Near the mouth of Bar Naddi, about 6 km upstream of North Gauhati on the north bank, the river water showed practically no current or only a feeble current, unsuitable for spawn net operation. However, the region was observed to serve as a nursery ground of major and minor carp fry. Fry of rohu and bata were encountered in large numbers at this site.

Khanamukh on the south bank, which had earlier been given up due to its unsuitability during the I flood, was visited again during the receding phases of floods I, II and III. The site continued to be a shadow zone throughout the I flood, but became suitable during the higher second flood. This site appears to be suitable only at higher flood levels and it becomes a shadow zone in between any two floods, unless they come off in quick succession.

The State Govt. operated collection centre at Dolgama on the south bank about 35 km upstream of Goalpara town. Spawn was reportedly available there only on 10.6.69. A sample of spawn from this spurt was analysed, as well as reared for determining the quality. Spawn analysis and rearing respectively yielded a major carp content of 27.8% and 23.60%. Rohu was the only major carp, while bata dominated the minor carps, which formed 76.40% of the total catch. An on the spot examination of this site showed the prevalence of suitable current pattern only towards the end of the rising phase and the beginning of the receding phase. At other times, the current pattern was irregular, and was thus unsuitable for proper net operation.

5.1.5 Nirathanallur stretch of river Coleroon

Participants

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River Coleroon is a distributary of river Cauvery, the largest perennial river in the southernmost part of Peninsular India. The head of the Cauvery delta is located at the Upper Anicut, where it divides into two branches (distributaries). While the southern branch retains the name Cauvery, the northern branch is known as the Coleroon. The Coleroon, which has a regulator at the Upper Anicut,

carries the bulk of flood waters to the sea. The two branches are connected with each other through the Wular Bypass about 32 km downstream near Grand Anicut. There again, the surplus water of the Cauvery is discharged into the Coleroon. The Coleroon flows uninterrupted below the Grand anicut for about 112 km, after which it has again been harnessed by the construction of an anicut, the Lower Anicut. The Coleroon finally meets the sea at Kaveripattinam near Sirkali in Tanjore district, after negotiating a course of about 50 km from the Lower Anicut.

The stretch of the river Coleroon selected for spawn prospecting during 1969 extended from Grand Anicut in the west to Lower Anicut in the east, a distance of about 112 km by the river route. The river in this stretch flows from south-west to north-east. Detailed round the clock observations were made at Nirathanallur from 4th July, 1969 to 14th August, 1969. In addition to this, sites at Valakkai, Anakudi, Achanur, Pundinagachi, all upstream of Nirathanallur, and Karumbangudi, Kachperumalnatham, Lower Anicut (north and south banks), all downstream of Nirathanallur were examined both during the pre-flood and flood periods for their suitability (Fig. 10). During the pre-flood period, the entire stretch of the Coleroon was dry, except for some cut off pools, getting only a very meagre supply from the water leaking out of the Grand Anicut shutters. The water level even at Lower Anicut was only a few centimetres in depth. The river course has very few deep pools in the entire stretch. The main source of breeders for the Coleroon is the Viranam rank (39 sq. km in extent), which is connected with the Coleroon at Lower Anicut through the Vadavar canal. But the migration is always dependent on the timely release of water into the Vadavar canal. The tank is of wet bundh type and as such if there are timely rains, it is reported, the fish breed in the tank itself in the shallower areas.

Since this stretch of the river falls between two anicuts and is bounded by embankments on both sides, fluctuations in the water level are always dependent on the release of water from the Grand and Lower Anicuts. The release of water from the Grand Anicut, which was the only source of water for the Coleroon during the period of observations, was again dependent on the release of water from the Mettur Dam. The seasonal rivulets, viz. Upper, Nandhiyar and Marudayar, drain into the Coleroon from the northern side. But, since the area is fed by north-east monsoon, occurring during October to December, discharge was made by them during the period of the present observations.

Nirathanallur site is situated on the southern bank of the Coleroon. It is located at a distance of about 8 km from Kumbakonam and can be approached by an all weather road. The site where the observations were made is at a distance of about 1 km from the village Nirathanallur. The river course, general terrain and topography of the river at Nirathanallur are shown in Fig. 11.

Occurrence of spawn spurts : During the period of observations, four floods were encountered in river Coleroon. The first flood commenced on 14.7.69 and its rising phase was spread over 116 hrs, till 19.7.69. The second flood commenced on 21.7.69 and the rising phase lasted for 32 hrs. The third flood commenced on 27.7.69 and lasted for 32 hrs. The fourth flood commenced on 28.7.69 and the water kept fluctuating irregularly at a high level between 0.69 and 1.03 m. till the closure of the season's observations.

Only 3 spawn spurts were encountered at Nirathanallur. The first spurt occurred in the rising phase of the I flood and lasted for 8 hours from 4.00 hrs on 14.7.69, yielding in all 882 ml of desirable spawn in 5 standard nets. In addition to this, 640 ml and 485 ml respectively were collected in 1-3 research nets and 2 extra standard nets, thereby bringing the total collection during the first spurt to 2007 ml. After a non-availability gap of 4 hours, spawn became 'available' again for 2 hours only, when 15 ml could be collected.

The second spurt occurred in the receding phase of the I flood. It commenced at 18 hrs on 20.7.69 and lasted for 18 hrs, yielding in all 35 ml of desirable and 75 ml of undesirable spawn in 5 standard nets. 1-3 research nets collected a further quantity of 21 ml of spawn during this spurt. Further, another 24 ml of spawn were collected in the 5 standard nets during a period of six hours in continuity with the spurt period, but occurring in density below the index of 'availability'.

The third spawn spurt occurred in the receding phase of the III flood and lasted only for 4 hours from 14.00 hrs on 25.7.69, yielding 50 ml of undesirable spawn. Apart from the quantities indicated above, 22 ml of spawn were collected in traces in between the spurts. Thus, the total spawn collection made at the centre amounted to 2,239 ml.

