The Cumberland Trail: An Assessment of the Land Acquisitions and Potential Ecological Value of Tennessee's New Linear Park

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Ben Miles

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To the Graduate Council:

I am submitting a thesis written by Ben Miles entitled "The Cumberland Trail: An Assessment of the Land Acquisitions and Potential Ecological Value of Tennessee's New Linear Park." I have examined the final copy of this thesis and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science with a major in Environmental Science.

[redacted]

John C. Tucker, Chairperson

We have read this thesis and
recommend its acceptance:

[redacted]

Dr. Thomas P. Wilson

[redacted]

Dr. Joey Shaw

[redacted]

Dr. David A. Aborn

Accepted for the Graduate Council:

[redacted]

Dr. Deborah Arfken

Dean of The Graduate School

"A path is little more than a habit that comes with knowledge of a place. It is a sort of ritual of familiarity. As a form, it is a form of contact with a known landscape. It is not destructive. It is the perfect adaptation, through experience and familiarity, of movement to place; it obeys the natural contours; such obstacles as it meets it goes around."

--Wendell Berry, *A Native Hill*

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ABSTRACT

Tennessee's first linear state park, the Cumberland Trail State Scenic Trail, will stretch over three hundred miles from Signal Point in Hamilton County, to the Cumberland Gap on the Kentucky border. Although the trail uses land already in public ownership at different locations along its proposed route, land purchased to secure a state-managed corridor for the Cumberland Trail acquires properties along an expansive area of the Cumberland Plateau. Efforts to acquire land for the trail's corridor utilize both federal and state funding, and constitute the largest land acquisition project in Tennessee. This large and unique State Park land acquisition effort, with further ecological monitoring and analysis, will provide substantial contributions to sound conservation of the Cumberland Plateau.

The ecological value and potential contribution of the developing park receive close analysis here, using academic research and field studies. Guidelines regarding the most effective design of nature reserves, derived from biogeography, are applied to the protected area of the Cumberland Trail to articulate that area's potential contribution to the region's ecological integrity. Additionally, research from field studies provides baseline data on the natural resources contained within the Cumberland Trail State Park's land, and identifies where further research could provide greater understanding of the Cumberland Plateau. The processes utilized for Cumberland Trail land acquisitions are also examined and analyzed to determine some of the difficulties in the acquisition procedures, and why these encumbrances arise. Florida's land acquisition efforts, as carried out by Water Management Districts in that state, are also examined in order to

provide a comparative lens through which the Tennessee system might be more critically analyzed. Based on these data and analyses, I argue that the Cumberland Trail presents an important opportunity for effective land conservation on the Cumberland Plateau, and that continuing research carried out on Cumberland Trail properties holds the promise of greatly increasing our ecological understanding of this diverse and threatened region. I further contend that the land acquisition process in place for Cumberland Trail acquisitions should be improved, and should receive more support from state agencies in Nashville, so that it may continue and fully realize the potential ecological contribution of this emerging park.

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I. INTRODUCTION

In 1998, the Cumberland Trail State Scenic Trail (CTSST) became Tennessee's first linear state park, reviving a vision for eastern Tennessee that emerged in the late 1960s. The Cumberland Trail is envisioned as an unbroken path over 300 miles long on land managed by the state, but no continuous corridor of public land currently exists over which the Cumberland Trail (CT) may pass. Therefore, land must be acquired that forms a continuous line linking the Cumberland Gap in Claiborne County and Signal Point in Hamilton County. The land acquisition effort underway to secure the corridor for the Cumberland Trail constitutes the largest land acquisition project in the state of Tennessee, extending state management and protection to thousands of acres on the Cumberland Plateau.

This thesis examines the ambitious effort to acquire land in eastern Tennessee for the CT. Specifically, this thesis evaluates the effectiveness of Tennessee's land acquisition system, including how well this system serves broader conservation goals of the region. In addition to the analysis of land acquisitions, the potential contribution of the CT to the ecological health of the region is evaluated, and baseline data are presented that display some of the natural resources being integrated into the new park. This thesis project examines two main claims, one based on the ecology of CT lands, and a second that is based on the policy for CT land acquisitions. First, I argue that the CT is an effective and needed conservation project that holds vast potential to sustain the overall ecological integrity and security of the Cumberland Plateau and eastern Tennessee. Second, I contend that the current land acquisition system is under-serving the mandated mission of the CT, and that certain improvements to Tennessee's system will enable the

CT project to more fully realize its potential to this ecologically unique region (Ricketts et al. 1999) facing substantial impending loss of habitat from multiple land use changes (Evans et al. 2002).

As one region of a larger plateau which fronts the Appalachian Mountains to the west, the Cumberland Plateau makes up one tenth of Tennessee's land area and spans the eastern third of the state from north to south (Luther 1977). Bisected by the Sequatchie Valley at its southern extent, and broken by the Cumberland Mountains near the Kentucky border, the table land of the Cumberland Plateau rises a thousand feet above adjacent valley floor (Luther 1977). Soils not conducive to farming and the relative inaccessibility of the Cumberland Plateau have kept its population lower than surrounding regions (Gardner 2006; Luther 1977). The history of land ownership on the plateau reveals common land speculation and absentee landowners. Consequently, residents developed a strong conception of the vast expanses of forest, owned by an unseen entity, as a commons accessible to local people (Gardner 2006).

In arguing for the ecological value of the CT project, the lands acquired for the CTSST are evaluated using principles for optimal design of protected areas, and data collected during extensive field work present baseline data regarding the natural resources of the new park. Maps created using Geographic Information Systems (GIS) tools display the increased habitat connectivity achieved by the acquisition of land for the purpose of its inclusion in the CTSST. This increase in the connectivity and amount of land under state management is examined using principles from the science of reserve design to argue that the CT project accomplishes many objectives for effective design of protected areas. Data collected during fieldwork present evidence of the ecological value

of the protected lands of the CT, and identify areas where additional research could lead to improved understanding of the ecology of the Cumberland Plateau in eastern Tennessee.

In order to secure the CT's corridor, many individual properties along the Cumberland Plateau must be purchased, in some way, for the CTSST. Land acquisitions for the CTSST must conform to processes administered by two different agencies because funding for CTSST land acquisitions is drawn from both state and federal sources. The processes required by both state and federal systems for land acquisitions are explicated here, as well as the precise manner by which the CTSST administers these two procedures. Key steps for each process are described, as well as the funding sources tapped by the CT for these land acquisitions. Several "keystone" parcels receive closer examination using the optimal timeline for CT acquisitions. Finally, this exposition and analysis of the CT's usage of the Tennessee land acquisition system is compared with Florida's land acquisition system, as used by Water Management Districts (WMDs) in that state.

Land acquisition efforts for the CT will eventually result in an unbroken ribbon of state managed land from the Cumberland Gap to Signal Point, forming an enormous greenway along the Cumberland Plateau and containing many ecological and scenic treasures (Figure 1). As the Cumberland Plateau increasingly becomes a prime target for developers and conservationists alike, land acquisitions by the state promise the benefits of public ownership and informed state management of important habitat. By improving the system by which such acquisitions take place, the CT can establish a groundbreaking

framework for successful conservation in a biologically rich and intact region facing land use changes and habitat fragmentation.

Figure 1. The Cumberland Trail (CT) winds through brilliant fall colors in Rock Creek, Hamilton County. Scenes such as this one on land recently acquired for the CT, reveal the tremendous scenic beauty of these properties and hint at the ecological value that they possess.

II. BACKGROUND

A. History of the Cumberland Trail

In 1965, a hiking trail called the Cumberland Trail was first envisioned and proposed to connect the Cumberland Gap and Cove Lake in Campbell County, but it did not progress beyond the planning stage (Means 1999). However, the idea persisted and, in 1968, the ambition to create a continuous hiking trail between the Cumberland Gap in Claiborne County and the Tennessee River Gorge near the Georgia border helped spark the creation of the Tennessee Trails Association (Means 1999). The Tennessee Trails System Act, the first such act by any state in the country, was adopted in 1971 and describes the Cumberland Trail as extending "roughly from the Tennessee state line near Marion and Hamilton counties to Cumberland Gap, following the scenic mountains, gorges, and escarpments of the Cumberland" (Tenn. Code Ann. § 11-11-106).

Despite thirty year old legislation explicitly authorizing the Cumberland Trail, in 1998 only about one fifth of the planned trail was open for hiking. By contrast, it took a mere 16 years for the Appalachian Trail (AT) to progress from vision to completion (Bunch 1979). The thirty years that followed the first mention of the CT are marked by periods of intermittent progress and stagnation. As administrations changed over the years, the CT was at times encouraged, but often neglected as priorities and funding shifted. For example, less than five years after the Tennessee Trails System Act was adopted as law, a change in the Governor's administration resulted in the "impoundment" of over half a million dollars that had been allocated for the Cumberland Trail (Means 1999). As a result of sporadic funding and varying political support, completion of the CT remains a long-term goal in 2007.

Funding during the period between 1971 and 1998 was sporadic at best, and never sufficient to support significant land acquisitions. Trail construction proceeded in the Tennessee River Gorge segment of the CT in Prentice Cooper State Forest, which had been owned and managed by the state since 1945 (Tennessee Department of Agriculture 2007). In the northern sections of the CT the trail was constructed on private land during this period. In 1990 the state cut all funding for maintenance and operations of the CT and most sections of the trail fell into disrepair from neglect (Means 1999).

A turning point for the CT occurred in 1998 when Governor Don Sundquist commissioned the CTSST as the state's first linear state park. The previous year saw the formation of the Cumberland Trail Conference (CTC), which partnered with the state park in 1998 for maintenance and acquisition responsibilities. When the CTSST became a state park in 1998, there were 65 miles of Cumberland Trail considered open to the public (Weber 1998). The revitalization of the CT vision at this time, however, led to dramatic increases in open trail. A partnership with the Spring Break Away program began in 1998 and continues to the present, yielding hundreds of volunteer college students over a five week period for the CTC's trail building efforts. Break Away: The Alternative Break Connection, a national nonprofit organization, provides training and information that facilitates participation of college students in various types of service projects around the country (Break Away 2007). The open trail mileage was also increased by including two existing loop trails in the Prentice Cooper State Forest in the total CT mileage (Deweese 1999). This additional finished trail mileage, combined with the hard work of many volunteers, resulted in 100 miles of open CT in 2000.

B. Management of the Cumberland Trail

The CTSST is administered by the Tennessee Department of Environment and Conservation (TDEC), which shares the CT's management responsibilities with the CTC. The land of Tennessee State Parks, including the land of the CTSST , "are dedicated to and forever reserved and administered by the state for the recreational and cultural use and enjoyment of the people" (Tenn. Code Ann. § 11-3-101), and must "be preserved in a natural condition so far as may be consistent with its human use and safety, and all improvements shall be of such character as not to lessen its inherent recreational value" (Tenn. Code Ann. § 11-3-102). Working in partnership with the staff of the CTSST, the CTC includes "development and completion of the Cumberland Trail corridor" (CTC 2006) as a part of its mission statement, but the focus of this organization has shifted to "leading the efforts on the construction of the CT" (CTC 2006).

The staff of the CTSST currently administers a TDEC contract for CTC's trail construction and maintenance responsibilities. Although negotiations for at least one land acquisition are still led by the CTC, all other land acquisition projects for the CT are carried out by the staff of the state park. Some early successes in securing funding and acquiring land followed the creation of the CTSST and CTC, but questions were subsequently raised regarding the CTC's authority to lead land acquisitions for a state agency and its appropriate role in the use of state and federal grant money. In March of 2004, land acquisition responsibilities for the CT project were formally given to the CTSST, though in reality the state park had played a role in all previous land acquisitions for the CT (Fulcher interview, 10/23/06). The CTC's main responsibilities now focus on

building trail, and the responsibilities of the CTSST's staff includes land acquisitions, administering the grant for trail building, and management of all current CT lands.

As indicated above, the CT includes trail located within Prentice Cooper State Forest (PCSF), which is managed by Tennessee Department of Agriculture (Tennessee Department of Agriculture 2007). This overlapping of public land management agencies occurs through much of the CT. The CT also enters into the borders of several Tennessee State Natural Areas, three Tennessee Wildlife Management Areas (WMA), two Tennessee State Parks, and three units of the National Park System (table 1). Where the CT enters such pre-existing parcels, the CTSST defers to the other management body for user restrictions. For example, the PCSF conducts regular, managed big game hunts in the spring and fall, and on those days the PCSF is closed to hikers, including hikers on the CT (Tennessee Department of Agriculture 2007), and hikers on the CT in the Royal Blue WMA are required to wear blaze orange during much of the year (CTC 2007). In addition, while the CTSST does not place restrictions on camping throughout the corridor, many individual units already have certain camping restrictions in place, which apply to the CT where it is within their boundary. The CTSST and CTC accept responsibility for maintaining trail in those areas, but hikers are expected to abide by the rules of the management strategy already in place. When more individual segments are completed that allow longer through-hikes on the CT to pass in and out of some of these existing areas, through-hikers will have to plan their trip so that it does not conflict with these restrictions, but for now information on the CTSST and CTC's websites, as well as signs at CT trailheads, describe the ways that hikers may comply with these rules for day hikes.

Table 1. Properties owned by state and federal agencies over which the Cumberland Trail passes.

