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Fleas of the National Reactor Testing Station

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FLEAS OF THE NATIONAL REACTOR TESTING STATION[1]

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From June, 1966 to September, 1967, 4050 mammals and 561 birds were examined for ectoparasites at the National Reactor Testing Station in southern Idaho (Table 2; Figs. 1, 2). This paper lists the fleas which were collected. A previous report (Allred, 1968) discussed the area, field activities, study sites, techniques, and ticks collected.

I am indebted to Dr. D Elden Beck for the identification of most of the fleas prior to his untimely death in August, 1967. Dr. William

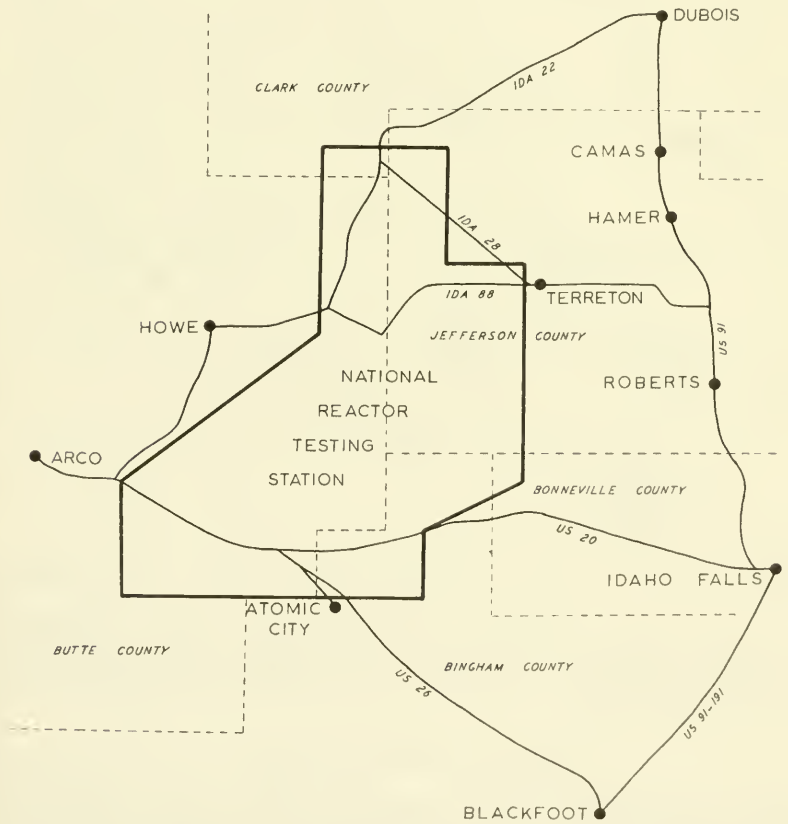

Fig. 1. Geographic position of the National Reactor Testing Station in southeastern Idaho.

1. BYU-AEC report no. C00-1559-2.
2. Department of Zoology and Entomology, Brigham Young University, Provo, Utah.

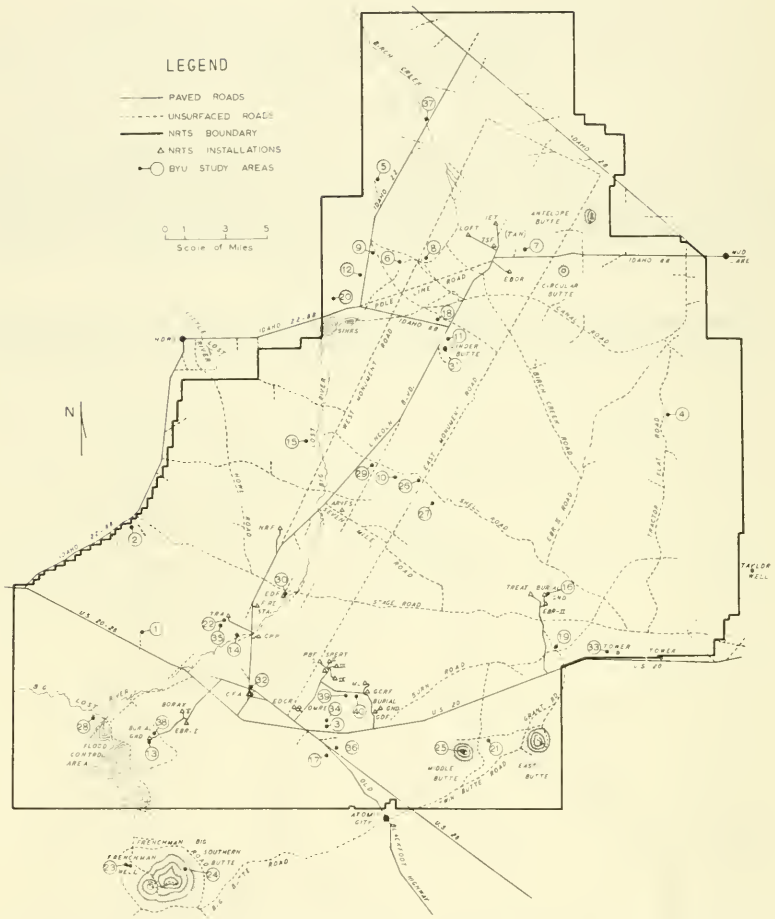

Fig. 2. Major installations, roads, and study areas at the National Reactor Testing Station.

