

Diatoms

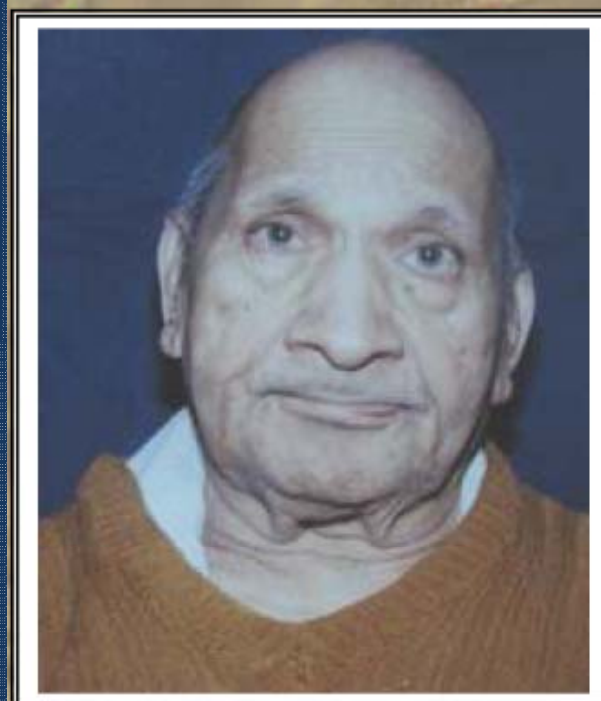
The Powerful Indicator

KARTHICK B

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Dedication

This presentation is dedicated to the memory of
H P Gandhi (1920 – 2008)

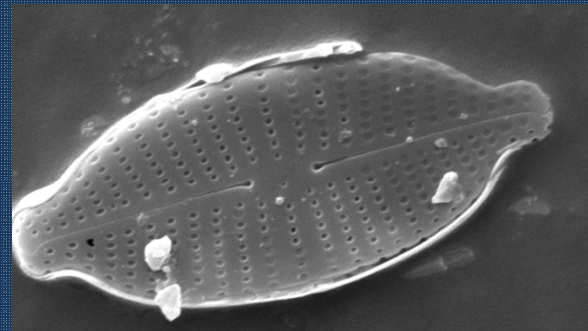
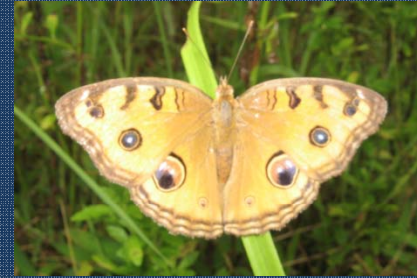


“All the efforts that I made in the field of diatomology was aimed at to provide best of work on the subject to the Indian workers of today and tomorrow in terms of descriptions and illustrations of diatoms” – H P Gandhi

What is a biological indicator?

- The fundamental principle behind biological indicator theory is that organisms provide information about their habitats.
- A biological indicator (or bioindicator) is a taxon/taxa selected based on **its sensitivity to a particular attribute**, and then assessed to make inferences about that attribute.

Choose among the many !



Photos: S Ali, Gururaja K V, Sreekantha

Criteria for Selecting Bioindicators

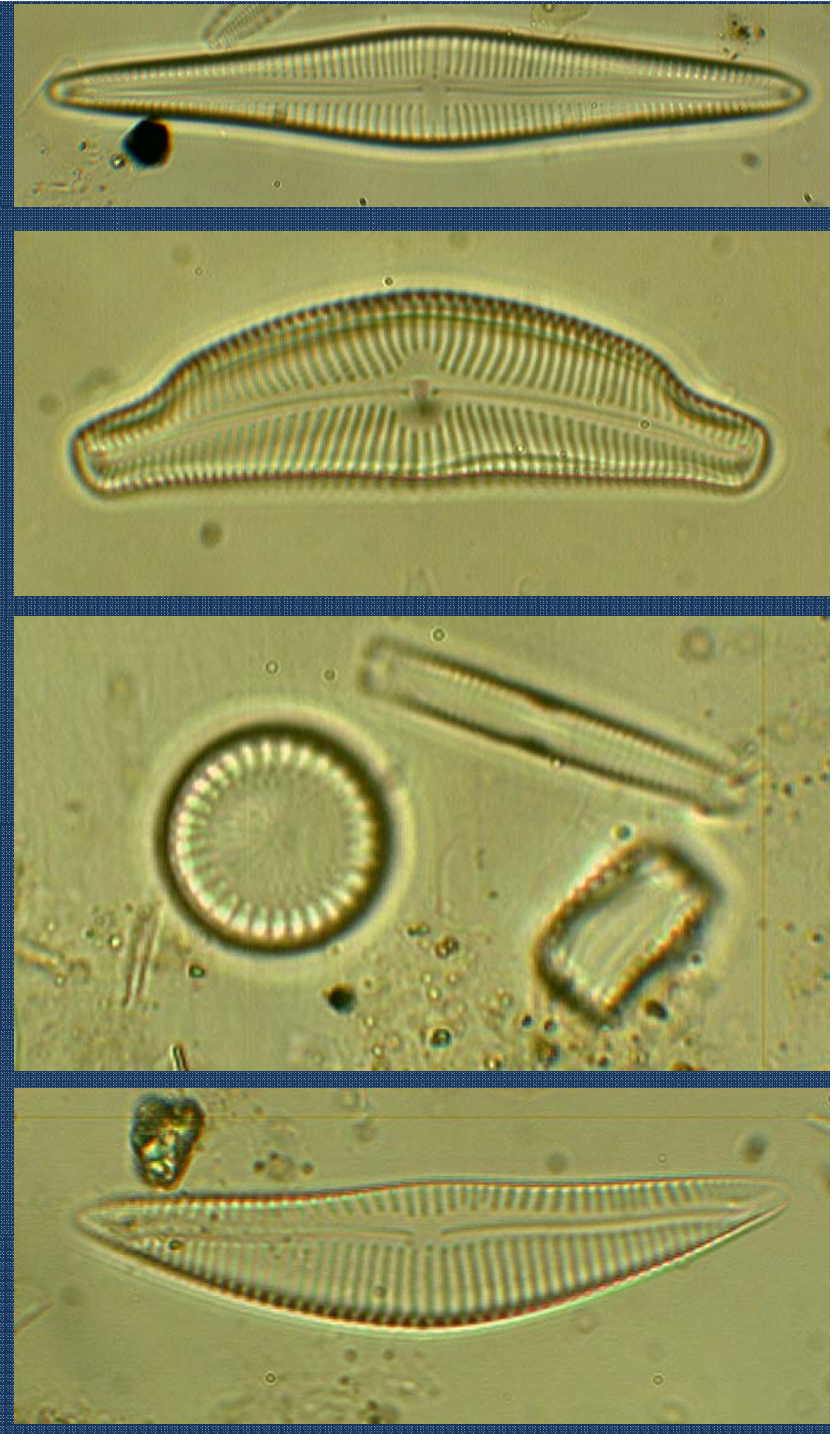
- **Relevance:** Relationship with ecological sensitivity end points
- **Sensitivity:** Response to specific stressor
- **Broad Applicability:** Across space & Time
- **Representativeness:** As a surrogate for whole response
- **Cost:** India is a developing country!

For me its Diatoms

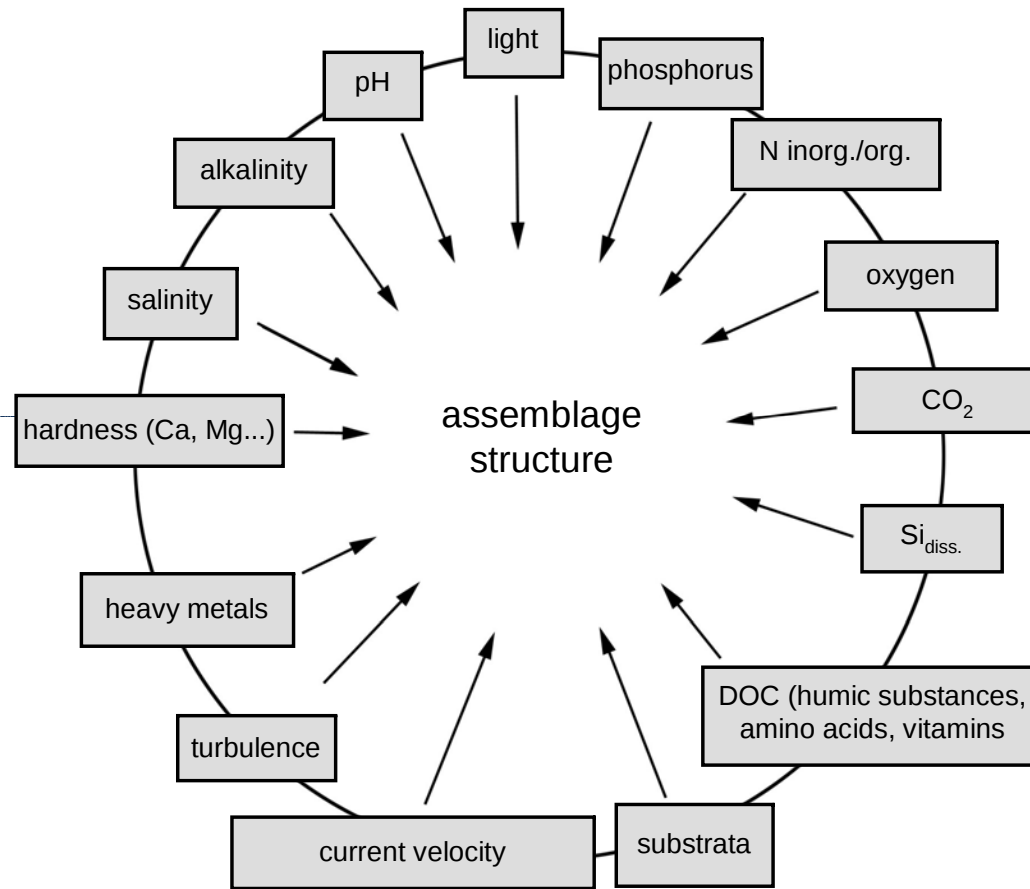
I 
DIATOMS

- **What are diatoms?**

- Single celled, occasionally filamentous algae belonging to the Bacillariophyceae
- Diatoms possess a unique cell covering, the frustule composed of silica
- A highly successful group colonising all habitats from sub-aerial to aquatic
- Highly diverse species each with specific, well documented environmental requirements



