

Atlas of Missouri Amphibians and Reptiles for 2023



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Recommended citation:

Daniel, R.E. and B.S. Edmond. 2024.
Atlas of Missouri Amphibians and Reptiles for 2023.
<<http://atlas.moherp.org/pubs/atlas23.pdf>>

Updated: 19 April 2024 12:50
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Introduction

Since 1988, members of the Missouri Herpetological Association have compiled new county distribution records for amphibians and reptiles native to the state (Daniel *et al.* 2022 and previous updates). Cumulative accounts of these new records were presented in Powell *et al.* (1993), Powell and Daniel (1997), and Daniel and Edmond (2002). Johnson (2000) presented revised distribution maps based on a combination of these cumulative accounts and more recent annual compilations. The publication of Johnson (1987, 2000) renewed interest in expanding our knowledge of the distribution of the state's herpetofauna. Briggler and Johnson (2021) published an updated version of the *The Amphibians and Reptiles of Missouri* that incorporated all *Atlas* records up until that time. We follow their taxonomy and nomenclature here. In order to provide herpetologists working in Missouri with current information that is easily taken into the field, we are presenting revised species distribution and county records maps in a format that can be easily updated as new records are documented.

In 1997, with the initiation of the Missouri Herpetological Atlas Project (MOHAP), a database was established to serve as the basis for verifying new distribution records and tracking changes in individual species distributions within the state (Edmond and Daniel 2024). Qualification for inclusion in the database requires a catalogued voucher specimen housed in an institutional collection (Appendix A). However, in order to be valuable in tracking changes in the distribution of individual species, it is important to document historical records. Many of the specimens collected prior to the 1970s, most notably those reported by Hurter (1911) and Anderson (1965), were documented by specimens that have since been lost or destroyed. In order to provide the most accurate picture of the distribution of the state's herpetofauna we have included some literature records (Appendix B).

Some records were not included because the identification could not be determined with certainty. Within Missouri, the *Hyla versicolor* complex consists of two broadly sympatric and morphologically indistinguishable species (*H. chrysoscelis* and *H. versicolor*). Specimens collected for which the species identification was not determined by some non-morphological trait were not included.

Currently, the MOHAP database contains 38,487 entries and 34,349 valid, non-duplicated collections. This represents specimens housed in 37 museum collections and cited from 33 historical literature sources; 5,347 documented county records; 10,816 unique localities; and 18,150 unique species / locality combinations. This new total constitutes 679 new database entries since the 2021 edition of the *Atlas* (Daniel and Edmond 2022). The total number of species contained in the current edition of the atlas is 118, comprised of 116 native species and 2 non-native species.

Previous editions of the atlas are available upon request. Readers may contribute new records and read more about project details online (Edmond and Daniel 2024). Questions, comments, and suggestions should be directed to the senior author.

Amphibians and Reptiles of Possible Occurrence

A number of species found in surrounding states are known to occur in close proximity to the borders of Missouri. While not currently recognized as part of the Missouri herpetofauna, some or all of these species may eventually be found within the state.

A number of primarily eastern species have distributions that reach the Mississippi River along a portion of the Missouri border. These include: Southern Two-lined Salamander (*Eurycea cirrigera*), Three-lined Salamander (*Eurycea guttolineata*), Northern Zigzag Salamander (*Plethodon dorsalis*), Northern Slimy Salamander (*Plethodon glutinosus*), Eastern Cricket Frog (*Acris crepitans*), Western Chorus Frog (*Pseudacris triseriata*), Bird-voiced Treefrog (*Hyla avivoca*), Eastern Fence Lizard (*Sceloporus undulatus*), Gray Ratsnake (*Pantherophis spiloides*), and Eastern Ribbonsnake (*Thamnophis sauritus*).

Rivers, even large ones, change course over time and typically form an imperfect geographic barrier. Shepard and Kuhns (2017) examined the separation between Northern Slimy Salamanders (*Plethodon glutinosus*) and Western Slimy Salamanders (*Plethodon albagula*) along the Illinois-Missouri border. They found that salamanders on Fountain Bluff, an island formed of Missouri uplands cut off by post-glacial changes in the Mississippi River channel, belong to the species found in Illinois.

Spotted Dusky Salamander (*Desmognathus conanti*) and Midwestern Earthsnake (*Carphophis amoenus*) have been reported in the southern portion of Crowley's Ridge of Arkansas. Crowley's Ridge is a thin, sandy upland formed during the Pleistocene, which extends from northeastern Arkansas through southeast Missouri to the Shawnee Hills of Illinois. Populations of one or both of these species may exist in the isolated remnants of Crowley's Ridge in Missouri.

Powell *et al.* (2016) shows the distribution of the Western Milksnake (*Lampropeltis gentilis*) extending into western Missouri along the Kansas border. However, the sparsity of records from this region makes it difficult to accurately define the species boundary. Until additional material is available for evaluation, we have not included this species as part of the state herpetofauna.

