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Commentary

Landscape Metrics as Indicators of Stream: Wetland Hydrologic Connection in the Coastal Plain

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DESCRIPTION

Landscape ecology studies and planning have long identified connectivity as a key concept. Connectivity across habitats has been a key factor in the study of metapopulational dynamics, gene flow, extinction risk, and reserve design as channels of mobility for organisms. Water is a universal driver of landscape form, ecological function, and ecosystem services. Hydrologic linkage, or the water-mediated transfer of materials, energy, and organisms within or across parts of the hydrologic cycle, has also drawn a lot of interest. Between transitional landscape elements like wetlands, whose size and degree of hydrologic linkage fluctuate based on their landscape position as well as on net inflows and outflows from the ground, surface, and subsurface, hydrologic connectivity can be very dynamo.

Wetlands perform numerous crucial hydrologic, biogeochemical, and habitat/food web services with local and regional implications, which can be largely attributed to their dynamic nature. Wetlands serve as a source of resources like water and organic matter, a sink for hazardous substances like excess nutrients and diseases, and a habitat or haven for creatures like fish and aquatic insects. Longer wetland hydro periods and sporadic surface water connections to permanent waters have been associated with increased species diversity and higher net primary productivity among digressional wetlands. It has been demonstrated that the presence of wetlands within a watershed greatly influences flood prevention and lower nitrate levels in surface and groundwater. The degree and manner of hydrologic connection between wetlands and other landscape components greatly influences the kind, amplitude, and scale of these functions.

Hydrologic linkage also has an impact on processes at the landscape scale, such as watershed runoff response downstream of digressional wetlands. The spatial arrangement of runoff-generating areas, flow channels, surface water storage, and the catchment outlet affects runoff. As a result, land use modifications that affect hydrologic connectivity (such as urbanization, agriculture, mining, and channelization) can have a significant impact on runoff and the movement of pollutants into downstream rivers. The largest global loss of wetlands has been from agricultural drainage by ditching and tiling, which has also disrupted hydrologic connections on large enough scales to wipe out some wetland species. Understanding the dynamics of SHC has sparked interest in safeguarding downstream streams, preserving wetlands, and restoring wetlands. When, where, and how significant are these dynamic relationships in ecological, chemical, and hydrological contexts are questions that researchers are trying to answer.

In order to improve our knowledge of the interaction between landscape features and the hydrologic connectivity between these wetlands and the surrounding stream network, Given that the majority lack clearly defined surface water inlets or exits, they had traditionally been categorized as "geographically isolated" wetlands that are entirely surrounded by uplands.

Despite this categorization, the amount of surface water in each bay varies seasonally and annually depending on the amount of rainfall and other factors. Surface water levels frequently exceed the capacity of storage during rainy seasons, and individual basins frequently combine to create vast wetland complexes that discharge to stream networks. In addition, the early to mid-1900s saw the construction of hand-dug ditches on the Delmarva Peninsula to drain marshes for farming and mosquito control.

At regional or national dimensions, distance-based approaches would be able to forecast structural physical wetland–stream connection with a good first–order approximation, but more precise methods are required to predict functional SHC at catchment scales. The significance of hydrologic linkages from wetlands to downstream streams is frequently predicated on estimates of SHC since groundwater dynamics are more difficult to measure than surface water connections. Recent developments in remote sensing and GIS-based methods offer an opportunity to more precisely map the spatial extent of streams and wetlands and predict the degree of connectivity between water features across the landscape.

These methods should be used in conjunction with a mechanistic understanding of the hydrologic factors in the area. These developments may also offer managers and regulators who require estimates of hydrologic connectivity a crucial tool. The purpose of this project was to provide a method for predicting connectivity utilizing landscape predictor variables from the field and GIS that describe the duration and time of connectivity.

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