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A Herpetofaunal Survey of the Braidwood Dunes and Savanna Nature Preserve

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A Herpetofaunal Survey of the Braidwood Dunes and Savanna Nature Preserve

(TITLE)

BY

Daniel J. O'Connell

THESIS

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ABSTRACT

A herpetofaunal survey was conducted on two sand prairie areas in Will Co., IL.; The Braidwood Dunes and Savanna Nature Preserve (BD+S), and Sandridge Savanna. Drift fences with pitfall traps, herpetological attractor panels, aquatic hoop traps, and manual collecting were used to sample the two preserves. A species list was compiled, and the habitat preferences and relative abundance of each species present were determined. The species list was compared with the species lists of other Illinois sand areas and the Nebraska sandhills. Guilds represented by the herpetofaunae of each area were also compared.

Seventeen species were recorded at BD+S and five were recorded at Sandridge. Based on this and previous studies, a total of 20 reptile and amphibian species are believed to exist at BD+S. The herpetofaunal composition of BD+S and Sandridge was found to be similar to that of the Nebraska sandhills and even more similar to that of other sand areas in Mason Co., IL., while being least like the herpetofaunal composition of the non-sand areas of Will Co. Because of the sand-specific nature of many of the reptiles and amphibians present at BD+S and Sandridge, these areas, and others like them, are important in maintaining populations of such species in the county and the State.

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7 November, 1992

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INTRODUCTION

The Braidwood Dunes and Savanna Nature Preserve (BD+S) is a 132 ha site located approximately 1.6 km southeast of the town of Braidwood in the southwest corner of Will Co., Illinois. This area consists of several prairie, marsh, and savanna ecosystems and is one of the only intact remnants of the Kankakee Sand Areas Section of the Grand Prairie of Illinois.

Similar sand areas occur in other parts of the state (Fig. 1). The largest lies from Tazewell Co. to northern Scott Co. along the east side of the Illinois River while another large area occurs in the Green River Lowland between the Green and Rock Rivers in the northwestern corner of the state. Small areas of sand occur at various localities along the east side of the Mississippi River and still smaller areas occur in Lawrence, La Salle, and Lake Cos.

The sand prairies and savannas of Illinois are the principal habitat of many xeric-adapted amphibians and reptiles typically found in the western and southwestern United States. These animals were able to extend their ranges into Illinois during the warm and arid Xerothermic period, a subunit of the Hypsithermal period (a time of generally elevated temperatures). Authorities differ over the precise timing of this period. Zumberge and Potzger (1955) set the maximum age of the Xerothermic period at 4,000 years before present (ybp), while Anderson (1991) places it

between 8,000 and 6,000 ybp. During this time, whenever it occurred, xeric plants and animals spread North and East across the continent with some of these forms reaching the Atlantic Ocean (Smith, 1957). When conditions became more mesic the ranges of most of these organisms again became restricted to the west. Many, however, were able to persist in areas with sandy soils where the drainage characteristics of the sand created situations similar to those found in their original habitats (Smith, 1957).

The herpetofauna of The Braidwood Dunes and Savanna Nature Preserve has been little studied. Smith (1961) summarized all Will Co. records and Mierzwa (1988) updated these records while including a list of several species characteristic of sand areas. Mierzwa and Beltz (1987) compiled a list of the amphibians and reptiles found during a two day search of the preserve in May, 1987. Since that time, several other species have been recorded at the site (Mauger, pers. comm.).

Specific objectives of this study were the following: 1) To determine the composition of the herpetofauna and the relative abundance of the species found at the site; 2) To examine the ecology and interrelationships of the species at the site including phenology, habitat usage, and trophic levels or guilds occupied, and; 3) To compare the herpetofaunal composition of this sand area with: a) other sand areas in Illinois, b) sand areas in other states, and c) non-sand areas in Will Co.

Another natural area, Sandridge Savanna, was also sampled during the course of this study. This area is less than five km east of the Braidwood site and has very similar sandy soils, but it is much more heavily overgrown with vegetation. Recent grazing and farming have taken place there and it has not been regularly burned. Because of this, the amount of data collected at the site was limited.

STUDY AREA

The plant communities of BD+S (Figure 2) are those typical of the sandy areas of the Grand Prairie. The most dominant communities are dry to dry-mesic prairie, dry-mesic sand savanna, mesic prairie, wet-mesic prairie, and wet prairie. An unpublished Will Co. Forest Preserve District environmental report (Anonymous) compiled the following vegetational data on the preserve. Little bluestem (Andropogon scoparius), panic grass (Panicum spp.), and sand dropseed (Sporobolus cryptandrus) are important grasses in the dry to dry-mesic prairie areas of the preserve, while the prickly-pear cactus (Opuntia velutina), sand milkweed (Asclepias amplexicaulis), and sand primrose (Oenothera rhombipetala) are common forbs. The dry mesic sand savannas of the site are dominated by the black oak (Quercus velutina) with little bluestem, porcupine grass (Stipa spartea), and June grass (Koeleria cristata) being the important grasses. Common forbs of these savannas include the hairy puccoon (Lithospermum croceum), wild lupine (Lupinus perrenis), and spiderwort (Tradescantia ohiensis).

Big bluestem (Andropogon gerardii) and Indian grass (Sorghastrum nutans) are common grasses of the mesic and wet-mesic sand prairies while the forbs include white false indigo (Baptisia leucantha), cowbane (Oxypolis rigidior), downy sunflower (Helianthus mollis), and many others including several previously mentioned species.

Sedges (Carex spp.), blue joint grass (Calamagrostis canadensis), and prairie cord grass (Spartina pectinata) are dominant grasses of the wet prairie areas of the preserve. Common forbs include colic root (Aletris farinosa), common boneset (Eupatorium perfoliatum), and Riddell's goldenrod (Solidago riddellii) while some of the more common shrubs are chokeberries (Pyrus spp.) and willows (Salix spp.). Patches of marsh dominated by cattail (Typha latifolia), sedges, and rushes (Juncus spp. and Scirpus spp.) are common in these wet prairies.

Several areas of the preserve were previously farmed. These are in various stages of recovery and show signs of returning to their natural state.

The Will Co. Forest Preserve District annually burns a majority of the preserve in order to maintain the sand prairie plant communities and to reclaim those areas which were farmed. These burns are conducted in early to mid May and generally consume the entire understory of both the savanna and prairie areas while the marshy areas are only partially burned. This survey began shortly after these burns were conducted in both 1991 and 1992.

The sandy soil at the Braidwood Dunes and Savanna site was originally laid down during the late Wisconsinian stage of the Pleistocene epoch by glacial meltwater. Glacial run-off drained into the Kankakee valley and through outlets in the surrounding moraines. These outlets were insufficient to accommodate all the run-off, and the water spread extensively into the uplands surrounding the valley causing the Kankakee flood (Willman and Frye, 1970). As the flood subsided, it deposited large amounts of sand in the upper Kankakee valley. The sand, being exposed to the wind, was blown into dunes on the terraces formerly occupied by the flood. These sites, called Parkland Sand areas, reach their greatest extent south of Wilmington, IL (Willman, 1971), and include the Braidwood Dunes and Savanna Nature Preserve. Beneath the top layer of sand is a layer of glacial till starting at around seven or eight meters and going down to about 18 meters. Upper layers of this till are composed of gray clay while the bottom layer is composed of sandy clay. Below the till layer is Pennsylvanian shale bedrock (Anonymous Will Co. env. rept.).

MATERIALS AND METHODS

The two areas included in this study, Braidwood Dunes and Savanna Area and Sand Ridge Savanna were sampled on several weekends during March and April of 1991 and were then sampled almost daily from 21 May through 7 August of the same year. Field work at the sites was completed in 1992 with sampling done from 17 through 19 April and again from 12 through 21 May.

The primary means of collection were drift-fences with pitfall traps (pf/dfs). The method used was a variation of the one developed by the U.S. Fish and Wildlife Service (Campbell and Christman, 1982). For this study the drift-fences were either 7.5 or 15 m long, 45 cm tall rolls of aluminum sheeting. These fences were buried in the ground approximately 15 cm deep and were arranged in various positions throughout the study areas to best sample each suitable habitat type. Two or three fences were usually placed in close proximity to each other with 18.9 or 11.3 liter buckets buried to their rims at each end and between each fence as pitfalls. Additionally, smaller buckets were buried alongside some fences at various intervals to catch any animals not traveling to the ends of the fence. Others were equipped with funnel traps consisting of plastic funnels stapled at the entrance to a cylinder made of window screening or medium gauge hardware cloth. Funnel traps were placed next to the fence with leaf litter and soil forming a

ramp to the mouth of the funnel and were arranged such that animals coming from any direction were led into one of these traps. Aluminum foil was placed over the funnel traps and leaf litter was placed in the buckets to provide shelter from the sun and rain for the animals being held. Most fences were set in quadrats varying in size from 900 to 3600 m^2, depending on habitat availability. These quadrats were searched regularly to find species which were not caught in the pitfalls or funnels and also for the purpose of determining population levels of the Six-lined racerunner, Cnemidophorus sexlineatus, in each habitat type.

One m^2 pieces of corrugated tin were laid out in transects through the study areas. These "Herpetological Attractor Panels" (HAPs) served as centers of concentration for amphibians, lizards, and snakes in the morning and evening hours due to their rapid heating and heat holding capacity.

Hoop traps (Legler, 1960) baited with sardines or chicken livers were set in the various aquatic habitats of the Braidwood Dunes study area to capture turtles. A variety of other conventional collecting methods were also used to sample the study areas. These included opportunistic manual collecting of amphibians and reptiles throughout all habitats, frequent road searches to find animals killed by vehicles, and nocturnal sampling which consisted of identification of calling frogs and flashlight searches of the study areas.

