Government of the Peoples Republic of Bangladesh
Flood Action Plan

FAP 17

Fisheries Studies and Pilot Project

FINAL REPORT

(Draft)

JUNE 1994

Supporting Volume
No. 6

FISHERIES STUDY

BRAHMAPUTRA RIGHT EMBANKMENT

ODA
Overseas Development Administration, U.K.

FAP 17

FINAL REPORT

SUPPORTING VOLUME NO. 6

** Draft **

FISHERIES STUDY

Brahmaputra Right Embankment

FAP 17
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AND PILOT PROJECT

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Funded by ODA in conjunction with the Government of Bangladesh

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PREFACE

The Fisheries Studies and Pilot Project (FAP 17) was funded by the British Overseas Development Administration (ODA) in conjunction with the Government of Bangladesh. The national implementing agency for the Fisheries Studies was the Department of Fisheries of the Ministry of Fisheries and Livestock. FAP 17 also reported to the Flood Plan Coordination Organisation of the Ministry of Water Resources. The project was one of a number of supporting studies of a broader programme known as the Flood Action Plan (FAP) of Bangladesh. The FAP consisted of a series of eleven major engineering studies, five of which comprised separate regional studies which aimed to identify feasible large-scale flood control and drainage projects through which it would be possible to regulate the extent of flooding during the monsoon. The engineering components were supported by a range of complementary studies, several of which were designed to address various social and environmental impacts which were anticipated to result from large-scale flood control.

FAP 17 was designed to address issues relating to fisheries and aimed to collect, analyse and interpret information with which to make predictions of the impacts of the planned flood control action upon the inland capture fisheries of Bangladesh. To do this, quantitative baseline fisheries and socioeconomic data were collected from inside and outside a range of different types of flood control projects in four regions of the country.

A total of eight FCD/I projects was studied and the results of each study were documented in a series of Supporting Volumes (Fisheries Studies) of the project Draft Final Report (see list of reports on page xi). Three further fisheries studies were completed, one of which described the fisheries of the main rivers Jamuna and Padma (Supporting Volume No. 10). The other two investigated the movements of a) adult and juvenile fish and b) fish hatchlings in regulated and unregulated rivers and assessed the impact of regulators on these movements (Supporting Volume Nos. 5 and 11). A parallel set of socioeconomic studies was carried out and the results documented in seven village study reports (Supporting Volumes 12-18). In addition to the fisheries and village studies, several special studies, mainly desk studies, were completed during the course of the project. These provided background information on fish, the environment and socioeconomics (Supporting Volumes No. 19-28). Several of these studies have been documented previously as annexes to the FAP 17 Interim Report. However, to ensure wider circulation, they were also included as part of the Draft Final Report.

One extremely important output from the FAP 17 study was the establishment of a detailed and comprehensive fisheries database which provides quantitative baseline information on inland fish resources and fisheries in Bangladesh. Fisheries and socioeconomic databases were submitted to the Government of Bangladesh through the Flood Plan Co-ordination Organisation of the Ministry of Water Resources and the Department of Fisheries in the Ministry of Fisheries and Livestock. Documentation of each database was included as Appendices 1 and 2 of the Draft Final Report.

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The present report is one of a series of eight fisheries studies which form part of the Supporting Volumes to the Draft Final Report. The principal objectives of the supporting studies are listed below.

1) Evaluation of the effects of different flood control measures on the production of fisheries.
2) Evaluation of the effects of different flood control measures on the movements and populations of fish.
3) Assessment of the feasibility of technical and developmental measures to compensate for or reduce potential losses to fisheries due to flood control.

Descriptions of the methods employed for field data collection, laboratory studies and analyses of data are provided in the FAP 17 Inception and Interim Reports and are presented again with some additions in Appendix 3 of the Draft Final Report.

Two taxonomic guides were used for the identification of fish found during this study. The first was Rahman, A. K. A. 1989, Freshwater Fishes of Bangladesh, published by the Zoological Society of Bangladesh. The second was Talwar, P. K. and Jhingran, A. G. 1991, Inland Fishes of India and Adjacent Countries, Vols. 1 and 2, published by Oxford and IBM Publishing Co. Ltd. The more recent guide was used to provide a systematic listing of the scientific names of fish. However, the guide by Rahman was used more widely by fisheries biologists and all Bengali names of fish used in the present report were derived from this guide. The FAP 17 database also provides comprehensive lists of local names of fish collected in each region studied.

The term "species diversity" was used in this report in its simplest sense to denote the total number of different species of fish recorded at each site. The numbers of species recorded depended on the sampling effort deployed. No doubt more species would have been recorded had more sites or gear units been sampled more often using larger sub-samples of catches. All species recorded were divided into three categories of habitat preference; riverine, migratory and floodplain residents based on distributions identified using the complete FAP 17 database. The categorisations should be regarded as provisional only. As more knowledge is gained of the ecology and behaviour of individual fish and prawn species in Bangladesh more accurate revisions to the list will be needed.

Local names of gears were used throughout the report despite considerable geographical differences in names used in Bangladesh. A list of all gears recorded by FAP 17, with local and English names, and a brief description of each, is provided as an appendix to this report.

The source of all tables and figures presented in this report, unless otherwise stated, is from data collected by FAP 17 fisheries surveys.

ACKNOWLEDGMENTS

This report is based on the concerted efforts of a large number of people whose responsibilities covered: field data collection; administrative support; entry of data into computers; management of databases; analyses and interpretation of results, and report preparation.

Under the guidance of a senior fisheries supervisor, fisheries biologists, directly recruited by the project or provided through temporary employment by the Department of Fisheries, were responsible for the collection of fisheries, hydrological and limnological data. Field survey schedules required the team to monitor fishing activities from dawn to dusk, 12 hours each day, with additional surveys carried out before dawn to monitor night fishing. That the team accomplished its objectives despite arduous working conditions and long, unsocial hours of work, warrants the highest recognition and is a credit to both the team and the senior fisheries supervisors, Drs. Islam and Wahab, who were responsible for maintaining not only discipline and high quality survey work but also team morale. The achievements of the FAP 17 fisheries survey teams demonstrated that it is possible in Bangladesh to obtain detailed quantitative fisheries appraisals based on the direct monitoring of fishermen's activities on water.

Administrative support staff and computer operators both in the field station and in Dhaka headquarters were responsible for the smooth running of the field programme and ensured that data were entered into the database promptly and accurately.

Mr. Asaf Hussain, senior computer programmer, was responsible for database management and programming and worked closely with Drs. James Scullion and Bernadette McCarton on data analyses. Fisheries resource assessment specialists, Professor John Beddington and Dr. Geoffrey Kirkwood of the Marine Resource Assessment Group, Imperial College, London, UK, advised on the statistical methods for the analysis of catch rates of gears which formed the basis of comparisons of fish catches inside and outside the flood control project.

Mr. Goutam Chandra Dhar, computer specialist, and a small team in Dhaka, were responsible for the preparation of the report.

Personnel contributing to the production of this report are listed below:

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Dr. Bernadette McCarton	:	Fisheries Scientist
Dr. M A Wahab	:	Senior Fisheries Supervisor, North Central Region
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<u>Fisheries Biologists</u>

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ABBREVIATIONS AND ACRONYMS

b. aman	Broadcast *aman*
BRE	Brahmaputra Right Embankment
BRRI	Bangladesh Rice Research Institute
BWDB	Bangladesh Water Development Board
°C	Degree(s) Centigrade
cm	centimetre(s)
CPUA	Catch Per Unit Area
CPUE	Catch Per Unit Effort
DO	Dissolved Oxygen
EIRR	Economic Internal Rate of Return
EUS	Epizootic Ulcerative Syndrome
FAP	Flood Action Plan
FAP 17	Flood Action Plan Study No. 17 (Fisheries Studies and Pilot Project)
FCD	Flood Control and Drainage
FCD/I	Flood Control and Drainage with or without Irrigation
FRI	Fisheries Research Institute
g	gram(s)
GPS	Geographical Positioning System
ha	hectare(s)
hr	hour(s)
HYV	High Yield Varieties
kg	kilogram(s)
km	kilometre(s)
m	metre(s)
mg/l	milligram(s) per litre
MIKE11	A microcomputer based modelling system for rivers and channels
NW	North West
NC	North Central
ODA	Overseas Development Administration
PIRDP	Pabna Irrigation and Rural Development Project
PWD	Public Works Datum (water level)
pH	Measure of acidity and alkalinity of water (log of hydrogen ion concentration)
STW	Shallow Tubewell
SWMC	Surface Water Modelling Centre
t	tonne(s)
t. aman	Transplanted *aman*
t/ha	tonne(s) per hectare
WARPO	Water Resources Planning Organisation (previously MPO, Master Plan Organisation)
μS	Measurement of conductivity of water (micro Siemens)

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SUMMARY

1. The Brahmaputra Right Embankment (BRE) is one of the largest and most significant flood control structures in the North West Region and in the whole of Bangladesh. The embankment runs from the Teesta River in the North to the Hurasagar River in the south, a distance of 220 km. The primary purpose of the BRE was to provide protection from flooding by the Jamuna on 240,000 ha of floodplain immediately bordering the embankment.

2. Between October 1992 and February 1994, fisheries catch assessment surveys were conducted at fortnightly intervals on rivers, canals and floodplains/*beel* inside the BRE and outside it on comparable areas in the North Central Region which were free-flooding.

Flooding Patterns

3. There was no difference in the timing of pre-monsoon rainfall flooding of regulated and unregulated *beel*. However, the timing of first entry of river floodwaters on to regulated floodplains was delayed by 9 weeks and the flood drawdown occurred 4 weeks earlier than on unregulated floodplains. The duration of river flooding was thus reduced to only 3 weeks on regulated floodplains compared with 16 weeks on unregulated floodplains. The duration of flooding on the lowest parts of unregulated and regulated *beel* was similar but on the latter, flooding was predominately due to rainfall, while on the former there was a greater mix of rainfall and river flooding.

Water Quality

4. Seasonal variations in water temperature, transparency, pH, dissolved oxygen concentration and total dissolved solids were monitored on floodplains, canals and rivers inside and outside the BRE. With the exception of transparency in rivers, no major differences in water quality between regulated and unregulated sites were detected. However, a greater clarity of water in the regulated Old Hurasagar River indicated either a reduced contribution to its flow by the silt-laden Jamuna River or the deposition of much of this silt in front of sluice gates where water velocities were reduced at the bottleneck to flow.

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Total Catch

5. Between March 1993 and February 1994, the annual catch per unit area (CPUA) from the unregulated Anahula floodplain/*beel* was 43 kg/ha compared with 7 kg/ha from the regulated Nandina floodplain/*beel*, a reduction of 81%. Major differences in gear usage between sites severely restricted statistical comparison of fish densities (see para 10). However, the substantially higher catch from unregulated floodplains/*beel* was certainly caused, to a large extent, by increased fishing effort by dominant gears such as *thella jal* and *ber jal*. The increased annual fishing effort was in turn related to a greater ingress and longer duration of river flooding.

6. The annual catch per kilometre from the regulated Nandina *Khal* inside the BRE (434 kg/km) was 70% lower that than from the unregulated Anahula *Khal* (1461 kg/km). In terms of catch per unit area, the regulated canal catch (523 kg/ha) was 53% lower than that from the unregulated canal (1115 kg/ha). Statistical analyses revealed no significant difference between fish densities between canals and that the higher catch from Anahula *Khal* resulted principally from increased fishing effort by dominant gears.

7. The annual catch per kilometre from the regulated Old Hurasagar River (1501 kg/km) was 3.4 times higher than that from the unregulated Northern Dhaleswari. In terms of catch per unit area, the difference between rivers was substantially larger: the regulated river catch was 14 times higher than that from the unregulated river. The value of CPUA from the Old Hurasagar was similar to those from other regulated rivers in the North West Region while the CPUA from the Northern Dhaleswari was the lowest recorded in the North Central Region. Reasons for such an atypically low catch from this river remain unclear. Statistical analyses revealed that fish densities were not significantly different between rivers and that the higher catch from the regulated Old Hurasagar resulted from higher fishing effort (see para 12).

8. Survey periods of 17 and 19 months in the North West and North Central Regions provided an opportunity to examine inter-annual changes in catch through two flood recessions and winters during which flooding patterns differed considerably. In 1992 there was a drought while in 1993 floods were a little higher than average. Catches from floodplains, canals and rivers were lower in 1992 and this was attributed to the lower flood.

Fish Densities

9. Statistical analyses of seasonally pooled catch rates of gears used inside and outside the BRE were carried out separately for each habitat type. The underlying assumption of the method was that once differences in catchabilities between gears had been accounted for, then any further differences in catch rates inside and outside the BRE were due solely to differences in fish densities.

10. Statistical comparison of the catch rates of dominant gears used on floodplains/*beel* inside and outside the BRE were made difficult by the marked difference in gear usage between sites. Only one gear, *thella jal*, was used extensively at both sites where it provided 61% of the annual catch from Nandina and 24% of the Anahula catch. Because of the absence of sufficient numbers of gears common to both sites, the proposed statistical model could not be used. Nevertheless, using alternative methods, statistical comparisons of catch rates of *thella jal* revealed significantly higher rates inside the BRE in one out of five seasons examined; in all other seasons catch rates were similar. From the results, it was concluded that there was no clear statistical evidence of differences in fish densities between sites inside and outside the BRE and that the higher catches from unregulated floodplains/*beel* were due solely to higher levels of fishing effort by dominant gears, particularly *thella jal* and *ber jal* for which there was a fivefold and twelvefold increase in effort on the unregulated site. These two gears together accounted for 67% and 72% of annual catches from regulated and unregulated floodplains/*beel* respectively.

11. Statistical comparisons of catch rates of dominant gears used on canals inside and outside the BRE revealed no significant difference between fish densities. The higher catch recorded from the unregulated canal was therefore principally due to higher fishing effort. The annual fishing effort per kilometre of canal was four times higher by *dharma jal* and twice as high by *thella jal* on the unregulated Anahula *Khal*. These two gears together provided 65% and 68% of the annual catch from regulated and unregulated canals respectively.

12. Statistical comparison of catch rates of dominant gears used on rivers inside and outside the BRE also revealed no clear significant difference in fish densities. The higher catch recorded in the regulated Old Hurasagar River therefore resulted from the greater amount of fishing effort by dominant gears. On the Old Hurasagar the annual fishing effort per kilometre of river was three to four times higher by the three

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most dominant gears: *deal* traps, *thella jal* and *dharma jal* which accounted for 59% of the annual catch.

Diversity

13. Between March 1993 and February 1994, the total annual number of fish species recorded from the regulated floodplain/*beel* at Nandina (31 species) was 38% lower than that from unregulated floodplains/*beel* (50 species). Examination of the diversity of different groups of fish showed greater adverse impacts on riverine and migratory species; riverine species were totally eliminated while the diversity of migratory species was reduced by 93%. In contrast, floodplain resident species increased in diversity by 11% on the regulated site. The severe reductions in diversity of riverine and migratory species were attributed to the substantial reduction in river flooding on regulated floodplains/*beel*.

14. Comparisons of the impacts of flood control on fish diversity in different habitats revealed clear reductions in the regulated river, canal and floodplain/*beel* with larger reductions in the canals (42%) and floodplain/*beel* (38%) than in the river (23%). There were also clear differences between the degree of impact of flood control on different groups of fish. On the regulated Nandina *Khal*, the diversities of riverine and migratory species were reduced by 82% and 69% respectively while that of floodplain residents was reduced by 16%. On the Old Hurasagar River, the number of riverine species was 61% lower than that on the Northern Dhaleswari while migratory and floodplain residents were reduced to a lesser degree, 15% and 3% respectively.

Catch Composition

15. Riverine and migratory species accounted for 26% of the annual catch from unregulated floodplains/*beel* compared with less than 1% on regulated floodplains/ *beel*. These included larger and higher value species such as *rui*, *mrigel* and *boal* which together provided 7% of the unregulated catch. Other dominant riverine and migratory species which were greatly reduced in abundance on the regulated Nandina site included *piali*, *fulchela*, and *chapila*. The results revealed that flood control caused by the BRE not only caused a harmful reduction in species diversity but also severely disrupted the fish community structure. This resulted principally from the loss of important components derived from migratory and riverine species but also

from major changes in the composition of the remaining floodplain resident species. At Nandina, 5 floodplain resident species, *khalisha* (2 species), *taki*, *piali* and *shingi* accounted for 69% of the annual catch. Of these, *khalisha* (*Colisa fasciatus*) and *taki* dominated the catch, comprising 27% and 20% respectively. In contrast, at Anahula there was a more equitable distribution of the catch between dominant species which included one riverine species, *piali*; 5 migratory species together accounting for 21% of the catch, and 15 floodplain resident species which provided a further 56%.

The most important floodplain residents included, in descending order of abundance, *puti*, *lal chanda*, *guchi baim*, *canchan puti*, *taki* and *nama chanda*. Prawns formed an important component of floodplain catches but were more abundant outside the BRE, where they provided 15% of the annual total, than inside it (7%).

16. Riverine species made negligible contributions to catches from regulated and unregulated canals while migratory species accounted for 41% of the catch from the unregulated Anahula *Khal* compared with only 7% from Nandina *Khal*. Migratory major carps, *catla*, *mrigel*, *rui* and *kalbaus* dominated the Anahula catch, providing 37% of the annual total, whereas on Nandina *Khal* only *rui* provided more than 1% of the catch. A total of 14 floodplain resident species provided 82% of the Nandina catch compared with 10 floodplain residents which comprised 41% of the Anahula catch. *Puti* and *taki* dominated catches from both regulated and unregulated canals. Other species whose relative abundances were notably greater in the regulated canal included *kaikka*, *shol* and *khalisha*. Prawns were important in both regulated and unregulated canals where they comprised 8% and 12% of annual catches respectively.

17. Riverine species provided 15% of the annual catch from the unregulated Northern Dhaleswari River compared with less than 1% from the regulated Old Hurasagar. Six dominant riverine species, *ghaura*, *kajuli*, *piali*, *bani koksa* (2 species) and *kauwa* accounted for 12% of the Northern Dhaleswari catch. Three of these, *ghaura*, *kajuli* and *piali* were also dominant species in the Jamuna River near the offtake points of the Northern Dhaleswari and Old Hurasagar. In contrast, migratory species accounted for 49% of the catch from the regulated river compared with 15% from the unregulated river. The greater abundance in the Old Hurasagar was due to an influx of major and minor carps during the flood drawdown. These did not originate from sampled floodplains/*beel* or linking rivers and so it was assumed that they migrated from other downstream areas of the Old Hurasagar catchment. Floodplain residents provided 57% and 43% of annual catches from unregulated and regulated rivers. The

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most abundant species on the Northern Dhaleswari included *puti*, *bailla*, *canchan puti*, *taki*, *guchi baim* and *baral baim*. On the Old Hurasagar, three species, *guchi baim*, *puti* and *taki* were particularly abundant in catches. Prawns again formed important components of the catch, providing 8% and 12% of annual catches from the regulated and unregulated river.

Fish Movements

18. Reductions in diversity and relative abundance of riverine and migratory species inside the BRE were caused by blockage or hindrance to their seasonal movements between rivers and floodplains. Flood control structures reduced fish migrations in two ways. Firstly, the number of entry points to floodplains was lowered thereby concentrating fish in fewer channels where they were more susceptible to capture. Secondly, the gates of regulators were closed for extended periods during the pre-monsoon and monsoon.

19. Eight riverine and 3 migratory species moved upstream into the Northern Dhaleswari River from the Dhaleswari when rainfall runoff increased river flows in May. The most abundant species included *piali*, *bele* and *fulchela* but others which increased in abundance later in the monsoon comprised *kajuli*, *gang tengra* and *golsha tengra*. In mid-June, floodwaters from the Jamuna entered the Northern Dhaleswari and brought with them a further influx of 4 riverine and migratory species including *ghaura*, *baghair*, *kauwa* and *chapila*. At this time, *kajuli* increased in abundance and accounted for 18% of the monthly catch. In July, a further 6 riverine and 3 migratory species arrived from the Jamuna and Dhaleswari rivers and in August a further 3 migratory species including juvenile *mrigel*. During the drawdown in September and October, 9 relatively scarce riverine and migratory species appeared probably from the Jamuna River or from floodplains of the North Central Region. Most riverine species migrated out of the Northern Dhaleswari in November to return to the shelter of larger rivers during the winter. In contrast, several migratory species, notably *boal* and *ayre*, remained in the Northern Dhaleswari during winter.

20. Riverine and migratory species commenced major lateral migrations from the Northern Dhaleswari on to adjacent unregulated floodplains/*beel* in July, about 2 to 4 weeks after the first ingress of river floodwaters on to the floodplains. A total of 13 species entered floodplains in July; all were juveniles and most averaged less than 4 g per individual. Riverine and migratory species accounted for 38% of the peak

monthly catch in July. The most abundant species comprised *piali*, *fulchela*, *rui*, *chapila*, *katari* and *bhangan*. In August, 4 migratory species appeared in floodplain/ *beel* catches; *mrigel*, *raik*, *golsha tengra* and *boal*. Again all were fry or juveniles. During July and August, 22 riverine and migratory species entered Anahula *Khal* from the Northern Dhaleswari River. The most abundant species were the juvenile major carps *rui*, *catla* and *mrigel* which accounted for 39% to 68% of monthly catches. Such high abundance in the canal was not matched on floodplains/*beel* during the same period where they provided 8% and 5% of monthly catches. During the drawdown in September and October, 5 riverine and migratory species appeared and the most abundant species at this time comprised *fulchela*, *boal*, *mrigel*, *catla*, *raik* and *rui*, all of which were juveniles of the year. By November all riverine and migratory species had migrated from the beel and returned to rivers.

21. On the regulated Old Hurasagar, there was no major influx of riverine and migratory species from downstream rivers comparable with that recorded on the Northern Dhaleswari River during May 1993. From June to August, entry of riverine and migratory species into the river was very limited. Only 5 species appeared in June, all in very low abundance. Of these, *catla*, *chapila* and *ilish* probably entered from the Jamuna through the partially open gates of Bauitara regulator since all were small fry averaging less than 1 g per individual. Two other species, *balichata* and *piali* were adults and may have entered from the Jamuna, the downstream Karatoya River or both. Contributions to monthly catches by riverine and migratory fish remained low (6-17%) up to August contrasting with those in the Northern Dhaleswari which reached 76% in August. During the drawdown in September, migratory species accounted for a very large share of the catch, ranging from 92% in September to 77% in October when a peak monthly catch was recorded. This contrasted sharply with the pattern in the Northern Dhaleswari where no major increase in percentage catch of migratory species was observed during the drawdown. On the Old Hurasagar, species which predominated during the drawdown included the major carps, *kalbaus*, *rui* and *mrigel* and others such as *chital* and *bata*. All major carps were juveniles of the year. Catches from *urani jal* set on the gates and walls of Bauitara regulator in September and October were dominated by *rui*, *kalbaus* and *raik* but also several other species. These fish again were juveniles which were captured as they migrated upstream into the Jamuna River. The regulator effectively blocked their movement and concentrated the fish in the immediate downstream area where they were also captured by *dharma jal* and *deal* traps.

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22. Movements of riverine and migratory fish from the Old Hurasagar River into the regulated Nandina *Khal* and Nandina *Beel* were extremely limited. Only two riverine species were recorded in the canal, *kachki* in June and *balichata* in September. *Kachki* was found on Nandina *Beel* in August 1993 and was the only riverine species to reach this habitat. Migratory species were recorded on Nandina *Khal* once only during the year, in September when 5 species, *rui*, *kalbaus*, *bata*, *raik* and *golsha tengra* accounted for 19% of the peak monthly catch. The four carp species were juvenile fish. In contrast, only 1 migratory species was found on the floodplain/*beel*; juvenile *mrigel* in August 1993. The substantial reduction in movements of fish from river to floodplains/*beel* was attributed to the greatly reduced ingress of river floodwaters.

Mitigation Measures

23. Within an area of 240,000 hectares impacted by the BRE, there is enormous potential for the introduction of mitigation measures to reduce adverse effects of flood control on capture fisheries and thereby increase fish production. On the basis of results from the present study and other FAP 17 studies carried out in the North West Region, several mitigation measures have been recommended for implementation in the short or near term. These relate mainly to distributaries of the Jamuna and their respective catchment areas behind the BRE. The recommended measures question a principal rationale of flood control: to convert low-lying wetlands to drier land where deepwater rice can be replaced with HYV *t. aman*. An alternative approach is recommended based on partial flood control on lowlands to allow the production of deepwater rice and wild fish. This procedure is also advocated by the North West Regional Study (FAP 2) in its "Green River" project for the lower Atrai basin. It requires fully integrated water management to increase agricultural and fisheries production and satisfy the requirements of both rice and fish.

24. Other mitigation measures to reduce losses to capture fisheries included improving the operation of regulators to increase fish and hatchling migrations on to the floodplain and *beel*. It is also recommended that a new design of regulator be constructed and tested on the BRE. The regulator design should take into account the needs of adult fish and hatchlings and incorporate a fish pass for upstream migrating fish.

25. Proposed mitigation measures also included rehabilitation and protection of dry season habitats such as perennial *beel*. This would involve canal re-excavation both inside and outside the BRE. Other measures involved fisheries conservation through the protection of fish populations during the dry season using *beel* as fish sanctuaries and through the establishment of prohibited fishing zones on and near regulators. In addition, several measures were recommended which related to institutional improvements mainly within BWDB. The most important of these was the establishment of an effective multidisciplinary technical assessment/planning unit in BWDB or WARPO comprising expertise from fisheries, agriculture, environment, hydrology and hydraulic engineering. The unit should be responsible for the re-evaluation of operating procedures of existing major structures and for the examination of future proposed flood control projects. Proposals for major new road or rail links which may affect flooding and drainage patterns should also be assessed by the unit.

Future Research

26. Several topics which require further research work were identified. Many of these follow on from baseline data provided by the FAP 17 studies. In relation to the impact of the BRE on capture fisheries, future research requirements were identified in three broad areas. The first focused on the need for a more detailed understanding of the movements of fish between rivers and floodplains at different stages of their life cycles and the impact of flood control structures on such movements. The second emphasised the need for detailed long-term studies running for at least five years to understand the functioning of complex floodplain fisheries in relation to biological, environmental and socioeconomic factors which influence fish populations. Quantitative fisheries data obtained from these studies, when linked with hydrological data on flooding patterns, will provide a basis for the development of a floodplain fisheries model. This can then be used as a predictive tool to advise on future fisheries management and development. The third area of research highlighted the need for detailed stock assessments of selected fish and prawns dominating floodplain catches from flood controlled areas. These studies are particularly relevant to higher elevation floodplains behind the BRE where the diversity of fish communities has decreased and a greater dependence has been placed on a small number of floodplain resident species. The current status of the stocks of these species is not known nor is the degree to which they can continue to sustain prevailing levels of fishing pressure.

BRAHMAPUTRA RIGHT EMBANKMENT

1 STUDY AREA: BACKGROUND

The Brahmaputra Right Embankment (BRE) is one of the largest and most significant flood control structures in the North West Region. Construction work started in 1957 and was completed in 1968 with funding provided by the World Bank. The embankment stretches from the Teesta River in the north to the Hurasagar River in the south, a distance of 220 km (Fig. 1.1). At least 31 regulators were incorporated over the full length of the BRE, mostly to enable water to be released from the Jamuna into what were originally distributary channels. Most of these channels have silted up due to improper operation of the regulators.

The primary purpose of the BRE was to ensure flood protection on the right bank floodplain of the Brahmaputra-Jamuna covering an area of 240,000 ha. No consideration was given to the impact on capture fisheries of the area during the design and planning of the BRE. This is a characteristic feature of most flood control projects constructed during this era, and later. Ever since embankment construction was completed, its success in flood protection has been threatened by continuous erosion problems which have resulted in the need to rebuild and set back a total of 140 km of embankment during the last 20 years. Serious breaches occurred in 1987 and 1988 and smaller breaches have occurred more recently.

In order to understand better morphological changes occurring in the river today, it is necessary to place these changes in both a geological and more recent timescale.

The Brahmaputra is one of the world's greatest rivers, covering a distance of about 3000 km and with a catchment area of about 560,000 km^2. An average discharge of about 20,000 cumecs and bankfull discharge of 44,000 cumecs make the Brahmaputra the fourth largest river in the world. The river rises on the northern flanks of the Himalayas close to the source of the Ganges (Fig. 1.2). It flows directly eastwards through China as the Tsangpo before turning abruptly south to enter India where it flows south west through Assam as the Brahmaputra. It then turns due south to enter Bangladesh. Until the late 18th century the river followed the course of the Old Brahmaputra, flowing south west into the southern end of the Sylhet Basin where it joined the Meghna River, and the combined flow entered the Bay of Bengal along the present course of the Meghna estuary.

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Figure 1.1 Location of Brahmaputra Right Embankment

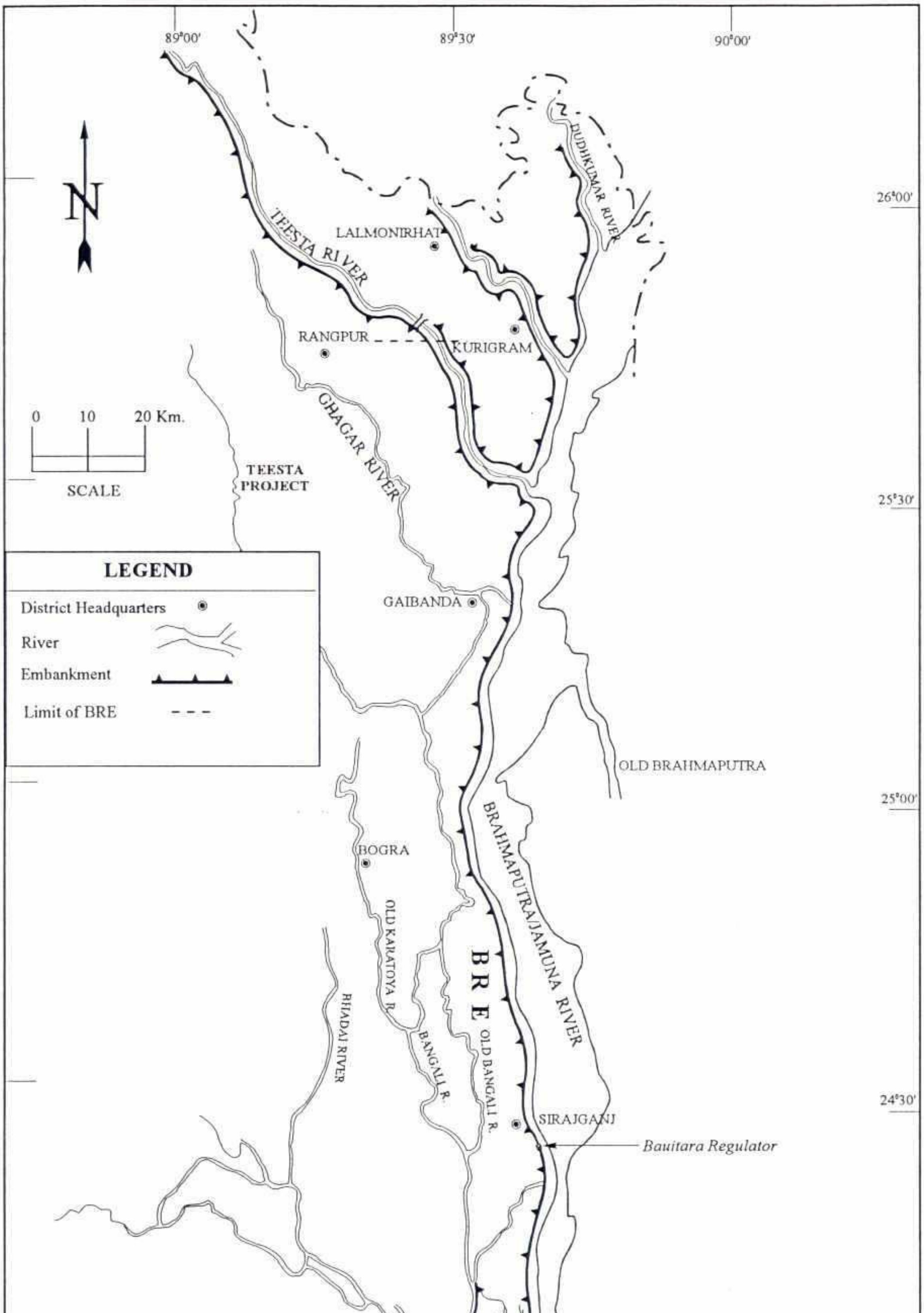
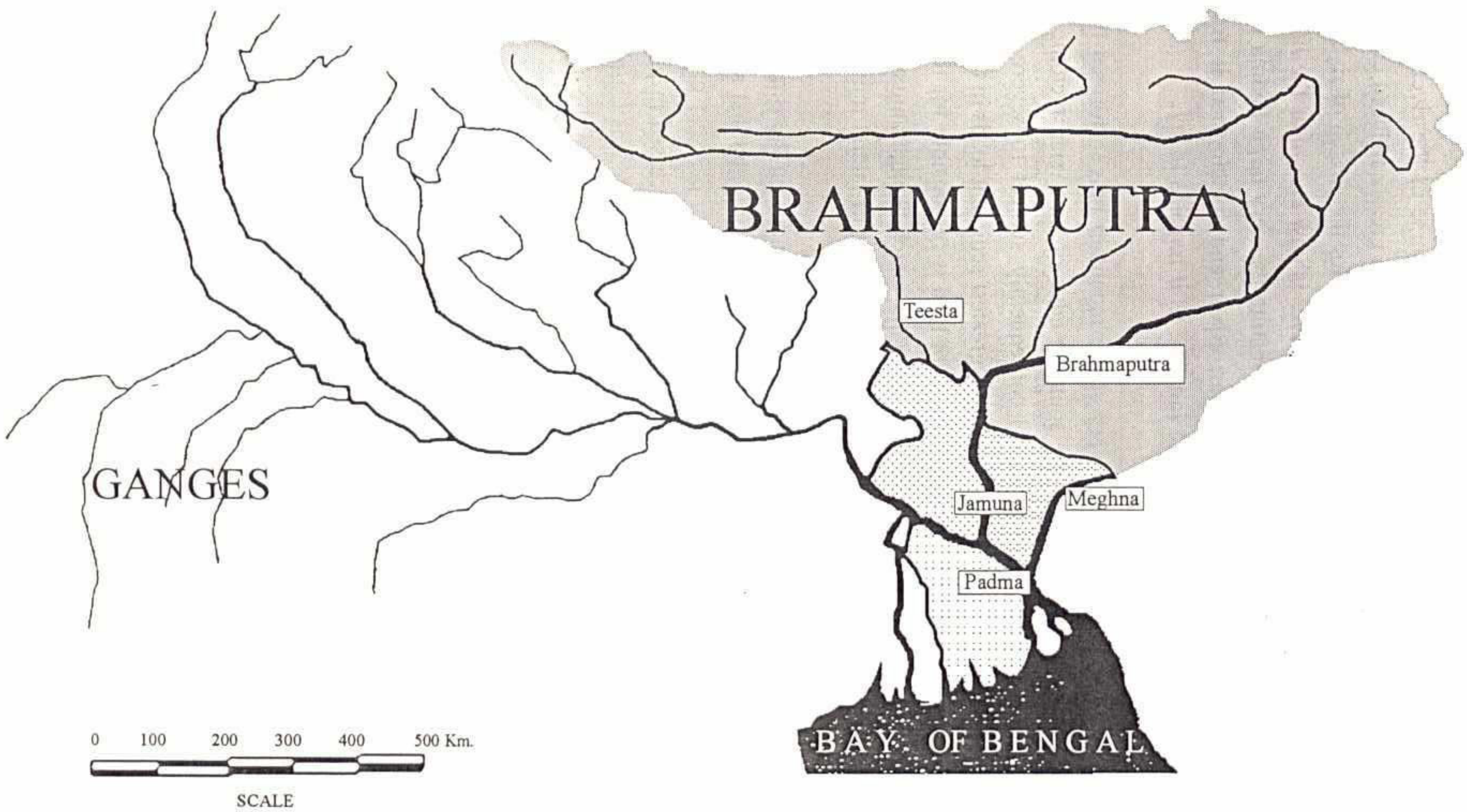


Figure 1.2 The Brahmaputra and Ganges rivers



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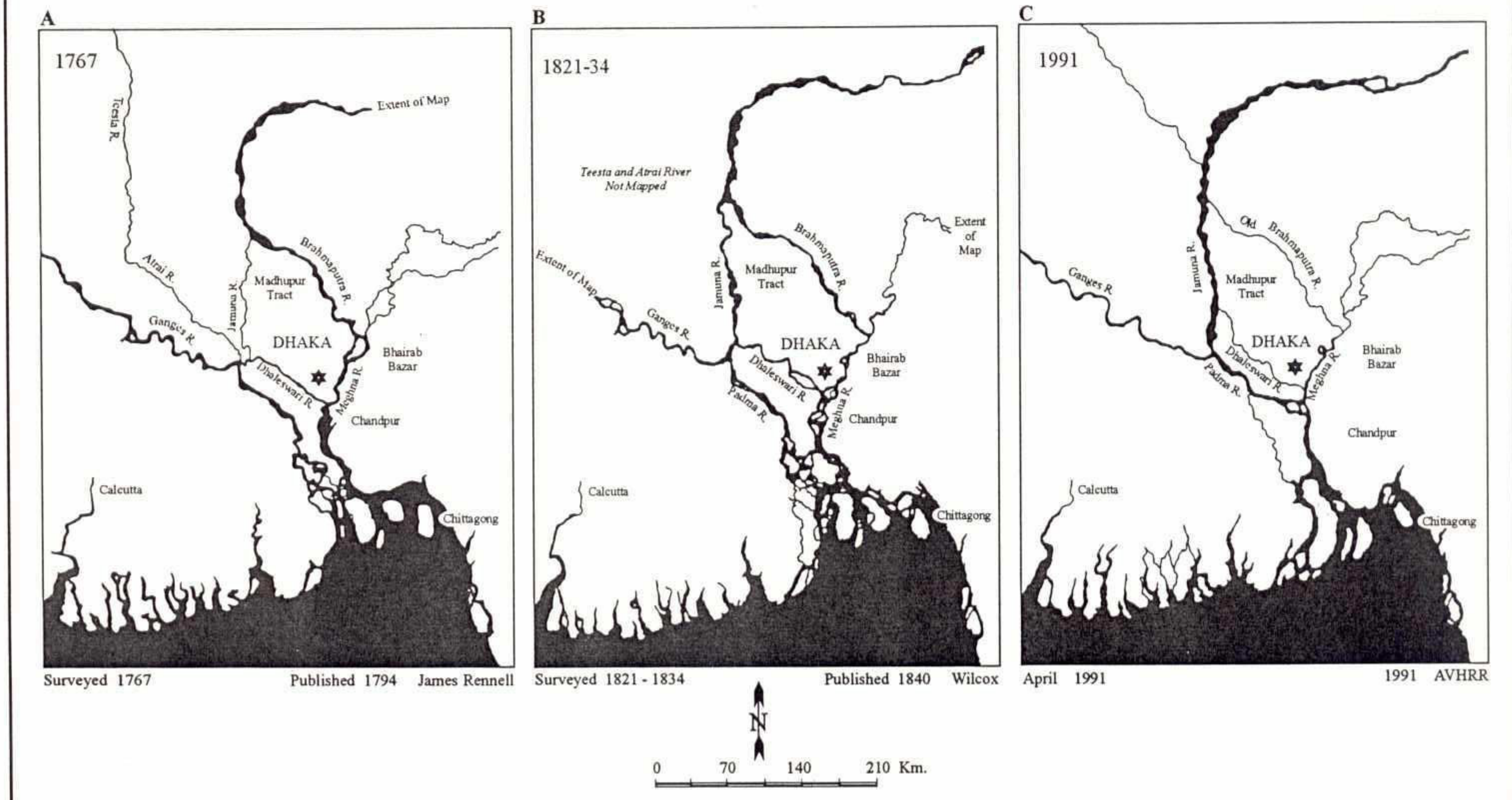
In a recent study of charlands on the Brahmaputra, FAP 19 showed clearly the historical changes in the river course since 1770 (Fig. 1.3)[1]. Sometime between 1780 and 1830 the Brahmaputra cut a new main course flowing directly south to form a new large river, the Jamuna, some 60 km west of its original course. The former course of the river, the Old Brahmaputra, gradually shrank until the present day resulting in a greatly reduced combined flow as it joins the Meghna. The name Brahmaputra is retained for the stretch of river north of the offtake of the Old Brahmaputra while to south the river is now known as the Jamuna. The river formed a new confluence with the Ganges creating the very large Padma River. As the Jamuna cut south it captured the Dhaleswari River and transformed it from a distributary of the Ganges to a distributary of the Jamuna, as it remains today.

The Himalayas are a young and tectonically very active mountain range formed by the movement of the Indian subcontinent under the southern edge of the Asian tectonic plate causing uplift of the Himalayan range which is consequently subject to severe natural erosion. As a result, the Brahmaputra carries one of the greatest sediment loads in the world. The combination of variable discharge and high sediment load is responsible for the highly braided pattern of multiple channels and sandbanks or *chars* which change annually. Such braided rivers are characteristically unstable and exhibit rapid rates of lateral movement.

FAP 19, in conjunction with FAP 1, recently studied the erosion rates on the Brahmaputra-Jamuna using historical maps and modern satellite images. The study found that since 1830 the river has been moving west at a annual erosion rate of about 50 m per year on the right bank and at the same time the river widened and the area of *chars* increased in proportion to this widening. A more recent average erosion rate of 100 m per year was estimated for the period 1973 to 1992 and this was expected to continue for some time in the absence of engineering interventions.

In response to the westward migration of the river and the resultant erosion and loss of land, the FAP 1 study[2] carried out a detailed investigation to identify engineering options which would ensure structural security of the BRE and prevent embankment breaching and external river flooding in the immediate hinterland of 240,000 ha of floodplains. In 1991, the BRE breached in several places along its length. The sealing of these breaches through a river training programme formed an important component of the FAP 1 study leading to the identification of a series of high priority engineering works to be implemented in the short-term. In the formulation of the North West regional plan by FAP 2, it was assumed that complete sealing of the BRE would be achieved[3].

Figure 1.3 Evolution of the Brahmaputra - Jamuna River system in Bangladesh



Source: FAP 19 (1993)[1]

Two sections of the BRE were studied in detail by FAP 12[4] and FAP 13[5]. The most northerly reach at Kamarjani was in a tributary area where land sloped towards the Jamuna River. The second reach at Kazipur, just north of Sirajganj covered an area which sloped away from the Jamuna and which, in the absence of the BRE, was seasonally flooded by the Jamuna which connected with adjacent rivers flowing south. In this reach the BRE successfully prevented the Jamuna flooding up to 1984 and during this period there was a shift in cropping patterns from mixed *b. aus* and *b. aman* to *t. aman* which required shallow water and an expansion of HYV *boro* which was related to the increasing availability of irrigation facilities. From 1984 onwards, *aman* cultivation became uncertain because of frequent serious flooding caused by embankment breaches. Despite frequent breaches bringing Jamuna floodwaters, local fishermen reported that there had been a 50% decrease in catches following embankment construction.

FAP 17 selected the BRE as one of its flood control projects to examine the impact of this regionally important structure on fish resources in an area where breaching was not a serious problem once the embankment had been reconstructed. Concomitant socioeconomic studies were not undertaken since the project had earlier decided not to study the Tangail area on the left bank of the Jamuna which provided a "control" area for the study. A separate survey was undertaken of the fisheries of the Jamuna River[6]. Results from this study relating to catch compositions are also incorporated into the present report in an examination of fish movements and the impact of flood control structures on such movements.

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2 SAMPLING SITES

Rivers, canals, floodplains and *beel* were sampled inside and outside the BRE at fortnightly intervals for a total of 17 months and 19 months respectively. Survey periods covered October 1992 to February 1994 inside the BRE and August 1992 to February 1994 outside it. Site selection and fisheries data collection were carried out following the procedures previously outlined in the FAP 17 Inception and Interim Reports.

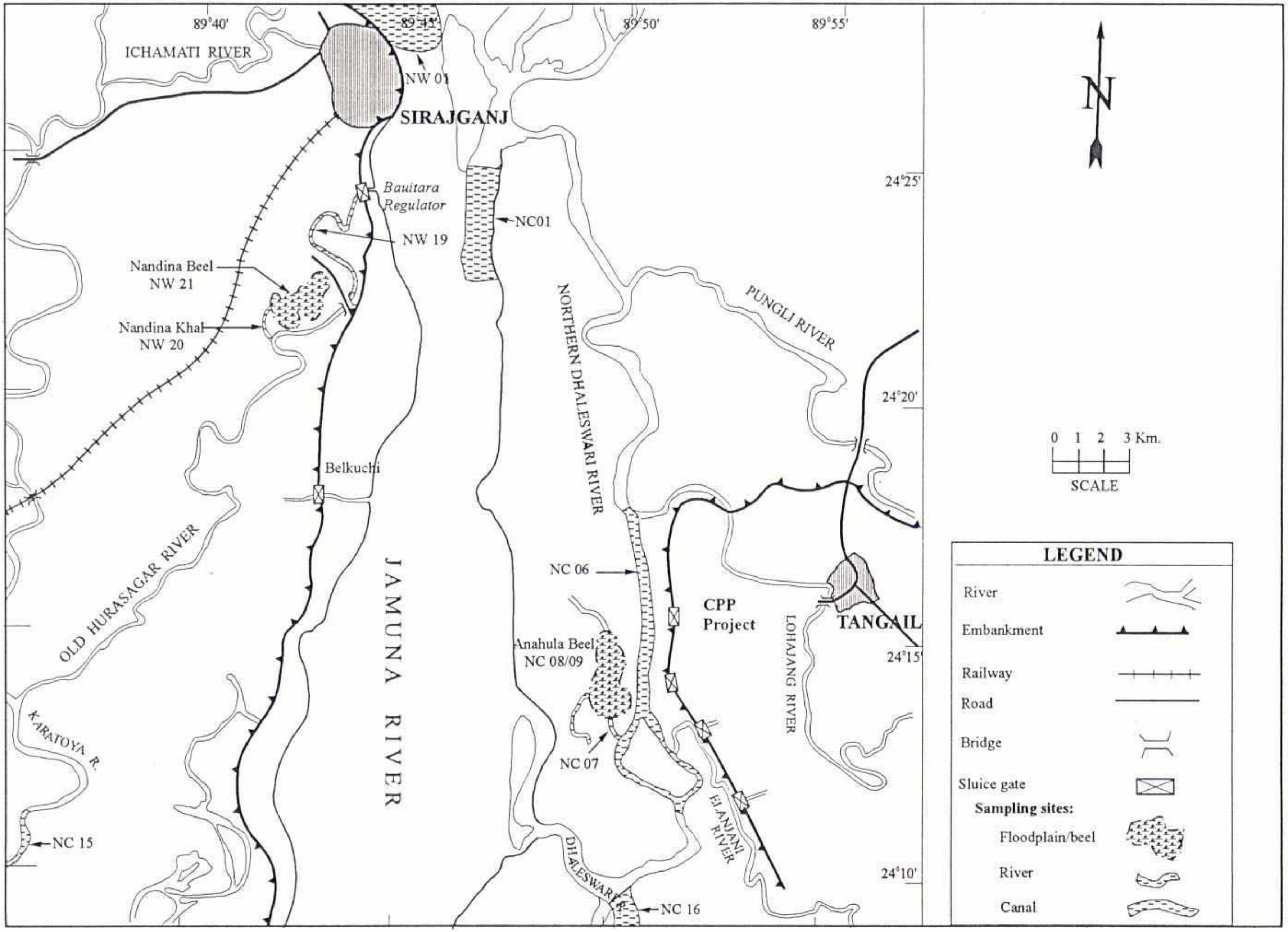
2.1 Inside Sites

The area selected for study, known locally as Nandina *Beel*, was located 10 km south of Sirajganj (Fig. 2.1). The *beel* and surrounding floodplain received seasonal river flooding from a distributary of the Jamuna, the Old Hurasagar River, via Nandina *Khal*. Three sites were selected, one covering the *beel* and adjacent floodplain, the second on Nandina *Khal*, for a distance of 2.1 km from the *beel* to its confluence with the Old Hurasagar and the third on the river itself for a distance of 6.7 km upstream to its point of regulation at Bauitara regulator on the BRE (Table 2.1). Additional information on catch composition from linking rivers Jamuna and Karatoya was used in an examination of fish movements. These rivers were surveyed as part of separate FAP 17 studies [6,7].

Table 2.1 Description of sampling sites

Site Code	Site Name	Habitat	Inside/Outside FCD	Size of site	
				Area (ha)	Length (km)
NC01	Jamuna River	Main River	Outside	1621	7.00
NW01	Jamuna River	Main River	Outside	1650	9.20
NC06	Northern Dhaleswari River	Secondary River	Outside	169	16.05
NC16	Dhaleswari River	Secondary River	Outside	277	15.55
NW19	Old Hurasagar River	Secondary River	Inside	17	6.65
NW15	Karatoya River	Secondary River	Outside	54	6.50
NC07	Anahula *Khal*	Canal	Outside	6	4.78
NW20	Nandina *Khal*	Canal	Inside	2	2.10
NC08/09	Anahula *Beel*	Floodplain/*beel*	Outside	92	-
NW21	Nandina *Beel*	Floodplain/*beel*	Inside	175	-

Figure 2.1 Location of sampling sites



The floodplain/*beel* site covered an area of privately owned land where a small central area formed Nandina *Beel* whilst the surrounding area increased abruptly in height on the *beel* margin. During the winter, the whole area was planted with HYV *boro* rice and during the monsoon the lower area was left fallow whilst *t. aman* and jute were grown around the site margin.

During preliminary surveys in September 1992, informal interviews were carried out with several local farmers. Most reported dissatisfaction with the operation of Bauitara regulator which resulted in insufficient river water reaching the *beel* and consequently farmers had to resort to STW irrigation for *t. aman* cultivation. All farmers agreed that there had been a decrease in fish catch since the BRE was constructed and that the numbers of full-time professional fishermen had declined.

2.2 Outside Sites

Since the entire length of the right bank of the Brahmaputra/Jamuna River is embanked in the North West Region, it was not possible to locate an adequate "control" area here. Instead a group of sites on the left bank of the Jamuna in the North Central Region was selected. The group comprised three sites, one on the Northern Dhaleswari River, a distributary of the Jamuna, the second on Anahula *Khal* which linked the river with the third site, Anahula *Beel* (Fig. 2.1). In the *beel*, data were collected separately for a small deeper water area comprising the *beel* itself (site NC09) and the surrounding floodplain (site NC08). However, the two together were essentially equivalent to the sampled area of Nandina floodplain/*beel* (NW21). The sites in North Central Region were originally selected to serve as part of a larger group of control sites in an investigation of the Tangail Compartmentalisation Pilot Project (CPP) the results of which have been documented separately[5]. Two other sites, one on the Jamuna River and the other on the Dhaleswari River into which the Northern Dhaleswari flowed, were included in the present study to compare movements of fish in regulated and unregulated systems. The Jamuna site was located close to the offtake of the Northern Dhaleswari and formed part of a broader, separate FAP 17 study of the fisheries of the Jamuna and Padma rivers[6].

The Northern Dhaleswari River, from its offtake point with the Jamuna, flowed 35 km south to join the larger Dhaleswari River and along its route supplied flows to three important distributaries on its left bank, the Pungli, Lohajang and Elanjani rivers. The Lohajang bisected the FAP 20 CPP area while the other two circumvented it on opposite sides. After completion of the FAP 17 field surveys in late 1994, the link between the Northern Dhaleswari River and the Jamuna was broken completely by a new embankment forming part of the construction of the Jamuna Bridge.

The sampled site on the Northern Dhaleswari commenced at the offtake point of the Lohajang for a distance of 16 km downstream which included an additional loop on the right bank that connected with Anahula *Khal* leading into Anahula *Beel*. The *khal* continued as a separate drainage channel on the western side of the *beel* which eventually drained back into the Northern Dhaleswari. A 3.2 km stretch of this part of the canal was also surveyed in addition to the 1.6 km reach of the southern end of the *beel*. At the northern end, there was a further connection of a feeder canal linking the *beel* during periods of high river flows with the Jamuna River. This canal was not monitored.

Anahula *Beel* site consisted of a small deeper water area of the *beel* itself and area of surrounding floodplain similar to that seen on Nandina *Beel* inside the BRE. Area elevation curves were constructed for each floodplain/*beel* site inside and outside the BRE using 8"/mile topographical maps and electronic planimetry (Fig. 2.2.). The range of land heights at the two sites was very similar but the regulated floodplain site at Nandina *Beel* contained a greater proportion of higher land. Cropping patterns at the two sites were fairly similar: HYV *boro* covered Anahula *Beel* and floodplain during the winter as it did at Nandina, while during the monsoon *t. aman* and jute were grown on the higher parts of the floodplain.

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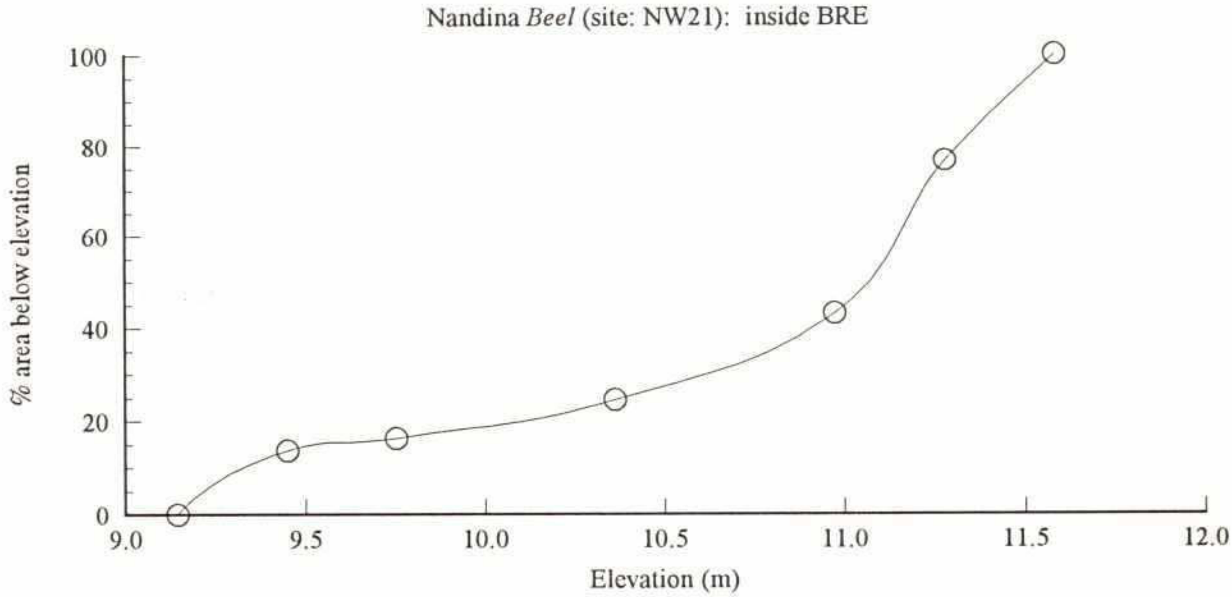
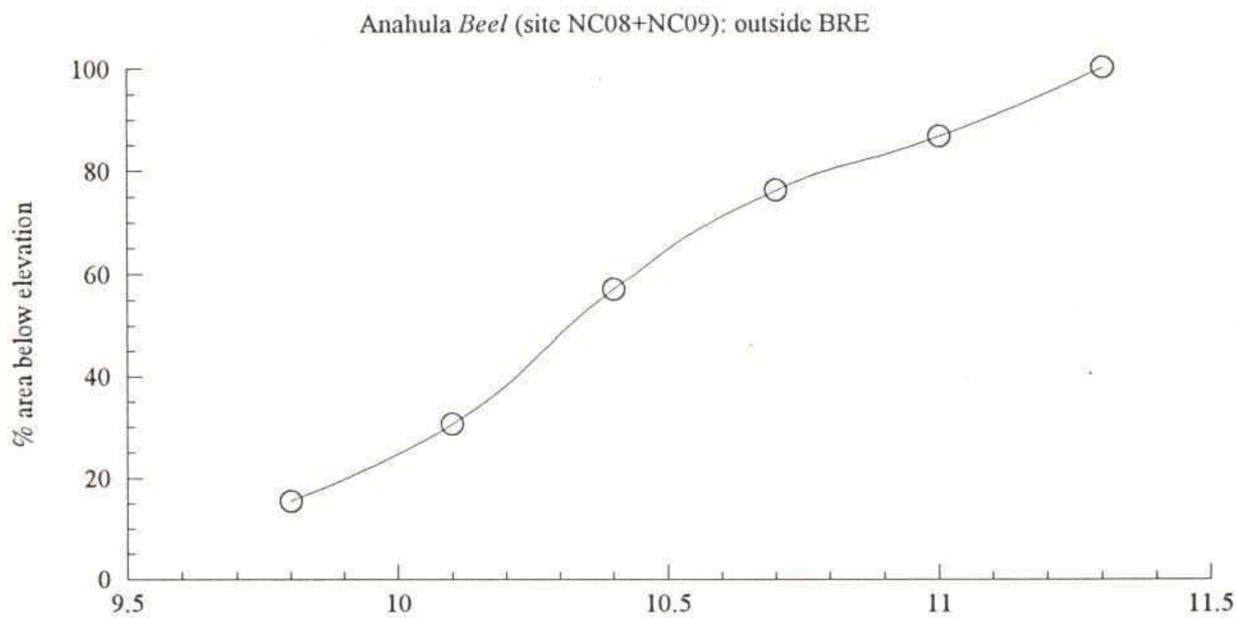
Figure 2.2 Area elevation curves of floodplain/*beel* sites inside and outside the BRE





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3 HYDROLOGY

Flooding patterns on regulated and unregulated floodplains were determined local rainfall and water levels in their nearest feeder rivers, the Old Hurasagar and the Northern Dhaleswari. The levels in these rivers were, to some extent, determined by the levels of the Jamuna River at its confluence with the Padma. In the North West Region, further drainage congestion of the Atrai River system resulted in the backing up of water levels in this river and its tributaries, including the Old Hurasagar.

Unfortunately BWDB did not maintain gauging stations an either the Old Hurasagar or the Northern Dhaleswari and therefore continuous records of water levels and river discharges were not available. The absence of water level data made it impossible to quantify accurately differences in flooding patterns on regulated and unregulated. During 1993, therefore, simple hydrological surveys were undertaken by fisheries biologists during routine fisheries assessment surveys. At each floodplain/*beel* site, water depths were measured at fortnightly intervals during 1993 at fixed points on different land heights. At the same time, the extent of the flood was recorded on sketch maps and points of entry and exit of floodwaters were noted together with directions of flow in associated canals.

3.1 Outside Site

Early rainfall between February and March 1993 had no impact on flooding. At this time of year water was pumped from shallow tubewells (STW) to irrigate fields of HYV *boro* rice which covered Anahula floodplain and much of the *beel*. Rainfall continued in April and resulted in the flooding of a small area on the lowest part of the *beel*.

