<u>Eutrophic Wetland Management: some current methods</u>

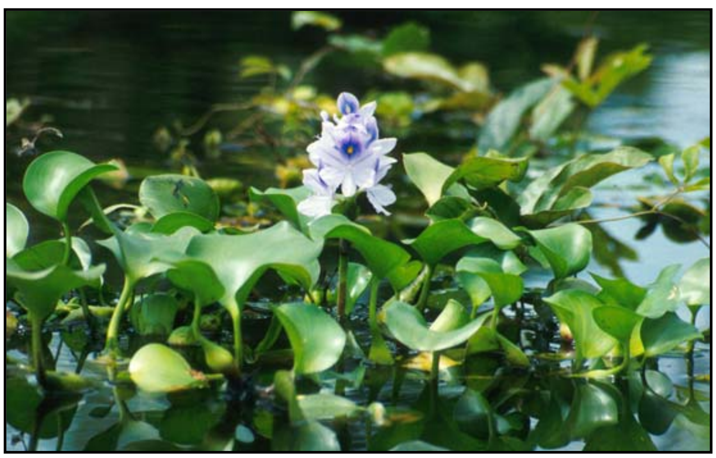
Adopt-A-Pond Programme 2008


© F. lamiot, Wikimedia Commons

Eutrophication is a process by which an ecosystem becomes rich in dissolved nutrients (particularly nitrogen and phosphorous). Eutrophication may occur naturally or via pollution. The common result is an excess of plant growth that in aquatic systems creates a lack of oxygen, reduced water quality, and lowered diversity of aquatic animal populations.

The first step in any eutrophic wetland remediation is prevention, by limiting the nutrient input. This may require control of fertilizer use in the surrounding area and/or natural buffers to filter nutrient sources. However there are also many methods for remediating wetlands that are already showing symptoms of eutrophication. This brief document attempts to present the pros and cons of just some of these methods.

Phytoremediation using Water Hyacinth:



Nutrients, particularly Nitrogen and Phosphorous, enter wetlands through runoff and leaching from agricultural and urbanized areas, from precipitation, N_2 fixation in water and sediment, and N release from decomposing aquatic plants and animals.

Any native emergent plant will take up aquatic nutrients and a diverse plant community should be encouraged in all wetlands. Native macrophytes such as waterlilies will also reduce light penetration mitigate undesirable algal blooms.

Despite worries over introductions of invasive species, non-native floating macrophytes have been also been used for decades as a temporary means to remove Nitrogen and Phosphorous from nutrient enriched waters. Water hyacinth (*Eichhornia crassipes*) is the most commonly used vascular aquatic plant in remediating aquatic effluents (Reddy and Tucker 1982; Reddy and DeBusk 1985; Boyd 1969; McDonald and Wolverton 1979). This plant is adaptable to a wide range of environmental factors including pH, electrical conductivity, and temperature and can be responsible for as much as 85% of N uptake in an aquatic system. The plant takes up and stores N in excess of what it requires for growth (luxury uptake) (Fox et al. 2008). Nutrients are removed from the water through direct plant uptake in the root system, though the hyacinths also support a diverse community of bacteria and invertebrates that contribute to nutrient uptake. In addition to nitrogen and phosphorus, water hyacinth is known to remove trace metals (Vesk et al. 1999).

Frequent harvesting of the water hyacinth from the aquatic system will remove stored N and P and trace metals from the wetland. This plant does not root in the sediment, but instead floats in mats on the surface facilitating physical removal. Plants can be harvested at a continual rate, maintaining the population in a rapidly expanding phase where the mineral uptake rates are greatest (Boyd 1969). It is optimal to harvest all plant material prior to winter to ensure stored nutrients are removed from the system. If multiple years of treatment are required a small number of plants can be maintained indoors throughout winter to avoid repurchasing plants the following spring.

E. crassipes is not native to temperate climates, but can be introduced in the spring and large populations could result in a few weeks. The plant is not capable of overwintering so there is limited danger of it escaping into natural waters and becoming invasive. Regardless, this method is only suggested for contained areas where control of plant growth is feasible. Removed plant material can be safely composted away from the wetland location to avoid further leaching into the wetland. Substantial research has also been allocated toward alternative uses of the removed plant biomass and it is known to serve well as animal fodder, material fibre and other products (Reddy and Tucker 1982).

