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SIGNIFICANCE OF MICRO-ALGAE IN AQUATIC ENVIRONMENT

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Phytoplankton play an important role in carbon dioxide fixation. It fixes about 30 to 50 billion tonnes of carbon in a year (Falkowski, 1994). It also prevents global warming and subsequent climatic changes. Although it fixes more proportion of carbon in the environment, its biomass contributes only 1 to 2% of the total plant carbon in the world (Falkowski, 1994). Hence, its sustainability is very important to environmental resource management.

The phytoplankton include diatoms, dinoflagellates, coccolithophores, silicoflagellates, holosphaera (comes under chlorophyta), and a few species of cyanophyta in the marine environment (Kilham & Hecky, 1988). Few species like *Alexandrium tamarense* (dinoflagellate) are toxic to marine animals since micro-algae contain saxitoxin causing death in animals preying on them (Anderson, 1994). Chlorophyta and cyanophyta are the major groups of phytoplankton present in the freshwater environment like river, lakes and ponds (Kilham & Hecky, 1988).

Basic Part of Food Chain

Phytoplankton serve as the primary producer in pelagic ecosystem. The food chain in aquatic environment contains producers (phytoplankton), herbivore fishes and predatory fishes (carnivore). The nature of trophic level depends upon nature of primary production (Sheldon et al., 1977). All part of the primary production is not consumed directly by herbivore fish, some part of primary production becomes the dead organic matter that is consumed by the detritivores fish (Fenchel, 1988).

Source of Dissolved Oxygen in Aquatic Environment

Phytoplankton is the source of dissolved oxygen in aquatic environment which in turn is consumed by aquatic fishes and this becomes one of the survival factors for the fishes (Smith & Piedrahita, 1988). However, this factor is affected by other factors like non-algal turbidity (due to rainfall and dust air) and planktonic respiration (Smith & Piedrahita, 1988). The growth of macrophytes in the pond ecosystem due to improper maintenance causes depletion of dissolved oxygen level that leads to the mortality of the fishes. It occurs due to non-penetration of sunlight into the pond. Hence it is advisable to remove the macrophytes at regular interval to increase the dissolved oxygen level of the pond from the source of phytoplankton (Smith & Piedrahita, 1988).

The oxygen required for fishes in water mainly comes from two sources. One is the phytoplankton respiration and another from the surface water current by means of atmospheric air (Diaz, 2001). Sometimes the dissolved oxygen level of water becomes lower causing suffocation of the fishes for oxygen intake, this situation is called hypoxia (Diaz, 2001). Extreme suffocation for dissolved oxygen causes death of the fishes.

Act as bio-indicator:

The phytoplankton is very sensitive to water pollution. Concentration of phytoplankton in highly polluted water is very low and phytoplankton concentration in low polluted water is high or optimal. The sewage contamination in the natural water resource is the main cause for the water pollution. It can alter the water quality making it unsuitable for the growth and procurement of the micro-algae (Parmar et al., 2016). *Euglena gracilis* is the pollution indicator for the organic water pollution (hosmani, 2014). *Chlorella vulgaris* removes the heavy metal contamination from soil and water (lilian, 2009). Lower concentration of phytoplankton in freshwater environment indicates that the lack of phosphate (limiting nutrient for that environment). Similarly, lower phytoplankton concentration in marine environment indicates that the lack of nitrogen (limiting nutrient for that environment) (Hecky & Kilham, 1988). Thus, the limiting nutrient play a key role for the proliferation of phytoplankton in different environments like freshwater, marine and estuarine (Hecky & Kilham, 1988).

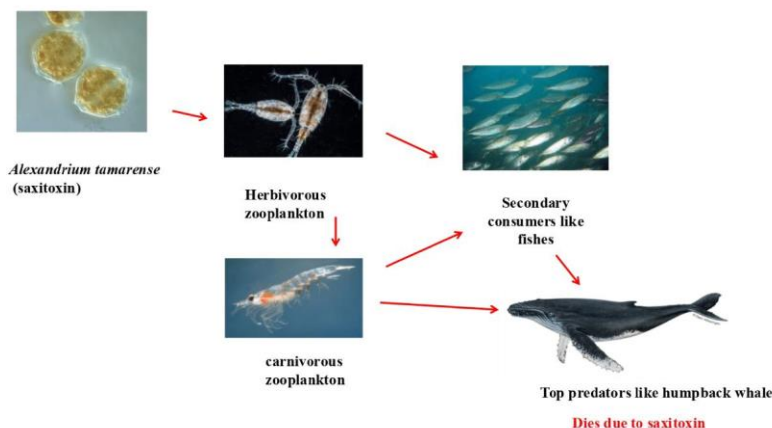
Provide inorganic nutrient by mineralization process in aquatic ecosystem:

Mineralization of phytoplankton is the process of decomposition of dead micro-algae into final release of inorganic nutrients (Kleerekoper, 1953). It occurs at the layer of epilimnion where the light penetration and dissolved oxygen content is high. It cannot occur at low oxygen environment like hypolimnion (Kleerekoper, 1953). For example, some micro-algae like coccolithophore produces calcium carbonate by calcification process in aquatic environment which act as the source of calcium ions in aquatic ecosystem (Poulton et al., 2006). Diatom produces silica debris after its degradation of silica frustules which in turn is utilized for the formation of new diatoms and some other silica utilizing species (Poulton et al., 2006).

