

RESTORATION OF CHANNELIZED AGRICULTURAL HEADWATER STREAMS

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Channelized agricultural headwater streams (i.e., agricultural drainage ditches) are agricultural headwater streams that have been created or modified to facilitate agricultural drainage. These streams are managed primarily for drainage to maintain agricultural productivity. Channelized agricultural headwater streams are common across the Midwestern United States. The reduced ecological integrity (i.e., physical, chemical, and biological quality) of these streams has been frequently documented by state and federal water quality agencies.

There is a need to incorporate environmental considerations into the management of these streams. Potential solutions range from repair of actively eroding streambanks to implementation of a comprehensive watershed restoration plan. Yet, the ecological effects of potential restoration practices on the aquatic biota are unknown. Thus, the information needed to develop effective restoration strategies is lacking.

THE RESEARCH PROGRAM

Dr. Smiley has developed a multi-faceted research program focused on providing the quantitative information required for developing restoration plans that will benefit the biota and improve the physical and chemical quality within these degraded streams.



Dr. Smiley's research program involves individual and collaborative cross-location research projects conducted in Ohio and Indiana. His field research projects are hypothesis-driven field experiments that examine relationships of the aquatic biota with physical and chemical habitat conditions or evaluate how habitat changes as a result of specific practices influence the biota. Dr. Smiley's research typically focuses on fishes, but he also works with amphibians, reptiles, and aquatic macroinvertebrates.

PAST RESEARCH ACCOMPLISHMENTS

Results from headwater stream research conducted from 2005 to 2019 have resulted in 13 peer review manuscripts, two invited peer review manuscript, two book chapters, and one technical report. These publications report the following research accomplishments:

- *Synthesized information on fish habitat relationships and the influence of conservation practices on fishes in channelized headwater streams.*
- *Quantified the relative influence of physical habitat and water chemistry on fishes and amphibians in channelized headwater streams.*
- *Documented that planting grass filter strips adjacent to channelized headwater streams does not contribute to restoration of these small streams.*
- *Quantified the influence of atrazine reduction practices on pesticides and fishes within channelized headwater streams.*
- *Documented that pesticide mixtures within channelized headwater streams consisted mostly of combinations of herbicides or herbicides and fungicides.*
- *Documented public health risks posed by agricultural contaminants and potential insect disease vectors within channelized headwater streams.*
- *Determined the channelization effects on aquatic macroinvertebrate colonization within the riparian habitats of agricultural headwater streams.*
- *Determined the hydrological effects of channelization on agricultural headwater streams.*

RESULTING RESTORATION GUIDANCE

Past research results provide needed information that can be used by state agencies, federal agencies, non-profit organizations, and private consulting firms for developing restoration strategies for channelized headwater streams. Specific guidance includes:

- *The need for a watershed approach in the management and restoration of channelized headwater streams.*
- *Restoration and conservation practices that lead to improvements in physical habitat quality and water quality will benefit fishes and amphibians.*
- *Grass filter strips need to be installed with other practices capable of improving physical habitat quality and water quality.*
- *Implementation of atrazine reduction practices in < 30% of the watershed will not influence pesticides or fishes in channelized headwater streams.*
- *Management of channelized agricultural headwater streams is needed to protect downstream drinking water sources.*
- *There is a need for watershed management plans that target the reduction of multiple pesticides within channelized agricultural headwater streams.*
- *Practices that lead to the development of forested riparian habitats will increase aquatic macroinvertebrate diversity within the riparian habitats of channelized headwater streams.*
- *The hydrology of channelized headwater streams needs to be modified to more closely mimic those of unchannelized headwater streams.*

FUTURE RESEARCH: 2016 – 2021

Dr. Smiley and collaborators from USDA ARS Soil Drainage Research Unit, Indiana University-Purdue University Fort Wayne, USDA ARS National Soil Erosion Research Laboratory, and the Ohio State University will be conducting research projects aimed at understanding the benefits of improved water quality and the quantification of the ecological effects of previously un-evaluated conservation practices. Specific research projects include:

- ***Evaluation of the influence of suspended solids, physical habitat, and agricultural contaminants on fishes within agricultural headwater streams.*** *This project involves a tiered approach that will use community assessments, sediment sampling, and ecotoxicology bioassays to determine the relative influence of suspended solids, physical habitat, and agricultural contaminants on fishes in channelized headwater streams in Ohio and Indiana.*
- ***Long term assessment of the ecological effects of grass filter strips on channelized headwater streams.*** *This research will ultimately encompass 15 years of sampling physical habitat, water chemistry, and fish communities in channelized streams with filter strips, channelized streams without filter strips, and unchannelized streams with forested riparian habitats.*
- ***Evaluating the ecological effects of planting grass filter strips on terrestrial animals within riparian habitats of channelized headwater streams.*** *This research will involve evaluating reptile community and population responses to planting of grass filter strips.*

Please contact me if you have questions regarding my research, are interested in receiving reprints, have consulting needs, or are interested being a collaborator.

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