

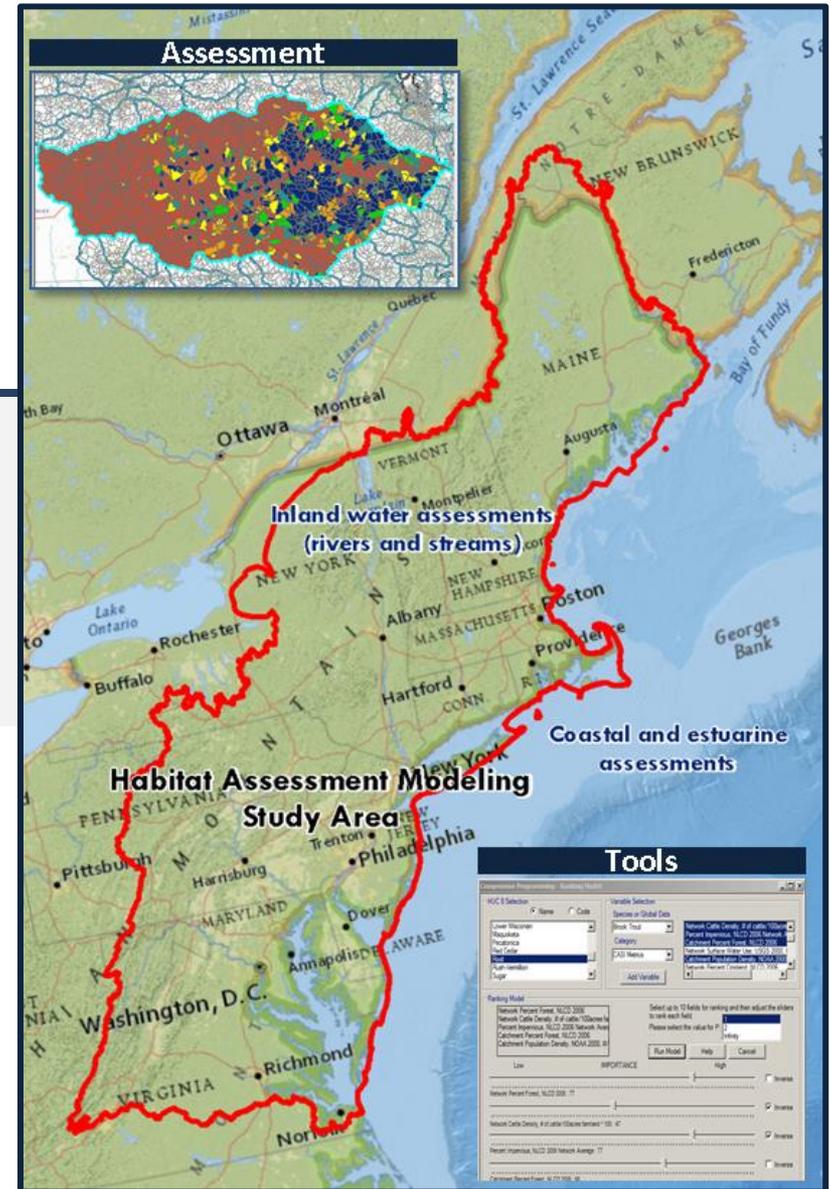
Habitat Assessment Models and Decision Support Tools for Aquatic Habitats

July 17, 2013



Atlantic Coastal Fish Habitat Partnership

Working together to conserve coastal, estuarine-dependent, and diadromous fish habitat



Watershed Assessment Models

Data

- Hydrologic model
- Landscape characteristics
- Stream characteristics
- Biological endpoints

Model

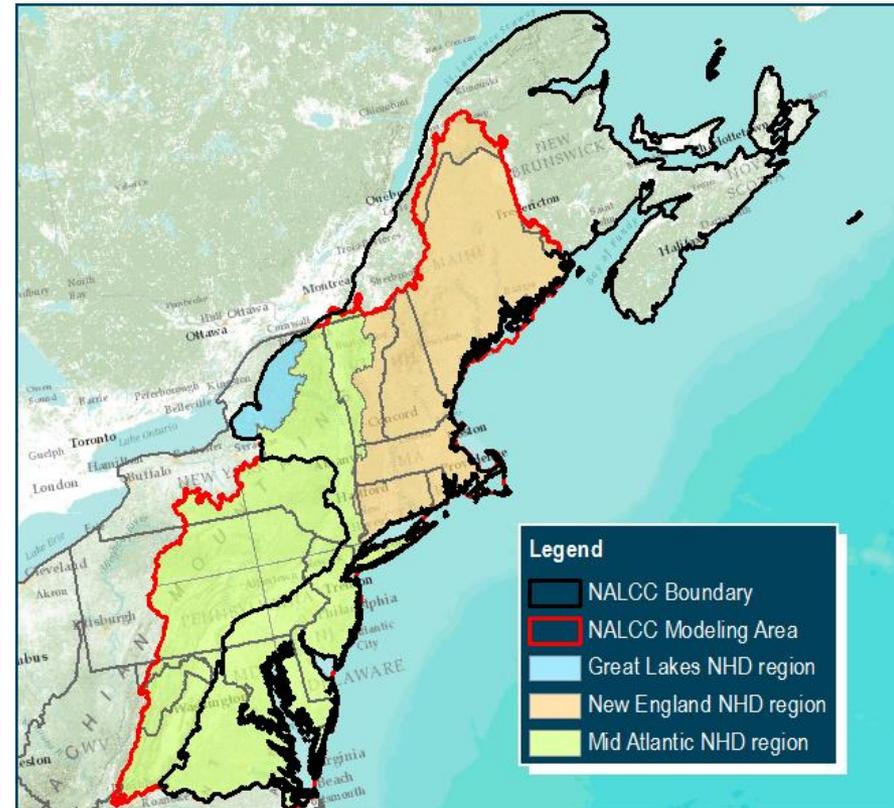
- Boosted regression trees
- Predicted conditions
- Functional relationships
- Anthropogenic stress
- Natural quality