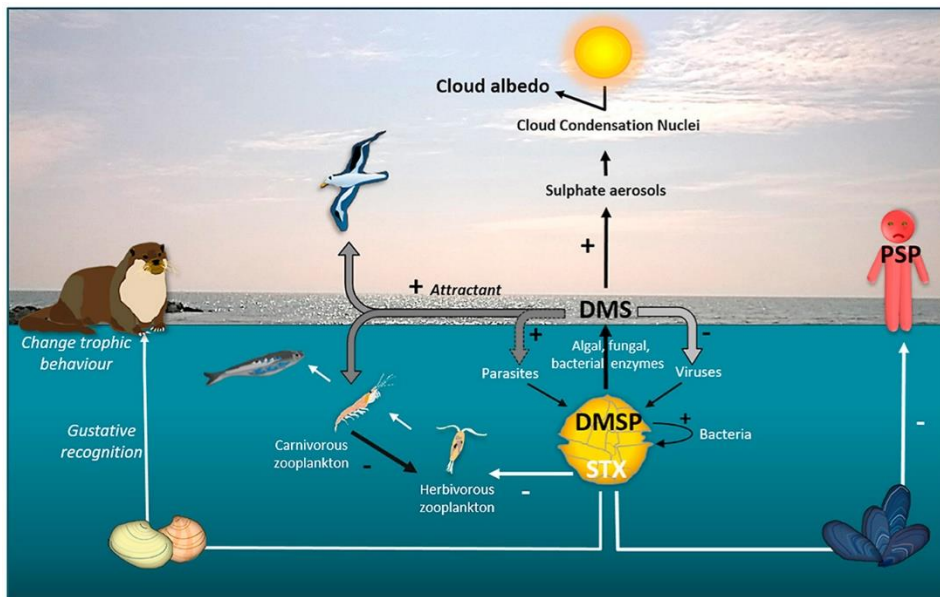
Harmful Effects of Some Species of Micro-Algae

Major species of the phytoplankton are known to be beneficial in nature as it is used as food for herbivore fish as well as take part in any other processes. But a few species of phytoplankton seem to be harmful to ecosystem. It mostly includes dinoflagellates like prymnesiophytes and chloromonads (Anderson, 1994). For example, dinoflagellate species, *Prymnesium parvum* produce toxin like galactoglycerolipids, hemolysin, polyene polyether, cyclo amines that gives cytotoxic, hemolytic, hepatotoxic effects to fish causing mortality (Burkholder, 2009). *Gymnodium brevis* is dinoflagellate that produce brevitoxin that causes skin allergy (Hofbauer, 2021). Some non-toxic algae like *Noctiluca* also causes death of marine animals due to lack of oxygen while blooming in shallow waterbodies (Anderson, 1994). *Alexandrium tamarense* is also a dinoflagellate that produces saxitoxin that kills marine animals by entering through food web (Anderson, 1994) (See Fig 1).

Fig 1: Impact of Harmful algal Blooms on marine animals



However, some dinoflagellates such as *A. minutum*, and as reported here *A. pacificum* as well, may also have a beneficial impact on the environment by producing dimethylsulfoniopropionate-DMSP, the precursor of dimethylsulfur-DMS and sulfate aerosols involved in climate balance. According to the study of Caruana et al. (2020), higher salinity disadvantages toxin production and tends to favor the production of the osmolytes DMSP and glycine betaine. Hence, this key metabolite production is strain and species-dependent and is influenced by environmental conditions of salinity which in turn, can diversely affect the environment. Widespread coastal blooms of *A. minutum* and *A. pacificum*, although being a risk for seafood contamination with toxins, are also a DMS and DMS source that potentially contribute to the ecosystem structuration and climate (See Fig 2).



(Source: <https://www.sciencedirect.com/science/article/abs/pii/S0141113619308669>)

Conclusion

Phytoplankton is smaller than zooplankton that why zooplankton always prefer to eat phytoplankton as the major food source (Fenchel, 1988). According to size, the phytoplankton mostly comes under picoplankton (0.2-2 μ m), nanoplankton (2-20 μ m) and microplankton (20-200 μ m) (Fenchel, 1988). Phytoplankton also play a role in detritus food chain as the dead micro-algae are decomposed by bacterial respiration and production of inorganic nutrients to same environment (Smith & Piedrahita, 1988). It plays an important role in therapeutic industries because it contains astaxanthin, polyunsaturated fatty acids, β -

carotene, etc. (Priyadarshani & Rath, 2012). It also takes part in waste water treatment. It is stocked in waste water to absorb the nutrients like nitrogen and phosphorus and utilize these nutrients for its growth and proliferation (Mohsenpour et al., 2021). Some industries produce EPA (Eicosa Pentanoic Acid) and DHA (Docosa Hexanoic Acid) rich oil extracted from micro-algae for human consumption such as medication (Winwood, 2013).

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