

Vertebrate Richness and Biogeography in the Big Thicket of Texas

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ABSTRACT.—The Big Thicket of Texas has been described as rich in species and a “crossroads:” a place where organisms from many different regions meet. We examine the species richness and regional affiliations of Big Thicket vertebrates. We found that the Big Thicket is neither exceptionally rich in vertebrates nor is it a crossroads for vertebrates. Its vertebrate fauna is predominantly eastern.

INTRODUCTION

The Big Thicket of southeastern Texas has been repeatedly described as exceptionally rich in species, diverse in plant communities and a crossroads where adjacent ecological regions meet and mingle (*see* Cozine, 2004; MacRoberts and MacRoberts, 2004, 2007, 2009; Callicott *et al.*, 2006; Diggs *et al.*, 2006 for history of this description and references). Probably the most cited example of this view is Eisner (1973: 525) when he wrote that the Big Thicket was

“a region of extraordinary biological exuberance ... ecologically unique not only to Texas, but to the entire North American expanse as well. Located at the crossroads between forests of the South and East and the vegetation of the West, the Thicket includes ... elements from all convergent zones. It is the way which diversity of kind is combined with diversity of association that gives the area its special mark.”

This view has been and continues to be repeated despite the lack of evidence to support it (*see* Gunter, 1993; Peacock, 1994; Watson, 2006 for examples of the view and references, and National Park Service, 2009a, b; UNESCO Biosphere Reserves, 2009, for current on-line examples). Botanical research over the last decade shows that the Big Thicket is a continuum of the southeastern mixed pine-hardwood forest, harbors only a few western plants and is no more floristically rich or diverse than other areas of equal size across the southeast (Diggs *et al.*, 2006; MacRoberts and MacRoberts, 2004, 2007, 2008b, c; MacRoberts *et al.*, 2007).

What about other organisms? How does the Big Thicket compare to other areas of North America? How does it compare to other areas of Texas? To see if our findings for plants hold for other groups of organisms, we examined the richness and regional association of the vertebrate fauna of the Big Thicket.

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METHODS

The Big Thicket is an ill-defined region of southeast Texas (*see* Cozine, 2004; MacRoberts and MacRoberts, 2004, 2008a; Callicott *et al.*, 2006; Diggs *et al.*, 2006 for discussion and literature). However, it is generally agreed that it encompasses all or part of Newton, Jasper, Hardin, Tyler, San Jacinto, Polk and northern Liberty counties, an area of approximately 15,700 km² (Diggs *et al.*, 2006). This six and a half county area includes almost all areas defined as the Big Thicket and includes all of the 14 scattered units of the Big Thicket National Preserve. We follow this definition here.

We used distribution maps, checklists and other sources to develop a list of fish (National Park Service, 1974a; Page and Burr, 1991), amphibians (Stebbins, 1966; National Park Service, 1974b; Conant and Collins, 1998; Dixon, 2000), reptiles (Stebbins, 1966; National Park Service, 1974b; Conant and Collins, 1998; Dixon, 2000), birds (National Park Service, 1996; Oberholser, 1974; Peterson, 1999; Sibley, 2000; Wolf *et al.*, 2001) and mammals (McCarley, 1959; Burt and Grossenheider, 1964; Hall, 1981; Schmidly, 1983; Davis and Schmidly, 1994; Reid, 2006) that occur in the Big Thicket.

To determine the geographical affinities of Big Thicket vertebrates, using many of the previously cited resources we classified species according to the region of North America they occupied. All species were classified into one of five categories: (1) western: species that occur predominantly west of about 98° west longitude (*e.g.*, roadrunner *Geococcyx californianus*), (2) central: species that are predominantly in the central plains area (*e.g.*, Great Plains narrow-mouthed toad *Gastrophryne olivacea*), (3) widespread: species that occur in virtually all states and provinces in North America north of Mexico (*e.g.*, pied-billed grebe *Podilymbus podiceps*), (4) eastern-western: species that are not widespread but which occur in both the east and in the west (*e.g.*, Mexican freetail bat *Tadarida brasiliensis*), (5) eastern: species that are exclusively or predominantly found in the east (*e.g.*, alligator *Alligator mississippiensis*).

