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THE BIOTA OF MAGAZINE MOUNTAIN (I): AN OUTLINE OF THE NATURAL HISTORY OF MAGAZINE MOUNTAIN

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ABSTRACT

One plant and five invertebrate species are thought to be endemic to Magazine Mountain, Logan County, Arkansas. The mountain is the highest point in the Interior Highlands reaching 2,753 feet. Previous studies have recorded over 650 species of plants including (or in addition to) 27 fern species. The animal fauna is less well known. It is suggested that an inventory of the biota of the mountain could be completed within the foreseeable future. It is further suggested that such an inventory would be useful in answering questions relevant to understanding the evolution and biogeography of selected taxa in North America. A list of collecting localities and approximate locations are given.

INTRODUCTION

Data concerning the total species composition (both plants and animals) of terrestrial communities in North America are almost non-existent in the published literature. One of the few efforts to study the entire biota of a limited geographical area was a biological survey of Mount Desert Island, Maine (Proctor, 1946). Rather than comprehensive surveys of biotas, one is more likely to find floral or faunal works or checklists on particular taxa available for specific taxa. Such floral and faunal works and checklists are certainly useful but they beg the question: "How many species of plants and animals are present in a particular area?" We are, for the most part, left without an answer to this question.

Comprehensive biological surveys, even for small geographical areas, are difficult to conduct. Sailer (1969) discussed some of the problems associated with such surveys. Among these problems are the lack of specialists to identify the specimens, obtaining funding, a long term commitment to the project, and the organization and storage of collections until they can be processed and identified. However, if these problems and others can be at least partially resolved, the benefits to biology, evolutionary biology in particular, could be enormous. For example, once the species composition of an area is known (perhaps known at the 75% level of completion), answers to questions relevant to an understanding of the relationship between evolution and ecology become possible. Indeed, we may be able to study whole organism evolution, biology, and species interactions more precisely than has been possible to date.

For a terrestrial community such as a deciduous forest in eastern North America, it is difficult to even estimate the number of animal species that might be present. Peck (1989) has discussed this problem in relation to a faunistic study he is doing on the insects of the Florida Keys. Using what data are available he estimated "a total of some 5,000 insect species, but this seems conservative because over 6,000 insect species are claimed for Mount Desert Island, Maine, USA (Proctor 1946)." Peck (personal communication) said that the Florida Keys are a somewhat depauperate biota, i.e. the biota is not too diverse. In contrast to Peck's estimate, Karl Stephan (personal communication), working in a more diverse area, has collected over 3,700 species of beetles (Insecta: Coleoptera) in Latimer County, Oklahoma over a 15 year period. Latimer County is on the western edge of the deciduous forest in the Ouachita Mountains. Based on the limited data available one might estimate that the number of arthropod species (spiders, mites, centipedes, millipedes, insects, etc.) found in a "typical" eastern deciduous forest community may exceed 20,000 to 30,000 species. This estimate does not include the many

other non-arthropod invertebrate taxa, plants, fungi, vertebrates, etc. The question that immediately arises is "Can an inventory of the biota of an area be completed in a realistic period of time?"

The answer I offer to the question just posed is a qualified yes. Although one may strive to do a complete inventory of an area, one must also accept the fact that the level of completeness of identification would be uneven in the taxa occurring in the area. However, I would argue that although a biotic inventory may never be "complete," this should not deter workers from engaging in such studies. I point out that the astronomers have been estimating the number of celestial bodies and the amount of matter occurring in the universe for decades, revising their estimates upwards and/or downwards each year. But more importantly, I would reiterate the suggestion that biological inventories, at any level of completeness, will open many new avenues of investigation and will generate a number of different questions, perhaps even new questions that have to be answered if we are to understand our environment and the processes by which the organisms in that environment have evolved.

