

not significantly correlated with arthropod population density in either the pine or the hardwood stands.

DISCUSSION

During the summer of 1962 the arthropod (insects, symphylans, and pauropods) population density appeared to be regulated, at least partially, by soil moisture. In both the pine and the hardwood stands, increases in soil moisture content resulted in increases in arthropod populations. This relationship pertained mainly to the Collembola, which made up the greater part of the populations. Soil moisture was consistently lower in the pine stands than in the hardwood stands, and it appeared that the arthropods in the pine stands were therefore more sensitive to slight changes in moisture levels than were those in the hardwood stands. The minor fluctuations in soil temperature during the summer appeared to have no great influence upon the population densities.

It should be pointed out that other factors help to control soil and litter arthropod populations. Among these are the type and amount of litter, the stage of decomposition of the litter, the characteristics of the soil and the other fauna present.

The virtual absence of Protura from pine stand III may have been due to the virtual absence of decaying organic matter, the litter being mostly undecomposed pine needles. Also, this was the driest of the 6 stands

and the Protura may have needed an environment with a higher moisture content.

Grimm (1958) stated that Thysanoptera migrated into the litter in response to low humidity. The collection of a large number of thrips from hardwood stand I during a very dry period appeared to be in agreement with his observation.

Whether the virtual absence of Symphyla from pine stand III was due to the lack of decaying organic matter, the low soil moisture content, or some other factor(s) was not determined. Pearse (1946) found that symphylans were more abundant in oak forests than in pine forests.

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Studies on the Association of Flies (Diptera) with Dung in Southeastern Washington¹

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ABSTRACT

Species of flies attracted to and/or reared from all available types of excrement in an area in southeastern Washington were recorded. Results are presented of studies on the relative attractiveness of 8 main types of dung to the fly population. One hundred thirty-nine species of Diptera were recorded, of which 48 are here con-

sidered to be members of the dung community. Cow dung, being most prevalent, attracted the largest number and widest variety of species. Information is given for each species concerning its dung preferences, seasonal distribution, geographic and climatic distribution, and other observations on bionomics.

Since World War II interest has increased in excrement-frequenting flies as potential transmitters of human disease. Bohart and Gressitt (1951) made a comparative study of the flies associated with all types of filth in Guam. Siverly and Schoof (1955a, b, c), Schoof and Siverly (1954), Savage and Schoof (1955), and Schoof et al. (1954) made exhaustive comparative studies of flies associated with various types of dung. The last-mentioned studies, however, were essentially urban, stressed public health problems rather than basic ecology and biology, and dealt

primarily with muscoid flies; also, none were carried out in the Pacific Northwest. Most other studies have dealt with flies associated with a single type of dung. Some of the more important are those by Hammer (1941), Howard (1900), Laurence (1954), Mohr (1943), and Hafez (1939, 1947, 1948, 1949).

In this country, studies on the relative attractiveness, abundance, and degree of infestation for all species of flies associated with all types of available dung are either lacking or incomplete. Further faunal and preference studies on a localized basis appear to be of great value, particularly if one is to assess better the disease-carrying potential of the dung flies.

This paper is presented as a contribution to our knowledge of the flies which frequent and/or breed in the various types of excrement found in a rather

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localized region: Whitman County, Washington, and certain adjacent areas. It is supplemented by investigations of dung-type preferences, extent of the coprophagous habit, relative abundance, seasonal distribution, and geographic and climatic distribution.

I am particularly indebted to Dr. Maurice T. James, Department of Entomology, Washington State University, for his patient help throughout this study. Dr. H. S. Telford also has given critical help with the manuscript. The facilities of the Zoology Department of Washington State University were made available. I made some determinations, particularly in the Sphaeroceridae, but many were made by spe-

cialists. They are gratefully acknowledged later in this paper by the inclusion of their names after the species they determined.

METHODS

Localities Investigated.—Most of the collecting sites for this study were situated in Whitman County, Wash., with the greatest concentration of effort in the environs of Pullman. Fig. 1 shows a map of the area, with all collecting sites indicated by numbers which are referred to hereinafter. These localities were selected to obtain information from as many diverse areas as possible within the limited region involved.