By the beginning of May rainfall flooding to a maximum depth of 0.7 m was recorded in Anahula *Beel* but floodplains remained dry (Fig. 3.1). Runoff from the *beel* entered the Northern Dhaleswari River via Anahula *Khal*. Rainfall flooding increased slightly during May but decreased again in the first week of June when *boro* rice was harvested. In mid-June, water levels in the Northern Dhaleswari rose rapidly due to first inflow from the Jamuna River and floodwaters entered the *beel* for the first time in the year, flooding both the *beel* and lower areas of the floodplain (Fig. 3.2). In July, water levels recorded on the floodplain and *beel* were lower than in June. However, the hydrograph of the Dhaleswari River 11 km downstream from the entry point of the Northern Dhaleswari indicated that two peak floods occurred in July between fortnightly surveys of floodplains when water depth

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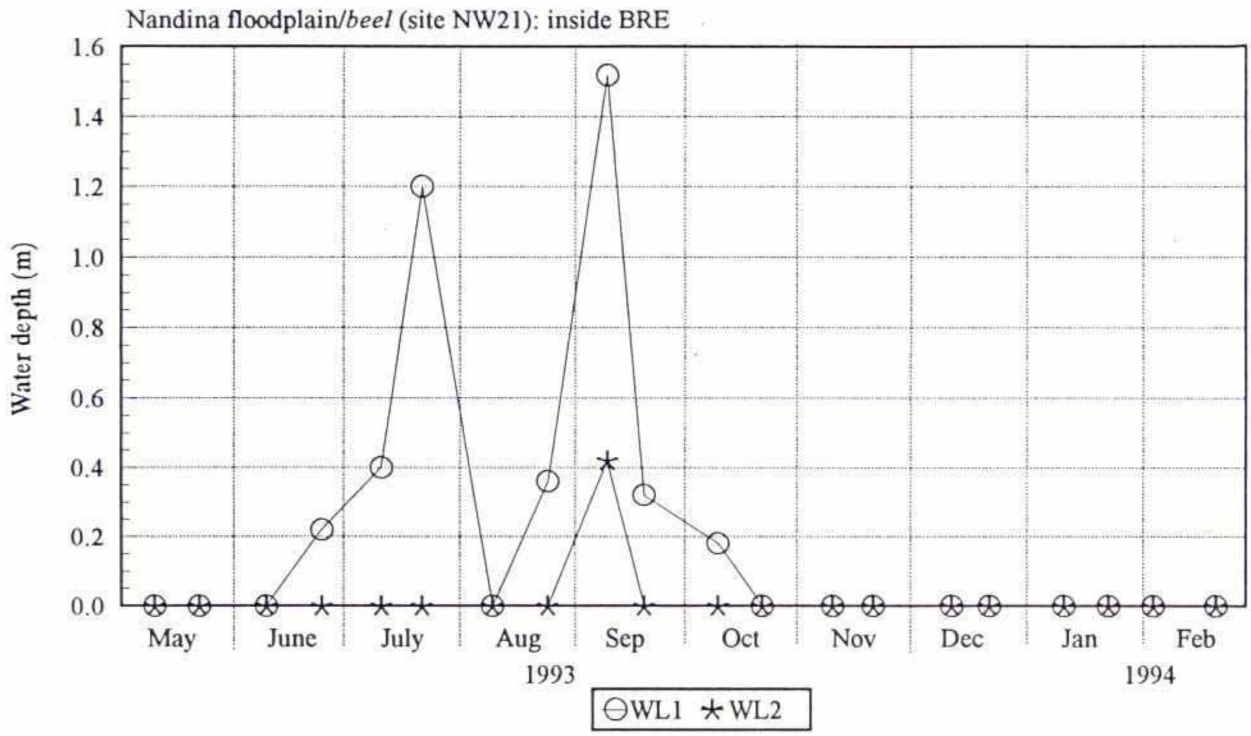
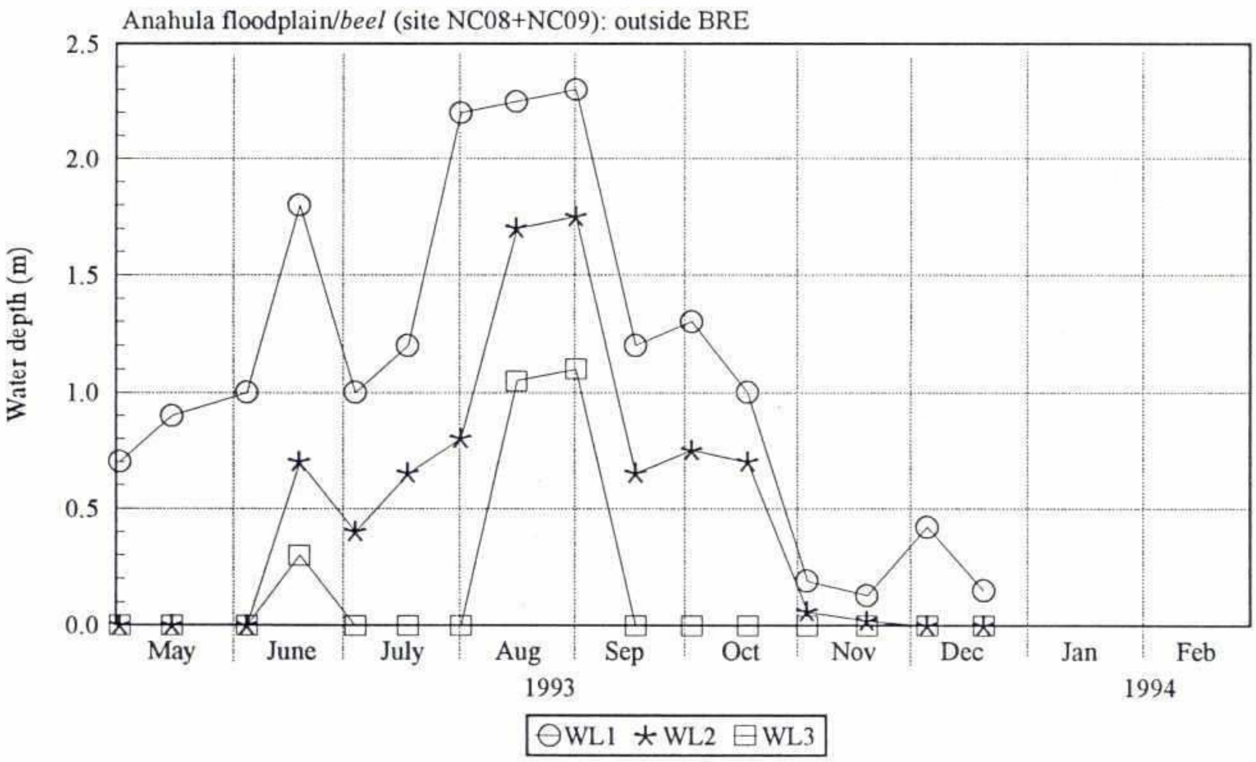
Figure 3.1 Seasonal variation in water depth on floodplains inside and outside the BRE



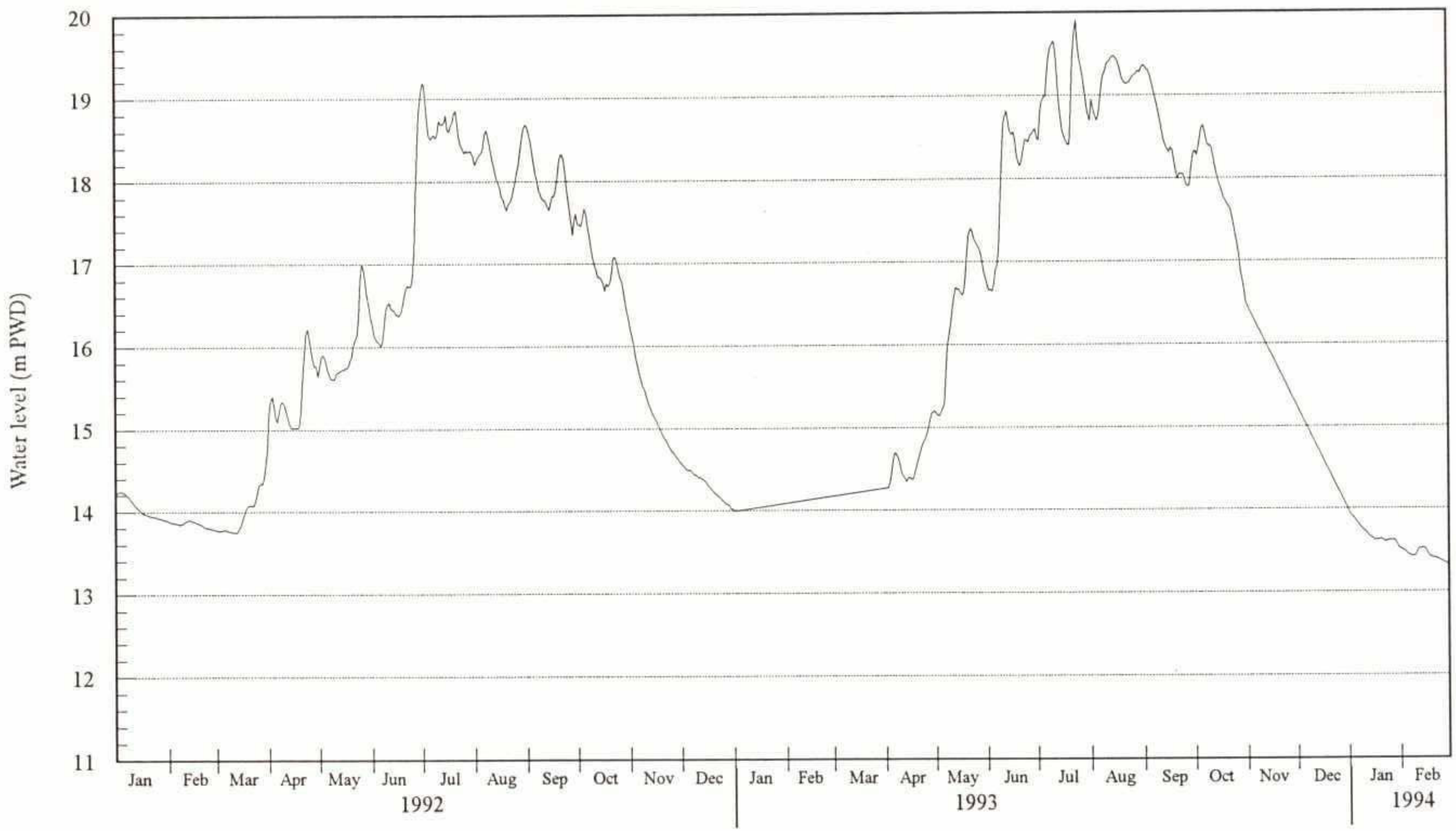
WL1 = 10.4 m and WL2 = 11.4 m



WL1 = 9.1 m , WL2 = 9.8 m and WL3 = 10.4 m

WL = Land elevations (m PWD) at positions of depth measurements

Figure 3.2 Seasonal variation in water levels of the Jamuna River at Bahadurabad



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measurements were made (Fig. 3.3). Flooding reached a peak between mid-August and the first few days in September when the whole site was inundated, including the highest parts of the floodplain. That this was the flood peak for the season was confirmed by downstream water levels in Dhaleswari River (Fig. 3.3).

The flood recession started in the second week of September and by the middle of the month most of the floodplain was again dry. However, during the first week of October the level of the Jamuna River rose and the site was again inundated. This was followed by a rapid flood drawdown and in mid-October most of the floodplain was dry. In the first week of November water remained only in the *beel* and by the middle of the month its connection with the Northern Dhaleswari via Anahula *Khal* was broken. The flooded area in the *beel* rapidly decreased during December and by mid-January the site was completely dry and planted with winter rice.

3.2 Inside Site

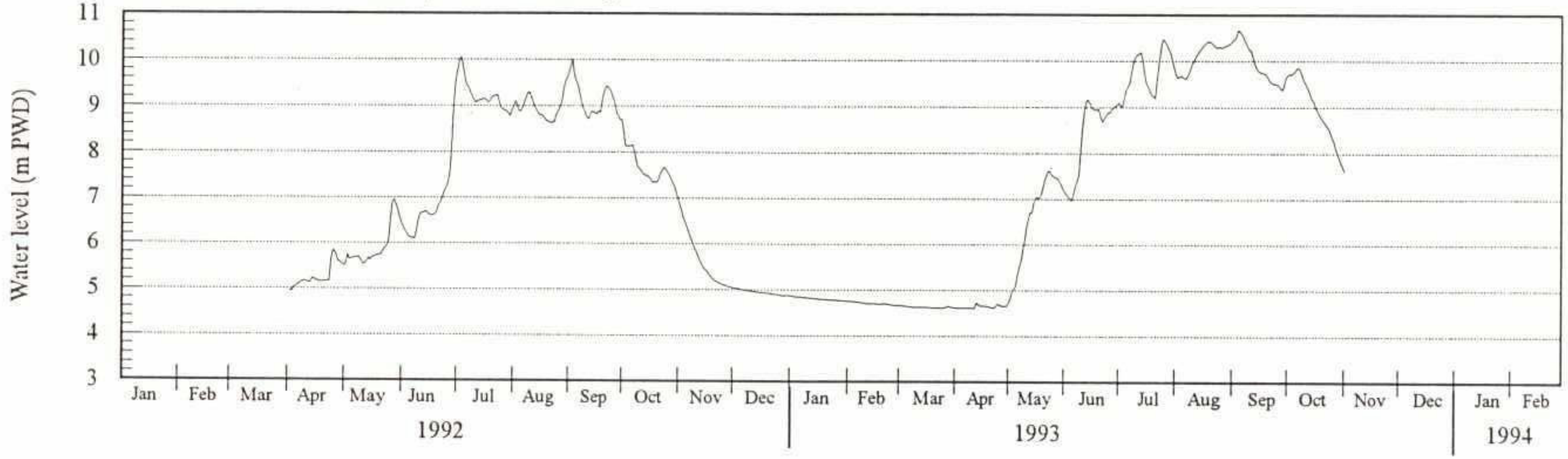
Bauitara regulator is a three-vent, undershot vertical lift gate through which water flows from the Jamuna to the Old Hurasagar River. Data on the operation of the regulator and records of water levels inside and outside it were not maintained by BWDB. However, the regulator was included in a separate FAP 17 study on the movement by passive drift of fish hatchlings across flood control structures[9]. During this study, observations were made of water level differences across the regulator (Fig. 3.4).

On the 12 June floodwaters from the Jamuna first crossed Bauitara regulator and entered the Old Hurasagar. At this time the gate opening were only 0.17 m. At the end of June gates were closed further but because of a mechanical fault a small gap of 0.05 m remained on each gate through which a small volume of water could pass. Under such conditions large differences in water levels across the structure occurred, accompanied by high water velocities, downstream turbulence and large hydrostatic pressure differences. Such severe hydraulic conditions have been shown to affect drifting fish hatchlings adversely and prevent or obstruct upstream migration of adult fish [9, 10].

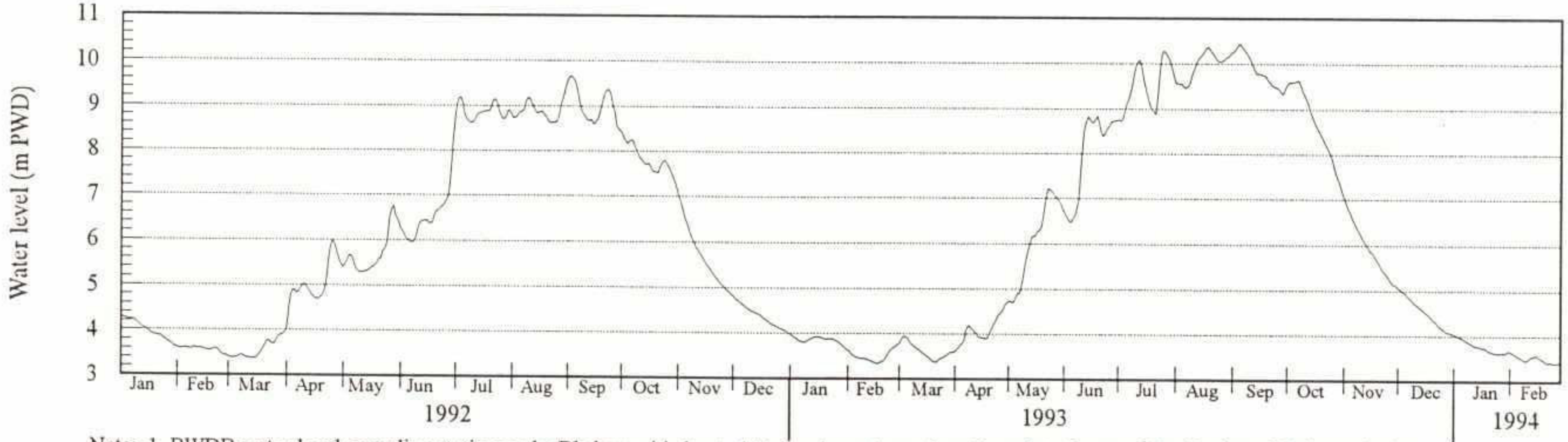
Records on gate heights indicated that all gates remained closed until the end of July but that during the first week in September they were partially opened to a height of 0.3 m. Such restrictions on the size of gate openings meant that the volumes of water discharged through the structure remained relatively low throughout the monsoon. Gate openings in early

Figure 3.3 Seasonal variation in water levels of the Dhaleswari and Baral rivers

a) Dhaleswari River at Elasin[1], North Central Region



b) Baral River at Baghabari[2], North West Region



Note: 1. BWDB water level recording station as the Dhaleswari is located 11 km downstream from the point of entry of the Northern Dhaleswari River
2. BWDB gauging station is located 13 km downstream from the point of entry of the Old Hurasagar River into the Karatoya River

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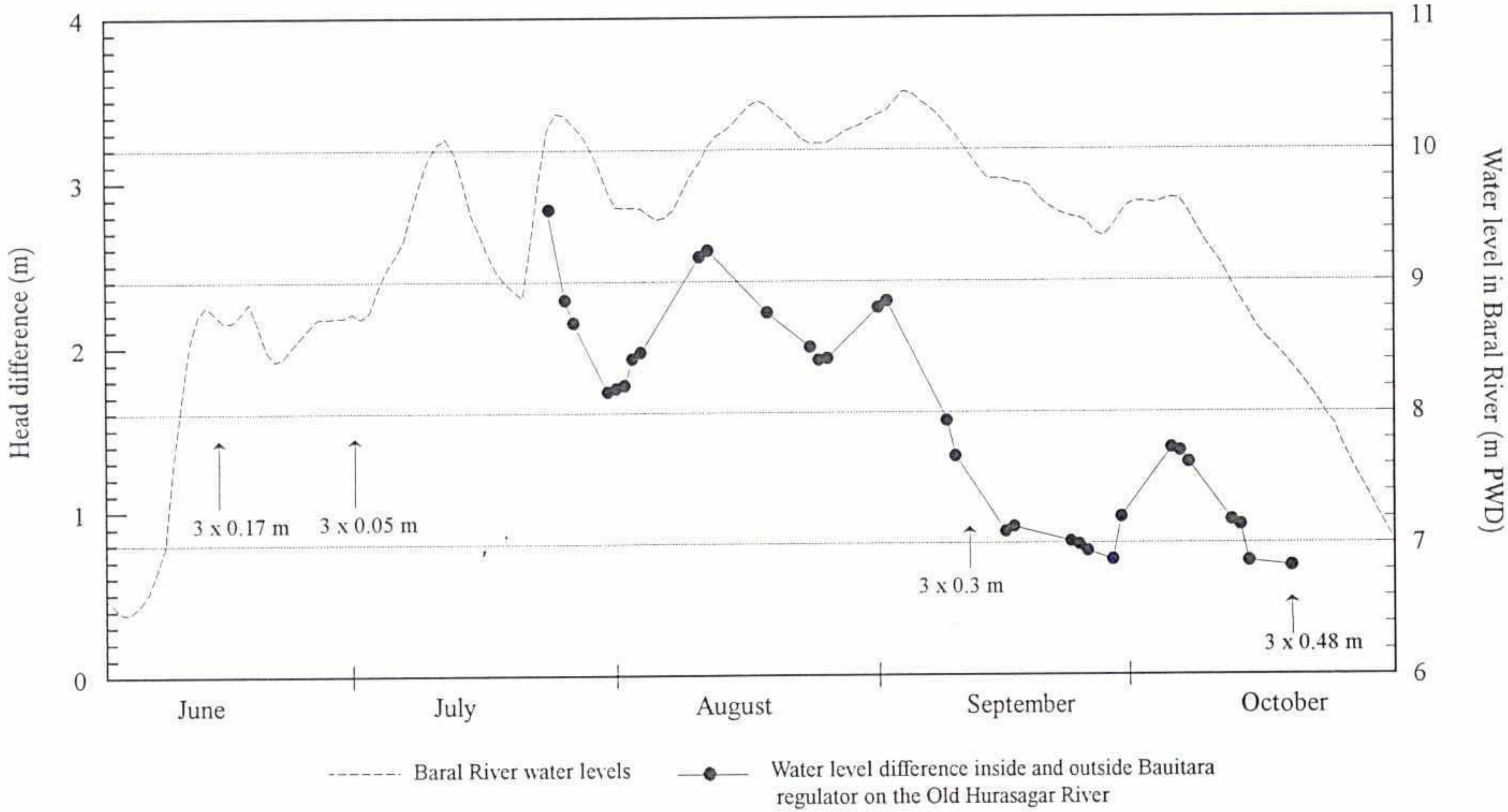
Figure 3.4 Seasonal variations in water level differences across Bauitara regulator and water levels in the Baral River at Baghabari, June to October 1993



Note: Vertical arrows denote dates when sluice gates were opened. The numbers refer to the number of gates opened and the height in metres to which they were opened

September were probably to allow fishing operations on the downstream walls of the structure itself and in a settling pool immediately next to it. Interviews with several gear operators revealed that most were local farmers who fished on the structure for about two months each year to catch upstream migrating fish.

The Old Hurasagar flowed south for a distance of 35 km before joining the larger Karatoya River which continued south for a further 16 km to empty into the Hurasagar. Drainage congestion at this point caused by high levels in the Jamuna resulted in the backing up of floodwaters in these rivers. It is not clear how far upstream levels in the Old Hurasagar were affected by this congestion. What is certain however, is that most flooding in this area was caused by internal rainfall.

On the floodplains and *beel* at Nandina, early rainfall in February and March 1993 caused no flooding. During these months STW irrigation was used for the cultivation of HYV winter rice which covered most of the area. Further rainfall in April and May eventually led to flooding in a small low-lying area around the *beel* by the end of May but floodplains remained dry. Rainfall flooding continued through June and July with no sign of entry of river waters. In early August water levels temporarily dropped but rose again later in the month. During the last week in August river waters, for the first time, flowed slowly into the *beel* via Nandina *Khal*. Flooding reached a peak in early September when the whole floodplain was inundated for up to two weeks. The flood drawdown commenced in mid-September and by mid-October, the floodplains were dry with water remaining only in an expanded area of *beel*. During the second week in November, Nandina *Khal* lost its connection with the river and *beel* and residual water remaining in the *beel* gradually dropped leaving only a very small flooded area (50 m x 20 m) in December. In January, several small *kua* appeared but these were not fished until after the study ended in February 1994. Water level readings taken at various points on the floodplain showed several inconsistencies in relation to each other and, although presented in Figure 3.1 for comparison with unregulated floodplain, the data should be treated with caution. The points shown in the figure included medium high and highest areas of the site. Water level readings on lower areas showed greatest inconsistencies and were therefore not used. The sharp rise in water level recorded on 9 September, and the equally sharp decline a week later, coincided with peak levels recorded in the Baral River at Baghabari suggesting that the drainage congestion at this point may have influenced floodplains as for north as Nandina.

3.3 Impact of BRE on Flooding Patterns

3.3.1 Flood source

River flooding on the regulated Nandina *Beel* was greatly reduced so that internal rainfall caused proportionally more of the monsoon flood here than on the unregulated Anahula *Beel*.

3.3.2 Flood timing and duration

There was no difference in timing of initial pre-monsoon rainfall flooding on the lowest areas of regulated or unregulated floodplain/*beel*. However, whilst the first river floodwaters entered the unregulated Anahula *Beel* in mid-June, river flooding at Nandina did not occur until the last week in August, a delay of 9 weeks. The flood drawdown also occurred one month earlier, in mid-September, at Nandina than at Anahula where an initial drawdown occurred at the same time but was interrupted by flooding in the first week of October. The duration of river flooding was thus limited to only 3 weeks at Nandina floodplain compared with 16 weeks at Anahula but duration of the rainfall flooding in the lowest parts of both sites was the same.

3.3.3 Flood magnitude and extent

The absence of river level data and inconsistencies between readings of water levels on different land heights in the two survey areas made it difficult to assess accurately differences in flood magnitude and extent between regulated and unregulated floodplains. The greater ingress of river waters on to unregulated floodplains resulted in deeper flooding over wider areas and the duration of complete inundation of floodplains was longer (4 weeks) at Anahula than that at Nandina (2 weeks).

4 WATER QUALITY

Surface water measurements of temperature, pH, dissolved oxygen (DO), conductivity and total dissolved solids were made at sites on rivers, canals and floodplains/*beel* at fortnightly intervals using electronic metering techniques. Seasonal variations in these parameters are presented for sites inside and outside the BRE in Figures 4.1-4.6. Given that temperature, pH and DO levels on floodplains generally depend on the time of day, attempts were made to standardise times when measurements were made. However, this was not always achieved and whilst most readings were taken between 07.00-09.00, some were outside this range. Therefore data in Figures 4.1 and 4.2 also reflect diurnal changes as well as seasonal variations.

Dissolved oxygen concentrations on Anahula floodplain ranged from 1 to 4 mg/l while those on Nandina varied slightly more, from 2 to 6 mg/l. Similar ranges were recorded in their feeder canals and rivers. Previous more detailed studies carried out in Bangladesh showed that oxygen levels ranged over a 24 hour period from a completely anoxic (zero oxygen) condition near dawn to supersaturation in mid-afternoon in both open flooded fallow land and in deepwater rice fields[11, 12]. The studies also revealed considerable vertical stratification in oxygen levels in fallow areas and rice fields with lowest concentrations (near zero) in the bottom layer and near saturation in surface layers. The effects of stratification were more pronounced towards the end of the monsoon season when amounts of decomposing macrophytic vegetation increased in decreasing volumes of water.

No seasonal trends in pH levels were detected on floodplains, canals or rivers. Values ranged from about 6 to 8, posing no danger to fish health or survival. Conductivities were lowest during the monsoon on both regulated and unregulated floodplains where they averaged about 150-160 μS, compared with values of 130 μS and 180 μS in the Northern Dhaleswari and Old Hurasagar rivers. Conductivities on both floodplains increased during the drawdown and winter due to a combination of natural causes such as the decomposition of plant material in smaller volumes of water and later to the inflow of ionically-rich groundwaters pumped to the surface for the irrigation of winter rice. The same seasonal increase was observed in canals and rivers, even in the Northern Dhaleswari, which retained a greater perennial flow.

Values of transparency in the Northern Dhaleswari River decreased during the monsoon due to the increased flow of silt-laden waters from the Jamuna. In contrast, transparencies increased in the Old Hurasagar during the same period reflecting either the reduced

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contribution to river flow by the Jamuna or the settlement of suspended silt in front of the sluice gates, both of which result from flood control. Transparencies also increased on regulated and unregulated floodplains during the monsoon which suggests that the mixing of river and rainfall floodwaters was incomplete at Anahula or that silt settled out in the feeder canal system prior to entry into the *beel*.

Figure 4.1 Water quality, Anahula *Beel* (site NC09): outside BRE

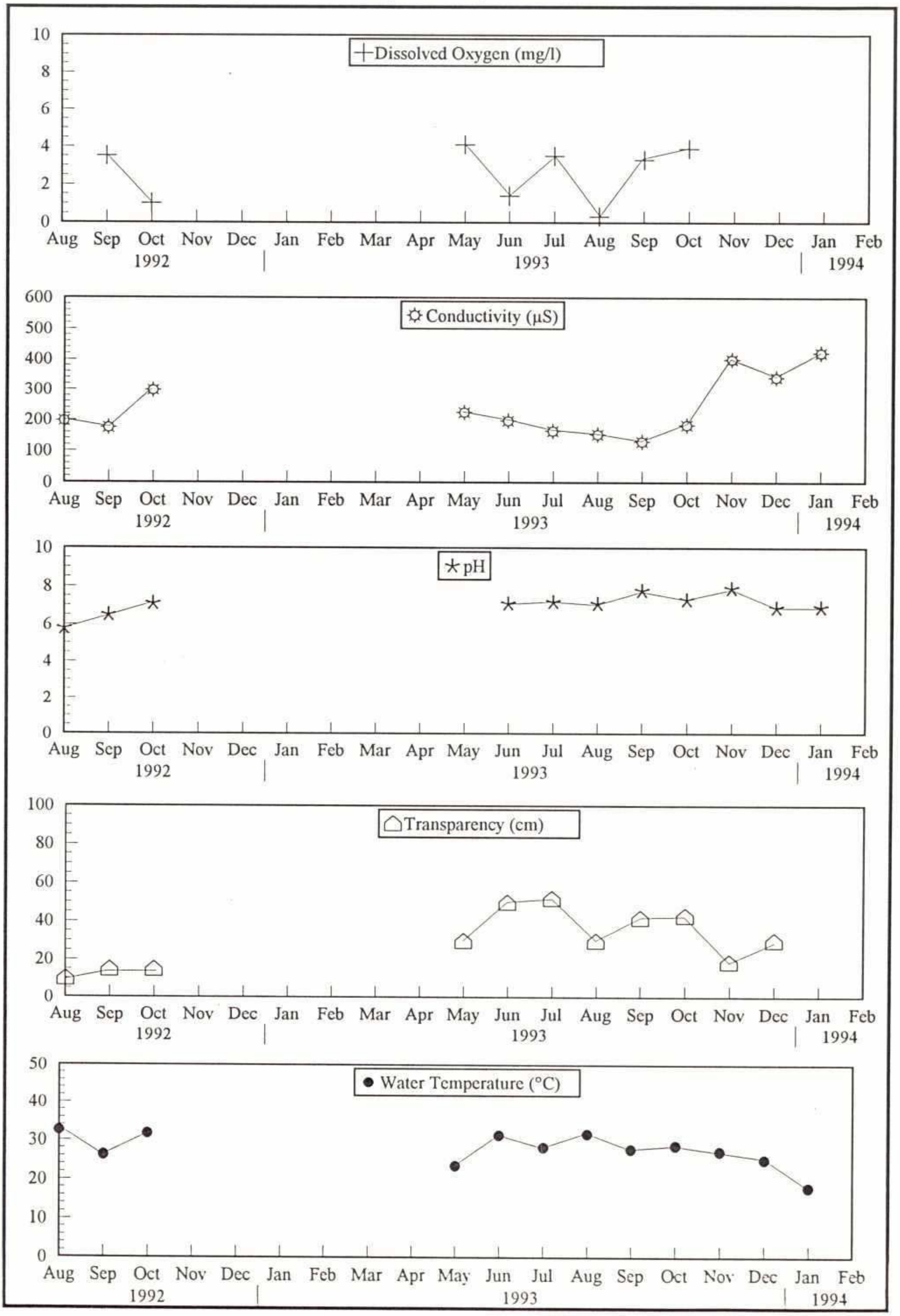

Figure 4.2 Water quality, Nandina *Beel* (site NW21): inside BRE

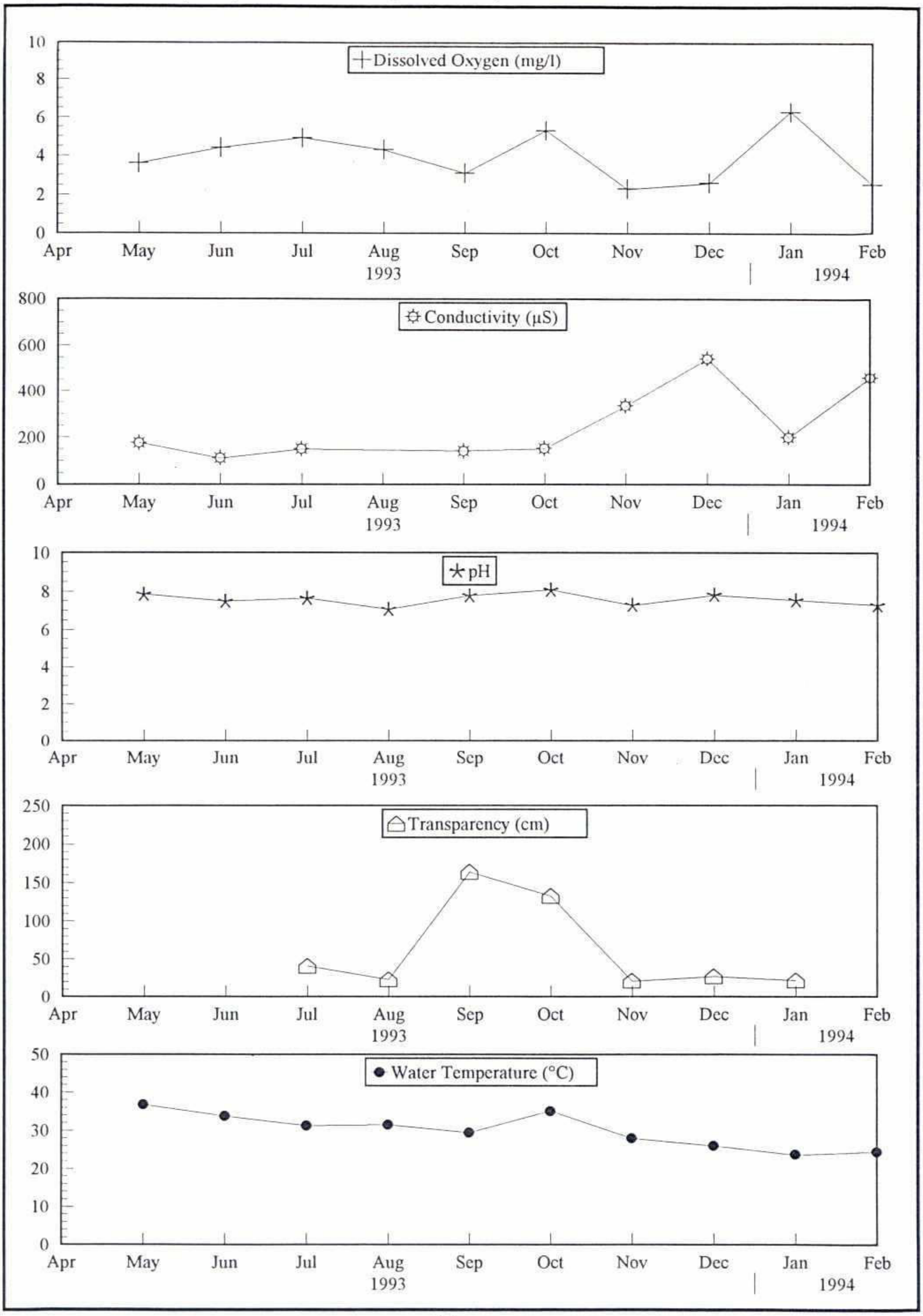

Figure 4.3 Water quality, Anahula *Khal* (site NC07): outside BRE

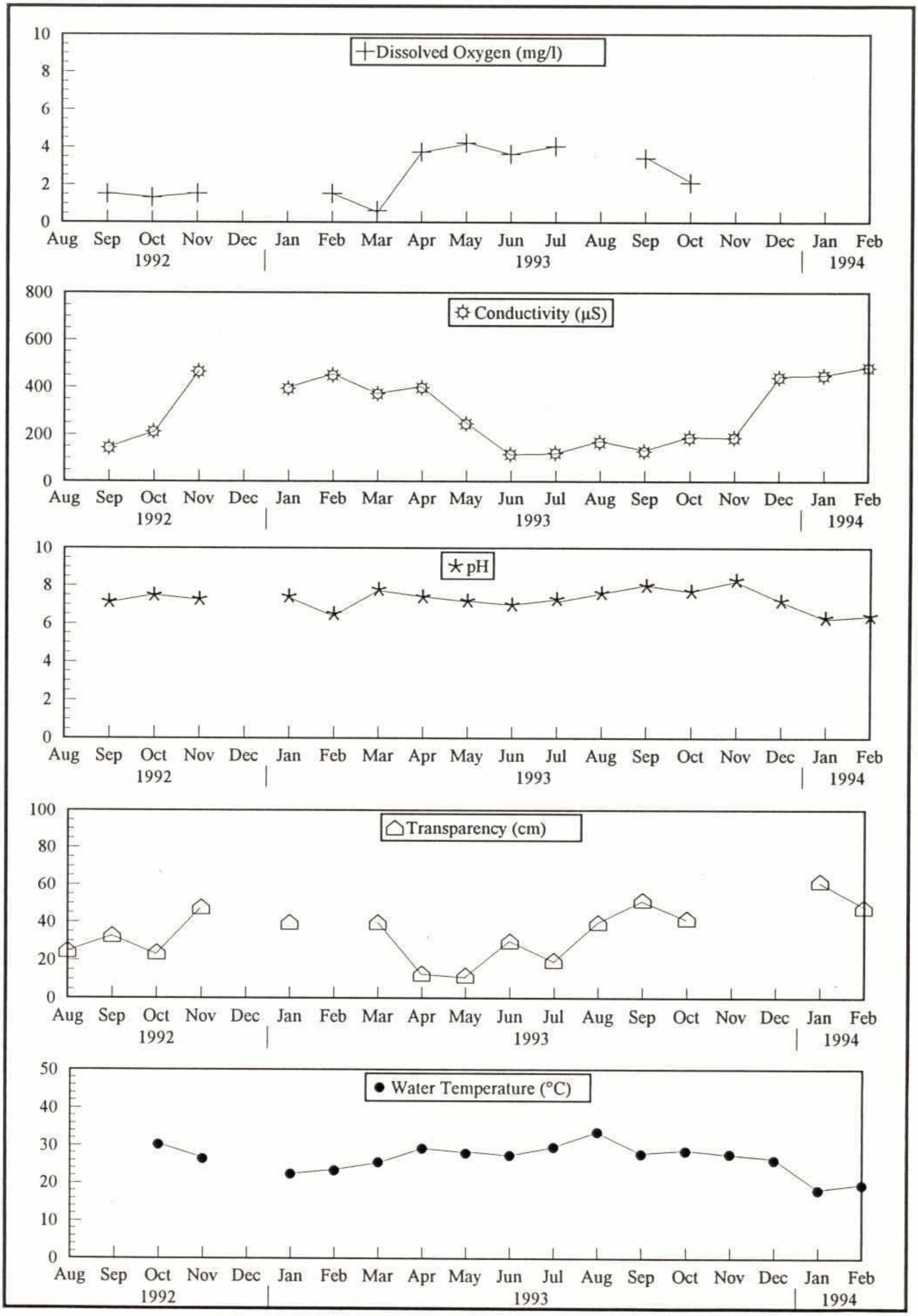

Figure 4.4 Water quality, Nandina *Khal* (site NW20): inside BRE

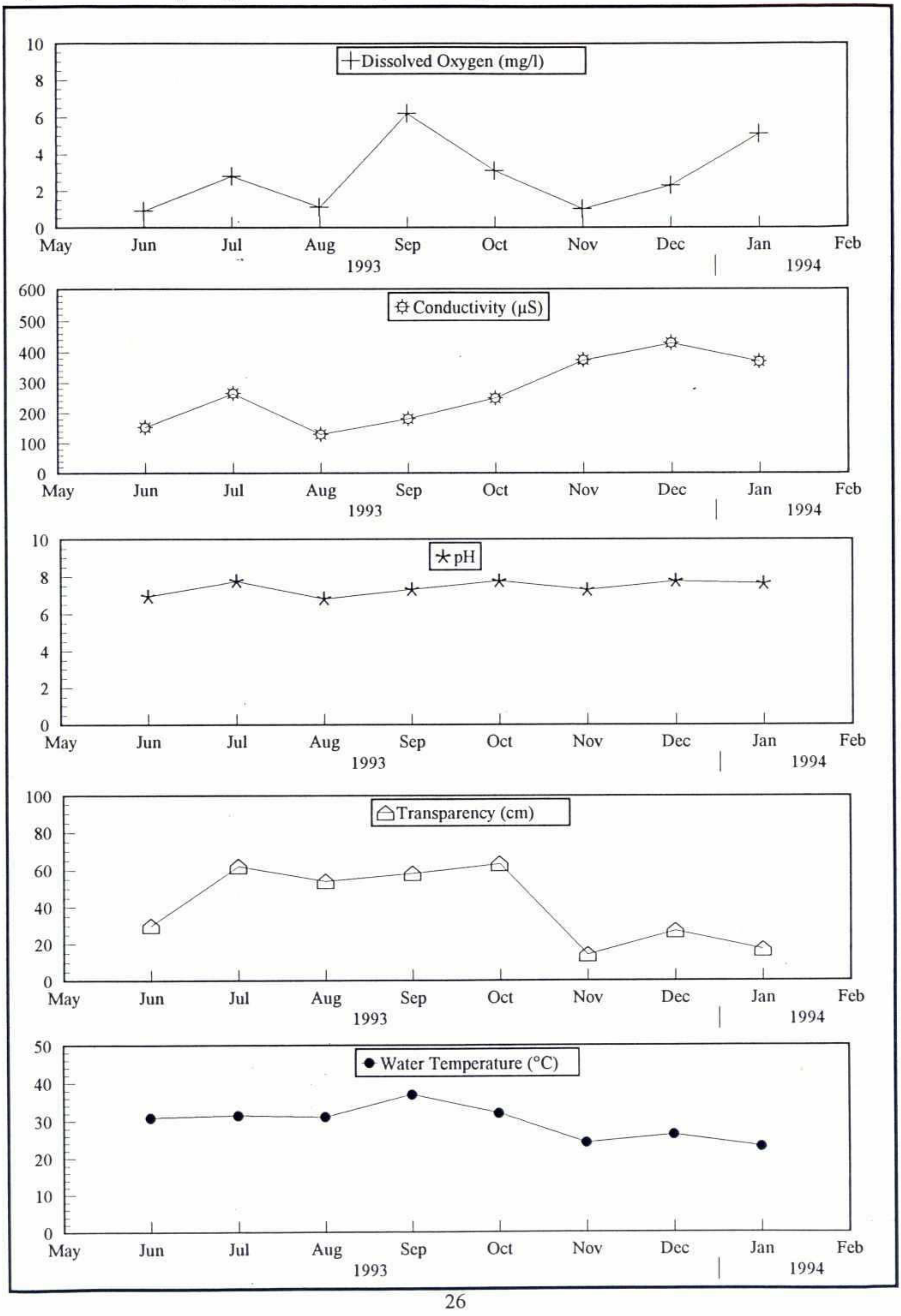

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Figure 4.5 Water quality, Northern Dhaleswari River (site NC06): outside BRE

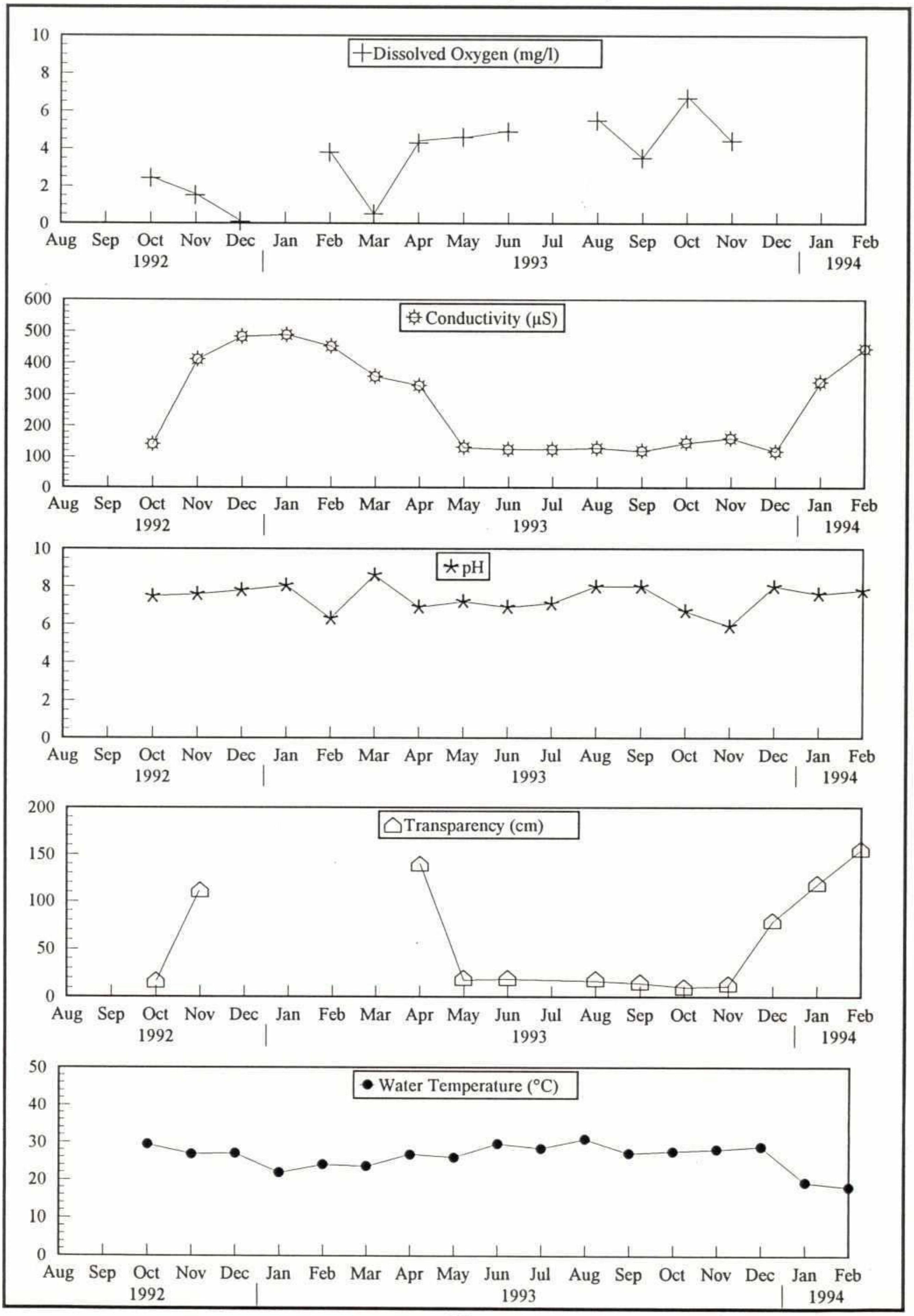

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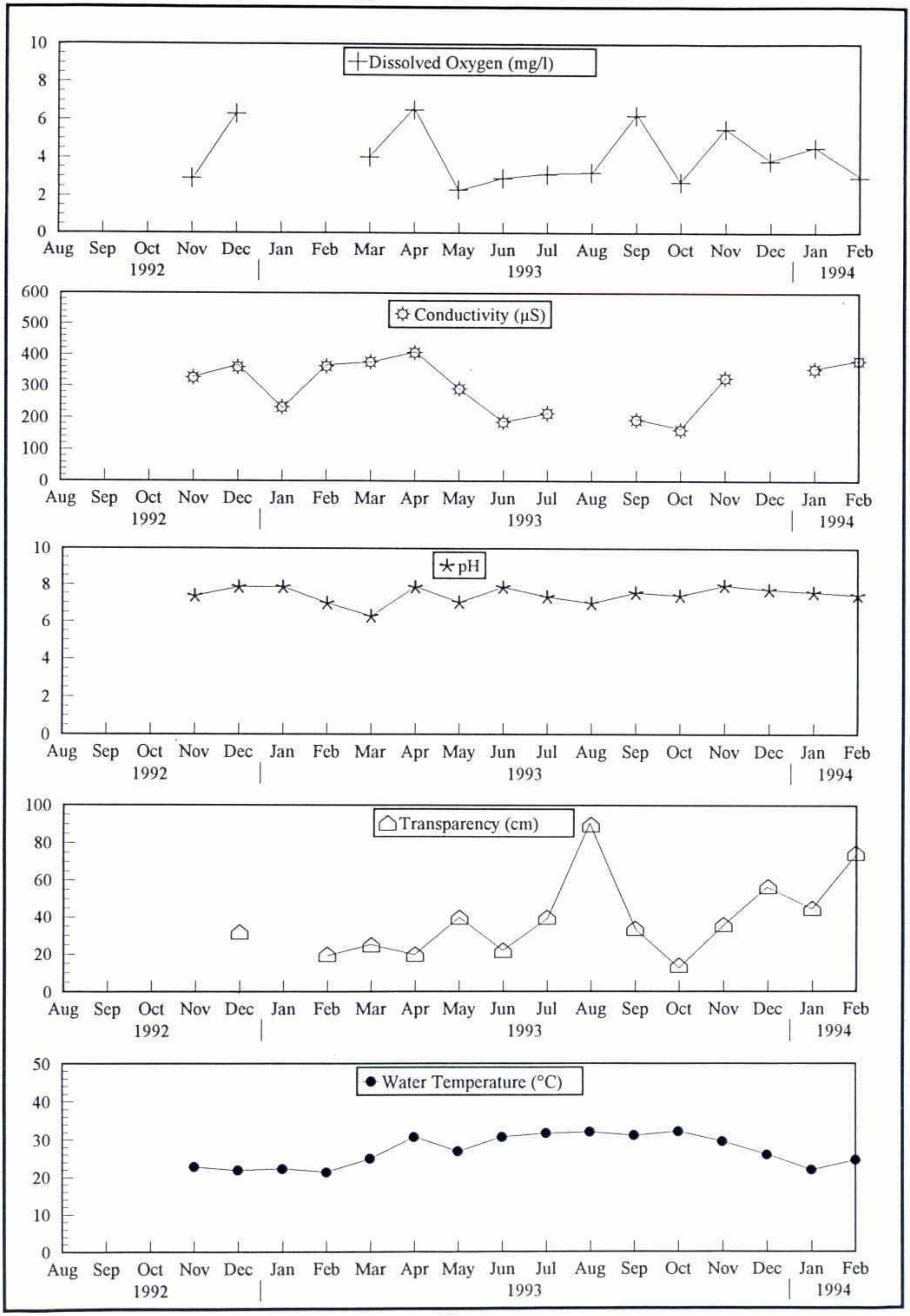
Figure 4.6 Water quality, Old Hurasagar River (site NW19): inside BRE



5 RIVER FISHERIES

In the following discussion data were included from sampling sites on the Jamuna River and on the Dhaleswari and Karatoya rivers into which the Northern Dhaleswari and Old Hurasagar respectively drain. These data were included to assist in the identification of fish movements through the river systems.

5.1 Total Catch

5.1.1 Pattern of catch

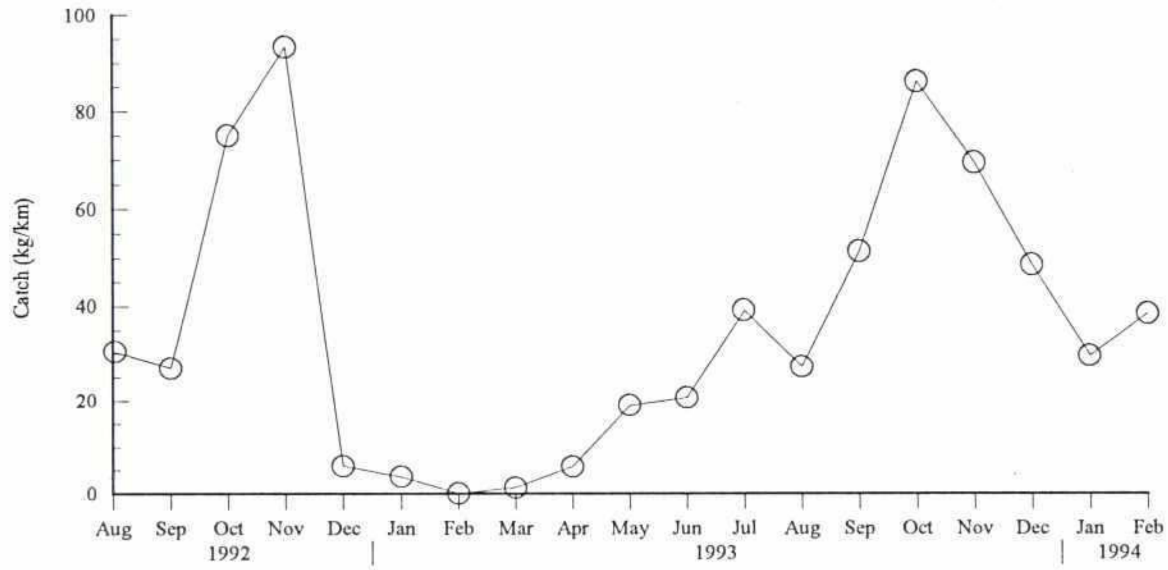
On the unregulated Northern Dhaleswari River, lowest catches were recorded during the winter and pre-monsoon periods from December 1992 to April 1993 (Fig. 5.1). A rise in water levels in May due to rainfall runoff stimulated increased fishing activity but later rapid rises in river levels in June resulting from hydraulic connection with the Jamuna River produced very little change in the monthly catch. Increased discharges and rapid fluctuations in water levels in July coincided with further increases in catch but, in the following month, the catch declined slightly under prevailing high flows. During the flood drawdown in September and October, catches increased sharply, reaching a peak in October before decreasing less rapidly from November to January.

On the highly regulated and seasonal Old Hurasagar River, catches were lowest between December 1992 and May 1993 with a slight peak in March due principally to *katha* harvesting in a series of disconnected pools along the river. As the first floodwaters from the Jamuna entered the river in mid-June via partial opening of Bauitara sluice gates, the catch increased temporarily before decreasing again in July. A slight rise in catch in August was followed by sharp increases in September and October coinciding with the flood drawdown. Catches then decreased equally rapidly to low levels between December and February.

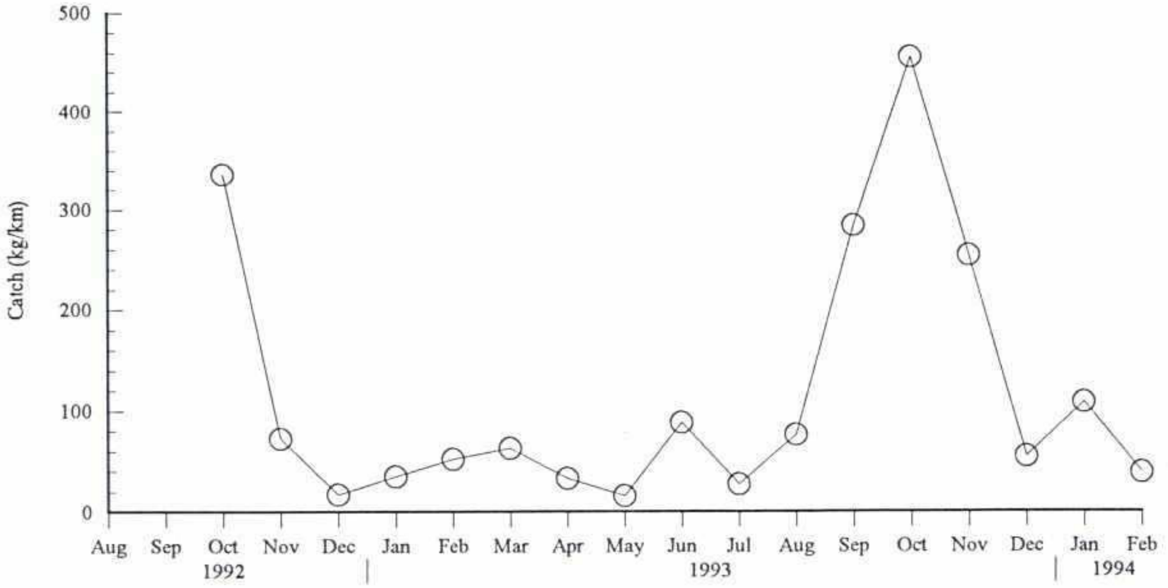
The major difference in catch patterns between rivers was seen in the more abrupt peak in catch during the drawdown in the Old Hurasagar and the reduced relative contribution to catch made during winter. This is reflected in annual percentage catch contributions of 47% and 66% made between September and November in the unregulated and regulated river respectively while 27% and 13% of the annual catch from these rivers was made between December 1993 and February 1994.

Figure 5.1 Seasonal variation in the catch per unit length of rivers outside and inside the BRE

Northern Dhaleswari (site NC06): outside BRE
Annual catch: 438 kg/km



Old Hurasagar (site NW19): inside BRE
Annual catch: 1501 kg/km



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5.1.2 Size of catch

The annual catch per kilometre of river from the Old Hurasagar was 3.4 times greater than that from the Northern Dhaleswari (Table 5.1). In terms of catch per unit area (CPUA) the difference between rivers was substantially greater: the catch from the regulated river was 14 times greater than that from the unregulated river.

Table 5.1 Comparison of the annual catch from rivers inside and outside the BRE, March 1993 - February 1994

Site code	Site name	Inside/ Outside FCD	Annual catch		
			Total	Kg/ha	Kg/km
NC01	Jamuna	Outside	48,037	30	2,963
NW01	Jamuna	Outside	35,529	22	2,153
NC06	Northern Dhaleswari	Outside	7,036	42	438
NW19	Old Hurasagar	Inside	9,982	600	1,501

In comparison with catches from other regulated and unregulated rivers in the North Central and North West regions, the catch per kilometre from the Old Hurasagar was less than those from three unregulated rivers in the North West but higher than catches from five North Central rivers (Table 5.2). The catch per unit area from the Old Hurasagar was higher than those from all rivers sampled in both regions. The catch from the Northern Dhaleswari was not typical of other rivers in the North Central Region; per unit area it was the lowest recorded in all rivers, seasonal and perennial, from both regions. Reasons for such low catches from this river remain unclear.

Statistical analyses of catch rates of dominant gears revealed no clear significant differences between rivers which indicated that fish densities or abundances were also not significantly different. The considerably higher catch from the Old Hurasagar could, however, be attributed to a higher amount of fishing effort by the three most important gears, *deal* traps, *thella jal* and *dharma jal*. Another reason for the higher catch from the Old Hurasagar was the blocking by Bauitara regulator of upstream migrations of fish and the concentration of certain species in the area immediately downstream of the structure where many *dharma jal* were established. Another more specialised gear, the *urani jal*, was set on the doors and walls on the downstream side of the regulator to catch fish as they leapt clear of the water in their attempts to cross the structure. The blocking of upstream migrations of adult and juvenile fish by structures built across distributaries has been documented in a separate FAP 17 study of the Charghat regulator on the Baral River in the North West Region[10].

Table 5.2 Comparison of the annual catch from regulated and unregulated rivers in the North Central and North West regions, March 1993 - February 1994

Region	Site Code	In/Out FCD/I	Name of River	Annual catch (kg/km)	Annual catch (kg/ha)
North West	NW19	In	Old Hurasagar	1501	600
	NW25	In	Baral	856	250
	NW03	In	Badai	8155	1631
	NW06	In	Ichamati	1596	236
	NW07	In	Kageswari	2028	541
	NW11	In	Chiknai	2079	555
	NW15	Out	Karatoya	4003	485
	NW14	Out	Baral/Atrai	5062	400
	NW27	Out	Atrai	2009	291
North Central	NC06	Out	Northern Dhaleswari	438	42
	NC02	Out	Pungli	794	85
	NC16	Out	Dhaleswari	1308	73
	NC21	Out	Gazikhali	332	74
	NC25	Out	Kaliganga	1768	132
	NC29	Out	Ichamati	2129	568
	NC12	In	Lohajang	748	299

5.1.3 Catch differences between years

Survey periods of 17 and 19 months, in the North West and North Central regions respectively, provided an opportunity to examine inter-annual changes in catch through two flood recessions and winters. In the North West Region, total catches for the period October

1992 - February 1993 were compared with those for the same period in 1993/94. A similar comparison was made in the North Central Region for the months August to February 1992/93 and 1993/94 (Table 5.3). Catches from *katha* fishing were excluded from the analyses since these required more intensive sampling which was provided in 1993/94 but not in 1992/93.

Table 5.3 Comparison of the total catch[1] (kg/km) from rivers inside and outside the BRE between different years

Site code	Site Name	Inside/Outside BRE	Catch		% reduction in catch in 92/93
			1992-1993	1993-1994	
NW19	Old Hurasagar	Inside	513	863	41
NC06	Northern Dhaleswari	Outside	236	305	23

Note 1: *Katha* catches were excluded from the analyses (see text for details)

In both rivers, catches in 1992/93 were substantially lower than in the following year. In Table 5.4 the catch is divided into three different groups of fish based on habitat preference: riverine, migratory and floodplain resident species (see Section 5.4.1 for definitions). The results showed that changes in catch between years varied between species groups and rivers. Results from studies elsewhere in the world have demonstrated that yields from floodplain fisheries are directly positively related to the flood extent[13]. Therefore, since 1992/93 was a relative drought year compared to 1993/94, lower catches of floodplain dependent fish would be expected. The results agree with those predicted from differences in flooding patterns between years. Catches of floodplain resident fish were lower in both rivers during 1992/93 but substantially lower in the unregulated Northern Dhaleswari. This suggested that differences in flood magnitude and extent were relatively greater between years on unregulated floodplains. Unfortunately, no direct hydrological evidence was available to examine this point. However, hydrographs presented in Figure 3.3 for the Dhaleswari and Baral rivers indicated almost identical inter-annual changes in flood magnitude and duration.

y2

Table 5.4 **Comparison of catch[1] (kg/ha) of riverine, migratory and floodplain resident fish from rivers inside and outside the BRE between different years**

Site code	Site name	In/ Out BRE	Riverine CPUA			Migratory CPUA			Floodplain resident CPUA		
			1992-1993	1993-1994	% change in 92/93	1992-1993	1993-1994	% change in 92/93	1992-1993	1993-1994	% change in 92/93
NW19	Old Hurasagar	In	62	4	+ 1450	49	389	- 87	347	381	- 9
NC06	Northern Dhaleswari	Out	40	37	+ 8	97	49	+ 98	75	184	- 59

Note 1: *Katha* catches were excluded from the analyses (see text for details)

Catches of riverine fish species were higher in the drier years in both rivers, considerably so in the Old Hurasagar. Since this group of fish is the least dependent on floodplains, it is expected to exhibit a less close relationship between inter-annual variations in catch and flood extent. Catches of migratory species were considerably lower in the drier year in the Old Hurasagar but higher in the Northern Dhaleswari. The principal species contributing to these catches were all dependent on floodplains for breeding and juvenile growth and therefore, for reasons which remain unclear, the result from the unregulated river does not agree with the expected pattern.

A second factor which may have influenced differences in fish catches between years was the occurrence of the fish disease, epizootic ulcerative syndrome (EUS). This disease first appeared in Bangladesh in 1988 and outbreaks have occurred irregularly since then. The disease was more serious in 1992 than in 1993 but since the first major outbreak occurred around mid-November 1992 after the bulk of the catch (excluding *katha* fishing) for the compared time periods had already been taken (96% and 80% in the Northern Dhaleswari and Old Hurasagar respectively) it is unlikely to have had a significant influence on catch comparisons between years.

5.2 Pattern of Fishing

5.2.1 Catch by gear

Percentage contributions made by dominant gears to the total annual catch from each river are presented in Table 5.5. More detailed information on percentage monthly and annual catches of all observed gears is given in Tables 5.6 and 5.7.

Table 5.5 Percentage contribution (by weight) to the total annual catch made by dominant[1] gears in rivers inside and outside the BRE, March 1993 - February 1994

Gear	Northern Dhaleswari: outside BRE (site NC06)	Old Hurasagar: inside BRE (site NW19)
Thella jal	16.8	18.1
Moi jal	14.8	-
Jhaki jal	11.9	4.6
Katha	10.8	7.7
Hand fishing	8.6	-
Doiar trap	8.1	8.2
Dharma jal	7.2	14.1
Ber jal	7.1	-
Sip	4.3	7.7
Kathi jal	4.2	-
Deal trap	-	27.1
Current jal (Stationary)	-	3.8

Note 1: Dominant gears are defined as those gears which, when ranked in order of abundance, comprised at least 90% of the total annual catch

The total numbers of fishing gears recorded on each river were similar: 20 on the Northern Dhaleswari and 23 on the Old Hurasagar. However, there were several important differences between rivers in terms of the composition of dominant gears. On the Northern Dhaleswari, seine nets, *ber jal* and *kathi jal* and drag nets (*moi jal*) together accounted for 26% of the annual catch whereas on the Old Hurasagar, *kathi jal* was not used and *ber jal* and *moi jal* together comprised only 2% of the catch. A second major difference between rivers was seen in the use of *deal* traps on the Old Hurasagar which captured the greatest proportion (27%)

Table 5.6 Percentage monthly catch by gear type: Northern Dhaleswari River (site NC06), outside BRE

Gear		Year: 1992					Year: 1993												Year: 1994		Total annual catch (Mar'93 – Feb'94)	
Code	Gear name	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Kg	%
255	*Thella jal*	33.983	12.593	5.747	5.765	26.652	40.460	–	41.853	18.756	11.908	17.139	32.263	62.701	32.609	13.789	1.959	6.370	–	8.470	1184.270	16.832
202	*Moi jal*	0.170	5.465	16.451	2.075	–	–	–	–	–	7.920	15.764	0.398	–	–	5.163	43.732	40.438	–	13.459	1039.238	14.770
164	*Jhaki jal*	24.061	2.964	27.240	3.636	4.541	33.978	–	–	33.824	24.927	6.005	12.290	5.835	12.417	22.221	13.356	2.547	2.398	2.543	838.315	11.915
270	*Katha*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	6.262	20.053	53.612	44.935	762.217	10.833
307	Hand fishing	–	–	–	–	–	–	–	58.147	18.681	–	–	–	–	28.274	19.635	2.346	–	–	6.382	602.177	8.559
95	*Doiar trap*	4.080	43.073	–	–	–	–	–	–	–	–	17.967	8.791	2.515	1.215	0.445	8.824	–	41.890	20.489	568.475	8.080
105	*Dharma jal*	15.015	28.881	2.989	3.354	–	4.766	–	–	–	6.485	1.004	2.376	7.325	12.339	21.609	3.119	–	–	–	507.081	7.207
45	*Ber jal*	–	–	9.070	20.285	–	–	–	–	24.299	42.690	40.081	–	–	2.852	12.053	1.774	–	–	–	496.835	7.061
30	*Sip*	3.036	–	37.059	46.806	58.081	–	–	–	–	–	–	3.237	1.098	5.225	0.653	4.243	22.967	–	–	304.521	4.328
175	*Kathi jal*	–	–	–	–	–	–	–	–	–	–	–	36.933	5.280	3.498	0.758	–	–	–	–	295.339	4.198
272	*Daun*	10.225	7.023	0.895	15.184	10.726	–	–	–	–	–	1.266	1.077	15.247	1.571	2.242	0.618	2.684	–	–	150.047	2.133
152	*Tana barsi*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	12.200	–	–	–	136.372	1.938
88	*Current jal (Stationary)*	–	–	–	–	–	–	100.000	–	–	–	–	–	–	–	–	–	4.242	0.926	3.365	58.488	0.831
271	*Suti jal*	–	–	–	1.532	–	–	–	–	–	6.070	–	2.635	–	–	–	–	–	–	–	35.159	0.500
123	*Koi jal*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1.567	–	0.729	–	21.006	0.299
89	*Dhor jal*	9.430	–	0.549	1.282	–	19.910	–	–	–	–	–	–	–	–	1.432	–	–	–	–	19.866	0.282
314	*Boat katha*	–	–	–	–	–	0.887	–	–	4.441	–	–	–	–	–	–	–	0.700	0.444	0.213	13.068	0.186
278	*Nol barsi*	–	–	–	–	–	–	–	–	–	–	0.774	–	–	–	–	–	–	–	–	2.569	0.037
170	*Juti*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.144	0.896	0.013
149	*Horgra*	–	–	–	0.081	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
		100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	7035.939	100

Note : – denotes zero catch

Table 5.7 Percentage monthly catch by gear type: Old Hurasagar River (site NW19), inside BRE

Gear		Year: 1992			Year: 1993												Year: 1994		Total annual catch (Mar'93 – Feb'94)	
Code	Gear name	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Kg	%
286	*Deal trap*	9.509	0.342	–	–	–	–	–	–	0.217	30.786	35.711	55.140	36.690	12.361	28.386	–	–	2707.865	27.127
255	*Thella jal*	55.363	13.370	46.119	7.105	10.323	0.455	7.671	90.056	20.978	23.282	28.328	1.663	11.910	42.746	36.162	11.518	21.649	1809.823	18.130
105	*Dharma jal*	4.311	16.131	1.793	–	–	–	–	–	–	–	7.349	28.339	25.053	4.249	–	–	2.682	1412.356	14.149
95	*Doiar trap*	–	–	–	–	–	–	–	2.404	69.087	–	–	0.104	1.724	18.622	10.858	–	–	817.471	8.189
270	*Katha*	–	–	–	–	0.562	66.533	73.932	–	–	–	–	–	–	–	–	40.725	13.708	769.700	7.711
30	*Sip*	5.526	25.408	10.634	–	–	–	–	3.103	6.794	1.454	14.222	7.547	8.072	10.027	12.208	1.000	14.708	764.861	7.662
164	*Jhaki jal*	10.235	2.499	21.107	45.810	16.537	2.803	16.738	–	–	6.999	7.184	0.123	1.822	5.461	9.078	13.749	31.512	460.834	4.617
88	*Current jal (Stationary)*	1.979	13.013	11.165	2.075	17.487	–	0.128	0.482	2.556	37.479	7.205	4.788	4.210	1.623	2.866	–	–	377.004	3.777
45	*Ber jal*	3.338	–	–	–	–	–	–	3.955	–	–	–	–	–	–	–	30.918	–	227.354	2.278
291	*Urani*	0.860	0.314	–	–	–	–	–	–	–	–	–	2.161	5.386	0.672	0.442	–	–	217.203	2.176
266	*Veshal*	6.639	–	–	–	–	–	–	–	–	–	–	–	4.204	0.398	–	–	–	134.220	1.345
307	Hand fishing	–	20.639	8.354	15.845	21.804	15.231	1.530	–	–	–	–	–	–	–	–	0.313	4.928	82.128	0.823
306	*Baoli jal*	–	–	–	–	–	–	–	–	–	–	–	–	–	3.672	–	–	–	62.212	0.623
298	*Akra*	–	–	–	–	–	7.181	–	–	–	–	–	–	–	–	–	–	5.993	45.503	0.456
97	By hand/Dewatering	–	–	–	–	–	4.661	–	–	–	–	–	–	–	–	–	1.777	–	32.371	0.324
272	*Daun*	–	–	–	–	–	–	–	–	–	–	–	0.136	0.898	0.022	–	–	–	30.186	0.302
202	*Moi jal*	2.241	7.786	–	–	32.763	3.118	–	–	0.368	–	–	–	–	–	–	–	–	15.233	0.153
263	*Ucha*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	4.819	12.374	0.124
152	*Tana barsi*	–	–	–	–	–	–	–	–	–	–	–	–	0.032	0.147	–	–	–	3.452	0.035
301	*Chunga*	–	–	–	–	–	0.020	–	–	–	–	–	–	–	–	–	–	–	0.083	0.001
276	*Hat panch*	–	–	–	29.165	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
149	*Horgra*	–	0.498	–	–	0.524	–	–	–	–	–	–	–	–	–	–	–	–	–	–
314	*Boat katha*	–	–	0.829	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
		100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	9982.233	100

Note: – denotes zero catch

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of the annual catch. In contrast, this type of trap was not used at all on the unregulated river or in any of the other six rivers sampled by FAP 17 in other parts of the North Central Region. Reasons for the absence of this gear are not known, but they may be related to cultural/traditional differences rather than biological differences between regions. Whilst the *deal* trap targeted juvenile major carp which comprised 59% of its annual catch, the smaller *doiar* trap (and its variations), which was equally important in the two rivers, targeted mainly prawns (24-46%) and other small species of fish.

