North Atlantic LCC Aquatic Habitat Assessment

Chesapeake Bay Brook Trout Pilot Model Methodology Framework DRAFT

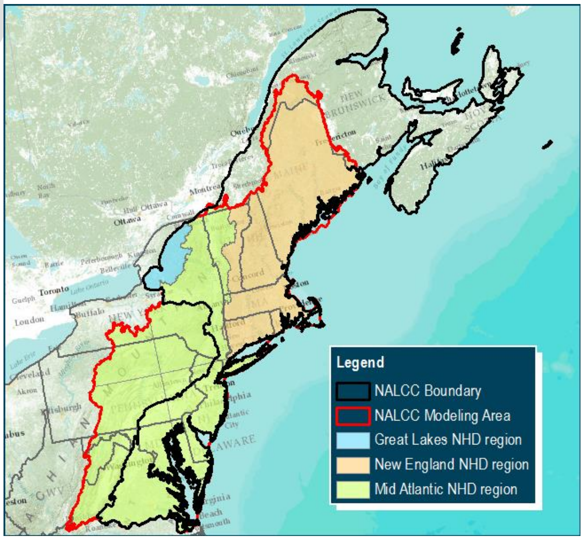
Prepared for the North Atlantic Landscape Conservation Cooperative (NALCC) Assessment Project

Contents

Introduction

Downstream Strategies (DS) has produced predictive models for several Fish Habitat Partnerships across the United States (example report: http://www.northatlanticlcc.org/projects/downstream-strategies-project/public-working-documents/example-report-habitat-modeling-report-for-the-ohio-river-basin-and-southeast-aquatic-resources-partnerships). These models utilized widely available landscape variables as predictors for instream aquatic responses, such as presence of certain guilds or species of fish. Boosted regression tree (BRT) models were utilized as the predictive statistical models for these analyses, and were chosen after careful consideration of their strengths and weaknesses compared to other available statistical methods. These models created a broad and unique understanding of the link between terrestrial and aquatic health, and allowed for the determination of stressors for each response.

FIGURE 1: STUDY AREA



DS was contracted by the North Atlantic Landscape Conservation Cooperative (NALCC) to perform between 15-20 habitat assessments—known as models— for areas within the NALCC region, shown in Figure 1. Our modeling approach is driven by collaboration with stakeholders throughout the project. This collaboration includes, but is not limited to, determining the:

- modeling endpoint,
- modeling scale and area of assessment,
- modeling approach and methods,
- selection—and in some cases, providing— of data for modeling input,
- reviewing preliminary model outputs and suggesting edits—based on local knowledge and expertise—to finalize models, and
- providing final oversight or approval of final models and deliverables developed as part of the assessment process

Modeling assessments will be developed for inland, estuarine, and coastal areas within the NALCC region. While the inland approach is mostly established, DS will lead stakeholders through a pilot project that will provide ample opportunity for input to the brook trout model for the Chesapeake Bay drainage. To communicate this process, the DS team will use this working document as a draft methodology brief, formally communicating our proposed approach and detailing the steps taken during the modeling process. This document will also allow the DS team and stakeholder to exchange ideas and track progress throughout the development of the case study.

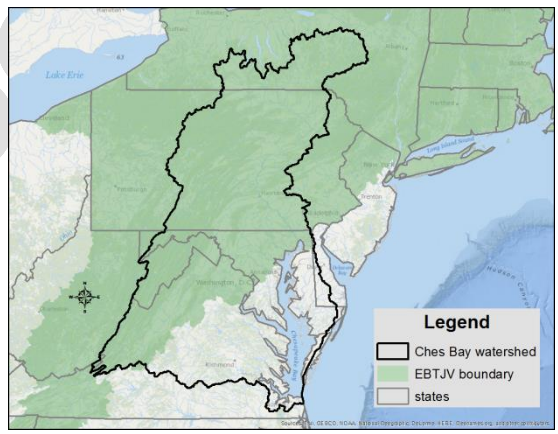
Background

Through initial conversations with many interested parties such as the Eastern Brook Trout Joint Venture (EBTJV), Maryland's Chesapeake Bay Field Office, other brook trout researchers, along with the NALCC project coordinators, the decision was made to create a model predicting brook trout presence within all watersheds draining to the Chesapeake Bay. This model will provide the basis for a dynamic decision support tool that stakeholders can use to spatially prioritize restoration and protection activities. The tool also provides a platform for viewing and analyzing all data from the model and for synthesizing predicted future conditions.

