RESULTS

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In the present studies on Krishna river, physical parameters like temperature, turbidity, transparency, total solids, total dissolved solids, total suspended solids and chemical parameters like pH, dissolved oxygen, free carbondioxide, chlorinity, hardness and plant nutrients like inorganic phosphate and nitrate and heavy metals from water, sediments and bivalve tissue were carried out.

I. PHYSICAL STUDIES

a. Water Temperature :

Water temperature and its fluctuations in the water bodies play an important role in the life of aquatic flora and fauna and various biological processes in the water body. Therefore, an attempt has been made to study this parameter. The surface water temperature fluctuates between 20^0C to 29^0C at three stations. At stations 'A'. 'B' and 'C' maximum water temperature (29^0C)was recorded in the month of May, 2000 and minimum (20^0C) water temperature at station 'A' and 'B' was recorded in the month of January, 2000, while at station 'C' in the month of December, 1999. The variations in water temperature at all three stations was observed but it showed more or less uniform pattern (Table No. 1, Fig. 2).

Basically warming and cooling of water is slower than air and land. In winter, water temperature is higher than air, while reverse

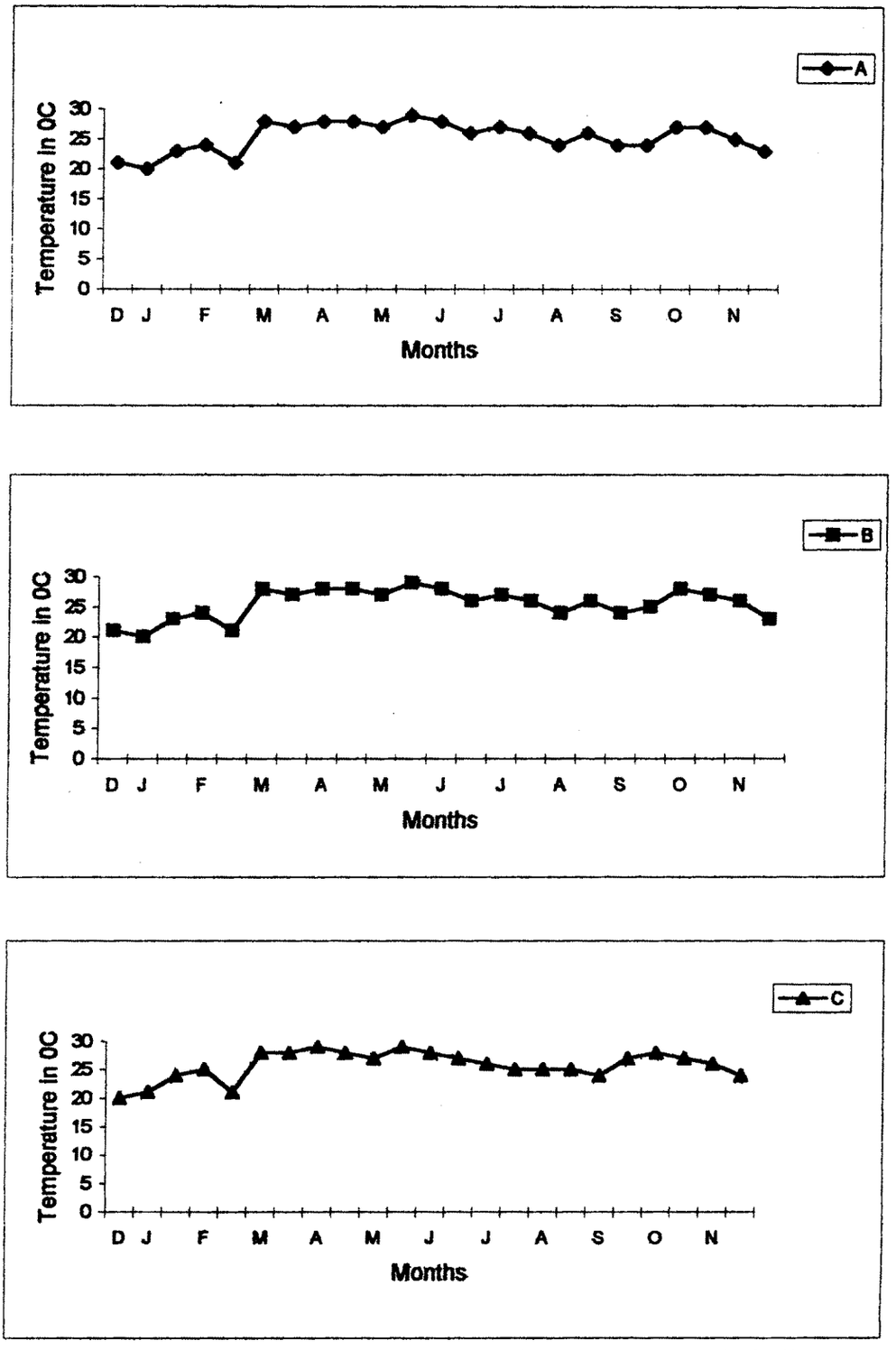
Table No.1

Fortnightly surface water temperature and turbidity at stations A, B & C (Dec-1999-Oct 2000) of Krishna river

	Temperature (in ^{0}C)			Turbidity (in NTU)		
Stations / Months	A	B	C	A	B	C
D	21	21	20	20	20	14
J	20	20	21	21	13	8
J	23	23	24	18	14	10
F	24	24	25	13	11	7
F	21	21	21	15	12	8
M	28	28	28	18	14	9
M	27	27	28	23	18	10
A	28	28	29	19	13	11
A	28	28	28	21	15	6
M	27	27	27	17	9	7
M	29	29	29	21	10	6
J	28	28	28	11	10	8
J	26	26	27	14	12	9
J	27	27	26	16	13	10
J	26	26	25	18	14	12
A	24	24	25	15	12	10
A	26	26	25	20	19	17
S	24	24	24	19	17	17
S	24	25	27	10	8	5
O	27	28	28	7	12	13
O	27	27	27	7	15	17
N	25	26	26	6	8	12
N	23	23	24	5	6	10

A - Sangli
B - Haripur
C - Ankali

Fig. No. 2 : Fortnightly surface water temperature (in ^{0}C) at stations A, B and C (Dec. 1999 – Nov. 2000) of Krishna river



Stations : A - Sangli B - Haripur C - Ankali

is the case in summer, during day time the air is warmer than water and cooler at night due to the specific heat of both the media.

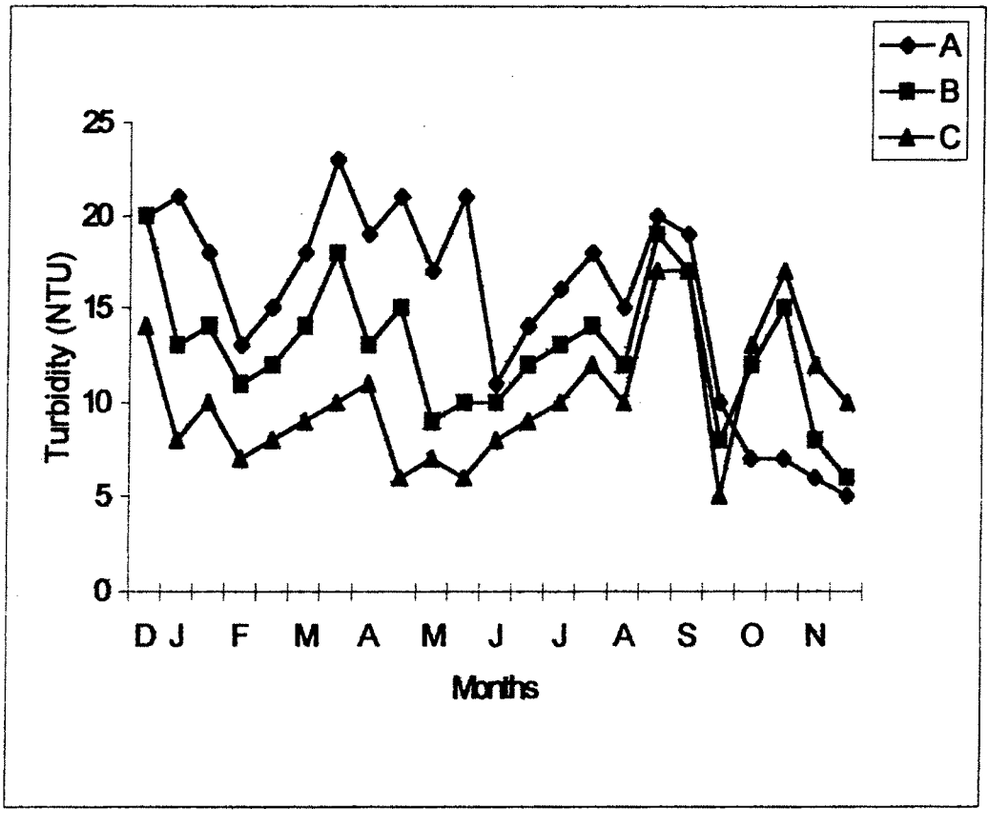
b. Turbidity :

In the natural water, turbidity may be due to the suspended inorganic substance such as silt, clay and planktonic organisms. It is important limiting factor in the productivity of aquatic body. Turbidity of Krishna river water shows fluctuations at three stations due to various activities in these areas, and sewage mixing in the river water. The turbidity of water fluctuates between 7 to 23 NTU. At station 'A' maximum turbidity was recorded (23 NTU) in the month of March, and minimum (5 NTU) in November. At stations 'B' maximum turbidity was recorded (20 NTU) in January and minimum (6 NTU) in November. At station 'C' maximum turbidity was recorded (17 NTU) in August and minimum (5 NTU) in September. Turbidity of water was more at station 'A' because of direct discharge of domestic sewage from Sangli city and sugar factory waste. Fortnightly average readings of turbidity are shown in Table No. 1 and Fig. 3.

c. Transparency :

Transparency depends upon suspended matter in the water. Light is an essential factor in freshwater bodies for the survival of variety of green plants which acts as a natural source of oxygen as the biproduct of photosynthesis. Light penetration directly affects

Fig. No. 3 : Fortnightly turbidity of water (in NTU) at stations A, B and C (Dec. 1999 – Nov. 2000) of Krishna river



Stations : A – Sangli B – Haripur C - Ankali

the productivity of the fresh water bodies. The transparency readings were taken during morning hours, when the light was adequate and minimum human activities. It was recorded with the help of standard Secchi disc of 30 cms in diameter. Fortnightly transparency readings were taken for three stations and are presented in Table No. 2 and Fig. 4.

