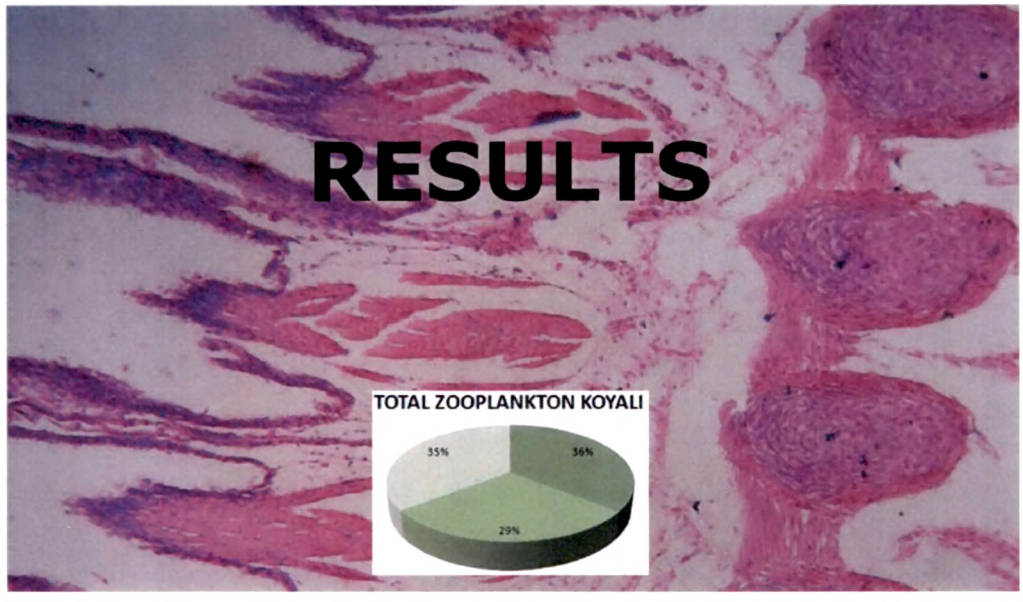

RESULTS
TOTAL ZOOPLANKTON KOYALI
35%
36%
29%

CHAPTER 3: RESULTS

3.1. Abiotic status studies

The industrial area around Vadodara spreads over several villages and the impact radiate to a much larger surrounding area. The surface and ground water of this entire area are expected to be influenced by the industrial pollutants. With a view to understand the pollution impact several surface and ground water sites were surveyed at the initiation of the study; since availability of surface water throughout the year was prime requisite - Koyali and Dumad pond were selected.

The study was planned as a biological impact assessment therefore both in situ and experiment components were involved. The water sampling for quantitative analysis was carried out for one year. In most cases the samples were collected from different locations twice a month and then pooled as a representative sample of the pond. Dumad was considered as a control site while Koyali pond was studied as polluted site.

The pH at Dumad pond exhibited season wise specific variations, particularly slight increase in pH during monsoon. At Koyali such specific variations were not seen and monthly values marginally deviated from the average value (Table 1and 2, Fig. 1).

The range of alkalinity varied at Dumad form 110 to 328 mg/l with the highest value noted in April and the lowest in September (Tables 1and 2, Fig. 2). The alkalinity was comparatively low during monsoon and highest during pre monsoon periods.

The chloride contents at Dumad ranged between 77 to 218 mg/l with an annual average value near 100 mg/l. The highest values were noted during February (Table 2, Fig. 3). At Koyali, during post monsoon season the chloride content was less but progressively increased in February to achieve a peak in May (285 mg/l). The Value ranged between 96 mg/l and 285 mg/l. Season wise the pattern at Dumad and Koyali were similar but variation at Koyali pond was high.

The Turbidity values ranged between 2 to12 NTU at Dumad, except that in July, it was noted to be 34 NTU. Similarly, at Koyali it ranged between 4 to 17 NTU with a dramatic increase to 50 NTU in July (Tables 1and 2, Fig. 4). Due to peak value in July, seasonal variations indicated much higher values during monsoon compared to post monsoon.

BOD and COD are corroborative parameters hence usually discussed together. At Dumad BOD ranged from 17mg/l to 37 mg/l (May) while the COD ranged from 25mg/l (December, January) to 61 mg/l (March, July) (Tables 1and 2, Fig. 5). At Koyali BOD ranged from 17mg/l (December, January) to 52 mg/l (May). During October and November and June to September the values were about 32 mg/l to 77mg/l (Tables 1and 2, Fig. 6). COD values were lowest in January (21mg/l) and highest during November and May (102 mg/l and 104 mg/l), respectively. The seasonal comparison showed higher BOD values during pre monsoon and monsoon with greater deviation during pre monsoon. The seasonal pattern of COD values were almost similar except that during monsoon the differences between the samples of two ponds were significantly different (Tables 1and 2, Fig. 6).

The conductivity values at Dumad ranged between 510 mg/l (September) to 1080 mg/l (July) and at Koyali between 535 mg/l (October) to1780 mg/l (March). At Dumad the values were about 1000 mg/l during July and above 900 mg/l on other 4 occasion while at Koyali on 9 occasions the values were about 1000 mg/l and they were above 700 mg/l during March, May, June, July (Tables 1and 2, Fig.7).

The TDS values at Dumad were high during monsoon and ranged between 330 mg/l to 740 mg/l. At Koyali, TDS values ranged between 250 mg/l to1450 mg/l with the values about 1000 mg/l during March to July (Tables 1and 2, Fig. 8).

Hardness was estimated in terms of Ca^{+2} hardness. At Dumad, total hardness was noted to range between 90 mg/l to 176 mg/l and ca hardness between 54 mg/l to 100 mg/l (Tables 1and 2, Fig. 9). At Koyali, total hardness was noted to range between 112 mg/l to 338 mg/l while ca^{+2} hardness between 60 mg/l to179 mg/l (Table 1and 2, Fig.10). The variations in total hardness content at Dumad and Koyali were significantly different.

Although, monthly or seasonal variations in various quantitative parameters were noted among the samples of Dumad and Koyali Ponds, the annual average values did not exhibit any significant deviation in the parameters at Koyali compare to that at Dumad Pond.

However, some of the values even at Dumad were towards the higher range compared to standard levels. The data analysis suggested that more parameters exhibited significant variations during pre monsoon (Table 3). Ground and surface water analysis of the other sources located within the

industrial area were carried out. Rampur and Ranoli sampling sites are parts of Ranoli industrial area and Nandesari site is part of Nandesari industrial area (Table 4).

Annual average of parameters at both study sites:

Parameters	pH	Alkalinity	Chlorides	Turbidity	BOD	COD	Conductivity	TDS	Total Hardness	Calcium Hardness
Koyali	7.6	285.92	169.17	13.42	28.83	61.08	1301.25	779.67	216.00	105.5
Dumad	7.5	223.33	123.58	10.17	27.00	41.58	799.92	514.33	122.33	70.67

The pH of these sources was near normal. The alkalinity were towards the higher range, However were less than those noted at Koyali Pond.

3.2. Zooplankton Studies

The zooplankton diversity was chiefly represented by phyla Rotifer and Arthopoda. The rotifer community composed of one class, one order, 6 families and 20 genera/species. Family Branchionidae dominated with maximum of 14 genera. Family Filidinae and Lacinidae were represented by 2 genera while other 3 included one genus each (Table 6). Arthropods were classified into three classes, 4 orders, 11 families and 24 genera/ species. 5 distinct larval forms were also noted; however they could not be classified up to generic level (Table 7).

Dumad pond system had comparatively higher density of zooplanktons then that noticed at Koyali. The annual averages of copepods were high at Koyali

(63.3 No/l), while at Dumad (49.2 No/l). The average of total zooplanktons population over the year was 250.9 No/l and 171 No/l at Dumad and Koyali, respectively.

Rotifers		Cladocera and Ostracoda		Copepods		Larvae		Total Zooplanktons	
Dumad	Koyali	Dumad	Koyali	Dumad	Koyali	Dumad	Koyali	Dumad	Koyali
76.6	34.8	95.8	54.2	49.2	63.2	29.1	18.8	250.9	171.09

Both at Dumad and Koyali maximum density of zooplankton was during December which gradually reduced with minimum density during March. During Monsoon the population density increased. It was interested to note that the pattern of month wise variation in zooplankton density were almost similar at both the study sites (Fig. 11). At Koyali, maximum density was 200 No/l, in November 2007, while at Dumad it was noted 303.8 No/l in December 2007. The minimum planktonic density at Koyali was 130.32 No/l in May 2008 while the lowest at Dumad was 211.7 No/l in March 2008 (Fig. 12).

The season wise percentage composition of overall zooplankton community did not differ much between Koyali and Dumad (Fig.-13). When group wise analysis were carried out, it was noted that copepods constituted more than 35% of zooplankton community at Koyali, while they range between 16% to 25% at Dumad (Fig.14). On the other, the rotifer population at Dumad ranged from 28% to 34% while, at Koyali it ranged from 19% to

22%. The population of Cladocera and Ostracoda was comparable at both the sites except post monsoon, where their contribution was 42% and 30% at Dumad and Koyali, respectively. The population of Arthropod larvae did not exhibit any noticeable variation throughout the year at both sites (Fig. 14). The Monthly variations in group wise densities of zooplankton are presented in Figs. 15 and 16. At Dumad, rotifer population was highest during December 2007, which gradually reduced by February 2008 and remained almost constant through the study period (Fig.15). At Koyali monthly variations were comparatively less with minimum value in May 2008 and maximum in November 2008 (Fig. 16). The population density of Cladocera and Ostracoda exhibited little variation in month wise density at both the sites lowest densities were noted March 2008. The copepod population at Dumad was lower than that of Cladocera and Ostracoda and Rotifers, while at Koyali they exhibited highest population densities almost throughout the year (Fig. 15). At Koyali the densities were high during post monsoon and the next peak was seen during monsoon in July 2008.

The analysis of overall data showed that monthly as well seasonal density pattern of total and different zooplankton groups were similar at both the study sites. The Rotifer and Arthropod density was not significantly changed almost throughout the year while prominent variation on monthly basis was noted for Cladocera and Ostracoda (Figs. 10-14). The copepod densities exhibited different pattern as compared other zooplankton groups (Fig.13).

Several indices were studied to compare the planktonic population at the study sites. At Dumad of the total 44 taxa, maximum 39 taxa were

recorded in August 2008, while minimum (31) were recorded during October, March, April, May (Table 9). At Koyali maximum 32 taxa were recorded in October 2007 and minimum 18 taxa were recorded in December 2007. The annual average numbers of taxa were 32 and 22 at Dumad and Koyali, respectively.

The number of Rotifers taxa varied from 13 to 17 at Dumad and only 4 to 8 at Koyali. Genus Brachionus was represented by 5 species followed by Keratella and Lacane, 2 species each. Density wise Keratella dominated the Rotifer population followed by Lacane (Table 11-13). At Koyali *Brachionus rubens,* was absent throughout the year and the rotifer population was dominated by *Brachionus divercicornis* (Table 14-16). Keratella was the most dominated genera, while Lacane was absent for major duration of study. The frequency of occurrence of Rotifers suggested that among Brachionus, 5 species were recorded throughout the year at Koyali while it was three at Dumad. Genera Platyais, Roteria, Scaridium, Annurea, Diphosis and Trichocra were present throughout the year at Dumad while they were absent or occurred maximum on two occasions during the year (Table 17).

Of the total 4 species recorded of Cladocera and Ostracoda at any given time the number of species recorded at Dumad and Koyali were 8 to 12 and 8 to 11 respectively (Table 10). Genus Sida, Ceriodaphnia and Cypris dominated density wise at Dumad (Tables 18-20). At Koyali the density of Sida was higher and community was co-dominated by Ceriodaphnia and Macropthrix (Tables 21-23). The higher frequency of occurrence of Brachionus species was recorded at Koyali pond. The frequency of occurrence of other 14 species was 0 to 5 out of 12 months of study period

(Table 24). At Dumad, for major portion of the observation period, only 4 out of 10 copepod species were recorded while at Koyali mostly 5-6 species were generally recorded with maximum numbers of 8 taxa in November 2007 (Table 10). The copepod population at Dumad was dominated by Diaptomus, while Mesocyclops, Heliopdiaptomus and Limnocalanus were least populated copepods (Tables 25-27). At Koyali, Mesocyclops and Cyclops were the most dominated species density wise (Tables 28-30). The analysis of frequency of occurrence suggested that while Streptocephalus and Diaptomus occurred throughout the year at Dumad, Mesocyclops, Cyclops, Eucyclops were observed throughout the year at Koyali (Table 31). The dominated species Streptocephalus at Dumad was recorded only twice during the study period at Koyali. Heliopdiaptomus and Limnocalanus were not encountered at Dumad but were recorded on 5 and 1 occassions, respectively, at Koyali (Table 31).

5 different types of Arthropod larvae were observed, however these were not identified at generic level and were classified into major categories as Nauplius, Metanuplius, Zoea, Megalopa and Mysis. At Dumad, generally 3 of the larval forms were seen while at Koyali only Nauplius was recorded throughout the year. Zoea and Megalopa were recorded one time each (Tables 32-37). The Nauplius larval stage dominated at Dumad pond. The frequency of occurrence indicated that Nauplius, Mysis and Megalopa were presented on 12-12 and 10 occasions at Dumad, while only Nauplius occurred throughout the year at Koyali (Table 38).

3.3. Fish Studies

The fishes from Koyali were collected and transferred to the lab immediately live for further studies. Periodically fishes of different sizes were collected and the tissues were harvested for analyses. These data are presented with experimental fish data for convenience.

3.3.1. *In situ* and experimental studies

For experimental studies, the fishes (*Oreochromis mossambicus*) were acclimatized in bath tub for 10 days to two weeks and dose determination study was carried out as described in Methods section. Primarily this was set as 96 hrs (4 days) toxicity testing experiment, later the same was considered for a longer duration where the fishes were treated with the freshly collected heterogeneous industrial effluent at different concentrations for durations ranging from 1 day to 30 days.

Up to 24 % of the effluent concentration mortality was not recorded till 30 days and up to 28% of dosages, no mortality was seen till 4 days (Table 39). Gradual increase in mortality was noted in 4 day toxicity assessment schedule. 34% mortality was recored at 30% doses both by 15 and 30 days, which resulted into 100% mortality at 40% doses by 15 days (Table 39). Based on these findings 10% and 20% doses were selected for exposure duration of 30 days in experimental set up.

The fishes collected from the polluted study site Koyali, were considered for in-situ studies. The experimental studies over 7, 15 and 30 days with 10%, 20% of industrial effluent exposure were compared with the fishes exposed to the pollutant at the Koyali pond.

3.3.1.1. Histological studies

The liver of fish has typical paranchymatous organisation, primarily of polyhedral hepatocytes with large central nuclei and prominently stained chromatin, central vein, sinusoid and portal areas with the bile ducts are appropriately organised. The blood sinus spaces are lined by endothelial cells. The reticuloendothelial cells are located at the margin of sinusoids, between the sinusoids and hepatocytes. In the portal area few lymphocytes are also seen(Plate 1).

Following the exposure to toxicant at 10% dose level, the changes were not significant by 7 days. A few pericentral hepatocytes were relatively swollen. By 15 days in the higher dose group cytoplasmic changes were prominent. The dissolution of cytoplasm was seen, however nuclear changes were not prominent. The endothelial lining of the sinusoids and the central vein were highly damaged. By 30 days, much alteration in the typical parenchymatous appearance was seen where the cord like arrangements of hepatocytes were almost lost. The nuclei were highly disintegrated. The cytoplasm dissolution and small vacuole degeneration was seen. In one of the fish liver severe cytoplasmic changes were seen as extensive eosinophilic stain. The fish collected from Koyali exhibited many of these histological abnormalities. The cell damage and presence of large vacuoles were prominent. At several places lymphocytes infiltration was seen in the peripheral region(Plates 1,2).

In tilapia, four gill arches extend on either side in the buccal cavity. The anterior edges have gill arches which protect the fragile gill filament .The

arches are supported by bone and cartilage with associated striated abductor and adductor muscles facilitating movement of gills. The gill filaments have central cartilaginous support, afferent and efferent arterioles and thin epithelial covering. On the superior and inferior surfaces of primary lamellae the secondary lamellae originate. The thin epithelial covering of secondary lamella rests on basement membrane supported by pillar cells. Other cell types found in primary and secondary lamellae include melanocytes, lymphocytes, macrophages, mucous and chloride cells. The mucous cells are located at the base of secondary lamellae; chloride cells are located at the base of secondary lamellae and gill filaments. Following exposure to the heterogeneous effluent hypertrophy and hyperplasia of cells was prominently seen. Fusion of secondary lamellae was also seen on day 15. On 30 days, the mucosal epithelium and sub mucosa of the gill racker exhibited severe damage(Plates 3,7) .

On day 30 in high dose group, the damage was more prominent and the secondary lamellae significantly exhibited clubbing at the tip. The primary lamellae showed irregular thickening. In the tissues collected from Koyali fish, the conditions were little more severe with damage to gill filaments. Due to damage to epithelial covering cells and supportive pillar cells the architecture of secondary lamellae collapsed. The secondary lamellae were oedematous and infiltration of erythrocytes was also seen(Plates 6,7) .

The muscles were organised as typical myofibril bundles surrounded by loose connective tissues or perimycium. The bundle of muscle fibres was packed by dense connective tissues, epimycium. The multiple nuclei were located at the periphery of muscle fibre. Exposure to the toxicant for 7days

had no prominent effect on the histoarchitecture of muscle. On day 15, in the high dose group the muscle organisation was severely affected. The damage to connective tissue components actively influences histoarchitecture. The fish collected from Koyali showed some amount of muscle dystrophy and prominent loss of connective tissues. The muscle bundles were loosely organized indicative of disintegration and dissolution of perimycium. The major pathological changes at high dose exposure for 30 days and that in the tissues of Koyali pond fish included focal necrosis, aggregation of inflammatory cells, vacuolar degeneration, atrophy of muscle cells and oedema(Plates 8,9).

3.3.1.2. Biochemical studies

The protein contents in liver and muscle did not exhibit any noticeable alterations on day 7 but in gills, 20% dose exposure resulted into significant reduction in protein content (Table 40, Figs. 26 to 28). On days 15 and 30, liver and gill protein exhibited significant reduction both in high dose experimental and Koyali pond fishes. Koyali pond fish did not exhibit any significant alteration in the protein contents of muscles (Table 41, Figs. 29 to 31).

Liver did not exhibit any significant change in alkaline phosphatase content by 7 days, but after 15 days some noticeable changes were seen. In gills, after 7 and 15 days exposure both at low and high doses, there was significant reduction in the enzyme activity. The muscles exhibited no change

during the study (Table 42, Figs. 32 to 34). Koyali fish tissues showed significant changes in gills only.

Acid phosphatase content in liver of experimental fishes did not show any changes but in gills significant changes were seen as dose responses on 7, 15 and 30 days. After 15 and 30 days, muscles showed some increase in activity by day 15 followed by decrease in enzymes activity at day 30. Koyali fish tissues exhibited significant alterations in the enzyme activity (Table 43, Figs. 35 to 37).

The superoxide dismutase activity was non-significantly altered in the fish tissues. As compared to 7 days, the enzyme activity was little more on 15 and 30 days in both the treatment and experimental groups (Table 44, Figs. 38 to 40). Similarly, the tissues of Koyali fish also showed no change in the enzyme activity.

Glutathione peroxidase activity significantly reduced in the liver and gill tissues on 15 days post exposure, however the activity in the treated groups then increased to be at par with the control values (Table 45, Figs. 41 to 43).

Glutathione content were almost equal to the control tissue levels on all the experimental durations and even in the tissues of Koyali fish (Table 46, Figs. 44 to 46). The trend indicated an increment in the GSH content on 30 days as compared to that noted on 7 and 15 days.

Ascorbic acid content showed increase in liver on high dose exposure at 15 and 30 days while in gills and muscles the contents significantly reduced on these experimental durations (Table 47, Figs. 47 to 49). In the

tissues of Koyali pond fish also similar type of changes were noted in different tissues.

Fish tissues were also analyzed for heavy metals like cadmium (Cd), nickel (Ni), lead (Pb), chromium (Cr) and copper (Cu). All these metals except chromium were detected in fish tissues of Koyali pond (Table 47). Cadmium and copper were present in all the analyzed tissues while lead was deposited in liver, muscle and gills and nickel was accumulated in liver and gills only (Table 47). Chromium was found to be below detection limits in all the tissues.

The order of bioaccumulation of different metals in different tissues of Koyali pond fish was:

Copper: kidney ≥ liver ≥ gills ≥ muscle.

Nickel: liver ≥ gill ≥ muscle ≥ kidney.

Lead: gill ≥ liver ≥ muscle ≥ kidney.

Cadmium: kidney ≥ liver ≥ muscle ≥ gills.

3.4. Molluscan diversity studies

The molluscan fauna was represented by one class Gastropoda inclusive of two sub classes, two orders and four families. Sub class Pulmonata, Order Basommatophora had one family Lymnaeidae and five species; four of which were present at Koyali and three at Dumad. *Planorbis rotundutus* (Geoffroy, 1767) was the only common species at the study sites

(Table 48). Sub class Prosobranchia, Order Mesogrstropoda was represented by three families and nine species (Table 48). Of these 8 species were observed at Dumad and 7 at Koyali while as many as 6 species were of common occurrance. *Bellamya bengalensis* was represented by five sub species at Dumad and 4 sub species at Koyali pond.

