

Geographic Variation, Status, and Distribution of Kirtland's Snake (*Clonophis kirtlandii* Kennicott) in Illinois

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ABSTRACT

Kirtland's snake, *Clonophis kirtlandii* (Kennicott, 1856), shows slight geographic variation in head scutellation and dorsal blotch number in Illinois. Although significant differences in mean number of supralabials, postoculars, anterior temporals, and lateral blotches exist between northern and southern populations, results of Principal Components Analysis does not suggest more than a single taxon in Illinois. Original wet prairie habitat of *C. kirtlandii* is virtually nonexistent in Illinois and most remaining populations are isolated remnants in greatly disturbed habitats. A survey was conducted at 33 sites, 27 of them in southern and western Illinois and the remainder in northeastern Illinois. One new population was found in Fulton County. Of the 70 localities represented by literature reports, museum specimens, and anecdotal reports, there is evidence that only eight currently support reproducing populations. Requirements include crayfish burrows in open areas that are prone to seasonal flooding. Intensive, long-term surveys are recommended to determine whether any additional populations of *C. kirtlandii* exist. Pending results of further investigation, *C. kirtlandii* should be listed as threatened in Illinois.

INTRODUCTION

Kirtland's snake, *Clonophis kirtlandii*, is a poorly known, fossorial colubrid endemic to the midwestern USA. It was described as *Regina kirtlandii*, by Kennicott (1856), from specimens collected in West Northfield, Cook County, Illinois. Detailed morphological descriptions appear in Conant (1938, 1943), Rossman and Powell (1985), and Ernst and Barbour (1989).

Information on the life history of *C. kirtlandii* is scant. Reported food items are mainly soft-bodied invertebrates such as earthworms, slugs, and leeches (Atkinson, 1901; Conant, 1938; Minton, 1944; Tucker, 1977) but recently water striders (Thurow, 1993), and crayfish (Bavetz, 1993) have been documented.

The original habitat of *C. kirtlandii* consisted of wet prairies, wet meadows, prairie fens, and associated wetlands, (Conant, 1943) most of which have long since been drained and

converted to agriculture (Reichenbach and Dalrymple, 1981). Present habitat consists mainly of open low grassy areas at the margins of either creeks, ponds or ditches (Minton, 1972; Ernst and Barbour, 1989; this study). Populations at the periphery of the range occur in relatively open woods while those in the core are more commonly found in urban or floodplain habitats (Wilsmann and Sellers, 1988; Conant, 1943; Minton, 1972).

At present, *C. kirtlandii* is listed as endangered in Kentucky (Warren et al., 1986) and Michigan (Holman et al., 1989), and as "status undetermined" in Pennsylvania (Genoways and Brenner, 1985). It presently may be appropriate for federal listing as endangered or threatened but more information is needed to determine its status and vulnerability (category 2 species, U. S. Fish and Wildlife Service, Dodd et al., 1985). Most known populations persist in either urban or other disturbed habitats and consequently are vulnerable to extirpation (Conant, 1938; McCoy, 1982). Many of these populations have been either declining or are extirpated (Garman, 1892; Minton et al., 1983; Wilsmann and Sellers, 1988).

After Kennicott's original description in 1856, *Clonophis kirtlandii* was subsequently found in Champaign-Urbana and Bloomington-Normal in the late 1800's. Specimens were presented to the British Museum in 1893 (C. McCarthey pers. comm.) by professor S. A. Forbes (Boulenger, 1896). By 1945, *C. kirtlandii* was known from several additional areas in or near Chicago and from Coles, DuPage, and Piatt counties (Hankinson, 1917; Schmidt and Necker, 1935, Pope, 1944).

Smith (1961) provided a map with all documented localities and several new ones that were discovered in the years 1948-57. Many populations have been reported or documented since Smith's work and the range has been extended considerably to the west and south (Brown, 1987; Brown et al., 1975; Clark, 1961; Moll, 1962; Holman and Arai, 1962; Morris, 1975; Munyer and Parmalee, 1967; Papiernik and Dundek, 1988; Tucker et al., 1977; Webb, 1985).

