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Glenn E. Haas
Boulder City, Nevada

James R. Kucera
Associated Regional and University Pathologist, Inc., Salt Lake City, Utah

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FLEAS (SIPHONAPTERA) IN NESTS OF VOLES (*MICROTUS* SPP.) IN MONTANE HABITATS OF THREE REGIONS OF UTAH

Glenn E. Haas¹ and James R. Kucera²

ABSTRACT.—As a parallel study of a survey of fleas of trapped small mammals in montane southern Utah, we removed 77 adult fleas from 12 of 13 nests of voles (*Microtus longicaudus*, *M. montanus* and *M. richardsoni*) collected from montane meadows in the Abajo and La Sal Mountains, the Markagunt Plateau and Pine Valley Mountains, and the Uinta Mountains, May 1991–July 2002. Six species and subspecies of fleas parasitic on *Microtus* spp. were found, 1–3 species in each nest. Three specimens of the ubiquitous deer mouse (*Peromyscus* spp.) flea *Aetheca wagneri* (Baker) were also found. We collected the following 7 taxa from the locations indicated: *Catallagia decipiens* Rothschild in 5 nests: Abajo and Pine Valley Mountains and Markagunt Plateau; *Hystrihopsylla dippiei truncata* Holland in 2 nests: La Sal and Uinta Mountains; *H. occidentalis sylvaticus* Campos & Stark in 5 nests: Pine Valley Mountains; *Peromyscopsylla selenis* (Rothschild) in 1 nest: Markagunt Plateau; *A. wagneri* in 2 nests: Abajo and Pine Valley Mountains; *Megabothris abantis* (Rothschild) in 5 nests: Abajo and Uinta Mountains and Markagunt Plateau; *Malaraeus telchinus* (Rothschild) in 2 nests: Abajo and Pine Valley Mountains. One preserved larva was identified as *Hystrihopsylla* prob. *occidentalis sylvaticus*, and 2 dead larvae, the only specimens found in nest 13, were identified as probably the same. Kane County is a new record for *C. decipiens* and *P. selenis*; Kane and Summit Counties are new for *M. abantis*. Nest surveys can generally supplement rather than replace trapped-host surveys. Their main value is in population studies. They are also a source of larvae for morphology and taxonomy research.

Key words: Siphonaptera, fleas, *Microtus*, voles, nests, Utah.

Eleven species of fleas are known parasites of voles (mostly *Microtus* spp. and *Clethrionomys gapperi*), at various degrees of host specificity, in Utah. Almost all of the records are from trapped hosts. The earliest collections from nests of *Microtus* appear to be those made over 50 years ago of *Catallagia decipiens* Rothschild and *Megabothris asio* (Baker) in Laketown, Rich County, by L. Beck and D Elden Beck et al. Three publications resulted from these collections: Hopkins and Rothschild (1962) recorded the 1st species, and the 2nd was recorded by Beck (1965) and Kucera (1995). In addition, specimens of *Malaraeus telchinus* (Rothschild) collected by D Elden Beck et al. (unpublished) from some of these same nests are in the Brigham Young University flea collection. We present the data for them in the *M. telchinus* species account.

Medical entomologist and zoologist D Elden Beck, the pioneer in studies of fleas collected from nests in Utah, was a faculty member of the Department of Zoology and Entomology, Brigham Young University, Provo, Utah (d. 9 August 1967), and principal investigator of Pro-

ject X, “Parasitic Arthropods and Arthropod Consorts [in Utah], 1949–1953” (Beck 1955, Tanner 1967, Beck and Allred 1968). Six vole nests were collected, 3 each in 1952 and 1953, as directed by Beck. Because of the lack of space for full collection data for each nest, Beck (1955) pooled data by counties from 277 mammal nests and about 5500 individual host animals for a tabulation of 20 fleas that are capable vectors of plague and 11 that are potential vectors. The other 51 species and subspecies of fleas collected were thereby omitted except for several recorded elsewhere, such as the exceptional find reported later by Beck (1965) of 52 specimens of *Megabothris asio*, a new species for Utah, in a single *Microtus montanus* nest at Laketown.

