INVENTORY AND CLASSIFICATION OF WETLANDS AT COWPENS NATIONAL BATTLEFIELD, CHESNEE, SOUTH CAROLINA

A Report Submitted to the National Park Service

by

Thomas H. Roberts and Kenneth L. Morgan

Center for the Management, Utilization, and Protection of Water Resources

Tennessee Technological University

Cookeville, TN

December 2006

EXECUTIVE SUMMARY

During the summer of 2004, an inventory was conducted to collect baseline information on wetlands at Cowpens National Battlefield (COWP). The inventory was conducted by walking transects of varying widths until the entire park had been systematically searched.

National Wetland Inventory (NWI) maps did not indicate wetlands were present at COWP, and no other published data were available that indicated wetlands occurred inside COWP boundaries. Methods to identify areas as wetlands followed the definition and procedures outlined in the 1987 U. S. Army Corps of Engineers, Wetland Delineation Manual (WDM). When a wetland was found, data were collected regarding wetland hydrology, hydric soils, dominant plant species, location, wetland type, and estimated size. The functions and potential values of the wetland also were recorded. Functions included surface water storage, ground water discharge to streams, carbon/nutrient export, provision of wildlife habitat, and support of wetland plants. Values included cultural importance, research and scientific value, and economic value. Additionally, observations regarding the presence of exotic plant species and alterations or degradations of the wetland and the potential for restoration of degraded wetlands also were recorded.

Upon completion of the inventory, thirty-seven wetlands had been located and characterized. These wetlands totaled approximately 13.36 acres, with the average wetland size being approximately 0.36 acres. Based on the Cowardin system, all of the wetlands located were classified as palustrine, forested, deciduous wetlands that were temporarily flooded (PFO1A). Using the Hydrogeomorphic (HGM) classification system thirty-two of the sites were slope wetlands and five were depressions.

TABLE OF CONTENTS

INTRODUCTION AND BACKGROUND

Wetlands are defined as "Those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas." (U. S. Army Corps of Engineers 1987). Wetlands are characterized by the presence of "hydric" soils and are dominated by "hydrophytes" that have adaptations that enable them to persist where "upland" plants cannot. A prolonged hydrologic regime (i.e., one in which the site is flooded, ponded, or saturated for approximately two or more consecutive weeks during the growing season) is the primary factor that controls the establishment and maintenance of wetland characteristics.

This waterlogging is responsible for the fundamental difference between wetland and non-wetland areas. Specifically, the upper portion of the soil profile in wetlands becomes anoxic when microorganisms consume the available oxygen that is not replenished because of the slow rate of diffusion from the atmosphere into and through a saturated medium. This anoxic environment supports unique microbial populations that have the ability to use elements other than oxygen as terminal electron acceptors in their metabolic processes. These anaerobic microorganisms are responsible for mediating the biochemical reactions in wetlands (e.g., denitrification) that typically do not take place in environments in which oxygen is present. From a practical perspective, these reactions also result in changes in soil color (from brown to gray) because of the conversion of oxidized ferric iron to reduced ferrous iron. The presence of this distinctive color can be used in combination with an examination of the plant community and indicators of hydrology to identify wetlands and delineate the extent of their boundaries. Examination of these three factors (hydrology, soils, and vegetation) has become accepted as the basis for the process of wetland delineation as outlined in the Wetland Delineation Manual (WDM) (U. S. Army Corps of Engineers 1987).

Wetlands include a variety of landforms including marshes, swamps, bogs, fens, vernal pools, pocosins, potholes, playas, wet meadows, and others that are described in varying detail in Mitch and Gosselink (2000). These diverse types occur in different landscape positions and may have quite different hydrologic regimes. For example, wetlands commonly are found in lower landscape positions such as lake fringes and river bottoms, but also may occur on hillsides or even on topographic highs such as watershed divides. Similarly, wetlands vary from those in which surface flooding or ponding occurs regularly to those in which surface water is seldom present. Examples of those in the former category include inland and coastal marshes, and river bottom swamps that are commonly referred to as bottomland hardwoods. These types account for the majority of wetlands in the Southeast. In the latter category are wetlands such as wet meadows and seeps or "springs" where groundwater discharges to the surface. Groundwater discharge wetlands have highly variable hydroperiods with some containing water throughout the year while others are wet only following periods of significant rainfall.

WETLAND CLASSIFICATION SYSTEMS/FUNCTIONS

Because of the many inherent differences in wetlands, several classification systems have been developed over the years to place wetlands into meaningful groups for inventory, management, and other purposes. Two of the most useful are the *Classification of Wetlands and Deepwater Habitats of the United States* (Cowardin et al. 1979) and *A Hydrogeomorphic Classification for Wetlands* (HGM) (Brinson 1993). The former, normally referred to as the Cowardin system, was developed as the basis for the National Wetland Inventory (NWI) conducted by the U. S. Fish and Wildlife Service. It assigns wetlands to 1 of 5 *systems* and then to a varying number of *subsystems* and *classes* based on hydrologic regime, water chemistry, plant community, and other characteristics. The notation or codes for these various attributes are recorded on the NWI maps so users have information not only regarding the presence of wetlands, but also the characteristics of those wetlands. The Cowardin system has proved very useful for the NWI but sometimes does not take into account even major differences in landscape position, the source of hydrology for the wetland, or its hydrodynamics; all factors that influence the functions wetlands perform. Thus, its use in classifying wetlands into groups that function similarly is limited. As a result, the HGM classification system that is based on those three factors (landscape setting, source of hydrology, and hydrodynamics) was developed. In the HGM classification system, wetlands are assigned to 1 of 7 *classes*: riverine, depressional, slope, tidal fringe, lacustrine fringe, mineral soil flats, and organic soils flats. Further subdivisions into *subclasses* are based on hydrology source and hydrodynamics. A desirable feature of the HGM classification system is that inferences regarding function can be made from the classification system alone. For example, wetlands in the depression class usually will store water whereas those in the slope class typically will not. Export of carbon and nutrients typically will occur in riverine wetlands, but typically will not in either of the flats classes. Thus, simply by assigning a wetland to the appropriate HGM class or subclass, much is known about the wetland's role in the landscape.

