



Annual Administrative Report and Work Plan for Inventories & Vital Signs Monitoring FY 2007 – FY 2008



Lost species? This native bumble bee, *Bombus affinis*, is one of up to three bumble bee species that have disappeared in the last several years from Great Smoky Mountains National Park. (see public highlights section)

Great Smoky Mountains National Park Approval Signatures

Dale Ditmanson, Superintendent Great Smoky Mountains National Park	Date
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Larry West, Regional Inventory & Monitoring Coordinator Southeast Region	Date
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Sherri Fields, Chief, Science & Natural Resources Division Southeast Region	Date
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Paul Hartwig, Associate Director, Natural Resource, Stewardship & Science Southeast Region	Date
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Arthur Frederick, Acting Regional Director Southeast Region	Date
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Table 1. AARWP Checklist

	<u>Budget program (MS Access, aarwp_budget.mdb)</u>
Y	The income amounts entered for Biological Inventories, Vital Signs Monitoring, Prototype \$\$ - Annual Transfer, Water Quality Monitoring and other sources matches the dollar amounts from the memos sent to the regions/networks by WASO (have you used the correct income amounts?).
Y	In the Add/Edit Budget Records form, the amount shown for Total Expenses matches that for Total Income. (If it doesn't, enter a record under Expenses in the 7_Other category to make it balance; use an entry such as 'Unexpended funds' or 'Overspent Funds' in the Description column to explain the amount.)
Y	For all Expense records, the Description field includes the name of the university, agency, company, or other vendor to help us document our outsourcing efforts. (If this expense involved a contract, cooperative agreement, interagency agreement, or other partnership, is it clear where the money went?)
Y	For all Expense records, the correct item from the picklist for 'Where \$\$ Went' has been entered. [Think about who the check was written to; e.g., enter 'Other Non-Federal' for funding that went directly to the private sector, such as for purchases (computers, supplies, etc.), travel (airlines, rental cars, hotels).]
N/A	On the Status of Biological Inventories form, there is one record for each inventory that is described in the text section of the AARWP or in the budget program. Be sure to list each park that was involved in the particular inventory.
Y	Each year's budget has been exported as an .rtf file (one for FY 2006 and one for FY 2007), and both files have been inserted into MS Word at the end of the AARWP document.
Y	The file aarwp_budget.mdb has been renamed to include the 4-character network alpha code and the years, as shown in this example: NCCN_FY0506_aarwp.mdb
	<u>Annual Report and Work Plan (MS Word)</u>
Y	I have carefully read the guidance for the AARWP and followed it.
	A header or footer with the date that the aarwp was last revised has been included.
Y	I gave special attention to the 'Summary of Major Accomplishments' and 'Public Interest Highlights' sections of the report, following this years' guidance and example. (We need good examples of the successes, applications, and highlights of the program to help us obtain funding for all 32 networks! Your 'Summary of Major Accomplishments' section at the beginning of your annual report is what we'll use for the I&M Program's annual Report to Congress to justify the funding spent by your network.)
N/A	In the 'Status of Park Vital Signs Monitoring' table, all entries are equal to or greater than the entries in last year's report.
N/A	Photographs that might be included in one of the reports to Congress, brochures, websites, or other materials that help the program have been submitted by the network. (See the photo database and guidelines for submitting photographs.)
Y	The aarwp file has been renamed using the network's 4-character alpha code and the years (FY0607) as in the example NCCN_FY0607_aarwp.doc
Y	The annual report has been approved by the appropriate individuals, per my region's procedures. (If you cannot get electronic signatures, it is okay to submit a hard copy with signatures after November 4.)
Y	I have followed my region's procedures for submitting the two files (e.g., NCCN_FY0607_aarwp.doc and NCCN_FY0506_aarwp.mdb). (Most regions require you to submit the files through the regional office. The files may be zipped into a zip file if desired, and then submitted to Steven Fancy via either email or ftp).
	<u>Review of FY 2008 Work Plan by WASO</u>
N/A	[Enter Yes or No]: Has the FY 2006 work plan been approved by the network Board of Directors, and therefore ready for the full WASO review? (If you enter No, the WASO I&M and WRD offices will only briefly review the work plan for 'red flags'.

EXECUTIVE SUMMARY

Great Smoky Mountains National Park Prototype 2007 Annual Administrative Report

Great Smoky Mountains National Park was established in the 1930's and protects 220,000 hectares (~810 square miles) of some of the highest peaks in the Southern Appalachian mountains. The Park has about equal acreage in North Carolina and Tennessee, and is known for its complex geology, high peaks, remnant uncut forests and one of the most species-rich temperate ecosystems in the world. Some of the best wildlife and scenery viewing opportunities in the eastern U.S. are in the Park – which gets about 9 million visitors annually.

The prototype monitoring program for the Park was established in 1993, and went through a 2-year development period under the auspices of the US Geological Survey – Biological Resources Discipline. Some of the components included in the monitoring program were Park projects that pre-dated the program. The Park's monitoring program has provided data that have been used to: address key points in Park land management decisions, nationwide decisions by the U.S. Forest Service, and even in imposing restrictions on the international export of rare species by the U.S. Fish & Wildlife Service. But early on, the Park decided that it had an inadequate base of information for being such an epicenter of biodiversity. In 1998, with concurrence of the Washington Office of the NPS, it embarked with a lead non-profit partner to inventory all life in the Park. This precedent setting project is called the All Taxa Biodiversity Inventory or ATBI. The Smokies program therefore emphasizes both natural resources inventories and long-term monitoring.

Neither the inventory nor monitoring portions of the program are funded as part of the Natural Resource Challenge. The ATBI is funded primarily through the Smokies' Friends group and cooperating association. The monitoring program was funded by an increase to the Park base in 1995.

Program Accomplishments

Inventories

- The Science Committee of Discover Life in America (DLIA), our ATBI partner, funded 18 “mini-grants” in FY 2007, and received final reports for 20 mini-grants that were issued in 2006. These are designed to leverage other monies, and were awarded in a number of biological inventory sub-fields, including entomology, mycology, botany and microbial sciences.
- The USDA-NRCS is conducting the first soil inventory of the Park and FY 2007 was the final year of funding for this Phase 1 inventory funded by the Washington Office. About 60 soils series have been documented, including 20 that are new to science. There are over 8,000 polygons mapped for the Park. These data are available on the Web at the national website for soils managed by the USDA. The Park is awaiting a draft final report and other items.

- Accuracy Assessment of new vegetation map completed. Revisions resulting from this independent assessment were incorporated into an updated version. It is now being used as an essential “ingredient” in the development of other geographic models.
- Several contracts, cooperative agreements or interagency agreements were consummated in FY 2007 that further our understanding of how to efficiently conduct a scientifically valid ATBI.
- An Alliance of ATBI’s has been developing during FY 2007. A second data management workshop was held for other parks/reserves at the Smokies, and planning assistance was given at Big Thicket National Preserve, Texas. Smokies staff helped write an initial Centennial Challenge project that attracted 70+ NPS units requesting to be involved. These efforts build on the pilot work at the Smokies.

Vital Signs Monitoring

- Densities of the balsam woolly adelgid (*Adelges piceae*), a non-native insect that kills Fraser fir (*Abies fraseri*) trees declined in 2007. The firs are endemic to the Southern Appalachians, a Federal Species of Concern, and have about ¾ of their entire range within the Smokies. Although reduced in number, monitoring was still high enough to trigger some treatments.
- Hemlock woolly adelgid (*Adelges tsugae*) accelerated infestation and mortality of Eastern hemlocks (*Tsuga canadensis*) in the Park. Several treatments are being compared. Most untreated hemlocks in the Park are now dying. Initial analysis of monitoring data and observations show that hemlocks benefit significantly from Imidacloprid treatments - probably for several years.
- A new rare plant protocol was written in 2007 that is applicable to the 35 species of vascular plants that have received quantitative monitoring in the Smokies. Most of the species data from previous years has been entered into a new database. (A non-vascular rare plant protocol was written in 2006).
- Several rare plants had polygons of their areal extent accurately determined using a new generation of high-accuracy GPS units. Data on contracting or expanding populations will now be included in future monitoring. One species, marsh bellflower (*Campanula aparinoides*), was found to have declined significantly, as has the open wetland habitat it shares with other rare species. As a result, a Technical Assistance Request is being submitted to WASO-Water Quality Office for a hydrological assessment of the site.
- Following concerns of the Park’s vegetation ecologist, the protocol for site selection of long-term plots that monitor vegetation was refined. Still using “3-plot clusters”, the protocol now assures that spatial auto-correlation is avoided. Vegetation ecologists at the University of North Carolina-Chapel Hill conducted the statistical and geographic analyses used to support the refinement, with input by the bio-statistics office of USGS-BRD.
- A cooperative agreement was consummated with Clemson University to process the backlogged samples of aquatic macro-invertebrates that resulted from previous years’ long-term monitoring. This will allow a longer time period of analysis. To date, all 27 sites have had very good to excellent site indices.