In the process of inventorying biotas I would suggest that biologists can also investigate important scientific questions. Suppose, for example, that the area to be studied is known to have one or more local endemic species and also species with disjunct populations. Two questions might be: (1) What is the percentage of endemism in the local area in relation to the number of non-endemic taxa in the same genus or higher taxon? and (2) Why does one genus exhibit local endemic forms while other genera have only disjunct populations? Perhaps a third question, following from question two, might be: Have different taxa been isolated for varying lengths of time? It might be possible to answer, at least in part, these types of questions as one proceeds with a basic inventory of an area. When questions such as the ones just suggested are considered, the value of biological inventories is greatly enhanced.

This paper is the first in a series that will report the results of a biological inventory of a local, somewhat isolated area in the Interior Highlands of North America, Magazine Mountain, Logan County, Arkansas. A number of papers and unpublished reports have previously documented a small portion of the Magazine Mountain biota. Building on the information now available and work done on the mountain during the past six years, it will be possible to inventory a significant part of the mountain's biota within the foreseeable future. Hopefully, the publication of the inventory data as quickly as possible will encourage specialists in a number of diverse fields to lend their expertise to this work.

LOCATION

Magazine Mountain is located in Western Arkansas in southeastern Logan County, Arkansas, south of the town of Paris. The mountain is

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approximately 55 miles southeast of Ft. Smith, Arkansas, and 100 miles northwest of Little Rock, Arkansas. Access is via State Highway 309 from either Paris to the north, or Havana to the south. The mountain rises about 2,400 feet above the level of the Arkansas River which is 16 miles to the north, to an elevation of 2,753 feet above sea level. The mountain lies along the south edge of the Arkansas River Valley.

GEOLOGY

The bedrock of Magazine Mountain is Pennsylvanian sedimentary rock consisting (from the top down) of the Savannah Sandstone Formation (about 800 feet thick), the McAlester Shale Formation (about 700 feet thick), the Hartshome Formation (about 220-223 feet thick), all of the Des Moines Series, and the Atoka Series which consists entirely of the Atoka formation (about 10,000 feet thick) (Anonymous, 1960).

The mountains lying within the area known as the Arkhoma Basin (Magazine Mountain, Mt. Nebo, and Petit Jean Mountain among others) are the results of erosional processes. The Arkhoma Basin was once an uplift area lying between the northern Ozark uplift and the southern Ouachita Mountains. As erosion proceeded in the Arkhoma area, a number of tall mountains were left in stark contrast to the surrounding landscape. The Arkansas River is now a prominent feature of the Arkhoma Basin and flows through Arkansas and part of eastern Oklahoma. The age of the Arkansas River is unknown, and therefore, the contribution this river has made to the erosion of the Arkhoma Basin is uncertain. It has been postulated that the precursor of the present day river was a vast drainage area receiving run-off from the northern Ozark and southern Ouachita Mountains. This drainage basin may have served as an effective barrier for the dispersal of some organisms (Carlton & Cox, 1990).

CLIMATE

The climate of the Magazine Mountain area was discussed in a U.S. Department of Agriculture Environmental Impact Statement compiled by an anonymous source (Anonymous, 1960).

"The average annual temperature on the summit of Magazine Mountain is 57°F, 6° cooler than the average of 63°F at its base and the surrounding areas. During January the average summit temperature is 37°F while that of the base and surrounding areas is about 42°F. The July summit temperature averages 76°F while that of surrounding areas average 82°F. The midsummer summit temperature is frequently 10-25 degrees cooler than that of the surrounding valleys. Temperatures on the mountain ranged from a high of 103°F to a low of 7°F during the period 1951-1960.

"Precipitation in the area is usually abundant and well distributed throughout the year with an average of 92 days per year having measurable precipitation. The average annual precipitation of 55 inches on the summit decreases to about 50 inches at lower elevations. Precipitation ranged from a high of 81 inches to a low of 37 inches during the period 1951-1960.

"The area has heavy fog on the average of 8.3 days per month. November, with an average of 16 foggy days and February, with an average of 14 foggy days, have the highest occurrences. March and April have the lowest occurrences. Because of the mountainous terrain, fog is frequently localized. At times heavy fog covers lower elevations while the summit remains fog free."