Apply

- Visualize conditions
- Determine priorities
- Make decisions
- Run future scenarios

Modeling Area

- National Hydrography Dataset V2
- Catchment level assessments
- Decision Support Tool



Assessment Outputs

Technical Reports

- Project background
- Overview of assessment process
- Modeling inputs
- Modeling process
- Post-modeling
- Mapped results

Data and Maps

- Geodatabase of model inputs and outputs
- Metadata and data dictionaries
- Processing notes and documentation
- Response (fish) database
- HUC-8 Mapbooks of prediction maps, at the catchment scale

GIS Decision Support Tool

- Integrate ArcMap 10.1 toolbar
- Visualization and Zoom-to features
 - Landscape variables
 - Predictor datasets
 - CASI and CNQI metrics
 - Predictions
 - Socioeconomic data
- Ranking model
 - Weight datasets based on criteria or preference
 - Comprise programming model
 - Identify catchments most / least like criteria
- Futuring tool (new for 2013)
 - Change current conditions at the local level
 - Propagate changes downstream
 - Visualize the impact of that change, locally and downstream

Past Assessments

Seven FHP/Partnership Assessments (2010-2013)



Seven FHP/Partnership Assessments

35 Separate Models

- Ohio River Basin/Southeast Aquatic Resource Partnership (7)
- Driftless Area Restoration Area (5)
- Great Lakes (5)
- Midwest Glacial Lakes (5)
- Fishers and Farmers (5)
- Great Plains(5)
- Midwest Regional (3)

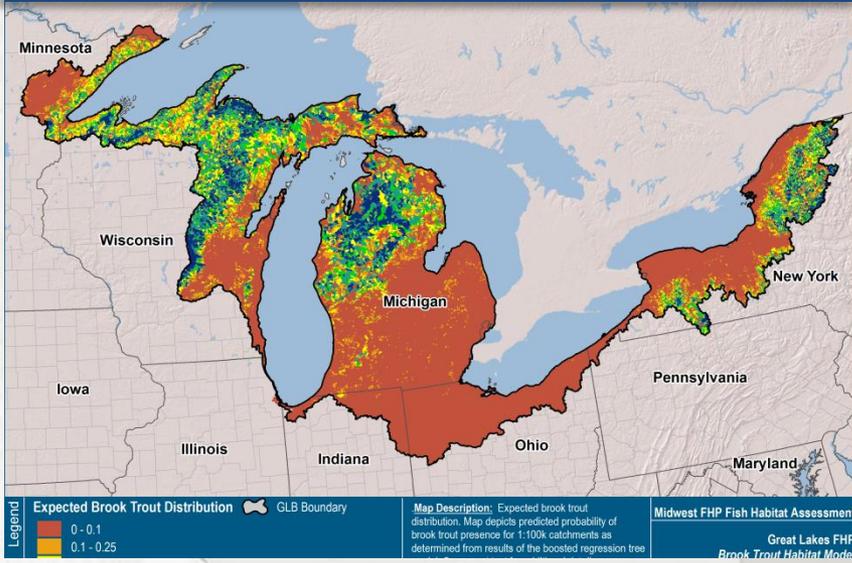
Species Model Examples

- Brook trout
- Walleye
- Smallmouth bass
- Large river species
- Intolerant mussels
- Redhorse
- Long nose dace

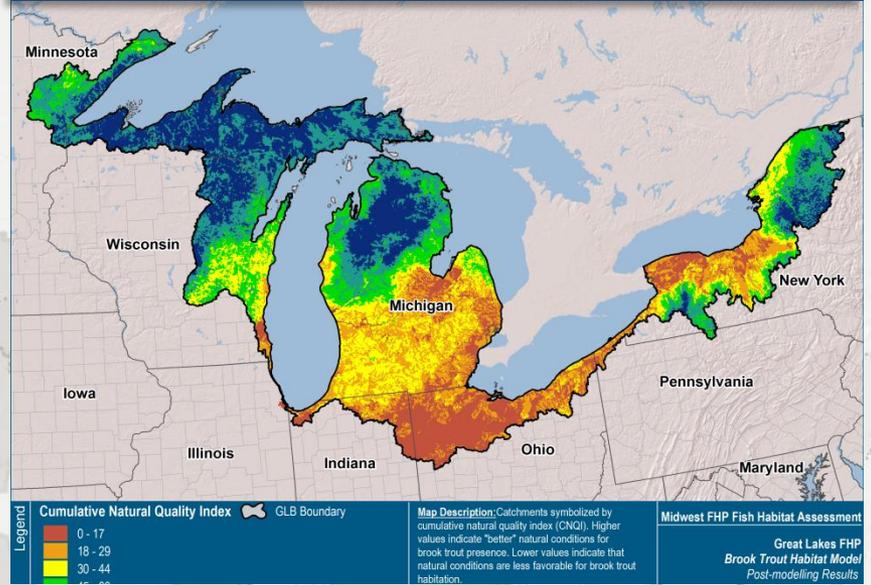
Aquatic Endpoint Examples

- Coldwater index
- Water quality (total summer phosphorous)
- Species richness
- Lithophilic species richness
- Modified index of centers of diversity score
- Small streams signature fish index score

