

IMPERILED AQUATIC SPECIES CONSERVATION STRATEGY *for the* UPPER TENNESSEE RIVER BASIN



Prepared by the U.S. Fish and Wildlife Service
Northeast and Southeast Regions

Imperiled Aquatic Species?

- Federally listed threatened and endangered species and others that are either proposed or candidates for listing.
- All species included in current strategy are either fish or mussels, though there is flexibility to include other taxa.

Why develop a strategy?



- In 2006, the US Fish & Wildlife Service endorsed **Strategic Habitat Conservation (SHC)** to achieve its mission in the 21st Century.
- Complex conservation challenges across a large landscape require an approach that is strategic, science-driven, collaborative, adaptive, and understandable.
- A documented strategy can help adapt management in response to changing circumstances and maximize the efficiency and effectiveness of conservation recovery actions.

UTRB Conservation Strategy

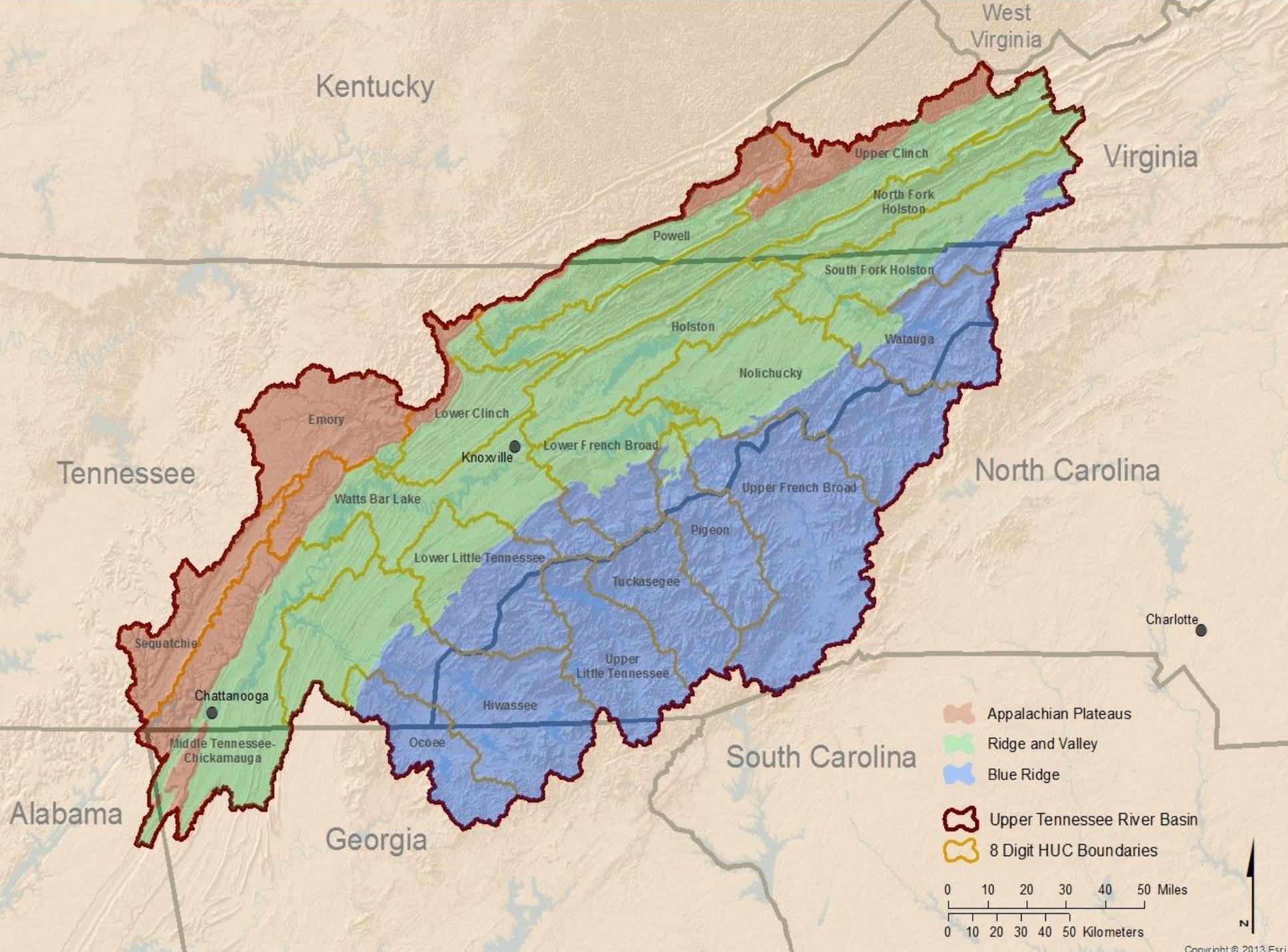
- *Purpose* - to provide a unified, cost effective approach to guide conservation and management of imperiled freshwater fish and mussel species in the UTRB.
- Not a rigid management prescription but is intended to guide management.
- Adaptability of the Strategy will allow integration of Partners' efforts that complement goal of maximizing conservation and recovery of imperiled aquatic species.

