CONSERVATION PLANNING WITH CASE STUDIES

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Texas Mussel Workshop
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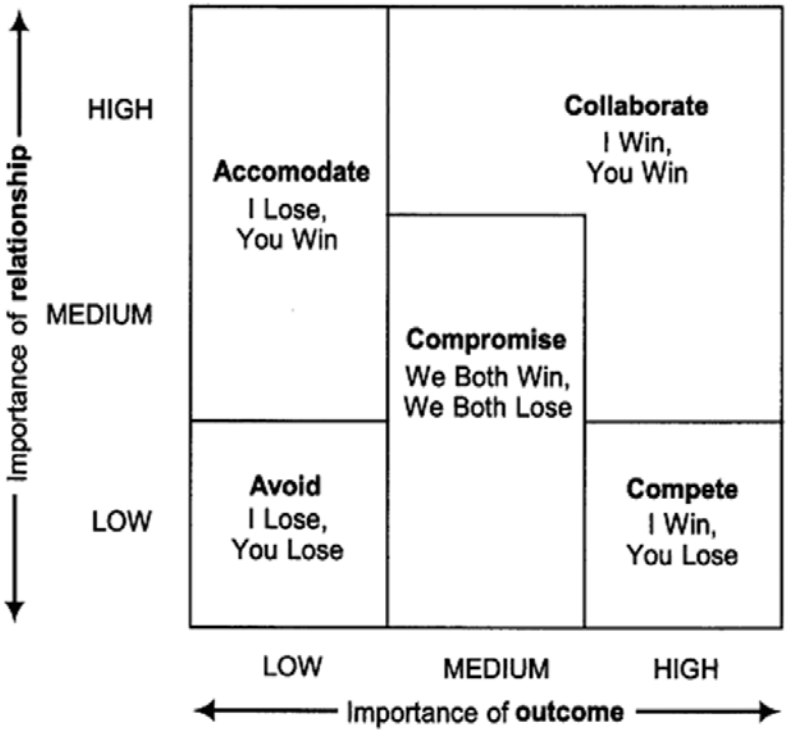
Collaborative Conservation

"It's not enough that we succeed. Cats must also fail."



Two approaches to decision making*

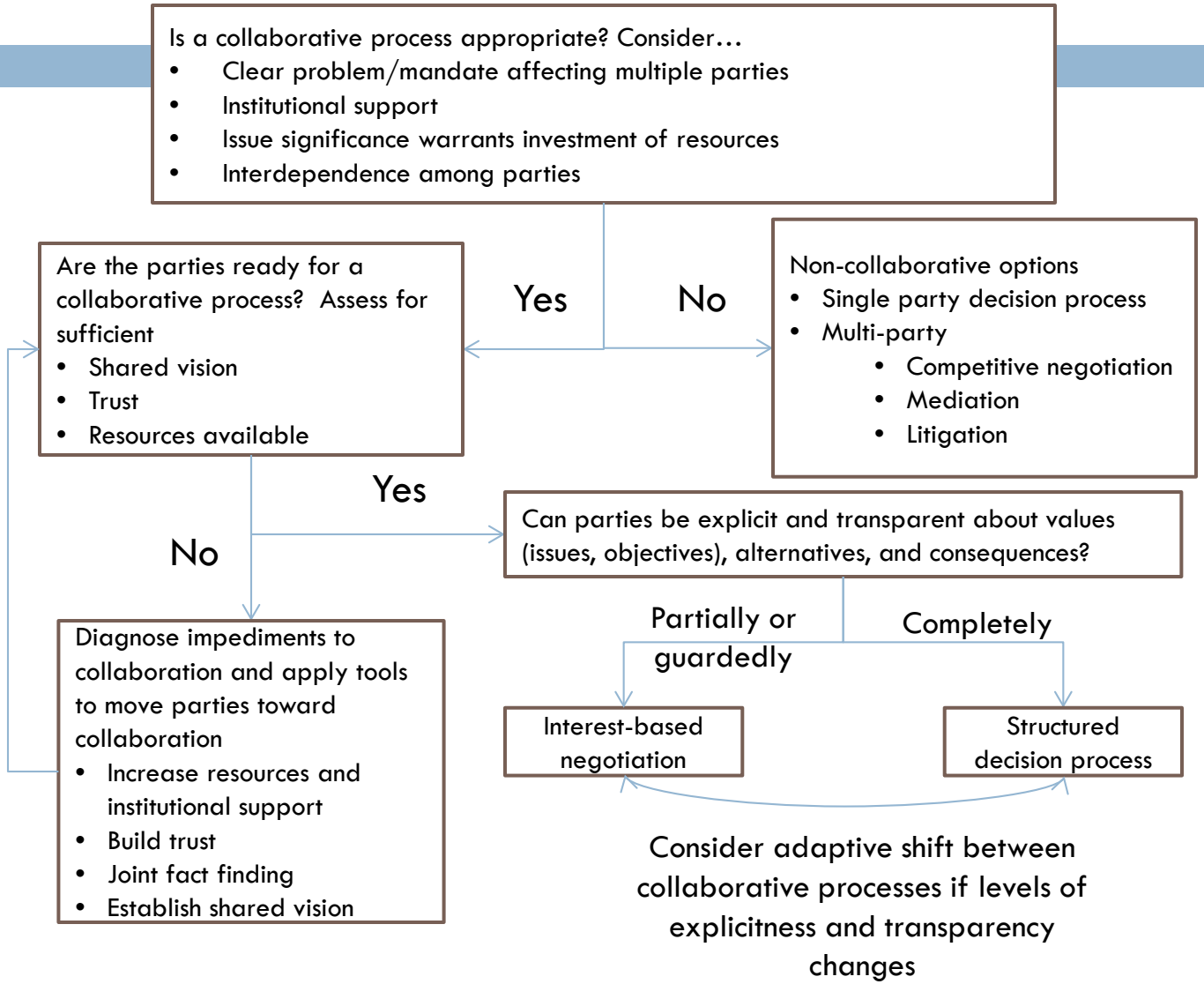
	Advocacy	Inquiry
Concept of decision making	a contest	collaborative problem solving
Purpose of discussion	persuasion and lobbying	testing and evaluating
Participants' role	spokespeople	critical thinkers
Patterns of Behavior	strive to persuade others defend your position downplay weakness	present balanced arguments remain open to alternatives accept constructive criticism
Minority views	discouraged or dismissed	cultivated and valued
Outcome	winners and losers	collective ownership

*Garvin, DA, and MA Roberto. 2001. What you don't know about making decisions. Pg.80 *in* Harvard Business Review. 2013. On making smart decisions. Harvard Business School Publishing.

