

Comprehensive EIA Report

# Environmental Impact Assessment of Proposed Mahadayi Hydroelectric Project

Volume II



Sponsor  
Karnataka Power Corporation Limited, Bangalore



National Environmental Engineering Research Institute  
Nehru Marg, Nagpur - 440 020

September 1997

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## ACRONYMS USED

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AAQS	:	Ambient Air Quality Status
ALWG	:	Average Linkage Within Group Method
AQMS	:	Ambient Air Quality Monitoring Station
ASP	:	Activated Sludge Process
BFDA	:	Brackishwater Fish Farmers Development Agency
bgl	:	below ground level
BHC	:	Benzene Hexa Chloride
BIS	:	Bureau Of Indian Standards
CCB	:	Cultivable Command Area
CDO	:	Central Design Organisation
CEC	:	Cation Exchange Capacity
CFU	:	Colony Forming Unit
CGWB	:	Central Ground Water Board
cm	:	centimeter
COD	:	Chemical Oxygen Demand
CPCB	:	Central Pollution Control Board
CVP	:	Climate Vegetation Productivity
CWC	:	Central Water Commission
dBA	:	decibel
DDT	:	Dichloro Diphenyl Trichloroethane
DO	:	Dissolved Oxygen
DPR	:	Detailed Project Report
EA	:	Environmental Assessment
ECe	:	Electrical conductivity
EIA	:	Environmental Impact Assessment
EL	:	Elevation Level
EMP	:	Environmental Management Plan
FRL	:	Full Reservoir Level
FSI	:	Forest Survey of India
GOI	:	Government Of India
ha	:	hectares
HQ	:	Headquarter
hr	:	hour
IRD	:	Integrated Rural Development
ISO	:	International Organisation of Standards
IST	:	Indian Standard Time
IVI	:	Importance Value Index
KPCL	:	Karnataka Power Corporation Limited
KPCB	:	Karnataka Pollution Control Board

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## ACRONYMS USED (CONTD...)

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lps	:	litre per second
MCE	:	Maximum Credible Earthquake
Mcum	:	Million cubic meter
MEF	:	Ministry of Environment and Forests
mg	:	milligrams
MHEP	:	Mahadayi Hydro Electric Project
min	:	minutes
mld	:	million litres per day
mm	:	milli meter
MSL	:	Mean Sea Level
mS	:	milli Siemens
MW	:	Mega Watt
m	:	meter
NGO's	:	Non Governmental Organisations
NTU	:	Nephelometric Turbidity Unit
NWDA	:	National Water Development Agency
PAP	:	Project Affected People
PAV	:	Project Affected Village
PET	:	Potential Evapotranspiration
PHC	:	Public Health Centre
ppm	:	parts per million
ppt	:	parts per thousand
PWD	:	Public Works Department
QOL	:	Quality Of Life
R & R	:	Rehabilitation and Resettlement
sec	:	seconds
SHW	:	State Highway
SPCB	:	State Pollution Control Board
SPM	:	Suspended Particulate Matter
SPSS	:	Statistical Package For Social Sciences
sq.km	:	square kilometer
TMC	:	Thousand Million Cubic feet
TOR	:	Terms Of Reference
TSS	:	Total Suspended Solids
T/ha	:	Tonnes per hectare
UGPH	:	Under Ground Power House
UPGMA	:	Unweighted Pair Group Method Arithmetic Averages
USEPA	:	United States Environmental Protection Agency
WASP	:	Water quality Analysis and Simulation Programme
yr	:	year
µg	:	microgram
µS	:	micro Siemens

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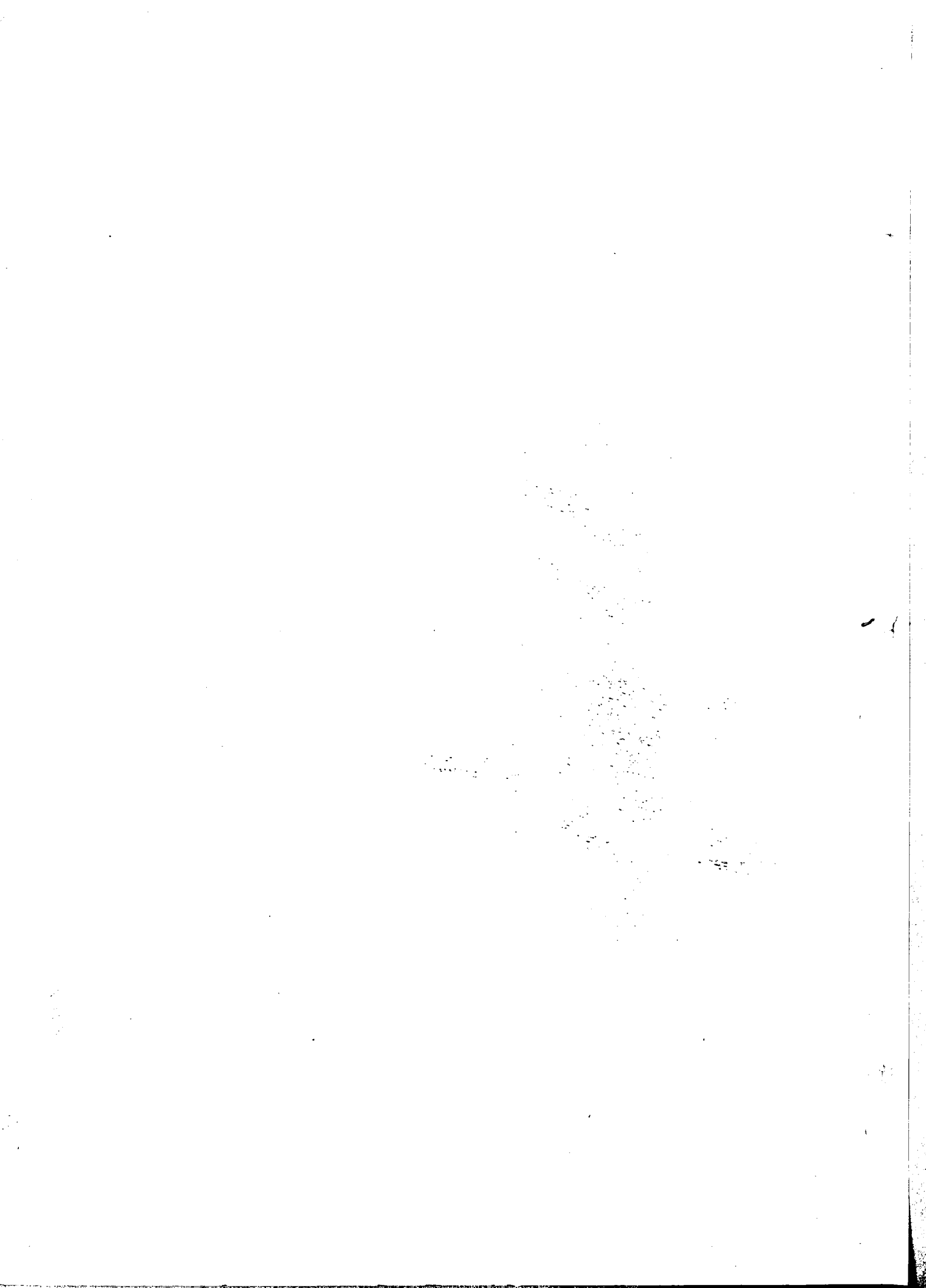
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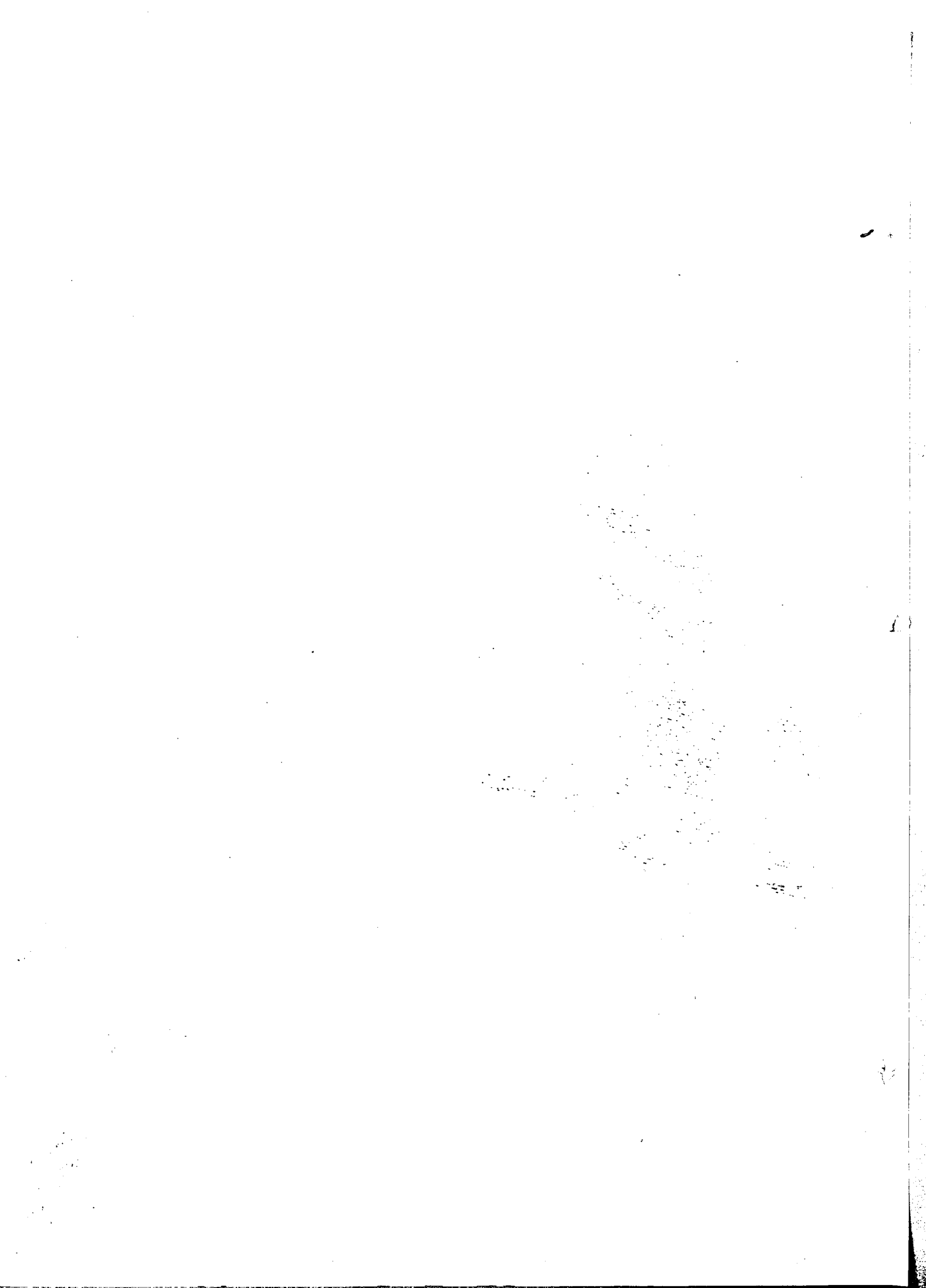
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## Annexure 1.1

### **Terms of references for carrying out the studies to assess the impact of construction of Mahadayi Hydro Electric Project and part diversion to Malaprabha river.**

Assessment of ecological/environmental impacts due to the projected changes in flow regime in the river system of Goa due to Mahadayi project during monsoon. In addition to other factors identified by the investigating agency, this study should invariably examine the possible impact on the status of the "Resources/Phenomena" listed as under :

- i) Ground water tables and aquifer replenishment & recharge
- ii) Surface water bodies under the influence of the river system
- iii) Water holes
- iv) Biological diversity
- v) Vegetation cover (forest as well as "plantation/ horticultural" species) under the influence of river system (both in the ghat region and plains)
- vi) Wild life
- vii) Fish and other ecologically important marine species
- viii) Sedimentation and flushing out of "silt/pollutants"
- ix) Natural process of dilution of salinity during monsoon, and the consequent influence on mangroves, fish breeding and other marine life processes
- x) Sand bar formation at the mouth of rivers, general river navigation, and navigability of Cumbarjua canal
- xi) Natural process of sand replenishment along the Beach Ecosystem of Goa. (along river estuaries-Mandovi river and connected river like Zuari)

- xii) Existing/proposed drinking water supply schemes dependent on Mahadayi river as well as irrigation schemes dependent on ground water

Assessment of the impact of projected increase in the total fresh water flow in the river system due to Mahadayi project during the dry months on the "ecology/environment" along the Mahadayi (Mandovi) estuarine region covering the following aspects

- 1) Mangrove ecosystem
- 2) Fish "breeding/nursery" grounds
- 3) Normal life processes and growth of marine life (includes planktons and fish species)
- 4) Fish catch in rivers, estuaries and coastal seas
- 5) Khazan paddy lands
- 6) Tidal marshes/wet lands (including saltpans)
- 7) Ecology and biology of creeks, backwaters and streams influenced by tidal action, connected to Mandovi river system
- 8) Natural flocculation and sedimentation processes
- 9) Erosivity of river banks and beach ecosystem situated on the coast and estuaries
- 10) Naturally established river regime
- 11) Diversion of partial yield from catchment in Karnataka (from Kalsa, Haltar and Potli) to Malaprabha and its effect on the environment and wild life

Effects on seismicity of the region due to recent earthquake at Killari in Maharashtra State. Considering this fact fresh studies are necessary to determine seismic rezoning of the area and the experts opinion to provide necessary safety measures in the design, construction and maintenance of the structure.

## **Annexure 2.1**

**EIA Notification of MEF, GoI. January 27, 1994 as amended on May 4, 1994.**

### **Schedule-I**

#### **Projects Requiring Environmental Clearance**

1. Nuclear power and related projects such as Heavy Water Plants, nuclear fuel complex, rare earths
2. River valley projects including hydel power, major irrigation and their combination including flood control
3. Ports, harbours, airports (except minor ports and harbours)
4. Petroleum refineries including crude and product pipelines
5. Chemical Fertilizers (Nitrogenous and Phosphatic) other than single superphosphate)
6. Pesticides (Technical)
7. Petrochemical complexes (both Olefinic and Aromatic) and Petro-chemical intermediates such as DMT, Caprolactum LAB etc. and production of basic plastics such as LLPDE, HDPE, PP PVC
8. Bulk drugs and pharmaceuticals
9. Exploration for oil and gas and their production, transportation and storage
10. Synthetic rubber
11. Asbestos and asbestos products
12. Hydrocyanic acid and its derivatives

13. Primary metallurgical industries (such as production of iron and steel, aluminium, copper, zinc, lead and ferro alloys) Electric arc furnaces (mini steel plants)
14. Chlor-alkali industry
15. Integrated paint complex including manufacture of resins and basic raw materials required in the manufacture of paints
16. Viscose staple fibre and filament yarn
17. Storage batteries integrated with manufacture of oxides of lead and lead antimony alloy
18. All tourism projects between 200m-500m of high water line and at locations with an elevation of more than 1000 m with investment of more than Rs. 5 crores
19. Thermal Power Plants
20. Mining projects (major minerals) with leases more than 5 hectares
21. Highway projects
22. Tarred roads in Himalayas and or Forest areas
23. Distilleries
24. Raw skins and hides
25. Pulp, paper and newsprint
26. Dyes
27. Cement
28. Foundries (individual)
29. Electroplating

## **CWC Guidelines for Sustainable Water Resources Development and Management**

### **Chapter 1 - Introduction**

- 1.1 The existing procedure for scrutiny and examination of irrigation, multipurpose projects by CWC and their acceptance by Planning Commission for inclusion in the State's development plans came up for discussions in the National Conference of Irrigation and Water Resources Ministers held in July 1986.
- 1.2 The recommendations of the National Conference of Irrigation and Water Resources Ministers (Annexure I) were again discussed in a meeting of the State Secretaries of Irrigation held by Union Secretary of Water Resources in September 1986. Having regard to the views expressed by representatives of a number of States, it was felt that there was need for abridgement of the extent and detailed nature of the scrutiny by the CWC and other Central agencies. To examine this issue, the Ministry of Water Resources set up a Group with Chairman, CWC, as its Chairman and representatives from Planning Commission, Ministry of Water Resources and various State Governments as its Members.
- 1.3 The Group set up by the Ministry of Water Resources held several meetings and finalised its report on abridgement of scope of project scrutiny which was forwarded to the Ministry of Water Resources in June 1987.
- 1.4 The report on "Abridgement of scope of project scrutiny in CWC" submitted by the Group was discussed in a meeting taken by Secretary, Ministry of Water Resources on 25th November 1987, which was attended by the Chairman, CWC and concerned officers of the Ministry of Water Resources, Planning Commission and CWC. During this meeting it was decided that keeping in view the recommendations of the Group as well as the National Conference of Irrigation and Water Resources Ministers, the guidelines indicating the procedure for submission, appraisal and clearance of irrigation and multipurpose projects should be prepared by the Project Appraisal Organisation of CWC.

- 1.5 This document has accordingly been prepared indicating the procedures to be adopted for processing of major, medium and revised project estimates. Separate guidelines have been given for the projects received from the States where Central Design and Planning Organisations have already been established and from those States where such organisations have not yet been established. Keeping in view the recommendations of the Irrigation Ministers and the Group, major part of the technical examination of the projects has been entrusted to the State Governments which have developed their Central Design Organisations. Where the design organisations have not been established, the procedure has been streamlined to avoid delay in appraisal and clearance of the projects.
- 1.6 The procedure for submission, appraisal and clearance outlined in these guidelines shall be followed by the State Governments with immediate effect.

## **Chapter II - Major Projects**

### **Part A Procedure in Respect of States where Central Design and Planning Organisation are Existing**

- 2.1 State Level Appraisal
- 2.2 All major irrigation projects (CCA more than 10 thousand ha) and multipurpose projects shall be investigated in full details and detailed project reports prepared in accordance with guidelines issued by Government of India, Ministry of Irrigation (now Ministry of Water Resources) 1980, as amended from time to time.
- 2.3 The basic Planning and hydrological studies relating to water availability, design flood and sedimentation shall be carried out by the respective specialised units established in the State Irrigation/Water resources Department. These studies shall be vetted by the Central Water Commission so as to avoid any major change in the project features at a later date.
- 2.4 State agriculture, Planning, Revenue, environment, Forest, Ground Water, Tribal Welfare and allied departments will be associated during the investigation, formulation and preparation of detailed project report.
- 2.5 Detailed project reports prepared by the field units shall be submitted to the Central Design and Planning Organisation of the State Government for technical examination and scrutiny in its various specialised units.

- 2.6 The technical examination and scrutiny by the State CDO will cover all the items of the check list given in Section I, volume II of the guidelines issued by Government of India (1980).
- 2.7 Based on the technical examination and scrutiny in the specialised units of CDO, the detailed project report will be amended/modified wherever necessary and the cost estimates finalised.
- 2.8 The B.C Ration and I.R.R shall be worked out as per guidelines to establish the economic viability of the project. The Environmental cost, to the extent it is chargeable to the project, should also be taken into account while working out the B.C. Ration and I.R.R.
- 2.9 The concurrence of the State Planning and Finance Departments shall be obtained for the project estimate finalised after scrutiny by CDO.
- 2.10 The project shall also be discussed and cleared by State level Project Appraisal and Environmental Appraisal Committees, wherever they exist, comprising of Irrigation, Agriculture, Ground Water, Revenue and Finance, Fisheries, Forest, Soil Conservation Tribal welfare etc.
- 2.11 Appraisal at Centre
- 2.12 Where the project reports have been examined and cleared by Central Design Organisation and State level Appraisal Committees, examination of the project by CEC will be restricted to inter-state aspects, hydrology and dam safety, water availability, water accounting and economic viability. Supplementary report covering the above aspects in 10 copies along with two sets of detailed project report shall be sent by the State Government along with letter of clearance (vide annexure-II) to CWC for further processing.
- 2.13 Central Water Commission will send copies of the project reports and relevant proforma to the Ministry of Environment and Forest. However, the State Govt. will directly correspond with the Ministry of Environment & Forest for obtaining clearance from the Environment and forest angle.
- 2.14 All projects in the Ganga-Brahmaputra-Meghna and Indus basins would be examined from International angle and cleared in the Ministry of Water Resources. The State Govts. which have borders with neighbouring countries should in particular keep this in view while considering any project close to International borders right from the initial stage of investigation and planning.

The applies to major as well as medium projects and also irrespective of the fact whether a Central Design and Planning Organisation exist exists or not in the State.

- 2.15 The scrutiny of the projects at CWC shall be completed in 7 months where the inter-State aspects have been resolved and hydrology and economic viability of the project is found acceptable.
- 2.16 In case of projects where certain observations and comments on these issues are made, the processing shall be completed in a period of 14 months.
- 2.17 For the projects where these issues have remained unsettled even after 14 months, the project shall be returned to the State Government for carrying out necessary modifications after the issues are settled and for resubmission of the project with updated cost estimates. Such projects will processed by CWC as new projects.
- 2.18 Consideration by Advisory committee of Ministry of Water Resources
- 2.19 After the appraisal of the project at Centre is completed, a note shall be prepared by Project Appraisal Organisation of CEC and put up to the Advisory Committee for its consideration and recommendation to the Planning Commission.
- 2.20 The State Engineers of the level of Chief Engineers/ Superintending Engineer associated with the project formulation/design will be invited to attend the Advisory Committee meeting so as to furnish information/clarifications if any sought by the Members of the Advisory committee.
- 2.21 The projects found acceptable by the Advisory committee shall be recommended for approval by the Planning Commission and inclusion in the Five Year Plan/Annual Plan.

### **Chapter III - Medium Projects**

#### **Part A Procedure in Respect of States where Central Design and Planning Organisations are Existing**

- 3.1 All medium projects (CCA 2000 to 10,000 ha.) shall be investigated and detailed project reports prepared in accordance with the guidelines issued by the Government of India.

- 3.2 The basic planning and hydrological studies relating to water availability, design flood and sedimentation shall be carried out by the State Government in consultation with the CWC.
- 3.3 For technical examination of such projects a proforma report will be prepared giving the salient features/notes in basic planning, inter-State aspects, hydrology, irrigation, storage planning, spillway capacity, rates of important items, abstract of cost estimates, benefits cost ratio and financial return statement.
- 3.4 These proforma reports shall be submitted to the Central Design and Planning Organisation of the State Government for technical examination in its specialised units.
- 3.5 The technical examination and scrutiny by the State CDO will cover all the technical aspects and the project shall be modified wherever necessary after appraisal and the cost estimates finalised.
- 3.6 In cases where clearance from Forest Conservations, Act 1980 is required the State Government will take up this matter simultaneously with the concerned authorities and submit the clearance from the environment angle is required, the State Govt, will pursue and obtain such clearance by approaching the concerned Department directly.
- 3.7 The medium projects which are found to be techno-economically feasible by CDO shall be sent to the regional office of CWC for scrutiny with regard to water availability and inter-State aspects.
- 3.8 The projects will be examined by the regional office and a note will be sent to the Project Appraisal Organisation of the Advisory Committee of the ministry of Water Resources.
- 3.9 In case of projects where the water availability and inter-State aspects are not found to be acceptable, efforts will be made to get them settled within a period of 7 months. In case these issues are not resolved within this period the project shall be returned to the State Government for resubmission after the issues are sorted out.

## Chapter IV - Revised Project Estimates

- 4.1 In case of major and medium projects which have been approved by the Planning Commission and where the revised estimates of the project have increased by more than 15% of the original estimates, excluding escalation due to price rise, or where there is change in scope will be required to be furnished to CEC for examination in the same way as new major and medium schemes irrespective of the fact whether the revision is due to change in scope or not. The procedure for scrutiny for such revised project estimates shall be same as outline in the preceding chapters.
- 4.2 In respect of revised project estimates where there is no change in the scope and where the cost excluding escalation due to price rise has not changes by more than 15%, the State Government need nit forward a detailed estimate for examination at Centre. For such projects the State Government should send to CWC an excess note after obtaining the concurrence of the State Finance Department giving the abstract of cost under major sub head indicating the excess cost over the sanctioned cost and giving reasons thereof. The note will include the salient features of the project as originally proposed and as being executed at site. The CEC will examine such estimates broadly and send its views to the Advisory Committee for consideration and recommendation of the Planning Commission.
- 4.3 In so far as preparation of cost estimates is concerned the estimates may be framed on the bases of local schedule of rates for items covered by the schedule and for others an analysis of rates will be prepared as per the guidelines issued by CWC and in case of any doubt on the viability of rates of any items a certificate of the State Chief Engineer on the reasonability of the rates shall be taken as final and acceptable.
- 4.4 The rate of escalation due to price rise shall be based on the studies made by the Construction Planning and management Unit of CWC from year to year.

## ECOLOGICAL ASPECTS OF RIVER VALLEY HYDRO ELECTRIC PROJECTS

1. Detailed basic information affecting the environment
  - 1.1 Predominant existing land-use pattern (agricultural land Reserve and other Forests etc.) in project area and upto 200 Km. upstream.
  - 1.2 Break-up of submerged area (hectares) :  
  
Total submerged area: .....  
Forest land .....  
Cultivated land .....  
Shrubs and Fallow ..... Rocky outcrop .....  
Wells and Open Water Bodies .....  
Other Uses .....
  - 1.3 (a) Forest Type in catchment and submerged areas : (indicate the type of trees, whether sparse or thickly wooded and other details).  
  
(b) Extent and nature of forest to be out for the construction of Roads, colony and other appurtenant work.
  - 1.4 Duration of project's construction stage:
  - 1.5 Estimated Peak Labour strength; ..... Skilled..... Unskilled.
  - 1.6 Population density in the area per Sq.Km.
  - 1.7 Number of villages and population to be displaced ..... size of affected villages .....  
  
Affected families in each.  
Village ..... ST ..... SC .....  
Others .....

Occupation of the affected people	Agriculture	Industrial Labour	Artisans	Forest based	Others
Owner	Marginal	Small	Medium	Big	
Cultivators by size of Land Holdings(Ha.)	0.01-10	1.0-2.5	2.5-5.0	Over 5.0	

### 1.8 Resettlement

Is a Rehabilitation Committee being constituted?

..... Existing guide-lines, if any, for compensation ..... Level of Compensation in cash and kind:

Number of oustee families likely to be settled in existing villages:

Number of oustee families likely to be settled in new settlements:

Size of proposed new settlements:

Layout plans / Master plans for new settlements distance of new settlements from the present habitat.

1.9 Number and type of facilities (e.g. school, post office, Bank, panchayat ghat, police station, approach road, drainage and water supply etc.) proposed to be provided; .....

1.10 Is the affected area covered by development programmes like IRD, SFD, drought prone area, tribal development etc. Any proposals to provide/create employment for oustees.

Nature and quantum of employment to be provided:

Vocational training programmes envisaged, if any.

1.11 What is the expected rate of siltation?

Details of how the siltation problem is proposed to be handled.

1.12 Is downstream area subject to flooding ?

1.13 Wind rose at Dam site.

(Diagram giving statistical information concerning the direction and speed of the wind at the site).

1.14 Hurricane, tornadoes, cyclones:

Frequency of occurrence .....

Wind velocity : average ..... Maximum.

1.15 Plan of areas, on the reservoir periphery, subject to erosion, slides and slips: including wildlife sanctuaries and national parks etc. likely to be affected by the proposed project?

If so, details thereof.

1.16 The depth of ground water table :

Maximum ..... Minimum .....

Quality of ground water :

Potable / non-potable; fit for irrigation industry.

1.17 Present ground water use pattern in the command area under irrigation .....

Surface .....

Ground water .....

1.18 Based on the experience of similar projects in the area specify the interaction between the altered surface water patterns and underground aquifers and their recharge.

## 2. Environmental Status:

2.1 (a) Indicate known pollution sources in the region (industries like chemicals, textiles and thermal power units; mining operations etc.)

(b) Indicate the industrial and other development projects likely to be taken up in the area during the next five to ten years.

2.2 a) Does the area support economically viable aquatic life-fish, crocodiles? Please give details.

b) Are there any fish/crocodile breeding grounds in the river/tributaries, in the submergence area.

2.3 Does the site contain a wild-life (including birds) habitat ..... breeding area/feeding area ..... migration route .....

Indicate the numbers of wild-life available in the area.

2.4 Is the site a potential wild-life sanctuary?

2.5 Specify any rare or endangered species of flora and fauna found in the affected area alongwith their approximate number and measures to salvage/ rehabilitate them.

2.6 Is the area a tourist resort?

2.7 Are any monuments/sites of cultural historical religious, archaeological or recreational importance including wild-life sanctuaries and national parks, etc. likely to be affected by the proposed project? If so, details thereof.

2.8 Does the proposed area suffer from endemic health problems due to water/soil borne diseases? If yes, specify the problem(s) and give details?

### 3. Environmental Impacts

3.1 What measures are planned to develop the site to enhance its aesthetic aspects (i.e. recreation and water sport facilities; and picnic sites etc.)?

3.2 Will the project help in flood control reduction or even eradication of flood havoc downstream ?

3.3 Are any changes in water salinity expected? If yes, details or proposed measures to counteract them.

- 3.4 Are problems of water logging envisaged in the command area. If so, give details of proposed steps to combat the problem.
- 3.5 Will the reservoir be used for fisheries development (fish culture as well as fish breeding) crocodile farming etc.
- 3.6 Will fish ladders/lifts and like arrangements be provided to allow movement of important migratory fish population? If not give reasons.
- 3.7 Measures proposed to prevent grazing and cultivation on reservoir slopes to avoid erosion and pre-mature silting up the impoundment?
- 3.8 Will any important natural resources (minerals, commercial timber etc.) be lost or their use precluded because of the presence or operation of the project?
- 3.9 What is potential loss in aquatic production on site, up and downstream? (Fish and other useful aquatic animals and plants)
- 3.10 Will the formation and use of the water body result in the introduction or enhancement of water borne diseases?
- 3.11 Will the impounded reservoir lead to -
- i) Noxious aquatic weeds like slevinia, water hyacinth etc?
  - ii) Intermediate hosts (vactors) like snails mosquitoes etc.
- 3.12 How will aquatic weeds be controlled in submerged areas so as to provide an improved habitat for fishery exploitation.
- 3.13 Will the project induce adverse climatological changes? (regarding temperature, humidity, wind and precipitation including modifications to micro and macro climate)
- 3.14 What impact is expected on geological factors? (e.g. seismic impact or reservoir loading)
- 3.15 Indicate the magnitude of impact due to population pressure on.
- i) felling of trees for firewood?
  - ii) forest fires;

- iii) Over grazing leading to depletion of the pastures; and.
- iv) Visual pollution and damage to scenic values.

3.16 What arrangements are being made.

- i. To meet fuel requirements of the labour force during construction period to prevent indiscriminate felling of trees for firewood;
- ii. For compensatory afforestation.
- iii. To enforce anti poaching laws;
- iv. To control flow of sediments and pollutants due to fertilizer and pesticide run off from cultivated area
- v. For restoration of land in construction areas (filling, grading, and reforestation etc. to prevent erosion and to erase the scar).
- vi. For soil conservation in the catchment; and
- vii. For prevention of increased salinity and water logging in the command.

## Geology and Tectonics of the Region

The tectonic evolution of the Indian Peninsular shield with Archean-Proterozoic fold belt forming the basement rocks, started with the development of very large basins, depressions, grabens, ridges and shelf with deposition of Proterozoic Cuddapah sequence which represents the oldest sedimentary formations and shows in part epi-grade metamorphism, basin intrusions and considerable faulting and thrusting. Subsequent stage of evolution led to the development of Vindhyan sequence (Upper Proterozoic-Lower Paleozoic) unconformably over Cuddapah or directly on the basement. The Vindhyan is much less disturbed, practically devoid of metamorphism and with less frequent basic intrusives.

After the close of Vindhyan sedimentation, Indian shield experienced vertical movements along ancient faults, probably along major basement lineaments, resulting in the formation of a set of intra-cratonic grabens for deposition of Gondwana sequence consisting of continental sediments ranging in age from Upper Carboniferous to Lower Cretaceous. Isolated outcrops of thin marine beds occur at the base in Narmada-Sone-Damodar graben resulting from marine transgressions through narrow depressions. The Gondwana sediments are in part highly faulted and contain basic and ultrabasic intrusives. The original configuration of grabens in which Gondwana sediments were deposited have subsequently been modified by later movements.

The deposition of Middle and Upper Mesozoic sequence marks a change in the tectonic evolution of Indian shield with development of peripheral structures in which continental sedimentation intercalated with marine formations or with transition from continental to marine facies were formed representing Mesozoic sequence as equivalents of inland upper most Gondwana sediments. The Mesozoic sequence has developed in Saurashtra-Kutch and Rajasthan shelves, flanks of the Cambay graben, parts of Narmada-Sone-Damodar graben and the Laccadive-Kerala graben along western peripheral parts of Peninsular shield. Possibility of the presence of marine Mesozoic sequence is also conjectured below Deccan traps in the inland as well as offshore region.

The Peninsular shield in the central and western parts of India were subjected to very widespread igneous activity represented by Deccan Trap lava flows covering an extensive area including present Saurashtra and Bombay offshore basin. Deccan traps of Upper Cretaceous to Eocene age represent plateau basalts alternating with

inter-trappean sediments. Negative gravity anomalies of the order of 90 milligals (Gulatee, 1958) observed over Deccan traps indicate likely presence of appreciable thickness of sediments below the traps. Fringing the traps are Cuddapah, Vindhyan, Gondwana and Mesozoic sequences.

The total area occupied by the Deccan Traps on land is about 320,000 sq.km (Krishnan, 1968), including Maharashtra, Gujarat, Madhya Pradesh and other parts of the Peninsula. The total thickness of the Traps in the west coast near Bombay is estimated to be about 2000 m (Gupta, et. al., 1976). The Deccan Traps in Western Maharashtra are composed of numerous flows which are generally horizontal in disposition and dip towards the Arabian sea at an angle of about 10° near Bombay coast. Chemical analysis of the Deccan Traps indicates that bulk of the lavas are of tholeiitic type. It has been the practice to subdivide the Deccan Traps into three groups - Lower, Middle and Upper by different workers on the basis of intertrappean, intratrappean and ash beds. Of all the above divisions, the youngest (Upper) Traps lie in the Bombay-Saurashtra area.

The Deccan Trap country is characterised by a uniform flat geomorphology with gentle undulations. This uniform plateau-like country shows a sharp fall of about 600 m to 700 m in the coastal area. In the low country of the Konkan a westerly dip of the basalt flows is observed. The basalt flows east of the continental divide are flat lying or dip at an angle of 1° to 2° towards east, while west of the divide dip is westerly varying between 12° to 15° near Panvel and 2° and 3° further south near Ratnagiri (Das and Ray, 1973), 6° to 8° near Bombay, 4° near Alibag, 2° to 3° near Shrivardhan. The belt along which the basalt flows attain a westerly dip, forms a monoclinial flexure, part of which has been named as Panvel Flexure by Auden (1949). Hot springs are noted to occur between latitude 16°40' N and 19°35' N flowing the Panvel Flexure along NNW-SSE trending zone. The hot springs align along NNW-SSE and NW-SE fractures. Gubin (1969) assumes that the hot springs arise along a fault zone within the basement. The reversal of basalt flow dips and presence of hot springs are indicative of existence of active faults and fracture zones below the Deccan Trap.

Konkan offshore basin is separated from Ratnagiri shelf in the north by cross trending Vengurla Arch and from Kerala-Laccadive basin to the south by NE-SW extension or offshoot of Laccadive trend near 11° 45' N latitude. Konkan basin is more differentiated in Eocene/Oligocene section with N-S trending horsts and grabens than in Neogene section which generally shows a gentle westerly dip with minor faulting. However as compared to Ratnagiri Shelf, the Konkan basin is less disturbed. Early Oligocene/Eocene regional unconformity of Bombay Offshore basin is also traceable in the Konkan Basin. The Kerala-Laccadive basin extends from the coastal

areas of Kerala in the east to Laccadive Ridge in the Arabian sea, and can be broadly divided into basin Margin Fault Zone near the coast, Miocene Shelf Edge with a long narrow horst feature in the northern part, Kerala-Laccadive Depression and Laccadive Ridge tectonic units.

The Peninsular shield forms a stable crustal block forming the Indian lithospheric plate. In response to ocean floor spreading in the Indian ocean, the Indian plate is considered to have moved towards north, and after the closure of the neo-Tethys ocean and collision and fusion at the Indus-Tsangpo Suture (ITS), continued convergence of India and Eurasia at this collision boundary has resulted in Himalayan uplift by continental reverse faulting (under thrusting). The Peninsular shield south of Himalayan Belt forming the intraplate region has undergone major crustal disturbances in such convergence of the Indian plate. Jain et. al. (1984) consider that the initial dragging of the Indian plate into the Eurasian plate occurred during late Cretaceous along the ITS zone and this rigid plate broke down along ENE fault systems following Narmada-Sone river course. This initiated further development of rift systems and graben structures within as well as peripheral areas of the shield.

The end of the Cretaceous period was also marked by the outburst of intense volcanic activity and out pouring of enormous lava flows which flooded the western, central and eastern parts of Peninsular shield. Tipnis and Srivastava (1968, 1969) postulated that the development of horsts and graben structures is the result of cymatogenic warping of the Crust-Upper Mantle boundary and is closely related to Deccan Trap volcanism. Tipnis and Srivastava (op.cit.) suggested that Deccan Trap eruption in Narmada-Tapti belts and north Konkan region occurred along east west and north south oriented fissures respectively as indicated by the alignment of dykes representing the fissures. The two regions also show the presence of eruptive centers and associated acidic and alkaline rocks. The Narmada trough and north Konkan region being geotectonically akin to one another and being probably the outcome of linear uplifts in E-W and N-S directions suggest a domal uplift of the region. The Deccan Trap volcanism thus represents a deep seated source for these eruptive rocks.

The Precambrian schistose rocks of Mysore state are spread over an area of over 75,000 sq.km. and have been assigned the single age of Dharwar. These rocks extend from Sangrur in the south to Dharwar (type area) and beyond upto the Deccan traps in the north. It is generally believed that there is a progressive degree of metamorphism from north to south. These rocks show a regional plunge to the north, which in effect has exposed the intensely metamorphosed deeper sections in the south.

The Precambrian sediments and the volcanic rocks constituting the bulk of the Dharwar formation in Mysore state have been studied in detail by many workers. The general strike of the Dharwar rocks in the northern parts of state is NNW-SSE. Southwards, it becomes almost N-S and after taking an acute swerve, attain a NW-SE trend. Based on the field evidences Read (1955) had recognised three types of geosynclinal sediments : The Pre-orogenic sediments, The Syn-orogenic sediments and the Post-orogenic sediments.

Table 1

## Ambient Air Quality Status in Winter 1997 : SPM

24 hours average

Unit :  $\mu\text{g}/\text{m}^3$ 

Sampling Location	Maximum	Minimum	Average	Standard Deviation	98th Percentile Value	CPCB Std. (Sensitive Area)
Jamboti	97	45	60	33	90	100
Chapoli	18	10	13	6	17	
Kotni	10	5	8	4	10	
Kanakumbhi	15	9	10	4	14	
Talewadi	12	8	9	3	12	

Table 2

Ambient Air Quality Status in Winter 1997: SO<sub>2</sub>

24 hours average

Unit :  $\mu\text{g}/\text{m}^3$ 

Sampling Location	Maximum	Minimum	Average	Standard Deviation	CPCB Std. (Sensitive Area)
Jamboti	6	NT	6	0	15
Chapoli	8	NT	6	1	
Kotni	6	NT	6	0	
Kanakumbhi	7	NT	6	0	
Talewadi	6	NT	6	0	

NT : Not Traceable

Table 3

Ambient Air Quality Status in Winter 1997 : NO<sub>2</sub>

24 hours average

Unit :  $\mu\text{g}/\text{m}^3$ 

Sampling Location	Maximum	Minimum	Average	Standard Deviation	CPCB Std. (Sensitive Area)
Jamboti	3	3	3	0	15
Chapoli	6	3	4	1	
Kotni	13	3	3	0	
Kanakumbhi	3	3	3	0	
Talewadi	7	3	4	1	

Table 4

## Hydrometeorological Data of Khanapur Station (Belgaum District) : 1991-92

Sl. No.	Month	Total Rainfall (mm)	Temperature (°C)			Wind Velocity (km/hour)			Relative Humidity (%)			Vapour Pressure (Milibars)		Total Evaporation (mm)	Sunshine in hours (daily mean)
			Daily Max.	Daily Min.	Daily Mean	Period A	Period B	Daily Mean	Daily Max.	Daily Min.	Daily Mean	Max.	Min.		
1.	Jun 91	463.6	30.7	20.6	25.6	4.0	1.3	2.3	92	65	84	31.5	22.0	114.8	4.2
2.	Jul 91	901.5	26.6	20.3	23.4	4.0	1.5	2.7	96	72	89	28.8	22.0	98.6	0.4
3.	Aug 91	373.3	26.4	20.3	23.3	2.5	0.9	1.5	95	84	91	27.4	22.7	88.6	0.2
4.	Sep 91	29.7	30.0	19.9	24.9	2.4	0.6	1.3	92	65	83	24.5	20.9	99.9	1.1
5.	Oct 91	83.4	31.8	19.1	25.4	1.7	0.5	0.9	91	57	80	26.9	17.5	104.1	4.7
6.	Nov 91	6.3	29.9	17.1	23.5	1.8	0.5	1.0	91	59	78	26.1	30.7	100.8	5.7
7.	Dec 91	0.0	30.6	13.4	22.0	1.7	0.5	0.9	91	47	71	22.8	11.9	102.1	6.8
8.	Jan 92	0.0	31.4	10.9	21.1	1.7	0.3	0.9	90	31	62	17.7	10.4	101.5	7.8
9.	Feb 92	0.0	33.3	13.3	23.3	1.5	0.3	0.8	91	33	62	19.9	11.9	120.5	8.6
10.	Mar 92	0.0	38.7	17.0	27.8	1.9	0.4	1.1	95	34	69	29.8	14.2	153.2	8.6
11.	Apr 92	12.9	39.0	19.6	29.3	2.5	0.5	1.6	96	60	79	32.0	19.9	140.6	8.8
12.	May 92	48.2	35.4	21.0	28.2	3.7	0.9	1.9	100	72	82	31.1	22.7	161.4	9.7
	Annual Total	1918.9												1386.1	
	Mean	159.9	32.0	17.7	24.8			1.4						115.5	5.5

1-day Maximum Rainfall  
N.A. - Not available

during the year and date : 26.7.91  
Period A - 8.30 hrs to 17.30 hrs = 9 hrs  
Period B - 17.30 hrs to 8.30 hrs = 15 hrs

Duration of Maximum Rainfall = 16.30 Hrs to 17.30  
24.5 MM

Source : WRDO

Table 5

## Annual Rainfall at Various Rainguaging Stations in Mahadayi Basin

Year	Total Rainfall at Station (mm)							
	Jamagaon	Gavali	Jamboti	Amagaon	Chapoli	Krishnapura	Nerse	Kotni
1960-61	3025	3814	2595	6035	3004	3212	1509	3066
1961-62	4724	6235	5417	9603	7119	5253	2467	5017
1962-63	3577	5298	3566	7349	4254	4463	2096	4259
1963-64	3102	5108	1817	3950	4390	4302	2020	4106
1964-65	2979	4782	1150	2622	5070	4029	1092	3044
1965-66	3110	4513	1219	5807	3441	3801	1705	3620
1966-67	1972	2017	2221	4623	3101	1699	790	1621
1967-68	2654	5897	3324	6067	4531	4960	2333	4741
1968-69	4141	5635	2502	5099	3321	4747	2231	4530
1969-70	4405	6593	3660	5830	3931	5553	2660	5300
1970-71	3774	6694	2923	6170	4182	5639	2649	5301
1971-72	3151	3873	2275	5540	2568	3263	1532	3113
1972-73	1361	4460	1935	4902	3274	3757	1764	3505
1973-74	2405	3256	2797	5353	3987	2743	1280	2610
1974-75	2006	4436	2815	5796	3992	3351	1755	3040
1975-76	4441	6873	2562	6187	4201	6190	3677	5190
1976-77	3732	5604	1939	4702	4038	5230	3412	4512
1977-78	3093	6479	1916	5674	3989	4014	2226	5065
1978-79	3291	6536	2289	6255	4767	7017	2347	5328
1979-80	3232	5707	2279	5071	4524	4958	1955	4963
1980-81	4080	7592	2696	7655	5509	5889	2656	5918
1981-82	4302	7034	2887	7331	4768	5297	3119	5388
1982-83	4712	6004	2633	6337	4910	5319	2192	5254
1983-84	4249	6286	2292	5967	4770	5397	1019	4720
1984-85	3930	6154	2060	5014	4300	6154	3503	5357
1985-86	2951	4929	1500	5366	3291	4929	1967	3849
1986-87	3657	4555	1641	4795	3364	4145	2551	4214
1987-88	2819	4275	1715	4120	2755	3576	1605	3394
1988-89	5400	6888	1733	7503	4699	5532	2602	4930
Average for 29 years	3458	5425	2426	5749	4140	4635	2160	4309

Table 6

**Mean Rainfall and Potential Evapotranspiration (PET) at Various Stations  
in the Study Area, Goa (1980-1991)**

Month	Meteorological Station					
	Mapusa	Mormugao	Panaji	Ponda	Volvoi	Mormugao
	Rainfall (mm)					PET (mm)
January	0.3	0.1	0.1	0.0	0.0	136.0
February	0.0	0.0	0.2	0.4	0.0	135.5
March	0.0	0.3	0.5	0.0	0.3	167.4
April	4.1	6.3	8.3	7.0	10.5	170.9
May	65.4	66.1	107.3	115.9	118.0	171.6
June	867.9	816.5	885.4	865.8	926.4	127.0
July	887.1	773.9	903.5	1069.4	1435.3	116.1
August	595.9	513.2	573.2	706.3	1013.7	119.0
September	272.8	239.2	248.8	324.1	412.2	112.6
October	113.4	92.3	110.6	142.9	182.2	123.0
November	39.6	45.9	37.0	38.4	62.4	90.9
December	22.0	11.4	15.5	8.9	13.6	130.4
<b>Annual</b>	<b>2868.5</b>	<b>2564.9</b>	<b>2890.3</b>	<b>3278.7</b>	<b>4174.6</b>	<b>1601.0</b>

Source : India Meteorological Department, Pune

Table 1

## Noise Levels at Different Locations in the Study Area

Sl. No.	Location	Time	Noise Level SPL (dBA)
1.	Jamboti (R)	1200	40 - 42
2.	Amte (R)	1230	40 - 42
3.	Chikle (R)	1300	40 - 42
4.	Betane (R)	1330	38 - 40
5.	Irrigation Colony (R)	1345	42 - 44
6.	Surla Village (R)	1570	44 - 46
7.	Mann (R)	1520	44 - 46
8.	Chorla (R)	1600	38 - 42
9.	Sorla (R)	1630	42 - 44
10.	Talewadi (R)	1100	35 - 38
11.	Chakoli (R)	1600	38 - 40
12.	Kalsa and Surla Nala (D) Confluence	1510	44 - 46
13.	Haltar Nala (R)	1545	38 - 40
14.	Pansheer Nala (D)	1115	38 - 40
15.	Tail-Race-Dam (D)	1330	38 - 42

R - Residential Area

D - Proposed Dam Site

Table 2

## Noise Levels at Sensitive Receptors in the Study Area

Sl. No.	Location	Time	Noise Level SPL (dBA)
1.	Mauli Vidyalaya, Kanakumbhi	1410	38 - 40
2.	Govt. Primary School, Chorla	1600	38 - 40
3.	Primary School, Sorla	1630	42 - 44
4.	Govt. Primary School, Chakoli	1335	40 - 42
5.	Middle School, Jamboti	1200	40 - 42

Annexure 4.3 (contd...)

Table 3

Day and Night Noise Levels in the Study Area

Sl. No.	Location	Noise Levels	
		Leq (Day)	Leq (Night)
1.	Talewadi (R)	50	40
2.	Krishnapur (R)	52	38
3.	Irrigation Colony (2 kms from Kanakumbhi)	48	38
4.	Mauli Vidyalaya, Kanakumbhi (S)	45	38
5.	Primary School, Sorla (S)	45	40
6.	Proposed Center of Storage Dam (Near Existing Rain-Gauge Station, Kotni)	49	38
7.	Proposed Site, Pansheer Dam	50	38
8.	Proposed Site, Tail Race Dam	48	40
9.	Proposed Site, Haltar Nala	52	40

R - Residential Area ; S - Silence Zone

Table 4

Noise Levels Due to Vehicular Traffic in the Study Area

Sl. No.	Location	Traffic Density during Peak Hour			Noise Level SPL (dBA)	Noise Level Predicted using FHAM Model Leq (dBA)
		H	M	L		
1.	Belgaum To Panaji Road near Inspection Bungalow at Jamboti	54	60	30	60 - 64	68 - 70
2.	Khanapur to Talewadi Road at Talewadi	12	24	12	52 - 54	60 - 62

H - High  
M - Medium  
L - Low

Table 5

## Ambient Noise Standards (Central Pollution Control Board)

Sl. No.	Category of Area	Limit in dBA Leq.	
		Day Time	Night Time
1.	Industrial	75	70
2.	Commercial	65	55
3.	Residential	55	45
4.	Silence Zone	50	40
<b>Permissible Noise Exposure for Industrial Workers</b>			
Exposure Time (hrs./day)		Sound Pressure Level	
8		90	
4		93	
2		96	
1		99	
1/2		102	
1/4		105	
1/8		108	
1/16		111	
1/32 ( 2 minutes or less)		114	
<b>Automobile Vehicles</b>		<b>By 1992</b>	
		<b>dBA</b>	
5.	Motor Cycles, Scooters and Three Wheelers	80	
6.	Passenger Cars	82	
7.	Passenger or Commercial Vehicle upto 4 MT	85	
8.	Passenger or Commercial Vehicle of above 4 MT and upto 12 MT	89	
9.	Passenger or Commercial Vehicle exceeding 12 MT	91	

Table 1  
Flow in Kalsa Nala - m<sup>3</sup>/sec

Month	Year 1992		Year 1993		Year 1994		Year 1995		Year 1996	
	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum
June	0.229	40.829	0.873	50.843	0.604	82.551	0.004	2.050	0.020	44.89
July	0.217	87.914	0.481	25.000	2.636	95.746	2.050	35.043	0.481	42.86
August	1.226	44.890	1.199	42.857	1.770	45.580	0.860	42.857	0.653	25.412
September	0.706	4.371	0.921	3.020	0.619	13.501	0.653	64.477	0.194	1.068
October	0.447	1.039	0.664	1.194	0.653	9.217	0.653	2.874	0.194	30.156
November	0.310	0.447	0.000	0.000	0.481	2.050	0.310	1.067	0.078	0.31
December	0.217	0.310	0.000	0.000	0.079	0.481	0.043	0.310	-	-

Table 2

Flow in Surla Nala - m<sup>3</sup>/sec

Month	Year 1992		Year 1993		Year 1994		Year 1995		Year 1996	
	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum
June	0.021	19.306	0.021	16.946	0.486	44.799	0.004	2.651	0.007	26.958
July	0.849	41.031	2.490	33.729	2.921	46.816	2.651	20.524	0.443	27.668
August	2.651	27.401	1.657	26.143	1.599	2.916	0.867	24.300	1.410	19.306
September	0.809	5.239	1.016	2.699	0.867	11.351	0.619	35.283	0.443	2.176
October	0.619	1.486	0.796	1.540	1.049	7.300	0.619	2.176	0.443	18.35
November	0.206	0.549	0.000	0.000	0.619	2.651	0.164	0.867	0.165	0.618
December	0.083	0.227	0.000	0.000	0.269	0.619	0.007	0.164	-	-

Table 3

Flow in Haltar Nala - m<sup>3</sup>/sec

Month	Year 1992		Year 1993		Year 1994		Year 1995		Year 1996	
	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum
June	0.006	30.181	0.006	5.264	0.259	73.282	0.032	4.158	0.064	6.612
July	0.061	29.918	0.700	30.576	2.800	38.250	3.305	20.379	0.828	18.488
August	0.276	21.861	0.505	13.018	1.352	14.329	0.727	10.542	3.052	4.563
September	0.038	4.184	0.198	3.570	0.233	4.580	0.727	20.379	0.400	3.355
October	0.038	1.079	0.061	1.624	0.233	2.137	1.052	3.570	0.400	4.852
November	0.032	0.057	-	-	0.064	0.402	0.233	1.506	0.232	0.724
December	0.026	0.032	-	-	0.045	0.064	-	-	-	-

Note : 75% dependable yield works out to be 155 Mcum considering the nala gauging from 1991 to 1996. This combined yield includes the yield from Kalsa, Suria and Haltara nala. Potli nala gauging is yet under investigation

Table 4

## Sampling Locations Along the River Mahadayi/Mandovi in Karnataka and Goa

Sl. No.	Source	Sampling Location	Location Code
<b>Karnataka State</b>			
1.	Mahadayi	Near Kongla Village	R1
2.	Mahadayi	Kotni Dam Site	R2
<b>Goa State</b>			
3.	Mandovi	Just Starting point in Goa region near Sonali village	R3
4.	Mandovi	At Kahadki bridge in between Bhironda and Khadki villages	R4
5.	Mandovi	At Ganjem near Bondla Water Supply intake point U/S of CWC River Gauging Station	R5
6.	Mandovi	Bridge at Usgaon Pali bridge	R6
7.	Mandovi	At Kotambi Village	R6K
8.	Mandovi	At Vagus Village	R6V
9.	Mandovi	At Volvoi Village	R6A
10.	Mandovi	At Ferri crossing near Amone Village	R7
11.	Mandovi	At Old Goa area	R8
12.	Mandovi	Near Tongaon Village	R9
13.	Mandovi	U/S of Pilligaon Village	R10
14.	Mandovi	U/S of Konkan Railway Bridge near Narao village	R11
15.	Mandovi	Between Chora and Dewar Islands	R12
16.	Mandovi	In Ribander area near two concrete pillars on right bank	R13
17.	Mandovi	Before Chora Island Bifurcation	R14
18.	Mandovi	End of Mandovi river at outfall in Arabian Sea near Jetty in Goa	R15

Table 5

## Physical Characteristics of Surface Water Along River Mahadayi

Sl. No.	Parameter	pH			Temperature °C			Conductivity (µS/cm)			TSS (mg/L)			Turbidity (NTU)		
		Station	Monsoon 95	Summer 96	Post-monsoon 96	Monsoon 95	Summer 96	Post-monsoon 96	Monsoon 95	Summer 96	Post-monsoon 96	Monsoon 95	Summer 96	Post-monsoon 96	Monsoon 95	Summer 96
1.	R1	7.2	7.7	6.9	24	27	24	34	68	33	0	0	0	1	1	1
2.	R2	7.4	7.3	6.8	25	30	23	46	74	44	0	0	0	1	1	1
3.	R3	7.7	7.1	7.2	25	35	25	60	120	63	0.005	0	0	1	1	4
4.	R4	7.7	7.7	8.0	25	35	24	60	120	97	0.001	0	0	1	1	2
5.	R5	7.6	7.7	7.8	24	32	23	58	110	60	0	0	0	1	1	1
6.	R6	7.5	7.4	7.5	24	31	23	70	15600	64	0	0.001	0	1	3	1
7.	R6K	7.2	7.4	7.6	25	32	23	90	25200	80	0	0	0	2	1	1
8.	R6V	7.0	7.8	7.4	24	32	24	95	21200	85	0.001	0	0	1	2	2
9.	R6A	7.0	7.7	7.2	25	31	24	90	30000	60	0.002	0.001	0	2	3	2
10.	R7	6.6	7.3	7.4	24	32	23	480	39200	343	0	0	0.002	1	1	1
11.	R11	7.0	7.8	7.3	26	31	25	2400	46400	9280	0.076	0.001	0.002	2	2	2
12.	R13	7.0	7.8	7.8	26	31	25	12800	51200	38120	0.071	0.001	0.008	2	3	2
13.	R15	7.5	8.1	7.9	26	31	25	22000	55200	45560	0.061	0.002	0.008	2	4	2

Table 6

## Chemical Characteristics of Surface Water along River Mahadayi

Sl. No.	Location Code	R1			R2			R3			R4			R5		
		Monsoon 95	Summer 96	Post-monsoon 96	Monsoon 95	Summer 96	Post-monsoon 96	Monsoon 95	Summer 96	Post-monsoon 96	Monsoon 95	Summer 96	Post-monsoon 96	Monsoon 95	Summer 96	Post-monsoon 96
1.	T-Hardness	22	48	10	30	34	9	26	60	16	28	50	37	32	54	18
2.	Ca-Hardness	14	22	6	20	10	5	16	36	10	16	34	18	16	24	10
3.	Mg-Hardness	8	26	4	10	24	4	10	24	6	12	16	19	16	30	8
4.	Tot. Alkalinity	12	40	10	18	52	10	16	48	20	18	48	40	18	46	24
5.	DO	6.9	6.0	7.6	6.8	6.9	7.8	6.3	7.6	6.9	6.7	7.5	7.5	6.5	7.4	6.8
6.	COD	3.9	5.2	4.8	7.8	6.8	5.2	11.7	30.2	15.6	7.8	14.4	10.5	3.9	17.3	9.8
7.	Chlorides	10	14	18	14	14	20	10	18	11	12	18	12	12	18	12
8.	Salinity	0.02	0.02	0.04	0.02	0.02	0.04	0.02	0.03	0.02	0.02	0.03	0.02	0.02	0.03	0.02
9.	Phosphate	0.01	0.01	ND	ND	0.6	ND	ND	0.21	ND	ND	ND	ND	0.01	ND	ND
10.	Nitrate	0.1	0.4	0.2	0.1	0.4	0.4	0.2	0.1	0.1	0.3	0.2	0.2	0.2	0.1	0.2
11.	Potassium	0.4	1.0	0.2	0.4	1.4	0.3	0.5	1.1	0.3	0.7	1.1	0.5	0.4	1.0	0.3
12.	Sodium	3.3	4.6	2.3	0.4	7.2	3.2	4.0	4.6	2.4	4.0	5.0	2.7	4.0	5.0	3.3
13.	Sulphate	3	4	1	4.2	4	2	3	10	2	3	5	2	3	1	2
14.	Total Kjeldahl Nitrogen	0.5	0.5	0.4	0.4	0.3	0.4	0.3	0.4	0.2	0.2	0.4	0.3	0.3	0.2	0.4
15.	Langelier Index	-2.69	-1.13	-3.07	-1.96	-1.75	-3.26	-1.66	-1.45	-2.27	-1.98	-0.71	-0.92	-1.7	-1.04	-1.59

All units except salinity are in mg/L

Salinity (ppt)

Table 6 (Contd...)

Sl. No.	Location Code	R6			R6K			R6V			R6A			R7		
		Parameter	Monsoon 95	Summer 96	Post-monsoon 96	Monsoon 95	Summer 96	Post-monsoon 96	Monsoon 95	Summer 96	Post-monsoon 96	Monsoon 95	Summer 96	Post-monsoon 96	Monsoon 95	Summer 96
1.	T-Hardness	30	1480	20	32	2660	17	35	2000	18	40	2460	22	48	4120	39
2.	Ca-Hardness	14	260	12	30	400	10	30	280	10	25	460	10	20	700	16
3.	Mg-Hardness	16	1220	8	25	2260	7	20	1720	8	15	1800	12	28	3420	23
4.	Tot. Alkalinity	18	40	24	15	50	20	14	48	22	14	60	16	20	60	26
5.	DO	6.6	4.9	6.6	6.7	4.8	7.4	6.5	5.0	6.7	6.2	5.0	6.5	6.5	4.1	7.2
6.	COD	7.8	38	28	16	46	25	15	44	32	8	46	45	7.8	46	8
7.	Chlorides	14	5560	11	30	8000	17	30	6100	16	55	9150	20	80	12650	100
8.	Salinity	0.02	10.04	0.02	0.02	14.45	0.03	0.02	11.01	0.03	0.10	16.53	0.04	0.14	22.85	0.18
9.	Phosphate	ND	ND	ND	ND	ND	0.02	ND	ND	ND	ND	ND	0.05	ND	ND	0.52
10.	Nitrate	0.2	0.6	0.2	0.2	0.8	0.2	0.4	0.4	0.2	0.2	0.3	0.7	0.3	0.6	0.4
11.	Potassium	0.5	102	0.4	0.5	155	0.5	1.0	115	0.4	1.0	184	0.6	2.5	255	2.2
12.	Sodium	4.4	3240	3.7	5.0	4400	5.8	6.5	3760	5.1	6	5280	2.2	39	7260	65
13.	Sulphate	3	1283	2	5	1870	2	3	1665	3	5	2040	3	10	2883	11
14.	Total Kjeldahl Nitrogen	0.4	0.5	0.4	0.4	0.5	0.4	0.3	0.4	0.5	0.4	0.3	0.5	0.5	0.4	0.4
15.	Langelier Index	-1.97	-0.53	-1.81	-0.32	-0.24	-1.87	-0.12	-0.02	-2.03	-0.06	+0.20	-2.36	-1.97	-0.01	-1.81

All units except salinity are in mg/L  
Salinity (ppt)

Table 6 (Contd...)

Sl. No.	Location Code	R11			R13			R15		
		Monsoon 95	Summer 96	Post-monsoon 96	Monsoon 95	Summer 96	Post-monsoon 96	Monsoon 95	Summer 96	Post-monsoon 96
1.	T-Hardness	240	5200	1160	830	5800	3900	2190	6440	5400
2.	Ca-Hardness	50	800	167	180	1180	647	330	1000	705
3.	Mg-Hardness	190	4400	993	650	4620	3353	1860	5440	4695
4.	Tot. Alkalinity	30	70	32	38	84	74	42	100	86
5.	DO	6.7	6.9	6.1	6.3	6.8	4.7	5.8	6.3	3.6
6.	COD	15.7	52	4	31.3	54	28	47.1	58	36
7.	Chlorides	774	15500	2800	3500	17400	14850	6000	19500	16550
8.	Salinity	1.40	28.0	5.05	6.32	31.45	26.82	10.84	35.22	29.9
9.	Phosphate	ND	ND	0.02	ND	ND	0.02	0.01	ND	0.04
10.	Nitrate	0.3	1.0	0.4	0.3	1.0	0.7	0.5	0.9	0.8
11.	Potassium	15	300	50	98	338	235	180	378	310
12.	Sodium	375	9960	1067	1850	11400	6000	3020	10980	7200
13.	Sulphate	16	3730	350	300	3665	1950	1180	3880	2500
14.	Total Kjeldahl Nitrogen	0.5	0.4	0.3	0.4	0.4	0.3	0.4	0.5	0.3
15.	Langelier Index	-1.74	+0.62	-0.92	-1.14	+0.87	+0.55	-0.35	+1.18	+0.75

All units except salinity are in mg/L  
Salinity (ppt)

Table 7

## Heavy Metals Concentration of Surface Water Along River Mahadayi

Sl. No.	Location Code	Iron			Manganese			Lead			Cadmium		
		Monsoon 95	Summer 96	Post-monsoon 96	Monsoon 95	Summer 96	Post-monsoon 96	Monsoon 95	Summer 96	Post-monsoon 96	Monsoon 95	Summer 96	Post-monsoon 96
1.	R1	0.09	0.29	0.13	0.05	0.06	0.06	ND	0.01	ND	ND	ND	ND
2.	R2	0.21	0.11	0.30	0.02	0.01	0.05	ND	ND	ND	ND	ND	ND
3.	R3	0.20	0.19	0.13	0.06	0.10	0.03	ND	ND	ND	ND	ND	ND
4.	R4	0.16	0.12	0.18	0.05	0.06	ND	ND	ND	ND	ND	ND	ND
5.	R5	0.19	0.04	0.11	0.09	0.04	0.02	ND	ND	ND	ND	ND	ND
6.	R6	0.14	0.26	0.15	0.10	0.14	0.03	ND	0.04	ND	ND	ND	ND
7.	R6K	0.12	0.05	0.11	0.15	0.06	0.07	0.01	ND	ND	ND	ND	ND
8.	R6V	0.09	0.07	0.16	0.08	0.24	0.07	0.01	ND	ND	ND	ND	ND
9.	R6A	0.10	0.17	0.01	0.85	0.95	0.05	ND	ND	ND	ND	ND	ND
10.	R7	0.35	0.22	0.28	1.88	0.05	0.12	ND	0.01	ND	ND	ND	ND
11.	R11	0.17	0.06	0.16	0.16	0.05	0.10	ND	0.02	ND	ND	ND	ND
12.	R13	0.33	0.28	0.25	0.14	0.02	0.06	ND	ND	ND	ND	ND	ND
13.	R15	0.33	0.14	0.13	0.11	0.02	0.03	0.018	0.01	0.01	ND	ND	ND

All units are in mg/L  
 ND : Not Detectable

Table 7 (Contd...)

Sl. No.	Location Code	Zinc			Copper			Nickel		
		Monsoon 95	Summer 96	Post-monsoon 96	Monsoon 95	Summer 96	Post-monsoon 96	Monsoon 95	Summer 96	Post-monsoon 96
1.	R1	ND	0.01	0.05	ND	ND	ND	ND	0.02	ND
2.	R2	ND	ND	0.37	ND	ND	ND	ND	0.02	ND
3.	R3	ND	0.03	0.06	ND	ND	ND	ND	ND	ND
4.	R4	ND	ND	0.10	ND	ND	ND	ND	0.01	0.01
5.	R5	ND	ND	0.09	ND	ND	ND	ND	ND	0.02
6.	R6	0.01	0.02	0.10	ND	ND	ND	ND	0.03	0.03
7.	R6K	0.02	0.02	0.03	ND	ND	ND	0.01	0.02	0.01
8.	R6V	0.02	0.04	0.11	ND	ND	ND	ND	0.01	0.02
9.	R6A	0.04	ND	0.06	ND	ND	ND	0.01	0.02	ND
10.	R7	0.06	0.06	0.05	ND	ND	ND	ND	0.03	ND
11.	R11	0.01	0.09	0.09	ND	ND	ND	0.01	0.03	0.01
12.	R13	0.01	0.02	0.07	ND	ND	ND	ND	0.04	ND
13.	R15	0.02	0.01	0.04	ND	ND	ND	0.01	0.04	0.02

All units are in mg/L  
 ND : Not Detectable

Table 8

**Ground Water Sampling Locations Along the River Mahadayi/Mandovi  
in Karnataka and Goa**

Sl. No.	Source	Sampling Location	Location Code
<b>Karnataka State</b>			
1.	Hand Pump	Village Chapoli near Vidya Mandir	G1
2.	Open Well	Village Talewadi (Near Pansheer Nala)	G2
<b>Goa State</b>			
3.	Open Well	Near Sonali Bus Stop in front of Naik's house	G3
4.	Open Well	Near Bhironda Village Bus Stand	G4
5.	Bore Well	At Ganjem near Bondla Water Supply Intake Point U/S of CWC River Gauging Station	G5
6.	Open Well	Usgaon Pali Village	G6
7.	Open Well	Amone Village	G7

Table 9

## Physical Characteristics of Ground Water Along River Mahadayl

Sl. No.	Parameter Location Code	pH			Temperature °C			Conductivity (μS/cm)			TSS (mg/L)			Turbidity (NTU)		
		Monsoon 95	Summer 96	Post-monsoon 96	Monsoon 95	Summer 96	Post-monsoon 96	Monsoon 95	Summer 96	Post-monsoon 96	Monsoon 95	Summer 96	Post-monsoon 96	Monsoon 95	Summer 96	Post-monsoon 96
1.	G1	6.7	7.2	7.9	26	27	24	230	280	302	ND	0.001	ND	2	2	3
2.	G2	6.2	5.6	7.8	24	27	25	38	34	32	ND	ND	0.001	1	1	2
3.	G3	6.1	5.9	5.7	24	35	24	50	68	53	0.001	ND	ND	1	1	1
4.	G4	6.4	6.2	7.2	25	32	25	140	155	135	0.002	0.001	0.002	1	2	2
5.	G5	7.8	7.6	8.5	26	30	24	260	888	280	0.001	ND	0.001	1	1	2
6.	G6	6.2	6.0	7.0	25	32	25	240	720	226	0.001	ND	ND	1	1	1
7.	G7	6.6	5.8	8.0	24	30	24	480	1500	674	ND	ND	ND	1	1	1

Table 10

## Chemical Characteristics of Ground Water Along River Mahadayi

Sl. No.	Location Code	G1			G2		G3			G4
		Monsoon 95	Summer 96	Post-monsoon 96	Monsoon 95	Summer 96	Monsoon 95	Summer 96	Post-monsoon 96	Monsoon 95
1.	T-Hardness	110	146	120	32	10	26	20	12	34
2.	Ca-Hardness	60	90	80	18	4	10	14	8	20
3.	Mg-Hardness	50	156	40	14	6	16	6	4	14
4.	Tot. Alkalinity	110	120	126	14	8	14	10	10	20
5.	DO	6.8	6.4	6.5	6.9	5.8	6.5	6.5	6.7	6.5
6.	COD	9.6	5.6	ND	2.5	1.2	ND	2.2	ND	4.5
7.	Chlorides	10	22	26	14	8	14	14	14	24
8.	Salinity	0.02	0.04	0.05	0.02	0.02	0.02	0.02	0.02	0.04
9.	Phosphate	ND	0.03	ND	ND	ND	ND	ND	ND	ND
10.	Nitrate	0.2	0.3	0.3	0.3	0.1	0.3	0.4	0.5	0.5
11.	Potassium	0.6	1.0	0.6	0.3	0.4	2.5	3.0	2.0	3.3
12.	Sodium	11	16.5	10	2.8	2.3	4.3	6.0	2.7	8
13.	Sulphate	6	6	3	2	4	4	7	2	3
14.	Langelier Index	-1.26	-0.59	-0.92	-3.34	-1.13	-3.55	-3.72	-4.16	-2.75

All units except salinity are in mg/L

Salinity (ppt)

ND : Not Detectable

Table 10 (Contd...)

Sl. No.	Location Code	G5			G6			G7		
		Monsoon 95	Summer 96	Post-monsoon 96	Monsoon 95	Summer 96	Post-monsoon 96	Monsoon 95	Summer 96	Post-monsoon 96
1.	T-Hardness	130	132	117	50	100	40	64	200	106
2.	Ca-Hardness	54	76	62	30	26	22	34	84	60
3.	Mg-Hardness	76	56	55	20	74	18	30	116	46
4.	Tot. Alkalinity	120	116	122	18	28	24	20	14	52
5.	DO	6.5	6.4	6.6	6.6	5.5	6.8	6.4	5.8	6.5
6.	COD	7.2	4.5	ND	5.9	4.5	ND	8.5	6.5	4
7.	Chlorides	14	16	13	50	45	36	116	556	166
8.	Salinity	0.02	0.03	0.02	0.09	0.08	0.07	0.21	1.0	0.3
9.	Phosphate	0.03	0.07	ND	ND	0.09	ND	ND	0.02	0.05
10.	Nitrate	0.3	0.1	0.1	6	4	5	2.6	3.2	4.2
11.	Potassium	0.7	0.6	0.6	11.4	7.6	8.5	9.4	13.2	8
12.	Sodium	10	8.2	7.7	23	19.4	17	64	243	65
13.	Sulphate	3	9	3	10	13	11	34	108	36
14.	Langelier Index	-0.35	-0.28	+0.56	-2.83	-2.95	-2.10	-2.35	-3.03	-0.37

All units except salinity are in mg/L

Salinity (ppt)

ND : Not Detectable

Table 11

## Heavy Metals Concentration in Ground Water Along River Mahadayi

Sl. No.	Parameter Location Code	Iron			Manganese			Lead			Cadmium		
		Monsoon 95	Summer 96	Post-monsoon 96	Monsoon 95	Summer 96	Post-monsoon 96	Monsoon 95	Summer 96	Post-monsoon 96	Monsoon 95	Summer 96	Post-monsoon 96
1.	G1	1.05	1.23	1.09	0.10	0.05	0.19	ND	ND	ND	ND	ND	ND
2.	G2	0.07	0.07	0.05	0.03	0.35	0.02	ND	ND	ND	ND	ND	ND
3.	G3	0.03	0.03	0.06	0.02	0.20	ND	ND	ND	ND	ND	ND	ND
4.	G4	0.08	0.04	0.05	0.03	0.03	0.02	ND	0.01	ND	ND	ND	ND
5.	G5	0.67	0.38	0.54	0.07	0.03	0.03	ND	0.01	ND	ND	ND	ND
6.	G6	0.02	0.07	0.04	0.03	0.05	0.02	ND	0.02	ND	ND	ND	ND
7.	G7	0.05	ND	0.05	0.03	0.03	0.01	ND	ND	ND	ND	ND	ND

All units are in mg/L  
 ND : Not Detectable

Table 11 (Contd...)

Sl. No.	Parameter	Zinc			Copper			Nickel		
		Location Code	Monsoon 95	Summer 96	Post-monsoon 96	Monsoon 95	Summer 96	Post-monsoon 96	Monsoon 95	Summer 96
1.	G1	ND	0.08	0.10	ND	ND	ND	ND	0.01	ND
2.	G2	0.07	0.05	0.10	ND	ND	ND	0.02	ND	ND
3.	G3	ND	ND	0.05	ND	ND	ND	ND	0.03	ND
4.	G4	0.01	0.04	0.03	ND	ND	ND	ND	0.01	0.01
5.	G5	0.17	0.03	0.29	ND	ND	ND	ND	0.03	0.01
6.	G6	ND	ND	0.04	ND	ND	ND	ND	0.01	0.01
7.	G7	0.01	0.06	0.08	ND	ND	ND	ND	ND	0.004

All units are in mg/L  
 ND : Not Detectable

Table 12

## Sampling Location in Tributaries (Karnataka)

Sl. No.	Sampling Location	Location Code
1.	Pansheer Nala	T1
2.	Bail Nadi	T2
3.	Kalsa Nala	T3
4.	Surla Nala	T4
5.	Haltar Nala	T5
6.	Andher Nala	T6
7.	Mahadayi Nala near Tail Race Dam	T7

Table 13

## Physical Characteristics of Water in Tributaries of River Mahadayi

Sl. No.	Parameter Location Code	pH			Temperature °C			Conductivity (µS/cm)			TSS (mg/L)			Turbidity (NTU)		
		Monsoon 95	Summer 96	Post-monsoon 96	Monsoon 95	Summer 96	Post-monsoon 96	Monsoon 95	Summer 96	Post-monsoon 96	Monsoon 95	Summer 96	Post-monsoon 96	Monsoon 95	Summer 96	Post-monsoon 96
1.	T1	7.2	7.5	7.4	25	27	25	28	170	95	ND	ND	0.001	2	1	2
2.	T2	8.2	7.6	6.8	24	29	25	34	45	39	ND	0.001	ND	2	2	1
3.	T3	8.3	6.8	6.3	25	33	24	60	120	30	ND	ND	0.005	1	2	3
4.	T4	8.3	8.2	8.5	25	32	23	96	120	56	ND	ND	0.007	1	1	4
5.	T5	8.3	6.2	6.5	24	30	24	96	65	29	0.007	0.001	0.007	2	6	5
6.	T6	7.1	7.2	6.8	24	30	24	26	48	32	0.002	ND	ND	2	2	1
7.	T7	6.9	6.0	7.3	25	31	23	85	100	50	ND	ND	ND	2	1	1

Table 14

## Chemical Characteristics of Water in Tributaries of River Mahadayi

Sl. No.	Location Code	T1		T2		T3			T4	
		Monsoon 95	Summer 96	Monsoon 95	Post-monsoon 96	Monsoon 95	Summer 96	Post-monsoon 96	Monsoon 95	Post-monsoon 96
1.	T-Hardness	12	22	16	12	38	36	9	22	26
2.	Ca-Hardness	12	12	12	8	22	22	5	18	14
3.	Mg-Hardness	0	10	4	4	16	14	4	4	12
4.	Tot. Alkalinity	10	20	12	10	24	30	8	22	22
5.	DO	7.1	7.3	6.9	7.2	7.4	6.8	7.4	6.6	7.1
6.	COD	ND	1.2	2.4	ND	3.5	2.5	ND	5.2	ND
7.	Chlorides	12	20	12	14	12	36	20	10	14
8.	Salinity	0.02	0.04	0.02	0.02	0.02	0.07	0.04	0.02	0.02
9.	Phosphate	ND	ND	ND	ND	ND	0.01	ND	ND	ND
10.	Nitrate	0.1	0.2	0.1	0.1	0.3	0.7	0.2	0.3	0.2
11.	Potassium	0.2	0.4	0.2	0.1	0.5	1.9	0.2	0.2	0.1
12.	Sodium	2.3	4.0	3	2.5	2.8	6.0	2.3	3.6	2.0
13.	Sulphate	3	5	2	2	2	6	1	2	1
14.	Langelier Index	-2.69	-1.92	-1.62	-3.05	-0.67	-2.17	-3.85	-0.89	-0.78

All units except salinity are in mg/L

Salinity (ppt)

ND : Not Detectable

## Annexure 4.4 (Contd...)

Table 14 (Contd...)

Sl. No.	Location Code	T5			T6	T7	
		Monsoon 95	Summer 96	Post-monsoon 96	Monsoon 95	Summer 96	Post-monsoon 96
1.	T-Hardness	52	20	8	10	58	14
2.	Ca-Hardness	40	12	4	8	28	10
3.	Mg-Hardness	12	8	4	2	30	4
4.	Tot. Alkalinity	30	22	12	4	48	16
5.	DO	6.4	5.3	7.2	6.4	7.6	7.4
6.	COD	6.2	4.5	3.2	4.6	5.2	4.2
7.	Chlorides	20	16	16	8	16	12
8.	Salinity	0.04	0.03	0.03	0.02	0.03	0.02
9.	Phosphate	ND	0.07	ND	ND	ND	0.03
10.	Nitrate	0.3	0.6	0.1	0.2	0.2	0.4
11.	Potassium	0.1	0.8	0.1	0.1	0.3	0.3
12.	Sodium	3.0	6.2	2.1	2.5	4.0	3.5
13.	Sulphate	2	5	1	3	2	3
14.	Langelier Index	-0.34	-3.15	-3.57	-3.26	-2.65	-2.26

All units except salinity are in mg/L

Salinity (ppt)

ND : Not Detectable

Table 15

## Heavy Metals Concentration in Water from Tributaries of River Mahadayi

Sl. No.	Parameter Location Code	Iron			Manganese			Lead			Cadmium		
		Monsoon 95	Summer 96	Post-monsoon 96	Monsoon 95	Summer 96	Post-monsoon 96	Monsoon 95	Summer 96	Post-monsoon 96	Monsoon 95	Summer 96	Post-monsoon 96
1.	T1	0.12	0.13	0.12	0.20	0.02	0.05	ND	ND	ND	ND	ND	ND
2.	T2	0.05	0.05	0.06	0.01	0.02	0.045	ND	ND	ND	ND	ND	ND
3.	T3	0.05	0.39	0.03	ND	0.14	0.010	ND	ND	ND	ND	ND	ND
4.	T4	0.14	0.12	0.11	0.02	0.03	0.027	ND	ND	ND	ND	ND	ND
5.	T5	0.13	0.58	0.13	0.01	0.12	0.021	ND	ND	ND	ND	ND	ND
6.	T6	0.05	0.32	0.11	0.02	0.02	0.01	ND	ND	ND	ND	ND	ND
7.	T7	0.10	0.07	0.19	0.05	0.13	0.144	ND	0.02	ND	ND	ND	ND

All units are in mg/L  
 ND : Not Detectable

Table 15 (Contd...)

