

Interim Report

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Project title: Enhancing Amphibian and Reptile Biodiversity
On Golf Courses through Use of Seasonal Wetlands

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Executive Summary

"Enhancing Amphibian and Reptile Biodiversity On Golf Courses through Use of Seasonal Wetlands"

After six months of this project we have completed most of our survey of the scientific literature pertaining to the use of seasonal wetlands by amphibians and reptiles. We have also accessed an unpublished data set for 50 seasonal wetlands that describes wetland water levels, size, and pond duration over a 5-yr period; these data will be useful in planning how a variety of wetlands across a landscape might be used to promote a "hydroperiod continuum" that enhances wildlife diversity. One author (JWS) analyzed previously collected data and formulated models that describe the relationship between amphibian species richness and the length of time a wetland contains water (i.e., the hydroperiod). These models for amphibians and wetlands in our immediate geographic area will be integral to the development of more general models for other regions.

A significant portion of our project involves sampling wetlands on and off golf courses. Field sampling is time consuming and requires personnel dedicated to the sampling. Due to a delay in funding for the project, we were not able to hire someone to help with sampling until mid-May, 1999. By that date many of our control wetlands were already dry due to near drought conditions. Consequently we will not begin our field sampling on courses until December 1999. Prior to receiving funding we sampled eight control wetlands, and based on that sample period we revised our sampling protocol. One result of this change is that fewer golf courses will be sampled in the first year (five instead of 10), due to the number of wetlands on each course, the distance between courses, the need for four sample periods instead of two, and the preference that we sample during low play periods. Following course surveys and discussions with grounds personnel, we have selected four courses in the Central Savannah River Area (Houndslake Country Club, Cedar Creek Golf Course, The River Course, and The Club at Jones Creek), and we have one more course to add before early December.

Although it was not in the original proposal, we have produced two educational "products" and plan to modify these and produce others. These products stemmed from conversations with course superintendents who were eager to have materials that they could show to course members that would 1) describe our study and 2) educate about amphibians, reptiles, and wetlands. Once these are distributed at three courses, we will assess whether additional materials might be of use.

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Project background: We are at the halfway point in the first year of this 3-yr study. Unfortunately, the funding for this project was not received until May 1, 1999. Given the nature of this study (data collection at seasonal wetlands), by the time personnel were hired the opportunity for sampling during late spring/early summer had passed [this is discussed in more detail below]. Nonetheless we have made substantial progress on our first-year objectives. These objectives are:

- identify golf course wetlands and control wetlands to sample for amphibian and reptile diversity,
- obtain permission from golf course superintendents to sample course wetlands,
- compile pertinent literature that relates species habitat needs to the management of wetland hydroperiods,
- locate unpublished databases that describe natural hydroperiod variation in seasonal wetlands,
- develop a statistical model to describe species abundance in relation to wetland hydroperiod, and
- produce educational products that courses can use to "educate" their membership.

Research in Year 1:

SAMPLING WETLANDS: We selected 12 seasonal wetlands to serve as "control" sites, or baselines for comparisons to golf course wetlands. These wetlands are located in Aiken and Barnwell Counties on the Savannah River Site (SRS) in South Carolina, and are generally within 30 miles of the golf courses we will sample this year. The control wetlands cover a broad range of hydroperiod variation (i.e., very temporary ponds to nearly permanent) and landscape position (e.g., upland sandhills versus river floodplain), and should provide good comparison data to golf courses in this geographic area. Ten of the wetlands already have a substantial herpetofaunal database from previous years of research on the amphibian and reptile species that inhabit the sites.

Despite the delay in funding we sampled eight wetlands in mid-March, 1999 to assess amphibian and reptile diversity. Most of 1999 was unusually dry in our area, and consequently many sites dried prior to summer. The single sample session allowed us to work out a sampling protocol that will also be used on the golf course wetlands. The protocol is based on extensive sampling by one of the investigators (JWS), and is ideally suited for comparing amphibian assemblages among sites. In general, the sampling involves setting small ("minnow") and large ("turtle") hoop traps in all microhabitats of a wetland for four days/three nights. Captured animals are identified, and some are collected for species verification. In addition, each wetland is hand sampled using time-constrained dip-net sampling. A number of microhabitat variables are also measured. Because different species breed in wetlands at different times, and also because animals are more trappable at some life stages than others, sampling at each wetland must be conducted four times, beginning in December and continuing at approximate 2-mo intervals.

