

Fleas (Siphonaptera) Infesting Giant Kangaroo Rats (*Dipodomys ingens*) on the Elkhorn and Carrizo Plains, San Luis Obispo County, California

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ABSTRACT The giant kangaroo rat, *Dipodomys ingens* (Merriam), has a limited distribution in the San Joaquin Valley, CA. Because of reductions in its geographic range, largely resulting from humans, the species was listed as an endangered species in 1980 by the California Fish and Game Commission. As part of a study of the community ecology of southern California endangered species, including *D. ingens*, we were able to make flea collections from the rats when they were trapped and marked for population studies. All but one of the fleas collected from the *D. ingens* in this study were *Hoplopyllus anomalus*, a flea normally associated with ground squirrels (Sciuridae). It has been suggested that giant kangaroo rats fill the ground squirrel niche within their range. Our data indicate that this role includes a normal association with *Hoplopyllus anomalus*.

KEY WORDS *Dipodomys ingens*, *Hoplopyllus anomalus*, population studies

THE GIANT KANGAROO RAT, *Dipodomys ingens* (Merriam), is the largest of the kangaroo rats and the largest North American heteromyid. The historical range of the species lies along the western side of the San Joaquin Valley, CA from the Tehachapi Mountains on the southern extremity in San Luis Obispo, Kern, and Santa Barbara counties to the southern tip of Merced County (Williams & Kilburn 1991) (Fig. 1). In addition, populations exist on the Carrizo and Elkhorn Plains west of the Temblor Mountains and in the upper Cuyama Valley adjacent to the Carrizo Plain (Grinnell 1922, Hall 1981, Williams 1992). As a result of habitat loss, indiscriminant poisoning, and other detrimental effects of humans, the species has been extirpated from many parts of its former range. Because of this, the giant kangaroo rat was listed as endangered by the U.S. Department of the Interior (1987) and by the California Department of Fish and Game (Williams 1992).

Although ectoparasitic faunas of other California *Dipodomys* species have been reviewed (Kelt 1988a,b, Best 1991), little is known about the fleas of *D. ingens*. In a review of the species Williams & Kilburn (1991) found that *Hoplopyllus anomalus*, a flea commonly associated with ground squirrels in western North America, was

the only flea known from *D. ingens*. We found no additional information on collection records from *D. ingens*. Therefore, we took the opportunity to collect and identify fleas from *D. ingens* as part of a larger study on the effects of drought, grazing by livestock, and humans on a community of endangered species that includes populations of *D. ingens*.

Materials and Methods

Between 1987 and 1991 we collected fleas from *D. ingens* at one site on the Elkhorn Ecological Reserve, Elkhorn Plain, San Luis Obispo County, California (119° 39' W, 35° 08' N), and from two sites on the Carrizo Plain, San Luis Obispo County, California; Goodwin Ranch site (119° 54' W, 35° 15' N) and the Washburn Ranch site (119° 50' W, 35° 10' N), which is ≈20 km south of the Goodwin site. The Elkhorn Ecological Reserve study site is rolling roughland and arid mountains. Elevation at the study site is 457 m. Common plant species include annual herbs such as red-stemmed filaree, *Erodium cicutarium* (L.); fiddleneck, *Amsinckia intermedia* (Fisher & Meyer); locoweed, *Astragalus oxyphasus* (Gray); and grasses such as *Schismus arabicus*, *Bromus rubens* (L.), and *Vulpia microstachys* (Nuttall). *Ephedra californica*, *Lycium andersonii*, and *Atriplex polycarpa* are common shrubs on the Elkhorn Plain study site, but are sparse on the two Carrizo Plain study sites. The geography of the study sites on the Carrizo Plain was flat. Elevations at the Goodwin Ranch and Washburn

