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DISTRIBUTION RECORDS AND COMMENTS ON FLEAS IN SOUTHWESTERN SOUTH DAKOTA

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ABSTRACT.—From October 2003 through April 2006, we collected 565 fleas incidental to a distribution survey of mammals in southwestern South Dakota. Sixty-one specimens, representing 18 species of mammals, possessed 20 species of fleas. The geographic distributions of these flea species revealed 8 new records for the Black Hills and its adjacent grasslands. Four species—*Megarhthroglossus divisus*, *Stenoponia americana*, *Odontopsyllus dentatus*, and *Amaradix euphorbi*—constitute new records for South Dakota, thus increasing the state's known flea fauna to 42 species. Hunters, trappers, and field biologists should be aware that serosurveillance during the 1990s revealed the presence of sylvatic plague and tularemia in the Black Hills area.

RESUMEN.—Desde octubre de 2003 hasta abril de 2006, colectamos 565 pulgas de manera incidental durante un estudio de la distribución de mamíferos en el suroeste del estado de Dakota del Sur. Los 61 especímenes, que representaban 18 especies de mamíferos, albergaban 20 especies de pulgas. Sus distribuciones geográficas revelaron 8 nuevos registros para las Colinas Negras (Black Hills) y las praderas adyacentes. Cuatro de estas especies (*Megarhthroglossus divisus*, *Stenoponia americana*, *Odontopsyllus dentatus* y *Amaradix euphorbi*) constituyen nuevos registros para Dakota del Sur. Esto aumenta el número de especies de pulgas conocidas del estado a 42 especies. Los cazadores, tramperos y biólogos de campo deben estar conscientes de que la vigilancia serológica durante la década de los 1990 reveló la presencia de la plaga silvática y la tularemia en el área de las Colinas Negras.

In his book *Fleas of Western North America*, Hubbard (1947) noted that he knew of only 4 publications concerning South Dakota fleas. The earliest of these was Baker's (1895) description of *Rhadinopsylla* (*Typhlopsylla*) *fraterna* from the eastern mole, *Scalopus aquaticus*, in Brookings County. A large study of fleas from North American rabbits and hares by Kohls (1940) listed *Hoplopsyllus affinis* (now *Euhoplopsyllus glacialis affinis*) and *Cediopsylla simplex*, also from Brookings County. The study was based on specimens from the 1920s and 1930s in the insect collection at South Dakota State University. The state's first extensive field collection of fleas occurred in the early 1940s in conjunction with plague surveillance by the U.S. Public Health Service. This survey was an eastward extension into both Dakotas after human plague was reported in several Rocky Mountain states. In Brown, Potter, and Spink counties, ground squirrels (*Spermophilus franklinii*, *Spermophilus richardsonii*, and *Spermophilus tridecemlineatus*) were infested with *Oropsylla* (*Opisocrostis*) *bruneri* and *Oropsylla* (*Thrassis*) *bacchi* (Prince 1943). Females of the latter species were described by Prince (1944). In addition to the above, Hubbard

(1947) noted that he had seen or studied specimens of *Ctenocephalides canis*, *Ctenocephalides felis*, and *Pulex irritans* from unspecified localities in South Dakota. With the addition of these 3 species, the known flea fauna of the state was 8 species.

Large multiple-year mammalian collections in Harding County (Andersen and Jones 1971) and the Black Hills (Turner 1974) also provided for opportunistic collecting of fleas. Smaller surveys in the state have focused on pocket gophers (Risky 1962), deer mice (Ulrich and Vaughn 1963), black-footed ferrets (Boddicker 1968), eastern fox squirrels (Coffman and Balsbaugh 1971, Wilson 1978, Kietzmann 1987a), rabbits (Kietzmann and Huggins 1984), porcupines (McDaniel and Easton 1986), and prairie dogs (Kietzmann 1987b). The relevance of these collections to the present study are considered in the species accounts.