- Monitoring data for annual bait station surveys for black bears indicated over 77% visitation, third highest value for this index since its inception in 1981. The hard mast surveys (oak acorns) showed mixed abundance by oak species, but better in mid to high elevations. Park wildlife personnel prepared for increased bear activity in the fall.
- White-tailed deer monitoring in Cades Cove continues with distance sampling and herd health checks, but wildlife biologists have initiated a review/synthesis of this sampling with Texas A&M, where a graduate student will test statistically valid alternatives and develop the best alternative into a written protocol.
- A comparison of long-term vegetation plots installed in the late 1970's in the Cades Cove area and in 2004 was completed in 2007. As a site with a concentrated white-tailed deer population, similar plots were also used from the same era from outside the Cove. The results indicate that chronic herbivory by deer has significantly reduced numbers of herbaceous plant species and diversity in forest stands over the intervening 26 years.
- In 2007, 10 years of monitoring vegetation plots in and outside deer exclosures were completed in Cades Cove. Deer herbivory, in combination with the aggressive plant Japanese stilt grass (*Microstegium vimineum*), were shown to inhibit forest succession of tree species. In a new discovery, a dramatic increase in tree seedling establishment inside exclosures (only) was correlated with drought years. Tree seedlings were unable to establish in plots without exclosures.

Water Quality Monitoring

- Noland Divide Watershed is a high elevation catchment that is instrumented for air and water quality research and monitoring. Data for 2006 wet, throughfall, and dry deposition elemental monitoring became available in 2007. It showed a slight increase in nitrogen from 2005, but still very close to the 15-year average deposition rate. Sulfur decreased slightly from the 2005 data, but is still above the 15-year average.
- At 43 stream survey points across the Park - at various elevations and stream sizes - the 15-year average pH decreases (becomes more acidic) with an increase in elevation. The 2006 data show a slight intensification of this process, i.e. slightly more acidification with increasing elevation in Park streams. These data will be compared with 2007 data to help ascertain its significance, if any.

PUBLIC INTEREST HIGHLIGHTS

Wild Hog Disease Monitoring

In 1998, GRSM began collecting blood serum samples from exotic wild hogs to monitor for swine brucellosis, pseudorabies and hog cholera (classical swine fever) - diseases that are a concern to the local livestock industry as well as public health. The survey was initiated because several hogs removed from the Park appeared to be semi-domesticated

and harbored unusual colorations or physical characteristics (e.g., spotted, curly tail, short snout, etc.; Fig. 1), that differ from the traditional black color phase found in the Park, but typical of feral hogs from other regions. In fact, in 1996 the Tennessee Wildlife Resources Agency informed the Park that their agency had received a report that a shipment of feral hogs from Florida had been released near the western boundary of the Park. Since 1998, serological samples have been collected from 685 wild hogs removed from the Park. Although there has been no evidence of swine brucellosis or hog cholera since 2005, 13 wild hogs have tested positive for pseudorabies. These hogs have been found primarily in the southwest portion of the Park, although the disease appears to be expanding north and east. Pseudorabies is a serious infectious disease for the commercial pork industry since it produces abortions and piglet deaths. Pseudorabies does not affect humans, but has been implicated as an infrequent cause of mortality for various wildlife. The disease produces a fatal infection of the central nervous system marked by itching, convulsions, excessive salivation, and other rabies-like symptoms (hence the name pseudorabies). The wild hog disease monitoring is conducted cooperatively with the North Carolina Department of Agriculture and Consumer Services and the USDA, Animal and Plant Health Inspection Service, Veterinary Services.



Figure 1. Feral hog exhibiting traits of domestic swine uncharacteristic of typical Smokies animals, including short snout, curled tail, and white markings.

Black Bear Monitoring

Monitoring data in the annual bait station surveys for bears indicated 77.2% visitation, the third highest value for this index since data were first collected in 1981. Additionally,

the annual hard mast survey indicated a fair white oak acorn crop and poor red oak acorn crop. However, the acorn crop was better in the mid and high elevations, especially white oak acorns. The lack of acorns in the lower elevations may have been due to a very hard freeze during late spring and/or extended drought conditions throughout the summer.

Park-wide Losses in Hemlock Forests

The Smokies have the largest remaining old-growth eastern hemlock forest left in the U.S.; some trees are over 500 years old. The tallest eastern hemlock known is also in the Park and is over 53 meters (173 ft.) tall. The majority of untreated hemlocks in the Park are now succumbing to the exotic hemlock woolly adelgid (*Adelges tsugae*). Monitoring plots for hemlock woolly adelgid (HWA) treatments vs. untreated were implemented in 2005 and have been remeasured annually since then. Ninety three monitoring plots were established in treated (three methods) and untreated areas. Analysis from 2005 showed that one of the parameters measured, number of branch tips with HWA, had significant reduction of HWA populations on treated trees vs. untreated (Fig.2). Data from 2006 and 2007 are being analyzed.



Figure 2. Hemlock woolly adelgid infested eastern hemlock branch (white spheres) being fed upon by biocontrol insect *Laricobius nigrinus* (black specks).

The Effects of Chronic Deer Herbivory in Cades Cove

Long-term chronic herbivory by white-tailed deer has profound effects on forest vegetation. Cades Cove, a historic landscape in western GRSM, had among the highest deer densities in the Southeast during the late 1970s. Contemporary deer numbers in the

Cove are lower, but still remain high compared to non-park areas. Over the past four years, three studies have been completed to examine the effects of this chronic herbivory at scales ranging from individual plant populations to the forest landscape of western GRSM. These studies have been conducted as collaborative efforts between researchers at Michigan Technological University, the University of North Carolina at Chapel Hill, and the GRSM botanist and ecologist.

Trillium and chronic herbivory

The effects of deer herbivory on the age structure of perennial herbs have not been studied. This lack of study largely results from the inherent difficulty of aging herbaceous perennials. However, *Trillium* plant ages can be readily determined by counting stem scars on the rhizome. To examine the effects of chronic herbivory and past land use on population structure, we determined the age distribution, stage structure, and height distribution of *Trillium catesbaei* populations in Cades Cove and Whiteoak Sink, a reference area with similar land use history, geology, and soils as Cades Cove that has been allowed to succeed to closed-canopy secondary forest and has a lower deer population. Populations were aged by excavating the rhizome of selected plants in each population, counting stem scars, and carefully replanting each plant. Chronic herbivory in Cades Cove has created a highly-truncated age structure with no plants older than 9 years, while plant ages at Whiteoak Sink were more evenly distributed up to 17 years of age. Compared to Whiteoak Sink, plants in Cades Cove were younger at a given height and more likely to flower when smaller and younger. Across all life stages (single-leaf, flowering, and non-flowering), populations at Cades Cove contained 68 times fewer plants than Whiteoak Sink. The results of this study were published in the journal *Applied Vegetation Science*.



Figure 3. Excavated rhizome of *Trillium catesbaei* showing stem scars used for aging.

Plant community change over a 26 year period

Thirty long-term monitoring plots that were established in western GRSM between 1977-79 were re-inventoried in 2004. Nineteen plots were located in the woodlots and surrounding disturbed forests of Cades Cove and 11 plots were located outside of the Cove and served as a reference to assess whether broad changes observed in Cades Cove plots occurred elsewhere in areas of similar vegetation without a history of chronic herbivory. Over the sampling interval, the mean coverage of herbaceous species on the Cades Cove plots declined significantly and 46 herbaceous species recorded on plots during the 1970s were wholly absent in 2004. Additionally, analyses showed that the herbaceous layer among forest types in Cades Cove became significantly more homogeneous over time. However, species richness increased on reference plots, and herbaceous species composition on different forest types did not become more similar. These results suggest that, through time, species have been lost in Cades Cove as a result of chronic herbivory. In addition, this species loss has reduced diversity of forest stands throughout the Cove. The results of this study are in review at the *Journal of Applied Ecology*.

The effects of drought and herbivory on an exotic grass species, *Microstegium vimineum*.

