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PLAGUE IMPORTANT FLEAS AND MAMMALS IN UTAH AND THE WESTERN UNITED STATES

DORALD M. ALLRED
Salt Lake City, Utah

In recent years increased interest has been shown toward those arthropods which are capable 2 and potential 3 vectors of diseases to man and animals closely associated with man. Although outbreaks of human plague in the United States have never been of such disastrous proportions as those in Europe and Asia, there has been continued concern over its presence in sylvatic form since its discovery in rats at San Francisco in 1900. Various workers have implicated more than sixty species and subspecies of fleas with human and sylvatic plague throughout the world. Of this number, over forty-five species and subspecies are known to occur in the United States as obligate or facultative parasites of birds and mammals. Although much work has been done, still relatively little is known concerning the disease transmission potentialities of these species of fleas and their ecological relationships to native mammals and birds which may serve as reservoirs of sylvatic plague.

This study was initiated for three major reasons: (1) to bring together the scattered data from the literature concerning plague important fleas and their hosts, (2) to add to the knowledge concerning the host-flea relationships, and (3) to determine the geographic distribution of medically important species of fleas in Utah.

The author wishes to express appreciation to those men and institutions 4 who helped to make this study possible. For access to unpublished collection records, thanks are due Dr. Vasco M. Tanner, Brigham Young University; Dr. J. Sedley Stanford, Utah State Agricultural College; Mr. Fred C. Harmston and Mr. Roy J. Myklebust, Utah State Board of Health, United States Public Health Service; the Communicable Disease Center, United States Public Health Services.

1 An abstract from a thesis submitted to the faculty of the Department of Zoology and Entomology, Brigham Young University, Provo, Utah in partial fulfillment for the degree of Master of Arts, June, 1951.
2 "Capable vectors" are herein classified as those fleas which have been found infected with plague bacilli in nature or have been infected under experimental conditions, and are known or have been experimentally shown to be able to transmit the disease either under natural or experimental conditions.
3 "Potential vectors" are those fleas which fall under the same categories of natural or experimental infection as "capable vectors," but are not known or have not been shown to be able to transmit the disease either naturally or under experimental conditions.
4 Collections for this study were supported (in part) by a research grant from the Microbiological Institute of the National Institutes of Health, United States Public Health Services.
Service, Atlanta, Georgia; Mr. Frank M. Prince and Harold Stark, Western Communicable Disease Center Laboratory, United States Public Health Service, San Francisco, California. For assistance in determinations and/or verifications, the writer is indebted to Lt. Col. Robert Traub and Lt. Vernon J. Tipton, Army Medical Service Graduate School, Washington, D. C. To Dr. D Elden Beck, Brigham Young University, the writer is much indebted for his permission to use unpublished records, and for his assistance in determinations, helpful suggestions, and enthusiastic support.

In the western United States more than sixty-five species and subspecies of rodents and lagomorphs have been shown to harbor plague bacilli in their body tissues or have acted as hosts for fleas infected with plague. Following is a list of mammals which have been reported as having plague-infected tissue, or have acted as hosts for plague-infected fleas. These reports were taken from the United States Public Health Reports, years 1936 to 1950 inclusive, from Mohr (1948), and from Ecke and Johnson (1950). The system of taxonomy followed is that of Anthony (1928), Hall (1946), and Howell (1938).

