MANGROVE

By- Dr Ekta Khare

Department of Microbiology,

Chhatrapati Shahu Ji Maharaj University, Kanpur

Mangrove

- Mangrove forests are coastal ecosystems of tropical and subtropical areas, continuously under tidal influence and submitted to environmental constraints varying according to the seasons and to spatial gradients (salinity gradients, tidal cycle, sediment anoxia, soil instability).
- There are about 80 different species of mangrove trees that belong primarily to the families Rhizophoraceae, Acanthaceae, Lythraceae, Combretaceae, and Arecaceae.
- Many mangrove forests can be recognized by their dense tangle of prop roots that make the trees appear to be standing on stilts above the water.
- Respiratory or knee roots (pneumatophores) are characteristic of many species; they project above the mud and have small openings (lenticels) through which air enters, passing through the soft spongy tissue to the roots beneath the mud.
- The Sundarbans is a cluster of low lying islands in the Bay of Bengal spread across Bangladesh and the West Bengal region of India. It is the largest single block mangrove forest in the world

Mangrove

Mangrove Forest

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Prop roots

Pneumatophores

Mangrove ecosystem

- Mangrove forests are highly productive systems are the main source of organic matter for the coastal marine food webs.
- They have also a high potential of carbon sequestration and storage due to rapid rates of net primary production and sedimentation.
- Such conditions make mangroves hotspots for microbial diversity, and the microbial community plays essential roles in the functioning and maintenance of the ecosystem .
- Microbial communities (belong to Gammaproteobacteria, Delta-proteobacteria, *Chloroflexi*, and Euryarchaeota) in mangroves sediments have a high diversity level.
- A variety of unique microorganisms that play an important role in nutrient biogeochemical cycles, such as carbon cycling, methane cycling, nitrogen cycling, and sulfate reduction.

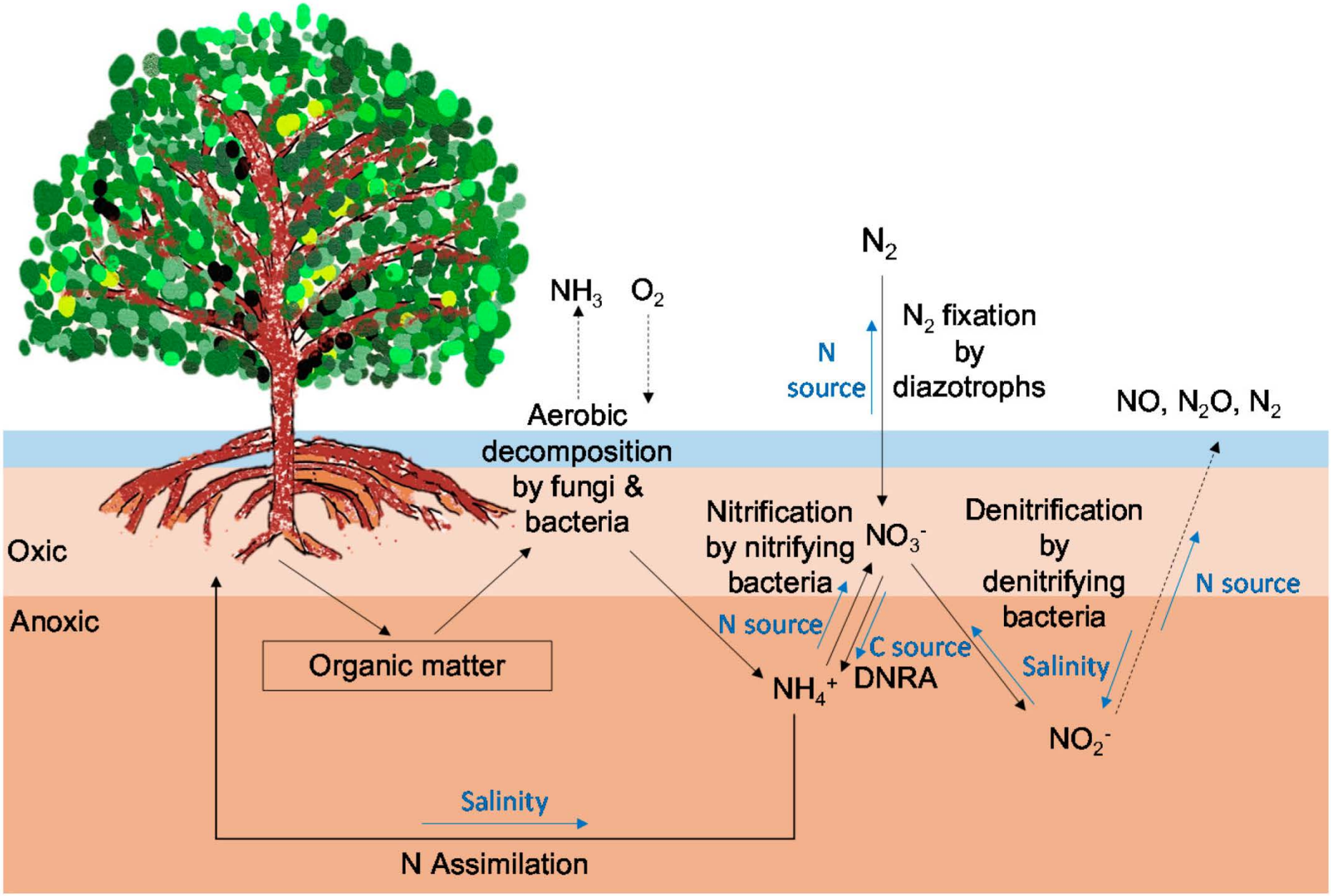
Phototrophic and heterotrophic microorganisms