Captured animals were generally released by the next morning and in all cases were released no later than two days after capture. All amphibians were marked using a toe clipping system developed by Martof (1953) for marking frogs. Turtles were marked using slight modifications of a shell notching technique developed by Cagle (1939). These modifications are the omission of marginal scutes four through seven for notching and the inclusion of the letters L or R to designate which side of the carapace has been marked. The marking system for lizards was developed independently for this study. Lizard toes were numbered 1 through 20 starting with the inside toe of the front-left foot and proceeding outward at first and then to the front-right, rear-left and lastly to the rear-right, beginning with the inside toe on each foot. Combinations of clipped toes were used with no foot having more than one clipped toe and with the numbers being separated by a comma. Therefore, a lizard numbered 1,6,11,16 would have the inside toe on each foot clipped. This method reduces the adverse effects of toe-clipping on motility by preventing the concentration of several clipped toes on one foot while still allowing individualized marking of up to 970 lizards. Quadrat-specific markings were also made on the back of the lizard's heads using white porcelain touch-up paint to allow the identification of previously captured or uncaptured individuals from a distance. Western slender glass lizards, Ophisaurus attenuatus, were marked by painting the tips of

their tails black. This method prevented individualized marking of each lizard but allowed the identification of recaptured individuals. Snakes were marked using a ventral scale clipping system developed by Brown and Parker (1976).

A species list was then compiled for both areas and this list was compared with the herpetofaunae of other Illinois sand areas and the Nebraska sandhills. Both species and guilds present were compared between BD+S and the other areas. One method for comparing the overall similarity of species between two areas is through the use of an index of similarity (Greig-Smith, 1964). The index used in this study is based only on species presence and ranges from 0 to 1.0 to show the range from no similarity (0) to complete similarity (1.0). In two separate communities, one with (a) number of species and another with (b) number of species, and with (c) species occurring in both, the index of similarity is calculated as follows: Index of similarity = $2c/(a+b)$.

RESULTS

SPECIES COMPOSITION AND RELATIVE ABUNDANCE

Seventeen species, eight amphibians and nine reptiles, were recorded at BD+S over the course of this study. Amphibians were represented by six frogs and two salamanders while the reptiles included two lizards, three snakes, and four turtles. Three additional reptile species previously recorded at the preserve were not taken in this study. Five species were recorded at Sandridge, and only one, the Ornate box turtle, Terrapene ornata, was unique. The other four included three frogs and one snake. Table 1 lists the species found at BD+S and includes the relative abundance of each species and the results of the various sampling procedures used in the study.

Relative abundance (RA) is a subjective measure of each species' numbers compared to those of other members of it's Order. The most common species or group of species were given four plus marks (++++) while the least common were given one plus mark (+), with a gradient in between these extremes. The criteria used in assigning these abundance ratings are listed in Table 2. Because of the great seasonal fluctuations in the numbers of larval and juvenile amphibians, only adults were used in determining RA.

Calling was the most important criterion for assessing anuran abundance because this indicated numbers of male adults in the populations. Based on calls, the three most

common anurans were the American toad, Bufo americanus, the Gray treefrog, Hyla versicolor, and the Western chorus frog, Pseudacris triseriata. Gray treefrogs called in the greatest numbers (90 max.), but were not found in the pitfall traps or otherwise regularly observed. The lack of pitfall captures is attributed to the treefrog's climbing ability enabling it to escape from the traps at will. The dearth of other observations is likely due to the frogs arboreal habits. Numerical data on captures and observations of the Western chorus frog were not included due to the sheer number of these frogs and the impracticality of recording such data.

The Green frog, Rana clamitans, was the next most common species of frog. Although it was not found as often as the Northern leopard frog, Rana pipiens, more adult Green frogs were observed (.32 adults/search day) and they were heard calling in greater numbers (10 max.). The leopard frog was the most common member of the herpetofauna observed outside of the pitfall traps (mostly juveniles) and was the second most common member found in the pitfalls, but it's maximum calling number was relatively low (6 max.). The adult population of this species appears small, possibly because of high mortality among juveniles. This is evident by the absence of adults in the pitfalls, and their scarcity in other observations (1.5% of total). The Bullfrog, Rana catesbeiana, was rarely encountered (.24 adults/7.5 m fence/day x 100 and .03 adults/search day).

Only two members of the Order Caudata were found at the

preserve, the Eastern tiger salamander, Ambystoma tigrinum, and the Central newt, Notopthalamus viridescens. Both leave water at some point in their life histories, so it seems likely that they would have been found in the pitfalls with some regularity if they were at all common. This was not the case, however, as very limited numbers of each were captured. The tiger salamander is unremarkable for this area, but the newt is a new record for Will Co. Smith (1961) shows the presumed range of the Central newt invading the northern one-half of the county but as of 1988, no reports of the newt had been documented (Mierzwa, 1988).

Due to habitat differences, the reptile populations were assessed in two groups; the Orders Squamata and Testudines. Relative abundance was based on pitfall and search data in the squamates and on search data and baited hoop traps in the turtles.

The Six-lined racerunner, Cnemidophorus sexlineatus, was easily the most common and conspicuous reptile in the entire preserve. This lizard was often found in the pitfalls (3.37 ind/7.5 m fence/day x 100) and was regularly seen during travels through the area (0.83 ind/search day). They were most often seen basking in the open on hot or sunny days. When approached, they would scurry off quickly. Bogert (1949) found the Six-lined racerunner to maintain the highest body temperature of any lizard he had studied. This allows the lizard to stay active during the hottest times of the day when other reptiles must seek cover.

The most common snake was the Blue racer, Coluber constrictor. This snake was regularly encountered during searches (0.17 ind/search day), but was only rarely caught in the funnel traps associated with the driftfences (0.16 ind/7.5 m fence/day x 100). Three of the six Bullsnakes, Pituophis melanoleucus, recorded in this study were found dead on the roads surrounding the preserve. The species may thus be rarer than it would appear based on the data. The Western slender glass lizard, on the other hand, may be more common than indicated by the data. It is a fossorial species which, because of it's secretive habits, is rarely seen or captured. The Chicago garter snake, Thamnophis sirtalis semifasciata, was found infrequently, while the Western ribbon snake, Thamnophis proximus, and the Eastern hognose snake, Heterodon platirhinos, previously recorded species, were not found at all.

The Painted turtle, Chrysemys picta, was the most commonly observed turtle (0.011 turt/trap-hr). It is given a rating of ++++ because of it's abundance compared to other turtles (5.5 times more common than the second most abundant turtle based on turtle trap data). Both Emydoidea blandingii, Blanding's turtle (0.002 turt/trap-hr), and Chelydra serpentina, the Common snapping turtle (0.002 turt/trap-hr), were occasionally captured in baited turtle traps while the Red-eared turtle, Trachemys scripta (0.0 turt/trap-hr), was captured only once. This individual, a hatchling, was caught in a pitfall trap. The Red-eared

turtle, whose original range was somewhat to the south, has been widely introduced through the pet trade. Breeding populations probably occur in Will Co. by now as evidenced by this hatchling, which was at most a few days old. The Ornate box_turtle, Terrapene ornata, found only at the Sandridge site, was previously recorded at BD+S, but it was not seen there during this study.

ECOLOGY

General habitat preferences were determined using data from pitfall/drift-fence (pf/df) captures and from searches of the preserve. The preserve was divided into seven habitat types, five of which contained quadrats and/or pf/dfs (Table 3). Only search data and turtle trap results were used to survey habitats 6 and 7 because it was not possible to place pf/dfs in these semi-permanent aquatic areas. Based on the search data, areas 6 and 7 appear to be the poorest and richest areas respectively in both categories. Habitat 7 (sedge meadow/marsh) registered nine species and 0.75 individuals per search-day as compared to habitat 6 (wet to wet-mesic prairie) with three species and 0.02 individuals per search-day (Table 4).

Based on pf/df sampling (Table 5) habitat 2 (dry mesic sand savanna bordering marsh) contained the most species (12). Habitat 5 (sand dune blowout) on the other hand was the richest in total individuals (13.04 ind/7.5 m fence/day x 100).

The Six-lined racerunner, which was the most common

member of the herpetofauna in every terrestrial habitat, was most numerous in habitat 5 (10.87 ind/7.5 m fence/day x 100). Additional data gathered during the regular searches (quadrat walks) of each quadrat surrounding the pf/dfs (Table 6) support this contention. The American toad was the only other animal found in as many habitat types.

Information on the feeding ecology and habitat use of the amphibians and reptiles occurring at BD+S is plentiful (Fitch, 1958, 1982; Smith, 1961; Conant, 1991; Brown and Parker, 1982; Reynolds and Scott, 1982; MacCulloch and Secoy, 1983; Kofron and Schreiber, 1985; Ballinger et al., 1990; Plummer, 1990; Punzo, 1990). Using data collected from this literature along with that from the study, the herpetofauna from the preserve were classified into eight guilds (Table 7). Notopthalamus viridescens and R. pipiens were placed in both the aquatic and terrestrial group because of their semi-aquatic natures.

