Physico-Chemical Aspects of Bangalore Lakes: An Overview

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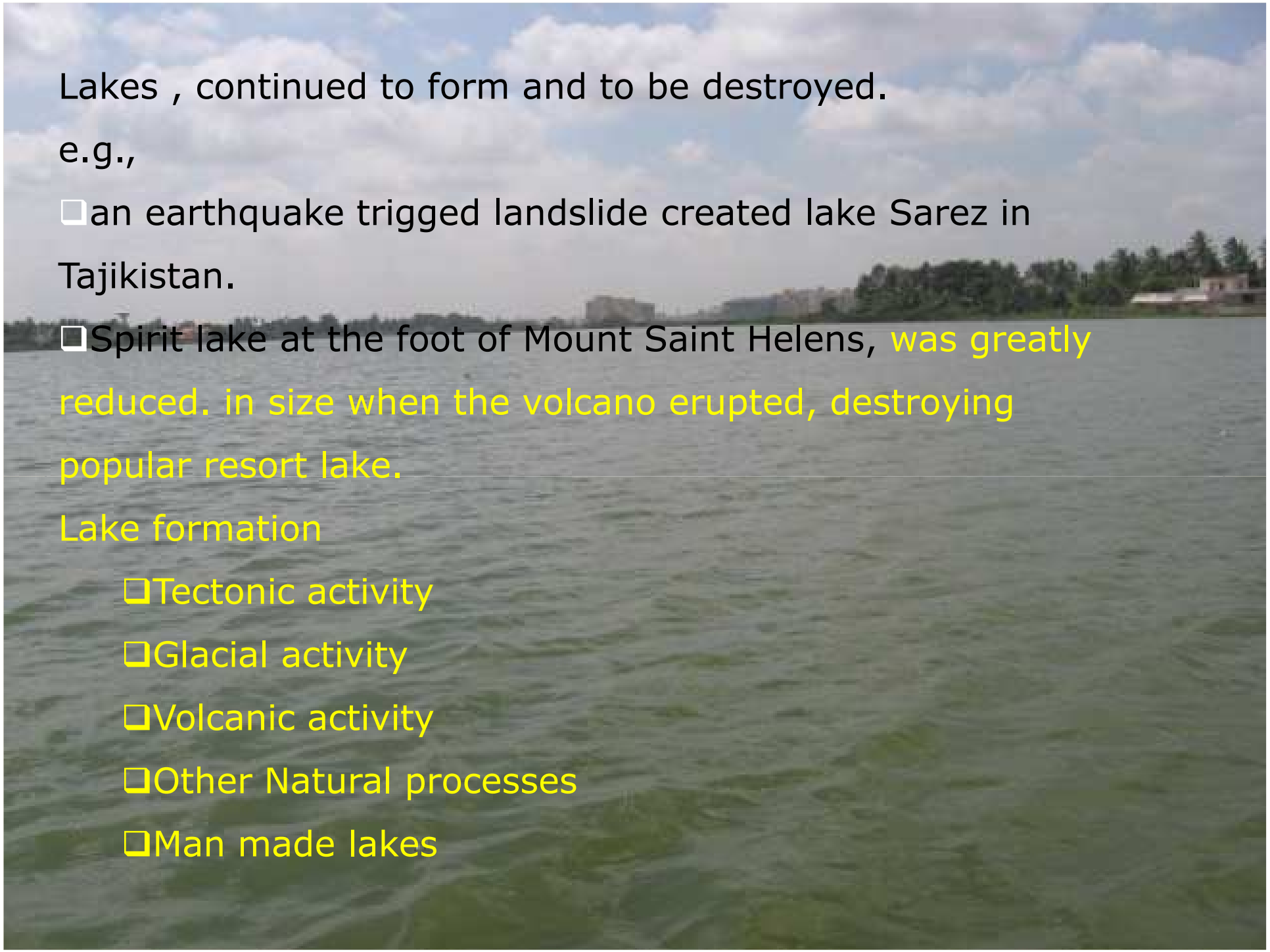
A natural lake is a fairly large body of water occupying an inland basin.

Lakes act as catchment basins for close to 40% of the landscape, supply drinking water, generate electricity, are used to irrigate fields, and serve as recreational areas.

Extremely varied in terms of origin, occurrence, size, shape, depth, water chemistry and other features.



Lakes , continued to form and to be destroyed.

e.g.,

- an earthquake trigged landslide created lake Sarez in Tajikistan.
- Spirit lake at the foot of Mount Saint Helens, was greatly reduced. in size when the volcano erupted, destroying popular resort lake.

