Density and Diversity of Molluscs at Three Different Irrigation Reservoirs of Central Gujarat

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Introduction

- Molluscs contribute the second largest invertebrate group on earth, next only to insects.
- The estimated species of molluscs today varies from 80,000 to 135,000 species. Of these 31,000-100,000 are marine, 14,000-35,000 are terrestrial and about 5000 freshwater species.
- The freshwater habitats are exclusively inhabited by the Gastropods and Bivalvia.
- Molluscan communities are good indicators of pollution status as they have limited migration patterns and can be studied to assess site-specific impacts.
- The presence of their thriving population indicates that the land is not acidic as hardly any molluscs survive below the pH 5.

Introduction (Contd.)

- Historically, research on relationships between terrestrial mollusc fauna and soil environmental properties has passed through various phases: from early descriptive studies, to current studies in which rationalized sampling techniques and sophisticated statistical procedures are used to identify the factors influencing the distribution of species, and to assess the extent to which such factors predict a species' presence in a given location.
- Although the importance of edaphic variables has been extensively documented, a number of important questions remains to be answered.
- The importance of pH and calcium, traditionally considered as limiting factors, has been questioned by some authors, who have either not found a direct relationship or have found other factors to be more important.

Introduction (Contd.)

- The molluscan density and diversity were studied at the following three irrigation reservoirs:
- Wadhwana Irrigation Reservoir (WIR)
- Timbi irrigation reservoir (TIR)
- Jawla irrigation reservoir (JIR)

AIM

To find out the relationship between the molluscan fauna and the soil chemistry at the three irrigation reservoirs in Central Gujarat.

Study Area

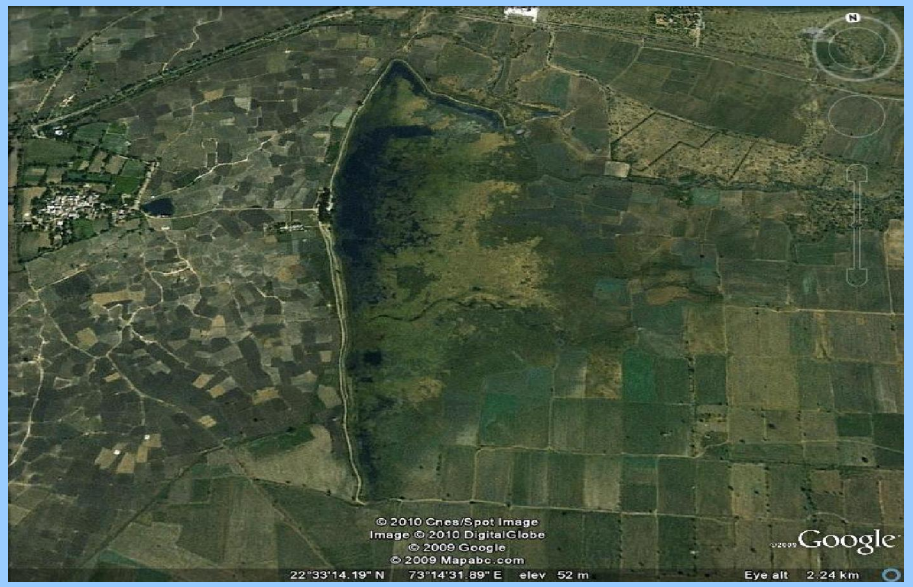
WIR	TIR	JIR
About 50 kms. south- east of Vadodara	12 kms. East of Vadodara city	32 kms. North of Vadodara city
Inundated with Narmada water	Inundated with Narmada water	Rain water is the major source of water
Spreads in 1430 acres	Spreads in 100.5 acres	Spreads in 192 acres
Perennial	Almost Perennial	Frequently dries off during Summer
Almost nil Anthropogenic pressures	Facing a slow increase in Anthropogenic pressures	Under high Anthropogenic pressures

Photographs and Google Earth images of the three irrigation reservoirs studied

Wadhwana Irrigation reservoir

Timbi Irrigation reservoir

Jawla Irrigation reservoir



Materials and Methods

- The study was carried out from March 2010 to November 2010 during three different seasons:

Ø Summer (March, April, May)

Ø Monsoon (June, July, August)

Ø Post-monsoon (September, October, November)

- The irrigation reservoirs were visited twice in a month.
- The molluscs were collected by quadrat sampling method.
- The molluscs were identified on the basis of Subba Rao (1989) and then counted.
- Soil samples were collected, dried and analysed further in the laboratory by methods described by Trivedy and Goel (1984).
- Total as well as seasonal Density was assessed.

The soil parameters studied were:

- pH
- Total nitrogen
- Total phosphorus
- Calcium (Ca^{+2})
- Magnesium (Mg^{+2})
- Acidity
- Alkalinity
- Chloride (Cl^{-})
- Total organic carbon

- Relation between the three study areas was assessed with the help of One-way ANOVA.
- Pearson correlation was performed.
- Statistical analysis was carried out using Prism and SPSS software.