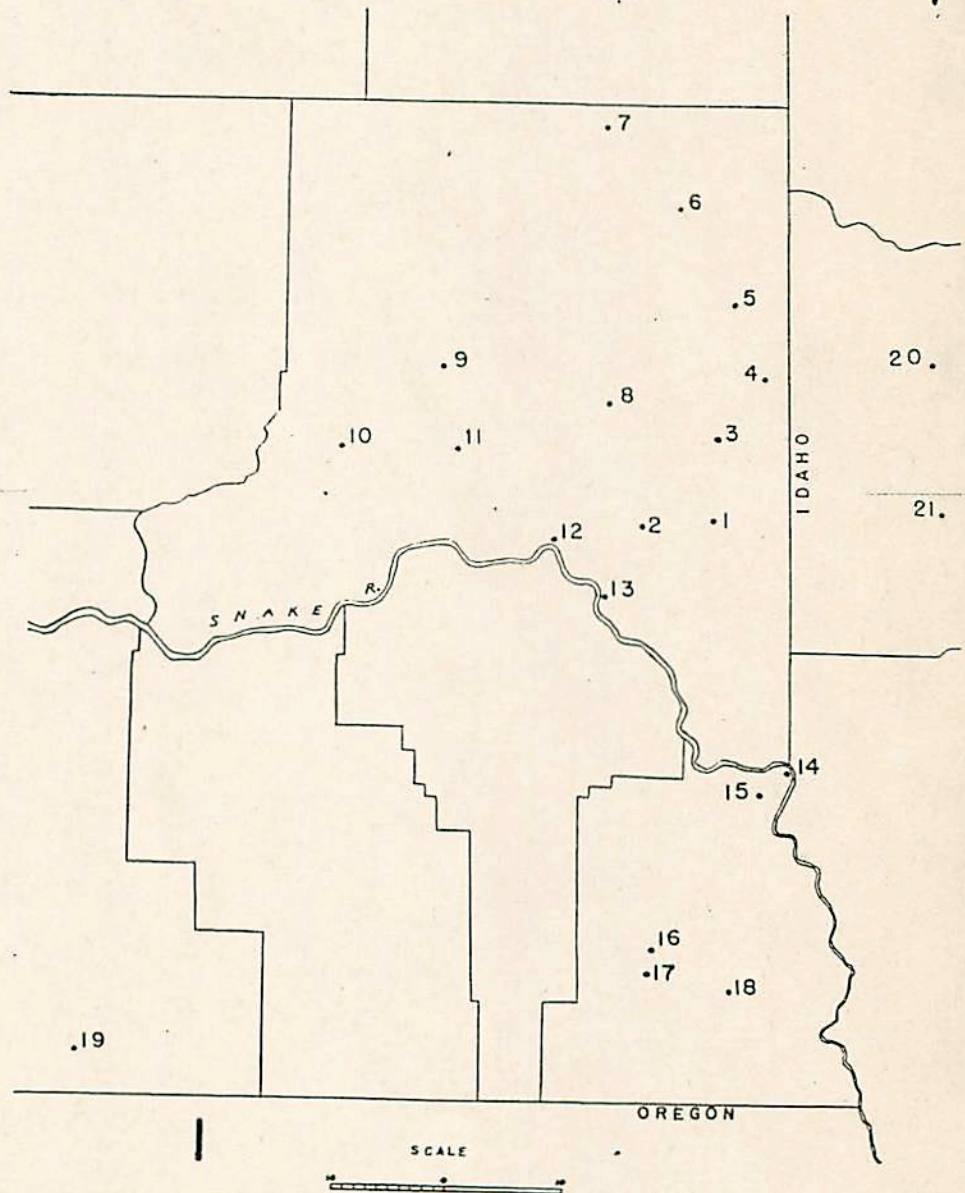


FIG. 1.—Map of southeastern Washington and adjacent Idaho collecting area. 1, Pullman; 2, Union Flat; 3, Four Mile Creek; 4, Palouse; 5, Garfield; 6, Oakesdale; 7, Rosalia; 8, Colfax; 9, Endicott; 10, LaCrosse; 11, Dusty; 12, Almota; 13, Wawawai; 14, Clarkston; 15, Alpowa Canyon; 16, 8 miles south of Cloverland; 17, 11 miles south of Cloverland; 18, 2 miles west of Anatone; 19, Walla Walla; 20, near Laird Park; 21, Troy.