Erroneously Reported and Non-Native Species

Anderson (1945) reported two specimens of the Dwarf Salamander (*Eurycea quadridigitata*) from Roaring River State Park in Barry County. With the nearest known naturally occurring populations of *E. quadridigitata* in southern Arkansas, more than 125 miles from the Missouri border, it is likely that this record is based on misidentified, but morphologically similar Oklahoma Salamanders (*E. tynerensis*).

Johnson and Bader (1974) included Lesser Earless Lizard (*Holbrookia maculata*) based on two specimens

collected from Knob Noster State Park in Johnson County. Nickerson and Kragger (1972) considered this record problematic because of the close proximity of the park to Whiteman Air Force Base and Central Missouri State University. The nearest record of this species is more than 115 miles away in central Kansas. Further searches failed to produce additional specimens. As a result, this species is not considered to be part of Missouri's herpetofauna.

Anderson (1957) listed the occurrence of the Queensnake (*Regina septemvittata*) in Missouri based on three specimens deposited in the American Museum of Natural History collection. These specimens were ascribed to G.K. Noble and reported to come from Stone County. In further investigation by Roger Conant (1960), Byron C. Marshall, who worked with Noble in the Interior Highlands during this period, reportedly had no recollection of finding this species. The nearest known populations of Queen Snake are in the Boston Mountains of Arkansas, approximately 80 miles south of this locality. The questions about the origin of the specimens and the absence of additional records from Missouri suggest that this species does not occur in the state.

One species of non-native frog and two species of lizards have been reported in Missouri. A population of Greenhouse Frogs (*Eleutherodactylus planirostris*) was established inside a commercial greenhouse in Jefferson City, Missouri (J. Briggler, pers. comm.). The population of these small terrestrial breeding frogs persisted for several years, but has apparently disappeared following renovation of the greenhouse. There are no other reports of this tropical species occurring within the state. Its apparent inability to survive extreme winter weather makes it unlikely for these frogs to exist in Missouri as a free-ranging species outside of sheltered habitats, such as greenhouses.

Mediterranean Gecko (*Hemidactylus turcicus*) is native to the Mediterranean basin and western Asia. This species is easily transported and a highly successful colonizer. Populations of this species have been established worldwide. In the United States, this species is currently established widely throughout the south, especially along the Gulf and East Coasts. Isolated populations are also found around numerous urban centers of the Midwest and central plains (Powell *et al.* 2016). Two populations appear to be established in Missouri. Bufalino (2004) reported this species from St. Louis County. A second population was discovered in Joplin, Missouri by Mr. A. Braun (Daniel *et al.* 2015).

Briggler *et al.* (2015) reported the presence of a robust population of Italian Wall Lizard (*Podarcis siculus*) in a Joplin neighborhood after being contacted by a resident in 2013. This population apparently descended from a series of lizards imported from Topeka, KS, which escaped in 2001. In many states, including Missouri, it is illegal to release non-native species. Despite prohibitions, the majority of introduced populations of this species in North America originated from released animals in the pet trade (Burke and Deichsel 2008).

Thus far, non-native amphibians and reptiles in Missouri have been confined to urban centers and do not appear to constitute a threat to our native herpetofauna. However, this is not the case everywhere and non-native

species that have become invasive are considered by many biologists to be a major threat, second only to habitat loss or degradation, to native species. Responsible pet owners should always exercise care to prevent the spread of this and all non-native species into the natural environment.

Distributions

Distribution is one of many characteristics used to describe a species and range maps (such as those found in Conant and Collins (1998)) are used to approximate a species' likely distribution. This atlas uses locality dot maps, with each dot representing a known locality for that species. This conservative method results in an underestimate of a species distribution but is more accurate than a range map. The purpose of the atlas project is to document as closely as possible both current and historical distributions for all native amphibians and reptiles in Missouri.

However, the printed version of the atlas only reflects the best historical approximation of each species' distribution in the state. The most noticeable resulting incongruity is that fact that some species are shown in historical localities in which they are almost certainly no longer found. For example, the Smooth Greensnake (*Opheodrys vernalis*) was once found in scattered populations in the prairie regions of the state. Due to extensive habitat loss and possibly other reasons, they are extremely rare or extirpated in the state.

While natural communities have long been a staple in ecology, formal classification of natural communities has been undertaken relatively recently in Missouri (Nelson 2005). Like individual species, natural communities can be described and characterized with distinct distributions and abundances in different ecoregions (see next section). For example, glades are common in the Ozarks but rare elsewhere in the state. Steyermark (1963), Yatskievych (1999), Pflieger (1989), Hawker (1992), and Unklesbay and Vineyard (1992) all describe and summarize the complex interplay among geology, natural history, ecoregions, natural divisions, and natural communities from slightly different perspectives. Taken together, these ideas form the basis of the biogeography of Missouri and they are essential in understanding why plants and animals have the distributions that we see today.