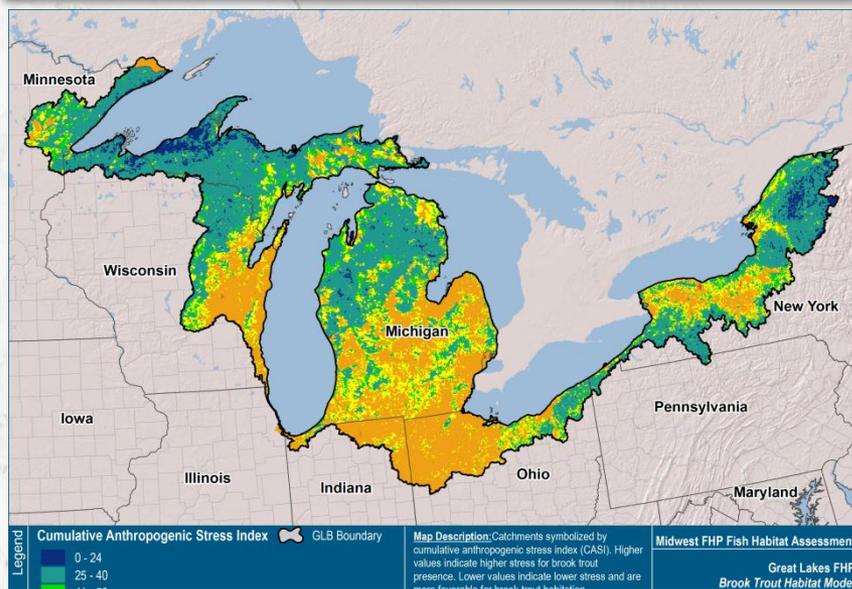
Predictions



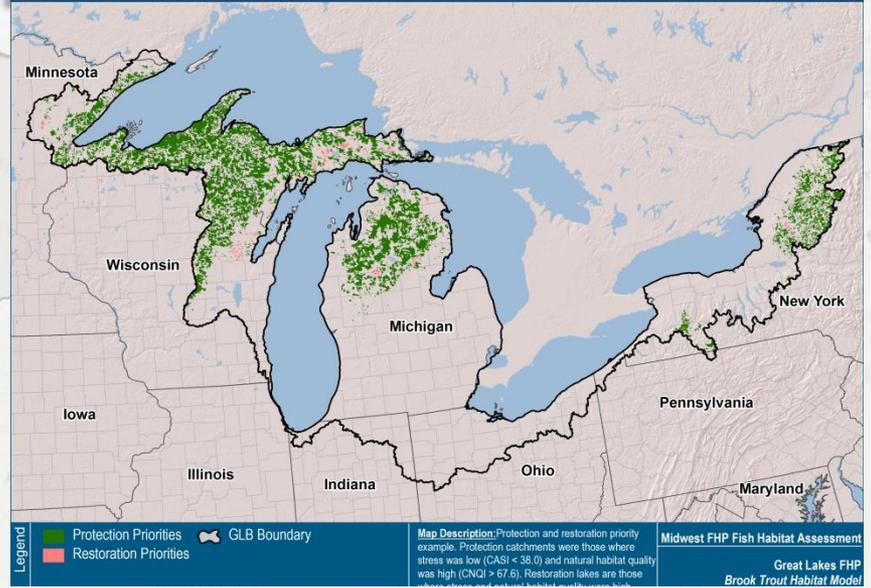
Natural Quality Index



Anthropogenic Stress Index

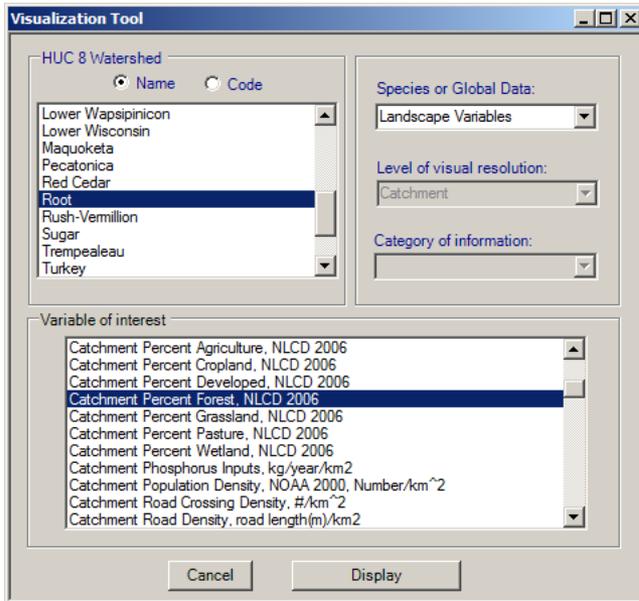
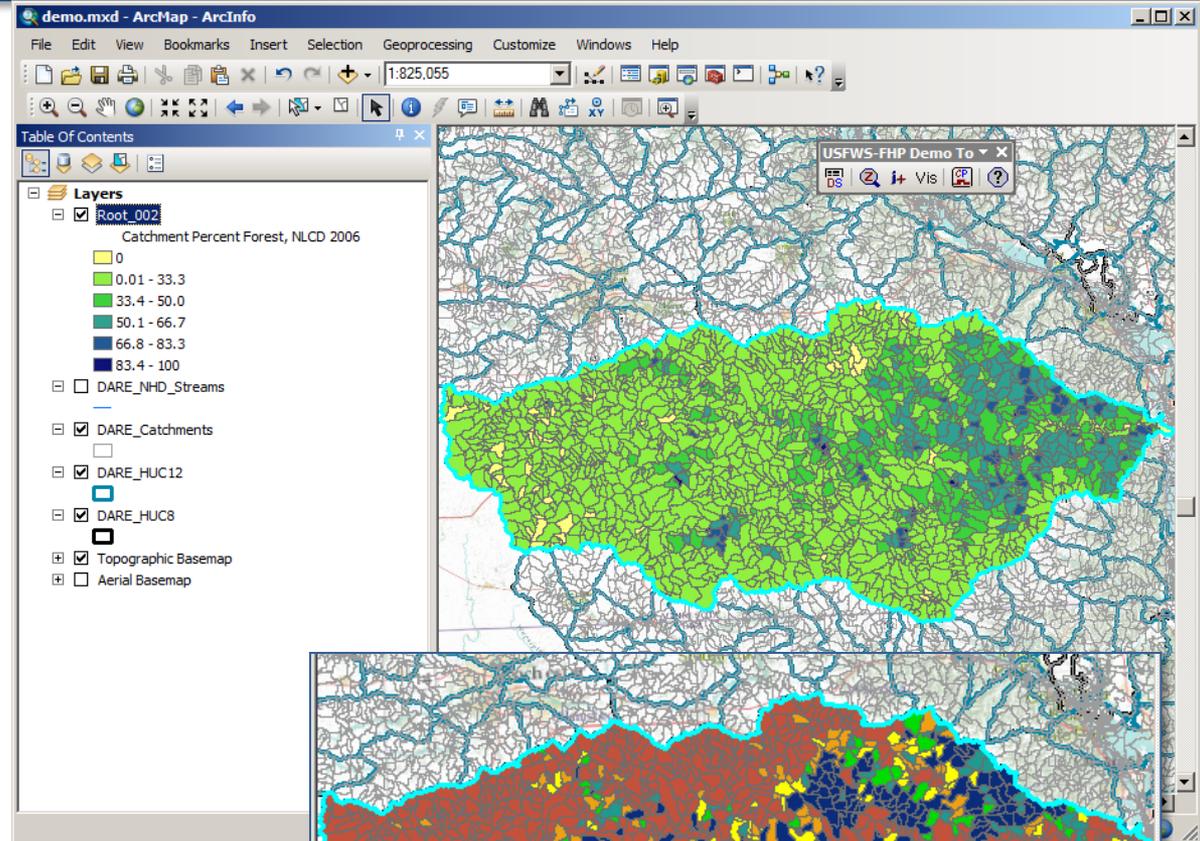


Restoration Protection Priorities



Decision Support Tools (v1)

Visualize the data



Visualization Tool

HUC 8 Watershed

Name Code

Lower Wapsipinicon
Lower Wisconsin
Maquoketa
Pecatonica
Red Cedar
Root
Rush-Vermillion
Sugar
Trempealeau
Turkey

Species or Global Data:
Landscape Variables

Level of visual resolution:
Catchment

Category of information:

Variable of interest

Catchment Percent Agriculture, NLCD 2006
Catchment Percent Cropland, NLCD 2006
Catchment Percent Developed, NLCD 2006
Catchment Percent Forest, NLCD 2006
Catchment Percent Grassland, NLCD 2006
Catchment Percent Pasture, NLCD 2006
Catchment Percent Wetland, NLCD 2006
Catchment Phosphorus Inputs, kg/year/km²
Catchment Population Density, NOAA 2000, Number/km²
Catchment Road Crossing Density, #/km²
Catchment Road Density, road length(m)/km²

Cancel Display

Decision Support Tools (v1)

Rank criteria and results



Compromise Programming - Ranking Model

HUC 8 Selection

Name	Code
Lower Wisconsin	
Maquoketa	
Pecatonica	