Concerns with this method:

Mosquito production is commonly associated with areas of extensive vascular aquatic vegetation and some rise in mosquito populations may be noticed when using phytoremediation to treat a eutrophic wetland.

Water hyacinth grows in dense mats that limit light penetration into the water column. This will limit algal and other submergent plant growth and therefore decrease concentrated oxygen in the wetland that would normally be present from photosynthesis and wind action. It is recommended that an oxygenating pump be used in cooperation with water hyacinth cultivation to mitigate anaerobic conditions.

Algae Control with Barley:

Overproduction of algae is a common result of eutrophication. Algae blooms can disrupt the normal functioning of a wetland and lead to reduced oxygen levels that limit aquatic animal populations. Several herbicide products exist to kill algae, but are not recommended as many of these products are non-selective and will also kill higher plants. As well, they may be banned in many municipalities.

The use of Barley straw for algae control is a method that has become popular in the last decade. When the straw decomposes in water it releases a number of chemicals which may prevent the growth of algae (Newman 2004, Pillinger et. al 1994), but has no known harmful affects on fish, invertebrates, or higher plants. However, the success of Barley straw in controlling algae growth has been observed with mixed results depending on the researcher (Lembi 2002). If attempting to use straw as a method of controlling algae growth, many considerations should be taken into account.

- The positive effects of straw are as an algastat rather than an algicide, which means that decomposing straw may limit the growth of new algae, but will not kill existing algal growth. Straw should be placed in the wetland in early spring before algae has a chance to bloom.
- Decomposition must occur in the presence of oxygen. Therefore straw bales must be broken up as much as possible to expose a maximum amount of the straw's surface to the water. Place the divided straw into mesh bags and weight the bags into the water in shallow areas where algae growth is most prevalent. A pump or aerator will increase water flow through the bags and aid oxygenation.
- An aerator should be used, particularly in small ponds, because decomposing plant material of any kind, including barley straw, uses oxygen and can create hypoxic conditions.
- Barley straw decomposition will be active for anywhere between 4 and 6 months and will need to be replaced after this period. Position the straw in an easily accesible location or tie a rope to your bags for retrieval.
- The suggested amount to be used for still waters is 25 to 50 grams straw per square metre of water surface (gm^{-2}).
- Barley has been noted to work more effectively and for longer periods than other straws. Hay and green plant materials should not be used as they will leach nutrients as they decompose and fuel algal growth.
- Barley straw may control planktonic forms of algae and lead to water clarification. Clearer water will allow submergent plants to grow, potentially to invasive levels.

Physical Harvesting of Existing Plant Material:

When a wetland cools and freezes over during winter the abundant organic matter associated with eutrophication sinks to the bottom where it decomposes and consumes available oxygen. This consumption of oxygen leads to hypoxic or anoxic conditions, which can kill aquatic organisms. One method of controlling this problem is by physically harvesting plant material from the wetland thereby removing nutrients from the system and the potential draw on oxygen.

Many methods are available for removing invasive aquatic plant growth depending on the scale of your wetland and the species of dominant plant. Techniques range from hand-pulling to large expensive harvesting equipment.

The time of year when plants should be harvested may also depend on the life cycle of the dominant plant species. However, one should remove as much of the dominant plant material as possible by the end of summer to autumn before the material has a chance to settle to the bottom of the wetland and decompose.

Aeration using Alternative Energy Pumps:

Hypoxic and Anoxic conditions in wetlands can be mitigated by increasing water movement and flow rates. A wide range of aerators and pumps are available for various scales. However the isolated nature of many wetlands makes using electric plug-in pumps impractical. For wetlands distant from electrical sources or for wetland stewards interested in self-sustaining alternative energy pumps there are now many products on the market that run off of wind or solar.

The average price of these products varies a great deal depending on the size of your wetland and the product you chose so it is recommended that you research available products fully before making a decision.

Some current companies that market alternative energy pond pumps are.
http://www.oase.ca
http://www.smartsolar.com
http://www.koenderswindmills.com/