In mesic forest understories, *Microstegium vimineum*, an exotic annual grass, is able to rapidly invade following disturbance and form a thick ground cover that prevents other species from establishing or persisting. Severe drought can reduce the coverage and seed set of *M. vimineum*, but populations quickly rebound following drought and native species seem incapable of capitalizing on the disturbance to the *M. vimineum* canopy. To investigate whether deer herbivory prevents other species from establishing after drought-induced reductions in *M. vimineum*, vegetation data collected from 15 exclosures and 15 control plots sampled from 1997 to 2006 were analyzed. Exclosures showed a dramatic increase in the cover of woody plants over the course of this study and the successful establishment of seedlings was correlated with the occurrence of drought. However, seedlings were unable to establish on control plots. Native species richness was similar between control and exclosure plots for the first four years of the study. Over the last six years native species richness has diverged with exclosure plots exhibiting greater richness. Results indicate that *Microstegium* patch dynamics and native species regeneration are influenced by deer herbivory and periodic drought. The results of this study are in review at the *Journal of Ecology*.



Figure 4. Herb layer dominated by the exotic grass *Microstegium vimineum*. White-tailed deer herbivory reinforces the dominance of this species in forest understories.

Noland Divide Watershed Deposition Rates

During 2007 the estimated amount of total inorganic nitrogen entering the Noland Divide Watershed (NDW) as throughfall was 1339.51 equivalents of nitrogen per hectare per year (eq/ha/yr), and 485.70 (eq/ha/yr) was collected as wet-only precipitation (Fig. 5). These deposition rates were slightly higher than last year's totals but very close to the 15-year average deposition rates recorded since the project began in 1991.

The estimated amount of sulfate entering the NDW as throughfall was 1992.09 (eq/ha/yr), and 634.10 (eq/ha/yr) as wet-only precipitation (Fig. 6). These deposition rates were above the 15-year average deposition rates. The difference between precipitation inputs and throughfall inputs represents a very good estimate of the dry and cloudwater inputs to these systems (Shubzda et al. 1995). Unlike nitrogen, sulfate flux represents a very good estimate of the total deposition rate entering a watershed, because foliar uptake and/or leaching is minimal (Garten et al., 1988; Lindberg and Garten, 1988).

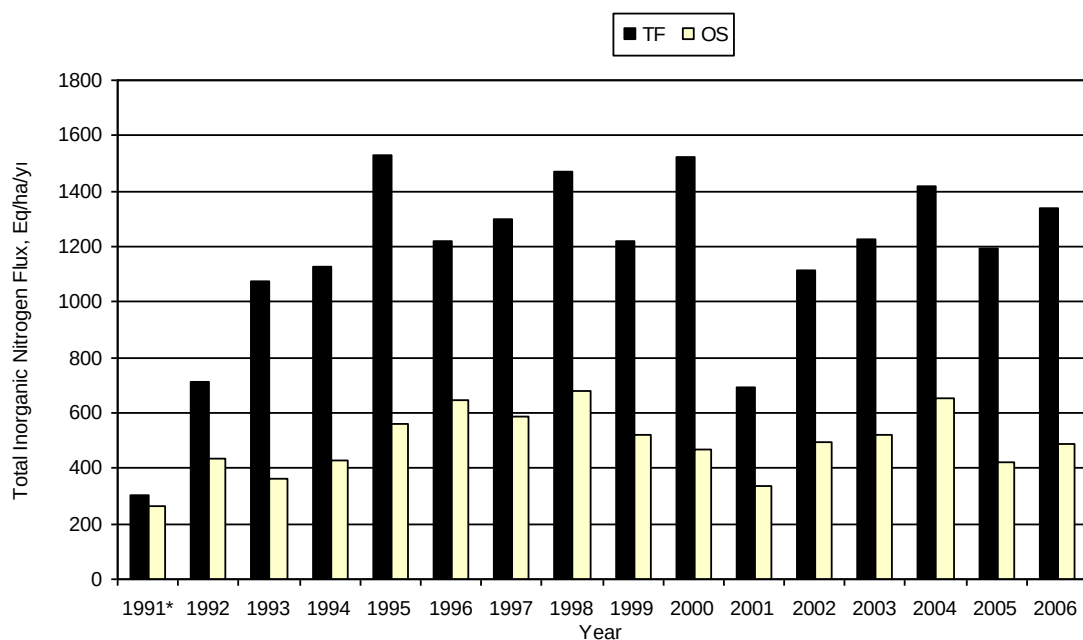


Figure 5. Total inorganic nitrogen deposition entering the NDW as throughfall (TF) and wet-only (OS) precipitation. *The collections in 1991 started in June, and represent only half of the years total deposition rate

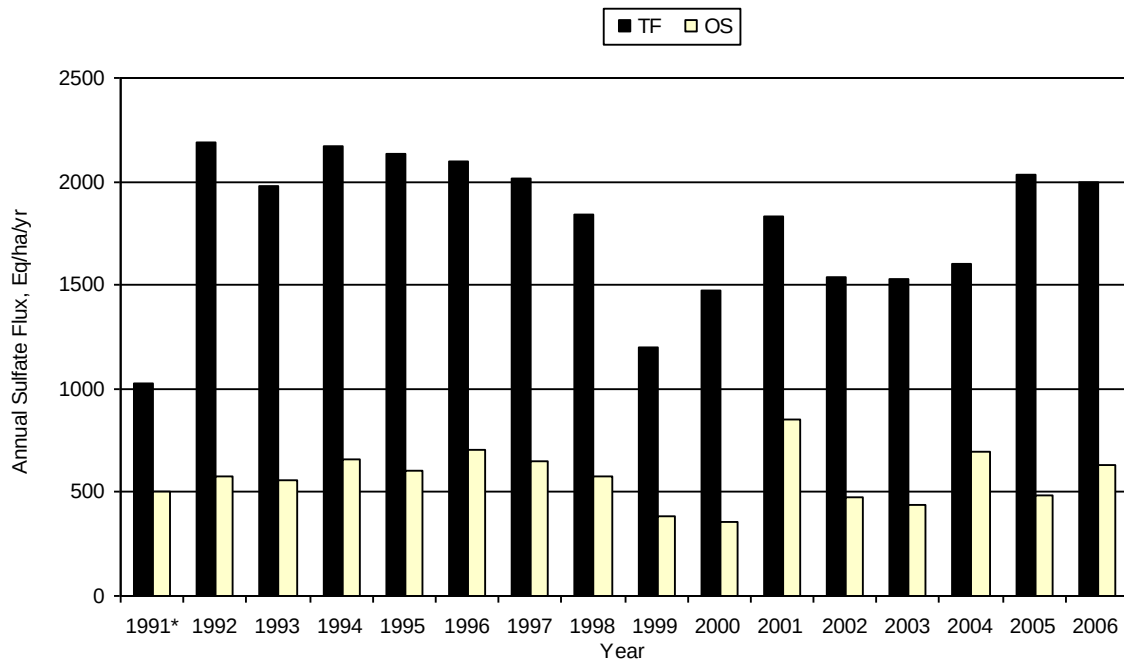


Figure 6. Total sulfate entering the NDW as throughfall (TF) and wet-only (OS) precipitation. *The collections in 1991 started in June, and represent only half of the years total deposition rates.

Loss of Important Pollinators

Bumble bees are one of the most effective plant pollinator groups, owing to their size and hairiness. The Smokies has 13 species of bumble bees documented for the Park, but in the last several years at least one, *Bombus affinis* (pictured on the cover of this report) and perhaps two other *Bombus* species have disappeared in the Park and elsewhere across their range in the eastern U.S. Another species in the west is believed to have become extinct within the last few years. The phenology, distribution, relative abundance of *B. affinis* and thousands of other arthropod species has been documented in the Park's All Taxa Biodiversity Inventory (ATBI). This bumble bee was formerly common at all elevations in the Park and is a pollinator of *Rugelia nudicaulis*, a plant in the aster family that is a strict endemic to Great Smoky Mountains National Park.

Exact causes of this bumble bee decline are unknown at this time, but speculation is that a new pathogenic microbe from Europe has invaded North America, possibly associated with bumble bees brought in to pollinate large-scale, commercial greenhouse tomato crops. The USDA-Bee Lab in Logan Utah, a collaborating partner in the Smokies ATBI, is investigating.

I. Overview and Objectives

Park Description – Great Smoky Mountains National Park was established in the mid 1930's from private lands bought by the states of Tennessee and North Carolina, and donated to the U.S. Department of the Interior for the creation of the Park. It is about 2,200 square kilometers (810 square miles) in size, with about equal amounts of land in each state.

Ecological Setting – The Park contains one of the most complex and deformed geologies in the eastern U.S., with bedrock spanning the geochemical spectrum from extremely acid-bearing and radioactive to karst areas, including one of the deepest caves in the east. Elevations range from 274 meters (~888 feet) above sea level, to 2,044 meters (6643 feet). Soils mapping and classification is currently being finalized. Many new soil types are being described. Although this is an unglaciated region, extinct peri-glacial features have been described at higher elevations.

