# THE CHANGING FOODWEB OF FLATHEAD LAKE, MONTANA.

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Introductions or invasions of nonnative organisms can mediate major changes in the trophic structure of aquatic ecosystems. Here we show that a community-wide trophic cascade extended to primary producers at the base of the food chain and to bald eagles at the very top when *Mysis diluviana*, an opossum shrimp, invaded Flathead Lake, Montana, the largest freshwater lake in western USA. Lake trout had been introduced 80 years prior but remained at low densities until nonnative *Mysis* appeared. The bottom dwelling mysids eliminated a recruitment bottleneck for lake trout by providing a deep water source of food where little was available previously. Lake trout subsequently flourished on mysids and this voracious piscivore now dominates the lake fishery; formerly abundant kokanee salmon were extirpated and native bull trout and cutthroat are imperiled. Predation by *Mysis* shifted zooplankton and phytoplankton community size structure. The highest photic zone phytoplankton biomass, chlorophyll *a* and primary production occurred in 1988, the year of maximum mysid abundance. During the period of record, numerous other changes in the phytoplankton community were evident; increase or decrease in biomass and/or density of 8 phytoplankton families, increase in percentage phytoplankton biomass in 10 to 30 μm size fraction, decrease in percentage phytoplankton biomass in >50 μm size fraction and decrease in 0–30 m chlorophyll *a*. Bayesian change point analysis of the primary productivity time series (27 years) showed a significant step increase of 55 mg C $m^{-2}$ $day^{-1}$ concurrent with the mysid invasion, but little trend before or after in spite of increasing nutrient loading. The step increase likely is explained by the increase in density of smaller phytoplankton with higher rates of metabolism. Such a large and sudden shift in carbon cycling during the exponential growth phase of a nonnative species has never been reported. Understanding trophic cascades requires that long-term data sets be formalized by robust models because of the extreme complexity of interactions.

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