Steps to develop the Strategy

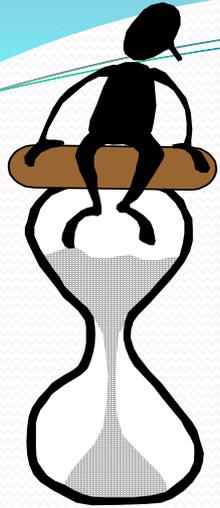
- Established team in 2011
- Defined area to be covered
- Set time-frame, goals, & objectives
- Identified limiting factors
- Identified mgmt. actions
- Formulated mgmt. actions into broad alternative mgmt. approaches
- Compared mgmt. approaches w/Structured Decision Making (SDM)
- Prioritized species & locations for mgmt.
- Determine optimal mgmt. approach
- Considered implementation and adaptation over time
- Partner review

Defining the UTRB

- Entire Tennessee River basin upstream of the confluence of the Tennessee and Sequatchie Rivers, including the Sequatchie River watershed.
- Nearly all of the UTRB lies within Tennessee, North Carolina and Tennessee.
- 22,360 square miles
- Harbors 12 extant species of imperiled fish and 24 extant species of imperiled mussels.



Species ¹	No. of 8-digit HUCs of Occurrence ²	Geographic Distribution
Fishes		
Chucky madtom	1	UTRB endemic
Citico darter	1	UTRB endemic
Duskytail darter	1	UTRB endemic
Laurel dace	2	UTRB endemic
Marbled darter	1	UTRB endemic
Pygmy madtom	1	Tennessee River Basin endemic
Sicklefin redhorse	3	UTRB endemic
Slender chub	2	UTRB endemic
Smoky madtom	1	UTRB endemic
Snail darter	8	Tennessee River Basin endemic
Spotfin chub	7	Tennessee River Basin endemic
Yellowfin madtom	3	UTRB endemic
Mussels		
Alabama lampmussel	2	Tennessee River Basin endemic
Appalachian elktoe	5	UTRB endemic
Appalachian monkeyface	2	UTRB endemic
Birdwing pearl mussel	4	Tennessee River Basin endemic
Cracking pearl mussel	2	Ohio River Basin endemic
Cumberland bean	1	Cumberlandian Region endemic ³
Cumberland monkeyface	1	Tennessee River Basin endemic
Cumberlandian combshell	3	Cumberlandian Region endemic ³
Dromedary pearl mussel	3	Cumberlandian Region endemic ³ , now restricted to UTRB
Fanshell	2	Ohio River Basin endemic
Finerayed pigtoe	4	Tennessee River Basin endemic, now restricted to UTRB
Fluted kidneyshell	7	Cumberlandian Region endemic ³
Golden riffleshell	3	Tennessee River Basin endemic, now restricted to UTRB
Littlewing pearl mussel	3	Cumberlandian Region endemic ³
Oyster mussel	6	Cumberlandian Region endemic ³ , now restricted to UTRB
Pink mucket	5	Mississippi River Basin endemic
Purple bean	3	UTRB endemic
Rough pigtoe	2	Ohio River Basin endemic
Rough rabbitsfoot	2	UTRB endemic
Sheepnose	3	Mississippi River Basin endemic
Shiny pigtoe	3	Tennessee River Basin endemic
Slabside pearl mussel	5	Cumberlandian Region endemic ³
Snuffbox	2	Mississippi River and Great Lakes Basins endemic
Spectaclecase	3	Mississippi River Basin endemic



