WATER CONTAMINANT PROFILE

Nitrite (NO_2^-)

HIGH IMPORTANCE

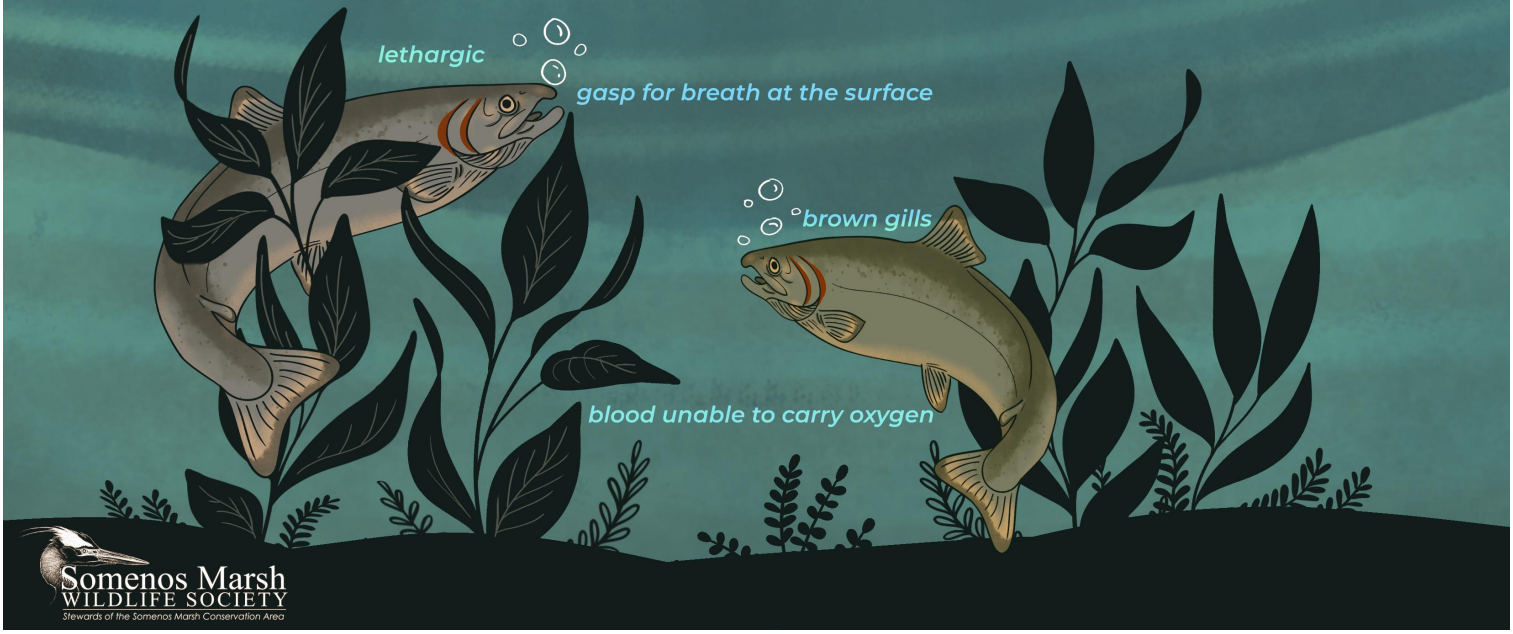
The nitrite ion is widely used throughout the pharmaceutical industry (usually in the form sodium nitrate). The nitrate anion is a pervasive intermediate in the nitrogen cycle and occurs naturally in nature. Fish excrete ammonia through their gills as their nitrogenous waste product. Good bacteria convert the toxic ammonia into nitrite. Nitrite, like ammonia, is extremely toxic to freshwater fish, but in a healthy system, other bacteria will convert nitrite into nitrate, which is harmless. Ammonia poisoning is often followed by nitrite poisoning since nitrite levels are dependant on ammonia levels.

Nitrite Effects on Salmon

Symptoms of nitrite poisoning include the fish hanging out near water outlets, gasping for breath at the water's surface, and becoming lethargic. Their gills move rapidly and change colour from a healthy pink to a brown. Their blood also turns brown from increased methemoglobin, which is why nitrite poisoning is also called "Brown Blood Disease." It renders the blood unable to carry oxygen, which means that fish can suffocate even is the oxygen levels in the water are sufficient. Fish that are exposed to low levels of nitrate for long periods of time suffer damage to their immune system. It makes them more susceptible to secondary diseases such as ich, fin rot, and/or bacterial infections. Increased levels of methemoglobin also damage the fish's liver, gills, and blood cells. Eventually the fish will die from lack of oxygen and/or secondary diseases.

Nitrite in Somenos

Somenos Creek likely has elevated levels of nitrite since it also likely has elevated levels of ammonia due to natural decomposition of organic matter and from surface run-off.



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Stewards of the Somenos Marsh Conservation Area

WATER CONTAMINANT PROFILE

Zinc (Zn)

MODERATE IMPORTANCE

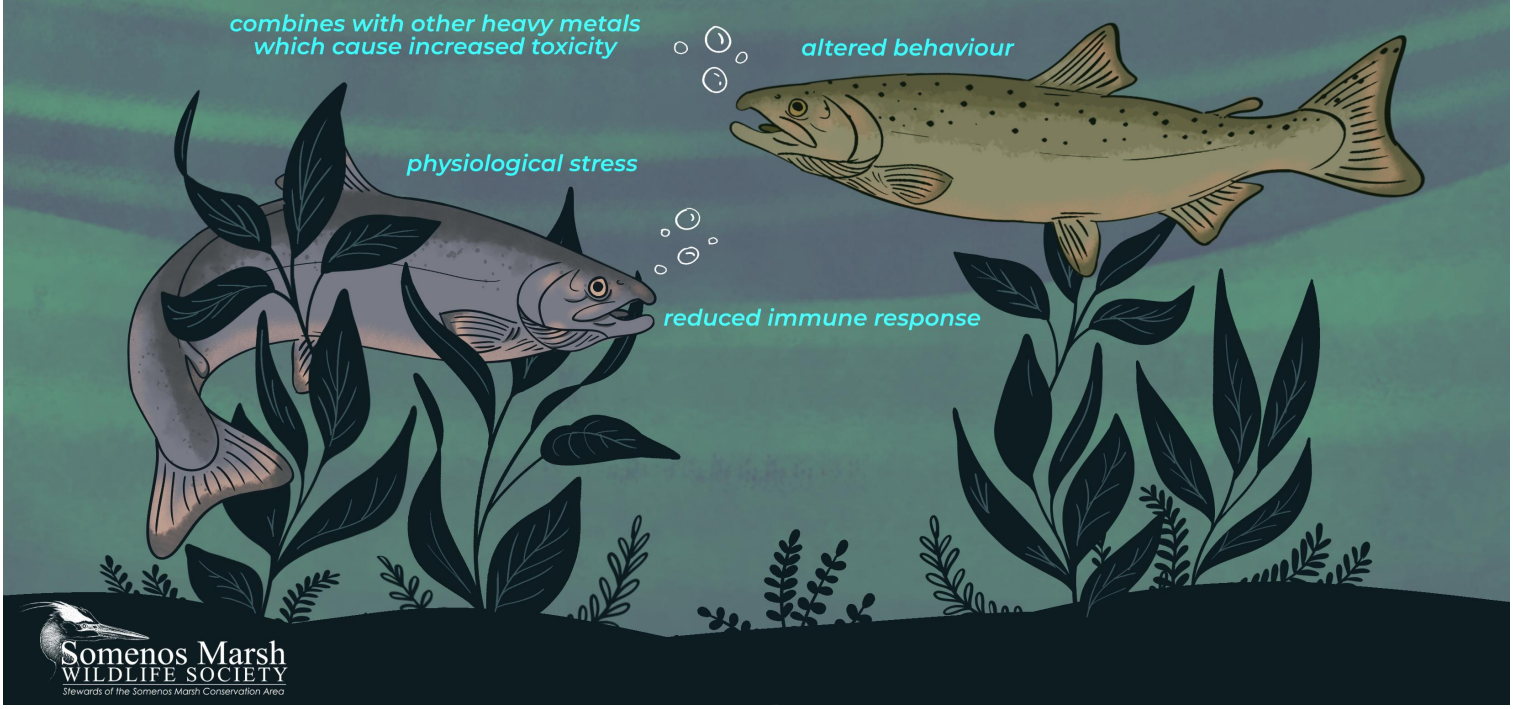
Zinc is silvery-white mineral commonly found in the environment. Zinc is an essential trace element used for growth, wound healing, immune functions, and other standard maintenance. At low levels, zinc is not only good for your health, but also used extensively for galvanizing other metals, die-castings, and the creation of alloys. Zinc oxide is used in the creation of numerous household items ranging from batteries, to cosmetics, to paints.

Effect of Zinc in Fish

Sub-lethal levels of zinc cause physiological stress, alter behaviour, and reduce immune responses. Zinc is known to react with various other heavy metals which cause increased toxicity, either of itself or the other metal. Zinc in combination with copper or lead, for example, lowers the concentration of zinc in which it takes to cause behavioral alterations in the form of avoidance reactions. The addition of zinc to cadmium in water decreases cadmium's lethal dosage by nearly half.

Zinc in Somenos

Zinc can erode out of rocks and soils into a water supply, but usually at very low concentrations. Other contributors of zinc can include the burning of wastes, leaching of fertilizers, and erosion of older galvanized pipes and well cribbing that were coated in zinc.



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WATER CONTAMINANT PROFILE

Ammonia (NH_3)

HIGH IMPORTANCE

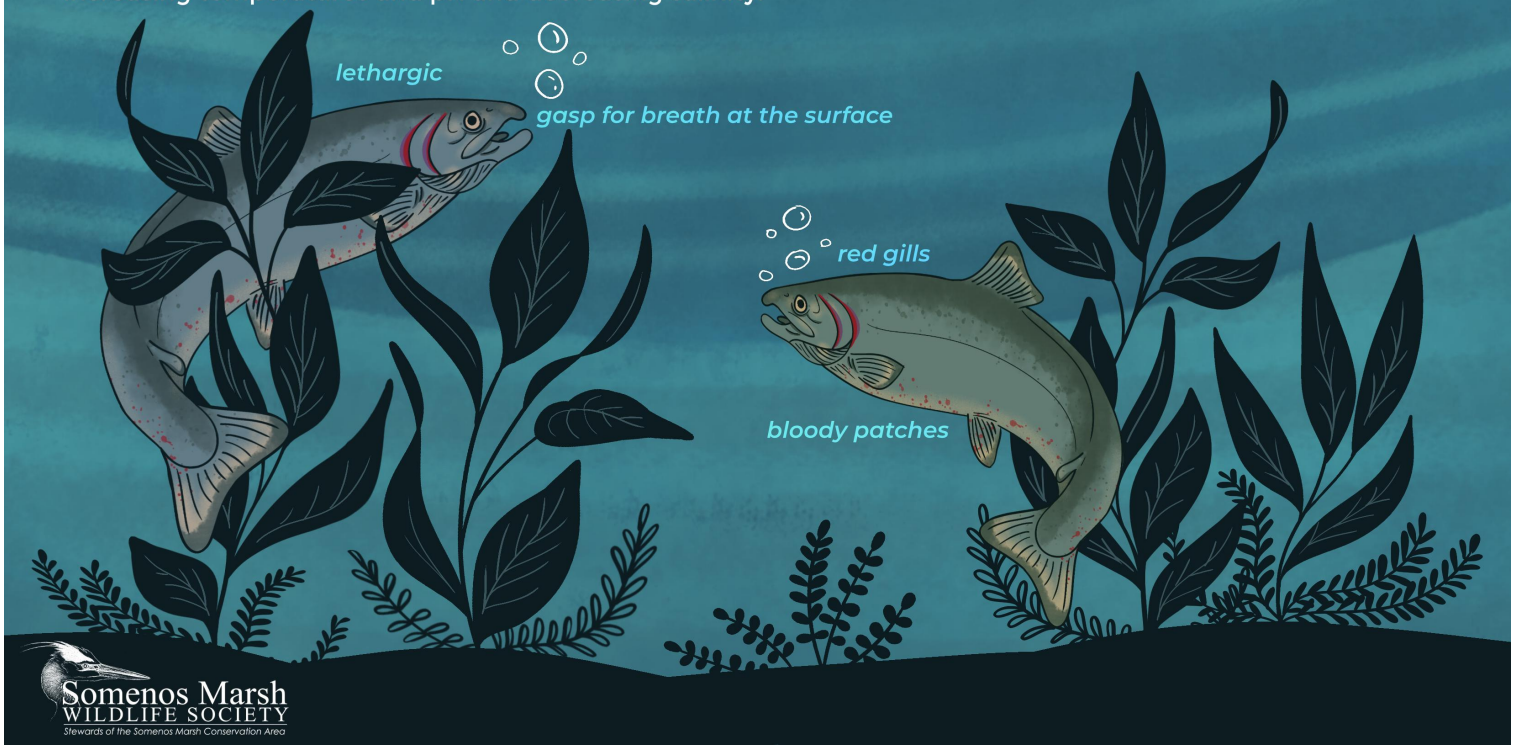
Ammonia is a colourless gas with a distinctive pungent smell that occurs naturally in water bodies, originating from the microbiological decomposition of nitrogenous compounds in organic matter. Ammonia can also make its way into freshwater through industrial processes, domestic sewage, or animal slurry. Unionized ammonia is toxic to freshwater fish, even at very low concentrations. Aquarium and pond owners have dubbed ammonia the "invisible fish killer" because it is invisible and is hard to detect before it's already too late.

