PHOTO INTERPRETATION REPORT

USGS-NPS VEGETATION INVENTORY AND MAPPING PROGRAM

GREAT SMOKY MOUNTAINS NATIONAL PARK

CADES COVE AND MOUNT LE CONTE

TOPOGRAPHIC QUADRANGLES PILOT SUDY AREA

JULY 1, 2000

Environmental Systems Research Institute
380 New York Street
Redlands, CA 92373

Aerial Information Systems
112 First Street
Redlands, CA 92373

U.S. Government Restricted/Limited Rights

Table of Contents

Section **Page**

Section **Page**

Section **Page**

I. INTRODUCTION

The National Park Service (NPS), in conjunction with the Biological Resources Division (BRD) of the U.S. Geological Survey (USGS), has implemented a program to "develop a uniform hierarchical vegetation methodology" at a national level. The program will also create a geographic information system (GIS) database for the parks under its management. The purpose of the data is to document the state of vegetation within the NPS service area during the 1990's, thereby providing a baseline study for further analysis at the Regional or Service-wide level. Aerial Information Systems (AIS) was subcontracted by Environmental Systems Research Institute (ESRI), the prime contractor, to perform the photo interpretation (PI) for the program. ESRI also subcontracted The Nature Conservancy (TNC) to conduct the field sampling effort and to support the development of the National Standard Classification.

Several parks representing different regions, environmental conditions, and vegetation types, were chosen by USGS/NPS to be part of the prototype phase of the program. The initial goal of the prototype phase is to "develop, test, refine, and finalize the standards and protocols" to be used during the production phase of the project. This includes the development of a standardized vegetation classification system for each park and the establishment of photo interpretation, field, and accuracy assessment procedures.

This report outlines and describes the project timeline, PI, methodologies, mapping criteria and data conversion procedures implemented in creating the final pilot study vegetation map for the Cades Cove and Mount Le Conte USGS topographic quadrangle maps within the Great Smoky Mountains National Park.

II. REFERENCES USED IN THE MAPPING EFFORT

Classification Source

- The Nature Conservancy – Southeast Regional Office, Jim Drake, Karen D. Patterson, & Chris Ulrey, Vegetation Classification of Great Smoky Mountains National Park, April 1999

General Documents Used

- Michael P. Shafale & Alan S. Weakley, Classification of the Natural Communities of North Carolina – Third Approximation, 1990
- USDA National Park Service – Uplands Field Research Laboratory, Debra Livingston & Cindy Mitchell, Site Classification and Mapping in the Mt. Le Conte Growth District,1976
- Edward C. Yost, Katherine S. Johnson, William F. Blozan, Old Growth Project: Stand Delineation and Disturbance Rating – Great Smoky Mountains National Park Technical Report, October, 1994
- Edward C. Yost, Katherine S. Johnson, William F. Blozan, Delineation of Old-Growth Oak and Eastern Hemlock in Great Smoky Mountains National Park, 1994

Plot Data Used

- The Nature Conservancy – Southeast Regional Office, Jim Drake, Karen D. Patterson, & Chris Ulrey – Plot data for the 1998 Field Season (160 Plots)
- The Nature Conservancy – Southeast Regional Office, Jim Drake, Karen D. Patterson, & Chris Ulrey - Preliminary Vegetation Classification of Great Smoky Mountains National Park – Report on the 1997 Field Season (60 Plots)
- The Nature Conservancy – Southeast Regional Office, Chris Ulrey, Polygon Verification Comments for Cades Cove & Mt. Le Conte (70 Polygons), 1998
- Bob Dellinger, 1996 Dellinger Data (32 Plots)
- Peter White, Mark Harmon & D. Kilgore, 1977-1979 Uplands Data (192 Plots)

III. GENERAL DESCRIPTION

Authorized by Congress in 1926 and established six years later in 1934, the Great Smoky Mountains National Park encompasses over 800 square miles of forested land straddling the crest of the Appalachian Trail along the Tennessee and North Carolina borders. Elevations range from approximately 900 to 6,600 feet and encompass areas of high elevation spruce and fir forests, pine-oak woodlands, and several prime examples of mountain cove communities. Additionally, some of the southern most examples of northern hardwood forests in the United States are found in the park. Containing over 1,500 species of flowering plants, Great Smoky Mountains National Park is a United Nations Biosphere Park. It is the most visited park in the United States with over ten million visitors annually.

Within the two quads mapped, (Mt. Le Conte and Cades Cove) all major forest types are represented. Elevations range from approximately 1,400 feet in the northeastern portion of Mt. Le Conte to over 6,500 feet at the summit of Mount Le Conte. *See Figure II.1 NPS Location Map of the two pilot quads*.

Regional Outline – Descriptions of Great Smoky Mountains National Park (Cades Cove and Mount Le Conte)

For purposes in aiding PI and developing training sites for field reconnaissance, the two quads within the Park were divided into several regions on the basis of macro climatic-floristic divisions and geographic accessibility. The following outline represents these general breakdowns, followed by short descriptions of each region.

Mount Le Conte Quadrangle

- High Elevation Spruce and Fir Forest
- High Elevation Northern Hardwood Forests
- Pine Oak Forests and Mountain Cove Forests

Cades Cove Quadrangle

- High Elevation Northern Hardwood Forests
- Pine Oak and Mountain Cove Forests south of the Appalachian Trail
- Pine Oak and Mountain Cove Forests primarily north of the cove
- Cades Cove and Surrounding Areas

General Location Descriptions

<u>High Elevation Spruce and Fir Forest</u>

Generally located south of Brushy Mountain, this region includes areas above 5,000 feet along the Rocky Spur, the Boulevard, Anakeesta Ridge and Mount Le Conte Ridge

from Balsam Point to the summit. Much of the area is covered by mixed northern hardwood – conifer and conifer communities including the following TNC associations: *Abies fraseri / Viburnum lantanoides / Dryopteris campyloptera – Oxalis Montana / Hylocomium splendens* Forests (6049)*, Picea rubens – Tsuga Canadensis / Rhododendron maximum* Forests (6272)*,* and the following mapping units; *Picea rubens – (Abies fraseri)* Multiple Association Mapping Unit (112) and *Picea rubens – Betula alleghaniensis* Forest Alliance (114)*.* Also included in this location are several successional units where *Rubus canadensis* forms a shrub canopy dominant.

High Elevation Northern Hardwoods Forests

Northern hardwood forests are located on both the Mt. Le Conte and Cades Cove quads. This region was sampled and visited along Highway 71 in the southeastern portion of the Mt. Le Conte from approximately 3,000 to 5,000 feet. On Cades Cove, this region occurs at similar elevations generally in the southern half of the quad along the main ridge of the Appalachian Trail and several north and south trending spurs across the quad. The dominant hardwood is yellow birch, with the following TNC associations occurring over extensive areas: *Aesculus flava – Betula alleghaniensis – Acer saccharum / Acer spicatum / Caulophyllum thalictroides – Laportea Canadensis* Forests (4973), *Betula alleghaniensis – Fagus grandifolia – Aseculus flava / Viburnum lantanoides / Aster chlorolepis – Dryopteris intermedia* Forests (7285) and *Tsuga Canadensis – Betula alleghaniensis / Rhododendron Maximum / Leucothoe fontanesiana* Forests (7861) being the most common on both quads. On the Cades Cove quad, along the ridge tops near and on the Appalachian Trail, several extensive but narrow polygons were mapped in the high elevation red oak alliance.

Pine-Oak and Mountain Cove Forests

Three major regions of these types occur on the two quad study area: 1) areas south of the Appalachian Trail on the Cades Cove quad, 2) areas north of Cades Cove proper and 3) lower elevations generally north of Brushy Mountain to the northern boundaries of the Park on the Mt. Le Conte quad. Each area has major unique differences.

Area 1, south of the Appalachian Trail on the Cades Cove quad contained a significant component of Montane white oak (TNC Element Code 7230) at middle elevations generally between dry chestnut oak types and northern hardwood communities.

Area 2, north of Cades Cove contained the most xeric communities since many of the ridges were steep major south facing slopes at low elevations. In this area, all three species of pine were noted as well as isolated stands of short leaf pine. In addition to the two major pine-oak zones noted above on Cades Cove, a narrow band also exists south of the cove at elevations below 4,000 feet. This region contains the most extensive continuous stands of Table Mountain pine in the two-quad study.