The objectives of this study were: (1) to attempt to determine the present status and distribution of *C. kirtlandii* in Illinois by searching for populations in the field, contacting individuals who have knowledge of extant populations or have observed snakes in the field, and compiling a bibliography and list of museum specimens; (2) to examine and describe the habitat of extant Illinois populations; and (3) determine if geographic variation exists in Illinois by collecting and analyzing morphological data.

MATERIALS AND METHODS

Specific localities were determined from the literature, museum specimens, Illinois Department of Conservation (IDOC) records, and from several people who sent photographs or reported seeing *C. kirtlandii* in Illinois.

Sites were classified according to their reliability. "Confirmed" sites are based on photographic slides or voucher specimens. Unconfirmed sites were classified as either "reported" or "anecdotal." Reported sites included those mentioned in the literature but for which no voucher specimen exists. Anecdotal sites are documented by neither voucher

specimens nor publications but were reported to me or to the IDOC by various individuals.

Restrictions on time, logistics, and funding made a limited survey on the lesser known localities in southern and western Illinois more feasible than a statewide survey. Most central and northern Illinois sites are well monitored by the IDOC. Between June 1991 and May, 1993, 33 locations were surveyed. Nineteen were confirmed or unconfirmed sites. The remainder were in the vicinity of a site and contained habitat that appeared suitable. Suitable habitat was taken to be pond, lake, and creek margins in the immediate vicinity of open areas or mowed grass. All of the sites examined appeared prone to immersion from seasonal flooding and contained active crayfish burrows (chimneys present). The searches were conducted by turning over cover and debris, especially along the water's edge, and inspecting the ground near crayfish burrows.

Specimens Examined

An effort was made to locate all Illinois specimens. Data were recorded from two live specimens and from 82 museum specimens from the following institutions: British Museum (Natural History) Department of Zoology (BMNH), Chicago Academy of Sciences (CA), Field Museum of Natural History (FMNH), Illinois Natural History Survey (INHS), Harvard University Museum of Comparative Zoology (MCZ), Illinois State Museum (ISM), Illinois State University (ISU), Louisiana State University Museum of Zoology (LSUMZ), National Museum of Natural History (USNM), Southern Illinois University (Carbondale) University Museum (SIUC), University of Illinois Museum of Natural History (UIMNH), University of Michigan Museum of Zoology (UMMZ). The following Illinois sites are confirmed by the associated specimens: Adams County: 1.5 miles [1.9 km] N Quincy (UIMNH 51001); Champaign County: Urbana (INHS 1361, 1363, 1364, ISM 621782); Champaign (INHS 1362); 2.0 miles [3.2 km] S Fisher (INHS 7830); 2 miles [3.2 km] W Seymour (UIMNH 52104) Christian County: Lake Sangchris East Boat Dock (ISM 691223); Coles County: Charleston (INHS 1930, 1931, 2048, 6426); Cook County: West Northfield (UMMZ 43928); Gross Point, Evanston (FMNH 2989, 16126); Chicago Ridge (FMNH 2975, 16127, UMMZ 58609); River Forest near Trailside Museum. (FMNH 25436-25437); 103rd and Central, Chicago Ridge (FMNH 17610); 103rd and Western (CAS 1342); Palos Park (FMNH 23166); Chicago, West Side (CAS 3862); School and Odell (FMNH 154908, 154909); Outside Willow Springs (FMNH 154910) Chicago (CA 16906); 1 mile [1.6 km] S Willow Springs (CA 13713); Oak Lawn (FMNH 83037) Saganashkee Slough (ISM 622042); Carlé Woods (INHS 10748); Orland Park (SIUC R-2367); DeWitt County: 3 miles [4.8 km] E Clinton (INHS 9087); Douglas County: Chesterville (INHS 2049, 2754); Villa Grove (INHS 8139, 10231, 10261); DuPage County: Westmont (FMNH 38063); Effingham County: Henrietta Street and Fayette Avenue, Effingham. (INHS 3544, UMMZ 200586); Fayette County: 1.5 miles [2.4 km] N Ramsey (ISU 5); Fulton County: Sumnum (SIUC R-2366); Macon County: Decatur (INHS 9088); McLean County: Normal (BMNH 93.1.2.1, 93.1.2.2, UIMNH 4962); Lake Dawson, Moraine View State Park (ISU T703); Piatt County: White Heath (INHS 9007); Sangamon River bottoms near Monticello (UIMNH 2170); 2 miles [3.2 km] E Lodge (INHS 6684, 6779) Sangamon County: Lake Springfield, 6 miles [9.6 km] S Springfield (ISM 621866); Lake Springfield (ISM 622096, 622267); Pond at entrance to Lake Sangchris State Park (SIUC R-2368); Lake Springfield Wildlife Sanctuary (ISM 620543); Schuyler County:

Camp Emmanuel (INHS 10609); Vermilion County: Armstrong (INHS 9161); Will County: Northeast corner Crete township (FMNH 55562); 2 miles [3.2 km] S Crete (FMNH 65902).

The following data were recorded for each specimen: sex, snout-vent length, of dorsal spot numbers (left and right separately), lateral spots (left and right separately), sublateral spots (left and right separately), ventral spots, ventral scales, supralabial scales (left and right), infralabial scales (left and right), preocular scales (left and right), postocular scales (left and right), anterior temporal scales (left and right), posterior temporal scales (left and right), anterior scale rows, midbody scale rows, posterior scale rows, head length, greatest parietal-rostral length, parietal scale length, internarial distance, prefrontal suture length, and interocular distance. Anterior scale rows were counted one head-length from the posterior end of the parietal scale. Ventral scale rows were counted from the anal plate anteriorly.

Measurements were taken with dial caliper, and recorded to the nearest 0.01 mm. Head and scale measurements of each specimen were divided by the geometric mean (the n th root of the product of n measurements) for that specimen to standardize the values. Each animal over 200 mm SVL was dissected and stomach contents examined.

Principal Components Analysis and Canonical Discriminant Function Analysis were run on meristic data from all specimens. F tests were conducted on each character to determine normality of distribution. T tests determined if differences existed in any characters between animals from north and south of the Kankakee Lake Plain. These two clusters of populations are referred to as the northern and southern groups. Because all neonatal snakes examined were from the northern group, all analyses were repeated after excluding them. Because the canonical DFA needs a minimum of three groups for the program to plot a graph, a third group was created by removing all of the animals from south and west of the Shelbyville Moraine from the southern group. This area was not covered by the Wisconsin glacier and is biogeographically distinct. It contains the only Illinois populations in areas that were ice free during the Wisconsinan

RESULTS

Distribution and Habitat of *Clonophis kirtlandii* in Illinois

Clonophis kirtlandii was observed from only two of the 33 sites examined. Two adult males and one adult female were found in Effingham (Site no. 10) and one adult female at the pond at Lake Sangchris (Site no. 19). Evidence for 19 other populations was obtained but only eight of these are confirmed.

Data were obtained from 70 localities and were used to estimate the historical (Figure 1) and current (Figure 2) range of *C. kirtlandii*. Evidence predating the rangewide survey begun in 1985 (Wilsmann and Sellers, 1988) was used for Figure 1, and the remainder for Figure 2. The following is a list of the sites in Figure 2 and the most recent year *C. kirtlandii* was collected or cited: SW Adams Co., 1985 (Thurrow, 1993); Camp Emmanuel, Schuyler Co., 1985 (Wilsmann and Sellers, 1988); Lake Springfield at entrance to wildlife sanctuary, Sangamon Co., 1985 (ISM 620543); East boat dock, Lake Sangchris State Park, Christian County, 1985 (ISM 691223); Carlé Woods, Des Plaines,