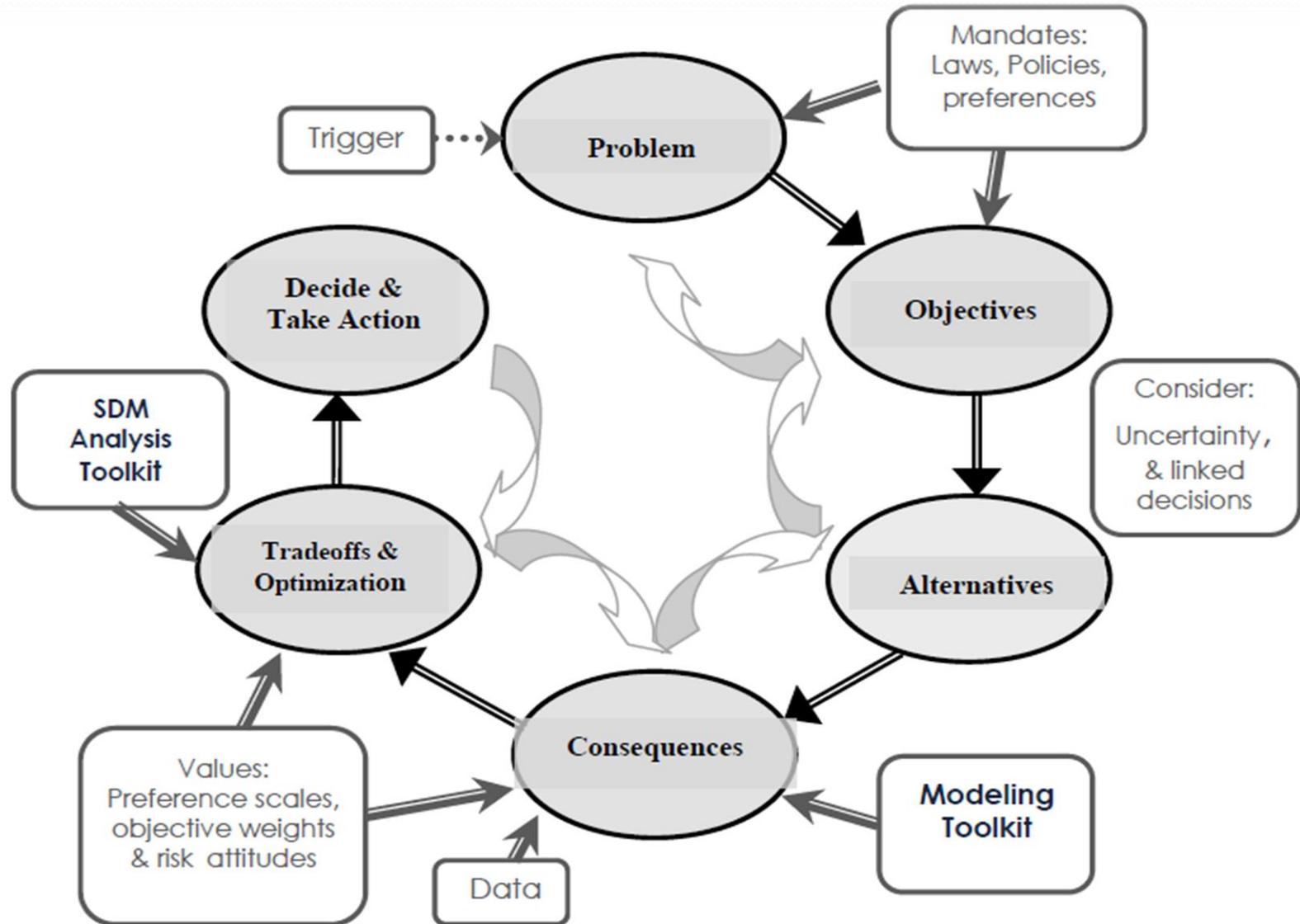
Time-frame

- Goals, objectives, & actions set for implementation over 20-yr period
- Strategy and its implementation to be adapted routinely in coordination with partners
 - *Annually* – plan specific projects & evaluate “lessons learned”
 - *Quadrennially* – strategy review & revision

Structured Decision Making?

- Organized analysis of problems to reach decisions focused clearly on achieving fundamental objectives
- Based in decision theory and risk analysis
- Every decision consists of management objectives, decision options, and predictions of decision outcomes.

Structured Decision Making





Max. conservation & recovery of imperiled aquatic species & the UTRB ecosystem upon which they depend

Max. imperiled species persistence & viability

Max. operational efficiency

Max. persistence of fish & mussel pop'ns

Max. habitat for aquatic species

Min. mgmt. cost

Max. pop'n growth & distribution

Maintain genetic diversity

Max. habitat quality

Max. trend in abundance & occupancy within streams & landscape mgmt units (HUCS)

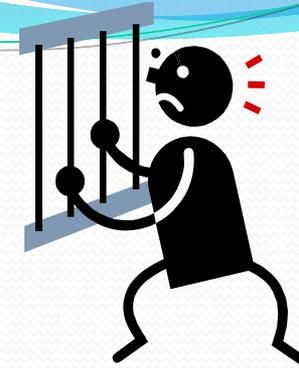
Min. risk of decline in diversity

Max. connectivity & suitable substrate, temp., water quality, & water quantity within landscape mgmt. units (HUCS)

Minimize cost for labor & operations

Limiting Factors Identification/Ranking

(Fish & Mussels Separately)



- Size & density (depensation)
- Contaminants
- Lack of dispersal
- Predation
- Invasive species
- Physical habitat
- Host fish (mussels only)
- Flows
- Dissolved oxygen
- Water temperature