PLAGUE IMPORTANT MAMMALS IN THE WESTERN UNITED STATES

Citellus armatus (Kennicott)  
C. beecheyi beecheyi (Richardson)  
C. beecheyi douglasii Richardson  
C. beecheyi fisheri Merriam  
C. beecheyi nudipes Huey  
C. holdingi oregonus (Merriam)  
C. columbianus columbianus (Ord)  
C. columbianus ruficaudus Howell  
C. idahoensis Merriam  
C. lateralis chrysodeirus (Merriam)  
C. mexicanus parvidens (Mearns)  
C. richardsonii elegans (Kennicott)  
C. richardsonii nevadensis Howell  
C. richardsonii richardsonii (Sabin)  
C. spilosoma major (Merriam)  
C. townsendii mollis (Kennicott)  
C. tridecemlineatus ssp.  
C. variegatus grammurus (Say)  
C. variegatus utah Merriam  
C. washingtoni longirungi Howell  
C. washingtoni washingtoni Howell  
Cynomys gunnisoni gunnisoni (Baird)  
C. gunnisoni zuniensis Hollister  
C. leucurus Merriam  
C. ludovicianus arizonensis Mearns  
C. parvidens Allen  
Dipodomys ordii ordii Woodhouse  
Eutamias quadivittatus frater (Allen)  
E. minimus ssp.  
Glaucomys sabrinus lascivus (Bangs)  
Lagurus curtatus ssp.  
Lepus californicus ssp.  
Marmota flaviventer avara (Bangs)  
M. flaviventer engelhardtii (Allen)  
M. flaviventer flaviventer (Audubon & Bachman)  
M. flaviventer nosophora Howell  
Microtus californicus ssp.  
M. montanus ssp.  
M. nanus ssp.  
M. townsendii (Bachman)  
Mus musculus ssp.  
Mustela ssp.  
Neotoma albigula ssp.  
N. cinerea occidentalis (Baird)  
N. fuscipes mohavensis Elliot  
N. lepida intermedia (?)  
N. lepida lepida Thomas  
N. micropus ssp.  
Onychomys leucogaster ssp.  
O. torridus ssp.  
Oryzomys sp.
In Utah, sylvatic plague was first discovered in 1936. Since that time it is believed to have occurred in thirteen of the twenty-nine counties implicating six species of rodents. Implication of these rodents was based on the identification of plague bacilli in the tissues of the animal, or fleas collected from the animal. Following is a listing of the counties, the implicated animals, and the dates of known occurrences of the disease in Utah.

Beaver County: Citellus variegatus, July and August, 1936
Marmota flaviventer, July, 1936

Sevier County: Citellus variegatus, July, 1936
C. armatus, May, 1949

Garfield County: Cynomys parvidens, August, 1936

Morgan County: Citellus variegatus, August, 1937

Kane County: Neotoma lepida, May, 1938

Rich County: Citellus armatus, July, 1938

Wasatch County: C. armatus, August, 1937 and June, 1938

Salt Lake County: C. variegatus, Sept., 1948 and March, 1949
Peromyscus maniculatus, Sept., 1948

Millard County: In late November or early December of 1939, a man supposedly contracted plague from skinning a coyote. (From conversation with residents who remember the case, the writer has strong reason to believe that the man had some other disease contracted from some other source).

Weber and Iron Counties: The Communicable Disease Center Bulletin (1948) lists plague as having occurred in these counties, but gives no specific data of date, host, or locality.

Grand and San Juan Counties: During 1949 a hyper-epizootic occurred among prairie dog colonies in these counties. However, no evidence was found to indicate sylvatic plague as the cause of the decrease in population.

Thirty-two species and subspecies of fleas which have been implicated with plague in the western United States are known to occur in Utah. Eleven of these are herein listed as potential vectors, and twenty-one are listed as capable vectors. Following is the known
distribution of these fleas in Utah. All collection records are listed by county. The plague transmission potentiality of each species is given following the name of the species of flea.

_Atyphloceras multidens_ (C. Fox 1909) — Capable Vector
Salt Lake, Utah

_Catalluga decipiens_ Rothschild 1915 — Potential Vector
Cache, Davis, Salt Lake, Uintah, Utah, Wasatch

_Ctenocephalides felis felis_ (Bouche 1835) — Capable Vector
Salt Lake

_Diamanus montanus_ (Baker 1895) — Capable Vector
Cache, Davis, Emery, Grand, Kane, Salt Lake, San Juan, Sanpete, Utah, Washington, Wayne, Weber

_Echidnophaga gallinacea_ (Westwood 1875) — Capable Vector
Grand, San Juan, Washington

_Epitedia wenmani_ (Rothschild 1904) — Potential Vector
Cache, Salt Lake, Utah

_Foxella ignota_ — Potential Vector
Beaver, Box Elder, Cache, Emery, Grand, Iron, Juab, Millard, Salt Lake, San Juan, Sevier, Tooele, Utah

_Hoplopyllus affinis_ (Baker 1904) — Potential Vector
Beaver, Garfield, Iron, Kane, San Juan, Sevier, Washington

_Hoplopyllus anomalus_ (Baker 1904) — Capable Vector

_Hystrichopsylla gigas dippiei_ Rothschild 1902 — Capable Vector
Box Elder, Cache, Duchesne, Iron, Salt Lake, Sevier, Summit, Uintah, Utah, Wasatch

_Malaraeus telchirmum_ (Rothschild 1905) — Capable Vector
Box Elder, Cache, Davis, Garfield, Millard, Salt Lake, Utah

