NORTHEAST REGIONAL CONSERVATION NEEDS GRANT
2015 PROGRESS REPORT

Quarter: (circle one) **2015 1st** 2015 2nd 2015 3rd 2015 4th

Grant Program, Number and Title: RCN Grant 2012-02: **The conservation status of the brook floater mussel, *Alasmidonta varicosa,* in the Northeastern United States: trends in distribution, occurrence, and condition of populations**

Organization: Saint Anselm College

Project Leader: Barry J. Wicklow, Ph.D.

Abstract: Please provide a short (1-2 paragraphs) abstract that addresses EACH of the following: the objectives of your project, accomplishments to date, future plans and timelines with an estimate for when the project will be completed.

Objectives of our RCN proposal:

a. Gather and review all available occurrence data for each of 12 northeast states.
b. Build a comprehensive dataset that includes biological, habitat, and spatial parameters.
c. Map the spatial distribution of brook floaters using GIS.
d. Using GIS, analyze both natural features and anthropogenic modifications within watersheds where brook floater occur to further identify critical habitat and threats.
e. Analyze temporal trends using all available long-term datasets.

Our major task for this quarter was to develop a complete and consistent EO and population condition dataset and use these data to generate distribution maps. We have gathered occurrence and population condition data from all 15 states that compose the US distribution range (including data from West Virginia) (objective a). We also received valuable feedback from state and federal biologists and academic researchers during our presentations at regional mussel meetings: (1) New England Mussel Meeting, January 8, 2015, (2) Chesapeake Bay Freshwater Mussel Workgroup Meeting, January 29, 2015, (3) Atlantic Slope Mussel Recovery Group Meeting, April 8, 2015. We have produced our final, publication quality state and range-wide population condition maps (objective c). Additionally, we worked to improve predictive habitat models (objective d). We used random forests to predict EO condition at the HUC12 watershed scale. Using data from only a few states as a test for model development (other states' data were still being prepared by state biologists), we were able to achieve models that predicted up to 85% of the variation in EO condition (response). Condition was positively associated with canopy density (s2011_cd_mean) and negatively associated with agriculture (s_1992_lc92_planted_pct). We intend to increase the resolution of the model by summarizing predictor variables in the area immediately surrounding individual populations, buffered by 1 km upstream, rather than summarizing the predictor variables within the whole HUC12 watershed.
Our future plans include: (1) Perform a final quality check of the *location* of EO data, especially as it relates to the location of adjacent waterways from the official NHD dataset. Matching EOs with points along streams in the NHD will be a daunting and time consuming network analysis, but it will allow us to accurately prepare for modeling: (a) Compile environmental data we have gathered so far and link to EO locations in preparation for modeling. (b) Finish stream gauge/flow graphs. (c) Show the percentage of impervious surfaces vs. forested land within various buffer sizes around EOs (e.g., 500 m, 1000 m, 3000 m). (2) Continue to develop habitat condition models at the population, and potentially at the HUC12 scales. (3) Report model results and use the model to describe how land use and other predictors of condition relate to habitat health. (4) Begin to formulate recommendations for priority conservation populations, high-risk populations, and potential areas for restoration.

Were planned goals/objectives achieved last quarter? We have made progress on goals a, c and d.

Progress Achieved: (For each Goal/Objective, list Planned and Actual Accomplishments)

As part of our effort to close data gaps for *A. varicosa*, we have made progress toward objectives a, c, and d from the RCN proposal:

a. Gather and review all available occurrence data for each of 12 northeast states.
c. Map the spatial distribution of brook floaters using GIS.
d. Using GIS, analyze both natural features and anthropogenic modifications within watersheds where brook floater occur to further identify critical habitat and threats.

We worked with state biologists from all 15 states to update EO rankings and aggregate ranks for cases where EO's were recorded for individuals instead of populations (objective A). When we received the final datasets from each state, they were not all in the same format and required manual standardizing before entering them into the database. For some states, this process was completed several times as more updates were provided. The resulting dataset was used to produce the final distribution maps for each state as well as the range wide distribution map (objective C). Generating the consistent EO dataset and completing the maps with the final data and symbology were our main tasks during this quarter (see Figure 1 for example).

Additionally, we worked to improve predictive habitat models (objective D). We used the machine learning algorithm random forest to predict EO condition at the HUC12 watershed scale. Using data from only a few states as a test for model development (other states' data were still being prepared by state biologists), we were able to achieve models that predicted up to 85% of the variation in EO condition (response). Important variables included slope, land cover, and precipitation trends over the last 100 years (Figure 2). Small sample sizes per class inhibited our ability to distinguish trends in some predictor variables (Figure 3); however we observed that surrounding land use plays a large role in population health. Condition was positively associated with canopy density (s2011_cd_mean) and negatively associated with agriculture (s_1992_lc92_planted_pct). We will continue to explore these associations with the final dataset as amended by state biologists. Additionally, we will try to increase the resolution of the model by summarizing predictor variables in the area immediately surrounding individual populations, buffered by 1 km upstream, rather than summarizing the predictor variables within the whole HUC12 watershed.

