Accuracy Assessment: Chickamauga and Chattanooga National Military Park

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Executive Summary

This report presents an accuracy assessment of the digital vegetation map of Chickamauga and Chattanooga National Military Park (CHCH). Vegetation at CHCH was mapped by The University of Georgia Center for Remote Sensing and Mapping Science (CRMS) (Jordan and Madden 2008) with ecological consultation assistance from NatureServe. The mapping was conducted as part of the National Park Service Vegetation Mapping Program.

Our team assessed the map accuracy by comparing the mapped vegetation type to the field verified vegetation type (the field "call") at randomized evaluation points. We chose the evaluation points prior to field work so as to represent the full range of map classes in the park in a statistically valid manner. We evaluated a total of 519 accuracy assessment points and calculated accuracy for each individual map class as well as an overall accuracy for all map classes combined.

It is important to point out that the accuracy assessment process is not meant exclusively to judge the performance of the mapper or the ecologists on the project since error can be created at many points throughout the vegetation classification and mapping process. Sources of error for the mapping project include not just "remote sensing error" but also "ecologist error" caused by poor interpretation of the vegetation community concepts, "field worker error" caused by mistakes made by fieldworkers while collecting the data (including misreading or misinterpretation of the key), and temporal error when conditions on the ground change between the mapping and assessment processes. Many errors are also caused by the constraints imposed by current technology: even the best photointerpreters cannot distinguish between species with very similar leaf shape and function, such as different species of pines. It is not possible to tease apart which of these errors is causing accuracy issues without more research. *The accuracy assessment, therefore, should be used more as a tool to discern usability of map classes rather than a way to judge the performance of the mapmakers or ecologists.*

In an attempt to provide the most useful information possible to the National Park Service, the University of Georgia (UGA) team has made a strong effort to pull out the highest level of detail possible when mapping vegetation of parks. As a consequence, assessment of the finished project requires a two step approach: assessing the overall accuracy of the finest scale map produced and then combining the most "confused" map classes and determining the accuracy of the coarser scale but higher accuracy map. In this way, we are able to report our best approximation of how accurate each individual map class is and also suggest a way to combine certain map classes to produce a more reliable map at a coarser scale.

For CHCH, the overall accuracy of the final map, which includes six grouped map classes, is 77.5%, with a kappa statistic of 0.724 (72.4%). This version of the map is the most appropriate for the standard user; what it misses in fine-scale detail, it makes up for in the relatively high level of accuracy of map classes. Vegetation associations displayed as grouped map classes on the coarse-scale map include:

a). Southern Limestone Glade Margin Shrubland (CEGL003938), Highland Rim Semi-natural Red-cedar - Oak Forest (CEGL004731) and Red-cedar Successional Forest

(CEGL007124) – these are all Eastern red- cedar dominated shrublands or forests with varying degrees of natural integrity.

b). Piedmont / Ridge and Valley Small Stream Sweetgum - Tuliptree Forest (CEGL004418), Box-elder Floodplain Forest (CEGL005033), Successional Tuliptree Bottomland Forest (CEGL007184), Interior Mid- to Late-Successional Sweetgum - Oak Forest (CEGL007217), Successional Tuliptree Forest (Circumneutral Type) (CEGL007220), Successional Sweetgum Floodplain Forest (CEGL007330), Sycamore - Silver Maple Calcareous Floodplain Forest (CEGL007334), Rich Levee Mixed Hardwood Bottomland Forest (CEGL008429), and Mid- to Late-Successional Loblolly Pine - Sweetgum Forest (CEGL008462) – these are all bottomland or lower slope forest types, many with degraded character, and some are temporarily flooded. A somewhat heterogeneous grouping but all occupy the drainages and lower slopes of the mapping units.

c). Virginia Pine Plantation (CEGL004730) and Interior Mid- to Late-Successional Loblolly Forest (CEGL007105) – both pine dominated forests with generally low natural integrity.

d). Appalachian Sugar Maple - Chinquapin Oak Limestone Forest (CEGL006017), Interior Low Plateau Chinquapin Oak - Mixed Oak Forest (CEGL007699) and Interior Plateau Chinquapin Oak - Shumard Oak Forest (CEGL007808) – these are all forests occurring on limestone and dominated or co-dominated by *Quercus muehlenbergii*.

e). Dry-Mesic Southern Appalachian White Oak - Hickory Forest (CEGL007231), Highland Rim White Oak - Tuliptree Mesic Lower Slope Forest (CEGL007709) and White Oak - Post Oak Subcalcareous Forest (CEGL008443) – these are all white oak dominated forests that occur in mesic to dry-mesic situations, usually on lower slopes and more sheltered situations.

f). Interior Low Plateau Chestnut Oak - Mixed Oak Forest (CEGL007700), Cumberland Plateau Dry-Mesic White Oak Forest (CEGL008430) and Xeric Ridgetop Chestnut Oak Forest (CEGL008431) – these are all chestnut oak dominated or co-dominated dry-mesic to xeric forests of middle slopes and upper ridgetops.

The accuracy assessment for this version of the map considered points as a match if the vegetation observed on the ground matched any of the dominant, secondary, or tertiary vegetation types attributed to the map by the mapmaking team.

The strictest analysis of the data (before any combining of map classes of ecological communities occurred and considering a point a match only if the vegetation observed on the ground matched the dominant vegetation type attributed by the mappers) showed an overall accuracy of the map of 44.1% with a kappa statistic of 0.413 (41.3%). This lower accuracy reflects the difficulty in differentiating the vegetation associations combined in the final analysis due to their similarities in composition on the ground and/or in the aerial photography. The lower

accuracy may also indicate successional changes and stand-level disturbances that occurred between the time of the mapping effort and the accuracy assessment.

Key findings:

For users interested in preserving the full detail of the map for the purpose of highly detailed studies or management of the landscape, we recommend use of the fine-scale map as published by UGA. For all other users, we recommend combining map classes as specified above to allow for an overall map accuracy of approximately 78%. These actions will allow for a map that is useful for the widest audience possible while not losing potentially important fine scale detail.

Introduction

In an effort to catalog and map the biodiversity of the United States, in 1994 the National Park Service (NPS) and the U.S. Geological Survey (USGS) embarked on a collaborative vegetative mapping project with the goal of mapping 230+ National Park units (ESRI et al. 1994). As part of this national mapping initiative, a digital vegetation map of Chickamauga and Chattanooga National Military Park (CHCH) was created in 2007 by the University of Georgia Center for Remote Sensing and Mapping Science (Jordan and Madden 2008), in consultation with NatureServe. The mapping effort included collection of field data, aerial photograph interpretation, and polygon attribution to GIS maps.

Chickamauga and Chattanooga National Military Park consists of four major land parcels totaling more than 8,900 acres straddling the Georgia – Tennessee border. Chickamauga Battlefield is located in the counties of Catoosa and Walker, Georgia and forms the largest management unit of the park, consisting of 5,283 acres within the Chickamauga Valley. Elevations vary from 680 to 950 feet. In addition to its significance as the site of a major civil war battle, this area has numerous exposures of Ordovician dolomite and limestones of the Knox and Chickamauga Groups (Jim Renner, pers. com.). It is located in the Southern Limestone/Dolomite Valley and Low Rolling Hills subsection of the Southern Ridge and Valley Ecoregion (Griffith et al. 2001).

The second largest management unit is Lookout Mountain Battlefield and Point Park (2,689 acres), which is located in Hamilton County, Tennessee and Walker County, Georgia. This area is a part of the Southern Table Plateaus subsection of the Southwestern Appalachian Ecoregion. It is closely related and similar to the Cumberland Plateau and consists of Pennsylvanian-age sandstone cap rock with associated shale and limestone layers below (Griffith et al. 2001). Elevations vary from 620 feet at Lookout Creek to nearly 2000 feet at Point Park.

A third management unit is Moccasin Bend, located adjacent to the Tennessee River due west of Chattanooga. Its 740 acres include sandstone bluffs along the east side of a peninsula that creates the bend in the river and low lying ground on the west side of the tract. Elevations range from 650 to 800 feet. There are several small holdings outside of the park's core area. One of the larger of these is the Sherman Reservation, located on Missionary Ridge adjacent to the city of Chattanooga.

Vegetation at CHCH was mapped and classified to the association level using the United States National Vegetation Classification (Grossman et al. 1998, White 2005), following NPS guidelines. The minimum mapping unit (MMU) was 0.5 hectare.

The accuracy assessment assigns a measure of validity to the map product and allows users to understand the reliability with which the mapped vegetation classes capture conditions on the ground. Knowing the accuracy of the map will enable potential users to determine the suitability of the map for any particular application (ESRI et al. 1994). This report describes the methods used in the accuracy assessment and the results for each map class.