Diatom assemblages are influenced by environmental factors
(causal principle)



and are analysable by them

(bioindication)

recent assemblages
assessment of current water quality

fossil assemblages
Paleolimnology

Diatom Based Biomonitoring

- Diatoms – should they form part of monitoring programs?
 - Benthic or attached diatoms are used in these studies as they are not washed away so the effects of pollution may be seen in the population structure.
 - These organisms are primary producers and actively integrate nutrients and other components of water quality.
 - Individual species have specific water chemistry and habitat requirements (e.g. pH, nutrients, chloride concentration etc.).
 - Diatom assemblages are species rich and provide a redundancy of data. Many monitoring systems are based on dominant species.

Diatom Based Biomonitoring

- Diatoms – should they form part of monitoring programs?
 - Diatoms have one of the shortest generation times of all biological indicators (2 weeks) and may thus give a better short term reflection of water quality than macro-invertebrate indices.
 - Due to the nature of the cell walls diatoms are usually well preserved in the sediments and can be used to infer past environmental conditions.
 - Taxa are cosmopolite, results may be compared between countries and even continents.
 - The taxonomy of the diatoms is well documented?

Diatom Indices

- Within the last 2 decades diatom indices have gained considerable popularity throughout the world as a tool to provide an integrated reflection of water quality.
- The results generated from diatom indices can form the basis of management decisions regarding rivers and streams.
- The design of software programmes such as OMNIDIA for the calculation of diatom indices has also facilitated the use of diatom based bio-monitoring methods.

How are diatom indices calculated?

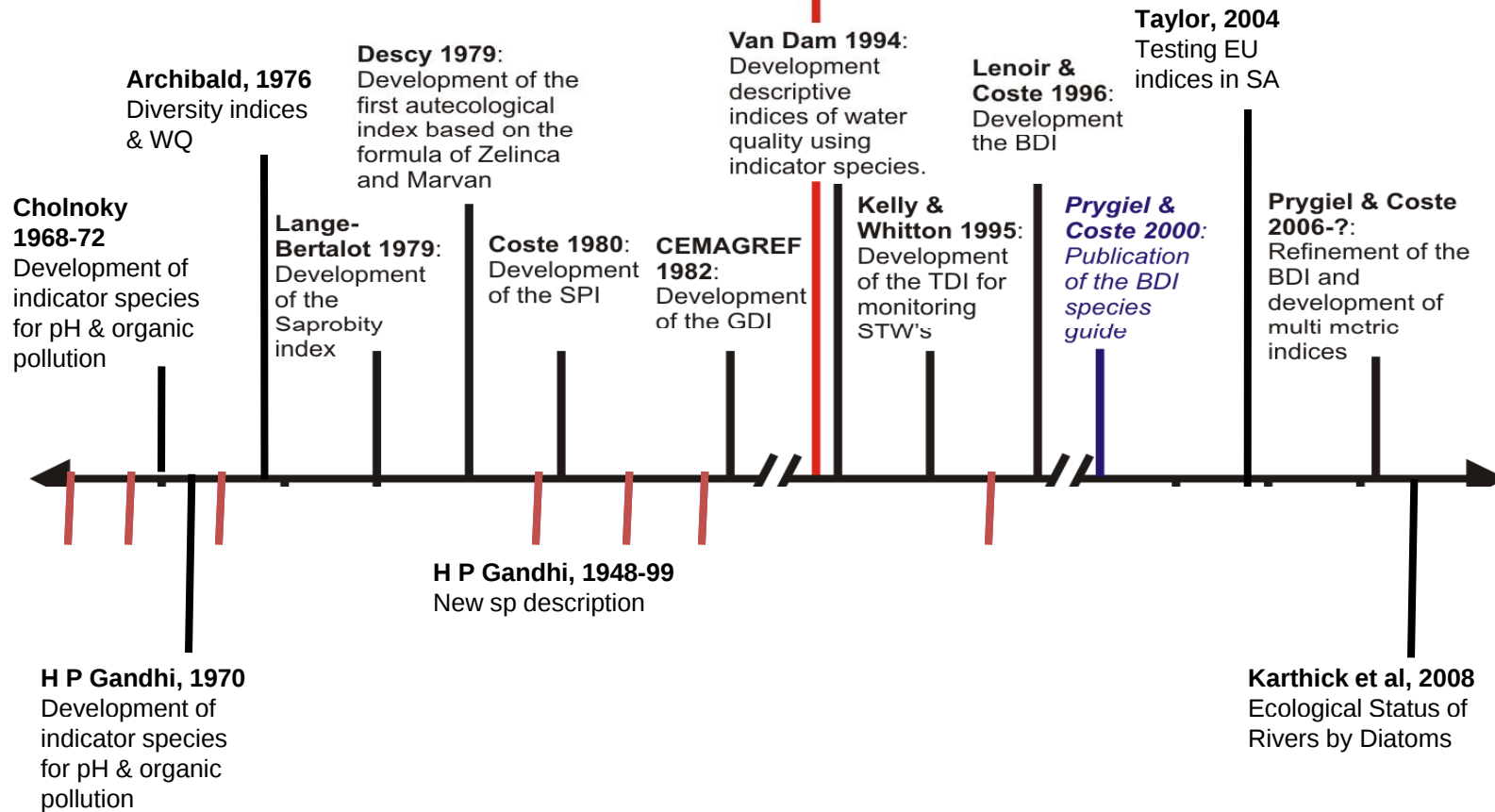
- Each diatom species used in the calculation/equation is assigned two values;
 - the first value reflects the tolerance or affinity of the diatom to a certain water quality (good or bad) while,
 - the second value indicates how strong (or weak) the relationship is.
 - These values are then weighted by the abundance of the diatoms in the sample .

Diatom index application

- Monitoring standard for shared EU waters.
- Used by American EPA (Rivers and wetlands).
- Used in Australia for monitoring urban waterways.
- Extensively used in the Far East to indicate ecosystem health.
- Used in South Africa and South America as an indicator of water quality.

REST

OMNIDIA VER. 1,1993

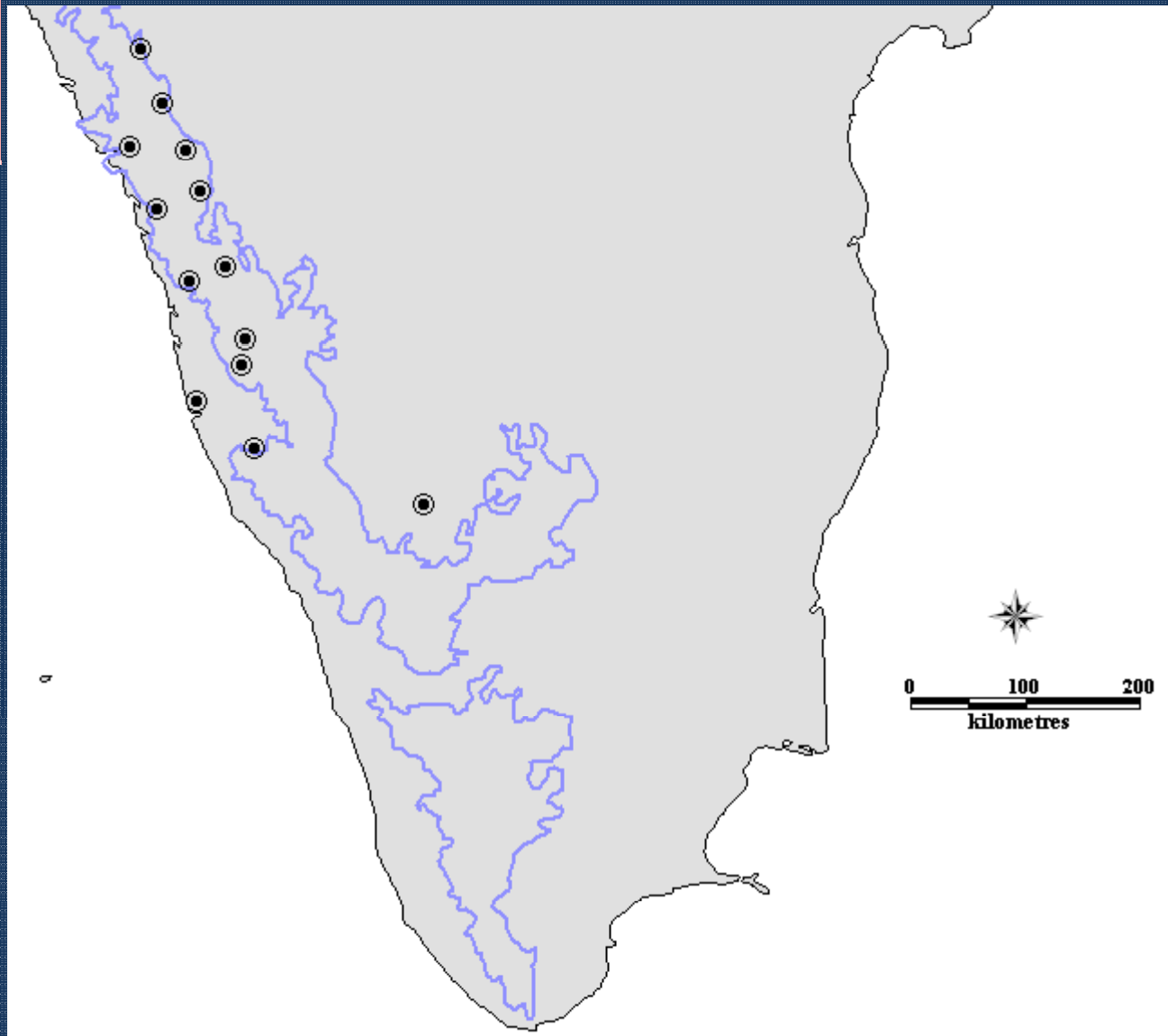


INDIA

Objective

- This presentation describes a case study using diatom assemblages to assess water quality in central Western Ghats Rivers.

