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A Comparison of Three Populations of the Plains Pocket Gophers, Geomys bursarius illinoensis, in Illinois

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A Comparison of Three Populations of the Plains Pocket Gophers, *Geomys bursarius illinoensis*, in Illinois

(TITLE)

BY

Frank P. Wray

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A Comparison of Three Populations of the Plains Pocket Gophers, Geomys bursarius illinoensis, in Illinois

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Abstract: Morphometric and karyotypic analyses were performed on three Illinois populations of the Plains Pocket Gopher, Geomys bursarius illinoensis, to determine if any differences were present among the populations. Gophers were collected in three localities: 1) Iroquois and Kankakee Counties (IKC); McLean County (MC); and St. Clair and Madison counties (SMC). All three populations had the same kind and number of chromosomes (2n=72, FN=70). External measurements did not differ significantly among the three populations. Multivariate analysis of variance of the cranial characters showed that a significant ($P<.05$) difference existed in both males, $F(78,1825)=1.65$, and females, $F(78,1961)=1.63$, between the three regions. Duncan's multiple range tests of some cranial measurements showed a clinal increase going from east to west.

Pocket gophers of the genus Geomys are fossorial rodents of the family Geomydidae that occur principally in tall-grass prairie in the northeastern portion of the great plains west of the Mississippi River (Honeycutt and

Schmidly, 1979). The Illinois subspecies (Geomys bursarius illinoensis Komarek and Spencer, 1931) occurs in tall-grass prairie and oak-hickory savannah communities in eastern and central Illinois and west-central Indiana (Küchler, 1964). Many workers (Thaeler, 1974; Patton and Yang, 1977; Patton and Feder, 1978, 1981; Patton et al., 1979; Patton and Smith, 1981) have suggested that the gophers low vagility and high local morphological differentiation have been factors which have contributed to speciation. Consequently, the taxonomic status of Geomys has been repeatedly revised.

The Geomys bursarius complex ranges across the central and northern great plains and includes three subspecies: Geomys bursarius illinoensis, Geomys bursarius bursarius and Geomys bursarius wisconsinensis. Heaney and Timm (1983) describe these differences in the subspecies: G. b. illinoensis differs from G. b. bursarius and G. b. wisconsinensis in being larger, having a proportionately longer rostrum and longer tail, and having slate gray fur rather than brown. Also, the Illinois gopher and G. b. bursarius have that portion of the frontals which projects between the premaxillaries and contacts the nasals in the shape of an elongated triangle rather than a square, like that found in G. b. wisconsinensis.

Geomys b. illinoensis has a very distinct range in Illinois (Heaney and Timm, 1983). The gopher occurs in three general areas: (1) Kankakee, Iroquois, and Will

counties; (2) LaSalle, Marshall, Tazewell, Woodward, McLean, DeWitt, Macon, Logan, Mason, Cass, Scott, Morgan, Sangamon, and Macoupin counties; (3) St. Clair and Madison counties. Within these areas are smaller discrete breeding units, or demes. Patton and Feder (1981) have suggested that populations of gophers that are characterized by high gene flow and random mating will be much less varied than those in which the reverse conditions hold. Thus, it would be in those species that are subdivided into demes, genetic drift and demic extinction could serve as strong evolutionary forces. These forces should be important in the gophers in Illinois because of the small population size and low vagility. Along with the previously mentioned evolutionary forces, low gene flow and frequent inbreeding would indicate that the Illinois Plains Pocket Gopher is a highly variable subspecies.

The populations that occur in Illinois are separate and contact zones between populations have not been reported. Possibly contact zones are absent because Plains Pocket Gophers are restricted to areas where the soil is well drained, not gummy or too hard packed, and where there are tuberous-rooted plants providing a ready source of food (Heaney and Timm, 1983). In Illinois such habitats are discontinuous, isolating the populations. Soil drainage appears to be more important than the type of soil because these gophers are not found where there is water standing for prolonged periods of time. The limited

range due to soil drainage is in contrast to other work (Davis, 1938, 1940; Vaughn, 1967; Thaeler, 1968b) who have attributed soil types to gopher distribution. This association with soil types, however, was with the Plains Pocket Gopher in the southwest United States where vast stretches of well drained soils are found.

This study deals with three populations of the Plains Pocket Gopher in Illinois. These populations are separated by areas of rivers, forests, hard-packed soils, non-porous soils, and plowed farmland which comprises the greatest area of land. The primary objective of this study was to compare these three populations by means of morphometric and karyotypic analyses.