In addition to those functions mentioned above, wetlands also may cycle nutrients, trap sediments and pollutants, and in some cases, recharge groundwater and provide base flow to streams and rivers. Almost all wetlands provide habitat for a wide variety of flora and fauna and are critical in maintaining local and regional biodiversity. Sather and Smith (1984), Marble

(1990), Mitsch and Gosselink (2000) and various HGM documents and guidebooks (e.g., Smith et al. 1995, Ainslie et al. 1999, Smith and Klimas 2002, Wilder and Roberts 2003) all provide excellent summaries of functions that wetlands perform and the values derived from them. During the past decade, consideration of wetland functions has become a routine part of the wetland regulatory process, and it is now common for functions to serve as the basis for decision making regarding issuance of permits and development of mitigation alternatives.

The HGM approach also has been used as the basis for the development of assessment "models" that identify functions performed by a specific wetland class and subclass and can be used to determine the degree to which those functions are performed. The output usually is on a 0 - 1.0 scale in which a score of 1.0 indicates the wetland performs the function to the highest degree, while a score of 0 indicates that the function is not performed at all. Such rigorous assessments may be needed to calculate potential impacts from a proposed project or to assist in the development of mitigation alternatives. Less detailed assessments where potential wetland function is ranked as high, medium, or low often are appropriate for inventory and baseline determination projects. The HGM approach has been recognized as one of the most useful tools for assessing wetland function by the major federal agencies with regulatory authority or oversight over wetlands; these include the U. S. Fish and Wildlife Service (FWS), U. S. Environmental Protection Agency (EPA), U. S. Army Corps of Engineers (COE), and the Natural Resources Conservation Service (NRCS)

RATIONALE FOR STUDY

In spite of the many functions that wetlands perform and the often significant value derived from those functions, approximately 53% of the wetlands originally present in the lower

48 states have been lost since European settlement as a direct result of human activities (Dahl 1990) and in many states, those losses are continuing (Hefner et al. 1994). Dahl (2000) reported that from 1986 to 1997, the wetland types in which the greatest losses occurred were freshwater, forested wetlands and freshwater marshes. Estimated losses in each category were 1.2 million acres.

While wetland loss continues today, our understanding of their importance has changed considerably since the mid-1800s through the 1900s when landowners were encouraged to drain, ditch, and fill wetlands (Mitsch and Gosselink 2000). State and Federal regulations have since been instituted to reduce wetland loss, and many entities at all levels of government have adopted programs to aid in wetland conservation and stewardship. The U. S. National Park Service, (NPS) which manages millions of acres in the United States, has begun an initiative to determine the extent and quality of natural resources (including wetlands) under its jurisdiction, including those at COWP.

With a general goal of improving the stewardship of wetlands at COWP, it was determined that information needed included the location and types of wetlands present and a rapid assessment of wetland functions performed by them. Such knowledge is necessary to facilitate the evaluation of future potential impacts on wetlands. Further, if unavoidable impacts do occur, this information would be useful in the determination of appropriate compensation as required by the U. S. Army Corps of Engineers under Section 404 of the Clean Water Act (CWA), State requirements under Section 401 of the CWA, and requirements by the NPS for compliance with Directors Order #77-1.

OBJECTIVES

The primary objectives of this inventory and assessment included: (1) identify and delineate all wetlands subject to jurisdiction under Sections 404 and 401 of the CWA, and all wetlands subject to National Park Service procedures for implementing Director's order #77-1, (2) produce a database that includes the location and description of all wetlands present including their Cowardin and HGM classifications, and (3) assess the biotic and abiotic functions and values of these wetlands.

METHODS

Prior to conducting the field investigation at COWP, data that might provide information regarding wetlands there were examined. The principal one was the NWI map for the Chesnee quad. In spite of their usefulness in inventory studies, NWI maps have limitations. For example, the NWI is more accurate in open landscapes in which wetland "signatures" such as open water can be seen and identified from remotely sensed imagery. Wetlands in which saturation, as opposed to ponding or flooding, is the primary source of hydrology often will not be detected by the NWI. Wetland size also is a factor that determines the likelihood of wetlands being identified on the NWI maps. Although there is no absolute minimum size necessary to be included on an NWI map, commonly, wetlands smaller than one acre will be missed.

Following this "office" investigation, the area within COWP boundaries (Figure 1) was systematically searched on foot to identify areas that potentially might meet the criteria for being considered a wetland according to the WDM (U. S. Army Corps of Engineers 1987). Detailed topographic maps that included the network of roads and trails within COWP along with a Global Positioning System (GPS) receiver were used as navigation aids in the field.