Mollusc species found at the three study areas

Bellamya benghalensis

Indoplanorbis exustus

Lamellidens consobrinus

Thiara granifera

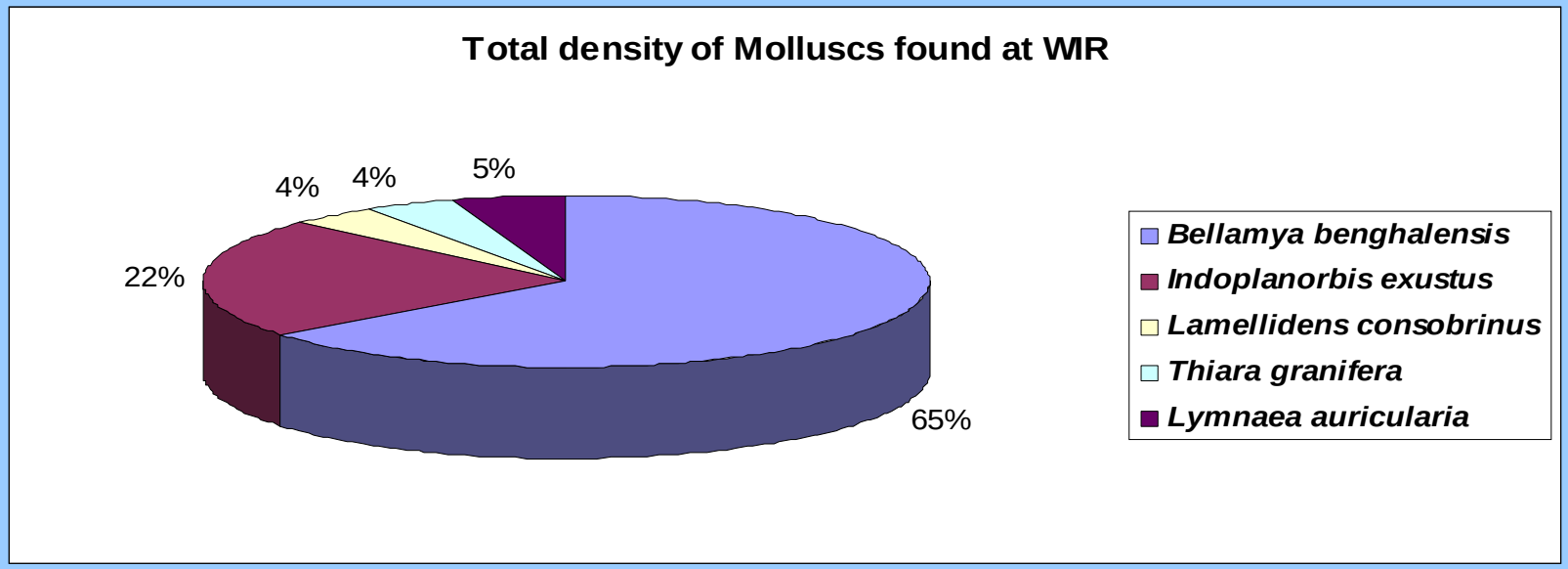
Lymnaea auricularia

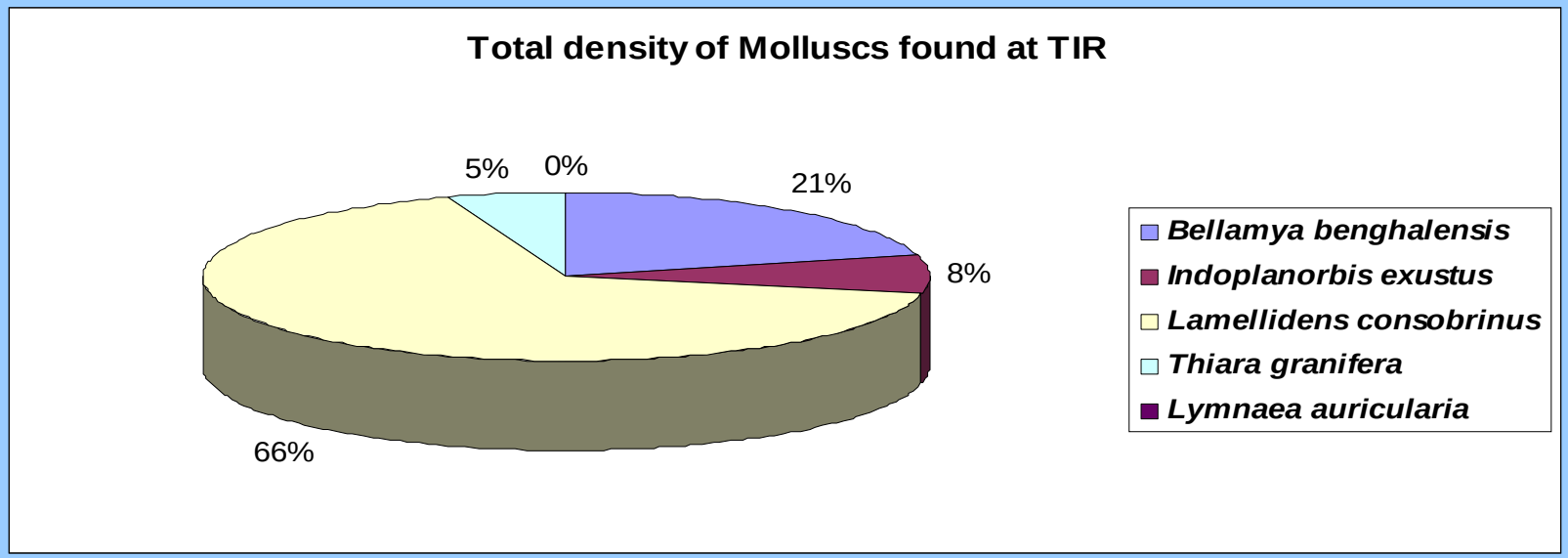
- *Bellamya benghalensis* (Viviparidae)- is the most common freshwater gastropod at all the three reservoirs.
- *Indoplanorbis exustus*- is the Second most abundant species found in the study.
- *Lamellidens consobrinus* (Unionidae)- is the Third most abundant species found in the study.

