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Intraspecific and interspecific territoriality in *Microtus ochrogaster* and *M. pennsylvanicus*

David J. Tazik

Lowell L. Getz

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DAVID J. TAZIK and LOWELL L. GETZ[1]

Ecosystem Evaluation and Engineering Division, Environmental Laboratory,
United States Army Engineer Research and Development Center,
3909 Halls Ferry Road, Vicksburg, MS 39180-6937 (DJT)
Department of Animal Biology, University of Illinois, 2113 Lynwood Dr.,
Champaign, IL 61821-5505 (LLG)

ABSTRACT -- Adult female *Microtus ochrogaster* and *M. pennsylvanicus* displayed interspecific territorial behavior in a bluegrass site in Illinois. We concluded that within a site, interspecific territorial behavior might be a factor in non-synchronous population fluctuations characteristic of the two species.

Key words: Illinois, meadow vole, *Microtus ochrogaster*, *Microtus pennsylvanicus*, prairie vole, territoriality.

Populations of *Microtus ochrogaster* (prairie vole) and *M. pennsylvanicus* (meadow vole) frequently are sympatric in bluegrass (*Poa pratensis*) sites in east central Illinois (Getz et al. 2001). Both species undergo erratic high-amplitude fluctuations in population density in bluegrass, often with periods of two or more years when one or both species are absent from a site. During a 25-year study of demography of the two species in bluegrass habitat, Getz et al. (2001) recorded 12 high-amplitude population fluctuations (increase, peak, and decline phases, with intervening low density trough phases) of *M. ochrogaster* and eight of *M. pennsylvanicus*. There were only two years in which the two species underwent simultaneous high-amplitude population fluctuations within a site. At other times, both species were present at low densities in the site.

Interspecific competition might prevent a species from becoming established

[1]Corresponding author. E-mail address: L-GETZ@life.uiuc.edu

in a site, thus resulting in non-synchrony of population fluctuations. Getz et al. (unpublished data) found no evidence, however, that interspecific competition between *M. ochrogaster* and *M. pennsylvanicus* negatively affected demography of either species in bluegrass. Presence of one species did not depress population densities of the other, nor was there evidence for reduced survival or reproduction as a result of presence of the other species.

Female *M. pennsylvanicus* are territorial (Getz 1961, Madison 1980), as are single females, male-female pairs, and communal groups of *M. ochrogaster* (Getz and Hofmann 1986, McGuire and Getz 1998). If females of the two species display interspecific territoriality, such behavior might have an impact upon which species predominates at a site. Klatt (1986) concluded that when habitat conditions were suitable for both species, advantage accrues to the species first occupying a site. If individuals of both species disperse into a site, the species with the most colonizers might quickly crowd out the other species, and any potential negative effects of one species on the other might not be obvious. There has been no test, however, of interspecific territoriality in *M. ochrogaster* and *M. pennsylvanicus*.

We mapped home ranges of sympatric adult female *M. ochrogaster* and *M. pennsylvanicus* in a bluegrass site during two periods in which both species were present in low numbers. We tested the hypothesis of interspecific territorial exclusion of adult females of the two species, as evidenced by non overlap of home ranges.

STUDY AREA and METHODS

The study site was located in the University of Illinois Biological Research Area ("Phillips Tract"), 6 km northeast of Urbana, Illinois (40°15'N, 88°28'W). We monitored populations of *M. ochrogaster* and *M. pennsylvanicus* in a 0.8 ha bluegrass site. The site (BG Cont) is described elsewhere (Getz et al. 1979, 1987, 2001).

We established a grid system with a 5-m interval and placed one locally made wooden multiple-capture live trap (Burt 1940) at each station (total of 255 stations). We used cracked corn as bait in the traps. The site was trapped at alternate two day intervals from 1 October to 30 November 1980 and 1981. We set the traps in the afternoon and checked them at 0800 hr and 1500 hr the following two days. The traps were opened the afternoon of the second day. Two days later, the sequence was repeated. Because of the frequency of trapping, we did not prebait the traps. At first capture, we toe-clipped all animals ($\leq$ 2 toes on each foot) for individual identification. All procedures were approved by the University of Illinois Laboratory Animal Care Committee and met the guidelines recommended by the American Society of Mammalogists (Animal Care and Use Committee 1998). At each capture we recorded grid station, individual identification, sex, reproductive

condition, and body mass to the nearest 1 g. For analysis, we considered animals that weighed greater than or equal to 30 g as adult (Hasler 1975).