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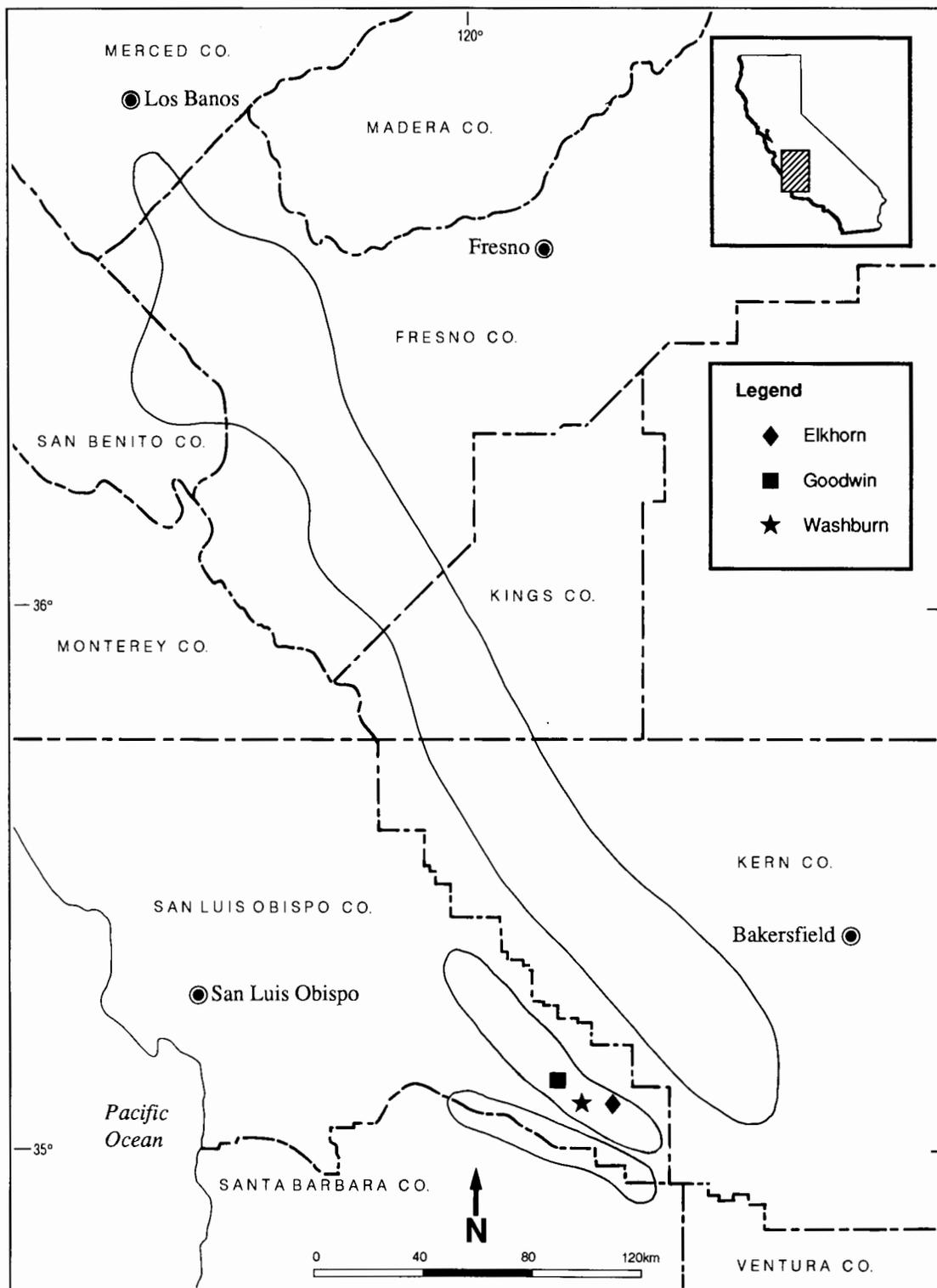


Fig. 1. Historical distribution of *D. ingens* in the San Joaquin Valley, CA and the sites from which giant kangaroo rats were collected for this study (redrawn from Williams & Kilburn 1991).

Ranch sites were 198 and 244 m, respectively. Common plant species at both sites include annual herbs (*E. cicutarium*, *A. intermedia*, and *A. oxyphasus*).

We set extra-long Sherman live-traps at dusk, baited them with millet seed, and checked the traps after 2 h. Industrial-grade paper towels were placed inside the traps to provide nesting material and to keep the kangaroo rats occupied, thereby increasing their metabolic rate and reducing risk of hypothermia.

