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GIS-Based Expert Systems Model for Predicting Habitat Suitability of Blackside Dace

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Abstract

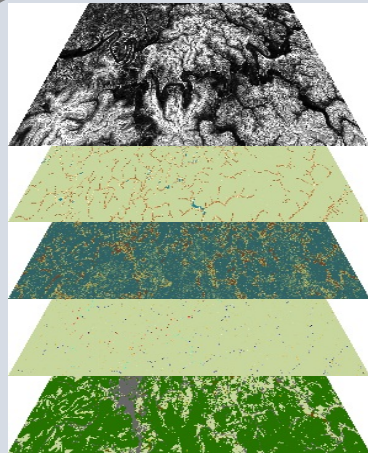
This study presents a GIS-based predictive habitat suitability model for the blackside dace, a federally-listed threatened species of the Upper Cumberland River basin in southeastern Kentucky. The model is a rules-based system which incorporates expert knowledge about habitat preferences for the species. The five habitat factors identified by experts and included in this model are stream gradient, canopy coverage, riparian vegetation type, riparian zone width, and stream order. Using GIS, the five habitat parameters were parameterized and combined across the entire stream network. Combinations were evaluated by blackside dace experts in terms of habitat suitability. The resulting model was tested against known blackside dace occurrences using locational modeling statistics. This analysis demonstrates success at identifying stream areas of both high and low likelihood of occurrences. Model results could be of particular usefulness to transportation planners in identifying sensitive areas in the landscape that may impact transportation planning.



GIS Layers

A single stream raster was created containing data for habitat factors conducive to predicting Blackside Dace presence along stream segments

- Gradient
- Stream Order
- Canopy
- Riparian Width
- Land Cover



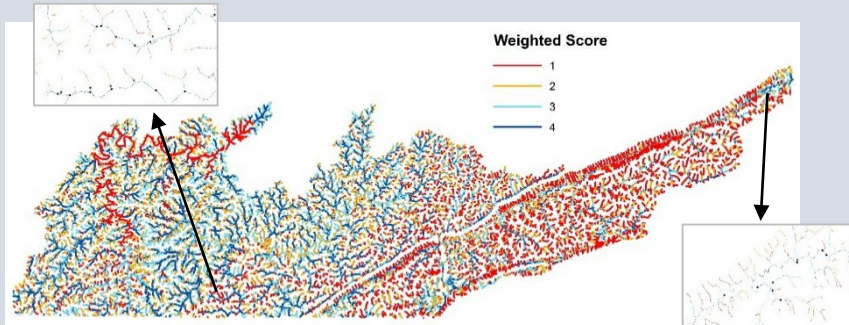
Habitat Factor Parameters

Habitat Factor	(Low)	Suitability		(High)
	1	2	3	4
Gradient (stream level)	>6 percent	4 – 6 percent	2 – 4 percent	<2 percent
Canopy (percent coverage)	0 – 50 percent	50 – 70 percent	70 – 90 percent	>90 percent
Riparian Vegetation	Cultivated, Developed, Barren	Grass, Herbaceous, Pasture (hay)	Shrubs, Scrub	Forested
Riparian Zone Width	<6 meter	6-12 meter	12-18 meter	>18 meter
Stream Order (Strahler)	6 – 7	1	4 – 5	2 - 3

Expert Systems Modeling

$$S = \sum W_i X_i$$

Where:
 S = surface of total probability score
 W = influence or weight factor of the ith factor
 X = Criteria score for the ith parameter



Model Results

Analyzed using locational modeling statistics (Kvamme 2006)

Rating	Suitability	M (#cells in model)	S (#dace occurrences)
1	Low	176,789	2
2	Below Average	138,361	14
3	Above Average	164,272	52
4	High	141,428	145

Rating	Probability	Statistic
1	28.49%	P(M)
2	22.28%	Base rate or chance probability that a model will indicate a site; proportion of study region mapped to M
3	26.46%	
4	22.78%	
1	0.94%	
2	6.57%	Model accuracy; probability that a model will correctly indicate a site: 100 * p(M/S) = percent correct
3	24.41%	
4	68.08%	
1	0.00113%	
2	0.01012%	Probability of Blackside Dace presence when model specifies an occurrence
3	0.03165%	
4	0.10253%	
1	0.02	
2	0.25	Model improvement ratio; indicates how many times more likely an occurrence is in M versus M'
3	0.90	
4	7.23	