

Karyotypic Variation in Pocket Gophers (Geomyidae:  
Geomys) from a Narrow Contact Zone in Nebraska

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Because pocket gophers have limited dispersal ability, populations may become isolated from each other by geographic barriers such as unsuitable soils and vegetation types. This low vagility is associated with a rich array of karyotypic variation throughout the genus Geomys. Most of the studies of chromosomal variation in Geomys have been on the southern populations (summarized by Honeycutt and Schmidly, 1979); the one karyological study that encompassed northern populations as well was that of Hart (1978). We became interested in karyotypic variation in the northern Geomys as an outgrowth of our previous independent studies (Hart, 1978; Heaney, 1979; Timm, 1979) which demonstrated that the current taxonomy of the gophers does not accurately reflect the relationships of the pocket gophers.

Hart (1978) documented karyotypic variation in Geomys from the Great Plains; he showed that two taxa that are parapatric in eastern Nebraska and Kansas have karyotypes that differ greatly in the number of banded autosomes. Heaney and Timm (1983) subsequently analyzed geographic variation in these populations and showed that these karyotypically distinct taxa should be recognized as valid species, Geomys bursarius and G. lutescens. They cited morphological evidence that hybridization is limited to a small area in Antelope County, Nebraska, near the town of Oakdale. Because this area near Oakdale has proven to be critical in elucidating the relationships of the northern Geomys, we karyotyped 24 additional pocket gophers from the area and present here all the karyotypic data available from the zone of contact in Antelope County.

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## Methods and Materials

Live Geomys from Antelope County were captured from several localities near Neligh, Oakdale, and Tilden for chromosomal analysis during the summers of 1969, 1970, and 1981 by Hart, and during the fall of 1980 by Heaney and Timm. Karyotypes were prepared in the field utilizing the techniques described by Patton (1967), except that Hart used potassium chloride instead of sodium citrate to induce spreading. A minimum of five counts of metaphase spreads were scored per animal. Technical difficulties caused Hart's preparations to be of variable quality, so that his counts should be interpreted as  $\pm 5$  for fundamental number (FN). The two data sets are referred to by collector's initials.

Voucher specimens were prepared as either skins with skulls, skins with skeletons, or fluid preserved, and are deposited in the Field Museum of Natural History (FMNH); Museum of Natural History, University of Kansas (KU); Stovall Museum, University of Oklahoma (SM); and Museum of Zoology, University of Michigan (UMMZ).

## Results

Hart (1978) found that Geomys bursarius from Iowa, Missouri, and Wisconsin had similar karyotypes ( $2n = 72$ , FN = 72, 2 biarmed autosomes) and these differed only slightly from gophers from Illinois and eastern Kansas ( $2N = 72$ , FN = 70, no biarmed autosomes), and eastern Nebraska and eastern South Dakota ( $2N = 70$ , FN = 68, no biarmed autosomes) (see Table 1). In contrast, Geomys lutescens lutescens from central and western Nebraska differs greatly in the number of biarmed autosomes ( $2N = 72$ , FN = 86-98, 16-28 biarmed autosomes) with some populations showing polymorphism (Hart, 1978). Hart also reported that the subspecies lutescens was the most variable of all taxa of Geomys that he examined.

We karyotyped 24 Geomys from the vicinity of the contact zone between G. bursarius and G. lutescens near Oakdale, Antelope County, Nebraska (Table 1). Two G. bursarius from 2 3/4 mi. E. Oakdale, Antelope County, had karyotypes identical to those reported by Hart (1978) for a single individual from 1 mi. W. Tilden, Antelope County (2N = 70, FN = 68, with no biarmed autosomes). One animal from 1 1/3 mi. E. Oakdale had a 2N of 72 and FM of 70. Gophers in the area from 6/10 mi. W. Oakdale to 1 1/10 mi. W. Oakdale had fundamental numbers ranging from 75 to 95. Geomys from all areas further west (from 1 2/10 mi. W. Oakdale and beyond) <sup>Fig. 13</sup> had fundamental numbers ranging from about 84 to 92, and 2N of 72. Gophers in the latter group have karyotypes indistinguishable from those in central and western Nebraska (Hart, 1978). Six individuals in the area between 6/10 mi. W. and 1 1/10 mi. W. Oakdale have fundamental numbers intermediate (75-82; Fig. 14) between the parental types (bursarius FN = 68-70, and lutescens = 84-92). The others are similar to G. lutescens (FN = 88-95, six specimens).