VEGETATION

Three major reports have described and cataloged the vegetation of Magazine Mountain. Pyle (1939) studied the plants found on Magazine

Mountain and listed some 434 species. Moore (1926) published a short paper listing 27 fern species and discussed the fern communities found in some of the moist protected habitats. Tucker (1972), after an extensive study of the vegetation on the mountain, listed over 600 species of plants that he had collected, or that he had confirmed as being present by the existence of herbarium specimens.

Tucker (1972) suggested that the vegetation on Magazine Mountain could be divided into three main units with subunits under two of the main divisions. These divisions are quite useful in understanding some of the major habitats on the mountain. Tucker's (1972) divisions and discussion of each of the major habitats, sometimes verbatim, were as follows:

I. PLATEAU SURFACE

Because the top of the mountain (the central part of the plateau) was once inhabited and developed, little of the original vegetation remains. However, the areas near the rim were not suited for farming and were left undisturbed.

I. A. Southern Rim of Plateau. Along the south rim is a mosaic of stunted, gnarled trees and open areas. The trees are mostly Red Cedar (*Juniperus virginiana*), Blackjack (*Quercus marilandica*) and Post Oak (*Q. stellata*), Gum Bumelia (*Bumelia lanuginosa*), Fringe Tree (*Chinoanthus virginica*), and Farkleberry (*Vaccinium arboreum*). The more open areas may be composed of bare or loose rock. Other open areas are covered with Big Bluestem (*Andropogon gerardii*), Jointgrass, Panic Grass (*Panicum* spp.), Gamma Grass (*Tripsacum dactyloides*), Love Grass (*Erogorstis* spp.), Black-eyed Susan (*Rudbeckia grandiflora*), Thistle (*Cirsium* spp.), Blazin Star (*Liatris* spp.), and Aster (*Aster* spp.).

The most important features along the south rim are the "spring seeps" present at the onset of spring rains and snow melt. These seeps provide microhabitats for amphipods and other freshwater invertebrates.

I. B. Northern Rim of Plateau. The north rim of the plateau is more moist than the southern rim, and there are more ravines of larger size. The tree assemblage is somewhat different, consisting of Northern Red Oak (*Quercus rubra* var. *borealis*), White Oak (*Q. alba*), and Chinkapin Oak (*Q. muhlenbergii*); several species of Hickory (*Carya* spp.); Basswood (*Tilia americana*); Serviceberry (*Amelanchier arborea*); and Sugar Maple (*Acer saccharum*). The rare Prickley Gooseberry (*Ribes cynosbati*) occurs along the rim at Brown Springs. The north rim is notable because it is the only known locality for the diminutive Maple-leaved Oak (*Q. shumardii* var. *acerifolia*).

I. C. Sphagnum Bog. There are several low areas toward the west end of the mountain that support assemblages of several species of Peat Moss (*Sphagnum* spp.). The spring-fed seep at Dripping Springs is the largest and most accessible. The Small-headed Pipewort (*Eriocaulon kornickianum*) is present, along with the occasional occurrence of Ragged Fringed Orchid (*Habenaria lacera*), Yellow Fringed Orchid (*Habenaria ciliaris*), Green Adder's Mouth (*Malaxis unifolia*), and Quillwort (*Isoetes melanopoda*). Each of these seep plants is considered rare in Arkansas.

I. D. Disturbed areas. When Tucker discussed the disturbed areas in 1972 he noted these areas were "still noticeable but are rapidly disappearing as the natural vegetation re-establishes itself." At the present time (1991) the older home sites, flower gardens, etc. have become obscure and are often difficult to locate. The area around the old lodge site on the south slope is still evident.