We surveyed the literature for information on vertebrate richness in North America and Texas and found it to be extensive (Simpson, 1964; Cook, 1969; Kiester, 1971; MacArthur, 1972; McAllister, 1986; Owen, 1990; Currie, 1991; Abell *et al.*, 1999; Ricketts *et al.*, 1999). Most of this information is presented in the form of equal area quadrants, with the number of species in each quadrant tabulated. The size of these quadrants is larger than the Big Thicket but allows for equal area/species matrix comparisons across all of North America. We used this information to compare Big Thicket region (*i.e.*, the quadrant(s) in which the Big Thicket occurs) vertebrate richness to the remainder of North America. Unfortunately, comparable information on the distribution of Mexican vertebrates is not available.

To compare the Big Thicket in detail with another region we analyzed the vertebrate fauna of Bossier and Caddo parishes, Louisiana, in the same manner we did for the Big Thicket. We chose these two parishes because they have good species lists (Hardy, 1979, 1982; Hardy and LeGrande, 1979; Wiedenfeld and Swan, 2000) and because, like the Big Thicket, they are in the West Gulf Coastal Plain. Bossier and Caddo parishes are located 150 km northeast of the Big Thicket in northwestern Louisiana on the Texas and Arkansas border and consist of 4457 km², or an area between one-fourth and one-third the size of the Big Thicket.

Our analyses include only freshwater and terrestrial species and only breeding birds. Marine vertebrates and exotic species are not included. Species that were recorded from the 19th and 20th centuries but do not presently occur in the region were included.

RESULTS

Fishes.—Abell *et al.* (1999) and McAllister *et al.* (1986) map freshwater fish richness in North America. The regions with the highest fish richness in North America are all within

TABLE 1.—Geographical affiliation of Big Thicket and Bossier and Caddo Parish vertebrates. Figures are number of species

Region	Fishes	Amphibians	Reptiles	Birds	Mammals	Total	%
Big Thicket							
West	0	0	0	2	5	7	2
Central	17	4	6	1	6	34	10
Widespread	0	1	2	30	14	47	14
East and West	1	2	4	31	6	44	13
East	68	23	43	48	22	204	61
Total	86	30	55	112	53	336	100
Bossier and Caddo parishes							
West	0	0	0	2	4	6	2
Central	24	3	4	2	4	37	11
Widespread	0	1	1	32	15	49	15
East and West	1	1	4	25	5	36	11
East	64	22	46	48	24	204	61
Total	89	27	55	109	52	332	100

the Mississippi River drainage, and each of these regions includes more than 200 species. Species richness tends to decline as a function of distance from the Mississippi drainage. As Conner and Suttkus (1986:455) have pointed out, “compared with those of the central and eastern portions of North America, the ichthyofauna of [east Texas and southwest Louisiana] is depauperate; it is somewhat richer, however, than those of more western parts of the continent.” The Big Thicket has 86 species. The distributional relationships of Big Thicket fishes are concentrated in the Mississippi drainage, mainly in the east-central region of the United States (Table 1). There are 17 central region fish species in the Big Thicket (e.g., silverband shiner *Notropis shumardi*) but no western species.

Amphibians.—Kiester (1971) and Currie (1991) map amphibian richness in the United States and Canada. The highest concentration of amphibians is in the southeastern United States, with numbers dropping from a high of between 50 and 60 in Georgia and South Carolina to around 30 in the Big Thicket region. However, the Big Thicket does not stand out as exceptional in Texas. All areas of eastern Texas have as many amphibians. Even comparable areas in the Edwards Plateau match the Big Thicket region in number of species (Kiester, 1971; Currie, 1991). It is only in west Texas that the numbers fall off significantly. The vast majority of Big Thicket amphibians are eastern (Table 1). None is western. Four species, Gulf Coast waterdog (*Necturus beyeri*), Gulf Coastal toad (*Bufo valliceps*), Great Plains narrow-mouthed toad (*Gastrophylax olivacea*), and Strecker’s chorus frog (*Pseudacris steckeri*) are central.