Found in reservoirs with less anthropogenic activities:

- *Thiara granifera* (Thiaridae)
- *Lymnaea auricularia* (Lymnaeidae)

Results and Discussion





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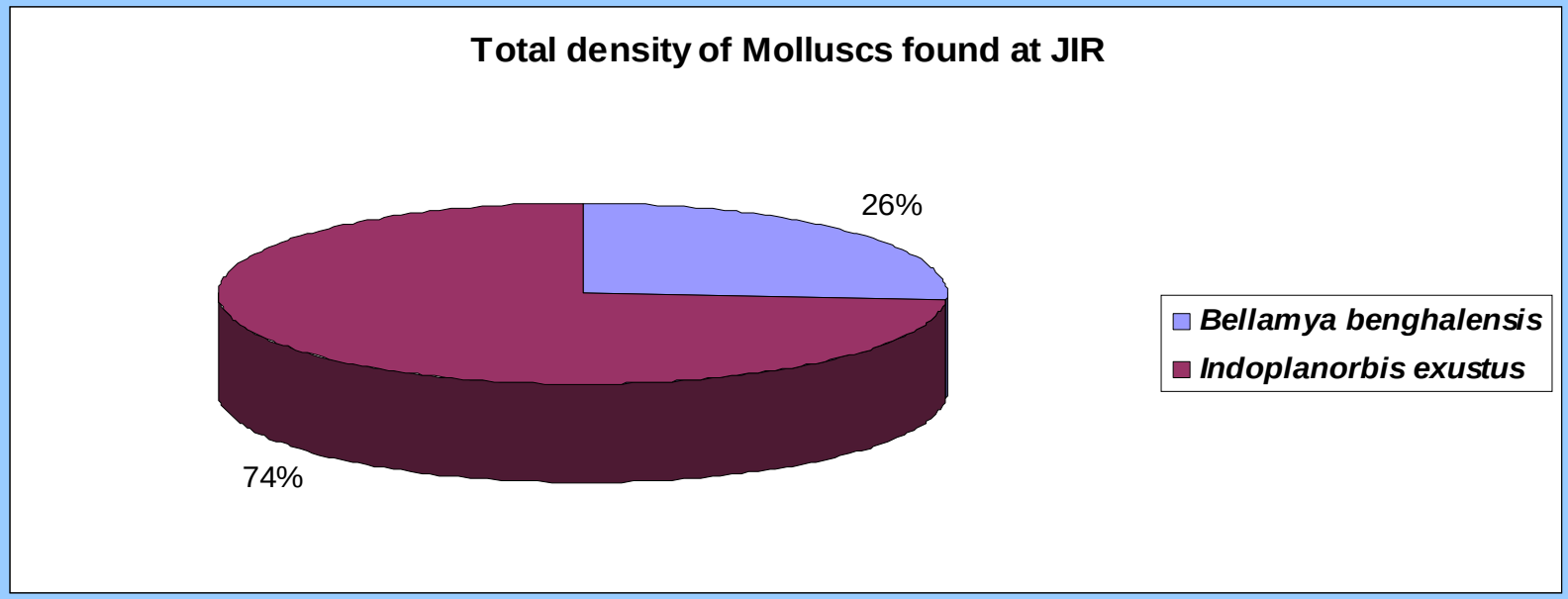

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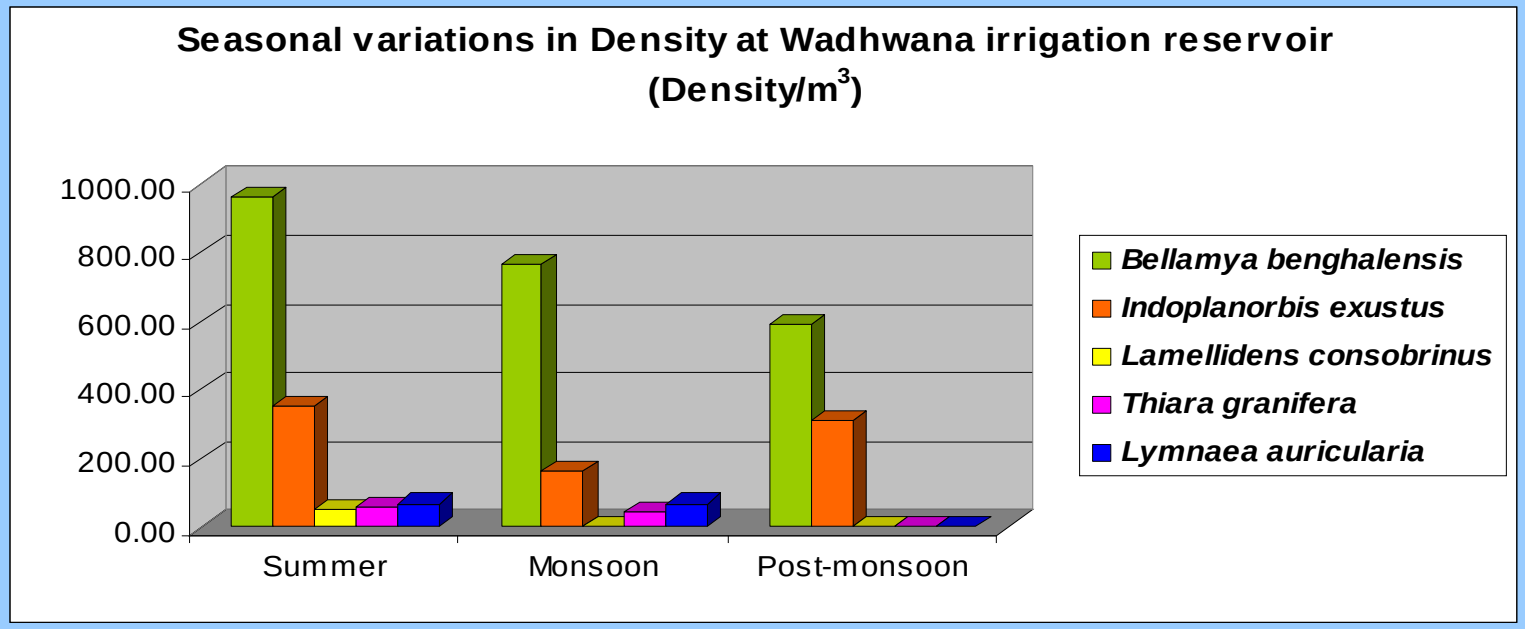