Methods

Our team assessed the thematic accuracy of the map by comparing the vegetation type shown on the map to the vegetation type identified on the ground from a representative sample of evaluation points. When polygons representing vegetation types are mapped and labeled with the correct community types, then the map has high thematic accuracy.

For each map class, we evaluated both producer's and user's accuracy. User's accuracy is a prediction of the percentage of points mapped as a certain type, which are confirmed to belong to that mapped vegetation type when visited in the field. In other words, user's accuracy is a measure of the reliability of the map to predict what is found on the ground (i.e. how likely the map user is to encounter correct information while using the map). Producer's accuracy is the percentage of points observed to be of a given vegetation type in the field that are correctly mapped to that type. In other words, producer's accuracy is a measure of the reliability of the aerial photo interpretation to distinguish the vegetation types (i.e. how well the map maker was able to represent the ground features). In addition to the user's and producer's accuracy, this report contains calculated measures of the overall map accuracy and contingency tables showing the frequency of confusion (i.e. misclassification) between associations.

Point Selection

We used a point-based approach to assess the accuracy of the map classes, with one or more evaluation points representing each map class. The map represents vegetation types using one or more polygons per type. We selected points from within those polygons using a stratified random sampling design, so that points were distributed across all map classes with a higher number of points placed within map classes with large areas (up to a maximum of 30 points per map class). Because we evaluated representative points, not entire polygons, the assessment results should be interpreted as a measure of the accuracy of the overall map class, rather than an assessment of whether whole polygons were classified correctly. For the CHCH accuracy assessment, we evaluated 519 points representing 32 mapped vegetation types.

In the mapping process, UGA assigned a dominant vegetation association based on the U.S. National Vegetation Classification (NVC) for each polygon. Many polygons were also assigned secondary and/or tertiary associations where ecotones, inclusions smaller than the minimum mapping unit, active succession, or blended vegetation types made assignment to one association unrepresentative of the situation on the ground. For the selection of evaluation points, we only considered the dominant vegetation type. We determined the number of required points for each dominant vegetation type based on the area of each vegetation association at the park (ESRI et al. 1994, NatureServe 2007). At that point, we then selected the locations of the evaluation points using the "Generate Random Points" tool in the GIS extension "Hawth's Analysis Tools for ArcGIS" (Beyer 2004). The tool excluded points from a 12 meter internal buffer around the boundary of each vegetation polygon to ensure that points were within polygons and to avoid misclassification due to GPS error in the field; however, in some instances the size and shape of the vegetation polygons prevented selection of an adequate number of points outside the buffered area. Likewise, the tool randomly placed sample points throughout the park, but polygons smaller than 0.045 hectares (452 square meters) were excluded because of the potential that GPS error could lead field crews to record data for an area outside the polygon of the mapped class. A

distance of at least 80 meters was maintained between adjacent points to prevent overlap in the area evaluated around each point.

Field Data Collection

Field crews collected accuracy assessment data during the Fall of 2009 and Spring of 2010. Fieldworkers located each evaluation point using a Garmin 76CS or 76CSx GPS unit. At each point, the field crew recorded new averaged field coordinates, GPS positional accuracy, and collected limited vegetation data. When collecting the data for the accuracy points, field crews considered the vegetation in an area approximately 0.5 hectare, within a 40 meter radius circle around each point. Field crews recorded only the dominant and diagnostic species for each stratum. They also determined the primary association type at that point using an existing key to the ecological and human influenced communities at CHCH (found in Govus and White 2007), and a "fit" value of this type of high, medium, or low. During the initial stage of the accuracy assessment data collection, it became evident that the vegetation key required some modification. As a consequence, during the first week of field work, we made some changes to the original field key and have included the modified version in this report as Attachment A. In total, crews collected field data from a total of 519 points.

Data Analysis

Data were summarized using contingency tables describing misclassification rates for each vegetation type, calculations of user's and producer's accuracy for each vegetation type, and an evaluation of the overall accuracy of the map using the kappa statistic (Cohen 1960). Our team analyzed the data for three scenarios. The first scenario was a strict interpretation of map accuracy at the finest scale. In this scenario, we considered an evaluation point correctly classified only if the dominant vegetation type assigned on the map matched the observed value on the ground. The second scenario considered a point a match if the dominant, secondary, or tertiary vegetation type assigned to the mapped polygon matched the observed type. The third scenario was similar to the second in that it used dominant, secondary, or tertiary vegetation, but it also combined several map classes into broader groups based on the initial scenario results, which highlighted those vegetation classes that were difficult to differentiate. If questions arose regarding the proper assignment of a point to a map class, we also considered the supplemental notes recorded by the field crew. In addition, for the third scenario, we regarded any points that fell within the 12 meter polygon buffer that appeared to have the same type of vegetation as that of an adjacent mapped polygon as correct. This accounts for any GPS error that may have occurred during data collection.

Once all data were entered, we constructed a contingency matrix for each scenario. This table lists sample data (i.e. mapped values) as rows and reference data (i.e. the type observed in the field) as columns. An example of a contingency matrix is presented below (Table 1). Cell values equal the number of points mapped or field-verified as belonging to that type, with numbers along the diagonal representing correctly classified points and all others cells representing misclassifications. In this example, four of the five evaluation points mapped as belonging to Class B were mapped correctly, while the fifth point was found to belong to Class D in the field. In addition, the field crew identified two evaluation points that were mapped as Class C but were

shown to belong in Class B in the field. Examining the contingency table in this manner allows the users to discern patterns in misclassifications between classes.

Table 1. A sample contingency matrix with shaded cells representing correctly classified points.

		Observed as:				Row Totals
		A	B	C	D	
Mapped as:	A	5	0	0	0	5
	B	0	4	0	1	5
	C	0	2	8	0	10
	D	0	0	3	2	5
Column Totals		5	6	11	3	25

User's and producer's accuracy are derived from the values in the contingency table. Producer's accuracy, or (1 - errors of omission), is calculated by dividing the number of correctly classified points for a map class by the total number of points determined to belong to that class in the field (i.e. the column total). In our example, the producer's accuracy for Class B is 4 divided by 6, or 67%. User's accuracy (1 - errors of commission) is determined by dividing the number of correctly classified points in one map class by the total number of evaluation points originally generated for that class (i.e. the row total). In our example, the users' accuracy for Class B is 4 divided by 5, or 80%.

For the project, we determined overall map accuracy by dividing the number of correct points by the total number of points assessed. We also calculated a kappa index, which takes into account that some polygons are correctly classified by chance (Cohen 1960, ESRI et al. 1994, Foody 1992). We calculated the overall accuracy and kappa index based on all map classes for all three analysis scenarios.

Results

The overall accuracy of the final CHCH vegetation map, which considered dominant, secondary, or tertiary vegetation types as well as several combined map classes, is 77.5% with a kappa statistic of 0.724 (72.4%). The contingency matrix for this scenario, along with a tabulation of user's and producer's accuracy for each map class, is provided in Appendix B, Tables 2a-b. We created groupings based on a review of the contingency matrix for the fine-scale analysis. In grouping the types, we attempted to group those associations that were related in habitat requirements, landscape distribution and floristic composition. This resulted in groups that are related from a land management point of view. Groups of ecologically related associations that were used include:

a). Southern Limestone Glade Margin Shrubland (CEGL003938), Highland Rim Semi-natural Red-cedar - Oak Forest (CEGL004731) and Red-cedar Successional Forest (CEGL007124) – these are all Eastern red- cedar dominated shrublands or forests with varying degrees of natural integrity.

b). Piedmont / Ridge and Valley Small Stream Sweetgum - Tuliptree Forest (CEGL004418), Box-elder Floodplain Forest (CEGL005033), Successional Tuliptree Bottomland Forest (CEGL007184), Interior Mid- to Late-Successional Sweetgum - Oak Forest (CEGL007217), Successional Tuliptree Forest (Circumneutral Type) (CEGL007220), Successional Sweetgum Floodplain Forest (CEGL007330), Sycamore - Silver Maple Calcareous Floodplain Forest (CEGL007334), Rich Levee Mixed Hardwood Bottomland Forest (CEGL008429), and Mid- to Late-Successional Loblolly Pine - Sweetgum Forest (CEGL008462) – these are all bottomland or lower slope forest types, many with degraded character, and some are temporarily flooded. This is a somewhat heterogeneous grouping but all occupy the drainages and lower slopes of the mapping units.

c). Virginia Pine Plantation (CEGL004730) and Interior Mid- to Late-Successional Loblolly Forest (CEGL007105) – both pine dominated forests with generally low natural integrity.

d). Appalachian Sugar Maple - Chinquapin Oak Limestone Forest (CEGL006017), Interior Low Plateau Chinquapin Oak - Mixed Oak Forest (CEGL007699) and Interior Plateau Chinquapin Oak - Shumard Oak Forest (CEGL007808) – these are all forests occurring on limestone and dominated or co-dominated by *Quercus muehlenbergii.*

e). Dry-Mesic Southern Appalachian White Oak - Hickory Forest (CEGL007231), Highland Rim White Oak - Tuliptree Mesic Lower Slope Forest (CEGL007709) and White Oak - Post Oak Subcalcareous Forest (CEGL008443) – these are all white oak dominated forests that occur in mesic to dry-mesic situations, usually on lower slopes and more sheltered situations.

f). Interior Low Plateau Chestnut Oak - Mixed Oak Forest (CEGL007700), Cumberland Plateau Dry-Mesic White Oak Forest (CEGL008430) and Xeric Ridgetop Chestnut Oak Forest (CEGL008431) – these are all chestnut oak dominated or co-dominated dry-mesic to xeric forests of middle slopes and upper ridgetops.

