Assessing the Water Quality of Lakes in Bangalore using Diatoms as Bioindicators
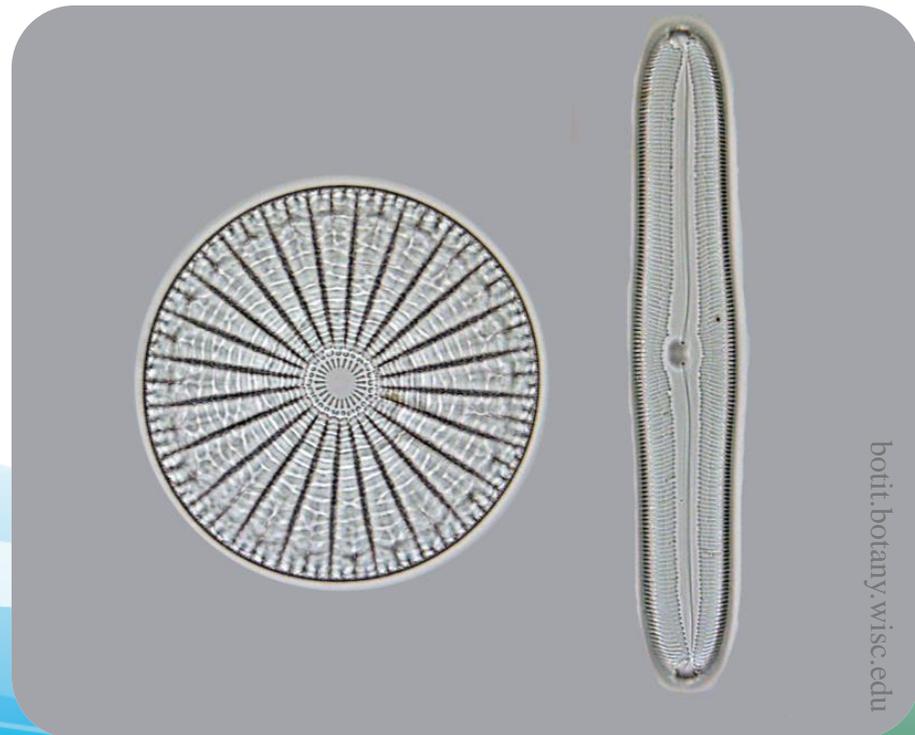
Done by Ram S. Hattikudur, Standard XI

What are Diatoms ?

- Unicellular, siliceous, microscopic organisms
- Responsible for 1/3rd the global photosynthetic C fixation and O_2 generation
- Ubiquitous in distribution
- Base of aquatic food webs
- Made of frustules (two valves made of silica)
- Morphology generally 2 shapes:

Taxonomic Position

- Domain : Eukaryota
- Kingdom : Protista
- Phylum   : Heterokontophyta
- Class   : Bacillariophyceae

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Diatom at 100X magnification

Why Diatoms?

- Easy availability and occurrence to collect

- Over 200 genera and 1 lakh species (wiki) - to choose from

- Inorganic frustules are preserved after death (sustained structural identification/analysis)

- Select species of diatoms being sensitive to small changes in the aquatic environments (wide to narrow range of tolerance) ➜ BIOINDICATORS