Collections from the Black Hills and throughout South Dakota by Easton (1981, 1982) provided 6 new state records and a checklist of 35 species for the state's flea fauna. A correction by Lewis and Galloway (2001) reduced that number to 34 species. Missing from Easton's

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checklist were *Rhadinopsylla fraterna* and Tipton et al.'s (1979) report of *Callistopsyllus terinus*. Since then, *Chaetopsylla setosa* and *Merinis parkeri* have also been reported in the state (McDaniel and Easton 1986, Eads et al. 1987), bringing the known flea fauna of South Dakota to 38 species. The present study was conducted to supplement previous reports on the host and geographic distribution of mammal fleas in the South Dakota portion of the Black Hills and the adjacent grasslands.

METHODS

This study was incidental to a study on mammals of Fall River, Custer, Pennington, and Shannon counties (Platt et al. 2009). The first 3 of these counties include portions of the Black Hills, an isolated mountainous formation in southwestern South Dakota. Shannon County, however, is rolling prairie and part of the Pine Ridge Indian Reservation. Results of the mammal study, along with methods of collection and descriptions of biotic and abiotic characteristics of the area, are presented elsewhere (Platt et al. 2009).

Fleas were collected intermittently from October 2003 through April 2006. The methodology for obtaining small mammals involved setting snap-traps in the late afternoon or early evening. These traps were checked the following morning, and any captures were placed individually in plastic bags for transport to the laboratory. Rodents were brushed over a white enamel pan, but larger mammals, such as leporids, had their pelage carefully inspected for ectoparasites. These were removed and preserved in ethanol for storage and shipment, and all fleas were processed as permanent whole mounts. Specimens were bleached in 10% KOH, dehydrated in ethanol, cleared in xylol, and mounted in Canada balsam on microscope slides. Processing and identifications were done at the University of North Dakota, and voucher specimens (1905–1968) were deposited in their Parasite Collection (UNDPC). Duplicates were deposited in the collections of the Department of Biology, Sul Ross State University, Alpine, Texas. Flea taxonomy follows Lewis (1993), and mammal classification is that of Wilson and Reeder (2005).

RESULTS

Sixty-one hosts, representing 18 species of mammals, possessed 565 fleas. Of the 20 flea

species collected, 311 specimens (55%) were recovered from 27 leporids, with *Cediopsylla inaequalis inaequalis* and *Euhoplosyllus glacialis affinis* being the most abundant. All species are presented alphabetically within each of 4 flea families, and the accounts also consider the known range of each species within and outside of South Dakota. A listing of hosts and their fleas is presented as an appendix.

Pulicidae

CEDIOPSYLLA INAEQUALIS INAEQUALIS (BAKER).—A total of 161 fleas (53 males, 108 females) were recovered from the 4 species of leporids collected during this study. These leporids included *Sylvilagus audubonii*, *Sylvilagus floridanus*, and *Lepus townsendii* from Fall River County, and *Sylvilagus nuttallii* from Custer County. This flea species is prevalent on rabbits and hares, and their predators, in all 11 western states (Kohls 1940). It has been collected in northwestern South Dakota (Andersen and Jones 1971) but not previously from the Black Hills or adjacent grasslands. A related species, *Cediopsylla simplex*, commonly occurs on leporids from the eastern Dakotas to the Atlantic states.

EUHOPLOPSYLLUS GLACIALIS AFFINIS (BAKER).—We collected 117 specimens (46 males, 71 females) from *Sylvilagus audubonii* and *Sylvilagus floridanus* in Fall River County, a new record for the Black Hills and adjacent grasslands. Although this flea is common on rabbits and hares throughout the Great Plains and Rocky Mountains, previous reports for the state are only from Brookings and McCook counties (Kohls 1940, Kietzmann and Huggins 1984).

PULEX SP.—Four females were collected, with *Lepus townsendii* and *Sylvilagus* sp. from Fall River County each yielding 2 specimens. One additional female was recovered from a *Taxidea taxus* (American badger) in Custer County. Easton (1982) noted the presence of *Pulex irritans* in Brookings, Harding, Fall River, and Shannon counties from coyotes (*Canis lupus*), swift foxes (*Vulpes vulpes*), and a human dwelling. Unfortunately, many records are uncertain since this species and *Pulex simulans* can only be distinguished by their male genitalia (Smit 1958). In the absence of males, our specimens must be listed as *Pulex* sp. Both flea species probably occur in the Black Hills area, as they do on white-tailed jackrabbits (*Lepus townsendii*) in

southwestern North Dakota (UNDPC 203, 204, 209, 210).

