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Report on

FISH SPAWN PROSPECTING INVESTIGATIONS

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ASSAM BIHAR WEST BENGAL
AND UTTAR PRADESH



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CENTRAL INLAND CAPTURE FISHERIES RESEARCH INSTITUTE
(INDIAN COUNCIL OF AGRICULTURAL RESEARCH)
BARRACKPORE - 743 101 WEST BENGAL INDIA

REPORT ON FISH SPAWN PROSPECTING INVESTIGATIONS, 1971
ASSAM, BIHAR, WEST BENGAL AND UTTAR PRADESH

by

H.P.C. Shetty

K.K. Ghosh, K.V. Rao, M. Yusuf Kamal, P. Das, S.K. Wishard,
S.D. Gupta, N.K. Srivastava and P.M. Mathew

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(Indian Council of Agricultural Research)
Barrackpore, West Bengal

INDIA

FOREWORD

Detailed spawn prospecting investigations initiated by the Central Inland Fisheries Research Institute in 1964 and carried through till 1970, established the necessity and importance of such studies for augmenting the fish seed supply so urgently required for meeting the huge deficit of fish seed in the country. These investigations also helped towards the attainment of the ultimate aim of gaining regional self-sufficiency and pinpointed the need for improvement in spawn collection methods. The findings made in these investigations led the Indian Council of Agricultural Research to launch an All-India Co-ordinated Research Project for "Investigations on Riverine carp spawn prospecting and collection techniques" in 1971. The collaborating States, under the Project, viz., Assam, West Bengal and Bihar, provided certain facilities, whereas, the major share of manpower, equipment and contingencies were borne by the Project. The Project is envisaged to work on the Ganga-Brahmaputra river complex on an integrated basis to find the spawn bearing potentiality of these river systems in the chosen States and also to develop more efficient spawn collection techniques.

The work done during the first year of the Co-ordinated Project in the States of Assam, Bihar and West Bengal and also at Allahabad, the headquarters of the Project and the results obtained therefrom are embodied in this report.

The investigations were carried out by a team of workers comprising officers of the Project and staff drawn from the Central Inland Fisheries Research Institute and the respective State Fisheries Departments, under the overall supervision and guidance of the Project Co-ordinator, Shri H.P.C. Shetty, assisted by Shri K.K. Ghosh, the Project's Statistician. This report has been prepared by Sarvashri H.P.C. Shetty and K.K. Ghosh, based on the reports of individual officers, who worked in the field and analysed the data and were in immediate charge of the field investigations. The State personnel worked in the field, while the analyses and preparation of reports thereon was done entirely by the Project Officers.

Shri R.K. Saxena, Research Assistant, has made all the drawings included in this report.

The active collaboration of the Directorates of Fisheries, Assam, Bihar and West Bengal in the smooth operation of the Project is gratefully acknowledged.

V. G. Jhingran
(V.G. Jhingran)
Director

Central Inland Fisheries
Research Institute,
Barrackpore.

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The acute shortage of fish seed required for pisciculture in the country was recognised with the setting up of the Fish Seed Committee by the Government of India in 1962. The report of this Committee (Anon, 1966) focussed attention on the huge gap of 580 crores of spawn to meet the country's immediate requirement of stocking the readily cultivable waters and advocated for concerted big efforts to raise seed production by tapping new seed resources. The Central Inland Fisheries Research Institute had recognised this earlier and by 1964 had initiated detailed spawn prospecting investigations aimed at locating new high yielding quality spawn collection centres all over the country, with a view to achieving required self-sufficiency. These investigations also aimed at evolving of new spawn collection techniques suitable for various hydrodynamical and hydrographical conditions. These investigations led to some very valuable results (Anon, 1965; Malhotra et al., 1966; Shetty, 1967; Shetty et al.; MS.1; Shetty et al.; MS.2; Shetty et al., MS.3; Shetty et al., MS.4; Ghosh and Sinha, MS.; Ghosh, Sinha and Srivastava, MS.;). The necessity for taking up spawn prospecting investigations along with research on development of more efficient and economical collection techniques on a more intensive and integrated way was amply demonstrated in these studies. Therefore, the Indian Council of Agricultural Research launched an All India Co-ordinated Research Project for "Investigations on carp spawn prospecting and collection techniques" in 1971 for operation in three States, viz. Assam, Bihar and West Bengal, with the Project Headquarters at Allahabad, where some basic studies initiated earlier by the Institute were to be continued. In all, the investigations were conducted at four centres, one each in Assam, Bihar and West Bengal on the rivers Brahmaputra, Ganga and Kangsabati respectively, and one on R. Yamuna in Uttar Pradesh. The latter centre, viz. Mahewapatti, near Allahabad, was taken up for long term study over a period of several years for understanding in greater detail the occurrence and drift of spawn in relation to meteorological and hydrodynamical factors. While the former three centres had staff drawn from the collaborating States also in addition to the Project staff and Institute staff, the latter centre on R. Yamuna had only Project and Institute staff. Every centre was under the charge of a Junior Fishery Scientist of the Project. The fieldwork and subsequent analyses of material and data were done by the teams working at the respective centres.

2 PRE-MONSOON SURVEY AND SELECTION OF STRETCHES AND SITES

The integrated approach demanded that the rivers be worked as complete units and a systematic approach at determining their potentials be made. Accordingly, the river Brahmaputra was surveyed from Bhuragaon in the downstream upto Burhapahar, a stretch of 150 km length. This stretch is just upstream of the already investigated (Shetty *et al.* MS.₃; Shetty *et al.* MS.₄) stretches of the river Brahmaputra. In West Bengal, the entire freshwater zone of the river Kangsabati was surveyed downstream of the Dam at Mukutmanipur, near Khatra, the river upstream of the Kangsabati reservoir having been surveyed earlier in 1970 (Shetty *et al.* MS.₄). The middle stretch of the Ganga in Bihar was surveyed from Patna down to Mokameh in Bihar State.

Details of the stretches surveyed and the sites examined are shown in Table 1, while the identity and approach details of the sites selected for investigations are given in Table 2. Figure 1 depicts the geographical location of the selected river stretches and sites.

3 MATERIAL AND METHODS

3.1 Gear used

The provisionally accepted standard net (1/8" meshed Midnapore type spawn net) was the gear employed for assessing the spawn yielding potentiality of the selected stretches.

Other nets made of the same material as the standard net and having the same shape, but of different mesh size and size, were used for testing the effect of size and mesh size on the efficiency of the net. These nets were made of all possible combinations of the following.

- (i) Three mesh sizes, viz. 1/8", 1/12" and 1/16".
- (ii) Four sizes, viz. these made of 6 m, 10 m, 14 m and 18 m of 105 cm wide Midnapore-type handloom netting.

The twelve nets generating from combinations of these were required to be tested under a randomised block design, having blocks of two hours of operation during spawn availability.

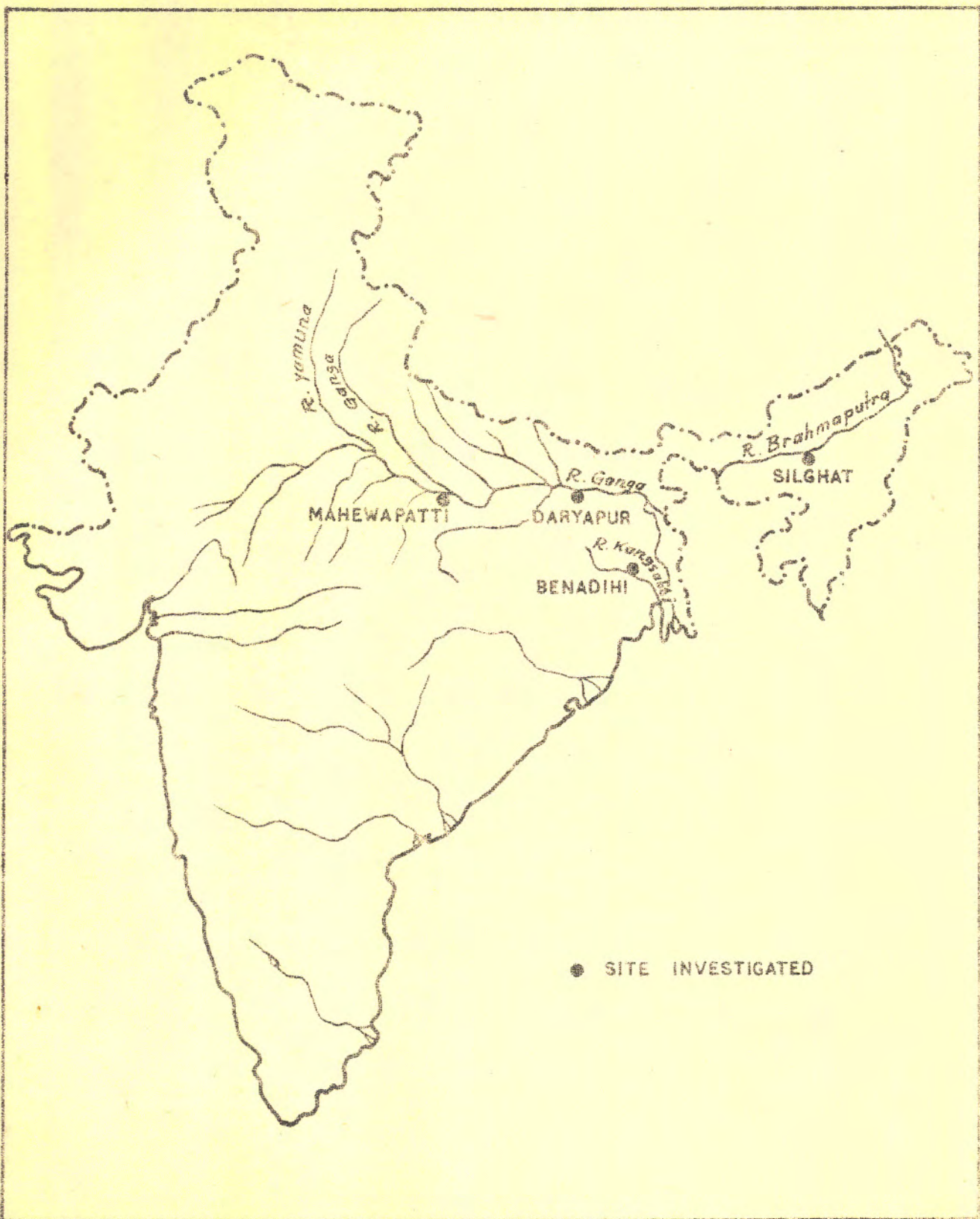


FIG. 1. MAP OF INDIA, SHOWING LOCATION OF SITES INVESTIGATED DURING FISH SPAWN PROSPECTING, 1971.