Area 3, located on the Mt. Le Conte quad, is by far the most disturbed, with areas along Greenbrier and south of Gatlinburg containing extensive stands of tulip on the flats and

adjacent areas. Porter's Flat represents a signature on the aerial photography that is a classic expression of an even tone that similar age stands of tulips yield. Several types of "cove forests" containing both hardwood and mixed hardwood-conifer types occur at the higher elevations within all three regions, in concavities that are primarily north trending.

Cades Cove and Surrounding Areas

Located at an elevation between 1,700 and 1,800 feet, this region is bisected along its north-south axis by three roads (Cades Cove Loop at the western end, Hyatt Road and Sparks Lane). The area is dominated with fescue grasses and other ruderal type vegetation. Rush species occupy several small swales primarily in the southern portion of the Cove. Disturbance types where white pine or Virginia pine dominate in pure conifer or mixed conifer-hardwood stands often surround the cove pasturelands.

IV. SUMMARY OF THE MAPPING EFFORT

The following section outlines in chronological order the vegetation mapping effort at Great Smoky Mountains National Park. For a detailed description of the tasks listed below, refer to sections V and Vl.

May 1995
- Initial Scoping Meeting – Review existing data, aerial photography and vegetation mapping program.

September 1995
- Received GRSM aerial photography (both contact prints and diapositives)

January 1996
- Review aerial photography, delineate photo signature training sites for March reconnaissance effort

March 1996
- Meeting at Chapel Hill discussing existing plot data and field reconnaissance effort
- Initial field reconnaissance for the two quads – 1 week effort

June 1996
- Preliminary PI signature keys complete and sent to TNC for review

May 1997
- New spring aerial photography flown (includes the northern quarter of Mt. Le Conte)

June 1997
- 1992 photography and overlays sent to TNC for aid in upcoming field season

October 1997
- New fall aerial photography flown (includes the lower ¾ of Mt. Le Conte)

May 1998
- Previous years field season TNC plots database sent to AIS for pre-reconnaissance review

June 1998
- One-week reconnaissance effort for two-quad mapping effort to tie in photo signatures to the new photography

July 1998
- Polygon data to help in field crew sampling effort and PI signature ties sent to TNC & Park
- Initial reviews and comments from several polygon visited at Cades Cove sent to AIS

August 1998
- Updates to spread sheet data with additional reviews from the field crew sent to AIS

October 1998
- New fall aerial photography flown (includes the Cades Cove quad) and the remainder of the Park

December 1998
- Complete set of 1998 review of polygon data sent to AIS for both quads

April 1999
- Received final classification, keys and descriptions for GRSM from TNC

April – August 1999
- Preliminary delineations on approximately 120 aerial photos for the two quads

September 1999
- PI verification effort for two quads

October 1999
- Updates and corrections made to photo delineations based on verification

November 1999
- Preliminary mapping classification and guidelines complete and sent to TNC for review

January – May 2000
- Geo-referencing (rectifying) polygon data for two quad study area

June 2000
- Final report and PI signature key complete, shape files delivered to ESRI

V. VEGETATION MAPPING

Overview

One of the most important mandates of the Vegetation Mapping Program is the consistent capture and classification of vegetation types through PI and field sampling methodologies. Mapping criteria and procedures developed during the prototype parks are currently being tested and revised.

The first two parks mapped - Assateague Island National Seashore and Tuzigoot National Monument utilized a vegetation layer mapping approach. Layer mapping consists of PI of multiple canopies of vegetation that are visible on the aerial photography. Canopies are normally defined by the structure of the vegetation (trees, shrubs, or herbaceous growth). Where possible, individual plant species are interpreted for each layer of vegetation. These data layers are then aggregated up into the appropriate alliance or community as defined by TNC. Subsequent parks, including the Nebraska grassland parks, Rock Creek Park, and Congaree Swamp National Monument, involved mapping an initial photo signature type describing multiple vegetation canopies. These photo signature types are then translated into a TNC community type or alliance. Height, density and pattern are additionally assigned to each polygon. PI signature types are retained to further describe at a more detailed level the attributes visible on the aerial photography for each polygon.

At Great Smoky Mountains National Park, an additional database field has been created to attribute code polygon data with special modifiers to denote characteristics of the vegetation that are of special interest to the park. These include modifiers concerning standing dead vegetation, physiognomic variabilities in the canopy cover denoting a strong dominance of conifer, or hardwood presence or modifiers depicting sparse shrub and tree layers in heath balds. Additional modifiers denote a high diversity in the canopy cover to cove types that can only be separated out on their understory components.

Initial Project Planning Meeting

A meeting was held at the Park headquarters resource office from May 8-11, 1995 and included staff from the National Park Service, National Biological Service (BRD-USGS) and contract staff from ESRI, AIS, TNC, and the Heritage Program. The purpose of the meeting was to discuss the mapping program objectives, review existing park vegetation inventories and discuss issues of special interest to the park.

During the meetings, imagery, basemaps, and other pertinent collateral materials were reviewed and evaluated. The following vegetation maps were discussed and reviewed as possible collateral sources for the Pilot study:

- 1930 ink drafted vegetation map, paper topo composite with approximately a 10 to 15 acre minimum mapping unit (MMU) with about 10 to 15 categories
- Satellite image based raster data (10 meter grid) of the entire park with elevation modeling built into the database

Chapel Hill Data Inventory Meeting

A meeting was held in March of 1996 at The Nature Conservancy office, Southeast Regional Headquarters to discuss the assessment of existing data and review initial field delineations for the upcoming reconnaissance effort. Discussed at the meeting were the approximately 400 permanent plots that make up the Uplands Study done in the late 1970's. It was noted that many of the plots were not positionally accurate and an effort was underway to correctly locate the plots onto the USGS quad base.

AIS field training sites on the aerial photography were reviewed and general strategies were discussed regarding the upcoming reconnaissance. Logistics were discussed regarding an early season (leaf-off) reconnaissance and the value to the photo interpreters. It was concluded that alliance level determinations could be made in the field by TNC biologists, which would be sufficient to assist the photo interpreters in the preliminary signature delineations for the two quads.

Development of Photo Interpretation Mapping Procedures

The normal process in vegetation mapping is to conduct an initial field reconnaissance, map the vegetation units through PI, and then conduct a field verification. The field reconnaissance visit serves two major functions. First, the PI keys the signature on the aerial photos to the vegetation on the ground at each signature site. Second, the photo interpreter becomes familiar with the flora, vegetation communities and local ecology that occur in the study area. Park and/or TNC field biologists that are familiar with the local vegetation and ecology of the park are present to help the photo interpreter understand these elements and their relationship with the geography of the park.

Upon completion of the field reconnaissance, photo interpreters delineate vegetation units on mylar sheets that overlay the 9"x9" aerial photographs. This effort is conducted in accordance with the TNC vegetation classification and criteria for defining each community or alliance. The initial mapping is then followed by a field verification effort, designed to confirm that the vegetation units were mapped correctly. Any PI related questions are also addressed during the visit.

The vegetation mapping at Great Smoky Mountains National Park deviated from the above procedures for the following reasons.

- It was determined upon further review, that the existing aerial photography (1992) contained numerous gaps of information. In addition, it was noted that the photos had parallax problems that were quite severe. Fall photography was extremely late and did not capture optimal leaf change phenology. A subsequent effort was undertaken to re-fly the Park during the following years (1997 and 1998) to provide photo interpreters with better quality photography.

Development of Photo Interpretation Mapping Criteria

From the onset of the Vegetation Inventory and Mapping Program, a standardized program-wide mapping criterion has been used. The mapping criteria contain a set of documented working decision rules used to facilitate the maintenance of accuracy and consistency of the

PI. This criterion assists the user in understanding the characteristics, definition and context for each vegetation community.

Additional criteria specific to mapping at Great Smoky Mountains National Park is described in the following three sections:

Park Specific Mapping Criteria

Of special interest to the park was the variability in the canopy cover that photo interpreters could capture which may not be a determining factor in defining the characteristics of a TNC association or alliance. These polygons are captured through use of a PI modifier denoting strong presence of evergreen or deciduous components to certain TNC types.

In addition, park officials were interested in capturing information related to dead vegetation that is visible on the aerial photography (standing dead within pine and fir communities). These attributes are also captured through a PI modifier depicting standing dead within pine and fir communities, or hurricane damage primarily in the spruce polygons.

TNC Classification, Key, and Descriptions

The assignment of alliance and community associations to the vegetation is based on criteria formulated by TNC. TNC provided AIS with a tentative community classification early on in the project. This classification was used as the basis in developing a PI signature type listing used during the preliminary PI task. Plot sample data collected by TNC for most of the types were also used to gain insight on how the community types were developed in the Park. A final vegetation classification, key, and descriptions were completed in April 1999.