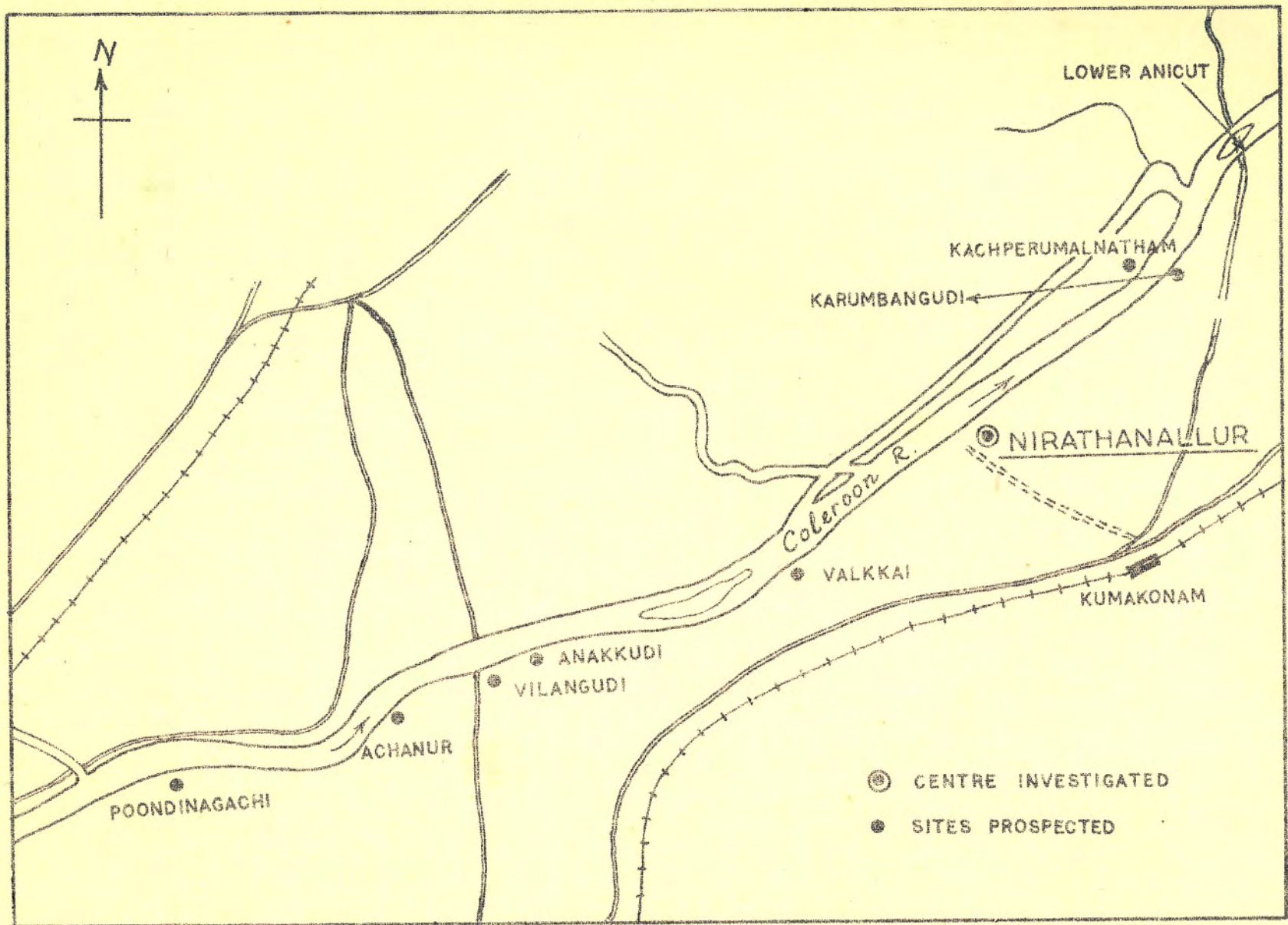


FIG. 10. NIRATHANALLUR STRETCH OF RIVER COLEROON SHOWING SITES PROSPECTED AND CENTRE INVESTIGATED.