Table 1

Details of stretches surveyed and probable sites examined during pre-monsoon survey

Surveyed stretch									Selected stretch and site				
State	River	From	To	Length in km	Site	Bank	Suitability (S / US)	Justifica- tion for rejection or acceptance	From	To	Length in km	Site	
1	2	3	4	5	6	7	8	9	10	11	12	13	
Assam	R. Brahma- putra	Bhur- agaon	Bur- hapa- bar	150	Bhuragaon	S	US	Steep bank	Chanimari	Diphu-	100	S	
											lu con- fluence		I
					Dhinghat	S	US	-do-		L			
					Kadulimari	S	US	-do-		G			
					Chanimari	S	US	Inaccessible, ground available		H			
					Burbanda	S	US	Steep bank, Inaccessible		A			
					Silghat	S	S	Good ground, accessible		T			
					Burhapahar	S	US						
					Bishnath- ghat	N	US	Only suitable for very low flood					
					Panpur	N	US	-					
					Bharelim- ukh	N	US	-					
					Bhomaragu- ri	N	US	Unfavourable current					
					Tinkhoria	N	US	-					
					Singri	N	US	-					
					Barsola	N	US	-					
Kherupet- iaghat	N	US	-										
Mangaldoi- ghat	N	US	-										
Kurua	N	S	-										

1	2	3	4	5	6	7	8	9	10	11	12	13
	R. Kangsa- bati	Khatra	Panskura	250	Bhogra- ghat (opp. Gopalpur)	East	US	Gradually sloping bank. No spawn is expected, due to low population of major carps.	Tikaram- pore	Pans - kura	112	Bar- muni- bgarh (16.6.71 to 3.7.71)
West Bengal					Chiltor (opp. Raipur)	West	US	-do-				Bena- dihi (from 7.7.71)
					Simlighat (opp. Sarenga)	West	US	-do-				
					Panchkala (opp. Bikrampore)	East	US	-do-				
					Barmuni- bgarh	South	S	Good collection ground, accessible too.				
					Munibgarh	South	US	Precipitous bank				
					Benadihi	North	S	Good collection ground				
West Bengal	R. Subar- narekha	Sona- kunla	Bhonsra- ghat	40	Mirzapur	North	US	Precipitous bank				
					Barsoti	North	US	Undulating bank due to sand bars. poor accessibility.				
					Belmoda	North	US	Unsuitable current pattern. Inaccessible.				
					Bhonsra	North	US	Precipitous bank				

* US = Unsuitable

S = Suitable

Table 2

Identity and approach details of the main investigated sites with areas available for net operation therein

State	Assam R. Brahmaputra	Bihar R. Ganga	West Bengal R. Kangsabati	Uttar Pra- desh R. Yamuna
<u>Details</u>				
1. Stretch (from... to..)	Diphulu confluence to Chanimari	Patna to Mokameh	Tikarampur to Panskura	Same as given in Shetty et al. (MS. 2)
2. Length in km	100	110	112	
3. Selected site	SILIGHAT	DARYAPUR	BENADIHI *	
4. Bank of river	South	South	North	
5. Tehsil/Sub-Division	Silghat	Mokameh	Midnapore	
6. Police Station	-do-	-do-	-do-	
7. District	Nowgong	Patna	-do-	
8. Distance from Dist. Hqrs.		110 km	20 km	
9. Nearest P.O.	Silghat	Hathidah	Janardanpur	
10. Distance of (9) in km.	2 km	2 km	3 km	
11. Nearest T.O.	Silghat	Hathidah	Kharagpur	
12. Distance of (11) in km.	2	2	22	
13. Nearest Telephone office	Silghat	Hathidah	Kharagpur	
14. Distance of (13) in km	2	2	22	
15. Nearest All weather road at	Silghat	Daryapur	Lachmapur	
16. Distance of (15) in km	nil	nil	5 km	
17. Nearest Rly. Station	Silghat	Hathidah	Kharagpur	
18. Distance of (17) in km	2	2	22	
19. No. of nets that can be operated at different flood levels	200-300 nets at all floods < 5 m above summer level	100 nets, < 2 m 50 nets > 2 m above summer level.	20 nets < 3.40m > 3.40 m above summer level.	

* Observations at Benadihi from 7th July. Earlier observations at Barmunbgarh from 16th June.

In addition to the above, the escapement properties of hatchling were proposed to be studied by employing full-cover and cod-end covered nets having a 6 m 1/8" or 1/12" meshed net as the principal gear and providing 1/16" and 1/24" meshed covers respectively.

3.2 Techniques of collection and analysis and for determination of hydrographical and meteorological factors

The techniques employed for collection, measurement and qualitative analyses of spawn and for determining selected hydrographical and meteorological factors were the same as those adopted by the Institute in 1964 (Anon, 1965) and later modified in 1965 (Malhotra, Ghosh and others, 1966). The frequency of observations was, likewise, the same, except for a slight modification of hourly observations of catches in trial nets during periods when spawn appearance was likely.

4 DEFINITIONS

The definitions adopted for the investigations were the same as proposed in 1964 (Anon, 1965) and modified by Malhotra, Ghosh and others (1966) and Shetty (1967).

5 OBSERVATIONS

5.1 Quantitative and qualitative spawn yielding potentiality of selected stretches

5.1.1 Silghat stretch of R. Brahmaputra

Participants:

Shri K.V. Rao, J.F.S.-in-Charge, Assam Centre., C.I.F.R.I.

Shri S.K. Wishard, R.A., C.I.F.R.I.

Shri S. Ali, Superintendent of Fisheries - Govt. of Assam.

Shri G.D. Majumdar, Marketing Inspector - Govt. of Assam.

A survey to assess the spawn yielding potentiality of *R. Brahmaputra* was initiated by the CIFRI in 1969. The lower stretches in Goalpara and Kamrup districts were covered during 1969 and 1970. The Project, therefore, started prospecting the river upstream of the stretch already covered, in a systematic survey of the river as to its spawn bearing potentiality.

The stretch selected for prospecting extended from the confluence of Diphulu water course with the Brahmaputra in the east to Chanimari in the west, a stretch of approximately 100 km (Fig. 2). Within this stretch, called here the Silghat stretch, the main investigations site was selected at Silghat on the south bank. Silghat is a town connected by rail with the district headquarters, Nowgong. It also provides a major link with the north bank through its steamer ghat, wherefrom steamers ply to Tezpur on the opposite bank.

The operational site at Silghat is a gentle slope, interspersed with flat areas, extending for a length of more than a kilometer (Fig. 3). As will be seen from Fig. 4, the river bank is steep in the beginning, followed by a stretch of flat area, about 100 m in width. The flat area in its turn ends in a ridge which gradually slopes towards the water margin for a width of another 100 m. The whole operational space is of sandy terrain.

Occurrence and magnitude of spawn spurts:

During the period of observations from 22.5.71 to 8.7.71, the river experienced two floods and the rising phase of another flood. In addition to the above, the river had already received the first flood during the second week of May, 1971, prior to the commencement of the investigations. The second flood lasted for a short duration of about 10 days between 24.5.71 and 2.6.71 while the third flood extended over a longer period of 23 days till 25.6.71 (Table 3). The rising phase of the last flood started on 26.6.71.

Six spawn spurts of varied duration and magnitude were available during the period from 3.6.71 to 13.6.71, which constituted the rising phase of the third flood. The spawn appeared for the first time at 22.00 hrs. on 3.6.71. This spurt lasted for four hours only, yielding 10 ml in one net. The second spawn spurt, bringing in a catch of 193 ml in five standard nets, was come across from 16.00 hrs. to 04.00 hrs. on 5.6.71. The third spurt which was the major spurt of the season and yielded 2,220 ml spawn in five nets, passed through the river between 20.00 hrs. and 04.00 hrs. on 7.6.71. Of the remaining three spurts, only two were of

significance, contributing 583 ml and 650 ml respectively on 8.6.71 and 13.6.71. The former lasted for 6 hours between 22.00 hrs. and 04.00 hrs. and the latter for 13 hrs from 07.00 hrs. to 20.00 hrs. In between these two, on 9.6.71, a minor spurt occurred between 16.00 hrs. and 20.00 hrs. on 9.6.71, the catch in five standard nets being 25 ml only.

Thus, spawn was available at Silghat for a total duration of 45 hrs. in the rising phase of the third flood, and a total quantity of 3,681 ml of spawn could be collected in five standard nets. Out of this, the third spurt accounted for the maximum, its percentage contribution being 60.31.

Details of occurrence, duration, magnitude and desirability of spawn spurts at Silghat along with their relation to the phase of the flood are presented in Table 3.

Quality of spawn collected:

The quality of spawn collected at Silghat, as revealed by microscopical analyses and rearing of spawn in State nurseries, nursery pits and plastic pools, is delineated in Table 4. As per the microscopical analyses, only the third and fourth spurts yielded desirable spawn, their desirable content being 30.07% and 13.00% respectively. The bulk of the catches in all the spurts contained minor carps, their percentage varying between 68.14 and 98.70. While prawns and mullets contributed considerably in the first two spurts, they were recorded in negligible quantities in the remaining spurts.

The major carp content in different spurts, as revealed by the rearing in the nursery pits and plastic pools, was very poor. Among the major carps, rohu was the only species recorded in negligible quantities (0.12% and 0.20% respectively) in plastic pool rearing of samples taken from the fourth and fifth spurts. While catla was recorded in the nursery pit rearing of fourth spurt spawn only, rohu was present in negligible numbers in the samples taken from the last three spurts. The bulk of the samples from these rearings contained minor carps, among which bata dominated.

The results of rearing of spawn samples taken from the second, third, fourth and sixth spurts in state nurseries presented an entirely different picture. The major carp content in these spurts was found to be 5.56%, 27.19%, 20.07% and 3.19% respectively. While rohu was recorded from all these spurts, catla was absent in the second spurt.

