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Notes

Flea Sharing Between the San Joaquin Antelope Squirrel (*Ammospermophilus nelsoni*) and Giant Kangaroo Rat (*Dipodomys ingens*)

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***Abstract.*—We examined flea sharing between the San Joaquin Antelope Squirrel (*Ammospermophilus nelsoni*) and the Giant Kangaroo Rat (*Dipodomys ingens*), two species that often share burrows and habitat in the San Joaquin Desert of California. We trapped small mammals and collected fleas to identify which species were present on each host. Many flea species that parasitize small mammals are generalist fleas (found on several host species) and live primarily in host burrows where moisture levels are higher than the external environment and temperatures remain lower. Based on these two suppositions, we expect that fleas may be shared between San Joaquin Antelope Squirrels and Giant Kangaroo Rats. We found the fleas *Hoplopsyllus anomalus* and *Thrassis augustsoni* on both species. Our findings indicate that the shared use of burrows likely facilitates the exchange of these ectoparasites.**

Key Words.—ectoparasites; Heteromyidae; San Joaquin Desert; Sciuridae; Siphonaptera.

Since its description and naming in 1916, the San Joaquin Antelope Squirrel (*Ammospermophilus nelsoni*) has been found in parts of Kern, Kings, San Benito, San Luis Obispo, and Fresno counties in the San Joaquin Desert of California (Taylor 1916; Cypher et al. 2021) and has been state-listed as Threatened since 1980 (USFWS 1998). The limited distribution of the species and the encroachment of development and agricultural use in the region have led to a decrease in numbers. *Ammospermophilus nelsoni* prefers desert grassland and shrubland habitats often shared with Giant Kangaroo Rats (*Dipodomys ingens*), and sometimes Heermann's Kangaroo Rats (*D. heermanni*; Best et al. 1990; Williams and Kilburn 1993; Cypher et al. 2021).

The San Joaquin Antelope Squirrel often uses burrows dug by *D. ingens*, thus burrow sharing between the two species may be common and potentially allows for exchange of ectoparasites, such as fleas (Taylor 1916; Best et al. 1990). The diurnal *A. nelsoni* has many burrows in the shared habitat rather than using one home burrow and they move from burrow to burrow while foraging (Cypher et al. 2021). Other researchers describe the nocturnal *D. ingens* as digging burrows and *A. nelsoni* using their abandoned burrows. Hawbecker (1953) and Best et al. (1990) stated that burrows dug by *D. ingens* and *A. nelsoni* are indistinguishable.

Hawbecker (1951) described *D. ingens* as the dominant rodent species in its territory, although other species of small mammals may be present. Tabor et al. (1993) stated that *A. nelsoni* may enter burrows of or with *D. ingens* to rest or to escape the heat. While trapping an area that supports both *D. ingens* and *A. nelsoni*, we found two species of fleas on both rodents.

On 3 and 4 March 2025, and 18–21 March 2025, we conducted small mammal trapping in the Tumey Hills, approximately 80 km west of Fresno, California, and 16 km east of Panoche Valley, California (Township 15S, Range 12E, Section 34; elevation 427 m). We placed 20 Sherman live traps (7.6 × 9.5 × 30.5 cm; H.B. Sherman Traps, Inc., Tallahassee, Florida) and 20 Tomahawk galvanized wire traps (60.1 × 15.2 × 15.2 cm; Tomahawk Live Trap, Hazelhurst, Wisconsin) together along a single 450 m transect with pin flags marking active burrows. As temperatures were cool during the day, we opened squirrel traps from sunrise to sunset, and Sherman traps were open throughout the night. We extracted fleas by hand and then stored the fleas in 70% isopropyl alcohol. We processed fleas using standard methods and identified using multiple references (Hubbard 1947; Augustson 1953; Hopkins and Rothschild 1962; Stark 1970; Campos 1971).

We inspected 11 *Dipodomys ingens* and 19 *Ammospermophilus nelsoni* for ectoparasites but only found fleas on three *D. ingens* and on eight *A. nelsoni* (we did not record the sex of the rodents when fleas were collected; Table 1). We found the fleas *Hoplopsyllus anomalus* and *Thrassis augustsoni* on both rodents, and the flea *Meringis californicus* only on *D. ingens*. Flea collection was opportunistic if the parasites were easy to remove by hand; our collection efforts were expeditious to limit handling time. We do note that we saw *D. ingens* and *A. nelsoni* using the same burrows along the transect.

Egoscue (1985) listed *Thrassis augustsoni* and *Meringis californicus* from San Joaquin Kit Foxes (*Vulpes macrotis mutica*) collected in Kern County, California. He believed these fleas came from *A. nelsoni*, *D. ingens*,

Table 1. Fleas collected from San Joaquin Antelope Squirrel (*Ammospermophilus nelsoni*) and Giant Kangaroo Rat (*Dipodomys ingens*) in Spring 2025 in the San Joaquin Desert, California. Note that while 17 fleas were collected, three were lost when we dropped a vial. The sample size (n) refers to all individuals that we inspected for fleas but not the number of individuals that had fleas.

No. fleas collected	Sex of fleas	Flea species
Ammospermophilus nelsoni (n = 19)		
2	F	*Thrassis augustsoni*
5	M	*Hoplopsyllus anomalus*
4	F	*Hoplopsyllus anomalus*
Dipodomys ingens (n = 11)		
1	M	*Meringis californicus*
1	F	*Hoplopsyllus anomalus*
1	F	*Thrassis augustsoni*

and *D. heermanni*, which kit fox eat. *Ammospermophilus nelsoni* is a known host of several flea species, including *T. augustsoni, H. anomalus*, and *Meringis parkeri*. In the same habitat, *D. ingens* is a host for *M. californicus* and *H. anomalus* (Hubbard 1949; Hawbecker 1953, 1959; Best et al. 1990; Williams and Kilburn 1993).

What are the consequences of this flea sharing? We posit that, as long as flea load per host does not increase significantly, that both species of rodent will transport fleas within the habitat. The bacterium *Yersinia pestis* sometimes is found in fleas and is lethal when transferred to rodents (Butler et al. 1982; Wimsatt and Biggins 2009). If no bacterial pathogen enters the flea populations, host numbers should remain steady, barring unforeseen outside events such as increased habitat degradation. In conclusion, we think that *A. nelsoni* and *D. ingens* share flea species as a result of their use of shared territory and burrows. Future work using data from common shared burrows would supplement our findings.

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Cameron A. Reid grew up spending time outdoors through his involvement in Boy Scouts of America. Those experiences left him with a great respect for nature. Having lived in Fresno his whole life, he was able to spend considerable time in the adjacent Sierra Nevada and on the Central Coast. He completed a B.S. in Biology at California State University, Fresno, in 2022. He has spent the last 3 y working professionally at Colibri Ecological Consulting, LLC, as a Wildlife Biologist with a particular interest in San Joaquin Valley species. (Photographed by Cameron Reid).

Helen K. Pigage earned her D.A. from the University of North Dakota, Grand Forks, in 1979. She taught biology courses (Anatomy and Physiology, Microbiology, Parasitology, and General Biology) for 43 y before retiring in July 2012. Her college teaching experience included work at West Liberty State College (West Virginia), Elmhurst College (Illinois), and the U.S. Air Force Academy (Colorado Springs, Colorado). She has conducted research on Botta's Pocket Gophers (*Thomomys bottae*), Eastern Woodrats (*Neotoma floridana*), and Mule Deer (*Odocoileus hemionus*). She is a Research Associate in the Zoology Department of the Denver Museum of Nature & Science, Colorado, working on the flea collection of the department. (Photographed by Jon Pigage).