Outline

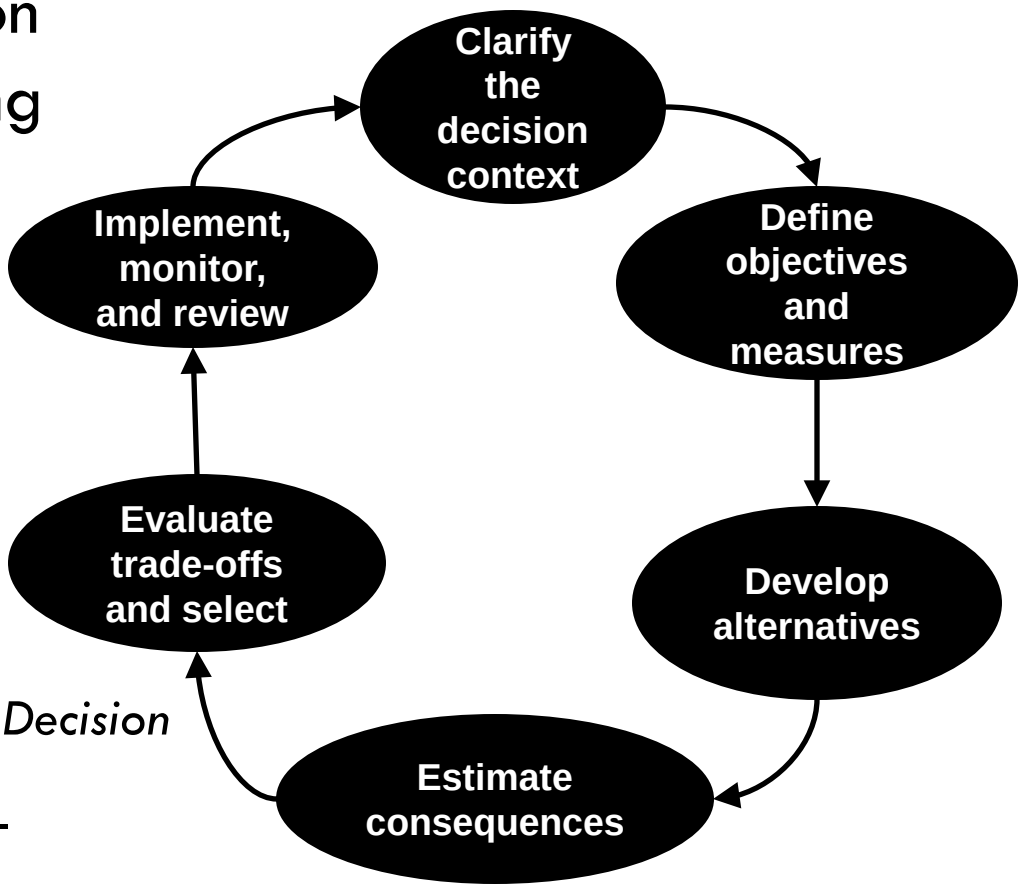
- Collaborative decision process
  - Build and maintain trust
  - Joint learning
  - Emphasize objectives
  - Decompose the problem for analysis
- Case studies
  - Estuarine restoration – complex multi-stakeholder objectives
  - Eel migration and power generation – search for win-win
  - Upper Tennessee River Basin – knapsack problem applied to conservation of imperiled aquatic species

Are you ready for a collaborative process?



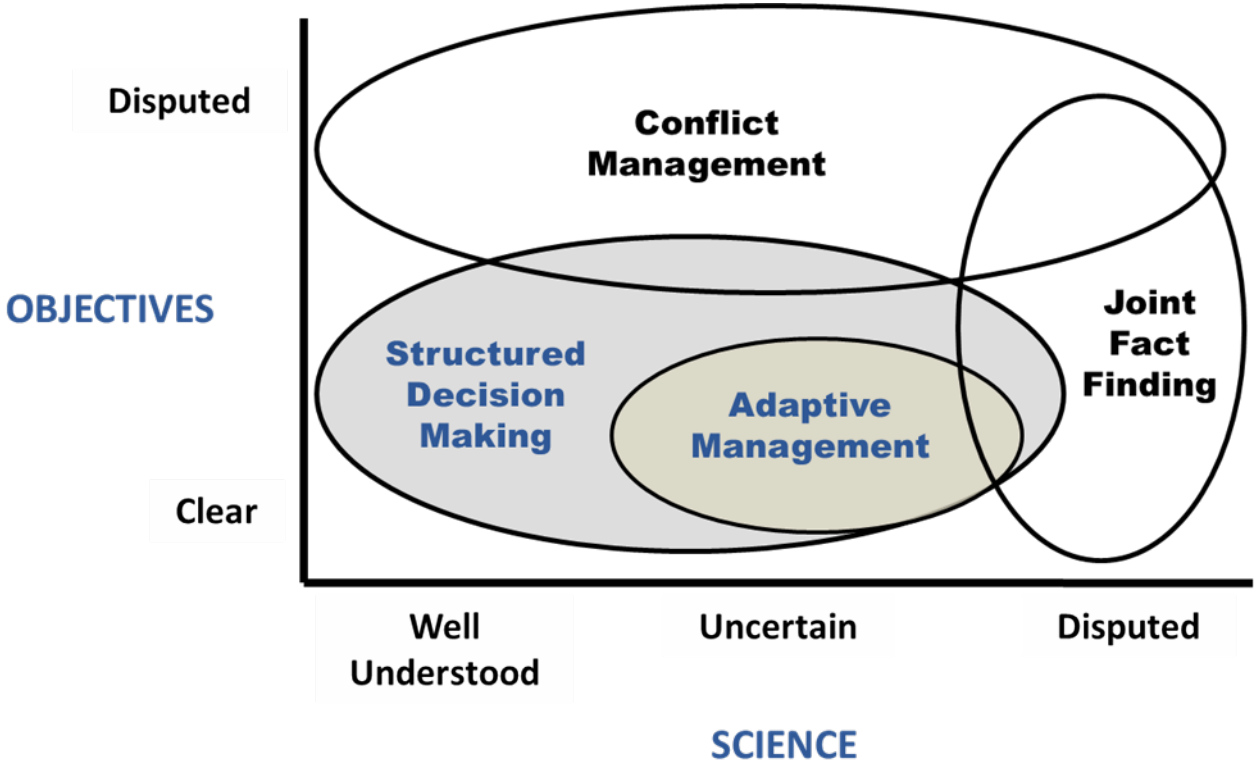
Decision process

- Problem decomposition
- Values-focused thinking



Gregory et al. 2012. *Structured Decision Making: A Practical Guide to Environmental Choices*. Wiley-Blackwell

Decision processes and conflict



Restoration of the Herring River estuary on Cape Cod

Gannon, Smith, Eaton. 2016. Managing estuary restoration: an adaptive framework under uncertainty and risk. INFORMS Annual Meeting, Nashville, TN

Herring River estuary: Cape Cod, MA

1100-acre in

Cape Cod National Seashore and Wellfleet and Truro

Chequessett Neck Road dike in 1909

- Current tidal restriction
- Low-lying private property
- Economically valuable oyster industry
- Native salt marsh
- Invasive phragmites