Terrestrial Ecoregions

An ecoregion classification system attempts to define and describe geographic regions that correspond to broad ecosystem patterns, topography, geology, soils, vegetation patterns, and the distributions of plants and animals. Omernik (1987) described ecoregions (Levels I, II, and III) for the conterminous United States as a hierarchical scheme with Level I corresponding to large regions and Level III representing smaller, more precisely described regions. The Environmental Protection Agency (2003) is coordinating an effort to further subdivide Level III regions into Level IV regions. Nigh and Schroeder (2002) published Level III and Level IV ecoregions for Missouri.

Some amphibian and reptile species follow defined ecoregions closely. For example, the Cave Salamander (*Eurycea lucifuga*) is neatly confined to the Ozark Highlands (Level III) and found throughout the ecoregion, with the exception of most of the Springfield Plateau (Level IV). Several species found in the southeastern alluvial plain are particularly characteristic and also confined to that area (e.g., Three-toed Amphiuma (*Amphiuma tridactylum*) and Southern Watersnake (*Nerodia fasciata*)).

Many species, however, seem to be abundant throughout Missouri, regardless of the region or natural community. The American Bullfrog (*Lithobates catesbeianus*), Snapping Turtle (*Chelydra serpentina*), and Western Ratsnake (*Pantherophis obsoletus*) among several others fall into this category. Finally, many species are more closely associated with a particular natural community or habitat than with a particular ecoregion or natural division. For example, The Flat-headed Snake (*Tantilla gracilis*) can be found in the Ozark Highlands, Osage Prairie, and Interior River Valleys and Hills but it is restricted to rocky glades.

In general, Level IV ecoregions are too granular to be useful in describing the distributions of Missouri amphibians and reptiles, several Ozark salamander species and many of the coastal plains species being notable exceptions. However, this level of detail is useful to understand natural community distributions on which some species are dependent. It also underscores the importance of looking at border states and across artificial political boundaries to understand distributions within Missouri.

Level I (page 8), Level II (page 9), Level III (page 10), and Level IV (page 11) ecoregion maps for Missouri and surrounding states, based on Omernik (1987) and Nigh and Schroeder (2002) are included here. The hierarchy for Levels I, II, and III is included in Table 1 (below), while the Level III and Level IV hierarchy is included in Table 2 (below). Unfortunately, the authors' coding scheme for Level III is inconsistent, though the names do match. Both authors' codes for Level III are included in the tables as a cross-reference. An earlier approach by Thom and Wilson (1980) divided Missouri into natural divisions and sections (page 7), roughly corresponding to Level III and Level IV ecoregions, respectively.

Table 1. List of Level I, II, and III Terrestrial Ecoregions from Omernik (1987). Those regions marked with an asterisk (*) do not occur in Missouri but are sufficiently close to be of interest to Missouri biologists. Level III codes from Nigh and Schroeder (2002) are in parentheses.

8. Eastern Temperate Forests

8.3. Southeastern USA Plains

8.3.3. Interior Plateau* (71)

8.3.6. Mississippi Valley Loess Plains (74)

8.3.2. Interior River Valleys and Hills (72)

8.4. Ozark / Ouachita / Appalachian Forests

8.4.5. Ozark Highlands (39)

8.4.6. Boston Mountains* (38)

8.5. Southeast US Coastal Plain

8.5.2. Mississippi Alluvial Plain (73)

9. Great Plains

9.2. Temperate Prairies

9.2.3. Western Corn Belt Plains (47)

9.2.4. Central Irregular Plains (40)

Table 2. List of Level III and Level IV Terrestrial Ecoregions from Nigh and Schroeder (2002). Those regions marked with an asterisk (*) do not occur in Missouri but are sufficiently close to be of interest to Missouri biologists. Those regions marked with a caret (^) are contained entirely within the state's borders.