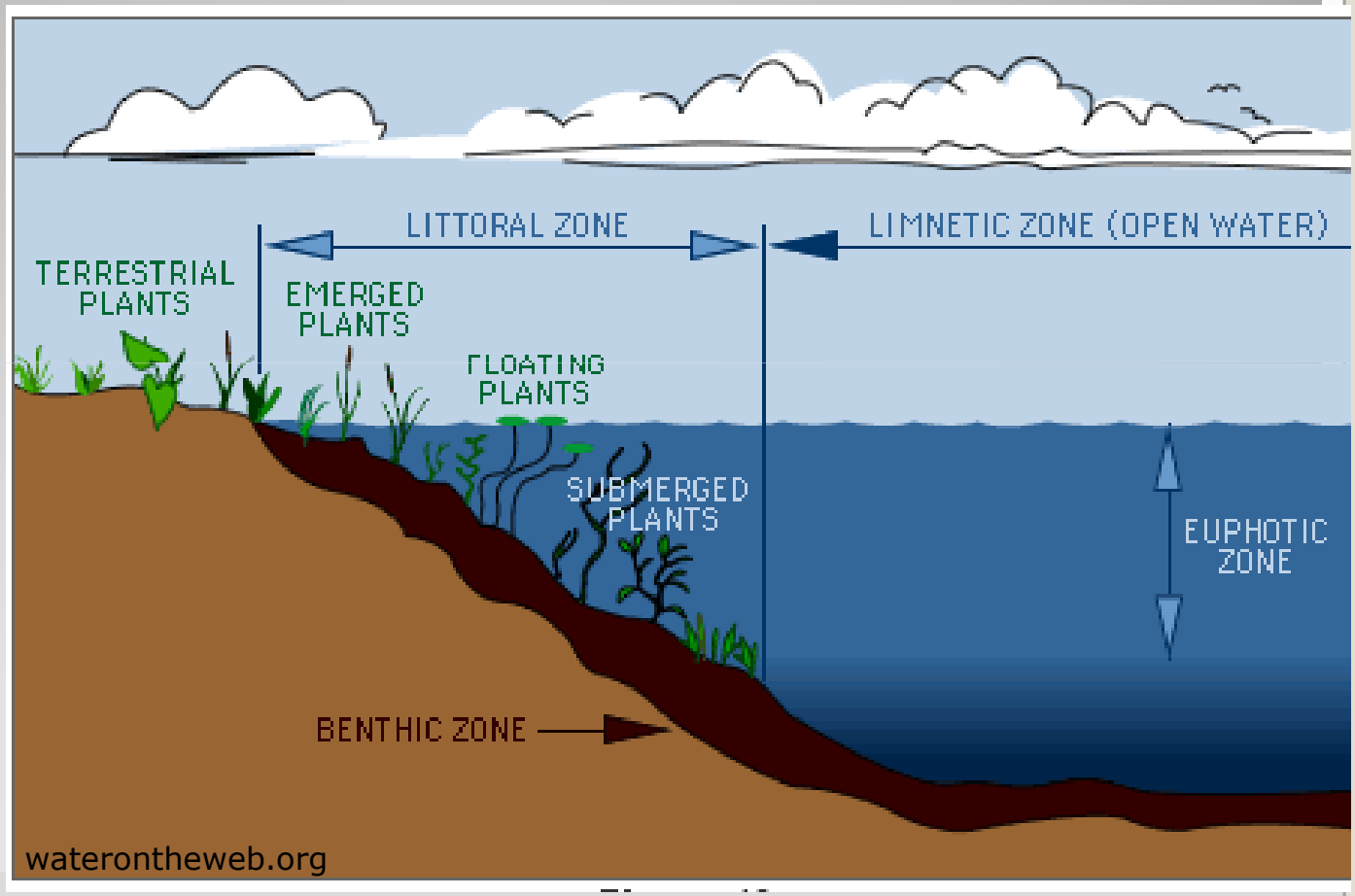
Lake formation

- Tectonic activity
- Glacial activity
- Volcanic activity
- Other Natural processes
- Man made lakes

Features of lakes

- drainage basin (also known as catchment area), inflow and outflow, nutrient content, dissolved oxygen, pollutants, pH, and sedimentation.

- 3 zones of lakes---
  - the littoral zone,
  - the photic, limnetic or open-water zone and
  - the deep-water profundal or benthic zone.



Classification of lakes

- **Oligotrophic**, Nutrient poor lakes and are generally clear, having a low concentration of plant life.
- **Mesotrophic** lakes have good clarity and an average level of nutrients.
- **Eutrophic** lakes are enriched with nutrients, resulting in good plant growth and possible algal blooms.
- **Hypertrophic** lakes are bodies of water that have been excessively enriched with nutrients.

Changing lakes..

Overtime, lake size and depth changes owing to various reasons.

- Natural process- sedimentation
- Anthropogenic process- “Urbanization”

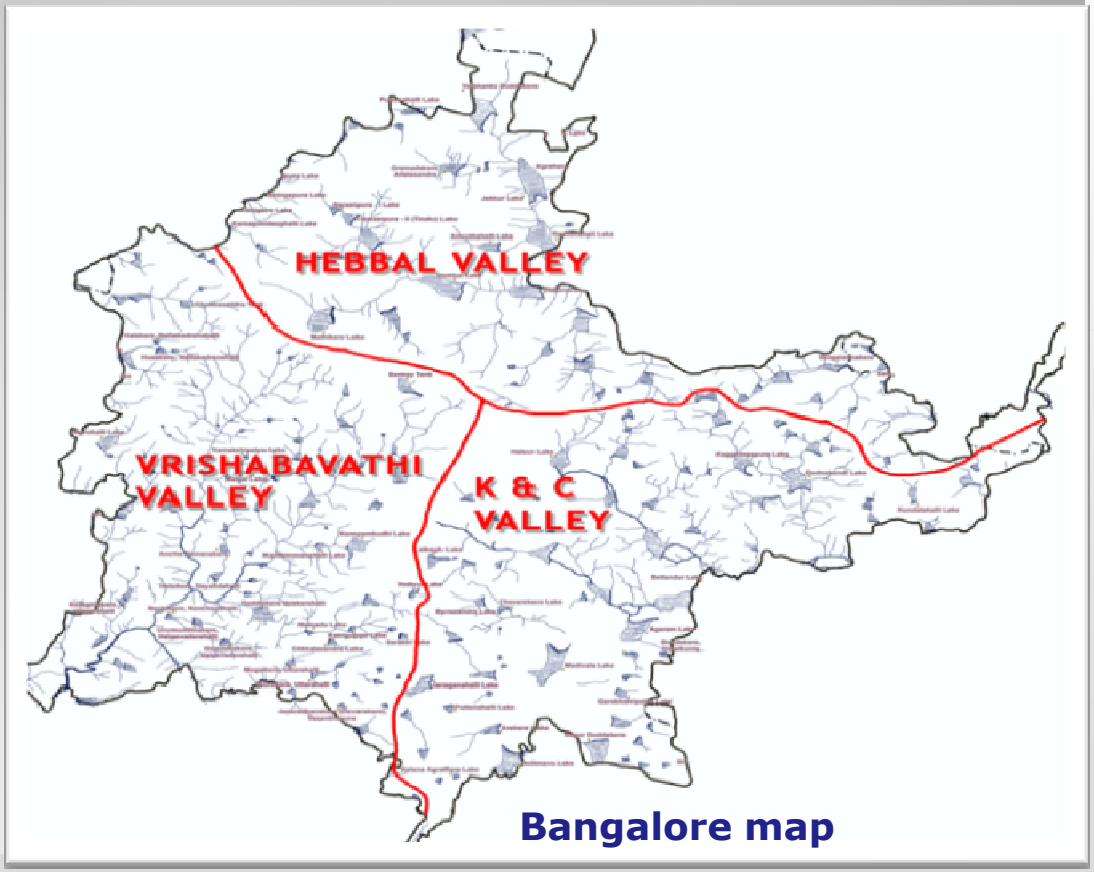
  - Urbanization , an anthropogenic land conversions, drastically affect the land cover and landscape characteristics in considerably short period of time.
  - Urban expansion occupies arable land, with accelerating urban growth, relatively wild habitats, such as urban forest and lake area, also became the target of urban spreading out.

Urban lakes

- shallow, highly artificial and often hypertrophic
- Highly interactive with people but poorly understood
- are vulnerable to changes in water quality in the course of nutrient fortification.

Case in point, Bangalore lakes

- one of the severely polluted expanses in India. The city harbours many man-made wetlands to meet the domestic and agricultural needs.
  - Lakes of Bangalore occupy about 4.8% of the geographical area (640 sq km) covering both urban and non-urban areas. They were built for various hydrological purposes, mainly to serve agriculture activities.



Bangalore map

- Studies on lakes of Bangalore during the past decade show that 35% tanks were lost owing to various anthropogenic pressures.
- Since last decade, 262 lakes within the Green belt area of the city, which has fallen to 81.
- lakes are declining..
  - Urbanization and land use activities, in order to accommodate the rapidly increasing populace
  - further contributing to the deterioration in water quality and significant change in local climate.
  - undeniably decline in Biological diversity

How to save lakes?

Essential to conserve biological diversity and has to be an integrated approach in terms of planning, execution, and monitoring, acquiring awareness on ecology, hydrology, wetland management, and local expertise, planners and decision makers.

