Flathead Lake Food Web

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A food web can be thought of as a community portrait of an ecosystem. It is a description of what species are present, who eats whom, and the resulting tangle of relationships. In a lake ecosystem, such as Flathead Lake, feeding relations can be highly complex. Even if a food web has only 10 fish species, the interactions among those fish and all the other organisms that the fish eat (for example, aquatic insects, zooplankton, snails, algae, etc.) can result in a veritable spider web of connectivity. When one factors in that fish and other organisms often eat different things during different seasons and during the various stages of their life cycle and that terrestrial species provide food or prey upon aquatic species, the scientific understanding and depiction of a food web can be quite challenging. The overview of the Flathead Lake food web and the dramatic changes that have occurred that is presented below were based upon numerous studies over the last century conducted by scientists at the Flathead Lake Biological Station, with input from State and Tribal fishery scientists.

A very simplistic overview of the food web of Flathead Lake is as follows. Consider that there are 21 different fish species in Flathead Lake. Different fish species, depending upon their life stage and the season, are feeding in different locations: the open water column, in shoreline areas or on the lake bottom. They can also be quite selective about which species of organism they prefer. Depending upon the species, they might prefer to feed on any of the following: zooplankton, aquatic insects, clams, snails, opossum shrimp, juvenile fishes, adult fishes, algae, or terrestrial insects. For example, cutthroat trout feed near the lake surface where they consume zooplankton in the winter and ants and caterpillars during the spring rains. Next, consider that each of those prey organisms also has a variety of food preferences. Zooplankton, depending upon their species and life stage, may consume algae and protozoans or are predatory on other zooplankton. Imagine how interconnected all of these organisms are from fish down to microscopic algae and protozoans. Finally, we must examine the terrestrial linkages with the lake food web: birds and mammals, such as bears and people, also feed on members of the lake food web. Numerous birds feed on fish, invertebrates and even aquatic vegetation in the lake. For example, osprey consume lake whitefish, mergansers eat aquatic insects, Canadian geese and mallards feast on aquatic vegetation and anything else they can find on the shallow lake bottom. The complex, interconnected web in Flathead Lake likely has hundreds of significant linkages among the various aquatic and terrestrial species, and the more we study the ecosystem, the more linkages we discover.

Source: Bonnie Ellis

Bonnie Ellis, Flathead Lake Biological Station, conducting research on Flathead Lake

The food web in Flathead Lake has changed dramatically since the time of the early explorers. Of the 21 fish species currently found in Flathead Lake, only 11 of those are native and were here when the first European explorers arrived in the area. Since the late 1800s, nineteen species of nonnative fish were purposefully introduced to the lake to "enhance" fishing opportunities. Of those introductions, kokanee salmon were flourishing by the mid-1900s. But, it wasn't until an opossum shrimp, *Mysis relicta*, was introduced to lakes upstream of Flathead Lake by State fisheries managers that major changes in the food web occurred. The shrimp increased exponentially in the mid-1980s as they discovered their preferred food, a large zooplankter called *Daphnia thorata*. The zooplankter was also the preferred prey of the kokanee salmon and the shrimp were able to avoid being eaten by the kokanee by remaining on the bottom of the lake during the day and coming up at night to feed. Hence, the shrimp dramatically reduced the food of the kokanee, leading to the collapse of the kokanee fishery in the lake.

But it wasn't just the loss of food that caused their decline. The shrimp provided a food resource for young lake trout, another introduced species that remained in low numbers

until this reservoir of food appeared on the lake bottom. Soon, lake trout increased and as they grew in size, they were able to eat the kokanee and other nonnative as well as native fishes in the lake. Before the shrimp was introduced, kokanee used to spawn in great numbers in McDonald Creek in Glacier National Park where they were fed upon by bald eagles. Once the kokanee disappeared, the eagles dispersed and are no longer a major tourist attraction in the fall. The change in food web relationships from the shrimp introduction altered many different trophic levels (e.g., primary producers, primary consumers, secondary consumers) from algae and zooplankton to eagles and is known as a trophic cascade.

The shrimp is perhaps a keystone species in Flathead Lake, one which has inordinate influences on the structure of the community. Given the large number of significant linkages in the interconnected food web of Flathead Lake it may seem surprising that the introduction of only one species can have such a profound impact on so many other species, but this has been shown for other lakes around the world (e.g., the introduction of Nile perch in Lake Victoria has decimated the native fishery which once boasted over 400 species; now catches are dominated by 3 fish species: nonnative perch, nonnative tilapia and native minnow). Appreciation for the delicate balance of predators and prey in our aquatic ecosystems is the key to maintaining the wonderful diversity of life we all enjoy and value.