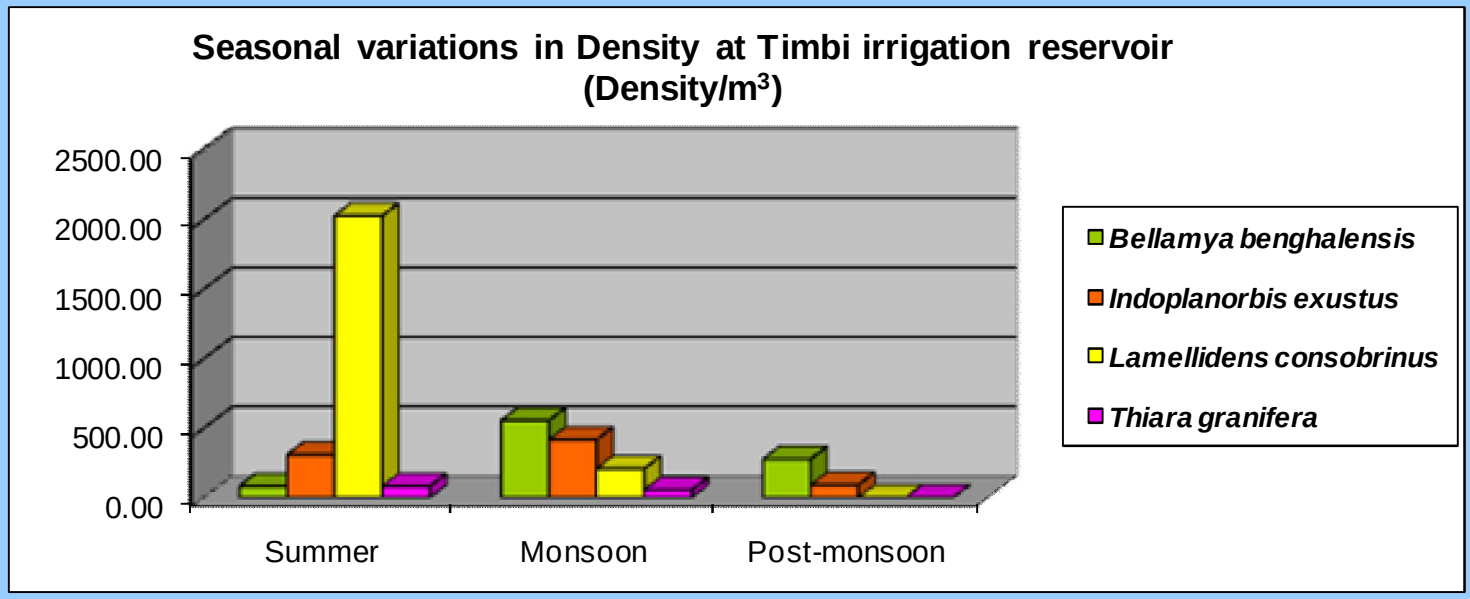

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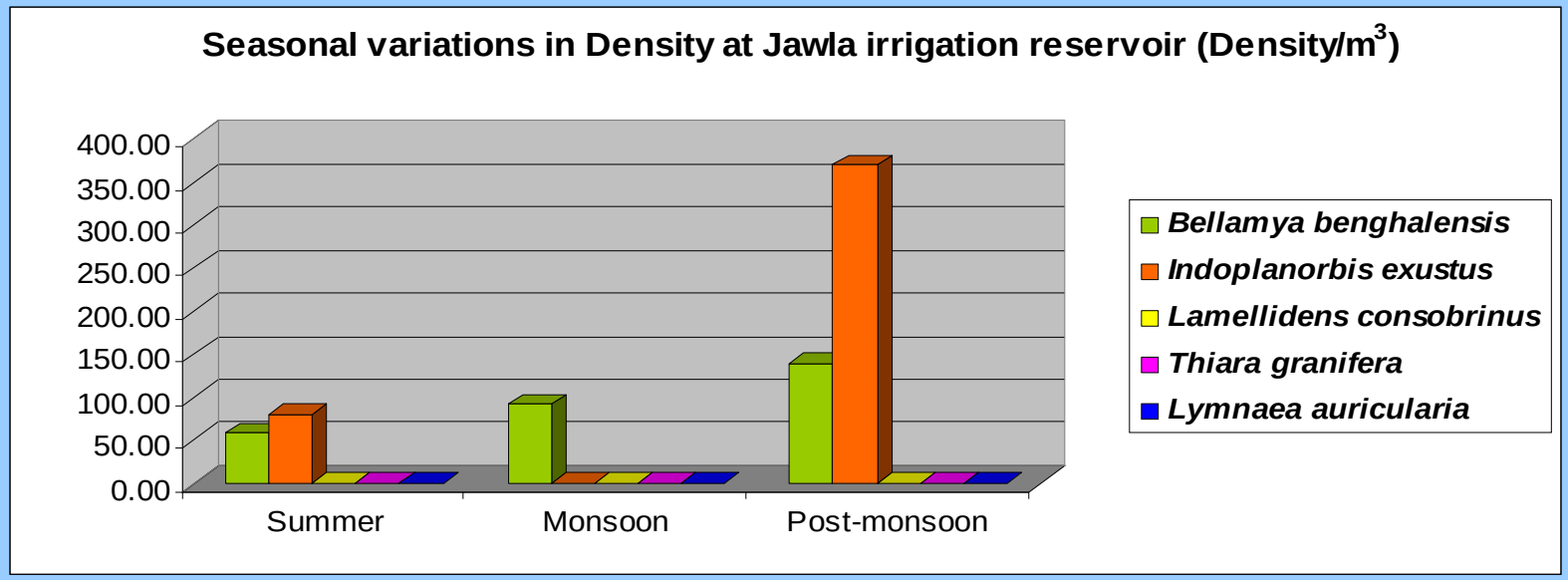