Monitoring of Bangalore lakes

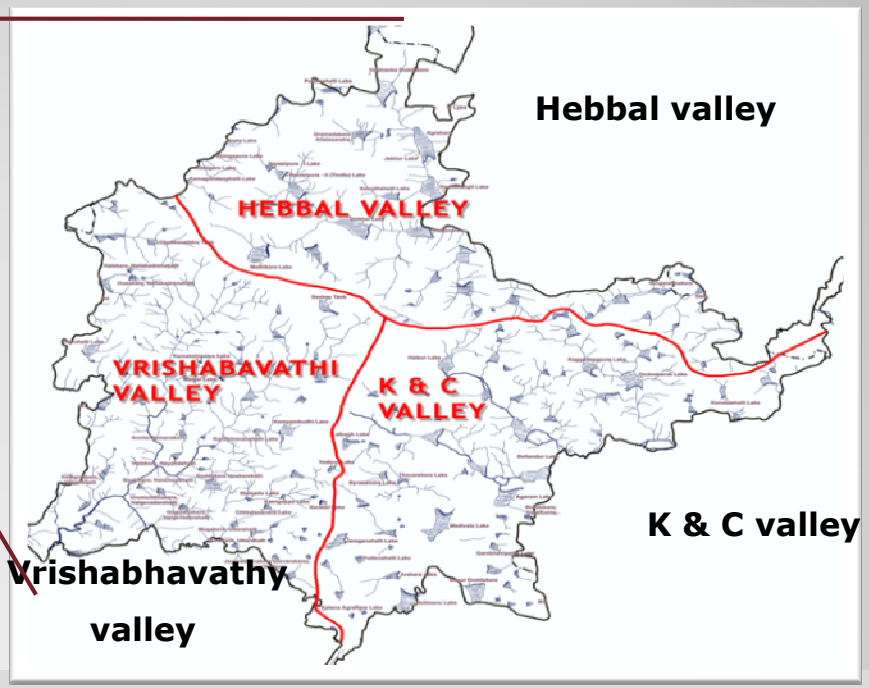
Selected lakes in Bangalore- 11 lakes

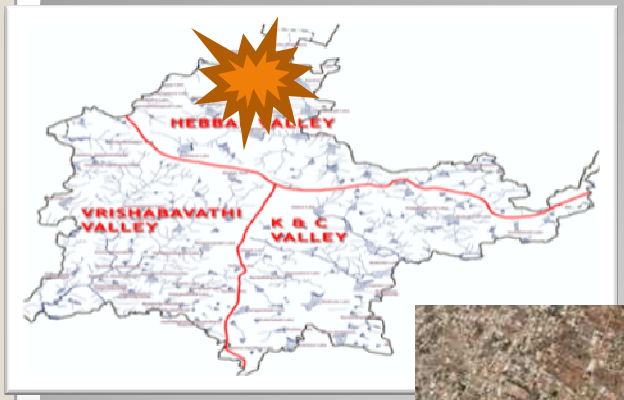
- Jakkur
- Rachenahalli
- Venkateshpura
- Ullalu
- Mallathalli
- Komghatta
- Kothnur
- Thalghatpura
- Somapura
- Konasandra
- Ramasandra

Circumstance in lakes

- Domestic use of water
- Sewage and industrial inlet into lakes
- Agricultural runoff
- Encroachments
- Dumping of wastes
- Defecation
- Mining

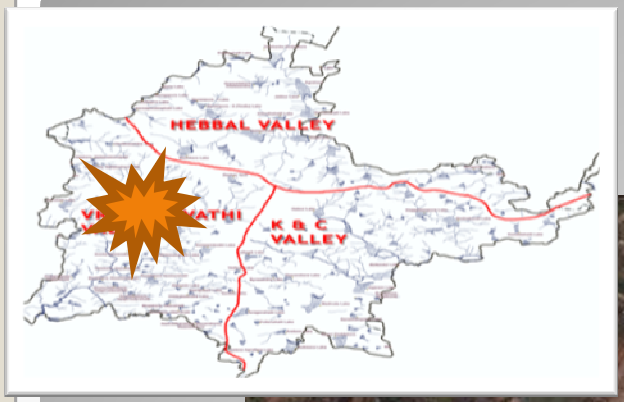
- Hebbal valley
- Vrishabhavathy valley
- K & C valley





