

**Inventory of Lepidopterans
and other Insects
at Nine Sites in
Great Smoky Mountains National Park,
October 1999**



by
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INTRODUCTION

Insects are the dominant animals on earth (Borror *et al.*, 1989). They account for more than half of all organisms on Earth, including plants (May, 1992). They have the most number of species, the largest number of individuals, and the greatest biomass. They include about 75% of all the described species of animals (Waterhouse *et al.*, 1970). They are exceptionally specialized, inhabiting nearly every terrestrial niche, and executing nearly every way of life: phytophagous, carnivorous, saprophagous, and parasitic. Thus they are excellent indicators of habitat definition (Hamilton 1994, Hamilton 1995). An ecosystem is incomplete without insects.

Lepidoptera are also popular with the public, thus support for inventories and management practices, aimed at Lepidoptera, receive public support.

The purpose of the inventory conducted in this project is to contribute to the total number of species of Lepidoptera known to occur in Great Smoky Mountains National Park. The time of year of the inventory, October, is not often inventoried for Lepidoptera, thus species not known from the Park should be found. Also, this inventory attempted to take many samples, on a few nights, in a diversity of habitats. The result should be a comparison of species that occur in each of the habitats on any given night.

Lastly, inasmuch as possible, the samples were taken in or as near to existing Park ATBI sites (Fig. 1 in Appendix I) as possible, thus contributing baseline data from the long term ATBI sites.

The appendices contain raw data in support of this report.

Appendix I: List of sample dates and locations.

Appendix II: List of species from this study.

Appendix III: Copy of Proposal for this project.

Appendix IV: Copy of Research and Collecting Permit.

METHODS and MATERIALS

It was determined to take as many samples as possible in two nights in October in Great Smoky Mountains National Park. The number of black light traps to use was determined by experience of the researcher in several previous studies. The locations for the traps was determined based on consultation with resource management personnel at the park. Preliminary selection criteria included:

- ◆ Habitat: a combination of plants, soils, and topography.
- ◆ The previously selected ATBI sites by Park resource personal greatly influenced the final selection of trap sites.
- ◆ Access to the trap sites, by vehicle or foot.

Final locations for the traps at each of the selected areas was based on inspections of each of the areas and include a combination of art and science. A list of criteria follows:

- ◆ Physiography. A visual inspection of each habitat usually reveals a combination of: edges (places where habitat variation is highest); an open area immediately adjacent to the trap for an unobstructed flight path by insects to the traps; elevation (the trap should be at the highest elevation in the habitat so that insects can easily fly to the trap); and an absence of vegetation or other crevices, immediately adjacent to the trap, where insects can crawl if they miss the entrance to the trap on their first approach.
- ◆ Direction of prevailing winds, and an absence of moon light, when appropriate.
- ◆ Protection of the traps from potential vandals. Because the traps are lighted, they are easily visible, at night, in remote locations. Locations must be hidden from view of nearby roadways.

Nine trap sites were selected for the two nights of October 4 and 5, 1999. The sites and their use each night is detailed in Appendix I. The samples were taken nearest the time of the month that has a new moon. Moths fly during all times of the month, but they are less attracted to black light traps when the moon is shining in the sky.

A last minute change in plans reduced the number of sites from 12 to 9. At the suggestion of Keith Langdon and Charles Parker, I decided to place as many traps as possible at preselected ATBI plots in the park. The decision meant that more time would be spent walking to and from trap sites, thus the amount of time for placing each trap was reduced. The reduction in time per trap resulted in few trap sites.

The black light traps are a design adapted from the standard USDA Elisco® trap. They are made from plastic buckets. Insects are attracted to 18 inch, 15 watt, fluorescent black light bulbs, after which they fall down a funnel into the trap. Electric power to the fluorescent bulb is provided by a 12 volt wet cell battery. Electric power to the fluorescent bulb was also controlled by a solar switch. The switch allowed the bulb to be lit at dark, and the switch turned the bulb off at dawn. A metal cover, from a standard garbage can, is used to keep rain from falling into the trap. Cyanogas® was used as the killing agent. The traps were set out just before dusk, and they were retrieved at dawn.