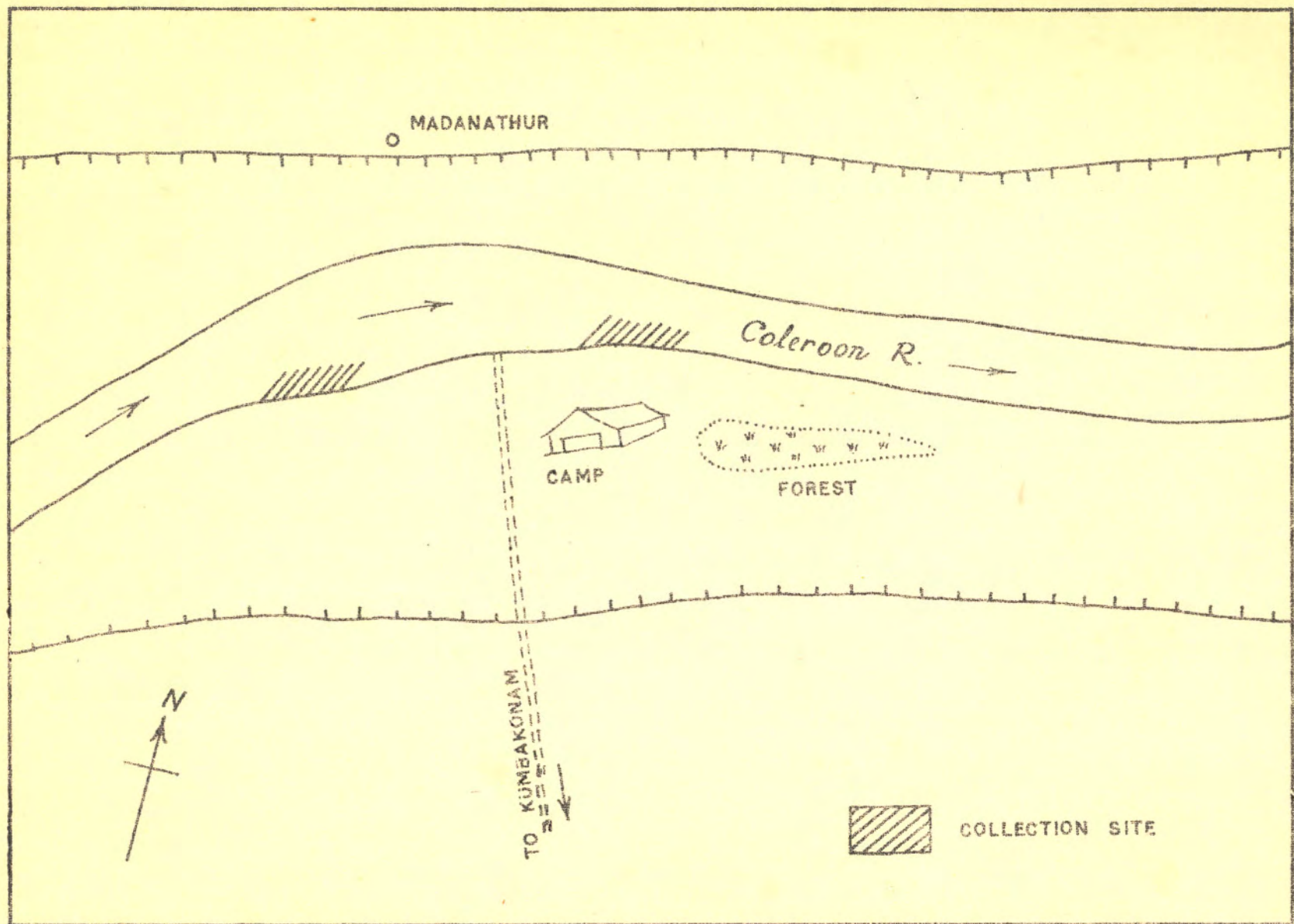


FIG. II. THE RIVER COURSE, GENERAL TERRAIN AND TOPOGRAPHY OF RIVER COLEROON AT NIRATHANALLUR.

Although the spawn occurred both during the rising and receding phases, bulk of the catch was obtained during a slight decline in water level in the rising phase of the first flood. The other 3 floods yielded spawn only in traces, except for a brief 4 hour period during the 3rd flood.

Details of occurrence, duration, desirability and magnitude of the three spawn spurts are shown in Table 13.

Spawn Quality : Of the three spurts, desirable spawn content was maximum in the first. Analyses of spawn samples revealed a desirable spawn content of 16% in the first spurt and 11% in the second spurt. The third spurt was entirely of undesirable quality. To determine the species composition of the spawn collected, samples from both the 1st and 2nd spurts were reared in nurseries. This rearing revealed a desirable carp content of 14.0% in the 1st spurt and 33.99% in the 2nd spurt. Details are given in Table 14. The observed differences in spawn quality as obtained by the two methods could be attributed to the drawing of water into the farm ponds directly from the adjoining canal without sieving, thereby allowing entry of other hatchlings and the mixing up of contents of the carious ponds which are interconnected with each other.

As such, taking these limitations into account, it is felt that the rearing did not give a clear picture of the spurts' species composition.

The indices of spawn quantity and quality for the centre were found to be 47.85 ml and 16.12% respectively.

Suitability of the prospected sites : Out of the eight sites surveyed in the selected stretch, only Kachperumalnatham was found to be suitable. The site can be approached through the embankment road from the Lower Anicut. All the remaining sites were found to be unsuitable, as they have very limited area for net operation.

Table 13

Flood-phase-wise occurrence, duration, desirability and magnitude of spawn spurts
at Nirathanallur on R. Coleroon in 1969

Flood details						Spurt details				
		Duration		Peak						
No.	Phase	Commencement Date/hr.	Total in hrs.	Date/hr.	Level in m	No.	Commencement Date/hr.	Dura- tion	Desira- bility	Catch in ml
I	Rising	14.7.69/14.00	116	19.7.69/6.00	0.59	1	14.7.69/4.00	8 hrs	D	882
	Receding	19.7.69/10.00	64	-	-	2	20.7.69/18.00	4 hrs 14 hrs	D UD	35 75
II	Rising	21.7.69/2.00	32	23.7.69/10.00	0.70					
	Receding	23.7.69/10.00	16							
III	Rising	23.7.69/2.00	32	25.7.69/10	0.61					
	Receding	25.7.69/10.00	76			3	25.7.69/14.00	4 hrs	UD	50
IV	Rising	28.7.69/14.00	Kept fluctuating irregularly till the close, mostly between 0.69 and 1.03.		1.03					

D = Desirable
UD = Undesirable

Table 14

Spurt-wise quality of spawn collected at Nirathanallur on R. Coleroon in 1969

Spurt No.	Desirability (D/UD)*	Spawn quality in percentage										
		By spawn analysis			By rearing							
		Major carps	Minor carps	Others	Desirable **			Undesirable ***				
					M	C	F	Gr.	K	R	B	O
1	D	16.00	85.50	0.50	-	1.00	7.50	2.50	3.00	0.50	62.50	23.00
2	D	22.00	78.00	-	0.97	13.60	19.42	-	-	5.50	11.65	48.86
	UD	3.14	94.76	2.10								
3	UD	-	100	-	-	-	-	-	-	-	-	-

*D = Desirable
UD = Undesirable

** M = C. Mrigala
C = L. Calbasu
F = L. Fimbriatus
K = L. Kontius
Cr = C. Cirrhosa

*** R = C. reba
B = L. bata
O = Others

5.1.6 Sosale stretch of River Cauvery

Participants

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After a detailed premonsoon survey of a 175 km stretch of river Cauvery between Krishnarajasagar and Hogainakal falls, Sosale, a Hobli Headquarters in the T. Narsipur taluk of Mysore district, studies on the north bank of the river, was selected for detailed spawn investigations during 1969. A considerable stretch of the river appeared to have either a precipitous bank or juxtaposing hill-ranges, rendering the river unsuitable for operation of shooting nets. However, the site at Sosale, about 5 km from T. Narsipur had an excellent approach from the metalled road. Besides having a sandy bed for operation of about fifty spawn collection nets, the collection ground had a gradually sloping bank. River Kabini drains into the Cauvery about 2 km downstream of the site at T. Narsipur. Fig. 12 diagrammatically depicts the bank contour and general topography of the site.

