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KENTUCKY SNAKES: THEIR SYSTEMATICS, VARIATION, AND DISTRIBUTION

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ABSTRACT

This research, conducted between 1979 and 1989, was based primarily on data obtained from museum specimens and the literature. Information recorded for each specimen included data on selected morphometric, meristic, and observed characters. These data were used to prepare detailed descriptions for each species and subspecies. Distribution maps for all species and subspecies were developed from collection data, from literature records, and from additional data obtained from field notes and maps provided by John MacGregor.

Forty-two species and subspecies of snakes were documented for Kentucky. *Crotalus horridus atricaudatus* (canebrake rattlesnake) was not recognized as a distinct form and was relegated to the synonymy of *Crotalus horridus* (timber rattlesnake); Kentucky populations of *Storeria dekayi* (brown snake) were designated as *Storeria d. dekayi x wrightorum* intergrades; and Kentucky populations of *Elaphe obsoleta* (rat snake) were all considered to be *Elaphe o. obsoleta* (black rat snake), including those in the Western Coal Field and Jackson Purchase. Intergrade zones were also defined for nine other subspecies groups within the state. Previously published distribution maps were often found to be inaccurate, especially for those species occurring in the Bluegrass and Western Coal Field. These regions act as filter barriers and regulate the dispersal of snakes. Sexual dimorphism was also defined for all Kentucky species and subspecies.

INTRODUCTION

The snake fauna of Kentucky was ignored by many researchers during the 1800s and early 1900s. A lack of information about Kentucky snakes resulted from: (1) the failure of local collections to be reported and/or deposited in herpetological collections at colleges, universities or museums, and (2) an absence of detailed surveys in several regions of the state. The available literature also added to confusion about the occurrence and distribution of certain species and subspecies within Kentucky. Checklists prepared by Cope (1875, 1896, 1900), Garman (1894), Funkhouser (1925, 1945), Gilpin (1941), Wright and Wright (1952, 1957), and Barbour (1957) were incomplete and included species and subspecies of snakes that were erroneously listed as part of the Kentucky fauna. Several of these snakes were also listed for Kentucky by other researchers (Bailey 1933, Neel 1938, Smith 1950 and 1956, Jordan 1952, Schmidt 1953, Cook 1962, and Blair et al. 1968).

Later checklists were much more accurate. In 1958, Conant reported 42 species and subspecies of snakes for Kentucky. Collins (1964) listed 44 species and subspecies of snakes "known to occur in Kentucky." Snyder et al. (1967) added *Sistrurus miliarius streckeri* to the state checklist. Barbour (1971) listed 45 species and subspecies of snakes in his book on the Kentucky herpetofauna, and Conant (1975) recognized the same 45 forms.

The purpose of this study was to examine the systematics, variation, and distribution of Kentucky snakes. During the course of this research, I attempted to: (1) examine, define, and describe the systematic characters of all species and subspecies of Kentucky snakes; (2) describe variation in these snakes, with emphasis on sexual dimorphism; and (3) prepare distribution maps showing the known Kentucky range for each species and subspecies.

METHODS

This research, conducted between 1979 and 1989, was based on systematic and distribution data collected from preserved specimens and available literature. Specimens came from collections at Kentucky colleges and universities, collections at universities and museums outside of Kentucky, from private herpetological collections, and from field trips throughout various regions of the state.

Information recorded for each specimen included data on selected morphometric, meristic, and observed characters. Morphometric characters included total length, tail length, snout-vent length, snout-vent length/total length, and tail length/total length. Meristic characters included the number of dorsal scale rows, ventrals, caudals, scales in the anal plate, supralabials, infralabials, nasals, loreals, preoculars, postoculars, suboculars, temporals, internasals, prefrontals, dorsal (or lateral) blotches, and tail blotches. Observed characters included presence or absence of keeling on scales, presence or absence of apical stigmata, presence or absence of an apical notch, hemipenis size and structure, and body coloration.

Systematic data were used to prepare detailed descriptions for each species and subspecies. Each description included information on body size and proportions, scutellation, coloration, and hemipenis structure. Statistical analysis of data was used to compare specific characters for sexual dimorphism. Student's t test was used because of small sample sizes; means of all characters were compared at the .05 and .01 alpha levels.

Distribution maps were prepared for all species and subspecies of Kentucky snakes. Their distributions are shown in relation to county and physiographic boundaries. These maps were developed from collection data, literature records, and unpublished data obtained from private field notes and distribution maps.

RESULTS AND DISCUSSION

Forty-two species and subspecies of Kentucky snakes were documented for Kentucky (Appendix A) and defined with regard to their statewide distributions (Appendix B). *Crotalus horridus atricaudatus* was not included as a distinct form; it was relegated to the synonymy of *C. horridus* as suggested by Pisani et al. (1973). Kentucky populations of *Storeria dekayi* were designated as *S. d. dekayi x wrightorum* intergrades. Typical specimens of *S. d. dekayi* have 175 or fewer ventrals plus caudals,

and less than 10 dorsal crosslines; typical specimens of *S. d. wrightorum* have 176 or more ventrals plus caudals, and 10 or more crosslines (Conant 1938, 1975). Intergrades may be like *S. d. dekayi* with respect to either of these two characters, but will be like *S. d. wrightorum* regarding the other. Using these criteria, intergrades were found statewide, and in greater numbers than typical specimens of either subspecies. *Elaphe obsoleta spiloides* also was not included as part of the Kentucky fauna. Specimens from the Western Coal Field, western edge of the Mississippian Plateau, and Jackson Purchase occasionally had *spiloides*-like characteristics, but were not typical *E. o. spiloides*. They were often as dark as specimens of *E. o. obsoleta* from eastern Kentucky, and should be referred to as populations of *E. o. obsoleta*.