MATERIALS AND METHODS

Pocket gophers were live-trapped from July 1988 to October 1988 in traps described by Hart (1973). Gophers were collected in five counties in three areas in the state: 1) Iroquois and Kankakee Counties (IKC) in notheast-central Illinois; 2) McLean County (MC) in north-central Illinois and 3) St. Clair and Madison Counties (SMC) in southwest Illinois. The areas were selected because each area supported pocket gopher populations that were separate and distinct from one another. Within each of the three study areas, samples were pooled to maximize sample sizes. Live specimens were transported in 20 liter buckets containing 15 to 25 cm of soil, roots and carrots. The

pocket gophers were processed within 48 hours, and all specimens were prepared as conventional study skins (skin with skull) and deposited with the Department of Zoology, Eastern Illinois University.

Morphometric Analysis

Morphometric analysis included both live-trapped and museum specimens. Museum specimens were provided by the following institutions (numbers in parentheses indicate number of specimens provided): University of Illinois Museum of Natural History (64), University of Kansas Museum of Natural History (17), Eastern Illinois University (6), Field Museum of Natural History (5) and Illinois State University (2). Adult males and females were analyzed separately due to marked sexual dimorphism (Kennerly, 1958; Baker and Genoways, 1975). Adults were distinguished from juveniles on the basis of pelage, fusion of the basiooccipital suture and cranial crest development (Heaney and Timm, 1983).

Four external measurements (total length, TL; length of tail, LT; length of hind foot, LF; and length of ear, LE) were taken from each live trapped gopher and measured to the nearest mm. Twelve cranial measurements were taken with dial calipers and recorded to the nearest 0.1 mm as defined by Hendricksen (1973) and Honeycutt and Schmidly (1979):

1. Greatest length of skull (GLS)
2. Basal length (BL)
3. Breadth of rostrum (BR)
4. Zygomatic breadth (ZB)

5. Interorbital breadth (IO)
6. Breadth of braincase (BB)
7. Mastoidal breadth (MB)
8. Length of nasals (LN)
9. Length of rostrum (LR)
10. Length of maxillary toothrow (LTR)
11. Palatal length (PL)
12. Palatofrontal depth (PFD)

Standard statistics (mean, range, SE, and CV) and were computed for each sample using the CONDESCRIPTIVE procedure of SPSS-X (Statistical Package for the Social Sciences Inc., 1986). Duncan's multiple range test (ONEWAY) was used for univariate analysis to determine maximal nonsignificant subsets of samples for each measurement. In order to assess the degree of divergence among samples, a multivariate analysis of variance (MANOVA) was used. With MANOVA, a comparison of the nonrepeated dependent variables from all three regions was computed, this in turn determined if homogeneity of dispersion matrices existed between regions.

Karyotypic Analysis

Karyotypes of the pocket gophers were taken within 48 hours after capture. Standard karyotypes were prepared from metaphase chromosomes by an *in vivo* bone marrow technique described by Lee (1969) and modified by Baker (1970); Robbins and Baker (1978); Lee and Elder (1980); Baker, et al. (1982). The diploid number (2N) was determined by counting at least ten spreads per slide. A representative karyotype was photographed and a karyotype constructed on the basis of the number of biarmed and uniarmed autosomes and the morphology of sex chromosomes

(Patton and Dingman, 1968). Metacentric, submetacentric, subtelocentric, and acrocentric (telocentric) chromosomes were described using the terminology described by Patton (1967). The fundamental number (FN) was defined as the number of major chromosome arms in the autosomal complement (Honeycut and Schmidly, 1979). Each population was analyzed for variation in diploid number, autosome morphology, sex chromosome morphology, and fundamental number.

RESULTS

A total of 43 pocket gophers were collected from July to October 1988. Thirteen gophers were collected from the St.Clair-Madison County (SMC) region (2 adult males, 3 adult females, 7 juvenile males and 1 juvenile female); 12 in the McLean County (MC) region (4 adult males, 5 adult females, 1 juvenile male and 2 juvenile females); 18 in the Iroquois-Kankakee County (IKC) region (5 adult males, 9 adult females, 2 male and 2 female juveniles).

Morphometric analysis. Geographic variation in the three populations of Illinois Geomys bursarius was examined on basis of cranial and external measurements. Analyses were based on adult gophers that I collected (n=28) and adult specimens from museum collections (n=94).

External measurements from both adult males and adult females (Table 1) were analyzed. The measurements did not differ significantly among the three populations when using

Table 1. Geographic variation in external morphometric variables (mm) of adult male and female G. b. illinoensis from SMC, MC, and IKC areas. Duncan's multiple range test found the measurements for both males and females to be not significant (P .05). F value for each variable is indicated in parentheses.