Working Photo Signature Key

A photo signature key is an important tool for maintaining consistency in interpretation. The key correlates the physical descriptions of the photo signature with the appropriate vegetation community. A key may also describe other useful information that would be helpful in the PI. For Great Smoky Mountains National Park, the PI signature name corresponds for the most part with the TNC association. In general, the PI signature name denotes what the photo interpreter can see, and will for the most part not list understory components which are often part of the corresponding TNC association. Several mapping units have been developed when it is not possible to map to the association level such as certain cove types or associations within the high elevation red oak forest.

Field data collected during the reconnaissance effort were analyzed and compared with the aerial photos and a consistent correlation between the photo signatures and vegetation types were noted. Each photo signature was then assigned a TNC association type based on the preliminary vegetation listing for GRSM. This photo signature key was later modified to accommodate the final classification.

The final signature key is in a table format, and contains the TNC community code and name, photo signature name, photo signature characteristics (color, crown shape and size, texture) and pertinent notes for each type which are further described in the mapping criteria document.

Standards and Guidelines for Photo Interpretation

Upon completion of the final verification effort in 1999, a descriptive text (Standards and Guidelines for Photo Interpretation, see Attachments) was developed which aided the photo interpreter in delineating the associations on the two quads. Each association is referenced to the TNC Classification by page number, and is followed by a complete set of biophysical parameters that were derived from reviewing the classification and preliminary delineations and labels on the two quads. In addition, a category denoting similar associations which may be difficult to distinguish are listed with notes that may aid in the labeling of the polygons. Included in the document are mapping criteria and rules used to delineate the association such as percent ranges of various canopy components.

The document is structured in a hierarchal format below the association level (alliance-formation) and uses the TNC ELCODE to label the associations within the alliance.

Project Set-Up – Aerial Photography

A complete set of aerial photography was provided for the project with the following specifications:

Cades Cove quad:

- CIR photography
- Flight date - spring 1992 (leaf flush)
- Nominal scale – 1:15,000
- Approximate photo size – 9” x 9”
- Prints and diapositives

Mount Le Conte quad:

- CIR photography
- Flight date – fall 1992 (leaf change – late season)
- Nominal scale – 1:15,000
- Prints and diapositives

Significant problems existed with the 1992 aerial photography that made alliance and association level interpretation for the most part not achievable. The most significant problems with the 1992 aerial photography were:

- Gaps between the flight lines (approximately 5% of the study area)
- Severe parallax along the flight line that made stereo interpretation impossible in places
- Fall photography flown too late into the season at mid to high elevations on the Mt Le Conte quad
- Problems with photo exposure – especially toward the edges and corners of the photography

A new set of aerial photography was flown for the entire park, significantly reducing the magnitude of the above listed problems, eliminating a great deal of parallax, filling in photo gap areas and flying earlier in the fall season to capture a greater variation in species reflectance at mid and higher elevations. The northern portion (approximately ¼) of Mt. Le Conte was flown in May, a bit too late for ideal spring flush conditions making it difficult to distinguish some of the lower elevation oak types. The specifications for the aerial photography is described below:

CIR photography (Mt. Le Conte – north ¼)
- Flight date - spring 1997 (leaf flush – toward the end)
- Nominal scale – 1:12,000
- Approximate photo size – 9" x 9"
- Prints and diapositives

CIR photography (Mt. Le Conte – south ¾, Cades Cove– north 1/3)
- Flight date – fall 1997 (leaf change – mid season)
- Nominal scale – 1:12,000
- Approximate photo size – 9" x 9"
- Prints and diapositives

CIR photography (Cades Cove – south 1/3)
- Flight date – fall 1998 (leaf change – mid season)
- Nominal scale – 1:12,000
- Approximate photo size – 9" x 9"
- Prints and diapositives

A general flight line index was created for each set of photography. See Figure IV.1 Mt. Le Conte Photo Index and Figure IV.2 Cades Cove Photo Index. These indexes were used for quick reference to photo locations and as a status tool showing work completed on various portions of the project.

Field Reconnaissance Preparation

Prior to the field reconnaissance, several in-house preparations were performed in order to facilitate a more organized trip. The two quads were each divided up into potential full day and ½ day efforts depending primarily on accessibility and hiking distances. Features were drafted on the field overlays registered to the aerial photo prints to aid in navigating in the field. Trails, roads and several reference points, including ridgelines, drainages and cultural points were utilized.

Each photo was reviewed under a stereoscope to choose field transect sites representing different signature types, geographic variables (% slope, aspect, shape of the slope, elevation), and other abiotic variables. PI check sites and associated notations were also drafted onto the field overlays. Multiple sites were chosen to provide alternatives if one or more sites proved inaccessible.

The field photographs (CIR prints), overlays and associated topographic sheets were arranged in packets for the field teams. Alternative sets of photos were also prepared to allow the team flexibility if logistical problems arose.

Field Reconnaissance Trips

Two seven-day PI field reconnaissance efforts were conducted in April 1996 and June of 1998 to establish relationships between the photo signatures evident on the aerial photographs and the TNC community types on the ground. Although the first reconnaissance effort tied signatures to the original photography that was later replaced, valuable biophysical relationships were attained and implemented in the final photo interpretation effort.

Personnel from NPS, TNC, Heritage Program, and AIS were involved in all or portions of both field efforts. The field crews conducted on-site investigations and visited the following areas during the two efforts:

Cades Cove quad:

- Rich Mountain Road
- Rich Mountain Trail
- Cooper Road
- Anthony Creek Trail
- Cades Cove
- Victory Branch Trail
- Forge Creek Road
- Parsons Branch Road
- Gregory Ridge Trail

Significant portions south of the Appalachian Trail, especially in the southeastern portion of the quad were not accessible during the reconnaissance efforts.

Mt. Le Conte quad:

- Roaring Fork Road
- Dudley Creek Trail
- Injun Creek
- Greenbrier Road
- Trillium Gap Trail
- Rainbow Falls and Balsam Point Trails
- Mt Le Conte Trail from Alum Cave Trail
- Chimney Tops Trail
- Highway 71

Significant portions in the southeastern portion of the quad around “The Boulevard” were not accessible during the reconnaissance efforts.

During the field visits, photo interpreters worked with the field biologists to identify the plant species, preliminary vegetation communities and the associated photo signature.
Field site numbers were annotated directly onto the photo field overlay, thereby correlating the field site to a specific location and photo signature. A field notebook was used to record pertinent information (canopy dominance, understory species present, abiotic features, disturbance history) for each site visited. Several ground photos (35mm) were taken at selected locations and later compared to the aerial photographs and the field sites. Areas not previously identified on the aerial photos were also visited. These sites included areas between initially selected sites, areas of noteworthy or unusual significance and areas the photo interpreter deemed important in transit from site to site.

Photo Delineations for 1998 TNC Sampling Effort

Following the second reconnaissance effort, photo interpreters delineated representative samples from over 75% of the alliances described on the two quads. Approximately 130 polygons were delineated onto the two quads. TNC field crews subsequently visited approximately 70 of these sites over the two quads, including areas that were inaccessible during the two reconnaissance trips. This effort served two major purposes:

1. It guided the 1998 field sampling efforts to sample the highest diversity with a greater chance of representing most of the alliances on the two quads.
2. Feedback from the field crews enabled photo interpreters to further refine their interpretation efforts in correlating photo signature to TNC communities.

Photo Interpretation of Vegetation

PI is the process of identifying map units based on their photo signature. All land cover features have a photo signature. These signatures are defined by the color, texture, tone and pattern they represent on the aerial photography. By observing the context and extent of the photo signatures associated with specific vegetation types, the photo interpreter is able to identify and delineate the boundaries between plant communities or signature units. Additional collateral sources (existing vegetation maps, supplemental photography, soil data, etc.) can be of great utility to the photointerpreter. Understanding the relationship between the vegetation and the context in which they appear is useful in the interpretation process. Familiarity with regional differences also aids PI by establishing a context for a specific area.

Approximately 120 photos were needed to provide full photo coverage of the two-quad study area. Due to the inconsistent spacing between flight lines and the rough terrain of the Park, it was determined that delineations would be done on every photograph.

Each photo was prepared with a 9” x 9” frosted mylar overlay for the photo signature delineations. Photo overlays were then pin-registered to the photos and project labels were affixed to each overlay identifying the photo number, status of work, and photo interpreters responsible for that task. Study area boundaries were drafted onto each photo overlay, defining the area within the photograph to be interpreted. The study area boundaries were edge matched to adjacent photos to ensure complete coverage.