The present survey resulted in new data from the southwestern Pine Valley Mountains and the Markagunt Plateau, the southeastern Abajo and La Sal Mountains, and the northern Uinta Mountains. From 12 of the 13 nests listed below were 5 additional records of *Catallagia decipiens*, 2 of *M. telchinus*, and the 1st records of 4 other fleas of microtines, plus *Aetheca*

¹557 California Ave., PMB 7, Boulder City, NV 89005-2796.

²Associated Regional & University Pathologists, Inc., Salt Lake City, UT 84108.

wagneri (Baker), the ubiquitous flea of deer mice (*Peromyscus maniculatus*). The 4 species not yet definitely found in microtine nests are the common wintertime nest-fleas *Eptedia wenmanni* (Rothschild) and *E. stanfordi* Traub (Beck 1955, Stark 1959, Hopkins and Rothschild 1962), the rare nest-flea *Delotelis telegoni* (Rothschild) (Kucera 1995), and the uncommonly collected non-nest-flea *Peromyscopsylla hamifer vigens* (Jordan) (Johnson and Traub 1954, Stark 1959, Hopkins and Rothschild 1971).

This nest survey originated as a parallel of our survey of fleas from trapped hosts (Kucera and Haas 1992). Progress was slowed by degradation of *Microtus* habitat by livestock overgrazing intensified by prolonged drought. In his monograph of mammals of Arizona, Hoffmeister (1986) described the many historic changes detrimental to wild mammals of the state. He targeted degradation of grassland and riparian habitats by overgrazing as causes of the elimination of some species. In their monograph of the mammals of Wyoming, Clark and Stromberg (1987) commented on the harmful effects of overgrazing on 3 species of lagomorphs and 9 species of rodents including *M. longicaudus* and *M. richardsoni*.

The new data from this study on nest populations, rearing, and larvae are examples of contributions that fleas from trapped hosts cannot directly provide. Nest surveys, however, are likely to remain supplementary to trapping for the delineation of distribution patterns.

MATERIALS AND METHODS

We searched for nests of *Microtus* spp. under and beside logs and stumps in and along the edges of grassy montane meadows. Nests were removed from their individual sites as intact as possible and sealed inside individual plastic bags. A series of small amounts of nest materials were transferred from a bagged nest to a light-colored dishpan to expose the fleas. Live adult fleas and a larva were captured with a lightweight forceps and conveyed to vials of 70% ethanol. A small camel's hair brush was used to gently lift out and drop the dead larval and adult fleas into dry vials. Fieldwork was conducted intermittently from May 1991 to July 2002, with 1–3 productive nests collected in each month, May–November.

Nests with flea larvae present were rebagged after the initial examination and held at room

temperature for as long as teneral adult fleas appeared at subsequent inspections. These nests were double bagged with moist paper towels in the sealed outer bag and the nest in the inner open bag.

Adult flea specimens were processed in 10% aqueous KOH, rinsed in distilled water, dehydrated in graded ethanols, degreased in oil of wintergreen, rinsed in xylene, and mounted in balsam on slides for microscopic study. Adult voucher specimens of vole fleas were deposited in the Brigham Young University flea collection, Provo, Utah (BYU). The preserved larvae are in the collection of Kucera.

RESULTS

The following 6 taxa of fleas parasitic on *Microtus* spp. in Utah were represented among the 74 adult fleas found, 1–3 species in each of 12 of the 13 nests collected. Nest A1 was probably of *M. montanus* (montane vole). Nests U1 and U2 were probably of *M. richardsoni* (water vole). The other 10 nests were probably of *M. longicaudus* (long-tailed vole). Three specimens of the ubiquitous *Peromyscus* spp. (deer mouse and allies) flea *Aetheca wagneri* (Baker) were also found in 2 nests. Nests PV1 and PV5 had 1–2 or 3 larvae, and only the 1 in PV1 could be identified as the 3rd taxon listed below. Attempts to rear the other larvae were unsuccessful. However, 17 adult fleas were reared from 2 other nests, with species 1 from A2 and species 7 from A2 and PV3 as listed. Two dead larvae were found in the 13th nest (PV6). No fleas were found in 6 other nests: Duck Creek 1, Milos Kitchen 1, Oak Grove Spring 1, Pine Valley Reservoir 3. The topographic abbreviations A, LS, M, PV, and U are spelled out in full in the annotated list of collections in the Appendix.