The vegetation of the Park is known to be one of the most complex in North America, and varies from dry pine-oak forests at low elevations, to highly diverse broadleaf deciduous mid-elevation forests, to dry peat shrub-heaths, to spruce-fir forests at the highest elevations. NatureServe has classified nearly 70 different associations which occur in 40,000 polygons. There are many unusual/globally rare vegetation associations.

It is apparent that the Park is a major center of species richness because of this vast array of vegetative communities and unique geological formations. A number of taxa, including salamanders, vascular plants, fungi, lichens, bees and wasps, land mollusks, aquatic insects in several orders, eumycetozoans, spiders, and other groups are being characterized relative to these systems.

Ecological Issues – Exotic invasive organisms, including forest insects and fungal diseases, plants, fish, and feral hogs are major biological problems. Air pollution, including ozone and acidification, are major chemical pollution problems. Increased fragmentation of natural areas in the immediate region of the Park, and unwise land/resource management decisions made decades ago represent other substantial issues. Poaching occurs for a variety of typical game species, but also for plants and even invertebrates.

Program Overview - The Smokies was selected as one of the first four prototype parks in the NPS's Inventory and Monitoring program. It identified maintenance of biodiversity as the primary natural resource related goal of Park management. The Park developed its monitoring plan in 1993 for detecting and assessing changes in biota, and identification and assessment of environmental impacts, which threaten the Park's biotic systems.

USGS developed the GRSM plan over a two-year period, which included the transfer of NPS personnel to NBS and the subsequent re-transfer of most personnel back to NPS in 1995. Some of the monitoring components in the program pre-date the I & M program, but were subsequently funded by it. Other components are new. Some initial

components (e.g., cave biota, T & E fish) were dropped early on, due to lack of funds. The Smokies has assisted other parks in the Southeast region with monitoring issues, and was the principal author of the inventory plan (Nichols et. al, 2001) for the Cumberland-Piedmont and Appalachian Highlands networks, when they were becoming established. The GRSM monitoring program has provided data that have been used to address key points in Park land management decisions, nationwide decisions by other agencies, and even in restricting export of certain rare species protected under international treaty (CITES). The program has been hampered, however, by a lack of funding for all components, in an era of consistently shrinking budgets.

As a prototype Inventory & Monitoring Park, we have decided to emphasize both natural resource inventories and monitoring. The Park is one of the most species-rich areas of its size in temperate zones of the world. After scientific conferences and consultation with WASO, Park management decided to undertake a project to discover and document all life in the Park in 1998. This is called an All Taxa Biodiversity Inventory (ATBI), and is funded principally through monies from local non-profits closely associated with the Park and in-kind funds are provided from other matched sources, including competitive science funding from the National Science Foundation. This project is in partnership with Discover Life in America, Inc. (DLIA), which has the operational lead in the project. It has not been funded from the original I & M program, or subsequent Natural Resource Challenge programs, but funding became available from a new increase earmarked for the ATBI in FY 2005.

Objectives for Biological Inventories:

- 1) Complete Phase 1 inventories for vascular plants and vertebrates; certify lists in NPSpecies.
- 2) Complete Phase 1 inventories for other categories (i.e., geology, soils, vegetation); portray and integrate data into GIS for use.
- 3) Accelerate comprehensive inventory of all other species in GRSM through partnership with DLIA. This includes development of an advanced data management system for the documentation and portrayal of all resource elements.
- 4) Assist other NPS units and reserves of other agencies/organizations in their efforts to begin comprehensive biodiversity inventories.

Objectives for Prototype Monitoring:

- 5) Vital Signs: Monitor trends in selected populations, communities, and abiotic components that are relevant to Park Management.
- 6) Update/transition from original 1993 prototype monitoring program to revised program that reflects new knowledge and new fiscal realities.
- 7) Monitor other biological and abiotic elements in the Park, through a mixture of collaborations and partnerships.
- 8) All Monitoring data (and eventually all data) will be made available to all park managers and the public on a regular basis.
- 9) Test/compare new monitoring techniques and evaluate new protocols. Share all our experiences with other parks in surrounding networks.

II. Accomplishments and Scheduled Activities:

A. BIOLOGICAL INVENTORIES:					
Objective/Task	Description	FY 2007 Goals	FY 2007 Accomplishments	FY 2008 Goals	Task Lead
1) Complete Phase 1 biological inventories and certify lists:					
1.1 Amphibians	Dr. Ken Dodd, USGS-BRD, Gainesville, FL, has conducted Park-wide amphibian inventories.	Obtain USGS amphibian data and enter into ATBI database.	Data obtained from USGS in Gainesville. In queue for transfer to ATBI database	Get data added to database/GIS and effect pilot modeling of distributions.	DLIA, GRSM
1.2 Reptiles	Dr. Ben Cash, Maryville College, has conducted reptile inventories as part of the NRPP Vertebrate Study.	Complete entering data into ATBI database.	Some data received, but still need researcher involvement.	Finish up all loose ends of reptile data.	DLIA
1.3 Small Mammals	Dr. Don Linzey, Wytheville Community College, and Dr. Ed Pivorun, Clemson University, have conducted small mammal inventories as part of the NRPP Vertebrate Study.	Update distribution maps on web pages. Continue to investigate new modeling techniques. Enter data into ATBI database.	Investigating National Geographic's new software for distributions	Ensure all data entered, test MetaLens software from NGS.	DLIA, GRSM
1.4 Bats	Dr. Michael Harvey, Tennessee Technological University, has conducted bat inventories throughout the Park.	Update distribution maps. Potential new park record of a federally listed species will be verified.	Cave re-checked for reported Federally listed Gray bat - negative	Re-check caves for Gray bats. Model T&E Indiana bat.	DLIA, GRSM

1.5 Fish	Patrick Rakes and J. R. Shute, Conservation Fisheries, Inc., have been conducting species surveys. Additional inventories and web page development have been completed by Dr. David Etnier, University of Tennessee, and Liz Etnier.	Model distribution of all fish species.	DLIA collaborator received postponement for work funded. Awaiting new data before modeling effort.	Receive new data from DLIA collaborator. Get at least rarest fish species modeled as first iteration	DLIA, GRSM
1.6 Birds	Dr. Ted Simons and Dr. Susan Shriner, North Carolina State University, have completed bird inventories in the Park. Paul Super, Appalachian Highlands Science Learning Center, conducts mist netting and parasite studies.	Continue modeling efforts for all species.	Birds records in ATBI database. Investigating Nat'l Geographic Maps new software application for modeling distributions.	Test MetaLens software from Nat'l Geographic, as replacement to interim ATBI database	GRSM, DLIA
1.7 Vascular Plants	Dr. Patricia Cox, Tennessee Valley Authority, is the TWIG leader. Illinois Natural History Survey (INHS), independent volunteers and NPS staff have done surveys in the Park.	Update certified vascular plant list. Continue developing fern web pages. Continue work on modeling distributions.	Fern Forays (includes acquisition of other plant data) continue. 4 new native plants for park reported in FY07, all uncommon to rare in park.	Time permitting use tree species data already in ATBI database as modeling test in Nat'l Geographic MetaLens	DLIA, GRSM
2) Complete other Phase 1 inventories:					
2.1 Soil Mapping	USDA-NRCS offices in TN and NC have conducted the first comprehensive soil	Complete population of project database. Produce final product for Sept. 30, 2007 delivery. Conduct	All field work now complete. Several close-out meetings held with USDA, WASO-	When draft report, database and other specified products are received from WASO-	USDA-NRCS, WASO-I&M (Biggam), GRSM

	survey of GRSM.	“final acre” ceremony.	NPS,GRSM. Additional database work required before NPS reviews draft product.	I&M (P.Biggam), park will review and comment. Conduct training/orientation for park staff.	
2.2 Geology Mapping	USGS-Reston has led this project in GRSM.	Integrate geology data into Park’s GIS.	Done. Bedrock data has been peer-reviewed by USGS, and is in park’s GIS.	If time allows, will add geomorphology data, primarily boulder deposits to GIS.	GRSM
2.3 Vegetation Mapping	Center for Remote Sensing and Mapping Science, University of Georgia, has led the mapping project in GRSM. Classification of Veg associations by NatureServe.	Work with GIS staff to prepare final version of vegetation map based upon accuracy assessment.	Due to lack of GIS position most of FY, Veg Ecologist (Jenkins) learned ARC software and made corrections to GIS file. These data were then appended to parks data catalog..	Request will be submitted to do selective updating of evergreen forest classes via remote sensing. Data on xeric pines and hemlocks need revision due to insect mortality.	GRSM
3) Accelerate additional biological inventories					
3.1 Traditional ATBI sampling	Cooperating partner (DLIA) , taxonomists, volunteers, etc. are organized into ~20 loose Taxonomic Work Groups (TWiG’s) & collecting field data. These data inform as to efficiency of structured sampling (see below)	DLIA issues RFP, awards competitive “mini grants”	18 “mini grants” awarded by science committee of DLIA in various TWiG’s. Similar # of reports received from 2006, plus Nat’l Science Foundation funded work con’t in several projects. (see dlia.org for far more info). Genetic “Bar-coding” continues in selected groups. Loss of Field Director for DLIA caused loss of traction.	DLIA to hire new field director, assess options in environment of shrinking funds.	DLIA, assist by GRSM
3.2 Structured sampling in ATBI	USGS & NPS designing protocol to sample maximum biodiversity				

	using protocol with : least impact, least cost and most efficiency. The data is different from traditional sampling (see above), but informative				
4) Assist other NPS units, other reserves in planning/design of comprehensive inventories:					
4.1 Assist with consultations for other ATBI start-ups, and participate in formation of ATBI Alliance.	Host ATBI data design workshop. Help create national Alliance of ATBI projects so that these projects can cooperate in planning, design, data management and funding	Hosted 2 nd data base design workshop in Dec.2006. Assisted in writing project proposal for service-wide ATBI Alliance.	Continue to assist in development of Alliance.		DLIA, and park staff (Langdon)