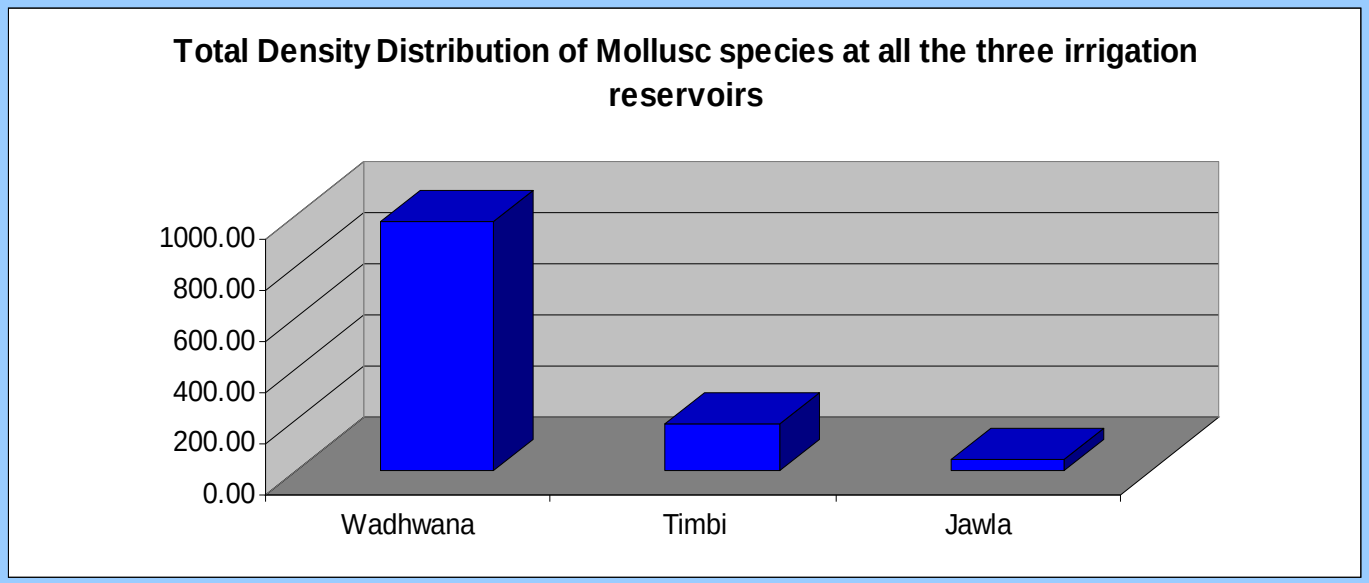

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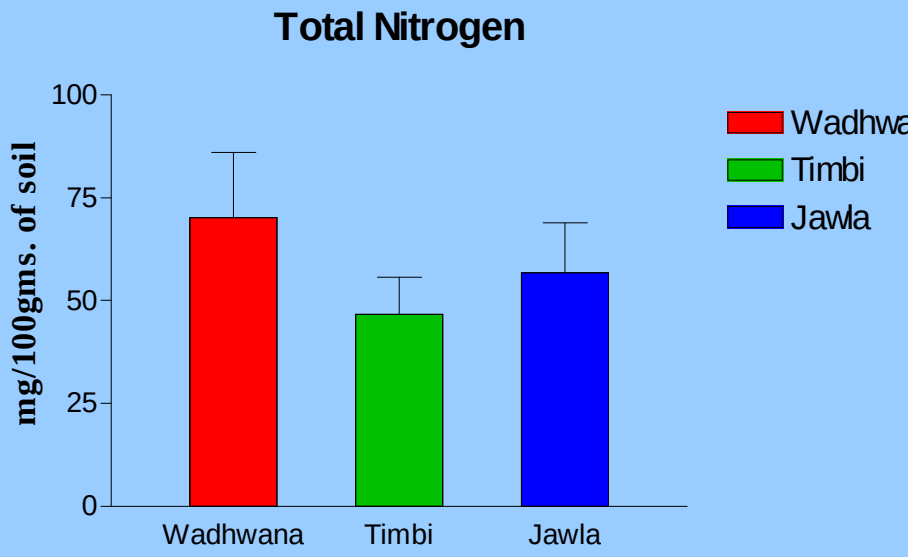
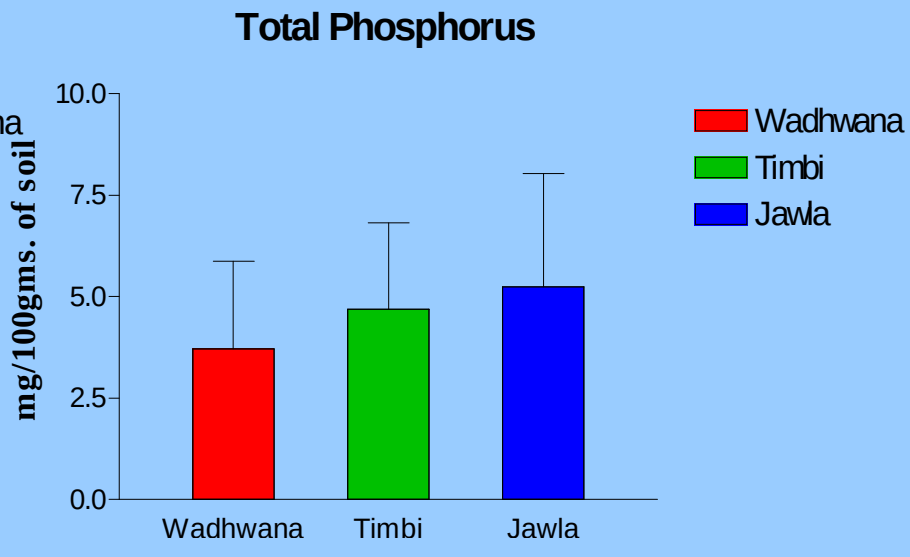