Seasonal activity of the BD+S herpetofauna varies from species to species as indicated in the phenology chart (Figs. 3a, 3b). Because amphibians tend to be more cold tolerant (Oliver, 1955), they become active earlier in the year than do reptiles. The Northern leopard frog and the Western chorus frog became active and began calling first (29 March) while the Green frog began and ended calling later than the rest (23 May - 31 Aug.). Bufo americanus and R. pipiens, the only two anuran species in which juveniles were found, began metamorphosis in early to middle June and continued through

August. Newts were observed only a few times, and never in an active state. The three individuals recorded, all efts, were found buried in the sand under pitfall buckets. Due to the small number of reptilian observations, it is difficult to tell which species becomes active first. One Blanding's turtle and one Bullsnake were observed on 29 March but few were seen after that. Of all the reptiles, the Six-lined racerunner was found to begin activity latest in the spring and end activity latest in the summer (6 May - 8 Aug.). Based on turtle trap results, it appears that the turtles of the preserve either ceased activity or left the study area in late June, presumably because of high daily temperatures and a lack of rainfall which caused the marshy areas to dry up.

DISCUSSION

The primary soil type found in Will Co. is black or loess soil with sand making up only a small portion of the total area. Mierzwa (1988) divided the county into three categories; the Valparaiso Moraine and Des Plaines River valley, the lake plain prairies, and the sand areas. The first two areas are very similar, differing from one another to a small enough degree that they will be considered together. They cover the entire county except for the southwest corner. Black soil savannas and prairies used to dominate in these areas, but now much of the area has become agricultural. The sand areas are also primarily savanna and prairie, but because of rapid water drainage through the sand these areas tend to support a more xeric-adapted group of plants and animals.

Of the 39 Will Co. amphibian and reptile species not restricted to rivers or large lakes, 19 are found only in black-soil areas, seven are found only in sand areas, and 13 are found in both (Table 8). Of these, Smith (1961) lists the Six-lined racerunner, Bullsnake, Blue racer, Eastern hognose snake, and Ornate box turtle as species characteristic of sand areas, while Mierzwa (1988) includes the Western slender glass lizard with this list. All of these species are found at BD+S and, of this group, all but the Blue racer are unique to the sand areas of the county. Smith (1956) lists soil moisture as the limiting factor

controlling the Six-lined racerunner's distribution as the lizard seems to thrive in xeric habitats. Fitch (1958) lists the sand itself as a requirement for this lizard. Whichever is more important, the racerunner is restricted to sand areas in Will Co. and elsewhere in the state. In the northeastern portion of Illinois, the Bullsnake, the Eastern hognose snake, and the Ornate box turtle are closely associated with the Kankakee sand areas (Smith 1961). In other parts of the state, however, these species occasionally occur in black soil prairies as well as sand prairies. The Western slender glass lizard is not as sand specific in Illinois as it is in Indiana (Smith, 1961), but it does seem to prefer these areas. The Blue racer, although common in sand areas, is not restricted to them. Being a generalist, it does well in many habitats but is most common in the forest-edge habitat of BD+S and Sandridge.

The herpetofauna of BD+S closely resembles that of other Illinois sand areas. In an inventory of several Mason Co. sites, Kruse and Moll (1987) found many of the same species recorded in this study. Two of these sites, Sand Prairie - Scrub Oak Nature Preserve and Shick Shack Pond, though larger and more diverse, contain habitats very much like those found at BD+S. Table 9 compares the species found BD+S with species from these sites. Even though 13 species are shared, there are several differences between the two areas. For example, more turtles occur at Braidwood, while there are more anurans at the Mason Co. sites. Several of the species

found in Mason but not Will Co. are near the northern or eastern limits of their range (e.g., Rana utricularia and Scincella laterale - northern limit, Heterodon nasicus - eastern limit). Rana pipiens and R. utricularia are ecological equivalents with mutually exclusive ranges. The occurrence of the latter in Mason Co. seemingly precludes the occurrence of the former, because the habitat appears suitable for R. pipiens at both sites. Kruse (1978) and Lynch (1978) note that in Nebraska the Northern leopard frog predominates in sandy areas while the Plains leopard frog, Rana blairi is associated with loess soils. According to Lynch (1985) R. pipiens is the only leopard frog of the Nebraska sandhills. Why Rana utricularia predominates over Rana pipiens and why Rana blairi thrives in the sand areas of Illinois remains to be determined.

Habitat differences may also be responsible for the lack of certain species in each site. Rana clamitans seems to be absent from the large prairie areas of central Illinois while the Northern water snake, Nerodia sipedon, requires permanent water not found at BD+S.

Many of the shared species are sand-typical, including Cnemidophorus, Pituophis, and Heterodon platirhinos. These species tend to be most common in sandy areas and are uncommon outside of these habitats. Ophisaurus attenuatus and Terrapene ornata, two species typical of sand prairies, were not recorded in the Mason Co. study. This was most likely due to chance, as the ranges of both species extend

through the Mason Co. study areas and as each prefers habitats similar to those found there.

Mason and Will Co. sand area guilds are compared in Figures 4 and 5. Eight guilds (aquatic and terrestrial) are recognized in both areas. Seven of these are shared. Aquatic piscivores-amphibivores (e.g. Nerodia) were found only in Mason Co., while terrestrial omnivores were recorded only in Will Co. Likely both existed historically in each study area. Also noticeable are the greater numbers of terrestrial insectivores (frogs) and rodentivores (snakes) at the Mason Co. sites. The greater number of anuran species at the Shick Shack and Scrub Oak areas may be due to the abundance of permanent water at these sites compared to at BD+S and Sandridge. The additional rodent eaters in Mason Co. (the Black rat snake, Elaphe obsoleta, and the Prairie kingsnake, Lampropeltis calligaster) may be supported by a large rodent population enhanced by greater habitat diversity, but this has not been determined. An important similarity between the herpetofaunae of the two counties is the presence of typically western, xeric-adapted species like the Six-lined racerunner and Bullsnake, and presumably the Ornate box turtle.

Illinois sand areas like BD+S and Sandridge show both differences and similarities with sand areas in the western states. The Nebraska sandhills are used here for comparison because they are well studied (Ballinger et al., 1979, 1990; Lynch, 1985) and are typical of western sand areas (Table

10). Immediately noticeable is the greater variety of squamates in Nebraska (11 species) than at BD+S (6 species) and the reduced variety of amphibians (6 vs. 8 species). This is to be expected as the Nebraska sandhills receive less precipitation than the Illinois sand prairies (Espenshade, 1987) and as amphibians typically require more water than do reptiles. The species which are present tend to be well adapted to dry conditions. Again, the same xeric species shared with the Mason Co. sand areas, namely the Six-lined racerunner, the Bullsnake, and the Ornate box turtle, are also shared with the sandhills prairie.

The guilds of the Nebraska sandhills are shown in Table 11 and are compared with the Will Co. sand area guilds in Figures 6 and 7. In the aquatic/riparian habitats of both BD+S and the Nebraska sandhills, omnivores predominate followed by insectivores. A significant difference is the substitution for the general carnivore guild by the piscivore-amphibivore guild in Nebraska.

The terrestrial habitats show an even greater degree of similarity. Although the overall number of species in the sandhills is greater than in the Will Co. sand areas, the percent of species in each guild is very similar. This, and the fact that there are many shared species (11), emphasize the similarity between the sand prairies and savannas of the two states.

Figure 8 compares the indices of similarity (Greig-Smith, 1964) for 1) BD+S/Sandridge and Mason Co. sand areas,

2) BD+S/Sandridge and the Nebraska sandhills, and 3) BD+S/Sandridge and loess soiled Will Co. areas. The terrestrial species are examined separately because the aquatic and riparian species tend to occur in many soil types and do not seem to prefer one soil type over another. The herpetofauna of the Will Co. sand areas is most similar to that of the Mason Co. sand areas (0.52) and is least similar to that of the loess soiled habitats of the same county (0.38). Even the Nebraska sandhills herpetofauna is more similar to that of the Will Co. sand areas (0.47) than is the herpetofauna found only a few miles away. This emphasizes the sand-specificity of many of the species occurring at BD+S and Sandridge.

A fairly wide variety of reptiles and amphibians occur in the Will Co. sand areas of Braidwood Dunes and Savanna and Sandridge Savanna. The combination of wetland and sand savanna provides suitable habitat for many members of the herpetofauna, both aquatic and terrestrial. Many of these species are shared with other sand areas in Illinois and Nebraska. Will Co. species dependent on the sand areas include Cnemidophorus sexlineatus, Pituophis melanoleucus, and Terrapene ornata. Other species benefitted by sandy soils are Coluber constrictor, Heterodon platirhinos, Ophisaurus attenuatus, and possibly Rana pipiens. The preservation of habitat in places like BD+S and Sandridge provides for the continued existence of these xeric species in Will Co. The herpetofaunae of these preserves are

specifically adapted to the sand savannas and prairies common there. These habitat types are an unusual feature outside of the western states.

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Table 1. Braidwood Dunes and Savanna Nature Preserve: species composition and relative abundance based on pitfall/drift fence (PF/DF) captures, search data, turtle trap captures, and anuran maximum calling number. In the Amphibia, adult records (ads) are included in parentheses, whereas in the Reptilia, all records are combined.

