

The Ecological and Water Quality Value of Headwater Wetlands in North Carolina
North Carolina Division of Water Quality
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Headwater wetlands are a highly important natural resource found in the highest reaches of the watershed at the head of and in association with first order intermittent and perennial stream channels. These wetland areas tend to be bowl-shaped in the piedmont and mountains while being somewhat wider and flatter in the coastal plain. These forested wetland systems grade into first order intermittent and perennial streams through braided channels or seepage areas. Headwater wetland plant communities are diverse and can vary with region and soil type. Headwater wetlands, though numerous within watersheds, are rarely if ever greater than 1 acre in size especially in the piedmont and mountain regions of North Carolina.

Water quality in North Carolina has been affected by watershed development. Urbanization, agriculture, and silviculture have decreased the quality of stormwater runoff that flows into wetlands. This can result in the increase of pollutants such as nutrients from fertilizers, pesticides, metals, oil, grease, bacteria and sediments that enter the wetland. Wetlands act as a natural filtering system for water quality by removing, reducing or transforming these pollutants. In addition to improving water quality, intact headwater wetlands can prevent stormwater from causing destructive downstream soil erosion by retaining stormwater runoff and releasing it more slowly after a heavy rain (Azous and Horner, 2001, and Ohio EPA, 2006). This natural filtering attribute is especially important for headwater wetland systems as their drainage provides the primary water source for first order streams. Therefore, maintaining the ecological integrity of these systems is necessary to protect the quality of the entire downstream watershed.

Headwater wetlands provide important habitat for macroinvertebrates and amphibians. Numerous species of macroinvertebrates such as dragonflies, midges and mayflies are known to use wetlands. A large body of research exists on the types of macroinvertebrates using streams of varying size and quality but less work has been done in the wetland field (Rader et al., 2001). NC Division of Water Quality is currently researching the types of macroinvertebrate species known to use headwater wetland areas and how water quality affects species diversity. In addition, many amphibian species are sensitive to environmental disturbances and act as indicators of the quality of their surroundings (EPA, 2002). North Carolina has 96 species of amphibians and is known for its diverse population of salamanders, boasting more than any other state in the Union at 54 species (many located in western NC) (Braswell, 2006). Deforestation and the increase of acidic conditions and pollutants such as nitrogen and heavy metals can affect these environmentally sensitive species (EPA 2002, Smith et al, 1994, Willson et al. 2002). Most amphibians spend part of their life in water and part on land or even in subterranean habitats, which consequently makes surveying especially difficult except during the yearly breeding season. Some species of amphibians can reproduce in farm ponds, lakes, ditches, puddles, or rivers, while other species have more specialized requirements needing mature forested wetland areas that have good water quality that lacks predatory fish. These conditions can occur in isolated wetlands or headwater wetlands that have an intermittent or small perennial connection to downstream locations. In North Carolina 53 species of amphibians are known to use these types of habitats during their breeding season, of which 31 species, or nearly one-third of the amphibian species in North Carolina, require these conditions solely to reproduce (Braswell, 2006). Of those 31 species, 7 are considered state threatened or state/federal special concern and 4 more are on the state watch list. Continued loss of these critical habitats in North Carolina has the potential to affect population diversity and survival of these unique and sensitive species (North Carolina Natural Heritage Program, 2006).

The Division of Water Quality (DWQ) is examining the feasibility of implementing a wetland-monitoring program for the state of North Carolina with an EPA funded grant. Headwater wetlands were chosen as the initial type of wetland to monitor due to their importance as a natural resource and location in the watershed as discussed above. This DWQ wetland study has been monitoring 23 wetland sites located in natural, agricultural, and urban landscapes in the piedmont and coastal plain areas of North Carolina for the past two years. The objective of this study is to determine the differences and similarities of the plant, amphibian and macroinvertebrate biotic communities and the soil and water quality and hydrology of these wetlands. In addition, what affects the condition of the surrounding landscape has on these wetland attributes will be assessed. A final report for the EPA will be written and information will be provided to DWQ on the feasibility and resources needed to further develop and implement a wetlands monitoring program that supports policies that meet the requirements of North Carolina's wetland regulatory programs.

At this time, all of the amphibian and soil data and part of the water quality, hydrology, and plant community data have been taken and are currently being analyzed. Macroinvertebrate surveys will be completed in April 2006. For the 2005 amphibian survey, 26 different species of amphibians were found in the wetland sites and surrounding buffers of which 9 of these species are known to require headwater wetland conditions to reproduce. Water quality samples have been taken on a quarterly basis and analyzed for metals, nutrients, organics, sediments, fecal coliform bacteria, acidity and oxygen levels. In order to assess the filtering capacity of headwater wetlands, samples have been taken in the wetland and 200 feet downstream either in the first order stream or lower drainage point in the wetland. Preliminary data of these upstream and downstream sampling points in the piedmont shows that headwater wetlands are improving water quality by significantly reducing the levels of sediment, nutrient, and heavy metal pollutants that flow into first order streams. The filtering capacity and water quality of wetlands located in urban, agricultural, and natural areas will be compared during future analyses.

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