HABITAT LOSS IS A MAJOR THREAT TO SALMON AND OTHER SPECIES

According to 7/2 — The Action Agenda for Puget Sound, Draft Book 1 — Page 18

Habitat loss is a major threat to salmon and other species*. The cumulative effect of the changes we have made to our floodplains, estuaries, marine shorelines, and stream flows has been a significant loss of habitat and declines in populations of the species that depend on those habitats and on one another for their survival. If we are to stop these declines and begin to recover these populations we must immediately stop further habitat loss and significantly restore habitat that has already been lost.*

Yet existing environmental regulations effectively thwart governmental agencies and citizen volunteers from taking timely, cost effective and meaningful restoration actions to restore the numerous degraded streams, wetlands and lakes located throughout the entire Puget Sound Basin. Streams, wetlands and lakes in these areas have been externally loaded with silt and organic and nutrient rich sediments to the extent that they no longer provide suitable habitat for native species. Instead, as a result of human activity, we have alternately flooded and dry streams, sediment covered gravel stream beds, malfunctioning wetlands and freshwater toxic algae infested lakes.

One of the goals of the PSP was to work with federal, state, county and city agencies to remove regulatory impediments that now thwart timely, cost effective and meaningful restoration acts by governmental agencies and citizen volunteers to *"... significantly restore habitat that has already been lost."*

So far there has been no evidence that PSP has acted to remove regulatory barriers to governmental agency and citizen volunteers restoring freshwater floodplain habitat. In this regard PSP has been woefully deficient.

Don Russell
7/4/2012

EFFECT OF CALCIUM, NITRATE, IRON, AMMONIA AND PHOSPHORUS ON SALMONID

Calcium ions in solution are a critical limiting factor for anadromous fish. The role that calcium ions play is threefold. They function as an osmotic regulator that controls the passage of fluids and ions (dissolved elements and compounds) into and out of the fish's gill tissue. They function to prevent (block) the absorption of toxic heavy metals (copper, mercury, zinc, lead, and cadmium) through gill tissue and into bodily fluids. And they enhance the alkalinity (which controls pH) of the water.

US EPA guideline for the protection of aquatic life is that alkalinity (a surrogate for calcium ion concentration) should be greater than 20 mg/L (CaCO3). WDOE does not have a surface water quality standard for alkalinity.

A recent study which reviewed all prior studies on the impacts of nitrates suggests that the most sensitive freshwater invertebrates and fish are affected by nitrate concentration as low as 2 ppm, with the primary physiological impact being a decreased ability of the blood to carry oxygen (anemia). Nitrate also damages the gills and kidneys affecting osmoregulatory ability (ability of the fish to regulate fluid levels and release toxins, something we do via urination, something they do via osmoregulation).

WDOE does not have a nitrate-nitrogen surface water quality standard for the protection of aquatic life.

Iron in low concentration is a cyanobacteria, filamentous green algae and aquatic plant growth stimulant and in higher concentrations (>0.35 mg/L for ferrous iron and >1.0 mg/L for ferrous plus ferric, i.e., total iron) toxic to aquatic life.

US EPA guideline for the protection of aquatic life is that total iron should not exceed 1.0 mg/L. WDOE does not have a surface water quality standard for either ferrous or total iron concentration.

Ammonia is very toxic to anadromous fish. The mechanisms of toxicity are complicated and are an active area of continued investigation by researchers. Its effects include damage to the gills, resulting in poor gas exchange, ion regulation and blood pH regulation. Other effects include hampering oxygen delivery to tissues, disrupting metabolism and toxicity to the nervous system that causes hyperactivity, convulsions and death.

WDOE does have a surface water quality standard for ammonia-nitrogen for the protection of aquatic life. It is pH and temperature moderated.

Phosphate-phosphorus is a cyanobacteria, filamentous green algae and aquatic plant growth stimulant when in excess of 20 ppb and their excessive growth can significantly impair water quality and salmon habitat.