Using a mirror stereoscope, with a 3X0 lens, photo signature units were delineated onto the mylar overlays. These initial photo delineations were based on a number of signature characteristics including color, tone, texture, relative height and density. Initial attribute codes (PI signature types) were assigned to each polygon. Height and density values were assigned to polygons that were atypical for that community. Subsequent modeling relating the TNC community populated the remaining polygons with a height and density value. The photo signature map units and codes were edge matched to the adjoining photo overlays.

PI of vegetation traditionally takes place after the vegetation classification has been developed. For Great Smoky Mountains National Park, the classification existed in a final form that included descriptions and keys. This information proved extremely valuable in the photo interpretation effort and enabled photo interpreters to further refine biophysical relationships to TNC communities.

Photo Interpretation Field Verification

The field verification trip for the AIS vegetation mapping project at Great Smoky Mountains National Park was held September 20-24, 1999. The goals of the verification trip were to ground-truth both specific polygons and general association signatures on photos for which initial interpretation was complete. Both vegetation classification and initial photo interpretation efforts were assessed for changes necessary to accurately finish the vegetation map. The field team concentrated on areas in the Cades Cove and Mount Le Conte quads that were not previously visited during plot surveys or AIS's earlier reconnaissance trips. On two of the days, the University of Georgia Remote Sensing Team joined the field verification team. The University of Georgia is mapping other quads within the Park.

Background

Preparation for the field verification trip involved several steps:

1. Initial PI was completed for areas to be visited within each quad.
2. Verification accuracy sites were chosen on each photo based on problematic signatures, commonly occurring associations, landforms, hydrological zones, slope, aspect, and accessibility.
3. Points representing the verification accuracy sites were delineated on USGS topographic maps.
4. The verification accuracy sites were plotted onto Digital Ortho Quarter Quad (DOQQ) maps and a spreadsheet was compiled of GPS locations of the points.

Field notes were taken at each verification accuracy site visited as well as at areas visited en route to these sites. Sites visited were geo-referenced on the topographic maps and photo overlays. Verification points are numbered with the aerial photo number first and the interpreted vegetation type or field site second. The points described in this report are labeled as such on the topographic maps but may be labeled otherwise on the photo overlays due to field revisions made after the trip.

Summary

Of the approximately 100 sites visited, the field checks confirmed 63% of the initial PI assignments to the association level. Two percent of the sites were not previously interpreted but were en route to problematic polygons on neighboring photos. Thirty-five percent of the field checks revealed different vegetation associations than expected from the initial photo interpretation.

Six of the 36 polygons requiring a change of vegetation type involved separate chestnut oak associations which have similar photo signatures. Field observations from this trip gave an insight into the differing environments of these types (e.g., the occurrence of the chestnut oak-rhododendron forest on steep slopes above acid coves) and can aid in future PI. Another seven polygons had significantly less evergreen component than expected. In a few areas where hemlock-white pine forest (7102) was interpreted, the deciduous cover was sufficient enough to change the area's classification to a hemlock-tuliptree acid cove forest (7543). Several of the interpretation changes that were discovered during the field

verification trip required a reexamination of the association specifications. Several types were found to occur more frequently or less frequently than was previously sampled.

Five multiple association mapping units were created by combining associations with complex and/or similar overstories, photo signatures, and environmental settings. These are the red spruce with Fraser fir type (0101), the red spruce with yellow birch and buckeye type (0113), the high elevation red oak montane forest type (0132), the "richer" cove type (0301), and the hemlock forest type (0302). At least one new association was described from the trip: areas of disturbed white pine forest surrounding Cades Cove are now classified as successional white pine forests (0826). For further description, please see the Standards and Guidelines for PI that was produced after the field verification trip. The new multiple association mapping unit and white pine successional forest association numbers are currently being used at AIS during PI in anticipation of new, nationally accepted ELCODE numbers from TNC.

Final Photo Interpretation

After the final verification effort, AIS proceeded with final revisions to the PI linework and photo signature typing. The TNC plot locations were drafted onto the corresponding aerial photo PI overlay for reference. Each polygon was reviewed with consideration of the field sampling plot data, classification and the information gathered during the reconnaissance and verification trips. Any uncertain interpretations were flagged on the mylar overlays for review during the quality control task.

Photo overlay edges were reviewed to the adjacent photo to ensure a seamless coverage in the database. Delineations and codes were compared and discrepancies between photos were resolved and corrected on the mylar overlays.

Quality Control of the Photo interpretation

A separate quality control step was performed for each photo upon completion of the PI. A senior photo interpreter reviewed each photo for map unit delineation, PI signature code, height code, and density code accuracy. Each photo overlay was checked for completeness, consistency, and adherence to the mapping criteria and guidelines. For those polygons flagged by the photointerpreter, the quality control reviewer assigned the appropriate vegetation code and discussed the situation with the photo interpreter.

UGA Photo Interpretation Effort

AIS photo interpreters did not have the opportunity to review the draft products completed by the University of Georgia Remote Sensing Team. Efforts are on going to standardize mapping using the UGA classification and the TNC classification, (may currently be complete). The mapping conventions, or crosswalk information relating the two classifications has not been completed. Therefore, polygon data interpreted on the two quads will not conform to the standards and conventions that are being used for the rest of the Park. This problem can be smoothed (edge matched) along the two quad boundaries, but the differences in mapping procedures cannot be standardized, since Cades Cove and Mt. Le Conte quadrangles were completed separately following the USGS/NPS Inventory and Mapping Program map standards and protocols using the TNC classification.

VI. DATA CONVERSION

Basemap Specifications

It was determined that polygons drafted onto the photo overlays would be subsequently geo-referenced (rectified) to eight digital orthophoto quarter quads representing the two-quad study area.

On-Screen Rectification

On-screen rectifying of the polygon data to the DOQQ base was performed in an ArcView environment on a Windows NT Platform. Geo-referencing was facilitated with background shape files depicting contours derived from digital elevation models. In several areas, contours tended to be slightly offset from the DOQQ. This was especially noticeable in ridge top and drainage settings in fairly steep environments over short distances. When this situation was observed, linework was rectified to the DOQQ base. One example where this occurred is noted below:

- Mt. Le Conte – Photo 14-039 281174E, 3947242N

Shape files showing stream course delineations were also used to help rectify the polygon data, although the data from this source tended to be less accurate.

A 24” X 36” light table was positioned in front of the computer view screen. The vegetation delineations were viewed in stereo (using 3x0 magnification) to aid the photo interpreter in locating the lines onto the DOQQ.

Due to the difference in seasonality between the CIR aerial photography and the DOQQ’s, (the DOQQ’s were flown in leaf-off phenology), several areas may appear not to conform to the signatures of the DOQQ. Most of these areas are visible in the high elevation ridge tops and upper slopes in the southern portion of the Cades Cove quad. This situation tends to occur in polygons that are either high elevation red oak or typic northern hardwood communities.

The four code attributes (PI code, height code, density code and modifier) were also transferred from the photo overlays. Each rectified image was edge matched to the adjacent sheet. To guarantee accuracy of the rectification, delineation, and transfer of attributes, a senior photo interpreter performed a quality control step.

Digital Edge Matching

An edge match program highlighted any inconsistencies between the overlays. Along edges with DOQQ data shift problems, the vegetation polygons were adjusted to create a seamless coverage. Typically these adjustments required an “averaging” of the error between the images.

DOQQ Edge Problems

While rectifying the delineations to the DOQQ's, spatial discrepancies between the quarter quad images were noted. The error ranged from 0 to 80 meters at several points along the edge. Several examples, which are easily visible on the Cades Cove quad, are given below:

Between Cades Cove NE and Cades Cove NW – at 245580E and 3943120N: Along a small creek within the cove pasturelands, visible offset between the two DOQQ's is approximately 15 meters.

Between Cades Cove NE and Cades Cove SE - at 249257E and 3938674N: In steep terrain, using a small man made structure near Russell Field as a reference point, offset between the two DOQQ's is approximately 80 meters.

It was noted that the edge discrepancies between the DOQQ's were not consistent, and were understandably the most severe in areas of greatest elevational relief. Vegetation lines were corrected to the DOQQ using the existing contour data as a backdrop environment. The DOQQ that spatially correlated closest to the contour lines was the one used as the base for edge matching the vegetation linework. *Note:* This effort was used to facilitate edge matching the vegetation data between DOQQ's only. Where inconsistencies between contour data and DOQQ imagery were seen elsewhere, the DOQQ was used as the standard base in which to rectify the vegetation linework.