As soon as the traps were retrieved, the insects were removed from the buckets. The insects were spread on paper plates and they were examined in detail. All of the moths were placed in relaxers (Tupperware® containers that I'd prepared with phenol, water, paper towels, plastizot® , and paper plates as refrigerator containers) for storage during the trip to Columbus. Each sample was placed in a separate relaxer, and the relaxers were kept in coolers - new ice was added to the coolers each day. All of the moths will be pinned and spread for subsequent identifications.

All other specimens of insects in the samples were placed in denatured ethyl alcohol, and shipped to Dr. Becky Nichols, National Park Service at Great Smoky Mountains National Park for further study and appropriate disposition.

Nearly all specimens of micro-moths, many specimens of Geometridae, and some Noctuidae will be dissected for examination of morphological characters. The preparations of the genitalia will be photographed for further study. Many of the specimens of micro-moths will be taken to specialists at the National Museum of Natural History (Smithsonian Institution), Washington, DC and the Canadian National Collection, Ottawa, Ontario, for subsequent study and assistance with the identifications.

The data from moths already identified were keyed into an IBM compatible computer using Visual dBase software. Each record, consisting of one or more specimens, includes the exact date and locality of each species from each sample. The data from moths that remain to be identified will be entered into the database when the identifications are available. Copies of the database will be given to Great Smoky National Park and the fund agency: Friends of the Great Smoky Mountains National Park.

The specimens of moths will be deposited in institutions as stated in the proposal: "The specimens will be deposited in the collections at Michigan State University and other institutions as appropriate. Representative material will be deposited in the U.S. National Museum of Natural History." In addition, some specimens will be sent to Great Smoky Mountains National Park, and some specimens will be given to specialists in exchange for identification services.

RESULTS and DISCUSSION

Several hundred moths were collected in 10 samples from 9 sites. A list of species identified thus far from each site is found in Appendix II. One specimen of *Pachypolis atricornis*, a species noted by the Park as "special" was vouchered from the Oconaluftee ATBI. *Papaipema obliqua*, an infrequently encountered species was vouchered from the Collins Creek Picnic Area sample site. *Anticarsia gemmatalis*, often considered an agricultural pest known as the velvet bean caterpillar, was common in nearly all the samples. Many of the other species of macro-moths, i.e. *Agrotis gladiaria*, *A. ypsilon*, *Feltia herilis*, *F. tricolor*, *Helicoverpa zea*, *Lacinipolia renigera*, *Nephelodes minians*, *Plathypena scabra*, *Pseudaletia unipuncta*, *Xestia badicollis*, *X. normaniana*, and *X. smithii* are ordinarily taken in samples in the Autumn of the year in eastern United States, north of Florida.

As shown by Ehrlich (1992) and Kremen (1992), there are insufficient resources to develop databases on all organisms. They both illustrate that Lepidoptera make ideal indicators of habitat quality and diversity, and Lepidoptera should be studied to take advantage of a wealth of existing information which allows interpretation of data.

RECOMMENDATIONS

1. Future researchers should make allowances in their research plans if they choose to use the ATBI plots for taking samples.

My decision to use the Park's ATBI plots as sample sites required a reduction in the number of sites to be sampled. The extra time required to walk, often through habitat not suitable for carrying a trap and battery, to the ATBI plots meant that I could not sample as many sites as originally proposed. Nonetheless, I took 10 samples at 9 sample sites. I'm glad I was able to contribute to the Park's database for the ATBI plots. Perhaps future researchers should be given options about potential sites, and the travel time required for the several options.

2. I suggest that information about travel time, especially low speed limits, traffic congestion, and special areas such as Cades Cove, be conspicuously presented to researchers in the future. Researchers will be grateful for warnings about the time it takes to get around in the Park.

I was unprepared for the heavy traffic, especially in the season of Autumn colors. The extra time to drive to the several sites, especially in Cades Cove, was a total surprise to me. Also, the location of the housing at Cosby, a 45 minute drive each way (by staying within the posted speed limits), took extra time. I am not discouraged. I would be pleased to conduct this research again, and my increased knowledge about travel times will help plan a successful series of samples.

ACKNOWLEDGMENTS

This project was funded by a generous grant from the Friends of Great Smoky Mountains National Park Discover Life in America. Additional support came from several persons at the Park in the form of a Research and Collecting Permit, access to scientists and administrators, advice, and constructive comments. Lodging at the "Cosby house" greatly facilitated my stay in the park.