Herring River: On-Going Effects of Tidal Restriction

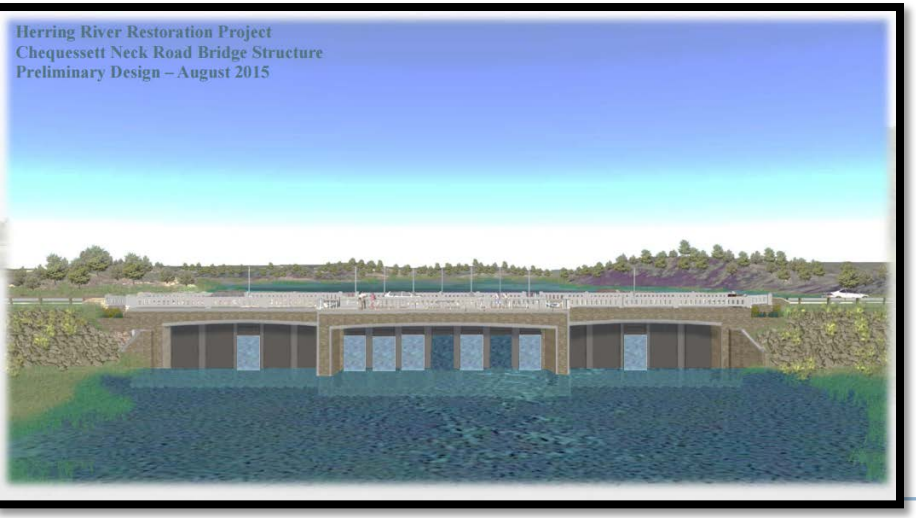
Fecal Coliform Bacteria Pollution = Closed Shellfish Areas

Loss of Estuarine Productivity

Degraded Habitat for River Herring; Acidification

Poor Water Quality/Low Dissolved Oxygen = Fish Kills

Problem statement



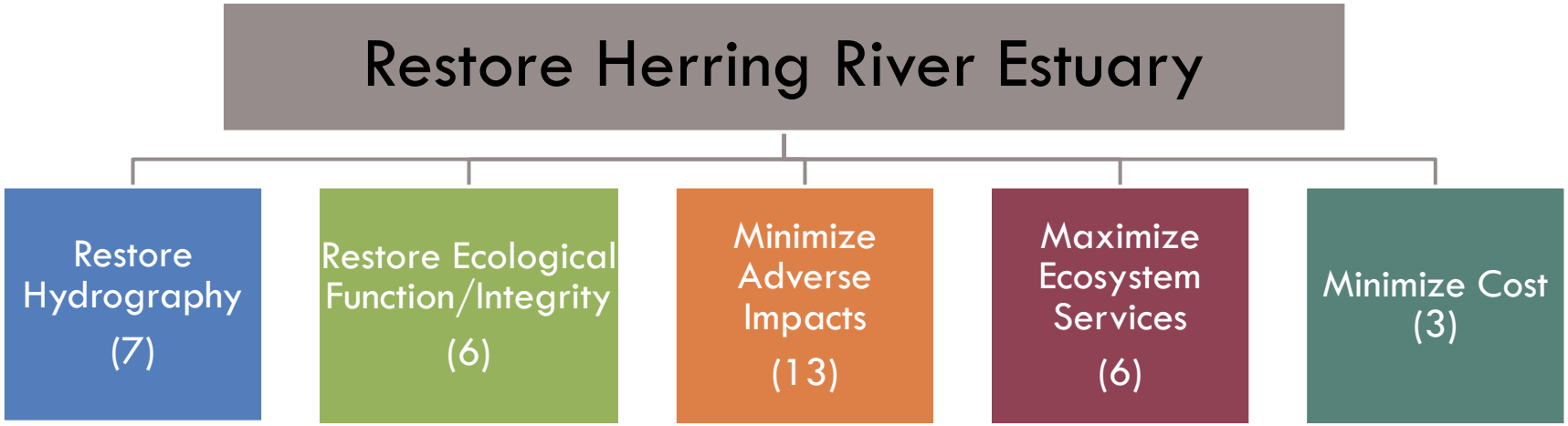
- The Executive Council comprised of Cape Cod National Seashore and towns of Truro and Wellfleet
- with input from technical and stakeholder advisory committees

will decide how to operate tidal gates at the new CNR dike and apply 2° actions

to restore the Herring River estuary and minimize adverse impacts

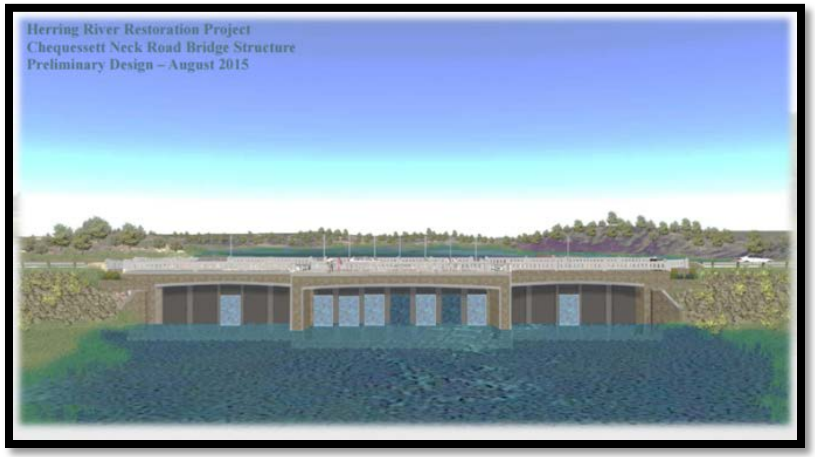
over some <u>finite</u> length of time (likely <25 years)

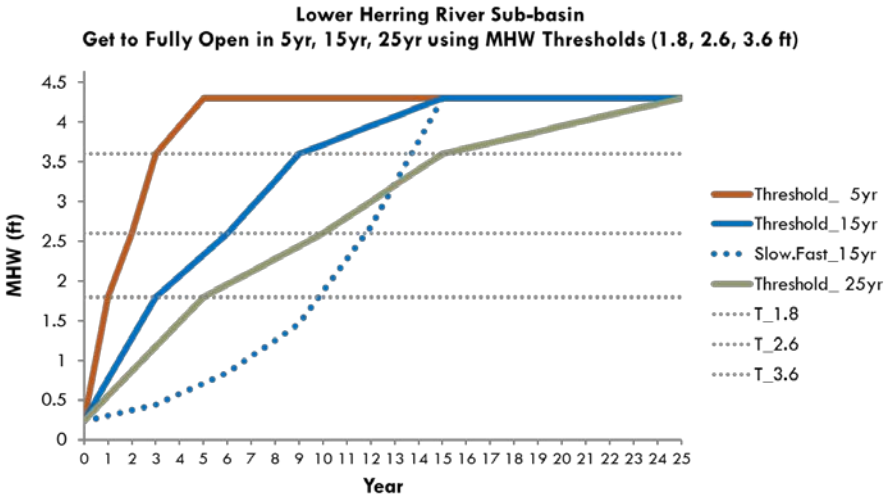
Fundamental objectives (# of subobjectives)



