Report for 2001ND461B: Effects of Fathead Minnows and Drainage on Wetland Ecosystems

- Articles in Refereed Scientific Journals:
  - Zimmer, K.D., M.A. Hanson, M.G. Butler, and W.G. Duffy, 2001, Influences of fathead minnows and aquatic macrophytes on nutrient partitioning and ecosystem structure in two prairie wetlands, Archiv für Hydrobiologie, 15, 411-433.
  - Zimmer, K.D., M.A. Hanson, M.G. Butler, and W.G. Duffy, Size distributions of aquatic invertebrates in two prairie wetlands, with and without fish, with implications for community production, Freshwater Biology, in press.
  - Muscha, M.J., K.D. Zimmer, M.G. Butler, and M.A. Hanson, A comparison of horizontally and vertically deployed aquatic invertebrate activity traps, Wetlands, in press.
  - Zimmer, K.D., M.A. Hanson, and M.G. Butler, Effects of fathead minnow colonization and removal on a prairie wetland ecosystem, Ecosystems, in press.
  - Melaas, C.L., K.D. Zimmer, M.G. Butler, and M.A. Hanson, Effects of rotenone on aquatic invertebrate communities in prairie wetlands, Hydrobiologia, in press.
- Dissertations:
  - Zimmer, K.D., Effects of Fathead Minnows and Drainage on Wetland Ecosystems, Ph.D. Dissertation, Department of Zoology, North Dakota State University, Fargo, May 2001.

Report Follows:

Effects of Fathead Minnows and Drainage History on Prairie Wetland Ecosystems

Kyle Zimmer (Graduate Research Fellow)
Malcolm Butler (Advisor)
Professor of Biological Sciences
Department Biological Sciences
North Dakota State University
Fargo ND 58105

Many studies have shown that fish can influence the structure and processes of aquatic ecosystems, but studies with replication at the ecosystem level are rare, as are studies involving wetlands. Some wetlands of the Prairie Pothole Region of North America support fish communities dominated by fathead minnows while others are fishless, providing an opportunity to assess the influence of these fish on wetland ecosystems. Additionally, extensive drainage of prairie wetlands has led to restoration of thousands of basins, but the success of these efforts is poorly known. I assessed the effects of fathead minnows and prior drainage on characteristics of prairie wetlands by studying 20 semipermanent wetlands in Minnesota from 1996-1999. I used a 2x2 factorial design to examine the effects of minnows (presence/absence) and drainage (restored/non-drained)on the abundances of aquatic invertebrates, aquatic macrophytes, and amphibians, as well as water-column levels of chlorophyll *a*, total phosphorus, total nitrogen, and turbidity. Results showed that presence/absence of fathead minnows is an important determinant of many biotic and abiotic characteristics of prairie wetlands. Wetlands with minnows had significantly fewer aquatic insects, large and small-bodied cladocerans, calanoid copepods, ostracods, and larval tiger salamanders, as well as a higher abundance of corixids and higher levels of turbidity and chlorophyll *a*. In contrast, higher concentrations of phosphorus in restored basins was the only consistent history effect, and no consistent fish-x-history interactions were detected. Additional research showed that the ecological characteristics of prairie wetlands can change rapidly in response to both minnow colonization and elimination. Thus, temporal variability in minnow presence/absence may be a source of temporal variability in other ecosystem components. Abiotic variables influence prairie wetlands, but this research indicates that these ecosystems may also be strongly influenced by the presence/absence of minnows. Inter-basin and inter-annual variability in minnow presence may be important for maintaining diverse assemblages of species at the landscape level, with fishless basins favoring certain assemblages of organisms and basins with minnows favoring others. From a management perspective, these effects should be considered prior to landscape manipulations that alter the regional proportion of basins supporting fathead minnow populations.

Kyle's work demonstrated that the presence of fathead minnows is an important determinant of ecosystem structure in prairie wetlands. Restored wetlands are very similar to non-drained analogs. Not only were these patterns consistent in five years of data collected from over 20 wetlands, but Kyle was able to demonstrate unequivocally that minnows actually cause observed differences between minnow-supporting and fish-free wetlands such as higher turbidity and lower invertebrate diversity and abundance.