Cook Co., 1987 (T. Anton pers. comm.); Lake Paradise Spillway, Coles Co. 1987 (J. Tucker pers. comm.); Tinley Park, Cook Co., 1988 (Photograph SIUC R- 2461); Waterfall Glen, DuPage Co., 1989 (Ludwig et al., 1992); Swift Meadows, DuPage Co., 1989 (Ludwig et al., 1992); Orland Park, Cook Co., 1989 (SIUC R-2367); Goodenow Grove Forest Preserve, Will Co., 1988 (Photograph SIUC R-2459); Rochester, Sangamon Co., 1989 (T. Strole pers. comm.); 6 miles [9.6 km] NNE of Monticello, Piatt Co., 1990 (Photographs SIUC R-2462); Lake Sara spillway, Effingham Co., 1990 (M. Redmer, pers. comm.); Walnut Point State Park, Douglas Co., 1991 (Photograph SIUC R-2461); Summum, Fulton Co., 1992 (SIUC R-2366); Lake Sangchris pond, Sangamon Co., 1992 (SIUC R-2368); Kiwanis Park, Charleston, Coles Co., 1992 (E. Moll pers. comm.); and Effingham, Effingham Co., 1992 (UMMZ 200586).

Morphological Characteristics of Illinois *Clonophis kirtlandii*

Slight morphological variation was observed among the Illinois specimens of *C. kirtlandii*. Principle Components Analysis (PCA) was unable to distinguish specimens from north and south of the Kankakee Lake Plain (Figure 3). T tests revealed that northern and southern populations differ significantly in seven of 23 meristic characters: SVL, number of right and left lateral spots, ventral scales, left supralabial scales, left postocular scales, and left anterior temporal scales. The northern group had an average of three more right and left lateral spots. In addition, all eight non-meristic characters differed significantly. However, many neonatal snakes had abnormal head scutellation. All nonneonatal specimens lacked loreals and all had one preocular and two postoculars. Of 13 neonates examined, three possessed loreals, three had two right and left preoculars, one had three right and left preoculars, and three had three right and left postoculars. Since eleven of the neonates came from litters born to two northern group females, the neonates subsequently were excluded and the tests were repeated. The subsequent analysis showed that the same six meristic characters were significantly different in the two groups with the exception of ventral scale counts. Nine specimens from the northern group had five left supralabial scales and seven had five right supralabials. All remaining northern and all southern specimens had six right and left supralabials. Five northern group specimens had three left postoculars and four had two left anterior temporals. The remaining northern group and all southern group specimens had the typical condition of one left anterior temporal and two left postoculars. None of the non-meristic characters were significantly different between groups after neonates were removed and the data was standardized with the geometric mean. The cluster analyses then were rerun using only those five meristic characters with significant differences between northern and southern groups. The second PCA (Figure 3) did not separate the groups, nor did the second DFA (Figure 4).

Clonophis kirtlandii from Villa Grove have white venters instead of the typical red (Morris, 1975). The three specimens from this site had no distinctive scalation characteristics. This is apparently the only site where white-bellied *C. kirtlandii* occur. Smith (1961) mentions a specimen with a pale venter seen near St. Joseph, Illinois, but no vouchers from this area were found.

DISCUSSION

Kirtland's snake habitat certainly has been drastically reduced during the past century. A decline in the number of Illinois *C. kirtlandii* was first noted by Garman (1892, p. 215), who stated:

“...ten years ago [it] was not uncommon along prairie brooks in the central part of the state. Tiling, ditching, and cultivation of the soil have destroyed its haunts and nearly exterminated it.”

