

# Habitat assessment models and decision support tools for aquatic habitats

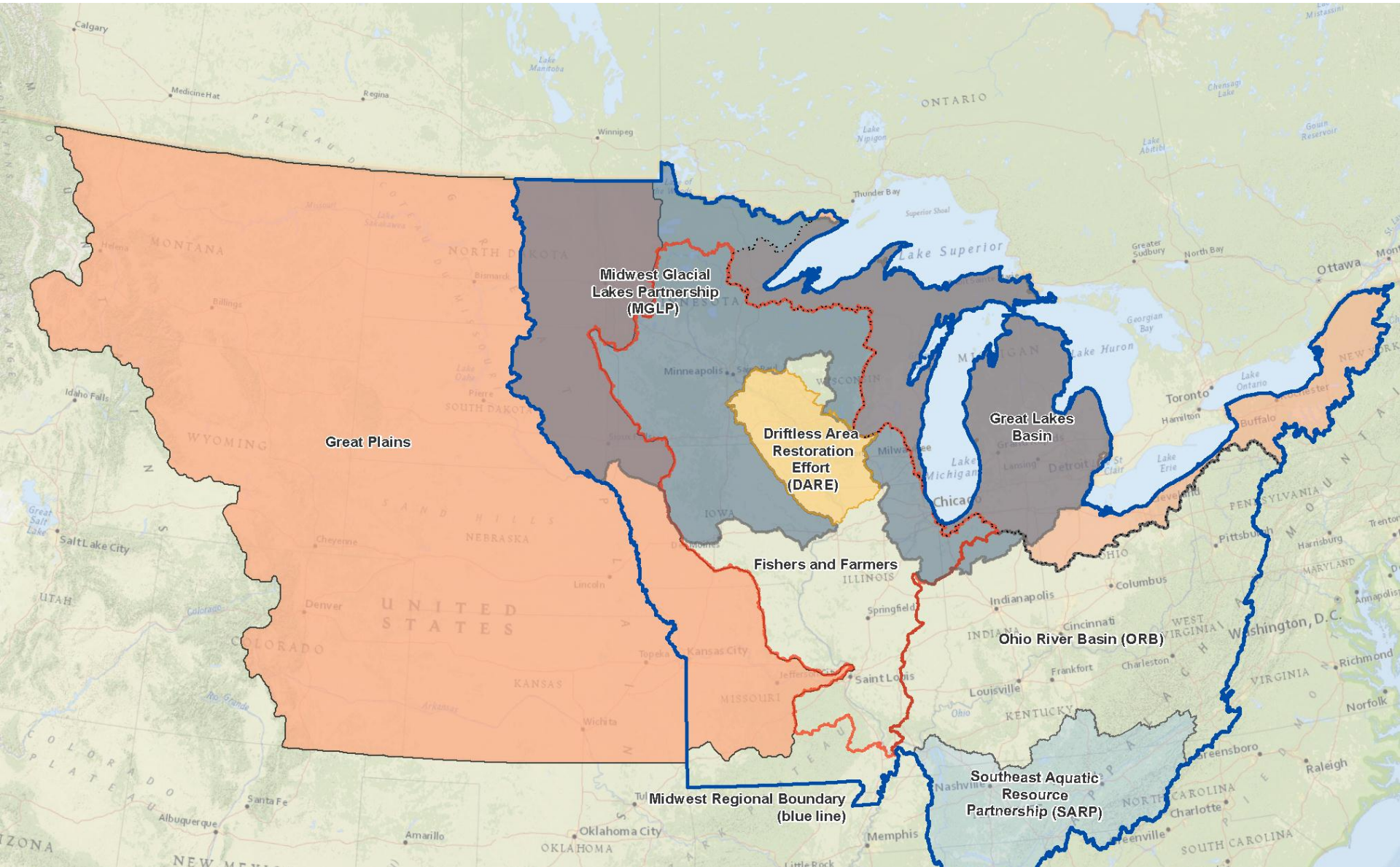
**DATA** → **MODEL** → **APPLY**

Raw vs. Processed  
Landscape vs. Stream  
Local vs. Network vs. DS  
Predictor vs. Response

Boosted Regression Trees  
Predicted Condition  
Stress/Response Functions  
Anthropogenic Stress Index  
Natural Habitat Quality Index

Visualization  
Prioritization  
What-If? Scenarios  
Scenario Animation  
Scroll Bar Interaction