L. Jellison, Hamilton, Montana, identified several hundred additional fleas, and verified some tentative identifications made by Dr. Beck of unusual specimens.

Flea-Host Associations

Data in the list below are arranged as follows: (1) The species of flea collected is given without subspecific relegation. An asterisk preceding the name of the flea indicates that in other studies it has been shown to be of medical importance in the epidemiology of plague (Stark, 1958). After the name of the flea, its general seasonal occurrence (in parentheses) and its geographic distribution at the

station as indicated by our collections are given. (2) Indented under the name of the flea are the hosts from which it was taken at the station. Where more than one host is listed, an asterisk preceding the name of the host indicates that it is the one from which the flea was most commonly taken and/or for which the flea-host index (number of fleas taken divided by the number of hosts infested) was high. After the host's name the number of hosts examined (in parentheses) is listed. This number is given only once for each host—the first time the host's name is listed. The number not in parentheses and immediately in front of the colon is the flea-host index. Behind the colon the numbers of each sex of flea taken during each month are given. Records for June, July, and August are the combined collections for 1966 and 1967; others as indicated represent only one month's data.

Amphipsylla siberica (summer-fall) limited distribution
Microtus montanus (25) 1: ♂ July
**Peromyscus maniculatus* (1866) 2: 2♂ Oct.

Anomiopsyllus amphibolus (winter) limited distribution
Neotoma cinerea (14) 1: ♀ Dec.

Callistopsyllus terinus (spring-summer) limited distribution
Peromyscus maniculatus 2: 2♂ 4♀ Feb., 3♂ 1♀ March, ♂ ♀ July, ♂ 3♀ Aug., ♀ Sept.

**Catallagia decipiens* (year round) limited distribution
Dipodomys ordii (808) 1: ♀ May
Eutamias minimus (398) 1: 2♂ 1♀ March, ♀ June
**Peromyscus maniculatus* 2: ♂ ♀ Jan., 6♂ 12♀ March, 3♂ 2♀ May, 4♂ 5♀ June, 4♂ 5♀ July, 10♂ 6♀ Aug., ♂ ♀ Oct., ♂ Nov.
Junco oreganus (30) 1: ♂ April

Cediopsylla inaequalis (year round) moderate distribution
Canis latrans (6) 5: 2♀ Jan., ♂ 8♀ Feb., ♀ Nov., 2♂ 5♀ Dec.
**Lepus californicus* (125) 4: ♂ 5♀ Jan., 37♂ 40♀ March, 5♂ 2♀ April, ♂ 2♀ May, 2♂ 5♀ June, ♂ 3♀ July, 2♂ 5♀ Aug., 2♂ 3♀ Sept., 3♂ 5♀ Oct., 3♂ 10♀ Nov., 14♂ 16♀ Dec.
Lynx rufus (8) 24: 14♂ 23♀ Jan., 10♂ 15♀ April, 24♂ 69♀ Nov.
Peromyscus maniculatus 4: 8♂ 6♀ Feb., ♂ March, ♂ July
**Sylvilagus idahoensis* (13) 21: 62♂ 109♀ Feb., ♂ 2♀ April, ♀ July, 7♂ 13♀ Nov.
**Sylvilagus nuttallii* (28) 13: 108♂ 42♀ Feb., ♂ March, 5♂ 4♀ May, 13♂ 4♀ June, ♂3♀ July, 4♂ 7♀ Aug., ♂ 5♀ Nov., 11♂ 15♀ Dec.

Epitedia stanfordi (spring) limited distribution
Peromyscus maniculatus 2: 3♂ 3♀ Feb., 3♂ April

**Epitedia wenmanni* (year round) moderate distribution
Dipodomys ordii 1: ♂ Oct.
Neotoma cinerea 1: ♀ Nov.
**Peromyscus maniculatus* 2: 2♂ 1♀ Jan., 3♂ 5♀ Feb., 4♂ 5♀ March, 2♂ April, ♂ May, ♀ June, ♀ Aug., ♂ Sept., 3♂ 4♀ Oct., 4♂ 3♀ Nov., 4♀ Dec.

**Foxella ignota* (spring-summer-fall) moderate distribution
Dipodomys ordii 1: ♀ June
Mustela frenata (4) 2: 2♂ 2♀ July
**Onychomys leucogaster* (63) 8: 4♂ 5♀ March, ♂ April, 14♂ 18♀ June, 18♂ 26♀ July, 6♂ 9♀ Aug., 41♂ 57♀ Sept., 3♀ Oct.
Peromyscus maniculatus 1: 2♂ March, ♂ 2♀ July, ♀ Aug., 2♂ Sept., ♀ Nov., ♂ Dec.
**Thomomys talpoides* (8) 8: 2♂ 7♀ March, 19♂ 14♀ June, ♀ Sept., 5♂ 9♀ Oct., 2♂ 7♀ Nov.

Hystrichopsylla occidentalis (summer-fall) limited distribution
Peromyscus maniculatus 1: ♀ May, ♂ ♀ Nov.

Malaraeus bitterrootensis (summer) limited distribution
Neotoma cinerea 2: ♂ 3♀ Aug., ♂ 2♀ Sept.