Species	PF/DFs; Ind(ads)/ 7.5m trap-day (x100)	Searches; Ind(ads)/ search day	Max. # call	Rel. abund
AMPHIBIA				
ANURA				
Hyla versicolor	0.23(0.16)	0.14(0.13)	90	++++
Bufo americanus	9.94(1.10)	0.84(0.10)	70	++++
Pseudacris triseriata	Many	Many	40	++++
Rana clamitans	0.00(0.00)	0.32(0.32)	10	+++
Rana pipiens	3.60(0.00)	2.08(0.03)	6	++
Rana catesbeiana	0.24(0.24)	0.03(0.03)	3	+
CAUDATA				
Ambystoma tigrinum	0.55(0.55)	0.00(0.00)	NA	+
Notopthalamus viridescens	0.31(0.31)	0.00(0.00)	NA	+
			Turt/ trap-hour	
REPTILIA				
SQUAMATA				
Cnemidophorus sexlineatus	3.37	0.83	NA	++++
Coluber constrictor	0.16	0.17	NA	++
Ophisaurus attenuatus	0.08	0.03	NA	+
Pituophis melanoleucus	0.00	0.10	NA	+
Thamnophis sirtalis	0.00	0.03	NA	+
Heterodon platirhinos	0.00	0.00	NA	+
Thamnophis proximus	0.00	0.00	NA	+
TESTUDINES				
Chrysemys picta	0.47	0.03	0.011	++++
Chelydra serpentina	0.00	0.02	0.002	++
Emydoidea blandingii	0.00	0.03	0.002	++
Terrapene ornata	0.00	0.00	0.0	+
Trachemys scripta	0.08	0.00	0.0	+

Table 2. Criteria used in determining the relative abundance (RA) of amphibians and reptiles at the Braidwood Dunes and Savanna Nature Preserve.

	Amphibia		Reptilia	
RA	Anura	Caudata	Squamata	Testudines
++++	30+ calling *OR* >2.35 adults/ 7.5 m trap-day (x100) *OR* >0.5 adults/ search day	>2.35 adults/ 7.5 m trap-day (x100) *OR* >0.5 adults/ search day	>2.35 ind./ 7.5 m trap-day (x100) *OR* >.45 ind./ search day	>.011 ind./ turtle trap-hour *OR* >.45 ind./ search day
+++	18-29 calling *OR* 1.57-2.34 adults/7.5 m trap-day (x100) *OR* .25-.49 adults/ search day	1.57-2.34 adults/7.5 m trap-day (x100) *OR* .25-.49 adults/ search day	1.57-2.34 ind./7.5 m trap-day (x100) *OR* .30-.44 ind./ search day	.006-.010 ind./turtle trap-hour *OR* .30-.44 ind./ search day
++	5-17 calling *OR* .78-1.56 adults/7.5 m trap-day (x100) *OR* .10-.24 adults/ search day	.78-1.56 adults/7.5 m trap-day (x100) *OR* .10-.24 adults/ search day	.78-1.56 ind./7.5 m trap-day (x100) *OR* .15-.29 ind./ search day	.001-.005 ind./turtle trap-hour *OR* .15-.29 ind./ search day
+	all others	all others	all others	all others

Table 3. Habitat types of the Braidwood Dunes and Savanna Nature Preserve; indicating habitat identification number from Figure 2, total drift fence length per habitat type (PF/DF), and the presence or lack of a quadrat in the given habitat.

Habitat type	ID#	PF/DF	Quadrat
Dry mesic sand savanna	1	22.5m	yes
Dry mesic sand savanna bordering marsh	2	37.5m	yes
Dry to dry-mesic prairie	3	15.0m	yes
Old (successional) field	4	45.0m	yes
Sand dune blowout	5	15.0m	yes
Wet to wet-mesic prairie	6	0.0m	no
Sedge meadow/marsh	7	0.0m	no
Old (successional) woods	8	0.0m	no

Table 4. Results of searches and turtle traps at the Braidwood Dunes and Savanna Nature Preserve showing the total number of individuals (adults in the Amphibia) recorded during the study for each habitat type. An X indicates the presence of juvenile amphibians which are not counted in the overall number of individuals but which do count towards total number of species.

	Habitat ID#						
Species	1	2	3	4	5	6	7
AMPHIBIA							
ANURA							
H. versicolor							8
B. americanus	2	3			1	X	
R. clamitans		2					18
R. pipiens		X				X	2
R. catesbeiana		1					1
CAUDATA							
A. tigrinum							2
REPTILIA							
SQUAMATA							
C sexlineatus	1		25		26		
C. constrictor	1		5	2	3		
O. attenuatus	1	2					
P. melanoleucus	2		2	1	1		
T. sirtalis		1					1
TESTUDINES							
C. picta	1					1	10
C. serpentina				1			2
E. blandingii				1			3
Total Ind(Adults)	8	9	32	5	31	1	47
Ind(Adults)/Day	.13	.14	.51	.08	.49	.02	.75
Total Species	6	6	3	4	4	3	9

Table 5. Results of pitfall/drift fence traps at the Braidwood Dunes and Savanna Nature Preserve showing the number of individuals(adults in the Amphibia)/7.5 m fence/day (x100) for each habitat type. An X indicates the presence of juvenile amphibians while a Y indicates a species found during searches. Both count towards total number of species but not towards number of individuals.

	Habitat ID#				
Species	1	2	3	4	5
AMPHIBIA					
ANURA					
H. versicolor	.33	.20			
B. americanus	2.64	1.20	X	X	X
R. clamitans		Y			
R. pipiens	X	X	X	X	
R. catesbeiana		Y		1.04	
CAUDATA					
A. tigrinum	.33	1.20			
N. viridescens		.80			
REPTILIA					
SQUAMATA					
C. sexlineatus	4.29	2.20	3.19	2.08	10.87
C. constrictor	.33	.20	Y	Y	Y
O. attenuatus	Y	.20			
P. melanoleucus	Y		Y	Y	Y
T. sirtalis		Y			
TESTUDINES					
C. picta	Y	1.00		Y	1.09
E. blandingii				Y	
T. scripta					1.09
Ind(Adults)/ 7.5 m fence/day (x100)	7.92	7.00	3.19	3.12	13.05
Total Species	9	12	5	8	6

Table 6. Observations of Cnemidophorus sexlineatus, the six-lined racerunner, during walks through quadrats located in the Braidwood Dunes and Savanna Nature Preserve.

	Habitat ID#				
	1	2	3	4	5
Area (m^2)	3600	900	2500	2500	3600
Total walks	13	12	13	29	16
Total lizards observed	6	0	5	9	27
Lizards/walk/ 1000 m^2	.13	0	.15	.12	.47

Table 7. Guilds occupied by the aquatic/riparian and terrestrial herpetofauna of the Braidwood Dunes and Savanna Nature Preserve. The percent of the total herpetofauna comprised by each guild (rounded off) is also given.

Guild	Aquatic/Riparian		Terrestrial	
Omnivores	C. picta E. blandingii T. scripta C. serpentina	44.4%	T. ornata	7.7%
Insectivores	A. tigrinum N. viridescens R. pipiens	33.3%	N. viridescens H. versicolor B. americanus P. triseriata R. pipiens C. sexlineatus	46.2%
Generalized Carnivores	R. catesbeiana R. clamitans	22.2%	O. attenuatus T. proximus T. sirtalis C. constrictor	30.8%
Bufonivores			H. platirhinos	7.7%
Rodentivores			P. melanoleucus	7.7%
Totals		100.0%		100.0%

Table 8. A comparison of the herpetofaunae of the black soil and sand soil areas of Will Co. Il. A (T) denotes terrestrial species while an asterisk (*) indicates species shared between the black soil and sand areas.

Black soil areas	Sand soil areas
Ambystoma laterale	Ambystoma tigrinum *
Ambystoma maculatum	Notopthalamus viridescens T
Ambystoma tigrinum *	Bufo americanus * T
Eurycea cirregera	Pseudacris triseriata * T
Bufo americanus * T	Hyla versicolor * T
Acris crepitans T	Rana catesbeiana *
Pseudacris crucifer T	Rana clamitans *
Pseudacris triseriata * T	Rana pipiens * T
Hyla versicolor * T	Chelydra serpentina *
Rana catesbeiana *	Chrysemys picta *
Rana clamitans *	Emydoidea blandingii *
Rana blairi T	Terrapene ornata T
Rana pipiens * T	Trachemys scripta *
Sternotherus oderatus	Cnemidophorus sexlineatus T
Chelydra serpentina *	Ophisaurus attenuatus T
Clemmys guttata	Heterodon platirhinos T
Chrysemys picta *	Pituophis melanoleucus T
Emydoidea blandingii *	Coluber constrictor * T
Trachemys scripta *	Thamnophis proximus T
Opheodrys vernalis T	Thamnophis sirtalis * T
Elaphe vulpina T	
Lampropeltis triangulum T	
Coluber constrictor * T	
Thamnophis radix T	
Thamnophis sirtalis * T	
Storeria dekayi T	
Storeria occipitomaculata T	
Clonophis kirtlandi T	
Regina grahami T	
Regina septemvittata T	
Nerodia sipedon	
Sistrurus catenatus T	
Black soil total = 32	Sand soil total = 20
Black soil terrestrial = 19	Sand soil terrestrial = 13

Shared species total = 13
Shared terrestrial species = 6

Table 9. A comparison of the herpetofaunae of the Braidwood Dunes and Savanna Nature Preserve and two sand soil areas in Mason Co. Il., Sand Prairie - Scrub Oak Nature Preserve and Shick Shack Pond. A (T) denotes terrestrial species while an asterisk (*) indicates species shared between the two areas.