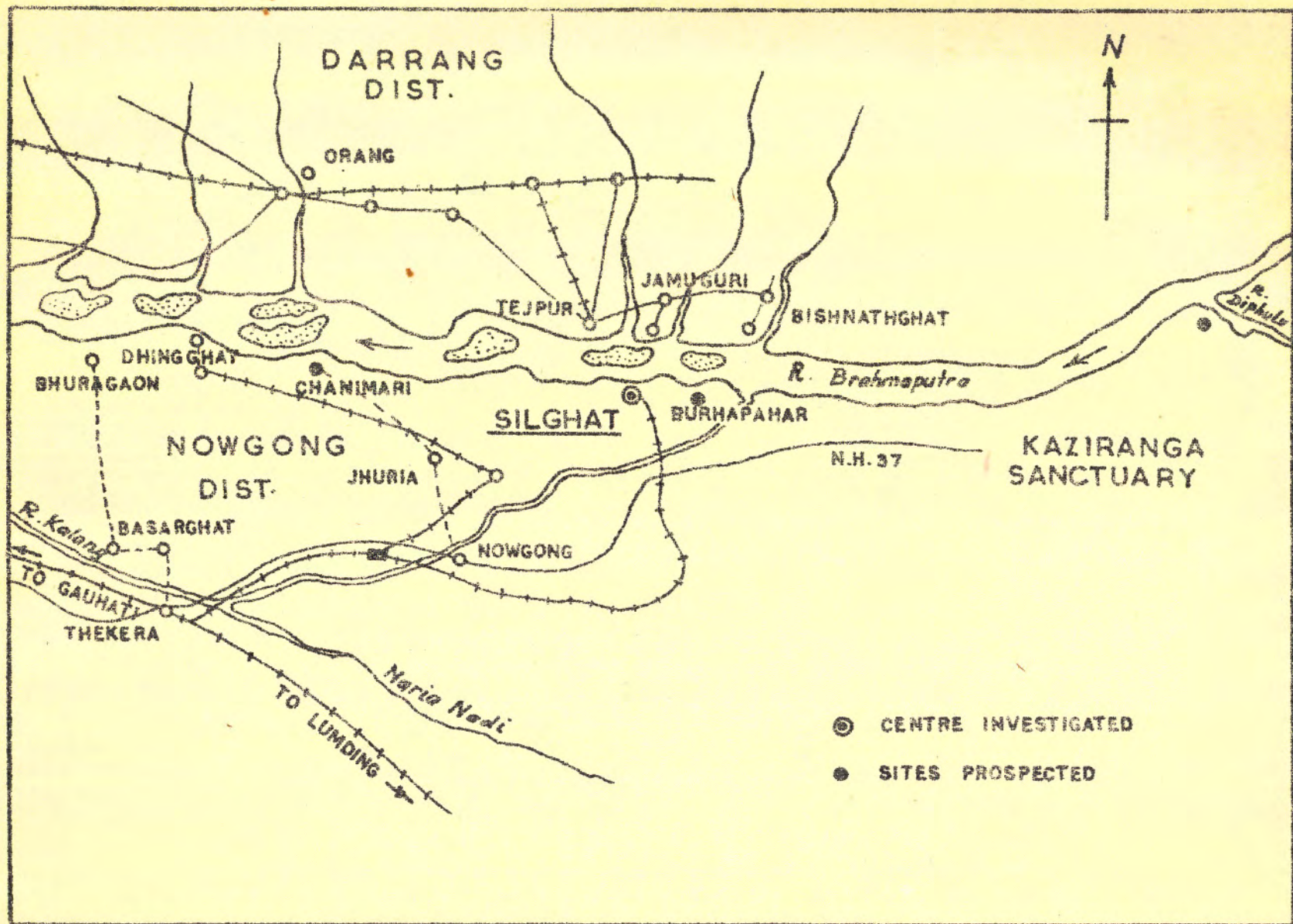


FIG. 2. SILGHAT STRETCH OF RIVER BRAHMAPUTRA SHOWING SITES PROSPECTED AND CENTRE INVESTIGATED.

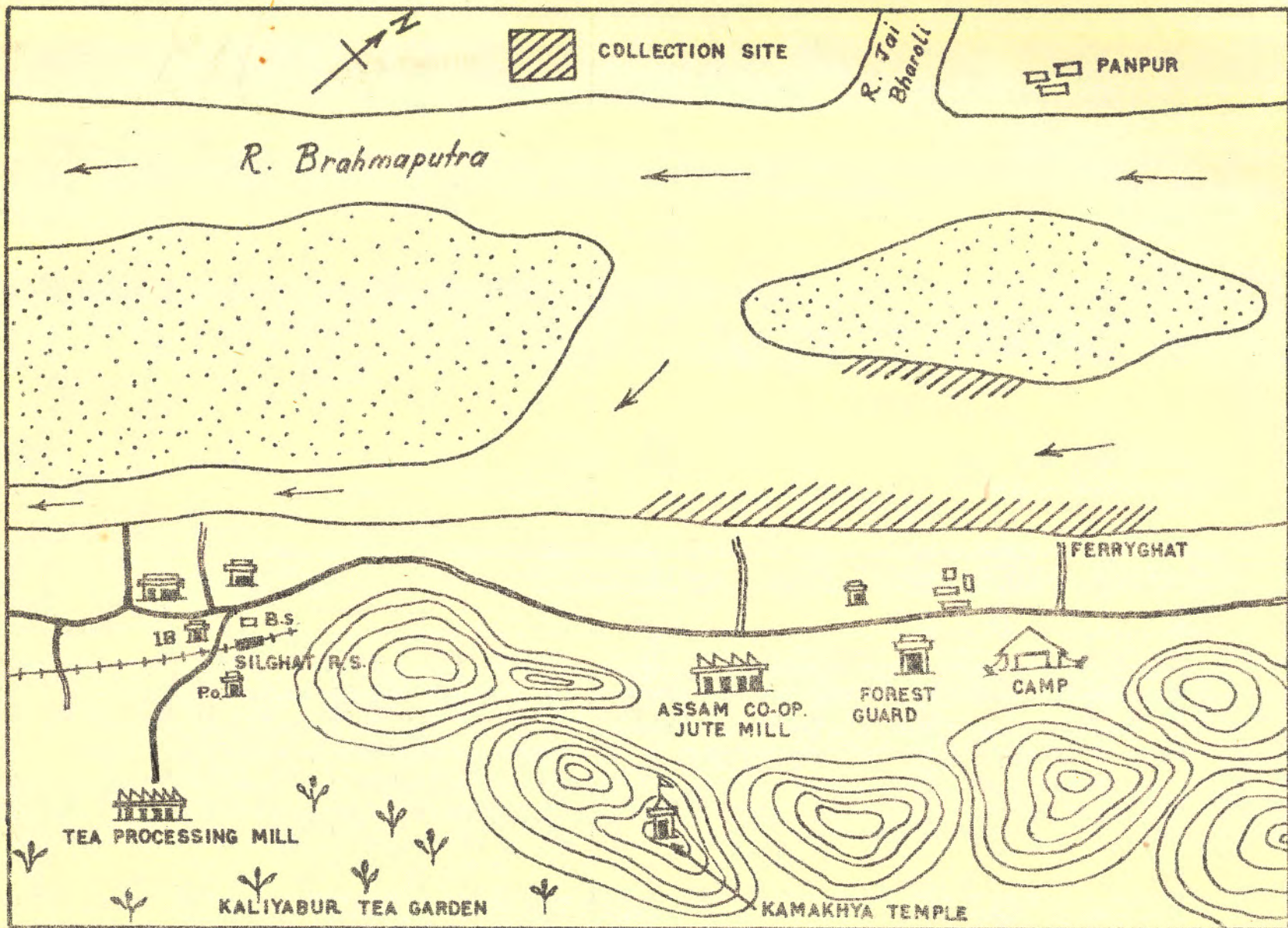


FIG. 3. THE COURSE, GENERAL TERRAIN AND TOPOGRAPHY OF RIVER BRAHMAPUTRA AT SILGHAT.

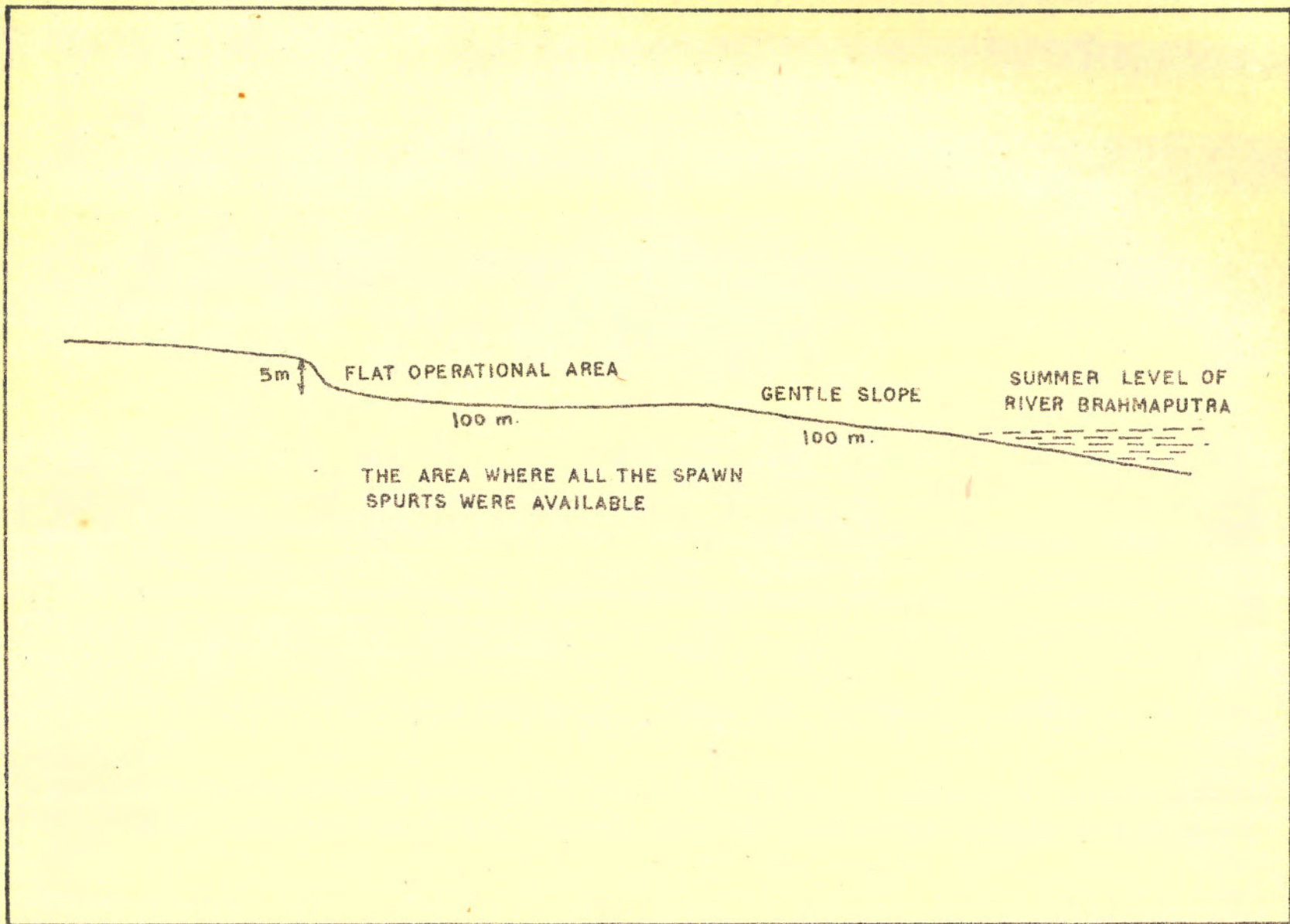


FIG. 4. CROSS-SECTION OF THE OPERATIONAL AREA AT SILCHAT .