A Note on Accuracy Assessment

Because the errors inherent in the DOQQ data is not limited to the edge (it is only visible on the edge in relation to the other DOQQ's), Accuracy Assessment procedures should include additional information (besides GPS) in which to make sure the reviewer is located in the correct polygon. This can be done with hard copy overlays of the vegetation linework in relation to other landscape features without compromising an unbiased approach as long as the reviewer is not aware of the actual polygon vegetation label.

Creation of Topology and Conversion to ARC/INFO Coverages

Topology is the mathematical procedure for explicitly defining spatial relationships. In the case of maps, topology defines connections between features, identifies adjacent polygons, and can define one feature such as an area, as a set of other feature types (i.e., lines). A topological database has several advantages: efficient data storage, faster processing, and the ability to perform analysis, such as modeling transportation networks or overlaying geographic features on one another.

Once the shape file has been converted to an ARC/INFO coverage, the ARC/INFO software CLEAN command was used to create the "coverage topology." The CLEAN fuzzy tolerance was set to .002 inches to preserve the required data resolution. When other coordinate edits were made to a coverage after the CLEAN command was run, topology was recreated utilizing the BUILD command.

Label Entry Error Processing

Label errors were identified by using the LABELERRORS command in ARC. Using ARCEDIT, any label errors identified were corrected by entering the missing label number and placing it within the correct polygon. Once all the errors were corrected, the coverages were joined with the attribute files.

Map Joining

After the digital rectification procedures were finished, the eight individual module coverages were combined into two complete coverages for the Pilot Study. A final automated edgematch check was performed. A code find and frequency program was run to review the code attribute accuracy.

Final Quality Assurance of the Vegetation Map

Once the crosswalk to the alliance/community classes was completed and the attribute items populated, a final vegetation community plot was created. The plot was reviewed for accuracy and consistency of community class assignments.

Pattern Assignment

The final community type plot was also used as a base to delineate the pattern types for the Park. The pattern variable describes the general distribution of the vegetation across the landscape. Pattern of vegetation can reflect the landform, soil, geology, climatic gradients, and/or elevational gradients. The minimum mapping unit (MMU) size for pattern assignment was 10 acres. The pattern types were input as a separate variable into the Park database. The completed coverage was delivered to ESRI to be formatted into the final Geographic Information System (GIS) structure.

VII. DATA DICTIONARY – GREAT SMOKY MOUNTAINS NATIONAL PARK

DATA FORMAT OUTLINE:

Coverage related variables:			
Area	8	18	F
Perimeter	8	18	F
Veg#	4	5	B
Veg-id	4	5	B
Defined variables:			
Quad	20	20	C
TNC	4	4	I
Height	1	1	I
Density	1	1	I
Land Use	3	3	I
Pattern	1	1	I

DATA DICTIONARY:

SEQNO (Defines AIS internal sequence number)

QUAD (Defines the module name abbreviation, corresponds to the USGS topographic quad sheet)

Cades_Cove
Mt_Le_Conte

TNC (Defines the TNC Association, Alliance, or Mapping Unit)

*Note: Types in bold are mapped

110 = SPRUCE / FIR FORESTS
- 111 = IA8Nc010 Abies fraseri – Picea rubens Forest Alliance
  - 6308 Abies fraseri / (Rhododendron catawbiense, Rhododendron carolinianum) Forest
  - **6049 Abies fraseri / Viburnum lantanoides / Dryopteris campyloptera - Oxalis montana / Hylocomium splendens Forest**
  - 7130 Picea rubens - (Abies fraseri) / (Rhododendron catawbiense, Rhododendron maximum) Forest
  - 7131 Picea rubens - (Abies fraseri) / Vaccinium erythrocarpum / Oxalis montana - Dryopteris campyloptera / Hylocomium splendens Forest
- **112 = 7130 – 7131 = Picea rubens – (Abies fraseri) Multiple Association Mapping Unit**
- 113 = IA8Nc030 Picea rubens Forest Alliance
  - **6272 Picea rubens - Tsuga canadensis / Rhododendron maximum Forest**
- **114 = IC3Na045 Picea rubens – Betula alleghaniensis Forest Alliance**
  - 4983 Picea rubens - (Betula alleghaniensis, Aesculus flava) / Rhododendron (maximum, catawbiense) Forest
  - 6256 Picea rubens - (Betula alleghaniensis, Aesculus flava) / Viburnum lantanoides / Oxalis montana - Solidago glomerata Forest

120 = BEECH GAP FORESTS
- 121 = IB2Nb020 Betula alleghaniensis – Fagus grandifolia – Aesculus flava Forest Alliance
  - 6246 Fagus grandifolia / Ageratina altissima var. roanensis Forest
  - 6130 Fagus grandifolia / Carex pensylvanica - Carex brunnescens Forest

130 = HIGH ELEVATION RED OAK OR WHITE OAK FORESTS
- 131 = IB2Nb070 Quercus alba Montane Forest Alliance
  - 7295 Quercus alba / Kalmia latifolia Forest
- **132 = IB2Nb080 Quercus rubra Montane Forest Alliance**
  - 7299 Quercus rubra / (Kalmia latifolia, Rhododendron maximum) / Galax urceolata Forest

7300 Quercus rubra / (Vaccinium simulatum, Rhododendron calendulaceum) / (Dennstaedtia punctilobula, Thelypteris noveboracensis) Forest
7298 Quercus rubra / Carex pensylvanica - Ageratina altissima var. roanensis Forest

140 = "NORTHERN HARDWOOD" FORESTS
141 = IB2Nb020 Betula alleghaniensis – Fagus grandifolia – Aesculus flava Forest Alliance
4973 Aesculus flava - Betula alleghaniensis - Acer saccharum / Acer spicatum / Caulophyllum thalictroides - Laportea canadensis Forest
7285 Betula alleghaniensis - Fagus grandifolia - Aesculus flava / Viburnum lantanoides / Aster chlorolepis - Dryopteris intermedia Forest
142 = IC3Na255 Tsuga canadensis - Betula alleghaniensis Forest Alliance
7861 Tsuga canadensis – Betula alleghaniensis / Rhododendron Maximum / Leucothoe fontanesiana Forest

150 = FORESTED BOULDERFIELDS
151 = IB2Nb020 Betula alleghaniensis – Fagus grandifolia – Aesculus flava Forest Alliance
4982 Betula alleghaniensis / Acer spicatum / Hydrangea arborescens - Ribes cynosbati / Dryopteris marginalis Forest
6124 Betula alleghaniensis / Ribes glandulosum / Polypodium appalachianum Forest

200 = XERIC RIDGE FORESTS

210 = TABLE MOUNTAIN PINE / PITCH PINE WOODLANDS
211 = IA8Nb109 Pinus virginiana Forest Alliance
7119 Pinus virginiana - Pinus (rigida, echinata) - (Quercus prinus) / Vaccinium pallidum Forest
212 = IIA4Na170 Pinus pungens – (Pinus rigida) Woodland Alliance
7097 Pinus pungens - Pinus rigida (Quercus prinus) / Kalmia latifolia - Vaccinium pallidum Woodland

220 = SHORTLEAF PINE / SHORTLEAF PINE-OAK FORESTS
221 = IA8Nb030 Pinus echinata Forest Alliance
7078 Pinus echinata / Vaccinium (pallidum, stamineum) - Kalmia latifolia Forest
3560 Pinus echinata / Schizachyrium scoparium Appalachian Woodland

230 = WHITE PINE / WHITE PINE - OAK FORESTS
231 = IC3Na160 Pinus strobus-Quercus (coccinea, prinus) Forest Alliance
7519 Pinus strobus - Quercus (coccinea, prinus) / (Gaylussacia ursina - Vaccinium stamineum) Forest
232 = IA8Nb140 Pinus strobus Forest Alliance
7100 Pinus strobus / Kalmia latifolia - (Vaccinium stamineum, Gaylussacia ursina) Forest
233 = IC3Na150 Pinus strobus - Quercus (alba, rubra, velutina) Forest Alliance
7517 Pinus strobus – Quercus alba – (Carya alba) / Gaylussacia ursina Forest

240 = CHESTNUT OAK FORESTS
241 = IB2Na350 Quercus prinus (Quercus coccinea, Quercus velutina) Forest Alliance
6271 (Quercus prinus - Quercus coccinea) / Kalmia latifolia / Galax urceolata Forest
242 = IB2Na360 Quercus prinus - Quercus rubra Forest Alliance
6286 Quercus prinus - Quercus rubra / Rhododendron maximum / Galax urceolata Forest

