Status of Native Lake Trout in Montana

Bob Snyder

Montana Fish, Wildlife and Parks
Helena, Montana

Dick Oswald

Montana Fish, Wildlife and Parks
Dillon, Montana

Taxonomy

Lake trout (*Salvelinus namaycush*) were first described from a specimen from Hudson Bay (Walbaum 1792 cited by Scott and Crossman 1973). *Salvelinus* is the generic name for arctic chars; *namaycush* is a North American Indian name for "dwellers of the deep" (NSDAF 2004). Lake trout are typically trout-like in shape. Like other chars, lake trout have light spotting on a dark background that can range from light green to almost black. A narrow, sometimes indistinct, white anterior border is present on the pectoral, pelvic and anal fins (NSDAF 2004). Lake trout can be distinguished from other chars by their deeply forked tail (Holton and Johnson 1996). Lake trout display significant genotypic and phenotypic variation throughout their range, with many local color and body morphological differences (Page et al. 2003; NatureServe 2004). Lake trout and bull trout (*Salvelinus confluentis*) are the only members of the genus *Salvelinus* native to Montana (Holton and Johnson 1996).

Historical Range

Lake trout are native to northern North America, with their historic range determined primarily by the extent and dynamics of the Pleistocene glaciations (Lindsey 1964 cited by Wilson and Hebert 1998; Wilson and Hebert 1998). More specifically, the lake trout's native range includes portions of all of the Canadian provinces except Newfoundland and Prince Edward Island, and the states of Alaska, Maine, Illinois, Indiana, Massachusetts, Michigan, Minnesota, Montana, New Hampshire, New York, Ohio, Pennsylvania, Vermont and Wisconsin (NatureServe 2004).

During the Pleistocene glaciations, a lake trout refugium was formed in the lakes occurring along the ice sheet in what is now Montana. As the Wisconsin ice sheet withdrew, fish from the Alberta/Montana refugium recolonized the newly exposed deep lakes (Wilson and Mandrak 2004). Montana's native lake trout populations are remnant examples of this important refugium (Wilson and Hebert 1998).

In Montana, native lake trout populations remain in Waterton Lake, Glenns Lake, Cosley Lake, and St. Mary Lake in Glacier National Park and Lower St. Mary Lake on the Blackfeet Indian Reservation (Figure 1). All of these waters are in drainages that eventually reach Hudson Bay. Additionally, other native populations are found in Twin Lake in the Big Hole River drainage and Elk Lake in the Red Rock River drainage, which are both tributaries to the upper Missouri River drainage (Figure 1). Although there are records of some stocking of lake trout into Cosley, Glenns and Lower St. Mary lakes, mtDNA analysis by Wilson and Hebert (1998) gives evidence of the native status of these populations. There are no records documenting the stocking of lake trout into Twin and Elk Lakes. Other lake trout populations in Montana are the result of legal and illegal introductions and are not remnant native populations.

The lake trout of Elk and Twin Lakes in southwestern Montana have long been accepted as representing native populations (Brown 1971). Recent examination of the literature and genetic analysis lend credence to this assumption. Vincent (1963) cited numerous authors from the late 1800's that described collections of native lake trout from Elk Lake prior to 1890, when the species was first brought to the intermountain west for introduction. He also referenced a type collection of three lake trout sent to the U.S. National Museum listing Elk Lake as the specimen locality. He concluded that the lake trout of Elk Lake were a glacial relict population and native in origin. Vincent (1963) also cited early naturalists' reports from the late 1800's which described visits to Twin Lakes and references to a native lake trout population prior to 1890. Khan and Quadri (1971), in a meristic and morphological examination of lake trout from across its range of distribution, determined that the lake trout of Elk and Twin Lakes represented a glacial refuge population in the upper Missouri River drainage. Genetic examination of a small collection of lake trout from Twin Lakes in 1994 led Wilson and Hebert (1998) to conclude that the fish were of a distinct haplotype and represent a glacial relict native population. This C3 haplotype originated in northernmost Alaska and Canada and is currently distributed in western Montana and southern Alberta. More recent genetic examination of 14 fish from Elk Lake and 14 fish from Twin Lakes led to agreement with Wilson and Hebert's findings and the conclusion that the lake trout populations of both lakes represent native populations of the same glacial origin (M.B. Curtis, US Geological Survey, personal communication 2000). This expanded examination also eliminated the possibility that the native Elk Lake stock had been contaminated by introduced lake trout of Great Lakes origin that were stocked in Yellowstone Park in 1890. Examinations of mitochondrial DNA (mtDNA) by Curtis also suggest that low variation is associated with a genetic "bottleneck" caused and maintained by low populations of breeding individuals in both lakes. This is substantiated by lake trout collection densities in Elk and Twin Lakes and also by the age and size structure of the sample populations.

