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Aggressive Interactions Between Male Cotton Mice (Peromyscus gossypinus) and Male Texas Mice (P. attwateri)

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General Notes

bats that hibernate in Missouri are known to summer in Arkansas caves (Harvey, 1989-90). Based on distances traveled between maternity sites and hibernacula in the Meramec River area of Missouri (LaVal and LaVal, 1980), distances from major maternity caves in northern Arkansas to this site are not excessive. Tuttle (1976) documented one-way migrations of gray bats between summer and winter sites of up to 525 km.

The occurrence of gray bats during the fall migratory period, and the accumulated pile of guano suggest this cave is used as a transitory or staging cave. However, the influx of gray bats in February, during the middle of the hibernating period indicates additional hibernacula likely exist in the area. It is highly unlikely that gray bats would move great distances in mid-winter due to the high energetic costs involved (Tuttle, 1976). Further, prior research has shown a strong site fidelity in gray bats to both winter and summer sites (Myers, 1964; Harvey, 1975; Tuttle, 1976; LaVal and LaVal, 1980). Tuttle's (1976) banding studies demonstrated that gray bats show lifetime fidelity to the hibernacula used during their first winter. This information, in conjunction with our discovery of gray bats at Land's End Cave, suggests that gray bats may have been wintering undetected in the Arkansas River Valley for some time.

This discovery constitutes a significant southward range extension for gray bats of at least 70 km from the other Arkansas caves known to house this species (Harvey et al., 1981; pers. comm., 1991). In addition, this report further emphasizes the need for additional field work in areas previously considered unlikely habitat, but which may contain pockets of suitable or marginal habitat (Gates et al., 1984).

The gray bat may be more restricted to cave habitats than any other mammal in the United States (Hall and Wilson, 1966). Their requirements for roost sites and habitat are so specific, that fewer than 5% of available caves are suitable for occupation (Tuttle, 1979). Harvey (1989-90) estimated that gray bat populations in the cave region of northern Arkansas have declined as much as 61% in recent years. It seems especially timely then to re-evaluate the importance of fracture caves and mines, located in areas adjacent to known occupied habitat, in the natural history, distribution, and recovery of this endangered bat.

ACKNOWLEDGMENT

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AGGRESSIVE INTERACTIONS BETWEEN MALE COTTON MICE *(PEROMYSCUS GOSSYPINUS)* AND MALE TEXAS MICE *(P. ATTWATERI)*

Four species of *Peromyscus* (deer mouse, *P. maniculatus*; white-footed mouse, *P. leucopus*; cotton mouse, *P. gossypinus*; and Texas mouse, *P. attwateri*) are found sympatrically in the Ouachita Mountains and the southern Ozark Mountain region of Arkansas. Of these, *P. attwateri* is the most restricted in habitat, being found only in rock outcroppings of the Ouachitas and rock outcrops and cedar glades of the Ozarks (Sealander and Heidt, 1990). This restricted habitat has apparently resulted in some morphological and genetic differentiation, leading to lowered heterozygosity, between populations of *P. attwateri* (Kilpatrick, 1984; Sugg et al., 1990). The reasons, however, for the observed habitat isolation of this species are not clear.

Brown (1964) demonstrated that male *P. leucopus* were highly dominant over male *P. attwateri,* and prolonged encounters often resulted in serious injury or death to the *P. attwateri.* Wolff (1985) has demonstrated that interspecific aggression between *P. leucopus* and *P. maniculatus* can influence home range size and location. Sugg *et al.* (1990) felt that interactions with congeners might also affect genetic variability in *P. attwateri* as has been suggested for other species of *Peromyscus* (Price and Kennedy, 1980). It may be that interspecific interactions between either *P. leucopus* or *P. gossypinus* and *P. attwateri* may contribute to the habitat restriction of the latter species.

The purpose of this study was to determine whether *P. gossypinus* or *P. attwateri* would be dominant in semi-forced encounters. As Brown (1964) primarily examined male-male interactions between *P. leucopus* and *P. attwateri* and male *Peromyscus* generally have larger home ranges and are more active (Madison, 1977; Metzgar, 1979; Myton, 1974; Taitt, 1981; Wolff, 1985), it was determined to only examine adult male mice in this study.