Sl. No.	Parameter Location Code	Zinc			Copper			Nickel		
		Monsoon 95	Summer 96	Post-monsoon 96	Monsoon 95	Summer 96	Post-monsoon 96	Monsoon 95	Summer 96	Post-monsoon 96
1.	T1	ND	0.05	0.02	ND	ND	-	0.03	ND	0.01
2.	T2	ND	0.15	0.208	ND	ND	ND	ND	0.02	0.013
3.	T3	ND	0.01	0.079	ND	ND	ND	ND	0.02	ND
4.	T4	0.02	0.01	0.053	ND	ND	ND	ND	0.01	ND
5.	T5	0.02	ND	0.056	ND	ND	ND	ND	ND	ND
6.	T6	ND	ND	ND	ND	ND	-	ND	0.02	0.01
7.	T7	0.05	ND	0.027	ND	ND	ND	0.01	0.02	ND

All units are in mg/L  
 ND : Not Detectable

Table 16

## Bacteriological Quality of Surface and Ground Water Along the River Mahadayi

Location Code	Monsoon 95		Summer 96		Post-monsoon 96	
	Total Coliforms	Faecal Coliforms	Total Coliforms	Faecal Coliforms	Total Coliforms	Faecal Coliforms
<b>Surface Water Samples from River Mahadayi</b>						
R1	2400	8	670	180	4140	1300
R2	766	66	540	132	600	122
R3	14000	94	580	85	1000	235
R4	3500	28	630	28	7650	2060
R5	10300	580	920	62	1450	730
R6	8350	225	800	206	2700	1980
R6K	925	85	630	80	3570	2000
R6V	3550	98	1300	390	16600	12000
R6A	360	125	1000	220	1860	336
R7	7850	140	2100	320	4300	1420
R11	1050	37	5032	2120	1740000	13800
R13	4900	94	2010	980	2680000	10000
R15	3200	34	1200	168	6800	1180
<b>Surface Water Samples from Tributaries</b>						
T1	3700	314	1620	996	-	-
T2	-	-	1300	34	710	208
T3	700	34	-	-	5620	2520
T4	21000	194	276000	33000	1413	152
T5	4300	78	-	-	1500	43
T6	10100	160	-	-	-	-
T7	-	-	103000	5920	-	-
<b>Ground Water Samples</b>						
G1	10	0	0	0	350	36
G2	2330	90	660	193	-	-
G3	6300	73	-	-	20600	4120
G4	8000	149	-	-	-	-
G5	3000	2	110	22	6200	960
G6	12750	786	390	168	5900	2800
G7	8000	1640	410	86	16000	3900

All units are expressed in CFU/100 mL

Table 17

## Heavy Metal Analysis of Sand Samples from Volvoi and Usagaon Pali

Sl. No.	Sampling Location	Heavy Metals, mg/kg of Sand							
		Fe	Mn	Zn	Cr	Cu	Pb	Cd	Ni
1.	Volvoi	10425	748.5	34.60	133.35	10.55	4.45	0.35	13.65
2.	Usagaon Pali	9530	971.95	11.95	141.7	15.65	5.35	0.30	15.70

Table 18

## Pesticides Concentration in Water and Bottom Sediments in Mahadayi River at Selected Sampling Locations (October 1995)

Sl. No.	Location Code	River Water Samples			Bottom Sediments		
		DDT ( $\mu\text{g/L}$ )	BHC ( $\mu\text{g/L}$ )	Endosulfan ( $\mu\text{g/L}$ )	DDT ( $\mu\text{g/L}$ )	BHC ( $\mu\text{g/L}$ )	Endosulfan ( $\mu\text{g/L}$ )
1.	R4	0.04	0.05	ND	20	10	ND
2.	R6	ND	0.04	ND	35	26	ND
3.	R8	ND	0.07	ND	38	28	ND
4.	R10	0.04	0.07	ND	32	30	ND

ND : Not Detectable

**Table 1**  
**Land Use Pattern in Mahadayi Basin**

Category	Area (ha.)	Percent of Basin Area
Total geographical area	203200	100.0
Forest area	74383	36.6
Land put to non-agricultural use	8264	4.1
Barren and unculturable land	9448	4.6
Culturable waste including fallow land	39993	19.7
Permanent pastures and other grazing land	1252	0.6
Land under miscellaneous trees and crops	582	0.3
Gross area sown:	71815	35.3
Net area sown	69278	34.1
Area sown more than once	2537	1.2

Table 2

## Land Use Pattern in Different Villages of the Study Area, Karnataka (1981)

Sl. No	Name of Village	Land Use Pattern, Hectares					
		Total Area	Forest	Agriculture		Wasteland	
				Irrigated	Unirrigated	Culturable	Unculturable
1.	Kapoli K.G.	1171.67	784.67	10.02	202.75	137.26	36.97
2.	Kapoli K.C.	755.22	612.25	-	49.00	83.74	10.23
3.	Kirvale	999.46	848.02	4.86	57.45	62.99	26.14
4.	Deogaon	666.55	612.34	-	11.41	23.31	19.49
5.	Holada	1252.55	1149.49	2.23	14.27	55.24	31.32
6.	Gawali	5309.61	4397.25	3.17	57.06	758.24	93.89
7.	Jamagaon	1481.30	1373.62	33.36	22.24	48.95	3.13
8.	Pastoli	692.62	626.69	22.36	15.52	14.56	13.49
9.	Kongale	1249.89	1151.41	18.34	14.29	52.20	13.65
10.	Nerse	1987.04	1647.41	26.47	109.33	177.09	26.74
11.	Kabanali	927.17	825.34	8.20	14.59	61.15	17.89
12.	Mugawade	1153.94	982.75	1.21	59.11	90.77	20.10
13.	Chapoli	889.50	646.62	-	26.39	200.09	16.40
14.	Amagoan	3410.26	3090.86	-	22.93	241.59	54.88
15.	Kanjale	316.28	146.59	13.89	37.39	108.82	9.59
16.	Kavale	533.26	-	-	21.58	498.32	13.36
17.	Jamboti	296.22	187.50	2.93	71.00	29.58	5.21
18.	Chikkle	2275.15	2167.81	-	80.11	12.14	15.09
<b>Total</b>		<b>25367.69</b>	<b>21250.62</b>	<b>147.04</b>	<b>886.42</b>	<b>2656.04</b>	<b>427.57</b>

Source : Census Report (1981)

Table 3

## Land Use Pattern in Different Villages of the Study Area, Karnataka (1991)

Sl. No.	Name of Village	Land Use Pattern, Hectares					
		Total Area	Forest	Agriculture		Wasteland	
				Irrigated	Unirrigated	Culturable	Unculturable
1.	Kapoli K.G.	1171.67	784.67	10.02	202.75	137.26	36.97
2.	Kapoli K.C.	755.22	612.74	-	113.78	29.00	19.00
3.	Kirvale	961.25	20.91	14.03	299.00	190.00	66.28
4.	Deogaon	658.89	603.63	3.00	24.99	1.76	-
5.	Holada	1238.00	1136.14	-	70.53	-	-
6.	Gawali	5247.95	4346.18	3.64	499.27	-	-
7.	Jamagaon	1464.10	1363.58	28.30	60.48	2.70	-
8.	Pastoli	684.58	619.41	-	42.19	-	-
9.	Kongala	1235.37	1162.15	7.35	44.24	-	-
10.	Nerse	1963.96	1267.78	78.19	238.81	11.53	-
11.	Kabnali	927.17	826.83	-	82.38	62.00	20.00
12.	Mugawade	1155.94	982.75	-	151.09	60.00	12.00
13.	Chapoli	889.50	646.62	-	26.39	200.09	16.40
14.	Amagoan	3370.61	3054.96	0.40	177.89	212.37	3158.02
15.	Kanjale	316.49	146.59	-	160.11	31.00	21.00
16.	Kavale	533.26	-	-	21.58	498.32	13.36
17.	Jamboti	296.22	187.50	2.93	71.00	29.58	5.21
18.	Chikkle	2249.22	2142.63	-	95.28	4.98	6.33
<b>Total</b>		<b>25119.40</b>	<b>18418.07</b>	<b>147.86</b>	<b>2081.76</b>	<b>1400.59</b>	<b>3071.12</b>

Source : Census Report (1991)

Table 4

## Major Soils in the Study Area of Karnataka

Sl. No.	Soil Type	Description
1.	Kanhaplic Rhodustalfs	Moderately deep, well drained, gravelly clay soils on elongated ridges, with severe erosion
2.	Kanhaplic Haplustalfs	Deep, well drained, clayey soils with medium AWC on elongated ridges with moderate erosion
3.	Typic Kandustalfs	Very deep, well drained, gravelly clay soils, strongly gravelly in the subsoil on steeply sloping high hill ranges, with moderate erosion
4.	Ustoxic Dystrypepts	Deep, well drained, gravelly clay soils with low AWC on high hill ranges, with moderate erosion
5.	Typic Kanhaplustalfs	Deep, well drained, clayey soils on dissected hills and valleys, with moderate erosion
6.	Typic Ustropepts (Clayey-skeletal, mixed)	Shallow, well drained, gravelly clay soils with very low AWC. strongly gravelly in sub soils on undulating interfluves
7.	Typic Ustropepts (Fine, mixed)	Moderately deep, well drained, clayey soils on rolling lands, with slight erosion
8.	Ustic Kandihumults	Very deep, well drained, gravelly clay soils with low AWC on steeply sloping high hill ranges
9.	Ustic Haplohumults	Very deep, well drained, gravelly clay soils with low AWC on low hill ranges, with moderate erosion
10.	Kandic Paleustalfs	Deep, well drained, gravelly clay soils on slopes of steeply sloping high hill ranges, with moderate erosion
11.	Typic Rhodustalfs	Moderately shallow, well drained, gravelly clay soils with very low AWC on undulating interfluves, with moderate erosion
12.	Typic Chromusterts	Very deep, moderately well drained, cracking clay soils of valleys, with moderate erosion
13.	Rhodic Paleustalfs	Deep, well drained, clayey soils with medium AWC on elongated ridges, with slight erosion
14.	Ustic Palehumults	Very deep, well drained, clayey soils with medium AWC on isolated hills, with moderate erosion

Table 5

## Soil Depth Classification in the Study Area - Karnataka

Sl. No.	Soil Depth Classification	Depth (cm)	Area	
			Hectares	Percentage
1.	Shallow	0-50	620	0.3
2.	Moderately shallow	50-75	556	2.4
3.	Moderately deep	75-100	61088	25.9
4.	Deep	100-150	126119	53.4
5.	Very deep	>150	40095	17.0

Table 6

## Soil Texture Classification in the Study Area - Karnataka

Sl. No.	Soil Texture	Area	
		Hectares	Percentage
1.	Loam	15582	6.61
2.	Loamy clay	16776	7.12
3.	Clay	83563	35.42
4.	Clay loam	117566	49.82

Table 7

## Soil Erosion Pattern in the Study Area - Karnataka

Sl. No.	Soil Erosion Class	Area	
		Hectares	Percentage
1.	Slight	49710	21.1
2.	Moderate	164206	69.6
3.	Severe	21984	9.3

Table 8

## Physical Properties of Soils in the Study Area, Karnataka

Sl. No	Name of Village	Soil Depth cm	Particle Size Distribution (%)				Textural Class	Bulk Density g/cm <sup>3</sup>	Max. WHC %	Hydraulic Conductivity mm/hr
			Coarse Sand	Fine Sand	Silt	Clay				
1.	Nerse	0-30	45.0	23.5	10.2	21.3	Sandy Clay Loam	1.6	18.5	120
		30-60	34.8	23.0	4.9	37.3	Sandy Clay	1.5	22.3	80
2.	Kawale	0-30	34.0	17.7	10.3	38.0	Sandy Clay	1.5	22.6	86
		30-60	27.0	18.7	10.4	43.9	Sandy Clay	1.4	24.5	90
3.	Kongla	0-30	26.9	18.2	12.4	42.0	Sandy Clay	1.4	21.2	94
		30-60	26.4	16.8	13.5	43.3	Sandy Clay	1.4	24.0	96
4.	Gawali	0-30	33.0	1.0	13.0	43.0	Sandy Clay	1.4	23.8	84
		30-60	31.0	11.5	10.5	47.0	Sandy Clay	1.3	25.3	82
5.	Jamboti	0-30	32.6	16.9	13.0	37.5	Sandy Clay	1.5	26.2	90
		30-60	32.1	15.5	9.7	42.7	Sandy Clay	1.4	27.5	86
6.	Kapoli	0-30	30.0	13.4	12.0	44.3	Sandy Clay	1.4	27.9	78
		30-60	28.0	13.6	13.4	45.0	Sandy Clay Loam	1.4	28.2	115
7.	Kirvale	0-30	57.00	9.0	13.0	21.0	Sandy Clay	1.6	17.6	110
		30-60	61.01	6.8	9.5	22.7	Sandy Clay Loam	1.6	19.2	96
8.	Chapoli	0-30	55.9	11.2	12.8	20.1	Sandy Clay	1.6	16.8	72
		30-60	61.8	8.6	9.8	19.8	Sandy Clay Loam	1.6	17.2	86
9.	Kalsa Dam	0-30	11.6	13.8	36.2	38.4	Clay Loam	1.3	29.4	14
		30-60	6.8	18.2	36.8	38.2	Clay Loam	1.2	26.2	12
10	Haltar Dam	0-30	11.2	14.2	36.8	37.8	Clay Loam	1.2	24.6	13
		30-60	8.2	18.8	34.8	38.2	Clay Loam	1.2	26.4	12

WHC : Water Holding Capacity

Table 9

**Water Soluble Cations and Anions in Saturation Extract of Soils  
in the Study Area, Karnataka**

Sl. No.	Name of Village	Soil Depth cm	pH	ECe mS/cm	Saturation Extract (meq/100 g)				
					Na	K	Ca	Mg	Cl
1.	Nerse	0-30	5.9	0.25	0.03	0.02	2.1	0.7	1.4
		30-60	5.9	0.27	0.03	0.01	2.1	0.6	1.3
2.	Kawale	0-30	6.0	0.30	0.04	0.02	2.2	0.7	1.2
		30-60	6.1	0.29	0.04	0.01	2.2	0.7	1.0
3.	Kongla	0-30	6.1	0.24	0.03	0.01	1.8	0.8	1.6
		30-60	6.2	0.25	0.02	0.02	1.8	0.8	1.5
4.	Gawali	0-30	5.3	0.18	0.04	0.01	1.2	0.5	1.2
		30-60	5.7	0.16	0.05	0.01	1.3	0.6	1.1
5.	Jamboti	0-30	5.9	0.13	0.02	0.01	1.4	0.3	0.9
		30-60	5.9	0.12	0.03	0.02	1.4	0.8	11.5
6.	Kapoli	0-30	5.7	0.17	0.03	0.01	1.3	0.3	0.7
		30-60	6.1	0.12	0.03	0.02	1.6	0.8	0.8
7.	Kilwale	0-30	6.2	0.16	0.04	0.01	1.8	0.8	0.6
		30-60	6.3	0.14	0.02	0.01	1.9	0.8	0.9
8.	Chapoli	0-30	6.5	0.20	0.04	0.01	1.8	0.7	1.1
		30-60	6.4	0.23	0.03	0.02	1.8	0.6	1.2
9.	Khalsa Dam	0-30	5.4	0.24	0.03	0.02	1.9	0.3	1.5
		30-60	5.8	0.22	0.02	0.02	1.8	0.7	1.3
10.	Haltar Dam	0-30	5.4	0.26	0.04	0.03	1.9	0.7	1.6
		30-60	5.7	0.24	0.03	0.02	1.9	0.5	1.4

ECe : Electrical Conductivity

Table 10

## Chemical Properties of Soils in the Study Area, Karnataka

Sl No.	Name of Village	Depth cm	Organic Carbon %	Total (%)			Exchangeable Cations (meq/100g)				
				N	P	K	CEC	Ca	Mg	Na	K
1.	Nerse	0-30	0.72	0.072	0.80	1.16	5.8	2.4	1.6	0.01	0.10
		30-60	0.66	0.094	0.046	1.02	11.5	6.2	2.2	0.10	0.10
2.	Kalwale	0-30	0.56	0.087	0.072	0.94	12.2	6.5	2.4	0.10	0.11
		30-60	0.35	0.062	0.052	0.97	12.3	6.6	2.2	0.10	0.10
3.	Kongla	0-30	0.63	0.052	0.041	0.92	11.2	6.4	2.2	0.13	0.10
		30-60	0.36	0.042	0.036	1.96	10.8	5.6	2.4	0.10	0.10
4.	Gawali	0-30	0.71	0.066	0.078	1.03	10.5	5.6	2.5	0.09	0.10
		30-60	0.35	0.046	0.032	1.18	12.8	6.8	2.8	0.14	0.22
5.	Jamboti	0-30	0.78	0.087	0.086	1.04	6.8	3.0	1.4	0.15	0.13
		30-60	0.35	0.042	0.052	1.08	12.6	6.8	1.6	0.11	0.20
6.	Kapoli	0-30	0.56	0.085	0.071	0.96	12.6	6.8	2.8	0.14	0.21
		30-60	0.21	0.036	0.038	0.98	13.0	7.8	2.2	0.12	0.18
7.	Kirwale	0-30	0.42	0.062	0.056	0.94	7.4	3.6	1.4	0.10	0.15
		30-60	0.36	0.048	0.024	0.94	9.8	5.0	2.0	0.12	0.18
8.	Chapoli	0-30	0.58	0.068	0.056	0.94	13.6	6.4	2.3	0.18	0.24
		30-60	0.32	0.042	0.035	1.08	12.8	7.2	2.8	0.17	0.26
9.	Khalsa Dam	0-30	0.52	0.041	0.035	0.72	20.8	15.7	3.2	0.56	0.14
		30-60	0.42	0.036	0.021	0.80	20.2	15.2	3.8	0.52	0.18
10.	Haltar Dam	0-30	0.46	0.039	0.034	0.64	18.6	13.6	3.7	0.46	0.16
		30-60	0.34	0.028	0.022	0.76	19.0	14.1	3.2	0.57	0.15

Annexure 4.5 (Contd...)

Table 11

Land Capability Classification of Soils in the Study Area - Karnataka

Sl. No.	Land Capability Classification	Area	
		Hectares	Percentage
1.	Good land for agriculture	27488	11.65
2.	Moderately good land for agriculture	25068	10.62
3.	Marginally good land for agriculture	69263	29.35
4.	Good land for forestry for pasture	111667	47.32

Table 12

Land Irrigability Classification of Soils in the Study Area - Karnataka

Sl. No.	Land Irrigability Classification	Area	
		Hectares	Percentage
1.	Severe limitation of soil & topography	5563	2.35
2.	Severe to moderate limitation of soil	13745	5.82
3.	Very severe limitation of soil	13745	5.83
4.	Very severe limitation of topography	25068	10.63
5.	Very severe limitation of soil & topography	44953	19.05
6.	Not suitable due to limitation of topography	130414	55.25

Table 13

## Land Use Pattern in the Study Area in Goa (1981)

Name of Block/Village	Land Use Pattern (Hectares)				
	Area of Village Ha	Forest	Agriculture	Wasteland	
				Culturable	Unculturable
<b>Tiswadi</b>					
Navelim	581.12	-	367.15	5.47	208.50
Chorao	2022.83	-	967.16	106.62	949.05
Ella	932.87	-	540.95	25.61	366.31
Narao	128.44	-	66.73	10.07	51.64
<b>Bicholi</b>					
Narao	724.03	-	650.36	12.57	61.10
Amone	675.95	-	428.28	48.00	199.67
Navelia	1050.20	-	710.07	120.82	219.31
<b>Ponda</b>					
Candola	494.63	-	413.18	21.79	59.66
Betqui	597.11	-	296.53	130.78	169.80
Savoivarem	904.62	-	602.99	111.03	190.60
Candepor	1148.92	491.97	539.85	30.07	87.03
Codar	909.62	358.09	409.10	78.31	64.12
Ganjem	655.72	419.37	38.29	37.86	160.20
<b>Satari</b>					
Biraondem	222.06	0.52	196.47	6.01	19.06
Nanus	248.02	-	88.53	79.02	80.47
Sonal	306.91	-	128.93	81.55	96.43
<b>Bardez</b>					
Pileme	672.49	-	416.06	63.58	192.85
<b>Total</b>	<b>12275.54</b>	<b>1269.95</b>	<b>6860.63</b>	<b>969.16</b>	<b>3175.80</b>

Source : Census Report, 1981

**Table 14**  
**Land Use Pattern in the Study Area at Goa (1991)**

Name of Block/Village	Land Use Pattern, Hectares					
	Area of Village Ha	Forest	Agriculture		Wasteland	
			Irrigated	Unirrigated	Culturable	Unculturable
<b>Tiswadi</b>						
Navelim	694.71	-	-	355.33	22.13	317.25
Chorao	1980.21	-	22.08	912.11	134.84	911.18
Ella	800.54	-	7.89	468.71	22.61	301.33
Naraoa	139.17	-		74.42	7.02	57.73
<b>Bicholi</b>						
Naraoa	800.68	-	63.31	467.54	30.25	239.58
Amone	734.06	-	6.86	362.06	70.65	294.49
Navelia	1088.73	-	73.83	428.25	142.48	444.17
<b>Ponda</b>						
Candola	851.79	-	16.30	303.04	63.32	469.13
Betqui	628.71	-	71.83	235.78	100.64	220.46
Savoivarem	928.62	-	114.58	435.62	134.85	243.57
Candepor	1110.55	491.93	73.66	428.12	36.83	80.01
Codar	972.28	90.50	11.57	307.00	292.71	270.50
Ganjem	541.05	419.38	1.16	50.94	54.25	15.32
<b>Satari</b>						
Biraondem	222.06	0.52	83.20	113.27	6.01	19.06
Nanus	248.02	-	29.85	58.68	79.02	80.47
Sonal	306.91	-	19.84	111.80	147.69	27.58
<b>Bardez</b>						
Pilerne	653.96	-	12.62	327.52	156.22	157.60
<b>Total</b>	<b>12702.0</b>	<b>1002.3</b>	<b>608.5</b>	<b>5440.1</b>	<b>1501.5</b>	<b>4149.4</b>

Source : Census Report, 1991

Table 15

## Cropping Pattern in the Study Area - Goa

Sl No.	Crop Grown	Area (within 1000 m)		Area (within 10000 m)	
		Hectares	Percentage	Hectares	Percentage
1.	Coconut	753	8.57	29544	14.62
2.	Rice	3757	42.78	50615	25.06
3.	Cashew	2463	28.04	77776	38.50
4.	Cashew-coconut	1809	20.59	44073	21.82

Table 16

## Description of Different Soil Series in the Study Area in Goa

Sl. No.	Physiography and Soil series	Description of Soil	Soil Taxonomy	Area, hectares
	<b>Mudflats</b>			
1.	Mandovi	Deep, poorly drained loamy sand, 1 to 3 percent slope	Mixed, Typic Psammaquent	359.76* (0.70%) 161** (1.33%)
2.	Koiva	Deep, poorly drained silty clay to clay loam, 0 to 1 percent slope	Fine, mixed Typic Tropaquept	64.73* (0.12%) 34** (0.28%)
	<b>Salt Pans</b>			
3.	Panaji	Deep, imperfectly drained, loamy sand, 0 to 1 percent slope,	Mixed, Typic Psammaquent	273.27* (0.53%) 56** (0.46%)
	<b>Plains</b>			
4.	Zuari	Deep, imperfectly drained, sandy loam to sandy clay loam, 0 to 3 percent slope, slight salinity in patches	Fine, Mixed Aquic Ustropept	7952.08* (15.63%) 3008** (24.85)
	<b>Conical Hills</b>			
5.	Nagowa	Deep, well drained, sandy clay loam to gravelly clay loam, 8 to 15 percent slope, moderately eroded	Fine, Mixed Typic Ustropept	420.75* (0.82%) 62** (0.51%)
	<b>Flat topped hills</b>			
6.	Raya	Very shallow, well drained, sandy clay loam to clay loam, 1 to 5 percent slope, severely eroded	Loamy-skeletal, Mixed, Lithic Ustorthent	887.47* (1.74%) 308** (2.54%)
	<b>Hillside Slopes</b>			
7.	Madgoan	Deep, well drained, sandy clay loam to clay loam, 8 to 15 percent slope, moderately eroded	Clayey-skeletal, Mixed, Typic Ustropept	3269.99* (6.43%) 647** (5.34%)
	<b>Undulating lands</b>			
8.	Chapora	Deep, well drained sandy loam to sandy clay loam, 3 to 8 percent slope, moderately eroded	Fine-loamy, Mixed, Typic Ustroppt	2554.18* (5.02%) 753** (6.22%)
	<b>Quartzite landform</b>			
9.	Netravli	Moderately shallow, well drained, clay loam, 8 to 30 percent slope, severely eroded	Clayey-skeletal, Mixed, Oxic Humitropept	1495.11* (2.94%) 515** (4.25%)
	<b>High hills</b>			
10.	Torse	Shallow, clay loam, 30 to 50 percent slope, moderately eroded	Clayey, Mixed Lithic Dystropept	15411.13* (30.30%) 2020** (16.69%)
	<b>Low hills</b>			
11.	Metavada	Shallow, well drained, sandy loam to sandy clay loam, 8 to 15 percent slope, severely eroded	Loamy-skeletal, Mixed Lithic Dystropept	1717.84* (3.21%) 1816** (15.00%)
	<b>Interhill basin</b>			
12.	Bandoli	Deep, well drained, clay loam to clay, 3 to 8 percent slope, moderately eroded	Clayey, Mixed, Typic Hapludult	3709.62* (7.09%) 1839** (14.94%)

## Annexure 4.5 (Contd...)

Table 16 (Contd...)

Sl. No.	Physiography and Soil series	Description of Soil	Soil Taxonomy	Area, hectares
13.	<b>Narrow valley</b>	Deep, moderately well drained, clay loam soil, 1 to 3 percent slope, slightly eroded	Fine-loamy, Mixed, Typic Dystropept	1582.67* (3.11%) 588** (4.86%)
	<b>Basalt landform</b>			
14.	Surta	Deep well drained clay loam, 15 to 30 percent slope severely eroded	-	440.92* (1.08%) 318** (2.63%)
15.	Rock Outcrops	Boulders of basalt		21.05* (0.04%)

\* for 10,000 meters width

\*\* for 1,000 meters width

Table 17

## Soil Depth Classification in the Study Area - Goa

Sl. No.	Depth Classification	Area (1000 m)		Area (10000 m)	
		Hectares	Percentage	Hectares	Percentage
1.	Very shallow (0-25 cm)	308	3.06	887	1.76
2.	Shallow (25-50 cm)	1816	18.02	22129	43.83
3.	Moderately shallow (50-75 cm)	515	5.11	1495	2.96
4.	Moderately deep (75-100 cm)	1553	15.41	4558	9.03
5.	Deep (100-150 cm)	2624	26.04	12685	25.12
6.	Very deep (>150 cm)	3259	32.35	8735	17.30

Table 18

## Soil Texture Classification in the Study Area - Goa

Sl. No.	Soil Texture Classification	Area (1000 m)		Area (10000 m)	
		Hectares	Percentage	Hectares	Percentage
1.	Sand	161	1.33	360	0.84
2.	Loamy sand - sandy loam	753	6.25	2827	6.62
3.	Sandy loam - sandy clay loam	4824	40.07	6598	15.45
4.	Loam - sandy clay loam	588	4.88	1583	3.71
5.	Sandy clay loam - clay loam	955	7.93	4157	9.74
6.	Graded sandy clay loam - graded clay loam	62	0.51	421	0.99
7.	Clay loam - clay	4662	38.72	26616	62.35
8.	Silty clay - clay	34	0.28	65	0.15
9.	Rock outcrops	-	-	62	0.14

Table 19

## Drainage Pattern in the Study Area - Goa

Sl. No.	Soil Drainage Classification	Area (1000 m)		Area (10000 m)	
		Hectares	Percentage	Hectares	Percentage
1.	Poorly drained	195	1.79	424	0.89
2.	Imperfectly drained	3064	28.18	8310	17.39
3.	Moderately well drained	588	5.40	1583	3.31
4.	Well drained	2029	18.66	10580	22.14
5.	Well-excessively drained	2978	27.39	11483	24.03
6.	Excessively drained	2020	18.58	15411	32.24

Table 20

## Soil Erosion Pattern in the Study Area - Goa

Sl. No.	Soil Erosion Class	Area (1000 m)		Area (10000 m)	
		Hectares	Percentage	Hectares	Percentage
1.	Slight	3847	32.66	10318	20.32
2.	Moderate	6460	54.85	34813	68.04
3.	Severe	1470	12.48	5652	11.12

Table 21

## Physical Properties of Soils within the Study Area, Goa

Sl. No.	Name of Village	Soil Depth cm	Particle Size Distribution (%)				Textural Class	Bulk Density g/cm <sup>3</sup>	Max WHC %	Hydraulic Conductivity mm/hr
			Coarse Sand	Fine Sand	Silt	Clay				
1.	Amona	0-30	54.9	33.6	1.4	10.0	Loamy sand	1.6	12.5	62
		30-60	41.4	20.2	19.3	19.0	Sandy Loam	1.4	14.3	10
2.	Pilerne	0-30	23.2	14.0	25.6	37.2	Clay loam	1.6	17.3	62
		30-60	12.2	24.7	36.5	26.5	Clay loam	1.5	15.1	82
3.	Navelim	0-30	39.9	13.8	20.5	26.0	Sandy Clay loam	1.4	14.2	60
		30-60	33.0	16.3	22.0	28.5	Sandy Clay loam	1.4	15.0	64
4.	Narora	0-30	57.7	8.2	6.5	30.5	Sandy loam	1.5	15.9	78
		30-60	56.7	8.7	11.5	23.0	Sandy clay loam	1.4	15.1	82
5.	Chorao	0-30	46.5	42.6	5.8	5.0	Loamy sand	1.6	12.3	20
		30-60	48.8	35.9	2.8	8.6	Loamy sand	1.6	10.3	28
6.	Navelia	0-30	70.0	10.0	4.0	16.0	Sandy loam	1.4	13.6	58
		30-60	64.6	9.8	7.0	18.5	Sandy loam	1.4	15.2	50
7.	Kalingat	0-30	15.5	45.0	13.7	25.8	Sandy clay loam	1.5	15.0	58
		30-60	19.4	29.1	6.0	45.8	Sandy clay	1.6	18.2	36
8.	Ella Goa	0-30	50.0	23.0	11.0	15.7	Loamy sand	1.6	12.3	62
		30-60	48.0	25.5	10.5	16.0	Loamy sand	1.6	14.5	56
		60-90	36.0	15.0	7.0	42.0	Sandy clay	1.4	26.8	36
		90-120	35.6	15.8	8.2	39.6	Sandy clay	1.4	30.2	32
9.	Candola	0-30	50.2	36.2	6.4	7.2	Sand	1.8	8.5	70
		30-60	42.4	18.3	17.8	21.5	Sandy clay loam	1.5	18.4	48
		60-90	25.8	15.1	26.5	32.6	Clay loam	1.4	24.5	32
		90-120	12.0	20.7	32.2	35.1	Clay loam	1.4	26.3	30
10.	Betqui	0-30	42.5	40.5	6.7	10.3	Loamy sand	1.5	10.4	88
		30-60	48.3	34.8	7.2	9.7	Loamy sand	1.4	12.8	62
		60-90	60.5	15.6	8.0	15.9	Sandy loam	1.4	19.0	52
		90-120	65.8	10.8	7.0	16.4	Sandy loam	1.4	18.6	46

WHC : Water Holding Capacity

Table 22

**Water Soluble Cations and Anions in Saturation Extract of Soils  
In the Study Area, Goa**

Sl. No.	Name of Village	Soil Depth cm	pH	ECe mS/cm	Ca	Mg	Na	K	Cl
					meq/L				
1.	Aname	0-30	6.2	0.24	0.65	0.28	0.54	0.73	1.26
		30-60	6.1	0.21	0.78	0.16	0.42	0.71	1.08
2.	Pilerne	0-30	5.6	0.15	0.32	0.12	0.48	0.36	0.98
		30-60	5.8	0.15	0.36	0.08	0.45	0.20	0.90
3.	Navelim	0-30	5.5	0.10	0.21	0.04	0.68	0.26	0.74
		30-60	5.4	0.21	0.82	0.36	0.48	0.29	1.32
4.	Narura	0-30	6.2	0.15	0.60	0.20	0.42	0.54	0.96
		30-60	6.2	0.12	0.32	0.26	0.24	0.29	0.70
5.	Chorao	0-30	5.8	0.24	0.84	0.46	0.50	0.48	1.42
		30-60	5.9	0.18	0.46	0.32	0.48	0.52	1.04
6.	Navelia (Dicholi)	0-30	6.2	0.18	0.52	0.38	0.52	0.54	1.12
		30-60	5.8	0.18	0.56	0.26	0.55	0.58	0.86
7.	Kalingat	0-30	6.0	0.36	1.08	0.52	1.00	0.50	2.24
		30-60	6.1	0.39	1.16	0.96	0.98	0.50	2.16
8.	Ella Goa	0-30	5.2	0.28	0.62	0.22	0.52	0.68	1.12
		30-60	5.1	0.24	0.72	0.18	0.42	0.70	1.10
		60-90	5.4	0.21	0.40	0.18	0.48	0.38	1.22
		90-120	5.1	0.23	0.36	0.16	0.45	0.21	1.18
9.	Candola	0-30	5.7	0.25	0.48	0.16	0.52	0.37	0.98
		30-60	5.4	0.27	0.52	0.38	0.51	0.32	0.96
		60-90	4.2	0.22	0.56	0.32	0.53	0.38	0.92
		90-120	5.2	0.26	0.45	0.18	0.48	0.51	0.94
10.	Betqui	0-30	5.2	0.26	0.42	0.23	0.62	0.28	0.97
		30-60	5.1	0.24	0.48	0.18	0.60	0.30	0.92
		60-90	5.3	0.27	0.62	0.22	0.68	0.42	0.90
		90-120	5.4	0.21	0.58	0.27	0.58	0.22	0.86

ECe : Electrical Conductivity

Table 23

## Chemical Properties of Soils in the Study Area, Goa

Sl. No.	Name of Village	Total			Organic Carbon (%)	Exchangeable Cation				
		Nitrogen	Phosphate	Potash		CEC	Ca	Mg	Na	K
1.	Amone	0.19	0.07	1.08	1.58	6.69	4.43	4.74	2.04	0.17
		0.16	0.06	1.04	1.42	13.59	9.50	8.01	2.72	0.27
2.	Pilerne	0.13	0.02	1.12	1.09	18.00	10.20	9.12	2.95	0.32
		0.14	0.02	1.14	1.35	15.04	7.33	2.00	3.67	0.22
3.	Navelim	0.12	0.08	0.69	1.25	14.30	11.40	8.10	2.82	0.24
		0.18	0.07	0.66	1.08	16.50	12.50	7.80	2.10	0.28
4.	Narora	0.16	0.06	0.16	1.24	24.00	9.96	30.60	1.50	0.29
		0.10	0.05	0.14	1.04	18.00	4.26	11.73	1.63	0.26
5.	Chorao	0.08	0.04	0.21	0.58	3.37	0.71	1.87	1.17	0.19
		0.08	0.03	0.24	0.42	4.67	0.56	1.76	1.90	0.22
6.	Navelia (Dicholi)	0.13	0.05	0.16	1.16	12.20	10.08	70.68	2.00	0.26
		0.18	0.08	0.18	0.98	13.60	9.20	7.84	2.10	0.32
7.	Kalingat	0.12	0.02	0.06	1.42	20.42	8.12	3.26	8.12	0.26
		0.16	0.04	0.09	1.52	28.20	8.76	10.25	10.22	0.26
8.	Ella Goa	0.20	0.04	0.39	1.62	8.7	3.41	4.62	1.90	0.13
		0.12	0.03	0.46	1.08	9.3	4.56	4.25	2.52	0.19
		0.08	0.06	0.17	0.62	20.5	8.20	3.84	7.60	0.24
		0.05	0.09	0.15	0.42	18.3	6.33	4.48	8.12	0.20
9.	Candola	0.15	0.07	0.12	1.36	6.2	4.20	2.16	2.08	0.16
		0.09	0.08	0.13	0.86	15.3	6.80	7.13	1.80	0.17
		0.03	0.04	0.15	0.42	18.4	10.20	8.30	2.13	0.24
		0.04	0.03	0.19	0.36	20.3	10.60	9.12	2.18	0.23
10.	Betqui	0.08	0.06	0.23	0.68	5.3	4.12	2.00	1.64	0.28
		0.06	0.03	0.18	0.42	6.2	4.32	3.10	2.18	0.20
		0.01	0.05	0.15	0.28	8.6	3.12	4.16	2.12	0.18
		0.01	0.05	0.09	0.22	7.2	3.50	2.16	1.63	0.21

Table 24

## Land Capability Classification - Goa

Land Capability Class	Area (10000 meters)		Area (1000 meters)	
	Hectares	Percentage	Hectares	Percentage
<b>Lands suitable for agriculture</b>				
	19329	38.0	2844	29.8
1. Good lands	2554	5.0	753	7.9
2. Moderately good lands	11904	23.4	3040	31.9
3. Marginally good lands				
<b>Lands suitable for forestry, pasture, recreation and rehabilitation</b>				
4. Good for forestry	887	2.4	626	6.6
5. Fairly good for forestry or pasture	15411	30.3	2020	21.2
6. Good only for recreation and rehabilitation	760	1.4	251	2.6

Table 25

## Land Irrigability Classification of Soils in the Study Area - Goa

Sl. No.	Land Irrigability Class	Area (10000 meters)		Area (1000 meters)	
		Hectares	Percentage	Hectares	Percentage
1.	Moderate limitation of soil and drainage	8037	15.8	3008	14.6
2.	Moderate limitations of drainage	1583	3.1	588	8.7
3.	Severe limitations of topography	12264	24.1	2532	37.5
4.	Very severe limitations of soil	1308	2.6	370	5.5
5.	Very severe	6718	13.3	-	-
6.	Not suitable due to limitations of topography	20176	39.7	251	3.7
7.	Not suitable due to limitation of drainage	698	1.4	-	-

Table 26

## Physical Properties of Soils of the Khazan Land in the Study Area in Goa

Sl. No.	Name of Village	Soil Depth cm	Particle Size Distribution (%)				Textural Class	Hydraulic Conductivity cm/hr.
			Coarse Sand	Fine Sand	Silt	Clay		
1.	Old Goa	0-30	9.6	10.8	37.4	42.2	Silty clay	0.82
		30-60	8.8	10.0	37.8	43.4	Silty clay	0.80
		60-90	7.2	11.1	38.0	43.7	Silty clay	0.76
2.	Cumbarjua Canal	0-30	7.2	9.8	39.2	43.8	Silty clay	0.82
		30-60	6.2	12.8	38.2	42.8	Silty clay	0.78
3.	Saptakoteshwar Temple	0-30	7.8	10.2	37.8	44.2	Silty clay	0.76
		30-60	7.2	13.8	37.6	41.4	Silty clay	0.80
4.	Candola	0-30	7.0	10.2	38.2	44.6	Silty clay	0.74
		30-60	2.8	14.0	38.4	44.8	Silty clay	0.76
5.	Amone	0-30	10.2	10.8	36.2	42.8	Silty clay	0.78
		30-60	6.2	11.6	37.4	43.8	Silty clay	0.76
		60-90	5.8	11.2	36.3	46.7	Silty clay	0.72
6.	Betique	0-30	10.2	7.4	38.2	44.2	Silty clay	0.74
		30-60	6.2	11.6	37.8	44.4	Silty clay	0.68
7.	Volvoi	0-30	5.2	19.8	36.2	38.8	Clay loam	1.22
		30-60	4.8	20.2	37.4	37.6	Clay loam	1.32
8.	Surla	0-30	11.8	5.8	38.2	44.2	Silty clay	0.74
		30-60	5.6	14.0	37.6	42.8	Silty clay	0.68
9.	Savai Varem	0-30	10.2	16.2	36.2	37.4	Clay loam	1.2
		30-60	4.4	21.4	35.8	38.4	Clay loam	0.96
10.	Usgaon	0-30	10.4	16.8	35.0	37.8	Clay loam	1.32
		30-60	6.2	20.8	36.2	36.8	Clay loam	1.34
		60-90	7.8	18.2	36.0	38.0	Clay loam	1.23

Table 27

**Water Soluble Cations and Anions in Saturation Extract of Soils of Khazanı Land  
in the Study Area in Goa**

Sl. No.	Name of Village	Soil Depth cm	pH	ECe mS/cm	Ca	Mg	Na	K	Cl
					meq/L				
1.	Old Goa	0-30	3.6	34.6	82.6	78.5	106.3	28.6	142.8
		30-60	4.6	21.3	57.4	50.2	71.7	32.6	104.3
		60-90	4.8	12.4	32.6	16.4	52.8	19.2	82.4
2.	Cumbarjua Canal	0-30	4.4	32.6	78.4	72.6	102.7	32.3	135.2
		30-60	4.8	18.2	52.3	48.3	65.2	10.4	92.4
3.	Saptakoteshwar Temple	0-30	4.9	22.12	44.8	40.8	98.3	15.7	112.4
		30-60	5.1	10.3	28.3	20.5	40.8	7.8	58.6
4.	Candola	0-30	4.3	21.2	59.2	48.3	72.3	26.2	106.8
		30-60	4.6	10.1	26.4	22.5	27.3	20.9	58.3
5.	Amone	0-30	4.2	18.3	50.8	36.4	70.8	21.8	96.2
		30-60	4.6	12.4	28.3	23.3	30.1	18.6	62.8
		60-90	5.0	8.2	21.4	15.7	25.2	8.2	51.6
6.	Betique	0-30	4.6	20.4	46.4	42.1	87.3	18.2	97.6
		30-60	4.3	16.2	38.1	31.2	56.8	14.5	84.2
7.	Volvoi	0-30	4.6	5.1	17.3	13.6	14.4	1.2	27.3
		30-60	4.8	4.4	15.2	14.8	9.1	1.8	22.1
8.	Surla	0-30	5.6	2.8	7.8	5.3	12.1	1.4	10.2
		30-60	5.4	1.5	3.2	2.6	8.2	1.1	7.3
9.	Savai Verem	0-30	5.4	2.4	7.3	6.8	7.8	1.2	14.3
		30-60	5.0	0.9	2.1	1.6	4.2	1.0	7.8
10.	Usgaon	0-30	5.0	0.7	1.7	1.3	3.1	0.8	3.2
		30-60	4.5	0.4	1.2	0.7	2.0	0.6	2.1
		60-90	5.0	0.3	0.8	0.5	1.2	0.5	1.8

ECe : Electrical Conductivity

Table 28

## Chemical Properties of Soils of the Khazan Land in the Study Area in Goa

Sl. No.	Name of Village	Soil Depth cm	Organic Carbon (%)	Total (%)		
				N	P	K
1.	Old Goa	0-30	0.72	0.12	0.03	0.46
		30-60	0.66	0.08	0.06	0.28
		60-90	0.42	0.03	0.02	0.12
2.	Cumbarjua Canal	0-30	1.08	0.18	0.07	0.66
		30-60	0.98	0.12	0.08	0.32
3.	Saptakoteshwar Temple	0-30	0.86	0.07	0.17	0.36
		30-60	0.52	0.05	0.06	0.30
4.	Candola	0-30	0.73	0.09	0.07	0.13
		30-60	0.62	0.03	0.04	0.15
5.	Amone	0-30	0.76	0.07	0.05	0.92
		30-60	0.52	0.04	0.02	0.72
		60-90	0.40	0.03	0.02	0.43
6.	Betique	0-30	0.69	0.08	0.06	0.23
		30-60	0.45	0.06	0.03	0.18
7.	Volvoi	0-30	0.56	0.04	0.09	0.26
		30-60	0.45	0.03	0.04	0.18
8.	Surla	0-30	0.78	0.07	0.03	0.28
		30-60	0.56	0.04	0.04	0.22
9.	Savai Verem	0-30	0.84	0.07	0.04	0.42
		30-60	0.62	0.05	0.02	0.36
10.	Usgaon	0-30	0.94	0.08	0.03	0.62
		30-60	0.82	0.06	0.02	0.48
		60-90	0.43	0.04	0.02	0.27

Table 29

**Salinity Status and Yield of Paddy of the Khazan Land  
in the Study Area, Goa**

Sl. No.	Name of Village	Electrical Conductivity of Saturation Extract (mS/cm)	* Average Yield of Local Paddy (T/ha)	* Average Yield of Improved Varieties of Paddy (T/ha)
1.	Old Goa	27.9	0.90	1.9
2.	Cumbarjua Canal	25.4	1.1	2.3
3.	Saptakoteshwar Temple	16.2	1.7	3.5
4.	Candola	15.6	1.8	3.8
5.	Amone	15.3	2.1	3.9
6.	Betique	18.3	1.4	3.2
7.	Volvoi	4.7	2.5	4.3
8.	Surla	2.2	3.1	5.2
9.	Savoi Varem	1.7	3.5	5.7
10.	Usgaon	0.6	3.8	5.6

\* Average yields of paddy at farmers level of management

Table 1

## Floristic Composition In State of Karnataka

## Pansheer Nala Dam Site

The area could be classified under a transitional belt between the Deciduous and Semi-evergreen types of vegetation

Moist Deciduous Type	Dry Deciduous Type	The Under Growth
<i>Terminalia tomentosa</i>	<i>Dendrobium</i> sp.	<i>Strobilanthes</i> sp.
<i>Careya arborea</i>	<i>Terminalia paniculata</i>	<i>Capparis</i> sp.
<i>Terminalia paniculata</i>	<i>Butea monosperma</i>	<i>Toddalia</i> sp.
<i>Lagerstroemia lanceolata</i>	<i>Randia dumetorum</i>	<i>Zizphus</i> sp.
<i>Madhuca indica</i>	<i>Mangifera indica</i>	<i>Colebrookea</i> sp.
	<i>Macaranga peltata</i>	<i>Garcinia</i> sp.
	<i>Embllica officinalis</i>	<i>Ochlandra</i> sp.
	<i>Bombax malabaricum</i>	<i>Lantana</i> sp.

## Shrubby Growth

## Notable Climbers

<i>Flacourtia</i> sp.	<i>Cyclea</i> sp.
<i>Ixora</i> sp.	<i>Tylophora</i> sp.
<i>Holigama</i> sp.	<i>Uvaria</i> sp.
<i>Melastoma</i> sp.	<i>Canes</i>

## Evergreen Components

*Syzygium cumini*  
*Carallia brachiata*  
*Ficus* sp  
*Artocarpus hirsutus*

## Pansheer Nala Dam Site

1. <i>Melastoma malabathricum</i>	15. <i>Pithecellobium bigeminum</i>
2. <i>Erythrina indica</i>	16. <i>Gardenia</i> sp.
3. <i>Calophyllum wightianum</i>	17. <i>Xanthium</i> sp.
4. <i>Pandanus furcatus</i>	18. <i>Acacia</i> sp.
5. <i>Sapium insigne</i>	19. <i>Bombax</i> sp.
6. <i>Cipadessa baccifera</i>	20. <i>Clerodendron serratum</i>
7. <i>Salix ichnostachya</i>	21. <i>Oldenlandia herbacea</i>
8. <i>Homonioia riparia</i>	22. <i>Capparis uniloides</i>
9. <i>Colebrookea oppositifolia</i>	23. <i>Dicanthium annulatum</i>
10. <i>Dendrocalamus strictus</i>	24. <i>Oplismenus compositus</i>
11. <i>Carissa carandas</i>	25. <i>Mucuna</i> sp.
12. <i>Careya arborea</i>	26. <i>Entada</i> sp.
13. <i>Heptapleurum venulosum</i>	27. <i>Tylophora</i> sp.
14. <i>Memecylon edule</i>	28. <i>Uvaria</i> sp.

Table 1 (Contd...)

**(A) Mahadayi River Bed Banks**

(1) Canopy	(2) 2nd Tree Layer	(3) Notable Climbers
<i>Dillenia pentagyna</i>	<i>Calycopteris floribunda</i>	<i>Gnetum ula</i>
<i>Holigama beddomei</i>	<i>Cassia fistula</i>	<i>Osmunda regalis</i>
<i>Homalium zeylanicum</i>	<i>Cinnamomum zeylanicum</i>	
<i>Machilus macrantha</i>	<i>Alangium salvifolium</i>	
<i>Barringtonia aculeata</i>	<i>Olea dioica</i>	
<i>Ehretia leavis</i>	<i>Wrightia tomentosa</i>	
<i>Memecylon edule</i>	<i>Actinodaphne aculeata</i>	
<i>Xylia xylocarpa</i>	<i>Melastoma malabathricum</i>	
	<i>Madhuca indica</i>	

**(B) Marginal Banks of The River Bed**

*Mallotus philippinensis*  
*Barringtonia aculeata*  
*Melastoma malabathricum*  
*Madhuca indica*  
*Osmunda regalis*

**Semi-Evergreen Forests Jamboti Block**

1. *Hopea parviflora*
2. *Lophopetalum wightianum*
3. *Calophyllum wightianum*
4. *Calophyllum elatum*
5. *Mysristica* sp.
6. *Syzygium cumini*
7. *Lagerstroemia lanceolata*
8. *Terminalia paniculata*
9. *Terminalia tomentosa*
10. *Cinnamomum zeylanicum*
11. *Holigama amottiana*
12. *Carallia brachiata*
13. *Euphoria longana*
14. *Olea dioica*
15. *Mimusops elengi*
16. *Memecyclon edule*
17. *Diospyros montana*
18. *Symploca* sp.
19. *Careya arborea*
20. *Emblica officinalis*
21. *Diospyros candolleana*
22. *Mallotus philippinensis*
23. *Glycosmis* sp.
24. *Atalantia racemosa*
25. *Strobilanthes* sp.
26. *Xanthium* sp.

Table 1 (Contd...)

**Bail Nadi Dam Site**

Bail River Bed Site	Bail River Bed Site-Blanks	Bail River Valley Upslope Relief
Homonoia riparia Woodfordia floribunda Colebrookea oppositifolia Ehretia laevis Melastoma malabathricum	Ardisia solanacea Calamus sp. Gnidia glauca Sapium insigne  Polyalthia fragrans Pithecellobium bigeminum Artocarpus hirsutus Carallia brachiata Dillenia indica Litsea stocksii	Olea dioica Syzygium cumini Macaranga peltata Dillenia pentagyna Ixora brachiata
Bail River Valley Upslope- Plateau Relief	The Common Climbers at the Bail Nadi Dam Site Area	The Serpentine or Rope Like Climbers
Careya arborea Butea monosperma Ziziphus oenoplia Randia dumetorum Calotropis gigantea Terminalia paniculata Cinnamomum zeylanicum Bauhinia racemosa Cassia fistula Strobilanthes strobilifera Capparis heyneana Dendrocalamus strictus Garcinia tinctoria	Hemidesmus indicus Cyclea peltata Cissus quadrangularis	Gnetum ula Anamirta cocculus Entada pursaetha
Ground Layer	Epiphytes	Undergrowths
Xanthium Crotalaria Desmodium sp. Ixora sp. Moghania sp. Pavetta sp. Grasses	Orchids sp. Loranthus sp.	Ferns Mosses
Small trees and Shrubs		
Adhatoda zeylanica Barleria involucreta Gymnostachyum canescens Haplanthodes verticillatum Lepidagathis cuspidata Strobilanthes asper	Antidesma ghaesaembilla Bischofia javanica Bridelia retusa Macaranga roxburghii Mallotus philippinensis	

Table 1 (Contd...)

---

**South-Indian Moist Deciduous  
Forests Compartments 1-5  
Hemmadaga Block & Kanakumbi**

---

1. *Terminalia paniculata*
  2. *Lagerstroemia* sp.
  3. *Dalbergia latifolia*
  4. *Grewia tiliaefolia*
  5. *Careya arborea*
  6. *Terminalia chebula*
  7. *Cassia fistula*
  8. *Diospyros montana*
  9. *Bridelia retusa*
  10. *Macaranga peltata*
  11. *Callicarpa lantana*
  12. *Clerodendron infortunatum*
  13. *Acacia* sp.
  14. *Caesalpaenia* sp.
  15. *Calycopteris floribunda*
  16. *Spatholobus roxburghii*
  17. *Xylia* sp.
  18. *Dillenia pentagyna*
  19. *Embllica officinalis*
  20. *Cinnamomum zeylanicum*
  21. *Symploca canarana*
  22. *Mangifera indica*
- 

**Kotni-Dam Site**

---

1. *Barringtonia aculeata*
  2. *Dillenia pentagyna*
  3. *Ehretia leavis*
  4. *Holigama beddomei*
  5. *Homalium zeylanicum*
  6. *Memecylon edule*
  7. *Machilus macrantha*
  8. *Xylia xylocarpa*
  9. *Alangium salvifolium*
  10. *Cassia fistula*
  11. *Calycopteris floribunda*
  12. *Olea dioica*
  13. *Wrightia tomentosa*
  14. *Actinodaphne bourdillonii*
  15. *Cyclea peltata*
  16. *Gnetum ula*
  17. *Mallotus philippinensis*
  18. *Barringtonia aculeata*
  19. *Melastoma malabathricum*
  20. *Madhuca indica*
  21. *Osmunda regalis*
-

Table 1 (Contd...)

---

**Upstream Portion of Mahadayi River  
Around Kongla (Hemmadga Section)**


---

1. Terminalia tomentosa
2. Terminalia paniculata
3. Terminalia bellerica
4. Terminalia chebula
5. Lagerstroemia lanceolata
6. Holarrhena sp
7. Memecylon edule
8. Mitragyna parviflora
9. Stereospermum sp
10. Spondias sp
11. Actinodaphne hookeri
12. Careya arborea
13. Randia dumetorum
14. Mallotus philippinensis
15. Bambusa sp.
16. Eucalyptus sp.
17. Casuarina sp.
18. Australian acacia
19. Pongamia sp.
20. Woodfordia floribunda
21. Homonoia riparia

---

**Kongla Village - is totally submersible area, the plant species recorded in this area are as follows**


---

- |                           |                              |
|---------------------------|------------------------------|
| 1. Bauhinia racemosa      | 22. Pongamia pinnata         |
| 2. Gnidia glauca          | 23. Anacardium occidentale   |
| 3. Strobilanthes sp       | 24. Careya arborea           |
| 4. Vitex negundo          | 25. Asparagus gonoclados     |
| 5. Bridelia scandens      | 26. Crotalaria retusa        |
| 6. Holigama beddomei      | 27. Ilex malabarica          |
| 7. Dendrocalamus strictus | 28. Flemingia strobilifera   |
| 8. Ixora brachiata        | 29. Atalantia wightii        |
| 9. Callophylum apetalum   | 30. Adhatoda zeylanica       |
| 10. Xanthium dicrococcum  | 31. Paracalyx scariosus      |
| 11. Catunaregum spinosa   | 32. Carissa carandas         |
| 12. Diospyros pruriens    | 33. Oxytenanthera monostigma |
| 13. Lygodium sp.          | 34. Olea dioica              |
| 14. Blumea sp.            | 35. Mangifera indica         |
| 15. Butea monosperma      | 36. Artocarpus integrifolia  |
| 16. Zizyphus rugosa       | 37. Cassia fistula           |
| 17. Terminalia paniculata | 38. Alstonia scholaris       |
| 18. Cocculus macrocarpus  | 39. Ficus religiosa          |
| 19. Dillenia pentagyna    | 40. Erythrina indica         |
| 20. Macaranga peltata     | 41. Diospyros melanoxylon    |
| 21. Wendlandia thyrsoides | 42. Emblica officinalis      |
-

Table 1 (Contd...)

---

**Upstream Portion of Mahadavi River Around Kongla (Hemmadga Section)**


---

22. <i>Colebrookea oppositifolia</i>	51. <i>Gymnostachyum canescens</i>
23. <i>Melastoma malabathricus</i>	52. <i>Haplanthodes verticillatum</i>
24. <i>Artocarpus hirsutus</i>	53. <i>Lepidagathis cuspidata</i>
25. <i>Dillenia indica</i>	54. <i>Strobilanthes asper</i>
26. <i>Syzygium cumini</i>	55. <i>Antidesma ghaesaembilla</i>
27. <i>Ixora brachiata</i>	56. <i>Bischofia javanica</i>
28. <i>Olea dioica</i>	57. <i>Bridelia retusa</i>
29. <i>Macaranga peltata</i>	58. <i>Macaranga roxburghii</i>
30. <i>Polyalthia fragans</i>	59. <i>Ixora</i> sp.
31. <i>Pithecellobium bigeminum</i>	60. <i>Crotalaria</i> sp.
32. <i>Carallia brachiata</i>	61. <i>Desmodium</i> sp.
33. <i>Litsea stocksii</i>	62. Ferns
34. <i>Calamus</i> sp.	63. Orchids
35. <i>Ardisia solanacea</i>	64. <i>Loranthus</i> sp.
36. <i>Gnidia glauca</i>	65. <i>Gnetum ula</i>
37. <i>Sapium insigne</i>	66. <i>Anamirta coculus</i>
38. <i>Butea monosperma</i>	67. <i>Entada pursaetha</i>
39. <i>Careya arborea</i>	68. <i>Hemidesmus indicus</i>
40. <i>Cinnamomum zeylanicum</i>	69. <i>Cyclea peltata</i>
41. <i>Bauhinia racemosa</i>	70. <i>Cissus quadrangularis</i>
42. <i>Cassia fistula</i>	71. <i>Grewia heterotricha</i>
43. <i>Strobilanthes strobilifera</i>	
44. <i>Capparis heyneana</i>	
45. <i>Dendrocalanus strictus</i>	
46. <i>Garcinia tinctoria</i>	
47. <i>Calotropis gigantea</i>	
48. <i>Randia dumetorum</i>	
49. <i>Adhatoda zeylanica</i>	
50. <i>Barleria involucreta</i>	

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**Andher Nala Dam Site**


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1. <i>Barringtonia racemosa</i>	5. <i>Dillenia pentagyna</i>
2. <i>Melastoma malabathricum</i>	6. <i>Grewia tiliacifolia</i>
3. <i>Madhuca indica</i>	7. <i>Lagerstroemia lanceolata</i>
4. <i>Homonoia riparia</i>	8. <i>Bridelia squamosa</i>
9. <i>Careya arborea</i>	22. <i>Cordia</i> sp.
10. <i>Terminalia paniculata</i>	23. <i>Cassia fistula</i>
11. <i>T. tomentosa</i>	24. <i>Dalbergia paniculata</i>
12. <i>T. arjuna</i>	25. <i>Cinnamomum zeylanicum</i>
13. <i>T. catappa</i>	26. <i>Holigama beddomei</i>
14. <i>Memecylon</i> sp.	27. <i>Ixora brachiata</i>
15. <i>Ehretia</i> sp.	28. <i>Colebrooks oppositifolia</i>
16. <i>Garcinia</i> sp.	29. <i>Toddalia aculeata</i>
17. <i>Emblica</i> sp.	30. <i>Gnidia glauca</i>
18. <i>Butea</i> sp.	31. <i>Randia</i> sp.
19. <i>Mangifera</i> sp.	32. <i>Artocarpus</i> sp.
20. <i>Dendrocalamus</i> sp.	
21. <i>Bombax</i> sp.	

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Table 1 (Contd...)

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**Muruduhaul Nala Dam Site**


---

1. <i>Careya arborea</i>	36. <i>Oxytenanthera</i> sp.
2. <i>Bauhinia racemosa</i>	37. <i>Calycopteris floribunda</i>
3. <i>Gnidia glauca</i>	38. <i>Ilex malabarica</i>
4. <i>Holigama beddomei</i>	39. <i>Dillenia pentagyna</i>
5. <i>Emblica officinalis</i>	40. <i>Callophyllum apetalum</i>
6. <i>Butea monosperma</i>	41. <i>Bridelia scandens</i>
7. <i>Terminalia paniculata</i>	42. <i>Calamus pseudotenuis</i>
8. <i>Calamus thwaitesii</i>	43. <i>Urena lobata</i>
9. <i>Alangium lamarckii</i>	44. <i>Lagerstroemia lanceolata</i>
10. <i>Strobilanthes</i> sp.	45. <i>Justicia</i> sp.
11. <i>Homonoia riparia</i>	46. <i>Discorea</i> sp.
12. <i>Sapium insigne</i>	47. <i>Mucuna monosperma</i>
13. <i>Toddalia asiatica</i>	48. <i>Memecylon edule</i>
14. <i>Vitex negundo</i>	49. <i>Grewia</i> sp.
15. <i>Triumfetta rhomboidea</i>	50. <i>Crotalaria retusa</i>
16. <i>Premna coriacea</i>	51. <i>Olea dioica</i>
17. <i>Blumea</i> sp.	52. <i>Ludwigia perennis</i>
18. <i>Olea dioica</i>	53. <i>Dalbergia latifolia</i>
19. <i>Ligustrum gambleii</i>	54. <i>Pongamia pinnata</i>
20. <i>Erythrina indica</i>	55. <i>Macaranga roxburghii</i>
21. <i>Colebrookea oppositifolia</i>	56. <i>Mangifera indica</i>
22. <i>Leucas lavandulifolia</i>	57. <i>Lantana camara</i>
23. <i>Butea monosperma</i>	58. <i>Zizyphus rugosa</i>
24. <i>Eriocaulon cinereum</i>	59. <i>Ixora brachiata</i>
25. <i>Catunaregum spinosa</i>	60. <i>Eleagmis latifolia</i>
26. <i>Carissa carandas</i>	61. <i>Bombax malabaricum</i>
27. <i>Dalbergia spinosa</i>	62. <i>Moullava spicata</i>
28. <i>Conarus paniculatus</i>	63. <i>Dactyloctenium</i> sp.
29. <i>Ficus benghalensis</i>	64. <i>Panicum ripens</i>
30. <i>Artocarpus integrifolia</i>	65. <i>Eragrostis riparia</i>
31. <i>Dalbergia latifolia</i>	66. <i>Themeda tremula</i>
32. <i>Piper hookeri</i>	67. <i>Ischaemum</i> sp.
33. <i>Cocculus macrocarpus</i>	68. <i>Andropogon</i> sp.
34. <i>Ixora nigricans</i>	
35. <i>Dendrocalamus strictus</i>	

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Table 2

## Species Composition of Mangroves in the Mahadayi Estuary

Sr. No.	Species	Sampling Location													
		R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R15
1.	<i>Sonneratia caseolaris</i>	-	-	-	+	+	+	-	-	-	-	-	-	-	-
2.	<i>Cyperus sp.</i>	-	-	-	-	+	-	-	-	-	-	-	-	-	-
3.	<i>Bruguiera parviflora</i>	-	-	-	-	+	+	-	+	+	+	-	-	-	-
4.	<i>Excoecaria agallocha</i>	-	-	-	-	-	+	-	+	+	+	-	+	-	
5.	<i>Kandelia rheedii</i>	-	-	-	-	-	+	-	+	+	+	-	-	-	
6.	<i>Sonneratia alba</i>	-	-	-	-	-	+	+	+	+	+	+	+	+	
7.	<i>Rhizophora apiculata</i>	-	-	-	-	-	+	-	+	+	+	+	-	+	
8.	<i>Rhizophora mucronata</i>	-	-	-	-	-	+	+	+	+	+	+	+	+	
9.	<i>Avicennia officinalis</i>	-	-	-	-	-	-	-	-	-	+	-	+	-	
10.	<i>Acanthus ilicifolius</i>	-	-	-	-	-	-	+	-	-	-	-	+	+	

Table 3

**Floristic Composition in the State of Goa**

**Mandovi River-Near Sonali Village (Trees Near River Bed)**

- |                                    |                                   |
|------------------------------------|-----------------------------------|
| 1. <i>Mangifera indica</i>         | 7. <i>Artocarpus hirsuta</i>      |
| 2. <i>Ficus religiosa</i>          | 8. <i>Ficus benghalensis</i>      |
| 3. <i>Mimusops</i> sp.             | 9. <i>Tectona grandis</i>         |
| 4. <i>Sterculia foetida</i>        | 10. <i>Anogeissus latifolia</i>   |
| 5. <i>Alstonia scholaris</i>       | 11. <i>Anacardium occidentale</i> |
| 6. <i>Lagerstroemia parviflora</i> |                                   |
-

**Table 4**  
**List of Fauna Recorded along the River Mahadayi**

Sl. No.	Common Name	Scientific Name	Included in the Schedule of Wild Life Protection Act
<b>Mammals</b>			
1	Chital	<i>Axis axis</i>	III
2	Common langur	<i>Presbytis entellus</i>	II
3	Indian hare	<i>Lepus nigricollis</i>	IV
4	Indian porcupine	<i>Hystrix indica</i>	IV
5	Indian wild boar	<i>Sus scrofa</i>	III
6	Jackal	<i>Canis aureus</i>	II
7	Pale hedgehog	<i>Paraechinus micropus</i>	-
8	Rhesus macaque	<i>Macaca mulatta</i>	II
9	Sambar	<i>Cervus unicolor</i>	III
10	Sloth bear	<i>Melursus ursinus</i>	I
11	Three-striped palm squirrel	<i>Funambulus palmarum</i>	-
<b>Birds</b>			
12	Black bird	<i>Turdus merula</i>	-
13	Black bulbul	<i>Hypsipetes madagascariensis</i>	IV
14	Black drongo	<i>Dicrurus adsimilis</i>	IV
15	Blackwinged kite	<i>Elanus caeruleus</i>	-
16	Blossomheaded parakeet	<i>Psittacula cyanocephala</i>	IV
17	Blue rock pigeon	<i>Columba livia</i>	IV
18	Brahminy kite	<i>Haliastur indus indus</i>	-
19	Brahminy myna	<i>Sturnus pagodarum</i>	IV
20	Blue-eared kingfisher	<i>Alcedo meninting</i>	IV
21	Bronzewinged jacana	<i>Metopidius indicus</i>	IV
22	Brown shrike	<i>Lanius cristatus</i>	-
23	Brownheaded gull	<i>Larus brunnicephalus</i>	IV
24	Cattle egret	<i>Bubulcus ibis</i>	IV
25	Comb duck	<i>Sarkidiomis melanotus</i>	IV
26	Common iora	<i>Aegithina tiphia</i>	IV

Contd...

Table 4 (Contd...)

Sl. No.	Common Name	Scientific Name	Included in the Schedule of Wild Life Protection Act
27	Common myna	<i>Acridotheres tristis</i>	IV
28	Common sandpiper	<i>Tringa hypoleucos</i>	IV
29	Coot	<i>Fulica atra</i>	IV
30	Coppersmith	<i>Megalaima haemacephala</i>	IV
31	Coucal	<i>Centropus sinensis</i>	-
32	Crested tree swift	<i>Hemiprocne longipennis</i>	-
33	Dabchik	<i>Podiceps ruficollis</i>	IV
34	Dull green leaf warbler	<i>Phylloscopus trochiloides</i>	-
35	Emerald dove	<i>Chalcophaps indica</i>	IV
36	Green sandpiper	<i>Tringa ochropus</i>	IV
37	Great black wood pecker	<i>Dryocopus javensis</i>	IV
38	Grey drongo	<i>Dicrurus leucophaeus</i>	IV
39	Grey heron	<i>Ardea cinerea</i>	IV
40	Grey jungle fowl	<i>Gallus sonneratii</i>	IV
41	Grey headed myna	<i>Sturnus malabaricus</i>	IV
42	Golden oriole	<i>Oriolus oriolus</i>	IV
43	Goldenbacked wood pecker	<i>Chrysocolaptes lucidus</i>	IV
44	Gullbilled tern	<i>Gelochelidon nilotica</i>	-
45	Hill myna	<i>Gracula religiosa</i>	IV
46	Hoopoe	<i>Upupa epops</i>	-
47	House crow	<i>Corvus splendens</i>	V
48	House sparrow	<i>Passer domesticus</i>	-
49	House swift	<i>Apus affinis</i>	-
50	Indian cliff swallow	<i>Hirundo fluvicola</i>	-
51	Indian robin	<i>Saxicoloides fulicata</i>	-
52	Indian roller	<i>Coracias benghalensis</i>	IV

Contd...

## Annexure 4.6 (Contd...)

Table 4 (Contd...)

Sl. No.	Common Name	Scientific Name	Included in the Schedule of Wild Life Protection Act
53	Jungle babbler	<i>Turdoides striatus</i>	IV
54	Jungle bushquail	<i>Perdica asiatica</i>	IV
55	Jungle crow	<i>Corvus macrorhynchos</i>	-
56	Jungle myna	<i>Acridotheres fuscus</i>	IV
57	Large cuckoo-shrike	<i>Coracina novaehollandiae</i>	-
58	Large egret	<i>Ardea alba</i>	IV
59	Large green barbet	<i>Megalaima zeylanica</i>	IV
60	Large wood-shrike	<i>Tephrodornis virgatus</i>	-
61	Lesser coucal	<i>Centropus toulou</i>	-
62	Little brown dove	<i>Streptopelia senegalensis</i>	IV
63	Little cormorant	<i>Phalacrocorax niger</i>	IV
64	Little egret	<i>Egretta garzetta</i>	IV
65	Little ringed plover	<i>Charadrius dubius</i>	-
66	Little stint	<i>Calidris minuta</i>	-
67	Magpie robin	<i>Copsychus saularis</i>	-
68	Mallard	<i>Anas platyrhynchos</i>	IV
69	Openbilled stork	<i>Anastomus oscitans</i>	IV
70	Orangeheaded ground thrush	<i>Zoothera citrina</i>	IV
71	Palm swift	<i>Cypsiurus parvus</i>	-
72	Paradise flycatcher	<i>Terpsiphone paradisi</i>	IV
73	Pariah kite	<i>Milvus migrans govinda</i>	-
74	Pheasant-tailed jacana	<i>Hydrophasianus chirurgus</i>	IV
75	Pied bushchat	<i>Saxicola caprata</i>	-
76	Pied kingfisher	<i>Ceryle rudis</i>	IV
77	Pintail	<i>Anas acuta</i>	IV
78	Pond heron	<i>Ardeola grayii</i>	IV

Contd...

Table 4 (Contd...)

Sl. No.	Common Name	Scientific Name	Included in the Schedule of Wild Life Protection Act
79	Purple heron	<i>Ardea purpurea</i>	IV
80	Purple moorhen	<i>Porphyrio porphyrio</i>	-
81	Purple sunbird	<i>Nectarinia asiatica</i>	IV
82	Purplerumped sunbird	<i>Nectarinia zeylonica</i>	IV
83	Racket-tailed drongo	<i>Dicrurus paradiseus</i>	IV
84	Red spurfowl	<i>Galloperdix spadicea</i>	IV
85	Red vented bulbul	<i>Pycnonotus cafer</i>	IV
86	Redwattled lapwing	<i>Vanellus indicus</i>	-
87	Redwhiskered bulbul	<i>Pycnonotus jocosus</i>	IV
88	Reef heron	<i>Egretta gularis</i>	IV
89	Roseringed parakeet	<i>Psittacula krameri</i>	IV
90	Rufous woodpecker	<i>Micropternus brachyurus</i>	IV
91	Rufousbacked shrike	<i>Lanius schach</i>	-
92	Scarlet minivet	<i>Pericrocotus flammeus</i>	IV
93	Shikra	<i>Accipiter badius</i>	IV
94	Shoveller	<i>Anas clypeata</i>	IV
95	Small blue kingfisher	<i>Alcedo atthis</i>	IV
96	Small green barbet	<i>Megalaima viridis</i>	IV
97	Small green bee-eater	<i>Merops orientalis</i>	-
98	Small minivet	<i>Pericrocotus cinnamomeus</i>	IV
99	Spotted dove	<i>Streptopelia chinensis</i>	IV
100	Spotted owlet	<i>Athene brama</i>	IV
101	Streaked fantail warbler	<i>Cisticola juncidis</i>	-
102	Swallow	<i>Hirundo rustica</i>	-
103	Tailor bird	<i>Orthotomus sutorius</i>	-
104	Tickell's flowerpecker	<i>Dicaeum erythromynchos</i>	IV

Contd...

Table 4 (Contd...)

Sl. No.	Common Name	Scientific Name	Included in the Schedule of Wild Life Protection Act
105	Tree pie	<i>Dendrocitta vagabunda</i>	IV
106	White eye	<i>Zosterops palpebrosa</i>	IV
107	White wagtail	<i>Motacilla alba</i>	-
108	Whitebacked munia	<i>Lonchura striata</i>	IV
109	Whitebacked vulture	<i>Gyps bengalensis</i>	IV
110	Whitebellied drongo	<i>Dicrurus caerulescens</i>	IV
111	Whitebreasted kingfisher	<i>Halcyon smymensis</i>	IV
112	Whitebreasted laughing thrush	<i>Garrulax jerdoni</i>	IV
113	Wiretailed swallow	<i>Hirundo smithii</i>	-
<b>Reptiles</b>			
114	Common green whip snake	<i>Ahaetulla nasutus</i>	IV
115	Indian cobra	<i>Naja naja</i>	II
116	Russell's viper	<i>Vipera russelli</i>	II
117	Forest calotes	<i>Calotes rouxi</i>	-
<b>Amphibians</b>			
118	Frog	<i>Hyla sp.</i>	-
119	Frog	<i>Rana sp.</i>	IV
120	Toad	<i>Bufo sp.</i>	-
<b>Others</b>			
121	Giant millipede	<i>Julus sp.</i>	-
122	Land leech	<i>Haemadipsa sp.</i>	-
123	Pill millipede	<i>Arthrosphaera sp.</i>	-

Schedules I, II, III, IV and V indicate wild animals for total protection, special game, big game, small game and vermin (no restriction) respectively under wild life (protection) Act 1972.

**Table 5**  
**List of Reptiles Available along the River Mandovi in Goa State**

Sl. No.	Family	Zoological Name	English Name
1.	Typhlopidae	<i>Typhlina bramina (Daudin)</i>	Blind snake
2.	Typhlopidae	<i>Typhlops acutus (Dam &amp; Bibr.)</i>	Beaked blind snake
3.	Uropeltidae	<i>Plectrurus canarius</i>	Shield tail snake
4.	Boidae	<i>Python molurus (Linn)</i>	Indian python
5.	Boidae	<i>Eryx conicus (Schn.)</i>	Common sand boa
6.	Boidae	<i>Eryx johnii (Russell)</i>	Red sand boa
7.	Dipsadidae	<i>Lycodon aulicus (Linn)</i>	Common wolf snake
8.	Dipsadidae	<i>Oligodon armensis (Shaw)</i>	Banded kukri
9.	Dipsadidae	<i>Oligodon taeniolatus (Jerdon)</i>	Russell's kukri snake
10.	Homalopsidae	<i>Boiga trigonata (Schn.)</i>	Common cat snake
11.	Homalopsidae	<i>Boiga forsteni (Dum. &amp; Bibr.)</i>	Forsten's cat snake
12.	Natricidae	<i>Amphiesma stolata (Linn)</i>	Striped keelback
13.	Natricidae	<i>Amphiesma beddomei (Gunther)</i>	Beddome's keelback
14.	Natricidae	<i>Macropisthodon plumbicolor (Cantor)</i>	Green keel back
15.	Natricidae	<i>Xenochrophis piscator (Schn.)</i>	Checkered keelback, water snake
16.	Elapidae	<i>Naja naja (Linn)</i>	Indian spectacled cobra
17.	Colubridae	<i>Elaphe helena (Daudin)</i>	Trinket snake
18.	Elapidae	<i>Bungarus caeruleus (Schn)</i>	Common krait
19.	Colubridae	<i>Chrysopelea ornata (Shaw)</i>	Flying snake, Ornamental snake
20.	Colubridae	<i>Dendrelaphis tristis (Daudin)</i>	Bronzeback tree snake
21.	Colubridae	<i>Ahaetulla nasutus (Lacepede)</i>	Vine snake
22.	Homalopsidae	<i>Cerberus rhynchops (Schn.)</i>	Dogfaced water snake
23.	Elapidae	<i>Callophis sp.</i>	Coral snake
24.	Viperidae	<i>Vipera russelli (Shaw)</i>	Russell's viper
25.	Viperidae	<i>Echis carinatus (Schn)</i>	Sawscaled viper
26.	Elapidae	<i>Hydrophis caeruleus (Shaw)</i>	Malacca seasnake
27.	Hydrophiidae	<i>Enhydrina schistosa (Daudin)</i>	Hooknosed sea snake
28.	Colubridae	<i>Dryophis pulverulentus (Dum &amp; Bibr)</i>	Brown vine snake
29.	Colubridae	<i>Ptyas mucosus (Linn)</i>	Common ratsnake

Table 5 (Contd...)

Sl. No.	Family	Zoological Name	English Name
30.	Gekkonidae	<i>Hemidactylus brooki</i> (Gray)	Brook's gecko
31.	Gekkonidae	<i>Hemidactylus frenatus</i> (Schlegel)	Southern house gecko
32.	Gekkonidae	<i>Hemidactylus prashadi</i> (Smith)	Prashad's gecko
33.	Gekkonidae	<i>Gymnodactylus albofasciatus</i> (Beulenger)	
34.	Agamidae	<i>Calotes versicolor</i> (Daudin)	Common garden lizard
35.	Agamidae	<i>Calotes rouxi</i> (Dum & Bibr)	Forest calotes
36.	Agamidae	<i>Draco dussumieri</i> (Dum & Bibr)	Flying lizard
37.	Scincidae	<i>Mabuya carinata</i> (Schn)	Common skink
38.	Scincidae	<i>Mabuya andamanensis</i> (Schmidt)	Andaman skink
39.	Scincidae	<i>Mabuya maculana</i> (Blyth)	Little skink
40.	Scincidae	<i>Riopa punctata</i> Gmelin	Snake skink
41.	Scincidae	<i>Riopa guentheri</i> (Peters)	Snake skink
42.	Lacertidae	<i>Ophisops beddomei</i> (Jerdon)	Snake-eye
43.	Varanidae	<i>Varanus monitor</i> (Linn)	Common monitor
44.	Chamaeleonidae	<i>Chameleo vulgar</i>	Chameleon
45.	Emyadidae	<i>Geomyda trijuga</i> (Schweigger)	Pond terrapin

Source : School of Ocean Sciences P.G.Center, Karnataka University, Karwar, Study file.

Table 6

## List of Birds Available along the River Mandovi In Goa State

Sl.No.	Zoological Name	English Name
1.	<i>Ardeola grayii</i>	Pond heron
2.	<i>Bubulcus ibis</i>	Cattle egret
3.	<i>Elanus coeruleus</i>	Blackwinged kite
4.	<i>Pernis ptilorhynchus ruficollis</i>	Crested honey buzzard
5.	<i>Milvus migrans</i>	Pariah kite
6.	<i>Haliastur indus</i>	Brahminy kite
7.	<i>Accipiter badius dussumieri</i>	Shikra
8.	<i>Butastur teesa</i>	White-eyed buzzard-eagle
9.	<i>Accipiter trivirgatus</i>	Crested goshawk
10.	<i>Ictinaetus malayensis</i>	Black eagle
11.	<i>Gyps bengalensis</i>	Whitebacked vulture
12.	<i>Spilornis cheela melanotis</i>	Peninsular serpent eagle
13.	<i>Pandion haliaetus</i>	Ospray
14.	<i>Falco peregrinus peregrinator</i>	Shahin falcon
15.	<i>Falco tinnunculus interstinctus</i>	Kestrel
16.	<i>Coturnix coturnix</i>	Grey quail
17.	<i>Galloperdix spadicea</i>	Red spurfowl
18.	<i>Tumix suscitator</i>	Common bustard-quail
19.	<i>Gallus sonneratii</i>	Grey jungle fowl
20.	<i>Amauromis phoenicurus</i>	Whitebreasted waterhen
21.	<i>Vanellus indicus</i>	Redwattled lapwing
22.	<i>Treron pompadora affinis</i>	Greyfronted green pigeon
23.	<i>Ducula badia</i>	Imperial pigeon
24.	<i>Columba livia</i>	Blue rock pigeon
25.	<i>Columba elphinstonii</i>	Nilgiri wood pigeon
26.	<i>Streptopelia orientalis erythrocephala</i>	Rufous turtle dove
27.	<i>Streptopelia chinensis</i>	Spotted dove
28.	<i>Streptopelia senegalensis</i>	Little brown dove
29.	<i>Chalcophaps indica</i>	Emerald dove
30.	<i>Psittacula cyanocephala</i>	Blossomheaded parakeet
31.	<i>Psittacula columboides</i>	Bluwinged parakeet

Table 6 (Contd...)

Sl.No.	Zoological Name	English Name
32.	<i>Loriculus vernalis</i>	Lorikeet
33.	<i>Cuculus micropterus</i>	Indian cuckoo
34.	<i>Eudynamys scolopacea scolopacea</i>	Koel
35.	<i>Centropus sinensis parroti</i>	Crow pheasant
36.	<i>Glaucidium radiatum</i>	Barred owlet
37.	<i>Eurostopodus macrotis</i>	Great eared night jar
38.	<i>Caprimulgus indicus</i>	Jungle nightjar
39.	<i>Caprimulgus macrurus atripennis</i>	Longtailed nightjar
40.	<i>Chaetura sylvatica</i>	White rumped spinetail swift
41.	<i>Cypsiurus parvus</i>	Palm swift
42.	<i>Hemiprocne longipennis</i>	Crested tree swift
43.	<i>Harpactes fasciatus malabaricus</i>	Malabar trogon
44.	<i>Alcedo atthis taprobana</i>	Small blue kingfisher
45.	<i>Alcedo meninting</i>	Blue-eared kingfisher
46.	<i>Halcyon smymensis</i>	Whitebreasted kingfisher
47.	<i>Merops leschenaulti leschenaulti</i>	Chestnutheaded bee-eater
48.	<i>Merops philippinus</i>	Blue tailed bee-eater
49.	<i>Merops orientalis</i>	Little green bee-eater
50.	<i>Nyctornis athertoni</i>	Blue bearded bee-eater
51.	<i>Coracias garrulus semenowi</i>	Kashmir roller
52.	<i>Coracias benghalensis</i>	Roller or blue jay
53.	<i>Upupa epops</i>	Hoopoe
54.	<i>Tockus griseus griseus</i>	Malabar grey hornbill
55.	<i>Anthracoseros coronatus coronatus</i>	Malabar pied hornbill
56.	<i>Buceros bicornis</i>	Great pied hornbill
57.	<i>Megalaima rubricapilla malabarica</i>	Crimsonthroated barbet
58.	<i>Megalaima viridis</i>	Small green barbet
59.	<i>Micropternus brachyurus jerdonii</i>	Rufous woodpecker
60.	<i>Dinopium benghalense puncticolle</i>	Golden backed woodpecker
61.	<i>Dryocopus javensis</i>	Great black woodpecker
62.	<i>Picooides nanus hardwickii</i>	Browncrowned pigmy woodpecker
63.	<i>Hemicircus canente</i>	Heartspotted woodpecker
64.	<i>Chrysocolaptes lucidus chersonesus</i>	Larger golden backed woodpecker

Table 6 (Contd...)

Sl.No.	Zoological Name	English Name
65.	<i>Calandrella cinerea</i>	Short toed lark
66.	<i>Hirundo rupestris</i>	Crag martin
67.	<i>Galerida malabarica</i>	Malabar crested lark
68.	<i>Hirundo rustica</i>	Swallow
69.	<i>Hirundo daurica</i>	Striated swallow
70.	<i>Lanius schach caniceps</i>	Indian grey backed shrike
71.	<i>Lanius cristatus</i>	Brown shrike
72.	<i>Oriolus oriolus kundoo</i>	Golden oriole
73.	<i>Oriolus xanthornus</i>	Blackheaded oriole
74.	<i>Dicrurus adsimilis</i>	Black drongo
75.	<i>Dicrurus leucophaeus longicaudatus</i>	Grey drongo
76.	<i>Dicrurus caerulescens caerulescens</i>	White bellied drongo
77.	<i>Dicrurus aeneus aeneus</i>	Bronzed drongo
78.	<i>Dicrurus hottentottus hottentottus</i>	Haircrested drongo
79.	<i>Dicrurus paradiseus paradiseus</i>	Large racket tailed drongo
80.	<i>Stumus malabaricus</i>	Greyheaded myna
81.	<i>Acridotheres tristis</i>	Indian myna
82.	<i>Acridotheres fuscus</i>	Jungle myna
83.	<i>Dendrocitta vagabunda</i>	Tree pie
84.	<i>Corvus splendens</i>	House crow
85.	<i>Corvus macrorhynchos</i>	Jungle crow
86.	<i>Hemipus picatus picatus</i>	Pied flycatcher-shrike
87.	<i>Tephrodornis gularis sylvicola</i>	Malabar wood shrike
88.	<i>Tephrodornis pondicerianus</i>	Lesser wood shrike
89.	<i>Coracina novaehollandiae</i>	Large cuckoo shrike
90.	<i>Coracina melanoptera sykesi</i>	Black headed cuckoo-shrike
91.	<i>Pericrocotus flammeus flammeus</i>	Orange minivet
92.	<i>Pericrocotus roseus roseus</i>	Rosy minivet
93.	<i>Pericrocotus cinnamomeus malabaricus</i>	Small minivet
94.	<i>Aegithina tiphia deignani</i>	Iora
95.	<i>Chloropsis aurifrons frontalis</i>	Goldenfronted chloropsis
96.	<i>Chloropsis cochinchinensis jerdoni</i>	Jerdon's chloropsis
97.	<i>Irena puella puella</i>	Fairy bluebird
98.	<i>Pycnonotus priocephalus</i>	Greyheaded bulbul

Table 6 (Contd...)

Sl.No.	Zoological Name	English Name
99.	<i>Pycnonotus melanicterus gularis</i>	Rubythroated yellow bulbul
100.	<i>Pycnonotus jocosus fuscicaudatus</i>	Redwhiskered bulbul
101.	<i>Pycnonotus cafer</i>	Redvented bulbul
102.	<i>Pycnonotus luteolus luteolus</i>	Whitebrowed bulbul
103.	<i>Hypsipetes indicus indicus</i>	Yellowbrowed bulbul
104.	<i>Hypsipetes madagascariensis</i>	Black bulbul
105.	<i>Pellorneum ruficeps ruficeps</i>	Spotted babbler
106.	<i>Pomatorhinus schisticeps</i>	Scimitar babbler
107.	<i>Rhopocichla atriceps atriceps</i>	Blackheaded babbler
108.	<i>Turdoides subrufus subrufus</i>	Rufous babbler
109.	<i>Turdoides striatus somervillei</i>	Jungle babbler
110.	<i>Alcippe poiocephala poiocephala</i>	Quaker babbler
111.	<i>Muscicapa muttui muttui</i>	Brownbreasted flycatcher
112.	<i>Muscicapa parva parva</i>	Red breasted flycatcher
113.	<i>Muscicapa superciliaris superciliaris</i>	Whitebrowed blue flycatcher
114.	<i>Muscicapa pallipes</i>	White bellied blue flycatcher
115.	<i>Muscicapa rubeculoides rubeculoides</i>	Bluethroated flycatcher
116.	<i>Muscicapa tickelliae</i>	Tickell's redbreasted blue flycatcher
117.	<i>Muscicapa thalassina thalassina</i>	Verditer flycatcher
118.	<i>Terpsiphone paradisi leucogaster</i>	Paradise flycatcher
119.	<i>Monarcha azurea styani</i>	Blacknaped monarch flycatcher
120.	<i>Orthotomus sutorius</i>	Tailor bird
121.	<i>Acrocephalus dumetorum</i>	Blyth's reed warbler
122.	<i>Phylloscopus tytleri</i>	Tytler's leaf warbler
123.	<i>Phylloscopus griseolus</i>	Olivaceous leaf warbler
124.	<i>Phylloscopus occipitalis occipitalis</i>	Large crowned leaf warbler
125.	<i>Copsychus malabaricus malabaricus</i>	Shama
126.	<i>Copsychus saularis</i>	Magpie robin
127.	<i>Saxicoloides fulicata</i>	Indian robin
128.	<i>Phoenicurus ochruros</i>	Redstart
129.	<i>Monticola cinclorhynchus</i>	Blueheaded rock thrush
130.	<i>Monticola solitarius</i>	Blue rock thrush
131.	<i>Myiophonus horsfieldii</i>	Malabar whistling thrush

Table 6 (Contd...)

Sl.No.	Zoological Name	English Name
132.	<i>Zoothera citrina cyanotus</i>	White breasted ground thrush
133.	<i>Turdus merula cyanotus</i>	Black capped blackbrid
134.	<i>Sitta frontalis frontalis</i>	Velvet fronted nuthatch
135.	<i>Anthus hodgsoni</i>	Tree pipit
136.	<i>Anthus trivialis</i>	Tree pipit
137.	<i>Motacilla caspica</i>	Gray wagtail
138.	<i>Motacilla indica</i>	Forest wagtail
139.	<i>Motacilla maderaspatensis</i>	Large pied wagtail
140.	<i>Dicaeum agile</i>	Thickbilled flowerpecker
141.	<i>Dicaeum concolor</i>	Plaincoloured flowerpecker
142.	<i>Nectarinia zeylonica sola</i>	Purple rumped sunbrid
143.	<i>Nectarinia minima</i>	Small sunbird
144.	<i>Nectarinia lotenia hindustanica</i>	Maroon breasted sunbird
145.	<i>Nectarinia asiatica asiatica</i>	Purple sunbird
146.	<i>Passer domesticus</i>	House sparrow
147.	<i>Petronia xanthocollis</i>	Yellow throated sparrow
148.	<i>Ploceus philippinus</i>	Baya weaver bird
149.	<i>Lonchura striata striata</i>	White backed munia
150.	<i>Emberiza melanocephala</i>	Blackheaded bunting

Source : School of Ocean Sciences P.G.Center, Karnataka University, Karwar, Study file.