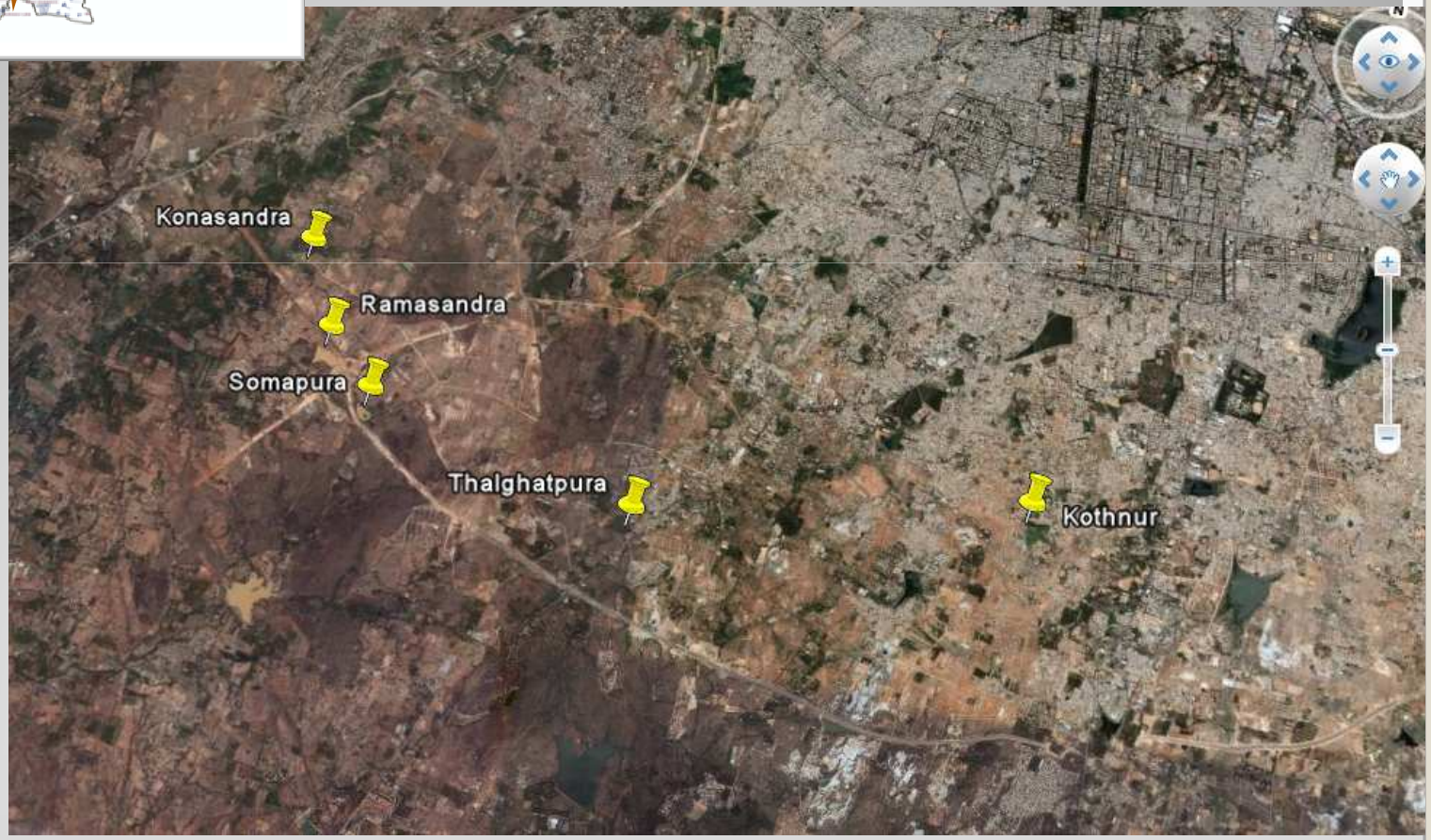
Hebbal valley

Vrishabhavathy valley




HEBBAL VALLEY
VRISHABAVATHI VALLEY
K & C

K & C valley


Konasandra
Ramasandra
Somapura
Thalghatpura
Kothnur

I. Water Sampling

Water samples collected from 3 selected sites (Inlet, Outlet and middle) in selected lake

Physical parameters like pH, Temperature, Total Dissolved Solids; Salinity and Electric Conductivity were measured using EXTECH EC500 Probe immediately after collection.

II. Water quality variables

Physical
- pH
- Temperature
- Electric conductivity
- Salinity
- Total dissolved solids

Chemical
- Nitrates
- Phosphates
- Dissolved oxygen
- Biological oxygen demand
- Chemical oxygen demand
- Hardness
- Alkalinity
- Sodium
- Potassium
- Chlorides

Experiments were conducted in laboratory using APHA (American Public Health Association) standard methods

Outcome: Hebbal valley

	JAKKUR	RACHENAHALLI	VENKATESHPURA
pH	8.07	9.10	8.38
temperature(˚C)	28.96	30.71	26.27
EC(µ S)	1260.42	874.00	350.00
Salinity(ppm)	634.75	449.50	171.50
TDS(ppm)	893.17	617.17	243.33
DO(mg/l)	6.31	7.62	7.23
BOD(mg/l)	2.55	3.10	2.68
COD(mg/l)	67.17	48.00	56.89
Nitrates(mg/l)	0.02	0.02	0.02
Phosphates(mg/l)	0.03	0.02	0.04
Sodium (mg/l)	788.55	646.83	170.25
Potassium(mg/l)	58.09	39.42	59.33
Total_hardness(mg/l)	332.00	220.00	134.67
Ca_hardness(mg/l)	90.67	76.33	61.11
Mg_hardness(mg/l)	58.89	35.05	17.95
Alkalinity(mg/l)	160.83	125.00	91.67
Chlorides(mg/l)	280.92	199.04	41.65

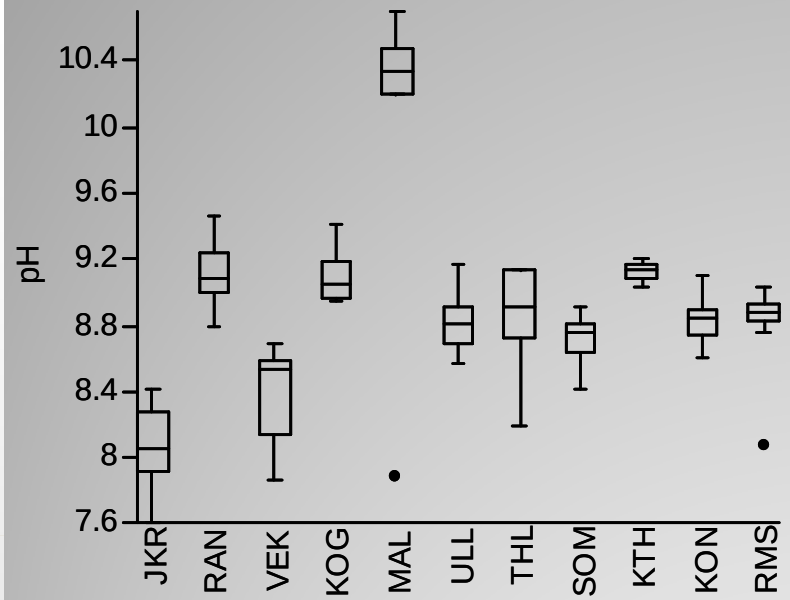
Vrishabhavathy valley

	KOMMAGHATTA	MALLATHALLI	ULLALU	THALLGHATPURA
pH	9.09	9.98	8.82	8.83
temperature(˚C)	28.46	28.80	26.82	29.37
EC(µ S)	787.50	1131.00	646.50	785.71
Salinity(ppm)	414.13	564.50	385.00	389.00
TDS(ppm)	563.13	797.83	475.17	578.86
DO(mg/l)	5.92	9.04	6.95	9.73
BOD(mg/l)				
COD(mg/l)	53.14	17.33	70.00	44.00
Nitrates(mg/l)	0.06	0.07	0.08	0.05
Phosphates(mg/l)	0.03	0.08	0.03	0.05
Sodium (mg/l)	16.36	28.38	13.12	15.41
Potassium(mg/l)	0.70	4.37	0.35	7.59
Total_hardness(mg/l)	283.25	303.33	259.13	180.00
Ca_hardness(mg/l)	23.45	28.06	22.98	34.58
Mg_hardness(mg/l)	63.39	67.17	57.62	35.48
Alkalinity(mg/l)	236.75	274.33	274.00	258.86
Chlorides(mg/l)	115.98	183.18	83.59	185.78

