Public Abstract
First Name:Jeffrey
Middle Name:Don
Last Name:Fore
Adviser's First Name:David
Adviser's Last Name:Galat
Co-Adviser's First Name:Scott
Co-Adviser's Last Name:Sowa
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Department:Fisheries & Wildlife
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Title:REMEDIATING EFFECTS OF HUMAN THREATS ON LOTIC FISH ASSEMBLAGES WITHIN THE MISSOURI RIVER BASIN: HOW EFFECTIVE ARE CONSERVATION PRACTICES?

Agricultural commodity production and its resulting sedimentation stressors pose the largest threat to lotic systems. Addressing agricultural threats will require strategic allocation of conservation resources and cooperation with private agricultural producers to identify ecologically degraded streams and to determine the appropriate place, type, and amount of conservation practices (CPs) needed to improve ecological conditions. The goal of this research was to develop tools agricultural conservation managers can use to reduce stream sedimentation and improve the allocation of limited conservation resources in a manner that results in improved water quality and ecological condition. Developing tools to address three major information needs can improve agricultural conservation, they are: 1) assessing total watershed conditions and determining stream segments where agricultural CPs are likely to be effective by conducting threat assessments, 2) assessing the effectiveness of agricultural CPs and determining where current conservation has been successful and future conservation efforts are needed, and 3) making strategic conservation decisions by using a decision support framework to understanding the amount and costs of CPs required to meet ecological objectives.

Total watershed condition for every stream segment in the Missouri River basin was summarized by conducting a threat assessment and developing a suite of human threat indices from 17 threat metrics for managers to select and prioritize watersheds to implement agricultural CPs. Agricultural threats were most prevalent across the Missouri River basin, but considerable heterogeneity of non-agricultural threats existed within the basin and in regions of high agricultural prevalence. Management capacity was identified for every stream segment and used to identify streams where US Department of Agricultureâ€™s Natural Resources Conservation Service (NRCS) conservation practices were most likely to be effective because the prevalence of agricultural threats was greater than non-agricultural threats.
Understanding the effects of applied NRCS CPs on fish assemblages will allow managers to maximize environmental benefits and ensure conservation funding is properly allocated. The response of lithophil and omnivore guild abundance of lotic fishes to multiple NRCS soil CPs was predicted using multiple-regression models to assess the effectiveness of CPs designed to reduce soil disturbance and sediments from entering stream channels. The relationships among NRCS CPs and omnivore and lithophil guild abundances indicated that NRCS soil CPs have the potential to reduce agricultural sources of stream sedimentation and improve ecological condition. I evaluated the effectiveness of NRCS soil CPs for individual stream segments by determining if â€˜moreâ€™ disturbed streams were predicted to shift to â€˜lessâ€™ disturbed conditions as a function of the association among fish guilds and applied CPs. Conservation practices were predicted to effectively shift 2% of the streams we evaluated from â€˜moreâ€™ to â€˜lessâ€™ distu conditions. The low number of watersheds where NRCS CPs were predicted to be effective was primarily due to low densities of CPs in watersheds, but the models suggested effectiveness could be improved by applying CPs in at least 50% of a watershedâ€™s land area.
Improving conservation outcomes in streams via application of CPs will require strategically allocating conservation resources (primarily funding) in a manner that ensures CPs are implemented in high enough densities to meet desired conservation goals. I integrated the results from the threat and CP assessments into a decision support framework designed to improve the allocation of conservation resources and to increase the ecological effectiveness of agricultural CPs on private lands. The framework used a

winnowing process to identify watersheds where ecological degradation has occurred, where CPs were likely to be effective, and where the total conservation cost and cost-benefit ratio (cost per unit increase in guild abundance) of applying CPs were lowest. A case study in portions of the Missouri River basin was conducted and I identified and estimated total conservation costs and cost-benefit ratios in 2,633 ecologically degraded watersheds where agricultural CPs were likely to be effective (i.e., the watersheds needed agricultural conservation and NRCS had primary management capacity). Conservation practices designed to prevent soil disturbance were generally more cost effective than CPs designed to prevent sediment from entering stream channels. Total conservation costs and cost-benefit ratios differed substantially between the Hot Continental Division and Prairie Division ecoregions due to relative differences in the estimated amount of conservation needed.

The threat indices developed in this research are advantageous over traditional landcover maps because they summarize total watershed conditions for individual stream segments and allow managers to evaluate where an agency has primary management capacity. The threat indices can be incorporated into decision support frameworks to prioritize regions and specific watersheds to conduct conservation efforts, and they can be coupled with assessments of ecological condition to identify likely stressors causing ecological degradation. The assessment of conservation practice effectiveness provides managers with estimates of ecological degradation for individual stream segments and allows managers to determine where applied CPs have improved fish assemblage condition, where current CPs can maintain ecological conditions, and where future conservation efforts are needed. The models developed to predict fish guild abundance also provided estimates of the type and amount of CPs that could be implemented in watersheds of individual stream segments so managers can estimate the total cost and cost-benefit ratio of applying CPs to meet ecological objectives. Incorporating the above elements into a decision support framework allows managers to make best use of conservation resources because they can strategically identify and select stream segments to apply CPs. Managers can improve CP adoption rates and fish assemblage condition by strategically focusing conservation efforts in specific stream segments and allocating the proper amount of funding for voluntarily applied CPs that are cost-shared with private producers.