Reptiles.—Kiester (1971) and Currie (1991) map reptile richness for North America north of Mexico. These maps show a fairly constant east-to-west number of species across North America at the latitude of the Big Thicket, with between 50 and 60 species. However, there is a peak in central Texas to the west of the Big Thicket, with 70 to 80 species, which is the highest density in North America north of Mexico (Kiester, 1971; Currie, 1991). Within Texas, the Big Thicket area has about as low a number of reptiles as is found in the state except for the panhandle and plains area (Kiester, 1971; Currie, 1991). The majority of Big Thicket reptiles are eastern (Table 1). None is western. Six species are central: yellow mud turtle (*Kinosternon flavescens*), ornate box turtle (*Terrapene ornata*), Texas horned lizard

(*Phrynosoma cornutum*), Texas spiny lizard (*Sceloporus olivaceus*), flat-headed snake (*Tantilla gracilis*) and Louisiana pine snake (*Pituophis ruthveni*).

Birds.—Cook (1969) and MacArthur (1972) map breeding bird richness across North America including Mexico and Central America. These maps show the Big Thicket area and the southeastern United States in general as having the lowest number of breeding birds in North America south of about 55°N. Although about 300 bird species are known to occur in the Big Thicket region, only about 112 breed there. Eastern breeding birds predominate, but there are many widespread and eastern-western species as well (Table 1). One species, the scissor-tailed flycatcher (*Tyrannus forficatus*), is a central plains species and two, the Inca dove (*Columbina inca*) and roadrunner, are western. Three species that once occurred in the Big Thicket are now extinct: passenger pigeon (*Ectopistes migratorius*), ivory-billed woodpecker (*Campephilus principalis*) and Carolina parakeet (*Conuropsis carolinensis*). Only the ivory-billed woodpecker is known to have bred in the Big Thicket.

Mammals.—Simpson (1964) and Currie (1991) map mammal richness for North America including Mexico and Central America. The southeastern United States, including the Big Thicket area, has about as low a number of species (40 to 60) as anywhere in North America south of about 50°N. latitude and as low a mammalian density as is found in Texas (Owen, 1990). The majority of Big Thicket mammals are eastern (Table 1). Nonetheless, there are many widespread and eastern-western species. Five species, blacktail jackrabbit (*Lepus californicus*), ringtail (*Bassariscus astutus*), eastern hognose skunk (*Conepatus leuconotus*), coyote (*Canis latrans*) and fulvous harvest mouse (*Reithrodontomys fulvescens*), are western, and six, armadillo (*Dasyfus novemcinctus*), Baird's pocket gopher (*Geomys bursairus*), hispid pocket mouse (*Perognathus hispidus*), pygmy mouse (*Baiomys taylori*), jaguar (*Felis onca*) and ocelot (*Felis pardalis*) are central. Six species, jaguar, ocelot, red wolf (*Canis rufus*), eastern hognose skunk (*Conepatus leuconotus*), black bear (*Ursus americanus*) and bison (*Bos bison*), are extirpated from the Big Thicket region.

The Big Thicket has no endemic vertebrate species.

The number and geographic affiliation of Bossier and Caddo Parish fishes, amphibians, reptiles, birds and mammals are almost identical to that of the Big Thicket (Table 1). These two parishes are as floristically diverse as the Big Thicket, with the same type of community proximity (e.g., the close proximity of many communities such as xeric sandylands, baygalls and upland pine forest) (MacRoberts and MacRoberts, 2008).