Ammonia Effects on Salmon

Symptoms of ammonia poisoning include the gills taking on a red or lilac colour, making them look as if they're bleeding. Fish lose their appetite, their body functions fail, and they become increasingly lethargic. The fish's tissues will also start to deteriorate and red streaks or bloody patches on their body/fins will appear. Eventually ammonia poisoning causes internal damage, effecting the brain, organs, and the central nervous system. The fish will begin to hemorrhage, both internally and externally, and eventually die.

Ammonia in Somenos

Somenos Creek likely has elevated levels of ammonia because of both the natural decomposition of organic matter and from contaminated surface run-off. Concentrations of unionized ammonia increase with increasing temperatures and pH and decreasing salinity.



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WATER CONTAMINANT PROFILE

Potassium (K)

LOW IMPORTANCE

Most people know potassium due to its dietary role in the human body. Recommended daily intake of potassium is sometimes hard to achieve, but is crucial in the human body, assisting with fluid balance, muscle contractions, and nerve signals. Potassium is a soft, light-weight metal that is known for burning hot enough to produce a lilac flame. Up to 95% of all harvested potassium goes towards the production of fertilizers. The rest is used to make potassium chloride which is used in soaps, and potassium carbonate which is used to make glass.

Effect of Potassium on Fish

Potassium reacts rapidly when introduced to water to form hydrogen gas and potassium hydroxide (aqueous). Potassium has not been shown to be directly lethal to fish at high concentrations of up to 800mg/L. It does, however, cause immobilization of sperm which effects recruitment of young.

Potassium in Somenos

Potassium has been found at high levels in some tributaries of Somenos Lake. This is likely due to usage of agricultural and forestry fertilizers containing potassium in the watershed.

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WATER CONTAMINANT PROFILE

Sulphate (SO_4^{2-})

LOW/MODERATE IMPORTANCE

Sulphate is a combination of sulphur and oxygen that is commonly found in most water supplies. It combines readily with various heavy metals such as magnesium, potassium, and sodium. Sulphate compounds are used in algaecides, supplements, shampoo, fertilizers, and occur in aerosols that increase the acidity of the atmosphere, causing acid rain.
Sulphates occur in some foods such as palm and coconut oil and sulphate allergies are moderately common. Foods containing sulphates are often tested on animals to determine skin, lung, and eye irritablility.

Effects of Sulphate on Fish
Sulphates are not generally toxic in themselves, even at high levels, but are known to pair with various heavy metals which then cause increased toxicity. Zinc sulphates, for example, cause a strong avoidance reaction. As an essential supplement for plant life, at high levels they can cause over production in water which can then contribute to anoxic conditions and fish death.

Sulphate in Somenos
Sulphates can transfer into water supplies in many different ways, including leaching from soils, runoff from fertilizers, combustion of fossil fuels, and input from decaying plant and animal matter. They are not toxic to humans when ingested at normal levels, but can cause some minor health problems when ingested at high levels of >500mg/L.

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WATER CONTAMINANT PROFILE

Titanium (Ti)

MODERATE IMPORTANCE

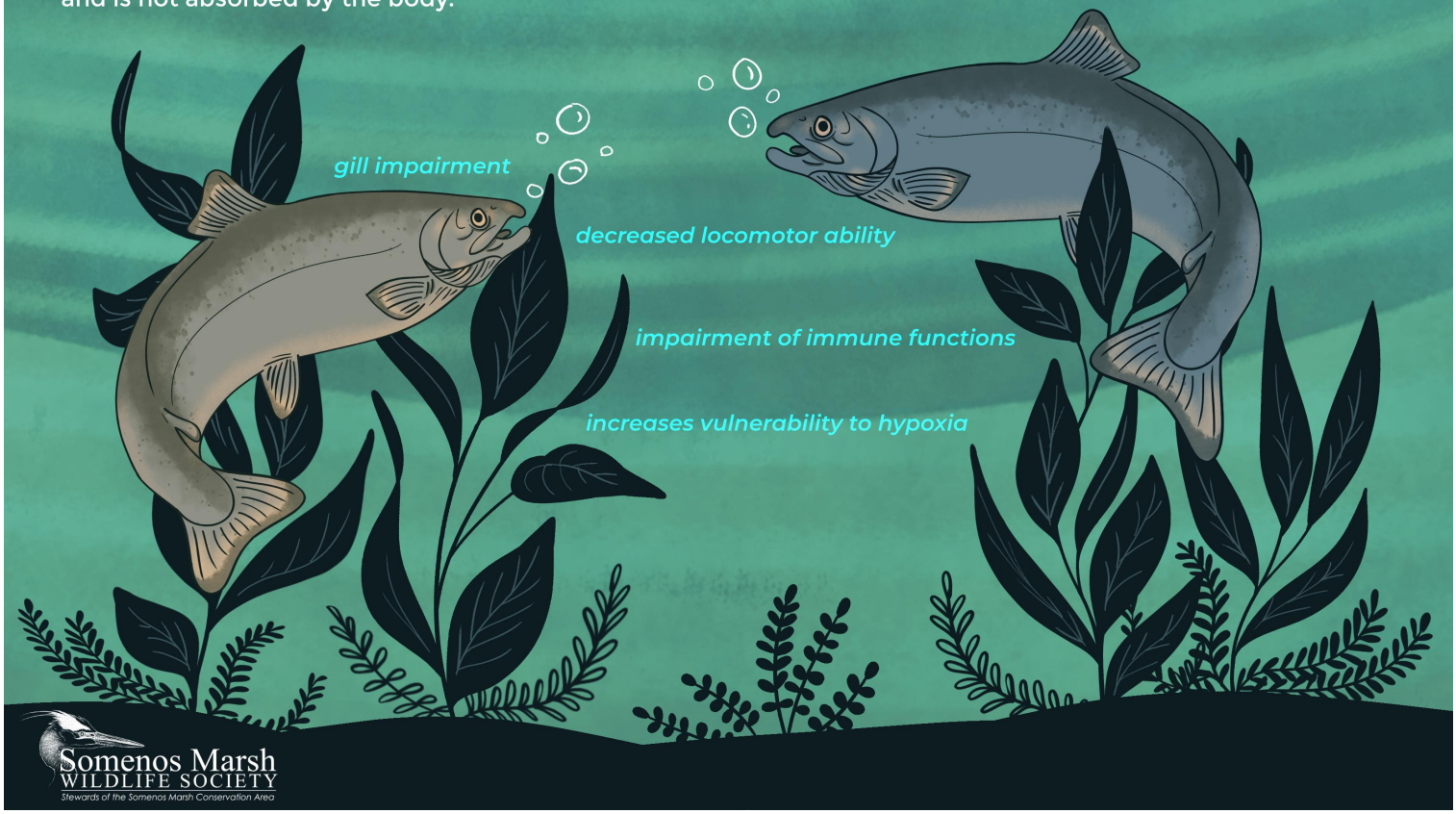
Titanium is an insoluble, light weight metal which is often considered environmentally friendly as it does not rust and is easily recycled. Due to its strength, anti-rust quality and lightness of weight, titanium is often used in medical sector and the aerospace industry, among other uses.

Effect of Titanium on Fish

Dietary exposure to titanium has been shown to cause accumulation of this element in several organs, including the brain. The accumulations do not clear after exposure and can cause long-term health effects. Effects include decreased locomotor abilities, gill impairment, impairment of immune functions and increases vulnerability to hypoxia.

Titanium in Somenos

Titanium has been found at high levels in some tributaries of Somenos Lake. The main source of titanium in water is natural erosion from rocks in the riverbed. Fortunately, titanium has no known side effects in humans and is not absorbed by the body.



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WATER CONTAMINANT PROFILE

Turbidity

HIGH IMPORTANCE

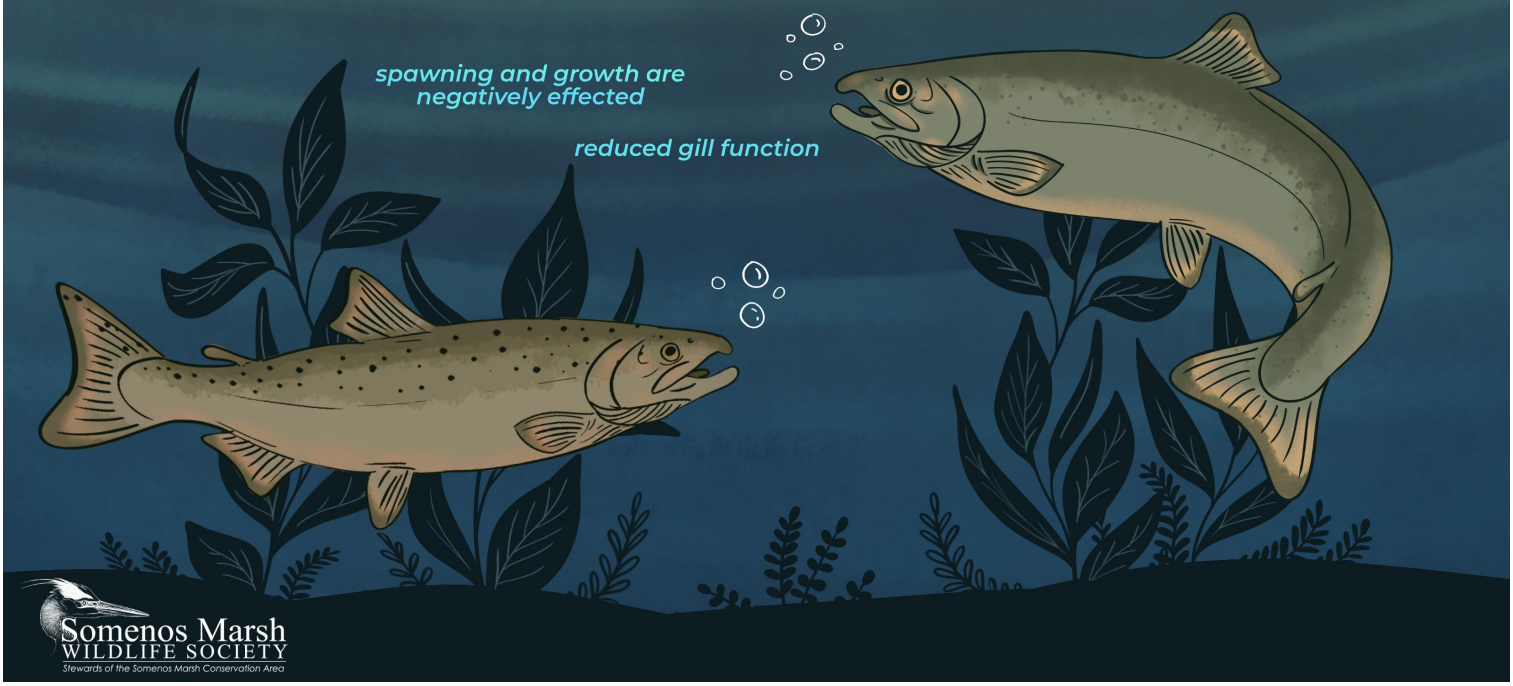
Turbidity refers to the clarity of water. It is affected by particulates and sediments suspended in the water column and is measured by the amount of light that penetrates a sample of water. Turbidity generally increases during high flows in which sediments are stirred up and during rain events in which there is input of sediments from the surrounding watershed.

