Habitat Partitioning by Three Darter Species in the Clinch River System with Implications for Stream Restoration Efforts

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Outline

- Introduction
  - Darters
  - Stream restoration
- Study Objectives
- Methods
- Analysis & Results
- References & Acknowledgements

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Darters

- Percidae- Etheostomatini[1]
  - *Ammocrypta, Etheostoma, Percina, Nothonotus*
  - 90 of the ~320 FW fish species in TN (most in N.AM)

Banded darter, *E. kanawahe*

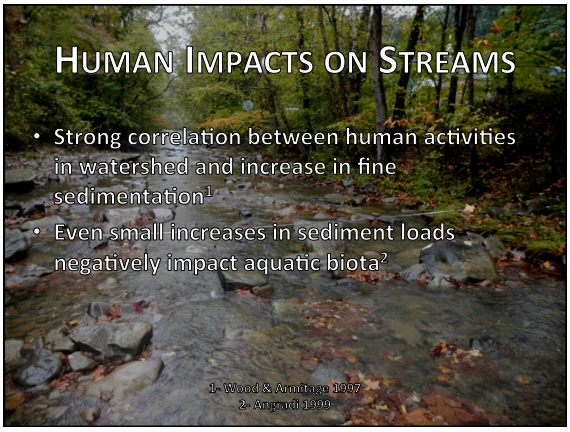
Gilt darter, *P. evides*

1- Etnier & Starnes 1993

Darters

Orangethroat darter, *E. spectabile*
Etnier & Starnes 1993

Darters


Human Impacts on Streams
• Strong correlation between human activities in watershed and increase in fine sedimentation[1]
• Even small increases in sediment loads negatively impact aquatic biota[2]
1- Wood & Armitage 1997
2- Angradi 1999

Stream Restoration
• Ecological engineering[1]
– Ecosystem restoration
• Restore ecosystem services of the stream or watershed[1]
• Remediate 'urban stream syndrome'[2]
1- Palmer et al. 2013
2 Walsh et al. 2005

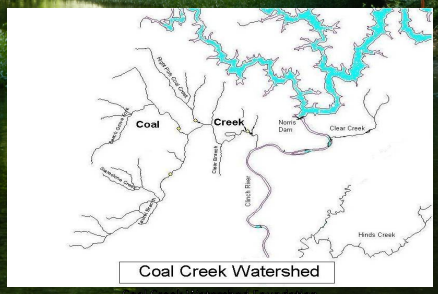
Stream Restoration
• Can address biological and geomorphological deficiencies
– Stream engineering and construction
– Aquatic faunal relocation

Coal Creek Restoration

- 3rd order stream in Anderson County, TN
- 1st tributary of Clinch River DS of Norris Dam
- Watershed drains area of coal mining activity[1]
  - Began 1830
  - Major economic activity in region

1 Brahana et al. 1986

Coal Creek Restoration



Coal Creek Watershed

Coal Creek Watershed Foundation

Coal Creek Restoration

COAL CREEK RESTORATION

COAL CREEK RESTORATION
• UTK fish relocation effort[1]
– TVA IBI showed larger, pelagic fishes had recolonized stream
– Smaller nongame species still missing
– Collected from Cove Creek and relocated
1-Schiding 2009

COAL CREEK RESTORATION
Rainbow darter, E. coeruleum
Telescope shiner, N. telescopus
Warpaint shiner, L. coccogenis
Tennessee shiner, N. leuciodus

STUDY OBJECTIVES
• Several studies assessing habitat usage by darters in small streams[1,2,3,4]
• Snorkel surveys of darters accepted method
– Low level of intrusion
– Territorial fish stay in place
• New wrinkle- species relocation
1- Paine et al. 1982
2- Matthews et al. 1982
3- Skyfield &Grossman 2008
4- Henry & Grossman 2008

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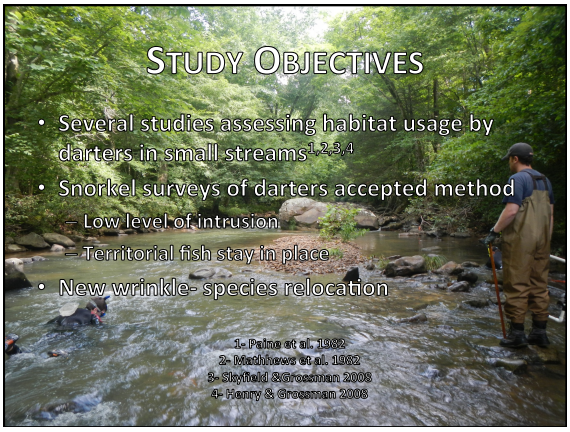
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Study Objectives
1. Determine if darter habitat usage is nonrandom
2. Determine darter habitat selection
3. Compare habitat partitioning among species
4. Assess impacts of stream restoration on habitat usage and substrate profile