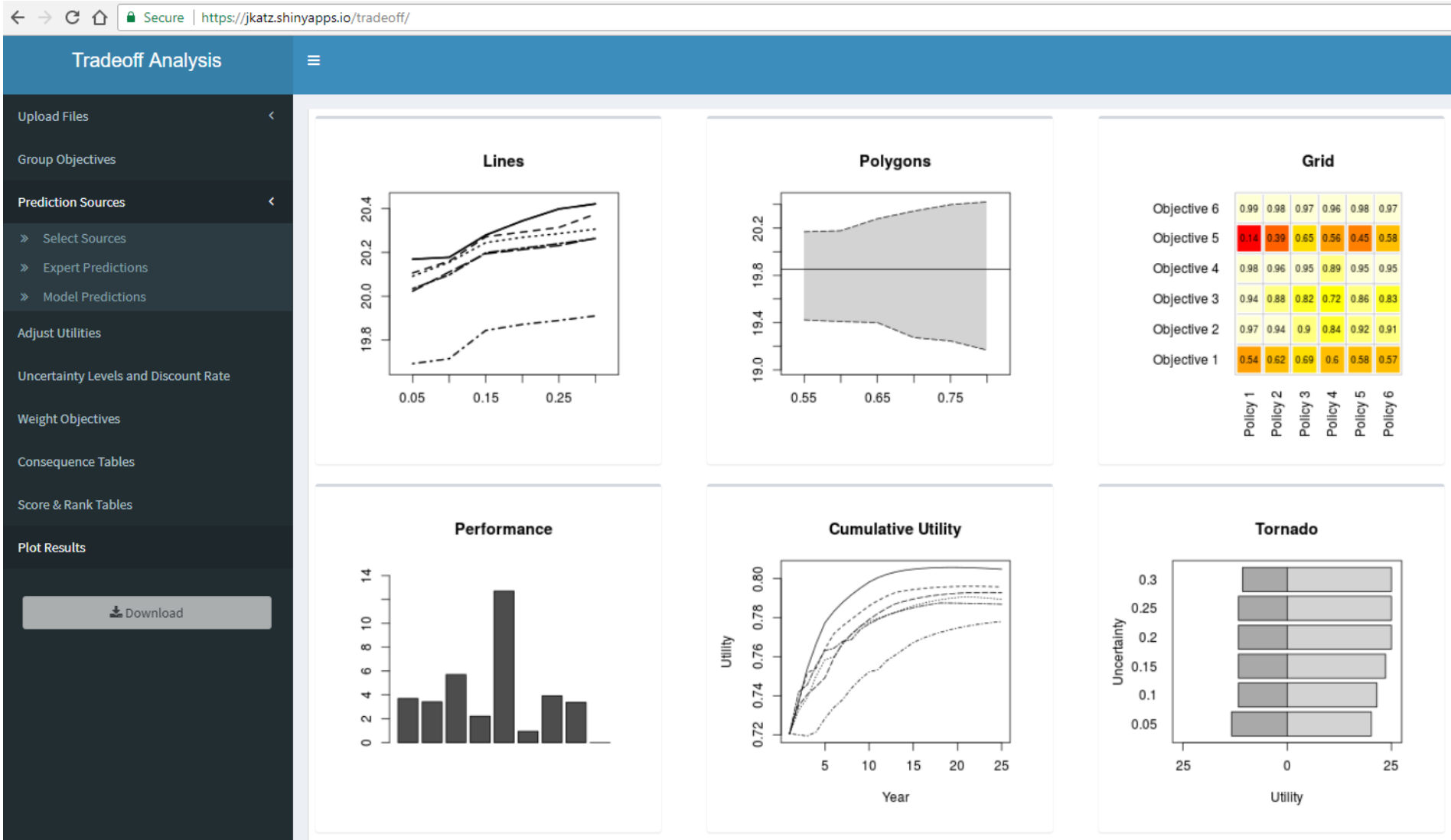
Alternative policies for tidal gate management

- Structured around restoration through time
- Policies varied by
  - Time to reach a restored hydrograph,
  - Pace (e.g., slow then fast vs fast then slow)
  - Variations to move sediment or enhance veg growth





Suite of tools



Sensitivity Analysis – a search for robust policies

Across 212 combinations of prediction confidence, utility, and weighting schemes

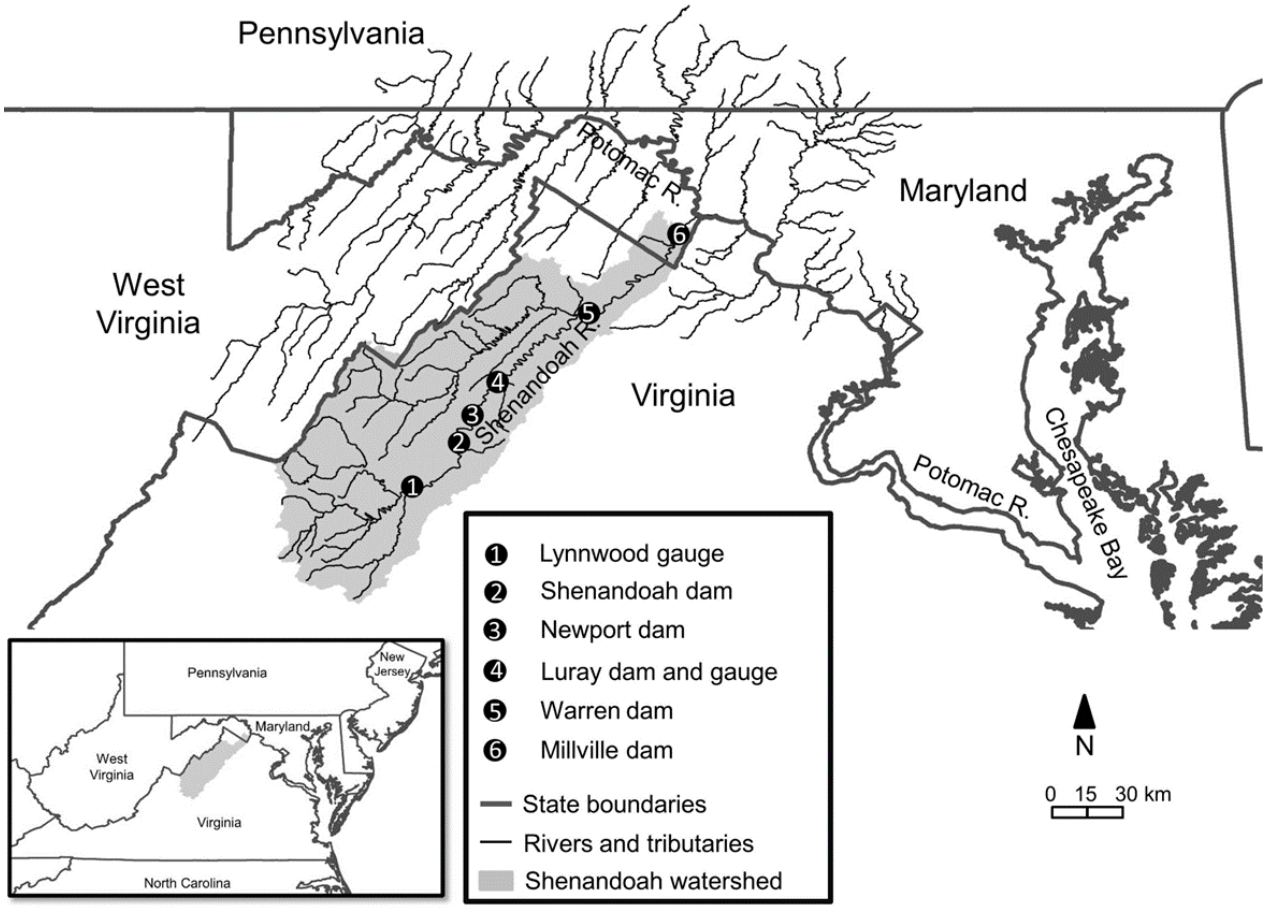
Frequencies

	Alternative Policies					
Rank	5-yr	15-yr	25-yr	SF 15yr	2GS	Sedi-ment
1	0.67	0.16	0.13	0.01	0	0.03
2	0.04	0.73	0.05	0.01	0.07	0.1
3	0.01	0.11	0.04	0.01	0.78	0.04
4	0.05	0	0.16	0.21	0.14	0.43
5	0.2	0	0.44	0.21	0.01	0.14
6	0.03	0	0.18	0.54	0	0.25