The observations at this site commenced on 21st May and lasted till 31st of September. In addition to the observations at Sosale, periodic prospecting was done at Bannur and Talakandu (Fig. 13).

Occurrence of spawn

In all, only 25 ml of spawn and 300 ml of eggs could be collected in the course of 19 major floods (total no. of floods 24) encountered in the river. Altogether 24 floods were encountered during the season, resulting from frequent release of water from the Krishnarajasagar Reservoir.

No sizable spawn spurt was observed during the entire season. With the recession in flood level, spawn showed up in traces, but the release of water at short intervals from the reservoir resulted in their dispersal. On 29.7.69 at 10 hrs., when the water receded after attaining a peak of 2.94 m, 0.5 ml of spawn could be collected, but soon from 18 hrs.,

the water level started rising abruptly and the spawn disappeared. Similarly on 30.7.69 at 2 hrs, spawn again showed up with the receding phase of the flood, but from 6 hrs. an upward tendency of the flood level offset the process. Again on 1.8.69 at 10 hrs., spawn (0.5 ml) showed up with the recession in flood level, but was soon lost with the rise in flood level from 14 hrs. Thus, no spawn spurt could be encountered at the site.

Spawn quality : The meagre quantities of spawn collected at Sosale could not be reared on account of want of rearing facilities. Microscopic examination of the spawn samples revealed only a negligible percentage (Nil - 0.4%) of desirable species.

Suitability of prospected sites : During spawn prospecting at Talakadu, 300 ml of eggs could be collected at a time when the egg-spurt was waning. For want of transport and rearing facilities, their species composition could not be determined. However, two advanced fry of C. catla were also collected at Talakadu. Both the prospected sites failed to yield any spawn.

The failure of the centre and the prospected stretch to yield any spawn-spurt may be attributed to :

- 1) The paucity of deep pools in the stretch investigated,
- 2) Very frequent release of water from the K.R.S. Reservoir, which must have dispersed the spawn flowing in the river,
- 3) Very low turbidity values (180 - >394 ppm) prevailing throughout the season, bringing down the efficiency of standard nets,
- 4) The mass destruction of migratory and brood fishes near the minor falls at Chanchunkatte (situated 32 km upstream of K.R.S.), which acts as barrier for the carps ascending from Krishnarajasagar, and
- 5) Inability of the fishes to ascend above Hogainakal falls. Fishes ascending from the Mettur Reservoir can only reach Hogainakal falls and congregate there in pools. To allow the fishes to ascend further, a 70-80 ft rise in water level is needed to bring it at par with that of the falls.

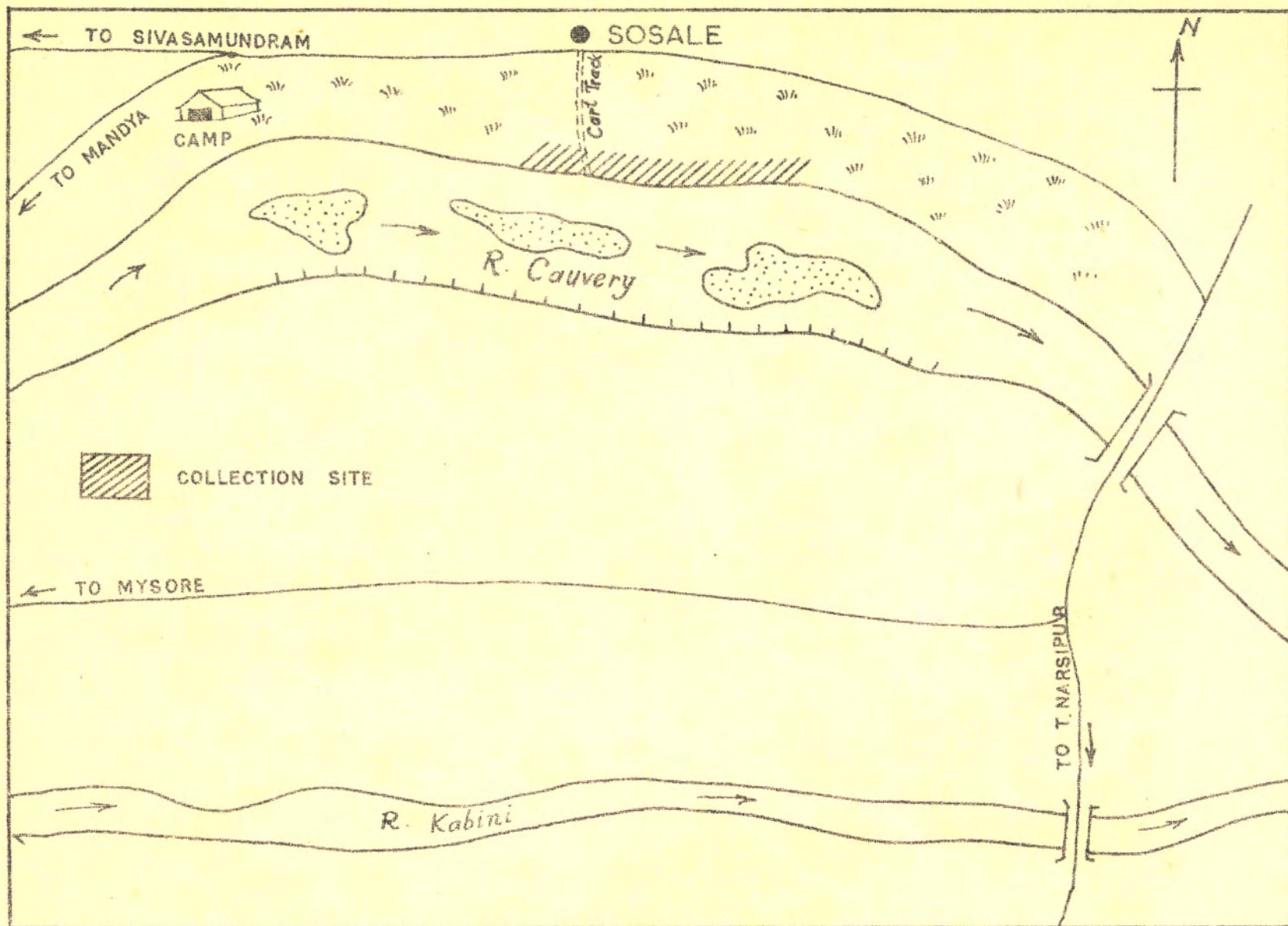


FIG 12. THE RIVER COURSE, GENERAL TERRAIN AND TOPOGRAPHY OF RIVER CAUVERY AT SOSALE.