B. VITAL SIGNS AND OTHER MONITORING:					
Objective/Task	Description	Date Initiated	Protocol Status (I&M components only)	FY07 Accomplishments	FY08 Plans
5) Vital Signs: Monitor trends in selected populations, communities, and abiotic components that are relevant to Park management:					
5.1 Aquatic invertebrates	Program tracks changes in species diversity and abundance as an indicator	1992	Protocols have been revised to meet new I&M national standards.	Due to budget limitations, no streams were monitored in FY06. The component	With current budget projections, it is likely that few, if any, sites will be

	of aquatic ecosystem health.		Revisions include a more comprehensive reference listing and better documentation of metadata.	protocol states that 27 sites should be monitored annually.	sampled in FY07. However, several years of macro-invertebrate samples from Noland Divide Watershed will be processed and data entered in FY 2008.
5.2 Bear bait station survey	Bait sites (e.g., sardine cans) are tied to trees along the same trails each year. Percent of bait sites visited by bears is used to determine relative densities and monitor population trends.	1981	Protocols currently in use are being revised to meet new I&M national standards.	Monitoring completed in FY07 recorded the highest visitation in 25 years of annual sampling.	Monitoring will continue in FY08.
5.3 Brook trout distribution	This component tracks changes in the distribution of brook trout in high elevation streams.	1986	Protocol in old format	Much progress was made in modernizing the database that includes Brook trout monitoring data	Monitoring field work inactive.
5.4 Cades Cove deer population	The deer population in Cades Cove is monitored by estimating density using distance sampling, and physical condition is estimated by using herd health checks.	1971	New distance sampling monitoring protocol was used in FY07, but not written in new format (but see other comments)	Distance sampling in winter continued, as was herd health checks. However, Texas A&M now engaged to review/synthesize deer protocol. Write new protocol.	Distance sampling to continue, but significant progress expected in review of entire deer monitoring issue by Texas A&M.
5.5 Cades Cove deer exclosures	Exclosure (15) and control plots (15) were established at three sites to track impacts of deer on plant species composition and structure.	1997	Protocol now needs to be modified to accommodate reduced sampling frequency	Article on 10 years of sampling written. 3 other professionally peer reviewed papers related to this project were published or in review.	Now that 10 years of annual monitoring is complete, a new monitoring frequency needs to be established. The methods need to change, need for a new protocol will be evaluated.
5.6 Fish communities in large streams	This program tracks changes in fish species composition through time.	1986	Protocol in old format.	Inactive	Inactive

	Selected biotic and abiotic variables are also measured.				
5.7 Forest insects and disease	Ten insects or pathogens and their impact on host species are monitored on rotational basis. These include the balsam woolly adelgid, beech scale, butternut canker, rhododendron decline, mountain ash sawfly, and holly decline.	1993	Protocols follow techniques outlined in the USDA FS Forest Health Monitoring protocols. Protocols for the balsam woolly adelgid and beech bark disease have been revised to meet new I&M national standards.	Balsam woolly adelgid, and hemlock woolly adelgid were monitored in FY07.	Balsam woolly adelgid, Beech bark disease and hemlock woolly adelgid plots will be monitored, and new data analyzed for trends.
5.8 Hard mast survey	Acorns are counted on random branches from selected trees along the same segments of trails each year. From these data, an index of mast quantity is calculated.	1977	Methods have been changed to sample the same trees each year, sample more trees at each site, and use an index calculation to measure mast quantity. This technique is being used across the southern Appalachians and was developed by USDA FS Research to provide a more efficient and objective survey technique.	Mast surveys were completed in FY07, and showed little acorn production in lower elevations.	Mast surveys will continue, and new methods will be drafted into protocol following the inter-agency regional methodology. Results offered to other staff, public.
5.9 Rare plants	Program tracks changes in 60 plant populations from 38 species. A subset of approximately 20 populations is selected for monitoring each year.	1989	New protocol for vascular plants written in 2007. Most data now transferred to new database. The monitoring protocol for <i>Gymnoderma lineare</i> (rock gnome lichen and other non-vasculars has been updated to meet new I&M standards, except the data	In 2007, several populations were delineated with polygons using a new highly accurate GPS. Other pop's received point registration and still others received quality checks.	With current budget projections, it is unlikely that more than a few populations will be monitored in FY08, but the new delineation technique will be evaluated for inclusion into the rare plant protocol.

			mgt. section.		
5.10 Vegetation communities	Program uses permanent plots to track changes in the composition and structure of vegetation communities through time.	1998	Protocol has been updated to meet new I&M national standards. Currently, the database is being redesigned and metadata are being developed for program and legacy data.	Six plots were installed using the new stratification, due to loss of field assistant at beginning of season. Protocol completed including database, with standardizations across the other veg projects. A spin-off project was initiated that focuses on acid deposition impacts to herbaceous plants in spruce-fir forests(funded by WASO-Air Quality)	More than 10 new plots are predicted to be selected, set-up and “read” in FY 08. New plot selection protocol modification developed in 2007 will be used. Also second year of field data collection on acid dep impacts in spruce-fir, design of 3 rd year lysimeter phase.
5.11 Water quality	Sample sites were selected to cover a gradient of elevation, vegetation, and geology. Some sites are co-located with fish and aquatic macroinvertebrate monitoring sites. A total of 43 sites are sampled regularly.	1993	Most protocol used by Un of TN copperator are USEPA standard techniques. Some low-ionic strength protocols are being developed for Smokies waters, however. When development is finalized, then a final protocol will be written in new format.	Sampling was completed at 43 sites using funding from the Friends organization.	Anticipate maintaining current level of water quality monitoring in FY 2008. Several ancillary “spin-off” projects, being worked on by cooperators.
5.12 Water quality—Noland Divide	Intensive sampling is being conducted at this small, high-elevation watershed. Data collected includes sulfate and nitrate deposition, total nitrogen, and base cations.	1993	Project protocols are USEPA standard methods, and are not being re-written into new format at this time.	Sampling continued. Nitrogen showed slight increase from FY06, but still near 15 yr. mean;Sulfate showed slight decrease, but still above mean.	Noland Divide sampling will continue in FY2008 , and if macro-invert data becomes available, co-analyses will begin.
6) Update/transition from original 1993 prototype monitoring program to revised program that					

reflects new knowledge and new fiscal realities:					
6.1 Revised Monitoring plan	Revise current, out-dated plan.	2006		Protocols are being re-written and added, and data mgt. plan is in draft, but draft of new monitoring plan is not written yet.	Assess opportunity to bring in “blue ribbon” panel of scientists not previously affiliated with the park to set basis for new generation monitoring plan. Complete draft of plan.
7) Monitor other biological and abiotic elements in the Park, through a mixture of collaborations and partnerships:					
7.1 Air quality	This is the largest air quality monitoring program in the NPS. Four categories of data are collected: (1) ozone and trace gases, (2) deposition, (3) particulates/visibility, (4) meteorology/climate.	1980	Program uses standard protocols that are used nationally by multiple agencies.	New trend analyses of nat'l parks shows Smokies as the best improved of ~40 units. Of 6 criteria considered, only ozone and ammonium appeared un-improved 1996-05	Monitoring will continue in FY08. Expect new mercury component design involvement with TVA/TN
7.2 Fire effects	Program monitors the effects of prescribed fire on vegetation composition and structure in NPS units throughout the Southeast. Monitoring plots have been established in six parks, including GRSM. Plots are sampled prior to burning, immediately after, 1 year after, 2 years after, and 5 years after.	1997	Program uses a nationwide NPS protocol.	Program continued to establish new plots and resample post-burn plots. Comprehensive analyses of multiyear and multi-burn data are underway in cooperation with the I&M Ecologist.	Monitoring will continue in FY07, in GRSM and in several other parks. Analyses of data with veg ecologist, if database issues can be finalized.