Intergradation was also documented for nine additional subspecies groups within the state. Intergrades between *Nerodia erythrogaster flavigaster* and *N. e. neglecta* were documented from throughout the Jackson Purchase, western edge of the Mississippian Plateau, and southwestern portion of the Western Coal Field. Many specimens were typical intergrades, often having bellies that were yellow anteriorly and orange posteriorly. *Nerodia s. sipedon* and *N. s. pleuralis* intergrades were discovered in a narrow zone from the western Bluegrass and northern arm of the Mississippian Plateau, southward and westward around the Western Coal Field to the Kentucky Lake region. *Diadophis punctatus edwardsii* and *D. p. stictogenys* intergrades were found in a narrow zone from the central and western Mississippian Plateau to the western edge of the Western Coal Field. *Carphophis a. amoenus* and *C. a. helenae* intergrades were observed over a much wider zone than indicated by Barbour (1971) and Conant (1975). This zone extends from the Cumberland Mountains to the Cumberland Plateau, southern Bluegrass, eastern and northern Mississippian Plateau, and western edge of the Western Coal Field. *Coluber c. constrictor* and *C. c. priapus* intergrades were discovered in a zone that extends from the western Bluegrass to the northern Mississippian Plateau. *Lampropeltis getula nigra* and *L. g. holbrooki* intergrades were seen only in extreme southwestern Kentucky (Carlisle and Fulton counties), and not the entire Jackson Purchase as indicated by Blaney (1971, 1977). Three forms of *Lampropeltis triangulum* were found in Kentucky, including *L. t. triangulum*, *L. t. syspila* and *L. t. elapsoides*. *Lampropeltis t. triangulum* and *L. t. elapsoides* were sympatric in eastern and central Kentucky without any evidence of intergradation. *Lampropeltis t. syspila* was found intergrading with *L. t. elapsoides* and *L. t. triangulum* in the Kentucky Lake region of western Kentucky; intergrades between it and *L. t. triangulum* also were observed from the western Bluegrass, northern arm of the Mississippian Plateau, and eastern edge of the Western Coal Field. *Agkistrodon c. contortrix* and *A. c. mokasen* intergrades were seen from across the Land Between The Lakes (LBL) region and adjacent Jackson Purchase. Typical specimens of *A. c. contortrix* were observed in extreme southwestern Kentucky. *Virginia v. valeriae* and *V. v. elegans* were allopatric in Kentucky, thus no intergrades from the state were observed. However, they possibly occur together in the vicinity of Metcalfe County.

Most available range maps did not accurately show the distribution of many Kentucky snakes. This was particularly true for species and subspecies occurring in the Bluegrass and Western Coal Field. Both regions act as filter barriers that regulate the dispersal of snakes. This study helped to clarify the distributions of many of these forms. Several species and subspecies of the Kentucky snake fauna were shown to have colonized peripheral regions of the Bluegrass. *Virginia v. valeriae* was found at both the northern and eastern edges of the Bluegrass; *Elaphe g. guttata* frequented the eastern edge; *N. e. neglecta*, *V. v. elegans*, *C. c. priapus*, *Lampropeltis c. calligaster*, and *Tantilla coronata* occurred at the western edge; *Clonophis kirtlandii* occurred at both the northern and western edges; *S. d. dekayi x wrightorum*, *Storeria o. occipitomaculata*; *Cemophora coccinea copei*, and *C. horridus* encircled the Bluegrass. Kentucky snakes which have reached the Bluegrass, but have not colonized the entire region, included *Thamnophis s. sauritus*, *D. p. edwardsii*, *C. a. amoenus*, *C. a. helenae*, *L. g. nigra*, *L. t. elapsoides*, and *A. c. mokasen*. These snakes may have successfully entered the Bluegrass along the Kentucky River and Licking River drainages.

Kentucky snakes that have colonized peripheral areas of the Western Coal Field included *N. e. flavigaster*, *N. s. sipedon*, *Regina septemvittata*, *S. d. dekayi x wrightorum*, *V. v. elegans*, *D. p. edwardsii*, *D. p. stictogenys*, *C. a. amoenus*, *C. a. helenae*, *Masticophis f. flagellum*, *E. g. guttata*, *Pituophis m. melanoleucus*, *L. t. triangulum*, *L. t. elapsoides*, *L. c. calligaster*, *C. c. copei*, and *T. coronata*. Forms known from scattered records included *C. kirtlandii*, *T. s. sauritus*, and *L. t. syspila*. Others have reached the Western Coal Field, but showed a limited dispersal across this region. *Storeria o. occipitomaculata* frequented eastern and southern portions of the Western Coal Field; *Nerodia r. rhombifer* and *Farancia abacura reinwardtii* were found in western portions; *N. e. neglecta* and *Agkistrodon piscivorus leucostoma* occurred in western and central portions.