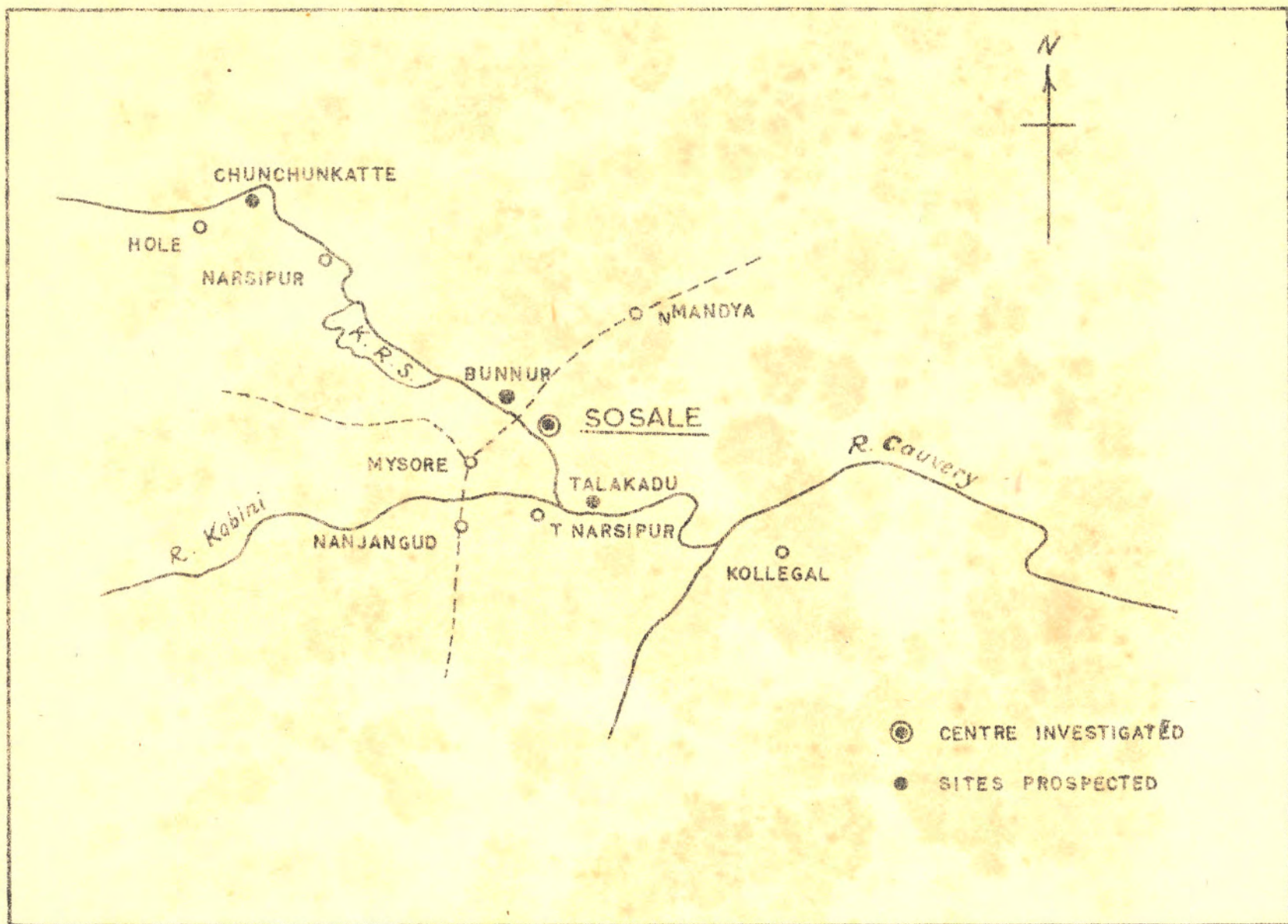


FIG. 13. SOSALE STRETCH OF RIVER CAUVERY SHOWING SITES PROSPECTED AND CENTRE INVESTIGATED.

5.2 Spawn availability in relation to environmental factors at investigated sites.

5.2.1 Flood level

At Baretha Barrier on R. Gambhir, the magnitude of spawn availability was too low to discern any relationship to flood level and other environmental factors. The little quantity of spawn that was obtained at the site occurred during the receding phase of the low I flood, which attained a peak level of only 2.49 m. During the period of availability the water level fall by 1.11 m in 14 hours. The II flood, which attained a peak level of 5.81 m, failed to yield any spawn. At Mahewapatti on R. Yamuna also, as observed at the other Yamuna centres, spawn occurred during the receding phases of floods. While the I flood failed to yield any spawn, the II flood yielded a greater position of the season's desirable spawn. This flood reached a peak level of 79.17 m above M.S.L., while the I flood recorded a peak level of 75.48 m above M.S.L. The III flood reached the peak level of 82.44 m above M.S.L. and yielded an appreciable quantity of desirable spawn. However, the major carp content of the II flood's spawn was much better than that of the III flood. This pattern had been observed earlier in other centres on R. Yamuna. It was observed that higher rates of spawn collection at Mahewapatti were associated with the rate of flood fall of about 1-2 cm/hour.

At Bahiara on the Son, peak collection of spawn was made during the I flood, when the receding flood level touched 2.70 m above the summer level on 9.7.69, from peak level of 3.23 m, the fall in the course of a day being 0.49 m. The spawn continued to be available during the succeeding two days, when the average flood levels were 2.35 m and 2.25 m respectively, the respective daily falls being 0.35 m and 0.10 m. During the II flood- spawn became available in bulk only briefly when the receding flood level touched 2.84 m. But this flood failed to recede further and no more spawn was available. As such, the I flood appears to provide more favourable water level and suitable rate of fall for bulk appearance of spawn at the site. Spawn availability over a longer duration was noticed during the III flood, but due to frequent abrupt vacillation in water level, only traces of spawn could be collected.