A stricter analysis, which considered dominant, secondary, or tertiary vegetation types but no combined map classes, produced an overall accuracy of 52.6% with a kappa statistic of 0.499 (49.9%) (Appendix B, Tables 3a-b). The strictest analysis of the CHCH map at its finest scale, which considered only the dominant mapped vegetation, resulted in an accuracy of 44.1% with a kappa statistic of 0.413 (41.3%) (Appendix B, Tables 4a-b).

Because of the low initial overall map accuracy for the park as a whole, a special analysis was undertaken to examine thematic accuracy separately for all three management units. This was also done because it was suspected that Moccasin Bend, due to its long history of human disturbance, may have had especially low mapping accuracy and was lowering overall results. The initial dataset was broken up into the three units and analyzed. The results revealed that Chickamauga Battlefield, as a separate mapping unit did have a higher overall accuracy (56%), while Lookout Mountain had an intermediate accuracy (49%) and Moccasin Bend had the lowest

accuracy (40%). Consideration was given to discarding the Moccasin Bend component of the map and using the combined results of Chickamauga Battlefield and Lookout Mountain. The analysis results for the two units combined did not support breaking up the map of all three units. The overall accuracy for the strict interpretation (dominant vegetation) of the combined map of Chickamauga Battlefield and Lookout Mountain was only 45%, just one percentage point above the initial analysis for all three sites combined. It was subsequently judged that using the map as it currently exists, with all three management units together, was the most practical way to proceed.

We did not calculate confidence intervals for user's and producer's accuracy for CHCH because the generally small number of assessment points per map class inflates the size of the confidence interval and thus limits its usefulness for meaningful interpretation.

It is apparent from the comparison of Tables 2 - 4 that overall map accuracy is considerably higher when classes are grouped and secondary and tertiary mapped vegetation classes are considered. The fine-scale detail that is available to users of the ungrouped map classes will be useful to researchers and managers interested in distinct vegetation associations, especially for those associations with relatively high mapping accuracy. This is particularly true for some of the matrix forest types such as the Southeastern Interior Southern Red Oak - Post Oak Forest (CEGL007247) which had a seventy-three percent user accuracy and the Interior Low Plateau Chestnut Oak - Mixed Oak Forest (CEGL007700) which had a user accuracy of one hundred percent. Few other associations showed high user accuracy at the finest scale. Because mapping at such fine-scale is inherently difficult, it is important that the user take into account the misclassification rates shown on the contingency tables in Appendix B when using this version of the map. Because much higher accuracies are achieved when vegetation types are grouped, we recommend that users who are less inclined to explore the accuracy assessment in depth be guided to use the coarser scale, higher accuracy version of the map.

Discussion

Overall, the combined classes for the vegetation map of Chickamauga and Chattanooga National Military Park provides an accurate representation of vegetation types within the park and we feel it satisfies the NPS accuracy guideline of 80%. A few of the vegetation classes had low user's or producer's accuracy, and thus map users should be very cautious in interpreting areas mapped or identified in the field as belonging to those classes. The low accuracy recorded for these communities is likely the result of difficulties distinguishing between associations that are ecologically similar (i.e. occur in similar topographic positions and share floristic similarities).

In addition, sites with a long history of human disturbance, such as Chickamauga and Chattanooga National Military Park are inherently difficult candidates for accurate mapping to the NVC association level for all map classes. Disturbed and/or successional vegetation types resulting from prior human activities do not lend themselves easily to being mapped at the association level. Chickamauga and Chattanooga National Military Park is composed of a patchwork of mature second growth forest, late successional forest types, small patch types, and recovering old agricultural land. The result is a continuum of spatial and temporal vegetation patterns. Due to floristic similarity in dominant strata, upland oak forest types were often

mistaken for one another in the field and on the map. When visiting a polygon, the surveyors sometimes were obligated to choose a map class among upland types that appeared to form an aggregation of a few classes rather than a homogenous type. In addition, occasionally the field assessment point did not fit well into any community description so the surveyors chose the closest one, which may not have been a perfect fit.

As one pertinent example of a particularly difficult group of associations to sort out, all the bottomland forest types were confused with one another at all three management units. This necessitated the grouping of all of the bottomland forests including some that occurred on well drained lower slopes. Many of these were successional types (although some were natural temporarily flooded communities that did have some examples with natural integrity). A good illustration of of the heterogeneity and mapping difficulties for these bottomlands can be observed on Lookout Creek. In some areas there were very pristine (but small) occurrences of Sycamore - Silver Maple Calcareous Floodplain Forest (CEGL007334). Adjacent to these areas were very young stands of Successional Sweetgum Floodplain Forest (CEGL007330) or degraded examples of Rich Levee Mixed Hardwood Bottomland Forest (CEGL008429). These types occurred as a mosaic and had no discernable pattern as one travels along Lookout Creek. The most accurately mapped association of this group was the Rich Levee Mixed Hardwood Bottomland Forest (CEGL008429) which had a producer accuracy of 54% and a user accuracy of 50%. Other associations had 0% producer and/or user accuracy. They were often most confused with other bottomland types. These flat, low elevation sites were undoubtedly the most heavily impacted areas within the park, used for crop production, grazing and logging. As a result, seven related bottomland types needed to be combined into one large mapping unit.

Lower slope, mesic to dry- mesic white oak forests were also difficult to separate by mappers. However, the combined group of Dry-Mesic Southern Appalachian White Oak - Hickory Forest (CEGL007231) and White Oak - Post Oak Subcalcareous Forests (CEGL008443) make a very natural grouping from an ecological perspective. They occur on lower to mid slopes with low herbaceous cover and understandably would be difficult to separate form one another with aerial photography. Mapped separately they had user's and/or producer's accuracies ranging from 29% to 48%. In the combined class the producer's accuracy was 88% and the user's accuracy was 79%. The only unfortunate grouping within these white oak forest types was the inclusion of the Highland Rim White Oak - Tuliptree Mesic Lower Slope Forest (CEGL007709) into the group. This had a very high producer's accuracy (100%) meaning that wherever it was found in the field, it was accounted for by the map; but it had a very low user's accuracy (27%) meaning that it was used by the mappers more widely in the park than our fieldwork suggested it should have been (an error of commission). The only remedy was to place this generally more mesic association in with other slightly drier white oak types.

A more satisfactory grouping of forest types was the clustering of the three forest types dominated by *Quercus muehlenbergii*. These are primarily restricted to Chickamauga Battlefield and occur on limestone. This includes Appalachian Sugar Maple - Chinquapin Oak Limestone Forests (CEGL006017), Interior Low Plateau Chinquapin Oak - Mixed Oak Forests (CEGL007699) and Interior Plateau Chinquapin Oak - Shumard Oak Forests (CEGL007808). They had generally good producer's accuracies (ranging from 56% to 100%) but lower user's accuracies (ranging from 20% to 50%). This means that sites found in the field with these types

are likely to be mapped correctly, but areas mapped of this type may likely not be one of these associations. The producer's and user's accuracy for this combined group is 79% and 58% respectively.

