Revised task list and schedule for the climate/environment/fish project – 3/11/13

Climate models

Done:

1. Created algorithm to calculate historic precipitation and climate times-series for a user-defined basin in the northeast.
2. Collected downscaled forecasts of precipitation and air temperature based on CMIP-3 GCM models.
3. Incorporated Stochastic Weather Generator v. 1. (Uses specific historic climate for user-defined basin) into web site.
4. Incorporated baseline shifted climate into web site.
5. Incorporated historic climate into web site.

Need to do:

1. Incorporate forecasts of precipitation and air temperature based on CMIP-5 GCM models and with improved downscaling methods. Ray Bradley's NECSC group at UMass is providing data.
2. Determine method for selecting among or combining the numerous available downscaled forecasts for use in the models in the web site. Ana Rosner will complete.
3. Adapt stochastic weather generator to allow variation among seasons rather than just across years. Scott Steinschneider from UMass will complete.
4. Complete simulation model of droughts and periods of extreme high temperatures. Incorporate into web site. Ana Rosner will complete.

Environmental models

Done:

1. Developed ABCDE stream flow model based on USGS gage data. This model works well for larger streams and rivers. To extend the model to ungaged streams we currently use a simple method based on proximity to gages and watershed size. Completed by Austin Polebitski.
2. Developed first option for stream temperature model (non-linear regression). Datasets across the New England portion of the NALCC have been collected and relationships

between air and stream temperature have been developed. Work has been completed by Austin Polebitski and Kyle O'Neil with support from NECSC.

Need to do:

1. Develop alternate stream flow models to address the following needs:
    a. specifically adept at modeling small headwater streams
    b. account for future changes in land use and impervious surface cover
    c. regionalization scheme/method to model flows at ungaged basins
        i. Alternative models under consideration include:
            1. Baseline Streamflow Estimator (BaSE)
            2. Parsimonious model (based on Generalized Watershed Loading Functions, GWLF)
            3. Coupled hydrology/hydraulic stream-routing model
            4. Method of Variance Extension (MOVE)
            5. Sustainable Yield Estimator (or other QPPQ-based method)
            6. Combinations of 1-5.
        ii. Ana Rosner will complete.

2. Investigate models to regionalize stream temperature and provide estimates for ungaged basins. Temperature data may be insufficient for effective regionalization, especially information on local groundwater input. Austin Polebitski and Ana Rosner, working with the UMass Civil and Environmental Engineering Department, will complete with assistance from NECSC personnel.
3. If time allows/future work:
    a. Possibly explore a general, broad spatial scale (minimal site-specific information) model to incorporate dams and/or culverts into stream flow models. This was done recently for reservoirs in the Rocky Mountains.
    b. Spatial network-based stream temperature model (Peterson & ver Hoff). This has also been done recently for Rocky Mountain streams.
    c. Incorporate stream flow into stream temperature model.

Fish models

At our last meeting in February, we decided to shift focus to broad-scale occupancy models because we should be able to complete these models fairly quickly. We will still develop abundance/mechanistic models, but occupancy will be the near-term priority. We will develop occupancy models first for CT and then for the rest of the NALCC.

Occupancy model

We are starting with state of Connecticut data, because CT has the best fish and stream temperature data.

Done:

1. Stream catchments defined for CT using ArcGIS ArcHydro extension. This extension allows definition of small basins of headwaters necessary for modeling brook trout.
2. Stream fish survey data (1988-present) and stream temperature data assembled for CT.

Need to do:

1. Assemble landcover and other GIS data layers to characterize delineated stream catchments for CT (e.g. % forest, road density, impervious surface, elevation, stream temperature and flow). Some of these layers will come from Kevin's project.
2. Statistical analysis of catchment and environmental factors affecting presence of brook trout in CT. By including stream temperature and flow in the model, the occupancy model will provide a broad-scale model for brook trout occurrence in the current landscape. The model will also be used to forecast occurrence across future landscapes under climate change scenarios.
3. Repeat the steps above for the rest of the NALCC

Abundance/lambda model

Done:

1. Development and application of population models based on abundance data (i.e. USGS Powell Center Bayesian hierarchical model working group) – one manuscript in review and another manuscript soon to be submitted. Manuscripts are based on simulations to test the power of the methods and small case studies.

Need to do:

1. Assemble population count data base of brook trout in the NALCC. Sites need to be sampled multiple times over years, ideally in consecutive years (this kind of data is not widely available). Unfortunately Mark Hudy's database for occurrence does not include abundance data.
2. Statistical analysis of count data, by incorporating realistic data situations (e.g. missing years and incomplete detection). The abundance/lambda model is an "intermediate" model between occupancy and mechanistic model. The goal is to understand what environmental drivers regulate population growth rate at several pockets of areas in the NALCC (where data are available). If enough data are available, we will predict dynamics at sites without data.

Mechanistic model

Done:

1. Parameter estimation using integrated survival/growth/movement model complete.
2. Integral projection model complete. This model synthesizes parameter estimates into a framework for estimating detailed sensitivities of population growth to variation in environmental conditions. It also provides a means to project population growth under various future scenarios. In the context of the NALCC, the model will be used to identify in which seasons stream flow and temperature have the greatest impact on population growth and what the direction of effects are for a single stream. The results can be thought of a 'guideposts' for potential environmental effects, but will not be useful for predictions across the NALCC.

Need to do:

1. Write manuscript

Web site

Done:

1. Alpha version of the server-side architecture and user interface has been completed.
2. Dynamic algorithm to allow user-delineated basins completed.
3. Climate, environmental, and fish population models are connected and executed via web site for scenario testing.
4. Initial output graphs (dynamically generated for user-executed modeling, but currently non-interactive) are complete.
5. Work started on interactive tree-display, to enable user to view and navigate multiple model runs.

Need to do:

1. Develop beta (user testing) version, by continuing work on server-side architecture and user interface.
    i. Pre-process data to display spatial availability of streamflow, stream temperature, and/or fish data; and allow users to choose additional model options for basins where data are available.
    ii. Adapt web site to enable analysis of multiple climate scenarios simultaneously using "response and resiliency curves".
    iii. Develop interactive output graphs for model results.
    iv. Allow user uploaded time series for climate or streamflow & stream temperature.
2. Revised web site based on pilot users' input.
3. Add process batch runs to allow sensitivity analysis of model output.

4. Solicit additional climate/environmental/animal models from users for incorporation into web site.
5. Run web site workshops.

Time line:

	Spring 2013	Summer 2013	Fall 2013	Winter 2013	Spring 2014
Task					
Climate model					
1					
2					
3					
4					
Environmental models					
1					
2					
3					
Fish models					
Occupancy 1					
2					
3					
Abundance 1,2					
Mechanistic 1					
Web site					
1					
2					
3					
4					
5					