effectiveness exceeded 0.1, the final weighted score for population management emphasis exceeded that of the other two approaches. Therefore, the selection of population management emphasis as an optimal management approach was found to be robust to relative uncertainty in management effectiveness.

Species and Location Prioritization

Because conservation benefit is not likely to be achieved equally among all species and locations under the population management emphasis approach, species and locations were prioritized. Based on a trade-off between expected conservation benefit and management costs and while accounting for degree of imperilment, imperiled fishes and mussels were prioritized for management (Table 10 and 11). To prioritize locations for habitat management emphasis actions, richness of imperiled species and feasibility of management implementation were used as the driving variables (Table 12). These prioritizations are intended to allow for flexibility in decisions regarding specific conservation projects.

For species prioritization, the degree of imperilment was based on a qualitative assessment of rangewide extinction risk over the next 20 years (Appendices 2 and 3). Expected conservation benefit, the maximum gain in abundance trend and distribution over 20 years relative to the current condition, was calculated by the difference between current status and what would be expected to result from applying the population emphasis approach (Tables 5 and 6). For distribution, the numerical difference between current status and the population emphasis was divided by current status to account for species-specific distribution (Table 10 and 11). Management cost was on a categorical scale based on a summary of cost for management actions (Appendix 5).

Species prioritization was carried out in steps. The first priority score, which was based on imperilment and conservation benefit, was derived as follows:

- If gains in both abundance trend and distribution are expected, then assign priority 1
- If a gain in either abundance trend or distribution is expected,
    - and degree of imperilment is high, then assign priority 1
    - but degree of imperilment is not high, then assign priority 2
- If no gain in abundance trend and distribution is expected, then assign priority 3

The second priority score reflected the categorical scale for management cost. Lastly, a final priority was calculated by multiplying the first and second priority scores (Tables 10 and 11).

Table 10. Prioritization of imperiled fishes of the UTRB. Prioritization input variables included degree of imperilment, management cost, and expected conservation benefit from management actions accrued over the next 20 years. Degree of imperilment is based on a qualitative assessment of rangewide extinction risk over 20 years (Appendix 2). Expected conservation benefit is the maximum gain over 20 years relative to current status (Table 5). Management costs are a categorical summary based on management action costs (Appendix 5). Lower scores indicate higher priority.

		Expected Conservation Benefit Relative to Current Status		Management Cost		Prioritization Steps		
Common Name	Degree of Imperilment	Net Gain in Abundance Trend	Net Gain in Distribution	Cost of Propagation	Cost of Reintroduction	Step One	Step Two	Priority
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 redhorse	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

Table 11. Prioritization of imperiled mussels of the UTRB. Prioritization input variables included degree of imperilment, management cost, and expected conservation benefit from management actions accrued over the next 20 years. Degree of imperilment is based on a qualitative assessment of rangewide extinction risk over 20 years (Appendix 3). Expected conservation benefit is the maximum gain over 20 years relative to current status (Table 6). Management costs are a categorical summary based on management action costs (Appendix 5). Lower scores indicate higher priority.

		Expected Conservation Benefit Relative to Current Status		Management Cost	Prioritization Steps		
Common Name	Degree of Imperilment	Net Gain in Abundance Trend	Net Gain in 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

For prioritization of location of habitat management, richness of imperiled species and feasibility of management implementation were used (Table 12). Species richness was at the scale of the 19, 8-digit HUC sub-basins (Figure 1) that comprise the UTRB (Table 2). For each sub-basin, feasibility of implementing habitat management actions (Appendix 4) was acquired through an averaged polling of expert opinion among the team using three categories:

- 1 = infeasible to low degree of feasibility. There is little or no opportunity for habitat restoration/protection and threat abatement. Threats will likely continue or increase over time even with significant investments in habitat restoration/protection.
- 2 = moderately feasible. There is limited opportunity for habitat restoration/protection and threat abatement. Threats may be reduced over time with significant investments in habitat restoration/protection.
- 3 = high degree of feasibility. There is substantial opportunity for habitat restoration/protection and threat abatement. Threats can likely be reduced over time with significant investments in habitat restoration/protection.

Both variables, species richness and management feasibility, were standardized as the difference from the minimum value divided by the difference between the minimum and maximum value. Standardized input values for species richness and management feasibility were multiplied by weighted values (0.63 and 0.37, respectively) derived from an averaged opinion of team members. Weighted values were summed, and then divided by the sum of weights to derive final scores.

Table 12. Prioritization of 8-digit HUC watersheds for location of habitat management actions based on species richness and management feasibility (see Table 2 for list of species by HUC). Species richness and management feasibility values were standardized and weighted to provide weighted average scores for prioritization. The weights of 0.63 and 0.37 on richness and feasibility, respectively, were elicited from members of the team most familiar with the watersheds. To standardize, the maximum received a 1, the minimum received a 0, and the intermediate values were interpolated between 0 and 1. Higher scores indicate higher priority.

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

Conclusions

Based on the outcome of the SDM analyses, population management emphasis emerged as the optimal approach for achieving conservation of imperiled aquatic species in the UTRB. By following this approach, USFWS will direct more available resources toward implementation of