Braidwood Dunes and Savanna	Mason Co. sand areas
Ambystoma tigrinum *	Ambystoma tigrinum *
Notopthalamus viridescens T	Bufo americanus * T
Bufo americanus * T	Bufo woodhousii T
Pseudacris triseriata * T	Acris crepitans T
Hyla versicolor * T	Pseudacris crucifer T
Rana catesbeiana *	Pseudacris streckeri T
Rana clamitans	Pseudacris triseriata * T
Rana pipiens T	Hyla versicolor * T
Chelydra serpentina *	Rana catesbeiana *
Chrysemys picta *	Rana blairi T
Emydoidea blandingii *	Rana utricularia T
Terrapene ornata T	Chelydra serpentina *
Trachemys scripta	Chrysemys picta *
Cnemidophorus sexlineatus * T	Emydoidea blandingii *
Ophisaurus attenuatus T	Cnemidophorus sexlineatus * T
Heterodon platirhinos * T	Scincella laterale T
Pituophis melanoleucus * T	Heterodon nasicus T
Coluber constrictor * T	Heterodon platirhinos * T
Thamnophis proximus T	Pituophis melanoleucus * T
Thamnophis sirtalis * T	Elaphe obsoleta T
	Lampropeltis calligaster T
	Coluber constrictor * T
	Thamnophis sirtalis * T
	Nerodia sipedon
BD+S total = 20	Mason Co. total = 24
BD+S terrestrial = 13	Mason Co. terrestrial = 18
Shared species total = 13	
Shared terrestrial species = 8	

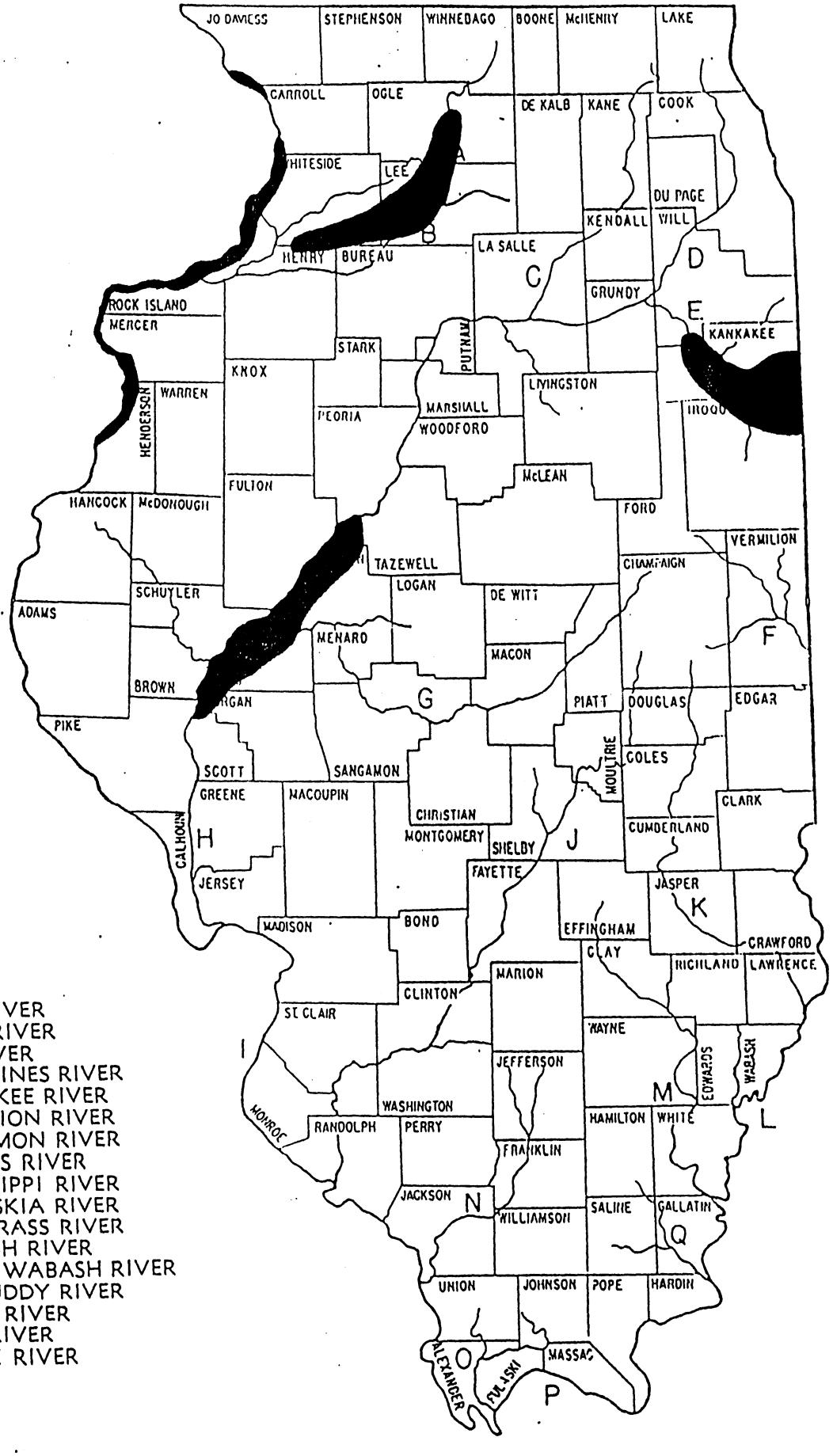
Table 10. A comparison of the herpetofaunae of the Braidwood Dunes and Savanna Nature Preserve and the Nebraska sandhills. A (T) denotes terrestrial species while an asterisk (*) indicates species shared between the two areas.

Braidwood Dunes and Savanna	Nebraska sandhills
Ambystoma tigrinum *	Ambystoma tigrinum *
Notopthalamus viridescens T	Bufo cognatus T
Bufo americanus T	Bufo woodhousii T
Pseudacris triseriata * T	Scaphiopus bombifrons T
Hyla versicolor T	Pseudacris triseriata * T
Rana catesbeiana	Rana pipiens * T
Rana clamitans	Kinosternon flavescens
Rana pipiens * T	Chelydra serpentina *
Chelydra serpentina *	Chrysemys picta *
Chrysemys picta *	Emydoidea blandingi *
Emydoidea blandingii *	Terrapene ornata * T
Terrapene ornata * T	Cnemidophorus sexlineatus * T
Trachemys scripta	Eumeces multivirgatus T
Cnemidophorus sexlineatus * T	Holbrookia maculata T
Ophisaurus attenuatus T	Sceloporus undulatus T
Heterodon platirhinos T	Heterodon nasicus T
Pituophis melanoleucus * T	Pituophis melanoleucus * T
Coluber constrictor * T	Lampropeltis triangulum T
Thamnophis proximus T	Coluber constrictor * T
Thamnophis sirtalis * T	Thamnophis radix T
	Thamnophis sirtalis * T
	Nerodia sipedon
	Crotalus viridis T
BD+S total = 20	Sandhills total = 23
BD+S terrestrial = 13	Sandhills terrestrial = 17
Shared species total = 11	
Shared terrestrial species = 7	

Table 11. Guilds occupied by the aquatic/riparian and terrestrial herpetofauna of the Nebraska sandhills (Ballinger et al., 1979; Lynch, 1985). The percent of the total herpetofauna comprised by each guild (rounded off) is also given.

Guild	Aquatic/Riparian		Terrestrial	
Omnivores	C. picta E. blandingii C. serpentina K. flavescens	57.1%	T. ornata	5.9%
Insectivores	A. tigrinum R. pipiens	28.6%	B. cognatus B. woodhousii S. bombifrons P. triseriata R. pipiens C. sexlineatus E. multivirgatus H. maculata S. undulatus	52.9%
Piscivore/ Amphibivores	N. sipedon	14.3		
Generalized Carnivores			L. triangulum C. constrictor T. radix T. sirtalis	23.5%
Bufonivores			H. nasicus	5.9%
Rodentivores			P. melanoleucus C. viridis	11.8%
Totals		100.0%		100.0%

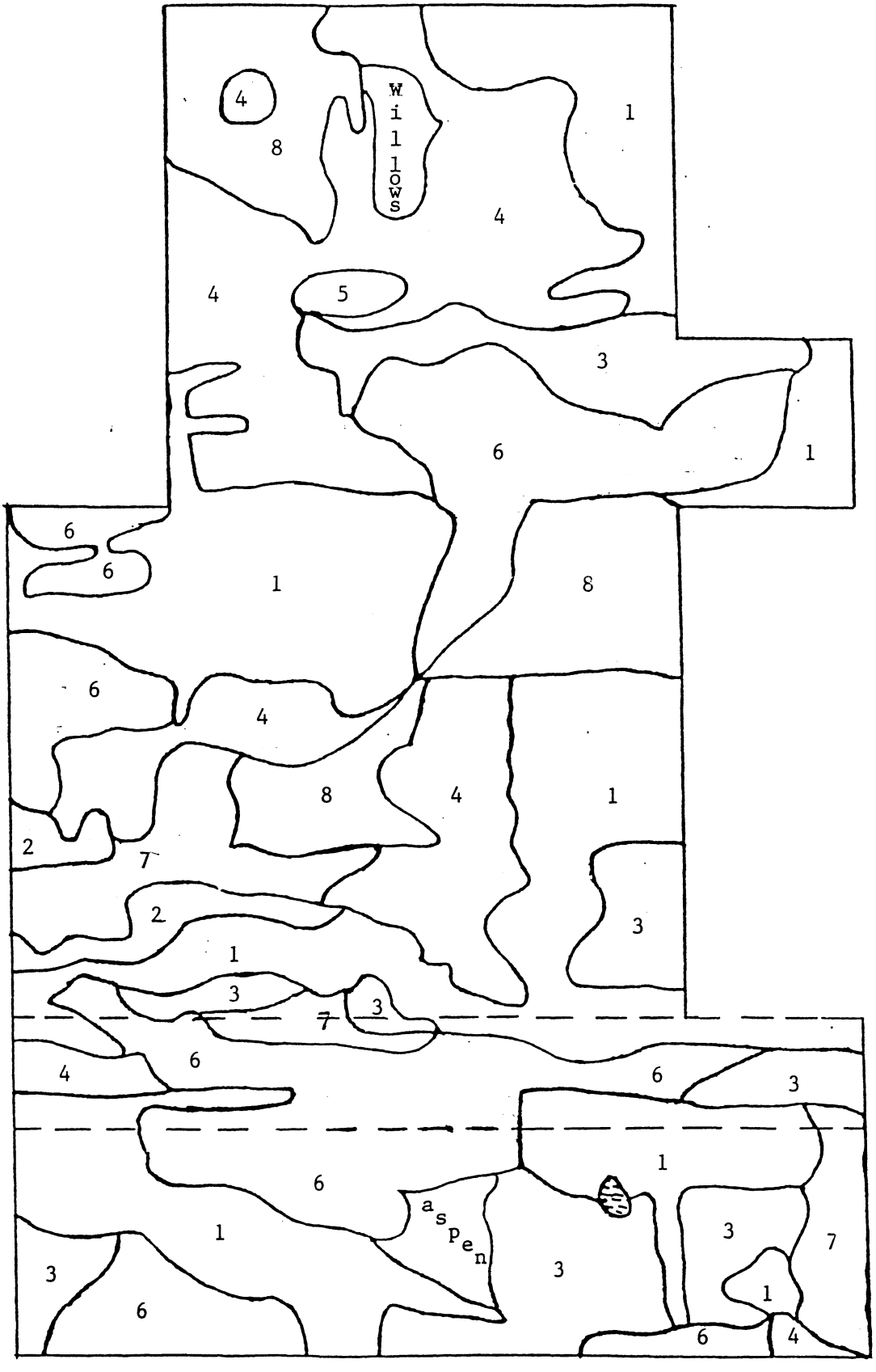
FIGURE 1: Sand areas of Illinois (black).