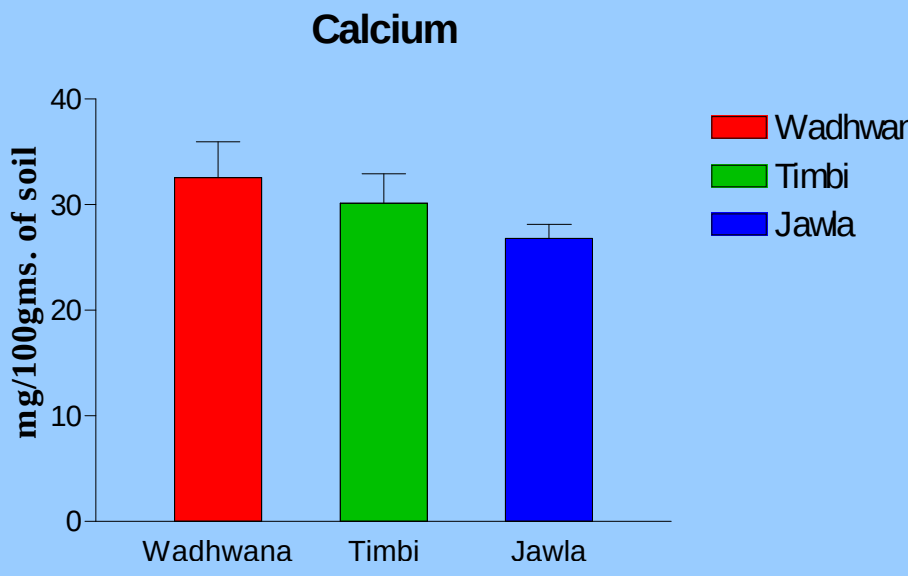
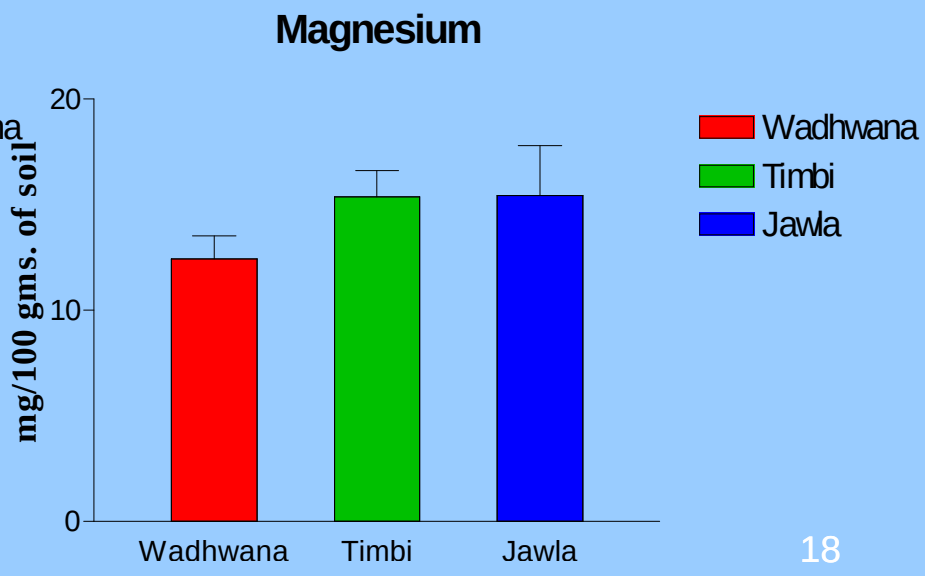
Results and Discussion (Contd.)









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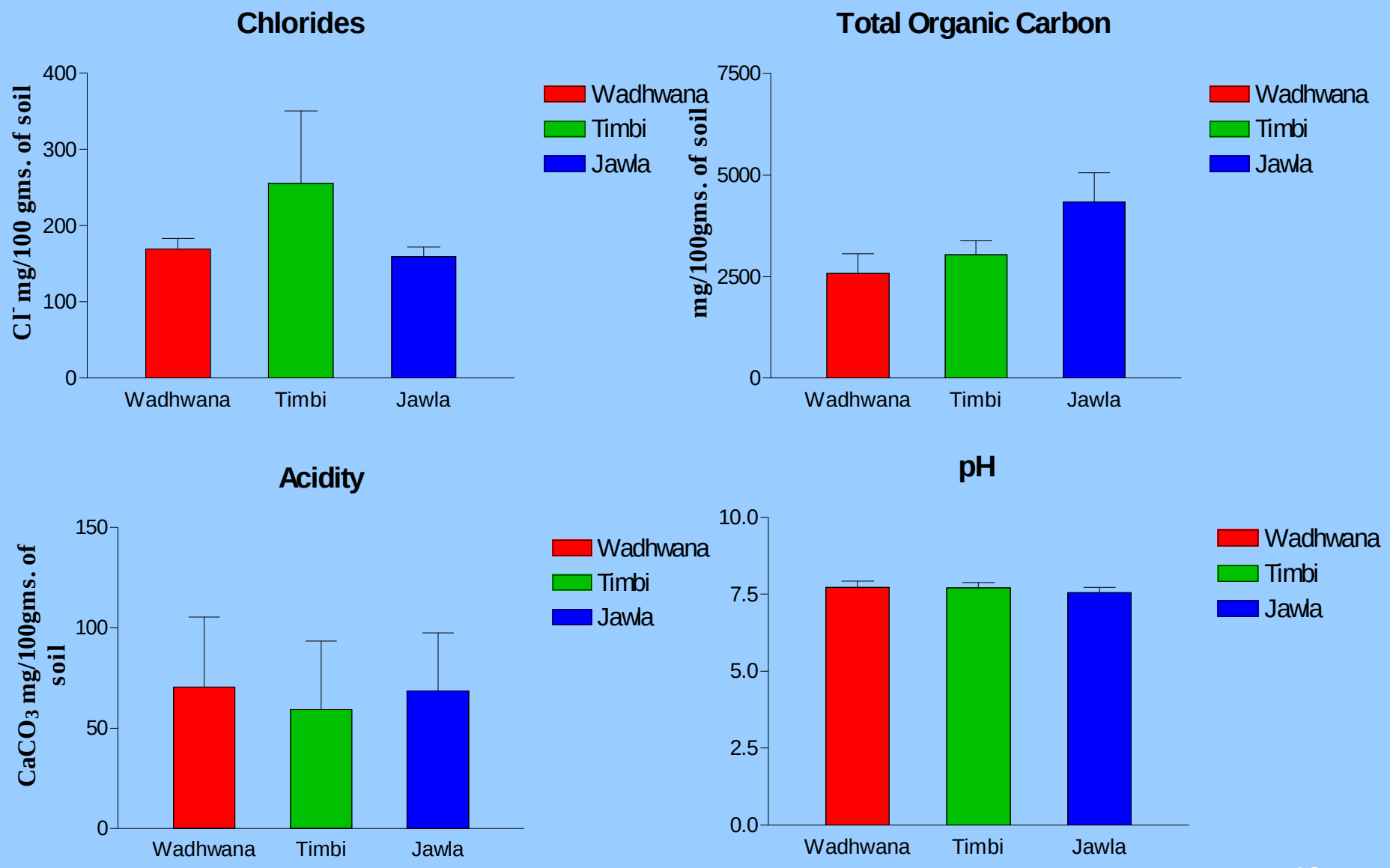