Locality	(N)	Mean	Range	SE	CV
		MALES			
		(TL) TOTAL LENGTH (F=2.36)			
SMC	2	268	260 - 275	7.50	3.97
MC	4	296	280 - 305	5.68	3.83
IKC	5	283	257 - 300	8.26	6.53
		(LT) LENGTH OF TAIL (F=.28)			
SMC	2	90	90 - 90	.00	.00
MC	4	84	75 - 95	4.15	9.88
IKC	5	88	72 - 100	5.53	14.04
		(LF) LENGTH OF FOOT (F=.93)			
SMC	2	33	32 - 34	1.00	4.27
MC	4	36	35 - 36	.29	1.61
IKC	5	36	32 - 38	1.40	8.69
		(LE) LENGTH OF EAR (F=.04)			
SMC	2	6	5 - 6	.50	11.83
MC	4	6	4 - 8	.85	28.33
IKC	5	6	5 - 6	.24	9.17
		FEMALES			
		(TL) TOTAL LENGTH (F=.79)			
SMC	2	252	250 - 254	2.00	1.12
MC	5	266	246 - 305	10.38	4.29
IKC	9	256	231 - 277	4.12	6.21
		(LT) LENGTH OF TAIL (F=1.58)			
SMC	2	82	80 - 85	2.50	5.19
MC	5	80	71 - 95	4.15	11.61
IKC	9	73	59 - 85	3.00	12.34
		(LF) LENGTH OF FOOT (F=.40)			
SMC	3	31	30 - 33	.88	4.92
MC	5	33	30 - 37	1.38	9.32
IKC	9	33	29 - 38	.87	7.87
		(LE) LENGTH OF EAR (F=.32)			
SMC	3	5	4 - 5	.33	11.34
MC	5	5	4 - 6	.32	14.14
IKC	9	5	3 - 6	.31	18.59

either the Duncan's test or MANOVA.

When the cranial measurements of females and males were compared, the IKC region had the largest mean value in nine of the measurements of the females (Table 2) and 10 of the males (Table 3). Manova showed a lack of homogeneity between the three regions for both females ($F(78, 1961)=1.63$, $P<.05$) and males ($F(78,1825)=1.65$, $P<.05$). Specific differences in cranial characteristics of females (n=70) were based on Duncan's univariate multiple range test which showed that skulls from IKC and MC regions together were significantly ($P<.05$) larger than those from the SMC region for all variables measured except BR, IB, BB and LN. IKC skulls were also significantly larger than the MC skulls in three of the variables (BL, BR and PFD). The MC skulls were significantly larger than the SMC skulls in all but four variables (IB, BB, LN and LTR).

Specific differences in the cranial characteristics of the male gophers (n=51) revealed that three of the 12 cranial variables measured on skulls from male gophers differed significantly ($P<.05$) within the three populations: BR, IB and LTR (Table 3). Breadth of Rostrum (BR) was significantly larger in the IKC region than the MC region but not the SMC region, and the LTR measurement was significantly larger in IKC than either MC or SMC skulls. The MC skulls were significantly larger than the SMC skulls but not the IKC skulls when IB was compared.

Karyotypic analysis. Standard karyotypes of the

Table 2. Geographic variation in cranial variables (mm) of adult female G. b. illinoensis from SMC (n=12), MC (n=43), and IKC (n=15) areas. Vertical lines represent non-significant subsets as determined by Duncan's multiple range test. F value for each variable is indicated in parentheses.

Locality	Mean	Range	SE	CV
(GLS) GREATEST LENGTH OF SKULL (F=9.47)				
SMC	45.6	39.5 - 48.7	.87	6.59
MC	48.0	43.0 - 53.1	.32	4.31
IKC	49.4	46.4 - 53.9	.58	4.57
(BL) BASAL LENGTH (F=7.12)				
SMC	44.0	36.3 - 47.2	1.07	8.40
MC	45.8	40.0 - 50.6	.34	4.81
IKC	47.7	44.4 - 52.3	.64	5.17
(BR) BREADTH OF ROSTRUM (F=16.54)				
SMC	10.0	8.6 - 11.0	.21	7.30
MC	10.4	9.2 - 11.5	.07	4.70
IKC	11.2	9.9 - 12.2	.16	5.56
(ZB) ZYGOMATIC BREADTH (F=9.84)				
SMC	27.1	22.2 - 29.1	.60	7.74
MC	29.3	25.1 - 34.6	.03	6.71
IKC	30.4	27.4 - 33.3	.45	3.86
(IB) INTERORBITAL BREADTH (F=1.92)				
SMC	6.4	6.1 - 6.7	.07	3.66
MC	6.6	6.1 - 7.3	.04	4.29
IKC	6.6	6.2 - 7.2	.07	4.03
(BB) BREADTH OF BRAINCASE (F=.69)				
SMC	19.4	17.2 - 20.6	.29	5.19
MC	19.6	17.7 - 21.7	.12	4.17
IKC	19.8	19.0 - 21.4	.22	8.15
(MB) MASTOIDAL BREADTH (F=5.56)				
SMC	25.1	21.2 - 27.2	.29	5.19
MC	26.8	23.7 - 29.7	.20	4.90
IKC	26.9	21.1 - 29.8	.57	8.15
(LN) LENGTH OF NASALS (F=.33)				
SMC	16.7	12.9 - 18.7	.54	11.24
MC	17.1	13.4 - 19.7	.19	7.16
IKC	16.9	11.4 - 20.9	.61	14.05
(LR) LENGTH OF ROSTRUM (F=4.34)				
SMC	20.9	17.7 - 23.0	.51	8.46
MC	22.2	18.8 - 25.2	.20	5.95
IKC	22.2	20.4 - 24.2	.29	4.98
(LTR) LENGTH OF MAXILLARY TOOTHROW (F=14.41)				
SMC	9.0	7.9 - 10.1	.20	7.87
MC	9.3	8.1 - 10.5	.08	5.82
IKC	10.0	9.4 - 11.0	.12	4.59
(PL) PALATAL LENGTH (F=5.44)				
SMC	31.4	26.0 - 34.0	.80	8.85
MC	33.1	28.8 - 36.8	.28	5.57
IKC	34.0	31.0 - 36.5	.49	5.63
(PFD) PALATOFRONTAL DEPTH (F=7.44)				
SMC	17.8	15.5 - 18.9	.35	6.80
MC	18.6	16.5 - 20.2	.12	4.27
IKC	19.2	18.0 - 20.7	.24	4.61