300 = LOW ELEVATION PROTECTED FORESTS

310 = MOUNTAIN COVE FORESTS
311 = IB2Na235 Liriodendron tulipfera-Tilia americana-Aesculus flava-Acer saccharum Forest Alliance
7695 Aesculus flava - Acer saccharum - (Fraxinus americana, Tilia americana) / Hydrophyllum canadense - Solidago flexicaulis Forest
7710 Liriodendron tulipifera - Aesculus flava - (Fraxinus americana, Tilia americana var. heterophylla) / Cimicifuga racemosa - Laportea canadensis
7291 Liriodendron tulipifera - Tilia americana var. heterophylla - (Aesculus flava) / Cimicifuga racemosa Forest
312 = 7695 – 7710 "Rich – Typic" Cove Multiple Association Mapping Unit
313 = IC3Na260 Tsuga canadensis-Liriodendron tulipfera Forest Alliance
7693 Tsuga canadensis - Halesia tetraptera - (Magnolia fraseri - Fagus grandifolia) / Rhododendron maximum / Dryopteris intermedia Forest
7543 Tsuga canadensis - Liriodendron tulipifera / Rhododendron maximum / Tiarella cordifolia Forest
314 = IB2Na027 Quercus alba – (Quercus rubra, Carya spp.) Forest Alliance
7878 Quercus rubra – Tilia americana var. heterophylla – Halesia tetraptera var. monticola/ Collinsonia canadensis – Tradescantia subaspera Forest

320 = HEMLOCK FORESTS
321 = IA8Nb150 Pinus strobus-Tsuga canadensis Forest Alliance
7102 Pinus strobus - Tsuga canadensis / Rhododendron maximum - Leucothoe fontanesiana Forest
322 = IA8Nc070 Tsuga canadensis Forest Alliance
7136 Tsuga canadensis / Rhododendron maximum - Leucothoe fontanesiana Forest
323 = 7102 – 7136 Hemlock Multiple Association Mapping Unit

330 = MONTANE OAK-HICKORY FORESTS
331 = IB2Na270 Quercus alba - Quercus (falcata, stellata) Forest Alliance
332 = IB2Na280 Quercus alba - (Quercus rubra-Carya spp.) Forest Alliance
7230 Quercus alba - Quercus (rubra, prinus) / Rhododendron calendulaceum - Kalmia latifolia - (Gaylussacia ursina) Forest
7692 Quercus alba - Quercus rubra - Quercus prinus / Collinsonia canadensis - Podophyllum peltatum - Sanguinaria canadensis Forest

6192 Quercus rubra - Acer rubrum / Calycanthus floridus – Pyrularia pubera / Thelypteris noveboracensis Forest
333 = IB2Na360 Quercus prinus - Quercus rubra Forest Alliance
7267 Quercus prinus - (Quercus rubra) - Carya spp. / Oxydendrum arboreum - Cornus florida Forest

400 = GLADES AND BARRENS

410 = SHALE BARRENS
411 = IC3Na230 Pinus virginiana-Quercus (coccinea, prinus) Forest Alliance
7539 Pinus virginiana - Quercus prinus - Quercus rubra / Vaccinium pallidum - Kalmia latifolia Forest
420 = CLIFFS AND FORESTED OUTCROPS
421 = VIIA1Na010 Asplenium montanum Sparsely Vegetated Alliance
4980 Asplenium montanum Felsic Cliff Sparse Vegetation
422 = VIIA1Na015 Asplenium ruta-muraria-Pellaea atropurpurea Sparsely Vegetated Alliance
4476 Asplenium ruta-muraria - Pellaea atropurpurea Sparse Vegetation
430 = SPRAY CLIFFS
431 = VB2Nf080 Vittaria appalachiana-Heuchera parviflora Saturated Herbaceous Alliance
4302 Vittaria appalachiana - Heuchera parviflora var. parviflora - Houstonia serpyllifolia / Plagiochila spp. Herbaceous Vegetation

500 = HIGH ELEVATION SUMMITS

510 = GRASS BALDS
511 = VA5Ne035 Danthonia compressa Herbaceous Alliance
4242 Danthonia compressa Herbaceous Vegetation
520 = HEATH BALDS
521 = IIIA2Nb050 Rhododendron (catawbiense, carolinianum) Kalmia latafolia Shrubland Alliance
3814 Kalmia latifolia - Rhododendron catawbiense (Gaylussacia baccata, Pieris floribunda, Vaccinium corymbosum) Shrubland
7876 Rhododendron carolinianum – Rhododendron catawbiense – Leiophyllum buxifolium Shrubland
530 = ROCKY SUMMITS
531 = VB2Nb050 Saxifraga michauxii Herbaceous Alliance
4278 Saxifraga michauxii - Carex misera - Calamagrostis cainii Herbaceous Vegetation
600 = NON-ALLUVIAL WETLANDS

610 = LOW ELEVATION MEADOWS**
611 = VA5Nk046 Juncus effusus Seasonally Flooded Herbaceous Alliance
4112 Juncus effusus Seasonally Flooded Herbaceous Vegetation
620 = SPHAGNUM AND SHRUB BOGS AND SEEPS
621 = VA5Nm101 Carex ruthii – Carex gynandra Saturated Herbaceous Alliance
7877 Calamagrostis cainii – Carex ruthii – Parnassia asarifolia / Sphagnum spp. Herbaceous Vegetation (Mapped to plot data only)
7697 Carex gynandra – Platanthera clavellata – Drosera rotundifolia – Carex ruthii – Carex atlantica / Sphagnum spp. Herbaceous Vegetation
630 = FORESTED SEEPS
631 = VB2Nf007 Diphylleia cymosa – Saxifraga micranthidifolia Saturated Herbaceous Alliance
4296 Diphylleia cymosa - Saxifraga micranthidifolia - Laportea canadensis Herbaceous Vegetation
632 = VB2Nf009 Impatiens (capensis, pallida) – Monarda didyma Saturated Herbaceous Alliance
4293 Impatiens (capensis, pallida) - Monarda didyma - Rudbeckia laciniata var. humilis Herbaceous Vegetation
640 = UPLAND POOLS
641 = lB2Ne006 Liquidambar styraciflua – (Acer rubrum) Seasonally Flooded Forest Alliance
7388 Liquidambar styraciflua / Sphagnum spp. Forest

700 = ALLUVIAL HABITATS

710 = RIVER GRAVEL / COBBLE BAR
711 = IIIC2Ne010 Alnus serrulata-Salix sericea-Rhododendron (catawbiense, maximum) Saturated Shrubland Alliance
3895 Alnus serrulata - Xanthorhiza simplicissima Shrubland
720 = SAND AND MUD BAR
721 = VA5Nj004 Carex torta Temporarily Flooded Herbaceous Alliance
4103 Carex torta Herbaceous Vegetation
730 = MONTANE ALLUVIAL FORESTS
731 = lB2Ne002 Acer rubrum Seasonally Flooded Forest Alliance
6347 Acer rubrum Seasonally Flooded Forest [Provisional]
732 = 1B2Nd014 Platanus occidentalis – (Liquidambar styraciflua , Liriodendron tulipfera) Temporarily Flooded Forest Alliance
7880 Liquidambar styraciflua – Liriodendron tulipfera (Platanus occidentalis) / Carpinus caroliniana – Halesia tetraptera var. monticola / Collinsonia candadensis – Tradescantia subaspera
4691 Platanus occidentalis - Liriodendron tulipifera - Betula (alleghaniensis, lenta) / Alnus serrulata - Leucothoe fontanesiana Forest
733 = 1B2Nd013 Platanus occidentalis – (Fraxinus pennsylvanica, Celtis laevigata, Acer saccharinum) Temporarily Flooded Forest Alliance
7339 Platanus occidentalis - Fraxinus pennsylvanica - Acer negundo / Boehmeria cylindrica Forest
740 = MONTANE CANEBRAKES
741 = llA2Ng001 Arundinaria gigantea Temporarily Flooded Shrubland Alliance