Ctenophthalmidae

CTENOPHTHALMUS PSEUDAGYRTES PSEUDAGYRTES BAKER.—Two female specimens collected from a *Microtus pennsylvanicus* in Shannon County constitute a county record. This flea has previously been reported in South Dakota only from Roberts County, which lies some 500 km to the northeast (Easton 1982). This parasite is common and widely distributed in the eastern half of the United States, but ever less so across the Great Plains. It displays low host specificity for small mammals.

EPITEDIA WENMANNI WENMANNI (ROTHSCHILD).—Although recovered in low numbers (1 male, 11 females), this parasite was found on a variety of hosts from 3 counties: *Microtus pennsylvanicus*, Shannon Co.; *Microtus ochrogaster*, *Peromyscus maniculatus*, and *Neotoma cinerea*, Fall River Co.; *Tamiasciurus hudsonicus*, Custer Co. The low infestation (1 or 2 fleas per host) was similar to that reported from Clay County in southeastern South Dakota (Ulrich and Vaughn 1963). Previous collections from the Black Hills were reported by Turner (1974) and Easton (1982), and from an unspecified location in the center of the state by Benton (1955). Two additional female specimens with an unusual combination of characters were collected, one each from *Chaetodipus hispidus* in Fall River County and *Peromyscus leucopus* in Shannon County. In the absence of male specimens, the females can only be tentatively identified as *Epitedia* sp. (T.D. Galloway personal communication).

MEGARTHROGLOSSUS DIVISUS (BAKER).—A single male specimen was recovered from a *Microtus ochrogaster* in Fall River County, which constitutes a state record. This small, delicate nest flea occurs throughout the western United States, ranging eastward into western Nebraska and southeastern Wyoming (Tipton et al. 1979). Various species of woodrats (*Neotoma*) appear to be preferred hosts, but this flea commonly occurs on other rodents.

STENOPONIA AMERICANA (BAKER).—We collected 16 specimens (7 males, 9 females) of this large (3.5–4.5-mm), dark brown flea from 2 *Peromyscus leucopus* in Fall River County. This parasite possesses a large abdominal ctenidium on tergum I, thus contributing to the flea's overall bristly appearance. Various species of cricetid mice are preferred hosts. This flea is widely

distributed throughout eastern North America but is relatively scarce beyond the Great Plains. Our specimens from the Black Hills represent a new record for South Dakota.

Leptopsyllidae

ODONTOPSYLLUS DENTATUS (BAKER).—A total of 27 specimens (14 males, 13 females) of this large (3–4-mm), dark flea were collected from *Sylvilagus audubonii* and *Sylvilagus floridanus* in Fall River County, and *Sylvilagus nuttallii* in Custer County. As with *Cediopsylla inaequalis inaequalis*, this rabbit flea is known from all 11 western states. Our collection is a new record for the state and a modest eastward extension of this species' range beyond Albany County, Wyoming. *Odontopsyllus multispinosus*, the other North American species in the genus, also occurs on leporids but has an eastern distribution and has not been reported from either of the Dakotas.

PEROMYSCOPSYLLA HESPEROMYS (BAKER).—Two males and 7 females were recovered from 2 *Peromyscus maniculatus* in Fall River County. The flea's presence on this host in Lawrence and Jackson counties was reported by Easton (1982). Of the 4 subspecies in North America, geography and host preference place *Peromyscopsylla hesperomys hesperomys* and *Peromyscopsylla hesperomys adelpha* in the Black Hills. However, intergrades have been reported from Pennington, Custer, and Meade counties (Johnson and Traub 1954); thus, specimens collected in the current study cannot be assigned with confidence to either subspecies.