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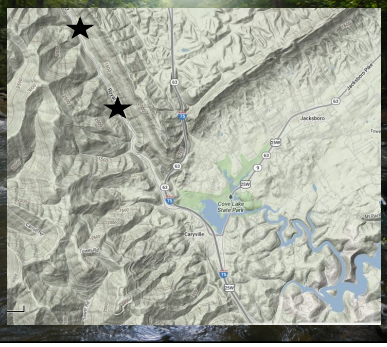
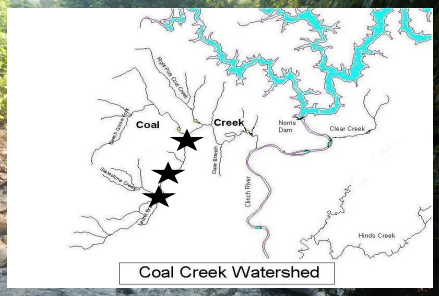
Study Sites- Cove Creek



Study Sites- Cove Creek

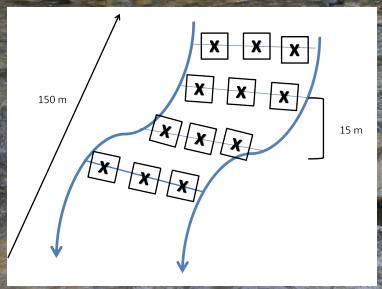
Study Sites- Coal Creek



Coal Creek Watershed Foundation

Study Sites- Coal Creek

Methods- Data Collection



Methods- Data Collection

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- 8 substrate measurements classified by Wentworth Scale[1]
  - Clay/Silt – 0.00024 mm- 12 mm
  - Sand
  - Gravel
  - Cobble
  - Boulder
  - Bedrock-- >2600 mm

1- Bunte & Abt 2001

Analyses

- Available data
  - Species observed per site (n_{total} = 331)

Rainbow darter, *E. caeruleum*

Analyses

- Available data
  - Species observed per site (n_{total} = 331)

Snubnose darter, *E. tennessense*

Analyses

- Available data
  - Species observed per site (n_{total} = 331)

Redline darter, *N. ruffilineatum*

Analyses

- Available data
  - Habitat usage by darters
  - Available habitat per site
    - Natural, Disturbed, Restored

Analyses

- ANOVA
  - PROC GLIMMIX, SAS 9.3
  - $\alpha = 0.05$
- Correspondence Analysis
  - PROC CORRESP, SAS 9.3
- Chi-squared tests for association
  - PROC FREQ, SAS 9.3
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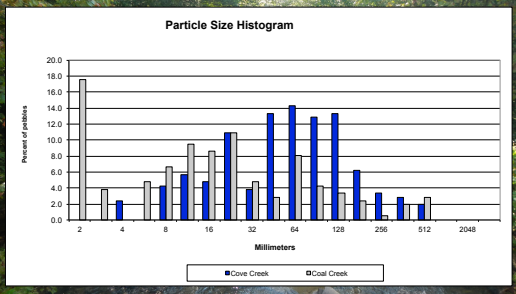
Results



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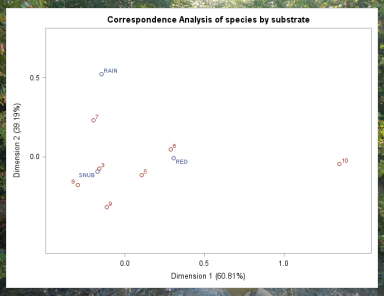

Results

Table of species by substrate

	substrate							
species	3	5	6	7	8	9	10	Total
RAIN	5	2	12	19	1	1	0	40
	-0.625	-1.333	-0.708	8.375	-0.458	-5.146	-0.104	
	0.0694	0.5333	0.0395	6.6015	0.144	4.3085	0.1042	
	1.30	0.52	3.13	4.95	0.26	0.26	0.00	10.42
	12.50	5.00	30.00	47.50	2.50	2.50	0.00	
	9.26	6.25	9.84	18.63	7.14	1.69	0.00	
RED	15	13	60	26	3	18	1	136
	-4.125	1.6667	16.792	-10.13	-1.958	-2.896	0.6458	
	0.8897	0.2451	6.5256	2.8378	0.7735	0.4013	1.1777	
	3.91	3.39	15.63	6.77	0.78	4.69	0.26	35.42
	11.03	9.56	44.12	19.12	2.21	13.24	0.74	
	27.78	40.63	49.18	25.49	21.43	30.51	100.00	
SNUB	34	17	50	57	10	40	0	208
	4.75	-0.333	-16.08	1.75	2.4167	8.0417	-0.542	
	0.7714	0.0064	3.9144	0.0554	0.7701	2.0235	0.5417	
	8.85	4.43	13.02	14.84	2.60	10.42	0.00	54.17
	16.35	8.17	24.04	27.40	4.81	19.23	0.00	
	62.96	53.13	40.98	55.88	71.43	67.80	0.00	
Total	54	32	122	102	14	59	1	384
	14.06	8.33	31.77	26.56	3.65	15.36	0.26	100.00

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