Four climatic areas can be recognized. The first is represented by Pullman (1) in eastern Whitman County, at an elevation of nearly 2500 ft and surrounded by rolling hills. The native vegetation is chiefly of the prairie type. Precipitation is moderate and may occur in any month, but is heaviest from November through March. Temperatures are fairly mild but winter minimums may go below 0°F and summer maximums are usually in the high 90's. Collections made from Union Flat (2), Four Mile Creek (3), Palouse (4), Garfield (5), Oakesdale (6), Rosalia (7), and Colfax (8) may be included in this climatic type.

The western part of Whitman County receives much less precipitation, the vegetation being more characterized by bunchgrass (Northern Desert shrub types). Temperatures are usually slightly higher than on the prairie. Collections made at Endicott (9), LaCrosse (10), and Dusty (11) represent this type of climatic area.

A third zone is represented by the lower elevations. About 20 miles to the south of Pullman, the Snake River flows through a canyon at an elevation of less than 1000 ft. The large drop in elevation occurring within a few miles produces a considerably different flora and climate as compared with the prairies. The winters may be cold but spring is greatly advanced and summer temperatures often exceed 100°F. The net effectiveness of climatic influences may be the same here as in the area near LaCrosse, since the dominant plant associations in virgin areas are similar. Perhaps the chief difference between the 2 areas is in phenology, the flies appearing earlier in the spring here than at LaCrosse. Collections from this area were made at Almota (12), Wawawai (13), and Clarkston (14).

The fourth area includes the Blue Mountain Range to the south, and the Moscow Mountains to the east in Idaho. The former includes collections near Cloverland (16, 17) and Anatone (18). The Latah County, Idaho, area includes Laird Park (20) and Troy (21). Here coniferous forests or meadows bordering such forests are the rule. The winters are more severe and the summers cool and often moist.

Alpowa Canyon (15) is somewhat transitional between areas III and IV, and Walla Walla (19) most closely resembles area III.

The localities discussed will be referred to as areas I, II, III, or IV in the distributional information for each species presented later in this paper.

Types of Dung Studied.—The types of dung studied depended largely upon their availability. In most cases manure is rarely allowed to accumulate in this region. Consequently, most studies were from pasture droppings. About two-fifths (54 out of 133) of the collections were made from cattle dung. In some cases the collections represent only flies collected on the dung. In other instances no adults were collected in the field but larvae were reared from dung samples taken to the laboratory. Generally both collections of adults attracted to dung and reared specimens were recorded.

An attempt was made to get samples from all ages of dung droppings so that data could be recorded on preferred breeding time and length of attractiveness. Differences found between fly populations of shady and sunny areas, and between droppings and accumulations also were noted.

Twenty-nine collections involving horse dung were made. In a few instances no flies emerged from rearing samples, probably owing either to extreme drying of field droppings in summer or to excessive moisture in spring and fall, resulting in a rapid overgrowth of fungi. Nearly all collections were from droppings, since horses are few in the area and the dung is usually spread out in the field rather than allowed to accumulate.

Swine dung was not readily available in all areas, the collections being primarily from the Washington State University swine barns. Droppings were collected from inside the pens, small piles in front of the pens, and a gutter between these piles and the pens. The latter contained several inches of liquid manure resulting from periodic washing of the pens. Each collecting area was a distinctive environment. Eighteen collections were made.

Five collections of chicken manure were made, all from the College poultry farm. They were from under roosts in the henhouses, small accumulations near watering and feeding troughs, and piles of manure mixed with straw and litter, on the outside of the henhouses. Often these piles remained for several days before being removed.

Sheep were not numerous in the areas sampled in southeastern Washington, and unless pastured in areas of fresh, green vegetation, their dung was unsuitable for fly breeding. Seven collections were made; 2 produced no flies.

Privies are nearly a thing of the past in this area; therefore, the 5 collections made from human excrement were from bait traps.

Dog dung was not given its due share of collections. Only 5 were made.

Six additional collections were made; 3 were from the university mink farm, 1 from turkey dung, 1 from accumulations of mixed horse and cow manure, and 1 from hamster pens.

Collecting and Rearing Methods.—A standard insect net was usually used to sweep flies from dung. In some cases, especially in bait-trap studies, a conical fly trap similar to that designed by Bishopp (1937) was used. This often was found to be unsatisfactory, since many flies such as sepsids and sphaerocerids would not fly up into it. The literature on baited fly-trap studies generally reports large numbers of the larger muscoid flies, but few of the small acalyptate Diptera. Early observations in this study indicated that the latter group often formed the most numerous and characteristic element of the dung community. In several instances special netting techniques were developed to collect individual species.

