



Seasonal Wetlands and Golf Courses

Innovative research demonstrates increasing golf course biodiversity.

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Seasonal wetlands generally hold water for only part of the year. In the Southeast, these wetlands usually fill with rains in late autumn and early winter, and often remain filled through early summer.

The golf course landscape may provide an ideal opportunity to combine golf course design objectives with conservation goals such as habitat protection and biodiversity enhancement. From a design standpoint, the incorporation of seasonal wetlands (areas that temporarily hold water) into a course layout has the potential to make a course more varied, aesthetically pleasing, and challenging. From a conservation standpoint, numerous isolated seasonal wetlands scattered across a habitat mosaic of forested and open areas on a course may create a biodiversity boon for amphibians and some reptiles.

Seasonal wetlands represent ideal habitats for many species due to the absence of predatory fish. In conjunc-

tion with permanent water hazards, seasonal wetlands of varied types create features with a variety of water-holding periods across the landscape that will be used by a diverse array of species.

THE VALUE OF SEASONAL WETLANDS

Seasonally flooded wetlands have an ecological value that is disproportionately large relative to the space they require and the time that water is present. In some coastal regions, they maintain water quality by controlling the seasonal movement and storage of rainfall. Seasonal wetlands provide essential habitat for a rich diversity of plant and aquatic invertebrate species.

Additionally, many species of semi-aquatic reptiles and amphibians use

small wetlands and surrounding uplands as linked habitats, both portions of which are vital to the organisms' survival. These isolated, *seasonal wetlands*, also known as ephemeral wetlands, are an important refuge for wildlife species, particularly in agricultural landscapes where the wetlands are the last remaining unexploited habitat. If a goal of conservation efforts is to maintain or restore the ecological value of small wetlands, then greater knowledge of seasonal wetlands and their contribution to regional biodiversity is critical.

HISTORIC WETLAND LOSS AND THE POSSIBILITIES FOR GOLF COURSES

Wetland loss in the southeastern U.S. has been of concern for many years.



Research at Frostburg State University (Maryland) investigated the viability of constructing seasonal wetlands on the golf course. The work identified amphibian species that inhabited seasonal and permanent wetlands on the golf course.

From the 1950s to the 1970s the loss of wetlands in the Southeast was greater than any other region of the country, with a net annual loss of 386,000 acres (6). On the Coastal Plain of North Carolina, 51% of all wetland acreage had been lost by 1980 (11).

In South Carolina, isolated freshwater wetlands account for more than 22% of the total wetland acreage, yet alteration and destruction of these types of wetlands also have been severe. A recent survey of the status of Carolina bays on the Coastal Plain of South Carolina found that approximately 97% have been altered or severely impacted, and fewer than 200 bays of the original thousands remain relatively unimpacted.

Seasonal wetlands are important from an ecological perspective because they retain surface water for only a portion

of a year. The length of time that a wetland holds water, the hydroperiod, has an overriding influence on the range of species that can live and reproduce in or near the wetland, especially with regard to amphibians and other semi-aquatic taxa.

Permanent lakes and ponds are at one end of a hydroperiod continuum because most water hazards on golf courses can be categorized as *permanent*. Lakes and ponds are usually inhabited by a few common non-native fish species (e.g., largemouth bass, bluegill), and, as a result, a limited number of amphibian species except bullfrogs. In general, most amphibian species are preyed upon heavily by fish and bullfrogs, and they do not fare well in permanent waters. Most *pond-breeding* amphibian species actually require seasonal wetlands for breeding and for

completing the larval stage of their life cycles.

The historic availability of seasonal wetlands probably accounts, at least in part, for the exceptionally high amphibian and reptile biodiversity of the southeastern U.S. Throughout the region, seasonal wetlands are used by large numbers of amphibian species: 16 species in a 0.40-acre Florida pond (3), more than 20 species in each of numerous wetlands in South Carolina (14,17), 19 species in each of two Tennessee ponds (13), and more than 15 species of just frogs and toads in a single Texas pond (22).

Thus, while increasingly recognized as the most valuable wetland habitat type for maintaining amphibian diversity in the Southeast, seasonal wetlands continue to disappear rapidly and remain unprotected by most wetlands regula-

tions. A concerted effort by golf courses to preserve and even create new seasonal wetlands has the potential for great conservation value.

THE GOALS OF OUR STUDY

In general, the goal of this research was to examine how amphibians use the variety of wetlands found on golf course landscapes, and compare them to amphibian use of off-course seasonal wetlands. This was accomplished through a combination of sampling on five courses and in ten off-course wetlands, surveying the literature, and analyzing prior data on seasonal wetlands. Based on the results, recommendations were developed for enhancing biodiversity on golf courses by increasing the distribution and abundance of seasonal wetlands as part of a golf course landscape.