Monitoring by Outside Cooperators:				
Objective/Task	Cooperator	Description	Length of study	Status
7.3 Vernal pool amphibians	University of North Carolina—Asheville	GRSM is part of this multi-park project that has resulted in multiple publications.	Since the early 1990's	Project completed.
7.4 Terrestrial salamanders	University of North Carolina—Chapel Hill	Data have been collected for 30 years; protocols were revised 11 years ago to make study more quantitative.	Over 30 years	Ongoing
7.5 Black bear population dynamics	University of Tennessee	This project is one of the longest bear population studies in the world. Only bears in the northwest quarter of the Park are tracked.	Over 30 years	Project is transitioning to new protocols that use DNA sampling to monitor population abundance. Continuation of project is dependent upon funding availability.
7.6 Bats	U.S. Fish & Wildlife Service	Bi-annual survey of the winter colony of federally endangered Indiana bats in Blowhole Cave	Over 30 years	Ongoing. Cave was last surveyed in FY07. Next survey planned for FY09.
7.7 Northern flying squirrel	North Carolina Wildlife Resources Commission	Use nest boxes to determine the distribution of flying squirrel populations and monitor.	10 years	Ongoing on the NC side of the Park. Nest boxes checked in FY05& FY06 . No surveys were conducted in FY07. Need survey on TN side as priority.
7.8 Breeding birds survey; Monitoring Avian Productivity and Survivorship (MAPS)	International effort	Two MAPS stations are in the Park, Tremont and Purchase Knob.	Over 5 years	This was last year for station at Purchase Knob, due to transition of duties. New station at BLRI may be started if volunteer collaborator can be found.
7.9 High elevation breeding birds	Purdue University	Elevation transects in the Park are compared to transects in Costa Rica. Data from before and after Fraser fir loss is also collected.	Over 20 years	Ongoing periodically, but no surveys were done in FY07, will check for FY08
7.10 Moth populations	Great Smoky Mountains Institute at Tremont and others	Light trapping has been conducted every two weeks to monitor moth population response to season, weather, and annual changes. Over	7 years	Sampling not conducted regularly in 2007, expected to be irregular in FY08

		600 species have been documented at Tremont alone. A second site (Purchase) was added in 2003.		
7.11 Monarch butterfly migratory populations	Part of national protocol, GSMIT has lead.	Butterflies have been monitored feeding on milkweed plants in Cades Cove as part of a nationwide study that examines temporal and spatial variations in migratory populations.	Over 7 years	Monitoring done in early FY08.
7.12 Gypsy moth populations	USFS, in cooperation with GRSM Vegetation Management staff	Pheromone traps are used to attract adult males. Trapping is done annually.	Over 20 years	Ongoing
7.13 Old-growth forests	Oregon State University, and Wright State University (Ohio)	These two projects track changes in selected old-growth forests. The OSU study consists of several 1 ha plots that are measured periodically. The WSU study measures transects that extend across gaps in old-growth forests. Both of these studies have been very influential and produced numerous publications.	Over 20 years	These enormous plots are not measured every year, no measurements taken in FY07, not expected in FY08
7.14 Fraser fir forest	in past TVA and others have conducted monitoring	Data have been collected to track post-adelgid changes. DBH and basic stand characteristics are measured. 66 plots are measured every 10 years.	Over 20 years	Plots remeasured in FY00-FY01, scheduled for next survey in FY10-FY11.
7.15 Forest Inventory and Assessment (FIA) plots	USFS FIA program, this is national program across all private and public lands. It uses different protocol from NPS.	Approximately 90 plots have been sampled throughout the Park on a 3-mile grid. In the past, the FIA program has refused to share precise data and plot locations.	Over 7 years	Interagency agreement signed, and permit issued in FY07. Still need to get site-level data from USFS_FIA, after we have a secure storage unit.
8). All monitoring data (and eventually all inventory data) to be made available to all Park managers				

and the public on a regular basis:				
8.1 All Monitoring data merged into one database	GRSM staff	All monitoring data is to be accessible to all RM&S employees who need it, and the public. This requires standardization	Substantial progress made, standards for files established,.new or modified databases/protocols in fisheries, rare plants, veg plots,. Rough draft circulated for initial round of comments.	Finalize data mgt plan. Some data will be in national databases managed by other agencies.
9). Test/compare new monitoring techniques and evaluate new protocols. Share all our experiences with other parks in surrounding networks:				
9.1 New protocols shared, participates in Network or national I&M meetings.	GRSM staff	Several meetings	N/A	All long-term monitoring protocols checked for completion. Ancillary monitoring projects evaluated for protocol need. Shared with outside park partners as available.

III. Inventory and Monitoring Staff (GRSM)

- Keith Langdon, Coordinator, Inventory and Monitoring Branch
- Janet Rock, Botanist
- Mike Jenkins, Ph.D., Forest Ecologist
- Becky Nichols, Ph.D., Entomologist
- Michael Kunze, Ph.D., Data Manager
- Adriean Mayor, Ph.D., Museum Curator
- Paul Super, Biologist (Appalachian Highlands Science Learning Center)
- Sue Powell, Computer Operator/Acting Office Manager

Other Resource Management and Science Division Staff involved directly in conducting monitoring:

Jim Renfro, Air Quality Specialist
Kristine Johnson, Supervisory Forester
Glenn Taylor, Forester
Kim Delozier, Supervisory Wildlife Biologist
Bill Stiver, Wildlife Biologist
Steve Moore, Supervisory Fisheries Biologist
Matt Kulp, Fisheries Biologist
Ben Zank, GIS

Contractors and Cooperators:

- Discover Life in America, Inc. (DLIA)
DLIA is a private non-profit organization that coordinates the ATBI in partnership with GRSM. Over 200 scientists are involved.
- University of Tennessee, Department of Civil and Environmental Engineering
Dr. Bruce Robinson is the principal investigator for the water quality monitoring program in GRSM.
- USDA-NRCS
Anthony Khiel and Doug Thomas are the principal investigators for the soils mapping project in GRSM.
- Rob Jean is private contractor, working on his PhD at Indiana State Un and specialist on bees of eastern US.
- Andy Royle is a research Bio-statistician at USGS-Patuxent Wildlife Research Center.

IV. Reports, Publications, and Presentations from FY 2007

Reports, Theses and Dissertations:

Jenkins, M.A. 2007. Thematic accuracy assessment: Great Smoky Mountains National Park vegetation association map. National Park Service, Great Smoky Mountains National Park, Gatlinburg, Tennessee. 26 p.

Kuppinger, D.M. 2007. Community recovery and invasion by *Paulownia tomentosa* following fire in xeric forests of the southern Appalachians Dissertation. University of North Carolina, Chapel Hill.

Publications:

Baird, R.E., C.E. Watson, and S. Woolfolk. 2007. Microfungi from bark of healthy and damaged American beech, Fraser fir, and eastern hemlock trees during an All Taxa Biodiversity Inventory in forests of the Great Smoky Mountains National Park. Southeastern Naturalist 6(1): 67-82.

Bernard, E.C. 2006. *Morulina delicata*, new species from Great Smoky Mountains National Park and redescription of *M. callowayia* Wray and *M. crassa* Christiansen & Bellinger (Collembola: Neanuridae). Proceedings of the Biological Society of Washington 119(4): 540-556.

Carlton, C.E. and V.M. Bayless. 2007. Documenting beetle diversity in Great Smoky Mountains National Park: beyond the halfway point! (Arthropoda: Insecta: Coleoptera). Southeastern Naturalist 5: in press.

DeWalt, R.E., L.M. Jacobus, and W.P. McCafferty. 2007. Summer Ephemeroptera, Plecoptera, and Trichoptera from southwestern drainages in Great Smoky Mountains National Park, with additional Ephemeroptera records. Proceedings of the Entomological Society of Washington 109(1): 136-154.

Dunn, R.R., C.R. Parker, and N.J. Sanders. 2007. Temporal patterns of diversity: assessing the biotic and abiotic controls on ant assemblages. Biological Journal of the Linnaean Society 91: 191-201.

Dunn, R.R., C.R. Parker, M. Geraghty, and N.J. Sanders. 2007. Reproductive phenologies in a diverse temperate ant fauna. Ecological Entomology 32: 135-142.