Of the 42 forms of Kentucky snakes, only four were found statewide and included *Thamnophis s. sirtalis*, *Heterodon platirhinos*, *Opheodrys aestivus*, and *E. o. obsoleta*. These forms probably occur in every county. Five additional forms were found throughout most regions of the state and included *S. d. dekayi x wrightorum*, *S. o. occipitomaculata*, *C. a. helenae*, *L. g. nigra*, and *C. horridus*. Four snakes were restricted to the Jackson Purchase and included *Nerodia cyclopion*, *N. fasciata confluens*, *Thamnophis p. proximus*, and *L. g. holbrooki*. *Sistrurus m. streckeri* was found in the southeastern corner of the Jackson Purchase and adjacent LBL region of Trigg County; *A. c. contortrix* frequented the southern edge of the Jackson Purchase and LBL region of Trigg County. Five snakes were found occurring in the Jackson Purchase, Mississippian Plateau, and Western Coal Field, and included *N. r. rhombifer*, *N. e. flavigaster*, *F. a. reinwardtii*, *D. p. stictogenys*, and *A. p. leucostoma*. Eight snakes found in the Jackson Purchase ranged eastward to the Bluegrass; these included *N. e. neglecta*, *N. s. pleuralis*, *T. s. sauritus*, *V. v. elegans*, *C. c. priapus*, *L. t. syspila*, *L. c. calligaster*, and *T. coronata*. Four snakes found in eastern Kentucky ranged westward to the Western Coal Field, western Mississippian Plateau, and LBL; these included *N. s. sipedon*, *D. p. edwardsii*, *L. t. elapsoides*, and *A. c. mokasen*. *Carphophis a. amoenus*, *C. c. constrictor*, and *L. t. triangulum* were found in eastern and central Kentucky, and westward to the eastern edge of the Western Coal Field. *Clonophis kirtlandii*, *P. m. melanoleucus*, and *C. c. copei* were documented by scattered records. *Virginia v. valeriae* was limited to eastern Kentucky.

Masticophis f. flagellum and *E. g. guttata* are probably represented in Kentucky by glacial relict populations. *Masticophis f. flagellum* has been collected in the Mammoth Cave region at the periphery of the Western Coal Field and Mississippian Plateau (Collins and Hirschfeld 1971, Barbour 1971). *Elaphe g. guttata* occurs in the Red River Gorge and Mammoth Cave regions (Barbour 1971). It is possible that the Kentucky populations of *M. f. flagellum* may have resulted from escaped specimens, and since there have been no recent sightings, this species may be extinct in the state. *Regina septemvittata* was found in the Bluegrass and eastern Mississippian Plateau, but was absent from much of eastern and western Kentucky. It was documented also from the Ohio River drainage in the northern arm of the Mississippian Plateau and northeastern Western Coal Field, the Cumberland River drainage in the southeastern Cumberland Plateau, and the Big Sandy River drainage at the eastern edge of the state.

With respect to sexual dimorphism, several trends were noticed in

Kentucky snakes. Total length was significantly different between males and females in 25.6% of snakes examined. Males reached greater lengths in *L. g. nigra*, *A. c. contortrix*, *A. c. mokasen*, *A. p. leucostoma*, and *C. horridus*. Females reached greater lengths in *N. cyclopion*, *T. s. sirtalis*, *S. d. dekayi x wrightorum*, *T. coronata*, and *C. c. copei*. Tail length/total length and snout-vent length/total length were significantly different between males and females in 82.1% of all Kentucky snakes examined. Tail length/total length was almost always greater in males and snout-vent length/total length was usually greater in females. Exceptions to this rule included *C. c. constrictor*, *C. c. priapus*, *L. t. triangulum*, *L. t. syspila*, *A. c. contortrix*, *A. c. mokasen*, and *A. p. leucostoma*.

The number of caudals was significantly different between males and females in 100% of Kentucky snakes, with males always having a greater number. The number of entire caudals was also significantly different between the sexes in all viperids, with males always having a greater number. The number of ventrals was significantly different between the sexes in 61.5% of Kentucky snakes. Males had a greater number of ventrals in *N. r. rhombifer*, *R. septemvittata*, and *T. s. sirtalis*; females had a greater number of ventrals in *C. kirtlandii*, *S. d. dekayi x wrightorum*, *S. o. occipitomaculata*, *V. v. valeriae*, *V. v. elegans*, *H. platirhinos*, *F. a. reinwardtii*, *C. a. amoenus*, *C. a. helenae*, *D. p. edwardsii*, *D. p. stictogenys*, *T. coronata*, *C. c. constrictor*, *C. c. priapus*, *O. aestivus*, *E. g. guttata*, *E. o. obsoleta*, *P. m. melanoleucus*, *L. c. calligaster*, *C. horridus*, and *S. m. streckeri*. The number of tail blotches was significantly different between males and females in 23.1% of Kentucky snakes, with males having a greater number in *N. cyclopion*, *N. r. rhombifer*, *N. s. sipedon*, *N. s. pleuralis*, *H. platirhinos*, *F. a. reinwardtii*, *E. g. guttata*, *E. o. obsoleta*, and *L. c. calligaster*. The number of dorsal (or lateral) blotches on the body was also significantly different between males and females in 12.8% of Kentucky snakes, with males having a greater number in *E. g. guttata*, *L. t. triangulum*, and *L. t. syspila* and females having a greater number in *F. a. reinwardtii* and *P. m. melanoleucus*. Neck ring width was significantly greater in males of *D. p. edwardsii* and *D. p. stictogenys*, and number of ventrals minus caudals was greater in females.

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APPENDIX A

CHECKLIST OF KENTUCKY SNAKES

The following checklist of Kentucky snakes (Order Squamata, Suborder Serpentes) includes 42 species and subspecies; 37 of these are colubrids (Family Colubridae) and five are pit vipers (Family Viperidae, Subfamily Crotalinae). Scientific names and common names are those given by Collins (1990).

