BANGLADESH FLOOD ACTION PLAN

COMPARTMENTALIZATION PILOT PROJECT
FAP - 20

PRELIMINARY RESULTS OF THE SPECIAL FISHERIES STUDY

HATCHLING MIGRATION IN THE LOHAJANG RIVER

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CPP Working Papers are produced by FAP 20 on specific issues. These are available to professionals involved in the FAP as well as to others interested individuals. Comments and suggestions are welcome. These working papers will be revised periodically.

HATCHLING MIGRATION IN LOHAJANG RIVER

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1 INTRODUCTION

The Compartmentalization Pilot Project (CPP or FAP 20) started in 1991 in Tangail, one of the overall objectives is:

> *"... To provide, through water management, a more secure environment for intensive agriculture, fisheries and integrated rural/urban development, and thereby improve the economic security and quality of the floodplain population" [ToR, p3.]*

The objectives of the fisheries component of the CPP project is to increase the availability of fish by securing fisheries production and by improving aquaculture. Such a concept can only be executed when a thorough understanding of fisheries within the area is available. Unfortunately most data available are secondary data for Bangladesh as a whole and they are of limited value for a small and specific area as the Tangail CPP project area. Therefore it was decided to start a special study for the fisheries component of the CPP project: The Special Fisheries Study (SFS).

The main objectives of the SFS are the collection of substantial baseline data on the existing fisheries in the CPP project area and the study focused on the following aspects of fisheries;

* Fish migration routes, especially the migration of riverine hatchlings. This study was set up, coordinated and funded by FAP 20 but during the 1992 monsoon period FAP 16 and FAP 17 provided extra manpower for the field work.
* The reproductive strategies of beel resident fish, as their reproduction could be hampered by drainage measures.
* The determination of the total fish production under the at present situation in the CPP project area through;
  - A catch assessment survey
  - A frame survey
  - An Aquaculture survey

This technical note has been written for colleagues in the field and contains primary data in a summarized form as obtained in the CPP area of Tangail. CPP/FAP 20 should be quoted if the data are used in official documents . This technical note should not be considered as a final report or statement of the CPP project on fisheries. It has **only** the intention to inform colleagues in the field and to make the data available for further use

2. Riverine Hatchlings

It is a general knowledge that hatchlings from riverine fish as catla, rui, mrigal etc are entering the floodplain with the river floodwater in the early monsoon. Specific information on distribution in time and distribution in the water column could not be found in the literature. This information is crucial for the design and the establishment of operation guidelines of water management structures as planned in the CPP project area.

The SFS studied the hatchling migration during the monsoon of 1992 and 1993. In 1992 vertical distribution was studied only, in 1993 horizontal distribution was added to the study

2.1 Short description of the sampling procedures

Nets made of mosquito netting (mesh size smaller as 0.5 mm) were placed in the Lohajang river. The opening of the net was made of iron bar and the net had a surface area of 0.125 m^2. At the side and at the middle of the river a net was placed 30 cm above the bottom of the river and a second net just below the surface. The flow rate of the water was determined with a floating object and during 1993 the 'real' flow rate was measured three times a week with a flow meter. The nets were placed at day time and at night time for approximately 1-2 hours. The caught larvae were preserved in formalin and counted and identified in the laboratory following the identification system as developed by FAP 17. The results of the sampling programme were calculated/expressed in *hatchling density* or *the number of hatchlings per cubic meter of water (No/m^3)*

2.2. Standardization of flow rates

It is a well known fact that flow rates in river system are changing with water depth and distance from the river bed. In general it can be stated that flow rates are the highest in the top layer and in the middle of the water column. For our sampling it means that less water flows through our bottom net as compared with the top net during an equal sampling time period which will result in a higher catch of the top net.
The 'real' flow measurements indicated that the nets were blocking the flow a little resulting in a lower flow inside the nets.

Correlation between the different flow rates were fitted for the best curve and the following standardizations/calibrations were made;

Lohajang near river bank (site 2)

* Surface flow rate to top layer flow rate (top net level)
  $(\text{Top layer flow})^{0.5} = 0.119 + 0.971*(\text{Surface flow})^{0.5}$, $R^2 = 0.68$, $P \leq 0.01$

* Top layer flow rate to bottom net flow rate
  $1/(\%\ \text{Bottom flow}) = 0.01599 - 0.00034*\text{Ln}(\%\text{Top flow})^2$, $R^2 = 0.49$, $P \leq 0.0001$

* Flow rate without net to flow rate with net
  With net = 0.865 * Without net, $R^2 = 0.77$, $P \leq 0.0001$

Lohajang middle site

* Surface flow rate to top layer flow rate (top net level)
  $(\text{Top layer flow})^{0.5} = 0.119 + 0.971*(\text{Surface flow})^{0.5}$, $R^2 = 0.68$, $P \leq 0.01$

* Top layer flow rate to bottom net flow rate
  $1/(\%\ \text{Bottom flow}) = 0.00893 + 7.4603/(\%\text{Top flow})^2$, $R^2 = 0.31$, $P \leq 0.01$

* Flow rate without net to flow rate with net
  With net = 0.865 * Without net, $R^2 = 0.77$, $P \leq 0.0001$

2.3 Hatchling Migration in the Lohajang and Dhaleswari river

The SFS study only studied the hatchling migration in the Lohajang river, but in order to get a complete picture events happening outside the project area are essential and data provided by FAP 17[1] are also used.

During the season of 1992 the river started to rise late, The hydraulogic connection between the Daleshwari river and the Lohajang river was made on 29th of June and sampling started on the 2nd/3rd of July. In 1993 the flood came in the normal expected period and the Lohajang got connected with the Dhaleswari river on the 10th of June and monitoring started soon after on the 12th of June.