Dry site chestnut oak dominated or co-dominated forests also proved difficult for mappers to accurately delineate. These are primarily (not entirely) restricted to sandstone on Lookout Mountain and the east side of Moccasin Bend. The three associations within this grouping follow a moisture gradient from dry-mesic to xeric and are typically arranged from lower mid slopes to upper slopes and ridge tops in the following order: Cumberland Plateau Dry-Mesic White Oak Forest (CEGL008430), Interior Low Plateau Chestnut Oak - Mixed Oak Forest (CEGL007700), and Xeric Ridgetop Chestnut Oak Forest (CEGL008431). Producer's accuracies for these associations mapped separately ranged from 44% to 100%* (*for Xeric Ridgetop Chestnut Oak Forest), but had generally lower user's accuracies varying widely from 17% to 100%* (*for Interior Low Plateau Chestnut Oak - Mixed Oak Forest). As a group this combined mapping unit had a much more consistent user's and producer's accuracy (84% and 88% respectively).

A final issue noticed during the end of the analysis process was the low number of accuracy assessment points located in the cedar glade communities (Central Limestone Glade, CEGL005131). The photointerpreters assigned twenty-eight polygons to this association but only three accuracy assessment points were designated to try to quantify the accuracy of this type. Based on this low sample, the producer accuracy for this type was 50% and the user accuracy was only 33%. It is expected that this association type would have a high degree of accuracy because it is restricted to open, treeless areas and easily detected with aerial photography, but because of the low number of sample points we cannot draw a definite conclusion about the actual accuracy of this type. The reason for the low sample rate was that these glades tend to be linear in shape and quite narrow. With the 12 m buffer applied by the Hawth's Analysis Tool many (or most) of the glades were rejected. These are rare plant associations (G2G3) that include a number of vascular plant species of conservation concern and a more thorough measurement of how accurately they were mapped at Chickamauga Battlefield is of importance to conservationists and land managers. Fortunately, in 2007 many of these glades were revisited as part of a project to resample monitoring plots previously established by TNC in 1993. Most of the areas resampled were still considered to be in glade habitat, though the quality of many sites has likely deteriorated based on the followup studies completed in 2008 (Govus and Lyons, 2008). Of eight glades sampled during this effort, seven were delineated at least partially by the photointerpreters. We should assume, based on the 2007 assessment, that the accuracy for glades mapped is much higher than that which we report out from our own data. If resources exist, it would be useful for the park to consider re-checking some or all of the 28 glade occurrences to confirm that the accuracy for this type is higher than we suggest.

While the accuracy assessment is intended to provide a measure of the reliability of the map classes, the reader should be aware that error is also inherent in the field assessment of evaluation points. The overall accuracy of the Chickamauga and Chattanooga National Military Park vegetation map was relatively low before grouping map classes. At any park, the overall accuracy and user's and producer's accuracy of individual map classes may be affected by many factors. These factors include but are not limited to: the fragmented state and changes in management practices, GPS error, data collection error by the field crew, poorly written and/or

untested classification keys, poor ecological community concepts, inconsistent interpretation of the classification key, and potential lag times between photointerpretation and accuracy assessment. Two or more community types could be similar enough such that one assessment point could be mistakenly assigned to a particular community type by the field crew when another community type was assigned to the same area by the map producers (Townsend 2000). Points may fall into ecotones or into inclusions within the larger community type and the resulting classification in the field may not be the same as that on the map. While measures were taken to reduce these errors, they are not altogether avoidable and it is not within the scope of this project to discern what mistakes led to which errors. However, it is important to note that mapping error is but one of many types of error that combine to create accuracy issues with any given map.

Users of the CHCH digital vegetation map should familiarize themselves with the results of this accuracy assessment, potential sources of classification error, and the contingency tables provided in Appendix B. When interested in using the map to locate a particular association, it is useful to know what other map classes have been shown to contain points matching that association, and what other vegetation types the mapped association of interest is likely to contain. We recommend that natural resource managers consider combining some commonly confused map classes together for display or other purposes. The results of the accuracy assessment indicate that almost all of the bottomland forest types cannot be consistently distinguished from each other on aerial imagery and may be best displayed as a combined map class. Likewise, Dry-Mesic Southern Appalachian White Oak - Hickory Forest (CEGL007231), Highland Rim White Oak - Tuliptree Mesic Lower Slope Forest (CEGL007709) and White Oak - Post Oak Subcalcareous Forest (CEGL008443) were difficult for the mappers to distinguish from one another and also may best be displayed as a combined upland class. Additionally, Interior Low Plateau Chestnut Oak - Mixed Oak Forest (CEGL007700), Cumberland Plateau Dry-Mesic White Oak Forest (CEGL008430) and Xeric Ridgetop Chestnut Oak Forest (CEGL008431) were problematic for mappers to delineate, indicating that these classes may also be best displayed as a combined class. Other combined classes that should be evaluated as groups include limestone oak forest dominated by chinquapin oak (*Quercus muehlenbergii*) and Eastern red-cedar (*Juniperus* virginiana) dominated shrublands, woodlands and forests.

For casual map users and general display purposes, use of the higher-accuracy map, which includes these lumped classes, will be most useful. For researchers and managers interested in fine-scale detail and rare vegetation types, a version of the map that preserves the full detail as published by UGA should be maintained. The more detailed version of the map, while less accurate for some map classes, contains valuable information for those interested in locating vegetation types that are inherently difficult to map. Used in conjunction with the results of this accuracy assessment, the original map provides the best tool available for understanding the spatial distribution of vegetation types at CHCH.

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Appendix A: Revised Vegetation Classification Key

Key to Ecological Communities of Chickamauga and Chattanooga National Military Park

This key was developed for Chickamauga and Chattanooga National Military Park and is intended to allow field workers and naturalists to help identify community types while in the field. Due to the small size of the park and the limited habitat types available within the park boundary, this key does not cover all of the plant communities of the adjacent region. However, within the boundary, we believe this key represents the range of variation of existing vegetation.

This key is primarily constructed in a dichotomous fashion, with only two choices at each junction. In a few cases (which are specifically noted), there are three choices. The user must make a series of choices based on the structure, composition, and environment of the vegetation to arrive at the correct association. If the key leads to a choice that is not reasonable, consider returning to the beginning of the key (or at least to an earlier junction) and reviewing your decisions to confirm that you are confident in all your choices. It may be useful to walk around the area in question to get a feel for the overall composition. This exercise may help you arrive at the correct place in the key since small-scale variations within a matrix community may be misleading. In addition, ecotones between ecological communities may have traits of both communities and so may need to be classified as both communities if they cannot be assigned with confidence to one or the other.

Associations, which are documented from the National Battlefield are in **bold type**. Those, which are potential, but undocumented, are in normal type.

KEY TO KEYS

1a. Vegetation dominated by trees, either closed forests or open woodlands **2**

1b. Vegetation not dominated by trees, trees are absent or very sparse (<20%cover) **5**

2a. Forest, dominated by trees, which provide >60% cover **3**

2b. Vegetation of sparse forest; open woodlands in which trees cover is <60% ... ***KEY D – WOODLANDS***

3a. Cultivated or heavily human influenced, successional forests with evident canopy disturbance or a dominance by successional species like loblolly pine (*Pinus taeda*) or sweetgum (*Liquidambar styraciflua*)
..... ***KEY A – SUCCESSIONAL FORESTS***

3b. Natural forests or semi-natural forests (i.e., not dominated by cultivated or successional species) **4**

4a. Upland forests, rarely if ever flooded ..... ***KEY B – UPLAND FORESTS***

4b. Forests occurring on floodplains and bottomlands, usually inundated during a part of the growing season, at least temporarily ..... ***KEY C – ALLUVIAL AND WETLAND FORESTS***

5a. Shrublands, deciduous or evergreen (includes cane and bamboo shrublands up to 10 m or 33' tall and vine dominated areas (with few or no trees) ..... ***KEY E - SHRUBLANDS***

5b. Vegetation dominated by herbaceous plants or substrate predominantly bedrock with only a small percentage of the surface area vegetated..... **6**

6a. Vegetation dominated or characterized by grasses, forbs or grass-like plants (perennial or annual), includes glades and pastures ..... ***KEY F – HERBACEOUS AND GRAMINOID VEGETATION***

6b. Sparse mixed vegetation associated with cliffs and rock outcrops, herb cover less than %10 ..... ***KEY G – SPARSE VEGETATION***

KEY A – SUCCESSIONAL FORESTS

1a. Cultivated or planted forests **2**

1b. Successional or strongly human-influenced, disturbed forests..... **3**

2a. Planted white pine (*Pinus strobus*) forest ..... ***White Pine Plantation*** **(CEGL007178)**

2b. Planted Virginia pine (*Pinus virginiana*) forest ..... ***Virginia Pine Plantation*** **(CEGL004730)**

