Hierarchical Landscape Models for Endemic Unionid Mussels:
Building Strategic Habitat Conservation Tools for Mussel Recovery
in the South Atlantic Landscape Conservation Cooperative

Progress Report (Sept 2012)

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We continue to develop the Tar River spinymussel models with the intent to conduct field sampling at the end of this field season and meet our scheduled project deadline. Since our last progress report, we have accomplished the following tasks.

1. Spatial data processing

The distance or area required for a threat to be realized (e.g. meters of riparian zone canopy removed) or to dissipate (e.g. dilution of a thermal or chemical input) varies among threats. A common simplification of aquatic habitat models is to attribute threats to catchments, ignoring distance or area relationships. Our models attempt to more precisely attribute threats to particular stream reaches. Based on NHDplus stream paths, Ernie Haine developed a relational database that links each 500 m reach to its immediate catchment and each catchment upstream in a manner that allows us to specify and model effect distances independently for each parameter in our models. This is a valuable tool that we will share with partners via the SALCC geospatial group.

Ernie and Ashton have also prepared data for the water chemistry, substrate, and temperature components of the model. A major aspect of this work is extracting the information necessary to define the elicitation questions. The questions are based on the distribution of values available within the study area extent, in addition to any data that may be available from past research to define critical threshold values. The recent research by T. Pandolfo and J. Archambault (NC Coop FW Research Unit) has been valuable for this purpose.

For each model variable, we also assessed if the distribution of mussel sampling sites is randomly distributed among available habitat (Figure 1). This provides a rough indication of whether data and expert knowledge represent a full and accurate picture of the environments available to mussels or apparent non-random distribution of mussels could be an artifact of non-random sampling.

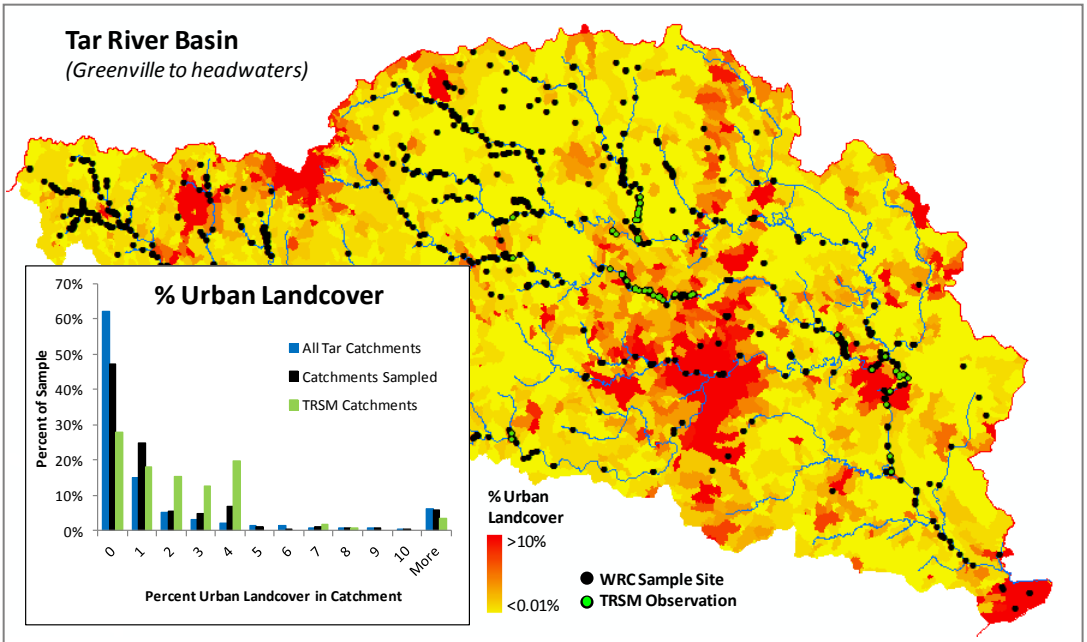

Figure 1 Example illustrating data exploration to test representativeness of past mussel sampling and to identify possible thresholds in mussel distribution relative to remotely-sensed GIS variables. Seventy-seven percent of catchments have 2% or less of their area mapped as urban landcover classes. Sampling by WRC has roughly mirrored this distribution, with 72% of sample sites falling in catchments with 2% or less urban landcover. Relative to availability and sampling effort, TRSM have been disproportionately found in catchments with up to 5% urban landcover. This information must be interpreted with caution as the landcover data represent a snapshot in time (2001), while sampling has been continuous over many years as development has spread. However, the information is useful to establish initial levels for the expert elicitations and Bayesian belief networks.