Table 3. Geographic variation in cranial variables (mm) of adult male G. b. illinoensis from SMC (n=13), MC (n=30), and IKC (n=8) areas. Vertical lines represent non-significant subsets as determined by Duncan's multiple range test. F value for each variable is indicated in parentheses.

Locality	Mean	Range	SE	CV
(GLS) GREATEST LENGTH OF SKULL (F=.86)				
SMC	52.3	44.2 - 58.7	1.21	8.34
MC	51.9	44.1 - 59.1	.74	7.78
IKC	54.0	48.5 - 56.6	1.10	5.74
(BL) BASAL LENGTH (F=1.42)				
SMC	50.7	41.5 - 56.9	1.28	9.15
MC	49.8	40.5 - 57.2	.83	9.16
IKC	52.7	47.2 - 55.7	1.11	5.96
(BR) BREADTH OF ROSTRUM (F=3.09)				
MC	11.0	9.6 - 12.3	.14	6.91
SMC	11.3	9.6 - 12.9	.27	8.76
IKC	11.7	10.6 - 12.8	.27	6.50
(ZB) ZYGOMATIC BREADTH (F=.30)				
SMC	32.1	25.8 - 36.8	.94	10.62
MC	31.9	26.7 - 37.9	.57	9.75
IKC	32.9	26.8 - 37.0	1.11	9.57
(IB) INTERORBITAL BREADTH (F=4.61)				
SMC	6.4	6.2 - 7.2	.07	3.88
IKC	6.5	6.1 - 7.1	.13	5.54
MC	6.7	6.1 - 7.3	.06	4.48
(BB) BREADTH OF BRAINCASE (F=.16)				
SMC	20.5	18.5 - 22.3	.28	4.88
MC	20.3	18.0 - 23.8	.24	6.50
IKC	20.2	18.9 - 21.2	.27	3.77
(MB) MASTOIDAL BREADTH (F=.26)				
SMC	28.2	23.6 - 31.3	.60	7.73
MC	28.7	25.2 - 37.8	.48	9.20
IKC	28.8	26.4 - 30.9	.52	5.10
(LN) LENGTH OF NASALS (F=1.10)				
SMC	19.9	14.0 - 24.4	.82	14.82
MC	18.7	14.5 - 24.1	.42	12.46
IKC	19.6	17.4 - 22.1	.53	7.70
(LR) LENGTH OF ROSTRUM (F=.50)				
SMC	24.3	19.6 - 27.8	.68	10.08
MC	24.1	19.9 - 28.6	.43	9.88
IKC	24.9	22.0 - 26.8	.59	6.75
(LTR) LENGTH OF MAXILLARY TOOTHROW (F=9.09)				
SMC	9.4	8.4 - 10.6	.17	6.60
MC	9.5	8.8 - 10.2	.09	5.37
IKC	10.4	9.6 - 11.7	.28	7.80
(PL) PALATAL LENGTH (F=.71)				
SMC	36.6	29.7 - 41.9	.98	9.62
MC	36.1	29.9 - 42.1	.62	9.42
IKC	37.7	33.2 - 40.4	.96	7.24
(PFD) PALATOFRONTAL DEPTH (F=.78)				
SMC	20.0	17.3 - 22.5	.42	7.55
MC	20.2	17.1 - 23.2	.30	8.17
IKC	20.8	18.5 - 22.2	.44	6.01

pocket gophers (n=23) from all three areas were identical; all the gophers exhibited the karyotype 2N=72, FN=70, and all three regions possessed a completely acrocentric chromosome complement (Fig. 1, 2, and 3).