Malaraeus euphorbi (fall-winter-spring) moderate distribution
Microtus montanus 3: 3♀ Aug.
**Peromyscus maniculatus* 3: 2♂ 1♀ Feb., 4♂ 5♀ March, ♂ May, 2♂ 2♀ Aug., ♂ ♀ Sept., 7♂ 11♀ Oct., 3♂ 2♀ Nov., ♂ Dec.

**Malaraeus telchinum* (winter-spring-summer) moderate distribution
Microtus montanus 1: ♂ Aug.
Neotoma cinerea 1: ♀ Aug.
Onychomys leucogaster 1: ♀ July
**Peromyscus maniculatus* 2: 4♂ Jan., 5♂ 1♀ Feb., 9♂ 8♀ March, 2♂ May, 24♂ 17♀ June, 15♂ 8♀ July, 3♂ Aug., ♂ Sept., 2♂ Dec.
Perognathus parvus (474) 1: ♂ June

**Megabothris abantis* (summer) limited distribution
Host unknown: ♀ June, 2♂ July

Megabothris obscurus (fall) limited distribution
Host unknown: ♂ Nov.

**Megarthroglossus divisus* (summer) limited distribution
Neotoma cinerea 1: ♀ Aug.

Meringis hubbardi (spring-summer-fall) moderate distribution
Dipodomys ordii 2: ♂ ♀ May, 6♂ 3♀ June, 4♂ ♀ July, 3♂ 2♀ Aug., ♂ Sept., ♀ Nov.
Eutamias minimus 1: ♂ Oct.
Mustela frenata 1: ♂ July
**Onychomys leucogaster* 4: ♂ March, 3♂ June, 13♂ 8♀ July, 22♂ 7♀ Aug.
**Perognathus parvus* 3: 36♀ 58♀ May, 11♂ June, 28♂ 18♀ July, 17♂ 4♀ Aug., 7♂ 3♀ Oct.
Peromyscus maniculatus 2: 6♀ March, ♂ April, 3♂ ♀ May, 19♂ 10♀ July, 18♂ 10♀ Aug., 2♂ ♀ Oct.
Reithrodontomys megalotis (39) 1: ♂ ♀ Aug.
Sorex merriami (9) 1: ♂ Aug.

Meringis parkeri (year round) extensive distribution
**Dipodomys ordii* 5: 29♂ 38♀ March, 23♂ 36♀ April, 20♂ 31♀ May, 148♂ 175♀ June, 186♂ 201♀ July, 298♂ 397♀ Aug., 62♂ 97♀ Sept., 87♂ 88♀ Oct., 14♂ 26♀ Nov.
Eutamias minimus 2: ♂ March, ♀ June, ♀ July, ♂ 3♀ Aug., 8♂ 5♀ Oct.
Lepus californicus 1: ♀ Dec.
Microtus montanus 1: ♀ Oct., ♀ Nov.
Mustela frenata 1: ♂ July
Neotoma cinerea 1: ♀ Aug.
**Onychomys leucogaster* 6: 5♂ 3♀ March, ♂ April, 17♂ 25♀ June, 13♂ 22♀ July, 18♂ 22♀ Aug., 3♂ 3♀ Sept., 29♂ 38♀ Oct., 3♂ 5♀ Dec.
Perognathus parvus 2: 4♂ 13♀ May, 17♀ June, 2♂ 17♀ July, ♂ 12♀ Aug., ♂ ♀ Oct.
Peromyscus maniculatus 2: ♀ Jan., ♂ 3♀ March, 2♂ 2♀ April, ♀ May, 7♂ 12♀ June, 15♂ 38♀ July, 14♂ 38♀ Aug., 4♂ 8♀ Sept., 12♂ 17♀ Oct., ♂ 2♀ Nov.
Reithrodontomys megalotis 1: ♂ Oct.
Sorex merriami 3: ♂ 5♀ Aug.
Spermophilus townsendii (60) 1: ♂ March, 2♀ June, ♀ July

**Monopsyllus eumolpi* (year round) moderate distribution
Dipodomys ordii 1: ♀ June, ♀ Sept., ♂ Oct.
**Eutamias minimus* 5: 74♂ 87♀ March, 2♂ ♀ May, 45♂ 88♀ June, 40♂ 59♀ July, 53♂ 85♀ Aug., 4♂ 3♀ Sept., 11♂ 39♀ Oct., ♂ ♀ Nov.
Perognathus parvus 1: ♀ July, ♀ Aug.

Peromyscus maniculatus 2: ♂ 2♀ Jan., 2♂ March, 2♀ June, ♂ 6♀ July, 3♂ 4♀ Aug., 2♂ ♀ Oct.
Spermophilus townsendii 1: ♂ June

**Monopsyllus exilis* (spring-summer-fall) limited distribution
Dipodomys ordii 1: ♂ May, ♂ June.
**Onychomys leucogaster* 6: 3♂ 3♀ March, 2♀ April, 29♀ 55♀ June, 18♂ 16♀ July, 11♂ 14♀ Aug., 2♂ 8♀ Sept., 6♂ 12♀ Oct.
Peromyscus maniculatus 1: ♀ Jan., ♀ Sept.

