ASSESSING THE TRANSFERABILITY OF A FRESHWATER MUSSEL FUNDAMENTAL NICHE MODEL WITHIN THE OZARK ECOREGION, MISSOURI.

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Mussel Research Framework in MO

• Identify habitat needs
• Assess risks
• Standardize protocol
• Detect trends in mussel assemblages
  • Fundamental niche model
  • Transference between drainage systems
Study Organism: Freshwater Mussels

- Unique life cycle
- Mussel Beds
- Importance
- Mussels in Decline
Freshwater Mussel Conservation
Species Distribution Modelling

Habitat distribution models
(Guisan and Zimmermann, 2000)

Species Distribution Models

Habitat suitability/selection models
(Akcakaya, 2000; Hirzel and Le Lay, 2008)

Gradient analysis
(Austin et al. 1984)

Resource selection models
(Boyce and McDonald, 1999; Manly et al. 2002)

Ecological niche models
(Stockwell 2006; Peterson 2006)
Fundamental Niche Theory
Objective

Transfer a fundamental niche model for multispecies aggregations of freshwater mussels from the Meramec River to the Gasconade and Little Black Rivers
Study Areas

- Gasconade River
- Meramec River
- Little Black River
Hypotheses

• Gasconade River = Combination model
• Little Black River = River specific model
• The same habitat variables will be important in predicting suitability in all three systems
Methods

• Use remotely-sensed elevation data and aerial imagery to derive hydrogeomorphic variables
• Identify species rich beds from the state database
• Create and transfer fundamental niche models in Maxent
• Further validate models using validation mussel beds
Methods

• Use remotely-sensed elevation data to derive hydrogeomorphic variables

• **Identify species rich beds from the state database**

• Create and transfer habitat models in Maxent

• Further validate models using validation mussel beds
Quantile 0.25: $\text{Species richness} = (1.4 \times \log_{10} \text{drainage area}) - 0.51$

Quantile 0.50: $\text{Species richness} = (2.9 \times \log_{10} \text{drainage area}) - 0.86$

Quantile 0.60: $\text{Species richness} = (3.0 \times \log_{10} \text{drainage area}) + 0.40$

Quantile 0.70: $\text{Species richness} = (3.0 \times \log_{10} \text{drainage area}) + 2.80$

Quantile 0.80: $\text{Species richness} = (3.4 \times \log_{10} \text{drainage area}) + 4.40$

Quantile 0.90: $\text{Species richness} = (2.3 \times \log_{10} \text{drainage area}) + 11.5$
Methods

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• Identify species rich beds from the state database
• **Create and transfer habitat models in Maxent**
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Methods

• Use remotely-sensed elevation data and aerial imagery to derive hydrogeomorphic variables
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Gasconade River

Combined Model
- Bluff adjacency
- Bed stability
- Lateral channel stability

River Specific Model
- Bluff adjacency
- Bed Stability

Test AUC: 0.65
Validation: 0.60

Test AUC: 0.67
Validation: 0.82
Little Black River

**Combined Model**
- Bed stability
- Water availability

**River Specific Model**
- Stream power
- Bluff adjacency
- Bed stability
- Water availability

Test AUC: 0.64  Validation: 0.64

Test AUC: 0.72  Validation: 0.80
Results

- Proximity to bluffs
- Bed stability

Meramec River

- Stream power
- Bed stability
- Lateral channel stability
- Water availability

Gasconade River

- Proximity to bluffs
- Bed stability
- Lateral channel stability

Little Black River

- Stream power
- Proximity to bluffs
- Bed stability
- Water availability
Discussion

Gasconade River

Meramec River

Habitat Suitability

Distance to persistent gravel bar

Validation Mussel Beds
Unsuitable
Suitable

Kilometers
Discussion

Little Black River

Meramec River

Water availability

Habitat Suitability

0.0 0.2 0.4 0.6 0.8 1.0

0 5 10 15

Unsuitable

Suitable

6 Kilometers
### Results

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<tr>
<th>Gasconade River</th>
<th>Meramec River</th>
<th>Little Black River</th>
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Gasconade River

- Proximity to bluffs
- Bed stability
Discussion

Little Black River

- Stream power
- Proximity to bluffs
- Bed stability

- Water availability
Discussion

- Gasconade River = Combination model ✔️
- Little Black River = River specific model ✔️
- The same habitat variables will be important in predicting suitability in all three systems ✔️
Conclusions

The relationship between mussels and habitats vary based on the specific system their relationships with hydrogeomorphic characteristics can lead to successful fundamental niche modeling.
• Understanding what factors allow freshwater mussel establishment and persistence can help inform successful conservation efforts and save sampling time
• By using remotely sensed data, under-sampled areas can still be examined for fundamentally suitable habitat
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