_Megabothris abantis_ (Rothschild 1905) — Capable Vector
Cache, Daggett, Salt Lake, Uintah, Utah

_Megarthroglossus divisus divisus_ (Baker 1895) — Potential Vector
Cache, Iron

_Monopsyllus eumolpi eumolpi_ (Rothschild 1905) — Capable Vector
Box Elder, Cache, Davis, Salt Lake, Sevier, Utah, Weber

_Monopsyllus wagneri wagneri_ (Baker 1904) — Potential Vector
Beaver, Box Elder, Cache, Davis, Garfield, Grand, Kane, Millard, Salt Lake, San Juan, Sevier, Tooele, Uintah, Utah, Wasatch, Weber

_Neopsylla inopina_ Rothschild 1915 — Potential Vector
Cache, Salt Lake, Summit, Wasatch, Weber

_Nosopsyllus fasciatus_ (Bosc 1801) — Capable Vector
Salt Lake, Utah

_Opisocrostis hirsutus_ (Baker 1895) — Capable Vector
Carbon, Daggett, Duchesne, Emery, Garfield, Iron, Kane, Millard, Rich, San Juan, Sevier, Uintah, Wayne

_Opisocrostis labis_ (Jordan and Rothschild 1922) — Capable Vector
Beaver, Daggett, Millard, Rich, Sevier, Summit

_Opisocrostis tuberculatus cynomuris_ Jellison 1939 — Potential Vector
Iron, Salt Lake, Weber

_Opisocrostis tuberculatus tuberculatus_ (Baker 1904) — Capable Vector
Beaver, Cache, Duchesne, Millard, Rich, Salt Lake, Summit, Utah, Weber

_Orchopeas sexdentatus agilis_ (Rothschild 1905) — Potential Vector
Beaver, Cache, Grand, Iron, Kane, Millard, Utah, Washington

_Orchopeas sexdentatus nevadensis_ (Jordan 1929) — Potential Vector
Kane

_Oropsylla idahoensis_ (Baker 1904) — Capable Vector
Beaver, Box Elder, Cache, Duchesne, Emery, Garfield, Iron, Kane,
Morgan, Rich, Salt Lake, Sanpete, Sevier, Summit, Uintah, Utah, Wasatch, Weber

*Pulex irritans* (Linnaeus 1758) — Capable Vector
Carbon, Duchesne, Emery, Millard, Summit, Uintah, Washington, Weber

*Thrassis acamantis* (Rothschild 1905) — Capable Vector
Duchesne, Sevier

*Thrassis arizonensis arizonensis* (Baker 1898) — Capable Vector
Cache

*Thrassis francisi* (C. Fox 1927) — Capable Vector
Beaver, Box Elder, Millard, Rich, Salt Lake, Sanpete, Sevier, Tooele, Utah, Wasatch, Weber

*Thrassis howelli howelli* (Jordan 1925) — Capable Vector
Salt Lake

*Thrassis petiolatus* (Baker 1904) — Potential Vector
Salt Lake

*Xenopsylla cheopis* (Rothschild 1903) — Capable Vector
Salt Lake

**FLEA-IIOST ASSOCIATIONS**
**KNOWN TO OCCUR IN UTAH**

**ATYPHLOCERAS MULTIDENTATUS**

<table>
<thead>
<tr>
<th>Neotoma cinerea</th>
<th>Peromyscus maniculatus</th>
</tr>
</thead>
</table>

**CATALLAGIA DECIPIENS**

| Citellus variegatus | Peromyscus sp. |
| Eutamias quadristatus | Phenacomys intermedius |
| Microtus montanus | Sorex sp. |
| Microtus sp. | Sylvilagus nuttallii |
| Neotoma cinerea (nest) | Thomomys talpoides |
| Peromyscus maniculatus | Zapus princeps |

**CTENOCEPHALIDES FELIS FELIS**

<table>
<thead>
<tr>
<th>Canis familiaris</th>
<th>Felis domestica</th>
</tr>
</thead>
</table>

**DIAMANUS MONTANUS**

| Citellus armatus | Marmota flaviventer |
| C. lateralis | Mustela frenata |
| C. leucurus | Neotoma cinerea |
| C. townsendii | N. cinerea (nest) |
| C. variegatus | Neotoma sp. |
| Citellus sp. | Peromyscus maniculatus |
| Cynomys gunnisoni | Rattus norvegicus |
| C. leucurus | Spilogale saxatilis |
| C. parvidens | Sylvilagus idahoensis |
| Dipodomys ordii | Sylvilagus sp. |
| Eutamias sp. | Thomomys bottae |
| Lepus californicus | |