**Monopsyllus wagneri* (year round) extensive distribution
Dipodomys ordii 1: ♂ Feb., ♀ March, 3♂ 10♀ June, 3♂ 4♀ July, 2♀ Aug., 2♂ Sept., ♂ 2♀ Oct.
Eutamias minimus 3: ♂ 4♀ March, 2♂ 2♀ June, ♂ 9♀ July, ♂ ♀ Aug.
Lepus californicus 1: ♀ June
Marmota flaviventris (6) 1: ♂ June
Microtus montanus 1: ♂ June, 2♀ July
Mus musculus (1) 1: 2♂ ♀ June
Neotoma cinerea 1: ♂ June, ♂ ♀ Sept.
**Onychomys leucogaster* 3: ♂ April, 9♂ 4♀ June, 7♂ 2♀ July, 3♂ 3♀ Aug., 4♂ ♀ Sept., 3♂ 5♀ Oct.
Perognathus parvus 2: 2♀ June, 4♂ 4♀ July, ♂ ♀ Aug.
**Peromyscus maniculatus* 5: 5♂ 13♀ Jan., 11♂ 5♀ Feb., 208♂ 199♀ March, 53♂ 44♀ April, 47♂ 62♀ May, 926♂ 1190♀ June, 688♂ 901♀ July, 313♂ 374♀ Aug., 71♂ 62♀ Sept., 55♂ 78♀ Oct., 19♂ 34♀ Nov., 4♂ 6♀ Dec.
Reithrodontomys megalotis 2: ♂ June, ♀ July, 4♂ 3♀ Aug., 2♀ Oct.
Spermophilus townsendii 3: ♀ April, 4♂ 5♀ June
Sylvilagus idahoensis 1: ♂ Feb.
Sylvilagus nuttallii 1: ♂ ♀ Aug.

Odontopsyllus dentatus (spring-summer) limited distribution
**Lepus californicus* 2: 4♂ 6♀ March, 6♂ April, ♀ July
Lynx rufus 6: 2♂ Jan., 11♂ 4♀ April

**Opisocrostis labis* (summer) limited distribution
Dipodomys ordii 1: ♂ May, ♂ July
Eutamias minimus 1: 2♀ July, ♀ Aug.
Onychomys leucogaster 1: ♂ July
Peromyscus maniculatus 1: ♂ Dec.
**Spermophilus townsendii* 3: ♂ April, 6♂ 5♀ June, 2♀ July

**Opisocrostis tuberculatus* (spring) limited distribution
Spermophilus townsendii 4: 4♂ 5♀ April

**Opisodasys keeni* (summer-fall) limited distribution
Peromyscus maniculatus 2: 4♂ 3♀ March, 7♀ May, 2♂ June, 2♂ 2♀ July, ♀ Oct., ♂ Nov.

**Orchopeas leucopus* (summer) limited distribution
Eutamias minimus 1: ♀ July

**Orchopeas sexdentatus* (summer-fall-winter) moderate distribution
Eutamias minimus 1: ♂ Sept.
Lynx rufus 1: ♂ ♀ Nov.
**Neotoma cinerea* 13: 10♂ 27♀ June, 3♂ 3♀ July, 19♂ 36♀ Aug., 36♂ 38♀ Sept., 7♂ 8♀ Nov., ♂ Dec.
Peromyscus maniculatus 7: ♀ Jan., 2♀ March, ♀ June, 10♂ 15♀ Aug.

**Peromyscopsylla hesperomys* (summer) limited distribution
Neotoma cinerea 1: ♂ Aug.
**Peromyscus maniculatus* 2: ♀ July, 4♂ 3♀ Aug., ♀ Sept.

Phalacropsylla allos (summer) limited distribution
Neotoma cinerea 1: ♂ ♀ Aug.
**Onychomys leucogaster* 2: 2♀ Sept.

Phalacropsylla paradisea (spring) limited distribution
Peromyscus maniculatus 1: ♂ March

**Pulex irritans* (summer-winter) extensive distribution (because of host relationships)
**Canis latrans* 3: 2♂ 6♀ Jan., ♂ Aug., ♂ 2♀ Nov., ♀ Dec.
Taxidea taxus (5) 1: ♀ April
**Vulpes fulva* (+) 9: 15♂ 13♀ July

Rectofrontia fraterna (fall) limited distribution
**Onychomys leucogaster* 15: 13♂ 17♀ Sept.
Peromyscus maniculatus 2: 2♂ ♀ Oct.

Rhadinopsylla sectilis (fall-winter-spring) moderate distribution
Dipodomys ordii 1: ♀ March, ♀ May
Eutamias minimus 2: 2♂ March
Neotoma cinerea 1: ♂ Dec.
Onychomys leucogaster 1: ♂ March, ♂ Oct.
**Peromyscus maniculatus* 3: 4♂ 12♀ Jan., ♂ 3♀ Feb., 14♂ 16♀ March, ♀ April, ♂ 2♀ May, ♀ June, ♂ 3♀ Oct., 3♂ 3♀ Nov.
Spermophilus townsendii 6: 6♀ May

**Stenistomera alpina* (winter) limited distribution
Neotoma cinerea 6: 6♂ 6♀ Dec.

Stenistomera macrodactyla (fall-winter) limited distribution
Neotoma cinerea 1: ♂ Aug.
**Peromyscus maniculatus* 7: 3♀ Jan., 16♂ 7♀ Feb., ♀ Oct., 4♀ Nov.

