FLEAS (SIPHONAPTERA) OF FLORIDA

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ABSTRACT

Nineteen species of fleas are presently known from Florida. *Pulex simulans*, *Corrodopsylla hamiltoni*, and *Orchopeas leucopus* are here recorded from the state for the first time. Considering only wild mammals, the number of flea species found on a particular host ranged from 1 to 6, whereas the number of hosts infested by a given species of flea varied from 1 to 13. Six of the fleas recorded from the state are introduced or cosmopolitan, 4 have Neotropical affinities, and the remainder have Holarctic or Nearctic affinities. One of the latter group has apparently been introduced from western United States. The present data suggest that most of the northern fleas occurring in Florida reach the limits of their range in the northern part of the State and are uncommon. Still other northern species that extend well into southeastern United States apparently fail to reach Florida. As suitable hosts occur beyond the known range of all of these fleas, the southward limitation of their ranges appears to be attributable to climatic factors.

This paper attempts to summarize previous knowledge of the fleas (Siphonaptera) of Florida and presents additional species, host, and locality records for the state based primarily on a series of approximately 1,300 fleas collected in the course of mammal studies carried on over a number of years. Approximately 5,000 mammals of 42 species were examined (Table 1). Many of the specimens, particularly bats handled during banding and small mammals marked and released in live-trapping studies, received only superficial examination for fleas; in the case of some heavily infested hosts no attempt was made to collect all fleas present. Thus the data are not suitable for detailed analysis of infestation rates. Additional records based on material contained in the Florida State Collection of Arthropods, Division of Plant Industry, Florida State Department of Agriculture and Consumer Services, are also included.

In the following species accounts, previously published records are given first, followed by new records and remarks. Localities are given to county only, and date of collection and collector have been omitted for the sake of brevity. Some of the previous records cited undoubtedly involve duplicate reporting of the same specimens. Records based on specimens in the Florida State Collection of Arthropods are denoted by an asterisk. Only records from this collection that supplement those of the present survey are included.

The classification and nomenclature of fleas follows Jellison and Glesne (1967). Mammalian host names follow Hall and Kelson (1959) except for changes dictated by more recent taxonomic studies.

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TABLE 1. SPECIES OF MAMMALS AND APPROXIMATE NUMBER OF INDIVIDUALS EXAMINED FOR FLEAS.

Species	Number of specimens examined		
	Dead	Live	Total
*Didelphis marsupialis**	63	303	366
Blarina brevicauda	96	28	124
*Cryptotis parva**	65		65
Sorex longirostris	2		2
Scalopus aquaticus	27		27
Lasiurus intermedius	14	1	15
Lasiurus borealis	3		3
Lasiurus seminolis	12	2	14
Nycticeius humeralis		8	8
*Myotis austroriparius**	1	245	246
Pipistrellus subflavus	2	73	75
*Tadarida brasiliensis**	15	260	275
Dasypus novemcinctus	6	20	26
*Sylvilagus floridanus**	25	22	47
*Sylvilagus palustris**	3	1	4
*Sciurus carolinensis**	21	38	59
*Sciurus niger**	5		5
*Glaucomys volans**	7	54	61
Geomys pinetis	342		342
*Oryzomys palustris**	18	1	19
*Reithrodontomys humulis**	4		4
*Peromyscus polionotus**	40	11	51
*Peromyscus floridanus**	912	281	1193
*Peromyscus gossypinus**	231	290	521
Ochrotomys nuttalli	27	45	72
*Sigmodon hispidus**	349	18	367
*Neotoma floridana**	9		9
Neofiber alleni	355		355
*Rattus rattus**	114	18	132
Rattus norvegicus	3		3
Mus musculus	323	2	325
Canis latrans	1		1
*Urocyon cinereoargenteus**	14	4	18
Vulpes vulpes	1		1
*Procyon lotor**	5	93	98
*Mephitis mephitis**	3		3
*Spilogale putorius**	3	11	14
*Mustela frenata**	2		2
Mustela vison	1		1
Lutra canadensis	1		1
*Lynx rufus**	10		10
Odocoileus virginiana	1		1

*Hosts from which fleas were collected.

Species Accounts

Family Pulicidae

Cediopsylla simplex (Baker)

Previous records: Alachua Co.—*Sylvilagus floridanus*; (Kohls 1940, Fuller 1943), "Chiefly Hillsborough Co."—*Sylvilagus palustris* (Worth 1950c). Jefferson Co.—*Lynx rufus* (Fox 1940).

New records: Alachua Co.—*Sylvilagus floridanus* (1 female), *Urocyon cinereoargenteus* (1 male, 3 females). Highlands Co.—*Lynx rufus* (1 male). Nassau Co.—*Sylvilagus palustris* (2 females). Putnam Co.—*Sylvilagus palustris* (1 female).

Remarks: This species is characteristically associated with rabbits; and the other known Florida hosts, bobcat and gray fox, are common rabbit predators.

High levels of infestation of *C. simplex* on cottontail rabbits have been reported frequently from more northern parts of its range, and even in Georgia 39% of 215 cottontails examined by Morlan (1952) were infested, with an average of 7 fleas per host. The scarcity of Florida records, despite the fact that a substantial sample of rabbits and other potential hosts has been examined, suggests that the species is relatively uncommon in the state.

Hoplopsyllus glacialis affinis (Baker)

Previous records: Dade Co.—*Sylvilagus floridanus* (Kohls 1940, Schwartz 1952). Locality not stated (see below)—*Peromyscus floridanus* (Johnson and Layne 1961, Layne 1963).