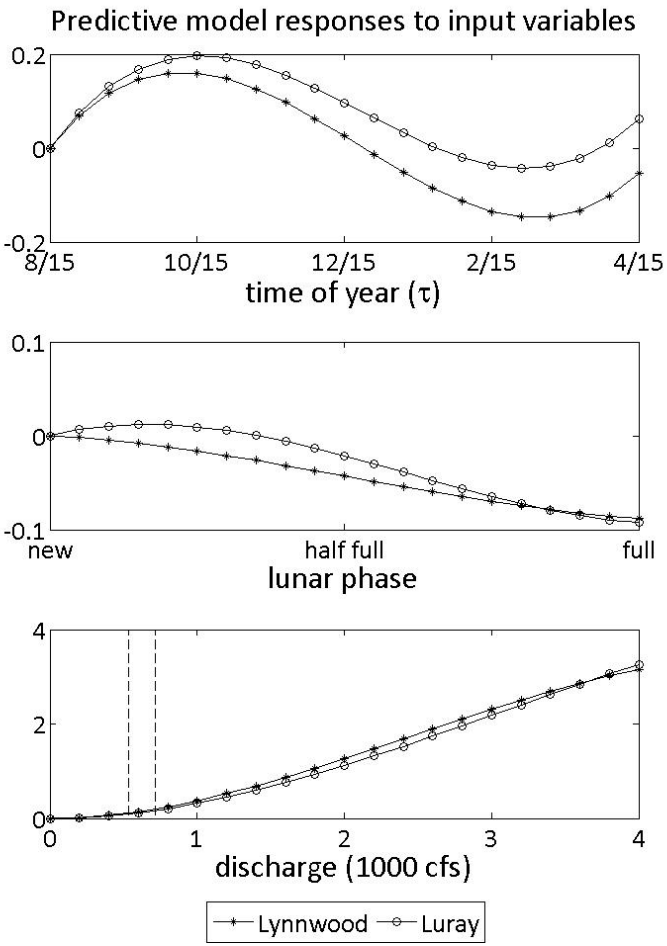
Migrating silver eels and hydropower generation

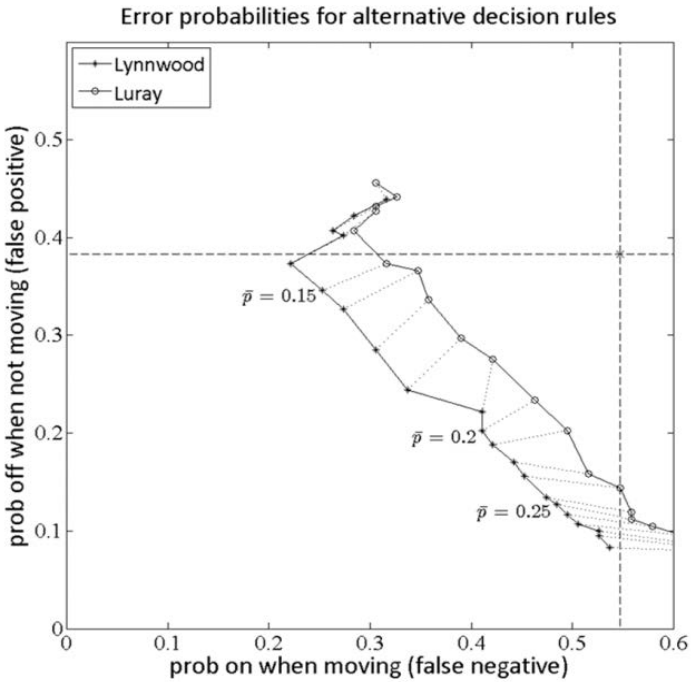
Smith, D. R., P. L. Fackler, S. M. Eyler, L Villegas Ortiz, S. A. Welsh. 2017. Optimization of decision rules for hydroelectric operation to reduce both eel mortality and unnecessary turbine shutdown: a search for a win-win solution. Rivers Research and Applications DOI: 10.1002/rra.3182