Ceratophyllidae

AETHECA WAGNERI (BAKER).—Four males and 6 females were collected from 4 species of cricetid mice. These included *Reithrodontomys megalotis*, *Microtus ochrogaster*, *Peromyscus leucopus*, and *Peromyscus maniculatus*, all from Fall River County. This flea exhibits low host specificity throughout its range from the Great Lakes region to the Pacific coast. Previous records from the Black Hills include *Neotoma cinerea* (Turner 1974) and *Zapus hudsonius* (Easton 1982), and Johnson (1961) noted the flea's presence in Custer County without specifying a host. Prior to a revision of the *Ceratophyllidae* (Smit 1983), these and numerous other reports placed *wagneri* in the genus *Monopsyllus*.

AMARADIX EUPHORBI (ROTHSCHILD).—Two females were removed from a *Peromyscus*

maniculatus collected in Fall River County. Prior to the creation of the genus *Amaradix* in 1983, this flea was included in the genus *Malaraeus*. This parasite of cricetid rodents has a distribution from western Canada southward to the Pacific Northwest and the Rocky Mountain states. Extensions of its range include southeastern Wyoming (Wiseman 1955) and west central North Dakota (Larson 1997). The latter appears to be the easternmost record in the United States, with the present report being the first for South Dakota.

EUMOLPIANUS EUMOLPI (ROTHSCHILD).—We recovered 2 males from a *Tamias minimus* in Pennington County and 1 female from a *Tamiasciurus hudsonicus* in Custer County. This flea of sciurids ranges from the Great Lakes westward to the Pacific coast. Turner (1974) found least chipmunks in the Black Hills with this parasite, and Easton (1982) similarly collected the flea in Lawrence County. An earlier report from Custer County (Johnson 1961) failed to note a host. Outside of the Black Hills, *E. eumolpi* is also known from Harding County (Andersen and Jones 1971). In their review of *Eumolpianus*, Lewis and Jameson (2002) synonymized the 2 subspecies of *eumolpi* (formerly in the genus *Monopsyllus*).

FOXELLA IGNOTA (BAKER).—We collected 16 specimens (7 males, 9 females) from a *Geomys bursarius* in Fall River County, a new record for the Black Hills. Members of the genus *Foxella* are parasites of pocket gophers wherever such hosts occur in North America. Rissky (1962) collected *F. ignota* in Clay County, and Easton (1982) listed this flea from Brookings and Harding counties. For nearly a century, *Foxella ignota* and *Foxella ignota albertensis* were viewed as valid subspecies, with the latter having the more westerly distribution. The male claspers display some differences in shape, size, and proportion. However, Lewis and Wilson (2006) reviewed the genus and synonymized these 2 subspecies and 9 others, with *F. ignota* as the only valid taxon. We accept their opinion that the species exists as a cline from east to west.

MALARAEUUS TELCHINUS (ROTHSCHILD).—Two females were recovered from a *Peromyscus maniculatus* in Fall River County. Turner (1974) reported this parasite in the Black Hills from this host and from *Reithrodontomys megalotis*. Easton (1982) noted *Zapus hudsonius* as a host in Lawrence County. Cricetids are commonly

parasitized throughout western North America, but the flea's presence in the Black Hills appears to be its easternmost distribution. Extensive trapping of small rodents 300 km to the north in southwestern North Dakota has failed to yield *M. telchinus* (Larson et al. 1985).

ORCHOPEAS AGILIS (ROTHSCHILD).—Three *Neotoma cinerea* from Fall River County possessed 95 specimens (46 males, 49 females). In the same county, 3 additional specimens were recovered from a *Peromyscus maniculatus*. For many years, *O. agilis* and 7 other related forms were considered to be subspecies of *Orchopeas sexdentatus*, a common and broad-ranging parasite on various species of woodrats. From this "sexdentatus" group, 2 were synonymized and 6 raised to species status by Lewis (2000). Previous collections in the Black Hills from deer mice and woodrats did not specify a subspecies (Turner 1974, Easton 1982).

ORCHOPEAS CAEDENS (JORDAN).—Three males and 10 females were removed from 3 *Tamiasciurus hudsonicus*, one each from Custer, Fall River, and Pennington counties. This parasite is commonly found on red squirrels throughout the host's North American range. In South Dakota, that range is restricted to the Black Hills, from which Easton (1982) noted the flea's presence in Custer and Lawrence counties. In the absence of red squirrels, *O. caedens* parasitizes other species of sciurids in eastern South Dakota (Coffman and Balsbaugh 1971, Wilson 1978).