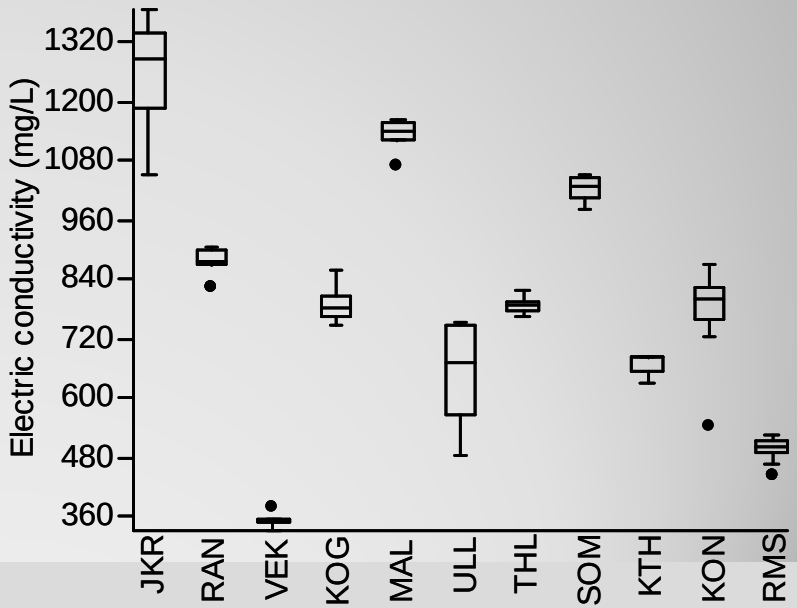
K & C valley

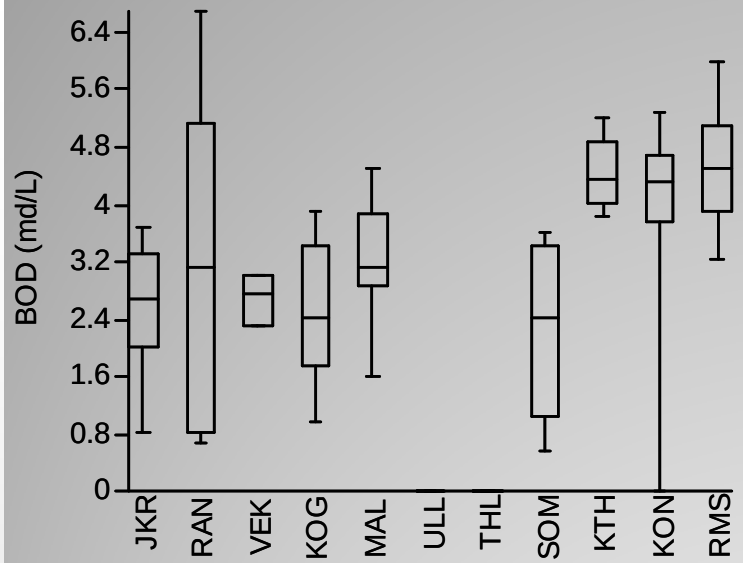
	SOMAPURA	KOTHNUR	KONASANDRA	RAMASANDRA
pH	8.71	9.12	8.82	8.83
temperature(˚C)	30.34	29.60	32.25	30.45
EC(µ S)	1022.38	667.00	775.42	494.40
Salinity(ppm)	503.38	333.75	396.00	245.40
TDS(ppm)	712.13	469.50	554.75	355.93
DO(mg/l)	6.76	7.24	6.54	6.47
BOD(mg/l)			3.70	4.52
COD(mg/l)	32.00	21.50	36.33	26.93
Nitrates(mg/l)	0.08	0.07	0.07	0.05
Phosphates(mg/l)	0.04	0.06	0.01	0.01
Sodium (mg/l)	41.05	21.05		
Potassium(mg/l)	1.60	5.45		
Total_hardness(mg/l)	111.25	75.00	85.00	112.40
Ca_hardness(mg/l)	32.87	24.05	23.71	30.94
Mg_hardness(mg/l)	19.13	12.43	14.95	19.88
Alkalinity(mg/l)	255.00	193.00	366.50	168.59
Chlorides(mg/l)	104.90	140.58	60.09	63.01

pH:
Permissible limit 6.0-8.5



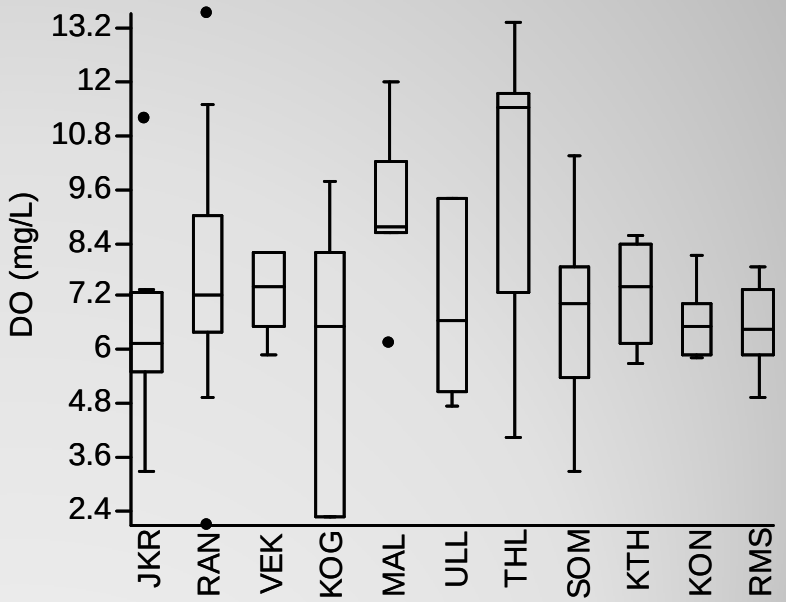
Electric conductivity:
Permissible limit