Table 3

Flood -phase-wise occurrence, duration and magnitude of spawn spurts in R. Brahmaputra (standard nets)
at Silghat

Flood details					Spurt details						
No.	Phase	Duration from/days	Peak Date Time	Level in m*	No.	From Date/hr.	Desirability (D/UD)**	Period in hrs.	Catch		No. of nets
									in ml	in lakhs	
II	Rising	24.5.71/6	30.5.71/10.00	1.81							
	Receding	30.5.71/3									
III	Rising	3.6.71/13	16.6.71/10.00	5.04	S ₁	3.6.71/22.00	UD	4	10	0.05	1
					S ₂	5.6.71/18.00	UD	10	193	0.97	5
					S ₃	7.6.71/20.00	D	8	2220	11.10	5
					S ₄	8.6.71/22.00	D	6	583	2.92	5
					S ₅	9.6.71/16.00	UD	4	25	0.13	5
					S ₆	13.6.71/07.00	UD	13	650	3.25	5
	Receding	16.6.71/10									
IV	Rising	26.6.71/	Still rising when observations were closed.								

* Above initial level as on 22.5.71

** D = Desirable. UD = Undesirable.

Table 4

Quality of fish seed collected at Silghat during different spurts

S p u r t No	Spawn quality in percentage																							
	By microscopical analysis			By rearing																				
	Major carps	Minor carps	Oth-ers	State Nurseries					Plastic Pools					Nursery Pits										
				Major carps					Minor carps	Oth-ers	Major carps					Minor carps	Oth-ers	Major carps					Minor carps	Oth-ers
Cat-la	Rohu	Mr-ig-al	Cal-basu	Total	Cat-la	Rohu	Mr-ig-al	Cal-basu			Tot-al	Cat-la	Rohu	Mr-ig-al	Cal-basu			Tot-al						
S ₁	-	75.77	24.33	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
S ₂	2.65	81.09	16.26	-	5.56	-	-	5.56	92.22	2.22	-	-	-	-	-	-	-	-	-	-	-			
S ₃	30.07	68.14	1.79	4.27	22.92	-	-	27.19	92.14	0.67	-	-	-	-	-	-	-	-	-	-	-			
S ₄	13.00	86.24	0.76	9.52	10.55	-	-	20.07	79.25	0.68	-	1.12	-	-	1.12	98.88	-	0.85	1.07	-	-	1.97	98.08	-
S ₅	1.30	98.70	-	-	-	-	-	-	-	-	-	0.20	-	-	0.20	99.80	-	-	0.13	-	-	0.13	99.61	0.26
S ₆	1.84	97.50	0.66	1.83	1.36	-	-	3.19	96.81	-	-	-	-	-	-	100.00	-	-	0.11	-	-	0.11	99.78	0.11
Pooled average for desirable spawn spurts				25.70																				

The seasonal index of spawn quality, as determined from the rearing of desirable spawn spurts in State nurseries, was found to be 25.7%. Among the minor carps, Labeo bata and Cirrhinus reba contributed 32.44% and 23.47% respectively to the total. The seasonal index of quantity for the Silghat centre was estimated to be 560.6 ml.

Suitability of prospected sites for spawn collection:

A few sites along the south bank of the river were visited during the course of the investigations, for adjudging their suitability for large scale exploitation. Among these places, Chanimari, about 40 km downstream of Silghat, and Burhapahar, 15 km upstream, were observed to be useful during the rising phase of the second flood. The operations at these sites will be useful only during low floods not exceeding by 1-2 m from the initial level*. Further rise of water at these sites adversely affects their operational feasibility, either due to fast or erratic currents. Further, Chanimari's accessibility is poor, due to its approach being through marshy areas.

Diphulu water course and Devsar form two tributaries traversing through the extensive marshes of Kaziranga Sanctuary. Spawn collection in these tributaries is not feasible due to the sharply sloping margins. As reported by the local fishermen, these rivulets harbour huge quantities of major carps, especially Labeo rohita and Catla catla. If these carps are breeding in the area, it should be possible to exploit the fertilised eggs or hatchlings during the month of May, when with the advent of initial freshets, the water depth would be low and suitable for operations.

* Initial level of flood refers to the 6 A.M. flood level on 22nd May, 1971.

5.1.2 Lower stretch of R. Kangsabati

Participants

Shri P. Das, Jr. Fishery Scientist,
Officer-in-Charge of
West Bengal Centre

C.I.F.R.I.

Shri N.K. Srivastava, Research Assistant

Shri C.R. Mondal, Assistant Research
Officer

Govt. of West
Bengal.

The 112 km stretch of Kangsabati selected for prospecting extended between Tikarampore and Panchkura (Fig. 5). Barmunibgarh, a village under Kharagpur P.S. in Midnapore district was initially selected for round the clock observations, which were made there from 16.6.71 to 3.7.71. The bank contour at Barmunibgarh was found to be gradually sloping at the time of pre-monsoon survey. The first two floods in the river highly eroded the sand bank rendering the site unsuitable. The current pattern also changed at the site due to erosion. Hence, during the 4th flood, the field of observations was shifted on 3.7.71 to Hatihalka, a place about 1 km upstream on the opposite bank, under Midnapore Police Station. The observations made from 3/7 to 7/7 at Hatihalka showed the site to be unsuitable due to unfavourable current pattern. On 7.7.71, the field of observations was again shifted to Benadihi in Midnapore Police Station, 3 km downstream on the opposite bank (north bank), where the marginal river bed was found to be sandy, with a wide expanse available for the operation of nets (Fig. 6). The river flows in a serpentine course in this region. The bank contour of the spot of maximum availability of spawn at Benadihi region is diagrammatically represented in Fig. 7. This figure also indicates the extent of area available for operation of spawn nets. The floods and their pattern at this site are largely controlled by the dam on the river at Mukutmonipur (Khatra) in Bankura district of West Bengal.

The observations at Benadihi continued from 7.7.71 to 5.9.71. In addition to the detailed investigations at Benadihi, occasional prospecting was carried out at Panchkura, Kapastikri and Ramnagar downstream of Benadihi and at Tikarampore and Amjhuki upstream of Benadihi.

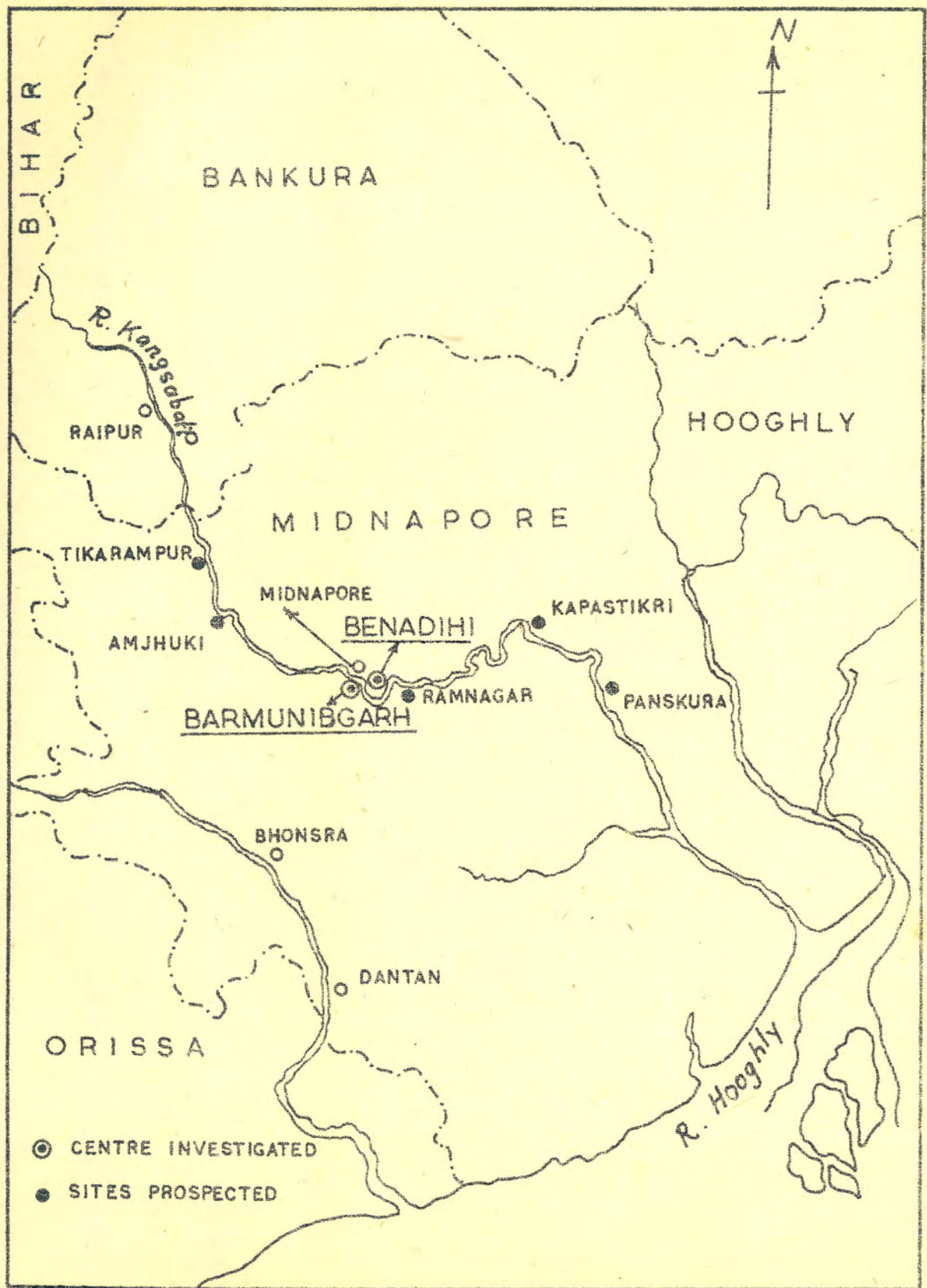


FIG: 5. BENADIHI AND BARMUNIBGARH STRETCHES OF RIVER KANGSABATI SHOWING SITES PROSPECTED AND CENTRE INVESTIGATED.