3a. Evergreen or mixed evergreen - hardwood dominated successional forests **4**

3b. Deciduous hardwood dominated successional forests **6**

4a. Forest dominated or co-dominated by loblolly pine (*Pinus taeda*)..... **5**

4b. Forest dominated by dense young Eastern red-cedar (*Juniperus virginiana*) with no natural integrity as opposed to semi-natural older stands surrounding cedar glades..... ..... ***Red-cedar Successional Forest*** **(CEGL007124)**

5a. Forest canopy strongly dominated by loblolly pine and sometimes sweetgum (*Liquidambar styraciflua*), often found on bottomlands or low lying areas .... ***Mid- to Late-Successional Loblolly Pine - Sweetgum Forest*** **(CEGL008462)**

5b. Forest canopy dominated by a mixture of loblolly pine, sometimes with tulip poplar (*Liriodendron tulipifera*) and successional hardwood species, usually in upland situations……..... ……..... ***Interior Mid- to Late-Successional Loblolly Forest*** **(CEGL007105)**

6a. Forest dominated by tulip poplar (*Liriodendron tulipifera*) **7**

6b. Forest dominated by deciduous trees other than tulip poplar **8**

7a. Bottomland forest dominated by tulip poplar and box-elder (*Acer negundo*) .... ***Successional Tuliptree Bottomland Forest*** **(CEGL007184)**

7b. Upland forest with a large mix of successional species which are usually indicative of basic soils [i.e. red bud (*Cercis canadensis*), slippery elm (*Ulmus rubra*), hackberry (*Celtis* sp), spicebush (*Lindera benzoin*)] ..... ***Successional Tuliptree Forest (Circumneutral Type)*** **(CEGL007220)**

8a. Small patch forest dominated almost exclusively by black walnut (*Juglans nigra*) usually found in vicinity of old home sites .....***Successional Black Walnut Forest*** **(CEGL007879)**

8b. Forest largely dominated or co-dominated by sweetgum **9**

9a. Young stand dominated largely by sweetgum to the exclusion of other species..... .....*Successional Sweetgum Forest* (CEGL007216)

9b. Older stand that has recovered and may include oaks or other hardwoods within the canopy..... .....***Interior Mid – Late Successional Sweetgum - Oak Forest*** **(CEGL007217)**

KEY B – UPLAND FORESTS

1a. Forests dominated or co-dominated by white oak (*Quercus alba*) as a dominant or significant component (at least 40% cover of white oak in most cases, but occasionally with as little as 25% cover of white oak) **2**

1b. Forest dominated by other tree species **6**

2a. Mesic white oak forests found on lower slopes, usually with deep soils (3 choices) **3**

2b. Drier white oak forests sometimes with high cover (up to 60%) of chestnut oak or hickory species, usually on well drained upper and exposed slopes **4**

3a. Slope forest with a mixed canopy including hickories and rich site species like sugar maple (*Acer saccharum* or *A. barbatum*) as well as a moderately rich herb layer of cove type herbs [i.e. black snakeroot (*Cimicifuga racemosa*), trillium and mayapple (*Podophyllum peltatum*) ....***Rich Low-Elevation Appalachian Oak Forest*** **(CEGL007233)**

3b. Small stream bluff forest dominated by beech (at least 40% cover) and with varying amounts of white oak, so far only located occasionally on Lookout Creek ....***Central Interior Beech - White Oak Forest*** **(CEGL007881)**

3c. Small stream bottomland white oak forest sometimes with tulip poplar, or more frequently sweet gum, and a generally poorly developed herb layer of acidic species particularly Christmas fern (*Polystichum acrostichoides*)..... .....***South-Central Interior White Oak - Tuliptree Mesic Lower Slope Forest*** **(CEGL007709)**

4a. Canopy with a mixture of white oak and chestnut oak (*Quercus prinus*)..... .....***Cumberland Plateau Dry-Mesic White Oak Forest*** **(CEGL008430)**

4b. Canopy not co-dominated by white and chestnut oak (3 choices) **5**

5a. Canopy including at least 20% cover of northern red oak (*Quercus rubra*)..... ..... ***Ridge-and-Valley Dry-Mesic White Oak - Hickory Forest*** **(CEGL007240)**

5b. Canopy including a strong co-dominance of white oak and/or post oak (*Quercus stellata*) without other diagnostic species .....***White Oak - Post Oak Subcalcareous Forest*** **(CEGL008443)**

5c. Canopy including a strong component of white oak and black oak and often on sandstone derived soils (sandy loams), can grade into *Southeastern Interior Southern Red Oak - Post Oak Forest* (CEGL007247) .....***Dry-Mesic Southern Appalachian White Oak - Hickory Forest*** **(CEGL007231)**

6a. Canopy with a substantial component of chinquapin oak (*Quercus muehlenbergii*) or shumard oak (*Quercus shumardii*) **and** typically restricted to limestone substrates, often associated with glade complexes (3 choices)..... **7**

6b. Canopy lacking a significant component of chinquapin oak (<25%) and usually occurring on different substrates **8**

7a. Canopy with a conspicuous mix of sugar maple and chinquapin oak, lacking an abundance of dry oak species (i.e. *Quercus falcata, Q. stellata*) ....***Appalachian Sugar Maple - Chinquapin Oak Limestone Forest*** **(CEGL006017)**

7b. Drier forests including an abundance of dry oak species such as *Quercus falcata* and *Quercus stellata* .....***Interior Low Plateau Chinquapin Oak - Mixed Oak Forest*** **(CEGL007699)**

7c. More mesic to dry-mesic forests including Shumard oak (*Quercus shumardii*) and shagbark hickories (*Carya carolinae-septentrionalis – C. ovata*) ....***Interior Plateau Chinquapin Oak - Shumard Oak Forest*** **(CEGL007808)**

8a. Canopy dominated by sweetgum (*Liquidambar styraciflua*), or tulip poplar (*Liriodendron tulipifera*) and oak species, especially white oak..... .....***Interior Mid- to Late-Successional Sweetgum - Oak Forest*** **(CEGL007217)**

8b. Canopy dominated by species other than sweetgum (3 choices)..... **9**

9a. Forest occurring on mesic lower slopes near streams and with a canopy including substantial amount of American beech (*Fagus grandifolia*)..... ***Central Interior Beech - White Oak Forest*** **(CEGL007881)**

9b. Forest dominated by chestnut oak and other deciduous canopy species **10**

9c. Forests dominated by a mixture of other oak species, either post oak (*Quercus stellata*), southern red oak (*Quercus falcata*); or oaks and evergreen species, either pines or Eastern red-cedar..... **11**

10a. Less frequent and more xeric chestnut oak forest on ridgetops/upper slopes and usually including scarlet oak (*Quercus coccinea*) and sand hickory (*Carya pallida*) in canopy and usually a shrub layer with sparkleberry (*Vaccinium arborescens*) often found on the upper slopes of Lookout Mountain..... ..... ***Xeric Ridgetop Chestnut Oak Forest*** **(CEGL008431)**

10b. Widespread and slightly more mesic chestnut oak forest of mid and lower slopes, lacking xeric canopy species and sometimes including more mesic species like northern red oak and white oak..... .....***Interior Low Plateau Chestnut Oak - Mixed Oak Forest*** **(CEGL007700)**

11a. Canopy of Eastern red cedar and mixed oak species, late successional and usually in areas that were pastured or cleared in historic times with canopy and/or subcanopy containing a large component of Eastern Red cedar……***Highland Rim Semi-natural Red-cedar - Oak Forest*** **(CEGL004731)**

11b. Eastern red cedar may be present but not dominating canopy and not an important subcanopy component or may be absent from the canopy……**12**

12a. Canopy usually dominated by a mix of post oak (*Quercus stellata*) and/or southern red oak (*Quercus falcata*), sometimes with a substantial pine component or occasionally with white oak *(Quercus alba)* as a minor component, usually occurring over limestone in rolling terrain..... ..... ***Southeastern Interior Southern Red Oak - Post Oak Forest* (CEGL007247)**

12b. Canopy dominated by shortleaf pine and dry oak species (*Quercus prinus, Q. coccinea, Q. falcata*), usually occurring on xeric west facing ridges over sandstone..... ..... ***Southern Blue Ridge Escarpment Shortleaf Pine - Oak Forest* (CEGL007493)**

KEY C – ALLUVIAL AND WETLAND FORESTS

1a. Forests associated with riverine environments or large order streams (including Lookout Creek)…….....**2**

1b. Forests associated with isolated wetlands such as depressions, or associated with beaver impoundments.....**4**

2a. Forests dominated largely by box-elder (*Acer negundo*) or sweetgum (*Liquidambar styraciflua*) and typically associated with successional habitats.....**3**