- Lack of dispersal
- Disease
- Other factors

Identified complete list of mgmt. actions to address limiting factors

- Population Management
- Habitat Management

Alternative Management Approaches



Status quo

- Maintain same management actions at the current level of effort.

Population Management Emphasis

- Address depensation & lack of dispersal (i.e., expand current & add new populations through propagation/translocation into suitable habitat.

Habitat Management Emphasis

- Address water quality, physical habitat, & flow concerns by protecting & restoring occupied/unoccupied habitat within the historical range.

Comparison of Approaches

- Used SDM to analyze and compare performance (over 20 years) of each approach relative to fundamental objectives
- Performance measures
 - Species persistence objective
 - ❖ Trend in abundance
 - ❖ Number of habitat units occupied (distribution)
 - ❖ Risk of decline in genetic diversity
 - Habitat objective
 - ❖ Connectivity
 - ❖ Suitable substrate, temp., water quality, water quantity
 - Operational efficiency
 - ❖ Based on cost (measured as staffing level and operational cost)
- Population management emphasis approach more effective and efficient
- Alternative approaches are not exclusive of each other, but instead differ by emphasizing some types of management actions more than others

Example: Conservation benefits over a 20-year period as measured by trend in abundance on a categorical scale (declining, stable, or increasing) and number of 12-digit HUCs occupied (trend in abundance: -1 = high decline; +1 = high increase).