3.5. Avifauna diversity studies

Diverse avifauna was represented by 40 families and a cumulative total of 80 species. 35 species were cited at Koyali pond while 75 species were recorded at Dumad (Table 49). Only 4 species belonging to family Ardeidae (3 species) and family Phalacrocorcidae (1 speceis) were exclusively located at Koyali pond and its surroundings, while 44 species were cited at Dumad but not at Koyali. Family Ardeidae was represented by 6 species followed by family Hirundinidae and family Motacillidae consisting of 5 species each.

3.6. Other faunal diversity studies

Other 33 species of animals belonging to phyla Annelida (1 species), Arthropods (26 species) and Chordata (6 species) were recorded from the study sites. The arthropods were dominated by Hemipteran and Arthropteran insects. Among chordates, 5 species of fishes and one mammal (bat) were recorded.

TABLE - 1

Physico Chemical Parameters of study site (Dumad Pond)

	Oct-07	Nov-07	Dec-07	Jan-08	Feb-08	Mar-08	Apr-08	May-08	Jun-08	Jul-08	Aug-08	Sep-08
pH	7.9	7.5	6.8	6.8	7.5	7.6	7.6	7.6	7.5	8.1	8.2	8.1
Alkalinity	160	318	250	250	284	276	328	205	195	180	124	110
Chlorides	115	124	77	77	218	153	91	150	139	124	102	113
Turbidity	9	8	9	9	2	5	12	6	8	34	8	12
BOD	24	20	17	18	25	34	32	37	35	26	29	27
COD	42	50	25	25	37	61	55	55	45	61	38	35
Conductivity	515	530	827	827	790	920	740	940	970	1080	950	510
TDS	322	330	513	513	490	570	740	504	610	670	590	320
Total Hardness	125	132	128	128	104	92	124	90	105	144	176	120
Ca Hardness	88	80	68	68	60	54	48	50	59	89	100	84

TABLE - 2

Physico Chemical Parameters of study site (Koyali Pond)

	Oct-07	Nov-07	Dec-07	Jan-08	Feb-08	Mar-08	Apr-08	May-08	Jun-08	Jul-08	Aug-08	Sep-08
pH	7.6	7.7	7.2	7.1	7.6	7.5	7.5	7.9	7.8	7.9	7.3	7.9
Alkalinity	220	330	336	336	384	428	432	305	240	128	188	104
Chlorides	126	140	128	128	142	180	207	285	245	238	96	115
Turbidity	4	4	12	12	8	11	14	13	17	50	12	4
BOD	32	32	17	17	20	19	20	55	37	35	32	30
COD	72	102	24	21	35	24	50	104	98	89	59	55
Conductivity	535	620	1230	1230	1360	1780	1450	1725	1705	1750	1410	820
TDS	315	380	760	760	840	1100	1450	1056	1105	1090	250	250
Total Hardness	145	170	206	206	240	246	252	252	265	338	160	112
Ca Hardness	87	95	92	92	110	78	60	143	157	179	93	80

TABLE - 3a

Correlation analysis of the abiotic parameters at the sites.

	Alkalinity	Chlorides	Turbidity	BOD	COD	Conductivity	TDS	Total Hardness	Ca Hardness
DUMAD									
pH	-0.589	0.220	0.359	0.456	0.459	-0.034	-0.027	0.308	0.516
Alkalinity	1.000	0.141	-0.260	-0.146	0.238	-0.053	0.231	-0.341	-0.641
Chlorides		1.000	-0.283	0.387	0.179	0.129	-0.079	-0.540	-0.291
Turbidity			1.000	-0.097	0.432	0.300	0.333	0.405	0.401
BOD				1.000	0.313	0.396	0.415	-0.421	-0.426
COD					1.000	0.120	0.363	0.039	0.025
Conductivity						1.000	0.780	0.014	-0.202
TDS							1.000	0.096	-0.361
Total Hardness								1.000	0.803
Ca Hardness									1.000
KOYALI									
pH	-0.437	0.573	0.260	0.700	0.743	0.074	0.098	0.215	0.538
Alkalinity	1.000	0.092	-0.325	-0.461	-0.425	0.198	0.516	0.227	-0.421
Chlorides		1.000	0.524	0.583	0.548	0.673	0.768	0.776	0.659
Turbidity			1.000	0.179	0.244	0.584	0.473	0.788	0.716
BOD				1.000	0.870	0.141	-0.048	0.110	0.609
COD					1.000	-0.022	-0.028	0.161	0.611
Conductivity						1.000	0.763	0.808	0.492
TDS							1.000	0.856	0.282
Total Hardness								1.000	0.652
Ca Hardness									1.000

TABLE - 3b

Statistical analysis of the parameters, comparison between the sites

Parameters between the sites	T-test value			
	Annual	Post Monsoon	Pre Monsoon	Monsoon
pH	0.94	0.03*	0.82	0.20
Alkalinity	0.54	0.13	0.01**	0.64
Chlorides	0.16	0.05*	0.37	0.19
Turbidity	0.29	0.75	0.02*	0.37
BOD	0.70	0.22	0.67	0.07
COD	0.06	0.24	0.74	0.02*
Conductivity	0.14	0.34	0.001***	0.01**
TDS	0.20	0.13	0.005***	0.57
Total hardness	0.01**	0.03*	0.003***	0.23
Ca^{+2} hardness	0.07	0.07	0.08	0.22

TABLE - 4

Abiotic Status of Water bodies in the vicinity of Study Sites

Parameter	Rampur Pond	Ranoli Pond	Rampur Hand Pump	Rampur Well	Nandesari Well	Nandesari Borewell
pH	7.9	7.5	8.1	8	7.7	7.6
Alkalinity	154	292	264	292	278	248
Chloride	170	269	172	530	292	372
Turbidity	87	16	12	8	5	6
BOD	33	20	20	36	22	28
COD	75	33	25	23	30	50
Conductivity	1330	1760	1440	2940	2140	1880
TDS	820	1090	890	1820	1330	1170
Ca-Hardness	100	132	180	220	298	252
Total Hardness	164	240	420	470	580	478

TABLE - 5

Pollutants Analysis of Water Samples

Parameters	Dumad Pond	Koyali Pond	Rampur Pond	Nandesari Well	Nandesari Bore well
Copper	BDL	0.005	BDL	BDL	0.002
Cadmium	BDL	0.002	BDL	0.001	0.002
Lead	BDL	0.006	0.004	0.009	0.005
Chromium	BDL	BDL	BDL	BDL	BDL
Zinc	BDL	0.29	BDL	BDL	BDL
Iron	BDL	0.33	2.736	0.26	3.072
Cobalt	BDL	BDL	BDL	BDL	BDL
Nickel	BDL	BDL	BDL	BDL	BDL
TOC	BDL	8.5	---	---	---
Phenols	BDL	BDL	---	---	---

All the values are in mg/l
Cu BDL =0.04 (µ g/ml) on 228.8 nm
Cr+6 BDL=0.1 (µ g/ml) on 357.9 nm
Co BDL=0.1 (µ g/ml) on 240.8 nm
Ni BDL=0.1 (µ g/ml) on 232.8 nm

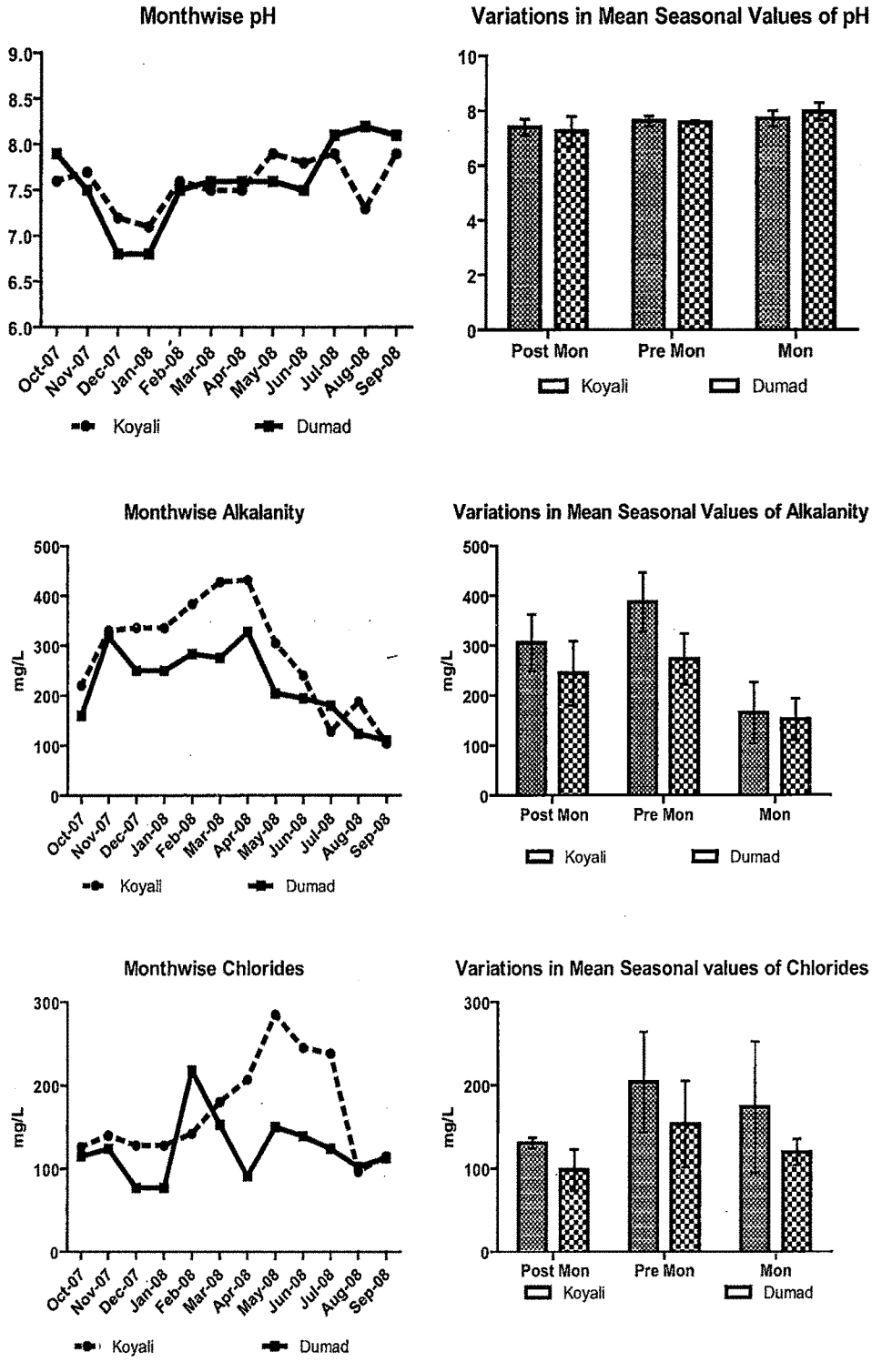
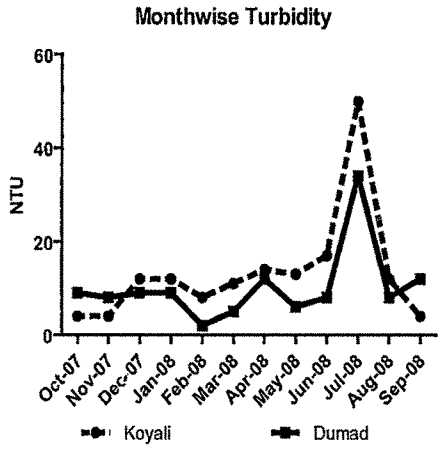
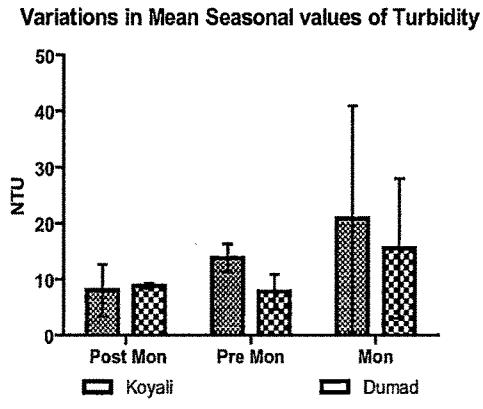


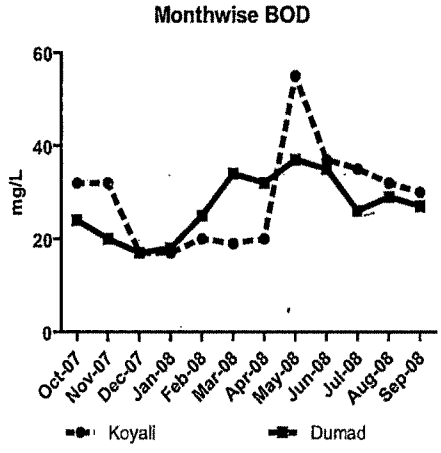
Fig. 1: Variations in water pH values of study sites.

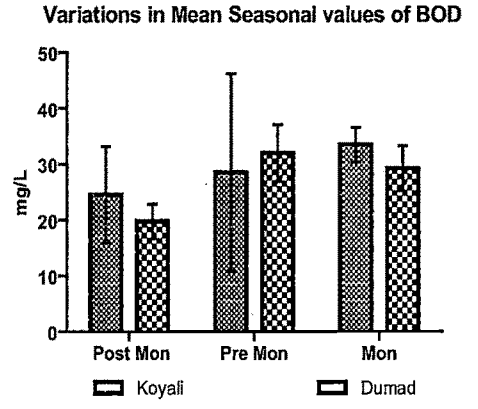
Fig. 2: Variations in water alkalinity values of study sites.

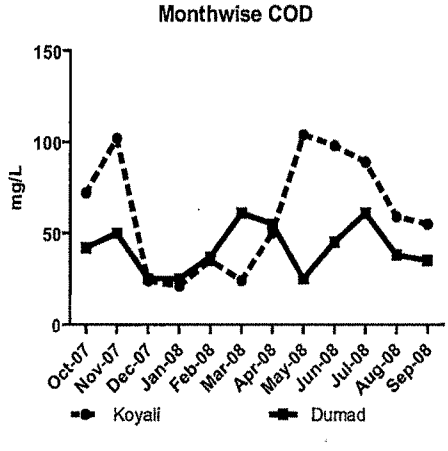
Fig. 3: Variations in water chlorides values of study sites.











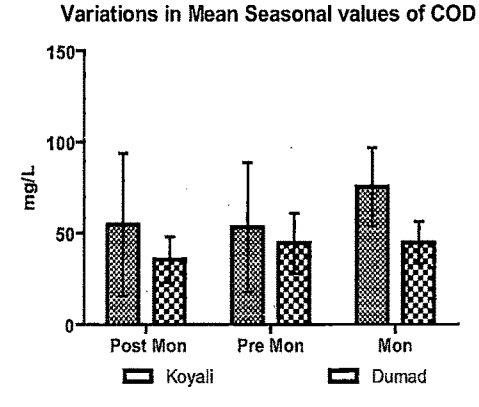


Fig. 4: Variations in water Turbidity values of study sites.

Fig. 5: Variations in water BOD values of study sites.

Fig.6: Variations in water COD values of study sites.

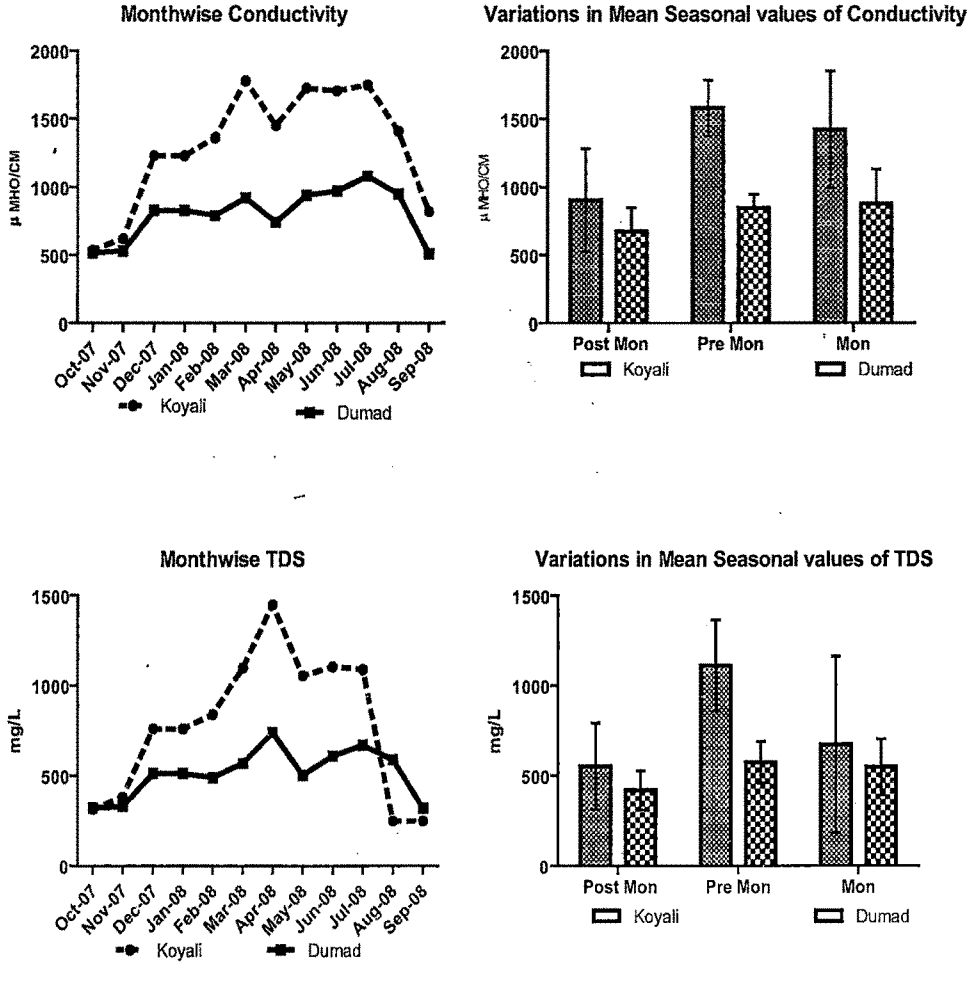
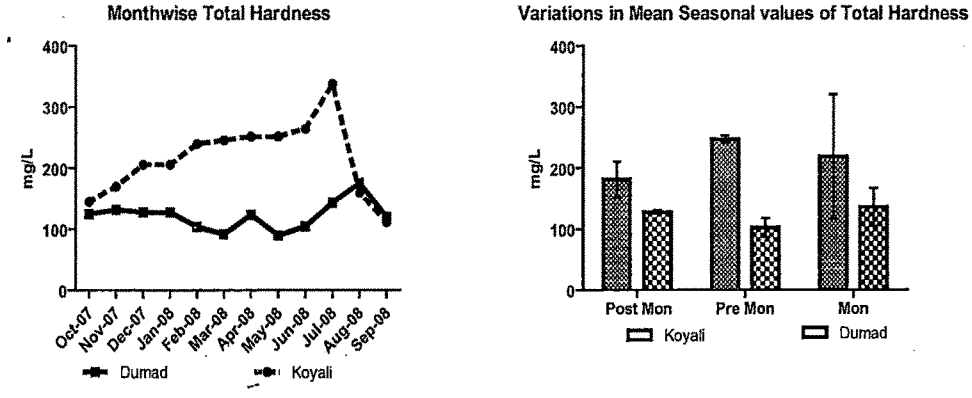


Fig. 7: Variations in water Conductivity values of study sites.

Fig. 8: Variations in water TDS values of study sites.



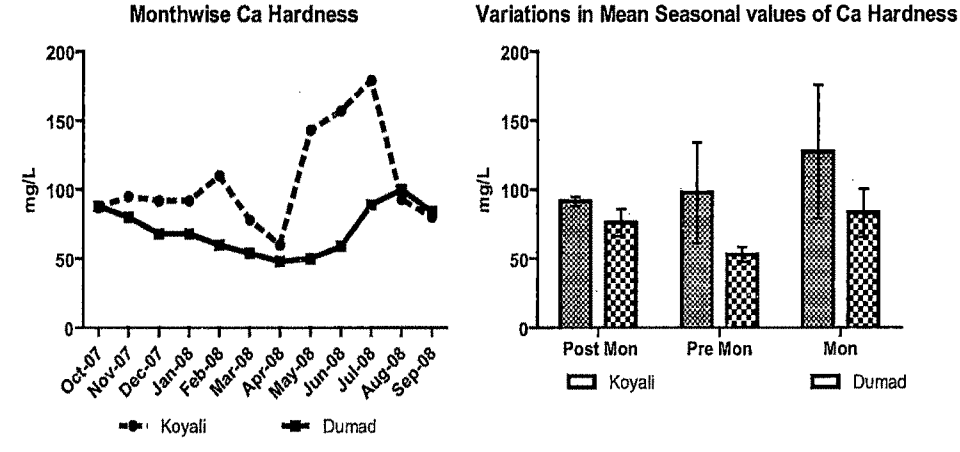


Fig. 9: Variations in water Total hardness values of study sites.

Fig. 10: Variations in water Ca^{+2} hardness values of study sites.

