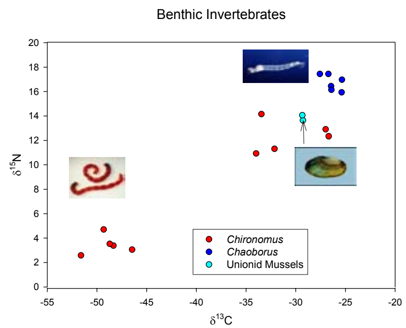


Figure 5: Isotopic composition of selected benthic invertebrate species

Fish:

The various fish species caught from Cougar Lake show a smooth gradation from low $\delta^{15}N$ and high $\delta^{13}C$ to high $\delta^{15}N$ and low $\delta^{13}C$ (Fig. 6). In general, the largest fish have the highest $\delta^{15}N$ and lowest $\delta^{13}C$ (Figs. 7 to 10). The two largest Bass caught have the highest $\delta^{15}N$ among the fish (Fig. 8).

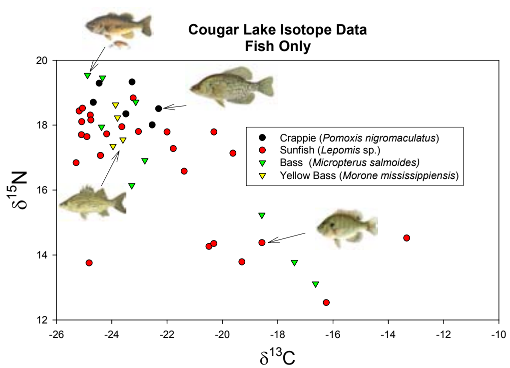


Figure 6: Isotopic composition of selected fish species

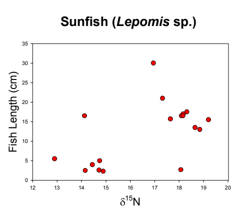


Figure 7: Length vs. $\delta^{15}N$ for sunfish

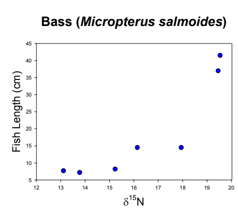
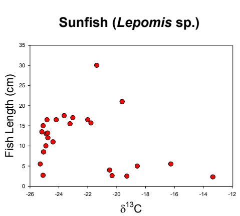


Figure 8: Length vs. $\delta^{15}N$ for bass



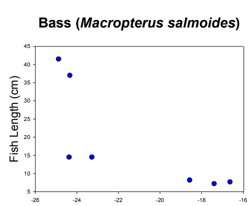


Fig 11 summarizes the data from all species. The figure emphasizes how anomalous the *Chironomus* results are. It also shows that the largest bass have the highest $\delta^{15}N$ values in the lake suggesting that they are the top predators.

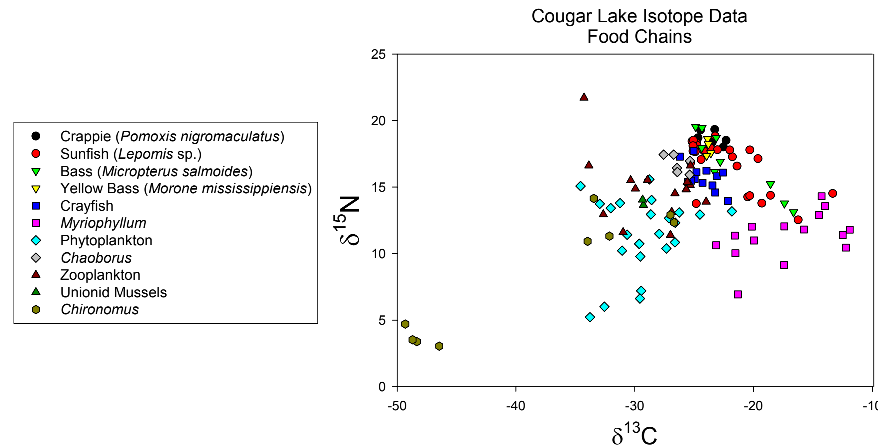


Figure 11: Isotopic composition of all organisms tested

Discussion:

Our results show that largemouth bass have taken the position of top-level predator of Cougar Lake with the largest δ ^{15}N value of any organism, +19‰. Average phytoplankton $\delta^{15}N$ was +11.2‰. Average zooplankton δ ^{15}N was +15‰. *Chaoborus*, a zooplanktivore, had a δ 15N value of +17‰. *Chironomus*, a detritivorous insect larva in the benthos, had a δ ^{15}N of +2‰. Littoral zone *Myriophyllum spicatum* had a $\delta^{13}C$ between -24‰ and -11‰ indicating that it is severely carbon-limited. The smallest bass and sunfish had a similarly high $\delta^{13}C$ value indicating that they were deriving most of their carbon from the littoral zone. *Chironomus* had the lowest $\delta^{13}C$ values in the lake (-52 to - 46 ‰) indicating significant recycling of methanogen-derived carbon in the deep lake benthos (Grey 2004).

Upon analysis of the data, our original hypothesis of a food chain was inadequate. The results indicate a food web comprised of several interlocking food chains. One food chain was located in the littoral zone and received most of its carbon from macrophytes. Another food chain was located in the pelagic zone receiving most of its carbon from phytoplankton. Fish utilized each of these food chains depending on body size. Small fish foraged in the littoral zone and larger fish in the pelagic zone. A third food chain included the deep benthos which processed recycled methanogen-derived carbon.

Conclusion:

The largest bass are the top of the food chain as expected from a fisheries analysis of the lake, but the food web of the lake is much more complicated than a simple model might predict. The lake seems have interlocking food webs that mix littoral zone and pelagic zone production.

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