Publicly owned property	Managing agency
Signal Point National Historic Park	National Parks Service
Cumberland Gap National Historic Park	National Parks Service
Obed Wild and Scenic River	National Parks Service
Frozen Head State Park	Tennessee State Parks
Cove Lake State Park	Tennessee State Parks
Prentice Cooper State Forest	Tennessee State Forests
Sundquist Wildlife Management Area	Tennessee Wildlife Resources Agency
Royal Blue Wildlife Management Area	Tennessee Wildlife Resources Agency
North Chickamauga Creek State Natural Area	TDEC Division of Natural Areas
Laurel Snow State Natural Area	TDEC Division of Natural Areas
Ozone Falls State Natural Area	TDEC Division of Natural Areas
Stinging Fork State Natural Area	TDEC Division of Natural Areas

C. Land acquisitions for the Cumberland Trail

There are currently about 8000 acres within the CTSST, and that number continues to grow. Land acquisition efforts for the CT aim to ensure that the trail can use the developing corridor in perpetuity, using several different methods. Purchasing all rights to intact tracts directly from the landowner is the preferred approach, but other methods such as acquiring an easement for the trail's passage, or purchasing a small corridor within a larger parcel of property, are also employed in some cases. By receiving a legal easement at the very least, and a fee-simple purchase at best, the CT avoids problems inherent in previous arrangements where non-binding agreements were terminated or lapsed over time. Land acquisition efforts for conservation purposes, such as these efforts to secure the CT's corridor, amount to "parcel by parcel" use restrictions (Newburn 2005), and secure the kind of permanent protection necessary for land conservation (Randolph 2004).

Historically, state acquired lands have been utilized in the route of the CT, but those property acquisitions have been primarily motivated by purposes other than for use

by the CT. Land acquired by the state since 1971, and now used by the CT for its corridor, includes properties on Black Mountain in Cumberland County, an addition to Frozen Head State Natural Area in Morgan County, the Royal Blue Wildlife Management Area, and the Sundquist Wildlife Management Area. The route of the CT has traversed through these properties, and they now include some mileage of the CT within each of their borders. Acquiring properties specifically and primarily for the CT's corridor, to be included in the CTSST, is a more recent phenomenon, most clearly exhibited in the acquisition of the Rock, Possum, and Soddy Creek gorge properties in northern Hamilton County (Figure 2).

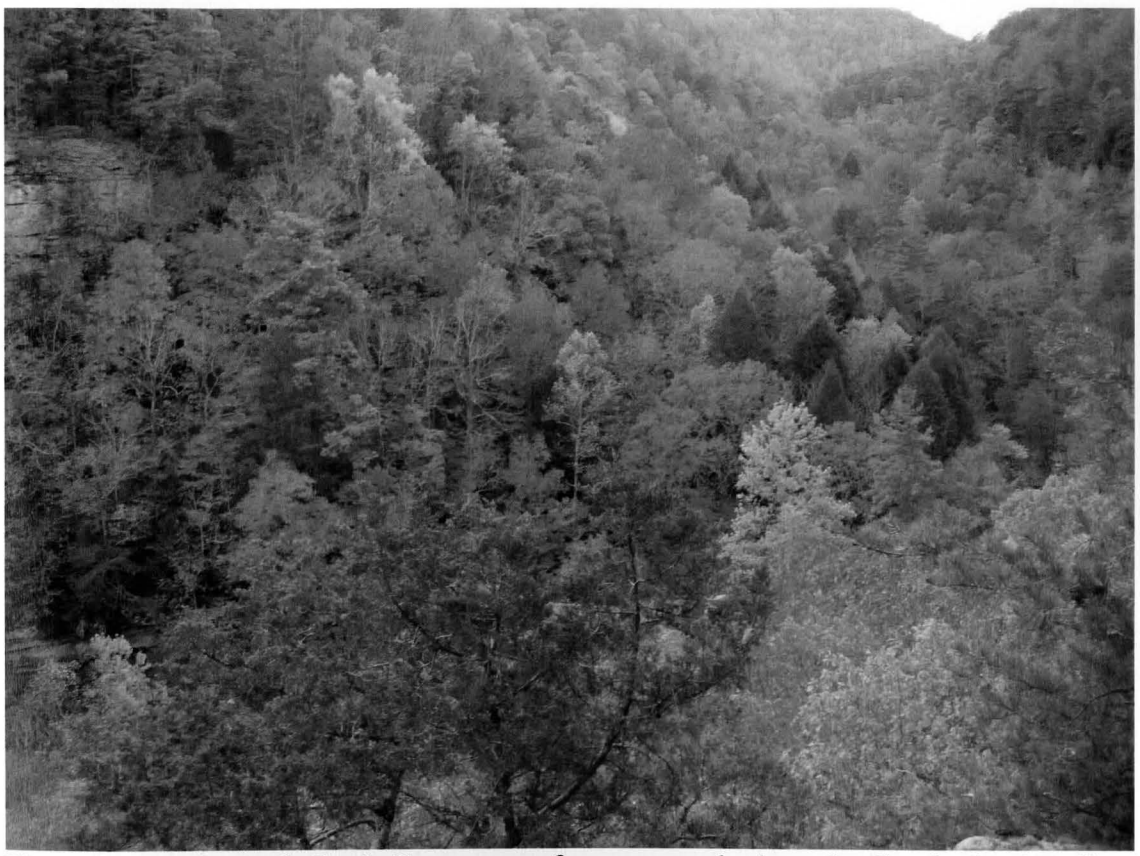

Figure 2. Scenic Rock Creek Gorge, seen from an overlook on the Cumberland Trail. Most land in this photo has recently been acquired for inclusion in the CTSST. Green peaks of towering hemlocks rise above Rock Creek at the bottom of the gorge.

Since receiving the responsibility for CT land acquisitions, the CTSST staff has established 2009 as the goal for completing all necessary land acquisitions. Currently, the staff of the state park considers dozens of parcels under active investigation or negotiation. Plans include over sixty properties proposed for acquisition in 2007, with over two dozen more identified to follow in 2008. These properties may be as large as several thousand acres, or as small as less than one acre. The amount of acreage acquired depends to some extent on how much of the property the owner is willing to sell, and how much the CTSST can afford to buy. A primary, preferred route for the CT has been planned and mapped, and all properties it passes over have been identified. Additionally, several alternative routes have also been examined, to assure continuance of the CT if individual landowners on any one route are unwilling to sell. This thesis examines more closely the value of this increase in protected land, as well as how these land acquisition efforts are carried out and how well the current land acquisition process used by the CT functions to serve its goals, and the greater conservation objectives for the entire region.

III. METHODS AND MATERIALS

A. Ecological Value

1. Habitat Conservation

Using facilities at the University of Tennessee at Chattanooga (UTC), maps have been created portraying the CT project. Existing CTSST mapping data has been integrated into maps assembled at UTC using ArcGIS software. Components of the GIS maps created for this project include the location of open trail and proposed trail routes, parcel boundaries for CTSST parcels and planned acquisitions, and GPS waypoint locations collected as part of the field work portion of this research. Upon completion, this mapping component facilitated productive analysis of the geography of the CT, assisting in the application of reserve design principles to the property managed by the emerging CTSST, and aided in the examination of the parcels targeted as keystone parcels in the land acquisition component of this research. The maps completed for this project not only produced quantitative data for further analysis, they also offer powerful and easily grasped visual presentation of the ecological contributions offered by the CT to the larger region.

2. Water Quality

Field research related to water resources included in CT land was partly motivated by the goal of determining the impact of Acid Mine Drainage (AMD) on CT streams, and the subsequent health dangers to hikers that might use these as drinking water sources. This component of the research was supported by a grant from the Office of Surface Mining (OSM), administered locally by the North Chickamauga Creek Conservancy and the CTSST. This research produced extensive data regarding the health of streams

occurring along the CT, especially in the southern sections, particularly relating to contaminants associated with AMD. Several water quality parameters were measured at water sampling locations along the corridor of the CT, and at each of these sites samples were collected for further analysis in the lab. At stream crossings likely to be used as a source of drinking water for backpackers, the pH, dissolved oxygen (DO), and temperature of the water were tested in the field. A Hanna Instruments HI 98140 GLP pH Meter (Figure 3) was used to obtain pH and temperature of the water body, and a LaMotte dissolved oxygen kit used for the DO. A water sample collected from each sampling location was then analyzed in lab facilities at UTC to determine the concentrations of substances associated with acid mine drainage. In the lab, a LaMotte test kit was used to determine concentrations of Aluminum, Iron, Manganese, and Sulfate.

Figure 3. The Hanna pH & temperature meter used in this research tests the waters of Mikel Branch, a stream with orange staining on the rocks that is indicative of the impacts of Acid Mine Drainage. The meter is in the bottom right of the photo.

3. Vascular Plants

Research involved in this project also initiated the first herbarium prepared exclusively for a state park in Tennessee. This part of the research was supported by TDEC, through the CTSST, and with consultation from the administrators of the Herbarium at UTC. Beginning in August of 2006, a trail centered survey of park lands was conducted to collect vascular plants for this new herbarium. Although this field study did not amount to a comprehensive survey of the vascular plants within CTSST lands, trail centered surveys have been used in the past to ascertain biological resources within a protected area (Chiarello 2000), and this type of approach facilitated the survey of a broad geographic range. Plants were collected that occurred along the CT, again

concentrating in the southern sections of the CT (Figure 4), when it was determined that their removal would not constitute a significant threat to the plant's population viability. A GPS waypoint was recorded at where which a plant was collected. Each plant was then pressed, identified, and mounted so that they could form the first entries in the new CTSST herbarium. Voucher specimens were submitted to the UTC herbarium, under the direction of Dr. Joey Shaw of the UTC Department of Biological and Environmental Sciences, who provided ongoing consultation and support for this herbarium project.

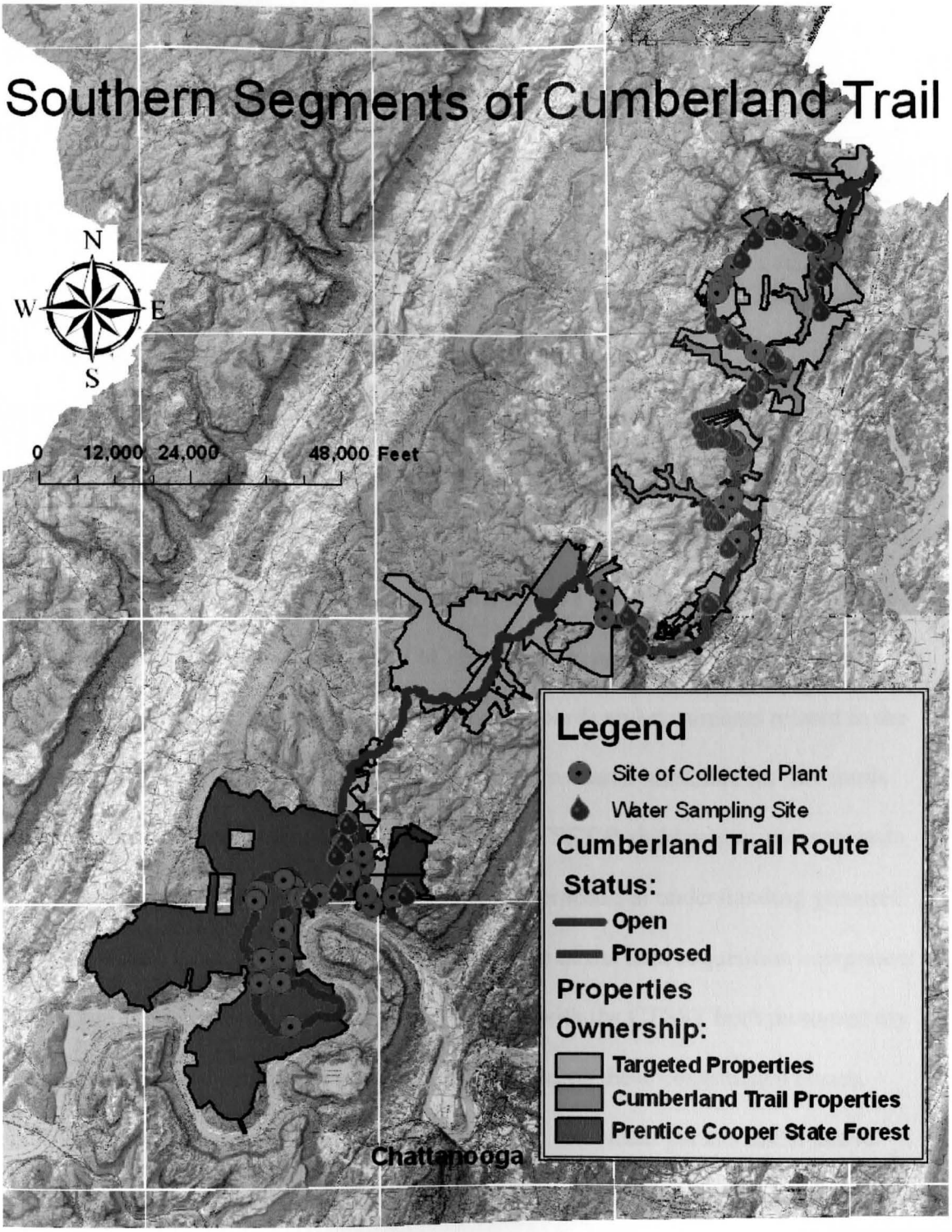

Figure 4. The southern extent of the Cumberland Trail, displaying locations where the bulk of field work for this project was carried out.