TABLE - 6

Check list and classification of Planktonic Rotifers

Class	Order	Family	Genus
Seisonidea	Bdelloida	Philodinidae	*Philodina* (Ehrenberg, 1832) *Rotaria (Storch and Welsch, 1969)*
Monogononta	Ploimida	Brachionidae	*Brachionus angularis (Goose,1851)* *Brachionus Calyciflorus (Pallas,1766)* *Brachionus divercicornis (Hermans,1783)* *Branchionus plicatalis* (Muller,1786) *Brachionus quadrideantatus* (Pejler, 1977) *Brachionus rubens* (Ehrenberg,1834) *Keratella quadrata(Muller, 1786)* *Keratella cochleris(Goose, 1851)* *Keratella Tropica(Apstein ,1907)* *Keratella valga* (Ehrenberg,1834) *Aneurea (Arthur Hill,1850)* *Nothelca(Muller,1786)* *Platyais quadricornis* (Ehrenberg, 1832) *Platyais longispinosus* (Arora,1966)
		Filinidae	*Filinia (* Myers,1938)
		Lecanidae	*Lacaneae bulla(Goose,1886)* *Lecane ploenensis* (Harring,1913)
		Scaridiidae	*Scaridium longicaudatum* (Ehrenberg,1830)
		Asplanchnidae	*Asplacha periodontal (Goose,1850)*

TABLE - 7

Check list and classificatio of Planktonic Arthropods.

Class	Order	Family	Genus
Mandibulata	Cladocera	Sididae	*Sida* Latreille, 1829
		Bosminidae	*Bosmina logirostris* (Mullar, 1785)
		Chydoridae	*Alonella* (Fischer, 1854) *Alona* (Baird, 1850) *Leydigia* (Schodler,1863) *Polyphemus*(Sandeman, 1978)
		Daphnidae	*Ceridephania quadragula* (Mullar, 1785) *Daphnia longishonia* (Mullar, 1785) *Daphniopsis* (Sars,1903) *Simocephalus* (Koch, 1841)
Ostracoda	Podocopa	Moinidae	*Moina* (Hutchinson, 1976) *Moinodaphnia* (Herrick,1887)
		Cyprididae Macrothricidae	*Cypris* (Westwood,1851) *Macrothrix* (Fischer,1848)
Copepoda	Calanoida	Calanidae	*Calanus* (Leach,1819)
		Psudo Calanidae	*Psudocalanus*,(Hartnoll, 1982)
		Diaptomidae	*Diaptomus* (Herrick 1879) *Heliodiaptomus viduus* (Gurney,1916) *Neodiaptomus* (Brehm,1953) *Streptocephalus diaptomus* (Mitchell, 1991)
	Cyclopoida		*Cyclops* (Jander,1966) *Eucyclopus agilis* (Koch,1838) *Eucylops sepratus* (Lilljeborg,1901) *Mesocyclop aspericornis* (Daday, 1906) *Microcyclopus* (Sars,1863)

TABLE - 8

Zooplanktons Density at Koyali and Dumad Ponds (No. /l)

		Oct-07	Nov-07	Dec-07	Jan-08	Feb-08	Mar-08	Apr-08	May-08	Jun-08	Jul-08	Aug-08	Sep-08
Rotifers	Dumad	66.6	100.0	117.6	85.3	67.6	66.6	61.7	56.8	65.7	77.4	77.4	77.4
	Koyali	40.2	55.9	30.4	33.3	32.3	32.3	28.4	21.6	36.3	30.4	35.3	41.2
Cladocera and Ostracoda	Dumad	123.5	100.0	106.8	112.7	104.9	61.7	71.5	71.5	97.0	110.7	99.0	91.1
	Koyali	56.8	53.9	56.8	51.9	56.8	34.3	56.8	52.9	53.9	58.8	60.8	56.8
Copepods	Dumad	47.0	40.2	39.2	43.1	50.0	54.9	58.8	58.8	45.1	46.1	42.1	65.7
	Koyali	65.7	69.6	66.6	65.7	60.8	46.1	60.8	44.1	63.7	81.3	63.7	70.6
Arthropod Larvae	Dumad	23.5	28.4	40.2	28.4	28.4	28.4	29.4	29.4	28.4	28.4	28.4	28.4
	Koyali	19.6	20.6	21.6	22.5	18.6	20.6	17.6	11.8	15.7	19.6	19.6	18.6
Total Zooplanktons	Dumad	260.7	268.5	303.8	269.5	250.9	211.7	221.5	216.6	236.2	262.6	247.0	262.6
	Koyali	182.3	199.9	175.4	173.5	168.6	133.3	163.7	130.3	169.5	190.1	179.3	187.2

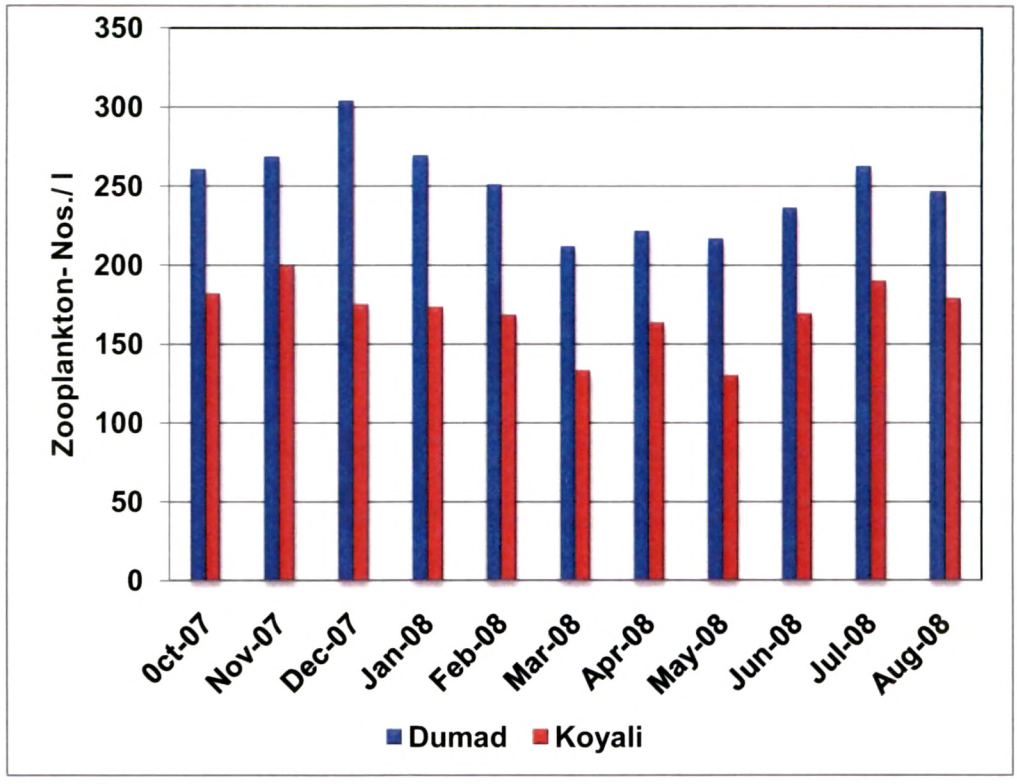


Fig.11: Monthly averages of total zooplankton densities at the study sites.

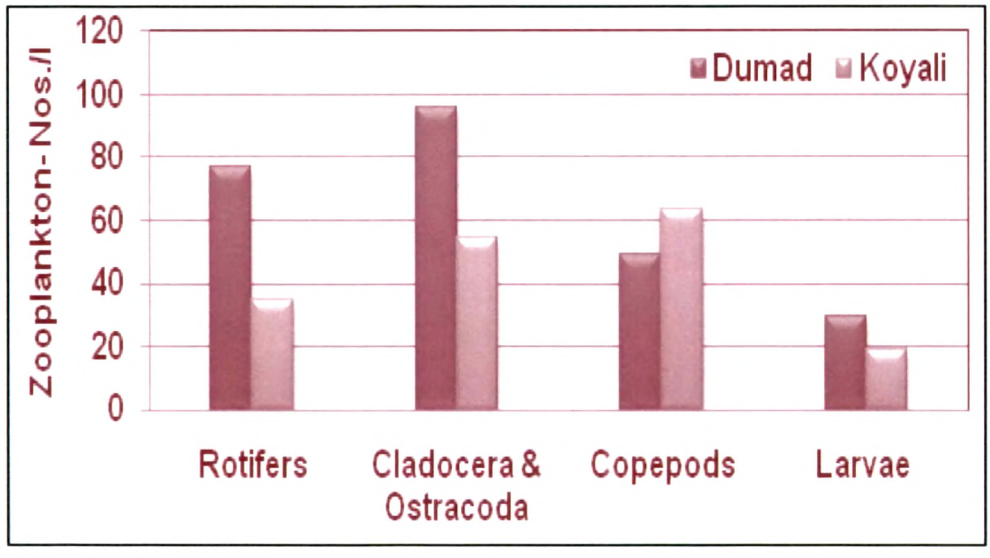


Fig.12: Annual averages of density of different zooplankton at the study sites.

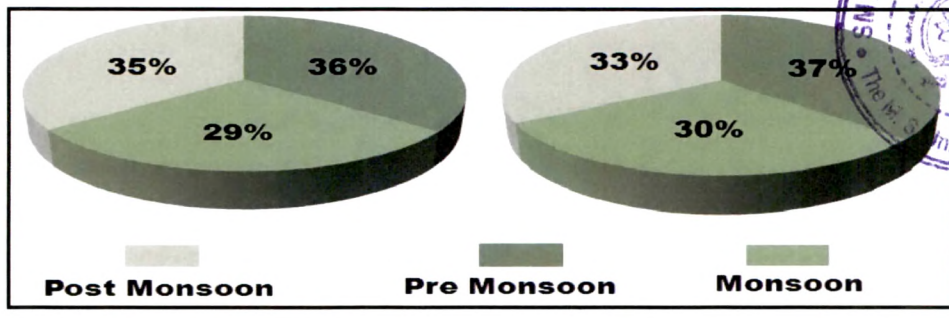


Fig.13: Percentile composition of total zooplankton during different seasons at Dumad and Koyali study sites.

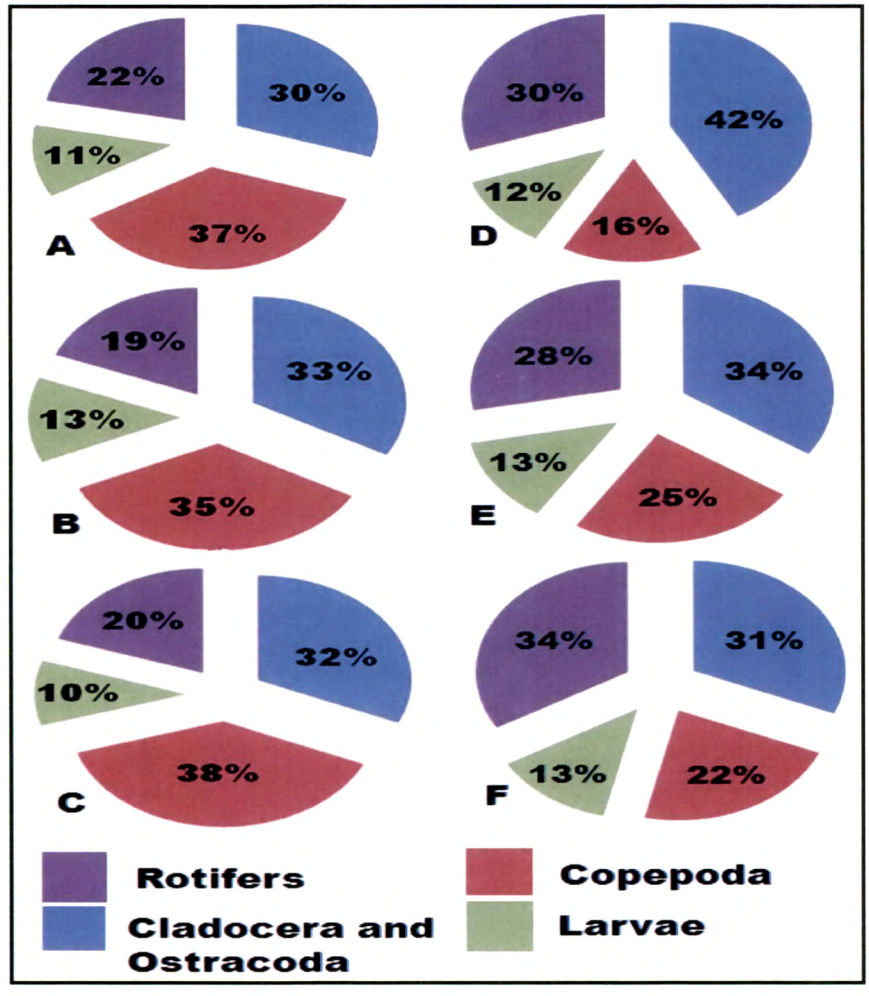


Fig.14: Percentile composition (annual averages) of different groups of zooplankton at Dumad and Koyali. A, B, C: Koyali and D, E, F: Dumad. A and D: Post monsoon, B and E: Pre monsoon, C and F: Monsoon.

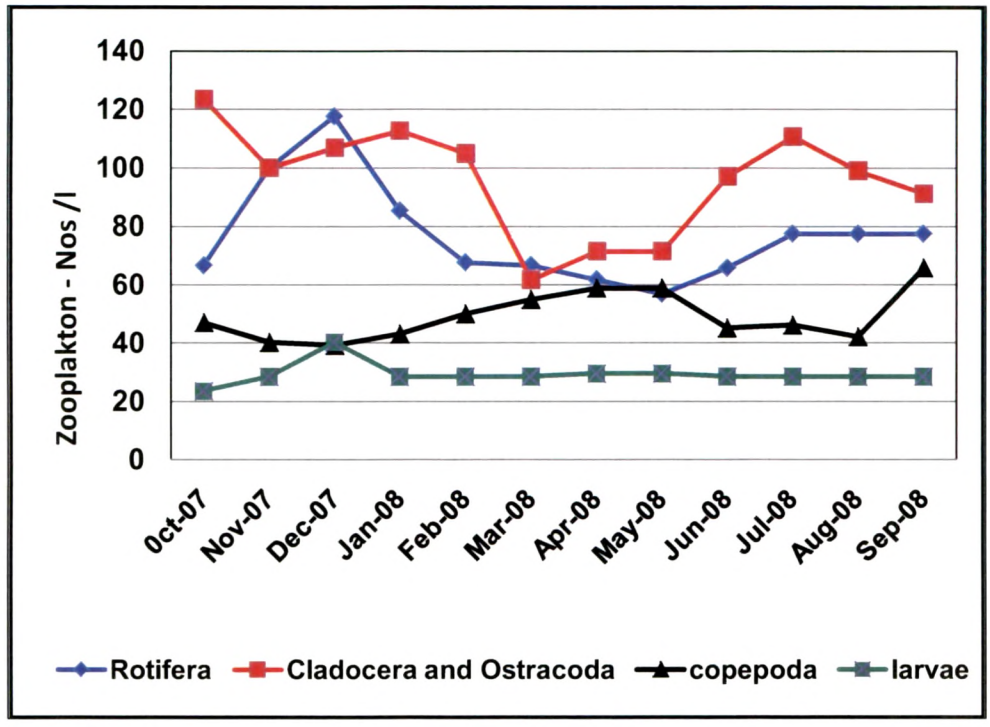


Fig. 15: Monthly variations in the densities of different zooplankton at Dumad pond.

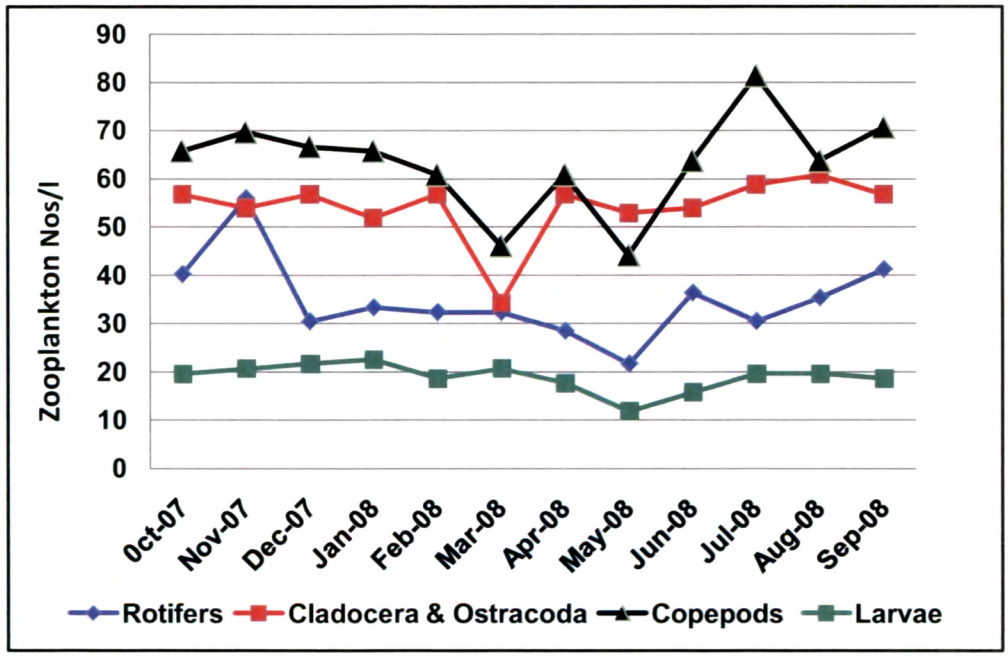


Fig.16: Monthly variations in the densities of different zooplankton at Koyali Pond.

Table - 9

Occurrence of number of taxa during the observation period at the study sites.

		Oct-07	Nov-07	Dec-07	Jan-08	Feb-08	Mar-08	Apr-08	May-08	Jun-08	Jul-08	Aug-08	Sep-08	Annual average
Rotifers	Dumad	15	14	17	14	15	13	13	13	13	13	13	13	13.83
	Koyali	6	8	4	6	6	8	4	6	5	4	8	8	6.08
Cladocera and Ostracoda	Dumad	10	11	11	12	10	10	9	8	10	11	10	11	10.25
	Koyali	9	9	9	9	8	9	9	9	11	10	10	8	9.17
Copepods	Dumad	4	4	4	4	4	4	6	6	6	5	4	5	4.67
	Koyali	2	3	5	3	3	3	3	3	3	3	2	3	3.00
Arthropod Larvae	Dumad	6	8	4	4	5	5	5	4	5	6	5	6	5.25
	Koyali	1	1	1	1	1	1	1	1	1	2	2	1	1.17
Total Zooplanktons	Dumad	31	32	37	23	32	31	31	31	32	33	39	32	32.00
	Koyali	32	26	18	20	21	22	19	20	21	22	25	22	22.33

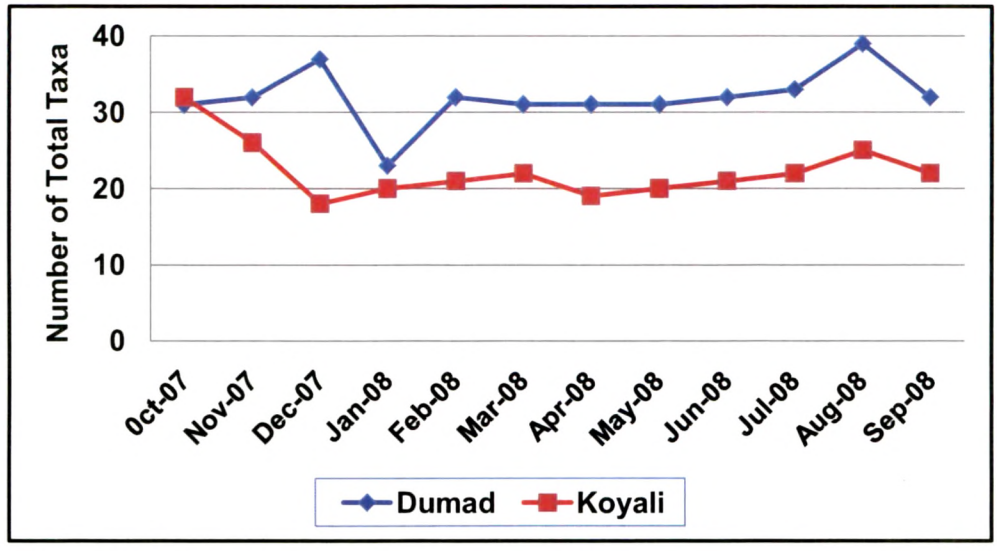


Fig. 17: Graph showing the occurrence of total number of taxa, month wise at the study sites.