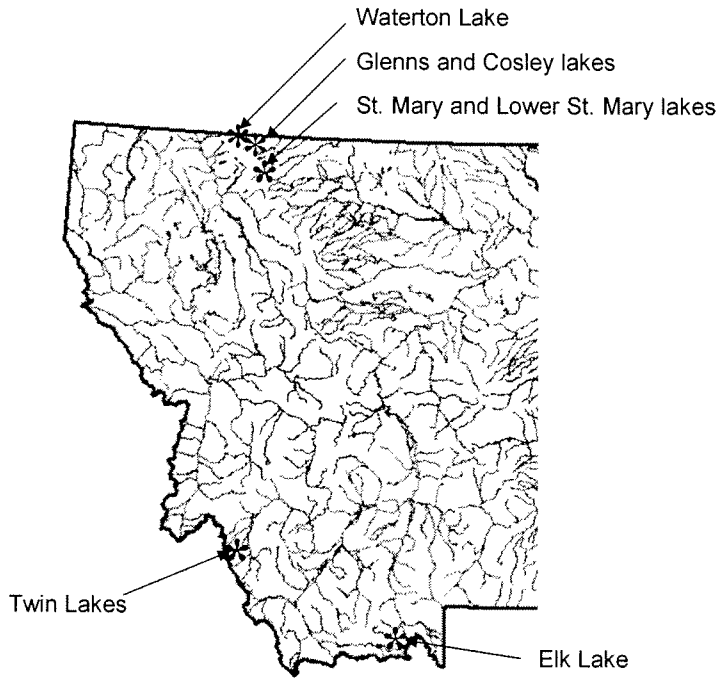

Figure 1. Current distribution of native lake trout populations in Montana.

Life History and Ecology

While lake trout can be found in cold rivers and shallow lakes in the northern portion of its range (Scott and Crossman 1973), in Montana, native lake trout inhabit a few relatively deep, cold lakes remaining from the Pleistocene glaciations. Lake trout typically use water temperatures in the 50-57 °F range (Magnuson et al. 1990) and, therefore, spend most of their lives in the deeper habitats associated with these water temperatures. Lake trout can occasionally be found in shallow water habitats during seasons when surface waters are within their preferred temperature range.

Lake trout are long-lived and reach sexual maturity relatively late, as early as age IV and as late as age XVII (NatureServe 2004). The oldest estimated age for lake trout is 65 years (NatureServe 2004). Lake trout are the largest freshwater salmonid native to North America, with specimens over 100 pounds caught by commercial fishermen (NSDAF 2004). The current (2005) Montana state record for lake trout is a 42 pound, 11.8 ounce fish from Flathead Lake that measured 42.5 inches (Easterling 2004).

Lake trout spawn during the fall when water temperatures decline to 46.4-57.2 °F, which typically coincides with the breakdown of thermal stratification (Gunn 1995). Lake trout do not demonstrate distinct sexual dimorphism (Martin and Olver 1980) and are the only salmonid that exhibits exclusively nocturnal spawning behavior (Gunn 1995). Lake trout are broadcast spawners. Eggs are deposited on boulder or cobble habitats in depths usually less than 40 feet, although spawning has been documented to occur at depths as

shallow as 1 foot and greater than 120 feet (Scott and Crossman 1973). Eggs and fry develop in the interstitial spaces of the substrate and emergence typically occurs 4 to 6 months after spawning (Scott and Crossman 1973).