FAMILY COLUBRIDAE

Subfamily Natricinae

- *Nerodia cyclopion* (Mississippi green water snake)
- *N. r. rhombifer* (diamondback water snake)
- *N. erythrogaster flavigaster* (yellowbelly water snake)
- *N. e. neglecta* (copperbelly water snake)
- *N. s. sipedon* (northern water snake)
- *N. s. pleuralis* (midland water snake)
- *N. fasciata confluens* (broad-banded water snake)
- *Regina septemvittata* (queen snake)
- *Clonophis kirtlandii* (Kirtland's snake)
- *Storeria d. dekayi x S. d. wrightorum* (northern x midland brown snake)
- *S. o. occipitomaculata* (northern redbelly snake)
- *Thamnophis s. sirtalis* (eastern garter snake)
- *T. s. sauritus* (eastern ribbon snake)
- *T. p. proximus* (western ribbon snake)
- *Virginia v. valeriae* (eastern earth snake)
- *V. v. elegans* (western earth snake)

Subfamily Xenodontinae

- *Farancia abacura reinwardtii* (western mud snake)
- *Heterodon platirhinos* (eastern hognose snake)
- *Diadophis punctatus edwardsii* (northern ringneck snake)
- *D. p. stictogenys* (Mississippi ringneck snake)
- *Carphophis a. amoenus* (eastern worm snake)
- *C. a. helenae* (midwest worm snake)
- *Tantilla coronata* (southeastern crowned snake)

Subfamily Colubrinae

- *Coluber c. constrictor* (northern black racer)
- *C. c. priapus* (southern black racer)
- *Masticophis f. flagellum* (eastern coachwhip)
- *Opheodrys aestivus* (rough green snake)
- *Elaphe g. guttata* (corn snake)
- *E. o. obsoleta* (black rat snake)
- *Pituophis m. melanoleucus* (northern pine snake)
- *Lampropeltis getula nigra* (black kingsnake)
- *L. g. holbrooki* (speckled kingsnake)
- *L. t. triangulum* (eastern milk snake)
- *L. t. syspila* (red milk snake)
- *L. t. elapsoides* (scarlet kingsnake)
- *L. c. calligaster* (prairie kingsnake)
- *Cemophora coccinea copei* (northern scarlet snake)

FAMILY VIPERIDAE

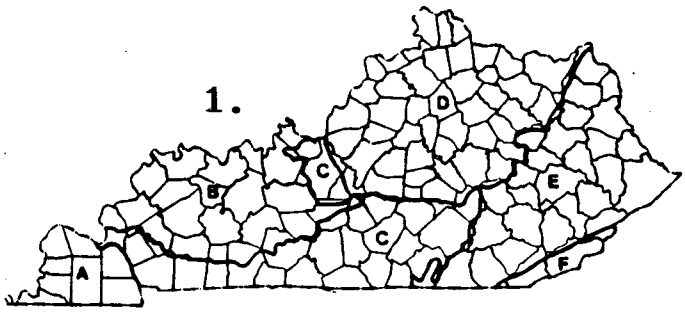
Subfamily Crotalinae

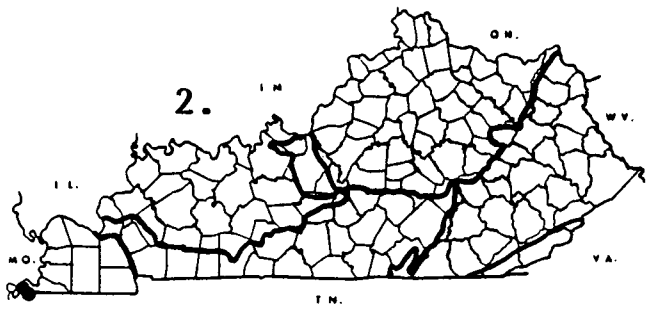
- *Agkistrodon c. contortrix* (southern copperhead)
- *A. c. mokasen* (northern copperhead)
- *A. piscivorus leucostoma* (western cottonmouth)
- *Crotalus horridus* (timber rattlesnake)
- *Sistrurus miliarius streckeri* (western pigmy rattlesnake)

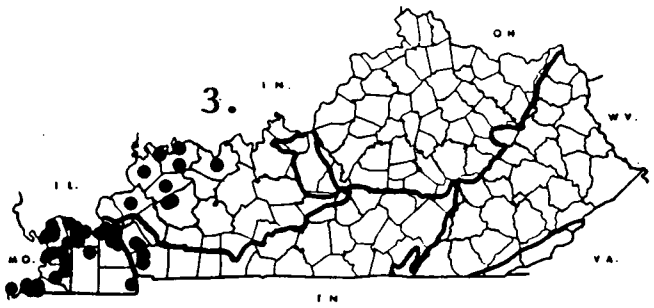
APPENDIX B

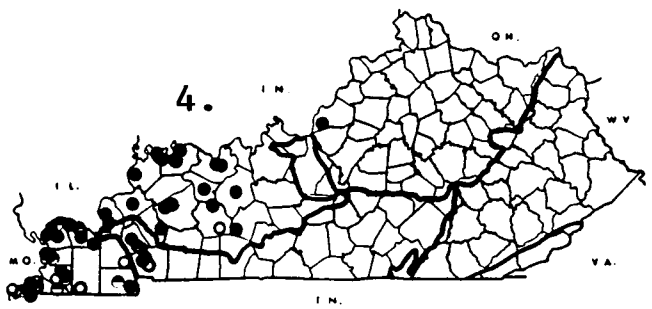
KEY TO DISTRIBUTION MAPS OF KENTUCKY SNAKES