Common Name	Trend in Abundance within UTRB: declining = -1, stable = 0, and increasing = +1				Number of 12-digit HUCs Occupied			
	Current	Status Quo	Habitat Emphasis	Pop'n Emphasis	Current	Status Quo	Habitat Emphasis	Pop'n Emphasis
Chucky madtom	-1	-1	-1	-1	1	1	1	1
Citico darter	0	1	0	1	2	3	3	3
Duskytail darter	0	-0.5	0	1	2	1	2	3
Laurel dace	-1	-1	-0.5	0	4	2	3	4
Marbled darter	-1	-0.5	0	0.5	4	4	4	5
Pygmy madtom	0	0	0	0.5	1	1	1	3
Sicklefin redhorse	0	0.5	0.5	0.5	22	22	22	22
Slender chub	-1	-1	-1	-1	1	0	0	1
Smoky madtom	1	1	0	1	2	3	3	4
Snail darter	1	1	1	1	21	21	21	21
Spotfin chub	0	0	0.5	1	26	26	26	29
Yellowfin madtom	1	1	0.5	1	10	10	10	11
Average	-0.08	0.04	0.00	0.46	8.00	7.83	8.00	8.92

Consequence table with performance measures to compare alternative management approaches.

Objective	Sub-objective (footnoted performance measures)	Direction	Alternative Approaches		
			Status Quo Management	Habitat Management Emphasis	Population Management Emphasis
Species persistence and viability	Fish abundance trend ¹	Maximize	0.04	0.00	0.46
	Fish distribution ²	Maximize	7.83	8.00	8.92
	Mussel abundance trend ³	Maximize	-0.13	-0.04	0.58
	Mussel distribution ⁴	Maximize	4.09	4.09	7.83
	Genetic diversity ⁵	Maximize	-0.17	-0.17	0.52
	Habitat quality ⁶	Maximize	2.73	3.34	2.68
Operating costs	Staff ⁷	Minimize	9.5	11.5	11.5
	Management costs ⁸	Minimize	4.8	5.4	4.7

Population Management Approach

Shift of Emphasis

- Maximizes species persistence & viability by increasing some actions
 - Sections 7 & 10 of ESA
 - Protect existing/establish new pop'ns
 - Augment extant pop'ns
 - Captive pop'n mgmt
 - BMPs for stream/riparian habitats
- Accounts for budget trade-offs by reducing emphasis on other actions
 - Land acquisition/easements
 - Active restoration of stream/riparian habitats
- Additional action needed to support the selected approach
 - Existing pop'n & habitat monitoring
 - Life history research
 - Evaluate & monitor threats
 - Genetics monitoring & research

Continued...

- Additional action needed to support the selected approach
 - Pop'n viability analyses
 - Habitat evaluation for reintroduction
 - Propagation & captive mgmt. research
 - Evaluation of ecosystem services
 - Increased outreach
 - Establishing new partnerships
 - Maintaining intra-agency communications

Prioritization - Species & Locations

- Species considerations
 - Level of imperilment
 - Expected maximum conservation benefit
 - Expected mgmt. cost
- Watershed location considerations
 - Feasibility of habitat management
 - Expected benefits to imperiled species
- Important note
 - Prioritization does **not** imply management should be restricted. Rather it is meant as a guide to help identify optimal actions for particular species and locations given resource preference and constraints.