# 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

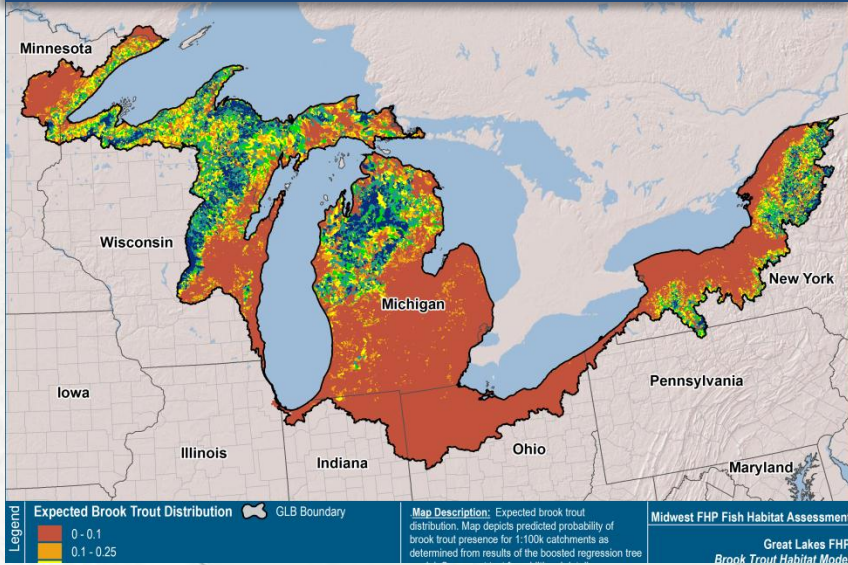
- Brook trout
- Walleye
- Smallmouth bass
- Large river species
- Intolerant mussels
- Redhorse
- Long nose dace

## Aquatic Endpoint Examples

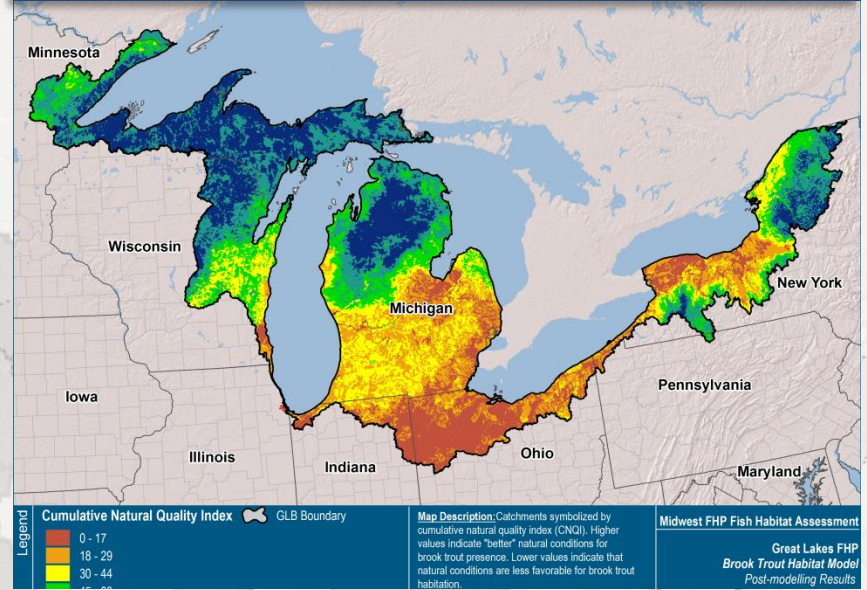
- Coldwater index
- Water quality (total summer phosphorous)
- Species richness
- Lithophilic species richness
- Modified index of centers of diversity score
- Small streams signature fish index score