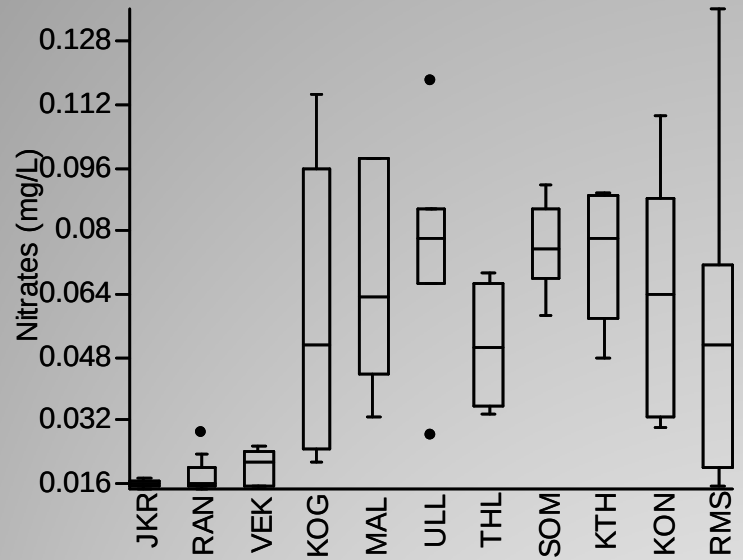




BOD:
Permissible limit <3

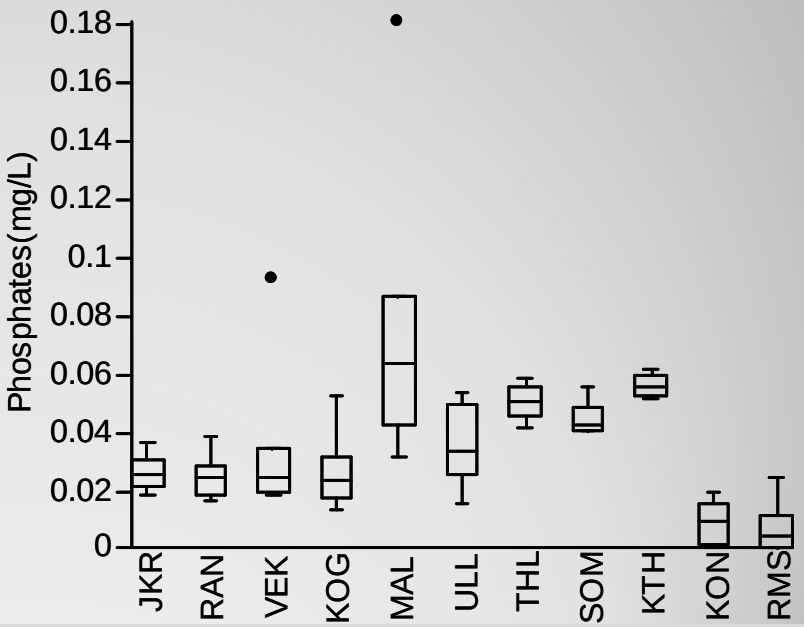
DO:
Permissible limit >5





Nitrates:
Permissible limit 6.0-8.5

Phosphates:
Permissible limit 6.0-8.5



Classification of Bangalore lakes

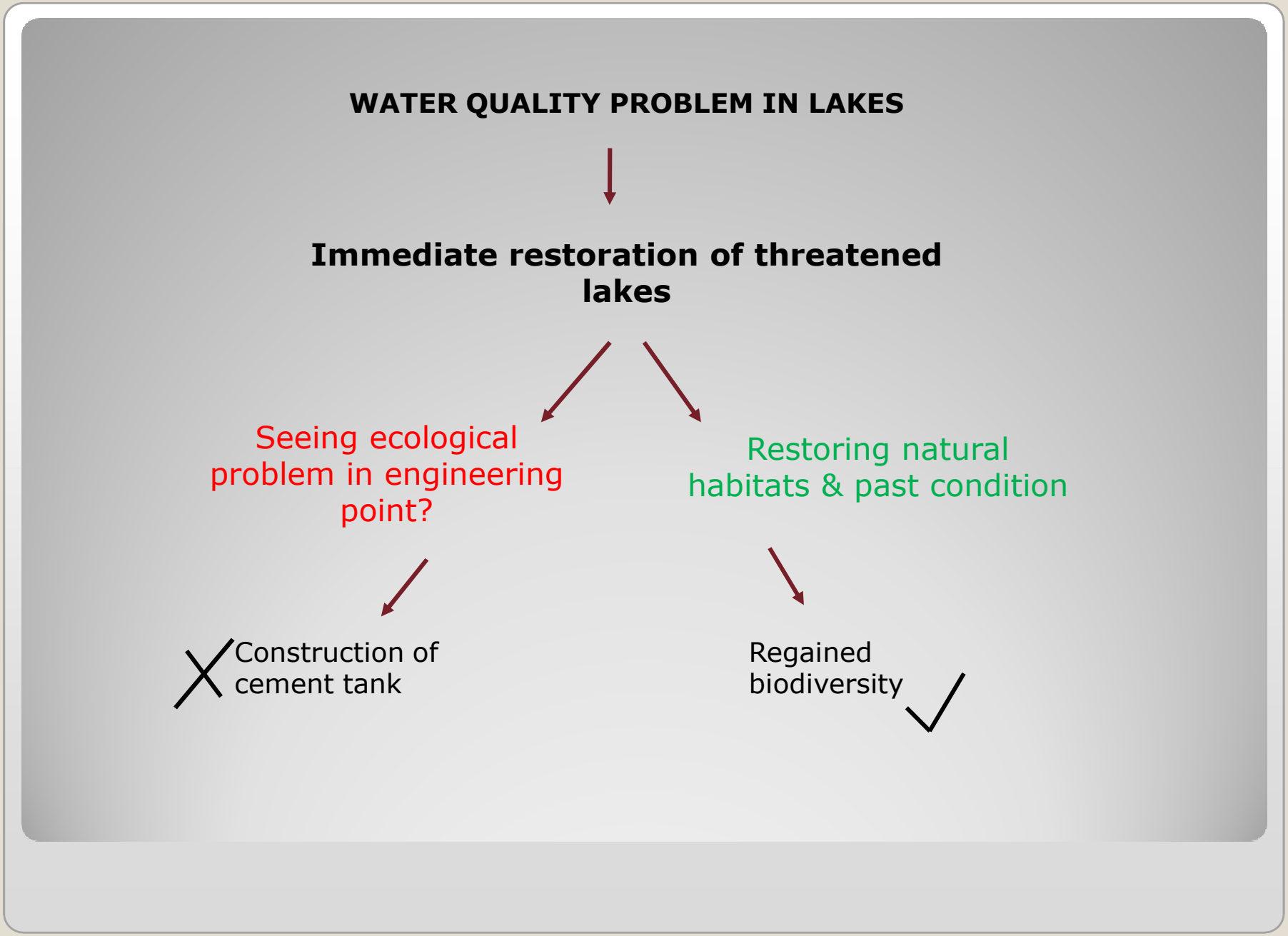
- Dissolved oxygen
- Nitrates
- Phosphates
- Electric conductivity

OLIGOTROPHIC	**MESOTROPHIC**	**EUTROPHIC**
Venkateshpura	Rachenahalli	Ullalu
Ramasandra	Komghatta	Komghatta
	Thalghatpura	Kothnur
		Jakkur
		Somapura
		Mallathalli