The hatchling densities in the Lohajang river with the water level of the Jamuna river are presented in Figure 1 and 2. The water level of the Jamuna river is used because it has exactly the same pattern as the downstream located Lohajang river.

The results clearly indicates that hatchlings are coming **"in waves"** and the peaks of the hatchling waves are closely related to peak levels of the river. This phenomena shows that the adult fish in the upper catchment area respond immediately on increased water level by spawning and large number of eggs are released and are drifting down streams. As a result the hatchling density in the Lohajang increases.

In both years the majority of the carp hatchlings are found within the first waves and they are not found any more after mid august. In both years the hatchling density does not exceed 1.5 hatchlings/m^3. In this respect it is of importance to use the data of the Dhaleswari river during the same period.
Figure 3 and Figure 5 presents the combined data of the Lohajang (FAP 20) and the Dhaleswari (FAP 17) during 1992 and 1993.

In 1992 the hatchling density in the Dhaleswari river starts increasing mid June with a maximum peak level on the first of July. Sampling of the Lohajang river started just after this peak level as complete hydraulogic connection between Dhaleswari and Lohajang river and complete flowing of the Lohajang river took place 29th of June and the 2nd of July and it can be stated that the peak was missed by the Lohajang river in 1992.
The hatchling densities are expressed differently for the two rivers; the Dhaleswari densities are expressed in No of hatchlings/hour/net where as the densities in the Lohajang are expressed in hatchlings per m^3 of water. A comparison of the different data is possible as in both places the density follows a similar pattern during the first peaks (see Figure 6) and correlation could be described as follows;

[1] The data of FAP 17 are preliminary as complete analyses has not yet been finalysed

$$\text{Lohajang density} = -0.075 + 0.01156 * (\text{Dhaleswari density}),\ R^2 = 0.38,\ P \leq 0.05$$

In Figure 4 the real values of the Dhaleswari are presented in combination with real values of the Lohajang and extrapolated data for the first days of July. It indicates that a density of 6-7 hatchlings/m^3 can be expected if the hydraulogic connection between the two rivers occurred earlier. ?

In 1993 the hatchling density in the Dhaleswari river starts increasing on the 5^{th} of June and a maximum peak level is reached on the 19^{th} of June. From the 12^{th} of June hatchlings were sampled from the Lohajang river and thus this peak period was also covered in the Lohajang. In June and the beginning of July the pattern of hatchling densities in both rivers is similar. After mid July several waves are observed in the Lohajang river while they are absent in the Dhaleswari river. The main reason is probably the fact that sampling of the Dhaleswari was not done daily after mid July.

The maximum peak level in the Lohajang in 1993 is more or less the same as in 1992, which is surprising, as sampling took place during the entire period of hatchling migration and theoretically a density of 6-7 hatchlings/m^3 could be expected.

This phenomena can be explained by the fact that the intake of the lohajang river is blocked by a sand rim, as is clearly visible on the aerial photograph (Figure 7). This rim either is a direct physical blockage or hydrologic pattern is created in such a way that distribution patterns of hatchlings are disturbed, resulting in the fact that the major part of the hatchlings are over shooting the Lohajang intake.

