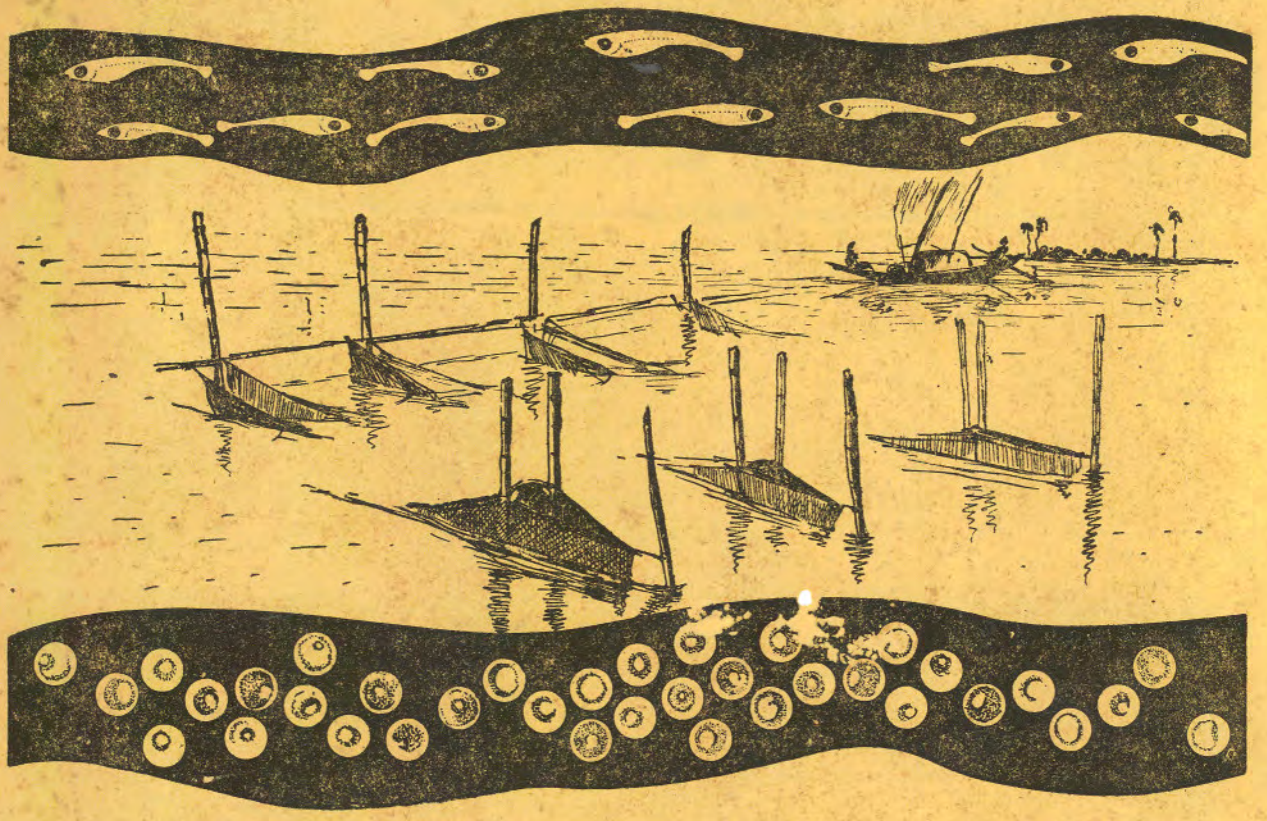
REPORT ON FISH SPAWN PROSPECTING INVESTIGATIONS, 1968

5, RAJASTHAN AND UTTAR PRADESH



Bulletin No. 14

March, 1971

CENTRAL INLAND FISHERIES RESEARCH INSTITUTE

(Indian Council of Agricultural Research)

BARRACKPORE, WEST BENGAL

INDIA

REPORT ON FISH SPAWN PROSPECTING INVESTIGATIONS, 1968
RAJASTHAN AND UTTAR PRADESH

by

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FOREWORD

Spawn prospecting investigations, initiated in 1964 for locating additional high yielding quality spawn collection centres in different parts of the country, were again carried out during 1968 in the States of Rajasthan and Uttar Pradesh by the Riverine Division of the Institute, in collaboration with the concerned State Governments. The results obtained therefrom are embodied in this report.

The investigations were carried out by a team of workers under the overall supervision and guidance of Shri H.P.C. Shetty, the Officer-in-Charge of the Riverine Substation of the Institute At Allahabad. The report has been edited and brought to its present consolidated form by Shri H.P.C. Shetty, while the initial sectional reports were prepared by the respective Institute teams, which worked in the field and analysed the data. The State technical personnel participated only in field work, while the analyses of the data and the the preparation of reports thereon were done entirely by the scientists of this Institute.

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

The active co-operation received from the Director of Fisheries, Uttar Pradesh, the Deputy Director of Fisheries, Rajasthan and several other regional officers of the two States is gratefully acknowledged. In addition to participating in the field investigations, the State Governments also provided part of field equipage and bore the major part of contingent expenditures.

V G Jhingran

(V.G. JHINGRAN)
DIRECTOR

Central Inland Fisheries
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CONTENTS

1 INTRODUCTION

The acute shortage of fish seed for culture in the country prompted the initiation in 1964 of spawn prospecting investigations by the Central Inland Fisheries Research Institute, aimed at the location of additional high yielding quality spawn collection centres in different parts of the country with a view to achieving regional self-sufficiency and the evolving of suitable collection techniques under varying sets of hydrodynamical conditions. The investigations carried out during the years 1964-67 have yielded valuable results in this direction (Anon, 1965; Malhotra et al., 1966; Shetty, 1967; Shetty et al., MS.). Similar work was carried out again during 1968 in the States of Uttar Pradesh and Rajasthan, the results of which are embodied in this report.

In all, investigations were conducted at 3 centres in Uttar Pradesh, 2 on the Yamuna and 1 on the Ganga, and at 1 centre in Rajasthan on R. Banas. Of these, one of the centres on R. Yamuna, 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. This centre was manned entirely by the staff of the Institute, while the others were run in collaboration with the concerned State Governments. As in the previous years, the Institute team provided the technical know-how and trained State Government personnel and local fishermen in riverine spawn collection techniques, while the greater part of the contingent expenditure was borne by the respective State Governments.

2 PRE-MONSOON SURVEY AND SELECTION OF SITES

Based on the developmental needs of the concerned regions, the Government of Uttar Pradesh suggested the investigation of a stretch of the Ganga in Kanpur and Farrukhabad districts, while the upstream stretch of the Banas in the districts of Tonk and Udaipur was suggested by the Government of Rajasthan. A pre-monsoon survey of both the above stretches was carried out during May, 1968, for selecting suitable stretches for prospecting and sites for detailed investigations, the selection criteria being the same as in the previous years. Further, a part of the lower stretch of the Yamuna in Fatehpur district, which could not be investigated during earlier years on account of poor accessibility, was also surveyed, as part of the systematic spawn resources survey of the Yamuna.

Details of stretches surveyed and the probable sites examined are shown in Table 1, while the identity and approach details of all the sites selected for detailed investigations are depicted in Table 2. The geographical locations of 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 shooting net) was the sole gear employed in the investigations aimed at assessing the spawn yielding potentiality of the selected centres. Two other nets of the same type as standard net, but made of 1/12" and 1/16" meshed Midnapore-type nettings respectively, were operated at Nanamau on the Ganga and at Deolan on the Yamuna, both in Uttar Pradesh, in order to test their efficiency vis-a-vis the standard net, under the available ranges of turbidity and current velocity.

For assessing the relative catching efficiencies of 1/18" and 1/16" meshed nettings under identical conditions, trouser-type net (Malhotra et al., 1966) was operated at Negria on R. Banas in Rajasthan. Double-walled blanket-type net (Shetty, 1967) was operated at Negria on R. Banas and at Deolan on R. Yamuna, for assessing the extent of spawn escapement from 1/8" meshed Midnapore-type netting.

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

The techniques employed for the collection, measurement and qualitative analyses of spawn and for the determination of selected hydrographical and meteorological factors were the same as those adopted since 1965 (Malhotra et al., 1966; Shetty, 1967). The frequency of observations was, likewise, the same.

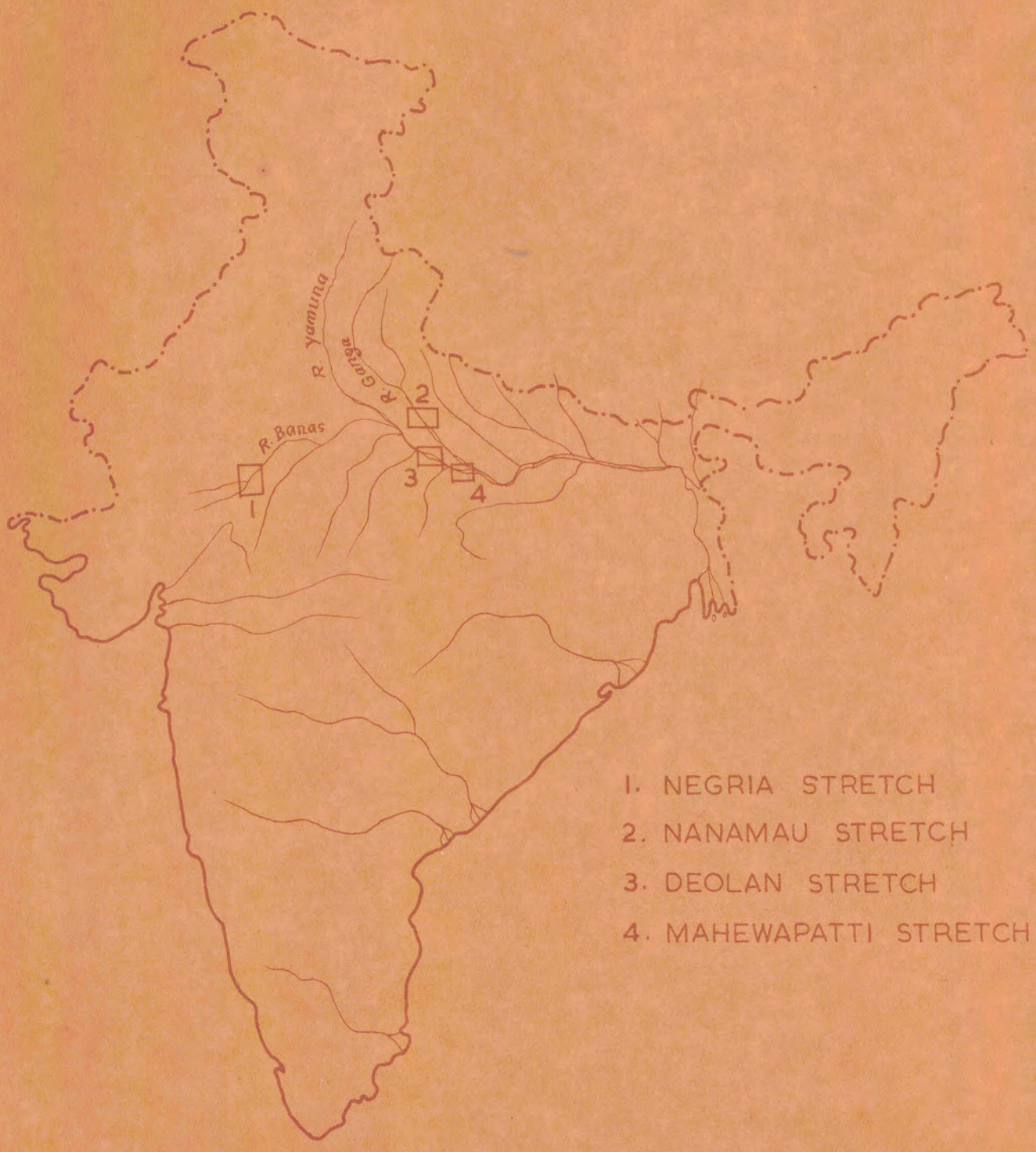

FIG. 1.

MAP OF INDIA, SHOWING STRETCHES PROSPECTED IN 1968.