Richard L. Brown alerted me about the availability of the financial aid and reviewed early drafts of my proposal. John Pickering, David Wagner, and John Brown gave much encouragement to pursue the research. Keith Langdon and Charles Parker also encouraged me to pursue this project, and they offered me much advice about the ATBI plots and access to the plots. Becky Nichols and Charles Parker gave entomological advice.

Jody Flemming provided excellent coordination of my visit, provided access to the "Cosby house," assisted me when I had automobile difficulties, and answered my many questions. John Morse was understanding of my last minute proposal, and gave me words of encouragement.

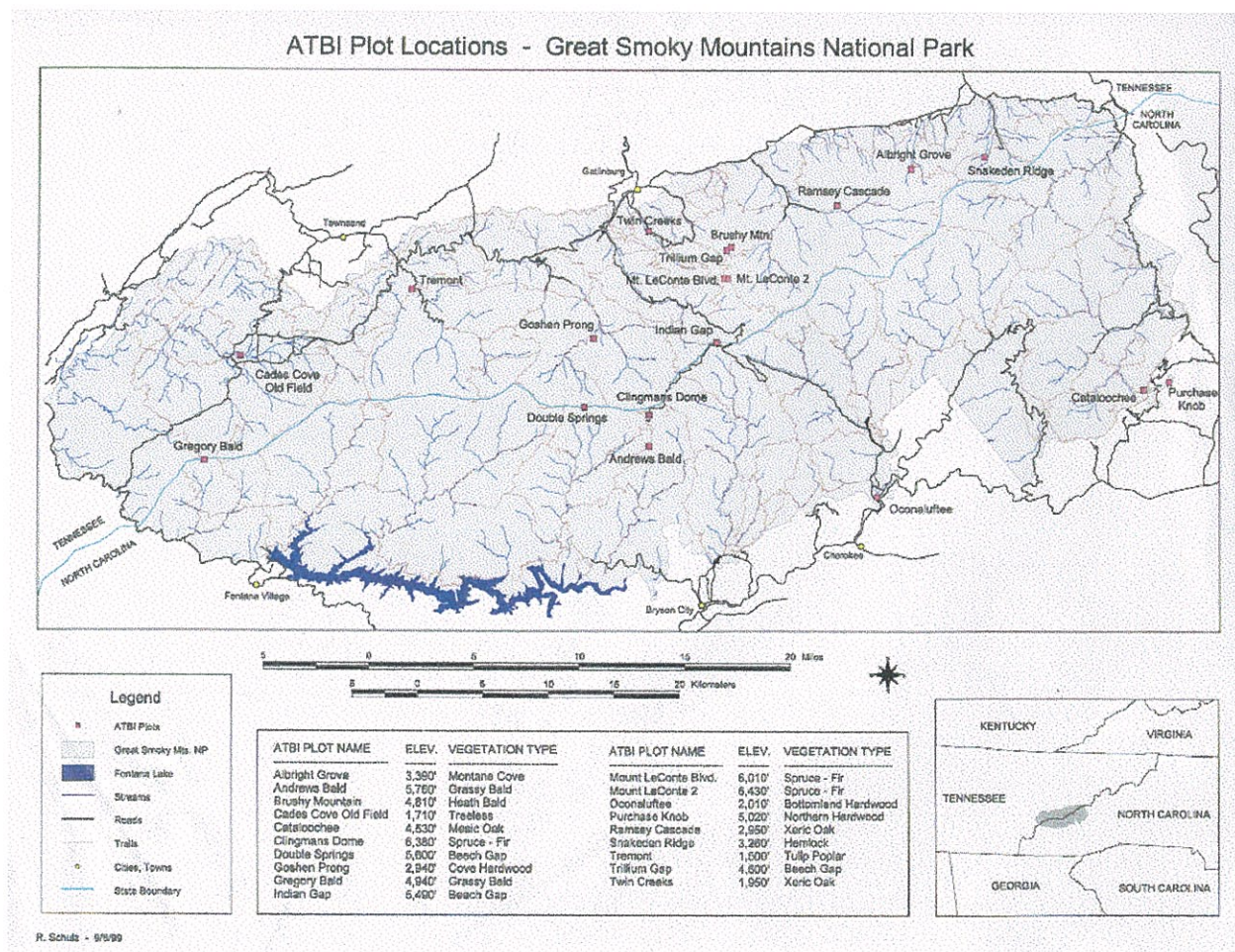
Fred Stehr agreed to accept the vouchered specimens at Michigan State University. Norman Johnson will assist me in transferring data from my database to the ATBI database.