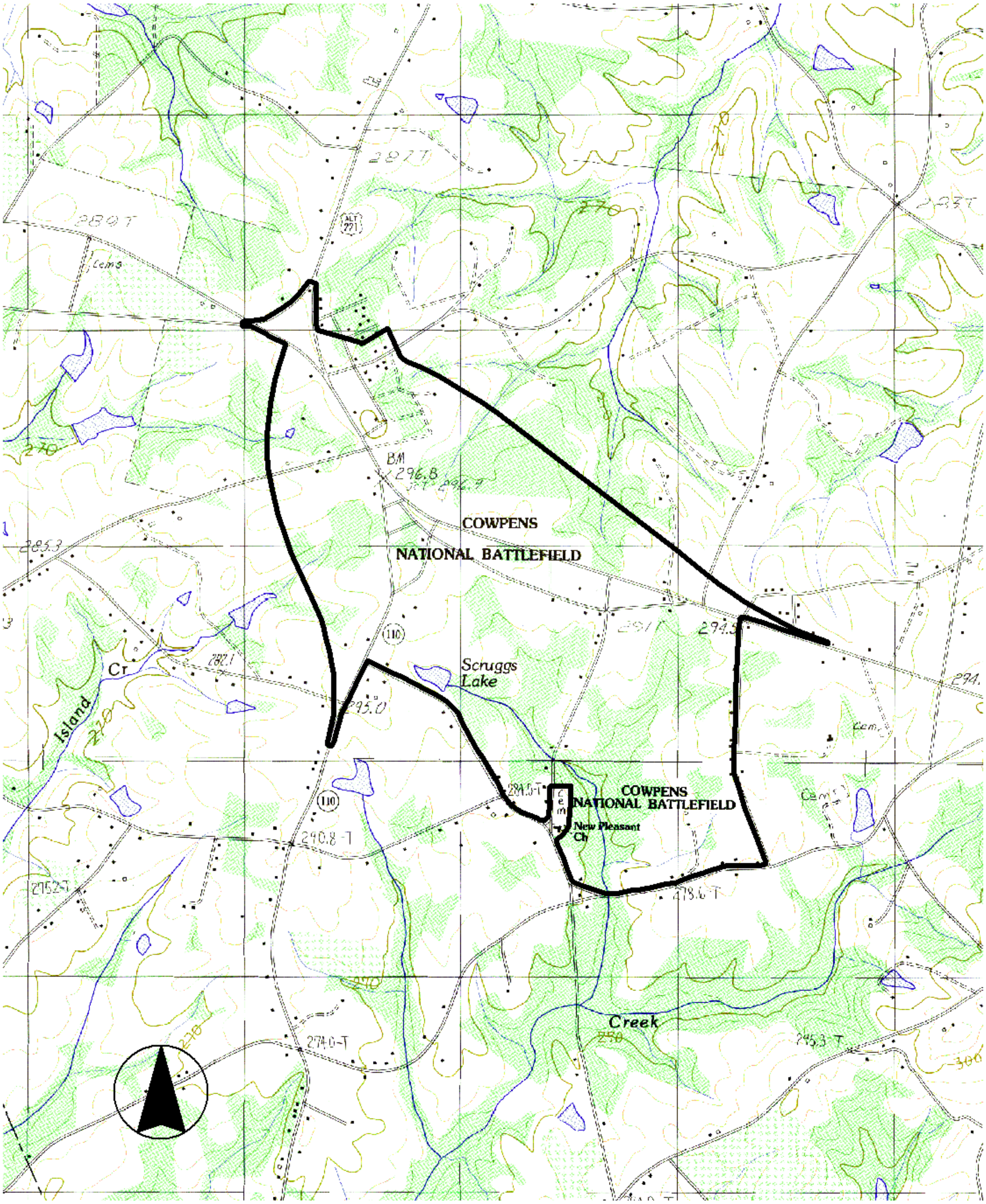

Figure 1. Location of Cowpens National Battlefield

The primary indicators of potential wetlands were the presence of surface water, an obvious change in vegetation cover, and the presence of plant species known to be occur primarily in wetlands (e.g., sedges (*Carex* spp.), royal fern (*Osmunda regalis*), giant cane (*Arundinaria gigantea*), and alder (*Alnus serrulata*), etc.

Once such areas were identified, procedures prescribed by the WDM (U. S. Army Corps of Engineers 1987) were employed to: 1) determine if the area was a wetland, and if so, 2) delineate the boundary of the wetland. This latter procedure involves documenting the dominant plant species and carefully examining potential indicators of soils and hydrology. The dominant plant species in all strata (i.e., tree, shrub, ground, and woody vine) were identified to species if possible using Radford et al. (1968) and Godfrey and Wooten (1979) and their indicator status (obligate, facultative wetland, etc.) was determined from Reed (1988) (Table 1). If more than 50% of the dominant species were facultative, facultative wetland, or obligate, then the site was considered dominated by hydrophytic vegetation. Soils were exposed either by digging a series of pits with a sharpshooter shovel, or extracting soil samples with a soil probe to a depth of approximately 18 inches. Color of the soil matrix (the primary color) and of the mottles (splotches of color within the matrix, if present) was described using standard Munsell color notation. Indicators of hydric soil listed in the WDM (U. S. Army Corps of Engineers 1987) were noted. The primary one used in this study was the presence of low matrix chromas (i.e., those < 2). This indicator develops as a result of prolonged reduction; thus it can be inferred that the site is flooded, ponded, or saturated for long periods during the growing season.

A determination of whether the site had a hydroperiod prolonged enough to be considered to have "wetland hydrology" was made based on field indicators described in the WDM (U. S. Army Corps of Engineers 1987). The primary indicators used in this study were the presence of

Table 1. Wetland indicator definitions according to Reed (1988) used to determine the indicator status of plant species recorded in wetlands at Cowpens National Battlefield.