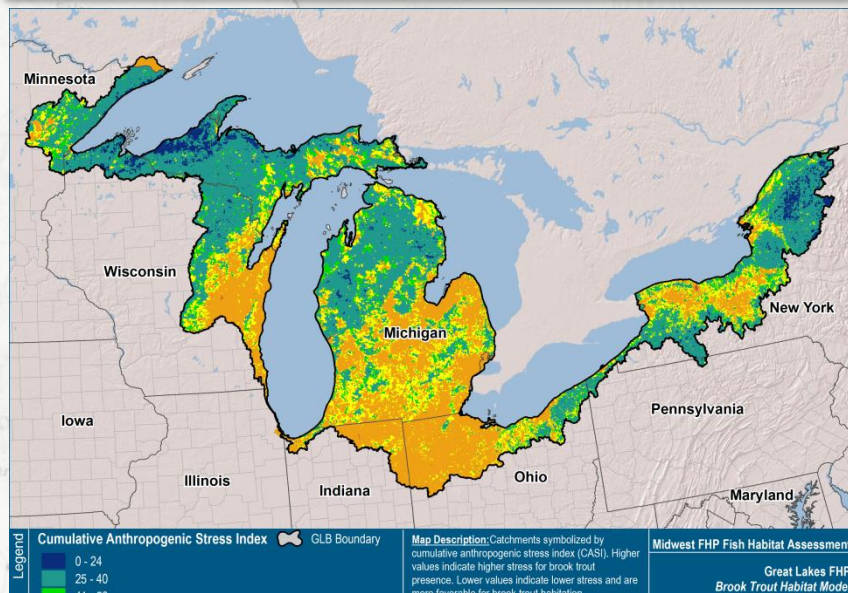
# Predictions



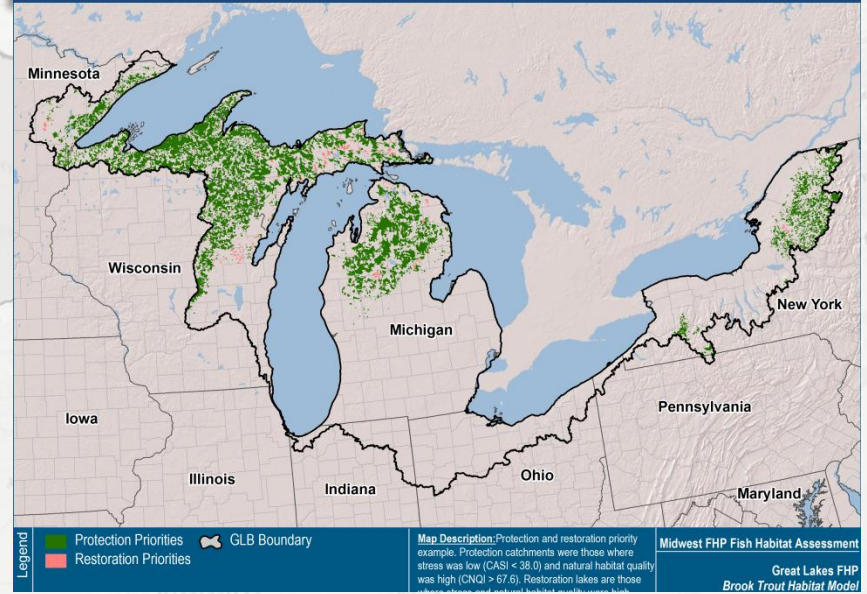
# Natural Quality Index



# Anthropogenic Stress Index



# Restoration Protection Priorities

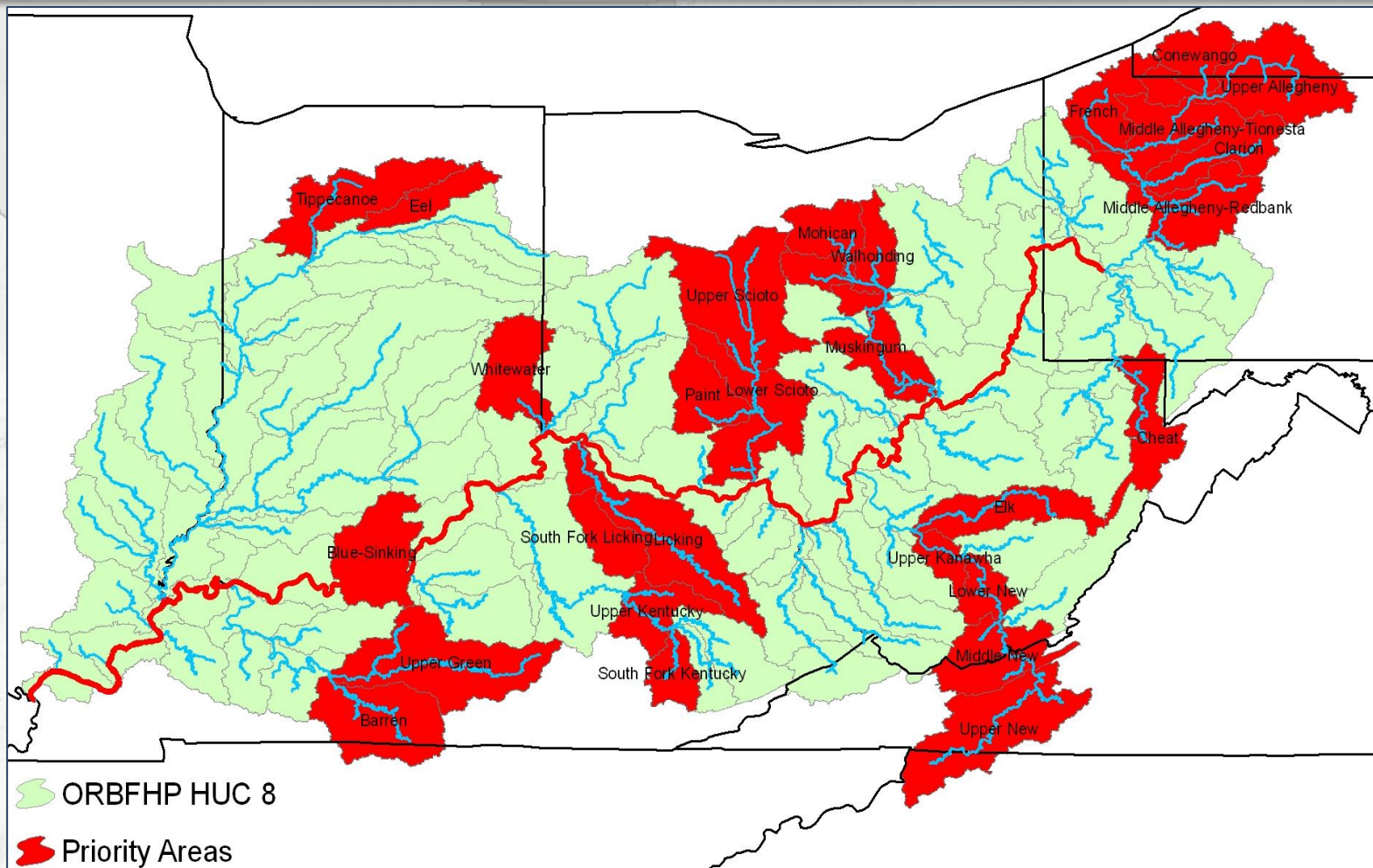




# Application Example

## Ohio River Basin Priorities

Using the model results, combined and scored all the models to develop a list of priority watersheds. This list was integrated as a factor for project selection