The transparency of water ranges from 20 cms to 62 cms. At station 'A' maximum transparency (56 cms) was recorded in March, while minimum (20 cms) in May. At station 'B' maximum transparency (53 cms) was recorded in January and minimum (26 cms) in July. At station 'C' maximum transparency (62 cms) was in June and minimum (32 cms) in August. This fluctuation is due to mining of sediments and organic matter in river water during rainy season.

d. Total Solids :

Total solids in water samples fluctuates between 100 mg/l to 1240 mg/l during study period. At station 'A' maximum (1200 mg/l) value was recorded in March and minimum (400 mg/l) in July. At station 'B' maximum (1240 mg/l) value was recorded in April and minimum (300 mg/l) in September. At station 'C' it was maximum (780 mg/l) in April and minimum (100 mg/l) in September. Fortnightly total solid readings are presented in Table No.2 and Fig. 4.

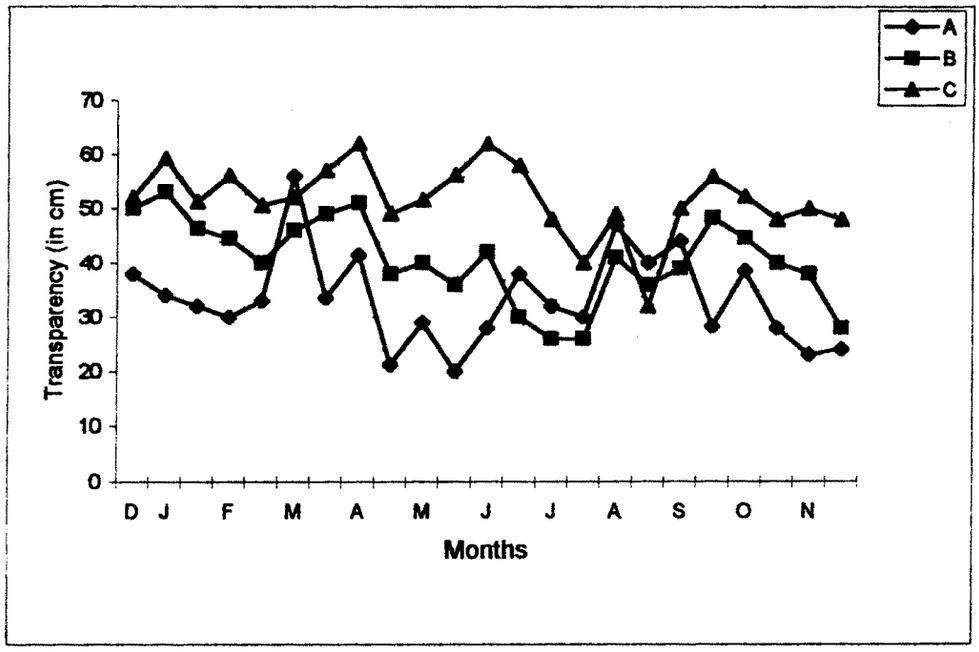
Table No. 2

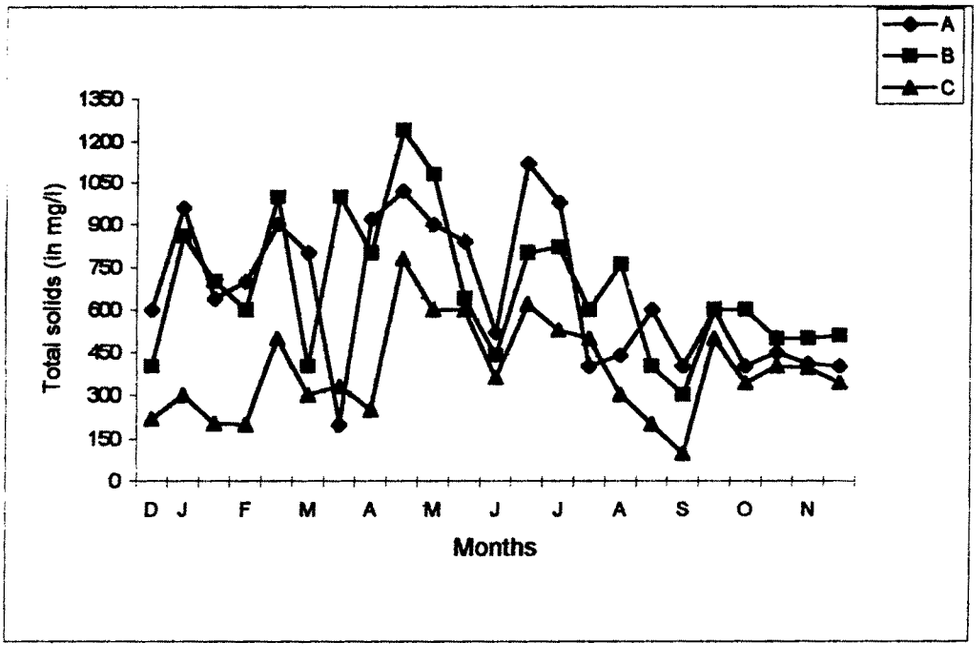
Fortnightly transparency and total solids of water at Stations A, B & C (Dec-1999 to Oct-2000) of Krishna river

	Transparency (in cm)			Total solids (mg/ l)		
Stations / Months	A	B	C	A	B	C
D	38	50	52	600	400	220
J	34	53	59.2	960	860	300
J	32	46.3	51.2	640	700	205
F	30	44.5	56.1	700	600	200
F	33	40	50.6	900	1000	500
M	56	46	52	800	400	300
M	33.6	49	57	200	1000	330
A	41.5	51	62	920	800	250
A	21.2	38	49	1020	1240	780
M	29	40	51.6	900	1080	600
M	20	36	56.2	840	640	600
J	28	42	62	520	440	360
J	38	30	58	1120	800	620
J	32	26	48	980	820	530
J	30	26	40	400	600	500
A	47	41	49	440	760	300
A	40	36	32	600	400	200
S	44	39	50	400	300	100
S	28.3	48.3	56	600	600	500
O	38.5	44.6	52.3	400	600	340
O	28	40	48	450	500	400
N	23	38	50	410	500	395
N	24	28	48	400	510	340

A - Sangli
B - Haripur
C - Ankali

Fig. No. 4 : Fortnightly transparency (in cm) and total solids (in mg/ l) of water at stations A, B and C (Dec. 1999 – Nov. 2000) of Krishna river





Stations : A – Sangli B – Haripur C - Ankali

e. Total Dissolved Solids (TDS) :

Total dissolved solids fluctuates between 80 mg/l to 100 mg/l. At stations 'A' maximum T.D.S. (1000 mg/l) was in March and minimum (260 mg/l) in November. At station 'B' maximum TDS (940 mg/l) was in April and minimum (125 mg/l) in September. At station 'C' maximum TDS (580 mg/l) was recorded in June and minimum (80 mg/l) in August. Fortnightly value of TDS are presented in Table No. 3 and Fig. 5.

f. Total Suspended Solids (TSS) :

Total suspended solids fluctuates between 20 mg/l to 600 mg/l. At station 'A' maximum TSS (600 mg/l) was recorded in February and minimum (40 mg/l) in September. At station 'B' maximum TSS (475 mg/l) was recorded in February and minimum (80 mg/l) in March. At station 'C' maximum TSS (200 mg/l) was in February and minimum (20 mg/l) in September. Fortnightly readings of total suspended solids are presented in Table No. 3 and Fig. 5.

CHEMICAL STUDIES

During the present investigation, seven major chemical parameters influencing the ecology of Krishna river were studied. The chemical parameters like pH (Hydrogen ion concentration), dissolved oxygen, free carbondioxide, chlorinity, hardness of water ($CaCO_3$) and nutrients like inorganic phosphates and nitrates were

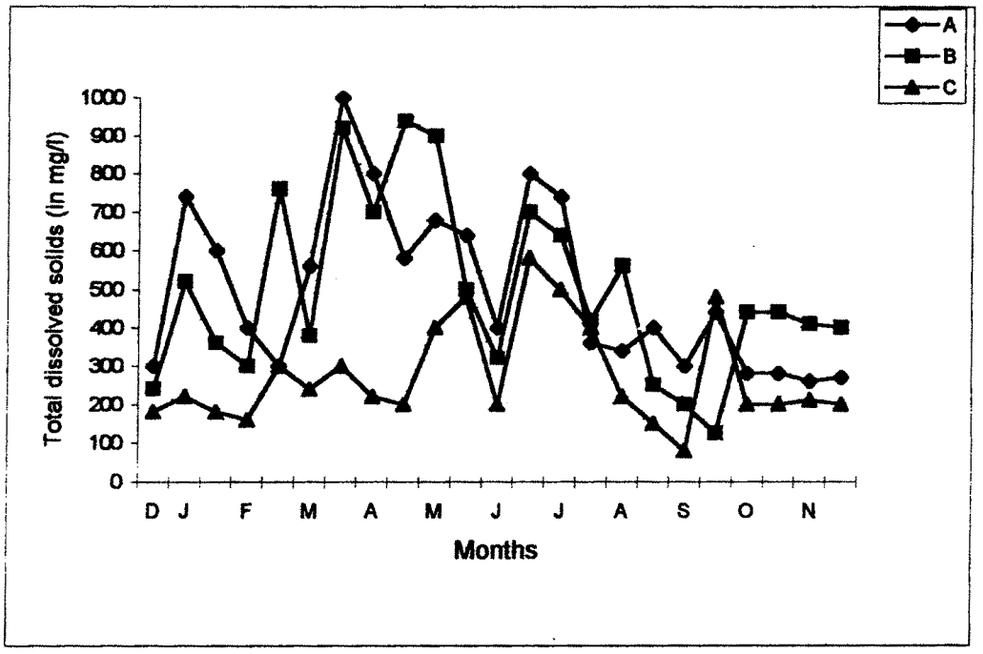
Table No. 3

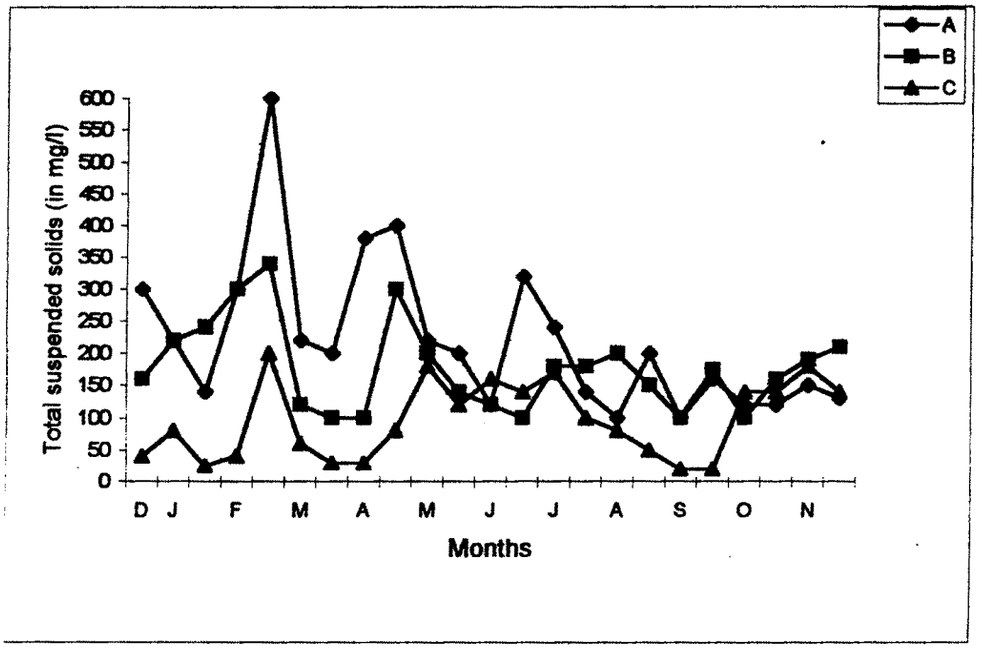
Fortnightly total dissolved solids and total suspended solids at stations A, B & C (Dec-1999-Oct 2000) of Krishna river