DISCUSSION

The pocket gopher in Illinois has been recognized as Geomys bursaris illinoensis since 1931, when it was named as a subspecies by Komarek and Spencer (1931). The Illinois subspecies is less variable and more restricted in its range than other members of the Geomys bursarius complex (Heaney and Timm, 1983). This restriction is related to the distribution of suitable soils (Hart, 1978). Major rivers have also been discussed as formidable barriers to the distribution of this species of gopher (Davis, 1940; Kennerly, 1954; Miller, 1964). In Illinois, the pocket gophers in general are restricted by the Mississippi river to the west, the Illinois river in the North, and throughout the state by the lack of suitable soil habitat.

Hart (1978) theorized that in the middle to late Pleistocene, a "breviceps-like group" (2n=74, FN=72) of pocket gophers were ancestral to the Illinois species or "major-like group" (2n=72, FN=70) gophers which radiated northward and eastward and occupied much of the Midwest. The "breviceps form" was present in the most stable geographic area historically, the Gulf Coastal Plains,

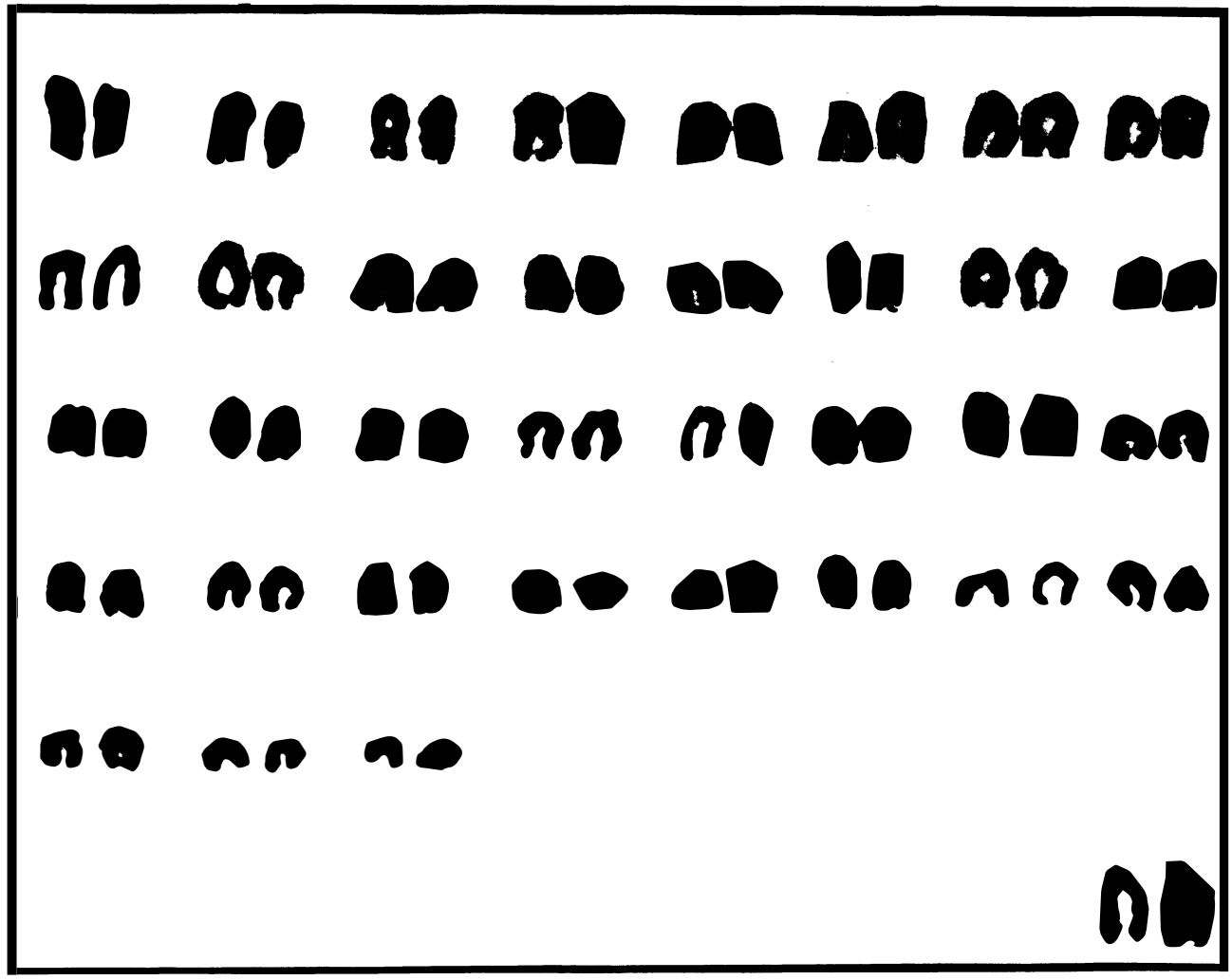

Figure 1. Karyotype of a female Geomys bursarius illinoensis from the SMC region near Collinsville, Madison Co., Illinois. 2N=72, FN=70.

