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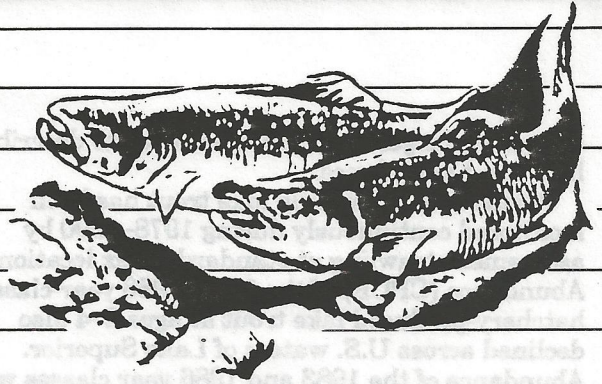

Survival of Hatchery-produced Lake Trout Declines in Lake Superior

Lake trout (*Salvelinus namaycush*) restoration in United States waters of Lake Superior may now depend on prudent management of naturally reproducing stocks, through control of fishing and sea lamprey (*Petromyzon marinus*), rather than on stocking of hatchery-reared fish. Lake trout were historically abundant in Lake Superior, but declined more than 90% during the 1950s. Later, abundance of hatchery-produced lake trout increased rapidly in Michigan and Wisconsin waters as stocking, sea lamprey control, and restrictions on commercial fishing became effective.

Remnant wild stocks of lake trout gradually recovered at Gull Island Reef in eastern Wisconsin waters, Stannard Rock in central Michigan waters, and Isle Royale in western Michigan waters. The abundance of wild lake trout across most Michigan and Wisconsin waters increased steadily during the 1970s and 1980s, though not as quickly as was expected if spawning of mature hatchery-produced fish had occurred. Abundance of wild lake trout increased more slowly in Minnesota waters.

Decline in Abundance of Hatchery-produced Fish

Abundance of adult lake trout in Lake Superior was monitored continuously since 1970 through assessment gillnetting at standard index locations. The average abundance of the 1963–1982 year classes of hatchery-produced lake trout at age 7 declined more than 75% across U.S. waters (Fig. 1). This decline was not explained by trends in stocking—there was no significant relation between U.S. stocking of the 1963–1982 year classes and subsequent catch per unit of effort (CPUE) at age 7 in gill nets during 1970–1989.

Abundance of age-7 lake trout declined significantly in most Michigan and Wisconsin waters of Lake Superior but increased in most Minnesota waters. The decline in abundance occurred earliest in eastern Wisconsin and eastern Michigan, where abundance fell off beginning with the 1963 year class. The decline began with the 1970 year class in central Michigan and the 1978 year class in western Michigan. In contrast, abundance increased in eastern Minnesota until the 1981 year class, and has yet to show a sustained decline in central Minnesota.

Declining abundance in Michigan waters was not generally associated with reduced stocking. Gillnet CPUE was significantly associated with stocking only in one area. However, abundance in Wisconsin and central Minnesota waters was significantly associated with stocking in those areas. Associations between CPUE in an area and stocking in other, often far-removed areas suggests that substantial movement of some marked hatchery-produced fish occurred between the times of their release and capture. However, recovery of 86–90% of tagged lake trout within the area where they were tagged in eastern and central Michigan waters suggests that movement is restricted to a home range that is

somewhat larger than the areas used to describe lake trout abundance.

Abundance of juvenile lake trout has been monitored continuously during 1978–1990 by assessment trawling at standard index locations. Abundance (CPUE) of the 1976–1986 year-classes of hatchery-produced lake trout at ages 2–4 also declined across U.S. waters of Lake Superior. Abundance of the 1983 and 1986 year classes was particularly low, and that of the 1984 and 1985 year classes was also lower than in previous years. The low abundance of the 1983 and 1986 year classes was at least partly a result of low stocking in both years.

Decline in Survival of Hatchery-produced Fish

Survival of the 1963–1982 year classes of hatchery-produced lake trout to age 7 (CPUE in gillnets per million hatchery-produced of that year class) declined more than 62% across U.S. waters of Lake Superior (Fig. 2). Survival was higher for 9 of 12 year classes through 1974 than for any subsequent year classes, and was lowest overall for the 1981 and 1982 year classes.

The patterns of survival in the various areas of U.S. waters were different than would be expected from patterns of stocking and abundance. In particular, higher than expected survival in eastern Minnesota suggests net immigration into that area, whereas lower than expected survival in eastern Wisconsin suggests net emigration from that area. These results confirmed our earlier conclusion that substantial movement of hatchery-produced fish occurs between the times of their release and capture. We conclude that lake trout movement precludes accurate estimation of survival within small areas, but that survival may be predictable on larger geographic scales or lakewide.