Turbidity Effects on Fish

Turbidity effects fish in numerous ways depending on their life stage. Spawning and growth are negatively affected by turbid water; spawning, by degrading the quality of spawning beds and growth, by reducing the availability of food. Gill function is also reduced by turbid waters. These stressors can heavily effect survival at all life stages and alter fish physiology, behaviour, and habitat.

Turbidity in Somenos

Extensive urban, rural, and commercial development has affected bank stability on streams throughout the Somenos Watershed. Tall trees and specific vegetation offer strong, complex root systems which aid in bank stability. Without this type of vegetation, riverbanks erode during high flows. Bank erosion can cause large amounts of sediments to be released into the water column increasing turbidity. Bank erosion can also cause complex habitat issues unrelated to turbidity such as channel widening and channel diversion.



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WATER CONTAMINANT PROFILE

Vanadium (V)

LOW/MODERATE IMPORTANCE

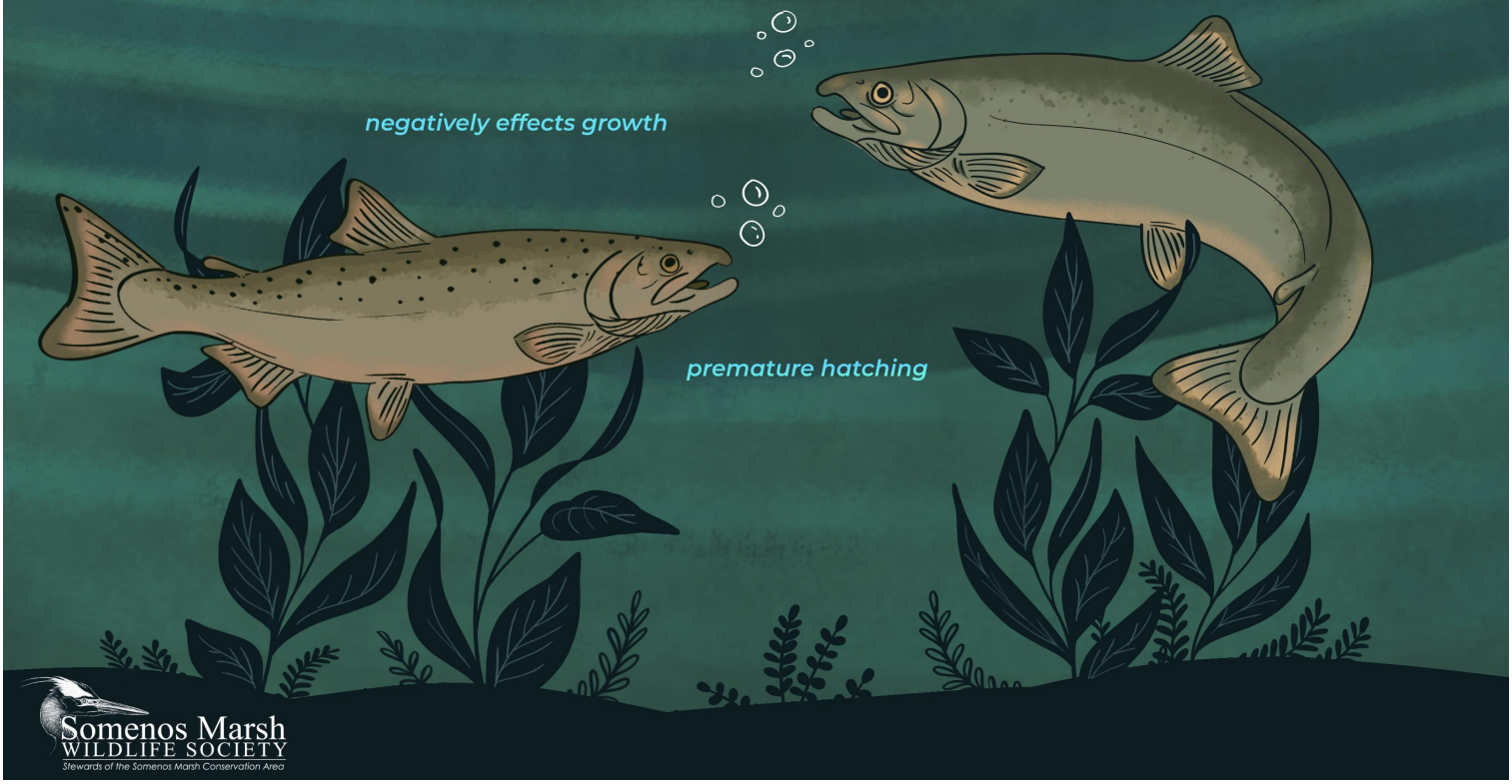
Vanadium is essential for normal bone growth and can be found in numerous sources such as grains, mushrooms, shellfish, and excitingly, beer and wine! Vanadium has various uses and is often used to make alloys which are then used in the construction of extremely tough tools such as axes, car gears, and armour. Vanadium alloys are desired for their anti-shock, anti-corrosion, and anti-neutron absorbing properties. These properties make it a prime source material in nuclear reactors.

Effect of Vanadium on Fish

Though not as highly toxic as copper or aluminium, vanadium can still cause mortality in fish when suspended in water. It has also been seen to cause premature hatching, negatively effect growth, but, fortunately, does not accumulate in the body which avoids any long-term health effects after exposure.

Vanadium in Somenos

Vanadium has been found consistently at medium to high concentrations throughout the Somenos watershed, as well as on the Cowichan River. Vanadium can enter surface water by being eroded from rocks and from industrial runoff.



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WATER CONTAMINANT PROFILE

Phosphate (PO_4^{3-})

MODERATE IMPORTANCE

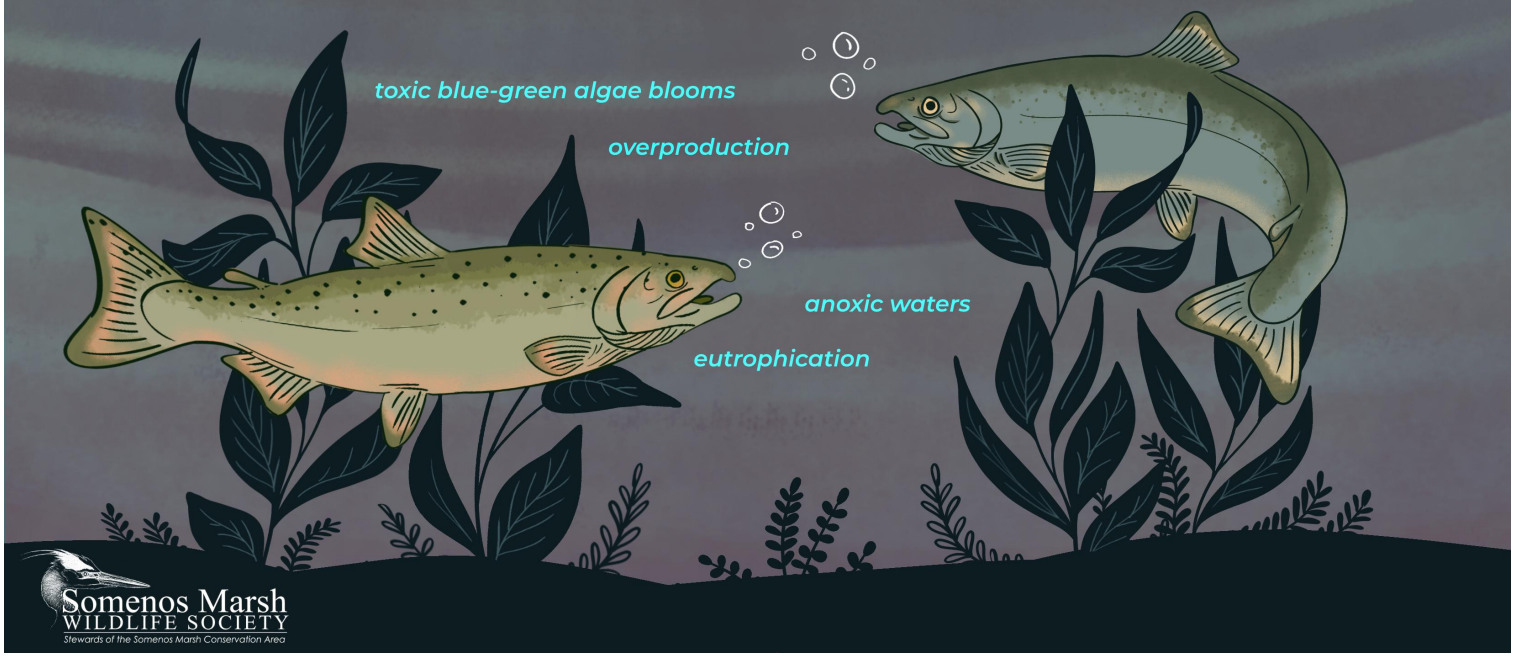
Phosphorus is a common constituent of agricultural fertilizers, manure, and organic waste in industrial run-off. It is an essential element for plant life, but when there is too much of it in a system, it can speed up eutrophication. Eutrophication is a reduction in dissolved oxygen in water bodies caused by an increase of organic nutrients. Phosphate stimulates the growth of plankton and aquatic plants, which provides food for larger organisms. Initially, increased productivity increases the fish population and biodiversity of a system, but overproduction of water can lead to an imbalance of nutrients.

Effects on Fish

Overproduction in a system can lead to several issues like anoxic waters (lack of dissolved oxygen in water), a decrease in diversity, food supply, habitat destruction, and toxic (blue-green) algae blooms. Phosphate itself isn't directly harmful to fish, but the conditions created as a side effect of elevated Phosphate levels are.

Phosphate in Somenos

Blue-green algae (cyanobacteria) can produce toxins which are extremely harmful to people, farm animals, and pets. It can cause anything from skin irritation to liver damage to death. Unfortunately, there have been incidents where pets have died after swimming in Quamchan Lake during a blue-green algae bloom. There have also been fish kills on both Somenos Lake and Quamichan Lake.