New records: Highlands Co.—*Sylvilagus floridanus* (11 males, 23 females); *Sciurus carolinensis* (1 female); *Sigmodon hispidus* (1 female); *Peromyscus floridanus* (1 male). Lee Co.—*Sylvilagus palustris* (1 male, 1 female). Okeechobee Co.—*Procyon lotor* (1 male). Polk Co.—*Sylvilagus floridanus* (3 males, 1 female). *Putnam Co.—*Sylvilagus floridanus* (1 male, 1 female).

Remarks: This primarily western flea, normally parasitic on rabbits, is known from only two states, Florida and New Jersey, east of the Mississippi River. It was first recorded from Florida (Miami) by Kohls (1940), and the records presently available indicate that it is fairly widespread in at least the peninsular region of the state. Burbutis (1956) collected it in New Jersey on cottontail rabbits imported from Kansas but stated that it did not appear to be established on native rabbits.

Although the occurrence of *H.g. affinis* in New Jersey is clearly the result of introduction, the origin of the Florida population is less certain. The species may have been introduced on jack rabbits (*Lepus californicus*) brought into the state from the west in the 1930's for the purpose of training greyhounds (Layne 1965). There are presently established populations of these rabbits in the Miami area, and individuals have been seen in recent years in the vicinity of Tampa (G.E. Woolfenden, personal communication). If such introductions were the original source of the Florida *Hoplopsyllus* population, the relatively wide scatter of locality records and the variety of hosts from which it has been collected in Florida indicate that the species is well established on native mammals and has spread rather rapidly. The tendency for the known occurrences to be more concentrated in the southern part of the peninsular may reflect the fact that the original introduction occurred in the Miami area.

It is also possible that the flea is native to Florida and that its disjunct

distribution is the result of earlier geologic-climatic events. There are a number of cases of animal species in Florida which are separated from conspecific populations or related species in western United States by a wide gap. In some cases, these distributional patterns appear to represent the survival of remnants of previously continuous populations in separate southern refugia in eastern and western North America with elimination of intervening populations as a result of Pleistocene climatic changes (Blair 1958). This explanation, however, does not seem to fit the case of *Hoplopsyllus*. The typical host of this flea, the cottontail rabbit (*Sylvilagus floridanus*), is not discontinously distributed in North America so there would seem to be little basis to expect a disjunct distribution of the flea. It might be argued that if the flea were less cold tolerant than the host, it might show a disjunct distribution even though the host does not. This possibility seems to be ruled out by the fact that *Hoplopsyllus* is a Holarctic genus and *H.g. affinis* itself ranges widely in Canada (Holland 1949). Furthermore, if the Florida population of *Hoplopsyllus g. affinis* were truly an isolated segment of the species dating to Pleistocene times or earlier, then some degree of morphological differentiation might be expected. Examination of the present series of the species from Florida reveals no obvious differences from the western segment of the species.

In summary, although the data presently available are not fully conclusive, the weight of the evidence seems to favor the hypothesis that it was introduced into Florida and is now well established.

Thirty-seven specimens for which the date of collection was recorded were taken in March (3), April (20), May (4), June (6), and September (4), suggesting that the species may be somewhat more prevalent during the warmer months.

Echidnophaga gallinacea (Westwood)

Previous records: ALACHUA CO.—*Gallus gallus* (Packard 1895); *Sylvilagus* ssp. (Fuller 1943); ? *Sylvilagus* (Kohls 1940); *Felis catus* (Fuller 1943); host(s) not included with locality data (Trembley and Bishopp 1940). BREVARD CO.—*Anas boschas* (=*platyrhynchos*), *Homo sapiens* (Hopkins and Rothschild 1953). DUVAL CO.—*Rattus rattus, Rattus norvegicus, Mus musculus* (Rumreich and Wynn 1945); host(s) not included with locality data (Trembley and Bishopp 1940). HILLSBOROUGH CO.—*Rattus rattus, Rattus norvegicus* (Worth 1950a). "Chiefly Hillsborough Co."—*Didelphis marsupialis, Sciurus carolinensis, Geomys pinetis, Sigmodon hispidus, Rattus rattus, Rattus norvegicus, Mus musculus,* (Worth 1950c). INDIAN RIVER CO.—*Spilogale putorius* (Hopkins and Rothschild 1953). LAKE CO.—Host(s) not included with locality data (Trembley and Bishopp 1940). LEON CO.—*Colinus virginianus, Rattus rattus* (Fox 1940); host(s) not specified (Trembley and Bishopp 1940). ORANGE CO., PASCO CO., PINELLAS CO.—*host(s) not specified* (*Trembley and Bishopp* 1940).

New records: ALACHUA CO.—*Gallus gallus* (4 females); *Didelphis marsupialis* (8 females); *Urocyon cinereoargenteus* (4 females). HIGHLANDS CO.—*Didelphis marsupialis* (6 males, 59 females); *Peromyscus floridanus* (1 male, 1 female); *Spilogale putorius* (2 males, 8 females); *Mustela frenata* (104 males, 7 females); *Felis catus* (15 males, 18 females); *Lynx rufus* (8 males, 120 females). *MARION CO.—captive *Falco sparverius*, captive *Acinonyx jubatus* (1 male, 2 females).

Remarks: This is the only flea presently recorded from presumably wild birds in Florida. With the exception of *Peromyscus floridanus*, the wild mammalian hosts on which it has been taken are those likely to live in or around poultry houses or to be predators on domestic fowl. This flea may

occur in large numbers on hosts. For example, 121 of the specimens listed from the bobcat (*Lynx rufus*) in Highlands County were obtained from a single individual and many more were seen but not collected. This animal was trapped near a chicken house and also carried specimens of *Ctenocephalides felis* (4), *Pulex simulans* (1), and *Cediopsylla simplex* (1). The specimens recorded from the opossum and weasel in Highlands County were also collected from individuals trapped in the vicinity of a poultry shed.