2b. Forests dominated by a variety of other species such as sycamore (*Platanus occidentalis*) or Shumard oak (*Quercus shumardii*) usually natural or semi-natural and not obviously successional **6**

3a. Forests dominated largely by box-elder ..... ***Box-elder Floodplain Forest* (CEGL005033)**

3b. Forests dominated largely by sweetgum **5**

4a. Forest dominated by black willow (*Salix nigra*), usually associated with beaver impoundments, wetland depressions or river and stream margins .....***Black Willow Riparian Forest* (CEGL002103)**

4b. Isolated upland wetland depressions usually associated with the sinking of the geologic substrate (sinkholes) or poorly drained flatwoods, canopy dominated by willow oak or including some willow oak or (*Quercus phellos*) .....***Cumberland Plateau Willow Oak Pond* (CEGL008441)**

5a. Young successional forest, monospecific and with little natural integrity .... ***Successional Sweetgum Floodplain Forest* (CEGL007330)**

5b. Mature forest with more diverse canopy and more natural integrity, usually a fairly diverse herbaceous layer.....***Piedmont Small Stream Sweetgum Forest*(CEGL004418)**

6a. Forests dominated or co-dominated by Shumard oak..... ..... ***Southern Interior Oak Bottomland Forest* (CEGL008487)**

6b. Forest not dominated by Shumard oak, usually including sycamore as an important component **7**

7a. Forests occurring on larger streams with a diverse canopy including sycamore, silver maple (*Acer saccharinum*), green ash (*Fraxinus pennsylvanica*), slippery elm (*Ulmus rubra*) and rich herbaceous layer, usually associated with larger streams and rivers (known only from Lookout Creek and Moccasin Bend) ..... ***Sycamore - Silver Maple Calcareous Floodplain Forest*** **(CEGL007334)**

7b. Forests occurring on small streams and poorly drained low areas, lacking silver maple and usually with abundant hackberry (*Celtis laevigata*), sometimes including overcup oak (*Quercus lyrata*), herbaceous layer less diverse, many examples are degraded and with a successional character..... ..... ***Rich Levee Mixed Hardwood Bottomland Forest*** **(CEGL008429)**

KEY D - WOODLANDS

1a. Woodland dominated principally by a mixture of Eastern red-cedar and post oak (*Quercus stellata*) .... ***Cumberland Escarpment Dry Limestone Oak Forest*** **(CEGL004583)**

1b. Woodland occurring as a part of the limestone glade matrix with scattered small chinquapin oak (*Quercus muehlenbergii*), Eastern red-cedar (*Juniperus virginiana*), Shumard oak (*Quercus shumardii*) and white ash (*Fraxinus americana*) within a matrix of exposed limestone rock and grassland. .... ***Central Limestone Glade*** **(CEGL005131)**

KEY E – SHRUBLANDS

1a. Evergreen or semi-evergreen dominated shrublands **2**

1b. Deciduous shrublands **7**

2a. Vegetation dominated by river cane or bamboo **3**

2b. Vegetation not dominated by cane or bamboo, evergreen or mixed shrublands **4**

3a. Vegetation dominated by non-native Golden bamboo (*Phyllostachys aurea)* up to 10m or 33' tall..... .....*Golden Bamboo Shrubland* (CEGL008560)

3b. Vegetation dominated by native Giant river cane (*Arundinaria gigantea)* ....*Floodplain Canebrake* (CEGL003836)

4a. Vegetation dominated by Chinese privet (*Ligustrum sinense)* or Common privet (*Ligustrum vulgare*) **5**

4b. Vegetation not dominated by Chinese privet (*Ligustrum sinense)* or Common privet (*Ligustrum vulgare*) **6**

5a. Wetlands or bottomlands .....*Chinese Privet Temporarily Flooded Shrubland* (CEGL003837)

5b. Uplands, not generally subject to flooding .....*Chinese Privet Upland Shrubland* (CEGL003807)

6a. Vegetation dominated by Eastern red-cedar (*Juniperus virginiana*), fragrant sumac (*Rhus aromatica*), and/or buckthorn bumelia (*Sideroxylon lycioides*) in some combination..... .....***Central Basin Limestone Glade Margin Shrubland*** **(CEGL003938)**

6b. Vegetation dominated by Southern blackberry (*Rubus argutus)*, Southern dewberry (*Rubus trivialis)* and greenbrier (*Smilax* spp.) ..... *Blackberry - Greenbrier Successional Shrubland Thicket* (CEGL004732)

7a. Temporarily flooded deciduous shrublands (occur in floodplain areas near rivers or creeks) **8**

7b. Upland deciduous shrublands (generally not subject to flooding), includes vine areas **9**

8a. Shrubland dominated by shrub sized black willow (*Salix nigra*), near river or stream ....*Black Willow Riverbank Shrubland* (CEGL003901)

8b. Shrubland dominated by Smooth alder (*Alnus serrulata*), near a river or stream ..... *Interior Alder Shrubland* (CEGL003894)

9a. Vegetation dominated by kudzu (*Pueraria montana* var. *lobata*), with few or no trees ....*Kudzu Vineland* (CEGL003882)

9b. Vegetation dominated by blackberries/dewberries (*Rubus argutus, Rubus trivialis*) and Greenbrier species (*Smilax glauca, Smilax rotundifolia*). May have a variety of tree saplings, other shrubs, herbs, and grasses. Successional, generally occurs following canopy removal ....*Blackberry – Greenbrier Successional Shrubland Thicket* (CEGL004732)

KEY F – HERBACEOUS AND GRAMINOID VEGETATION

1a. Communities associated with limestone glades or natural wetland areas and consisting of native species, some of them rare in the general landscape..... **2**

1b. Graminoid vegetation made up largely of cultivated, very common non-native species **6**

2a. Vegetation associated with wetland depressions, ponds or beaver impoundments **3**

2b. Vegetation associated with limestone glades..... **4**

3a. Wetland depressions or ponds dominated by American burr-weed (*Sparganium americanum*)..... ..... ***Piedmont/Mountain Semipermanent Impoundment (Montane Boggy Type)*****(CEGL004510)**

3b. Wetland areas dominated by smartweed (*Polygonum* sp) and cutgrass (*Leersia* sp.) usually in ponds or beaver impoundments..... ***Smartweed - Cutgrass Beaver Pond*** **(CEGL004290)**

4a. Open, generally flat limestone glade with annual grass much of which is Annual dropseed (*Sporobolus vaginiflorus*) only a few inches high (<10 cm) in the thin soil areas, but forbs and taller annual grasses can be in areas with thicker soil.***Southern Ridge and Valley Annual Grass Glade*** **(CEGL004339)**

4b. Vegetation not with the above combination of characteristics **5**

5a. Mosaic of open woodland with large patches of perennial graminoid vegetation dominated largely by little bluestem (*Schizachyrium scoparium*) and glade species such as purpletassles (*Dalea gattingeri*), straggling St. John's-wort (*Hypericum dolabriforme*), Nashville breadroot (*Pediomelum subacaule*) and least gladecress (*Leavenworthia exigua* variety *exigua*)..... ***Central Limestone Glade*** **(CEGL005131)**

5b. Small patch seepage herbaceous vegetation within glade complex dominated by flat spikerush (*Eleocharis compressa*) and Crawe's sedge (*Carex crawei*) .....***Limestone Seep Glade*** **(CEGL004169)**

6a. Grassland pastures and hayfields, more-or-less cultural, but may no longer be actively maintained, dominated by European tall fescue or Meadow fescue (*Lolium arundinaceum, pratense*) ..... ***Cultivated Meadow*** **(CEGL004048)**

6b. Grass lawns or frequently mowed areas with perennial grasses and forbs (weedy lawns) ..... ***Lawns***

KEY G – SPARSE VEGETATION

1a. Vegetation occurring on exposed sandstone cliffs and consisting of small patches of sedges, grasses (*Deschampsia flexuosa*), dwarfed trees, lichens and mosses..... .....***Cumberland Plateau Sandstone Cliff (Dry Type)*** **(CEGL004392)**

1b. Vegetation occurring on talus slopes at the base of sandstone cliffs, largely dominated by Virginia creeper and poison ivy .....***Appalachian Talus Slope*** **(CEGL004454)**

Appendix B: Contingency Matrices and Accuracy Tables

Table 2a. Contingency Matrix Using Mapped Dominant, Secondary, or Tertiary Vegetation (Best Match), plus Combined Map Classes, and accounting for GPS error, Chickamauga and Chattanooga National Battlefield.