ORCHOPEAS LEUCOPUS (BAKER).—Eight *Microtus ochrogaster* from Fall River and Shannon counties possessed 51 specimens (19 males, 32 females). Lightly infested *Reithrodontomys montanus* and *Reithrodontomys megalotis* from Fall River County and *Peromyscus leucopus* and *Microtus pennsylvanicus* from Shannon County harbored 14 additional specimens. This parasite is one of the most common and widely distributed fleas on cricetid rodents in North America. However, the only previous report of this flea in South Dakota listed prairie voles and deer mice as hosts in the Black Hills (Turner 1974).

OROPSYLLA (OPISOCROSTIS) HIRSUTA (BAKER).—One male was collected from a *Cynomys ludovicianus* in Shannon County. This parasite occurs throughout the range of prairie dogs, and was first reported from the Black Hills by King (1955) as occurring in "great numbers." Additional records from the Black Hills include Custer and Pennington counties

(Easton 1982, Kietzmann 1987b). Boddicker (1968) reported this flea on *Mustela nigripes* in Bennett County and from a prairie dog burrow inhabited by black-footed ferrets in Mellette County. This parasite was formerly in the genus *Opisocrostitis*, but Smit (1983) lowered the taxon to subgeneric status.

OROPSYLLA (THRASSIS) FOTUS (JORDAN).— One male specimen was collected from a *Spermophilus tridecemlineatus* (thirteen-lined ground squirrel) in Fall River County. This parasite occurs east of the Rockies, from the western portion of the Dakotas, southward to Mexico. Various species of ground-dwelling sciurids are commonly infested, including thirteen-lined ground squirrels in Custer County (Turner 1974). Stark (1970) noted this parasite, without giving specific information, from 2 locations in northern and central South Dakota.

OROPSYLLA (THRASSIS) STANFORDI WAGNER.— One male and one female were recovered from a *Sylvilagus nuttallii* in Custer County. Although mainly a parasite in the Rocky Mountain region, its occurrence in the Black Hills relates to the presence of the preferred host, a disjunct population of *Marmota flaviventris* (yellow-bellied marmot). Ecological associates of yellow-bellied marmots, such as ground squirrels, prairie dogs, and rabbits, may also serve as hosts. Easton (1981) reported this parasite from marmots collected in Lawrence County, and Stark (1970) noted the flea's presence in Custer County, without specifying a host.

DISCUSSION

The diversity of fleas collected reflects the diversity of hosts examined. Although the number of specimens recovered was less than anticipated, this result largely relates to our use of snap-traps for collecting small mammals (Platt et al. 2009). Live-trapped rodents tend to retain most of their fleas, but if the rodents are handled carelessly or killed, rapid abandonment occurs (Stark and Kinney 1962). Also contributing to abandonment is the tendency of fleas to leave a dead host as it loses body heat.

Eight of the 20 species we collected constitute new records for the Black Hills and adjacent grasslands: *Cediopsylla inaequalis inaequalis*, *Euhoplopsyllus glacialis affinis*, *Ctenophthalmus pseudagyrtis pseudagyrtis*, *Foxella ignota*, *Amaradix euphorbi*, *Megarathroglossus divisus*, *Stenoponia americana*, and *Odontopsyl-*

lus dentatus. The last 4 in the list are new South Dakota records, thus bringing the state's known flea fauna to 42 species.

Only *Epiteidia wenmanni wenmanni*, *Peromyscopsylla hesperomys*, *Orchopeas leucopus*, and *Pulex* sp. have transcontinental ranges. The Black Hills area appears to represent the easternmost range for 5 of the 16 species with regional distributions (*Megarathroglossus divisus*, *Odontopsyllus dentatus*, *Amaradix euphorbi*, *Malaraeus telchinus*, and *Oropsylla stanfordi*).