**ECHIDNOPHAGA GALLINACEA**

| Citellus leucurus | Neotoma lepida |
| C. variegatus | Neotoma sp. |
| Dipodomys merriami | Sylvilagus audubonii |
Epitedia wenmanni
Microtus montanus
M. pennsylvanicus
Mus musculus
Peromyscus maniculatus
P. maniculatus (nest)

Foxella ignota
Citellus variegatus
Clethrionomys gapperi
Mustela arizonensis
M. frenata
Perognathus parvus
Perognathus sp.
Peromyscus maniculatus

Hoplopyllus affinis
Lepus californicus
Sylvilagus audubonii

Hoplopyllus anomalus
Citellus grammurus
C. lateralis
C. leucurus
C. townsendii
C. variegatus
Cynomys leucurus
C. parvidens
Eutamias sp.
Marmota flaviventer
Microtus montanus
M. pennsylvanicus
Mustela frenata
Onychomys leucogaster
Peromyscus sp.
Spilogale saxatilis
Sylvilagus sp.

Hystrichopsylla gigas dippiei
Citellus armatus
C. lateralis
Clethrionomys sp.
Marmota flaviventer
Microtus montanus
M. pennsylvanicus
Mustela frenata
Onychomys leucogaster
Peromyscus sp.
Sylvilagus sp.

Malaraeus telchinum
Microtus montanus
Neotoma sp.
Peromyscus boylii
P. maniculatus
P. truei
Peromyscus sp.

Megabothris abantis
Citellus armatus
Clethrionomys gapperi
Microtus longicaudus
M. montanus
Microtus sp.
Peromyscus maniculatus
Phenacomys intermedius
Rattus norvegicus
Zapus princeps

Megarthroglossus divius divius
Neotoma cinerea
Tamiasciurus fremonti

Monopsyllus eumolpi eumolpi
Citellus armatus
Eutamias minimus
E. pictus
E. quadrivittatus
Eutamias sp.
Glaucomyis sabrinus
Microtus montanus
Peromyscus boylii
P. maniculatus
Reithrodontomys megalotis
### Monopsyllus Wagneri Wagneri

<table>
<thead>
<tr>
<th>Host Species</th>
<th>Flea Species</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bubo virginianus</td>
<td>Mustela arizonensis</td>
</tr>
<tr>
<td>Citellus armatus</td>
<td>M. frenata</td>
</tr>
<tr>
<td>C. lateralis</td>
<td>Mustela sp.</td>
</tr>
<tr>
<td>C. townsendii</td>
<td>Neotoma lepida</td>
</tr>
<tr>
<td>C. variegatus</td>
<td>N. stephensi</td>
</tr>
<tr>
<td>Clethrionomys gapperi</td>
<td>Neotoma sp.</td>
</tr>
<tr>
<td>Cynomys leucurus</td>
<td>Ochotona princeps</td>
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<tr>
<td>Dipodomys ordii</td>
<td>Onychomys leucoaster</td>
</tr>
<tr>
<td>Dipodomys sp.</td>
<td>Peromyscus crinitus</td>
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<tr>
<td>Eutamias minimus</td>
<td>P. maniculatus</td>
</tr>
<tr>
<td>E. quadriovittatus</td>
<td>P. maniculatus (nest)</td>
</tr>
<tr>
<td>Lepus californicus</td>
<td>P. truei</td>
</tr>
<tr>
<td>Microtus macropus</td>
<td>Peromyscus sp.</td>
</tr>
<tr>
<td>M. montanus</td>
<td>Rattus norvegicus</td>
</tr>
<tr>
<td>Microtus sp.</td>
<td>Reithrodontomys megalotis</td>
</tr>
<tr>
<td>Mus musculus</td>
<td>Sylvilagus audubonii</td>
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</table>

### Neopsylla inopina

<table>
<thead>
<tr>
<th>Host Species</th>
<th>Flea Species</th>
</tr>
</thead>
<tbody>
<tr>
<td>Citellus armatus</td>
<td>Neotoma lepida</td>
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</table>