Central Western Ghats



Tunga
Sharavathi
Kali
Bedthi
Krishna
Aghanashini
Varadha
Bhadra
Kaveri

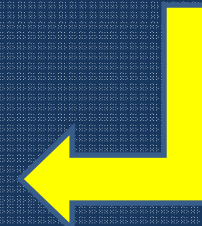
Sampling & Analysis of Diatoms



Pretreatment (cleaning) and enumeration

AFNOR T90-354

EN 14407 Guidance standard for the identification, enumeration and interpretation of benthic diatom samples from rivers for water quality assessment



Methods...

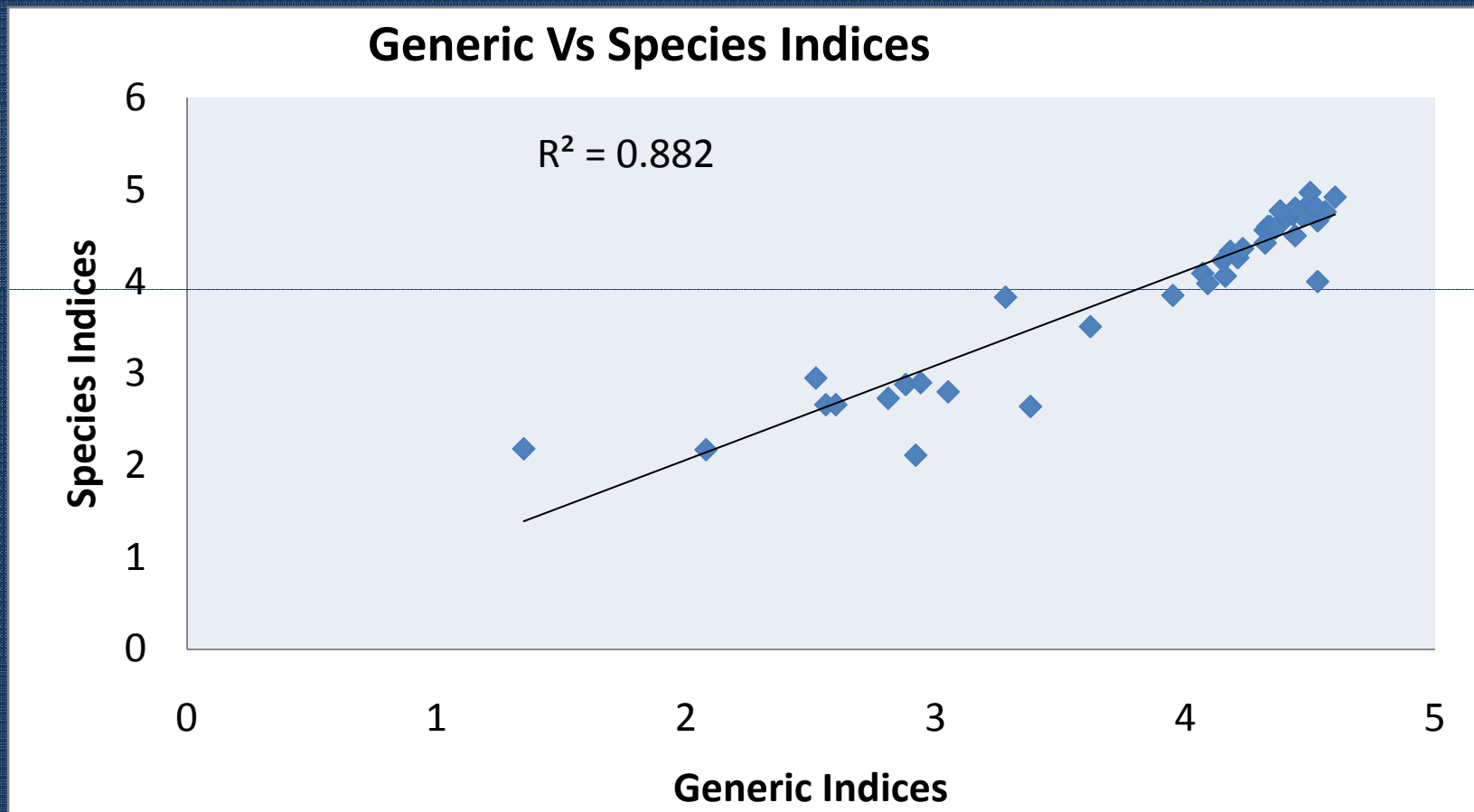
- 400 valves were enumerated for each sample.
- From these counts a number of diatom indices were calculated using OMNIDIA v.3.
- Diatom index scores were calculated
- Correlated to physical and chemical water quality variables.

Diatom Indices for Central Western Ghats Rivers

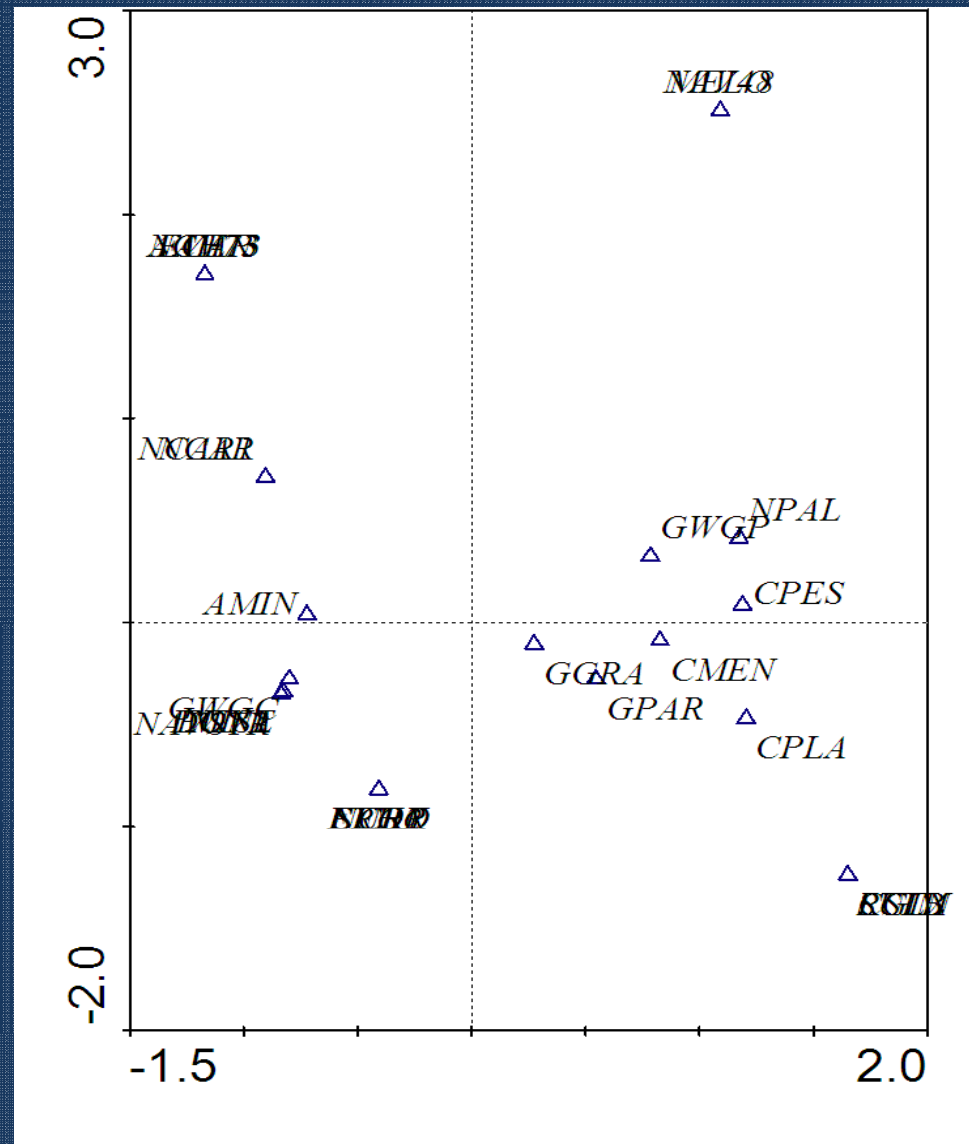
Rivers	IPS	SLAD.	DESCY	L&M	SHE	WAT	EPI-D	ROTT	IDG	CEE	IBD	IDAP
Tunga	19	15.2	15.3	15.3	16.8	17.6	12.9	15.2	17.5	0	17.7	19
Sharavathi	18.1	15.3	15.3	15.3	16.8	18.6	12.9	15.2	12.4	0	1	18.1
Kali	15.7	15.3	15.6	15.3	16.8	15.3	13	15.8	13.4	18.1	1	15.7
Kali	15.2	14.9	15.1	14.6	16.8	14.5	12.7	15.2	13.4	14.3	17.4	15.2
Bedthi	5.9	9	9.4	7.6	5.4	8.3	9.1	18.8	10.8	4	7.4	6.3
Krishna	13.9	15.1	16.8	15.3	15.3	11.5	11.7	16.2	13.2	13.7	12.3	13.8
Aghanashini	15	15.1	18	15.3	17.8	14.9	12.5	17.4	13.4	18.1	15.9	14.9
Varadha	14.7	12.6	12	11.6	13.4	14.7	10.5	13.6	14.1	17.7	15.7	14.3
Bhadra	15.1	15.3	15.3	15.3	16.2	14.9	12	15.9	13.2	0	1	15.1
Kaveri	17.1	14.3	14.2	14.3	13.7	0	12.9	17.8	15.1	12.4	12.4	14.6