38. Boston Mountains* (8.4.6)

38a. Upper Boston Mountains*

38b. Lower Boston Mountains*

39. Ozark Highlands (8.4.5)

39a. Springfield Plateau

39b. Elk River Hills

39c. White River Hills

39d. Central Plateau

39e. Osage / Gasconade River Hills^

39f. Saint Francois Knobs / Basins^

39g. Meramec River Hills^

39h. Current River Hills^

39i. Easter Ozark Border^

39j. Black River Hills Border^

39k. Prairie Ozark Border^

40. Central Irregular Plains (9.2.4)

40a. Loess Flats and Till Plains

40b. Osage Cuestas*

40c. Wooded Osage Plains

40d. Cherokee Plains

40e. Claypan Prairie^

47. Western Corn Belt Plains (9.2.3)

47d. Missouri Alluvial Plain

47e. Steeply Rolling Loess Prairies

47f. Rolling Loess Prairies

47h. Nebraska / Kansas Loess Hills*

47i. Loess and Glacial Drift Hills*

47m. Western Loess Hills

71. Interior Plateau* (8.3.3)

71m. Northern Shawnee Hills*

71n. Southern Shawnee Hills*

72. Interior River Valleys and Hills (8.3.2)

72a. Wabash / Ohio Bottomlands*

72d. Upper Mississippi Alluvial Plain

72e. Middle Mississippi Alluvial Plain

72f. River Hills

72g. Southern Ozarkian River Bluffs*

72i. Western Dissected Illinoian Till Plain*

72j. Southern Illinoian Till Plain*

72k. Cretaceous Hills*

72l. Karstic Northern Ozarkian River Bluffs*

73. Mississippi Alluvial Plain (8.5.2)

73a. Northern Holocene Meander Belts

73b. Northern Pleistocene Valley Trains*

73c. Saint Francis Lowlands

73f. Western Lowlands Holocene Meander Belts

73g. Western Lowlands Pleistocene Valley Trains

74. Valley Loess Plains (8.3.6)

74a. Bluff Hills

74b. Loess Plains

Aquatic Subregions

Like terrestrial ecoregions, aquatic subregions can be classified in discrete units, based on watershed and hydrological characteristics. Subregions are composed of ecological drainage units, which are major watersheds that are consolidated based on similarity and proximity (MSDIS 2009a). Subregions and their component drainage units can be seen in Table 3 (below).

Naturally, many of the same patterns emerge in both terrestrial and aquatic geographic classifications since the two are not independent of one another. However, aquatic subregions and ecological drainage units can differ from their terrestrial counterparts since most aquatic organisms are confined to watersheds as well as specific habitats. Since many species of amphibians and reptiles are partially or wholly dependent on aquatic habitats, distributions can sometimes be best understood and explained by examining aquatic subregions, ecological drainage units, and even individual watersheds.

The base map for major rivers and streams (page 12) shows locations of actual rivers and streams inside Missouri and just outside the state's borders where appropriate (USGS 1994; MDC 2007b). The watershed boundaries map (page 13) displays the maximum terrestrial boundary for major watersheds (NRCS 2002). Both of these maps are underlain with unique background colors to display Missouri's primary drainage systems: a) Mississippi River, b) Missouri River, c) Arkansas River, and d) White River.

Some species found in the state exhibit distributions that can be better understood by referring to these primary drainage systems. The ecological drainage units map (page 14) shows a somewhat consolidated view of the watersheds map based on those watersheds and other characteristics. It is underlain with unique background colors showing the three broad aquatic subregions in the state. Still more detailed aquatic region classifications are available but often include areas based on very small creeks and their watersheds and are therefore not included here.

Table 3. List of Aquatic Subregions and Ecological Drainage Units from MSDIS (2009a, 2009c). Each drainage unit is indicated with its primary drainage system: a) Mississippi River, b) Missouri River, c) Arkansas River, d) White River.

★ Central Plains Subregion

- ★ Blackwater / Lamine (b)
- ★ Cuivre / Salt (a)
- ★ Des Moines (a)
- ★ Grand / Chariton (b)
- ★ Kansas (b)
- ★ Nishnabotna / Platte (b)
- ★ Osage / South Grand (b)

★ Ozarks Subregion

★ Apple / Joachim (a)

★ Black / Current (d)

★ Gasconade (b)

★ Meramec (a)

★ Moreau / Loutre (b)

★ Osage (b)

★ Neosho (c)

★ Upper Saint Francis / Castor (a)

★ White (d)

★ Mississippi Alluvial Subregion

★ Black / Cache (a)