B. Land Acquisitions

1. Tennessee

The inclination to further examine and evaluate the land acquisitions of the CT grew from my experience working with the CTSST for the past year, and learning how their land acquisition process worked. Some of my work for the CTSST has included clerical tasks related to land acquisitions for the CT, and my experience in that role contributed to my estimation that there was room for improvement in the way that the current state land acquisition process served the CT project. These tasks have required considerable analysis and understanding of the entire land acquisition process required by the state, as well as procedures followed by the CTSST for individual projects. State and federal oversight demands a high level of transparency, and this requires organized documentation on the part of the CTSST. These records and documents related to the CT's land acquisition efforts provide indispensable research materials for this thesis project. With the permission from Bob Fulcher, CTSST Park Manager, these records have been examined at great length. The data and procedural understanding garnered from reviewing these documents form the backbone of the land acquisition component of this research project. In this way, my employment with the CTSST both prompted my further research and provided invaluable background on these complicated issues.

Currently, there are as many as seventy-five individual parcels under active negotiations or investigation by the staff of the CTSST, and over 170 that fall along the preferred or an alternate route. Analysis revealed that there were several factors complicating the mission of acquiring a corridor of state-managed land across the Cumberland Plateau. Some of these complications related to the absolutely critical

aspect of continuity and connectedness for this 'trail-driven' land acquisition mission. Acquiring a continuous corridor for the CT requires acquisition of contiguous properties. Each property that is acquired influences which nearby parcels are themselves targets for acquisition, and failure to acquire a particular property can alter the trail's route, possibly requiring acquisition of different subsequent properties. Further, some landowners refuse to enter into negotiations with the CTSST until adjacent land has been successfully acquired (Fulcher personal communication 8/06). In order to prepare for such developments, planning by the CTSST staff includes "alternate routes" for the trail. All of these continuity issues undoubtedly complicate land acquisition efforts for the CT; however they are distinct from complications arising from adhering to processes required by state agencies for these acquisitions.

As my analysis was chiefly focused on difficulties in the state system for conservation minded land acquisitions, I designed my research to filter out inherent difficulties associated with continuity. Thus, the closest scrutiny was not focused on the entirety of the land acquisition efforts for the trail, or even that of specific segments of the trail, because such a perspective will include those challenges associated with continuity. Instead, I limited my closest analysis to certain individual parcels targeted for acquisition by the CTSST. In order to ensure that full efforts of the CTSST had been brought to bear on these targeted parcels, I focused solely on those properties which were critical to the planning for a specific segment of the trail, which I refer to as "keystone parcels." Identification of the "keystone parcels" was based on my research and experience in the land acquisition efforts for the CT, and supported by maps created for this project. The maps also provided data for a comprehensive description of these

keystone parcels. By focusing on individual properties this research concentrated on the state of Tennessee's land acquisition system and its efficacy related to land acquisitions for the CT.

The analysis of keystone parcels involved examining several aspects of the efforts to acquire each particular property. With property values on the rise in areas targeted for CT land acquisitions, the time required to complete acquisition becomes highly significant. In some cases, properties identified for acquisition have changed hands multiple times before the CTSST can make an offer, each instance causing the parcel's cost to increase (Fulcher interview 10/23/06). Thus, this research examined overall time required to complete acquisition of individual properties, as well as the time required for each important step for the acquisition of each keystone parcel. In addition, the funding sources for the acquisition of each keystone parcel were examined, as well as the requirements for using such funding sources.

A metric was developed during this research to assist in the analysis of the overall effectiveness of the CT's land acquisition efforts. The metric was designed and applied to examine individual properties, and thus concentrated on the aforementioned keystone parcels. The metric was intended to help illustrate the time required for the parcel to progress through the acquisition process, the types and sources of money utilized for acquisition, and the type of acquisition achieved (or attempted). However, the properties selected as keystones had not progressed far enough in the acquisition process to adequately display total time each parcel required to move through the procedures, existing documents recording their progress often proved incomplete, and the dates for completed documents did not follow the timeline used to establish the metric. Thus, the

data collected to complete the metric was not well suited to quantitative analysis, but the metric nonetheless provided an indispensable framework for researching the effectiveness of land acquisition efforts for individual properties.

My employment with the CTSST also introduced me to several principle personnel in the land acquisition efforts, who were subsequently interviewed for this research project. Park manager Fulcher and two of his park rangers intimately involved in land acquisitions, Andy Wright and Joey Carlton, were interviewed to learn their perspective on the state land acquisition process. These interviews afforded valuable perspectives and evidence to my examination of perceived and real difficulties in the Tennessee state land acquisition system.

2. The Florida Model

Finally, in order to provide insight into successful land acquisition practices, two water management districts (WMDs) in Florida were examined to learn how those WMDs acquire land. Florida's WMDs receive considerable recognition for their land acquisition efforts and successes, and have been called the most successful state-sponsored land acquisition group in the country (Farr & Brock 2006, McQueen & McMahan 2003, Diamond & Noonan 1996, Endicott 1993). Generally, lands are acquired by WMDs to "build water resource development and restoration projects and to conserve natural resources," including floodplains and aquifer recharge areas (SJRWMD 2007). In reviewing Florida's WMDs, background literature (including relevant statutes, regulations, and documents published on the web by WMDs and Florida's Department of Environmental Protection) was first examined to provide a basic understanding of WMD

programs. Second, field visits were conducted to the headquarters of the St. Johns River Water Management District (SJRWMD) in Palatka and the South Florida Water Management District (SFWMD) in West Palm Beach, where interviews with land acquisition staff provided an understanding of land acquisition practices, challenges and accomplishments in Florida. Examining procedures employed by these WMDs, as well as discovering some of the lessons they have learned along the way, yielded a perspective which facilitated critical examination of Tennessee's system and suggested areas which might be improved to better serve conservation oriented land acquisitions in this state.

IV. RESULTS

A. Ecological Value

1. Habitat Conservation

Though the effects of a long history of mining and timber production are in some places more severe than others, contiguous forest communities exist today largely on private land over expansive areas of the Cumberland Plateau (Evans et al. 2002). The Cumberland Plateau contains "globally outstanding biodiversity value with extraordinarily high species richness and endemism" (Ricketts et al. 1999), with vegetation exhibiting a diversity not often seen in similar climates (Shaw & Wofford 2003). Although historically low population pressures have allowed these unique habitats and communities to survive, habitat pressures now threaten to erode the Cumberland Plateau's distinctive biologically diverse landscape. In 2004, the Natural Resources Defense Council recognized the Cumberland Plateau as a World Biogem, declaring its exceptional biodiversity to be "endangered" (Paine 2004; Natural Resources Defense Council 2006).

Ecological communities on the Plateau face a two pronged threat from development and environmentally unsound forestry practices (Wear & Greis 2001). Population growth on the Cumberland Plateau in Tennessee has increased in recent years as large number of retirees move to the agreeable climate of the region (Lawson 2005). Changes in the timber industry threaten to further degrade the landscape of the Plateau. Bowater Inc, a timber company based in South Carolina, is in the process of selling over 250,000 acres of land it owns in the region (Dogwood Alliance 2006). Bowater made headlines recently when it reached an agreement with the Dogwood Alliance, a regional

conservation organization, regarding its policy for replanting harvested areas (Dogwood Alliance 2006). Hopes that were raised for the region-wide implications of the new management policy have been dampened with the announcement that much of the land subject to the new policy will soon change hands to an owner not bound by any previous management agreements (Dogwood Alliance 2006).

Establishing protected areas in biologically diverse areas under threat of substantial land use changes is an essential step to accomplishing the goals of modern ecology, habitat conservation, and biodiversity preservation (Westra et al. 2000; Noss & Cooperrider 1994). Land acquisitions for the Cumberland Trail have been driven by the desire to create a continuous corridor for a linear hiking trail, and have not been motivated by academic debates among ecologists. However, the principles that emerged during scholarly debate over the design of nature reserves, when applied to the corridor for the CT, help to reveal the unique ecological benefits that this park can offer to the region. Concepts from the field of island biogeography applied to the design and management of protected areas helped spawn a debate over whether a single large reserve would be superior to several small reserves of the same total area. The debate came to be known by the acronym SLOSS (for: Single Large Or Several Small), and it continued in its most spirited period for fifteen years. By the early 1990s, most participants in the debate agreed that large reserves were more ecologically valuable than the same amount of area in smaller patches (Cox & Moore 2005; Groves 2003; Noss & Cooperrider 1994; Saunders et al. 1991), but also asserted that greater connectivity between protected areas improves their ecological value (Guirado et al. 2006; Laurence et al. 2002; Chiarello 2000). In addition, studies continue to confirm that small reserves can provide important

value for certain species and across landscapes (Walter 1990; Loman & von Schant 1991; Moss 2002). A list of guidelines or rules that emerged from the SLOSS debate, presented in Table 2, continues to receive widespread support today.

Table 2. Guidelines for the design of protected areas (Groves 2003).

In designing nature reserves, all else being equal:	
1.	Larger reserves are better than small reserves.
2.	A single large reserve is better than a group of small ones of similar area.
3.	Reserves closer together are better than reserves far apart.
4.	Reserves clustered compactly are better than reserves in a line.
5.	Reserves connected by corridors are better than unconnected dots.
6.	Round reserves are better than long, thin ones.

Widespread agreement that large reserves are better than small ones (Guirado et al. 2006; Foreman 2004; Noss & Cooperrider 1994; Saunders et al. 1991), indicates that increasing the size of existing reserves will improve their ecological effectiveness. Expanding even the largest nature preserves will increase ecological benefits they provide (Sauer 1998), and expansion of protected areas will increase interior habitat, which is required for many species (Shafer 1990). Efforts to establish the Cumberland Trail State Park could increase total state-managed land by over 20,000 acres when the corridor is fully acquired (Figure 5), in many cases acquiring land that is contiguous with large existing publicly owned properties of 10,000 acres or more. Land acquisition efforts for the CT have played a role in increasing the amount of protected area contiguous to Frozen Head State Natural Area by over 1000 acres. They have protected an additional 5000 acres in the North Chickamauga Creek Gorge, and helped increase the size and amount of protected area on world famous Black Mountain. Land acquisition efforts for the CT also contributed to the purchase of a 75,000 acre addition to the Royal Blue Wildlife Management Area in Anderson County (Nolt 2005).

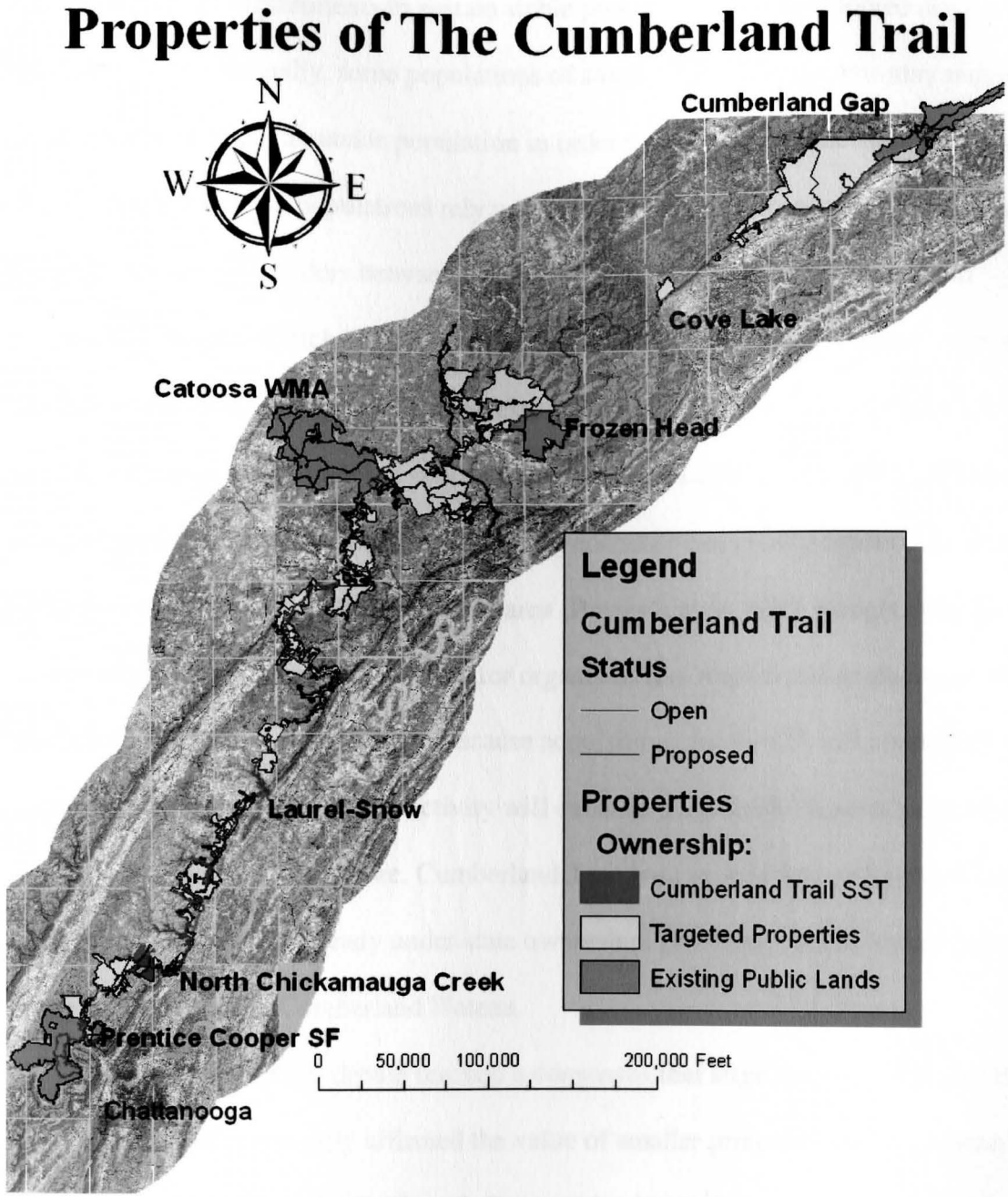

Figure 5. Properties owned or targeted for acquisition by the Cumberland Trail, with locations of field study sites noted.