Shenandoah River



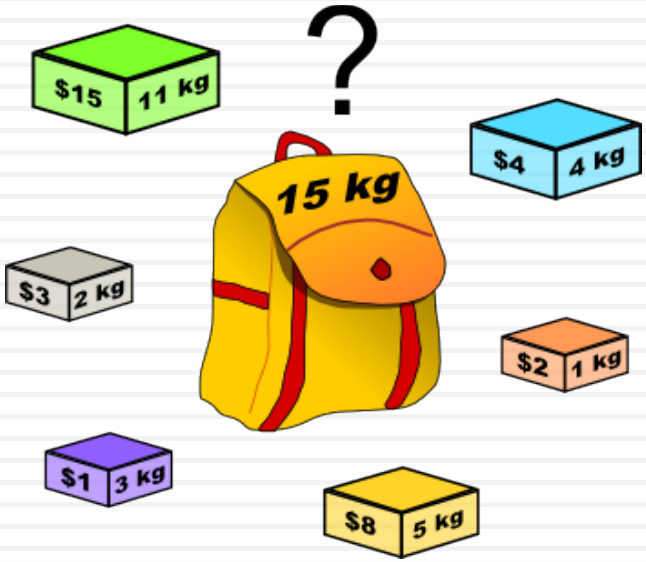
Search for a win-win solution



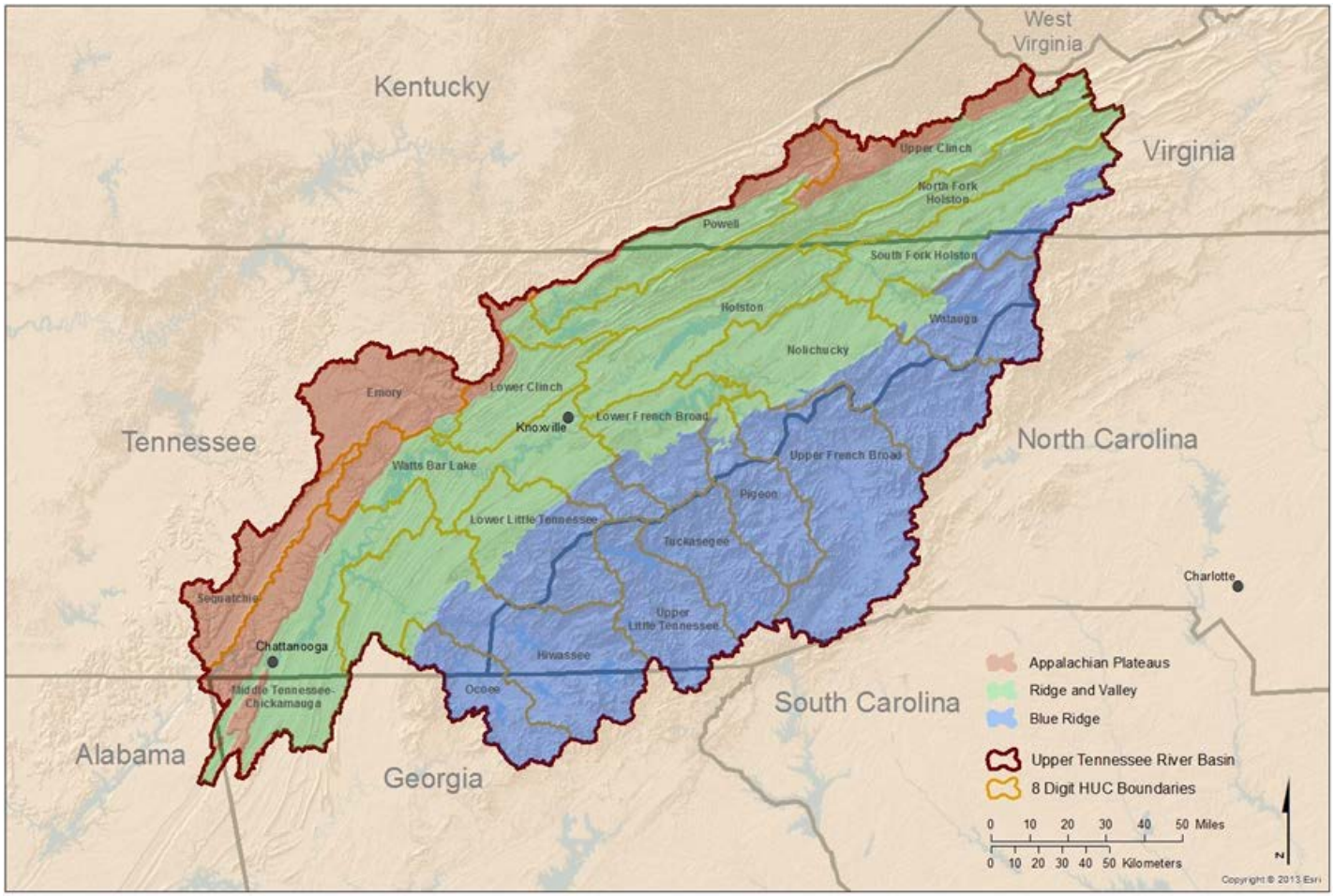


Imperiled aquatic species in the Upper Tennessee River Basin

Smith, D. R., R. S. Butler, J. W. Jones, C. M. Gatenby, R. Hylton, M. Parkin, and C. Shultz. 2016. Developing a landscape-scale, multi-species, and cost-efficient conservation strategy for imperiled aquatic species in the Upper Tennessee River Basin, USA. Aquatic Conservation: Marine and Freshwater Ecosystems https://doi.org/10.1002/aqc.2785



Large geographic area (22,360 square miles primarily in VA, NC, and TN)

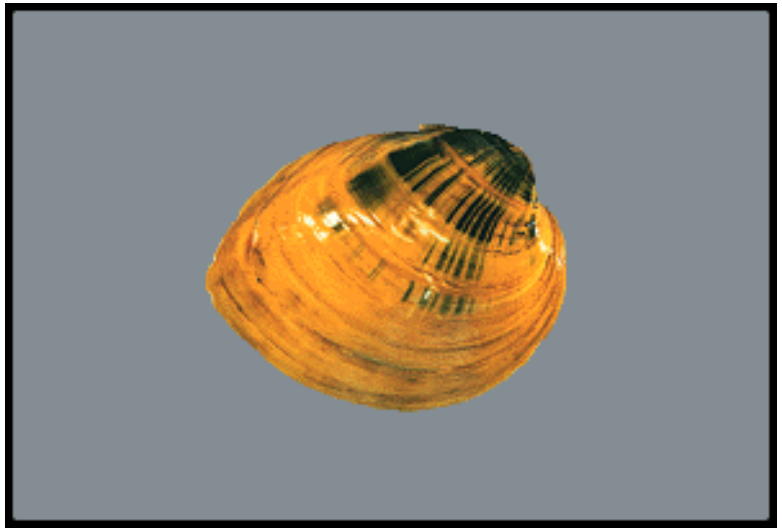


Mussels and Fishes of Upper Tennessee River Basin

INHS

Mussel Species Known: 83
Extant Endangered: 24

Fish Species Known: 172
Extant endangered: 12



Endangered Slabside Pearlymussel

Endangered Slender Chub

Current Conditions: Fragmentation and Multiple Stressors…..

Why Develop the Strategy?

- Complex situation:
  - Limited FWS staff, many partners, limited budgets, extensive coordination, large number of species facing a variety of threats, large geographic area

- Aspire to provide a cost effective approach to guide conservation and management of imperiled freshwater fish and mussel species in the UTRB

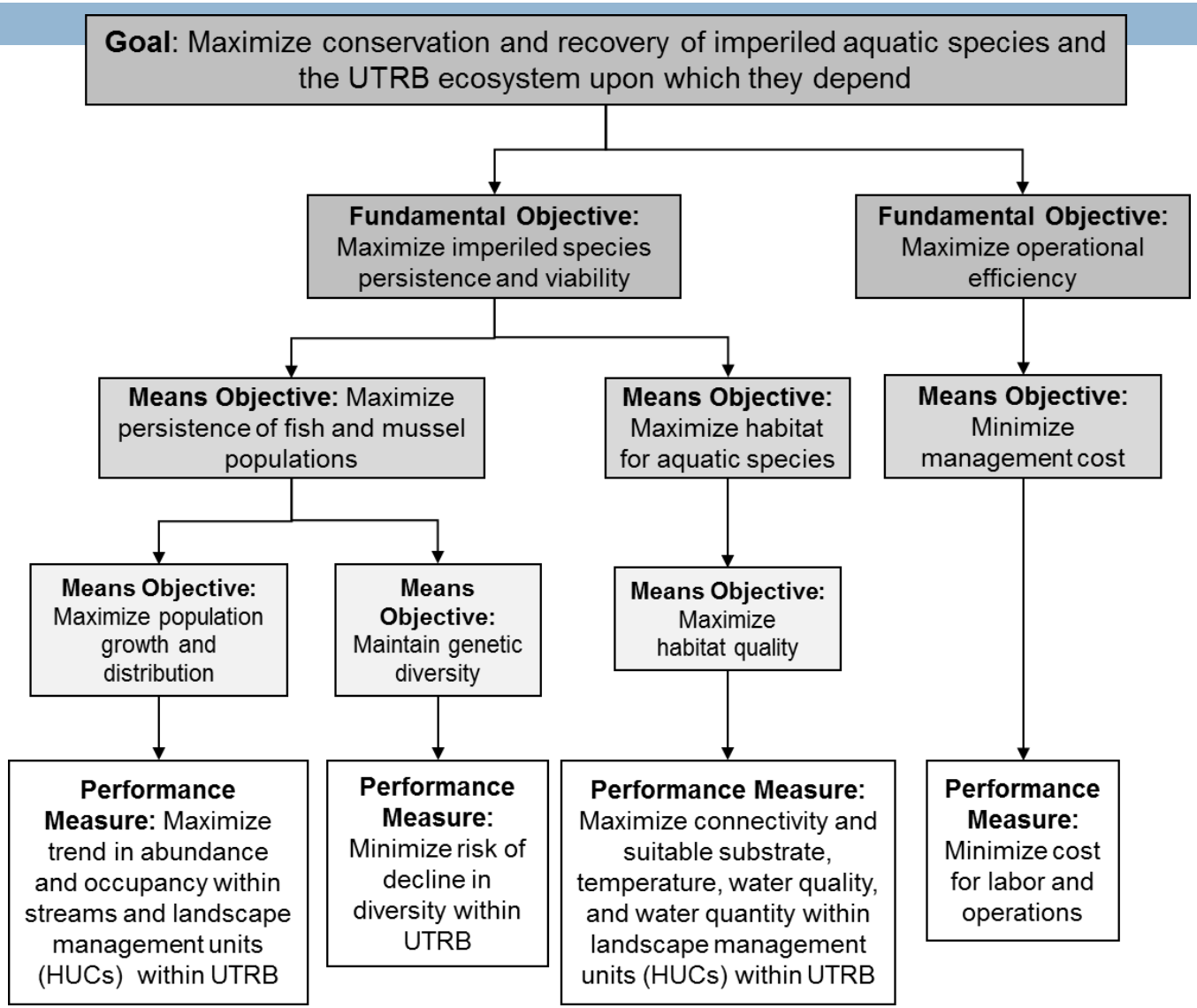
  - FWS team sought to determine which actions to emphasize to best achieve recovery of these species in the UTRB