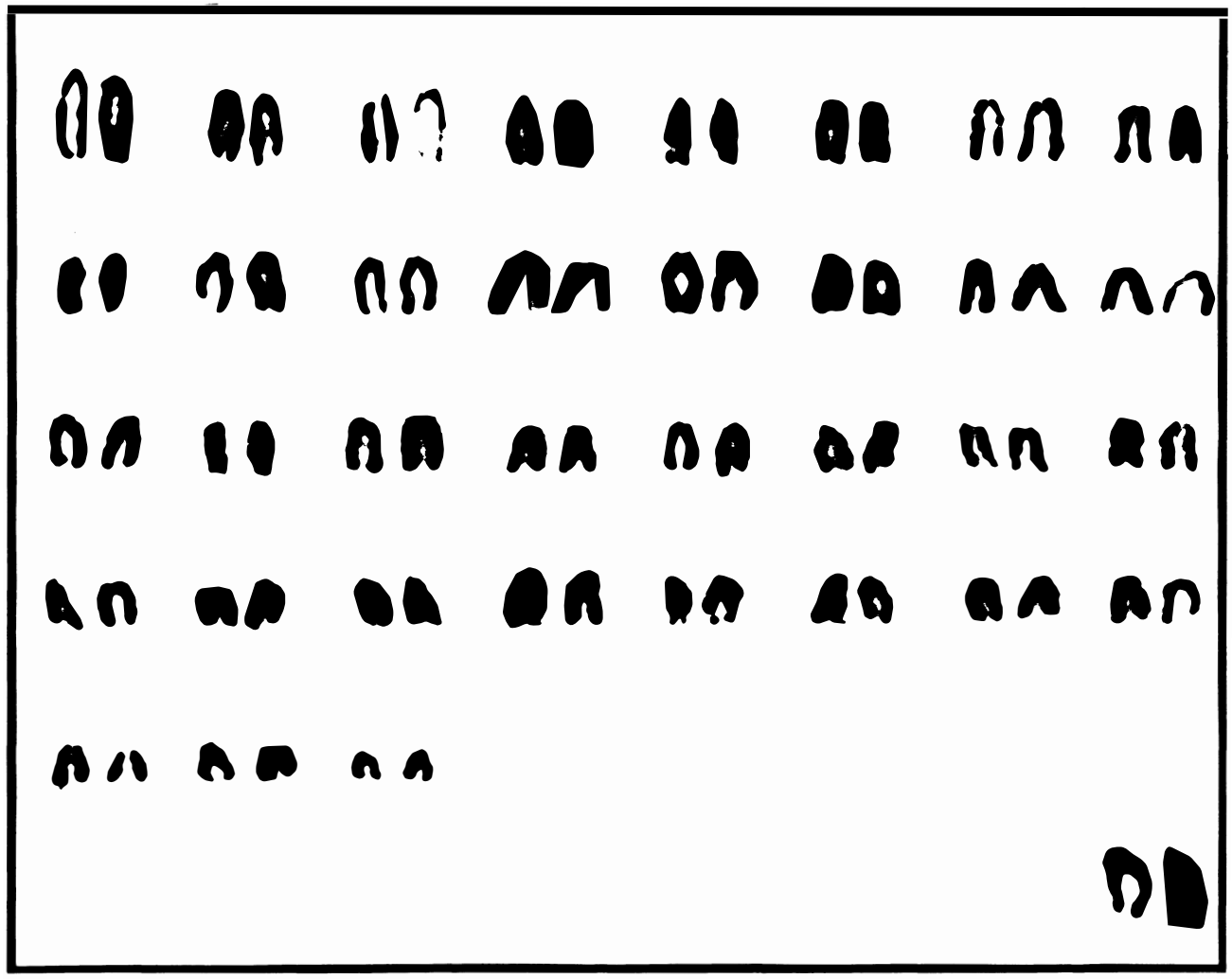

Figure 2. Karotype of a female Geomys bursarius illinoensis from the MC region near Hudson, McLean Co., Illinois. 2N=72, FN=70.

