TECHNICAL NOTES

U.S. DEPARTMENT OF AGRICULTURE WYOMING SOIL CONSERVATION SERVICE

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Subject: WALLEYE*

General

The walleye is native to freshwater rivers and lakes of Canada and the United States with rare occurrences in brackish water. In the United States, its native range occurs primarily in drainages east of the Rocky Mountains and west of the Appalachians; however, it has been widely introduced into reservoirs outside its native range. Walleye hybridize with sauger (S. canadense) and blue pike (S. v. glaucum).

Age, Growth, and Food

Walleye live at least 17 years in cool northern waters; age VIII or younger fish were predominant in Tennessee impoundments. Males mature at age II to IV and females at age III to VIII. Growth of walleye depends primarily on food supply, temperature, and population density. In general, length of sexually mature walleye (age I11+) is 30 Cm.

Walleye fry eat zooplankton and aquatic insects and start feeding on fish at 1.5 to 2.5 cm in length. The diet of juvenile and adult walleye consists primarily of fish, but aquatic invertebrates, particularly mayfly larvae and crayfish, may be locally or seasonally important. In northern areas, age 0+ and 1+ yellow perch often account for a large portion of the diet in classic large, shallow perch-walleye lakes. Cannibalism may become significant when other prey are scarce.

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*Information taken from Ecoregion M3113 Handbook and Habitat Suitability Index Models, Wildlife Species Narratives (literature searches), U.S. Fish and Wildlife Service, various dates between 1978-1984.

Reproduction

The water temperature regime and the quality and quantity of suitable substrate are major factors affecting walleye reproductive success. Walleye spawn in spring during periods of rapid warming soon after ice breakup. Spawning is usually initiated at water temperatures of 7° to 9°C with most spawning occurring in the range of 6° to 11°C. Preferred spawning habitats are shallow shoreline areas, shoals, riffles, and dam faces with rocky substrate and good water circulation from wave action or currents. Lacustrine populations often migrate up rivers to spawn.

Walleye spawning activity occurs at night and is often concentrated within a few days. Eggs are broadcast freely over the substrate and fall into cracks and crevices. Walleye do not provide any parental care.

Specific Habitat Requirements

Walleye are tolerant of a wide range of environmental conditions, but are generally most abundant in moderate-to-large lacustrine (>100 ha) or riverine systems characterized by cool temperatures, shallow to moderate depths, extensive littoral areas, moderate turbidities, extensive areas of clean rocky substrate, and mesotrophic conditions. One study suggested that the littoral and sublittoral habitats occupied by walleyes in lakes are the equivalent of extensions of suitable riverine habitat into the lacustrine environment.

Walleye survival, growth, and standing crop have been related to the abundance and availability of the small forage fishes it utilizes as food. Light conditions also are an important factor affecting walleye distribution, abundance, and feeding. Walleye survive and grow in a wide range of turbidities, but reach their highest abundance moderately turbid conditions. Peak feeding occurs at water transparencies of approximately 1 to 2 m Secchi disk depths with a great decrease in activity at < 1 or> 5 m Secchi disk depths. Walleye feed most actively under low light intensity. Lower standing crops of walleye in clear lakes may be at least partially attributable to the reduced length of time favorable for feeding. However, this relationship may not always hold in deep, clear lakes with adequate forage (e.g., cisco or whitefish, Coregonus sp.) available in deep water.

Walleye fry are photopositive until becoming demersal at lengths of 25 to 40 mm. The demersal fry, juveniles, and adults are very photosensitive. They actively seek the shelter of dim light during periods of strong light intensities in clear waters. They are often found in deep or turbid water or in contact with the substrate under cover of boulders, log piles, brush, and dense beds of submerged vegetation during the day.

Walleye are generally most abundant in lakes or lake sections classified as mesotrophic. They are less abundant in oligotrophic conditions (usually dominated by salmonids) and in eutrophic conditions (usually dominated by centrarchids). Eutrophication tends to significantly reduce habitat quality for walleye.

Walleye are commonly found in lakes with a pH ranging from 6.0 to 9.0; the species exhibits no behavioral changes when exposed to varying pH levels within this range. Lower pH levels (<6.0) are associated with failures in reproduction and recruitment. Higher pH levels (>9.0) generally are unsuitable for most freshwater fish.

Adult. Adult Walleye generally are found under cover in moderately shallow (<15 m) waters during the day and move inshore at night to feed. Adults often are found in areas with slight currents, except during the winter when they tend to avoid turbulent areas.

Preferred (optimum) temperatures for growth of adults are 20° to 24°C. Adults seem to avoid temperatures >24°C, if possible. One study reported that growth in adults ceases at temperatures <12°C. Upper lethal temperatures of 29° to 32°C were reported by one researcher, while two others reported an upper lethal range of 34° to 35°C.

Adult walleye can tolerate dissolved oxygen (DO) levels of 2 mg/1 for a short time, but the greatest abundance of walleye occurs where minimum DO levels are greater than 3 to 5 mg/1. DO levels of <1 mg/1 are lethal.

Embryo. Highest embryo production and survival has been observed on clean gravel or rubble substrates (2.5 to 15 cm in diameter). Survival also is good on dense mats of vegetation with adequate water circulation. Percent survival of embryos is greatly reduced on sand, and survival of eggs deposited on soft muck and detritus is negligible. Years of highest embryo production in lakes are often associated with rising or stable spring water levels that increase the amount of littoral area available for spawning and prevent stranding of embryos.

Embryos require well-oxygenated water, and DO levels 5 mg/l considered necessary for high survival and growth. DO levels ≤3.4 mg/l resulted in delayed hatching and a significant reduction in size at hatching. Streamflows and wind-generated currents in spawning areas must be sufficient for adequate circulation of oxygenated water around embryos.

Proper maturation of gonads in female walleyes requires minimum winter water temperatures of <10°C. One study reported that walleyes failed to reproduce in a reservoir with minimum winter temperatures of 10° to 12.5°C. Embryos are adapted to steadily increasing water temperatures during the spring. Optimum temperatures are 6° to 9°C for fertilization and 9° to 15°C for incubation. Upper lethal (TL_{50}) temperatures for embryos are near 19°C.

Eggs hatch in 14 to 21 days at temperatures of 8° to 15°C. Steady spring warming rates of >0.28°C/day have been positively correlated with embryo and fry production. Poor survival of embryos is associated with cold water temperatures due to slow spring warming rates, cold weather fronts, or release of cold reservoir water into tailwaters during spawning and incubation.

Fry. Stream velocities in spawning tributaries must be sufficient to transport fry downstream to lakes within the period of yolk-sac absorption (3 to 5 days) or fry will perish from lack of food. Fry will not begin to feed at temperatures <15°C.

Optimum temperatures for growth of walleye fry are near 22°C. No growth occurs at temperatures ≤12°C or ≥29°C. Upper lethal temperatures for fry are in the range of *31*° to 33°C. Conditions that reduce or retard growth (e.g., low temperature, low zooplankton abundance, and delayed hatching) can greatly affect fry overwinter survival because smaller fry experience more overwinter mortality than larger fry.

Optimum DO concentrations for fry are ≥5 mg/l. One study reported that DO levels below 5 mg/l resulted in poor survival of stocked fry. Low DO levels also retard fry development and reduce swimming ability.

Fry can withstand only slight current velocities. Two researchers reported that high velocities near a reservoir outlet can result in significant fry losses, particularly if spawning occurs at the dam face.

Juvenile. Habitat requirements for juvenile walleye seem to be similar to those of adults.