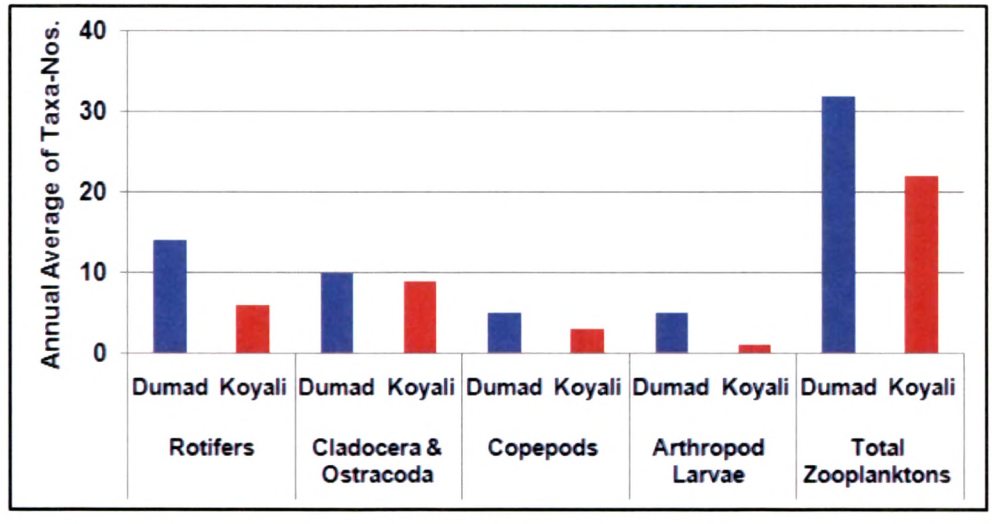


Fig. 18: Graph showing annual averages of occurrence oftotal number of taxa at study sites.

TABLE - 10

Population Indices

Population Indices	Study sites	Oct-07	Nov-07	Dec-07	Jan-08	Feb-08	Mar-08	Apr-08	May-08	Jun-08	Jul-08	Aug-08	Sep-08
Shannon	Dumad	2.19	2.17	2.3	2.19	3.17	3.04	2.63	2.88	2.83	2.56	2.19	2.39
	Koyali	2.07	2.07	1.94	1.79	2.63	2.63	2.3	2.39	2.19	2.39	2.02	2.07
Merglef	Dumad	3.64	3.64	3.9	3.64	7.23	6.56	4.92	5.64	5.64	4.67	2.36	4.17
	Koyali	3.36	3.36	3.08	0.27	4.92	4.92	3.9	4.17	3.64	4.17	3.36	3.36
Dominance	Dumad	0.11	0.11	0.11	0.11	0.16	0.04	0.04	0.07	0.05	0.05	0.76	0.11
	Koyali	3.36	3.36	3.08	0.27	4.92	4.92	3.9	4.17	3.64	4.17	3.36	3.36
Simpson	Dumad	0.11	0.11	0.11	0.11	0.16	0.04	0.04	0.07	0.05	0.05	0.76	0.11
	Koyali	0.87	0.87	0.85	0.83	0.92	0.92	0.92	0.9	0.9	0.88	0.9	0.87
Berger Parker	Dumad	0.11	0.11	0.11	0.11	0.16	0.04	0.04	0.07	0.05	0.05	0.76	0.11
	Koyali	0.12	0.12	0.14	0.16	0.07	0.07	0.1	0.09	0.11	0.09	0.12	0.12

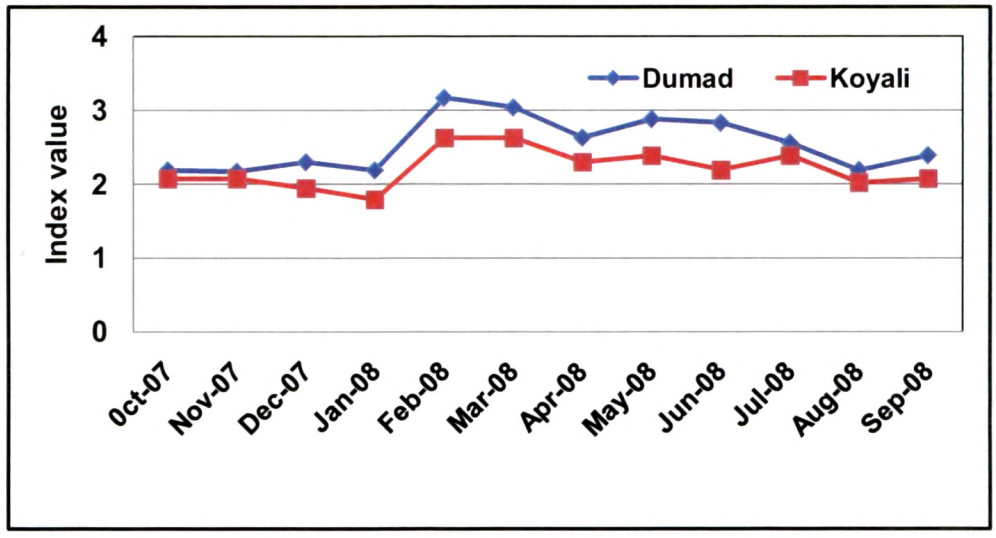


Fig. 19: Graph showing the Shannon Diversity index comparison of the study sites.

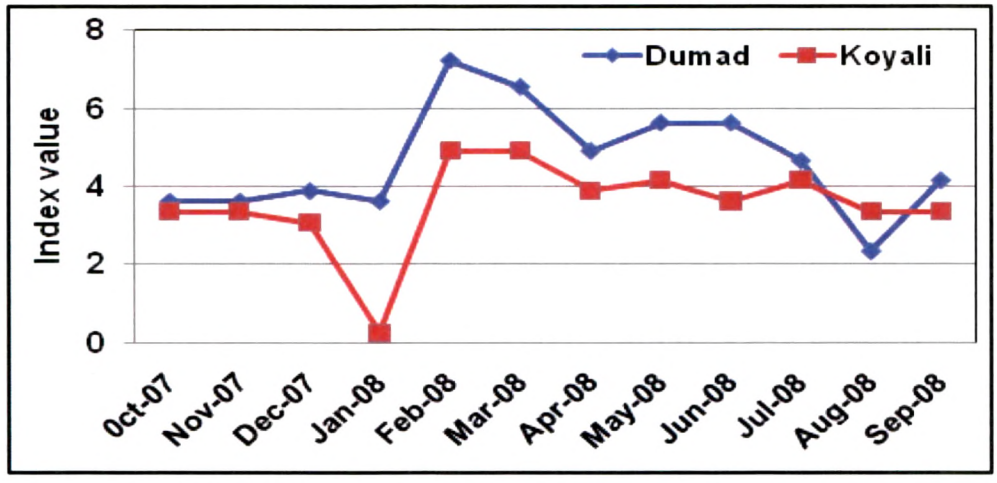


Fig. 20: Graph showing the Marglef index comparison of the study sites.

TABLE - 11
Planktonic Community (Rotifera) of Dumad Pond During Post Monsoon season

	Oct-07			Nov-07			Dec-07			Jan-08		
	D	RD.G	RD. T	D	RD.G	RD. T	D	RD.G	RD. T	D	RD.G	RD. T
Brachionus divercicornis	0.0	0.0	0.0	0.0	0.0	0.0	2.0	1.7	0.6	0.0	0.0	0.0
Banchionus angularis	4.9	7.4	1.9	15.7	15.7	5.8	15.7	13.3	5.2	15.7	18.4	5.8
Branchionus plicatalis	2.0	2.9	0.8	2.0	2.0	0.7	2.0	1.7	0.6	2.0	2.3	0.7
Branchionus Calyciflours	2.0	2.9	0.8	0.0	0.0	0.0	3.9	3.3	1.3	0.0	0.0	0.0
Branchionus Rubens	3.9	5.9	1.5	13.7	13.7	5.1	3.9	3.3	1.3	3.9	4.6	1.5
Keratella tropica	0.0	0.0	0.0	2.9	2.9	1.1	10.8	9.2	3.5	7.8	9.2	2.9
Keratella valga	4.9	7.4	1.9	14.7	14.7	5.5	22.5	19.2	7.4	4.9	5.7	1.8
Lacianularia	2.9	4.4	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Platyais quadricornis	2.0	2.9	0.8	2.0	2.0	0.7	2.0	1.7	0.6	2.0	2.3	0.7
Platyais longispinosus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rotaria rotaria	5.9	8.8	2.3	5.9	5.9	2.2	5.9	5.0	1.9	5.9	6.9	2.2
Scaridium	6.9	10.3	2.6	6.9	6.9	2.6	6.9	5.8	2.3	6.9	8.0	2.5
Filinia	0.0	0.0	0.0	0.0	0.0	0.0	5.9	5.0	1.9	0.0	0.0	0.0
Lecane ploenensis	8.8	13.2	3.4	8.8	8.8	3.3	8.8	7.5	2.9	8.8	10.3	3.3
Lacane (Monostyla)bulla	7.8	11.8	3.0	7.8	7.8	2.9	7.8	6.7	2.6	7.8	9.2	2.9
Aneurea	3.9	5.9	1.5	3.9	3.9	1.5	3.9	3.3	1.3	3.9	4.6	1.5
Diphosis	4.9	7.4	1.9	4.9	4.9	1.8	4.9	4.2	1.6	4.9	5.7	1.8
Ploesoma	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Notholca	2.9	4.4	1.1	2.9	2.9	1.1	2.9	2.5	1.0	2.9	3.4	1.1
Tricocera porcellus	2.9	4.4	1.1	7.8	7.8	2.9	7.8	6.7	2.6	7.8	9.2	2.9
Total	66.6			100.0			117.6			85.3		

TABLE - 12
Planktonic Community (Rotifera) of Dumad Pond During Pre Monsoon Season

	Feb-08			Mar-08			Apr-08			May-08		
	D	RD.G	RD. T	D	RD.G	RD. T	D	RD.G	RD. T	D	RD.G	RD. T
Brachionus divercicornis	1.0	1.4	0.4	4.9	7.4	2.3	0.0	0.0	0.0	0.0	0.0	0.0
Banchionus angularis	3.9	5.8	1.6	5.9	8.8	2.8	5.9	9.5	2.7	0.0	0.0	0.0
Branchionus plicatalis	2.0	2.9	0.8	2.0	2.9	0.9	2.0	3.2	0.9	2.0	3.4	0.9
Branchionus Calyciflours	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Branchionus Rubens	3.9	5.8	1.6	3.9	5.9	1.9	2.0	3.2	0.9	11.8	20.7	5.4
Keratella tropica	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Keratella valga	4.9	7.2	2.0	4.9	7.4	2.3	4.9	7.9	2.2	4.9	8.6	2.3
Lacianularia	0.0	0.0	0.0	0.0	0.0	0.0	2.0	3.2	0.9	0.0	0.0	0.0
Platyais quadricornis	2.0	2.9	0.8	2.0	2.9	0.9	2.0	3.2	0.9	2.0	3.4	0.9
P. longispinosus	4.9	7.2	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rotaria rotaria	5.9	8.7	2.3	5.9	8.8	2.8	5.9	9.5	2.7	5.9	10.3	2.7
Scaridium	6.9	10.1	2.7	6.9	10.3	3.2	6.9	11.1	3.1	6.9	12.1	3.2
Filinia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	3.4	0.9
Lecane ploenensis	4.9	7.2	2.0	2.9	4.4	1.4	4.9	7.9	2.2	4.9	8.6	2.3
Lacane(monostyla)bulla	7.8	11.6	3.1	7.8	11.8	3.7	5.9	9.5	2.7	3.9	6.9	1.8
Aneurea	3.9	5.8	1.6	3.9	5.9	1.9	3.9	6.3	1.8	3.9	6.9	1.8
Diphosis	4.9	7.2	2.0	4.9	7.4	2.3	4.9	7.9	2.2	4.9	8.6	2.3
Ploesoma	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Notholca	2.9	4.3	1.2	2.9	4.4	1.4	2.9	4.8	1.3	2.9	5.2	1.4
Tricocera porcellus	7.8	11.6	3.1	7.8	11.8	3.7	7.8	12.7	3.5	1.0	1.7	0.5
Total	67.6			66.6			61.7			56.8		

TABLE - 13
Planktonic Community (Rotifera) of Dumad Pond During Monsoon Season

	Jun-08			Jul-08			Aug-08			Sep-08		
	D	RD.G	RD. T	D	RD.G	RD. T	D	RD.G	RD. T	D	RD.G	RD. T
Brachionus divercicornis	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Banchionus angularis	15.7	23.9	6.6	15.7	20.3	6.0	15.7	20.3	6.3	15.7	20.3	6.0
Branchionus plicatalis	2.0	3.0	0.8	2.0	2.5	0.7	2.0	2.5	0.8	2.0	2.5	0.7
Branchionus Calyciflours	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Branchionus Rubens	3.9	6.0	1.7	3.9	5.1	1.5	3.9	5.1	1.6	3.9	5.1	1.5
Keratella tropica	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Keratella valga	4.9	7.5	2.1	4.9	6.3	1.9	4.9	6.3	2.0	4.9	6.3	1.9
Lacianularia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Platyais quadricornis	2.0	3.0	0.8	2.0	2.5	0.7	2.0	2.5	0.8	2.0	2.5	0.7
P. longispinosus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rotaria rotaria	5.9	9.0	2.5	5.9	7.6	2.2	5.9	7.6	2.4	5.9	7.6	2.2
Scaridium	6.9	10.4	2.9	6.9	8.9	2.6	6.9	8.9	2.8	6.9	8.9	2.6
Filinia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lecane ploenensis	8.8	13.4	3.7	8.8	11.4	3.4	8.8	11.4	3.6	8.8	11.4	3.4
Lacane(monostyla)bulla	2.9	4.5	1.2	7.8	10.1	3.0	7.8	10.1	3.2	7.8	10.1	3.0
Aneurea	3.9	6.0	1.7	3.9	5.1	1.5	3.9	5.1	1.6	3.9	5.1	1.5
Diphosis	4.9	7.5	2.1	4.9	6.3	1.9	4.9	6.3	2.0	4.9	6.3	1.9
Ploesoma	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Notholca	2.9	4.5	1.2	2.9	3.8	1.1	2.9	3.8	1.2	2.9	3.8	1.1
Tricocera porcellus	1.0	1.5	0.4	7.8	10.1	3.0	7.8	10.1	3.2	7.8	10.1	3.0
Total	65.7			77.4			77.4			77.4		

TABLE - 14
Planktonic Community (Rotifera) of Koyali Pond During Post Monsoon season

	Oct-07			Nov-07			Dec-07			Jan-08		
	D	RD.G	RD. T	D	RD.G	RD. T	D	RD.G	RD. T	D	RD.G	RD. T
Brachionus divercicornis	11.8	29.3	6.5	11.8	21.1	5.9	10.8	35.5	6.1	9.8	29.4	5.6
Banchionus angularis	5.9	14.6	3.2	0.0	0.0	0.0	0.0	0.0	0.0	2.9	8.8	1.7
Branchionus plicatalis	7.8	19.5	4.3	7.8	14.0	3.9	6.9	22.6	3.9	7.8	23.5	4.5
Branchionus Calyciflours	7.8	19.5	4.3	7.8	14.0	3.9	8.8	29.0	5.0	3.9	11.8	2.3
Branchionus Rubens	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Keratella tropica	3.9	9.8	2.2	3.9	7.0	2.0	3.9	12.9	2.2	3.9	11.8	2.3
Keratella valga	0.0	0.0	0.0	2.9	5.3	1.5	0.0	0.0	0.0	0.0	0.0	0.0
Lacianularia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Platyais quadricornis	0.0	0.0	0.0	3.9	7.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0
P. longispinosus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rotaria rotaria	0.0	0.0	0.0	2.0	3.5	1.0	0.0	0.0	0.0	0.0	0.0	0.0
Scaridium	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Filinia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lecane ploenensis	0.0	0.0	0.0	6.9	12.3	3.4	0.0	0.0	0.0	0.0	0.0	0.0
Lacane(monostyla)bulla	2.9	7.3	1.6	1.0	1.8	0.5	0.0	0.0	0.0	4.9	14.7	2.8
Aneurea	0.0	0.0	0.0	2.9	5.3	1.5	0.0	0.0	0.0	0.0	0.0	0.0
Diphosis	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ploesoma	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Notholca	0.0	0.0	0.0	4.9	8.8	2.5	0.0	0.0	0.0	0.0	0.0	0.0
Tricocera porcellus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	40.2			55.9			30.4			33.3		

TABLE - 15
Planktonic Community (Rotifera) of Koyali Pond During Pre Monsoon season

	Feb-08			Mar-08			Apr-08			May-08		
	D	RD.G	RD. T	D	RD.G	RD. T	D	RD.G	RD. T	D	RD.G	RD. T
Brachionus divercicornis	11.8	36.4	7.0	9.8	30.3	7.4	8.8	31.0	5.4	5.9	27.3	4.5
Banchionus angularis	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	4.5	0.8
Branchionus plicatalis	7.8	24.2	4.7	7.8	24.2	5.9	7.8	27.6	4.8	6.9	31.8	5.3
Branchionus Calyciflours	2.9	9.1	1.7	2.0	6.1	1.5	6.9	24.1	4.2	4.9	22.7	3.8
Branchionus Rubens	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Keratella tropica	6.9	21.2	4.1	3.9	12.1	2.9	4.9	17.2	3.0	2.0	9.1	1.5
Keratella valga	0.0	0.0	0.0	2.9	9.1	2.2	0.0	0.0	0.0	0.0	0.0	0.0
Lacianularia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Platyais quadricornis	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P. longispinosus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rotaria rotaria	0.0	0.0	0.0	2.9	9.1	2.2	0.0	0.0	0.0	0.0	0.0	0.0
Scaridium	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Filinia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lecane ploenensis	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lacane(monostyl)bulla	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Aneurea	2.0	6.1	1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Diphosis	0.0	0.0	0.0	2.0	6.1	1.5	0.0	0.0	0.0	0.0	0.0	0.0
Ploesoma	0.0	0.0	0.0	1.0	3.0	0.7	0.0	0.0	0.0	0.0	0.0	0.0
Notholca	1.0	3.0	0.6	0.0	0.0	0.0	0.0	0.0	0.0	1.0	4.5	0.8
Tricocera porcellus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	32.3			32.3			28.4			21.6		

TABLE - 16
Planktonic Community (Rotifera) of Koyali Pond During Monsoon season

	Jun-08			Jul-08			Aug-08			Sep-08		
	D	RD.G	RD. T	D	RD.G	RD. T	D	RD.G	RD. T	D	RD.G	RD. T
Brachionus divercicornis	11.8	32.4	6.9	10.8	35.5	5.7	11.8	33.3	6.6	10.8	26.2	5.8
Banchionus angularis	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	4.8	1.0
Branchionus plicatalis	7.8	21.6	4.6	8.8	29.0	4.6	7.8	22.2	4.4	7.8	19.0	4.2
Branchionus Calyciflours	7.8	21.6	4.6	7.8	25.8	4.1	6.9	19.4	3.8	7.8	19.0	4.2
Branchionus Rubens	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Keratella tropica	3.9	10.8	2.3	2.9	9.7	1.5	3.9	11.1	2.2	3.9	9.5	2.1
Keratella valga	0.0	0.0	0.0	0.0	0.0	0.0	1.0	2.8	0.5	0.0	0.0	0.0
Lacianularia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	4.8	1.0
Platyais quadricornis	4.9	13.5	2.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P. longispinosus	0.0	0.0	0.0	0.0	0.0	0.0	1.0	2.8	0.5	0.0	0.0	0.0
Rotaria rotaria	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Scaridium	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.9	9.5	2.1
Filinia	0.0	0.0	0.0	0.0	0.0	0.0	1.0	2.8	0.5	0.0	0.0	0.0
Lecane ploenensis	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lacane(monostyla)bulla	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Aneurea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Diphosis	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ploesoma	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Notholca	0.0	0.0	0.0	0.0	0.0	0.0	2.0	5.6	1.1	2.9	7.1	1.6
Tricocera porcellus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	36.3			30.4			35.3			41.2		

Table - 17

Frequency of occurrence of Rotifers

Species	Post-Monsoon		Pre-Monsoon		Monsoon		Annual	
	D	K	D	K	D	K	D	K
Brachionus divercicornis	3	4	4	4	0	4	7	12
Banchionus angularis	4	4	3	1	4	1	11	6
Branchionus plicatalis	4	4	4	4	4	4	12	12
Branchionus Calyciflours	4	4	4	4	4	4	12	12
Keratella tropica	4	4	4	4	4	4	12	12
Keratella valga	4	1	1	1	1	1	6	3
Lacianularia	1	1	1	0	0	1	2	2
Platyais quadricornis	4	1	4	0	4	1	12	2
P. longispinosus	0	0	1	0	0	0	1	0
Rotaria rotaria	4	1	4	1	4	0	12	2
Scaridium	4	0	4	0	4	0	12	0
Filinia	1	0	1	0	0	1	2	1
Lecane ploenensis	4	0	4	0	1	1	9	1
Lacane (monostyla) bulla	4	3	4	1	4	0	12	4
Aneurea	4	1	4	1	4	0	12	2
Diphosis	4	1	4	1	4	0	12	2
Ploesoma	0	0	0	2	0	0	0	2
Notholca	4	1	4	2	4	2	12	5
Tricocera porcellus	4	0	4	0	4	0	12	0

TABLE - 18

Planktonic Community (Cladocera and Ostracoda) of Dumad Pond During Post Monsoon season