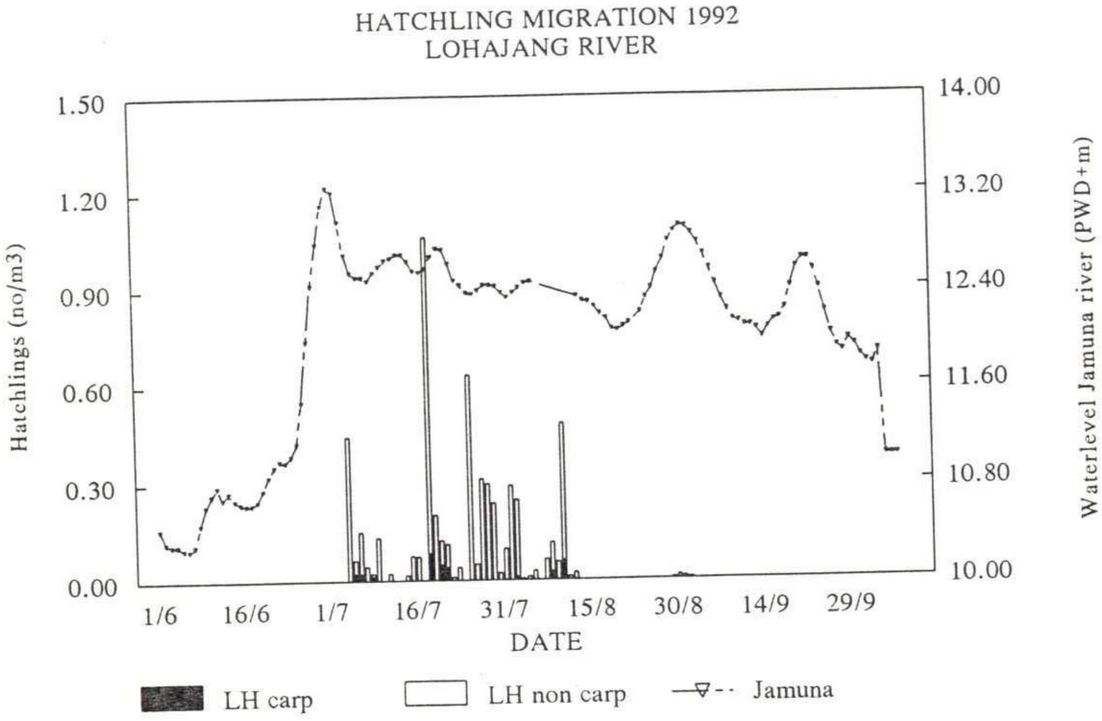


Figure 1

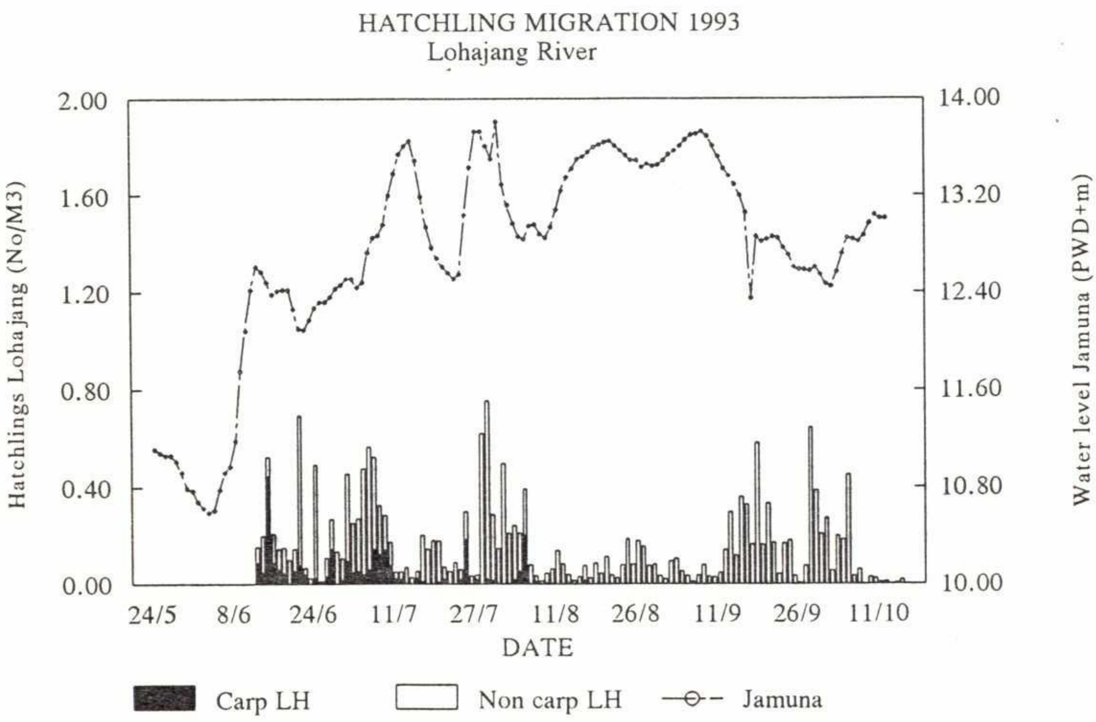


Figure 2

Figure 3

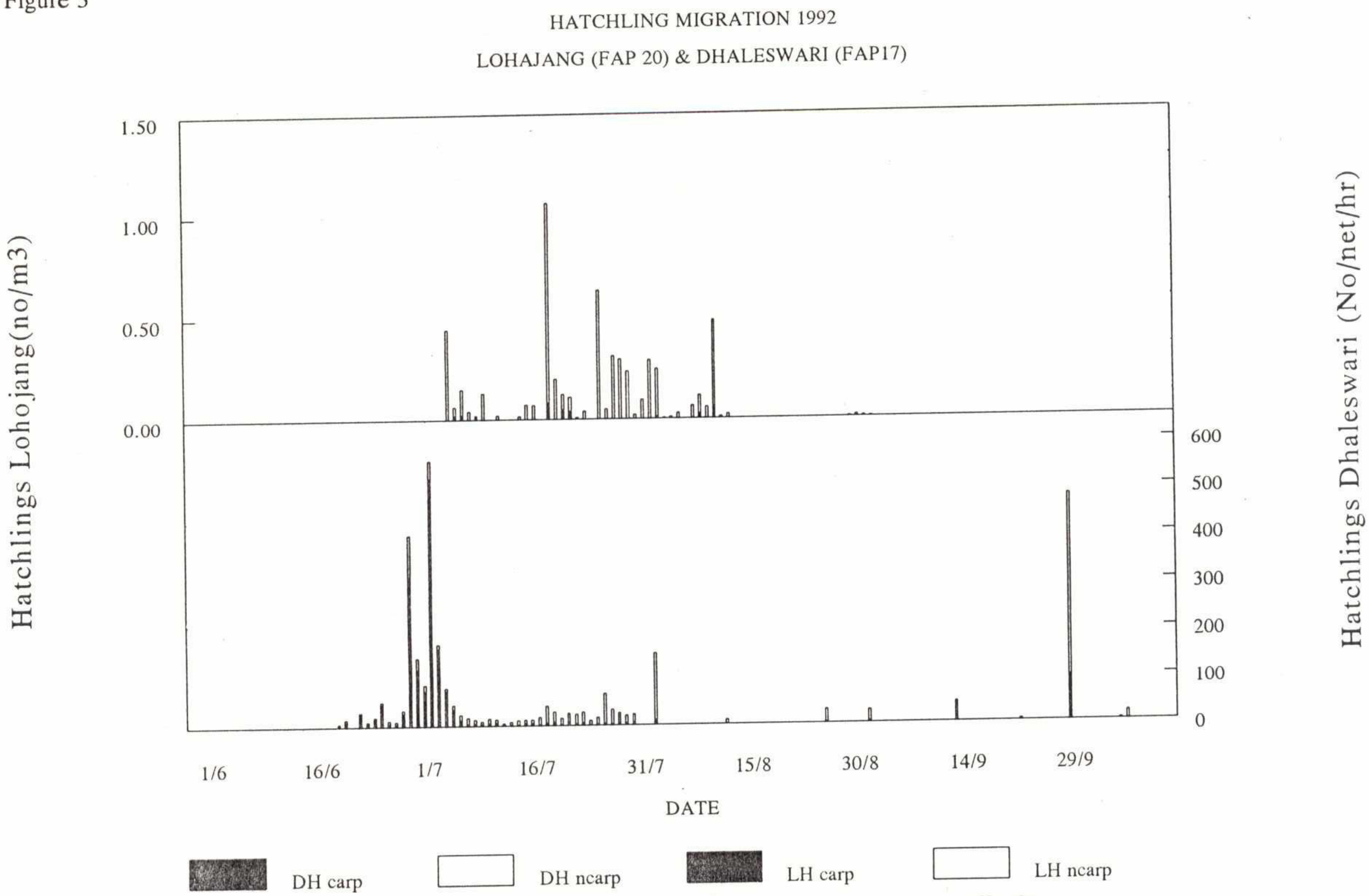

HATCHLING MIGRATION 1992
LOHAJANG (FAP 20) & DHALESWARI (FAP17)
Hatchlings Lohojang(no/m3)
1.50
1.00
0.50
0.00
Hatchlings Dhaleswari (No/net/hr)
600
500
400
300
200
100
0
1/6
16/6
1/7
16/7
31/7
15/8
30/8
14/9
29/9
DATE
DH carp
DH ncarp
LH carp
LH ncarp