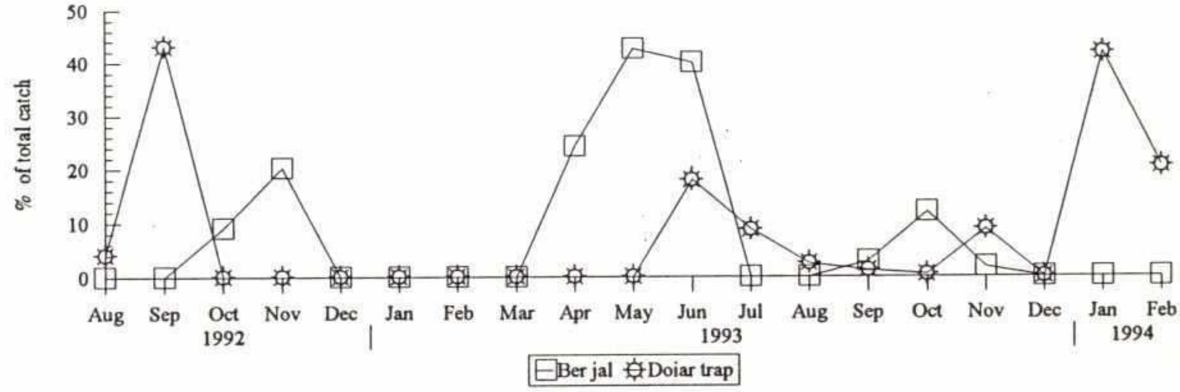
A third difference in gear usage was seen in the increased importance of lift nets, particularly *dharma jal*, in the Old Hurasagar where they captured 14% of the catch compared with 7% in the Northern Dhaleswari. Several *dharma jal* were established immediately downstream of Bauitara regulator in an enlarged pool area on the river. A further difference between rivers which was directly related to the presence of the regulator, was the use of *urani jal* set on the gates and their supporting side walls where they captured upstream migrating fish which jumped out of the water in their attempts to cross the gates. One final major difference was the larger share of catch taken by hand fishing in the unregulated rivers. This is rather surprising since this method might be expected to be of greater importance in the seasonally disconnected pools of the Old Hurasagar.

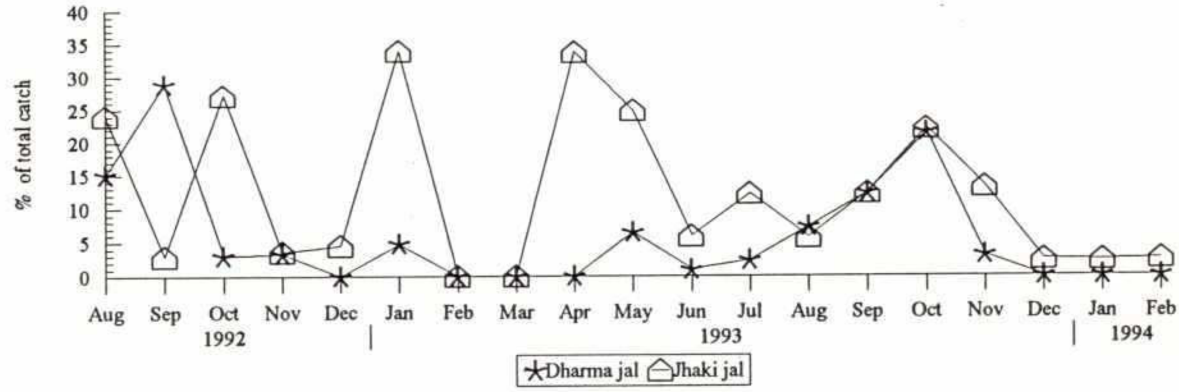
Similarities between rivers included the equal dominance of *thella jal* which provided 17% and 18% of the annual catches; the equal share of catches by *doiar* traps mentioned earlier, and the use of *katha* which provided 11% and 8% of annual catches respectively.

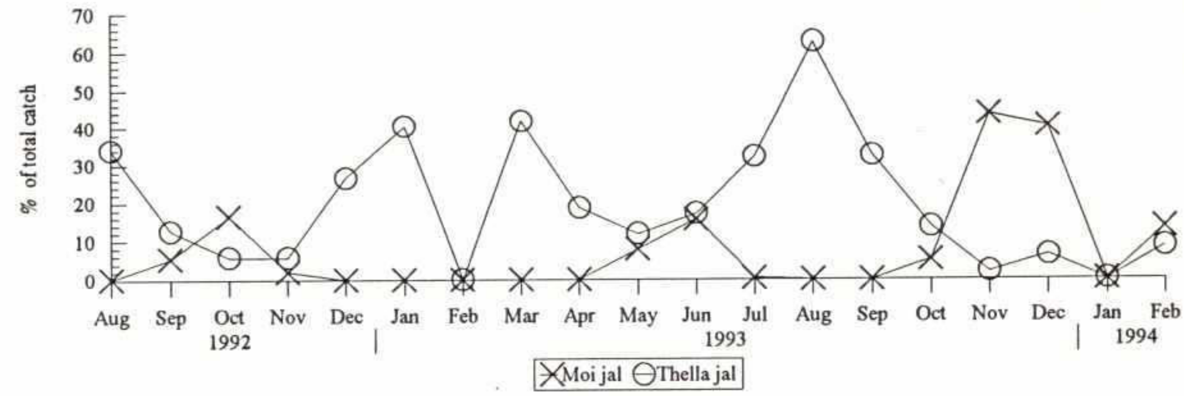
5.2.2 Catch by gear by month

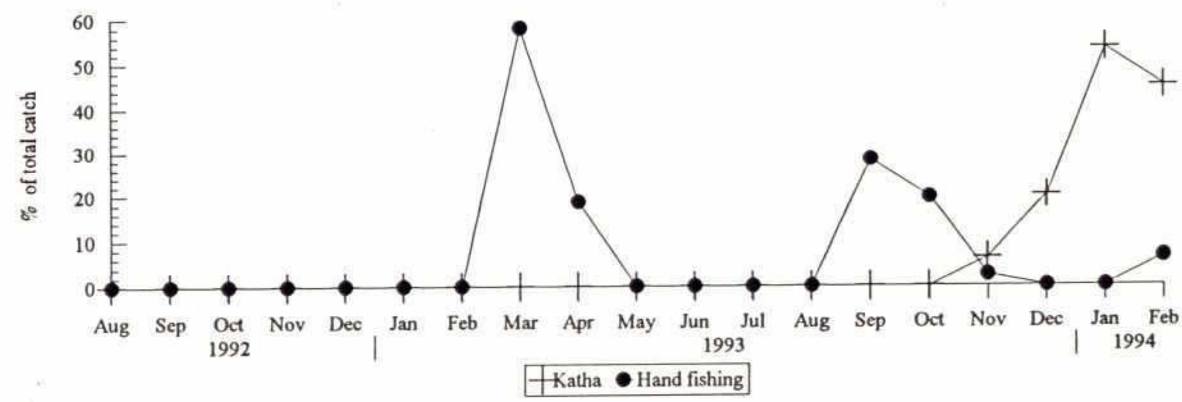
On the Northern Dhaleswari, only two gears, hand fishing and *thella jal*, were recorded in March 1993, but as flows increased somewhat a month later these gears were joined by *jhaki jal* and *ber jal* which captured 34% and 24% of the low monthly catch (Fig. 5.2). As flows continued to increase in May and June, the numbers of different types of gears also increased to 6 then 8. In May, *ber jal*, *jhaki jal* and *thella jal* dominated catches but in June, as floodwaters from the Jamuna entered the river, *doiar* traps appeared and captured 18% of the monthly catch. However, *ber jal* still took the largest share (40%) and *moi jal* gained in importance taking 16% of the catch. During the full flood period from July to early September, *thella jal* consistently provided a large share (32-63%) while *kathi jal* took 40% in July and *daun* took 15% in August.

Figure 5.2 Percentage of total monthly catch taken by dominant gears: site NC06 (outside BRE)









During the drawdown from September to November, the numbers of different types of gears used each month increased progressively from 9 to 12. During the early drawdown in September, *thella jal* and hand fishing provided the greatest share of the catch but *jhaki jal* and *dharma jal* increased in importance. As water levels decreased rapidly in October, *dharma jal*, *jhaki jal* and hand fishing took about an equal share of the catch (19-22%) while *thella jal* captured 14% and *ber jal* increased in importance to take 12% of the catch. During later stages of the drawdown in November, *moi jal* predominated (44%), but for the remaining gears there was a more equitable share of the catch than seen earlier. Peak catches recorded during the drawdown were a function of both peak or high fishing effort and catch rates by dominant gears (Figs 5.3 and 5.4). In December, three gears predominated: *moi jal* (40%), *sip* (23%) and *katha* (20%). In the subsequent winter months of January and February 1994, *katha* provided 54% and 45% of monthly catches and *doiar* traps regained importance and provided 42% and 20% of catches.

On the regulated Old Hurasagar River, *katha* harvesting accounted for 66%-74% of monthly catch in March and April 1993 (Fig. 5.5). There were about 30 *katha* units on this river compared with 27 on the Northern Dhaleswari. On the latter river, no units were observed fishing during this period. In May, 90% of the Old Hurasagar catch was taken by *thella jal*. This compares with only 12% of the May catch taken by this gear in the Northern Dhaleswari where *ber jal* and *jhaki jal* predominated reflecting the larger river flows. In June, when the first floodwaters passed through Bauitara regulator into the Old Hurasagar, *doiar* traps were set and took 69% of the catch while a further 21% was again taken by *thella jal*. In July, *doiar* traps disappeared and were replaced by *deal* traps which accounted for about a third of the catch. *Current jal* gained in importance in this month when they captured 37% of the catch and *thella* continued to supply an important share of the catch (23%). Catch contributions from *deal* traps increased progressively during the flood season, rising to 36% in August and 55% in September. In contrast, *thella jal* catches increased to 21% in August but dropped to 2% in September when *dharma jal* became more important as the flood drawdown commenced. At the height of the drawdown in October, peak catches were taken principally by *deal* traps (37%), *dharma jal* (25%) and *thella jal* (12%). The peak catch was a function peak fishing effort by *deal* traps and *thella jal* (Fig. 5.6) and peak catch rates of all three gear types (Fig. 5.7).

In November and December, *thella jal* again predominated with *thella jal* while *dharma jal* lost their effectiveness in the slower flows and shallower depths and were replaced by a *doiar* trap fishery. In the winter months of January and February 1994, *katha* harvesting commenced and provided 41% and 14% of monthly catch. *Thella jal* and *jhaki jal* were also dominant gears at this time of year.

Figure 5.3 Total monthly fishing effort per kilometre of river by dominant gears: site NC06 (outside BRE)

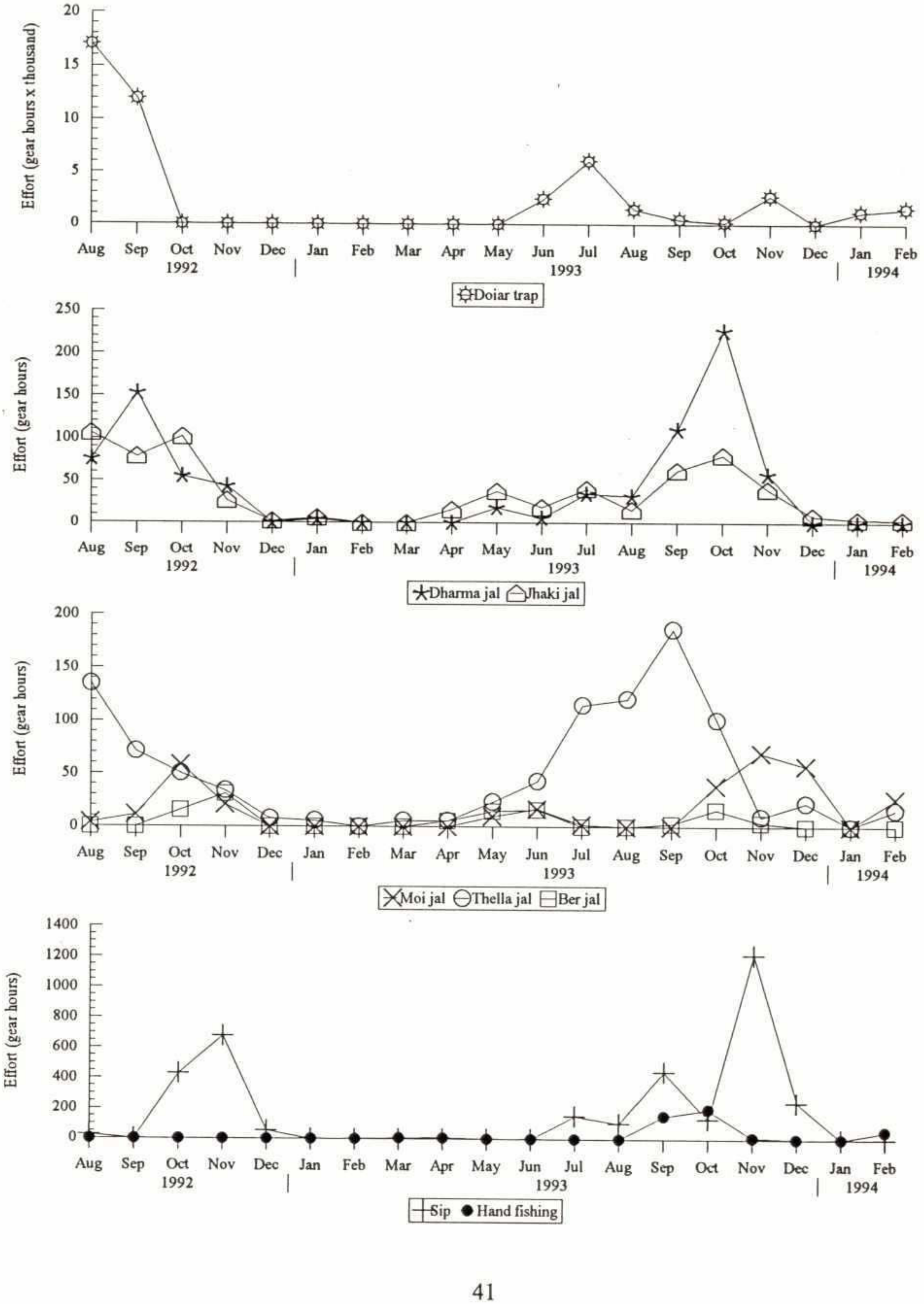
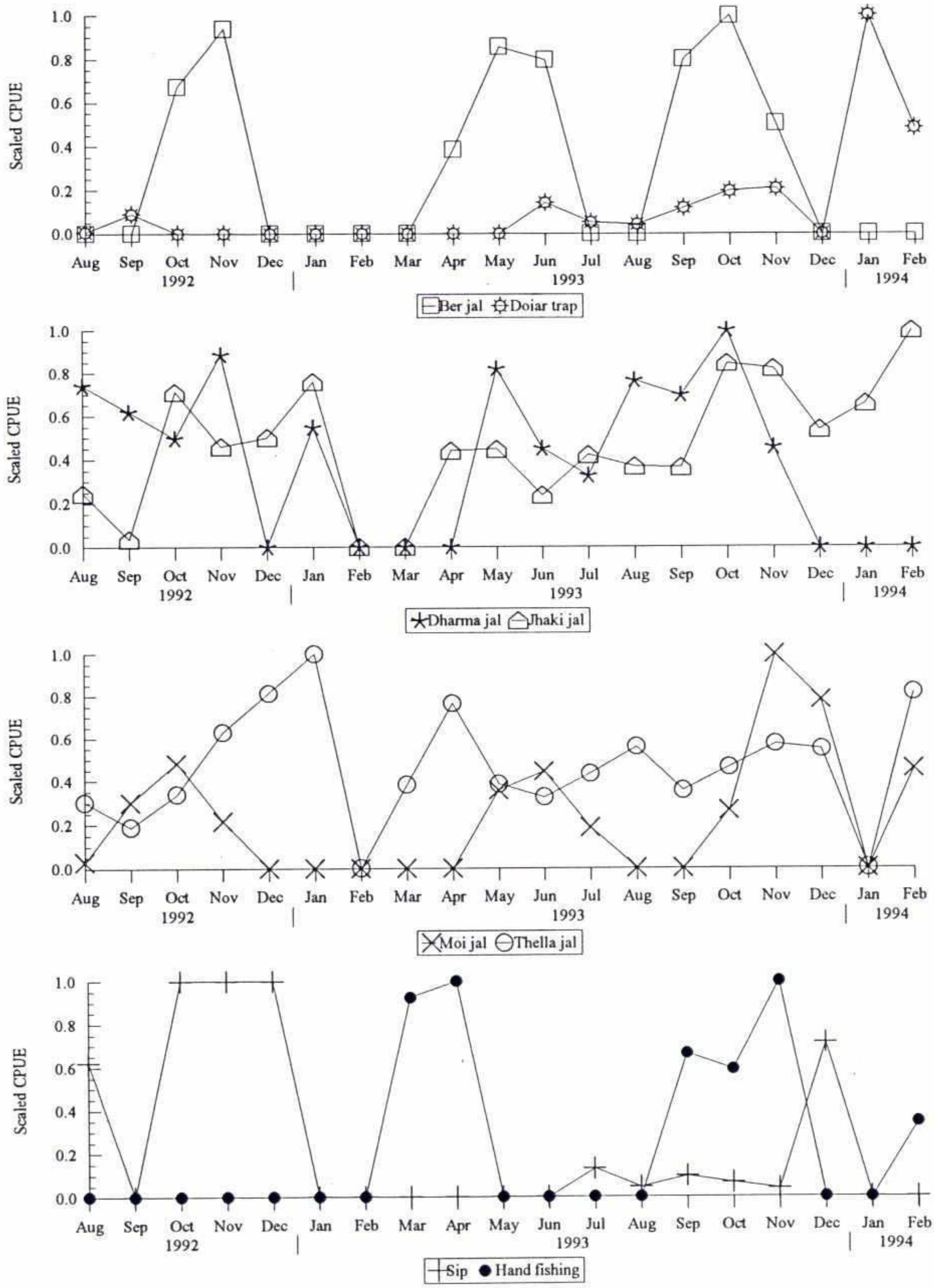


Figure 5.4 Scaled CPUE of dominant gears: site NC06 (outside BRE)



Note: Scaled CPUE are values of CPUE expressed as a proportion (decimal) of the maximum monthly value recorded

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Figure 5.5 Percentage of total monthly catch taken by dominant gears: site NW19 (inside BRE)

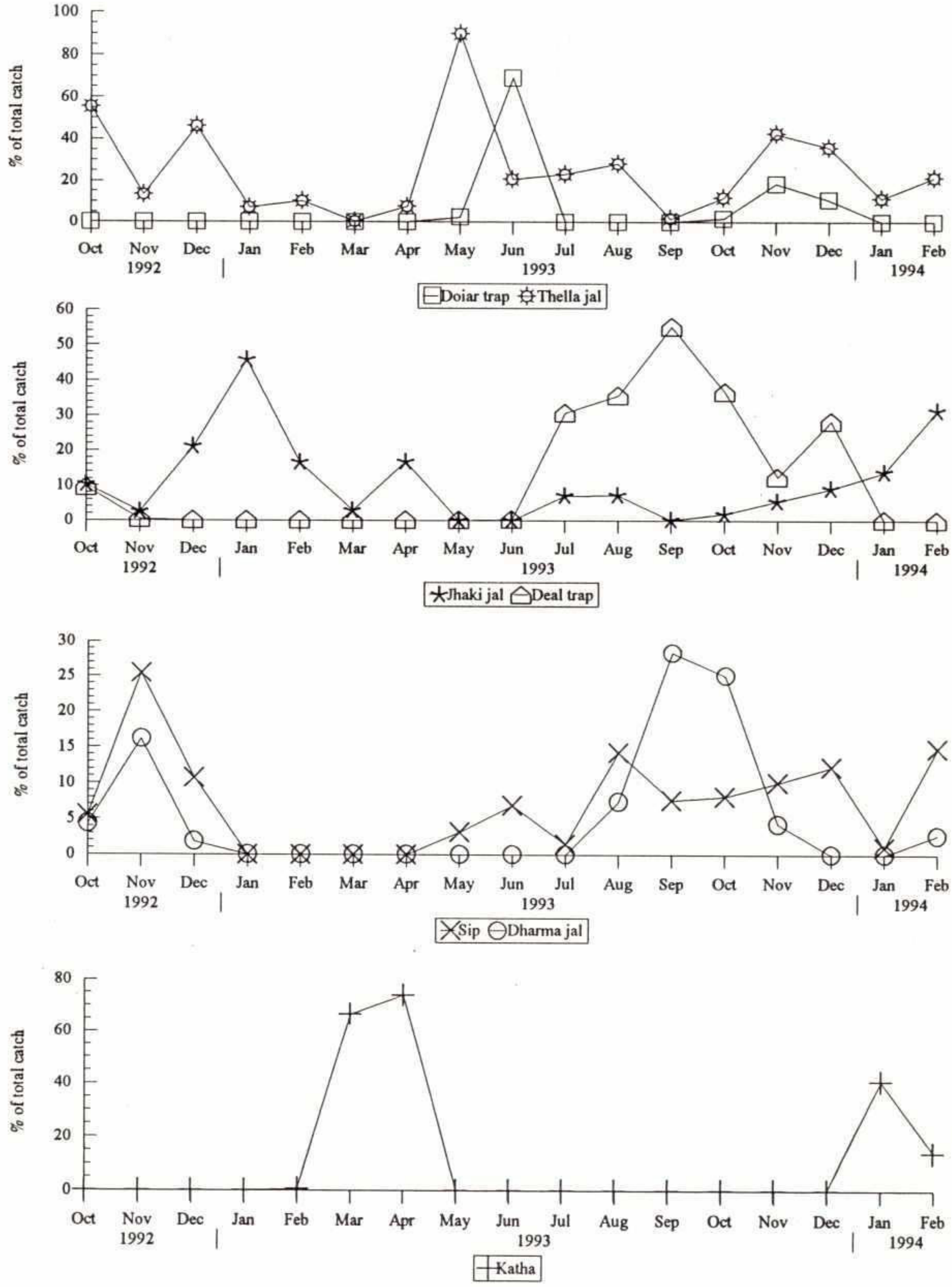

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Figure 5.6 Total monthly fishing effort per kilometre of river by dominant gears: site NW19 (inside BRE)

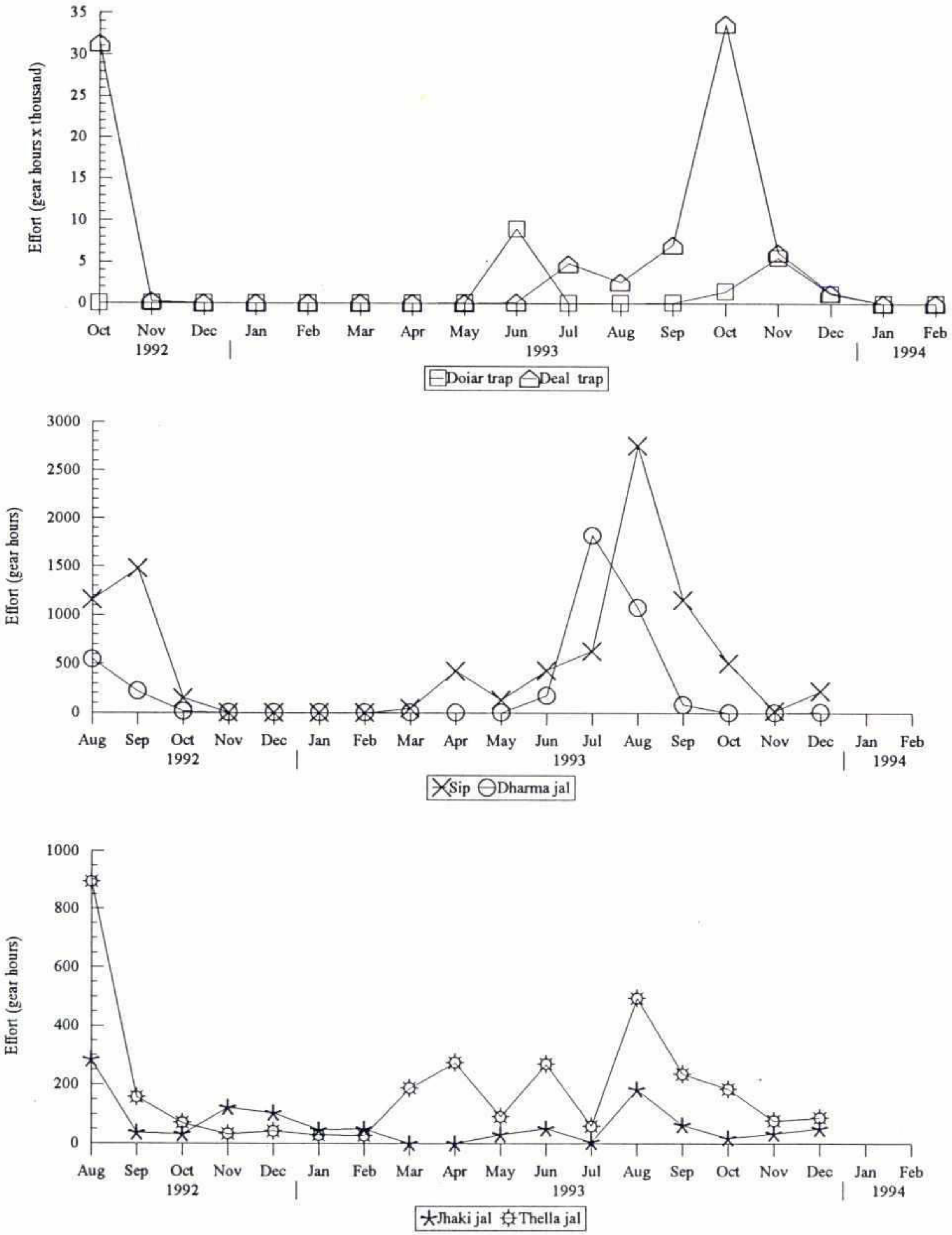
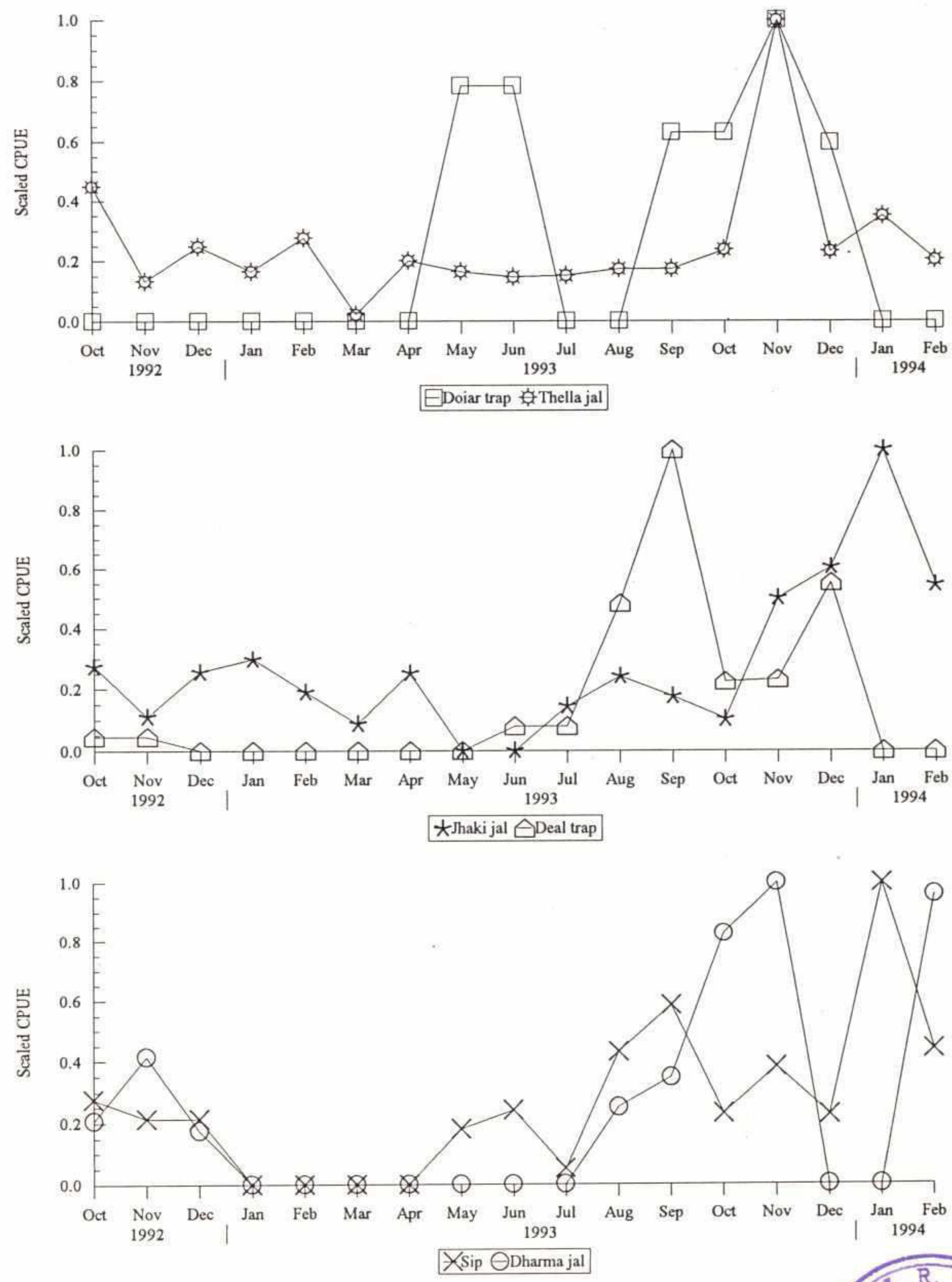


Figure 5.7 Scaled CPUE of dominant gears: site NW19 (inside BRE)



Note: Scaled CPUE are values of CPUE expressed as a proportion (decimal) of the maximum monthly value recorded.

5.3 Statistical Comparison of Catch Rates from Rivers Inside and Outside the BRE

Statistical analyses of seasonally pooled catch rates of dominant gears used inside and outside the BRE were carried out. The underlying assumption of the method was that differences in catch rates of a particular gear inside and outside the BRE reflected differences in fish densities and abundance.

There were five dominant gears, excluding *katha*, common to the two rivers; *thella jal*, *dharma jal*, *jhaki jal*, *doiar* traps and *sip*. One very important gear, the *deal* trap, could not be included in the analyses since although it provided the greatest proportion of the catch from the Old Hurasagar, it was not used on the Northern Dhaleswari. It was also not possible to combine the catch rates of this gear with those of smaller *doiar* traps, since mesh size and target species differed between gears. Mean catch rates of each of the five common gears from the two rivers were compared, where data were available, for each of five seasons and for all seasons combined between March 1993 and February 1994 (Table 5.8 and Fig. 5.8). The non-parametric Mann-Whitney U-test was used since catch rate data were not normally distributed. However, the parametric student t-test on logarithmic transformed catch rates produced essentially the same results as those presented in Table 5.8 for four gears.

Of the 20 gear/season combinations examined statistically, significant ($p < 0.05$) differences were found in only one case. This was for the annual catch rate of *doiar* traps which was significantly higher in the Old Hurasagar. There was also no consistency between catch rate differences of different gears: *thella jal* and *jhaki jal* provided the highest sample sizes and catch rates were generally higher in the Northern Dhaleswari River whereas catch rates of *doiar* traps and *sip* were higher in the Old Hurasagar and those of *dharma jal* showed no clear trend. It must therefore be concluded that on the basis of these results, no clear statistically significant difference in fish densities between rivers could be detected.

The substantially higher catch recorded in the Old Hurasagar was therefore due largely to a greater amount of fishing effort by dominant gears (Table 5.9). Most of the increased effort resulted from the activities of the three most dominant gears, *deal* traps, *thella jal* and *dharma jal*, which accounted for 59% of the annual catch from the Old Hurasagar.

Figure 5.8 Comparison of mean monthly catch rates (kg/hr) of dominant gears from rivers inside and outside the BRE

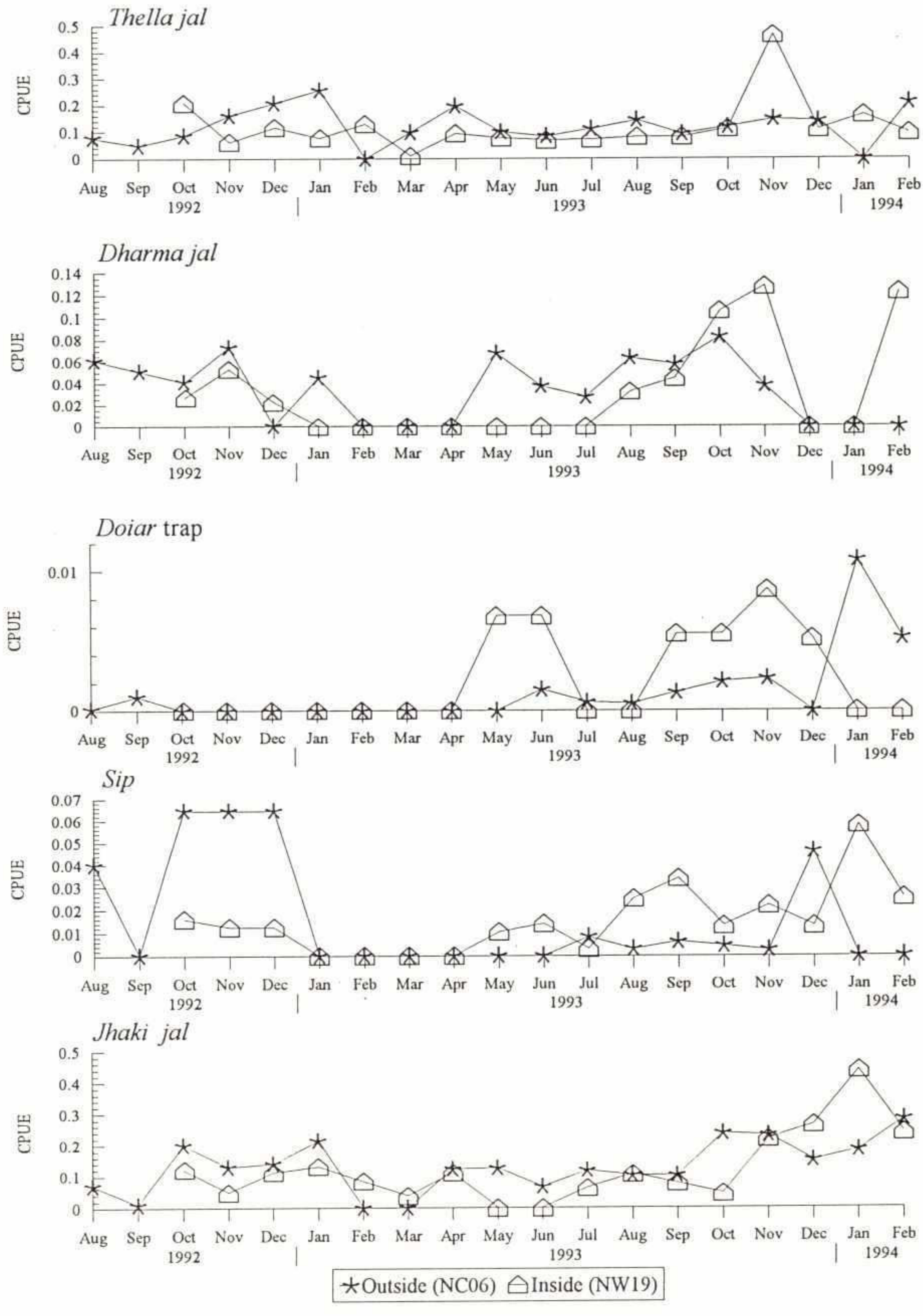


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Table 5.8 Statistical comparison of catch rates (kg/hr) of dominant gears used inside and outside the BRE, March 1993 - February 1994

Gear	Season	Site: NW19 inside BRE		Site: NC06 outside BRE		Mann-Whitney U-test on CPUE		
		Sample size	Mean	Sample size	Mean	Z- value	P-value	Comment
Thella jal	1	4	0.052	6	0.151	-1.71	0.088	NS
	2	11	0.079	9	0.097	-0.87	0.382	NS
	3	9	0.073	13	0.115	-1.37	0.171	NS
	4	10	0.268	8	0.132	-0.44	0.657	NS
	5	14	0.114	6	0.162	-1.15	0.248	NS
	All seasons	48	0.134	42	0.126	-1.44	0.150	NS
Dharma jal	3	9	0.063	12	0.082	0.00	1.000	NS
	4	7	0.133	11	0.067	-0.50	0.618	NS
	All seasons	17	0.095	29	0.070	-0.47	0.641	NS
Doiar trap	4	2	0.007	4	0.003	-1.85	0.064	NS
	All seasons	4	0.006	13	0.003	-2.04	0.041	SIG
Sip	3	10	0.039	6	0.010	-0.93	0.353	NS
	4	12	0.026	3	0.005	-1.44	0.149	NS
	5	6	0.049	5	0.047	-0.36	0.715	NS
	All seasons	33	0.032	14	0.022	-0.99	0.322	NS
Jhaki jal	1	7	0.093	4	0.124	-0.94	0.345	NS
	3	5	0.076	10	0.101	-0.86	0.391	NS
	4	9	0.119	9	0.244	-1.81	0.070	NS
	5	5	0.285	4	0.192	-1.47	0.142	NS
	All seasons	26	0.136	37	0.144	-0.56	0.576	NS

Notes: 1. NS - Not significant, SIG - Significant at 5% level
2. Seasons: 1. March - April, 2. May-June, 3 - July-September, 4. October-November and 5. December-February

Table 5.9 Annual fishing effort[1] by dominant gears used on rivers inside and outside the BRE, March 1993 - February 1994

Gear	Northern Dhaleswari (site NW21)	Old Hurasagar (site NC06)	% change compared with NC06
Thella jal	647	2,010	+ 211
Dharma jal	817	3,168	+ 288
Doiar trap	16,053	17,165	+7
Sip	36,770	6,333	- 83
Jhaki jal	327	48	- 85
Deal trap	0	55,670	-

Notes: 1. Annual fishing effort measured as total gear hours per kilometre of river
2. + and - denote increase and decrease in catch respectively

5.4 Biodiversity and Catch Composition

5.4.1 Species richness

Between March 1993 and February 1994, 78 species of fish were recorded from the Northern Dhaleswari River (Table 5.10). This compares with 60 species found in the Old Hurasagar during the same period, a reduction in species diversity of 23%. In Table 5.10, species have been divided into three categories of habitat preference based on spatial distributions derived from the FAP 17 fisheries database covering four FAP regions. The categories are defined below.

a) Riverine
Species which are usually confined to rivers and estuaries (or sea in the case of *ilish*) throughout their life cycle with no direct dependence on floodplains, although some species can be found on more extensive floodplains, particularly in the North East Region.

b) Migratory
Species which move between river and floodplain during different stages of their life cycle and therefore have some dependence on floodplains for growth and/or reproduction.

c) Floodplain resident

Species which are capable of surviving in perennial waters of the floodplain throughout the year and are largely dependent upon them for growth and reproduction. Many of these species occupy a variety of habitats, including large rivers.

Table 5.10 Total annual number of fish species, classified by habitat preference, recorded from rivers inside and outside the BRE, March 1993 - February 1994

Site code	River name	In/Out BRE	Number of species			Total
			Riverine	Migratory	Floodplain resident	
NC06	Northern Dhaleswari	Out	23	20	35	78
NW19	Old Hurasagar	In	9	17	34	60
NC16	Dhaleswari	Out	27	19	33	79
NW15	Karatoya	In	34	20	34	88
NC01	Jamuna	Out	22	19	28	69
NW01	Jamuna	Out	21	18	27	66

It is clear from the results in Table 5.10 that differences between rivers were due principally to differences in riverine and migratory species of which there were 40% fewer in the regulated river. In the Northern Dhaleswari 23 riverine species were found compared with only 9 in the regulated river, a reduction of 61% and 20 migratory species compared with 17 in the Old Hurasagar, a reduction of 15%. In contrast, the numbers of floodplain resident species were similar, with only 3% fewer in the regulated river.

Compared with the numbers of species recorded from adjacent sites in the Jamuna River, the numbers of riverine and migratory species were similar in the Northern Dhaleswari but lower in the Old Hurasagar while numbers of floodplain resident species were higher in both the regulated and unregulated distributaries. In comparison with rivers into which the Northern Dhaleswari and Old Hurasagar flowed, numbers of floodplain resident and migratory species were similar but numbers of riverine species were substantially lower in the Old Hurasagar than in the Karatoya (34 species).

5.4.2 Catch Composition

Percentage contributions made by riverine, migratory and floodplain resident species to annual catches from rivers inside and outside the BRE are presented in Table 5.11. The results revealed marked differences in catch compositions. In the Northern Dhaleswari, riverine species comprised 15% of the catch compared with less than 1% in the Old Hurasagar. In contrast, migratory species were considerably more abundant in catches from the regulated river where they accounted for 49% of the catch compared with 15% on the unregulated river. Floodplain resident species comprised a greater share (57%) of the catch in the Northern Dhaleswari than that in the Old Hurasagar (43%).

Table 5.11 Percentage contributions of riverine, migratory and floodplain resident species to annual catches from rivers inside and outside BRE, March 1993 - February 1994

Site code	River name	In/Out BRE	% Total annual catch		
			Riverine	Migratory	Floodplain resident
NC06	Northern Dhaleswari	Out	15.2	15.4	57.1
NW19	Old Hurasagar	In	<1	49.2	42.7
NC16	Dhaleswari	Out	13.5	36.7	42.7
NW15	Karatoya	In	15.0	33.5	35.6
NC01	Jamuna	Out	53.2	15.9	21.0
NW01	Jamuna	Out	58.8	16.8	9.2

On the Jamuna River, migratory and riverine species accounted for 69-76% of annual catch. On the Dhaleswari River, these groups comprised 50% of the catch compared with 31% on its tributary, the Northern Dhaleswari. On the Karatoya, they formed 49% of the catch but riverine species were more abundant than on the Old Hurasagar and migratory species less so.

The percentage contribution of individual dominant species to annual catches from each river are presented in Table 5.12. Dominant species are defined here as those comprising 1% or more of the annual catch.

Table 5.12 Percentage contribution (by weight) to the total annual catch by dominant species from rivers inside and outside the BRE, March 1993 – February 1994

Habitat Preference	Species name: Scientific	Species name: Bengali	Inside BRE: Old Hurasagar NW19	Inside BRE: Karatoya NW15	Outside BRE: N. Dhalewari NC06	Outside BRE: Dhaleswari NC16	Outside BRE: Jamuna NC01	Outside BRE: Jamuna NW01
Riverine	*Aspidoparia morar*	*Piali*	–	–	1.6	2.0	5.2	10.4
	Barilius barna	*Bani koksa*	–		1.2	–	–	–
	Barilius evezardi		–		2.0	–	–	–
	Crossocheilus latius	*Kalabata*	–		–	–	1.2	–
	Hilsa ilisha	*Ilish*	–	4.6	–	–	28.3	8.0
	Corica soborna	*Kachki*	–	1.7	–	2.7	–	–
	Rhinomugil corsula	*Khorsula*	–	–	–		4.5	2.4
	Ailia coila	*Kajuli*	–	3.2	2.7	1.0	3.4	5.4
	Clupisoma garua	*Ghaura*	–	2.1	3.0	2.6	4.5	20.3
	Bagarius bagarius	*Baghair*	–		–	–	–	2.3
	Gagata cenia	*Kauwa*	–		1.4	–	–	–
	Gagata nangra	*Gang tengra*	–		–	–	1.2	–
	Gagata youssoufi	*Gang tengra*	–	1.0	–	–	3.0	4.0
Subtotal			–	12.6	11.9	8.3	51.4	52.7
Migratory	*Aorichthys aor*	*Ayre*	–	1.1	1.4	2.5	–	2.4
	Mystus bleekeri	*Golsha tengra*	1.2	4.3	–	–	–	–
	Mystus cavasius	*Kabashi*	1.1	9.3	1.3	2.0	–	–
	Cirrhinus mrigala	*Mrigel*	7.1	–	1.3	–	–	–
	Cirrhinus reba	*Raik*	4.1	1.2	–	1.8	–	–
	Labeo bata	*Bata*	4.1		–	–	3.8	2.4
	Labeo calbasu	*Kalbaus*	9.1	5.6	–		–	–
	Labeo rohita	*Rui*	10.8		–	–	–	–
	Salmostoma bacaila	*Katari*	–		–	–	2.3	5.5
	Salmostoma phulo	*Fulchela*	1.2	1.7	1.4	3.9	–	–
	Wallagu attu	*Boal*	5.4	6.0	5.3	22.3	5.6	2.7
	Notopterus chitala	*Chital*	3.9		–	–	–	–
Subtotal			47.9	29.2	10.7	32.5	11.7	13.0
Floodplain Resident	*Mystus vittatus*	*Tengra*	–	2.1	2.6	–	–	–
	Colisa fasciatus	*Khalisha*	2.8		1.1		–	–
	Xenentodon cancila	*Kaikka*	1.7	1.9	1.3	2.6	–	–
	Puntius conchonius	*Canchan puti*	3.2	2.8	7.1	17.0	4.2	3.5
	Puntius sophore	*Puti*	6.0	3.6	13.1	2.6	5.4	–
	Glossogobius giurus	*Bailla*	3.0	5.7	7.3	7.0	4.4	1.9
	Lepidocephalus guntea	*Gutum*	2.1	–	1.3	–	–	–
	Channa punctatus	*Taki*	4.6	1.2	6.6	1.6	–	–
	Heteropneustes fossilis	*Shingi*	1.4	–	–		–	–
	Macrognathus aculeatus	*Tara baim*	1.4	–	–		–	–
	Macrognathus pancalus	*Guchi*	7.2	2.4	6.3	1.7	1.6	–
	Mastacembelus armatus	*Baral baim*	1.9	8.6	6.0	7.4	–	–
	Notopterus notopterus	*Foli*	1.4	–	–		–	–
	Chanda nama	*Nama chanda*	1.1	–	–	–	–	–
	Chanda ranga	*Lal chanda*	1.1	1.6	–	–	–	–
Subtotal			38.9	29.9	52.6	39.9	15.6	5.4
Other	Prawn spp.	*Chingri/Icha*	7.8	15.8	12.2	7.0	10.0	14.6
Subtotal			7.8	15.8	12.2	7.0	10.0	14.6
Grand total			94.6	87.5	87.5	87.7	88.6	85.7

Notes:

1. Dominant species are those species contributing 1% or more by weight to the total annual catch
2. Shaded values highlight the most important species (>4%)
3. See text for definitions of habitat preference categories (Section 5.4.1)

On the Northern Dhaleswari, six dominant riverine species together accounted for 12% of the catch whereas no riverine species formed more than 1% of the catch from the Old Hurasagar. Three of these species *piali*, *kajuli* and *ghaura* were also among the dominant species of the linking Jamuna and Dhaleswari rivers.

Five dominant migratory species comprised 11% of the catch on the Northern Dhaleswari. *Boal* was the most abundant of these, providing 5% of the catch whilst the others, *ayre*, *kabashi*, *mrigel* and *fulchela* each comprised less than 2%. The composition of these dominant species was more similar to that of the Dhaleswari River than to that of the neighbouring site on the Jamuna. A total of 10 migratory species together accounted for 48% of the catch from the Old Hurasagar of which 3 major carps, *rui*, *kalbaus* and *mrigel*, comprised 27% of the catch while two other carps, *raik* and *bata*, provided a further 8%. Other important species included *boal* and *chital*. The possible causes of such marked differences in riverine and migratory species compositions between rivers are explored in more detail in Section 5.5 when migrations of individual species are examined.

A total of 10 floodplain resident species was recorded on the Northern Dhaleswari, 9 of which also occurred on the Old Hurasagar. Although dominant species compositions were similar, there were differences in relative abundances of individual species between rivers. On the regulated river, *guchi baim*, *puti* and *taki* predominated whereas on the unregulated river these three species plus *canchan puti*, *bailla* and *baral baim* accounted for the greatest catch shares. Prawns formed 8% and 7% of the catch from the regulated and unregulated river respectively.

5.5 Fish Migrations

Seasonal movements of fish were identified from changes in monthly catch compositions from the Northern Dhaleswari and Old Hurasagar and their connecting rivers (Tables 5.13 - 5.18) together with temporal and spatial changes in the distributions of important individual species and changes in monthly species numbers and catch contributions of riverine, migratory and floodplain resident fish. Where available, additional data on the average size of fish were used to determine whether the fish were adults or juveniles.

Table 5.13 Monthly catch composition (% by weight) from the Northern Dhaleswari River: outside BRE (site NC06)

Species Code	Habitat Preference	Species name: Scientific	Species name: Bengali	Year: 1992 Aug	Sep	Oct	Nov	Dec	Year: 1993 Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec	Year: 1994 Jan	Feb	Total annual catch (Mar'93 – Feb'94) Kg	%
186	Riverine	*Rita rita*	*Rita*	2.776		0.394									0.027	0.085	2.685						22.753	0.323
12		*Aspidoparia jaya*	*Piali*	1.688																				
13		*Aspidoparia morar*	*Piali*	1.415	3.131	0.364	0.356					0.218	4.449	2.455	5.319	5.911	0.141	0.963	0.374	1.701			113.463	1.613
18		*Barilius barna*	*Bani Koksa*												13.458								84.791	1.205
218		*Barilius evezardi*					0.074								16.489	4.881	1.473						137.542	1.955
22		*Barilius tileo*	*Tila koksa*	2.524																				
20		*Raiamas bola*	*Bhol*	0.104																				
59		*Crossocheilus latius*	*Kalabata*			0.210											0.553	0.042	0.086				6.118	0.087
139		*Nemacheilus botia*	*Balichata*		0.147	0.511	0.092		0.065			2.561	0.085	1.251	0.052	0.151		0.362	0.568	0.784	0.065	0.680	29.826	0.424
198		*Somileptes gongota*	*Gharpoia*			0.053							0.084						1.401				15.911	0.226
28		*Botia dario*	*Rani*	0.762		0.184	0.063								0.052			0.197				0.051	3.372	0.048
89		*Hilsa ilisha*	*Ilish*										0.009										0.027	0.0004
85		*Gonialosa manmina*	*Goni chapila*										0.237										0.723	0.010
193		*Setipinna phasa*	*Phasa*														0.075	0.568					8.490	0.121
14		*Awaous stamineus*	*Bele*										2.215	0.109									7.130	0.101
128		*Liza parsia*	*Bata*		0.082																			
185		*Rhinomugil corsula*	*Khorsula*	1.132			0.141		4.766						0.035		0.129	0.025					1.628	0.023
923		*Sicamugil cascasia*	*Bata*														0.872						7.214	0.103
2		*Ailia coila*	*Kajuli*	18.484	0.410	1.923	3.099						0.170	18.704	5.051	3.858	1.255	4.936	0.084				191.155	2.717
51		*Clupisoma garua*	*Ghaura*	17.004	20.727	6.764	4.876							4.557	6.496	15.895	1.715	4.187	0.661	0.637			210.621	2.993
196		*Silonia silondia*	*Shillong*	0.069			0.267											0.860					11.935	0.170
16		*Bagarius bagarius*	*Baghair*	0.831	0.492	1.474								0.050	1.179	0.829							11.242	0.160
77		*Gagata cenia*	*Kauwa*		0.055	0.447								2.697	2.720	16.142	0.291	0.131					101.319	1.440
80		*Gagata viridescens*	*Gang tengra*										0.051			8.517							37.625	0.535
81		*Gagata youssoufi*	*Gang tengra*	1.497	0.139	0.586	0.062						0.019	2.878	2.376	5.741	0.553	0.744	0.335				68.471	0.973
197		*Sisor rhabdophorus*	*Sisor*												0.005								0.034	0.0005
155		*Pama pama*	*Poa*										0.004										0.013	0.0002
158		*Pangasius pangasius*	*Pangas*	0.065																				
	Subtotal			48.350	25.182	12.909	9.030		4.831			2.779	7.321	32.700	53.258	62.009	9.741	13.014	3.509	3.122	0.065	0.731	1071.403	15.227
130	Migratory	*Aorichthys aor*	*Ayre*	5.619									0.004	0.047	1.479	4.472	0.313	0.504	1.878	0.478		5.693	98.824	1.405
135		*Aorichthys seenghala*	*Guizza*													1.764		0.495					14.624	0.208
24		*Batasio batasio*	*Tengra*	0.026																				
25		*Batasio tengana*	*Tengra*														0.716						5.920	0.084
131		*Mystus bleekeri*	*Golsha tengra*			0.624	0.019						0.027	1.704	0.089	0.604		0.189	2.054	1.651	0.621	3.075	69.510	0.988
132		*Mystus cavasius*	*Kabashi*		5.638	0.769	0.238										1.279	0.513	5.143	0.122	0.317	2.672	94.257	1.340
47		*Cirrhinus mrigala*	*Mrigel*													5.620	8.054						91.360	1.298
48		*Cirrhinus reba*	*Raik*	0.211											0.042	0.194	0.333	1.654	0.655	1.034	0.047	2.241	56.371	0.801
100		*Labeo bata*	*Bata*		0.220	2.134	0.064												0.258				2.879	0.041
101		*Labeo boga*	*Bhangan*			0.659	0.037											1.075	0.135				16.425	0.233
102		*Labeo calbasu*	*Kalbaus*														1.450	1.246		1.541	0.729		44.823	0.637
107		*Labeo rohita*	*Rui*	0.425											0.274		1.020				0.355		11.870	0.169
44		*Chela laubuca*	*Kash Khaira*																0.013				0.144	0.002
188		*Salmostoma bacaila*	*Katari*	0.207	0.738	0.655	0.074									0.399		0.799	0.161				14.635	0.208
189		*Salmostoma phulo*	*Fulchela*	0.049		1.278	0.616		9.634			2.190	2.308	3.793	4.874	0.491	0.322	1.409	0.518		0.170	2.205	97.066	1.380
154		*Securicula gora*	*Chora chela*	10.190													0.852	0.541	0.021				14.790	0.210
86		*Gudusia chapra*	*Chapila*	0.323	0.028	0.109	0.039							0.597	0.534	0.132		0.202	0.011			1.379	17.418	0.248
76		*Europiichthys vacha*	*Bacha*	0.081			0.138						0.690	1.492				1.437					26.991	0.384

(Cont.)