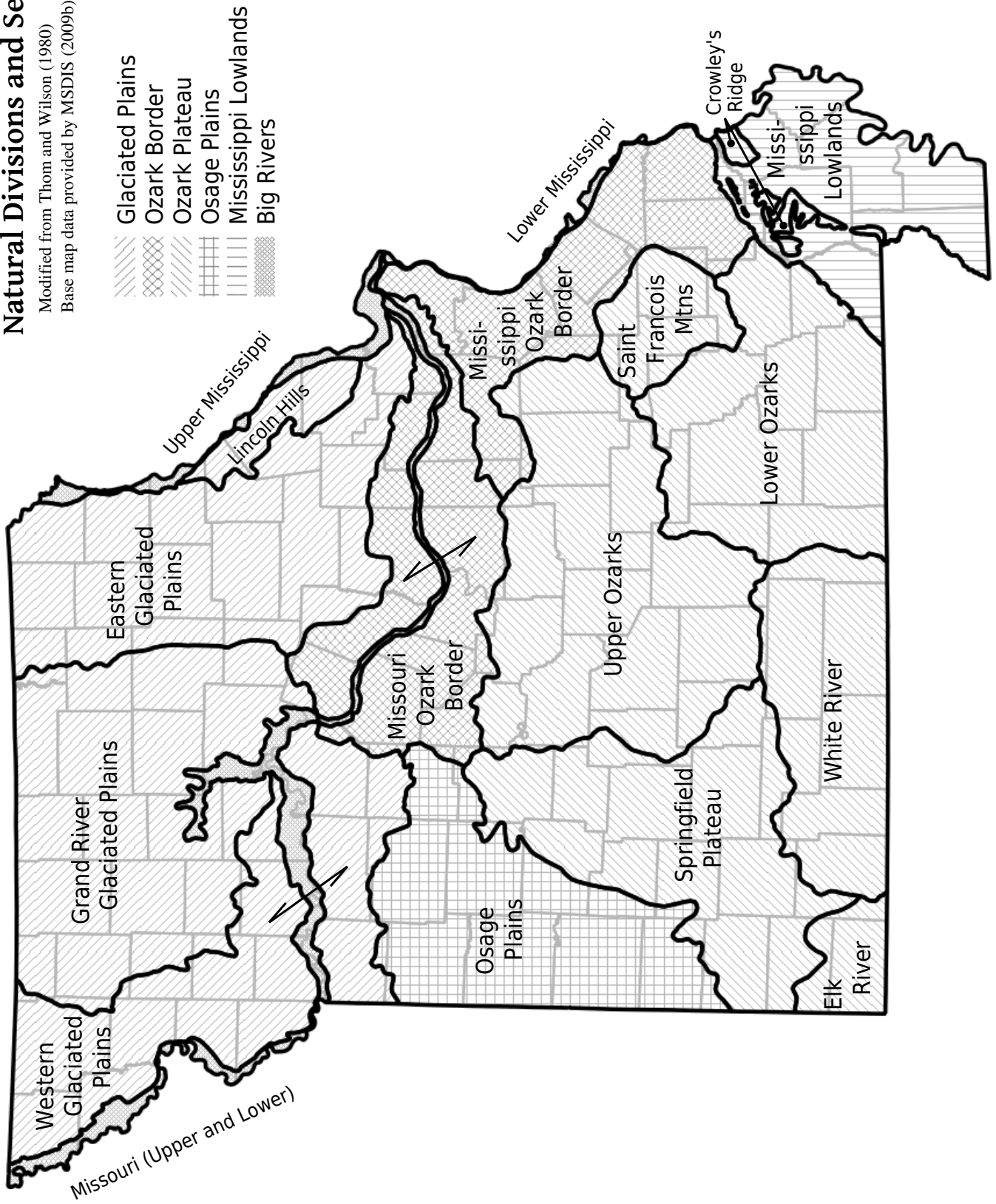
★ Saint Francis / Little (a)

★ Saint Johns Bayou (a)