Specimens were collected in January (47), February (153), March (175), April (11), June (8), August (18), October (12) and December (1). Rumreich and Wynn (1945) found no correlation between abundance of *E. gallinacea* on *Rattus* and weather in the Jacksonville area.

Pulex simulans Baker

? Previous records (all referred to *Pulex irritans* in original publications): ALACHUA CO.—*Sylvilagus floridanus* (Fuller 1943). BREVARD CO.—*Homo sapiens* (Hopkins and Rothschild 1953, not specifically reidentified by Hopkins and Rothschild 1962); host(s) not included with locality data (Trembley and Bishopp 1940). DADE CO.—*Mephitis mephitis* (Schwartz 1952). GADSDEN CO.—host(s) not specified (Trembley and Bishopp 1940). "Chiefly Hillsborough Co."—*Didelphis marsupialis* (Worth 1950c). ORANGE CO.—host(s) not specified (Trembley and Bishopp 1940). SANTA ROSA CO.—"rats," presumably *Rattus rattus* and/or *Rattus norvegicus* (Fox and Sullivan 1925). County unknown—"Little River," host unknown and *Homo sapiens* (Fox 1940).

New records: ALACHUA CO.—*Didelphis marsupialis* (1 female); **Sylvilagus floridanus* (1 male); *Urocyon cinereoargenteus* (11 males, 24 females); **Vulpes vulpes* (3 males, 12 females); *Mephitis mephitis* (1 female). **Canis familiaris* (15 males, 17 females); **Homo sapiens* (2 males, 1 female). HIGHLANDS CO.—*Didelphis marsupialis* (1 female); *Lynx rufus* (1 female). MARION CO.—*Urocyon cinereoargenteus* (4 females).

Remarks: Smit (1958) concluded that *Pulex simulans* described by Baker in 1895 but regarded as a synonym of *Pulex irritans* Linnaeus for over 50 years was a valid species. This finding rendered questionable numerous North American records referred to *P. irritans.* Since Smit's study, *P. simulans* has been reported from many mammalian hosts over a broad geographic range in North, Middle, and South America, including ten of the western and southern states. These records have been summarized by Wilson (1966). The new records listed above constitute the first for Florida. I have not had the opportunity to re-examine any of the Florida specimens previously determined as *P. irritans,* but it appears likely that all are actually *P. simulans.* However, the possibility that *P. irritans* also occurs in the state presently cannot be dismissed.

Smit (1958) suggested that *Pulex simulans* was primarily a parasite of colony forming rodents such as *Cynomys* and that *P. irritans* was more commonly associated with larger carnivores and man. However, Wilson (1966) pointed out that *simulans* had been reported from twice as many carnivores as rodents. The Florida data support the view that carnivores and other larger mammals such as the opossum are the general hosts of this flea.

Specimens were taken in January (1), April (13), August (15), October (1), and February (1). This distribution of records suggests that the species may be more prevalent during the warmer months of the year.

Ctenocephalides felis (Bouché)

Previous records: COLLIER CO.—host(s) not included with locality records (Trembley and Bishopp 1940). DADE CO.—*Spilogale putorius* (Schwartz 1952), host(s) not specified (Trembley and Bishopp 1940). DUVAL CO.—*Rattus rattus* and/or *Rattus norvegicus* (Rumreich and Wynn 1945); host(s) not specified (Trembley and Bishopp 1940). HENDRY CO.—*Procyon lotor* (Fox 1940). HILLSBOROUGH CO.—*Rattus rattus* (Worth 1950a). Chiefly Hillsborough Co."— *Didelphis marsupialis* (Worth 1950c). LEON CO.—host(s) not specified (Trembley and Bishopp 1940). ORANGE CO.—*Homo sapiens* (Fox 1940); host(s) not specified (Trembley and Bishopp 1940). ? SANTA ROSA CO.—"rats", presumably *Rattus rattus* and/or *R. norvegicus*, fleas identified as *C. canis* or *C. felis* (Fox and Sullivan 1925). VOLUSIA CO.—host(s) not specified (Trembley and Bishopp 1940).

New records: ALACHUA CO.—*Didelphis marsupialis* (1 male, 1 female); *Homo sapiens* (2 females); *Sylvilagus floridanus* (1 female); *Urocyon cinereoargenteus* (2 males); **Canis familiaris* (7 males, 20 females). *DADE CO.—in house (2 females). *DUVAL CO.—host unknown (1 male, 3 females). HIGHLANDS CO.—*Didelphis marsupialis* (3 males, 11 females); *Homo sapiens* (1 female); *Felis catus* (1 male, 2 females); *Lynx rufus* (2 males, 6 females). *MARION CO.—captive *Acinonyx juabatus* (3 males). SUMTER CO.—*Cryptotis parva* (1 male).

Remarks: The cat flea is generally found on larger wild hosts such as the opossum, gray fox, and rabbits. The least shrew, *Cryptotis parva*, from which it has been collected once is an unlikely host. The specimen from which the flea was obtained was trapped in a house and had probably accidentally acquired the flea there.

Specimens were collected in the following months: February (3), March (2), April (1), June (3), July (3), August (3), September (4), October (5), December (3). The numbers taken each month do not appear to show any indication of a seasonal trend in abundance.

Ctenocephalides canis (Curtis)

Previous records: GADSDEN CO.—*Sigmodon hispidus* (Worth 1950c). LEON CO.—*Urocyon cinereoargenteus* (Fox 1940); host(s) not included with locality data (Trembley and Bishopp 1940). ? SANTA ROSA CO.—"rats," presumably *Rattus rattus* and/or *Rattus norvegicus*, fleas identified as *C. canis* or *felis* (Fox and Sullivan 1925).