At Dighwara on the Ganga, it was noticed that flood levels above 3.5 m failed to yield any spawn beyond traces only.

At North Gauhati site on the Brahmaputra, it was seen that spawn became available only during the I flood and a part of the II flood, when the water level was below 545.00 cm. Beyond this level, the site became unsuitable.

At Nirathanallur on the Coleroon, it was observed that fluctuations in water level were dependent on water discharges from the Grand Anicut. The very first discharge appears to have stimulated the fishes to breed, since the bulk of the season's catch was obtained during the first flood. Attainment of sufficient water level in this river early in the season is necessary for connecting it to the Viranam tank, which is a good source of breeders. Failure to achieve the level in time before the tank gets flooded through local rains, results in the carps breeding in the Tank itself.

The frequent abrupt changes in water level in the Cauvery came in the way of spawn availability in the selected stretch.

5.2.2 Current velocity

The earlier finding regarding the suitability of a current velocity range of about 1.00-3.00 km/hr for spawn collection was found valid during 1969 also. The brief spawn availability period at Baretha Barrier coincided with a current velocity of 2.25 km/hr, while it was around 1.0-1.5 km/hr at Mahewapatti during the I flood, which yielded the maximum quantity of spawn. At Bahiara and North Gauhati on the other hand, current velocity at the time of spawn availability ranged from 0.70 to 0.99 km/hr and 0.76 to 1.07 km/hr respectively. At Nirathanallur, the current velocity range of 0.68 to 1.50 km/hr prevailed during the period of spawn availability.

Current velocity, in combination with turbidity, largely determined the catchability of spawn nets.

5.2.3 Turbidity

Turbidity was not correlated directly with spawn availability. It was of importance in determining the efficiency of the spawn collection nets. However, turbidity of river water at all the sites increased with the coming of the floods and often turbidity values reached their peak during the time of peak collection of spawn,

as at Bahiara on R. Son and Dighwara on R. Ganga. Turbidity was generally above 500 ppm and upto 1255 ppm at Mahewapatti, Baretha Barrier, Bahiara, Dighwara and Tilanthu centres at the time of bulk spawn availability. However, turbidity values remained low even during spawn spurts in the Brahmaputra, Coleroon and Cauvery, under which condition the catching efficiency of the standard net goes down. This is attributed as one of the reasons for the poor spawn catch at Sosale on the Cauvery, where the turbidity ranged from 12 to 52 cm. It ranged from 107 to 205 ppm and 107 to 195 ppm respectively in the Brahmaputra and Coleroon during periods of spawn availability.

Turbidity of water is generally taken as an index of spawn availability in R. Ganga in the region of Dighwara. This was found to be true, in that the incursion of silt-laden red-coloured flood waters of the Son into the milky waters of the Ganga coincided with the appearance of spawn at Dighwara, since the Son waters were actually bringing down the spawn bred in the lower reaches of R. Son.

5.2.4 Associates

No indicator species could be made out among the associates at any of the centres. The only correlation was that the magnitude of associates was generally more during periods of spawn availability.

5.3 Catching efficiency of spawn nets in relation to size, mesh size and material

5.3.1 Net efficiency in relation to net size

Four sizes of nets, viz. the 6 m, 10 m, 14 m and 18 m nets, made of Midnapore-type 1/8" meshed handloom netting of 105 cm width, were employed for testing the effect of net size on its catching efficiency. The 6 m, 14 m, and 18 m nets were fabricated on exactly the same pattern as the 10 m standard net. These nets were operated under a 'Latin square' experimental design. Five replications of the experiment were possible within the period of spawn availability. The results when subjected to analysis of variance showed that the effect of net size was highly significant at 1% level.

The details of catching efficiency of the various nets are given in Table 15.

Table 15Catching properties of different sized nets

Net size	Average catch in ml			
	6 m	10 m	14 m	18 m
Catch per net per hour	17.250	45.875	77.375	27.275
Catch per net per hour per metre of cloth	2.8750	4.5875	5.5269	1.5153
Catch per net per hour per metre of width of mouth	7.19	14.80	20.68	6.36

The above table shows that the 14 m net was clearly the most efficient of the lot on all counts, while the 6 m and 18 m nets were found to be inferior to the standard net. The 18 m net was found to be too big and unweildy for proper stretching, with the result that it sagged heavily in the middle, thereby adversely affecting the flow of water through the ring.

5.3.2 Net efficiency in relation to mesh size

Two experimental nets, identical to the standard net in material, dimensions and type but of mesh sizes 1/12" and 1/16" respectively, were tested at Mahewapatti for their efficiency against the standard net, in a latin square design with six repetitions of the rows of the latin square. During the experiment, current velocity ranged from 0.45-1.20 km/hr, while the turbidity was around 750 ppm. The extremely high net to net variability rendered the precision of tests extremely low. In general, the 1/16" meshed net was seen to be distinctly more efficient than the other two during the first four hours of operation, after which its efficiency dropped to less than that of the other two.

At North Gauhati on the Brahmaputra, only the 1/12" meshed net was tested against the standard net. The average catch per net-hour in the 1/12" meshed net worked out to 16.65 ml, against 7.16 ml in the standard net. Details of spurtwise relative efficiency of the experimental net are shown in Table 16.

Table 16

Comparative efficiency of 1/12" meshed experimental net

Spurt No. & Date	Flood No.	Catch in Nos. per net-hour		Relative efficiency of experimental net in percentage	
		Standard net (1/8" mesh)	Experimental net (1/12" mesh)	Spurt-wise	Flood-wise
<u>S₂</u> 23.5.69	I	5,365	6,550	123.95	
<u>S₄</u> 25.5.69	I	2,875	8,335	289.91	181.85
<u>S₆</u> 9.6.69	II	4,735	10,355	218.69	195.29

As can be seen from the above table, the relative efficiency of the 1/12" meshed net ranged from 123.95-289.91%. This higher efficiency of the smaller meshed net is readily attributed to the low turbidity of the Brahmaputra waters, wherein the spawn are prone to escape through the larger meshes of the 1/8" meshed net in the absence of reduction of its meshed through silt deposition.