3836 Arundinaria gigantea ssp. gigantea Shrubland

800 = CULTURAL / SUCCESSIONAL / EXOTIC / MODIFIED VEGETATION

810 = EXOTIC / ALIEN VEGETATION
3687 Paulownia tomentosa Woodland
7191 Ailanthus altissima Forest
4048 Festuca spp. Herbaceous Vegetation
820 = OTHER SUCCESSIONAL OR MODIFIED VEGETATION
821 = lA8Nb017 Pinus virginiana Forest Alliance
2591 Pinus virginiana Successional Forest
822 = lB2Na107 Juglans nigra Forest Alliance
7879 Juglans nigra / Verbesina alternifolia Forest
823 = lB2Na024 Liriodendron tulipfera Forest Alliance
7219 Liriodendron tulipfera – Acer rubrum – Robinia pseudoacacia Forest
824 = llB2Nb002 Rubus allegheniensis – Rubus canadensis Shrubland Alliance
3893 Rubus canadensis – (Rubus idaeus ssp. strigosus) / Solidago glomerata Shrubland
825 = llB2Na018 Vitis aestivalis Vine-Shrubland Alliance
3890 Vitis aestivalis Vine-Shrubland
826 = White Pine Successional Stands

9000 = Land Use
9100 = Water

HEIGHT

1 = < 0.5 meters
2 = 0.5 – 2 meters
3 = 2 – 5 meters
4 = 5 – 15 meters
5 = 15 – 35 meters
6 = 35 – 50 meters
7 = > 50 meters
9 = Not Applicable

DENSITY

1 = Closed/Continuous	< 60%
2 = Discontinuous	40% - 60%
3 = Dispersed	25% - 40%
4 = Sparse	10% - 25%
5 = Rare	2% - 10%

9 = Not Applicable

LANDUSE

100 = Urban/Built-up
200 = Agriculture
300 = Mining
400 = National Park Facilities
401 = Park facilities
402 = Parking
403 = Campground
404 = Sewage Disposal
405 = Cemetery
800 = Water
900 = Vacant

PHOTO INTERPRETATION MODIFIERS

1 = A modifier used for conifer communities (types 2591, 7097, 7119 7861 and 7519) to indicate an evergreen component in the canopy layer of over 80-90%.
2 = A modifier used in the dry Chestnut Oak community (type 6271) to indicate the presence of standing dead Pine.
3 = A “cove type” modifier for the “rich” and “typic” coves (types 7710 and 7595) to

Indicate the presence of an extremely high diversity in the canopy layer. Mapped where based on photo signature, a majority of the cove has a diversity of at least four or five canopy species.

4 = Higher elevation heath bald modifier (type 7876) used to denote the presence of at least 5-10% Picea.

5 = Dry chestnut oak modifier (type 6271) used to denote a strong component of post burn disturbance species Oxydendrum arboreum, Nyssa sylvatica, Acer rubrum, and Robinia pseudoacacia.

6 = Modifier to the northern hardwood (type 7861, Hemlock – Birch) to denote areas where Hemlock in the canopy is below 5-10%.

7 = *(Since combined with Modifier 1)* Modifier to the northern hardwood (type 7861, Hemlock-Birch) to denote areas where Hemlock in the canopy is above 80-90%.

8 = Modifier to the spruce-fir (mapping unit 0112) to denote presence of standing dead fir.

9 = Heath bald modifier (types 3814 and 7876) used to denote the presence of at least 5-10% hardwoods. Hardwood species in the heath bald may include but are not limited to Quercus prinus, Oxydendrum arboreum, Nyssa sylvatica, Acer rubrum, Robinia pseudoacacia at lower elevations and Betula alleghaniensis, Sorbus americana, Quercus rubra in higher elevation heath balds.

10 = Modifier to the Virginia pine and Table mountain – pitch pine forest types (7119 and 7097) to indicate areas of 80-90% dead pine. The understory is often extensively evident in the photo signature.

11 = Modifier used primarily in the Spruce communities to denote canopy blow down damage from storm.