Survival of hatchery-produced lake trout to ages 2–4 (CPUE in trawls per million hatchery-produced of that year class) in U.S. waters of Lake Superior increased for the 1976–1979 year classes, and generally decreased for subsequent year classes. The pattern of survival for age 2–4 hatchery-produced lake trout showed little correspondence to the pattern of survival for age-7 fish of the 1976–1982 year classes where both had been estimated. Thus, trawl catches of age 2–4 hatchery-produced lake trout provided a poor predictor of survival to age 7 for the 1983–1986 year classes. It is likely that the sources of mortality evident at age 7 were different than those evident at ages 2–4.

Natural Stocks Should be Focus of Management

Declining survival of hatchery-produced lake trout in Lake Superior raises serious doubts about the continued usefulness of stocking for restoration. The interagency lake trout restoration plan for Lake Superior may need to be modified to recognize that hatchery-reared lake trout no longer supplement abundance in many areas of the lake, but rather, that abundance is being regulated by natural recruitment and sources of mortality. Lake trout restoration may now depend on prudent management of naturally reproducing stocks, through reduction of fishing and through continued sea lamprey mortality, rather than on stocking of hatchery-reared fish.

For further information, contact:

Michael J. Hansen or James H. Selgeby
National Fisheries Research Center
—Great Lakes
1451 Green Road
Ann Arbor, MI 48105
(313) 994-3331

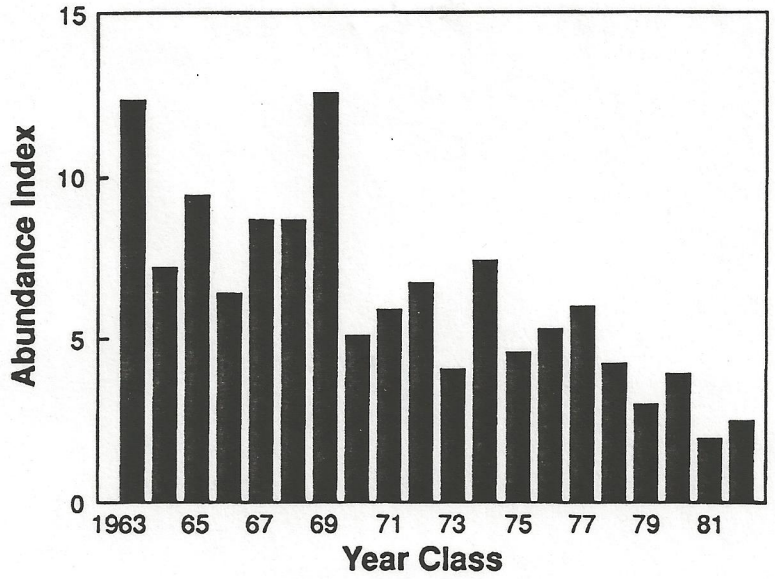

Figure 1. Abundance index (CPUE, or catch per 305-m gill net) at age 7 of stocked lake trout of the 1963–1982 year classes in United States waters of Lake Superior. Age-7 fish were in the first fully recruited year class caught in assessment nets and were less subject to fishing and lamprey-induced mortality than older fish.

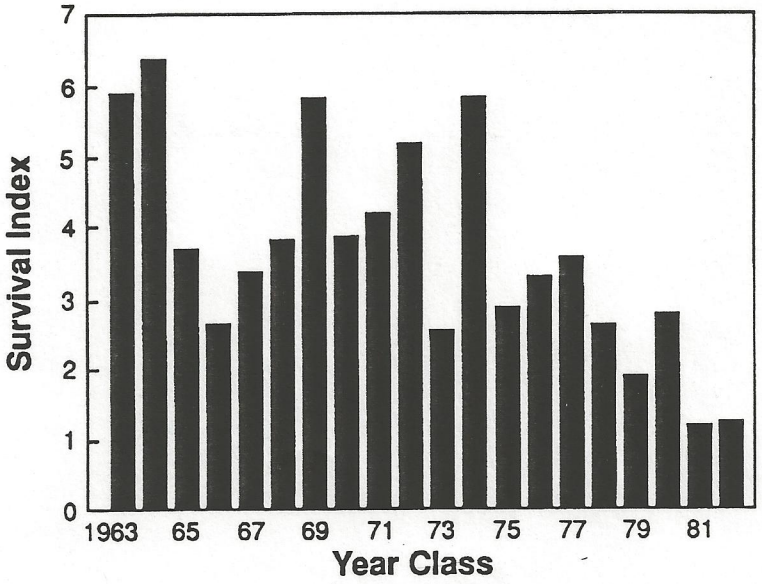

Figure 2. Survival index (CPUE per million hatchery-produced fish released) to age 7 of the 1963–1982 year classes of stocked lake trout in United States waters of Lake Superior.