- Rapid growth and development cycles/generation time

- Low cost compared to chemical methods

5 μm
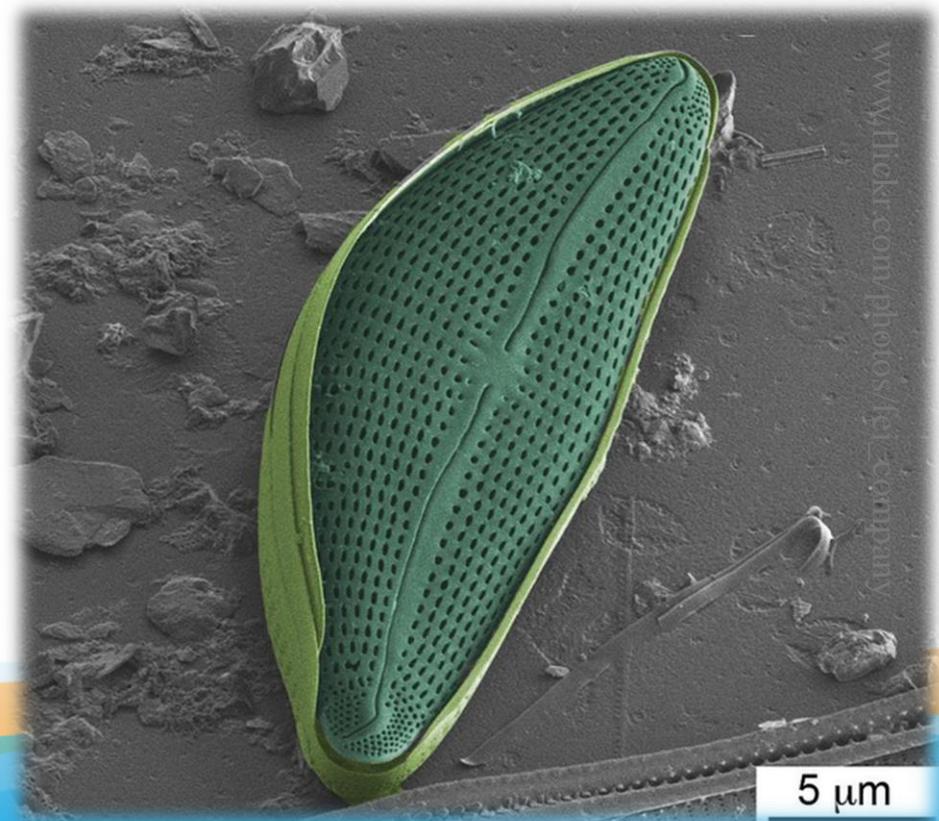
The Study

A comparative assessment of the status of two urban lakes with Diatoms as bio-indicators

Neelagondanahalli Lake   *Chikkabanavara Lake*

Latitude/Longitude	13°24'58.06"N / 77°14'32.98"E	13° 4'52.13"N / 77°30'26.76"E
Zone	Industrial	Residential
Observations	• Surrounded by industries and slums • Water discoloured • Rubber footwear spotted • Only people walking • Lower diversity of birds	• Forested area with little housing • Relatively clear • Plastic and polyethene spotted • People washing clothes/bathing • Greater diversity of birds

Materials and Method

Materials:
Microscope
Centrifuge
Hot plate
Sulphuric acid
Naphrax

Sampling:
Two samples taken from each lake.

Collection:
Take 15cm of plant sections place in a plastic bag, add water and shake, put water in a tray so that it settles.

Processing:
Heat this concentrate with sulphuric acid, centrifuge and then add distilled water, prepare slides with Naphrax.

Diatom enumeration and observation Count and identify the daitoms under the microscope in 100x magnification and oil immersion.