Awareness about lakes

Restoration

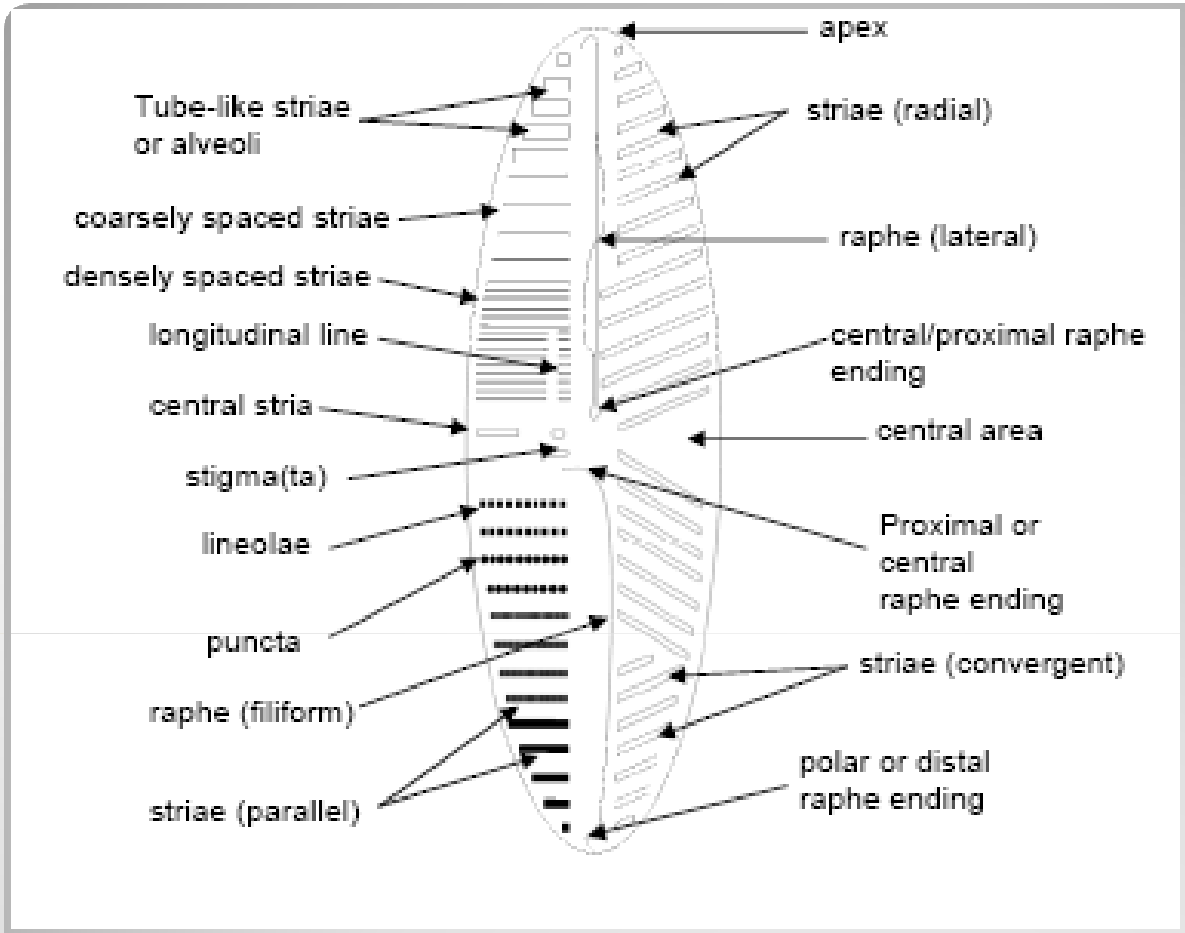
Conservation and Management of restores lakes


WATER QUALITY PROBLEM IN LAKES
Immediate restoration of threatened lakes
Seeing ecological problem in engineering point?
Restoring natural habitats & past condition
Construction of cement tank
Regained biodiversity

- Assessment of restoration practice using Aquatic organisms
- Biological Indicators

  Monitoring ecosystem's condition using organisms

  enables both preventive as well as restorative measures.
- Indicator organisms
  - Diatoms
  - Fish
  - Insects
  - Birds



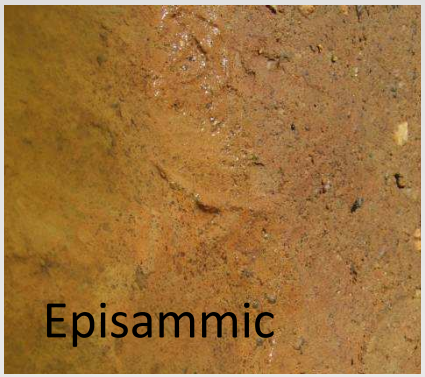
DIATOMS

- ✓Unicellular,
- ✓Eukaryotic algae
- ✓Bacillariophyceae
- ✓Primary producers

Objective: to Investigate diatom assemblages in Selected lakes of Bangalore

Sampling: Diatoms were sampled from different habitats

Stones- Epilithic
Sediments- Episammic
Plants- Epiphytic



Caught diatoms?

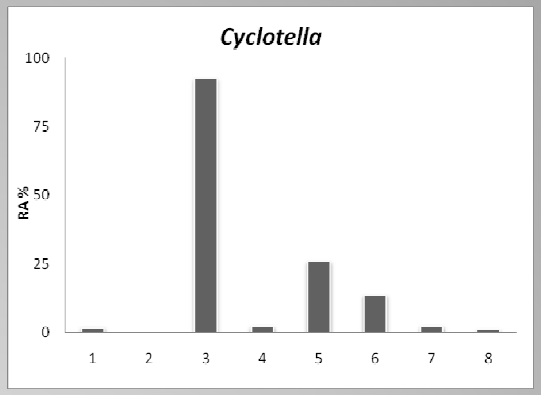
✓ 7 dominant Genus

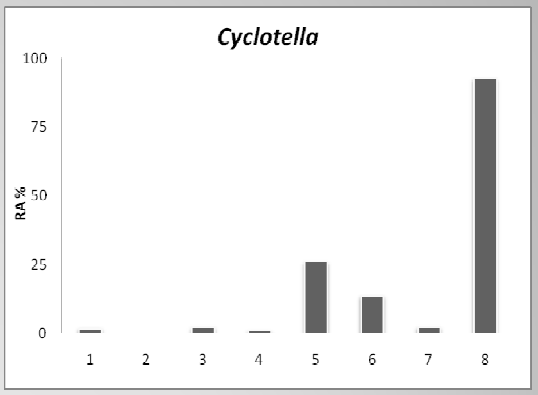
- Achnanthes sp.
- Aulacoseira sp.
- Cyclotella sp.
- Cymbella sp.
- Gomphonema sp.
- Nitzschia sp.
- Navicula sp.

Cyclotella

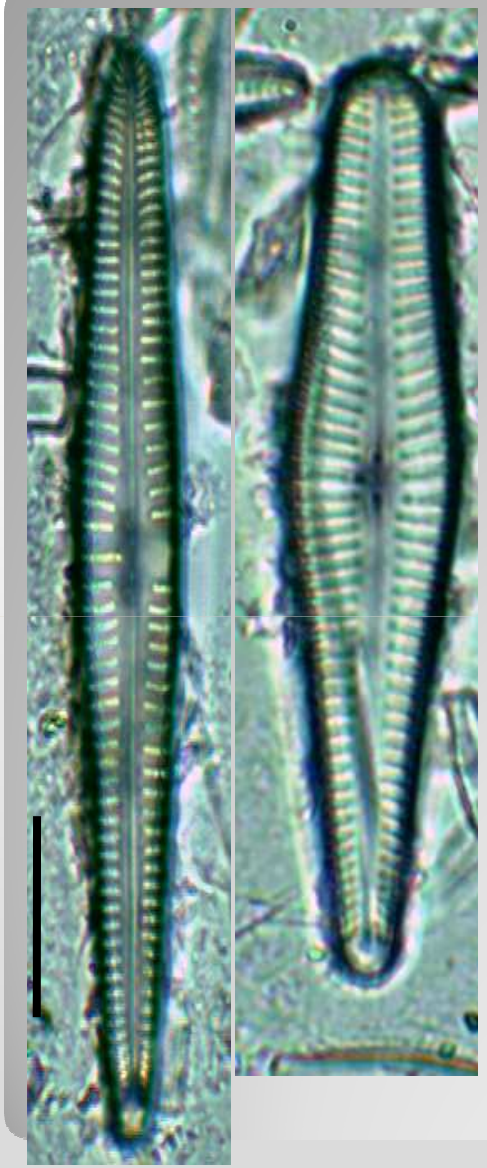
Dimensions: Diameter :5-28µm
Striae density: 6-10/10µm

Ecology: This taxon has a cosmopolitan distribution in the benthos and plankton of eutrophic, electrolyte rich lakes, rivers and streams.