Prioritization of imperiled fishes

Common Name	Degree of Imperilment	Expected Conservation Benefit Relative to Current Status		Management Cost		Prioritization Steps		Priority
		Abundance Trend	Distribution	Cost of Propagation	Cost of Reintroduction	Step One	Step Two	
Marbled darter	High	1.5	0.3	Low	Low	1	1	1
Citico darter	High	1.0	0.5	Low	Low	1	1	1
Duskytail darter	High	1.0	0.5	Low	Medium	1	2	2
Laurel dace	High	1.0	0.0	Medium	Low	1	2	2
Pygmy madtom	High	0.5	2.0	Medium	Medium	1	3	3
Smoky madtom	High	0.0	1.0	Medium	Medium	1	3	3
Spotfin chub	Low	1.0	0.1	Medium	High	1	4	4
Yellowfin madtom	Medium	0.0	0.1	Low	Medium	2	2	4
Sicklefin redbhorse	Low	0.5	0.0	High	High	2	5	10
Chucky madtom	High	0.0	0.0	High	Medium	3	4	12
Slender chub	High	0.0	0.0	High	High	3	5	15
Snail darter	Low	0.0	0.0	High	Medium to High	3	5	15

Prioritization of imperiled mussels

Common Name	Degree of Imperilment	Expected Conservation Benefit Relative to Current Status		Management Cost	Prioritization Steps		
		Abundance Trend	Distribution	Cost of Propagation and Reintroduction	Step One	Step Two	Priority
Cumberlandian combshell	Medium	0.5	0.7	Low	1	1	1
Alabama lampmussel	High	0.5	0	Low	1	1	1
Oyster mussel	Medium	0.5	0.4	Low	1	1	1
Snuffbox	Low	1.0	1.0	Low	1	1	1
Pink mucket	Low	2.0	9.0	Low	1	1	1
Dromedary pearlymussel	High	1.0	1.0	Medium	1	2	2
Purple bean	High	1.0	0.5	Medium	1	2	2
Fanshell	Medium	1.0	2.0	Medium	1	2	2
Birdwing pearlymussel	Medium	0.5	0.4	Medium	1	2	2
Cumberland bean	High	1.0	0.0	Medium	1	2	2
Golden riffleshell	High	1.0	0.0	Medium	1	2	2
Cracking pearlymussel	High	0.5	2.3	High	1	3	3
Littlewing pearlymussel	High	0.5	2.0	High	1	3	3
Shiny pigtoe	Medium	0.5	0.3	High	1	3	3
Finerayed pigtoe	Medium	0.5	0.4	High	1	3	3
Rough pigtoe	Medium	0.5	9.0	High	1	3	3
Rough rabbitsfoot	Medium	1.0	0.3	High	1	3	3
Cumberland monkeyface	High	1.5	0.0	High	1	3	3
Appalachian monkeyface	High	0.5	0.0	High	1	3	3
Sheepnose	Low	0.5	0.4	High	1	3	3
Appalachian elktoe	Medium	0.5	0.0	Medium	2	2	4
Fluted kidneyshell	Medium	0.5	0.0	Medium	2	2	4
Slabside pearlymussel	Medium	1.0	-0.1	High	2	3	6
Spectaclecase	Medium	0.0	0.0	High	3	3	9

Prioritization of 8-digit HUC watersheds for location of habitat management actions based on species richness and management feasibility.

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

Summary



The Strategy is a combination of the...

- 1) most advantageous and cost effective management approach for conserving imperiled fish and mussel species,
- 2) Priority imperiled fish and mussel species for focused management consideration, and
- 3) Priority areas for focused habitat management.