CTENOPHTHALMIDAE

1. *Catallagia decipiens* Rothschild in 5 nests: A1: 1♂, 4♀♀; A2: 3♂♂ (2 reared), 7♀♀ (2 reared); M2: 1♂; PV1: 2♀♀; PV5: 1♀.

HYSTRICHOPSYLLIDAE

2. *Hystrichopsylla dippiei truncata* Holland in 2 nests: LS1: 1♀; U2: 2♀♀.

3. *Hystrichopsylla occidentalis sylvaticus* Campos and Stark in 5 nests: PV1: 1♂, 4♀♀ + 1 larva; PV2: 1♀; PV4: 1♂; PV5: 1♂, 2♀♀; PV6: 2 dead larvae.

LEPTOPSYLLIDAE

4. *Peromyscopsylla selenis* (Rothschild) in 1 nest: M1: 1 ♀.

CERATOPHYLLIDAE

5. *Aetheca wagneri* (Baker) in 2 nests: A2: 2 ♀ ♀; PV1: 1 ♂.

6. *Megabothris abantis* (Rothschild) in 5 nests: A1: 1 ♂, 1 ♀; A2: 3 ♂ ♂; M2: 1 ♀ (dead); U1: 4 ♂ ♂, 4 ♀ ♀; U2: 2 ♂ ♂.

7. *Malaraeus telchinus* (Rothschild) in 2 nests: A2: 2 ♂ ♂ (reared), 4 ♀ ♀ (3 reared); PV3: 7 ♂ ♂ (5 reared), 12 ♀ ♀ (3 reared).

DISCUSSION

Catallagia decipiens
(Rothschild)

Catallagia is a Holarctic genus of nest-fleas (Traub 1972), and *C. decipiens* has the widest distribution in western North America north of Mexico (Lewis and Haas 2001). For Utah, Stark (1959) and Hopkins and Rothschild (1962) listed records from a wide variety of small mammals including species of *Microtus* and *Peromyscus*. The earliest record from a *Microtus* nest in Utah appears to be the collection of 5 specimens from a nest of *M. montanus* in Rich County in 1952 by Beck and Beck as cataloged by Hopkins and Rothschild (1962). Egoscue (1976) concluded from comparative snap-trapping of *M. longicaudus* and *P. maniculatus* in western Utah that the former is perhaps a secondary host of *C. decipiens*. We tentatively rank it and *M. montanus* as secondary hosts in Utah. Elsewhere, however, the *Microtus* spp. and *P. maniculatus* may rank more nearly equal as hosts of *C. decipiens*. For example, in a survey using live-traps in north central New Mexico, Haas et al. (1973) determined that 11.4% of 132 *M. longicaudus*, 9.4% of 371 *M. montanus*, and 7.7% of 606 *P. maniculatus* were infested. *Catallagia decipiens* differs from the other 6 species in the Utah *Microtus* nest survey in being the only true nest-flea. It was also one of only 2 species that was successfully reared, with 4 additional adult specimens credited to *M. longicaudus* nest A2. The total number of adult specimens of *C. decipiens*, i.e., 19 (4 reared), was 2nd only to the 25 (13 reared) specimens of *M. telchinus*. The *C. decipiens* specimen in *M. longicaudus* nest M2 along Duck Creek on the Markagunt Plateau added

Kane as the 18th county to the checklist of Beck (1955).