THE MAIN PLAYERS . . . FROGS, TOADS, AND SALAMANDERS

Approximately 40 species of amphibians occur in the Central Savannah River Area (CSRA), and many of them use seasonal wetlands for breeding and larval development. Individual species vary in the times of year they breed.



Some species, particularly some salamanders, breed in the autumn, followed by other species that breed in winter, spring, and summer. We sampled wetlands on and off golf courses throughout the year to account for species differences in breeding chronology. Wetlands were sampled approximately every two months. Each sample period consisted of four days/three nights of trapping with small-meshed minnow traps, supplemented by dip-netting,

hoop-net trapping, hand collecting, and visual observations.

Sampling in off-course seasonal wetlands began in April 1999. Golf course wetland sampling at five courses was added in late summer of 1999. We compared the diversity and abundance of amphibians in permanent aquatic habitats to those of seasonal wetlands,



both among courses and between courses, and the off-course wetlands.

Sampling confirmed a well-known trend in amphibian ecology — wetlands that harbor fish populations are generally not suitable for a diversity of amphibian species. In the permanent lakes and ponds on CSRA golf courses we have found three primary amphibian species: bullfrog (*Rana catesbeiana*), green frog (*Rana clamitans*), and southern toad (*Bufo terrestris*). All lakes and ponds contain numerous predatory fish species, including species of sunfish (*Lepomis* spp.), largemouth bass (*Micropterus salmoides*), redbfin pickerel (*Esox americanus*), mosquitofish (*Gambusia affinis*), and lake chub (*Couesius plumbeus*). Additional amphibian species were found in stream and marsh areas on some courses, including the lesser siren (*Siren intermedia*), dwarf waterdog (*Necturus punctatus*), southern leopard frog (*Rana utricularia*), and mud salamander (*Pseudotriton montanus*).

The seasonal wetlands sampled off golf courses had greater numbers of amphibian species than permanent golf course wetlands. Off-course seasonal wetlands generally had 2-3 additional salamander species and 2-5 additional frog and toad species. On the two courses that have seasonal wetlands (Edgefield, S.C., and North Augusta,

S.C.), we found some of this region's pond-breeding species in our sampling of the on-course seasonal wetlands, but we did not find these species in the on-course permanent lakes. Species at the permanent golf course wetlands were the expected species, i.e., those known to be tolerant of fish and to inhabit long hydroperiod wetlands, such as bullfrogs and southern toads. At the on-course seasonal wetlands we picked up several species generally associated with shorter hydroperiod wetlands and a lack of fish, including marbled salamanders, spotted salamanders, and narrowmouth toads. At the comparison sites we found many species not captured on any golf course, including mole salamanders, ornate chorus frogs, spadefoot toads, and gopher frogs.

IMPLICATIONS OF THE RESULTS

Most golf course water hazards had a lower diversity of amphibians than



comparison seasonal wetlands (i.e., similarly sized, natural wetlands with variable hydroperiods). Consequently, we predict that incorporating more seasonal wetlands into the golf course design will increase the biodiversity of amphibians and other semi-aquatic animals. This idea cannot be tested until seasonal wetland habitats are implemented in golf course designs and the amphibian populations are monitored. However, our extensive sampling of seasonal wetlands indicates that if the wetland itself is intact, and if there is suitable adjacent terrestrial habitat, then it is likely that amphibians and other wetland species will thrive. One unknown, of course, is whether effects from chemical use on golf courses will be any different in a variable hydro-

Summary Points and Management Recommendations

- ◆ Seasonal wetlands enhance amphibian diversity on golf courses.
- ◆ Increased landscape diversity of wetlands equals higher diversity of amphibians.
- ◆ Education of the golf community on the value of seasonal wetlands is vital.
- ◆ Seasonal wetlands should be incorporated into golf courses, either in out-of-play areas or as course hazards.
- ◆ Some permanent wetlands can be converted successfully to seasonal wetlands.
- ◆ Upland habitats of amphibian species also must be conserved.

period habitat, as compared to permanent waters.

The creation of true seasonal wetlands from scratch is largely an unknown art/science. Although there is abundant information on techniques for restoring previously degraded wetlands, if the goal is to create a wetland with a variable hydroperiod that mimics a natural seasonal wetland, then little research has been conducted. Given the need for and benefit of such wetlands on a golf course landscape, studies that determine the best methods for constructing these habitats are essential.

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