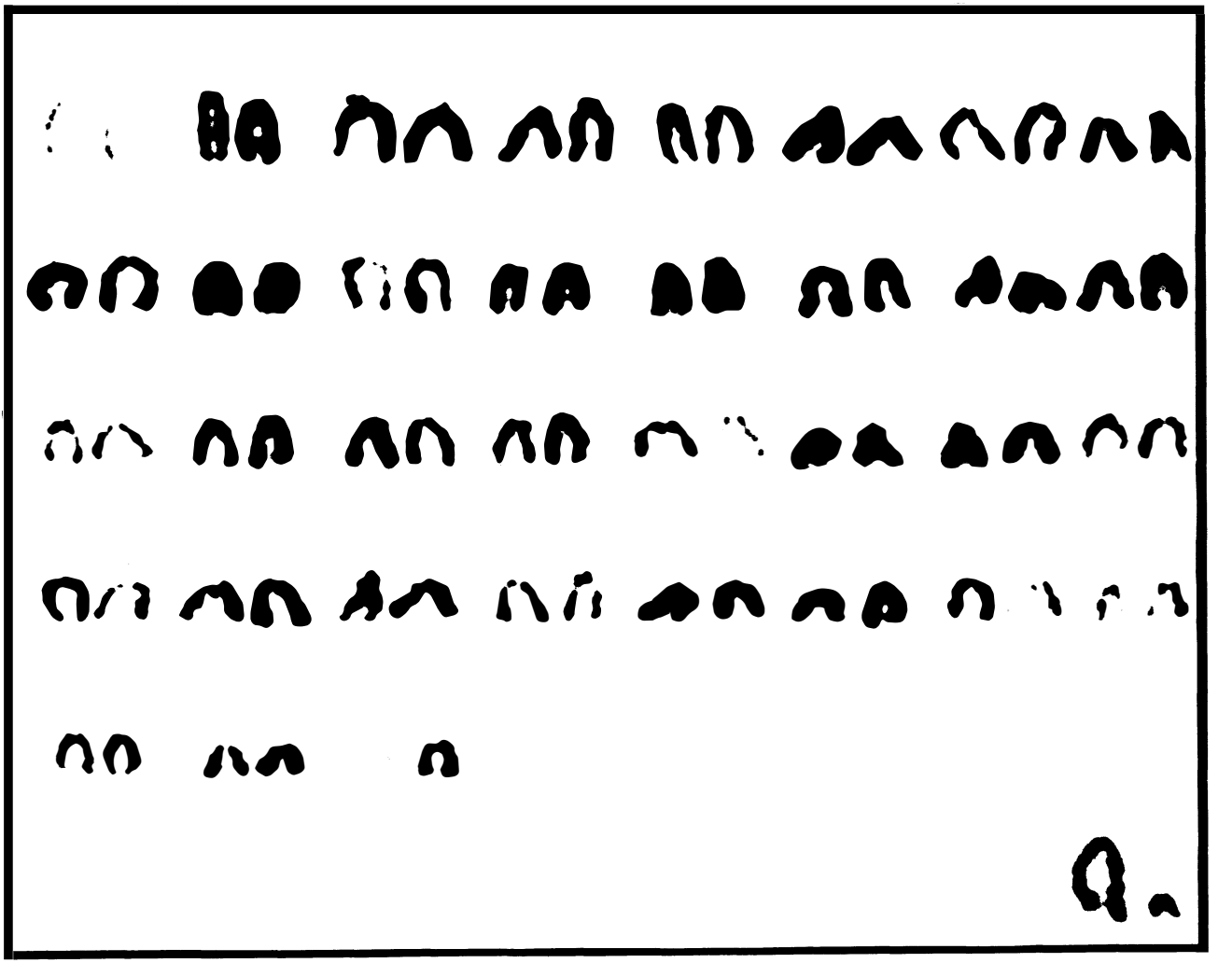

Figure 3. Karotype of a male Geomys bursarius illinoensis from the IKC region near Chebanse, Iroquois Co., Illinois. 2N=72, FN=70.

during the Pleistocene and were not subject to glacial advancement. This supports the premise that the population of pocket gophers in Illinois was probably continuous with those to the west at one time, but glacial advancement followed by meltwater rivers initially bifurcated populations of Geomys, isolating G. b. illinoensis in the east Hart (1978). Thus, the Gulf Coastal Plains acted as an important dispersal corridor (Auffenberg and Milsted, 1965). In recent times agricultural development further divided the Illinois pocket gophers into three general areas with smaller disjunct populations contained within them (Heaney and Timm, 1983). I sampled a population in each of these areas.

The gophers in the St. Clair-Madison County (SMC) region were restricted to the west by the Mississippi river, but their lack of expansion to the north, east, and south cannot be directly due to soil type or rivers for suitable soil apparently radiates in all three directions for a reasonable distance (Smith and Smith, 1938; Goddard and Sabata, 1982). I believe that human activity is the primary reason this population is apparently restricted to its present small distribution. Collection locations of museum specimens were searched but unfortunately many are now residential or other development areas. The only population of pocket gophers observed in the SMC region was in Madison County at the Collinsville High School.

The population I sampled in McLean County (MC) was

restricted by effective water drainage. Their habitat was unusual in that the soil was a hard black clay loam (Hopkins, et al., 1915) in contrast to the loose, sandy, well drained soils used by most pocket gophers. The small scattered demes observed in this collecting area were on the incline of ditches or in cultivated fields. These areas were all well drained and no pocket gophers were found in areas where water could remain standing for a prolonged period of time.