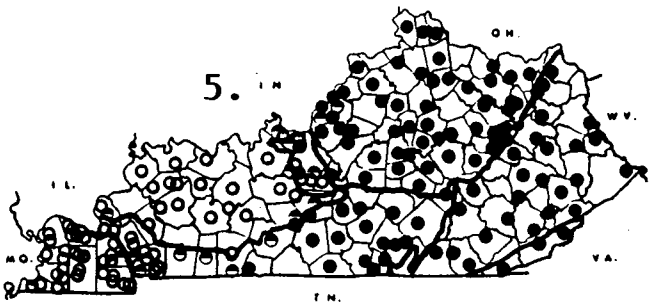
1. Kentucky's physiographic regions: A. Jackson Purchase, B. Western Coal Field, C. Mississippian Plateau, D. Bluegrass, E. Cumberland Plateau, F. Cumberland Mountains.
2. *Nerodia cyclopion*
3. *Nerodia r. rhombifer*
4. *Nerodia erythrogaster flavigaster* (open circles), *N. e. neglecta* (solid circles), and intergrades (half circles).
5. *Nerodia s. sipedon* (solid circles), *N. s. pleuralis* (open circles), and intergrades (half circles).
6. *Nerodia fasciata confluens*
7. *Regina septemvittata*
8. *Clonophis kirtlandii*
9. *Storeria d. dekayi x S. d. wrightorum*
10. *Storeria o. occipitomaculata*
11. *Thamnophis s. sirtalis*
12. *Thamnophis s. sauritus*
13. *Thamnophis p. proximus*
14. *Virginia v. valeriae* (solid circles) and *V. v. elegans* (open circles).
15. *Farancia abacura reinwardtii*
16. *Heterodon platirhinos*
17. *Diadophis punctatus edwardsii* (solid circles), *D. p. stictogenys* (open circles), and intergrades (half circles).
18. *Carphophis a. amoenus* (solid circles), *C. a. helenae* (open circles), and intergrades (half circles).
19. *Tantilla coronata*
20. *Coluber c. constrictor* (solid circles), *C. c. priapus* (open circles), and intergrades (half circles).
21. *Masticophis f. flagellum*
22. *Opheodrys aestivus*
23. *Elaphe g. guttata*
24. *Elaphe o. obsoleta*
25. *Pituophis m. melanoleucus*
26. *Lampropeltis getula nigra* (solid circles), *L. g. holbrooki* (open circles), and intergrades (half circles).
27. *Lampropeltis t. triangulum* (solid circles), *L. t. syspila* (open circles), *L. t. elapsoides* (hexagons), and intergrades (half circles).
28. *Lampropeltis c. calligaster*
29. *Cemophora coccinea copei*
30. *Agkistrodon c. contortrix* (open circles), *A. c. mokasen* (solid circles), and intergrades (half circles).
31. *Agkistrodon piscivorus leucostoma*
32. *Crotalus horridus*
33. *Sistrurus miliarius streckeri*