Category	Abbreviation	Definition
Obligate Wetland	OBL	Occur almost always (estimated probability >99%) in wetlands under natural conditions
Facultative Wetland	FACW	Usually occur in wetlands (estimated probability 67-99%), but occasionally found in non-wetlands
Facultative	FAC	Equally likely to occur in wetlands or non-wetlands (estimated probability 33-66%)
Facultative Upland	FACU	Usually occur in non-wetlands (estimated probability 67-99%), but occasionally found in wetlands
Upland	UPL	Occur almost always (estimated probability >99%) in non-wetlands under natural conditions

standing water (i.e., inundation), soil saturation within 12 inches of the surface, and moss/lichen lines on trees. Oxidized rhizospheres that indicate prolonged saturation were found at some sites. Additional information regarding each of the indicators/parameters on the data form can be found in the WDM (U. S. Army Corps of Engineers 1987).

Once an area was determined to be a wetland, its boundaries were delineated based on the presence or absence of each of the three parameters (soils, hydrology, and vegetation). A flag or other marker was placed in the ground to indicate the point at which one or more of the parameters ceased to be present, thus denoting the edge of the wetland. Wetland size was estimated by approximating geometric figures (square, rectangle, circle, etc.) and using a rangefinder to determine distances needed for the appropriate calculations.

Universal Transverse Mercator (UTM) coordinates for each wetland were determined using a handheld GPS receiver. Coordinates were stored in the receiver and recorded on field data sheets. After each field sampling period, the UTM coordinates were transferred to a Geographic Information System (GIS) and graphically represented using ArcView© software. By continuously updating the GIS database (and maps), areas of COWP that still needed to be searched could be identified.

Each wetland was assigned to the most detailed Cowardin and HGM classification possible. The Cowardin classification uses an alphanumeric code to denote characteristics of the wetland. The first character is an upper case letter that represents the *system*. All the wetlands at COWP fall within the palustrine system that is denoted by the letter P on NWI maps. The palustrine system includes most interior freshwater wetlands not associated with large open water bodies. Next is a set of two upper case letters that represent the *class*. For the wetlands at COWP, the potential classes included: EM - emergent wetland (dominated by non-wood vegetation), SS - scrub/shrub (dominated by woody vegetation < 20 feet tall and < 3 inches in diameter), and FO - forested (dominated by woody vegetation > 20 feet tall and 3 inches or greater in diameter). The next character is a number representing the *subclass*. These modifiers provide more detail regarding the plant community and they vary with the class. In forested and scrub/shrub wetlands, the most common modifiers at COWP was "1" - broad leaved deciduous (those plants that lose their leaves in winter). In emergent wetlands, the two potential modifiers included "1" - persistent (species that remain standing until the next growing season) and "2" - non-persistent (species that do not remain standing until the next growing season). The next character is an upper case letter that represents the water regime (i.e., the hydroperiod). Examples of potential modifiers at COWP included: A - temporarily flooded (typically floods for < 2 weeks during the growing season), B - saturated (substrate saturated for most of growing season, but rarely floods), and C - seasonally flooded (typically floods for two or more weeks during the growing season). As an example, a wetland assigned a code of PSS1A is a freshwater wetland not associated with a lake or open water body that is dominated by deciduous, scrub/shrub vegetation and is inundated for less than two weeks during the growing season. A complete explanation of these notations can be found in Cowardin et al. (1979).

In the HGM system, the wetland classes occurring at COWP were depression and slope. Further designations are not as structured as in Cowardin and vary among classes. Examples of factors that potentially could be used to assign wetlands to the more-detailed subclass level include: stream gradient (high or low) for riverine wetlands, landscape form (open or closed contours) for depressions, and primary source of hydrology (ground or surface water) for depressions. Species of vegetation usually is not considered formally when determining class and subclass within the HGM system.

The initial list of potential functions/values (biotic, hydrologic, research/scientific, cultural, and economic) was reviewed to determine their applicability to the wetland types most likely to occur at COWP. Further, a review of HGM guidebooks, the scientific literature, and previous inventory and assessment work completed in the region was conducted to identify the physical, chemical, and biological characteristics of the wetlands responsible for the performance of the function(s). Based on this preliminary work, eight specific functions/values believed to be the most relevant at COWP were selected for evaluation. These included: surface water storage, groundwater discharge to streams, carbon/nutrient export, provide wildlife habitat, support wetland plants, cultural value, research/scientific value, and economic value. These functions/values along with a section in which ratings could be recorded were included on the field data form.

The functions/values of each wetland identified at COWP were evaluated by visually examining the characteristics of wetlands likely to be related directly to one or more functions/values. The following references provided background regarding these characteristics and recommendations on how they can be estimated: Mueller-Dombois and Ellenberg (1974) and Hays et al. (1981) for plant and habitat-related parameters; Brady and Weil (1999) for soil and soil-related parameters; and Ponce (1989) for hydrologic parameters. Examples of characteristics presumed to be related to the capacity of the wetlands to perform one or more functions include: species composition of the vegetation in the overstory, midstory, and understory layers, diameter at breast height (DBH) of the overstory and midstory trees, density of saplings and shrubs, size and density of logs and snags, percent cover of understory vegetation, and percent cover of litter. Non-vegetation characteristics included hydrology source (i.e., flooding, ponding, or saturation), timing and duration of inundation or saturation, depth to the seasonal high water table, landscape position (i.e., HGM classification), and soil characteristics (i.e., color, depth to redoximorphic features, texture, presence of confining layers, etc.). Nominal ratings of high, medium, or low were used for three functions; high and low only for two functions; and yes or no for the three "values." The following sections provide a description of each function/value and an overview of the characteristics and conditions used to derive the ratings. More detail regarding the logic used to assign ratings to various wetland functions can be found in Ainslie et al. (1999), Smith and Klimas (2002), and Wilder and Roberts (2003). Wetland size is an obvious factor related to all functions or values. In many instances larger wetlands provide increased function and value over that produced by smaller wetlands. Size however is not considered directly in the HGM process. If desired, users can incorporate size into the comparison when two or more wetlands are being assessed.