**Table 7**  
**List of Resident and Migratory Birds Recorded in Chorao Forest, Goa**

Sr. No.	Common Name	Scientific Name
1.	Black drongo	<i>Dicrurus adsimilis</i>
2.	Blackwinged kite	<i>Elanus caeruleus</i>
3.	Brahminy kite	<i>Haliastur indus indus</i>
4.	Blue-eared kingfisher	<i>Alcedo meninting</i>
5.	Bronzewinged Jacana*	<i>Metopidius indicus</i>
6.	Cattle egret	<i>Bubulcus ibis</i>
7.	Comb duck (Nakta)*	<i>Sarkidiornis melanotus</i>
8.	Coot*	<i>Fulica atra</i>
9.	Cormorants*	<i>Phalacrocorax spp.</i>
10.	Great black woodpecker	<i>Dryocopus javensis</i>
11.	Grey drongo	<i>Dicrurus leucophaeus</i>
12.	Grey heron*	<i>Ardea cinerea</i>
13.	Greyheaded myna	<i>Stumus malabaricus</i>
14.	Goldenbacked woodpecker	<i>Chrysocolaptes lucidus</i>
15.	Hoopoe	<i>Upupa epops</i>
16.	Indian roller (Bluejay)	<i>Coracias benghalensis</i>
17.	Large cuckoo-shrike	<i>Coracina novaehollandiae</i>
18.	Lesser wood-shrike	<i>Tephrodornis sp.</i>
19.	Mallard*	<i>Anas platyrhynchos</i>
20.	Openbilled stork*	<i>Anastomus oscitans</i>
21.	Pheasant-tailed jacana*	<i>Hydrophasianus chirurgus</i>
22.	Pied kingfisher	<i>Ceryle rudis</i>
23.	Pintail*	<i>Anas acuta</i>
24.	Pond heron	<i>Ardeola grayii</i>
25.	Purple heron*	<i>Ardea purpurea</i>
26.	Purple moorhen*	<i>Porphyrio porphyrio</i>
27.	Rufous woodpecker	<i>Micropternus brachyurus</i>
28.	Shoveller*	<i>Anas clypeata</i>
29.	Small blue kingfisher	<i>Alcedo atthis</i>
30.	Teals*	-
31.	Terns*	-
32.	Treepie	<i>Dendrocitta vagabunda</i>
33.	Whitebreasted kingfisher	<i>Halcyon smymensis</i>

\* Migratory birds

Source : Forest Deptt. Office, Panaji, Goa

Table 8

## Census of Select Mammals during 1984 through 1993 in Sanctuaries of Goa

Sl. No.	Species	Animal Census in Year				Percent increase in D over A
		1984 A	1987 B	1990 C	1993 D	
1.	Indian Bison	174	482	603	521	199
2.	Cheetal	87	50	156	421	384
3.	Sambar	45	71	162	315	600
4.	Wild Boar	267	148	488	666	149
5.	Barking deer	40	97	106	104	160
6.	Mouse deer	25	107	181	156	524
7.	Panther	10	18	20	31	210
8.	Bear	3	18	20	34	1033
9.	Malbar Squirrel	48	110	225	322	571
10.	Tiger	-	-	-	3	-

Source : State Forest Department

Table 9

## Seasonwise Distribution and Abundance of Algal Species along the River Mahadayl (Karnataka)

Season	Algal Species	Sampling Location										
		R1	R2	T1	T2	T3	T4	T5	T6	T7	G1	G2
	<b>Cyanophyceae</b>											
Monsoon 95	Phoramidium sp.	-	-	-	-	-	-	-	-	-	-	-
Summer 96	"	-	-	-	-	-	-	-	-	-	P	-
Post-monsoon 96	"	P	P	-	P	P	P	P	-	-	P	-
	<b>Chlorophyceae</b>											
Monsoon 95	Chlorella sp.*	-	-	-	-	-	-	P	P	-	-	-
Summer 96	"	-	-	-	-	-	-	-	-	-	-	-
Post-monsoon 96	"	-	-	-	-	-	P	P	-	-	P	-
Monsoon 95	Mougeotia sp.	-	-	-	-	-	-	-	P	-	-	-
Summer 96	"	-	-	-	-	-	-	-	-	-	-	-
Post-monsoon 96	"	-	-	-	-	-	-	-	-	-	-	-
Monsoon 95	Chlorococcum sp.	-	-	-	-	-	-	-	-	-	-	-
Summer 96	"	P	P	-	-	-	-	-	-	-	-	-
Post-monsoon 96	"	P	P	-	-	P	-	-	-	-	-	-
Monsoon 95	Cosmarium sp.	-	-	-	-	-	-	-	-	-	-	-
Summer 96	"	P	-	-	-	-	-	-	-	-	-	-
Post-monsoon 96	"	P	-	-	-	-	P	P	-	-	-	-
Monsoon 95	Selenastrum sp.	-	-	-	-	-	-	-	-	-	-	-
Summer 96	"	-	-	P	-	-	-	-	-	-	-	-
Post-monsoon 96	"	-	-	-	-	P	-	-	-	-	-	-
Monsoon 95	Trachelomona sp.	-	-	-	-	-	-	-	-	-	-	-
Summer 96	"	-	-	-	-	P	-	-	-	-	-	-
Post-monsoon 96	"	-	-	-	-	-	-	-	-	-	-	-
Monsoon 95	Microspora sp.	-	-	-	-	-	-	-	-	-	-	-
Summer 96	"	-	-	-	-	-	-	-	-	-	-	-
Post-monsoon 96	"	-	-	-	P	-	-	-	-	-	-	-
Monsoon 95	Crucigenia sp.	-	-	-	-	-	-	-	-	-	-	-
Summer 96	"	-	-	-	-	-	-	-	-	-	-	-
Post-monsoon 96	"	-	-	-	-	-	-	P	-	-	-	-

Table 9 (Contd...)

Season	Algal Species	Sampling Location										
		R1	R2	T1	T2	T3	T4	T5	T6	T7	G1	G2
	<b>Bacillariophyceae</b>											
Monsoon 95	Opephora sp.	P	P	P	P	P	P	P	-	-	-	-
Summer 96	"	P	-	-	-	-	P	-	-	-	-	-
Post-monsoon 96	"	-	-	-	P	-	P	P	-	-	-	-
Monsoon 95	Navicula sp.*	P	-	P	P	P	P	P	-	-	-	-
Summer 96	"	P	P	-	-	-	-	-	-	-	-	-
Post-monsoon 96	"	P	P	-	-	P	-	P	-	-	-	-
Monsoon 95	Frustulia sp.	-	P	-	-	-	-	-	-	-	-	-
Summer 96	"	-	-	-	-	-	-	-	-	-	-	-
Post-monsoon 96	"	-	-	-	-	-	-	-	-	-	-	-
Monsoon 95	Amphora sp.	-	P	-	-	-	-	-	-	-	-	-
Summer 96	"	P	-	-	-	-	-	-	-	-	-	-
Post-monsoon 96	"	-	-	-	-	-	-	-	-	-	-	-
Monsoon 95	Cymbella sp.	-	-	P	P	-	P	-	-	-	-	-
Summer 96	"	P	P	-	-	-	-	-	-	-	P	-
Post-monsoon 96	"	-	-	-	P	P	P	P	-	-	P	-
Monsoon 95	Fragillaria sp.	-	-	P	P	-	P	P	-	-	-	-
Summer 96	"	P	-	-	-	-	-	-	-	-	-	-
Post-monsoon 96	"	-	P	-	-	-	P	-	-	-	-	-
Monsoon 95	Stauroneis sp.	-	-	P	-	-	-	P	-	-	-	-
Summer 96	"	-	-	-	-	-	-	-	-	-	-	-
Post-monsoon 96	"	-	-	-	-	-	-	-	-	-	-	-
Monsoon 95	Synedra sp.*	-	-	-	-	-	P	-	-	-	-	-
Summer 96	"	-	-	-	-	-	-	-	-	-	-	-
Post-monsoon 96	"	-	-	-	-	-	-	-	-	-	-	-
Monsoon 95	Nitzschia sp.*	-	-	-	-	-	P	P	-	-	-	-
Summer 96	"	P	P	P	-	P	P	-	-	-	-	-
Post-monsoon 96	"	-	-	-	-	-	-	-	-	-	-	-
Monsoon 95	Melosira sp.*	-	-	-	-	-	-	P	-	-	-	-
Summer 96	"	-	-	-	-	-	-	-	-	-	-	-
Post-monsoon 96	"	-	-	-	P	-	P	-	-	-	-	-

Table 9 (Contd...)

Season	Algal Species	Sampling Location											
		R1	R2	T1	T2	T3	T4	T5	T6	T7	G1	G2	
Monsoon 95	Tabellaria sp.	-	-	-	-	-	-	-	-	-	-	-	-
Summer 96	"	P	-	-	-	-	-	-	-	-	-	-	-
Post-monsoon 96	"	-	-	-	-	-	-	-	-	-	-	-	-
Monsoon 95	Scoliopleura sp.	-	-	-	-	-	-	-	-	-	-	-	-
Summer 96	"	P	-	-	-	-	-	-	-	-	-	-	-
Post-monsoon 96	"	-	-	-	-	-	-	-	-	-	-	-	-
	<b>Dinophyceae</b>												
Monsoon 95	Peridinium sp.*	-	-	-	-	-	-	-	-	-	-	-	-
Summer 96	"	-	P	-	-	P	P	-	-	-	-	P	-
Post-monsoon 96	"	-	-	-	-	P	-	-	-	-	-	-	-

P : Present

- : Absent

\* : Indicator species of organic pollution

Table 10

Seasonwise Distribution and Abundance (No./100 ml) of Phytoplankton in Mandovi River/Estuary (Goa)

Season	Genera	Sampling Location													
		R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R15
	<b>Cyanophyceae</b>														
Winter 95	<i>Trichodesmium erythraeus</i>	-	-	-	65	243	3	10	-	-	58	13	133	-	67
Summer 96	..	-	-	-	86	-	3	13	-	-	-	-	80	16	72
Monsoon 96	..	-	-	-	-	-	-	-	-	-	-	-	-	1	1
	<b>Chlorophyceae</b>														
Winter 95	<i>Pediastrum sp.</i>	-	1	-	-	-	1	-	9	-	-	1	-	3	16
Summer 96	..	-	-	-	1	-	-	3	10	-	-	2	-	-	-
Monsoon 96	..	11	6	16	25	25	28	33	13	60	19	16	7	3	-
Winter 95	<i>Spirogyra sp.</i>	107	71	175	5	-	15	31	227	-	3	96	-	-	-
Summer 96	..	80	18	126	-	-	-	5	65	35	-	57	-	-	-
Monsoon 96	..	-	1	2	8	-	1	1	-	3	2	1	-	-	-
Winter 95	<i>Ulothrix sp.</i>	16	6	5	4	-	1	1	-	-	6	-	-	-	-
Summer 96	..	-	-	1	1	-	1	1	1	-	-	-	-	-	-
Monsoon 96	..	-	1	1	-	-	-	1	-	1	2	-	-	-	-
Winter 95	<i>Cosmarium sp.</i>	3	-	3	4	-	1	-	-	-	3	-	-	-	-
Summer 96	..	-	-	-	1	-	1	1	-	-	1	-	-	-	-
Monsoon 96	..	-	-	1	2	-	-	1	3	1	-	-	-	-	-

Table 10 (Contd...)

Season	Genera	Sampling Location													
		R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R15
Winter 95	<i>Micrasterias sp.</i>	-	-	3	-	-	-	-	1	-	1	-	-	-	-
Summer 96	"	-	-	-	-	-	-	1	1	2	-	-	-	-	
Monsoon 96	"	-	-	-	1	2	1	-	2	2	2	3	1	-	
Winter 95	<i>Zygnema sp.</i>	1	3	-	-	-	1	-	-	-	3	3	-	-	
Summer 96	"	4	-	-	-	-	1	-	1	-	3	1	5	-	
Monsoon 96	"	-	-	1	2	-	1	1	1	-	-	-	-	-	
	<b>Bacillariophyceae</b>														
Winter 95	<i>Coscinodiscus sp.</i>	363	105	191	204	678	321	220	204	196	447	456	329	278	439
Summer 96	"	106	50	139	186	-	188	112	226	231	235	239	174	148	253
Monsoon 96	"	40	15	34	54	45	52	34	62	93	54	53	60	126	181
Winter 95	<i>Skeletonema sp.</i>	16	29	-	11	-	9	76	-	8	25	8	125	-	164
Summer 96	"	-	-	3	13	-	9	4	3	-	-	3	-	10	51
Monsoon 96	"	-	-	1	-	-	1	1	-	1	1	1	-	9	27
Winter 95	<i>Hemidiscus sp.</i>	18	21	23	45	101	105	-	-	13	122	2	129	59	121
Summer 96	"	-	-	-	-	-	-	4	-	-	103	-	42	76	54
Monsoon 96	"	-	-	-	-	-	2	4	1	3	1	10	7	12	18
Winter 95	<i>Melosira sp</i>	16	18	46	216	-	31	18	-	27	14	16	29	4	7
Summer 96	"	-	-	-	-	-	-	12	8	-	52	21	8	28	32
Monsoon 96	"	-	-	-	-	-	-	1	3	1	-	7	6	10	14

Table 10 (Contd...)

Season	Genera	Sampling Location													
		R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R15
Winter 95	<i>Stephanopyxis sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	15	4
Summer 96	"	-	-	-	-	-	-	-	-	-	-	5	4	13	31
Monsoon 96	"	-	-	-	-	-	-	-	-	-	-	2	6	5	5
Winter 95	<i>Triceratium sp.</i>	8	10	-	30	48	3	13	-	-	1	13	4	-	3
Summer 96	"	-	-	-	-	-	-	-	-	3	3	3	11	4	19
Monsoon 96	"	-	-	-	-	-	-	-	-	-	-	2	3	5	6
Winter 95	<i>Biddulphia sp.</i>	48	-	-	-	56	-	-	17	17	48	3	17	14	45
Summer 96	"	-	-	-	-	-	-	-	-	-	5	11	24	22	31
Monsoon 96	"	-	-	-	-	-	-	-	-	5	1	1	5	4	10
Winter 95	<i>B. mobiliensis</i>	55	8	7	24	-	-	62	-	-	100	34	92	20	83
Summer 96	"	-	-	-	-	-	-	-	-	-	3	19	22	22	30
Monsoon 96	"	-	-	-	-	-	-	-	-	-	2	2	12	19	24
Winter 95	<i>B. sinensis</i>	-	-	-	-	-	-	-	-	1	-	-	6	5	21
Summer 96	"	-	-	-	-	-	-	-	-	1	-	3	15	14	22
Monsoon 96	"	-	-	-	-	-	-	-	-	-	-	1	5	4	7
Winter 95	<i>Guinardia sp.</i>	-	-	-	-	-	-	-	-	-	-	-	1	1	8
Summer 96	"	-	-	-	-	-	-	-	-	-	2	-	11	5	13
Monsoon 96	"	-	-	-	-	-	-	-	-	-	-	1	1	7	11

Table 10 (Contd...)

Season	Genera	Sampling Location													
		R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R15
Winter 95	<i>Bellerochea sp.</i>	16	-	3	-	49	12	12	-	-	11	12	7	18	33
Summer 96	..	-	-	-	-	-	-	-	-	-	-	-	2	10	11
Monsoon 96	..	-	-	-	-	-	-	-	-	-	-	-	1	3	15
Winter 95	<i>Ditylum sp.</i>	-	-	-	-	-	-	-	-	-	-	8	66	3	21
Summer 96	..	-	-	-	-	-	-	-	-	-	6	14	19	8	18
Monsoon 96	..	-	-	-	-	-	-	-	-	-	-	1	5	10	15
Winter 95	<i>Lithodesmium sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	2	4
Summer 96	..	-	-	-	-	-	-	-	-	-	-	-	2	5	11
Monsoon 96	..	-	-	-	-	-	-	-	-	-	-	-	1	1	4
Winter 95	<i>Chaetoceros sp.</i>	18	27	37	92	-	60	144	149	71	61	69	171	73	394
Summer 96	..	-	-	-	51	-	113	122	165	84	67	71	86	59	184
Monsoon 96	..	-	-	1	1	4	12	41	43	35	46	14	27	32	54
Winter 95	<i>Grannatophora sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	3	4
Summer 96	..	-	-	-	-	-	-	-	-	-	-	-	1	7	4
Monsoon 96	..	-	-	-	-	-	-	-	-	-	4	-	1	8	11
Winter 95	<i>Canpylodiscus sp.</i>	-	19	-	37	464	30	103	-	-	85	53	125	142	51
Summer 96	..	-	-	-	-	-	-	-	-	-	-	-	1	4	6
Monsoon 96	..	-	-	-	-	-	-	-	-	-	-	-	1	1	1

Table 10 (Contd...)

Season	Genera	Sampling Location													
		R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R15
Winter 95	<i>Planktoniella sp.</i>	26	17	18	11	63	51	13	-	-	-	16	42	4	26
Summer 96	"	-	-	-	-	-	-	-	-	-	-	14	15	9	18
Monsoon 96	"	-	-	-	-	-	-	-	-	-	-	7	5	6	7
Winter 95	<i>Bacteriastum sp.</i>	-	11	5	70	68	25	28	-	-	13	-	14	1	6
Summer 96	"	-	-	-	-	-	-	-	-	-	-	-	4	9	2
Monsoon 96	"	-	-	-	-	-	-	-	-	-	-	-	2	1	3
Winter 95	<i>Eucampia sp.</i>	-	-	-	24	96	-	-	-	-	-	12	1	13	27
Summer 96	"	-	-	-	-	-	-	-	-	-	-	-	2	11	7
Monsoon 96	"	-	-	-	-	-	-	-	-	-	-	2	2	5	5
Winter 95	<i>Climacodium sp.</i>	-	-	-	-	-	3	6	1	-	24	-	-	3	29
Summer 96	"	-	-	-	-	-	-	-	-	2	4	1	1	8	12
Monsoon 96	"	-	-	-	-	-	-	-	-	-	-	1	1	2	3
Winter 95	<i>Streptothecca sp.</i>	-	-	-	22	86	13	13	-	-	13	-	1	24	26
Summer 96	"	-	-	-	-	-	-	-	-	-	-	-	-	5	6
Monsoon 96	"	-	-	-	-	-	-	-	-	-	-	-	-	1	3
Winter 95	<i>Thalassiosira sp.</i>	-	-	-	-	-	8	27	23	35	54	-	-	39	240
Summer 96	"	-	-	-	-	-	-	-	-	105	51	-	40	47	81
Monsoon 96	"	-	-	-	-	-	-	-	-	2	3	-	3	12	19

Table 10 (Contd...)

Season	Genera	Sampling Location													
		R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R15
Winter 95	<i>T. gravida</i>	-	-	-	-	-	39	-	-	-	-	-	49	3	60
Summer 96	"	-	-	-	-	-	-	-	-	-	-	-	49	3	37
Monsoon 96	"	-	-	-	-	-	-	-	-	-	2	7	9	5	14
Winter 95	<i>Thalassionea sp.</i>	-	-	-	-	-	-	-	-	-	-	-	64	12	95
Summer 96	"	-	-	-	-	-	-	-	-	-	-	3	35	11	71
Monsoon 96	"	-	-	-	-	-	-	-	-	-	-	3	3	2	6
Winter 95	<i>Rhizosolenia sp.</i>	26	27	13	42	148	172	90	197	133	202	66	78	53	114
Summer 96	"	-	-	-	5	-	1	26	56	70	72	70	54	61	61
Monsoon 96	"	-	1	-	1	-	1	1	2	8	11	5	6	6	13
Winter 95	<i>R. stouterfothii</i>	-	-	8	20	61	18	8	78	76	43	24	10	7	39
Summer 96	"	-	3	1	7	-	2	6	25	34	21	11	7	12	24
Monsoon 96	"	-	-	-	1	-	1	-	-	1	1	1	2	8	21
Winter 95	<i>R. styliformis</i>	57	57	46	98	102	70	16	12	21	21	4	56	3	8
Summer 96	"	-	-	-	-	1	1	11	-	9	18	3	6	7	17
Monsoon 96	"	-	-	-	-	-	1	1	-	-	1	2	6	16	25
Winter 95	<i>R. hebatata</i>	32	29	24	-	106	28	8	11	27	21	2	9	25	24
Summer 96	"	-	-	3	-	-	1	-	10	13	9	8	16	4	23
Monsoon 96	"	-	-	-	-	-	-	2	1	1	2	1	2	2	5

Table 10 (Contd...)

Season	Genera	Sampling Location													
		R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R15
Winter 95	<i>Fragillaria oceanica</i>	-	-	28	-	-	-	111	-	-	120	-	-	173	246
Summer 96	"	-	-	-	-	-	-	-	-	-	-	-	10	13	22
Monsoon 96	"	-	-	1	-	-	-	-	1	-	-	-	1	5	33
Winter 95	<i>Thalassiothrix sp.</i>	66	50	-	-	-	-	-	-	-	7	-	17	12	100
Summer 96	"	-	-	-	-	-	-	-	-	-	-	-	15	19	27
Monsoon 96	"	-	-	-	-	-	-	-	-	-	-	-	2	4	6
Winter 95	<i>T. longissima</i>	-	-	-	26	48	-	21	-	-	48	15	16	4	100
Summer 96	"	-	-	-	-	-	-	-	-	-	1	9	8	13	18
Monsoon 96	"	-	-	-	-	-	-	-	-	-	-	1	3	4	7
Winter 95	<i>Asterionella japonica</i>	1	-	3	1	4	1	4	8	16	17	10	18	3	37
Summer 96	"	-	-	-	-	-	1	-	-	-	7	3	4	12	21
Monsoon 96	"	-	-	-	1	-	-	1	-	-	-	1	2	11	11
Winter 95	<i>Gyrosigma sp.</i>	33	20	-	84	-	74	75	115	35	89	21	27	8	34
Summer 96	"	-	-	10	-	-	-	11	16	12	4	17	29	31	33
Monsoon 96	"	-	-	-	-	-	-	-	-	-	2	2	4	6	10
Winter 95	<i>Pleurosigma sp.</i>	3	3	-	15	-	6	29	24	25	-	48	16	6	3
Summer 96	"	-	-	-	-	-	7	13	19	29	26	-	13	14	19
Monsoon 96	"	-	-	1	-	-	-	1	1	-	-	1	2	3	7

Table 10 (Contd...)

Season	Genera	Sampling Location													
		R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R15
Winter 95	<i>Navicula sp.</i>	-	-	3	-	-	-	-	1	-	3	3	8	12	5
Summer 96	"	-	-	-	-	-	-	-	1	-	-	1	5	1	9
Monsoon 96	"	-	-	-	-	5	1	1	1	1	1	3	3	4	7
Winter 95	<i>Nitzschia sp.</i>	3	3	-	3	-	11	5	-	1	-	10	16	1	1
Summer 96	"	-	-	-	-	-	-	-	-	-	3	3	8	15	13
Monsoon 96	"	-	-	-	-	-	1	1	1	1	1	2	1	6	7
Winter 95	<i>N. longissima</i>	-	3	-	-	14	-	3	-	-	3	1	7	-	3
Summer 96	"	-	-	-	-	-	-	-	-	-	-	-	7	-	11
Monsoon 96	"	-	-	-	-	-	-	2	1	2	-	2	5	9	16
	<b>Dinophyceae</b>														
Winter 95	<i>Prorocentrum sp.</i>	-	-	-	-	-	-	1	-	-	-	-	8	1	3
Summer 96	"	-	-	-	-	-	-	-	-	1	-	-	11	1	8
Monsoon 96	"	-	-	-	-	-	-	-	-	1	-	1	2	5	6
Winter 95	<i>Dinophysis sp.</i>	-	6	3	18	-	6	-	-	-	12	5	15	1	9
Summer 96	"	-	-	-	-	-	-	-	3	-	-	1	9	7	5
Monsoon 96	"	-	-	-	-	-	1	-	-	-	-	1	2	5	6
Winter 95	<i>Peridinium sp.</i>	-	-	3	-	3	3	-	-	-	-	-	49	26	29
Summer 96	"	-	-	-	-	-	-	-	-	-	1	-	22	8	22
Monsoon 96	"	-	-	-	-	-	-	-	-	1	-	1	1	4	5

Table 10 (Contd...)

Season	Genera	Sampling Location													
		R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R15
Winter 95	<i>Ceratium tripos</i>	-	4	-	-	6	-	30	-	-	-	-	44	1	26
Summer 96	"	-	-	-	-	-	-	-	-	-	-	-	23	2	8
Monsoon 96	"	-	-	-	-	-	1	-	1	-	-	1	2	3	5
Winter 95	<i>C. fusus</i>	6	-	-	6	-	2	1	-	-	-	5	1	6	6
Summer 96	"	-	-	-	-	-	-	-	1	-	-	1	22	5	7
Monsoon 96	"	-	-	-	-	-	-	-	1	1	1	2	2	6	8
Winter 95	<i>C. massiliensis</i>	-	-	8	-	10	-	18	-	-	3	-	7	1	24
Summer 96	"	-	-	-	-	-	-	-	-	2	1	-	3	8	13
Monsoon 96	"	-	-	-	-	-	-	-	1	-	1	1	1	4	4
Winter 95	<i>C. furca</i>	2	-	-	11	-	-	12	-	-	26	6	-	16	25
Summer 96	"	-	-	-	-	-	-	-	-	2	1	-	3	8	13
Monsoon 96	"	-	-	-	-	-	-	-	1	1	1	2	2	6	8
Winter 95	<i>Pyrocystis fusiformis</i>	-	1	-	3	10	11	20	-	-	39	-	22	3	3
Summer 96	"	-	-	-	-	-	-	-	-	-	-	-	2	11	16
Monsoon 96	"	-	-	-	-	-	-	-	-	-	-	1	3	7	8
Winter 95	<i>Noctiluca miliaris</i>	3	-	-	1	-	3	10	8	21	80	24	20	1	49
Summer 96	"	1	1	1	1	-	1	1	1	1	2	3	5	5	6
Monsoon 96	"	-	-	-	1	-	-	-	-	-	-	1	1	3	3

- Not recorded

Table 11

Seasonwise Distribution and Abundance (No./m<sup>3</sup>) of Zooplankton in Mandovi River/Estuary (Goa)

Season	Genera	Sampling Location													
		R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R15
	<b>Ciliata</b>														
Winter 95	<i>Tintinnopsis sp.</i>	-	-	-	-	1	1	-	5	-	8	3	9	14	18
Summer 96	"	-	-	-	-	-	-	-	1	1	6	3	4	2	14
Monsoon 96	"	-	-	-	-	-	-	-	-	1	2	1	1	1	3
Winter 95	<i>Favella sp.</i>	3	-	-	1	-	1	-	-	51	22	29	8	15	14
Summer 96	"	1	1	-	1	1	1	-	-	25	17	13	11	6	9
Monsoon 96	"	-	-	-	-	-	-	1	-	2	1	2	2	3	5
Winter 95	<i>Rhabdonella sp.</i>	-	-	-	-	-	1	-	-	-	-	1	-	1	4
Summer 96	"	-	-	-	-	-	-	-	-	-	-	-	1	1	3
Monsoon 96	"	-	-	-	-	-	-	-	-	-	-	-	-	1	2
	<b>Foraminifera</b>														
Winter 95	<i>Globigerina sp.</i>	-	-	-	-	-	-	1	-	-	-	1	1	2	1
Summer 96	"	-	-	-	-	-	-	-	-	-	-	-	-	2	2
Monsoon 96	"	-	-	-	-	-	-	-	-	-	-	-	-	1	2
	<b>Cnidaria</b>														
Winter 95	<i>Siphonophora sp.</i>	-	-	-	-	-	-	-	-	-	-	1	-	-	3
Summer 96	"	-	-	-	-	-	-	-	-	-	-	2	1	1	3
Monsoon 96	"	-	-	-	-	-	-	-	-	-	-	-	-	1	2

Table 11 (Contd...)

Season	Genera	Sampling Location													
		R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R15
	<b>Ctenophora</b>														
Winter 95	<i>Pleurobrachia sp.</i>	-	-	-	-	-	1	-	-	-	1	1	-	1	1
Summer 96	..	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Monsoon 96	..	-	-	-	-	-	-	-	-	-	-	-	-	-	1
	<b>Copepoda</b>														
Winter 95	<i>Undinula sp.</i>	-	-	-	-	-	-	-	3	11	4	3	14	13	16
Summer 96	..	-	-	-	-	-	-	-	5	9	7	2	1	1	2
Monsoon 96	..	-	-	-	-	-	-	-	1	1	1	1	1	1	2
Winter 95	<i>Acartia sp.</i>	-	-	-	-	-	-	-	-	-	-	-	24	-	23
Summer 96	..	-	-	-	-	-	-	-	-	-	-	-	1	1	2
Monsoon 96	..	-	-	-	-	-	-	-	-	-	1	-	2	2	4
Winter 95	<i>Temora sp.</i>	3	-	-	-	2	1	2	4	18	37	23	16	5	16
Summer 96	..	-	1	-	-	-	1	1	1	8	17	11	11	-	7
Monsoon 96	..	-	-	-	-	-	-	1	-	-	1	1	1	1	2
Winter 95	<i>Eutemora sp.</i>	-	-	-	-	-	-	2	-	-	-	6	10	7	15
Summer 96	..	-	-	-	-	-	-	-	-	-	-	-	3	1	3
Monsoon 96	..	-	-	-	-	-	-	-	-	-	-	-	1	1	2
Winter 95	<i>Oithona sp.</i>	-	-	-	-	3	4	5	3	25	17	24	12	8	8
Summer 96	..	-	-	-	-	-	-	-	5	3	5	20	15	12	5
Monsoon 96	..	-	-	-	-	-	-	-	-	-	2	6	11	7	10

Table 11 (Contd...)

Season	Genera	Sampling Location													
		R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R15
Winter 95	<i>O. plumifera</i>	-	-	-	-	-	1	-	-	-	2	-	5	-	28
Summer 96	..	-	-	-	-	-	-	-	-	-	-	-	1	1	3
Monsoon 96	..	-	-	-	-	-	-	-	-	-	-	-	-	1	2
Winter 95	<i>Euterpina sp.</i>	-	-	-	-	2	1	3	1	-	8	5	10	5	14
Summer 96	..	-	-	-	-	-	-	-	3	-	-	-	1	1	1
Monsoon 96	..	-	-	-	-	-	-	-	-	-	-	1	1	3	4
Winter 95	<i>Paracalanus sp.</i>	-	2	4	1	2	1	6	7	19	26	27	19	11	41
Summer 96	..	-	-	1	2	2	-	1	5	5	11	15	16	9	9
Monsoon 96	..	-	-	-	-	-	1	-	-	1	1	1	2	2	2
Winter 95	<i>Eucalanus sp.</i>	-	-	-	3	1	1	-	-	33	102	8	6	5	17
Summer 96	..	-	-	-	-	-	3	-	-	-	37	2	11	-	2
Monsoon 96	..	-	-	-	-	-	-	-	-	1	1	1	3	4	5
Winter 95	<i>Centropages sp.</i>	-	-	-	-	-	-	-	-	7	1	4	2	5	8
Summer 96	..	-	-	-	-	-	-	-	1	5	1	2	-	1	1
Monsoon 96	..	-	-	-	-	-	-	-	-	1	-	-	1	2	4
Winter 95	<i>Pseudocalanus sp.</i>	-	-	-	12	5	8	-	2	122	117	78	17	4	36
Summer 96	..	-	-	-	-	-	8	-	-	103	125	72	20	-	22
Monsoon 96	..	-	-	-	1	2	-	1	3	6	7	7	5	6	10

Table 11 (Contd...)

Season	Genera	Sampling Location													
		R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R15
Winter 95	<i>Macrosetella sp.</i>	-	2	-	-	-	-	1	-	6	10	8	8	9	15
Summer 96	"	-	-	-	-	-	-	-	-	1	6	6	6	4	5
Monsoon 96	"	-	-	-	-	-	-	-	-	-	-	1	2	1	2
Winter 95	<i>Microsetella sp.</i>	3	-	-	1	1	1	-	-	-	1	6	5	3	9
Summer 96	"	-	-	-	-	-	1	1	-	1	-	3	3	2	3
Monsoon 96	"	-	-	-	-	-	-	-	-	-	-	1	2	1	3
Winter 95	<i>Metridia sp.</i>	-	-	-	-	-	1	-	-	-	-	-	-	1	1
Summer 96	"	-	-	-	-	-	-	-	-	-	-	-	2	1	1
Monsoon 96	"	-	-	-	-	-	-	-	-	-	1	-	1	2	3
Winter 95	<i>Isias sp.</i>	-	-	1	-	-	-	1	1	1	-	4	1	1	1
Summer 96	"	-	-	-	-	-	-	-	-	-	-	2	-	1	2
Monsoon 96	"	-	-	-	-	-	-	-	-	-	-	-	2	2	5
Winter 95	<i>Candacia sp.</i>	-	-	-	-	-	-	1	-	-	-	6	-	-	2
Summer 96	"	-	-	-	-	-	-	-	-	-	-	4	1	-	3
Monsoon 96	"	-	-	-	-	-	-	-	-	-	-	-	-	1	2
Winter 95	<i>Canthocalanus sp.</i>	-	-	-	-	-	1	-	-	-	1	1	2	2	2
Summer 96	"	-	-	-	-	-	-	-	-	-	-	-	1	1	3
Monsoon 96	"	-	-	-	-	-	-	-	-	-	-	1	-	2	2

Table 11 (Contd...)

Season	Genera	Sampling Location													
		R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R15
Winter 95	<i>Nannocalanus sp.</i>	-	-	-	-	-	-	-	-	-	1	1	1	2	2
Summer 96	..	-	-	-	-	-	-	-	-	-	-	-	1	1	3
Monsoon 96	..	-	-	-	-	-	-	-	-	-	-	-	1	2	4
Winter 95	<i>Rhincalanus sp.</i>	-	-	-	2	1	1	-	1	19	7	11	5	1	10
Summer 96	..	-	-	-	-	-	-	1	3	1	2	5	4	7	11
Monsoon 96	..	-	-	-	-	-	-	1	-	-	-	3	2	4	6
Winter 95	<i>Microcalanus sp.</i>	-	-	-	-	-	-	1	-	-	-	-	1	4	7
Summer 96	..	-	-	-	-	-	-	-	-	-	-	-	1	-	1
Monsoon 96	..	-	-	-	-	-	-	-	-	-	-	-	-	2	2
Winter 95	<i>Parapontella sp.</i>	-	-	-	-	-	-	-	-	-	-	2	4	-	1
Summer 96	..	-	-	-	-	-	-	-	-	-	-	-	-	2	2
Monsoon 96	..	-	-	-	-	-	-	-	-	-	-	-	1	1	2
Winter 95	<i>Labidocera sp.</i>	-	-	-	1	-	-	-	-	-	-	-	-	3	4
Summer 96	..	-	-	-	-	-	-	-	-	-	-	-	1	2	3
Monsoon 96	..	-	-	-	-	-	-	-	-	-	-	-	-	1	2
Winter 95	<i>Oncaea sp.</i>	-	-	-	-	-	-	-	-	-	-	-	1	2	4
Summer 96	..	-	-	-	-	-	-	-	-	-	-	-	1	1	1
Monsoon 96	..	-	-	-	-	-	-	-	-	-	-	-	1	2	3

Table 11 (Contd...)

Season	Genera	Sampling Location													
		R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R15
Winter 95	<i>Heliodiaptomus sp.</i>	10	8	6	4	2	1	-	-	-	-	-	-	-	-
Summer 96	..	13	10	4	3	1	-	-	-	-	-	-	-	-	-
Monsoon 96	..	8	5	3	2	1	-	-	-	-	-	-	-	-	-
Winter 95	<i>Mesocyclops sp.</i>	4	5	8	2	4	2	-	-	-	-	-	-	-	-
Summer 96	..	4	6	7	4	3	-	-	-	-	-	-	-	-	-
Monsoon 96	..	7	4	3	1	1	-	-	-	-	-	-	-	-	-
Winter 95	<i>Microcyclops sp.</i>	3	3	3	4	2	1	-	-	-	-	-	-	-	-
Summer 96	..	4	4	2	7	4	-	-	-	-	-	-	-	-	-
Monsoon 96	..	6	3	2	1	1	-	-	-	-	-	-	-	-	-
Winter 95	<i>Diaptomus sp.</i>	3	5	2	2	3	2	-	-	-	-	-	-	-	-
Summer 96	..	-	1	1	1	1	-	-	-	-	-	-	-	-	-
Monsoon 96	..	3	3	1	1	1	-	-	-	-	-	-	-	-	-
	<b>Cladocera</b>														
Winter 95	<i>Penilia sp.</i>	-	-	-	-	-	1	2	-	-	-	2	3	6	10
Summer 96	..	-	-	-	-	-	-	-	-	-	-	-	-	2	2
Monsoon 96	..	-	-	-	-	-	-	-	-	-	-	-	-	3	2
Winter 95	<i>Evadne sp.</i>	-	-	-	-	-	-	-	-	-	8	2	2	4	8
Summer 96	..	-	-	-	-	-	-	-	-	-	5	-	2	2	3
Monsoon 96	..	-	-	-	-	-	-	-	-	-	-	-	1	6	4

Table 11 (Contd...)

Season	Genera	Sampling Location													
		R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R15
Winter 95	<i>Moina sp.</i>	4	4	3	2	1	-	-	-	-	-	-	-	-	-
Summer 96	..	3	3	3	1	1	-	-	-	-	-	-	-	-	-
Monsoon 96	..	4	3	1	2	1	-	-	-	-	-	-	-	-	-
Winter 95	<i>Daphnia sp.</i>	5	4	3	5	1	1	-	-	-	-	-	-	-	-
Summer 96	..	5	5	5	3	1	-	-	-	-	-	-	-	-	-
Monsoon 96	..	6	4	2	3	1	-	-	-	-	-	-	-	-	-
Winter 95	<i>Macrothrix sp.</i>	3	2	3	3	3	1	-	-	-	-	-	-	-	-
Summer 96	..	3	4	4	2	1	-	-	-	-	-	-	-	-	-
Monsoon 96	..	4	2	1	1	1	-	-	-	-	-	-	-	-	-
	<b>Rotifera</b>														
Winter 95	<i>Brachionus sp.</i>	4	2	1	1	1	1	-	-	-	-	-	-	-	-
Summer 96	..	6	4	3	2	-	-	-	-	-	-	-	-	-	-
Monsoon 96	..	7	4	2	1	1	-	-	-	-	-	-	-	-	-
Winter 95	<i>Keratella sp.</i>	3	2	1	1	-	-	-	-	-	-	-	-	-	-
Summer 96	..	3	2	2	1	1	-	-	-	-	-	-	-	-	-
Monsoon 96	..	5	3	2	1	1	-	-	-	-	-	-	-	-	-
Winter 95	<i>Polyarthra sp.</i>	5	4	1	1	1	-	-	-	-	-	-	-	-	-
Summer 96	..	2	3	1	1	1	-	-	-	-	-	-	-	-	-
Monsoon 96	..	3	2	1	1	-	-	-	-	-	-	-	-	-	-

Table 11 (Contd...)

Season	Genera	Sampling Location													
		R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R15
	<b>Pteropoda</b>														
Winter 95	<i>Creseis acicula</i>	-	-	-	1	-	1	1	-	-	-	2	3	2	7
Summer 96	"	-	-	-	-	-	-	-	-	-	-	-	1	-	2
Monsoon 96	"	-	-	-	-	-	-	-	-	-	-	-	1	2	2
Winter 95	<i>Creseis sp.</i>	1	-	-	1	-	1	11	1	14	6	5	4	5	13
Summer 96	"	-	-	-	-	-	-	1	1	1	2	1	3	3	3
Monsoon 96	"	-	-	-	-	-	-	-	-	-	-	-	1	3	3
	<b>Appendicularia</b>														
Winter 95	<i>Oikopleura sp.</i>	2	-	-	-	-	-	-	-	-	-	-	1	3	4
Summer 96	"	-	-	-	-	-	-	-	-	-	1	-	1	1	1
Monsoon 96	"	-	-	-	-	-	-	-	-	-	-	-	-	1	2
	<b>Larval Forms</b>														
Winter 95	<i>Brachiopoda</i>	-	-	-	-	-	-	1	-	4	-	-	4	-	6
Summer 96	"	-	-	-	-	-	-	-	1	1	-	-	-	1	1
Monsoon 96	"	-	-	-	-	-	-	-	-	-	-	-	1	2	2
Winter 95	<i>Polychaeta</i>	-	-	-	-	-	-	-	-	4	-	-	8	2	1
Summer 96	"	-	-	-	-	8	-	-	1	1	-	-	1	1	3
Monsoon 96	"	-	-	-	-	-	-	-	-	-	-	-	1	1	1

Table 11 (Contd...)

Season	Genera	Sampling Location													
		R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R15
Winter 95	<i>Copepoda</i>	17	81	44	68	34	27	50	38	156	170	199	59	94	129
Summer 96	..	10	13	19	22	11	9	20	26	105	118	139	25	24	35
Monsoon 96	..	3	2	3	1	1	1	-	1	3	4	6	16	19	34
Winter 95	<i>Cirripedia</i>	-	-	2	1	1	-	-	-	-	8	3	2	16	6
Summer 96	..	-	-	-	1	-	-	-	-	1	7	-	6	1	6
Monsoon 96	..	-	-	-	-	-	-	-	-	-	-	1	1	2	4
Winter 95	<i>Arachnactis</i>	-	-	-	-	-	-	1	-	-	-	-	1	1	1
Summer 96	..	-	-	-	-	-	-	-	-	-	-	-	1	1	2
Monsoon 96	..	-	-	-	-	-	-	-	-	-	-	-	-	1	1
Winter 95	<i>Bivalvia</i>	58	-	-	-	-	2	1	-	1	1	-	-	30	6
Summer 96	..	1	1	-	-	1	3	-	3	1	-	1	1	1	4
Monsoon 96	..	-	-	1	-	1	1	-	1	1	-	3	3	4	3
Winter 95	<i>Gastropoda</i>	3	5	-	-	1	4	10	-	19	8	29	4	13	5
Summer 96	..	6	5	-	1	16	1	5	-	7	1	13	3	3	6
Monsoon 96	..	1	1	-	1	1	2	1	2	1	1	4	3	4	7
Winter 95	<i>Fish eggs and Larvae</i>	61	19	184	29	31	20	45	72	154	142	27	63	14	65
Summer 96	..	33	13	11	21	21	20	27	49	93	107	35	43	17	39
Monsoon 96	..	19	9	10	8	12	11	8	17	20	18	17	15	18	26

- Not recorded

Table 12

Seasonwise Distribution and Abundance (No./10 cm<sup>2</sup>) of Meiobenthos in Mandovi River/Estuary (Goa)

Season	Group	Sampling Location													
		R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R15
Winter 95	Foraminifera	21	10	2	12	-	40	44	5	28	29	34	35	47	43
Summer 96	..	35	3	4	4	-	20	39	4	34	24	27	30	32	60
Monsoon 96	..	3	-	-	-	-	-	2	1	1	6	7	6	12	16
Winter 95	Diatom	115	105	75	37	-	27	62	52	98	35	137	158	122	122
Summer 96	..	155	127	27	39	-	8	79	67	126	42	43	218	145	159
Monsoon 96	..	55	44	10	18	-	10	20	21	29	18	19	41	38	60
Winter 95	Nematoda	76	38	21	19	-	46	81	22	56	85	44	56	90	58
Summer 96	..	106	46	29	32	-	28	94	23	54	95	28	23	66	31
Monsoon 96	..	13	12	9	10	-	17	26	6	12	30	15	8	16	15
Winter 95	Turbellaria	2	-	3	1	-	-	18	18	2	9	-	4	11	1
Summer 96	..	4	-	3	-	-	5	26	15	3	9	-	5	3	2
Monsoon 96	..	-	-	-	-	-	-	2	1	2	1	1	3	1	5
Winter 95	Polychaeta	32	10	2	7	-	14	26	19	80	45	24	56	38	19
Summer 96	..	49	12	4	11	-	6	36	22	91	55	9	82	69	29
Monsoon 96	..	6	1	1	-	-	3	3	3	5	15	16	5	20	10
Winter 95	Bivalvia	-	5	1	9	-	3	-	2	16	5	2	4	20	23
Summer 96	..	-	-	1	3	-	4	-	4	16	9	3	5	14	26
Monsoon 96	..	-	1	1	1	-	1	-	-	-	1	1	4	4	11

Table 12 (Contd...)

Season	Group	Sampling Location													
		R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R15
Winter 95	Ostracoda	20	18	5	2	-	2	5	3	23	14	27	18	25	26
Summer 96	..	31	29	-	-	-	1	7	3	29	22	16	26	42	42
Monsoon 96	..	4	2	-	-	-	-	-	1	4	3	2	3	7	10
Winter 95	Amphipoda	-	-	-	-	-	2	4	5	-	6	1	6	8	1
Summer 96	..	-	-	-	-	-	-	5	7	-	4	-	3	11	3
Monsoon 96	..	-	1	-	-	-	-	-	1	1	1	1	3	4	6
Winter 95	Copepoda	6	-	2	6	-	5	18	18	3	15	8	5	7	8
Summer 96	..	7	1	3	7	-	8	27	22	9	12	12	9	12	13
Monsoon 96	..	5	8	8	4	-	8	5	10	10	4	2	4	4	10
Winter 95	Isopoda	-	-	2	-	-	-	4	3	-	7	2	4	10	4
Summer 96	..	-	-	2	-	-	1	6	3	-	9	3	7	17	4
Monsoon 96	..	-	-	-	-	-	-	-	-	-	1	3	1	3	4
Winter 95	Cumacea	-	-	4	-	-	2	1	-	-	5	3	-	-	1
Summer 96	..	-	-	3	-	-	3	-	-	-	8	4	-	1	2
Monsoon 96	..	-	-	-	-	-	-	1	-	1	1	2	2	2	2
Winter 95	Crustaceans	11	3	8	4	-	2	16	19	11	7	-	-	14	25
Summer 96	..	15	3	13	11	-	4	24	21	13	9	-	1	-	38
Monsoon 96	..	5	2	4	5	-	3	5	4	4	4	5	6	9	11

Table 12 (Contd...)

Season	Group	Sampling Location													
		R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R15
Winter 95	Arachnactis	25	18	8	24	-	4	37	26	14	-	23	4	19	1
Summer 96	..	9	1	-	8	-	4	10	28	17	-	3	6	1	5
Monsoon 96	..	-	-	-	-	-	-	-	-	-	-	-	-	1	1
Winter 95	Fish egg	36	33	28	31	-	8	15	15	23	21	42	78	62	37
Summer 96	..	30	27	12	18	-	12	23	21	29	5	30	86	33	66
Monsoon 96	..	19	48	18	22	-	10	10	12	8	6	9	7	16	23

- Not recorded

Table 13

Seasonwise Distribution and Abundance (No./m<sup>2</sup>) of Macrobenthos in Mandovi River/Estuary (Goa)

Season	Group	Sampling Location													
		R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R15
Winter 95	Foraminifera	-	-	-	-	-	-	-	-	-	-	-	29	-	37
Summer 96	"	-	-	-	-	-	-	-	-	-	-	-	44	1	56
Monsoon 96	"	-	-	-	-	-	-	-	-	-	-	4	7	4	12
Winter 95	Porifera	-	3	7	2	-	2	4	-	-	2	-	1	4	-
Summer 96	"	-	1	5	3	-	2	1	-	-	-	-	1	9	7
Monsoon 96	"	-	-	-	1	-	-	-	-	-	1	1	2	1	2
Winter 95	Coelenterata	-	-	-	-	-	-	-	-	-	-	-	7	-	22
Summer 96	"	-	-	-	-	-	-	-	-	-	-	-	8	-	29
Monsoon 96	"	-	-	-	-	-	-	-	-	-	-	-	1	3	5
Winter 95	Nematoda	1	11	25	13	-	6	6	20	18	17	8	5	3	5
Summer 96	"	2	21	26	19	-	7	8	20	25	12	8	3	14	11
Monsoon 96	"	1	3	2	4	-	1	-	1	3	3	3	2	1	4
Winter 95	Polychaeta	38	36	43	42	-	51	32	43	22	76	15	75	65	67
Summer 96	"	7	9	25	20	-	34	51	53	28	25	-	13	24	15
Monsoon 96	"	1	1	2	4	-	7	5	7	5	3	1	1	3	2
Winter 95	Gastropoda	17	-	-	15	-	-	10	-	-	-	32	23	33	73
Summer 96	"	7	1	-	-	-	-	-	-	-	-	27	-	34	71
Monsoon 96	"	-	-	1	-	-	-	1	2	1	3	1	2	6	11

Table 13 (Contd...)

Season	Group	Sampling Location													
		R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R15
Winter 95	Bivalvia	35	15	8	53	-	-	-	5	-	-	8	15	68	47
Summer 96	"	-	-	-	-	-	-	1	6	3	-	1	16	94	67
Monsoon 96	"	-	-	-	-	-	-	1	5	1	4	5	7	12	16
Winter 95	Harpacticoida	-	-	-	-	-	-	-	-	-	-	-	18	-	64
Summer 96	"	-	-	-	-	-	-	-	-	-	-	-	3	-	53
Monsoon 96	"	-	-	-	-	-	-	-	-	-	1	2	1	3	4
Winter 95	Cumacea	-	-	-	-	-	1	-	-	-	-	-	3	-	4
Summer 96	"	-	-	-	-	-	-	-	-	-	-	-	1	-	2
Monsoon 96	"	-	-	-	-	-	-	-	-	-	-	-	-	1	2
Winter 95	Tanaidacea	-	-	-	-	-	-	-	-	-	43	32	3	32	25
Summer 96	"	-	-	-	-	-	-	-	-	-	-	41	-	45	6
Monsoon 96	"	-	-	-	-	-	-	-	-	-	-	3	1	6	2
Winter 95	Isopoda	6	-	-	-	-	-	-	-	-	-	26	6	29	10
Summer 96	"	6	1	-	1	-	-	1	-	-	-	34	1	42	2
Monsoon 96	"	-	-	1	-	-	-	-	-	-	-	4	2	3	4
Winter 95	Amphipoda	-	-	-	-	-	1	-	-	-	-	34	1	54	35
Summer 96	"	-	-	-	-	-	-	1	-	-	-	49	-	38	52
Monsoon 96	"	-	-	-	-	-	-	-	-	-	1	11	3	4	16

Table 13 (Contd...)

Season	Group	Sampling Location													
		R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R15
Winter 95	Ostracoda	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Summer 96	..	-	-	-	-	-	-	-	1	-	-	-	1	1	2
Monsoon 96	..	-	-	-	-	-	-	-	-	-	1	3	1	2	3
Winter 95	Stomatopoda	-	-	-	-	-	1	-	-	-	-	-	-	-	-
Summer 96	..	-	-	-	-	-	-	-	-	-	-	-	1	-	2
Monsoon 96	..	-	-	-	-	-	-	-	-	-	-	-	-	1	2
Winter 95	Mysidacea	-	-	-	-	-	-	-	-	-	-	-	23	-	55
Summer 96	..	-	-	-	-	-	-	-	-	-	1	-	31	-	67
Monsoon 96	..	-	-	-	-	-	-	-	-	-	-	-	-	2	4
Winter 95	Decapoda	9	-	-	-	-	-	-	-	-	-	104	147	-	201
Summer 96	..	9	-	1	-	-	-	-	-	-	-	106	156	3	209
Monsoon 96	..	-	-	-	-	-	-	-	-	-	2	6	14	4	12
Winter 95	Pisces	-	-	-	-	-	1	-	-	-	-	-	-	-	37
Summer 96	..	1	-	-	-	-	1	-	-	-	1	1	7	2	46
Monsoon 96	..	5	3	3	4	-	1	2	2	4	3	4	8	7	11
Winter 95	Prawn Larvae	6	-	-	-	-	-	-	-	-	-	-	-	-	-
Summer 96	..	8	1	-	1	-	-	-	-	-	-	3	3	6	25
Monsoon 96	..	1	-	-	1	-	1	2	1	2	3	4	4	8	13

Table 13 (Contd...)

Season	Group	Sampling Location													
		R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R15
Winter 95	Worms & Others	5	11	8	13	-	3	3	10	-	6	-	17	10	9
Summer 96	..	9	15	10	20	-	5	3	12	-	11	-	19	18	16
Monsoon 96	..	4	5	1	4	-	2	3	4	2	2	5	9	7	11
Winter 95	Gastrotricha	1	-	1	1	-	1	1	2	1	-	-	1	1	1
Summer 96	..	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Monsoon 96	..	-	-	-	-	-	-	-	-	-	-	-	-	-	-

- Not recorded

Table 14

## Seasonwise Variation of Density of Various Nektons (No/hauls) in Mandovi River/Estuary (Goa)

Season	Species	Sampling Location													
		R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R15
	<b>Finfish</b>														
Winter 95	<i>Ambassis commersonii</i>	-	-	-	3	-	1	21	5	-	4	2	3	2	2
Summer 96	..	-	-	-	7	5	11	16	1	2	12	2	-	1	4
Monsoon 96	..	-	-	-	5	1	1	5	2	1	1	2	4	2	5
Winter 95	<i>Ambassis dussumieri</i>	-	-	-	-	-	-	5	-	-	-	-	-	-	1
Summer 96	..	-	-	-	-	-	1	1	-	-	-	-	-	3	-
Monsoon 96	..	-	-	-	-	1	-	1	1	-	1	1	1	2	-
Winter 95	<i>Awaous grammepomus</i>	1	1	-	1	-	1	-	-	-	-	-	-	-	-
Summer 96	..	1	-	1	-	-	-	-	-	-	-	-	-	-	-
Monsoon 96	..	1	1	1	1	-	-	-	-	-	-	-	-	-	-
Winter 95	<i>Barilius evezardi</i>	1	1	-	-	-	-	-	-	-	-	-	-	-	-
Summer 96	..	1	1	1	1	-	-	-	-	-	-	-	-	-	-
Monsoon 96	..	1	1	-	1	-	-	-	-	-	-	-	-	-	-
Winter 95	<i>Cynoglossus puncticeps</i>	-	-	-	-	-	1	-	-	-	1	-	1	1	1
Summer 96	..	-	-	-	-	-	1	-	1	1	-	-	-	1	-
Monsoon 96	..	1	-	-	1	-	-	-	-	-	-	-	-	1	-

Table 14 (Contd...)

Season	Species	Sampling Location													
		R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R15
Winter 95	<i>Danio devario</i>	2	4	1	1	-	-	-	-	-	-	-	-	-	-
Summer 96	"	4	-	-	-	-	-	-	-	-	-	-	-	-	-
Monsoon 96	"	2	1	1	-	-	-	-	-	-	-	-	-	-	-
Winter 95	<i>Etrepus suratensis</i>	-	-	-	1	-	-	-	1	-	-	1	1	-	-
Summer 96	"	-	-	-	1	-	-	-	1	-	1	1	-	-	-
Monsoon 96	"	1	-	-	-	-	-	-	-	-	-	-	1	-	-
Winter 95	<i>Garra gotyla gotyla</i>	1	1	-	-	-	-	-	-	-	-	-	-	-	-
Summer 96	"	1	1	-	-	-	-	-	-	-	-	-	-	-	-
Monsoon 96	"	1	-	1	1	-	-	-	-	-	-	-	-	-	-
Winter 95	<i>Gonoproktopterus thomassi</i>	-	1	1	-	-	-	-	-	-	-	-	-	-	-
Summer 96	"	-	1	-	-	-	-	-	-	-	-	-	-	-	-
Monsoon 96	"	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Winter 95	<i>Labeo kawrus</i>	2	1	-	-	-	-	3	-	-	-	-	-	-	3
Summer 96	"	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Monsoon 96	"	1	1	-	-	-	-	-	-	-	-	-	-	-	-
Winter 95	<i>Leiognathus blochii</i>	-	-	-	-	-	-	-	-	-	-	-	1	1	-
Summer 96	"	-	-	-	-	-	-	1	1	-	-	1	-	4	1
Monsoon 96	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 14 (Contd...)

Season	Species	Sampling Location													
		R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R15
Winter 95	<i>Mugil cephalus</i>	2	1	2	-	-	-	-	-	1	1	1	-	-	1
Summer 96	"	-	-	-	-	1	-	-	-	1	-	-	-	-	-
Monsoon 96	"	-	-	-	-	-	-	-	-	-	-	-	-	1	-
Winter 95	<i>Nemacheilus rubidipinnis</i>	1	1	1	1	-	-	-	-	-	-	-	-	-	-
Summer 96	"	5	3	2	1	-	-	-	-	-	-	-	-	-	-
Monsoon 96	"	2	1	1	2	-	-	-	-	-	-	-	-	-	-
Winter 95	<i>Osteobrama dayi</i>	4	2	1	-	-	-	-	-	-	-	-	-	-	-
Summer 96	"	1	1	1	-	-	-	1	-	1	-	-	1	-	-
Monsoon 96	"	2	1	1	3	-	-	-	-	-	-	-	-	-	-
Winter 95	<i>Pseudorhombus arsius</i>	1	-	-	-	-	-	3	-	-	-	-	1	1	1
Summer 96	"	1	-	1	-	1	2	-	-	-	-	-	1	1	1
Monsoon 96	"	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Winter 95	<i>Paruciosoma daniconius</i>	3	3	1	2	-	-	-	-	-	-	-	-	-	-
Summer 96	"	2	1	1	-	-	-	-	-	-	-	-	-	-	-
Monsoon 96	"	2	1	-	1	-	-	-	-	-	-	-	-	-	-
Winter 95	<i>Puntius filamentosus</i>	4	3	1	-	-	-	-	-	-	-	-	-	-	-
Summer 96	"	1	1	-	-	-	-	-	-	-	-	-	-	-	-
Monsoon 96	"	2	1	1	1	-	-	-	-	-	-	-	-	-	-

Table 14 (Contd...)

Season	Species	Sampling Location													
		R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R15
Winter 95	<i>P. amphibus</i>	-	1	-	-	-	-	-	-	-	-	-	-	-	-
Summer 96	..	1	1	1	-	-	-	-	-	-	-	-	-	-	-
Monsoon 96	..	1	-	-	1	-	-	-	-	-	-	-	-	-	-
Winter 95	<i>P. nigrofasciatus</i>	-	1	-	-	-	-	-	-	-	-	-	-	-	-
Summer 96	..	1	2	1	-	-	-	-	-	-	-	-	-	-	-
Monsoon 96	..	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Winter 95	<i>P. ophiocephalus</i>	2	-	-	-	-	-	-	-	-	-	-	-	-	-
Summer 96	..	1	1	-	-	-	-	-	-	-	-	-	-	-	-
Monsoon 96	..	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Winter 95	<i>P. arulius</i>	-	1	-	-	-	-	-	-	-	-	-	-	-	-
Summer 96	..	2	3	1	-	-	-	-	-	-	-	-	-	-	-
Monsoon 96	..	1	-	1	-	-	-	-	-	-	-	-	-	-	-
Winter 95	<i>Rasbora neilgherriensis</i>	3	-	2	-	-	-	-	-	-	-	-	-	-	-
Summer 96	..	5	2	3	4	-	-	-	-	-	-	-	-	1	-
Monsoon 96	..	1	2	2	-	-	-	-	1	-	-	-	-	-	-
Winter 95	<i>Sieyepeterus graseus</i>	-	-	1	-	-	-	-	-	-	-	-	1	1	1
Summer 96	..	1	1	2	-	-	-	-	-	-	-	-	-	-	-
Monsoon 96	..	-	1	1	-	-	-	-	-	-	-	-	-	-	-

Table 14 (Contd...)

Season	Species	Sampling Location													
		R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R15
Winter 95	<i>Scatophagus argus</i>	-	-	-	-	-	-	-	1	1	1	1	1	1	1
Summer 96	..	-	-	-	1	1	-	-	-	-	1	1	1	-	1
Monsoon 96	..	-	-	-	-	1	-	-	-	-	-	-	-	-	-
Winter 95	<i>Sillago sihama</i>	-	-	-	-	1	-	1	-	-	-	1	1	1	1
Summer 96	..	-	-	-	-	1	1	-	-	-	1	-	-	-	-
Monsoon 96	..	-	-	-	-	-	1	-	-	-	-	-	-	-	-
Winter 95	<i>Stenogobius gymnopomus</i>	1	1	1	2	1	1	-	1	1	3	-	1	2	-
Summer 96	..	-	-	-	1	-	1	-	-	-	-	-	1	2	1
Monsoon 96	..	-	-	-	-	1	-	1	-	-	-	-	-	-	1
Winter 95	<i>Teuthis vermiculata</i>	-	-	-	-	-	-	3	2	1	-	1	1	1	1
Summer 96	..	-	-	-	-	-	-	1	-	-	-	2	1	-	3
Monsoon 96	..	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Winter 95	<i>Chanos chanos</i>	-	-	-	-	-	-	-	1	-	-	-	1	-	1
Summer 96	..	1	-	1	-	-	-	-	-	-	-	-	-	-	-
Monsoon 96	..	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	<b>Shell Fish</b>														
Winter 95	<i>Macrobrachium maicoimsonii</i>	3	2	1	6	-	1	-	-	-	-	-	-	-	-
Summer 96	..	1	2	2	3	-	-	-	1	1	-	-	-	-	-
Monsoon 96	..	4	1	4	6	1	1	-	1	-	-	1	-	-	-

Table 14 (Contd...)

Season	Species	Sampling Location													
		R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R15
Winter 95	<i>Metapenaeus affinis</i>	-	-	-	-	-	-	1	1	1	-	7	1	3	1
Summer 96	"	-	-	-	-	-	-	1	-	-	1	-	-	-	-
Monsoon 96	"	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Winter 95	<i>M. monoceros</i>	-	-	-	-	-	1	6	3	2	-	1	2	1	3
Summer 96	"	-	-	-	1	1	1	2	2	-	-	1	-	1	1
Monsoon 96	"	-	-	-	2	1	3	1	1	-	1	1	1	1	-
Winter 95	<i>M. dobsoni</i>	-	-	-	1	-	1	4	1	2	1	1	1	1	1
Summer 96	"	-	-	-	1	2	7	1	1	3	-	4	1	4	-
Monsoon 96	"	-	-	-	1	-	-	2	1	1	-	-	1	-	4
Winter 95	<i>Penaeus marguiensis</i>	-	-	-	1	2	1	4	2	2	-	1	1	-	1
Summer 96	"	-	-	-	1	-	5	1	-	-	-	1	4	-	3
Monsoon 96	"	-	-	-	-	-	-	1	-	-	-	-	-	-	-
Winter 95	<i>P. indicus</i>	-	-	-	-	-	1	1	-	1	-	-	-	-	2
Summer 96	"	-	-	-	1	-	1	1	2	-	-	-	-	2	-
Monsoon 96	"	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Winter 95	<i>Scylla serrata</i>	-	-	-	1	-	-	-	1	1	1	1	1	1	-
Summer 96	"	-	-	-	-	-	-	-	-	-	-	-	-	1	-
Monsoon 96	"	-	-	-	-	-	1	-	-	-	-	-	-	-	-

Table 14 (Contd...)

Season	Species	Sampling Location													
		R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R15
Winter 95	Unidentified (small crab)	-	-	-	5	-	-	-	-	-	-	-	-	-	-
Summer 96	"	-	-	-	4	-	-	-	-	-	-	-	-	-	
Monsoon 96	"	-	-	-	1	-	-	-	-	-	-	-	-	-	
Winter 95	<i>Macrobrachium rude</i>	1	3	1	5	-	-	-	-	-	-	-	-	-	
Summer 96	"	-	-	-	2	-	-	-	-	-	-	-	-	-	
Monsoon 96	"	1	1	1	4	-	1	1	-	-	-	-	-	-	
Winter 95	<i>Villorita cyprinoides</i>	1	-	-	2	-	-	-	-	-	-	-	-	-	
Summer 96	"	-	-	1	1	-	-	-	-	-	-	-	-	-	
Monsoon 96	"	-	-	-	2	-	-	-	-	-	-	-	-	-	
Winter 95	<i>Meretrix meretrix</i>	-	-	-	-	-	-	-	-	-	-	-	1	2	
Summer 96	"	-	-	-	-	-	-	-	-	-	-	-	-	1	
Monsoon 96	"	-	-	-	-	-	-	-	-	-	-	-	-	-	
Winter 95	<i>M. casta</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	
Summer 96	"	-	-	-	-	-	-	-	-	-	-	-	2	-	
Monsoon 96	"	-	-	-	-	-	-	-	-	-	-	-	-	-	
Winter 95	<i>Paphia malabarica</i>	-	-	-	-	-	-	-	-	-	-	-	-	1	
Summer 96	"	-	-	-	-	-	-	-	-	-	-	-	-	2	
Monsoon 96	"	-	-	-	-	-	-	-	-	-	-	-	-	-	

- Not recorded

## Cluster Analysis Technique

### 1. Classification Using Cluster Analysis Technique

In statistics, the search for relatively homogeneous groups of objects is called cluster analysis. In biology, this technique is used to classify animals and plants. In this the concepts of distance and similarity are basic since cases are grouped on the basis of their nearness. There are many different definitions of distance and similarity. Selection of a distance measure is based both on the properties of the measure and on the algorithm for cluster formation.

#### 1.1 Distances and Similarities

Some of the most common measures are as follows.

##### 1.1.1 Squared Euclidian Distance

The distance between two cases is the sum of the squared differences over all the variables i.e.,

$$\text{Distance (X,Y)} = \sum (X_i - Y_i)^2.$$

where X and Y are the cases and i is the value of the case for ith species available for that case.

This measure is dependent on the unit of measurement (in this case it is abundance of the species) for the variables. One means of circumventing this problem is to express all variables in standardized form that is all variables are converted to have a mean 0 and a standard deviation of 1.

##### 1.1.2 Euclidian Distance

The distance found by taking the square root of the sum of the squared differences in values for each variable is known as the Euclidian distance.

$$\text{Distance (X,Y)} = \sqrt{\sum (X_i - Y_i)^2}$$

### 1.1.3 Chebyshev Distance

The distance between two cases is the maximum absolute difference in values for any variable.

$$\text{Distance}(X, Y) = \text{Max} | X_i - Y_i |$$

## 1.2 Methods of forming Clusters

A commonly used method for forming clusters is **hierarchical cluster analysis** using one of two methods: **agglomerative**, or **divisive**. In agglomerative hierarchical clustering, clusters are formed by grouping cases into bigger and bigger clusters until all cases are members of a single cluster. Divisive hierarchical clustering starts out with all cases grouped into a single cluster and splits clusters until there are as many clusters as there are cases.

One of the simplest methods of clustering is **single linkage**. The first two cases combined are those that have the smallest distance (or largest similarity) between them. The distance between the new cluster and individual cases is then computed as the minimum distance between an individual case and a case in the cluster. At every step, the distance between two clusters is the distance between their two closest points.

Another commonly used method is called **complete linkage** in which the distance between two clusters is calculated as the distance between their two furthest points.

The **unweighted pair group method using arithmetic averages (UPGMA)** is another common method. In this method distance between two clusters is defined as the average of the distances between all pair of cases. The members of each pair consist of a element from each cluster. For example, if cases 1 and 2 form Cluster A and 3 and 4 form Cluster B then the average of the distances between all pairs of cases: (1,3),(1,4),(2,3),(2,4) is taken to be the distance between Clusters A and B. This method is also called **average linkage between group method**. This method uses information for all pairs of distances, not just the nearest or furthest.

A variant of the preceding method, the **average linkage within groups (ALWG)**, combines clusters so that the average distance between all cases in the resulting cluster is as small as possible. Thus the distance between two clusters is taken to be the average of the distances between all possible pairs of cases in the resulting cluster.

### 1.3 Performing a Cluster Analysis

The first step therefore is to calculate the distance coefficient matrix. Once the distance matrix has been calculated, the actual formation of clusters commence. Cluster formation continues until all cases are merged into a single cluster.

One way of visually representing the steps in a hierarchical clustering solution is with a display called a **dendrogram**. The dendrogram indicates not only which clusters are joined but also the distance at which they are joined. The dendrogram produced by the SPSS CLUSTER procedure do not plot actual distances but rescales them to numbers between 0 and 25.

Different stations with different dates of sampling were considered as an individual case for clustering for example 3DEC represents station no 3R sampled during the month of December. In statistics this is referred as Q-technique of clustering.

The R technique of cluster analysis has been used to identify homogeneous groups of zooplankton species. Here, the species are grouped using the value of the correlation coefficient among all pairs of species as a measure of similarity.

Rescaled Distance Cluster Combine

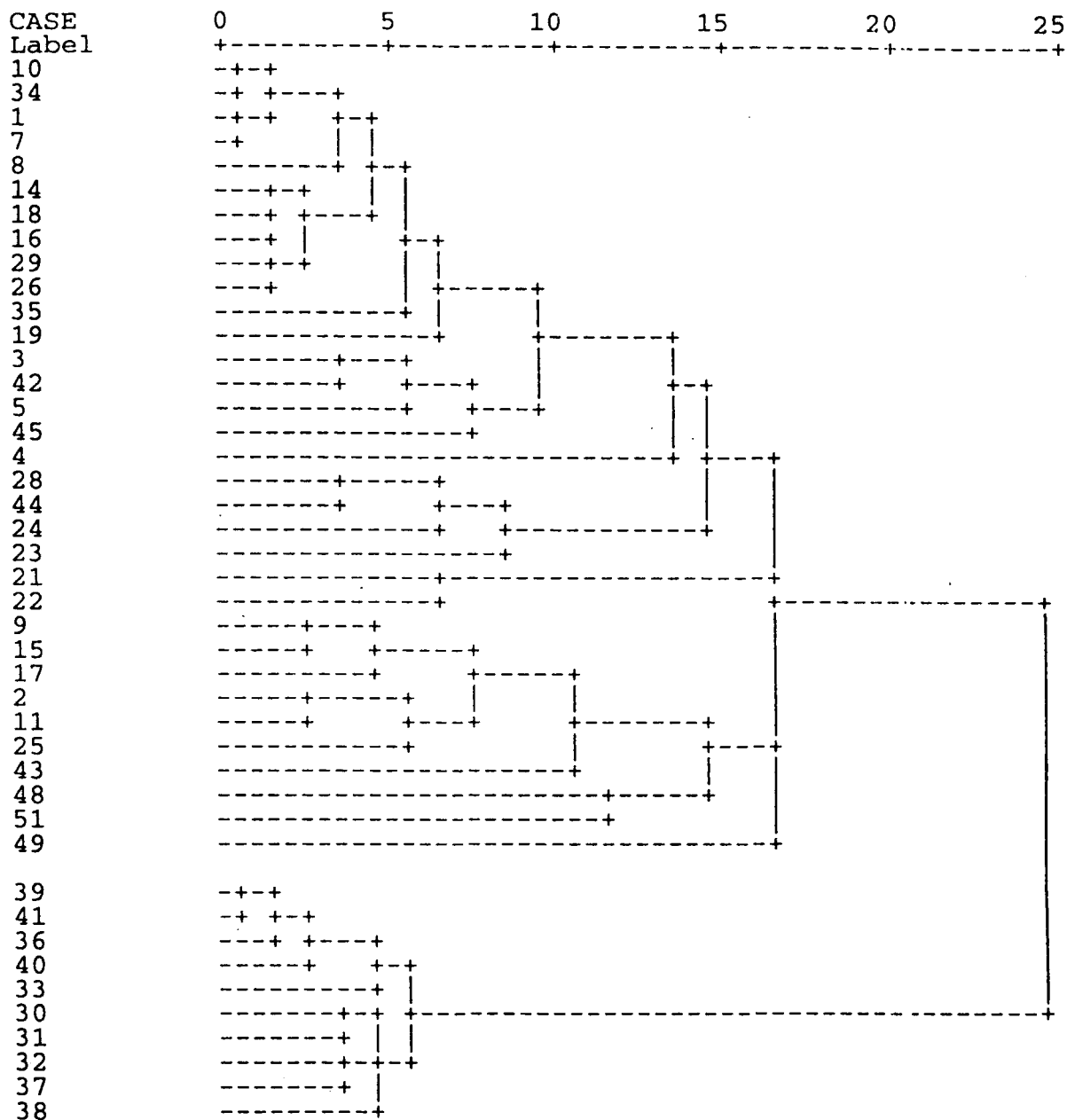


Fig. 1 : Dendrogram Results of Cluster Analysis (Q-technique) using Average Linkage (Between Groups) for Zooplankton during Winter Season

Rescaled Distance Cluster Combine

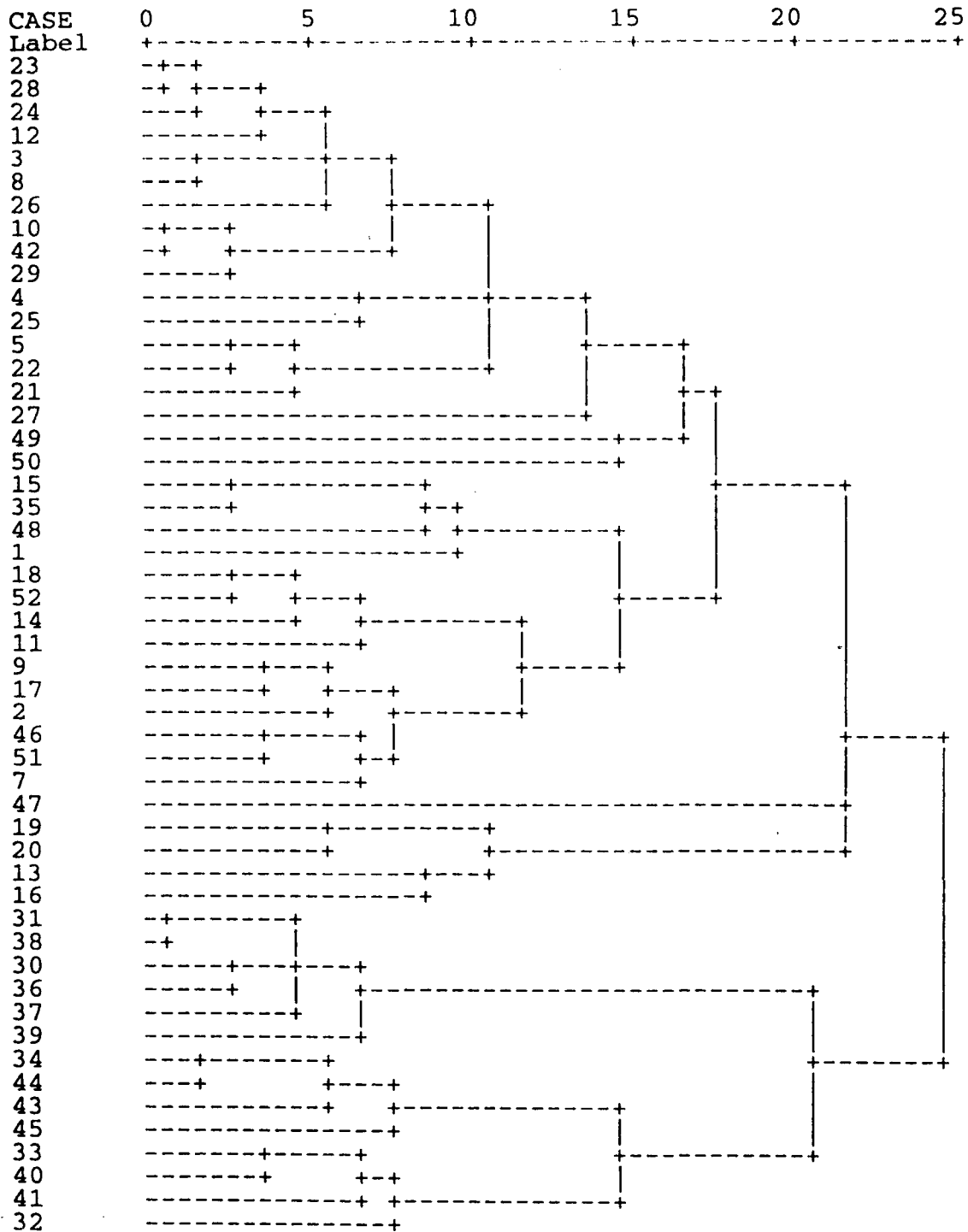


Fig. 2 : Dendrogram Results of Cluster Analysis (Q-technique) using Average Linkage (Between Groups) for Zooplankton during Summer Season

Rescaled Distance Cluster Combine

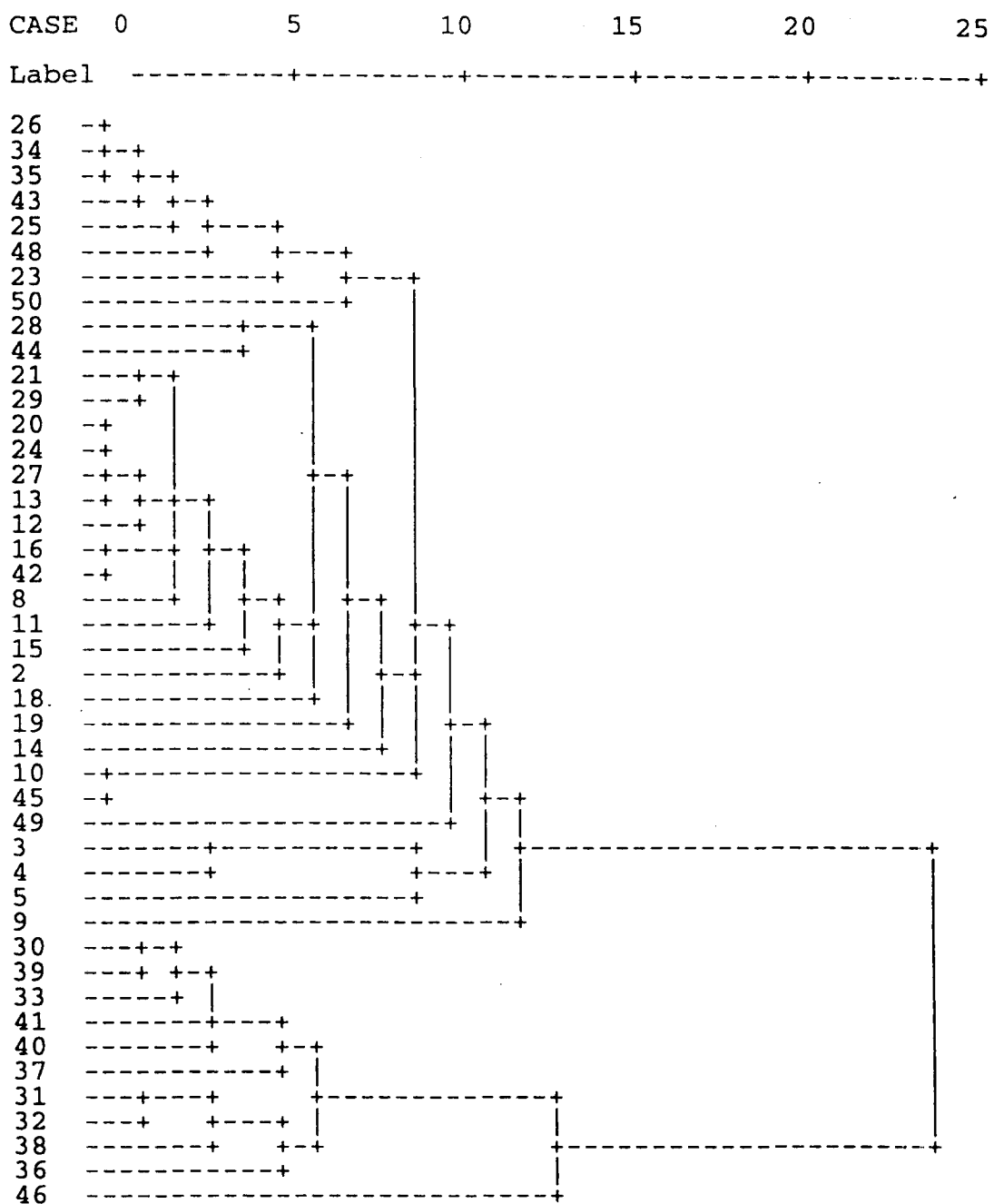


Fig. 3 : Dendrogram Results of Cluster Analysis (Q-technique) using Average Linkage (Between Groups) for Zooplankton during Monsoon Season

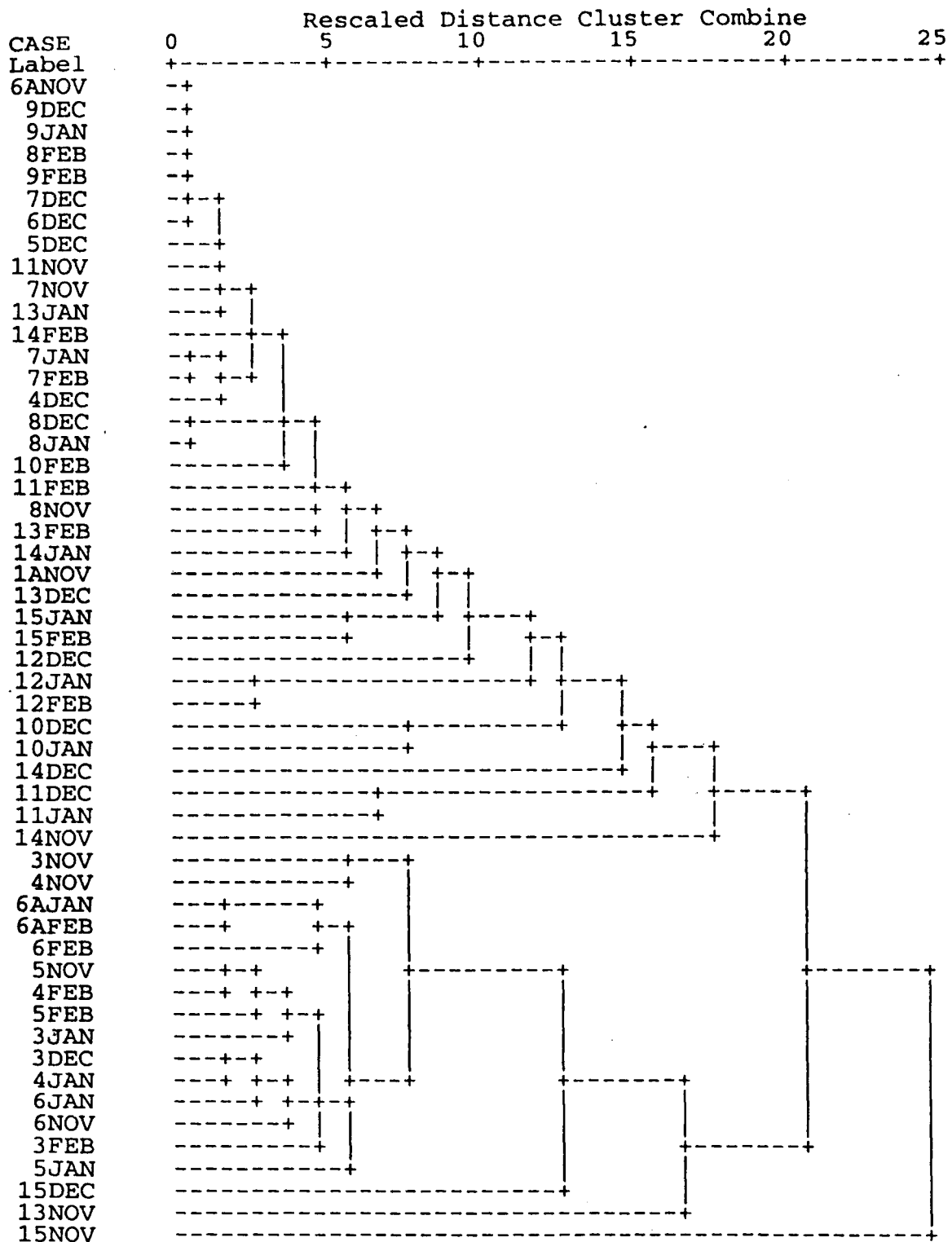


Fig. 4 : Dendrogram results of Cluster Analysis (R-Technique) using Average Linkage (Within Group) for Zooplankton during Winter Season

Rescaled Distance Cluster Combine

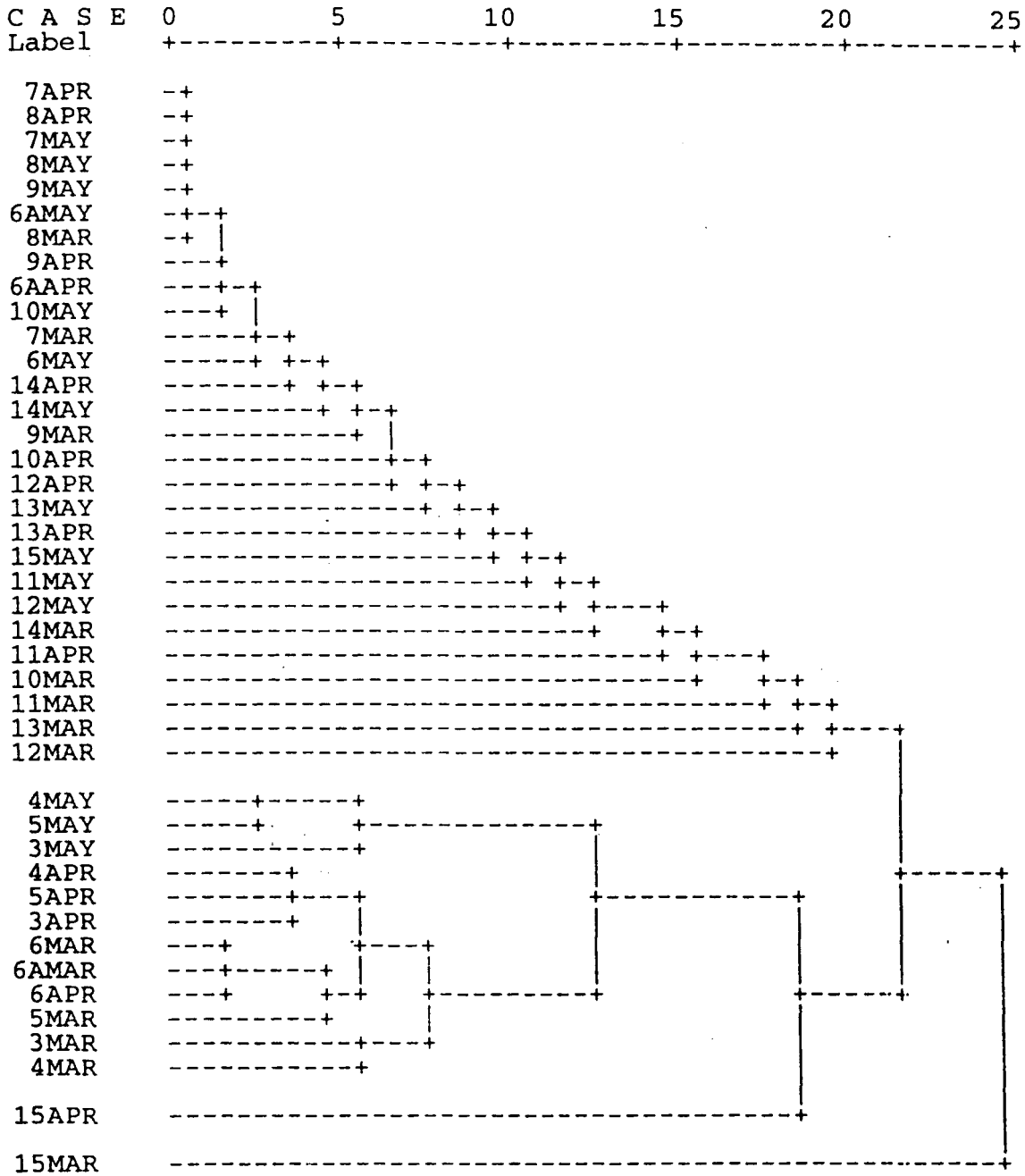
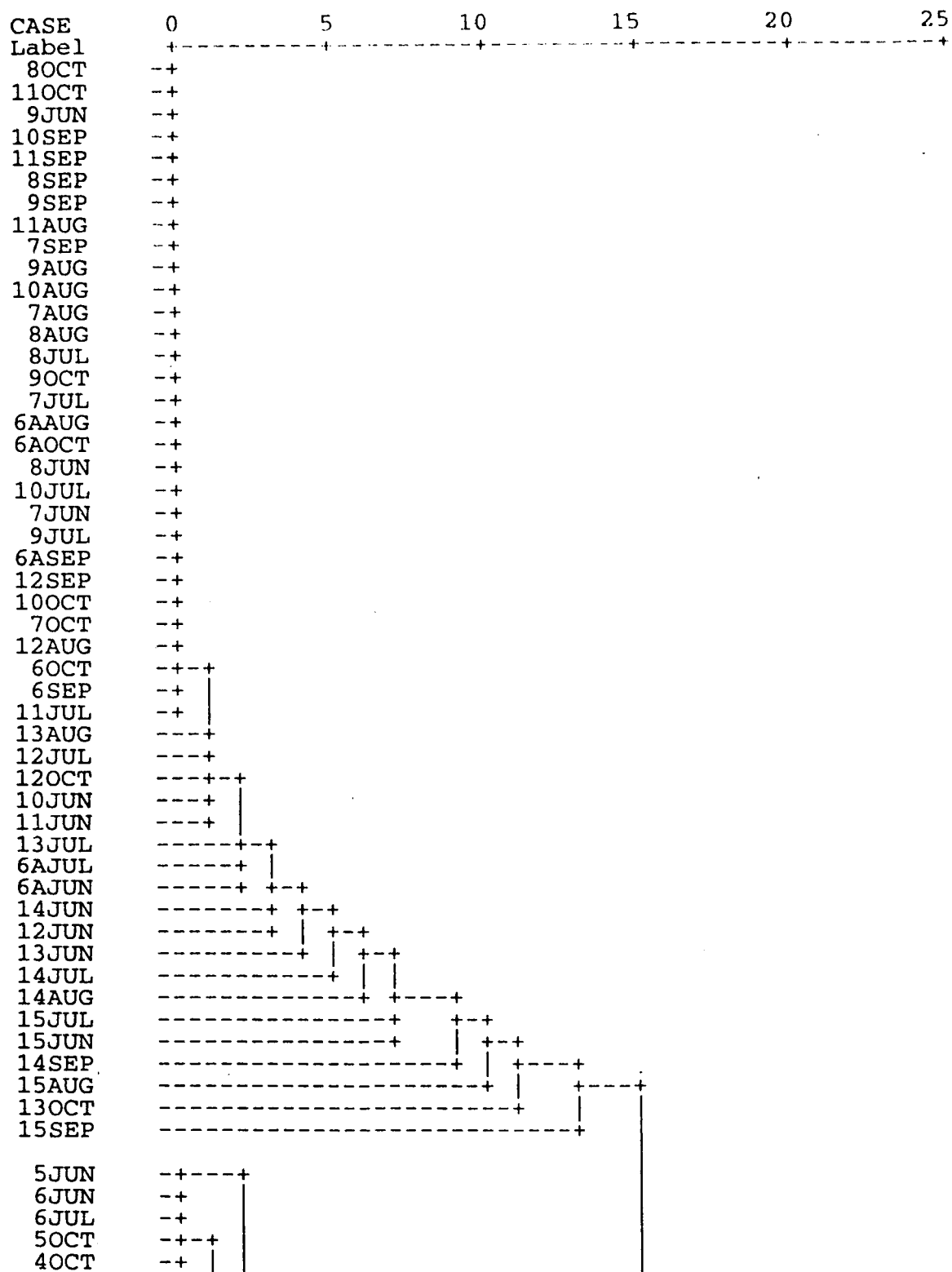


Fig. 5 : Dendrogram results of Cluster Analysis (R-Technique) using Average Linkage (Within Group) for Zooplankton during Summer Season

Rescaled Distance Cluster Combine



contd...

