ENVIRONMENT EDUCATION VICTORIA

Unit 1 Environmental Science Assignment

Eutrophication

Background:

Eutrophication is the natural ageing process of lakes. This very slow process, which ultimately transforms aquatic environments into terrestrial habitats, begins with the addition of nutrients into the system. These nutrients in turn stimulate the growth of microscopic free-floating aquatic plants known as **phytoplankton** (such as algae). The term eutrophication is also used to describe the human induced process where by human activity such as agriculture, use of fertilizers, and changes in land surrounding aquatic environments accelerates the growth of phytoplankton.

A more accurate term for this process is **cultural eutrophication.** Cultural eutrophication is the accelerated enrichment of surface waters due human activities. Like the natural process of eutrophication, this process results in the excessive growth of phytoplankton caused by the over-enrichment of nutrients.

Nutrients enter aquatic environments as dissolved solutes and compounds bound to organic and inorganic particles. Rivers and streams are mainly responsible for the loading of nutrients to aquatic environments. **Loading** is the amount of nutrients delivered to aquatic environments by way of rivers, streams, or groundwater. Nutrients enter rivers and streams from both point and non point sources. **Point sources** are those from which nutrients are directly being released into the environment. A sewage discharge pipe draining into a river is an example of a point source of nutrients. On the other hand, **non point sources** enter the environment from no specific point. Runoff from an agricultural field that washes into a nearby stream after it rains is an example of a non point source.

Two of the most important nutrients responsible for eutrophication are nitrogen and phosphorus. In freshwater environments (e.g. lakes), phosphorus is usually the nutrient in the lowest concentration and therefore generally limits the growth of phytoplankton. In coastal environments (estuaries), nitrogen usually limits the growth of phytoplankton because it is generally the nutrient in the lowest concentration. **Nitrogen** is commonly found in aquatic environments as nitrate (NO_3^-), nitrite (NO_2^-), or ammonia (NH_4^+ or NH_3). Human factors affecting the concentration of nitrogen in aquatic environments are wastewater and septic system effluent, fertilizer runoff, animal waste, fossil fuel, and industrial discharge. **Phosphorus** is commonly found in aquatic environments as phosphate (PO_4^{-3}). Human factors affecting the concentration of phosphorus in aquatic environments are wastewater and septic system effluent, detergents, fertilizer runoff, animal waste, development/paved surfaces, industrial discharge, phosphate mining, drinking water treatment, forest fires, and synthetic material.

Based on the amount of phytoplankton growth and the concentration of nutrients, the degree of eutrophication in aquatic environments can be classified as oligotrophic, mesotrophic, eutrophic, or hypereutrophic. **Oligotrophic** environments are characterized by clear waters, little suspended organic matter or sediment, and low primary production (phytoplankton growth). **Mesotrophic** environments have higher nutrient inputs and rates of primary production. **Eutrophic** environments have extremely high nutrient concentrations and biological productivity.

Hypereutrophic environments are characterized by murky, highly productive waters in which many clear water species cannot survive.

The production of harmful algal blooms, low dissolved oxygen concentrations, and changes in species composition are just a few of the effects of eutrophication.

Harmful algal blooms are usually produced under eutrophic or hypereutrophic conditions. Cyanobacteria and dinoflagellates are examples of phytoplankton responsible for surface scum, oxygen depletion, and consequent fish kills. Low dissolved oxygen concentrations can result from the decomposition of phytoplankton. As bacteria break down and decompose phytoplankton, they take up dissolved oxygen. Also, the phytoplankton in the bloom consume dissolved oxygen at night. **Dissolved oxygen** is essential to many organisms living in aquatic environments; therefore a decrease in dissolved oxygen concentrations could affect many aquatic organisms. Changes in the abundance and species composition of phytoplankton could change the quality of food available to higher trophic level organisms.

In addition, blooms of phytoplankton can reduce the amount of light available to organisms and plants beneath the surface layer. Submerged aquatic vegetation (**SAV**) can be very sensitive to changes in water clarity. Phytoplankton blooms often make the surface layer very turbid and attenuate light. **Light attenuation** is the decrease in light intensity as a result of absorption of energy and of scattering due to particles (such as phytoplankton) in the water. Severe eutrophication could therefore affect growth of SAV. A decrease in SAV can cause a shift in the species composition due to the important role they play as nursery habitats and refuges for many aquatic organisms. The management and control of cultural eutrophication is closely related to the prevention and control of pollution. Many state and federal agencies monitor surface and groundwater quality with the goal of preventing severe eutrophication. Dissolved oxygen, pH, nutrients, and chlorophyll a are just a few of the **water quality parameters** that are often monitored. There are many things that as individuals we can do to help prevent human induced eutrophication. Reducing the use of lawn fertilizers and purchasing household detergents and cleaners with low phosphorus concentrations are just two actions that could help control of cultural eutrophication.

Activities:

Field trip to Ballyang sanctuary Geelong

Aim: The aim of this trip is twofold: a)To observe how wetlands are used to control nutrient runoff into river systems; and b) to observe the impact high nutrient loads have on water quality.

Procedure:

1. Describe the physical layout of the wetland. This should include information such as the location, how far it is from roads, how far it is from the Barwon river, what the surrounds are like ands it size. It would be a good idea to include photos and to draw a map.
2. Around the wetlands you will find 3 signs called the litter trail containing information on the role of the wetland. Find these signs and answer the following questions:

a) How much of the litter in the Barwon river comes from our streets?

b) How many loads of litter is removed from pollutant traps throughout Geelong?

c) Where does the runoff that enters Balyang Sanctuary come from?

d) Why is it illegal to connect stormwater to the sewerage system?

e) What is sediment? How does fine sediment impact on water quality?

f) What is a Gross Pollutant trap? Why are they installed? What are the disadvantages?

g) Why is a small amount of nutrient good for a healthy water way?

h) What role do blue-green algae and other microscopic plant life play in a healthy water system?

i) What causes blue green algae blooms? What impact do these blooms have on water water ways?

j) What harmful effects can these blooms have on humans and animals?

k) What is the source of the nutrients that cause these blooms?

l) Why shouldn't you feed the birds?

DISCUSSION QUESTIONS

1. What is eutrophication?
2. List two physical factors that influence eutrophication?
3. What are the biological factors that influence eutrophication?
4. What are the effects of eutrophication?
5. Name and define the major classifications of eutrophication?
6. Name at least 3 sources of nitrogen to aquatic environments?
7. Name at least 3 sources of phosphorus to aquatic environments?
8. Explain how dissolved oxygen becomes an issue in a highly eutrophic environment.