# Assessment Outputs

## Technical Reports

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

## Data and Maps

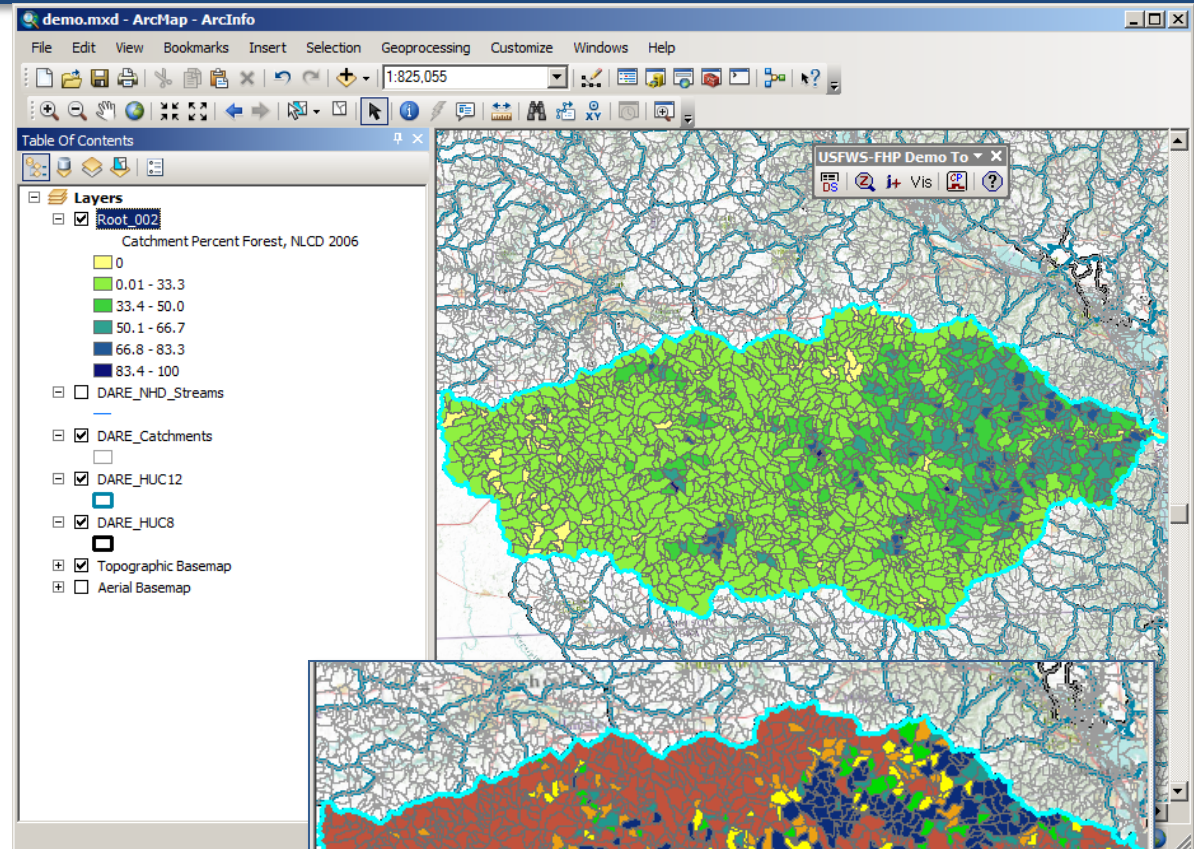
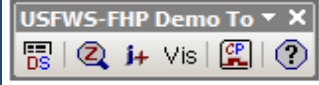
- Geodatabase of model inputs and outputs
- Metadata and data dictionaries
- Processing notes and documentation
- Response (fish) database
- HUC-8 Mapbooks of prediction maps, at the catchment scale

