

American Water Resources Association
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GIS & Water Resources VI
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Wednesday, March 31

1:30 PM – 3:00 PM

SESSION 38: Environmental

Ecological Sites And Rangeland Watershed Hydrology - Philip Heilman, USDA-ARS SWRC, Tucson, AZ
(co-authors: J.J. Stone, D. Robinett)

Soil and water conservation efforts on rangelands require a marriage of hydrologic and range management concepts. One important range management concept is that of an ecological site, which is defined by its ability to produce a plant community consisting of certain kinds, amounts, and proportions of vegetation. Multiple soil series can produce the same plant community, and so are associated with a single ecological site. One can create maps of ecological sites using SSURGO soils maps by assigning map units, each consisting of a number of soil series, to the ecological site of the dominant soil series in each map unit. Such maps are too coarse for ranch management. However, these maps might be the only way to apply currently documented range management knowledge in hydrologic models, at least until ecological sites are more widely mapped. The Natural Resources Conservation Service (NRCS) provides written descriptions of ecological sites, including a state and transition model and information applicable to hydrologic models. We examine the utility of ecological sites for hydrologic research in the context of the Walnut Gulch Experimental Watershed, a 150 km² research watershed in southeastern Arizona. We list the ecological sites on Walnut Gulch; illustrate the distribution of ecological sites across the watershed compared with the SSURGO soils map; present hydrologic information about ecological sites contained in NRCS site descriptions, and describe a state and transition model and its hydrologic implications for one ecological site, Loamy Upland.

Landscape Modeling for Blue Wing Teal in the Sheboygan River Basin: A Weighted Criterion Approach - Chris Pekar, Student, Cottage Grove, WI

The Sheboygan River Basin Area of Concern Fish and Wildlife Technical Advisory Committee is undertaking a watershed-based approach to GIS site-selection search for potentially restorable wetlands with the intent of improving nest success for Blue Wing Teal in the Sheboygan River Basin. The GIS model will incorporate up to 10 criterion layers that will be differentially weighted by the committee members and a limited number of experts by using the Analytic Hierarchy Process. Because the expert panel is composed of stakeholders found throughout the State of Wisconsin, the expert panel will determine the relative importance of each criterion with respect to all other criteria by using an online survey form. This online survey method also allows the participants to fill this out at their convenience. The results of these rankings will be averaged and entered into an AHP plug-in tool developed by Australian researchers that integrates with ArcGIS Spatial Analyst extension. The resulting suitability map will be used by the Committee to guide restoration efforts throughout the Sheboygan River Basin. Additionally, a comparison map will be created that identifies any differences between the primary Output Map and an unweighted version of the Output Map. This step will provide insight into how significant the weighting process is. The Sheboygan River Basin was listed as an Area of Concern by the United States Environmental Protection Agency in 1985 due to historic discharge of pollutants and habitat loss along the lower 14 river miles of the Sheboygan River. Although de-listing targets for the Sheboygan River Basin Area of Concern are still being created, these targets are required to have a wildlife habitat restoration component. Blue Wing Teal are an ideal focal species for watershed-based restoration planning efforts for many reasons. Blue Wing Teal are considered a species of greatest conservation need by the Wisconsin Department of Natural Resources and they are considered an umbrella species so restoration efforts made to enhance Blue Wing Teal populations will likely confer benefits to many other wetland flora and fauna.

GIS Analysis of the Hydrogeomorphic Attributes of the Niobrara River - Nathaniel Schaepe, U.S. Geological Survey, Lincoln, NE (co-author: Jason S. Alexander)

The Niobrara River is an economically and ecologically important resource in Nebraska. In order to maintain the present quantity and diversity of stream physical habitats it is necessary to understand the Niobrara River's geomorphic state. In cooperation with the Nebraska Game and Parks Commission, the U.S. Geological Survey investigated the hydrogeomorphic attributes of the Niobrara River along a 531-kilometer section in northern Nebraska. This longitudinal characterization of the Niobrara River and its valley was performed using existing and created geographic and hydrologic data sets coupled with geographic information system (GIS) analysis. Aerial photographs and topographic quadrangle maps were used to digitize channel and valley attributes. The authors devised a strategy to longitudinally sample the width of the channel, width of the valley bottom, and number of channel islands using sample nodes spaced one average channel width apart along the channel centerline. This channel centerline also was used to index a longitudinal cumulative discharge curve and a longitudinal channel elevation curve. Flow duration curves were developed from daily streamflow data at Niobrara main-stem and tributary gages. The longitudinal cumulative discharge curve was created by assigning the discharges from the flow duration curves to the corresponding locations along the digitized centerline. A longitudinal channel elevation curve of the Niobrara was created by overlaying the channel centerline on the 10-meter National Elevation Dataset and sampling channel elevations every 20 meters. Discharge and slope values were interpolated from these curves at each sampling node. Each node's values were then used to calculate unit-streampower, which can be used as a primary indicator of sediment transport capacity. The river was divided into three broad fluvial geomorphic provinces on the basis of natural breaks in the distribution of hydrogeomorphic characteristics: Meandering Bottoms, Canyons and Restricted Bottoms, and the Braided Bottoms. A more detailed segment classification system based on degree of valley confinement, channel-planview pattern, channel-width variation, and bar configuration was applied through GIS analysis and resulted in 14 distinguishable classes.

Influence of Riparian Spatial Structure on Aquatic Environment Conservation in Small Streams of Southeast Brazil - Silvio Ferraz, ESALQ/USP, Piracicaba, SP (co-authors: Felipe Rossetti de Paula; Gisele Biem Mori; Giovana Athayde; Pedro Gerhard; Antônio Fernando Monteiro Camargo)

Riparian environment is an important component for integrity of streams in agroecosystems located in São Paulo State, southeast Brazil. Their function includes habitat, soil conservation and lotic environment protection. Forest fragmentation and land-use are degrading environmental conditions at riparian areas disturbing ecological processes at streams. This study investigates riparian environment landscape structure influences on channel structure and water chemical composition. The central hypothesis is that spatial configuration of land-use at riparian area is important for conservation of hydrological processes. Fifteen catchments in the Corumbataí river basin, including different levels of forest fragmentation were analyzed in the study at riparian environment scale. Ecological units were defined by combination of soils, slope and land-use at riparian zone. Landscape level characteristics of ecological units, channel physical structure, large wood debris (LDW) characteristics and water chemical composition were considered into univariate and multivariate methods in order to identify relationship between riparian landscape structure, channel characteristics and chemical composition of water. Stream habitat was found highly influenced by landscape since LDW is directly correlated to forest proportion and the absence of riparian vegetation at sand soils ecological units is reducing LDW input and simplifying channel structure. Higher turbidity and NO₃ concentrations are found in ecological units characterized by vegetation at initial stage of regeneration, clay soils and low elevation areas. Nitrogen concentration was found related to hydrologic distance of mature forest units in sand soils. We conclude that riparian land-use composition and configuration influence channel structure and water chemical composition and, the riparian ecological units characterization should help the definition of reforestation strategies regarding conservation of water and aquatic environment.