Urbanization Pathways to Habitat Alteration

Allison E. Cornell, Kristen J. Murphy, Michael A. Turns, and Randolph Chambers

Keck Environmental Lab, College of William and Mary, Williamsburg, VA

Introduction

Watersheds with higher levels of urbanization typically exhibit poorer water quality and increased stream incision. This lower quality environment negatively affects animals that depend on aquatic habitats within the zone of urbanization. The impacts of development ,however, can extend beyond the region of cleared land. We monitored amphibian abundance downstream of development because amphibians are especially sensitive to changes in land use, and are dependent on both aquatic and terrestrial environments. We chose wetlands downstream of watersheds with different levels of urbanization to measure amphibian abundance and independent metrics of downstream habitat quality.

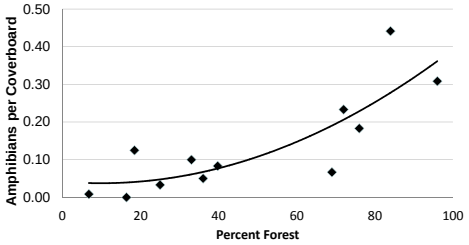
Methods

- Two sets of data were collected; six downstream wetland sites examined in 2001 and four in 2010.
- Sites were selected for their varying degrees of upstream watershed development, all on the coastal plain of southeastern Virginia.
- The standard coverboard method for sampling amphibians was employed; using 60x60cm, 3/8inch plywood boards.
- 15 coverboards were installed per site and were sampled weekly without amphibian removal.

- ArcView 3.2 GIS software measured the area and percentage of urbanization upstream of each wetland.
- Stream incision measurements were taken as a proxy for erosion, using the depth of the channel relative to the surrounding floodplain.
- Measurements of stream pH, temperature, conductivity, concentration of phosphate, ammonium, nitrate and nitrite were also made.

Results

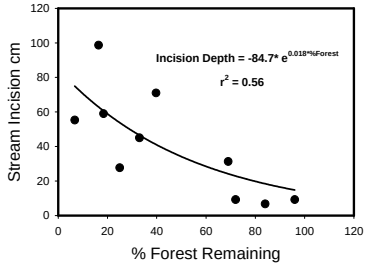
Percent Forest and Amphibian Abundance



Correlation between percent forest and downstream amphibian population size:
r^2 =0.70 p<0.05

Environmental Factor	Model Relationship to Amphibian Abundance	R2	P Value
Undeveloped Area	Linear	0.05	>0.05
Temperature	Exponential Decay	0.56	<0.02
Phosphate	Linear	0.25	>0.05
pH	Exponential Decay	0.01	>0.05
Nitrate	Linear	0.01	>0.05
Ammonium	Linear	0.12	>0.05
Conductivity	Exponential Decay	0.45	<0.05

Urbanization and Downstream Incision



Correlation between percent forest upstream and downstream incision:
r^2=0.56 p=0.01

Conclusions

- Watershed quality—not quantity—was strongly correlated with amphibian abundance.
- Stream incision was negatively correlated with percent remaining forest.
- Temperature and stream conductivity were the only water quality variables strongly correlated with amphibian abundance.
- Incision disconnects the floodplain habitat from the stream, lowering amphibian habitat quality.
- Also, areas with higher degrees of urbanization tend to have more flashy storm flow which degrades amphibian habitat.
- Amphibian habitat is lost by two pathways: (1) directly clearing land, and (2) developing land upstream.
- Riparian corridor protection downstream is thwarted by upstream development.

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