When possible, samples of dung were brought to the laboratory for rearing the larvae. All samples were of approximately equal size, weighing about 1

Table 1.—Numbers of flies recorded from dung according to taxonomic categories.

Type of dung	Families		Genera		Species		Common species ^a	
	Coll.	Reared	Coll.	Reared	Coll.	Reared	Coll.	Reared
Cow	28	12	62	28	89	46	21	19
Horse	19	9	41	14	64	23	18	11
Swine	17	9	40	16	59	25	16	9
Chicken	9	3	19	7	29	10	15	6
Sheep	5	4	11	6	17	8	10	7
Human	6	3	17	4	22	5	9	5
Mink	6	5	14	6	15	8	8	6
Dog	8	3	14	4	18	4	5	2
Turkey	3	1	4	1	4	1	?	1
Hamster	0	1	0	1	0	1	0	1
Totals	29	18	90	37	132	64	41	35
Totals, excl. overlap	29		94		139		48	

^a Species found often enough to be considered members of the dung community.

lb. They were placed in small containers, with moist sand on the bottom to provide a pupation site for those flies which do not pupate in the larval medium. Screened cages or jars were used to contain the flies until removal.

To see which dung-frequenting flies were attracted to houses (in relation to possible disease transmission), flies were netted from houses in Pullman throughout all months of 2 years.

Seasonal Studies.—Collections were made at random intervals, depending largely on weather and availability-of-time factors. The numbers of collections made each month were: April, 17; May, 8; June, 26; July, 27; August, 30; September, 10; October, 14. In some years flies were observed on dung in March and November (probably rare in other winter months), but the present study was restricted to the period of fly activity in this area. Except for a few collections in the fall of 1953 and the summer of 1954, the study periods were from April 23 to October 22, 1955, and April 10 to September 12, 1956. The earliest collection was made on April 10, the latest on October 27.

Taxonomic Study.—Adults collected in the field were brought to the laboratory and representative numbers were pinned. All reared specimens also were pinned for study, except where there were large numbers. About 7000 pinned and 8000 unpinned specimens were recorded, making the number of specimens examined approximately 15,000.

The numbers of flies recorded from dung according to taxonomic categories are given in Table 1.

In this paper, where the generic name "*Madiza*" is given, quotation marks are used since it is in dispute between the families Milichiidae and Chloropidae.

Leptocera (Coprophiola) exiguella Spuler requires special mention. It consists of apparently at least 3 distinct species, all running to *exiguella* in Spuler's key (1925). Each is different from the others, not only morphologically, but apparently biologically as

well. This confusion of 3 or possibly more species is evident from specimens under the label *L. exiguella* in the United States National Museum² and in the collection of Washington State University. For purposes of discussion, the species of this complex are referred to as *L. exiguella* species A, B, and C.

RESULTS AND DISCUSSION

Probably few, if any, species of coprophagous flies are specific for a particular type of dung, but preferences are usually indicated. In this study no species was so restricted but several were rare on all but 1 type of excrement. A study of the degree of attraction of the several dung types for a given species shows some interesting results. Table 2 lists the number of individuals and the number of times collected for some of the commoner species. The percentage of occurrence of some of the common species, in the total fly population of each type of dung is given in Table 3. The lists of species in these 2 tables are not exact duplicates of each other, since each table is designed to show different characteristics.

In the following list of species, short statements are given regarding the results of dung preference studies, seasonal distribution, geographical and climatic distribution, and other observations on the bionomics for each species, within its respective family. For each species that I did not determine the determiner's name is included in parentheses.

PSYCHODIDAE

Psychoda alternata Say. (Larry Quate.) Collected and reared only from liquid swine manure, very abundant; taken only at Pullman, in August; occasionally found in dwellings.

P. pusilla Tonnoir. (Larry Quate.) Collected and reared from cow, swine, and horse dung; often abundant in cow pats but is only a minor influent; collected June and July except once in April; widely distributed; may enter houses on occasion.

² Personal communication from Curtis W. Sabrosky.

CHIRONOMIDAE

Hydrobaenus sp. (Paul Arnaud, Jr.) Collected and reared from cow and horse dung, large numbers from both on occasion; probably prefers dung in shade; life cycle long, larvae associated with old dung; June 13-Sept. 5 (mostly June); common area I, found also areas III and IV but not II.