Natural Divisions and Sections

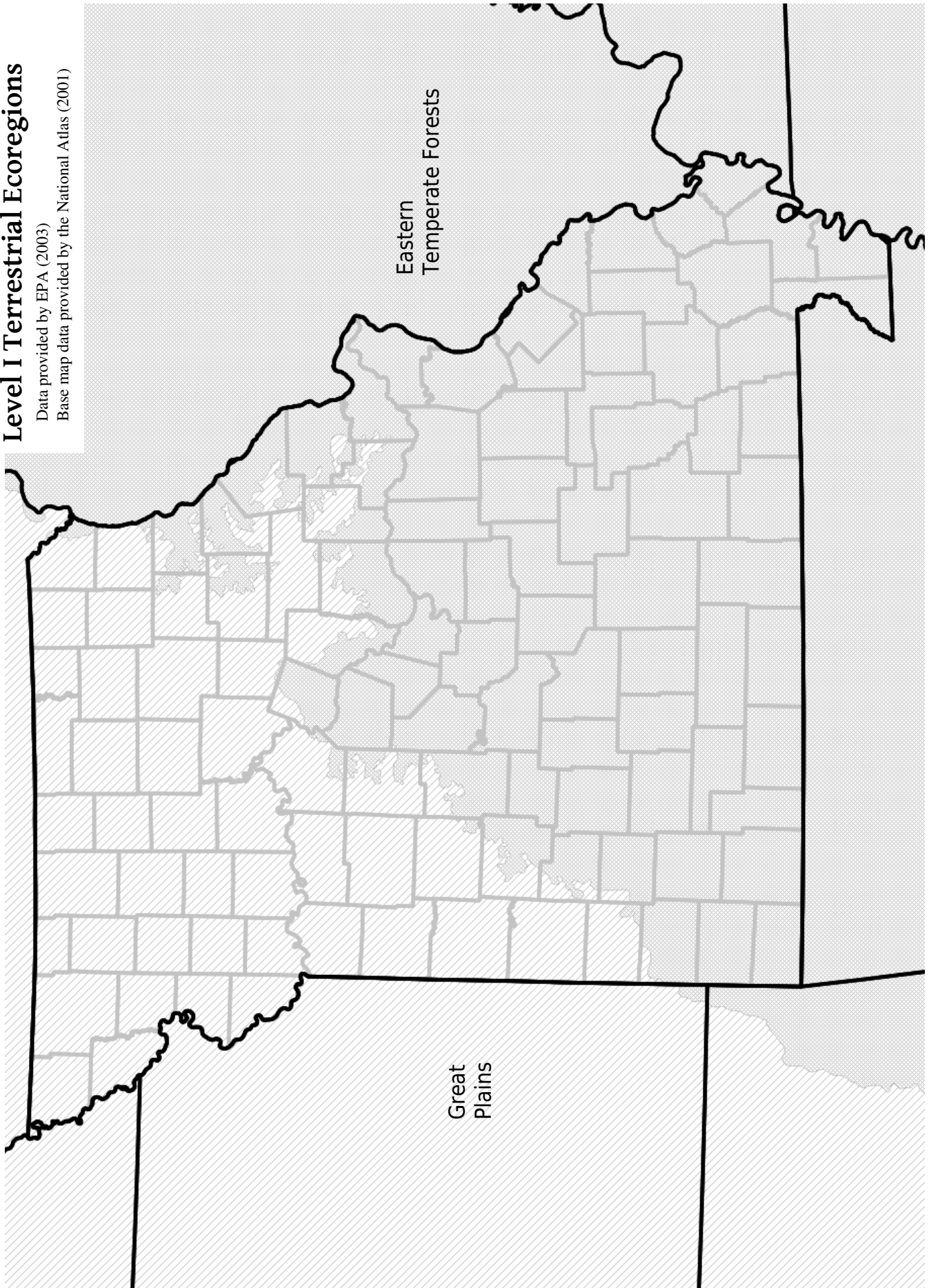
Modified from Thom and Wilson (1980)

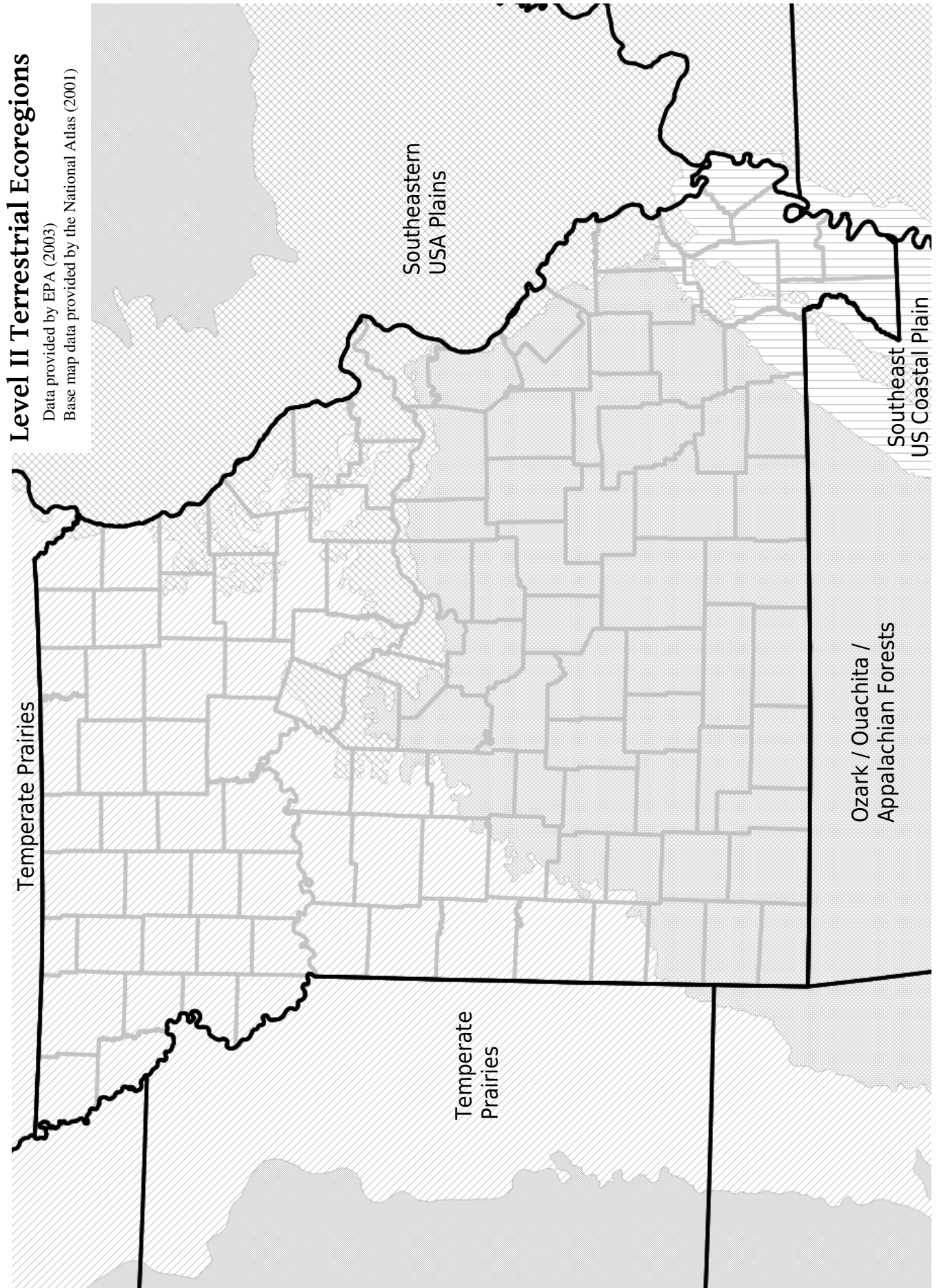
Base map data provided by MSDIS (2009b) and MDC (2007a)



