Vernal Pools: The Influence of Road Salt on Benthic Vernal Pool Communities

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Abstract
Vernal pools are temporary bodies of water that provide habitat for a diverse microflora and microfauna, including microcrustaceans, such as fairy shrimp and copepods. Studies have shown that proximity to roads has negative impacts on vernal pool communities. This study explores the influence of roads, specifically road salt runoff, on benthic diversity and abundance. Water properties and their influence on benthic communities were investigated in six ephemeral pools in Sewanee, Tennessee, three of which were surrounded by paved road. We hypothesized that benthic abundance and diversity in vernal pools adjacent to roads would be reduced. As a measure of the impact of roads, we measured water conductivity, pH, and turbidity weekly.

Introduction
Ephemeral ponds, also known as vernal pools, are temporary bodies of water that fill topographic depressions during winter and early spring, and drain down the summer months. The organisms live in these pools and have developed life histories to cope with the dynamics of a vernal pool ecosystem. Vernal pools provide fish free habitat for a diverse assemblage of microcrustaceans, such as fairy shrimp and copepods. These habitats are also extremely important in the breeding sites of some salamander species, such as the spotted salamander. The proliferation of some vernal pool species is dependent on water quality. Previous studies have shown that high salt concentrations in aquatic habitats negatively affect populations due to increased water conductivity. However, high concentrations of salts in water detrimentally affect aquatic communities because it disrupts their osmotic balance with their water environments.

Methods

Water Properties
• Mean conductivity was overall higher in vernal ponds adjacent to roads compared to ponds surrounded by forest.
• Mean turbidity values were higher in the three Airport locations compared to the forested vernal pools except for Pine Point.
• Water pH at vernal ponds ranged from 4.2-4.6 except for Airport 3, which had a pH of 5.4, the most neutral water pH of all the ponds.

Results

Benthic Abundance and Diversity
• There was no significant correlation between mean abundance and mean diversity between the six vernal pool benthic communities.

Conclusions
Water sampling at three vernal pool locations surrounded by forests and three pools surrounded by roads revealed significant differences in conductivity, pH, turbidity, and salinity (p<0.001), however, the impact of these differences did not affect benthic abundance (p=0.310) and diversity (p=0.154). Conductivity was elevated in ponds around Airport Road, especially Airport 3, which has the longest railroad track. Over the years, the limestone gravel bed would have leached calcium carbonate, and it is likely that the amount of impurities in the water at Airport 3, thus increasing its conductivity. Conductivity in ponds surrounded by forests, however, was low and varied little.

Mean turbidity values were overall higher in the three Airport locations compared to Pine Point. Sediment resulting from runoff and road construction were likely factors in the higher turbidity readings for the vernal pools adjacent to Airport Road. As with conductivity, site history involving the railroad likely contributed to the elevated turbidity readings in Airport 3. Vernal pools surrounded by forests had low mean turbidity readings, except Pine Point, which likely receives sediment inputs from the nearby walking trails.

With the exception of Airport 3, vernal pools surrounded by roads had lower water pH than vernal pools in forested areas. Road runoff as well as local site soil conditions could have made these vernal pools more acidic. The anomalous mean pH observed for Airport 3 was likely neutralized from the old limestone railroad bed that once occupied the site.

Even though conductivity, turbidity, and water pH did not have a significant influence on benthic abundance and diversity, there was a significant effect of temporal variation on these benthic communities in the vernal pools sampled in these study sites (p<0.001). Over time, both abundance and biodiversity generally increased among the six sites, peaked at March 22nd, and then decreased. Abundance and species richness were increased in the spring due to favorable ambient air temperatures. The decline in abundance and biodiversity may be a result of a freezing event that occurred on April 10th, predatory invertebrates, or population decline in salamander populations may have an effect on these vernal pool benthic communities.

Literature Cited

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