2. Hydrologic data acquisition

We have been negotiating with Michele Cutrofello of Research Triangle Institute for delivery of WaterFALL program flow data for the Tar and Neuse river basins (https://waterfall.rti.org/). Data could not be compiled for release to us until a contract between SALCC, TNC, and RTI had been finalized, an action which was completed in mid-July. Given this delay, we considered using the NHDplus data as an alternative; however, these data are at too coarse of spatial and temporal resolutions to parameterize our model. Furthermore, the WaterFALL data are used to derive TNC models of hydrologic alteration and will form the foundation of SALCC aquatic habitat and habitat threat models and TNC aquatic ecosystem resiliency models. Sharing a single data platform will ultimately strengthen the accuracy and precision of our mussel models, facilitate data sharing among these partners, and improve the transferability of our models to other taxa or geographies in the Southeast.

3. Model network structure and expert elicitations

We are currently transcribing the model structures into Netica (Bayesian belief network software) and coding the elicitations into Elicitator (software to statistically encode expert point estimates and confidence into prior probability distributions). Four models predict stream habitat suitability based on GIS data based on the probabilities of (1) suitable temperatures, (2) suitable flow, (3) suitable substrate, and (4) suitable water chemistry. In each case, "suitability" is defined by a set of field measurements which capture the range of conditions believed appropriate for mussel survival and reproduction. In each model, where two or more input nodes meet to jointly predict a response, the probability of alternative responses must be defined through expert elicitation (Figure 2). The specific questions posed will be based on the variable analysis results from the spatial data processing to ensure experts quantify expected responses across the full range of conditions present in the Tar and Neuse river systems. Formal elicitations will be conducted in early and mid-September to guide field sampling in late September and early October.

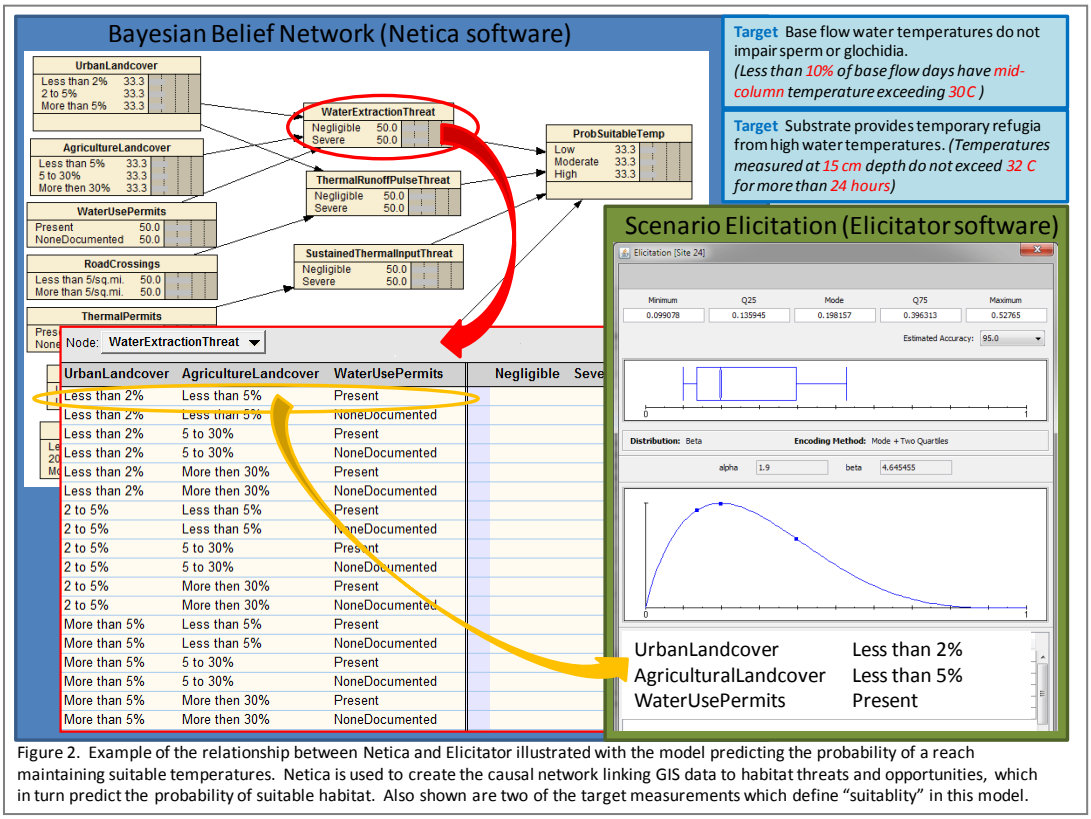

Figure 2. Example of the relationship between Netica and Elicitator illustrated with the model predicting the probability of a reach maintaining suitable temperatures. Netica is used to create the causal network linking GIS data to habitat threats and opportunities, which in turn predict the probability of suitable habitat. Also shown are two of the target measurements which define "suitablity" in this model.

4. Presentations at conferences and workshops

- SALCC symposium at the US International Association for Landscape Ecology, Newport, RI, April 2012
- Southeast Atlantic Slope Mollusk Meeting, Raleigh, NC, January 2012
- Dwarf Wedgemussel Strategic Habitat Conservation Workshop, Raleigh, NC, November 2011