**Thrassis bacchi* (summer) limited distribution
Microtus montanus 1: ♂ Aug.

**Thrassis francisi* (spring-summer) limited distribution
Dipodomys ordii 1: ♂ Aug.
Peromyscus maniculatus 4: 4♂ March
**Spermophilus townsendii* 5: ♂ March, ♂♀ April, 28♂ 39♀ May, 5♂ 20♀ June

Thrassis howelli (summer) limited distribution
Marmota flaviventris 2: 24♂ 28♀ May, 2♂ 2♀ June
Neotoma cinerea 1: ♀ Aug.

**Thrassis pandorae* (summer) limited distribution
Onychomys leucogaster 1: ♀ June
Spermophilus townsendii 1: ♀ April

Species of Questionable Placement

Catallagia sp.
Peromyscus maniculatus 1: 3♀ Aug.

Foxella sp.
Onychomys leucogaster 2: ♂ ♀ June

Malaraeus sp.
Microtus montanus 2: 1 ? sex March, 3♀ July
Neotoma cinerea 1: 4♀ Aug., ♀ Sept.
Peromyscus maniculatus 2: 5♂ May, ♀ Feb., 6♀ March, 12♀ May, 4♀ June, 10♀ July, 3♀ Aug., 3♀ Nov., ♀ Dec.

Megabothris sp.
Microtus montanus 1: ♀ July, 5♀ Aug., 8♂ 5♀ Oct.
Neotoma cinerea 1: ♀ Aug.
Peromyscus maniculatus 1: ♀ Aug., ♂ Dec.

Meringis sp.
Dipodomys ordii 2: ♂ March, 7♂ ♀ June, 4♀ July, 9♀ Aug.
Lepus californicus 1: ♀ Aug.
Onychomys leucogaster 1: ♀ Aug.
Perognathus parvus 1: ♀ Aug.
Peromyscus maniculatus 1: 5♀ July, 7♀ Aug.

Monopsyllus sp.
Peromyscus maniculatus 1: ♂ 2♀ June

Orchopeas sp.
Perognathus parvus 1: ♀ July

Pulex sp.
Peromyscus maniculatus 1: 2♀ Aug.
Vulpes fulva 12: 23♀ July

Thrassis sp.
Marmota flaviventris 1: ♂ June, ♀ Aug.
Onychomys leucogaster 1: ♀ Oct.
Peromyscus maniculatus 1: ♀ Aug.
Spermophilus townsendii 2: ♀ April, 3♀ May, 2 ♀ July

Summary of Host-Flea Associations

(* preceding flea indicates new host record)

Canis latrans
Cediopsylla inaequalis
Pulex irritans

Dipodomys ordii
**Catallagia decipiens*
Epitedia wenmanni
Foxella ignota
Meringis hubbardi
Meringis parkeri
Meringis telchinum
**Monopsyllus eumolpi*
**Monopsyllus exilis*
Monopsyllus wagneri
**Opisocrostis labis*
**Rhadinopsylla sectilis*
**Thrassis francisi*

Eutamias minimus
Catallagia decipiens
**Meringis hubbardi*
**Meringis parkeri*
Monopsyllus eumolpi
Monopsyllus wagneri
Opisocrostis labis
**Orchopeas leucopus*
Orchopeas sexdentatus
**Rhadinopsylla sectilis*

Lepus californicus
Cediopsylla inaequalis
**Meringis parkeri*
Monopsyllus wagneri
Odontopsyllus dentatus

Lynx rufus
Cediopsylla inaequalis
Odontopsyllus dentatus
**Orchopeas sexdentatus*

Marmota flaviventris
Monopsyllus wagneri
Thrassis howelli

Microtus montanus
**Amphipsylla siberica*
**Malaraeus euphorbi*
Malaraeus telchinum
Megabothris sp.
**Meringis parkeri*
Monopsyllus wagneri
**Thrassis bacchi*

Mus musculus
Monopsyllus wagneri

Mustela frenata
Foxella ignota
**Meringis hubbardi*
**Meringis parkeri*

Neotoma cinerea
Anomiopsyllus amphibolus
Epitedia wenmanni
Malaraeus bitterrootensis
Malaraeus telchinum
Megabothris sp.
Megarthroglossus divisus
**Meringis parkeri*
Monopsyllus wagneri
Thrassis acamantis
Orchopeas sexdentatus
Peromyscopsylla hesperomys
Phalacropsylla allos
**Rhadinopsylla sectilis*
Stenistomera alpina
**Stenistomera macrodactyla*
Thrassis howelli

Onychomys leucogaster
Foxella ignota
Opisocrostis labis

**Malaraeus telchinum*
Meringis hubbardi
Meringis parkeri
Monopsyllus exilis
Monopsyllus wagneri

Perognathus parvus
**Malaraeus telchinum*
Meringis hubbardi
Meringis parkeri

Peromyscus maniculatus
**Amphipsylla siberica*
Callistopsyllus terinus
Catallagia decipiens
**Cediopsylla inaequalis*
Epitedia stanfordi
Epitedia wenmanni
Foxella ignota
Hystrichopsylla occidentalis
Malaraeus telchinum
Megabothris sp.
Meringis hubbardi
Meringis parkeri