Table 1

Stretches and sites surveyed during pre-monsoon survey and those selected for prospecting investigations

River	SURVEYED							Stretch selected for prospecting			
	Stretch			Site							
	From	To	Length in km	Name	Bank	Suitability (S/US)*	Justification for acceptance/ rejection	From	To	Distance in km	Main site for investigations
1	2	3	4	5	6	7	8	9	10	11	12
Banas	Negria	Khamnor Panchayat Samiti	262	1. Negria	West	S	Sloping bank, well connected.	Negria	Mandpia	175	Negria
				2. Jahazpur Ghat	East	S	Gradually sloping bank, inaccessibility during floods goods.				
				3. Lalpura	East	S	Good site in all respect.				
				4. Behara	West	S	Good collection ground accessibility fairly good.				
				5. Zira	West	S	-do-				
				6. Triveni	East	US	Rocky terrain, current pattern not suitable.				
				7. Mandpia	North	US	Site good but major carp population not noticed.				
				8. Mukundpura		US	Rocky terrain				
				9. Nathdwara	West	US	Rocky terrain				
				10. Khamnor		US	Rocky terrain				
Ganga	Kanpur	Fategarh	132	1. Ganga Ghat	East	S	Good collection ground and accessibility. Exploited by State Government.	Rajghat	Bithoor	70	Nanamau

1	2	3	4	5	6	7	8	9	10	11	12
				2. Bithoor	West	US	Difficult access. Limited area available for collection for short period.				
				3. Gadanpur	West	US	Accessibility poor. River bank flat.				
				4. Nanamau	West	S	Good collection ground accessibility fairly good				
				5. Araul	West	US	Precipitous bank				
				6. Durjanpur	West	US	Inaccessible during monsoons.				
				7. Salempur	East	US	-do-				
				8. Kapoor Katri	West	US	-do-				
				9. Mahabalipur	West	US	-do-				
				10. Kusumkhor	South	US	-do-				
				11. Chandapur	South	US	-do-				
				12. Chyasar	West	US	-do-				
				13. Bhojpur	West	US	-do-				
				14. Neewalpur	West	US	-do-				
				15. Pakhiyan	West	US	-do-				
				16. Ganglai	West	US	-do-				
				17. Sinoli	West	US	-do-				
				18. Raipur Khas	West	US	-do-				
				19. Ranighat	West	S	Good collection ground and accessibility.				
				20. Kutechery Ghat	West	S	Collection ground almost ladder like, good accessibility.				
				21. Toka Ghat	West	S	Good collection ground and accessibility.				

* S = Suitable
US = Unsuitable

Table 2

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

Details	Banas	Ganga	Yamuna	
1. Stretch (from - to)	Negria to Mandpia	Rajghat to Bithoor	Lalauli-Ashat	-
2. Selected site	Negria	Nanamau Ghat	Deolan	Mahewapatti
3. Bank	West	West	North	South
4. Tehsil/Taluk/ Sub-division	Deoli	Bilhaur	Ghazipur	Karchana
5. Police Station	Deoli	Bilhaur	Ghazipur	Naini Bhatahi
6. District	Tonk	Kanpur	Fatehpur	Allahabad
7. State	Rajasthan	Uttar Pradesh	Uttar Pradesh	Uttar Pradesh
8. Block	-	-	-	Chaka
9. Distance from Block H.Q. in km	-	-	-	5
10. Nearest Post Office	Deoli	Nanamau	Deolan	Agriculture Institute
11. Distance to (10) in km	10	2	2	3
12. Nearest Telegraph Office	Deoli	Bilhaur	Ghazipur	Naini
13. Distance to (12) in km	10	8	8	5
14. Nearest Telephone	Deoli	Bilhapur	Ghazipur	Agriculture Institute

Contd... Table 2

1	2	3	4	5
15. Distance to (14) in km	10	8	8	3
16. Nearest all weather road	Ajmer-Kota	Nanamau	Fatehpur-Augasi	Allahabad - Rewa
17. Distance to (16) in km	1	2	1	3
18. Nearest Railway Station	Ajmer	Bilhaur	Fatehpur	Naini
19. Distance to (18) in km	91	8	16	5
20. Number of nets that could be operated at different flood level.	75 - 100	50(only during low) floods	<4 M -250-300 >4 M -150-200	100-200

4 DEFINITIONS

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

5 OBSERVATIONS

5.1 Quantitative and qualitative spawn yielding potentiality of selected stretches, and spawn availability in relation to environmental factors at investigated sites

5.1.1 Negria stretch of river Banas

Participants

Dr. A.G. Jhingran (Leader)	Central Inland Fisheries Research Institute (I.C.A.R.)
Shri S.C. Pathak	
Shri R.M. Sexena	Government of Rajasthan
Shri S.K. Singh	
Shri N.B. Koshti	
Shri M.L. Aggarwal	
Shri Lakshman Singn	

A survey to assess the spawn yielding potentiality of river Banas in Rajasthan was initiated in 1967. The stretch of the river between Sawai Madhopur and Negria was surveyed and a few potential spawn-collection centres selected and prospected. In 1968, the survey was extended further upstream from Negria (Tonk district) to Khamnor Panchayat Samiti (Udaipur district). Based on the survey, Jahazpur was selected as the main site of investigation for 1968. On reaching the site on 5th July, 1969, it was, however, found that the foundation work for the construction of a bridge, linking Jahazpur with Shahpura had been laid down in June end, thus diverting the current to the other bank and rendering the selected site unsuitable for net-operations. Therefore, the stretch of the river a little up and downstream was surveyed with a view to locating an alternate site. While no suitable collection ground could be located upstream, Negria, downstream of Jahazpur, was found to be suitable, and was, therefore, chosen for the main investigations. The work commenced at this site on 7.7.68.

The Negria stretch (175 km) of river Banas extends from Negria in the north-east to Mandpia in the south-west (Fig. 2). Negria is a village situated 10 km west of Deoli, a tehsil of Tonk district, on the Kota-Ajmer Road. River Khari drains into the Banas on its western bank opposite Negria village, just above the road bridge. A number of nalas drain into the river both up and downstream on both the banks. A number of deep pools are located in the river both up and downstream, harbouring a sizable major carp population. The important pools are : Upstream : Triveni, Jamoli, Zira and Behra Downstream : Shalsingh Deh at Rajmahal, Kala deh, Deola and Banthali.

The work site, situated on the bank opposite to Negria, has a vast area of gently sloping sandy bank and an ideal current pattern. The general topography of the site at Negria and its vicinity is depicted in Fig. 3.

I. Occurrence of spawn spurts :

Only 3 spawn spurts were encountered at Negria during the entire season, lasting for 72 hours, 12 hrs and 16 hrs respectively. With the appearance of spawn spurts I and III, simultaneous trial nettings were made at all the suitable spots available in the vicinity of the site, as well as on the opposite bank (spots A to D) and the battery of nets operated only at the spot yielding maximum catch/net. The results of spurt-wise trial nettings are given in Table 3.

Table 3

Spurt-wise availability at various spots in trial nettings at Negria

Spawn spurt	Average spawn catch/net-hr				Most suitable spot
	A	B	C	D	
I	2.5	1.5	1.0	1.5	A
III	5.0	2.5	nil	3.0	A

Details pertaining to the occurrence, duration, quantity and quality of each spawn spurt are depicted in Table 4.

A total of 7939 ml of spawn was collected during the entire season in 1-5 standard nets in the course of 3 spurts. The first spawn spurt occurred in the receding phase of the Ist major flood which commenced from 2 P.M. on 12.7.68 and lasted till 2 P.M. of 15.7.68. The spawn appeared 8 hrs after the flood had attained its peak level of 1.69 m on 12.7.68 at 6 A.M.. Appearance of spawn in

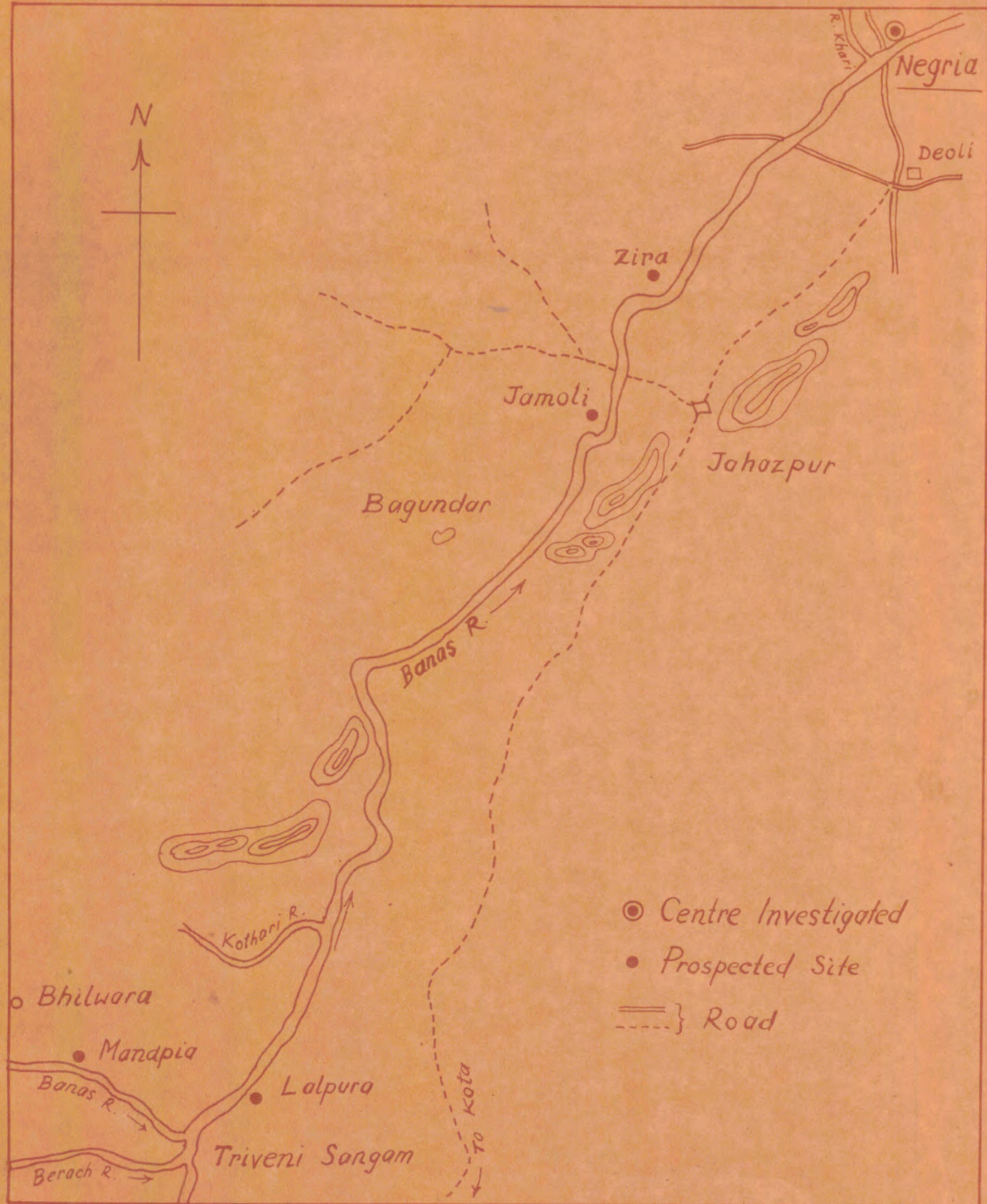

FIG. 2.

NEGRIA STRETCH OF RIVER BANAS, SHOWING SITES PROSPECTED AND CENTRE INVESTIGATED.