Level I Terrestrial Ecoregions

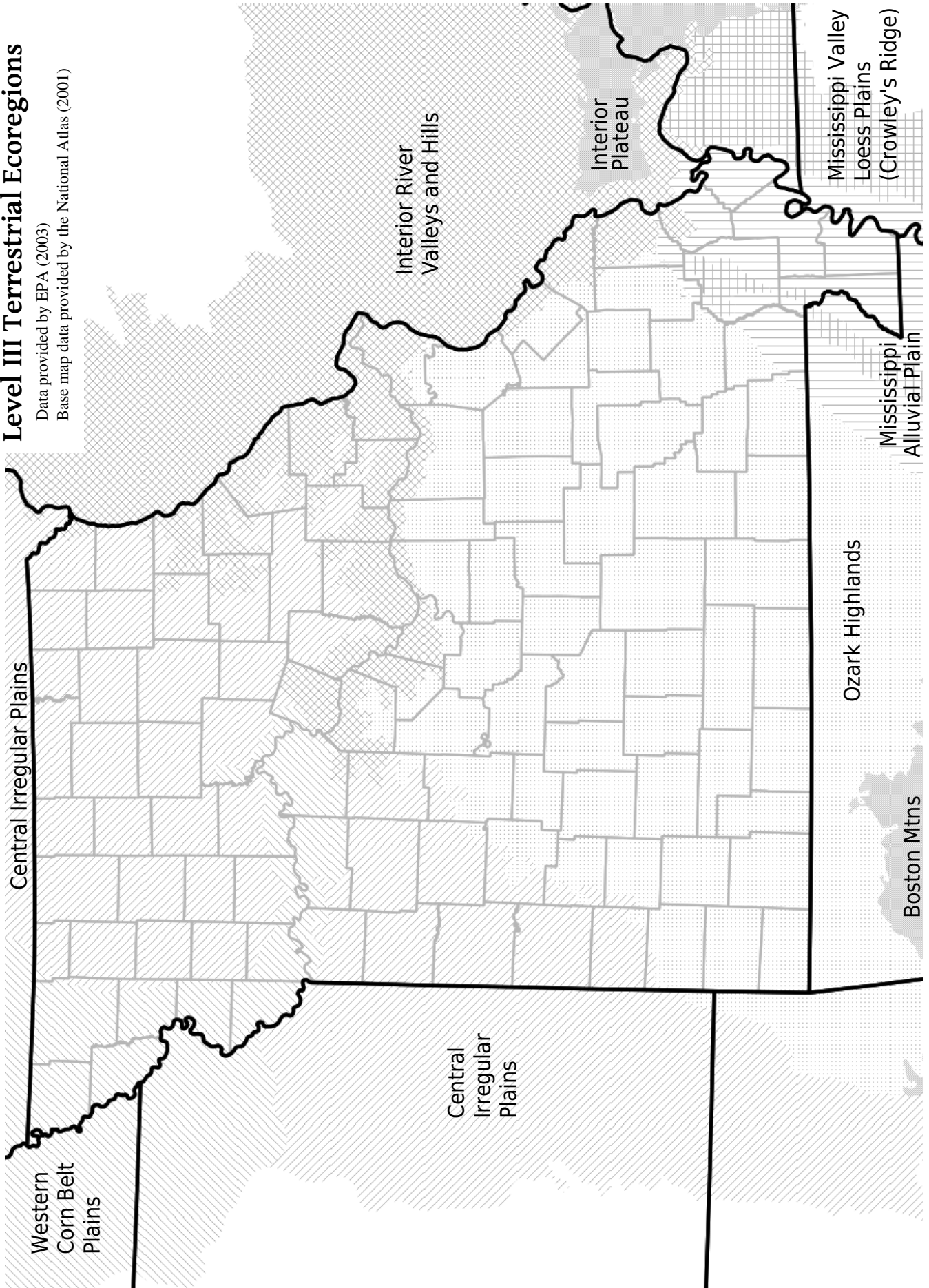
Data provided by EPA (2003)
Base map data provided by the National Atlas (2001)