The remaining populations are in a few isolated islands of land that have been spared urbanization or agriculture. Former *C. kirtlandii* sites in Evanston (Grosse Point), Westmont, and Chicago (103rd and Western, School and Odell) are completely urbanized and *C. kirtlandii* is certainly extirpated there. Populations in the cities of Champaign-Urbana, and Bloomington-Normal have not been documented since the 1950's and appear to be extirpated as well. *Clonophis kirtlandii* was last reported from Champaign County in 1961 (Wilsmann and Sellers, 1988), and from McLean County in 1966 (ISUT 703). Cliburn (1960) postulated *C. kirtlandii* to be approaching a natural extinction.

The highly disturbed nature of the remaining *C. kirtlandii* sites precludes in-depth analysis of the original habitat to which they were adapted. Some of the sites (e. g., Effingham) are surrounded by urban development and several populations of snakes exist in the midst of trash and debris in vacant city lots. Pristine sites in Illinois containing the original habitat for *C. kirtlandii* are unknown. The only common site characteristics were mowed grass, crayfish burrows, and a temporary or permanent source of water.

Many Kirtland's snake populations are in protected areas but even protected sites are vulnerable to harmful activities. Controlled burns, vehicular traffic, and mowing are all known to contribute to the mortality of snake populations. Minton (1972) found 18 road killed *C. kirtlandii* along a short (0.6 km) stretch of road in Indianapolis, IN. Six of the specimens examined in this study were road kills. The substitution of herbicide spraying for burning along railroad rights of way probably has been detrimental to *C. kirtlandii* populations.

In light of the apparent declines and extirpations of Illinois populations, *C. kirtlandii* should be classified as threatened. The remaining populations are Extant populations should be monitored closely to determine reproductive status. Management programs should consider limiting spring and fall mowing to midday or mowing only in the summer when *C. kirtlandii* are less likely to be active at the surface as suggested by Dalrymple and Reichenbach (1984) for Ohio populations of *Thamnophis radix*.

Successive visits are often required to confirm the existence of *C. kirtlandii* populations, so all unconfirmed sites should continue to be monitored for its presence. Continued surveys are strongly recommended as additional relict populations may still be located. Particular attention should be paid to central and northeastern Illinois sites since they were not adequately surveyed in this study. A detailed natural history study of *C. kirtlandii* is imperative before the status of individual populations can be determined.

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Table 1. Illinois sites examined for *Clonophis kirtlandii*, 1991-1993. Confirmed sites underlined.

Site			
<u>No.</u>	<u>County</u>	<u>Locality</u>	<u>Dates visited</u>
1	Adams	Bob Bangert Park, Quincy	7/12/91
<u>2</u>	Adams	2.4 km N Quincy	7/12/91, 10/19/91
3	Adams	Frazier Creek	7/12/91, 10/19/91
4	Bond	Keyesport Landing	9/22/91, 3/7/92
5	Brown	Siloam Springs State Park	7/13/91
<u>6</u>	Christian	Sangchris Lake State Park East Boat Dock	7/13/91, 9/30/91, 10/20/91, 4/11/92
7	Clinton	South Shore State Park	6/16/91, 7/13/91, 7/17/91, 4/19/92, 5/1/92
8	Clinton	Eldon Hazlet State Park	7/6/91, 9/22/91, 10/7/91, 11/1/91, 3/7/92
<u>9</u>	Douglas	Villa Grove	8/27/91, 10/26/91
<u>10</u>	Effingham	Neibrugge Oil Co. Henrietta St. & Fayette Ave	7/23/91, 5/2/92, 10/21/92, 4/20/93
11	Fayette	Caryle Lake Wildl Mgt. Area	9/22/91, 3/7/92
12	Fayette	Ramsey Lake St. Park	6/18/91, 7/23/91, 9/30/91, 4/19/92
13	Jasper	Sam A. Parr State Park	10/13/91
14	Lawrence	Red Hills State Park	10/13/91
15	Marion	Stephen A. Forbes St. Park	8/4/91, 4/24/92
16	Montgomery	Coffeen Lake	7/6/91
<u>17</u>	Sangamon	Lake Springfield	9/30/91, 10/20/91, 4/11/92, 5/12/92
18	Sangamon	Sangchris Lake Spillway	9/30/91
<u>19</u>	Sangamon	Sangchris Lake Pond	9/30/91, 10/20/91, 4/11/92, 5/12/92
<u>20</u>	Schuyler	Lake Emanuel	7/13/91, 10/19/91, 5/12/92
21	Schuyler	Weinberg-King State Park	10/19/91
22	Shelby	Hidden Springs State Forest	6/18/91
23	Washington	Washington Co. Cons. Area	7/17/91, 9/30/91, 3/7/92
24	DuPage	Swift Meadows	7/3/92, 5/20/93
25	DuPage	Warrenville Grove	7/3/92
<u>26</u>	Coles	Charleston, 3 Sites	10/21/92
<u>27</u>	Coles	Lake Paradise Spillway	5/2/92
28	Effingham	Bean Implement	5/2/92
<u>29</u>	Cook	Carlé Woods	5/23/93
<u>30</u>	Cook	Palos Hills	5/20/93
<u>31</u>	Douglas	Walnut Point S. P.	5/19/93
32	Coles	Lake Charleston Spillway	4/20/93
33	Coles	Fox Ridge State Park	4/20/93