>17	– High Quality	– Oligotrophy
15 to 17	– Good Quality	– Oligo Mesotrophy
12 to 15	– Moderate Quality	– Mesotrophy
9 – 12	– Poor Quality	– Meso-eutrophy
<9	– Bad Quality	– Eutrophy

I am new to this science..

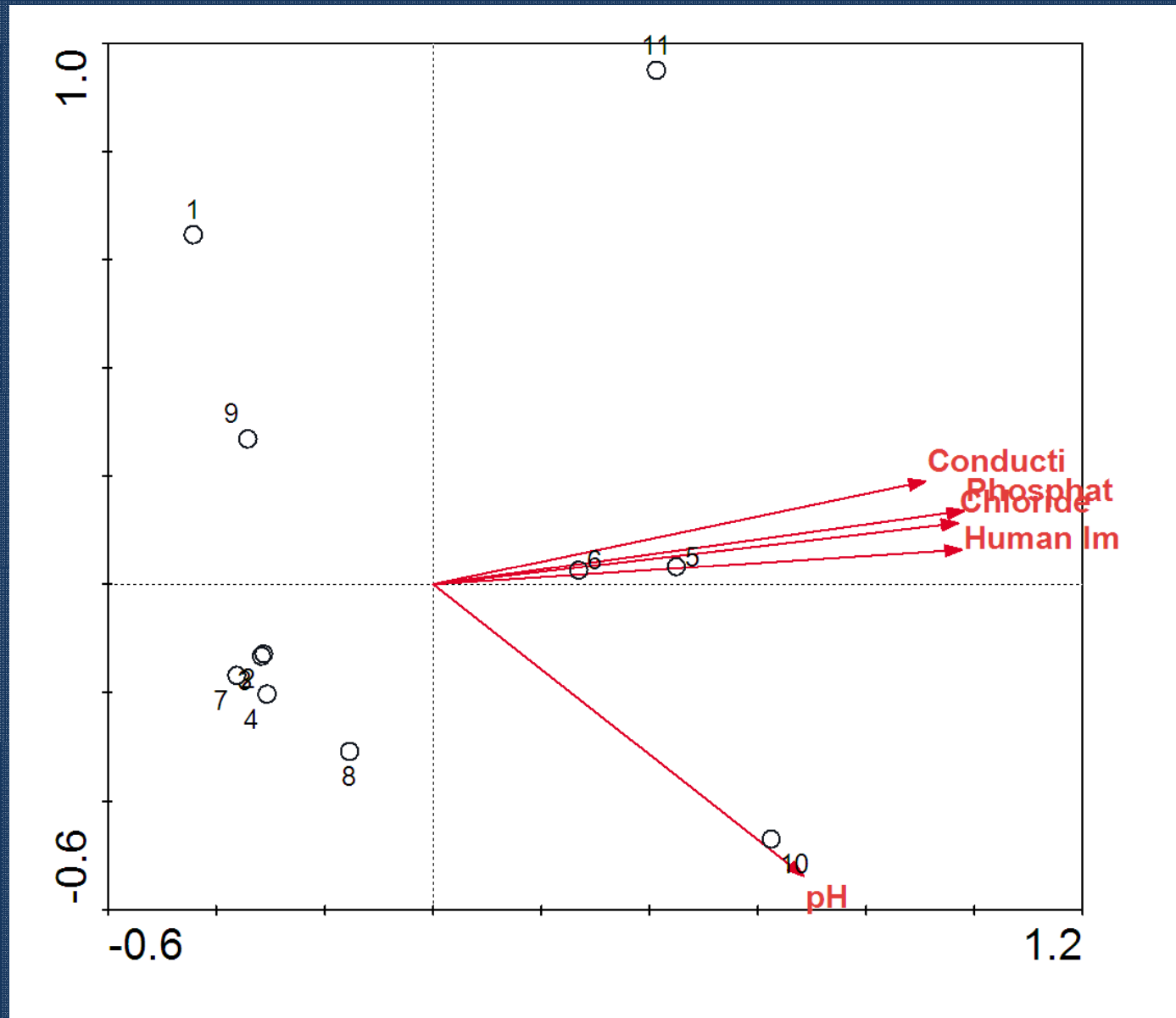


Diatom assemblages : Canonical Correspondence Analysis