Hystrihopsylla dippiei truncata
Holland and *Hystrihopsylla*
occidentalis sylvaticus
Campos & Stark

Both species are large, spiny, and bristly fleas that may be common in nests at certain times of the year, although they are not classified as true nest-fleas (Traub 1972, see also Stark 1959, 2002). These species are represented in western North America by 3 or more subspecies that parasitize a wide variety of small mammals. With *H. o. sylvaticus*, however, species of *Peromyscus* and *Microtus* are the most frequently infested hosts (Lewis and Lewis 1994). There are few records of *H. d. truncata* and *H. o. sylvaticus* in northern Arizona (Hopkins and Rothschild 1962, Campos and Stark 1979), but in Utah considerably more locality records are known (Holland 1957, Campos and Stark 1979). The 2 species are sympatric on the Kaibab Plateau, Arizona (Haas and Kucera unpublished data), and may be sympatric in southeastern Utah. Campos and Stark (1979) reported *H. o. sylvaticus* from San Juan County (without locality), and we collected *H. d. truncata* from the La Sal Mountains (nest LS1) and the Abajos (Kucera and Haas 1992). Egoscue (1976) found both species on *P. maniculatus* and *M. longicaudus* taken on the same trap lines in western Utah.

Peromyscopsylla selenis
(Rothschild)

This is a fur-flea well equipped with structures for a secure life in the pelage of the host (Traub 1972). *Peromyscopsylla* spp. spend so little time free-living in nests that live specimens are seldom collected from them. For example, in Oregon, *P. selenis* was only 0.9% of the total flea population in nests of *M. canicaudus* (gray-tailed vole; Robbins 1983). For another example, in Alaska, where the absence of grazing by livestock allows *Microtus* spp. to attain much higher densities than in Utah, 2420 fleas (618 reared) were obtained from 160 flea-infested nests, and only 29 specimens (1.2%; 12 reared) of *P. ostsibirica* (Scalon) were taken from 5 (3.1%) of the nests (Haas 1982).

Peromyscopsylla hamifer vigens (Jordan) also parasitizes *Microtus* spp. in Utah, but *P. selenis* is much better known from a mixture of

records from microtines and *Peromyscus* spp. in 11 counties widely distributed between the Arizona and Idaho borders: Box Elder, Cache, Iron, Kane (new), Millard, Salt Lake, San Juan, Sanpete, Tooele, Utah, and Washington (1 Traub 1944, 1 Hubbard 1947, 5 Johnson and Traub 1954, 7 Stark 1959, 1 Egoscue 1966, 1976, 2 Hopkins and Rothschild 1971, 1 Jellison and Senger 1976, 2 Kucera and Haas 1992, 1 present study). In contrast, *P. hamifer vicens* is poorly known with only 4 original records from *Microtus* spp., *M. montanus* and *M. longicaudus*, in Cache, Salt Lake, and Tooele Counties (Johnson and Traub 1954, Stark 1959, Hopkins and Rothschild 1971, Egoscue 1976).

Aetheca wagneri (Baker)

This ubiquitous flea (formerly *Monopsyllus wagneri*) of the ubiquitous *P. maniculatus* and congeners is distributed across much of North America between the West Coast and Great Lakes (Johnson 1961; Haddow et al. 1983: map 2; Holland 1985: map 72). Beck (1955) tabulated its presence in all counties of Utah. In a comparative study of flea exchange between *P. maniculatus* and associated rodents in western Utah, Egoscue (1976) identified key factors that ensure frequent reports of *A. wagneri* found on secondary and accidental hosts in most western surveys of small mammal fleas. He noted that *P. maniculatus* was found in every habitat and readily used runways, burrows, and vacant nests of other mammals. Thus, high populations of *P. maniculatus* and *A. wagneri* frequently resulted in transfer of this flea to other hosts.

Megabothris abantis
(Rothschild)

This flea of western North America occurs from near sea level along the West Coast inland and upward into the western cordillera over an extensive territory stretching in length from southwestern Alaska to northern New Mexico and in width from Oregon and northern California to western Montana and central Colorado (Haas 1982; Haddow et al. 1983: map 76; Holland 1985: map 76; Lewis et al. 1988:195; Haas et al. 1989: fig. 5). *Megabothris abantis* ranges farther south than other members of this Holarctic genus in North America (Haddow et al. 1983: maps 76–79, 82). The southernmost record is in southern California (Augustson 1955). In Utah most counties with *Microtus*

spp. have records for *M. abantis*. The revised list of 18 includes 2 new counties from our survey: Beaver, Box Elder, Cache, Daggett, Duchesne, Grand, Iron, Kane (new), Rich, Salt Lake, San Juan, Sevier, Summit (new), Tooele, Uintah, Utah, Wasatch, and Wayne (12 Beck 1955, 7 Stark 1959, 3 Egoscue 1966, 1976, 1977, 1988, 2 Kucera and Haas 1992, 2 present study).