Individual nature reserves do not exist independently from their surrounding landscape, instead they are influenced to varying degrees by the condition of land in which they are located (Hobbs 2002; Wiens 1996). Most protected areas, if they are

capable of providing sufficient habitat and resources for populations of small organisms, cannot provide all requirements to sustain stable populations of larger bodied organisms (Noss 2000). Additionally, some populations of smaller bodied organisms may require genetic material from an outside population in order to maintain genetic viability (Wiens 1996). Therefore, these populations rely upon dispersal of some organisms into or out of the protected area. Corridors between suitable habitat patches have been shown to increase the success of such dispersal movements (Hilty et al. 2006). A nature reserve can thus improve its ecological effectiveness by improving the connectivity between it and other areas of suitable habitat (Foreman 2004; Groves 2003; Noss 2000). Within a group or system of nature reserves, establishing corridors can greatly enhance the overall ecological contribution of each individual area (Baydack et al. 1999, Rouget et al. 2006), as well as providing conditions suitable for organisms that require metapopulations for their survival (Beier & Noss 1998). Because acquisitions for the CT will necessarily be connected to each other, that connectivity will enhance the potential habitat value of each individual property. Furthermore, Cumberland Trail land acquisitions will protect land connecting twelve areas already under state ownership, providing habitat linkages across the eastern edge of the Cumberland Plateau.

Though the SLOSS debate reached a consensus that large reserves are better than small ones, it also continually affirmed the value of smaller protected areas (Foreman 2004; Groves 2003; Noss 2000; Noss & Cooperrider 1994). These small reserves can harbor certain types of organisms (Walter 1990; Loman & von Schant 1991), sometimes including endemic species (Shafer 1990), and can serve vital functions in preserving biodiversity at the local scale (Moss 2002). In many cases along the CT, small sheltered

areas receive greater protection as a result of their inclusion within the CT corridor. For example, Hamilton County's Rock Creek benefited from a ruling in 1987 by the Office of Surface declaring the watershed unsuitable for surface mining (52 FR 10174). However, the watershed enjoyed only that minimal protection for many years, suffering from overuse and neglect in certain areas, evidenced by the 10 dump-truckloads of garbage hauled out following state acquisition of that property (Wright interview 4/10/07). As a result of being included in CT land acquisitions, Rock Creek now receives greater protection and management, ensuring this watershed's availability for the enjoyment of future Tennesseans. The CT's inclusion of some of Bowater's Pocket Wildernesses, such as North Chickamauga Creek (Figure 6), Laurel-Snow Falls and Piney River, also offer small protected areas greater protection and more active management because they were integrated into the developing CT State Park.

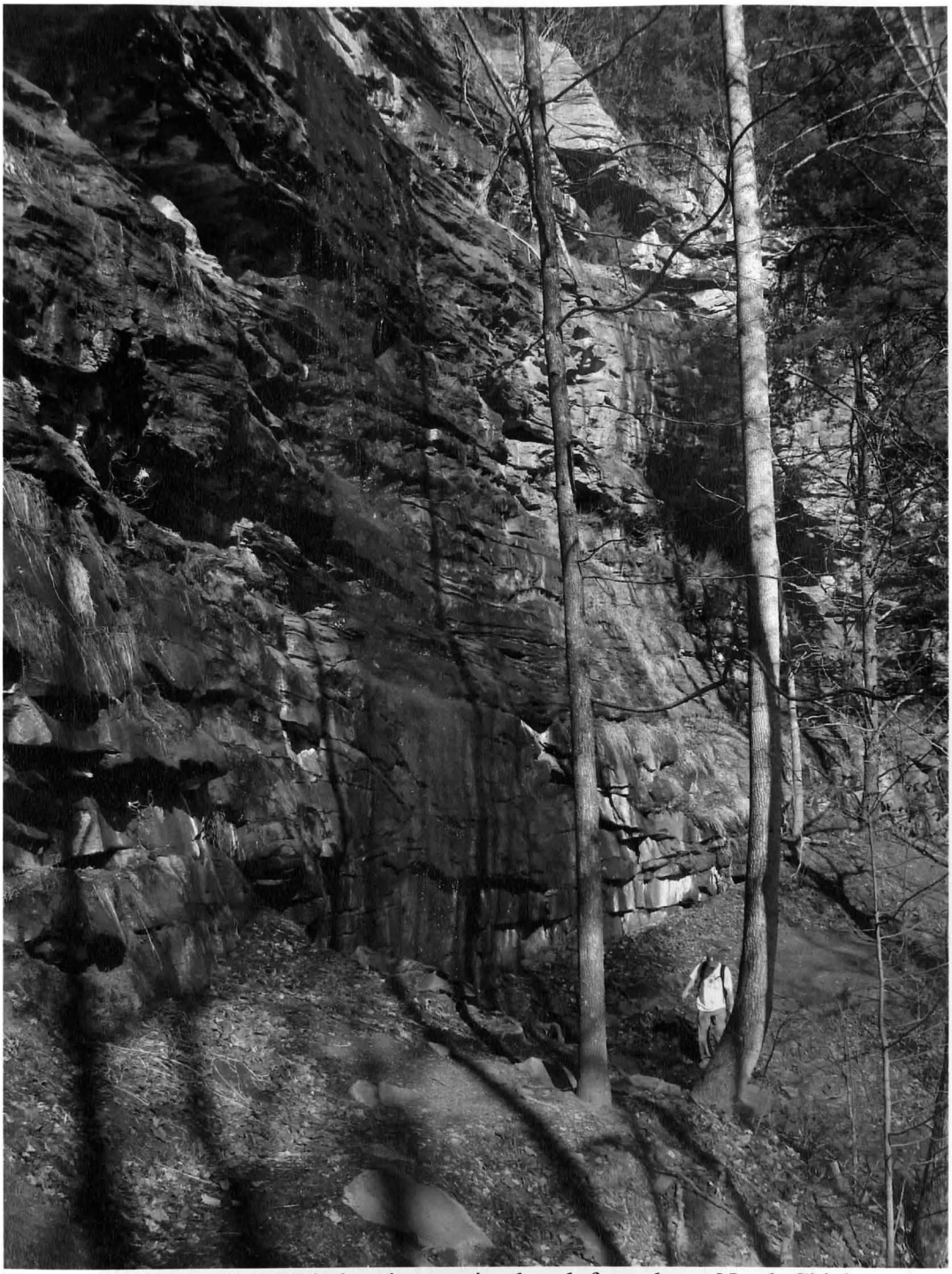

Figure 6. Hiker on the CT below iron-stained rock face above North Chickamauga Creek. This gorge, previously set aside by Bowater as a "Pocket Wilderness," now enjoys state park protection and management.

2. Water Quality

Data gathered reflecting the state of surface water within a protected area is vital to understand the overall ecological health of the area and facilitates more effective land management strategies (Blood 2003). In the course of this research project, forty-five different water sampling sites were examined along the path of the CT (Table 3), and five of the sites were retested during the course of this research (Table 4). Nearly all of these testing sites lie in the southern section of the CT, but some sites were established in more northern sections of the trail. Each water sampling site fell along the CT, and most represent a location where a stream crosses the trail. In each case enough water was present to provide the opportunity to filter a quart of drinking water for a hiker. All water quality data collected during this research was shared with OSM and TDEC's water pollution control board, and represented the first ecological water quality data on record for many of these water courses.

Table 3. Water quality sampling sites along Cumberland Trail.

Name	Date tested	Evidence of AMD impacts?
Big Soddy Creek	18-Aug	N
Deep Creek	18-Aug	N
#1 stream S. from 111	1-Sep	N
Little Blue pond beside trail (111 benches)	1-Sep	N
"Old mine wall" stream (Sluder connector)	6-Sep	N
Second (more natural) xing (Sluder connector)	6-Sep	N
Mikel Branch	6-Sep	Y
Suck Creek	8-Sep	N
North Suck Creek	8-Sep	N
"Waterfall stream" near Heiss Mtn Rd	13-Sep	N
Big Possum	13-Sep	N
Little Possum (N of Coal Rd)	15-Sep	N
"Little Orange" above Little Possum	29-Sep	Y
Little Possum (S of Coal Rd)	29-Sep	N
Hogskin Branch	11-Oct	Y
Coal Mine Near Hogskin	11-Oct	Y
Stream just uphill from Hogskin	11-Oct	Y

Table 3 continued. Water quality sampling sites along Cumberland Trail.

Name	Date tested	Evidence of AMD impacts?
North Chickamauga (@ picnic area)	11-Oct	Y
Rarity (@ sm. bridge below overlook)	24-Oct	Y
Cove Creek	24-Oct	N
"CCO orange stream"	24-Oct	Y
Flat Branch	30-Oct	N
Legget Branch	30-Oct	N
Rock Creek	30-Oct	N
Bottom pole bridge on Rock Creek Trail	30-Oct	N
27 spur trail stream (CT spur intersection)	1-Nov	N
Sulfur Branch	1-Nov	N
"Pipeline Stream" (PCSF)	1-Nov	N
First stream in clearcut (Retro-H) w/ rock culvert	8-Nov	N
Second stream in clearcut (Retro-H) w/ hemlocks	8-Nov	N
Old Dayton Reservoir	10-Nov	N
Second stream from L-S pking (w/rock wk)	10-Nov	N
First stream from L-S pking (in sight of cars)	10-Nov	N
Richland Creek	10-Nov	N
Big Soddy Creek (retest)	29-Nov	N
Deep Creek (retest)	29-Nov	N
Coal Mine near Deep	29-Nov	Y
"Little Orange" above Little Possum (retest)	18-Dec	Y
small stream w/ waterfall uphill (Little Possum area)	18-Dec	Y
small stream runs beside trail (Little Possum area)	18-Dec	Y
Little Possum (S. of Coal Rd) [retest]	18-Dec	N
"Bob Wire Stream" (111 benches)	10-Jan	N
First Highwall Stream--no truck (111 benches)	10-Jan	N
"Rusty Pickup Stream" (111 benches)	10-Jan	Y
"Little Blue Pond" beside trail (111 benches)	10-Jan	N
Board Camp (@ truck frame)	10-Jan	N
Small stream xing w/ big hemlock (111 area)	10-Jan	N
"Hemlock Flats" stream xing	10-Jan	N
"CCO orange stream"	21-Feb	Y
Mikel Branch	22-Feb	Y
"Little Orange" above Little Possum	13-Mar	Y
Middle Creek	21-Mar	N
Small stream xing under CT on Rock Loop	26-Mar	N
Rock Creek	5-Apr	N

Table 4. Streams along the Cumberland Trail retested for AMD effects during this research project.

Stream	Date	pH	Temp	DO	Sulfate	Fe	Al	Mn
Big Soddy Creek	18-Aug	6.52	25		20	<.5	<.1	<.05
Big Soddy Creek (retest)	29-Nov	6.84	9.3	9.8	0	<.5	0	<.05
Deep Creek	18-Aug	7.13	22		<10	<.5	0.1	<.05
Deep Creek (retest)	29-Nov	6.85	10.8	9.8	0	<.5	0	<.05
"Orange Stream" above Little Possum	29-Sep	4			200	6	0.4	0.8
"Orange Stream" above Little P. (retest)	18-Dec	3	13.7	9.2	>200	6	0.4	1
Little Possum (beside concrete bridge)	29-Sep	6			<10	0.5	0.1	<.05
Little Possum (beside c. bridge--retest)	18-Dec	6.26	6.4	>10	0	<.5	0	<.05
Mikel Branch	6-Sep	3.36	19.3	6.2	200	3	0.3	0.8
Mikel Branch (retest)	22-Feb	3.57	11.5	9.8	120	0.5	0.5	>1.0
Rock Creek	30-Oct	7.07	10.7	9.8	0	0	<0.5	<.05
Rock Creek	5-Apr	6.66	12.2	9.2	0	0	<0.5	<.05

Coal mining has been a part of the landscape of the Cumberland Plateau since the early 1800s (Floyd 1965), leading to widespread impacts from AMD in the region (Nolt 2005). Common signs of AMD include elevated concentrations of sulfate and metals in surface water including iron, manganese, and aluminum (Doyle 1976). Indicators of the impacts of AMD were detected at eight of the water sampling sites surveyed for this research (Table 5). Each of these eight locations revealed levels of manganese >0.4 ppm and aluminum levels of 0.4 ppm or greater, and five showed concentrations of iron at 5 ppm or greater. Eight of the water sampling sites had a pH level of below 4.00, a pH level in the range of orange juice and vinegar (Hill et al. 2005, Olmstead & Williams 2006). It has been suggested that high levels of sulfate might be responsible for diuretic effects (EPA 1999), and nine of the water sampling sites displayed sulfate levels in this range of concern.

Table 5. Water bodies on Cumberland Trail properties that indicate the presence of impacts from Acid Mine Drainage.