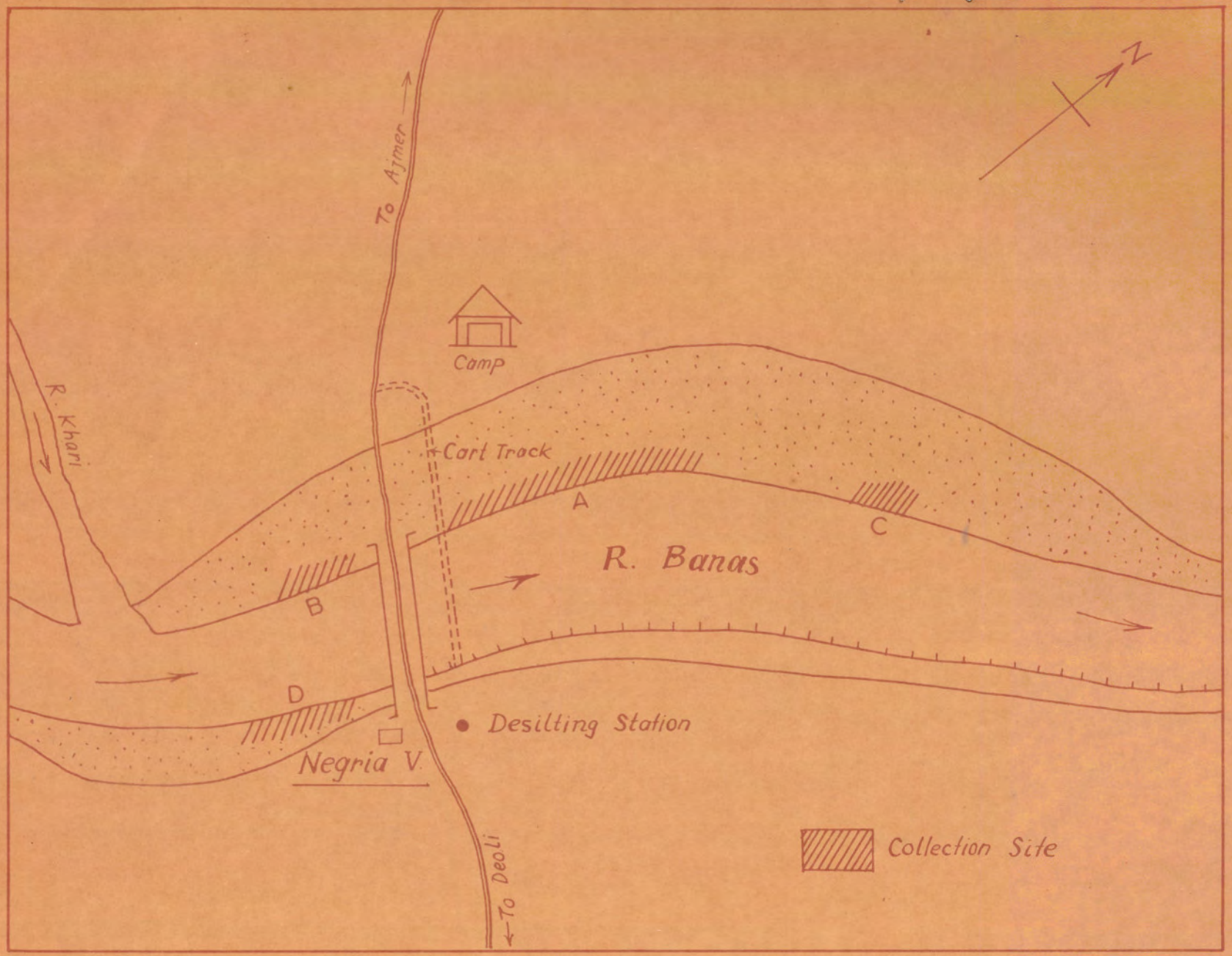

FIG. 3.

THE COURSE, GENERAL TERRAIN AND TOPOGRAPHY OF RIVER BANAS AT NEGRIA.

bulk quantities, occurred on 14.7.68 from 10 P.M. and continued upto the end of the spurt. Within this period, the average spawn catch/net-hour ranged between 34.5 ml and 142.0 ml. After this the spawn waned in magnitude, its concentration falling below the index of availability to start with and being totally absent from 6 A.M. to 6 P.M. on 16.7.68. This was probably due to a slight rise in the water level from 0.10 m to 0.18 m and this rise continued till 2 P.M. on that day when the water level touched the mark of 0.2 m. From 6 P.M. the water level again started falling and with this commenced the comparatively shorter spawn spurt, which lasted 12 hours, till 6 A.M. of 17.7.68. A total of 7742 ml of spawn was collected in the first flood itself, and this accounted for 97.5% of the season's total catch. Both the first two spurts yielded desirable spawn.

The third spawn spurt was also of short duration, lasting for only 16 hours. It commenced at 2 P.M. on 25.7.68 in the receding phase of the II flood. The flood having attained a peak of 0.7 m on 23.7.68 at 2 P.M., started declining and immediately spawn started appearing in traces. This spurt, though of a very low magnitude as compared to the I spurt, yielded a total of 197 ml of entirely desirable spawn. The average catch/net-hour ranged from 1.0 ml to 4.4 ml.

In the subsequent flood (Flood III) no spawn was encountered.

II. Quality of fish seed collected

Percentage composition of spawn catches made during the three spurts, based on two-hourly microscopical analyses of the samples is given in Table 5. While the first two spawn spurts had a fairly high percentage of major carps (43.00% and 43.75% respectively) the major carp content of the 3rd spurt was found to be slightly low (31.2%).

Samples from the I and III spawn spurts were also reared in earthen gamlas, in the ditches near the site and in the nurseries of the Government of Rajasthan at Hindoli, Bundi and Ajmer. A detailed account of the species composition of different samples drawn from them is given in Table 6. The samples drawn from the nurseries in the Bundi district showed excellent growth of catla and rohu to about 7" and 4.5" respectively. In these nurseries "Surlex", an artificial food manufactured by the Raj Industries of Jaipur was provided to the growing spawn and fry. The spawn from the same spurt reared in

Ajmer nurseries was found to have a stunted growth as no artificial food was provided to the fry, and the water from the nursery, had almost dried up for want of care.

The spawn collected on 14.7.68 and 15.7.68 showed a high percentage of Catla (39.8% and 37.7% respectively), followed by rohu (13.9% and 11.8% respectively). The percentage composition of mrigal and calbasu amounted to 6.9 and 1.8 respectively. Among minor carps L. bata, followed by C. reba, mostly dominated.

The seasonal indices of spawn quantity and quality for this centre were estimated to be 1688 ml and 56.78% respectively for 1968 season. [illegible] estimated to be 1688 ml and 56.78% respectively for 196[illegible] season.

Spawn availability at prospected sites :

Spawn prospecting was attempted at Jahazpur, Lalpura and Mandpia sites. The trial netting done in the initial phases at Jahazpur revealed the availability of spawn at this site, slightly downstream of the orginally selected point.

At Lalpura, meagre quantities of spawn could only be collected, as the prospecting at this centre was slightly delayed, with the result that on reaching the site it was found that the river had already shrunk to its pre-flood size and the spawn spurt had passed through this stretch. Consequently, whatever collections were made were only remnants of a dwindling spawn-spurt. However, it was felt that this site promises to provide good quantities of quality seed, because of its location at a point a little upstream of which, at Triveni, three rivers join and there are a good number of deep pools harbouring major carps population both upstream and downstream of the site. The area has a vast sandy, gently sloping bank ideal for operation of 50-100 nets throughout the season..

Trial nettings done at Mandpia did not yield any spawn. On enquiry from the State personnel, it was learnt that there are no deep pools about 130 km downstream and 65 km upstream of this site. During the pre-monsoon survey in May, the stretch of the river from Triveni upto Madri Dam was surveyed and a good part of which was found to be completely dry, devoid of any deep pools. It is felt that chances of encountering sizeable quantities of major carps spawn at Mandpia are rather remote.

Table 4

Flood-phase-wise occurrence, duration and magnitude of spawn spurts recorded at Negria on river Banas in 1968

Flood No.	Phase	From - To Date	Hour	Duration in days	Peak flood level Date	Hour	Flood level in m	Spawn spurt No.	Quality D/UD	Commencement Date	Hour	Duration in hrs.	Spawn Catch by standard nets No. of nets	Catch in ml	Catch in lakhs
I	Rising	11.7.68 to 12.7.68	6 to 6	1	12.7.68	6	1.69	-	-	-	-	-	-	-	-
	Receding	12.7.68 to 18.7.68	10 to 10	6				1	D	12.7.68	14	72	5	7,346	36,73,000
								2	D	16.7.68	18	12	5	396	1,98,000
II	Rising	22.7.68 to 23.7.68	18 to	1	23.7.68	14	0.70								
	Receding	23.7.68	22					3	D	25.7.68	14	16	5	197	98,500
III	Rising	17.8.68 to 18.8.68	18 to 18	1	188.68	18	10.82			no spawn					

Table 5

Catch per unit of effort and quality of fish seed as determined by spawn analysis of the samples collected at Negria on R. Banas in 1968

Spawn spurt	Flood phase	Catch per unit effort (net-hour) in standard nets, in ml	Quality major carps	By microscopical analyses (%) Minor carps & others
I	Receding	26.15	43.00	57.00
II	Receding	10.48	43.75	56.25
III	Receding	3.5	31.20	68.80

Table 6

Quality of fish seed collected during different spurts in the Banas at Negria in 1968, as revealed by rearing experiments

Spurt No.	Date of collection of spawn	Sample No.	Sample Size	Percentage Composition Major carps Catla	Major carps Rohu	Mrigal	Kalbasu	Total	Minor carps	Others
I	13.7.68	I	84	13.6	29.8	6.4	1.7	51.5	48.5	nil
	14.7.68	II	146	39.8	13.9	8.2	1.8	63.7	36.3	nil
	15.7.68	III	266	37.7	11.8	6.2	2.0	57.7	42.3	nil
	Pooled average :			30.4	18.5	6.9	1.8	57.6	42.4	nil
2	25.7.68	I	145	5.0	8.2	9.7	3.3	26.2	66.1	7.7
	26.7.68									

Spawn availability in relation to hydrographical and biotic factors :

Flood level : Three major floods occurred in the river Banas in 1968 season, out of which the first two yielded spawn. About 97.5% of the season's total catch was yielded by the first flood alone, which touched a peak of 1.69 m on 12.7.68 at 6 A.M. The second flood-peak, of a lesser magnitude, attained on 23.7.68 at 2 P.M., touched the highest of 0.7 m and yielded the rest of the total catch. The third flood, abrupt and severe; touched a peak of 10.8 m on 18.8.69 at 2 P.M. and with the incoming of freshets the entire topography of the river was unfavourably transformed temporarly. However, by this time, as was observed by examination of gonads of major carps caught, the fishes had already shed their eggs and were recovering from the spent condition.

Turbidity : Turbidity values mostly ranged between 107 and >1200 ppm. However, during spawn availability, it ranged between 127 and 900 ppm. No direct relationship could be observed between turbidity values and spawn availability.

Current velocity: During the season as a whole, the current velocity ranged from 0.28 to 3.8 km/hr. However, during the spawn availability period, the values ranged from 1.05 to 3.4 km/hr.

Associates : Associates were encountered more during the first flood, and declining thereafter. 37 species of associates were encountered, the most common of which were: Barilius barila, Ambassis nama, Mastacembelus pancalus, Notopterus notopterus, Glossogobius giuris, Puntius sophore and Puntius filamentosus.

5.1.2 Nanamau stretch of river Ganga

Participants

K.P. Srivastava (Leader)	Central Inland Fisheries Research Institute (I.C.A.R.)
M. Sinha	
K.A. Ansari	Govt. of Uttar Pradesh

A stretch of the river Ganga, from Rajghat (Kannauj) in the district of Farrukhabad to Bithoor in Kanpur district of U.P., approximately 70 km by river route, was prospected during the year 1968 (Fig. 4). For detailed investigations, a site near village Nanamau (Tehsil Bilhaur, Distt. Kanpur) on the southern bank of the river was chosen, where round the clock observations were conducted from 5th July to 31st August, 1968 (58 days). The site situated at a distance of about 10 km north of Bilhaur town, is connected to it by a fair-weather road, rather a cart-tract, which is liable to be inundated in the monsoon season.