### Nosopsyllus fasciatus

<table>
<thead>
<tr>
<th>Host Species</th>
<th>Flea Species</th>
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</thead>
<tbody>
<tr>
<td>Citellus armatus</td>
<td>Mustela frenata</td>
</tr>
<tr>
<td>C. variegatus</td>
<td>Peromyscus maniculatus</td>
</tr>
<tr>
<td>Microtus montanus</td>
<td>Phenacomys intermedius</td>
</tr>
<tr>
<td>M. pennsylvanicus</td>
<td>Rattus norvegicus</td>
</tr>
<tr>
<td>Mus musculus</td>
<td>R. rattus</td>
</tr>
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### Opisocrostis hirsutus

<table>
<thead>
<tr>
<th>Host Species</th>
<th>Flea Species</th>
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</thead>
<tbody>
<tr>
<td>Citellus armatus</td>
<td>Dipodomys ordii</td>
</tr>
<tr>
<td>C. lateralis</td>
<td>Lepus californicus</td>
</tr>
<tr>
<td>Cynomys gunnisoni</td>
<td>Mustela sp.</td>
</tr>
<tr>
<td>C. parvidens</td>
<td>Neotoma sp.</td>
</tr>
<tr>
<td>Cynomys sp.</td>
<td>&quot;Rabbit&quot; sp.</td>
</tr>
</tbody>
</table>

### Opisocrostis labis

<table>
<thead>
<tr>
<th>Host Species</th>
<th>Flea Species</th>
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<tbody>
<tr>
<td>Citellus armatus</td>
<td>Cynomys leucurus</td>
</tr>
<tr>
<td>C. townsendii</td>
<td>Cynomys leucurus</td>
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### Opisocrostis tuberculatus cynomuris

<table>
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<th>Flea Species</th>
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</thead>
<tbody>
<tr>
<td>Citellus armatus</td>
<td>Cynomys parvidens</td>
</tr>
</tbody>
</table>

### Opisocrostis tuberculatus tuberculatus

<table>
<thead>
<tr>
<th>Host Species</th>
<th>Flea Species</th>
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<tbody>
<tr>
<td>Citellus armatus</td>
<td>C. variegatus</td>
</tr>
<tr>
<td>C. leucurus</td>
<td>Cynomys leucurus</td>
</tr>
<tr>
<td>C. mollis</td>
<td>Marmota flaviventer</td>
</tr>
<tr>
<td>C. townsendii</td>
<td>Lepus californicus</td>
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### Orchopeas sexdentatus agilis

<table>
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<th>Host Species</th>
<th>Flea Species</th>
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<tbody>
<tr>
<td>Neotoma cinerea</td>
<td>Peromyscus crinitus</td>
</tr>
<tr>
<td>N. cinerea (nest)</td>
<td>P. maniculatus</td>
</tr>
<tr>
<td>N. desertorum</td>
<td>Reithrodontomys megalotis</td>
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<tr>
<td>N. lepida</td>
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### Orchopeas sexdentatus nevadensis

<table>
<thead>
<tr>
<th>Host Species</th>
<th>Flea Species</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neotoma desertorum</td>
<td>N. lepida</td>
</tr>
</tbody>
</table>
**Oropsylla idahoensis**

- Citellus armatus
- C. castanurus
- C. lateralis
- C. leucurus
- C. townsendii
- C. variegatus
- Cynomys parvidens
- Eutamias sp.

- Falco mexicanus
- Marmota flaviventer
- Mustela arizonensis
- Mustela sp.
- Peromyscus maniculatus
- Sylvilagus sp.
- Thomomys sp.

**Pulex irritans**

- Canis latrans
- Cynomys leucurus
- Cynomys sp.

- Speotyto cunicularia
- S. cunicularia (nest)

**Thrassis acamantis**

- Marmota flaviventer

**Thrassis arizonensis arizonensis**

- Citellus armatus

**Thrassis francisci**

- Citellus armatus
- C. leucurus
- C. townsendii

- Cynomys leucurus
- Thomomys sp.

**Thrassis howelli howelli**

- Citellus variegatus
- Marmota flaviventer

**Thrassis pandorae**

- Citellus armatus
- C. mollis
- C. townsendii
- C. variegatus
- Cynomys leucurus

- Eutamias sp.
- Marmota flaviventer
- Peromyscus sp.
- Thomomys sp.

**Thrassis petiolatus**

- Citellus armatus

**Xenopsylla cheopis**

- Rattus norvegicus

- R. rattus

**SELECTED REFERENCES**