Reithrodontomys megalotis
**Meringis hubbardi*
**Meringis parkeri*
Monopsyllus wagneri

Sorex merriami
**Meringis hubbardi*
**Meringis parkeri*

Spermophilus townsendii
Meringis parkeri
**Monopsyllus eumolpi*
Monopsyllus wagneri
Opisocrostis labis

Sylvilagus idahoensis
**Cediopsylla inaequalis*
**Monopsyllus wagneri*

Sylvilagus nuttallii
Cediopsylla inaequalis
Monopsyllus wagneri

Taxidea taxus
Pulex irritans

Thomomys talpoides
Foxella ignota

Vulpes fulva
Pulex irritans

Junco oreganus
**Catallagia decipiens*
**Phalacropsylla allos*
Rectofrontia fraterna
**Rhadinopsylla sectilis*
Thrassis pandorae

Monopsyllus eumolpi
**Monopsyllus wagneri*
**Orchopeas* sp.

Monopsyllus eumolpi
**Monopsyllus exilis*
Monopsyllus wagneri
**Opisocrostis labis*
Opisodasys keeni
Orchopeas sexdentatus
Peromyscopsylla hesperomys
**Phalacropsylla paradisea*
**Pulex* sp.
Rectofrontia fraterna
Rhadinopsylla sectilis
**Stenistomera macrodactyla*
**Thrassis francisi*

Opisocrostis tuberculatus
**Rhadinopsylla sectilis*
Thrassis francisi
Thrassis pandorae

Degree of Host Infestation

Fleas of several species varied greatly in their occurrence on their preferred host between different study areas (Table 1). Greatest to lesser extremes were demonstrated by *Monopsyllus wagneri*, *Meringis parkeri*, *Monopsyllus eumolpi*, *Thrassis francisi*, and *Meringis hubbardi*, respectively. In three areas where the lowest degree of host infestation occurred, the flea-host index was higher than in most

Table 1. Extremes of host infestation and flea-host index of fleas of eleven species in selected areas.*

Flea	% hosts infested by area Highest	Lowest	Highest flea-host index by area
Catallagia decipiens	15.6 (36)	2.6 (16)	2 (17)
Epitedia wenmanni	18.2 (35)	.8 (3)	2.5 (3)
Malaraeus euphorbi	25.0 (28)	.4 (3)	4.5 (36)
Malaraeus telchinum	31.8 (36)	.8 (8)	2.2 (13)
Meringis hubbardi	51.5 (1)	0 (17)	2.9 (2)
Meringis parkeri	84.6 (14)	0 (29)	6.4 (10)
Monopsyllus eumolpi	83.3 (23)	11.1 (7)	5.3 (2)
Monopsyllus wagneri	100 (38)	0 (29)	7 (9)
Opisodasys keeni	4.9 (36)	.4 (3)	2.2 (36)
Rhadinopsylla sectilis	13.9 (36)	.8 (3)	6.8 (3)
Thrassis francisi	90.9 (3)	20.0 (9)	4 (9)

*Area in parentheses.

other areas. The flea-host index was high in only two areas where the degree of host infestation was also high. In three other areas where the flea-host index was high, the degree of host infestation was only moderate.

Host Abundance and Species Variety

In some cases the number of different fleas found on a particular host was directly proportional to the number of hosts examined (Table 2). This may be expressed as the more common the host, the greater the variety of fleas it possesses. This was demonstrated by

Table 2. Number of mammals examined and number of species of fleas found on each kind.

Host	No. examined	Species of fleas
Peromyscus maniculatus	1866	27
Dipodomys ordii	808	12
Perognathus parvus	474	6
Eutamias minimus	398	9
Lepus californicus	125	5
Plecotus townsendii	78	0
Onychomys leucogaster	63	11
Spermophilus townsendii	60	8
Reithrodontomys megalotis	39	3
Sylvilagus nuttallii	28	2
Microtus montanus	25	7
Neotoma cinerea	14	15
Sylvilagus idahoensis	13	3
Sorex merriami	9	2
Lynx rufus	8	4
Thomomys talpoides	8	1
Marmota flaviventris	6	3
Canis latrans	6	2
Taxidea taxus	5	1
Mustela frenata	4	3
Vulpes fulva	4	1
Mus musculus	1	1

Peromyscus maniculatus, *Dipodomys ordii*, *Eutamias minimus*, *Onychomys leucogaster*, and *Spermophilus townsendii*. Conversely, some hosts taken in abundance had relatively few species of fleas on them, such as *Perognathus parvus*, *Lepus californicus*, *Plecotus townsendii*, *Reithrodontomys megalotis*, and *Sylvilagus nuttallii*. Still other animals, although relatively unabundant, possessed a greater variety of fleas than would normally be expected. These were *Neotoma cinerea*, *Microtus montanus*, and *Lynx rufus*.

Degree of Infestation by Sex

Where sufficient numbers were taken to be indicative of rates of infestation, most fleas showed little if any difference relative to sex relationships. Significant differences were present, however, for fleas of seven species on hosts of eight species (Table 3). On hosts of three species, male fleas were much more abundant on the male hosts than on the female. The reverse situation occurred with hosts of two species where the male fleas were much more abundant on the female hosts than on the male. Female fleas were more abundant on the male hosts than on the female of four species, whereas on hosts of another species the female fleas were more abundant on the female hosts than on the male.