The karyotype shown in Fig. 14 is from a female near the western edge of the hybrid zone. It possesses five pairs of biarmed chromosomes (excluding the unidentified sex chromosomes), rather than the eight to fourteen pairs that are characteristic of G. lutescens. Because most of the biarmed chromosomes are submetacentric, counts of arms appear to be non-ambiguous. The specimen shown was apparently unique in our sample in possessing a 2N of 71. Two other hybrids (EBH 616, LRH 1823) each had a single microchromosome present in some (but not all) spreads. These microchromosomes were not included in the 2N counts in Table 1.

Because of the high variability in FN present in the parental population of G. lutescens, and due to the similarity of FN in the parental populations, it is not possible to say whether the karyotypically intermediate individuals are F<sub>1</sub> hybrids or backcrosses. It is apparent that the change from G. bursarius

to G. lutescens karyotypes takes place over a distance of about one-half mile.

#### Discussion

The presence of a contact zone between Geomys bursarius and G. lutescens in the vicinity of Antelope County has long been suspected. Merriam (1895:129) stated that "if [lutescens] integrates with bursarius it must do so in the narrow strip between the ninety-eighth and ninety-ninth meridians." Merriam examined two gophers from Oakdale that he referred to lutescens. Jones (1964:161) assigned the same two specimens to G. bursarius. Heaney and Timm (1983) examined these two specimens and on the basis of morphological features, considered the subadult female to be lutescens and the adult female to be a hybrid between the two species. In 1969 and 1970 Hart (1978) obtained several gophers from the area around 1 mi. W. of Oakdale which he believed were hybrids between bursarius and lutescens on the basis of karyotypes. Additional specimens were obtained by us as detailed above.

Geomys bursarius is a large, dark species typically found in eastern tall-grass prairie, including the bluestem prairie (Andropogon-Panicum-Sorghastrum), oak savanna (Quercus-Andropogon) and bluestem-oak-hickory savanna (Andropogon-Quercus-Carya) vegetational communities of Kuchler (1964). These associations are commonly found on dark silty-loam soils. Geomys lutescens is a small, pallid pocket gopher that inhabits the western short- and mid-grass prairie, including bluestem grama prairie (Andropogon-Buchloe) and grama-buffalo grass prairie (Bouteloua-Buchloe) vegetational communities (Heaney and Timm, 1983) that occur on sand and sandy-loam soils.

Within the contact zone described here, G. bursarius and G. lutescens occur in their usual habitats on either side of the abrupt margin of the Nebraska Sandhills. The individuals with hybrid karyotypes occur in a soil and vegetational association that is intermediate between the habitats of the parental types, although the vegetation has been disturbed in many areas by

agriculture (Heaney, 1979). The intermediate soil and vegetation near Oakdale are limited to several patches with north-south extent of a few hundred meters. Soils that are unsuitable for pocket gophers are common in the area along the eastern margin of the Sandhills, perhaps accounting for the absence of additional known hybrid zones.

Although karyotypic evidence indicates little gene flow out of the hybrid zone, the hybrids do not show conspicuous evidence of lowered fitness. All adult females trapped in the Oakdale area showed evidence of reproduction (uterine scars and enlarged nipples), and one was pregnant with a normal-sized litter; age and sex composition of the population also appears to be normal (Heaney, 1979).