Surface Water Storage

This function addresses the capacity of a wetland to store water during periods of rainfall and runoff**.** It is performed by wetlands in both the depression and riverine HGM classes. Many benefits related to flood attenuation, reduction of flood damage, and provision of wildlife habitat, occur as a result of wetlands performing this function. For example, storage of water in wetlands can reduce the velocity of the floodwave, resulting in a decrease in the peak discharge downstream. Standing surface water also provides a source of water for various wildlife species especially amphibians that require it for reproduction. Similarly, this reduction in velocity can have a dramatic effect in reducing damage from erosive forces.

Wetlands at COWP were assigned a rating of either high or low for this function based on the HGM classification of the wetland type. Depressions occur in both upland and floodplain locations and vary greatly in size. Regardless of their location or size, depressions store water so they were assigned a rating of high for this function. Riverine wetlands (i.e., those on floodplains) adjacent to mid-and low-gradient streams or rivers also store water, so those in this landscape position also scored high. Other types of wetlands do not store surface water and were assigned a rating of low or not applicable (N/A) for this function.

Groundwater Discharge to Streams

This function addresses the capacity of a wetland to retain and convey subsurface water to an adjacent stream or river; it is performed most commonly by wetlands in the HGM riverine and slope HGM classes. Subsurface water stored in or moving through the wetland will be released more slowly than would surface flow. This slow release is important in maintaining water levels in the channel during periods of low rainfall, that in turn is important in developing and maintaining habitat structure and biotic diversity in stream or river systems.

Wetlands at COWP were assigned a rating of high or low for this function based on HGM classification and landscape position. Only riverine and slope wetlands adjacent to a stream or river have the opportunity to facilitate the slow release of water to maintain baseflow; those that met this condition received a score of high. Conversely, wetlands not adjacent to a stream or river were assigned a score of low or not applicable (N/A) for this function.

Carbon/Nutrient Export

This function addresses the capacity of a wetland to export dissolved and particulate organic carbon and other nutrients present in the wetland to down-gradient systems. Mechanisms include leaching and flushing of litter by overland flows. It is performed most commonly, by wetlands in the riverine and slope HGM classes. Many benefits accrue from the performance of this function. Material exported to downstream systems is vital for supporting aquatic food webs and numerous biogeochemical processes. Dissolved organic carbon is a significant source of energy for the microorganisms that form the base of detrital food webs, while particulate carbon is used to support invertebrate shredders within the wetland itself.

Wetlands at COWP were assigned a rating of high, medium, or low for this function based on HGM classification, landscape position, and condition of the plant community. First, only riverine and slope wetlands adjacent to a conveyance, stream or river have the opportunity to export significant amounts of carbon, so these conditions had to be met before a score could be assigned. Wetlands in other HGM classes that were not adjacent to a stream or river were assigned a score of low or N/A for this function. Second, only wetlands with a well-developed plant community have the potential to produce substantial amounts of organic carbon and other nutrients. Assuming wetlands at COWP were forested historically, only wetlands in which all vegetation strata (understory, midstory, and overstory) were present received a high score for this function. Wetlands with two strata received a score of medium, while those with only one stratum received a score of low. These conditions were determined onsite, but can be approximated by the Cowardin classification. In most cases palustrine forested (PFO) wetlands are comprised of three strata, palustrine scrub/shrub (PSS) wetlands of two strata, and palustrine emergent (PEM) wetlands of only one stratum.

Provide Wildlife Habitat

This function addresses the capacity of the wetland to provide habitat for wildlife either periodically or year around. This function is somewhat unique in that wetlands in all HGM classes support various species of wildlife. The focus of this assessment was on amphibians, a group of organisms that is dependent on wetlands for completing their life cycle in that generally they must lay their eggs in water or saturated soils. Amphibians have experienced worldwide population declines, thus they are ideal for serving as the emphasis of this function.

Wetlands were assigned a rating of high, medium, or low for this function based on their hydrologic regime. Only wetlands with prolonged hydroperiods and ones that contained areas of standing water for extended periods (usually two or more weeks) have the potential to provide breeding habitat for amphibians, so only these wetlands could receive a high score for this function. Such wetlands often are referred to as vernal pools and typically belong to the HGM depression class; although, wetlands in other classes may contain depressions within their boundaries. Wetlands in which only short-term ponding occurs were assigned a score of medium. These mostly could be characterized as micro-depressions. Wetlands in which only soil saturation occurred were assigned a score of low for this function.

Support Wetland Plants

This function addresses the capacity of a wetland to support a plant community comprised primarily of species and age classes associated with relatively little disturbance. In this study, the emphasis was placed on species found only or primarily in wetlands (i.e., the obligate and facultative wetland groups described by Reed (1988)). In addition to the inherent value of the plants themselves, the plant community in most instances is one of the major factors upon which the animal community depends. Further, the plant community is the ultimate source of primary production and as such essentially drives many of the other functions such as on-site cycling of nutrients and production of material for export to other systems.