Although an ideal place for spawn collection was not available because of the irregular river terrain, mounds and ravines on the bank, the area most suited for the purpose was selected on the eastern side of the village. The main stream branches into four parts just below the investigated site, leaving in between vast stretches of sand dunes. The tributaries Ramganga, Garra and Kali meet the river at about 35 km upstream, while Isan joins it about 5 km down-stream of Nanamau. A nala, originating from the mainstream about 10 km upstream and following a serpentine course, joins the river just opposite the investigated site. This nala in rainy season, is joined by many other nalas, which bring rainwater from the catchment area and a small jheel. The entire course, through which these nalas pass, are low lying fields, which could possibly be fish breeding grounds. Fig. 5 depicts details of the site, including the spots of spawn collection.

The mounds and the steep south western bank (bank of detailed investigations) cause the mainstream to change the course, sometimes creating back currents. However, the spot chosen for investigation was gently sloping and was more suitable for operation of nets in low magnitude floods. During high floods, the river touches the steep banks and mounds and practically very little space is left for the operation of nets. The other bank (north-eastern) is infested with wild 'Jhau' plants and during floods due to fast current and resultant erosion, the area is unsuitable.

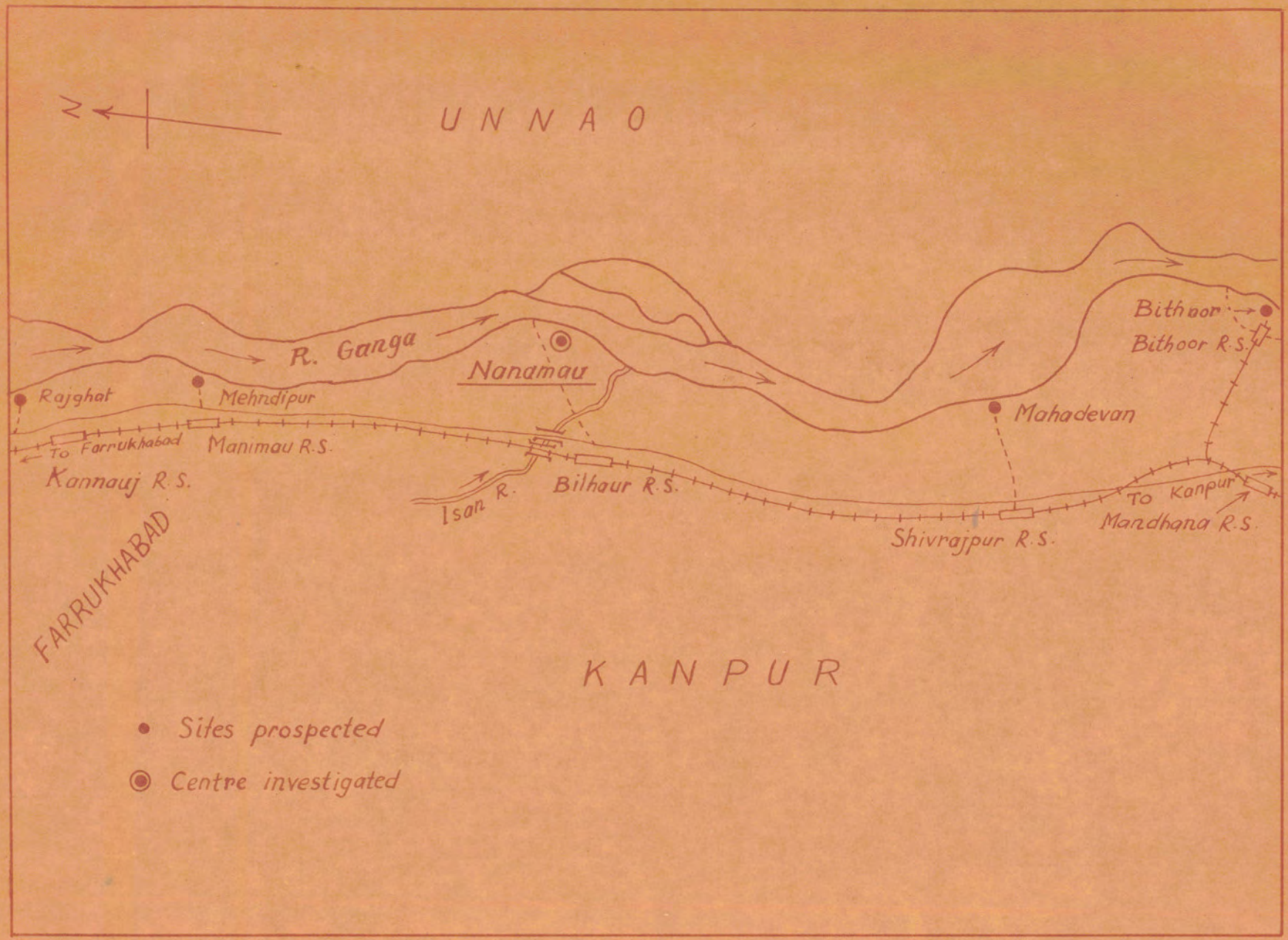

FIG. 4.

NANAMAU STRETCH OF RIVER GANGA, SHOWING SITES PROSPECTED AND CENTRE INVESTIGATED.

Occurrence, areas of concentration and quantity of spawn:

Three spawn spurts were encountered at Nanamau during the season, all during the rising phase of the II flood. They lasted for 12, 56 and 18 hours respectively. With the appearace of spawn in each spurt, simultaneous trial nettings were made at several suitable spots in the vicinity of the site (Fig. 5, spots A-D), and the battery of 5 standard nets operated at the spot yielding the maximum catch. The results of spurt-wise trial nettings are given in Table 7.

Table 7

Spurt-wise spawn availability at various poots in trial nettings at Nanamau

Spawn spurt No.	Average Spawn Catch/net - hr in ml				Most suitable spot.
	A	B	C	D	
I	0.5	nil	1.5	1.0	C
II	2.5	2.0	6.0	3.0	C
III	nil	1.0	2.0	1.5	C

Thus, spot C was found to be invariably the most suitable spot. Trial nets were also operated on the opposite bank (Fig.5, spots E & F), but except for a few minor carp eggs nothing was found. However, it is possible that the nalas on this bank form a breeding ground of carps.

Details relating to the time of occurrence, duration, quantity and quality of spawn during various spawn spurts are depicted in Table 8.

FIG. 5.

THE COURSE, GENERAL TERRAIN AND TOPOGRAPHY OF RIVER GANGA AT NANAMAU.

Table 8

Flood-phase-wise occurrence, duration, desirability and magnitude of spawn spurts at Nanamau on R. Ganga 1968

FLOOD DETAILS								SPAWN SPURT DETAILS						
Flood No.	Phase	From Date	From Hour	Duration in days	Peak flood level Date	Peak flood level Hour	Peak flood level Flood level in m*	Spurt No.	Duration from Date	Duration from Hour	Period in hrs.	Quality D/UD	Spawn catch by standard nets No. of nets	Spawn catch by standard nets Catch in ml
I	Rising	5.7.68	6	1	6.7.68	6	0.37	-	-	-	-	-	-	-
	Receding	6.7.68	10	5	-	-	-	-	-	-	-	-	-	-
II	Rising	11.7.68	10	14½	25.7.68	18	1.62	I	11.7.68	6	12	D	1	8
												UD	5	70
								II	13.7.68	22	56	D	5	3762
								III	20.7.68	18	18	D	5	73
												UD	5	37
	Receding	25.7.68	22	6	-	-	-	-	-	-	-			
	Vascillation	31.7.68	2	8	-	-	-	-	-	-	-			
III	Rising	8.8.68	2	5½	14.8.68	10	2.02	-	-	-	-			
	Receding	14.8.68	14	2½	-	-	-	-	-	-	-			
	Vascillation	16.8.68	18	4½	-	-	-	-	-	-	-			
	Rising	21.8.68	6	4	24.8.68	2	2.13	-	-	-	-			
	Receding	25.8.68	6	7	The flood was still receding when observations were discontinued									
	Total			58							86			

* Height above the lowest water level observed during the investigation

A total of 3950 ml of spawn was collected in 1-5 standard nets in the course of the 3 spawn spurts. The total catch of the season, including that of 2 research nets, amounted to 6000 ml.

Although meagre quantities of spawn were available on 8th & 9th July (5 ml and 2 ml respectively), the catch of 8 ml spawn at 6 hrs of 11.7.68 was an indicator of the commencement of the Ist spurt. This spurt lasted only for a brief period of 12 hrs, and except for 8 ml catch during 6 hrs all the other spawn collected during this period was of undesirablle quality. In all, it yielded only 78 ml of spawn.

The second spurt commenced at 22.00 hrs on 13.7.68, after a gap of 52 hrs. Bulk spawn then appeared and continued for a total period of 56 hrs (i.e. till 6 hrs of 16.7.68). There was, however, a period of 4 hrs from 14.00 hrs to 18.00 hrs of 15.7.68, when the intensity of the catch was low, but again from 20.00 hrs. hatchlings were available in appreciable numbers. Sometimes, the intensity of collection was so high that hourly scooping became necessary. This spurt yielded the bulk of the season's catch (3762 ml). The peak day of collection was 14th July and this single day's catch amounted to 2419 ml. All the catches of this spurt were of desirable quality.

The third spawn spurt made its appearance at 18.00 hrs. on 20.7.68 and continued for 18 hours till 12 hrs. on 21.7.68, yielding 73 ml of desirable spawn and 37 ml of undesirable spawn.

Spawn did appear at a later date at 18.00 hrs. on 29.7.68 during the receding phase of IInd flood and the nets were duly fixed, but immediately after that, there was a high intensity storm followed by torrential rains, resulting in blowing up of tail pieces and uprooting of poles. No positive results could be obtained after refixing of the nets.

The catch per net-hour, considering the catch of standard nets alone was 1.2 ml, 13.2 ml and 1.2 ml during I, II and III spurts respectively, while it was 2.3 ml for the entire season.

Quality of fish seed collected :

Two-hourly spawn samples were microscopically analysed to determine the quality of spawn and the weighted average for each spurt calculated. In addition to this, spawn samples of each spurt were reared in earthen gamlas, plastic tanks and nursery pits near the site. Besides, a sample from the State nersery at Kalyanpur, where the spawn of second spurt had been released, was analysed. The spurt-wise quality of spawn, determined by the above mentioned two methods, is shown in Table 9 and 10.

Table 9

Spurt-wise quality of spawn collected at Nanamau in 1968, as determined by microscopical analysis and rearing

Spurt No.	Percentage Composition					
	By spawn analyses (weighted average)			By rearings (pooled average		
	Major carps	Minor carps	Others	Major carps	Minor carps	Others
I	6.1	90.3	3.6	25.7	73.8	0.5
II	56.4	40.5	3.1	79.4	20.2	0.4
III	28.1	70.0	1.9	22.2	77.8	-

In the absence of any definite characteristics for differentiation of carp spawn below 5 mm size, into major and minor, all the hatchlings of this size have been put in the group of minor carps for the purpose of this analysis.

Table 10

Spurt-wise spawn quality as determined by various modes of rearing

Spurt No.	Sample from	Percentage of Mrigal	Catla	Rohu	Kalbasu	Min. carps	Others
I	Nursery pit I	0.4	-	30.4	0.7	68.5	-
	Nursery pit II	-	-	34.8	0.3	64.9	-
	Chetty pot	5.5	0.7	4.3	-	87.9	1.6
	Average	2.0	0.2	23.2	0.3	73.8	0.5
				25.7			
II	Plastic Tank I	96.7	-	-	-	3.3	-
	Plastic Tank II	51.9	-	0.5	0.5	48.1	-
	Nursery pit	10.5	48.0	9.7	1.2	29.1	1.5
	State Nursery	-	18.2	74.5	5.6	1.7	-
	Average	39.8	16.6	21.2	1.8	20.2	0.4
				79.4			
III	Chetty pot	-	-	22.2	-	77.8	-
	Average	-	-	22.2	-	77.8	-

It is evident from the above tables that the first spurt spawn was of very poor quality, as per microscopical analysis. However, in the rearing experiments, the pooled average of major carps content was found to be as much as 25.7%. This could be due to the higher rate of mortality of minor carps during rearing, or possibly due to their over estimation in spawn analyses, wherein all spawn below 5 mm were included among minor carps. The second spurt was by far of best quality, while the third spurt was more or less comparable to the first, as revealed by rearing experiments.