DISCUSSION

The geographical affinities of Big Thicket vertebrates vary among groups. The distribution of Big Thicket fishes is predominantly controlled by drainage patterns. Many are restricted to the Mississippi and Sabine River drainages, and all but one are restricted to various Gulf Coast drainages. Consequently, species with western affinities are essentially precluded. The geographical affinities of the remaining classes are somewhat less constrained. However, the location of the Big Thicket within the generally forested Austroriparian Province, well east of the steep gradient in precipitation from more arid areas to the west, limits the distribution of most western species adapted to more arid conditions and more open plant communities. Big Thicket amphibian and reptile faunas are predominantly eastern, with only 13% and 11% of species, respectively, with central affinities; inclusion of east-west and widespread species raises these percentages to 23% and 22%. Bird and mammal faunas exhibit a similar pattern, but birds have only 3% of species with western and central affinities, and mammals have a substantially higher 21% with

similar affinities: inclusion of east-west and widespread species results in much higher percentages of 57% and 58%, respectively.

Our examination of the North American vertebrate species-richness maps shows that southeast Texas is in no way exceptional and certainly is not the richest area for vertebrates in North America. Within Texas itself, the Big Thicket region has fewer birds, mammals, reptiles and fishes than do many other areas and only ranks near the top of the state for number of amphibians. This is not surprising because southeast Texas, where the Big Thicket is located, is among the wettest areas in Texas and is edaphically, geologically, and climatically continuous with the southeastern United States (MacRoberts and MacRoberts, 2008b).

Our analysis of the vertebrates of Bossier and Caddo parishes, Louisiana, underlines these results. Although smaller in area than the Big Thicket, these two parishes support almost as many vertebrates as does the Big Thicket, of which 84% are the same. Their geographical affinities are almost identical to those of the Big Thicket.

These findings are reinforced by World Wildlife Fund conservation assessments, which do not recognize the Big Thicket as a unique area (Ricketts *et al.*, 1999; Abell *et al.*, 1999; *see also* Diamond *et al.*, 1997; Dobson *et al.*, 1997). Additionally, biogeographers do not recognize the Big Thicket as a crossroads or an independent or special ecological region (MacRoberts and MacRoberts, 2003; McLaughlin, 2007) but rather subsume it within a larger region or province.

While we have examined vertebrate species richness only at a large scale, it remains possible that at smaller scales, such as 100 km² or 1000 km², the fauna might be rich, but the data to test this possibility are not available: small scale species/area studies for animals simply have not been carried out. However, the data on Big Thicket plants do not support small-scale richness (MacRoberts *et al.*, 2007). Small scale samples of plants (1 m² to 100 km²) in the Big Thicket show the same richness as equal sized-plots elsewhere across the south (MacRoberts *et al.*, 2007). Additionally, the Big Thicket does not have any plant communities unique to it but is a floristic continuum with adjacent areas of Texas and Louisiana.

Reviewers and readers of our papers (including this one) that reevaluate the traditional view of the Big Thicket as a species rich, diverse crossroads, sometimes accuse us of wanting to do away with the Big Thicket Preserve and of providing ammunition to opponents of the Big Thicket. Nothing could be further from our intention. That the traditional story about the Big Thicket is incorrect does not detract from its importance. For example, in 2004 we wrote: "... when all is said and done, what is important is that the conservationists saved not something atypical but something typical. The idea that only singularities are worthwhile is passé as far as conservation biology is concerned. The Big Thicket conservation movement achieved precisely this: by saving a representative sample of the Big Thicket, it saved a typical part of the West Gulf Coastal Plain—for which we must be eternally grateful" (MacRoberts and MacRoberts, 2004: 47–48). In 2009 we wrote: "... the most important reason for considering the Big Thicket immensely valuable was made by Donovan Correll." Testifying before the Senate committee in Beaumont in 1970 before a part of the Big Thicket became a national preserve, Correll pointed out that the vast pine-hardwood forest that characterized the southeastern United States had no areas that were preserved and that most, if not all, of the forest was rapidly vanishing. He then said: "We ought to have a representation of the great Southeastern pine hardwood forests somewhere, and since the development is so optimum here in Texas ... the Big Thicket would be ideal for that representation" (quoted in MacRoberts and MacRoberts, 2009: 403–404).

The Big Thicket can and should be preserved but on its own merits, not on false ones.

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