

FISH

Burbot *Lota lota*

Ecology: Burbot are large fish known to grow to as much as 1.5 meters in length and 34 kilograms in mass (Morrow 1980). These fish are yellow, light tan, or brown with dark brown or black patterning on the body, head and most fins. The underbelly and pectoral fins are pale to white (Morrow 1980; Cohen et al. 1990). The first dorsal fin is short and is followed by a long second dorsal fin at least six times the length of the first and joined to a rounded caudal fin (Morrow 1980). Burbot have neither dorsal nor anal spines and have 67 to 96 soft dorsal rays, and 58 to 79 soft anal rays (Cohen et al. 1990). Gill rakers are short, pectoral fins are rounded, and caudal fins have 40 rays (Morrow 1980). Like other cods, burbot are also characterized by a single barbel located on the chin (Morrow 1980; Cohen et al. 1990).

Newly hatched burbot are completely planktivorous, and remain so even when they are no longer gape limited (Ghan and Sprules 1993). Diet of larval burbot is dominated by rotifer species for the first two weeks. Diet then shifts to slightly larger nauplii, changing further during week four to cycloid copepods, daphnia and calanoid copepods (Ghan and Sprules 1993). Juveniles have a diet of molluscs and insect larvae (Tolanen et al. 1999). Adult burbot are piscivorous and diet consists of over 99% fish, by mass, in Lake Superior (Bailey 1972). Though burbot are primarily a piscivorous fish, their diet changes seasonally and in response to competition. After the winter months, Tolanen et al. (1999) found that burbot ate a much higher proportion of aquatic invertebrates, namely crustaceans in the early summer and opossum shrimp in the fall. In Siberia's Vilyusk Reservoir, their diet overlaps with pike and forces burbot to broaden their diet breadth to include more benthic invertebrates (Kirillov 1988). In addition to fish and invertebrates, Bailey (1972) also found rocks, wood chips, plastic, and other inert materials in burbot stomachs, indicating that burbot feeding habits were somewhat indiscriminate (Bailey 1972; Kirillov 1988; Ghan and Sprules 1993; Tolanen, Kjellmann, and Lappalainen 1999). Burbot are the top predators in their ecosystem, sometimes overlapping with similar top predators such as pike or large salmonids (Kirillov 1988).

Burbot are demersal fish found in deep temperate lake bottoms and slow moving cold river bottoms with temperatures between four and eighteen degrees Celcius (Cohen et al. 1990; Riede 2004). Primarily found at depths ranging from 1 to 700 meters, these fish prefer fresh waters, but are also found in some brackish water systems (Cohen et al. 1990). These fish often dwell among benthic refugia such as roots, trees, rocks and dense vegetation (Scott and Crossman 1973; Morrow 1980; Cohen et al. 1990; Billard 1997; Riede 2004).

Burbot eggs hatch in the spring between April and June, depending on location (Bjorn 1940; Cohen 1990). Incubation time is temperature and population specific and eggs usually take between 30 and 70 days to hatch (Bjorn 1940; MacCrimmon 1959). In four weeks, larval burbot increase in length from less than one centimeter to over two centimeters (Ghan and Sprules 1993). Burbot in Lake Superior exhibited very fast growth rates during the first two growing seasons, and attain 42% of their total length after ten

growing seasons (Bjorn 1940; MacCrimmon 1959; Bailey 1972; Cohen et al. 1990; Ghan and Sprules 1993). In the Vilyuy River Basin, Siberia, burbot attain sexual maturity in their 7th or 8th year, with males usually maturing one year before females (Kirillov 1988). In Lake Superior, burbot as young as one year old were sexually mature (Bailey 1972). Though sexually mature specimens were found for both sexes in year one and older age classes, there was not a high proportion of sexually mature males until year five, when all specimens of both sexes were sexually mature (Bailey 1972). Activity of burbot increases in autumn as energy reserves are concentrated on the growth and development of gonads for the winter spawning season (Kirillov 1988). Maturation of the gonads in both sexes occurs at about four months after the fall peak in nutritional reserves (Bailey 1972; Kirillov 1988; Pulliainen and Korhonen 1990).

Burbot breed once per year in the winter, migrating to shallow water or to a smaller stream to spawn (Cohen et. al. 1990). Burbot move to spawning areas individually and males tend to arrive before females (Morrow 1980). Spawning occurs during the night when individuals form a globular mass, each fish pushing toward the center and releasing eggs or sperm (Cahn 1936; MacCrimmon 1959). Post spawning runs upstream have been observed, most likely for feeding (Cahn 1936; MacCrimmon 1959; Morrow 1980; Cohen et al. 1990). Burbot are broadcast spawners and provide no parental care. Parental investment in burbot is characterized by an increased metabolic activity level and food consumption rates in the fall in order to contribute to the growth and maturation of gonads in both male and females over a four month period preceding spawning events (Kirillov 1988; Pulliainen and Kohonen 1990). It has been suggested that burbot may require one to two years to replenish their nutritional reserves after each spawning event. (Kirillov 1988; Pulliainen and Korhonen 1990).