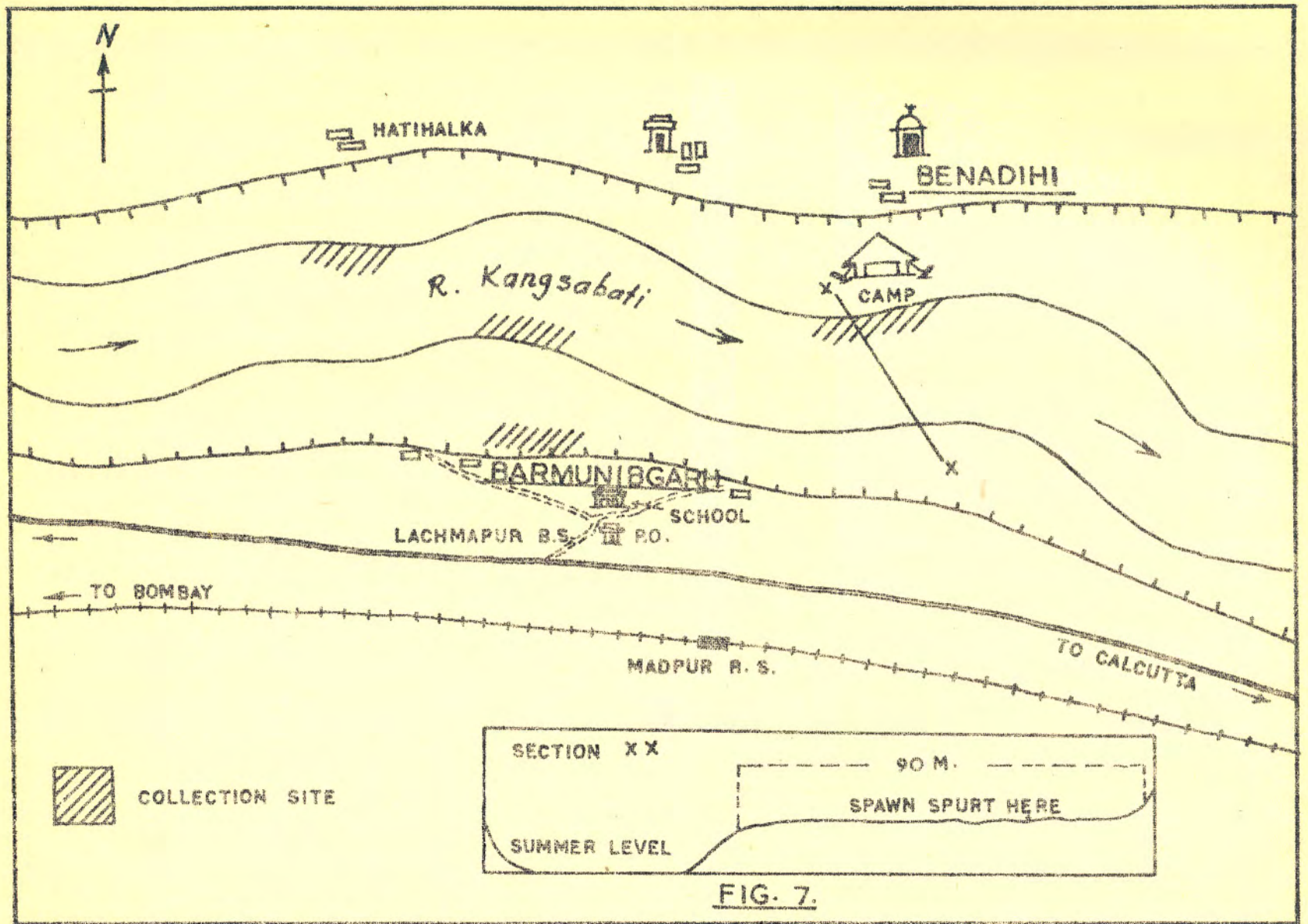


FIG. 7.

FIG. 6. THE COURSE, GENERAL TERRAIN AND TOPOGRAPHY OF RIVER KANGSABATI AT BENADIHI AND BARMUNIBGARN.

Occurrence of spawn spurts:

In the course of the entire period of investigations, only one spawn spurt, lasting for 20 hrs, was recorded at Benadihi. Simultaneous trial nettings were done at all the nearby suitable spots and the full battery of nets was operated at the spot of maximum availability of spawn. This spurt occurred in the receding phase of the seventh flood, which reached its peak level at 14 hrs. on 1.8.71 and then started receding steadily. The spawn spurt commenced at 14.00 hrs itself, with the turn of the flood to recession, and lasted till 10 hrs on the following day. Trial net operation was resumed at 12 hrs on 2.8.71. This spurt yielded a total of 401 ml desirable spawn, out of which 269 ml were collected by 5 standard nets. The remaining catch was made by other experimental nets.

Details of occurrence, duration, quantity and desirability of the spawn spurt recorded at Benadihi are depicted in Table 5.

Spawn quality:

With a view to assess the quality of the spawn collected, microscopical analyses were done as in previous years (Shetty, 1967) and the desirable spawn were also reared upto identifiable stage for ascertaining their species composition. The percentage composition of the spawn based on microscopical analyses of two hourly samples and by rearing are given in Table 6.

The rearing experiments showed a major carp content of 16.4% in the only spawn spurt of the season. The seasonal indices of spawn quantity and quality were found to be 53.8 ml and 16.4% respectively.

Spawn availability at prospected sites:

Occasional spawn prospecting was carried out for 2 days in each at Panchkura, Kapastikri, Ramnagar, Tikarempore and Amjhuki. No spawn was encountered at any of the centres during the prospecting period. The bank at Panchkura is almost steep and only one net can be operated in a row. As per the information gathered, good quantities of spawn was available at Panchkura in 1969, but much lesser in 1970 and negligible in 1971. At Ramnagar, the river is shallow. Spawn collection by local people is reported to be in vogue. Enquiries revealed that moderate quantity of spawn was available for the last few years. It appears

Table 5

Flood-wise occurrence, duration, magnitude and desirability of spawn spurts at Benadihi on R. Kangsabati in 1971

Flood details					Spurt details										
Flood No. & Phase	From Date & Hour	Dura- tion in days	Peak flood level		Quality (D/UD)*	Commence- ment Date & Hour	Dura- tion in hrs.	Spawn catch							
			Date & Hour	Metre above ini- tial level				By standard net			By experimental net				
								No. of nets	Catch in ml	Catch in lakhs	No. of nets	Catch in ml	Catch in lakhs		
7th Rising	30.7.71 18 hrs	2	1.8.71 14 hrs	3.40											
7th Receding	1.8.71 16 hrs	3			D	1.8.71 16 hrs	20	5	269	1.08	11	132	0.53		

* D = Desirable
UD = Undesirable

Table -6

Quality of seed collected at Benadihi on R. Kangasabati in 1971

Collection Hours & Date	Spawn quality in percentage									
	By Microscopical analysis			By rearing						
	Major carps	Minor carps	Others	Major carps					Minor carps	Others
				Catla	Rohu	Mrigal	Calbasu	Total		
18 hrs 1.8.71	66.0	21.0	13.0	-	12.5	-	-	12.5	25.0	62.5
20 hrs 1.8.71	20.0	40.0	40.0	4.2	8.4	4.2	-	16.8	33.2	50.0
22 hrs 1.8.71	19.0	30.0	51.0	4.5	-	-	4.5	9.0	22.7	68.3
24 hrs 1.8.71	33.0	42.0	25.0	-	-	10.0	-	10.0	30.0	60.0
2 hrs 1.8.71	11.0	25.0	66.0	-	6.6	-	-	6.6	53.4	40.0
4 hrs 1.8.71	40.0	10.0	50	5.8	5.8	5.8	5.8	23.2	23.8	53.0
6 hrs 2.8.71	30.0	35.0	35.0	8.0	4.0	12.0	-	24.0	12.0	64.0
8 hrs 2.8.71	10.0	25.0	65.0	5.0	-	-	-	5.0	15.0	80.0
10 hrs 2.8.71	5.0	50.0	45.0	-	-	-	-	-	46.1	53.9
12 hrs 2.8.71	0.0	40.0	60.0	-	-	-	-	-	29.0	71.0
Pooled average quality of desirable spawn (By rearing)				6.84	5.48	1.36	2.74	16.4	31.6	52.0

that in Panchkura, nets in columns can be operated with expectations of moderate quantity of spawn while in Ramnagar, little quantity of spawn can be expected and nets can be conveniently operated in low floods. Other sites were found to be unsuitable for spawn collection.

5.1.3 Daryapur stretch of R. Ganga

Participants

Shri M.Y. Kemal, Jr. Fishery Scientist,
Officer-in-Charge,
Bihar Centre

C.I.F.R.I.

Shri P.M. Mathew, Research Assistant

Shri M. Ishaque

-

Govt. of Bihar

The 110 km stretch of river Ganga, referred to here as the Daryapur stretch, extending from Patna in the west to Hathidah in the east, was prospected for spawn during the period 24.6.71 to 22.8.71 (Fig. 8). Village Daryapur, the site selected for detailed investigations, is situated on the south bank of river Ganga in Patna district and is well connected by road from Mokameh. The river bank at the site is gently sloping (Fig. 9). The flood pattern of the river in this stretch is heavily dependent on the flood patterns of the three tributaries of R. Ganga, viz. the Son, Gandak and Punpun. Unusually high floods in river Ganga and its tributaries during the 1971 season resulted in widespread inundation of large areas both upstream and downstream of Daryapur. Hence, no other site except Barh could be visited for occasional prospecting. Prolonged and alarming flood situation forced the closure of observations on 22.8.71.

The river had already experienced one flood when round the clock observations were initiated at Daryapur.

Occurrence of spawn spurts:

During the entire period of investigations, six floods were experienced at Daryapur, yielding seven spurts of spawn (Table 7). The first flood was in its receding phase at the start of the investigations and spawn spurt occurred during this phase. It was the only spurt of the season yielding undesirable spawn. There occurred two spawn spurts each in the rising phase of flood II, and the vacillation phases between floods II and III, III and IV. All these six spurts yielded desirable spawn. Though stray spawn was appearing in the trial net almost every day from 24.6.71 to the end of July, the availability criterion was rarely satisfied.

Spawn was available at this centre for a total period of 172 hours, the desirable part being available for 162 hours. Its total yield of the desirable spawn in the entire season was 1,410 ml, constituting 96.7% of the season's total spawn catch. The overall catch was 1,457 ml of spawn by standard nets.

