

## Impacts of Land-Applied Wastes from Concentrated Animal Feeding Operations on Aquatic Organisms

M. S. Sepúlveda, J. K. Leet, S. Sassman, H. Gall, C. Jafvert, D. Villeneuve, K. Jensen, G. Ankley, J. Lazorchak, J. Meyer, S. Rogers, R. R. Goforth, and L.S. Lee

Midwest agricultural fields typically have subsurface tile-drain networks that facilitate transport of excess water from fields to a ditch network system, which can contain sediments, nutrients and pesticides as well as hormones from fields fertilized with manure and associated lagoon effluent. We hypothesize that these ditch waters are characterized by altered aquatic community structures and reproductive alterations in adult organisms compared to largely intact headwater streams. A 3-y summary (2007-2010) of our research in waters associated with a predominantly beef and dairy concentrated animal feeding operation (CAFO) will be presented including: 1) Fish population and community structure of CAFO-influenced ditches; 2) Evaluation of reproductive and sex ratio effects from *in situ* studies with fathead minnow (*Pimephales promelas*) adults and embryos; and 3) Evaluation of reproductive condition of adult common snapping turtles (*Chelydra serpentina*) inhabiting CAFO-influenced ponds. For the duration of the study, species richness was lower in the CAFO sites compared to the reference. Pollution-intolerant species were absent from the CAFO sites as well. Reproductive condition of creek chubs (*Semotilus atromaculatus*) was lower in the agricultural ditches compared to those from the reference ponds. The relative abundance of creek chub was also found to be significantly different among the sites. We observed a skewed sex ratio towards males (59%) when fathead minnow embryos (day 0 post-fertilization) were exposed to ditch water until day 45 post hatch. However, when adult fathead minnows were caged in the ditches for one week, we observed no obvious effects, including lack of changes on plasma vitellogenin concentrations. Adult male snapping turtles at the CAFO site had ten times more plasma testosterone compared to males from the reference site, and no plasma vitellogenin was detected in males of either population. Hormone concentrations in the CAFO sites (E2, E1, E3, 17 $\alpha$ - and 17 $\beta$ -trenbolone, testosterone, trendione, and androstenedione) were variable, but were typically < 10 ng/L. Median atrazine concentrations were ~113 ng/L and 40 to 60 ng/L for associated metabolites. Nitrate was consistently detected in the 10-20 mg/L range. Overall, our results suggest that CAFO-dominated ditches have altered stream communities, and that these characteristics are much more variable over time compared to the reference site. In addition, exposure of early life stages to water from these agricultural ditches appear to be causing alterations in normal sex ratios, whereas short-term adult exposures resulted in no obvious effects. Finally, the cause(s) for the increased testosterone concentrations in turtles from the CAFO site are unknown at this time, but are most likely related to differences in reproductive stage among populations and/or possibly exposure to androgenic compounds.