Mapped As	Observed As																						User's Accuracy
	2103	3837	4048	4290	4392	4583	4732	5131	7216	7233	7240	7493	7881	8441	8487	9000	9001	9002	9003	9004	9005	Total	
2103	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	**100**
3837	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	2	**50**
4048	0	0	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30	**100**
4290	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	**100**
4392	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	**100**
4583	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**N/A**
4732	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**N/A**
5131	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	2	0	0	0	0	0	3	**33**
7216	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**N/A**
7233	0	0	0	0	0	0	0	0	0	2	1	0	0	0	1	0	0	1	0	2	2	9	**22**
7240	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**N/A**
7493	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	4	2	0	0	0	8	**25**
7881	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	2	**50**
8441	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	1	0	1	0	5	**20**
8487	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	4	0	0	0	0	5	**20**
***9000**	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	29	0	1	2	2	0	35	**83**
***9001**	0	0	0	0	0	0	1	0	1	1	0	0	0	1	1	5	106	8	2	7	1	134	**79**
***9002**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	6	0	1	0	9	**67**
***9003**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	2	1	19	2	0	33	**58**
***9004**	0	0	0	0	0	2	0	0	0	0	1	2	0	0	2	4	5	3	1	119	11	150	**79**
***9005**	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	5	1	0	2	76	86	**88**
Total	2	1	30	1	5	2	1	2	1	3	3	4	1	2	7	49	131	24	24	136	90	**519**	
Producer's Accuracy (%)	**100**	**100**	**100**	**100**	**100**	**0**	**0**	**50**	**0**	**67**	**0**	**50**	**100**	**50**	**14**	**59**	**81**	**25**	**79**	**88**	**84**		

Overall accuracy: 77.5%

Kappa statistic: .724 (72.4%)

*** = combined classes/ecological groupings – see synopsis of groupings in report discussion, legend for groupings on following page.**

Legend for Ecological Groupings, Chickamauga and Chattanooga National Military Park

9000 – Southern Limestone Glade Margin Shrubland (CEGL003938), Highland Rim Semi-natural Red-cedar - Oak Forest (CEGL004731) and Red-cedar Successional Forest (CEGL007124) – these are all Eastern red- cedar dominated shrublands or forests with varying degrees of natural integrity.

9001– Piedmont / Ridge and Valley Small Stream Sweetgum - Tuliptree Forest (CEGL004418), Box-elder Floodplain Forest (CEGL005033), Successional Tuliptree Bottomland Forest (CEGL007184), Interior Mid- to Late-Successional Sweetgum - Oak Forest (CEGL007217), Successional Tuliptree Forest (Circumneutral Type) (CEGL007220), Successional Sweetgum Floodplain Forest (CEGL007330), Sycamore - Silver Maple Calcareous Floodplain Forest (CEGL007334), Rich Levee Mixed Hardwood Bottomland Forest (CEGL008429), and Mid- to Late-Successional Loblolly Pine - Sweetgum Forest (CEGL008462) – these are all bottomland or lower slope forest types, many with degraded character, and some are temporarily flooded. This is a somewhat heterogeneous grouping but all occupy the drainages and lower slopes of the mapping units.

9002 – Virginia Pine Plantation (CEGL004730) and Interior Mid- to Late-Successional Loblolly Forest (CEGL007105) – both pine dominated forests with generally low natural integrity.

9003 – Appalachian Sugar Maple - Chinquapin Oak Limestone Forest (CEGL006017), Interior Low Plateau Chinquapin Oak - Mixed Oak Forest (CEGL007699) and Interior Plateau Chinquapin Oak - Shumard Oak Forest (CEGL007808) – these are all forests occurring on limestone and dominated or co-dominated by *Quercus muehlenbergii*.

9004 – Dry-Mesic Southern Appalachian White Oak - Hickory Forest (CEGL007231), Highland Rim White Oak - Tuliptree Mesic Lower Slope Forest (CEGL007709) and White Oak - Post Oak Subcalcareous Forest (CEGL008443) – these are all white oak dominated forests that occur in mesic to dry-mesic situations, usually on lower slopes and more sheltered situations.

9005 – Interior Low Plateau Chestnut Oak - Mixed Oak Forest (CEGL007700), Cumberland Plateau Dry-Mesic White Oak Forest (CEGL008430) and Xeric Ridgetop Chestnut Oak Forest (CEGL008431) – these are all chestnut oak dominated or co-dominated dry-mesic to xeric forests of middle slopes and upper ridgetops.

Table 2b
Accuracy Calculations Using Mapped Dominant, Secondary, or Tertiary Vegetation (Best Match), plus Combined Map Classes and accounting for GPS error Chickamauga and Chattanooga National Military Park

Map Class	Producer's Accuracy		User's Accuracy	
	Accuracy (%)	n	Accuracy (%)	n
2103	100	2	100	2
3837	100	1	50	2
4048	100	30	100	30
4290	100	1	100	1
4392	100	5	100	5
4583	0	2	N/A	0
4732	0	1	N/A	0
5131	50	2	33	3
7216	0	1	N/A	0
7220	67	3	22	9
7233	0	3	N/A	0
7240	50	4	25	8
7493	100	1	50	2
7881	50	2	20	5
8441	14	7	20	5
8487	59	49	83	35
9000*	81	131	79	134
9001*	25	24	67	9
9002*	79	24	58	33
9003*	88	136	79	150
9004*	84	90	88	86
9005*	100	2	100	2

n — The sample size. For user's accuracy, this is the number of points mapped in this class. For producer's accuracy, it is the number of points assigned to that class in the field.

n/a — Not applicable. For user's accuracy, no evaluation points were mapped in this class. For producer's accuracy, no evaluation points were assigned to this class in the field.

-- — A confidence interval could not be calculated due to the small sample size.

* — Combined classes of vegetation – see previous page (p 30) for legend.

Table 3a. Contingency Matrix Using Mapped Dominant, Secondary, or Tertiary Vegetation (Best Match), Chickamauga and Chattanooga National Military Park.

Matching Veg	Observed As																																								User's Accuracy (%)
	2103	3837	3938	4048	4290	4392	4418	4583	4730	4731	4732	5033	5131	6017	7105	7124	7184	7216	7217	7220	7231	7233	7240	7247	7330	7334	7493	7699	7700	7709	7808	7881	8429	8430	8431	8441	8443	8462	8487	Total	
2103	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	**100**
3837	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	2	**50**
3938	0	0	3	0	0	0	0	0	0	5	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	**30**
4048	0	0	0	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30	**100**
4290	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	**100**
4392	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	**100**
4418	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	3	4	0	0	1	0	1	0	1	0	0	1	0	3	0	18	**17**
4583	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**N/A**
4730	0	0	0	0	0	0	0	0	1	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	**33**
4731	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	**67**
4732	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**N/A**
5033	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	5	**60**
5131	0	0	0	0	0	0	0	0	0	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	**33**
6017	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	**50**
7105	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	**50**
7124	0	0	0	0	0	0	0	0	0	12	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	19	**26**
7184	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**N/A**
7216	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**N/A**
7217	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	**89**
7220	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	**25**
7231	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	23	0	0	3	0	0	2	0	1	0	0	0	0	0	0	0	1	0	0	31	**74**
7233	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	2	1	1	0	0	0	0	1	0	0	0	0	1	0	0	1	0	1	9	**22**
7240	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**N/A**
7247	0	0	0	0	0	0	0	2	0	3	0	0	0	0	2	1	0	0	0	0	0	0	0	52	0	0	0	1	0	0	0	0	0	0	0	0	1	1	2	65	**80**
7330	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	1	5	**0**
7334	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	3	0	2	3	0	0	0	0	5	9	0	0	0	0	0	0	2	0	0	0	0	2	0	28	**32**
7493	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	2	0	0	0	0	2	0	8	**25**
7699	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	4	0	0	0	0	0	0	0	0	9	**22**
7700	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	36	0	0	0	0	0	0	0	0	0	0	36	**100**
7709	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	4	0	1	5	0	0	0	0	6	8	0	0	0	3	0	0	0	0	0	29	**28**
7808	0	0	0	0	0	0	0	0	0	5	0	0	0	1	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	10	0	0	0	0	0	1	0	0	20	**50**
7881	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	2	**50**
8429	0	0	0	0	0	0	0	0	0	2	0	1	0	0	1	2	0	0	2	1	0	0	0	2	0	0	0	0	0	0	1	0	17	0	0	0	0	2	0	31	**55**
8430	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	1	0	1	0	0	0	0	0	15	0	0	0	1	5	0	0	0	0	1	27	**19**
8431	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	1	0	0	0	0	7	0	0	0	0	1	12	0	0	0	0	23	**52**
8441	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	5	**20**
8443	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	16	0	0	3	0	0	0	0	1	0	0	0	0	0	0	0	3	0	0	25	**12**
8462	0	0	0	0	0	0	0	0	0	1	0	1	0	0	7	0	0	1	2	1	0	0	0	4	0	0	0	0	0	0	0	0	1	0	0	0	0	16	0	34	**47**
8487	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	5	**20**
Total	2	1	3	30	1	5	5	2	1	37	1	7	2	3	23	9	3	1	29	7	44	3	3	77	9	15	4	3	68	8	18	1	28	10	12	2	7	28	7	**519**	
Producer's Accuracy (%)	**100**	**100**	**100**	**100**	**100**	**100**	**60**	**0**	**100**	**11**	**0**	**43**	**50**	**67**	**0**	**56**	**0**	**0**	**28**	**14**	**52**	**67**	**0**	**68**	**0**	**60**	**50**	**67**	**53**	**100**	**56**	**100**	**61**	**50**	**100**	**50**	**43**	**57**	**14**		