Mice used in this study (9 male *P. attwateri* and 7 *P. gossypinus*) were live trapped, using Sherman LFAGD traps baited with rolled oats and omaline, from their natural habitats in Hot Spring, Garland, and Montgomery counties, Arkansas. Animals were transported to the Basic Animal Services Unit at the University of Arkansas at Little Rock, housed individually in plastic cages (28.6 x 18.1 x 12.4 cm), maintained on a 12 hour light/dark cycle, and provided with water and Purina rat chow *ad libitum.* The animals were allowed to acclimate in the laboratory for a minimum of 30 days before they were tested.

Procedures for testing aggressive behavior primarily followed that of Ambrose and Meehan (1977). Testing was conducted in a plexiglass arena (54 x 69 x 44 cm) divided into two equal halves by a black, removable partition; the floor was covered by a 1 cm layer of ash wood chips. Encounters between experimental animals were done at night in a dark room illuminated by two 40 watt red lights.

Males of each species were randomly paired, placed on either side of the partition, and allowed to acclimate for 10-15 minutes. The partition was then removed and behavioral interactions were observed for 10-15 minutes. Numbers and times of conflict, postures (erect tail and ears, eye squinting, upright stance, pawing, rearing, and ducking), and overt movements (chase, lunge, and avoidance) were recorded. A confrontation occurred when there was overt interactions between the two individuals. Based on the criteria of Wolff *et al.* (1983), each confrontation was judged to be a win, draw, or loss.

A total of 39 trials was conducted which resulted in 192 confrontations. Of these, *P. gossypinus* were judged the winner of 115 (59.9%), *P. attwateri* 40 (20.8%), and 37 (19.3%) were considered draws. These data are highly significant (Chi Square, P < 0.01) and demonstrate the aggressive dominance of male *P. gossypinus* over male *P. attwateri* in this experimental paradigm.

Figures 1 and 2 illustrate individual results of each species. Only two *P. attwateri* were at all successful, accounting for 60% of this species' wins. On the other hand, the *P. gossypinus* wins were more evenly distributed, averaging 61% (ranging from 42 to 91%) of each individual's encounters.
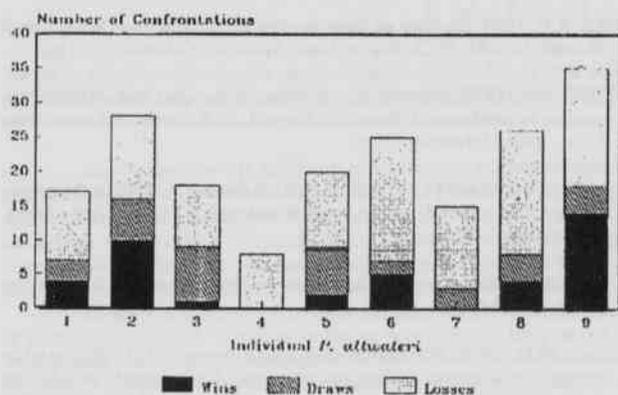

Figure 1. Percent of individual *P. attwateri* confrontational wins, draws, and losses.
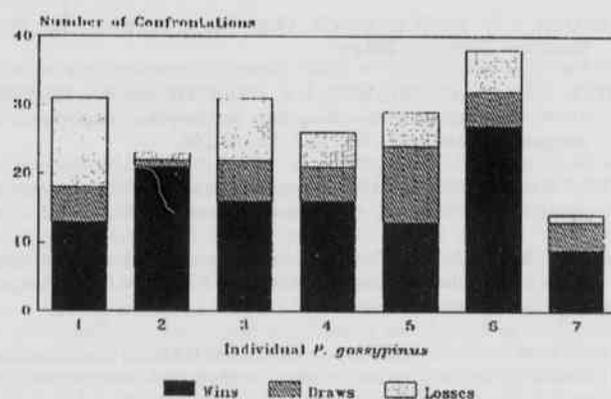

Figure 2. Percent of individual *P. gossypinus* confrontational wins, draws, and losses.