The changes in our original sampling protocol made us realize that our initial plan to sample ten golf courses during the first year was overly optimistic. The fact that each course

has numerous wetlands and that courses are many miles apart makes it logistically impossible to sample more than 5-6 courses in our area with existing personnel. Because some of the sampling (i.e., dip-netting) can be somewhat conspicuous, we have arranged with the courses to sample during times when play is lowest (generally Monday thru Thursday).

GOLF COURSE PARTICIPANTS: To date we have arranged to sample four courses in the Central Savannah River Area of South Carolina and Georgia. We plan to start sampling in mid-December, after the breeding season for many of the local amphibian species has begun. By mid-December we will have selected 1-2 additional courses.

In the Aiken, South Carolina area we will sample the Houndslake Country Club golf courses and the Cedar Creek Golf Club. Both clubs have wetlands located in the uplands; Cedar Creek in particular is in sandhills habitat. Many of our comparison wetlands are in similar habitats. Hounds Lake CC has agreed to install some small seasonal wetlands in out-of-play areas as an experiment in enhancing amphibian diversity. Houndslake has also asked us for guidance on other environmental enhancements that might be made to benefit the course.

In North Augusta, South Carolina we will sample the newly built River Course, which is adjacent to the Savannah River. The course has a wide variety of wetlands, and should make for an interesting comparison to control sites we will monitor on the Savannah River floodplain. The River Course is also eager for any information we can provide that would help them manage water levels to enhance their wetland habitats for wildlife.

In Augusta, Georgia we will sample four ponds, the streams, and a seepage area at the Jones Creek Country Club. In addition, we may have the opportunity to help them design a seasonal wetland that could be constructed as early as next year. Although Jones Creek CC is not immediately adjacent to the Savannah River, we will have similar habitats to sample at comparison wetlands.

By June/July 2000 we will have sampled the amphibian and reptile communities of wetlands at 5-6 courses in South Carolina/Georgia, along with our comparison wetlands. We hope to continue to sample at least two of these local courses during 2000-2001, as well as add 4-6 coastal courses. We have already made arrangements to sample courses on Kiawah Island, Spring Island, and Bray's Island in South Carolina.

The data analysis for this study will be relatively straightforward. We will compare diversity and abundance data from permanent aquatic habitats to data from seasonal wetlands on the same course when possible. At courses where there are no seasonal wetlands we will compare the permanent golf-course wetlands to seasonal wetland control sites on the SRS or other nearby sites.

LITERATURE COMPILATION: We believe that our literature compilation of the numerous observational, experimental, and manipulative field studies that relate amphibian "success" (persistence through successful reproduction) to wetland hydroperiod (i.e., pond duration) will be useful at a number of levels. As stated in our proposal, these data will allow us to: 1) construct regional lists of amphibians that use seasonal wetlands, 2) predict hydroperiod regimes that are most suitable for particular species, and 3) suggest wetland characteristics that are likely to enhance amphibian and reptile diversity. The primary use will be to take the information and put it in a useful management context.

We have assembled more than 100 references from scientific journals that relate amphibian and reptile habitat use to wetland hydroperiod. These references encompass all regions of the United States. We will continue to acquire more journal references, but our primary future emphasis to meet this objective will be to delve into the "gray" literature. For example, some regions of the country, such as the San Diego (CA) area, have strict regulations for protecting seasonal wetlands. A corollary of this is that these regions often require the construction of new seasonal wetlands. Little of this "how to" methodology appears in the ecological literature with which we are familiar, but this sort of information will be valuable to incorporate seasonal wetlands into golf course design.

SEASONAL WETLAND DATABASES: Our main goal for the first year of study is to acquire hydroperiod data for local seasonal wetlands. We now have access to an unpublished data set of seasonal wetland (i.e., Carolina bay) water levels for more than 50 wetlands over a 5-yr period. By working with the researchers who collected these data (Robert Lide and Rebecca Sharitz), we will be able to describe "natural" hydroperiod variation related to climate and wetland size and make suggestions for maintaining a hydroperiod continuum across a golf course landscape.

STATISTICAL MODEL: Sampling over the last two years by one of us (JWS) at 22 relatively undisturbed seasonal wetlands provided the basis for developing a model relating amphibian species abundance to wetland hydroperiod. Although we do not present the model details here, several observations by JWS are of interest. First, larval amphibian richness and total numbers in relation to hydroperiod showed a unimodal pattern and fit a quadratic model. That is, amphibian numbers increased from "short" hydroperiod wetlands to "intermediate" hydroperiod wetlands, and then decreased in "long" hydroperiod wetlands. The decrease in long hydroperiod wetlands was likely due to predation by fish. Second, the model developed by JWS showed distinct breaks in the "assemblages" of amphibians that use particular types of wetlands. Particular suites of amphibian species were found in short versus intermediate versus long hydroperiod wetlands, as well as in wetlands that had fish. This model is an important first step in the development of a more general species richness/hydroperiod model. By creating such a model specific to the Southeast, where the highest amphibian biodiversity in the U.S. occurs, simpler versions can be adapted for other regions.