Seasonal Occurrence

Fleas were taken every month of the year, but the greatest number of species (23) was taken in August, and the least number (11) in February. The seasonal occurrence and number of species taken

Table 3. Relative degrees of infestation by male and female fleas on hosts of different sexes.

	Flea-host index*			
	Male fleas on		Female fleas on	
Flea and host	♂ hosts	♀ hosts	♂ hosts	♀ hosts
Cediopsyllus inaequalis				
Lepus californicus	1.3	3.0	2.1	2.6
Sylvilagus nuttallii	5.0	10.8	5.0	4.1
Foxella ignota				
Onychomys leucogaster	6.0	3.6	8.5	3.4
Meringis hubbardi				
Peromyscus maniculatus	1.2	1.0	2.6	1.3
Meringis parkeri				
Perognathus parvus	2.5	1.0	1.7	1.1
Monopsyllus eumolpi				
Eutamias minimus	1.8	2.4	2.1	4.5
Orchopeas sexdentatus				
Neotoma cinerea	7.0	5.5	17.0	7.8
Thrassis francisi				
Spermophilus townsendii	2.0	2.3	4.5	2.8

*Total number of fleas divided by total number of infested hosts.

was winter 2, spring 2, summer 13, fall 3, winter-spring 1, spring-summer 1, summer-fall 3, fall-winter 2, fall-winter-spring 1, spring-summer-fall 1, year round 12.

Species Interaction

Whether competition between fleas on the same host actually exists is not known, but host specificity and relative numbers on the same host as observed in these studies are suggestive that the phenomenon does exist. Should species interaction occur, it is expected that the ratio of times a species occurs as the only one on the host would be great. Conversely, where little interaction is demonstrated, the greater the ratio of times a species may be expected to occur in association with others. Data for five species were indicative of considerable interaction, and for eight, a lesser degree (Table 4). *Cediopsylla inaequalis* and *Monopsyllus eumolpi* demonstrated greatest reaction, and *Monopsyllus exilis* and *Malaraeus euphorbi* the least.

Table 4. Frequency of species associations for some commonly collected fleas.

Flea	Ratio of times found	
	Alone	With other species
Cediopsylla inaequalis	4	1
Monopsyllus eumolpi	4	1
Meringis parkeri	3	1
Monopsyllus wagneri	3	1
Thrassis francisi	2	1
Meringis hubbardi	1	1
Orchopeas sexdentatus	1	2
Foxella ignota	1	4
Catallagia decipiens	1	6
Malaraeus telchinum	1	8
Rhadinopsylla sectilis	1	8
Epitedia wenmanni	1	9
Malaraeus euphorbi	1	11
Monopsyllus exilis	1	12

Study Area Relationships of Fleas

No apparent correlation between the number of species of fleas found and a predominant plant type was evident. However, there was some variance in the number of species found in different study areas (Table 5). It is expected that the number of species of fleas found should be directly proportional to the number and kinds of hosts examined in a given area. In areas 4, 6, 9, 21 and 39 the numbers of species of fleas found were less than expected, whereas in areas 14, 23, 24, 28, 32, 33, 35, 37, 38 and 40 the numbers were greater. This may be indicative that the former areas are not as favorable for the survival and reproduction of fleas as are the latter ones.

Table 5. Numbers of species of fleas in proportion to numbers and kinds of hosts examined in selected study areas.

Area	No. species of fleas Expected*	Actual
4	7-8	4
6	10-11	5
9	8-9	5
14	3-4	6
17	1	7
21	12	2
23	3-4	9
24	1	7
28	1	7
32	3	10
33	1-2	6
35	1	4
37	1-2	6
38	2-3	8
39	8	2
40	3-4	5

*Approximation based on the relative numbers and kinds of hosts examined in relationship to fleas found in all other study areas.

Radiation Influence

Comparative rates of host infestation and flea-host indices showed some differences between a radioactive waste burial ground and an ecologically similar control area (Table 6). Although there was little difference in the flea-host index of the two areas, in four of five cases approximately twice as many mammals were infested with fleas in the control area than in the irradiated area. This lower infestation rate is not necessarily due to the effects of radiation, but more likely is due to the effect of sorptive dusts resulting from physical disturbance of the area (excavation, grading, and plant removal).

Table 6. Variations in degree of infestation between an irradiated area and a non-irradiated control plot.

Flea	Irradiated area 13 Flea-host index	Irradiated area 13 % hosts infested	Non-irradiated area 38 Flea-host index	Non-irradiated area 38 % hosts infested
Foxella ignota	2	50	2.5	100
Malaraeus telchinum	2.2	7.5	1	13.6
Meringis parkeri	2.5	21.1	2.3	33.3
Monopsyllus eumolpi	3.3	55	2.5	44.4
Monopsyllus wagneri	6.9	51.4	4.9	100

Geographic Distribution

The geographic distribution of a species of flea usually is related to the geographic range and variety of its hosts. In this study this generally was the case, and those fleas which were found on the

greatest variety of hosts demonstrated the most widespread geographic distribution (Table 7). Some exceptions were noted, however, wherein this correlate did not hold true. *Foxella ignota*, *Malaraeus telchinum*, *Monopsyllus eumolpi*, and *Orchopeas sexdentatus* were widely distributed, yet were not found on as many hosts as some other species. Conversely, *Catallagia decipiens* and *Opisocrostis labis* were not widely distributed, yet occurred on a greater variety of hosts than some other species.