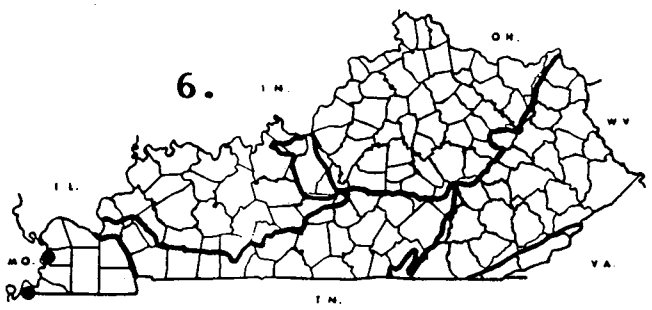


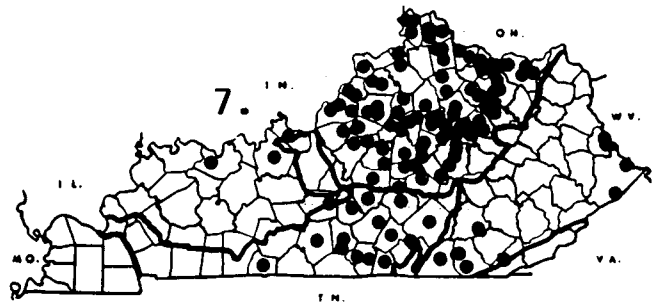








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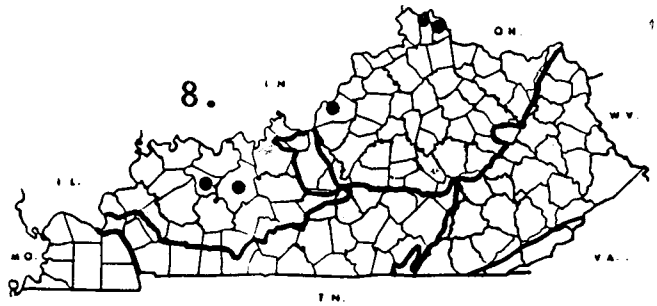
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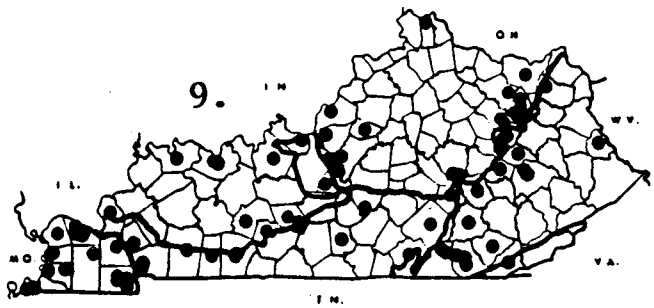
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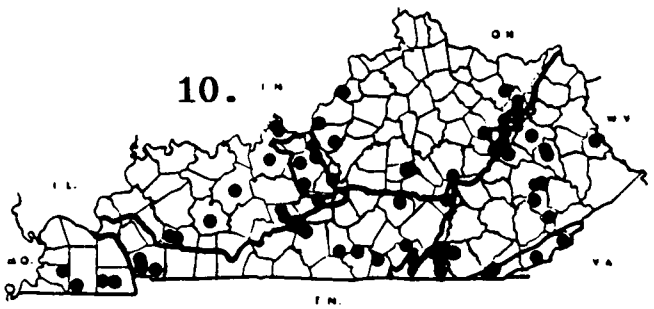
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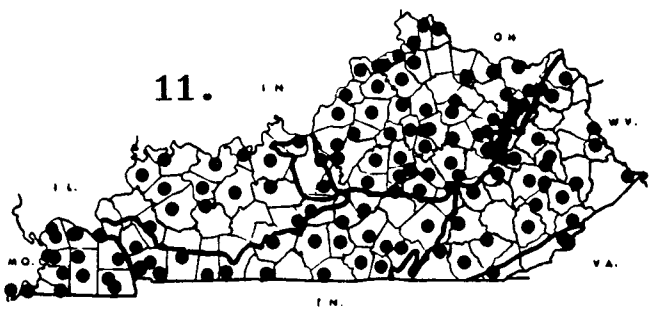
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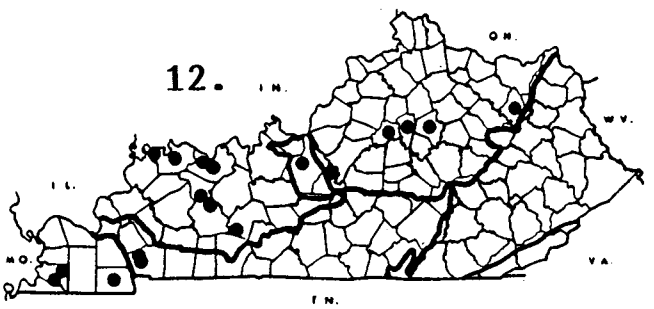
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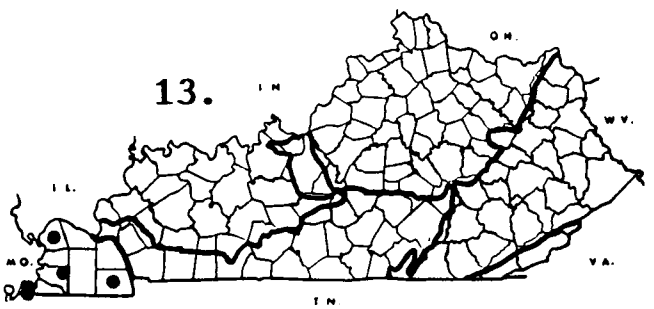
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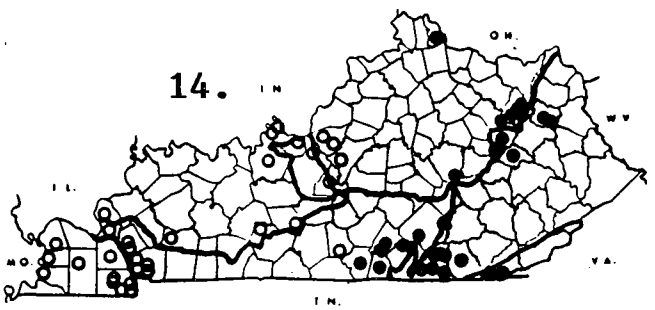
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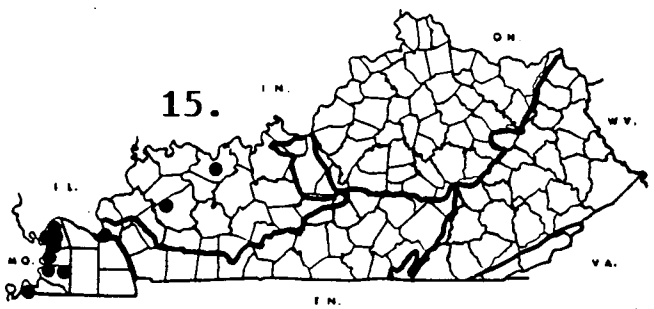
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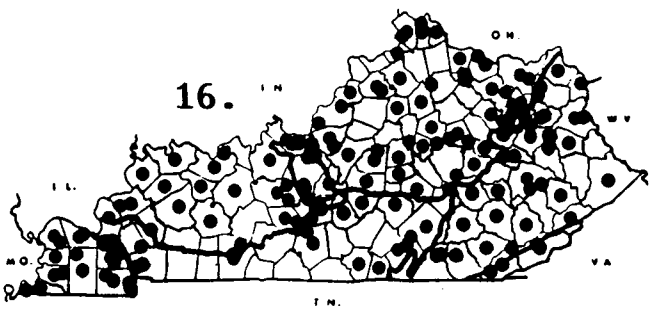
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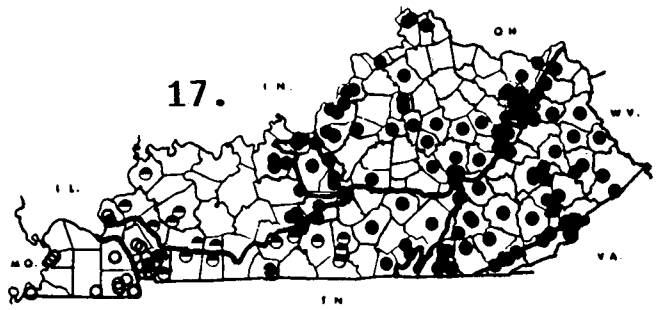
