Nitrate Pollution and Amphibians: A Hidden Cost of Fertilizer Use

I don’t think it comes as a surprise to anybody to hear that amphibian populations, such as frogs and salamanders, are declining worldwide. Several of the identified threats to amphibian survival include habitat destruction, introduced species, commercial exploitation, pathogens, changes to the global environment, and chemical contamination.

When I say chemical contamination, one might automatically think of pesticides as the culprit. While it is true that pesticides may be one factor contributing to the decline of amphibian populations, a more serious threat is nitrate pollution.

Nitrate is an example of a pollutant that now occurs in many watercourses around the world at concentrations that can kill amphibians. While nitrate is a natural compound present in all ecosystems and is essential to plant life, too much can be a problem.

So where does nitrate come from? Nitrate is a component of chemical and manure-based fertilizers and can enter watercourses from sources such as areas of high fertilizer use, agricultural areas, and sewage treatment areas.

Nitrate is applied to fields and lawns as a nutrient for plants, but during rainstorms it can be washed directly into nearby lakes and rivers through surface runoff.

Amphibians are at the highest risk of exposure and are most sensitive to nitrate when they are in the egg and tadpole stage of their lifecycle. For most species, these life stages occur in water during the months when fertilizers and other chemicals reach their peak application levels.

Nitrate pollution is generally highest in the late fall, winter and spring because dormant plants are unable to take up the nitrogen in fertilizers, leaving it to leach into the ground and water table. The highly water-soluble nutrient will also move readily with surface runoff into rivers and lakes.

Amphibians as indicators

So why should we be concerned with declining amphibian populations? For starters, amphibians can serve as indicators of the overall condition of the environment. They have permeable skin and eggs that come into direct contact with soil, water and sunlight, allowing them to readily absorb toxic substances from the environment.

Amphibians have a complex life history that usually includes an aquatic larval stage and an ability of the adult to live on land. This allows them to be exposed to a wide array of environmental contaminants. Amphibians are also found in a wide variety of ecosystems.

Amphibians are key predators within their ecosystems, and they are also prey for a number of other animals, including snakes, birds, fish and invertebrates.
What happens to amphibians may be an indication of what other organisms may encounter over time. In Ontario, six amphibians are on the Species At Risk List and that number will likely increase in the future. Currently, none of the amphibians in Muskoka are on the list.

**Nitrate guidelines**

Levels of nitrate in water that aren’t harmful to humans appear to be harmful to some species of amphibians. The Drinking Water Quality Guideline for nitrate is 10 mg/L. An interim Canadian Water Quality Guideline for the Protection of Aquatic Life has been established at 13 mg/L, while chronic effects on amphibians can occur at concentrations as low as 2 to 5 mg/L for some species.

Almost twenty percent of samples collected from the states and provinces bordering the Great Lakes were found to contain nitrate concentrations exceeding 2 mg/L, which can cause development effects in amphibians. Over three percent of samples contained concentrations of nitrate above 10 mg/L, which can be lethal to amphibian tadpoles.

**Effects of nitrate pollution**

Some of the effects of nitrate pollution that have been observed in tadpoles include reduced feeding and mobility resulting in severe weight loss and high mortality, developmental deformities including bent tails, body swelling and bulging, head deformities, and digestive system deformities. The severity of effects increased as the concentration of nitrate increased.

Nitrate fertilizers can seriously harm or kill adult amphibians as they migrate over recently fertilized areas. Amphibian prey and predators are also sensitive to elevated levels of nitrate.

**What can you do?**

The first step to reduce the amount of nitrate entering your waterway is to reduce the amount of fertilizer being applied to fields and lawns. If fertilizer must be applied, ensure that it is applied at the correct time, when the plants will use it.

Where agriculture is present, such as in Bracebridge and the Three-Mile Lake area, fence watercourses to prevent livestock from entering the water and flattening the vegetation around the edges of the watercourse. This not only reduces nitrate concentrations by eliminating the direct deposition of manure, but also by allowing the surrounding area to become re-vegetated.

Creating and maintaining buffer zones around lakes and rivers will reduce the amount of nitrate entering surface water through runoff as it is retained in the soil and plants. Buffers can also improve shelter and spawning or nesting habitat for amphibians and birds.

Because amphibians are so varied, it is unlikely that a single factor is the cause of their declining numbers. However, it has been proven that nitrate pollution is a factor in this decrease, and may also work to make amphibians more susceptible to other factors, such as habitat destruction, pathogens and global environment changes.

Frogwatch is a volunteer-based monitoring program administered by the Canadian Nature Federation. If you are interested in monitoring the amphibian populations around your cottage, get more information about the Frogwatch program at [http://www.cnf.ca/frog/](http://www.cnf.ca/frog/)