Thiamine Deficiency Syndrome – the Alewives' Revenge?

By Jim Johnson, retired Michigan DNR fish biologist

Predator fish, especially trout and salmon, suffer from thiamine deficiency if they eat too many Alewives. It works like this: Alewives' digestive tracts are loaded with an enzyme called thiaminase. The "ase" means it's an enzyme that destroys the vitamin that makes up the base of the name. Thus, thiaminase destroys thiamine. Without enough thiamine, trout and salmon cannot reproduce – their embryos die. Like French fries are to humans, Alewives are an irresistible junk food for trout and salmon. If you are a trout or a salmon and you eat too many of them, you suffer "Alewives' revenge": reproductive failure.

Thiamine, vitamin B1, is one of eight B vitamins. Thiamine **helps turn food into energy and to keep the nervous system healthy**. Same as with trout and salmon, your body cannot make thiamine for itself. However, you can usually get all you need from your food. Thiamine is found in a variety of foods, with good sources including pork, fish, poultry, whole grains, legumes, and fortified cereals and breads. And even beer. Fish are unable to make thiamine either and must find it in their prey. But if their prey base is 95% Alewives, as it was in lakes Michigan and Huron in the 1970s-1990s, thiamine deficiency rears its ugly head.

Coho Salmon, Chinook Salmon, Atlantic Salmon, and Lake Trout are among the most vulnerable species, wherever Alewives are the predominant prey. Thiamine deficiency is not generally a problem in Lake Superior, where Alewives are scarce. Rainbow Smelt are a source of thiaminase but have not been implicated in recent thiamine deficiency issues. Smelt may have contributed to problems with Lake Trout during the 1940s and 1950s. Distressed and dying Lake Trout were reported then by many commercial fishers, when Smelt became especially abundant in the Great Lakes, but diagnostics were not available during that time.

Thiamine deficiency in trout and salmon is most often expressed in the form of embryo and fry mortality, shortly after hatch. Symptoms of thiamine deficient fry are lethargy, disorientation, and failure to begin feeding. The fry would become thin, lay on their sides, turn very dark in color, and finally die. This reproductive failure was widespread during the early days of salmon stocking, in the late 1960s through the late 1990s, when Alewives were especially abundant in all the Great Lakes but Lake Superior. Hatchery managers learned that fry survival could be greatly enhanced by bathing the eggs and recently hatched fry in thiamine solutions. This deficiency was not only a problem in hatcheries. Natural reproduction of trout and salmon was suppressed, and this became a major constraint to restoration of native Lake Trout. Thiamine deficiency and reproduction failure subsided as Alewife numbers declined, and the prey base became more diverse. The Round Goby, which invaded the Great Lakes during the 1990s, is rich in thiamine and is now important to the diets of Lake Trout; thankfully, Lake Trout are now reproducing again. A bonus with Round Goby is that it feeds on the invasive Quagga and Zebra mussels and converts them into a thiamine-rich, healthy prey for Lake Trout, Walleye, and many other species.