Juvenile lake trout feed on a variety of zooplankton and aquatic invertebrates. Adult lake trout are predacious, feeding upon a wide range of organisms including crustaceans, aquatic and terrestrial insects and fish (Scott and Crossman 1973). Faster growth rates and eventual larger size occur when abundant fish forage is available. The importance of benthic cottids as a forage to some lake trout populations has been documented (Rawson 1961 in Scott and Crossman 1973; Scott and Crossman 1973).

Great genotypic and phenotypic variability can be found in lake trout populations throughout their range, with many unique local adaptations including various life histories, differing ability to avoid lamprey predation, and varieties of body form, coloration, and spotting patterns (Page et al. 2003).

As a top trophic level predator with a mostly piscivorous diet, non-native lake trout have caused catastrophic declines in native fish assemblages where they have been introduced (Cordone and Frantz 1966; Donald and Alger 1993; and Stapp; Hayward 2002).

Status

The Natural Heritage Program classifies native lake trout in Canada and the United States as an N5 (Secure-Common, widespread, and abundant in the nation) (NatureServe 2004). The NHP conservation status rank for Montana native lake trout populations is currently SU (Status Under Review) (NatureServe 2004).

Within the United States, introduced lake trout populations are widespread and, in some cases, expanding. Native lake trout populations, however, are in a more tenuous status. The lake trout's long generation time, low fecundity, specific adult and spawning habitat requirements and status as a top-end predator make the species vulnerable to anthropogenic disturbances (Wilson and Mandrak 2004). Lake trout populations have been decimated by over-harvest, habitat loss, pollution, and introductions of non-native fish species, especially sea lampreys (*Petromyzon marinus*) into the Great Lakes. Efforts to re-establish native lake trout populations have generally not met management goals (Wilson and Mandrak 2004).

Elk Lake, in the Red Rock River drainage, is a 283 surface acre lake at 6,674 feet elevation with a maximum depth of 70 feet (USFS 2004). It is a moderately productive and would probably be characterized as mesotrophic. The lake trout population in Elk Lake has been most recently described by Oswald (2000, 2002, 2004). Lake trout numbers appear relatively stable at low density; varying between about 0.8 and 1.6 per net since 1991. Analyses of mean length, length range, and composite length frequency over the 1991-2001 period demonstrate stability within the sample population. Mean length varied only slightly, with length-frequency analysis demonstrating that the

majority of lake trout sampled range between 16.5 and 19.5 inches in length. Juvenile fish only appeared in the 1994, 1998, and 2001 samples, suggesting limited recruitment into the population. It is estimated that the Elk Lake population is small (250-1000 fish) with an irregular age structure. Lake trout inhabit Elk Lake along with native burbot (*Lota lota*), white sucker (*Catostomus commersoni*), and mottled sculpin (*Cottus bairdi*). A lacustrine population of Arctic grayling (*Thymallus arcticus*) also occupied the lake until the mid 1990's when persistent drought dewatered spawning streams, resulting in a lack of recruitment and ultimate extirpation. Currently, the most abundant salmonid inhabiting Elk Lake is a stocked population of westslope cutthroat trout (*Oncorhynchus clarkii lewisi*) that provides a popular sport fishery. The lake trout population of Elk Lake has been managed under catch and release regulations since 2000.

Twin Lakes, in the Big Hole River drainage, is a 75 surface acre lake at 7,235 feet elevation with a maximum depth of 72 feet (USFS 2004). Twin Lakes, like the adjacent lakes along the west Big Hole Valley, is quite limited in productivity and would probably be classified as oligotrophic. The fish populations of Twin Lakes have been sampled sporadically since 1964 and have been reported in detail by Oswald (2000, 2002, 2004). In the interest of better determining the native genetic status of the lake trout of Twin Lakes, an intensive sampling effort was conducted in 1998 (Oswald and Roberts 1998) resulting in the setting of 20 overnight experimental gill nets between July 17 and October 8, 1998. The 1998 sampling effort resulted in a clearer description of the fish populations of Twin Lakes than had previously existed. Trends in lake trout numbers over the 1964-1998 period revealed that, prior to 1998, lake trout sample numbers varied between 1.0 and 5.0 per net. The highest capture rates were noted in the 1964, 1986 and 1990 samples. Intensive sampling in 1998 revealed a capture rate of 0.6 per net. The length-frequency distribution of fish collected in the 1998 sampling program revealed the presence of only two age classes of fish. The juvenile year class was composed of fish in the 12.0-13.9 inch length range, while the mature age group consisted entirely of fish in excess of 30 inches in length. The disparate size classes indicative of sporadic success in lake trout recruitment was also observed in the 1964 and 1986 samples. In contrast with Elk Lake, the length range and mean length of the lake trout from Twin Lakes samples has varied widely over the sample period. It is estimated that the Twin Lakes population is substantially smaller than that of Elk Lake (50 – 250 fish) and is declining due to extremely sporadic and limited recruitment.