	Oct-07			Nov-07			Dec-07			Jan-08		
	D	RD.G	RD. T	D	RD.G	RD. T	D	RD.G	RD. T	D	RD.G	RD. T
Daphnia	5.9	4.8	2.3	5.9	5.9	2.2	5.9	5.5	1.9	5.9	5.2	2.2
Sida	24.5	19.8	9.4	2.0	2.0	0.7	2.0	1.8	0.6	2.0	1.7	0.7
Moina	3.9	3.2	1.5	11.8	11.8	4.4	3.9	3.7	1.3	3.9	3.5	1.5
Simocephalus	9.8	7.9	3.8	9.8	9.8	3.6	9.8	9.2	3.2	9.8	8.7	3.6
Moinodaphia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bosmia	8.8	7.1	3.4	8.8	8.8	3.3	8.8	8.3	2.9	8.8	7.8	3.3
Leydigia	7.8	6.3	3.0	7.8	7.8	2.9	7.8	7.3	2.6	7.8	7.0	2.9
Polyphemus	5.9	4.8	2.3	5.9	5.9	2.2	5.9	5.5	1.9	5.9	5.2	2.2
Ceroidaphnia	21.6	17.5	8.3	12.7	12.7	4.7	21.6	20.2	7.1	21.6	19.1	8.0
Macrothrix	17.6	14.3	6.8	17.6	17.6	6.6	17.6	16.5	5.8	17.6	15.7	6.5
Allonella globulosa	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cypris	17.6	14.3	6.8	9.8	9.8	3.6	19.6	18.3	6.5	20.6	18.3	7.6
Stenocypris	0.0	0	0.0	7.8	7.8	2.9	3.9	3.7	1.3	3.9	3.5	1.5
Cyprinotus	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	4.9	4.3	1.8
Total	123.5			100.0			106.8			112.7		

TABLE - 19

Planktonic Community (Cladocera and Ostracoda) of Dumad Pond During Pre Monsoon season

	Feb-08			Mar-08			Apr-08			May-08		
	D	RD.G	RD. T	D	RD.G	RD. T	D	RD.G	RD. T	D	RD.G	RD. T
Daphnia	5.9	5.6	2.3	0.0	0.0	0.0	5.9	8.2	2.7	5.9	8.2	2.7
Sida	2.0	1.9	0.8	2.0	3.2	0.9	2.0	2.7	0.9	2.0	2.7	0.9
Moina	3.9	3.7	1.6	3.9	6.3	1.9	3.9	5.5	1.8	3.9	5.5	1.8
Simocephalus	9.8	9.3	3.9	9.8	15.9	4.6	9.8	13.7	4.4	9.8	13.7	4.5
Moinodaphia	0.0	0.0	0.0	5.9	9.5	2.8	0.0	0.0	0.0	0.0	0.0	0.0
Bosmia	8.8	8.4	3.5	0.0	0.0	0.0	6.9	9.6	3.1	6.9	9.6	3.2
Leydigia	7.8	7.5	3.1	4.9	7.9	2.3	5.9	8.2	2.7	5.9	8.2	2.7
Polyphemus	5.9	5.6	2.3	5.9	9.5	2.8	5.9	8.2	2.7	5.9	8.2	2.7
Ceroidaphnia	21.6	20.6	8.6	5.9	9.5	2.8	0.0	0.0	0.0	0.0	0.0	0.0
Macrothrix	17.6	16.8	7.0	8.8	14.3	4.2	8.8	12.3	4.0	8.8	12.3	4.1
Allonella globulosa	0.0	0.0	0.0	2.9	4.8	1.4	0.0	0.0	0.0	0.0	0.0	0.0
Cypris	21.6	20.6	8.6	11.8	19.0	5.6	22.5	31.5	10.2	22.5	31.5	10.4
Stenocypris	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cyprinotus	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0.0	0.0
Total	104.9			61.7			71.5			71.5		

TABLE - 20

Planktonic Community (Cladocera and Ostracoda) of Dumad Pond During Monsoon season

	Jun-08			Jul-08			Aug-08			Sep-08		
	D	RD.G	RD. T	D	RD.G	RD. T	D	RD.G	RD. T	D	RD.G	RD. T
Daphnia	5.9	6.1	2.5	5.9	5.3	2.2	5.9	5.9	2.4	2.9	3.2	1.1
Sida	2.0	2.0	0.8	11.8	10.6	4.5	2.0	2.0	0.8	2.0	2.2	0.7
Moina	3.9	4.0	1.7	3.9	3.5	1.5	3.9	4.0	1.6	13.7	15.1	5.2
Simocephalus	9.8	10.1	4.1	9.8	8.8	3.7	9.8	9.9	4.0	9.8	10.8	3.7
Moinodaphia	0.0	0.0	0.0	2.9	2.7	1.1	0.0	0.0	0.0	2.0	2.2	0.7
Bosmia	8.8	9.1	3.7	8.8	8.0	3.4	8.8	8.9	3.6	8.8	9.7	3.4
Leydigia	7.8	8.1	3.3	7.8	7.1	3.0	7.8	7.9	3.2	0.0	0.0	0.0
Polyphemus	5.9	6.1	2.5	5.9	5.3	2.2	5.9	5.9	2.4	5.9	6.5	2.2
Ceroidaphnia	21.6	22.2	9.1	21.6	19.5	8.2	21.6	21.8	8.7	9.8	10.8	3.7
Macrothrix	17.6	18.2	7.5	17.6	15.9	6.7	17.6	17.8	7.1	17.6	19.4	6.7
Allonella globulosa	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cypris	13.7	14.1	5.8	14.7	13.3	5.6	15.7	15.8	6.3	16.7	18.3	6.3
Stenocypris	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	2.2	0.7
Cyprinotus	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0.0	0.0
Total	97.0			110.7			99.0			91.1		

TABLE - 21

Planktonic Community (Cladocera and Ostracoda) of Koyali Pond During Post Monsoon season

	Oct-07			Nov-07			Dec-07			Jan-08		
	D	RD.G	RD. T	D	RD.G	RD. T	D	RD.G	RD. T	D	RD.G	RD. T
Daphnia	4.9	8.6	2.7	3.9	7.3	2.0	4.9	8.6	2.8	4.9	9.4	2.8
Sida	2.0	3.4	1.1	2.0	3.6	1.0	2.0	3.4	1.1	2.0	3.8	1.1
Moina	3.9	6.9	2.2	3.9	7.3	2.0	3.9	6.9	2.2	3.9	7.5	2.3
Simocephalus	7.8	13.8	4.3	7.8	14.5	3.9	7.8	13.8	4.5	9.8	18.9	5.6
Moinodaphia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bosmia	6.9	12.1	3.8	6.9	12.7	3.4	6.9	12.1	3.9	3.9	7.5	2.3
Leydigia	7.8	13.8	4.3	7.8	14.5	3.9	7.8	13.8	4.5	4.9	9.4	2.8
Polyphemus	5.9	10.3	3.2	5.9	10.9	2.9	5.9	10.3	3.4	6.9	13.2	4.0
Ceroidaphnia	11.8	20.7	6.5	11.8	21.8	5.9	11.8	20.7	6.7	10.8	20.8	6.2
Macrothrix	5.9	10.3	3.2	3.9	7.3	2.0	5.9	10.3	3.4	4.9	9.4	2.8
Allonella globulosa	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cypris	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0.0
Stenocypris	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cyprinotus	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0.0	0.0
Total	56.8			53.9			56.8			51.9		

TABLE - 22

Planktonic Community (Cladocera and Ostracoda) of Koyali Pond During Pre Monsoon season

	Feb-08			Mar-08			Apr-08			May-08		
	D	RD.G	RD. T	D	RD.G	RD. T	D	RD.G	RD. T	D	RD.G	RD. T
Daphnia	4.9	8.6	2.9	0.0	0.0	0.0	4.9	8.6	3.0	1.0	1.9	0.8
Sida	2.0	3.4	1.2	2.0	5.7	1.5	2.0	3.4	1.2	2.0	3.7	1.5
Moina	3.9	6.9	2.3	3.9	11.4	2.9	3.9	6.9	2.4	3.9	7.4	3.0
Simocephalus	7.8	13.8	4.7	6.9	20.0	5.1	7.8	13.8	4.8	7.8	14.8	6.0
Moinodaphia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bosmia	6.9	12.1	4.1	0.0	0.0	0.0	6.9	12.1	4.2	6.9	13.0	5.3
Leydigia	7.8	13.8	4.7	2.9	8.6	2.2	7.8	13.8	4.8	7.8	14.8	6.0
Polyphemus	5.9	10.3	3.5	5.9	17.1	4.4	5.9	10.3	3.6	5.9	11.1	4.5
Ceroidaphnia	11.8	20.7	7.0	3.9	11.4	2.9	11.8	20.7	7.2	11.8	22.2	9.0
Macrothrix	5.9	10.3	3.5	5.9	17.1	4.4	5.9	10.3	3.6	5.9	11.1	4.5
Allonella globulosa	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cypris	0.0	0	0.0	2.9	8.6	2.2	0.0	0.0	0.0	0.0	0	0.0
Stenocypris	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cyprinotus	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0.0	0.0
Total	56.8			34.3			56.8			52.9		

TABLE - 23

Planktonic Community (Cladocera and Ostracoda) of Koyali Pond During Monsoon season

	Jun-08			Jul-08			Aug-08			Sep-08		
	D	RD.G	RD. T	D	RD.G	RD. T	D	RD.G	RD. T	D	RD.G	RD. T
Daphnia	3.9	7.3	2.3	4.9	8.3	2.6	4.9	8.1	2.7	4.9	8.6	2.6
Sida	2.0	3.6	1.2	2.0	3.3	1.0	2.0	3.2	1.1	2.0	3.4	1.0
Moina	3.9	7.3	2.3	3.9	6.7	2.1	3.9	6.5	2.2	3.9	6.9	2.1
Simocephalus	7.8	14.5	4.6	2.9	5.0	1.5	7.8	12.9	4.4	7.8	13.8	4.2
Moinodaphia	1.0	1.8	0.6	2.0	3.3	1.0	0.0	0.0	0.0	0.0	0.0	0.0
Bosmia	6.9	12.7	4.0	16.7	28.3	8.8	6.9	11.3	3.8	6.9	12.1	3.7
Leydigia	7.8	14.5	4.6	2.0	3.3	1.0	7.8	12.9	4.4	7.8	13.8	4.2
Polyphemus	5.9	10.9	3.5	5.9	10.0	3.1	5.9	9.7	3.3	5.9	10.3	3.1
Ceroidaphnia	8.8	16.4	5.2	4.9	8.3	2.6	11.8	19.4	6.6	11.8	20.7	6.3
Macrothrix	4.9	9.1	2.9	13.7	23.3	7.2	5.9	9.7	3.3	5.9	10.3	3.1
Allonella globulosa	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cypris	0.0	0	0.0	0.0	0.0	0.0	3.9	6.5	2.2	0.0	0	0.0
Stenocypris	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cyprinotus	1.0	1.81	0.6	0.0	0	0.0	0.0	0	0.0	0.0	0.0	0.0
Total	53.9			58.8			60.8			56.8		

Table - 24

Frequency of occurrence of Cladocera and Ostracoda

Species	Post-Monsoon		Pre-Monsoon		Monsoon		Annual	
	D	K	D	K	D	K	D	K
Daphnia	4	4	3	3	4	4	11	11
Sida	4	4	4	4	4	4	12	12
Moina	4	4	4	4	4	4	12	12
Simocephalus	4	4	4	4	4	4	12	12
Moinodaphia	0	0	1	0	2	2	3	2
Bosmia	4	4	3	3	4	4	11	11
Leydigia	4	4	4	4	4	4	12	12
Polyphemus	4	4	4	4	4	4	12	12
Ceroidephnia	4	4	4	4	4	4	12	12
Macrothrix	4	4	4	4	4	4	12	12
Allonella globulosa	0	0	1	0	0	0	1	0
Cypris	4	0	4	1	4	1	12	2
Stenocypris	1	0	0	0	0	0	1	0
Cyprinotus	1	0	0	0	0	1	1	1

TABLE - 25

Planktonic Community (Copepod) of Dumad Pond During Post Monsoon season

	Oct-07			Nov-07			Dec-07			Jan-08		
	D	RD.G	RD. T	D	RD.G	RD. T	D	RD.G	RD. T	D	RD.G	RD. T
Mesocyclop aspericornis	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Heliodiaptomus viduus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cyclops	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Diaptomes	15.7	33.3	6.0	13.7	34.1	5.1	13.7	35.0	4.5	13.7	31.8	5.1
Limnocalanus marcrurus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Streptocephalus diaptomus	20.6	43.8	7.9	17.6	43.9	6.6	14.7	37.5	4.8	17.6	40.9	6.5
Eucylops sepratus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Eucyclopus agilis	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Cyclopoid Copepod	5.9	12.5	2.3	4.9	12.2	1.8	5.9	15.0	1.9	6.9	15.9	2.5
Other Calanoid Copepod	4.9	10.4	1.9	3.9	9.8	1.5	4.9	12.5	1.6	4.9	11.4	1.8
Total	47.0			40.2			39.2			43.1		

TABLE - 26

Planktonic Community (Copepod) of Dumad Pond During Pre Monsoon season

	Feb-08			Mar-08			Apr-08			May-08		
	D	RD.G	RD. T	D	RD.G	RD. T	D	RD.G	RD. T	D	RD.G	RD. T
Mesocyclopaspericornis	0.0	0.0	0.0	4.9	8.9	2.3	0.0	0.0	0.0	0.0	0.0	0.0
Heliodiaptomus viduus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cyclops	0.0	0.0	0.0	0.0	0.0	0.0	11.8	20.0	5.3	11.8	20.0	5.4
Diaptomes	19.6	39.2	7.8	9.8	17.9	4.6	13.7	23.3	6.2	13.7	23.3	6.3
Limnocalanus marcrurus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Streptocephalus diaptomus	16.7	33.3	6.6	17.6	32.1	8.3	17.6	30.0	8.0	17.6	30.0	8.1
Eucylops sepratus	0.0	0.0	0.0	11.8	21.4	5.6	0.0	0.0	0.0	0.0	0.0	0.0
Eucyclopus agilis	0.0	0.0	0.0	0.0	0.0	0.0	4.9	8.3	2.2	4.9	8.3	2.3
Other Cyclopoid Copepod	8.8	17.6	3.5	5.9	10.7	2.8	5.9	10.0	2.7	5.9	10.0	2.7
Other Calanoid Copepod	4.9	9.8	2.0	4.9	8.9	2.3	4.9	8.3	2.2	4.9	8.3	2.3
Total	50.0			54.9			58.8			58.8		

TABLE - 27

Planktonic Community (Copepod) of Dumad Pond During Monsoon season

	Jun-08			Jul-08			Aug-08			Sep-08		
	D	RD.G	RD. T	D	RD.G	RD. T	D	RD.G	RD. T	D	RD.G	RD. T
Mesocyclopaspericornis	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Heliodiaptomus viduus	0.0	0.0	0.0	3.9	8.5	1.5	0.0	0.0	0.0	6.9	10.4	2.6
Cyclops	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.7	19.4	4.9
Diaptomes	13.7	30.4	5.8	13.7	29.8	5.2	13.7	32.6	5.6	13.7	20.9	5.2
Limnocalanus marcrurus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Streptocephalus diaptomus	17.6	39.1	7.5	17.6	38.3	6.7	17.6	41.9	7.1	17.6	26.9	6.7
Eucylops sepratus	1.0	2.2	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Eucyclopus agilis	2.0	4.3	0.8	0.0	0.0	0.0	0.0	0.0	0.0	3.9	6.0	1.5
Other Cyclopoid Copepod	5.9	13.0	2.5	5.9	12.8	2.2	5.9	14.0	2.4	5.9	9.0	2.2
Other Calanoid Copepod	4.9	10.9	2.1	4.9	10.6	1.9	4.9	11.6	2.0	4.9	7.5	1.9
Total	45.1			46.1			42.1			65.7		

TABLE - 28

Planktonic Community (Copepod) of Koyali Pond During Post Monsoon season

	Oct-07			Nov-07			Dec-07			Jan-08		
	D	RD.G	RD. T	D	RD.G	RD. T	D	RD.G	RD. T	D	RD.G	RD. T
Mesocyclopaspericornis	12.7	19.4	7.0	12.7	18.3	6.4	12.7	19.1	7.3	11.8	17.9	6.8
Heliodiaptomus viduus	0.0	0.0	0.0	5.9	8.5	2.9	0.0	0.0	0.0	0.0	0.0	0.0
Cyclops	21.6	32.8	11.8	21.6	31.0	10.8	21.6	32.4	12.3	21.6	32.8	12.4
Diaptomes	3.9	6.0	2.2	5.9	8.5	2.9	5.9	8.8	3.4	7.8	11.9	4.5
Limnocalanus marcrurus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Streptocephalus diaptomus	0.0	0.0	0.0	2.9	4.2	1.5	0.0	0.0	0.0	0.0	0.0	0.0
Eucylops sepratus	2.0	3.0	1.1	1.0	1.4	0.5	0.0	0.0	0.0	0.0	0.0	0.0
Eucyclopus agilis	7.8	11.9	4.3	8.8	12.7	4.4	8.8	13.2	5.0	7.8	11.9	4.5
Other Cyclopoid Copepod	17.6	26.9	9.7	10.8	15.5	5.4	17.6	26.5	10.1	16.7	25.4	9.6
Other Calanoid Copepod	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	65.7			69.6			66.6			65.7		

TABLE - 29

Planktonic Community (Copepod) of Koyali Pond During Pre Monsoon season

	Feb-08			Mar-08			Apr-08			May-08		
	D	RD.G	RD. T	D	RD.G	RD. T	D	RD.G	RD. T	D	RD.G	RD. T
Mesocyclopaspericornis	11.8	19.4	7.0	11.8	25.5	8.8	11.8	19.4	7.2	9.8	22.2	7.5
Heliodiaptomus viduus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cyclops	17.6	29.0	10.5	9.8	21.3	7.4	17.6	29.0	10.8	14.7	33.3	11.3
Diaptomes	3.9	6.5	2.3	0.0	0.0	0.0	5.9	9.7	3.6	0.0	0.0	0.0
Limnocalanus marcrurus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Streptocephalus diaptomus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Eucylops sepratus	0.0	0.0	0.0	2.0	4.3	1.5	0.0	0.0	0.0	0.0	0.0	0.0
Eucyclopus agilis	8.8	14.5	5.2	8.8	19.1	6.6	8.8	14.5	5.4	8.8	20.0	6.8
Other Cyclopoid Copepod	18.6	30.6	11.0	13.7	29.8	10.3	16.7	27.4	10.2	10.8	24.4	8.3
Other Calanoid Copepod	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	60.8			46.1			60.8			44.1		

TABLE - 30

Planktonic Community (Copepod) of Koyali Pond During Monsoon season

	Jun-08			Jul-08			Aug-08			Sep-08		
	D	RD.G	RD. T	D	RD.G	RD. T	D	RD.G	RD. T	D	RD.G	RD. T
Mesocyclopaspericornis	12.7	20.0	7.5	12.7	15.7	6.7	10.8	16.9	6.0	12.7	18.1	6.8
Heliodiaptomus viduus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cyclops	21.6	33.8	12.7	21.6	26.5	11.3	18.6	29.2	10.4	21.6	30.6	11.5
Diaptomes	2.0	3.1	1.2	0.0	0.0	0.0	5.9	9.2	3.3	5.9	8.3	3.1
Limnocalanus marcrurus	1.0	1.5	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Streptocephalus diaptomus	0.0	0.0	0.0	11.8	14.5	6.2	0.0	0.0	0.0	0.0	0.0	0.0
Eucylops sepratus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.9	5.6	2.1
Eucyclopus agilis	8.8	13.8	5.2	8.8	10.8	4.6	8.8	13.8	4.9	8.8	12.5	4.7
Other Cyclopoid Copepod	17.6	27.7	10.4	17.6	21.7	9.3	19.6	30.8	10.9	17.6	25.0	9.4
Other Calanoid Copepod	0.0	0.0	0.0	8.8	10.8	4.6	0.0	0.0	0.0	0.0	0.0	0.0
Total	63.7			81.3			63.7			70.6		

Table - 31

Frequency of occurrence of Copepods

Species	Post-Monsoon		Pre-Monsoon		Monsoon		Annual	
	D	K	D	K	D	K	D	K
Mesocyclop aspericornis	0	4	1	4	0	4	1	12
Heliodiaptomus viduus	0	3	0	0	2	0	0	5
Cyclopoid Copepod	4	4	4	4	4	4	12	12
Calanoid Copepod	4	0	4	0	4	1	12	1
Cyclops	0	4	2	4	1	4	3	12
Diaptomes	4	4	4	1	4	3	12	8
Limnocalanus marcrurus	0	0	0	0	0	1	0	1
Streptocephalus diaptomus	4	1	4	0	4	1	12	2
Eucylops sepratus	0	1	1	1	1	0	2	2
Eucyclopus agilis	0	4	2	4	2	4	4	12

TABLE - 32

Planktonic Community (Larvae) of Dumad Pond During Post Monsoon season

	Oct-07			Nov-07			Dec-07			Jan-08		
	D	RD.G	RD. T	D	RD.G	RD. T	D	RD.G	RD. T	D	RD.G	RD. T
Nauplius	20.6	87.5	7.9	20.6	72.4	7.7	20.6	51.2	6.8	20.6	72.4	7.6
Metanauplius	0.0	0.0	0.0	0.0	0.0	0.0	4.9	12.2	1.6	0.0	0.0	0.0
Zoea	0.0	0.0	0.0	0.0	0.0	0.0	6.9	17.1	2.3	0.0	0.0	0.0
Megalopa	0.0	0.0	0.0	4.9	17.2	1.8	4.9	12.2	1.6	4.9	17.2	1.8
Mysis	2.9	12.5	1.1	2.9	10.3	1.1	2.9	7.3	1.0	2.9	10.3	1.1
Total	23.5			28.4			40.2			28.4		