CERATOPOGONIDAE

Forcipomyia brevipennis (Macquart). (L. G. Saunders.) Reared from horse (largest numbers) and cow dung; larvae probably associated with old dung and fungi; June only; Pullman and Blue Mountains.

F. bipunctata (L.). (L. G. Saunders.) Collected and reared from cow and horse dung, only large collection from cow pats in July; larvae with habits similar to *F. brevipennis*; June 13-July 12; areas I, II, and IV.

Dasyhelea sp. (Paul Arnaud, Jr.) One specimen on cow dung; Oakesdale; June 13.

BIBIONIDAE

Biblio nigrifemoratus var. *gilvus* Hardy. (M. T. James.) Collected only from horse dung (LaCrosse) and cow dung (Dusty) on April 21; probably no dung-frequenting significance.

SCATOPSIDAE

Scatopse fuscipes Meigen. (Edwin Cook.) Collected on cow dung, reared from cow (60%), horse, swine, sheep, and dog dung; larvae often numerous in cow pats and manure piles; Apr. 10-Oct. 22, mostly late summer and fall; widely distributed.

Svammerdamella sp. (Edwin Cook.) Reared once from cow dung; Oakesdale; June 13.

Ectactia sp. (Edwin Cook.) One specimen on horse dung; Troy, Idaho; June 8.

SCIARIDAE

Sciara sp. Occasionally collected from horse, cow, and swine dung in small numbers; associated with older dung; June 13-Oct. 22; all areas except II; occasionally entered houses.

CECIDOMYIIDAE

Anarete johnsoni (Felt). (Richard Foote.) Collected occasionally from swine (commonest), cow, horse, and poultry dung; probably a general scavenger; June 26-Sept. 18; all areas except III.

STRATIOMYIDAE

Microchrysa polita (L.). (M. T. James.) Collected and reared from cow and horse dung, a few times in large numbers; larvae associated with old dung and have a very long developmental period; June-Aug.; widely distributed.

Sargus cuprarius (L.). (M. T. James.) Collected only from cow dung; Pullman; July 30; larvae may be associated with old cow pats in wooded areas.

EMPIDIDAE

Drapetis spp. (Paul Arnaud, Jr.) Collected on cow dung; Pullman, July 10, Wawawai, Aug. 14.

Brachystoma occidentalis Melander. (Paul Arnaud, Jr.) On cow dung; Rosalia; June 13.

Rhamphomyia sp. (Paul Arnaud, Jr.) On cow dung; Dusty; Apr. 21.

DOLICHOPODIDAE

Dolichopus sp. (M. T. James.) One specimen on cow dung; Laird Park, Idaho; July 21.

LONCHOPTERIDAE

Lonchoptera dubia Curran. Collected once on cow dung at Rosalia; June 13.

PHORIDAE

Megaselia spp. (Paul Arnaud, Jr.) On cow dung; Oakesdale, June 13, and Wawawai, June 22.

PIPUNCULIDAE

Chalarus latifrons Hardy. (M. T. James.) On cow dung; Blue Mountains; June 30.

Tomosvaryella sp. (M. T. James.) On horse dung; Wawawai; Aug. 14.

SYRPHIDAE

Eristalis brousi Williston. (H. S. Telford.) Collected and reared from liquid swine dung and collected on cow manure; prefers semiliquid substrates; taken only in May and August, but observed other times; Pullman.

E. tenax (L.). (H. S. Telford.) Collected on swine dung, common in same situations as *T. brousi*; Pullman; collected June and Sept. (also present other times).

Pipiza sp. (H. S. Telford.) One specimen on swine dung; Pullman; June 26; known to be an aphid predator.

Scaeva pyrastris (L.). (H. S. Telford.) One specimen on cow dung; Pullman; July 10; also an aphid predator.

Syrilla pipiens (L.). (H. S. Telford.) Collected on cow, chicken, and swine dung (manure piles); Pullman; Aug. and Sept.; may enter houses.

OTITIDAE

Physiphora demandata (F.). (M. T. James.) Reared only on cow dung (manure pile) but attracted to human (preponderantly), chicken, swine, dog, horse, and sheep dung; Pullman and Wawawai; July and Aug. only.

Euxesta notata Wiedemann. (M. T. James.) Collected on human, dog, and cow dung equally; Pullman and Wawawai; July and Aug.