We presented our recent results on the conservation status of *A. varicosa* at three regional meetings: (1) New England Mussel Meeting ("Life history and conservation status of the brook floater *Alasmidonta varicosa*"), (2) Chesapeake Bay Freshwater Mussel Workgroup Meeting ("Conservation status of the brook floater *Alasmidonta varicosa*"), (3) Atlantic Slope Mussel Recovery Group Meeting ('Conservation status of the brook floater *Alasmidonta varicosa* from Maine to Georgia").

Difficulties Encountered: None

Activities Anticipated Next Quarter:

Given the recent arrival of the final EO data, we are now in a position to continue progress with the following activities:

1. Perform a final quality check of the *location* of EO data, especially as it relates to the location of adjacent waterways from the official NHD dataset. Matching EOs with points along streams in the NHD will be a daunting and time consuming network analysis, but it will allow us to accurately prepare for modeling:

    a. Compile environmental data we have gathered so far and link to EO locations in preparation for modeling.
    b. Finish stream gauge/flow graphs.
    c. Show the percentage of impervious surfaces vs. forested land within various buffer sizes around EOs (e.g., 500 m, 1000 m, 3000 m)

2. Continue to develop habitat condition models at the population, and potentially at the HUC12 scales.

3. Report model results and use the model to describe how land use and other predictors of condition relate to habitat health.

4. Begin to formulate recommendations for priority conservation populations, high-risk populations, and potential areas for restoration.

Expected End Date: December 2015

Costs:

Total life to date expenses (include this quarter): $59,936.14

Total Approved Budgeted Funds: $72,940

Are you within the approved budget plan and categories? Yes

Signature: Barry Wicklow

Date: 05/12/2015

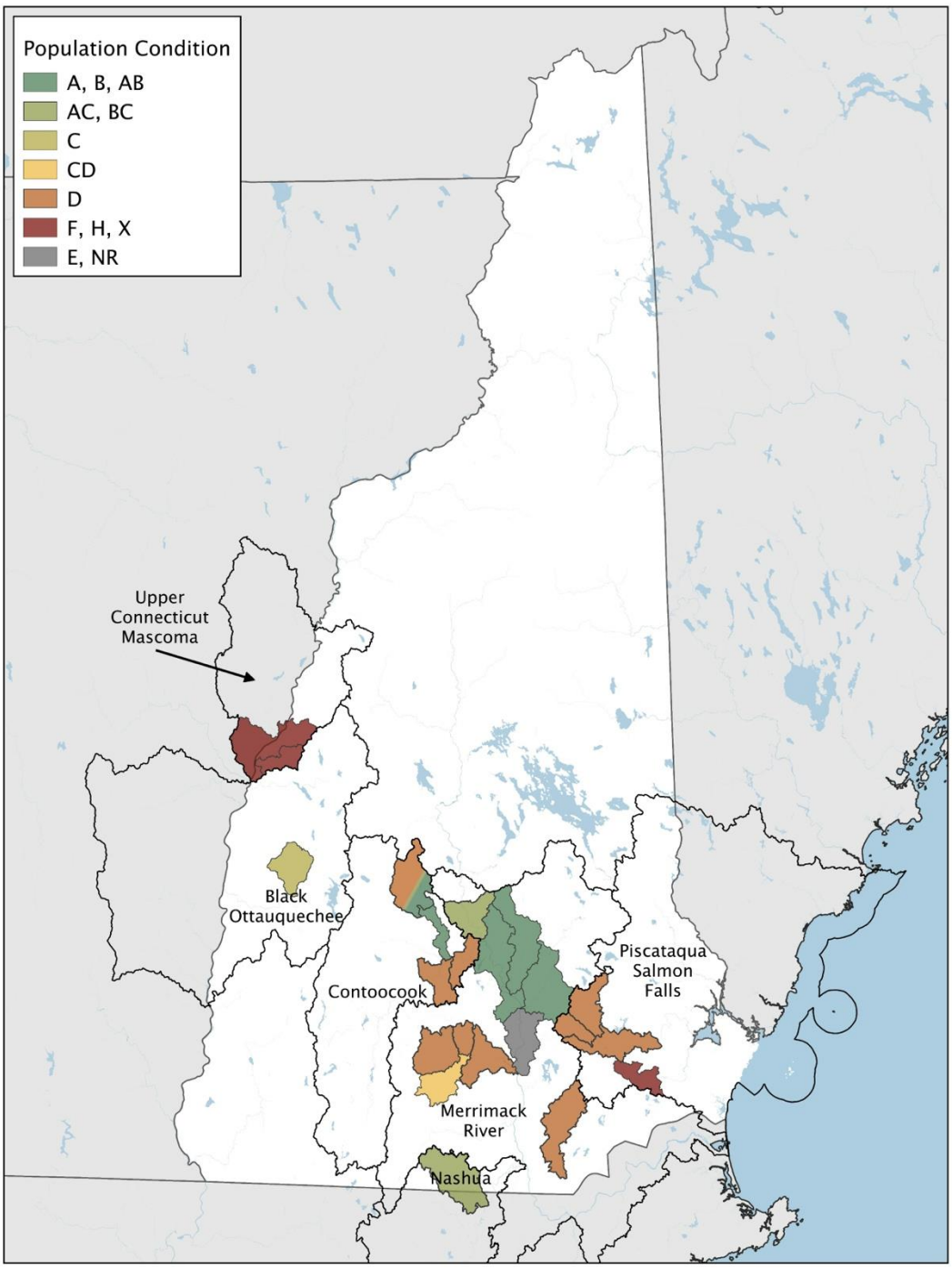

Figure 1. Example of final state-level maps produced this quarter (NH).

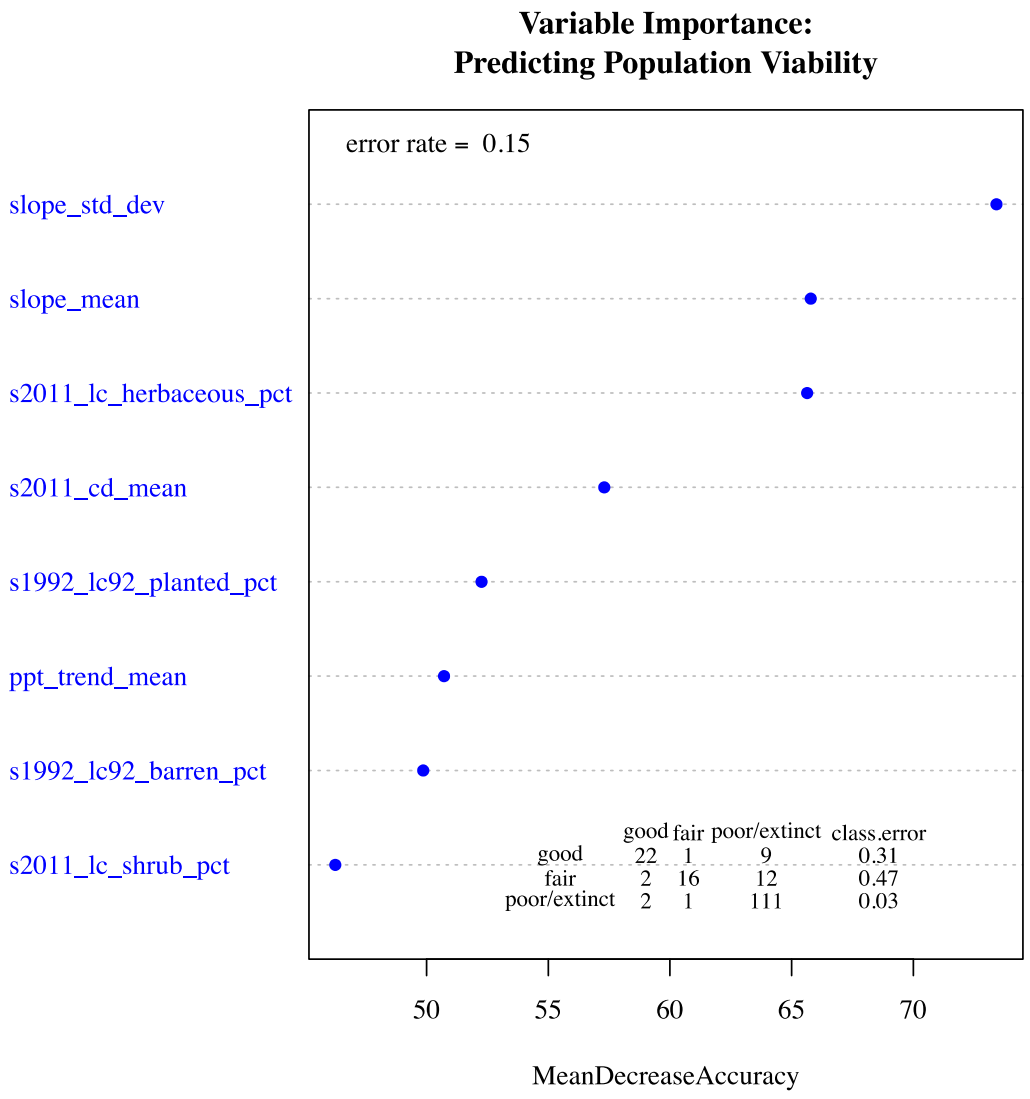

Figure 2. Random Forest modeling results showing variable importance. Variables at the top of the list are most important. The classification table at the bottom shows per-class accuracy. The columns represent observed values and rows represent modeled predictions. Where they match (on the diagonal from top left to bottom right) are where the model matched the observed. Other "off-diagonal" values represent errors.