TABLE - 33

Planktonic Community (Larvae) of Dumad Pond During Pre Monsoon season

	Feb-08			Mar-08			Apr-08			May-08		
	D	RD.G	RD. T	D	RD.G	RD. T	D	RD.G	RD. T	D	RD.G	RD. T
Nauplius	20.6	72.4	8.2	20.6	72.4	9.7	22.5	76.7	10.2	22.5	76.7	10.4
Metanauplius	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Zoea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Megalopa	4.9	17.2	2.0	4.9	17.2	2.3	3.9	13.3	1.8	3.9	13.3	1.8
Mysis	2.9	10.3	1.2	2.9	10.3	1.4	2.9	10.0	1.3	2.9	10.0	1.4
Total	28.4			28.4			29.4			29.4		

TABLE - 34

Planktonic Community (Larvae) of Dumad Pond During Monsoon season

	Jun-08			Jul-08			Aug-08			Sep-08		
	D	RD.G	RD. T	D	RD.G	RD. T	D	RD.G	RD. T	D	RD.G	RD. T
Nauplius	20.6	72.4	8.7	20.6	72.4	7.8	20.6	72.4	8.3	20.6	72.4	7.8
Metanauplius	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Zoea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Megalopa	4.9	17.2	2.1	4.9	17.2	1.9	4.9	17.2	2.0	4.9	17.2	1.9
Mysis	2.9	10.3	1.2	2.9	10.3	1.1	2.9	10.3	1.2	2.9	10.3	1.1
Total	28.4			28.4			28.4			28.4		

TABLE - 35

Planktonic Community (Larvae) of Koyali Pond During Post Monsoon season

	Oct-07			Nov-07			Dec-07			Jan-08		
	D	RD.G	RD. T	D	RD.G	RD. T	D	RD.G	RD. T	D	RD.G	RD. T
Nauplius	19.6	100.0	10.8	20.6	100.0	10.3	21.6	100.0	12.3	22.5	100.0	13.0
Metanauplius	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Zoea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Megalopa	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mysis	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	19.6			20.6			21.6			22.5		

TABLE-36

Planktonic Community (Larvae) of Koyali Pond During Pre Monsoon season

	Feb-08			Mar-08			Apr-08			May-08		
	D	RD.G	RD. T	D	RD.G	RD. T	D	RD.G	RD. T	D	RD.G	RD. T
Nauplius	18.6	100.0	11.0	20.6	100.0	15.4	17.6	100.0	10.8	11.8	100.0	9.0
Metanauplius	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Zoea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Megalopa	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mysis	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	18.6			20.6			17.6			11.8		

TABLE - 37

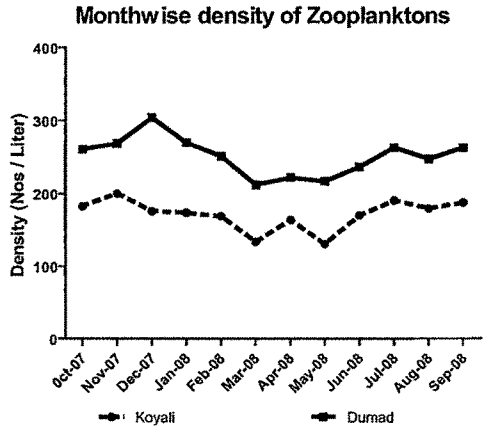
Planktonic Community (Larvae) of Koyali Pond During Monsoon season

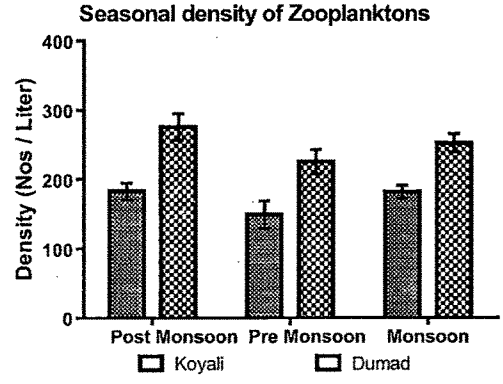
	Jun-08			Jul-08			Aug-08			Sep-08		
	D	RD.G	RD. T	D	RD.G	RD. T	D	RD.G	RD. T	D	RD.G	RD. T
Nauplius	15.7	100.0	9.2	16.7	85.0	8.8	17.6	90.0	9.8	18.6	100.0	9.9
Metanauplius	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Zoea	0.0	0.0	0.0	0.0	0.0	0.0	2.0	10.0	1.1	0.0	0.0	0.0
Megalopa	0.0	0.0	0.0	2.9	15.0	1.5	0.0	0.0	0.0	0.0	0.0	0.0
Mysis	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	15.7			19.6			19.6			18.6		

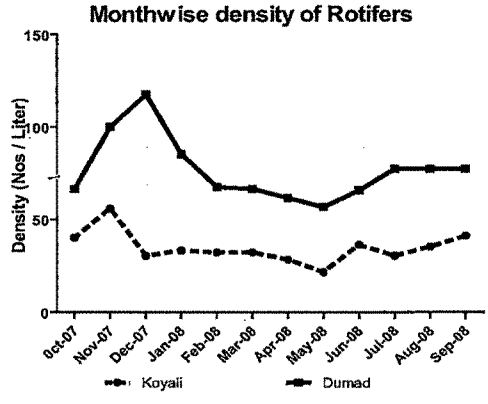
Table - 38

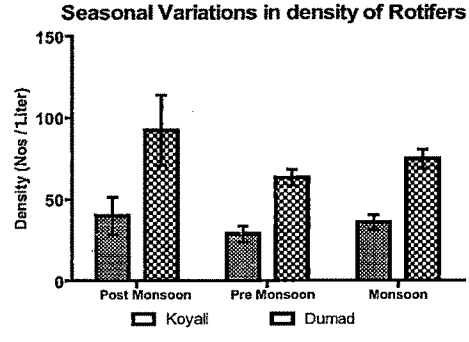
Frequency of occurrence of Arthropod Larvae

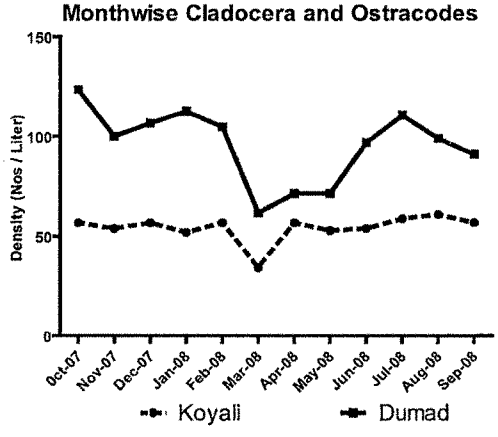
Species	Post-Monsoon		Pre-Monsoon		Monsoon		Annual	
	D	K	D	K	D	K	D	K
Nauplius	4	4	4	4	4	4	12	12
Metanauplius	1	0	0	0	0	0	1	0
Megalopa	2	0	4	0	4	1	10	1
Zoea	0	0	0	0	0	1	0	1
Mysis	4	0	4	0	4	0	12	0











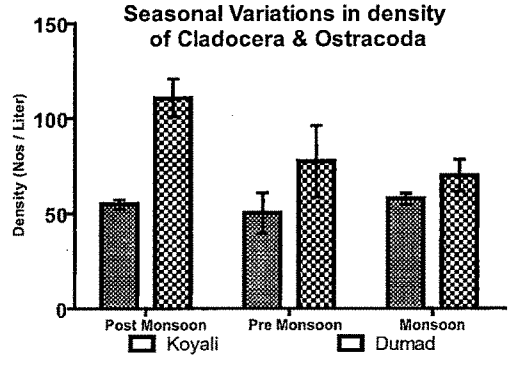
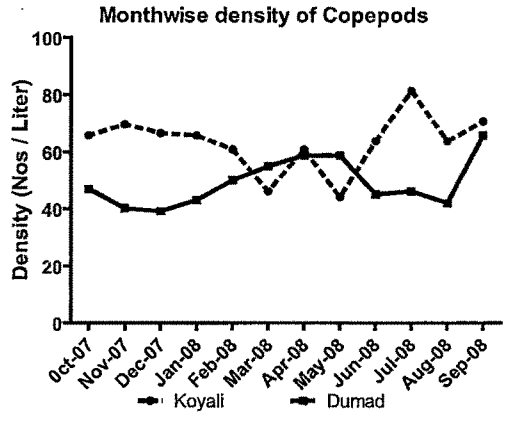
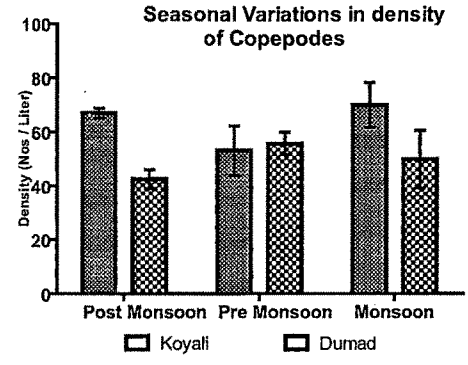


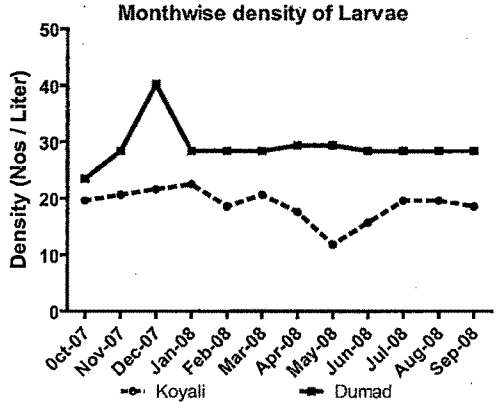
Fig. 21: Variations in month wise density values of total zooplanktons of study sites.

Fig. 22: Variations in month wise density values of rotifera of study sites.

Fig.23: Variations in month wise density values of cladocera and copepods of study sites.







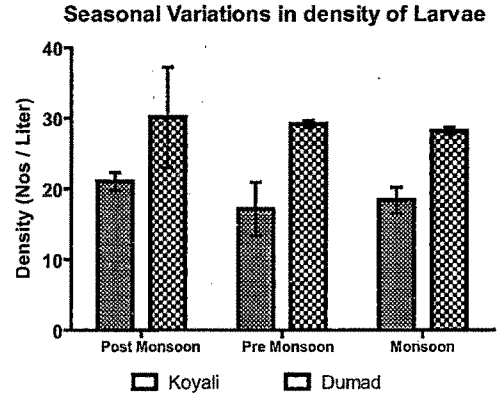


Fig. 24: Variations in month wise density values of larvae at study sites.

Fig. 25: Variations in month wise density values of larvae of study sites.

TABLE - 39

Fish toxicity assay to determine the experimental doses

Concentration of effluent	Percent mortality					
	1 day	2 days	3 days	4 days	15 days	30 days
05%	0	0	0	0	0	0
10%	0	0	0	0	0	0
15%	0	0	0	0	0	0
20%	0	0	0	0	0	0
22%	0	0	0	6	18	30
24%	0	0	6	12	18	36
26%	0	0	12	18	24	36
28%	0	0	18	24	30	42
30%	2	8	24	30	36	60
35%	6	17	30	36	42	72
40%	12	23	36	42	60	80
45%	19	30	42	42	66	86
50%	45	60	72	100	100	100

TABLE-40

Effect of effluent water on fish tissue protein (mg/100mg)

	Control	10%	20%	Koyali
LIVER 7 days	4.119±0.025	4.097±0.048	4.000±0.03	----------
15days	4.210±.0377	4.032±0.0380	3.281±0.088***	----------
30days	4.011±0.060	4.000±0.088	3.092±0.076	3.237±0.075
GILL 7 days	2.89±0.100	2.669±0.060	2.532±0.125*	----------
15days	2.592±0.190	2.589±0.176	2.409±0.241***	----------
30days	2.489±0.146	2.478±0.141**	2.037±0.181***	2.233±0.161***
MUSCLE 7 days	2.410±0.080	2.390±0.060	2.331±0.50	----------
15days	2.352±0.088	2.341±0.145	2.220±0.117	----------
30days	2.341±0.078	2.329±0.066	2.086±0.0598	2.189±0.098

TABLE 41

Effect of effluent water on fish tissue ALPase

(μ mole of PNPP released/mg protein/h)

	Control	10%	20%	Koyali
LIVER 7 days	6.633±0.005	6.530±0.0079	6.348±0.0044	---------
15days	6.200±0.004	6.486±0.0017	6.203±0.0050	----------
30days	6.730±0.003	6.737±0.009	6.884±0.007	6.798±0.008
GILL 7 days	3.721±0.004	3.789±0.0079	3.386±0.0044**	--------
15days	3.721±0.004	3.672±0.0017**	3.285±0.0050 **	--------
30days	4.292±0.003	4.189±0.009***	4.290±0.007 ***	4.109±0.008 ***
MUSCLE7days	4.292±0.003	3.800±0.0079	3.769±0.0044	--------
15days	3.825±0.004	3.787±0.0017	3.646±0.0050 ***	---------
30days	4.001±0.003	3.946±0.009***	3.999±0.007 ***	3.896±0.008 ***

TABLE-42

Effect of effluent water on fish tissue ACPase

(μ mole of PNPP released/mg protein/h)

	Control	10%	20%	Koyali
LIVER 7 days	1.896±0.005	1.852±0.0079	1.802±0.0044	--------
15days	1.806±0.004	1.796±0.0017	1.780±0.0050	-------
30days	1.900±0.003	1.904±0.009	1.994±0.007	1.926±0.008
GILL 7 days	2.218±0.007	2.027±0.0050	1.929±0.010 **	---------
15days	1.881±0.004	1.908±0.0017 **	1.898±0.0050 **	---------
30days	1.800±0.003	1.876±0.009***	1.804±0.007***	1.837±0.008***
MUSCLE7days	3.052±0.023	2.980±0.0125	2.180±0.010	---------
15days	2.880±0.013	2.670±0.0117	2.320±0.0150***	---------
30days	2.322±007	2.290±0.011***	2.100±0.011***	2.180±0.047***

TABLE- 43

Effect of effluent water on fish tissue SOD

(μ moles GSH oxidized/min/mg protein)

	Control	10%	20%	KOYALI
LIVER 7 days	1.619±0.0050	1.639±0.0079	1.704±0.0044	--------
15days	1.713±0.0045	1.702±0.0017	1.694±0.0050	-------
30days	1.789±0.0030	1.836±0.009	1.894±0.007	1.882±0.008
GILL 7 days	2.758±0.0050	2.639±0.0079	2.623±0.0044	-------
15days	2.804±0.0045	2.842±0.0017	2.898±0.0050	-------
30days	2.821±0.0030	2.849±0.009	2.899±0.007	2.838±0.008
MUSCLE 7days	3.598±0.0050	3.477±0.0079	3.398±0.0044	----------
15days	3.608±0.0045	3.628±0.0017	3.881±0.0050	----------
30days	3.666±0.0030	3.796±0.009	3.892±0.007	3.782±0.008

TABLE-44

Effect of effluent water on fish tissue GPx

(μ mole GSH oxidized/min/mg protein)

	Control	10%	20%	Koyali
LIVER 7 days	0.0128±0.0050	0.0125±0.0079	0.0115±0.0044	---------
15days	0.0126±0.0045	0.0110±0.0017	0.0105±0.0050	---------
30days	0.0127±0.0030	0.0129±0.009	0.0132±0.007	0.0130±0.008
GILL 7 days	0.0208±0.0050	0.0196±0.0079	0.0200±0.0044	---------
15days	0.0198±0.0045	0.0182±0.0017	0.0176±0.0050	---------
30days	0.0210±0.0030	0.0212±0.009	0.0219±0.007	0.0213±0.008
MUSCLE 7days	0.0208±0.0050	0.0310±0.0079	0.0306±0.0044	---------
15days	0.0304±0.0045	0.0302±0.0017	0.0281±0.0050 *	---------
30days	0.0320±0.0030	0.0330±0.009	0.0332±0.007	0.0335±0.008

TABLE-45: Effect of effluent water on fish tissue GSH

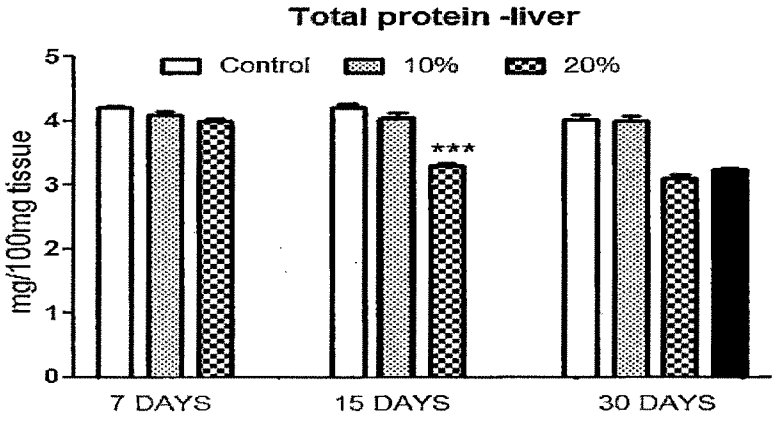
(μ mole GSH oxidized/min/mg protein)

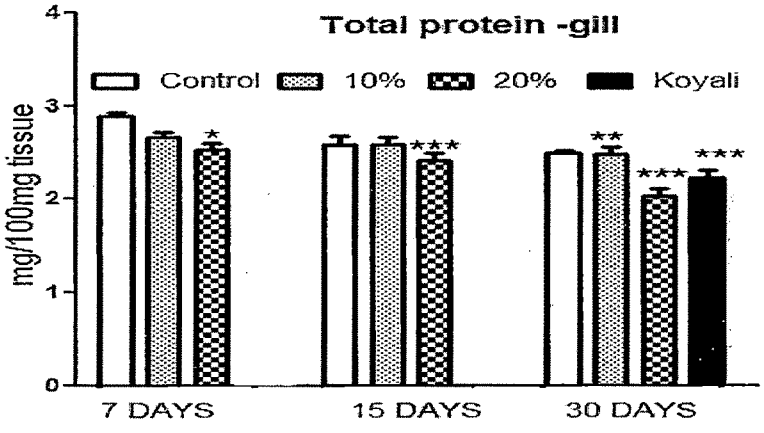
	Control	10%	20%	Koyali
LIVER 7days	0.01467±0.0050	0.01403±0.0079	0.01326±0.0044	---------
15days	0.01310±0.0045	0.01314±0.0017	0.01319±0.0050	---------
30days	0.01480±0.0030	0.0129±0.009	0.0132±0.007	0.0130±0.008
GILL 7 days	0.02667±0.0050	0.02413±0.0079	0.02447±0.0044	---------
15days	0.02230±0.0045	0.02226±0.0017	0.02218±0.0050	---------
30days	0.02964±0.0030	0.02978±0.009	0.03280±0.007	0.03080±0.008
MUSCLE 7 days	0.0250±0.0050	0.0248±0.0079	0.0237±0.0044	---------
15days	0.0304±0.0045	0.0231±0.0017	0.0229±0.0050	---------
30days	0.0268±0.0030	0.0248±0.0079	0.0237±0.0044	0.0240±0.0088

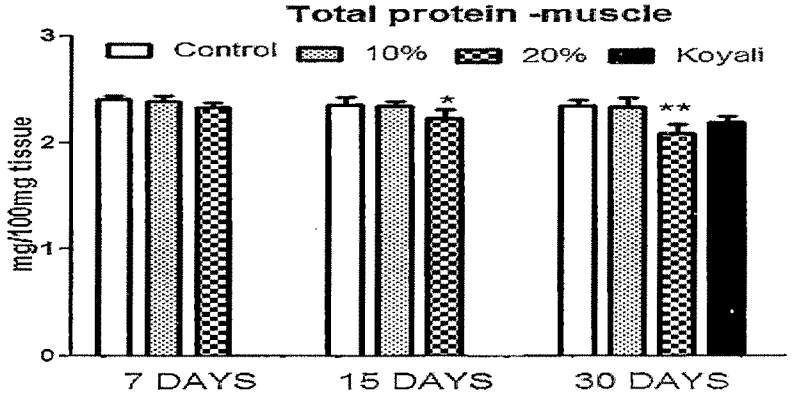
TABLE-46: Effect of effluent water on fish tissue Ascorbic acid (µg/100mg)

	Control	10%	20%	Koyali
LIVER 7 days	0.151±0.0050	0.156±0.0079	0.167±0.0044	---------
15days	0.160±0.0045	0.161±0.0017	0.181±0.0050 *	---------
30days	0.164±0.0030	0.169±0.009	0.189±0.007 **	0.165±0.008
GIL 7 days	0.313±0.0050	0.310±0.0079	0.298±0.0044	---------
15days	0.303±0.0045	0.299±0.0017	0.242±0.0050 ***	---------
30days	0.292±0.0030	0.286±0.009a	0.239±0.007 ***	0.260±0.008 ***
MUSCLE 7 days	0.378±0.0050	0.369±0.0079	0.287±0.0044***	---------
15days	0.357±0.0045	0.354±0.0017 *	0.276±0.0050 ***	---------
30days	0.348±0.0030	0.343±0.009***	0.264±0.007 ***	0.300±0.008 ***

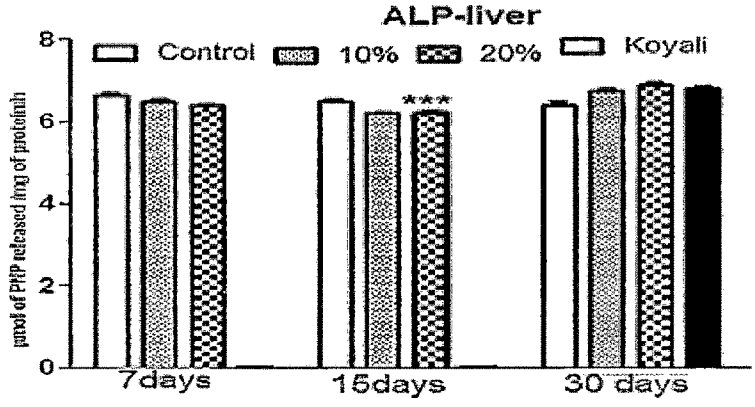
Data expressed as Mean ± SE. (n=3) ***p<0.001, **p<0.01,*p<0.05*, Control Vs other groups when compared with control values; the values of the control and effluent -exposed group are based on different days exposure.