Figure 4

HATCHLING MIGRATION 1992

Extrapolated values for Lohajang added

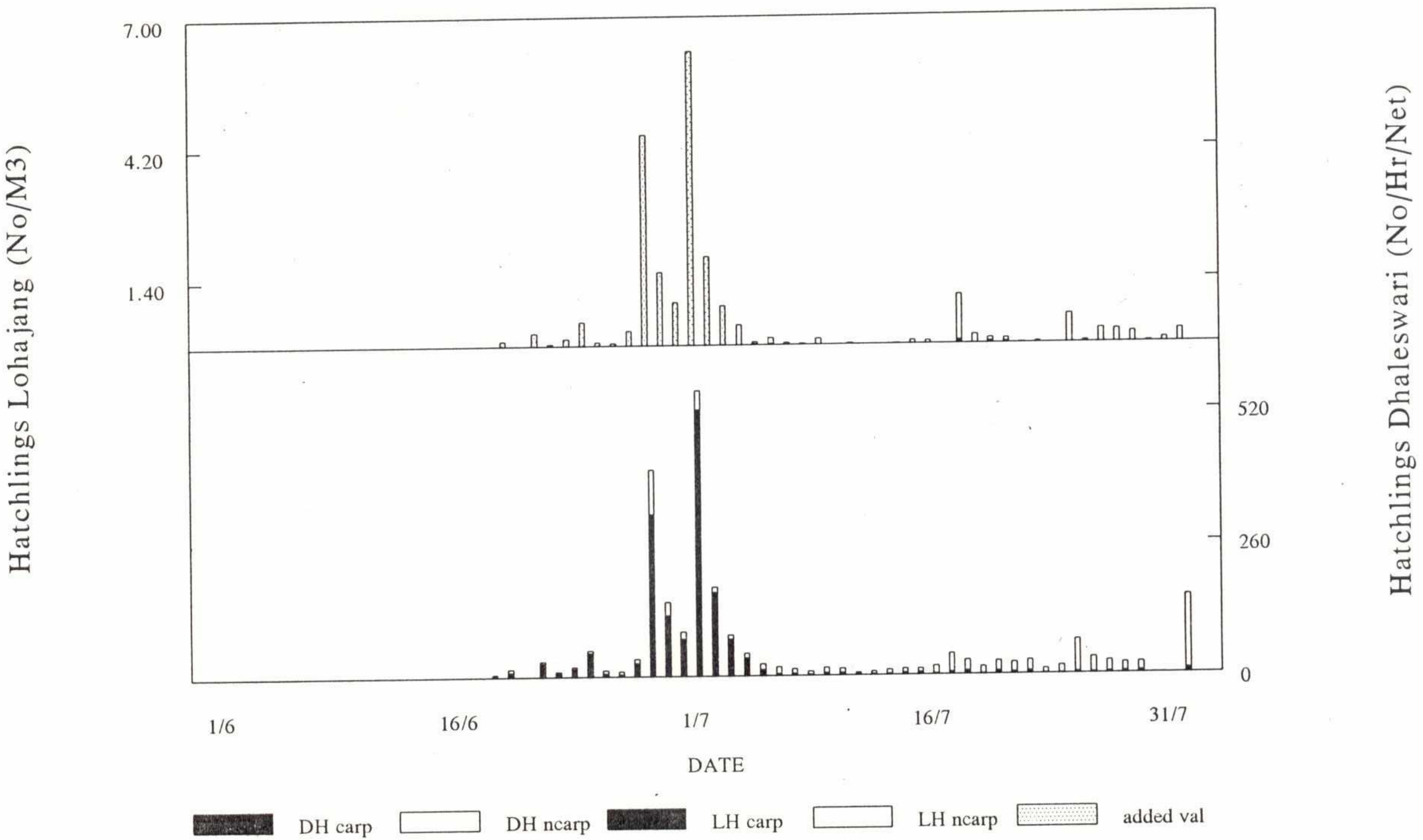