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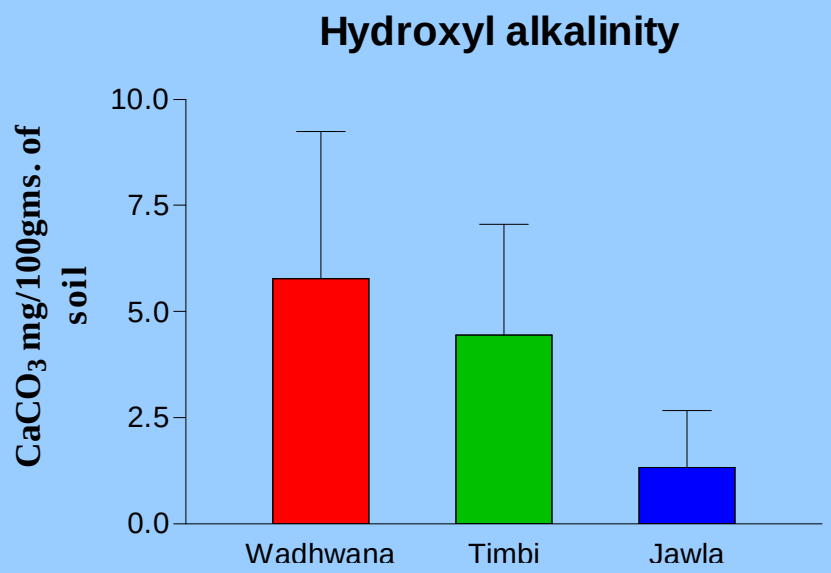