Fig. 6 : Dendrogram results of Cluster Analysis (R-Technique) using Average Linkage (Within Group) for Zooplankton during Monsoon Season

Fig. 6 contd...

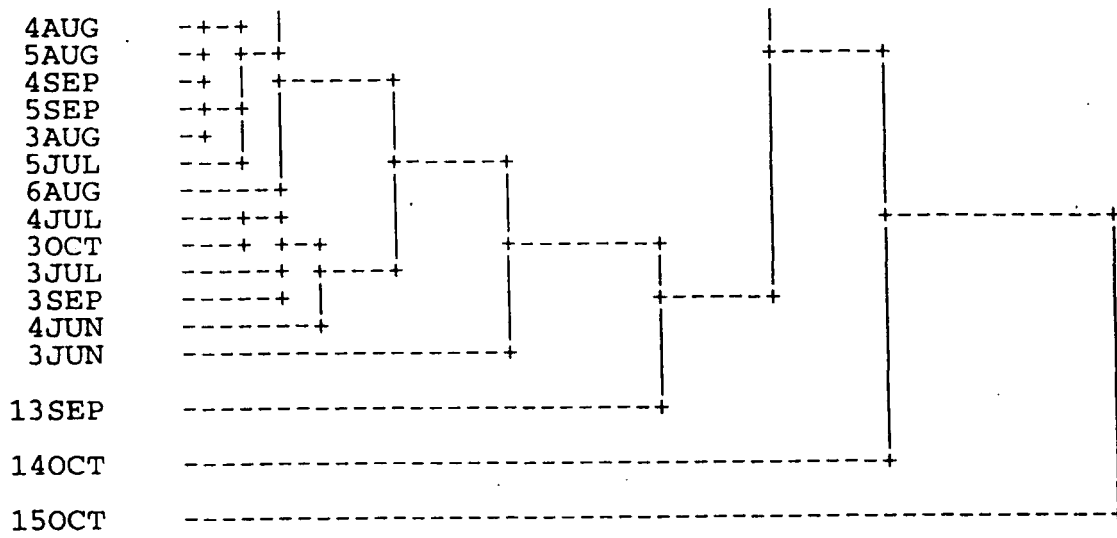


Table 1

## Demographic Structure of the Study Area - Mahadayi River Basin (Belgaum District)

Village	Total Area (in ha)	Total Households	Total Polulation	Male	Female	Total SC Population	Male	Female	Total Literates	Male	Female	Total Main Workers	Male	Female
Asoga	572.66	175	1022	503	519	124	54	70	400	263	137	368	254	114
Kirawale	999.46	37	210	102	108	Nil	-	-	79	50	29	107	55	52
Ambewadi	496.04	24	144	77	67	2	1	1	81	54	27	74	41	33
Dongargaon	1546.79	70	395	183	212	2	1	1	130	87	43	202	107	95
Abanali	1178.42	40	254	123	131	6	3	3	56	48	8	129	69	60
Hemmadage	3327.88	99	530	263	267	42	22	20	157	109	48	264	147	117
Degaon	666.55	18	104	49	55	Nil	-	-	5	3	2	54	25	29
Mendil	1409.36	18	133	68	65	Nil	-	-	23	19	4	64	31	33
Holada	1252.55	6	33	18	15	Nil	-	-	5	2	3	12	11	1
Pastolli	692.62	16	108	54	54	Nil	-	-	18	15	3	60	28	32
Gawali	5309.61	84	420	195	225	4	3	1	38	33	5	225	110	115
Jamagoaon	1481.30	41	240	118	122	13	6	7	26	22	4	152	73	79
Kongla	1249.89	51	272	145	127	Nil	-	-	60	36	24	140	71	69
Nerase	1987.04	321	1614	820	794	143	75	68	399	288	111	838	491	347
Teregali	747.93	45	187	94	93	18	9	9	4	24	18	114	57	57
Tivoli	1003.88	154	905	463	442	12	7	5	480	308	172	507	241	266
Manturge	1255.53	205	1047	514	533	24	12	12	499	311	188	541	292	249

Table 1 (Contd...)

Village	Total Area (in ha)	Total Households	Total Population	Male	Female	Total SC Population	Male	Female	Total Literates	Male	Female	Total Main Workers	Male	Female
Nilavade	372.87	86	437	199	238	65	38	27	188	112	76	260	117	143
Amboli	672.98	108	637	328	309	25	12	13	109	82	27	385	204	181
Kabanali	927.17	26	138	71	67	Nil	-	-	58	36	22	52	43	09
Kawale	----- Uninhabited -----													
Mugawadi	1155.94	65	297	143	154	33	15	18	122	73	49	147	84	63
Kopoli ki Chapoli	755.22	95	320	263	257	Nil	-	-	152	96	56	338	182	156
Chapali	2889.50	79	444	212	232	25	11	14	78	59	19	232	113	119
Amagaon	3410.21	58	279	129	150	Nil	-	-	60	41	19	159	76	83
Kanjale	316.28	47	246	126	120	Nil	-	-	107	82	25	140	75	65
Chikhale	2275.65	144	664	302	362	9	3	3	174	17	57	356	170	186
Total	37953.33	2112	11080	5562	5518	547	272	272	3546	2270	1176	5552	2913	2639

Source : 1991 Census

Notes : 1) SC - Scheduled Caste

2) The Scheduled Tribe Population is only in 2 villages as:

Nerase - 1 Male

Nilavada - 84 Males and 71 Females = 155 Total

3) Information for villages Kankanivada, Bandekarvadi are not available (Ref. Fig.1)

Table 2

**Demographic Structure of the Study Area - Mahadayi River Basin  
(Belgaum District) - A Summary**

No. Of Taluka	1
Name of Taluka	Khanapur
Total Area	37953.33 Hectare
Total no. Of Households	2112
Total Population	11080
Male	5562 (50.2%)
Female	5518 (49.8%)
Sex ratio	992
Density	291
Total SC	547 (4.93%)
Total ST	Nil
Total literates	3546 (32%)
Total main workers	5552 (50%)

Source : 1991 Census

**Table 3**  
**Demographic Structure of the Study Area - Mandovi River Basin (Goa District)**

Sl. No.	Name of Village	Area	Household	Total Population	Total Population		SC Population		ST Population		Literates		Total Workers	
					Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
<b>Rural</b>														
1.	Surla	1478.77	79	352	154	198	0	0	0	0	71	51	61	51
2.	Nanorem	368.09	49	235	119	116	0	0	0	0	79	42	69	47
3.	Pole	793.54	179	915	450	465	0	0	0	0	261	162	206	91
4.	Navgvem	343.39	33	213	114	99	34	36	0	0	55	24	56	39
5.	Malon	561.76	68	338	174	164	0	0	0	0	108	52	76	31
6.	Sonali	306.91	64	370	180	190	0	0	0	0	120	102	87	34
7.	Velguem	652.35	216	1099	546	553	0	0	0	0	298	158	287	133
8.	Birondem	277.56	72	348	165	183	6	5	0	0	131	106	98	30
9.	Cumbarjua	240.15	740	4239	2170	2069	10	14	0	0	1802	1345	1001	238
10.	Osgao	355.37	731	3669	1866	1803	4	3	0	0	1530	1174	943	301
11.	Beteui	628.71	263	1601	834	767	30	27	0	0	667	431	360	53
12.	Valvoi	133.14	333	1996	10112	984	0	0	0	0	901	695	484	146
13.	Ganjem	541.05	101	537	294	243	13	60	0	0	230	160	142	26
14.	Usgao	2545.84	1978	9822	5154	468	55	37	2	0	3681	2466	2652	672
15.	Bondir	795.52	247	1182	594	588	8	13	0	0	278	183	318	167
16.	Verem	4410.31	229	961	514	447	3	7	0	0	172	86	369	292
17.	Piligao	818.05	472	2632	1312	1320	21	29	0	0	1032	715	694	306
18.	Amone	734.06	510	2826	1448	1378	44	37	0	0	1168	851	795	304
<b>Urban</b>														
19.	Old Goa	13.36	2028	10474	5313	5161	61	51	0	0	4216	3407	2550	816
	<b>Total</b>	<b>15997</b>	<b>8392</b>	<b>43809</b>	<b>22413</b>	<b>21396</b>	<b>289</b>	<b>265</b>	<b>2</b>	<b>0</b>	<b>16800</b>	<b>12210</b>	<b>11248</b>	<b>3777</b>

Source : 1991 Census

Notes : SC - Scheduled Caste; ST - Scheduled Tribe

Annexure 4.8 (Contd...)

Table 4

Demographic Structure of the Study Area - Mandovi River Basin (Goa) - A Summary

No. of Taluka	6
Name of Taluka	Satari, Tiswadi, Ponda, Panaji, Bicholim, Sanguem
No. of Villages	18 (1 urban area - Old Goa)
Total Area	15997 Hectare
Total no. Of Households	8392
Total Population	43809
Male	22413
Female	21396
Sex ratio	954
Density	273
Total SC	554 (1.26%)
Total ST	2
Total literates	29010 (66.21%)
Male	16800 (74.95%)
Female	12144 (42.15%) (57.33%)
Total main workers	15025 (34.29%)

Source : 1991 Census

Table 5

## Infrastructure in the Study Area - Mahadayi River Basin (Belgaum District)

Village	Education	Medical	Drinking Water	Post & Telegraph	Market	Communication	Approach	Nearest Town	Power Supply
Asoga	P	-(5)	W, HP	-(5)	-(5)	-(5)	KR	Khanapur	EA
Mendil	P	-(10+)	O	-(10+)	-(10+)	-(10+)	KR	Khanapur	EA
Holada	-(5)	-(10+)	R	-(10+)	-(10+)	-(10+)	KR	Khanapur	EA
Pastoli	P	-(5-10)	O	-(5)	-(5-10)	-(5-10)	KR	Khanapur	EA
Jamagaon	P	-(5-10)	W	-(5-10)	-(10+)	-(5-10)	KR	Khanapur	EA
Kongala	P	-(10+)	W	-(5-10)	-(10+)	-(10+)	KR	Khanapur	EA
Nerese	P <sub>3</sub> M <sub>2</sub>	-(5-10)	W, HP	-(5-10)	-(10+)	-(10+)	KR	Khanapur	EA
Teregali	P	-(5-10)	W, HP	-(5-10)	-(10+)	-(5-10)	KR	Khanapur	EA
Tivoli	P <sub>3</sub> M	-(5-10)	W,HP	-(5-10)	-(5-10)	-(5-10)	KR	Khanapur	ED
Manturge	P <sub>2</sub> M	-(5)	W,HP	PO	-(5)	-(5)	KR	Khanapur	ED
Nilawade	P <sub>2</sub> M	-(5-10)	W	-(5)	-(5-10)	BS	KR	Khanapur	-
Kabanali	P	-(10+)	W	-(5)	-(10+)	-(5)	KR	Khanapur	-
Ambali	P <sub>2</sub>	-(5-10)	W	-(5-10)	-(5-10)	-(5)	KR	Khanapur	-
Mugawada	P	-(5-10)	W	-(5)	-(5-10)	-(5)	KR	Khanapur	-
Kapoli ki Chapoli	P <sub>2</sub>	-(5)	W	-(5)	-(5)	-(5)	KR	Khanapur	-
Chapoli	P	-(10+)	W,HP	-(5)	-(10+)	-(5)	KR	Khanapur	-
Amagaon	P	-(5-10)	W	-(5-10)	-(5-10)	-(5)	KR	Khanapur	-

Table 5 (Contd...)

Village	Education	Medical	Drinking Water	Post & Telegraph	Market	Communication	Approach	Nearest Town	Power Supply
Gawase	P	-(5-10)	W	-(5-10)	-(5)	KR	KR	Khanapur	-
Chikhale	P	-(5)	W	-(5-10)	-(10+)	-(5-10)	KR	Khanapur	-
Kanjali	P	-(10+)	W	-(5-10)	-(10+)	-(5-10)	KR	Khanapur	-
Kirawale	P <sub>2</sub>	-(5)	W,HP	-(5)	-(10+)	-(5)	KR	Khanapur	-
Ambewadi	P	-(5)	W	-(5)	-(10+)	-(5)	KR	Khanapur	-
Dongargaon	P	-(5-10)	W	-(5-10)	-(10+)	-(5)	KR	Khanapur	-
Abanali	P	-(5)	W,HP	-(5)	-(10+)	-(5)	KR	Khanapur	-
Hemmadage	P <sub>2</sub>	-(5-10)	W,HP	PO	-(10+)	-(5-10)	KR	Khanapur	
Degaon	P	-(10+)	R	-(5-10)	-(10+)	-(10+)	KR	Khanapur	

Source : 1991 Census

Notes : Amexities available (if not available within the village, a dash (-) is shown in the column and next to it in brackets, the distance in kms., in broad ranges, viz - 5 km, 5-10 km and 10+ km of the nearest place where the facility is available is given.

P - Primary or Elementary School

M - Junior Secondary or Middle School

T - Tap Water; W - Well Water

TK - Tank Water; HP - Hand Pump

R - River Water; O - Others

KR - Kutcha Road

ED - Electricity for Domestic Purpose

EA - Electricity for all Purposes

Table 6

## Commonly Prevalent Diseases among the Population in Belgaum (1995)

Sl. No.	Name of Disease	No. of Cases in the Month						
		June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1.	Upper respiratory disease	40	45	50	55	54	56	60
2.	Lower respiratory disease	40	40	45	50	56	58	60
3.	Urinary tract infection	30	35	50	45	48	52	62
4.	Malaria	-	-	-	-	-	-	-
5.	Filaria	-	-	-	-	-	-	-
6.	Fungal infections	38	40	46	48	38	40	46
7.	Scabies	53	56	48	63	70	74	78
8.	Pyodemic lesions, (infections)	64	68	72	78	84	88	86
9.	Worm infections	100	100	100	90	96	98	92
10.	Dyspeptic symptoms like higher acidity diseases	80	86	88	82	84	88	84
11.	Oesophagitis	40	42	48	48	46	41	42
12.	Gastric Ulcer	40	42	48	48	46	41	42
13.	Arthritis	60	62	65	68	66	64	68
14.	Protein Energy malnutrition	100	100	98	99	96	99	98
15.	All vitamins deficiency diseases vit 'A' common (Deficiency)	80	77	64	68	68	60	68
16.	Goitre iodine deficiency	8	10	12	13	14	16	12
17.	Diarrhoea	34	38	40	32	36	30	28
18.	Gastro enteritis	52	44	48	46	25	35	28
19.	Arthritis	46	48	52	66	68	66	72
20.	Myalgia	74	78	82	88	86	82	80
21.	Leucossohoea (White discharge)	40	44	48	46	40	43	46
22.	Moderate to severe anaemia	100	98	99	96	94	92	96
23.	Ringworm infections	40	42	46	47	46	40	48
24.	Tinea varisicolor white patches	40	42	46	47	46	40	48
25.	Asthama	8	12	14	16	18	20	24

Source : Primary Health Centre (PHC), Kanakumbi (Belgaum)

Table 7

## Commonly Prevalent Diseases among the Population in Betki, Goa (1995)

Sl. No.	Name of Disease	No. of Cases in the Month					
		July	Aug.	Sept.	Oct.	Nov.	Dec.
1.	Diarrhoeal diseases	87	76	66	26	25	21
2.	Pulmonary tuberculosis	6	7	6	-	7	5
3.	Ascariasis	54	52	18	-	-	1
4.	Diabetis	29	12	-	13	8	4
5.	Nutritional deficiencies	37	41	15	32	22	19
6.	Anaemias	30	45	40	37	-	-
7.	Neurotic disorders	52	54	43	12	17	17
8.	Diseases of eye	276	226	389	270	267	203
9.	Diseases of ear	24	22	39	12	12	8
10.	Hypertension	41	36	-	31	31	30
11.	Chronic obstructive Pul. diseases	24	43	-	-	29	31
12.	Upper respiratory infection	213	101	145	83	68	101
13.	Bronchitis	62	-	59	53	58	61
14.	Asthma	41	3	51	-	11	-
15.	Diseases and condition of teeth	76	71	127	119	210	102
16.	Gastritis and deodenities	43	84	79	-	-	-
17.	Disorder of liver	32	-	-	-	-	-
18.	Urinary tract infection	42	51	43	42	-	34
19.	Infection of skin	29	342	51	58	44	35
20.	Arthritis	42	47	58	-	-	-
21.	Low back ache	26	37	-	-	-	-
22.	Fever and headache	122	109	130	-	7	6
23.	Abdominal pain	23	29	29	-	-	-
24.	General debility	78	45	91	6	-	-
25.	Infected wound	32	23	36	94	51	41
26.	Menstrual disorder	1	-	-	-	-	-
27.	Early labour	3	1	2	2	2	-
28.	Skin ulcer	1	8	-	-	-	-
29.	Birth trauma	2	1	-	-	1	4
30.	Renal colics	1	-	-	-	-	-
31.	Injuries 2 snaketribe	28	28	49	5	3	18
32.	Bronche pneumonia	1	2	-	-	-	-
33.	Delivery	-	1	-	-	3	2
34.	Tonsillites	-	1	-	-	-	-

Source : Primary Health Centre, Betki (Goa)

**Annexure 4.8 (Contd...)**

**Questionnaire for Establishing Quality of Life**

* Village Name	:	
* Name	:	
* Sex	:	Male/Female
* Age (Years)	:	
* Education	:	Illiterate/Primary/Secondary/College
* Caste	:	SC/ST/Other
<b>Housing</b>		
* House type	:	(K/S/P)
* Courtyard	:	(Y/N)
* Rented House	:	(Y/N)
* No. of Rooms	:	
* Family Size	:	
* Satisfaction about Housing	:	HS/SA/NE/NS/HU
* Expenditure on Housing/Month (Rs.)	:	
<b>Education</b>		
* No. of Literates in the Family	:	
* Satisfaction about Education Facility	:	HS/SA/NE/NS/HU
<b>Employment &amp; Working Conditions</b>		
* No. of Family Members Employed	:	
* No. Of Family Members Employed in Village or Outside	:	
* Occupation	:	Unemployed/Farmer/Service/ Business/Labour
* Working Condition (Safety)	:	Very Good/Good/Neutral/Bad/ Very Bad
* Job Satisfaction	:	HS/SA/NE/NS/HU
* Satisfaction with the Wages and Perks	:	HS/SA/NE/NS/HU
<b>Income</b>		
* Family Income including all sources Rs./Month	:	
* Per Capita Income, Rs./Month	:	
* Can you suggest avenues for increasing income	:	
* Satisfaction with Income	:	HS/SA/NE/NS/HU

HS : Highly Satisfied  
NS : Not Satisfied

SA : Satisfied  
HU : Highly Unsatisfied

NE : Neutral

## Annexure 4.8 (Contd...)

<b>Clothing</b>	
* Expenditure on Clothing for Family Members per year Rs.	:
* Expenditure on Clothing per month Rs.	:
* Avg. Pair of Dresses Purchased per Member per year	:
* Satisfaction about Clothing	: HS/SA/NE/NS/HU
<b>Nutrition</b>	
* Staple Food	: Rice/Wheat
* Supplimentary Diet	:
* Quantity of Milk used per day (lit.)	:
* Quantity of Vegetables used per day (kg.)	:
* Expenditure on Food/Month (Rs.)	:
* Satisfaction about Nutrition	: HS/SA/NE/NS/HU
<b>Health</b>	
* No. of Family Members with Permanent Diseases	:
* Type of Disease	:
* Most Common Ailment in the Family	: Cough/Cold/Dysentery/Diarrhea/Malaria/Other
* Any specific discomfort due to activity	: Y/N
* Expenditure on Health/Month (Rs.)	:
* Type of Medical Facility Availled	: Govt./Private
* Satisfaction with the Health Status	: HS/SA/NE/NS/HU
* Satisfaction with the Medical Facilities	: HS/SA/NE/NS/HU
<b>Transportation</b>	
* No. Of Vehicles in the Family	:
* Expenditure on Transportation/Month (Rs.)	:
* Satisfaction with the Transportation Facilities	: HS/SA/NE/NS/HU
<b>Communication</b>	
* Satisfaction with Communication Facilities viz; Post Office / Telecom Office etc.	: HS/SA/NE/NS/HU

Annexure 4.8 (Contd...)

<b>Energy</b>		
*	Cooking Fuel	: Wood/Kerosene/LPG/Cow-Dung
*	Electricity Bill per month (Rs.)	:
*	Expenditure on Cooking Fuel, (Rs./Month)	:
*	Satisfaction with the Fuel-Availability	: HS/SA/NE/NS/HU
*	Satisfaction with the Electricity Supply	: HS/SA/NE/NS/HU
<b>Water Supply &amp; Sanitation</b>		
*	Source of Water Supply	: Well/HP/Tap/River
*	Satisfaction with Water Supply (Quality)	: HS/SA/NE/NS/HU
*	Satisfaction with Water Supply (Quantity)	: HS/SA/NE/NS/HU
*	Satisfaction with Sanitation Facilities	: HS/SA/NE/NS/HU
*	Satisfaction with Drainage Facilities	: HS/SA/NE/NS/HU
<b>Environment &amp; Pollution</b>		
*	Main Difficulties Experienced	: Air Pollution/ Water Pollution/ Noise Pollution/ Garbage Disposal
*	Satisfaction with the Physical Environment of the Area	: HS/SA/NE/NS/HU
*	Satisfaction with the Social Environment in the village (Alcoholism/ Drugs/ Gambling/ Vandalism)	: HS/SA/NE/NS/HU
*	Satisfaction with the Aesthetic Environment	: HS/SA/NE/NS/HU
<b>Recreation</b>		
*	What is your idea of Recreation	:
*	Availability of Recreation Facility at Home	: Radio/TV/VCR/Newspaper/Library
*	Frequency of Visiting Recreation Centres (Cinema, Club, Picnic, Mela)	: Daily/Weekly/Monthly/Yearly/ Not at all
*	Expenditure on Recreation	:
*	Satisfaction with the Recreation Facilities	: HS/SA/NE/NS/HU
<b>Social Security</b>		
*	Type of Saving	: Bank/PO/LIC/GPF/ Purchase of Gold & Silver
*	Amount of Saving per month	:
*	Feeling of Security with the Saving	: HS/SA/NE/NS/HU
*	Satisfaction with the Police Protection	: HS/SA/NE/NS/HU

Annexure 4.8 (Contd...)

*	Any Specific Problem Faced	Terrorism/Naxalisms/ Arson & Riots
*	Satisfaction with the Life Security in general	HS/SA/NE/NS/HU
<b>Human Rights</b>		
*	Do you go for voting at the time of election	Yes/No
*	Do you have the liberty to vote for the candidate of your choice	Yes/No
*	Satisfaction with the working of your elected local village representative (Sarpanch)	HS/SA/NE/NS/HU
*	Satisfaction with the working of your elected representative (MLA/MP)	HS/SA/NE/NS/HU
*	Satisfaction with the Basic Provision & made by the Govt.	HS/SA/NE/NS/HU
*	Satisfaction with the Priviledges on the basis of Caste/Religion/Income Group	HS/SA/NE/NS/HU

## Annexure 4.8 (Contd..)

### Methodology Followed for Evaluating Quality of Life (QOL)

In the present study an exercise has been carried out to assess the Quality of Life (QOL) in the study area. The concept and the details of the study are :

QOL is defined as a function between "objective conditions" and "subjective attitudes" involving a defined "area" of concern.

The "objective conditions" are defined as numerically measurable artifacts of a physical event, sociological event or economic event. Objective conditions may be defined as any number which stands for a given quantity of variable of interest so long as it is independent of subjective opinion.

"Subjective attitude" is primarily concerned with affective and cognitive dimensions. It is specifically concerned with how aspects of cognition vary as objective conditions vary'.

Once objective measures are obtained for each factor they are transformed to a normal scale varying from 0 to 1 (value function curve) in which 0 corresponds to the lowest and 1 to the highest. Weights are assigned to each factor by pairwise comparison technique by the expert group based on the secondary data and general observations.

For each objective measure, a corresponding subjective measure is developed for each individual of the sample population by asking him to rate his satisfaction with the objective measure for each factor. Again, the 0 to 1 scale (value function curve) is used. Weights are assigned to each factor using ranked-pairwise comparison technique.

#### The Socio-economic Indicators for QOL Assessment are:

1. Employment and Working Condition, Income
2. Housing
3. Food
4. Clothing
5. Water Supply and Sanitation
6. Health

7. Energy
8. Transportation and Communication
9. Education
10. Environment and Pollution
11. Recreation
12. Social Security
13. Human Rights

### I. Objective Quality of Life

$$QOL_0 = \sum_{i=1}^n QI_i \times W_i$$

Where,  $QOL_0$  - Objective Quality of Life Index  
 $n$  = No. of QOL Factors  
 $i = 1, \dots, n$   
 $QI_i$  - Satisfaction level (assigned by the expert group) for the  $i^{th}$  objective indicator.  
 $W_i$  - Normalized Weight of the  $i^{th}$  factor

### II. Subjective Quality of Life

$$QOL_s = 1/p \sum_{i=1}^m \sum_{j=1}^p QI_{ij} \times W_i$$

Where,  $QOL_s$  - Subjective Quality of Life Index  
 $p$  = No. of Respondents,  $j=1, \dots, p$   
 $m$  = No. of Factors,  $i=1, \dots, m$   
 $QI_{ij}$  - Subjective Quality Index (VFC) for  $i^{th}$  factor assigned by  $j^{th}$  respondent  
 $\sum QI_{ij}$  - Subjective Quality Index (VFC) for  $i^{th}$  factor assigned by all respondents in an area  
 $W_i$  - Weight of the  $i^{th}$  factor

### III. Quality of Life

$$QOL = \frac{QOL_{(o)} + QOL_{(s)}}{2}$$

The index values for the study population are presented in Annexure 4.8, Table 8.

Annexure 4.8 (Contd...)

Table 8

Quality of Life in the Villages Surveyed

Name of Village	QOL (s)
<b>I) Mahadayi Basin (Belgaum)</b>	
Kirvale	0.305
Kabnali	0.269
Kongla	0.325
Nerse	0.400
QOL(s) an average -	0.324
QOL(o) -	0.370
QOL(c) -	0.347
<b>II) Mandovi Basin (Goa)</b>	
Sonali	0.510
Sawarde	0.480
Bindodem	0.520
Ganjem	0.650
Usgaon	0.750
Volvoi	0.675
Betaqu	0.600
Marsela	0.700
Old Goa	0.720
QOL(s) an average -	0.622
QOL(o)	0.800
QOL(L)	0.711

QOL(s) - Quality of Life (Subjective Index)

QOL(o) - Quality of Life (Objective Index)

QOL(c) - Quality of Life (Cumulative Index)

Index Value:

- 0.1 - Highly unsatisfied
- 0.3 - Unsatisfied
- 0.5 - Neutral
- 0.8 - Satisfied
- 1.0 - Highly satisfied

Table 9

**Details of Land Holdings in Project Affected Villages  
in Karnataka**

Name of Village	Khatedar having Land (in ha)	
	<2 ha	>2 ha
<b>Fully Submerged</b>		
Kongla	24	7
Kirwale	26	4
Kabnali	32	12
<b>Total</b>	<b>82</b>	<b>23</b>
<b>Partially Submerged</b>		
Gavali	10	7
Pastoli	22	4
Nerse	10	1
Jamgaon	3	1
Mugwede	2	3
Chapoli	Nil	1
Kavale	9	27
<b>Total</b>	<b>56</b>	<b>44</b>
<b>Grand Total</b>	<b>138</b>	<b>67</b>

Khatedar - Land Holder

Source :

Table 10

## Demographic Structure of the Project Affected Villages - Mahadayi River Basin

Sl. No.	Name of Village	Total Area (in ha)	Total Households	Population		Total Literate	Main Worker	Non Worker
				Total	SC			
<b>Totally Submerged</b>								
1.	Kongla	1249.89	51	272	-	60	140	132
2.	Kirwale	999.46	37	210	-	79	107	86
3.	Kabnali	927.17	26	138	-	58	52	58
<b>Partly Submerged</b>								
4.	Gavali	5309.61	84	420	-	38	225	195
5.	Pastoli	692.62	16	108	-	18	60	48
6.	Nerse	1987.04	321	1614	143	399	838	765
7.	Jamgaon	1481.30	41	240	13	26	152	88
8.	Mugwade	1155.94	65	297	33	122	147	124
9.	Chopoli	2889.50	79	444	25	78	232	210
10.	Kavale	533.26	Uninhabited village			-	-	-
	<b>Total</b>	<b>17225.79</b>	<b>720</b>	<b>3743</b>	<b>214</b>	<b>878</b>	<b>1953</b>	<b>1706</b>

Source : 1991 Census

Note : 114 No. of households and 620 No. Of population from three villages namely Kongla, Kirwale and Kabnali would be affected due to project activities.

SC - Scheduled Caste

## Annexure 6.1

### Empirical Equations Used for Computing the Annual Rate of Sediment Deposition in the Kotni Reservoir

#### 1. Khosla's Equation

Khosla analysed the data from small and medium sized reservoirs in India and presented the following equation for annual rate of deposition in the reservoirs

$$V_s = 0.00323 \times A^{0.72} \quad \dots\dots\dots(1)$$

in which  $V_s$  is the annual sediment deposition rate in M Cum and  $A$  is area of catchment in sq.Km

For Kotni dam, the catchment area is 124.4 sq.Km

Hence, the sedimentation rate  $V_s$  will be

$$\begin{aligned} V_s &= 0.00323 \times (124.4)^{0.72} \\ &= 0.103 \text{ M Cum per year} \end{aligned}$$

#### 2. Dhruva Narayan and Babu

Dhruva Narayan and Babu used data from 18 river basins in India and obtained the relation for annual sedimentation rate  $T$  in million tonnes per year as

$$T = 0.014 A_1^{0.84} P^{1.37} \quad \dots\dots\dots(2)$$

in which  $A_1$  is the catchment area in M ha and  $P$  is average annual rainfall in cm.

Using  $A_1 = 124.4 \times 10^4$  M ha and  $P = 436.1$  cm

$$T = 1.452 \text{ M Tonnes per year}$$

Assuming unit weight of sediment deposits as 2.65 Tonnes per Cum

$$V_s = 0.55 \text{ M Cum per year}$$

They have also proposed another relationship as under

$$T = 14.25 Q^{0.84} \dots\dots\dots(3)$$

in which Q is annual runoff in million ha-m

Using  $Q = 464 \times 10^{-4}$

$$T = 14.25 \times (0.0464)^{0.84}$$

$$T = 1.0807 \text{ M Tonnes per year}$$

Hence,

$$V_s = 0.410 \text{ M Cum per year}$$

### 3. Garde and Kothyari

Garde and Kothyari analysed data from 50 small and large Indian catchments and proposed the following relationship for sediment yield erosion rate Y in cm/year per sq.m

$$Y = 0.02 P^{0.6} Fe^{1.7} S^{0.25} Dd^{0.1} (P_{max} / P)^{0.19} \dots\dots(4)$$

in which Fe is the erosion factor which depends upon land use pattern, S is the catchment slope, P<sub>max</sub> is the average maximum monthly rainfall in cm, Dd is the drainage density and P is the average annual rainfall in cm.

For using the above equation, the following values can be used

$$Fe = 0.5, Dd = 0.1, P_{max} = 436.1, P = 153, S = 1 \text{ in } 100$$

Therefore,

$$Y = 0.048 \text{ cm / year per sq.m}$$

Hence

$$V_s = 0.059 \text{ M Cum per year}$$

### 4. Iso - Erosion Rate Lines

Garde and Kothyari prepared Iso-erosion rate maps for India based upon data of 135 catchments distributed evenly all over India as shown in Fig. 1 From this figure it can be seen that for Kotni dam site the sedimentation erosion rate is about 1000 Tonnes per sq. Km.

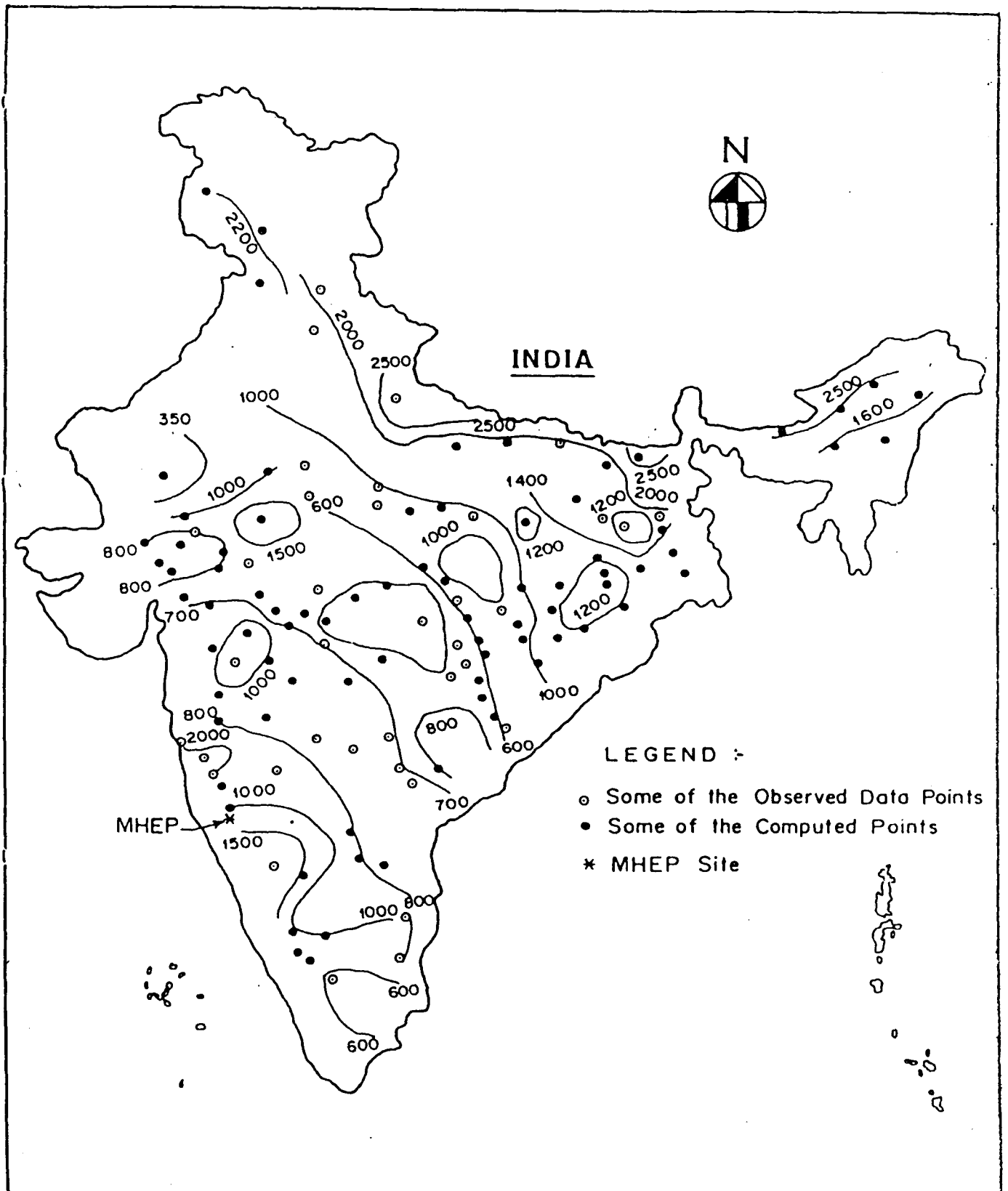


Fig 1 Iso erosion map for India

Therefore,

$$V_s = 0.047 \text{ M Cum per year}$$

## 5. Suspended Sediment Measurements

Water sample collected from river Mahadayi in the close vicinity of the proposed Kotni reservoir site reveals that it contains about 70 ppm of suspended material during monsoon season. This is what will be deposited in the Kotni reservoir.

Therefore

$$\begin{aligned} V_s &= \text{ppm} \times \text{Runoff} \dots\dots\dots(5) \\ &= 70 \times 464 \\ &= 32480 \text{ Cum} \\ &= 0.03248 \text{ M Cum per year} \end{aligned}$$

Since the water samples were collected from a few locations, it is proposed that during next monsoon (1996-97) a few more observations would be made to achieve better reliability of this approach.

## 6. CWC Compendium

The Central Water Commission has prepared a compendium on reservoir siltation rates for various regions of India. According to them, the siltation rate for the west flowing rivers varies from 0.0096 to 0.254 Mcum/100 sq.Km/year considering the highest sedimentation rate can be considered.

$$\begin{aligned} V_s &= 0.254 \times 1.244 \dots\dots\dots(6) \\ &= 0.316 \text{ Mcum per year} \end{aligned}$$

## Overview of WASP Model

WASP (Water Quality Analysis Program) is a 3-D dynamic compartmental model for aquatic system. Efficient hydrodynamic module is often needed to model the water quality parameters for complex systems like an estuary. WASP has such a module called DYNHYD capable of representing the propagation of long wave through a shallow water system while conserving the momentum and volume through equations of motion and continuity to simulate the time dependent tidal effects in an estuary.

DYNHYD estimates several space and time dependent parameters like channel flow, velocity, head, depth, flow direction etc.

The equation of motion is given by

$$\frac{\delta U}{\delta t} = -U \frac{\delta U}{\delta x} + a_{g,\mu} + a_f + a_{w,\mu} \quad (1)$$

= the local inertia term or the velocity rate of change with respect to time, m/sec<sup>2</sup>

$U \frac{\delta U}{\delta x}$  = the Bernoulli acceleration, or the rate of momentum change by mass transfer, also defined as the convective inertia term from Newton's second law

$a_{g,\mu}$  = gravitational acceleration

$$= -g \sin S = -g \frac{\delta H}{\delta x} \quad (2)$$

$a_f$  = frictional acceleration =  $g \frac{\delta H}{\delta x}$  (3)

$a_{w,\mu}$  = wind stress acceleration along axis of channel

t = time

U = velocity along the axis of the channel

$\mu$  = longitudinal axis

S = water surface slope

H = water surface elevation or head

$\phi$  = angle between channel and wind directions

The equation of continuity is given by

$$\frac{\delta A}{\delta t} = - \frac{\delta Q}{\delta x}$$

where

A = cross sectional area

Q = flow

For a rectangular channel of constant width B

$$\frac{\delta H}{\delta t} = \frac{1}{B} \frac{\delta Q}{\delta X} = \text{rate of water volume change w.r.t. distance per unit width}$$

where

H = water surface elevation

The tidal effect is simulated as boundary condition by defining the surface elevation as a time function as

$$y = A_1 + A_2 \sin(\omega t) + A_3 \sin(2\omega t) + A_4 \sin(3\omega t) \\ + A_5 \cos(\omega t) + A_6 \cos(2\omega t) + A_7 \cos(3\omega t)$$

The tidal data for the location is fitted in this equation internally by the program and the boundary conditions are generated for each simulation time.

The basic equations of motion and continuity are used in a finite difference scheme and are solved using standard method.

Frictional acceleration term can be expressed using Manning's equation for steady uniform flow

$$U = \frac{R^{2/3} \delta H^{1/2}}{n \delta x} \quad (4)$$

where

R = hydraulic radius, approximately the depth for wide channel

n = Manning's roughness coefficient (0.01 - 0.1)

$\frac{\delta H}{\delta x}$  = the energy gradient

Over short time intervals, flow may be considered steady and (4) may be substituted to (3) to give

$$a_f = - \frac{g n^2}{R^{4/2}} U |U| \quad (5)$$

where  $U^2$  has been replaced by  $U$  times the absolute value of  $U$  so friction will always oppose the direction of flow.

Magnitude of the wind acceleration term can be defined from shear stress equation at the air-water boundary:

$$\tau_w = C_d \rho_a W^2 \quad (6)$$

where

$\tau_w$  = the boundary shear stress

$C_d$  = drag coefficient (0.0026)

$\rho_a$  = density of air

W = wind speed

from which the component of acceleration along the channel may be derived as

$$a_w = \frac{C_d \rho_a}{R \rho_w} W^2 \cos$$

where

Table 1

Regression Equation of Abundance of Zooplankton Species  
with Salinity

Sl. No.	Genera	Equation
<b>Ciliata</b>		
1	<i>Tintinnopsis sp.</i>	$Y = 0.1433 X + 0.1045$
2	<i>Favella sp.</i>	$Y = 0.3558 X + 0.3540$
3	<i>Rhabdonella sp.</i>	$Y = 0.0228 X + 0.0305$
<b>Foraminifera</b>		
4	<i>Globigennia sp.</i>	$Y = 0.018 X + 0.0078$
<b>Cnidaria</b>		
5	<i>Siphonophora sp.</i>	$Y = 0.0227 X - 0.0453$
<b>Ctenophora</b>		
6	<i>Pleurobrachia sp.</i>	No linear equation can be formed
<b>Copepoda</b>		
7	<i>Undinula sp.</i>	$Y = 0.1467 X + 0.0839$
8	<i>Acartia sp.</i>	$Y = 0.1132 X - 0.0443$
9	<i>Temora sp.</i>	$Y = 0.2388 X + 0.8110$
10	<i>Eutemora sp.</i>	$Y = 0.08916 X + 0.0554$
11	<i>Oithona sp.</i>	$Y = 0.3093 X + 0.4421$
12	<i>O. plumifera</i>	No linear equation can be formed
13	<i>Euterpina sp.</i>	$Y = 0.1152 X + 0.3779$
14	<i>Paracalanus sp.</i>	$Y = 0.3469 X + 0.7785$
15	<i>Eucalanus sp.</i>	No linear equation can be formed
16	<i>Centropages sp.</i>	$Y = 0.0871 X - 0.0038$
17	<i>Pseudocalanus sp.</i>	$Y = 1.0831 X + 1.6587$
18	<i>Macrosetella sp.</i>	$Y = 0.1445 X + 0.1381$
19	<i>Microsetella sp.</i>	$Y = 0.1466 X - 0.0109$
20	<i>Metridia sp.</i>	$Y = 0.0313 X - 0.0417$
21	<i>Isias sp.</i>	$Y = 0.0418 X - 0.0151$
22	<i>Candacia sp.</i>	$Y = 0.0455 X - 0.1424$
23	<i>Canthocalanus sp.</i>	$Y = 0.0382 X - 0.0532$
24	<i>Nannocalanus sp.</i>	$Y = 0.0312 X - 0.0352$
25	<i>Rhincalanus sp.</i>	$Y = 0.1369 X + 0.3265$

## Annexure 6.3 (Contd...)

Table 1 (Contd...)

Sl. No.	Genera	Season
26	<i>Microcalanus sp.</i>	$Y = 0.047 X - 0.0704$
27	<i>Paradontella sp.</i>	$Y = 0.033 X - 0.0386$
28	<i>Labidocera sp.</i>	$Y = 0.0319 X - 0.0928$
29	<i>Oncaea sp.</i>	$Y = 0.0291 X - 0.0387$
30	<i>Heliodiaptomus sp.</i>	$Y = - 0.1171 X + 3.2589$
31	<i>Mesocyclops sp.</i>	$Y = - 0.096 X + 2.7381$
32	<i>Microcyclops sp.</i>	$Y = - 0.0746 X + 2.095$
33	<i>Diaptomus sp.</i>	$Y = - 0.0556 X + 1.5645$
<b>Cladocera</b>		
34	<i>Penilia sp.</i>	$Y = 0.0513 X + 0.2855$
35	<i>Evadne sp.</i>	$Y = 0.0783 X + 0.0688$
36	<i>Moina sp.</i>	$Y = - 0.0602 X + 1.6719$
37	<i>Daphnia sp.</i>	$Y = - 0.0875 X + 2.456$
38	<i>Macrothrix sp.</i>	$Y = - 0.0510 X + 1.4860$
<b>Rotifera</b>		
39	<i>Brachionus sp.</i>	$Y = - 0.0647 X + 1.7903$
40	<i>Keratella sp.</i>	$Y = - 0.556 X + 1.534$
41	<i>Polyarthra sp.</i>	$Y = - 0.0478 X + 1.323$
<b>Pteropoda</b>		
42	<i>Creseis acicula</i>	$Y = 0.0422 X - 0.00227$
43	<i>Creseis sp.</i>	$T = 0.1173 X + 0.4048$
<b>Appendicularia</b>		
44	<i>Oikopleura sp.</i>	$Y = 0.0252 X + 0.0666$
<b>Larval Forms</b>		
45	Brachiopoda	$Y = 0.0464 X + 0.0161$
46	Polychaeta	$Y = 0.4024 X + 0.5499$
47	Copepod	$Y = 1.1192 X + 18.6871$
48	Cirripede	$Y = 0.940 X + 0.1495$
49	Arachnactis	$Y = 0.0149 X + 0.1215$
50	Bivalvia	No linear equation can be formed
51	Gastropoda	$Y = 0.4370 X + 3.5130$
52	Fish eggs & larvae	$Y = 0.9713 X + 24.744$

**Table 2**  
**Regression Equation of Abundance of Phytoplankton Species with Salinity**

Sl. No.	Species	Equation
<b>Cyanophyceae</b>		
1	<i>Trichodesmium erythaeus</i>	No linear equation can be formed
<b>Chlorophyceae</b>		
2	<i>Pediastrum sp.</i>	No linear equation can be formed
3	<i>Spirogyra sp.</i>	$Y = - 0.9731 X + 38.22$
4	<i>Ulothrix sp.</i>	No linear equation can be formed
5	<i>Cosmarium sp.</i>	No linear equation can be formed
6	<i>Microasterias sp.</i>	No linear equation can be formed
7	<i>Zygnema sp.</i>	No linear equation can be formed
<b>Bacillariophyceae</b>		
8	<i>Cosonidiscus sp.</i>	$Y = 2.5624 X + 139.746$
9	<i>Skeletonema sp.</i>	$Y = 0.8765 X + 3.8690$
10	<i>Hemidiscus sp.</i>	No linear equation can be formed
11	<i>Melosira sp.</i>	No linear equation can be formed
12	<i>Stephanopyxis sp.</i>	$Y = 0.1523 X - 0.0672$
13	<i>Triceratium sp.</i>	No linear equation can be formed
14	<i>Biddulphia sp.</i>	$Y = 0.2671 X + 4.7035$
15	<i>B.mobiliensis.</i>	No linear equation can be formed
16	<i>B.sinensis</i>	$Y = 0.2357 X - 0.3457$
17	<i>Guinardia sp.</i>	$Y = 0.1451 X - 0.3429$
18	<i>Bellerochea sp.</i>	No linear equation can be formed
19	<i>Ditylum sp.</i>	$Y = 0.3554 X + 0.8942$
20	<i>Lithodesmium sp.</i>	$Y = 0.0705 X - 0.2083$
21	<i>Chaetoceros sp.</i>	$Y = 2.4781 X + 31.1808$
22	<i>Grannatophora sp.</i>	$Y = 0.1089 X - 0.0652$
23	<i>Campylodiscus sp.</i>	No linear equation can be formed
24	<i>Planktoniella sp.</i>	No linear equation can be formed
25	<i>Bacteriastum sp.</i>	No linear equation can be formed
26	<i>Eucampia sp.</i>	No linear equation can be formed

## Annexure 6.3 (Contd...)

Table 2 (Contd...)

Sl. No.	Species	Equation
27	<i>Climacodium sp.</i>	$Y = 0.1675 X + 0.3339$
28	<i>Streptothecca sp.</i>	No linear equation can be formed
29	<i>Thalassiosira sp.</i>	No linear equation can be formed
30	<i>T. gravida</i>	$Y = 0.4190 X + 1.7926$
31	<i>Thalassionea sp.</i>	$Y = 0.4403 X - 1.0032$
32	<i>Rhizosolenia sp.</i>	$Y = 0.8159 X + 26.3126$
33	<i>R. stolterfothii</i>	No linear equation can be formed
34	<i>R. styliformis</i>	No linear equation can be formed
35	<i>R. hebatata</i>	No linear equation can be formed
36	<i>Fragillaria oceanica</i>	No linear equation can be formed
37	<i>Thalassiothrix sp.</i>	No linear equation can be formed
38	<i>T. longissima</i>	$Y = 0.3591 X + 2.0696$
39	<i>Asterionella japonica</i>	$Y = 0.2746 X + 1.5509$
40	<i>Gyrosigma sp.</i>	No linear equation can be formed
41	<i>Pleurosigma sp.</i>	No linear equation can be formed
42	<i>Navicula sp.</i>	$Y = 0.0832 X + 0.5977$
43	<i>Nitzschia sp.</i>	$Y = 0.0982 X + 1.7362$
44	<i>N. longissima</i>	$Y = 0.1249 X + 0.5349$
<b>Dinophyceae</b>		
45	<i>Prorocentrum sp.</i>	$Y = 0.0832 X + 0.2378$
46	<i>Dinophysis sp.</i>	No linear equation can be formed
47	<i>Peridinium sp.</i>	$Y = 0.2549 X + 0.9166$
48	<i>Ceratium tripos</i>	No linear equation can be formed
49	<i>C. fusus</i>	$Y = 0.0941 X + 0.4719$
50	<i>C. massiliensis</i>	$Y = 0.1428 X + 0.5338$
51	<i>C. furca</i>	$Y = 0.1552 X + 1.5788$
52	<i>Pyrocystis fusiformis</i>	No linear equation can be formed
53	<i>Noctiluca miliaris</i>	No linear equation can be formed

Table 3

## Regression Equation of Abundance of Fish Species with Salinity

Sl. No.	Species	Equation
<b>Fin Fish</b>		
1.	<i>Ambassis commersonii</i>	$Y = 0.0966 + 1.5382$
2.	<i>Ambassis dussumieri</i>	No linear equation can be formed
3.	<i>Awaous grammepomus</i>	$Y = - 0.1198 X + 0.3094$
4.	<i>Barilius evezardi</i>	$Y = - 0.0089 X + 0.2546$
5.	<i>Cynoglossus puncticeps</i>	No linear equation can be formed
6.	<i>Danio devario</i>	$Y = - 0.0263 X + 0.7067$
7.	<i>Etroplus suratensis</i>	No linear equation can be formed
8.	<i>Garra gotyla gotyla</i>	$Y = - 0.0071 X + 0.1904$
9.	<i>Gonoproktopterus thomassi</i>	No linear equation can be formed
10.	<i>Labeo kawrus</i>	No linear equation can be formed
11.	<i>Leiognathus blochii</i>	$Y = 0.0183 X - 0.0853$
12.	<i>Mugil cephalus</i>	No linear equation can be formed
13.	<i>Nemacheilus rubidipinnis</i>	$Y = - 0.0343 X + 0.9239$
14.	<i>Osteobrama dayi</i>	$Y = - 0.0321 X + 0.9131$
15.	<i>Pseudorhombus arsius</i>	No linear equation can be formed
16.	<i>Paruciosoma daniconius</i>	$Y = - 0.0245 X + 0.6632$
17.	<i>Puntius filamentosus</i>	$Y = - 0.0334 X + 0.8977$
18.	<i>P. amphibius</i>	$Y = - 0.004 X + 0.1088$
19.	<i>P. nigrofasciatus</i>	$Y = - 0.0056 X + 0.1496$
20.	<i>P. ophiocephalus</i>	No linear equation can be formed

Table 3 (Contd...)

Sl. No.	Species	Equation
21	<i>P. arulius</i>	$Y = - 0.0097 X + 0.2923$
22	<i>Rasbora neilgherriensis</i>	$Y = - 0.0360 X + 0.9740$
23	<i>Sieyepterus graseus</i>	No linear equation can be formed
24	<i>Scatophagus argus</i>	No linear equation can be formed
25	<i>Sillago sihama</i>	No linear equation can be formed
26	<i>Stenogobius gymnopomus</i>	No linear equation can be formed
27	<i>Teuthis vermiculata</i>	$Y = 0.0222 X - 0.0295$
28	<i>Chanos chanos</i>	No linear equation can be formed
<b>Shell Fish</b>		
29	<i>Macrobrachium malcolmsoni</i>	$Y = - 0.0702 X + 2.0587$
30	<i>Metapenaeus affinis</i>	$Y = 0.0343 X - 0.1202$
31	<i>M. monoceros</i>	No linear equation can be formed
32	<i>M. dobsoni</i>	$Y = 0.0256 X + 0.4201$
33	<i>Penaeus marguiensis</i>	$Y = 0.0241 X + 0.2120$
34	<i>P. indicus</i>	No linear equation can be formed
35	<i>Scylla serrata</i>	No linear equation can be formed
36	Unidentified (small crab)	$Y = - 0.0138 X + 0.3755$
37	<i>Macrobrachium rude</i>	$Y = - 0.0368 X + 1.0179$
38	<i>Villorita cyprinoides</i>	$Y = - 0.0077 X + 0.2256$
39	<i>Meretrix meretrix</i>	No linear equation can be formed
40	<i>M. casta</i>	No linear equation can be formed
41	<i>Paphia malabarica</i>	$Y = 0.0060 X - 0.0311$

### Seismic Impacts

While designing the dam structures, seismic coefficients as per the IS 1983-1975 were adopted (i) horizontal - 0.01 g at the top uniformly reducing to 0 at the bottom and (ii) Vertical - equivalent to half the horizontal acceleration. The analysis of the stability of dam was considered under various conditions, viz.,

1. reservoir empty with earthquake from downstream to upstream
2. reservoir full at FRL with earthquake from upstream to downstream and normal uplift
3. reservoir full at FRL from upstream to downstream and uplift corresponding to drains fully clogged

As suggested by the KPCL, the site specific parameters have been studied for the Kotni dam and presented hereunder.

#### 1 Earthquake Occurrence

Chandra (1977) studied the seismotectonic activity of the peninsular India. Various source zones, based largely on the distribution of earthquake epicenters, but also partly on geology and fault plane solutions are tentatively identified. Some of the zones of weakness in the peninsular India were related to the plume generated triple or four armed rifts formed at different times in geological past. Fault plane solutions of six earthquakes, widely separated geographically are related to different seismic zones, show two consistent features. One of these features is that one of the pressure axis P, trends nearly NS direction and the other is that one of the nodal planes strikes in a NSE to E direction and shows left lateral sense of motion. The former observation made by Chandra (1977) indicates that the high stresses generated by the continental collision, caused by the northward movement of India, have affected the entire Indian peninsula. The latter observation made by Chandra (1977) suggest that the whole region may be under a state of left lateral shear. This shear is believed to be the consequence of the geometric disposition of the Indian and Eurasian continents at the time of collision and subsequent plate kinematics. The latter observation also suggests that the orientation of the zones of weakness with

respect to the ambient stress field may be an important factor in determining the faults along which earthquakes are likely to occur.

The seismicity around the area listed in **Table 1** is plotted in **Fig. 1**. The Koyna earthquake (magnitude 6.5) of 1967 occurred at a distance of 270 km from the Goa site. The now famous Latur-Osmanabad earthquake of 30th Sept. 1993 (magnitude 6.3) occurred at an epicentral distance of about 410 km from the site. The acceleration generated from such distances is very small to be considered for design purposes. There are in all 5, 28, 38 earthquakes which occurred in the area of  $2^\circ \times 2^\circ$  with magnitudes greater than 6, 5, and 4 respectively. The earthquakes for which magnitudes are not estimated are marked as \* in **Fig. 1**. Most of the earthquake activity is concentrated around Koyna site, many of them being aftershocks of the main 1967 earthquake.

## **2 Seismotectonic Features around the Kotni Dam Site**

Various seismotectonic features have been marked on the geological and tectonic map around the Kotni dam site based on available literature. Srinivas and Sreenivas (1977) interpreted the landsat imageries of the Karnataka state. One of the lineaments marked as 'A' (**Fig. 4.4**) was interpreted by them as Hemavati Tunga fault which passes south of Shimoga. This feature is the nearest feature to the site and passes at a distance of 8 km west of the site. Based on the geological setting of the area, tectonics and past earthquake history, a magnitude of 6.0 is assigned to this seismotectonic feature at a depth of 12 km.

The other feature which runs ENE-WSW passes at a distance of 15 km from the site and, marked as b at an epicentral distance of 15 km, has also been assigned a magnitude of 6.0 at a focal depth of 12 km. Another seismotectonic feature marked as 'c' at an epicentral distance of 50 km, is also considered to be a seismotectonic source with magnitude 6.0 and focal depth 12 km. The deep seated fault which passes at a distance of 30 km in the NE direction of the site is considered as a source which can have a potential of magnitude 6.0 at a focal depth of 12 km. These features with their earthquake potentials are summarised in **Table 2**.

## **3 Attenuation Relationship**

The estimate of effective peak ground acceleration is generally made using empirical formulae worked out by various research workers. Most attenuation regressions for the computation of expected acceleration consider the event as a point source and suffer from the disadvantages that are derived from the stations very close to large magnitude earthquakes. Thus, different formulae provide different ground

Table 1  
List of Earthquakes occurred around the site

DATE			ORIGIN TIME			LOCATION		MAG/ INT	REF
MM	DD	YYYY	HR	MIN	SEC	LAT	LONG		
3	20	1826				15	74.1	V	OLD
8	22	1828				15.9	73.6	VI	OLD
9	1	1962				17	73.3	4.3	IMD
6	4	1965	3	37	12	17	73.4	5.4	NDI
11	8	1965				17.4	73.7	3.6	IMD
6	14	1966				17	73.1	4.8	CWP
9	13	1967	6	23	31	17.4	73.7	5.8	NDI
9	13	1967	6	48	25	17.4	73.7	5.6	NDI
12	10	1967	22	51	19	17.37	73.74	7.5	NDI
12	10	1967	22	51	24.3	17.4	73.9	6	USG
12	10	1967	23	52	16.7	17.4	73.7	5	USG
12	11	1967	20	49	47.5	17.27	73.68	5.8	NDI
12	11	1967	20	49	48.5	17.3	73.7	5.2	USG
12	12	1967	6	18	33.5	17.29	73.65	6.2	NDI
12	12	1967	6	18	37.9	17.6	73.9	5.4	USG
12	12	1967	15	48	51.7	17.29	73.63	5.9	NDI
12	12	1967	15	48	55.5	17.4	73.9	5	USG
12	13	1967	5	9	41.8	17.31	73.68	5.5	NDI
12	13	1967	19	19	45.5	17.5	73.62	5.6	NDI
12	24	1967	23	49	51	17.35	73.71	5.8	NDI
12	24	1967	23	49	53.9	17.5	73.9	5.5	USG
12	25	1967	17	37	39.1	17.2	73.9	5.1	USG
1	25	1968	20	15	17	17.27	73.68		NDI
2	7	1968	8	9	13	17.27	73.68		NDI
3	4	1968	21	36	35	17.27	73.68		NDI
8	31	1968	2	53	40	17.3	74	5.7	NDI
10	29	1968	9	59	59.9	17.3	73.9	5.4	USG
10	29	1968	10		2.5	17.4	73.8	5.5	NDI
11	4	1968	8	18	18.5	16.2	74	3.5	NDI
6	27	1969	20	5	10	17.28	73.67		NDI
6	27	1969	20	5	25	17.28	73.67		NDI
11	3	1969	23	22	10	17.5	73.8	5.7	NDI
11	3	1969	23	22	12.6	17.3	73.9		ISG
4	16	1970	14	46	53	17.41	74.2		NDI
5	27	1970	12	45	37	17.4	73.7	4.5	NDI
6	8	1970	5	30	10.4	17.27	73.68		NDI
6	17	1970	6	48	55.4	17.41	74.2		NDI
9	25	1970	4	12	58	17.4	73.6	5	NDI
4	24	1972	7	52		13.67	76		ISE

Table 1. Contd...

DATE			ORIGIN TIME			LOCATION		MAG/ INT	REF
MM	DD	YYYY	HR	MIN	SEC	LAT	LONG		
10	17	1973	15	24	48	17.4	73.7	6.2	ISE
11	15	1973	8	20		16.86	75.81		ISE
2	17	1974	14	6	5	17.3	73.7		ISE
4	17	1974	15	22	1	17.5	73.1	5	ISE
7	29	1974	23	17	24	17.2	73.7		ISE
8	28	1974	20	20	50	17.3	73.7		ISE
5	12	1975	15	9	28	15	76	5	ISE
3	14	1976	5	16	45	17.3	73.7		ISE
6	2	1976	11		34	17.2	74		ISE
8	19	1977		3	52	17.3	73.6		NDI
9	19	1977		3	52	17.3	73.6	4.5	NDI
11	4	1977	20	54	43	17.3	73.8		NDI
9	26	1979	20	2	8	17.3	73.3		NDI
2	6	1980	22	13	5	17	73.8		NDI
9	2	1980	16	39	8	17.1	73.7		NDI
9	2	1980	16	39	14	17.2	73.7	4.9	USG
9	20	1980	7	28	51	17.2	73.7	5.2	NDI
9	20	1980	7	28	57.7	17.2	73.8	4.1	USG
9	20	1980	10	45	29	17.3	73.7		NDI
9	20	1980	10	45	32	17.3	73.6	5.3	USG
9	25	1980	13	28	25	17.4	74.2		NDI
10	4	1980	16	37	9	17.2	73.7		NDI
10	4	1980	16	37	12.7	17	73.9	4.5	USG
1	25	1981	20	30	37	17	74		USG
9	17	1981	8	32	10	17.3	73.7		NDI
4	25	1982	23	4	45	17.3	73.9		NDI
9	11	1982	2	41	28.6	17.3	73.9	3.8	NDI
11	14	1984	11	58	21	17.3	74.2	6.1	NDI
11	14	1984	11	58	21.4	17.16	73.81	4.5	USG
10	29	1985	21	42	19	17.3	73.9		NDI
12	15	1986	14	44	1	17.3	73.7		NDI
4	26	1987	7	57	29	17.6	73.8		NDI
1	11	1988	8	43	14	17.3	73.7		NDI
9	11	1988	20	39	11.3	17.17	73.85		USG
10	29	1989	7	30	10	17.5	73.8	3	NDI
1	18	1990	21	22	51	17.34	73.8	2.9	NDI
3	12	1990		51	17	17.4	73.6	3.8	NDI
7	30	1990		27	6	17.3	73.2	4.0	NDI
1	6	1991	22	13	22.4	17.26	73.9	4.4	USG

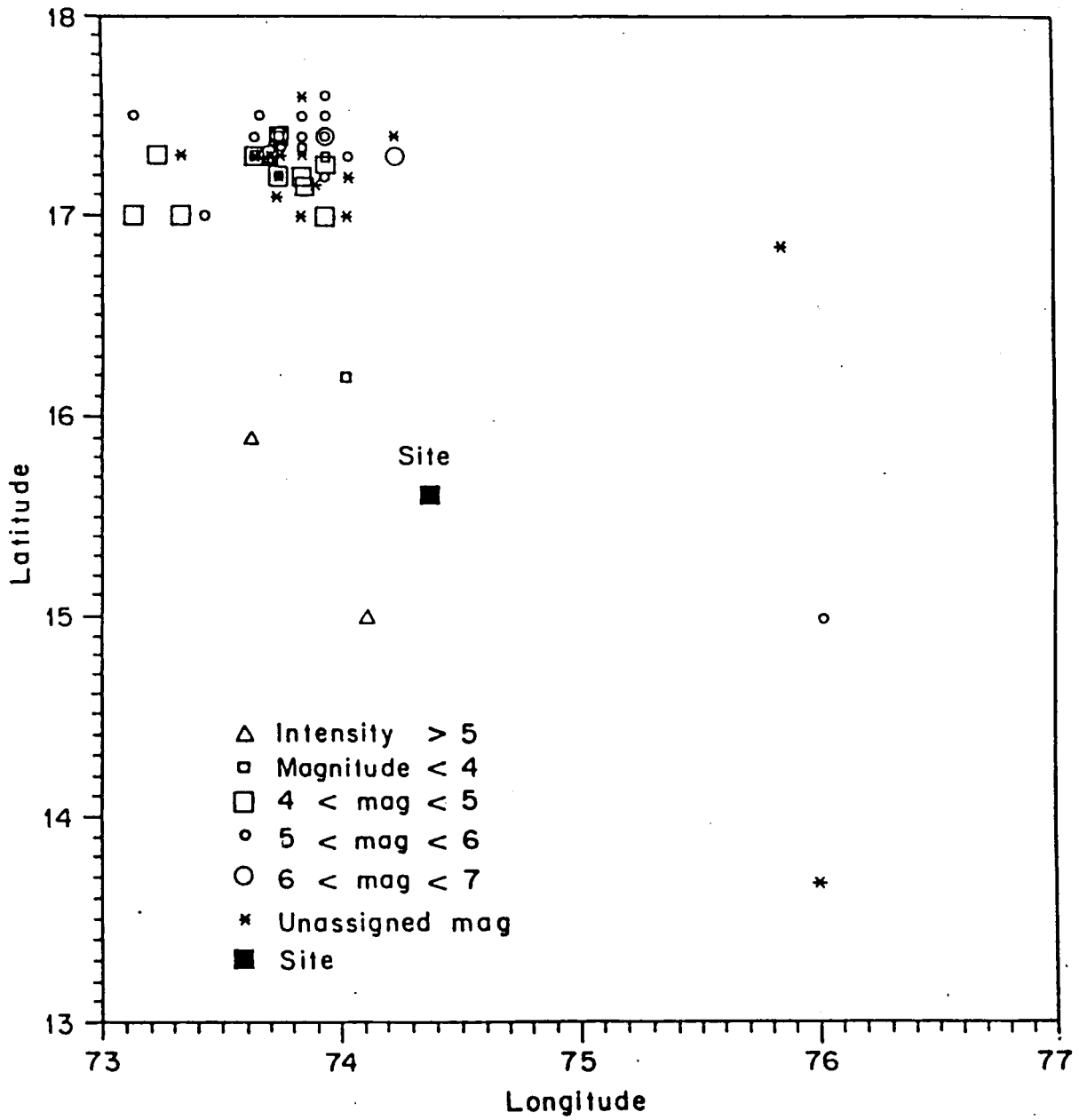


Fig 1: Seismicity around the site

**Table 2**

**Seismic Sources and their Potential around the Kotni Dam Site**

Epi Dis	Focal Depth	Mag	Dis to Eng Zone	Accer	Feature
8	12	6.0	10.00	0.18	Lineament A
15	12	6.0	16.15	0.13	Lineament B
50	12	6.0	50.35	0.05	Lineament C
30	12	6.0	30.59	0.08	Deep sealed fault

The attenuation relationship given by Abrahamson and Litehiser (1989).  
In this case E and F are taken to be 0.

Lineament A, B and C are shown in Fig. 4.4.

acceleration, and judicious estimate of ground acceleration is, therefore, required for adoption in any particular situation.

Abrahamson and Litehiser (1989) proposed an attenuation model for peak ground accelerations based on 585 strong ground motion records from 76 worldwide earthquakes which have a magnitude dependent shape. The regression used a two-step procedure that is hybrid of the Joyner and Boore (1981) and Campbell (1981) regression methods. Abrahamson and Litehiser (1989) also computed horizontal peak ground acceleration from the same suit of earthquake records using the vertical to horizontal acceleration ratio. The resulting horizontal attenuation relation is

$$\log(a) = -0.62 + 0.177M - 0.982\log(r+e^{0.284M}) + 0.132F - 0.0008Er$$

where  $a$  is peak horizontal acceleration,  $r$  is the distance in km to the closest approach of the zone of energy release,  $M$  is the magnitude,  $F$  is dummy variable that is 1 for reverse or reverse oblique fault otherwise 0, and  $E$  is a dummy variable that is 1 for interplate and 0 for intraplate events. The distance to the closest approach of the zone of energy release is defined by Campbell (1981). The closest approach to the zone of energy release is taken as  $(x^2 + h^2)^{1/2}$  where  $x$  is the epicentral distance and  $h$  is the focal depth.

#### 4 Parameters for Design Earthquake

Based on the local and regional geological information, seismotectonics and earthquake occurrence and the parameters postulated above for Maximum Credible Earthquake (MCE), the peak ground horizontal accelerations (PGA-H) are given in Table 2, ICOLD bulletin, 72 (1989) has recommended (in appendix 2 of the bulletin) use of some empirical relationships like that of Campbell (1981) and Joyner and Boore (1981). Subsequently, Abrahamson and Litehiser (1989) using similar formulation like that of the two authors, have made comprehensive recommendations (para 3 of this annexure) for attenuation relationship for horizontal peak ground acceleration. Table 2 shows the peak ground accelerations computed based on the attenuation relationship given by Abrahamson and Litehiser (1989). The lineaments marked as A, B and C have been considered for the probable MCE. Based on the above, the maximum horizontal acceleration is 0.18 g. The site appears to be near the border of Seismic Zone III of IS:1893-1984. The draft proposal for revision before the IS:1893 envisages a value of 0.16 for MCE for the seismic zone III (Fig. 4.4) also shows the seismic zones). A value of 0.18 g may be adopted for horizontal component of MCE.

Once the seismic parameters have been postulated, the next step is to evaluate design ground motion. The ground motion is described either in the form of time history or indirectly in the form of response spectra or both. If expressed in the form of response spectra, then artificial time history is generated to match the shape of spectra. This method is now recommended for site specific earthquake motion for special structures like nuclear power plants and dams. The shape of spectra is usually given in a normalized form, with zero period acceleration of unit gravity. To convert into design spectra, attenuation relationships are used to convert seismic parameters into multiplying factor for shape of spectra. Usually this multiplying factor is given in the form of peak acceleration.

## 5 Normalized Shape of Spectra

There are no records of strong motions available in the region around this site. Seed, et. al., 1974 have proposed the shape of site dependent spectra for earthquake resistant design. This shape is very much more conservative than that derived from Koyana records (Chandrasekaran et. al., 1995). Seed, et. al., 1974 have given shape of mean as well as mean plus standard deviation graphs for various rock/soil sites for 5% damping. From that report, the graphs have been digitized for the rock conditions. Assuming a confidence level of mean plus sigma, the graph for 5% damping has been evaluated and proposed as target spectra for this site. This is as per the recommendations of ICOLD (1989). Fig. 2 shows the target spectra as a function of frequency. The digital values for the target spectra are given in Table 3. The curve and the values in the Table are normalised to unit gravity. A comparison of the target and generated shape of spectra is also given in Figs. 2, 3 and 4 gives shape of spectra for 5%, 7% and 10% damping with respect to frequency and time periods respectively. Table 4 and Table 5 give a listing of acceleration spectra with respect to frequencies and time periods respectively.

