

CYANOBACTERIA



ERGOFITO

PREAMBLE:

Cyanobacteria, also known as Cyanophyta, is a phylum of bacteria that obtain their energy through photosynthesis, and are the only photosynthetic prokaryotes able to produce oxygen. The name "cyanobacteria" comes from the color of the bacteria. Sometimes, they are called blue-green algae, and incorrectly so, because cyanobacteria are prokaryotes and the term "algae" is reserved for eukaryotes.

Like other prokaryotes, cyanobacteria have no membrane-sheathed organelles. Photosynthesis is performed in distinctive folds in the outer membrane of the cell (unlike green plants which use organelles adapted for this specific role, called chloroplasts). Biologists commonly agree that chloroplasts found in eukaryotes have their ancestry in cyanobacteria, via a process called endosymbiosis.

By producing oxygen as a byproduct of photosynthesis, cyanobacteria are thought to have converted the early oxygen-poor, reducing atmosphere, into an oxidizing one, causing the "rusting of the Earth" and the Great Oxygenation Event, that dramatically changed the composition of life forms and led to the near-extinction of anaerobic organisms.

TEST CASE:

A severe case of blue algae invasion in South Africa is the Hartbeespoort dam. Many technical reports have surfaced over time regarding the state of this dam. The university of Johannesburg published the following article which happens to be 100 % correct in its assessment. It accurately states the mechanism that made and keeps the dam highly polluted

Hartbeespoort Dam water quality is hyper-eutrophic due to continuous inflow of excess phosphate from sewage and via sediments. Yearly, phosphate input is around 200 tons. Further nutrients are being released from lake sediments adding to the phosphate excess. The nutrient excess leads to rapid growth of water hyacinth and periodic algal blooms, mainly in summer, with an estimated 10000 – 15000 tons of algal biomass being produced per year.

However, 200 tons of phosphate could give rise to at least 20000 – 40000 tons of biomass per year, indicating other limitations on biomass growth or only partial removal of the biomass growing in the lake, limitations that have to be overcome for effectively reducing the lakes nutrient load. Since surplus plant material decomposes and sinks to the bottom, nutrients are accumulating in sediment that is continuously stirred up by bottom feeding fish. The major algae bloom is caused by *Microcystis*, a cyanobacterium that can produce powerful toxins that results in the lake water being unfit for human and animal consumption.

On the other hand, balanced algal growth coupled with biomass harvesting from the lake is an efficient bioremediation strategy, as algal biomass removed from the lake is equivalent to nutrient removal. Algal biomass harvested from the lake may be applied for biofuel or electricity generation or used as fertilizer in agriculture. The ultimate purpose of this program is maximal bioremediation of lake water by controlled algal cultivation and harvesting, avoiding the development of algal blooms and toxin production. Researchers from the Centre for Aquatic Research are involved in a collaborative research project together with Prof. Sammy Boussiba, the leading world authority on algal biotechnology from Microalgal Biotechnology Laboratory of the Jacob Blaustein Institutes for Desert Research, Ben-Gurion University. The project is funded through Friends of the Ben-Gurion University in South Africa.

BIOLOGICAL REMEDIATION:

The first step to remediate a cyanobacteria polluted dam is to curtail the inflow of phosphates and nitrates caused by sewage discharge and agricultural leaching into the said waters.

As the above mentioned task is often near impossible to implement, control and transformation of the pollution may be the only option available. Biological remediation with *Ergofito* plays an important role as it synchronize with nature to resolve the pollution problems. The excess of nutrients in the water will invariably trigger a floating plant (such as water Hyacinth or *Lemna minor*)

algae and cyanobacteria explosion. That is how nature converts excess nutrients into plant matter.

Any aquatic plant can produce the highest quality of compost which can be used as a fertilizer once bacterial introduction and conversion is effected. Please refer to Ergofito Compost document for further information. Furthermore the growth of Hyacinth or similar floating plant occurs, it immediately eliminates cyanobacteria diffusion as cyanobacteria needs sunlight for photosynthesis, which the floating plant blocks the sunlight. A balanced plants/nutrients/harvest management must take place to best suit the situation in the dam. Ergofito bioflush is used directly in the water to eliminates the pathogens which raw sewage brings to the body of water.

If the desire is to go back to clear water and the total elimination of cyanobacteria as well as floating plants, then a total water inflow filtering (biological or conventional) is necessary.

Fine and inexpensive nano bubbles injection into the worst parts of the water body is also recommended as some of the area could be anaerobic and producing CH₄.

The remediation starts with an aerial NDVI mapping as well as an Orthomosaic high definition mapping, allowing for the quantification of the pollution problem, then a protocol is issued for implementation.

CONCLUSION:

Remediating a polluted body of water implies to fully understand what provoked the problem in the first place. More than ever the answer is increased human effluent pollution and the lack of controlling it. Cyanobacteria eventually converts the body of water into a dangerous area for all living bodies. Floating plants explosion could be regarded as a great help if the said plants are used for agriculture after composting it with Ergofito. It creates jobs and absorbs huge amounts of phosphates and nitrates. However large bodies of water

attracts human settlements and expensive developments for which clear and safe water is expected for recreational and life style usage. The obvious solution is the deployment of large numbers of inexpensive plants using a mix of biological filters and conventional waste water treatment plants. In all cases , Ergofito has a proven and simple solution as it has a symbiotic relationship with nature.