It may be argued that size may have contributed to the overall success of *P. gossypinus* as members of this species averaged 39.52 g, whereas *P. attwateri* averaged 24.52 g. To test this, a different experimental design would be necessary. However, Brown (1964) felt that the smaller *P. leucopus* was dominant over *P. attwateri* because of general temperament. Furthermore, Healey (1967) found no direct relationship within members of *P. maniculatus.*

In conclusion, while there are individual differences expressed between members of each species, this study demonstrated the dominance of adult male *P. gossypinus* over male *P. attwateri.* While nothing conclusive can be stated concerning the ecological isolation of *P. attwateri,* the results indicate that further research into aggressive behavioral interactions between these two species as well as *P. leucopus* is warranted.

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POSTERIOR MAXILLARY FANGS OF THE FLATHEAD SNAKE, *TANTILLA GRACILIS* (SERPENTES: COLUBRIDAE), USING SCANNING ELECTRON MICROSCOPY

Opisthoglyphous snakes constitute a group of more or less venomous, rear-fanged species within the family Colubridae (Smith, 1952; Fitch, 1970; Bellairs, 1970; Porter, 1972). The fangs reside on the posterior end of the maxillary bone and are larger, grooved, and often recurved compared to other maxillary teeth. Injection of venom into prey is accomplished by chewing the victims in the so-called "slash and swab" method (McDowell, 1986); the poison is released from the parotid gland (Duvernoy's gland) through a single duct which opens into a furrow along the lateral sides of the teeth.

The genus *Tantilla*, a New World group of small colubrid snakes comprising around 46 species, ranges throughout most of the southeastern and south-central United States (Telford, 1966) and is found in parts of the arid southwestern United States. The group is characterized by a combination of characters which includes the presence of posterior maxillary grooved teeth (Wilson, 1982). Hardy and Cole (1968) and Savitzky (1983) illustrated the maxillary bone of *Tantilla* and showed the grooved nature of the fangs; i.e., the grooves lie on the lateral face of the teeth. The present study examines the fangs and other maxillary teeth of the flathead snake, *Tantilla gracilis*, for the first time using scanning electron microscopy in order to reveal their surface morphology.

The left maxilla of 14 adult and juvenile specimens of *Tantilla gracilis* collected from the Interior Highlands of Arkansas were prepared for scanning electron microscopy (SEM). Each maxilla was removed using jewelers forceps and microscissors, stripped of muscle and connective tissue, and placed into vials of 70% ethanol. Routine laboratory techniques were employed to prepare teeth for SEM (Dawes, 1988). Maxillae were dehydrated in a graded series of ethanol and amyl acetate, dried with a Samdri critical point dryer, coated with gold/palladium in a Hummer IV sputter coater, and viewed with a JEOL100 CXII TEM-SCAN electron microscope at an accelerating voltage of 40 kV. All snakes and prepared tissues are deposited in the Arkansas State University Museum of Zoology.

All maxillary teeth of *Tantilla gracilis* showed varying degrees of structural modification (Figs. 1 and 2). The fangs are of two basic types: 1) curved and 2) linear. Also, the nature of the groove differed between these two types. Two fangs per maxilla is the general rule (excluding replacement fangs) in this species (Fig. 1B and E), although one specimen (Fig. 1D) exhibited three fangs. In most cases, fangs were separated from the anterior maxillary teeth by a space or diastema (Fig. 1G). The fangs of juveniles (Fig. 1A and B) are similar to those of adults (e.g., Fig. 1E) in that the fangs are curved, and the grooves project anterio-laterally. However, the linear fang type is straighter, and grooves project laterally (Fig. 1C and D). The fang groove, a concavity running the entire labial surface of the fang, is situated between the mesial and distal surfaces; the groove is presumably formed by an expansion of dental ridges (Wright *et al.*, 1979; Vaeth *et al.*, 1985) that are characteristic of all maxillary teeth. The dental ridges are, however, more conspicuous in teeth near the fangs (Fig. 1F and G; Fig. 2D) compared to anterior teeth (Fig. 2C) and contribute to the semblance of grooves most noticeable on teeth near the fangs. Anterior maxillary teeth may also exhibit dental ridges that possess serrations (Fig. 2C), whereas, in other instances, these ridges appear smooth (Fig. 2D).