Little is known about the status of Montana's northern native lake trout populations. The populations in Waterton, Cosley, Glenns and St. Mary lakes are afforded the protection of their location within Glacier National Park. The Waterton Lake population, in the Waterton river drainage, is believed to be abundant and stable (L. Marnell, National Park Service, personal communication).

There is some question whether the Glenns and Cosley lakes populations, in the Belly river drainage, are native due to the location of a downstream barrier falls (L. Marnell, NPS, personal communication). Holton and Johnson (1996) did not list these as native populations; however, Wilson and Hebert (1998) found that there is genetic evidence that the Cosley Lake haplotype is consistent with the other populations that formed the

Alberta/Montana refugium. The Cosley and Glenns lakes populations are believed to be stable, but there is no data to support this presumption. There are records of stocking lake trout of unknown origin into Cosley and Glenns lakes, so the genome of these populations may contain introduced alleles. Genetic analysis has been performed, but not reported, to identify the source stock for these introductions (L. Marnell, NPS, personal communication; R. Wagner, US Fish and Wildlife Service, personal communication).

The St. Mary Lake population is also believed to be abundant and stable. Lake trout are the second most abundant fish species after lake whitefish in St. Mary Lake. There are records of stocking lake trout into St. Mary Lake, so the genome of this population may contain exotic alleles. DNA analysis has been performed, but not reported, to identify the source stock for these introductions (L. Marnell, NPS, personal communication; R. Wagner, USFWS, personal communication).

Lower St. Mary Lake is located within the Blackfeet Indian Reservation. This population is stable and abundant. Lake trout are the most dominant fish species after lake whitefish and comprise 10-30% of the commercial lake whitefish catch. Again, there are records of stocking lake trout of unknown origin into Lower St. Mary Lake. Water level fluctuations and dewatering due to lake management for irrigation impacts this population (R. Wagner, USFWS, personal communication).

The genetic uniqueness and significance of Montana's native lake trout populations to the post-glacial distribution of the species mandate that these remnant native populations be conserved.

References

Brown, C.J.D. 1971. Fishes of Montana. Big Sky Books. Montana State University, Bozeman. 207pp.

Cordone, A.J., and T.C. Frantz. 1966. The Lake Tahoe sport fishery. Calif. Fish & Game 52(4):240-274.

Curtis, M.B. 2000. Personal communication of unpublished data. USGS Great Lakes Science Center, Ann Arbor, Michigan.

Donald, D.B., and D.J. Alger. 1993. Geographic distribution, species displacement, and niche overlap for lake trout and bull trout in mountain lakes. Canadian Journal of Zoology. 71(2): 238-247.

Easterling, C. 2004. Kalispell (Montana) Daily Inter Lake, August 11, 2004.

Gunn, J.M. 1995. Spawning behavior of the lake trout: effects on colonization ability. Journal Great Lakes Research 21 (Supplement): 323-329.

Holton, G.D., and Johnson, H.E. 1996. A field guide to Montana Fishes. Second edition. Dave Books editor. Montana, Fish, Wildlife and Parks, Helena, Montana.

Khan, N.Y., and Qadri, S.U. 1971. Intraspecific variations and post-glacial distribution of lake char (*Salvelinus namyacush*). Journal of the Fisheries Research Board of Canada 28: 465-476.

Lindsey, C.C. 1964. Problems in zoogeography of the lake trout *Salvelinus namaycush.* Journal of the Fisheries Research Board of Canada 21: 977-994.

