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EVALUATION OF PISCICIDES FOR CONTROL OF EURASIAN RUFFE

The ruffe (*Gymnocephalus cernuus*), a Eurasian percid, was introduced into Duluth harbor of western Lake Superior in the early 1980's, probably via ballast water exchange from an ocean-going vessel. The ruffe is a spiny-rayed percid that closely resembles the indigenous yellow perch (*Perca flavescens*). Since their introduction, ruffe have become the most abundant species in Duluth harbor, based on catches in trawls, and have proliferated at the expense of endemic fishes, particularly bullheads, trout perch, and yellow perch. European scientists report commercial harvests of whitefish (*Coregonus* spp.) have been reduced by as much as 50% because of ruffe predation on eggs, whereas some European perch (*Perca fluviatili*) populations have been reduced by as much as 80% in areas where ruffe have been introduced. Under optimum conditions, ruffe have been shown to spawn three times annually with gravid females producing up to 150,000 eggs during each spawning period. Because of this high reproductive capacity, rapid colonization of new areas can occur. Since ruffe were introduced into Duluth harbor, they have expanded their range about 100 miles east to the Ontonogan River, Michigan, and north to the French and Sucker rivers in northern Minnesota.

POTENTIAL EFFECT ON THE GREAT LAKES AND INLAND WATERS

Continued expansion of ruffe from western Lake Superior to the rest of the Great Lakes and the nation's inland freshwater systems poses a serious threat to our freshwater commercial and sport fisheries. For example, yellow perch populations in Duluth harbor have declined about 90% from 1989 to 1994 as ruffe populations increased. Expansion of ruffe into Lake Erie, the nation's leading perch and walleye fishery, could result in an economic loss of as much as $90 million annually. Effects on commercial harvests of Great Lakes whitefish could reach $5 million annually, whereas total projected impacts in job losses and other economic activities could total $2 billion per year. Although it is unlikely that widespread invasions by ruffe would destroy the nation's entire sport industry, a loss of only 10% would result in an annual economic loss of $7 billion.

SENSITIVITY TO PISCICIDES

Toxicity tests using two registered piscicides (antimycin and rotenone) and a lampricide (3-trifluoromethyl-4-nitrophenol [TFM]) have shown ruffe to be more sensitive than most other endemic fin fish. Based on preliminary tests, delineative toxicological data were developed on the Amnicon, Brule, Bad, Flag, Iron, Middle, Raspberry, Red Cliff, and Sand rivers in northern Wisconsin, all of which are known to contain ruffe populations. On-site toxicity tests were conducted to determine lethal concentrations required to kill 50% (LC50) of ruffe, brown trout, and yellow perch in water from each river.

Results of on-site toxicity tests on all rivers for antimycin (48-h exposure) showed LC50's for ruffe and brown trout from 0.05 to 0.50 µg/L and for yellow perch from 0.50 to 1.47 µg/L. Results for rotenone (24-h exposure) were similar to that of antimycin. Ruffe and brown trout were similar in sensitivity, while yellow perch was about twice as resistant. Toxicity tests with TFM (12-h exposure) showed ruffe to be more sensitive than brown trout or yellow perch. LC50's were from 0.8 to 2.4 mg/L for ruffe, but were from 3.0 to >6.0 mg/L for brown trout and from 4.1 to >6.0 mg/L for yellow perch.

Effect of Larval Lampricide Treatment on Ruffe

Based on results of the toxicity tests showing the relative sensitivity of ruffe to TFM, we evaluated the effect of lampricide treatments with TFM on two streams (Brule River, Wisconsin, and Amnicon River, Wisconsin) that contained ruffe as well as sea lamprey (*Petromyzon marinus*). Pretreatment population estimates of ruffe were conducted in the estuaries of the Amnicon and Brule rivers using the mark (fin-clip) and recapture technique. The pretreatment ruffe populations were 2,691 (95% confidence interval, 1,603–4,893) for the Brule River, and 13,263 (5,209–53,130) for the Amnicon River. The effects of the lampricide treatment on ruffe were assessed. Live ruffe were placed in cages in the river prior to treatment, mortality was measured after treatment, and pre- and posttreatment catches per unit effort (CPUE) in the river estuaries were compared. The estuary of the Brule River was treated at 3.2 mg/L TFM for 12 h. Mortality of caged ruffe was 97%. Comparison of pre- and posttreatment CPUE's also showed a 97% reduction of ruffe. The estuary of the Amnicon River was treated at 1.6 mg/L TFM for 12 h. Mortality of caged ruffe was 76%. Comparison of pre- and posttreatment CPUE's showed a 67% reduction of ruffe.

Both toxicity tests and results from larval lampricide treatments indicate that ruffe are more sensitive to TFM than most endemic fishes and that significant numbers are killed by routine lampricide treatments. However, TFM concentrations used for sea lamprey control will not completely control ruffe. In most instances, a higher concentration of TFM would be required to completely eradicate ruffe, consequently, some deaths would likely occur among endemic fishes.

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