In summary, a contact zone exists in northeastern Nebraska between two karyotypically and morphologically distinct species of Geomys, G. bursarius and G. lutescens. The karyotype for G. bursarius throughout its range is  $2N = 70-72$ ,  $FN = 68-72$ ; the karyotype for G. lutescens from central and western Nebraska is  $2N = 72$ ,  $FN = 86-98$ . Gophers with intermediate karyotypes have been found in an area that has soil and vegetation that is intermediate between the habitats usually occupied by the parental species. Hybrids are limited to an area about 1/2 mile wide, and appear to reproduce normally. Karyological studies are being continued by Hart.

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Table 1. Karyotypes of the northern Geomys. All localities are within the state of Nebraska unless other wise noted. Specimens from contact zone are ordered along an east-west transect south of the Elkhorn River. Specimen numbers are the author's field numbers.

Karyotype	Locality	Reference or specimen no.
<u>Geomys bursarius</u>		
2N = 72, FN = 72	Iowa, Missouri, and Wisconsin	Hart, 1978
2N = 72, FN = 70	Kansas and Illinois	Hart, 1978
2N = 70, FN = 68	South Dakota	Hart, 1978
<u>Geomys from contact zone, Antelope Co., Nebraska</u>		
2N = 70, FN = 68	1 mi. W. Tilden	EBH 628
2N = 70, FN = 68	2 3/4 mi. E. Oakdale	RMT 1876
2N = 70, FN = 68	2 3/4 mi. E. Oakdale	LRH 1833
2N = 72, FN = 70	1 1/3 mi. E. Oakdale	EBH 401
2N = 72, FN = 75	6/10 mi. W. Oakdale	EBH 396
2N = 72, FN = 80	6/10 mi. W. Oakdale	EBH 627
2N = 72, FN = 82	7/10 mi. W. Oakdale	EBH 9-25-B
2N = 72, FN = 95	7/10 mi. W. Oakdale	EBH 616
2N = 72, FN = 82	9/10 mi. W. Oakdale	EBH 9-24-B
2N = 72, FN = 90	9/10 mi. W. Oakdale	EBH 280
2N = 72, FN = 90	9/10 mi. W. Oakdale	EBH 283
2N = 72, FN = 88	9/10 mi. W. Oakdale	EBH 284
2N = 72, FN = 90	9/10 mi. W. Oakdale	LRH 1823
2N = 70, FN = 78	1 mi. W. Oakdale	RMT 1877
2N = 72, FN = 89	1 mi. W, 1/10 mi. S. Oakdale	LRH 1801
2N = 72, FN = 82	1 1/10 mi. W. Oakdale	EBH 9-26-A
2N = 72, FN = 88	1 2/10 mi. W. Oakdale	LRH 1799
2N = 72, FN = 86	2 mi. W. Oakdale	EBH 287
2N = 72, FN = 88	3 mi. W, 1/2 mi. S. Oakdale	RMT 1890
2N = 72, FN = 87	3 3/4 mi. W, 1/2 mi. S. Oakdale	LRH 1838
2N = 72, FN = 92	1 mi. E, 5 mi. S. Neligh	EBH 621
2N = 72, FN = 90	1 1/2 mi. S. Neligh	EBH 288
2N = 72, FN = 84	4 mi. S. Neligh	EBH 614
2N = 72, FN = 91	4 mi. S. Neligh	EBH 613
2N = 72, FN = 86	1 mi. W, 2 mi. S. Neligh	LRH 1665
<u>Geomys lutescens</u>		
2N = 72, FN = 92	Nebraska: Boyd Co.	Hart, 1978
2N = 72, FN = 86-98	Nebraska: Dawes Co.	Hart, 1978