Gimmel, M. L. and A. Slipinski. 2007. A new species of the genus *Philothermus* Aubé (Coleoptera: Cerylonidae) from Great Smoky Mountains National Park, U.S.A. Zootaxa 1390: 17-20.

- Goldarazena, A. and L. Mound. 2006. The biodiversity of Thysanoptera at the Great Smoky Mountains National Park (U.S.A.), an introduction. *Boletín Sociedad Entomológica Aragonesa* 38: 291-299.
- Gonzon, A.T., C.R. Bartlett, and J.L. Bowman. 2006. Planthopper (Hemiptera: Fulgoroidea) diversity in the Great Smoky Mountains National Park. *Transactions of the American Entomological Society* 132(3): 243-260.
- Holzmueller, E.J., S. Jose, and M.A. Jenkins. 2007. Influence of calcium, potassium, and magnesium on *Cornus florida* L. density and resistance to dogwood anthracnose. *Plant and Soil* 290: 189-199.
- Holzmueller, E.J., S. Jose, and M.A. Jenkins. (Accepted, pending revision) The relationship between fire history and an exotic fungal disease in a deciduous forest. *Oecologia*
- Holzmueller, E.J., S. Jose, and M.A. Jenkins. 2007. Influence of *Cornus florida* L. on calcium mineralization in two southern Appalachian forest types. *Forest Ecology and Management* 245: 110-117.
- Huang, B., R.A. Humber, and K.T. Hodge. 2007. A new species of *Conidiobolus* from Great Smoky Mountains National Park. *Mycotaxon* 100: 227-233.
- Jenkins, M.A. (In press) Vegetation communities of Great Smoky Mountains National Park. *Southeastern Naturalist* (Invited)
- Jenkins, M.A. and K.D. Johnson. (In press) Exotic plant species invasion and control in Great Smoky Mountains National Park, USA. Chapter for book entitled *Invasive Plants and Forest Ecosystems*, CRC Press/Taylor and Francis (Invited)
- Jenkins, M.A., C.R. Webster, and J.R. Rock. 2007. Effects of chronic herbivory and historic land use on population structure of a forest perennial, *Trillium catesbaei*. *Applied Vegetation Science* 10: 441-450.
- Jenkins, M.A., S. Jose, and P.S. White. 2007. Impacts of an exotic disease and vegetation change on foliar calcium cycling in Appalachian forests. *Ecological Applications* 17: 869-881.
- Keller, H.W., J.S. Ely, H.T. Lumbsch, and S.B. Selva. 2007. Great Smoky Mountains National Park's first lichen bio-quest. *Southeastern Naturalist*. In press.
- Landolt, J.C., S.L. Stephenson, and J.C. Cavender. 2006. Distribution and ecology of dictyostelid cellular slime molds in Great Smoky Mountains National Park. *Mycologia* 98(4): 541-549.

- Lessard, J-P., R.R. Dunn, and N.J. Sanders. 2007. Rarity and diversity in forest ant assemblages of the Great Smoky Mountains National Park. *Southeastern Naturalist* (in press).
- McCune, B., T. Tønsberg, and T. Ahti. 2007. *Hypogymnia incurvoides* new to Fennoscandia and the Appalachian Mountains. *Graphis Scripta* 19(1) (in press).
- Muise, C., K.R. Langdon, R.P. Shiflett, D. Trently, A. Hoff, P. Super, A. Mayor, and B. Nichols. 2007. Checklist of Odonata from Great Smoky Mountains National Park. *Southeastern Naturalist*. In press.
- Nichols, B.J., and K.R. Langdon. 2007. The Smokies all Taxa Biodiversity Inventory: history and progress. *Southeastern Naturalist*. In press.
- Printzen, C. and T. Tønsberg. 2007. *Bacidia lobarica* (Bacidiaceae, Lecanorales) sp. nov., a sorediate lichen from the southeastern U.S.A. *The Bryologist* 110 (in press).
- Raja, H.A., A.M. Stchigel, A.N. Miller, J.L. Crane, and C.A. Shearer. 2007. Hyphomycetes from the Great Smoky Mountains National Park, including three new species. *Fungal Diversity* 26: 271-286.
- Reeves, W.K., L.A. Durden, C.M. Ritzi, K.R. Beckham, P.E. Super, and B.M. OConnor. 2007. Ectoparasites and other ectosymbiotic arthropods of vertebrates in the Great Smoky Mountains National Park, USA. *Zootaxa* 1392: 31-68.
- Scholtens, B. and D.L. Wagner. 2007. Lepidopteran fauna of the GSMNP. *Southeastern Naturalist*. In press.
- Sokolov, I.M., Y.Y. Sokolova, and C.E. Carlton. 2007. New species of *Anillinus* casey (Carabidae: Trechinae: Bembidiini) from Great Smoky Mountains National Park, U.S.A. and phylogeography of the *A. langdoni* species group. *Zootaxa*: in press.
- Tishechkin, A.K. 2007. A new species of *Ptomaphagus* (*Appadelopsis*) (Coleoptera: Leiodidae) from Great Smoky Mountains National Park, U.S.A. *Zootaxa*: in press.
- Tønsberg, T. 2006. Notes on some lichens from Great Smoky Mountains National Park, North Carolina/Tennessee, U.S.A. *Evansia* 23(3): 61-63.
- Tønsberg, T. 2007. Notes on the lichen genus *Lepraria* in Great Smoky Mountains National Park, southeastern North America: *Lepraria lanata* and *L. salazinica* spp. nov. *Opuscula Philolichenum* 4: 51-54.
- Vasilyeva, L.N. and S.L. Stephenson. 2006. Pyrenomycetes of the Great Smoky Mountains National Park. III. *Cryptosphaeria*, *Eutypa* and *Eutypella* (*Diatrypaceae*). *Fungal Diversity* 22: 243-254.

- Vasilyeva, L.N. and S.L. Stephenson. 2007. *Cryptovalsaria* gen. nov. and its two new species from eastern Asia and south central North America. *Sydowia* 59: 154-160.
- Vasilyeva, L.N., S.L. Stephenson, and A.N. Miller. 2007. Pyrenomycetes of the Great Smoky Mountains National Park. IV. *Biscogniauxia*, *Camaropella*, *Camarops*, *Camillea*, *Peridoxylon* and *Whalleya*. *Fungal Diversity* 25: 219-231.
- Wagner, D.L. 2006. A precautionary tale about rarity: on the larva and life history of *Lithophane joannis* (Lepidoptera: Noctuidae). *Journal of the Lepidopterists Society* 60: 174-176.
- Wagner, D.L. 2007. Barking up a new tree: ancient pupation behavior suggests *Cerma* Hubner is an acronictine noctuid (Lepidoptera). *Systematic Entomology*. In press.
- Wagner, D.L. 2007. The larva of *Cerma* Hübner and its enigmatic linkages to the Acronictinae (Lepidoptera: Noctuidae). *Proceedings of the Entomological Society of Washington* 109(1): 198-207.
- Wagner, D.L. and K. Langdon. 2006. Sourwood defoliation by lettered sphinx (*Deidamia inscripta*) in southern Appalachians (Lepidoptera: Sphingidae). *Journal of the Lepidopterists Society* 60: 230-232.
- Wagner, D.L., E.W. Hossler, and F.E. Hossler. 2006. Not a tiger but a dagger: the larva of *Comachara cadburyi* and reassignment of the genus to Acronictinae (Lepidoptera: Noctuidae). *Annals of the Entomological Society of America* 99(4): 638-647.
- Webster, C.R., M.A. Jenkins, and S. Jose. 2006. Woody invaders and the challenges they pose to forest ecosystems in the eastern United States. *Journal of Forestry* 104: 366-374.

Presentations:

- Holzmueller, E.J., S. Jose, and M.A. Jenkins. Fire suppression alters understory community composition of oak-hickory forests in Great Smoky Mountains National Park, USA. Ecological Society of America Annual Meeting, San Jose, CA. August 5-10, 2007.
- Holzmueller, E. J., Jose, S. and M. A. Jenkins. Response of understory vegetation communities to fire frequency in oak-hickory forests of Great Smoky Mountains National Park, USA. Sixth North America Forest Ecology Workshop, Vancouver, Canada. June 18-22, 2007.

Jenkins, M.A. Blights, bugs, and burns: Understanding seventy years of human impacts at Great Smoky Mountains National Park. Ecology Seminar Series, Curriculum in Ecology, University of North Carolina at Chapel Hill. October 6, 2006. (Invited)

Jose, S., Holzmüller, E.J., and M.A. Jenkins. Can prescribed fire save dogwood from anthracnose? 3rd International Fire Ecology and Management Congress, San Diego, CA. November 12-15, 2006;

Taylor, G. Eleven years of Beech bark Disease Monitoring in Great Smoky Mountains National Park. At Southern Appalachian Forest Entomology and pathology Seminar, Crossnore, NC Jan. 2007

Webster, C.R. and M.A. Jenkins. Spatial patterning and age structure of *Trillium* populations in old-growth forests. Ecological Society of America Annual Meeting, San Jose, CA. August 5-10, 2007.