Among the wide variety of mammalian species recorded as hosts of *M. abantis*, *Microtus* spp. and some other western rodents that build their summer nests where the soil is cool and moist are predominant. Haddow et al. (1983:111) specified the main hosts as “microtine voles, particularly *Microtus* and *Clethrionomys*.” Their collection records came from a variety of rodents including *M. longicaudus*, *M. montanus*, and *M. richardsoni*. The first 2 species are known from many more localities across Utah than the 3rd (Durrant 1952: figs. 60–62; Schafer 1991). Stark (1959) included *M. montanus* in a diverse list of hosts in Utah. It was also recorded by Allred (1952) and Beck (1955), while *M. longicaudus* was reported by Tipton (1950), Allred (1952), Beck (1955), Egoscue (1976, 1977), and Kucera and Haas (1992). Egoscue (1966) reported *M. richardsoni*. Ten of our nests were probably of *M. longicaudus*. Nest A1 was most likely of *M. montanus*, and nests U1 and U2 were probably of *M. richardsoni*. *Megabothris abantis* was present in these last 3 nests but only in 2 of the other 10 (A2, M2).

The Utah record in Haddow et al. (1983) of a single female of *Megabothris quirini* (Rothschild), a flea of *Microtus* spp. in northern North America, needs confirmation by collecting a male specimen, as some females of *M. abantis* resemble those of *M. quirini*. The specimen reported by Haddow et al. (1983) is in the British Museum (Natural History), London, bearing the following (somewhat unclear) slide data: “*quirini* Roths. 1905, Mammoth Ranger Station, Manti Nat Forest, Utah, 31 May 1927, ♀.” The opposite label reads: “from *Eutamias*, A.W. Moore, Brit. Mus. 1923–615” [Moore was probably the collector; it is unclear if he also identified the specimen].

Malaraeus telchinus
(Rothschild)

Malaraeus is a western North American genus of 3 species, with *M. telchinus* the one best adapted to cool, humid microclimates. Consequently, it ranges farther north, into

Canada, and to higher elevations in western states where it parasitizes not only *Peromyscus* spp. but *Microtus* spp., *Clethrionomys* spp., and other small mammals as well (Hubbard 1947; Haddow et al. 1983: maps 73 and 74; Holland 1985: map 84; Lewis et al. 1988). Haddow et al. (1983: map 74) indicated locality records for all states surrounding Utah except Colorado and Wyoming; however, *M. telchinus* does range eastward into Colorado (Ecke and Johnson 1952, Eads and Campos 1983, Ayala et al. 1988) and Wyoming (Kucera unpublished data).

There are many Utah records from a variety of localities and hosts (Hubbard 1947, Stark 1959, Parker and Howell 1959, Egoscue 1966, 1976, Haddow et al. 1983: map 74). Beck (1955) tabulated records for more than half of the counties (16) including San Juan and Washington, the counties with our records (nests A2, PV3).

The unpublished Project X field records of D. E. Beck and voucher specimens in the Brigham Young University flea collection document the earliest collections of this species from nests of voles in Utah: field #2683, Rich Co., Laketown, under fallen trees in marsh near Bear L., ex 3 nests of *M. montanus*, 22 August 1952, D. E. Beck and L. Beck, 8♂♂, 15♀♀; field #3555, same locality, ex 3 nests of *Microtus*, 26 June 1953, Beck et al., 8♂♂, 3♀♀.