Overall accuracy = 52.6%

Kappa statistic = .499 (49.9%)

Table 3b
Accuracy Calculations Using Mapped Dominant, Secondary, or Tertiary Vegetation (Best Match)
Chickamauga and Chattanooga National Military Park

Map Class	Producer's Accuracy		User's Accuracy	
	Accuracy (%)	n	Accuracy (%)	n
2103	100	2	100	2
3837	100	1	50	2
3938	100	3	30	10
4048	100	30	100	30
4290	100	1	100	1
4392	100	5	100	5
4418	60	5	17	18
4583	0	2	N/A	0
4730	100	1	33	3
4731	11	37	67	6
4732	0	1	N/A	0
5033	43	7	60	5
5131	50	2	33	3
6017	67	3	50	4
7105	0	23	50	6
7124	56	9	26	19
7184	0	3	N/A	0
7216	0	1	N/A	0
7217	28	29	89	9
7220	14	7	25	4
7231	52	44	74	31
7233	67	3	22	9
7240	0	3	N/A	0
7247	68	77	80	65
7330	0	9	0	5
7334	60	15	32	28
7493	50	4	25	8
7699	67	3	22	9
7700	53	68	100	36
7709	100	8	28	29
7808	56	18	50	20
7881	100	1	50	2
8429	61	28	55	31
8430	50	10	19	27
8431	100	12	52	23
8441	50	2	20	5
8443	43	7	12	25
8462	57	28	47	34
8487	14	7	20	5

n	The sample size. For user's accuracy, this is the number of points mapped in this class. For producer's accuracy, it is the number of points assigned to that class in the field.
n/a	Not applicable. For user's accuracy, no evaluation points were mapped in this class. For producer's accuracy, no evaluation points were assigned to this class in the field.
--	A confidence interval could not be calculated due to the small sample size.

Table 4a Contingency Matrix Using Mapped Dominant Vegetation Only, Chickamauga and Chattanooga National Military Park

Mapped As	Observed As																																								User's Accuracy (%)
	2103	3837	3938	4048	4290	4392	4418	4583	4730	4731	4732	5033	5131	6017	7105	7124	7184	7216	7217	7220	7231	7233	7240	7247	7330	7334	7493	7699	7700	7709	7808	7881	8429	8430	8431	8441	8443	8462	8487	Total	
2103	2	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	**67**
3837	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	2	**50**
3938	0	0	3	0	0	0	0	0	0	5	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	**30**
4048	0	0	0	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30	**100**
4290	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**N/A**
4392	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	**0**
4418	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	1	3	4	0	0	1	0	1	0	2	0	0	1	0	3	0	23	**1**
4583	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**N/A**
4730	0	0	0	0	0	0	0	0	1	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	**33**
4731	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	**67**
4732	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**N/A**
5033	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	5	**60**
5131	0	0	0	0	0	0	0	0	0	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	**33**
6017	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	**50**
7105	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	2	0	8	**38**
7124	0	0	0	0	0	0	0	0	0	12	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	18	**22**
7184	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**N/A**
7216	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**N/A**
7217	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	**60**
7220	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	6	**17**
7231	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	21	0	0	3	0	0	2	0	1	0	0	0	0	0	0	0	2	0	0	30	**70**
7233	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	2	1	1	0	0	0	0	1	0	0	0	0	1	0	0	1	0	1	9	**22**
7240	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**N/A**
7247	0	0	0	0	0	0	0	2	0	3	0	0	0	0	2	1	0	0	0	0	0	0	0	37	0	0	0	1	0	0	0	0	0	0	0	0	1	2	2	51	**73**
7330	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	1	5	**0**
7334	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	3	0	2	3	0	0	0	0	5	9	0	0	0	0	0	0	3	0	0	0	0	2	0	29	**31**
7493	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	5	0	0	2	0	0	0	0	0	2	0	0	0	0	2	0	13	**15**
7699	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	2	0	0	4	0	0	0	0	0	0	0	0	10	**20**
7700	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30	0	0	0	0	0	0	0	0	0	0	30	**100**
7709	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	4	0	1	6	0	0	0	0	6	8	0	0	0	3	0	0	0	0	0	30	**27**
7808	0	0	0	0	0	0	0	0	0	5	0	0	0	1	1	1	0	0	0	0	0	0	0	4	0	0	0	0	0	0	10	0	0	0	0	0	1	0	0	23	**43**
7881	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	2	**50**
8429	0	0	0	0	0	0	0	0	0	2	0	1	0	0	1	3	0	0	2	1	0	0	0	2	0	0	0	0	0	0	1	0	15	0	0	0	0	2	0	30	**50**
8430	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	1	0	1	0	0	0	0	0	18	0	0	0	1	5	0	0	0	0	1	30	**17**
8431	0	0	0	0	0	5	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	1	0	0	0	0	9	0	0	0	0	1	12	0	0	0	0	30	**40**
8441	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	5	**20**
8443	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	18	0	0	7	0	0	0	0	1	0	0	0	0	0	0	0	2	0	0	30	**7**
8462	0	0	0	0	0	0	0	0	0	1	0	1	0	0	7	0	0	1	2	1	0	0	0	5	0	0	0	0	0	0	0	0	1	0	0	0	0	11	0	30	**37**
8487	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	5	**20**
Total	2	1	3	30	1	5	5	2	1	37	1	7	2	3	23	9	3	1	29	7	44	3	3	76	9	15	4	2	68	8	18	1	28	10	12	2	7	28	7	**519**	
Producer's Accuracy (%)	**100**	**100**	**100**	**100**	**0**	**0**	**40**	**0**	**100**	**11**	**0**	**43**	**50**	**67**	**13**	**44**	**0**	**0**	**10**	**14**	**48**	**67**	**0**	**49**	**0**	**60**	**50**	**100**	**44**	**100**	**56**	**100**	**54**	**50**	**100**	**50**	**29**	**39**	**14**		

Overall accuracy = 44.1%

Kappa statistic = .413 (41.3%)

Table 4b
Accuracy Calculations Using Mapped Dominant Vegetation Only
Chickamauga and Chattanooga National Military Park

Map Class	Producer's Accuracy		User's Accuracy	
	Accuracy (%)	n	Accuracy (%)	n
2103	100	2	67	3
3837	100	1	50	2
3938	100	3	30	10
4048	100	30	100	30
4290	0	1	N/A	0
4392	0	5	0	1
4418	40	5	1	23
4583	0	2	N/A	0
4730	100	1	33	3
4731	11	37	67	6
4732	0	1	N/A	0
5033	43	7	60	5
5131	50	2	33	3
6017	67	3	50	4
7105	13	23	38	8
7124	44	9	22	18
7184	0	3	N/A	0
7216	0	1	N/A	0
7217	10	29	60	5
7220	14	7	17	6
7231	48	44	70	30
7233	67	3	22	9
7240	0	3	N/A	0
7247	49	76	73	51
7330	0	9	0	5
7334	60	15	31	29
7493	50	4	15	13
7699	100	2	20	10
7700	44	68	100	30
7709	100	8	27	30
7808	56	18	43	23
7881	100	1	50	2
8429	54	28	50	30
8430	50	10	17	30
8431	100	12	40	30
8441	50	2	20	5
8443	29	7	7	30
8462	39	28	37	30
8487	14	7	20	5

n — The sample size. For user's accuracy, this is the number of points mapped in this class. For producer's accuracy, it is the number of points assigned to that class in the field.

n/a — Not applicable. For user's accuracy, no evaluation points were mapped in this class. For producer's accuracy, no evaluation points were assigned to this class in the field.

-- — A confidence interval could not be calculated due to the small sample size.