## 6 Artificial Time History

Whereas if a response spectra is evaluated from a time history it is unique, the reverse process of obtaining ground motion from a given spectra is non-unique. Hence, there are several methods proposed by different authors. The aim of generation is to obtain a response spectra from artificial time history to match the target spectra. The generated response spectra would lie in a band within say,  $\pm 10\%$  of the target spectra. The method used in the report is broadly based on Jennings et. al., 1968 and Scanlan and Sachs, 1974 and developed by one of the authors to the report. The duration of the record has been assumed as 25 seconds. The matching is such that the derived response spectra is above target spectra and within  $\pm 5\%$ . Figure 2 shows a comparison of derived and target spectra at discrete frequencies and the

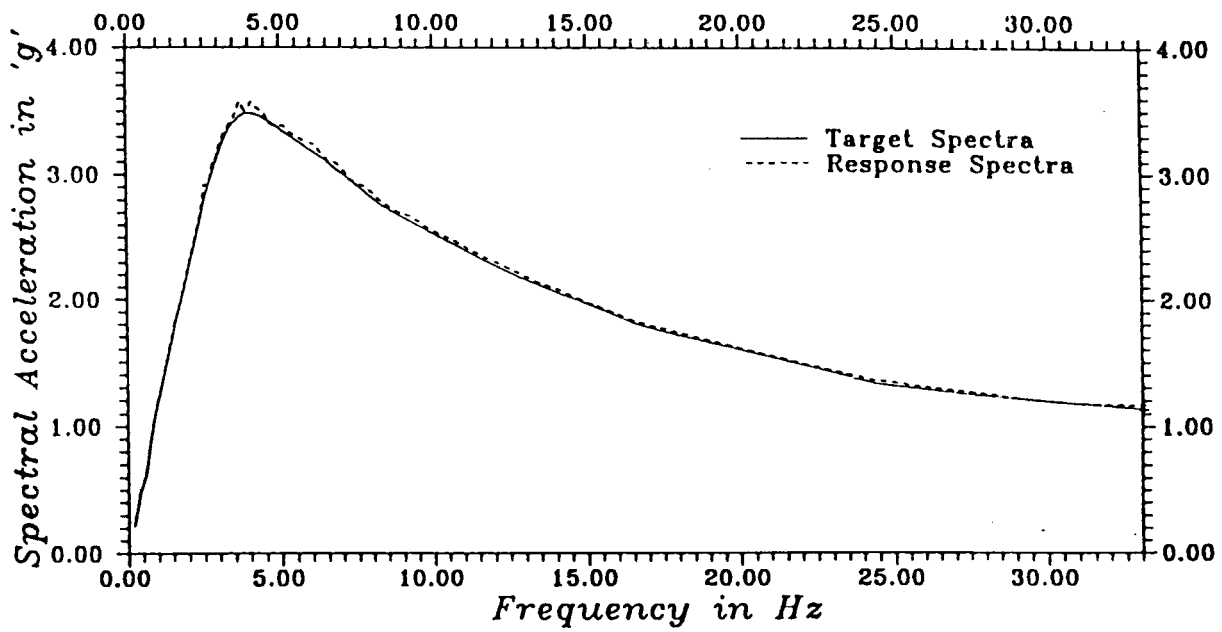
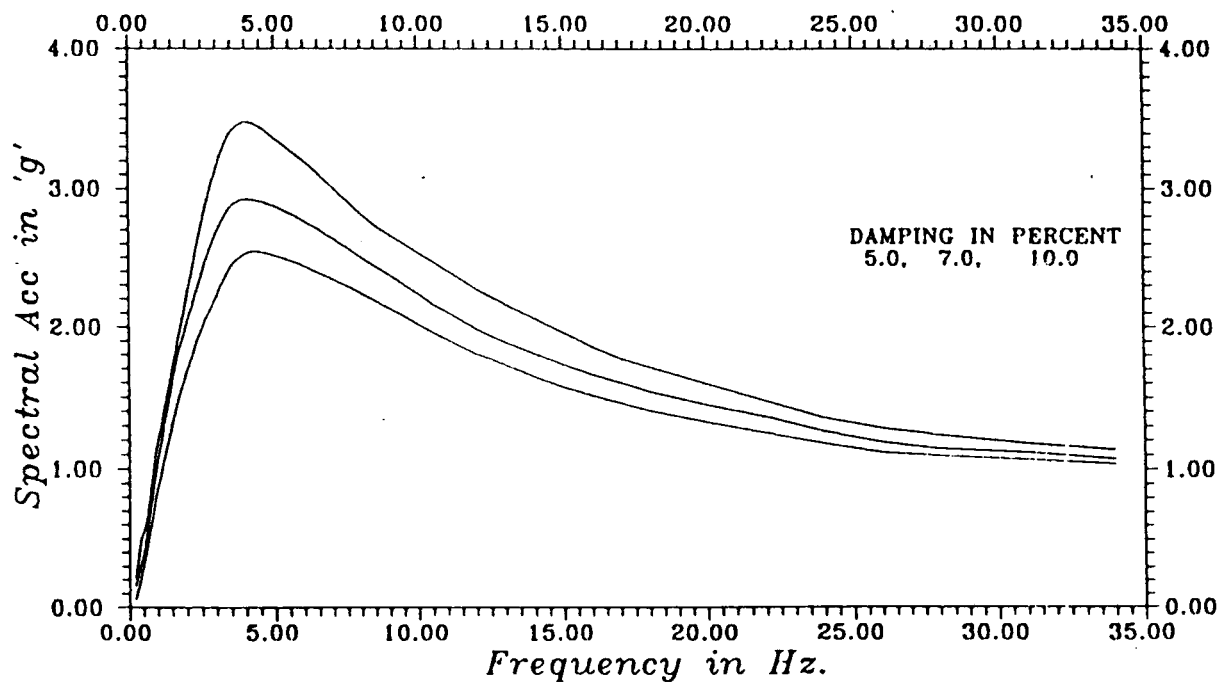


Fig 2 Comparison of Target and Response Spectra (Normalised to Unit Gravity)  
 Site : MAHADAYI PROJECT, GOA Damping :5 percent

Table 3

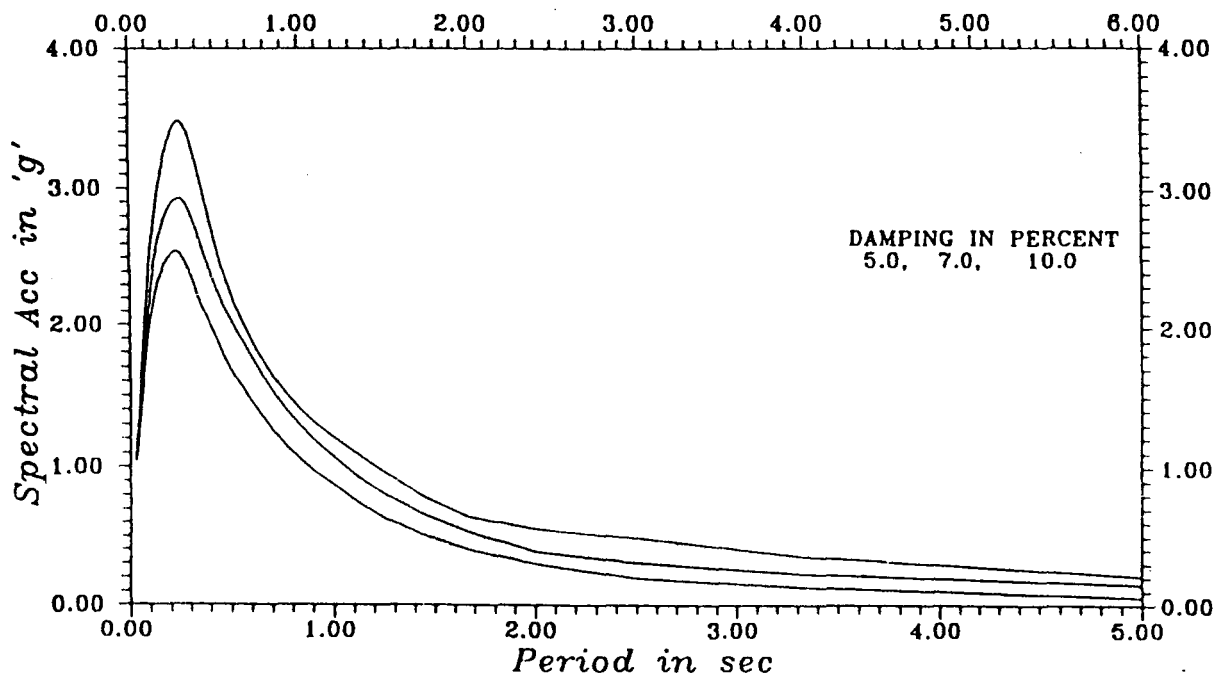
## Target and Derived Response Spectra for 5 % Damping

Frq (Hz)	Target Spectra	Response Spectra	Frq (Hz)	Target Spectra	Response Spectra
0.1953	0.2074	0.2094	4.6875	3.4156	3.4037
0.2930	0.3434	0.3482	4.8828	3.3832	3.3807
0.3906	0.4829	0.4886	5.1270	3.3422	3.3922
0.4883	0.5492	0.5558	5.3711	3.3006	3.3295
0.5859	0.6262	0.6332	5.6152	3.2593	3.2946
0.6836	0.7717	0.7809	5.8594	3.2193	3.2592
0.7813	0.9368	0.9478	6.1035	3.1792	3.2462
0.8789	1.0686	1.0808	6.3477	3.1361	3.1660
0.9766	1.1841	1.1997	6.5918	3.0884	3.1051
1.0742	1.2777	1.2925	6.8359	3.0407	3.0933
1.1719	1.3745	1.3951	7.0801	2.9930	3.0299
1.2695	1.4764	1.4908	7.3242	2.9461	2.9562
1.3672	1.5759	1.5921	7.5684	2.8994	2.9268
1.4648	1.6812	1.7068	7.8125	2.8528	2.9018
1.5625	1.7775	1.8181	8.3008	2.7595	2.7918
1.6602	1.8817	1.8969	8.7891	2.6939	2.7150
1.7578	1.9772	1.9869	9.2773	2.6302	2.6741
1.8555	2.0785	2.1096	9.7656	2.5665	2.5914
1.9531	2.1826	2.1957	10.2539	2.5035	2.5272
2.0508	2.2830	2.3126	10.7422	2.4410	2.4763
2.1484	2.3813	2.4024	11.2305	2.3785	2.4032
2.2461	2.4795	2.4995	11.7188	2.3160	2.3445
2.3438	2.5891	2.6266	12.2070	2.2535	2.2907
2.4414	2.6921	2.7185	12.6953	2.1964	2.2282
2.5391	2.7846	2.9205	13.1836	2.1473	2.1687
2.6367	2.8713	2.9182	13.6719	2.0982	2.1209
2.7344	2.9497	2.9528	14.1602	2.0491	2.0774
2.8320	3.0270	3.0910	14.6484	2.0000	2.0204
2.9297	3.1034	3.1158	15.6250	1.9018	1.9230
3.0762	3.2038	3.2566	16.6016	1.8036	1.8261
3.2227	3.2910	3.3308	17.5781	1.7424	1.7641
3.3691	3.3631	3.3955	19.5313	1.6254	1.6437
3.5156	3.4070	3.4332	21.4844	1.5084	1.5206
3.7109	3.4532	3.5742	24.4141	1.3329	1.3572
3.9063	3.4819	3.5028	27.3438	1.2503	1.2748
4.1016	3.4822	3.5707	30.2734	1.1910	1.1879
4.2969	3.4675	3.5237	33.2031	1.1341	1.1644
4.4922	3.4453	3.4933			



ACCELERATION SPECTRA FOR MAHADAYI PROJECT, GOA  
(Normalised to Unit Gravity)

Fig 3



ACCELERATION SPECTRA FOR MAHADAYI PROJECT, GOA  
(Normalised to Unit Gravity)

Fig 4

Table 4  
Acceleration Response Spectra for (Mahadayi Project)  
(Normalised to Unit Gravity)

FRQ (Hz)	DAMPING			FRQ (Hz)	DAMPING		
	5.0%	7.0%	10.0%		5.0%	7.0%	10.0%
0.20	0.2139	0.1531	0.0619	4.80	3.3970	2.8888	2.5268
0.30	0.3534	0.2307	0.1299	5.00	3.3635	2.8736	2.5156
0.40	0.4893	0.3084	0.1978	5.25	3.3212	2.8491	2.4978
0.50	0.5584	0.3860	0.2988	5.50	3.2788	2.8199	2.4790
0.60	0.6471	0.5338	0.3097	5.75	3.2372	2.7921	2.4589
0.70	0.7994	0.6705	0.5161	6.00	3.1962	2.7620	2.4380
0.80	0.9621	0.8072	0.6326	6.25	3.1533	2.7330	2.4127
0.90	1.0936	0.9369	0.7524	6.50	3.1063	2.7030	2.3897
1.00	1.2066	1.0666	0.8722	6.75	3.0575	2.6710	2.3683
1.10	1.3032	1.1782	0.9632	7.00	3.0086	2.6374	2.3457
1.20	1.4039	1.2897	1.0543	7.25	2.9603	2.6033	2.3188
1.30	1.5074	1.3941	1.1457	7.50	2.9125	2.5710	2.2934
1.40	1.6113	1.4984	1.2371	7.75	2.8647	2.5356	2.2694
1.50	1.7159	1.6034	1.3202	8.00	2.8170	2.4984	2.2442
1.60	1.8175	1.7083	1.4033	8.50	2.7327	2.4362	2.1893
1.70	1.9207	1.7960	1.4787	9.00	2.6664	2.3772	2.1334
1.80	2.0210	1.8837	1.5542	9.50	2.6012	2.3102	2.0804
1.90	2.1259	1.9583	1.6164	10.00	2.5362	2.2414	2.0233
2.00	2.2308	2.0330	1.6786	10.50	2.4720	2.1690	1.9675
2.10	2.3325	2.1034	1.7426	11.00	2.4080	2.1088	1.9150
2.20	2.4331	2.1738	1.8066	11.50	2.3440	2.0527	1.8595
2.30	2.5400	2.2418	1.8733	12.00	2.2800	1.9916	1.8118
2.40	2.6484	2.3098	1.9400	12.50	2.2192	1.9391	1.7737
2.50	2.7476	2.3829	1.9925	13.00	2.1657	1.8969	1.7315
2.60	2.8387	2.4560	2.0451	13.50	2.1154	1.8544	1.6891
2.70	2.9221	2.5120	2.0853	14.00	2.0652	1.8118	1.6472
2.80	3.0016	2.5680	2.1255	14.50	2.0149	1.7740	1.6096
2.90	3.0802	2.6248	2.1729	15.00	1.9646	1.7365	1.5757
3.00	3.1516	2.6816	2.2204	16.00	1.8641	1.6658	1.5159
3.15	3.2478	2.7498	2.2996	17.00	1.7786	1.6058	1.4658
3.30	3.3291	2.8074	2.3629	18.00	1.7171	1.5444	1.4130
3.45	3.3873	2.8542	2.4154	20.00	1.5973	1.4532	1.3319
3.60	3.4269	2.8901	2.4622	22.00	1.4775	1.3644	1.2541
3.80	3.4663	2.9177	2.5012	24.00	1.3577	1.2642	1.1784
4.00	3.4820	2.9276	2.5310	26.00	1.2882	1.1871	1.1174
4.20	3.4748	2.9241	2.5438	28.00	1.2370	1.1431	1.0938
4.40	3.4557	2.9148	2.5444	31.00	1.1799	1.1195	1.0702
4.60	3.4289	2.9035	2.5376	34.00	1.1341	1.0721	1.0369

Table 5  
 Acceleration Response Spectra for (Mahadayi Project)  
 (Normalised to Unit Gravity)

TP (sec)	DAMPING			TP (sec)	DAMPING		
	5.0%	7.0%	10.0%		5.0%	7.0%	10.0%
0.029	1.1341	1.0721	1.0369	0.217	3.4289	2.9035	2.5376
0.032	1.1799	1.1195	1.0702	0.227	3.4557	2.9148	2.5444
0.036	1.2370	1.1431	1.0938	0.238	3.4748	2.9241	2.5438
0.038	1.2882	1.1871	1.1174	0.250	3.4820	2.9276	2.5310
0.042	1.3577	1.2642	1.1784	0.263	3.4663	2.9177	2.5012
0.045	1.4775	1.3644	1.2541	0.278	3.4269	2.8901	2.4622
0.050	1.5973	1.4532	1.3319	0.290	3.3873	2.8542	2.4154
0.056	1.7171	1.5444	1.4130	0.303	3.3291	2.8074	2.3629
0.059	1.7786	1.6058	1.4658	0.317	3.2478	2.7498	2.2996
0.063	1.8641	1.6658	1.5159	0.333	3.1516	2.6816	2.2204
0.067	1.9646	1.7365	1.5757	0.345	3.0802	2.6248	2.1729
0.069	2.0149	1.7740	1.6096	0.357	3.0016	2.5680	2.1255
0.071	2.0652	1.8118	1.6472	0.370	2.9221	2.5120	2.0853
0.074	2.1154	1.8544	1.6891	0.385	2.8387	2.4560	2.0451
0.077	2.1657	1.8969	1.7315	0.400	2.7476	2.3829	1.9925
0.080	2.2192	1.9391	1.7737	0.417	2.6484	2.3098	1.9400
0.083	2.2800	1.9916	1.8118	0.435	2.5400	2.2418	1.8733
0.087	2.3440	2.0527	1.8595	0.455	2.4331	2.1738	1.8066
0.091	2.4080	2.1088	1.9150	0.476	2.3325	2.1034	1.7426
0.095	2.4720	2.1690	1.9675	0.500	2.2308	2.0330	1.6786
0.100	2.5362	2.2414	2.0233	0.526	2.1259	1.9583	1.6164
0.105	2.6012	2.3102	2.0804	0.556	2.0210	1.8837	1.5542
0.111	2.6664	2.3772	2.1334	0.588	1.9207	1.7960	1.4787
0.118	2.7327	2.4362	2.1893	0.625	1.8175	1.7083	1.4033
0.125	2.8170	2.4984	2.2442	0.667	1.7159	1.6034	1.3202
0.129	2.8647	2.5356	2.2694	0.714	1.6113	1.4984	1.2371
0.133	2.9125	2.5710	2.2934	0.769	1.5074	1.3941	1.1457
0.138	2.9603	2.6033	2.3188	0.833	1.4039	1.2897	1.0543
0.143	3.0086	2.6374	2.3457	0.909	1.3032	1.1782	0.9632
0.148	3.0575	2.6710	2.3683	1.000	1.2066	1.0666	0.8722
0.154	3.1063	2.7030	2.3897	1.111	1.0936	0.9369	0.7524
0.160	3.1533	2.7330	2.4127	1.250	0.9621	0.8072	0.6326
0.167	3.1962	2.7620	2.4380	1.429	0.7994	0.6705	0.5161
0.174	3.2372	2.7921	2.4589	1.667	0.6471	0.5338	0.3997
0.182	3.2788	2.8199	2.4790	2.000	0.5584	0.3860	0.2988
0.190	3.3212	2.8491	2.4978	2.500	0.4893	0.3084	0.1978
0.200	3.3635	2.8736	2.5156	3.333	0.3534	0.2307	0.1299
0.208	3.3970	2.8888	2.5268	5.000	0.2139	0.1531	0.0619

values are given in Table 3 Artificial time history so derived is shown in Fig. 5 and a listing at equal time interval of 0.01 sec is given in Table 6.

## 7 Design Spectra

Having obtained spectra and time history for Maximum Credible Earthquake conditions, the design spectra for other conditions is evaluated by using appropriate reduction factors. A reduction factor of 2 is proposed for obtaining design basis earthquake, under which conditions, maximum tensile stresses in case of gravity dams is half the ultimate tensile stresses. In case of fill dams, there may be no tension in the core and tension permitted in the shell.

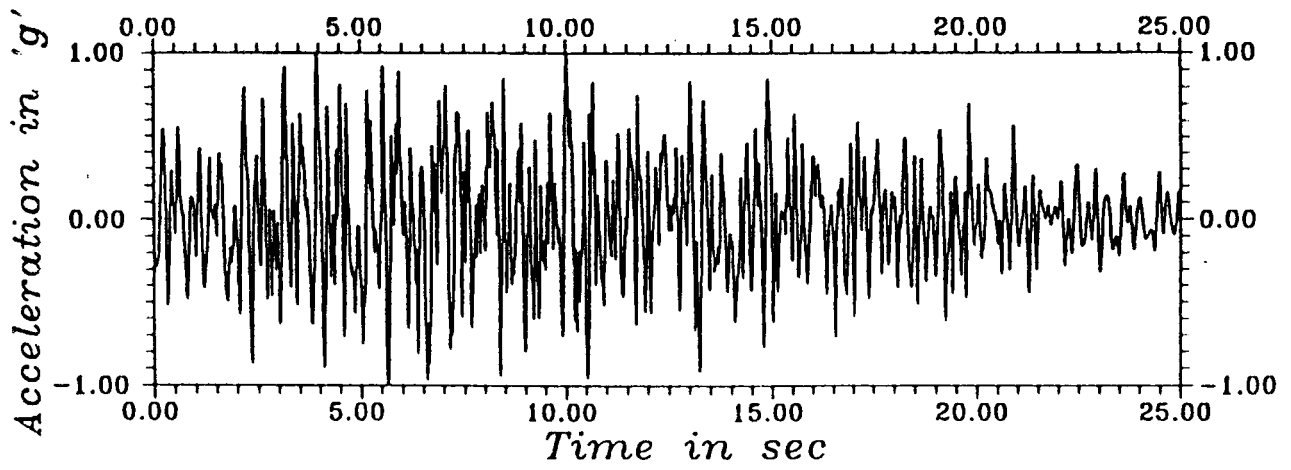
Response spectra values have been given for 5%, 7% and 10% values of damping in Table 3 and Table 4. For design under DBE conditions, these values are to be multiplied by 0.09 ( $=0.18 \times 0.5$ ) for horizontal direction and by 0.06 ( $=0.18 \times 0.5 \times 2/3$ ) for vertical direction.

## 8 Recommendations

It is recommended that the maximum credible earthquake for the site, as proposed in the study reported here be taken to be of magnitude 6.0 at an epicentral distance of 8 km from the site with focal depth as 12 km. The peak ground acceleration in horizontal direction (PGA-H) is conservatively taken as 0.18 g for MCE and 0.09 for DBE.

It is further recommended that for vertical component of earthquake, 2/3 of the value corresponding to the horizontal component be used for design purposes.

Design Response Spectra value given in Table 4 and Table 5 are to be multiplied by 0.09 for DBE in horizontal direction and by 0.06 for vertical direction.



GROUND MOTION TIME HISTORY (NORMALISED TO UNIT GRAVITY)

Fig 5

Table 6

INPUT ACCELERATION TIME HISTORY at 0.01 sec interval for MAHADAYI  
PROJECT, COA, Ordinates Normalised to Unit Gravity  
(Values to be read horizontally)

-.102223	-.268259	-.323864	-.261834	-.246196	-.275606	-.257786
-.245576	-.276099	-.282248	-.264245	-.249925	-.206691	-.138651
-.065630	.031827	.129811	.204859	.297064	.396373	.457950
.503703	.540465	.542876	.534096	.514500	.446547	.345080
.215285	.029891	-.170390	-.333716	-.458401	-.516327	-.492877
-.433762	-.348385	-.226624	-.101434	.021887	.149211	.237360
.274117	.282387	.251864	.194998	.148378	.101318	.046749
.001462	-.046165	-.086484	-.077457	-.017959	.081277	.219017
.355712	.457793	.527720	.551918	.526163	.474285	.396416
.296488	.205268	.128749	.069050	.045789	.046348	.046518
.039584	.005232	-.058279	-.119158	-.174891	-.234721	-.289088
-.349912	-.420075	-.465622	-.479481	-.469336	-.419777	-.341951
-.259414	-.164697	-.066013	.015912	.084318	.126941	.130331
.120705	.113351	.106852	.114433	.120417	.094474	.044090
-.027833	-.121723	-.196352	-.224032	-.209182	-.143086	-.040269
.060563	.156570	.246808	.314418	.370653	.415087	.419925
.387856	.320366	.195393	.032620	-.124559	-.255631	-.339654
-.376749	-.399695	-.414180	-.409464	-.390940	-.350869	-.291379
-.245318	-.219376	-.195775	-.164038	-.098144	.018129	.157505
.284867	.360896	.349051	.270153	.174083	.089020	.040474
.026500	.010012	-.004914	.006391	.027134	.049550	.079311
.087042	.057492	.007611	-.055619	-.100705	-.074718	.024937
.165990	.307304	.388041	.385219	.335292	.275136	.241846
.263945	.308787	.327686	.309698	.248741	.150751	.045171
-.063177	-.179824	-.286533	-.373500	-.434544	-.455086	-.456907
-.473395	-.492671	-.496170	-.483133	-.441798	-.369256	-.286076
-.211223	-.165947	-.167592	-.201514	-.238952	-.261157	-.256715
-.229713	-.191707	-.138947	-.067753	.006427	.060278	.076747
.058167	.025750	-.003990	-.031060	-.070709	-.142740	-.241371
-.341803	-.439326	-.528819	-.574216	-.547664	-.450946	-.290669
-.086058	.124293	.312162	.462023	.559885	.616780	.670240
.737460	.792048	.791622	.713253	.573174	.425145	.325428
.290436	.292211	.280796	.211689	.079149	-.085476	-.255953
-.419001	-.560302	-.681183	-.789217	-.863021	-.867689	-.781843
-.603772	-.369267	-.135522	.056854	.175450	.212160	.217429
.243763	.296453	.357520	.376644	.297595	.146952	-.001201
-.112941	-.177163	-.206052	-.242331	-.280684	-.269032	-.181773
-.005645	.245493	.489792	.657100	.724738	.667335	.509776
.339814	.191935	.045232	-.106702	-.266857	-.413101	-.483751
-.457373	-.366057	-.241623	-.113699	-.006065	.058427	.039440
-.067049	-.212870	-.359986	-.463643	-.465725	-.369555	-.219421
-.056427	.048563	.046224	-.036365	-.159570	-.275644	-.320785
-.297731	-.242729	-.151323	-.053347	-.017088	-.062835	-.190187
-.378381	-.545230	-.631038	-.631274	-.537744	-.373114	-.183088
.033449	.267810	.480098	.663010	.794613	.841149	.852227
.883738	.912469	.911102	.850837	.689680	.460112	.234930
.044973	-.084007	-.151311	-.207782	-.267575	-.318746	-.378170
-.411820	-.343201	-.163696	.087494	.351145	.529633	.576778
.544680	.484548	.400053	.278987	.113469	-.082557	-.280944
-.445416	-.515747	-.454343	-.292488	-.092281	.080041	.181632
.246360	.335491	.456284	.576048	.636562	.586870	.465064
.358776	.309182	.325939	.389189	.429534	.400282	.311430
.192229	.095008	.065739	.089247	.120607	.124086	.086710

contd...

Table 6 contd...

.035133	-.014926	-.087871	-.184679	-.288336	-.400488	-.499453
-.559432	-.597108	-.623170	-.633514	-.632306	-.598968	-.522683
-.434847	-.343453	-.247473	-.159287	-.031726	.177692	.422446
.669667	.891357	.995919	.987000	.974249	.945976	.820195
.636366	.494544	.436907	.416489	.334732	.161788	-.073091
-.364764	-.639347	-.786979	-.850976	-.896927	-.858278	-.733941
-.620587	-.513782	-.356696	-.142685	.125903	.401411	.595868
.679273	.643607	.479373	.245134	.009595	-.199857	-.332239
-.353256	-.302227	-.213422	-.097036	.003785	.031175	-.045918
-.204331	-.354049	-.394657	-.279407	-.035262	.234018	.404463
.415052	.287052	.110552	-.000961	.012354	.140524	.328054
.502675	.637670	.745188	.808719	.804325	.711988	.484603
.133182	-.232147	-.519072	-.685519	-.710854	-.629109	-.486123
-.294746	-.075526	.172480	.451148	.659669	.699067	.593474
.394743	.171227	.018748	-.080659	-.195991	-.289062	-.329745
-.344326	-.319460	-.282734	-.295479	-.321470	-.336715	-.389256
-.461707	-.520699	-.570325	-.557235	-.458713	-.344855	-.235078
-.125289	-.060152	-.037757	-.040034	-.080137	-.121669	-.152782
-.224777	-.310257	-.367890	-.432778	-.498356	-.563114	-.673810
-.753791	-.708158	-.613396	-.541705	-.497510	-.507356	-.488620
-.319606	-.069471	.167225	.398382	.583314	.698198	.780612
.770389	.621063	.427712	.262852	.169797	.221939	.380179
.525995	.593905	.519113	.292780	.039678	-.135880	-.205237
-.164142	-.089122	-.060881	-.060831	-.082169	-.133900	-.164359
-.172810	-.213750	-.280365	-.356837	-.415972	-.366549	-.211723
-.082625	-.036386	-.033205	-.018948	.080900	.302969	.588302
.823074	.915375	.908818	.904719	.813972	.499691	.072937
-.313721	-.660019	-.910885	-.993378	-1.000000	-.995797	-.939011
-.887633	-.887814	-.787261	-.480449	-.095289	.217429	.421288
.496475	.427756	.282280	.149727	.042354	-.037912	-.027038
.098708	.266278	.413501	.525209	.570479	.523303	.412407
.299864	.255148	.334365	.528526	.747762	.883189	.874365
.722417	.474676	.210479	.009920	-.088986	-.103222	-.078603
-.047355	-.009994	.038145	.084469	.104121	.067473	-.032458
-.163887	-.301430	-.442114	-.568038	-.651218	-.657131	-.541559
-.319155	-.063758	.180245	.365770	.419306	.349437	.229148
.110038	.059788	.094566	.089119	-.042150	-.225704	-.361889
-.385623	-.288909	-.179915	-.174928	-.295553	-.511449	-.724562
-.812011	-.759214	-.599075	-.347215	-.084694	.109937	.239351
.298513	.300671	.305180	.303281	.272148	.246878	.209570
.126859	.016868	-.148797	-.370812	-.558046	-.698915	-.821289
-.890865	-.938614	-.965568	-.862287	-.694379	-.628632	-.646314
-.736656	-.875000	-.772692	-.318612	.146172	.386085	.436655
.318063	.131755	.046784	.073946	.171822	.296869	.332455
.258987	.131959	-.066239	-.252988	-.272674	-.139716	.081233
.345253	.529363	.619904	.706196	.717160	.592267	.435968
.288182	.160848	.141005	.200120	.255778	.330072	.401643
.425626	.458930	.521173	.593472	.709200	.805451	.756073
.565919	.292024	-.009265	-.233904	-.369950	-.505328	-.647844
-.752183	-.785734	-.714155	-.587744	-.514249	-.523205	-.600516
-.693438	-.670897	-.476519	-.186017	.114161	.326051	.385090
.375042	.401974	.474096	.574089	.647136	.617943	.521060
.445796	.436063	.518616	.633341	.622575	.424225	.098822
-.271749	-.547974	-.588391	-.400778	-.104093	.163998	.283145
.224803	.046693	-.164258	-.270157	-.171369	.056391	.276594
.432146	.501146	.506756	.522954	.536759	.462502	.294515
.069148	-.198184	-.442564	-.593165	-.652733	-.625544	-.520973
-.412825	-.332811	-.240170	-.136379	-.032031	.071978	.089617

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Table 6 contd...

-.026057	-.162044	-.228867	-.219707	-.111683	.041792	.130423
.150893	.108902	-.025135	-.162753	-.206695	-.167854	-.042734
.122333	.198410	.190918	.164779	.093767	.021851	-.000892
-.060977	-.154731	-.185583	-.155323	-.031164	.205221	.407647
.537345	.647577	.631616	.522796	.509921	.493254	.364004
.297317	.320390	.339346	.430911	.559194	.609619	.662838
.706539	.637367	.572571	.574678	.542311	.485400	.368821
.120876	-.079295	-.093667	.003902	.207262	.419104	.405951
.183631	-.138164	-.547739	-.866485	-.942490	-.874805	-.702713
-.468100	-.338447	-.248565	-.034968	.233860	.519089	.791712
.845943	.660322	.390570	.040611	-.298621	-.441167	-.442745
-.381610	-.246116	-.154516	-.123831	-.020529	.102733	.171612
.216320	.138862	-.079489	-.257725	-.354216	-.394038	-.328359
-.247936	-.240604	-.243934	-.276877	-.333647	-.289128	-.186711
-.111799	.003852	.125328	.187928	.277052	.369173	.387650
.409524	.417405	.318520	.190576	.107842	.097413	.240973
.461068	.580970	.571431	.405584	.081417	-.232551	-.460312
-.644859	-.735674	-.761303	-.806683	-.781467	-.644879	-.480154
-.281295	-.110957	-.082553	-.082023	-.001117	.103197	.230811
.309560	.185488	-.039314	-.201254	-.325283	-.386572	-.372886
-.413035	-.502022	-.558940	-.607333	-.559729	-.311202	.018763
.306445	.471928	.375271	.078115	-.184234	-.332873	-.378764
-.369481	-.448013	-.589591	-.595770	-.433686	-.189460	.063532
.203500	.190497	.091755	-.074167	-.230148	-.253060	-.198476
-.157481	-.119663	-.136331	-.232764	-.297386	-.274623	-.169464
.025401	.199678	.219663	.108263	-.052484	-.161886	-.114298
.057913	.276364	.514999	.643607	.571577	.458445	.385452
.216601	-.024906	-.163136	-.175222	-.116907	-.003169	.114419
.189106	.218259	.186548	.120608	.077654	.022502	-.075609
-.133693	-.115497	-.079601	-.048018	-.053873	-.160277	-.312054
-.412786	-.479299	-.536789	-.585416	-.662934	-.710430	-.598698
-.356430	-.080331	.202196	.423943	.554661	.688326	.833731
.921206	.973621	.994078	.943619	.857027	.737612	.573521
.458511	.426827	.429130	.495626	.607139	.661950	.651191
.566548	.376925	.147593	-.117829	-.431921	-.609213	-.559705
-.424586	-.268909	-.174097	-.286554	-.495427	-.624453	-.674610
-.582852	-.360610	-.221299	-.185508	-.194127	-.341699	-.504634
-.492558	-.425799	-.346069	-.199238	-.139082	-.126365	.014612
.131663	.195693	.380085	.460406	.227267	-.113547	-.456305
-.756396	-.879116	-.927593	-.952805	-.878678	-.879550	-.754384
-.040446	.643304	.480269	.039796	-.008762	.070742	.161421
.358917	.474877	.554066	.730956	.828938	.800999	.627062
.167345	-.283770	-.399475	-.386759	-.329027	-.125592	.018635
.054751	.140216	.147502	.057650	.047800	-.004390	-.163079
-.245888	-.303133	-.386238	-.354825	-.300738	-.341224	-.372541
-.425124	-.515971	-.468020	-.301574	-.121468	.120602	.319025
.350603	.344418	.337062	.257930	.176422	.090634	-.042640
-.118221	-.135729	-.182037	-.203618	-.202473	-.224792	-.174866
-.047572	.058321	.163934	.239835	.194453	.088353	-.030389
-.173639	-.240284	-.188647	-.094275	.040872	.189870	.290309
.397011	.505308	.518739	.466043	.364827	.156117	-.084518
-.269516	-.411961	-.454692	-.388546	-.357544	-.403664	-.455246
-.477961	-.412442	-.246330	-.091738	-.006497	.018082	-.028322
-.083297	-.073560	-.023186	.067269	.216205	.365713	.478388
.549347	.542423	.475693	.406685	.345547	.316023	.335484
.347556	.321217	.273509	.193211	.079293	-.059964	-.248697
-.464608	-.619941	-.640949	-.486925	-.175327	.204419	.548308
.752641	.750942	.597997	.411808	.276723	.239047	.267469

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Table 6 contd...

.269925	.213561	.121822	.020859	-.052611	-.110026	-.205753
-.325840	-.430715	-.519038	-.561113	-.535775	-.473001	-.358466
-.171025	.029317	.198529	.337076	.403866	.351764	.177963
-.082076	-.339978	-.509843	-.569205	-.522220	-.401713	-.270328
-.154517	-.065665	-.024765	-.002845	.040788	.105729	.193543
.279096	.308844	.298620	.282879	.238554	.162101	.063845
-.062207	-.153810	-.135891	-.026080	.136838	.305667	.396989
.398573	.366252	.334852	.348868	.416469	.464238	.476731
.495219	.503556	.502328	.510691	.476588	.384093	.281500
.163976	.040546	-.033850	-.064235	-.055931	.010606	.075111
.086138	.069767	.020761	-.048544	-.067244	-.042108	-.008388
.062678	.138311	.139658	.083607	.033135	.043709	.158078
.322460	.428437	.428125	.311599	.109476	-.098037	-.277897
-.429366	-.520443	-.550876	-.530378	-.422098	-.230412	-.004266
.221525	.371243	.383439	.311454	.221845	.144881	.121299
.125480	.088248	.024683	-.036514	-.107617	-.153743	-.136487
-.067483	.054193	.210769	.350531	.472344	.586660	.673602
.748738	.817477	.833490	.789042	.696324	.534925	.322619
.092973	-.165492	-.426142	-.610645	-.672572	-.595350	-.409643
-.222243	-.125922	-.149276	-.283043	-.459934	-.605645	-.727697
-.844684	-.917730	-.917701	-.844390	-.692967	-.475443	-.222799
.040176	.283778	.473976	.600092	.677912	.721562	.717620
.646076	.521862	.384712	.268197	.186463	.117360	.024505
-.092229	-.211418	-.320298	-.398918	-.426744	-.393292	-.279330
-.088989	.111028	.241828	.265246	.179008	.015973	-.158875
-.281342	-.321746	-.298531	-.259425	-.243003	-.255398	-.266631
-.241245	-.189430	-.157774	-.173697	-.226444	-.272507	-.253600
-.140982	.042377	.233298	.359104	.395166	.372090	.319735
.264921	.239547	.231721	.200693	.135770	.040567	-.078469
-.198452	-.305683	-.388777	-.426838	-.434262	-.435844	-.414603
-.359548	-.277040	-.167858	-.083033	-.082826	-.129264	-.159793
-.165468	-.142686	-.120156	-.161533	-.259510	-.368484	-.481901
-.573718	-.612681	-.619983	-.602306	-.551612	-.502363	-.464079
-.410352	-.358274	-.330968	-.313123	-.282320	-.201192	-.047820
.124391	.239130	.250492	.144763	-.027351	-.189882	-.310511
-.358843	-.311607	-.212131	-.103624	.011941	.116582	.200934
.282696	.355026	.411179	.454873	.456017	.399374	.301800
.152832	-.032597	-.188262	-.295392	-.370426	-.408644	-.426336
-.432463	-.391206	-.300238	-.190400	-.071067	.036532	.120460
.214481	.327680	.439347	.533082	.548829	.440148	.271666
.132415	.068118	.108926	.216540	.300822	.334255	.319942
.243507	.132007	.019084	-.103628	-.227580	-.347887	-.499635
-.666718	-.771710	-.768875	-.649699	-.437392	-.203446	-.000146
.180913	.355141	.520085	.665359	.774699	.838131	.848306
.804147	.739271	.689870	.642803	.562534	.422007	.205328
-.062067	-.315987	-.504695	-.605397	-.619331	-.564152	-.446466
-.271824	-.079235	.077721	.155755	.123481	-.009080	-.183708
-.340405	-.435253	-.440714	-.372405	-.278363	-.189075	-.108158
-.035138	.023413	.054853	.054088	.033884	.012649	.003728
.014019	.034478	.043023	.026524	-.013278	-.062684	-.089686
-.062130	.020619	.137748	.268413	.385845	.463864	.486517
.436469	.319190	.190305	.101437	.054655	.026390	-.024761
-.127833	-.229791	-.245776	-.163861	-.011926	.189427	.391942
.543543	.629356	.639712	.573923	.460455	.314833	.139676
-.040213	-.199055	-.313040	-.351443	-.323543	-.274980	-.231127
-.201212	-.178559	-.120620	.000918	.164825	.331195	.446114
.454271	.347334	.166689	-.017560	-.135400	-.178932	-.196983
-.224679	-.275713	-.344864	-.388879	-.375945	-.320266	-.241966

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Table 6 contd...

-.165342	-.119381	-.092033	-.050083	.014278	.096817	.180090
.237410	.276258	.317695	.355536	.380586	.381327	.337058
.260756	.189249	.142253	.136064	.173015	.225696	.276532
.313052	.316560	.311579	.326419	.322286	.268897	.193825
.119607	.068616	.068980	.093909	.103894	.112754	.130876
.141322	.136198	.099134	.018638	-.075650	-.161638	-.246502
-.324705	-.390757	-.443766	-.453010	-.397782	-.305282	-.203599
-.108463	-.043252	-.012415	.002888	.016862	.040647	.073039
.088248	.069926	.026600	-.029038	-.083292	-.136297	-.214946
-.332540	-.471899	-.612107	-.713365	-.714564	-.592257	-.376722
-.126598	.076856	.173127	.169161	.107363	.038964	.018947
.055297	.110926	.168859	.219283	.240422	.243273	.244136
.214963	.130692	-.004435	-.169666	-.308960	-.377460	-.396805
-.395616	-.388546	-.408524	-.449147	-.457011	-.405851	-.282945
-.099219	.064249	.153263	.188954	.193617	.230321	.357485
.453742	.379004	.210892	.054470	-.104433	-.258251	-.389681
-.518020	-.595267	-.560750	-.430732	-.225309	.010486	.195219
.337361	.472398	.555386	.580531	.586084	.548669	.465459
.371974	.255702	.129795	.042239	-.022233	-.069076	-.062329
-.022296	.030250	.115145	.204957	.271992	.334093	.373163
.368008	.332769	.249861	.119260	-.009610	-.136127	-.269449
-.369036	-.433839	-.481370	-.483319	-.440414	-.369915	-.251502
-.108762	-.001012	.060876	.077164	.055775	.038906	.039049
.055423	.113365	.189969	.241033	.276755	.299920	.312161
.358253	.430408	.472829	.478952	.443168	.357968	.272252
.202076	.115291	.023778	-.071307	-.191368	-.290985	-.327659
-.306648	-.205928	-.044804	.082044	.141360	.158768	.148997
.151358	.177497	.170811	.111295	.017502	-.103625	-.206863
-.253316	-.272200	-.276263	-.252808	-.216382	-.159425	-.066886
.030405	.110559	.162510	.158538	.118933	.088799	.070027
.072104	.105826	.134498	.139750	.122531	.046695	-.089910
-.233661	-.351302	-.415136	-.397738	-.317619	-.203102	-.080216
.001153	.024238	.012609	-.022775	-.053921	-.045655	-.006918
.061414	.171494	.287176	.376837	.444579	.479335	.486576
.492961	.480283	.426466	.342469	.225228	.086391	-.035480
-.141401	-.237002	-.292571	-.312078	-.328715	-.350763	-.381469
-.412566	-.412844	-.375253	-.309275	-.211166	-.088270	.048698
.194425	.316155	.374391	.353304	.245066	.063681	-.149640
-.352045	-.488489	-.514175	-.444421	-.322135	-.188005	-.082853
.000130	.099946	.209586	.301279	.357771	.345236	.257245
.139784	.032026	-.042452	-.080699	-.125214	-.200666	-.283278
-.352361	-.380734	-.347102	-.285777	-.223346	-.149473	-.083300
-.036530	.014216	.056192	.070859	.074593	.061687	.032427
.021332	.024736	.023905	.024597	.000989	-.064288	-.135562
-.204761	-.278600	-.326727	-.341629	-.329169	-.275347	-.202708
-.130115	-.026442	.105625	.241524	.380644	.484464	.524700
.540728	.538047	.502375	.467061	.426500	.354881	.275618
.167832	-.004695	-.195737	-.376428	-.538552	-.617514	-.610895
-.572181	-.483623	-.362274	-.281164	-.230554	-.197436	-.197369
-.163839	-.066116	.032921	.119137	.162072	.086633	-.068033
-.232168	-.387453	-.448690	-.374959	-.246854	-.080263	.107763
.210924	.237274	.248486	.210063	.164937	.179107	.172295
.121207	.074340	-.015960	-.112935	-.114546	-.111326	-.189284
-.272754	-.329946	-.339131	-.253877	-.151762	-.087422	-.033480
-.039300	-.038647	.102115	.161099	-.086131	-.379628	-.475726
-.460439	-.365308	-.168044	.049532	.267869	.484307	.628496
.698164	.686652	.556267	.409219	.329154	.245386	.154806
.092254	.000496	-.096391	-.128635	-.144423	-.154152	-.113595

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Table 6 contd...

-.078161	-.072822	-.047448	-.029717	-.032114	.010384	.088320
.155004	.205354	.201309	.126130	.032985	-.062777	-.157893
-.209292	-.224861	-.230869	-.201144	-.151034	-.137518	-.156244
-.171717	-.159028	-.092467	.019937	.144987	.262485	.342543
.363513	.344455	.301328	.242666	.197034	.175318	.165886
.168077	.173690	.168465	.157792	.144672	.125896	.109635
.095705	.078131	.063876	.053751	.044178	.041183	.039207
.026405	.004622	-.028042	-.073442	-.116383	-.144567	-.151470
-.127405	-.080488	-.032886	-.001353	-.006550	-.060449	-.145939
-.237316	-.307823	-.326104	-.282583	-.191448	-.070785	.050331
.141566	.194183	.208684	.190331	.157326	.121651	.084270
.048507	.010382	-.038666	-.095898	-.158053	-.222337	-.274474
-.302848	-.302920	-.265980	-.190746	-.085772	.043575	.186192
.323770	.443353	.529194	.564131	.546558	.483477	.385363
.273766	.167990	.076696	.006860	-.042787	-.082333	-.115095
-.140810	-.159926	-.165947	-.154385	-.129749	-.096604	-.062171
-.036363	-.019809	-.008133	.001985	.018143	.045076	.079397
.118258	.156682	.184616	.195808	.185949	.149896	.088865
.006940	-.092269	-.198515	-.298724	-.381960	-.434654	-.446238
-.415218	-.343823	-.240764	-.123170	-.006262	.097911	.178190
.230813	.256475	.254000	.224799	.171585	.095100	.001239
-.098398	-.191532	-.263330	-.300574	-.298980	-.260205	-.191056
-.105254	-.016911	.062539	.122825	.159223	.173302	.168836
.152592	.132438	.112701	.095850	.082984	.071934	.060769
.049297	.036817	.023994	.013203	.005703	.002933	.007065
.018383	.035648	.056119	.074004	.083002	.079416	.062582
.036048	.006970	-.017596	-.032791	-.036936	-.032156	-.022128
-.009572	.004028	.018497	.034341	.050893	.065753	.075689
.077831	.071061	.056728	.038142	.019540	.005105	-.001660
.001872	.017450	.045467	.083923	.128201	.171888	.207378
.227101	.225525	.199845	.150228	.080576	-.002082	-.088517
-.167776	-.229715	-.267660	-.278810	-.264720	-.231103	-.185660
-.136541	-.090565	-.051349	-.020880	-.001041	.007193	.002798
-.015300	-.045573	-.084260	-.126388	-.164805	-.192478	-.204593
-.197178	-.168849	-.122456	-.062191	.006534	.076677	.143081
.202241	.250680	.287387	.312522	.324741	.323792	.310387
.284136	.245971	.197733	.140553	.077961	.015056	-.044244
-.094585	-.130757	-.151997	-.159739	-.157508	-.152296	-.148904
-.148013	-.148958	-.147502	-.137481	-.116620	-.085226	-.045607
-.003825	.034872	.067369	.089644	.099795	.098241	.084181
.059053	.027049	-.009123	-.045660	-.077654	-.103289	-.120158
-.124056	-.113242	-.085631	-.039008	.023054	.094019	.166515
.229481	.273718	.295039	.289723	.257318	.202072	.127574
.039516	-.052522	-.140677	-.216991	-.272895	-.305824	-.316638
-.306320	-.279709	-.241328	-.192520	-.137364	-.080292	-.023599
.027176	.067192	.096687	.115497	.125186	.131220	.135446
.137799	.140324	.141573	.139247	.134490	.125702	.110462
.089948	.062946	.028012	-.011404	-.053006	-.094646	-.130504
-.158056	-.177077	-.184875	-.182661	-.174025	-.159181	-.141030
-.124135	-.109106	-.098589	-.096101	-.100333	-.111683	-.131237
-.154430	-.178013	-.200217	-.214404	-.216196	-.204674	-.176251
-.131129	-.073793	-.006095	.066588	.135050	.194372	.239045
.262920	.266968	.253313	.223672	.185480	.143832	.099376
.057118	.020965	-.008291	-.025196	-.026808	-.016526	.004058
.030227	.052958	.069443	.078107	.074764	.060998	.038311
.004303	-.037268	-.080903	-.124014	-.158640	-.178207	-.184347
-.177333	-.158728	-.135067	-.107207	-.074048	-.039252	-.002959
.034110	.065179	.088713	.106521	.116905	.122885	.127843

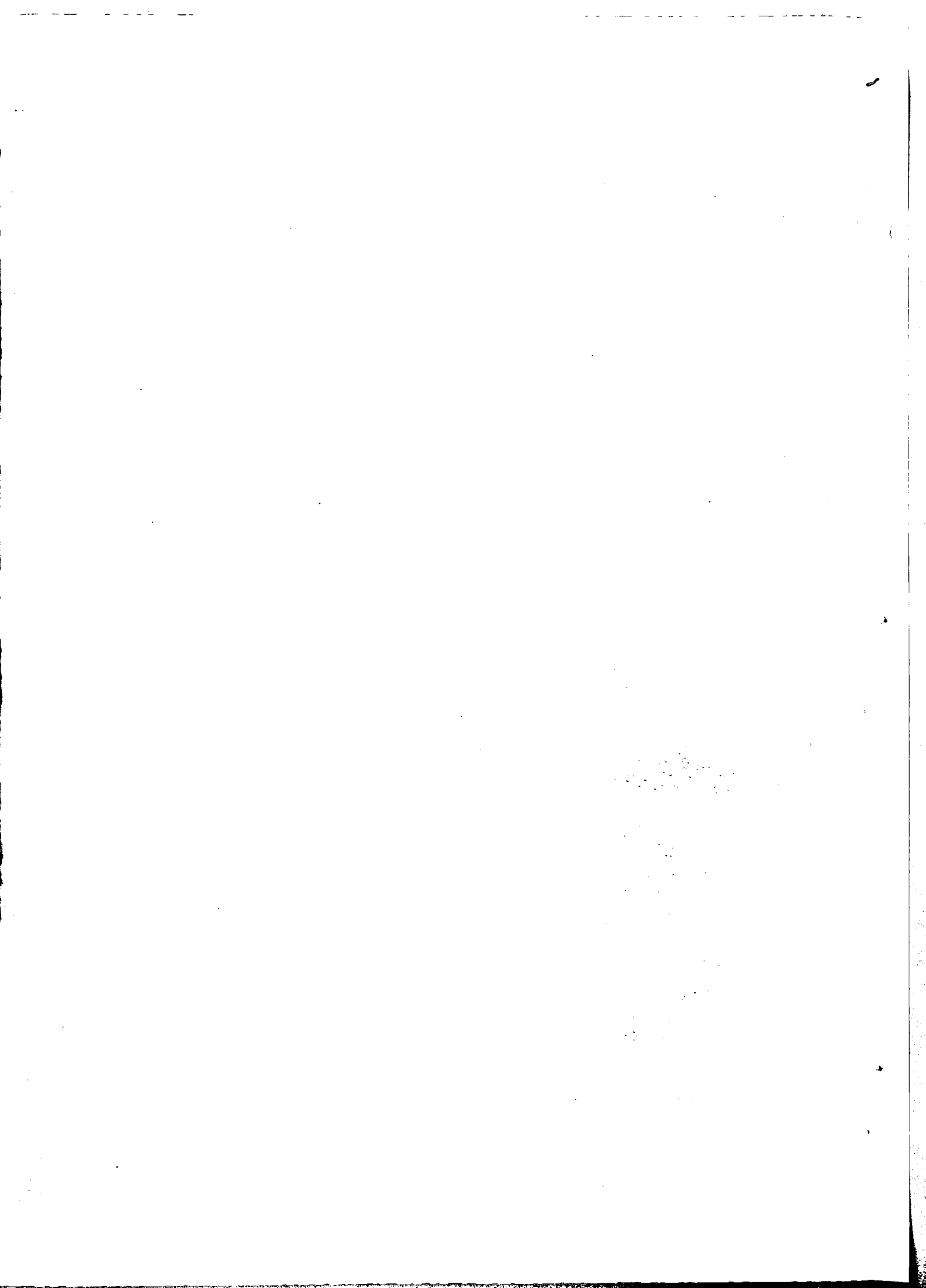
contd...

Table 6 contd...

.127673	.121097	.109068	.088712	.062982	.037705	.012343
-.011620	-.032334	-.054329	-.077152	-.096033	-.111319	-.120340
-.119771	-.115247	-.110234	-.104288	-.101686	-.101459	-.097669
-.091721	-.084296	-.073527	-.064568	-.059756	-.056004	-.055901
-.060073	-.065427	-.076272	-.094932	-.117197	-.143201	-.169731
-.187054	-.191768	-.180805	-.148184	-.097246	-.033440	.040783
.114928	.179324	.231993	.266792	.280495	.278089	.258320
.220601	.173043	.118024	.058018	.004460	-.038577	-.071469
-.087816	-.087784	-.075335	-.047033	-.006380	.037062	.080938
.119053	.142981	.155778	.159277	.151119	.137313	.121273
.100187	.077727	.056132	.033171	.012689	-.003731	-.019408
-.033192	-.046673	-.062214	-.074561	-.084133	-.093057	-.093405
-.088334	-.087134	-.078207	-.055504	-.031806	-.002377	.041557
.084842	.119767	.149859	.163125	.154135	.130042	.085769
.031091						

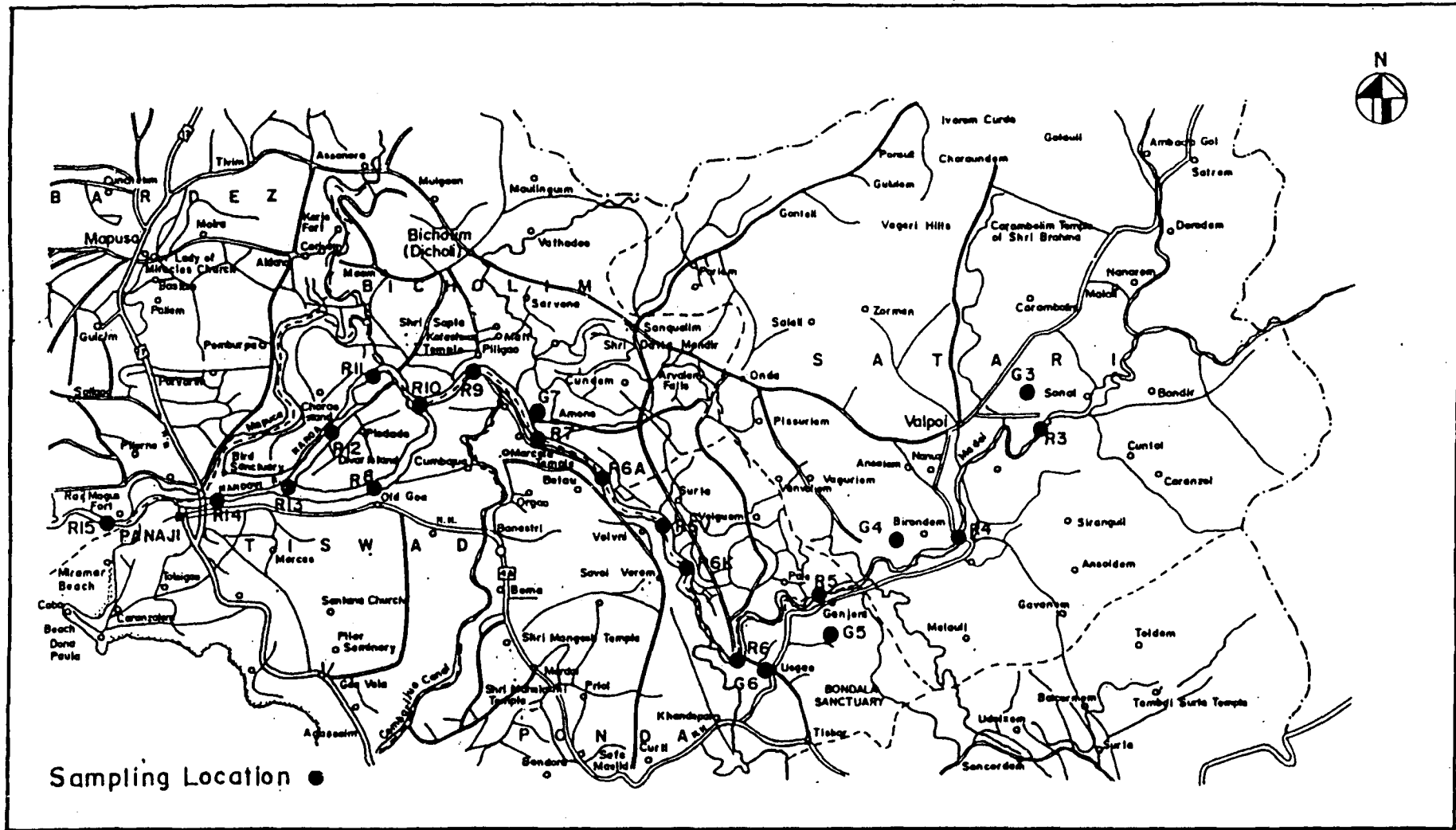
## **Supplementary Information**

**Data Generated during November 1995 to  
October 1996 on Ecology of the Mandovi in Goa**



**Sampling Locations for Data Generated on Flora and Fauna  
along the River Mandovi in Goa**

Sampling Location	Location Code
Just Starting point in Goa region near Sonali village	R3
At Khadki bridge in between Bhironda and Khadki villages	R4
At Ganjem near Bondla Water Supply intake point U/S of CWC River Gauging Station	R5
Bridge at Usgaon Pali bridge	R6
At Kotambi Village	R6K
At Vagus Village	R6V
At Volvoi Village	R6A
At Ferri crossing near Amone Village	R7
At Old Goa area	R8
Near Tongaon Village	R9
U/S of Pilligaon Village	R10
U/S of Konkan Railway Bridge near Narao village	R11
Between Chora and Deewar Islands	R12
In Ribander area near two concrete pillars on right bank	R13
Before Chorao Island Bifurcation	R14
End of Mandovi river at outfall in Arabian Sea near Jetty in Goa	R15



Water Quality Sampling Locations in the Study Area In Goa

Table 1

## Physico-chemical Water Quality in Mandovi River/Estuary along with Details of Sampling Conditions (November 1995)

Parameter	Sampling Location											
	R3	R4	R5	R6	R6A	R7	R8	R11	R11A	R13	R14	R15
Time of Sampling	181	174	171	1650	1450	1545	0805	1445	1330	0825	1200	0845
Air Temperature (°C)	27.1	27.2	28.0	29.8	32.8	30.8	26.0	30.5	30.5	26.7	30.4	27.1
Water Temperature (°C)	28.5	28.5	29.5	29.6	29.8	30.2	29.0	30.0	29.6	29.0	29.8	29.0
Salinity (ppt)	0.0	0.0	0.0	0.0	0.0	2.3	20.73	5.8	10.6	25.76	24.33	31.89
Dissolved O <sub>2</sub> (mg/L)	5.0	5.2	5.4	4.8	4.7	4.1	4.8	4.5	4.3	4.3	4.1	4.6
pH	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7
Suspended Load (mg/L)	1.0	1.1	1.2	2.2	5.0	2.0	5.5	5.0	2.5	2.0	3.0	5.0
V.E.C.	11.76	12.35	12.94	10.58	5.88	10.0	4.7	5.88	7.06	10.0	8.82	5.88
Phosphate as P (µg/L)	0.90	0.91	0.87	0.88	0.77	0.86	0.76	0.82	0.84	0.68	1.21	0.72
Silicate as Si (µg/L)	97.6	93.1	91.5	87.0	83.6	94.5	81.6	91.7	90.2	98.7	89.1	93.4
Nitrate as N (µg/L)	5.92	6.07	6.32	5.91	5.83	6.15	5.36	5.70	4.61	5.49	5.27	5.44

Table 2

River Mandovi - Bottom Sediment Analysis (November 1995)

Sampling Location	Moisture Content (%)	Organic* Matter (%)	Organic* Carbon (%)	Sand (%)	Silt (%)	Clay (%)
R3	12.70	2.55	1.48	43.72	39.12	17.16
R4	30.40	3.03	1.76	40.86	19.54	39.50
R5	30.14	3.17	1.84	58.58	18.42	23.00
R6	15.78	3.10	1.80	64.24	22.46	13.30
R7	43.30	4.19	2.43	71.64	21.46	6.90
R8	32.10	2.45	1.42	62.10	26.42	11.48
R9	39.14	3.62	2.10	58.14	25.14	16.72
R10	40.12	4.90	2.84	59.24	22.12	18.64
R11	30.42	3.10	1.80	42.04	36.14	21.82
R12	34.60	3.83	2.22	68.64	14.24	17.12
R13	24.18	4.55	2.64	46.72	26.43	26.85
R14	32.10	5.72	2.32	48.14	17.84	34.02
R15	36.24	3.93	2.28	49.24	18.92	31.84

\* Based on dry weight basis

Table 3

Distribution and Abundance (No/100 ml) of Phytoplankton in Mandovi River/Estuary  
(November 1995)

Genera	Sampling Location											
	R3	R4	R5	R6	R6A	R7	R8	R11	R12	R13	R14	R15
<b>Cyanophyceae</b>												
<i>Trichodesmium erythraceum</i>	-	-	-	-	243	-	-	-	52	-	51	102
<b>Chlorophyceae</b>												
<i>Pediastrum sp.</i>	-	-	-	-	-	-	-	-	-	-	10	64
<i>Spirogyra sp.</i>	18	16	-	22	-	-	-	10	-	-	-	-
<i>Ulothrix sp.</i>	64	23	19	14	-	-	-	24	-	-	-	-
<i>Cosmarium sp.</i>	12	-	10	-	-	-	-	-	10	-	-	-
<i>Micrasterias sp.</i>	-	-	11	-	-	-	-	-	-	-	-	-
<i>Zygnema sp.</i>	-	10	-	-	-	-	-	10	-	-	-	-
<b>Bacillariophyceae</b>												
<i>Coscinodiscus sp.</i>	1050	296	304	191	678	743	511	701	401	650	804	1000
<i>Skeletonema sp.</i>	64	98	-	-	-	-	302	101	-	500	-	600
<i>Hemidiscus sp.</i>	73	48	91	181	101	414	-	212	510	-	201	400
<i>Melosira sp.</i>	64	71	-	96	-	48	52	-	-	100	-	-
<i>Stephanopyxis sp.</i>	-	-	-	-	-	-	-	-	-	-	51	-
<i>Triceratium sp.</i>	-	40	-	46	48	-	51	-	-	-	-	50
<i>Biddulphia sp.</i>	191	-	-	-	56	-	-	-	-	-	-	-
<i>B. mobiliensis</i>	221	32	26	96	-	-	246	401	102	302	49	200
<i>B. sinensis</i>	-	-	-	-	-	-	-	-	-	-	-	-
<i>Guinardia sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-
<i>Bellerochea sp.</i>	65	-	10	-	49	48	-	43	50	-	51	100
<i>Ditylum sp.</i>	-	-	-	-	-	-	104	-	-	150	-	-
<i>Lithodesmium sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-
<i>Chaetoceros sp.</i>	71	106	146	91	-	-	100	48	-	200	-	300
<i>Campylodiscus sp.</i>	-	74	-	148	464	120	411	341	211	501	568	201
<i>Planktoniella sp.</i>	104	68	71	43	63	204	51	-	-	100	-	-
<i>Bacteriastum sp.</i>	-	43	21	281	68	101	112	51	-	54	-	-

**Table 3 (Contd...)**  
**Distribution and Abundance (No/100 ml) of Phytoplankton in Mandovi River/Estuary**  
**(November 1995)**

Genera	Sampling Location											
	R3	R4	R5	R6	R6A	R7	R8	R11	R12	R13	R14	R15
<i>Eucampia sp.</i>	-	-	-	96	-	-	-	-	49	-	48	104
<i>Climacodium sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-
<i>Streptotheca sp.</i>	-	-	-	86	-	50	56	50	-	-	96	102
<i>Thalassiosira sp.</i>	-	-	-	-	-	110	-	-	-	-	-	-
<i>T. gravida</i>	-	-	-	-	-	156	-	-	-	-	-	-
<i>Thalassionea sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-
<i>Rhizosolenia sp.</i>	104	109	-	140	148	650	78	100	-	196	150	104
<i>R. stolterfothii</i>	-	-	-	64	61	48	-	-	50	-	-	-
<i>R. styliformis</i>	221	210	184	392	102	280	-	-	-	188	-	-
<i>R. hebetata</i>	96	-	48	-	106	101	-	-	-	-	101	61
<i>Fragillaria oceanica</i>	-	-	110	-	-	-	446	482	-	-	684	974
<i>Thalassiothrix sp.</i>	263	202	-	-	-	-	-	-	-	-	-	-
<i>T. longissima</i>	-	-	-	104	48	-	86	48	51	-	-	78
<i>Asterionella japonica</i>	02	-	-	03	04	06	-	22	18	51	21	64
<i>Gyrosigma sp.</i>	-	-	-	14	-	12	-	10	-	14	08	22
<i>Pleurosigma sp.</i>	14	12	-	-	-	-	-	-	-	-	30	10
<i>Navicula sp.</i>	-	-	10	-	-	-	-	11	-	-	-	-
<i>Nitzschia sp.</i>	10	11	-	12	-	13	-	-	10	10	-	-
<i>N. longissima</i>	-	13	-	-	14	-	10	12	-	-	-	-
<b>Dinophyceae</b>												
<i>Prorocentrum sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-
<i>Dinophysis sp.</i>	-	-	-	-	-	-	-	46	-	-	-	-
<i>Peridinium sp.</i>	-	-	10	-	-	10	-	-	-	62	101	101
<i>Ceratium tripos</i>	-	16	-	-	06	-	-	-	-	-	-	-
<i>C. fusus</i>	22	-	-	22	-	07	-	-	10	-	-	-
<i>C. massiliensis</i>	-	-	30	-	10	-	72	10	-	-	-	74
<i>C. furca</i>	08	-	-	43	-	-	48	103	22	-	46	94
<i>Pyrocystis fusiformis</i>	-	03	-	10	10	02	-	-	-	10	-	-
<i>Noctiluca miliaris</i>	12	-	-	06	-	-	-	10	93	76	-	196
<b>Total</b>	<b>2749</b>	<b>1501</b>	<b>1101</b>	<b>2201</b>	<b>2279</b>	<b>3123</b>	<b>2736</b>	<b>2846</b>	<b>1639</b>	<b>3164</b>	<b>3070</b>	<b>5001</b>

- Not recorded

Table 4

Distribution and Abundance (No/haul) of Zooplankton in Mandovi River/Estuary  
(November 1995)

Genera	Sampling Location											
	R3	R4	R5	R6	R6A	R7	R8	R11	R11A	R13	R14	R15
<b>Protozoa</b>												
<i>Tintinnopsis sp.</i>	-	-	-	-	03	03	-	-	-	29	38	46
<i>Favella sp.</i>	-	-	-	-	-	-	-	02	-	-	32	12
<i>Rhabdonella sp.</i>	-	-	-	-	-	03	-	-	04	-	-	06
<i>Globigerina sp.</i>	-	-	-	-	-	-	03	-	01	02	-	02
<i>Siphonophora sp.</i>	-	-	-	-	-	-	-	-	-	-	-	04
<b>Ctenophora</b>												
<i>Pleurobrachia sp.</i>	-	-	-	-	-	02	-	01	03	-	05	04
<b>Copepoda</b>												
<i>Undinula sp.</i>	-	-	-	-	-	-	-	-	-	55	43	57
<i>Acartia sp.</i>	-	-	-	-	-	-	-	-	-	94	-	85
<i>Temora sp.</i>	-	-	-	-	06	-	08	10	10	12	06	44
<i>Eutemora sp.</i>	-	-	-	-	-	-	08	-	22	37	22	43
<i>Oithona sp.</i>	-	-	-	-	-	-	-	10	-	-	-	15
<i>O. plumifera</i>	-	-	-	-	-	04	-	08	-	19	-	109
<i>Euterpina sp.</i>	-	-	-	-	02	-	12	32	21	38	19	57
<i>Paracalanus sp.</i>	-	-	-	-	-	03	-	12	18	32	28	145
<i>Eucalanus sp.</i>	-	-	-	-	-	-	-	-	-	-	21	66
<i>Centropages sp.</i>	-	-	-	-	-	-	-	03	-	06	18	28
<i>Pseudocalanus sp.</i>	-	-	-	-	03	-	-	-	-	-	-	57
<i>Macrosetella sp.</i>	-	-	-	-	-	-	03	04	-	10	26	38
<i>Microsetella sp.</i>	-	-	-	-	02	-	-	03	04	08	-	26
<i>Metridia sp.</i>	-	-	-	-	-	01	-	-	-	-	-	04
<i>Isias sp.</i>	-	-	-	-	-	-	-	-	-	02	-	01
<i>Candacia sp.</i>	-	-	-	-	-	-	02	-	01	-	-	02
<i>Canthocalanus sp.</i>	-	-	-	-	-	01	-	-	01	-	02	04
<i>Nannocalanus sp.</i>	-	-	-	-	-	-	-	01	03	-	-	02
<i>Rhincalanus sp.</i>	-	-	-	-	03	-	-	-	-	06	-	08
<i>Microcalanus sp.</i>	-	-	-	-	-	-	01	-	-	04	13	27

Table 4 (Contd...)

Distribution and Abundance (No/haul) of Zooplankton in Mandovi River/Estuary  
(November 1995)

Genera	Sampling Location											
	R3	R4	R5	R6	R6A	R7	R8	R11	R11A	R13	R14	R15
<i>Parapontella sp.</i>	-	-	-	-	-	-	-	-	06	14	-	-
<i>Labidocera sp.</i>	-	-	-	01	-	-	-	-	-	-	-	03
<i>Oncaea sp.</i>	-	-	-	-	-	-	-	-	-	-	06	14
<i>Heliodiaptomus sp.</i>	08	06	08	05	-	-	-	-	-	-	-	-
<i>Mesocyclops sp.</i>	04	05	08	02	-	-	-	-	-	-	-	-
<i>Microcyclops sp.</i>	03	06	04	04	-	-	-	-	-	-	-	-
<i>Diaptomus sp.</i>	05	07	02	03	-	-	-	-	-	-	-	-
<b>Cladocera</b>												
<i>Penilia sp.</i>	-	-	-	-	-	02	08	-	08	12	16	27
<i>Evadne sp.</i>	-	-	-	-	-	-	-	-	04	07	04	22
<i>Moina sp.</i>	08	06	04	-	-	-	-	-	-	-	-	-
<i>Daphnia sp.</i>	06	04	04	07	-	-	-	-	-	-	-	-
<i>Macrothrix sp.</i>	04	02	02	-	-	-	-	-	-	-	-	-
<b>Rotifera</b>												
<i>Brachionus sp.</i>	06	03	03	02	-	-	-	-	-	-	-	-
<i>Keratella sp.</i>	06	04	-	-	-	-	-	-	-	-	-	-
<i>Polyarthra sp.</i>	08	06	03	03	-	-	-	-	-	-	-	-
<i>Creseis acicula</i>	-	-	-	01	-	01	04	-	08	-	-	18
<i>Creseis sp.</i>	-	-	-	-	-	-	-	-	-	-	-	26
<i>Oikopleura sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-
<b>Larval forms</b>												
Brachiopod	-	-	-	-	-	-	04	-	-	-	-	12
Polychaeta	-	-	-	-	-	-	-	-	-	30	06	-
Copepod	-	277	106	151	66	57	136	194	196	179	186	236
Cirripede	-	-	-	-	-	-	-	-	-	-	57	-
Arachnectis	-	-	-	-	-	-	01	-	-	02	01	-
Bivalvia	228	-	-	-	-	-	-	-	-	-	113	04
Gastropoda	-	-	-	-	-	10	-	19	35	-	37	-
Fish eggs & Larvae	136	47	698	20	38	20	72	-	-	36	-	38
<b>Total</b>	<b>422</b>	<b>373</b>	<b>842</b>	<b>199</b>	<b>123</b>	<b>107</b>	<b>262</b>	<b>299</b>	<b>345</b>	<b>634</b>	<b>699</b>	<b>1292</b>

- Not recorded

Table 5

**Distribution and Abundance (No./10cm<sup>2</sup>) of Meiobenthos in Mandovi River/Estuary  
(November 1995)**

Group	Sampling Location											
	R3	R4	R5	R6	R6A	R7	R8	R11	R11A	R13	R14	R15
Foraminifera	-	30	-	38	69	139	60	60	69	69	109	34
Diatom	59	110	234	53	246	87	60	28	438	43	91	106
Nematoda	43	60	21	-	40	114	74	102	109	132	212	161
Polychaeta	-	10	-	-	-	38	10	41	70	31	-	-
Bivalvia	-	-	-	29	-	-	-	-	-	-	43	20
Ostracoda	-	-	21	-	41	-	-	-	62	-	-	-
Amphipoda	-	-	-	-	-	08	-	10	-	-	-	-
Copepoda	-	-	-	-	-	-	-	21	-	-	-	-
Cumacea	-	-	08	-	-	-	-	-	-	-	-	-
Cirripede larvae	-	-	-	-	-	-	-	-	-	-	54	-
Arachnecis	71	72	32	79	62	-	110	-	39	-	64	-
Fish egg	68	60	82	76	148	-	-	72	89	109	171	-
Turbellaria	-	-	-	-	-	-	-	-	-	-	36	-
<b>Total</b>	<b>241</b>	<b>342</b>	<b>398</b>	<b>275</b>	<b>606</b>	<b>386</b>	<b>314</b>	<b>334</b>	<b>856</b>	<b>384</b>	<b>780</b>	<b>321</b>

- Not recorded

Table 6

Biomass (mg wet wt./10cm<sup>2</sup>) of Meiobenthos Taxa in Mandovi River/Estuary (November 1995)

Group	Sampling Location											
	R3	R4	R5	R6	R6A	R7	R8	R11	R11A	R13	R14	R15
Foraminifera	-	0.07	-	0.08	0.15	0.31	0.13	0.13	0.15	0.15	0.24	0.08
Diatom	0.13	0.14	0.50	0.12	0.54	0.19	0.13	0.06	0.90	0.10	0.20	0.23
Nematoda	0.38	0.53	0.19	-	0.36	0.10	0.66	0.91	0.97	1.18	1.89	1.43
Polychaeta	-	0.29	-	-	-	1.10	0.29	1.19	2.00	0.90	-	-
Bivalvia	-	-	-	0.87	-	-	-	-	-	-	1.29	0.60
Ostracoda	-	-	0.86	-	1.68	-	-	-	2.54	-	-	-
Amphipoda	-	-	-	-	-	0.22	-	0.28	-	-	-	-
Copepoda	-	-	-	-	-	-	-	0.05	-	-	-	-
Cumacea	-	-	0.22	-	-	-	-	-	-	-	-	-
Cirripede larvae	-	-	-	-	-	-	-	-	-	-	0.48	-
Arachnectis	0.63	0.64	0.29	0.70	0.55	-	0.98	-	0.35	-	0.57	-
Fish egg	2.79	2.46	3.37	3.12	6.07	-	-	2.95	3.65	4.47	7.02	-
Turbellaria	-	-	-	-	-	-	-	-	-	-	0.10	-
Total	3.93	4.13	5.43	4.89	9.35	1.92	2.19	5.57	10.56	6.80	11.79	2.34

- Not recorded

Table 7

Distribution and Abundance (No./m<sup>2</sup>) of Macrobenthos in Mandovi River/Estuary (November 1995)

Group	Sampling Location											
	R3	R4	R5	R6	R6A	R7	R8	R11	R11A	R13	R14	R15
Coelenterata	-	-	-	-	-	-	-	-	-	08	-	10
Polychaeta	130	120	110	120	130	120	-	240	60	270	220	230
Gastropoda	50	-	-	60	40	-	40	-	40	90	20	64
Bivalvia	140	60	30	210	180	-	-	-	30	20	-	-
Harpacticoida	-	-	-	-	-	-	-	-	-	72	-	118
Cumacea	-	-	-	-	-	-	-	-	-	10	-	14
Tanaidacea	-	-	-	-	-	-	-	170	-	12	-	100
Isopoda	-	-	-	-	-	-	-	-	-	24	-	40
Amphipoda	-	-	-	-	-	-	-	-	-	-	110	-

- Not recorded

Table 8

Biomass (mg/m<sup>2</sup>) of Macrobenthos Taxa in Mandovi River/Estuary (November 1995)

Group	Sampling Location											
	R3	R4	R5	R6	R6A	R7	R8	R11	R11A	R13	R14	R15
Coelenterata	-	-	-	-	-	-	-	-	-	1.76	-	2.20
Polychaeta	0.97	0.90	0.82	0.90	0.97	0.90	-	1.80	0.45	2.02	1.65	1.72
Gastropoda	37.95	-	-	45.54	30.36	-	30.36	-	30.36	68.31	15.18	48.57
Bivalvia	106.26	45.54	22.77	159.39	136.62	-	-	-	22.77	15.18	-	-
Harpacticoida	-	-	-	-	-	-	-	-	-	0.03	-	0.04
Cumacea	-	-	-	-	-	-	-	-	-	0.002	-	0.003
Tanaidacea	-	-	-	-	-	-	-	0.033	-	2.34	-	0.02
Isopoda	-	-	-	-	-	-	-	-	-	0.252	-	0.42
Amphipoda	-	-	-	-	-	-	-	-	-	-	0.066	-

- Not recorded

Table 9

Density of Various Nektons (No/hauls) in Mandovi River/Estuary  
(November-December 1995)

Species	Sampling Location												
	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15
<b>Fin Fishes</b>													
<i>Ambassis commersonii</i>	-	-	-	-	-	-	15	-	4	2	-	7	4
<i>Ambassis dussumieri</i>	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Awaous grammepomus</i>	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Barilius evezardi</i>	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Cynoglossus puncticeps</i>	-	-	-	-	-	-	-	-	-	-	3	-	1
<i>Danio devario</i>	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Etroplus suratensis</i>	-	-	-	-	-	-	1	-	-	1	-	-	-
<i>Garra gotyla gotyla</i>	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Gonoproktopterus thomassi</i>	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Mugil cephalus</i>	-	-	-	-	-	-	-	3	1	1	-	-	1
<i>Nemacheilus rubidipinnis</i>	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Osteobrama dayi</i>	11	3	4	-	-	-	-	-	-	-	-	-	-
<i>Pseudorhombus arsius</i>	-	-	-	-	-	2	-	-	-	-	1	2	1
<i>Paruciosoma daniconius</i>	3	7	1	-	-	-	-	-	-	-	-	-	-
<i>Puntius filamentosum</i>	8	13	-	-	-	-	-	-	-	-	-	-	-
<i>P. amphibius</i>	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>P. nigrofasciatus</i>	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>P. ophiocephalus</i>	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>P. arulius</i>	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Rasbora neilgherriensis</i>	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Sleyopterus graseus</i>	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 9 (Contd...)

Density of Various Nektons (No/hauls) in Mandovi River/Estuary  
(November-December 1995)

Species	Sampling Location												
	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15
<i>Scatophagus argus</i>	-	-	-	-	-	-	2	1	3	3	1	-	2
<i>Sillago sihama</i>	-	-	-	-	-	1	-	-	-	1	2	1	-
<i>Stenogobius gymnopomus</i>	4	2	1	2	3	-	1	1	1	-	-	-	-
<i>Teuthis vermiculata</i>	-	-	-	-	-	3	-	-	-	1	2	1	-
<i>Chanos chanos</i>	-	-	-	-	-	-	-	-	-	-	-	-	2
<b>Shell Fishes</b>													
<i>Macrobrachium malcolmsoni</i>	4	1	2	2	1	-	-	-	-	-	-	-	-
<i>Metapenaeus affinis</i>	-	-	-	-	-	2	2	1	-	-	1	8	-
<i>M. monoceros</i>	-	-	-	-	4	5	3	7	-	2	-	-	3
<i>M. dobsoni</i>	-	-	-	-	-	-	-	3	2	1	2	3	-
<i>Penaeus merguensis</i>	-	-	-	-	2	2	3	2	-	1	-	-	2
<i>P. indicus</i>	-	-	-	-	1	2	-	1	-	-	-	-	2
<i>Scylla serrata</i>	-	-	-	-	-	-	1	3	1	1	1	-	-
Unidentified (small crab)	-	-	-	4	-	-	-	-	-	-	-	-	-
<i>Macrobrachium ruda</i>	3	8	2	11	-	-	-	-	-	-	-	-	-
<i>Villerita cyprinoides</i>	-	-	-	2	-	-	-	-	-	-	-	-	-
<i>Meretrix meretrix</i>	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>M. casta</i>	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Paphia malabarica</i>	-	-	-	-	-	-	-	-	-	-	-	-	-

- Not recorded

Table 1

## Physico-chemical Water Quality in Mandovi River/Estuary along with Details of Sampling Conditions (December 1995)

Parameter	Sampling Location												
	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15
Time of Sampling	0800	0910	0950	1015	1205	1440	1240	1330	1405	1720	1610	1710	1630
Tidal Condition	-	-	-	High	Low	Low	Low	Low	Low	Low	Low	Low	Low
Air Temperature (°C)	22.6	24.1	27.2	27.8	31.1	32.8	33.3	33.2	30.3	28	28.4	28.1	29.2
Water Temperature (°C)	25	26.2	28	28	29	28.7	29.3	29	29.1	28.3	29.4	28.6	29
Salinity (ppt)	0.0	0.0	0.0	0.6	1.9	26	4.6	8.9	14.8	32.6	30	32.1	32.6
Dissolved O <sub>2</sub> (mg/L)	6.3	5.8	6.6	5.6	5.2	6.0	5.4	5.8	5.1	5.4	5.7	5.2	5.6
pH	7.5	7.4	7.5	7.5	7.7	7.9	7.6	7.6	7.8	7.9	8.0	8.0	8.0
Suspended Load (mg/L)	1.0	1.0	1.0	2.0	1.0	1.0	1.0	4.0	1.0	1.0	1.0	1.0	1.0
V.E.C.	14	11	19	10	15	16	20	6	14	13	18	12	16
Phosphate as P (µg/L)	0.49	0.57	0.45	0.59	0.55	0.96	0.60	0.57	0.91	0.87	0.69	0.83	0.54
Silicate as Si (µg/L)	77.1	77.5	76.2	80.1	77.4	66.0	80.6	81.3	68.2	76.1	54.2	78.7	78.1
Nitrate as N (µg/L)	0.96	0.92	0.90	0.94	0.92	1.01	0.8	0.89	1.03	0.91	0.88	0.83	0.8

V.E.C. : Vertical Extinction Coefficient

Table 2

River Mandovi - Bottom Sediment Analysis (December 1995)

Sampling Location	Moisture Content (%)	Organic* Matter (%)	Organic* Carbon (%)	Sand (%)	Silt (%)	Clay (%)
R3	4.43	5.50	3.20	83.02	14.0	2.0
R4	7.02	5.10	3.00	68.56	29.0	2.0
R5	0.64	3.60	2.10	90.56	7.0	2.0
R6	5.01	4.30	2.50	80.44	17.0	2.0
R7	4.40	4.80	3.80	81.10	16.0	2.8
R8	7.60	12.00	7.00	15.74	80.0	4.0
R9	3.97	12.40	7.20	22.48	75.0	2.0
R10	9.12	11.80	6.90	17.16	80.6	2.0
R11	11.91	10.60	6.20	48.76	49.0	2.0
R12	9.42	15.60	9.10	7.88	90.0	2.0
R13	11.18	14.90	8.70	4.76	90.2	5.0
R14	12.10	9.90	5.80	48.15	49.4	2.4
R15	13.74	12.90	7.50	3.42	92.0	4.0

\* Based on dry weight basis

Table 3

Distribution and Abundance (No./100ml) of Phytoplankton in Mandovi River/Estuary  
(December 1995)

Genera	Sampling Location												
	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15
<b>Cyanophyceae</b>													
<i>Trichodesmium erythraceum</i>	-	-	-	260	10	40	-	-	230	-	280	-	-
<b>Chlorophyceae</b>													
<i>Pediastrum sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Spirogyra sp.</i>	170	60	300	-	60	80	540	-	-	140	-	-	-
<i>Ulothrix sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Cosmarium sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Microasterias sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Zygnema sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	-
<b>Bacillariophyceae</b>													
<i>Coscinodiscus sp.</i>	130	50	160	200	80	120	220	230	360	570	240	80	270
<i>Skeletonema sp.</i>	-	10	-	15	-	-	-	10	-	10	-	-	-
<i>Hemidiscus sp.</i>	-	20	-	-	60	-	-	50	20	-	-	-	-
<i>Stephanopyxis sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Melosira sp.</i>	-	-	100	480	120	-	-	-	55	-	-	-	-
<i>Triceratium sp.</i>	20	-	-	30	10	-	-	-	-	30	-	-	-
<i>Biddulphia sp.</i>	-	-	-	-	-	-	30	30	100	-	30	20	70
<i>B. mobiliensis</i>	-	-	-	-	-	-	-	-	-	10	32	10	60
<i>B. sinensis</i>	-	-	-	-	-	-	-	-	-	-	21	10	34
<i>Guinardia sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	10
<i>Bellerochea sp.</i>	-	-	-	-	-	-	-	-	-	-	10	-	15
<i>Ditylum sp.</i>	-	-	-	-	-	-	-	-	-	10	51	-	70
<i>Lithodesmium sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	10
<i>Chaetoceros sp.</i>	-	-	-	40	30	180	180	46	60	90	200	110	310
<i>Grannatophora sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Campylodiscus sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Planktoniella sp.</i>	-	-	-	-	-	-	-	-	-	30	32	-	50
<i>Bacteriastum sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	10
<i>Eucampia sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 3 (Contd...)

Distribution and Abundance (No./100ml) of Phytoplankton in Mandovi River/Estuary  
(December 1995)

Genera	Sampling Location												
	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15
<i>Climacodium sp.</i>	-	-	-	-	10	20	-	-	80	-	-	10	60
<i>Streptothecca sp.</i>													
<i>Thalassiosira sp.</i>	-	-	-	-	-	-	510	1160	80	-	-	-	620
<i>T. gravida</i>	-	-	-	-	-	-	-	-	-	-	30	10	80
<i>Thalassionea sp.</i>													
<i>Rhizosolenia sp.</i>	-	-	30	10	30	120	170	180	200	60	30	20	160
<i>R. stolterfothii</i>	-	-	20	10	20	10	110	90	100	20	20	10	30
<i>R. styliformis</i>	-	10	-	-	-	30	20	30	50	10	20	10	10
<i>R. hebetata</i>	10	-	30	-	10	20	20	40	60	20	10	-	20
<i>Fragillaria oceanica</i>													
<i>Thalassiothrix sp.</i>	-	-	-	-	-	-	-	-	20	-	40	20	280
<i>T. longissima</i>	-	-	-	-	-	-	-	-	10	-	30	-	210
<i>Asterionella japonica</i>	-	-	-	-	-	-	-	30	30	-	10	-	40
<i>Gyrosigma sp.</i>	70	30	-	200	100	180	210	40	60	60	60	-	80
<i>Pleurosigma sp.</i>	-	-	-	40	10	70	40	50	-	170	40	-	-
<i>Navicula sp.</i>	-	-	-	-	-	-	-	-	-	-	20	-	-
<i>Nitzschia sp.</i>	-	-	-	-	30	-	-	-	-	20	30	-	-
<i>N. longissima</i>	-	-	-	-	-	-	-	-	-	-	10	-	-
<b>Dinophyceae</b>													
<i>Prorocentrum sp.</i>	-	-	-	-	-	-	-	-	-	-	10	-	-
<i>Dinophysis sp.</i>	-	10	-	40	10	-	-	-	-	20	20	-	04
<i>Peridinium sp.</i>	-	-	-	-	-	-	-	-	-	-	70	-	-
<i>Ceratium tripos</i>	-	-	-	-	-	120	-	-	-	-	110	-	60
<i>C. fusus</i>	-	-	-	-	-	-	-	-	-	-	-	20	06
<i>C. massiliensis</i>	-	-	-	-	-	-	-	-	-	-	20	-	06
<i>C. furca</i>	-	-	-	-	-	-	-	-	-	-	-	10	-
<i>Pyrocystis fusiformis</i>	-	-	-	-	40	80	-	-	130	-	60	-	-
<i>Noctiluca miliaris</i>	-	-	-	-	10	40	20	60	230	-	-	-	-
<b>Total</b>	<b>400</b>	<b>190</b>	<b>640</b>	<b>1325</b>	<b>640</b>	<b>1110</b>	<b>2070</b>	<b>2046</b>	<b>1875</b>	<b>1270</b>	<b>1536</b>	<b>340</b>	<b>2575</b>

- Not recorded

Table 4

Distribution and Abundance (No./haul) of Zooplankton in Mandovi River/Estuary  
(December 1995)

Genera	Sampling Location												
	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15
<b>Protozoa</b>													
<i>Tintinnopsis sp.</i>	-	-	-	-	-	-	5	-	10	-	-	14	16
<i>Favella sp.</i>	5	-	-	-	2	-	-	50	40	50	10	10	15
<i>Rhabdonella sp.</i>	-	-	-	-	-	-	-	-	-	-	-	2	4
<i>Globigennia sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Siphonophora sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	5
<i>Pleurobrachia sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	-
<b>Copepoda</b>													
<i>Undinula sp.</i>	-	-	-	-	-	-	-	10	5	5	-	5	4
<i>Acartia sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	2
<i>Temora sp.</i>	5	-	-	-	-	-	5	20	60	40	20	12	4
<i>Eutemora sp.</i>	-	-	-	-	-	-	-	-	-	-	-	6	16
<i>Oithona sp.</i>	-	-	-	-	6	10	-	35	30	45	15	4	12
<i>O. Plumifera</i>	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Euterpina sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Paracalanus sp.</i>	-	5	5	-	2	10	5	25	40	35	5	4	5
<i>Eucalanus sp.</i>	-	-	-	5	-	-	-	50	160	10	5	-	2
<i>Centropages sp.</i>	-	-	-	-	-	-	-	5	-	5	-	-	-
<i>Pseudocalanus sp.</i>	-	-	-	25	10	-	-	52	150	105	25	2	45
<i>Macrosetella sp.</i>	-	5	-	-	-	-	-	10	20	10	5	1	9
<i>Microsetella sp.</i>	5	-	-	-	-	-	-	-	-	5	5	2	-
<i>Metridia sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Isias sp.</i>	-	-	-	-	-	-	-	-	-	5	-	-	-
<i>Candacia sp.</i>	-	-	-	-	-	-	-	-	-	5	-	-	-
<i>Canthocalanus sp.</i>	-	-	-	-	-	-	-	-	5	-	5	7	-
<i>Nannocalanus sp.</i>	-	-	-	-	-	-	-	-	-	-	-	6	-
<i>Rhincalanus sp.</i>	-	-	-	5	2	-	-	30	15	15	-	4	6
<i>Microcalanus sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Parapontella sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 4 (Contd...)