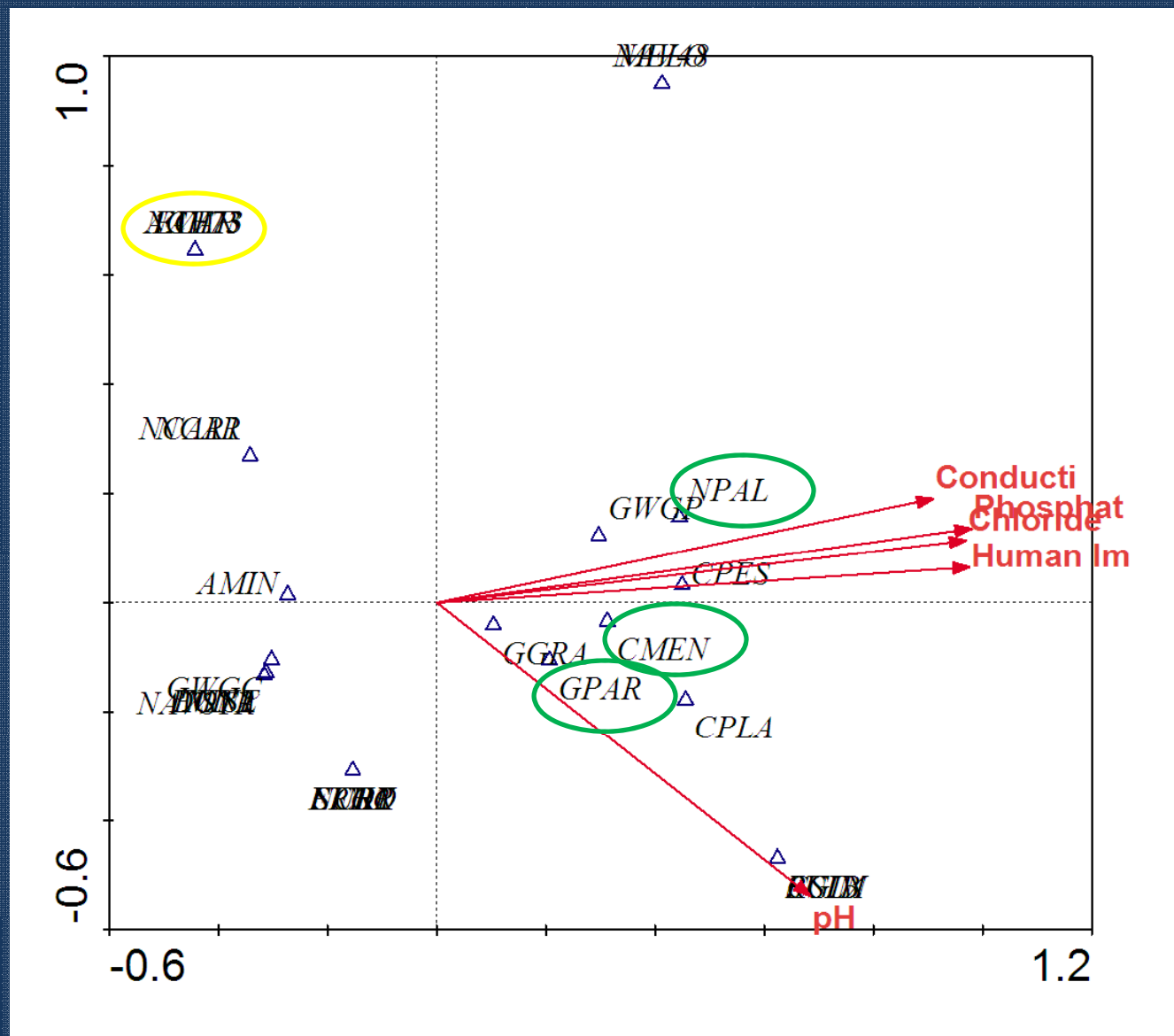


Water Quality: Canonical Correspondence Analysis

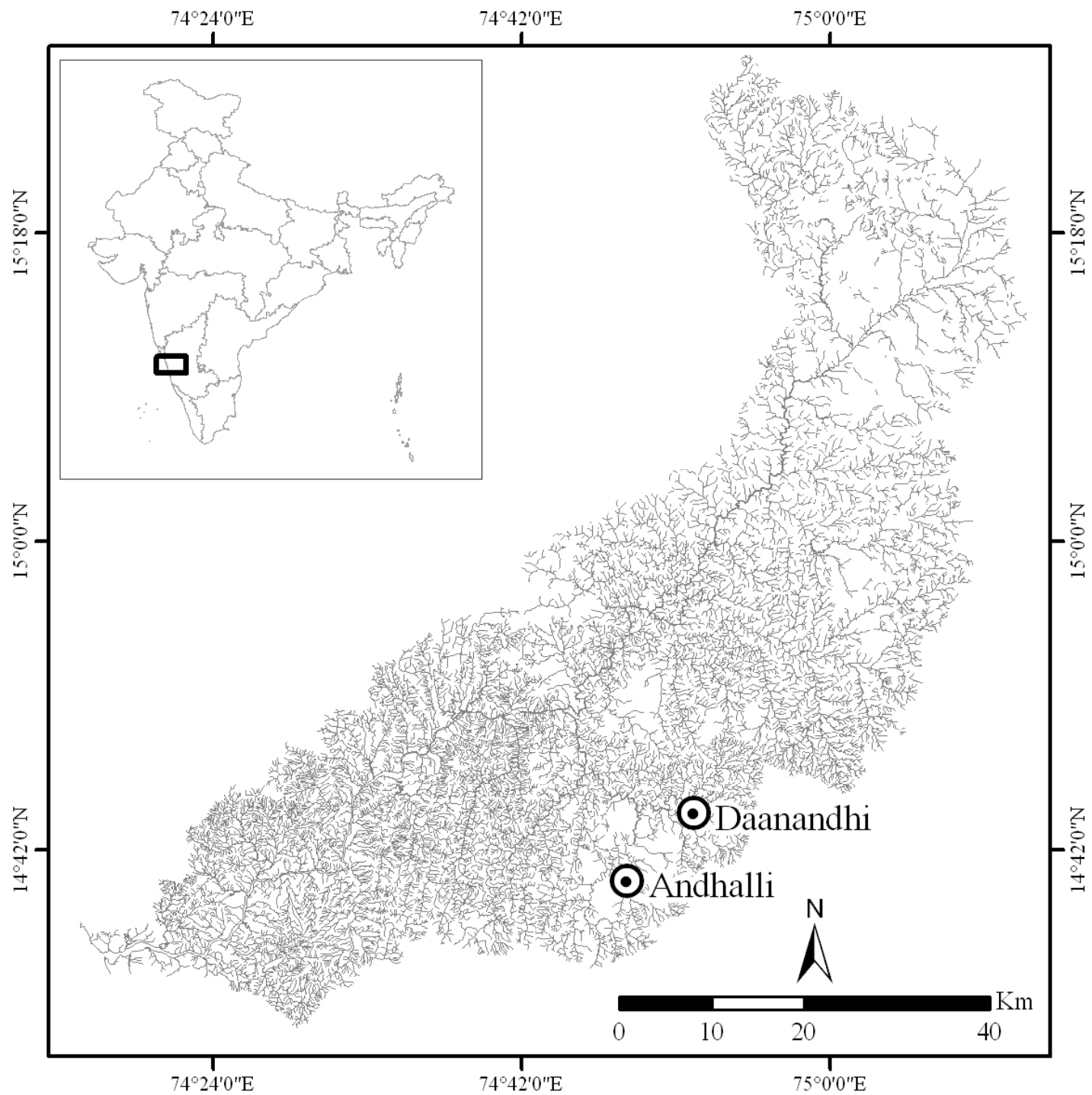
Conductivity
Phosphates
Chlorides
pH



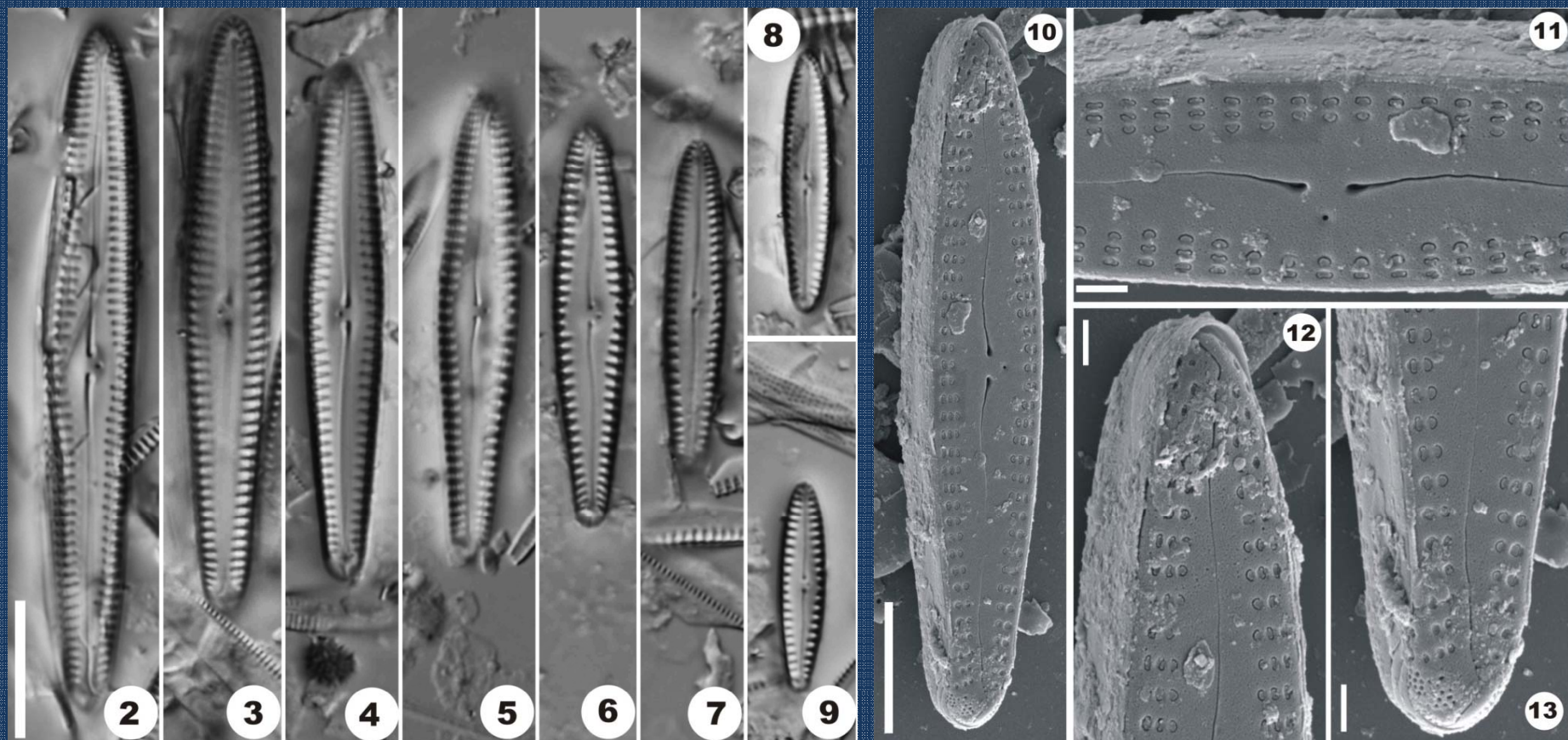
Diatom & Water Quality: Canonical Correspondence Analysis