Red Cedar	
Root	
Rush-Vermillion	
Sugar	

Variable Selection

Species or Global Data: Brook Trout

Category: CASI Metrics

Add Variable

Ranking Model

Select up to 10 fields for ranking and then adjust the sliders to rank each field. Please select the value for P: 1, 2, Infinity

Run Model Help Cancel

Low IMPORTANCE High

Network Percent Forest, NLCD 2006: 77 Inverse

Network Cattle Density, # of cattle/100acres farmland * 100: 47 Inverse

Percent Impervious, NLCD 2006 Network Average: 77 Inverse

Catchment Percent Forest, NLCD 2006: 66 Inverse

Catchment Population Density, NOAA 2000, #/km²: 21 Inverse

Help

The Prioritization Model

Prioritizations of spatial alternatives quite often include multiple objectives and criteria, making them multicriteria evaluation problems (Malczewski, 1999). The common procedure for solving multicriteria problems is the integration of an evaluation matrix with a vector consisting of weights corresponding to the assigned priority of the criteria (Jankowski and Richard, 1994), (Carver, 1991). The evaluation matrix E and weight vector W can take the following forms:

(1)

$$E = \begin{bmatrix} f_{11} & \dots & f_{1j} \\ \vdots & & \vdots \\ f_{i1} & \dots & f_{ij} \end{bmatrix}$$