Distribution and Abundance (No./haul) of Zooplankton in Mandovi River/Estuary  
(December 1995)

Genera	Sampling Location												
	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15
<i>Labidocera sp.</i>	-	-	-	-	-	-	-	-	-	-	-	6	6
<i>Oncaea sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Heliodiaptomus sp.</i>	6	4	3	2	-	-	-	-	-	-	-	-	-
<i>Mesocyclops sp.</i>	3	2	5	-	1	-	-	-	-	-	-	-	-
<i>Microcyclops sp.</i>	1	3	2	1	1	-	-	-	-	-	-	-	-
<i>Diaptomus sp.</i>	2	4	-	1	1	-	-	-	-	-	-	-	-
<b>Cladocera</b>													
<i>Penilia sp.</i>	-	-	-	-	-	-	-	-	-	-	-	8	8
<i>Evadne sp.</i>	-	-	-	-	-	-	-	-	10	-	-	10	6
<i>Moina sp.</i>	3	2	1	1	-	-	-	-	-	-	-	-	-
<i>Daphnia sp.</i>	6	2	2	3	1	-	-	-	-	-	-	-	-
<i>Macrothrix sp.</i>	2	1	-	1	2	-	-	-	-	-	-	-	-
<b>Rotifera</b>													
<i>Brachionus sp.</i>	3	1	1	-	1	-	-	-	-	-	-	-	-
<i>Keratella sp.</i>	2	1	-	1	-	-	-	-	-	-	-	-	-
<i>Polyarthra sp.</i>	4	2	-	-	-	-	-	-	-	-	-	-	-
<i>Creseis acicula</i>	-	-	-	-	-	-	-	-	-	-	5	6	5
<i>Creseis sp.</i>	-	-	-	-	-	20	-	30	20	20	5	20	18
<i>Oikopleura sp.</i>	-	-	-	-	-	-	-	-	-	-	5	8	6
<b>Larval Forms</b>													
Brachiopoda	-	-	-	-	-	-	-	5	-	-	14	-	10
Polychaeta	-	-	-	-	-	-	-	5	-	-	-	-	-
Copepod	20	15	20	50	22	20	50	169	165	195	15	160	230
Cirripede	-	-	5	-	-	-	-	-	10	5	-	4	10
Arachnactis	-	-	-	-	-	-	-	-	-	-	-	-	-
Bivalvia	-	-	-	-	-	-	-	-	-	-	-	6	15
Gastropoda	-	5	-	-	-	25	-	25	10	50	5	10	5
Fish eggs and Larvae	35	5	10	30	12	35	70	165	225	25	70	15	130
<b>Total</b>	<b>102</b>	<b>57</b>	<b>54</b>	<b>125</b>	<b>63</b>	<b>120</b>	<b>135</b>	<b>686</b>	<b>1375</b>	<b>630</b>	<b>214</b>	<b>332</b>	<b>594</b>

- Not recorded

Table 5

**Distribution and Abundance (No./10cm<sup>2</sup>) of Meiobenthos in Mandovi River/Estuary  
(December 1995)**

Group	Sampling Location												
	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15
Diatom	38	32	07	10	04	19	16	29	13	12	62	44	43
Foraminifera	09	01	01	02	12	01	08	05	06	07	06	12	16
Nematoda	28	08	06	08	05	25	10	17	35	11	36	10	07
Turbellaria	01	-	02	-	-	07	05	01	04	-	02	01	-
Polychaeta	13	03	01	03	02	10	06	27	15	03	20	08	08
Bivalvia	-	03	-	01	02	-	01	05	02	01	02	02	08
Ostracoda	08	08	-	01	02	03	-	08	06	05	08	02	10
Amphipoda	-	-	-	-	-	02	02	-	02	-	02	-	-
Copepoda	02	-	01	03	01	07	05	01	04	03	02	01	03
Isopoda	-	-	01	-	-	02	01	-	03	01	02	01	07
Cumacea	-	-	01	-	01	01	-	-	02	01	-	-	01
Crustaceans	05	01	-	02	04	07	07	03	03	-	-	-	-
Arachnecis	03	-	-	02	02	04	09	04	-	15	02	-	-
Fish egg	08	08	03	04	02	07	04	07	01	08	20	12	14
<b>Total</b>	<b>115</b>	<b>64</b>	<b>23</b>	<b>35</b>	<b>25</b>	<b>106</b>	<b>67</b>	<b>110</b>	<b>95</b>	<b>66</b>	<b>165</b>	<b>86</b>	<b>113</b>

- Not recorded

Table 6

Biomass (mg wet wt./10cm<sup>2</sup>) of Meiobenthos Taxa in Mandovi River/Estuary  
(December 1995)

Group	Sampling Location												
	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15
Diatom	0.082	0.068	0.015	0.021	0.013	0.041	0.035	0.063	0.028	0.026	0.134	0.103	0.093
Foraminifera	0.02	0.002	0.002	0.004	0.026	0.002	0.002	0.011	0.013	0.015	0.012	0.026	0.036
Nematoda	0.25	0.071	0.053	0.071	0.062	0.223	0.090	0.151	0.312	0.098	0.320	0.196	0.062
Turbellaria	0.003	-	0.005	-	-	0.011	0.013	0.003	0.011	-	0.005	0.003	-
Polychaeta	0.377	0.087	0.029	0.087	0.058	0.029	0.03	0.15	0.06	0.03	0.06	0.12	0.24
Bivalvia	-	0.123	-	0.041	0.082	-	0.041	0.205	0.082	0.041	0.082	0.082	0.328
Ostracoda	0.328	0.328	-	0.041	0.08	0.123	-	0.328	0.246	0.205	0.328	0.502	0.410
Amphipoda	-	-	-	-	-	0.056	-	-	0.056	-	0.056	-	-
Copepoda	0.045	-	0.022	0.067	0.045	0.156	0.111	0.022	0.090	0.067	0.045	0.067	0.067
Isopoda	-	-	0.004	-	-	0.008	0.004	-	0.012	0.004	0.008	0.02	0.028
Cumacea	-	-	0.20	-	0.20	0.20	-	-	0.40	0.20	-	-	0.20
Crustaceans	0.045	0.009	-	0.018	0.078	0.062	0.062	0.027	0.027	-	-	-	-
Arachnecis	0.016	-	-	0.004	0.011	0.009	0.049	0.022	-	0.081	0.004	-	-
Fish egg mass	15.88	15.88	5.955	7.94	5.955	13.90	7.94	13.90	1.99	15.88	39.70	11.91	27.79

- Not recorded

Table 7

Distribution and Abundance (No./m<sup>2</sup>) of Macrobenthos in Mandovi River/Estuary (December 1995)

Group	Sampling Location												
	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15
Foraminifera	-	-	-	-	-	-	-	-	-	-	12	-	16
Porifera	-	01	03	01	01	02	-	-	01	-	-	02	-
Coelenterata	-	-	-	-	-	-	-	-	-	-	02	-	10
Nematoda	-	03	12	06	03	03	08	04	08	-	03	-	02
Polychaeta	02	03	07	05	02	14	13	06	07	-	03	08	04
Gastropoda	-	-	-	-	-	-	-	-	-	10	-	14	24
Bivalvia	-	-	-	-	-	-	02	-	-	-	04	34	24
Harpacticoida	-	-	-	-	-	-	-	-	-	-	-	-	14
Cumacea	-	-	-	-	01	-	-	-	-	-	-	-	-
Tanaidacea	-	-	-	-	-	-	-	-	-	12	-	14	-
Isopoda	02	-	-	-	-	-	-	-	-	10	-	12	-
Amphipoda	-	-	-	-	01	-	-	-	-	15	-	10	14
Stomatopoda	-	-	-	-	01	-	-	-	-	-	-	-	-
Mysidacea	-	-	-	-	-	-	-	-	-	-	10	-	23
Decapoda	-	-	-	-	-	-	-	-	-	52	64	-	82
Pisces	-	-	-	-	01	-	-	-	-	-	-	-	12
Worms & Others	02	04	02	05	03	01	03	-	02	-	07	04	03
Gastrotricha	02	-	05	03	01	02	06	02	-	-	04	01	02

- Not recorded

Table 8

Biomass (mg/m<sup>2</sup>) of Macrobenthos Taxa in Mandovi River/Estuary (December 1995)

Groups	Sampling Location												
	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15
Foraminifera	-	-	-	-	-	-	-	-	-	-	1.60	-	2.13
Porifera	-	0.30	0.09	0.30	0.30	0.06	-	-	0.30	-	-	0.6	-
Coelenterata	-	-	-	-	-	-	-	-	-	-	440	-	2200
Nematoda	-	0.53	1.07	0.53	0.26	0.26	0.71	0.36	0.71	-	0.27	-	0.18
Polychaeta	14.98	22.47	52.43	37.45	14.98	104.86	97.37	44.94	52.43	-	22.47	59.92	29.96
Gastropoda	-	-	-	-	-	-	-	-	-	7590	-	10626	18216
Bivalvia	-	-	-	-	-	-	1918	-	-	-	3036	25806	16698
Harpacticoida	-	-	-	-	-	-	-	-	-	-	-	-	5.04
Cumacea	-	-	-	-	-	-	-	-	-	-	-	-	-
Tanaidacea	-	-	-	-	-	-	-	-	-	2.34	-	2.73	-
Isopoda	20.98	-	-	-	-	-	-	-	-	104.3	-	125.88	-
Amphipoda	-	-	-	-	0.6	-	-	-	-	9.0	-	6.0	8.4
Stomatopoda	-	-	-	-	85.0	-	-	-	-	-	-	-	-
Mysidacea	-	-	-	-	90.0	-	-	-	-	-	-	900	2070
Decapoda	-	-	-	-	-	-	-	-	-	5502	6771	-	8675.6
Pisces	-	-	-	-	1585	-	-	-	-	-	-	-	23820
Worms & Others	12.6	25.2	12.6	31.5	18.9	6.3	18.9	-	12.6	-	44.1	25.2	18.9
Gastrotricha	0.08	-	0.21	0.12	0.04	0.08	0.25	0.08	-	-	0.16	0.04	0.08

- Not recorded

Table 1

## Physico-chemical Water Quality in Mandovi River/Estuary along with Details of Sampling Conditions (January 1996)

Parameter	Sampling Location													
	R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R15
Time of Sampling	0800	0910	0950	1015	1005	1205	1440	1240	1330	1400	1725	1610	1710	1630
Tidal Condition	-	-	-	-	High	High	High	High	High	High	High	High	High	High
Air Temperature (°C)	20	22	27.2	27.8	30.8	31.1	32.8	33.3	33.2	30.3	28.6	28.4	28.1	29.2
Water Temperature (°C)	25	26.2	28	28.2	28.6	29	28.7	29.3	29.1	29.1	28.3	29.4	28.6	29
Salinity (ppt)	0.0	0.0	0.0	0.3	2.4	3.8	26	10	20	14.8	33.5	30	34.1	34.6
Dissolved O <sub>2</sub> (mg/L)	6.3	5.8	6.6	5.6	5.1	5.2	6.0	5.4	5.8	5.1	5.3	5.7	5.2	5.6
pH	7.5	7.6	7.5	7.8	7.7	7.6	7.9	7.6	7.5	8.0	8.1	8.0	8.0	8.1
Suspended Load (mg/L)	9	9	6	9	9	10	9	8	11	8	8	8	9	9
V.E.C.	14	11	19	10	10	15	16	20	6	16	10	18	12	16
Phosphate as P (µg/L)	1.23	1.37	1.29	1.41	1.27	1.30	0.71	1.45	1.48	0.67	1.52	0.71	0.79	0.81
Silicate as Si (µg/L)	88.2	63.6	81.7	59.0	52.3	67.2	33.5	52.1	56.5	47.3	51.8	44.0	40.6	55.1
Nitrate as N (µg/L)	2.16	2.32	1.78	2.16	2.20	3.46	4.07	3.56	3.28	2.88	3.26	3.78	4.11	3.65

V.E.C. : Vertical Extinction Coefficient

Table 2

River Mandovi - Bottom Sediment Analysis (January 1996)

Sampling Location	Moisture Content (%)	Organic* Matter (%)	Organic* Carbon (%)	Sand (%)	Silt (%)	Clay (%)
R3	62.06	20.09	11.64	9.00	84.0	6
R4	48.14	25.02	14.49	12.60	81.2	6
R5	55.17	27.32	15.83	78.00	78.9	3
R6	-	18.63	10.79	-	-	-
R7	66.66	15.12	8.76	33.46	60.4	6
R8	31.57	18.86	11.38	67.80	22.4	10
R9	50.00	20.20	10.93	30.60	64.0	5
R10	20.00	19.12	11.70	31.10	62.6	6
R11	17.50	16.64	11.08	78.80	13.0	8
R12	4.44	12.55	9.58	9.00	4.0	6
R13	20.00	11.26	7.27	83.82	9.0	7
R14	20.50	12.05	6.52	84.00	9.5	6

\* Based on dry weight basis

Table 3

Distribution and Abundance (No/100ml) of Phytoplankton in Mandovi River/Estuary  
(January 1996)

Genera	Sampling Location												
	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15
<b>Cyanophyceae</b>													
<i>Trichodesmium erythraeus</i>	-	-	-	-	-	-	-	-	-	-	140	-	92
<b>Chlorophyceae</b>													
<i>Pediastrum sp.</i>	-	02	-	-	01	-	22	-	-	02	-	-	-
<i>Spirogyra sp.</i>	121	26	226	-	-	43	236	-	-	136	-	-	-
<i>Ulothrix sp.</i>	-	-	-	-	-	02	-	-	-	-	-	-	-
<i>Cosmarium sp.</i>	-	-	-	-	01	-	-	-	-	-	-	-	-
<i>Micrasterias sp.</i>	-	-	-	-	-	-	-	-	03	-	-	-	-
<i>Zygnema sp.</i>	01	-	-	-	03	-	-	-	-	06	-	-	-
<b>Bacillariophyceae</b>													
<i>Coscinodiscus sp.</i>	146	48	168	224	241	136	312	294	410	478	227	122	260
<i>Skeletonema sp.</i>	-	08	-	16	21	-	-	15	-	21	-	-	-
<i>Hemidiscus sp.</i>	-	14	-	-	06	-	-	-	364	06	-	22	28
<i>Melosira sp.</i>	-	-	84	286	-	-	-	-	-	64	-	-	-
<i>Stephanopyxis sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	02
<i>Triceratium sp.</i>	10	-	-	43	-	-	-	-	-	21	-	-	-
<i>Biddulphia sp.</i>	-	-	-	-	-	-	22	21	93	-	28	15	76
<i>B. mobilensis</i>	-	-	-	-	-	-	-	-	-	12	22	10	72
<i>B. sinensis</i>	-	-	-	-	-	-	-	02	-	-	15	10	28
<i>Guinardia sp.</i>	-	-	-	-	-	-	-	-	-	-	-	04	12
<i>Bellerochea sp.</i>	-	-	-	-	-	-	-	-	-	-	08	12	06
<i>Ditylum sp.</i>	-	-	-	-	-	-	-	-	-	11	41	04	12
<i>Lithodesmium sp.</i>	-	-	-	-	-	-	-	-	-	-	-	03	06
<i>Chaetoceros sp.</i>	-	-	-	154	127	164	223	54	74	110	181	105	722
<i>Grannatophora sp.</i>	-	-	-	-	-	-	-	-	-	-	-	10	08
<i>Canpytodiscus sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Planktoniella sp.</i>	-	-	-	-	-	-	-	-	-	22	24	10	36
<i>Bacteriastum sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	12

Table 3 (Contd..)

Distribution and Abundance (No/100ml) of Phytoplankton in Mandovi River/Estuary  
(January 1996)

Genera	Sampling Location												
	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15
<i>Eucampia sp.</i>	-	-	-	-	-	-	-	-	-	-	06	-	-
<i>Climacodium sp.</i>	-	-	-	-	-	10	-	-	12	-	-	02	46
<i>Streptotheca sp.</i>	-	-	-	-	-	-	-	-	-	-	02	-	-
<i>Thalassiosira sp.</i>	-	-	-	-	-	-	126	146	72	-	-	92	224
<i>T. gravida</i>	-	-	-	-	-	-	-	-	-	-	102	-	68
<i>Thalassionea sp.</i>	-	-	-	-	-	-	-	-	-	-	64	12	95
<i>Rhizosolenia sp.</i>	-	-	22	10	06	102	141	122	104	28	22	01	102
<i>R. stolterfothii</i>	-	-	14	04	02	06	92	64	71	10	10	04	21
<i>R. styliformis</i>	-	06	-	-	-	22	12	22	22	08	12	03	08
<i>R. hebatata</i>	12	-	10	-	02	10	11	32	24	12	04	-	09
<i>Fragillaria oceanica</i>	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Thalassiothrix sp.</i>	-	-	-	-	-	-	-	-	06	-	20	10	102
<i>T. longissima</i>	-	-	-	-	-	-	-	-	-	10	24	-	94
<i>Asterionella japonica</i>	-	-	-	-	-	-	-	08	15	-	12	-	30
<i>Gyrosigma sp.</i>	62	48	-	122	72	102	102	21	23	22	32	-	37
<i>Pleurosigma sp.</i>	-	-	-	21	12	46	32	26	-	21	22	-	-
<i>Navicula sp.</i>	-	-	-	-	-	-	-	-	-	-	14	-	-
<i>Nitzschia sp.</i>	-	-	-	-	-	21	-	04	-	10	18	06	-
<i>N. longissima</i>	-	-	-	-	-	-	-	-	-	04	06	-	08
<b>Dinophyceae</b>													
<i>Prorocentrum sp.</i>	-	-	-	-	-	-	-	-	-	-	12	04	-
<i>Dinophysis sp.</i>	-	12	-	32	14	-	-	-	-	-	18	-	06
<i>Peridinium sp.</i>	-	-	-	-	-	-	-	-	-	-	32	02	08
<i>Ceratium tripos</i>	-	-	-	-	-	-	-	-	-	-	41	-	42
<i>C. fusus</i>	-	-	-	-	-	-	-	-	-	-	06	04	04
<i>C. massiliensis</i>	-	-	-	-	-	-	-	-	-	-	-	-	08
<i>C. furca</i>	-	-	-	-	-	-	-	-	-	-	-	02	02
<i>Pyrocystis fusiformis</i>	-	-	-	-	-	-	-	-	06	-	10	-	-
<i>Noctiluca miliaris</i>	-	-	-	-	-	-	02	-	-	-	-	-	-
<b>Total</b>	<b>352</b>	<b>164</b>	<b>524</b>	<b>912</b>	<b>508</b>	<b>664</b>	<b>1333</b>	<b>831</b>	<b>1299</b>	<b>1014</b>	<b>1175</b>	<b>469</b>	<b>2286</b>

- Not recorded

**Table 4**  
**Distribution and Abundance (No./haul) of Zooplankton in Mandovi River/Estuary**  
**(January 1996)**

Genera	Sampling Location													
	R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R15
<b>Ciliata</b>														
<i>Tintinnopsis sp.</i>	-	-	-	-	-	-	-	6	-	12	6	3	4	4
<i>Favella sp.</i>	5	-	-	1	-	-	-	-	60	22	44	12	10	18
<i>Rhabdonella sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	3
<b>Foraminifera</b>														
<i>Globigerina sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	4	2
<b>Cnidaria</b>														
<i>Siphonophora sp.</i>	-	-	-	-	-	-	-	-	-	-	1	-	-	2
<b>Ctenophora</b>														
<i>Pleurobrachia sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<b>Copepoda</b>														
<i>Undinula sp.</i>	-	-	-	-	-	-	-	-	14	8	4	-	2	3
<i>Acartia sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	2
<i>Temora sp.</i>	6	-	-	-	-	-	-	4	23	54	28	18	-	6
<i>Eutemora sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Oithona sp.</i>	-	-	-	-	8	8	11	-	41	22	29	17	12	-
<i>O. Plumifera</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Euterpina sp.</i>	-	-	-	-	4	4	-	-	-	-	-	-	-	-
<i>Paracalanus sp.</i>	-	4	7	-	-	-	12	6	28	36	32	7	4	6
<i>Eucalanus sp.</i>	-	-	-	6	3	-	-	-	48	183	12	4	-	-
<i>Centropages sp.</i>	-	-	-	-	-	-	-	-	7	-	4	-	-	-
<i>Pseudocalanus sp.</i>	-	-	-	22	12	10	-	5	172	164	114	21	12	17
<i>Macrosetella sp.</i>	-	4	-	-	-	-	-	-	8	10	12	6	3	7
<i>Microsetella sp.</i>	6	-	-	4	1	-	-	-	-	-	8	6	5	4
<i>Metridia sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Isias sp.</i>	-	-	5	-	-	-	1	1	2	-	6	-	-	-
<i>Canadacia sp.</i>	-	-	-	-	-	-	-	-	-	-	7	-	-	-
<i>Canthocalanus sp.</i>	-	-	-	-	-	-	-	-	-	-	-	2	-	3
<i>Nannocalanus sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Rhincalanus sp.</i>	-	-	-	4	-	1	-	1	26	10	16	-	-	12
<i>Pleuromamma sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Microcalanus sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 4 (Contd..)

Distribution and Abundance (No./haul) of Zooplankton in Mandovi River/Estuary  
(January 1996)

Genera	Sampling Location													
	R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R15
<i>Paradontella sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Labidocera sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	2	2
<i>Oncaea sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Heliodiaptomus sp.</i>	10	8	5	4	2	2	-	-	-	-	-	-	-	-
<i>Mesocyclops sp.</i>	6	4	8	1	4	2	-	-	-	-	-	-	-	-
<i>Microcyclops sp.</i>	4	2	2	4	3	2	-	-	-	-	-	-	-	-
<i>Diaptomus sp.</i>	4	3	2	2	4	4	-	-	-	-	-	-	-	-
<b>Cladocera</b>														
<i>Penilia sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	1	3
<i>Evadne sp.</i>	-	-	-	-	-	-	-	-	-	12	2	-	-	2
<i>Moina sp.</i>	4	3	3	2	1	-	-	-	-	-	-	-	-	-
<i>Daphnia sp.</i>	8	5	3	4	3	-	-	-	-	-	-	-	-	-
<i>Microthrix sp.</i>	3	2	3	5	6	-	-	-	-	-	-	-	-	-
<b>Rotifera</b>														
<i>Brachionus sp.</i>	3	1	-	2	2	-	-	-	-	-	-	-	-	-
<i>Keratella sp.</i>	3	2	-	3	-	-	-	-	-	-	-	-	-	-
<i>Polyarthra sp.</i>	3	4	-	2	2	-	-	-	-	-	-	-	-	-
<b>Pteropoda</b>														
<i>Creseis acicula</i>	-	-	-	-	-	-	-	-	-	-	-	4	2	2
<i>Creseis sp.</i>	4	-	-	2	-	3	22	2	12	-	1	-	1	3
<b>Appendicularia</b>														
<i>Oikopleura sp.</i>	6	-	-	-	-	-	-	-	-	-	-	-	1	5
<b>Larval Forms</b>														
Brachiopoda	-	-	-	-	-	-	-	-	4	-	-	-	-	1
Polychaeta	-	-	-	-	-	-	-	-	4	-	-	-	3	-
Copepod	24	18	24	36	14	16	22	33	148	173	210	27	15	26
Cirripede	-	-	4	-	-	-	-	-	-	12	7	-	2	8
Archnactis	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Bivalvia	1	-	-	-	-	6	-	-	2	1	-	-	-	3
Gastropoda	2	8	-	-	-	3	10	-	22	3	12	6	4	8
Fish eggs and Larvae	42	12	14	40	24	26	42	82	174	196	36	84	21	49

- Not recorded

Table 5

Distribution and Abundance (No./10cm<sup>2</sup>) of Meiobenthos in Mandovi River/Estuary (January 1996)

Group	Sampling Location												
	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15
Foraminifera	42	06	05	06	05	61	05	42	27	31	35	36	62
Diatom	190	154	36	54	12	99	81	146	66	67	315	246	216
Nematoda	136	43	31	41	36	120	51	86	121	34	32	74	35
Turbellaria	05	-	11	-	-	36	26	05	21	-	10	06	-
Polychaeta	65	17	06	16	11	51	31	136	76	16	101	81	41
Bivalvia	-	15	-	07	06	-	06	27	11	06	10	21	42
Ostracoda	40	42	-	06	-	16	-	41	31	26	41	62	51
Amphipoda	-	-	-	-	-	07	10	-	10	-	10	21	-
Copepoda	11	-	06	14	11	36	27	06	21	15	11	15	17
Isopoda	-	-	05	-	-	11	06	-	15	05	10	25	05
Cumacea	-	-	04	-	05	02	-	-	10	06	-	-	-
Coscinodiscus	-	-	-	-	-	-	-	-	-	-	-	-	-
Crustaceans	27	06	16	05	-	36	30	16	15	-	-	-	56
Arachnactis	17	-	-	09	10	22	45	21	-	12	10	06	-
Fish egg	43	41	16	22	16	35	21	37	06	48	120	38	72
Total	576	324	136	180	112	532	339	563	430	226	705	631	597

- Not recorded

Table 6

Biomass (mg wet wt. /10cm<sup>2</sup>) of Meiobenthos Taxa in Mandovi River/Estuary (January 1996)

Group	Sampling Location												
	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15
Foraminifera	0.084	0.012	0.01	0.012	0.01	0.122	0.01	0.084	0.054	0.062	0.075	0.072	0.124
Diatom	0.399	0.323	0.076	0.113	0.025	0.208	0.170	0.307	0.139	0.141	0.662	0.517	0.454
Nematoda	1.210	0.383	0.276	0.365	0.320	1.068	0.454	0.761	1.077	0.303	0.285	0.659	0.312
Turbellaria	0.013	-	0.029	-	-	0.096	0.069	0.013	0.056	-	0.027	0.016	-
Polychaeta	1.884	0.493	0.174	0.464	0.319	1.478	0.898	3.943	2.203	0.464	2.928	2.348	1.189
Bivalvia	-	0.45	-	0.21	0.18	-	0.18	0.81	0.33	0.18	0.300	0.630	1.26
Ostracoda	1.642	1.724	-	0.246	-	0.657	-	1.683	1.272	1.067	1.683	2.544	2.093
Amphipoda	-	-	-	-	-	0.195	0.279	-	0.279	-	0.279	0.586	-
Copepoda	0.245	-	0.134	0.312	0.245	0.803	0.602	0.134	0.468	0.335	0.245	0.335	0.379
Isopoda	-	-	0.02	-	-	0.044	0.024	-	0.060	0.02	0.040	0.100	0.020
Cumacea	-	-	0.8	-	1.0	0.4	-	-	2	1.2	-	-	-
Coscinodiscus	-	-	-	-	-	-	-	-	-	-	-	-	-
Crustaceans	0.240	0.053	0.142	0.142	0.045	0.320	0.267	0.142	0.134	-	-	-	0.498
Arachnactis	0.092	-	-	0.049	0.054	0.119	0.243	0.113	-	0.065	0.054	0.032	-
Fish egg mass	85.36	81.39	31.76	43.67	31.76	69.48	41.69	73.45	95.28	95.28	238.20	75.43	142.92
Total	91.16	84.82	38.42	45.58	33.96	74.99	44.88	86.44	108.35	99.11	244.78	83.27	149.25

- Not recorded

Table 7

Distribution and Abundance (No./m<sup>2</sup>) of Macrobenthos in River/Estuary (January 1996)

Group	Sampling Location												
	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15
Foraminifera	-	-	-	-	-	-	-	-	-	-	62	-	81
Porifera	-	05	15	06	05	11	-	-	05	-	-	10	-
Coelenterata	-	-	-	-	-	-	-	-	-	-	12	-	52
Nematoda	-	31	54	32	10	15	42	22	46	-	15	-	11
Polychaeta	11	15	36	27	54	72	66	37	35	-	17	12	21
Gastropoda	15	-	-	-	-	-	-	-	-	54	-	72	122
Bivalvia	-	-	-	-	-	-	10	-	-	-	22	171	111
Harpacticoida	-	-	-	-	-	-	-	-	-	-	-	-	72
Cumacea	-	-	-	-	-	-	-	-	-	-	-	-	-
Tanaidacea	-	-	-	-	-	-	-	-	-	61	-	72	-
Isopoda	12	-	-	-	-	-	-	-	-	52	-	63	-
Amphipoda	-	-	-	-	-	-	-	-	-	78	-	54	76
Ostracoda	-	-	-	-	-	-	-	-	-	-	-	-	-
Stomatopoda	-	-	-	-	-	-	-	-	-	-	-	-	-
Mysidacea	-	-	-	-	-	-	-	-	-	-	52	-	115
Decapoda	22	-	-	-	-	-	-	-	-	260	321	-	411
Pisces	-	-	-	-	-	-	-	-	-	-	-	-	63
Prawn Larvae	10	-	-	-	-	-	-	-	-	-	-	-	-
Worms & Others	12	22	11	27	06	06	16	-	11	-	38	21	16

- Not recorded

Table 8

Biomass (mg/m<sup>2</sup>) of Macrobenthos Taxa in Mandovi River/Estuary (January 1996)

Group	Sampling Location												
	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15
Foraminifera	-	-	-	-	-	-	-	-	-	-	0.08	-	0.011
Porifera	-	-	-	-	-	-	-	-	-	-	-	-	-
Coelenterata	-	-	-	-	-	-	-	-	-	-	2.64	-	11.44
Nematoda	-	0.003	0.005	0.003	0.001	0.001	0.004	0.002	0.004	-	0.001	-	0.001
Polychaeta	0.082	0.112	0.269	0.202	0.404	0.539	0.494	0.277	0.262	-	0.127	0.314	0.157
Gastropoda	11.39	-	-	-	-	-	-	-	-	40.99	-	54.65	2.591
Bivalvia	-	-	-	-	-	-	0.879	-	-	-	1.935	15.04	9.762
Harpacticoida	-	-	-	-	-	-	-	-	-	-	-	-	0.029
Cumacea	-	-	-	-	-	-	-	-	-	-	-	-	-
Tanaidacea	-	-	-	-	-	-	-	-	-	0.012	-	0.014	-
Isopoda	0.126	-	-	-	-	-	-	-	-	0.545	-	0.661	-
Amphipoda	-	-	-	-	-	-	-	-	-	0.047	-	0.032	0.046
Ostracoda	-	-	-	-	-	-	-	-	-	-	-	-	-
Stomatopoda	-	-	-	-	-	-	-	-	-	-	-	-	-
Mysidacea	-	-	-	-	-	-	-	-	-	-	4.68	-	10.35
Decapoda	2.328	-	-	-	-	-	-	-	-	27.51	33.96	-	43.48
Pisces	-	-	-	-	-	-	-	-	-	-	-	-	125.06
Prawn Larvae	0.173	-	-	-	-	-	-	-	-	-	-	-	0.073
Worms & Others	0.069	0.139	0.069	0.170	0.038	0.038	0.101	-	0.069	-	0.239	0.132	0.2101

- Not recorded

Table 9

## Density of Various Nektons (No/hauls) in Mandovi River/Estuary (January 1996)

Species	Sampling Location													
	R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R15
<b>Finfishes</b>														
<i>Ambassis commersonii</i>	-	-	-	-	-	4	34	-	-	7	3	8	-	2
<i>Ambassis dussumieri</i>	-	-	-	-	-	-	15	-	-	-	-	-	-	3
<i>Awaous grammepomus</i>	2	1	-	1	-	-	-	-	-	-	-	-	-	-
<i>Barilius evezardi</i>	-	4	-	-	-	-	-	-	-	-	-	-	-	-
<i>Cynoglossus puncticeps</i>	-	-	-	-	-	-	-	-	-	2	-	-	3	1
<i>Danio devario</i>	6	11	2	4	-	-	-	-	-	-	-	-	-	-
<i>Etroplus suratensis</i>	-	-	-	4	-	-	-	-	-	-	-	1	-	-
<i>Garra gotyla gotyla</i>	-	1	-	-	-	-	-	-	-	-	-	-	-	-
<i>Gonoproktopterus thomasi</i>	-	-	3	-	-	-	-	-	-	-	-	-	-	-
<i>Labeo kawrus</i>	7	1	-	-	-	-	-	-	-	-	-	-	-	-
<i>Leiognathus blochii</i>	-	-	-	-	-	-	-	-	-	-	-	4	-	-
<i>Mugil cephalus</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	2
<i>Nemacheilus rubidipinnis</i>	1	3	2	1	-	-	-	-	-	-	-	-	-	-
<i>Osteobrama dayi</i>	-	2	-	-	-	-	-	-	-	-	-	-	-	-
<i>Pseudorhombus arsius</i>	-	-	-	-	-	-	6	-	-	-	-	-	-	-
<i>Paruciosoma daniconius</i>	2	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Puntius filamentosus</i>	1	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>P. amphibius</i>	-	2	-	-	-	-	-	-	-	-	-	-	-	-
<i>P. nigrofasciatus</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>P. ophiocephalus</i>	3	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 9 (Contd...)

## Density of Various Nektons (No/hauls) in Mandovi River/Estuary (January 1996)

Species	Sampling Location													
	R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R15
<i>P. arulius</i>	-	4	-	-	-	-	-	-	-	-	-	-	-	-
<i>Rasbora nêilgherriensis</i>	8	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Sieyopterus graseus</i>	-	-	1	-	-	-	-	-	-	-	-	-	-	-
<i>Scatophagus argus</i>	-	-	-	-	-	-	-	-	-	-	-	-	2	-
<i>Sillago sihama</i>	-	-	-	-	2	-	-	-	-	-	-	-	-	1
<i>Stenogobius gymnopomus</i>	-	-	-	3	-	-	-	-	-	4	-	-	7	-
<i>Teuthis vermiculata</i>	-	-	-	-	-	-	2	-	-	-	-	-	-	1
<i>Chanos chanos</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<b>Shell Fishes</b>														
<i>Macrobrachium malcolmsoni</i>	4	2	-	6	-	-	-	-	-	-	-	-	-	-
<i>Metapenaeus affinis</i>	-	-	-	-	-	-	-	-	-	-	17	-	-	-
<i>M. monoceros</i>	-	-	-	-	-	-	8	-	-	-	-	-	4	3
<i>M. dobsoni</i>	-	-	-	3	-	-	-	1	2	1	-	-	-	-
<i>Penaeus marguiensis</i>	-	-	-	1	5	-	11	2	1	-	-	3	-	-
<i>P. indicus</i>	-	-	-	-	-	-	-	-	3	-	-	-	-	5
<i>Scylla serrata</i>	-	-	-	-	-	-	-	3	-	-	-	-	-	-
Unidentified (small crab)	-	-	-	6	-	-	-	-	-	-	-	-	-	-
<i>Macrobrachium rude</i>	-	3	1	3	-	-	-	-	-	-	-	-	-	-
<i>Villorita cyprinoides</i>	-	-	-	1	-	-	-	-	-	-	-	-	-	-
<i>Meretrix meretrix</i>	-	-	-	-	-	-	-	-	-	-	-	2	-	-
<i>M. casta</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Paphia malabarica</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	1

- Not recorded

Table 1

## Physico-chemical Water Quality in Mandovi River/Estuary along with Details of Sampling Conditions (February 1996)

Parameters	Sampling Location													
	R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R15
Time of Sampling	0950	1025	1105	1215	1230	1245	1235	1240	1245	1255	1525	1630	1645	1715
Tidal Condition	-	-	-	-	Low	Low	High	High	High	High	High	High	Low	Low
Air Temperature (°C)	29.2	30	30.4	32.1	32.0	32.4	31.8	32.5	31.4	31.5	31.9	31.2	31.0	30.5
Water Temperature (°C)	29.5	29.8	30.2	30.8	31.0	31.1	31.4	31.5	30.6	30.6	30.2	30.1	30.3	30.0
Salinity (ppt)	0.0	0.0	0.0	0.6	2.3	6.6	32.3	24.1	30.2	30.6	33.1	32.6	32.9	34.7
Dissolved O <sub>2</sub> (mg/L)	4.5	4.9	5.2	4.9	4.8	5.0	5.1	5.2	5.0	5.3	4.9	5.1	5.0	5.3
pH	7.4	7.5	7.3	7.6	7.7	7.8	7.4	7.5	7.8	7.6	7.9	7.9	8.0	8.0
Suspended Load (mg/L)	8	7	9	6	8	8	9	8	7	7	8	8	9	8
V.E.C.	11	8	16	10	12	18	13	10	10	12	11	10	13	12
Phosphate as P (µg/L)	0.45	0.48	0.54	0.52	0.50	0.43	0.47	0.41	0.52	0.50	0.48	0.49	0.47	0.63
Nitrate as N (µg/L)	2.4	1.6	1.5	1.2	1.8	2.1	2.0	1.5	1.0	1.8	2.1	1.0	1.45	1.65
Silicate as Si (µg/L)	40.5	42.6	47.3	44.1	40.3	48.1	46.3	40.2	44.6	42.4	47.3	47.8	44.3	42.1

V.E.C. : Vertical Extinction Coefficient

Table 2

River Mandovi - Bottom Sediment Analysis (February 1996)

Sampling Location	Moisture Content (%)	Organic* Matter (%)	Organic* Carbon (%)	Sand (%)	Silt (%)	Clay (%)
R3	58.08	12.99	7.54	8.00	80.0	12
R4	43.10	16.39	9.51	10.40	81.6	8
R5	51.06	18.03	10.46	14.30	77.8	79
R6	52.72	13.46	7.81	12.00	72.4	15.6
R7	62.21	8.38	4.86	28.40	67.5	4.14
R8	28.14	12.81	7.43	69.40	18.2	12.4
R9	43.32	11.76	6.82	28.60	61.2	10.2
R10	14.51	12.86	7.46	27.30	59.5	13.2
R11	11.43	12.62	7.32	67.50	16.2	16.3
R12	4.62	9.36	5.43	45.60	44.2	10.2
R13	16.14	7.46	4.33	68.21	22.6	9.19
R14	17.22	9.34	5.42	74.80	21.4	3.8
R15	18.19	9.53	5.53	72.80	22.3	4.9

**Table 3**  
**Distribution and Abundance (No/100ml) of Phytoplankton in Mandovi River/Estuary**  
**(February 1996)**

Genera	Sampling Location												
	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15
<b>Cyanophyceae</b>													
<i>Trichodesmium erythraceum</i>	-	-	-	-	-	-	-	-	-	-	112	-	74
<b>Chlorophyceae</b>													
<i>Pediastrum sp.</i>	-	-	-	-	-	-	14	-	-	-	-	-	-
<i>Spirogyra sp.</i>	120	14	174	-	-	-	132	-	-	110	-	-	-
<i>Ulothrix sp.</i>	-	-	-	-	01	-	-	-	-	-	-	-	-
<i>Cosmarium sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Micrasterias sp.</i>	-	-	-	-	-	-	02	-	-	-	-	-	-
<i>Zygnema sp.</i>	04	-	-	-	01	-	-	-	-	06	-	-	-
<b>Bacillariophyceae</b>													
<i>Coscinodiscus sp.</i>	124	26	132	201	218	114	284	261	315	376	198	104	224
<i>Skeletonema sp.</i>	-	-	-	12	14	-	-	08	-	-	-	-	58
<i>Hemidiscus sp.</i>	-	-	-	-	-	-	-	-	104	-	14	72	54
<i>Melosira sp.</i>	-	-	-	-	-	18	-	-	82	-	-	14	29
<i>Stephanopyxis sp.</i>	-	-	-	-	-	-	-	-	-	-	-	10	15
<i>Triceratium sp.</i>	-	-	-	-	-	-	-	-	04	-	14	-	10
<i>Biddulphia sp.</i>	-	-	-	-	-	-	-	-	-	14	18	22	34
<i>B. mobiliensis</i>	-	-	-	-	-	-	-	-	-	10	15	11	22
<i>B. sinensis</i>	-	-	-	-	-	-	-	-	-	-	10	17	22
<i>Guinardia sp.</i>	-	-	-	-	-	-	-	-	-	-	04	-	10
<i>Bellerochea sp.</i>	-	-	-	-	-	-	-	-	-	-	-	10	12
<i>Ditylum sp.</i>	-	-	-	-	-	-	-	-	-	10	22	08	14
<i>Lithodesmium sp.</i>	-	-	-	-	-	-	-	-	-	-	-	04	-
<i>Chaetoceros sp.</i>	-	-	-	123	96	130	192	48	63	76	101	78	243
<i>Grammatophora sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	06
<i>Campylodiscus sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	01
<i>Planktoniella sp.</i>	-	-	-	-	-	-	-	-	-	10	12	08	16
<i>Bacteriastum sp.</i>	-	-	-	-	-	-	-	-	-	-	-	06	-

Table 3 (Contd..)

Distribution and Abundance (No/100ml) of Phytoplankton in Mandovi River/Estuary  
(February 1996)

Genera	Sampling Location												
	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15
<i>Eucampia</i> sp.	-	-	-	-	-	-	-	-	-	-	-	05	02
<i>Climacodium</i> sp.	-	-	-	-	-	-	04	-	06	-	-	04	10
<i>Streptotheca</i> sp.	-	-	-	-	-	-	-	-	-	-	-	-	02
<i>Thalassiosira</i> sp.	-	-	-	-	-	-	-	104	63	-	-	62	114
<i>T. Gravida</i>	-	-	-	-	-	-	-	-	-	-	92	-	46
<i>Thalassionema</i> sp.	-	-	-	-	-	-	-	-	-	-	43	07	80
<i>Rhizosolenia</i> sp.	-	-	-	08	-	63	101	96	103	74	63	41	81
<i>R. stollerfothii</i>	-	04	-	10	-	07	61	74	-	16	10	14	26
<i>R. styliformis</i>	08	-	-	-	-	14	-	10	10	-	04	-	14
<i>R. hebatata</i>	10	-	06	-	-	-	14	10	31	16	22	-	14
<i>Fragillaria oceanica</i>	-	-	-	-	-	-	-	-	-	-	-	10	12
<i>Thalassiothrix</i> sp.	-	-	-	-	-	-	-	-	-	-	10	18	19
<i>T. longissima</i>	-	-	-	-	-	-	-	-	14	-	10	-	14
<i>Asterionella japonica</i>	-	-	10	-	-	14	26	10	-	21	-	10	14
<i>Gyrosigma</i> sp.	-	-	-	-	12	21	32	43	22	-	-	22	-
<i>Pleurosigma</i> sp.	-	-	-	-	-	-	-	-	-	-	04	-	02
<i>Navicula</i> sp.	-	-	-	-	-	-	06	-	-	14	-	18	10
<i>Nitzschia</i> sp.	-	-	-	-	-	-	-	-	-	-	06	-	04
<i>N. longissima</i>	-	-	-	-	-	-	-	-	-	-	10	-	03
<b>Dinophyceae</b>													
<i>Prorocentrum</i> sp.	-	-	-	-	-	04	-	-	-	-	10	-	12
<i>Dinophysis</i> sp.	-	-	-	-	-	-	-	-	-	-	24	06	28
<i>Peridinium</i> sp.	-	-	-	-	-	-	-	-	-	-	32	-	10
<i>Ceratium tripos</i>	-	-	-	-	-	-	-	-	-	-	24	04	-
<i>C. fusus</i>	-	-	-	-	-	04	-	-	-	10	-	-	12
<i>C. massiliensis</i>	-	-	-	-	-	-	-	-	-	-	06	02	-
<i>C. furca</i>	-	-	-	-	-	-	-	-	-	-	-	04	06
<i>Pyrocystis fusiformis</i>	-	-	-	-	-	-	-	-	-	-	10	12	10
<i>Noctiluca miliaris</i>	01	01	01	01	02	02	02	03	02	02	03	02	01
<b>Total</b>	<b>267</b>	<b>45</b>	<b>323</b>	<b>355</b>	<b>344</b>	<b>391</b>	<b>870</b>	<b>667</b>	<b>819</b>	<b>765</b>	<b>903</b>	<b>605</b>	<b>975</b>

- Not recorded

**Table 4**  
**Distribution and Abundance (No./haul) of Zooplankton in Mandovi River/Estuary**  
**(February 1996)**

Genera	Sampling Location														
	R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R15	
<b>Ciliata</b>															
<i>Tintinnopsis sp.</i>	-	-	-	-	-	-	-	4	-	10	6	3	2	4	
<i>Favella sp.</i>	2	-	-	1	-	-	-	-	42	12	22	10	6	10	
<i>Rhabdonella sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	4	
<b>Foraminifera</b>															
<i>Globigerina sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	2	1	
<b>Cnidaria</b>															
<i>Siphonophora sp.</i>	-	-	-	-	-	-	-	-	-	-	1	-	-	2	
<b>Ctenophora</b>															
<i>Pleurobrachia sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
<b>Copepoda</b>															
<i>Undinula sp.</i>	-	-	-	-	-	-	-	8	10	6	2	-	2	1	
<i>Acartia sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	2	
<i>Temora sp.</i>	2	-	-	-	-	2	-	2	10	24	14	12	-	8	
<i>Eutemora sp.</i>	-	-	-	-	-	-	-	-	-	-	-	4	-	2	
<i>Oithona sp.</i>	-	-	-	-	-	-	-	8	-	6	22	17	14	6	
<i>O. plumifera</i>	-	-	-	-	-	-	-	-	-	-	-	1	-	2	
<i>Euterpina sp.</i>	-	-	-	-	-	-	-	4	-	-	-	2	-	-	
<i>Paracalanus sp.</i>	-	-	3	2	5	-	-	10	4	14	22	30	6	8	
<i>Eucalanus sp.</i>	-	-	-	-	-	4	-	-	-	64	10	14	-	-	
<i>Centropages sp.</i>	-	-	-	-	-	-	-	-	8	-	6	-	-	2	
<i>Pseudocalanus sp.</i>	-	-	-	-	-	10	-	-	142	154	94	22	-	24	
<i>Macrosetella sp.</i>	-	-	-	-	-	-	-	-	-	6	8	10	4	6	
<i>Microsetella sp.</i>	-	-	-	-	-	2	-	-	-	-	6	2	4	6	
<i>Metridia sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	2	-	
<i>Isias sp.</i>	-	-	-	-	-	-	-	-	-	-	4	-	2	2	
<i>Candacia sp.</i>	-	-	-	-	-	-	-	-	-	-	10	-	-	4	
<i>Canthocalanus sp.</i>	-	-	-	-	-	-	-	-	-	-	-	1	-	2	
<i>Nannocalanus sp.</i>	-	-	-	-	-	-	-	-	-	-	-	1	-	3	
<i>Rhincalanus sp.</i>	-	-	-	-	-	1	-	4	-	2	14	12	-	14	
<i>Pleuromamma sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
<i>Microcalanus sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	4	-	

Table 4 (Contd..)

Distribution and Abundance (No./haul) of Zooplankton in Mandovi River/Estuary  
(February 1996)

Genera	Sampling Location													
	R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R15
<i>Parapontella sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	2
<i>Labidocera sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	2	3
<i>Oncaea sp.</i>	-	-	-	-	-	-	-	-	-	-	-	1	-	2
<i>Heliodiaptomus sp.</i>	14	12	8	6	4	-	-	-	-	-	-	-	-	-
<i>Mesocyclops sp.</i>	4	8	12	5	8	4	-	-	-	-	-	-	-	-
<i>Microcyclops sp.</i>	3	2	4	6	2	2	-	-	-	-	-	-	-	-
<i>Diaptomus sp.</i>	-	4	2	-	4	3	-	-	-	-	-	-	-	-
<b>Cladocera</b>														
<i>Penilia sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	2
<i>Evadne sp.</i>	-	-	-	-	-	-	-	-	-	10	1	-	-	3
<i>Moina sp.</i>	2	4	4	3	2	-	-	-	-	-	-	-	-	-
<i>Daphnia sp.</i>	-	6	4	6	1	-	-	-	-	-	-	-	-	-
<i>Macrothrix sp.</i>	2	3	4	6	4	-	-	-	-	-	-	-	-	-
<b>Rotifera</b>														
<i>Brachionus sp.</i>	2	3	1	-	2	-	-	-	-	-	-	-	-	-
<i>Keratella sp.</i>	2	1	2	-	-	-	-	-	-	-	-	-	-	-
<i>Polyarthra sp.</i>	3	4	2	-	1	-	-	-	-	-	-	-	-	-
<b>Pteropoda</b>														
<i>Creseis acicula</i>	-	-	-	-	-	-	-	-	-	-	-	2	-	2
<i>Creseis sp.</i>	-	-	-	-	-	-	2	-	-	4	-	12	-	4
<b>Appendicularia</b>														
<i>Oikopleura sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	2	3
<b>Larval Forms</b>														
<b>Brachlopoda</b>	-	-	-	-	-	-	-	-	2	-	-	-	-	2
<b>Polychaeta</b>	-	-	-	-	-	-	-	-	2	-	-	-	-	3
<b>Copepod</b>	22	14	23	34	22	12	22	30	152	148	194	16	14	22
<b>Cirripede</b>	-	-	-	4	1	-	-	-	-	10	-	8	-	6
<b>Arachnactis</b>	-	-	-	-	-	-	-	-	-	-	-	2	-	2
<b>Bivalvia</b>	2	-	-	-	-	-	4	-	2	2	-	-	-	2
<b>Gastropoda</b>	10	6	-	-	3	2	6	-	10	-	18	4	2	6
<b>Fish eggs and Larvae</b>	32	10	12	24	32	22	30	64	122	148	46	62	18	44

- Not recorded

Table 5

Distribution and Abundance (No./10cm<sup>2</sup>) of Meiobenthos in Mandovi River/Estuary  
(February 1996)

Group	Sampling Location												
	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15
Foraminifera	32	02	02	02	03	55	01	36	21	27	29	31	61
Diatom	172	124	24	32	06	71	60	120	32	31	211	106	121
Nematoda	96	41	24	25	27	104	06	64	82	21	22	64	28
Turbellaria	01	-	-	01	-	30	22	01	09	-	02	-	02
Polychaeta	49	11	01	10	04	32	20	78	49	08	72	64	25
Bivalvia	-	-	04	-	03	-	-	15	06	02	03	14	21
Ostracoda	31	22	-	-	04	-	10	21	17	14	22	34	43
Amphipoda	-	-	-	-	-	06	04	-	-	02	10	12	02
Copepoda	10	-	-	07	08	29	22	02	12	14	07	12	12
Isopoda	-	-	01	-	-	04	01	-	10	02	04	14	02
Cumacea	-	-	02	-	01	02	-	-	08	03	-	-	-
Coscinodiscus	-	-	-	-	-	-	-	-	-	-	-	-	-
Crustaceans	12	03	14	10	02	21	20	14	10	-	-	-	42
Arachnactis	10	-	-	04	02	10	24	17	-	03	02	04	03
Fish egg	24	21	12	20	12	18	20	26	04	22	64	28	63
Total	437	224	84	111	72	382	211	394	260	149	448	383	425

- Not recorded

**Table 6**  
**Biomass (mg wet wt./10cm<sup>2</sup>) of Meiobenthos Taxa in Mandovi River/Estuary (February 1996)**

Group	Sampling Location												
	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15
Foraminifera	0.064	0.004	0.004	0.004	0.006	0.11	0.002	0.072	0.042	0.054	0.058	0.062	0.122
Diatom	0.361	0.260	0.050	0.067	0.013	0.015	0.013	0.252	0.067	0.065	0.443	0.223	0.254
Nematoda	0.864	0.369	0.216	0.225	0.243	0.936	0.054	0.576	0.738	0.189	0.198	0.576	0.252
Turbellaria	0.003	-	-	0.003	-	0.080	0.058	0.003	0.024	-	0.005	-	0.005
Polychaeta	1.421	0.319	0.029	0.29	0.116	0.928	0.580	2.262	1.421	0.232	2.088	1.856	0.725
Bivalvia	-	-	0.120	-	0.090	-	-	0.450	0.180	0.060	0.090	0.420	0.630
Ostracoda	1.240	0.880	-	-	0.160	-	0.400	1.840	0.680	0.560	0.880	1.360	1.720
Amphipoda	-	-	-	-	-	0.168	0.112	-	-	0.056	0.280	0.336	0.056
Copepoda	0.220	-	-	0.154	0.176	0.638	0.484	0.044	0.264	0.308	0.154	0.264	0.264
Isopoda	-	-	0.004	-	-	0.016	0.004	-	0.040	0.008	0.016	0.056	0.008
Cumacea	-	-	0.400	-	0.200	0.400	-	-	1.600	0.600	-	-	-
Crustaceans	0.096	0.024	0.112	0.080	0.016	0.168	0.160	0.112	0.080	-	-	-	0.336
Arachnactis	0.050	-	-	0.020	0.010	0.050	0.120	0.085	-	0.015	0.010	0.020	0.015
Fish egg mass	47.64	41.69	23.82	39.70	23.82	35.73	39.70	51.61	7.940	43.67	127.04	55.58	125.1
<b>Total</b>	<b>51.96</b>	<b>43.55</b>	<b>24.76</b>	<b>40.54</b>	<b>24.85</b>	<b>39.24</b>	<b>41.69</b>	<b>57.306</b>	<b>13.076</b>	<b>45.82</b>	<b>131.26</b>	<b>60.753</b>	<b>129.49</b>

- Not recorded

Table 7

**Distribution and Abundance (No./m<sup>2</sup>) of Macrobenthos in Mandovi River/Estuary  
(February 1996)**

Group	Sampling Location												
	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15
Foraminifera	-	-	-	-	-	-	-	-	-	-	43	-	52
Porifera	-	04	10	02	02	04	-	-	03	-	02	04	-
Coelenterata	-	-	-	-	-	-	-	-	-	-	07	-	14
Nematoda	0.1	1.1	32	14	10	06	10	28	12	31	-	12	07
Polychaeta	07	05	20	17	28	42	51	24	22	-	10	19	12
Gastropoda	02	-	-	-	-	-	-	-	-	24	-	26	83
Bivalvia	-	-	-	-	-	-	03	-	-	-	12	68	51
Harpacticoida	-	-	-	-	-	-	-	-	-	-	-	-	50
Cumacea	-	-	-	-	-	-	-	-	-	-	-	-	-
Tanaidacea	-	-	-	-	-	-	-	-	-	54	-	43	-
Isopoda	10	-	-	-	-	-	-	-	-	43	-	41	-
Amphipoda	-	-	-	-	-	-	-	-	-	42	02	43	51
Ostracoda	-	-	-	-	-	-	-	-	-	-	-	-	-
Stomatopoda	-	-	-	-	-	-	-	-	-	-	-	-	-
Mysidacea	-	-	-	-	-	-	-	-	-	-	31	-	82
Decapoda	12	-	-	-	-	-	-	-	-	102	203	-	312
Pisces	-	-	-	-	-	-	-	-	-	-	-	-	72
Prawn Larvae	12	-	-	-	-	-	-	-	-	-	-	-	-
Worms & Others	06	17	18	21	04	03	10	-	12	-	22	15	17

Table 8

Biomass (mg/m<sup>2</sup>) of Macrobenthos Taxa in Mandovi River/Estuary (February 1996)

Group	Sampling Location												
	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15
Foraminifera	-	-	-	-	-	-	-	-	-	-	0.005	-	0.007
Porifera	-	-	-	-	-	-	-	-	-	-	-	-	-
Coelenterata	-	-	-	-	-	-	-	-	-	-	1.540	-	3.080
Nematoda	9.79	13.82	3.072	1.344	0.576	0.960	2.688	1.15	2.976	-	1.152	-	0.672
Polychaeta	0.052	0.067	0.148	0.126	0.207	0.311	0.377	0.178	0.163	-	0.074	0.141	0.089
Gastropoda	1.518	-	-	-	-	-	-	-	-	18.22	-	19.734	62.997
Bivalvia	-	-	-	-	-	-	0.264	-	-	-	1.055	5.977	4.483
Harpacticoida	-	-	-	-	-	-	-	-	-	-	-	-	0.018
Cumacea	-	-	-	-	-	-	-	-	-	-	-	-	-
Tanaidacea	-	-	-	-	-	-	-	-	-	0.011	-	0.009	-
Isopoda	0.105	-	-	-	-	-	-	-	-	0.451	-	0.430	-
Amphipoda	-	-	-	-	-	-	-	-	-	0.025	0.021	0.026	0.031
Ostracoda	-	-	-	-	-	-	-	-	-	-	-	-	-
Stomatopoda	-	-	-	-	-	-	-	-	-	-	-	-	-
Mysidacea	-	-	-	-	-	-	-	-	-	-	2.790	-	7.38
Decapoda	1.270	-	-	-	-	-	-	-	-	10.79	21.48	-	33.010
Pisces	-	-	-	-	-	-	-	-	-	-	-	-	142.926
Prawn Larvae	0.876	-	-	-	-	-	-	-	-	-	-	-	-
Worms & Others	0.037	0.105	0.050	0.130	0.025	0.019	0.062	-	0.074	-	0.136	0.093	0.105

- Not recorded

Table 9

Density of Various Nektons (No/hauls) in Mandovi River/Estuary (February 1996)

Species	Sampling Location													
	R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R15
<b>Finfishes</b>														
<i>Ambassis commersonii</i>	-	-	-	8	-	-	28	-	-	-	-	6	-	-
<i>Ambassis dussumieri</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Awaous grammepomus</i>	-	-	-	-	-	1	-	-	-	-	-	-	-	-
<i>Barilius evezardi</i>	2	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Cynoglossus puncticeps</i>	-	-	-	-	-	3	-	-	-	-	-	-	-	-
<i>Danio devario</i>	-	2	-	-	-	-	-	-	-	-	-	-	-	-
<i>Etroplus suratensis</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Garra gotyla gotyla</i>	2	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Gonoproktopterus thomassi</i>	-	1	-	-	-	-	-	-	-	-	-	-	-	-
<i>Labeo kawrus</i>	-	-	-	-	-	-	10	-	-	-	-	-	-	8
<i>Leiognathus blochii</i>	-	-	-	-	-	-	-	-	-	-	-	-	3	-
<i>Mugil cephalus</i>	6	1	5	-	-	-	-	-	-	-	-	-	-	-
<i>Nemacheilus rubidipinnis</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Osteobrama dayi</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Pseudorhombus arsius</i>	4	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Paruciosoma daniconius</i>	5	2	-	7	-	-	-	-	-	-	-	-	-	-
<i>Puntius filamentosus</i>	3	11	1	-	-	-	-	-	-	-	-	-	-	-
<i>P. amphibius</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>P. nigrofasciatus</i>	-	1	-	-	-	-	-	-	-	-	-	-	-	-
<i>P. ophiocephalus</i>	4	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 9 (Contd..)

## Density of Various Nektons (No/hauls) in Mandovi River/Estuary (February 1996)

Species	Sampling Location													
	R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R15
<i>P. arulius</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Rasbora nailgherriensis</i>	-	-	5	-	-	-	-	-	-	-	-	-	-	-
<i>Sieyopterus graseus</i>	-	-	-	-	-	-	-	-	-	-	-	2	1	3
<i>Scatophagus argus</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Sillago sihama</i>	-	-	-	-	2	-	-	-	-	-	-	-	-	-
<i>Stenogobius gymnopomus</i>	-	-	-	1	1	-	-	-	-	3	-	4	-	-
<i>Teuthis vermiculata</i>	-	-	-	-	-	-	3	7	2	-	-	-	-	-
<i>Chanos chanos</i>	-	-	-	-	-	-	-	2	-	-	-	1	-	-
<b>Shell Fishes</b>														
<i>Macrobrachium malcolmsoni</i>	1	4	2	11	-	-	-	-	-	-	-	-	-	-
<i>Metapenaeus affinis</i>	-	-	-	-	-	-	-	-	-	-	3	-	-	4
<i>M. monoceros</i>	-	-	-	-	-	-	5	-	-	-	-	7	-	2
<i>M. dobsoni</i>	-	-	-	-	-	3	12	1	-	-	2	-	1	1
<i>Penaeus marguiensis</i>	-	-	-	-	-	-	-	-	2	-	-	-	-	-
<i>P. indicus</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Scylla serrata</i>	-	-	-	1	-	-	-	-	-	2	-	-	2	-
Unidentified (small crab)	-	-	-	4	-	-	-	-	-	-	-	-	-	-
<i>Macrobrachium rude</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Villorita cyprinoides</i>	1	-	-	3	-	-	-	-	-	-	-	-	-	-
<i>Meretrix meretrix</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	5
<i>M. casta</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Paphia malabarica</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-

- Not recorded

Table 1

## Physico-chemical Water Quality in Mandovi River/Estuary along with Details of Sampling Conditions (March 1996)

Parameter	Sampling Location													
	R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R15
Time of Sampling	0900	1050	1055	1130	1205	1350	1500	1410	1425	1445	1630	1530	1615	1600
Tidal Condition	-	-	-	-	High	High	High	High	High	High	High	High	High	High
Air Temperature (°C)	32.0	32.2	33.0	33.2	33.0	33.2	35.0	34.8	33.6	34.6	31.8	32.3	32.0	31.8
Water Temperature (°C)	31.5	31.8	31.0	31.8	31.7	32.0	32.6	32.5	31.9	32.4	31.5	31.5	31.0	31.2
Salinity (ppt)	0.0	0.0	0.0	0.6	3.5	7.2	33	30.5	33.5	33.8	34.0	32.8	34.2	34.6
Dissolved O <sub>2</sub> (mg/L)	3.8	4.1	5.6	5.0	4.8	5.2	5.4	4.6	4.7	5.0	4.8	4.8	5.1	5.0
pH	6.8	7.3	7.5	7.6	7.6	7.5	7.9	7.6	7.8	7.8	7.9	8.0	7.9	8.0
Suspended Load (mg/L)	8	9	7	9	9	9	11	9	9	7	9	10	9	9
V.E.C.	12	10	19	12	13	14	10	13	12	16	14	10	13	12
Phosphate as P (µg/L)	0.21	0.35	0.28	0.42	0.51	0.75	0.68	0.66	0.68	0.79	0.70	0.62	0.75	0.59
Silicate as Si (µg/L)	89.7	83.2	85.3	80.6	76.4	92.5	96.7	84.2	90.3	92.1	89.7	94.7	97.0	89.5
Nitrate as N (µg/L)	4.8	4.85	4.77	4.82	4.67	5.04	4.95	4.91	4.86	4.92	5.95	5.11	5.05	5.06

V.E.C. : Vertical Extinction Coefficient

Table 2

River Mandovi - Bottom Sediment Analysis (March 1996)

Sampling Location	Moisture Content (%)	Organic* Matter (%)	Organic* Carbon (%)	Sand (%)	Silt (%)	Clay (%)
R3	50.28	14.21	8.24	9.60	79.2	11.2
R4	41.40	16.84	9.77	13.20	84.3	2.5
R5	46.30	19.86	11.52	19.70	74.3	6.0
R6	47.80	14.89	8.64	10.50	70.3	19.2
R7	54.60	8.79	5.10	32.70	62.5	4.8
R8	24.70	14.67	8.51	68.10	23.2	8.7
R9	40.50	13.65	7.92	31.20	65.8	3.0
R10	12.60	15.19	8.81	31.70	63.4	4.9
R11	10.40	14.69	8.52	79.10	14.3	6.6
R12	6.40	11.14	6.49	19.70	64.8	15.5
R13	12.70	8.38	4.86	67.10	24.2	8.7
R14	18.40	10.89	6.32	73.20	25.6	1.2
R15	17.20	11.05	6.41	71.40	26.3	2.3

\* Based on dry weight basis

Table 3

## Distribution and Abundance (No/100ml) of Phytoplankton in Mandovi River/Estuary (March 1996)

Genera	Sampling Location												
	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15
<b>Cyanophyceae</b>													
Trichodesmium erythraceum	-	-	-	-	-	-	-	-	-	-	78	-	101
<b>Chlorophyceae</b>													
Pediastrum sp.	-	-	-	-	-	-	10	-	-	-	-	-	-
Spirogyra sp.	134	22	186	-	-	-	148	-	-	173	-	-	-
Ulothrix sp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Cosmarium sp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Micrasterias sp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Zygnema sp.	08	-	-	-	-	-	-	-	10	-	12	-	-
<b>Bacillariophyceae</b>													
Coscinodiscus sp.	156	74	193	254	243	143	314	293	264	412	240	146	274
Skeletonema sp.	-	-	-	18	26	-	-	-	-	-	-	29	63
Hemidiscus sp.	-	-	-	-	-	-	-	-	124	-	43	122	76
Melosira sp.	-	-	-	-	-	26	-	-	113	-	24	63	45
Stephanopyxis sp.	-	-	-	-	-	-	-	-	-	14	-	24	38
Triceratium sp.	-	-	-	-	-	-	-	-	10	-	24	-	32
Biddulphia sp.	-	-	-	-	-	-	-	-	-	22	31	42	54
B. mobiliensis	-	-	-	-	-	-	-	-	-	22	34	31	43
B. sinensis	-	-	-	-	-	-	-	-	-	-	24	24	33
Guinardia sp.	-	-	-	-	-	-	-	-	06	-	17	-	22
Bellerochea sp.	-	-	-	-	-	-	-	-	-	-	-	24	21
Ditylum sp.	-	-	-	-	-	-	-	-	-	22	33	15	27
Lithodesmium sp.	-	-	-	-	-	-	-	-	-	-	-	10	14
Chaetoceros sp.	-	-	-	154	127	163	241	79	94	110	143	112	276
Grammatophora sp.	-	-	-	-	-	-	-	-	-	-	-	10	26
Campylodiscus sp.	-	-	-	-	-	-	-	-	-	-	-	10	12
Planktoniella sp.	-	-	-	-	-	-	-	-	-	22	24	16	33
Bacteriastum sp.	-	-	-	-	-	-	-	-	-	-	10	14	-

Table 3 (Contd..)

## Distribution and Abundance (No/100ml) of Phytoplankton in Mandovi River/Estuary (March 1996)

Genera	Sampling Location												
	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15
<i>Eucampia</i> sp.	-	-	-	-	-	-	-	-	-	-	-	22	10
<i>Climacodium</i> sp.	-	-	-	-	-	-	-	-	10	-	-	16	24
<i>Streptotheca</i> sp.	-	-	-	-	-	-	-	-	-	-	-	10	08
<i>Thalassiosira</i> sp.	-	-	-	-	-	-	-	126	94	-	110	78	136
<i>T. gravida</i>	-	-	-	-	-	-	-	-	-	-	104	-	56
<i>Thalassionema</i> sp.	-	-	-	-	-	-	-	-	-	-	58	21	114
<i>Rhizosolenia</i> sp.	-	-	-	12	-	78	124	104	121	96	78	49	110
<i>R. stolterfothii</i>	-	10	-	22	-	10	74	54	-	22	09	22	36
<i>R. styliformis</i>	-	-	-	-	-	22	-	16	17	-	-	14	23
<i>R. hebatata</i>	-	-	06	-	-	-	31	21	24	-	24	10	43
<i>Fragillaria oceanica</i>	-	-	-	-	-	-	-	-	-	-	22	34	43
<i>Thalassiothrix</i> sp.	-	-	-	-	-	-	-	-	-	-	29	36	49
<i>T. longissima</i>	-	-	-	-	-	-	-	-	-	12	18	23	38
<i>Asterionella japonica</i>	-	-	-	-	-	-	-	-	10	-	-	26	32
<i>Gyrosigma</i> sp.	-	-	22	-	-	31	36	20	-	43	48	52	64
<i>Pleurosigma</i> sp.	-	-	-	-	10	24	36	42	41	-	26	32	34
<i>Navicula</i> sp.	-	-	-	-	-	-	-	-	-	-	10	-	21
<i>Nitzschia</i> sp.	-	-	-	-	-	-	-	-	10	-	22	34	29
<i>N. longissima</i>	-	-	-	-	-	-	-	-	-	-	12	-	26
<b>Dinophyceae</b>													
<i>Prorocentrum</i> sp.	-	-	-	-	-	-	-	-	-	-	22	-	14
<i>Dinophysis</i> sp.	-	-	-	-	-	-	-	-	-	-	18	10	22
<i>Peridinium</i> sp.	-	-	-	-	-	-	-	-	-	-	34	22	39
<i>Ceratium tripos</i>	-	-	-	-	-	-	-	-	-	-	30	-	14
<i>C. fusus</i>	-	-	-	-	-	-	-	-	-	-	43	-	10
<i>C. massiliensis</i>	-	-	-	-	-	-	-	-	-	-	-	24	32
<i>C. furca</i>	-	-	-	-	-	-	-	-	-	-	08	10	20
<i>Pyrocystis fusiformis</i>	-	-	-	-	-	-	-	-	-	-	-	21	29
<i>Noctiluca miliaris</i>	01	01	01	01	02	02	02	03	02	02	03	02	01
<b>Total</b>	<b>299</b>	<b>107</b>	<b>407</b>	<b>461</b>	<b>408</b>	<b>499</b>	<b>1016</b>	<b>758</b>	<b>950</b>	<b>972</b>	<b>1465</b>	<b>1260</b>	<b>2265</b>
<b>Biomass</b>	<b>1.8</b>	<b>1.2</b>	<b>1.3</b>	<b>1.5</b>	<b>2.1</b>	<b>2.8</b>	<b>3.1</b>	<b>2.1</b>	<b>2.9</b>	<b>2.4</b>	<b>4.3</b>	<b>2.6</b>	<b>2.2</b>

- Not recorded

Table 4

Distribution and Abundance (No./haul) of Zooplankton in Mandovi River/Estuary (March 1996)

Genera	Sampling Location													
	R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R15
<b>Ciliata</b>														
<i>Tintinnopsis sp.</i>	-	-	-	-	-	-	-	-	-	4	-	8	4	6
<i>Favella sp.</i>	-	2	-	2	2	-	-	-	44	18	24	12	10	14
<i>Rhabdonella sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	6
<b>Foraminifera</b>														
<i>Globigerina sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	4	2
<b>Cnidaria</b>														
<i>Siphonophora sp.</i>	-	-	-	-	-	-	-	-	-	-	4	-	-	6
<b>Ctenophora</b>														
<i>Pleurobrachia sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<b>Copepoda</b>														
<i>Undinula sp.</i>	-	-	-	-	-	-	-	10	14	8	3	-	4	2
<i>Acartia sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	4
<i>Temora sp.</i>	-	2	-	-	-	2	-	-	14	26	16	18	-	10
<i>Eutemora sp.</i>	-	-	-	-	-	-	-	-	-	-	-	06	-	04
<i>Oithona sp.</i>	-	-	-	-	-	-	-	10	2	8	24	20	16	8
<i>O. plumifera</i>	-	-	-	-	-	-	-	-	-	-	-	2	-	3
<i>Euterpina sp.</i>	-	-	-	-	-	-	-	6	-	-	-	-	2	-
<i>Paracalanus sp.</i>	-	-	4	2	-	-	-	12	8	20	24	36	10	8
<i>Eucalanus sp.</i>	-	-	-	-	-	6	-	-	-	52	-	12	-	-
<i>Centropages sp.</i>	-	-	-	-	-	-	-	-	10	-	4	-	2	-
<i>Pseudocalanus sp.</i>	-	-	-	-	-	12	-	-	156	168	104	28	-	32
<i>Macrosetella sp.</i>	-	-	-	-	-	-	-	-	-	8	10	12	6	10
<i>Microsetella sp.</i>	-	-	-	-	-	-	4	-	-	-	-	4	2	4
<i>Metridia sp.</i>	-	-	-	-	-	-	-	-	-	-	-	4	3	-
<i>Isias sp.</i>	-	-	-	-	-	-	-	-	-	-	4	-	2	4
<i>Candacia sp.</i>	-	-	-	-	-	-	-	-	-	-	12	-	2	6
<i>Canthocalanus sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	2	4
<i>Nannocalanus sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	4
<i>Rhincalanus sp.</i>	-	-	-	-	-	2	1	6	-	4	5	-	16	18
<i>Pleuromamma sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Microcalanus sp.</i>	-	-	-	-	-	-	-	-	-	-	-	2	-	2

Table 4 (Contd..)

## Distribution and Abundance (No./haul) of Zooplankton in Mandovi River/Estuary (March 1996)

Genera	Sampling Location													
	R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R15
<i>Parapontella sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	2	3
<i>Labidocera sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	2	4
<i>Oncaea sp.</i>	-	-	-	-	-	-	-	-	-	-	-	2	-	3
<i>Heliodiaptomus sp.</i>	18	14	6	3	2	-	-	-	-	-	-	-	-	-
<i>Mesocyclops sp.</i>	4	7	10	4	6	-	-	-	-	-	-	-	-	-
<i>Microcyclops sp.</i>	2	4	-	8	7	-	-	-	-	-	-	-	-	-
<i>Diaptomus sp.</i>	-	2	2	1	2	-	-	-	-	-	-	-	-	-
<b>Cladocera</b>														
<i>Penilia sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	4	4
<i>Evadne sp.</i>	-	-	-	-	-	-	-	-	-	8	-	2	2	4
<i>Moina sp.</i>	3	3	1	2	1	-	-	-	-	-	-	-	-	-
<i>Daphnia sp.</i>	-	4	3	3	1	-	-	-	-	-	-	-	-	-
<i>Macrothrix sp.</i>	4	4	6	2	1	-	-	-	-	-	-	-	-	-
<b>Rotifera</b>														
<i>Brachionus sp.</i>	4	3	3	1	-	-	-	-	-	-	-	-	-	-
<i>Keratella sp.</i>	6	-	4	2	1	-	-	-	-	-	-	-	-	-
<i>Polyarthra sp.</i>	4	6	3	1	2	-	-	-	-	-	-	-	-	-
<b>Pteropoda</b>														
<i>Creseis acicula</i>	-	-	-	-	-	-	-	-	-	-	-	3	-	4
<i>Creseis sp.</i>	-	-	-	-	-	-	-	2	-	4	4	-	10	6
<b>Appendicularia</b>														
<i>Oikopleura sp.</i>	-	-	-	-	-	-	-	-	-	1	-	-	2	1
<b>Larval Forms</b>														
Brachiopoda	-	-	-	-	-	-	-	-	3	-	-	-	1	-
Polychaeta	-	-	-	-	24	-	-	-	2	-	-	-	1	3
Copepod	02	18	26	38	6	16	28	36	156	174	212	18	22	34
Cirripede	-	-	-	4	-	-	-	-	-	8	-	6	-	10
Arachnactis	-	-	-	-	-	-	-	-	-	-	-	2	1	4
Bivalvia	2	-	-	-	2	6	-	6	4	-	-	-	1	5
Gastropoda	14	8	-	-	46	4	8	-	12	-	10	2	6	8
Fish eggs and Larvae	48	24	14	32	22	34	44	82	144	162	58	74	26	64

- Not recorded

Table 5

Distribution and Abundance (No./10cm<sup>2</sup>) of Meiobenthos in Mandovi River/Estuary (March 1996)

Group	Sampling Location												
	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15
Foraminifera	51	08	11	12	11	68	12	45	34	36	42	44	66
Diatom	157	159	43	64	18	104	88	152	72	78	322	252	221
Nematoda	142	51	43	54	39	136	64	51	134	48	39	84	45
Turbellaria	11	-	10	-	-	43	28	10	24	-	15	08	04
Polychaeta	72	19	12	21	18	59	34	143	79	19	121	93	44
Bivalvia	-	-	-	09	10	-	11	29	22	10	15	22	49
Ostracoda	44	52	-	-	-	22	-	56	43	29	49	74	53
Amphipoda	-	-	-	-	-	11	18	-	12	-	-	22	10
Copepoda	14	-	10	19	20	38	31	10	27	19	14	17	24
Isopoda	-	-	07	-	-	16	10	-	17	10	18	32	11
Cumacea	-	-	09	-	08	-	-	-	15	12	-	-	04
Crustaceans	32	08	22	24	11	43	39	22	19	-	-	-	63
Arachnactis	19	-	-	21	12	17	53	29	-	10	14	-	10
Fish egg	51	46	17	24	17	38	29	43	11	54	143	49	81
Total	593	343	184	248	164	595	417	590	509	325	792	697	685

- Not recorded

Table 6

Biomass (mg wet wt./10cm<sup>2</sup>) of Meiobenthos Taxa in Mandovi River/Estuary (March 1996)

Group	Sampling Location												
	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15
Foraminifera	0.102	0.016	0.022	0.024	0.022	0.136	0.024	0.098	0.068	0.072	0.084	0.088	0.132
Diatom	0.414	0.334	0.090	0.134	0.038	0.218	0.185	0.319	0.151	0.164	0.676	0.529	0.464
Nematoda	1.278	0.459	0.387	0.486	0.351	1.224	0.576	0.819	1.206	0.432	0.351	0.756	0.405
Turbellaria	0.029	-	0.027	-	-	0.114	0.074	0.027	0.064	-	0.040	0.021	0.011
Polychaeta	2.085	0.551	0.348	0.609	0.522	1.711	0.986	4.147	2.291	0.551	3.509	2.697	1.276
Bivalvia	-	-	-	0.270	0.300	-	0.330	0.870	0.660	0.300	0.450	0.660	1.470
Ostracoda	1.760	2.080	-	-	-	0.880	-	2.240	1.720	1.160	1.960	2.960	2.520
Amphipoda	-	-	-	-	-	0.308	0.504	-	0.336	-	-	0.616	0.280
Copepoda	0.380	-	0.220	0.418	0.440	0.836	0.682	0.220	0.599	0.418	0.308	0.374	0.528
Isopoda	-	-	0.028	-	-	0.064	0.040	-	0.068	0.040	0.072	0.128	0.044
Cumacea	-	-	1.8	-	1.6	-	-	-	3.000	2.400	-	-	0.800
Crustaceans	0.256	0.064	0.176	0.192	0.088	0.344	0.312	0.176	0.152	-	-	-	0.504
Arachnactis	0.095	-	-	0.105	0.060	0.085	0.265	0.145	-	0.050	0.070	-	0.050
Fish egg mass	1.240	1.310	33.750	47.640	33.740	75.430	57.570	85.360	21.835	107.20	283.86	97.265	160.79
Total	107.6	4.81	36.848	49.88	37.16	81.35	61.55	94.421	32.15	112.7	291.38	106.09	169.2

- Not recorded

Table 7

Distribution and Abundance (No./m<sup>2</sup>) of Macrobenthos in Mandovi River/Estuary (March 1996)

Group	Sampling Location												
	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15
Foraminifera	-	-	-	-	-	-	-	-	-	-	71	-	93
Porifera	-	02	02	09	06	02	-	-	-	-	-	21	17
Coelenterata	-	-	-	-	-	-	-	-	-	-	15	-	64
Nematoda	-	28	32	34	12	12	31	43	-	-	-	29	24
Polychaeta	14	19	41	32	59	79	71	43	41	-	24	47	26
Gastropoda	21	-	-	-	-	-	-	-	-	59	-	78	131
Bivalvia	-	-	-	-	-	-	15	-	-	04	29	182	120
Harpacticoida	-	-	-	-	-	-	-	-	-	-	-	-	81
Cumacea	-	-	-	-	-	-	-	-	-	-	-	-	-
Tanaidacea	-	-	-	-	-	-	-	-	-	66	-	79	12
Isopoda	16	-	-	-	-	-	-	-	-	57	-	66	-
Amphipoda	-	-	-	-	-	-	-	-	-	81	-	59	82
Ostracoda	-	-	-	-	-	-	-	-	-	-	-	-	-
Stomatopoda	-	-	-	-	-	-	-	-	-	-	-	-	-
Mysidacea	-	-	-	-	-	-	-	-	-	-	55	-	112
Decapoda	26	-	-	-	-	-	-	-	-	276	326	-	422
Pisces	-	-	-	-	-	-	-	-	-	-	-	-	72
Prawn Larvae	15	-	-	-	-	-	-	-	-	-	-	14	62
Worms & Others	15	24	15	32	12	09	22	-	14	-	43	26	18

- Not recorded

**Table 8**  
**Biomass (mg/m<sup>2</sup>) of Macrobenthos in Mandovi River/Estuary (March 1996)**

Group	Sampling Location												
	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15
Foraminifera	-	-	-	-	-	-	-	-	-	-	0.009	-	0.012
Porifera	-	-	-	-	-	-	-	-	-	-	-	-	-
Coelenterata	-	-	-	-	-	-	-	-	-	-	3.300	-	14.080
Nematoda	-	2.69	3.072	3.264	1.152	1.152	2.976	4.13	-	-	-	2.784	2.304
Polychaeta	0.104	0.141	0.303	0.237	0.437	0.585	0.525	0.318	0.303	-	0.178	0.348	0.192
Gastropoda	15.94	-	-	-	-	-	-	-	-	44.78	-	59.202	99.429
Bivalvia	-	-	-	-	-	-	1.319	-	-	0.352	2.549	15.998	10.548
Harpacticoida	-	-	-	-	-	-	-	-	-	-	-	-	0.029
Cumacea	-	-	-	-	-	-	-	-	-	-	-	-	-
Tanaidacea	-	-	-	-	-	-	-	-	-	0.013	-	0.016	0.002
Isopoda	0.168	-	-	-	-	-	-	-	-	0.597	-	0.692	-
Amphipoda	-	-	-	-	-	-	-	-	-	0.049	-	0.035	0.049
Ostracoda	-	-	-	-	-	-	-	-	-	-	-	-	-
Stomatopoda	-	-	-	-	-	-	-	-	-	-	-	-	-
Mysidacea	-	-	-	-	-	-	-	-	-	-	4.950	-	10.080
Decapoda	2.751	-	-	-	-	-	-	-	-	29.20	34.49	-	44.648
Pisces	-	-	-	-	-	-	-	-	-	-	-	-	142.920
Prawn Larvae	1.095	-	-	-	-	-	-	-	-	-	-	1.022	4.526
Worms & Others	0.093	0.149	0.093	0.198	0.074	0.056	0.136	-	0.087	-	0.267	0.161	0.112

- Not recorded

Table 9

## Density of Various Nektons (No/hauls) in Mandovi River/Estuary (March 1996)

Species	Sampling Location													
	R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R15
<b>Finfishes</b>														
<i>Ambassis commersonii</i>	-	-	-	3	6	-	14	-	-	36	4	-	-	-
<i>Ambassis dussumieri</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Awaous grammepomus</i>	-	-	2	-	-	-	-	-	-	-	-	-	-	-
<i>Bairdus evezardi</i>	-	-	1	1	-	-	-	-	-	-	-	-	-	-
<i>Cynoglossus puncticeps</i>	-	-	-	-	-	1	-	2	1	-	-	-	-	-
<i>Danio devario</i>	9	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Etroplus suratensis</i>	-	-	-	1	-	-	-	-	-	-	3	-	-	-
<i>Garra gotyla gotyla</i>	2	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Gonoproktopterus thomasi</i>	-	1	-	-	-	-	-	-	-	-	-	-	-	-
<i>Labeo kawrus</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Leiognathus blochii</i>	-	-	-	-	-	-	-	-	-	-	4	-	11	-
<i>Mugil cephalus</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Nemacheilus rubidipinnis</i>	4	6	2	-	-	-	-	-	-	-	-	-	-	-
<i>Osteobrama dayi</i>	1	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Pseudorhombus arsius</i>	-	-	-	-	-	-	-	-	-	-	-	-	3	-
<i>Paruclosoma daniconius</i>	3	2	-	-	-	-	-	-	-	-	-	-	-	-
<i>Puntius filamentosus</i>	3	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>P. amphibius</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>P. nigrofasciatus</i>	-	3	1	-	-	-	-	-	-	-	-	-	-	-
<i>P. ophiocephalus</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 9 (Contd...)