Table 5.13 Monthly catch composition (% by weight) from the Northern Dhaleswari River: outside BRE (site NC06)

Species Code	Habitat Preference	Species name: Scientific	Species name: Bengali	Year: 1992 Aug	Year: 1992 Sep	Year: 1992 Oct	Year: 1992 Nov	Year: 1992 Dec	Year: 1993 Jan	Year: 1993 Feb	Year: 1993 Mar	Year: 1993 April	Year: 1993 May	Year: 1993 June	Year: 1993 July	Year: 1993 Aug	Year: 1993 Sep	Year: 1993 Oct	Year: 1993 Nov	Year: 1993 Dec	Year: 1994 Jan	Year: 1994 Feb	Total annual catch (Mar'93 – Feb'94) Kg	Total annual catch (Mar'93 – Feb'94) %
169		*Pseudeutropius atherinoide*	*Batasi*	-	-	1.034	0.071	-	-	-	-	-	-	-	-	-	-	0.254	1.033	-	-	-	15.068	0.214
209		*Wallagu attu*	*Boal*	0.194	-	35.742	56.007	59.795	-	-	-	-	-	-	3.237	-	-	1.405	4.126	31.013	2.536	5.247	373.210	5.304
144		*Notopterus chitala*	*Chital*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.474	-	-	-	16.477	0.234
	Subtotal			17.325	6.624	43.003	57.302	59.795	9.634	-	-	2.190	3.029	7.634	10.529	13.676	14.338	11.723	17.481	35.839	4.775	22.512	1082.662	15.387
6	Floodplain	*Anabas testudineus*	*Koi*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.189	-	-	6.261	-	32.567	0.463
136	Resident	*Mystus tengara*	*Bajari tengra*	0.341	-	0.020	-	-	1.266	-	-	-	-	-	-	-	0.229	-	2.856	-	-	-	33.810	0.481
137		*Mystus vittatus*	*Tengra*	-	-	1.845	2.904	3.776	1.911	-	-	7.681	0.504	0.181	-	-	0.991	2.191	5.890	2.245	5.048	3.957	180.030	2.559
55		*Colisa fasciatus*	*Khalisha*	-	-	-	-	-	-	-	-	0.093	0.035	-	-	-	1.735	0.090	0.274	0.310	7.221	3.218	75.795	1.077
56		*Colisa lalia*	*Lal Khalisha*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.047	-	-	-	-	0.656	0.009
57		*Colisa sota*	*Khalisha*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.248	-	-	1.940	0.028
210		*Xenentodon cancila*	*Kaikka*	0.722	-	0.027	0.030	-	10.167	-	-	0.125	1.971	-	-	-	-	0.308	1.443	1.292	5.048	4.454	88.444	1.257
187		*Osteobrama cotio cotio*	*Keti*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.004	-	-	-	0.048	0.001
174		*Puntius chola*	*Chala puti*	-	-	0.053	-	-	-	-	-	-	-	-	-	-	-	-	-	0.144	-	2.414	16.110	0.229
175		*Puntius conchonius*	*Canchan puti*	-	0.176	2.679	8.121	2.220	12.582	-	25.812	45.556	58.200	5.299	0.301	0.407	0.982	3.795	3.413	12.635	3.672	5.927	499.458	7.099
176		*Puntius gelius*	*Giliputi*	-	-	0.013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
177		*Puntius guganio*	*Mola puti*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.004	-	-	-	0.048	0.001
178		*Puntius phutunio*	*Phutani puti*	-	-	-	0.017	-	9.445	-	-	0.513	0.761	-	-	-	-	-	-	-	-	0.385	5.198	0.074
179		*Puntius sarana*	*Sarputi*	-	-	-	-	-	-	-	-	-	0.500	-	-	-	-	-	-	-	-	-	1.530	0.022
180		*Puntius sophore*	*Puti*	0.071	0.088	17.066	6.937	11.019	2.060	85.369	2.468	2.467	2.931	0.298	0.302	3.173	2.761	37.180	15.080	6.451	14.004	11.285	923.346	13.123
181		*Puntius terio*	*Teri punti*	-	-	0.979	0.602	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.071	0.439	0.006
212		*Puntius ticto*	*Tit puti*	9.463	16.510	-	-	-	5.205	-	-	-	-	-	0.021	-	2.032	0.462	1.060	0.223	0.020	0.319	39.020	0.555
5		*Amblypharygodon mola*	*Mola*	-	-	-	-	-	-	-	-	-	-	-	-	-	0.094	0.036	0.286	-	0.363	-	6.216	0.088
68		*Danio devario*	*Chebli*	-	-	-	-	-	-	-	-	-	-	-	-	-	0.099	-	-	-	-	-	0.823	0.012
75		*Esomus danricus*	*Darkina*	0.280	-	0.018	0.004	-	0.424	-	-	-	0.417	-	-	-	0.182	0.460	-	-	-	-	9.165	0.130
83		*Glossogobius giurus*	*Bailla*	5.975	1.597	2.543	3.555	1.559	13.688	14.631	22.252	25.247	5.414	9.545	5.312	7.748	19.748	6.018	2.505	3.430	5.730	6.032	510.737	7.259
43		*Chela cachius*	*Chep Chela*	0.380	-	-	-	-	-	-	-	-	0.052	-	-	-	-	-	-	-	-	-	0.160	0.002
110		*Lepidocephalus guntea*	*Gutum*	0.505	-	1.893	0.246	0.904	-	-	0.906	1.386	1.123	0.832	-	-	1.956	1.011	2.166	2.726	0.493	1.248	93.531	1.329
217		*Lepidocephalus thermalis*	*Puiya*	-	-	-	-	-	-	-	-	-	-	1.194	-	-	-	-	-	-	-	-	3.960	0.056
9		*Aplocheilus panchax*	*Kanpona*	0.069	-	-	-	-	0.424	-	-	-	0.313	-	-	-	-	-	-	-	-	-	0.956	0.014
41		*Channa punctatus*	*Taki*	0.115	0.198	6.772	0.698	3.310	-	-	29.851	0.810	2.083	0.720	0.037	-	8.795	10.958	3.653	8.900	14.049	7.135	462.880	6.579
88		*Heteropneustes fossilis*	*Shingi*	-	-	0.208	-	-	1.221	-	-	-	-	-	-	-	0.225	-	1.383	0.152	0.151	0.634	23.178	0.329
121		*Macrognathus aculeatus*	*Tara baim*	-	-	0.303	0.108	-	-	-	-	-	0.587	-	0.119	-	-	1.041	-	-	-	0.998	23.183	0.329
123		*Macrognathus pancalus*	*Guchi*	0.414	0.220	0.485	0.372	0.288	5.770	-	9.035	6.847	5.949	3.832	1.849	-	-	4.438	11.758	13.652	9.048	8.299	445.442	6.331
122		*Mastacembelus armatus*	*Baral baim*	0.338	0.678	5.818	7.352	7.667	0.173	-	-	-	-	10.030	0.843	3.937	7.680	0.844	17.651	4.666	4.028	6.184	422.602	6.006
15		*Badis badis*	*Napit koi*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.037	-	4.960	0.070
148		*Ompok pabda*	*Madhu pabda*	-	-	0.324	-	-	-	-	-	-	-	-	-	-	-	-	-	0.310	-	-	2.425	0.034
145		*Notopterus notopterus*	*Foli*	-	-	-	-	-	-	-	-	-	-	-	-	-	0.290	-	0.106	-	0.148	-	4.293	0.061
203		*Tetraodon cutcutia*	*Potka*	-	-	-	-	-	-	-	-	-	0.096	-	-	-	-	-	-	0.004	-	-	0.325	0.005
36		*Chanda nama*	*Nama Chanda*	0.113	-	0.061	0.078	-	-	-	-	0.400	2.802	0.245	0.015	2.658	0.803	0.363	0.746	0.595	0.256	-	47.436	0.674
37		*Chanda ranga*	*Lal chanda*	0.165	-	0.016	0.009	-	-	-	-	0.031	1.118	0.316	0.083	1.133	3.586	0.566	0.457	0.273	0.593	0.308	59.530	0.846
	Subtotal			18.952	19.468	41.121	31.032	30.743	64.335	100.000	90.324	91.155	84.854	32.492	8.882	19.056	52.186	69.998	70.737	58.257	77.170	62.868	4020.241	57.138
998	Others	Unidentified fish		0.036	0.328	0.053	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
120		*Macrobrachium rosenbergii*	*Golda*	-	-	-	-	-	-	-	-	-	-	-	0.011	-	-	-	-	-	-	-	0.068	0.001
931		Prawn spp.	*Chingri/Icha*	15.336	48.397	2.913	2.636	9.463	21.200	-	9.676	3.876	4.795	27.174	27.319	5.259	23.734	5.265	8.272	2.782	17.989	13.888	861.659	12.246
	Subtotal			15.372	48.725	2.966	2.636	9.463	21.200	-	9.676	3.876	4.795	27.174	27.330	5.259	23.734	5.265	8.272	2.782	17.989	13.888	861.727	12.247
	Grand total			100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	7036.033	100

Note: – denotes zero catch

Table 5.14 Monthly catch composition (% by weight) from the Dhaleswari River: outside BRE (site NC16)

Species Code	Habitat Preference	Species name		Year: 1992					Year: 1993												Year: 1994		Total annual catch (Mar'93 – Feb'94)	
		Scientific	Bengali	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Kg	%
186	Riverine	*Rita rita*	*Rita*		0.028	0.168	0.185	0.202	0.291								0.222	0.128	1.070				36.250	0.178
106		*Labeo pangusia*	*Longu*																0.016				0.477	0.002
13		*Aspidoparia morar*	*Piali*	3.671	3.254	3.321	1.316	8.046	17.767	2.412	5.196	4.250	3.297	4.928			0.302	3.203	0.110	0.878	3.296	0.635	414.580	2.038
18		*Barilius barna*	*Bani koksa*																					
218		*Barilius evezardi*						0.231										0.263					5.750	0.028
22		*Barilius tileo*	*Tila koksa*			0.004	0.060									3.873	4.350	0.132	0.432				69.859	0.343
59		*Crossocheilus latius*	*Kalabata*	0.245	0.243		0.352	0.005		0.339	0.169						0.109	0.792	0.865		2.815	0.081	88.999	0.438
139		*Nemacheilus botia*	*Balichata*	0.028	0.028	1.135	2.405	0.087	0.065	1.014	0.106	0.504	1.185	0.600	0.878		0.163		0.028	0.192	0.425	0.214	55.283	0.272
941		*Neoeucirrhichthys maydelli*	*Gutum*						0.005															
198		*Somileptes gongota*	*Gharpoia*				0.008						0.852					0.123				0.039	13.583	0.067
28		*Botia dario*	*Rani*	0.233	0.231	0.068	1.067	0.835	0.081	0.001		0.002			0.067		0.773	0.199	0.613	0.036	0.817	0.205	47.062	0.231
29		*Botia lohachata*	*Putul*	0.003														0.066					1.437	0.007
89		*Hilsa ilisha*	*Ilish*	0.609	11.149	0.551	0.062							1.713			0.773	0.027	0.305		0.043		23.660	0.116
85		*Gonialosa manmina*	*Goni chapila*						0.159	0.002	0.271							0.118	0.164	0.279	8.878	0.483	165.541	0.814
58		*Corica soborna*	*Kachki*				0.005	0.034		0.404		0.073							0.003		0.010	37.039	548.487	2.696
193		*Setipinna phasa*	*Phasa*	0.036	0.051						0.038					0.959	0.119	0.142	0.347		0.213		21.170	0.104
14		*Awaous stamineus*	*Bele*					0.111	0.035	2.100	2.716	2.790	3.803	1.480		0.288	0.055		0.017		0.605	0.585	178.153	0.876
940		*Awaous sp*	*Bele*				0.001																	
128		*Liza parsia*	*Bata*			0.681																		
922		*Liza sp*	*Bata*				0.002																	
185		*Rhinomugil corsula*	*Khorsula*	0.121	0.119	0.633	0.661	2.136	2.504	0.079		0.225	0.660			0.247	0.823	1.235		0.077	3.238	1.351	122.429	0.602
923		*Sicamugil cascasia*	*Bata*	0.036	0.035											0.274		0.038	0.105				4.800	0.024
163		*Pisodonophis boro*	*Kharu*										0.586		0.878			0.081			0.022		10.830	0.053
2		*Ailia coila*	*Kajuli*	2.185	3.522	3.686	3.519	0.010	0.015	0.0004			0.004	5.832	15.545	23.035	4.470	0.809	0.890		0.097		212.708	1.046
51		*Clupisoma garua*	*Ghaura*	1.467	2.817	20.647	9.965	0.491	0.354	0.010				7.191	10.438	20.965	9.425	3.609	6.477	0.426		2.965	538.583	2.648
196		*Silonia silondia*	*Shillong*			0.340	0.408	0.060	0.651	0.018	0.100								0.391				12.588	0.062
16		*Bagarius bagarius*	*Baghair*	0.138	0.019		0.389								0.542	0.284			0.650	0.035			22.818	0.112
77		*Gagata cenia*	*Kauwa*				0.098							0.094	1.589	1.318	0.029		0.016				8.301	0.041
78		*Gagata gagata*	*Gang tengra*													0.251							0.820	0.004
80		*Gagata viridescens*	*Gang tengra*				0.001												0.123				3.607	0.018
81		*Gagata youssoufi*	*Gang tengra*	0.727	0.648	2.576	3.655	0.791	0.020						7.249	2.643	0.142	0.574	2.416	0.020	0.025	0.016	108.357	0.533
155		*Pama pama*	*Poa*	0.049		0.303	0.025		0.109						0.067		0.799		0.619	0.014			26.659	0.131
171		*Psilorhynchus balitora*	*Balitora*					0.082																
955		*Amblyceps mangois*	*Magur*						0.004															
	Subtotal			9.548	22.143	34.111	24.182	13.118	22.059	6.379	8.596	7.844	10.386	21.837	37.252	54.137	22.554	11.539	15.657	1.957	20.483	43.613	2742.791	13.484
7	Migratory	*Anguilla bengalensis*	*Bamosh*	0.014	0.014																			
130		*Aorichthys aor*	*Ayre*	0.239	0.463	11.139	3.318	1.502	0.556	3.288			0.647	0.813	9.494	10.792	0.095	2.034	9.076	0.584	6.409		501.840	2.467
135		*Aorichthys seenghala*	*Guizza*				0.422	1.972												1.836	0.829		110.575	0.544
25		*Batasio tengana*	*Tengra*				0.005								0.852		0.124	0.031	1.419				44.993	0.221
131		*Mystus bleekeri*	*Golsha tengra*	0.050		0.018	0.037	0.053	0.422	0.012	0.186	0.020	0.255		0.063		0.072	0.017	0.556	0.389	2.162	0.494	83.706	0.412
132		*Mystus cavasius*	*Kabashi*	0.127	0.152	1.113	5.217	1.645	0.151	1.257	0.018	0.910	0.230	5.683	0.134	2.800	1.233	4.904	2.071	1.325	2.951	4.081	412.350	2.027
134		*Mystus menoda*	*Ghagla*															0.241					5.273	0.026
32		*Catla catla*	*Catla*	11.265	8.994	2.162								0.016									0.056	0.0003
47		*Cirrhinus mrigala*	*Mrigel*	1.440	1.426	0.288						0.009					1.108		1.245				47.294	0.233
48		*Cirrhinus reba*	*Raik*	1.187	1.043	0.386	4.404	0.360	0.423	0.394	2.021	0.144	0.182	4.601	0.731	0.014	2.232	1.695	1.202	0.536	6.777	6.169	361.634	1.778
100		*Labeo bata*	*Bata*			2.105	0.317	0.048									0.244	1.780		0.002	0.160		43.775	0.215
101		*Labeo boga*	*Bhangan*	0.070	0.197	0.236	0.253																	
102		*Labeo calbasu*	*Kalbaus*	0.493	0.936		0.948												1.234	0.635			70.066	0.344
107		*Labeo rohita*	*Rui*	1.406	6.885	15.178										0.018	0.651						6.300	0.031
188		*Salmostoma bacaila*	*Katari*	1.078	1.364	0.194	2.799		0.416	0.454	1.253	0.302			0.585		0.163		0.005	0.008	0.209	0.223	32.126	0.158
189		*Salmostoma phulo*	*Fulchela*		0.254	0.588	0.526	4.763	0.582	1.210	6.496	1.173	15.963	12.617	3.780	1.541	1.989	10.061	0.531		3.446	8.516	787.955	3.874
154		*Securicula gora*	*Chora chela*	0.167														0.858	0.063	0.021	0.146		23.912	0.118
86		*Gudusia chapra*	*Chapila*	0.461	0.448	0.143	1.376	4.837	0.261	0.380	1.933	0.111	0.105	0.177	0.603			0.140	2.853	0.109	0.975	1.069	150.791	0.741
76		*Eutropiichthys vacha*	*Bacha*	0.454	0.961	0.604		0.075					0.067	0.657			8.142		2.636				158.353	0.778
169		*Pseudeutropius atherinoides*	*Batasi*	0.355	0.280	0.998	0.117	0.101		0.061	0.313	0.131	0.048		0.502		0.136	2.645	0.428	0.159	0.121		90.618	0.445
209		*Wallagu attu*	*Boal*	0.848	0.765	4.823	0.687											6.780	32.687	63.722	0.860	0.930	4538.442	22.312
	Subtotal			19.654	24.181	39.973	20.425	15.354	2.809	7.054	12.220	2.800	17.497	24.563	16.744	15.165	16.188	31.185	56.006	69.326	25.046	21.481	7470.059	36.724

(Cont.)

Table 5.14 Monthly catch composition (% by weight) from the Dhaleswari River: outside BRE (site NC16)

Species Code	Habitat Preference	Species name: Scientific	Species name: Bengali	Year: 1992 Aug	Sep	Oct	Nov	Dec	Year: 1993 Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec	Year: 1994 Jan	Feb	Total annual catch (Mar'93 – Feb'94) Kg	%
136	Floodplain	*Mystus tengara*	*Bajari tengra*	0.034	0.035	-	-	-	-	-	-	-	-	-	-	-	-	-	0.040	-	-	-	1.172	0.006
137	Resident	*Mystus vittatus*	*Tengra*	1.419	0.932	0.109	0.926	-	-	0.189	0.009	0.186	0.188	-	0.014	0.058	0.570	0.604	0.274	0.380	1.122	0.158	73.853	0.363
55		*Colisa fasciatus*	*Khalisha*	0.453	0.463	-	-	-	-	-	-	-	0.046	-	-	-	0.031	0.179	-	-	0.318	-	9.538	0.047
211		*Colisa labiosus*	*Khalisha*	-	-	-	-	-	-	-	-	-	-	-	0.841	-	0.419	-	-	-	-	-	5.574	0.027
56		*Colisa lalia*	*Lal khalisha*	0.014	0.014	-	-	-	-	-	-	-	-	-	-	-	0.577	0.066	-	-	-	-	6.972	0.034
57		*Colisa sota*	*Khalisha*	-	-	0.273	0.030	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
210		*Xenentodon cancila*	*Kaikka*	0.632	0.626	0.571	0.476	-	0.065	0.196	1.784	7.320	2.436	-	0.573	0.209	0.564	7.591	0.256	0.172	3.881	1.687	522.873	2.571
187		*Osteobrama cotio cotio*	*Keti*	0.682	0.675	0.006	-	-	-	-	-	-	-	-	-	-	-	-	0.013	-	-	-	0.382	0.002
175		*Puntius conchonius*	*Canchan puti*	0.062	0.063	3.438	4.314	3.969	12.905	17.047	60.391	59.686	21.616	3.494	0.289	0.014	1.747	11.136	0.759	5.696	9.435	9.609	3463.421	17.027
176		*Puntius gelius*	*Gilliputi*	-	-	-	-	-	-	-	-	-	0.008	-	-	-	0.290	0.323	0.050	0.007	-	-	11.739	0.058
178		*Puntius phutunio*	*Phutani puti*	-	-	-	0.039	-	0.119	0.359	-	-	-	-	-	0.005	0.802	-	-	-	-	-	7.699	0.038
180		*Puntius sophore*	*Puti*	0.352	0.370	3.482	1.446	0.710	1.002	1.205	1.673	2.675	0.194	0.291	10.573	0.494	6.133	8.922	0.390	1.340	3.368	1.104	520.424	2.558
181		*Puntius terio*	*Teri punti*	-	0.037	0.716	1.089	0.120	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
212		*Puntius ticto*	*Tit puti*	0.141	0.139	-	-	0.005	0.019	15.125	-	0.005	-	0.634	-	0.052	0.486	0.292	0.284	0.033	-	-	23.684	0.116
5		*Amblypharyngodon mola*	*Mola*	0.268	0.264	-	-	-	-	-	0.417	-	-	-	2.320	0.243	6.571	0.189	0.010	-	-	-	77.241	0.380
69		*Brachydanio rerio*	*Anju*	-	-	-	-	-	-	-	-	-	-	-	0.063	-	0.046	-	-	-	-	-	0.555	0.003
68		*Danio devario*	*Chebli*	0.065	-	0.004	0.005	-	-	-	-	-	0.057	0.033	-	-	-	1.468	0.002	0.096	0.239	0.029	42.107	0.207
75		*Esomus danricus*	*Darkina*	-	-	-	-	-	-	-	-	-	0.090	-	7.268	2.355	0.803	0.182	0.013	-	-	-	34.262	0.168
182		*Rasbora daniconius*	*Darkina*	0.062	0.063	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
83		*Glossogobius giurus*	*Bailla*	1.372	0.717	0.970	4.159	2.492	4.027	16.463	11.390	11.979	22.562	10.508	10.962	5.177	12.114	6.406	1.261	2.377	5.477	7.627	1419.684	6.979
43		*Chela cachius*	*Chep chela*	-	-	0.051	-	0.005	-	-	-	-	0.045	-	-	-	-	0.169	0.010	-	0.019	-	4.833	0.024
109		*Lepidocephalus berdmorei*	*Pulya*	-	-	-	-	-	-	-	-	-	0.046	0.249	-	-	-	-	-	-	-	-	1.439	0.007
110		*Lepidocephalus guntea*	*Gutum*	0.120	0.070	0.035	0.573	-	0.816	0.003	0.013	0.010	-	0.834	2.341	-	-	0.643	0.023	-	0.248	-	26.168	0.129
217		*Lepidocephalus thermalis*	*Pulya*	-	-	-	-	-	-	-	-	-	0.046	-	-	-	-	0.090	-	-	-	-	2.516	0.012
39		*Channa marulius*	*Gajar*	-	-	-	-	-	-	-	-	-	0.141	-	-	-	-	-	-	-	-	-	1.705	0.008
41		*Channa punctatus*	*Taki*	3.356	2.613	1.619	1.102	0.063	0.124	0.583	0.053	0.449	0.647	0.032	1.317	1.583	0.417	3.056	4.622	1.123	2.433	0.020	331.355	1.629
42		*Channa striatus*	*Shol*	-	-	-	-	-	-	-	-	0.150	-	-	-	-	-	-	-	-	-	-	4.105	0.020
50		*Clarias gariepinus*	*African magur*	-	-	-	-	-	-	-	-	-	-	-	0.071	-	-	-	-	-	-	-	0.131	0.001
88		*Heteropneustes fossilis*	*Shingi*	-	-	-	-	-	1.306	0.002	-	-	-	-	-	-	-	-	-	-	-	-	-	-
121		*Macrognathus aculeatus*	*Tara baim*	0.175	0.174	-	-	-	-	-	-	-	-	0.499	-	0.046	-	-	-	-	-	-	1.918	0.009
123		*Macrognathus pancalus*	*Guchi*	0.559	0.453	0.211	0.585	0.380	-	0.135	0.207	1.699	3.620	2.269	0.189	0.952	15.868	0.523	1.021	0.204	1.884	0.543	344.807	1.695
122		*Mastacembelus armatus*	*Baral baim*	0.014	0.068	0.181	31.031	59.570	3.091	3.521	0.096	1.326	0.379	1.054	-	1.389	1.013	1.610	10.337	16.826	11.669	1.668	1496.783	7.358
15		*Badis badis*	*Napit koi*	-	-	-	-	-	-	-	-	0.001	0.034	0.068	0.502	0.262	0.017	0.027	-	-	-	-	3.205	0.016
147		*Ompok bimaculatus*	*Kani pabda*	0.177	0.175	-	-	0.216	-	-	-	-	-	-	-	-	-	0.822	-	0.013	0.260	-	22.552	0.111
148		*Ompok pabda*	*Madhu pabda*	0.083	-	0.334	-	-	0.207	0.006	-	-	-	-	-	-	-	-	-	-	-	-	-	-
220		*Ompok sp*	*Ompok sp.*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.096	-	-	-	-	2.091	0.010
145		*Notopterus notopterus*	*Foli*	-	-	-	-	-	-	-	-	-	-	0.047	-	-	-	-	-	-	0.241	-	3.780	0.019
203		*Tetraodon cutcutia*	*Potka*	-	-	0.007	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
33		*Chaca chaca*	*Cheka*	10.634	8.368	2.162	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
35		*Chanda baculis*	*Chanda*	-	-	-	0.001	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
36		*Chanda nama*	*Nama chanda*	0.006	0.007	0.010	0.121	0.313	0.097	0.560	1.080	0.223	1.589	0.339	1.054	0.014	1.836	0.879	0.263	0.026	1.367	1.290	126.242	0.621
37		*Chanda ranga*	*Lal chanda*	0.062	0.063	0.023	0.164	0.005	-	0.302	-	-	0.015	-	0.924	0.046	2.950	2.322	0.067	0.023	0.080	-	85.475	0.420
	Subtotal			20.739	16.386	14.198	46.061	67.848	23.778	55.695	77.113	85.711	53.757	20.348	39.299	12.897	53.254	47.592	19.695	28.314	42.042	23.735	8680.285	42.673
998	Others	Unidentified fish		-	-	-	-	0.010	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
119		*Macrobrachium malcolmsonii*	*Chingri chotka*	40.785	32.085	8.291	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
120		*Macrobrachium rosenbergii*	*Golda*	-	-	-	0.042	-	-	0.023	-	0.155	-	0.501	0.031	-	0.838	-	0.111	-	-	0.020	17.654	0.087
931		Prawn spp.	*Chingri/Icha*	9.273	5.204	3.425	9.289	3.669	51.348	30.848	2.071	3.489	18.359	32.751	6.674	17.799	7.165	9.683	8.529	0.402	12.428	11.150	1430.384	7.032
946		*Turtle*	*Dur kasim*	-	-	-	-	-	0.005	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Subtotal			50.058	37.289	11.716	9.330	3.679	51.353	30.871	2.071	3.645	18.359	33.252	6.705	17.799	8.003	9.683	8.640	0.402	12.428	11.170	1448.038	7.119
	Grand total			100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	20341.173	100

Note: – denotes zero catch

Table 5.15 Monthly catch composition (% by weight) from the Jamuna River: outside BRE (site NC01)

Species Code	Habitat Preference	Scientific name: Scientific	Scientific name: Bengali	Year: 1992 Aug	Sep	Oct	Nov	Dec	Year: 1993 Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec	Year: 1994 Jan	Feb	Total annual catch (Mar'93 – Fen'94) kg	%
133	Riverine	*Mystus gulio*	*Nuna tengra*	0.149	–	0.020	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
186		*Rita rita*	*Rita*	0.008	–	0.488	–	2.120	–	–	–	–	0.302	0.166	0.113	0.148	–	0.001	–	0.003	0.015	0.032	26.879	0.056
12		*Aspidoparia jaya*	*Piali*	3.932	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
13		*Aspidoparia morar*	*Piali*	–	0.918	0.015	0.476	9.307	4.555	5.543	18.320	6.081	0.456	0.042	1.789	0.003	0.383	1.508	0.072	0.852	8.769	29.651	2512.810	5.231
59		*Crossocheilus latius*	*Kalabata*	–	–	–	0.320	3.019	16.938	0.364	0.074	0.008	–	–	0.416	0.049	3.850	0.076	0.140	0.077	4.990	0.438	555.571	1.157
139		*Nemacheilus botia*	*Balichata*	–	–	–	–	0.215	–	–	0.167	–	0.434	0.043	0.506	0.0004	0.010	0.062	0.191	0.018	0.147	0.235	64.088	0.133
28		*Botia dario*	*Rani*	–	0.272	0.078	–	0.101	–	0.003	–	–	–	–	0.022	0.093	0.131	–	0.296	0.065	0.046	–	26.943	0.056
89		*Hilsa ilisha*	*Ilish*	35.601	31.579	70.647	56.291	19.668	3.642	1.141	16.941	4.287	20.511	94.422	33.975	40.897	2.127	12.886	48.467	30.078	20.210	14.909	13579.525	28.269
58		*Corica soborna*	*Kachki*	–	–	–	–	0.284	–	–	–	–	–	–	0.065	–	–	–	0.005	–	–	–	3.132	0.007
193		*Setipinna phasa*	*Phasa*	–	–	–	0.064	0.376	–	–	–	–	0.042	–	0.203	0.909	0.001	–	0.627	–	–	–	45.099	0.094
10		*Apocryptes bato*	*Chiring*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.028	1.385	0.003
30		*Brachygobius nunus*	*Nunabailla*	–	–	–	–	0.599	0.146	0.138	1.398	2.637	–	–	0.060	0.001	–	–	–	0.020	0.209	0.061	98.287	0.205
922		*Liza sp*	*Bata*	–	–	–	–	–	–	–	–	–	–	–	0.044	0.007	–	0.438	–	–	–	–	23.573	0.049
185		*Rhinomugil corsula*	*Khorsula*	0.370	18.986	3.554	5.660	1.445	–	0.043	7.281	14.682	4.183	0.064	18.349	0.003	0.297	9.206	8.085	1.325	0.494	0.016	2154.005	4.484
923		*Sicamugil cascasia*	*Bata*	–	–	0.042	1.536	1.120	–	–	–	–	–	–	–	–	–	–	0.040	0.007	–	–	1.233	0.003
2		*Ailia coila*	*Kajuli*	4.872	–	–	0.865	3.322	0.309	0.260	1.079	0.753	3.646	1.555	13.714	8.254	1.626	0.086	12.754	0.809	0.899	1.794	1644.192	3.423
51		*Clupisoma garua*	*Ghaura*	3.361	15.238	5.863	1.551	1.521	–	0.142	0.970	3.859	–	0.547	2.555	6.876	10.339	2.992	8.948	1.136	4.794	4.429	2164.528	4.506
196		*Silonia silondia*	*Shillong*	–	–	–	3.742	–	–	–	–	0.978	0.128	–	0.352	0.690	0.177	0.570	2.314	–	0.018	–	154.129	0.321
16		*Bagarius bagarius*	*Baghair*	0.243	0.613	–	7.848	–	–	–	–	–	0.024	–	0.909	–	–	3.750	–	1.991	0.265	–	312.078	0.650
77		*Gagata cenia*	*Kauwa*	–	0.536	0.121	–	0.908	–	–	0.023	0.055	–	0.052	0.610	0.186	0.069	0.010	0.031	0.071	0.020	0.102	53.481	0.111
79		*Gagata nangra*	*Gang tengra*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.607	10.029	6.870	599.343	1.248
81		*Gagata youssoufi*	*Gang tengra*	0.100	0.920	0.023	0.145	17.319	7.651	5.313	9.250	38.524	2.301	0.010	2.095	3.547	0.393	0.022	0.327	0.205	4.227	2.438	1462.218	3.044
197		*Sisor rhabdophorus*	*Sisor*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.016	–	0.015	0.004	0.930	0.002
155		*Pama pama*	*Poa*	–	–	–	1.083	0.028	–	0.079	–	–	0.122	–	0.018	2.227	–	–	–	–	–	–	50.881	0.106
955		*Amblyceps mangois*	*Magur*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.008	0.391	0.001
	Subtotal			48.635	69.061	80.852	79.580	61.352	33.240	13.026	55.501	71.863	32.148	96.901	75.794	63.890	19.403	31.607	82.311	37.263	55.145	61.015	25534.701	53.156
130	Migratory	*Aorichthys aor*	*Ayre*	8.508	–	0.0003	5.220	–	–	–	0.143	–	0.102	0.147	2.104	2.828	0.488	–	0.230	–	0.740	2.374	360.816	0.751
135		*Aorichthys seenghala*	*Guizza*	0.227	3.111	–	–	–	–	2.900	–	–	–	–	–	–	–	–	–	–	–	6.843	334.888	0.697
131		*Mystus bleekeri*	*Golsha tengra*	–	–	–	–	–	–	–	–	–	–	–	–	0.001	0.467	1.288	0.077	0.021	–	0.027	113.462	0.236
132		*Mystus cavasius*	*Kabashi*	–	0.185	0.021	0.040	0.459	–	0.009	0.682	–	0.268	0.059	3.528	0.078	2.127	1.091	0.308	0.103	0.069	0.062	474.007	0.987
32		*Catla catla*	*Catla*	–	–	–	–	–	–	–	–	–	–	0.028	–	–	0.801	–	–	–	–	–	81.260	0.169
47		*Cirrhinus mrigala*	*Mrigel*	–	–	–	–	–	–	–	–	–	–	–	–	0.089	–	–	–	–	–	–	1.900	0.004
48		*Cirrhinus reba*	*Raik*	0.008	–	0.085	–	3.415	–	–	0.698	–	–	–	–	0.026	0.678	–	0.828	0.882	0.120	–	145.350	0.303
100		*Labeo bata*	*Bata*	–	0.195	0.012	0.015	10.796	–	–	–	–	–	–	–	0.035	17.625	0.214	0.187	1.995	–	–	1847.174	3.845
101		*Labeo boga*	*Bhangan*	–	–	–	0.030	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
102		*Labeo calbasu*	*Kalbaus*	–	–	–	–	–	–	–	–	–	–	–	0.009	–	0.938	0.055	–	–	–	–	96.298	0.200
107		*Labeo rohita*	*Rui*	–	–	–	–	–	–	–	–	–	–	–	0.074	0.104	0.014	–	–	–	–	–	7.100	0.015
44		*Chela laubuca*	*Kash khaira*	–	0.062	–	–	–	–	–	–	–	–	–	–	–	–	0.172	–	–	–	–	8.424	0.018
188		*Salmostoma bacaila*	*Katari*	0.050	6.816	10.441	11.271	6.880	–	0.153	–	–	–	0.182	7.013	1.469	5.948	2.205	0.589	0.012	0.259	0.306	1102.321	2.295
189		*Salmostoma phulo*	*Fulchela*	–	–	–	–	1.079	–	–	–	–	0.004	0.014	0.078	0.117	0.619	1.290	0.332	0.006	0.037	0.102	145.880	0.304
154		*Securicula gora*	*Chora chela*	5.507	–	0.509	0.172	–	–	0.092	–	–	–	–	0.240	–	0.191	0.216	–	–	0.090	–	42.793	0.089
86		*Gudusia chapra*	*Chapila*	–	–	0.141	0.099	0.891	–	0.014	–	–	–	–	–	–	0.007	0.172	1.082	0.194	0.019	–	43.731	0.091
76		*Eutropiichthys vacha*	*Bacha*	0.706	–	–	0.933	0.893	–	–	–	–	–	0.027	–	–	–	–	0.167	0.292	3.346	0.008	97.509	0.203
169		*Pseudeutropius atherinoides*	*Batasi*	1.011	14.235	0.813	0.007	0.089	–	0.014	0.018	–	–	–	0.008	0.0001	0.127	0.252	0.194	0.057	0.008	–	33.032	0.069
209		*Wallagu attu*	*Boal*	0.050	–	–	–	–	–	–	–	–	–	–	0.075	–	0.079	–	3.959	54.883	16.813	–	2710.114	5.642
144		*Notopterus chitala*	*Chital*	–	–	–	–	–	–	–	–	–	–	0.014	0.018	–	0.031	–	–	–	–	–	4.753	0.010
	Subtotal			16.066	24.603	12.022	17.786	24.501	–	3.182	1.540	–	0.374	0.472	13.146	4.746	30.141	6.956	7.953	58.445	21.499	9.723	7650.812	15.927
136	Floodplain	*Mystus tengara*	*Bajari tengra*	–	–	–	–	–	–	–	–	–	0.111	–	–	–	0.024	–	–	–	–	–	4.691	0.010
137	Resident	*Mystus vittatus*	*Tengra*	–	–	–	–	0.118	–	0.001	–	0.100	–	–	0.086	0.002	3.117	0.253	0.114	0.029	–	0.006	332.255	0.692
942		*Rama chandramara*	*Laia*	–	–	–	–	0.255	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
55		*Colisa fasciatus*	*Khalisha*	0.151	–	–	–	–	–	–	–	–	–	–	0.074	0.001	0.044	–	–	–	–	–	7.846	0.016

(Cont.)

Table 5.15 Monthly catch composition (% by weight) from the Jamuna River: outside BRE (site NC01)

Species Code	Habitat Preference	Scientific name: Scientific	Scientific name: Bengali	Year: 1992 Aug	Sep	Oct	Nov	Dec	Year: 1993 Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec	Year: 1994 Jan	Feb	Total annual catch (Mar'93 – Fen'94) kg	%
210		*Xenentodon cancila*	*Kaikka*	–	–	–	0.229	–	–	–	–	0.026	–	–	–	0.293	0.306	0.255	–	0.063	–	–	52.180	0.109
187		*Osteobrama cotio cotio*	*Keti*	–	–	–	–	–	–	0.001	–	–	0.003	–	–	–	0.105	0.071	0.031	0.005	0.009	–	15.094	0.031
175		*Puntius conchonius*	*Canchan puti*	–	–	–	–	0.092	–	0.550	3.510	4.455	47.814	0.210	0.193	0.014	0.940	14.206	0.250	0.217	–	0.037	2002.356	4.168
176		*Puntius gelius*	*Giliputi*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.006	0.005	–	–	0.343	0.001
178		*Puntius phutunio*	*Phutani puti*	–	–	0.021	–	–	–	–	–	–	–	0.014	0.022	–	–	0.121	–	–	–	–	7.791	0.016
179		*Puntius sarana*	*Sarputi*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.580	–	–	–	–	28.343	0.059
180		*Puntius sophore*	*Puti*	1.070	1.803	0.157	0.074	0.269	–	0.096	–	0.324	0.094	–	0.035	0.563	17.550	15.661	1.633	0.182	–	0.017	2578.871	5.368
212		*Puntius ticto*	*Tit puti*	–	0.242	0.258	0.462	0.030	–	0.008	–	–	–	–	–	–	0.228	0.075	–	0.006	–	–	26.577	0.055
5		*Amblypharyngodon mola*	*Mola*	–	–	–	–	–	–	–	–	–	–	–	0.120	–	0.714	–	–	–	–	–	76.559	0.159
68		*Danio devario*	*Chebli*	0.174	–	–	–	0.209	–	–	–	–	–	–	–	–	–	–	–	0.006	–	–	0.255	0.001
75		*Esomus danricus*	*Darkina*	–	–	0.021	–	–	–	–	–	–	0.079	0.042	0.030	0.391	1.031	5.210	–	–	–	–	371.005	0.772
83		*Glossogobius giurus*	*Bailla*	22.894	0.359	0.017	0.034	1.101	52.657	75.874	22.003	6.174	5.120	0.842	4.111	0.415	5.718	2.267	0.138	0.037	0.861	7.005	2116.449	4.406
43		*Chela cachius*	*Chep chela*	–	0.156	0.148	–	1.090	–	–	–	–	–	–	–	–	0.530	0.086	0.020	–	0.004	0.068	60.727	0.126
110		*Lepidocephalus guntea*	*Gutum*	–	–	–	–	–	–	0.012	–	–	–	–	0.055	0.0003	1.142	0.206	–	0.008	–	–	126.475	0.263
9		*Aplocheilus panchax*	*Kanpona*	–	–	–	–	–	–	–	–	–	–	–	–	–	0.024	–	–	–	–	–	2.376	0.005
41		*Channa punctatus*	*Taki*	–	0.826	0.451	0.058	–	–	–	–	–	–	–	0.921	0.561	2.476	3.214	0.393	0.017	–	–	467.987	0.974
42		*Channa striatus*	*Shol*	–	0.515	0.080	–	–	–	–	–	–	–	–	–	–	–	0.353	–	–	–	–	17.239	0.036
88		*Heteropneustes fossilis*	*Shingi*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.046	–	–	–	–	2.249	0.005
121		*Macrognathus aculeatus*	*Tara baim*	0.919	–	–	–	–	–	–	–	–	–	–	0.384	0.002	0.348	–	–	–	–	–	52.436	0.109
123		*Macrognathus pancalus*	*Guchi*	–	0.078	0.0003	–	–	–	0.004	0.010	–	0.975	0.084	0.189	0.638	6.353	2.077	0.142	–	–	–	784.367	1.633
122		*Mastacembelus armatus*	*Baral baim*	4.366	–	0.132	0.167	0.019	–	0.062	0.852	–	0.181	–	–	0.001	0.748	0.752	2.655	0.653	–	0.007	229.276	0.477
203		*Tetraodon cutcutia*	*Potka*	–	–	–	0.172	–	–	–	–	–	–	–	–	–	0.053	–	–	–	–	–	5.231	0.011
35		*Chanda baculis*	*Chanda*	–	–	–	–	–	–	–	–	–	–	–	0.033	–	1.311	1.111	–	0.002	–	–	186.180	0.388
36		*Chanda nama*	*Nama chanda*	–	–	–	0.043	0.239	–	0.003	0.089	–	0.002	–	0.542	0.215	1.379	2.134	0.212	0.016	0.002	–	279.306	0.581
37		*Chanda ranga*	*Lal chanda*	–	–	0.085	0.011	–	–	–	–	–	–	0.014	0.011	0.007	1.764	1.231	–	–	0.004	–	237.014	0.493
	Subtotal			29.574	3.979	1.371	1.249	3.422	52.657	76.610	26.464	11.079	54.379	1.206	6.804	3.100	45.903	49.908	5.593	1.248	0.880	7.138	10071.478	20.966
998	Others	Unidentified fish		3.146	–	–	0.067	2.814	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
931		Prawn spp.	*Chingri/Icha*	2.580	2.356	5.755	1.317	7.909	14.103	7.182	16.494	17.058	13.098	1.420	4.254	28.263	4.552	11.526	4.141	3.043	22.475	22.123	4780.210	9.951
	Subtotal			5.725	2.356	5.755	1.383	10.723	14.103	7.182	16.494	17.058	13.098	1.420	4.254	28.263	4.552	11.526	4.141	3.043	22.475	22.123	4780.210	9.951
	Grand total			100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	48037.201	100

Note: – denotes zero catch

Table 5.16 Monthly catch composition (% by weight) from the Old Hurasagar River: inside BRE (site NW19)

Species Code	Habitat Preference	Species name: Scientific	Species name: Bengali	Year: 1992 Oct	Year: 1992 Nov	Year: 1992 Dec	Year: 1993 Jan	Year: 1993 Feb	Year: 1993 Mar	Year: 1993 April	Year: 1993 May	Year: 1993 June	Year: 1993 July	Year: 1993 Aug	Year: 1993 Sep	Year: 1993 Oct	Year: 1993 Nov	Year: 1993 Dec	Year: 1994 Jan	Year: 1994 Feb	Total annual catch (Mar'93 – Feb'94) Kg	Total annual catch (Mar'93 – Feb'94) %
186	Riverine	*Rita rita*	*Rita*	0.272	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
13		*Aspidoparia morar*	*Piali*	–	–	–	–	–	–	–	–	0.038	–	–	–	–	–	–	–	–	0.226	0.002
59		*Crossocheilus latius*	*Kalabata*	12.081	0.114	–	–	–	–	–	–	–	–	–	–	0.211	–	–	–	–	6.391	0.064
139		*Nemacheilus botia*	*Balichata*	0.180	–	–	0.154	–	0.084	–	–	0.560	0.560	–	–	–	–	–	–	–	4.666	0.047
28		*Botia dario*	*Rani*	3.190	0.020	–	–	–	–	–	–	–	–	–	–	0.289	–	–	–	–	8.777	0.088
89		*Hilsa ilisha*	*Ilish*	1.717	–	–	–	–	–	–	–	0.027	–	–	–	–	–	–	–	–	0.156	0.002
30		*Brachygobius nunus*	*Nunabailla*	–	–	–	–	–	–	–	–	–	–	0.043	–	–	–	–	0.119	0.250	1.717	0.017
128		*Liza parsia*	*Bata*	–	–	–	–	–	–	0.574	–	–	–	–	–	–	–	–	–	–	1.254	0.013
2		*Ailia coila*	*Kajuli*	0.793	0.003	–	–	–	–	–	–	–	–	–	–	0.139	–	–	–	–	4.204	0.042
81		*Gagata youssoufi*	*Gang tengra*	–	–	–	–	–	–	–	–	–	–	–	0.002	0.109	–	–	–	–	3.336	0.033
87		*Hara hara*	*Kutakanti*	0.129	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
93		*Ichthyocampus carce*	*Kumirer khil*	–	–	–	–	0.299	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Subtotal			18.362	0.136	–	0.154	0.299	0.084	0.574	–	0.625	0.560	0.043	0.002	0.747	–	–	0.119	0.250	30.727	0.308
130	Migratory	*Aorichthys aor*	*Ayre*	–	–	–	–	–	–	–	–	–	3.083	0.940	1.095	–	–	–	–	–	31.123	0.312
131		*Mystus bleekeri*	*Golsha tengra*	–	3.422	1.340	–	0.557	0.113	0.843	1.374	3.015	2.073	1.411	0.096	2.062	1.099	–	–	0.567	116.803	1.170
132		*Mystus cavasius*	*Kabashi*	3.209	0.427	–	0.307	–	2.423	–	–	2.168	11.213	–	–	1.232	1.358	–	0.368	–	106.378	1.066
32		*Catla catla*	*Catla*	–	–	–	–	–	–	–	–	0.027	–	4.769	–	2.037	–	–	–	–	86.094	0.862
47		*Cirrhinus mrigala*	*Mrigel*	–	–	–	–	–	1.932	–	–	–	–	0.672	30.104	4.142	–	–	–	–	707.169	7.084
48		*Cirrhinus reba*	*Raik*	5.115	0.434	–	–	–	18.282	–	–	–	0.110	0.586	0.959	8.356	3.090	–	0.979	–	410.830	4.115
100		*Labeo bata*	*Bata*	1.044	0.011	–	–	–	–	–	–	–	–	–	0.888	13.067	0.017	–	–	–	413.340	4.140
101		*Labeo boga*	*Bhangan*	–	–	–	–	–	–	–	–	–	–	–	–	0.160	–	–	–	–	4.838	0.048
102		*Labeo calbasu*	*Kalbaus*	–	–	–	–	–	–	–	–	–	–	–	6.189	21.975	5.984	5.385	–	–	904.605	9.062
107		*Labeo rohita*	*Rui*	0.399	–	–	–	–	7.726	–	–	–	–	–	46.134	5.580	–	–	–	–	1075.260	10.771
188		*Salmostoma bacaila*	*Katari*	0.375	0.042	–	–	–	0.063	–	–	–	–	–	–	–	–	–	–	0.502	1.553	0.016
189		*Salmostoma phulo*	*Fulchela*	0.030	–	–	–	–	–	0.241	1.057	–	–	4.051	0.004	2.411	–	–	2.082	1.988	115.497	1.157
86		*Gudusia chapra*	*Chapila*	–	–	–	–	–	–	–	–	0.027	–	–	–	–	–	–	–	–	0.156	0.002
169		*Pseudeutropius atherinoides*	*Batasi*	–	–	–	–	–	0.084	–	–	–	0.331	–	–	0.008	–	–	–	–	1.201	0.012
209		*Wallagu attu*	*Boal*	–	–	3.170	29.164	–	28.759	4.871	–	–	0.441	–	6.576	3.425	0.020	–	24.934	–	540.788	5.417
144		*Notopterus chitala*	*Chital*	–	–	–	–	–	–	–	–	–	–	–	–	12.772	–	–	–	–	387.301	3.880
216		*Nemacheilus zonalternans*		–	–	–	–	–	–	–	2.115	0.397	–	–	–	–	–	–	–	–	4.553	0.046
	Subtotal			10.171	4.335	4.510	29.471	0.557	59.381	5.955	4.545	5.633	17.251	12.431	92.044	77.226	11.568	5.385	28.364	3.057	4907.489	49.159
6	Floodplain	*Anabas testudineus*	*Koi*	–	–	–	–	–	–	–	–	–	–	–	–	0.048	–	–	–	–	1.469	0.015
136	Resident	*Mystus tengara*	*Bajari tengra*	–	–	–	0.102	–	–	–	0.423	0.019	0.197	0.489	–	–	0.023	–	–	–	3.783	0.038
137		*Mystus vittatus*	*Tengra*	1.472	21.491	5.819	1.634	1.549	0.261	3.517	2.115	1.443	3.925	–	0.041	0.148	2.474	0.257	1.499	3.864	95.502	0.957
55		*Colisa fasciatus*	*Khalisha*	0.892	0.005	1.064	0.950	0.574	–	–	0.362	4.816	1.018	8.171	0.367	0.144	5.526	21.257	2.990	1.793	280.495	2.810
211		*Colisa labiosus*	*Khalisha*	–	–	–	–	–	–	–	0.022	0.748	0.306	0.317	0.010	–	0.056	–	–	–	7.724	0.077
56		*Colisa lalia*	*Lal Khalisha*	–	–	0.046	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
57		*Colisa sota*	*Khalisha*	0.594	0.106	0.679	0.640	0.067	–	–	0.318	–	0.110	0.836	–	0.018	–	2.460	0.396	0.092	17.360	0.174
210		*Xenentodon cancila*	*Kaikka*	0.739	–	–	1.522	–	–	0.539	–	0.312	0.441	0.086	0.083	1.172	2.631	–	7.027	13.010	170.075	1.704
175		*Puntius conchonius*	*Canchan puti*	–	–	13.266	23.495	19.374	0.486	0.843	2.008	1.870	5.726	10.833	1.171	2.877	4.770	7.196	1.881	1.300	315.702	3.162
176		*Puntius gelius*	*Giliputi*	–	–	–	–	–	–	–	–	0.053	–	1.975	0.002	0.089	1.699	0.228	0.416	–	45.685	0.458

(Cont.)

Table 5.16 Monthly catch composition (% by weight) from the Old Hurasagar River: inside BRE (site NW19)

Species	Habitat	Species name		Year: 1992			Year: 1993												Year: 1994		Total annual catch (Mar'93 – Feb'94)	
Code	Preference	Scientific	Bengali	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Kg	%
177		*Puntius guganio*	*Mola puti*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.661	1.697	0.017
178		*Puntius phutunio*	*Phutani puti*	–	–	–	–	–	–	–	0.022	0.806	0.110	3.137	0.021	0.053	0.910	0.926	0.075	–	42.181	0.423
180		*Puntius sophore*	*Puti*	4.764	12.945	2.982	8.992	10.642	0.918	1.576	3.731	3.683	13.060	11.663	0.571	2.843	12.970	10.580	15.797	4.212	595.959	5.970
212		*Puntius ticto*	*Tit puti*	15.498	10.166	0.419	0.387	–	–	–	0.211	0.166	–	–	–	0.008	0.103	–	1.717	3.452	24.445	0.245
5		*Amblypharygodon mola*	*Mola*	–	–	–	–	0.100	0.056	–	–	–	–	–	–	–	0.015	–	0.119	0.662	3.045	0.031
69		*Brachydanio rerio*	*Anju*	–	–	–	–	–	–	–	–	–	–	0.172	–	–	–	–	–	–	0.873	0.009
75		*Esomus danricus*	*Darkina*	–	–	0.046	0.148	–	–	0.573	1.163	0.424	0.331	1.249	–	0.141	0.624	1.511	0.103	0.833	35.119	0.352
83		*Glossogobius giurus*	*Bailla*	3.228	1.884	1.795	10.709	26.328	2.312	1.655	9.540	14.936	14.083	6.909	0.029	0.319	4.776	0.514	2.338	6.207	297.582	2.981
43		*Chela cachius*	*Chep Chela*	–	–	–	–	–	–	–	–	–	–	–	–	0.018	–	–	–	–	0.532	0.005
110		*Lepidocephalus guntea*	*Gutum*	3.742	10.513	7.287	7.454	10.397	7.639	4.006	2.537	0.598	2.173	0.647	–	0.013	6.550	2.518	2.226	5.612	205.245	2.056
9		*Aplocheilus panchax*	*Kanpona*	–	–	0.253	–	–	0.062	–	0.318	–	0.331	0.086	0.005	–	0.442	0.257	–	–	10.150	0.102
39		*Channa marulius*	*Gajar*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2.656	6.820	0.068
40		*Channa orientalis*	*Cheng*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.212	–	1.530	0.015
41		*Channa punctatus*	*Taki*	2.496	5.211	13.552	5.317	13.394	1.377	14.220	1.057	4.678	4.142	16.607	2.654	3.580	2.641	6.629	5.170	14.236	458.733	4.595
49		*Clarias batrachus*	*Magur*	–	–	0.034	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
88		*Heteropneustes fossilis*	*Shingi*	1.859	3.535	2.764	0.756	3.942	2.379	42.443	1.113	–	0.662	–	–	–	0.348	3.849	1.719	1.347	140.856	1.411
121		*Macrognathus aculeatus*	*Tara baim*	0.129	–	–	–	0.371	–	–	4.785	17.010	4.346	0.317	–	0.285	0.636	0.494	0.253	1.352	140.965	1.412
123		*Macrognathus pancalus*	*Guchi*	9.323	7.932	4.511	3.676	4.877	17.275	18.982	52.861	25.402	13.920	4.949	1.043	0.542	16.353	1.113	1.670	8.291	719.754	7.210
122		*Mastacembelus armatus*	*Baral baim*	1.876	7.032	2.462	1.050	0.351	0.016	0.899	4.334	–	0.221	4.703	0.206	0.032	3.185	–	13.239	3.106	193.196	1.935
138		*Nandus nandus*	*Bheda*	0.060	–	–	–	–	–	–	–	–	–	–	–	–	1.002	–	0.961	–	23.907	0.239
15		*Badis badis*	*Napit koi*	2.695	0.571	0.554	0.437	0.154	0.028	–	0.172	4.936	0.221	0.471	0.005	–	0.675	0.680	0.091	0.416	47.817	0.479
147		*Ompok bimaculatus*	*Kani pabda*	0.032	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
145		*Notopterus notopterus*	*Foli*	3.887	–	–	–	–	6.318	–	–	0.079	–	–	–	3.671	–	–	0.352	–	140.835	1.411
203		*Tetraodon cutcutia*	*Potka*	–	–	–	–	–	0.056	–	–	–	–	0.258	–	0.031	–	1.284	–	0.070	7.355	0.074
35		*Chanda baculis*	*Chanda*	4.360	0.002	0.381	–	–	–	–	0.423	0.318	0.221	–	0.002	0.134	–	–	–	–	6.804	0.068
36		*Chanda nama*	*Nama Chanda*	3.617	0.007	–	–	0.040	0.501	0.540	2.705	0.609	1.189	0.302	0.006	2.794	0.019	0.846	0.814	1.059	110.228	1.104
37		*Chanda ranga*	*Lal chanda*	0.010	–	0.253	0.387	–	0.028	0.060	0.297	3.311	0.662	4.841	0.052	1.357	0.273	2.349	0.587	2.582	111.934	1.121
	Subtotal			61.273	81.399	58.165	67.655	92.161	39.711	89.854	90.516	86.218	67.392	79.018	6.268	20.315	68.700	64.947	61.651	76.811	4265.357	42.727
120	Others	*Macrobrachium rosenbergii*	*Golda*	2.494	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
931		Prawn spp.	*Chingri/Icha*	7.700	10.313	37.325	2.719	6.981	0.822	3.617	4.939	7.524	14.796	8.508	1.686	1.711	19.732	29.667	9.866	19.881	779.353	7.807
168		*Potamon*	*Kakra*	–	3.816	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Subtotal			10.194	14.129	37.325	2.719	6.981	0.822	3.617	4.939	7.524	14.796	8.508	1.686	1.711	19.732	29.667	9.866	19.881	779.353	7.807
	Grand total			100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	9982.926	100

Note : – denotes zero catch

Table 5.17 Monthly catch composition (% by weight) from the Karatoya River: inside BRE (site NW15)

Species	Habitat	Species name		Year: 1992			Year: 1993												Year: 1994		Total annual catch (Mar'93 – Feb'94)	
Code	Preference	Scientific	Bengali	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Kg	%
186	Riverine	Rita rita	Rita	–	–	–	–	–	–	–	–	–	–	0.675	0.206	–	0.309	–	–	–	30.238	0.116
13		Aspidoparia morar	Piali	0.676	1.796	0.041	0.056	–	0.023	0.111	1.417	–	–	–	–	0.060	–	0.037	–	0.069	19.890	0.076
218		Barilius evezardi		–	–	–	–	–	–	–	–	0.599	–	–	–	–	–	–	0.067	0.109	7.114	0.027
20		Raiamas bola	Bhol	–	–	0.111	–	–	–	–	0.081	–	–	–	–	–	–	–	–	–	0.729	0.003
59		Crossocheilus latius	Kalabata	1.018	0.766	1.892	0.267	0.106	–	–	–	–	–	–	0.018	1.918	0.041	0.098	–	–	89.903	0.346
139		Nemacheilus botia	Balichata	0.265	0.184	–	–	0.818	1.224	0.869	1.793	0.319	–	–	–	0.051	0.089	0.039	0.229	0.011	60.919	0.234
198		Somileptes gongota	Gharpoia	0.008	–	1.341	0.814	0.456	0.117	0.601	2.287	–	–	0.315	–	–	–	0.007	0.092	0.534	45.650	0.175
28		Botia dario	Rani	0.085	–	0.003	0.208	–	–	–	–	–	0.130	0.928	0.442	0.536	0.053	–	0.013	0.485	50.526	0.194
29		Botia lohachata	Putul	–	–	–	–	–	–	–	–	–	–	–	0.028	–	–	–	–	–	0.456	0.002
89		Hilsa ilisha	Ilish	–	–	0.003	–	–	5.805	0.504	9.626	5.188	48.333	20.631	4.994	0.439	0.029	–	–	–	1197.588	4.603
90		Hilsa toli	Chandana	–	–	–	–	–	–	–	–	–	0.319	–	–	–	–	–	–	–	4.677	0.018
85		Gonialosa manmina	Goni chapila	–	–	–	–	–	–	–	–	–	–	–	–	0.050	0.229	–	–	–	16.990	0.065
58		Corica soborna	Kachki	2.315	0.232	0.729	0.021	–	0.321	0.077	–	0.295	0.186	0.370	4.983	0.210	4.848	0.324	0.212	0.934	441.327	1.696
193		Setipinna phasa	Phasa	–	–	–	–	–	–	–	–	0.252	–	0.037	–	0.013	–	–	–	–	2.855	0.011
952		Awaous grammepomus	Nonda baila	–	–	–	–	–	–	–	–	–	–	0.068	–	–	–	–	–	–	0.692	0.003
14		Awaous stamineus	Bele	–	–	–	–	–	–	–	–	0.044	–	–	–	–	–	–	–	–	0.332	0.001
30		Brachygobius nunus	Nunabaila	–	–	–	–	–	–	–	0.454	–	–	–	–	0.009	0.003	–	–	–	4.658	0.018
128		Liza parsia	Bata	–	–	–	–	–	–	–	–	0.425	–	–	–	–	–	–	–	–	3.196	0.012
185		Rhinomugil corsula	Khorsula	0.127	0.050	–	–	–	–	1.038	0.816	0.149	0.125	–	0.307	0.071	0.004	–	–	–	42.204	0.162
923		Sicamugil cascasia	Bata	–	–	–	–	–	–	–	–	–	0.053	0.277	0.181	0.013	0.040	–	–	–	9.727	0.037
164		Platycephalus indicus	Mur bailla	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.582	5.619	0.022
2		Ailia coila	Kajuli	9.737	0.696	3.353	–	–	–	–	0.310	20.349	8.717	17.952	10.626	4.103	0.148	–	–	0.323	833.737	3.204
51		Clupisoma garua	Ghaura	9.823	4.396	3.037	0.277	5.730	0.040	0.049	–	4.837	4.993	9.112	4.801	1.682	1.995	1.384	–	1.178	540.860	2.079
52		Clupisoma naziri	Muri bacha	0.581	–	–	–	–	–	–	–	1.369	–	–	–	0.037	0.282	–	–	–	30.124	0.116
196		Silonia silondia	Shillong	0.271	0.017	–	–	–	–	–	–	–	–	–	–	0.137	0.395	–	0.914	–	52.690	0.203
16		Bagarius bagarius	Baghair	0.142	9.272	–	–	–	–	–	–	–	–	–	0.839	–	–	–	–	–	13.865	0.053
74		Erethistes pussilus	Kutakanti	–	–	–	–	0.458	–	–	–	–	–	–	–	–	0.003	–	0.031	–	0.925	0.004
77		Gagata cenia	Kauwa	–	–	–	–	0.052	0.047	0.059	–	–	–	–	–	0.181	–	0.017	–	–	10.093	0.039
80		Gagata viridescens	Gang tengra	–	–	–	0.106	0.067	–	–	–	10.672	0.078	0.019	0.136	0.008	–	–	0.204	–	88.868	0.342
81		Gagata youssoufi	Gang tengra	1.031	–	4.460	0.853	0.542	–	–	0.270	6.725	1.622	2.206	1.988	0.660	1.314	0.151	0.308	0.027	257.948	0.991
84		Glyptothorax tekchitta	Tekchitta	–	–	–	–	–	–	–	–	–	–	0.730	1.045	0.364	–	–	–	–	40.618	0.156
958		Glyptothorax sp	Lal moina	–	–	–	–	–	–	–	–	–	–	–	0.087	–	–	–	–	–	1.446	0.006
87		Hara hara	Kutakanti	–	0.804	0.003	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
95		Johnius coitor	Koitor	–	–	–	–	–	–	0.013	–	–	–	–	–	–	–	–	–	–	0.300	0.001
171		Psilorhynchus balitora	Balitora	–	–	–	–	–	–	–	–	–	–	–	0.062	–	–	–	–	–	1.032	0.004
158		Pangasius pangasius	Pangas	–	–	–	–	–	–	–	–	–	–	–	–	–	0.027	–	–	–	1.711	0.007
	Subtotal			26.079	18.214	14.971	2.602	8.230	7.576	3.322	17.053	51.224	64.555	53.320	30.743	10.541	9.811	2.057	2.069	4.252	3909.507	15.026
130	Migratory	Aorichthys aor	Ayre	0.522	0.936	1.426	14.305	2.066	0.058	0.180	–	–	0.470	1.957	1.323	0.181	2.393	0.470	0.327	5.051	286.851	1.103
135		Aorichthys seenghala	Guizza	–	–	0.261	0.184	–	0.346	1.098	–	–	–	–	0.759	0.038	0.983	0.138	0.087	–	111.173	0.427
24		Batasio batasio	Tengra	–	–	–	–	–	–	–	–	–	–	–	0.022	–	–	–	–	–	0.360	0.001
131		Mystus bleekeri	Gobha tengra	3.457	2.746	10.731	0.598	1.571	6.738	4.637	8.677	0.079	1.642	1.033	3.157	3.050	3.423	3.390	12.298	6.645	1126.887	4.331
132		Mystus cavasius	Kabashi	1.639	2.170	8.202	41.723	21.122	18.728	12.296	7.575	1.674	0.784	1.545	0.313	2.147	9.021	13.913	30.612	7.054	2414.147	9.279
32		Catla catla	Catla	–	–	–	–	–	–	–	–	–	–	–	5.428	3.017	–	–	–	–	221.622	0.852
48		Cirrhinus reba	Raik	2.146	2.223	4.816	0.164	0.955	0.997	–	–	–	–	2.596	6.950	1.874	0.590	0.151	0.258	2.960	307.268	1.181
100		Labeo bata	Bata	0.426	3.868	0.088	0.562	0.017	–	–	–	–	–	–	0.048	0.826	–	–	0.653	–	52.038	0.200
102		Labeo calbasu	Kalbaus	–	1.104	0.588	–	–	–	1.644	–	–	0.076	–	0.055	3.942	12.580	1.485	12.894	8.123	1448.282	5.567
107		Labeo rohita	Rui	–	–	–	–	–	–	–	–	–	–	–	3.675	0.016	–	–	–	–	61.433	0.236
188		Salmostoma bacaila	Katari	0.387	0.469	0.008	–	–	3.483	–	–	–	–	–	–	–	0.034	0.130	0.191	–	33.949	0.130
189		Salmostoma phulo	Fukchela	0.317	0.616	2.041	2.071	–	2.113	4.545	–	1.016	0.053	0.920	1.057	0.469	1.925	1.267	3.676	0.936	431.452	1.658
154		Securicula gora	Chora chela	–	–	0.015	–	–	–	–	–	0.295	–	–	–	–	–	–	0.879	0.163	24.163	0.093
86		Gudusia chapra	Chapila	7.651	1.433	–	0.187	–	1.334	0.188	0.013	0.244	0.785	–	3.272	1.786	0.817	0.167	–	0.054	217.324	0.835
76		Eutropiichthys vacha	Bacha	–	1.393	–	–	–	–	–	0.108	4.466	0.099	1.318	3.692	–	–	–	–	–	110.427	0.424
169		Pseudeutropius atherinoides	Batasi	1.348	1.794	0.006	–	0.764	1.370	0.146	0.477	–	0.049	–	–	0.129	1.760	0.797	0.824	3.811	218.063	0.838
209		Wallagu attu	Boal	1.797	0.091	24.734	7.223	3.616	–	0.620	–	–	0.536	–	2.548	4.074	4.053	30.030	1.762	6.153	1563.337	6.009
144		Notopterus chitala	Chital	–	–	–	–	–	–	–	–	–	–	–	–	1.675	–	0.098	–	–	76.326	0.293
142		Nemacheilus scaturigina	Dari	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.020	–	–	0.645	0.002
216		Nemacheilus zonalternans		–	–	–	–	–	–	–	–	–	–	–	0.059	–	–	–	–	–	0.974	0.004
	Subtotal			19.691	18.842	52.915	67.017	30.110	35.167	25.353	16.850	7.774	4.494	9.369	32.357	23.222	37.578	52.054	64.460	40.950	8706.721	33.465

Note: – denotes zero catch

(Cont.)

