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Dear Robert Szafoni,

Enclosed please find a copy of the abstract and results from my thesis completed at Eastern Illinois University. Thank you very much for the money provided by the Wildlife Preservation Fund Contract; it was essential for the completion of this thesis. If you need additional information please contact Robert Fischer at Eastern Illinois University (217-581-2817). Thank you once again for selecting me as a grant recipient.

Sincerely,

Ann Marie Hogan

ABSTRACT

In agricultural watersheds, channelization and the conversion of native vegetation into agricultural crops contribute to a loss or simplification of near-stream vegetation and a reduction in the complexity of the physical stream environment. Since changes to near-stream vegetation can have a significant effect on the stream biological community, this study investigated the relationship between a habitat quality index and stream fish assessment indices used to evaluate stream quality. Fish data and stream habitat quality data were collected from 13 sampling localities associated with the Embarras River basin. Habitat quality was measured using the Stream Habitat Assessment Procedure (SHAP), while stream fish quality was determined by species richness and the Index of Biotic Integrity (IBI). A positive linear correlation was observed between SHAP and IBI ($r^2 = 0.409$, $n = 13$, $p < 0.05$) for the 13 sites sampled. However no significant correlation was observed between SHAP and species richness ($r^2 = 0.195$, $n = 13$, $p = 0.13$). Multiple stepwise forward regression analysis was performed to determine which SHAP variables would be the best predictors of stream biotic integrity as measured by IBI and species richness. Two significant variables (pool quality and bank vegetation) were used in creating a model for predicting IBI in which 76% of the variance in IBI was explained by these SHAP variables. In addition, a model which explained approximately 84% of the variance in species richness among sites was created using the four significant SHAP variables of pool quality, pool variability, deposition and canopy cover. The SHAP variables included in these models are related to features such as riparian zone vegetation and channel morphology, and play an important role in creating and maintaining the key

qualities of the stream ecosystem. Models such as those suggested in this paper demonstrate the potential for predicting the biotic integrity of a stream fish community from commonly collected, and often readily available, habitat data. Thus, the models may be an important management tool which will allow for the rapid prediction of the biotic integrity of a stream, and thus permit intensive management practices to be focused on critical sites within a stream basin.

RESULTS

A total of 4690 fish were collected at 13 sampling locations in the Embarras River basin during June through July 1996 (Appendix B). Fish from 59 species representing 13 families were collected. Cyprinidae (minnow and carp) was the most common family with 14 species. The family Catostomidae (suckers) was the second most common family with 12 species followed by the families Percidae (darters and perch) and Centrarchidae (sunfish) with 10 and 9 species respectively. In all, the 14 cyprinid species comprised 3922 individuals, or more than 83% of the total number of fish collected. Steelcolor shiner (27%), sand shiner (18%), bluntnose minnow (16%), and silverjaw minnow (10%) were the four most abundant taxa at all sites and made up 71% of the total fish collected. The most widely distributed fish in the Embarras River basin were the steelcolor shiner and the longear sunfish which were present at 100 and 92 percent of the sites, respectively. The bluntnose minnow, green sunfish, golden redhorse, and spotted bass were the next most frequently collected taxa occurring in 84% of the sites sampled (Figure 2).

The Index of Biotic Integrity (IBI) values ranged from a high of 50 at Polecat Creek (BEO-01), to a low of 34 at Scattering Fork (BER-01) (Appendix B; Figure 3) with a mean IBI for the 13 sampling locations of 41. Of the 13 sites sampled, none received an "excellent" rating. Six sites received a "good rating" including two North Fork of Embarras sites (BEF-02 and BEF-03), and one each from the Little Embarras (BEP-01), Kickapoo Creek (BENA-01), Polecat Creek (BEO-01), and Indian Creek (BEZB-07). The remaining seven sites (Hurricane Creek (BEL-01), Riley Creek (BEN-

01), Scattering Fork (BER-01), Embarras River (BE-19), Brushy Creek (BEZZ-02), Muddy Creek (BEJ-01), and North Fork of Embarras (BEF-01)) received "fair" ratings.

Species richness or the number of species at each site ranged from a high of 25 taxa at Indian Creek (BEZB-01), to a low of 13 in the Embarras River (BE-19) and in Muddy Creek (BEJ-01) (Figure 3). The average number of species for the basin was 18.

Stream Habitat Assessment Procedure (SHAP) scores for the 13 sites ranged from a high of 151 at Polecat Creek (BEO-01) to a low of 62 at Scattering Fork (BER-01) (Figure 4). The average SHAP score for the basin was 112. The two highest scoring sites, Polecat Creek and North Fork of the Embarras (BEF-02), were categorized as "excellent"; the next eight highest scores, Brushy Creek, Muddy Creek, Riley Creek, Little Embarras, Kickapoo Creek, North Fork of the Embarras (BEF-03), Indian Creek, and Embarras River, were categorized as "good"; and the remaining three sites, North Fork of the Embarras (BEF-01), Hurricane Creek, and Scattering Fork, received a "fair" rating.

There was a significant linear relationship between SHAP and IBI, with SHAP explaining 41% of the variance in IBI ($r^2 = 0.409$, $n = 13$, $p < 0.05$; Figure 5). But if two strongly influential points are removed from the analysis, there was no correlation between SHAP and IBI ($r^2 = 0.042$, $n = 11$, $p = 0.55$). Further, no significant linear relationship was observed between SHAP and species richness ($r^2 = 0.195$, $n = 13$, $p = 0.13$; Figure 6). Therefore, multiple stepwise forward regression analysis was performed using SAS to determine which SHAP variables would be the best predictors of stream biotic integrity as measured by IBI and species richness. Pool quality alone explained 46.9% of the variation between SHAP and IBI. Pool quality along with bank vegetation explained 75.7% of the variation in IBI values (Table 4).

An additional multiple stepwise forward regression analysis was performed to determine which SHAP variables were the best predictors of stream species richness. Pool quality alone explained 45.7% of the variation in species richness. Pool quality associated with the following three additional variables: pool variability, deposition, and canopy cover explained 83.5% of the variation in species richness (Table 5).

Once the key SHAP variables were identified, models were developed which will allow for the prediction of IBI and species richness. Since two variables were found to be important in the relationship between IBI and SHAP, these significant variables were used to create the following model for predicting IBI:

Predicted IBI = (0.9504*Pool Quality) + (0.9359*Bank Vegetation) + 28.8276

In addition, the 4 significant variables found for the relationship between species richness and SHAP, which explained approximately 84% of the variance, were used to create the following model for predicting species richness:

Predicted Richness = (1.1378*Pool Quality) + (-0.8007*Pool Variability) + (2.0608*Deposition) + (-0.8916*Canopy Cover) + 9.2985

The models used for predicting IBI and species richness had pool quality as the most correlated variable in both models. The variables that are present in both models are associated with riparian zone and stream channel features and illustrate the importance of both habitat and channel alterations on stream biotic integrity.