## 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

# 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

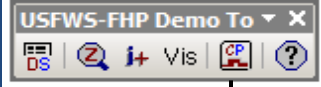
Catchment Percent Agriculture, NLCD 2006  
Catchment Percent Cropland, NLCD 2006  
Catchment Percent Developed, NLCD 2006  
Catchment Percent Forest, NLCD 2006  
Catchment Percent Grassland, NLCD 2006  
Catchment Percent Pasture, NLCD 2006  
Catchment Percent Wetland, NLCD 2006  
Catchment Phosphorus Inputs, kg/year/km<sup>2</sup>  
Catchment Population Density, NOAA 2000, Number/km<sup>2</sup>  
Catchment Road Crossing Density, #/km<sup>2</sup>  
Catchment Road Density, road length(m)/km<sup>2</sup>

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	
<b>Root</b>	
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, or 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, #/km<sup>2</sup>: 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

1:805,217

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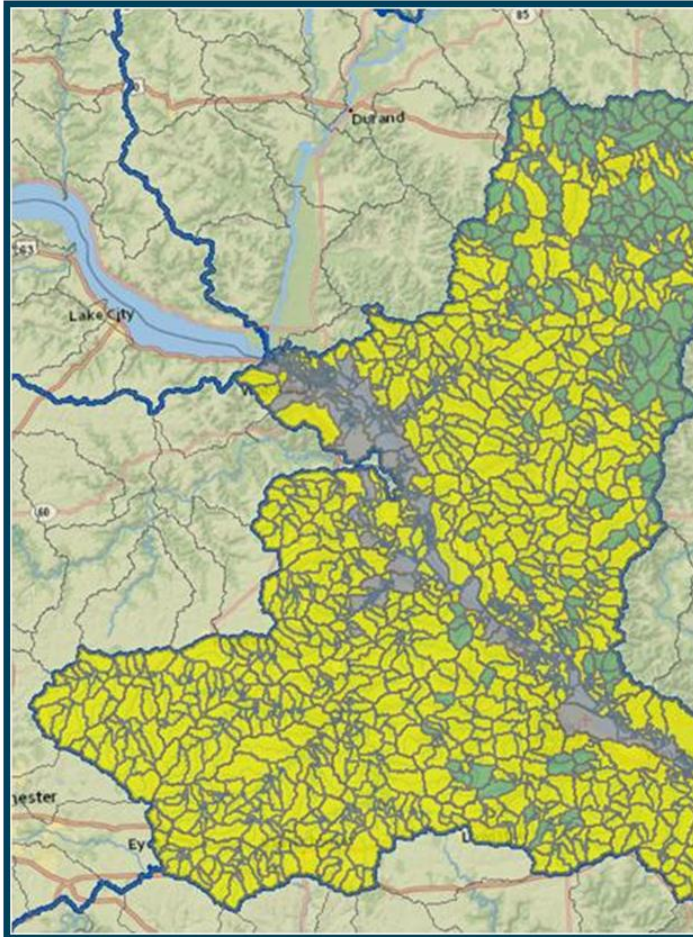
Layers

- 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

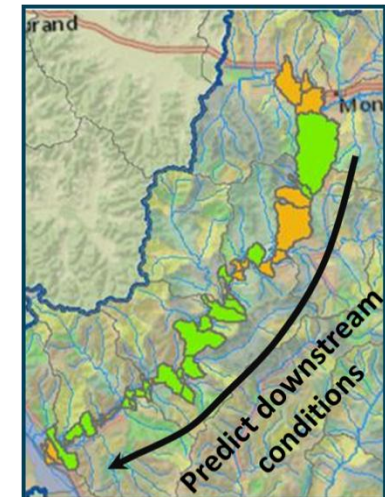
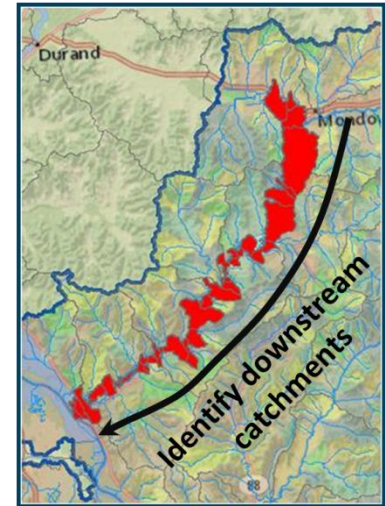
Selected Catchments: 13652878, 13653576