There was a remarkable difference in the species composition in various rearings as can be seen from in Table 10. This might be due to differences in the feeding habits of these species in relation to different food items available in various rearings. There is every possibility of differential mortality in the rearings accounting for varied percentage composition as shown by spawn analysis and reared samples. Rohu dominated amongst the major carps in I and III spurts, mrigal dominated the total spawn catch in the II spurt. I The seasonal indices of spawn quantity and quality for this centre were estimated to be 387 ml and 54.5% respectively.

Spawn availability at prospected sites :

Sites near Rajghat (Kannauj), Mehndipur on the upstream and Mahadevan and Bithoor situated downstream of Nanamau were prospected for spawn availability. The area near Rajghat is low lying and is inundated during the floods of even low magnitude. A nala, running near the fort of Kannuaj, and tributaries Ramganga, Garra and Kali surround the area of operation, resulting in high current velocity, thereby making the place unsuitable for net operation. The Mehndipur and Mahadevan sites have steep banks and at Bithoor very little space is available below Brahmavat Tila for operation of shooting nets. Trial nets were operated in these places, but no positive results could be obtained.

Spawn availability in relation to hydrographical and biotic factors:

Flood level : Flood in R. Ganga near Nanamau is caused by incoming water from tributaries, viz. Ramganga, Garra and Kali upstream, and also the local rain water in the catchment area.

During the course of observations, four major floods and two vascillatoryphases, as indicated in Table 8, were encountered. The river showed a rising trend from 5th July, the first day of observation, reaching a peak of 0.37 m (height from lowest observed water level during the season), at 6.00 hrs on 6.7.68, negligible spawn was obtained. Thus, it may be surmised that the first flood was not high enough to inundate the breeding grounds.

The second flood started at 10.00 hrs. on 11.7.68 and reached its peak level of 1.62 m on 25.7.68 at 18 hrs. This flood yielded all the three spurts of spawn on 11.7.68, 13.7.68 and 20.7.68 respectively. It is interesting to note that all the spawn spurts occurred only in the rising phase of the flood. It can be explained as follows. The collection centre is situated just 35 km below the confluence of Ramganga, Garra and Kali rivers with River Ganga. With the rise of water in them, these rivers swell up enormously, thus inundating fields in their vicinity. Flooding of these rivers might have caused the spawners to breed there. After the discharge of water of these tributaries in their receding phase, the main stream of Ganga might have experienced the second flood thus bringing the spawn of these rivers to Nanamau in the rising phase of this flood.

There was a eight day vascillating phase starting from 31.7.68 followed by the third flood which commenced at 2 hrs on 8.8.68, reaching a peak of 2.02 m at 10 hrs. on 14.8.68 but no spawn was available either during rising or receding phase of this flood.

Again a vasillatory phase of 4½ days duration was encountered from 16.8.68, followed by the fourth flood staring at 6 hrs. on 21.8.68 and reaching a peak of 2.13 m at 2.00 hrs on 24.8.68, the heighest of the season. But during this flood also no spawn was available. The flood was still receding at the time of closure of observations.

Thus from the above observations it is seen that at Nanamau quality spawn was available during the moderate floods of mid-July when the water rose by about 1.6 m over the summer level.

Turbidity : Turbidity at the centre ranged from 215 to 550 ppm. The bank and the soil of the catchment area near the centre are and as such the water was never too turbid. During the period of availability, the turbidity fluctuated at a low range/215 to 310 ppm. However, no definite relation between turbidity and spawn availability could be established. On the other hand, as discussed later in this report, because of low turbidity finer meshed nets yielded better results at this centre.

/of

Current velocity : The minimum current velocity observed at the centre was 0.52 km/hr and the maximum 3.46 km/hr. Often back currents were generated, making the operation of nets impossible. It is noteworthy that during all three spurts of the second flood the current velocity ranged between 1.05 to 1.38 km/hr. However, no correlation could be established between spawn availability and current velocity, as these values also encountered in the receding phase of the fourth flood which was a nonavailability period.

During the trial net operations at the other bank of the river, near the confluence of the nalas (spot E & F in Fig. 5), the current velocity was quite high and the spawn, though available in traces, was found to be dead due to impact of water current.

Weather condition : Cloudy and overcast sky with a little drizzle and gentle wind was found to be favourable for collection of spawn. Sometimes interruptions in the availability were caused by high stormy winds.

Rainfall data indicated that rainfall at the centre had no bearing on the availability of spawn.

Associates : Though associates were available throughout, their number was more when the water level rose suddenly. In the bulk availability period, their magnitude was generally less. The more common associates were Cirrhina reba, Labeo bata, Chela spp., Puntius ticto, Rohtee cotio, Aspidoparia morar and Barilius barila.

However, no direct correlation could be established between the associates and spawn availability.

5.1.3 Deolan stretch of the river Yamuna

Participants

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The systematic survey of the spawn resources of river Yamuna, initiated in 1964, was concluded in 1968 with the coverage of the left over section of the lower stretches. The 75 km stretch of the Yamuna around Deolan, a village situated 2 km off the Fatehpur-Augasighat road in the Fatehpur district of U.P., was selected for prospecting investigations in 1968. The main investigations were carried out at Deolan from the 5th of July to 28th of August 1968, while a number of sites, distributed over the selected stretch, from lalauli in the north to Ashat in the south, were prospected for spawn.

The river in this region flows from west to east in a serpentine course and is joined by R. Ken and R. Garara on its southern bank (Fig. 6). While the seasonal tributary Garara joins the river a little upstream of the site on the opposite bank, a nala opens into the river a little upstream on the same bank. The biggest known deep pool of the river Yamuna is located about 15 km downstream of the site and is known as the Jarauli kund.

The northern bank of the river at Deolan has a vast expanse of gently sloping bank, while the southern bank opposite the site is highly precipitious. The Augasi village is situated on the top of the high bank opposite the site. A comparatively smaller deep pool, variedly estimated to be 15-30 m deep, is located almost touching the high bank at Augasi. Because of the course that the river negotiates in this stretch, especially in the upstream region, the current pattern at Deolan is highly favourable for spawn collection. The topography of the site at Deolan and its neighbourhood has been illustrated diagrammatically in Fig. 7. This figure also contains the operational area available at different flood levels at Deolan.

Occurrence of spawn spurts :

The occurrence of floods in this region is governed by the discharge of river Ken and by the run-off of the upstream catchements of the river and its tributaries. The flood pattern at the site was typical of large rivers, well marked floods with prolonged rising and receding phases.

Four floods were experienced by the river at Deolan, of which the first and third did not yield any spawn. The first flood was almost wholly a resultant of the discharge of the Ken and rose to 9.57 m above the summer level. The second flood registered a peak of 5.55 m on 24th July after rising for about 60 hours and yielded the first spawn spurt in the rising phase and the second spawn spurt in the receding phase. The third flood touched a peak level of 8.45 m on 7th August, but failed to yield any spawn, while the fourth flood in its rising phase yielded the third and last spawn spurt of the season.

With the appearance of spawn in the trial net satisfying the availability criterion in second and third spawn spurts, spots of maximum spawn availability were determined by operation of trial nets at various spots (Fig. 7). The operation of full battery of nets was made in either of these spurts at the spot yielding the highest catches in the concerned spurt in the two hour period of trial netting immediately following the availability criterion satisfaction. The results of these operations are given in Table 11.

Table 11

Spurt-wise spawn availability at various spots in trial nettings at Deolan

Spurt No.	Spawn	Catch	(in ml) at	per net-hour	Most suitable spot
	A	B	C	D	
2	1	1.5	neg.	neg.	B
3	neg.	2	neg.	1	B

Since the spawn of spurt I was known to be undesirable, being composed of prawns and minor carps, neither trial nettings at various spots was done, nor the full battery of nets operated.

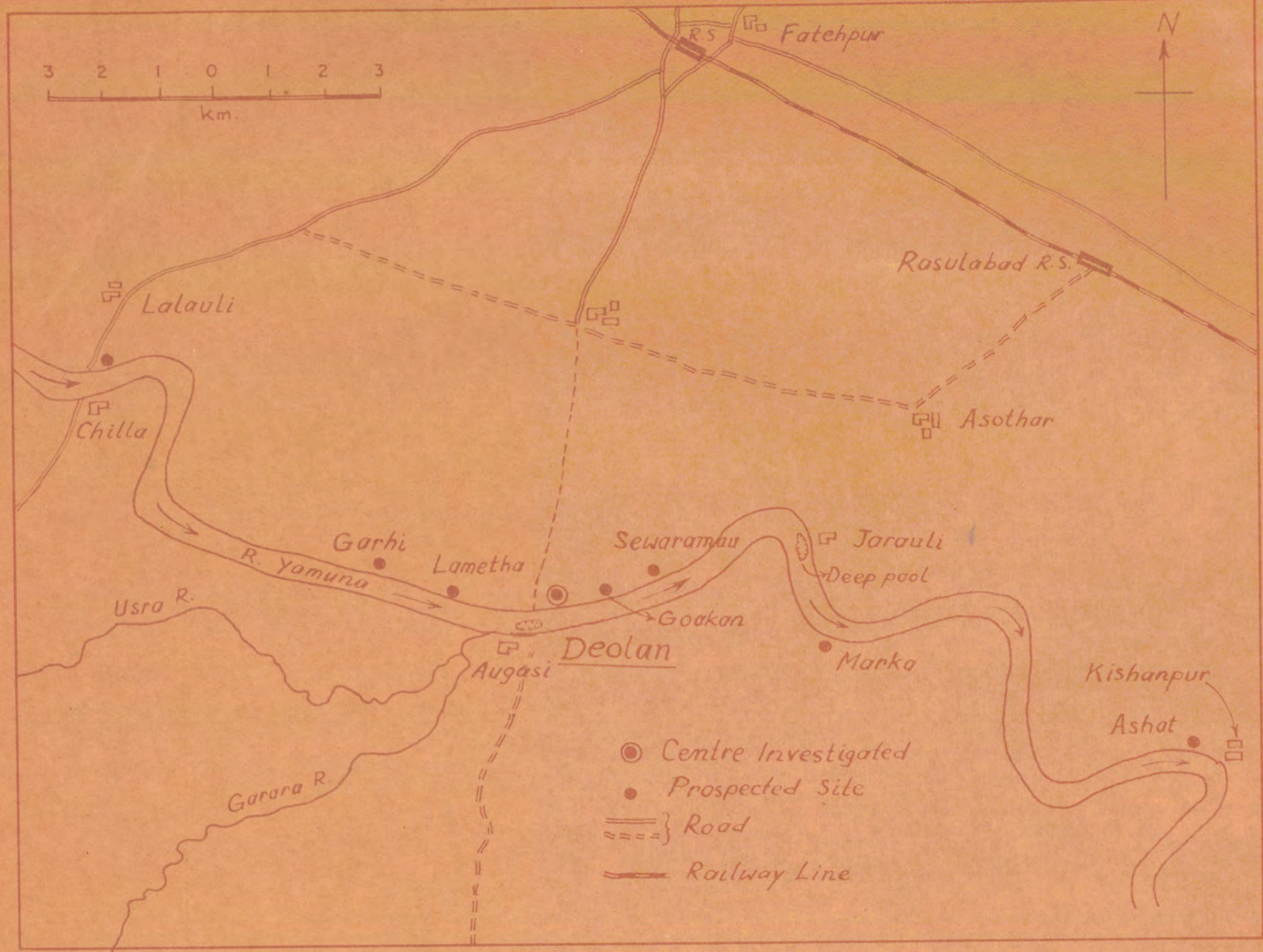

FIG. 6.

DEOLAN STRETCH OF RIVER YAMUNA SHOWING SITES PROSPECTED AND CENTRE INVESTIGATED.