Plague is an occasional but widely distributed zoonotic disease in the western United States, and its possible spread into the Great Plains was the impetus for surveillance work in the early 1940s. Prince (1943) collected plague-positive fleas from *Spermophilus richardsonii* in Divide County, North Dakota. However, in South Dakota's Potter County, the same host possessed uninfected *Oropsylla bacchi* and *Oropsylla bruneri*, which later were shown to be capable vectors of the disease. Although no human cases of plague are known from South Dakota, there is evidence of the sylvatic form in the Black Hills area. Serosurveillance for plague in wild and domestic mammals has been conducted in most western states by the Centers for Disease Control and Prevention and other agencies. No carnivores collected in Pennington County were seropositive in 1990 (CDC 1992), but a badger, 2 coyotes, and a red fox (*Vulpes vulpes*) from Fall River County tested positive for plague in 1994–1995 (CDC 1995). The diets of these animals suggest infected rodents and their fleas as sources of transmission. Of the 20 species of fleas collected in the present study, at least 13 are known to be associated with plague, either through natural infections or laboratory feeding experiments. Although fleas are of minimal, if any, importance as vectors of tularemia, this zoonotic disease is associated with cottontail rabbits and their predators. In the fall of 1990, 48 of 80 sera from carnivores in Pennington County tested positive for tularemia antibodies (CDC 1992). Unknown, but potentially occurring in the Black Hills region, are Bartonellosis, a group of emerging zoonotic diseases of mammals. Although domestic cats and dogs are primary reservoirs for 4 species of *Bartonella* that are infective to humans, it is the unknown distribution and relevance of other species in coyotes, foxes, rabbits, ground squirrels, and wild mice that are of concern (Chomel et al. 2006). Hunters,

trappers, and field biologists should be aware of possible zoonotic diseases when collecting mammals.

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APPENDIX. The fleas recovered from mammals collected in 4 southwestern South Dakota counties, 2003–2006. The number of hosts examined is noted in parentheses. Taxonomy follows Wilson and Reeder 2005.

MUSTELIDAE

Taxidea taxus (1)
Pulex sp.

SCIURIDAE

Cynomys ludovicianus (1)
Oropsylla hirsuta
Spermophilus tridecemlineatus (1)
Oropsylla fotus
Tamias minimus (1)
Eumolpianus eumolpi
Tamiasciurus hudsonicus (3)
Eumolpianus eumolpi
Epitedia w. wenmanni
Orchopeas caedens

GEOMYIDAE

Geomys bursarius (1)
Foxella ignota

HETEROMYIDAE

Chaetodipus hispidus (1)
Epitedia sp.

CRICETIDAE

Microtus ochrogaster (9)
Aetheca wagneri
Epitedia w. wenmanni
Megarthrogllossus divisus
Orchopeas leucopus
Microtus pennsylvanicus (1)
Ctenophthalmus p. pseudagyrtis
Epitedia w. wenmanni
Orchopeas leucopus
Neotoma cinerea (3)
Epitedia w. wenmanni
Orchopeas agilis

Peromyscus leucopus (3)
Aetheca wagneri
Epitedia sp.
Orchopeas leucopus
Stenoponia americana
Peromyscus maniculatus (4)
Aetheca wagneri
Amaradix euphorbi
Epitedia w. wenmanni
Malareus telchinus
Orchopeas agilis
Peromyscopsylla hesperomys
Reithrodontomys megalotis (2)
Aetheca wagneri
Orchopeas leucopus
Reithrodontomys montanus (1)
Orchopeas leucopus

LEPORIDAE

Lepus townsendii (1)
Cediopsylla i. inaequalis
Pulex sp.
Sylvilagus audubonii (7)
Cediopsylla i. inaequalis
Euhoplopsyllus glacialis affinis
Odontopsyllus dentatus
Sylvilagus floridanus (4)
Cediopsylla i. inaequalis
Euhoplopsyllus glacialis affinis
Odontopsyllus dentatus
Sylvilagus nuttallii (5)
Cediopsylla i. inaequalis
Odontopsyllus dentatus
Oropsylla stanfordi
Sylvilagus sp. (12)
Cediopsylla i. inaequalis
Euhoplopsyllus glacialis affinis
Odontopsyllus dentatus
Pulex sp.