## Density of Various Nektons (No/hauls) in Mandovi River/Estuary (March 1996)

Species	Sampling Location														
	R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R15	
<i>P. arulius</i>	-	4	-	-	-	-	-	-	-	-	-	-	-	-	
<i>Rasbora neilgherriensis</i>	14	5	2	7	-	-	-	-	-	-	-	-	-	-	
<i>Sieyopterus graseus</i>	-	-	1	-	-	-	-	-	-	-	-	-	-	-	
<i>Scatophagus argus</i>	-	-	-	-	1	-	-	-	-	-	4	-	-	-	
<i>Sillago sihama</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
<i>Stenogobius gymnopomus</i>	-	-	-	2	-	-	-	-	-	-	-	1	3	-	
<i>Teuthis vermiculata</i>	-	-	-	-	-	-	2	-	-	-	-	-	-	4	
<i>Chanos chanos</i>	2	-	2	-	-	-	-	-	-	-	-	-	-	-	
<b>Shell Fishes</b>															
<i>Macrobrachium malcolmsoni</i>	2	5	2	8	-	-	-	2	1	-	-	-	-	-	
<i>Metapenaeus affinis</i>	-	-	-	-	-	-	19	-	-	4	-	-	-	-	
<i>M. monoceros</i>	-	-	-	3	-	-	7	5	-	-	-	-	4	-	
<i>M. dobsoni</i>	-	-	-	-	-	4	4	-	-	-	3	2	2	-	
<i>Penaeus marguiesis</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
<i>P. indicus</i>	-	-	-	-	-	3	-	-	-	-	-	-	-	-	
<i>Scylla serrata</i>	-	-	-	-	-	-	-	-	-	-	-	-	1	-	
Unidentified (small crab)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
<i>Macrobrachium rude</i>	-	-	-	5	-	-	-	-	-	-	-	-	-	-	
<i>Villorita cyprinoides</i>	-	-	1	-	-	-	-	-	-	-	-	-	-	-	
<i>Meretrix meretrix</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
<i>M. casta</i>	-	-	-	-	-	-	-	-	-	-	-	-	4	-	
<i>Paphia malabarica</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	6	

- Not recorded

**Table 1**  
**Physico-chemical Water Quality in Mandovi River/Estuary along with Details of Sampling Conditions (April 1996)**

Parameter	Sampling Location													
	R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R15
Time of Sampling	0825	0850	0925	1045	1135	1200	1300	1215	1225	1245	1315	1330	1425	1740
Tidal Condition	-	-	-	High	High	High	High	High	High	High	High	High	Low	Low
Air Temperature (°C)	29.6	30.0	31.5	33.0	32.7	33.5	32.2	33.1	31.9	32.4	32.2	32.0	32.1	31.4
Water Temperature (°C)	30.0	29.6	31.0	33.1	33.0	33.0	32.0	33.4	33.0	32.8	32.6	32.6	32.0	31.8
Salinity (ppt)	0.0	0.0	0.0	0.4	6.1	8.6	34.7	32.4	28.2	28.6	31.4	34.7	33.7	34.50
Dissolved O <sub>2</sub> (mg/L)	4.2	3.9	5.2	5.4	4.8	4.7	5.1	4.8	4.9	5.0	4.9	5.1	5.0	5.3
pH	7.4	7.5	7.6	7.5	7.6	7.6	7.9	7.8	7.8	7.9	8.0	7.9	8.0	8.0
Suspended Load (mg/L)	9	8	8	9	8	10	8	9	8	9	7	8	7	8
V.E.C.	12	18	16	12	10	9	16	10	8	9	11	13	12	14
Phosphate as P (µg/L)	0.48	0.56	0.52	0.55	0.53	0.59	0.80	0.54	0.63	0.62	0.74	0.68	0.78	0.68
Nitrate as N (µg/L)	1.72	1.34	1.32	1.35	1.21	1.38	2.84	2.56	2.11	2.18	2.35	2.04	2.08	2.11
Silicate as Si (µg/L)	85.3	86.40	86.20	88.3	80.2	80.4	85.10	79.60	98.50	78.20	79.30	79.4	78.5	76.5

V.E.C. : Vertical Extinction Coefficient

Table 2

River Mandovi - Bottom Sediment Analysis (April 1996)

Sampling Location	Moisture Content (%)	Organic* Matter (%)	Organic* Carbon (%)	Sand (%)	Silt (%)	Clay (%)
R3	56.21	11.09	6.43	8.20	82.0	9.8
R4	41.33	14.50	8.41	11.40	82.4	6.2
R5	49.52	14.50	8.41	14.80	79.3	5.9
R6	51.84	12.09	7.01	12.60	70.2	17.2
R7	60.42	8.14	4.72	29.40	68.4	2.2
R8	29.14	11.76	6.82	68.30	19.3	12.4
R9	43.23	9.36	5.43	26.40	64.7	6.9
R10	12.40	9.03	5.24	29.36	63.4	7.3
R11	10.84	7.45	4.32	66.40	18.3	15.3
R12	5.71	6.91	4.01	44.30	49.5	6.2
R13	15.43	8.69	5.04	66.50	24.5	9.0
R14	16.43	8.31	4.82	72.10	24.3	3.6
R15	17.12	8.25	4.94	70.40	23.2	6.4

\* Based on dry weight basis

Table 3

Distribution and Abundance (No/100ml) of Phytoplankton in Mandovi River/Estuary  
(April 1996)

Genera	Sampling Location												
	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15
<b>Cyanophyceae</b>													
<i>Trichodesmium erythraeum</i>	-	-	-	260	10	40	-	-	-	-	98	-	64
<b>Chlorophyceae</b>													
<i>Pediastrum sp.</i>	-	-	-	02	-	-	10	-	-	06	-	-	-
<i>Spirogyra sp.</i>	64	22	130	-	-	06	-	104	-	-	-	-	-
<i>Ulothrix sp.</i>	-	-	02	-	02	-	04	-	-	-	-	-	-
<i>Cosmarium sp.</i>	-	-	-	-	01	-	-	-	02	-	-	-	-
<i>Micrasterias sp.</i>	-	-	-	-	-	-	-	06	-	-	-	-	-
<i>Zygnema sp.</i>	02	-	-	-	02	-	02	-	-	-	04	-	-
<b>Bacillariophyceae</b>													
<i>Coscinodiscus sp.</i>	102	64	122	184	196	107	242	268	294	312	104	234	364
<i>Skeletonema sp.</i>	-	-	-	10	-	12	-	-	-	10	-	-	48
<i>Hemidiscus sp.</i>	-	-	-	-	-	-	-	-	122	-	72	64	46
<i>Melosira sp.</i>	-	-	-	-	-	-	24	-	-	64	-	10	24
<i>Stephanopyxis sp.</i>	-	-	-	-	-	-	-	-	-	-	06	08	14
<i>Triceratium sp.</i>	-	-	-	-	-	-	-	10	-	12	-	-	12
<i>Biddulphia sp.</i>	-	-	-	-	-	-	-	-	10	12	32	10	24
<i>B. mobiliensis</i>	-	-	-	-	-	-	-	-	10	18	10	14	22
<i>B. sinensis</i>	-	-	-	-	-	-	-	02	-	-	08	10	16
<i>Guinardia sp.</i>	-	-	-	-	-	-	-	-	-	-	08	-	10
<i>Bellerophon sp.</i>	-	-	-	-	-	-	-	-	-	-	04	06	04
<i>Ditylum sp.</i>	-	-	-	-	-	-	-	-	20	10	14	-	12
<i>Lithodesmium sp.</i>	-	-	-	-	-	-	-	-	-	-	06	-	08
<i>Chaetoceros sp.</i>	-	-	-	-	130	84	120	142	54	42	48	-	174
<i>Grammatophora sp.</i>	-	-	-	-	-	-	-	-	-	-	04	-	08
<i>Campylodiscus sp.</i>	-	-	-	-	-	-	-	-	-	-	04	-	04
<i>Planktoniella sp.</i>	-	-	-	-	-	-	-	-	-	08	10	04	08
<i>Bacteriastum sp.</i>	-	-	-	-	-	-	-	-	-	-	-	10	04

Table 3 (Contd..)

Distribution and Abundance (No/100ml) of Phytoplankton in Mandovi River/Estuary  
(April 1996)

Genera	Sampling Location												
	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15
<i>Eucampia</i> sp.	-	-	-	-	-	-	-	-	-	-	-	08	06
<i>Climacodium</i> sp.	-	-	-	-	-	-	-	06	-	-	-	06	08
<i>Streptotheca</i> sp.	-	-	-	-	-	-	-	-	-	-	-	04	06
<i>Thalassiosira</i> sp.	-	-	-	-	-	-	-	64	42	-	-	24	46
<i>T. gravida</i>	-	-	-	-	-	-	-	-	-	-	42	-	54
<i>Thalassionema</i> sp.	-	-	-	-	-	-	-	-	-	-	24	10	62
<i>Rhizosolenia</i> sp.	-	-	-	04	-	-	46	52	38	72	60	54	42
<i>R. stollerfothii</i>	-	-	02	-	-	08	-	40	52	-	10	-	18
<i>R. styliformis</i>	-	-	-	-	-	10	-	-	30	-	10	-	18
<i>R. hebatata</i>	-	-	02	-	-	-	-	10	-	20	10	-	22
<i>Fragillaria oceanica</i>	-	-	-	-	-	-	-	-	-	-	08	-	12
<i>Thalassiothrix</i> sp.	-	-	-	-	-	-	-	-	-	-	08	14	22
<i>T. longissima</i>	-	-	-	-	-	-	-	-	-	12	-	12	08
<i>Asterionella japonica</i>	-	-	-	-	-	-	-	-	08	-	05	-	10
<i>Gyrosigma</i> sp.	-	-	08	-	-	-	12	18	06	-	20	-	12
<i>Pleurosigma</i> sp.	-	-	-	-	10	14	22	44	36	-	10	-	22
<i>Navicula</i> sp.	-	-	-	-	-	-	-	-	-	-	06	-	04
<i>Nitzschia</i> sp.	-	-	-	-	-	-	-	-	-	12	-	10	08
<i>N. longissima</i>	-	-	-	-	-	-	-	-	-	-	04	-	02
<b>Dinophyceae</b>													
<i>Prorocentrum</i> sp.	-	-	-	-	-	-	-	-	-	-	08	02	08
<i>Dinophysis</i> sp.	-	-	-	-	-	-	08	-	-	04	-	06	08
<i>Peridinium</i> sp.	-	-	-	-	-	-	-	-	02	-	12	02	22
<i>Ceratium tripos</i>	-	-	-	-	-	-	-	-	-	-	24	04	08
<i>C. fusus</i>	-	-	-	-	-	-	-	-	-	-	20	14	06
<i>C. massiliensis</i>	-	-	-	-	-	-	-	04	-	-	06	-	08
<i>C. furca</i>	-	-	-	-	-	-	-	-	-	-	04	02	04
<i>Pyrocystis fusiformis</i>	-	-	-	-	-	-	-	-	-	-	02	06	10
<i>Noctiluca miliaris</i>	-	-	-	-	-	-	-	-	-	04	08	10	16
<b>Total</b>	<b>168</b>	<b>86</b>	<b>266</b>	<b>460</b>	<b>351</b>	<b>281</b>	<b>490</b>	<b>770</b>	<b>726</b>	<b>618</b>	<b>734</b>	<b>558</b>	<b>1338</b>
<b>Biomass</b>	<b>1.0</b>	<b>0.8</b>	<b>1.0</b>	<b>1.2</b>	<b>1.4</b>	<b>1.8</b>	<b>1.6</b>	<b>1.9</b>	<b>2.2</b>	<b>1.6</b>	<b>2.4</b>	<b>1.2</b>	<b>1.0</b>

- Not Recorded

Table 4

## Distribution and Abundance (No./haul) of Zooplankton in Mandovi River/Estuary (April 1996)

Genera	Sampling Location													
	R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R15
<b>Ciliata</b>														
<i>Tintinnopsis sp.</i>	-	-	-	-	-	-	-	2	-	8	4	2	1	2
<i>Favella sp.</i>	1	-	-	-	-	1	-	-	30	10	5	4	4	8
<i>Rhabdonella sp.</i>	-	-	-	-	-	-	-	-	-	-	-	1	-	1
<b>Foraminifera</b>														
<i>Globigerina sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	1	1
<b>Cnidaria</b>														
<i>Siphonophora sp.</i>	-	-	-	-	-	-	-	-	-	-	1	1	-	2
<b>Ctenophora</b>														
<i>Pleurobrachia sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<b>Copepoda</b>														
<i>Undinula sp.</i>	-	-	-	-	-	-	-	4	6	4	-	1	-	2
<i>Acartia sp.</i>	-	-	-	-	-	-	-	-	-	-	-	1	-	1
<i>Temora sp.</i>	-	1	-	-	-	1	-	1	4	12	8	6	-	4
<i>Eutemora sp.</i>	-	-	-	-	-	-	-	-	-	-	-	2	-	3
<i>Oithona sp.</i>	-	-	-	-	-	-	-	4	-	3	12	15	10	4
<i>O. plumifera</i>	-	-	-	-	-	-	-	-	-	-	-	2	-	4
<i>Euterpina sp.</i>	-	-	-	-	-	-	-	2	-	-	-	1	1	2
<i>Paracalanus sp.</i>	-	-	-	3	05	-	2	-	6	4	10	12	14	16
<i>Eucalanus sp.</i>	-	-	-	-	-	2	-	-	-	52	4	10	-	3
<i>Centropages sp.</i>	-	-	-	-	-	-	-	-	4	-	2	-	-	1
<i>Pseudocalanus sp.</i>	-	-	-	-	-	6	-	-	130	142	84	17	-	22
<i>Macrosetella sp.</i>	-	-	-	-	-	-	-	-	4	3	5	-	4	4
<i>Microsetella sp.</i>	-	-	-	-	-	1	-	-	1	-	4	3	2	4
<i>Metridia sp.</i>	-	-	-	-	-	-	-	-	-	-	-	1	1	-
<i>Isias sp.</i>	-	-	-	-	-	-	-	-	-	-	1	-	1	2
<i>Candacia sp.</i>	-	-	-	-	-	-	-	-	-	-	-	2	-	2
<i>Canthocalanus sp.</i>	-	-	-	-	-	-	-	-	-	-	-	1	2	3
<i>Nannocalanus sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	1	3
<i>Rhincalanus sp.</i>	-	-	-	-	-	-	-	2	-	1	10	8	-	10
<i>Microcalanus sp.</i>	-	-	-	-	-	-	-	-	-	-	-	1	-	1

Table 4 (Contd..)

## Distribution and Abundance (No./haul) of Zooplankton in Mandovi River/Estuary (April 1996)

Genera	Sampling Location													
	R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R15
<i>Parapontella sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	3	3
<i>Labidocera sp.</i>	-	-	-	-	-	-	-	-	-	-	-	1	3	6
<i>Oncaea sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	1	-
<i>Heliodiaptomus sp.</i>	14	10	04	03	01	-	-	-	-	-	-	-	-	-
<i>Mesocyclops sp.</i>	03	06	08	05	02	-	-	-	-	-	-	-	-	-
<i>Microcyclops sp.</i>	01	04	-	06	04	-	-	-	-	-	-	-	-	-
<i>Diaptomus sp.</i>	-	-	01	01	-	-	-	-	-	-	-	-	-	-
<b>Cladocera</b>														
<i>Penilia sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	2
<i>Evadne sp.</i>	-	-	-	-	-	-	-	-	-	6	-	2	2	4
<i>Moina sp.</i>	03	02	04	01	02	-	-	-	-	-	-	-	-	-
<i>Daphnia sp.</i>	08	06	06	04	01	-	-	-	-	-	-	-	-	-
<i>Macrothrix sp.</i>	02	04	03	02	-	-	-	-	-	-	-	-	-	-
<b>Rotifera</b>														
<i>Brachionus sp.</i>	06	04	03	03	-	-	-	-	-	-	-	-	-	-
<i>Keratella sp.</i>	-	04	01	-	-	-	-	-	-	-	-	-	-	-
<i>Polyarthra sp.</i>	-	02	01	-	01	-	-	-	-	-	-	-	-	-
<b>Pteropoda</b>														
<i>Creseis acicula</i>	-	-	-	-	-	-	-	-	-	-	-	1	-	1
<i>Creseis sp.</i>	-	-	-	-	-	-	1	-	1	2	-	6	-	2
<b>Appendicularia</b>														
<i>Oikopleura sp.</i>	-	-	-	-	-	-	-	-	-	-	-	1	-	2
<b>Larval Forms</b>														
Brachiopoda	-	-	-	-	-	-	-	1	-	-	-	-	-	3
Polychaeta	-	-	-	-	-	-	-	2	-	-	-	1	-	4
Copepod	18	12	19	29	22	10	18	26	124	132	164	10	12	18
Cirripede	-	-	-	-	-	-	-	-	1	14	-	6	2	4
Arachnactis	-	-	-	-	-	-	-	-	-	-	-	1	-	2
Bivalvia	-	1	-	-	1	2	-	4	-	-	1	4	3	6
Gastropoda	-	2	-	1	3	-	4	-	8	-	14	4	1	5
Fish eggs and Larvae	28	6	8	20	34	18	24	48	110	124	28	38	14	32

- Not recorded

Table 5

Distribution and Abundance (No./10cm<sup>2</sup>) of Meiobenthos in Mandovi River/Estuary  
(April 1996)

Group	Sampling Location												
	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15
Foraminifera	27	-	-	-	-	49	-	29	15	21	22	26	55
Diatom	165	119	19	27	02	64	58	115	26	24	184	96	115
Nematoda	91	48	21	22	24	82	02	56	76	18	16	58	24
Turbellaria	-	-	-	-	-	24	16	-	04	-	-	-	01
Polychaeta	44	10	-	06	01	26	16	65	42	03	64	58	21
Bivalvia	-	-	01	-	01	-	-	10	02	-	-	10	14
Ostracoda	26	17	-	-	01	-	05	16	12	10	16	29	38
Amphipoda	-	-	-	-	-	01	01	-	-	-	04	06	-
Copepoda	06	-	-	01	01	22	16	-	09	10	02	10	04
Isopoda	-	-	-	-	-	01	-	-	04	-	-	10	-
Cumacea	-	-	-	-	-	-	-	-	04	-	-	-	01
Crustaceans	06	-	10	06	-	16	14	10	04	-	02	-	34
Arachnactis	07	-	-	01	-	10	19	09	-	-	04	02	01
Fish egg	18	16	10	14	08	15	17	21	01	17	58	26	59
Total	390	210	61	77	38	310	164	331	199	103	372	331	367

- Not recorded

Table 6

Biomass (mg wet wt./10cm<sup>2</sup>) of Meiobenthos Taxa in Mandovi River/Estuary (April 1996)

Group	Sampling Location												
	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15
Foraminifera	0.054	-	-	-	-	0.098	-	0.058	0.030	0.042	0.044	0.056	0.110
Diatom	0.346	0.250	0.040	0.057	0.004	0.134	0.122	0.242	0.055	0.050	0.386	0.202	0.032
Nematoda	0.819	0.432	0.189	0.198	0.216	0.783	0.018	0.504	0.684	0.162	0.144	0.522	0.216
Turbellaria	-	-	-	-	-	0.064	0.043	-	0.011	-	-	-	0.003
Polychaeta	1.276	0.290	-	0.174	0.290	0.759	0.464	1.885	1.218	0.087	1.856	1.682	0.609
Bivalvia	-	-	0.030	-	0.030	-	-	0.300	0.060	-	-	0.300	0.420
Ostracoda	1.040	0.680	-	-	0.040	-	0.200	0.640	0.480	0.400	0.640	1.160	1.520
Amphipoda	-	-	-	-	-	0.028	0.028	-	-	-	0.112	0.169	-
Copepoda	0.132	-	-	0.022	0.022	0.484	0.352	-	0.198	0.220	0.044	0.220	0.088
Isopoda	-	-	-	-	-	0.004	-	-	0.016	-	-	0.040	-
Cumacea	-	-	-	-	-	-	-	-	0.800	-	-	-	0.200
Crustaceans	0.048	-	0.080	0.048	-	0.128	0.112	0.080	0.032	-	0.016	-	0.272
Arachnactis	0.035	-	-	0.005	-	0.050	0.095	0.045	-	-	0.020	0.010	0.005
Fish egg mass	35.73	31.76	19.85	27.79	15.88	29.775	33.76	41.685	1.985	33.75	115.13	51.610	117.10
Total	39.48	33.41	20.189	28.29	16.48	32.307	35.19	45.439	5.569	34.71	118.39	55.970	120.55

- Not recorded

Table 7

Distribution and Abundance (No./m<sup>2</sup>) of Macrobenthos in Mandovi River/Estuary (April 1996)

Group	Sampling Location												
	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15
Foraminifera	-	-	-	-	-	-	-	-	-	-	34	04	41
Porifera	-	-	06	-	-	01	-	-	-	-	-	05	04
Coelenterata	-	-	-	-	-	-	-	-	-	-	04	-	12
Nematoda	-	10	27	10	02	07	22	11	27	-	09	02	03
Polychaeta	03	05	15	12	22	36	45	20	16	-	08	12	09
Gastropoda	-	01	-	-	-	-	-	-	-	10	-	06	41
Bivalvia	-	-	-	-	-	-	-	02	-	-	10	45	32
Harpacticoida	-	-	-	-	-	-	-	-	-	-	08	-	36
Cumacea	-	-	-	-	-	-	-	-	-	-	-	-	04
Tanaidacea	-	-	-	-	-	-	-	-	-	34	-	23	-
Isopoda	-	02	-	-	-	03	-	-	-	28	02	30	04
Amphipoda	-	-	-	-	-	01	-	-	-	31	-	24	37
Ostracoda	-	-	-	-	-	-	01	-	-	-	-	04	05
Stomatopoda	-	-	-	-	-	-	-	-	-	-	02	-	04
Mysidacea	-	-	-	-	-	-	-	-	04	-	26	-	56
Decapoda	02	-	04	-	-	-	-	-	-	-	74	12	102
Pisces	-	-	-	-	-	-	-	-	-	-	12	-	54
Prawn Larvae	-	02	-	-	-	-	-	-	-	-	-	03	-
Worms & Others	04	09	07	14	02	-	06	-	10	-	-	17	14

- Not recorded

**Table 8**  
**Biomass (mg/m<sup>2</sup>) of Macrobenthos Taxa in Mandovi River/Estuary (April 1996)**

Group	Sampling Location												
	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15
Foraminifera	-	-	-	-	-	-	-	-	-	-	0.004	0.001	0.005
Porifera	-	-	-	-	-	-	-	-	-	-	-	-	-
Coelenterata	-	-	-	-	-	-	-	-	-	-	0.880	-	2.640
Nematoda	-	0.960	2.592	0.960	0.192	0.672	2.112	1.056	2.592	-	0.864	0.192	0.288
Polychaeta	0.022	0.037	0.111	0.089	0.163	0.266	0.333	0.148	0.118	-	0.059	0.089	0.067
Gastropoda	-	0.759	-	-	-	-	-	-	-	7.590	-	4.554	31.119
Bivalvia	-	-	-	-	-	-	-	0.176	-	-	0.879	3.956	2.813
Harpacticoida	-	-	-	-	-	-	-	-	-	-	0.003	-	0.013
Cumacea	-	-	-	-	-	-	-	-	-	-	-	-	1.000
Tanaidacea	-	-	-	-	-	-	-	-	-	0.007	-	0.005	-
Isopoda	-	0.200	-	-	-	0.314	-	-	-	2.934	-	2.515	3.878
Amphipoda	-	-	-	-	-	0.001	-	-	-	0.019	-	0.014	0.022
Ostracoda	-	-	-	-	-	-	0.003	-	-	-	-	0.014	0.017
Stomatopoda	-	-	-	-	-	-	-	-	-	-	0.180	-	0.360
Mysidacea	-	-	-	-	-	-	-	-	0.360	-	2.340	-	5.040
Decapoda	0.212	-	0.423	-	-	-	-	-	-	-	7.829	1.270	10.729
Pisces	-	-	-	-	-	-	-	-	-	-	23.82	-	107.19
Prawn Larvae	-	0.146	-	-	-	-	-	-	-	-	-	0.219	-
Worms & Others	0.025	0.056	0.043	0.087	0.012	-	0.037	-	0.062	-	-	0.105	0.087

- Not recorded

Table 9

## Density of Various Nektons (No/hauls) in Mandovi River/Estuary (April 1996)

Species	Sampling Location													
	R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R15
<b>Finfishes</b>														
<i>Ambassis commersoni</i>	-	-	-	12	8	32	8	2	-	-	-	-	1	4
<i>Ambassis dussumieri</i>	-	-	-	-	-	-	-	-	-	-	-	-	5	-
<i>Awaous grammepomus</i>	1	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Bariius evezardi</i>	1	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Cynoglossus puncticeps</i>	-	-	-	-	-	-	-	-	-	-	-	-	2	-
<i>Danio devanio</i>	1	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Etoplus suratensis</i>	-	-	-	-	-	-	-	-	-	3	-	-	-	-
<i>Garra gotyla gotyla</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Gonoproktopterus thomasi</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Labeo kawrus</i>	1	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Leiognathus blochii</i>	-	-	-	-	-	-	-	2	-	-	-	-	-	3
<i>Mugil cephalus</i>	-	-	-	-	1	-	-	-	-	-	-	-	-	-
<i>Nemacheilus rubidipinnis</i>	7	1	3	-	-	-	-	-	-	-	-	-	-	-
<i>Osteobrama dayi</i>	-	3	-	-	-	-	-	-	-	-	-	-	-	-
<i>Pseudorhombus arsius</i>	-	-	-	-	2	5	-	-	-	-	-	1	-	2
<i>Paruciosoma daniconius</i>	2	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Puntius filamentosus</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>P. amphibius</i>	1	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>P. nigrofasciatus</i>	-	2	-	-	-	-	-	-	-	-	-	-	-	-
<i>P. ophiocephalus</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 9 (Contd..)

## Density of Various Nektons (No/hauls) in Mandovi River/Estuary (April 1996)

Species	Sampling Location													
	R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R15
<i>P. arulius</i>	2	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Rasbora neilgherriensis</i>	2	-	-	4	-	-	-	-	-	-	-	-	-	-
<i>Sieyopterus graseus</i>	1	2	5	-	-	-	-	-	-	-	-	-	-	-
<i>Scatophagus argus</i>	-	-	-	3	-	-	-	-	-	-	-	-	-	2
<i>Silago sihama</i>	-	-	-	-	1	-	-	-	-	-	-	-	-	-
<i>Stenogobius gymnopomus</i>	-	-	-	2	-	3	-	-	-	-	-	-	2	-
<i>Teuthis vermiculata</i>	-	-	-	-	-	-	-	-	-	-	7	1	-	4
<i>Chanos chanos</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<b>Shell Fishes</b>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Macrobrachium malcolmsoni</i>	-	-	-	2	-	-	-	-	-	-	-	-	-	-
<i>Metapenaeus affinis</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>M. monoceros</i>	-	-	-	1	3	1	-	-	-	-	2	-	-	1
<i>M. dobsoni</i>	-	-	-	4	-	3	-	2	9	-	-	1	2	-
<i>Penaeus marguiesis</i>	-	-	-	-	-	-	1	-	-	-	3	-	-	5
<i>P. indicus</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Scylla serrata</i>	-	-	-	-	-	-	-	-	-	-	-	-	1	-
Unidentified (small crab)	-	-	-	8	-	-	-	-	-	-	-	-	-	-
<i>Macrobrachium rude</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Vilorita cyprinoides</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Meretrix meretrix</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>M. casta</i>	-	-	-	-	-	-	-	-	-	-	-	-	1	-
<i>Paphia malabarica</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	1

- Not recorded

**Table 1**  
**Physico-chemical Water Quality in Mandovi River/Estuary along with Details of Sampling Conditions (May 1996)**

Parameter	Sampling Location													
	R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R15
Time of Sampling	0820	0915	1005	1050	1110	1115	1430	1200	1215	1240	1540	1455	1625	1705
Tidal Condition	-	-	-	Low	Low	Low	Low	Low	Low	Low	Low	High	High	High
Air Temperature (°C)	30.2	30.6	31.1	31.4	31.6	31.6	31.2	32.0	32.2	32.0	31.4	31.1	31.0	30.7
Water Temperature (°C)	30.4	30.4	30.7	30.9	30.8	30.7	31.2	30.8	30.8	31.0	31.1	31.0	31.0	30.9
Salinity (ppt)	0.0	0.0	0.0	0.8	5.4	9.4	33.6	25.1	27.4	28.5	32.2	34.0	33.8	35.2
Dissolved O <sub>2</sub> (mg/L)	4.6	5.1	4.3	4.5	4.8	4.8	4.7	5.1	5.0	4.8	4.6	5.0	5.1	5.0
pH	7.3	7.5	7.6	7.5	7.8	7.6	7.8	7.9	7.8	8.0	8.0	8.1	8.0	8.1
Suspended Load (mg/L)	8	8	9	8	8	8	9	9	9	8	9	8	7	8
V.E.C.	12	11	13	10	12	14	16	15	11	10	15	16	12	14
Phosphate as P (µg/L)	0.38	0.32	0.35	0.55	0.51	0.50	0.42	0.48	0.25	0.71	0.65	0.61	0.69	0.74
Nitrate as N (µg/L)	2.3	2.4	2.0	2.1	2.3	2.4	2.5	2.9	2.8	2.7	1.9	2.4	2.2	2.3
Silicate as Si (µg/L)	68.3	64.2	66.5	67.2	62.4	60.8	76.5	58.3	75.2	67.2	84.3	87.7	88.4	85.1

V.E.C. : Vertical Extinction Coefficient

Table 2

River Mandovi - Bottom Sediment Analysis (May 1996)

Sampling Location	Moisture Content (%)	Organic* Matter (%)	Organic* Carbon (%)	Sand (%)	Silt (%)	Clay (%)
R3	54.06	11.07	6.42	7.8	78.2	14.0
R4	42.08	13.15	7.63	8.4	80.2	11.4
R5	49.10	14.52	8.42	12.4	74.3	13.3
R6	48.22	11.14	6.46	10.2	68.4	21.4
R7	58.10	5.55	3.24	26.3	66.8	6.9
R8	24.12	11.09	6.43	66.8	16.2	14.0
R9	36.14	8.86	5.14	26.2	59.0	14.8
R10	12.56	10.55	6.12	29.4	60.2	10.4
R11	10.54	10.76	6.24	68.2	16.4	15.4
R12	5.12	8.31	4.82	46.3	48.2	5.5
R13	14.12	7.10	4.12	69.2	24.4	6.4
R14	14.64	7.52	4.36	72.2	24.3	3.5
R15	14.22	8.79	5.10	70.6	24.4	5.0

\* Based on dry weight basis

Table 3

Distribution and Abundance (No/100ml) of Phytoplankton in Mandovi River/Estuary  
(May 1996)

Genera	Sampling Location												
	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15
<b>Cyanophyceae</b>													
<i>Trichodesmium erythraceum</i>	-	-	-	-	-	-	-	-	-	-	64	48	52
<b>Chlorophyceae</b>													
<i>Pediastrum sp.</i>	-	-	-	-	-	08	10	-	-	-	-	-	-
<i>Spirogyra sp.</i>	44	10	62	-	-	10	48	-	-	-	-	-	-
<i>Ulothrix sp.</i>	-	-	-	02	-	04	-	-	-	-	-	-	-
<i>Cosmarium sp.</i>	-	-	-	02	-	01	-	-	-	-	-	-	-
<i>Micrasterias sp.</i>	-	-	-	-	-	02	02	-	-	-	-	-	-
<i>Zygnema sp.</i>	02	-	-	-	01	-	-	-	-	04	-	-	-
<b>Bacillariophyceae</b>													
<i>Coscinodiscus sp.</i>	62	12	104	122	126	68	124	132	146	154	178	64	120
<i>Skeletonema sp.</i>	-	-	10	12	-	-	10	-	-	-	-	-	42
<i>Hemidiscus sp.</i>	-	-	-	-	-	12	-	-	62	-	10	42	40
<i>Melosira sp.</i>	-	-	-	-	-	10	-	-	44	-	-	10	16
<i>Stephanopyxis sp.</i>	-	-	-	-	-	-	-	-	-	-	06	08	12
<i>Triceratium sp.</i>	-	-	-	-	-	-	-	-	-	-	10	12	14
<i>Biddulphia sp.</i>	-	-	-	-	-	-	-	-	06	-	10	14	16
<i>B. mobiliensis</i>	-	-	-	-	-	-	-	-	-	16	22	20	24
<i>B. sinensis</i>	-	-	-	-	-	-	-	-	-	12	12	8	16
<i>Gulnardia sp.</i>	-	-	-	-	-	-	-	-	-	-	08	14	18
<i>Bellerochea sp.</i>	-	-	-	-	-	-	-	-	-	-	02	-	08
<i>Ditylum sp.</i>	-	-	-	-	-	-	-	-	-	10	10	08	14
<i>Lithodesmium sp.</i>	-	-	-	-	-	-	-	-	-	-	-	06	10
<i>Chaetoceros sp.</i>	-	-	-	-	82	120	134	30	54	62	68	66	102
<i>Grammatophora sp.</i>	-	-	-	-	-	-	-	-	-	-	-	10	08
<i>Campylodiscus sp.</i>	-	-	-	-	-	-	-	-	-	-	-	02	02
<i>Planktoniella sp.</i>	-	-	-	-	-	-	-	-	-	12	10	06	12
<i>Bacteriastum sp.</i>	-	-	-	-	-	-	-	-	-	-	02	02	03

Table 3 (Contd..)

Distribution and Abundance (No/100ml) of Phytoplankton in Mandovi River/Estuary  
(May 1996)

Genera	Sampling Location												
	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	F:13	R14	R15
<i>Eucampia</i> sp.	-	-	-	-	-	-	-	-	-	-	06	04	04
<i>Climacodium</i> sp.	-	-	-	-	-	-	-	-	02	04	04	03	05
<i>Streptotheca</i> sp.	-	-	-	-	-	-	-	-	-	-	-	02	04
<i>Thalassiosira</i> sp.	-	-	-	-	-	-	-	24	18	-	10	40	62
<i>T. gravida</i>	-	-	-	-	-	-	-	-	-	-	62	10	32
<i>Thalassionema</i> sp.	-	-	-	-	-	-	-	-	-	10	22	02	36
<i>Rhizosolenia</i> sp.	-	-	-	-	04	-	-	54	56	43	24	80	32
<i>R. stotterfothii</i>	-	-	02	-	06	-	-	08	10	10	12	14	18
<i>R. styliformis</i>	-	-	-	01	02	-	-	10	06	08	08	06	10
<i>R. hebatata</i>	-	-	-	-	04	-	-	08	02	04	04	02	04
<i>Fragillaria oceanica</i>	-	-	-	-	-	-	-	-	-	-	-	04	12
<i>Thalassiothrix</i> sp.	-	-	-	-	-	-	-	-	-	-	08	06	10
<i>T. longissima</i>	-	-	-	-	-	-	-	-	02	04	06	04	08
<i>Asterionella japonica</i>	-	-	-	-	04	-	-	-	04	08	06	10	12
<i>Gyrosigma</i> sp.	-	-	-	-	-	02	-	-	06	08	-	10	24
<i>Pleurosigma</i> sp.	-	-	-	-	-	-	-	-	-	-	02	06	02
<i>Navicula</i> sp.	-	-	-	-	-	-	02	-	-	04	-	04	02
<i>Nitzschia</i> sp.	-	-	-	-	-	-	-	-	-	-	04	02	02
<i>N. longissima</i>	-	-	-	-	-	-	-	-	-	-	06	06	06
<b>Dinophyceae</b>													
<i>Prorocentrum</i> sp.	-	-	-	-	-	-	-	02	-	-	04	-	02
<i>Dinophysis</i> sp.	-	-	-	-	-	-	-	-	-	-	10	04	14
<i>Peridinium</i> sp.	-	-	-	-	-	-	-	-	-	-	22	-	04
<i>Ceratium tripos</i>	-	-	-	-	-	-	-	-	-	-	14	02	02
<i>C. fusus</i>	-	-	-	-	-	-	02	-	-	02	02	-	06
<i>C. massiliensis</i>	-	-	-	-	-	-	-	01	02	-	04	02	04
<i>C. furca</i>	-	-	-	-	-	-	-	-	-	02	02	02	08
<i>Pyrocystis fusiformis</i>	-	-	-	-	-	-	-	-	-	-	04	06	10
<i>Noctiluca miliaris</i>	-	-	-	-	02	-	-	-	04	02	04	04	02
<b>Total</b>	<b>108</b>	<b>22</b>	<b>178</b>	<b>139</b>	<b>231</b>	<b>237</b>	<b>332</b>	<b>269</b>	<b>424</b>	<b>379</b>	<b>664</b>	<b>575</b>	<b>866</b>

- Not recorded

Table 4

## Distribution and Abundance (No./haul) of Zooplankton in Mandovi River/Estuary (May 1996)

Genera	Sampling Location													
	R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R15
<b>Ciliata</b>														
<i>Tintinnopsis sp.</i>	-	-	-	-	-	-	-	-	3	7	4	3	2	3
<i>Faveia sp.</i>	-	-	-	-	-	1	-	-	-	22	10	16	4	6
<i>Rhabdonella sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	1	3
<b>Foraminifera</b>														
<i>Globigerina sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	1	2
<b>Cnidaria</b>														
<i>Siphonophora sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	1	2
<b>Ctenophora</b>														
<i>Pleurobrachia sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<b>Copepoda</b>														
<i>Undinula sp.</i>	-	-	-	-	-	-	-	-	7	8	4	1	-	1
<i>Acartia sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	1	2
<i>Temora sp.</i>	-	-	-	-	-	-	2	-	6	12	10	8	-	6
<i>Eutemora sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	1	1
<i>Oithona sp.</i>	-	-	-	-	-	-	-	-	6	4	24	11	10	4
<i>O. plumifera</i>	-	-	-	-	-	-	-	-	-	-	-	-	1	1
<i>Euterpina sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	1	-
<i>Paracalanus sp.</i>	-	-	-	2	-	-	-	4	1	8	12	1	2	2
<i>Eucalanus sp.</i>	-	-	-	-	-	-	-	-	-	6	2	10	-	2
<i>Centropages sp.</i>	-	-	-	-	-	-	-	4	-	2	-	-	-	-
<i>Pseudocalanus sp.</i>	-	-	-	-	-	6	-	-	24	64	28	14	-	12
<i>Macrosetella sp.</i>	-	-	-	-	-	-	-	-	-	6	4	6	1	2
<i>Microsetella sp.</i>	-	-	-	-	-	-	-	-	-	-	4	1	2	2
<i>Metridia sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Isias sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	1	1
<i>Candacia sp.</i>	-	-	-	-	-	-	-	-	-	-	-	1	-	2
<i>Canthocalanus sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Nannocalanus sp.</i>	-	-	-	-	-	-	-	-	-	-	-	1	-	1
<i>Rhincalanus sp.</i>	-	-	-	-	-	-	1	-	2	-	-	4	6	4
<i>Microcalanus sp.</i>	-	-	-	-	-	-	-	-	-	-	-	1	-	1

Table 4 (Contd..)

## Distribution and Abundance (No./haul) of Zooplankton in Mandovi River/Estuary (May 1996)

Genera	Sampling Location													
	R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R15
<i>Parapontella sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Labidocera sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	1	-
<i>Oncaea sp.</i>	-	-	-	-	-	-	-	-	-	-	-	1	-	1
<i>Heliodiaptomus sp.</i>	08	06	02	04	-	-	-	-	-	-	-	-	-	-
<i>Mesocyclops sp.</i>	06	04	03	02	01	-	-	-	-	-	-	-	-	-
<i>Microcyclops sp.</i>	08	04	05	06	02	-	-	-	-	-	-	-	-	-
<i>Diaptomus sp.</i>	-	02	-	01	-	-	-	-	-	-	-	-	-	-
<b>Cladocera</b>														
<i>Penilia sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	1	1
<i>Evadne sp.</i>	-	-	-	-	-	-	-	-	-	-	-	1	2	1
<i>Moina sp.</i>	04	03	04	01	-	-	-	-	-	-	-	-	-	-
<i>Daphnia sp.</i>	08	06	05	02	-	-	-	-	-	-	-	-	-	-
<i>Macrothrix sp.</i>	02	04	04	01	-	-	-	-	-	-	-	-	-	-
<b>Rotifera</b>														
<i>Brachionus sp.</i>	08	04	03	01	-	-	-	-	-	-	-	-	-	-
<i>Keratella sp.</i>	04	03	02	01	01	-	-	-	-	-	-	-	-	-
<i>Polyarthra sp.</i>	03	02	-	-	01	-	-	-	-	-	-	-	-	-
<b>Pteropoda</b>														
<i>Creseis acicula</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Creseis sp.</i>	-	-	-	-	-	-	-	-	-	-	-	4	-	2
<b>Appendicularia</b>														
<i>Oikopleura sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<b>Larval Forms</b>														
<b>Brachiopoda</b>														
<i>Brachiopoda</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<b>Polychaeta</b>														
<i>Polychaeta</i>	-	-	-	-	-	-	-	-	-	-	-	2	-	1
<b>Copepod</b>														
<i>Copepod</i>	10	8	12	-	4	-	14	16	36	48	42	48	40	54
<b>Cirripede</b>														
<i>Cirripede</i>	-	-	-	-	-	-	-	-	-	-	-	6	-	4
<b>Archnactis</b>														
<i>Archnactis</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<b>Bivalvia</b>														
<i>Bivalvia</i>	-	-	-	-	-	-	-	-	-	-	1	-	-	1
<b>Gastropoda</b>														
<i>Gastropoda</i>	4	4	-	-	-	-	2	-	-	2	14	2	2	4
<b>Fish eggs and Larvae</b>														
<i>Fish eggs and Larvae</i>	24	8	10	10	8	8	12	16	24	34	20	18	10	22

- Not recorded

Table 5

Distribution and Abundance (No./10cm<sup>2</sup>) of Meiobenthos in Mandovi River/Estuary (May 1996)

Group	Sampling Location												
	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15
Foraminifera	28	-	-	-	49	-	-	27	22	24	26	27	58
Diatom	143	104	18	26	04	68	56	110	28	26	148	86	142
Nematoda	84	38	22	21	20	64	04	56	76	18	14	56	24
Turbellaria	-	-	-	-	14	12	-	-	-	-	-	-	02
Polychaeta	32	08	-	06	-	24	16	64	44	04	60	56	22
Bivalvia	-	-	01	-	-	-	-	08	02	-	-	10	14
Ostracoda	22	18	-	-	02	-	04	14	11	10	14	24	34
Amphipoda	-	-	-	-	-	02	01	-	-	-	04	06	-
Copepoda	-	04	-	02	04	22	18	18	-	08	10	08	10
Isopoda	-	-	-	-	01	-	-	-	06	-	02	10	01
Cumacea	-	-	-	-	01	-	-	-	04	-	-	01	-
Crustaceans	08	-	08	04	-	12	10	06	04	-	-	-	18
Arachnactis	-	02	-	02	-	04	12	12	-	-	-	-	03
Fish egg	22	18	10	16	10	16	18	24	02	18	56	24	58

- Not recorded

Table 6

Biomass (mg wet wt./10cm<sup>2</sup>) of Meiobenthos Taxa in Mandovi River/Estuary (May 1996)

Group	Sampling Location												
	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15
Foraminifera	0.062	-	-	-	0.018	-	-	0.060	0.049	0.053	0.057	0.060	0.128
Diatom	0.309	0.225	0.039	0.056	0.009	0.147	0.121	0.238	0.061	0.056	0.320	0.186	0.307
Nematoda	0.748	0.338	0.196	0.187	0.178	0.570	0.036	0.499	0.677	0.160	0.125	0.499	0.214
Turbellaria	-	-	-	-	0.037	0.032	-	-	-	-	-	-	0.005
Polychaeta	0.928	0.232	-	0.174	-	0.696	0.464	1.855	1.276	0.116	1.739	1.623	0.638
Bivalvia	-	-	0.030	-	-	-	-	0.240	0.060	-	-	0.300	0.420
Ostracoda	0.903	0.739	-	-	0.082	-	0.164	0.575	0.451	0.410	0.575	0.985	1.395
Amphipoda	-	-	-	-	-	0.056	0.028	-	-	-	0.112	0.168	-
Copepoda	-	0.088	-	0.044	0.088	0.484	0.396	0.396	-	0.176	0.220	0.176	0.220
Isopoda	-	-	-	-	0.004	-	-	-	0.024	-	0.008	0.040	0.004
Cumacea	-	-	-	-	0.200	-	-	-	0.800	-	-	0.200	-
Crustaceans	0.064	-	0.064	0.032	-	0.096	0.080	0.048	0.032	-	-	-	0.144
Arachnactis	-	0.010	-	0.010	-	0.020	0.060	0.060	-	-	-	-	0.040
Fish egg mass	43.67	35.73	19.85	31.76	19.85	31.76	35.73	47.64	3.970	35.73	111.16	47.64	115.13

- Not recorded

Table 7

Distribution and Abundance (No./m<sup>2</sup>) of Macrobenthos in Mandovi River/Estuary (May 1996)

Group	Sampling Location												
	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15
Foraminifera	-	-	-	-	-	-	-	-	-	-	28	-	34
Porifera	-	01	06	-	-	01	-	-	-	-	01	01	-
Coelenterata	-	-	-	-	-	-	-	-	-	-	04	-	10
Nematoda	06	24	18	12	08	04	06	22	10	24	-	10	06
Polychaeta	05	03	20	15	22	38	43	20	18	-	06	12	10
Gastropoda	-	01	-	-	-	-	-	-	-	12	-	18	42
Bivalvia	-	-	-	-	-	02	04	08	-	-	10	54	48
Harpacticoida	-	-	-	-	-	-	-	-	-	-	-	-	42
Cumacea	-	-	-	-	-	-	-	-	-	-	04	-	01
Tanaidacea	-	-	-	-	-	-	-	-	-	24	-	32	06
Isopoda	02	-	-	04	-	-	-	-	-	18	02	30	02
Amphipoda	-	-	-	-	-	-	-	-	-	34	-	31	36
Ostracoda	-	-	-	-	-	-	-	-	-	-	01	-	02
Stomatopoda	-	-	-	-	-	-	-	-	-	-	-	-	03
Mysidacea	-	-	-	-	-	-	-	-	-	-	12	-	32
Decapoda	-	-	-	-	-	-	-	-	-	43	68	-	104
Pisces	02	-	-	-	02	-	-	-	01	04	08	06	12
Prawn Larvae	10	-	-	04	-	-	-	-	-	08	10	-	12
Worms & Others	08	12	07	14	02	01	08	-	10	-	14	12	16

- Not recorded

**Table 8**  
**Biomass (mg/m<sup>2</sup>) of Macrobenthos Taxa in Mandovi River/Estuary (May 1996)**

Group	Sampling Location												
	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15
Foraminifera	-	-	-	-	-	-	-	-	-	-	3.724	-	4.522
Porifera	-	-	-	-	-	-	-	-	-	-	-	-	-
Coelenterata	-	-	-	-	-	-	-	-	-	-	0.880	-	2.200
Nematoda	0.576	2.304	1.728	1.152	0.768	0.384	0.576	2.112	0.960	2.304	-	0.960	0.576
Polychaeta	37.45	22.47	149.8	112.4	164.8	284.6	322.1	149.8	134.8	-	44.94	89.88	74.90
Gastropoda	-	0.759	-	-	-	-	-	-	-	9.108	-	13.66	31.878
Bivalvia	-	-	-	-	-	1518	3036	6072	-	-	7590	40987	36432
Harpacticoida	-	-	-	-	-	-	-	-	-	-	-	-	15.12
Cumacea	-	-	-	-	-	-	-	-	-	-	1.00	-	0.25
Tanaidacea	-	-	-	-	-	-	-	-	-	4.68	-	6.24	1.17
Isopoda	20.98	-	-	41.96	-	-	-	-	-	188.8	20.98	314.7	20.98
Amphipoda	-	-	-	-	-	-	-	-	-	20.40	-	18.60	21.60
Ostracoda	-	-	-	-	-	-	-	-	-	-	0.003	-	0.0068
Stomatopoda	-	-	-	-	-	-	-	-	-	-	-	-	0.270
Mysidacea	-	-	-	-	-	-	-	-	-	-	1.08	-	2.88
Decapoda	-	-	-	-	-	-	-	-	-	4.551	7.197	-	11.001
Pisces	3.970	-	-	-	3.970	-	-	-	1.985	7.940	15.88	11.91	23.82
Prawn Larvae	0.730	-	-	0.292	-	-	-	-	-	0.584	0.730	-	0.876
Worms & Others	0.050	0.074	0.043	0.087	0.012	0.006	0.050	-	0.062	-	0.087	0.074	0.099

- Not recorded

Table 9

## Density of Various Nektons (No/hauls) in Mandovi River/Estuary (May 1996)

Species	Sampling Location													
	R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R15
<b>Finfishes</b>														
<i>Ambassis commersonii</i>	-	-	-	5	-	-	27	-	7	-	2	-	-	8
<i>Ambassis dussumieri</i>	-	-	-	-	-	3	4	-	-	-	-	-	3	-
<i>Awaous grammepomus</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Barilius evezardi</i>	-	3	-	-	-	-	-	-	-	-	-	-	-	-
<i>Cynoglossus puncticeps</i>	-	-	-	-	-	-	-	-	-	-	-	-	1	-
<i>Danio devario</i>	3	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Eetroplus suratensis</i>	-	-	-	-	-	-	-	3	-	-	-	-	-	-
<i>Garra gotyla gotyla</i>	-	2	-	-	-	-	-	-	-	-	-	-	-	-
<i>Gonoproktopterus thomassi</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Labeo kawrus</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Leiognathus blochii</i>	-	-	-	-	-	-	1	-	-	-	-	-	1	1
<i>Mugil cephalus</i>	-	-	-	-	-	-	-	-	3	-	-	-	-	-
<i>Nemacheilus rubidipinnis</i>	3	2	1	2	-	-	-	-	-	-	-	-	-	-
<i>Osteobrama dayi</i>	2	1	1	-	-	-	1	-	1	-	-	1	-	-
<i>Pseudorhombus arsius</i>	2	-	1	-	-	-	-	-	-	-	-	-	-	-
<i>Paruciosoma daniconius</i>	1	-	1	-	-	-	-	-	-	-	-	-	-	-
<i>Puntius filamentosus</i>	1	2	-	-	-	-	-	-	-	-	-	-	-	-
<i>P. amphibius</i>	-	1	2	-	-	-	-	-	-	-	-	-	-	-
<i>P. nigrofasciatus</i>	1	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>P. ophiocephalus</i>	1	1	-	-	-	-	-	-	-	-	-	-	-	-

Table 9 (Contd..)

## Density of Various Nektons (No/hauls) in Mandovi River/Estuary (May 1996)

Species	Sampling Location													
	R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R15
<i>P. arulius</i>	3	5	1	-	-	-	-	-	-	-	-	-	-	-
<i>Rasbora neilgherriensis</i>	-	2	6	-	-	-	-	-	-	-	-	-	2	-
<i>Sieyopterus graseus</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Scatophagus argus</i>	-	-	-	1	-	-	-	-	-	1	-	2	-	1
<i>Sillago sihama</i>	-	-	-	-	-	3	-	-	-	1	-	-	-	-
<i>Stenogobius gymnopomus</i>	-	-	-	-	-	-	-	-	-	-	-	-	1	1
<i>Teuthis vermiculata</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Chanos chanos</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<b>Shell Fishes</b>														
<i>Macrobrachium malcolmsoni</i>	2	-	3	-	-	-	-	-	-	-	-	-	-	-
<i>Metapenaeus affinis</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>M. monoceros</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>M. dobsoni</i>	-	-	-	-	5	14	-	-	-	-	10	-	7	-
<i>Penaeus marguiesis</i>	-	-	-	1	-	14	-	-	-	-	-	11	-	5
<i>P. indicus</i>	-	-	-	3	-	-	3	5	-	-	-	-	7	-
<i>Scylla serrata</i>	-	-	-	-	-	-	-	-	-	-	-	-	1	-
Unidentified (small crab)	-	-	-	4	-	-	-	-	-	-	-	-	-	-
<i>Macrobrachium rude</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Villorita cyprinoides</i>	-	-	-	1	-	-	-	-	-	-	-	-	-	-
<i>Meretrix meretrix</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>M. casta</i>	-	-	-	-	-	-	-	-	-	-	-	-	1	-
<i>Paphia malabarica</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-

- Not recorded

**Table 1**  
**Physico-chemical Water Quality in Mandovi River/Estuary along with Details of Sampling Conditions (June 1996)**

Parameter	Sampling Location													
	R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R15
Time of Sampling	0815	0905	0735	1015	1050	1120	1330	1150	1220	1305	1445	1530	1505	1645
Tidal Condition	-	-	-	Low	Low	Low	Low	Low	Low	Low	High	High	High	High
Air Temperature (°C)	27.9	28.4	28.6	28.8	29.0	29.2	29.0	29.4	29.5	29.3	29.0	28.7	28.9	28.2
Water Temperature (°C)	28.2	28.2	28.4	28.6	28.8	28.7	28.6	28.7	28.8	28.5	28.5	28.3	28.4	28.0
Salinity (ppt)	0.0	0.0	0.0	0.0	1.6	4.3	12.4	4.8	5.8	8.2	6.1	18.7	19.2	20.4
Dissolved O <sub>2</sub> (mg/L)	5.0	5.9	6.4	5.5	5.1	5.4	5.3	5.6	5.6	5.7	5.7	5.4	5.8	5.2
pH	7.6	7.6	7.8	7.6	7.6	7.5	7.8	7.6	7.8	7.8	7.8	7.6	7.7	7.9
Suspended Load (mg/L)	1040	1070	1010	1070	1030	1110	1090	1050	1070	1000	1050	1090	1040	1100
V.E.C.	10	11	8	9	8	10	10	12	13	11	9	13	8	10
Phosphate as P (µg/L)	0.34	0.37	0.49	0.32	0.36	0.48	0.52	0.42	0.37	0.39	0.46	0.49	0.53	0.59
Nitrate as N (µg/L)	6.7	7.1	7.4	7.2	7.0	7.1	6.9	7.1	7.3	7.2	7.0	7.2	7.0	6.8
Silicate as Si (µg/L)	141.4	140.8	138.2	138.6	134.1	132.0	127.3	134.5	136.6	133.2	130.8	124.2	127.2	126.7

V.E.C. : Vertical Extinction Coefficient

Table 2

River Mandovi - Bottom Sediment Analysis (June 1996)

Sampling Location	Moisture Content (%)	Organic* Matter (%)	Organic* Carbon (%)	Sand (%)	Silt (%)	Clay (%)
R3	12.2	3.05	1.77	40.86	45.78	13.36
R4	32.3	3.15	1.83	31.44	51.20	17.36
R5	31.5	3.05	1.77	20.89	50.06	29.05
R6	18.2	4.18	2.43	81.73	15.71	2.56
R7	36.5	3.62	2.10	23.18	58.57	18.57
R8	27.8	3.36	1.95	71.26	11.48	17.26
R9	40.2	3.10	1.80	20.89	60.06	18.03
R10	38.4	4.75	2.77	23.75	57.14	18.57
R11	27.2	3.87	2.26	23.75	58.46	17.79
R12	36.5	3.36	1.98	74.70	15.17	10.13
R13	22.9	4.65	2.70	52.80	26.04	22.16
R14	36.2	4.68	2.76	30.87	55.71	13.42
R15	27.4	4.40	2.54	72.40	16.54	11.06

\* Based on dry weight basis

Table 3

Distribution and Abundance (No/100ml) of Phytoplankton in Mandovi River/Estuary  
(June 1996)

Genera	Sampling Location												
	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15
<b>Cyanophyceae</b>													
<i>Trichodesmium erythraceum</i>	-	-	-	-	-	-	-	-	-	-	-	-	-
<b>Chlorophyceae</b>													
<i>Pediastrum sp.</i>	20	15	25	45	44	46	15	110	30	25	20	10	-
<i>Spirogyra sp.</i>	-	-	05	-	-	05	-	-	10	-	-	-	-
<i>Ulothrix sp.</i>	-	-	-	-	-	05	-	-	05	-	-	-	-
<i>Cosmarium sp.</i>	-	-	-	05	-	-	05	-	-	-	-	-	-
<i>Micrasterias sp.</i>	-	-	-	05	-	-	05	05	10	-	-	-	-
<i>Zygnema sp.</i>	-	-	-	-	-	05	-	-	-	-	-	-	-
<b>Bacillariophyceae</b>													
<i>Coscinodiscus sp.</i>	50	10	75	85	70	55	105	110	85	96	50	45	65
<i>Skeletonema sp.</i>	-	-	05	-	05	-	-	05	-	-	-	-	10
<i>Hemidiscus sp.</i>	-	-	-	-	06	-	-	15	-	05	05	20	25
<i>Melosira sp.</i>	-	-	-	-	-	-	06	-	-	08	-	04	02
<i>Stephanopyxis sp.</i>	-	-	-	-	-	-	-	-	-	-	15	05	-
<i>Triceratium sp.</i>	-	-	-	-	-	-	-	-	-	-	05	10	15
<i>Biddulphia sp.</i>	-	-	-	-	-	-	-	24	-	-	05	-	05
<i>B. mobiliensis</i>	-	-	-	-	-	-	-	-	-	10	12	15	17
<i>B. sinensis</i>	-	-	-	-	-	-	-	-	-	06	04	02	10
<i>Guinardia sp.</i>	-	-	-	-	-	-	-	-	-	04	02	06	10
<i>Bellerochea sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	10
<i>Ditylum sp.</i>	-	-	-	-	-	-	-	-	-	04	04	02	08
<i>Lithodesmium sp.</i>	-	-	-	-	-	-	-	-	-	-	-	05	02
<i>Chaetoceros sp.</i>	-	-	-	-	30	64	68	12	32	28	24	16	46
<i>Grammatophora sp.</i>	-	-	-	-	-	-	-	-	-	-	-	08	12
<i>Campylodiscus sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Planktoniella sp.</i>	-	-	-	-	-	-	-	-	-	10	08	04	08
<i>Bacteriastum sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	02

Table 3 (Contd..)

Distribution and Abundance (No/100ml) of Phytoplankton in Mandovi River/Estuary  
(June 1996)

Genera	Sampling Location												
	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15
<i>Eucampia</i> sp.	-	-	-	-	-	-	-	-	-	-	04	08	06
<i>Climacodium</i> sp.	-	-	-	-	-	-	-	-	-	02	-	-	04
<i>Streptotheca</i> sp.	-	-	-	-	-	-	-	-	-	-	-	-	02
<i>Thalassiosira</i> sp.	-	-	-	-	-	-	-	10	12	-	-	24	36
<i>T. gravida</i>	-	-	-	-	-	-	-	-	-	14	22	04	20
<i>Thalassionema</i> sp.	-	-	-	-	-	-	-	-	-	04	10	-	14
<i>Rhizosolenia</i> sp.	-	01	-	-	02	-	-	30	34	22	06	04	15
<i>R. stouterfothii</i>	-	-	-	02	-	-	-	06	04	03	04	06	10
<i>R. styliformis</i>	-	-	-	-	01	-	-	-	04	04	03	02	08
<i>R. hebatata</i>	-	-	-	-	-	10	-	-	04	-	-	-	02
<i>Fragillaria oceanica</i>	-	-	02	-	-	-	-	-	-	-	-	-	08
<i>Thalassiothrix</i> sp.	-	-	-	-	-	-	-	-	-	-	06	04	02
<i>T. longissima</i>	-	-	-	-	-	-	-	-	-	-	02	-	04
<i>Asterionella japonica</i>	-	-	-	-	-	02	-	-	-	02	-	08	10
<i>Gyrosigma</i> sp.	-	-	-	-	-	-	-	-	02	04	-	-	08
<i>Pleurosigma</i> sp.	-	-	02	-	-	04	-	-	-	-	-	01	02
<i>Navicula</i> sp.	-	-	-	-	-	02	-	02	-	-	04	-	04
<i>Nitzschia</i> sp.	-	-	-	-	01	-	-	-	-	-	-	02	-
<i>N. longissima</i>	-	-	-	-	-	04	-	-	-	-	02	-	03
<b>Dinophyceae</b>													
<i>Prorocentrum</i> sp.	-	-	-	-	-	-	-	02	-	-	02	-	03
<i>Dinophysis</i> sp.	-	-	-	-	04	-	-	-	-	-	04	02	06
<i>Peridinium</i> sp.	-	-	-	-	-	-	-	02	-	-	-	04	08
<i>Ceratium tripos</i>	-	-	-	-	02	-	-	-	-	-	08	-	06
<i>C. fusus</i>	-	-	02	-	-	-	-	02	-	01	02	-	02
<i>C. massiliensis</i>	-	-	-	-	-	-	01	-	02	-	02	04	04
<i>C. furca</i>	-	-	-	-	-	-	-	01	-	-	01	-	04
<i>Pyrocystis fusiformis</i>	-	-	-	-	-	-	-	-	-	-	02	02	06
<i>Noctiluca miliaris</i>	-	-	-	02	-	-	-	-	-	02	-	02	03
<b>Total</b>	<b>70</b>	<b>26</b>	<b>116</b>	<b>144</b>	<b>165</b>	<b>202</b>	<b>205</b>	<b>336</b>	<b>234</b>	<b>254</b>	<b>238</b>	<b>229</b>	<b>447</b>

- Not recorded

Table 4

## Distribution and Abundance (No./haul) of Zooplankton in Mandovi River/Estuary (June 1996)

Genera	Sampling Location													
	R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R15
<b>Ciliata</b>														
<i>Tintinnopsis sp.</i>	-	-	-	-	-	-	-	-	2	4	3	3	1	1
<i>Favella sp.</i>	-	-	-	-	-	-	1	-	6	4	8	2	2	3
<i>Rhabdonella sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	2	2
<b>Foraminifera</b>														
<i>Globigerina sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	2	2
<b>Cnidaria</b>														
<i>Siphonophora sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<b>Ctenophora</b>														
<i>Pleurobrachia sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<b>Copepoda</b>														
<i>Undinula sp.</i>	-	-	-	-	-	-	-	2	4	4	1	2	-	-
<i>Acartia sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Temora sp.</i>	-	-	-	-	-	-	1	-	-	4	3	2	4	5
<i>Eutomora sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Oithona sp.</i>	-	-	-	-	-	-	-	-	-	6	2	8	4	3
<i>O. plumifera</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Euterpina sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	1	-
<i>Paracalanus sp.</i>	-	-	-	-	-	2	-	-	4	-	4	6	-	2
<i>Eucalanus sp.</i>	-	-	-	-	-	-	-	-	3	-	3	4	-	4
<i>Centropages sp.</i>	-	-	-	-	-	-	-	-	2	-	-	-	-	-
<i>Pseudocalanus sp.</i>	-	-	-	4	8	-	-	10	22	14	10	-	4	8
<i>Macrosetella sp.</i>	-	-	-	-	-	-	-	-	-	-	4	5	-	3
<i>Microsetella sp.</i>	-	-	-	-	-	-	-	-	-	-	2	-	-	2
<i>Metridia sp.</i>	-	-	-	-	-	-	-	-	-	-	-	1	-	1
<i>Isias sp.</i>	-	-	-	-	-	-	-	-	-	-	-	2	-	2
<i>Candacia sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Canthocalanus sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Nannocalanus sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Rhabdocalanus sp.</i>	-	-	-	-	-	-	1	-	-	-	-	2	-	3
<i>Microcalanus sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	2

Table 4 (Contd..)

## Distribution and Abundance (No./haul) of Zooplankton in Mandovi River/Estuary (June 1996)

Genera	Sampling Location													
	R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R15
<i>Parapontella sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Labidocera sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Oncaea sp.</i>	-	-	-	-	-	-	-	-	-	-	-	1	-	-
<i>Heliodiaptomus sp.</i>	12	8	6	6	2	-	-	-	-	-	-	-	-	-
<i>Mesocyclops sp.</i>	18	10	6	4	1	-	-	-	-	-	-	-	-	-
<i>Microcyclops sp.</i>	14	8	4	2	-	-	-	-	-	-	-	-	-	-
<i>Diaptomus sp.</i>	4	6	3	1	-	-	-	-	-	-	-	-	-	-
<b>Cladocera</b>														
<i>Penia sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	2
<i>Evadne sp.</i>	-	-	-	-	-	-	-	-	-	-	-	2	-	1
<i>Moina sp.</i>	6	8	2	-	1	-	-	-	-	-	-	-	-	-
<i>Daphnia sp.</i>	14	8	7	6	-	-	-	-	-	-	-	-	-	-
<i>Macrothrix sp.</i>	8	4	3	-	1	-	-	-	-	-	-	-	-	-
<b>Rotifera</b>														
<i>Brachionus sp.</i>	9	6	4	1	2	-	-	-	-	-	-	-	-	-
<i>Keratella sp.</i>	8	4	3	1	-	-	-	-	-	-	-	-	-	-
<i>Polyarthra sp.</i>	4	3	-	2	-	-	-	-	-	-	-	-	-	-
<b>Pteropoda</b>														
<i>Cresels acicula</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Cresels sp.</i>	-	-	-	-	-	-	-	-	-	-	-	1	-	2
<b>Appendicularia</b>														
<i>Oikopleura sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	2
<b>Larval Forms</b>														
Brachiopoda	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Polychaeta	-	-	-	-	-	-	-	-	-	-	-	-	-	2
Copepod	8	4	6	-	2	-	-	4	8	14	18	22	8	34
Cirripede	-	-	-	-	-	-	-	-	-	-	-	4	1	2
Archnactis	-	-	-	-	-	-	-	-	-	-	-	-	1	-
Bivalvia	-	-	-	-	-	-	-	-	-	-	-	2	1	-
Gastropoda	2	-	-	2	-	-	1	-	-	4	8	-	-	3
Fish eggs and Larvae	20	6	14	8	6	6	8	9	12	16	12	8	4	12

- Not recorded

Table 5

Distribution and Abundance (No./10cm<sup>2</sup>) of Meiobenthos in Mandovi River/Estuary  
(June 1996)

Group	Sampling Location												
	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15
Foraminifera	12	-	-	-	-	10	-	-	15	10	11	22	31
Diatom	104	84	08	20	06	42	34	48	12	14	58	36	114
Nematoda	34	28	18	14	12	32	-	40	38	12	06	32	20
Turbellaria	-	-	-	-	-	10	-	12	-	-	-	-	04
Polychaeta	18	02	-	-	14	-	12	10	42	22	-	32	18
Bivalvia	-	02	-	-	-	-	-	-	04	-	02	06	12
Ostracoda	12	10	-	-	-	-	02	20	04	02	04	08	14
Amphipoda	-	-	-	-	-	-	02	-	-	-	02	-	04
Copepoda	04	08	-	-	-	10	12	08	-	02	04	-	08
Isopoda	-	-	-	-	-	-	-	-	04	-	-	04	02
Cumacea	-	-	-	-	-	01	-	-	-	02	-	-	01
Crustaceans	04	02	04	01	-	-	08	06	02	-	-	04	06
Arachnactis	-	-	-	-	-	-	-	-	-	-	-	-	01
Fish egg	14	10	08	10	04	10	12	12	-	08	22	12	18
Total	202	146	38	45	26	115	82	146	121	72	109	156	253

- Not recorded

**Table 6**  
**Biomass (mg wet wt./10cm<sup>2</sup>) of Meiobenthos Taxa in Mandovi River/Estuary (June 1996)**

Group	Sampling Location												
	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15
Foraminifera	0.027	-	-	-	-	0.022	-	-	0.033	0.022	0.024	0.048	0.068
Diatom	0.225	0.181	0.017	0.043	0.013	0.091	0.073	103.63	0.024	0.030	0.125	0.078	0.246
Nematoda	0.301	0.249	0.160	0.125	0.107	0.284	-	356.04	0.338	0.106	0.053	0.284	0.178
Turbellaria	-	-	-	-	-	0.027	-	32.00	-	-	-	-	0.011
Polychaeta	0.522	0.058	-	-	0.116	-	0.347	289.90	1.217	0.638	-	0.927	0.521
Bivalvia	-	0.600	-	-	-	-	-	-	0.120	-	0.060	0.180	0.360
Ostracoda	0.493	0.410	-	-	-	-	0.082	410.40	0.164	0.082	0.164	0.328	0.574
Amphipoda	-	-	-	-	-	-	0.056	-	-	-	0.056	-	0.111
Copepoda	0.088	0.176	-	-	-	0.220	0.264	176.00	-	0.044	0.088	-	0.176
Isopoda	-	-	-	-	-	-	-	-	0.016	-	-	0.016	0.008
Cumacea	-	-	-	-	-	0.200	-	-	-	0.400	-	-	0.200
Crustaceans	0.036	0.018	0.036	0.009	-	-	0.053	53.44	0.018	-	-	0.036	0.053
Arachnactis	-	-	-	-	-	-	-	-	-	-	-	-	0.005
Fish egg mass	27.790	19.850	15.880	19.850	7.940	19.850	23.820	23.820	-	15.880	43.670	23.820	35.730

- Not recorded

Table 7

Distribution and Abundance (No./m<sup>2</sup>) of Macrobenthos in Mandovi River/Estuary (June 1996)

Group	Sampling Location												
	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15
Foraminifera	-	-	-	-	-	-	-	-	-	12	04	-	18
Porifera	-	-	-	01	-	-	-	-	-	01	02	-	01
Coelenterata	-	-	-	-	-	-	-	-	-	-	-	02	06
Nematoda	02	12	10	04	02	-	01	12	04	08	-	-	02
Polychaeta	02	-	10	08	10	14	18	10	08	-	-	04	02
Gastropoda	-	-	01	-	-	-	-	-	-	-	04	10	16
Bivalvia	-	-	-	-	-	01	06	-	-	08	10	22	34
Harpacticoida	-	-	-	-	-	-	-	-	-	-	-	04	08
Cumacea	-	-	-	-	-	-	-	-	-	-	-	01	02
Tanaidacea	-	-	-	-	-	-	-	-	-	06	-	12	01
Isopoda	-	-	02	-	-	-	-	-	-	10	-	10	01
Amphipoda	-	-	-	-	-	-	-	-	-	14	02	-	32
Ostracoda	-	-	-	-	-	-	-	-	01	-	01	-	01
Stomatopoda	-	-	-	-	-	-	-	-	-	-	-	-	02
Mysidacea	-	-	-	-	-	-	-	-	-	-	-	08	12
Decapoda	-	-	-	-	-	-	-	-	-	12	24	-	14
Pisces	01	-	-	06	-	-	-	02	-	02	10	04	10
Prawn Larvae	02	-	-	01	-	02	-	04	06	08	-	10	16
Worms & Others	06	10	02	10	-	-	02	01	-	04	10	09	10
<b>Total</b>	<b>13</b>	<b>22</b>	<b>25</b>	<b>30</b>	<b>12</b>	<b>17</b>	<b>27</b>	<b>29</b>	<b>19</b>	<b>85</b>	<b>67</b>	<b>96</b>	<b>248</b>

- Not recorded

**Table 8**  
**Biomass (mg/m<sup>2</sup>) of Macrobenthos Taxa in Mandovi River/Estuary (June 1996)**

Group	Sampling Location												
	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15
Foraminifera	-	-	-	-	-	-	-	-	-	1.596	0.532	-	2.394
Porifera	-	-	-	-	-	-	-	-	-	-	-	-	-
Coelenterata	-	-	-	-	-	-	-	-	-	-	-	440.0	1320.0
Nematoda	0.192	1.152	0.96	0.384	0.192	-	0.096	1.152	0.384	0.768	-	-	0.192
Polychaeta	14.98	-	74.90	59.92	74.90	104.9	134.8	74.90	59.92	-	-	29.96	14.98
Gastropoda	-	-	0.759	-	-	-	-	-	-	-	3.040	7.59	12.14
Bivalvia	-	-	-	-	-	759.0	4554	-	-	6072	7590	16698	25806
Harpacticoida	-	-	-	-	-	-	-	-	-	-	-	1.44	2.88
Cumacea	-	-	-	-	-	-	-	-	-	-	-	0.25	0.50
Tanaidacea	-	-	-	-	-	-	-	-	-	1.17	-	2.34	0.195
Isopoda	-	-	20.98	-	-	-	-	-	-	104.9	-	104.9	10.49
Amphipoda	-	-	-	-	-	-	-	-	-	8.40	1.200	-	19.20
Ostracoda	-	-	-	-	-	-	-	-	Tr	-	Tr	-	Tr
Stomatopoda	-	-	-	-	-	-	-	-	-	-	-	-	0.0002
Mysidacea	-	-	-	-	-	-	-	-	-	-	-	720.0	1080.0
Decapoda	-	-	-	-	-	-	-	-	-	1269.6	2539	-	7829.2
Pisces	1985	-	-	11910	-	-	-	3970	-	3970	19850	7940	19850
Prawn Larvae	0.146	-	-	0.073	-	0.146	-	0.292	0.438	0.584	-	0.730	1.168
Worms & Others	37.80	63.0	12.60	63.0	-	-	12.6	6.30	-	25.20	63.00	56.70	63.0

- Not recorded

Table 9

## Density of Various Nektons (No/hauls) in Mandovi River/Estuary (June, 1996)

Species	Sampling Location													
	R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R15
<b>Finfishes</b>														
<i>Ambassis commersoni</i>	-	-	-	7	2	2	3	5	2	1	5	3	-	1
<i>Ambassis dussumieri</i>	-	-	-	-	3	-	-	1	-	3	-	1	2	-
<i>Awaous grammepomus</i>	1	1	-	1	-	-	-	-	-	-	-	-	-	-
<i>Barilius evezardi</i>	1	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Cynoglossus puncticeps</i>	-	-	-	1	-	-	-	-	-	-	-	-	2	-
<i>Danio devario</i>	3	1	-	-	-	-	-	-	-	-	-	-	-	-
<i>Etroplus suratensis</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Garra gotyla gotyla</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Gonoproktopterus thomasi</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Labeo kawrus</i>	4	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Leiolepis blochi</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Mugil cephalus</i>	-	-	-	-	-	-	-	-	-	-	-	-	3	-
<i>Nemacheilus rubidipinnis</i>	5	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Osteobrama dayi</i>	2	3	1	5	-	-	-	-	-	-	-	-	-	-
<i>Pseudorhombus arsius</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Paruclosoma daniconius</i>	2	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Puntius filamentosus</i>	5	-	4	1	-	-	-	-	-	-	-	-	-	-
<i>P. amphibius</i>	-	-	-	1	-	-	-	-	-	-	-	-	-	-
<i>P. nigrofasciatus</i>	3	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>P. ophlocephalus</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 9 (Contd..)

## Density of Various Nektons (No/hauls) in Mandovi River/Estuary (June, 1996)

Species	Sampling Location													
	R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R15
<i>P. arulius</i>	-	-	1	-	-	-	-	-	-	-	-	-	-	-
<i>Rasbora neilgherriensis</i>	-	3	3	-	-	-	-	-	-	-	-	-	-	-
<i>Sicyopterus graseus</i>	-	-	3	-	-	-	-	-	-	-	-	-	-	-
<i>Scatophagus argus</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Sillago sihama</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Stenogobius gymnopus</i>	-	-	-	-	2	-	-	-	-	-	-	-	-	-
<i>Teuthis vermiculata</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Chanos chanos</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<b>Shell Fishes</b>														
<i>Macrobrachium malcolmsoni</i>	7	5	15	13	-	4	-	-	-	-	-	-	-	-
<i>Metapenaeus affinis</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>M. monoceros</i>	-	-	-	7	5	5	-	4	-	2	1	3	-	-
<i>M. dobsoni</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Penaeus marguiensis</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>P. indicus</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Scylla serrata</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Unidentified (small crab)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Macrobrachium rude</i>	-	-	-	17	-	4	3	-	-	-	-	-	-	-
<i>Villorita cyprinoides</i>	-	-	-	5	-	-	-	-	-	-	-	-	-	-
<i>Meretrix meretrix</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>M. casta</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Paphia malabarica</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-

- Not recorded

**Table 1**  
**Physico-chemical Water Quality in Mandovi River/Estuary along with Details of Sampling Conditions (July 1996)**

Parameter	Sampling Location													
	R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R15
Time of Sampling	0855	0945	1015	1105	1135	1220	1640	1315	1350	1425	1510	1705	1545	1740
Tidal Condition	-	-	-	Low	Low	Low	High	Low	Low	Low	Low	High	Low	High
Air Temperature (°C)	28.0	28.4	28.5	28.9	28.5	28.3	28.3	29.4	29.5	29.2	29.3	28.7	28.9	28.5
Water Temperature (°C)	27.6	27.7	27.6	27.8	28.0	28.0	28.0	28.4	28.5	28.6	28.4	28.0	28.2	27.9
Salinity (ppt)	0	0	0	0	1.7	4.2	16.5	4.8	6.2	9.7	13.9	19.1	18.5	21.4
Dissolved O <sub>2</sub> (mg/L)	5.4	6.5	5.8	5.6	5.3	5.8	5.8	5.1	5.5	5.1	5.6	5.2	5.3	5.1
pH	7.6	7.6	7.5	7.7	7.7	7.6	7.6	7.5	7.7	7.9	7.8	7.9	7.9	7.9
Suspended Load (mg/L)	990	1010	980	1030	1020	1040	1070	1020	1010	1030	1050	1040	1020	1030
V.E.C.	7	8	9	5	5	6	7	7	6	7	8	6	8	7
Phosphate as P (µg/L)	0.27	0.28	0.28	0.24	0.21	0.26	0.39	0.31	0.30	0.32	0.34	0.35	0.37	0.42
Nitrate as N (µg/L)	8.1	8.14	8.16	8.12	8.0	8.54	7.93	8.1	8.06	8.08	8.10	7.99	7.97	7.92
Silicate as Si (µg/L)	127.8	132.4	138.5	131.7	136.5	130.1	125.5	134.7	128.2	131.4	128.5	122.3	124.9	121.5

V.E.C. : Vertical Extinction Coefficient

Table 2

River Mandovi - Bottom Sediment Analysis (July 1996)

Sampling Location	Moisture Content (%)	Organic* Matter (%)	Organic* Carbon (%)	Sand (%)	Silt (%)	Clay (%)
R3	13.4	3.10	2.80	56.8	27.14	15.06
R4	32.6	3.36	1.95	28.18	59.16	16.66
R5	32.9	3.15	1.82	26.18	55.18	18.64
R6	16.8	4.24	2.46	78.16	12.06	9.78
R7	32.9	3.68	2.14	30.19	54.16	15.69
R8	27.4	3.41	1.98	29.80	56.20	14.0
R9	42.4	3.68	2.13	72.66	12.85	14.49
R10	39.6	4.71	2.73	73.18	15.22	11.60
R11	28.8	3.94	2.28	28.40	62.18	9.42
R12	29.6	3.52	2.04	75.15	12.12	12.73
R13	24.8	4.76	2.76	62.10	28.15	9.75
R14	34.6	4.82	2.82	33.10	55.16	11.74
R15	35.8	4.49	2.61	34.5	57.35	8.15

\* Based on dry weight basis

**Table 3**  
**Distribution and Abundance (No/100ml) of Phytoplankton in Mandovi River/Estuary**  
**(July 1996)**

Genera	Sampling Location												
	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15
<b>Cyanophyceae</b>													
<i>Trichodesmium erythraceum</i>	-	-	-	-	-	-	-	-	-	-	-	-	-
<b>Chlorophyceae</b>													
<i>Pediastrum sp.</i>	10	5	15	20	20	25	10	25	15	15	5	5	-
<i>Spirogyra sp.</i>	-	-	-	25	-	-	-	05	-	05	-	-	-
<i>Ulothrix sp.</i>	-	-	-	-	-	01	-	-	05	-	-	-	-
<i>Cosmarium sp.</i>	-	-	-	05	-	-	10	-	-	-	-	-	-
<i>Micrasterias sp.</i>	-	-	-	-	05	-	05	-	-	15	-	-	-
<i>Zygnema sp.</i>	-	-	-	05	-	-	05	-	-	-	-	-	-
<b>Bacillariophyceae</b>													
<i>Coscinodiscus sp.</i>	24	04	38	42	34	28	74	82	41	56	22	25	32
<i>Skeletonema sp.</i>	-	-	02	-	-	02	-	-	03	-	-	-	08
<i>Hemidiscus sp.</i>	-	-	-	-	03	-	04	-	02	-	10	10	14
<i>Melosira sp.</i>	-	-	-	-	-	02	-	01	-	02	-	-	10
<i>Stephanopyxis sp.</i>	-	-	-	-	-	-	-	-	-	-	02	03	05
<i>Triceratium sp.</i>	-	-	-	-	-	-	-	-	-	-	02	01	02
<i>Biddulphia sp.</i>	-	-	-	-	-	-	-	-	02	-	-	-	02
<i>B. mobilensis</i>	-	-	-	-	-	-	-	-	-	07	06	10	12
<i>B. sinensis</i>	-	-	-	-	-	-	-	-	-	01	03	-	06
<i>Guinardia sp.</i>	-	-	-	-	-	-	-	-	-	02	-	03	08
<i>Bellerochea sp.</i>	-	-	-	-	-	-	-	-	-	-	-	02	08
<i>Ditylum sp.</i>	-	-	-	-	-	-	-	-	-	-	03	04	08
<i>Lithodesmium sp.</i>	-	-	-	-	-	-	-	-	-	-	01	-	02
<i>Chaetoceros sp.</i>	-	-	-	-	15	32	43	04	20	12	10	08	24
<i>Grammatophora sp.</i>	-	-	-	-	-	-	-	-	02	-	-	04	06
<i>Campylodiscus sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Planktoniella sp.</i>	-	-	-	-	-	-	-	-	-	24	02	-	04
<i>Bacteriastum sp.</i>	-	-	-	-	-	-	-	-	-	-	-	02	-

Table 3 (Contd..)

Distribution and Abundance (No/100ml) of Phytoplankton in Mandovi River/Estuary  
(July 1996)

Genera	Sampling Location												
	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15
<i>Eucampia sp.</i>	-	-	-	-	-	-	-	-	-	01	-	06	04
<i>Climacodium sp.</i>	-	-	-	-	-	-	-	-	-	-	02	-	02
<i>Streptotheca sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	01
<i>Thalassiosira sp.</i>	-	-	-	-	-	-	-	-	02	-	04	10	14
<i>T. gravida</i>	-	-	-	-	-	-	-	-	-	10	14	-	10
<i>Thalassionema sp.</i>	-	-	-	-	-	-	-	-	-	04	-	06	04
<i>Rhizosolenia sp.</i>	-	-	-	01	-	-	-	12	14	10	-	-	10
<i>R. stolterfothii</i>	-	-	-	-	02	-	-	-	-	02	-	02	04
<i>R. styliformis</i>	-	-	-	-	-	01	-	-	02	02	-	02	04
<i>R. hebatata</i>	-	-	-	-	-	-	04	-	-	-	-	-	01
<i>Fragillaria oceanica</i>	-	-	-	-	-	-	02	-	-	-	-	-	04
<i>Thalassiothrix sp.</i>	-	-	-	-	-	-	-	-	-	-	-	01	02
<i>T. longissima</i>	-	-	-	-	-	-	-	-	-	01	-	-	03
<i>Asterionella japonica</i>	-	-	-	-	-	01	-	-	-	-	-	04	05
<i>Gyrosigma sp.</i>	-	-	-	-	-	-	-	-	02	-	-	-	02
<i>Pleurosigma sp.</i>	-	-	-	-	-	01	-	-	01	-	-	-	01
<i>Navicula sp.</i>	-	-	-	-	-	02	-	02	-	-	02	-	01
<i>Nitzschia sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	02
<i>N. longissima</i>	-	-	-	-	-	-	-	02	-	-	-	02	02
<b>Dinophyceae</b>													
<i>Prorocentrum sp.</i>	-	-	-	-	-	-	-	-	-	01	-	02	02
<i>Dinophysis sp.</i>	-	-	-	-	-	04	-	-	-	-	01	02	03
<i>Peridinium sp.</i>	-	-	-	-	-	02	-	-	-	02	-	02	02
<i>Ceratium tripos</i>	-	-	-	-	-	02	-	-	-	-	-	04	06
<i>C. fusus</i>	-	-	-	-	-	01	01	-	-	02	-	02	03
<i>C. massiliensis</i>	-	-	-	-	-	01	-	-	-	02	-	-	02
<i>C. furca</i>	-	-	-	-	-	01	-	-	-	-	-	-	02
<i>Pyrocystis fusiformis</i>	-	-	-	-	-	-	-	-	-	-	-	02	03
<i>Noctiluca miliaris</i>	-	-	-	-	-	-	-	-	01	-	-	03	02
<b>Total</b>	<b>34</b>	<b>9</b>	<b>55</b>	<b>98</b>	<b>79</b>	<b>106</b>	<b>158</b>	<b>133</b>	<b>112</b>	<b>178</b>	<b>89</b>	<b>127</b>	<b>252</b>

- Not recorded

Table 4

## Distribution and Abundance (No./haul) of Zooplankton in Mandovi River/Estuary (July 1996)

Genera	Sampling Location													
	R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R15
<b>Ciliata</b>														
<i>Tintinnopsis sp.</i>	-	-	-	-	-	-	-	-	-	2	-	-	-	-
<i>Favea sp.</i>	-	-	-	-	-	-	-	-	2	1	4	-	-	1
<i>Rhabdonella sp.</i>	-	-	-	-	-	-	-	-	-	1	-	-	1	1
<b>Foraminifera</b>														
<i>Globigerina sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	2	1
<b>Cnidaria</b>														
<i>Siphonophora sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	1	2
<b>Ctenophora</b>														
<i>Pleurobrachia sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<b>Copepoda</b>														
<i>Undinula sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Acartia sp.</i>	-	-	-	-	-	-	-	-	2	3	-	1	1	-
<i>Temora sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	1	-
<i>Eutemora sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	1	1
<i>Oithona sp.</i>	-	-	-	-	-	-	-	-	-	3	-	4	1	1
<i>O. plumifera</i>	-	-	-	-	-	-	-	-	-	-	-	-	1	-
<i>Euterpina sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Paracalanus sp.</i>	-	-	-	-	-	-	-	2	-	2	-	2	3	-
<i>Eucalanus sp.</i>	-	-	-	-	-	-	-	-	-	1	-	2	3	2
<i>Centropages sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	2
<i>Pseudocalanus sp.</i>	-	-	-	-	-	-	2	4	8	6	4	-	-	4
<i>Macrosetella sp.</i>	-	-	-	-	-	-	-	-	-	-	2	1	-	-
<i>Microsetella sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	1	-
<i>Metridia sp.</i>	-	-	-	-	-	-	-	-	-	-	-	1	-	1
<i>Isias sp.</i>	-	-	-	-	-	-	-	-	-	-	-	2	-	2
<i>Candacia sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Canthocalanus sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Nannocalanus sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Rhincalanus sp.</i>	-	-	-	-	-	-	-	1	-	-	-	2	-	1
<i>Microcalanus sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	1

Table 4 (Contd..)