Figure 5

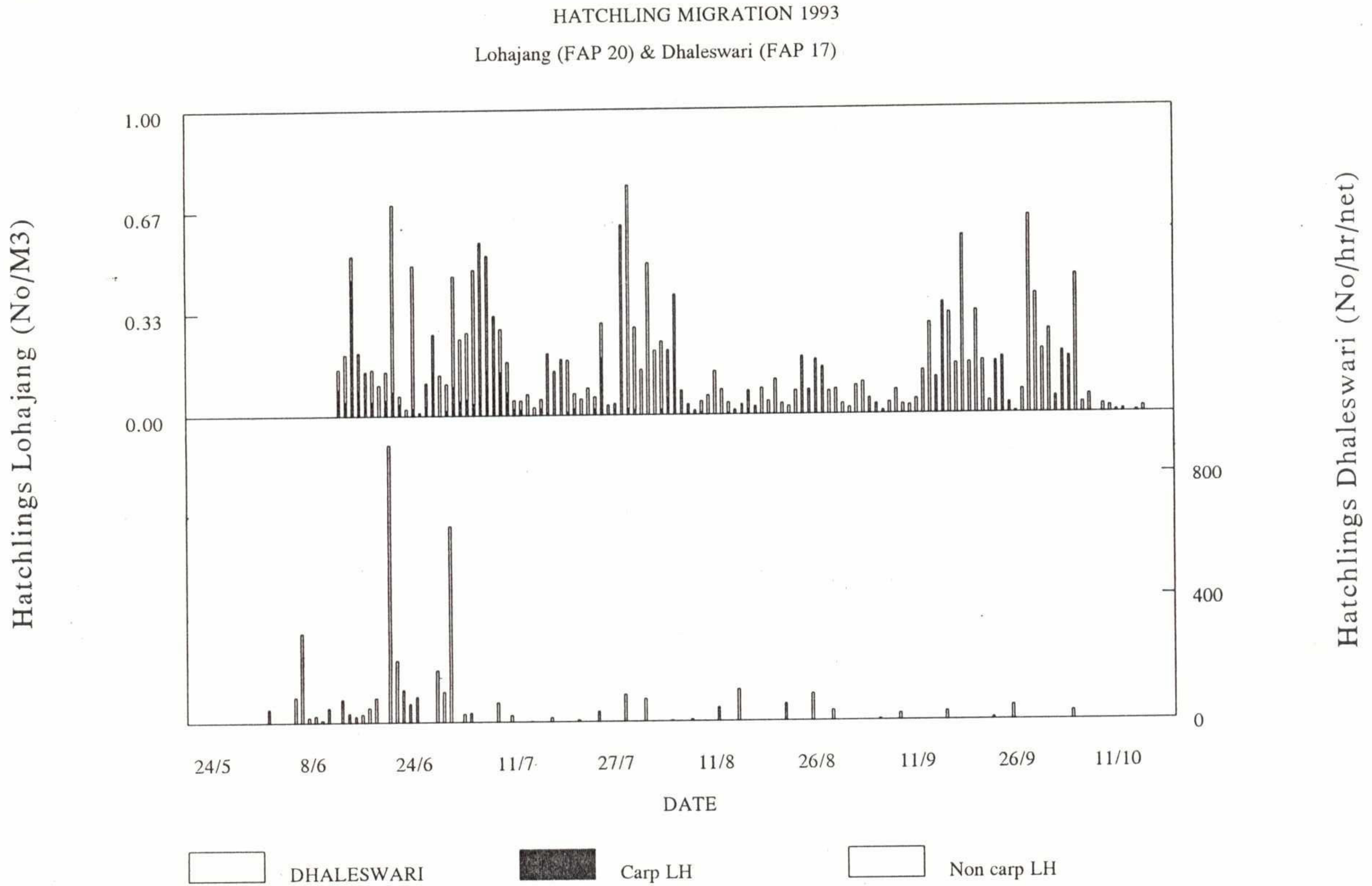
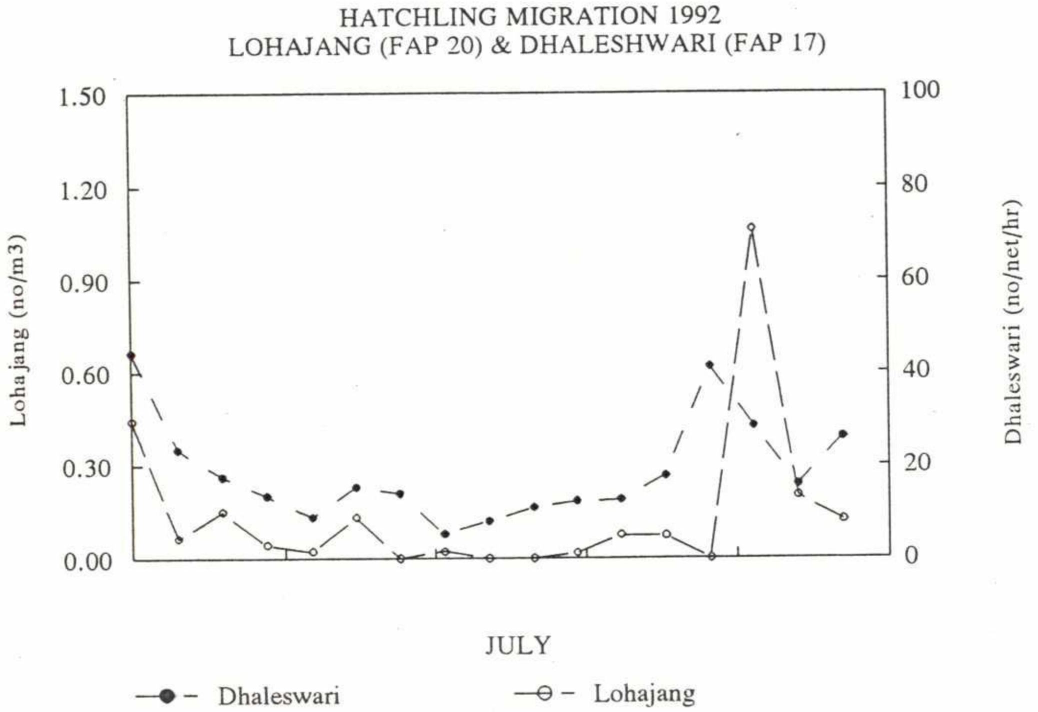