In order to study further the comparative qualities of the $1/8"$ and $1/16"$ meshed nets as regards their catching efficiencies, experiments were initiated with 10 m nets of the two meshes to assess the filtration rate of water through them, since spawn retention by a net is dependent on the amount of water passing through it. In the case of $1/16"$ meshed net, the net mouth velocities were found to fall almost to zero in eight hour of operation; under conditions of 1200 ppm turbidity and a current velocity of 1.5 km/hr. Excepting for some points near the centre of net mouth, there was vomiting of spawn from the running areas. The velocities at net mouth were measured at eight points, four at surface level of water and the other four at sub-surface points, 25 cm below surface. Due to hydropressure, the net mouth got enlarged by about 50% and the lower belly portion got completely pushed to the river bed with heavy sand and silt deposition. The $1/8"$ meshed net under similar conditions showed an average fall of 30-35% in the inflow of water into the net.

5.3.3 Net efficiency in relation to material

The Bihar Fisheries Department employed nets of two materials, cotton and synthetic. These two types of nets differed in dimensions, as well as in mesh size (vide supra) and as such their results are not comparable. At Dighwara, while the synthetic net yielded a slightly better result during the I flood, the cotton net proved a little more efficient during the II flood. The positional identities of the two sets of nets were also separate, thereby further reducing the value of the results. Frequent clogging of meshes by silt and heavy mortality was observed in the case of synthetic net. This was evidently due to its smaller mesh size of $1/24"$, compared to the cotton nets $1/16"$ mesh. It was further seen that the synthetic net could not stabilise itself in water at higher velocities.

6.1 Potentiality of investigated sites

In the foregoing pages have been elucidated the various details regarding the occurrence, quantity and quality of spawn spurts at the various selected centres, their relation to environmental factors and experimental work to determine the catching efficiencies of spawn nets in relation to net size, mesh size and material. Of the 8 centres investigated, including the two operated by the State staff alone, only Bahiara on R. Son and Dighwara on R. Ganga appeared to be fairly lucrative, while Tilanthu on the Son and Mahewapatti on the Yamuna appeared to be moderately good centres. On the other hand, even though North Gauhati on the Brahmaputra yielded over 1200 ml of spawn, it was all of the undesirable type, while Sosale on the Cauvery and Baretha Barrier on R. Gambhir were found to be totally unsuitable for commercial exploitation. Nirathanallu on R. Cauvery was also a poor centre.

Major carps were totally absent in the little quantity of spawn collected at Baretha Barrier, while it was nearly the same at Sosale too. Harnessing of the river by a series of dams and erratic water discharge, coupled with large scale massacre of migrating breeders near obstructions, were largely responsible for the failure of the Sosale site. Likewise, R. Gambhir and its tributaries are also extensively barricaded with a series of earthen dams and large scale massacre of breeders migrating from the Yamuna is also reported. This accounts for the failure of the Baretha Barrier centre. In both the above cases, absence of deep pools precludes the possibility of a local population of breeders.

The North Gauhati site on the Brahmaputra remained suitable for spawn collection only during the early floods, at which time, however, the quality of spawn obtained was found to be quite poor. By the time the spawn quality improved, the site had become unsuitable. It was reported, as well as unified through analysis of spawn samples, that desirable spawn in quantities were available later at some of the other centres, like Khanarnket, Palastian and Bamundi. Khanamuck had earlier been found unsuitable for exploitation during the I flood. As such,

it is necessary in the Brahmaputra not to remain stationary at one spot throughout the season, but to move promptly from one site to another, depending on their suitability in the course of the season. In Kamrup district, it appears that sites suitable for operation under higher flood levels of the later floods are only likely to yield desirable spawn in appreciable quantities. A high percentage of Labeo bata was throughout observed in the spawn catches. Since this fish is being cultured and is fairly fast growing, the spawn catches can be made use of, even though their major carp content is poor.

The two centres on R. Son and the single centre on the adjoining stretch of the Ganga, all yielded spawn of very high quality. The study has revealed that major carp breeders ascend from the Ganga into the Son, there they apparently breed profusely below the Indrapuri Anicut, while only a few might be successful in going above the anicut. The spawn thus bred in the Son flows down into the Ganga, where it gives ample material for lucrative spawn collection in the Dighwara stretch. The species composition of spawn spurts was nearly similar at all the three centres, but the magnitude was decidedly low at Tilanthu. However, the quantity and quality of spawn were reported by much higher in the region further upstream of Tilanthu near the confluence of R. Koel with R. Son. All the three centres yielded spawn spurts only during the earlier floods. The failure to collect spawn in bulk quantities in later floods was mainly due to the frequent and quick vacillations of the flood level dispersing the spawn.

Mahewapatti on the Yamuna was found to be a centre of average potentiality, yielding moderately high quality spawn. At Nirathanallur on the Cauvery, only the 1st spurt yielded a sizable quantity of spawn, which, even though desirable, did not have more than 20% of major carps. This site is also handicapped by the harnessing of the river both above and below the site, and since the flooding in this stretch largely depends on the release of water from the Grand Anicut, spawn production and availability cannot be expected on any regular pattern.

The seasonal indices of spawn quantity and quality for the various investigated sites are given in Table 17.

Table 17

Seasonal indices of spawn quantity and quality at the various sites investigated in 1969

Name of river	Name of centre	Index of quantity (ml)	Index of quantity (% of major carps)
Yamuna	Mahewapatti	1,098	52.2
Gambhir	Baretha Barrier	-	-
Son	Bahiara	252	88.5
Brahmaputra	North Gauhati	-	8.62
Coleroon	Nirathanallur	47.85	16.12
Cauvery	-	-	-

6.2 Spawn availability in relation to environmental factors

In most of the investigation centres, the early low floods yielded the bulk of the season's catch. Frequent and erratic water discharges along harnessed rivers often upset first breeding and spawn availability. A current velocity range of 0.68-2.25 km/hr was noticed during the periods of bulk spawn availability at the various sites. Since turbidity influences net selectivity, nets of smaller meshes than the standard net should yield better results in the less turbid waters of the Brahmaputra, Coleroon and Cauvery. At Dighwara on the Ganga, appearance of turbid waters heralds the appearance of spawn, coming down along with the silt-laden red-coloured flood waters of the Son.

