

PROJECT NUMBER: PMQR T50

PROJECT TITLE: The Effects of Habitat Fragmentation on Sensitive Aquatic Species

Summary:

Although aquatic ecosystems in Illinois have been shown to be fragmented by agricultural activity, it is unknown whether habitat specialists or sensitive species, such as darters, exhibit population isolation. Thus, this study will determine if aquatic habitat fragmentation has had an isolating effect on darter populations. Specifically to estimate population size of isolated populations and determine dispersal rate of individuals between isolated high quality patches, as well as assess the degree of genetic isolation and gene flow of darters between patches. "High Quality" sites consist of a meandering stream with rocky substrate, good tree cover ($\geq 70\%$), a good riparian zone (containing relatively undisturbed soil and non-cultivated plants) and contain a series of riffles. Information from this study will be critical in designing proper management practices which will reestablish isolated habitats and native fish populations within a continuous and cohesive ecosystem that provides benefits to all members of the ecosystem, including humans. This report summarizes work completed for the period ending June 1, 2009.

OBJECTIVES:

The overall project goals are to: **1) estimate population size of isolated populations, 2) determine the dispersal rate of individuals between isolated high quality patches, and 3) assess the degree of genetic isolation and gene flow of darters between high quality patches.** To accomplish these goals we have five primary objectives each with a series of secondary objectives contained within the primary objective.

Objective One: Identify the spatial sampling unit. (Time frame 5/08-2/10; % budget – 15%)

1.1) Identify appropriate darter habitat. During this period the entire length of Polecat Creek was surveyed for riffle habitat. A total of 45 riffles or riffle units (multiple riffles located less than 10m apart) were identified.

1.2) GPS the habitats. The beginning and end of all riffle sites was obtained using a Trimble sub-meter gps unit. From this data all sites were placed into one of four categories based upon distance to closest riffle (1: < 60m, 2: 60 – 90m, 3: 90 – 120m, and 4: > 120m.

1.3) Integrate the GPS'ed habitat into appropriate GIS coverages. All data points were input into an ARCGIS coverage.

1.4) Utilize the GIS coverage to quantitatively estimate landuse patterns around the habitat areas. This will be done for all sites actually utilized so will be done following the last field samplings.

Objective Two: Identify Candidate Species. (Time frame 5/08-11/08; % budget – 5%)

Not every species of darter occurs in every stream, or in every location in every stream. Rather when viewing darters as an indicator species of environmental perturbation, one seeks

to identify a series of species that can be utilized interchangeably as indicator species within the aquatic environments they exist. To accomplish this primary objective we have three (3) secondary objectives.

2.1) Preliminary sampling of darter habitat identified in objective 1.1. Catch and release sampling was utilized to determine the species composition of darters in the riffle units.

2.2) Integrate species occurrence patterns into GIS coverage created in objective 1.3. Darter species occurrence patterns were input into the GIS coverage of riffle habitats.

2.3) Determine appropriate candidate species for sampling area. From this a series of 30 sites was chosen that contained large enough population sizes of the two candidate species, greenside darters (*Etheostoma blennioides*) and the rainbow darter (*Etheostoma caeruleum*).

Objective Three: Determine Demographic Population Structure. (Time frame 8/08-8/10; % budget – 35%)

The population structure estimation is necessary to identify current ecological conditions of the existing populations and place an appropriate ecological context for the genetic analysis. To accomplish this primary objective we have three (3) secondary objectives.

3.1) Sample sites identified in objective 1.1 for candidate species identified in objective two. Due to exceptionally heavy spring and early summer rains two sampling bouts of the 30 identified sites were carried out. These samplings were conducted in conjunction with Robert U. Fischer and Amanda Steber from Eastern Illinois University. This allowed consistency in marking technique and guaranteed that study specific markings were used within each study. In addition , it allowed this data to be utilized in both studies. A total of 313 greenside darters (8 recaptures; 100% same site) and 668 rainbow darters (31 recaptures; 10% < 60m upstream) were captured and marked with riffle specific tags.

3.2) Perform mark/recapture analyses utilizing site and riffle specific tags. Scheduled after all field sampling is complete

3.3) Estimate population size and structure utilizing program MARK (Cooch and White 2008, White 2007). Scheduled after all field sampling is complete

Objective Four: Determine Genetic Population Structure. (Time frame 8/08-8/10; % budget – 35%)

The genetic population structure should reflect historical as well as recent ecological and demographic conditions. Therefore, it may or may not correlate well with current ecological measures in objective three. To accomplish this primary objective we have four (4) secondary objectives.

4.1) Collect fin clips from candidate species identified in objective two. Fin clips were collected from all captured greenside and rainbow darters collected within the 30 sites. Labeled samples were placed in 95% ethanol and stored in a refrigeration unit at Eastern Illinois University along with hard copy and computerized metadata.

4.2) Confirm species-specific primer amplification and determine a final set of microsatellite primers. No work scheduled.

4.3) Genotype all samples collected in objective 4.1 for all primers identified in objective 4.2. No work scheduled.

4.4) Assess and quantify the genetic spatial structure utilizing appropriate analysis software. No work scheduled.

Objective Five: Integrate Demographic and Genetic Data. (Time frame 5/10-8/10; % budget – 10%)

The final analysis will be a simultaneous analysis of ecological and genetic statistics to assess the degree of “historical lag” in the genetic structure of darter species. To accomplish this primary objective we have two (2) secondary objectives.

5.1) Preparation of a final report to the IDNR. No work scheduled.

5.2) Preparation of a manuscript for publication in an appropriate professional scientific journal. No work scheduled.

LITERATURE CITED:

Cooch, E. and G. C. White. 2008. Program Mark: A Gentle Introduction, 6th edition.

<http://www.phidot.org/software/mark/docs/index.html> .

White, G. C. 2007. Program MARK.

<http://www.warnercnr.colostate.edu/~gwhite/mark/mark.htm>