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

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

Buttons: Run Model, Help, Cancel



# NALCC Project

## Project Overview

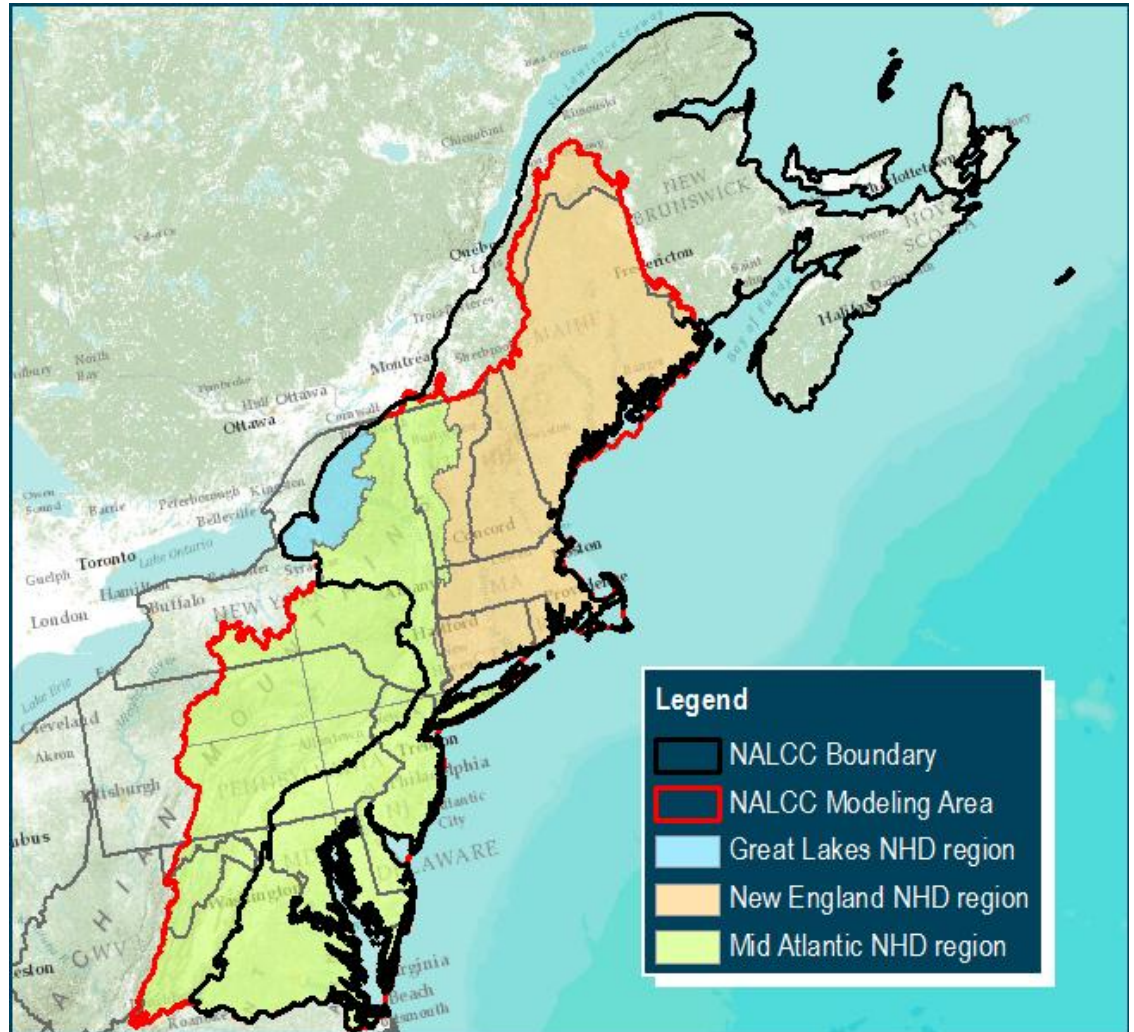
- Same modeling process, with some modifications:
  - Working with stakeholders to modify framework for estuarine and coastal assessments
  - Improved post modeling
- 15-20 total models
- Inland waters, estuarine, and coastal
- Two-year time frame
- Decision support tool v2