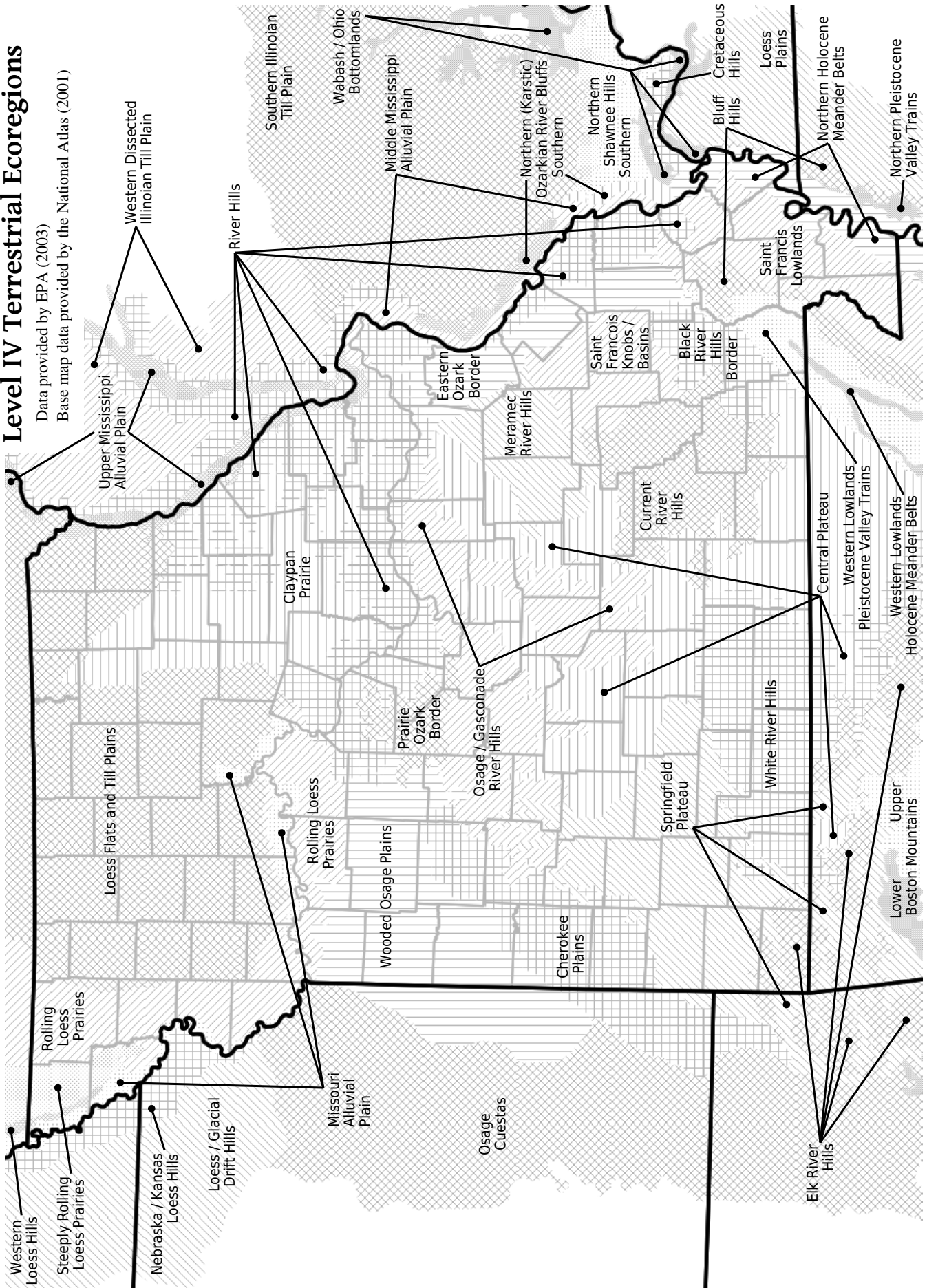
Level III Terrestrial Ecoregions

Data provided by EPA (2003)
Base map data provided by the National Atlas (2001)



Level IV Terrestrial Ecoregions

Data provided by EPA (2003)
Base map data provided by the National Atlas (2001)



Rivers and Major Streams

Data provided by USGS (1994) and MDC (2007b)
Base map data provided by MSDIS (2009b)

Mississippi River Watershed
Missouri River Watershed
White River Watershed
Arkansas River Watershed