$W = (w_1, w_2, \dots, w_p)$

$\begin{bmatrix} A_1 \\ \vdots \\ A_p \end{bmatrix}$ function of $\begin{bmatrix} f_{11} & \dots & f_{1j} \\ \vdots & & \vdots \\ f_{i1} & \dots & f_{ij} \end{bmatrix}$ and $\begin{bmatrix} w_1 \\ \vdots \\ w_p \end{bmatrix}$

demo.mxd - ArcMap - ArcInfo

File Edit View Bookmarks Insert Selection Geoprocessing Customize Windows Help

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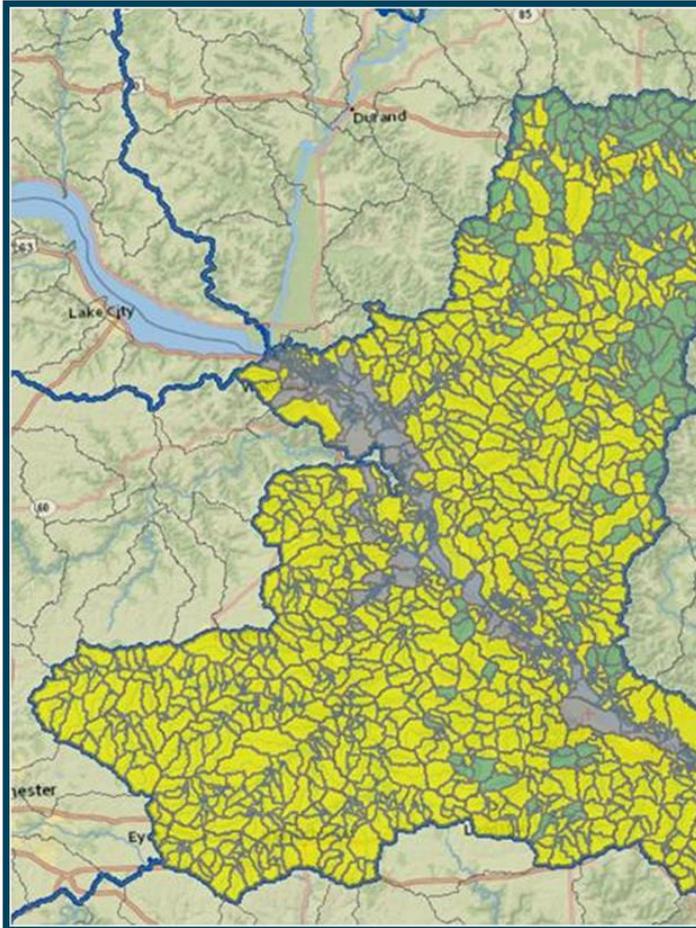
Table Of Contents

Layers

- Root_RankingOutput_005
 - Ranking Result
 - Top 3rd
 - Middle 3rd
 - Bottom 3rd
- DARE_NHD_Streams
- DARE_Catchments
- DARE_HUC12
- DARE_HUC8
- Basemap
- National Geographic
- Aerial Basemap

Decision Support Tools (v2)

Futuring tool



Futuring

Scenario Name: Demo

Model: Brook Trout

Area Selection: HUC 8 (Name selected), Baraboo

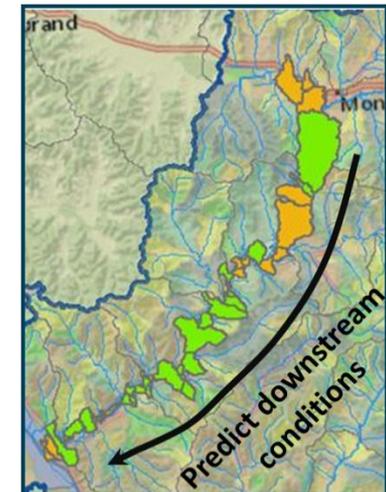
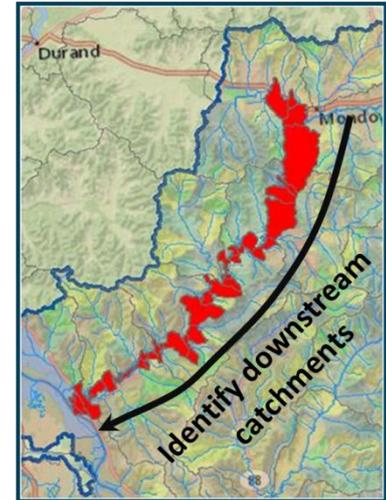
Selected Catchments: 13652878, 13653576

Variable Name	Weight	Value
Catchment Percent Forest, NLCD 2006	30.99	15.39
Catchment Percent Cropland, NLCD 2006	12.79	43.35
Catchment Population Density, NOAA 2000	11.36	380.00
Network Percent Catchments with 303d Impairment	5.33	2.99
Percent Impervious, NLCD 2006 Average	1.37	1.32
Catchment Dam Density	0.02	0.00

Buttons: Select, Flash, Remove, Add Selected Variables, Run Model, Help, Cancel

Futuring sliders:

- Catchment Percent Forest, NLCD 2006: Weight: 30.99, Default Value: 15.39, User Selected: 19.00
- Catchment Percent Cropland, NLCD 2006: Weight: 12.79, Default Value: 43.35, User Selected: 46.00
- Catchment Population Density, NOAA 2000: Weight: 11.36, Default Value: 380.26, User Selected: 466.00
- Network Percent Catchments with 303d Impairment: Weight: 5.33, Default Value: 2.99, User Selected: 7.00
- Percent Impervious, NLCD 2006 Average: Weight: 1.37, Default Value: 1.32, User Selected: 15.00
- Catchment Dam Density: Weight: 0.02, Default Value: 0.00, User Selected: 0.00