Distribution: Burbot are native to Alaska, Canada and the northern continental U.S., with their range extending as far south as Wyoming and northeastern Utah. Burbot have been widely introduced and populations are now established in Connecticut, Illinois, Indiana, New Jersey, Ohio and Pennsylvania (Fuller 2008). Burbot have been found in Flaming Gorge Reservoir as far south into Utah as Linwood Bay and Antelope Flat. Biologists expect the burbot to move into the reservoir's array of canyons and as far south as the Flaming Gorge Dam (Pers. Comm. Roger Schneidervin. 2008. Aquatic Program Manager, Northeastern Region, Utah Division of Wildlife Resources).

Pathways of Introduction: Burbot are a non-native invasive species probably introduced by sportsman into Flaming Gorge Reservoir (Pers. Comm. Roger Schneidervin. 2008. Aquatic Program Manager, Northeastern Region, Utah Division of Wildlife Resources).

Management Considerations: The only management tactic that has been tried on Flaming Gorge Reservoir, so far, is angling. Burbot have no limit and have a must kill or illegal to release law. Burbot have been caught over the winter months through the ice in large quantities. Because this is a newly introduced species into Flaming Gorge Reservoir, Utah Division of Wildlife Resources, in cooperation with Utah State University, will begin a graduate study in 2008 to closer study the impacts of burbot on this ecosystem. It will be difficult to convince Utah's anglers that burbot is an AIS, since they grow large

and taste good; regardless, they will likely impact desired game fish in Flaming Gorge Reservoir (Pers. Comm. Roger Schneidervin. 2008. Aquatic Program Manager, Northeastern Region, Utah Division of Wildlife Resources).

Literature Cited:

- Bailey, M.M. 1972. Age, growth, reproduction, and food of the burbot, *Lota lota* (Linnaeus), in Southwestern Lake Superior. Transactions of the American Fisheries Society 101(4): 667-674.
- Billard, R. 1997. Les poissons d'eau douce des rivières de France: identification, inventaire et répartition des 83 espèces. Delachaux & Niestlé, Lausanne, Switzerland.
- Bjorn, E. 1940. Preliminary Observations and Experimental Study of the ling, *Lota maculosa* (LeSueur), in Wyoming. Transactions of the American Fisheries Society 69:192-196.
- Cahn, A. 1936. Observations on the breeding of lawyer, *Lota maculosa*. Copeia 3:163-165.
- Cohen, D., T. Inada, T. Iwamoto, and N. Scialabba. 1990. Gadiform fishes of the world : order Gadiformes, an annotated and illustrated catalogue. Food and Agriculture Organization of the United Nations, Rome.
- Fuller, P. 2008. *Lota lota*. USGS Nonindigenous Aquatic Species Database, Available: nas.er.usgs.gov/queries/FactSheet.asp?speciesID=698.(August 27, 2008).
- Ghan, D., and W. Sprules. 1993. Diet and prey selection in young burbot. Journal of Fish Biology 42:47-64.
- Kirillov, A. 1988. Burbot of Vilyusk Reservoir. Journal of Ichthyology 28(2):49-55.
- MacCrimmon, H. 1959. Observations on spawning of burbot in Lake Simcoe, Ontario. Journal of Wildlife Management 23(4): 447-449.
- Morrow, J. 1980. The Freshwater Fishes of Alaska. Alaska Northwest Publishing Company, Anchorage.
- Pulliainen, E., K. Korhonen. 1990. Seasonal changes in condition indices in adult mature and non-maturing burbot, *Lota lota* (L.), in the north-eastern Bothnian Bay, Northern Finland. Journal of Fish Biology 36(2): 251-259.
- Riede, K. 2004. Global register of migratory species: from global to regional scales. Federal Agency for Nature Conservation, Final report of the R&D Projekt 808 05 081, Bonn, Germany.

Scott, W., E. Crossman. 1973. Freshwater fishes of Canada. Bulletin of the Fisheries Research Board Canada 184:1-966.

Tolonen, A., J. Kjellmann, and J. Lappalainen. 1999. Diet overlap between burbot and whitefish in a subarctic Lake. *Anale. Zoologici Fennici* 36:205-214.

Burbot

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Legend

— Streams

■ Lakes