II. SLOPES

II. A. North and East Slopes. The North-facing slope of the mountain supports a rich and diverse flora. The largest tree dominants are White Oak (*Q. alba*), Red Oak (*Q. falcata*), Black Oak (*Q. velutina*), Ohio Buckeye (*Aesculus glabra*), Black Gum (*Nyssa sylvatica*), and often Ozark Chinkapin (*Castanea pumila* var. *ozarkensis*). In the steeper and

more inaccessible ravines, there are very large specimens of most of these species. The more common shrubs are Prickly Gooseberry (*Ribes synobati*), Spicebush (*Lindera benzoin*), and Bladdernut (*Staphylea* sp.). A few specimens of the relatively rare Yellow-Wood (*Cladrastis lutea*) may also be found. Ground cover may consist of dense patches of Dutchman's Breeches (*Dicentra cucullaria*), Bellwort (*Uvularia grandiflora*), Trillium (*Trillium* spp.), Spiderwort (*Tradescantia ernestiana*, *T. ohioensis*, and *T. ozarkana*), Toothwort (*Dentaria laciniata*), and Mayapple (*Podophyllum peltatum*). A few deep ravines on the east slope, especially Bear Hollow, are almost identical in plant species composition to those on the north slope.

II. B. South and West Slopes. The south slope and part of the west-facing slope support a Shortleaf Pine (*Pinus echinata*) and deciduous tree forest. Some areas are predominately pine. The deciduous trees may be White Oak (*Q. alba*), Post Oak (*Q. stellata*), Black Oak (*Q. velutina*), and a number of Hickory species (*Carya* spp.). Understory trees may include Flowering Dogwood (*Cornus florida*), Hawthorn (*Crateagus* spp.), Redbud (*Cercis canadensis*), and Sassafras (*Sassafras albidum*).

III. ROCK OUTCROPS

Concerning the rock outcrops, Tucker (1972) gave the following analysis: "The rock outcrops of the shaded and protected northern and eastern slopes are particularly noteworthy for their pockets of ferns of numerous species. The shaded outcrop in the vicinity of Dripping Springs is very rich in fern diversity. The very rare Hay-scented Fern (*Dennea punctilobula* [Michx.] Moore), and Rocky Mountain Splenwort (*Woodsia scopulina* [D. C. Eat.] var. *appalachiana* [T. M. C. Taylor] Morton) are among the more interesting of that region. Also growing abundantly here is a grass common in the mountains of the Appalachian region, Hairgrass (*Descampsia flexuosa*)." Some of the outcrops on the plateau (and northern slopes) support communities of the relatively rare Indigo Bush (*Amorpha ouachitensis*) also known as the Ouachita Leadplant. Peck (1986) reported the presence of the Spinulose Wood Fern (*Dryopteris carthusiana* H. B. Fuchs) on the north slope at Brown's Spring. This is a predominately northern species and the Magazine Mountain population represents a distinct disjunction.

FAUNA

The early work on the fauna of Magazine Mountain, 1900-1985, was sporadic and consisted of the description of new taxa. The following species were described from various localities on the mountain and are still known only from Magazine Mountain: *Mesodon magazinensis* Pilsbry & Farris (1906); *Paravitrea aulocogyra* Pilsbry & Farris (1906); *Stygobromus elatus* Holsinger (1967); *Arianops sandersoni* Barr (1974). The first two organisms are land snails, the third is a fresh water amphipod, and the fourth is a short-winged mold beetle. *Mesodon magazinensis* has been placed on the federal list of threatened and endangered species.

During the past six years an additional two new insect species and one genus have been found on Magazine Mountain and are thought to be endemics. The new endemic taxa are as follows: a jumping bristletail *Pedetontus gerschneri* Allen (1992) (in press); a caddisfly *Paucicalcaria ozarkensis* Mathis & Bowles (1989) (an endemic genus and species). Other species that were originally found on the mountain but have subsequently been found in other areas in the Interior Highlands are as follows: a mayfly *Paraleptophlebia calcarica* Robotham & Allen (1988); a lace bug *Acalypta susanae* Allen et al. (1988); a ground beetle *Scaphinotus parisana* Allen & Carlton (1988); a new genus and species of short-winged mold beetle *Ouachitychus parvoculus* Chandler (1988).