Remarks: No additional specimens of this flea were collected. Worth (1950c) indicated that it was not common on *Sigmodon* in Gadsden County. This together with the paucity of records from elsewhere in Florida suggests that the dog flea is much rarer in this area than the cat flea (*Ctenocephalides felis*) and may also be limited to the northern part of the state.

Xenopsylla cheopis (Rothschild)

Previous records: DUVAL CO.—*Rattus norvegicus* (Fox 1940); *Rattus rattus, Rattus norvegicus, Mus musculus* (Rumreich and Wynn 1945). HILLSBOROUGH CO.—*Rattus rattus, Rattus norvegicus* (Worth 1950a). "Chiefly Hillsborough Co."—*Didelphis marsupialis, Cryptotis parva, Sigmodon hispidus, Neotoma floridana* (Worth 1950c). LEON CO.—*Rattus rattus* (Fox 1940); host(s) not included with locality records (Trembley and Bishopp 1940). ORANGE CO.—host(s) not specified (Trembley and Bishopp 1940). SANTA ROSA CO.—"rats," presumably *Rattus rattus* and/or *Rattus norvegicus* (Fox and Sullivan 1925). Mapped records: various localities throughout State, with relatively few records in south central Florida—*Rattus rattus* or *Rattus norvegicus* (Pratt and Good 1954).

Remarks: The absence of this flea from the present collection suggests

that it is not a common species in natural habitats on wild mammal hosts. Worth (1950c) listed it as rare on *Didelphis, Cryptotis, Sigmodon,* and *Neotoma,* whereas it was common on *Rattus rattus* and *R. norvegicus.*

Family Rhopalopsyllidae

Polygenis floridanus Johnson and Layne

Previous records (Johnson and Layne 1961): ALACHUA CO.—*Peromyscus floridanus.* GILCHRIST CO.—*Peromyscus floridanus.* HIGHLANDS CO.—*Peromyscus floridanus.* ST. JOHNS CO.—*Peromyscus floridanus.*

New records: HIGHLANDS CO.—*Peromyscus floridanus* (3 males, 4 females); *Peromyscus gossypinus* (2 females).

Remarks: This flea is highly specific to the Florida mouse, *Peromyscus floridanus,* and has previously not been taken on any other host (Johnson and Layne 1961, Layne 1963). The 2 specimens listed above from the cotton mouse, *Peromyscus gossypinus,* were collected from two individuals occurring in typical *Peromyscus floridanus* habitat types (slash pine-turkey oak woodland and sand pine scrub) with substantial numbers of that species present. In these habitats, cotton mice apparently sometimes use the same type of ground burrows preferred for nesting by the Florida mouse; thus the specimens of the Florida mouse flea might have been accidentally acquired. In view of the large numbers of cotton mice and other potential small mammal hosts examined from Florida mouse habitat types, the two records of occurrence of *Polygenis floridanus* on a species other than the Florida mouse indicates that even accidental transfers are very rare.

Polygenis floridanus has been collected in every month of the year, but there is a distinct trend toward greater abundance in the cooler part of the year and peak incidence in spring. Numbers of specimens collected each month are as follows: January (10), February (53), March (40), April (87), May (15), June (18), July (26), August (18), September (3), October (3), November (15), December (56).

Of a total of 360 individuals of this species examined, 168 (47%) were males and 192 (53%) females. This nearly balanced sex ratio is in marked contrast to the usual predominance of females in the other species of the genus (*P. gwyni*) also occurring in Florida.

Polygenis gwyni (C. Fox)

Previous records: BROWARD CO.—*Oryzomys palustris* (Fox 1940). DADE CO.—*Didelphis marsupialis, Sigmodon hispidus* (Worth 1950b): *Sigmodon hispidus* (Worth 1951); *Oryzomys palustris, Sigmodon hispidus, Spilogale putorius* (Schwartz 1952). DUVAL CO.—*Rattus rattus* and/or *Rattus norvegicus* (Rumreich and Wynn 1945). HILLSBOROUGH CO.—*Rattus rattus, Rattus norvegicus* (Worth 1950a); *Oryzomys palustris, Peromyscus gossypinus, Neotoma floridana, Rattus rattus, Rattus norvegicus* (Worth 1950b). "Chiefly Hillsborough Co."—*Didelphis marsupialis, Oryzomys palustris, Peromyscus gossypinus, Sigmodon hispidus, Neotoma floridana, Rattus rattus, Rattus norvegicus* (Worth 1950c). LEON CO.—*Sigmodon hispidus* (Fox 1940). OSCEOLA CO.—*Didelphis marsupialis* (Fox 1940). MONROE CO.—*Oryzomys palustris* (Schwartz 1952). Locality not stated (see below under new records)—*Reithrodontomys humulis, Peromyscus floridanus, Peromyscus polionotus, Peromyscus gossypinus, Sigmodon hispidus, Oryzomys palustris* (Johnson and Layne 1961); *Peromyscus floridanus* (Layne 1963).