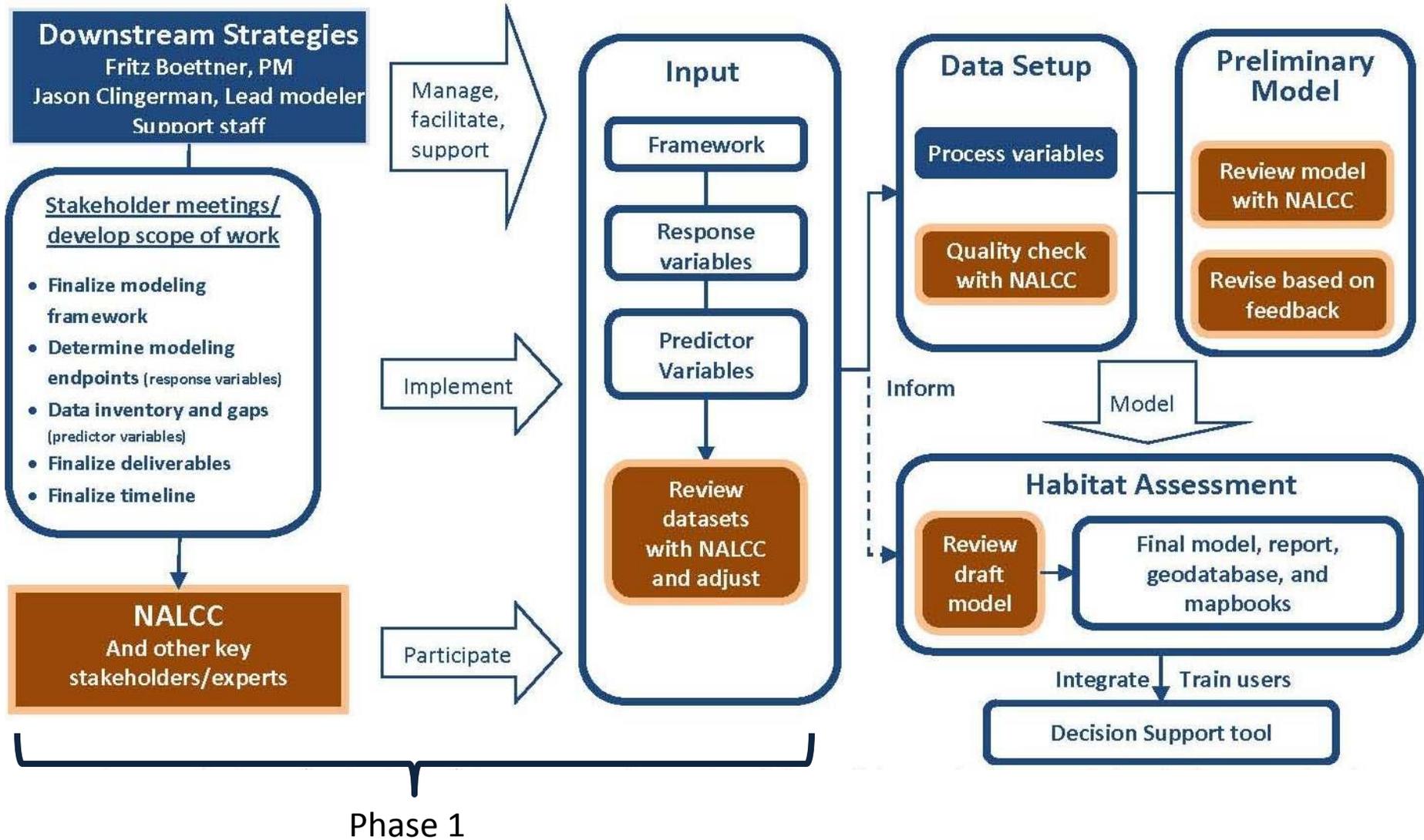


NALCC Project

Project overview

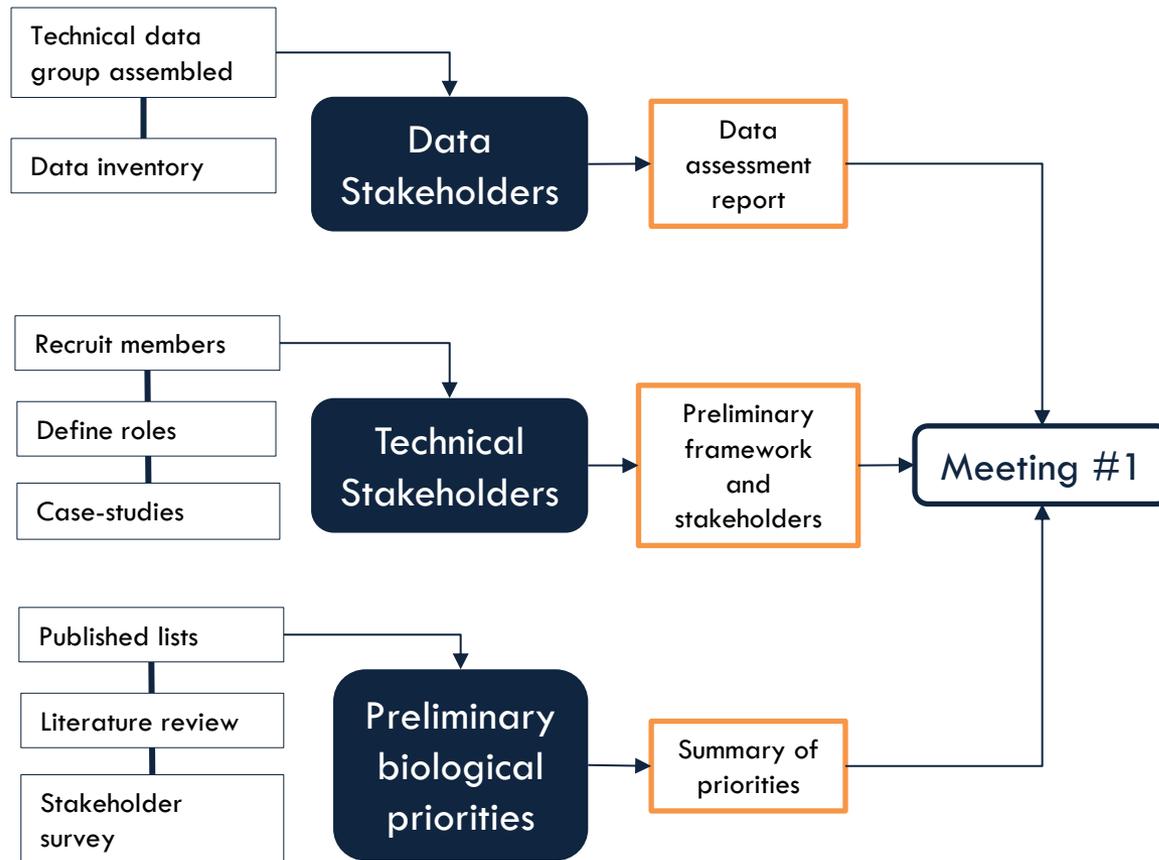
- Same modeling process, with some modifications:
 - Working with stakeholders to modify framework for estuarine and coastal assessments
 - Improved post modeling
- 15-20 total models
- Inland waters, estuarine, and coastal
- Two-year time frame
- Decision support tool v2

Project Process



NALCC Project Status

Phase 1 – Spring/Summer 2013



- Form stakeholder and advisory groups
- Case studies
- Research methods, data, and priorities
- Webinars, committee meetings, set actions
- Face-to-face stakeholder meeting early fall

NALCC Project Status

Phase 1 progress

- **Project management website:**
<http://www.northatlanticlcc.org/projects/downstream-strategies-project>
- **Documents:** Briefs and information related to the project
 - Preliminary framework (inland models)
 - Data summaries (Midwest and Great Plains)
 - Example Report
 - Case study
 - Case Study: Analysis of scale on boosted regression tree fish habitat models
 - Incorporating future climate and land use changes into aquatic habitat assessments

NALCC Project Status

Forming stakeholder groups

- **Technical review committees:**

- Local knowledge of species and existing habitat conditions.
- Provide feedback to the modeling team in the development of one or more models.



- **Data development and acquisition committees:**

- identify key datasets response variables (fish species/biological endpoints) and predictor datasets (landscape data/ in-stream measurements/other conditions)
- Assist with processing datasets and provide expertise on model inputs and outputs.

NALCC Project Status

Developing and refining methodology

North Atlantic LCC Aquatic Habitat Assessment Proposed Methodology for Aquatic Assessments Prepared for the North Atlantic Landscape Conservation Cooperative (NALCC) Assessment Project 04-12-2013

Contents

Introduction.....	1
Stakeholder process.....	1
Geographic scope of project.....	2
Methodology.....	3
Inland Assessments.....	4
Data compilation and preparation.....	4
Modeling methodology.....	5

Introduction

