



Vitamin B1 May Hold the Key to Atlantic Salmon Survival in Lake Ontario

Early Mortality Syndrome (EMS) prevents successful survival of Atlantic Salmon in Lake Ontario and the Finger Lakes of New York. The USGS Tunison Laboratory of Aquatic Science in Cortland, New York, found that EMS can be reduced or prevented.



Landlocked Atlantic salmon (*Salmo salar*) fry showing signs of early mortality syndrome. Symptoms include abnormal accumulation of fluid, popeye, hemorrhages, whitish spots in the yolk, and shortened jawbones.

Atlantic Salmon do not successfully reproduce in Lake Ontario and most inland waters of New York where they historically lived. A disease called Early Mortality Syndrome (EMS) kills most fry in the wild shortly after they hatch. Scientists at the USGS Great

Lakes Science Center's Tunison Laboratory of Aquatic Science in Cortland, New York, are collaborating with state, federal, and university researchers to understand the causes of EMS and to find ways to reduce or eliminate it.

showed that EMS could be reduced and fry survival could be increased to 95% by injecting female salmon with thiamine two to three weeks before they spawned. In collaboration with the New York Department of Environmental Conservation (NYDEC) Bath Hatchery, Tunison scientists showed that fry from thiamine-injected wild salmon could be successfully reared and stocked into a tributary of Cayuga Lake. About six months after stocking, electro fishing in the tributary resulted in the capture of 109 lively fingerlings—an estimated 3.4% for the stocked area.

Native landlocked Atlantic Salmon (*Salmo salar*) were abundant in Lake Ontario and the Finger Lakes of New York until the late 1800s. Loss of stream habitat due to the damming of tributary streams where the salmon spawned is thought to have led to the decline of this prized sport and commercial fish. At the same time as the decline occurred, alewife invaded Lake Ontario and became a major food fish for the salmon. This may have hastened the salmon's decline. Today, the U.S. Fish and Wildlife Service, the New York Department of Environmental Conservation, and the USGS are examining the feasibility of restoring self-sustaining populations of Atlantic salmon in Lake Ontario and the Finger Lakes.

In 1995, researchers at Cornell University demonstrated that EMS in fry from naturally spawning salmon in New York's Cayuga Lake could be reduced or eliminated by treating the fry with thiamine, vitamin B1. This suggested that the fry were deficient in this vitamin.

Cornell researchers traced the cause of this deficiency to the alewife, a major food fish of the salmon. Alewives contain thiaminase, an enzyme that destroys vitamin B1 in their predators. For the salmon, the result is reproductive failure through EMS.

USGS Tunison Laboratory scientists built upon the Cornell findings. They

Tunison scientists made comparisons of strategies for administering the thiamine. Injections less than 11 days prior to spawning markedly reduced vitamin uptake in eggs and fry survival, while injections between two to four weeks before spawning were highly effective.

Furthermore, recent observations in

the Platte River (Michigan) suggested that returning pre-spawning steelhead were weak and lacked swimming stamina to migrate normally.

Therefore, we evaluated the effect of injecting thiamine in 63 tagged pre-spawning steelhead from Cayuga Lake. Of these, 31 were injected with thiamine. All fish were released to evaluate their migration upstream over low barriers (0.5 to 1 meter) in their spawning tributary. Nine to 13 days after release, eight tagged fish were recovered above the barriers, all of which were injected, indicating that migration stamina was likely impaired by thiamine deficiency and that injecting the vitamin increased stamina. It is possible that all affected species may exhibit reduced stamina because lethargy is a typical sign of thiamine deficiency.

Further USGS research is being planned in collaboration with NYDEC. Possible applications include treating wild salmon with thiamine at the NYDEC Cayuga Inlet spawning channel or at fish ladders on Lake Ontario tributary streams. Researchers hope that this will enable successful reproduction of wild salmon.