Spurt 1, which lasted for 10 hrs and yielded only undesirable spawn, constituted to 3.3% of the season's total spawn catch. Spurt 2, which occurred in the rising phase of flood II, was of short duration, lasting only for 8 hours, and formed only 1.8% of the total catch of desirable spawn. Spurt, lasting for 80 hours, also in the rising phase of flood II, accounted for the highest catch in any spurt during the season, contributing 92.9% to the total desirable spawn catch. Spurt 4, like spurts 2 and 3, yielded only desirable spawn during the vacillating phase inbetween floods II and III for 24 hours and accounted for 10.9% of the season's desirable spawn yield. Spurt 5, which occurred in the same vacillation phase, lasted for 22 hours and produced 23.9% of the total desirable spawn catch. Spurt 6, which occurred in the vacillation phase between floods III and IV, lasted for 14 hours, yielding 5.9% of the desirable spawn catch of the season. Spurt 7, the last spawn spurt of the season, also occurred during the same vacillation phase and lasted for 14 hours, yielding 4.6% of the season's total desirable catch.

Floods IV and V did not yield any spawn and during these flood the flood level of river Ganga remained constantly much above the danger level. Table 7 represents the details of occurrence, magnitude and duration of the spawn spurts at Daryapur.

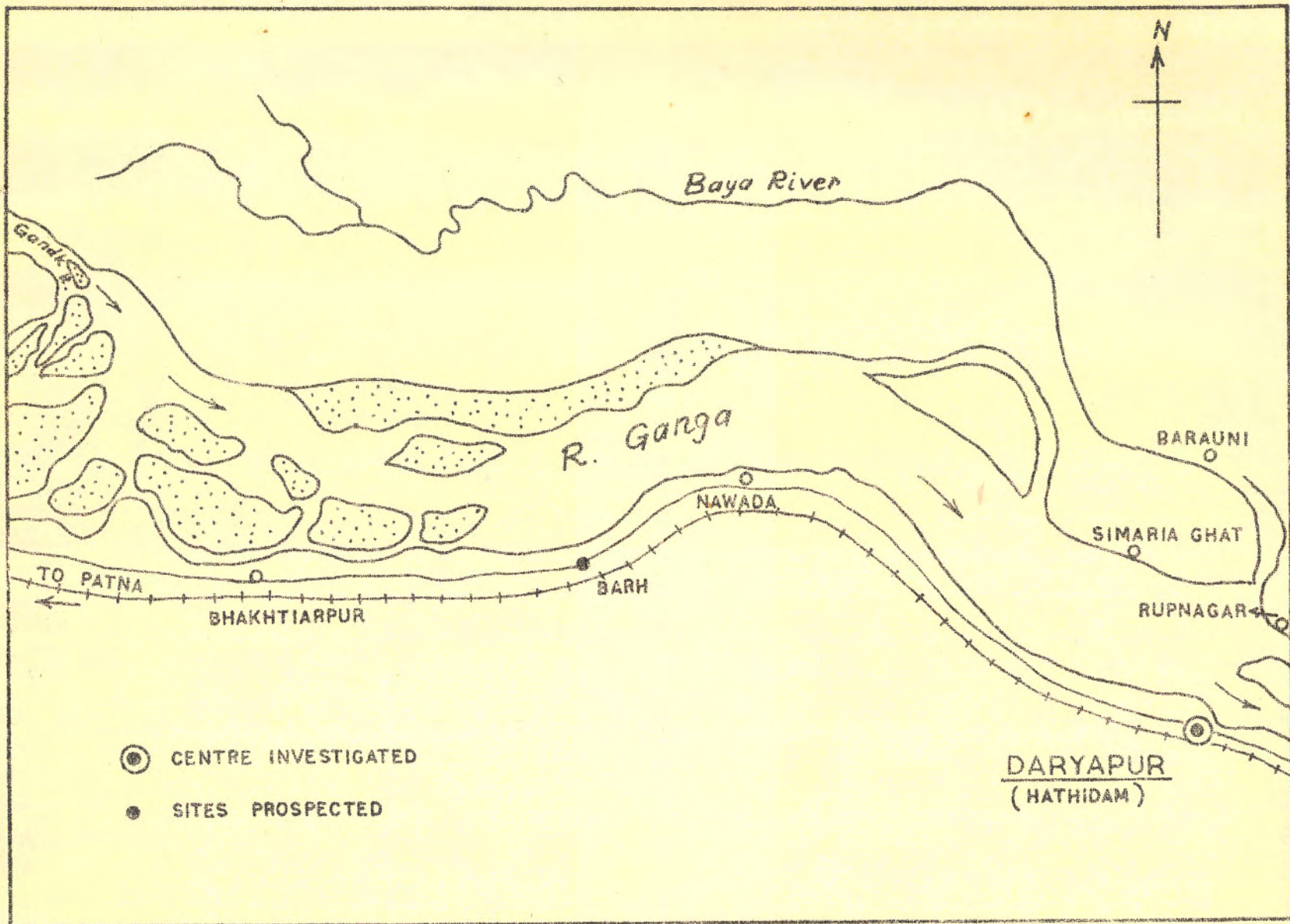


FIG. 8. DARYAPUR STRETCH OF RIVER GANGA SHOWING SITES PROSPECTED AND CENTRE INVESTIGATED.

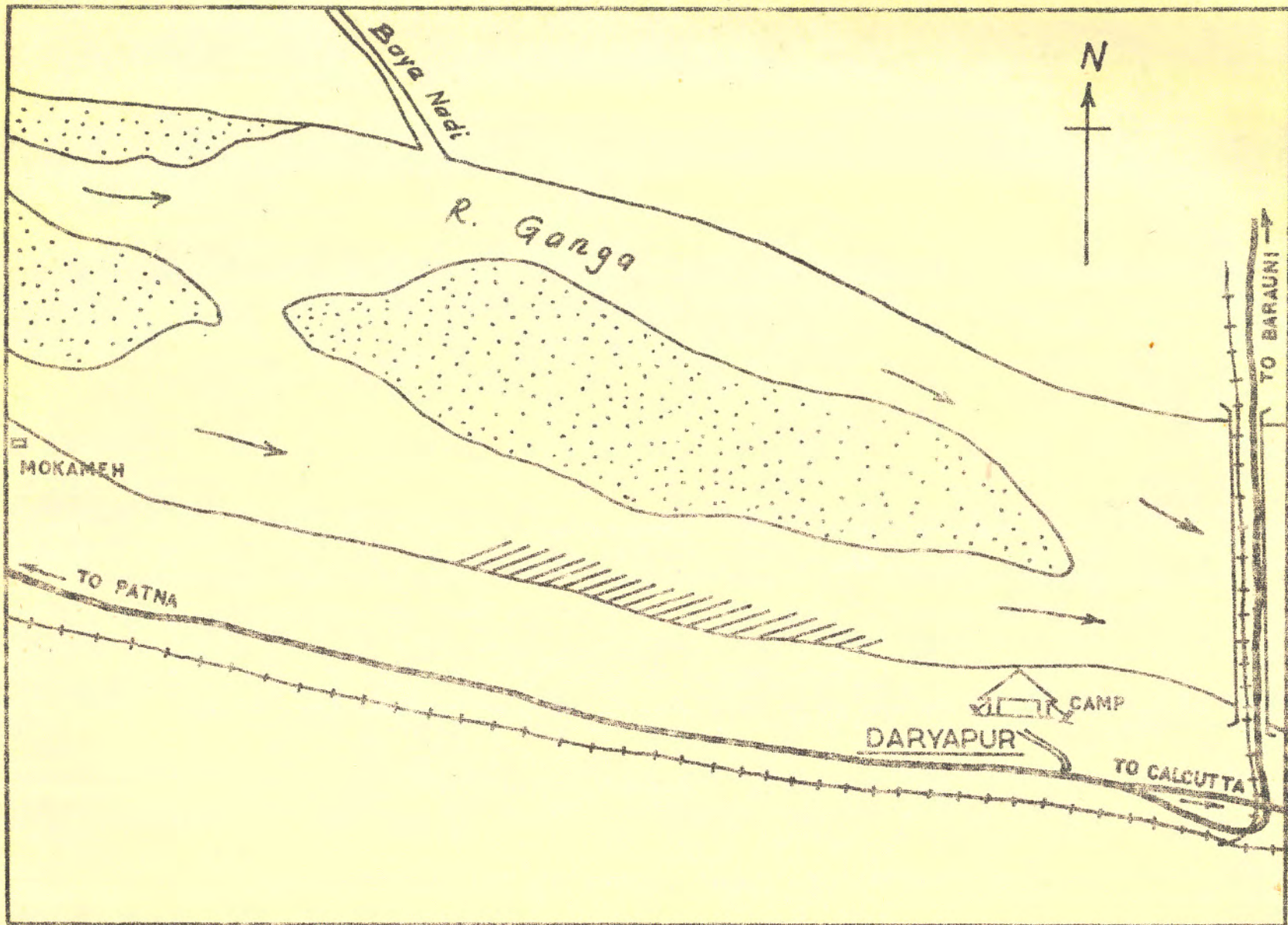


FIG. 9. THE COURSE, GENERAL TERRAIN AND TOPOGRAPHY OF RIVER GANGA AT DARYAPUR.

Table 7

Flood-phase-wise occurrence, duration, desirability and magnitude of spawn spurts
at Daryapur on R. Ganga in 1971

No.	Phase	FLOOD DETAILS		Spawn spurt No.	Spurt duration		Associate catch in numbers	Spawn desirability (D/UD) **	Total spawn catch in ml
		Duration From No. of days	Peak Date Flood level in metres*		From Date hour	Period in hours			
1	2	3	4	5	6	7	8	9	10
I	Rising	<u>24.6.71</u> 3	-	1	<u>26.6.71</u> 6.00	10	108	UD	47
	Rising	<u>27.6.71</u> 12	2.90	2	<u>30.6.71</u> 18.00	8	723	D	25
II	"			3	<u>2.7.71</u> 2.00	80	"	D	747
	Vascillation	<u>9.7.71</u> 7	-	4	<u>10.7.71</u> 18.00	24	373	D	153
	"	"	-	5	<u>13.7.71</u> 16.00	22	"	D	338
	Receding	<u>16.7.71</u> 3	-	-	-	-	9	-	-

contd.....

1	2	3	4	5	6	7	8	9	10
	Rising	<u>19.7.71</u> 4	<u>22.7.71</u> 4.66	-	-	-	145	-	-
III	Vascillation	<u>23.7.71</u> 5	-	6	<u>24.7.71</u> 22.00	14	1714	D	83
	"	"	-	7	<u>25.7.71</u> 20.00	14	1714	D	64
	Rising	<u>28.7.71</u> 4	<u>31.7.71</u> 5.30	-	-	-	158	-	-
	Vascillation	<u>1.8.71</u> 3	-	-	-	-	501	-	-
IV	Rising	<u>4.8.71</u> 3	<u>6.8.71</u> 5.66	-	-	-	146	-	-
	Receding	<u>7.8.71</u> 12	-	-	-	-	3389	-	-
V	Rising	<u>19.8.71</u> 4	<u>22.8.71</u> 5.39	-	-	-	401	-	-
TOTAL		60				172	7658		1457

* Above initial level as on 24.6.71.