Budget Summary

FY07 Admin Report

Network: Great Smoky Mtns. Prototype

Category: 1_Income

Description	\$ Amount	\$\$ Source	Where \$ Went	Comments
From Friends for Water Quality	\$110,300.00	Other Partners		
From WASO, 1996, plus Park Base	\$789,200.00	Prototype \$\$ - Park Base		
ATBI Base	\$155,000.00	Prototype \$\$ - Park Base		
Subtotal	\$1,054,500.00			

Category: 2_Personnel

Description	\$ Amount	\$\$ Source	Where \$ Went	Comments
Aquatic Entomologist(Nichols)	\$92,799.10	Prototype \$\$ - Park Base	NPS	
Data/IT Specialist (Kunze)	\$97,536.17	Prototype \$\$ - Park Base	NPS	
Computer Operator/Office Mgr. (Powell)	\$44,049.40	Prototype \$\$ - Park Base	NPS	
I&M Coord. (Langdon)	\$106,957.48	Prototype \$\$ - Park Base	NPS	
Museum Curator (Mayor)	\$73,139.93	Prototype \$\$ - Park Base	NPS	
Wildlife Biologist(Stiver)	\$52,600.00	Prototype \$\$ - Park Base	NPS	
Forester (Taylor)	\$45,500.00	Prototype \$\$ - Park Base	NPS	
GIS Specialist (Zank)	\$13,074.28	Prototype \$\$ - Park Base	NPS	
Botanist (Rock)	\$92,613.67	Prototype \$\$ - Park Base	NPS	
Temp. Biotech	\$13,200.00	Prototype \$\$ - Park Base	NPS	
Other Salaries	\$26,146.37	Prototype \$\$ - Park Base	NPS	
Forest Ecologist (Jenkins)	\$96,501.60	Prototype \$\$ - Park Base	NPS	
Subtotal	\$754,118.00			

Category: 3_Coop. Agreements

Description	\$ Amount	\$\$ Source	Where \$ Went	Comments
Mod. to DLIA for ATBI	\$62,000.00	Prototype \$\$ - Park Base	Other non-Federal	ATBI
Peer-review of Structured Sampling Plan	\$36,900.00	Prototype \$\$ - Park Base	USGS	
Aquatic Invertebrate Sample Processing	\$14,382.00	Prototype \$\$ - Park Base	University-CESU	
Water Quality monitoring	\$110,300.00	Other Partners	Univ_Non-CESU	
Subtotal	\$223,582.00			

Category: 4_Contracts

<i>Description</i>	<i>\$ Amount</i>	<i>\$\$ Source</i>	<i>Where \$ Went</i>	<i>Comments</i>
Taxonomic Identifications of Bees	\$15,000.00	Prototype \$\$ - Park Base	Other non-Federal	
Subtotal	\$15,000.00			

Category: 5_Operations/Equipment

<i>Description</i>	<i>\$ Amount</i>	<i>\$\$ Source</i>	<i>Where \$ Went</i>	<i>Comments</i>
Equipment	\$22,500.00	Prototype \$\$ - Park Base	NPS	
Subtotal	\$22,500.00			

Category: 6_Travel

<i>Description</i>	<i>\$ Amount</i>	<i>\$\$ Source</i>	<i>Where \$ Went</i>	<i>Comments</i>
Attendance at Professional Meetings	\$1,200.00	Prototype \$\$ - Park Base	NPS	
Subtotal	\$1,200.00			

Category: 7_Other

<i>Description</i>	<i>\$ Amount</i>	<i>\$\$ Source</i>	<i>Where \$ Went</i>	<i>Comments</i>
Utilities	\$2,000.00	Prototype \$\$ - Park Base	NPS	
Field/Lab/Museum/Office Supplies	\$36,100.00	Prototype \$\$ - Park Base	NPS	
Subtotal	\$38,100.00			

Budget Analysis

Analysis of Expenses by Where \$ Went

<i>Funding Source</i>	<i>Total \$\$</i>	<i>NPS</i>	<i>USGS</i>	<i>Other Federal</i>	<i>Univ.-CESU</i>	<i>Univ_Non-CESU</i>	<i>Other non-Federal</i>
Other Partners	\$110,300					\$110,300	
Prototype \$\$ - Park Base	\$944,200	\$815,918	\$36,900		\$14,382		\$77,000
Totals	\$1,054,500	\$815,918	\$36,900		\$14,382	\$110,300	\$77,000

Analysis of Expenses by Category

<i>Funding Source</i>	<i>Total \$\$</i>	<i>Personnel:</i>	<i>Coop Agree.</i>	<i>Contracts</i>	<i>Operations/Equip.</i>	<i>Travel</i>	<i>Other</i>
Other Partners	\$110,300		\$110,300				
Prototype \$\$ - Park Base	\$944,200	\$754,118	\$113,282	\$15,000	\$22,500	\$1,200	\$38,100
Totals	\$1,054,500	\$754,118	\$223,582	\$15,000	\$22,500	\$1,200	\$38,100

Expense Totals By Category

<i>Category</i>	<i>SubTotal</i>	<i>Percent</i>
2_Personnel	\$754,118	71.51%
3_Coop. Agreements	\$223,582	21.20%
4_Contracts	\$15,000	1.42%
5_Operations/Equipment	\$22,500	2.13%
6_Travel	\$1,200	0.11%
7_Other	\$38,100	3.61%
	\$1,054,500	

Budget Summary

FY08 Work Plan

Network: Great Smoky Mtns. Prototype

Category: 1_Income

Description	\$ Amount	\$\$ Source	Where \$ Went	Comments
Water Quality Monitoring from Friend	\$110,300.00	Other Partners		
Park Base including Prototype Funding	\$789,000.00	Prototype \$\$ - Park Base		
ATBI Base	\$155,000.00	Prototype \$\$ - Park Base		
Subtotal	\$1,054,300.00			

Category: 2_Personnel

Description	\$ Amount	\$\$ Source	Where \$ Went	Comments
Combined personnel costs; est.	\$845,000.00	Prototype \$\$ - Park Base	NPS	
Subtotal	\$845,000.00			

Category: 3_Coop. Agreements

Description	\$ Amount	\$\$ Source	Where \$ Went	Comments
Cooperative, Interagency Agreements; est.	\$115,000.00	Prototype \$\$ - Park Base	Other Federal	
Subtotal	\$115,000.00			

Category: 5_Operations/Equipment

Description	\$ Amount	\$\$ Source	Where \$ Went	Comments
Laboratory equipment for new facilities; est.	\$39,300.00	Prototype \$\$ - Park Base	NPS	
Subtotal	\$39,300.00			

Category: 6_Travel

Description	\$ Amount	\$\$ Source	Where \$ Went	Comments
Travel to professional meetings; est.	\$5,000.00	Prototype \$\$ - Park Base	NPS	
Subtotal	\$5,000.00			

Category: 7_Other

Description	\$ Amount	\$\$ Source	Where \$ Went	Comments
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Combined field/lab/office materials; est.

Subtotal

\$50,000.00

Prototype \$\$ - Park Base NPS

\$50,000.00

Budget Analysis

Analysis of Expenses by Where \$ Went

<i>Funding Source</i>	<i>Total \$\$</i>	<i>NPS</i>	<i>USGS</i>	<i>Other Federal</i>	<i>Univ.-CESU</i>	<i>Univ_Non-CESU</i>	<i>Other non-Federal</i>
Prototype \$\$ - Park Base	\$1,054,300	\$939,300		\$115,000			
Totals	\$1,054,300	\$939,300		\$115,000			

Analysis of Expenses by Category

<i>Funding Source</i>	<i>Total \$\$</i>	<i>Personnel:</i>	<i>Coop Agree.</i>	<i>Contracts</i>	<i>Operations/Equip.</i>	<i>Travel</i>	<i>Other</i>
Prototype \$\$ - Park Base	\$1,054,300	\$845,000	\$115,000		\$39,300	\$5,000	\$50,000
Totals	\$1,054,300	\$845,000	\$115,000		\$39,300	\$5,000	\$50,000

Expense Totals By Category

<i>Category</i>	<i>SubTotal</i>	<i>Percent</i>
2_Personnel	\$845,000	80.15%
3_Coop. Agreements	\$115,000	10.91%
5_Operations/Equipment	\$39,300	3.73%
6_Travel	\$5,000	0.47%
7_Other	\$50,000	4.74%
	\$1,054,300	