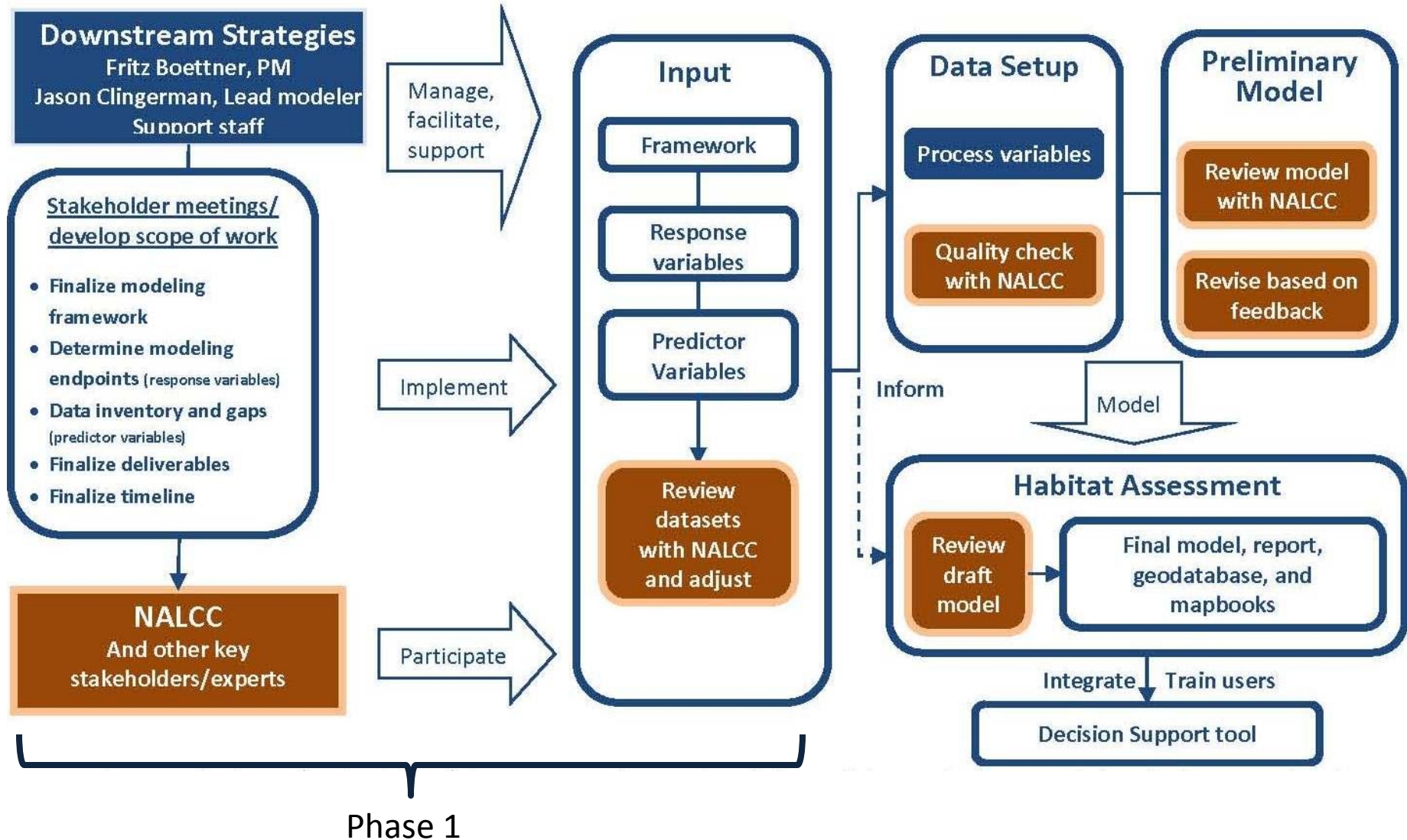
# NALCC Project

## Modeling area

- Geographic scope includes NALCC region (excluding areas outside the NHD extent, Canada) plus the Hudson, Delaware, Susquehanna, Potomac-Shenandoah, and James River Drainages