Table 5.17 Monthly catch composition (% by weight) from the Karatoya River: inside BRE (site NW15)

Species	Habitat	Species name		Year: 1992			Year: 1993												Year: 1994		Total annual catch (Mar'93 – Feb'94)	
Code	Preference	Scientific	Bengali	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Kg	%
136	Floodplain	*Mystus tengara*	*Bajari tengra*	0.754	–	0.240	0.229	0.146	0.065	–	–	–	–	–	0.087	–	0.005	0.055	0.213	0.291	11.717	0.045
137	Resident	*Mystus vittatus*	*Tengra*	1.723	2.699	2.866	0.814	0.345	1.054	1.187	1.903	–	0.065	0.460	–	0.453	2.625	2.257	7.215	5.517	538.432	2.069
55		*Colisa fasciatus*	*Khalisha*	–	–	0.030	–	–	–	–	–	–	–	–	0.005	0.090	0.050	–	–	–	7.239	0.028
211		*Colisa labiosus*	*Khalisha*	–	–	–	–	–	–	–	–	–	0.042	–	–	0.015	–	–	–	–	1.286	0.005
57		*Colisa sota*	*Khalisha*	0.023	0.003	0.011	–	–	–	–	0.027	–	–	–	–	0.516	–	–	–	–	22.802	0.088
210		*Xenentodon cancila*	*Kakka*	8.860	3.494	2.478	0.575	0.473	0.818	3.552	–	–	–	–	0.233	1.698	3.574	0.753	2.301	1.315	484.583	1.863
60		*Ctenopharyngodon idellus*	*Gheso carp*	–	–	–	–	–	–	–	–	–	–	–	–	1.457	–	–	–	–	63.703	0.245
187		*Osteobrama cotio cotio*	*Keti*	0.013	2.807	0.437	0.415	0.577	0.171	0.138	0.335	–	0.159	0.105	–	0.117	0.438	0.406	0.343	3.274	96.635	0.371
174		*Puntius chola*	*Chala puti*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.143	–	3.303	0.013
175		*Puntius conchonius*	*Canchan puti*	–	5.483	1.245	2.183	1.184	4.671	8.415	8.821	0.788	0.030	0.102	0.023	3.209	4.170	0.265	0.077	0.065	728.747	2.801
176		*Puntius gelius*	*Gilliputi*	–	–	–	–	–	–	–	–	–	–	–	–	0.018	–	–	–	0.393	4.596	0.018
177		*Puntius guganio*	*Mola puti*	–	–	–	0.031	0.383	0.142	0.138	–	–	–	–	–	–	0.004	–	–	–	4.303	0.017
178		*Puntius phutunio*	*Phutani puti*	–	–	–	0.021	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
180		*Puntius sophore*	*Puti*	4.730	2.023	0.512	0.497	0.849	2.448	0.860	1.287	0.490	0.607	0.021	0.144	9.625	4.495	1.563	1.810	6.233	925.504	3.557
181		*Puntius terio*	*Teri punti*	0.052	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
212		*Puntius ticto*	*Tit puti*	4.811	0.588	–	0.030	0.004	0.011	–	–	–	–	–	–	–	0.074	–	–	–	4.835	0.019
5		*Amblypharyngodon mola*	*Mola*	–	–	–	0.123	–	0.009	–	–	–	–	0.307	0.070	4.524	–	–	–	–	202.125	0.777
68		*Danio devario*	*Chebli*	–	–	0.002	–	–	–	0.148	–	–	–	0.655	0.388	0.106	–	–	–	0.023	21.289	0.082
75		*Esomus danricus*	*Darkina*	–	–	0.002	1.277	–	–	–	–	0.044	–	–	0.019	0.039	0.018	–	–	–	3.517	0.014
182		*Rasbora daniconius*	*Darkina*	0.132	0.009	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
83		*Glossogobius giurus*	*Bailla*	5.820	3.720	5.155	3.404	13.461	11.356	19.976	16.437	8.663	6.637	5.503	1.910	6.651	2.702	1.751	0.904	1.861	1484.894	5.707
110		*Lepidocephalus guntea*	*Gutum*	2.028	0.276	1.305	0.488	0.578	2.527	1.625	0.530	0.225	0.236	–	–	0.427	0.560	0.228	0.009	0.645	131.991	0.507
9		*Aplocheilus panchax*	*Kanpona*	0.017	0.004	–	–	–	–	–	–	–	–	–	–	0.027	–	–	–	–	1.195	0.005
39		*Channa marulius*	*Gajar*	0.027	0.014	–	–	–	–	–	–	–	–	–	–	–	0.093	–	–	–	6.000	0.023
41		*Channa punctatus*	*Taki*	0.382	0.045	0.614	–	–	0.409	0.291	0.013	0.121	0.397	–	0.281	0.005	4.154	0.423	0.043	0.064	304.282	1.170
88		*Heteropneustes fossilis*	*Shingi*	0.279	0.011	–	–	–	–	0.061	–	–	–	–	–	–	0.079	0.369	–	–	18.300	0.070
121		*Macrognathus aculeatus*	*Tara baim*	0.020	–	–	–	–	–	0.474	0.217	–	–	0.988	–	0.932	0.214	–	0.065	0.624	84.798	0.326
123		*Macrognathus pancalus*	*Guchi*	2.976	0.170	2.102	0.017	1.662	5.909	4.365	10.344	1.195	0.132	0.153	0.708	0.338	3.320	1.980	0.974	5.822	626.397	2.408
122		*Mastacembelus armatus*	*Baral baim*	3.819	23.695	2.394	3.461	0.891	0.697	1.383	9.869	–	0.141	–	9.661	6.521	14.202	19.946	0.973	9.429	2239.127	8.606
15		*Badis badis*	*Napit koi*	–	–	0.002	0.031	0.038	0.043	–	–	–	–	–	–	0.281	0.003	–	–	–	12.731	0.049
147		*Ompok bimaculatus*	*Kani pabda*	–	0.018	–	0.266	1.675	–	–	–	–	0.309	–	–	0.865	–	1.300	–	0.649	90.113	0.346
148		*Ompok pabda*	*Madhu pabda*	–	–	–	–	–	–	–	–	–	–	0.094	–	–	1.787	1.369	–	–	160.060	0.615
145		*Notopterus notopterus*	*Foli*	0.115	4.043	–	–	–	–	–	–	–	–	–	–	1.907	0.167	2.425	0.076	1.151	184.484	0.709
203		*Tetraodon cutcutia*	*Potka*	–	–	0.876	0.614	0.879	0.131	–	0.094	–	–	–	0.089	1.468	0.366	0.332	0.015	–	101.970	0.392
35		*Chanda baculis*	*Chanda*	1.386	3.160	0.002	0.634	0.041	0.009	–	0.586	–	–	1.380	0.350	0.855	0.117	0.698	0.383	1.180	112.604	0.433
36		*Chanda nama*	*Nama chanda*	2.932	0.720	0.505	3.130	0.038	1.709	0.273	0.183	1.579	0.484	1.064	0.982	0.935	0.594	0.490	0.333	0.322	170.962	0.657
37		*Chanda ranga*	*Lal chanda*	0.447	–	0.292	0.250	–	0.171	–	0.052	0.151	0.047	1.881	0.383	4.657	2.133	0.048	0.130	3.759	410.956	1.580
	Subtotal			41.345	52.983	21.069	18.491	23.223	32.351	42.884	50.698	13.256	9.286	12.714	15.332	47.737	45.944	36.657	16.006	42.616	9265.480	35.612
998	Others	Unidentified fish		–	–	–	–	0.038	–	–	–	–	–	–	–	–	–	–	–	–	–	–
120		*Macrobrachium rosenbergii*	*Golda*	–	–	–	–	–	–	–	–	–	–	–	–	0.626	–	–	–	–	27.383	0.105
931		Prawn spp.	*Chingri/Icha*	12.884	9.960	11.045	11.889	38.398	24.905	28.440	15.399	27.745	21.665	24.596	21.566	17.873	6.666	9.230	17.464	12.181	4108.685	15.792
	Subtotal			12.884	9.960	11.045	11.889	38.436	24.906	28.440	15.399	27.745	21.665	24.596	21.566	18.499	6.666	9.230	17.464	12.181	4136.068	15.897
	Grand total			100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	26017.776	100

Note: – denotes zero catch

Table 5.18 Monthly catch composition (% by weight) from the Jamuna River: outside BRE (site NW01)

Species Code	Habitat Preference	Species name: Scientific	Species name: Bengali	Year: 1992 Aug	Sep	Oct	Nov	Dec	Year: 1993 Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec	Year: 1994 Jan	Feb	Total annual catch (Mar'93 – Feb'94) kg	%
186	Riverine	*Rita rita*	*Rita*	–	0.688	0.577	0.017	7.823	0.116	0.074	0.436	2.218	0.712	9.405	–	0.661	1.008	1.120	–	–	–	–	317.949	0.895
13		*Aspidoparia morar*	*Piali*	0.115	0.859	0.876	0.323	1.250	3.129	50.152	19.078	9.203	8.646	0.346	28.804	0.791	2.897	1.831	3.752	20.188	35.990	6.574	3702.267	10.420
59		*Crossocheilus latius*	*Kalabata*	–	–	–	–	1.913	10.306	–	–	–	–	–	0.324	3.837	1.075	3.430	2.328	2.769	3.966	1.734	636.722	1.763
139		*Nemacheilus botia*	*Balichata*	–	–	–	–	–	–	0.060	–	–	0.123	0.295	0.109	0.055	–	0.0001	0.067	0.138	0.115	0.268	38.723	0.109
28		*Botia dario*	*Rani*	–	–	0.024	–	2.704	0.877	1.093	1.305	0.938	–	–	0.032	0.441	0.180	0.021	0.062	0.098	0.292	0.019	58.213	0.164
89		*Hilsa ilisha*	*Ilish*	72.388	42.342	52.392	38.039	2.595	25.386	8.388	39.514	8.964	2.841	17.166	1.833	–	19.690	4.105	0.578	11.529	4.796	10.192	2828.553	7.961
58		*Corica soborna*	*Kachki*	–	–	–	–	–	–	0.053	–	–	0.439	–	–	–	–	–	–	–	–	–	14.871	0.042
193		*Setipinna phasa*	*Phasa*	–	0.521	0.110	1.523	0.048	–	–	0.399	–	–	–	–	–	0.066	0.670	0.019	–	0.008	–	29.008	0.082
30		*Brachygobius nunus*	*Nunabailla*	–	–	–	–	–	0.561	2.705	2.569	1.945	0.280	–	0.349	0.127	–	–	–	0.189	0.690	1.758	197.491	0.556
128		*Liza parsia*	*Bata*	–	0.032	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–		–
922		*Liza sp*	*Bata*	–	–	–	–	–	–	–	–	–	–	–	0.912	–	0.586	0.238	–	–	–	–	61.304	0.173
185		*Rhinomugil corsula*	*Khorsula*	0.552	1.730	0.178	0.170	–	–	1.107	0.740	1.714	1.250	0.354	4.074	0.991	12.803	0.670	0.077	2.790	0.086	0.648	855.003	2.406
923		*Sicamugil cascasia*	*Bata*	–	–	0.171	0.103	–	0.113	–	–	–	–	–	–	–	–	3.341	0.850	0.415	0.015	–	151.264	0.426
2		*Ailia coila*	*Kajuli*	–	–	–	0.370	14.996	3.630	0.074	10.188	1.398	4.877	13.005	4.462	3.654	2.643	1.022	1.482	4.201	3.528	13.133	1905.533	5.363
51		*Clupisoma garua*	*Ghaura*	0.230	3.740	15.734	44.800	4.980	1.072	–	3.460	2.393	2.166	36.091	8.473	7.054	10.915	34.096	54.631	16.857	24.891	10.758	7201.643	20.270
196		*Silonia silondia*	*Shillong*	–	–	0.975	0.633	0.233	–	–	0.153	0.962	2.855	1.612	1.092	0.217	0.045	0.132	1.574	–	1.653	–	321.204	0.904
16		*Bagarius bagarius*	*Baghair*	20.236	–	–	–	23.681	–	0.909	1.092	3.537	–	–	0.413	30.143	–	0.275	–	–	–	–	812.939	2.288
77		*Gagata cenia*	*Kauwa*	0.046	0.225	0.059	0.011	1.177	0.058	0.035	0.129	0.422	–	0.077	0.279	2.333	0.335	0.132	0.024	–	0.025	0.254	108.442	0.305
78		*Gagata gagata*	*Gang tengra*	–	0.385	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–		–
79		*Gagata nangra*	*Gang tengra*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2.671	1.874	1.252	160.995	0.453
81		*Gagata youssoufi*	*Gang tengra*	–	1.330	–	0.538	11.247	26.246	0.545	0.590	14.919	0.997	2.042	2.104	0.652	2.428	8.320	3.664	5.758	3.670	6.815	1424.694	4.010
197		*Sisor rhabdophorus*	*Sisor*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.061	3.547	0.010
155		*Pama pama*	*Poa*	–	–	–	–	2.177	–	0.338	2.684	–	–	–	–	–	–	0.003	–	–	–	0.910	82.089	0.231
955		*Amblyceps mangois*	*Magur*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.044	–	–	–	0.038	3.558	0.010
	Subtotal			93.567	51.851	71.095	86.528	74.824	71.495	65.530	82.336	48.614	25.185	80.394	53.258	50.955	54.671	59.449	69.108	67.601	81.598	54.412	20916.012	58.841
130	Migratory	*Aorichthys aor*	*Ayre*	–	–	0.008	0.002	–	–	–	–	–	0.018	14.224	2.189	6.639	7.828	0.327	0.001	1.387	–	–	850.146	2.393
135		*Aorichthys seenghala*	*Guizza*	0.068	6.098	0.381	5.584	–	–	–	–	–	–	–	–	–	–	–	–	–	2.243	–	75.778	0.213
131		*Mystus bleekeri*	*Golsha tengra*	–	0.039	–	–	–	–	–	–	–	–	–	–	–	–	0.005	0.067	0.078	0.256	0.254	27.743	0.078
132		*Mystus cavasius*	*Kabashi*	–	–	0.008	0.230	3.280	1.789	0.156	0.787	0.285	–	–	1.278	2.632	1.036	1.302	0.360	2.511	0.327	0.325	273.026	0.768
32		*Catla catla*	*Catla*	–	–	–	–	–	–	–	–	–	–	0.009	1.000	3.937	–	–	–	–	–	–	129.884	0.366
47		*Cirrhinus mrigala*	*Mrigel*	–	–	–	–	–	–	–	–	–	–	–	–	–	0.403	–	–	–	–	–	16.797	0.047
48		*Cirrhinus reba*	*Raik*	–	–	0.065	0.064	–	–	1.811	0.085	–	–	–	0.595	–	0.318	0.940	1.322	0.138	0.301	1.071	204.265	0.575
100		*Labeo bata*	*Bata*	–	–	0.459	0.157	0.117	2.855	–	–	–	–	–	–	1.678	13.987	2.429	0.303	1.383	3.180	–	836.119	2.353
102		*Labeo calbasu*	*Kalbaus*	–	–	–	–	3.450	–	0.501	0.466	–	–	–	0.081	0.508	–	–	1.341	–	–	–	89.395	0.252
107		*Labeo rohita*	*Rui*	–	0.158	–	–	–	–	–	–	–	–	–	1.631	–	–	–	–	–	–	–	52.756	0.148
44		*Chela laubuca*	*Kash khaira*	–	–	–	–	–	–	–	–	0.057	–	–	–	–	0.015	0.008	0.011	–	–	–	1.992	0.006
188		*Salmostoma bacaila*	*Katari*	–	0.047	5.876	1.034	0.175	0.169	0.370	0.102	2.120	–	1.103	13.279	0.784	6.001	4.035	7.082	3.173	5.151	8.776	1944.236	5.472
189		*Salmostoma phulo*	*Fulchela*	–	–	0.098	–	–	–	0.017	–	–	0.082	0.059	1.344	0.004	0.271	0.239	0.313	0.010	0.023	–	83.127	0.234
154		*Securicula gora*	*Chora chela*	3.125	9.629	0.451	–	–	–	–	1.596	–	–	–	0.340	–	0.332	0.046	–	–	–	0.339	63.276	0.178
86		*Gudusia chapra*	*Chapila*	–	0.079	0.293	0.045	–	–	1.234	–	7.885	–	–	0.155	–	–	0.088	2.088	0.141	0.115	0.721	237.386	0.668
76		*Eutropiichthys vacha*	*Bacha*	–	–	–	0.173	–	–	–	–	–	–	0.267	1.247	–	–	0.166	0.251	–	0.738	0.842	137.204	0.386
169		*Pseudeutropius atherinoides*	*Batasi*	2.068	12.955	1.644	0.248	–	–	–	0.015	–	0.059	0.099	0.037	–	0.015	0.053	0.008	–	0.017	–	8.399	0.024
209		*Wallagu attu*	*Boal*	–	–	–	–	–	–	–	–	–	–	–	0.044	–	–	12.820	9.601	6.291	–	–	950.598	2.676
	Subtotal			5.262	29.006	9.283	7.537	7.022	4.814	4.088	3.052	10.348	0.158	15.761	23.219	16.181	30.205	22.457	22.749	15.112	12.350	12.327	5982.127	16.837

(Cont.)

Table 5.18 Monthly catch composition (% by weight) from the Jamuna River: outside BRE (site NW01)

Species Code	Habitat Preference	Species name: Scientific	Species name: Bengali	Year: 1992 Aug	Sep	Oct	Nov	Dec	Year: 1993 Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec	Year: 1994 Jan	Feb	Total annual catch (Mar'93 – Feb'94) kg	%
136	Floodplain	*Mystus tengara*	*Bajari tengra*	–	–	0.037	0.040	–	–	0.220	–	–	–	–	–	–	–	–	–	–	–	–	–	–
137	Resident	*Mystus vittatus*	*Tengra*	–	–	–	–	–	–	–	0.060	–	–	–	–	–	–	0.228	0.104	–	–	0.078	17.591	0.050
55		*Colisa fasciatus*	*Khalisha*	–	–	–	–	–	–	–	–	–	0.123	–	0.251	0.199	0.187	–	–	–	–	–	24.997	0.070
57		*Colisa sota*	*Khalisha*	0.023	0.102	0.024	–	–	–	–	–	–	0.082	–	0.064	–	–	–	–	–	–	–	4.834	0.014
210		*Xenentodon cancila*	*Kaikka*	–	–	–	0.481	–	–	0.106	–	–	–	–	0.180	0.038	0.015	0.005	0.416	0.310	–	–	31.889	0.090
187		*Osteobrama cotio cotio*	*Keti*	–	0.347	0.049	–	–	–	–	–	–	–	–	0.064	–	0.090	0.200	0.060	0.068	–	0.122	22.840	0.064
175		*Puntius conchonius*	*Canchan puti*	–	–	–	–	0.073	–	1.269	1.112	17.044	27.195	0.122	1.108	0.064	0.312	1.472	0.081	0.492	0.263	0.367	1232.600	3.469
176		*Puntius gelius*	*Giliputi*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.001	0.109	–	–	–	5.619	0.016
178		*Puntius phutunio*	*Phutani puti*	–	–	–	–	–	–	–	–	–	–	–	0.015	–	–	0.132	–	–	–	–	4.539	0.013
180		*Puntius sophore*	*Puti*	–	–	1.367	1.474	–	0.113	0.078	–	–	0.100	–	2.575	0.563	1.175	0.799	0.129	0.092	–	0.234	195.338	0.550
212		*Puntius ticto*	*Tit puti*	–	0.118	0.421	0.354	–	–	–	–	–	–	–	–	–	–	0.002	0.008	0.029	–	–	0.721	0.002
5		*Amblypharyngodon mola*	*Mola*	–	–	–	–	–	–	–	–	–	–	–	0.022	–	–	–	–	–	–	–	0.716	0.002
75		*Esomus danricus*	*Darkina*	–	–	0.012	–	–	–	–	–	–	0.157	0.255	1.560	0.661	0.145	0.263	0.002	0.044	–	–	91.587	0.258
83		*Glossogobius giurus*	*Bailla*	–	0.607	1.420	0.424	0.700	3.824	18.732	2.992	7.398	2.925	0.577	0.969	0.923	0.454	2.633	0.299	1.031	0.618	4.216	657.798	1.851
43		*Chela cachius*	*Chep chela*	–	–	0.146	0.120	–	0.056	–	–	0.033	0.082	–	0.160	0.064	0.326	0.134	0.282	0.010	0.028	–	43.130	0.121
110		*Lepidocephalus guntea*	*Gutum*	–	–	0.016	0.017	–	–	0.035	–	–	–	–	0.104	0.008	–	0.237	0.003	0.043	0.025	–	12.292	0.035
9		*Aplocheilus panchax*	*Kanpona*	–	–	–	–	–	–	–	–	–	–	–	0.015	–	–	–	–	–	–	–	0.477	0.001
41		*Channa punctatus*	*Taki*	–	–	0.075	0.054	–	–	–	–	–	0.393	0.352	2.205	7.874	0.838	0.682	0.000	0.084	–	–	342.709	0.965
49		*Clarias batrachus*	*Magur*	–	–	–	–	–	–	–	–	–	–	–	0.089	–	–	–	–	–	–	–	2.863	0.008
121		*Macrognathus aculeatus*	*Tara baim*	–	–	–	–	–	–	–	–	0.358	–	–	0.280	–	–	–	–	–	–	–	12.468	0.035
123		*Macrognathus pancalus*	*Guchi*	–	0.111	0.057	0.002	–	–	0.121	–	–	3.384	–	0.147	0.042	0.077	0.223	0.015	–	–	–	131.365	0.370
122		*Mastacembelus armatus*	*Baral baim*	–	0.197	0.039	0.010	0.265	0.070	1.431	–	–	0.064	–	0.022	0.165	0.015	1.165	3.687	2.858	0.257	0.513	298.849	0.841
15		*Badis badis*	*Napit koi*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.144	–	–	–	–	4.427	0.012
147		*Ompok bimaculatus*	*Kani pabda*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.444	–	–	0.007	23.272	0.066
148		*Ompok pabda*	*Madhu pabda*	–	–	–	–	2.063	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
203		*Tetraodon cutcutia*	*Potka*	–	–	–	–	–	–	–	–	–	0.082	–	–	–	–	–	–	–	–	–	2.776	0.008
35		*Chanda baculis*	*Chanda*	–	–	–	–	–	–	–	–	–	–	–	0.176	0.008	–	0.279	0.005	–	–	–	14.766	0.042
36		*Chanda nama*	*Nama chanda*	–	–	–	–	0.088	–	–	–	–	0.409	0.020	0.428	0.076	0.452	0.209	0.298	0.108	0.022	–	72.342	0.204
37		*Chanda ranga*	*Lal chanda*	–	0.016	0.030	0.006	–	–	–	–	–	0.041	0.059	0.454	0.114	0.101	0.177	–	–	–	–	29.628	0.083
	Subtotal			0.023	1.498	3.692	2.981	3.189	4.063	21.991	4.164	24.833	35.036	1.384	10.886	10.799	4.187	8.983	5.941	5.170	1.212	5.537	3282.433	9.239
998	Others	Unidentified fish		0.046	0.220	0.050	0.438	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
931		Prawn spp.	*Chingri/Icha*	1.103	17.424	15.879	2.514	14.965	19.628	8.390	10.446	16.205	39.621	2.462	12.635	22.065	10.935	9.109	0.536	12.116	2.699	27.724	5190.397	14.609
97		*Kachuga tectum*	*Kori kaitya*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2.140	–	72.299	0.203
207		*Trionyx gangeticus*	*Kachhim*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1.665	–	–	–	85.868	0.242
	Subtotal			1.148	17.644	15.929	2.952	14.965	19.628	8.390	10.446	16.205	39.621	2.462	12.635	22.065	10.935	9.109	2.202	12.116	4.838	27.724	5348.564	15.054
	Grand total			100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	35529.136	100

Note: – denotes zero catch

5.5.1 The unregulated Northern Dhaleswari

The numbers of riverine species were lowest from December 1992 to March 1993 (Fig. 5.9). A sharp rise in numbers was seen in May and after some fluctuation between June and July numbers stabilised until well into the flood drawdown in October. Numbers declined fairly rapidly in November and December to reach low levels again in January and February 1994 when most species returned to larger rivers such as the Dhaleswari and Jamuna.

Numbers of migratory species followed a somewhat different pattern. Again, lowest numbers were observed between December 1992 and April 1993. However, there was no sharp rise in May but rather a gradual progressive increase in numbers from May onwards to reach a peak in October and November after which numbers declined rapidly to a stable lower level between December 1993 and February 1994.

Numbers of floodplain resident species followed a different pattern again. Lowest numbers were recorded in February and March but rapidly increased in April to reach an initial peak in May after which numbers declined until August. In September numbers rose sharply to reach a second peak stable level until February 1994. This pattern suggests that there were two influxes of floodplain residents into the river, the first during the pre-monsoon when rainfall runoff drained from floodplains to river and the second during the drawdown again when floodplain runoff entered the river.

In February and March 1993, no riverine or migratory species were present in the Northern Dhaleswari but in May, when rainfall runoff substantially increased river flows, an influx of 8 riverine and 3 migratory species was recorded. These species must have migrated upstream from the Dhaleswari River since the connection with the Jamuna was not yet made due to a low earthen road leading to a ferry ghat at its offtake point which acted as a submersible embankment. The 11 species arriving in May, together with 3 others which appeared in April, comprised 10% of the total monthly catch (Fig. 5.10). The most abundant of these species were *piali* (4%), *bele* (2%) and *fulchela* (2%), but others which gained in abundance later in the season included *kajuli*, *gang tengra* and *golsha tengra*.

In mid-June, Jamuna floodwaters entered the Northern Dhaleswari and adjacent floodplains. Three riverine species, *ghaura*, *baghair* and *kauwa* and one migratory species, *chapila* appeared in catches which increased considerably due mainly to the increased abundance of *kajuli* which accounted for 18% of the catch. In July, there was a further major influx of fish

Figure 5.9 Seasonal variation in the number of riverine, migratory and floodplain resident fish species in the Northern Dhaleswari River

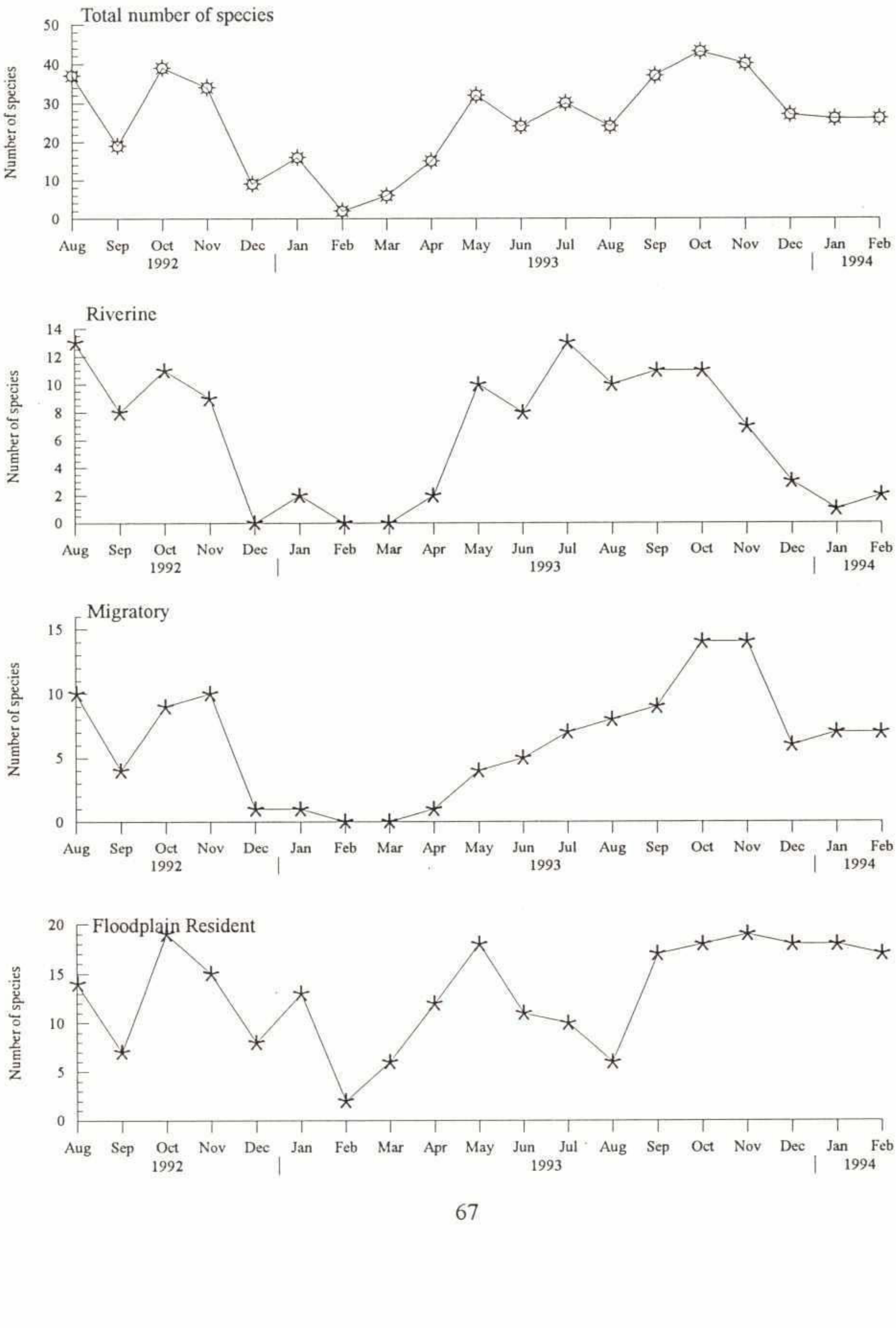

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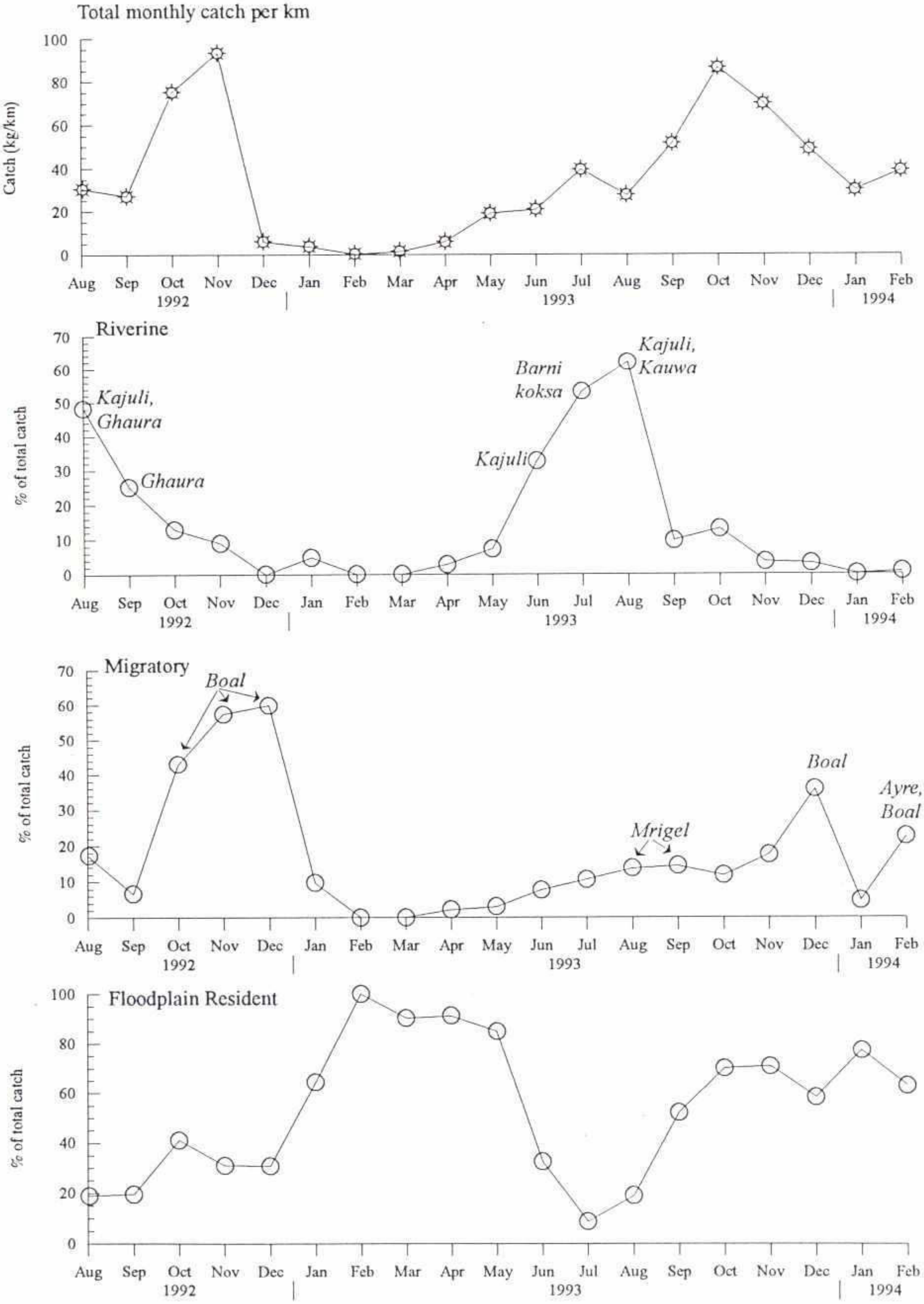
Figure 5.10 Percentage total monthly catch of riverine, migratory and floodplain resident groups of fish from the Northern Dhaleswari River



Notes: 1. See text for definition of different categories of fish based on habitat preference (Section 5.4.1)
2. Dominant species are shown for peak relative abundances of riverine and migratory fish

with the arrival of 6 riverine and 3 migratory species. The most abundant of these were two *Barilius* species (*barni*, *koksa*) which provided 30% of the monthly catch. These species together with *sisor* were found in the Dhaleswari but not in the Jamuna and therefore probably moved upstream from the Dhaleswari whilst the remaining species may have migrated from both the Jamuna and Dhaleswari rivers. While no new riverine species appeared in August, the catch contribution by this group of fish reached a peak (62%) mainly due to the abundance of *kajuli* and *kauwa*. Three migratory species appeared in this month, *guizza*, *mrigel* and *katari*. *Mrigel* was the most abundant species forming 6% of the monthly catch. Data on average weight per individual (58 g) suggested that these were juveniles of the year and probably hatched in May or June[9].

During the drawdown in September and October, 4 new riverine and 5 migratory species appeared but all in relatively low abundance and none forming more than 2% of the monthly catch. Later in the year most riverine species migrated out of the river but several migratory species remained; the most notable were two large catfish species, *boal* and *ayre* captured by *katha*.

5.5.2 The regulated Old Hurasagar

Numbers of riverine species remained low throughout the year with two small peaks in June and October coinciding with the first restricted entry of floodwaters from the Jamuna and with the drawdown later in the year (Fig. 5.11).

Numbers of migratory species followed a different seasonal pattern. Numbers were lowest between December and February, temporarily increased in March but declined to low levels in April and May. In June and July there were slight increases in numbers and these stabilised in August before increasing more sharply during the drawdown in September to reach a peak in October. Numbers dropped equally rapidly in November to low levels from December onwards.

Numbers of floodplain resident species remained fairly stable throughout the year with slight reductions in April, September and December.

In February 1993, only 1 riverine and 1 migratory species were recorded in the Old Hurasagar but in the following month 7 migratory species appeared in catch, not by migration since the river was by this time divided into a series of disconnected pools, but

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Figure 5.11 Seasonal variation in the number of riverine, migratory and floodplain resident fish species in the Old Hurasagar River

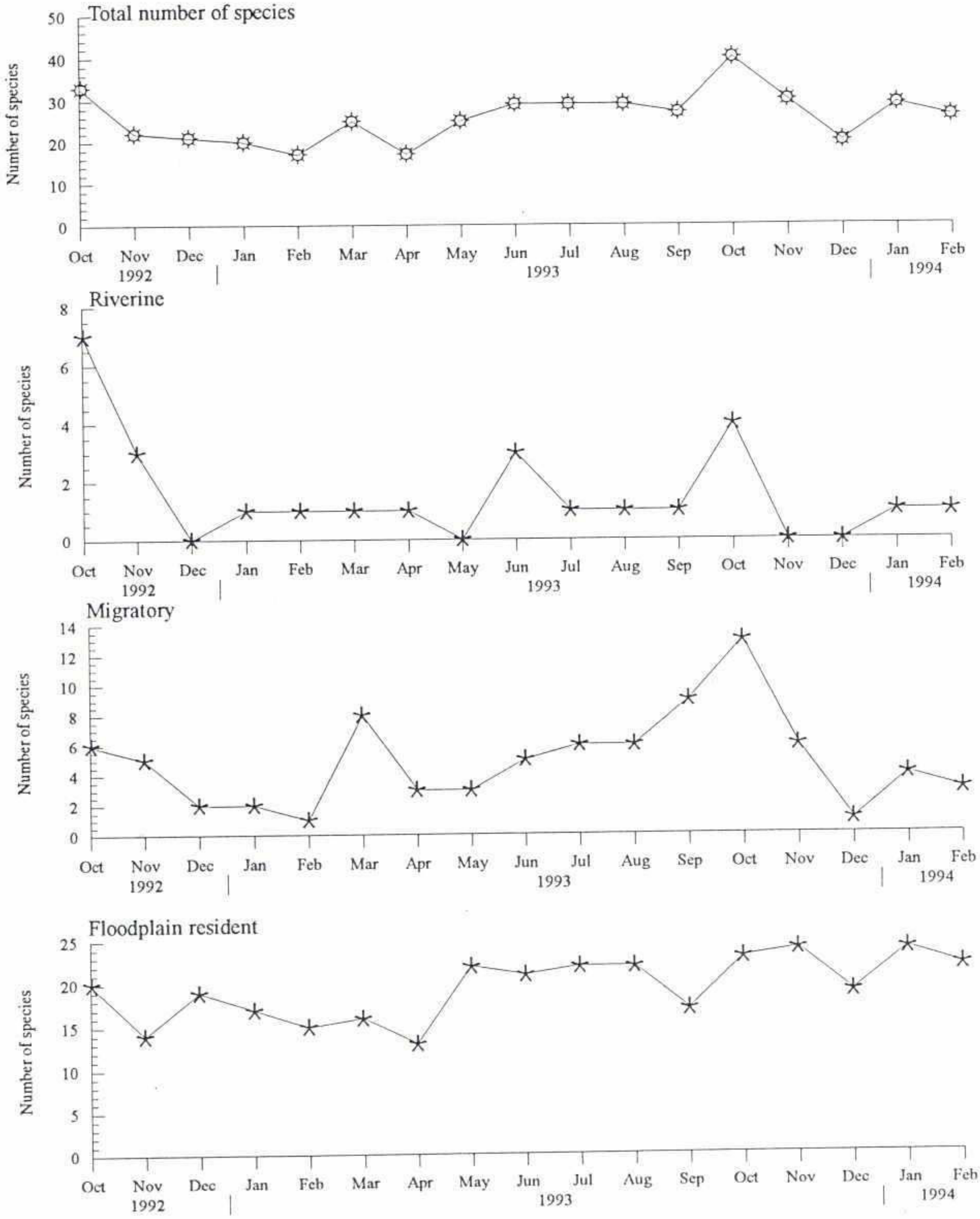
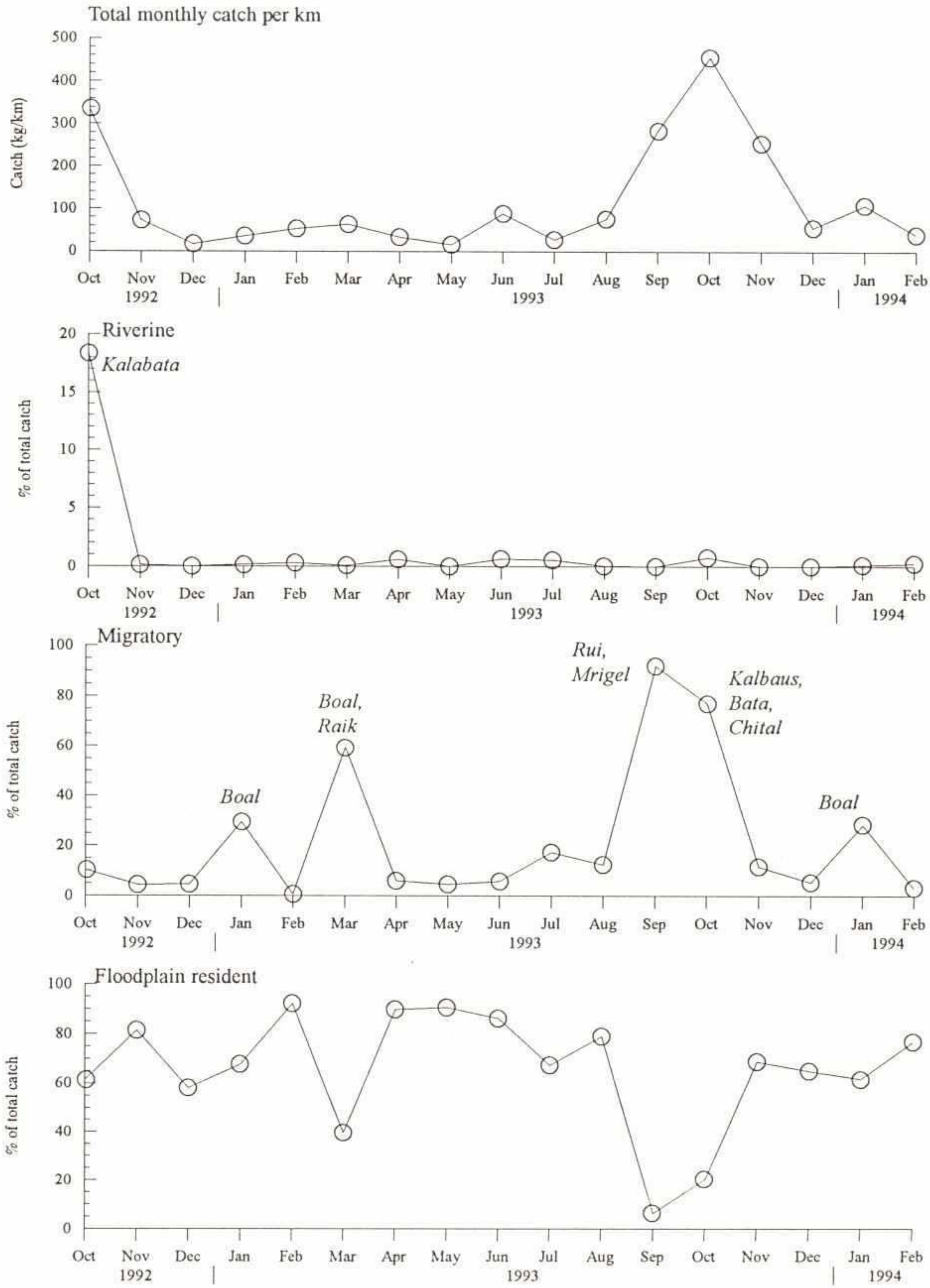


Figure 5.12 Percentage total monthly catch of riverine, migratory and floodplain resident groups of fish from the Old Hurasagar River



Notes: 1. See text for definition of different categories of fish based on habitat preference (Section 5.4.1)
2. Dominant species are shown for peak relative abundances of riverine and migratory fish

from *katha* fishing. The most abundant species by weight were *boal*, *raik* and *rui* which together accounted for 55% of the monthly catch (Fig. 5.12). Between April and May only 1 riverine and 3 migratory species were recorded in any one month. This contrasted with the situation on the unregulated Northern Dhaleswari where there was a large influx of riverine species in May.

In June, 3 new riverine and 2 migratory species appeared in very low abundance in the catch. Of these, *catla*, *chapila* and *ilish* probably entered from the Jamuna through the partially open gates of Bauitara regulator since all were fry with average individual weights of 1 g or less. The other two species, *balichata* and *piali*, were adult fish which may have entered from either the Jamuna or Karatoya or both. No new riverine species was recorded in July but 3 new migratory species appeared, *ayre*, *raik* and *batasi*. *Ayre* were small juveniles (55 g/indv.) while the others were fry of 1 g or less. Contributions to the monthly catch by riverine species remained very low (<1%) but migratory species accounted for 17%, a rise from the previous month's contribution of 6%. In August there were only two new arrivals, 1 riverine species, *nunabailla* fry averaging 1 g and 1 migratory species, juvenile *mrigel* averaging 43 g per individual. The overall catch contribution by migratory species declined slightly in August to 12% while riverine species made a negligible contribution (<0.1%). This pattern again differed greatly from that in the Northern Dhaleswari where riverine species made a peak catch contribution of 62% in August while migratory species provided a further 14%.

During the flood drawdown in September and October, 4 new riverine and 5 migratory species appeared. Riverine species were uncommon, providing less than 1% of monthly catches, but migratory species accounted for a very large share of the catch, ranging from 92% in September to 77% in October when a peak monthly catch for the year was recorded. This contrasted sharply with the pattern of catch from the unregulated Northern Dhaleswari where no major increase in percentage catches of migratory species was observed during the drawdown when they comprised 12%-14% of catches. At the same time the catch contributions of riverine species declined considerably from peaks in July and August to between 10% to 13% of catches during the drawdown. On the Old Hurasagar predominant species during the drawdown included the major carps, *kalbaus*, *rui* and *mrigel* and others such as *chital* and *bata*. Information on average weights per individual fish indicated that all major carps were juveniles of the year ranging in size from 30 to 247 g. Catch compositions from the Jamuna showed that these species were uncommon at this time of year. On the Karatoya, *rui*, *kalbaus* and *bata* were present but they were not particularly abundant while *chital* was very rare and *mrigel* was not recorded at all on this river. The catch distributions suggest that these species originated internally within the Old Hurasagar catchment after entering possibly as hatchlings from the Jamuna. However, as will be shown later in this report (Section 7.5.2), these species were not abundant in the sampled areas and therefore must have originated from elsewhere in the lower catchment. Catches from *urani jal* set on the gates and walls of Bauitara regulator in September and October included juvenile *rui*, *kalbaus*, *raik*, *bata*, *kalabata*, *katari* and *taki*. These fish were captured as they migrated upstream towards the Jamuna River. The regulator effectively blocked those movements and concentrated the fish in the immediate downstream area where they were also captured by *dharma* and *deal* traps. Similar blockage to movements of upstream migrating fish was recorded by FAP 17 in a separate study of Charghat regulation on the Baral River[10].

In November, the percentage catch contribution of migratory species declined considerably to generally low levels which prevailed throughout the winter with the exception of a temporary slight increase in January due largely to a good catch of *boal* from *katha* fishing.

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6 CANAL FISHERIES

6.1 Total Catch

6.1.1 Pattern of catch

Catches from the unregulated Anahula *Khal* and regulated Nandina *Khal* followed a broadly similar seasonal pattern (Fig. 6.1). On Anahula *Khal*, catches remained very low between December and June, rising slightly in July to reach a peak in August. During the drawdown catches were relatively high but not as high as in August. In November catches decreased considerably. On Nandina *Khal*, catches were lowest from December to July, rising slightly in August and reaching a peak in September. This differed from the pattern seen on the unregulated canal where catches began to increase in July and peak in August. A further difference between sites was seen in November when catches remained relatively higher on Nandina *Khal* before decreasing to almost zero levels from December onwards.

6.1.2 Size of catch

Between March 1993 and February 1994, a total annual catch of 1461 kg/km was recorded from Anahula *Khal* compared with 434 kg/km from the regulated Nandina *Khal*, a reduction of 70% in catch (Table 6.1). In terms of catch per unit area, the catch from Anahula was 1,115 kg/ha compared with 523 kg/ha from Nandina, a reduction of 53%.

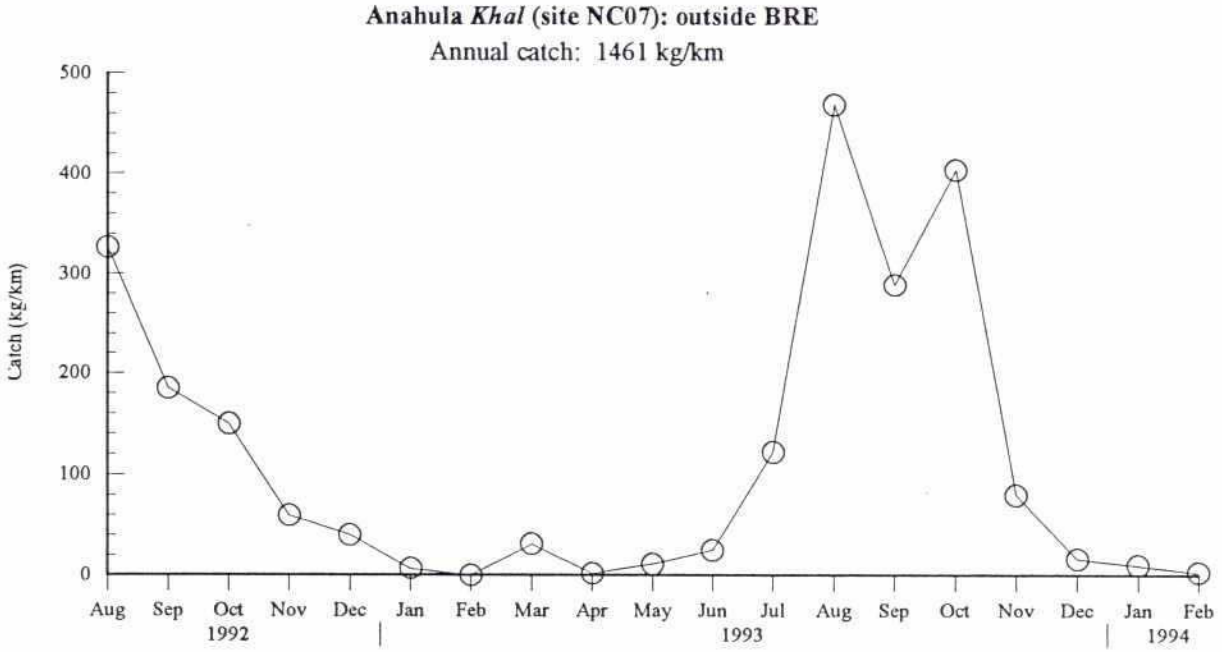
Table 6.1 Annual catch from canal inside and outside the BRE, March 1993 - February 1994

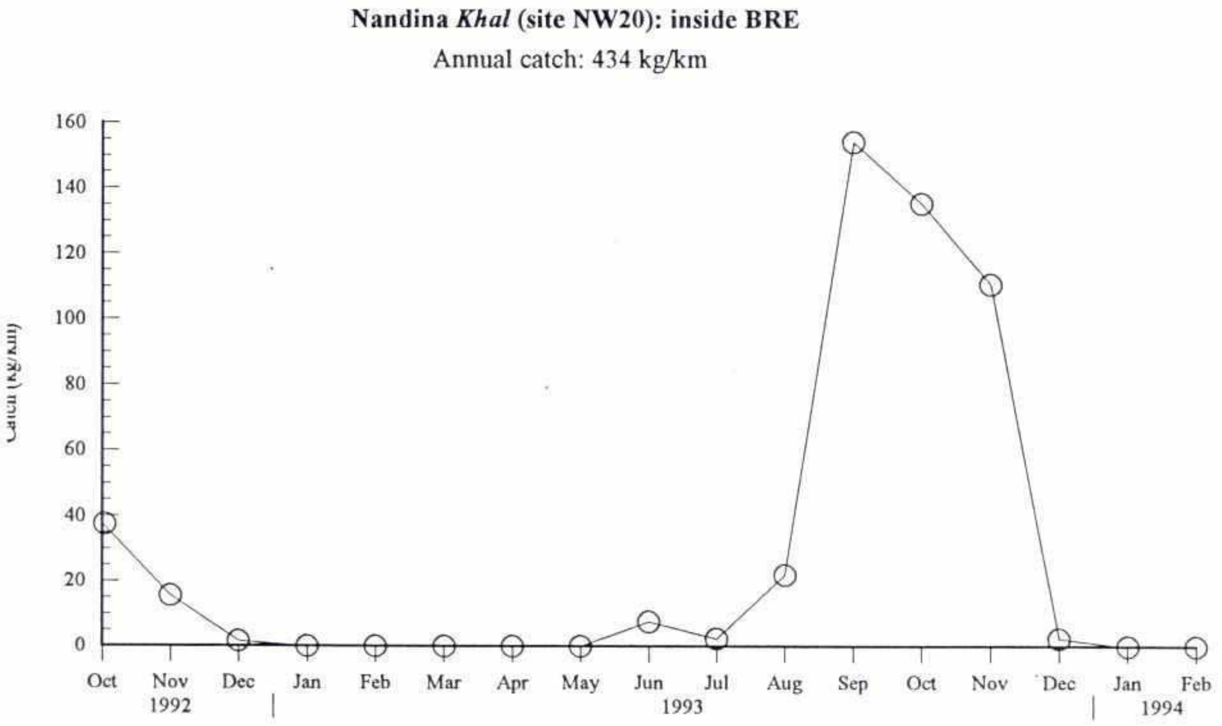
Site Code	Site name	Inside/ Outside BRE	Catch per unit area	
			kg/km	kg/ha
NC07	Anahula *Khal*	Outside	1461	1115
NW20	Nandina *Khal*	Inside	434	523

Note: Values of catch are rounded to nearest whole number

Statistical comparisons of catch rates of dominant gears used in these canals revealed no significant difference in underlying fish densities and that the substantially higher catch from the free-flooding canal resulted from the increased fishing effort by dominant gears (see Section 6.3).

Figure 6.1 Seasonal variation in the catch per unit length from canals inside and outside the BRE





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6.1.3 Comparison of catch between years

Comparisons of canal catches between 1992/93 and 1993/94 were made at sites inside and outside the BRE following the procedure outlined in Section 5.1.3. In both the regulated and unregulated canals, catches were considerably lower in the drier year of 1992/93 (Table 6.2). A similar result was found in rivers (Table 5.2). The total catch from each year was then divided into different groups of fish based on habitat preference: riverine, migratory and floodplain resident species (see Section 5.4.1 for definitions). Catches of floodplain resident species were lower in both canals during the drier year but reductions in catch were higher in the regulated canal (Table 6.3). Lower catches of floodplain resident species from rivers were also found in the drier year but catch differences between years were greater in the unregulated river. No riverine or migratory species were found in Nandina *Khal* during the periods when comparisons were made between years (October - February). On the unregulated Anahula *Khal*, catches of riverine species were higher in the drier year, a result also seen in rivers, but migratory species were less abundant. The results agree with patterns predicted on the basis of inter-annual changes in flood magnitude and extent and their impact on floodplain dependent species (see Section 5.1.3 for more detailed discussion).

Table 6.2 Comparison of the total catch (kg/km) from canals inside and outside the BRE between different years

Site code	Site name	Inside/Outside BRE	Catch		% Reduction in catch in 92/93
			1992-1993	1993-1994	
NC07	Anahula	Outside	767	1265	39
NW20	Nandina	Inside	55	248	78

Note: *Katha* catches were excluded from analyses (see Section 5.1.3)

Table 6.3 Comparison of the total catch (kg/km) of riverine, migratory and floodplain resident fish from canals inside and outside the BRE between different years

Site code	Site name	Inside/ Outside BRE	Riverine CPUA			Migratory CPUA			Floodplain Resident CPUA		
			1992-1993	1993-1994	% change in 92/93	1992-1993	1993-1994	% change in 92/93	1992-1993	1993-1994	% change in 92/93
NC07	Anahula	Outside	69	11	+ 471	196	547	- 64	499	548	- 9
NW20	Nandina	Inside	-	-	-	-	-	-	54	223	- 76

Note: *Katha* catches were excluded from the analyses (see Section 5.1.3)

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6.2 Pattern of Fishing

6.2.1 Catch by gear

Percentage contributions made by dominant gears to annual catches from regulated and unregulated canals are presented in Table 6.4. More detailed information on monthly catches from all observed gears is given in Tables 6.5 and 6.6.

Table 6.4 Percentage contribution (by weight) to the total annual catch made by dominant[1] gears in canals inside and outside the BRE, March 1993 - February 1994

Gear	Inside FCD	Outside FCD
	Site NW20	Site NC07
Thella jal	40.8	14.9
Dharma jal	24.6	52.9
Veshal	11.7	
Jhaki jal	7.5	4.8
Urani	5.5	
Ber jal		7.8
Current jal (Stationary)	-	2.5
Sip	-	3.2
Hand fishing	-	4.5

Notes: 1. Dominant gears are defined as those gears which, when ranked in order of abundance, comprised at least 90% of the total annual catch
2. - denotes gear present but not dominant, blank denotes gear absent

A total of 14 different gear types was recorded on Anahula *Khal* compared with 12 on Nandina. Only 7 gears were common to both sites and 2 of these, *thella jal* and *dharma jal* comprised the most important gears at each site. *Thella jal* accounted for 41% of the annual catch on Nandina but only 15% on Anahula while *dharma* took 53% of the catch from this canal and 25% on Nandina. *Veshal* provided a further 12% of the Nandina catch but this type of lift net was not used on Anahula *Khal*. *Jhaki jal* was a fairly important gear at both sites while *urani jal* was exclusive to Nandina *Khal* where it accounted for about 6% of the catch and *ber jal* was exclusive to Anahula providing 8% of the catch. Other small seines such as *dhor jal* and *kathi jal* and the drag net, *moi jal*, were used also exclusively on Anahula *Khal*

Table 6.5 Percentage monthly catch from Anahula Khal by gear type: outside BRE (site NC07)

Gear Code	Gear name	Year: 1992					Year: 1993												Year: 1994		Total annual catch (Mar'93 – Feb'94)	
		Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	kg	%
105	*Dharma jal*	6.478	43.345	59.951	74.102	59.680	50.314	–	–	–	–	77.196	23.146	77.861	48.609	40.261	59.620	35.141	37.641	–	3691.778	52.867
255	*Thella jal*	4.370	0.456	1.550	3.187	6.348	–	–	4.973	100.000	43.533	5.328	3.834	0.478	21.948	30.516	7.323	33.307	18.775	28.766	1037.786	14.861
45	*Ber jal*	72.317	30.886	–	–	–	–	–	–	–	–	–	46.789	6.088	9.557	–	–	–	–	–	541.242	7.751
164	*Jhaki jal*	0.063	2.628	8.776	22.711	33.972	37.810	–	–	–	28.234	–	1.421	7.815	1.899	5.219	–	1.503	–	71.234	335.666	4.807
307	Hand fishing	–	–	–	–	–	–	–	24.592	–	28.234	–	–	–	1.666	8.867	17.258	–	–	–	311.625	4.463
30	*Sip*	1.461	2.201	10.381	–	–	11.876	–	–	–	–	11.445	0.248	1.009	5.348	3.675	3.865	12.067	43.584	–	226.567	3.245
88	*Current jal (Stationary)*	3.825	0.146	5.001	–	–	–	–	–	–	–	6.031	2.187	2.187	–	5.605	–	–	–	–	177.218	2.538
89	*Dhor jal*	1.965	0.448	–	–	–	–	–	–	–	–	–	16.069	–	2.551	1.020	2.681	–	–	–	158.903	2.276
202	*Moi jal*	–	–	–	–	–	–	–	–	–	–	–	–	–	6.936	1.808	–	17.981	–	–	144.641	2.071
95	*Doiar trap*	7.874	19.892	10.873	–	–	–	–	–	–	–	–	4.362	0.683	1.131	2.537	3.033	–	–	–	116.946	1.675
272	*Daun*	1.647	–	–	–	–	–	–	–	–	–	–	1.944	3.879	0.355	0.491	–	–	–	–	112.597	1.612
175	*Kathi jal*	–	–	3.468	–	–	–	–	70.435	–	–	–	–	–	–	–	–	–	–	–	104.403	1.495
270	*Katha*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	6.220	–	–	–	23.730	0.340
314	*Boat Katha*	–	–	–	–	–	–	100.000	–	–	–	–	–	–	–	–	–	–	–	–		–
		100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	6983.10	100

Note: – denotes zero catch

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Table 6.6 Percentage monthly catch from Nandina Khal by gear type: inside BRE (site NW20)

Gear		Year: 1992			Year: 1993							Total annual catch (Mar'93 – Feb'94)	
Code	Gear name	Oct	Nov	Dec	June	July	Aug	Sep	Oct	Nov	Dec	Kg	%
255	*Thella jal*	9.568	10.256	100.000	62.264	–	56.764	1.577	56.017	72.019	100.000	372.016	40.838
105	*Dharma jal*	56.692	23.885	–	–	–	–	39.346	29.517	5.510	–	223.803	24.568
266	*Veshal*	–	–	–	–	–	6.565	31.949	–	–	–	106.328	11.672
164	*Jhaki jal*	26.453	64.916	–	–	–	–	8.945	4.230	11.843	–	68.423	7.511
291	*Urani*	–	–	–	–	–	–	15.586	–	–	–	50.400	5.533
30	*Sip*	7.288	0.943	–	37.736	100.000	36.671	–	7.297	–	–	48.571	5.332
88	*Current jal (Stationary)*	–	–	–	–	–	–	2.598	2.939	–	–	16.742	1.838
97	By hand/Dewatering	–	–	–	–	–	–	–	–	3.515	–	8.160	0.896
307	Hand fishing	–	–	–	–	–	–	–	–	2.865	–	6.651	0.730
95	*Doiar trap*	–	–	–	–	–	–	–	–	1.654	–	3.840	0.422
286	*Deal trap*	–	–	–	–	–	–	–	–	1.587	–	3.684	0.404
296	*Tukri*	–	–	–	–	–	–	–	–	1.008	–	2.340	0.257
		100	100	100	100	100	100	100	100	100	100	910.958	100

Notes: 1. No fishing activities were observed from January to May 1993, and January to February 1994

2. – denotes zero catch

but were not dominant gears. Small-scale gears common to both sites and used primarily for subsistence fishing included *current jal*, *sip* and fishing by hand. These gears together provided 10% of the catch from Anahula and, although not listed as dominant gears on Nandina, still provided 8% of its annual catch.

6.2.2 Catch by gear by month

On Anahula *Khal* very few gears operated during the pre-monsoon months from March to June 1993 and prevailing monthly catches were extremely low. In March a *kathi jal* fishing in the few remaining isolated pools took most of the catch while hand fishing and *thella jal* accounted for the remainder. In April only *thella jal* were observed fishing but as water depths increased in May and rainfall runoff flowed into the Northern Dhaleswari, *jhaki jal* fishing started alongside *thella jal* and hand fishing (Fig. 6.2). In June, *dharma jal* were established to take advantage of increasing flows at a time when river floodwaters first entered the floodplains via feeder canals. At this time they accounted for 77% of the monthly catch.

As water levels continued to rise in July, fishing activities increased and the number of different types of gear deployed increased from 4 to 9. *Ber jal* and *dharma jal* took the largest share of the catch and the smaller, two-man *dhor jal* appeared for the first time and provided 16% of the catch. Gear diversity remained high during August, when a peak catch was recorded, and during the drawdown in September and October. *Dharma jal* predominated during this period, providing between 40% to 77% of monthly catches. *Thella jal* was also important during the drawdown when it accounted for 22% to 31% of catches. Other important gears included *ber jal* and *moi jal* which operated chiefly during the early drawdown in September and hand fishing which was employed later in October when water levels had decreased sufficiently to allow this fishing method. The peak catches recorded between August and October were due principally to the very high levels of fishing effort by dominant gears, particularly *dharma jal* and *thella jal* (Fig. 6.3) and, to a lesser extent, high catch rates of some of these gears (Fig. 6.4). Later in the year, *dharma jal* continued to provide the largest share of monthly catches until December after which *sip*, *jhaki jal* and *thella jal* predominated.