** D = Desirable, UD = Undesirable.

The quantitative estimate of the spawn catch, at Daryapur, as determined by the catch per net per hour, remained poor during all the spurts, probably because of the excessive exploitation of the stretch by private parties from West Bengal upstream of Daryapur and the very high floods during 1971. Only during 14 hours of spawn availability period, out of a total of 172 hours, the catch per net per hour ranged between 5 to 12.5 ml. These 14 hours yielded 41.6% of the desirable catch.

The quantitative potentiality of the stretch under investigation is evident from Table 8 which shows the total catches at Daryapur, the catches by private parties along the stretch and the catches made by Department of Fisheries, Bihar.

Table 8

Spawn catch in ml in the Daryapur stretch on R. Ganga

Railway booking by private parties	Spawn purchased by State Department from private parties	Spawn catch of State Department	Spawn catch at Daryapur
2,79,720 *	6,750 **	3,000	1,457

* 518 "Hundies"

** 50 "Baties"

Quality of spawn collected:

The percentage composition of the spawn catches as obtained through microscopical examination of two-hourly spawn samples and through rearing in chettypots and pits dug out for nursing them, is delineated in Table 9. The first spurt, which was undesirable, had rohu and mrigal, in equal magnitude of 4.26% each. Mrigal dominated the major carps during spurts 3 and 6. Catla shared the top position with rohu, amongst the

Table 9
Quality of spawn collected at Daryapur

Spurt No.	Spawn quality by										Spawn catch in ml
	Microscopical Analysis			Rearing							
	Major carps	Minor carps	Others	Rohu	Catla	Mrigal	Calbasu	Major carps	Minor carps	Others	
1	5.0	34.0	61.0	4.26	-	4.26	1.42	9.94	87.33	2.13	47
2	24.7	64.7	10.7	9.68	6.60	5.76	0.88	23.88	75.12	-	25
3	21.0	62.1	16.9	9.46	0.86	27.09	0.43	37.84	61.49	-	747
					34.66*	36.66*	1.34*	72.66*			
4	13.7	38.0	48.3	42.18	-	8.74	1.20	51.82	48.18	--	153
5	34.7	48.1	17.2	14.20	14.20	10.65	3.55	42.60	49.92	7.10	338
6	30.0	63.7	6.3	1.64	-	35.26	0.82	37.72	61.52	0.82	83
7	37.7	52.3	10.7	not reared	64
Pooled average of desirable spurts							40.37				

* Based on a rearing done at the Mithapore Fish Farm of Fisheries Research Institute, Govt. of Bihar.

major carps, during spurt 5 only, while rohu dominated spurt 2 and 4. Mrigal, rohu and calbasu were present in all the spurts, whereas catla was encountered during spurts 2, 3 and 5 only. The percentage composition of kalbasu among the major carps remained poor throughout the season.

The percentage composition of major carps of spurt 3, as found in samples reared by the Fisheries Research Institute, Government of Bihar in their nursery tank at Mithapore, Patna, was found to be 72.66%, consisting mainly of mrigal (36.56%) and catla (34.66%). Calbasu formed only 1.34%, while rohu was not observed in the sample.

The index of quality was estimated to be 40.37%, while the index of quantity was found to be 282 ml.

Spawn availability at prospected sites:

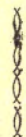
Due to high floods, roads were cut off and no prospecting could be done except at Barn.

5.1.4 Mahewapatti centre on R. Yamuna

Participants

Shri K.K. Ghosh, Jr. Fishery Scientist-
in-Charge.

Shri S.D. Gupta, Research Assistant



C.I.F.R.I.

The site at Mahewapatti was selected in 1968 for carrying out certain investigations aimed at obtaining a comprehensive understanding of the influence of various environmental factors on spawn occurrence and availability, by continuing the observations over a few years. This was the fourth year of observation at Mahewapatti. In addition to the above, other studies on the operational efficiency of different gear by study of filtration rates was also done at this centre. During 1971, the investigations at this site lasted from 28th June to 6th September.

Occurrence of spawn spurts:

River Yamuna experienced very high flood rather early in 1971. Usually, spawn is available at Mahewapatti during late July and early August, when the flood level crosses 79 m above MSL mark at Allahabad. This year, due to extraordinary flood situation and very heavy rains very early in June, the river experienced the first flood peak on 4th July, when the flood level was 78.99 m. This flood did not produce any spawn.

The second flood of the season had a very prolonged rising phase of 15 days and the flood touched the very high level of 86.43 m above MSL on 31st July. During the past four years, such a high level was never touched in July or August. The spawn bearing floods of the Yamuna at Mahewapatti normally rise to about 80-83 m as per past experience. This year too the river had a relatively stationary spell on 22nd and 23rd July, when the flood level was mostly 82.09 m. This spell yielded only spawn spurt of the season for a total duration of 32 hours, when 605 ml of desirable spawn was collected mostly in 5 standard nets, except the first two hours, which yielded 40 ml of spawn in two standard nets. Further rapid rise in flood level resulted in complete disappearance of spawn. The receding phase of this flood failed to produce any more spawn as was the case with the last flood observed at the site. The details of magnitude, occurrence, etc. of the spawn are given in Table 10.

Quality of spawn:

The microscopical analysis of samples from two-hourly spawn catches showed the major carp content to range from 27% to 54%, with an overall average of 42.9%. The quality of spawn as obtained through analysis of spawn samples and through rearing in a small cement cistern are delineated in Table 11. The reared sample showed a major carp content of 43.4%.

The indices of quantity and quality for the Mahewapatti centre for 1971 were found to be 135 ml and 43.4% respectively.

Table 10

Flood-wise occurrence, duration, magnitude and desirability of spawn spurts at Mahewapatti on R. Yamuna in 1971

Flood details					Spurt details					
Flood No. & Phase	Commencement		Peak flood level		No.	Desirability (D/UD)*	Commencement		Spawn catch in ml	
	From Date/hour	Duration in days	Date/hour	M. above MSL			Date/hour	Duration in hours	Standard nets	Experimental nets
I	Rising	Commenced before 28/6/71	4/7/71 18.00	78.99						
	Receding	4/7/71 2.00	11							
II	Rising	16/7/71 6.00	15	31/7/71 6.00	86.43	1	D	22/7/71 14.100	32	605 820
	Receding	31/7/71 10.00	14							
III	Rising	14/8/71 10.00	5	19/8/71 18.00	83.12					
	Receding	19/8/71 18.00	Continued receding till 6/9/71 when camp was closed							

* D = Desirable
UD = Undesirable

Table 11

Quality of spawn collected at Mahewapatti on R. Yamuna in 1971

Spurt No.	Percentage quality by									
	Microscopical analysis			Rearing in cement cistern						
	Major carps	Minor carps	Others	Major carps					Minor carps	Others
				Rohu	Catla	Mrigal	Calbasu	Total		
1	42.9	42.2	14.9	6.7	6.7	20.0	10.0	43.4	56.6	-

5.2 Spawn availability in relation to environmental factors

5.2.1 Flood phase and level

The availability of desirable spawn during the rising phase of flood in R. Brahmaputra at Silghat was significant. Earlier observations in the lower stretches of this river also had shown a sizable catch in the rising phase. However, the highest concentrations of catch were available when the rising phase had a stationary spell. The highest catch per net-hour was 62.5 ml during the third spurt, when the flood was stationary. The river Brahmaputra has a wide basin and many backwaters get connected during floods of even low heights. This invariably leads to drastic changes in current patterns and many sites apparently suitable at certain flood levels turn unsuitable with the rise in floods. Such a pattern of flooding appears to be the primary reason for multi-spurt appearance of spawn at Silghat within the same flood phase.

At Daryapur, the spawn was available in rising and vacillation phase of floods. In the lower stretch of Ganga, spawn is generally reported to be available in the rising phase of the floods probably due to incursion of flood discharges of tributaries which bear the spawn, since Ganga is largely bound by embankment on either side in Bihar and affords little opportunity for the existence of breeding grounds.

The flood pattern of R. Kangsabati in its lower stretches is not directly dependent on rainfall pattern, but on the Dam at Mukutmanipur in Bankura district of West Bengal. Because of this dam, the deep pools below the reservoir have been largely silted up reducing the fish population in general. Whatever spawn was available at Benadihi on R. Kangsabati, was found in the receding phase of the flood, when the water level was 3.25 m above the initial level.

In R. Yamuna, desirable spawn in large quantities are generally available associated with receding phase of floods touching proper heights. At Mahewapatti, the flood level around which spawn is normally available was crossed in the rising phase of flood II, days before the flood touched the peak level much higher than the optimum. As expected, a temporary recession in rise of flood produced the only spurt. The close proximity of this site to the confluence of R. Yamuna with R. Ganga, adversely affects the flood pattern and discharge sites, since the high level of Ganga restricts the normal flow of R. Yamuna. The temporary stationary phase would normally have been a receding spell, had not the high level of R. Ganga checked the discharge of R. Yamuna.

Generally, early and heavy monsoon rains brought about early and very high floods in all the rivers of the northern part of the country. This coupled with prolonged and continuous heavy downpour almost all over adversely affected the flooding patterns and spawn availability during 1971 in the Gangetic System, as well as in R. Brahmaputra.

5.2.2 Current velocity

Current velocity at site was not seen to be directly correlated with spawn availability or abundance. It ranged between 0.85 and 4.90 km/hr in R. Kangsabati. Because of controlled discharge from the Dam, the current were comparatively high at times. During the spawn availability period, it ranged from 1.46 to 2.45 km/hr, which was sufficiently high to erode the bottom sands, necessitating frequent change of nets.

At Silghat on R. Brahmaputra, the current velocity fluctuated with a narrow range of 0.80-1.20 km/hr, while at Daryapur on R. Ganga, the current velocity at the site ranged between 0.94 and 2.74 km/hr during spawn availability with peak collections bearing associated with velocities in the range 1.26-1.57 km/hr.

In R. Yamuna, the current velocity at the site was mostly too low due to low discharge of the river caused by the hydropressure of the swollen Ganga only 3 km downstream. The current velocity ranged from 0.32 to 1.09 km/hr at the site during the season, while spawn was available when current velocity ranged between 0.62 and 0.82 km/hr. The low current velocity of marginal waters probably affected spawn availability at the site.

5.2.3 Turbidity

No correlation between turbidity and spawn availability was found. The turbidity values during this season ranged between <100 and 310 ppm at Silghat, 200-1200 ppm at Daryapur, <100 and 750 ppm at Benadihi and <100 and 2000 ppm at Mahewapatti. The spawn availability periods were associated with turbidity values ranging from 310-500 ppm at Benadihi, 300-360 ppm at Daryapur < 100 to 195 ppm at Silghat and 450-650 ppm at Mahewapatti.