	Total dissolved solids (in mg/ l)			Total suspended solids (in mg/l)		
Stations / Months	A	B	C	A	B	C
D	300	240	180	300	160	40
J	740	520	220	220	220	80
J	600	360	180	140	240	25
F	400	300	160	300	300	40
F	300	760	300	600	340	200
M	560	380	240	220	120	60
M	1000	920	300	200	100	30
A	800	700	220	380	100	30
A	580	940	200	400	300	80
M	680	900	400	220	200	180
M	640	500	480	200	140	120
J	400	320	200	120	120	160
J	800	700	580	320	100	140
J	740	640	500	240	180	170
J	360	420	400	140	180	100
A	340	560	220	100	200	80
A	400	250	150	200	150	50
S	300	200	80	100	100	20
S	440	125	480	160	175	20
O	280	440	200	120	100	140
O	280	440	200	120	160	140
N	260	410	210	150	190	180
N	270	400	200	130	210	140

A - Sangli
B - Haripur
C - Ankali

Fig. No. 5 : Fortnightly total dissolved solids and total suspended solids (in mg/ l) of water at stations A, B and C (Dec. 1999 – Nov. 2000) of Krishna river





Stations : A – Sangli B – Haripur C - Ankali

studied. Water samples were analyzed for these parameters at fortnightly intervals.

a. pH (Hydrogen ion concentration) :

Among chemical parameters, the pH is an important factor in the water bodies. pH maintains the acidity or alkalinity of water, which is determined by concentration of hydrogen ion (H^+) and hydroxyl (OH^-) ions. Mathematically, it is expressed as negative logarithm of hydrogen ions concentration. The pH depends on the biological processes, free CO_2 present in maintaining pH from neutral to acidic whereas, bicarbonates help to maintain the pH towards alkalinity. The fresh water bodies shows seasonal variation in pH.

pH of water at three stations of Krishna river was recorded fortnightly with the help of pocket digital pH meter (Hanna instrument). It ranges between 7.5 to 8.5 throughout the year (December, 1999 to November, 2000). At station 'A' maximum pH (8.5) was in March and April while minimum (7.5) in July. At station 'B' it was maximum (8.3) in April and minimum (7.7) in July. At station 'C' maximum, pH (8.2) was in April and minimum (7.6) in July. The fortnightly reading of pH are presented in Table No. 4 and Fig. 6.

b. Dissolved Oxygen (DO) :

Dissolved oxygen is the most important factor in the freshwater for existence of biota (living organisms). The dissolved

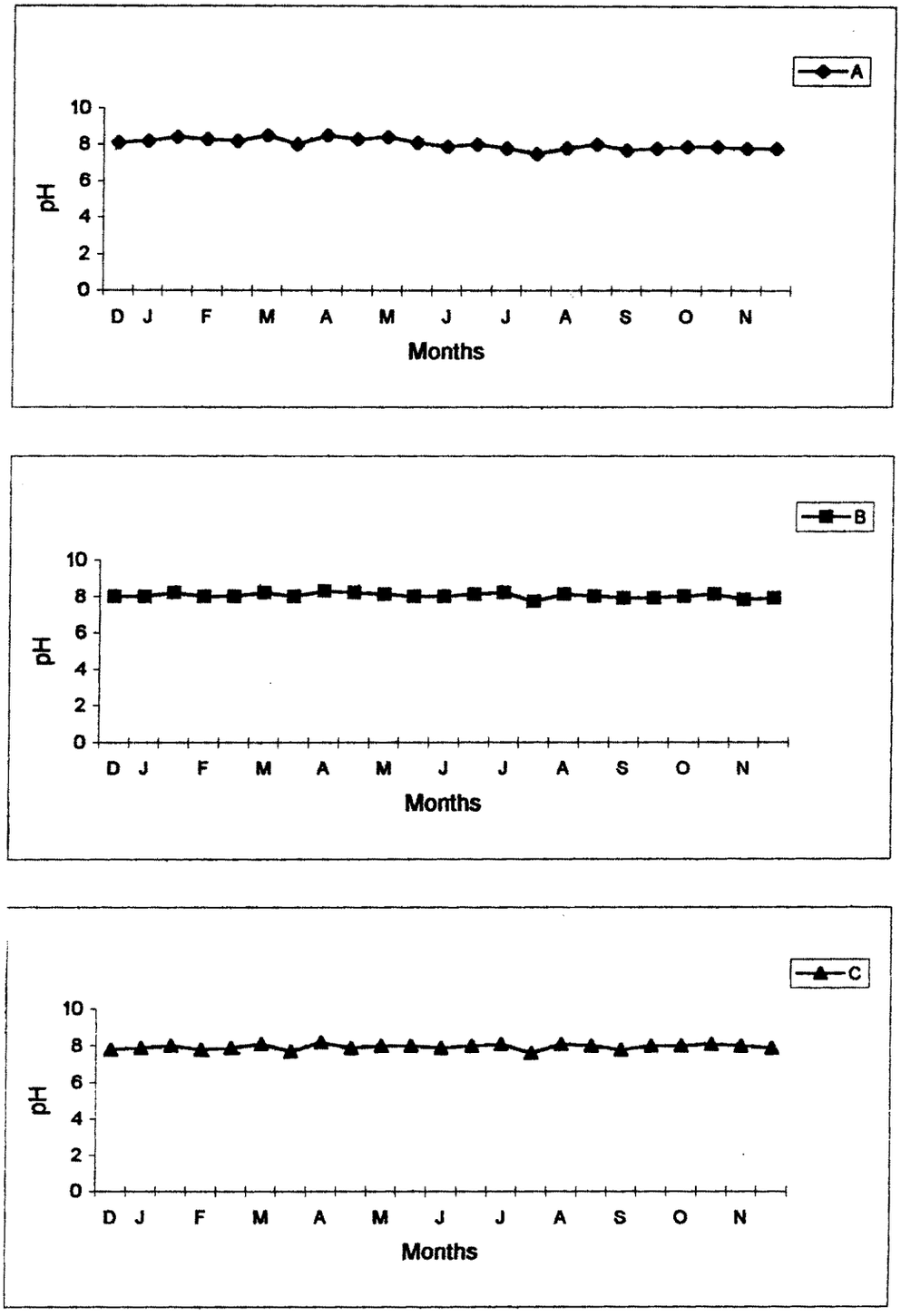
Table No. 4

Fortnightly pH (Hydrogen ion concentration) of water at Stations A, B & C (Dec-1999 to Oct-2000) of Krishna river

Stations / Months	A	B	C
D	8.1	8	7.8
J	8.2	8	7.9
J	8.4	8.2	8
F	8.3	8	7.8
F	8.2	8	7.9
M	8.5	8.2	8.1
M	8	8	7.7
A	8.5	8.3	8.2
A	8.3	8.2	7.9
M	8.4	8.1	8
M	8.1	8	8
J	7.9	8	7.9
J	8	8.1	8
J	7.8	8.2	8.1
J	7.5	7.7	7.6
A	7.8	8.1	8.1
A	8	8	8
S	7.7	7.9	7.8
S	7.8	7.9	8
O	7.9	8	8
O	7.9	8.1	8.1
N	7.8	7.8	8
N	7.8	7.9	7.9

A - Sangli
B - Haripur
C - Ankali

Fig. No. 6: Fortnightly pH (Hydrogen ion concentration) of water at stations A, B and C (Dec. 1999 – Nov. 2000) of Krishna river



Stations : A - Sangli B - Haripur C - Ankali

oxygen is responsible for the biological and biochemical processes undergoing in the water body. The main source of oxygen in freshwater body is from atmospheric absorption and as by product of photosynthesis from the aquatic plants. It is utilized by aquatic animals, biochemical as well as inorganic chemical reactions.

The fortnightly average values of dissolved oxygen are expressed in mg/ l. It fluctuates between 0.8 mg/l to 25.4 mg/l. At station 'A' maximum D.O. (16.8 mg/l) value was recorded in February and minimum (0.8 mg/l) in June. At station 'B' maximum D.O. (20.4 mg/l) value was recorded in January and minimum (5.6 mg/l) in May. At station 'C' maximum (25.4 mg/l) value was recorded in January and minimum (3.2 mg/l) in June. Fortnightly readings of dissolved oxygen are presented in Table No. 5 and Fig. 7.

c. Free Carbondioxide :

The availability of free carbondioxide in the freshwater bodies depends upon various sources like atmosphere, respiration of living organisms, bacterial decomposition of organic matter, in flowing of ground water etc. chiefly community respiration and decomposition are the sources of carbondioxide while, it is consumed in photosynthesis depending on pH and other biological conditions, free carbondioxide usually combines with water to form carbonic acid.