Stream	Date	pH	Temp	DO	Sulfate	Fe	Al	Mn
Hogskin Branch	21-Aug	2.98	23.2	5.8				
Mikel Branch	6-Sep	3.36	19.3	6.2	160	3	0.3	0.8
"Orange Stream" above Little Possum	29-Sep	4*			200	6	0.4	0.8
Hogskin Branch	11-Oct	2.94	16.7	8.3	180	5	0.5	1
Stream b/t Hogskin & Coal Mine	11-Oct	4.00	16.4	8	200	0.5	0.4	1
Coal Mine on CT (NCCC)	11-Oct	3.87	15.8	7	200	0.5	0.4	0.1
"Orange Stream" in Cove Lake area	24-Oct	7.24	11.7	7	80	5	0.1	>1
Coal Mine near Deep Creek	29-Nov	3.50	11.2	9	50	0.5	0.4	0.5
"Orange Stream" above Little Possum	18-Dec	3.00	13.7	9.2	>200	6	0.4	1
"Orange Stream" above Little Possum	13-Mar	3.05	12.7		>200	3.5	0.4	1
"Rusty Pickup Stream" near Hwy 111	10-Jan	3.69	5.2	>10	70	<.5	0.4	0.6
Mikel Branch	22-Feb	3.57	11.5	9.8	120	0.5	0.5	>1.0

Field studies for this research also identified two streams that consistently show severe impacts of AMD and that were previously unknown to suffer from these deleterious effects (Table 6).

Table 6. Streams with previously unknown severe AMD impacts.

Stream	Date	pH	Temp	DO	Sulfate	Fe	Al	Mn
"Orange Stream" above Little Possum	29-Sep	4*			200	6	0.4	0.8
"Orange Stream" above Little Possum	18-Dec	3.00	13.7	9.2	>200	6	0.4	1
"Orange Stream" above Little Possum	13-Mar	3.05	12.7		>200	3.5	0.4	1
Mikel Branch	6-Sep	3.36	19.3	6.2	160	3	0.3	0.8
Mikel Branch	22-Feb	3.57	11.5	9.8	120	0.5	0.5	>1.0

This research project reveals that most water sources in the southern extent of the Cumberland Plateau in Tennessee have escaped degradation from AMD, one of the most widespread and damaging water quality threats in the southern Appalachians and prevalent within the North Chickamauga Creek Watershed (Figure 7).

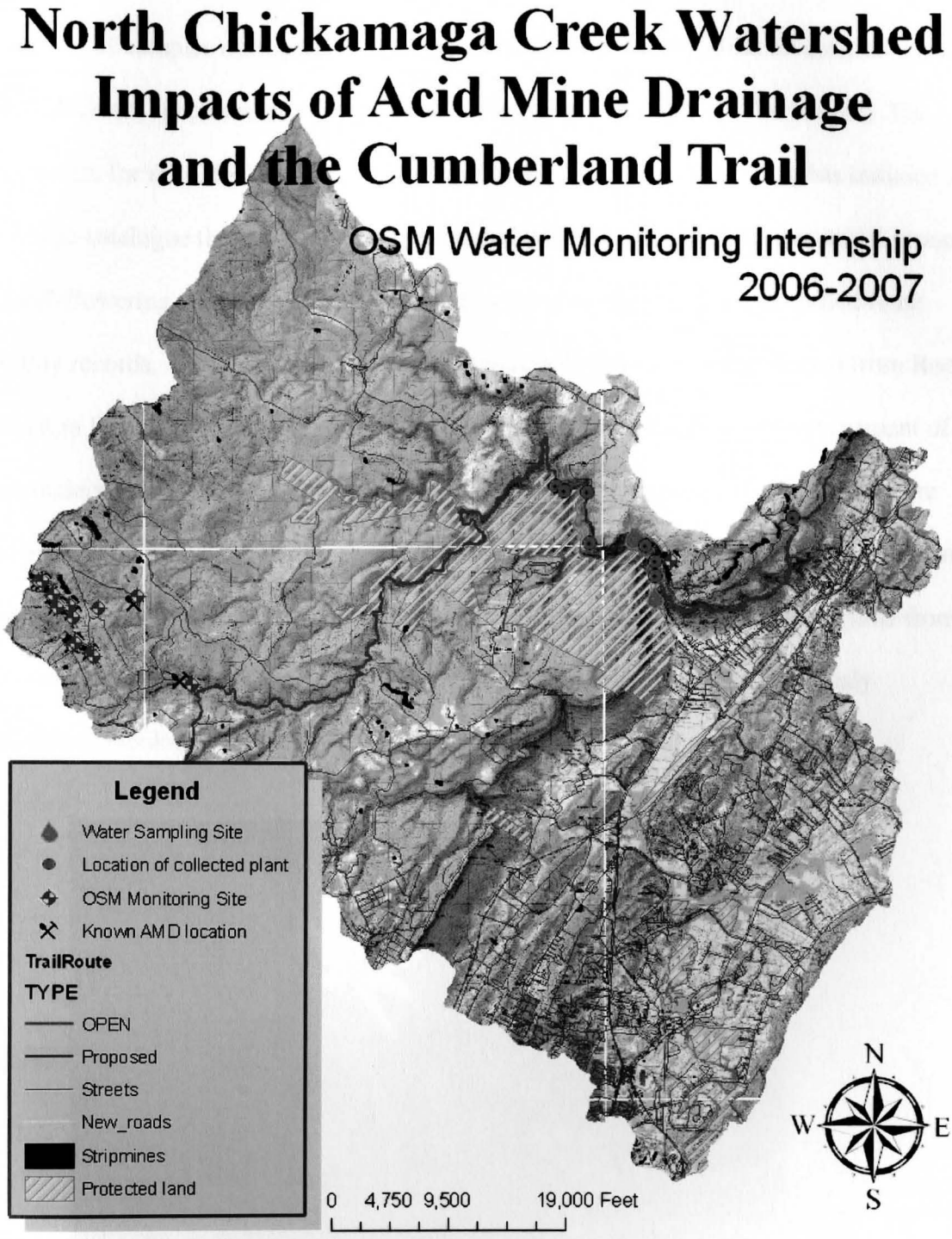

Figure 7. The Cumberland Trail within the North Chickamauga Creek watershed, noting research locations and the protected area.

Collection of vascular plants within CT lands began in August of 2006, and yielded 121 samples during the fall season. Preliminary identification revealed at least sixty different species were collected for this initial group for the CT herbarium. The herbarium for the CTSST represents the first time a Tennessee State Park has initiated an effort to catalogue the vascular plants contained within its borders. Of this initial group of fall-flowering plants, at least fifteen, and as many as thirty, were determined to be county records. Furthermore, a *Helianthus glaucophyllus* specimen collected from Rock Creek in Hamilton County (Figure 8) reveals an even more substantial improvement of our understanding of plant distributions. Locations for this species in Tennessee were previously only documented in three counties in extreme northeastern Tennessee, among the Appalachian Mountains. The confirmed identification of the *H. glaucophyllus* from the eastern edge of the Cumberland Plateau represents discovery of a previously unknown population of the plant from a distinct physiographic region.

Figure 8. *Helianthus glaucophyllus* collected in Hamilton County, previously unknown to occur on the Cumberland Plateau.

The CTSST herbarium project promises to be an ongoing effort. Collections are currently underway for the first group of spring wildflowers, with over forty collected by April 3, 2007. This thesis project lays the foundation for ongoing botanical research in the CT, and preparations have been made for the continuation of this inventory of vascular plants, with a seasonal youth conservation corps and volunteers trained to continue the herbarium project. As more plant samples are collected from the CT, a picture emerges of floral resources contained in the developing park. The floral survey can also offer indications of different ecological communities occurring along the CT's corridor by providing verifiable representatives of those communities collected from locations on CTSST property. This inventory and biological data can aid in future management decisions by providing a fuller picture of natural resources that may be affected by those management policies.

The ongoing CT biological inventory draws some inspiration from the well-funded and well-supported All Taxa Biological Inventory (ATBI) that is currently underway in the Great Smokey Mountains National Park (Fox 2004). Locations of plants that represent county records have been shared with the small staff of individuals that are beginning a similarly inspired ATBI project for Tennessee State Parks. Although the scale of the CT project is small compared with that of the ATBI underway in the Smokies, if continued it may one day provide a similarly useful tool in understanding and protecting the ecology of the Cumberland Plateau.

B. Land Acquisitions

1. Tennessee

Benton McKaye, the first person to envision the AT, in arguing for the value of long trails, writes that the important thing is that through trails "be put still further *through,*" utilizing the land of "owners who are with us now" (McKaye 1968). Early years of the CT saw this strategy borne out as many miles of the CT were built on private land. Often in these situations, no formal legal easement existed for the trail's access, and they are often referred to as "handshake agreements." In other cases, temporary easements were granted for the CT by the owners of a property (Fulcher personal communication 2/07). Current land acquisition efforts for the CT attempt to avoid such unstable arrangements for the CT's future by obtaining a legal title or easement that guarantees the CT's right to be located on each particular property.

Funding necessary for Cumberland Trail land acquisitions derives from a variety of sources, because no dedicated funding source exists exclusively for CT land acquisitions. Federal grant money constitutes a leading percentage of the funding sources for current Cumberland Trail land acquisitions. Major funding is provided by the Transportation Equity Act for the 21st Century (TEA-21) which replaced the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA). Adoption of ISTEA marked the first time that federal highway legislation included provisions for conservation objectives, granting millions of dollars for bicycle and pedestrian trails between 1992 and 1997 (Levitt 2005). Funds from TEA-21 can be used to acquire "scenic easements" as well as "facilities for pedestrians" (Flink, Olka & Searns 2001), two allocations frequently used for CT purposes. Initially created by ISTEA, the Recreational Trails Program continues

to be funded by TEA-21, granting funds to states for developing and maintaining trails (Flink, Olka & Searns 2001).

All projects that use federal funding must conform to the requirements of the National Environmental Policy Act (NEPA) of 1969 (42 USCS §4332). In the case of the land acquisitions for the CT, this requirement is satisfied by completing a categorical exclusion (CE) request for each acquisition (40 CFR 1508.4). No further environmental documentation is required of projects that adequately meet the requirements to be granted a CE, and can be approved by the state official administering the federal requirements (Flink, Olka & Searns 2001). The categorical exclusion must explain each parcel to be acquired and show that, among other things, no endangered species or important cultural resources will be harmed as a result of the acquisition. For the CT land acquisitions, the Tennessee Department of Transportation (TDOT) acts as administrator for federal funding from TEA-21, and thus approves those CEs and issues the necessary Notice to Proceed (NTP).

Eminent domain, the ability of a government agency to condemn land if it serves the public good, is the most visible attribute of government land acquisitions, and the one most reviled among the public (Freyfogle 2003). Although the acquisitions for the CT are carried out by TDEC, and therefore might be eligible to use eminent domain, a ruling by TDOT regarding use of federal funding for CT land acquisitions prohibits the use of eminent domain for those acquisitions (Fulcher interview 3/15/07). Land acquisitions for the CT are only negotiated with willing sellers, and eminent domain is never used, thereby avoiding the damaging publicity and controversy that the use of condemnation can lend to efforts to acquire land for a trail corridor (Flink, Olka & Searns 2001) .

Additionally, because the goal for CT land acquisitions is a continuous and unbroken corridor, all land acquisitions are linked together by that common goal, and any and all land acquisitions for the CT must adhere to federal regulations. Thus, the process for any and all CT land acquisitions has been federalized, under the current procedural interpretation (Fulcher interview 7/4/06).

TDOT's need for land acquisitions is most often motivated by its road-building projects, and TDOT will use the power of condemnation in order to acquire necessary land for those road projects. Although eminent domain cases do not always progress to condemnation, having that option at ready disposal lends significant inertia to land acquisitions which utilize eminent domain, so that those acquisitions become inevitable (Randolph 2004). Thus land acquisitions for the CT's corridor conform to a process administered by TDOT, which uses eminent domain and thus have structured their procedures to accommodate this powerful and controversial tool, despite the fact that land acquisitions for the CT never use that tool (Fulcher interview 3/15/07).

Grant money derived from state funding constitutes the other largest percentage of funding for land acquisitions for the CT. State funding sources include State Land Acquisition Fund (SLAF), which accounted for $1.2 million for land acquisitions in the 2006 CTSST budget. Funding for the SLAF derives from a tax on real estate transfers, about $3 million of which annually goes to SLAF (McQueen & McMahan 2003). The Department of Finance and Administration (F&A) administers state funding from SLAF, and F&A requires compliance with the established procedures for SLAF funded land acquisitions (Fulcher interview 1/11/07). State land acquisitions also require that each project be approved by the State Land Acquisition Committee (SLAC) as well as the

State Building Commission (SBC). In the Tennessee land acquisition system, F&A also orders and oversees the survey work done immediately before closing (Fulcher interview 1/11/07).

Significant uncertainties exist concerning the time required for state processing of CT land acquisition proposals. This widespread land acquisition effort by a state agency involving a multiplicity of individual parcels is unusual for the state of Tennessee, and a smooth procedure has not been established for processing these CT requests in Nashville. Both F&A and TDOT supervise many other land acquisitions by other groups, some of which have a longer history of working with these departments. In addition, certain regulations conspire to slow down the process. For example, current rules prohibit any CT parcel from being examined at the meetings of both SBC and SLAC in the same month and the survey that must be ordered by F&A may take up to ninety days to complete (Fulcher interview 3/15/07). All of these factors combine to create an atmosphere for CT land acquisitions in which there is little predictability for speedy procedural approvals, and no dependable timeline around which to structure the many aspects of acquisition efforts for individual properties.