CONCLUSION

Microtus nest surveys will generally not be as productive per unit of effort as the trapping of hosts for faunal distribution data. Nests, however, being nurseries of fleas are sources of larvae and pupae for laboratory studies in taxonomy and morphology. Bagged nests held in the laboratory sometimes result in the rearing of adults after the original adult inhabitants are removed. One flea-infested nest can provide more complete population data than several trapped hosts can; e.g., adult fleas represent the present generation, subadult stages are the next generation, and dead adults are the previous generation(s).

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APPENDIX

ANNOTATED LIST OF COLLECTIONS

A1 San Juan Co., Abajo Mtns., 15.3 km WNW of Monticello at Foy L., 2549 m, 6 Sep 1991, small grass nest under log in extensive grassy meadow below dam.

A2 Same data as A1 but spherical grass nest under cut stump at edge of grove of Gambel oaks (*Quercus gambelii*) and quaking aspens (*Populus tremuloides*) along FR 100.

LS1 Grand Co., La Sal Mtns., 26.8 km ESE of Moab in Oowah L. CG, 2682 m, 14 Jun 1991, small grass nest under old sheet of plywood.

M1 Kane Co., Markagunt Plat., 1 km E of Duck L. between Duck Cr. and UT Hwy 14, 2636 m, 19 Jul 2002, abandoned grass nest with moist bottom under old aspen log in low-lying grassy meadow with nearby blue spruce trees (*Picea pungens*).

M2 Same Co. and Plat., 23 m E of Duck L. along N bank of Duck Cr., 2644 m, 20 Jul 2002, large nest of dry, fine grass, shredded string, and cloth, under aspen log in low-lying, densely grassy meadow with several small aspens, white firs (*Abies concolor*), and blue spruces.

PV1 Washington Co., Pine Valley Mtns., 12.2 km NW of Leeds, Oak Grove CG, 2010 m, 10 May 1991, spherical grass nest in ditch in small grassy meadow at Oak Grove Spring in forest of Gambel oaks and ponderosa pines (*Pinus ponderosa*).

PV2 Same Co. and Mtns., 5.6 km ESE of Pine Valley (town), in canyon of Left Fork Santa Clara R., Juniper Park CG, 2120 m, 8 Nov 1991, spherical grass nest in saucer-shaped depression in ground under cottonwood (*Populus*

sp.) log in low, moist patch of horsetails (*Equisetum* sp.), sedges, and ferns near creek.

PV3 Same Co. and Mtns., 3.6 km ESE of Pine Valley, below Pine Valley Reservoir dam, 2047 m, 10 Nov 1991, spherical grass nest in saucer-shaped depression in ground at base of willow (*Salix* sp.) clump in extensive low, moist grassy flat with several willow clumps.

PV4 Same Co., Mtns. and locality, but along S bank of Santa Clara R., 2042 m, 13 Oct 2000, old moist, collapsed grass nest beside willow log in thick, ungrazed grassy meadow with high water table, scattered clumps of willows, alders (*Alnus* sp.), and in dry places a few blue spruces, ponderosa pines, Gambel oaks, and junipers (*Juniperus* sp.).

PV5 Close to PV4, 13 Oct 2000, perfect fist-size, spherical grass nest with opening on one side, moist bottom, coarse outer and fine inner grass, 2–3 unidentified larvae present but nest apparently recently abandoned, in ground-level cavity of dead, rotten willow stump.

PV6 Same Co. and Mtns., but 6.2 km ESE of Pine Valley along S bank of Middle Fork Santa Clara R., 2195 m, 16 Jul 2002, nest of dry, fine grass on ground under aspen log in grassy meadow with aspens, white firs and ponderosa pines.

U1 Summit Co., Uinta Mtns., 31.9 km ENE of Kamas, nr base S slope Bald Mtn., 3193 m, 21 Aug 1996, nest of grass, shredded waste paper, and plastic bag with moist bottom, under slab of rotted Engelmann spruce (*Picea engelmannii*) log in seep area.

U2 Close to U1, 3192 m, 21 Aug 1996, a 25-cm spherical nest of grass on surface in sedge (undet. Cyperaceae) bed beside rivulet in seep area, with feeding sign nearby.