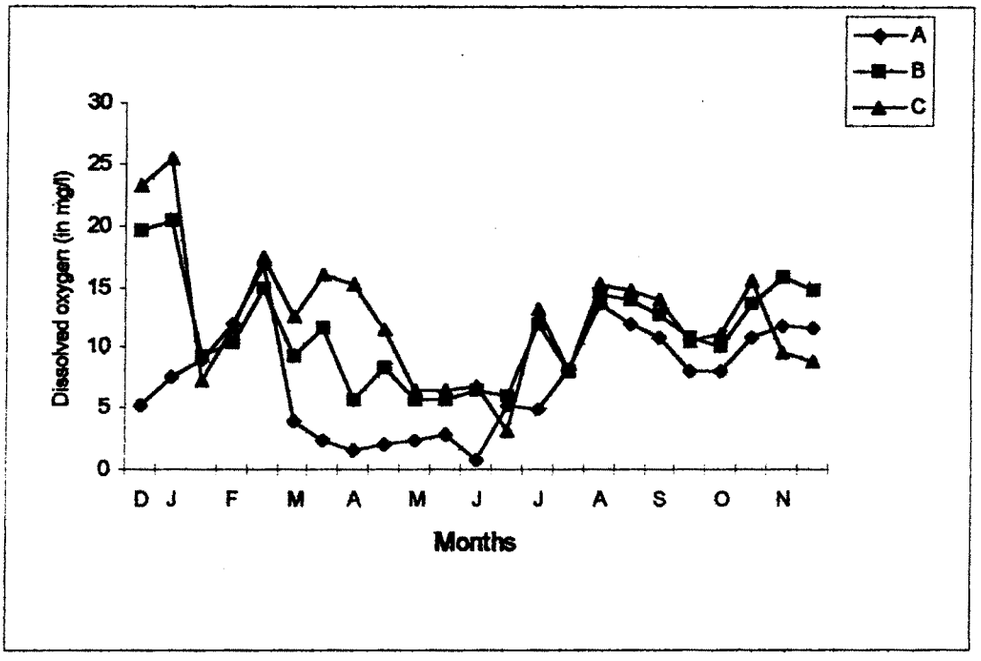
Table No. 5

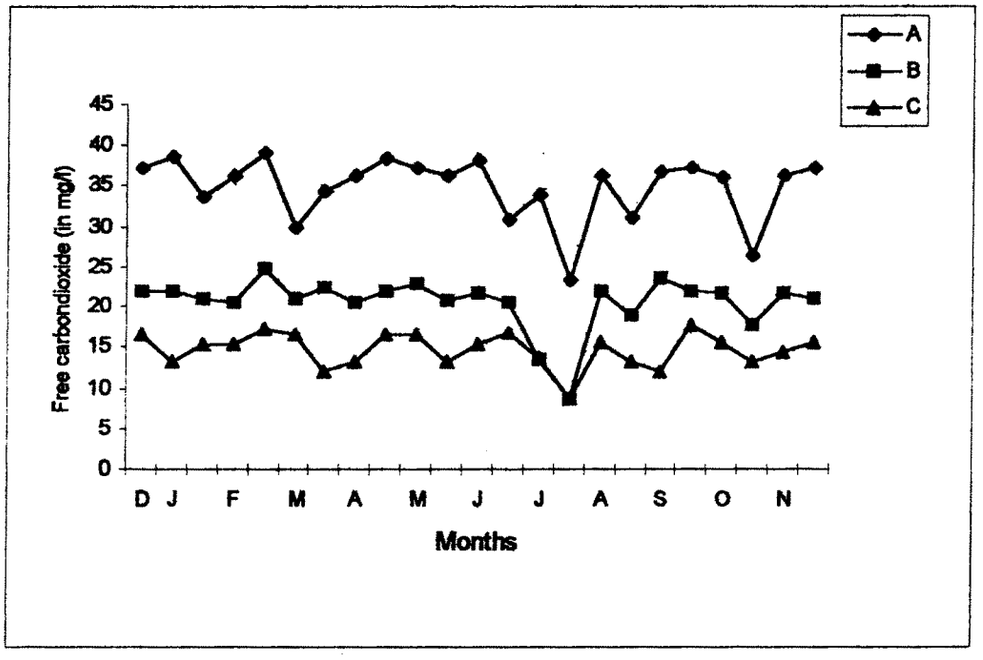
Fortnightly dissolved oxygen and free carbondioxide of water at Stations A, B & C (Dec-1999 to Oct-2000) of Krishna river

	Dissolved oxygen (in mg/ l)			Free carbondioxide (in mg/l)		
Stations / Months	A	B	C	A	B	C
D	5.2	19.6	23.2	37.2	22.0	16.4
J	7.6	20.4	25.4	38.6	22.0	13.2
J	9.0	9.2	7.2	33.6	21.0	15.2
F	12.0	10.4	11.6	36.4	20.4	15.4
F	16.8	15.0	17.5	39.0	24.8	17.2
M	3.9	9.2	12.5	30.0	21.0	16.4
M	2.4	11.6	16.0	34.4	22.3	12.0
A	1.6	5.6	15.2	36.2	20.6	13.2
A	2.0	8.4	11.5	38.4	22.0	16.6
M	2.4	5.6	6.4	37.2	22.8	16.4
M	2.8	5.6	6.4	36.4	20.8	13.2
J	0.8	6.4	6.8	38.2	21.6	15.2
J	5.2	6.0	3.2	30.8	20.4	16.8
J	4.8	12.0	13.2	34.0	13.4	13.6
J	8.1	8.0	8.0	23.4	8.8	8.8
A	13.6	14.4	15.2	36.4	22.0	15.6
A	12.0	14.0	14.8	31.2	18.8	13.2
S	10.8	12.8	14.0	36.8	23.6	12.0
S	8.0	10.8	10.6	37.2	22.0	17.6
O	8.0	10.0	11.2	36.0	21.6	15.6
O	10.8	13.6	15.6	26.4	17.6	13.2
N	11.8	15.9	9.6	36.3	21.7	14.3
N	11.6	14.8	8.8	37.2	21.0	15.6

A - Sangli
B - Haripur
C - Ankali

Fig. No. 7: Fortnightly dissolved oxygen and free carbondioxide (in mg/l) of water at stations A, B and C (Dec. 1999 – Nov. 2000) of Krishna river





Stations : A - Sangli B- Haripur C - Ankali

Fortnightly average values were expressed in mg/l. During present study, it fluctuates between 8.8 mg/l to 39 mg/l. At station 'A' maximum (39 mg/l) value of CO_2 was recorded in February and minimum (23.4 mg/l) in July. At station 'B' maximum (24.8 mg/l) value was recorded in February and minimum (8.8 mg/l) in July and August. At station 'C' maximum (17.2 mg/l) value was recorded in February and minimum (8.8 mg/l) in July. Fortnightly readings are expressed in Table No. 5 and Fig. 7.

d. Hardness ($CaCO_3$) :

Hardness of water is imparted by alkaline earth metal cations, mainly calcium and magnesium present in it. An aquatic ecosystem receives calcium from lime stone, dolomite and gypsum deposits in the catchment area. In fresh water, there will be bicarbonates associated mainly with calcium and magnesium. These salts are useful for assimilation, but never help to store carbondioxide. Hardness of water may be temporary, caused by dissolved calcium and magnesium bicarbonates or permanent, by predominant bicarbonates and sulphates of calcium and magnesium.

Total hardness of water fluctuates between 60 mg/l to 480 m/l. at station 'A' maximum (480 mg/l) value was recorded in January and minimum (84 mg/l) in September. At station 'B' maximum (350 mg/l) value was recorded in February and minimum (80 mg/l) in September. At station 'C' maximum (242 mg/l) value was recorded in December, 1999 and minimum (60 mg/l) in September.

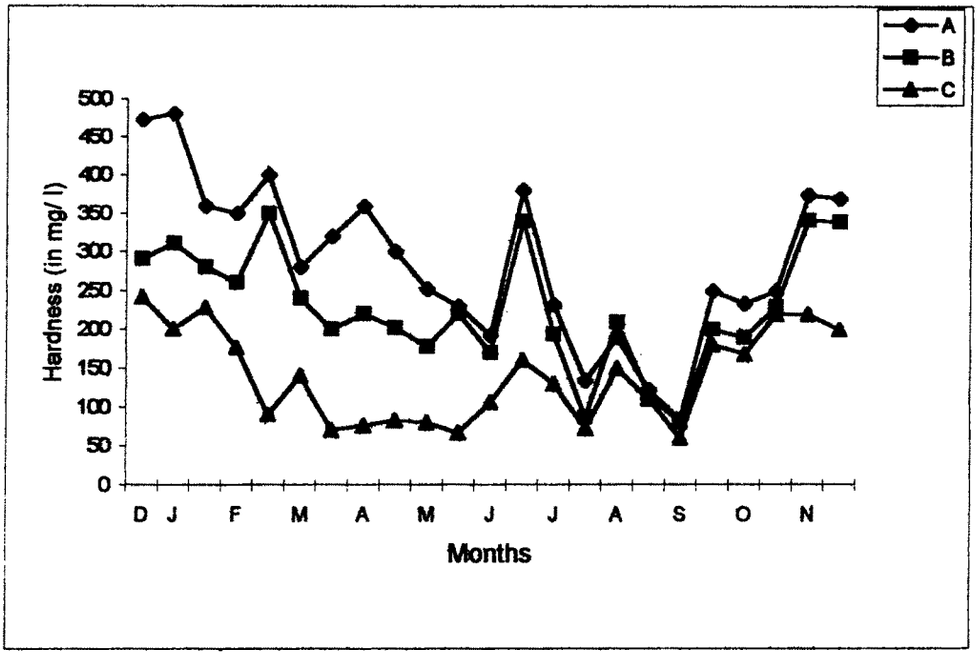
Table No. 6

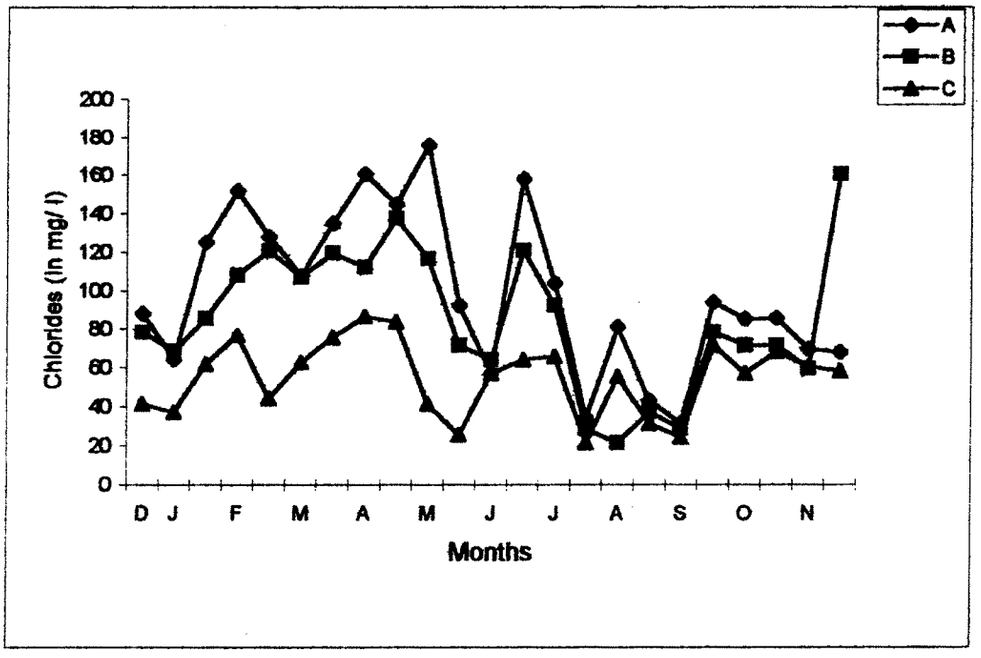
Fortnightly hardness and chlorides of water at Stations A, B & C (Dec-1999 to Oct-2000) of Krishna river