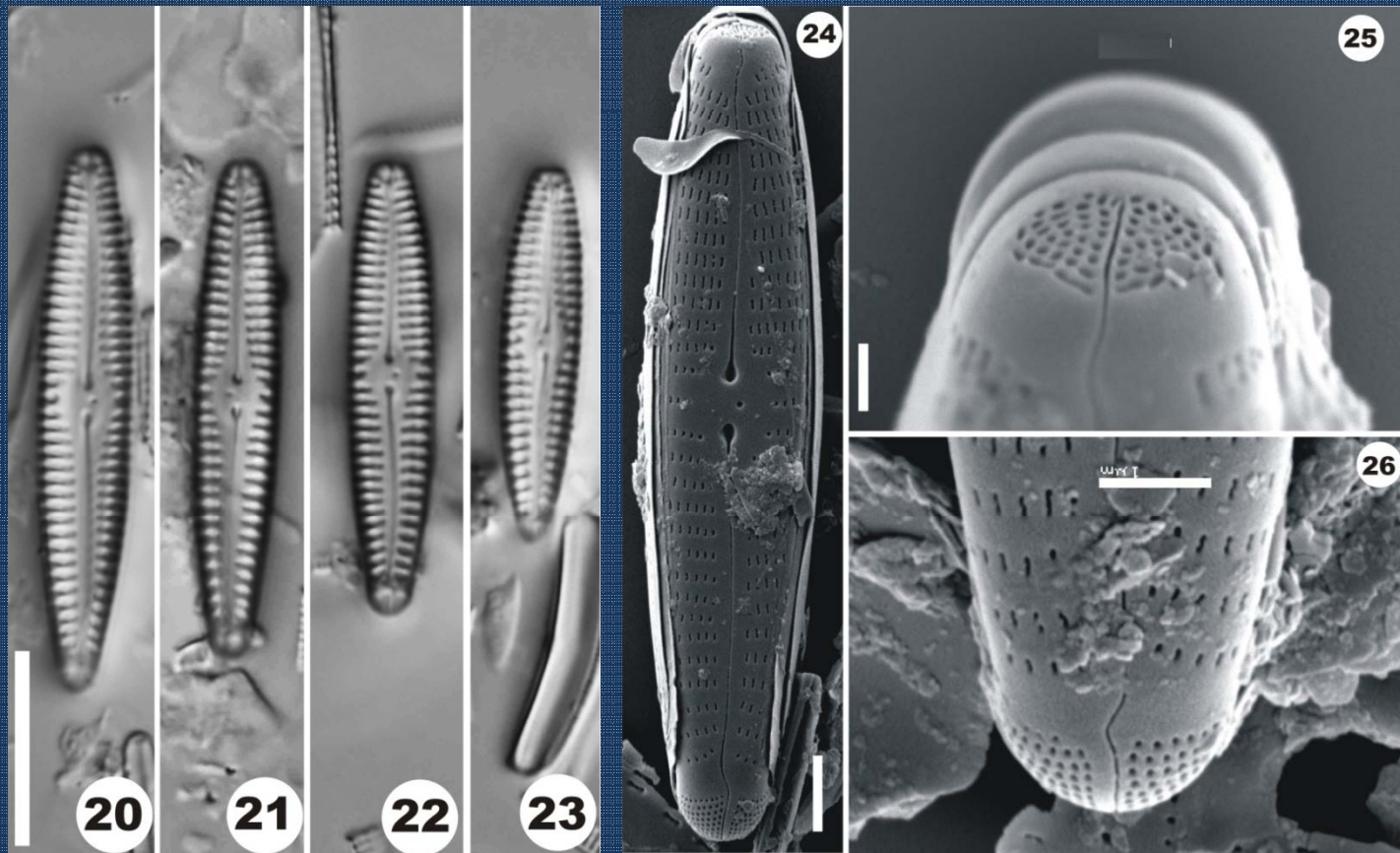
Taxonomy
Its not TAX ON ME



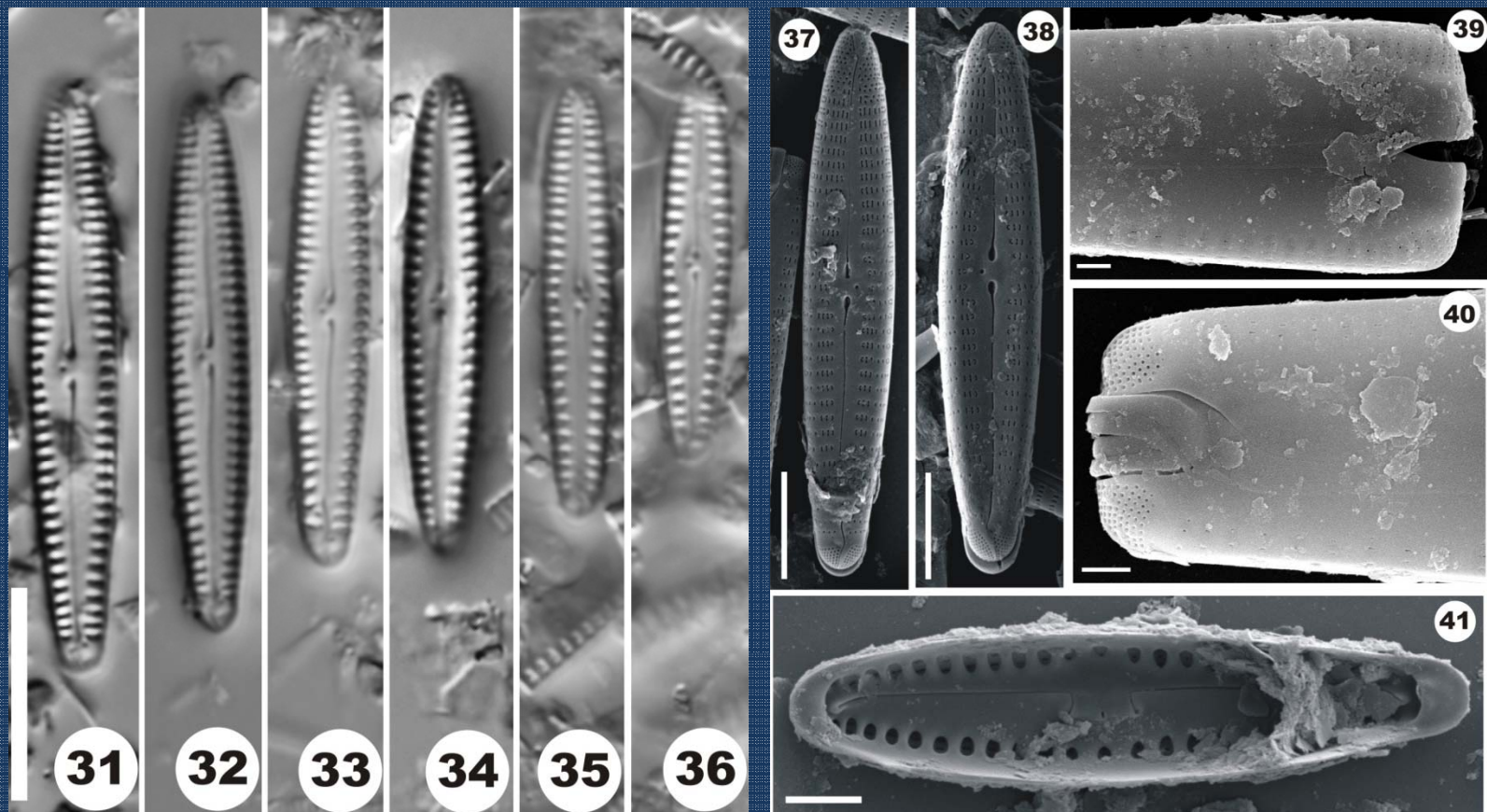
Gomphonema gandhii Karthick and Kociolek

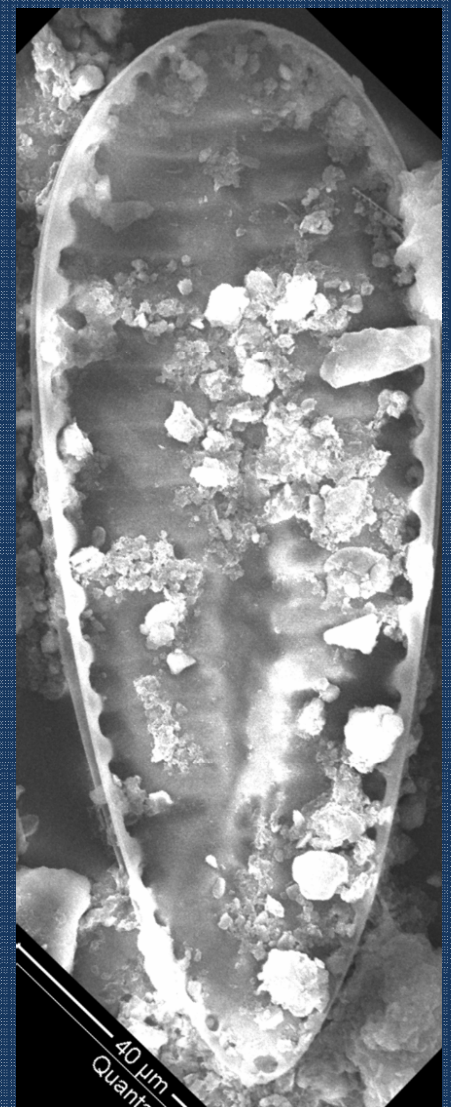
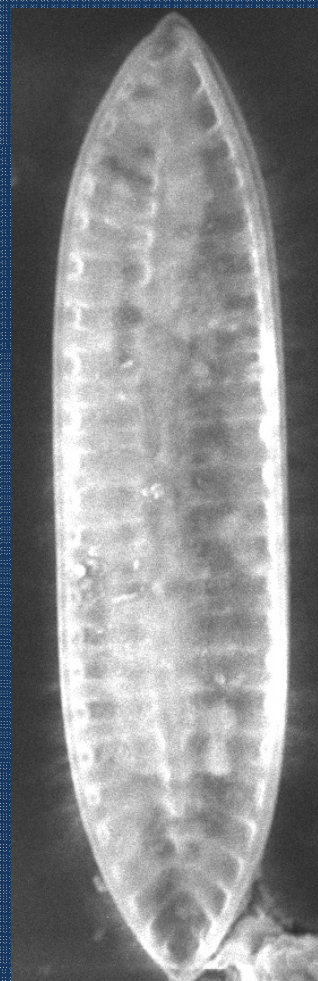
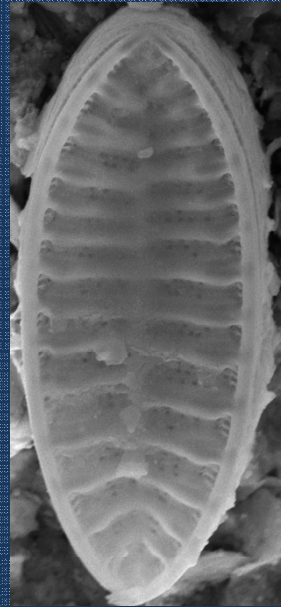
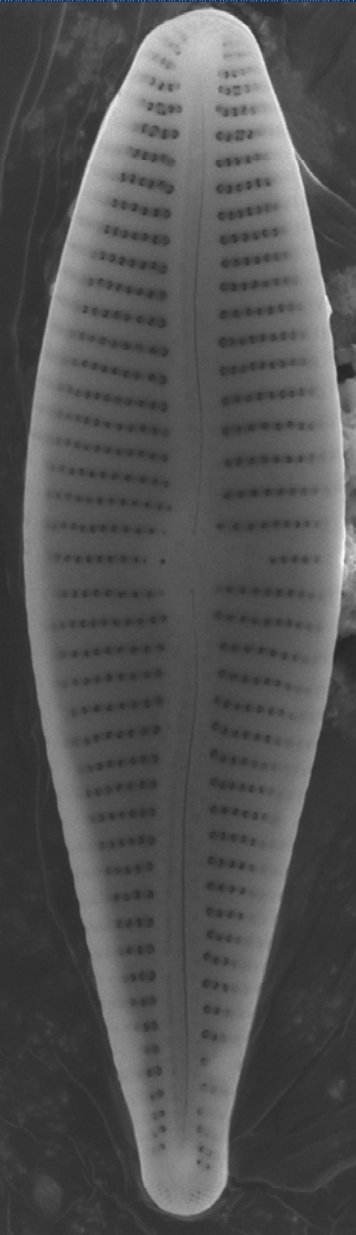
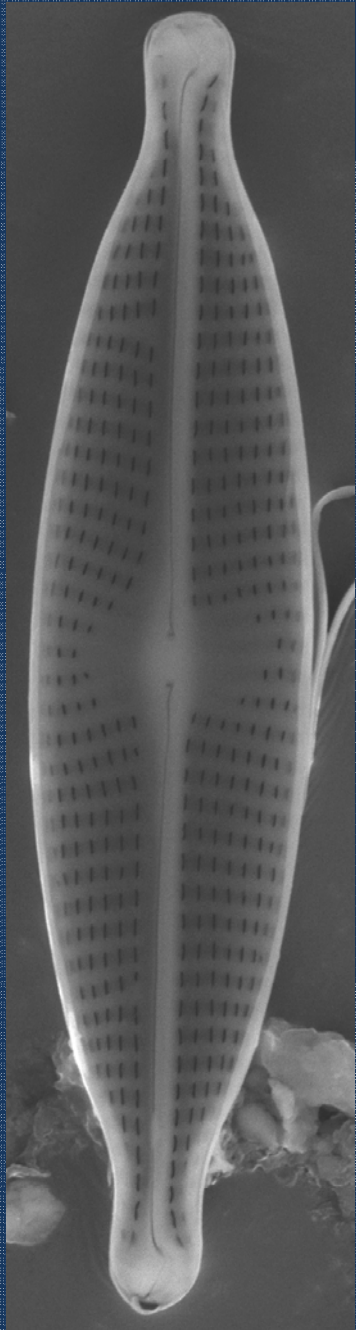