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WATER CONTAMINANT PROFILE

Nitrite (NO_2^-)

HIGH IMPORTANCE

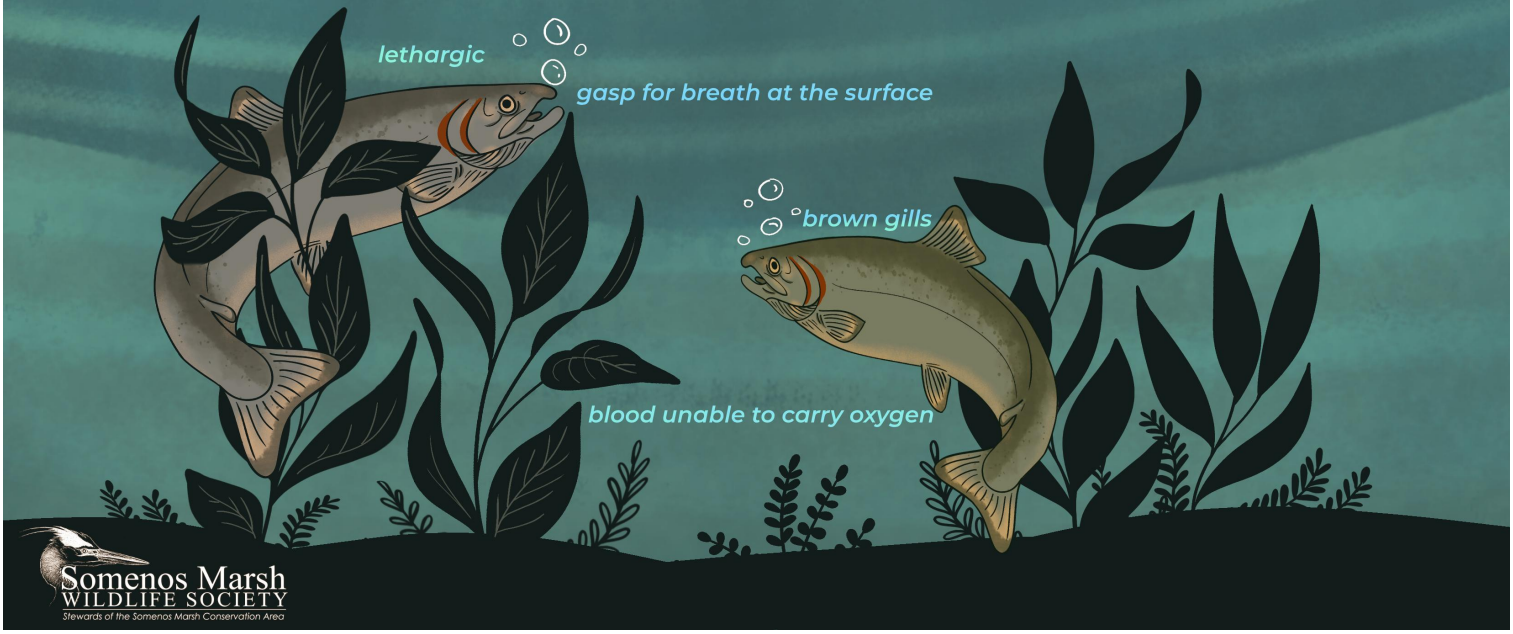
The nitrite ion is widely used throughout the pharmaceutical industry (usually in the form sodium nitrate). The nitrate anion is a pervasive intermediate in the nitrogen cycle and occurs naturally in nature. Fish excrete ammonia through their gills as their nitrogenous waste product. Good bacteria convert the toxic ammonia into nitrite. Nitrite, like ammonia, is extremely toxic to freshwater fish, but in a healthy system, other bacteria will convert nitrite into nitrate, which is harmless. Ammonia poisoning is often followed by nitrite poisoning since nitrite levels are dependant on ammonia levels.

Nitrite Effects on Salmon

Symptoms of nitrite poisoning include the fish hanging out near water outlets, gasping for breath at the water's surface, and becoming lethargic. Their gills move rapidly and change colour from a healthy pink to a brown. Their blood also turns brown from increased methemoglobin, which is why nitrite poisoning is also called "Brown Blood Disease." It renders the blood unable to carry oxygen, which means that fish can suffocate even is the oxygen levels in the water are sufficient. Fish that are exposed to low levels of nitrate for long periods of time suffer damage to their immune system. It makes them more susceptible to secondary diseases such as ich, fin rot, and/or bacterial infections. Increased levels of methemoglobin also damage the fish's liver, gills, and blood cells. Eventually the fish will die from lack of oxygen and/or secondary diseases.

Nitrite in Somenos

Somenos Creek likely has elevated levels of nitrite since it also likely has elevated levels of ammonia due to natural decomposition of organic matter and from surface run-off.



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WATER CONTAMINANT PROFILE

Nitrate (NO_3^-)

LOW/MODERATE IMPORTANCE

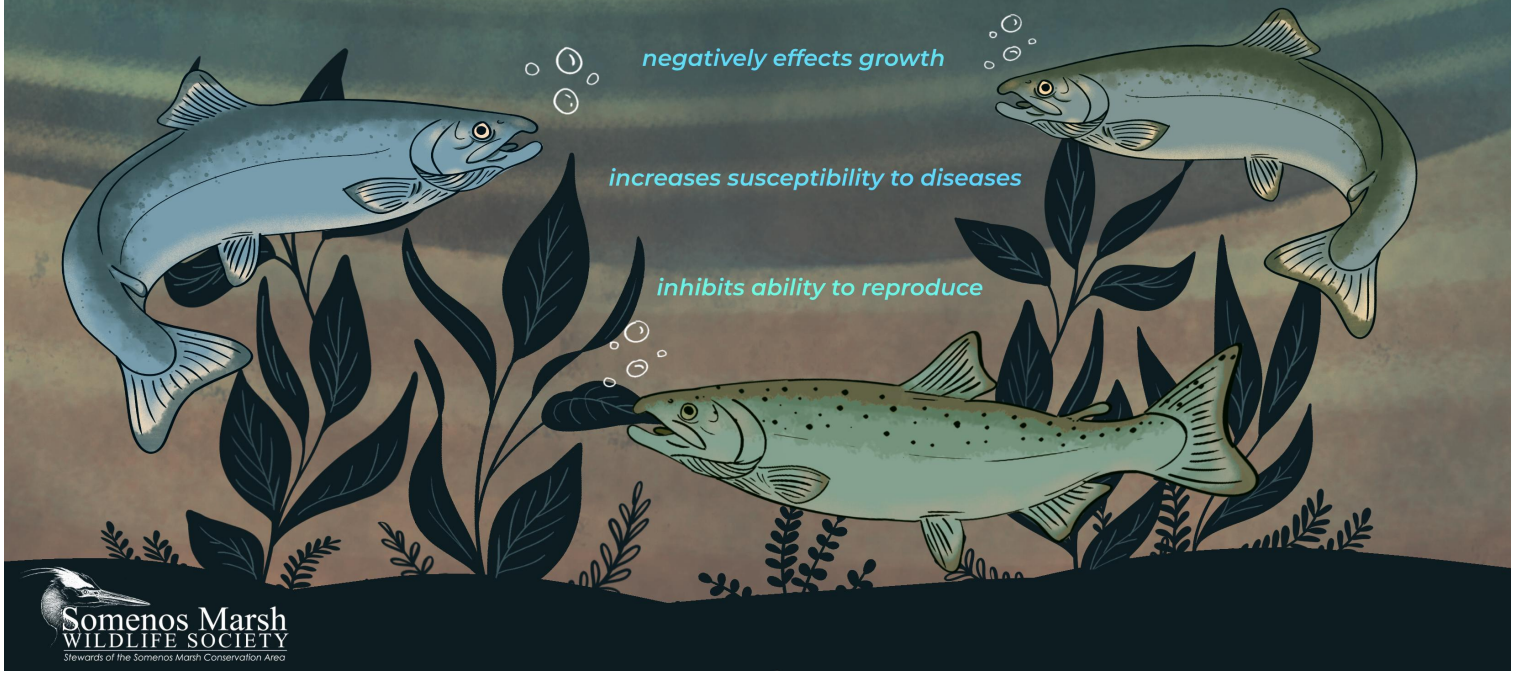
Nitrate is a polyatomic ion. Salts containing this ion are called nitrates and almost all nitrates are soluble in water. Nitrates are primarily produced for use as fertilizers because of their high solubility and biodegradability. They are also produced as oxidizing agents, most notably in explosives. Nitrate is relatively harmless in comparison to both ammonia and nitrite, but they are still closely linked as they are all part of the nitrogen cycle in nature. Nitrate usually makes its way into water bodies in surface run-off from agricultural or landscaped areas where excess nitrate fertilizer has been used. The result of excess nitrate levels is eutrophication (reduction in dissolved oxygen in water bodies caused by an increase of organic nutrients) and algae blooms, which can lead to anoxic waters and dead zones.

Nitrate Effects on Fish

Nitrate is less lethal than both ammonia and nitrite, but over time, elevated levels of nitrate can begin to effect fish and the aquatic environment negatively. Fish will experience the effects of elevated nitrate by the time levels reach 100ppm, especially if exposed for long periods of time. Elevated nitrate levels leave fish more susceptible to diseases, inhibits their ability to reproduce, and negatively effects the growth of fry and young fish.

Nitrate in Somenos

Somenos Lake and Creek potentially have elevated levels of nitrate because of their proximity to urban and agricultural areas.



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WATER CONTAMINANT PROFILE

Manganese (Mn)

LOW IMPORTANCE

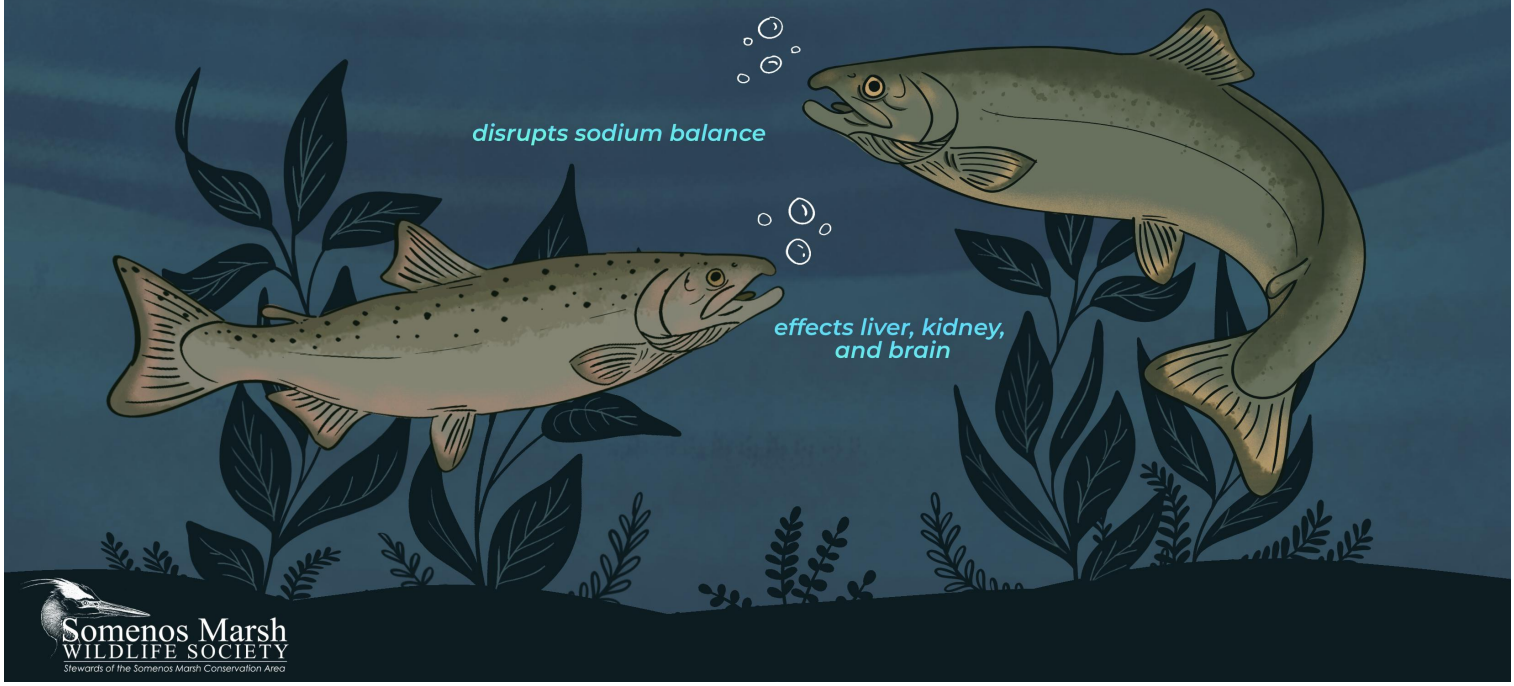
Manganese is an abundant earth metal, naturally occurring in the Earth's crust. It is silver in colour and can commonly be found dissolved in water at low levels. Manganese can be washed into freshwater by normal weathering processes and can also be introduced by human activities. Manganese is a primary additive in steel production and can also be found in alkaline batteries. Non-metallic sources include paint, oil, and fertilizer. At low levels, manganese is an essential nutrient to biological processes of aquatic species. However, when in excess can become extremely toxic.