Conservation Strategy

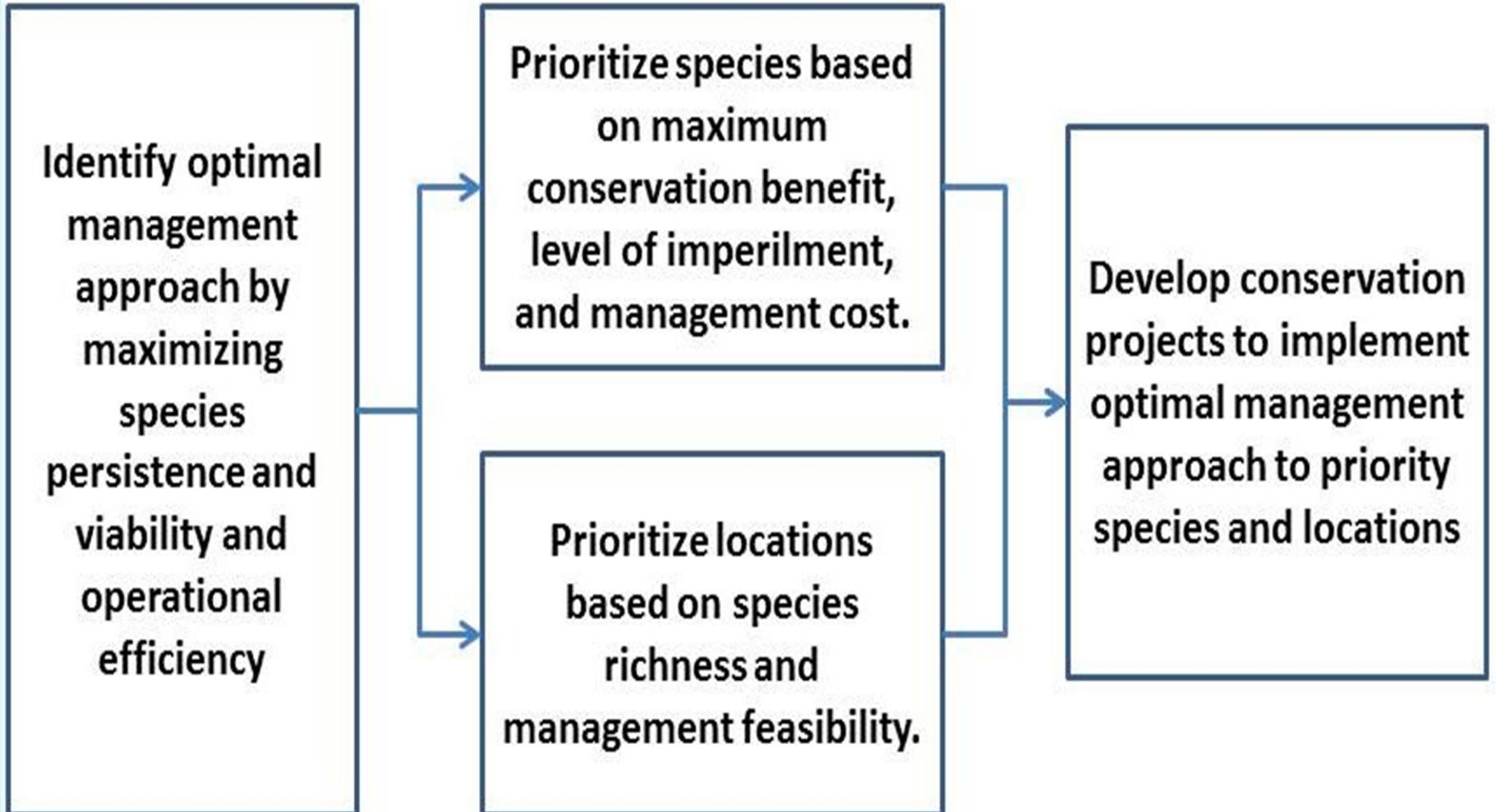
Project Development

Identify optimal management approach by maximizing species persistence and viability and operational efficiency

Prioritize species based on maximum conservation benefit, level of imperilment, and management cost.

Prioritize locations based on species richness and management feasibility.

Develop conservation projects to implement optimal management approach to priority species and locations



Status and Future of Strategy

- *Review and Comment* - Team considering comments received from state and other partners in TN, NC, VA, GA, and AL on draft Strategy
- *Implementation* – Annual project planning with partners and review of lessons learned
- *Revision* – Review/revise with partners every 4 yrs. based on effectiveness and results of monitoring

Questions?