Gomphonema difformum Karthick and Kociolek

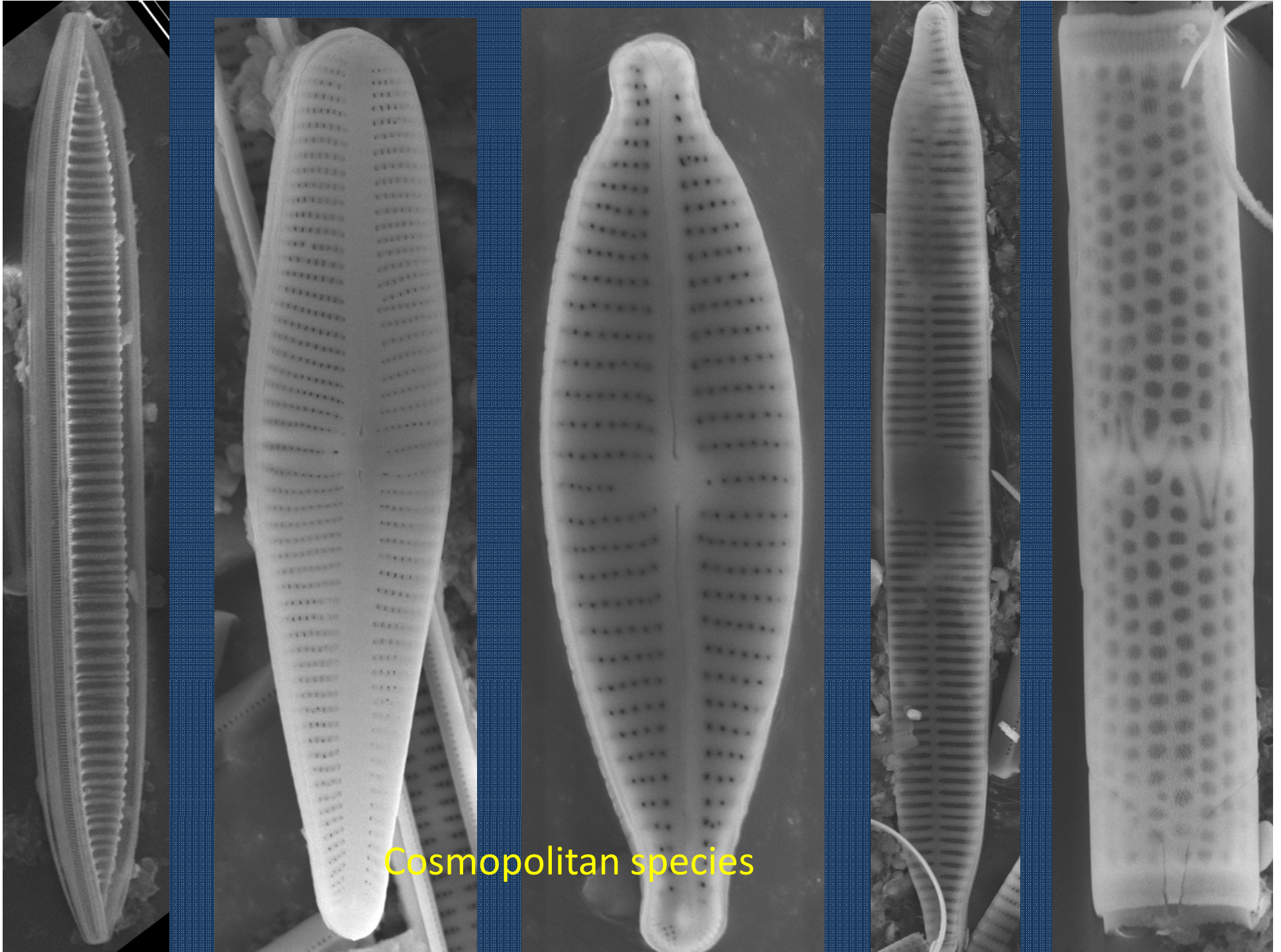


Gomphonema diminutum Karthick and Kociolek

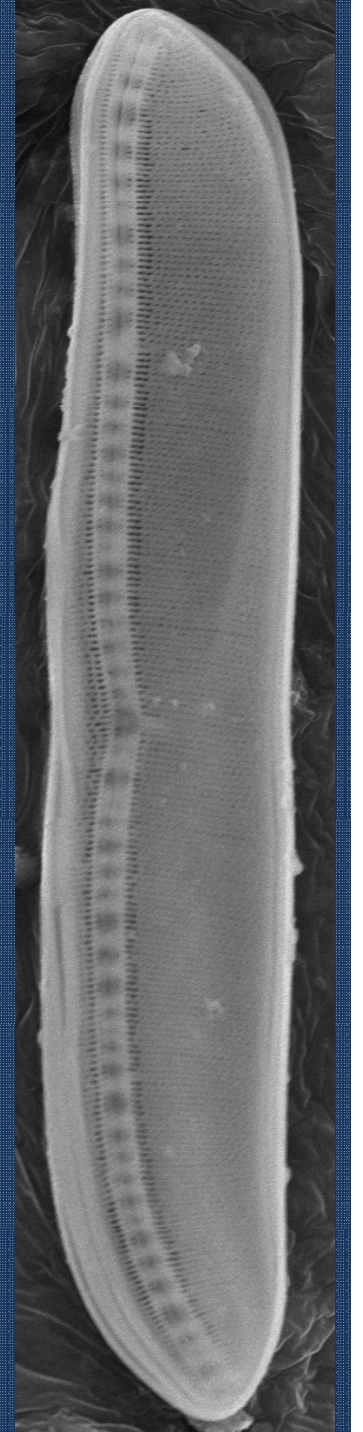
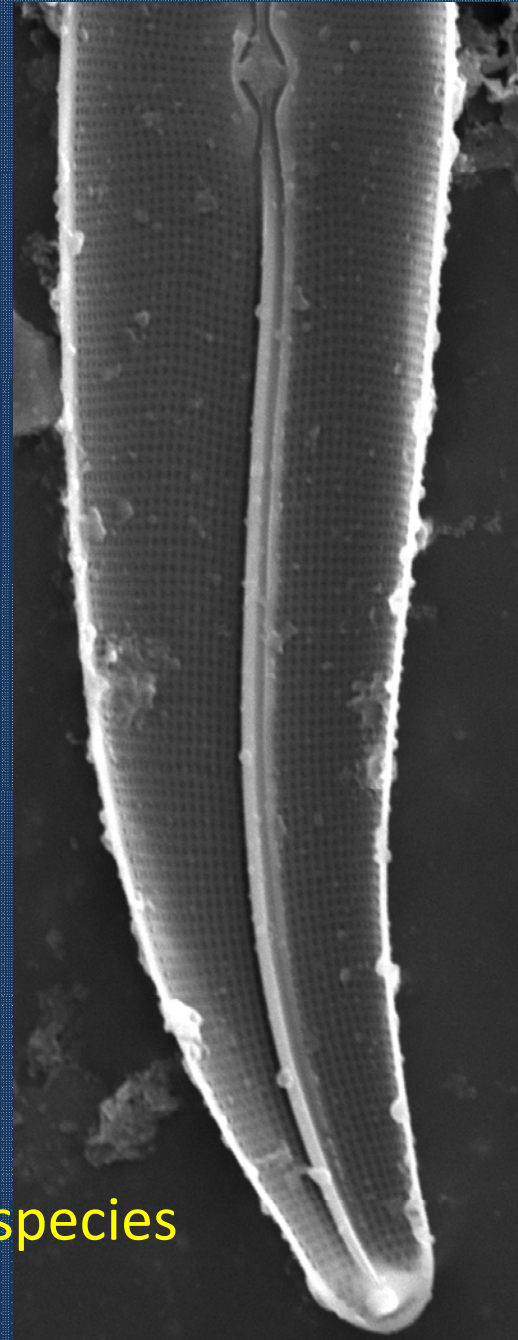
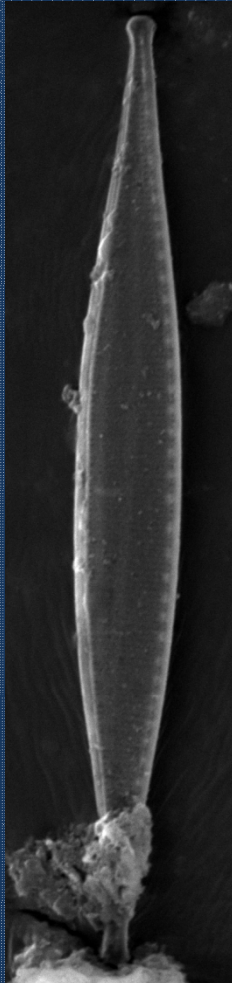
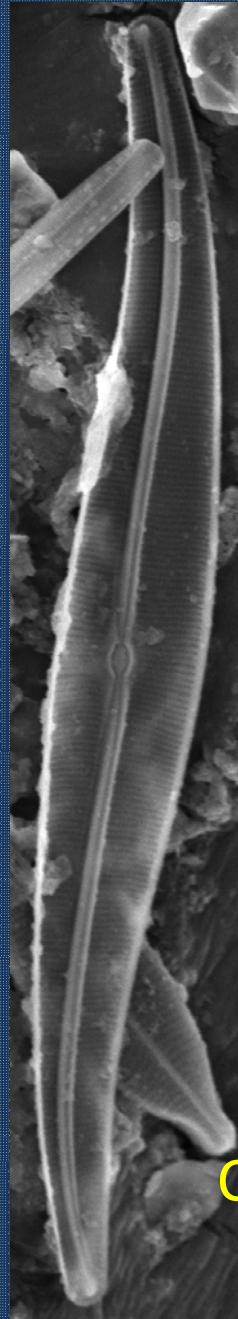
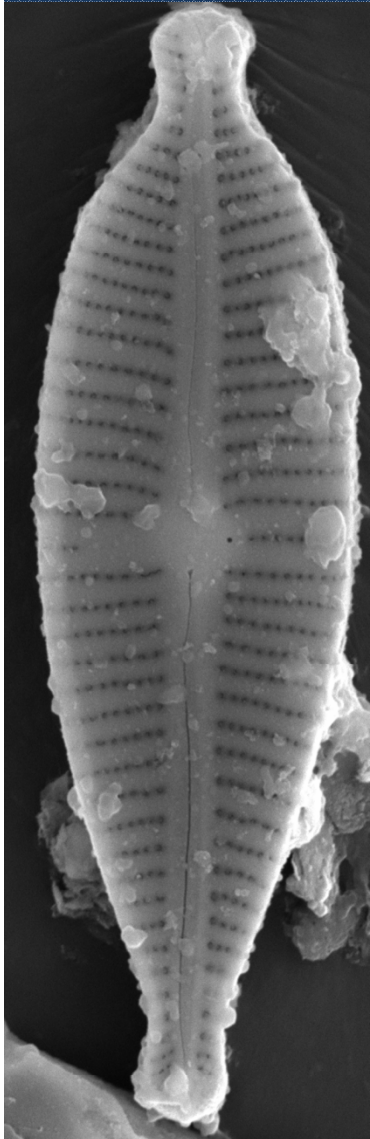




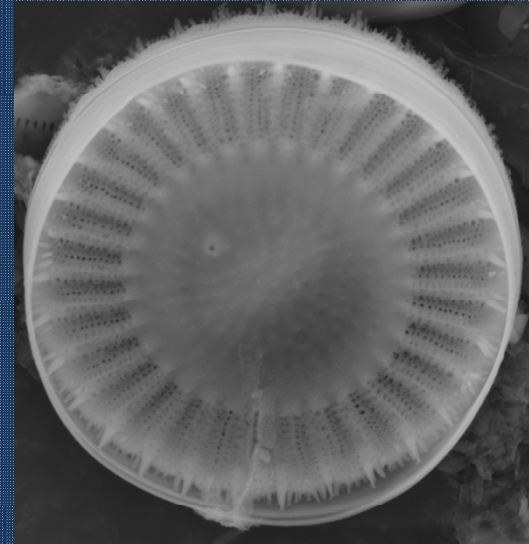
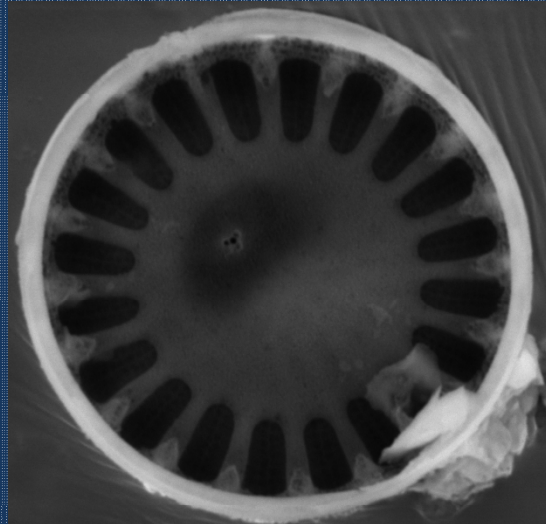
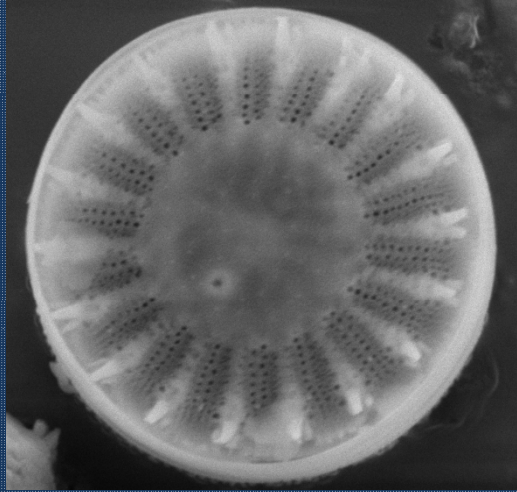
Endemic Diatoms of Western Ghats ?



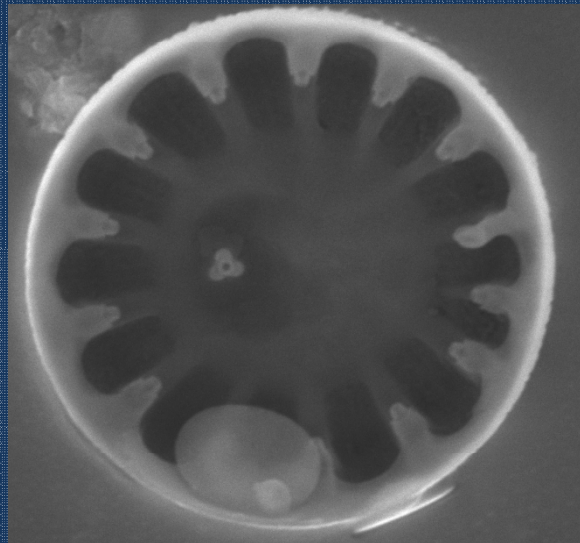
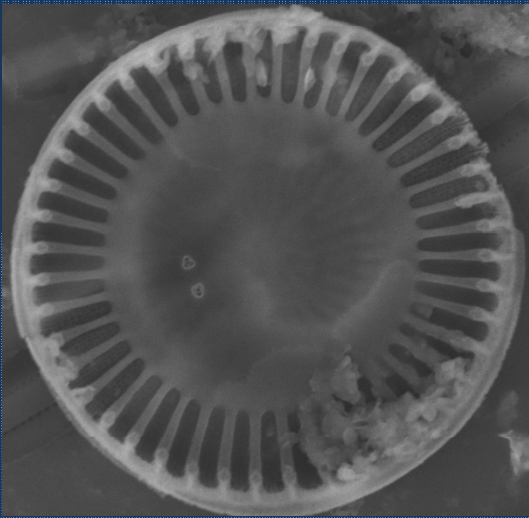
Cosmopolitan species



Cosmopolitan species



Cosmopolitan species



Conclusion

- Indices calculated are very similar to the WQ data
- Results are comparable to those obtained in several European/African studies.
- Ecology of endemic diatoms should be focused in future.
- It is concluded that diatom-based indices, if implemented in India, would provide a valuable addition to India's suite of tools for the biological monitoring of water quality.

Future Research

- Macro ecological Studies
- Habitat Specifications
- Community concordance
- Regional Species Pool



ACKNOWLEDGEMENTS

Energy & Wetlands Research Group



Questions & Discussions

Thank you

Best Microphotography of 2008 - "GLASS FOREST"