This project will assemble data and analyze conditions to understand fish distribution, habitat, and threats to aquatic species. Downstream Strategies (DS) will implement, improve, and customize our assessment methodology specific to the North Atlantic Landscape Conservation Cooperative (NALCC). Additionally, DS will leverage existing in-house datasets, decision support tools, and institutional knowledge and expertise to enable NALCC stakeholders to prioritize conservation and management efforts for inland, estuarine, and coastal aquatic species. The NALCC has partnered with the Atlantic Coast Fish Habitat Partnership (ACFHP) for the coastal and estuarine portions of this assessment. The ACFHP contributors will contribute critical coastal fish expertise and guidance to all phases of the coastal and estuarine assessment.

We will use a participatory stakeholder process to identify, compile, analyze, and model data determined to be most useful to resource managers for supporting conservation efforts. The process will include a detailed review of existing datasets, collection and standardization of new datasets, development of spatially explicit models, and delivery of a readily accessible geospatial decision support tool that provides NALCC stakeholders with an interactive and flexible tool for evaluating various conservation and management decisions.

This document details a preliminary methodology that we will use to guide the modeling process. This document is a working document and will be updated as input is gathered and decisions on the methodology are made.

Stakeholder process

The development and implementation of the modeling framework is designed as an inclusive process. We recognize the critical role that stakeholder involvement throughout all phases of the project plays in ensuring credible and useable project outcomes. DS will initially lead several "face-to-face" meetings with key stakeholders and aquatic experts in the region to better understand stakeholders' species/habitat/threat priorities, data availability, and inform modeling approaches. DS will then prepare a detailed methodology and submit for stakeholder comment, questions, and suggestions. Guided by stakeholder input, DS will customize the modeling methodology to best meet the needs of the NALCC. We will continue to solicit review and feedback from stakeholders throughout the entire modeling process. We understand the importance of continued involvement and have specifically built time into the anticipated project schedule to both obtain and incorporate stakeholder input. This approach ensures that the NALCC stakeholders understand the inputs and approve the outputs, creating an inclusive and participatory process. The stakeholder process and project workflow is shown in Figure 1.