A. ROCK RIVER
B. GREEN RIVER
C. FOX RIVER
D. DES PLAINES RIVER
E. KANKAKEE RIVER
F. VERMILION RIVER
G. SANGAMON RIVER
H. ILLINOIS RIVER
I. MISSISSIPPI RIVER
J. KASKASKIA RIVER
K. EMBARRASS RIVER
L. WABASH RIVER
M. LITTLE WABASH RIVER
N. BIG MUDDY RIVER
O. CACHE RIVER
P. OHIO RIVER
Q. SALINE RIVER

FIGURE 2: Map of the Braidwood Dunes and Savanna Nature Preserve showing major habitat types.

1 - Dry-mesic sand savanna
2 - Dry-mesic sand savanna bordering marsh
3 - Dry to dry-mesic prairie
4 - Old (successional) field
5 - Sand dune blowout
6 - Wet to wet-mesic prairie
7 - Sedge meadow/marsh
8 - Old (successional) woods


4
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Willows
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6
3
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6
aspen
1
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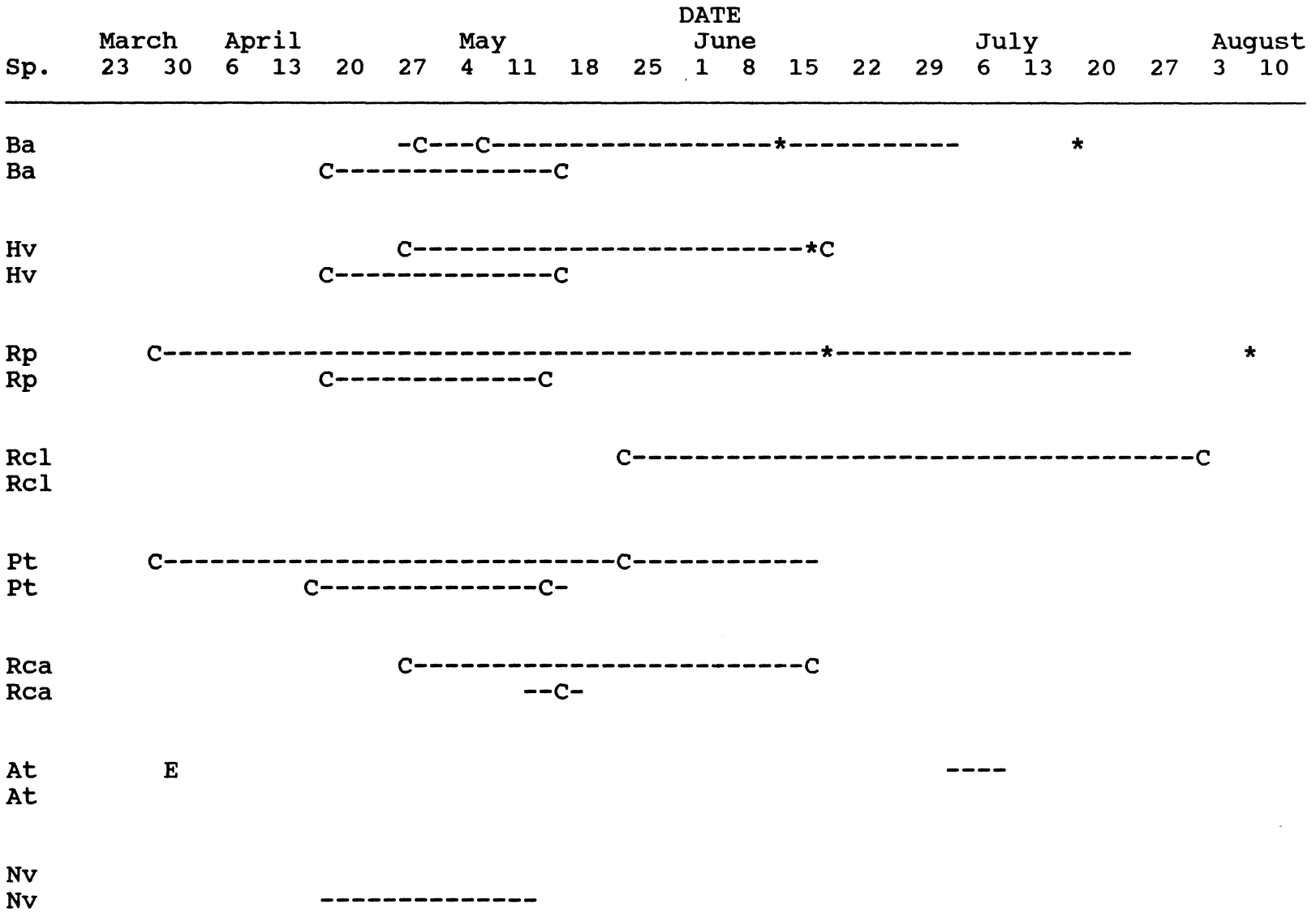
7
3
3
1
6
6
4

FIGURE 3a: Phenology chart of amphibians at The Braidwood Dunes and Savanna Nature Preserve and Sandridge Savanna. The symbol Sp represents species recorded. The upper line of each pair represents 1991 observations while the lower line represents 1992 observations.

Ba - Bufo americanus
Hv - Hyla versicolor
Rp - Rana pipiens
Rcl- Rana clamitans
Pt - Pseudacris triseriata
Rca- Rana catesbiana
At - Ambystoma tigrinum
Nv - Notopthalamus viridescens

Dashed lines (---) indicate the observed activity period of adults.
Asterisks (*) indicate the first and last observation of juveniles.
The letter C indicates the first and last observations of calling by males.
The letter E indicates eggs observed.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August
Sp.
23 30 6 13 20 27 4 11 18 25 1 8 15 22 29 6 13 20 27 3 10
Ba
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Rp
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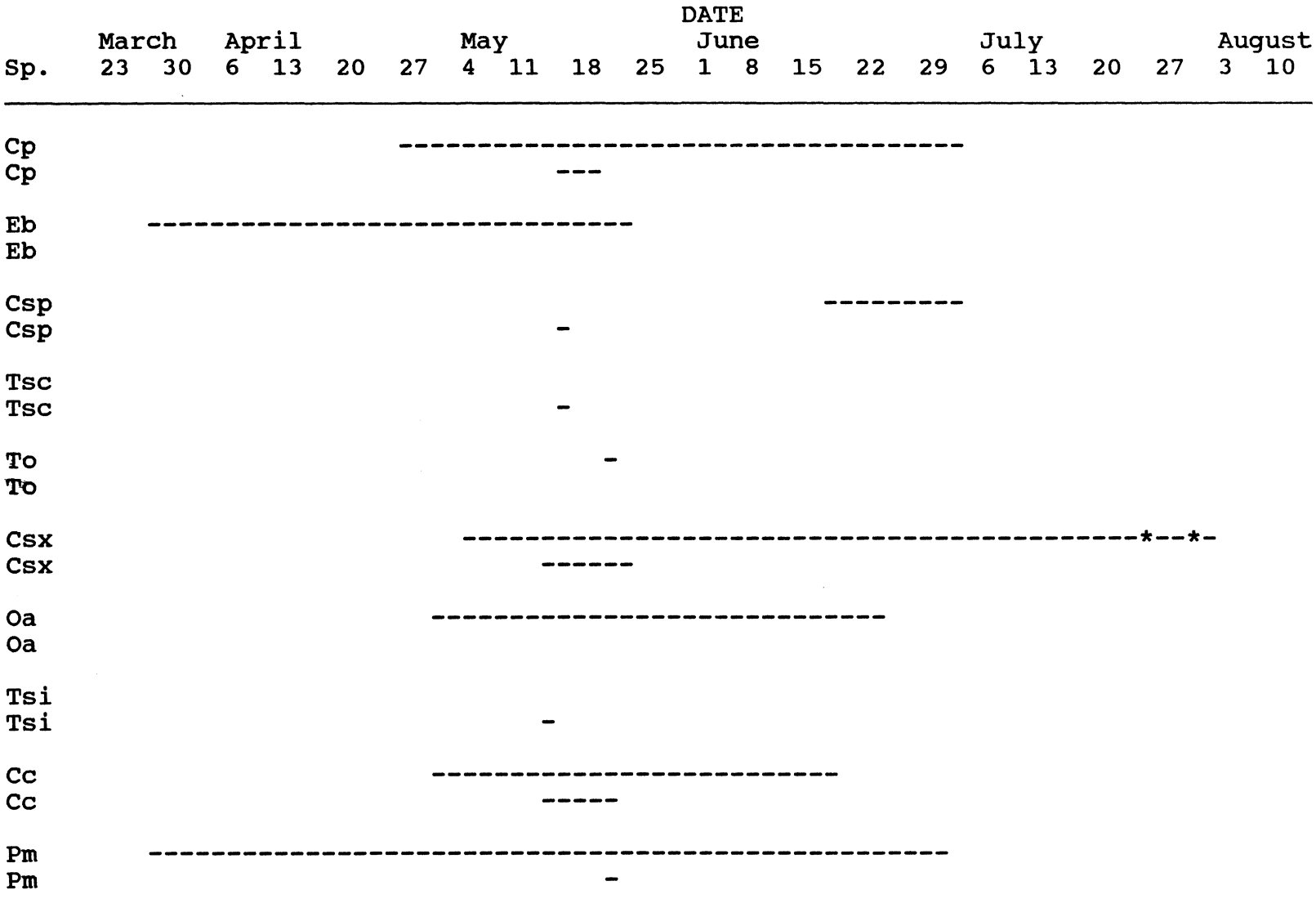
Rcl
Pt
Pt
Rca
Rca
At
At
Nv
Nv