On the regulated Old Hurasagar River, no fishing activities were observed between January and May 1993. In June two gears were recorded, *thella jal* and *sip*, which captured 62% and 38% of the very low monthly catch (Fig. 6.5). Fishing activities and catches remained at

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Figure 6.2 Percentage of total monthly catch taken by dominant gears: site NC07 (outside BRE)

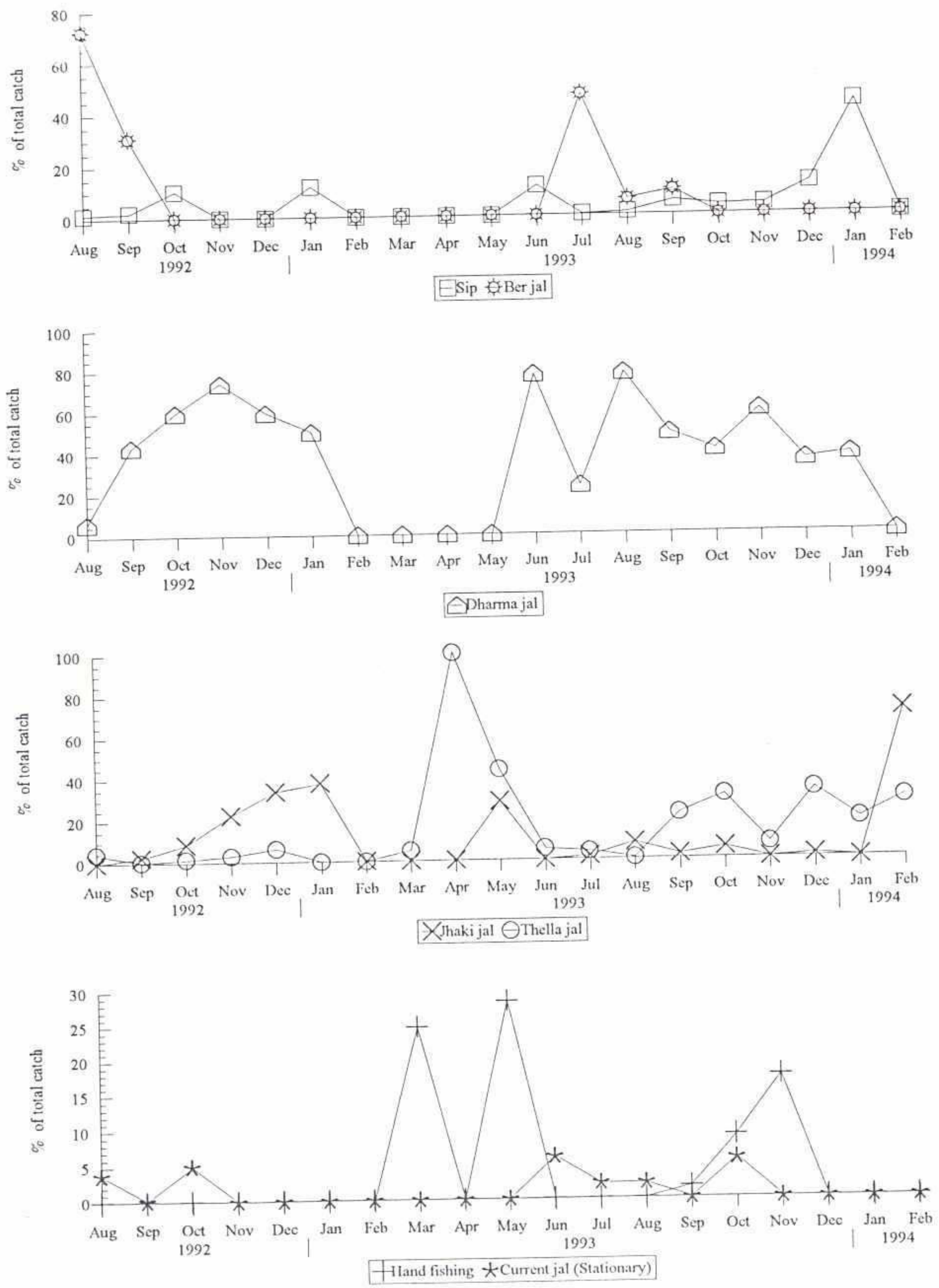

Figure 6.3 Total monthly fishing effort per kilometre of canal by dominant gears: site NC07 (outside BRE)

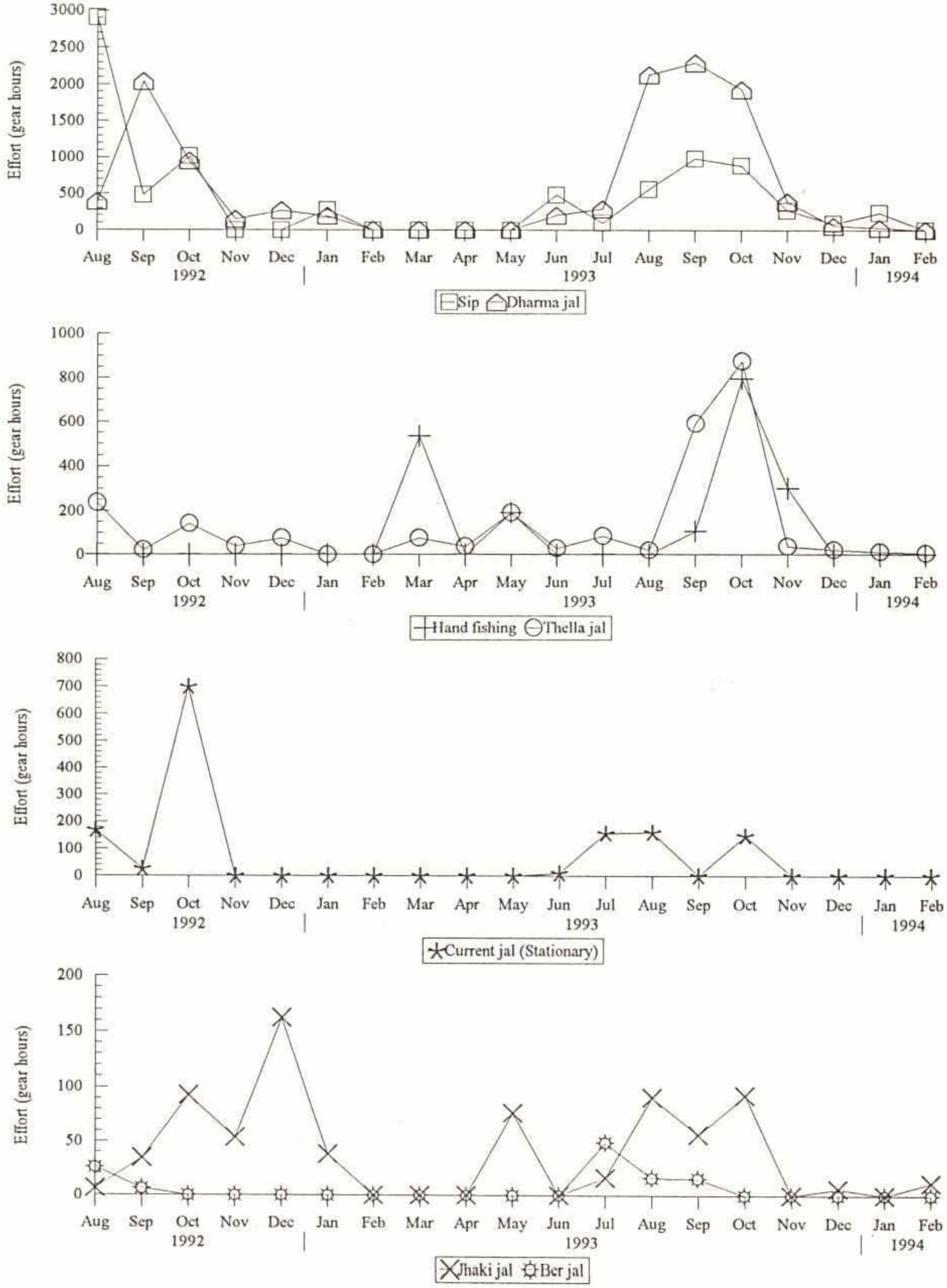

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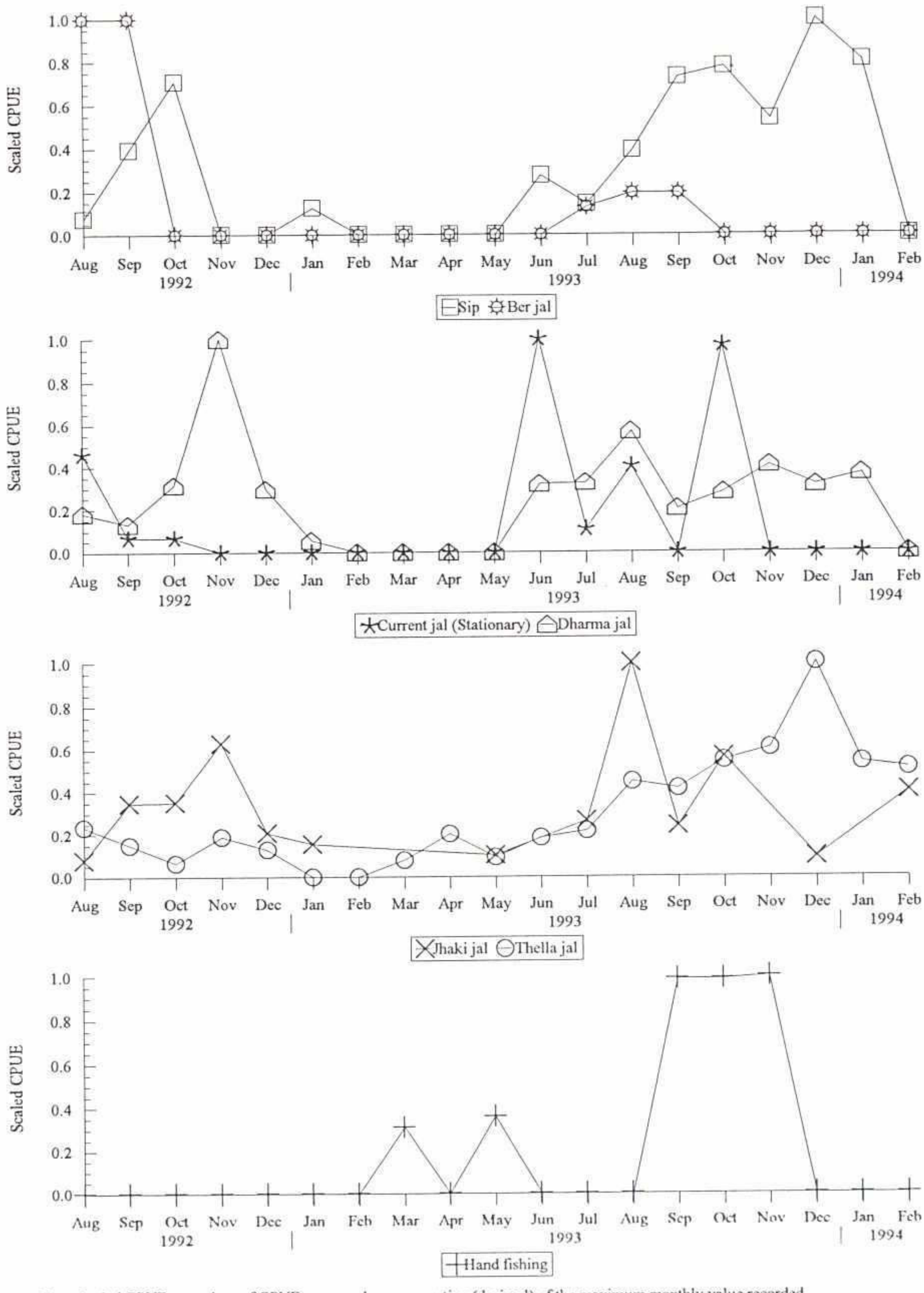
Figure 6.4 Scaled CPUE of dominant gears: site NC07 (outside BRE)



Note: Scaled CPUE are values of CPUE expressed as a proportion (decimal) of the maximum monthly value recorded

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Figure 6.5 Percentage of total monthly catch taken by dominant gears: site NW20 (inside BRE)

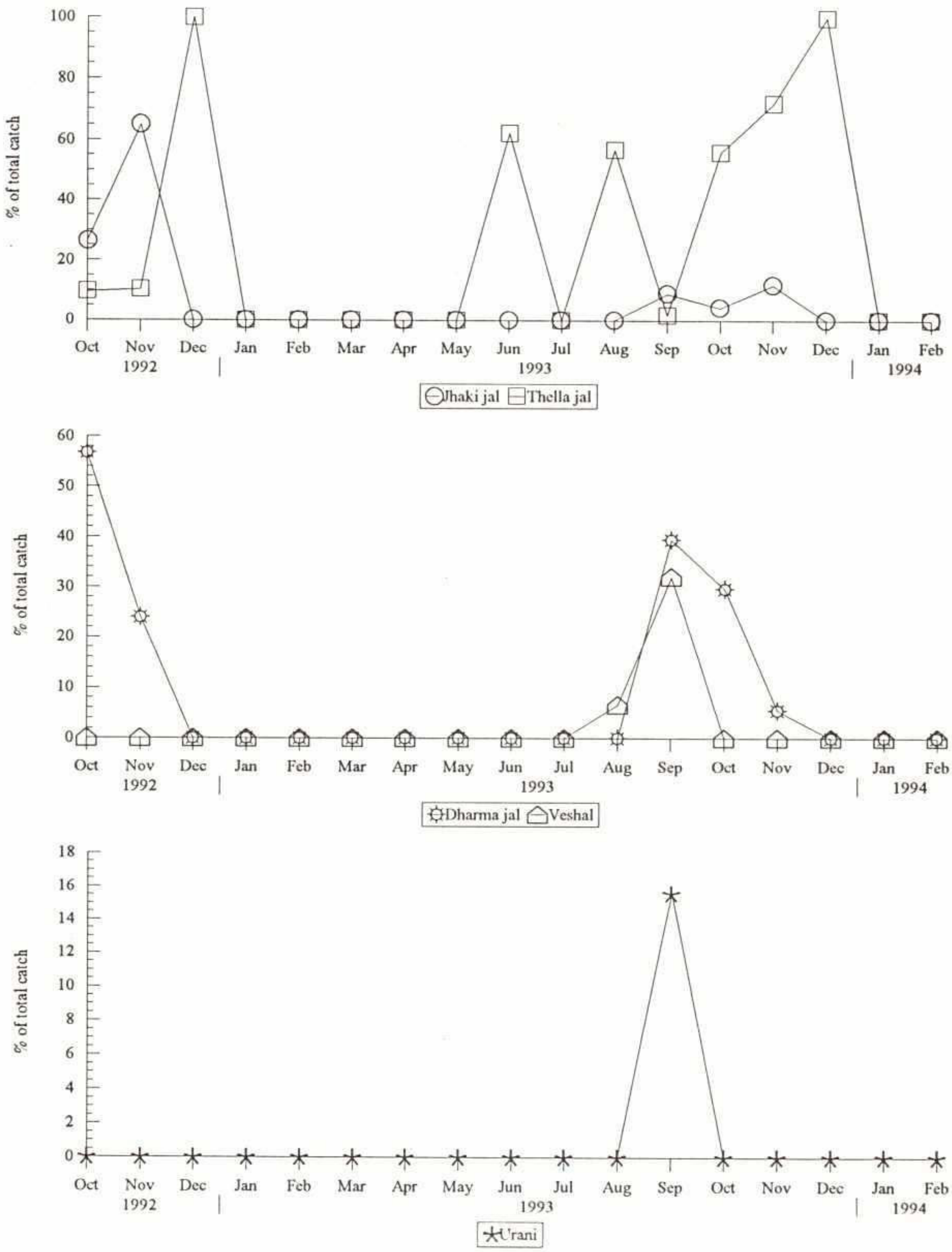

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Figure 6.6 Total monthly fishing effort per kilometre of canal by dominant gears: site NW20 (inside BRE)

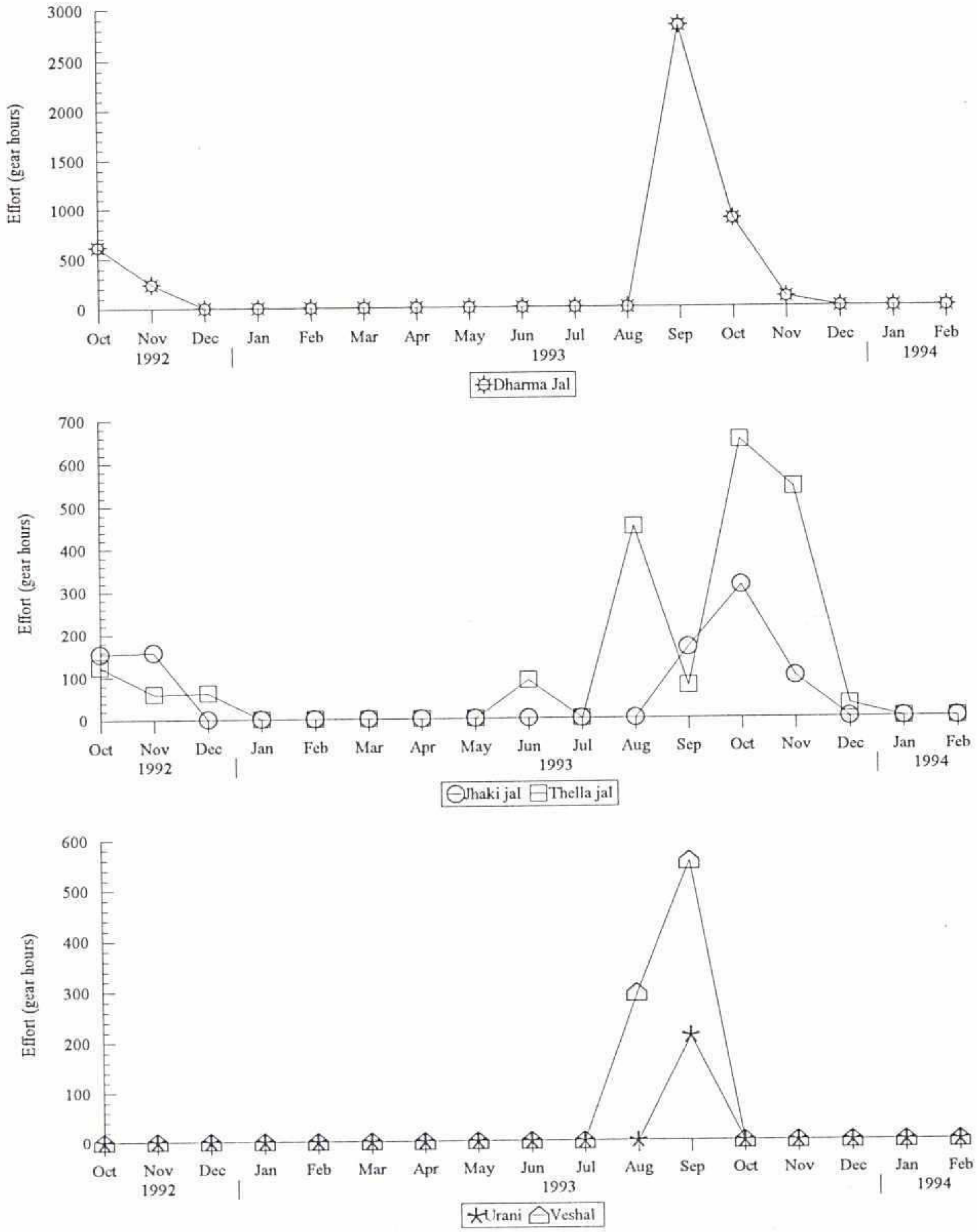
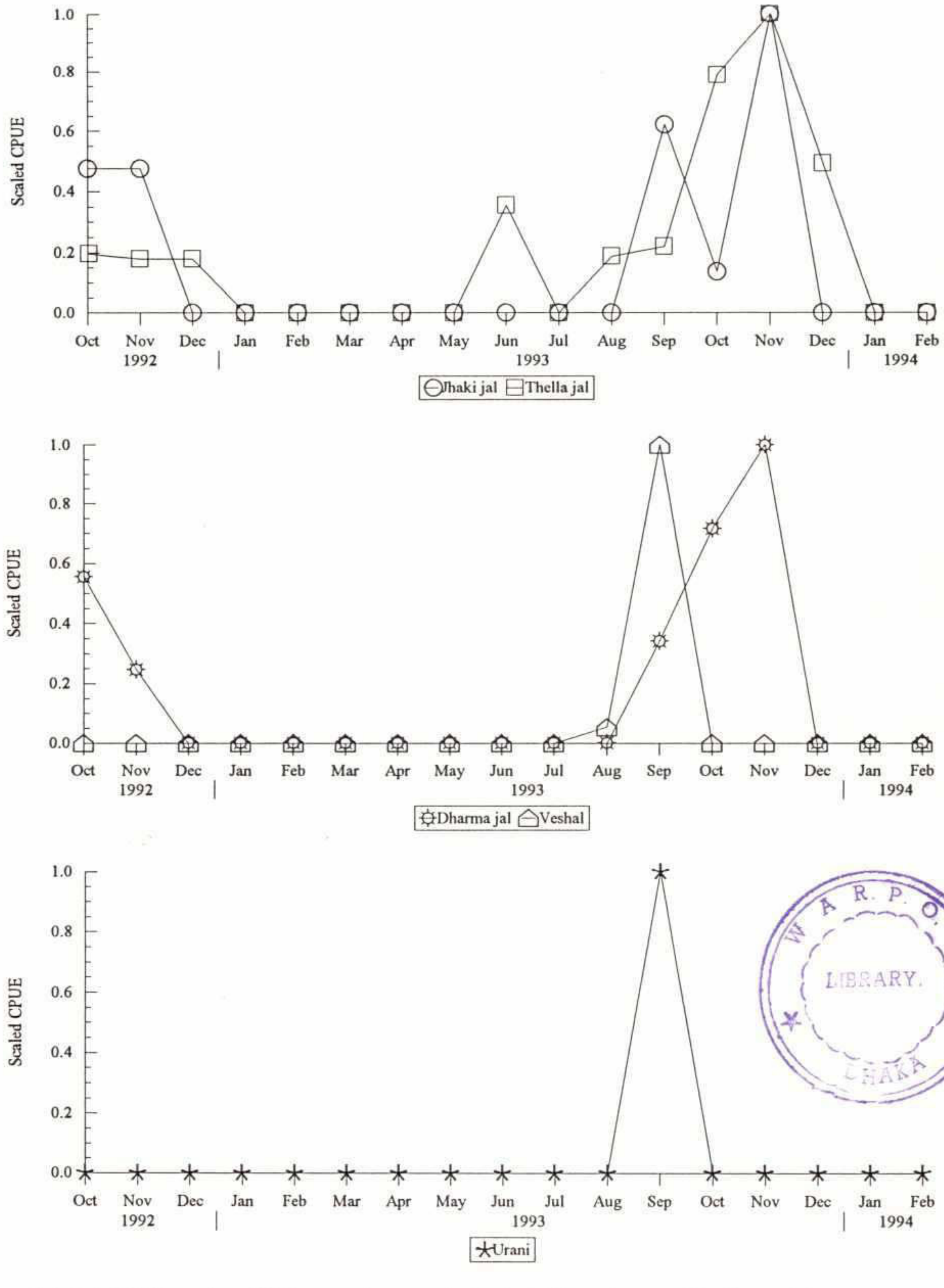


Figure 6.7 Scaled CPUE of dominant gears: site NW20 (inside BRE)



Note: Scaled CPUE are values of CPUE expressed as a proportion (decimal) of the maximum monthly value recorded

very low levels during July and August when again *sip* and/or *thella* predominated. In September catches increased sharply and remained high until November. The number of different types of fishing gear also increased slightly from 3 in August to 5 or 6 in September and October then to a maximum of 8 in November. Three gears predominated during this period, lift nets *dharma jal* and *veshal* which together took 71% of the catch in September, and *thella jal* which accounted for 65% and 72% of catches in October and November. *Veshal* were used for only one month but *dharma jal* continued to provide an important share of the catch (29%) in October. The high catches recorded between September and November were a function of peak fishing effort by dominant gears (Fig. 6.6) and peak catch rates (Fig. 6.7). In December 1993, only one gear, *thella jal* remained active, providing a very low monthly catch from the remaining disconnected pools in the canal. No fishing activities were observed in January and February 1994.

6.3 Statistical Comparison of Catch Rates from Canals Inside and Outside the BRE

Statistical analyses of seasonally pooled catch rates of dominant gears used in canals inside and outside the BRE were carried out. The underlying assumption of the method was that differences in catch rates of a particular gear type reflected differences in fish densities and abundance inside and outside the BRE.

There were only three gears which were dominant on both canals: *dharma jal*, *thella jal* and *jhaki jal*. These gears accounted for 73% of the annual catch from both Anahula *Khal* and Nandina *Khal*. Mean catch rates of each of the three gears from the two canals were compared, where data were available, for each of five seasons and for all seasons combined between March 1993 and February 1994 (Table 6.7 and Fig. 6.8). The non-parametric Mann-Whitney U-test was used since catch rate data were not normally distributed. However, the parametric student t-test on logarithmic transformed data produced essentially the same results as those shown in Table 6.7.

Of the 9 gear/season combinations examined statistically, a significant ($p<0.05$) difference in catch rates was found in only one case. This was for *thella jal*, where catch rates were significantly higher on Nandina *Khal* during the drawdown. It is concluded from these results therefore that there was no strong statistical evidence for significant differences in catch rates, and therefore fish densities, between canals.

Table 6.7 Statistical comparison of catch rates (kg/hr) of dominant gears used inside and outside the BRE, March 1993 - February 1994

Gear	Season	Inside BRE		Outside BRE		Non-parametric Mann-Whitney U-test on CPUE		
		Sample size	Mean CPUE	Sample size	Mean CPUE	Z- value	P-value	Comment
Thella jal	3	5	0.058	9	0.084	-0.20	0.841	NS
	4	6	0.261	10	0.133	-2.17	0.030	SIG
	All seasons	13	0.163	30	0.114	-1.19	0.234	NS
Dharma jal	3	5	0.041	25	0.120	-1.25	0.210	NS
	4	4	0.108	18	0.103	-0.26	0.798	NS
	All seasons	9	0.071	52	0.111	-1.10	0.272	NS

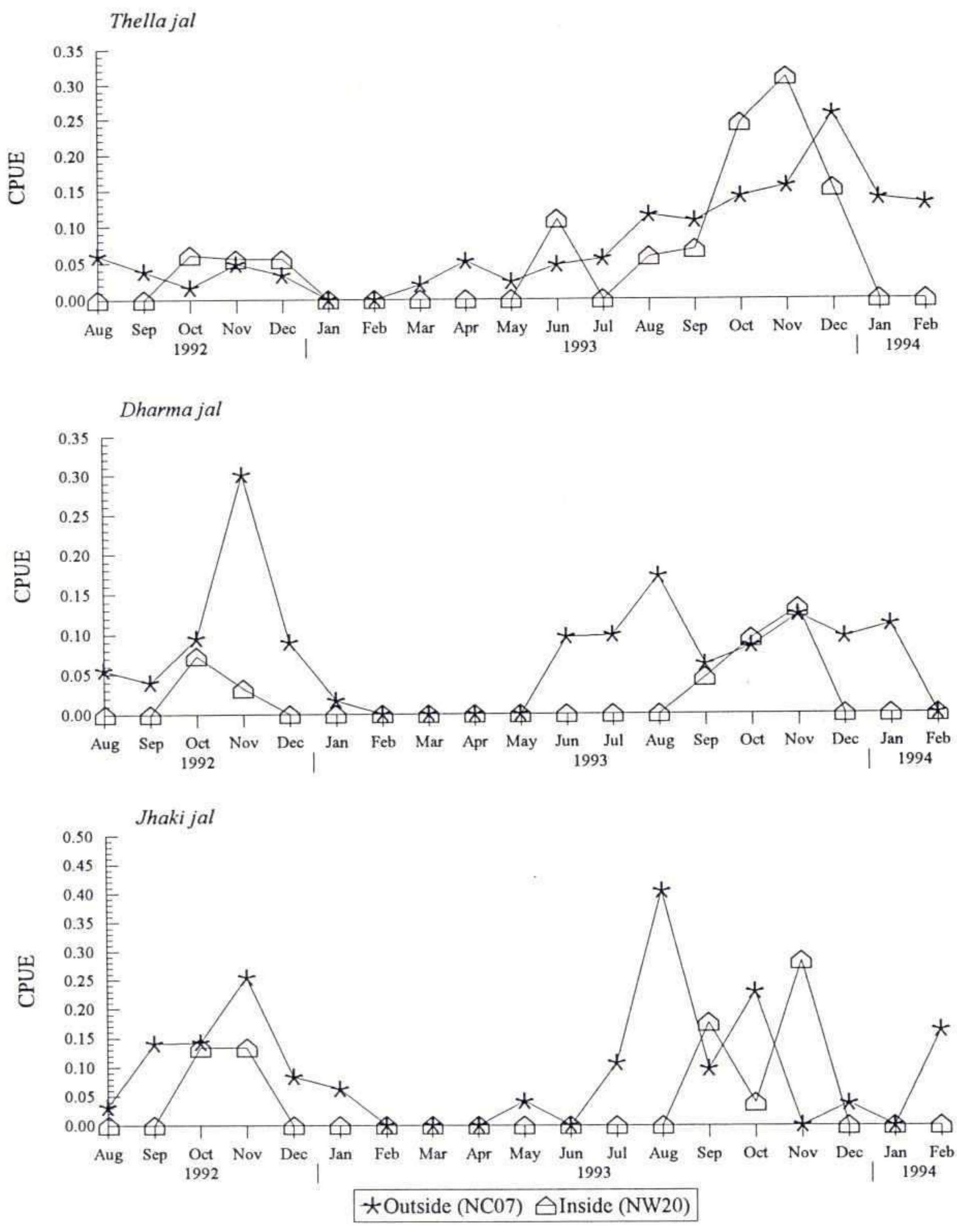
Notes: 1. NS - Not significant, SIG - Significant at 5% level
2. Seasons: 1. March-April, 2. May-June, 3. July-September, 4. October-November and 5. December-February

The higher catch from the unregulated Anahula *Khal* was therefore due to the higher amount of fishing effort expended by dominant gears (Table 6.8). The annual fishing effort per kilometre of canal was four times higher by *dharma jal* and twice as high by *thella jal* in the unregulated Anahula *Khal*.

Table 6.8 Comparison of annual fishing effort by dominant gears in canals inside and outside the BRE, March 1993 - February 1994

Gear	Anahula *Khal* (site NC07)	Nandina *Khal* (site NW20)	% change compared with NC07
Thella jal	1,982	875	- 65
Dharma jal	7,323	1,821	- 75
Jhaki jal	350	273	- 22

Figure 6.8 Comparison of mean monthly catch rates (kg/hr) of dominant gears from canals inside and outside the BRE



6.4 Biodiversity and Catch Composition

6.4.1 Species richness

Between March 1993 and February 1994, 59 species of fish were recorded from the unregulated Anahula *Khal* compared with 34 species from the regulated Nandina *Khal*, a reduction in species diversity of 42%. When these species were divided into different groups based on habitat preference: riverine, migratory and floodplain residents (see Section 5.4.1 for definitions), clear differences emerged between the regulated and unregulated canal (Table 6.9). Clearly, there was a more severe impact of flood control on species which moved between rivers and floodplains. The numbers of riverine species were reduced by 82% in Nandina *Khal* and migratory species by 69% compared with numbers in Anahula *Khal*. Floodplain resident species were less adversely affected, but still showed a reduction of 16%.

Table 6.9 Total annual number of fish species, classified by habitat preference, recorded from canals inside and outside the BRE, March 1993 - February 1994

Fish group	Anahula *Khal* (site NC07)	Nandina *Khal* (site NW20)	% reduction in NW20
Riverine species	11	2	82
Migratory species	16	5	69
Floodplain resident species	32	27	16
Total species	59	34	42

6.4.2 Catch composition

Percentage contributions made by riverine, migratory and floodplain resident species to annual catches from canals are presented in Table 6.10. Riverine species made negligible contributions to catches from both canals while migratory species accounted for 41% of the catch from the unregulated Anahula *Khal* compared with only 7% from Nandina *Khal*. These catch compositions differ markedly from those seen on adjacent rivers where migratory species, mainly carps, accounted for 49% of the catch from the Old Hurasagar while riverine and migratory species each comprised 15% of the catch from the Northern Dhaleswari.

Table 6.10 Percentage contribution of riverine, migratory and floodplain resident species to annual catches from canals inside and outside the BRE, March 1993 - February 1994

Site Code	Site name	Inside/ Outside BRE	% Total annual catch		
			Riverine	Migratory	Floodplain resident
NC07	Anahula *Khal*	Outside	<1	41.0	46.4
NW20	Nandina *Khal*	Inside	<.1	6.7	85.4

Percentage contributions of individual dominant species showed that four major carps, *mrigel*, *catla*, *rui* and *kalbaus* together comprised 37% of the catch from Anahula *Khal* and the smaller carp, *raik* provided a further 2% (Table 6.11). In contrast, on Nandina *Khal* only 3 dominant migratory species were found, one major carp, *rui* and two minor carps, *raik* and *bata* together comprising 6% of the annual catch. With such a high proportion of the unregulated canal catch provided by major carps, it is surprising that they did not account for a greater share of the river catch.

A total of 14 dominant floodplain resident species provided 82% of the Nandina catch which was almost the total catch (85%) provided by this group of fish. In comparison, 10 dominant floodplain resident species were found on Anahula *Khal* and comprised 41% of the catch; again these few dominant species accounted for most of the catch (46%) of this group. There were 9 species found on both canals. Of the remainder which were not dominant on Anahula *Khal* only two were abundant, *kaikka* and *shol*, which each comprised about 6% of the Nandina catch. On both canals *puti* predominated, forming 25% of the catch at Nandina and 16% at Anahula. *Taki* was the second most abundant species by weight on both canals while *guchi baim*, *khalisha*, *darkina* and *canchan puti* were proportionately more abundant on Nandina *Khal*. Prawns were important at both sites, forming 8% and 12% of catches from Nandina and Anahula respectively.

6.5 Fish Migrations

Seasonal fish movements were identified from changes in monthly catch compositions (Tables 6.12 and 6.13), temporal changes in the distributions of important individual species and changes in monthly species numbers and catch contributions of riverine, migratory and floodplain resident groups of fish.

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Table 6.11 Percentage contribution (by weight) to the total annual catch by dominant species from canals inside and outside the BRE, March 1993 – February 1994

Habitat Preference	Species name: Scientific	Species name: Bengali	Anahula Khal Outside BRE (site NC07)	Nandina Khal Inside BRE (site NW20)
Migratory	*Catla catla*	*Catla*	12.1	–
	Cirrhinus mrigala	*Mrigel*	13.2	–
	Cirrhinus reba	*Raik*	1.7	1.1
	Labeo bata	*Bata*	–	1.9
	Labeo calbasu	*Kalbaus*	2.4	–
	Labeo rohita	*Rui*	9.5	2.9
Subtotal			38.9	5.9
Floodplain Resident	*Mystus vittatus*	*Tengra*	1.8	1.1
	Colisa fasciatus	*Khalisha*	1.4	5.5
	Xenentodon cancila	*Kaikka*	–	6.3
	Puntius conchonius	*Canchan puti*	2.3	4.8
	Puntius sophore	*Puti*	15.8	25.1
	Puntius ticto	*Tit puti*	1.5	–
	Amblypharyngodon mola	*Mola*	–	1.1
	Esomus danricus	*Darkina*	2.7	5.4
	Glossogobius giurus	*Bailla*	3.9	2.7
	Lepidocephalus guntea	*Gutum*	2.1	3.5
	Channa punctatus	*Taki*	5.9	11.7
	Channa striatus	*Shol*	–	5.5
	Macrognathus pancalus	*Guchi*	3.2	6.7
	Badis badis	*Napit koi*	–	1.0
	Chanda ranga	*Lal chanda*	–	1.6
Subtotal			40.6	82.1
Other	Prawn spp.	*Chingri/Icha*	11.5	7.9
Subtotal			11.5	7.9
Grand total			91.0	95.9

Notes: 1. Dominant species are those species contributing 1% or more by weight to the total annual catch

2. Shaded values highlight the most important species (>4%)

3. See text for definitions of habitat preference categories (Section 5.4.1)

Table 6.12 Monthly catch composition (% by weight) from Anahula Khal: outside BRE (site NC07)

Species Code	Habitat Preference	Species name: Scientific	Species name: Bengali	Year: 1992 Aug	Sep	Oct	Nov	Dec	Year: 1993 Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec	Year: 1994 Jan	Feb	Total annual catch (Mar'93 – Feb'94) kg	%
133	Riverine	*Mystus gulio*	*Nuna tengra*	-	0.053	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13		*Aspidoparia morar*	*Piali*	-	-	-	-	-	-	-	-	-	-	-	-	0.587	-	-	-	-	-	-	13.138	0.188
59		*Crossocheilus latius*	*Kalabata*	-	-	-	-	-	-	-	-	-	-	-	-	0.117	-	-	-	-	-	-	2.628	0.038
139		*Nemacheilus botia*	*Balichata*	0.405	0.070	-	-	-	-	-	-	-	-	-	-	-	0.044	0.012	-	-	-	-	0.833	0.012
198		*Somileptes gongota*	*Gharpoia*	0.170	-	-	-	-	-	-	-	-	-	-	-	-	0.257	-	-	-	-	-	3.542	0.051
28		*Botia dario*	*Rani*	0.008	0.001	-	-	-	-	-	-	-	-	-	0.351	0.263	0.069	0.005	-	-	-	-	8.982	0.129
29		*Botia lohachata*	*Putul*	-	-	-	-	-	-	-	-	-	-	-	-	0.078	0.037	0.002	-	-	-	-	2.284	0.033
940		*Awaous sp*	*Bele*	15.296	6.533	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
127		*Liza melinoptera*	*Bata*	-	0.088	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
128		*Liza parsia*	*Bata*	0.004	0.001	0.005	0.010	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
923		*Sicamugil cascasia*	*Bata*	-	-	-	-	-	-	-	-	-	-	-	0.040	-	-	-	-	-	-	-	0.233	0.003
163		*Pisodonophis boro*	*Kharu*	-	-	-	-	-	-	-	-	-	-	-	0.279	-	-	-	-	-	-	-	1.628	0.023
2		*Ailia coila*	*Kajuli*	-	-	-	-	-	-	-	-	-	-	-	-	-	0.011	-	-	-	-	-	0.147	0.002
51		*Clupisoma garua*	*Ghaura*	-	-	-	-	-	-	-	-	-	-	-	-	-	0.285	-	-	-	-	-	3.936	0.056
16		*Bagarius bagarius*	*Baghair*	0.122	0.053	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
81		*Gagata youssoufi*	*Gang tengra*	-	-	-	-	-	-	-	-	-	-	-	-	0.727	0.316	0.003	-	-	-	-	20.704	0.296
	Subtotal			16.006	6.797	0.005	0.010	-	-	-	-	-	-	-	0.670	1.771	1.018	0.021	-	-	-	-	58.055	0.831
130	Migratory	*Aorichthys aor*	*Ayre*	0.552	-	-	-	-	-	-	-	-	-	-	0.201	0.192	-	-	-	-	-	-	5.483	0.079
135		*Aorichthys seenghala*	*Guizza*	-	-	-	-	-	-	-	-	-	-	-	0.017	-	-	-	-	-	-	-	0.101	0.001
131		*Mystus bleekeri*	*Golsha tengra*	-	-	2.514	-	-	-	-	-	-	-	-	-	-	0.075	0.632	-	-	13.174	-	19.269	0.276
132		*Mystus cavasius*	*Kabashi*	-	-	-	0.274	0.407	-	-	-	-	-	-	0.017	0.557	0.137	0.087	-	-	-	-	16.150	0.231
32		*Catla catla*	*Catla*	4.445	10.000	-	-	-	-	-	-	-	-	-	18.067	21.352	18.856	-	-	-	-	-	843.947	12.086
47		*Cirrhinus mrigala*	*Mrigel*	7.874	21.525	10.873	-	-	-	-	-	-	-	-	2.670	34.443	9.556	-	-	-	-	-	918.910	13.159
48		*Cirrhinus reba*	*Raik*	0.777	0.461	0.621	-	-	-	-	-	-	-	-	0.306	0.440	5.277	1.745	0.007	-	-	-	118.244	1.693
100		*Labeo bata*	*Bata*	0.306	4.668	5.067	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
101		*Labeo boga*	*Bhangan*	-	-	-	-	-	-	-	-	-	-	-	-	0.507	0.222	-	-	-	-	-	14.407	0.206
102		*Labeo calbasu*	*Kalbaus*	0.253	0.301	-	-	-	-	-	-	-	-	-	0.319	2.867	7.446	-	0.009	-	-	-	168.903	2.419
104		*Labeo gonius*	*Goni*	-	-	-	-	-	-	-	-	-	-	-	-	0.298	-	-	-	-	-	-	6.676	0.096
107		*Labeo rohita*	*Rui*	0.189	2.967	0.820	-	-	-	-	-	-	-	-	17.888	13.372	5.826	9.321	-	-	-	-	664.329	9.513
188		*Salmostoma bacaila*	*Katari*	0.018	0.090	-	-	-	-	-	-	-	-	-	0.996	-	-	-	-	-	-	-	5.813	0.083
189		*Salmostoma phulo*	*Fulchela*	8.566	3.657	0.015	0.031	-	-	-	-	-	-	-	3.746	0.694	0.444	-	-	-	-	-	43.522	0.623
154		*Securicula gora*	*Chora chela*	0.291	0.078	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
86		*Gudusia chapra*	*Chapila*	0.192	0.078	-	-	-	-	-	-	-	-	-	0.646	0.323	-	-	-	-	-	-	11.001	0.158
169		*Pseudeutropius atherinoides*	*Batasi*	0.070	0.089	-	-	-	-	-	-	-	-	-	0.020	0.009	0.014	-	0.004	-	-	-	0.540	0.008
209		*Wallagu attu*	*Boal*	2.002	0.788	-	-	-	-	-	-	-	-	-	0.120	0.587	2.054	-	-	-	-	-	42.191	0.604
	Subtotal			25.536	44.701	19.910	0.304	0.407	-	-	-	-	-	-	45.013	75.640	49.907	11.786	0.020	-	13.174	-	2879.486	41.235
6	Floodplain Resident	*Anabas testudineus*	*Koi*	-	-	-	-	-	-	-	-	-	-	-	-	0.008	-	-	-	1.442	-	-	1.309	0.019
136		*Mystus tengara*	*Bajari tengra*	15.899	9.309	-	1.204	1.801	-	-	-	-	-	0.237	-	0.019	0.099	0.510	-	-	-	-	11.925	0.171
137		*Mystus vittatus*	*Tengra*	0.547	1.212	7.776	6.548	13.150	8.049	-	-	-	-	8.578	1.049	1.014	1.686	2.865	0.950	3.261	9.001	3.167	128.338	1.838
55		*Colisa fasciatus*	*Khalisha*	0.033	0.626	0.208	1.548	-	-	-	4.457	10.531	-	2.890	0.598	0.054	1.230	2.447	2.676	4.484	0.652	7.390	94.912	1.359
211		*Colisa labiosus*	*Khalisha*	-	-	-	-	-	-	-	-	-	-	6.862	0.922	-	0.101	0.051	-	-	-	-	15.940	0.228
56		*Colisa lalia*	*Lal khalisha*	-	-	0.025	-	-	-	-	-	-	-	9.054	0.080	0.018	-	1.173	0.502	1.918	0.976	-	38.179	0.547
57		*Colisa sota*	*Khalisha*	0.008	0.037	0.101	0.020	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
210		*Xenentodon cancila*	*Kaikka*	0.191	0.133	-	-	6.373	-	-	-	-	-	-	1.116	0.469	0.099	0.224	-	2.160	1.243	-	24.970	0.358
174		*Puntius chola*	*Chala puti*	-	0.443	-	-	-	-	-	-	-	-	3.676	-	-	-	-	-	-	-	-	4.388	0.063
175		*Puntius conchonius*	*Canchan puti*	-	-	1.941	2.247	26.950	-	-	0.406	-	26.717	11.498	6.302	1.486	0.300	2.134	3.911	3.525	2.665	3.597	163.316	2.339
173		*Puntius cosuatis*	*Kosuati*	-	-	0.374	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
176		*Puntius gelius*	*Giliputi*	-	-	0.010	0.020	-	-	-	-	-	-	0.919	0.159	-	-	-	-	-	-	-	2.027	0.029
178		*Puntius phutunio*	*Phutani puti*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.064	-	1.085	-	0.739	0.011
180		*Puntius sophore*	*Puti*	3.969	16.650	40.237	65.601	33.714	47.614	-	4.465	-	14.391	36.508	9.849	5.796	5.224	29.823	46.338	20.852	35.819	23.399	1105.687	15.834
181		*Puntius terio*	*Teri punti*	-	1.738	1.085	1.504	-	-	-	-	-	-	1.378	-	-	-	-	-	-	-	-	1.645	0.024
212		*Puntius ticto*	*Tit puti*	1.741	0.228	0.005	0.010	1.421	-	-	-	-	-	2.312	0.908	0.688	1.213	0.096	13.865	14.205	1.518	-	106.673	1.528
939		*Puntius sp.*		11.013	4.704	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5		*Amblypharyngodon mola*	*Mola*	5.072	2.097	-	-	-	0.929	-	-	-	-	8.272	2.232	-	0.422	0.528	-	-	-	-	38.915	0.557
68		*Danio devario*	*Chebli*	-	-	-	-	-	-	-	-	-	-	-	-	0.019	0.030	-	-	-	-	-	0.831	0.012

(Cont.)

Table 6.12 Monthly catch composition (% by weight) from Anahula Khal: outside BRE (site NC07)

Species Code	Habitat Preference	Species name		Year: 1992					Year: 1993												Year: 1994		Total annual catch (Mar'93 – Feb'94)	
		Scientific	Bengali	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	kg	%
75		*Esomus danricus*	*Darkina*	7.942	3.176	3.163	0.061	–	–	–	64.277	20.000	7.049	0.577	6.871	0.169	0.502	1.428	0.291	3.702	0.869	5.904	185.090	2.651
182		*Rasbora daniconius*	*Darkina*	0.186	0.019	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
83		*Glossogobius giurus*	*Baila*	3.779	2.218	0.942	6.697	0.655	–	16.279	–	–	3.767	0.473	4.134	4.835	4.725	3.061	0.618	10.113	1.748	–	270.340	3.871
91		*Hypophthalmichthys molitrix*	*Silver carp*	–	–	–	–	–	–	–	–	–	–	–	–	2.818	–	–	–	–	–	–	63.113	0.904
43		*Chela cachius*	*Chep chela*	0.088	0.005	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
110		*Lepidocephalus guntea*	*Gutum*	0.254	0.436	2.593	6.582	4.486	5.642	30.233	11.206	–	1.689	0.355	1.277	0.237	2.049	3.902	0.744	9.896	–	17.236	147.084	2.106
9		*Aplocheilus panchax*	*Kanpona*	–	–	–	–	–	–	–	–	–	–	–	0.017	0.244	0.057	0.023	–	–	–	–	6.778	0.097
41		*Channa punctatus*	*Taki*	0.490	2.009	11.833	6.739	6.118	35.213	46.512	12.752	65.260	–	5.196	1.931	1.380	4.627	9.796	16.299	11.509	20.311	12.137	408.355	5.848
42		*Channa striatus*	*Shol*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.092	–	–	–	0.350	0.005
88		*Heteropneustes fossilis*	*Shingi*	0.209	0.159	0.866	–	–	2.553	–	0.812	–	–	–	–	–	0.430	0.104	0.047	–	–	5.232	10.001	0.143
121		*Macrognathus aculeatus*	*Tara baim*	0.247	0.617	4.604	–	–	–	–	–	–	–	–	0.280	0.450	0.074	0.412	–	–	–	–	20.701	0.296
123		*Macrognathus pancalus*	*Guchi*	2.595	1.023	2.886	0.061	4.925	–	–	1.320	–	40.186	0.237	4.409	1.167	4.627	3.571	3.628	3.247	1.066	8.970	226.366	3.242
122		*Mastacembelus armatus*	*Baral baim*	0.609	0.108	–	–	–	–	–	–	–	–	–	0.080	0.021	2.061	0.252	4.049	–	–	–	49.716	0.712
15		*Badis badis*	*Napit kol*	–	–	–	–	–	–	–	–	4.208	–	–	–	0.005	0.456	–	–	0.601	0.976	–	7.700	0.110
203		*Tetraodon cutcutia*	*Potka*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.155	0.072	–	–	–	3.262	0.047
33		*Chaca chaca*	*Cheka*	0.013	0.001	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1.439	–	–	1.116	0.016
36		*Chanda nama*	*Nama chanda*	0.635	0.282	0.459	0.214	–	–	–	–	–	–	0.059	3.696	1.035	0.254	0.237	0.657	1.039	0.543	–	56.475	0.809
37		*Chanda ranga*	*Lal chanda*	1.365	0.881	0.689	0.356	–	–	–	–	–	–	0.459	1.375	0.371	1.165	0.298	1.217	0.840	2.713	–	45.246	0.648
	Subtotal			56.883	48.110	79.796	99.410	99.593	100.000	93.024	99.695	99.999	93.798	99.541	47.285	22.302	31.432	63.088	96.018	94.234	81.184	87.033	3241.487	46.419
114	Others	*Machrobrachium lammariel*	*Kuuchu icha*	–	–	0.133	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
117		*Machrobrachium styliferus*	*Gura icha*	–	–	0.099	0.204	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
931		Prawn spp.	*Chingri/Icha*	1.575	0.391	0.057	0.071	–	–	6.977	0.304	–	6.203	0.459	7.032	0.286	17.643	25.104	3.961	5.766	5.643	12.966	804.073	11.515
	Subtotal			1.575	0.391	0.288	0.275	–	–	6.977	0.304	–	6.203	0.459	7.032	0.286	17.643	25.104	3.961	5.766	5.643	12.966	804.073	11.515
	Grand total			100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	6983.101	100

Note: – denotes zero catch

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Table 6.13 Monthly catch composition (% by weight) from Nandina Khal: inside BRE (site NW20)

Species Code	Habitat Preference	Species name: Scientific	Species name: Bengali	Year: 1992 Oct	Year: 1992 Nov	Year: 1992 Dec	Year: 1993 June	Year: 1993 July	Year: 1993 Aug	Year: 1993 Sep	Year: 1993 Oct	Year: 1993 Nov	Year: 1993 Dec	Total annual catch (Mar'93 – Feb'94) Kg	Total annual catch (Mar'93 – Feb'94) %
139	Riverine	*Nemacheilus botia*	*Balichata*	–	–	–	–	–	–	0.098	–	–	–	0.317	0.035
58		*Corica soborna*	*Kachki*	–	–	–	1.132	–	–	–	–	–	–	0.180	0.020
	Subtotal			–	–	–	1.132	–	–	0.098	–	–	–	0.497	0.055
131	Migratory	Mystus bleekeri	*Golsha tengra*	–	–	–	–	–	–	0.245	–	–	–	0.793	0.087
48		*Cirrhinus reba*	*Raik*	–	–	–	–	–	–	2.994	–	–	–	9.682	1.063
100		*Labeo bata*	*Bata*	–	–	–	–	–	–	5.391	–	–	–	17.433	1.914
102		*Labeo calbasu*	*Kalbaus*	–	–	–	–	–	–	1.962	–	–	–	6.343	0.696
107		*Labeo rohita*	*Rui*	–	–	–	–	–	–	8.249	–	–	–	26.674	2.928
	Subtotal			–	–	–	–	–	–	18.841	–	–	–	60.925	6.688
136	Floodplain	*Mystus tengara*	*Bajari tengra*	–	–	–	–	–	–	–	–	0.560	–	1.300	0.143
137	Resident	*Mystus vittatus*	*Tengra*	3.213	8.417	10.525	5.283	35.101	2.722	–	0.275	2.209	–	9.754	1.071
55		*Colisa fasciatus*	*Khalisha*	1.348	2.949	6.524	11.321	–	1.655	2.778	10.406	3.876	–	50.080	5.497
211		*Colisa labiosus*	*Khalisha*	–	–	–	–	–	0.289	0.171	–	–	–	0.686	0.075
57		*Colisa sota*	*Khalisha*	4.212	6.503	2.262	–	–	0.146	0.432	–	1.383	19.737	5.605	0.615
210		*Xenentodon cancila*	*Kaikka*	–	–	–	–	–	2.881	1.079	17.569	1.253	–	57.591	6.322
175		*Puntius conchonius*	*Canchan puti*	–	–	–	3.396	–	3.620	6.147	6.174	1.623	–	43.375	4.761
176		*Puntius gelius*	*Giliputi*	–	–	–	–	–	0.581	–	–	0.198	–	0.727	0.080
178		*Puntius phutunio*	*Phutani puti*	–	–	–	–	–	1.013	–	–	–	–	0.466	0.051
180		*Puntius sophore*	*Puti*	49.699	46.145	2.001	–	4.263	5.793	20.335	26.391	35.993	26.316	228.344	25.066
212		*Puntius ticto*	*Tit puti*	10.196	8.653	6.524	–	–	–	0.221	–	–	–	0.714	0.078
5		*Amblypharygodon mola*	*Mola*	0.037	–	–	–	–	–	3.079	0.082	–	–	10.190	1.119
75		*Esomus danricus*	*Darkina*	0.510	0.565	5.509	2.264	–	–	–	0.012	20.970	2.632	49.203	5.401
83		*Glossogobius giurus*	*Bailla*	1.519	0.464	4.523	9.811	6.384	36.669	0.428	0.250	1.610	–	24.575	2.698
110		*Lepidocephalus guntea*	*Gutum*	0.542	1.779	11.772	2.264	–	–	0.070	3.210	9.706	–	32.230	3.538
9		*Aplocheilus panchax*	*Kanpona*	0.364	0.464	4.523	1.132	–	0.870	–	0.317	0.543	2.632	2.864	0.314
40		*Channa orientalis*	*Cheng*	–	0.642	6.263	–	–	–	–	–	–	–		–
41		*Channa punctatus*	*Taki*	11.944	9.526	31.342	31.698	34.040	2.607	9.774	16.764	7.503	44.737	106.658	11.708
42		*Channa striatus*	*Shol*	–	–	–	–	–	–	15.586	–	–	–	50.400	5.533
88		*Heteropneustes fossilis*	*Shingi*	4.240	6.061	3.508	–	–	–	–	–	1.827	–	4.241	0.466
121		*Macrognathus aculeatus*	*Tara baim*	1.471	3.609	–	–	–	–	0.613	0.064	–	–	2.165	0.238
123		*Macrognathus pancalus*	*Guchi*	6.880	1.902	–	2.264	20.212	12.598	13.206	3.334	0.874	–	61.358	6.735
122		*Mastacembelus armatus*	*Baral baim*	0.254	–	–	–	–	0.289	–	–	–	–	0.133	0.015
138		*Nandus nandus*	*Bheda*	1.034	1.453	–	–	–	–	–	–	–	–		–
15		*Badis badis*	*Napit koi*	1.164	0.025	0.232	9.057	–	3.910	0.024	1.585	0.570	3.947	9.327	1.024
203		*Tetraodon cutcutia*	*Potka*	–	–	–	–	–	–	0.589	–	–	–	1.903	0.209
35		*Chanda baculis*	*Chanda*	0.155	0.384	–	–	–	0.435	0.981	0.285	–	–	4.180	0.459
36		*Chanda nama*	*Nama Chanda*	–	–	–	–	–	0.900	1.419	–	–	–	5.001	0.549
37		*Chanda ranga*	*Lal chanda*	0.254	0.025	0.232	–	–	0.435	2.667	1.585	0.642	–	14.816	1.626
	Subtotal			99.035	99.564	95.738	78.491	99.999	77.412	79.598	88.304	91.338	100.001	777.886	85.391
931	Other	Prawn spp.	*Chingri/Icha*	0.964	0.436	4.262	20.377	–	22.588	1.462	11.696	8.662	–	71.664	7.867
	Subtotal			0.964	0.436	4.262	20.377	–	22.588	1.462	11.696	8.662	–	71.664	7.867
	Grand total			100	100	100	100	100	100	100	100	100	100	910.972	100

Notes : 1. No fishing activities were observed from January to May 1993 and January to February 1994

2. – denotes zero catch

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6.5.1 Unregulated Anahula *Khal*

Between January and June 1993 no riverine or migratory species were recorded in Anahula *Khal* despite the first entry of river floodwaters in mid-June (Fig. 6.9). In July numbers of riverine species increased only slightly but there was a substantial increase of migratory species. During August and September, riverine species numbers continued to rise to a peak in September while numbers of migratory species stabilised at a peak level in August and decreased slightly in September. During the flood drawdown in October, all riverine species returned to rivers and none remained in the canal by November. The migration out of the canal by migratory species was rather more gradual but most had left by October and all by December.

Numbers of floodplain resident species followed a different pattern. Numbers remained at their lowest between January and May 1993 but increased sharply in June and more gradually in July and August to a stable peak which was maintained until October. From November to January there was a slow decline followed by a more rapid decrease in February 1994.

Data from monthly catch compositions showed that in July, 3 riverine species entered the canal in low abundance together with 13 migratory species which moved upstream from the Northern Dhaleswari River. These species accounted for 45% of the monthly catch (Fig. 6.10) and the most abundant individual species included the major carps *catla* (18%), *rui* (18%) and *mrigel* (3%) and others such as *fulchela* (4%), *katari* (1%) and *chapila* (0.6%). All major carps entered as fry with individual average weights ranging from 3-4 g. *Katari* entered as adults (6 g) while *fulchela* and *chapila* were juveniles of 2-3 g per individual. In August, 4 new riverine and 2 migratory species appeared in catches but none was abundant. The catch contribution of migratory fish reached a peak of 76% in August due mainly to *mrigel* (34%), *catla* (21%) and *rui* (13%). These were all juveniles of the year averaging in size from 56 g to 85 g for *catla*, 27 g for *mrigel* and 19 g for *rui*. In September, 4 new riverine species appeared in low abundance together with 1 migratory species. The catch contribution by migratory species decreased slightly to 50%, the bulk of which was provided by juvenile *catla* (126 g/indiv), *mrigel* (37 g), *kalbaus* (130 g) and *rui* (45 g).

Catch contributions made by floodplain resident species ranged from 93% to 100% from January to June 1993. The sharp increase in numbers of species from 6 in May to 19 in June probably resulted from a migration from the Northern Dhaleswari River where 9 of these

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Figure 6.9 Seasonal variation in the number of riverine, migratory and floodplain resident fish species in Anahula *Khal* (site NC07, outside BRE)

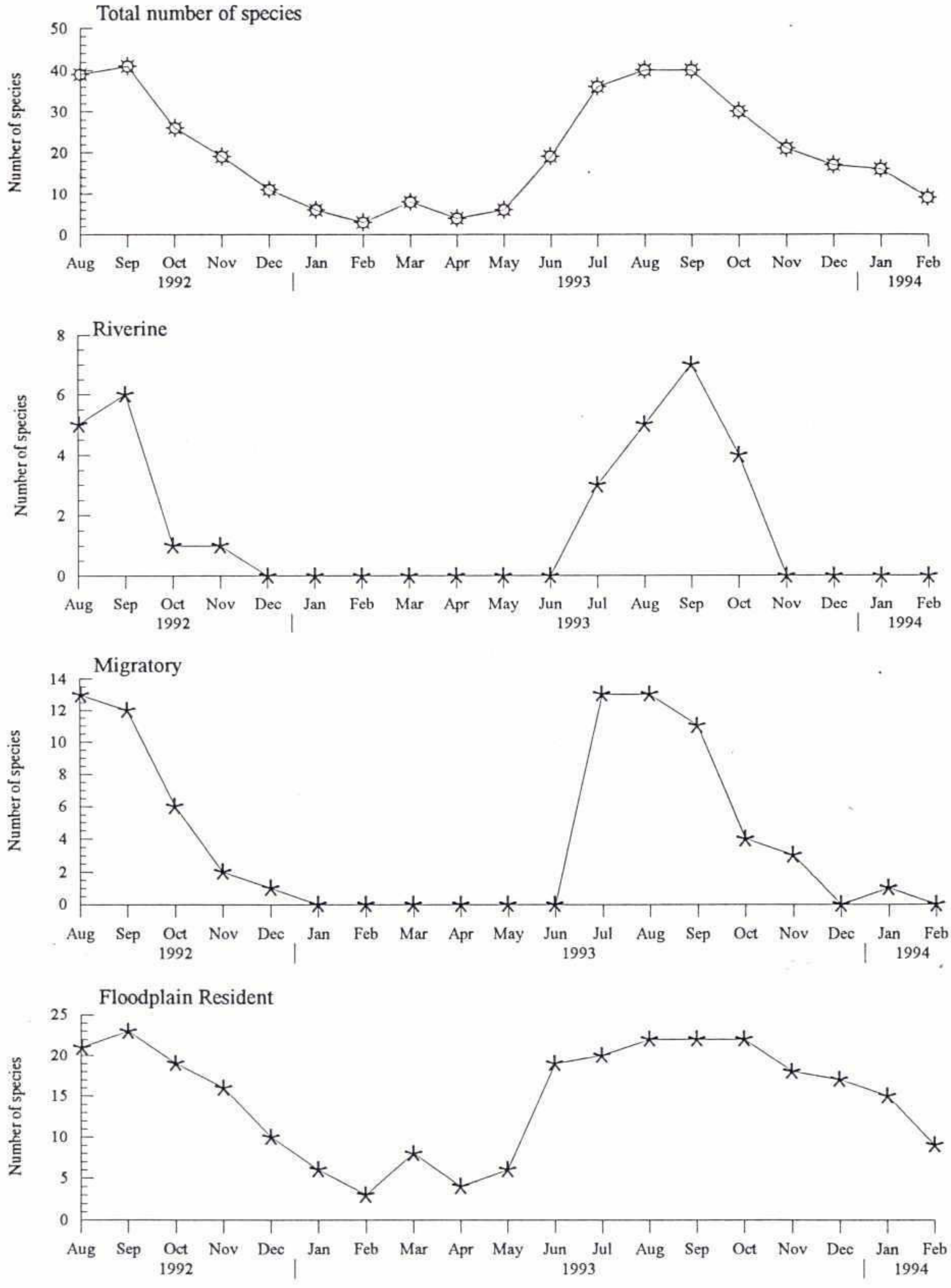
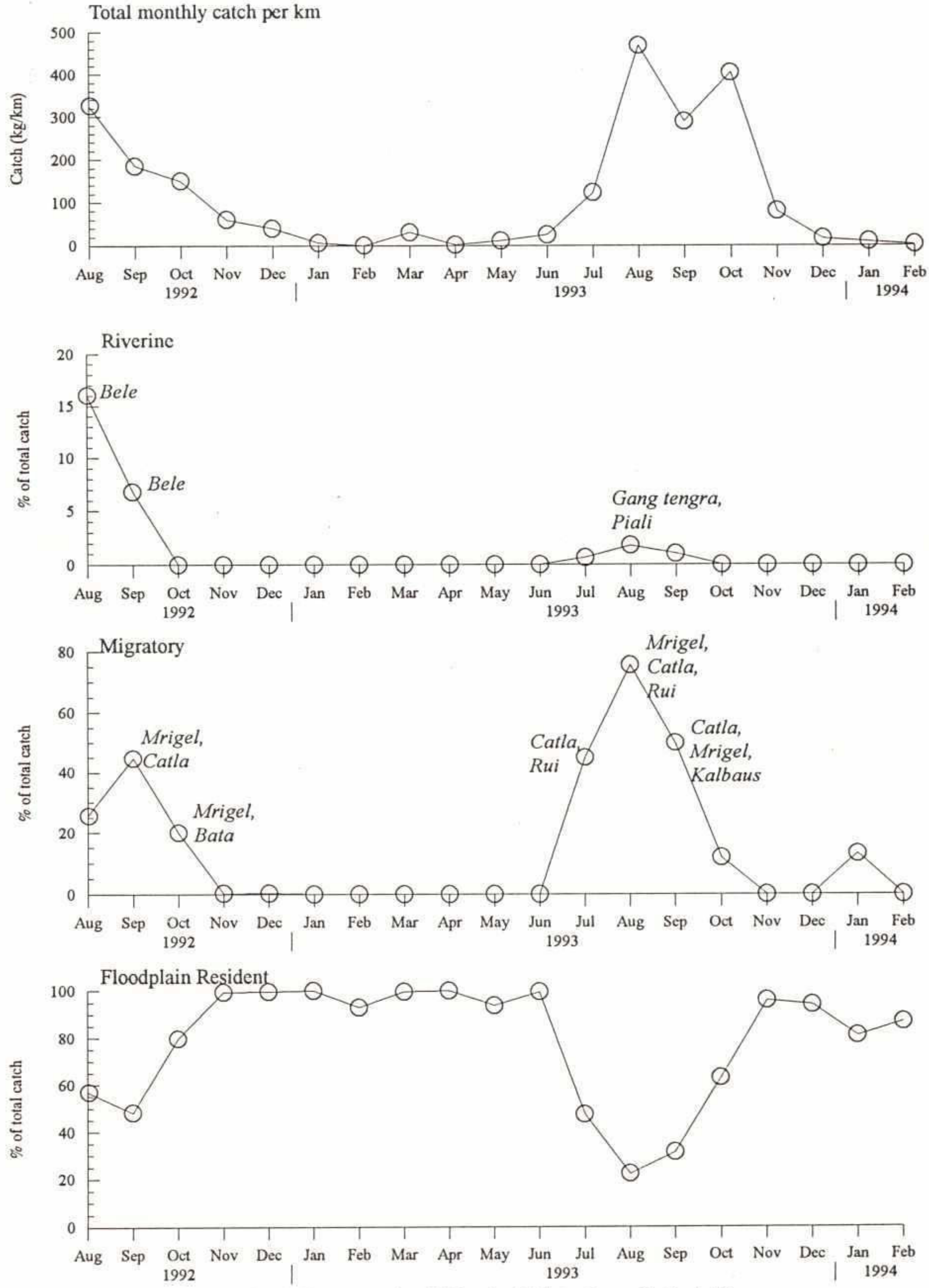


Figure 6.10 Percentage total monthly catch of riverine, migratory and floodplain resident groups of fish from Anahula *Khal*, (site NC07, outside BRE)



Notes: 1. See text for definition of different categories of fish based on habitat preference (Section 5.4.1)
2. Dominant species are shown for peak relative abundances of riverine and migratory fish

species were recorded in April and May while on adjacent floodplains very few species were found during the same period (see Section 7.5.1).

6.5.2 Regulated Nandina *Khal*

No fishing was observed in the regulated Nandina *Khal* between January and May 1993 and between January and February 1994. During the rest of the year, migrations into the canal by riverine and migratory species were greatly reduced compared with those on the unregulated canal (Figs 6.11 and 6.12). Only 2 riverine species were recorded, *kachki* in June and *balichata* in September and their contributions to catches were very low (1% or less). Migratory species were only found in September when 5 species, *rui*, *kalbaus*, *bata*, *raik* and *golsha tengra* accounted for 19% of the peak monthly catch. The four species of carp entered as juveniles while *golsha tengra* were small adults.

Numbers of floodplain resident species increased moderately in June and decreased in July before rising sharply again in August to a peak level of diversity which was maintained until November, after which numbers declined rapidly to zero in January 1994. Catch compositions from the Old Hurasagar River and Nandina floodplain/*beel* indicated that while only 1 to 3 species were recorded on Nandina *Beel* in May and June, all 10 species which entered the canal in June were present in the Old Hurasagar in May and June. It seems highly likely therefore that these species entered the canal by upstream migration from the river.