New records: ALACHUA CO.—**Didelphis marsupialis* (1 male, 1 female);

Oryzomys palustris (2 males, 6 females); *Reithrodontomys humulis* (1 female); *Peromyscus floridanus* (9 males, 8 females); *Peromyscus gossypinus* (2 males); *Peromyscus polionotus* (1 female); *Sigmodon hispidus* (41 males, 56 females). COLLIER CO.—*Sigmodon hispidus* (1 female). HIGHLANDS CO.—*Didelphis marsupialis* (9 males, 15 females); *Rattus rattus* (7 females); *Peromyscus floridanus* (3 males, 1 female); *Peromyscus gossypinus* (2 females); *Sigmodon hispidus* (8 males, 21 females); *Mustela frenata* (1 male). INDIAN RIVER CO.—*Oryzomys palustris* (1 male, 3 females); *Neotoma floridana* (4 males, 8 females); *Peromyscus gossypinus* (2 females); *Sigmodon hispidus* (8 males, 18 females); *Spilogale putorius* (1 male, 1 female); mixed lot *Sigmodon hispidus—Peromyscus gossypinus* (4 males, 2 females); mixed lot *Sigmodon hispidus—Neotoma floridana* (3 males, 2 females). LEE CO.—*Oryzomys palustris* (3 males, 14 females); *Peromyscus gossypinus* (5 males, 7 females); *Sigmodon hispidus* (6 males, 10 females). LEVY CO.—**Didelphis marsupialis* (2 females); *Peromyscus floridanus* (6 males, 3 females); *Peromyscus gossypinus* (3 females); *Sigmodon hispidus* (15 males, 48 females). MONROE CO.—(Key Largo)— *Neotoma floridana* (2 males, 5 females). NASSAU CO.—*Sigmodon hispidus* (2 females. PINELLAS CO.—*Sigmodon hispidus* (11 males, 26 females).

Remarks: This is undoubtedly the most ubiquitous flea on small mammals in Florida. Although the cotton rat appears to be the primary host, *Polygenis gwyni* seems to be rather broadly host tolerant, although showing a decided preference for rodents. The only hosts other than rodents from which it has been taken in Florida are the opossum, weasel, and spotted skunk. In Highlands County, opossums collected away from farm buildings tended to be infested with this species more frequently than with any other flea. This was the only species collected on the rice rat (*Oryzomys palustris*) and harvest mouse (*Reithrodontomys humulis*).

Examination of the seasonal distribution shows the same annual trend in abundance on hosts as found in *Polygenis floridanus,* that is, increased prevalence during the cooler part of the year and maximum abundance in spring. Numbers of specimens collected each month were as follows: January (17); February (16); March (120); April (54); May (19); June (13); July (20); August (27); September (0); October (4); November (2); December (83). A similar pattern of seasonal abundance has been reported by Worth (1950b) for the Everglades and Tampa regions of the state and by Morlan (1952) and Smith and Love (1958) in Georgia.

The over-all sex ratio in *P. gwyni* (36% males, 67% females) is decidedly more biased in favor of females than in the case of *Polygenis floridanus.* As the 2 samples are about equal in size and seasonal distribution the difference is apparently real. When the sex ratio of *P. gwyni* on the typical host, *Sigmodon,* and on a less common host, *Peromyscus floridanus,* are compared, an interesting difference shows up. The sex ratio on *Sigmodon,* based on 269 specimens, is 33% ♂ and 67% ♀, while of a sample of 30 specimens from *Peromyscus floridanus* 60% were ♂ and only 40% ♀. Thus the sex ratio of *Polygenis gwyni* on *Peromyscus floridanus* resembles that of *Polygenis floridanus* on its true host. The biological significance of this relationship between sex ratio and host species is not clear.

Of all the small rodents examined for fleas in this survey, *Sigmodon* is undoubtedly the most heavily infested. This appears to apply to other kinds of ectoparasites as well. Worth (1950b) found more ectoparasites of several kinds on *Sigmodon* than on *Oryzomys.* He also noted a higher prevalence of fleas on *Sigmodon* from drier habitats, which he attributed to the difficulties of larval development in wet soil (Worth 1950b).

Family Vermipsyllidae
Chaetopsylla floridensis (I. Fox)

Previous record: ALACHUA CO.—found in "garden truck leaf mold," host unknown (Fox 1940).

Remarks: This species remains known only from the original four specimens collected at Gainesville and described in 1939. The other member of the genus in eastern North America, *Chaetopsylla lotoris*, occurs on the raccoon (*Procyon lotor*) and gray fox (*Urocyon cinereoargenteus*).

Family Hystrichopsyllidae
Corrodopsylla hamiltoni (Traub)

New record: ALACHUA CO.—*Cryptotis parva* (7 females).

Remarks: The above is the first record of this flea from Florida. All of the specimens were collected from least shrews trapped at the same locality in January (3 fleas) and February (4 fleas). Although a number of *Cryptotis* have been examined from other localities, no additional fleas of this species have been encountered.

Ctenophthalmus pseudagyrtes Baker

Previous records: JACKSON CO.—*Peromyscus polionotus* (Fuller 1943, Young 1949). Locality not stated (see below)—*Peromyscus floridanus* (Johnson and Layne 1961, Layne 1963).

New record: ALACHUA CO.—*Peromyscus floridanus* (1 male, 7 females).

Remarks: The 8 specimens were collected at the same locality in March (2), April (4), May (1), and June (1). This species is commonly associated with small burrowing mammals, and its presence on *Peromyscus polionotus* and *P. floridanus* may be attributable to the fact that both of these hosts typically utilize underground nest sites.

Stenoponia americana (Baker)

Previous record: LEON CO.—*Peromyscus gossypinus* (Fox 1940).

Remarks: The absence of this flea on the many potential hosts examined in this survey suggests that it may be rare or absent over much of the state, perhaps reaching only northern Florida. Morlan's (1952) data for southwestern Georgia indicate that the species is scarce in that region also. He collected only 2 specimens from 966 cotton rats (*Sigmodon hispidus*) and none from many other possible host species.

In other parts of its range, *S. americana* tends to be most abundant in fall and winter (Fox 1940), and the single Florida record is dated 15 January.