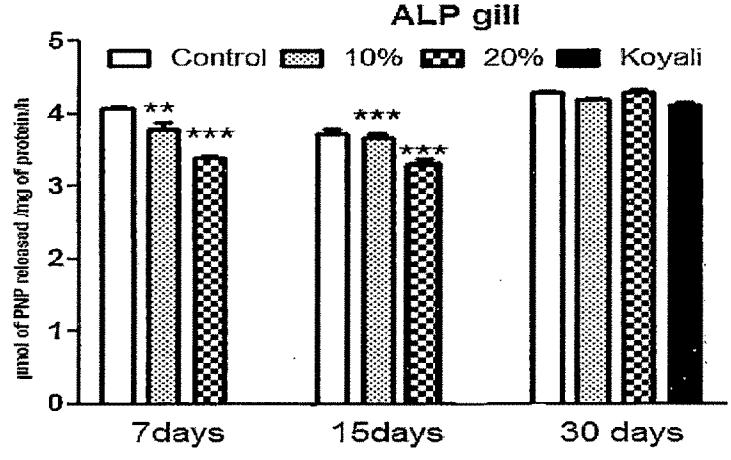


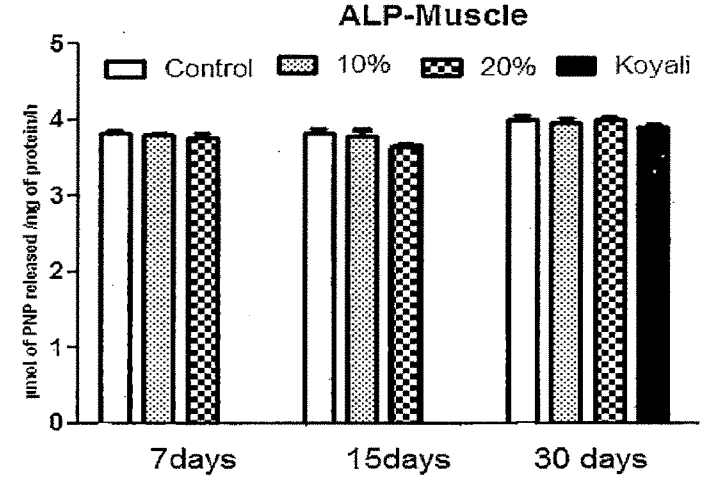




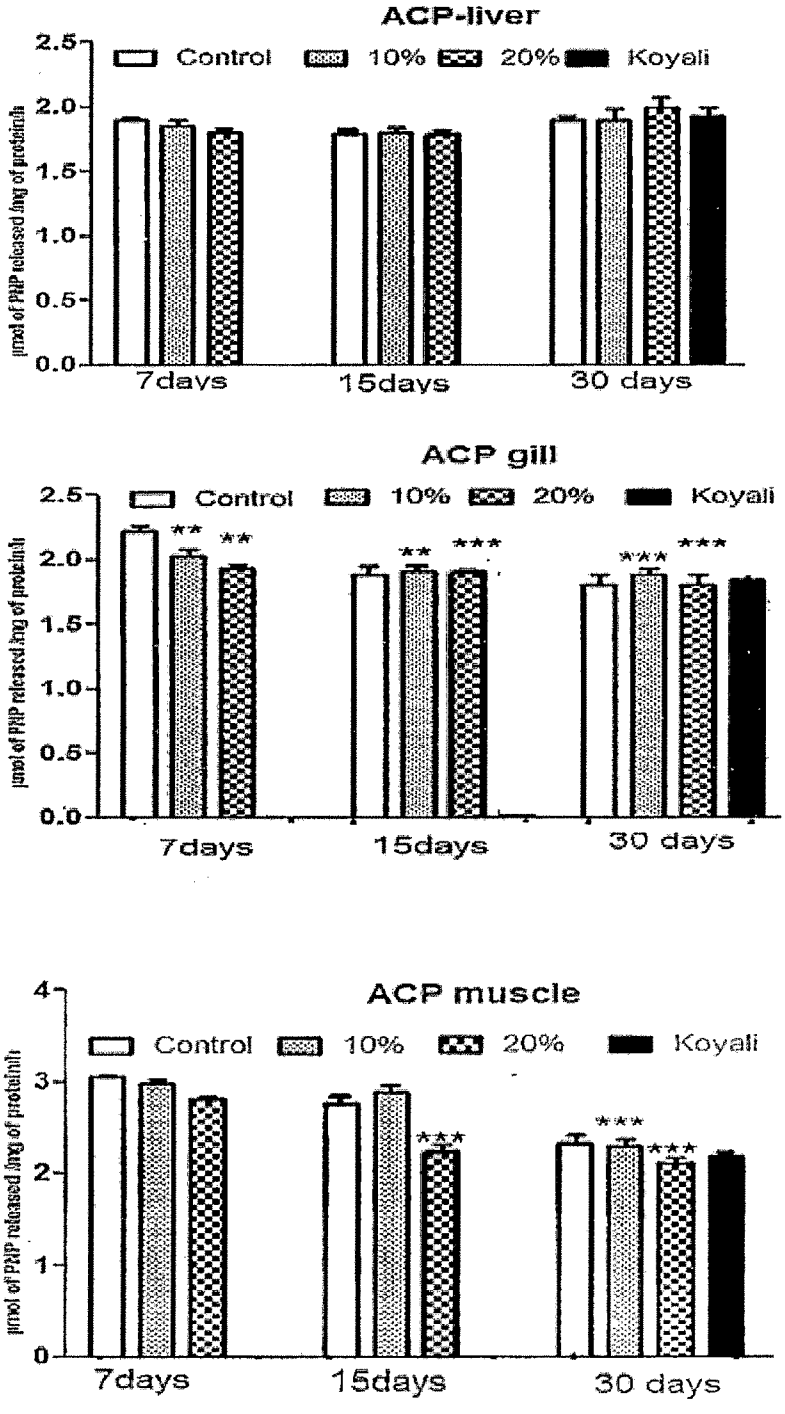
Figs. 26- 28: Values of total protein contents in tissues of in situ and experimentally exposed fishes



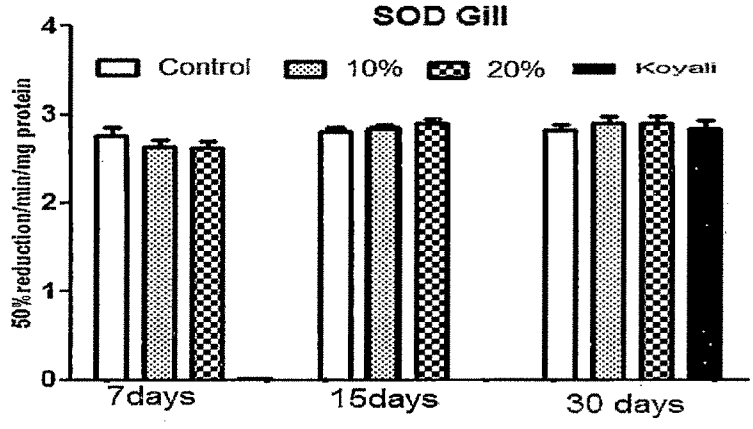


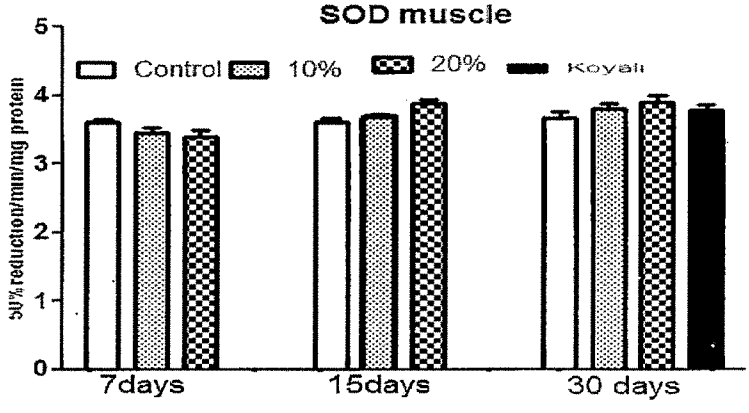


Figs. 29- 31: Values of alkaline phosphatase activity in tissues of in situ and experimentally exposed fishes.

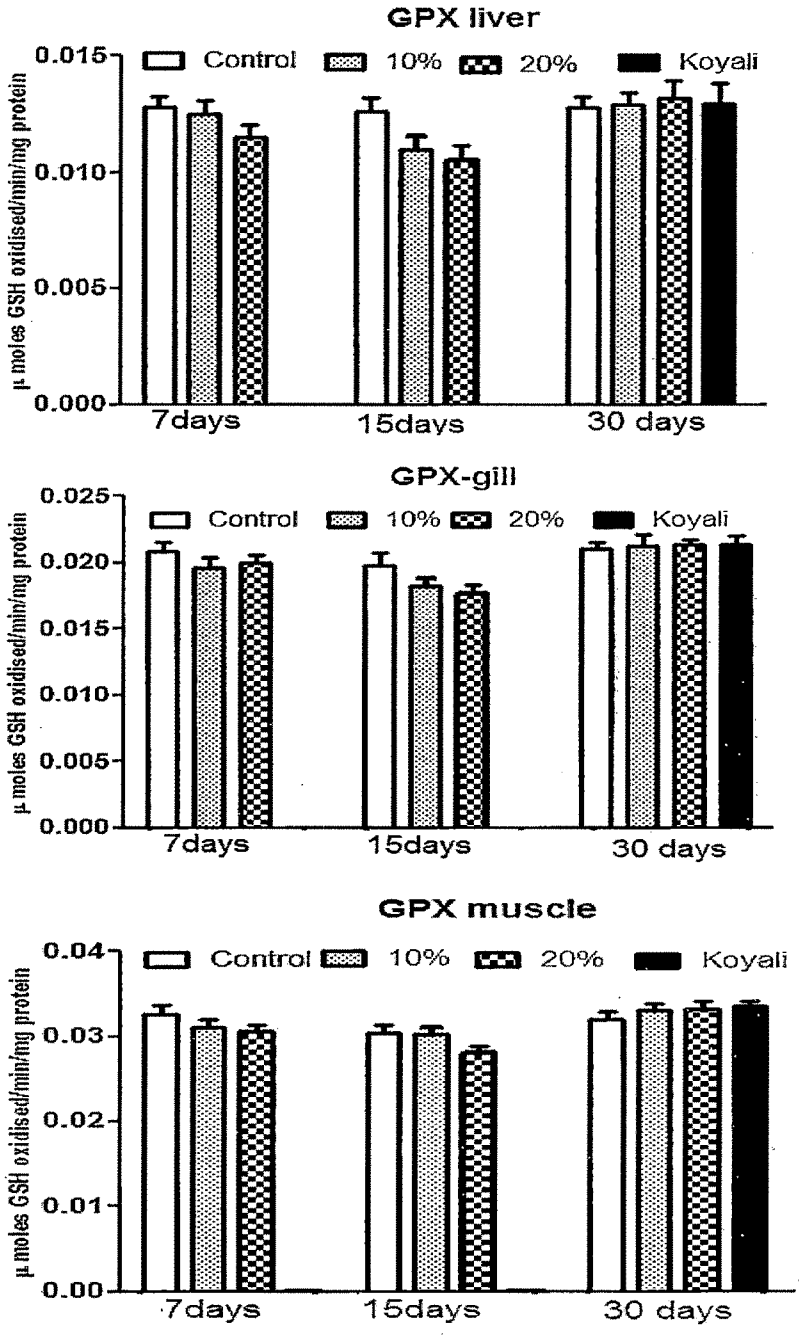


Figs. 32- 34: Values of acid phosphatase activity in tissues of in situ and experimentally exposed fishes.

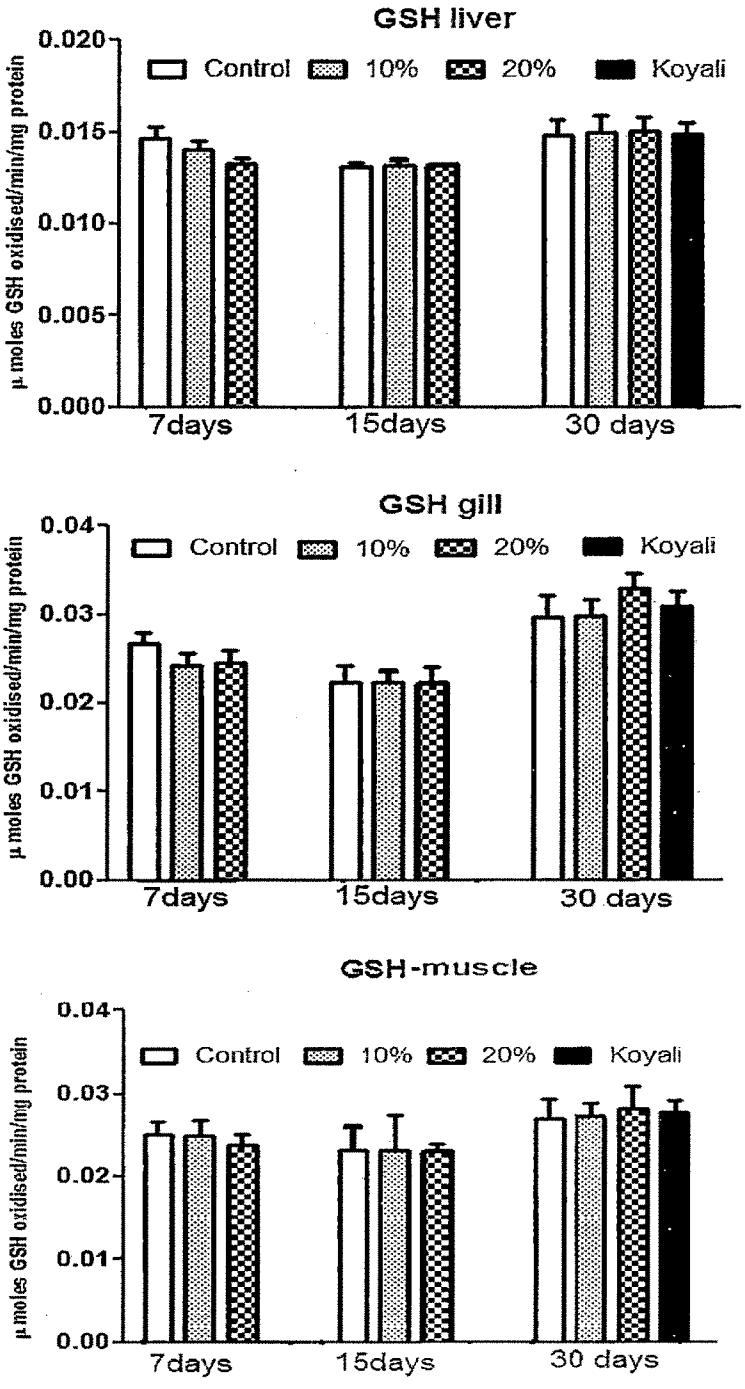




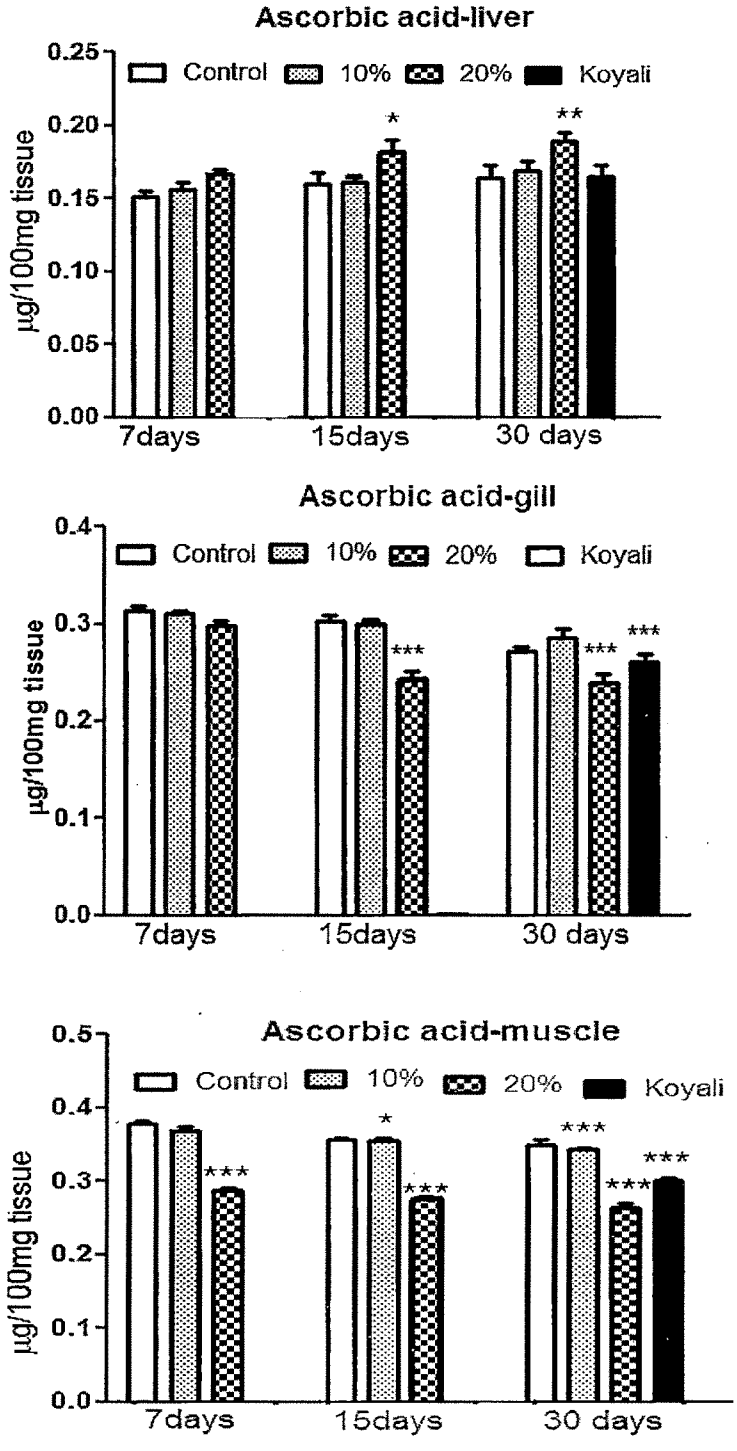
Figs. 35- 37: Values of superoxide dismutase activity in tissues of in situ and experimentally exposed fishes.



Figs. 38- 40: Values of glutathione peroxidise activity in tissues of in situ and experimentally exposed fishes



Figs. 41- 43: Values of reduced glutathione contents in tissues of in situ and experimentally exposed fishes.



Figs.44-46: Values of total ascorbic acid contents in tissues of in situ and experimentally exposed fishes.