Manganese Effects on Salmon

Uptake of manganese begins at the gills, then passes throughout the body to affect the liver, kidney, and brain. The median lethal dose of manganese on Coho salmon is between 2.4 – 17.4 mg/L. High levels of the metal can cause a disruption of sodium balance in salmonids.

Manganese in Somenos

Both Somenos Creek and Somenos Lake are likely to have manganese present in the water at any given time. The lake may have higher amounts as it is a sink for all upstream activity with the metal running off into the system. Event of erosion and high runoff will cause short increases of manganese in the creek. Both Bings Creek and Menzies Creek were found to have manganese levels "exceeding by far the Provincial guidelines for fish habitat" according to a survey done in summer 2018.



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WATER CONTAMINANT PROFILE

Lead (Pb)

LOW/MODERATE IMPORTANCE

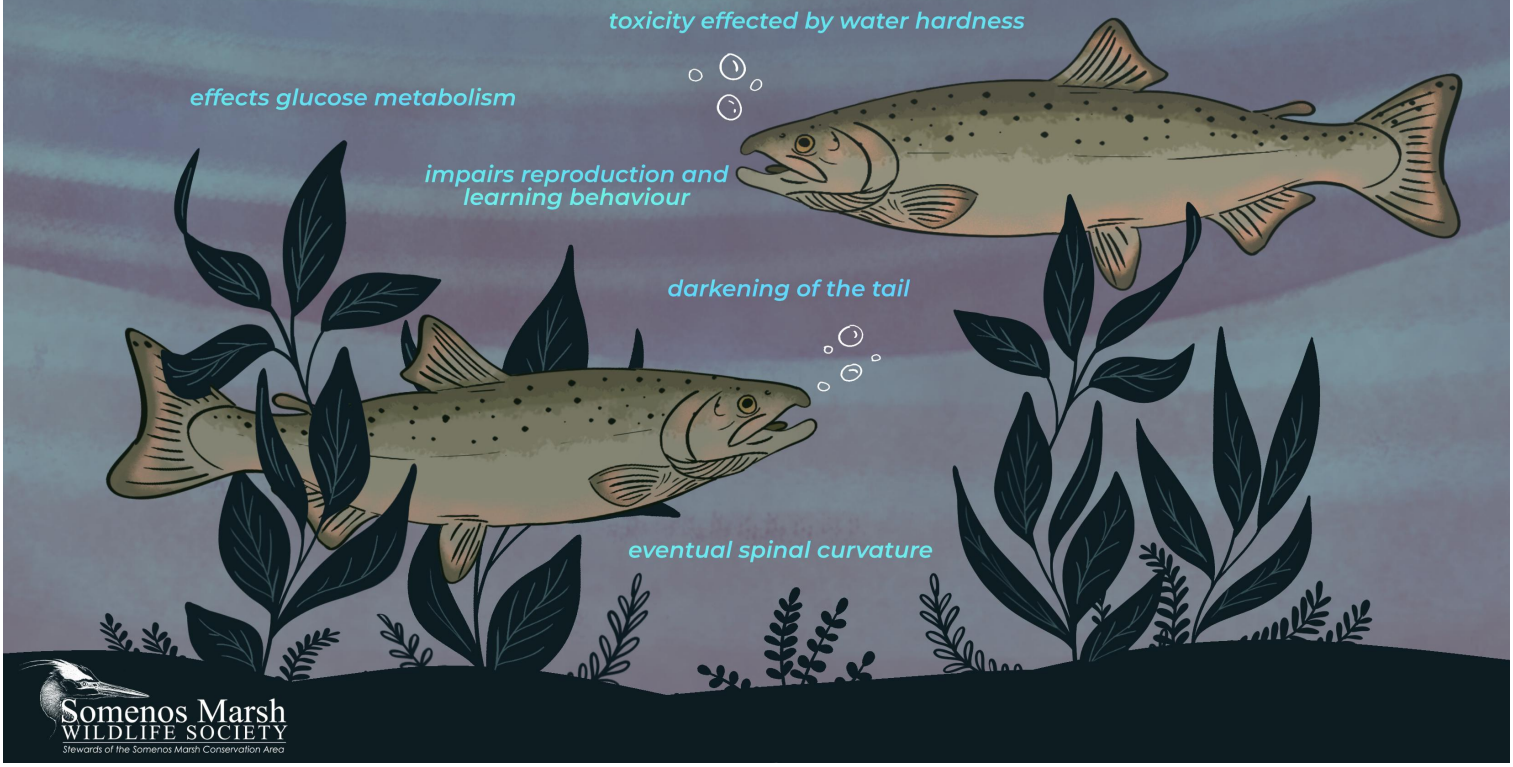
Lead is a heavy metal that is denser than most common materials. It is soft, malleable, and has a relatively low melting point. Lead is also incredibly toxic. In humans, it is highly poisonous whether inhaled or swallowed and effects almost every organ and system in the body. Lead is present in very low concentrations in nature, but it rarely occurs naturally in water. The main source for lead in water is from the corrosion of items that contain lead such as lead pipes, lead-based paint, batteries, solder, and gasoline. It can also bioaccumulate in aquatic organisms but is generally not available in sufficient concentrations to cause significant problems.

Effects of Lead on Fish

The toxicity of lead is hardness-dependant. The toxicity of lead to freshwater animals is greater in soft water rather than hard water. Extended exposure to lead can impair reproduction and learning behaviour, lead to darkening of the tail, eventual spinal curvature, and effects glucose metabolism.

Lead in Somenos

Somenos Lake and Creek could potentially have elevated levels of lead due to corrosion and their close proximity to urban and industrial areas.



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WATER CONTAMINANT PROFILE

Chromium (Cr)

MODERATE IMPORTANCE

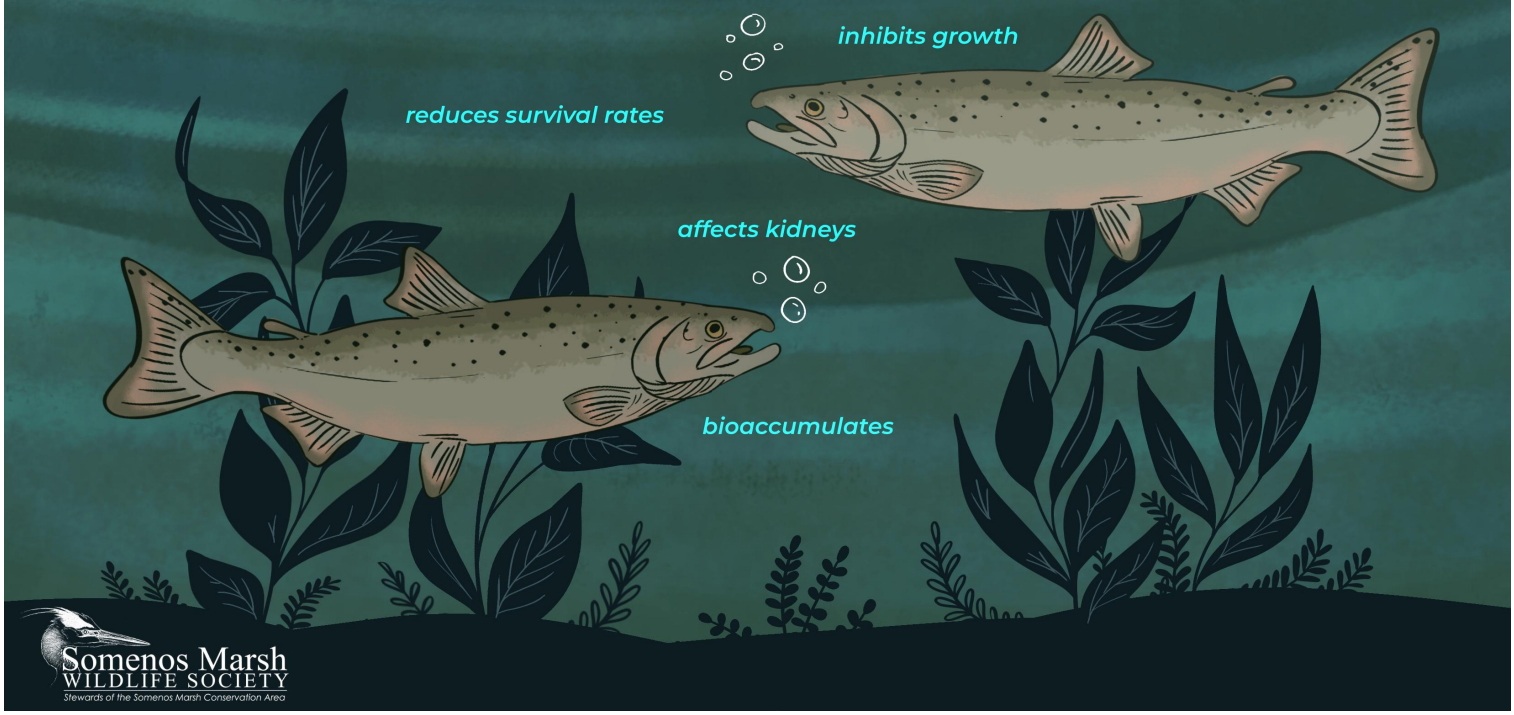
Chromium is a hard metal frequently used for its lustrous, non-tarnishing and lustrous properties. It is commonly found in steel alloys, decorative chrome plating and as a corrosion resistant coating. Chromium is typically mined from the ground as Chromite from Africa, Europe, and Asia. There are two common variations of chromium found in the world with vastly different effects. In trace amounts, trivalent chromium can be an essential mineral in human biological processes and is also found in RNA. In contrast, hexavalent chromium can be 1000 times more toxic and is a known carcinogen.

Effects on Salmonids

In high amounts, Chromium has been shown to inhibit growth and reduce survival rates in juvenile salmonids. The kidney of these fish was affected the most by chromium poisoning, where the element accumulates and causes small lesions. Chromium is known to bioaccumulate in tissues of salmonids over time, allowing larger predators and humans to ingest higher than normal quantities.

Chromium in Somenos

Chromium is not common in naturally sourced ground and surface water. A primary source of chromium pollution in a water source is the introduction of untreated wastewater from industrial operations. Water sampling on Bings Creek has tested positive for chromium in the past.