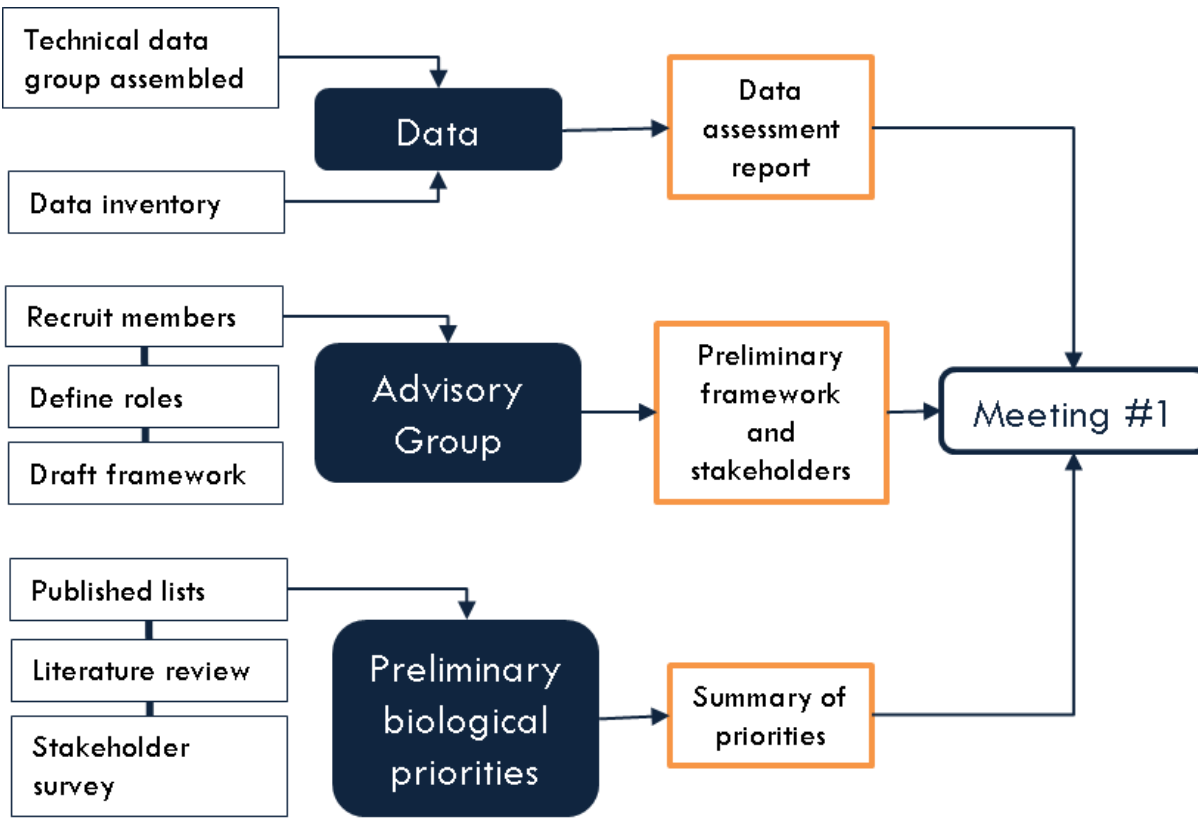
# Project Process





# NALCC Project Status

## Phase 1 – Spring 2013



- Form stakeholder and advisory groups
- Research methods, data, and priorities
- Webinars, committee meetings, set actions
- Face-to-face stakeholder meeting late summer

# NALCC Project Status

## Advisory groups

- **Project advisor and coordinators:** Assist the project team with organizing and compiling resources (people, data, tools, etc.).
- **Technical review committees:** Participate in the modeling process (one or more models) by providing critical feedback and expertise in reviewing methods, preliminary models, and model outputs.
- **Data development and acquisition committees:** Assist the project team with gathering data for the modeling process.



# NALCC Project Status

## 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>	

# Atlantic Coast FHP

## Coastal/Estuarine considerations

- Different methodology likely, but same framework
  - Perhaps raster-based multi-scale approach like Gulf coastal assessment
  - Need time to research best methods once data availability is known
  - Need technical and data support
  - Integrating climate change and future growth scenarios
- Data Availability
  - Predictor variables
  - Response variables

# Atlantic Coast FHP

## Planning priorities

- **ACFHP Strategic Plan, C.2.3 Strategic Action**
  - “...products that can be used to inform the goals and objectives laid out in this plan and to develop time-bound, spatially-explicit, and quantitative conservation objectives in future Plans or revisions to the Strategic Conservation Plan.”
- **Approved FHP Policies and guidance, capabilities for scientific assessment**
  - “Organizations involved in each FHP will have capabilities to measure and demonstrate progress – through existing programs where possible – using science based resource assessment, project evaluation, and reporting of ...”
- **Evaluating FHP performance**
  - “...partnership uses resource condition assessment and/or analysis results to determine conservation priorities and identify the actions they require...”
  - “...listing of the conservation priorities, and the actions they require, determined by the resource condition assessment and/or analysis results.”



# NALCC Project Status

## Next steps

- **Publish background information and research**
  - Project website ([www.northatlanticlcc.org/projects/downstream-strategies-project](http://www.northatlanticlcc.org/projects/downstream-strategies-project))
  - Modeling framework, methodology, and data summaries
  - Climate change and future growth case studies
- **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