Wetlands were assigned a score for this function based on the uniqueness of the plant community present. Wetlands that were dominated by unique species, particularly those in the obligate category or those wetlands containing a rare, threatened, or endangered plant species were assigned a score of high. Wetlands that were dominated by species in the facultative wetland category were assigned a score of medium. Wetlands dominated by species in the facultative category were assigned a score of low. Sites in which exotic species were dominants received a lesser designation than had exotics not dominated the site.

Cultural Values

Cultural values include a broad array of concepts ranging from aesthetics to archeological significance. The values differ somewhat from those derived from the above functions, but are extremely important at a facility such as COWP where consideration for the experiences of the visiting public are a high priority.

Wetlands at COWP were assigned either a "yes" or "no" (i.e., either having or not having value) for this category. Factors that were considered were uniqueness, size (the larger the better), evidence of historical use by humans, and proximity to trails and roads (important consideration for environmental education). It could be argued that all wetlands have cultural significance in the form of aesthetics and potential for environmental education; but, unless a wetland "stood out" for one or more of the above reasons, it was given a rating of "no." As an example, wetlands smaller than average size, that had no apparent evidence of past human activity and were not readily accessible by the public, were not considered to have cultural significance. Reasons for rating wetlands as having cultural significance were noted on the field forms. Nothing was noted for wetlands judged to lack cultural significance.

Research/Scientific Value

Research/scientific values include a broad array of concepts ranging from supporting unique species to serving as "reference" sites to promote a better understanding of ecosystems function and how they may be degraded. As with cultural considerations, these values differ somewhat from those derived from the above ecological functions.

Wetlands at COWP were assigned either a "yes" or "no" (i.e., either having or not having value) for this category. Factors that were considered included uniqueness, size, degree of disturbance, and presence of species of high interest. It could be argued that all wetlands have research/scientific value; but, unless a wetland "stood out" for one or more of the above reasons, it was given a rating of "no." Reasons for rating wetlands as having research/scientific value were noted on the field forms. Nothing was noted for wetlands judged to have no research/scientific potential.

Economic Values

Economic values may be derived from resources produced by or within a wetland or may be due to some function that the wetland performs. Examples of the former include timber or fisheries production. Examples of the latter include the value of a wetland for reducing flooding downstream because of its ability to store water. Some wetlands are unique or otherwise of sufficient interest to serve as an attraction for park visitors.

Wetlands at COWP were assigned either a "yes" or "no" (i.e., either having or not having value) for this category. The two factors that were considered were the ability of the wetland to serve as a significant attraction to COWP visitors (i.e., increase tourism) and the value of the wetland for reducing flood damage. Given that COWP is a NPS facility, values associated with timber and commercial exploitation of wildlife and other natural resources were not considered. Reasons for rating wetlands as having economic value were noted on the field forms. Nothing was noted for wetlands judged to have no economic value.

RESULTS

The preliminary investigation for wetlands using the NWI database yielded little information. Although wetlands were shown in the vicinity of COWP, none were identified within COWP boundaries. Thus, based solely on this source, it seemed likely that COWP contained few if any wetlands.

The field investigation revealed however, that numerous wetlands did occur at COWP, and that the limitations of the NWI mentioned previously simply had not permitted them to be identified; likely because of small size and short hydroperiods. Thirty-seven wetlands totaling 13.36 acres were located within the COWP boundaries (Figure 2). The average wetland size was approximately 0.36 acres with the largest being approximately 2.7 acres and the smallest 0.01 acres. Most supported both woody and herbaceous vegetation. Common species included red maple (*Acer rubrum*), sweetgum (*Liquidambar styraciflua*), and various species of sedges, and ferns.

Within the Cowardin system, all wetlands were assigned to the PFO subclass (n = 37). Specifically, all wetlands (n = 37) were further classified as PFO1A, forested wetlands that are temporarily flooded.   Within the HGM system, thirty-two were classified as slope wetlands and were associated with stream drainages. The primary type of hydrology, even in those adjacent to