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WATER CONTAMINANT PROFILE

Cobalt (Co)

MODERATE IMPORTANCE

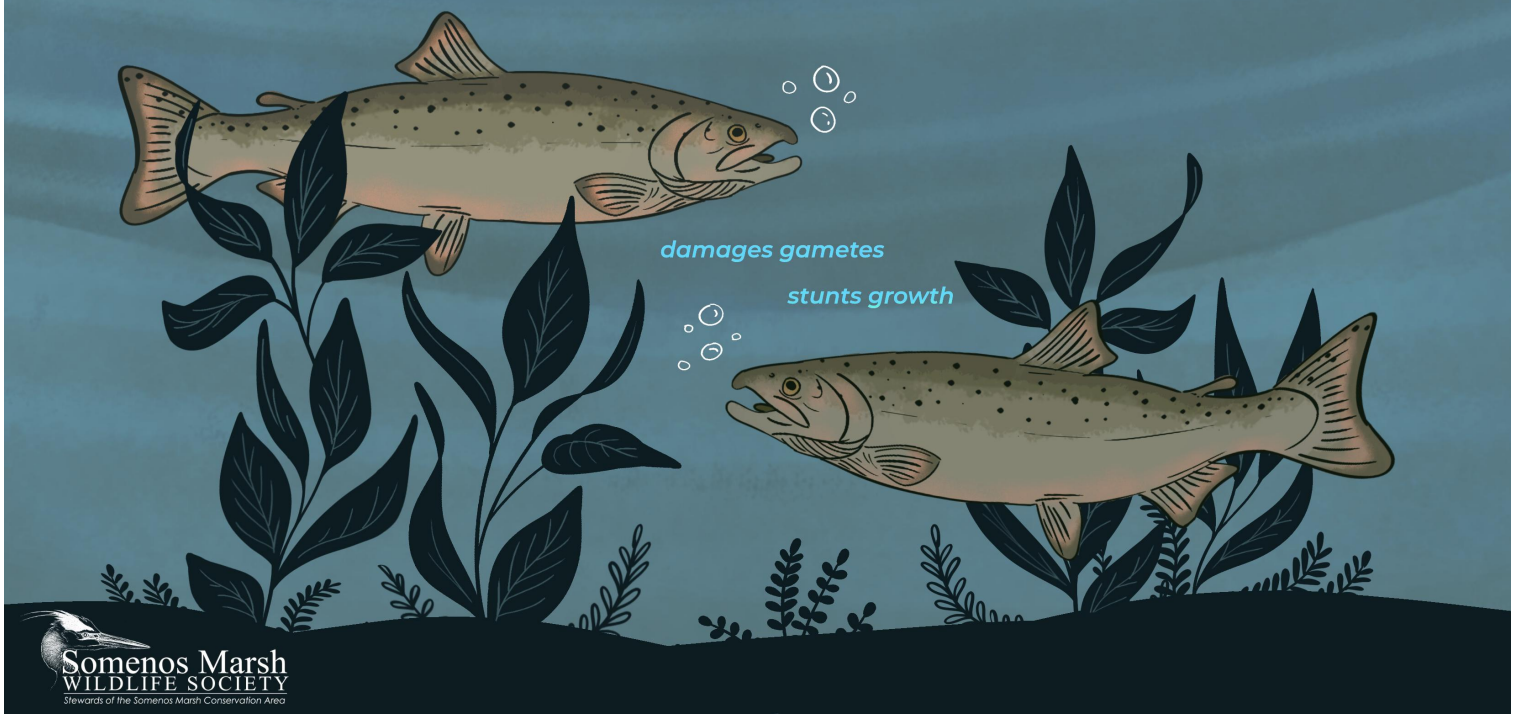
Cobalt is rare, highly magnetic Earth metal that is essential in many biological processes of humans, plants, and animals. Cobalt is a commercially produced resource in Canada for use in steel and other metal alloys. In small amounts, cobalt is key in the growth of marine algal species and can improve growth of some plants. However, in excessive amounts it can be toxic. The largest anthropogenic contributor of cobalt to a waterway is industrial and agriculture runoff.

Effects on Salmonids

Studies indicate that cobalt ions can damage the gametes of adult salmon when spawning. Exposure to sub-lethal levels of cobalt have been shown to stunt growth over an extended period of time.

Cobalt in Somenos

The maximum allowable level of cobalt in a watercourse for sustaining aquatic life in freshwater is 110ppb. When found in water, cobalt exists in a salt form that is soluble in water. Mayflies have been shown to be impeded in their growth and emergence by cobalt. Water hardness has been shown to have a direct relation to cobalt toxicity, where softer water increases the toxic effects to fish. According to a survey conducted in summer 2018, high levels of cobalt are present in the waters of Menzies Creek.



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WATER CONTAMINANT PROFILE

Copper (Cu)

HIGH IMPORTANCE

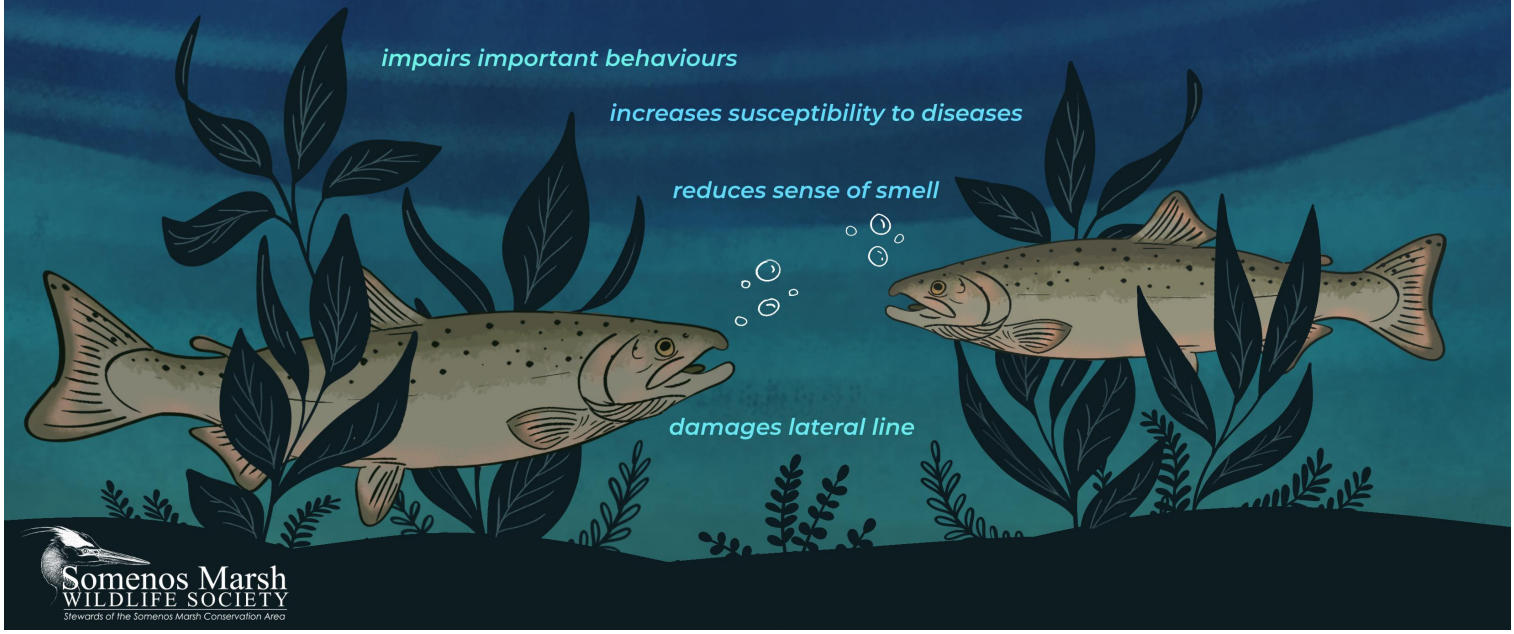
Copper is an industrial metal that is ductile, malleable, and an excellent conductor of electricity. It occurs naturally in aquatic environments in low concentrations. Copper concentrations tend to be elevated near mining operations and/or in urban areas. Even though it is an essential trace metal necessary for growth and metabolism in all living organisms, elevated concentrations can be toxic to freshwater fish. The toxicity of copper changes depending on the hardness/softness of water, pH, anions and dissolved organic carbon (DOC). Dissolved copper is more lethal in soft water rather than hard water. Copper is more toxic under acidic conditions when pH is less than 6. Anions and DOC bind to dissolved copper, creating compounds which reduce dissolved copper concentrations and toxic effects.

Copper Effects on Fish

At levels just above what is necessary for growth and reproduction, copper can accumulate and cause irreversible harm to freshwater fish. In fish, copper is important for nervous system function and necessary for hemoglobin synthesis. It can impair behaviours crucial for survival and reproduction by significantly reducing a fish's sense of smell. It can also damage the hair cells/epithelial cells that make up a fish's lateral line, which provides the fish with information about its environment and is important for schooling, predator avoidance, orientation to water flow, and feeding. Elevated levels of copper can also make fish more susceptible to diseases and disrupt migration patterns.

Copper in Somenos

Copper likely has a presence in many local water bodies. It was detected in Bings Creek during a survey done in summer 2018 in excessively high concentrations.



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WATER CONTAMINANT PROFILE

Hardness

LOW IMPORTANCE

Water hardness refers to the amount of calcium carbonate, measured in milligrams per litre, dissolved in the water. Magnesium and iron are also considered to affect hardness to a lesser degree. Water hardness is sometimes observed by leaving residue on kitchenware from washing. When hard water is heated, it can solidify as deposits of calcium.

Effects on Salmonids

Hardness has been shown to have a negative relationship with other contaminants where softer water exacerbates the effects of pollutants on salmonids, especially with heavy metals. Low hardness can cause a minor side effect of a contaminant to turn lethal in certain cases.

Water Hardness in Somenos

Somenos Lake has shown to have an average hardness of 32.0 mg/L (Calcium Carbonate), this is considered "soft" water. In contrast, the City of Duncan's water is considered moderately hard.

Somenos Marsh
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Stewards of the Somenos Marsh Conservation Area

WATER CONTAMINANT PROFILE

Iron (Fe)

HIGH IMPORTANCE

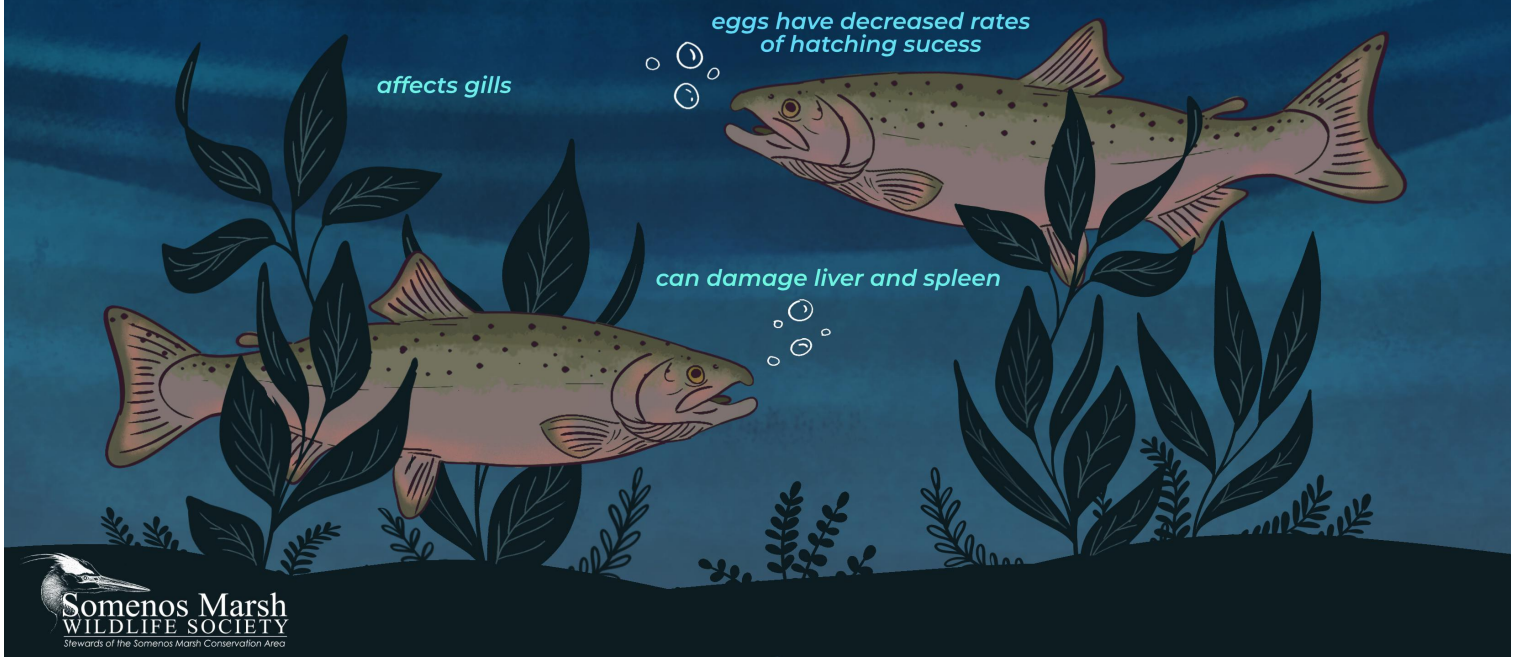
The fourth most common element on Earth is iron and it naturally occurs in water from geologic weathering. Human activities that contribute iron to water courses include mining, forestry, and agriculture. In trace quantities, iron is an essential element for biological processes such as the hemoglobin of blood for oxygen transport. Iron can be introduced in excess to a watercourse by wastewater, especially from anoxic environments.