In addition to the new insect species that have been discovered on the mountain, Tedder and Allen (1989) listed 68 species of Collembola collected during a three year study.

No recent inventories of the vertebrate fauna of Magazine Mountain

have been published. Baerg (1927) listed 48 bird species as summer residents on the mountain.

SPECIFIC LOCALITIES AND METHODS

Since 1985, the inventory of the biota of Magazine Mountain has concentrated on the arthropods. Although any area on the mountain is subject to study, collecting has been concentrated at several specific localities. Figure 1 is a schematic diagram showing distances from major intersections to localities from which numerous samples have been taken. The following is a list of these localities:

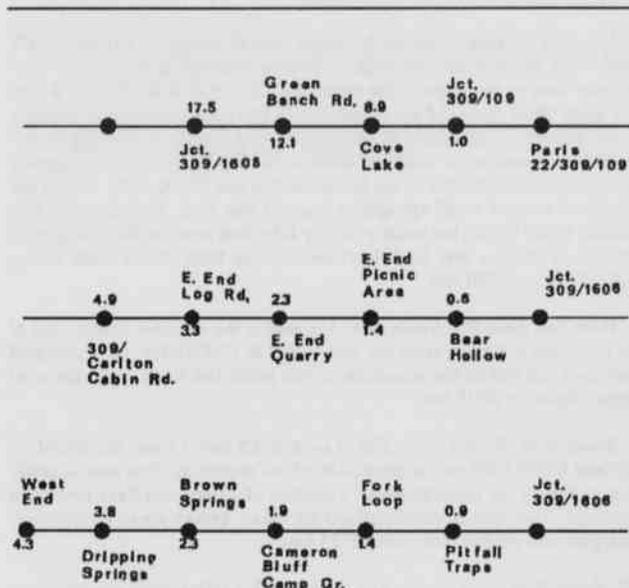


Figure 1. Distances, in miles, of primary collecting from major highway/road intersections.

1. *Cove Lake*. Located near the base of the mountain approximately 8.9 miles south of Paris on Highway 309. The campground has been used as a base of operation. The area has a greater concentration of pines and is similar to the upper reaches of the east side and south slope of the mountain. Elevation 1050 feet.

2. *Gutter Rock Creek*. This stream emanates from a number of run-off areas on the north slope of the mountain including Brown Springs. The principle collecting area has been at the low water bridge crossing on Green Bench Road, approximately 2.5 miles west of the junction of Highway 309 and Green Bench Road. Elevation 1300 feet.

3. *Slocum Springs*. Located on the north slope, the spring is reached by traveling west on Green Bench Road 4.7 miles from Highway 309. A small, overgrown, abandoned road on the south side of Green Bench Road leads through a clear cut area, then into the north slope forest. It is about a two mile hike up the north slope to Slocum Springs. The spring itself is small and difficult to locate. Elevation 2050 feet.

All the remaining localities are on the upper reaches of the mountain. Each locality is measured in miles from the intersection of Highway 309 and U.S. Forest Road (USFR) 1606. The Forest Road extends west on the main portion of the plateau of Magazine Mountain. Greenfield Picnic Area is located at the intersection.

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4. *Cameron Bluff Campground*. This area has been used as a base of operation on most collecting trips since 1989. The area is 1.9 miles west of Intersection of 309 and USFR1606. Elevation 2500 feet.

5. *Signal Hill*. The north entrance to the Signal Hill Trail begins across the road from the entrance to the Cameron Bluff Campground. Collecting has been at numerous points along this trail. The trail leads up Signal Hill to the highest point on the mountain, 2753 feet.

6. *Brown Springs Picnic Area*. Located 2.3 miles west of Inters. of 309 and USFR1606. The spring is free flowing in the spring but usually dry by mid June. This area is one of the major localities of the endemic Maple-leaved Oak. Elevation 2575 feet.