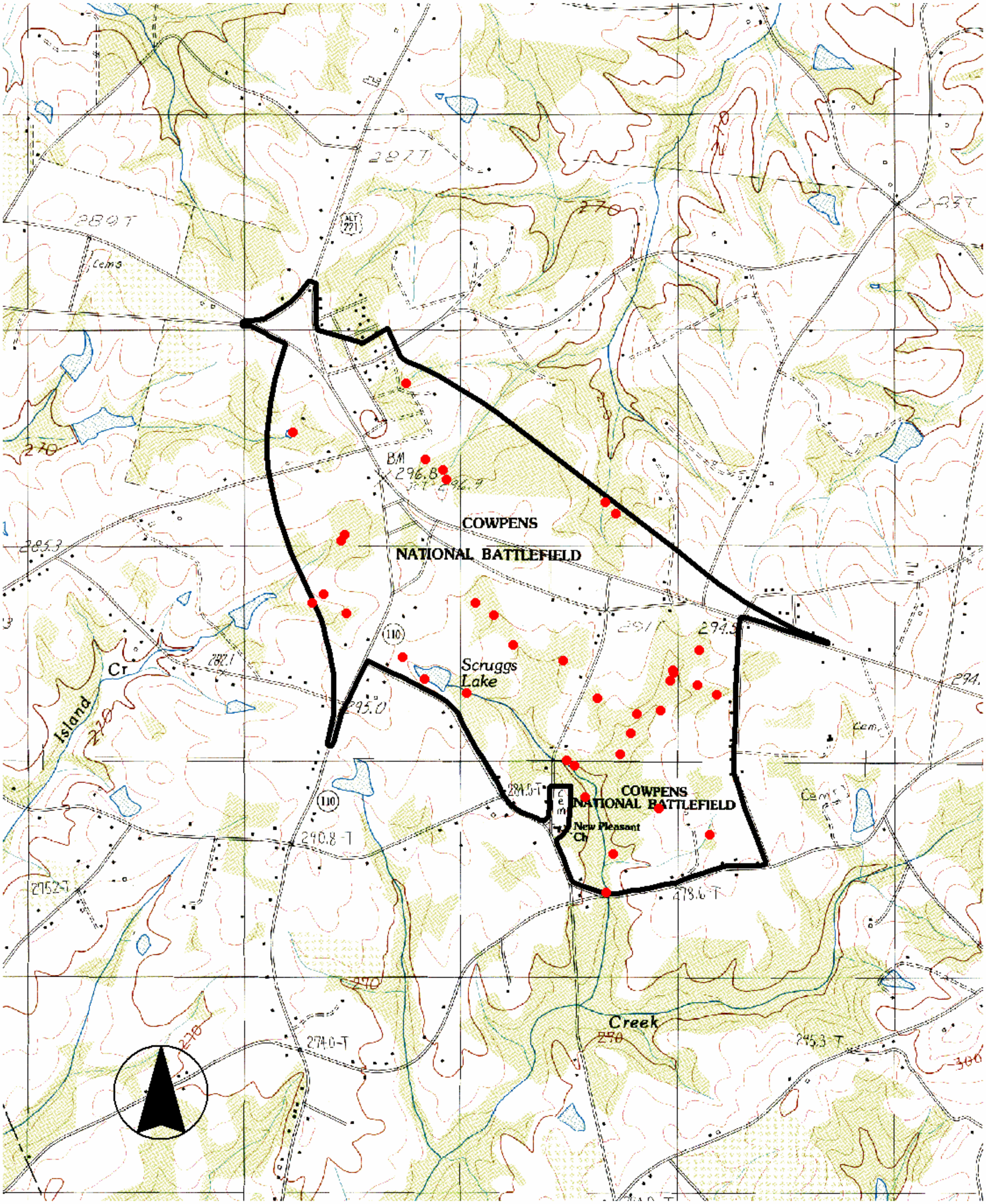

Figure 2. Wetland locations at Cowpens National Battlefield

streams, was groundwater discharge. Overbank flooding did not appear to be the primary source of hydrology for any wetland at COWP. The remaining five wetlands were classified as depressions, with the primary hydrology sources being precipitation and overland flow. Photographs of each wetland are found in Appendix A.

The primary functions performed by the majority of wetlands at COWP were to maintain base flow and export carbon and nutrients to streams and rivers. These processes are critical for maintaining water levels and food webs necessary to support vertebrate and invertebrate organisms associated with such systems. Several wetlands ponded water long enough to be utilized by amphibians for breeding habitat (e.g., CP15). Although no threatened or endangered animals or plants were confirmed, *Hexastylus naniflora* has been documented at COWP. This species is best identified in flower; however, the wetland inventory was conducted during a time when the species was not flowering, and identification of this species was difficult. However, sites at which the genus was present were noted (e.g., CP10), and may aid in future surveys for this species. Some wetlands also supported populations of obligate plant species seldom found in other habitats (e.g., CP15 and CP21). In landscapes where surface water is not plentiful, small wetlands and headwater streams are the only habitats suitable for many such species. Although some wetlands at COWP did store minor amounts of surface water, overall, this was not considered a major function. None of the wetlands had the capability to store enough water to reduce downstream flooding; and at COWP (as in most landscapes), it is the cumulative storage of water within all the wetlands that is significant. Several wetlands were located adjacent to trails and have interpretive and educational potential (e.g., CP1 and CP10). Several of the wetlands have potential as research areas and as reference sites (e.g.CP17). The original forest community at COWP has been altered and as such, none of the sites are "pristine."

The hydrology and soils of most however, have not been altered substantially; thus, they are examples of wetlands in generally good condition. They should be valuable as standards of comparison in model development projects (e.g., HGM guidebooks) and examples for the restoration of more severely degraded wetlands, especially those on private lands.

RECOMMENDATIONS FOR FUTURE RESEARCH

Small, isolated wetlands have heretofore received little attention by researchers and managers, thus, wetlands at COWP should be investigated further. Though not common, we observed several wetlands holding water late in the growing season and obviously were used as breeding habitat by amphibians. Because of the nature of our survey, there was not time to document use by other vertebrate groups. Because wetlands at COWP exist as unique patches within a mostly upland landscape, their value as water sources for other groups of wildlife should be investigated. This could be accomplished by live-trapping, track counts, or use of remotely-operated cameras.

It is possible that some wetlands at COWP contain rare plants or animals. This inventory will facilitate searches by botanists, herpetologists, and other researchers. If rare species are found, it would be useful to determine the role these wetlands play in maintaining their populations. Further, genetic makeup of these populations would be of interest to scientists as part of recent endeavors to understand metapopulation dynamics.

Fire historically had a significant influence on community composition of eastern forests including COWP, and decades of fire suppression doubtless resulted in changes to the forest communities. The return to a more frequent fire regime in recent years provides a unique opportunity for investigators to examine the role of fire and its influence on small wetland ecosystems at the park.