## References

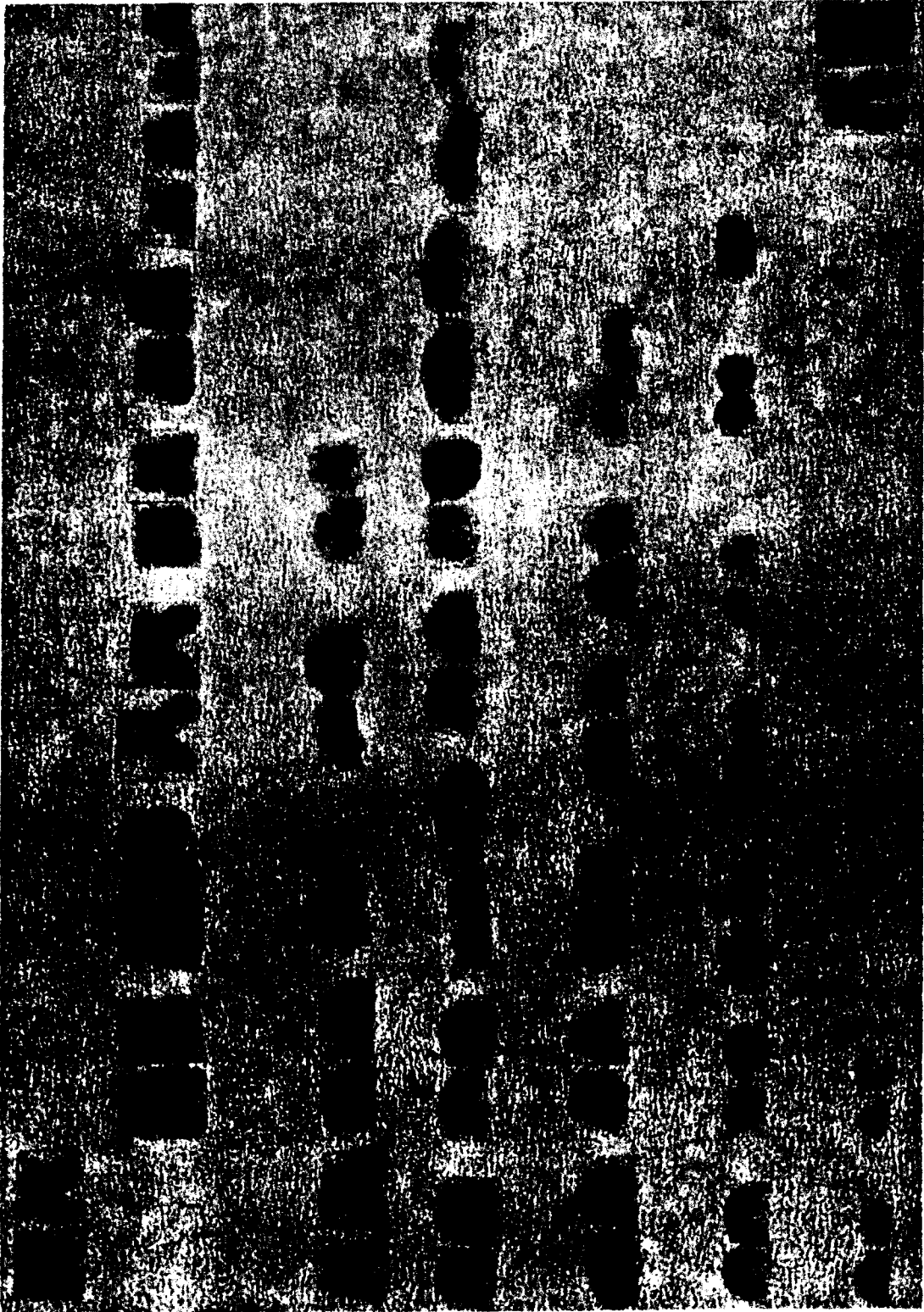
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Figure Legends

Fig. 13. Karyotype of a male Geomys lutescens lutescens from 2 mi. W. Oakdale (EBH 287).  $2N = 72$ ,  $FN = 86$ .

Fig. 14. Karyotype of a female hybrid (Geomys bursarius bursarius X Geomys lutescens lutescens) from 1 mi. W. Oakdale (RMT 1877).  $2N = 71$ ,  $FN = 80$ .





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41. 42. 43. 44. 45. 46. 47. 48. 49. 50.