Figure 6.11 Seasonal variation in the number of riverine, migratory and floodplain resident fish species in Nandina *Khal* (site NW20, inside BRE)

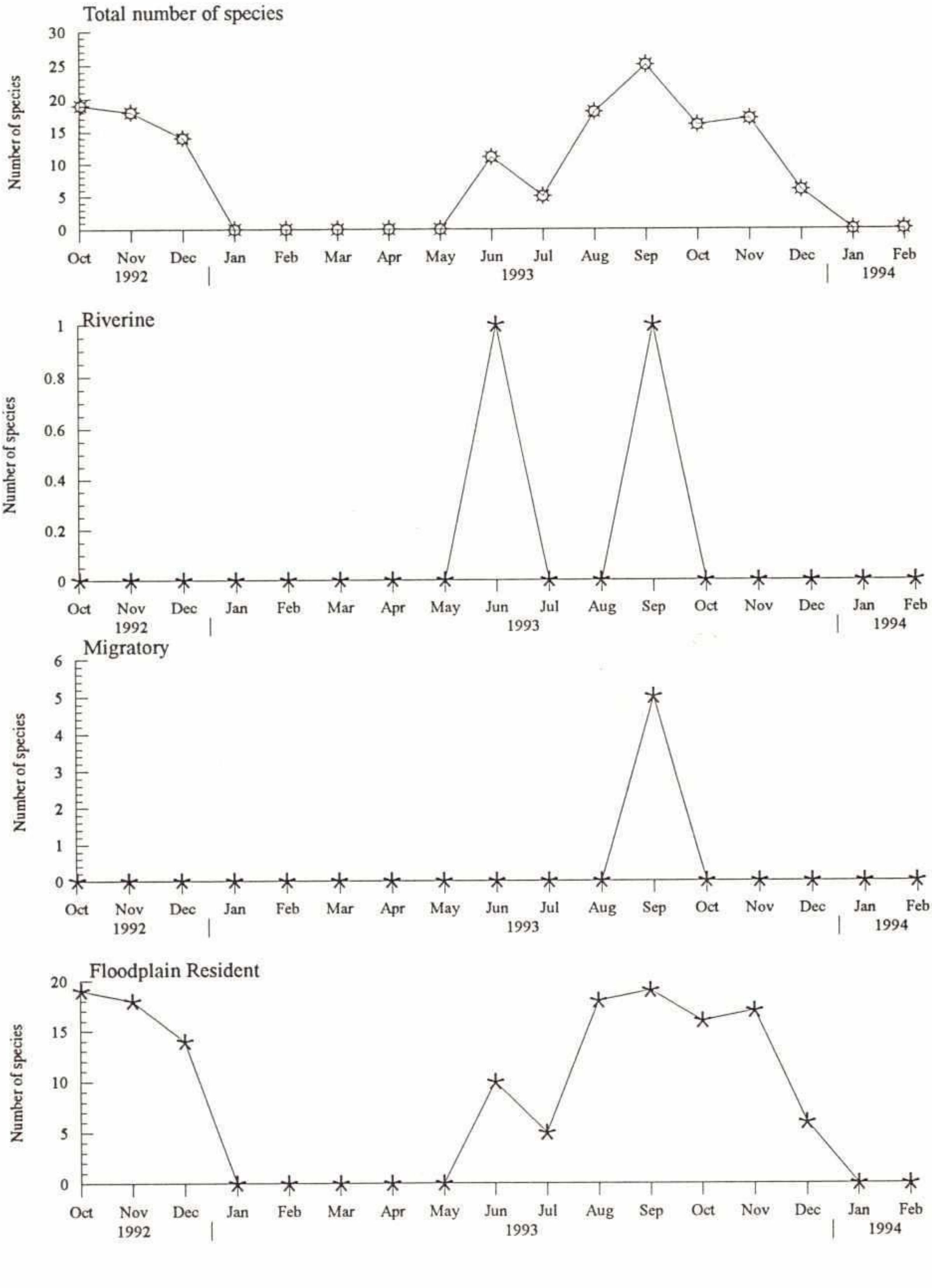


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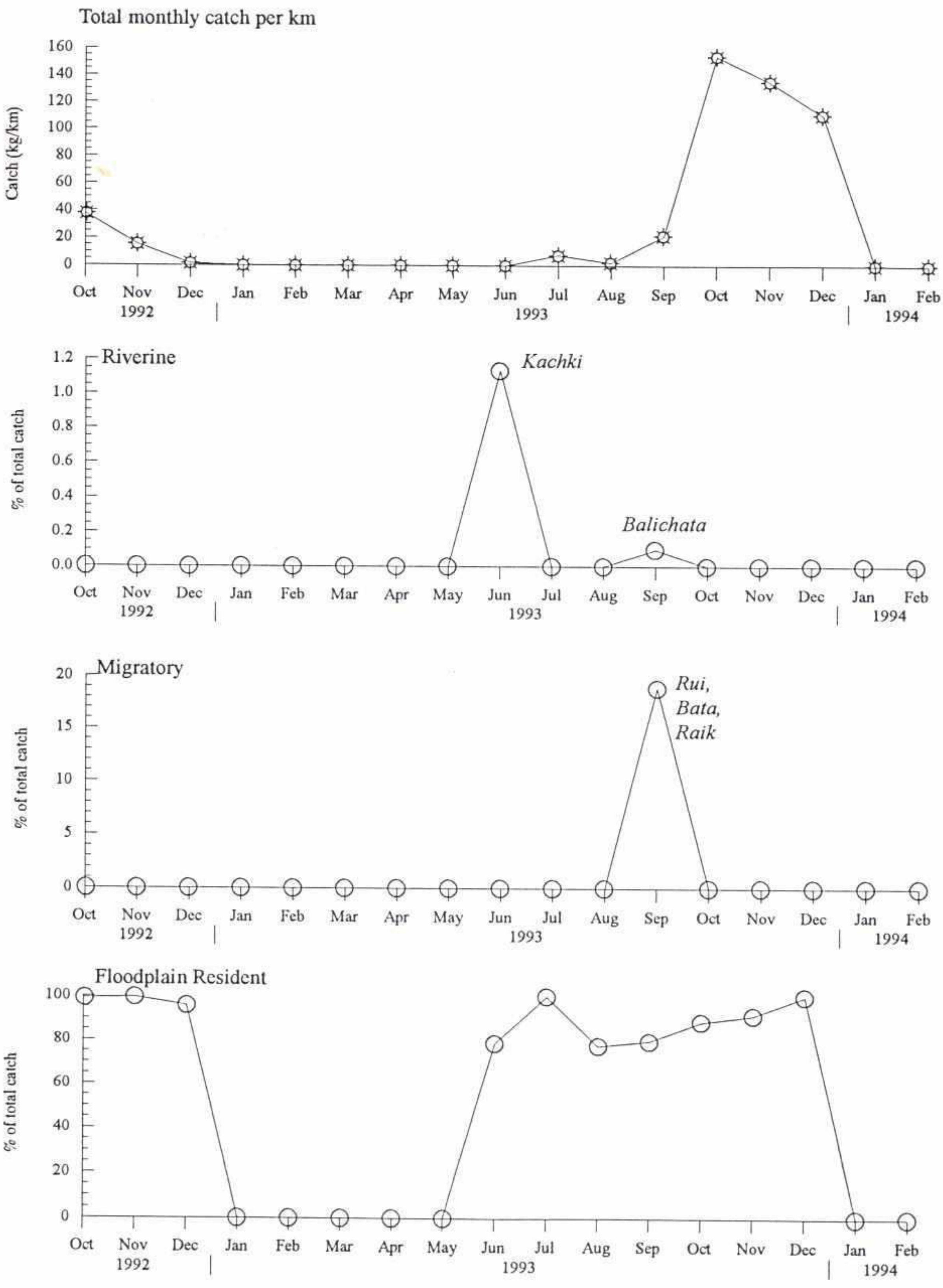
Figure 6.12 Percentage total monthly catch of riverine, migratory and floodplain resident groups of fish from Nandina *Khal*, (site NW20, inside BRE)



Notes: 1. See text for definition of different categories of fish based on habitat preference (Section 5.4.1)
2. Dominant species are shown for peak relative abundances of riverine and migratory fish
3. Note differences in percentage scales

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7 FLOODPLAIN FISHERIES

7.1 Total Catch

7.1.1 Pattern of catch

On the unregulated Anahula floodplains/*beel* no fishing activities were observed from November 1992 to April 1993 and from January to February 1994 (Fig. 7.1). The earlier end to fishing activities in 1992 resulted from the lower flood in that year compared with 1993. In May and June 1993, fishing effort and catch remained extremely low despite rainfall inundation of the *beel* in May and entry of river floodwaters in mid-June. The catch peaked sharply in July but dropped equally rapidly in August before rising to a secondary peak during the drawdown in September and October. In November and December catches again decreased to very low levels.

On the regulated Nandina floodplains/*beel*, monthly catches remained very low (<3 kg/ha) throughout the year making it difficult to identify clear seasonal patterns. Catches were lowest between April and July 1993 and in February 1994. A peak catch was observed in November 1993 but catches during the drawdown of September and October did not exceed those seen earlier in the year, between February and March 1993. The differences in winter catches between years resulted from *kua* harvesting which was carried out in 1993 but not during the survey period in 1994.

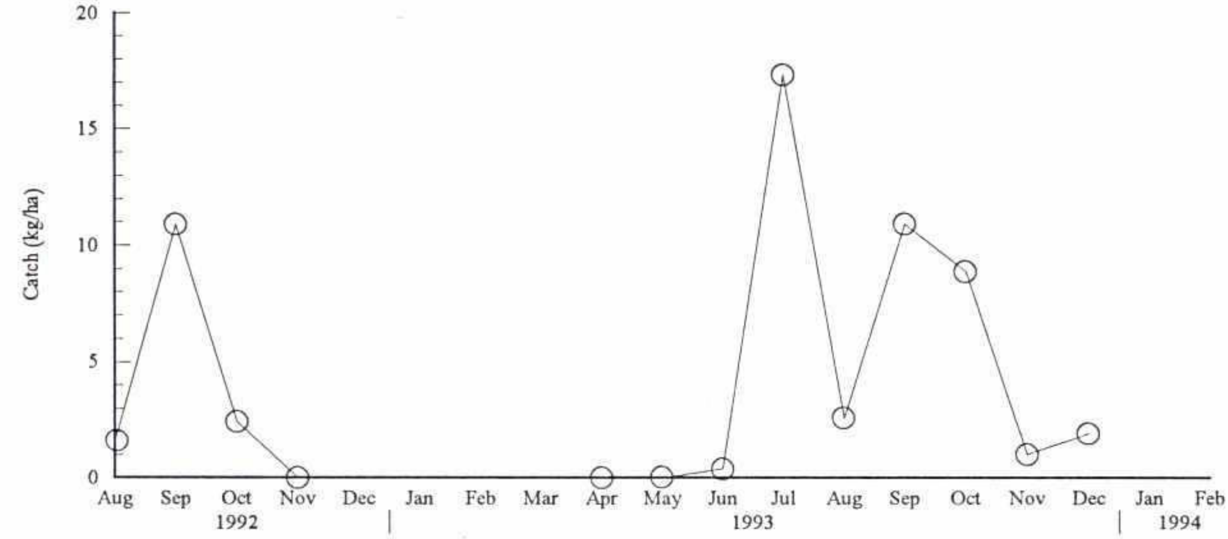
7.1.2 Size of catch

Between March 1993 and February 1994, the annual catch from Anahula was 43 kg/ha compared with only 8 kg/ha from Nandina, a reduction of 81% (Table 7.1). Statistical comparisons of fish densities between sites were inconclusive since they were limited by the fact that there was only one dominant gear common to both sites and that this gear accounted for only a minor proportion of the total catch from the unregulated Anahula *Beel* (see Section 7.3). The higher catch at Anahula could be explained more clearly in terms of the higher fishing effort expended by the two most dominant gears, *thella jal* and *ber jal*, which together accounted for 72% and 68% of the catch from unregulated and regulated sites respectively.

Figure 7.1 Seasonal variation in the catch per unit area from floodplains/*beel* inside and outside the BRE

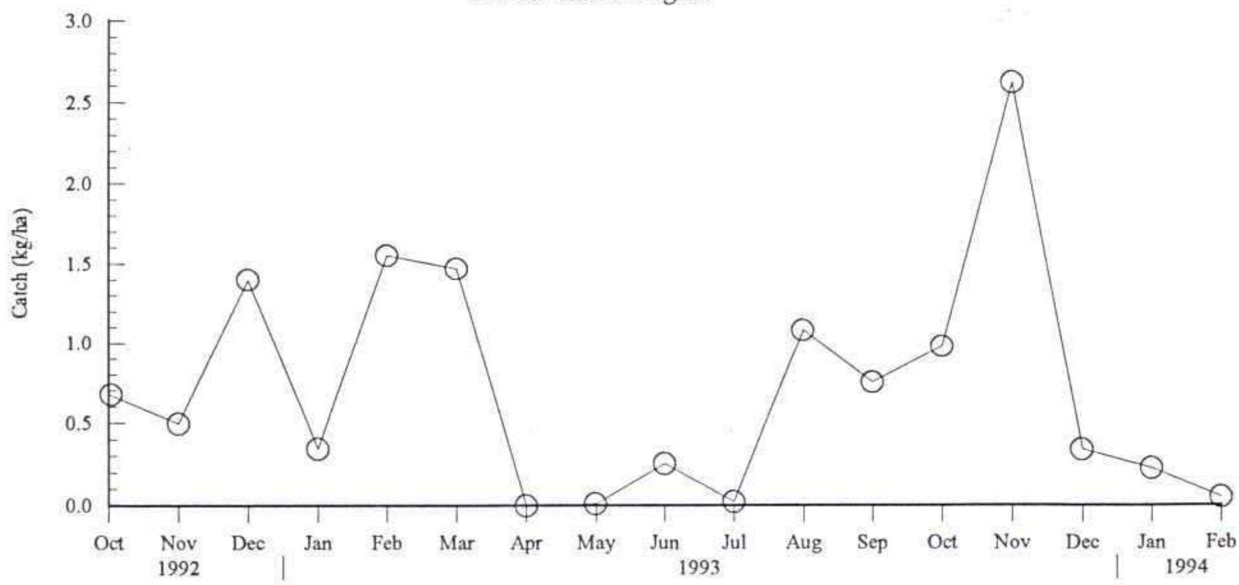
Anahula (site NC08+NC09): outside BRE

Annual catch: 43 kg/ha



Nandina (site NW21): inside BRE

Annual catch: 8 kg/ha



Note: 1. At site NC08+NC09, no fishing activities were observed from Nov-Dec 1992, Jan-April 1993 and Jan-Feb 1994
At site NW21 no fishing activities were observed in April 1993

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Table 7.1 Annual catch from floodplain/*beel* sites inside and outside the BRE compared with sites at lower elevations, March 1993 - February 1994

Site Code	Site Name	Inside/Outside BRE	Catch per unit area (kg/ha)
NC08+NC09	Anahula	Outside	43
NW21	Nandina	Inside	8
NC04	Gazaria	Outside	108
NC18+NC19	Mailjani	Outside	105
NW17+NW18	Potajia	Inside	84

Note: Values of catch are rounded to nearest whole number

The annual fish yields from Anahula and Nandina floodplains/*beel* were considerably lower than those from adjacent lower-lying areas in the North Central and North West regions (Table 7.1). The catch differences were attributed to differences in flooding patterns between high and lower-elevation sites within each region.

7.1.3 Comparisons of catches between different years

Survey periods of 17 and 19 months in the North West and North Central regions respectively provided an opportunity to examine inter-annual changes in catch through two flood recessions and winters. In the North West Region, total catches for the period October 1992 - February 1993 were compared with those for the same period in 1993/94. A similar comparison was made in the North Central Region for the months August to February 1992/93 and 1993/94. Catches from *kua* fishing were excluded from the analyses since these were harvested in the winter of 1993 but not during the survey period up to February 1994. It is not known whether they were harvested in March or April 1994.

Catches were lower in the drier year of 1992/93 from both regulated and unregulated floodplains (Table 7.2). Results from studies elsewhere in the world have demonstrated that yields of floodplain fisheries are directly positively related to the magnitude and extent of flooding[13]. Lower catches would therefore be expected in the relative drought year of 1992/93 than in 1993/94 when flooding increased (see Fig. 3.3).

Table 7.2 **Comparison of catches (kg/ha) from floodplains/*beel* inside and outside the BRE between different years**

Site Code	Site Name	Inside/Outside BRE	Catch		% reduction in catch in 92/93
			1992-1993	1993-1994	
NC08 + NC09	Anahula	Outside	15	25	40
NW21	Nandina	Inside	2.8	3.8	26

Note: *Kua* catches were excluded from the analyses (see text for details)

The total catch for each survey period was then divided into three groups of fish based on habitat preference: riverine, migratory and floodplain resident species (see Section 5.4.1 for definitions). At Anahula, the catch of floodplain residents was more greatly reduced (39%) than that of riverine species (9%) during the drier year. However, the catches of the latter were so small (<0.2 kg/ha) that percentage values were highly sensitive to small changes in catch (Table 7.3). Catches of migratory species were also small ($\leq$ 5 kg/ha) but these increased slightly during the drier year of 1992/93. The results generally agree with patterns predicted on the basis of inter-annual changes in flood extent and their impact on floodplain dependent species (see Section 5.1.3 for more detailed discussion). At Nandina, riverine and migratory species were very rare and therefore the total catch reduction of 26% in the drier year was due solely to a lower catch of floodplain resident species. The greater reduction in floodplain resident species seen on the unregulated site agrees with the patterns found on adjacent rivers and suggests that the flood extent was more greatly reduced during the dry year on unregulated floodplains than on regulated areas. However, as mentioned in Section 5.1.3, while no direct hydrological data were available to examine differences in inter-annual flooding patterns, hydrographs for the Dhaleswari and Baral rivers indicated almost identical inter-annual changes in flood magnitude and duration between 1992/93 and 1993/94 (see Fig. 3.3).

Table 7.3 Comparison of catches[1] (kg/ha) of riverine, migratory and floodplain resident fish species from floodplains/*beel* inside and outside the BRE between different years

Site code	Site Name	Inside/ Outside BRE	Riverine CPUA			Migratory CPUA			Floodplain Resident CPUA		
			1992-1993	1993-1994	% change in 92/93	1992-1993	1993-1994	% change in 92/93	1992-1993	1993-1994	% change in 92/93
NC08 +NC09	Anahula	Outside	0.150	0.164	- 9	5.0	4.2	+ 19	9.5	15.5	- 39
NW21	Nandina	Inside	0.07	-	-	-	-	-	2.8	3.8	- 26

Notes: 1. *Kua* catches were excluded from the analyses (see text for details)
2. + and - denote increase and decrease in catch respectively

7.2 Pattern of Fishing

7.2.1 Catch by gear

Percentage contributions made by dominant gears to the total annual catch from floodplains/ *beel* are presented in Table 7.4. More detailed data on percentage monthly and annual catches of all observed gears are given in Tables 7.5 and 7.6.

Table 7.4 Percentage contribution (by weight) to the total annual catch made by dominant[1] gears on floodplains/*beel* inside and outside the BRE, March 1993 - February 1994

Gear	Anahula (site NC08+NC09), outside BRE	Nandina (site NW21), inside BRE
Ber jal	47.9	-
Thella jal	24.3	60.7
Dharma jal	10.6	
Hand fishing	8.8	-
Kua		18.1
Current jal (Stationary)	-	13.0

Notes: 1. Dominant gears are defined as those gears which, when ranked in order of abundance, comprised at least 90% of the total annual catch
2. - denotes gear present but not dominant; blank denotes gear absent

Table 7.5 Percentage monthly catch from Anahula floodplain/beel by gear type: outside BRE (site NC08+NC09)

Gear Code	Gear name	Year : 1992			Year : 1993								Total annual catch (Mar'93 – Feb'94)	
		Aug	Sep	Oct	May	June	July	Aug	Sep	Oct	Nov	Dec	Kg	%
45	*Ber jal*	48.296	85.559	–	–	–	80.873	–	50.557	12.017	–	–	1890.636	47.881
255	*Thella jal*	51.704	6.850	32.606	100.000	100.000	13.923	73.381	21.687	32.597	26.604	11.594	960.394	24.322
105	*Dharma jal*	–	6.658	50.142	–	–	–	8.265	21.476	22.177	3.112	–	418.123	10.589
307	Hand fishing	–	–	–	–	–	–	–	–	21.442	29.081	83.172	347.338	8.796
175	*Kathi jal*	–	–	–	–	–	4.790	1.579	–	5.412	–	–	124.026	3.141
30	*Sip*	–	–	–	–	–	0.320	3.119	1.294	2.858	3.218	–	51.669	1.309
272	*Daun*	–	–	–	–	–	0.085	9.131	2.359	0.176	–	–	48.008	1.216
88	*Current jal (Stationary)*	–	–	–	–	–	0.009	3.268	2.306	0.341	3.575	–	37.036	0.938
97	By hand/Dewatering	–	–	–	–	–	–	–	–	–	34.410	–	31.760	0.804
164	*Jhaki jal*	–	0.933	17.252	–	–	–	–	0.322	2.809	–	–	26.106	0.661
89	*Dhor jal*	–	–	–	–	–	–	1.258	–	–	–	5.234	12.152	0.308
278	*Nol barsi*	–	–	–	–	–	–	–	–	0.170	–	–	1.381	0.035
		100	100	100	100	100	100	100	100	100	100	100	3948.629	100

Notes: 1. No fishing activities were observed from November to December 1992, from January to April 1993 and from January to February 1994

2. – denotes zero catch

Table 7.6 Perçentage monthly catch from Nandina floodplain/beel by gear type: inside BRE (site NW21)

Gear		Year: 1992			Year:1993										Year: 1994		Total annual catch (Mar'93 – Feb'94)	
Code	Gear name	Oct	Nov	Dec	Jan	Feb	Mar	May	June	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Kg	%
255	*Thella jal*	83.659	57.407	93.753	100.000	23.503	2.502	100.000	100.000	34.026	31.694	18.252	82.153	96.559	97.967	100.000	100.000	830.641	60.661
302	*Kua*	–	–	–	–	76.497	96.292	–	–	–	–	–	–	–	–	–	–	247.633	18.084
88	*Current jal (Stationary)*	3.906	42.593	5.935	–	–	–	–	–	65.974	68.306	11.915	17.847	–	–	–	–	178.506	13.036
45	*Ber jal*	–	–	–	–	–	–	–	–	–	–	69.833	–	–	–	–	–	92.400	6.748
97	By hand/Dewatering	12.435	–	–	–	–	–	–	–	–	–	–	–	3.441	–	–	–	15.823	1.156
307	Hand fishing	–	–	–	–	–	1.205	–	–	–	–	–	–	–	–	–	–	3.100	0.226
30	*Sip*	–	–	–	–	–	–	–	–	–	–	–	–	–	2.033	–	–	1.213	0.089
314	*Boat katha*	–	–	0.312	–	–	–	–	–	–	–	–	–	–	–	–		–	–
		100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	1369.316	100

Notes : 1. No fishing activities were observed in April 1993

2. – denotes zero catch

A total of 12 different types of gear was recorded at Anahula compared with 8 at Nandina. Data in Table 7.4 revealed marked differences in fishing patterns between sites. On the unregulated floodplain/*beel*, *ber jal* accounted for the highest share (48%) of the catch while on Nandina this gear took only 7%. *Thella jal* was the second most important gear at Anahula where it provided 24% of the catch but at Nandina this was the most important gear accounting for 61% of the annual catch. *Dharma jal* were used on Anahula *Beel* where water flowed between various canal systems and took 11% of the catch. In contrast, this gear was absent at Nandina. The third dominant gear at this site was *current jal* providing 13% of the catch compared with only 1% at Anahula. A further difference between sites was the presence of several small *kua* in Nandina *Beel* which took 18% of the annual catch while at Anahula, farmers made no attempt to construct *kua* in the small *beel* area. Instead, hand fishing in the shallow water and mud during the flood drawdown was more important at this site.

7.2.2 Catch by gear by month

At Anahula, no fishing activity was observed from November 1992 to April 1993. In May and June, despite rainfall inundation of the *beel* and ingress of river waters in mid-June, only one gear, *thella jal* was recorded which provided extremely low monthly catches (Fig. 7.2). The peak catch of the year was taken a month later in July, resulting principally from *ber jal* operations which captured 81% of the catch. *Thella jal* accounted for a further 14% and the remainder of the catch was shared by four new gears, *kathi jal*, *sip*, *daun* and *current jal*. The total catch decreased considerably in August possibly as a result of the *ber jal* moving out of the area and the bulk of the catch was taken by *thella jal*. However, a smaller seine net, *kathi jal* continued operations but provided less than 2% of the catch. Of the 5 other gear types used in August, *daun* and *dharma jal* provided the highest catch shares of 9% and 8% respectively.

During the drawdown in September and October, catches increased again to a secondary seasonal peak. During September, *ber jal* reappeared and took half the monthly catch while most of the remainder was taken equally by *thella jal* and *dharma jal*. In October, the share taken by *ber jal* dropped to 12% while that of *thella jal* increased to 33%. *Dharma jal* continued to provide an important part (22%) of the catch and hand fishing commenced, accounting for a further 21%.

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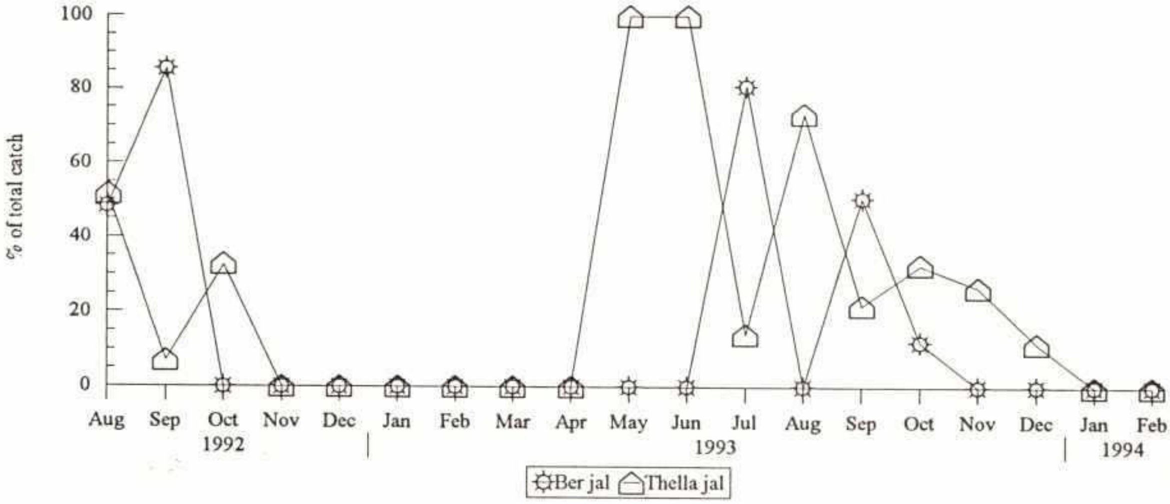
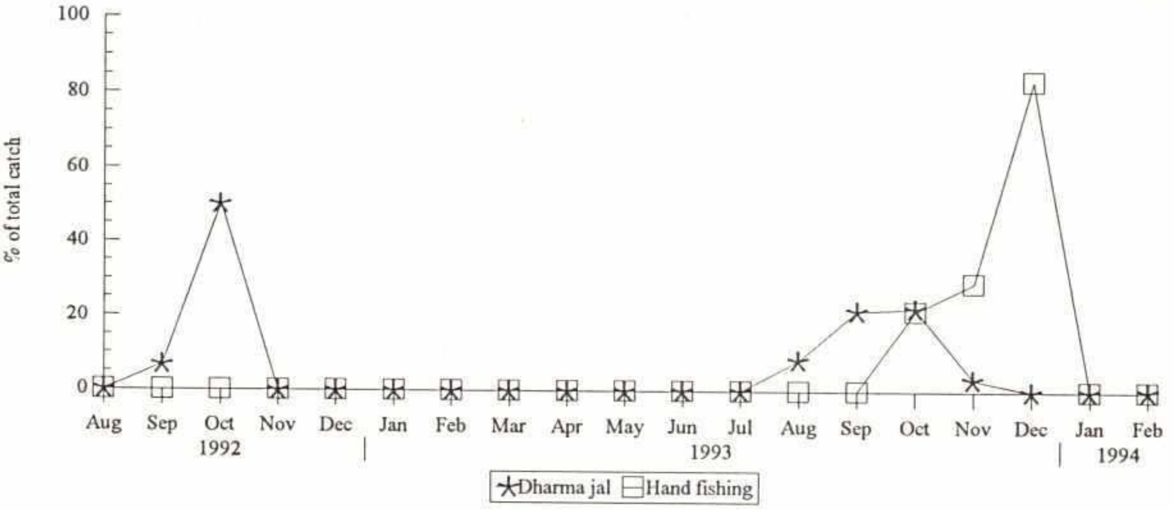
Figure 7.2 Percentage of total monthly catch taken by dominant gears: site NC08+NC09 (outside BRE)





The peak catch seen in July resulted mainly from the peak fishing effort (Fig. 7.3) and peak catch rate of *ber jal* (Fig. 7.4). Secondary catch peaks in September and October were largely a function of high (or sometimes peak) fishing effort and catch rate of three dominant gears, *ber jal*, *thella jal* and *dharma jal*. In November and December monthly catches decreased sharply and were provided almost exclusively by *thella jal* and hand fishing.

On the regulated Nandina floodplain/*beel*, catches were dominated for most of the year by *thella jal* which accounted for 80% to 100% of the catch in several months (Fig. 7.5). The months when it did not dominate included February and March 1993, when *kua* provided 76% to 96% of catches, and the monsoon period when *current jal* increased effort from August to October (Fig. 7.6) and *ber jal* appeared in September to take the largest share (70%) of the catch. The peak catch seen in November was a function more of a peak in fishing effort by *thella jal* than a peak in catch rate (Fig. 7.7).

7.3 Statistical Comparison of Catch Rates from Floodplains/*Beel* Inside and Outside the BRE

Statistical comparisons were undertaken of seasonally pooled catch rates of dominant gears used on Anahula and Nandina floodplains/*beel* following the method described in the Draft Final Report, Appendix 3. The underlying assumption of the method was that once differences in catchabilities between gears had been accounted for, any further differences in catch rates inside and outside the BRE were due solely to differences in fish densities.

On the regulated floodplains/*beel* at Nandina, more than 90% of the total annual catch per hectare, excluding *kua*, was taken by three gears. In descending order of contribution to the catch these were *thella jal*, *current jal* and *ber jal*. On the unregulated floodplains/*beel* at Anahula, 92% of the annual catch was taken by four gears. In descending order of contribution to the catch, they were *ber jal*, *thella jal*, *dharma jal* and hand fishing. *Ber jal* accounted for 48% and *thella jal* 24% of the catch.

Inspection of gear usage and catch rate trends revealed that there was relatively little fishing at Nandina. In particular, *ber jal* was recorded in use in only one month and *current jal* were used extensively in only one season. Neither was therefore a suitable gear on which to base comparisons of seasonal catch rates. With only one gear remaining (*thella jal*), statistical comparisons using the model could not be carried out.

Figure 7.3 Total monthly fishing effort per hectare of floodplain by dominant gears: site NC08+NC09 (outside BRE)

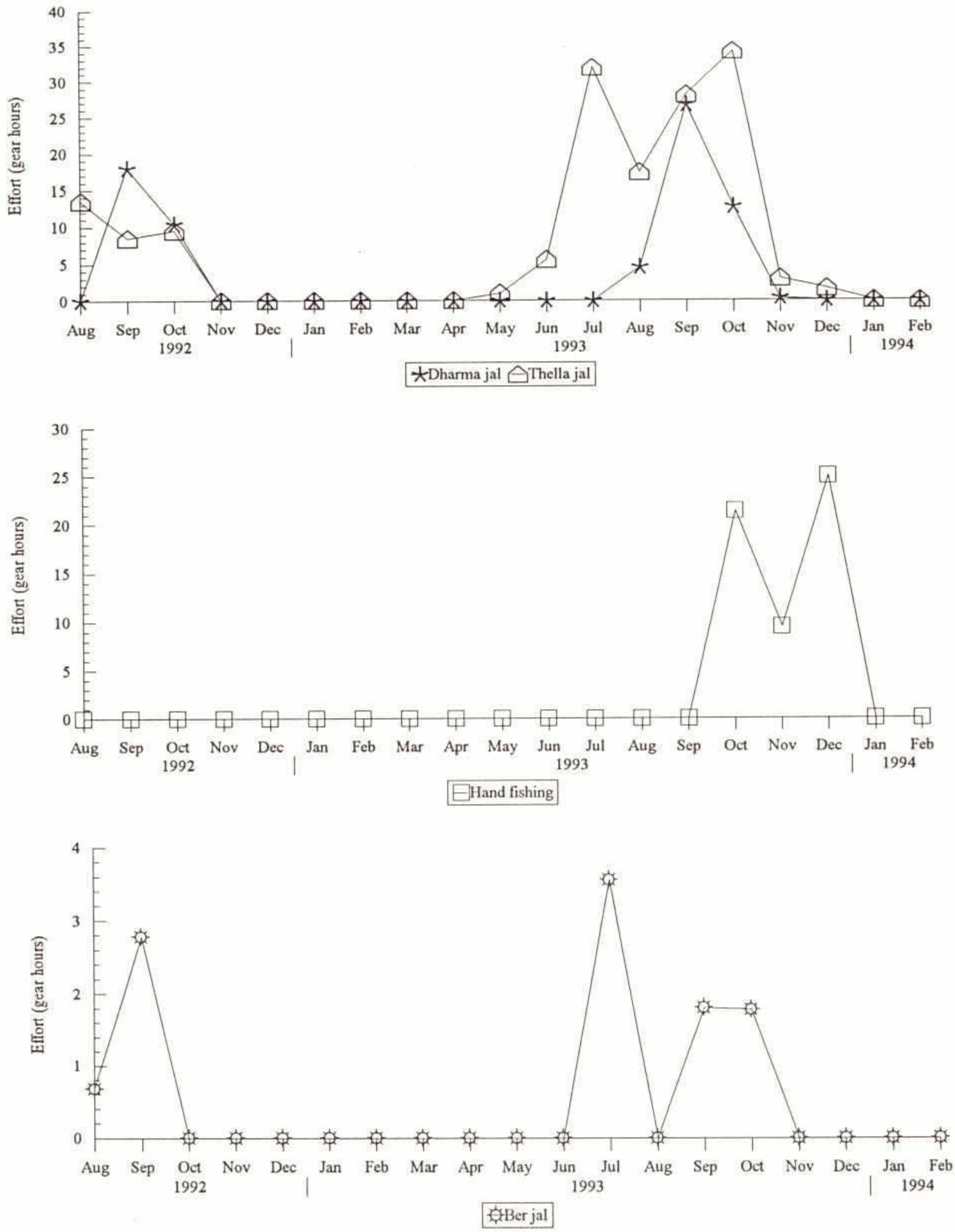


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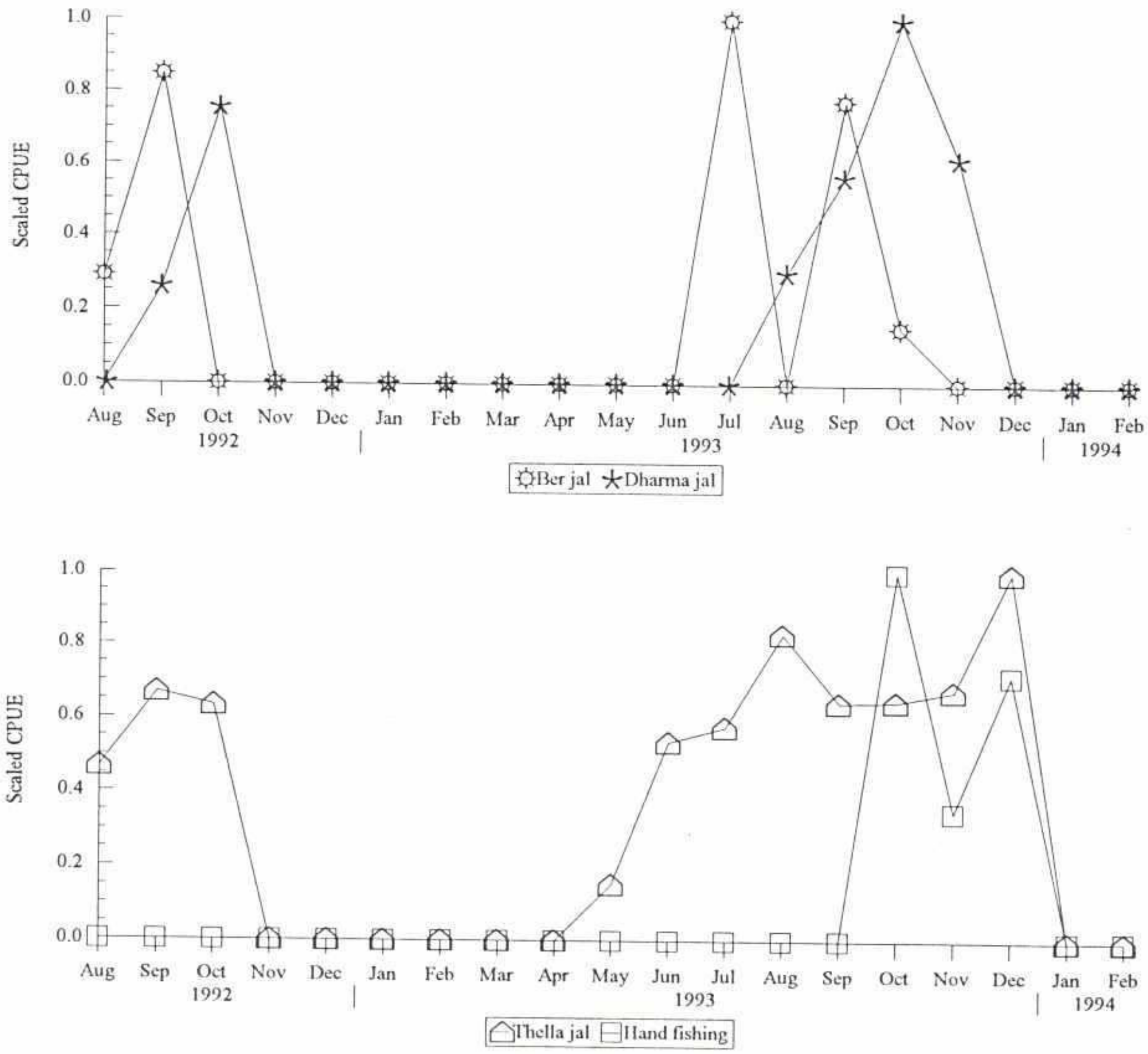
Figure 7.4 Scaled CPUE of dominant gears: site NC08+NC09 (outside BRE)



Note: Scaled CPUE are values of CPUE expressed as a proportion (decimal) of the maximum monthly value recorded

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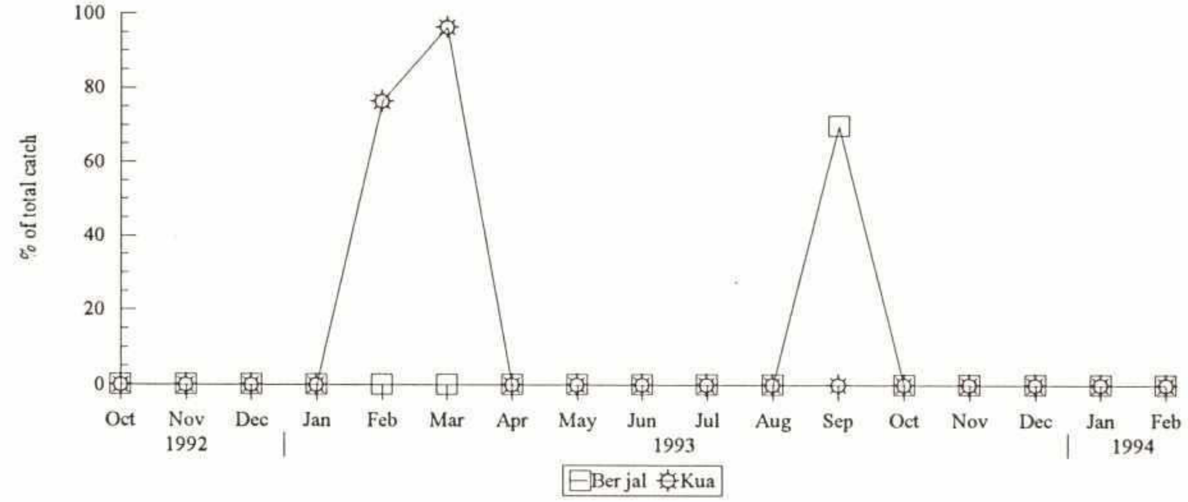
Figure 7.5 Percentage of total monthly catch taken by dominant gears: site NW21 (inside BRE)



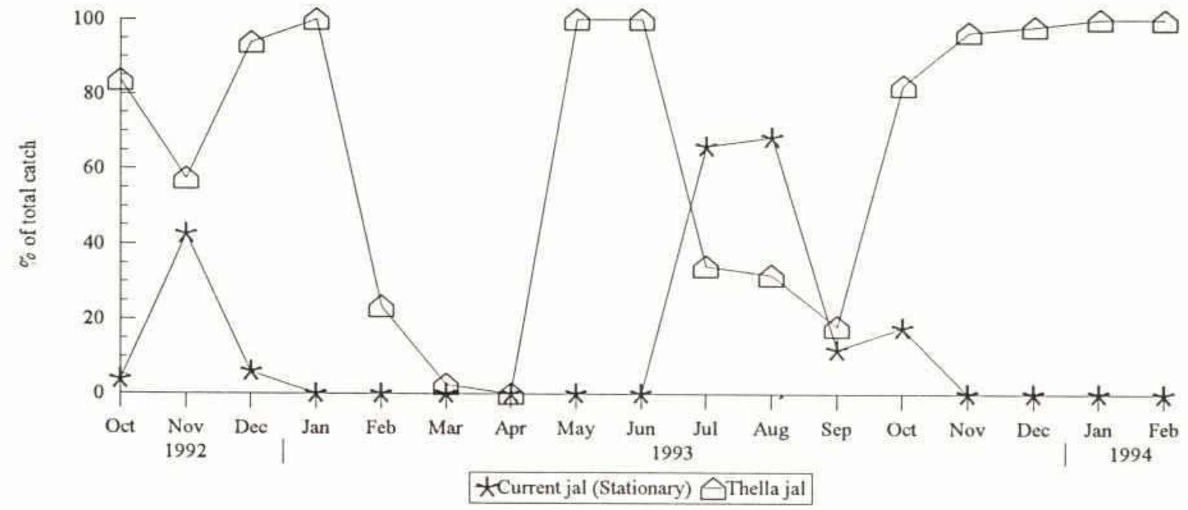


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Figure 7.6 Total monthly fishing effort per hectare of floodplain by dominant gears: site NW21 (inside BRE)

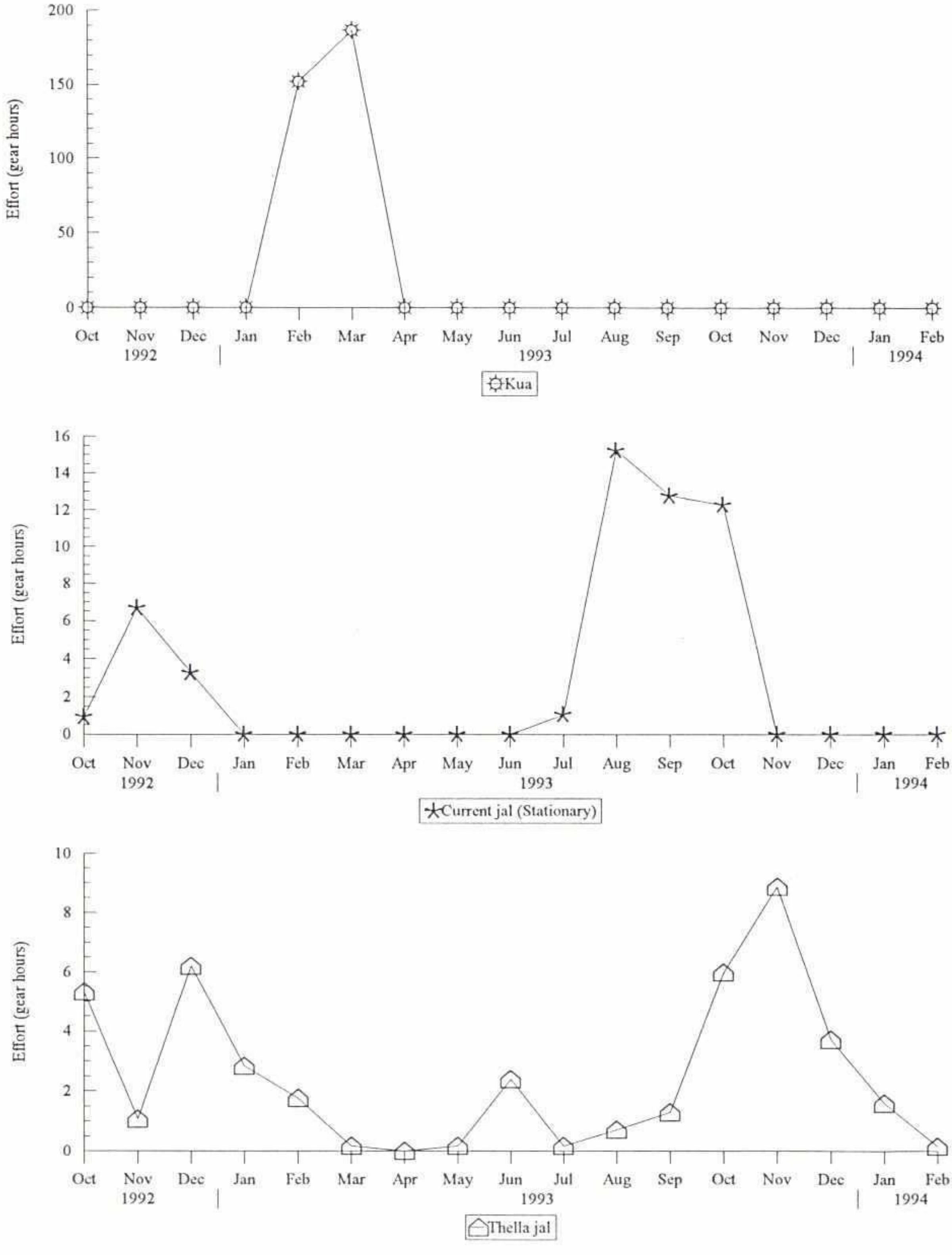
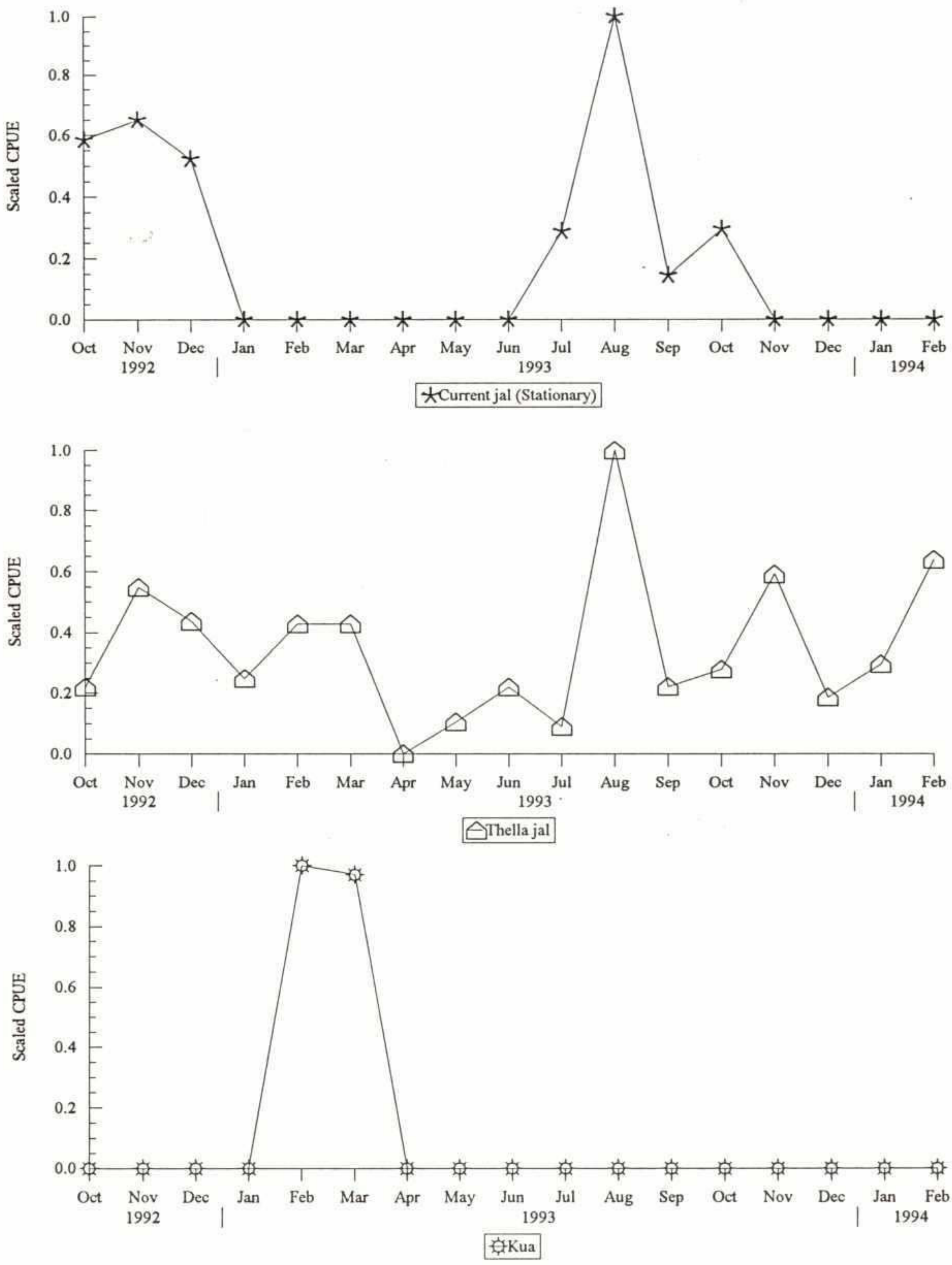


Figure 7.7 Scaled CPUE of dominant gears: site NW21 (inside BRE)



Note: Scaled CPUE are values of CPUE expressed as a proportion (decimal) of the maximum monthly value recorded

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It was nevertheless considered useful to examine the differences in catch rate trends for *thella jal* which provided 61% of the Nandina catch. Mean catch rates of *thella jal* were compared for four seasons and for all seasons combined between March 1993 and February 1994 (Table 7.7 and Fig. 7.8). The non-parametric Mann-Whitney U-test was used since catch rates were not normally distributed. However, the parametric student t-test on logarithmic transformed catch rates produced essentially the same results as those presented in Table 7.7.

Table 7.7 Statistical comparison of catch rates (kg/hr) of dominant gears used inside and outside the BRE, March 1993 - February 1994

Gear name	Season	Inside BRE		Outside BRE		Non-parametric Mann-Whitney U-test on CPUE		
		Sample size	Mean CPUE	Sample size	Mean CPUE	Z-Value	P-Value	Comment
Thella jal	2	7	0.114	5	0.066	-0.16	0.871	NS
	3	5	0.256	31	0.090	-1.33	0.185	NS
	4	12	0.171	16	0.086	-3.02	0.002	HS
	5	10	0.141	2	0.117	-0.21	0.830	NS
	All seasons	34	0.163	54	0.087	-3.13	0.002	HS

Notes: 1. NS - Not significant, HG - Highly significant
2. Seasons: 1. March-April, 2. May-June, 3. July-September, 4. October-November and 5. December-February

No significant difference was detected in three of the four seasons examined. During the drawdown, however, a highly significant ($p<0.01$) difference between sites was detected with a higher mean catch rate found on the regulated Nandina *Beel*. When seasonal data were combined a significantly ($p<0.01$) higher mean annual catch rate was observed at Nandina. It can be concluded from these results that while there is some evidence of significantly higher catch rates and thus fish densities at Nandina, the gear on which this evidence was based accounted for only a small proportion (24%) of the total catch at Anahula. It can therefore not be stated conclusively that there were significant differences in fish abundances between sites.

The considerably higher catch from the unregulated site was due principally to the greater amount of fishing effort expended by the two most dominant gears, *thella jal* and *ber jal*. The annual effort per hectare of floodplain/*beel* at Anahula was fivefold and twelvefold greater for *thella jal* and *ber jal* respectively (Table 7.8). These two gears together accounted for 67% and 72% of annual catches from regulated and unregulated floodplains/*beel* respectively.

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Figure 7.8 Comparison of mean monthly catch rates (kg/hr) of dominant gears from floodplains/*beel* inside and outside the BRE

Thella jal

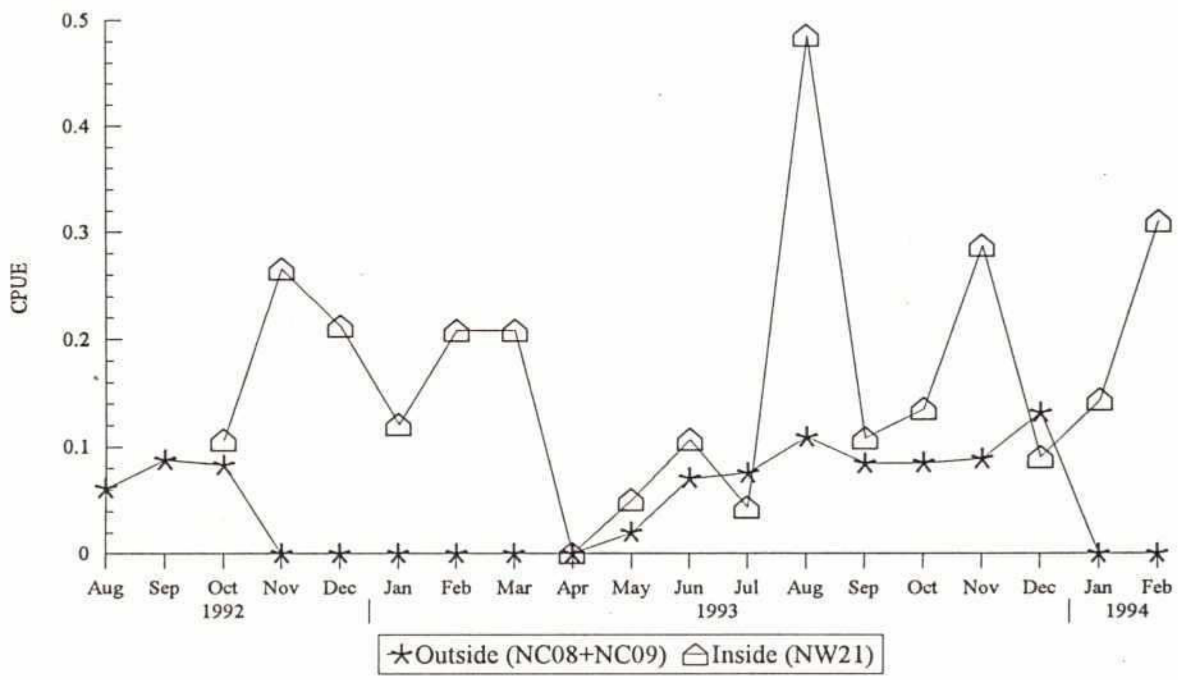

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Table 7.8 Comparison of annual fishing effort per hectare of floodplain/*beel* by dominant gears inside and outside the BRE, March 1993 - February 1994

Gear	Anahula (site NC08+NC09)	Nandina (site NW21)	% change compared at NW21
Thella jal	123	25	- 78
Ber jal	7	0.6	- 91
Current jal	25	41	+ 64

Note: + and - denote increase and decrease in effort respectively

7.4 Biodiversity and Catch Composition

7.4.1 Species richness

Between March 1993 and February 1994, 50 species of fish were recorded from the unregulated Anahula *Beel* compared with 31 species from Nandina *Beel* during the same period, a reduction in species diversity of 38%. When species were divided into different groups based on habitat preference: riverine, migratory and floodplain residents (see Section 5.4.1 for definitions), clear differences emerged between unregulated and regulated sites (Table 7.9). The adverse impact of flood control by the BRE was considerably greater on those species which typically migrate between rivers and floodplains. No riverine species were found at Nandina compared with 8 species at Anahula. Similarly, only 1 migratory species occurred at Nandina compared with 15 at Anahula, a 93% reduction in diversity of migratory species on regulated floodplains/*beel*. In contrast the number of floodplain resident species was slightly higher (11%) at Nandina than at Anahula.

Table 7.9 Total annual number of fish species, classified by habitat preference, recorded from floodplains/*beel* inside and outside the BRE, March 1993 - February 1994

Fish group	Anahula (site NC08+ NC09, outside BRE)	Nandina (site NW21, inside BRE)	% change compared to NC08+NC09
Riverine species	8	0	
Migratory species	15	1	- 93
Floodplain resident species	27	30	+ 11
Total species	50	31	- 38

Note: + and - denote increase and decrease in diversity respectively

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Table 7.10 summarises and compares the results from regulated and unregulated floodplains/ *beel* with those from canals and rivers. Species diversity was highest in rivers and lowest on floodplains both inside and outside the BRE due mainly to the higher numbers of migratory and riverine species. Compared with unregulated habitats in the North Central Region the reduction in species diversity on regulated floodplains was higher than that in rivers but slightly lower than that recorded in Nandina canal (Table 7.11). Results in Table 7.11 revealed a clear difference in the impact of flood control on different groups of fish. Riverine species suffered the greatest reductions in diversity in all habitats, followed by migratory species again in all habitats, while floodplain resident species were slightly reduced in number in rivers, moderately in canals, but not at all on floodplains.

Table 7.10 Total annual number of riverine, migratory and floodplain resident fish species from different habitats inside and outside the BRE, March 1993 - February 1994

Fish group	Habitat					
	Outside BRE			Inside BRE		
	River	Canal	Floodplain/ *beel*	River	Canal	Floodplain/ *beel*
Riverine species	23	11	8	9	2	0
Migratory species	20	16	15	17	5	1
Floodplain resident species	35	32	27	34	27	30
Total species	78	59	50	60	34	31

Table 7.11 Percentage change in annual species diversity of different fish groups from rivers, canals and floodplains/*beel* inside the BRE, March 1993 -February 1994

Fish group	Habitat		
	River	Canal	Floodplain/*beel*
Riverine species	- 61	- 82	-
Migratory species	- 15	- 69	- 93
Floodplain resident species	- 3	- 16	+ 11
All species	- 23	- 42	- 38

Notes: 1. - denotes absence of species on regulated site
2. + and - denote percentage increase and decrease in species numbers respectively

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7.4.2 Catch composition

Percentage contributions made by riverine, migratory and floodplain resident species to annual catches from floodplains/*beel* are shown in Table 7.12. Riverine species made a rather small contribution (5%) to the annual catch from Anahula but were completely absent from Nandina. Similarly, migratory species accounted for about 21% of the catch from Anahula but provided a negligible proportion (< 1%) of the catch from Nandina. Conversely, floodplain resident species comprised 93% of the catch at Nandina and 59% at Anahula. The results revealed that flood control caused by the BRE resulted not only in a serious harmful reduction in species diversity but also resulted in severe disruption to the fish community structure. This was caused principally by the loss of important seasonal components derived from migratory and riverine species.

Table 7.12 Percentage contribution of riverine, migratory and floodplain resident species to annual catches from floodplains/*beel* inside and outside the BRE, March 1993 - February 1994

Site Code	Site Name	Inside/ Outside BRE	% Total annual catch		
			Riverine	Migratory	Floodplain resident
NC08 + NC09	Anahula	Outside	5	20.5	59.2
NW21	Nandina	Inside	-	<1	92.9

Percentage contributions of different groups of fish to annual catches from different habitats inside and outside the BRE are shown in Table 7.13. The results again indicated that the impact of flood control varied not only between different groups of fish but also between habitats. Reductions in relative abundance were highest for riverine species followed by migratory species, excluding the river where they increased, while floodplain resident catch contributions increased on the regulated canals and floodplains. Between habitats, greatest reductions in riverine and migratory species were recorded on floodplains.

Table 7.13 Percentage contributions of riverine, migratory and floodplain resident fish species to annual catches from different habitats inside and outside the BRE, March 1993 - February 1994

Fish group	Unregulated			Regulated		
	River	Canal	Floodplain/*beel*	River	Canal	Floodplain/*beel*
Riverine species	15	< 1	5	< 1	< 1	0
Migratory species	15	41	21	49	7	< 1
Floodplain resident	57	46	59	43	85	93

Percentage contributions of individual dominant species showed that from a total of 14 floodplain resident species, 5 species, *khalisha* (2 species), *taki*, *puti* and *shingi* accounted for 69% of the annual catch from Nandina (Table 7.14). In contrast, on the unregulated Anahula floodplains/*beel*, there was a more equitable distribution of dominant species which included one riverine species, *piali*; 5 migratory species which together accounted for 21% of the catch, and 15 floodplain resident species which provided a further 56% of the catch. Only 8 floodplain resident species occurred at both sites but the relative abundances of 4 of these species differed greatly between sites. *Khalisha* (*Colisa fasciatus*) and *taki* dominated the Nandina catch where they comprised 27% and 20% respectively compared with only 3% and 6% at Anahula. *Lal chanda* and *guchi baim* were more abundant on the unregulated floodplain where together they provided 13% of the catch. Of the 6 species recorded as dominant only at Nandina, 2 species, *shingi* and *khalisha* (*C. sota*) were most abundant and comprised 7% and 5% respectively. Of the 7 species found exclusively at Anahula, two species, *canchan puti* and *nama chanda*, were also particularly abundant forming 6% and 5% of the catch.

Prawns formed an important component of the catch at both sites but were relatively more abundant on unregulated floodplains. Unfortunately, because of taxonomic difficulties, prawns were rarely identified in the field but sub-samples were sent routinely to the University of Chittagong for identification. Results so far indicate that all species of prawn belong to the genus *Macrobrachium*. This genus is regarded as an estuarine spawner which makes migrations into freshwaters at the juvenile stage in its life cycle. However, FAP 17 studies of hatchling movements at Bauitara regulator and in several other areas of Bangladesh revealed that recently hatched prawns formed an important component of the drift which suggests that there is widespread breeding inland by some species[9].

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Table 7.14 Percentage contribution (by weight) to the annual catch by dominant species from floodplains/beel inside and outside the BRE, March 1993 – February 1994

Habitat Preference	Species name: Scientific	Species name: Bengali	Outside BRE Site NC08+NC09	Inside BRE Site NW21
Riverine	*Aspidoparia morar*	*Piali*	3.9	–
Subtotal			3.9	–
Migratory	*Cirrhinus mrigala*	*Mrigel*	1.5	–
	Labeo rohita	*Rui*	3.7	–
	Salmostoma phulo	*Fulchela*	7.5	–
	Gudusia chapra	*Chapila*	1.7	–
	Wallagu attu	*Boal*	1.7	–
Subtotal			16.1	–
Floodplain resident	*Anabas testudineus*	*Koi*	–	2.3
	Mystus vittatus	*Tengra*	1.1	–
	Colisa fasciatus	*Khalisha*	2.7	27.3
	Colisa lalia	*Lal khalisha*	2.7	–
	Colisa sota	*Khalisha*	–	5.3
	Puntius conchonius	*Canchan puti*	6.1	–
	Puntius phutunio	*Phutani puti*	–	1.9
	Puntius sophore	*Puti*	10.7	10.1
	Puntius ticto	*Tit puti*	1.1	–
	Amblypharyngodon mola	*Mola*	1.0	1.5
	Esomus danricus	*Darkina*	1.7	1.2
	Glossogobius giurus	*Bailla*	2.6	–
	Lepidocephalus guntea	*Gutum*	1.4	2.4
	Channa punctatus	*Taki*	5.5	19.6
	Channa striatus	*Shol*	–	2.4
	Clarias batrachus	*Magur*	–	1.9
	Heteropneustes fossilis	*Shingi*	–	7.0
	Macrognathus aculeatus	*Tara baim*	1.3	–
	Macrognathus pancalus	*Guchi*	6.2	2.0
	Chanda nama	*Nama chanda*	4.6	–
	Chanda ranga	*Lal chanda*	7.2	2.8
Subtotal			55.9	87.7
Other	Prawn spp.	*Chingri/Icha*	15.3	7.0
Subtotal			15.3	7.0
Grand total			91.2	94.7

Notes: 1. Dominant species are defined as those species which comprised 1% or more of the total annual catch
2. Shaded values highlight the most abundant species (>4%)
3. See text for definations of habitat preference categories (Section 5.4.1)

The results from analyses of catch compositions revealed that the fish community structure in flood controlled areas has been disrupted not only by the loss of riverine and migratory species but also by major changes in the compositions of the remaining floodplain resident species. Such loss in species heterogeneity results in a less stable fish community dominated by a few very abundant species. Under these conditions disease outbreaks may be more frequent and damaging. This may account for the perception noted in some studies that the incidence and severity of the disease known as epizootic ulcerative syndrome is greater within flood controlled areas[14].

7.5 Fish Migrations

Seasonal movements of fish were identified from changes in monthly catch compositions (Tables 7.15 and 7.16); temporal and spatial changes in the distributions of important individual species, and changes in monthly species numbers and catch contributions of riverine, migratory and floodplain resident fish. Where available, additional information on the average size (weight) of fish and their reproductive state (Table 7.17) was used to determine whether fish were adults or juveniles and whether movements were primarily for growth, breeding or both.

7.5.1 Unregulated Anahula floodplain/*beel*

No fishing was observed between November 1992 and April 1993 which accounts for much of the extended seasonal absence of riverine, migratory and floodplain resident species shown in Figure 7.9. No riverine or migratory species were found in the rainfall-flooded *beel* during May while in June, when river floodwaters first arrived, only one migratory species was recorded. In July however, the numbers of riverine and migratory species increased sharply, followed a month later by an equally rapid decrease in riverine species and a slight decline in the number of migratory species. In September, numbers of species in both groups peaked and then decreased rapidly in October and were gone by November.