HATCHLING MIGRATION 1993
Lohajang (FAP 20) & Dhaleswari (FAP 17)
1.00
0.67
0.33
0.00
Hatchlings Lohajang (No/M3)
800
400
0
Hatchlings Dhaleswari (No/hr/net)
24/5
8/6
24/6
11/7
27/7
11/8
26/8
11/9
26/9
11/10
DATE
DHALESWARI
Carp LH
Non carp LH

Figure 6


HATCHLING MIGRATION 1992
LOHAJANG (FAP 20) & DHALESHWARI (FAP 17)
1.50
1.20
0.90
0.60
0.30
0.00
Lohajang (no/m3)
100
80
60
40
20
0
Dhaleswari (no/net/hr)
JULY
Dhaleswari
Lohajang

gure 7

2.4. Horizontal and vertical distribution patterns of hatchlings

For the location of regulators, the engineering details as sill level, gate openings and for the formulation of operation rules it is important to know if hatchlings have a vertical or horizontal distribution pattern through the water column. No information on this subject could be found and the results of the SFS hatchling sampling programme was set up and analyzed in this respect.

Figure 8 presents the no of hatchlings caught per hour in 1993 in the middle of the Lohajang river. It is clear (P = 0.0000) that more hatchlings are caught in the top layer. It is however not clear from this picture why there are more hatchlings caught in the top layer, the question is if it is caused by:

* Biological behaviour, the hatchlings are moving actively in the water column.
* Hydrological patterns, more hatchlings are caught in the top nets because more water passes through the net during the sampling period.

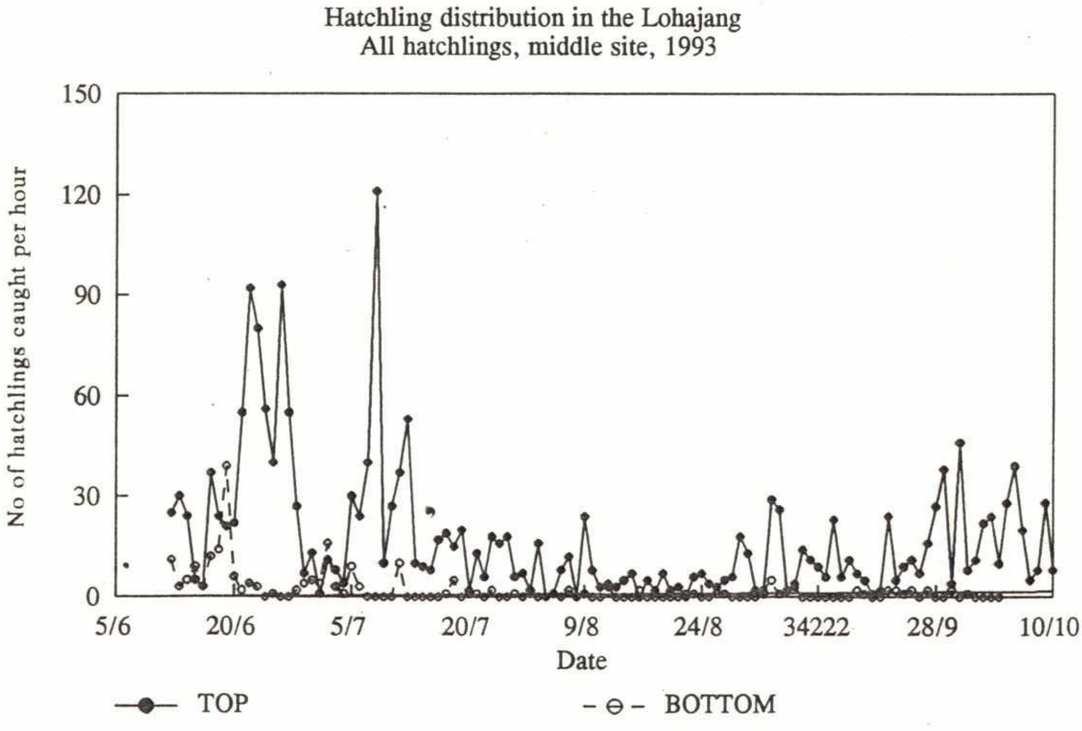


fig. no ?

In order to separate these two phenomena, all densities are expressed in number per cubic meter of water. The graphs become less clear when the data are expressed this way and conclusions can not be drawn from graphs because they can be misleading as the spectator often picks out the positive points leading to verification of a hypothesis. Therefore all parameters have been analyzed statistically by using a Wilcoxon matched-pairs signed rank test (which compares for ranking, with taking in consideration the absolute values of the data). Probability levels are given in absolute values as calculated with SPSS[2]. For 1992 and 1993 all data on densities in numbers caught per hour and in no per cubic meter were analyzed and the probability values are presented in Table 1 and Table 2.

TABLE 1: Probability levels for hatchling migration in the Lohajang river

TEST PARAMETERS FOR NO CAUGHT PER HOUR	PROBABILITY LEVEL		CONCLUSIONS
	1992	1993	
Top,site2,day,all/Bottom,site2,day,all	0.32	0.0000	Top more
Top,site2,day,carp/Bottom,site2,day,carp	0.22	0.21	No difference
Top,site 2,day,non carp/Bottom,site2,day,non carp	0.14	0.0000	Top more
Top,site 2,night,all/Bottom,site2,night,all	0.0002	0.0001	Top more
Top,site 2,night,carp/Bottom,site2,night,carp	0.0135	0.2703	Top more
Top,site2,night,non carp/Bottom,site2/night, non carp	0.0002	0.0002	Top more
Top,middle,day,all/Bottom,middle,day,all		0.0000	Top more
Top,middle,day,carp/Bottom,middle,day,carp		0.0029	Top more
Top,middle,day,non carp/Bottom,middle,day,non carp		0.0000	Top more
Top,middle,day,carp/Top,site2/day,carp		0.1846	No difference
Top,middle,non carp/Top,site2,day,non carp		0.1049	No difference
Bottom,middle,day,carp/Bottom,site2,day,carp		0.0532	No difference
Bottom,middle,day,non carp/Bottom,site2,day,non carp		0.0000	site 2 more