5.2.4 Temperature

The water and air temperatures during the season varied within comparatively narrow ranges at all the centres. During the spawn availability period, the air and water temperatures ranged between 26.0°-30.0°C respectively. No correlation between the air or water temperatures and spawn availability or abundance at a site could be detected.

5.2.5 Weather

For most of the season, all the centres experienced overcast skies with occasional rains. As reported earlier, calm days were more conducive to spawn collection than stormy or heavily raining days. Heavy rains resulted in complete disappearance of spawn.

5.2.6 Spawn associates

No indicator species for producing spawn availability could be found, nor did the abundance of associates appear associated with spawn availability.

5.3 Catching efficiency of nets in relation to size and mesh size

With a view to estimate the effect of size and mesh size on catching efficiency, nets made of 4 sizes and 3 mesh sizes were operated under a randomised block design at all the centres. The effect of position of a net was assumed to be absent in the linear model adopted for the randomised block design.

At Silghat centre on R. Brahmaputra, 1/12" meshed 14 m net was found to be most efficient, followed by 1/16" 10 m and 14 m nets. The turbidity during the operations of these nets averaged to only 130 ppm, a very low value compared to other rivers of India, while the current velocity ranged between 0.86 and 1.03 km per hour.

Because of low densities of spawn at Daryapur, the efficiency could not be tested well. However, the catches, indicated the 14 m 1/12" meshed net to be better than the 14 m 1/16" meshed net, although 18 m and 14 m 1/8" meshed nets were also sometimes equally efficient.

The very low catches at Benadihi on R. Kangsabati failed to indicate any significant results. Smaller meshed nets appeared to be better than the largest mesh of 1/8" under conditions of low turbidity (300-500 ppm) and moderate velocities (1.46-2.45 km/hr). In some case, however, the 1/2" meshed net's catch was better.

At Mahewapatti on R. Yamuna, the 1/12" meshed net caught more than the 1/16" and 1/8" meshed nets. The 14 m size appeared to be best, although the 13 m 1/3" meshed net in one case had a higher catch. The turbidity during the operation at this centre was around 600 ppm, but current velocity was very low, varying between 0.62 and 0.82 km/hr.

It thus appeared that for velocities less than or about 1 km/hr and turbidities below 600 ppm, 1/12" mesh was more efficient than 1/8". Probably because of low turbidity, 1/12" meshed nets were found catching better than 1/8". The 14 m size also generally proved better than the others.

5.4 Filtration rate

Some experiments on filtration rate of different meshed 10 m nets were done at Mahewapatti. The fall in filtration rate in the 1/12" and 1/16" meshed nets in comparison to 1/3" meshed net in four hours of operation were found to be 23% for 1/12" meshed net and 43% for 1/16" meshed net, when turbidity was about 400-600 ppm and current velocity 0.75-0.93 km/hr.

6 DISCUSSION

The investigations during this year were conducted under conditions of very early and abnormal monsoon rains, which resulted in widespread heavy floods in almost all the rivers of northern India much earlier than the normal. These early and heavy floods presented conditions which generally had an adverse effect on the availability of spawn and probably spawning success as well.

In the middle stretches of R. Brahmaputra, around Silghat in Nowgong district, the general abundance of major carps in mixed collection of riverine spawn was found rather low. However, the availability of spawn during rising phases of floods in R. Brahmaputra appeared

characteristic of the river. The site prospected in the stretch proved promising for spawn collection. However, the extremely high eroding character of R. Brahmaputra, results in quick appearance of new sites, as well as destruction of old sites. The stretch prospected generally had low turbidity with fairly high abundance of spawn, which, it appears, can be effectively collected by 1/12" meshed nets.

Silghat centre appeared very promising; since this site has an operational area for about 200 nets and is well connected by rail and road with the rest of the State.

This year, R. Ganga in Bihar was mostly in very high floods, above the danger level during most part of July. This condition was very unusual for the Ganga. The spawn availability, therefore, during 1971 was not typical of the Ganga during years of normal rains and floods. The stretch from Patna down to Mokameh is a well exploited stretch, when commercial spawn collectors from the State and West Bengal exploit the river in addition to the State Department of Fisheries, which also exploits a few points.

The location of a new promising site at Daryapur, where nets can be operated for most part of the season, appears a valuable addition to the already existing sites in Bihar.

The Kangsabati river failed to produce any sizable quantity of spawn. The rivers of south western West Bengal are almost all seasonal in character, originating from the Chota Nagpur Plateau and fed by rains only. R. Kangsabati is one of the biggest of such rivers. The construction of a dam near Khatra on this river has cut off the normal flow, especially during monsoons, which has resulted in the silting up of deep pools. These deep pools in seasonal rivers are the only sources, where fish populations thrive during the year. Their disappearance has adversely affected the populations of major carps. Whatever breeding takes place now is largely dependent on the releases of water from the dam. The appearance of eleven floods, sometimes in quick succession, associated with fast rates of rise or fall in flood level, depending on the discharge from the reservoir upstream, itself reflects the bleak possibility of a good spawning success and much lesser possibility of availability of spawn at sites in bulk. The concentration of spawn at few sites and its flow are badly impaired in such rivers below the dam site.

The investigations this year tended to confirm that the riverine spawn bearing potentiality of R. Kangsabati is low, although the major carp population in the Kangsabati reservoir is high.

Unusual flooding in R. Yamuna affected spawn availability at Mahewapatti. Four years of observations at Mahewapatti have shown that the close proximity of this site to the confluence of R. Yamuna with R. Ganga has a very detrimental effect on spawn availability at Mahewapatti. The flood picture is largely dependent on that of R. Ganga. The discharge rate during high floods becomes very low whenever the level of R. Ganga is higher than that of R. Yamuna. The brood fishes of R. Yamuna are also reported to be migrating to R. Ganga, in case floods set in R. Ganga earlier than in R. Yamuna. The overall abundance of spawn availability at Mahewapatti is, therefore, much lower in quantity and quality than at other centres on the Yamuna, which is known to harbour one of the richest major carps riverine fishery in the country.

The availability of spawn in R. Brahmaputra and middle stretches of R. Ganga during rising phases of floods was characteristic, while in R. Yamuna the receding phase availability was latently apparent, since this year too the availability was during a stationary phase, which was caused by the pressure of high level of R. Ganga.

Amongst the nets tested of size 6, 10, 14 and 18m, the 14 m sized net generally proved superior to others, while the 1/12" meshed netting proved better than 1/8" meshed netting. In conditions of low turbidity of less than 150 ppm, the 1/16" meshed nets also proved equally efficient in Silghat. But in the comparatively higher velocities of R. Kangsabati the 1/8" meshed net appeared sometime better. However, since the catches were generally low and many replicates could not be obtained, more observations are necessary in order to be able to draw conclusive inferences.

7 SUMMARY

i) During 1971, spawn prospecting investigations were carried out in the three collaborating States of Assam, Bihar and West Bengal along stretches of R. Brahmaputra, R. Ganga and R. Kangsabati respectively. In addition to above, Mahewapatti on R. Yamuna, near Allahabad, was also investigated as a part of a long term study.

ii) Pre-monsoon surveys of 150 km stretch of R. Brahmaputra in Nowgong district, 110 km stretch of R. Ganga in Patna district and 250 km stretch of R. Kangsabati in Bankura and Midnapore districts of West Bengal, resulted in the selection of sites at Silghat, Daryapur and Baruminbgarh on the three rivers respectively. Benadihi centre on R. Kangsabati was surveyed during this survey, where investigations site was shifted from Barmunibgarh.

iii) Investigations were primarily directed towards assessing the spawn producing potential of the selected river stretches, location of new spawn collection grounds and testing the efficiency of different sized and mesh sized Midnapore-type nets under various hydrological conditions.

iv) At Silghat on R. Brahmaputra, 6 spawn spurts were observed, all in the rising phase of flood III, to produce a total of 3681 ml of spawn in 45 hours in 1-5 standard nets, comprising 2,803 ml of desirable spawn, collected in 14 hours during spurts 3 and 4. These spurts were available in the first week of June. The seasonal indices of spawn quality and quantity were found to be 25.7% and 560.6 ml respectively. The Silghat stretch of R. Brahmaputra appeared promising for riverine spawn collection. /al

v) R. Ganga in Bihar experienced exceptionally high floods during 1971, with its level being mostly above the danger mark almost throughout the month of July. Under such conditions desirable spawn was available in comparatively low magnitude during rising phase of flood II and vacillation phases between floods II and III, and III and IV at Daryapur in six spurts spreading over 162 hours, when a total of 1,410 ml of desirable spawn were collected. Spawn was available mostly during the last week of June and first fortnight of July. The seasonal indices of spawn quantity and quality for the Daryapur site were estimated to be 282 ml and 40.37% respectively.

vi) The lower stretches of R. Kangsabati in West Bengal were found to be generally poor in spawn abundance. The flooding pattern of the stretch being fully dependent on the discharge from the Reservoir near Khatra, breeding and availability of spawn also appeared to have been adversely affected. A total of 401 ml of desirable spawn was available in the only spurt on 1st and 2nd of August, at Benadihi during a receding phase in 20 hours. The river did not hold promise as a commercially important riverine spawn source. Seasonal indices of quality and quantity for the Benadihi site were found to be 16.4% and 53.8 ml respectively.

vii) The Mahewapatti site on R. Yamuna experienced very high floods during the entire August and later period of July. The availability of spawn was badly impaired because of abnormally prolonged and exceptionally high flooding. During the third and fourth weeks of July, the second flood crossed the level of 80 m above MSL and rose by another 6 m in eight days of further rise. A short stationary spell in this rising phase produced 605 ml of spawn in 32 hours, a week earlier than the flood touching its peak. The seasonal index of quantity of Mahewapatti was found to be 135 ml, while the quality index was 43.4%.

viii) The appearance of spawn during rising phases of flood in Brahmaputra and Ganga rivers were recorded this year also. The erratic pattern of currents in R. Brahmaputra, probably due to connection of backwaters, and in R. Ganga in Bihar, probably due to exceptionally high floods, resulted in appearance of many spawn spurts in comparatively quick succession. The exceptionally high floods in R. Yamuna adversely affected spawn availability, while the lower stretches of R. Kangsabati experienced too many floods dependent on flood discharge from the reservoir on Kangsabati.

ix) Most of the meteorological and hydrological factors observed, did not show any discernible correlation or association with spawn availability.

x) 1/12" meshed 14 m nets were found to be generally more efficient than 1/8" or 1/16" meshed nets of size 6 m, 10 m or 18 m., under conditions of low to moderate turbidity, <500 ppm and low current velocities, around 1 km/hour. Even in turbidity of 600 ppm and very low velocity, the 1/12" mesh was found better at Mahewapatti.

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