Therefore, acquisitions for the CT must conform to two processes, those for federal and state funded projects administered by F&A and TDOT, respectively. Each of these two entities has a preferred order of operations, and do not have a long history of functioning concurrently on projects in Tennessee. Conflicts arise when applying these two acquisition systems to one parcel. For example, TDOT gets title insurance before initiating a survey, but F&A does a survey before doing title work. TDOT and F&A each have a certified list of appraisers who must conduct any appraisal, so CT appraisers must

appear on both lists. Differences also exist regarding when contact with a landowner is required, and the specific type of appraisal completed. Efforts by the staff of the CTSST for CT land acquisitions must then identify areas of overlap between these two discrete systems, within which those efforts may comply with both sets of requirements, because funding derives from sources administered by these two distinct agencies.

Further adding to the complexity of the CT land acquisition project, the acquisition of an individual parcel may not always be as simple as paying a landowner for the deed to her property. For any particular property, a "bundle" of rights exists that pertains to all aspects of ownership of that property (Randolph 2004; Freyfogle 2003; Geisler & Daneker 2000). Although one owner might hold the surface rights to the property, a mining company may own rights to the minerals on or under the surface, and a forestry company may own rights to the timber on the property. Ownership of such a property, then, is divided or shared among several different entities, with mineral rights historically taking precedence over the surface rights owner (MacDonnell & Bates 1993). In order for any purchaser to assure unfettered ownership of the parcel, rights must be purchased for that property from any party with ownership of any component of that bundle of rights. A "fee-simple" acquisition purchases all rights to a parcel (Randolph 2004), and is the preferred type of acquisition for conservation purposes (Czech 2002). Purchasing conservation easements, on the other hand, restricts some of the rights in the "bundle" for a property, such as the ability to develop the land, harvest its timber in a particular manner, or hold exclusive rights to access the property (Randolph 2004). Such easements may be used to protect resources when a landowner has the ability to develop

the land, and the easement's purchaser compensates the landowner for restrictions placed on that parcel (Newburn et al. 2005).

These separations of rights associated with real property are reflected in the deed or title to that property, but may not be known to the owner of the surface rights. On the Cumberland Plateau these separations of the different aspects of the ownership of a parcel are very common (Gardner 2006), however many new residents are unaware that another party owns any resources contained in their property (Sohn 2006). Fee-simple acquisitions are the preferred method for CT acquisitions, but may not always be feasible. In some cases an owner of the surface rights may be willing to sell the property to the CTSST, but owners of the mineral or timber rights may not be willing to sell. In other cases, the owner may not be willing to sell the deed to a parcel, but may sell an easement for the trail's access and passage. Such easements also entail conservation restrictions on the land, but only for that portion of the property covered in the easement. Current efforts to secure a corridor for the CT, while aspiring for fee-simple acquisitions, sometimes must settle for what is available which may entail a less than fee-simple purchase or easements across a property.

Keystone parcels were selected for greater scrutiny from four different counties along the trail's proposed route. In Claiborne County, the parcel owned by the Ataya Company covers tens of thousands of acres, and the CTSST proposes to acquire rights to about 1500 acres for the CT. Over thirty miles of the CT would cross this acquisition when trail-building is complete. This property adjoins property that contains completed trail at either end of that thirty mile span, and at least three other properties would be required for the CT if acquisition of the Ataya property proved impossible. In Hamilton

County, a property owned by the Audubon Society targeted for acquisition will form one part of the proposed link between Prentice Cooper State Forest and the North Chickamauga Creek Gorge State Natural Area. A property in Morgan County owned by Heartwood Forestland would form a crucial link between Frozen Head State Park and Cove Lake State Park. The Lonestar property on Bird Mountain in Cumberland County, a 1296 acre acquisition, would contain almost six miles of the CT and include the most prominent physiologic feature in the region, Big Rock on Bird Mountain. Finally, also in Morgan County, the Brasel property in the town of Wartburg is proposed to be the point at which the CT makes its only entrance into a town along its route, and the property will contain one of two proposed visitor centers for the CT.

Each of these properties is important to the CT, and the ability of to effectively acquire rights to these parcels has pervasive effects on the ability to move forward on other components of the land acquisition plan for the CT. Each of these properties has also been slated for acquisition for at least two years, inviting a closer examination of how well the land acquisition process is functioning in each effort. This closer examination included determining funding sources for each property (Table 7), and the date of approval for important documents, including the CE and appraisal report.

Table 7. Funding for acquisition of "keystone" parcels.

Property name	Funding: State/Federal	State Source, Amount	Federal Source, Amount	Type of Purchase
Ataya	64/36	SLAF: $800,000	TEA-21: $450,000	Corridor Easement
Audubon	100/0 (Survey & Title work)	SLAF	--	Donation of Corridor Easement
Brasel	20/80	SLAF: $76,320	TEA-21: $305,280	Fee-Simple
Forestland	50/50	SLAF: $290,000	TEA-21: $290,000	Fee-Simple
Lonestar	17/83	SLAF: $100,000	TEA-21: $500,000	Fee-Simple

A preferred sequence was established for important benchmarks required for land acquisitions so that the time required for the land acquisition process for each keystone parcels could be displayed quantitatively (Table 8). The date of first appearance reflects the earliest dated document in the records for land acquisitions. Approval of the CE is required before any land acquisition may progress further because this assures that NEPA requirements have been fulfilled and no deeper examination is required by NEPA. The notice of intent conveys to the property owner that their property has been targeted for state acquisition for the CT and must be documented before an appraisal can be ordered for that parcel. The completion of the appraisal marks a point at which the acquisition efforts should be moving toward their final stages.

Table 8. The five "Keystone Parcels" examined using an optimal sequence of steps for CT land acquisitions.

Property	Date of first appearance	CE approval	Notice of Intent	Appraisal completed
Ataya	27-Feb-00	23-Jul-06	16-Aug-05	10-Aug-06
Audubon	Mar-06	Aug-06	14-Feb-06	*donation*
Brasel	30-Nov-04	16-June-2006	22-Aug-06	7-Jun-06
Forestland	1998	22-Nov-05, 19-Dec-06		10-Jul-03
Lonestar	2/04	Aug-06	11-Sep-05	20-Jun-06

Close examination of the dates in Table 8 reveals the difficulties in quantitative analysis of the data collected for the metric. Clearly, each parcel has been "in the pipeline" for inclusion in the CT corridor for many years. The dates for procedural approvals do not follow the optimal sequence for these approvals, revealing the sporadic and discontinuous nature of land acquisition efforts for the CT over the past nine years, further displayed by the multiple CE approval dates existent for the Forestland property. Because the order of these approvals for each of the keystone parcels does not follow the sequence for required processes, it proved impossible to quantify the speed at which these parcels made it through the process currently required for CT land acquisition. However, the metric's framework provided a very useful outline by which to examine acquisition of these properties.

Some general conclusions became apparent in examining existent CTSST land acquisition records and assembling these data on each keystone parcel. For instance, an early rush of activity for land acquisitions followed the 1998 establishment of CTSST as a state park, when the CTC had recently been empowered to carry out those negotiations. Many of these keystone properties were identified at this time, and some forms were approved for their acquisition during this early period. However when TDEC assumed exclusive authority for land acquisitions in 2004, these properties remained unacquired and became the focus of renewed acquisition efforts by the CTSST's staff. Research into acquisition records for each of these parcels revealed an apparent gap in progress between the two periods of recent land acquisition efforts. This problem of fluctuating efforts for land acquisitions has been cited as a source of landowner frustration and failed

conservation land acquisition efforts (Endicott 1993), and has been identified as a historic difficulty for the Cumberland Trail (Hall 2000).

2. The Florida Model

Since 1990, the state of Florida has had a land acquisition budget that exceeds every other state, as well as the federal government's budget for land acquisitions for the entire country (Farr & Brock 2006). Since the 1970s, Florida has conserved 3.6 million acres of land, at an investment of over $6 billion (2006 Florida DEP). Florida's population continues to grow, with 350,000 new residents coming to the state each year (Farr & Brock 2006). This expanding population lies surrounded on three sides by seawater, so ensuring adequate freshwater supply within the state of Florida remains critical to the ability of the state to support the increased population, and to protect the quality of life for all Florida residents. In 1976, the Florida legislature created five Water Management Districts around the state charged with providing "for the management of water and related land resources" (Fla. Code Ann. §28-373-069).

Florida's WMDs have used a variety of techniques to achieve their water conservation goals, but land acquisition has proven to be one of their most effective tools (SJRWMD 2007). This research project focused on two WMDs, the SJRWMD which has used $46.48 million from the Florida Forever program to protect 64,260 acres of land since 2001 (SJRWMD 2007), and the SFWMD which has acquired over 1.3 million acres of land since its formation in 1976 (SFWMD 2006). The land acquisition efforts of Florida's WMDs and Tennessee's CT exhibit many differences, but both are conservation

land acquisition efforts by state agencies, and that common ground provided a framework in which to compare the two systems.

Availability of funding sources established by the state over the past thirty years reveals one reason for the success of Florida's WMD land acquisition efforts. Florida Forever follows the highly successful Preservation 2000 program in continuing state-funded conservation programs in Florida (2006 Florida DEP). Money awarded through the Preservation 2000 acquired over 1,781,489 acres for the people of Florida, making it the "largest program of its kind in the United States" (2006 Florida DEP). When this popular program expired in 2000, the Florida legislature enacted its successor, Florida Forever, by a wide margin (McQueen & McMahon 2003). The first several years of the Florida Forever program have also been successful, resulting in the addition of 1.2 million acres to state lands in its first seven years (2006 Florida DEP).

Florida Forever will raise about $105 million each year for land acquisitions until the legislation expires in 2010 (2006 Florida DEP). Funding for this program derives from the annual sale of bonds, which is derived from a real estate transfer tax known as the Documentary Stamp Tax in Florida (McQueen & McMahan 2003). Each year Florida Forever funding is divided among the five water management districts in Florida, reflected in Table 9. The SFWMD receives the largest portion of any one WMD: 35%, with SJRWMD receiving 25% of Florida Forever funding (SJRWMD 2007). Of the $195.65 million that SJRWMD receives from Florida Forever, $106.87 million will be used for land acquisitions through 2010 (SJRWMD 2007). This funding is secure, guaranteed bond payments that the WMD has at their disposal for conservation acquisitions.

Table 9 (SJRWMD 2007). Florida Forever funding for WMDs.

Water Management District	Percent Allocation	Total 10 Year Amount
South Florida	35.0%	$36,750,000
St. John's River	25.0%	$26,250,000
Southwest Florida	25.0%	$26,250,000
Suwannee River	7.5%	$7,875,000
Northwest Florida	7.5%	$7,875,000
Total	100.0%	$105,000,000

In addition to the large amount of funding set aside for payments for land acquisitions, the SFWMD is further aided by a large staff devoted to the procedural requirements of state processes. At SFWMD I interviewed the lead Acquisition Agent, Senior Supervising Planner, Chief Appraiser, Supervising Land Manager, Title and Closing Manager, as well as the Director of the Real Estate and Land Management Department. With a department of two to five individuals devoted to each of these important stages of the process, these professionals become specialized in their role for each acquisition. In this way, each step of the process attains a high degree of regularity, which is dependable and predictable to the professionals working on each particular step along the way. This familiar process facilitates a speedy progression for projects to advance to closing, sometimes proceeding from initial identification to closing in less than four months (M. Wilson interview 3/2/07).

Cooperation of partners at the state administrative offices in the capital, Tallahassee, including their following a predictable and dependable schedule for the necessary state approvals, further enhances the increased speed for acquisitions gained by specialization of staff members at the WMDs. For instance, if an acquisition agent of the SFWMD successfully negotiates a contract to buy a property, a closing officer will

submit a request for bond funds from the DEP. That closing officer then works on all other aspects of closing on a property, including approval of the transaction by the governing board, confident that request for funds will be honored in sixty days (M. Wilson interview 3/2/07). Regimented schedules for procedural approvals and a specialized and devoted staff for each level of the necessary processes combine to assure that progress may begin at each stage as soon as practicable, with all preliminary background work completed.

Finally, WMDs in Florida also enjoy widespread public support for their mission (Farr & Brock 2006). Public support is evidenced, in part, by the popularity of the Preservation 2000 program, and the subsequent overwhelming approval of its successor, Florida Forever. Additionally, public support for WMD land acquisitions can be seen in the impressive support for local and county tax measures to supplement funding for WMD and local government conservation projects. Voters in Florida communities have repeatedly approved measures by overwhelming margins that raise or establish a local tax to raise money for land acquisitions (Farr & Brock 2006). These locally raised funds can leverage increased matching funds from state and federal sources, thereby increasing the power of available funds, and ultimately can increase total land acquired for conservation. These characteristics that distinguish land acquisition efforts by WMDs in Florida from those for the CT, such as guaranteed funding allocations, specialized land acquisition staff, cooperation from approving agencies and broad public support, indicate areas in which the CT land acquisition project may be improved.

V. DISCUSSION

A. Ecological Value

Application of the principles of reserve design to the land acquisition plans for the CT reveals that those CT land acquisitions offer sound potential for protecting and maintaining the ecological integrity of the region. The extensive greenway formed by CT lands will link a vast series of preserved areas, forming important and groundbreaking "green infrastructure" (Randolph 2004) in eastern Tennessee. In addition to providing habitat linkages and greenways for the ecological communities along the Cumberland Plateau, the CT promises to also offer cohesive administrative management across a broad bioregion. In this way, management plans for CT lands can adapt to aid separate ongoing management objectives. In other cases, the large geographic area united by CTSST administration and management may serve to unite and accommodate ecological management goals for geographically discrete protected areas.