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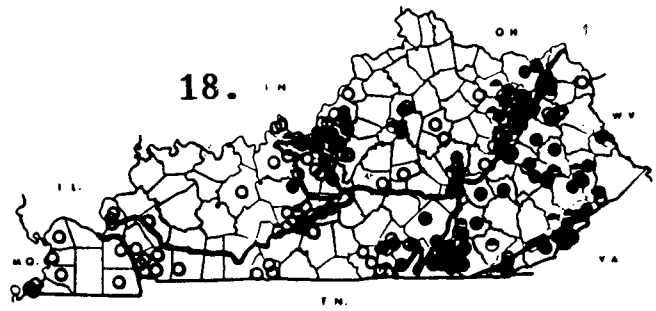
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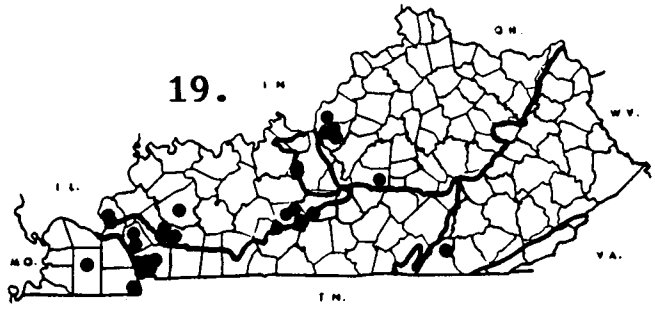
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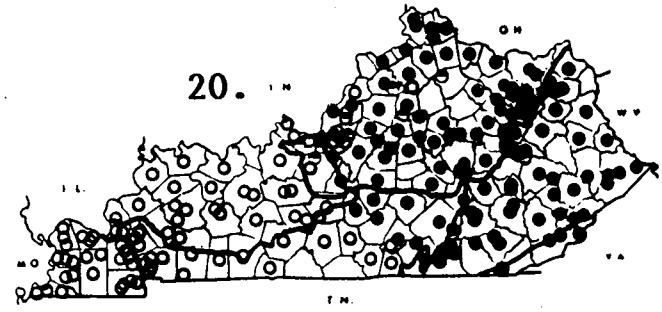
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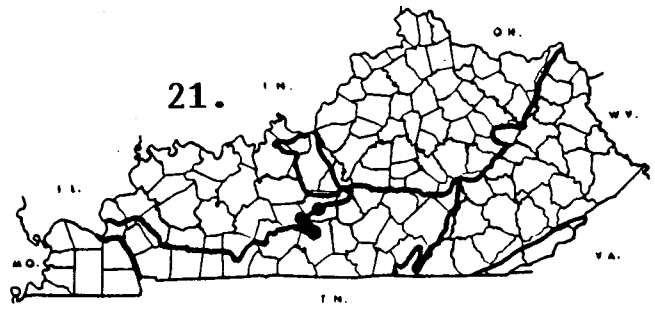
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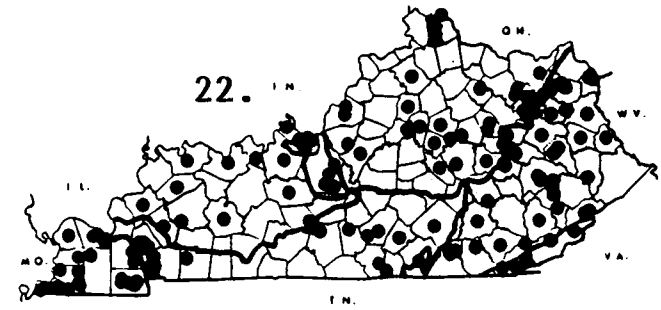
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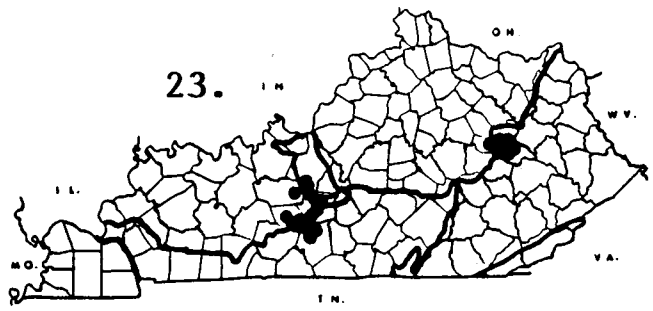
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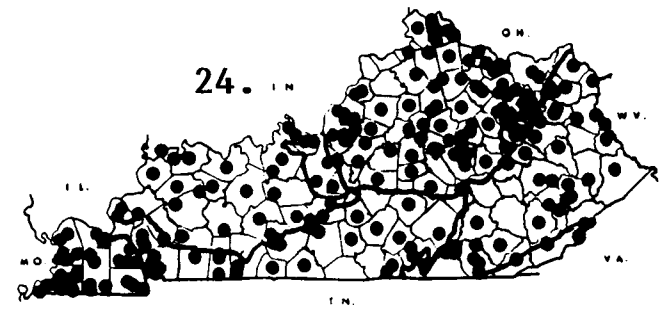
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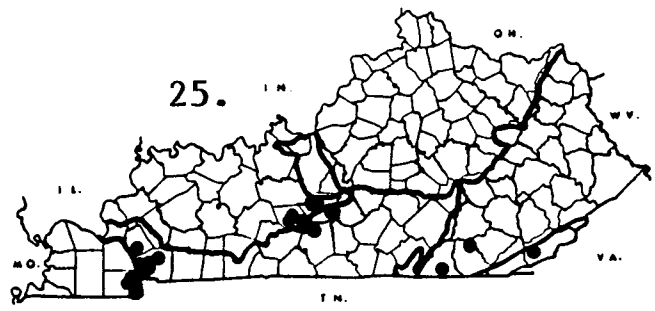
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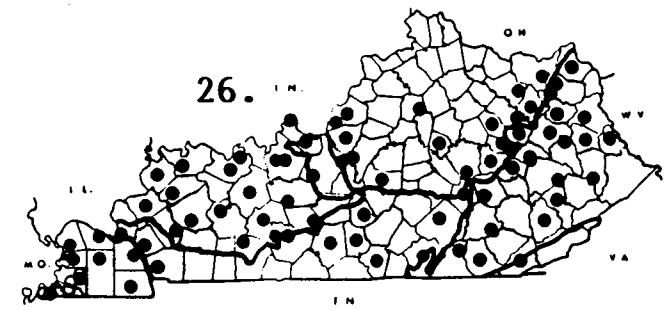
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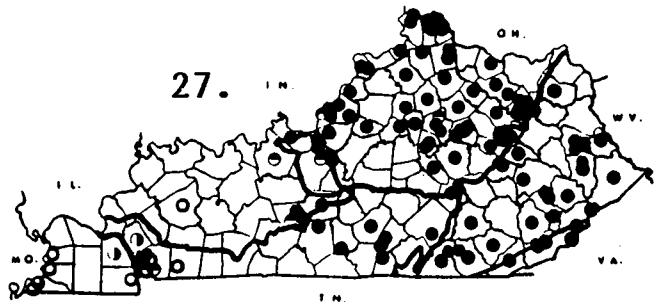