Patricia A. Metzler said it was OK to be away from home, collecting moths in Tennessee, on her birthday. We postponed the celebration for a few days.

LITERATURE CITED

- Borror, Donald J., Charles A. Triplehorn, and Norman F. Johnson. 1989. An introduction to the study of insects. Saunders College Pub., Philadelphia, Pennsylvania. 875 pages.
- Erlich, Paul R., 1992. Population biology of checkerspot butterflies and the preservation of global biodiversity. *Oikos*. 63:6-12
- Hamilton, K. G. A. 1994. Leafhopper evidence for origins of northeastern relict prairies (Insecta: Homoptera: Cicadellidae). Proceedings of the Thirteenth North American Prairie Conference. 61-70
- Hamilton, K. G. A. 1995. Evaluation of leafhoppers and their relatives (Insecta: Homoptera: Auchenorrhyncha) as indicators of prairie preserve quality. Proceedings of the 14th Annual North American Prairie Conference. 211-226
- Hodges, Ronald W., Tatiana Dominick, Donald R. Davis, Douglas C. Ferguson, John G. Franclemont, Eugene G. Munroe, and Jerry A. Powell. 1983. Check List of the Lepidoptera of America North of Mexico. E. W. Classey Limited and The Wedge Entomological Research Foundation. London. 284 pages.
- Kremen, Claire. 1992. Assessing the indicator properties of species assemblages for natural areas monitoring. *Ecological Applications* 2(2):203-217.
- May, Robert M. 1992. How many species inhabit the Earth? *Scientific American*. 267(4):42-48.
- Waterhouse, Douglas Frew, *et al.* 1970. The Insects of Australia. Melbourne University Press, Carlton, Victoria, Australia. 1,029 pages.

APPENDIX I



Appendix I, Figure 1. Map of Great Smoky Mountains NP and ATBI plots.

SITES SURVEYED

Clingman's Dome ATBI is a Red Spruce and Fraser Fir forest east and southeast of the water tank. It is characterized by *Abies fraseri*, *Viburnum lantanoides*, *Dryopteris campyloptera*, *Oxalis montana*, and *Hylocomium splendens*. The slope may approach 10%. The vegetative cover in the ATBI plot is dense, and I determined that were the trap placed within the site, few if any insects would be able to see the trap. Thus, I placed the trap on a ridge at a higher elevation than the ATBI.



Appendix I, Figure 2. Black light trap at Clingman's Dome

The trap is visible in the center of the photograph (Figure 2).

specification of the trap site:

elevation: 6,480'
35° 33.6' N 83° 29.77' W

Indian Gap ATBI is within the Indian Gap special protection area. The protection area is fenced, and the fence serves as the ATBI boundary. The community is described as Beech Gap, and it is an association of *Fagus grandifolia*, *Carex pensylvanica*, and *Carex brunnescens*. The fence is designed to exclude wild pigs, thus protecting the native plants in the area. The trap was placed on a razor back ridge, in a clearing, along the Appalachian Trail.



Appendix I, Figure 3. Trap site at Indian Gap ATBI

The trap is visible in the photograph (Figure 3).

specification of the trap site:

elevation: 5,600'
35° 36.72' N 83° 26.59' W

Tremont ATBI is described as a tulip poplar community. It is characterized by *Liriodendron tulipifera*, *Acer rubrum*, and *Robina pseudoacacia*. It is a successional forest. The topography is a steep hillside. I placed the trap at the highest elevation in the plot. I set the trap too late in the afternoon to take photographs.

specification of the trap site:

elevation: 1,800'
35° 38.29' N 83° 42.17' W

Cosby House site is immediately behind the house reserved for visiting scientists in Cosby. The yard is mowed and backed by a flood plain woods with many small trees. I left the house each morning before dawn, and I returned to the house each night after dark. I was not able to obtain a photograph of the trap site.

specification of the trap site:

elevation: 1,720'
35° 48.67" N 83° 12.83' W

Oconaluftee ATBI is described as a montane alluvial forest. Its plant community is described as a *Plantanus occidentalis*, *Liriodendron tulipifera*, *Betula alleghaniensis*, *B. lenta*, *Alnus serrulata*, and *Leucothoe fontanesiana* forest. I placed the trap in the center of an ephemeral stream bottom, marked by large rounded rocks and absence of most vegetation.