Species Variation

Amphipsylla siberica. These specimens are similar to the subspecies *pollionis* from Alaska.

Cediopsylla inaequalis. Beck identified males of series 3169 and 3170 from *Lynx rufus* as subspecies *interrupta.* These were in company with subspecies *inaequalis* which predominates on lagomorphs and some of its predators, *Lynx rufus* and *Canis latrans.* Jellison examined both males and females of a series and designated the males as *inaequalis.*

Malaraeus bitterrootensis. A male of series 2647 has features of both this species and *M. euphorbi.* Differences are the basal hook on the 8th sternite of *bitterrootensis*, and the distal part of the sternite which on this specimen has only one long seta, whereas typical *bitterrootensis* has several.

Malaraeus euphorbi. Jellison tentatively assigned two females of series 5855 to the *euphorbi* group because of their similarity to species figured by Stark (1958). Another two females of series 5827

Table 7. Species of greatest abundance (arranged in diminishing order of geographic distribution) and number of species of hosts on which found.

Species	No. of areas in which found	No. of hosts on which found
Monopsyllus wagneri	34	14
Meringis parkeri	28	12
Monopsyllus eumolpi	22	5
Meringis hubbardi	20	8
Foxella ignota	14	5
Rhadinopsylla sectilis	13	6
Malaraeus telchinum	12	5
Orchopeas sexdentatus	11	4
Cediopsylla inaequalis	10	6
Epitedia wenmanni	10	3
Malaraeus euphorbi	10	2
Monopsyllus exilis	9	3
Opisocrostis labis	9	5
Thrassis francisi	7	3
Catallagia decipiens	6	4
Opisodasys keeni	6	1
Stenistomera macrodactyla	5	2
Rectofrontia fraterna	2	2
Thrassis howelli	2	2

were designated as distinct from those of 5855, and probably are not *M. telchinum*.

Megabothris obscurus. A male of series 3098 was designated by Beck as having some variations from the original description of this species. Jellison designated a number of females from a variety of hosts, series 5164, 5435, 5566, 5800 and 5827, as probably this species.

Meringis hubbardi. Beck had some question on several specimens which were very similar to *M. parkeri*, but called them *hubbardi* on the basis of Stark's (1958) drawing. Jellison designated a group of males from series 76, 1437, 1438, 1689, 2010, 2032 and 2072 as not typical *hubbardi* or *parkeri*, and suggested that these may be abnormal males as figured by Hopkins and Rothschild (1953-1962). Some females of series 1437, 1934, 2032, 2072, 2098, 5638, 5700, 5719, 5723, 5756 and 5757 Jellison designated only as of the *parkeri-hubbardi* group.

Orchopeas sexdentatus. Jellison observed a great variation in sternite 7 of the females in series 5826.

Rectofrontia fraterna. Beck indicated that in the Idaho specimens the 9th sternite of the male is not as figured by Holland (1949).

Thrassis bacchi. Jellison designated these as subspecies *gladiolis*. Two females of series 4893 have numerous apical spinelets on the metanotum similar to those on *T. aridis*.

Thrassis francisi. Beck indicated that some of these specimens are very similar to *T. howelli*, although the finger of some males is broader than shown in illustrations.

Thrassis howelli. Jellison designated these as belonging to the subspecies *utahensis*. However, on many fleas of the series 3896 the posterior dorsal edge of tergite VIII of the males is nude, whereas in most published illustrations there are several long setae present. The distal posterior edge of sternite VIII is likewise not as hirsute as in the illustrations.

Summary

Fleas of 38 species were collected from mammals of 21 species and one species of bird between June, 1966 and September, 1967 at the National Reactor Testing Station in Idaho. Almost two-thirds of the species collected represent new records for Idaho, and over 40 collections represent new host records. Twenty-one of the species are of medical importance in plague transmission as demonstrated by findings in nature or experiments in the laboratory (Stark, 1958). Fourteen of these important species have a limited geographic distribution at the station, five are moderately distributed, and two demonstrate a wide-spread distribution. The greatest number of species was taken in August. Most species showed little if any difference relative to sex relationships and degree of host infestation. The num-

ber of species of fleas infesting a particular host was not directly proportional to the numbers of hosts examined in all cases. Frequencies of simultaneous occurrence of fleas of two different species on the same host were indicative that species competition may occur in some instances. There was no apparent correlation between the number of species of fleas and a predominant plant type in any area, although variations in numbers did occur between different study areas. The geographic distribution of fleas at the station was related to the geographic range and variety of their hosts. Species of fleas infesting the greatest variety of hosts were *Monopsyllus wagneri*, *Meringis parkeri*, and *Meringis hubbardi*. Mammals infested by the greatest variety of fleas were *Peromyscus maniculatus*, *Neotoma cinerea*, *Dipodomys ordii*, *Onychomys leucogaster*, *Eutamias minimus*, *Spermophilus townsendii*, and *Microtus montanus*. Comparative rates of infestation between an irradiated area and a non-irradiated control area showed that twice as many animals were infested in the control area as in the irradiated plot.

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