The population I sampled in the Iroquois-Kankakee County (IKC) region was restricted in range primarily by the distribution of suitable soil found in the area. The soil in the region where these rodents are present is a brown sandy loam (Hopkins, et al., 1916 and Mosier, et al., 1922). This soil drains very well, therefore burrow systems are found in a variety of topographic sites.

Methods for showing variation in Geomys bursarius and other fossorial rodents have been well documented. Morphometric analysis was once the only criterion for systematic study, now chromosomal and electrophoretic analyses along with morphometric analysis now provide evidence of variation among similar forms.

Chromosomal variation has been a source of controversy when the matter of populational relationships throughout the range of G. bursaris have been considered (Kim, 1972; Hart, 1978). Both Hart and Kim concluded that chromosomal divergence seen within the G. bursaris complex could

represent karyotypic differences among obscure species. Studies of other fossorial animals (e.g. moles, pocket mice, etc.) have also shown karyotypic differences to be indicative of species-level differentiation (Patton and Dingman, 1968; Patton, 1973; Thaeler, 1968a, 1968b, 1974). However, other investigations that involved contact zones between chromosomally distinct populations, have shown that not all karyotypic differences justify species recognition. Baker et al. (1975) and Thaeler (1974) concluded the true role of karyotypic variation in speciation can be determined only by examining interactions of chromosomal forms in zones of contact. Hart (1978) reported the karyotype of G. b. illinoensis to be of the "major group" (2n=72, FN=70) and designated this karyotype as the "major karyotype". I found this karyotype in all three regions. I believe that since the Illinois subspecies of pocket gopher had no observed zones of contact with other chromosomally distinct subspecies (e.g., G. b. bursarius or G. b. wisconsinensis) and no karyotypic variation was observed within the regions studied, species recognition is not warranted for those pocket gophers in Illinois.

In contrast to the lack of karyotypic variation there was morphometric variation. External measurements (Table 1) did not differ significantly between the three areas, however, cranial measurements differed significantly in some instances. Female skulls were significantly larger in IKC for nine of the twelve characteristics measured and

males were larger in one measurement from this locality. The univariate analysis thus revealed a trend toward a clinal increase in size from west to east across Illinois. This was particularly evident when comparing female skulls from the IKC and SMC regions.

Although univariate analysis showed significance, Honeycutt and Schmidly (1979) have shown that single morphological characters cannot explain entirely the patterns of geographic variation in G. bursarius. It has been shown that by using multivariate analysis along with univariate analysis will give a more accurate means for analyzing the variation can be obtained. When MANOVA was used to interpret the variation of G. b. illinoenis, it showed that the three regions were significantly different in cranial measurements in both the males and females.

Isolation has been shown to be the chief mechanism of speciation. The differences in cranial characteristics that I observed between regions in Illinois is probably the result of the isolation the Illinois subspecies has had from other members of the Geomys bursarius complex and isolation between other populations in Illinois. Differences in chromosome morphology often follow isolation but, as noted by Jackson (1971), phenotypic differences may occur in the absence of changes in chromosome morphology. With the limited distribution and the enforced inbreeding which must occur in the Illinois populations, chromosome variability may occur in the future. This along with

changes due to geographic isolation increase differences within the Illinois pocket gophers.

Workers who have analyzed the Illinois subspecies in the past have not described a clinal increase in size of the cranial characteristics. Hart's (1978) work was centered entirely on karology of the Plains Pocket Gopher. Heaney and Timm (1983) compared G. b. illinoensis to the Missouri subspecies (G. b. bursarius) and found that the Illinois subspecies was smaller and had a proportionately shorter rostrum and shorter tail. Their sample however consisted of 45 gophers from the counties in and around my MC region and only two from the IKC region and three from the SMC region. This is interesting in that the SMC skulls I sampled had a significantly shorter rostrum length, along with other smaller cranial measurements, than the other two regions.

I submit two theories to explain the trend toward clinal changes in some cranial features. First, pocket gophers in the SMC area were in contact with G. b. bursarius longer than the populations found in and near the MC and IKC regions. The Xerothermic period in the Pleistocene did allow for a eastwardly movement of plains animals (Smith, 1957), thus the Missouri subspecies could have come in contact with the Illinois subspecies in the SMC region without coming in contact with any of the other populations in Illinois. It could be argued that the gophers in the SMC region have not been in contact with G.

b. bursarius from Missouri or other components of the Illinois subspecies for a greater length of time and have developed independently of either of them. Heaney and Timm (1983) and Hart (1978) both have reported the distribution of the pocket gophers in Illinois shows a large geographical separation between the SMC region and the gophers found in the central and northeastern part of the state. The large physical separation is probably due to glacial action, changes in climatic conditions and formation of river systems that occur here in Illinois.

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