	Hardness (in mg/ l)			Chlorides (in mg/l)		
Stations / Months	A	B	C	A	B	C
D	472	290	242	88	78.1	41.1
J	480	310	200	64	68.3	37.1
J	360	280	228	124.9	85.6	61.42
F	350	260	176	151.9	107.9	76.6
F	400	350	90	127.8	120.7	44
M	280	240	140	107.4	106.7	62.4
M	320	200	70	134.9	119.2	75.2
A	360	220	76	160.4	112.1	86.6
A	300	202	82	144.8	137.5	83.7
M	252	178	80	175.6	116.4	41.1
M	230	220	66	92.3	71	25.56
J	192	170	106	56.8	63.9	56.8
J	380	340	160	157.9	120.7	63.9
J	232	194	130	103.6	92.3	65.3
J	134	86	72	34	28.4	21.3
A	190	210	150	80.9	21.3	55.3
A	122	116	110	42.6	36.9	31.2
S	84	80	60	31.2	28.8	24.4
S	250	200	180	93.7	78.1	71
O	234	190	168	85.2	71	56.8
O	250	230	220	85.5	71	68.1
N	375	342	220	69.2	59.2	60.2
N	370	340	200	67.5	160.5	58.2

A - Sangli
B - Haripur
C - Ankali

Fig. No. 8: Fortnightly hardness and chlorides (in mg/l) of water at stations A, B and C (Dec. 1999 – Nov. 2000) of Krishna river





Stations : A - Sangli B - Haripur C - Ankali

Maximum hardness was recorded in winter season, while minimum hardness was recorded in monsoon. Fortnightly readings are presented in Table No. 6 and Fig. 8.

e. Chlorides :

Natural water normally has a low chloride contents compared to bicarbonates and sulphates. High chlorides are found in the inland saline lakes, estuaries and marine waters. High chloride level indicate pollution from domestic sewage and industrial effluents. The chloride level, as high as 250 mg/l is safe for human consumption, a level above this imparts a salty taste to the potable water.

The chloride in water fluctuates between 21.3 mg/l to 175.6 mg/l. At station 'A' maximum chloride (175.6 mg/l) value was recorded in May and minimum (34 mg/l) in July. At station 'B' maximum (137.5 mg/l) value was recorded in April and minimum (28.4 mg/l) in July. At station 'C' maximum (86.6 mg/l) value was recorded in April and minimum (21.3 mg/l) in July. Maximum values of chlorides were recorded in summer season, while minimum values in monsoon. Fortnightly readings are presented in Table No. 6, Fig. 8.

f. Acidity :

Acidity of water sample was estimated with standard method and values are expressed in mg/l. It fluctuates between 15 mg/lit. to

255 mg/l. At station A, B and C maximum and minimum values were recorded in the months of May and August, respectively. Maximum and minimum values of acidity at station 'A' were 255 and 35 mg/l, at station 'B' were 230 and 20 mg/l, and at station 'C' were 175 and 15 mg/l. Fortnightly readings are expressed in Table No. 7 and Fig. 9.

g. Alkalinity :

Alkalinity of water samples was estimated and values are expressed in mg/l. It fluctuates between 80 mg/l to 400 mg/l. At station 'A' maximum (400 mg/l) value was recorded in January and minimum (120 mg/l) in September. At station 'B' maximum (320 mg/l) value was recorded in February and minimum (80 mg/l) in September. At station 'C' it was maximum (200 mg/l) in January and minimum (80 mg/l) in August. Maximum value of alkalinity was recorded in the month of January and minimum in the month of August-September. Fortnightly readings are presented in Table No.7 and Fig. 9.

Alkalinity of the water is its capacity to neutralize a strong acid and is characterized by the presence of hydroxyl ions capable of combining the hydrogen ions. Alkalinity of natural waters is due to free hydroxyl ions and hydrolysis of salts formed by weak acids and strong bases such as carbonates and bicarbonates.

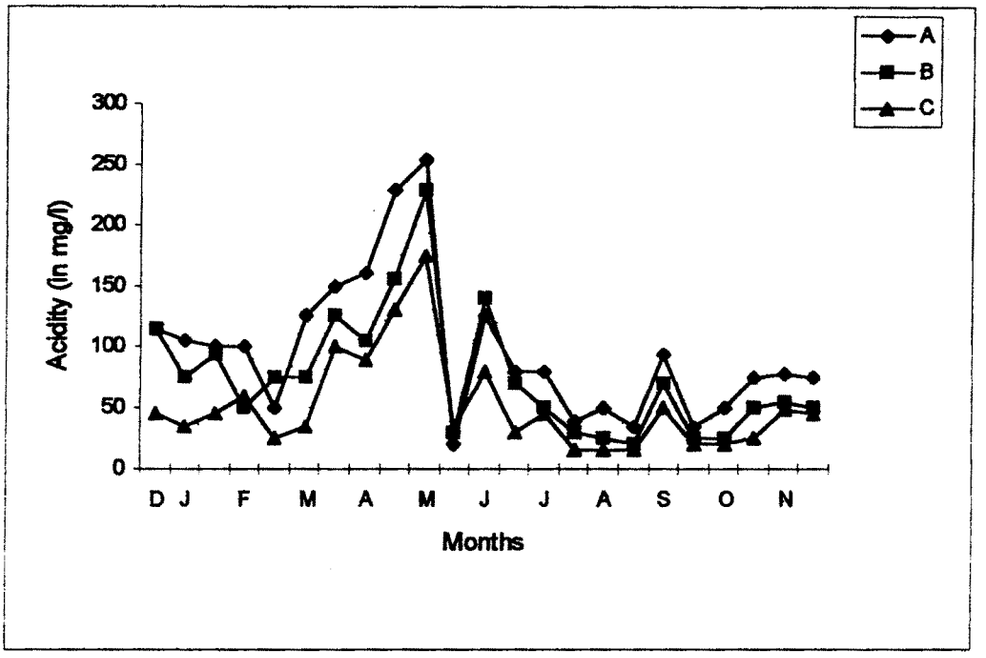
Table No. 7

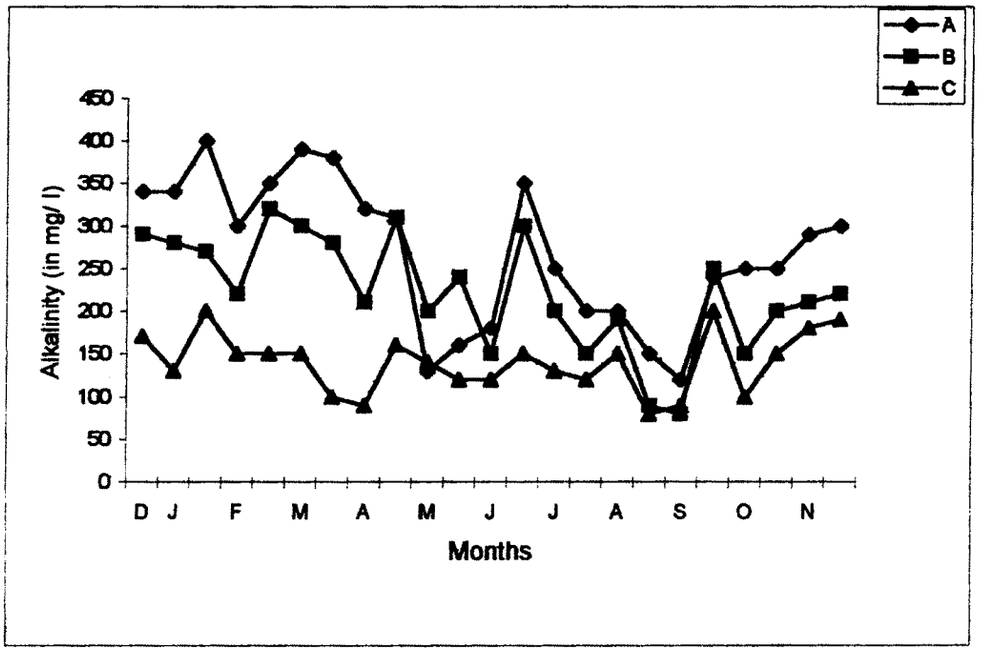
Fortnightly Acidity and alkalinity of water at Stations A, B & C (Dec-1999 to Oct-2000) of Krishna river

	Acidity (in mg/ l)			Alkalinity (in mg/l)		
Stations / Months	A	B	C	A	B	C
D	115	115	45	340	290	170
J	105	75	35	340	280	130
J	100	95	45	400	270	200
F	100	50	60	300	220	150
F	50	75	25	350	320	150
M	125	75	35	390	300	150
M	150	125	100	380	280	100
A	160	105	90	320	210	90
A	230	155	130	310	310	160
M	255	230	175	130	200	140
M	20	30	35	160	240	120
J	125	140	80	180	150	120
J	80	70	30	350	300	150
J	80	50	45	250	200	130
J	40	30	15	200	150	120
A	50	25	15	200	190	150
A	35	20	15	150	90	80
S	95	70	50	120	80	90
S	35	25	20	240	250	200
O	50	25	20	250	150	100
O	75	50	25	250	200	150
N	78	55	48	290	210	180
N	75	50	45	300	220	190

A - Sangli
B - Haripur
C - Ankali

Fig. No. 9: Fortnightly acidity and alkalinity (in mg/l) of water at stations A, B and C (Dec. 1999 – Nov. 2000) of Krishna river





Stations : A - Sangli B - Haripur C - Ankali

h. Phosphate - Phosphorus :

Phosphate is an important nutrient essential for productivity of phytoplankton and macrophytes in aquatic ecosystem. In an aquatic ecosystem phosphorus occurs both in inorganic and organic forms. Of the two, the inorganic phosphorus as orthophosphate plays an important role by acting as a nutrient along with nitrates. Phosphorus is found in combine form as phosphate of iron and calcium. Excess phosphate stipulates development of algal blooms such as blooms of blue green like microcystis.

The amount of phosphate (Phosphorus) was estimated and expressed in mg/l, it fluctuates between 11 ± 1.7 μg/l and 494 ± 13.63 μg/l. At station A, B and C maximum and minimum values of phosphate was recorded in July and May respectively. At station 'A' maximum phosphate (494 ± 13.63 μg/l) value was recorded in July and minimum (20 ± 2.62 μg/l) in May. At station 'B' maximum (294 ± 42.80 μg/l) value was recorded in July and minimum (11 ± 1.7 μg/l) in May. At station 'C' maximum (304 ± 11.14 μg/l) value was recorded in July and minimum (24 ± 2.6 μg/l) in May. Maximum values of phosphates were recorded in the month of July, while minimum values were recorded in May due to decrease in water level and increased temperature. Fortnightly readings are presented in Table No. 8 and Fig. 10.