Figure 1. Illinois reports of *Clonophis kirtlandii* prior to 1985. Solid circles = confirmed reports, open circles = unconfirmed reports from literature, open triangles = anecdotal reports

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Figure 2. Illinois reports of *Clonophis kirtlandii* since 1985. Solid circles = confirmed reports, open circles = unconfirmed reports, open triangles = anecdotal reports. Sources are Wilsmann and Sellers, (1988), and the present study.

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Figure 3. Principal components analysis of morphological characters of Illinois *Clonophis kirtlandii* excluding neonate animals under 125 mm snout-vent length.

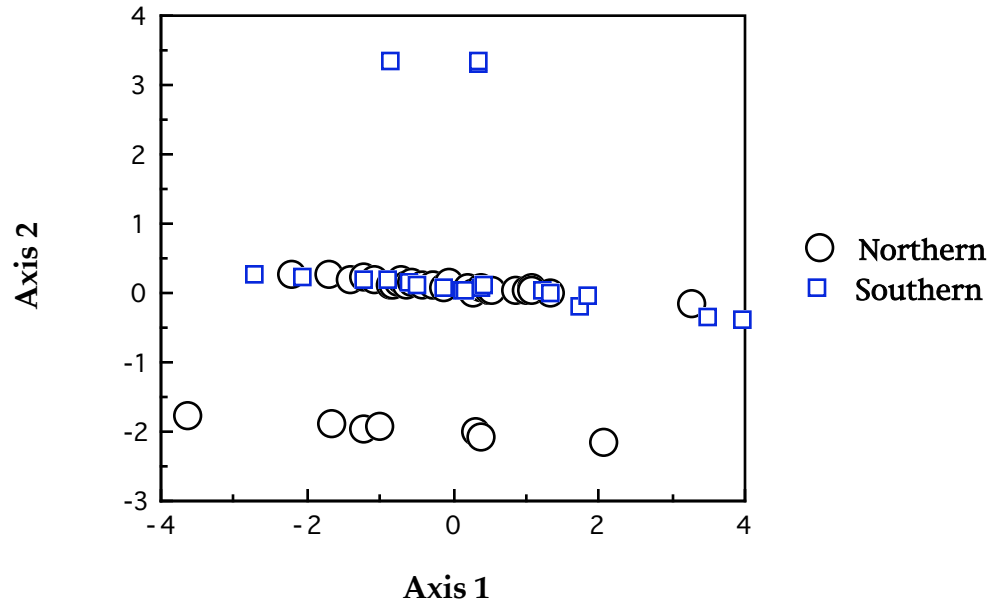


Figure 4. Canonical discriminant functions analysis of morphological characters of Illinois *Clonophis kirtlandii* excluding neonate animals less than 125 mm snout-vent length.