Effects on Salmonids

The mayfly, an indicator species of pollution and a primary food source for salmonids in freshwater, has been shown to be highly sensitive to increases in dissolved iron. The liver and spleen of salmonids store the most iron and may be damaged when exposed to high amounts of dissolved iron. In Coho, high levels of iron were observed affecting the gills of juveniles and adults. Additionally, their eggs had decreased rates of hatching success.

Iron in Somenos

The provincial guidelines for iron in water for the purpose of sustaining aquatic life is 1000 ppb. Bright orange iron oxide bacteria can occasionally be observed precipitating from the ground naturally along streams. A possible benefit of intentional introduction of iron is for control of cyanobacteria in Somenos Lake by bonding with existing phosphorus.



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WATER CONTAMINANT PROFILE

Cadmium (Cd)

HIGH IMPORTANCE

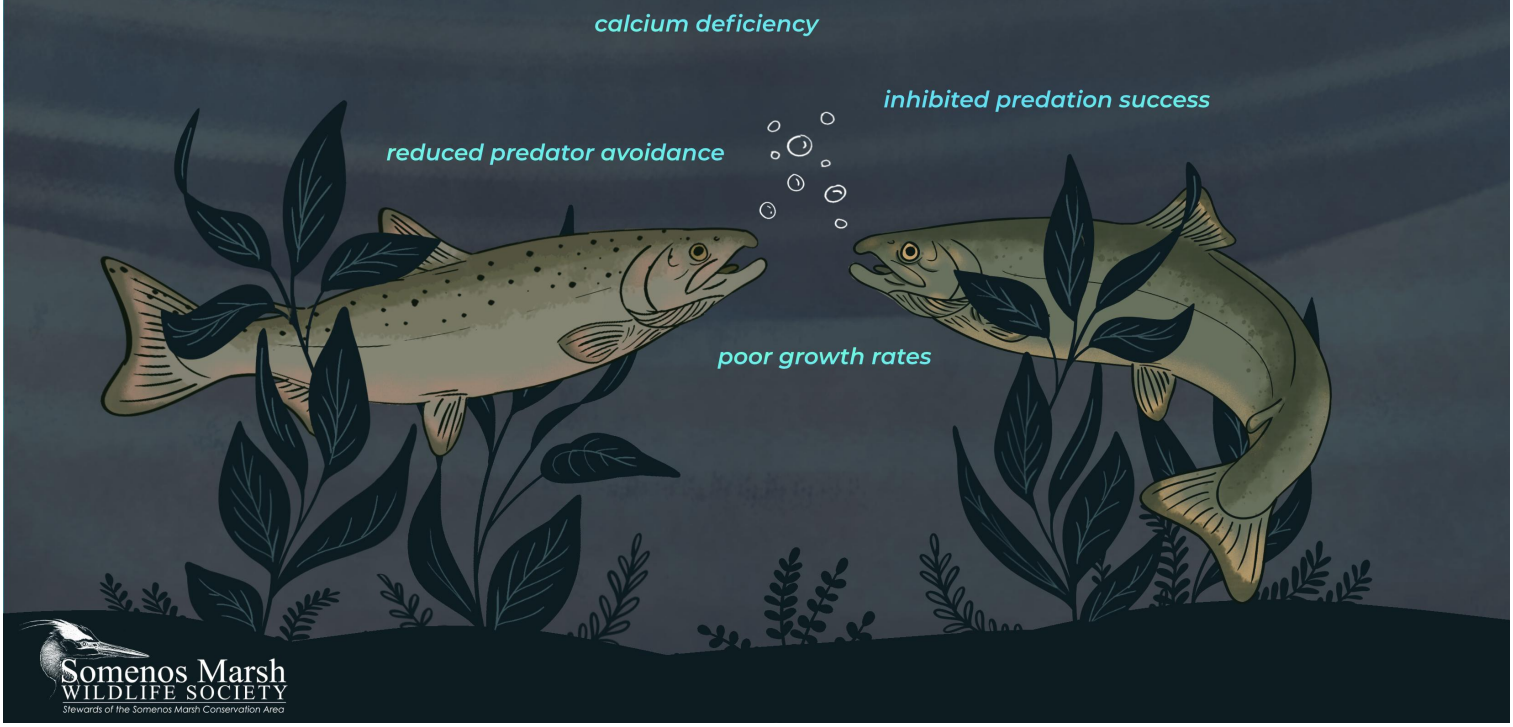
Cadmium is heavy metal that is toxic to both humans and wildlife. Cadmium is a known carcinogen in humans and can also contribute to birth defects. The metal is still frequently used in rechargeable batteries and was once commonly applied to steel plating to prevent corrosion. The main source of Cadmium into a waterway is from fertilizer, wastewater, and smelter fumes, especially in areas of high industrial activity.

Effects on Salmonids

Even at extremely low quantities, Cadmium is toxic. A frequent side effect of cadmium exposure is calcium deficiency in salmonids. Prolonged exposure to cadmium has been shown to affect behavior of trout, with juveniles showing reduced predator avoidance and adults having inhibited predation success. Poor growth rates in several species were also shown to be a negative symptom of cadmium contamination

Cadmium in Somenos

A past study of Richards Creek in 2009 indicated a detection of Cadmium among other heavy metals. The cadmium detected was in trace amounts and was below sufficient levels to give an exact measurement. Cadmium has shown the ability to bioaccumulate through predation. Cadmium is highest in streams adjacent to urban industrial areas.



Somenos Marsh
WILDLIFE SOCIETY
Stewards of the Somenos Marsh Conservation Area

WATER CONTAMINANT PROFILE

Arsenic (As)

LOW IMPORTANCE

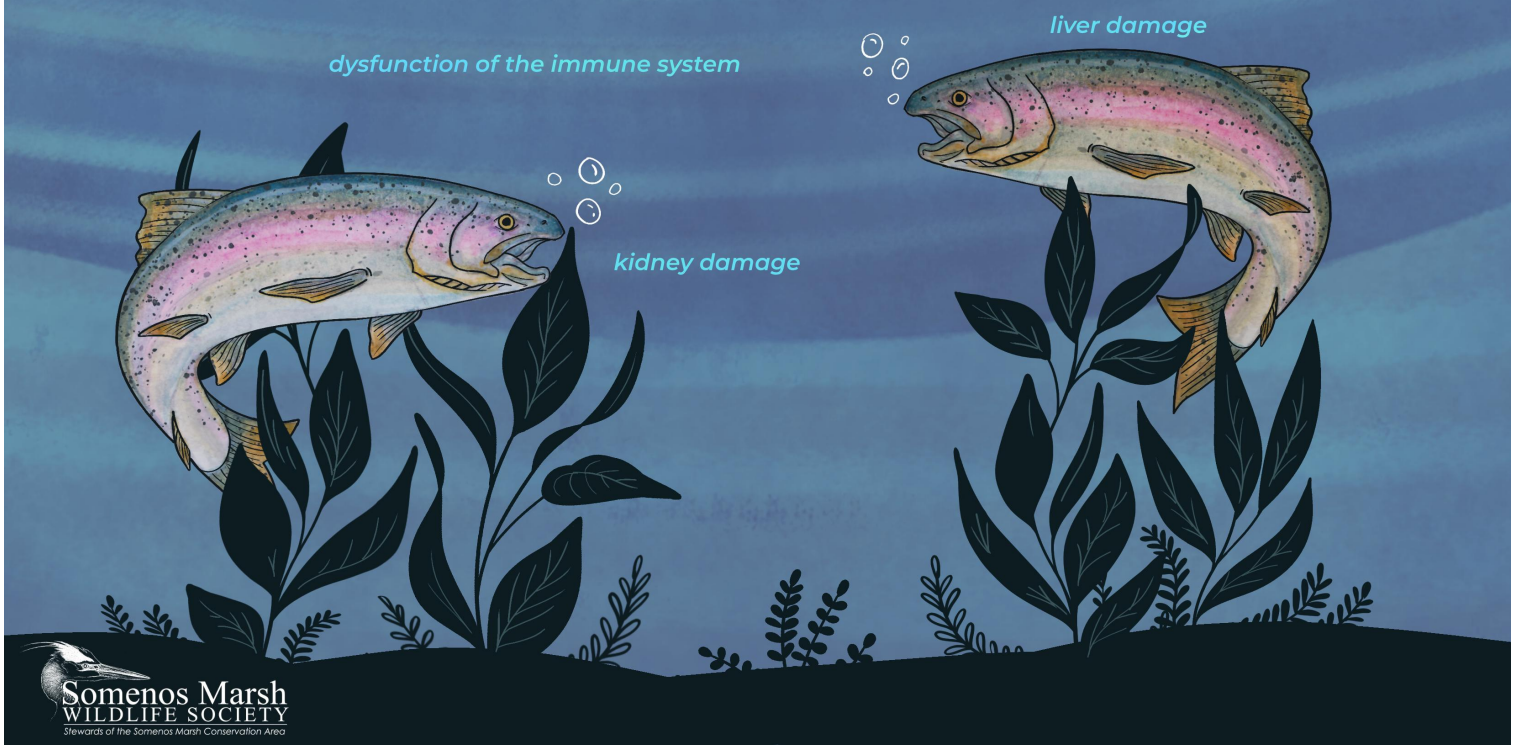
Arsenic is a tasteless, colourless, odourless, gas, commonly found on Earth. It can be found naturally occurring in water, air, soil, and even food. Items for human consumption that most frequently contain arsenic include rice, fish, tobacco, and drinking water. Arsenic mixes into water from weathering and erosion of rock or soil found along streams, carrying it downstream into larger bodies of water. Additionally, pesticides, industrial activities, and mining operations can lead to arsenic leaching into watersheds and aquifers.

Effects on Our Salmonid Species

Juvenile trout and salmon are more susceptible to arsenic toxicity than their larval stages (alevin). The median lethal limit of arsenic for rainbow trout is 550 parts per billion (ppb). Extended exposure of arsenic results in bioaccumulation and results in kidney and liver damage. A side effect of this damage is dysfunction of the immune system.

Arsenic in Somenos

The maximum safe level of arsenic in water for humans is 10 ppb and the BC water quality guidelines for sustaining freshwater aquatic life recommends no more than 5 ppb. A spike of 1.53 ppb was observed in Bings Creek in spring 2019.