2 Statistical Packet for Social Science

TABLE 2: Probability levels of hatchling migration in the lohajang river

TEST PARAMETERS FOR NO/M^3	PROBABILITY LEVEL		CONCLUSIONS
	1992	1993	
Top,site2,day,all/Bottom,site2,day,all	0.82	0.0000	Top more
Top,site2,day,carp/Bottom,site2,day,carp	0.073	0.77	No difference
Top,site 2,day,non carp/Bottom,site2,day,non carp	0.87	0.0018	Top more
Top,site 2,night,all/Bottom,site2,night,all	0.0026	0.0000	Top more
Top,site 2,night,carp/Bottom,site2,night,carp	0.0277	0.66	No difference
Top,site2,night,non carp/Bottom,site2/night, non carp	0.0032	0.32	No difference
Top,middle,day,all/Bottom,middle,day,all		0.0000	Top more
Top,middle,day,carp/Bottom,middle,day,carp		0.91	No difference
Top,middle,day,non carp/Bottom,middle,day,non carp		0.0000	Top more
Top,middle,day,carp/Top,site2/day,carp		0.2450	No difference
Top,middle,non carp/Top,site2,day,non carp		0.0000	Site 2 more
Bottom,middle,day,carp/Bottom,site2,day,carp		0.0961	No difference
Bottom,middle,day,non carp/Bottom,site2,day,non carp		0.0000	site 2 more

The results of the analyses are not completely uniform for the two years, night and day patterns and the distribution of the carps are different. These differences are probably caused by the low numbers of carps in the total catch.

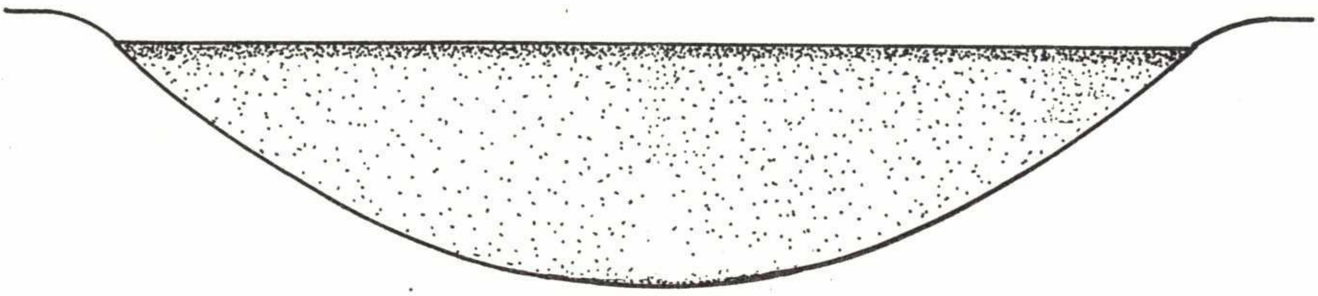
The results of the analyses indicates the existence of the following trends in distribution patterns which are visualized in Figure 9;

* Most hatchlings are moving and caught in the top layer of the river and differences in middle or near the embankment are not significant.

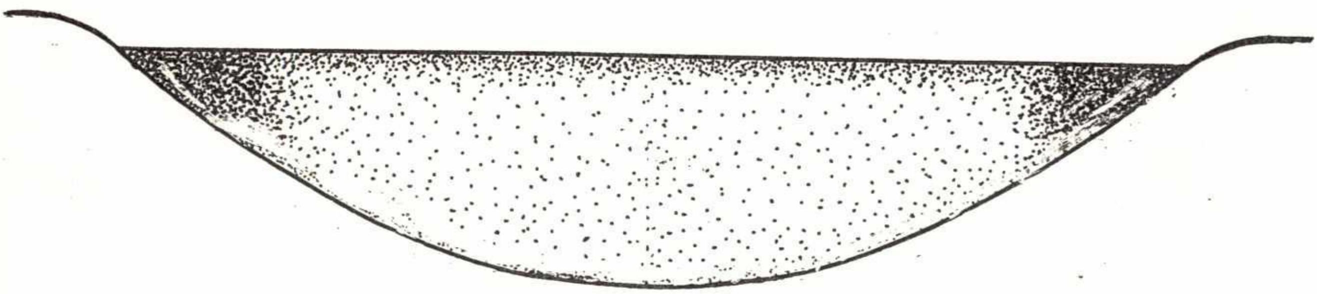
* The distribution pattern, irrespective of the absolute flow rate, gives a distinct pattern of accumulation of hatchlings near the embankments at the top layer of the water.

The latter indicates that next to water velocities/flow rates another force exists which is forcing the hatchlings to the sides and top layer of the river. This force could be biological: **active movement of the hatchlings**, or related to non biological features; for example difference in water densities caused by suspended solids as suggested by team members of FAP 17.

Figure 9



Hatchling distribution pattern in Lohajang river, when differences in flow rates are not considered



Absolute hatchling distribution pattern in the Lohajang river (No/M3)

2.5 Conclusions and Recommendations

Analyses of the data on hatchling migration in the Lohajang river indicate that:

a) Adult riverine fish in the upper catchment of the Jamuna river respond immediately on a rise in water level. They spawn and consequently egg/hatchling densities in the river water increases. The major peak of hatchlings is found in the first flood peak and the 1992 experience indicates that timing for the intake of water is essential. Operation rules of regulators within the CPP project must be defined in such away that this first peak **always** enters the project area.

b) The period in which Carp respond to a rise in water level is limited and reproduction upstream ended mid august, during the 1992 and 1993 season. Consequently no carp hatchlings are found in the river after this date.