The trap is visible in the photograph (Figure 4).



Appendix I, Figure 4. Oconaluftee ATBI trap site.

specification of the trap site:

elevation: 2,015'
35° 48.67" N 83° 12.83' W

Collins Creek Picnic Area. The trap was placed along side the road, along the side of Oconaluftee River, in the flood plain within 50' of the river. The vegetation was mixed floodplain forest. One of the prominent trees was sycamore. One of the dominant plants adjacent to the road was rhododendron.

specification of the trap site:

elevation: 2,250'
35° 33.59' N 83° 19.42' W

Cades Cove ATBI is an old field. The trap was placed on a dike crossing the ditch immediately to the west of the ATBI plot. The ditch was dry, but evidence of wetter times included young cotton wood trees, various sedges, cat tails, and other wetland vegetation. The upland immediately adjacent to the ditch was dominated by grasses.

The trap is visible in the photograph (Figure 5).



specification of the trap site:

elevation: 1,712'
35° 35.61' 83° 50.36' W

Appendix I, Figure 5. Cades Cove ATBI.

Vernal pond in Cades Cove. This is a deep hole (about 6' deep) covering 2 acres that was completely dry when I set the trap. It is apparently full of water for long enough periods that neither trees nor woody plants grow in the pond. Black gum and sycamore, evidence of wet soils were at the pond's edge. Dominant trees in the adjacent woods are oaks and pines. I set the trap in the middle of the dry pond.

The trap is visible in the photograph (Figure 6).



Appendix I, Figure 6. Vernal pond in Cades Cove.

specification of the trap site:

elevation: 1,860'
35° 35.6' N 83° 47.34' W

Tremont II was selected because of its location in the middle of Dorsey Branch, a tributary of Middle Prong, and the dominance of rhododendron plants. The trap site is at a lower elevation and directly downstream from the Tremont ATBI plot. The trap was set after dark by moving the trap from Tremont ATBI to Tremont II.

specification of the trap site:

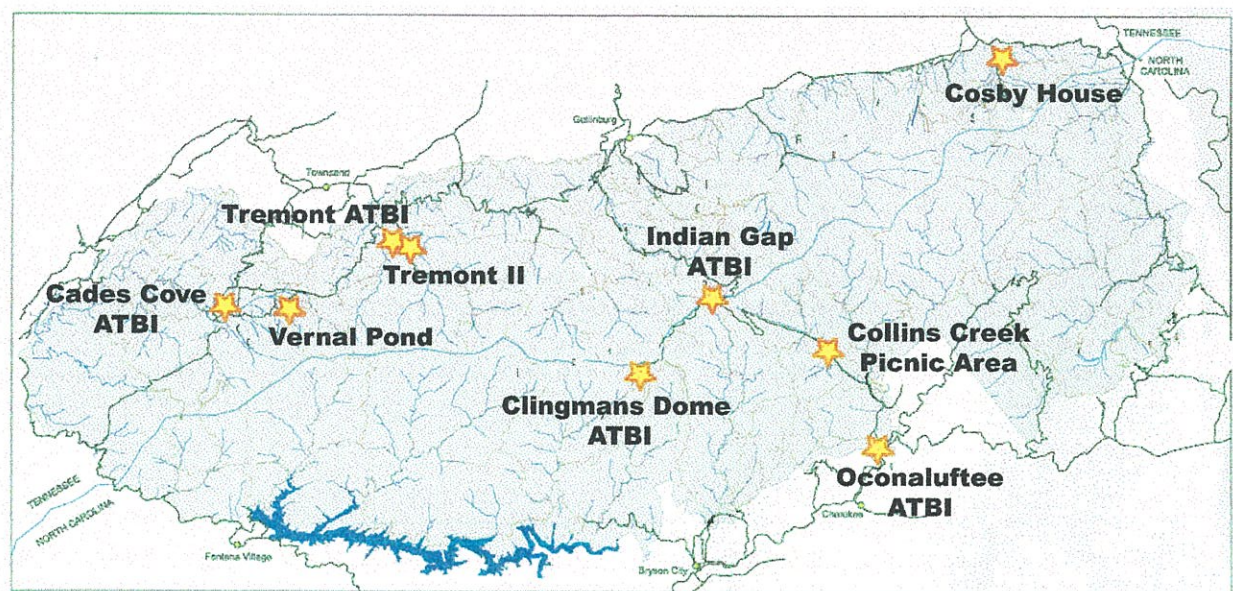
elevation: 1,400'
35° 38.54' N 83° 41.77' W