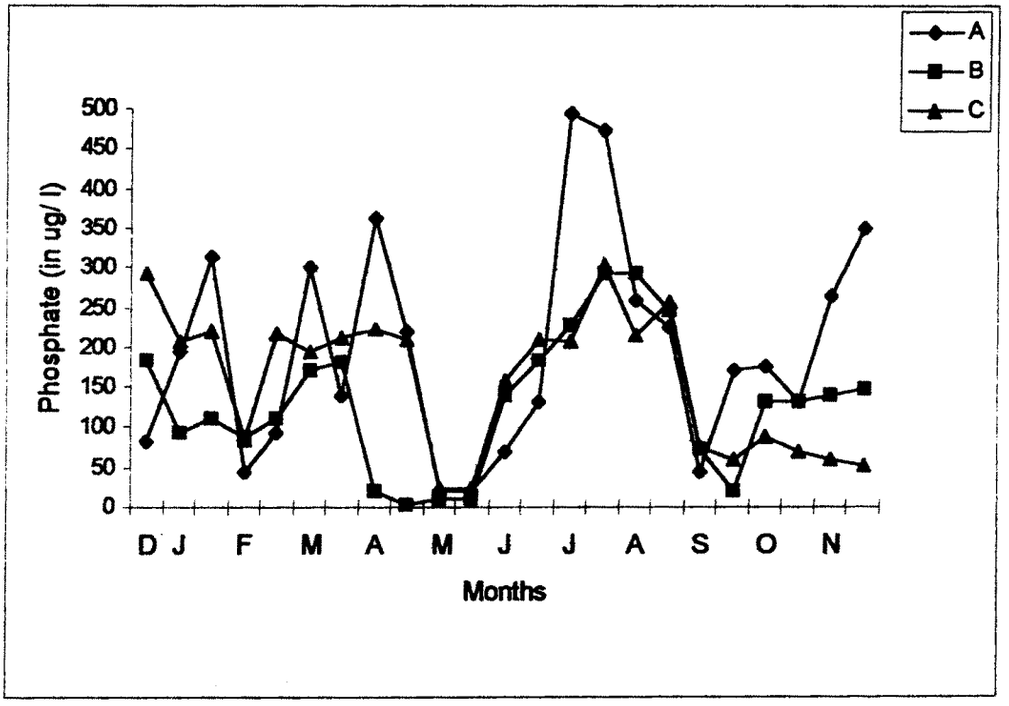
Table No. 8

Fortnightly Phosphate of water (in µg/ l) at Stations A, B & C (Dec-1999 to Oct-2000) of Krishna river

Stations / Months	A	B	C
D	83 ± 10.40	185 ± 8.8	294 ± 8.28
J	194 ± 13.71	93 ± 9.9	206 ± 8.28
J	313 ± 13.09	112 ± 8.4	221 ± 14.19
F	44 ± 8.17	88 ± 9.4	85 ± 4.8
F	93 ± 9.10	112 ± 7.13	218 ± 5.8
M	300 ± 19.0	171 ± 19.20	194 ± 6.2
M	141 ± 26.54	181 ± 7.48	212 ± 2.62
A	362 ± 18.85	142 ± 38.17	222 ± 8.21
A	219 ± 3.26	185 ± 8.80	211 ± 6.16
M	21 ± 2.48	11 ± 1.7	24 ± 3.77
M	20 ± 2.62	11 ± 1.7	24 ± 2.6
J	69 ± 17.30	141 ± 5.71	158 ± 4.6
J	133 ± 19.16	185 ± 4.78	211 ± 8.64
J	494 ± 13.63	227 ± 0.74	208 ± 4.98
J	474 ± 19.68	294 ± 42.80	304 ± 11.14
A	259 ± 14.61	293 ± 12.24	214 ± 7.25
A	226 ± 62.02	246 ± 2.94	257 ± 3.29
S	45 ± 2.94	72 ± 21.22	75 ± 3.26
S	170 ± 2.62	22 ± 15.55	59 ± 5.73
O	176 ± 4.46	131 ± 11.81	88 ± 3.3
O	131 ± 11.81	133 ± 29.16	69 ± 17.30
N	265 ± 5.6	140 ± 6.20	60 ± 7.5
N	350 ± 6.1	147 ± 6.34	51 ± 8.1

A - Sangli
B - Haripur
C - Ankali

Fig. No. 10 : Fortnightly phosphate - P (in µg/ l) of water at stations A, B and C (Dec. 1999 – Nov. 2000) of Krishna river



Stations : A - Sangli B - Haripur C - Ankali

i. Nitrate- Nitrogen :

Nitrate nitrogen is present only in trace quantities in water. In an aquatic ecosystem nitrates are formed on biological oxidation of organic nitrogenous matter received from domestic sewage, agricultural runoff and industrial effluents. In addition to this, metabolic waste, excretory products and dead organisms, further add organic nitrogen. Such organic nitrogen is mainly oxidised by nitrifying bacteria e.g. Nitrosomonas, Nitrobacter, Algal-anabaena, Nostoc etc.

The estimation of nitrates from water samples at three stations of Krishna river fluctuates between 66.6 ± 16.43 μg/l to 947 ± 31.04 μg/l. At station 'A' maximum (941 ± 42.12 μg/l) value was recorded in the month of May and minimum (112 ±5.37 μg/l) in September. At station 'B' maximum (974 ± 31.4 μg/l) value was recorded in May and minimum (101 ± 35.82 μg/l) in September. At station 'C' maximum (766 ± 19.68 μg/l) value was recorded in May and minimum (66.6 ± 16.43 μg/l) in September. Fortnightly readings of nitrate-nitrogen are presented in Table No. 9 and Fig. 11.

HEAVY METALS

Krishna river is facing the problems of industrial and domestic sewage pollution. Large amount of sewage is entering directly into the river at station 'A' (Sangli), which affects the physico-chemical and biological characteristics, productivity and flora and fauna of

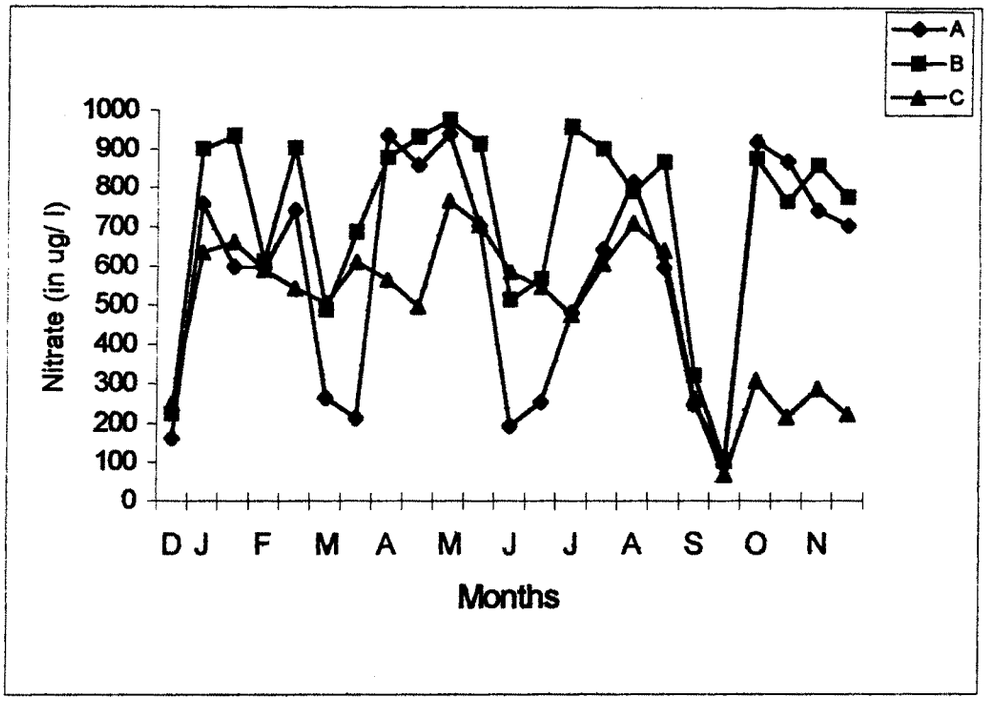
Table No. 9

Fortnightly Nitrate of water (in µg/ l) at Stations A, B & C (Dec-1999 to Oct-2000) of Krishna river

Stations / Months	A	B	C
D	161 ± 6.7	233 ± 17.98	249 ± 21.66
J	756 ± 23.55	901 ± 19.8	634 ± 32.87
J	598.6 ± 24.9	934 ± 102.3	660 ± 13.6
F	594.6 ± 9.97	612 ± 14.2	589 ± 19.95
F	741 ± 24.72	904 ± 37.66	542 ± 33.74
M	265 ± 40.15	488 ± 23.55	505 ± 42.66
M	212 ± 18.18	686 ± 14.27	609 ± 11.46
A	936 ± 39.5	878 ± 28.90	564 ± 35.70
A	858 ± 38.80	932 ± 34.56	496 ± 23.55
M	941 ± 42.12	974 ± 31.04	766 ± 19.68
M	702 ± 48.43	914 ± 39.26	709 ± 38.13
J	193 ± 29.10	514 ± 20.99	584 ± 28.47
J	254 ± 11.46	568 ± 19.97	546 ± 37.46
J	481 ± 11.46	957 ± 38.08	474 ± 19.13
J	642 ± 29.04	902 ± 16.75	605 ± 11.46
A	816 ± 45.4	789 ± 24.03	708 ± 28.3
A	597 ± 29.27	868 ± 19.05	638 ± 42.77
S	246 ± 18.80	321 ± 19.13	262 ± 10.65
S	112 ± 5.37	101 ± 35.82	66.6 ± 16.43
O	921 ± 22.90	877 ± 29.49	308 ± 35.50
O	870 ± 18.93	764 ± 12.74	214 ± 18.40
N	741 ± 72.22	860 ± 39.50	288 ± 8.64
N	702 ± 48.43	776 ± 16.75	221 ± 7.65

A - Sangli
B - Haripur
C - Ankali

Fig. No. 11 : Fortnightly nitrate -N (in µg/ l) of water at stations A, B and C (Dec. 1999 – Nov. 2000) of Krishna river



Station : A - Sangli B- Haripur C - Ankali

the habitat. Well mixed water and sewage reaches at Haripur (station B) where water current is very slow, hence maximum suspended solids settled at the bottom of river, it affects the fish productivity and other invertebrates population. The bottom of the river at station A and B was entirely covered by algal blooms.

In India, wide use of metal in different chemical forms by the industrial, agricultural and domestic sector has resulted in a great deal of concern about release of toxic metals in the environment. Considering the industrial waste and sewage into Krishna river, the water samples, sediment samples and bivalve molluscs were collected and analysed for heavy metal detection during the investigation by atomic absorption spectrophotometer. Heavy metals such as Lead (Pb), Zinc (Zn), Nickel (Ni) and Aluminium (Al) were found in the samples and expressed in ppm.