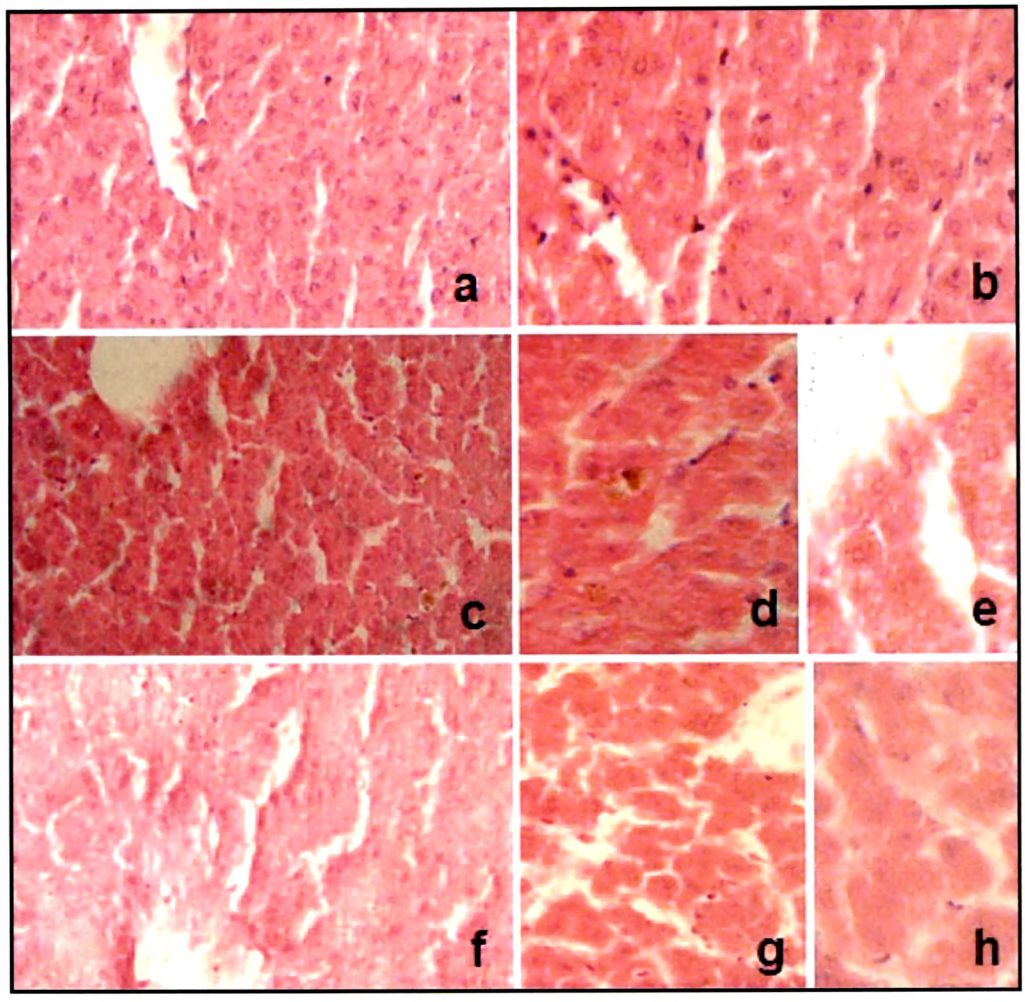
TABLE-47: **Heavy metals in fish of Koyali Pond**

Parameters	Kidney	Muscle	Liver	Gill
Cadmium	1.4 ±0.02	0.03±0.002	0.06±0.01	0.01±0.003
Chromium	B.D.L.	B.D.L.	B.D.L.	B.D.L.
Nickel	B.D.L.	B.D.L.	0.7± 0.03	0.7±0.004
Lead	B.D.L.	0.04± 0.005	0.1±0.01	0.7±0.002
Copper	4.5±0.003	0.01±0.001	1.7±0.02	0.65±0.01

All heavy metals in ug / g dry wt.

Cu BDL =0.04(μ g/ml) on 228.8nm
Cr^{+6} BDL=0.1(μ g/ml) on 357.9 nm
Ni BDL=0.1 (μ g/ml) on232.8nm
Pb BDL=0.25(μ g/ml) on217nm

PLATE 1: Liver



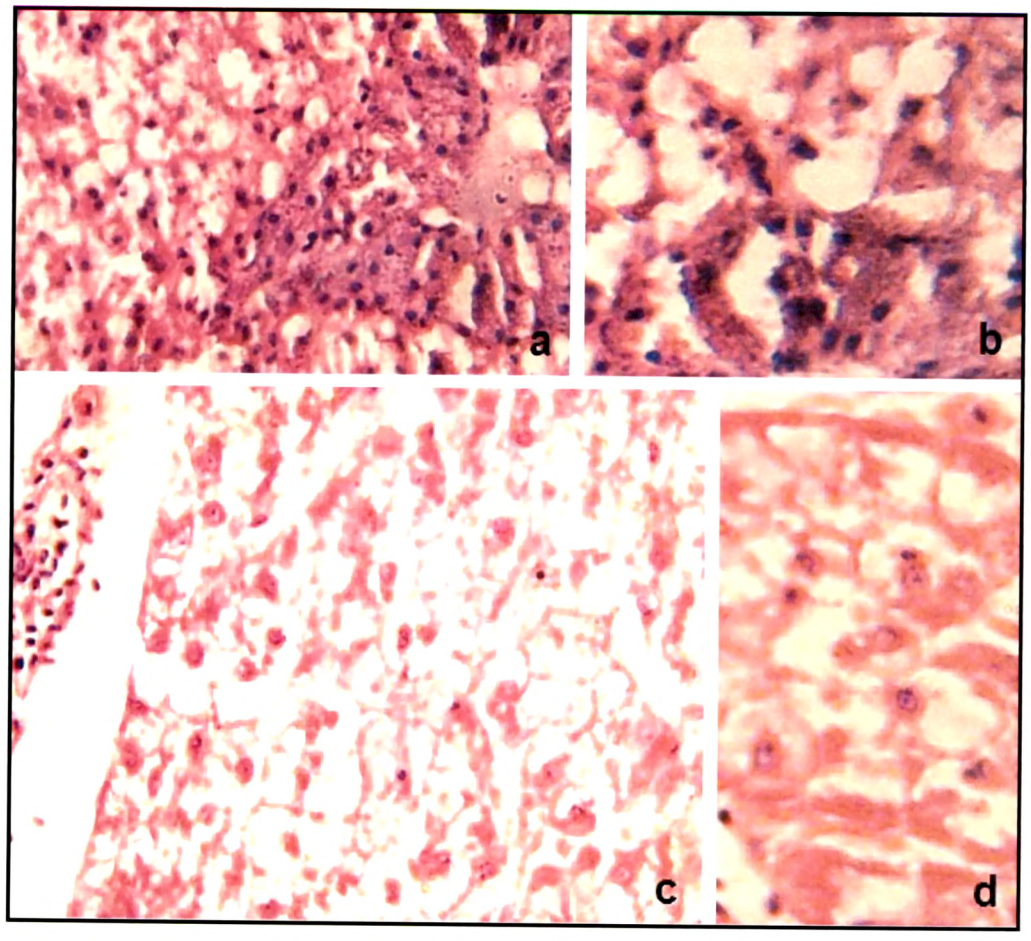
a. and b. Control liver showing parenchymatous appearance and arrangement of hepatocytes.

c. d. and e. Exposure to 10% toxicant for 15 days resulting into swelling of cells and architectural alterations. Note disintegration of endothelial lining of the central vein (e).

f. g. and h. Exposure to 10% toxicant for 30 days lead to severe cellular changes and vacuolation of cells.

(a, b, c, f: 200X, d, e, g, h: 400 X)

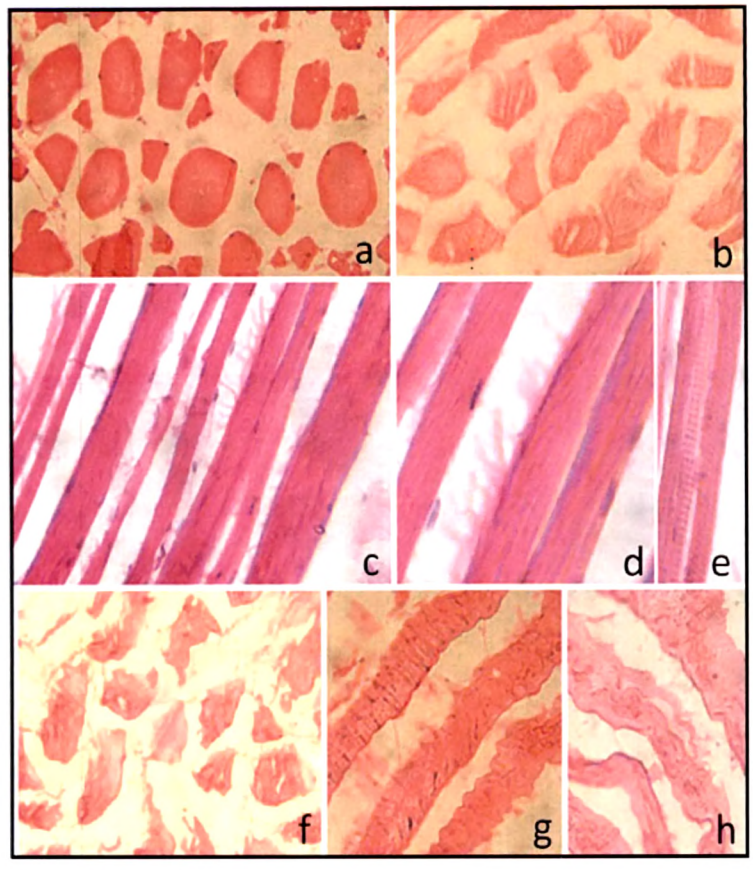
PLATE 2: Liver



a. and b. Exposure of fishes to 20% doses for 30 days lead to extensive large vacuolatiion and disintegration of cellular contents. The arrangemt of the cells in peri central region is highly compromised.
c. and d. Liver of fish from Koyali pond showing severe degenerative changes.

(a, c: 200X; b, d: 400X)

PLATE 8: Muscles

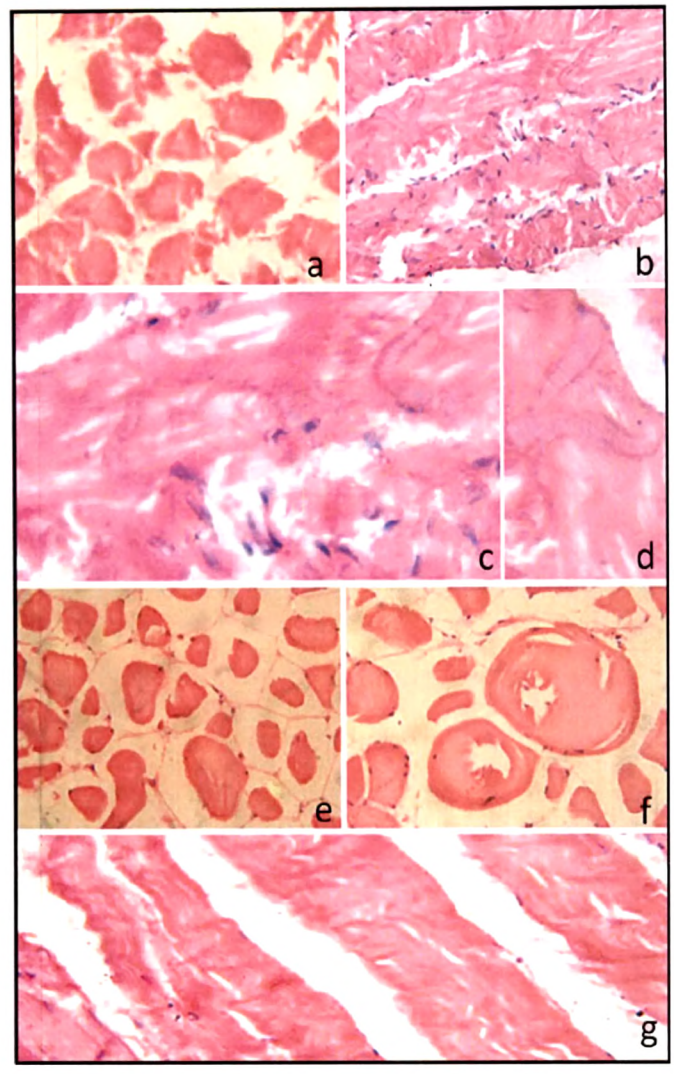


a-e Control showing typical myofibril bundles surrounded by loose connecting tissue . a, b are cross sections
c, d, e shows the fibre and striation in e.

f-h: 10% exposure for 15 days showing loosely organized muscle bundles indicative of perimycium.

(a-d 200X, e: 400X)

PLATE 9: Muscles



a-d: fish exposed to 20 % for 30 days showing necrosis, aggregation of inflammatory cells.

e-g fish from Koyali pond showing muscle dystrophy, prominent lost of connecting tissue and vacuolar degeneration.

(a, b, e, f: 200X; c, d, g: 400X)

Table - 48

Checklist of Mollusca recorded at the study sites.

PHYLUM	CLASS	SUB CLASS	ORDER	FAMILY	SPECIES	sites	
						Koyali	Dumad
MOLLUSCA	Gastropoda	Pulmonata	Basommatophora	Lymnaeidae	*Lymnae luteola* (Lamark,1822)	+	+
					Indoplanorbis exustus (Deshayes,1834)	-	+
					Planorbis rotundutus (Geoffroy,1767)	+	+
					Gyralus labiatus (Benson,1850)	+	-
					Gyralus convexiusculus (Hutton,1849)	+	-
		Prosobranchia	Mesogastropoda	Bithyniidae	*Digoniostama textum* (Annandale,1921)	-	+
				Thiaradae	*Thiara mainwaringia* (Nevill,1884)	+	+
					T.tuberculata crebra (Lea,1850)	+	-
				Viviparidae	*Bellamya bengalensis ehurnea* (Annandale,1921)	+	+
					B.bengalensis typical (Lamark,1882)	+	+
					Bellamya bengalensis mandiensis (Kobelt,1909)	-	+
					Bellamya bengalensis colairensis (Kobelt,1909)	+	+
					Bellamya crassa (Benson,1836)	+	+
					Bellamybengalensis balteata (Benson,1836)	+	+

TABLE - 49

Check list of birds cited at Dumad/Koyali ponds during the study period

Sr. no	Common name	Scientific name	Sites
Order: Ciconifomes Family: Ardeide			
1.	Little Egret	*Egretta garzetta*	Koyali
2.	Cattle Egret	*Bubulcus ibis*	Koyali, Dumad
3.	Great Egret	*Egretta alba*	Koyali
4.	Pond Heron	*Ardeola grayii*	Koyali
5.	Purple heron	*Ardea purpuria*	Dumad
6.	Grey heron	*Ardea cinerea*	Koyali, Dumad
Order: Podicipediformes Family: Podicipedae			
7.	Little grebe	*Tachybaptus rufficolis*	Koyali, Dumad
Family: Ciconiidae			
8.	Painted Stork	*Mycteria leucocephala*	Koyali, Dumad
9.	Asian Open bill-Stork	*Anastomus oscitans*	Dumad
10	Black-necked Stork	*Ephippiorhvnchus asiaticus*	Dumad
11	White-necked Stork	*Ciconia episcopus*	Koyali, Dumad
Family: Threskiornithidae			
12.	Oriental White Ibis	*Threskiornis elanocephalus*	Dumad
13.	Blackibis	*Pseudibis papillosa*	Koyali, Dumad
14.	Glossy Ibis	*Plegadisfalcinellus*	Dumad
15.	Eurasion Spoonbill	*Platalea. Leucorodia*	Dumad

Order: Anserlformes Family: Anatidae			
16	Barheaded goose	*Anser.indicus-*	Dumad
17	Brahminy-Shelduok	*Tudomafetruginea.*	Koyali, Dumad
18	Northern Pintail	*Anus acuta*	Koyali, Dumad
19	Spot billed duck	*Anas poecilorhyncha*	Koyali, Dumad
Order: Falconiformis Family: Accipitridae			
20	Black-shouldered kite	*Elanus caerulus*	Dumad
21	Black kite	*Milvus migrans*	Dumad
Order: Galiformes Family: Phasianidae			
22	Grey francolin	*Francolinus pioius*	Dumad
23	Indian Peafowl	*Pavo cristatus*	Dumad
Order: Gruiformes Family: Gruidae			
24	Demoiselle Crane	*Anthropoides virgo*	Dumad
Family: Rallidae			
25	White-breasted Waterhen	*Amauromis phoenicurus*	Dumad
26	Purple Moorhen	*Porphyrio porphyrio*	Dumad
27	Common Coot	*Fulica atra*	Dumad
Order: Pelicaniformes Family: Phalacrocorcidae			
28	Little Cormorant	*Phalacrocorax niger*	Koyali
Order: Charadriformis			

Family: Recurevirostridae			
29	Black wiged stilt	*Himanotopus himanotopus*	Koyali, Dumad
Family: Charadridae			
30	Red wattled lapwing	*Vanelus indicus*	Koyali, Dumad
31	Little ringed plover	*Charadrius dubius*	Dumad
Family: Scolopacidae			
32	Common sandpiper	*Actitus hypoleucous*	Dumad
33	Curlew sandpiper	*Calidris ferrugenea*	Dumad
Family: Laridae			
34	Indian river tern	*Sterna auratia*	Dumad
Order: Columbiformis Family: Columbidae			
35	Blue rock pigeon	*Columbia livia*	Koyali, Dumad
36	Little brown dove	*Streptopelia sensgelensis*	Dumad
Order: Psittaciformis Family: Psittacidae			
37	Roseriged parakeet	*Psittacula krameri*	Koyali, Dumad
38	Blossom headed parakeet	*Psittacula roseta*	Dumad
Family: Cuculidae			
40	Asian koel	*Eudynymys scolopcea*	Dumad
Order: Apodiformis Family: Apodidae			
41	House swift	*Apus affinis*	Dumad
Order: Coraciiformis			

Family:Alcidinidae			
42	Lesser pied Kingfisher	*Ceryle rudis*	Koyali, Dumad
43	Small biue Kingfisher	*Alcedo attis*	Koyali, Dumad
44	White breasted Kingfisher	*Halcyon smyrnesis*	Koyali, Dumad
Family: Meropidae			
45	Small bee eater	*Merops orientalis*	Koyali, Dumad
Family: Coracidae			
46	Indian roller	*Coracious bengalensis*	Koyali, Dumad
Family: Upupidae			
47	Common Hoopoe	*Upupa epops*	Dumad
Family: Bucerotidae			
48.	Indian Grey hombill	*Ocyceros birostris*	Dumad
Order: Piciformes Family: Capitonidae			
49	Coppersmith Barbet	*Megalaima haemacephala*	Dumad
Order: Passeriformes Family: Alaudidae			
50.	Rufous-tailed FinchLark	*Ammomanes phoenicurus*	Dumad
51.	Bengal Bush-Lark	*Mirafra assamica*	Dumad
Family: Hirundinidae			
52.	Wire-tailed Swallow	*Hirundo smithii*	Dumad
53.	Common Swallow	*Hirundo rustica*	Dumad
54.	House Swallow	*Hirundo tahitica*	Koyali, Dumad

55	Red-romped Swallow	*Hirndo daurica*	Dumad
56.	Streak-throated Swallow	*Hirundo fluvicola*	Dumad
Family: Laniidae			
57.	Great Grey Shrike	*Lanius excubitor*	Dumad
58.	Baybacked shrike	*Lanius vittatus*	Koyali, Dumad
Family: Dicruridae			
59.	Black Drongo	*Dicrurus macrocercus*	Koyali, Dumad
Family: Sturnidae			
60.	Common Myna	*Acridotheres tristis*	Koyali, Dumad
61.	'Brahminy Starling	*Sturnus pagodarum*	Dumad
62.	Rosy Starling	*Sturnus roseus*	Koyali, Dumad
Family: Pycnonotidae			
63.	Red-vented Bulbul	*Pvcnonotus cater*	Koyali, Dumad
64.	Black Bulbul	*Hvpsipetes leucocephalus*	Koyali, Dumad
Family: Muscicapidae Sub Family: Timaliinae			
65.	Large Grey Babbler	*Turdoides malcolmi*	Koyali, Dumad
66.	Jungle Babbler	*Turdoides striatus*	Koyali, Dumad
Sub Family: Monarchinae			
67.	Asian Paradise-Flycatcher	*Terpsiphone paradisi*	Dumad
Sub Family: Sylviinae			
68.	Ashy Prinia	*Prinia socialis*	Dumad
Sub family: Turdinae			

69.	Indian Robin	*Saxicoloides fulicata*	Dumad
Family: Motacillidae			
70.	Oriental Tree Pipit	*Anthus hodgsoni*	Dumad
71.	Yellow wagtail	*Motacilia favia*	Koyali, Dumad
72.	Grey wagtail	*Motaciliacinerea*	Koyali, Dumad
73.	White wagtail	*Motacilia alba*	Koyali, Dumad
74.	Large pied wagtail	*Motacilia moderaspentis*	Dumad
Family: Nectarinidae			
75	Purple rumped Sunbird	*Nectarina zeylonica*	Koyali, Dumad
76.	Sunbird	*Nectarina asiatica*	Dumad
77.	Sunbird	*Nectarina minima*	Dumad
Family: Passeridae Sub-family: Passerinae			
78.	House sparrow	*Passer domesticus*	Dumad
Sub-family: Plocinae			
79.	Baya weaver	*Ploceus phillipinus*	Dumad
Sub-family: Esterildidae			
80.	White throated munia	*Lonchura malabarica*	Dumad

TABLE- 50

Check list of other fauna

No.	Common Name	Order
Phylum Annelida		
1.	Leech	Gnathobdellida
Phylum Arthropoda		
2.	Spider	Aranedea
3.	Ant	Hymenoptera
4.	Ant Lion	Neuroptera
5.	Giant Water Bug	Hemiptera
6.	Plant Hopper	Hemiptera
7.	Bug	Hemiptera
8.	Water Strider	Hemiptera
9.	Nepa	Hemiptera
10.	Beetle	Coleoptera
11.	Cow-Dung Beetle	Coleoptera
12.	Termite	Isoptera
13.	Mosquito Larvae	Diptera
14.	Blue Bottle Fly	Diptera
15.	Soldier Fly	Diptera
16.	Butterfly	Lepidoptera
17.	Moth	Lepidoptera
18.	Earwig	Dermaptera
19.	Locust	Orthoptera
20.	Grass Hopper	Orthoptera
21.	Mole Cricket	Orthoptera
22.	Damsel Fly	Odonata
23.	Dragon Fly	Odonata
Phylum Chordata		
24.	Gambusia (larva feeding fish)	Cyprinidontiformis
25.	Tilapia	Perciformes
26.	Rohu	Cypriniformis
27.	Catla	Cypriniformis
28.	Labeo	Cypriniformis
29.	Frugivorous Bats	Chiroptera