PATTERNS IN SPECIES COMPOSITION AND DIVERSITY ALONG INTERMITTENT CREEKS IN THE MISSOURI OZARKS

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The southeast Missouri Ozarks is a rugged, deeply dissected landscape. Intermittent creeks are commonly found throughout the region, yet our understanding of this ecosystem component is poor. Landform features, flooding frequency, and flooding duration are variables known to affect vegetation distribution patterns along perennial systems. We investigated if these variables, and/or the geological substrate and parent material, could also be used to explain distribution patterns of natural communities and species groups along intermittent creeks in the southeast Missouri Ozarks.

We selected 13 intermittent creeks within the watersheds of the Current, Jacks Fork, and Eleven Point Rivers for sampling: 11 1st- and 2nd-order creeks, one 3rd-order, and one 5th-order creek. For each creek, we collected information at the watershed level, e.g., underlying geological strata, drainage area, stream order, and stream length. Eight to ten 20-m by 20-m plots were located down the length of each creek within the bounds of a distinct fluvial landform. For each plot we recorded waterway width, elevation above creek channel, geological parent material, percent surficial rock, soil textural, and soil structural characteristics, as well as collected overstory, understory, and ground flora data. All woody stems >1.25 cm d.b.h. were recorded to species and d.b.h. and all ground flora vegetation (<1 m-tall) was recorded to species and given a cover class code. Detrended Correspondence Analysis (DCA) ordination of all strata was conducted. DCA sample axis scores were examined for relationships with environmental variables using Spearman rank correlation analysis and analysis of variance to identify potential classifications of vegetation based on physical variables. From these results a multi-factor, physically-based, hierarchical classification incorporating highly correlated environmental variables was developed. Plots distributed to these classes were tested for within-class homogeneity and between-class differences with the Multi-Response-Permutation Procedure (MRPP).

We found that fluvial landform parameters, e.g., soil texture, soil development, and their associated characteristics, such as flooding intensity, duration, and frequency, were important predictors of species distribution patterns in higher order creeks (3rd and 5th). Differential suites of species were associated with channel, active floodplain, and terrace features. These features differed in their elevation above the creek channel, and soil textural characteristics in both the surface and subsurface horizons. Channel features, unique to intermittent high order creeks, had two distinct vegetation strata, an extremely dense shrub layer of the flood-tolerant species, *Hamamelis vernalis* Sarg. and *Ptelea trifoliata* L. and a sparse scattering of ground flora species adapted to intense, frequent flood disturbance. Active floodplains were typically three-tiered, with a dense closed canopy of mesic overstory species, *Quercus muehlenbergii* Engelm., *Q. alba* L., and *Fraxinus americana* L., shading an understory of *Lindera benzoin* (L.) Blume, *Asimina triloba* (L.) Dunal, and *F. americana* saplings and a lush ground flora layer of forbs and woodland grasses. Terrace features had relatively open mature stands of *Q. alba* with *Cornus florida* L., low-growing shrubs, woody vines, and woody seedlings in the understory.

For lower order intermittent creeks (1st - 2nd), soil texture, drainage and base-saturation, and vegetation were more strongly associated with parent material and underlying bedrock type than with fluvial landform. In general, individual lower order intermittent creeks were characterized by similar parent material and

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underlying geologic strata along their length. Creeks developed in Roubidoux-Upper Gasconade cherty limestone and sandstone substrates with rocky, coarse-textured soils, were characterized by an open, three-tiered mixed *Quercus-Carya/Cornus* dry-mesic forest and a sparse ground flora dominated by upland generalist species such as *Parthenocissus quinquefolia* (L.) Planch., *Desmodium nudiflorum* (L.) DC., *Smilacina racemosa* (L.) Desf., and *Sanicula canadensis* L. and species of upland mesic/alfic forests (*Cimifuga racemosa* (L.) Nutt., *Geranium maculatum* L., *Agrimonia rostellata* Wallr., and *Brachyelytrum erectum* (Schreb.) Beauv.).

Conversely, creeks developed in lower Gasconade and Eminence dolomitic limestone substrates, with relatively chert-free, fine-textured soils, were characterized by a shaded, multiple-tiered mixed hardwood mesic bottomland forest community (*Carya cordiformis* (Wangenh.) K. Koch-*Q. muehlenbergii-Ulmus rubra* Muhl./*Lindera benzoin-Asimina triloba*), and an extremely lush, diverse ground flora. Further, within intermittent low-order creeks of like-bedrock types, patterns of water flow along the length of a creek were also strongly related to species distribution patterns. For all vegetation strata, species composition and structure changed in a downstream direction (e.g., increases in richness in the ground flora and understory, and increases in total cover and density in the ground flora and understory, respectively). These changes in species diversity, abundance, and cover were associated with position within a waterway, local watershed characteristics, and water flow.

From Indicator Species Analysis, indicator species groups were identified. Seven ecological species groups comprised of co-occurring ground flora and understory species were identified and described. Species and species groups were not unique to a community, but rather the dominance of a species or group varied across communities. Likely, high inherent ecological species amplitude and substantial micro-habitat variability created from deposition, erosion, and scouring of flood events, treefall pit and mounds, and bedrock and parent material complexity allow wide distribution of Ozark species.

Intermittent creeks were highly floristically and physically diverse, complex components of the Ozark landscape. Patterns in diversity and differences in species composition were strongly related to differences in the underlying geology and parent materials along lower-order intermittent creeks, and to landform parameters along higher-order intermittent creeks.