Family Ceratophyllidae
Nosopsyllus fasciatus (Bosc)

Previous records: DUVAL CO.—*Rattus norvegicus* (Fox 1940). SANTA ROSA CO.—"rats", presumably *Rattus rattus* and/or *Rattus norvegicus* (Fox and Sullivan 1925); *Rattus rattus, Rattus norvegicus* (Rumreich and Wynn 1945). Mapped records: several from *Rattus rattus* or *Rattus norvegicus* (Pratt and Good 1954).

Remarks: This introduced flea normally associated with *Rattus* (Holland 1949) is apparently rare in Florida, and it may be limited to urban environments with high rat populations. The distribution map of this species in Pratt and Good (1954) shows many fewer locality records in Flor-

ida than in the case of other domestic rat fleas. These authors also note that it is more abundant in northern United States and becomes less common in southern United States. It appears to be absent or very rare in south Florida.

Family Amphipsyllidae

Opisodasys pseudarctomys (Baker)

Previous record: DADE CO.—*Glaucomys volans* (Schwartz 1952).

Remarks: Schwartz (1952) stated that all flying squirrels (*Glaucomys volans*) that he handled in Dade County harbored numbers of this species. As no additional specimens have been taken from a substantial number of flying squirrels examined from various other localities in the state, it may be concluded that this is not a common flea in Florida.

The occurrence and apparent abundance of *O. pseudarctomys* in extreme southern Florida, in contrast to its apparent absence or rarity elsewhere in the state, is puzzling. This characteristic flea of flying squirrels is primarily northern in distribution. The bulk of the records in eastern United States are from Maine and New York. Tibbetts (1953) reported it from *Sciurus niger* in North Carolina, but Morlan (1952) did not record it from Georgia. Thus, there may be a major discontinuity in the range of *O. pseudarctomys* in southeastern United States.

Orchopeas leucopus (Baker)

New records: LEVY CO.—*Peromyscus gossypinus* (2 females). NASSAU CO.—*Peromyscus gossypinus* (3 males, 8 females).

Remarks: The 2 specimens noted above apparently constitute the first records of this flea from Florida. The nearest locality from which it was previously known is the Okefenokee Swamp in southeast Georgia (Fox 1940). *O. leucopus* is primarily a parasite of mice of the genus *Peromyscus* and is generally common on such hosts in most areas of eastern United States. Thus, the rare occurrence of this flea in the large sample of *Peromyscus* (*P. floridanus, polionotus,* and *gossypinus*) examined indicates that it is rare in Florida and possibly confined to the northern portion of the state.

Orchopeas howardi Baker

Previous records: ALACHUA CO.—*Sciurus niger* (Fuller 1943). GILCHRIST CO.—*Sciurus carolinensis* (Moore 1957). "Chiefly Hillsborough Co."—*Sciurus carolinensis* (Worth 1950c). LEON CO.—*Peromyscus gossypinus, Rattus rattus, Mus musculus* (Fox 1940). LEVY CO.—*Sciurus niger* (Moore 1957). MONROE CO. (Key Largo)—*Neotoma floridana* (Schwartz 1952). PUTNAM CO.—*Sciurus niger* (Moore 1957).

New records: ALACHUA CO.—*Sciurus carolinensis* (5 males, 2 females); *Sciurus niger* (6 males, 8 females); **Glaucomys volans* (1 male, 6 females). CLAY CO.—*Glaucomys volans* (3 males, 1 female). DUVAL CO.—*Sciurus carolinensis* (1 male). HIGHLANDS CO.—*Sciurus carolinensis* (2 males, 12 females); *Sciurus niger* (3 males, 7 females); *Glaucomys volans* (5 males, 17 females). INDIAN RIVER CO.—*Didelphis marsupialis* (1 male, 1 female); *Sciurus carolinensis* (1 female); *Neotoma floridana* (1 female). LEVY CO.—*Sciurus carolinensis* (5 males, 2 females); *Rattus rattus* (3 males). *ST. JOHNS CO.—*Sciurus carolinensis* (5 males, 12 females). *SUMTER CO.—*Sciurus carolinensis* (1 female); *Sciurus niger* (1 male).

Remarks: Throughout its range this flea is commonly parasitic on squirrels, and this host orientation is also reflected in the Florida records.

It is the only flea generally occurring on the flying squirrel in Florida. With the exception of the record for *Didelphis* from Indian River County, all other non-sciurid hosts recorded from Florida are rodents. This flea appears to be generally distributed in the state and comparatively abundant. Moore (1957) collected fleas from 16 of 24 fox squirrels in Putnam County, and all of the specimens identified (13) proved to be of this species.

Months in which specimens examined in this study were collected are as follows (number of specimens in parentheses): January (18), February (2), March (10), April (32), May (4), June (4). As suitable hosts were examined at other times of the year, these data suggest that the species may be most abundant on hosts during winter and spring.

Family Leptopsyllidae
Leptopsylla segnis (Schönherr)

Previous records: BREVARD CO.—*Rattus norvegicus* (Fox 1940). DUVAL CO.—*Rattus norvegicus* (Fox 1940); *Sigmodon hispidus, Rattus rattus, Rattus norvegicus, Mus musculus* (Rumreich and Wynn 1945). HILLSBOROUGH CO.—*Rattus rattus* (Worth 1950a). "Chiefly Hillsborough Co."—*Rattus rattus* (Worth 1950c). LEON CO.—*Rattus rattus, Mus musculus* (Fox 1940). SANTA ROSA CO.—"rats", presumably *Rattus rattus* and/or *Rattus norvegicus* (Fox and Sullivan 1925). Mapped records: fairly numerous, mostly limited to the northern half of peninsula—*Rattus rattus* or *Rattus norvegicus* (Pratt and Good 1954).