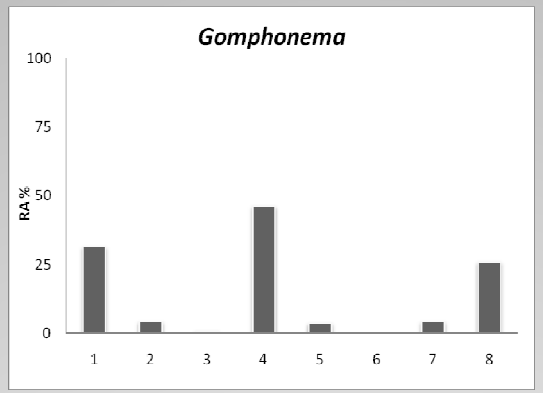


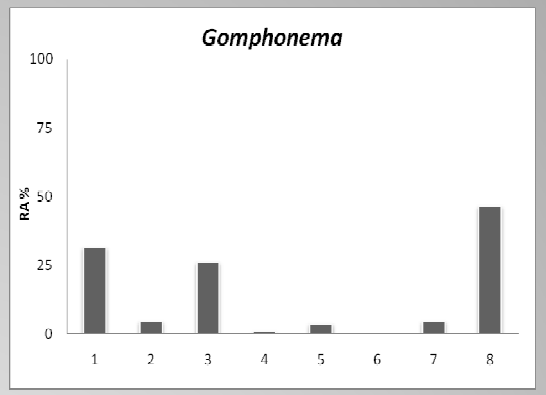


Relative abundance of *Cyclotella* genus plotted with sites arranged in order of increase in Electrical conductivity (left) and pH (right)



Gomphonema

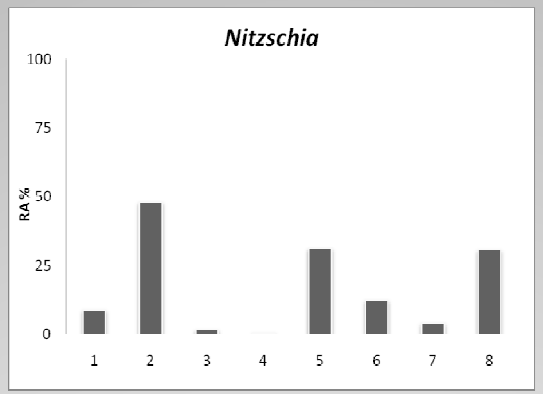


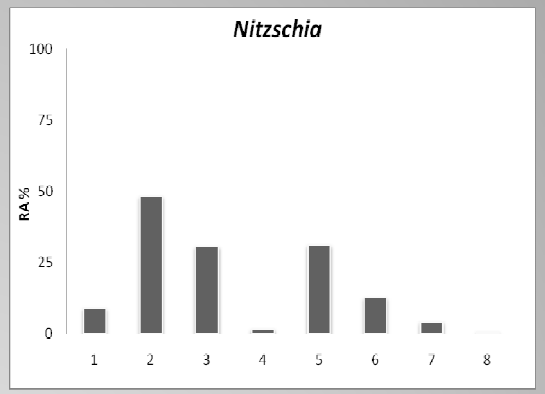


Relative abundance of *Gomphonema* genus plotted with sites arranged in order of increase in Electrical conductivity (left) and pH (right)

Ecology:
Species of Gomphonema are very common epiphytes found attached to substrata by branched, gelatinous stalks originating at their narrow, or base, end. They occur in a wide range of mostly fresh waters including those enriched with sewage.

Nitzschia

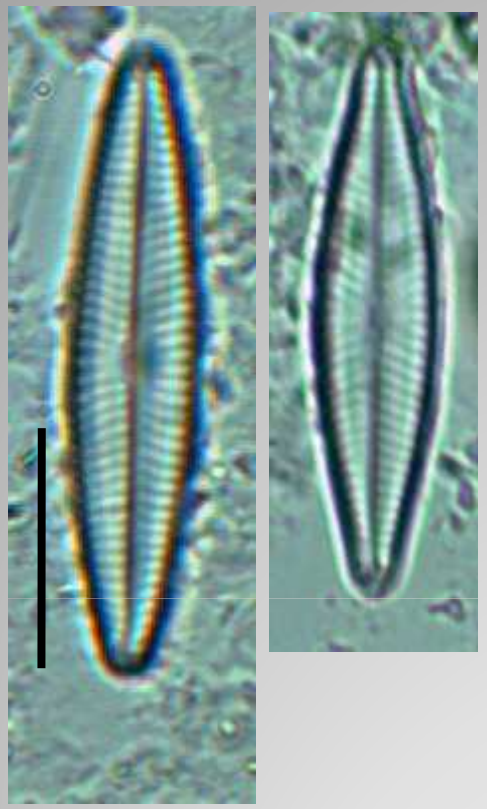




Relative abundance of *Nitzschia* genus plotted with sites arranged in order of increase in Electrical conductivity (left) and pH (right)

Ecology:

Nitzschia is a large, diverse and ecologically versatile Genus. They are mostly benthic but include Planktonic taxa (e.g. *N. acicularis* (Kutzing) W Smith). The genus can yield much ecological information since several taxa are indicative of nutrient enrichment (eutrophication), while other are useful indicators of elevated salinities. Nitzschia may also occur in oligotrophic waters, but they are rarely a major component of these assemblages.



Navicula

Dimensions:
Valve length: 28-32 µm
Valve breadth: 6-9 µm
Striae density: 12-14/10 µm

Ecology:
Navicula is found in all types of waters ranging from oligotrophic to eutrophic. Cells inhabit the plankton or benthos. In benthic habitats the cells may occur singly, in films on submerged substrates and sediments, or as colonies within a mucilage tube (e.g., N. recens).

So Now?

Classification of lakes based on Diatom distribution

Eutrophic lakes

Ullalu

Jakkur

Sompura

Kothnur

Dominance of *Cyclotella* and *Gomphonema* sp.


Mallathalli lake: Eutrophication

Meso to eutrophic lakes

Rachenahalli

Thalgatpura

Dominance by *Nitzschia* and *Navicula* species


Thallgatpura: Meso to Eutrophic

“ Pristine but not so pristine”

Ramsandra
Rachenahalli
Venkateshpura

DYING LAKES !!!!!!!!

Save US!


THANK YOU

Any ???

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