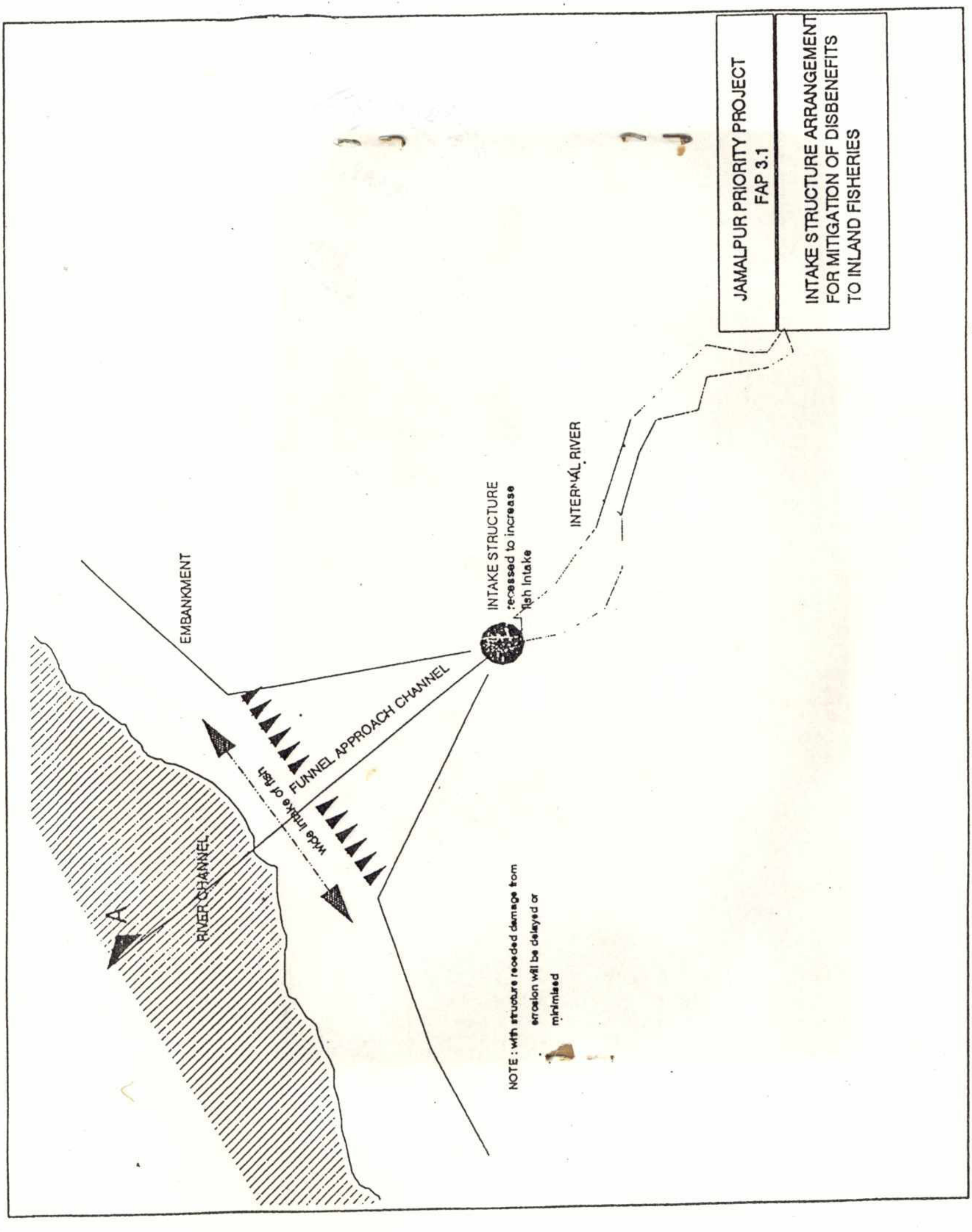
c) Hatchlings in the Lohajang river have a horizontal as well as a vertical distribution pattern. Hatchling densities, expressed in **No/m^3**, are the highest at the top layer near the river embankment and the lowest near the bottom in the middle of the river.

This finding stresses again the importance of **"overshot/overflow regulators"** which should be used in all FCD/I projects. The location for entry points of hatchlings is not only dependent on distribution pattern, but also on the volume of water during the high hatchling peak levels. Taking water through the middle will result in higher nos. of hatchlings per unit time as compared to side intake. As water flow per unit time in the middle is higher. However fish friendly regulaters should be constructed near the river bank. In order to Garuntee hatchling migrations during period of closure of the middle regulators.

d) Peak levels of all hatchlings in the Lohajang river varies between 0.5 - 1.5 hatchlings/m^3 in 1992 and 1993. A peak level of 6-7 hatchlings/m^3 could be expected in 1993 if the densities in the Dhaleswari river and the timing of the main peak in the Dhaleswari river are taken into consideration. The blockage of the intake of the Lohajang river by a sand rim is probably the cause and it is recommended to remove this rim during the dry season of 1994 and widen its mouth following the principle proposed by FAP 3.1, (see Figure 10). This operation is essential because if positive it could increase carp production through natural recruitment in the CPP project area. It could finally result in the fact that the proposed culture based fisheries mitigation measures are less needed.

The effect of this operation should be monitored during the monsoon of 1994.

Figure 10


JAMALPUR PRIORITY PROJECT
FAP 3.1
INTAKE STRUCTURE ARRANGEMENT
FOR MITIGATION OF DISBENEFITS
TO INLAND FISHERIES
INTERNAL RIVER
INTAKE STRUCTURE
recessed to increase
fish intake
EMBANKMENT
FUNNEL APPROACH CHANNEL
wide intake of fish
RIVER CHANNEL
A
NOTE : with structure receded damage from
erosion will be delayed or
minimised