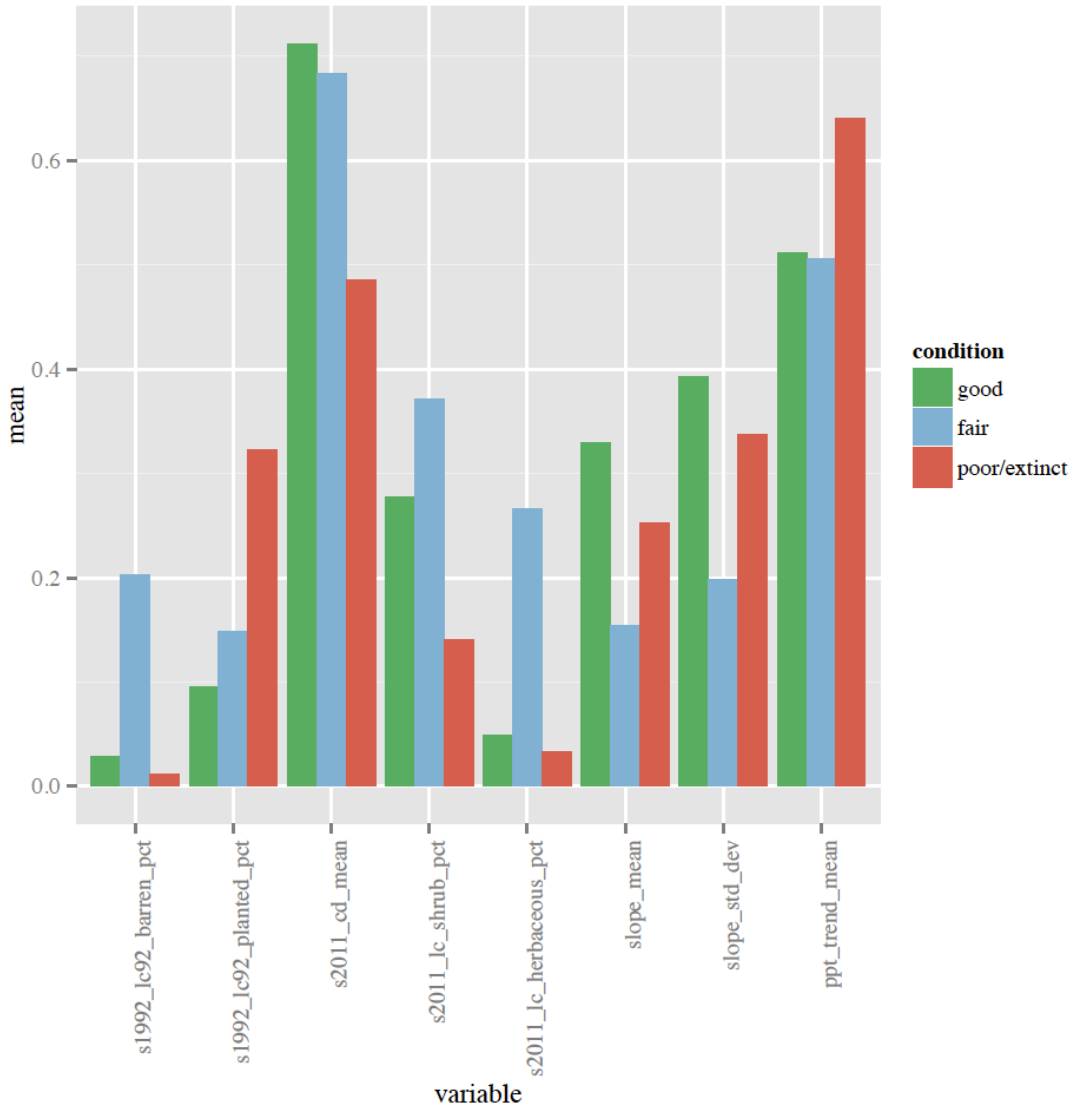

Figure 3. Mean values of predictor variables (normalized) by EO Condition.