SUMMARY MAP OF SAMPLE DATES

Sample site description	Sample Dates	
	4 Oct 1999	5 Oct 1999
Clingman's Dome ATBI elevation: 6,480' 35° 33.6' N 83° 29.77' W		
Indian Gap ATBI elevation: 5,600' 35° 36.72' N 83° 26.59' W		
Tremont ATBI elevation: 1,800' 35° 38.29' N 83° 42.17' W		
Cosby House elevation: 1,720 35° 48.67" N 83° 12.83' W		
Oconaluftee ATBI elevation: 2,015 35° 48.67" N 83° 12.83' W		
Collins Creek Picnic Area elevation: 2,250' 35° 33.59' N 83° 19.42' W		
Cades Cove ATBI elevation: 1,712' 35° 35.61' 83° 50.36' W		
Vernal pond in Cades Cove elevation: 1,860' 35° 35.6' N 83° 47.34' W		

Sample site description	Sample Dates	
	4 Oct 1999	5 Oct 1999
Tremont II elevation: 1,400 35° 38.54' N 83° 41.77' W		

SUMMARY MAP OF SAMPLE SITES



Appendix I, Figure 7. Overview map sample sites for moths.

APPENDIX II

The list of species is arranged by family according to the Hodges (1983) check list. One family name, Crambidae, is a name not recognized in Hodges. The list of species within each family is alphabetical, first by genus, followed by species, also in alphabetical order. The taxa identified only to genus will require inspection of morphological characters, usually genitalia, before a positive identification can be made. Only a few of the several hundred specimens have been positively identified.

Nymphalidae

Nymphalis interrogationis
Polygonia interrogationis

Crambidae

Udea rubigalis

Geometridae

Campea perlata
Ennomos magnaria
Euphyia unangulata
Lamdina sp
Orthonama centrostrigaria
Procherodes transversata

Noctuidae

Agrotis gladiaria
Agrotis ypsilon — *Amphipyra pyramidoides*
Elaphria grata — *Anticarsia gemmatalis*

Feltia herilis
Feltia tricola
Galgula partita
Helicoverpa zea
Lacinipolia renigera
Leucania linda
Leucania sp
Nephelodes minians
Oligia indocilis
Oligia modica
Pachypolia atricornis
Papaipema cerrusata — *Papaipema duplicata*
Papaipema parallella
Papaipema rigida
Papaipema sp
Plathypena scabra
Pseudaletia unipuncta
Thioptera nigrofimbria
Xestia badicollis
Xestia bollii
Xestia normaniana
Xestia smithii

Yponomeutidae
Atteva punctella

MEMORANDUM

5 January 2000

latest info:
Oct. '99 Report
1999 IAR

FROM: Eric H. Metzler, spruance@infinet.com 
TO: John Morse
Jody Flemming
Keith R. Langdon
Charles R. Parker
Becky Nichols
Richard L. Brown
Nancy Keohane
SUBJECT: Report for DLIA research grant, Moth Survey in GSMNP

Enclosed is a draft copy of my research report. Please excuse its lateness, serious illness in my wife's family out of state prevented me from working on the report for several weeks.

This report is a draft. I ask for your comments and suggestions. Please share this with any colleagues who you feel can improve the report.

While reading the report, I ask for your patience with the following:

The color photos and maps are printed in draft form. The quality of the color in the final copy will be much improved.

Most of the moths are awaiting final identification. Many more will be identified by the deadline for me to file my Investigator's Annual Report by March 31, 2000.

I will use the revised report to generate an abstract which will be filed electronically with the NPS.

I plan to submit the final version to Discover Life in America by 15 February 2000. I ask for your help by submitting comments in time for me to meet that deadline.

I will use the **RESULTS and DISCUSSION** section to list species, such as *Papaipemas duplicata*, which were newly recorded from the Park in my samples.

Have I missed anyone who should receive a copy of the final report?

Thank you very much.