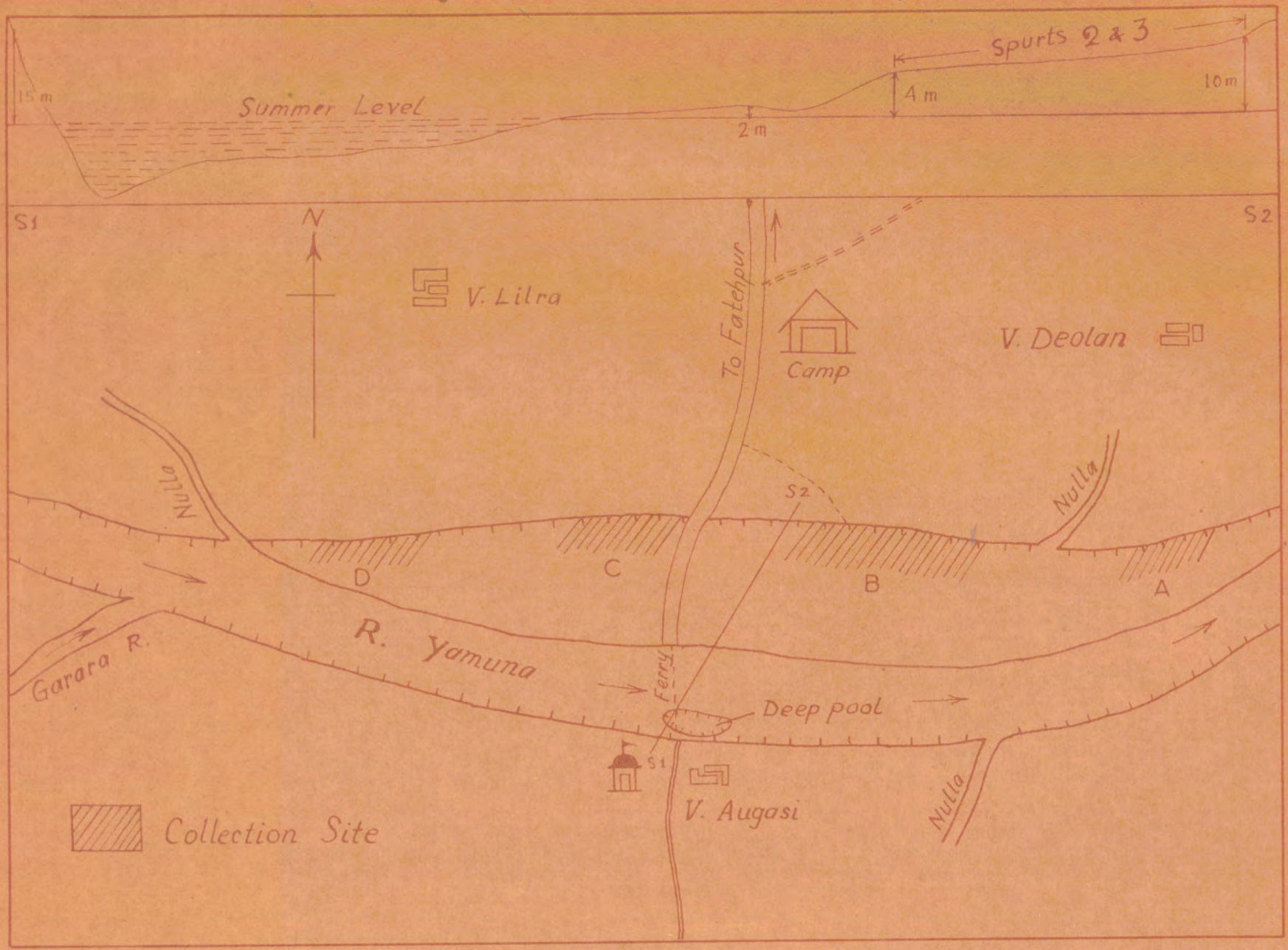

FIG. 7.

THE COURSE, GENERAL TERRAIN AND TOPOGRAPHY OF RIVER YAMUNA AT DEOLAN.

Details of occurrence, duration, magnitude and desirability of the various spawn spurts encountered at Deolan are given in Table 12. In the entire season, a total of 1,219 ml of spawn was collected in 42 hours of availability. This catch comprised 80 ml of undesirable spawn collected in 8 hours and 1139 ml of desirable spawn collected in the remaining 34 hours. The first spawn spurt of the season that came within eight hours of the rising phase of the first flood, yielded the only undesirable spawn collected at the site. The second and third spawn spurts yielded 814 ml and 325 ml of desirable spawn only, in 14 and 20 hours respectively. The three spawn spurts accounted for 6.5%, 66.8% and 26.7% of the total seasonal spawn yield at the site. 71.4% of the total desirable spawn catch of the site was made in the second spurt and the remaining 28.6% in the third spurt. While the undesirable spawn of spurt 1 had a rate of yield of 10 ml per net-hour, the desirable spawn catch of second and third spurts came at the rate of 13.1 ml and 3.6 ml per net-hour respectively. The desirable spawn spurt 2 commenced 24 hours after the flood had changed to recession. The commencement of spurt 3 preceded the touching of peak flood level of 7.21 m by 70 hrs.

Quality of spawn collected :

The first spurt, which was purely undesirable, revealed on microscopical analysis of two hourly spawn samples, a minor carp content of 52% and prawn content of 48%. The second and third spurts showed, on similar analysis, 17.4% and 51% of major carps respectively Table 13.

The spawn of spurt I was not reared at all, while the spawn of spurts 2 and 3 were reared in nurseries of the Government of Uttar Pradesh. The reared samples showed a major carp content of 70% in the second spurt and 95% in the third spurt. Catla dominated in both the second and third spurt, with its contribution of 54.3% and 85% in the two spurts respectively. Rohu, which had a percentage of 20 in the second spawn spurt and 10 in the third spurt, was the next dominant major carp. Mrigal was conspicuously absent in all the samples drawn from the nursery. It may be because of the fact that the samples were drawn from completely filled nurseries with the help of a Jaunpur drag net, which normally fails to collect the bottom dwellers. The apparent underestimation of major carp content in spawn samples may be due to some of the smaller hatchlings of size about 5 mm being inaccurately classified as minor carps for want of knowledge for correct identification at that stage when both minor and major carps have yolk present in good quantity.

Table 12

Flood-phase-wise occurrence, duration, magnitude and desirability of spawn spurts at Deolan in 1968

Flood Details								Spurt Details				No. of nets	Spawn catch		
No.	Phase	From Date	From Hour	Duration in hrs.	Peak flood level Date	Peak flood level Hrs.	Peak flood level in m.	No.	Desirability	From Date	From Hr.	Duration in hrs.		in ml	in lakhs	per net hour in ml
I	Rising	7.7.68	10	132	12.7.68	22	9.57									
	Receding	13.7.68	6	204												
II	Rising	21.7.68	18	60	24.7.68	6	5.55	1	UD	22.7.68	6	8	1	80	0.40	10.0
	Receding	24.7.68	6	244				2	D	25.7.68	6	14	1-5	814	4.07	13.1
III	Rising	3.8.68	10	104	7.8.68	18	8.45									
	Receding	7.8.68	18	208												
IV	Rising	16.8.68	10	140	22.8.68	6	7.21	3	D	19.8.68	8	20	1-5	325	1.58	3.6
	Receding	22.8.68	6	till observations closed on 28.8.68												

Table 13

Quality of fish spawn collected at Deolan on R. Yamuna in 1968, as determined by microscopical analysis and rearing

Spurt No.	Quality (%)									
	By microscopical analysis			By rearing						
	Major carps	Minor carps	Others	Rohu	Catla	Mrigal	Kalbasu	Major carps total	Minor carps	Others carps
1	0.00	52.0	48.0							
2	17.4	44.8	37.8	20.0	54.3	0.0	5.7	70.0	17.1	2.9
3	51.0	48.0	1.0	10.0	85.0	0.0	0.0	95.0	5.0	0.0

Indices of spawn quantity and quality :

The indices of spawn quantity and quality for the Deolan site were estimated to be 239 ml and 83.7% respectively.

Spawn availability at prospected sites :

Prospecting for spawn by operation of a standard net for six hours duration was done at Lalauli, Goakan, Sewrapau, Marka and Ashat. Attempts at Garhi and Lametha proved futile as the banks at those places were steep rendering net operation impossible. The sites listed first above are suitable for operation of nets, especially those at Lalauli and Ashat, where spawn collection is or has been made by State Government. Since the availability of spawn was generally poor throughout the stretch, quantitative comparison of different sites could not be done.

Spawn availability in relation to hydrological and biotic factors:

Flood level and phase : The river Yamuna is known to yield quality spawn in good measure generally during the receding phases of floods. However, this year the third spurt of spawn commenced and ended within the rising phase of flood IV. It is difficult to explain this availability for want of fuller knowledge of the topography of the areas inundated by the river and of the breeding grounds.

The role of flood level and its rate of change, especially if it be in a receding phase, in determining spawn availability was markedly noticeable. Table 14 shows the rates of spawn availability and change of flood level in the two major spurts of the season.

Table 14

The correlation of rate of change of flood level and spawn catch per net-hour

Spurt No.	Period From hr	Period To hr	Catch per net/ hr in ml	Rate of change of flood level in cm/hr	Flood levels of availability
2	8	10	40.5	2.0	
	10	12	24.0	1.5	Appearance 5.32 m
	12	14	8.0	1.5	
	14	16	3.5	0.5	Disappearance 5.18 m
	16	18	2.0	0.5	
	18	20	2.5	0.5	
	20	22	neg	0.0	
3	8	10	1.5	5.0	
	10	12	8.5	2.0	
	12	14	7.5	2.0	
	14	16	7.0	2.0	Appearance 4.60 m
	16	18	3.2	3.5	
	18	20	1.7	3.5	
	20	22	nets washed and refixed		
	22	24	2.2	0.5	Disappearance 5.07 m
	24	2	1.2	0.5	
	2	4	0.5	0.5	
	4	6	1.0	0.0	
	6	8	nil	0.0	

The above table amply illustrates that the rates of change of flood level around 1-2 cm per hour are conducive to maximum availability of spawn. The availability of spawn around 5 m water level is another significant observation. The III flood although failed to yield any measurable quantity of spawn, none the less showed traces of good quality spawn only when its receding phase had flood levels around 5 m mark.

Associates : No indicator species for predicting spawn availability could be located. The associates were never come across in large numbers throughout the season. Amongst the associates, Puntius spp. dominated throughout the season. Amongst the associates, Puntius spp. dominated throughout the season. This was in direct contrast to the observations made at Kishanpur, situated about 45 km downstream on the same bank of the river, where bucket loads of prawns were seen in two catches associated with spawn in July 1964.

Weather condition : Extremely high and strong winds were experienced in the early part of August, when flood III was rising, which made net operation impossible.

Turbidity : The turbidity at the site initially was less than 100 ppm and with the onset of monsoon and flooding of the river rose to even 2500 ppm. But its values mostly ranged between 400 and 750 ppm. The spawn availability was associated with turbidity values of 440-550 ppm. No direct correlation was discernible between turbidity values and availability or abundance of spawn.

Current velocity : The current velocity at the site varied from 0.68 to 2.58 km/hr and did not show any direct effect on spawn availability. The spawn availability periods had current velocities ranging between 1.00 and 1.15 km/hr.

5.1.4 Mahewapatti on river Yamuna

Participants

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The site at Mahewapatti on river Yamuna near Allahabad was selected 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. The village Mahewapatti is situated on the south bank of the Yamuna, about 10 km from the city of Allahabad near the Allahabad-Rewa highway. The investigation site is situated about 5 km upstream of the confluence of the Yamuna with the Ganga. The meanderings of the river in this area are comparatively less serpentine and the banks are less precipitous. Except for the small seasonal stream 'Susar Khadari' which joins the Yamuna in this area on the north bank just opposite the investigation site, no other major river or stream joins the Yamuna in the vicinity of the selected site. Investigations at this site were commenced on July 12, 1968 and continued till September 3, 1968.

Occurrence of spawn spurts : With the appearance of spawn spurts 1 and 3 at Mahewapatti, trial nets were simultaneously operated at spots A and B (Fig. 8), in order to determine the spot of maximum spawn concentration. The results of these trials are given in Table 15.