HABITAT REQUIREMENTS FOR NATIVE SALMON AND TROUT

PHYSICAL REQUIREMENTS

- **Stream flow regimen - neither flooding, scouring or drying**
- **Access to suitable migratory, spawning and rearing habitat**
- **Stream reaches, wetlands and lakes fed by discharging groundwater, not surface water runoff**
- **Sediment free gravel (of suitable size) substrate stream beds**
- **Summer time water temperature not more than 16 C or 61 F**
- **Summer time dissolved oxygen not less than 9.5 mg/L**
- **Turbidity not to exceed 5 NTU over background**

CHEMICAL REQUIREMENTS

- **6.5 to 8.5 pH**
- **A natural buffering system to maintain pH in this range**
- **Adequate calcium and bicarbonate ions in solution to maintain alkalinity above 20 ppm**
- **Low nutrient (N< 2 ppm and P< 0.02 ppm or 20 ppb) and toxic material (As, Cd, Cr, Cu, Hg, Pb, Zn, PCB, PAH, cyanotoxin) concentration**
- **Ferrous iron not to exceed 0.35 mg/L, total iron not to exceed 1.0 mg/L**
- **Nitrate-nitrogen concentration below toxic conditions (<2.0 mg/L)**
- **Ammonia-nitrogen concentration below toxic concentrations (<1.9 mg/L)**
- **Appropriate water salinity for each life cycle stage**

BIOLOGICAL REQUIREMENTS

- **Adequate prey to meet nutritional requirements**
- **Protection from natural predators**
- **Favorable riparian conditions**
- **Absence of introduced or invasive species**
- **Protection from destructive acts by developers or vandals**

THE SIGNIFICANCE OF NITRATE-NITROGEN CONCENTRATION

Evidence suggests that sensitivity to nitrate is species-specific. Kincheloe et al. (1979) reported larval mortality of Chinook salmon, rainbow trout, and cutthroat trout at concentrations as low as 2.3-7.6 mg/L NO3-N.

A recent study which reviewed all prior studies on the impacts of nitrates suggests that the most sensitive freshwater invertebrates and fish are affected by nitrate concentration as low as 2ppm, with the primary physiological impact being a decreased ability of the blood to carry oxygen (anemia).

Autopsies revealed elevated nitrate concentrations resulted in the following physiological impacts:

1. Affects antibody production

2. Increased number of immature red blood cells

3. Lowered level of mature red blood cells (anemia)

4. Higher count of monocyte (a specific white blood cell)

5. Higher count of neutrophil (a specific white blood cell that is especially destructive to microorganisms)

6. Higher count of TLC - Thrombocyte-like cell (a blood cell of nonmammalian vertebrates that promotes blood clotting)

7. Higher levels of creatine (A nitrogenous organic acid found in muscle tissue that supplies energy for muscle contraction)

8. Higher calcium values in the blood

9. Lower Chloride values in the blood

10. Autopsy revealed damage to the spleen, liver, and kidneys

Other conclusions reached:

1. Nitrate damages the gills and kidneys affecting osmoregulatory ability (ability of the fish to regulate fluid levels and release toxins, something we do via urination, something they do via osmoregulation).

2. The observed changes are the result of a pathological response and not of a generalized stress response.

So what does the abnormal blood chemistry indicate? In short, it means the fish are suffering from infection, severe physical stress, and tissue damage. Their blood is incapable of distributing sufficient oxygen, the immune system is in overdrive and has become deficient, and the kidneys are failing.

A compiled review of prior testing conducted in Spain at the Universidad de Alcala suggests that the effects of nitrate toxicity in the most sensitive freshwater species can begin in concentrations as low as 2ppm and that long term exposure to nitrates in concentrations of 10ppm are known to adversely affect rainbow trout, chinook salmon, and cutthroat trout.

Nitrate, like ammonia, is a toxin.

Kincheloe, J.W., Wedemeyer, G.A., Koch, D.L., 1979. Tolerance of developing salmonid eggs and fry to nitrate exposure. Bull. Environ. Contam. Toxicol. 23, 575–578

Camargo, Julio A., 2004, Nitrate Toxicity to aquatic animals: a Review with new data for freshwater invertebrates, Chemosphere 58 (2005) 1255-1267

WDOE does not have a nitrate-nitrogen water quality standard for the protection of aquatic life.