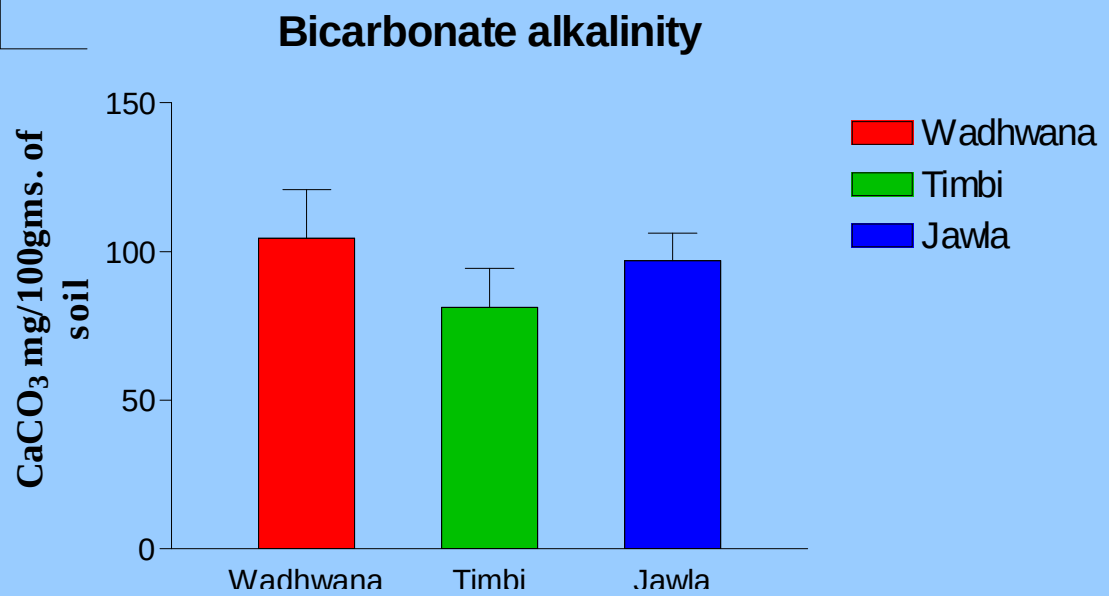

Pearson Correlation result table for Wadhwana Irrigation reservoir

	Acidity	Bellamya Spp.	Ca^{2+}	Cl^-	HCO_3	Indoplan. Spp.	Lamellidens Spp.	Lymnaea Spp.	Mg^{2+}	Total molluscs	OH^-	pH	Thiara Spp.	TN	TOC	TP
Acidity	1.000															
Bellamya Spp.	-.100	1.000														
Ca^{2+}	.256	-.035	1.000													
Cl^-	.675	.403	.335	1.000												
HCO_3	-.322	-.145	-.014	-.412	1.000											
Indoplan. Spp.	-.195	.980	-.130	.295	-.179	1.000										
Lamellidens Spp.	.180	.370	.630	.364	.193	.337	1.000									
Lymnaea Spp.	-.202	-.145	-.136	.228	-.201	-.108	-.206	1.000								
Mg^{2+}	-.009	.142	.581	.056	.610	.096	.871**	-.260	1.000							
Total molluscs	-.154	.997	-.047	.365	-.143	.986	.364	-.115	.136	1.000						
OH^-	-.330	-.028	-.320	-.321	.561	-.081	-.336	-.025	.021	-.048	1.000					
pH	.211	-.165	-.198	.354	-.167	-.216	-.520	.544*	-.465	-.179	.067	1.000				
Thiara Spp.	.391	-.141	.357	.319	-.469	-.204	-.136	-.212	-.279	-.185	-.127	.099	1.000			
TN	.673	.313	.611	.823	-.147	.191	.697**	-.070	.454	.286	-.412	-.043	.126	1.000		
TOC	-.322	.085	-.832	-.570	.105	.186	-.530*	-.188	-.447	.109	.245	-.109	-.481	-.621	1.000	
TP	-.241	.963**	-.095	.253	-.099	.971**	.401	-.121	.188	.975**	-.054	-.284	-.322	.244	.172	1.000

Pearson Correlation result table for Timbi Irrigation reservoir

	Acidity	Bellamya Spp.	Ca^{2+}	Cl^{-}	HCO_3	Indoplan. Spp.	Lamellidens Spp.	Mg^{2+}	Total molluscs	OH^{-}	pH	Thiara Spp.	TN	TOC	TP
Acidity	1.000														
Bellamya Spp.	-.515	1.000													
Ca^{2+}	-.046	.014	1.000												
Cl^{-}	-.227	-.319	-.175	1.000											
HCO_3	.383	-.617*	.255	.109	1.000										
Indoplan. Spp.	-.300	.567	-.239	-.224	-.562*	1.000									
Lamellidens Spp.	-.199	.221	.202	-.122	-.172	.367	1.000								
Mg^{2+}	.555	-.231	.035	-.427	.503	-.155	-.246	1.000							
Total molluscs	-.443	.878	.214	-.295	-.419	.410	-.143	-.030	1.000						
OH^{-}	-.288	-.031	-.086	.560	-.051	.190	.717**	-.557	-.358	1.000					
pH	-.239	.385	.155	-.035	.413	-.063	-.046	.022	.442	.021	1.000				
Thiara Spp.	-.188	.366	.091	-.087	.098	-.055	.261	.282	.327	.060	.441	1.000			
TN	-.343	-.009	.619	.220	.229	-.217	.121	.070	.142	.095	.090	.054	1.000		
TOC	.535	-.658*	-.370	.060	-.026	-.393	-.255	.058	-.689**	-.158	-.673	-.289	-.468	1.000	
TP	-.089	-.324	-.257	-.101	.095	-.306	-.237	.207	-.322	-.273	-.275	-.230	.267	.338	1.000

Pearson Correlation result table for Jawla Irrigation reservoir

	Acidity	Bellamya Spp.	Ca^{2+}	Cl^-	HCO_3	Indoplan. Spp.	Mg^{2+}	Total molluscs	OH^-	pH	TN	TOC	TP
Acidity	1.000												
Bellamya Spp.	-.306	1.000											
Ca^{2+}	.017	-.054	1.000										
Cl^-	-.707	-.218	-.241	1.000									
HCO_3	-.017	-.417	.171	.395	1.000								
Indoplan. Spp.	.271	.293	-.135	-.711	-.498	1.000							
Mg^{2+}	.434	-.180	-.040	-.228	-.073	.033	1.000						
Total molluscs	.137	.568	-.133	-.681	-.560	.954	-.028	1.000					
OH^-	-.238	.218	.787	.006	.112	-.166	-.398	-.074	1.000				
pH	-.426	.104	-.418	.693	.283	-.485	-.445	-.385	.026	1.000			
TN	-.219	-.330	.159	.421	.430	-.382	.286	-.433	-.030	.314	1.000		
TOC	.138	-.132	-.154	-.228	-.508	.361	.540	.269	-.366	-.401	.138	1.000	
TP	.186	-.115	-.059	-.002	-.371	-.152	.431	-.168	-.184	.104	.469	.561	1.000

Results and Discussion (Contd.)

- Mollusc shells consist mainly of $CaCO_3$ so the calcium demand in these animals is high.
- They play an important role both in accumulation and circulation of elements like N, C and Ca especially in habitats where their populations are high like WIR.
- A significant positive correlation between the molluscs and total phosphorus contents strongly support the reports that molluscs need P for gametogenesis.
- Significant correlations of molluscs with TOC and TN supports the reports that TOC and TN are required by molluscs for building structural proteins in shells.
- Positive and significant correlation with pH, Hydroxyl and Bicarbonate alkalinity suggests that alkaline conditions is favorable for their growth.

Conclusion

- WIR favours the highest molluscan density and diversity. (Many species of birds feed on molluscs for their calcium requirements. WIR has been declared as Nationally Important Wetland on the basis of number of migratory birds present here during winter).
- WIR harbours 5 species of molluscs as compared to TIR and JIR which supports 4 and 2 species of molluscs respectively.
- Increasing anthropogenic pressures at TIR and JIR may be considered as the main reason for less dense molluscan fauna at these two reservoirs.
- The Calcium and Magnesium content were highest at WIR which indicates the availability of the same for the increasing density and diversity of molluscs in the area.

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THANK YOU