Table 15

Spurt-wise spawn yield at various spots during trial net operations in the Yamuna at Mahewapatti

Spurt No.	Spawn catch in ml per net - hr. at		Spot of maximum concentration
	A	B	
1	5.0	75.0	B
3	7.5	35.0	B

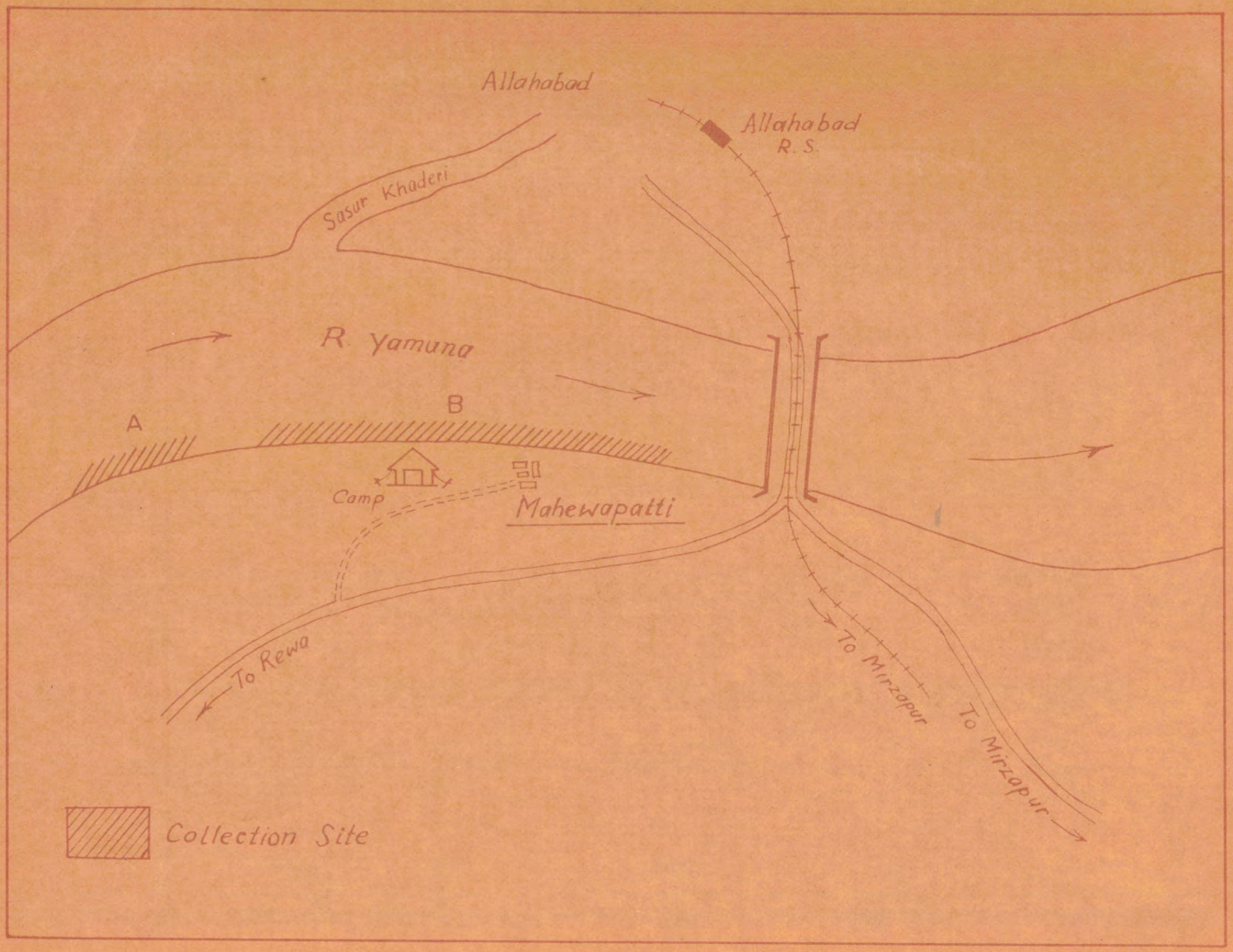

FIG. 8.

THE COURSE, GENERAL TERRAIN AND TOPOGRAPHY OF RIVER YAMUNA AT MAHEWAPATTI.

It is evident from the above table that spot B was the pocket of maximum spawn concentration during both the spurts. The comparatively low magnitude of spawn concentration at spot A could be attributed to its location within the shadow zone (Anon, 1965).

During the entire investigation period, four floods were observed (Table 16). The I flood's peak level of 5 m over the summer level was reached on July 13, 1968, while the peak levels during floods II, III and IV were reached on 25.7.68, 7.8.68 and 22.8.68 respectively, the respective maximum levels reached were : 2.47, 4.99 and 4.53 m. This observed pattern of relative peak levels of the various floods, wherein that of the I flood was the highest, appears to be rather abnormal, as compared to the observations made at Kishanpur and Jamunapur (Anon, 1965), Anwara and Dhumanpura (Malhotra et al., 1966) and Majhawali (Shetty, 1967), where the peak levels reached during the first flood of the season were the lowest and thereafter the levels increased progressively, the highest level being reached during the last flood of the season. The abnormal flood pattern at Mahewapatti during this season probably adversely affected the production and availability of spawn.

An examination of Table 16 brings out that in the Yamuna at Mahewapatti, spawn were available in four spurts, ranging in duration from 24 to 82 hours. All the four spurts were associated with the floods. In the entire season, 3,252 ml of spawn were collected by 1-5 standard nets in 172 hours of spawn availability. Of these, 2844 ml consisted of desirable spawn, which were collected in 112 hours. Spawn spurt 1, of 30 hours duration, occurred in the receding phase of the I flood and yielded only desirable spawn, which formed 1.1% of the total desirable spawn at the centre. Spawn spurt 2, which commenced 12 hours before the II flood touched its peak, continued for another 12 hours in the receding phase of the flood as well, yielding in all 193 ml of spawn, all of undesirable quality. 60.1% of the catch was made during the rising phase of the flood. Spurt 3, the major spurt of the season, occurred during the III flood. Like spurt 2, it also commenced during the rising phase of the flood, but only 2 hours before the peak level was reached and continued for 80 hours in the receding phase of the flood. This spurt contributed 98.1% to the total catch of desirable spawn at the centre, but 70 to 90% were received in dead condition. Further, most of the spawn collected in living condition were in a very poor state

of health and majority of them died during their temporary storage in hapas, plastic pools and earthen pots. The last spurt, which was of 36 hours duration in the receding phase of flood IV, yielded only undesirable spawn. In addition to the above, 213 ml of spawn were collected in 1-3 standard nets (mostly one net) in the intervening period between the spurts.

During the 1 spurt, no spell of bulk spawn availability was observed, while during the 3 spurt, 61.4% of the spurts total yield of desirable spawn was collected in a period of 10 hours, commencing 38 hours after the commencement of the spurt. The catch per net hour during the spell of maximum availability was estimated to be 34.9 ml, as against 6.2 ml for the spurt as a whole (Table 17).

Quality of spawn collected : Microscopical analysis of the spawn samples revealed that major carps contents of the desirable spawn in spurts 1 and 3 were 15.4 and 22.9 percent respectively. The percentage of major carps in the spawn collected during the period of maximum availability was estimated to be 22. To determine the spurt-wise species composition, spawn samples of spurt 1 and 3 were reared in nursery ponds, which revealed the major carps percentage in the two spurts to be 30.0 and 16.8 respectively. It was further observed that in spurt 1, catla accounted for 22.5% of the major carp content, followed by mrigal (7.6%). In spurt 2, rohu which formed 8.1% of the total major carps content was the dominant species, closely followed by catla (7.6%) and kalbasu (1.1%). The estimates given above may not be very reliable, since 70 to 90% of the spawn collected were in dead condition.

The seasonal indices of spawn quantity and quality for this centre were estimated to be 601 ml and 18.2% respectively.

Table 16

Flood-phase-wise occurrence, duration, magnitude and desirability of spawn spurts at Mahewapatti in 1968

No	Phase	Flood Details			Peak flood level				Spurt Details			No. of nets	Spawn catch		
		From Date	From Hour	Duration in hrs	Date	Hrs	in m	No.	Desirability	From Date	From Hr	Duration in hrs.		in ml	in lakhs	Per net hour in ml
I	Rishing	12.7.68	2	44	13.7.68	22	5.0	No spawn available					1	NIL		
	Receding	13.7.68	22	184	-	-	-	1	D	14.7.68	6	30	1-4	298	1.49	2.6
II	Rising	21.7.68	14	100	25.7.68	18	2.47	2	UD	24.7.68	2	12	1-3	116	0.58	11.6
	Receding	25.7.68	18	216	-	-	-	2	UD	25.7.68	14	12	1-3	77	0.385	5.5
III	Rising	3.8.68	18	100	7.8.68	22	4.99	3	D	7.8.68	20	2	1	22	0.11	2.75
	Receding	7.8.68	22	150	-	-	-	3	D	7.8.68	22	80	5	2524	12.62	6.3
	Vacillation	14.8.68	6	88	-	-	-	-	-	-	-	-	1	nil	-	-
IV	Rising	17.8.68	22	112	22.8.68	14	4.53	-	-	-	-	-	1	nil	-	-
	Receding	22.8.68	14	300	-	-	-	4	UD	22.8.68	22	36	3	275	1.075	2.9

Table 17

Quality of spawn obtained during spurts and during spells of maximum spawn availability within spurts in the Yamuna at Mahewapatti in 1968

Spurt details			Spawn Quality (Percentage)										Period of maximum spawn availability							
			By microscppical analysis			By rearing							Duration			By microscopical analysis				
						Major carps														
Spurt No.	Desirability	Catch in ml	Major carps	Minor carps	Others	Catla	Rohu	Mrigal	Kalbasu	Total	Minor carps	Others	Commencement	Total hrs	Catch in ml	Catch per net hr in ml	Major carps	Minor carps	Others	Remarks
1	D	298	15.4	54.5	30.1	22.5	0.0	7.6	0.0	30.1	38.8	31.1	no spell of maximum availability							
	UD	nil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
2	D	nil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	UD	193	6.8	42.9	50.3	no sample reared				-	-	-	-	-	-	-	-	-	-	
3	D	2546	22.9	67.1	10.0	7.6	8.1	0.0	1.1	16.8	82.6	0.6	9/8/68 10	10	1745	34.9	22.0	72.0	6.0	70 to 90% spawn received in dead condition
	UD	nil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
4	D	nil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	UD	215	8.0	80.5	11.5	No samples reared				-	-	-	-	-	-	-	-	-	-	-do-

Spawn availability in relation to hydrographical and biotic factors :

Flood level and phase : As already mentioned earlier, the Yamuna had four floods at Mahewapatti during the investigaion period, and it is possible that the abnormal pattern of flood adversely affected the production and availability of spawn at the site. In the Yamuna, usually, the first flood is the lowest of the season, but during the year of investigation this was the highest. It is just possible, as pointed out by Malhotra et al., (1966), that the breeding grounds of those major carps which breed late in the season are situated at elevations which get inundated during the floods subsequent to the first of the season, provided the flood peaks during the subsequent floods are of higher magnitude as compared to that in the first flood. This probably explains the low magnitude of spawn availability at Mahewapatti during 1968. Further, since bulk of the spawn was collected in dead condition, it could not be said with certainty that the production was actually low, as it is very unlikely that the behaviour of dead spawn is similar to that of the live ones.

Since most of the spawn was collected in dead condition, the relationship between spawn availability and current velocity, nor the effects of current velocity and turbidity on the catching efficiency of shooting nets of different mesh sizes could be determined at this centre.

5.2 Catching efficiency of nets in relation to mesh size

5.2.1 Relative efficiencies of 1/8", 1/12" and 1/16" meshed standard-type nets

In order to test the relative efficiencies of nets of different mesh sizes under the available ranges of turbidity and current velocity, two experimental nets of the same type and dimensions as the standard net, but made of 1/12" and 1/16" meshed Midnapoore-type nettings respectively, were fabricated and operated alongside the standard net at Nanamau on R. Ganga and at Deolan on R. Yamuna. The operational positions of the nets were randomly determined irrespective of their mesh size, or their relative positions were frequently interchanged in order to eliminate the likely effects of relative position.