- Work with stakeholders and technical advisors to integrate coastal and estuarine assessments into the framework
- Refine inland methodology and approach

NALCC Project Status

Case-studies

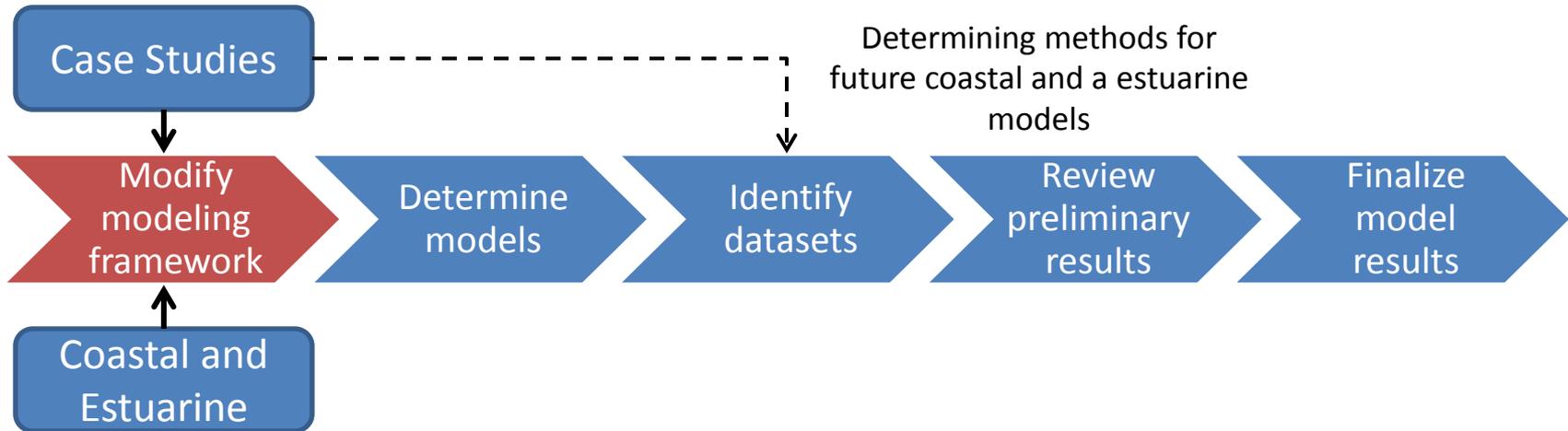


Image courtesy of NOAA

- **Case Studies**
 - Walk stakeholders through the modeling process
 - Develop coastal and estuarine modeling framework
- **Coastal/ estuarine**
 - Winter Flounder
 - Questions submitted to stakeholder group
 - River Herring (alewife and blue back herring)

Coastal/Estuarine Case Study

Process



- **Question 1:** Geographic extent
- **Question 2:** Analysis scale
- **Question 3:** Accounting for harvest
- **Question 4:** Measure of habitat quality
- **Question 5:** Key predictor variables
- **Question 6:** Management endpoints and threats

NALCC Project Status

Next steps

- **Develop case-studies**
 - Inland – Need stakeholders
 - Coastal (Complete) – Need stakeholders
- **Develop priorities**
 - Literature review of listed priority species
 - Administer survey to respondents for stakeholder recruitment and the development of priorities
- **Recruit Stakeholders**
 - Assist the project team with gathering data, finalizing priorities, and providing technical review(s) of the modeling process.
- **Webinars and face-to-face meeting**
 - Several webinars to explain the process and organize stakeholders
 - 2-day workshop to set modeling endpoints and methodology for coastal/estuarine assessments

NALCC Project Status

Developing priority species

Common Name	ACFHP	Federal	ME	NH	VT	MA	RI	CT	NY	NJ	PA	DE	MD	DC	VA	WV	TOTAL
Shortnose Sturgeon		E	X	X		X	X	X	X	X	X	X	X	X	X		
Atlantic Sturgeon*	X	IF	X	X		X	X	X	X	X	X	X	X	X	X		
American Eel		IF	X	X	X	X	X	X	X		X			X	X	X	
American Brook Lamprey*				X	X	X	X	X		X	X	X	X		X	X	
American Shad		IF	X	X	X	X	X	X	X				X	X	X		
Banded Sunfish*				X		X	X	X	X	X	X	X	X		X		
Bridle Shiner*				X	X	X	X	X		X	X	X	X		X		
Brook Trout		SS	X	X	X	X	X	X	X	X			X			X	
Alewife		IF		X		X	X	X	X		X			X	X		
Blueback Herring		IF		X	X	X	X	X	X					X			
Rainbow Smelt			X	X			X	X	X	X	X						
Atlantic Salmon	X	E	X	X	X	X	X	X	X								
Hickory Shad		IF						X		X	X	X	X	X			
Slimy Sculpin				X		X		X		X					X	X	
Swamp Darter			X	X		X		X	X				X				
Ironcolor Shiner									X	X	X	X	X		X		
Longnose Sucker			X			X		X			X		X				
Least Brook Lamprey											X	X	X		X	X	
Burbot			X	X		X		X			X						
Comely Shiner									X	X		X	X			X	
<i>Sum</i>	<i>2</i>	<i>9</i>	<i>10</i>	<i>15</i>	<i>7</i>	<i>15</i>	<i>12</i>	<i>17</i>	<i>13</i>	<i>11</i>	<i>13</i>	<i>9</i>	<i>13</i>	<i>7</i>	<i>11</i>	<i>6</i>	