6.3 Net efficiency in relation to size, mesh size and material

Experimental work carried out with four sizes of nets (6 m, 10 m, 14 m and 18 m) showed that the effect of net size on its efficiency was highly significant at 1% level.

Of the four nets, the 14 m net appeared to be the best, while the standard net (10 m net) was superior to the other too. The 18 m net suffered from its big size resulting in heavy sagging in the middle, thereby hindering the filtration rate. It may be worth while to try some internal frame work for this net to help it retain its shape while in operation and to see whether it would yield better catches.

Experimental operation of nets of different meshes ($1/8"$, $1/12"$ and $1/16"$) under turbidity conditions of around 750 ppm and current velocity of 0.45-1.20 km/hr, indicated the $1/16"$ meshed net to be most efficient during the first four hours, after which, however, its efficiency was the least. The $1/12"$ meshed net proved distinctly superior to the $1/8"$ meshed standard net in the less turbid waters of the Brahmaputra. This again pinpoints the necessity for adopting different mesh sizes for different combinations of turbidity and current velocity.

The work carried out by the Bihar Fisheries staff in testing the relative efficiencies of cotton and synthetic netting is far from satisfactory, since the two nets differed widely in dimensions and mesh size. All the same, it has indicated certain inherent differences in the two types of material. It is, therefore, worthwhile to test these two materials in a statistically designed experiment with identical nets of the two materials.

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SUMMARY

i) Spawn prospecting investigations in the 1969 were carried out along seven riverine stretches in the country, one each of the rivers Gambhir, Yamuna, Son, Ganga, Brahmaputra, Coleroon and Cauvery.

ii) After a pre-monsoon survey, 7 centres were selected for detailed investigation, viz. Baretha Barrier on R. Gambhir (Rajasthan), Bahiara and Tilanthu on R. Son (Bihar), Dighwara on R. Ganga (Bihar), North Gauhati on R. Brahmaputra (Assam), Nirathanllur on R. Coleroon (Tamil Nadu) and Sosale on R. Cauvery (Mysore). Mahewapatti on R. Yamuna (U.P.) was taken up as the 8th centre, as part of the long-term investigations to understand the role of environmental factors in spawn occurrence and

drift. The centre on R. Ganga was taken up to study the inter-relationship between the rivers Son and Ganga in regard to spawn availability in two rivers.

iii) Baretha Barrier on R. Gambhir was found to be totally unsuitable for spawn collection. It yielded a total catch of only 135 ml spawn in the entire season, and that too was completely devoid of major carps. The prospected sites in this stretch also did not yield any spawn. This may be attributed to the erection of numerous earthen dams across the river and its tributaries and large scale capture of breeders ascending from the Yamuna. Indices of spawn quality and quantity were nil for the same.

iv) A total of 8715 ml of spawn was collected at Mahewapatti on the Yamuna in 3 spurts, of which 2210 ml only were desirable. The desirable spawn were obtained in the 2nd and 3rd spurts during the receding phases of floods II and III. The seasonal indices of spawn quantity and quality for this site were 1,098 ml and 52.2% respectively.

v) At Bahiara on R. Son below the Indrapuri Anicut, a total of 3120 ml of spawn was collected in 1-5 standard nets and State nets. Of the above, the standard nets yielded 1690 ml of spawn, all desirable, in 5 spurts during the first two floods. All the spawn spurts showed a high major carp content. The seasonal indices of quantity and quality were estimated to be 252 ml and 88.5% respectively.

vi) Tilanthu on R. Son above the Indrapuri Anicut yielded 900 ml of high quality spawn, similar to that at Bahiara, during the first two floods. However, the magnitude of the catches was distinctly less than at Bahiara.

vii) A total of 2,806 ml of high quality spawn, was collected in 1-5 experimental nets of the State at Dighwara on the Ganga. The I flood yielded the greater bulk of the season's catch.

viii) A close similarity is evidenced in the period and floods of occurrence and quality of the spawn spurts at Tilanthu, Bahiara and Dighwara. The observations revealed that major carps from the Ganga migrates up the Son and breed

there, and the resultant spawn drift down into the Ganga. The Indrapuri Anicut appears to have adversely affected the upward migration of the breeders.

ix) A total of 1,223 ml of only undesirable spawn could be collected in six spurts during the first two floods in the Brahmaputra at North Gauhati. The catches had a very high content of L. bata. The site was found to be suitable only during the earlier low floods. Desirable spawn was, however, available in the later floods at some of the adjoining centres. The seasonal indices of quantity and quality were nil and 8.62% respectively.

x) 917 ml of desirable and 125 ml of undesirable spawn were collected in 3 spurts at Mirathanallur on R. Coleroon in 1-5 standard nets. A further quantity of 1197 ml of spawn was also collected in 1-3 research nets, 2 extra standard nets and in between the spurts. The seasonal indices of spawn quantity and quality were estimated to be 47.85 ml and 16.12% respectively.

xi) Sosale on R. Cauvery failed to yield any spawn spurt. What little was obtained in traces contained practically no desirable species. The failure of this centre is attributable to frequent water discharges from the K.R.S. Reservoir, large scale capture of breeders, lack of deep pools and low turbidity of the water.

xii) In most of the centres, the early low floods yielded the bulk of the season's catch. During periods of spawn availability, current velocity ranged from 0.68-2.25 km/hr.

xiii) Of the 4 sizes of nets tried (6, 10, 14 and 18 m nets), the 14 m net appeared to be most efficient, while the 10 m standard net was found to be superior to the 6m and 18 m nets.

xiv) The 1/12" meshed net proved distinctly superior to the 1/8" meshed net in the less turbid waters of the Brahmaputra. The 1/16" meshed net displayed better operational efficiency than the 1/8" and 1/12" meshed nets during the first 4 hours of operation, after which its efficiency dropped below that of the other two.

xv) Experiments carried out to test the effect of material on net efficiency did not give any reliable results due to differences in net size and mesh size of the two nets.

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