Details of spurt-wise spawn catch per net-hour in the three types of nets at Nanamau are given in Table 18.

Table 18

Spurt-wise spawn catch per unit effort in various nets at Nanamau

Spawn spurt No.	Spawn catch per net-hour (in ml) in net of mesh size		
	1/8"	1/12"	1/16"
I	1.2	1.3	0.8
II	13.2	25.4	19.5
III	1.2	2.0	1.4

As can be seen from the above table, the 1/12" meshed net was invariably found to be the most efficient in the conditions prevailing at Nanamau, even during the II spurt when the catch concentration was quite high. During the spawn availability period, both turbidity and current velocity were low, ranging from 215-310 ppm and 1.05-1.38 km/hr respectively. Under these conditions, even the 1/16" meshed net was found to be generally more efficient than the 1/8" meshed standard net. This confirms the opinion earlier expressed (Anon, 1965) that finer meshed nets are likely to be more efficient in waters of low turbidity. The higher efficiency of the 1/12" meshed net over that of the 1/16" meshed net appears to be due to the fact that the former permits a higher rate of filtration and is less prone to get clogged.

At Deolan, on the other hand, the 1/8" meshed standard net was found to be the most efficient, under conditi ons of turbidity and current velocity ranging from 440-550 ppm and 1.0-1.15 km/hr respectively. The detailed observations are depicted in Table 19.

Table 19

Relative efficiency of different meshed Midnapore type nets vis-a-vis the standard net in parallel operations at Deolan

Spurt No.	Turbidity in ppm	Current velocity in km/hr	Net of mesh size	Average catch per net hour in ml	Efficiency
II	550	1.0-1.15	1/16"	5.10	63.8%
			1/12"	4.40	55.0%
			1/8"	8.00	-
III	440-550	1.0-1.10	1/16"	3.17	87.6%
			1/12"	2.72	75%
			1/8"	3.61	-

It is seen from the above table that at velocities of about 1.0 km/hr and turbidities around 550 ppm, the efficiency of the 1/12" meshed net was poorer than that of 1/16" meshed net, probably because of comparatively greater escapement from the larger meshes of 1/12" meshed net than what the increased filtration by the net would have compensated for. However, in the case of the standard net, the filtration rate appears to be more than compensating for the escapement. The slightly reduced current velocity and turbidity during the III spurt led to appreciable increase in the efficiency of the smaller meshed nets.

5.2.2 Relative efficiencies of 1/8" and 1/16" meshed Midnapore type nettings under identical conditions

The specially designed trouser-type net (Malhotra et al., 1966) was employed in this regard at Negria on R. Banas during the II spawn spurt. It was observed that over the turbidity range of 127-215 ppm and an average current velocity of 1.9 km/hr, 1/16" meshed Midnapore type netting proved more efficient. This serves to confirm the inference drawn in regard to the catches at Nanamau, that under conditions of low turbidity finer meshed nets are likely to be more efficient. The details of catches made in the two limbs (of 1/8" and 1/16" mesh) are given in Table 20.

Table 20

Spawn catches in the two limbs of trouser-type net

S.No. of catch	Spawn catch in nl in	
	1/8" meshed limb	1/16" meshed limb
1	5	10
2	1	25
3	5	10
4	Traces	1
5	0.5	0.5
6	nil	2

The above table shows that the 1/16" meshed limb was, on an average, above 4 times more efficient than the other limb of 1/8" mesh.

5.2.3 Spawn escapement from net made of 1/8" meshed Midnapore type netting

In order to assess the extent of spawn escapement from 1/8" meshed Midnapore type netting, the specially fabricated double-walled net (Shetty, 1967) was operated at Negria and Deolan. At Negria, the percentage of escapement ranged from nil to 62.5, with an average of 25.74, under the prevailing turbidity range of 127-215 ppm and an average current velocity of 1.9 km/hr. At Deolan, the poor spawn catch did not permit the drawing up of any valid inferences regarding the extent of spawn escapement.

6 DISCUSSION

6.1 Potentiality of investigated sites and prospected stretches

Details of time and flood level of occurrence, magnitude and quality of spawn spurts at the four investigated sites have been elucidated in the preceding pages under Chapter 5. Of the four centres, high quality spawn in appreciable quantities were obtained only at Negria on R. Banas and at Nanamau on R. Ganga. At both these centres, the bulk of quality spawn was obtained in mid-July during the early low floods. The full potentiality of the Mahewapatti centre could not be adjudged properly due to the abnormal pattern of floods and heavy mortality among the drifting spawn. The Deolan centre, on the other hand, indicated the possibility of its yielding high quality spawn in good quantities in years of normal spawn production.

In Rajasthan, spawn collection was unknown till 1967, when, under this very programme of work, a lucrative quality spawn collection centre was located at Sopari (near Tonk) on R. Banas in its lower stretches (Shetty *et al.*, MS). The current year's findings in the same river, a little upstream of the above site, are significant and rewarding, in that they have indicated the availability of quality spawn over a long stretch of the river. Apart from Negria, the investigated site, 3 other sites, at Jahazpure,

Zira and Lalpura, were also found suitable in this stretch for commercial exploitation, specially the last named centre. These studies have also shown that spawn are unlikely to be available upstream of Triveni. About 75-100 nets can be operated at Negria during the early floods.

As stated above, the Nanamau site also yielded high quality spawn in mid-July during the early low floods, when about 50 nets could be operated. However, the site would become unsuitable in higher floods, for lack of gently sloping ground at higher levels. Although all the other sites prospected during the monsoon months (Rajghat, Mehndipur, Mahadevan and Bithoor) were found unsuitable, the pre-monsoon survey conducted earlier indicated the suitability of sites at Ganga Ghat, Rani Ghat, Kutchehry Ghat and Toka Ghat. Of these, the first is already being exploited by the State Government.

The Deolan site on R. Yamuna presents an extensive area suitable for net operation. About 250-300 nets can be operated in flood levels < 4 m, while 150-200 nets can be operated when the flood level exceeds 4 m. Quality spawn was available at this centre from the last week of July upto the 3rd week of August. Even though the quantity collected was not appreciable, the rearing experiments yielded a very high major carp content (83.7%). It is quite probable that spawn production in this region was adversely affected by the large scale indiscriminate fishing of breeders, which was going on upstream of the sire. In years of normal spawn production, this site should be worth exploiting on a commercial scale. The earlier drawback of very poor accessibility to this site has now been largely overcome by the construction of a Kutcha approach road. Apart from Deolan, this stretch also has suitable sites at Lalauli, Goakan, Sewranau, Marka and Ashat. Of these, Lalauli and Ashat are already being exploited by the State Government.

As already state in Chapter 5, the abnormal flood pattern appears to have come in the way of major carps spawn availability at Mahewapatti. The observations were further vitiated by heavy mortality of spawn in the river. Whatever desirable spawan were collected, came during the period 14th July to 7th August. It is felt that this site also can yield appreciable quantities of quality spawn during years of normal floods. The site presents a vast area, where about 100-200 nets can be operated at different flood levels.

The seasonal indices of spawn quantity and quality for the various investigated sites are given in Table 21.

Table 21

Seasonal indices of spawn quantity and quality at various sites investigated in 1968

Name of river	Name of centre	Indices of spawn quantity (in ml)	Indices of spawn quality based on rearing (% of major carps)
Banas	Negria	1688	56.78
Ganga	Nanamau	387	54.50
Yamuna	Deolan	239	83.70
Yamuna	Mahewapatti	601	18.2

6.2 Efficiency of nets in relation to mesh size and turbidity

Observations made with standard type nets of different mesh sizes and trouser-type net indicated that finer meshed (1/12" or 1/16") nets were more efficient in the prevailing low turbidities at Negria (215-310 ppm) and Nanamau (127-215 ppm), while in the slightly higher turbidity range of 440-550 ppm at Deolan the standard net of 1/8" mesh was found to be the most efficient. This was further confirmed by the study of spawn escapement from net made of 1/8" mesh, in that it showed an average escapement of 25.74% (range: 0 - 62.5%) in the less turbid waters at Negria, while it appeared to be less than 20% in the more turbid waters at Deolan. It, therefore, appears that 1/12" meshed net would be more useful than the standard net in the Negria stretch of the Banas and the Nanamau stretch of the Ganga, under conditions of turbidity as observed during 1968.

7 SUMMARY

i) During 1968, spawn prospecting investigations were carried out along four riverine stretches in the country, one each of the Banas (Rajasthan) and the Ganga (U.P.) and two of the Yamuna (U.P.).

ii) The sites selected for detailed investigations after a pre-monsoon survey of the concerned areas were : Negria on R. Banas, Nanamau on R. Ganga, and Deolan and Mahewapatti on R. Yamuna. While the first three centres were taken up for study in the search for location of lucrative quality spawn collection centres, the last was chosen to carry out long-term investigations to understand the occurrence and drift of spawn in relation to environmental factors. At all the centres regular periodic observations were made round-the-clock on the quantity and quality of spawn and spawn associates collected in the various nets and on selected hydrological and meteorological factors.

iii) At Negria on the Banas, 3 spawn spurts were recorded, yielding in all 7939 ml of desirable spawn in 100 hours of availability. 97.5% of the above spawn was obtained during the receding phase of the I flood in two spurts round about the middle of July, and the rest during the receding phase of the II flood. The seasonal indices of spawn quantity and quality for the site were estimated to be 1688 ml and 56.78% respectively.

iv) A total of 3950 ml of spawn, 3843 ml of which were desirable, was collected at Nanamau on the Ganga in the course of three spawn spurts, all during the rising phase of the II flood from 11th to 21st July, with the peak collection obtaining on 14th July. The total availability period lasted 86 hours, of the II spurt alone lasted 56 hours and yielded 3762 ml of spawn. The seasonal indices of spawn quantity and quality for this centre were estimated to be 387 ml and 54.5% respectively.

v) Three spawn spurts, one each during the rising and receding phase of the II flood and the rising phase of the IV flood, were recorded at Deolan on R. Yamuna, yielding in all, in

42 hrs. of availability, 1219 ml of spawn, of which 1139 ml comprised of desirable spawn. The first spurt was of undesirable spawn, while the latter two were of desirable spawn. The 3 spurts accounted for 6.5%, 66.8% and 26.7% of the total seasonal yield of spawn, while the II spurt accounted for 71.4% of the total desirable spawn catch. The seasonal indices of spawn quantity and quality were estimated to be 239 ml and 83.7% respectively.

vi) A total of 3252 ml of spawn was obtained in the course of four spurts during the season in 172 hours of availability, of which 112 hours yielded desirable spawn, amounting to 2844 ml. The two desirable spawn spurts occurred in the receding phase of the I flood, and the rising and receding phases of the III flood during 14th-15th July and 7th-11th August respectively. The latter contributed to 98.1% of the season's total catch of desirable spawn, but 70-90% were received in dead condition. The seasonal indices of spawn quantity and quality were estimated to be 601 ml and 18.2% respectively.

vii) Of the various sites investigated, high quality spawn in appreciable quantities were obtained only at Negria on R. Banas and at Nanamau on R. Ganga. Negria was found to be the most productive, followed by Nanamau. The work also indicated that during years of normal floods and good spawn production, both the sites at Mahewapatti and Deolan on R. Yamuna could yield commercial quantities of quality spawn.

viii) Finer meshed (1/12" on 1/16") nets were found to be more efficient in the prevailing low turbidities at Negria (215-310 ppm) and Nanamau (127-215 ppm), while in the slightly higher turbidity range of 440-550 ppm at Deolan the 1/8" meshed net (standard net) was found to be the most efficient.

ix) Spawn escapement from net of 1/8" mesh was found to be more in the less turbid waters at Negria (25.74%) than in the more turbid waters at Deolan (less than 20%). This confirms the better efficiency of finer meshed nets at centres of low turbidity like Negria and Nanamau.

8 REFERENCES

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