Challenges to strategy development

- Uncertainty in species response to management actions
  - Paucity of data available to evaluate potential consequences
- Budgetary constraints
- Scale expected conservation benefits from local to landscape and from single species to multiple species

- Seek a strategy that
  - Has greatest chance to achieve conservation objectives
  - Robust to uncertainties in conservation outcomes

Objectives and measures



Alternative approaches

Management Actions		Alternative Approaches		
Type	**Task**	**Status Quo**	**Habitat Emphasis**	**Population Emphasis**
Population Management	• Implement ESA Section 7 & 10 • Protect or establish populations • Conduct status assessment • Increase extant populations • Establish new populations • Manage captive populations	0 (100)	– (85)	+ (159)
Habitat Management	• BMPs for habitat mgmt • Land acquisition and easements • Restoration of habitat	0 (100)	+ (136)	– (82)
Monitoring & Research	• Life history • Popn and habitat monitoring • Evaluate and monitor threats • Genetics monitoring & research • Population viability analyses • Evaluate habitat for reintroductions • Propagation and captive management research • Evaluate ecosystem services	0 (100)	0 (109)	+ (191)
Communication & Partnerships	• Outreach • Work with partners and industry • Intra-agency	0 (100)	+ (169)	+ (131)

Estimate consequences

- Existing data provided the species current condition
- Elicited knowledge and judgment from experts in imperiled fish and mussel to project consequences over 20 years

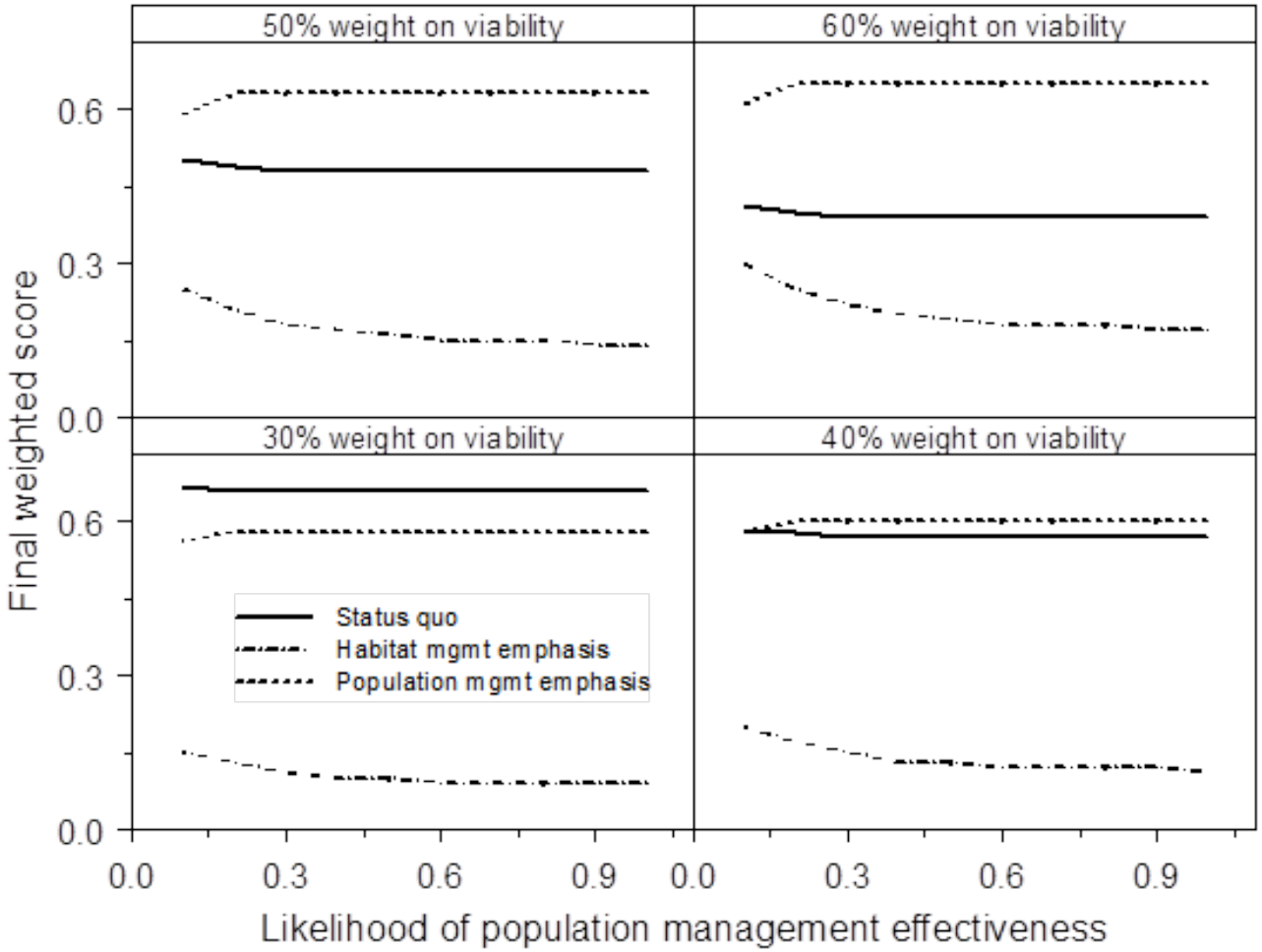
- Species-specific abundance trend and distribution
  - 12-digit HUC for fishes
  - Important stream reaches for mussels
- Habitat quality at 8-digit HUC
- Genetic diversity
- Operational costs