EDUCATIONAL PRODUCTS: We developed two educational products thus far, and, after conversations with several course superintendents, we have plans for others. The first product is simply a handout to use when talking to course superintendents about the feasibility of sampling on their courses (see enclosed brochure). The document uses photos to outline what our study is, who is funding it, why we are conducting it (i.e., the importance of seasonal wetlands to amphibians and reptiles), and how we will sample. We cover most of the details concerning the study and wetlands in general during verbal discussions with course superintendents, but they have suggested that we modify and expand the document so that it is self-explanatory. The brochure would then be more useful to course superintendents to show to others to describe our study and what it entails.

The second product (also enclosed) is a species fact sheet that we have tailored to a "golf course" audience. Again, superintendents suggested that educational materials which present some of the basics about the ecology of amphibians and reptiles would help club

members understand our presence during sample periods, and possibly even encourage the membership to be tolerant of slight changes in the way some areas of the course could be maintained.

Research Schedule:

Sampling: We have acquired all the necessary sampling equipment and are prepared to begin sampling. The chronology of breeding for amphibians begins in autumn and early winter, with certain species breeding in particular types of wetlands into the summer months. Our sampling schedule is as follows:

November 15, 1999—Have 1-2 additional courses lined up for sampling

December 6-9, 1999—Sample Houndslake Country Club

December 9-12, 1999—Sample three controls

December 13-16, 1999—Sample the River Course and The Club at Jones Creek

December 16-19, 1999—Sample three controls

December 20-23, 1999—Sample Cedar Creek Golf Course

December 23-26—Sample three controls

December 27-30—Sample additional course

December 30-January 2—Sample three controls

This sampling schedule will be repeated in February, April, and June.

Participants: The last course for the 1st year sampling will be chosen by November 15, 1999.

Literature compilation: Our search of the scientific literature is largely completed for both amphibians and reptiles. We will have the references in End Note format by April 30, 2000. The search for pertinent references in the gray literature is ongoing. By the end of the second year we will complete this aspect of the literature search so that we will be able to make meaningful management and engineering recommendations.

Database search: We have basically completed the search for unpublished databases on hydroperiod variation in our region of the country. As the project expands in the third year to summarize recommendations for other regions, we will attempt to locate similar data for other regions.

Statistical model: Development of the statistical models relating amphibian species richness and abundance to hydroperiod is largely completed (JWS). The model developed by JWS will be used as we gather data from the golf courses and refined accordingly. A general model, at least for this area of the Southeast, that predicts species richness based on hydroperiod, will be developed by April 30, 2000.

Educational products: We will have an expanded version of our project description "handout" available by December 31, 1999. The other product (the salamander fact sheet with information on seasonal wetlands) is completed. It will be distributed to at least three courses in December 1999. We will assess the response to this fact sheet and then decide whether others would be useful for a golf audience. An additional educational product, an interactive CD, is scheduled for the third year of this project. We have experimented with the software required to produce such a CD (Macromedia's Authorware) and have ordered a copy of the

software. We believe this product, the CD, will be extremely useful to a diverse array of golf enthusiasts.

Anticipated Results:

Based on our initial surveys of wetlands on the courses we will sample, we do not expect to find many true "seasonal" wetlands. Consequently, the large number of species that use such a habitat will likely be missing. If so, then we anticipate that our results should be useful in incorporating seasonal wetlands into the design of future golf courses, or into existing courses if they choose to modify the course in small ways. We believe that even slight modifications on areas of the course that are not in play might make a big difference to the variety of species that the golf course "habitat" supports. Because local courses appear to be very supportive of our efforts, we may be able to experiment with such modifications on a small scale to assess their effectiveness.

We also believe that education will play a large role in the golf community's acceptance of changes to course appearance. While it is true that seasonal wetlands do not look like permanent ponds and lakes, such wetlands are nonetheless aesthetically appealing. If the public is informed of the value of such habitat to wildlife, these wetlands may be even more appealing. One result we expect is that, as people are told of the value of seasonal wetlands, they will actually be eager to have such habitats as part of their home course.