Remarks: No additional Florida specimens were obtained in this study, although many *Rattus rattus* and *Mus*, apparently its true host (Holland, 1949), were examined. This flea is apparently prevalent only in urban areas, mainly on *Rattus*, and is not likely to occur on native mammals in natural habitats in the state.

Family Ischnopsyllidae
Sternopsylla distincta texana (C. Fox)

Previous records (listed as *Sternopsylla texana* in original publications): ALACHUA CO.—*Myotis austroriparius* (Fox 1940), *Tadarida brasiliensis* (Fuller 1943). COLLIER CO.—*Tadarida brasiliensis* (Schwartz 1952). LEON CO.—*Tadarida brasiliensis* (Fox 1940). Locality not given—*Myotis austroriparius* (Rice 1957).

New records: COLUMBIA CO.—mixed sample of *Tadarida brasiliensis* and *Myotis austroriparius* (1 male, 14 females); **Tadarida brasiliensis* (2 males, 30 females).

Remarks: In addition to the new records summarized above, there is a slide of a specimen of this species in the Florida State Collection of Arthropods labelled as being collected from *Rattus rattus* on Seahorse Key, Levy County, by C. H. Wharton on 15 December 1956. This is undoubtedly a mislabelled slide, as it is extremely unlikely that this specialized bat flea would even occur accidentally on *Rattus*; and, in addition, there is no known colony of *Tadarida* on this small island or in the general vicinity.

Sternopsylla is typically associated with the free-tail bat and may occur on *Myotis austroriparius* in Florida only when this species is present in free-tail colonies. I have not collected it from hundreds of *Myotis* examined from caves or other refugia where *Tadarida* was not present. Rice (1957) also concluded that its occurrence on *Myotis* is associated with the presence of *Tadarida*. The flea does not always seem to be present in

Tadarida colonies. Despite a considerable number of free-tailed bats which I have examined from different localities, I have collected *Sternopsylla* only in a colony located in the attic of an old building in White Springs, Columbia County. The series in the Florida State Collection of Arthropods noted under new records presumably came from this colony also. The fleas from this colony were collected in September (15) and April (32) and show a very high proportion of females.

Discussion

The 19 species of fleas presently known from Florida and their recorded host associations in the state are listed in Table 2. The paucity of avian records probably reflects lack of collecting and examination of wild birds and their nests in Florida, particularly hole-nesting species. However, bird fleas may be genuinely rare in the state.

Considering only wild mammals, including both native and introduced, 27 (64%) of the 42 species examined have been recorded as hosts to one or more species of flea. Insectivores and bats have the lowest proportion of hosts per species examined and lagomorphs and rodents, the highest. Carnivores are intermediate in this respect.

The number of flea species recorded from a given host ranges from 1 to 6, with a mean of 3.0. In comparison, the number of hosts known for individual species of fleas varies from 1 to 13 with a mean of 4.5. The greater average number of hosts per flea species is caused by four fleas with an especially high (7 to 13) number of recorded hosts. If these are eliminated, the number of hosts infested by a given flea tends to be lower than the number of fleas associated with a particular host.

With regard to zoogeographic relationships, 6 of the Florida fleas are introduced or cosmopolitan. Of the native species, 4 are Neotropical in origin, and 8 species have Holarctic or Nearctic affinities. One is apparently introduced from western United States. The introduced or cosmopolitan species include *Echidnophaga gallinacea, Ctenocephalides felis, C. canis, Xenopsylla cheopis, Nosopsyllus fasciatus,* and *Leptopsylla segnis. Echidnophaga* and *C. felis* occur on a wide variety of hosts throughout the state and, together with *Pulex simulans,* are the only species thus far recorded from domestic or captive birds and mammals and man. *Xenopsylla cheopis* is the only other member of this group that appears to occur with any frequency on native mammals. The narrow restriction of *Nosopsyllus* and *Leptopsylla* to the introduced *Rattus* and *Mus* may in part reflect an inability to compete successfully with the abundant native flea *Polygenis gwyni.*

Another world-wide flea that might be expected to occur in Florida is *Tunga penetrans* (Linnaeus). Although this possibility was stated by Baker in 1904, no actual records were available up to 1940 (Fox). Ewing and Fox (1943) stated that, ". . . .although reported from Florida, Louisiana, and Texas, it probably is not permanently established in the United States." However, these authors did not cite definite records. Thus its status in Florida and the southern states generally still seems to be in question. Because of previous confusion between *Pulex simulans* and *P. irritans,* the occurrence of the latter in Florida also remains to be verified.

