Flathead Lake Biological Station
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Fishes of Flathead Lake (Part 1): How we got here

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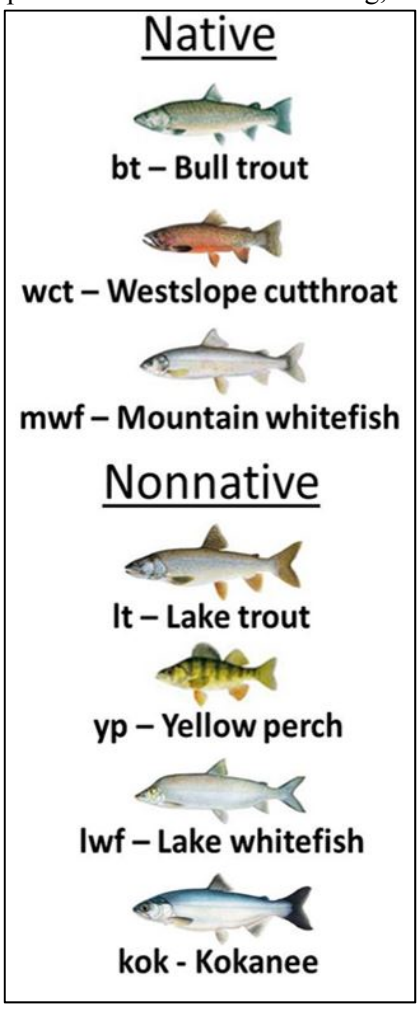
When the first settlers of European descent arrived in NW Montana in the late 1800s, they found about 10 fish species in Flathead Lake. Native fishes of note were westslope cutthroat trout (Montana's state fish) and bull trout (the top predator). Since Flathead Lake had been ice as recently as 15-20,000 years prior and ice is a tough place for a fish to make a living, this low diversity is not surprising.



But early fisheries managers saw opportunity. Opportunity to 'improve' Flathead Lake and the waters of Montana. So they did what fisheries managers of that era did − they stocked nonnative fishes. They did so widely − from buckets, from backpacks, from mule trains, railroad cars, tanker trucks and even helicopters. Between 1890 and 1950 state and federal fisheries managers intentionally introduced roughly 25 fish species into Flathead Lake to see what would take. They predominantly stocked fishes that were fun to fish for and tasty to eat. These included rainbow trout from the west coast in 1914 (the most widely stocked fish in the world), brook trout from the east coast in 1913, and lake trout from the Midwest in 1905.

Many of these fishes did not survive the low nutrient, cold waters of the Flathead. Others did well, reproducing naturally after initial stocking and becoming what biologists term "naturalized". Today we have 21 species of fish in Flathead Lake of which 10 are native. And the most abundant fishes are nonnatives: lake trout, lake whitefish and yellow perch. (Detailed information about the fishes of the Flathead can be found at http://flbs.umt.edu/lake/flatheadlake.aspx) So how did we get here? What happened along the way?

To understand this we must talk about salmon and shrimp. One of the fish that managers introduced to the Lake was kokanee salmon (1916). Kokanee is a landlocked sockeye salmon. Salmon typically are born in freshwater streams and after a year or two swim to the ocean to take advantage of abundant food resources. There they get significantly larger and after several years (depending on the species) they head back upstream to the place that they were born, reproduce and die. However, salmon stocked in interior areas cannot reach the ocean, so they adapt to what is available. In the Flathead they used the Lake as their "ocean" and traveled up the Flathead River to reproduce. Subsequently, each fall there were large salmon spawning congregations in streams such as McDonald Creek in Glacier National Park.

These kokanee salmon were very popular. During the "Kokanee era" (c.1940-1980), they were very abundant (more than 300,000 in Flathead Lake), fun to catch and delicious. You could fillet them, you could grill them, you could smoke them, you could can them. In short, you could survive a winter off of them. So people caught lots of them. Additionally, wildlife recognized their value. During the fall they were accessible in shallow spawning streams to bears seeking out fatty and protein-rich foods in preparation for hibernation. Bald eagles came from afar to feed, resulting in the largest congregations of eagles in the US outside of Alaska. Subsequently, camera-toting tourists came to witness this internationally renowned wildlife spectacle.