1. Water Sample :

For the study of heavy metals from the selected stations, water samples were collected and analysed. Heavy metals such as Pb, Zn, Ni, Al, Hg, Cd, Mg, Cu were absent throughout the investigation (December 1999 to November 2000).

2. Sediment Samples :

Sediment samples were analysed for heavy metal concentration/ load during different seasons like winter, summer and

monsoon i.e. in the months of January, May and July, 2000. The results are expressed in ppm and presented in Table No. 10.

Metal Concentrations in Sediments :

The detection of metals (Zn, Ni, Pb and Al) from sediment samples at three different stations showed that, zinc concentration in the sediments from the Krishna river was higher at station 'A', during winter (71 ppm) and summer (64.5 ppm) while at station 'B' in monsoon (39.9 ppm) as compared to other two stations. Similarly these values were maximum during winter as compared to summer and monsoon at three respective stations. Concentration of zinc recorded during present study is much more higher than the ISI standard (15 ppm).

Concentration of Nickel in sediments from the Krishna river was higher at station 'A'; during summer (0.0028 ppm) as compared to other two stations, while, concentration of nickel was higher during monsoon (0.0014 ppm) at station 'B'. These values are compared with ISI standard (3.0 ppm) and found to be below permissible level.

Content of Lead in sediments from the Krishna river was maximum at station 'A' during winter and summer (0.00082 ppm), while at station 'C' in monsoon (0.00044 ppm) as compared to other two stations. In general, concentration of lead was higher during

Table No. 10

Metal concentrations in sediments from Krishna river (in ppm)

Winter (January, 2000)

Metals / Stations	Zinc	Nickel	Lead	Aluminium
Sangli	71	0.002	0.00082	0.082
Haripur	74	0.0001	0.0042	0.042
Ankali	53	Nil	Nil	0.051

Summer (May, 2000)

Metals / Stations	Zinc	Nickel	Lead	Aluminium
Sangli	64.5	0.0028	0.00082	0.081
Haripur	54.1	0.0012	0.00042	0.066
Ankali	59.2	0.0002	0.00011	0.058

Monsoon (July, 2000)

Metals / Stations	Zinc	Nickel	Lead	Aluminium
Sangli	36.5	0.0014	0.00040	0.061
Haripur	39.9	0.0014	0.00044	0.066
Ankali	35.9	0.00022	0.00009	0.058

summer and winter at station 'A' as compared to the ISI standard (0.1 ppm). These values are below permissible level.

Concentration of Aluminium in sediments from the Krishna river was higher at station 'A' during winter (0.082 ppm) and summer (0.081 ppm) whereas at station 'B' in monsoon (0.066 ppm) as compared to other two stations. In general, concentration of aluminium was higher during summer as compared to winter and monsoon at respective stations.

HEAVY METAL CONCENTRATION IN BIVALVE TISSUE

Winter :

The detection of metals (Zn, Al, Ni and Pb) from bivalve molluscs of different species was carried out. At station 'C' (Ankali) the metal content during winter season (January) from the bivalve tissues (*L. corrianus*) was estimated as follows. The zinc content in different tissues was in the order of gill > gonads > mantle > hepatopancreas > siphon > foot (0.65, 0.56, 0.42, 0.19, 0.16, 0.09 ppm respectively). The nickel content in different tissues was in the order of gonads > hepatopancreas > mantle > gill > foot > siphon (0.661, 0.553, 0.497, 0.483, 0.083, 0.008 ppm respectively). The lead concentration in different tissues was in the order of gonads > hepatopancreas > mantle > gill > foot > siphon (0.094, 0.088, 0.082, 0.081, 0.062, 0.006 ppm respectively). The aluminium content in different tissues was in the order of gonads >

hepatopancreas > gill > foot > siphon > mantle (0.221, 0.123, 0.112, 0.081, 0.062, 0.061 ppm respectively) (Table No. 11).

Comparatively maximum concentration of heavy metals in different tissues of bivalve molluscs (*L. corrianus*) was observed during winter season (January). The zinc content was maximum (0.65 ppm) in gill and minimum (0.09 ppm) in foot. Whereas nickel content was maximum (0.661 ppm) in gonads and minimum (0.0008 ppm) in siphon, lead content was maximum (0.221 ppm) in gonad and minimum (0.061 ppm) in siphon and mantle. Aluminium content was maximum (0.221 ppm) in gonad and minimum (0.062 ppm) in siphon.

The metal content during winter season (January) from the bivalve tissue (*L. marginalis*) was estimated as under. The zinc concentration in different tissues was in the order of gill > gonad > siphon > foot > hepatopancreas > mantle (0.60, 0.37, 0.12, 0.10, 0.08, 0.07 ppm respectively). The nickel content in various tissues was in the order of gonads > hepatopancreas > gill > mantle > foot > siphon (0.592, 0.482, 0.462, 0.382, 0.072, 0.0072 ppm respectively). The lead content in different tissues was in the order of gonads > foot > mantle > hepatopancreas > gill > siphon (0.088, 0.076, 0.072, 0.058, 0.0005 ppm respectively). The aluminium content in different tissues was in the order of gonad > hepatopancreas > gill > foot > siphon > mantle (0.182, 0.100, 0.068, 0.056, 0.052 ppm respectively) (Table No. 11).

Comparatively metal content during winter season (January) from the bivalve tissue (*L. marginalis*) showed that, zinc content was maximum (0.60 ppm) in gill and minimum (0.08 ppm) in hepatopancreas. Whereas maximum (0.592 ppm), nickel content was in gonads and minimum (0.0072 ppm) in siphon. Lead content was maximum (0.088 ppm) in gonads and minimum (0.005 ppm) in siphon, while aluminium content was maximum (0.221 ppm) in gonads and minimum (0.052 and 0.056 ppm) in mantle and siphon.

The metal content during winter season (January) from the bivalve tissues (*I. caeruleus*) was estimated as under. The zinc content in different tissues was in the following order as siphon > mantle > gill > gonads > hepatopancreas > foot (0.67, 0.65, 0.015, 0.012, 0.11, 0.10 ppm respectively). Nickel content in various tissues was in the following order as gonad > hepatopancreas> gill > mantle > foot > siphon (0.608, 0.521, 0.361, 0.072, 0.064 ppm respectively). The lead content in different tissues was in the following order as gonads > mantle > hepatopancreas > foot > gill > siphon (0.090, 0.080, 0.078, 0.076, 0.061, 0.0052 ppm respectively). The aluminium content in different tissues was in the following order as gonads > hepatopancreas > gill > foot > siphon > mantle (0.211, 0.122, 0.082, 0.068, 0.046, 0.042 ppm respectively) (Table No.11).

The metal content during winter season (January) from bivalve tissue (*I. caeruleus*) showed that, zinc content was maximum (0.67

Table No. 11

Heavy metal concentrations in bivalve tissues (in ppm) in Winter (January, 2000) from Krishna river at Station Ankali

Species	Tissues	Zinc	Nickel	Lead	Aluminium
Lc	Mantle	0.42	0.497	0.081	0.061
	Gill	0.65	0.483	0.062	0.112
	Siphon	0.16	0.008	0.006	0.062
	Foot	0.09	0.082	0.082	0.081
	Hepatopancreas	0.19	0.553	0.088	0.123
	Gonads	0.56	0.661	0.094	0.221
Lm	Mantle	0.07	0.382	0.076	0.052
	Gill	0.60	0.462	0.058	0.100
	Siphon	0.12	0.0072	0.005	0.056
	Foot	0.10	0.072	0.076	0.068
	Hepatopancreas	0.08	0.482	0.072	0.100
	Gonads	0.37	0.592	0.088	0.182
Ic	Mantle	0.65	0.361	0.080	0.042
	Gill	0.15	0.361	0.061	0.082
	Siphon	0.67	0.064	0.0052	0.046
	Foot	0.10	0.072	0.076	0.068
	Hepatopancreas	0.11	0.511	0.078	0.122
	Gonads	0.12	0.608	0.090	0.211

Lc - *Lamellidens corrianus*
Lm - *Lamellidens marginalis*
Ic - *Indonaia caeruleus*

ppm) in siphon and minimum (0.10 ppm) in foot, whereas nickel content was maximum (0.608 ppm) in gonads and minimum (0.0064 ppm) in siphon. The lead content was maximum (0.090 ppm) in gonad and minimum (0.005 ppm) in siphon, while aluminium content was maximum (0.211 ppm) in gonads and minimum (0.042 ppm) in mantle.

Summer :

At station 'C' (Ankali) the metal content during summer season (May) from the bivalve tissues (*L. corrianus*) was estimated as under. The zinc content in different tissues was in the order of gill > gonads > mantle > siphon > hepatopancreas > foot (0.76, 0.337, 0.33, 0.285, 0.22, 0.13 ppm respectively). The nickel content in different tissues was in the order of gonads > hepatopancreas > mantle > gill > foot > siphon (0.67, 0.51, 0.493, 0.441, 0.079, 0.009 ppm respectively). The lead concentration in different tissues was in the order of gonads > hepatopancreas > mantle > foot > gill > siphon (0.089, 0.086, 0.0798, 0.076, 0.064, 0.0051 ppm respectively). The aluminium concentration in different tissues was in the order of gonads > hepatopancreas > gill > mantle > siphon (0.200, 0.109, 0.083, 0.0618,. 0.0031 ppm respectively) (Table No.12).

The metal content during summer season (May) from bivalve tissue (L. corrianus) was studied. The zinc content was maximum (0.76 ppm) in gill and minimum (0.13 ppm) in foot, whereas nickel

content was maximum (0.67 ppm) in gonads and minimum (0.009 ppm) in siphon. The lead content was maximum (0.089 ppm) in gonads and minimum (0.009 ppm) in siphon. The aluminium content was maximum (0.200 ppm) in gonad and minimum (0.0031 ppm) in siphon.

Metal content during summer season (May) from the bivalve tissues (*L. marginalis*) was estimated as under. The Zinc content in different tissues was in the order of gill > gonads > mantle > siphon > foot > hepatopancreas (0.525, 0.189, 0.102, 0.071, 0.053, 0.048 ppm respectively). The nickel content in different tissues was in the order of gonads > hepatopancreas > gill > mantle > foot > siphon (0.589, 0.471, 0.41, 0.36, 0.071, 0.0042 ppm respectively). The lead content in different tissues was in the order of gonads > foot > hepatopancreas > mantle > gill > siphon (0.085, 0.079, 0.075, 0.073, 0.058, 0.051 ppm respectively). The aluminium concentration in different tissues was in the order of gonads > gill > hepatopancreas > foot > mantle > siphon (0.188, 0.101, 0.100, 0.064, 0.038, 0.005 ppm respectively) (Table No. 12).