FILE SPECIFICATIONS

Coordinate system: NAD83 UTM projection – Meters

Appendices

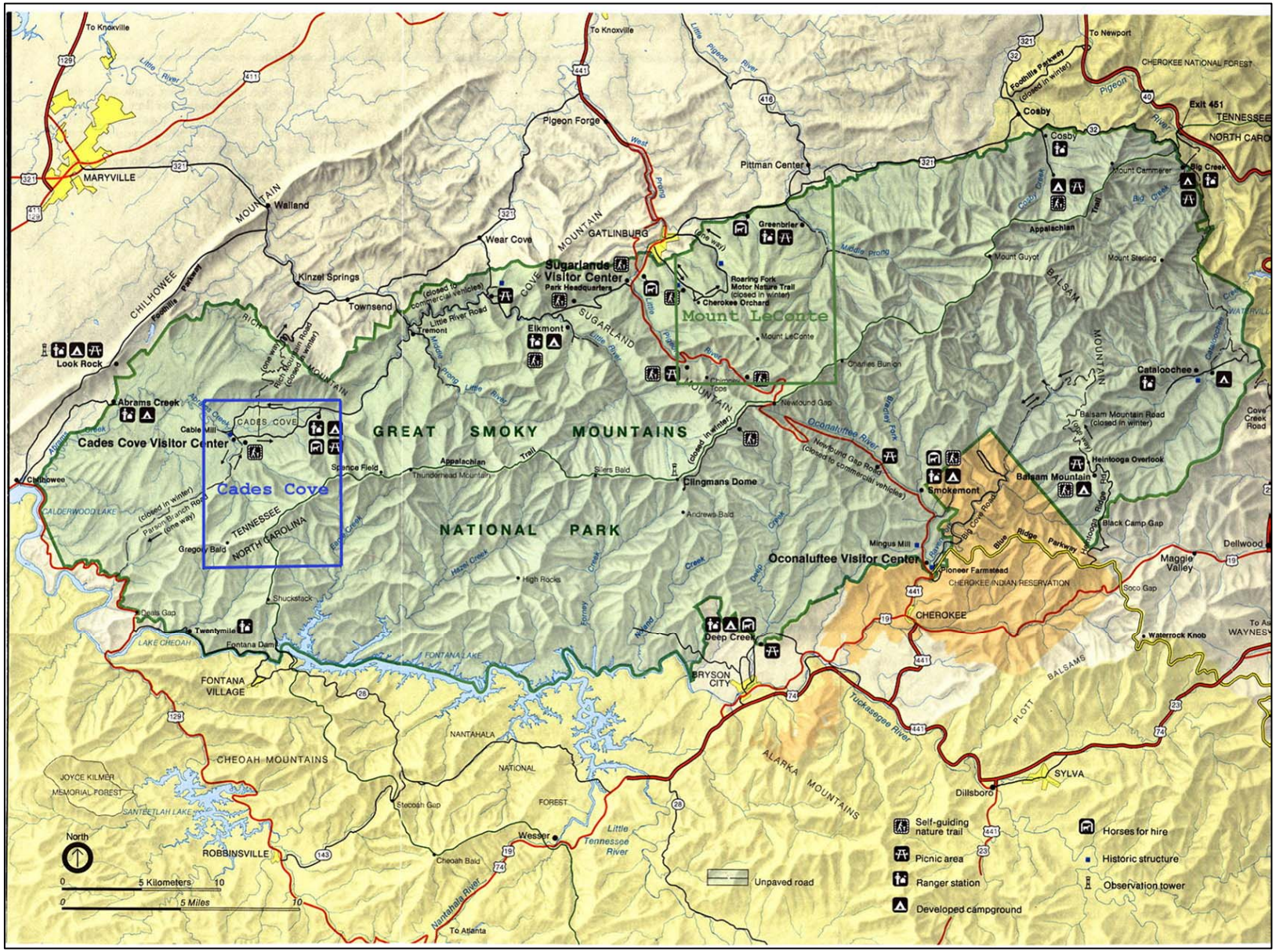

Figure II.1 Location Map

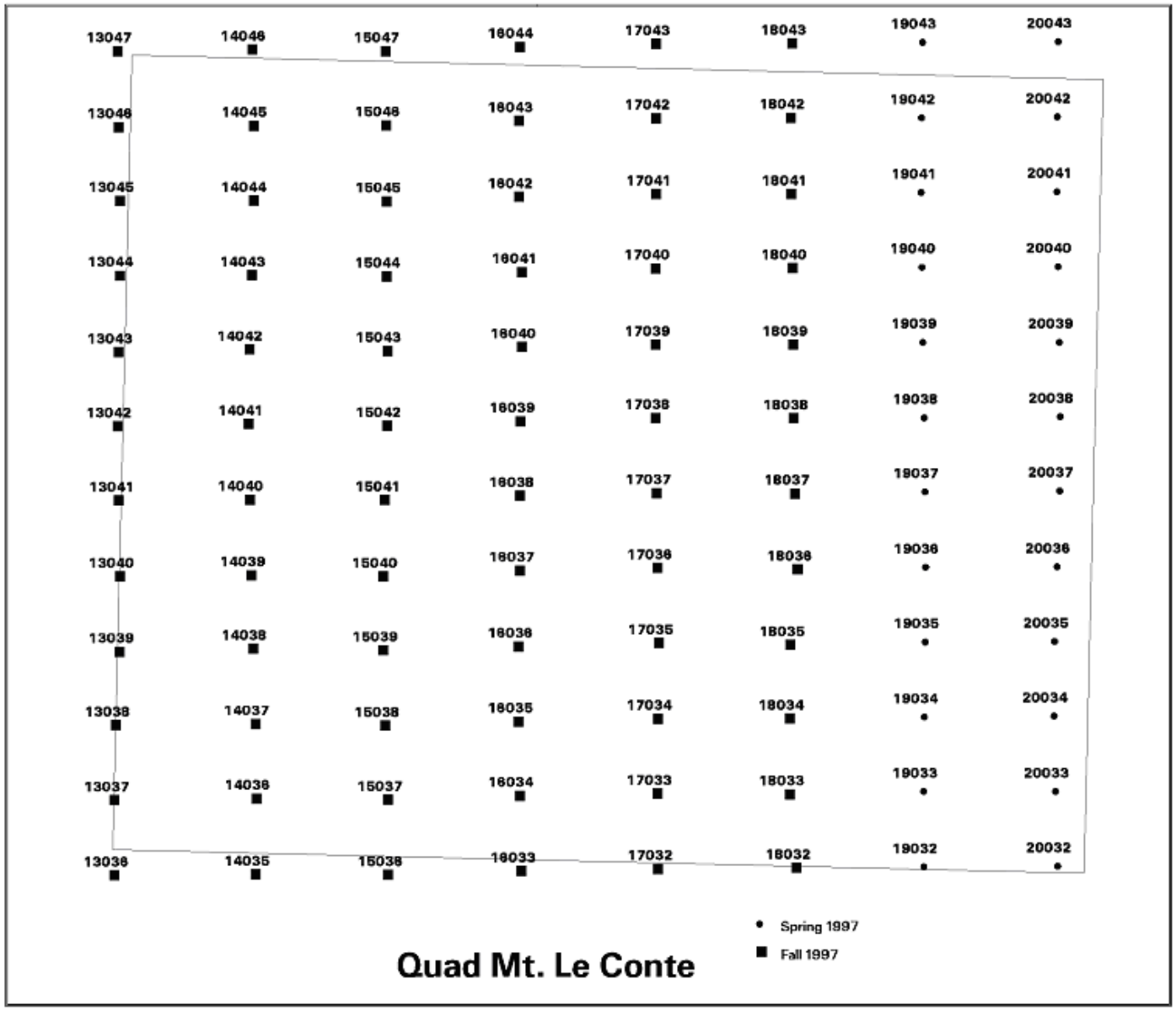

Figure IV.1 Quad Mt LeConte Photo Index

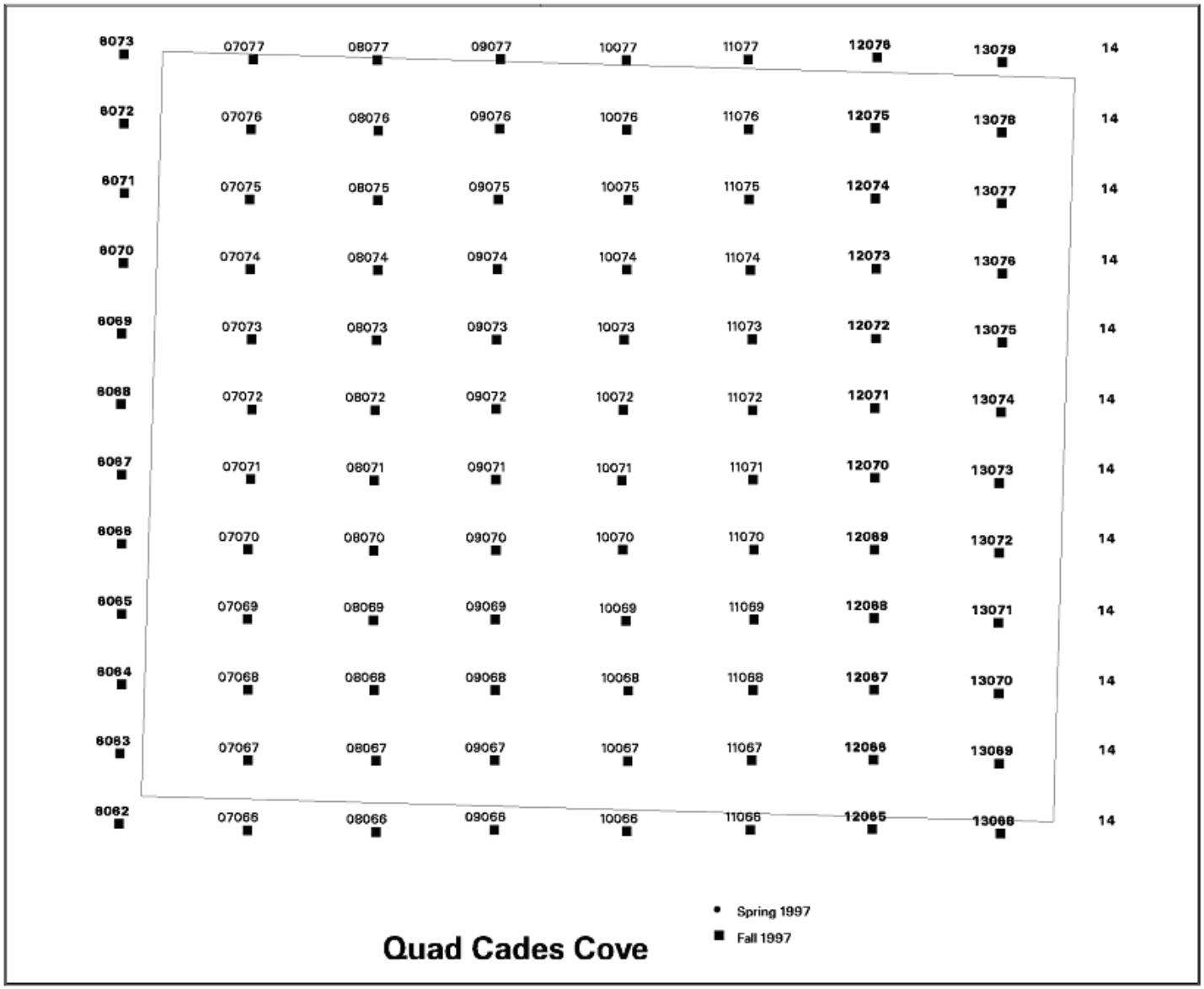

Figure IV.1 Quad Cades Cove Photo Index

DOQQ Index

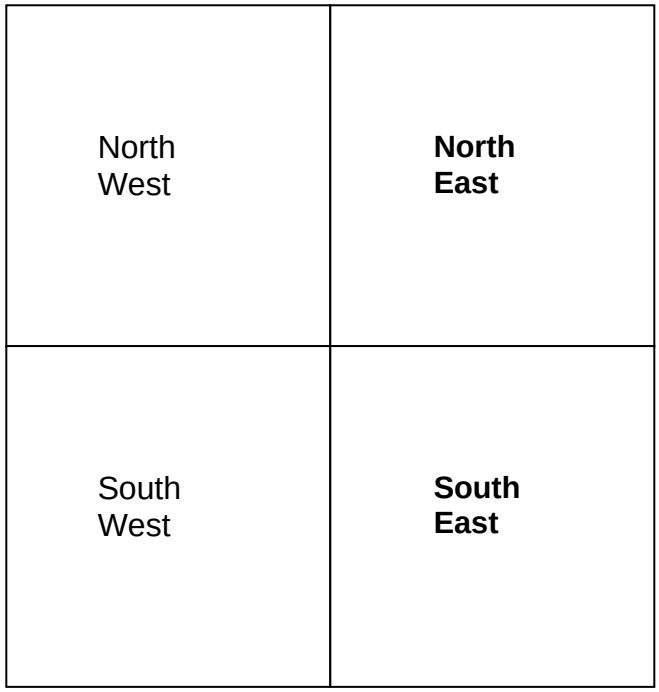

Figure V.1 DOQQ Index