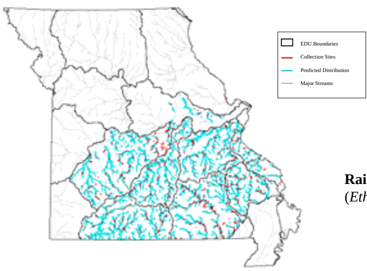
Modeling Species Distributions for Conservation Planning

Purpose/Need

"Understanding and predicting the composition of local biological communities across the landscape is one of the main challenges confronting ecologists, including stream ecologists"
N. LeRoy Poff, 1997

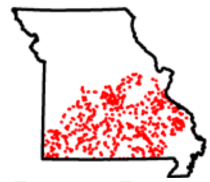
Why predict species distributions?

- The Clean Water Act mandates that we restore and maintain the chemical, physical and biological integrity of our nation's waters. Not select waters – all waters.
- Unfortunately, we have not nor will we ever sample the biota of every individual stream segment.
- Most impacts and management occur at a local scale with a lack of coordination among management efforts.
- Most management decisions are made within short time frames with limited information.

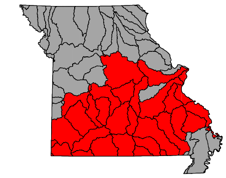


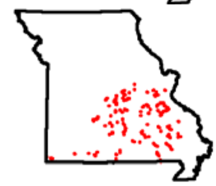
Rainbow darter
(*Etheostoma caeruleum*)

Step 3. Identify Known Species Ranges

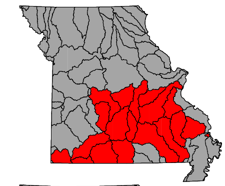


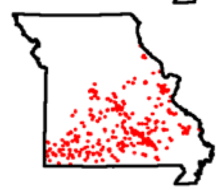
Ozark minnow
(*Notropis nubilus*)



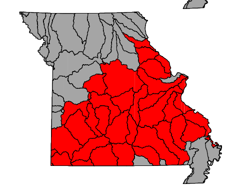


Wedgespot shiner
(*Notropis greenei*)





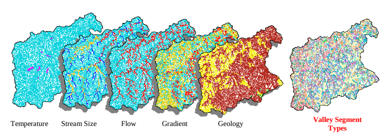
Southern redbelly dace
(*Phoxinus erythrogaster*)



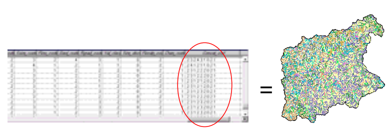
Stream Reaches Where Collected | Watersheds Depicting Species Range

Step 1. Classify Valley Segment Types

1. Stream reaches are classified according to physical factors that are known to influence the presence and abundance of aquatic biota.

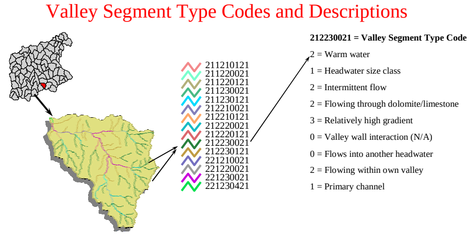


2. Each variable is given a numeric code and placed into the GIS database. These individual codes are then concatenated into a single numeric code that represents distinct valley segment types or distinct habitats.



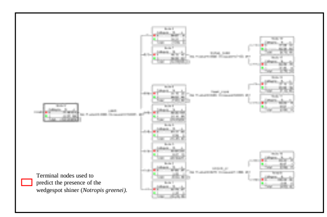
3. Once the valley segment classification is complete we know the particular characteristics of every stream reach and can display the streams accordingly.

Valley Segment Type Codes and Descriptions

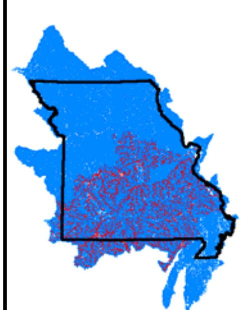


Step 4. Model Species Distributions Within Known Ranges

To model the distribution of each species we use a nonparametric procedure known as classification tree analysis. All community samples within the known geographic range of each species are used in the modeling process. Classification tree analysis compares the relative proportions of presence and absence for each species relative to five independent stream variables (size, flow, temperature, gradient, and size discrepancy). Resulting models are used to select stream reaches within the NHD that meet the model parameters. These reaches are then attributed as being appropriate habitat for the given species.

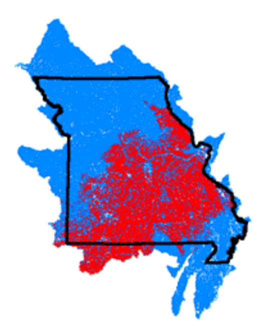


Classification Tree Diagram for the Wedgespot shiner



Ozark minnow

Wedgespot shiner

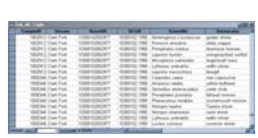


Southern redbelly dace

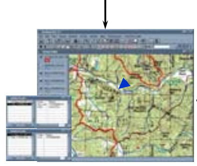
Step 2. Link Biological Data to the National Hydrography Dataset

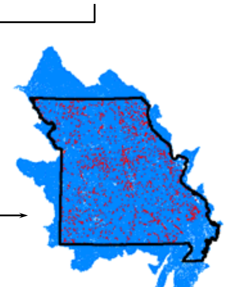
To georeference species sampling locations to the NHD, they are placed in a geographic information system (GIS) using spatial references provided in the source data, such as UTM coordinates or latitude/longitude. These locations are matched to individual stream segments in the NHD. The unique stream segment identifier from the NHD is captured and placed into the species database. With every sampling location tied to individual stream segments, every species collection point can be displayed in the statewide stream network.

Statewide National Hydrography Dataset (NHD) Streams



Species Collection Database

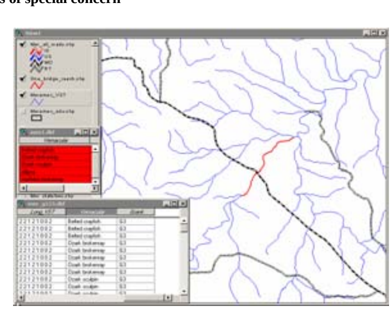




Stream Locations with Fish Community Collection Data

Utility

- Compiling biological inventory statistics
- Conducting biodiversity assessments
- Establishing study designs to document additional populations of species of special concern
- Decision support systems for planners, managers and regulators
- Tool for researching relations between environmental variables and biological communities



Species of Concern Predicted to Occur in Mineral Fork Creek at Missouri Route 185's Bridge Crossing

Knowing the biological potential of every stream segment can be of tremendous assistance for planning and management.

In this example, all fish, crayfish and mussel species of special concern were identified to assist with transportation planning occurring along the Route 185 bridge crossing Mineral Fork Creek in the Big River drainage.

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Annis, G. M., D. D. Diamond, M. E. Morey, and S. P. Sowa. 2005.
Modeling Species Distributions for Conservation Planning.
MoRAP Map Series MS-2005-010.