The metal content during summer season (May) from bivalve tissue (*L. marginalis*) was studied. The zinc content was maximum (0.525 ppm) in gill,. Whereas minimum (0.048 ppm) in hepatopancreas. The nickel content was maximum (0.589 ppm) in gonads and minimum (0.0042 ppm) in siphon. Lead content was maximum (0.085 ppm) in gonads and minimum (0.0051 ppm) in

siphon. The aluminium concentration was maximum (0.188 ppm) in gonad, while minimum (0.005 ppm) in siphon.

The metal concentration during summer season (May) from the bivalve tissues (*I. caeruleus*) was estimated as under. The zinc content in different tissues was in the order of siphon > mantle > gill> hepatopancreas > foot > gonads (0.68, 0.56, 0.275, 0.206, 0.16, 0.127 ppm respectively). The nickel content in different tissues was in the order of gonads > hepatopancreas > gill > mantle > foot > siphon (0.60, 0.48, 0.35, 0.34, 0.071, 0.065 ppm respectively). Lead content in different tissues was in the order of gonads > hepatopancreas > foot > mantle > gill > siphon (0.092, 0.082, 0.081, 0.080, 0.60, 0.0047 ppm respectively). The aluminium concentration in different tissues was in the order of gonads > hepatopancreas > gill > foot > mantle > siphon (0.201, 0.126, 0.086, 0.069, 0.041, 0.0047 ppm respectively) (Table No. 12).

The metal content during summer season (May) from the bivalve tissue (*I. caeruleus*) was estimated as under. The zinc concentration was maximum (0.68 ppm) in siphon and minimum (0.127 ppm) in gonads. The nickel content was maximum (0.602 ppm) in gonads and minimum (0.065 ppm) in siphon and the lead content was maximum (0.092 ppm) in gonads and minimum (0.0053 ppm) in siphon. Whereas the aluminium content was maximum (0.201 ppm) in gonads and minimum (0.0047 ppm) in siphon.

Table No. 12

Heavy metal concentrations in bivalve tissues (in ppm) in Summer (May, 2000) from Krishna river at Station Ankali

Species	Tissues	Zinc	Nickel	Lead	Aluminium
Lc	Mantle	0.33	0.493	0.0798	0.0618
	Gill	0.76	0.441	0.064	0.109
	Siphon	0.285	0.009	0.0051	0.0031
	Foot	0.13	0.079	0.076	0.083
	Hepatopancreas	0.22	0.51	0.086	0.109
	Gonads	0.337	0.67	0.089	0.200
Lm	Mantle	0.120	0.36	0.073	0.038
	Gill	0.525	0.418	0.0585	0.101
	Siphon	0.071	0.0042	0.0051	0.005
	Foot	0.053	0.071	0.079	0.064
	Hepatopancreas	0.048	0.471	0.075	0.100
	Gonads	0.189	0.589	0.085	0.188
Ic	Mantle	0.56	0.349	0.080	0.041
	Gill	0.275	0.351	0.060	0.086
	Siphon	0.68	0.065	0.0053	0.0047
	Foot	0.16	0.071	0.081	0.069
	Hepatopancreas	0.206	0.48	0.082	0.126
	Gonads	0.127	0.602	0.092	0.201

Lc - *Lamellidens corrianus*
Lm - *Lamellidens marginalis*
Ic - *Indonaia caeruleus*

Monsoon :

The metal content during monsoon season (July) from the bivalve tissues (*L. corrianus*) was estimated as under. The zinc content in different tissues was in the following order as gill > siphon > mantle and hepatopancreas > foot > gonads (0.875, 0.410, 0.255, 0.255, 0.175, 0.115 ppm respectively). The concentration of nickel in different tissues was in the following order as gonads > hepatopancreas > mantle > gill > foot > siphon (0.692, 0.540, 0.489, 0.400, 0.076, 0.010 ppm respectively). The lead content in different tissues was in the following order as gonads > hepatopancreas > mantle > foot > gill > siphon (0.089, 0.090, 0.078, 0.070, 0.067, 0.004 ppm respectively). The aluminium concentration in different tissues was in the following order as gonads > hepatopancreas > gill> foot > mantle > siphon (0.204, 0.099, 0.098, 0.084, 0.064, 0.0042 ppm respectively) (Table No.13).

Comparatively metal content during monsoon season (July) from bivalve tissues (*L. corrianus*) was studied. The zinc content was maximum (0.875 ppm) in gill, while minimum (0.115 ppm) in gonads. The nickel content was maximum (0.692 ppm) in gonads while minimum (0.010 ppm) in siphon. The lead content was maximum (0.090 and 0.089) in gonads and hepatopancreas, while minimum (0.004 ppm) in siphon. The concentration of aluminium was maximum (0.204 ppm) in gonads, while minimum (0.0042 ppm) in siphon.

The metal concentration during monsoon (July) from the bivalve tissues (*L. marginalis*) was estimated as under. The zinc content in different tissues was in the following order as gill > mantle > siphon > hepatopancreas > foot > gonads (0.455, 0.135, 0.0225, 0.017, 0.009, 0.007 ppm respectively). Nickel content in different tissues was in the order of gonads > hepatopancreas > gill> mantle > foot > siphon (.0580, 0.469, 0.455, 0.378, 0.072, 0.0062 ppm respectively). The lead content in different tissues was in the order of gonads > foot > hepatopancreas > mantle > gill > siphon (0.090, 0.080, 0.079, 0.070, 0.59, 0.0049 ppm respectively). The aluminium content in different tissues was in the order of gonads > gill > hepatopancreas > foot > mantle > siphon (0.193, 0.104, 0.098, 0.062, 0.040, 0.0056 ppm respectively) (Table No. 13).

Metal content during monsoon (July) from bivalve tissues (*L. marginalis*) was studied. The zinc content was maximum (0.455 ppm) in gill, while minimum (0.007 ppm) in foot. The nickel content was maximum (0.580 ppm) in gonads and minimum (0.0062 ppm) in siphon. The lead concentration was maximum (0.090 ppm) in gonads while minimum (0.0049 ppm) in siphon. The aluminium content was maximum (0.193 ppm) in gonads and minimum (0.0056 ppm) in siphon.

The metal content during monsoon season (July) from the bivalve tissues (*I. caeruleus*) was estimated as under. The zinc concentration in different tissues was in the following order as

siphon > mantle > gill > hepatopancreas > foot > gonads (0.700, 0.485, 0.405, 0.300, 0.225, 0.225 ppm respectively). The nickel concentration in different tissues was in the order of gonads > hepatopancreas > mantle > gill > foot > siphon (0.600, 0.498, 0.370, 0.352, 0.070, 0.065 ppm respectively). The lead content in different tissues was in the following order as gonads > hepatopancreas > foot> mantle > gill > siphon (0.097, 0.088, 0.081, 0.062, 0.0051 ppm respectively). The aluminium content in different tissues was in the following order as gonads > hepatopancreas > gill > foot > siphon (0.200, 0.128, 0.090, 0.071, 0.044, 0.00050 ppm respectively) (Table No. 13).

Metal content was estimated during monsoon (July) from bivalve tissue (*I. caeruleus*). The zinc content was maximum (0.700 ppm) in siphon and minimum (0.135 ppm) in gonads. The nickel content was maximum (0.600 ppm) in gonads and minimum (0.065 ppm) in siphon. The concentration of lead was maximum (0.097 ppm) in gonads, while minimum (0.0051 ppm) in siphon. The aluminium content was maximum (0.200 ppm) in gonads while it was minimum (0.0050 ppm) in siphon.

Comparatively the concentration of zinc in bivalve tissues (*L. corrianus*) showed that, maximum Zn content (0.875 ppm) was found in monsoon season (July) than the summer and winter seasons. The maximum nickel content (0.692 ppm) was found in monsoon (July) than the summer and winter seasons. The maximum

concentration of lead (0.094 ppm) was found in winter (January) season than the summer and monsoon. Similarly maximum aluminium content (0.221 ppm) was found in winter season (January) than the summer (May) and monsoon (July) season.

The metal content in bivalve tissues (*L. marginalis*) was compared seasonally. It showed that maximum zinc content (0.60 ppm) was found in monsoon season (July) than winter and summer seasons. Similarly maximum nickel content (0.592 ppm) was found in winter season (January) than the summer and monsoon. The concentration of lead in bivalve tissues (*L. marginalis*) showed that, maximum lead content (0.090 ppm) was found in monsoon season (July) than the summer and winter seasons. The aluminium content in bivalve tissues (*L. marginalis*) showed that, maximum aluminium content (0.193 ppm) was found in monsoon season (July) than the summer and winter.

The metal content in bivalve tissue (*I. caeruleus*) was compared seasonally. It showed that, maximum zinc content (0.700 ppm) was found in monsoon season (July) than the winter and summer. The nickel content in bivalve tissue (*I. caeruleus*) showed that maximum nickel (0.608 ppm) was found in winter season (January) than the summer and monsoon seasons. The concentration of lead in bivalve tissue (*I. caeruleus*) showed that, maximum lead content (0.097 ppm) was found in monsoon season (July) than the summer and winter. The content of aluminium in bivalve tissue

Table No. 13

Heavy metal concentrations in bivalve tissues (in ppm) in Monsoon (July, 2000) from Krishna river at Station Ankali

Species	Tissues	Zinc	Nickel	Lead	Aluminium
Lc	Mantle	0.255	0.489	0.078	0.062
	Gill	0.875	0.400	0.067	0.098
	Siphon	0.410	0.010	0.004	0.0042
	Foot	0.175	0.076	0.070	0.084
	Hepatopancreas	0.255	0.540	0.090	0.099
	Gonads	0.115	0.692	0.089	0.204
Lm	Mantle	0.135	0.378	0.070	0.040
	Gill	0.455	0.455	0.059	0.104
	Siphon	0.022	0.0062	0.0049	0.0056
	Foot	0.007	0.072	0.080	0.620
	Hepatopancreas	0.017	0.469	0.079	0.098
	Gonads	0.009	0.580	0.090	0.193
Ic	Mantle	0.485	0.370	0.081	0.044
	Gill	0.405	0.352	0.062	0.090
	Siphon	0.700	0.065	0.0051	0.0050
	Foot	0.225	0.070	0.088	0.071
	Hepatopancreas	0.300	0.498	0.088	0.128
	Gonads	0.135	0.600	0.097	0.200

Lc - *Lamellidens corrianus*
Lm - *Lamellidens marginalis*
Ic - *Indonaia caeruleus*

(*I. caeruleus*) showed that, maximum value (0.211 ppm) was found in winter season (January) than the monsoon and summer seasons.

While studying the accumulation of metal content in different species of bivalve molluscs in various tissues showed that, the maximum zinc content was observed in gill and minimum in foot of the bivalve *L. corrianus* in all the seasons. In case of *L. marginalis* maximum zinc content was observed in gill while minimum in foot in the winter and monsoon seasons. In *I. caeruleus* maximum zinc content was observed in siphon, while it was minimum in gonad during summer and monsoon.

The maximum Ni, Pb and Al content was observed in gonad while, it was minimum in siphon in all the three species studied during all the seasons.