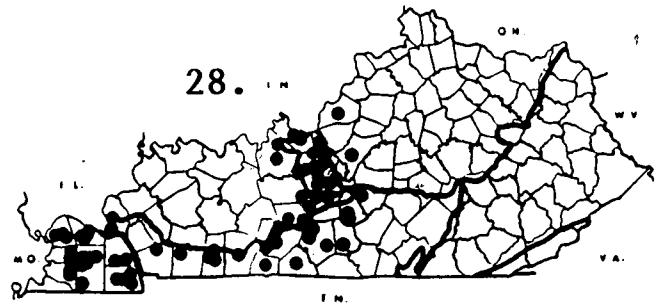

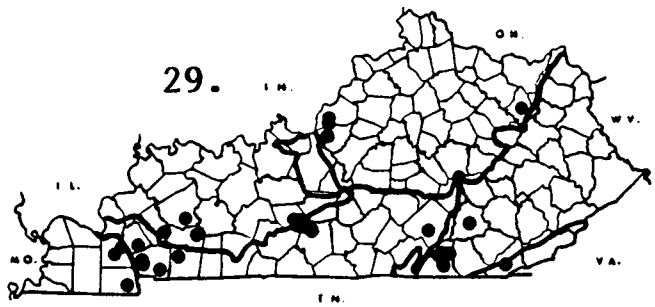

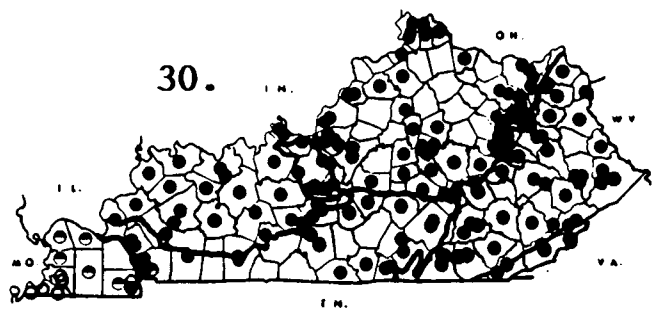

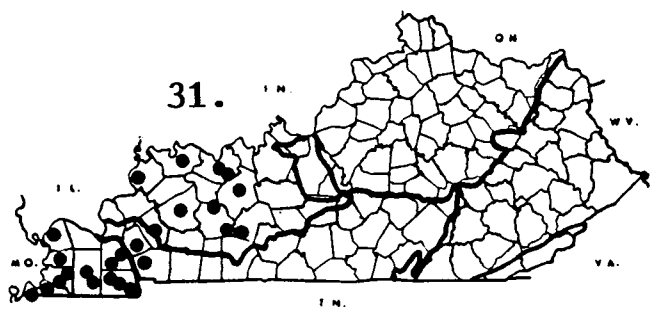

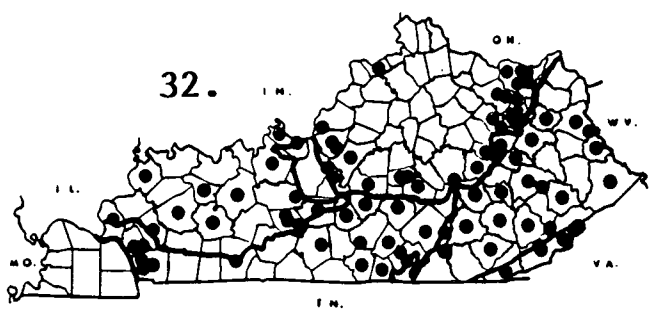

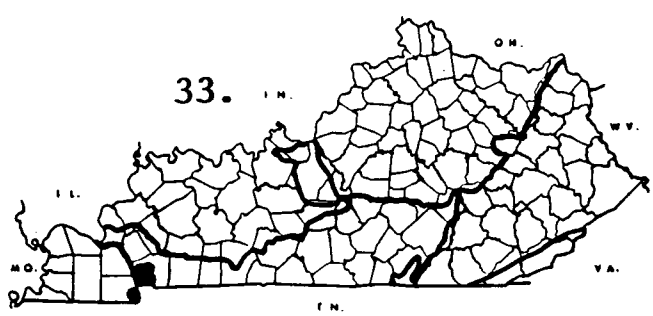

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