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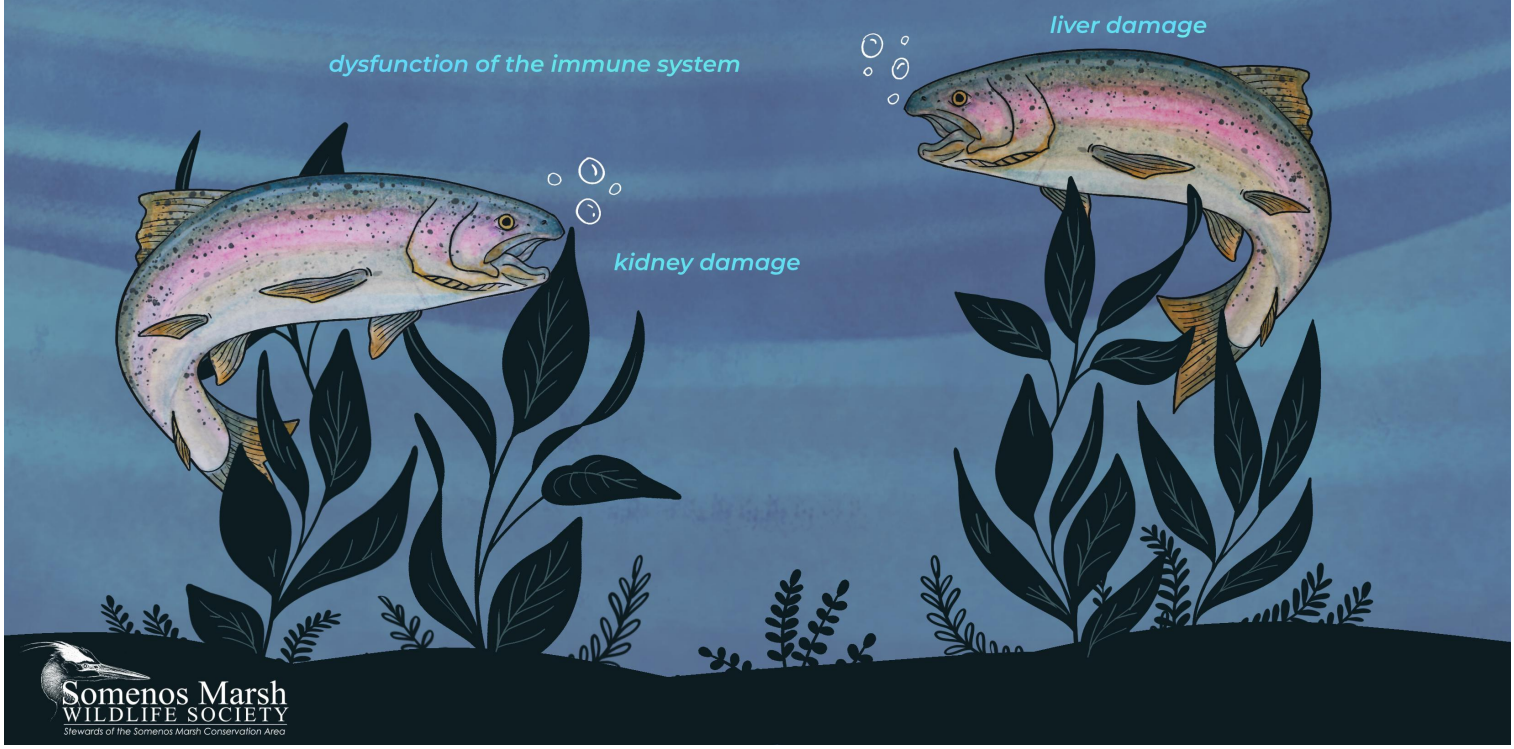

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WATER CONTAMINANT PROFILE

Ammonia (NH_3)

HIGH IMPORTANCE

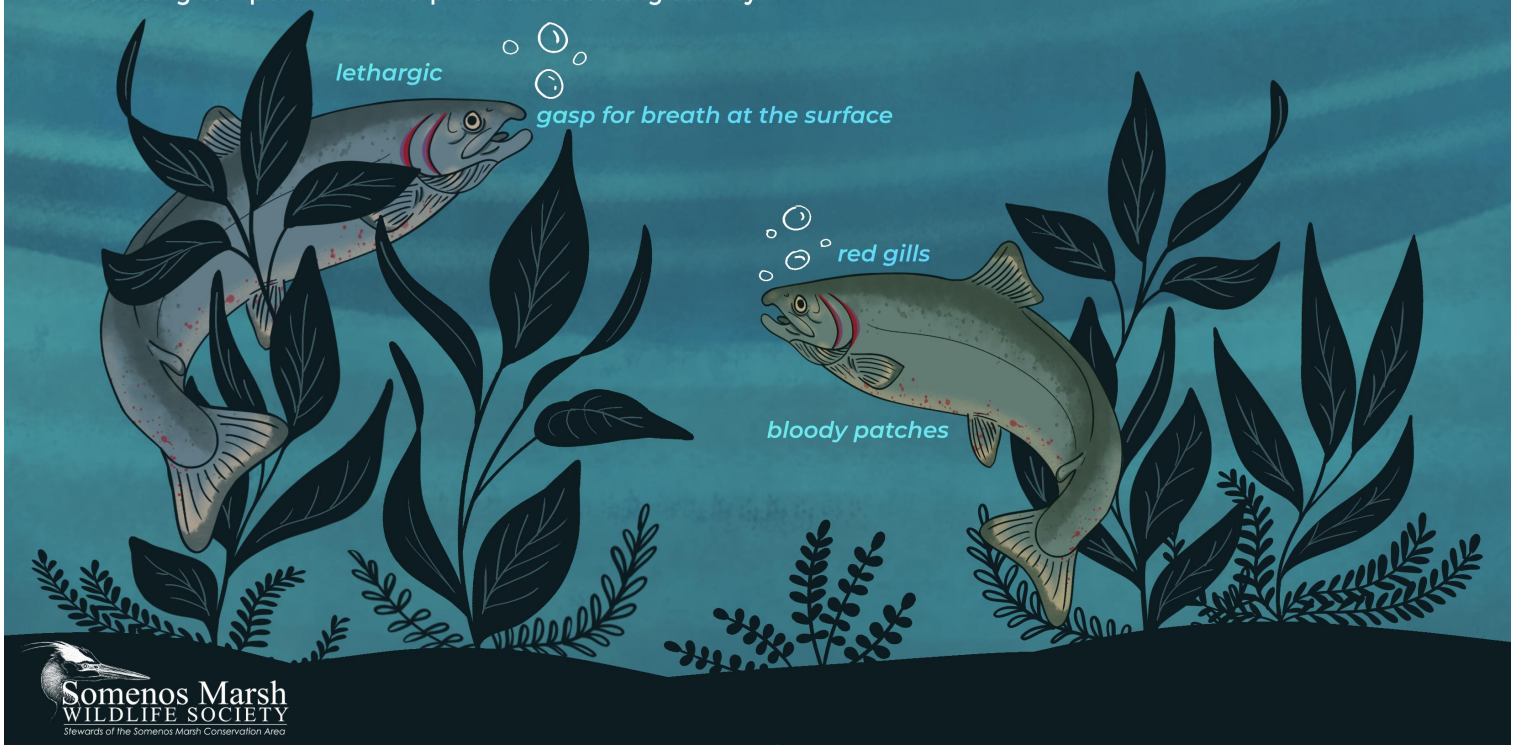
Ammonia is a colourless gas with a distinctive pungent smell that occurs naturally in water bodies, originating from the microbiological decomposition of nitrogenous compounds in organic matter. Ammonia can also make its way into freshwater through industrial processes, domestic sewage, or animal slurry. Unionized ammonia is toxic to freshwater fish, even at very low concentrations. Aquarium and pond owners have dubbed ammonia the "invisible fish killer" because it is invisible and is hard to detect before it's already too late.

Ammonia Effects on Salmon

Symptoms of ammonia poisoning include the gills taking on a red or lilac colour, making them look as if they're bleeding. Fish lose their appetite, their body functions fail, and they become increasingly lethargic. The fish's tissues will also start to deteriorate and red streaks or bloody patches on their body/fins will appear. Eventually ammonia poisoning causes internal damage, effecting the brain, organs, and the central nervous system. The fish will begin to hemorrhage, both internally and externally, and eventually die.

Ammonia in Somenos

Somenos Creek likely has elevated levels of ammonia because of both the natural decomposition of organic matter and from contaminated surface run-off. Concentrations of unionized ammonia increase with increasing temperatures and pH and decreasing salinity.



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WATER CONTAMINANT PROFILE

Aluminum (Al)

MODERATE/HIGH IMPORTANCE

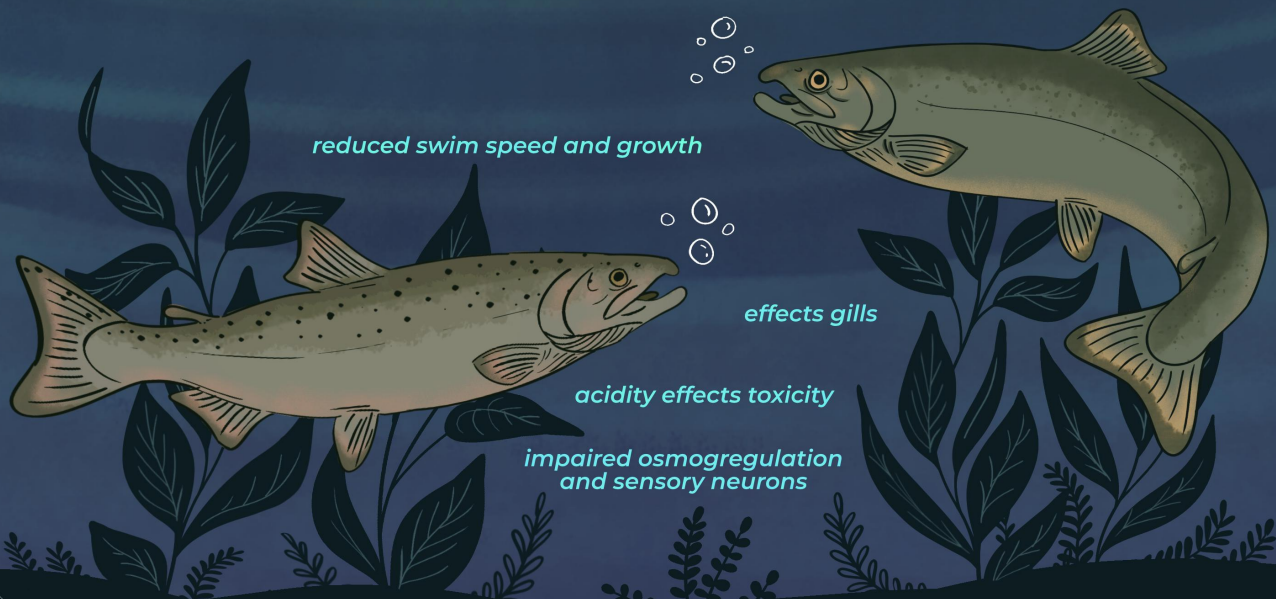
Aluminium is extremely common in the natural environment, making up about 8% of the earth's crust. It is often found in drinking water as aluminium sulphate is commonly used in purification processes. Though aluminium is not considered dangerous at low levels, it can become toxic to many organisms as levels increase.

Effect of Aluminium on Fish

Aluminium accumulates in the gills of fish causing reduced functionality of essential operations. This causes reduced fitness and survival. The more acidic that water becomes, the more toxic aluminium is to fish, allowing its accumulation in the gills to happen much more readily. Sub-lethal side effects include reduced swim speed, reduced growth, impaired osmoregulation, and impaired sensory neurons.

Aluminium in Somenos

Aluminium occurs naturally in the environment and can naturally occur in water when it is leached from rocks and soils in the riverbed. Leaching occurs much more speedily when water is lower in pH, causing aluminium levels to become dangerous for fish and effect them much more harshly. Data collected in the Somenos Watershed over 20+ years has shown pH readings that have hung consistently around neutral, but recent sampling has shown aluminium levels beyond acceptable bounds for fish habitat. This suggests either inorganic input or extremely rich geological presence of aluminium in the watershed.



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