Distribution and Abundance (No./haul) of Zooplankton in Mandovi River/Estuary (July 1996)

Genera	Sampling Location													
	R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R15
<i>Parapontella sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Labidocera sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Oncaea sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	1	-
<i>Heliodiaptomus sp.</i>	8	6	2	3	-	-	-	-	-	-	-	-	-	-
<i>Mesocyclops sp.</i>	7	5	3	1	1	-	-	-	-	-	-	-	-	-
<i>Microcyclops sp.</i>	6	3	2	2	-	-	-	-	-	-	-	-	-	-
<i>Diaptomus sp.</i>	4	4	3	2	-	-	-	-	-	-	-	-	-	-
<b>Cladocera</b>														
<i>Penilia sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Evadne sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	2	3
<i>Moina sp.</i>	4	3	3	2	1	-	-	-	-	-	-	-	-	-
<i>Daphnia sp.</i>	3	2	2	-	-	-	-	-	-	-	-	-	-	-
<i>Macrothrix sp.</i>	4	3	-	2	-	-	-	-	-	-	-	-	-	-
<b>Rotifera</b>														
<i>Brachionus sp.</i>	6	4	2	2	1	-	-	-	-	-	-	-	-	-
<i>Keratella sp.</i>	6	3	2	1	-	-	-	-	-	-	-	-	-	-
<i>Polyarthra sp.</i>	4	2	2	1	-	-	-	-	-	-	-	-	-	-
<b>Pteropoda</b>														
<i>Creseis acicula</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Creseis sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<b>Appendicularia</b>														
<i>Oikopleura sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	1	1
<b>Larval Forms</b>														
Brachiopoda	-	-	-	-	-	-	-	-	-	-	-	-	1	-
Polychaeta	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Copepod	2	2	4	-	-	-	-	-	4	-	10	14	16	20
Cirripede	-	-	-	-	-	-	-	-	-	-	1	-	2	2
Arachnactis	-	-	-	-	-	-	-	-	-	-	-	-	-	2
Bivalvia	-	-	-	-	-	-	-	-	-	-	-	-	2	3
Gastropoda	-	2	-	-	1	2	-	-	1	-	-	4	2	3
Fish eggs and Larvae	10	2	8	10	14	4	8	10	14	12	10	14	8	10

- Not recorded

Table 5

Distribution and Abundance (No./10cm<sup>2</sup>) of Meiobenthos in Mandovi River/Estuary (July 1996)

Group	Sampling Location												
	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15
Foraminifera	04	-	-	-	-	-	04	-	04	08	04	10	14
Diatom	46	30	02	10	02	14	12	16	14	10	30	32	48
Nematoda	12	10	08	10	10	18	02	-	30	14	06	10	12
Turbellaria	-	-	-	-	-	-	04	-	04	-	-	-	02
Polychaeta	10	-	01	-	-	02	-	10	-	12	-	14	06
Bivalvia	-	-	01	-	-	-	-	-	-	04	-	02	10
Ostracoda	06	02	-	-	-	-	-	01	04	-	-	04	06
Amphipoda	-	02	-	-	-	-	01	01	-	-	01	-	02
Copepoda	01	-	04	-	-	-	04	04	02	-	-	-	03
Isopoda	-	-	-	-	-	-	-	-	-	06	-	02	01
Cumacea	-	-	-	-	-	-	-	01	-	01	-	-	-
Crustaceans	02	-	02	02	-	-	04	02	-	-	-	-	01
Arachnactis	-	-	-	-	-	-	-	-	-	-	-	-	-
Fish egg	10	08	12	16	-	02	06	06	02	-	-	08	12

- Not recorded

**Table 6**  
**Biomass (mg wet wt./10cm<sup>2</sup>) of Meiobenthos Taxa in Mandovi River/Estuary (July 1996)**

Group	Sampling Location												
	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15
Foraminifera	8.82	-	-	-	-	-	8.82	-	8.82	17.63	8.82	22.04	30.86
Diatom	99.31	64.77	4.32	21.59	4.32	30.23	25.91	34.54	30.23	21.59	64.77	69.09	103.6
Nematoda	106.8	89.01	71.21	89.01	89.01	160.22	17.81	-	267.03	124.6	53.41	89.01	106.8
Turbellaria	-	-	-	-	-	-	10.67	-	10.67	-	-	-	5.33
Polychaeta	289.9	-	28.99	-	-	57.98	-	289.9	-	347.9	-	405.86	173.9
Bivalvia	-	-	30.0	-	-	-	-	-	-	120.0	-	60.00	300.0
Ostracoda	246.2	82.08	-	-	-	-	-	41.04	164.16	-	-	164.16	246.2
Amphipoda	-	55.88	-	-	-	-	27.93	27.93	-	-	27.93	-	55.86
Copepoda	22.0	-	88.0	-	-	-	88.0	88.0	44.0	-	-	-	66.0
Isopoda	-	-	-	-	-	-	-	-	-	24.0	-	8.0	4.0
Cumacea	-	-	-	-	-	-	-	200.0	-	200.0	-	-	-
Crustaceans	17.81	-	17.81	17.81	-	-	35.63	17.81	-	-	-	-	8.907
Arachnactis	-	-	-	-	-	-	-	-	-	-	-	-	-
Fish egg mass	19850	15880	23820	31760	-	3970	11910	11910	3970	-	-	15880	23820

- Not recorded

Table 7

Distribution and Abundance (No./m<sup>2</sup>) of Macrobenthos in Mandovi River/Estuary (July 1996)

Group	Sampling Location												
	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15
Foraminifera	-	-	-	-	-	-	-	-	-	-	08	02	10
Porifera	-	-	-	-	-	-	-	-	-	-	02	-	02
Coelenterata	-	-	-	-	-	-	-	-	-	-	-	03	04
Nematoda	-	04	02	-	-	-	-	-	04	-	04	-	01
Polychaeta	-	01	-	10	-	04	08	02	02	-	-	02	01
Gastropoda	-	-	-	-	-	01	-	-	01	-	02	06	10
Bivalvia	-	-	-	-	-	-	02	-	-	06	04	10	14
Harpacticoida	-	-	-	-	-	-	-	-	-	01	-	02	04
Cumacea	-	-	-	-	-	-	-	-	-	-	-	01	01
Tanaidacea	-	-	-	-	-	-	-	-	-	04	-	04	01
Isopoda	-	-	-	-	-	-	-	-	-	04	-	01	01
Amphipoda	-	-	-	-	-	-	-	-	-	10	-	-	12
Ostracoda	-	-	-	-	-	-	-	-	-	01	-	01	-
Stomatopoda	-	-	-	-	-	-	-	-	-	-	-	-	01
Mysidacea	-	-	-	-	-	-	-	-	-	-	-	02	04
Decapoda	-	-	-	-	-	-	-	-	-	02	10	-	08
Pisces	04	-	02	-	-	03	-	06	-	04	04	02	06
Prawn Larvae	-	-	-	-	01	-	-	02	-	04	02	04	08
Worms & Others	03	06	-	04	-	-	-	-	02	-	06	03	04
Total	07	11	04	14	01	08	10	10	09	36	42	43	92

- Not recorded

**Table 8**  
**Biomass (mg/m<sup>2</sup>) of Macrobenthos Taxa in Mandovi River/Estuary (July 1996)**

Group	Sampling Location												
	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15
Foraminifera	-	-	-	-	-	-	-	-	-	-	1.064	0.266	1.33
Porifera	-	-	-	-	-	-	-	-	-	-	-	-	-
Coelenterata	-	-	-	-	-	-	-	-	-	-	-	660.0	880
Nematoda	-	0.384	0.192	-	-	-	-	-	0.384	-	0.384	-	0.096
Polychaeta	-	7.49	-	74.9	-	29.96	59.92	14.98	14.98	-	-	14.98	7.49
Gastropoda	-	-	-	-	-	0.759	-	-	0.759	-	1.518	4.554	0.759
Bivalvia	-	-	-	-	-	-	1518	-	-	4554.1	3036	759.0	10626
Harpacticoida	-	-	-	-	-	-	-	-	-	0.36	-	0.72	1.44
Cumacea	-	-	-	-	-	-	-	-	-	-	-	0.25	0.25
Tanaidacea	-	-	-	-	-	-	-	-	-	0.78	-	0.78	0.195
Isopoda	-	-	-	-	-	-	-	-	-	41.96	-	10.49	10.49
Amphipoda	-	-	-	-	-	-	-	-	-	6.0	-	-	7.2
Ostracoda	-	-	-	-	-	-	-	-	-	0.000003	-	0.000034	-
Stomatopoda	-	-	-	-	-	-	-	-	-	4	-	-	0.00009
Mysidacea	-	-	-	-	-	-	-	-	-	-	-	180.0	360.0
Decapoda	-	-	-	-	-	-	-	-	-	211.6	1058	-	846.4
Pisces	7940	-	3970	-	-	5955	-	11910	-	7940	7940	3970	11910
Prawn Larvae	-	-	-	-	0.07	-	-	0.146	-	0.292	0.146	0.292	0.584
Worms & Others	18.9	37.8	-	25.2	3	-	-	-	12.6	-	37.8	18.9	25.2

- Not recorded

Table 9

## Density of Various Nektons (No/hauls) in Mandovi River/Estuary (July 1996)

Species	Sampling Location													
	R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R15
<b>Finfishes</b>														
<i>Ambassis commersonii</i>	-	-	-	16	-	-	22	-	3	-	-	13	-	8
<i>Ambassis dussumieri</i>	-	-	-	-	-	-	2	-	-	-	5	-	7	-
<i>Awaous grammepomus</i>	3	1	5	-	-	-	-	-	-	-	-	-	-	-
<i>Bairilius evezardi</i>	-	5	-	1	-	-	-	-	-	-	-	-	-	-
<i>Cynoglossus puncticeps</i>	-	-	-	2	-	-	-	-	-	-	-	-	-	-
<i>Danio devario</i>	4	1	1	-	-	-	-	-	-	-	-	-	-	-
<i>Etroplus suratensis</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Garra gotyla gotyla</i>	2	-	1	-	-	-	-	-	-	-	-	-	-	-
<i>Gonoproktopterus thomasi</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Labeo kawrus</i>	-	1	-	-	-	-	-	-	-	-	-	-	-	-
<i>Leiognathus blochii</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Mugil cephalus</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Nemacheilus rubidipinnis</i>	4	7	2	3	-	-	-	-	-	-	-	-	-	-
<i>Osteobrama dayi</i>	4	2	-	-	-	-	-	-	-	-	-	-	-	-
<i>Pseudorhombus arsius</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Paruciosoma daniconius</i>	-	1	-	-	-	-	-	-	-	-	-	-	-	-
<i>Puntius filamentosus</i>	4	3	1	2	-	-	-	-	-	-	-	-	-	-
<i>P. amphibius</i>	1	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>P. nigrofasciatus</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>P. ophiocephalus</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 9 (Contd..)

## Density of Various Nektons (No/hauls) in Mandovi River/Estuary (July 1996)

Species	Sampling Location													
	R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R15
<i>P. arulius</i>	2	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Rasbora neilgherriensis</i>	3	7	1	-	-	-	-	1	-	-	-	-	-	-
<i>Sieyepterus graseus</i>	-	4	3	-	-	-	-	-	-	-	-	-	-	-
<i>Scatophagus argus</i>	-	-	-	-	1	-	-	-	-	-	-	-	-	-
<i>Sillago sihama</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Stenogobius gymnopomus</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Teuthis vermiculata</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Chanos chanos</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<b>Shell Fishes</b>														
<i>Macrobrachium malcolmsoni</i>	5	-	-	17	3	-	-	2	-	-	5	-	-	-
<i>Metapenaeus affinis</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>M. monoceros</i>	-	-	-	5	-	-	3	-	-	4	-	-	5	-
<i>M. dobsoni</i>	-	-	-	1	-	-	2	1	1	-	-	3	-	2
<i>Penaeus marguiensis</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>P. indicus</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Scylla serrata</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Unidentified (small crab)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Macrobrachium rude</i>	3	4	2	5	-	-	-	-	-	-	-	-	-	-
<i>Villorita cyprinoides</i>	-	-	-	3	-	-	-	-	-	-	-	-	-	-
<i>Meretrix meretrix</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>M. casta</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Paphia malabarica</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-

- Not recorded

**Table 1**  
**Physico-chemical Water Quality in Mandovi River/Estuary along with Details of Sampling Conditions (August 1996)**

Parameter	Sampling Location													
	R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R15
Time of Sampling	0810	0900	0940	1035	1045	1115	1505	1150	1230	1310	1400	1610	1455	1650
Tidal Condition	-	-	-	Low	Low	Low	High	Low	Low	High	High	High	High	High
Air Temperature (°C)	28.5	28.5	28.7	29.4	29.7	30.0	30.1	30.5	30.8	30.8	30.7	30.1	30.0	29.3
Water Temperature (°C)	28.3	28.2	28.4	28.8	29.0	29.1	29.9	29.7	29.6	29.8	29.4	29.0	29.1	28.8
Salinity (ppt)	0	0	0	0	1.1	1.3	24.6	13.3	12.8	10.4	16.1	20.2	21.4	22.3
Dissolved O <sub>2</sub> (mg/L)	5.2	5.0	5.0	4.9	4.7	4.8	5.1	5.0	5.1	4.9	4.8	5.0	5.1	4.9
pH	7.6	7.7	7.5	7.8	7.8	7.9	7.8	7.9	7.8	7.7	7.6	7.8	8.0	8.0
Suspended Load (mg/L)	9	8	9	8.7	8	8	9	9.9	9.1	10.6	9.5	10.3	9.2	9.8
V.E.C.	12	14	17	13	12	16	10	13	12	10	12	9	12	13
Phosphate as P (µg/L)	0.41	0.43	0.44	0.42	0.46	0.58	0.75	0.63	0.67	0.59	0.66	0.61	0.62	0.71
Nitrate as N (µg/L)	6.3	6.1	6.8	5.7	6.2	7.1	8.3	6.9	6.8	6.3	6.8	6.7	6.9	7.8
Silicate as Si (µg/L)	108.2	109.4	108.7	113.3	112.8	139.6	158.3	142.6	145.1	143.0	149.3	138.2	134.3	146.2

V.E.C. : Vertical Extinction Coefficient

**Table 2****River Mandovi - Bottom Sediment Analysis (August 1996)**

Sampling Location	Moisture Content (%)	Organic* Matter (%)	Organic* Carbon (%)	Sand (%)	Silt (%)	Clay (%)
R3	12.8	4.14	2.40	54.84	29.24	15.92
R4	22.4	3.14	1.82	22.32	63.81	13.87
R5	28.7	2.81	1.63	21.41	60.52	18.07
R6	14.8	3.24	1.88	63.43	18.10	13.47
R6A	21.3	2.47	1.43	28.30	63.42	08.28
R7	26.4	3.17	1.84	26.43	58.72	14.85
R8	22.3	2.96	1.72	68.42	18.14	13.44
R9	29.4	3.33	1.93	66.25	14.82	18.93
R10	24.3	3.83	2.12	78.46	16.72	04.82
R11	22.1	3.46	2.01	29.58	56.32	14.10
R12	23.2	3.38	1.96	68.22	19.14	12.64
R13	17.4	3.84	2.23	63.16	29.43	07.41
R14	24.6	4.15	2.41	38.17	53.72	08.11
R15	25.1	4.31	2.50	36.82	58.43	04.75

\* Based on dry weight basis

Table 3

Distribution and Abundance (No/100ml) of Phytoplankton in Mandovi River/Estuary  
(August 1996)

Genera	Sampling Location													
	R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R15
<b>Cyanophyceae</b>														
<i>Trichodesmium erythraceum</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<b>Chlorophyceae</b>														
<i>Pediastrum sp.</i>	8	3	12	18	21	24	27	16	28	14	12	02	-	-
<i>Spirogyra sp.</i>	-	-	-	14	-	-	-	-	02	-	-	-	-	-
<i>Ulothrix sp.</i>	-	-	-	-	-	-	02	-	01	-	-	-	-	-
<i>Cosmarium sp.</i>	-	-	-	02	-	-	03	-	-	-	-	-	-	-
<i>Micrasterias sp.</i>	-	-	-	-	03	-	-	-	04	-	-	03	-	-
<i>Zygnema sp.</i>	-	-	02	03	-	-	-	02	-	-	-	-	-	-
<b>Bacillariophyceae</b>														
<i>Coscinodiscus sp.</i>	31	14	12	43	39	43	24	84	82	34	43	68	172	221
<i>Skeletonema sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	08	22
<i>Hemidiscus sp.</i>	-	-	-	-	-	-	08	-	-	-	-	03	05	12
<i>Melosira sp.</i>	-	-	-	-	-	-	-	02	-	-	04	05	08	10
<i>Stephanopyxis sp.</i>	-	-	-	-	-	-	-	-	-	-	-	02	03	01
<i>Triceratium sp.</i>	-	-	-	-	-	-	-	-	-	-	-	02	01	03
<i>Biddulphia sp.</i>	-	-	-	-	-	-	-	-	-	01	-	03	04	12
<i>B. mobilensis</i>	-	-	-	-	-	-	-	-	-	04	-	08	12	17
<i>B. sinensis</i>	-	-	-	-	-	-	-	-	-	-	-	03	02	02
<i>Guinardia sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	04	06
<i>Bellerophon sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	03	10
<i>Ditylum sp.</i>	-	-	-	-	-	-	-	-	-	-	-	02	06	10
<i>Lithodesmium sp.</i>	-	-	-	-	-	-	-	-	-	-	-	01	-	03
<i>Chaetoceros sp.</i>	-	-	-	-	04	08	31	28	46	52	08	22	38	56
<i>Grammatophora sp.</i>	-	-	-	-	-	-	-	-	-	04	-	-	05	09
<i>Campylodiscus sp.</i>	-	-	-	-	-	-	-	-	-	-	-	02	-	04
<i>Planktoniella sp.</i>	-	-	-	-	-	-	-	-	-	-	-	02	12	08
<i>Bacteriastum sp.</i>	-	-	-	-	-	-	-	-	-	-	-	03	-	04

Table 3 (Contd..)

Distribution and Abundance (No/100ml) of Phytoplankton in Mandovi River/Estuary  
(August 1996)

Genera	Sampling Location													
	R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R15
<i>Eucampia</i> sp.	-	-	-	-	-	-	-	-	-	-	02	-	02	03
<i>Climacodium</i> sp.	-	-	-	-	-	-	-	-	-	-	-	01	-	02
<i>Streptothecca</i> sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	02
<i>Thalassiosira</i> sp.	-	-	-	-	-	-	-	-	-	-	-	02	08	12
<i>T. gravida</i>	-	-	-	-	-	-	-	-	-	01	-	01	04	12
<i>Thalassionema</i> sp.	-	-	-	-	-	-	-	-	-	-	02	-	02	03
<i>Rhizosolenia</i> sp.	-	-	-	-	-	-	01	-	-	03	04	05	07	11
<i>R. stofferthii</i>	-	-	-	-	-	-	-	-	-	-	-	-	10	21
<i>R. styliformis</i>	-	-	-	-	-	-	-	-	-	-	-	07	21	32
<i>R. hebatata</i>	-	-	-	-	-	-	-	-	01	-	-	02	-	05
<i>Fragillaria oceanica</i>	-	-	-	-	-	-	-	-	-	-	-	01	04	10
<i>Thalassiothrix</i> sp.	-	-	-	-	-	-	-	-	-	-	-	-	02	03
<i>T. longissima</i>	-	-	-	-	-	-	-	-	-	-	-	02	04	05
<i>Asterionella japonica</i>	-	-	-	01	-	-	-	-	-	-	-	04	12	08
<i>Gyrosigma</i> sp.	-	-	-	-	-	-	-	-	-	01	-	03	04	08
<i>Pleurosigma</i> sp.	-	-	-	-	-	-	02	-	-	-	02	01	03	02
<i>Navicula</i> sp.	-	-	-	-	05	-	-	-	-	-	02	-	04	06
<i>Nitzschia</i> sp.	-	-	-	-	-	-	04	-	-	02	-	-	08	12
<i>N. longissima</i>	-	-	-	-	-	-	-	03	04	-	-	03	12	20
<b>Dinophyceae</b>														
<i>Prorocentrum</i> sp.	-	-	-	-	-	-	-	-	-	-	01	-	06	04
<i>Dinophysis</i> sp.	-	-	-	-	-	-	-	-	-	-	02	-	10	03
<i>Peridinium</i> sp.	-	-	-	-	-	-	-	-	-	-	-	01	04	02
<i>Ceratium tripos</i>	-	-	-	-	-	-	-	01	-	-	-	-	02	01
<i>C. fusus</i>	-	-	-	-	-	-	-	04	-	-	04	02	-	01
<i>C. massiliensis</i>	-	-	-	-	-	-	-	-	-	-	-	-	02	07
<i>C. furca</i>	-	-	-	-	-	-	-	02	-	-	02	-	10	05
<i>Pyrocystis fusiformis</i>	-	-	-	-	-	-	-	-	-	-	-	03	05	02
<i>Noctiluca miliaris</i>	-	-	-	-	-	-	-	-	-	-	-	01	04	01
<b>Total</b>	<b>39</b>	<b>17</b>	<b>26</b>	<b>81</b>	<b>72</b>	<b>75</b>	<b>102</b>	<b>142</b>	<b>168</b>	<b>116</b>	<b>88</b>	<b>170</b>	<b>433</b>	<b>613</b>

- Not recorded

Table 4

Distribution and Abundance (No./m<sup>3</sup>) of Zooplankton in Mandovi River/Estuary (August 1996)

Genera	Sampling Location													
	R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R15
<b>Ciliata</b>														
<i>Tintinnopsis sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Favella sp.</i>	-	-	-	-	-	-	-	-	-	-	-	2	3	3
<i>Rhabdonella sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	1	-
<b>Foraminifera</b>														
<i>Globigerina sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<b>Cnidaria</b>														
<i>Siphonophora sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	2
<b>Ctenophora</b>														
<i>Pleurobrachia sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<b>Copepoda</b>														
<i>Undinula sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Acartia sp.</i>	-	-	-	-	-	-	-	-	-	-	-	2	1	3
<i>Temora sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Eutemora sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Oithona sp.</i>	-	-	-	-	-	-	-	-	-	-	3	5	4	8
<i>O. plumifera</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Euterpina sp.</i>	-	-	-	-	-	-	-	-	-	-	-	1	4	2
<i>Paracalanus sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	2	2
<i>Eucalanus sp.</i>	-	-	-	-	-	-	-	-	-	-	2	3	5	6
<i>Centropages sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	2	4
<i>Pseudocalanus sp.</i>	-	-	-	-	-	-	-	-	-	4	3	4	6	5
<i>Macrosetella sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	1	2
<i>Microsetella sp.</i>	-	-	-	-	-	-	-	-	-	-	-	2	-	3
<i>Metridia sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	1	1
<i>Isias sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	2	1
<i>Candacia sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Canthocalanus sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	2	3
<i>Nannocalanus sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	2	2
<i>Rhincalanus sp.</i>	-	-	-	-	-	-	-	-	-	-	4	2	5	7
<i>Microcalanus sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	2	1

Table 4 (Contd..)

Distribution and Abundance (No./m<sup>3</sup>) of Zooplankton in Mandovi River/Estuary (August 1996)

Genera	Sampling Location													
	R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R15
<i>Paradontella sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Labidocera sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	1	2
<i>Oncaea sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	2	2
<i>Heliodiaptomus sp.</i>	6	3	1	1	1	-	-	-	-	-	-	-	-	-
<i>Mesocyclops sp.</i>	4	2	1	-	1	-	-	-	-	-	-	-	-	-
<i>Microcyclops sp.</i>	3	-	2	1	-	-	-	-	-	-	-	-	-	-
<i>Diaptomus sp.</i>	2	1	-	3	1	-	-	-	-	-	-	-	-	-
<b>Cladocera</b>														
<i>Penilia sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	4	2
<i>Evadne sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	8	4
<i>Moina sp.</i>	2	1	-	1	-	-	-	-	-	-	-	-	-	-
<i>Daphnia sp.</i>	1	4	1	2	-	-	-	-	-	-	-	-	-	-
<i>Macrothrix sp.</i>	1	1	2	-	-	-	-	-	-	-	-	-	-	-
<b>Rotifera</b>														
<i>Brachionus sp.</i>	4	2	1	-	1	-	-	-	-	-	-	-	-	-
<i>Keratella sp.</i>	5	4	2	1	-	-	-	-	-	-	-	-	-	-
<i>Polyarthra sp.</i>	2	1	2	1	-	-	-	-	-	-	-	-	-	-
<b>Pteropoda</b>														
<i>Creseis acicula</i>	-	-	-	-	-	-	-	-	-	-	-	-	1	2
<i>Creseis sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	4	3
<b>Appendicularia</b>														
<i>Oikopleura sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	2	2
<b>Larval Forms</b>														
Brachiopoda	-	-	-	-	-	-	-	-	-	-	-	-	2	1
Polychaeta	-	-	-	-	-	-	-	-	-	-	-	2	1	-
Copepod	3	4	2	2	-	-	-	-	-	-	1	8	14	26
Cirripede	-	-	-	-	-	-	-	-	-	-	-	-	1	3
Arachnactis	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bivalvia	-	-	-	-	-	-	-	-	-	-	2	-	3	2
Gastropoda	-	-	-	-	2	-	-	1	-	1	1	-	4	5
Fish eggs and Larvae	12	4	6	6	8	6	5	12	14	8	6	10	12	22

- Not recorded

Table 5

Distribution and Abundance (No./10cm<sup>2</sup>) of Meiobenthos in Mandovi River/Estuary  
(August 1996)

Group	Sampling Location													
	R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R15
Foraminifera	-	-	-	-	-	-	-	-	-	-	03	01	05	07
Diatom	38	29	08	12	10	08	10	14	22	18	19	34	30	43
Nematoda	06	04	03	04	72	14	21	04	02	24	10	05	06	08
Turbellaria	-	-	-	-	-	-	-	-	-	-	-	02	-	03
Polychaeta	-	-	02	-	-	-	02	-	-	08	10	06	12	04
Bivalvia	-	-	-	01	-	-	-	-	-	-	-	04	-	08
Ostracoda	-	-	-	-	-	-	-	-	-	02	-	03	04	05
Amphipoda	-	-	-	-	-	-	-	-	-	01	-	02	03	05
Copepoda	04	05	03	02	04	08	-	06	08	03	-	01	04	10
Isopoda	-	-	-	-	-	-	-	-	-	-	01	-	02	02
Cumacea	-	-	-	-	-	-	-	-	-	-	-	01	01	-
Crustaceans	03	-	-	04	05	-	04	-	02	04	05	06	08	12
Arachnactis	-	-	-	-	-	-	-	-	-	-	-	-	-	01
Fish egg	21	72	18	22	06	12	08	10	05	04	08	-	14	22
Total	72	50	34	45	37	42	45	34	39	64	56	65	89	130

- Not recorded

Table 6

Biomass (mg wet wt./10cm<sup>2</sup>) of Meiobenthos Taxa in Mandovi River/Estuary (August 1996)

Group	Sampling Location													
	R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R15
Foraminifera	-	-	-	-	-	-	-	-	-	-	6.61	2.20	11.02	15.43
Diatom	82.04	62.61	17.27	25.91	21.59	17.27	21.59	30.23	47.50	38.86	41.02	73.41	64.77	92.84
Nematoda	53.41	35.60	26.70	35.60	106.8	124.6	186.92	35.60	17.80	213.62	89.01	44.51	53.41	71.21
Turbellaria	-	-	-	-	-	-	-	-	-	-	-	5.33	-	8.00
Polychaeta	-	-	57.98	-	-	-	57.98	-	-	231.92	289.90	173.94	347.88	115.96
Bivalvia	-	-	-	30.0	-	-	-	-	-	-	-	120.00	-	240.00
Ostracoda	-	-	-	-	-	-	-	-	-	82.08	-	123.12	164.16	205.20
Amphipoda	-	-	-	-	-	-	-	-	-	27.93	-	55.86	83.79	139.65
Copepoda	88.00	110.0	66.00	44.00	88.00	176.0	-	132.0	176.00	66.00	-	22.00	88.00	220.00
Isopoda	-	-	-	-	-	-	-	-	-	-	4.00	-	8.00	8.00
Cumacea	-	-	-	-	-	-	-	-	-	-	-	200.00	200.00	-
Crustaceans	26.72	-	-	35.62	44.52	-	35.62	-	17.81	35.62	44.53	53.43	71.24	106.86
Arachnactis	-	-	-	-	-	-	-	-	-	-	-	-	-	5.00
Fish egg mass	41685	23820	35730	43670	1190	23820	15580	19850	9925	7940	15880	-	27790	43670
Total	41935	24028	35897	43841	1451	24137	15882	20047	10184	8636	16355	873.8	28882	44898

- Not recorded

Table 7

Distribution and Abundance (No./m<sup>2</sup>) of Macrobenthos in Mandovi River/Estuary  
(August 1996)

Group	Sampling Location													
	R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R15
Foraminifera	-	-	-	-	-	-	-	-	-	-	-	06	04	08
Porifera	-	-	-	-	-	-	-	-	-	-	-	01	-	01
Coelenterata	-	-	-	-	-	-	-	-	-	-	-	-	02	02
Nematoda	-	-	-	04	02	-	-	-	-	02	-	01	02	03
Polychaeta	-	-	01	-	-	06	-	02	06	-	-	-	01	01
Gastropoda	-	-	-	-	-	-	-	02	-	04	-	-	04	08
Bivalvia	-	-	-	-	-	-	-	04	-	04	02	04	08	10
Harpacticoida	-	-	-	-	-	-	-	-	-	-	01	-	03	01
Cumacea	-	-	-	-	-	-	-	-	-	-	-	-	-	01
Tanaidacea	-	-	-	-	-	-	-	-	-	-	01	-	03	02
Isopoda	-	-	-	-	-	-	-	-	-	-	01	02	-	04
Amphipoda	-	-	-	-	-	-	-	-	-	-	10	-	04	10
Ostracoda	-	-	-	-	-	-	-	-	-	-	01	-	01	02
Stomatopoda	-	-	-	-	-	-	-	-	-	-	-	-	-	01
Mysidacea	-	-	-	-	-	-	-	-	-	-	-	-	-	02
Decapoda	-	-	-	-	-	-	-	-	-	02	04	08	-	08
Pisces	05	02	04	03	02	02	-	02	02	04	03	06	01	08
Prawn Larvae	-	-	-	-	01	01	-	01	-	02	01	04	08	12
Worms & Others	02	04	-	02	-	-	03	04	-	-	04	07	04	09
Total	07	06	05	09	05	09	05	15	08	18	17	39	54	88

- Not recorded

**Table 8**  
**Biomass (mg/m<sup>2</sup>) of Macrobenthos Taxa in Mandovi River/Estuary (August 1996)**

Group	Sampling Location													
	R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R15
Foraminifera	-	-	-	-	-	-	-	-	-	-	-	0.798	0.532	1064
Porifera	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Coelenterata	-	-	-	-	-	-	-	-	-	-	-	-	440.0	440.0
Nematoda	-	-	-	0.384	0.192	-	-	-	-	0.192	-	0.096	0.192	0.288
Polychaeta	-	-	7.49	-	-	44.94	-	14.94	44.94	-	-	-	7.49	7.49
Gastropoda	-	-	-	-	-	-	1.518	1.518	-	3.036	-	-	3.036	6.072
Bivalvia	-	-	-	-	-	-	-	3036	-	3036	1518	3036	6073	7590.10
Harpacticoida	-	-	-	-	-	-	-	-	-	-	0.36	-	1.08	0.36
Cumacea	-	-	-	-	-	-	-	-	-	-	-	-	-	0.25
Tanaidacea	-	-	-	-	-	-	-	-	-	-	0.195	-	0.585	0.39
Isopoda	-	-	-	-	-	-	-	-	-	-	10.49	20.98	-	41.96
Amphipoda	-	-	-	-	-	-	-	-	-	-	-	-	2.40	6.00
Ostracoda	-	-	-	-	-	-	-	-	-	-	-	-	0.003	0.0006
Stomatopoda	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00009
Mysidacea	-	-	-	-	-	-	-	-	-	-	-	-	-	180.0
Decapoda	-	-	-	-	-	-	-	-	-	211.6	423.20	846.4	-	423.20
Pisces	9925	3970	7940	5955	3970	3970	-	3970	3970	7490	5995	11910	19850	15880
Prawn Larvae	-	-	-	-	0.073	0.073	-	0.073	-	0.146	0.073	0.292	0.584	0.876
Worms & Others	12.60	25.20	-	12.60	-	-	18.90	25.20	-	-	25.20	44.10	25.20	56.7
<b>Total</b>	<b>9940</b>	<b>3999</b>	<b>7952</b>	<b>5973</b>	<b>3976</b>	<b>4022</b>	<b>29.4</b>	<b>7057</b>	<b>4024.9</b>	<b>10752</b>	<b>7984</b>	<b>15872</b>	<b>26417</b>	<b>25712.6</b>

- Not recorded

Table 9

## Density of Various Nektons (No/hauls) in Mandovi River/Estuary (August 1996)

Species	Sampling Location													
	R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R15
<b>Finfishes</b>														
<i>Ambassis commersonii</i>	-	-	-	-	-	-	-	7	-	-	-	4	5	9
<i>Ambassis dussumieri</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Awaous grammepomus</i>	-	3	-	-	-	-	-	-	-	-	-	-	-	-
<i>Barilius evezardi</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Cynoglossus puncticeps</i>	3	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Danio devario</i>	4	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Etroplus suratensis</i>	1	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Garra gotyla gotyla</i>	-	-	3	1	-	-	-	-	-	-	-	-	-	-
<i>Gonoproktopterus thomassi</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Labeo kawrus</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Leiognathus blochii</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Mugil cephalus</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Nemachellus rubidipinnis</i>	-	-	-	7	-	-	-	-	-	-	-	-	-	-
<i>Osteobrama dayi</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Pseudorhombus arsius</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Paruciosoma daniconius</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Puntius filamentosus</i>	-	-	-	3	-	-	-	-	-	-	-	-	-	-
<i>P. amphibius</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>P. nigrofasciatus</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>P. ophiocephalus</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 9 (Contd..)

## Density of Various Nektons (No/hauls) in Mandovi River/Estuary (August 1996)

Species	Sampling Location													
	R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R15
<i>P. arulius</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Rasbora neilgherriensis</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Sieyopterus graseus</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Scatophagus argus</i>	-	-	-	-	1	-	-	-	-	-	-	-	-	-
<i>Sillago sihama</i>	-	-	-	-	-	2	-	-	-	-	-	-	-	-
<i>Stenogobius gymnopomus</i>	-	-	-	-	-	-	2	-	-	-	-	-	-	-
<i>Teuthis vermiculata</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Chanos chanos</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<b>Shell Fishes</b>														
<i>Macrobrachium malcolmsoni</i>	2	-	4	2	3	-	-	-	-	-	-	-	-	-
<i>Metapenaeus affinis</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>M. monoceros</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>M. dobsoni</i>	-	-	-	2	-	-	-	-	-	-	-	-	-	-
<i>Penaeus marguiensis</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>P. indicus</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Scylla serrata</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Unidentified (small crab)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Macrobrachium rude</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Villorita cyprinoides</i>	-	-	-	1	-	-	-	-	-	-	-	-	-	-
<i>Meretrix meretrix</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>M. casta</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Paphia malabarica</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-

- Not recorded

**Table 1**  
**Physico-chemical Water Quality in Mandovi River/Estuary along with Details of Sampling Conditions (September 1996)**

Parameter	Sampling Location													
	R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R15
Time of Sampling	0810	0855	0935	1015	1105	1200	1515	1215	1240	1315	1405	1615	1650	1725
Tidal Condition	Low	Low	Low	Low	High	High	High	High	High	High	High	High	High	High
Air Temperature (°C)	26.9	27.0	27.1	27.6	28.9	29.5	30.4	29.9	30.8	30.3	30.5	30.0	29.8	29.5
Water Temperature (°C)	26.1	26.2	26.5	26.3	26.4	27.3	29.6	28.1	28.4	28.7	28.6	27.3	28.6	27.9
Salinity (ppt)	0	0	0	0	0	0	28.6	10.4	10.8	10.0	22.8	30.5	29.26	30.58
Dissolved O <sub>2</sub> (mg/L)	6.2	5.8	6.4	5.2	4.8	5.0	4.9	4.8	5.1	4.9	4.6	4.7	4.9	4.8
pH	7.31	7.40	7.22	7.38	7.5	7.63	8.0	7.8	7.8	7.9	7.9	7.8	8.0	8.1
Suspended Load (mg/L)	840	890	780	930	800	860	830	880	900	950	910	890	810	930
V.E.C.	12	10	15	11	13	12	12	10	10	9	10	11	13	10
Phosphate as P (µg/L)	ND	ND	ND	ND	ND	0.6	0.18	0.07	0.09	0.09	0.08	0.14	0.12	0.16
Nitrate as N (µg/L)	4.1	4.3	4.8	4.6	4.7	4.5	6.3	5.1	4.7	5.3	4.9	5.8	5.9	6.2
Silicate as Si (µg/L)	78.12	63.26	68.73	58.21	60.1	86.47	89.31	97.11	86.05	85.48	87.53	90.32	95.87	96.91

V.E.C. : Vertical Extinction Coefficient

Table 2

River Mandovi - Bottom Sediment Analysis (September 1996)

Sampling Location	Moisture Content (%)	Organic* Matter (%)	Organic* Carbon (%)	Sand (%)	Silt (%)	Clay (%)
R3	28.6	10.36	6.01	81.38	15.21	3.41
R4	44.3	12.84	7.45	74.79	20.44	4.85
R5	39.5	9.48	5.50	88.52	9.27	2.21
R6	58.4	24.62	14.28	72.58	24.36	3.08
R6A	52.7	14.31	8.30	63.28	24.61	12.11
R7	62.1	21.44	12.44	58.83	37.14	4.00
R8	47.3	23.76	13.78	53.19	32.39	14.22
R9	42.8	30.45	17.66	62.84	31.70	5.46
R10	31.4	10.38	6.02	29.38	70.20	0.42
R11	39.7	28.14	16.32	56.42	41.91	1.65
R12	34.6	32.42	18.81	37.32	54.70	8.51
R13	7.8	14.36	8.33	80.06	18.98	1.03
R14	2.8	8.35	4.84	84.68	12.17	2.61
R15	4.3	7.54	4.37	91.38	8.62	0.0

\* Based on dry weight basis

Table 3

Distribution and Abundance (No/100ml) of Phytoplankton in Mandovi River/Estuary  
(September 1996)

Genera	Sampling Location													
	R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R15
<b>Cyanophyceae</b>														
<i>Trichodesmium erythraceum</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<b>Chlorophyceae</b>														
<i>Pediastrum sp.</i>	07	04	13	19	25	27	31	12	18	16	10	03	-	-
<i>Spirogyra sp.</i>	-	-	02	10	-	01	-	-	03	-	-	-	-	-
<i>Ulothrix sp.</i>	-	01	-	-	-	-	-	-	-	-	-	-	-	-
<i>Cosmarium sp.</i>	-	-	-	01	-	-	02	01	01	-	-	-	-	-
<i>Micrasterias sp.</i>	-	-	-	-	02	-	-	-	-	-	-	01	-	-
<i>Zygnema sp.</i>	-	-	-	-	-	-	01	-	-	-	-	-	-	-
<b>Bacillariophyceae</b>														
<i>Coscinodiscus sp.</i>	42	18	19	52	43	49	29	78	88	45	48	75	184	273
<i>Skeletonema sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	16	43
<i>Hemidiscus sp.</i>	-	-	-	-	-	-	10	-	-	-	-	07	12	18
<i>Melosira sp.</i>	-	-	-	-	-	-	-	04	-	-	08	10	17	22
<i>Stephanopyxis sp.</i>	-	-	-	-	-	-	-	-	-	-	04	05	07	04
<i>Triceratium sp.</i>	-	-	-	-	-	-	-	-	-	-	-	04	03	05
<i>Biddulphia sp.</i>	-	-	-	-	-	-	-	-	-	02	01	05	07	15
<i>B. mobiliensis</i>	-	-	-	-	-	-	-	-	-	08	-	17	22	31
<i>B. sinensis</i>	-	-	-	-	-	-	-	-	-	-	-	06	05	07
<i>Guinardia sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	08	14
<i>Bellerochea sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	07	22
<i>Ditylum sp.</i>	-	-	-	-	-	-	-	-	-	-	-	04	15	23
<i>Lithodesmium sp.</i>	-	-	-	-	-	-	-	-	-	-	-	03	01	05
<i>Chaetoceros sp.</i>	-	-	-	02	07	11	38	31	54	63	09	27	43	64
<i>Grammatophora sp.</i>	-	-	-	-	-	-	-	-	-	07	-	04	08	11
<i>Campylodiscus sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	03
<i>Planktoniella sp.</i>	-	-	-	-	-	-	-	-	-	-	-	01	08	10
<i>Bacteriastum sp.</i>	-	-	-	-	-	-	-	-	-	-	-	02	-	06

Table 3 (Contd..)

Distribution and Abundance (No/100ml) of Phytoplankton in Mandovi River/Estuary  
(September 1996)

Genera	Sampling Location														
	R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R15	
<i>Eucampia sp.</i>	-	-	-	-	-	-	-	-	-	-	03	02	03	05	
<i>Climacodium sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	03	04	
<i>Streptotheca sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	02	03	
<i>Thalassiosira sp.</i>	-	-	-	-	-	-	-	-	-	-	-	03	11	15	
<i>T. gravida</i>	-	-	-	-	-	-	-	-	-	04	02	03	07	14	
<i>Thalassionema sp.</i>	-	-	-	-	-	-	-	-	-	-	01	03	00	05	
<i>Rhizosolenia sp.</i>	-	-	-	-	-	-	-	02	-	04	07	09	06	13	
<i>R. stolterfothii</i>	-	-	-	-	-	-	-	-	-	-	-	-	15	27	
<i>R. styliformis</i>	-	-	-	-	-	-	-	-	-	-	-	08	25	36	
<i>R. hebatata</i>	-	-	-	-	-	-	-	-	-	02	-	04	03	07	
<i>Fragillaria oceanica</i>	-	-	-	-	-	-	-	-	-	-	-	03	08	17	
<i>Thalassiothrix sp.</i>	-	-	-	-	-	-	-	-	-	-	-	02	05	09	
<i>T. longissima</i>	-	-	-	-	-	-	-	-	-	-	-	04	07	08	
<i>Asterionella japonica</i>	-	-	-	-	-	-	-	-	-	-	-	05	17	13	
<i>Gyrosigma sp.</i>	-	-	-	-	-	-	-	-	-	02	01	07	09	12	
<i>Pleurosigma sp.</i>	-	-	-	-	-	-	-	01	-	-	03	05	07	08	
<i>Navicula sp.</i>	-	-	-	-	-	02	-	-	-	-	04	01	03	07	
<i>Nitzschia sp.</i>	-	-	-	-	-	-	01	02	-	-	04	02	11	14	
<i>N. longissima</i>	-	-	-	-	-	-	01	03	05	-	02	10	14	28	
<b>Dinophyceae</b>															
<i>Prorocentrum sp.</i>	-	-	-	-	-	-	-	-	-	-	-	03	08	05	
<i>Dinophysis sp.</i>	-	-	-	-	-	-	-	-	-	-	-	01	06	03	
<i>Peridinium sp.</i>	-	-	-	-	-	-	-	-	-	-	02	-	03	08	
<i>Ceratium tripos</i>	-	-	-	-	-	-	-	02	-	-	-	-	04	06	
<i>C. fusus</i>	-	-	-	-	-	-	-	-	-	-	03	02	-	04	
<i>C. massiliensis</i>	-	-	-	-	-	-	-	-	-	-	-	-	08	01	
<i>C. furca</i>	-	-	-	-	-	-	-	03	-	02	04	01	08	12	
<i>Pyrocystis fusiformis</i>	-	-	-	-	-	-	-	-	-	-	-	06	11	07	
<i>Noctiluca miliaris</i>	-	-	-	-	-	-	-	-	-	-	-	-	01	03	
<b>Total</b>	<b>49</b>	<b>23</b>	<b>26</b>	<b>84</b>	<b>77</b>	<b>90</b>	<b>113</b>	<b>139</b>	<b>169</b>	<b>155</b>	<b>116</b>	<b>258</b>	<b>568</b>	<b>868</b>	

- Not recorded

**Table 4**  
**Distribution and Abundance (No./haul) of Zooplankton in Mandovi River/Estuary**  
**(September 1996)**

Genera	Sampling Location													
	R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R15
<b>Ciliata</b>														
<i>Tintinnopsis sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	01	03
<i>Favella sp.</i>	-	-	-	-	-	-	-	-	-	-	-	03	02	05
<i>Rhabdonella sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	02
<b>Foraminifera</b>														
<i>Globigerina sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	01
<b>Cnidaria</b>														
<i>Siphonophora sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	01
<b>Ctenophora</b>														
<i>Pleurobrachia sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<b>Copepoda</b>														
<i>Undinula sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	01	03
<i>Acartia sp.</i>	-	-	-	-	-	-	-	-	-	-	-	03	01	05
<i>Temora sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	01
<i>Eutemora sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	01	02
<i>Oithona sp.</i>	-	-	-	-	-	-	-	-	-	-	04	07	08	11
<i>O. plumifera</i>	-	-	-	-	-	-	-	-	-	-	-	-	01	02
<i>Euterpina sp.</i>	-	-	-	-	-	-	-	-	-	-	02	02	04	05
<i>Paracalanus sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	02	03
<i>Eucalanus sp.</i>	-	-	-	-	-	-	-	-	-	-	-	02	04	07
<i>Centropages sp.</i>	-	-	-	-	-	-	-	-	-	-	-	03	02	05
<i>Pseudocalanus sp.</i>	-	-	-	-	-	-	-	-	-	05	06	07	08	09
<i>Macrosetella sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	02	02
<i>Microsetella sp.</i>	-	-	-	-	-	-	-	-	-	-	-	03	-	04
<i>Metridia sp.</i>	-	-	-	-	-	-	-	-	-	-	-	01	02	03
<i>Isias sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	04	07
<i>Candacia sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	01	03
<i>Canthocalanus sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	03	04
<i>Nannocalanus sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	03	05
<i>Rhincalanus sp.</i>	-	-	-	-	-	-	-	-	-	-	06	03	08	06
<i>Microcalanus sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	03	02

**Table 4 (Contd..)**  
**Distribution and Abundance (No./haul) of Zooplankton in Mandovi River/Estuary**  
**(September 1996)**

Genera	Sampling Location													
	R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R15
<i>Parapontella sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	01	02
<i>Labidocera sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	01
<i>Oncaea sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	03	05
<i>Heliodiaptomus sp.</i>	08	04	02	01	01	-	-	-	-	-	-	-	-	-
<i>Mesocyclops sp.</i>	03	05	03	02	03	-	-	-	-	-	-	-	-	-
<i>Microcyclops sp.</i>	05	-	-	02	02	-	-	-	-	-	-	-	-	-
<i>Diaptomus sp.</i>	04	02	-	-	01	-	-	-	-	-	-	-	-	-
<b>Cladocera</b>														
<i>Penia sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	04	01
<i>Evadne sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	10	04
<i>Moina sp.</i>	04	03	-	02	01	-	-	-	-	-	-	-	-	-
<i>Daphnia sp.</i>	08	02	01	04	02	-	-	-	-	-	-	-	-	-
<i>Macrothrix sp.</i>	04	01	-	-	01	-	-	-	-	-	-	-	-	-
<b>Rotifera</b>														
<i>Brachionus sp.</i>	08	04	02	01	-	-	-	-	-	-	-	-	-	-
<i>Keratella sp.</i>	04	03	03	02	01	-	-	-	-	-	-	-	-	-
<i>Polyarthra sp.</i>	04	02	-	01	-	-	-	-	-	-	-	-	-	-
<b>Pteropoda</b>														
<i>Cresels acicula</i>	-	-	-	-	-	-	-	-	-	-	-	-	02	03
<i>Cresels sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	03	02
<b>Appendicularia</b>														
<i>Oikopleura sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	01	01
<b>Larval Forms</b>														
<b>Brachiopoda</b>														
<i>Brachiopoda</i>	-	-	-	-	-	-	-	-	-	-	-	-	03	02
<b>Polychaeta</b>														
<i>Polychaeta</i>	-	-	-	-	-	-	-	-	-	-	-	02	01	01
<b>Copepod</b>														
<i>Copepod</i>	-	-	-	-	-	-	-	-	-	-	01	09	18	28
<b>Cirripede</b>														
<i>Cirripede</i>	-	-	-	-	-	-	-	-	-	-	-	-	04	03
<b>Archnactis</b>														
<i>Archnactis</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<b>Bivalvia</b>														
<i>Bivalvia</i>	-	-	-	-	-	-	-	-	-	-	04	02	01	03
<b>Gastropoda</b>														
<i>Gastropoda</i>	-	-	-	-	-	02	-	-	02	01	-	-	04	05
<b>Fish eggs and Larvae</b>														
<i>Fish eggs and Larvae</i>	15	12	08	10	10	13	08	15	18	24	12	15	22	34
<b>Biomass</b>														
<i>Biomass</i>	1.3	1.0	2.0	2.4	2.2	1.8	1.8	2.2	2.2	2.4	2.5	2.6	3.2	4.0

- Not recorded

Table 5

**Distribution and Abundance (No./10cm<sup>2</sup>) of Meiobenthos in Mandovi River/Estuary  
(September 1996)**

Group	Sampling Location													
	R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R15
Foraminifera	-	-	-	-	-	-	-	-	-	04	06	05	10	12
Diatom	42	36	15	21	15	12	14	19	26	21	24	39	41	45
Nematoda	05	08	07	09	84	21	26	10	08	27	16	10	14	16
Turbellaria	-	-	-	-	-	-	-	-	-	-	01	04	02	06
Polychaeta	-	-	-	-	01	-	04	-	01	12	16	09	17	09
Bivalvia	-	-	-	02	02	-	-	-	-	-	-	06	04	11
Ostracoda	-	-	-	-	-	-	-	-	-	04	02	06	07	10
Amphipoda	-	-	-	-	-	-	-	-	-	02	01	04	06	09
Copepoda	08	10	09	08	09	14	04	10	12	05	02	04	07	14
Isopoda	-	-	-	-	-	-	-	-	-	-	03	02	05	04
Cumacea	-	-	-	-	-	-	-	-	-	-	02	02	01	03
Crustaceans	05	02	04	05	11	05	08	02	03	06	09	12	14	19
Arachnactis	-	-	-	-	-	-	-	-	-	-	-	-	02	02
Fish egg	29	84	23	29	08	15	12	14	05	08	13	04	21	29
<b>Total</b>	<b>87</b>	<b>140</b>	<b>58</b>	<b>78</b>	<b>130</b>	<b>67</b>	<b>68</b>	<b>55</b>	<b>55</b>	<b>89</b>	<b>103</b>	<b>105</b>	<b>151</b>	<b>133</b>

- Not recorded

**Table 6**  
**Biomass (mg wet wt./10cm<sup>2</sup>) of Meiobenthos Taxa in Mandovi River/Estuary (September 1996)**

Group	Sampling Location													
	R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R15
Foraminifera	-	-	-	-	-	-	-	-	-	8.82	13.22	11.02	22.04	26.45
Diatom	90.68	77.72	32.38	45.34	32.38	25.91	30.22	41.02	56.13	45.34	51.82	84.20	88.52	105.7
Nematoda	44.51	71.21	62.31	80.11	747.7	786.93	231.4	89.01	71.22	240.34	142.42	89.01	124.62	142.4
Turbellaria	-	-	-	-	-	-	-	-	-	-	2.67	10.67	5.33	16.00
Polychaeta	-	-	-	-	28.99	-	116	-	28.99	347.88	463.84	260.91	492.83	260.9
Bivalvia	-	-	-	60.0	60.00	-	-	-	-	-	-	180.00	120.00	330.0
Ostracoda	-	-	-	-	-	-	-	-	-	164.16	82.08	246.24	287.28	410.4
Amphipoda	-	-	-	-	-	-	-	-	-	55.86	27.93	111.72	167.58	251.3
Copepoda	176.0	220.0	198.0	176.0	198.0	308.00	88.00	220.0	264.0	110.00	44.00	88.00	154.00	308.0
Isopoda	-	-	-	-	-	-	-	-	-	-	12.00	08.00	20.00	16.00
Cumacea	-	-	-	-	-	-	-	-	-	-	400.00	400.00	200.00	600.0
Crustaceans	44.53	97.81	35.63	80.16	97.97	44.53	71.25	17.81	26.72	53.44	80.16	106.88	124.69	109.2
Arachnactis	-	-	-	-	-	-	-	-	-	-	-	-	10.00	10.0
Fish egg mass	57565	166740	45655	57565	15880	29975	23820	27790	17865	15880	25805	7940	41685	57565
<b>Total</b>	<b>57920</b>	<b>167206</b>	<b>45983</b>	<b>58006</b>	<b>17045</b>	<b>31140</b>	<b>24356</b>	<b>28157</b>	<b>18312</b>	<b>16905</b>	<b>27125</b>	<b>9536</b>	<b>43501</b>	<b>60151</b>

- Not recorded

Table 7

**Distribution and Abundance (No./m<sup>2</sup>) of Macrobenthos in Mandovi River/Estuary  
(September 1996)**

Group	Sampling Location													
	R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R15
Foraminifera	-	-	-	-	-	-	-	-	-	-	03	08	07	11
Porifera	-	-	-	-	-	-	-	-	-	-	01	02	01	03
Coelenterata	-	-	-	-	-	-	-	-	-	-	-	01	04	05
Nematoda	-	-	-	05	04	-	-	-	01	03	-	03	03	06
Polychaeta	-	-	-	-	-	09	03	04	07	-	-	01	02	03
Gastropoda	-	-	-	-	-	-	-	03	-	07	-	02	05	09
Bivalvia	-	-	-	-	-	-	-	06	-	07	04	07	09	11
Harpacticoida	-	-	-	-	-	-	-	-	-	-	03	01	03	02
Cumacea	-	-	-	-	-	-	-	-	-	-	-	-	-	03
Tanaidacea	-	-	-	-	-	-	-	-	-	-	02	01	03	03
Isopoda	-	-	-	-	-	-	-	-	-	-	01	03	-	05
Amphipoda	-	-	-	-	-	-	-	-	-	-	12	04	06	12
Ostracoda	-	-	-	-	-	-	-	-	-	-	04	02	03	05
Stomatopoda	-	-	-	-	-	-	-	-	-	-	-	-	01	03
Mysidacea	-	-	-	-	-	-	-	-	-	-	-	-	-	01
Decapoda	-	-	-	-	-	-	-	-	-	04	06	12	08	12
Pisces	06	04	05	07	03	01	01	03	04	03	04	08	14	11
Prawn Larvae	-	-	-	-	-	02	01	-	02	03	03	06	10	14
Worms & Others	03	02	01	02	04	03	05	06	04	03	07	10	08	15
<b>Total</b>	<b>09</b>	<b>06</b>	<b>06</b>	<b>14</b>	<b>11</b>	<b>15</b>	<b>10</b>	<b>22</b>	<b>18</b>	<b>30</b>	<b>50</b>	<b>71</b>	<b>77</b>	<b>134</b>

- Not recorded

**Table 8**  
**Biomass (mg/m<sup>2</sup>) of Macrobenthos Taxa in Mandovi River/Estuary (September 1996)**

Group	Sampling Location													
	R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R15
Foraminifera	-	-	-	-	-	-	-	-	-	-	0.399	1.06	0.93	1.46
Porifera	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Coelenterata	-	-	-	-	-	-	-	-	-	-	-	220.0	880.0	100.0
Nematoda	-	-	-	0.48	0.384	-	-	-	0.096	0.288	-	0.288	0.288	0.576
Polychaeta	-	-	-	-	-	67.41	22.47	29.96	52.43	-	-	7.49	14.98	22.47
Gastropoda	-	-	-	-	-	-	-	2.28	-	5.31	-	1.52	3.79	6.83
Bivalvia	-	-	-	-	-	-	-	4554	-	5313	3036	5313.7	6832	8349
Harpacticoida	-	-	-	-	-	-	-	-	-	-	1.08	0.36	1.08	0.72
Cumacea	-	-	-	-	-	-	-	-	-	-	-	-	-	0.75
Tanaidacea	-	-	-	-	-	-	-	-	-	-	0.39	0.19	0.58	0.58
Isopoda	-	-	-	-	-	-	-	-	-	-	10.49	31.47	-	52.45
Amphipoda	-	-	-	-	-	-	-	-	-	-	7.20	2.40	3.60	7.20
Ostracoda	-	-	-	-	-	-	-	-	-	-	0.000014	0.000007	0.00001	0.00002
Stomatopoda	-	-	-	-	-	-	-	-	-	-	-	-	0.00009	0.0003
Mysidacea	-	-	-	-	-	-	-	-	-	-	-	-	-	90.00
Decapoda	-	-	-	-	-	-	-	-	-	423.2	634.8	1269.6	846.4	1269.6
Pisces	11910	7940	9925	13895	5955	1985	1985	5955	7940	5955	7540	15880	27790	21835
Prawn Larvae	-	-	-	-	-	0.15	0.07	-	0.15	0.22	0.22	0.44	0.73	1.02
Worms & Others	18.90	12.6	6.30	12.6	25.2	18.90	31.5	37.8	25.2	18.9	44.1	63.0	50.40	94.40
Total	11928	7957	9936	13914	5986	2078	2048	10588	8027.7	11727	11287	22804	36439	31847

- Not recorded

Table 9

## Density of Various Nektons (No/hauls) in Mandovi River/Estuary (September 1996)

Species	Sampling Location													
	R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R15
<b>Finfishes</b>														
<i>Ambassis commersonii</i>	-	-	-	-	-	-	2	-	-	-	-	-	4	7
<i>Ambassis dussumieri</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Awaous grammepomus</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Barilius evezardi</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Cynoglossus puncticeps</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Danio devario</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Etroplus suratensis</i>	-	-	-	-	-	-	-	-	-	-	-	1	-	-
<i>Garra gotyla gotyla</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Gonoproktopterus thomasi</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Labeo kawrus</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Leiognathus blochi</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Mugil cephalus</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Nemacheilus rubidipinnis</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Osteobrama dayi</i>	4	-	-	11	-	-	-	-	-	-	-	-	-	-
<i>Pseudorhombus arsius</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Paruciosoma daniconius</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Puntius filamentosus</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>P. amphibius</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>P. nigrofasciatus</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>P. ophiocephalus</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 9 (Contd..)

## Density of Various Nektons (No/hauls) in Mandovi River/Estuary (September 1996)

Species	Sampling Location													
	R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R15
<i>P. arulius</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Rasbora neilgherriensis</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Sieypterus graseus</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Scatophagus argus</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Sillago sihama</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Stenogobius gymnopomus</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Teuthis vermiculata</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Chanos chanos</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<b>Shell Fishes</b>														
<i>Macrobrachium malcolmsoni</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Metapenaeus affinis</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>M. monoceros</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>M. dobsoni</i>	-	-	-	-	-	-	6	-	-	-	-	-	-	19
<i>Penaeus marguiensis</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>P. indicus</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Scylla serrata</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Unidentified (small crab)	-	-	-	2	-	-	-	-	-	-	-	-	-	-
<i>Macrobrachium rude</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Villorita cyprinoides</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Meretrix meretrix</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>M. casta</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Paphia malabarica</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-

- Not recorded

**Table 1**  
**Physico-chemical Water Quality in Mandovi River/Estuary along with Details of Sampling Conditions (October 1996)**

Parameter	Sampling Location													
	R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R15
Time of Sampling	0830	0905	0930	0950	1020	1050	1415	1115	1140	1205	1245	1530	1615	1725
Tidal Condition				Low	High	High	High	High	High	High	High	High	High	Low
Air Temperature (°C)	27.0	27.7	28.3	28.8	29.4	29.5	30.7	30.4	30.6	30.9	31.2	31.0	30.1	29.7
Water Temperature (°C)	26.8	27.1	27.5	27.6	28.2	28.9	29.9	30.0	30.1	30.0	30.1	30.0	29.2	28.9
Salinity (ppt)	0	0	0	0	0	0.8	32.7	8.8	10.7	12.3	13.8	24.8	28.6	31.4
Dissolved O <sub>2</sub> (mg/L)	5.2	5.0	5.0	4.8	5.1	4.9	4.5	4.9	5.0	4.9	4.8	4.9	4.7	4.6
pH	7.2	7.3	7.5	7.3	7.4	7.6	7.9	7.8	7.7	7.9	7.8	7.7	7.9	8.0
Suspended Load (mg/L)	860	880	840	830	890	840	800	860	890	840	830	810	880	890
V.E.C.	13	12	13	10	12	11	12	10	09	10	10	11	10	09
Phosphate as P (µg/L)	0.38	0.36	0.39	0.47	0.44	0.41	0.58	0.53	0.52	0.57	0.51	0.57	0.56	0.64
Nitrate as N (µg/L)	5.71	5.93	6.42	5.83	6.08	5.83	6.87	6.08	6.25	6.37	6.59	6.45	6.73	6.85
Silicate as Si (µg/L)	67.3	67.9	65.5	68.3	64.2	66.8	69.4	76.1	68.5	70.1	73.8	77.4	73.2	78.4

V.E.C. : Vertical Extinction Coefficient

Table 2

River Mandovi - Bottom Sediment Analysis (October 1996)

Sampling Location	Moisture Content (%)	Organic* Matter (%)	Organic* Carbon (%)	Sand (%)	Silt (%)	Clay (%)
R3	20.3	18.72	10.86	78.20	17.14	4.66
R4	34.2	22.34	12.96	68.83	30.78	0.39
R5	28.6	11.48	6.66	91.35	6.48	2.17
R6	36.3	39.21	22.74	62.38	35.71	1.91
R6A	42.7	15.74	9.13	58.77	34.06	7.17
R7	39.6	30.58	17.74	61.68	36.44	1.98
R8	44.8	46.10	26.74	49.11	50.21	0.68
R9	58.7	19.54	11.33	71.48	26.92	1.6
R10	18.5	8.37	4.85	40.05	56.88	3.07
R11	27.5	11.44	6.64	68.12	31.68	0.2
R12	47.6	6.78	3.93	37.46	60.45	2.09
R13	18.5	21.47	12.45	76.94	22.08	0.98
R14	12.9	11.58	6.72	82.14	17.66	0.2
R15	15.2	4.51	2.62	94.56	4.95	0.49

\* Based on dry weight basis

Table 3

Distribution and Abundance (No/100ml) of Phytoplankton in Mandovi River/Estuary  
(October 1996)

Genera	Sampling Location													
	R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R15
<b>Cyanophyceae</b>														
<i>Trichodesmium erythraceum</i>	-	-	-	-	-	-	-	-	-	-	-	-	02	05
<b>Chlorophyceae</b>														
<i>Pediastrum sp.</i>	10	06	17	22	29	26	38	15	21	18	14	05	-	-
<i>Spirogyra sp.</i>	-	02	04	04	-	02	-	-	04	-	-	-	-	-
<i>Ulothrix sp.</i>	-	-	03	-	-	-	-	-	-	-	-	-	-	-
<i>Cosmarium sp.</i>	-	-	01	-	-	-	01	02	03	-	-	-	-	-
<i>Micrasterias sp.</i>	-	-	-	-	-	01	-	-	-	-	02	-	-	-
<i>Zygnema sp.</i>	-	-	-	-	-	01	-	01	-	-	-	-	-	-
<b>Bacillariophyceae</b>														
<i>Coscinodiscus sp.</i>	54	21	26	48	52	63	32	68	102	64	73	86	204	312
<i>Skeletonema sp.</i>	-	-	-	-	-	-	-	-	-	-	01	-	23	52
<i>Hemidiscus sp.</i>	-	-	-	-	-	-	-	-	-	-	-	10	15	22
<i>Melosira sp.</i>	-	-	-	-	-	-	-	01	-	-	11	14	23	27
<i>Stephanopyxis sp.</i>	-	-	-	-	-	-	-	-	-	-	05	07	09	13
<i>Triceratium sp.</i>	-	-	-	-	-	-	-	-	-	-	06	02	02	06
<i>Biddulphia sp.</i>	-	-	-	-	-	-	-	-	-	-	02	11	09	18
<i>B. mobilensis</i>	-	-	-	-	-	-	-	-	-	-	01	15	31	43
<i>B. sinensis</i>	-	-	-	-	-	-	-	-	-	-	-	07	10	12
<i>Guinardia sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	12	16
<i>Bellerochea sp.</i>	-	-	-	-	-	-	-	-	-	-	-	02	03	25
<i>Ditylum sp.</i>	-	-	-	-	-	-	-	-	-	-	-	14	21	27
<i>Lithodesmium sp.</i>	-	-	-	-	-	-	-	-	-	-	-	02	01	06
<i>Chaetoceros sp.</i>	-	-	02	-	-	08	39	43	61	65	12	43	58	72
<i>Grammatophora sp.</i>	-	-	-	-	-	-	-	-	-	08	-	-	13	18
<i>Campylodiscus sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	01	04
<i>Planktoniella sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	04	07
<i>Bacteriastum sp.</i>	-	-	-	-	-	-	-	-	-	-	-	04	01	05

Table 3 (Contd..)

Distribution and Abundance (No/100ml) of Phytoplankton in Mandovi River/Estuary.  
(October 1996)

Genera	Sampling Location													
	R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R15
<i>Eucampia sp.</i>	-	-	-	-	-	-	-	-	-	-	02	03	07	06
<i>Climacodium sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	05	03
<i>Streptotheca sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	04	07
<i>Thalassiosira sp.</i>	-	-	-	-	-	-	-	-	-	-	-	05	07	18
<i>T. grvida</i>	-	-	-	-	-	-	-	-	-	05	07	04	10	15
<i>Thalassionema sp.</i>	-	-	-	-	-	-	-	-	-	-	04	02	-	04
<i>Rhizosolenia sp.</i>	-	-	-	-	-	-	-	07	-	-	04	12	14	18
<i>R. stouterthi</i>	-	-	-	-	-	-	-	-	-	-	-	04	07	31
<i>R. styiformis</i>	-	-	-	-	-	-	-	-	-	-	04	12	29	45
<i>R. hebatata</i>	-	-	-	-	-	-	-	-	-	04	01	05	07	10
<i>Fragilaria oceanica</i>	-	-	-	-	-	-	-	-	-	-	-	04	15	24
<i>Thalassiothrix sp.</i>	-	-	-	-	-	-	-	-	-	-	-	04	07	12
<i>T. longissima</i>	-	-	-	-	-	-	-	-	-	-	-	08	10	14
<i>Asterionella japonica</i>	-	-	-	-	-	-	-	-	-	-	-	02	14	21
<i>Gyrosigma sp.</i>	-	-	-	-	-	-	-	-	-	03	02	10	15	18
<i>Pleurosigma sp.</i>	-	-	-	-	-	-	-	-	-	-	-	04	05	21
<i>Navicula sp.</i>	-	-	-	-	-	-	-	04	-	02	08	10	12	17
<i>Nitzschia sp.</i>	-	-	-	-	-	04	02	03	04	-	06	03	15	22
<i>N. longissima</i>	-	-	-	-	-	-	04	02	01	-	04	08	15	28
<b>Dinophyceae</b>														
<i>Prorocentrum sp.</i>	-	-	-	-	-	-	-	-	-	-	-	04	09	15
<i>Dinophysis sp.</i>	-	-	-	-	-	-	-	-	-	-	-	02	04	13
<i>Peridinium sp.</i>	-	-	-	-	-	-	-	-	-	04	01	-	05	07
<i>Ceratium tripos</i>	-	-	-	-	-	-	-	-	-	-	01	-	02	08
<i>C. fusus</i>	-	-	-	-	-	-	-	-	-	-	02	01	05	-
<i>C. massiliensis</i>	-	-	-	-	-	-	-	-	-	-	-	-	04	05
<i>C. furca</i>	-	-	-	-	-	-	-	-	02	04	06	09	12	17
<i>Pyrocystis fusiformis</i>	-	-	-	-	-	-	-	-	-	-	02	05	15	22
<i>Noctiluca miliaris</i>	-	-	-	-	-	-	-	-	-	-	-	-	04	06
<b>Total</b>	<b>64</b>	<b>29</b>	<b>53</b>	<b>74</b>	<b>81</b>	<b>105</b>	<b>116</b>	<b>146</b>	<b>198</b>	<b>177</b>	<b>181</b>	<b>343</b>	<b>700</b>	<b>1117</b>

- Not recorded

Table 4

Distribution and Abundance (No./haul) of Zooplankton in Mandovi River/Estuary  
(October 1996)

Genera	Sampling Location													
	R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R15
<b>Ciliata</b>														
<i>Tintinnopsis sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	04	12
<i>Favella sp.</i>	-	-	-	-	-	-	-	-	-	-	-	04	08	11
<i>Rhabdonella sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	02	04
<b>Foraminifera</b>														
<i>Globigerina sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	04
<b>Cnidaria</b>														
<i>Siphonophora sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	02
<b>Ctenophora</b>														
<i>Pleurobrachia sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	02
<b>Copepoda</b>														
<i>Undinula sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	03	05
<i>Acartia sp.</i>	-	-	-	-	-	-	-	-	-	-	-	05	07	09
<i>Temora sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	01	02
<i>Eutemora sp.</i>	-	-	-	-	-	-	-	-	-	-	-	01	02	05
<i>Oithona sp.</i>	-	-	-	-	-	-	-	-	-	-	21	32	18	29
<i>O. plumifera</i>	-	-	-	-	-	-	-	-	-	-	-	-	02	08
<i>Euterpina sp.</i>	-	-	-	-	-	-	-	-	-	-	04	03	08	11
<i>Paracalanus sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	04	05
<i>Eucalanus sp.</i>	-	-	-	-	-	-	-	-	-	-	-	04	06	08
<i>Centropages sp.</i>	-	-	-	-	-	-	-	-	-	-	-	04	07	10
<i>Pseudocalanus sp.</i>	-	-	-	-	-	-	-	-	-	08	11	15	14	23
<i>Macrosetella sp.</i>	-	-	-	-	-	-	-	-	-	-	-	03	04	05
<i>Microsetella sp.</i>	-	-	-	-	-	-	-	-	-	-	-	03	-	04
<i>Metridia sp.</i>	-	-	-	-	-	-	-	-	-	01	-	02	05	07
<i>Isias sp.</i>	-	-	-	-	-	-	-	-	-	-	-	05	04	12
<i>Candacia sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	05	08
<i>Canthocalanus sp.</i>	-	-	-	-	-	-	-	-	-	-	01	-	04	02
<i>Nannocalanus sp.</i>	-	-	-	-	-	-	-	-	-	-	-	02	05	12
<i>Rhincalanus sp.</i>	-	-	-	-	-	-	-	-	-	-	04	03	08	14
<i>Microcalanus sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	05	04

**Table 4 (Contd.)**  
**Distribution and Abundance (No./haul) of Zooplankton in Mandovi River/Estuary**  
**(October 1996)**

Genera	Sampling Location													
	R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R15
<i>Parapontella sp.</i>	-	-	-	-	-	-	-	-	-	-	-	02	03	07
<i>Labidocera sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	01	04
<i>Oncaea sp.</i>	-	-	-	-	-	-	-	-	-	-	-	03	02	06
<i>Heliodiaptomus sp.</i>	06	03	02	01	-	-	-	-	-	-	-	-	-	-
<i>Mesocyclops sp.</i>	02	-	01	-	-	-	-	-	-	-	-	-	-	-
<i>Microcyclops sp.</i>	03	02	01	-	01	-	-	-	-	-	-	-	-	-
<i>Diaptomus sp.</i>	03	02	01	01	-	-	-	-	-	-	-	-	-	-
<b>Cladocera</b>														
<i>Penilia sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	08	06
<i>Evadne sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	12	08
<i>Moina sp.</i>	05	02	-	01	01	-	-	-	-	-	-	-	-	-
<i>Daphnia sp.</i>	04	04	-	03	01	-	-	-	-	-	-	-	-	-
<i>Macrothrix sp.</i>	04	03	02	01	-	-	-	-	-	-	-	-	-	-
<b>Rotifera</b>														
<i>Brachionus sp.</i>	06	02	03	01	-	-	-	-	-	-	-	-	-	-
<i>Keratella sp.</i>	02	03	02	-	01	-	-	-	-	-	-	-	-	-
<i>Polyarthra sp.</i>	03	02	01	01	-	-	-	-	-	-	-	-	-	-
<b>Pteropoda</b>														
<i>Cresels acicula</i>	-	-	-	-	-	-	-	-	-	-	-	02	05	04
<i>Cresels sp.</i>	-	-	-	-	-	-	-	-	-	-	-	03	07	06
<b>Appendicularia</b>														
<i>Oikopleura sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	01	04
<b>Larval Forms</b>														
<b>Brachlopoda</b>														
<i>Brachlopoda</i>	-	-	-	-	-	-	-	-	-	-	-	02	05	07
<b>Polychaeta</b>														
<i>Polychaeta</i>	-	-	-	-	-	-	-	-	-	-	-	01	03	04
<b>Copepod</b>														
<i>Copepod</i>	-	-	02	-	-	05	-	02	04	08	02	28	38	64
<b>Cirripede</b>														
<i>Cirripede</i>	-	-	-	-	-	-	-	-	-	-	03	-	04	08
<b>Arachnactis</b>														
<i>Arachnactis</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	01
<b>Bivalvia</b>														
<i>Bivalvia</i>	-	-	02	-	01	03	-	01	04	-	08	10	12	08
<b>Gastropoda</b>														
<i>Gastropoda</i>	-	-	-	-	-	04	-	08	03	-	10	12	08	21
<b>Fish eggs and Larvae</b>														
<i>Fish eggs and Larvae</i>	38	21	12	15	21	28	09	38	41	31	43	28	43	54
<b>Biomass</b>														
<i>Biomass</i>	1.0	1.0	1.5	1.6	1.8	1.4	1.4	1.8	1.9	1.8	1.6	2.1	5.2	6.3

- Not recorded

Table 5

**Distribution and Abundance (No./10cm<sup>2</sup>) of Meiobenthos in Mandovi River/Estuary  
(October 1996)**

Group	Sampling Location													
	R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R15
Foraminifera	-	-	-	-	-	-	-	-	02	08	10	11	15	18
Diatom	47	41	19	28	21	18	19	24	32	26	29	45	49	53
Nematoda	09	12	10	15	26	27	34	15	12	31	22	14	18	21
Turbellaria	-	-	-	-	-	-	-	-	-	-	05	07	04	08
Polychaeta	-	-	-	-	-	02	05	01	03	15	18	15	25	11
Bivalvia	-	-	-	-	04	04	-	-	-	-	02	08	09	14
Ostracoda	-	-	-	-	-	-	-	-	-	02	05	03	11	13
Amphipoda	-	-	-	-	-	-	-	-	-	03	02	07	09	11
Copepoda	12	18	22	10	12	18	10	15	19	10	05	09	09	17
Isopoda	-	-	-	-	-	-	-	-	-	-	04	01	03	09
Cumacea	-	-	-	-	-	-	-	-	-	02	03	05	07	06
Crustaceans	09	04	08	12	16	11	15	06	07	09	12	14	17	15
Arachnactis	-	-	-	-	-	-	-	-	-	-	-	-	01	03
Fish egg	21	63	28	34	15	18	14	18	12	14	18	07	25	34
Total	98	138	87	99	164	98	97	79	87	120	123	146	202	233

- Not recorded

**Table 6**  
**Biomass (mg wet wt./10cm<sup>2</sup>) of Meiobenthos Taxa in Mandovi River/Estuary (October 1996)**

Group	Sampling Location													
	R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R15
Foraminifera	-	-	-	-	-	-	-	-	4.41	17.63	20.04	24.24	33.03	39.67
Diatom	101.4	88.52	41.02	60.45	45.34	38.86	41.02	51.82	69.09	56.13	62.61	97.16	105.79	114.4
Nematoda	80.11	106.81	89.01	133.5	854.5	240.33	302.63	133.5	106.8	275.93	195.82	124.61	160.22	186.9
Turbellaria	-	-	-	-	-	-	-	-	-	-	8.00	18.67	10.67	21.34
Polychaeta	-	-	-	-	-	57.98	144.95	28.99	86.97	434.85	521.82	434.85	724.75	318.9
Bivalvia	-	-	-	-	120.0	120.0	-	-	-	-	60.00	240.00	270.00	420.0
Ostracoda	-	-	-	-	-	-	-	-	-	82.08	205.20	123.12	451.44	533.5
Amphipoda	-	-	-	-	-	-	-	-	-	83.79	55.86	195.51	251.37	307.2
Copepoda	264.0	396.00	484.0	220.0	264.0	396.00	220.00	330.0	418.0	220.00	110.00	198.00	198.00	374.0
Isopoda	-	-	-	-	-	-	-	-	-	-	16.00	04.00	12.00	36.00
Cumacea	-	-	-	-	-	-	-	-	-	-	600.00	1000.0	1400.0	1200
Crustaceans	80.16	35.63	71.25	106.7	142.5	97.97	133.60	53.44	52.35	80.16	106.88	124.69	151.41	133.6
Arachnactis	-	-	-	-	-	-	-	-	-	-	-	-	05.00	15.0
Fish egg mass	41685	120555	55580	67490	29775	35730	27790	35730	23820	27790	35730	13895	49625	67490
<b>Total</b>	<b>42210</b>	<b>121181</b>	<b>56265</b>	<b>68010</b>	<b>31201</b>	<b>36681</b>	<b>28632</b>	<b>36327</b>	<b>24558</b>	<b>29040</b>	<b>37692</b>	<b>16479</b>	<b>53398</b>	<b>71190</b>

- Not recorded

Table 7

**Distribution and Abundance (No./m<sup>2</sup>) of Macrobenthos in Mandovi River/Estuary  
(October 1996)**

Group	Sampling Location													
	R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R15
Foraminifera	-	-	-	-	-	-	-	-	-	-	04	09	09	14
Porifera	-	-	-	-	-	-	-	-	-	01	02	03	04	05
Coelenterata	-	-	-	-	-	-	-	-	-	-	-	02	03	06
Nematoda	-	-	-	07	05	-	-	01	-	02	05	04	02	07
Polychaeta	-	-	-	-	-	08	02	05	-	05	01	02	04	05
Gastropoda	-	-	-	-	-	-	-	04	01	05	02	03	07	10
Bivalvia	-	-	-	-	-	-	-	07	02	08	05	09	10	12
Harpacticoida	-	-	-	-	-	-	-	-	-	02	04	03	03	05
Cumacea	-	-	-	-	-	-	-	-	-	-	-	-	02	04
Tanaidacea	-	-	-	-	-	-	-	-	-	-	03	04	07	05
Isopoda	-	-	-	-	-	-	-	-	-	-	02	05	02	09
Amphipoda	-	-	-	-	-	-	-	-	-	03	09	07	08	15
Ostracoda	-	-	-	-	-	-	-	-	-	-	07	03	05	07
Stomatopoda	-	-	-	-	-	-	-	-	-	-	-	-	01	05
Mysidacea	-	-	-	-	-	-	-	-	-	-	-	-	01	03
Decapoda	-	-	-	-	-	-	-	-	-	06	07	14	12	16
Pisces	08	07	06	03	04	03	04	07	06	07	09	11	15	18
Prawn Larvae	-	-	-	-	-	-	04	02	03	04	05	09	10	15
Worms & Others	04	01	03	04	06	05	07	08	05	04	10	14	11	17
<b>Total</b>	<b>12</b>	<b>08</b>	<b>09</b>	<b>14</b>	<b>15</b>	<b>16</b>	<b>19</b>	<b>44</b>	<b>17</b>	<b>46</b>	<b>75</b>	<b>102</b>	<b>116</b>	<b>178</b>

- Not recorded

Table 8

Biomass (mg/m<sup>2</sup>) of Macrobenthos Taxa in Mandovi River/Estuary (October 1996)

Group	Sampling Location														
	R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R15	
Foraminifera	-	-	-	-	-	-	-	-	-	-	0.53	1.20	1.20	1.86	
Porifera	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Coelenterata	-	-	-	-	-	-	-	-	-	-	-	440.0	660.0	1320.0	
Nematoda	-	-	-	0.67	0.48	-	-	0.09	-	0.19	0.48	0.38	0.19	0.67	
Polychaeta	-	-	-	-	-	59.92	14.98	37.45	-	37.45	7.49	14.98	29.96	37.45	
Gastropoda	-	-	-	-	-	-	-	3.04	0.76	3.79	1.52	2.28	5.31	7.59	
Bivalvia	-	-	-	-	-	-	-	5313.07	1518.2	6072.08	3795.05	6831.9	7590.1	9108.12	
Harpacticoida	-	-	-	-	-	-	-	-	-	0.72	1.44	1.08	1.08	1.80	
Cumacea	-	-	-	-	-	-	-	-	-	-	-	-	0.50	1.00	
Tanaidacea	-	-	-	-	-	-	-	-	-	-	0.58	0.78	1.36	0.97	
Isopoda	-	-	-	-	-	-	-	-	-	-	20.98	52.45	20.98	24.41	
Amphipoda	-	-	-	-	-	-	-	-	-	1.20	5.40	4.20	4.80	9.00	
Ostracoda	-	-	-	-	-	-	-	-	-	-	0.000002	0.000001	0.000002	0.000024	
Stomatopoda	-	-	-	-	-	-	-	-	-	-	-	-	0.00009	0.0004	
Mysidacea	-	-	-	-	-	-	-	-	-	-	-	-	90.00	270.00	
Decapoda	-	-	-	-	-	-	-	-	-	634.80	740.60	1481.2	1269.6	1692.8	
Pisces	15880	13895	11910	5955	7940	5955	7940	73895	11310	13895	17865	218350	29775	35730	
Prawn Larvae	-	-	-	-	-	-	0.29	0.15	0.22	0.29	0.36	0.66	0.73	1.09	
Worms & Others	25.1	6.30	18.9	25.2	37.8	31.50	44.1	50.4	31.50	25.2	63.0	88.2	69.30	107.1	
Total	15905	13901	11928	5980	7978	6046	8000	79299	12860	20670	22502	227269	39521	48313	

- Not recorded

Table 9

## Density of Various Nektons (No/hauls) in Mandovi River/Estuary (October 1996)

Species	Sampling Location													
	R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R15
<b>Finfishes</b>														
<i>Ambassis commersonii</i>	-	-	-	-	-	-	-	-	-	-	5	-	-	-
<i>Ambassis dussumieri</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Awaous grammepomus</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Barrus evezardi</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Cynoglossus puncticeps</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Danio devario</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Etroplus suratensis</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Garra gotyla gotyla</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Gonoproktopterus thomasi</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Labeo kawrus</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Lelognathus blochii</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Mugil cephalus</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Nemacheilus rubidipinnis</i>	2	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Osteobrama dayi</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Pseudorhombus arsius</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Paruclosoma daniconius</i>	6	-	-	2	-	-	-	-	-	-	-	-	-	-
<i>Puntius filamentosus</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>P. amphibi</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>P. nigrofasciatus</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>P. ophiocephalus</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 9 (Contd..)

## Density of Various Nektons (No/hauls) in Mandovi River/Estuary (October 1996)

Species	Sampling Location													
	R3	R4	R5	R6	R6A	R7	R8	R9	R10	R11	R12	R13	R14	R
<i>P. arulius</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Rasbora neilgherriensis</i>	-	-	4	-	-	-	-	-	-	-	-	-	-	-
<i>Sieyopterus graseus</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Scatophagus argus</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Sillago sihama</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Stenogobius gymnopus</i>	-	-	-	-	-	-	2	-	-	-	-	-	-	1
<i>Teuthis vermiculata</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Chanos chanos</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<b>Shell Fishes</b>														
<i>Macrobrachium malcolmsoni</i>	6	-	1	-	-	-	-	-	-	-	-	-	-	-
<i>Metapenaeus affinis</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>M. monoceros</i>	-	-	-	-	-	11	-	-	-	-	-	-	-	-
<i>M. dobsoni</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Penaeus marguiesis</i>	-	-	-	-	-	-	7	-	-	-	-	-	-	-
<i>P. indicus</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Scylla serrata</i>	-	-	-	-	-	1	-	-	-	-	-	-	-	-
Unidentified (small crab)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Macrobrachium rude</i>	3	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Villorita cyprinoides</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Meretrix meretrix</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>M. casta</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Paphia malabarica</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-

- Not recorded