7. *Dripping Springs*. Located 3.8 miles west of Inters. of 309 and USFR 1606. Just beyond the entrance to Brown Springs, a dirt/gravel road extends west to the edge of the mountain. The road is marked by a sign that reads "Fire Tower" / "Electronic Site". The spring must be reached by hiking about 0.5 mile along an abandoned road. This road is easily recognized by several large boulders used to deter vehicle traffic. Dripping Springs is 3.8 miles west of the Inters. of 309 and USFR 1606. This is the largest of several small sphagnum bogs in this area. The spring is free flowing in the spring but usually dry by July. Just north of the spring are a number of ravines that lead downward to the base of the north facing cliff. Elevation 2650 feet.

8. *West End Area/Electronic Site*. Located at the extreme western end of the mountain 4.3 miles from the Inters. 309 & USFR1606. An abandoned road near the end of the mountain on the south rim leads down the west slope. Elevation 2675 feet.

9. *South Rim, West Cabin Site*. Located 2.5 miles from the Inters. of 309 and USFR1606 on the south side of the mountain. This area is easily recognized by the foundations of a number of cabins that have now been removed. The area is characterized by clear, grassy areas interspersed with pine and juniper. Elevation 2575 feet.

10. *South Rim, East Cabin Site*. Located 2.9 miles from the Inters. of 309 and USFR 2606. Similar to the West Cabin Site but with more open grassy areas along the south rim. Elevation 2550 feet.

11. *Mossback Ridge*. This is the crest that extends along the eastern part of the mountain. The north and south slopes of the ridge appear to be very different in terms of moisture retention especially in late July, August, and September. The north slope is noticeably more moist than the south slope, even though the two sides are separated by only a short distance. One of the sites used most frequently is 0.9 mile west of the Inters. of 309 and USFR 1606. Elevation 2550 feet.

12. *Bear Hollow*. Located 0.6 mile south of Inters. of 309 and USFR 1606 on the east side of Highway 309. This hollow contains a rich, older vegetational component as evidenced by the diameter of many of the large trees in the hollow. Elevation 2400 feet.

13. *East End Picnic Area*. Located 1.4 miles south of Inters. of 309 and USFR 1606. The immediate area around the picnic tables is predominately young pine and small hardwoods. The area supports a wide variety of wildflowers early in the spring. Elevation 2400 feet.

14. *East End Pond*. Almost directly across the road from the entrance to the East End Picnic Area is an overgrown dirt road leading to a small man-made pond. Location of the road entrance is 1.4 miles south of the Inters. of Highway 309 and USFR 1606. Elevation 2400 feet.

15. *East End Quarry*. Located 2.3 miles south of the Inters. of Highway 309 and USFR 1606 on the east side of Highway 309. The quarry area was created in the early 1970s when Highway 309 was renovated and paved. The quarry pit contains water throughout the year. A large clear cut area borders the pit on the north side. Elevation 2250 feet.

16. *East End Log Road*. Located 3.3 miles south of the Inters. of Highway 309 and USFR 1606 on the west side of Highway 309. This abandoned road extends west along the south slope of the mountain. Within the first one-half mile of the road there are a number of spring run-off streams that are usually dry by mid July. Elevation 1990 feet (bench mark reading).

17. *Junction, 309/Carlton Cabin Road*. Located 4.9 miles south of the Inters. of Highway 309 and USFR 1606. The area is predominately pine with some mixed hardwoods. Elevation 1370 feet.

DISCUSSION

Published reports and the preliminary data that have been collected during the past six years demonstrate that Magazine Mountain harbors a large and diverse flora and fauna. A significant number of species appear to be very restricted local endemics while other species are disjunct populations of species with more extensive ranges in northeastern North America and perhaps in western North America.

It is possible that an inventory of the biota of Magazine Mountain could be completed within the foreseeable future. Such an inventory would form the foundation for other inventory studies throughout the Interior Highlands and in other parts of North America. The inventory would also lead to a better understanding of the biogeography of selected taxa and the concept of endemism. Workers interested in participating in this study are encouraged to contact the author.

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