We collected fleas while manually restraining the kangaroo rats during marking for release-recapture studies. No immobilizing drugs were used to restrain the rats for flea collection because the species is protected and chemical immobilization is not permitted. We collected visibly moving fleas with forceps and brushed the animal with a fine bristled toothbrush to search for additional fleas. We placed fleas in 70% EtOH with a field tag that identified the ear or passive integrative transponder (PIT) tag number, sex, age, host species, and the date of collection. We cleared and mounted the fleas on slides generally following techniques described by Hopla (1965). Fleas were mounted on glass microscope slides, sexed, and keyed to species. Representative specimens of these fleas have been deposited with Robert E. Lewis at Iowa State University.

Results and Discussion

In total, 67 *D. ingens* were examined for fleas (30 adult males, 23 adult females, 1 juvenile male, 3 juvenile females, and a pool of 10 rats trapped in 1987 for which no age or sex data are available). From these rats 283 fleas were collected, all of which were identified as *Hoplopyllus anomalus* (92 males, 189 females, and 1 unknown), except for a single male *Meringis californicus*. The average number of fleas per rat was 4.34. Collections ranged from 10 fleas on 1 juvenile female at the Goodwin site to 1 flea from each of 12 rats that represented each of the collection sites. Only one rat (an adult female trapped at the Elkhorn site) had no fleas (specific collection data are available from S.P.T.). Other rodents collected during trapping for *D. ingens* included *D. nitratoides* Gray, *D. heermanni* LeConte, *Perognathus inornatus* (Merriam), *Ammospermophilus nelsoni* Merriam, *Spermophilus beecheyi* (Richardson), and *Onychomys torridus* Baird.

Collection of *M. californicus* from these rats would be considered a normal flea-host association because members of the genus *Meringis* are often collected from heteromyid rodents, especially from kangaroo rats. However, *H. anomalus* is more typically associated with the sciurids *A. nelsoni* (Best et al. 1990) and *S. beecheyi*, also

collected in the study areas. All but one of the fleas collected from the *D. ingens* were *H. anomalus*, which suggests that either a normal association between the kangaroo rats and this flea has evolved, or the sciurids are visiting or cohabiting the kangaroo rat burrows for transfer of *H. anomalus* to be this extensive. Grinnell (1922) stated that *D. ingens* dominates the rodent community to the exclusion of other burrowing rodent species, taking the place of ground squirrels in this habitat. Although we did not find *D. ingens* excluding ground squirrels in our study areas, the implication that they may fill a ground squirrel niche suggests that they might also provide an appropriate microhabitat for ground squirrel fleas. Previously, it has been suggested that *Onychomys* spp., another member of this particular rodent community, might provide a suitable host-habitat for sciurid fleas or other rodent-associated flea species and develop normal flea-host associations with them (Thomas 1988).

Because *D. ingens* are known to be aggressive to other rodents (Hawbecker 1944) it is unlikely that they would tolerate cohabitation by another species. Yet, *A. nelsoni* have been found to use abandoned burrows of *D. ingens* (Hawbecker 1947). Our observations also show that antelope squirrels regularly enter burrows occupied by *D. ingens* to escape potential predators and possibly to prevent overheating. *D. ingens* are known to make food caches in their burrows, and investigation of these burrows by antelope squirrels for the purpose of cache raids or escape cover, or the rehabilitation of burrows by *D. ingens* after use by *A. nelsoni*, are reasonable mechanisms for flea transfer. It is also possible that transfer is part of the history of this rodent community and that *H. anomalus* has developed a normal host association with *D. ingens*. The hypothesis of a normal association between this flea and giant kangaroo rats is supported by the lack of other flea species collected in this study and in the only other report of fleas from *D. ingens*.

We do not contend that our collections allow us to adequately analyze the complete flea fauna of giant kangaroo rats because we were unable to anesthetize the rats for thorough flea removal. It is possible that other species of fleas, such as *Meringis* spp., would be collected if other techniques could be used on this protected species of *Dipodomys*. It remains, however, that an interesting association between a heteromyid, and a flea species normally associated with sciurids has been established in a southern California rodent community. We intend to continue analysis of the flea-host associations in this rodent community by collecting fleas from other heteromyid species present in our collection areas.

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