- Scaled up to basin scale for fishes and mussels

Evaluate trade-offs

Objective	Sub-objective	Direction	Alternative Approaches		
			Status Quo	Habitat Emphasis	Popn Emphasis
Species persistence and viability	Fish abundance trend	Maximize	0.04	0	0.46
	Fish distribution	Maximize	7.83	8	8.92
	Mussel abundance trend	Maximize	-0.13	-0.04	0.58
	Mussel distribution	Maximize	4.09	4.09	7.83
	Genetic diversity	Maximize	-0.17	-0.17	0.52
	Habitat quality	Maximize	2.73	3.34	2.68
Operating costs	Staff	Minimize	9.5	11.5	11.5
	Management costs	Minimize	4.8	5.4	4.7

Sensitivity analysis

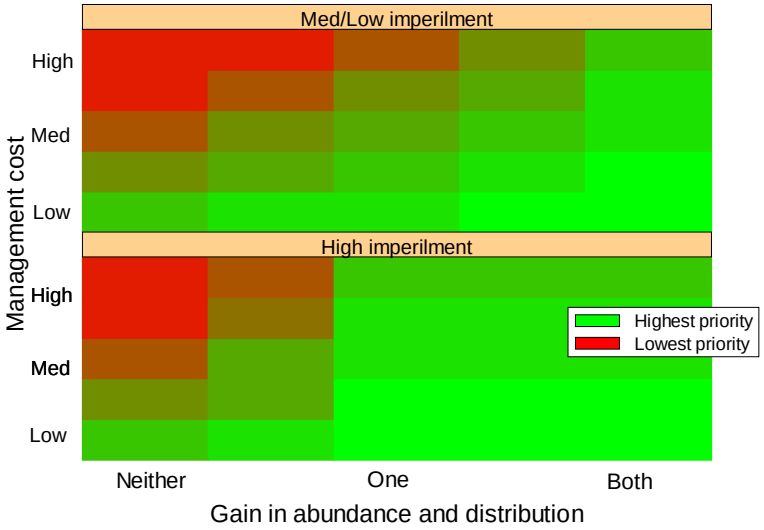


Prioritization: species and watersheds

- Conservation benefits are not likely to be achieved equally among all species and watersheds.

- Prioritize imperiled fish and mussels based on degree of imperilment, expected gain in abundance trend and distribution, and management costs.

- Prioritize watersheds at HUC8 level based on richness of imperiled species and feasibility of implementing habitat management



Species Prioritization – Imperiled Fishes

Prioritization variables included degree of imperilment, expected conservation benefit from management actions, and management cost accrued over the next 20 years.

		Expected Conservation Benefit Relative to Current Status		Management Cost		Priority
Common Name	**Degree of Imperilment**	**Net Gain in Abundance Trend**	**Net Gain in Distribution**	**Cost of Propagation**	**Cost of Reintroduction**	
Marbled darter	High	1.5	0.3	Low	Low	1
Citico darter	High	1.0	0.5	Low	Low	1
Duskytail darter	High	1.0	0.5	Low	Medium	2
Laurel dace	High	1.0	0.0	Medium	Low	2
Pygmy madtom	High	0.5	2.0	Medium	Medium	3
Smoky madtom	High	0.0	1.0	Medium	Medium	3
Spotfin chub	Low	1.0	0.1	Medium	High	4
Yellowfin madtom	Medium	0.0	0.1	Low	Medium	4
Sicklefin redhorse	Low	0.5	0.0	High	High	10
Chucky madtom	High	0.0	0.0	High	Medium	12
Slender chub	High	0.0	0.0	High	High	15
Snail darter	Low	0.0	0.0	High	Medium to High	15

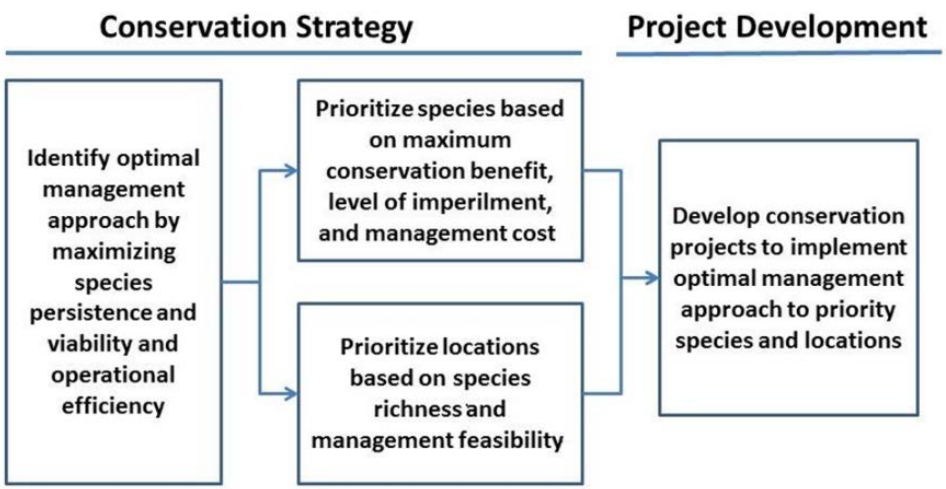
Watershed Prioritization

Species richness and management feasibility values were standardized and weighted to provide weighted average scores for prioritization.

8-digit HUC	Species Richness	Standardized Richness	Feasibility	Standardized Feasibility	Weighted Average
Upper Clinch	24	1.00	2.50	0.7	0.90
Powell	16	0.65	2.33	0.6	0.65
Nolichucky	7	0.26	2.67	0.8	0.47
Upper Little Tennessee	4	0.13	3.00	1.0	0.45
Hiwassee	7	0.26	2.40	0.7	0.41
Tuckasegee	2	0.04	3.00	1.0	0.40
North Fork Holston	6	0.22	2.33	0.6	0.37
Lower Little Tennessee	6	0.22	2.33	0.6	0.37
Emory	3	0.09	2.60	0.8	0.35
Sequatchie	3	0.09	2.40	0.7	0.31
Upper French Broad	1	0.00	2.50	0.7	0.27
Pigeon	1	0.00	2.50	0.7	0.27
South Fork Holston	4	0.13	2.00	0.5	0.25
Lower French Broad	4	0.13	2.00	0.5	0.25
Holston	5	0.17	1.67	0.3	0.21
Watts Bar Lake	6	0.22	1.40	0.1	0.18
Middle Tennessee-Chickamauga	6	0.22	1.25	0.0	0.15
Ocoee	1	0.00	1.80	0.3	0.13
Lower Clinch	1	0.00	1.17	0.0	0.00

Overview

- Conservation Strategy
  - Emphasize population management,
  - Prioritize imperiled fish and mussel species for focused population management, and
  - Prioritize watersheds for focused habitat management.
- Guides project development. Not a rigid management prescription.
- Flexibility will help FWS better integrate its efforts internally and with those of partners.
- Monitor effectiveness, periodic review, and adapt.



Ongoing or recent SDM efforts on conservation of freshwater mussels

- Imperiled species in the Roanoke-Dan Basin, including James spinymussel and green floater (Jamie Roberts, Paul Angermeier, Dave Smith)
- Range-wide conservation of brook floater (Sean Sterrett and Alison Roy)
- Imperiled aquatics in the Upper Tennessee River Basin, including Cumberland combshell and oyster mussel (Dave Smith and Andrew Henderson/Bob Butler)
- Dwarf wedgemussel in North Carolina (Dave Smith and Sarah McCrae)
- Illinois Natural History Survey mussel restoration (Alison Stodola)