The numbers of floodplain resident species increased slightly in May as the *beel* filled with rainwater and more rapidly in June and July. Following a small drop in August, species numbers increased again to reach peak levels during the drawdown in September and October. Numbers then dropped sharply in November and temporarily stabilised in December before fishing stopped and the site dried out in January and February.

Table 7.15 Monthly catch composition (% by weight) from Anahula floodplain/beel: outside BRE (site NC08+NC09)

Species Code	Habitat Preference	Species name: Scientific	Species name: Bengali	Year: 1992 Aug	Year: 1992 Sep	Year: 1992 Oct	Year: 1993 May	Year: 1993 June	Year: 1993 July	Year: 1993 Aug	Year: 1993 Sep	Year: 1993 Oct	Year: 1993 Nov	Year: 1993 Dec	Total annual catch (Mar'93 – Feb'94) Kg	Total annual catch (Mar'93 – Feb'94) %
13	Riverine	*Aspidoparia morar*	*Piali*	–	–	–	–	–	9.519	–	0.199	–	–	–	153.413	3.885
59		*Crossocheilus latius*	*Kalabata*	–	0.182	–	–	–	0.714	–	–	0.066	–	–	11.895	0.301
139		*Nemacheilus botia*	*Balichata*	–	1.014	–	–	–	–	–	–	0.086	–	–	0.703	0.018
28		*Botia dario*	*Rani*	–	–	–	–	–	0.434	1.379	0.076	–	–	–	10.915	0.276
58		*Corica soborna*	*Kachki*	–	–	–	–	–	–	–	0.066	–	–	–	0.661	0.017
185		*Rhinomugil corsula*	*Khorsula*	–	0.182	–	–	–	–	–	–	–	–	–	–	–
2		*Ailia coila*	*Kajuli*	–	–	–	–	–	0.040	–	0.155	–	–	–	2.191	0.055
51		*Clupisoma garua*	*Ghaura*	–	–	–	–	–	–	–	0.554	–	–	–	5.544	0.140
81		*Gagata youssoufi*	*Gang tengra*	–	–	–	–	–	0.725	–	–	–	–	–	11.534	0.292
	Subtotal			–	1.378	–	–	–	11.431	1.379	1.049	0.152	–	–	196.856	4.985
131	Migratory	*Mystus bleekeri*	*Golsha tengra*	–	–	–	–	–	–	1.494	–	–	–	–	3.534	0.089
132		*Mystus cavasius*	*Kabashi*	–	–	–	–	–	0.142	–	–	–	–	–	2.265	0.057
32		*Catla catla*	*Catla*	–	–	–	–	–	0.234	0.347	2.879	–	–	–	33.368	0.845
47		*Cirrhinus mrigala*	*Mrigel*	–	–	–	–	–	–	3.037	5.166	–	–	–	58.910	1.492
48		*Cirrhinus reba*	*Raik*	–	12.065	0.056	–	–	–	2.558	2.708	–	–	–	33.171	0.840
100		*Labeo bata*	*Bata*	–	23.204	0.378	–	–	–	–	0.150	0.289	–	–	3.855	0.098
101		*Labeo boga*	*Bhangan*	–	–	0.056	–	–	1.356	–	0.576	–	–	–	27.339	0.692
102		*Labeo calbasu*	*Kalbaus*	–	–	–	–	–	0.609	0.376	0.933	–	–	–	19.928	0.505
104		*Labeo gonius*	*Goni*	–	–	–	–	–	0.468	–	–	–	–	–	7.440	0.188
107		*Labeo rohita*	*Rui*	–	0.036	–	–	–	7.627	1.720	2.049	–	–	–	145.910	3.695
188		*Salmostoma bacaila*	*Katari*	2.213	–	–	–	1.673	1.439	–	–	–	–	–	23.494	0.595
189		*Salmostoma phulo*	*Fulchela*	–	8.233	0.074	–	–	10.611	–	11.167	1.864	–	0.878	297.330	7.530
86		*Gudusia chapra*	*Chapila*	–	1.640	–	–	–	3.979	0.334	0.119	–	–	–	65.275	1.653
209		*Wallagu attu*	*Boal*	–	–	–	–	–	–	0.435	6.611	0.176	–	–	68.665	1.739
144		*Notopterus chitala*	*Chital*	–	–	–	–	–	–	–	1.993	–	–	–	19.956	0.505
	Subtotal			2.213	45.177	0.564	–	1.673	26.465	10.302	34.351	2.329	–	0.878	810.440	20.525
136	Floodplain	*Mystus tengara*	*Bajari tengra*	–	0.182	0.187	–	–	0.035	0.360	2.548	0.215	–	–	28.684	0.726
137	Resident	*Mystus vittatus*	*Tengra*	2.330	1.313	–	–	–	1.356	0.782	0.928	1.183	1.497	–	43.735	1.108
55		*Colisa fasciatus*	*Khalisha*	1.123	0.003	2.274	10.000	15.354	2.323	0.435	0.404	3.962	13.705	7.261	105.372	2.669
211		*Colisa labiosus*	*Khalisha*	–	–	–	–	25.910	0.529	0.261	1.059	0.641	–	–	34.157	0.865
56		*Colisa lalia*	*Lal khalisha*	–	0.002	0.068	20.000	25.093	0.541	9.188	3.662	3.303	2.320	–	105.429	2.670
57		*Colisa sota*	*Khalisha*	–	0.121	0.095	–	–	–	–	–	–	–	–	–	–
210		*Xenentodon cancila*	*Kaikka*	–	0.121	–	–	–	0.107	0.202	0.407	0.905	–	–	13.623	0.345
187		*Osteobrama cotio cotio*	*Keti*	0.578	–	–	–	–	–	–	–	–	–	–	–	–
174		*Puntius chola*	*Chala puti*	–	–	0.254	–	–	–	–	–	–	–	–	–	–
175		*Puntius conchonius*	*Canchan puti*	–	2.958	23.846	–	–	9.507	0.511	0.271	9.035	10.398	0.545	239.311	6.061
176		*Puntius gelius*	*Giliputi*	–	–	–	–	0.521	–	–	0.280	–	–	–	2.988	0.076
178		*Puntius phutunio*	*Phutani puti*	–	–	0.056	–	2.657	0.704	1.866	0.043	0.018	–	–	17.141	0.434
180		*Puntius sophore*	*Puti*	9.926	34.784	55.698	–	–	4.200	9.503	8.602	24.260	38.528	8.901	424.218	10.743
181		*Puntius terio*	*Teri punti*	8.213	0.651	2.758	–	–	–	–	–	–	–	–	–	–

Notes :– 1. No fishing activities were observed from November to December 1992, from January to April 1993 and from January to February 1994

2. – denotes zero catch

(Cont.)

Table 7.15 Monthly catch composition (% by weight) from Anahula floodplain/beel: outside BRE (site NC08+NC09)

Species Code	Habitat Preference	Species name: Scientific	Species name: Bengali	Year: 1992 Aug	Year: 1992 Sep	Year: 1992 Oct	Year: 1993 May	Year: 1993 June	Year: 1993 July	Year: 1993 Aug	Year: 1993 Sep	Year: 1993 Oct	Year: 1993 Nov	Year: 1993 Dec	Total annual catch (Mar'93 – Feb'94) Kg	Total annual catch (Mar'93 – Feb'94) %
212		*Puntius ticto*	*Tit puti*	0.246	0.270	6.450	-	0.781	-	0.661	2.719	1.377	1.690	1.404	44.303	1.122
5		*Amblypharyngodon mola*	*Mola*	-	0.742	0.292	-	1.673	-	-	3.882	0.215	-	0.096	41.397	1.048
75		*Esomus danricus*	*Darkina*	19.446	0.789	0.573	70.000	3.756	1.513	1.093	0.471	2.712	5.372	2.746	65.887	1.669
182		*Rasbora daniconius*	*Darkina*	-	-	0.019	-	-	-	-	-	-	-	-	-	-
83		*Glossogobius giurus*	*Bailla*	0.983	0.729	1.114	-	2.863	0.780	7.794	2.544	3.582	6.048	5.766	102.208	2.588
43		*Chela cachius*	*Chep chela*	24.035	-	-	-	-	-	-	-	-	-	-	-	-
109		*Lepidocephalus berdmorei*	*Puiya*	-	-	-	-	-	0.054	-	-	-	-	-	0.852	0.022
110		*Lepidocephalus guntea*	*Gutum*	-	1.683	1.122	-	2.509	0.264	-	1.587	0.836	0.219	15.214	54.676	1.385
9		*Aplocheilus panchax*	*Kanpona*	-	-	0.019	-	0.259	0.035	0.435	-	0.054	0.102	-	2.217	0.056
41		*Channa punctatus*	*Taki*	2.913	0.596	3.193	-	0.836	0.447	8.617	0.193	19.323	16.520	8.834	217.864	5.517
88		*Heteropneustes fossilis*	*Shingi*	2.330	-	-	-	-	0.270	-	0.053	0.289	-	-	7.185	0.182
121		*Macrognathus aculeatus*	*Tara baim*	-	0.389	0.453	-	-	3.172	0.376	0.192	-	-	-	53.262	1.349
123		*Macrognathus pancalus*	*Guchi*	3.511	1.765	0.317	-	3.644	5.193	7.029	3.636	4.226	0.794	41.831	245.445	6.216
122		*Mastacembelus armatus*	*Baral baim*	-	0.888	-	-	-	0.483	0.261	-	0.180	-	-	9.759	0.247
15		*Badis badis*	*Napit koi*	-	-	-	-	-	0.052	1.027	0.050	0.126	-	-	4.778	0.121
145		*Notopterus notopterus*	*Foli*	-	-	-	-	-	-	-	-	0.820	-	-	6.676	0.169
203		*Tetraodon cutcutia*	*Potka*	-	-	-	-	-	-	-	0.053	0.116	-	-	1.477	0.037
36		*Chanda nama*	*Nama chanda*	5.900	0.831	0.187	-	1.932	10.311	-	0.739	1.197	-	0.716	183.113	4.637
37		*Chanda ranga*	*Lal chanda*	3.688	3.036	0.287	-	2.713	13.539	2.737	4.518	1.670	0.520	0.119	282.349	7.151
214		*Oryzias melastigma*	*Kanpona*	-	-	0.019	-	-	-	-	-	-	-	-	-	-
	Subtotal			85.222	51.853	99.280	100.000	90.501	55.415	53.135	38.839	80.243	97.712	93.432	2338.106	59.213
931	Other	Prawn spp.	*Chingri/Icha*	12.566	1.591	0.154	-	7.826	6.689	35.183	25.760	17.276	2.287	5.690	603.213	15.277
	Subtotal			12.566	1.591	0.154	-	7.826	6.689	35.183	25.760	17.276	2.287	5.690	603.213	15.277
	Grand total			100	100	100	100	100	100	100	100	100	100	100	3948.615	100

Notes :– 1. No fishing activities were observed from November to December 1992, from January to April 1993 and from January to February 1994

2. – denotes zero catch

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Table 7.16 Monthly catch composition (% by weight) from Nandina floodplain/beel: inside BRE (site NW21)

Species Code	Habitat Preference	Species name: Scientific	Species name: Bengali	Year: 1992 Oct	Year: 1992 Nov	Year: 1992 Dec	Year: 1993 Jan	Year: 1993 Feb	Year: 1993 Mar	Year: 1993 May	Year: 1993 June	Year: 1993 July	Year: 1993 Aug	Year: 1993 Sep	Year: 1993 Oct	Year: 1993 Nov	Year: 1993 Dec	Year: 1994 Jan	Year: 1994 Feb	Total annual catch (Mar'93 – Feb'94) Kg	Total annual catch (Mar'93 – Feb'94) %
58	Riverine	*Corica soborna*	*Kachki*	-	-	4.648	-	-	-	-	-	-	-	-	-	-	-	-	-		-
	Subtotal			-	-	4.648	-	-	-	-	-	-	-	-	-	-	-	-	-		-
47	Migratory	*Cirrhinus mrigala*	*Mrigel*	-	-	-	-	-	-	-	-	-	0.975	-	-	-	-	-	-	1.848	0.135
	Subtotal			-	-	-	-	-	-	-	-	-	0.975	-	-	-	-	-	-	1.848	0.135
6	Floodplain resident	*Anabas testudineus*	*Koi*	-	-	-	-	-	7.728	-	-	-	6.051	-	-	-	-	-	-	31.338	2.289
137		*Mystus vittatus*	*Tengra*	-	4.499	-	-	1.472	2.618	-	-	-	-	-	-	-	-	-	-	6.733	0.492
55		Colisa fasciatus	*Khalisha*	1.794	18.498	35.466	13.285	14.832	5.471	-	-	-	31.078	17.800	6.760	52.495	31.728	8.897	17.086	373.524	27.278
211		*Colisa labiosus*	*Khalisha*	-	-	-	-	-	-	-	-	13.095	-	1.020	-	0.083	-	-	-	2.247	0.164
56		*Colisa lalia*	*Lal Khalisha*	1.931	-	-	-	-	-	-	-	-	-	-	1.468	-	-	-	-	2.526	0.184
57		*Colisa sota*	*Khalisha*	11.612	10.676	14.703	52.959	16.834	1.616	-	-	-	13.982	-	-	6.338	12.107	14.169	-	72.669	5.307
175		*Puntius conchonius*	*Canchan puti*	-	-	-	-	0.575	0.022	-	-	31.940	0.196	1.290	0.189	0.282	1.808	4.613	-	7.939	0.580
176		*Puntius gelius*	*Giliputi*	-	-	0.067	-	-	-	-	-	-	-	0.925	2.106	0.028	-	-	-	4.976	0.363
178		*Puntius phutunio*	*Phutani puti*	-	-	-	-	-	-	-	-	-	2.213	10.723	4.138	-	-	-	-	25.503	1.862
180		*Puntius sophore*	*Puti*	12.234	28.997	12.716	12.863	22.524	10.605	-	-	-	29.493	10.536	10.748	4.221	3.618	3.624	-	138.609	10.122
212		*Puntius ticto*	*Tit puti*	2.561	-	0.067	-	-	-	-	-	-	-	-	0.150	-	-	-	-	0.259	0.019
5		*Amblypharygodon mola*	*Mola*	-	0.217	-	0.121	0.368	-	-	-	-	0.049	14.799	-	0.062	-	-	-	19.959	1.458
75		*Esomus danricus*	*Darkina*	-	0.433	0.598	2.054	0.118	0.784	-	-	-	0.025	0.794	3.009	1.550	1.530	1.483	-	16.924	1.236
182		*Rasbora daniconius*	*Darkina*	2.060	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-
83		*Glossogobius giurus*	*Bailla*	-	-	-	0.544	0.877	0.035	-	-	-	-	-	0.946	-	-	1.318	-	2.242	0.164
110		*Lepidocephalus guntea*	*Gutum*	5.548	0.909	2.390	4.952	0.710	0.546	15.796	-	-	0.951	-	-	4.323	11.272	2.306	26.421	33.266	2.429
9		*Aplocheilus panchax*	*Kanpona*	-	0.044	0.199	0.422	-	0.058	-	-	-	-	1.360	2.784	0.110	0.695	-	-	7.662	0.560
40		*Channa orientalis*	*Cheng*	-	-	-	-	-	-	-	-	-	-	-	2.558	0.827	-	-	-	8.205	0.599
41		*Channa punctatus*	*Taki*	13.626	26.988	16.161	5.677	29.217	28.411	-	100.000	52.356	2.937	3.628	10.553	19.725	28.056	25.041	27.334	268.112	19.580
42		*Channa striatus*	*Shol*	-	-	-	-	-	11.017	-	-	-	-	-	2.934	-	-	-	-	33.383	2.438
49		*Clarias batrachus*	*Magur*	-	-	-	-	1.031	6.546	-	-	-	-	-	-	-	-	23.066	-	26.025	1.901
88		*Heteropneustes fossilis*	*Shingi*	2.134	1.730	2.093	1.329	9.779	18.380	-	-	2.609	1.030	-	3.385	7.641	3.896	6.425	9.797	96.023	7.012
121		*Macrognathus aculeatus*	*Tara baim*	0.191	0.606	0.465	-	-	-	-	-	-	-	-	2.859	-	-	-	-	4.921	0.359
123		*Macrognathus pancalus*	*Guchi*	3.415	3.980	1.660	0.181	1.219	3.528	53.949	-	-	2.178	1.701	0.677	1.042	2.227	6.096	10.929	26.961	1.969
138		*Nandus nandus*	*Bheda*	0.083	-	-	-	-	0.862	-	-	-	-	-	2.155	0.291	-	-	-	7.263	0.530
15		*Badis badis*	*Napit koi*	3.117	0.390	2.261	1.872	-	0.079	2.612	-	-	0.953	0.907	2.633	0.145	-	0.823	3.189	9.050	0.661
124		*Monopterus cuchia*	*Kuchia*	-	-	-	-	-	0.132	-	-	-	-	-	-	-	-	-	-	0.340	0.025
148		*Ompok pabda*	*Madhu pabda*	-	-	0.531	-	-	1.436	-	-	-	-	-	-	-	-	-	-	3.694	0.270
203		*Tetraodon cutcutia*	*Potka*	-	-	-	-	-	-	-	-	-	0.340	-	-	-	-	-	-	0.645	0.047
36		*Chanda nama*	*Nama Chanda*	-	0.130	-	-	-	-	-	-	-	-	0.925	-	-	-	0.823	-	1.552	0.113
37		*Chanda ranga*	*Lal chanda*	2.561	0.087	0.199	-	-	-	-	-	-	0.025	28.655	-	0.110	-	1.318	-	38.995	2.848
	Subtotal			62.866	98.183	89.575	96.257	99.556	99.873	72.357	100.000	100.000	91.500	95.062	60.053	99.273	96.939	100.000	94.755	1271.545	92.860
931	Other	Prawn spp.	*Chingri/Icha*	37.134	1.817	5.777	3.743	0.443	0.126	27.643	-	-	7.524	4.938	39.947	0.727	3.062	-	5.245	95.926	7.005
	Subtotal			37.134	1.817	5.777	3.743	0.443	0.126	27.643	-	-	7.524	4.938	39.947	0.727	3.062	-	5.245	95.926	7.005
	Grand total			100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	1369.319	100

Notes: 1. No fishing activities were observed in April 1993

2. – denotes zero catch

Table 7.17 Breeding seasons of selected fish, inside and outside the BRE, October 1992 – February 1994

LEGEND

Peak season >50% fish ripe, ripe running, spent	
20–50% fish ripe, ripe running, spent	
<20% fish ripe, ripe running, spent	
0% fish ripe, ripe running, spent	
No data	

Note: Numbers quoted are numbers of fish examined

Habitat Preference	Species name		Habitat	Inside/		Year: 1992			Year: 1993												Year: 1994	
	Scientific	Bengali		Outside BRE	Site	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb
Riverine species	*Aspidoparia morar*	*Piali*	Main river	Outside	NW01												6	7	3	10	10	1
			Secondary river	Outside	NC06								11					9	3	3		
	Barilius evezardi		Secondary river	Outside	NC06											20	5	28	3			
	Nemacheilus botia	*Balichata*	Secondary river	Outside	NC06							1							1	6		
	Rhinomugil corsula	*Khorsula*	Main river	Outside	NC01										3				4			
					NW01								3				3			1		
	Ailia coila	*Kajuli*	Main river	Outside	NC01										1					2	11	2
					NW01															1	2	5
			Secondary river	Outside	NC06									21	9	2	2	33	4			
	Clupisoma garua	*Ghaura*	Secondary river	Outside	NC06								1				4	7	7			
	Gagata youssoufi	*Gang tengra*	Main river	Outside	NC01											3			1	5	4	9
					NW01													2		9	8	
			Secondary river	Outside	NC06													8	6			
Migratory species	*Mystus bleekeri*	*Golsha tengra*	Secondary river	Inside	NW19									3	1				3			
	Mystus cavasius	*Kabashi*	Main river	Outside	NW01													2		1	4	2
			Secondary river	Outside	NC06												2		11		9	
	Cirrhinus reba	*Raik*	Secondary river	Outside	NC06													12	4			
	Salmostoma bacaila	*Katari*	Main river	Outside	NC01											2			3		5	2
					NW01	20													1	7	8	5
			Secondary river	Outside	NC06		1									3		1	1			
	Salmostoma phulo	*Fulchela*	Secondary river	Outside	NC06								5			2	24	5	20			
				Inside	NW19							2	4					35			14	
			Floodplain	Outside	NC09										2		2					
	Gudusia chapra	*Chapila*	Main river	Outside	NW01	4													1		1	1
			Secondary river	Outside	NC06													4	1			
	Eutropiichthys vacha	*Bacha*	Secondary river	Outside	NC06													4				
	Pseudeutropius atherinoid	*Batasi*	Secondary river	Outside	NC06									1					21			
Floodplain resident species	*Mystus tengara*	*Bajari tengra*	Secondary river	Outside	NC06														19			
			Canal	Outside	NC07												7					
	Mystus vittatus	*Tengra*	Secondary river	Outside	NC06		18					20		1			1		23		17	
				Inside	NW19		1	3			1	10	1		8			1		1	4	2
			Canal	Inside	NW20					3	5								3			
	Colisa fasciatus	*Khalisha*	Secondary river	Outside	NC06																13	
				Inside	NW19								2	4	2		1	2	8		4	3
			Canal	Outside	NC07										3							
				Inside	NW20		6		5	9	9	7		6		31	15		88			
	Xenentodon cancila	*Kaikka*	Secondary river	Outside	NC06							1	2						1		9	
	Puntius conchonius	*Canchan puti*	Main river	Outside	NC01								4	2								
					NW01								12	2	1	1				6	3	1
			Secondary river	Outside	NC06								110	4	1					17	8	
			Canal	Outside	NC07										9		1					
			Floodplain	Outside	NC08 + NC09										21							

(Cont.)

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Table 7.17 Breeding seasons of selected fish, inside and outside the BRE, October 1992 – February 1994

LEGEND

Peak season >50% fish ripe, ripe running, spent
20–50% fish ripe, ripe running, spent
<20% fish ripe, ripe running, spent
0% fish ripe, ripe running, spent
No data

Note: Numbers quoted are numbers of fish examined

Habitat Preference	Species name: Scientific	Species name: Bengali	Habitat	Inside/ Outside BRE	Site	Year: 1992 Oct	Nov	Dec	Year: 1993 Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Year: 1994 Jan	Feb
	Puntius sophore	*Puti*	Main river	Outside	NW01	2							1		7							
			Secondary river	Outside	NC06	20	19					1						5	22	21	29	
				Inside	NW19		2	4		19	1	6	7	5	25			22	21	25	42	
			Canal	Inside	NW20		9		3	24	24						31	3	59			
			Floodplain	Outside	NC09										7		3					
	Puntius ticto	*Tit puti*	Secondary river	Outside	NC06														9	9		
	Amblypharygodon mola	*Mola*	Canal	Outside	NC07										12							
	Glossogobius giurus	*Bailla*	Main river	Outside	NC01							1	2			1		6				
					NW01	9	1					2	6		3							
			Secondary river	Outside	NC06	4	20					4	5	5		3	13	1		22		
				Inside	NW19	4		10		102	3	19	37	17	5		2	1	3	1	3	
			Canal	Outside	NC07												8					
	Lepidocephalus guntea	*Gutum*	Secondary river	Outside	NC06								2				1		4	2	3	
				Inside	NW19			1		6		17	3	2	1			1	29		2	
			Canal	Outside	NC07												20					
				Inside	NW20		3		4			1							6			
	Channa punctatus	*Taki*	Secondary river	Outside	NC06	2							2								16	
				Inside	NW19					5		5						1	2		2	
			Canal	Inside	NW20		6			3	10	8		1			5		1			
	Heteropneustes fossilis	*Shingi*	Secondary river	Inside	NW19					15		5			1					1	1	
			Canal	Inside	NW20		2			1	18	25										
	Macrognathus pancalus	*Guchi*	Secondary river	Outside	NC06								6	5					24	21		
				Inside	NW19	1				1		44	149	36	2		12	2	31	1	1	
			Canal	Outside	NC07										[illegible]		6					
			Floodplain	Outside	NC08 + NC09										17		2					
				Inside	NW21						7						18	6	1			
	Chanda nama	*Nama Chanda*	Main river	Outside	NC01												4	6			1	
					NW01								1		4	1				2	4	
			Secondary river	Outside	NC06								10	4			32		20			
				Inside	NW19							19	20	19	3			24	2	1	6	2
			Canal	Inside	NW20												14					
			Floodplain	Outside	NC08 + NC09										4		1					
	Chanda ranga	*Lal chanda*	Secondary river	Outside	NC06	1							4		1		15		4	3	1	
				Inside	NW19										3		16	35	2	1	3	4
			Canal	Outside	NC07										2	3	13					
			Floodplain	Outside	NC08 + NC09										18		17					
				Inside	NW21											8	44		15			

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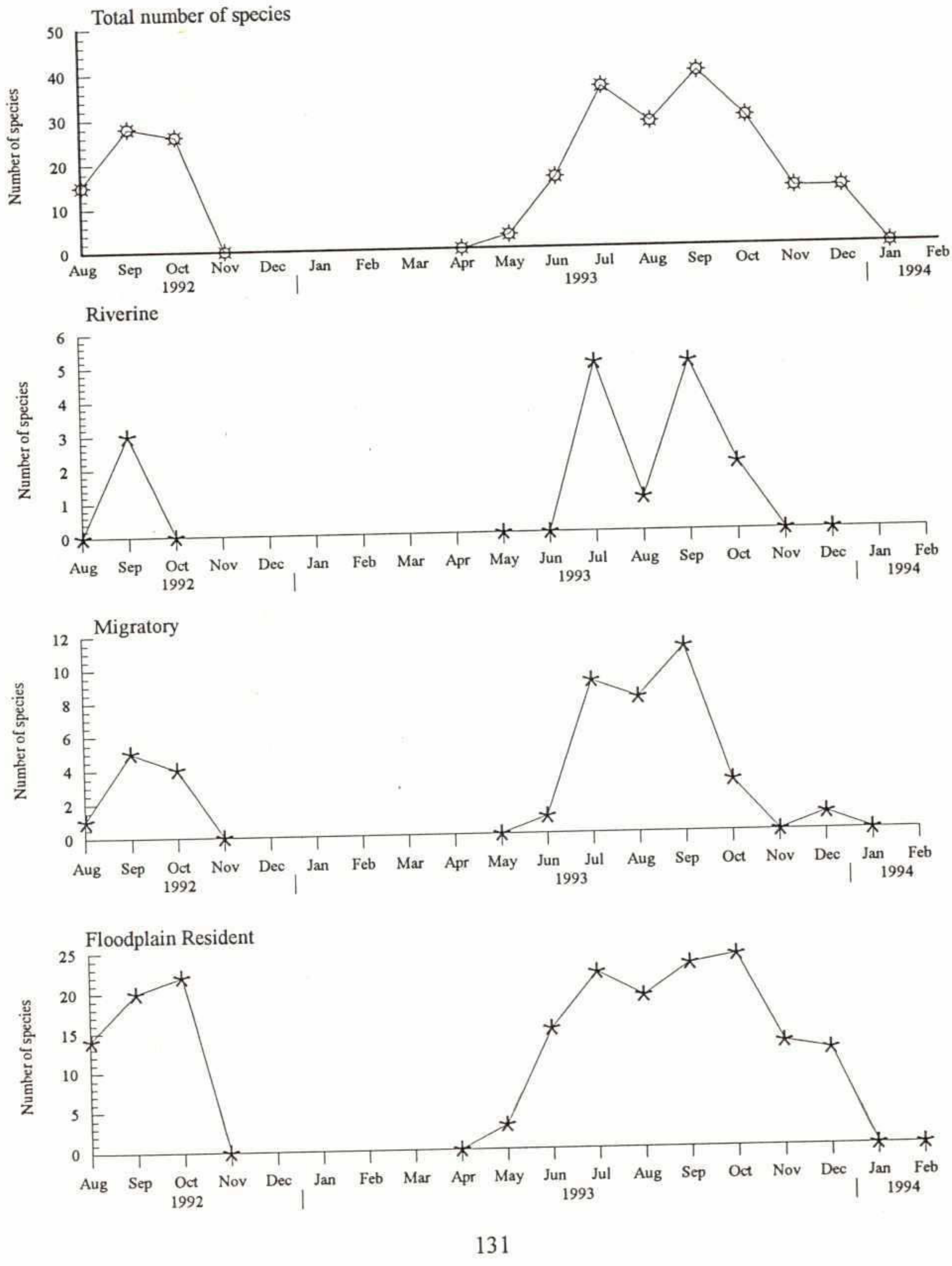
Figure 7.9 Seasonal variation in the number of riverine, migratory and floodplain resident fish species from Anahula floodplain/*beel* (site NC08+NC09, outside BRE)



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Katari was the first migratory species to enter the *beel* in June. Data on mean weight per individual fish indicated that this species arrived as juveniles (2 g/indiv). In July, there was an influx of 5 riverine and 8 migratory species. All species entered as small juveniles, most averaging less than 4 g/indiv. The two fish groups accounted for 38% of the monthly catch with most (26%) provided by migratory species (Fig. 7.10). The most abundant species included *piali*, *fulchela*, *rui*, *chapila*, *katari* and *bhangan*. Two of these species, *piali* and *fulchela* were found in breeding condition in the Northern Dhaleswari in May (Table 7.17). In August there was no new riverine species but 4 new migratory species appeared in catches: *mrigel*, *raik*, *golsha tengra* and *boal*. Again all were fry or juvenile fish. The most abundant species were *mrigel* (60 g/indiv), *raik* (3-7 g/indiv) and *rui* (3-6 g/indiv). *Boal* appeared as small fry averaging 5 g. Contributions to catches made by riverine and migratory species decreased in this month to 1% and 10% respectively.

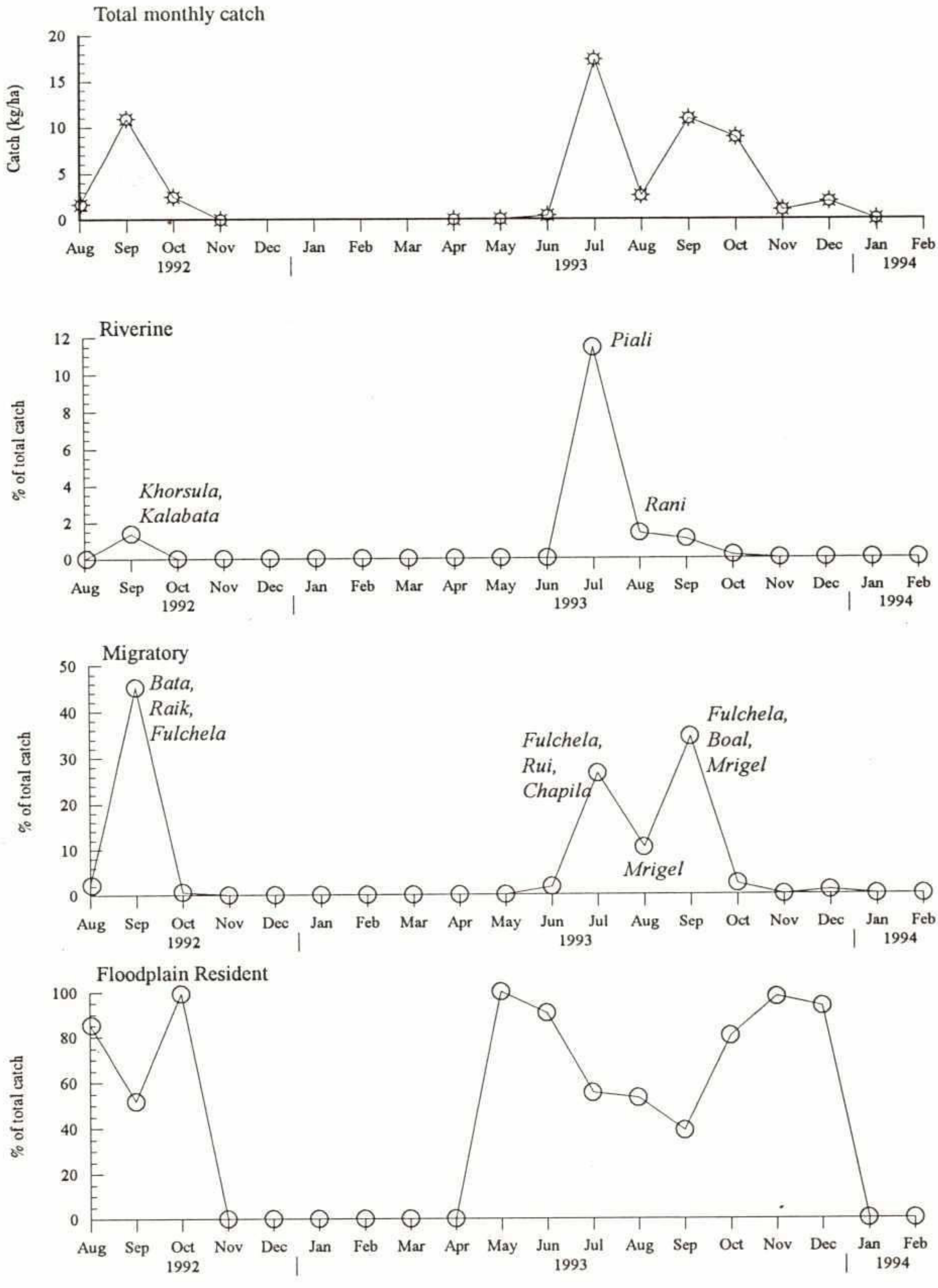
During the flood drawdown in September and October, 3 new riverine and 2 migratory species appeared: *Kachki* (0.3 g), *ghaura* (25 g), *bata* (14 g) and *chital* (180 g). It is obvious from the mean size of *kachki* that spawning had occurred in adjacent rivers in August and September. Catch contributions by riverine species continued to decline to very low levels during this period; however the percentage catch of migratory species increased sharply in September to 34% before falling considerably in October (2%). The most abundant migratory species in September included *fulchela*, *boal*, *mrigel*, *catla*, *raik* and *rui*. Average weights indicated that these species were again juveniles of the year.

7.5.2 Regulated Nandina floodplain/*beel*

Riverine and migratory species were recorded at Nandina on only two occasions during the 17 month survey period. In December 1992 *kachki* accounted for about 5% of the monthly catch and in August 1993 juvenile *mrigel* (20 g/indiv.) provided 1% of the catch (Figs 7.11 and 7.12). It is surprising that the ingress of 6 riverine and migratory species into Nandina *Khal* during September 1993, when they comprised a peak catch contribution of 19%, had no impact on floodplain catch composition at a time of maximum flooding during the early part of the month.

Three floodplain resident species were recorded in May; *gutum*, *guchi baim* and *napit koi*. In June, only one species, *taki*, was found and in July, 4 species: *khalisha*, *canchan puti*, *taki* and *shingi*. In August there was an influx of 12 new species and a further 10 species appeared during the drawdown in September and October. Diversity remained relatively high in November before decreasing during the winter.

Figure 7.10 Percentage total monthly catch of riverine, migratory and floodplain resident groups of fish from Anahula floodplain/*beel*, (site NC08+NC09, outside BRE)



Notes: 1. See text for definition of different categories of fish based on habitat preference (Section 5.4.1)
2. Dominant species are shown for peak relative abundances of riverine and migratory fish

Figure 7.11 Seasonal variation in the number of riverine, migratory and floodplain resident fish species from Nandina floodplain/*beel* (site NW21, inside BRE)

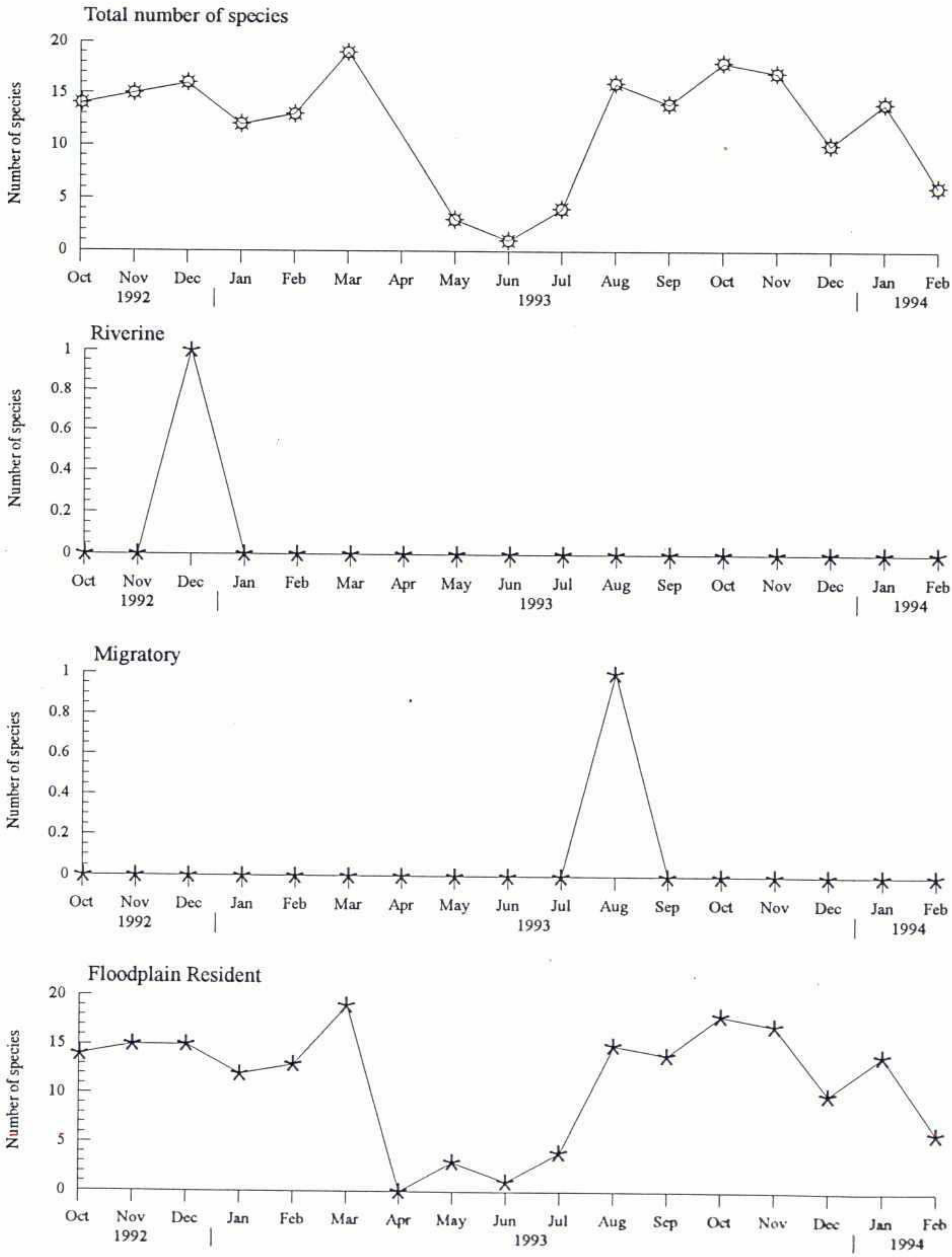
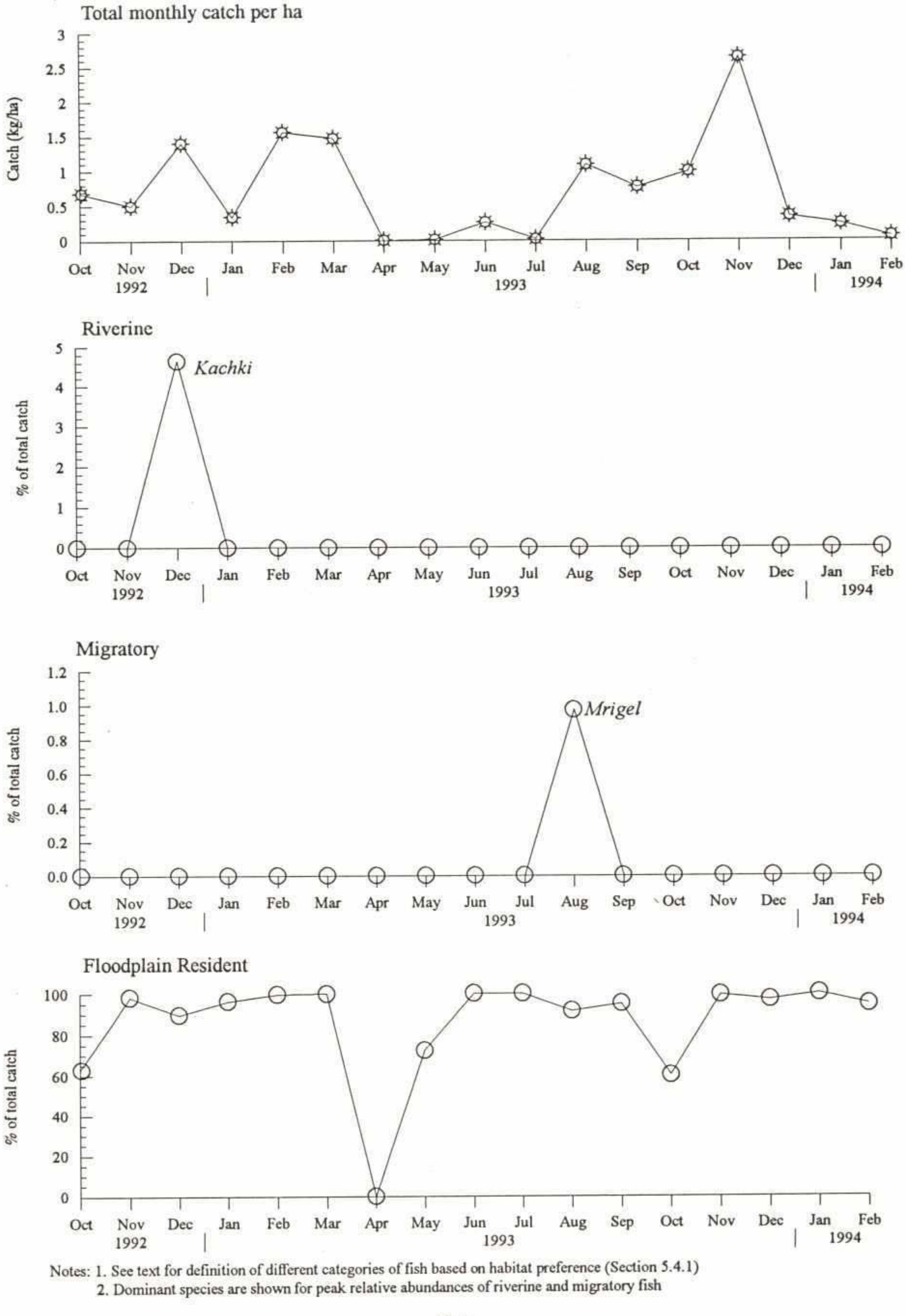


Figure 7.12 Percentage total monthly catch of riverine, migratory and floodplain resident groups of fish from Nandina floodplain/*beel*, (site NW21, inside BRE)



Notes: 1. See text for definition of different categories of fish based on habitat preference (Section 5.4.1)
2. Dominant species are shown for peak relative abundances of riverine and migratory fish

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8 RECOMMENDED MITIGATION MEASURES

Several mitigation measures are listed below. The first six are directly relevant to the BRE impact area and are recommended for implementation in the short or near-term. These measures are also relevant to areas of proposed embankment on the left bank of the Jamuna such as the Jamalpur Priority Project and the Jamuna Multipurpose Bridge Project. The others involve broad institutional development, mainly within BWDB/WARPO, and are therefore of a longer term nature. The measures recommended for short or near-term implementation are based on the assumption that the BRE will be made structurally secure and that natural breaches no longer occur.

Formulation of the mitigation measures listed below drew a distinction between mitigation i.e. measures to reduce losses to capture fisheries caused by flood control, and compensation i.e. measures to replace such losses by culture-based techniques. Only mitigation measures are listed below. This does not imply, however, that aquaculture developments should not be encouraged. Indeed, the ODA has supported work in various aspects of fish culture in Bangladesh for many years, covering activities such as pond culture, cage culture, rice-fish culture and open-water stocking of floodplains. Many of these techniques could be developed further inside and outside areas of controlled flooding. The greater area of the BRE comprising higher floodplains, provides suitable habitats for such small-scale aquaculture developments.

However, FAP 17 studies[15] have shown that considerably greater economic benefits can be derived through mitigation measures from small potential increases in capture fisheries over wide areas than from aquaculture development in the same areas. Future work should therefore focus on mitigation measures.

Within the area of 240,000 ha impacted by the BRE, there is enormous potential for the introduction of mitigation measures to reduce harmful effects of flood control on capture fisheries. Mitigation strategies must take into account topographical and hydrological characteristics of the impacted area. The measures listed below relate principally to distributary systems of the Jamuna River which extend for most of the length of BRE apart from areas in the extreme north where tributaries drain land sloping towards the Jamuna.

The proposed mitigation measures question a principal rationale of flood control: to convert low-lying wetlands to drier land where deepwater rice can be replaced with HYV *t. aman*.

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Experience in Bangladesh has shown that most flood control projects have failed, for one reason or another, to achieve this objective. The BRE is no exception and in this case the reason is due to repeated breaches caused by natural erosion by the Jamuna River. An alternative approach advocated by the North West Regional Study (FAP 2), for partial flood control on lowlands to allow the production of *b. aman* or transplanted deepwater *aman*, would cause considerably less damage to fisheries providing that the degree of flood control does not substantially alter normal flooding patterns during the early monsoon.

In a recent detailed and comprehensive review, Catling[16] dispelled certain myths surrounding deepwater rice. The most important of these was that yields of deepwater rice are low and usually less than 1 t/ha. Using the most complete data available in Bangladesh, Catling showed that between 1997 and 1979, yields of unmilled paddy from various parts of the country averaged 2.3 t/ha. The study was based on crop cuts from 291 fields of which 13% yielded 3 to 4 t/ha. The average yield was about 50% higher than those reported in Government statistics which indicated an average yield of about 1.5 t/ha. Three surveys carried out independently in the North West Region during 1991 reported differences in yields between HYV *t. aman* and *b. aman* of 0.9 to 1.3 t/ha, again substantially lower than that indicated by official statistics (1.7 t/ha). It is clear that a yield of just over 3 t/ha of HYV *t. aman* reported by farmers in the North West Region is well within the upper range of *b. aman* recorded in other parts of the country. Catling concluded that the yield potential for the best traditional varieties of *b. aman* was about 4 t/ha but in areas of flood control new varieties of deepwater rice may produce 5 t/ha. The reduced difference in yields of *b. aman* and HYV *t. aman* has considerable implications for the economic viability of many flood control projects, especially when the value of high fish losses associated with HYV *t. aman* production are also taken into consideration. Under these circumstances it seems probable that many projects would fail to produce viable levels of EIRR.

1. Increased fish migration across flood control structures

The supply of fish hatchlings, juveniles and adults should be increased by modification of sluice gate operating schedules. This measure is designed to reduce the negative impact of flood control on fish productivity caused by blocking movements of fish hatchlings, especially those of major carps, between rivers and floodplains at critical times of the year and by reducing the entry of adult riverine and migratory species. Hydrodynamic modelling will be needed to predict geographical areas of conflict between the water requirements of rice and fish. These should be taken into account in the design of the gate operations to achieve an integrated approach to water management through controlled flooding. It is anticipated that this mitigation measure will also result in increased species diversity as more migratory fish will be able to move from the Jamuna River to the floodplains behind the BRE. Since there are reportedly 31 cross-flow structures along the entire length of the BRE, most of which are flushing regulators on distributaries or former distributaries of the Jamuna, there is enormous scope for mitigation using this measure. It is anticipated that canal re-excavation work will be required both outside and inside the BRE to improve flows in silted systems. Key target areas should include low-lying floodplains in the southern section of the BRE and potentially highly productive *baor*-like water bodies wherever they connect with adjacent river systems.

2. Production of deepwater rice and fish

The most effective mitigation measure to reduce losses to capture fisheries caused by flood control is to extend the recommendations of the North West Regional Study (FAP 2) for the lower Atrai basin to the impact area of the BRE. This would entail the provision of controlled river flooding on low floodplains of the BRE for the production of deepwater rice rather than an attempt to convert these seasonal wetlands into drier land by complete closure of regulators for the production of HYV *t. aman*. Observations from many floodplains in the North West Region indicate that it would also be possible to obtain a harvest of HYV *boro* during winter as well as a harvest of deepwater rice during the monsoon.

3. Habitat rehabilitation and protection

Important dry season habitats such as perennial *beel* and *baor* in which the magnitude, extent and duration of flooding have been severely reduced by flood control should be rehabilitated by reconnection to original feeder river systems and maintenance of adequate dry season water levels. This measure is designed to reduce the negative impact of flood control caused by loss of winter and pre-monsoon habitats. It is anticipated that canal re-excavation work will be needed inside and outside the BRE together with modifications to sluice gate operations referred to in mitigation measure number (1) above.

4. Fisheries conservation

Dry season fish sanctuaries should be established using *beel* and *kua* to protect overwintering broodstock. This measure is designed to reduce the negative impact inside flood protected

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areas of heavy fishing pressure on the remaining small areas of water during the dry season which can reduce fish productivity. It is anticipated that protection of the overwintering broodstock will result in increased recruitment of juveniles to the fishery which in turn will lead to increased productivity.

5. Prohibited fishing zones at regulators

Flood control structures which block or delay movements of fish in rivers or canals thereby increasing their susceptibility to capture should be classified as prohibited fishing zones. Fishing from the structure itself and from a set distance upstream or downstream from it should be made illegal. Distances will vary depending on the location of the structure but as an example, fishing at Bauitara regulator should be prohibited on it and for a distance of 1 km downstream.

6. Design and construction of a new type of regulator with a fish pass

A regulator should be designed and field tested so that water is controlled principally through undershot gates with outer vents to provide overshot flow to facilitate the downstream passage of fish hatchlings. Undershot gates should be sufficiently wide to generate minimum head differences across the structure when gates are fully open. This type of regulator was proposed for the Lohajang River in the Tangail Compartmentalization Pilot Project. However, in view of the current construction of the Jamuna Bridge which involves the closure of the Northern Dhaleswari River which feeds the Lohajang, a new location is needed for meaningful field trials of a new regulator design. The most appropriate location for such a regulator would be along the right and left banks of the Jamuna River in conjunction with FAP 1 activities and the construction of the Jamuna Bridge respectively. Evidence from the present study indicated that there was upstream migration from the Old Hurasagar to the Jamuna River by juveniles of several species of fish and that their movements were blocked or hindered by Bauitara regulator. There is therefore a need to test the effectiveness of a fish pass to assist the upstream passage of fish in distributaries of the Jamuna River. The design of the pass should also incorporate facilities to allow the downstream passage by passive drift of fish hatchlings as an alternative to overshot gates.

7. Monitoring biodiversity

A national capability to provide systematic quantitative information on geographical variations in diversity of aquatic resources of Bangladesh should be established. This measure is designed to improve the basic knowledge of the diversity of fish, shrimp and prawns and to identify environmental problems, including flood control, linked with reductions in biodiversity. This information can then be considered at the project identification and planning stage of future developments which impact on aquatic resources. The measure should involve the strengthening of institutions such as DoF and FRI through training in a) fish taxonomics b) procedures for the establishment of fish reference collections c) methods for planning and implementing field surveys and sample collections and d) data analysis. It is anticipated that there would be a need to assist institutions in the design and implementation of national field surveys and sample collections.

8. Strengthening of technical assessment and planning capabilities of BWDB/WARPO

There is a need to establish within BWDB/WARPO a multidisciplinary technical assessment unit comprising expertise from fisheries, agriculture, environment, hydrology and hydraulic engineering. The unit should be responsible for the re-evaluation of operating procedures of existing structures and for the examination of future flood control projects. Proposals for major new road or rail links should also be assessed by the unit in terms of their impact on flooding patterns, fisheries and agriculture. The eventual siting of the assessment unit would depend on the future roles of BWDB and WARPO.

9. Establishment of national database on FCD/I projects

A detailed and comprehensive national database should be established by BWDB to provide information on all flood control projects in Bangladesh and the major regulatory structures within these projects. The database should provide a basic description of the design and size of each structure, its function within the project area and its state of repair. Daily water level data at each structure should also be provided with computed head differences. The database should be made available, in a user-friendly form, to other government agencies.

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10. Improvement of data collection by BWDB

There is an urgent need to improve the quality of data collection by BWDB personnel responsible for the operation of regulatory structures. Supervisory personnel should ensure that accurate detailed daily records are maintained of water levels at the structure (inside and outside), numbers of gates open and height to which each gate is opened. These data should be incorporated into the national database at monthly intervals.

11. Establishment of water-user groups

Local groups of water users should be established in flood control projects to represent the full range of sectors affected by modified flooding patterns. This should include capture fisheries as a water-user group. Representatives from each group should form a local committee in association with relevant government departments to establish operating procedures of regulatory structures. The committee would provide the mechanism for the establishment of local integrated water management.

12. Training within BWDB

An annual series of training courses should be established within BWDB to give engineers a basic understanding of the water requirements within each natural resource sector, focusing attention on fisheries and agriculture. The fisheries course should contain descriptions of identified adverse impacts of flood control on fish and various methods of mitigation against such impacts.

13. Development of flood modelling techniques

There is a need to continue the development of flood modelling techniques using the MIKE11 hydrodynamic model. The SWMC and FAP 19 are currently active in this field but require future support, both financial and technical, to continue to make progress. The work would require detailed field surveys to improve basic topographical information.

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9 FUTURE RESEARCH REQUIREMENTS

FAP 17 investigations provided quantitative baseline data on several aspects of freshwater fisheries in various regions of Bangladesh. Because of the widespread nature of sampling effort and the relative short duration of field data collection (13-19 months), it was not possible to obtain a detailed understanding of the ecology, biology or population dynamics and movements of even the few most important floodplain fish in relation to changes in flooding patterns. It is therefore important to use the baseline data of FAP 17 as a foundation for further longer term fisheries studies which should provide both greater detail and scope of research activities.

In the formulation of future research requirements listed below, it has been assumed that the BRE will be effectively sealed against Jamuna flooding and that flooding inland will result from local rainfall and controlled flooding through regulators. A package of fisheries mitigation measures has been recommended for implementation in the short or near term. The measures will need to be supported by further research, some basic, but most adaptive. Many of the research areas listed below are relevant not only to the BRE and the adjacent FCD/I area to the immediate south in the PIRDP but also to other regions of Bangladesh. Certain areas of research - for example, the establishment of a quantitative floodplain fisheries model to predict impacts of changes in annual flooding patterns - require work inside and outside flood controlled areas. Within the BRE area, such studies can serve two purposes. Firstly, to provide a method of monitoring changes in fish yields and composition resulting from various mitigation measures. Secondly, to provide information which can be incorporated into the establishment of a fisheries production model.

1. Investigation of the biology and ecology of selected fish and prawn species dominating floodplain catches inside and outside flood controlled areas. Information collected should include data on age, breeding biology, feeding habits and micro-distributions in relation to seasonal changes in flooding and the distribution of aquatic vegetation including deepwater rice. The study should also include detailed limnological investigations which examine plankton, macroinvertebrates and water quality, particularly nutrient levels. The role of deepwater rice fields in providing shelter from certain fishing gears and natural predators in addition to providing food, should also be explored in detail. This study will provide an understanding of the overall functioning of the dominant fish and prawn community in relation to open-water habitats and deepwater rice fields.

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2. Stock assessment using length frequency analysis and ageing techniques to obtain information on the population dynamics of selected species of fish and prawns dominating floodplain catches. This study will provide information on growth, mortality and the status of stocks and allow predictions to be made of the effects on fisheries of further increases in fishing pressure. This study is particularly relevant to flood controlled areas of the BRE project where there are high levels of fishing effort on fish communities in which diversity has been reduced and a greater dependence placed on a small number of floodplain resident species. The current status of the stocks of these species is not known.

3. Establishment of catch assessment surveys to obtain estimates of fish densities and yield per unit area of floodplain. These data, when collected over a period of at least five years and linked with a concomitant set of quantitative data on flooding patterns, will provide the first rational basis for the development of a quantitative floodplain fisheries model. This can then be used as a predictive tool to provide future advice on fisheries management and development.

4. Investigation of the movements of fish and prawns between rivers and floodplains which are free-flooding and others on which flooding is controlled. This study will require continuous daily monitoring of catches in canals linking rivers with floodplains. Tagging studies may also be employed if preliminary studies indicate that the method provides useful information.

5. Investigation of the movements by passive downstream drift of fish and prawn hatchlings between rivers and floodplains in relation to seasonal changes in river discharge. This study is essential on the BRE where the Jamuna River provides an annual supply of hatchlings of major carps and many other species of fish.

6. Investigation of the impact of water regulators on the survival and movement by passive downstream drift of fish and prawn larvae in relation to seasonal changes in river discharge. This study has particular relevance on the Brahmaputra/Jamuna and Padma rivers.

7. Determination of water velocities from a range of different types of structures operating under varying head differences and gate openings. These data should be

collected by BWDB and incorporated into a national database on water regulators (mitigation measure no. 9).

8. Determination of swimming speeds of selected fish species. This work requires carefully controlled laboratory flume studies and therefore the most appropriate approach may be a joint study between the Fisheries Research Institute (FRI) and the River Research Institute. Results from this study would be related to data on water velocities at regulators (No. 7 above) to provide quantitative management advice on the operation of various types of regulator.

9. Investigation of the physiological effects on fish of passage through regulators under different prevailing head differences. This work requires the controlled release of selected species upstream of a regulator and their subsequent capture downstream. Physiological examinations could be undertaken by FRI and or universities.

10. Integration of biological information derived from research studies (numbers 4-9) and flood modelling techniques to improve the predictive capability of impact assessments of flood control projects and assist in the design of future water regulator structures. This work requires institutional collaboration between fisheries research organisations and hydrodynamic modelling specialists such as the SWMC, Dhaka.

11. Identification of possible spawning grounds of major carps in the Brahmaputra and Padma rivers in Bangladesh and investigation of upstream breeding migrations in these rivers.

12. Investigation of the migrations of fish along rivers of the North Central Region to identify possible environmental factors which might explain the general scarcity of riverine and migratory species compared to some other regions in Bangladesh.

13. Assessment of the impact of FCD/I projects on the diversity of fish and prawns. Standardised systematic, intensive sampling is required to record not only the more common species but also the numerous rarer species which may be more vulnerable to adverse impacts caused by flood control.

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APPENDIX 1

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Appendix 1 List of fishing gears recorded during FAP 17 surveys in Bangladesh

Gear Type	Name	Code	Description
Gill Net	*Current jal(Stationary)*	88	Monofilament fixed gill net, usually small mesh
	Current jal(Drifting)	282	Monofilament drifting gill net, usually top set, any mesh size
	Koi jal	123	Multifilament fixed gill net, usually small mesh
	Chandi jal	65	Multifilament drifting gill net, usually top set, any mesh size
	Par jal	315	Multifilament drifting gill net, usually bottom set, large mesh
	Kajuli jal	316	Multifilament drifting gill net, usually bottom set, small mesh
	Awo jal	324	Multifilament fixed gill net set in zig-zag pattern to catch large fish
	Foot jal	327	Very small gill set horizontally at surface in shallow water
	Gai Dasem	132	Drifting net used in rivers, has pockets at base
Seine Net	*Ber jal*	45	Seine net: small, medium or large size
	Baoli jal	306	Medium sized seine net pulled by 2 ropes
	Moi jal	202	Small drag net with pockets at base
	Dora jal	325	Similar to moi jal but pulled by 2 long ropes
	Konaber jal	268	Seine net with pocket at one end
	Dhor jal	89	Small seine usualy pulled by 2 men by sticks on each end of net
	Horhori	297	Seine net with a series of large pockets along net
	Kathi jal	175	Seine net with a series of vertical sticks along net
	Chabi jal	293	Seine/gill net pulled to shore, often used with polo traps
	Hat panch	276	Medium size seine pulled at each end by one man while man in boat beats water to drive fish into net
	Satiber jal	304	Seine net with a series of pockets at base
	Kachitana	277	Type of lift net hung from boat on floodplain or beel. Net used with drag rope to drive fish into net.
	Ferra jal	126	Drag rope used to drive fish into gill net/seine net
Bag Net	*Thaga*	285	Barrier across river with bag nets set perpendicular to it
	Suti jal	271	Single bag net staked to river bed
	Ghori jal	320	Barricade/fence with nets set in gaps to trap fish
	Bhuti jal	328	Clap net on bamboo frame hung from boat anchored in a gap of barrier fence
Lift Net	*Veshal*	266	Triangular lift net on large bamboo frame
	Dharma jal	105	Square or round lift nets on bamboo pole
	Jhali jal	160	Small veshal used on main rivers at night for prawns
	Jhap jal	319	Boat lift net: lifted at 4 corners by men in boats
	Chota jal	323	Gill net fixed horizontally on bottom to catch fish by spines
	Dara jal	329	Lift net and barrier used in canals or small rivers
Scoop Net	*Hat Tana*	287	Oval or triangular scoop nets used with pole and rope or by hand
	Ucha	263	Basket scoop on pole used by hand
	Tukri	296	Small basket scoop used by hand
	Afa/Hat bauli	321	Large thella jal, large mesh, used on boat
	Uttar jal	68	Like a cast net but hung from a boat drifting along river and lifted to catch fish
Clap Net	*Shangla jal*	234	Multifilament drifting bag net on bamboo frame boat used for hilsa fishing
FAD	*Katha*	270	Submerged brush shelter used to attract fish
	Boat Katha	314	Submerged boat filled with branches used to attract fish
	Horgra	149	Submerged basket filled with branches used to attract fish
	Kua	302	Fish pit on floodplain, invariably contains brush shelter

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Appendix 1 Continued

Gear Type	Name	Code	Description
Traps	*Polo*	222	Bell-shaped trap used to catch fish by hand
	Doiar trap	95	Small, oval or box traps used for prawns or small fish
	Deal	286	Larger trap, bilaterally divided to catch fish on 2 sides of bank
	Kadum trap	311	Large box traps used to catch larger fish e.g. Koi, Taki
	Kakila bana	310	Bamboo fence pulled downstream to trap fish in small area
	Katra	326	Active trap: fish speared after entering trap
	Kalsi pata	299	Clay pot used to trap fish set in bank side.
	Kotta	318	Bunded area on floodplain used to trap fish as water recedes
	Char jal	322	Tidal fence trap
	Kharia/Kore	330	Fence trap used on floodplain during flood recession
	Malai pata	331	Coconut shell drilled with holes and baited to catch small fish
	Patar savar	332	Large active fence trap used to surround fish on flooplain
	Tui	334	Small polo-type trap used to catch fish in mud on floodplain
Hook/ Lines	*Daun*	272	Long line: many hooks set at intervals on one line
	Sip	30	Rod and line : usually one hook per line
	Nol barsi	278	Hook & line attached to bamboo floats. Many floats/hooks may be joined along line
	Tana barsi	152	Hand line (no rod) from bank or boat with or without groundbait
Spear	*Juti*	170	Spears of various types: fixed or detachable barbs
Other	*Jhaki jal*	164	Multifilament circular net thrown by hand
	Thella jal	255	Small triangular push net set on bamboo frame
	Urani	291	Various barrier nets/fences used to catch jumping fish.
	Akra	298	Pole with metal hooks used to catch mud-dwelling fish e.g. baim
	Chunga	301	Hollow bamboo rod shelter used to attract baim
	Thushi	317	Cloth/basket traps used to drive baim into them
	Hand fishing	307	Picking fish by hand but without dewatering
	By hand/Dewatering	97	Empty water and catch fish by hand in mud
	Net/Basket+Dewatering	98	Empty water through an outlet where net or basket used to trap fish
	Nimbaich	335	Large scale fishing by whole village using many different gears
	Canal dewatering	336	Large section of canal isolated by cross dams and emptied by pumping by other means to catch fish by various methods

Notes:

1. Local names of gears vary between different districts and regions in Bangladesh. Those listed in the table above are generally used in the North Central Region. If gears were not found in this region, the name from the region in which the gear was most recorded was used.
2. Some names e.g. juti (spear) doiar traps and hat tana were used to denote a group of similar gears. A more detailed list and description of individual gears is provided in the FAP 17 database.
3. FAD = Fish Aggregation Device.