- Phototrophic and heterotrophic microorganisms embedded into a matrix of extracellular polymeric substances which participate in:
  - the sediment stabilization
  - plant growth promotion
  - the chelation of toxic metals and other contaminants
- Phototrophic microorganisms such as diatoms, green algae or cyanobacteria contribute to the primary production of the ecosystem and constitute a food source for heterotrophic protists and meiofauna.
- Microbial organic matter decomposition occurs slowly because vegetative material is rich in tannins, polyphenols, cellulose and lignin.
- Organic matter deposited on the mangrove floor is colonized by sediment fungi and bacteria capable of degrading lignocellulose.

Microorganisms involve in N_2 cycle

- The microorganisms involved in nitrogen cycle in mangrove ecosystem contribute through different metabolic processes: nitrogen (N_2) fixation, nitrification, denitrification, ammonification, anaer obic ammonium oxidation (anammox) and dissimilatory nitrate reduction to ammonium (DNRA).
- These microorganisms participate in the degradation of organic nitrogen into inorganic nitrogen compounds available for the trophic chain, notably for the mangrove trees.
- Nitrogen can be removed from the sediments under the gaseous forms (N_2, NO, N_2O) by the denitrification and anammox processes carried out by denitrifying bacteria and anammox bacteria, respectively.

Microbial functions in mangrove ecosystem



Methane cycling

- Organic matter mineralization in sediments is a multi-step process that depends on the availability of oxygen and presence of terminal electron acceptors (TEAs).
- At the terminal step of organic matter decomposition, when all the TEAs have been consumed and electron donors are in surplus, CH_4 is produced by a fermentative disproportionation reaction of low-molecular weight compounds (e.g., acetate), or by reduction of CO_2 via hydrogen or simple alcohols.
- In wetlands, sedimentary-derived CH_4 can escape to the adjacent water/atmosphere during low-tide conditions, CH_4 -rich pore water is transported to adjacent creeks and estuaries.
- In estuarine water columns, CH_4 can be partly oxidized to CO_2 by methanotrophs.

Sulphur cycling

- Sulphur reducing bacteria are anaerobic microorganisms that are wide spread in mangrove sediments, where they use sulphate as terminal electron acceptor for the degradation of organic compounds, resulting in the production of sulphide.
- The sulphide can be oxidized under oxic conditions by chemolithotrophic sulphur bacteria or under anoxic conditions by phototrophic sulphur bacteria.
- However, some species (*Beggiatoa* sp., *Thioploca* sp., *Thiobacillus denitrificans*, *Thiomicrospira denitrificans*) oxidize H_2S and anaerobically coupling it to nitrate reduction.

Questions

- What is mangrove forest? Explain mangrove ecosystem and microbial communities functions.
- Write short note on:
  - Mangrove
  - Microbial community of mangrove ecosystem