Because this emerging park embodies such great potential for ecological contributions, extensive data collection and monitoring is appropriate to help realize that potential. Proper management of protected backcountry areas requires accurate inventory and understanding of the biological resources contained within them (Leonard 1979), and this thesis project represents the first efforts at assembling baseline ecological data on the CT. William Bunch, in the Introduction to *Long Distance Trails: The Appalachian Trail as a Guide to Future Research and Management Needs* writes that, because long distance trails represent an important area where social institutions come in contact with wilderness, "research that monitors change and stability on long distance trails may also measure gains in the quality of our national life" (Bunch 1979). Such lofty and

amorphous intentions need not be the primary motivation for ongoing research on the CT, however because continuing ecological research and monitoring of the CT promises to provide, at the least, a much deeper understanding of the ecology of the Cumberland Plateau. Compiling baseline data can prove critical to proper ecological management of an area whose design does not grow specifically from ecological concerns (Lindenmayer et al, 2000; Zorn et al 2001), as well as inspiring further research, and this thesis project has initiated study in areas of interest that could be further pursued to the benefit of CTSST managers and users alike. Ensuing field studies that utilize the CT as spatial base for the survey can further examine the vast geographic region and many habitats crossed by the CT.

The eastern edge of the Cumberland Plateau, the route followed by the CT, is "notched" by many small drainages emptying into the Tennessee River (Luther 1977), and the CT corridor will include many of these small watersheds. The vast majority of water bodies tested for this research reveal the apparent absence of the degrading effects of AMD, but these streams need to be monitored to ensure that upstream activities do not cause such impacts to injure these watersheds. Future biological studies carried out on these creeks and streams could further expand our understanding of these hydrologic systems, and assist in managing the CTSST to conserve and enhance these intact systems. Further monitoring and assessment of those streams showing effects of AMD should lead to remediation efforts at those sites where remediation is most needed, which would improve health of the overall water quality in this region.

Floral surveys take many years to complete, but collecting information on vascular plants promises to reveal important aspects of the ecology of the region, without

necessarily completing a full flora of the entire park. This ongoing research represents a long-term project that, when initiated to answer fundamental ecological questions, can lead to many ecological benefits while short term tactics concurrently work to enhance protection of the area (Bildstein & Brisbin Jr. 1990). Furthermore, a brief site description accompanies each site where a flower is collected, and may prove useful in assembling a comprehensive picture of the habitats and communities contained within the developing Cumberland Trail State Park. By providing county records for several species of plants, and some more remarkable records of plants such as *H. glaucophyllus*, the vascular plant survey component of this research has already broadened our understanding and picture of the geographic distribution of vascular plant life in this state. Because this region of the Cumberland Plateau has received little previous ecological monitoring, similarly unknown distinct floral populations could be expected to result from ongoing study of this now-protected area. Finally, GIS mapping of CT land acquisition projects and accumulating biological data should continue to be integrated, which may provide the opportunity to develop an in-depth land selection database that can assist in assuring future land acquisitions will serve ecological goals (Newburn 2005).

Although the forests of the Cumberland Plateau survive as relatively intact communities of eastern deciduous forests (Evans et al. 2002), many factors now threaten the continuing ecological stability of the region. More localized factors such as changing objectives and methods for resource extraction and the boom of second homes in the region, combine with larger scale issues such as the invasion of exotic pests and climate change, to create a very uncertain future for the Cumberland Plateau. Land acquired for the CT and the subsequent management of those lands, if informed by thoughtful

ecological analysis and monitoring, offers a way to observe and preserve the biodiversity in this rich and changing landscape.

One example of pending and certain change coming to CT lands will occur in one of the areas most closely examined during the field work for this research project: the three gorges of Rock, Possum, and Soddy Creeks (RPS) in northern Hamilton County (Figure 9). The invasion of the hemlock woolly adelgid moth (*Adelges tsugae*), a native of Asia, will dramatically change the ecology and appearance of these gorge properties along the eastern edge of the Cumberland Plateau. Invasions of *Adelges tsugae* threaten to decimate the entire natural range of the Eastern Hemlock (*Tsuga canadensis*), having already decimated many forests in New England (Orwig et al. 2002), reaching Tennessee in 2002 (Hale 2003), and Hamilton County in June of 2006 (Hightower 2007). The Cumberland Plateau represents a portion of the southeastern extent of the natural range of *T. canadensis* (Petrides 1998) and many of the watercourses in these gorges in Hamilton County are surrounded with towering hemlocks, as evidenced in Figures 10 and 2. The shade tolerant *T. canadensis* slowly forms mature and stable forests (Peattie 1950), creating microclimates in those wet areas where they dominate the forest structure (Kricher 1988). Mortality events deriving from *Adelges tsugae* invasions threaten to dramatically alter the ecology of backcountry stream communities across the range of *T. canadensis* (Ross et al. 2003). The pending invasion of this pest to the Cumberland Plateau and CTSST properties, promises dramatic alteration of the appearance and ecology of these recently acquired state park properties.

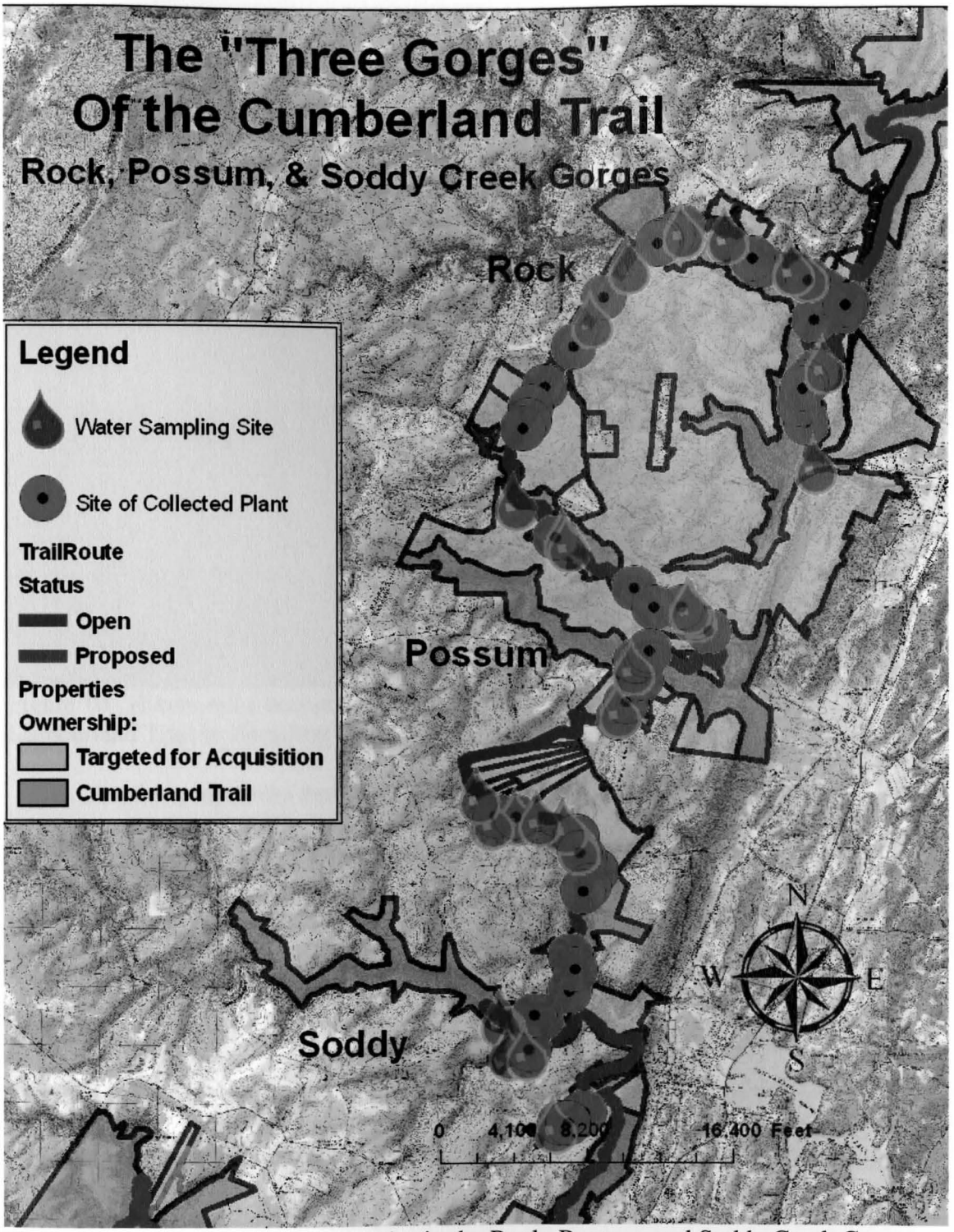

Figure 9. Cumberland Trail properties in the Rock, Possum, and Soddy Creek Gorges, with locations where data was collected as a part of this thesis project's field studies.

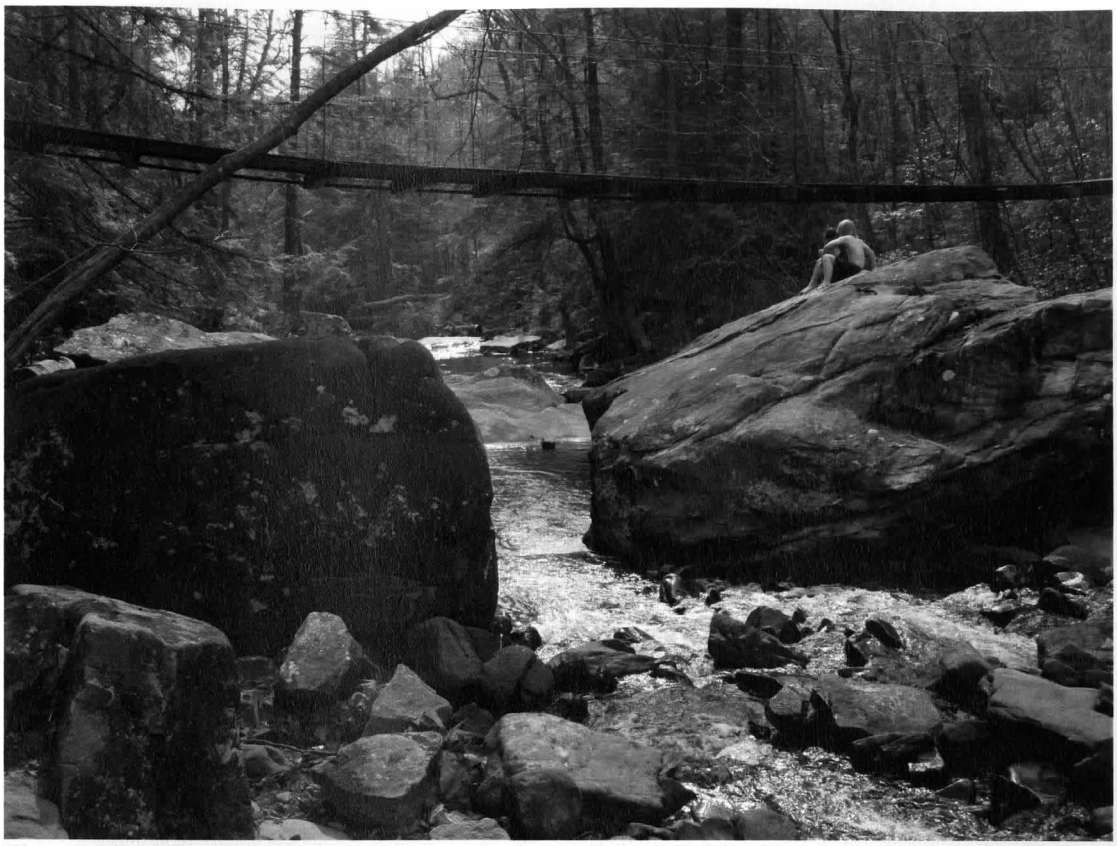

Figure 10. Hikers relax beneath hemlocks and the Middle Creek Swinging Bridge on the Cumberland Trail in Hamilton County.

Another potentially devastating factor that is already changing the face of Soddy Creek Gorge has its origins in the legal arena. Rock harvesting, the collection of sandstone rock from the cap-rock formation on the Cumberland Plateau, is not currently regulated as a mining activity in the state of Tennessee, though the legal ownership of that rock is interpreted to be included in the mineral rights of a particular property. Therefore, current interpretations allow the owners of mineral rights to "harvest" the cap rock from that property, often using machinery and explosives, without being forced to comply with more stringent laws applied to mining operations (Sohn 2006). Mineral rights to the RPS properties were retained by Lahiere-Hill Co. LLC., which is currently harvesting rock from these properties owned by the CTSST. These rock harvesting operations necessarily involve significant disturbance to surface features of the

landscape, destroying microhabitats and even burying the CT near Deep Creek (see Figure 11). Because separation of mineral and timber rights from surface rights is a common occurrence on the Cumberland Plateau (Gardner 2006), issues surrounding ecological degradation from rock harvesting threaten to affect many acres of the Plateau and many properties included in the CTSST, unless some resolution to this counter-intuitive interpretation of property rights and law can be accomplished.

Figure 11. Sign on the Cumberland Trail announcing a closure caused by the impacts of a rock harvesting operation in Hamilton County.