Methodology

The primary goals of the models are to assess habitat for specific biological endpoints in a consistent framework that can be applied to various endpoints developed as part of this project. In addition to the assessment, the team must produce results that can be integrated into the existing decisions support tool. For this pilot assessment, the decision has been reached by multiple stakeholder groups to apply the process below to brook trout within the Chesapeake Bay watershed (**Error! Reference source not found.**). The Chesapeake Bay watershed is an area of concern that covers much of the middle ranges of the eastern brook trout. Within this area, there are active groups working toward restoration at multiple scales, all of which will have access to the decision support tool that will be produced as part of this project.

FIGURE 2. CHESAPEAKE BAY WATERSHED



To ensure buy-in to the final assessment products, the project team will work with the stakeholders to develop deliverables that are consistent with the goals of the project and its end-users. By working through this modeling process with a real data example, it will allow stakeholders to have more complete understanding of the process, which will ensure a smooth application of this methodology to additional inland modeling efforts.

Modeling process

- We have already compiled data that summarizes local and upstream conditions for many datasets, such as temperature, land cover, geology for the NHD plus version 2 catchments. This data, along with any additional relevant predictor datasets identified by the review team will be utilized as predictor data for model.
- The predictor data will be combined with response data (fish survey data) for those catchments where fish survey data was available. The resulting dataset will be used to create a predictive model that will allow for characterization of the fish response for ALL catchments. The statistical methodology we will use for the predictive modeling will be boosted regression trees (BRT).
- See more details on the methodology in the example report for the Ohio River Basin and Southeast Aquatic Resources Partnerships.
- The technical review team will critique results and make suggestions to the resulting preliminary model.
- After making any necessary revisions, we will run a final model, then utilize our "post-modeling" process to quantify stress and natural quality, based on the relationships found in the model.
- We will then document all results in a formal report, which the review team will provide final comments on before the process is finalized.

- All model inputs, outputs, and other relevant data will be incorporated into the final decision support tool.

Data

The availability and extent of the data will drive many decisions made by the project team and stakeholders. Therefore it is critical to understand what data is available, its coverage, and its limitations. Our modeling data is broken down into two types of input (outlined below), response and predictor datasets.

Response data

- ***Biological modeling endpoint:*** For this pilot assessment, presence of brook trout will be the modeled response. We need a dataset of field-sampled fish collections that indicate the presence or absence of brook trout to utilize as the response variable.

Predictor data

- **Data used to predict habitat conditions:** Midwest and Great Plains Data Summary shows examples of the datasets used as predictors and which were generally most influential in structuring the fish responses in the Midwest and Great Plains. Below is a list of some of the potential data we have identified for this assessment. This list is not meant to be comprehensive or finalized.
- Known existing data
    - NLCD 2006 land use/land cover
    - NLCD 2006 impervious surfaces
    - NHD Plus value added attributes (mean annual temp, precip, elevation, basin area, etc)
    - Bedrock Geology (TNC stream classification project)
- Tentatively identified data
    - TNC connectivity assessment data (needs format conversion for our needs)

Limitations

- Limitations for similar types of modeling efforts have generally revolved around the data used to build the model, both the predictor and response data, which is why gathering as much quality data as possible up front is critical.
- The next most important limitation deals with the issue of extent. Models with too large an extent cannot be utilized for finer-scale decision making, and models with small extents cannot be extrapolated to other areas to make broad generalizations of region-wide populations. See the report here that illustrates how the extent at which a model is built influences the model predictions and the influence of individual predictor variables.
- The details of exact limitations will become clearer as the data and methodology takes shape.