FIGURE 3b: Phenology chart for reptiles at The Braidwood Dunes and Savanna Nature Preserve and Sandridge Savanna. The symbol Sp represents species recorded. The upper line of each pair represents 1991 observations while the lower line represents 1992 observations.

Cp - Chrysemys picta
Eb - Emydoidea blandingi
Csp- Chelydra serpentina
Tsc- Trachemys scripta
To - Terrapene ornata
Csx- Cnemidophorus sexlineatus
Oa - Ophisaurus attenuatus
Tsi- Thamnophis sirtalis
Cc - Coluber constrictor
Pm - Pituophis melanoleucus

Dashed lines (---) indicate the observed activity period of adults.

Asterisks (*) indicate the first and last observation of juveniles.


DATE
March
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Sp.
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Cp
Cp
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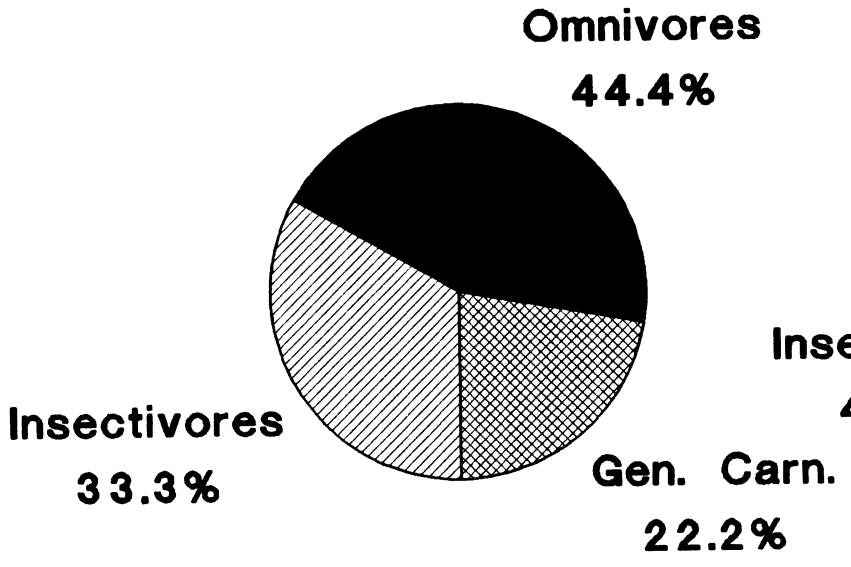
Eb
Csp
Csp
Tsc
Tsc
To
To
Csx
Csx
Oa
Oa
Tsi
Tsi
Cc
Cc
Pm
Pm

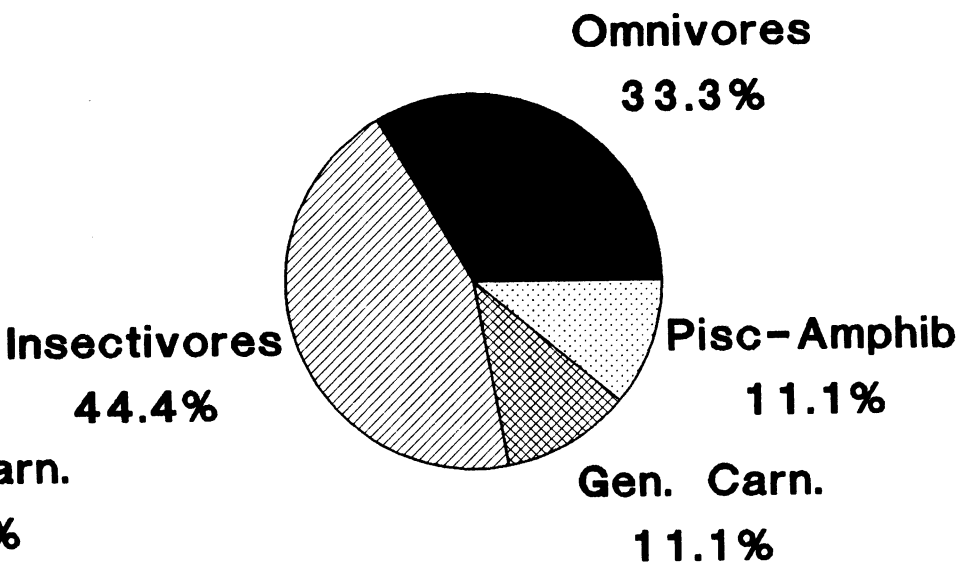
FIGURE 4: Aquatic herpetofaunal guilds present in the Will County and Mason County sand areas.

Gen Carn = Generalized carnivores

Pisc-Amphib = Piscivores and Amphibivores



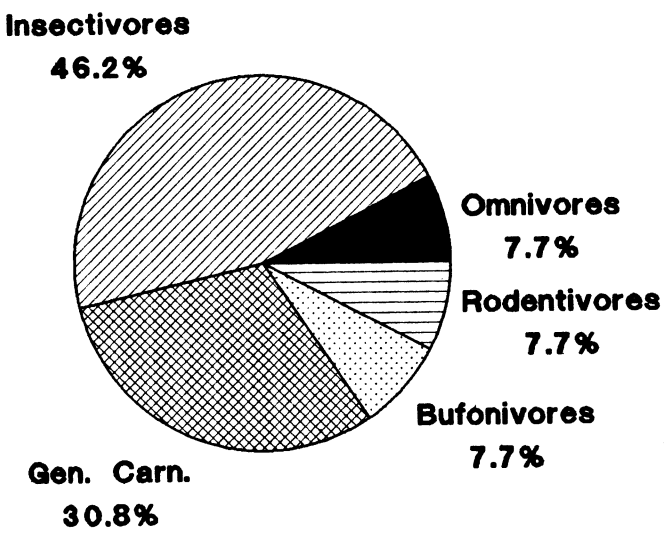
Will Co.



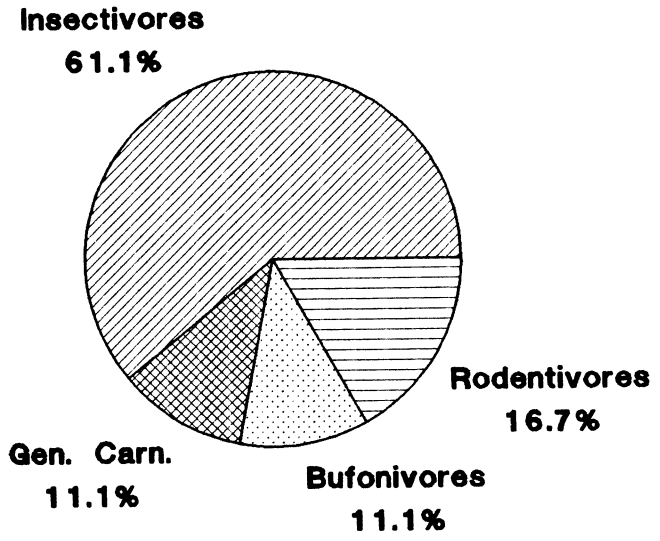
Mason Co.

FIGURE 5: Terrestrial herpetofaunal guilds present in the Will County and Mason County sand areas.

Gen Carn = Generalized carnivores

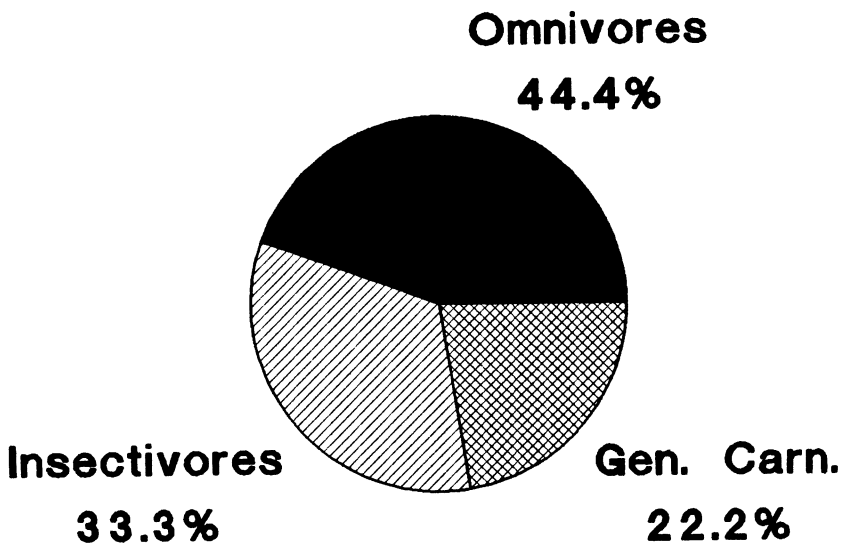


Will Co.