We recorded the number of stations at which resident adult females of each species were captured, the total number of captures of resident females of each species, and the number of stations and total captures at stations where more than one female of the same or both species were captured. We also checked for multiple captures in the same trap of females of the same or of both species.

We plotted the captures of all resident adult females at each station and drew lines half way between the stations at which a female was captured and those where the female was not captured. Because we used a 5-m grid interval, boundaries of home ranges were rather accurately delineated. From these plots we determined the stations at which there were captures of more than one female of the same species (intraspecific home range overlap) and of the other species (interspecific home range overlap).

There were sufficient numbers of resident females of the two species on the site to test our hypothesis during only October and November of 1980 and 1981. There was no obvious habitat variation within the site during these four months that would have affected distribution of the two species within the study site.

RESULTS

During October and November 1980 the six resident adult female *M. ochrogaster* on the site were captured a total of 94 times at 45 stations and the eight resident female *M. pennsylvanicus* 57 times at 41 stations (Table 1). Home ranges of the female *M. ochrogaster* did not overlap (Fig. 1). Home ranges of four female *M. pennsylvanicus* overlapped at three stations; only four (7.0 %) female captures involved two female at the same station (Fig. 1, Table 1). During October and November 1980, there were interspecific home range overlaps involving three captures, each, of two females of each species at three stations (Fig. 1, Table 1). The stations of interspecific home range overlap comprised 6.7 % and 7.3 % of the total stations at which the female *M. ochrogaster* and female *M. pennsylvanicus*, respectively, were captured. Only 3.2 % of the total captures of *M. ochrogaster* and 5.3 % of the captures of *M. pennsylvanicus* were at stations where the other species also was captured.

During October and November 1981, nine resident adult female *M. ochrogaster* were captured a total of 79 times at 28 stations (Table 1). Home ranges of four of the females overlapped at seven stations (Fig. 2); 42 (53.2 %) of the total captures were at stations where another female *M. ochrogaster* was captured. In October and November 1981, 14 adult female *M. pennsylvanicus* were captured 126 times at 79 stations; home ranges of only two females overlapped, three total captures at one station (Fig. 2). In 1981, interspecific home range

pecies (interspecific) were captured. See figures 1 and 2.

	Intraspecific overlaps		Interspecific overlaps	
	1980 (No./total)	1981 (No./total)	1980 (No./total)	1981 (No./total)
M. ochrogaster				
Home ranges	0/6 (0.0%)	4/9 (44.4%)	2/6 (33.3%)	4/9 (44.4%)
Stations	0/45 (0.0%)	7/28 (25.0%)	3/45 (6.7%)	4/28 (14.3%)
Captures	0/95 (0.0%)	42/79 (53.2%)	3/95 (3.2%)	5/79 (6.3%)
M. pennsylvanicus				
Home ranges	4/8 (50.0%)	2/14 (14.3%)	2/8 (25.0%)	3/14 (21.4%)
Stations	3/41 (7.3%)	1/79 (1.3%)	3/41 (7.3%)	4/79 (5.1%)
Captures	4/57 (7.0%)	3/126 (2.4%)	3/57 (5.3%)	6/126 (4.8%)

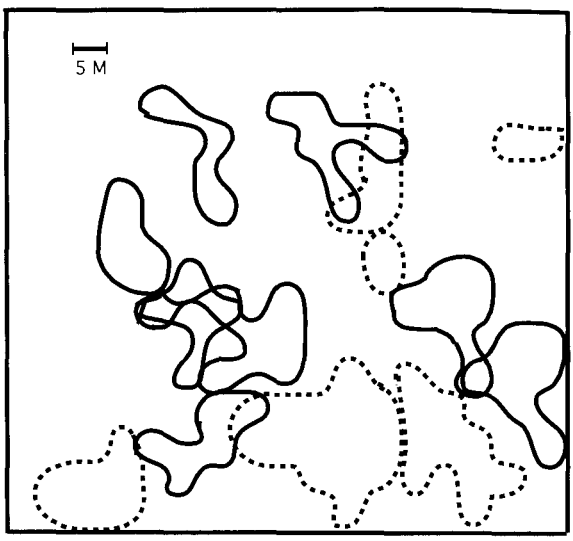

Figure 1. Home ranges of *Microtus ochrogaster* (dashed lines) and *M. pennsylvanicus* (solid lines) in bluegrass habitat October-November 1980.