Findings

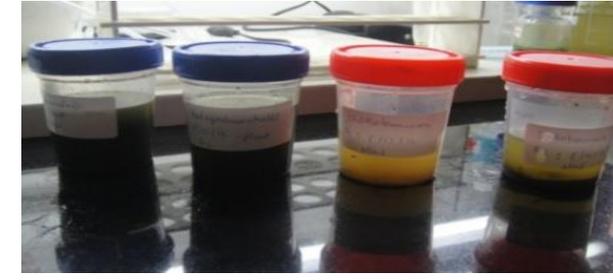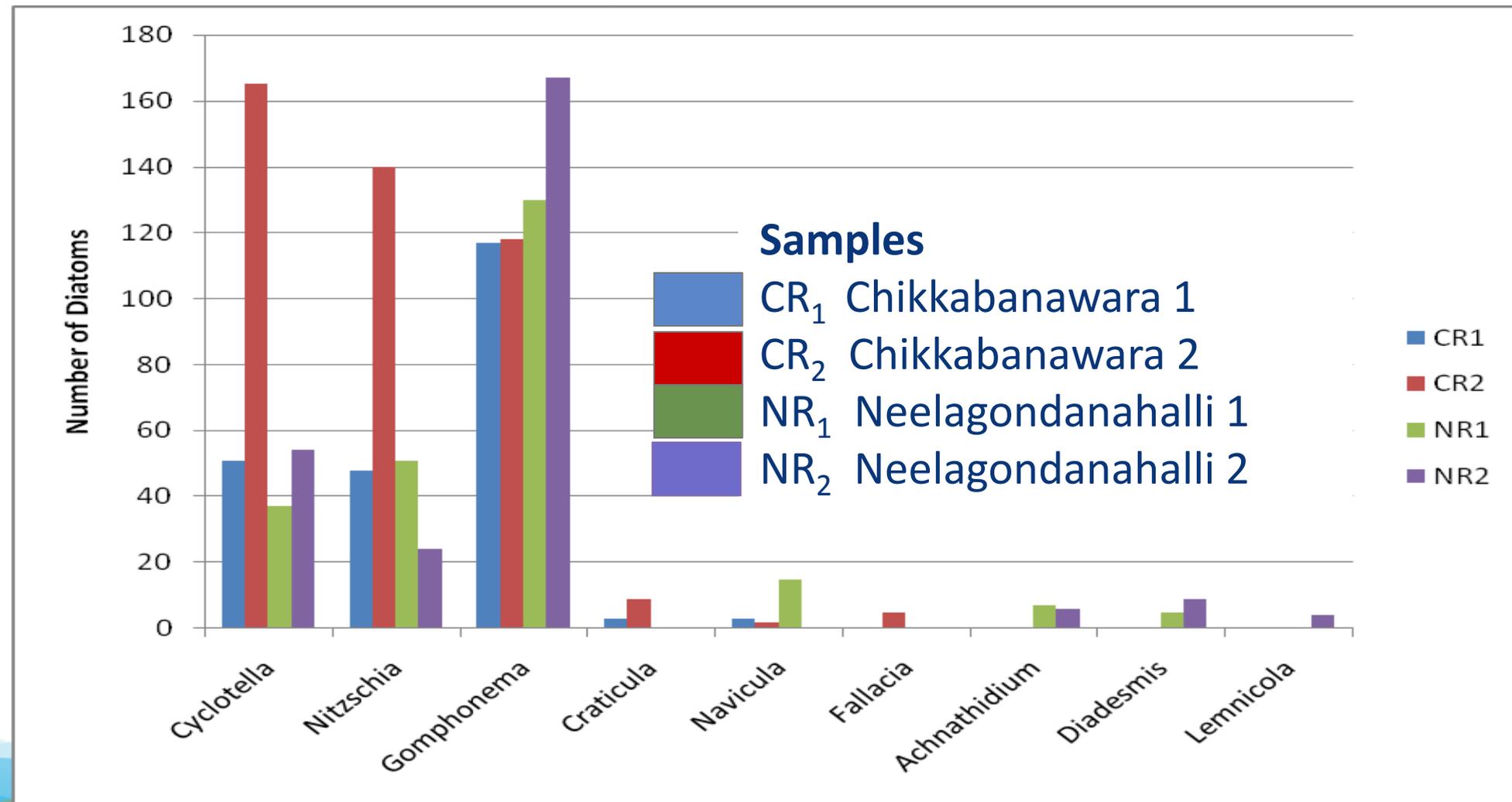TDI (Trophic Diatom Index)- Index to determine nutrient content of lake using diatoms

$$index = \frac{\sum\limits_{j=1}^{n} a_j s_j v_j}{\sum\limits_{j=1}^{n} a_j v_j}$$

where a_j = abundance or proportion of valves of species j in sample, s_j = pollution sensitivity (1 - 5) of species j and v_j = indicator value (1-3). Values of sensitivity (s)

Source: 'Trophic Diatom Index, A User's Manual' Revised Ed. 2001

Samples

CR$_1$ Chikkabanawara 1
CR$_2$ Chikkabanawara 2
NR$_1$ Neelagondanahalli 1
NR$_2$ Neelagondanahalli 2

TDI Values

Sample	Trophic Diatom Index
CR1	67
CR2	65.5
NR1	56.5
NR2	59

Key:

0-20 = clean waters

21-40 mild pollution

41-60 bad waters

61-100 severely polluted

Source: 'Trophic Diatom Index, A User's Manual' Revised Ed. 2001

Conclusion

Chikkabanawara:

Severely polluted (mean TDI- 66). Attributable to inflow of untreated sewage

Neelagondanahalli:

Relatively less organically polluted, but with bad water quality (mean TDI- 58). Attributable to inflow of industrial waste

Dominant genus *Gomphonema* and *Cyclotella* indicates high organic pollution while and *Nitzschia* high electrolyte content

Recommendations And Proposed Management Strategies

- Sewage treatment (sludge/biomass produced– used as bio-fertilizers/ manures)

- Treatment and recycle/reuse of industrial waste- water (nutrient/chemical recycle and reuse)

- Reduce use of phosphorous detergents (avoid nutrient enrichment)

- Use "Arboform" as substitute for polyethylene (bio-degradable polymers)

- Be eco-conscious (awareness/environmental literacy)

"Civilization in its present form hasn't got long"

James Lovelock (An independent scientist, environmentalist and futurist)

Questions?