The species with Neotropical relationships include *Polygenis gwyni,*

TABLE 2. KNOWN FLEA—HOST ASSOCIATIONS IN FLORIDA

Flea species	Birds		Wild mammals																							Man, domestic and captive animals						
	Anas platyrhynchos	*Colinus virginianus*	*Didelphis marsupialis*	*Cryptotis parva*	*Myotis austroriparius*	*Tadarida brasiliensis*	*Sylvilagus palustris*	*Sylvilagus floridanus*	*Sciurus carolinensis*	*Sciurus niger*	*Glaucomys volans*	*Geomys pinetis*	*Oryzomys palustris*	*Reithrodontomys humulis*	*Peromyscus polionotus*	*Peromyscus gossypinus*	*Peromyscus floridanus*	*Sigmodon hispidus*	*Neotoma floridana*	*Rattus rattus*	*Rattus norvegicus*	*Mus musculus*	*Urocyon cinereoargenteus*	*Vulpes vulpes*	*Procyon lotor*	*Spilogale putorius*	*Mephitis mephitis*	*Mustela frenata*	*Lynx rufus*	*Falco sparverius*	*Gallus gallus*	*Homo sapiens*	*Canis familiaris*	*Felis catus*	*Acinonyx jubatus*	Host(s) unknown
Cediopsylla simplex							X	X															X						X						
Hoplopsyllus g. affinis							X	X	X								X	X							X				X						
Echidnophaga gallinacea	X	X	X					X	X			X					X	X			X	X	X			X		X	X	X	X			X	X
*Pulex simulans**			X					X															X	X			X		X			X	X		
Ctenocephalides felis			X	X				X												X	?		X		X	X			X			X	X	X	X
Ctenocephalides canis																		X		?	?		X												
Xenopsylla cheopis			X	X														X	X	X	X	X													
Polygenis floridanus																X	X																		
Polygenis gwyni			X								X		X	X	X	X	X	X	X	X	X					X	X								X
Chaetopsylla floridensis																																			
Corrodopsylla hamiltoni				X																															
Ctenophthalmus pseudagyrtes															X		X																		
Stenoponia americana																X																			
Nosopsyllus fasciatus																					X														
Opisodasys pseudarctomys											X																								
Orchopeas leucopus																X																			
Orchopeas howardi			X						X	X	X								X	X			X												
Leptopsylla segnis																		X		X	X	X													
Sternopsylla d. texana					X	X																													

*Previously published host records referred to *Pulex irritans* not included.

P. floridanus, Pulex simulans, and *Sternopsylla distincta. P. gwyni* is the most abundant flea on small mammals in Florida, although its primary host is the cotton rat (*Sigmodon hispidus*), a member of a Neotropical group. In contrast, *Polygenis floridanus* is narrowly host specific and more closely resembles certain species such as *Polygenis occidentalis* (Cunha) of northern South America than *P. gwyni* with which it is sympatric (Johnson and Layne, 1961). Its true host, *Peromyscus floridanus,* appears to have affinities with Middle America (Linzey and Layne 1968). The occurrence of *Sternopsylla distincta* in Florida is also easily explained by its typical host, *Tadarida brasiliensis,* which is primarily a Middle and South American bat. Only *Pulex simulans* of the Neotropical group does not exhibit some indication of its zoogeographic affinity in its host associations. The fleas of northern relationships appear to be largely restricted to the northern part of the state and relatively rare. The only apparent exception is *Opisodasys pseudarctomys,* allegedly occurring on the flying squirrel (*Glaucomys volans*) in south Florida. In addition, a number of northern flea species that extend into southeastern United States apparently fail to reach Florida. These include *Chaetopsylla lotoris* (Stewart), *Odontopsyllus multispinosus* Baker, *Orchopeas sexdentatus* (Baker), *Conorhinopsylla stanfordi* Stewart, *Peromyscopsylla scotti* I. Fox, and *Myodopsylla insignis* (Rothschild). Of the northern fleas, *Orchopeas howardi* and the presumably introduced *Hoplopsyllus glacialis affinis* have the widest geographic and host distribution within the state.

The limitation in the southward distribution of northern fleas appears to be attributable to climatic factors rather than host distribution. In every instance, suitable hosts occur beyond the southern limit of the range of the flea. A particularly marked example of this is the case of *Orchopeas sexdentatus.* This is a characteristic flea of woodrats (*Neotoma*), and, although the woodrat, *Neotoma floridana,* occurs as far south in the state as Key Largo, the southernmost locality recorded for *O. sexdentatus* is the Okefenokee Swamp of southern Georgia. In Florida, *Neotoma* is most commonly infested with *Orchopeas howardi* and *Polygenis gwyni.*

An even more extreme case of range limitation by climatic factors may be the absence of *Foxella ignota* on the pocket gopher, *Geomys pinetis.* Although this flea is typical of *Geomys* and *Thomomys* in western North America (east to Illinois), there is presently no evidence of its presence within the range of *Geomys* in Florida and elsewhere in the southeast despite the fact that numerous specimens and burrows (Hubbell and Goff 1940) have been searched.

Acknowledgments

I am greatly indebted to Dale E. Birkenholz, William O. Wirtz, Chet E. Winegarner, Peter Cone, James Koschmann, James Selman, Sara J. Hoyt, Glen E. Woolfenden, and Charles W. Myers for help in collecting mammal hosts and fleas. Grateful acknowledgment is also made to the many individuals who donated fleas or mammal specimens from which fleas were collected. These include Kenneth M. Backhouse, Larry N. Brown, Robert K. Burns, Archie F. Carr, Jr., B. W. Clements, Edwin Gould, William J. Hamilton, Jr., Mary E. Hight, William L. Jennings, Herbert W. Kale, Ben-

jamin B. Leavitt, Arthur J. Manaro, Lawrence R. Penner, Marsha Siegler, John Taylor, Charles H. Wharton, Elizabeth Wing, and James Wing.

Howard Weems very kindly allowed me to examine the flea specimens in the Florida State Collection of Arthropods, Bureau of Entomology, Division of Plant Industry, Florida State Department of Agriculture and Consumer Services. Allen H. Benton made available some comparative material and aided in identifications of *Pulex simulans*. Gratitude is also expressed to Dorothy Wilkinson for bibliographic aid and to John M. Kinsella for helpful comments on the manuscript.

Many of the specimens reported upon in this paper were collected in the course of studies supported by National Science Foundation grants G3215, G13240, and GB3072 and U.S. Public Health Service grant E3730. Several of the persons (Cone, Koschmann, Selman, Hoyt) who assisted in this study were participants in the Undergraduate Research Program of the American Museum of Natural History supported in part by National Science Foundation grant GY4349.

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ANNUAL MEETING

The 54th annual meeting of the Florida Entomological Society will be held September 8, 9, and 10, at the Sheraton Motor Hotel in Jacksonville. Information on the invitational speakers will appear in the June issue. Plan now to attend.