CONCLUSIONS

This study revealed that COWP contained numerous wetlands that had not been indicated by the NWI. Most were small and were driven hydrologically by groundwater discharge. Flooding seldom occurs in these wetlands, but the soil may remain saturated for extended periods. Many supported plants found primarily in wetland habitats, and a few supported breeding populations of amphibians. A common critical function performed by many of the wetlands likely was to maintain stable stream levels by storing and slowly releasing water. Many also exported material such as particulate and dissolved organic carbon to downstream systems. Some had cultural significance and the potential to be used in an environmental education program. Additionally, several could serve as reference sites for scientific studies given that they have not been as severely impacted as most wetlands on private lands.

ACKNOWLEDGEMENTS

We wish to thank Dan Twyman for his assistance in the field, and Jerald Moore for developing the GIS database. Pat Ruff and other COWP staff, as well as Shepard McAninch (Kings Mountain National Battlefield) provided us with valuable assistance on locating potential wetlands and made arrangements for access to all portions of the Park. We also wish to thank Teresa Liebfreid and the Cumberland Piedmont Network and the Water Center at Tennessee Tech University for providing support and administering the project.

LITERATURE CITED

Ainslie, W. G., Smith, R. D., Pruitt, B., Roberts, T. H., Sparks, E. J., West, L., Godshalk, G., and Miller, M. 1999. A regional guidebook for assessing the functions of low gradient, riverine wetlands in western Kentucky. Technical Report WRP-DE-17. U. S. Army Engineer Waterways Experiment Station. Vicksburg, MS.

Brady, N. C., and R. R. Weil. 1999. The nature and properties of soils 12th ed. Prentice Hall. Upper Saddle River, NJ.

Brinson, M. 1993. A hydrogeomorphic classification for wetlands. Technical Report WRP-DE-4. U. S. Army Engineer Waterways Experiment Station. Vicksburg, MS.

Cowardin, L. M., V. Carter, F. C. Golet, and L. T. LaRoe. 1979. Classification of wetlands and deepwater habitats of the United States. FWS/OBS-79/31. U. S. Fish and Wildlife Service. Washington, DC.

Dahl, T. E. 1990. Wetlands losses in the United States 1780's to 1980's. U. S. Fish and Wildlife Service. Washington, DC.

Dahl, T. E. 2000. Status and trends of wetlands in the coterminous United States 1986 to 1997. U. S. Fish and Wildlife Service. Washington, DC.

Godfrey, R. K., and J. W. Wooten. 1979. Aquatic and wetland plants of southeastern United States, monocotyledons. University of Georgia Press. Athens, GA.

Hefner, J. M., B. O. Wilen, T. E. Dahl., and W. E. Frayer. 1994. Southeast wetlands status and trends, mid-1970's to mid-1980's. U. S. Fish and Wildlife Service; U. S. Environmental Protection Agency. Washington, DC.

Hays, R., Summers, C., and Seitz, W. 1981. Estimating wildlife habitat variables. FWS/OBS-81/47. U. S. Fish and Wildlife Service. Washington, DC.

Marble, A. D. 1990. A guide to wetland functional design. Report No. FHWA-IP-90-010. Federal Highway Administration. McLean, VA.

Mitsch, W. J., and J. G. Gosselink. 2000. Wetlands, third edition. John Wiley and Sons, Inc. New York, NY.

Mueller-Dombois, D., and H. Ellenburg. 1974. Aims and methods of vegetation ecology. John Wiley and Sons. New York, NY.

Ponce, V. 1989. Engineering hydrology, principles and practices. Prentice Hall. Englewood Cliffs, NJ.

Radford, A. E., H. E. Ahles, and C. R. Bell. 1968. Manual of the vascular flora of the Carolinas. The University of North Carolina Press. Chapel Hill, NC.

Reed, P. B. 1998. National list of plant species that occur in wetlands: 1988 national summary. Biological Report 88 (24). U. S. Fish and Wildlife Service. St. Petersburg, FL.

Sather, J. H., and R. D. Smith. 1984. An overview of major wetland functions and values. FWS/OBS-84/18. U. S. Fish and Wildlife Service. Washington, DC.

Smith, R. D., A. Ammann, C. Bartoldus, and M. M. Brinson. 1995. An approach for assessing wetland functions using hydrogeomorphic classification, reference wetlands, and functional indices. Technical Report WRP-DE-9. U. S. Army Corps of Engineers Waterways Experiment Station. Vicksburg, MS.

Smith, R. D., and C. V. Klimas. 2002. A regional guidebook for applying the hydrogeomorphic approach to assessing wetland functions of selected regional wetland subclasses, Yazoo

Basin, Lower Mississippi River Alluvial Valley. ERDC/EL TR-02-4. U. S. Army Engineer Research and Development Center. Vicksburg, MS.

U. S. Army Corps of Engineers. 1987. Corps of Engineers wetlands delineation manual. WRP Technical Note Y-87-1. U. S. Army Engineers Waterways Experiment Station. Vicksburg, MS.

Wilder T. C. and T. H. Roberts. 2003. A regional guidebook for assessing the functions of low-gradient riverine wetlands in western Tennessee. U. S. Army Corps of Engineers Waterways Experiment Station. Vicksburg, MS (in press).

APPENDIX A

Wetland photographs and selected data

APPENDIX B

Database Table

APPENDIX C

List of plant species and indicator status

APPENDIX D

Data Forms