Magnuson, J.J., Crowder, L.B., and Medvick, P.A. 1979. Potential changes in the habitat of Great Lakes fish after global climate warming. Trans. Am. Fish. Soc. 119:254-264.

Martin, N.V., and Olver, C.H. 1980. The lake charr, *Salvelinus namyacush.* In *Charrs, Salmonid Fishes of the genus* Salvelinus. Edited by E.K. Balon and Dr. W. Junk. The Hague. pp. 205-277.

NatureServe. 2004. NatureServe Explorer: An online encyclopedia of life [web application]. Version 4.0. NatureServe, Arlington, Virginia. Available: http://www.natureserve.org/explorer. (Accessed: August 12, 2004).

Nova Scotia Department of Agriculture and Fisheries (NSDAF) 2004. Available: http://www.gov.ns.ca/nsaf/sportfishing/species/lktrout.htm. (Accessed August 11, 2004).

Oswald, R.A., and Roberts, B. 1998. Twin Lakes Fish Population Sampling. Report to Big Hole Watershed Com., Mont. Fish, Wild. and Parks, Dillon 13pp.

Oswald, R.A. 2000. Inventory and survey of fisheries in lowland lakes and reservoirs of the Red Rock, Ruby, Beaverhead, and Big Hole River drainages of southwest Montana. Job Prog. Rpt., Fed. Aid in Fish and Wild. Rest., Proj. Nos. F-78-R-1, R-2, R-3, R-4, and R-5. 50pp.

Oswald, R.A. 2002. Inventory and survey of fisheries in lowland lakes and reservoirs of the Red Rock, Ruby, Beaverhead, and Big Hole river drainages of southwest Montana. Job Prog. Rpt., Fed. Aid in Fish and Wildlife Restoration, Project numbers F-78-R-6 and F-113-R-1. 44pp.

Oswald, R.A. 2004. Inventory and survey of fisheries in lowland lakes and reservoirs of the Red Rock, Ruby, Beaverhead, and Big Hole river drainages of southwest Montana. Job Progress Report, Federal Aid in Fish and Wildlife Restoration, Project Numbers F-78-R-6 and F-113-R-2, R-3 and R-4. 48pp.

Page, K.S., Scribner, K.T., and Burnham-Curtis, M. 2003. Genetic diversity of wild and hatchery lake trout populations: relevance for management and restoration in the Great Lakes. Transactions of the American Fisheries Society: Vol. 133, No. 3, pp. 674-691.

Rawson, D. S. 1961. The lake trout of Lac la Ronge, Saskatchewan. Journal of the Fisheries Research Board of Canada 18(3): 423-462.

Scott, W.B., and Crossman, E.J. 1973. Freshwater Fishes of Canada. Bulletin 184 of the Fisheries Research Board of Canada, Ottawa. 966 pp.

Stapp, P.and Hayward, G.D. Effects of an Introduced Piscivore on Native Trout: insights from a Demographic Model. Biological Invasions. 2002. Vol. 4, No. 3, pp. 299-316(18).

US Forest Service (USFS). Beaverhead-Deerlodge National Forest Lake Inventory. Available: http://www.fs.fed.us/r1/b-d/lakes.htm. (Accessed: August 12, 2004).

Vincent, R.E. 1963. The native range of lake trout (*Salvelinus namaycush*) in Montana. Copeia 1963(1): 188 – 189.

Walbaum, J.J. 1792. Petri Artedi renovati, i.e. bibliotheca et philosophia ichthyolgica. Ichthyoloiae pars III. Grypeswaldiae. Ant. Ferdin. Roese. 723 pp.

Wilson, C.C., and Mandrak, N.E. 2004. History and evolution of lake trout in Shield lakes: past and future challenges. In J. M. Gunn, R. J. Steedman and R. A. Ryder, editors. Boreal Shield watersheds: lake trout ecosystems in a changing environment. Lewis Publishers, Boca Raton.

Wilson, C.C., and Hebert, P.D.N. 1998. Phylogeography and postglacial dispersal of lake trout (*Salvelinus namaycush*) in North America. Canadian Journal of Fisheries and Aquatic Sciences 55: 1010-1024.