So what do you do if you are the manager of such a popular fishery? You try to make it better, of course. Starting in the 1950s, fisheries managers across the West widely stocked a freshwater shrimp, *Mysis*, in lakes. Native zooplankton (small aquatic animals eaten by many fish, including kokanee and cutthroat trout) are typically barely visible with the naked eye, whereas *Mysis* are large − adults are over 1/2 inch. The rationale for *Mysis* stocking was that a larger food package would yield more and larger fish for people to enjoy. In the Flathead, managers noted that just 4 hours to the north Kootenai Lake in British Columbia was yielding world record kokanee. So between 1968 and 1975, Montana Fish, Wildlife & Parks introduced *Mysis* to 5 lakes in the Flathead including Whitefish and Swan Lakes. By 1981 they had drifted downstream and were found in Flathead Lake by the Flathead Lake Biological Station's young (at that point) monitoring program.

Unfortunately, the shrimp did not boost the kokanee population in Flathead Lake as managers had hoped. Instead, it caused a total population crash of the species that it was supposed to enhance. Between 1984 and 1989 kokanee in Flathead Lake went from more than 300,000 to zero, the *Mysis* went from roughly 5 per square meter of lake to nearly 130 per square meter, the bears were forced to search for other rich foods in the fall and the eagles went elsewhere.

What happened? Well, *Mysis* shrimp eat zooplankton so they became a competitor for food with kokanee. As the shrimp population exploded they gobbled up all the large, nutritious and tasty zooplankton, leaving little for kokanee and other fishes. Additionally *Mysis* vertically migrate, spending the day on the bottom when kokanee were feeding near the surface, and coming up at night to eat zooplankton, the salmon food. So kokanee never had the chance to feed upon the shrimp, and the shrimp ate all of the salmon's preferred food. Bio Station researchers documented these species interactions known as a "trophic cascade" in a scientifically famous paper in 1991 (Spencer, McClelland and Stanford. "Shrimp stocking, salmon collapse and eagle displacement: Cascading interactions in the food web of a large aquatic ecosystem. BioScience 41(1):14–21).

But the story doesn't end there. It turns out that two fish species introduced from the Great Lakes in the early 1900s, lake trout and lake whitefish, evolved with *Mysis* and feed on the bottom. Until the advent of the "*Mysis* era", lake trout and lake whitefish had survived but had not become abundant in Flathead Lake, as there was not much food down deep. When *Mysis*, one of their favorite foods, showed up their populations grew. Lake whitefish eat *Mysis* and other bottom-dwelling invertebrates for their entire lives, whereas most lake trout eat *Mysis* when small (up to 24 inches) and then switch to fish when they are larger. So the introduction of the shrimp (an abundant food source on the bottom) removed the bottleneck for growth and survival of juvenile lake trout and lake trout numbers increased dramatically.

Lake trout are voracious and indiscriminant predators. They can eat a fish more than 50% of their own body size and will even eat their own kind and their own young. So, as the population of a large predator increased in Flathead Lake, other fishes were consumed. This included our native trout and the kokanee. In particular, young kokanee salmon that were stocked in the 1990s by Montana Fish, Wildlife & Parks during an unsuccessful reestablishment effort were tasty morsels for the growing lake trout population. Netting in Yellow Bay during kokanee stocking yielded lake trout with distended bellies and kokanee tails sticking out of their mouth.

So today, Flathead Lake is dominated by nonnative species that evolved together in the Midwest: lake trout, lake whitefish and *Mysis* shrimp; while most native fishes have declined. In fact, native bull trout are listed as threatened by the Endangered Species Act and cutthroat trout are a state "species of special concern". Recent estimates put Flathead Lake lake trout numbers at over 1 million and bull trout below 20,000. The *Mysis* population fluctuates but has generally stabilized at about 50 per square meter as they are now preyed upon heavily by lake trout and whitefish. In short, through intentional species introductions a Rocky Mountain Lake has essentially been turned into a Great Lake.

This 100 year story of Flathead Lake's community changes was published by Bio Station researchers (plus others) in 2011 in another important scientific paper (Ellis, Stanford, Goodman, Stafford, Gustafson, Beauchamp, Chess, Craft, Deleray and Hansen. "Long-term effects of a trophic cascade in a large lake ecosystem." Proceedings of the National Academy of Sciences USA 108(3):1070–1075).