B. Land Acquisitions

Examining previous land acquisitions for the CT revealed that most of these early land acquisitions have been 'special,' receiving enthusiastic support from a variety of sources for different reasons. These 'special' acquisitions sometimes enjoy political support that provokes unusually speedy processing by state agencies, such as that exhibited by the Cumberland Forest acquisition in northern Tennessee. In other cases, certain acquisitions are led or expedited by involvement of other groups like the Conservation Fund. Properties acquired on historic Black Mountain enjoyed such

involvement of other groups. These unique acquisitions unquestionably serve the mission of acquiring a state-managed corridor for the CT, however they do little to create an established process that other CT acquisitions might follow.

Plans for CT land acquisitions include almost 200 individual properties for possible inclusion in the CTSST, and each one of these parcels cannot be 'special' acquisitions. Therefore, establishing a standard system for CT land acquisitions would provide a very useful tool to facilitate completion of these acquisitions. Such a procedure would lend predictability and structure to an important quest to increase public land in eastern Tennessee. Such an established process could be followed for each subsequent CT land acquisition, but it could also be followed for other conservation land acquisitions in Tennessee using similar state and federal funding sources.

Although this thesis has examined the land acquisitions for the CT in an effort to identify difficulties or deficiencies in the system used for those acquisitions, the overall plan for acquiring a linear corridor for the CT displays very solid foundations for an effective land acquisition program. The small staff within the CTSST works diligently on those acquisitions, and they are devoted to the cause of completing all acquisitions necessary to open the entire CT. However, with the Cumberland Plateau's increasing popularity to developers and maturing timber stands, long delays in this acquisition process can spell disaster for individual properties targeted for acquisition, and possibly the entire acquisition effort. Therefore, the devotion and commitment of existing CTSST staff is not enough to assure speedy completion of this ambitious effort to acquire land in Tennessee, and must be supplemented by additional commitment of funding and staff to land acquisition efforts.

The acquisition component of the CT's mission has never received sufficient attention and effort at all levels of state agencies, nor by the Tennessee General Assembly. It is important to distinguish between deficiencies in efforts mounted by agencies, and the efforts of individuals within those agencies. For example, Bob Fulcher spends close to seventy percent of his time on acquisitions for the CT, often working into the early morning hours on negotiations, form approvals, and procedural compliance issues. Other park rangers for the CT contribute nearly half of their total time to the acquisition process. These efforts must be balanced, however, against the need to manage and patrol the thousands of acres in the CTSST, and with more closings on properties, more land management responsibilities are necessarily incurred by CTSST staff. Additional expertise and manpower for CTSST land acquisition efforts is needed to increase the speed and effectiveness of the land acquisitions undertaken to secure the CT's corridor. Even the addition of one land acquisition specialist would do much to alleviate some acquisition responsibilities for these rangers, and allow them more time for law enforcement and land management. The addition of a specialist in real estate transfers and land acquisitions would also greatly add to the expertise available to contribute to CTSST land acquisitions.

Similarly diligent efforts may also be exhibited by professionals in the state agency offices in Nashville. Those professionals may devote maximum practicable time to these CT acquisitions, but have other responsibilities which prevent them from committing more time to these CTSST projects. However, the level of commitment for processing CT land acquisitions exhibited by the *agencies* of TDEC's F&A and TDOT is deficient. Widespread uncertainties, shifting timelines, and changing protocols create an

atmosphere in which CT land acquisitions can get lost and stalled amidst these various factors outside of the control of CTSST staff. Often, the staff of CTSST is left in the dark as to when a ruling or approval might be issued, handicapping their ability to prepare for subsequent steps. In some cases these delays can cause property owners to find other buyers, creating damaging setbacks for the overall CT acquisition goals. If all state agency staff are working at or above their maximum practicable commitment for this project, then more staff are needed in those agencies.

The long history of conservation-minded land acquisitions by Florida's WMDs has provided those agencies with opportunities to refine procedural requirements, and establish protocols that make those acquisitions smooth and successful exercises. The high level of predictability for state processing of WMD land acquisitions appears to be one of the most important characteristics that distinguish them from land acquisitions for Tennessee's CT. This predictable and swift approval process from Tallahassee reflects the high level of commitment to conservation land acquisitions exhibited by Florida agencies at many levels. The large and specialized staff within the SFWMD also reflects the long-term dedication to these land acquisitions by WMDs in Florida.

Originally, when the SFWMD was created in the seventies by state legislation, land acquisitions did not form a leading component of that agency's activities or objectives. Although it had worked to acquire several large parcels that were suggested for acquisition in the early years of its existence, SFWMD's widely heralded land acquisition efforts did not become such a efficacious operation until it was joined by Chuck Renaldi, whose previous land acquisition experience came through his work to secure a corridor for the AT. After twenty years in that role acquiring land for inclusion

within the Appalachian Trail National Scenic Trail, Renaldi was hired to work on acquisitions for a young SFWMD. His experience and expertise working on acquiring this linear corridor for the AT, when added to an organization with ample funding but less experience in land acquisitions, is credited (Moore interview 3/2/07; M. Wilson interview 3/2/07) with advancing the SFWMD's land acquisition program to a high point for SFWMD acquisitions in 1995-96 when that agency successfully acquired over 400 properties in one year (M. Wilson interview 3/2/07). This phenomenon argues persuasively for the potential of CT land acquisitions, if those acquisitions are similarly granted greater funding and commitment.

Another important distinction between SFWMD acquisitions and those for the CT involves the flexibility in securing and dispersing funding for those acquisitions. The CTSST has been directed that it may *only* offer the appraised value for any particular property, while WMDs are not encumbered by that restriction on all of their acquisitions. On federally funded projects, the WMDs must offer the appraised value for the property, but on projects funded by Florida Forever, that restriction does not apply (Palmer interview 3/2/07). Thus, many WMD acquisitions enjoy the flexibility to offer less or more than the appraised value for a particular property. That freedom allows the WMD to negotiate a price for a property that may save thousands of dollars, in cases where an offer is made below appraised cost; or assure acquisition of an important property if the seller is unwilling to sell at the appraised cost.

Observing other rapid state land acquisitions can add to frustrations of people working on CT land acquisitions because similarly swift processing, if regularly applied to CT acquisitions, could lead to completion of the overall CT land acquisition project in

the near future. However, the needed increase in speed should not be gained by attempting to fit each CT acquisition into the mold of those 'special' and speedy acquisitions, rather the more appropriate tactic for improving speed of all CT acquisitions would be to establish a standard and reliable format which may be applied to any conservation acquisition undertaken by a Tennessee state agency. Establishing this standardized format and process for conservation acquisitions in Tennessee must include harmonizing the two systems currently in place for approving land acquisitions in this state. Though the differences between the F&A and TDOT administration of grant funding may appear minor, in reality these differences cause delay and disagreement which slow the necessary processing of these acquisition proposals. A standardized acquisition procedure would include specific directives regarding the proper sequence and timing of steps in the acquisition process that had been endorsed by all authorizing agencies involved in CT land acquisitions. Because funding from TDOT and SLAF will likely be utilized by most future conservation land acquisitions in Tennessee, the harmonization of the procedures required by these two agencies could avoid a repeat of the difficulties that currently plague acquisitions for the CTSST.

In order to realize the full potential for the ecological contribution of the CT to the Southern Appalachian bioregion, land acquisitions by the CTSST ought to not be viewed as a finite mission with an easily attainable end result. In other words, successful acquisition of the corridor of state-managed land for the CT should not mean the termination of land acquisition efforts by the CTSST. If more commitment is made to increase the effectiveness of the CT land acquisition process, then those efforts should be seen as ongoing in much the same way that land acquisition efforts by SFWMD continue

despite many successes. By incorporating reserve design principles into the ongoing acquisition efforts, those ensuing acquisitions can offer many important benefits to the ecological communities of the Cumberland Plateau region.

Designing effective protected areas can always be aided by protecting more land in important areas that will increase the ecological integrity of existing reserves (Sauer 1998, Noss & Cooperrider 1994), and the CT can be used as "green infrastructure" (Randolph 2004) to guide future conservation minded land acquisitions on the Cumberland Plateau. In this way, with continued mapping and monitoring of CTSST lands, certain areas can be identified as priority conservation areas in much the same way that the SJRWMD identifies priority areas for its Florida Forever acquisitions (L. A. Wilson interview 2/28/07). Thus, future acquisition efforts on behalf of the CT can increase state managed land where it can best serve the ecology of the region. In addition, efforts to create additional greenways in the region, such as the efforts to connect Fall Creek Falls and the CT, could be enhanced and assisted by continuing the building momentum for CT land acquisitions.

In many cases, the current land acquisition efforts for the CT are carried out for the minimum practicable level, to secure a corridor that will allow passage of the CT. Sometimes that means acquiring a property for less than fee-simple, and sometimes that means that very narrow conservation easements are purchased from a landowner, leaving thousands of acres of a property open to the objectives of a private landowner. In cases where a narrow corridor is purchased within a larger parcel, or an easement is granted allowing only the right of access for the trail, subsequent residential development or destructive resource extraction on the remainder of the property will damage the

experience of the hiker on the CT, and have substantial impacts on the ecological value of the CTSST's land in that area. In Florida, the SJRWMD views its land acquisition efforts as "opportunity driven" (L. A. Wilson interview 2/28/07), meaning that if the opportunity surfaces to purchase a property in targeted areas, then the established framework and procedures can be set in motion to acquire that parcel. I contend that if an effective land acquisition system is established for the CTSST, and funding remains in place, then the CT may provide the Green Infrastructure and the foundation for a successful "opportunity driven" conservation land acquisition effort for the Cumberland Plateau. In this way, an existing network of protected lands would be created with an established process, staff, and dedicated funding in place for acquiring additional land. Then, when a property within or adjacent to the corridor became available for acquisition, for any reason, these land acquisition resources could be focused on that property, thus adding it to protected public land on Tennessee's Cumberland Plateau. Furthermore, continuing the CT's land acquisition efforts allow for certain less-than-fee properties to be revisited to secure fee-simple interests in those parcels. In such cases, if a third party retains mineral rights for a property, that party may be subsequently persuaded to sell those rights to the CTSST so that the state may acquire all rights to that property, thereby ensuring exclusive state management of that land.

Conservation initiatives often cross many political and administrative boundaries, and accomplishing those goals requires inclusion of many partners in the process (Endicott 1993, Meffe et al. 2002). The CTSST partners with the CTC on all trail building and maintenance for the trail, and works together on some land acquisitions as well. Trail work projects bring in volunteers from across the state through the Tennessee

Trails Association, and college students from across the country through the Spring Break-Away program. Groups such as the Conservation Fund and North Chickamauga Creek Conservancy (NCCC) have contributed expertise and funding for land acquisitions for the CT. Finally, management of CT lands requires that the CTSST cooperate and partner with all public agencies managing land through which the CT passes. This research project has repeatedly affirmed the value of partnerships, even presenting a vivid example of what can be accomplished when many like-minded groups cooperate to achieve conservation goals. The water quality internship, which spurred this project's research into the water quality resources of the CT, is funded by the Office of Surface Mining and co-sponsored locally by the NCCC and CTSST. Each of these three groups involved in this internship had specific objectives, but through cooperation all expectations have been met and valuable data has been added to the scientific knowledge of the Cumberland Plateau. Additionally, lab space for this water quality research was provided through the generous cooperation of the Department of Biological and Environmental Sciences at UTC, and the guidance and expertise of many UTC professors and employees has proved critical to the success of this thesis project.

VI. CONCLUSIONS

Enthusiasm and commitment to the CT project has seen many highs and lows in the forty years of its existence. Recent efforts have resulted in unprecedented successes for the Cumberland Trail, but the return to a similar period of waning interest must be guarded against. Efforts directed toward the CT project promise to serve conservation goals for the entire Cumberland Plateau region, a unique and valuable region under increasing threats to its ecological integrity. Baseline data collected during this research project reveals that the properties of the CTSST present rich opportunities for closer and continuing ecological scrutiny. A rich diversity of vascular plants and a multitude of pristine streams have received critical protection as a result of land acquired for the CT, and future study of these and all future acquisitions promises to reveal a state park of unparalleled ecological resources.

In order to fully realize the enormous potential for ecological contributions promised by the CT project, the CTSST must continue to acquire land for inclusion in this growing state park. By continuing its land acquisition mission, the CT project can increase the amount of land protected by the CTSST and, by using principles from the study of reserve design, those acquisitions can target properties most likely to make positive contributions to the ecological integrity of existing CTSST lands (Noss & Cooperrider 1994). In addition, acquiring additional rights to mineral or timber resources on a property can bestow increased protection upon biologically rich land under perilous threats. However, fully realizing the potential for these CT land acquisitions requires raising the level of commitment by the state to land acquisitions for the CT. Only by adding professionals within the CTSST and the state agencies that process these

acquisitions, as well establishing an approved and coherent procedure that each CT acquisition may follow, can those acquisitions achieve the full ecological potential of the Cumberland Trail.

In closing, I would offer that there is no time to loose in improving Tennessee's commitment to the CT. Important groundwork has accumulated over the past ten years, which offer a blueprint to green infrastructure for the Cumberland Plateau. However, that groundwork must be built upon, and the conditions must be improved for the CT to achieve its ecological potential. Change is coming to the Cumberland Plateau: change in the form of housing developments, clear cuts, exotic pests and a changing global climate. Conservation efforts arising from the Cumberland Trail project offer one path by which these changes may be combated and monitored. Protection of Tennessee's invaluable Cumberland Plateau, using the CT as a foundation, can achieve many lofty conservation goals, but must proceed at a swift pace in order to conserve the maximum amount of this rich land before these powerful changes arrive.

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