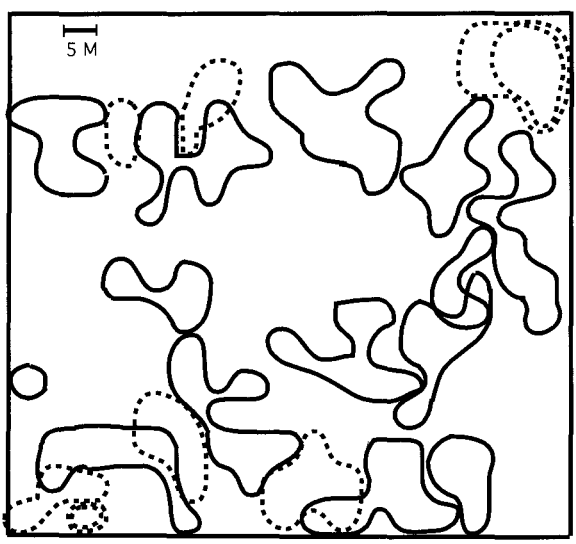

Figure 2. Home ranges of *Microtus ochrogaster* (dashed lines) and *M. pennsylvanicus* (solid lines) in bluegrass habitat October-November 1981.

overlaps involved four *M. ochrogaster* (five captures) and three *M. pennsylvanicus* (six captures) at four stations (Fig. 2). Interspecific home range overlaps constituted 14.3 % and 5.1 % of the total stations at which captured and 6.3 % and 4.8 % of the total captures for *M. ochrogaster* and *M. pennsylvanicus*, respectively.

All interspecific home range overlaps and all intraspecific home range overlaps of *M. pennsylvanicus* were at the periphery of home ranges (Figs. 1 and 2). During 1981, home ranges of two dyads of female *M. ochrogaster* broadly overlapped (Fig. 1). There was no incident of multiple capture in the same trap of a female *M. ochrogaster* and a female *M. pennsylvanicus*, nor of two female *M. pennsylvanicus* during either year. Two female *M. ochrogaster* were captured together once during the two years.

DISCUSSION and CONCLUSIONS

Results of our study agreed with previous studies that showed very little intraspecific overlap of female home ranges (i.e., evidence for intraspecific territorial behavior) of adult female *Microtus ochrogaster* (Getz and Hofmann 1986, McGuire and Getz 1998) and *M. pennsylvanicus* (Getz 1961, Madison 1980). Our results also showed little interspecific overlap of home ranges of females of the two species, suggesting interspecific territorial behavior of females. The few interspecific home range overlaps were at the periphery of the home ranges of the two females.

Even though there were more adult females of both species (*M. ochrogaster*, 9 vs. 6 and *M. pennsylvanicus*, 14 vs. 8, respectively) on the site in 1981 as contrasted to 1980, home ranges of only three more *M. ochrogaster* overlapped those of one more *M. pennsylvanicus*, at only one more station in 1981. That there were two dyads of intraspecific home range overlaps of female *M. ochrogaster* most likely represented communally nesting females (McGuire and Getz 1998). An adult male was captured within the home ranges of the two sets of female dyads in the upper right and lower left corners of the study site (Fig. 2). The number of captures at stations of overlap of interspecific home ranges constituted a very small proportion of the total captures of the females, further indicating interspecific territoriality. This also was supported by the absence of interspecific multiple captures of females.

Klatt (1986) and Lin and Batzli (2001) suggested that advantage to the first dispersers into a site determined habitat segregation in *M. ochrogaster* and *M. pennsylvanicus*. Our results suggesting interspecific territoriality in the two species provided insight into such a mechanism. When habitat conditions were suitable for both species, the species arriving in greatest numbers would lay claim to most of the site through establishment of territories. Later arrivals of the other

species would be unable to become established. Thus, the first arriving species would predominate for the duration of the next population fluctuation. Getz et al. (2005) have shown that the number of immigrants of *M. ochrogaster* and *M. pennsylvanicus* into a site is very low most months, thus creating conditions for competitive exclusion of a species through interspecific territorial behavior.

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