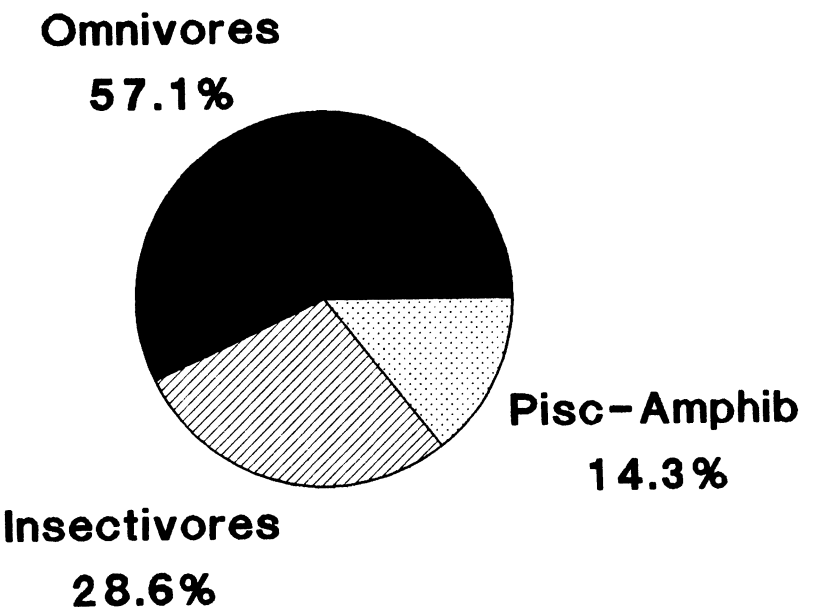


Mason Co.

FIGURE 6: Aquatic herpetofaunal guilds present in the sand areas of Will County and the Nebraska sandhills.
Gen Carn = Generalized carnivores
Pisc-Amphib = Piscivores and Amphibivores



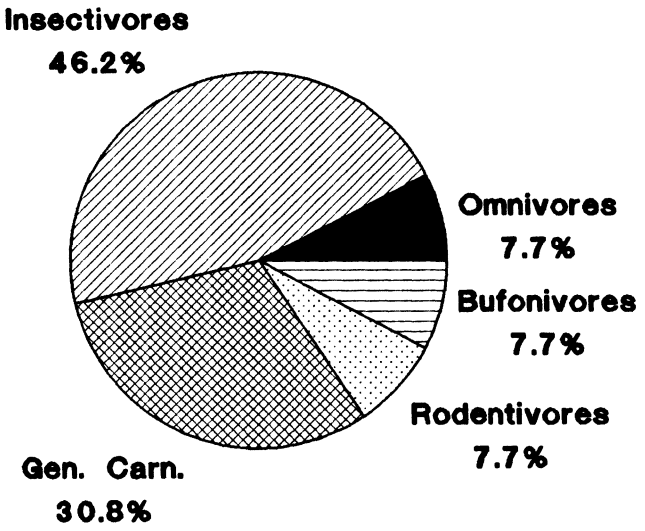
Will Co. sand



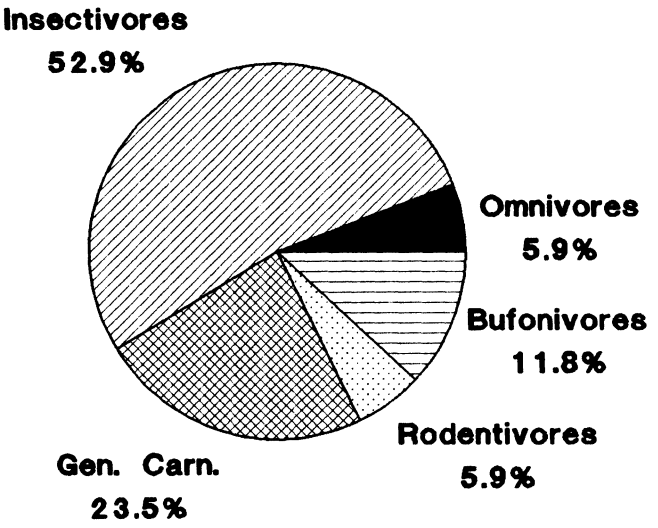
Nebraska sand

FIGURE 7: Terrestrial herpetofaunal guilds present in the sand areas of Will County and the Nebraska sandhills.

Gen Carn = Generalized carnivores

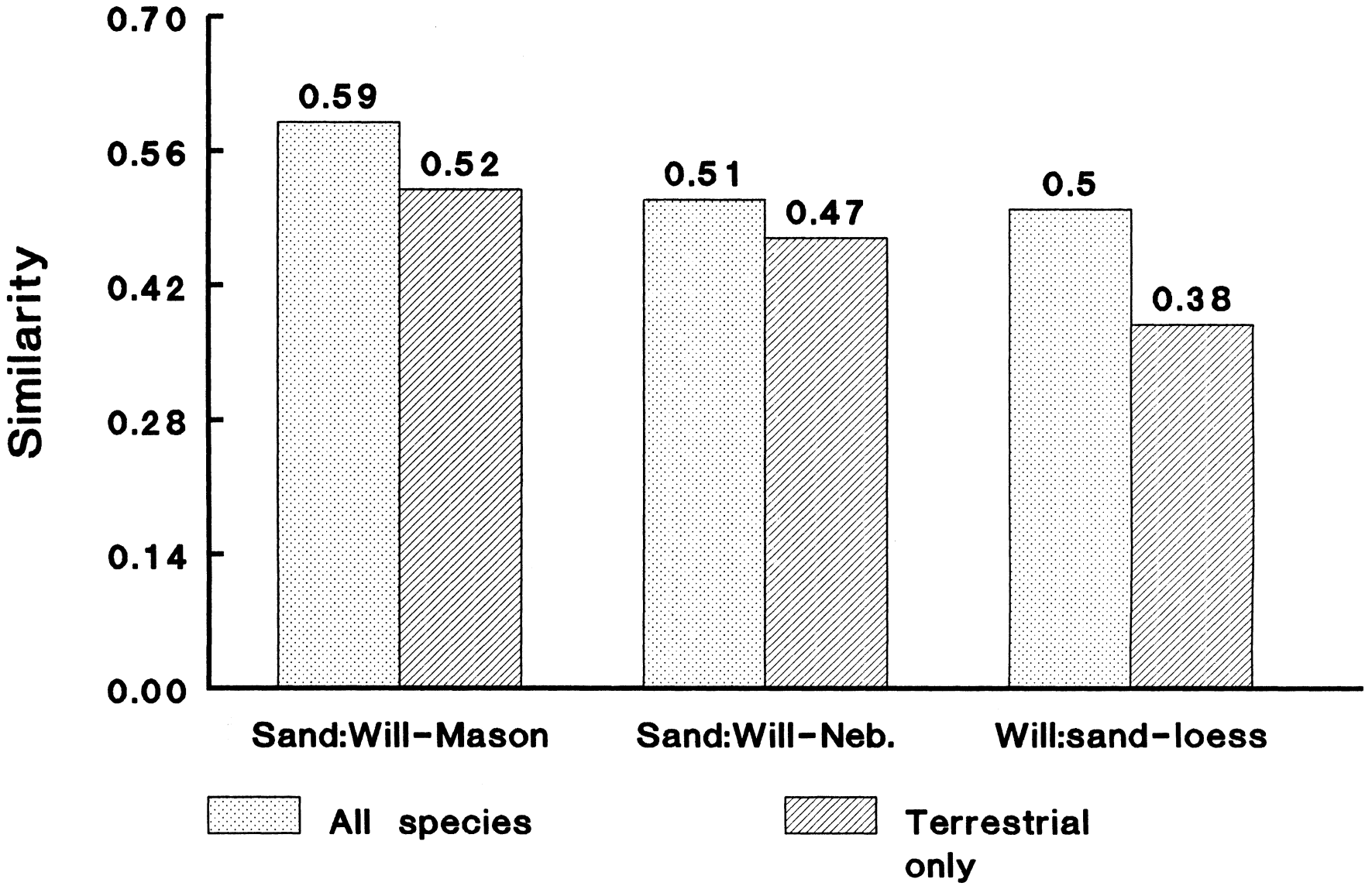


Will Co. sand



Nebraska sand

FIGURE 8: Indices of similarity between Will County sand areas and Mason County sand areas, Will County sand areas and the Nebraska sandhills, and Will County sand areas and Will County non-sand areas (Greig-Smith, 1964). Index of similarity = 2c/(a+b) where (a) is the number of species in one community, (b) is the number of species in the other community, and (c) is the number of species occurring in both communities. Scale ranges from 0 to 1.0 to show the range from no similarity to complete similarity.


Similarity
0.70
0.56
0.42
0.28
0.14
0.00
0.59
0.52
0.51
0.47
0.5
0.38
Sand:Will-Mason
Sand:Will-Neb.
Will:sand-loess
All species
Terrestrial only