SEPSIDAE

Decachaetophora aenipes DeMeijere. (Howard Smith.) Collected once on chicken dung; Pullman; Sept. 6.

Enicomira minor (Haliday). (Howard Smith.)

Table 2.—Relative attractiveness of different dung types for 35 of the commoner species, expressed as number of flies secured and (in parentheses) number of collections in which a species was present.

	Cow (54) ^a	Horse (32) ^a	Swine (19) ^a	Chicken (5) ^a	Sheep (7) ^a	Human (5) ^a	Mink (3) ^a
<i>Calythea micropteryx</i>							
Collected	47 (12)	22 (7)	20 (3)	0	2 (1)	0	0
Reared	5 (3)	0	0	0	0	0	0
Total ^b	52 (13)	22 (7)	20 (3)	0	2 (1)	0	0
<i>Copromyza equina</i>							
Collected	10 (5)	98 (11)	0	0	0	0	0
Reared	0	29 (2)	0	0	0	0	0
Total	10 (5)	127 (11)	0	0	0	0	0
<i>Copromyza marmorata</i>							
Collected	74 (15)	1037 (22)	45 (8)	0	2 (1)	0	0
Reared	6 (2)	70 (12)	2 (1)	0	0	0	0
Total	80 (15)	1107 (24)	47 (8)	0	2 (1)	0	0
<i>Fannia canicularis</i>							
Collected	2 (2)	0	5 (2)	28 (4)	0	1 (1)	33 (2)
Reared	4 (2)	0	3 (1)	421 (5)	0	0	27 (2)
Total	6 (4)	0	8 (2)	449 (5)	0	1 (1)	60 (2)
<i>Leptocera acutangula</i>							
Collected	14 (7)	1724 (21)	18 (7)	0	7 (2)	0	0
Reared	82 (2)	1188 (16)	2 (2)	0	0	0	0
Total	96 (9)	2912 (23)	20 (9)	0	7 (1)	0	0
<i>Leptocera crassimana</i>							
Collected	45 (13)	14 (6)	2 (1)	0	0	0	0
Reared	8 (4)	0	0	0	1 (1)	0	0
Total	53 (14)	14 (6)	2 (1)	0	1 (1)	0	0
<i>Leptocera elegans</i>							
Collected	6 (3)	7 (1)	4 (2)	4 (2)	0	0	0
Reared	43 (3)	14 (1)	1 (1)	0	0	0	0
Total	49 (4)	21 (1)	5 (3)	4 (2)	0	0	0
<i>Leptocera exiguella</i> A							
Collected	26 (8)	0	2 (1)	9 (3)	1 (1)	0	0
Reared	46 (1)	0	494 (8)	27 (4)	0	13 (2)	59 (2)
Total	72 (8)	0	496 (8)	36 (4)	1 (1)	13 (2)	59 (2)
<i>Leptocera exiguella</i> B							
Collected	93 (12)	31 (13)	163 (11)	17 (4)	2 (1)	0	4 (1)
Reared	69 (6)	1 (1)	8 (3)	21 (4)	1 (1)	0	21 (1)
Total	162 (13)	32 (13)	171 (11)	38 (5)	3 (1)	0	25 (1)
<i>Leptocera exiguella</i> C							
Collected	149 (18)	41 (7)	2 (2)	1 (1)	3 (1)	0	0
Reared	98 (13)	0	2 (1)	0	0	0	0
Total	247 (21)	41 (7)	4 (2)	1 (1)	3 (1)	0	0
<i>Leptocera ferruginata</i>							
Collected	28 (5)	27 (1)	4 (4)	0	0	0	0
Reared	59 (2)	464 (1)	0	0	0	0	0
Total	87 (5)	491 (1)	4 (4)	0	0	0	0
<i>Leptocera spinnipennis</i>							
Collected	5 (3)	20 (6)	2 (1)	2 (1)	0	0	0
Reared	11 (2)	1 (1)	0	0	0	0	0
Total	16 (3)	21 (7)	2 (1)	2 (1)	0	0	0
<i>Leptocera vagans</i>							
Collected	169 (9)	23 (6)	56 (11)	10 (1)	0	0	3 (1)
Reared	4 (1)	6 (1)	20 (3)	2 (1)	0	0	0
Total	173 (9)	29 (6)	76 (12)	12 (1)	0	0	3 (1)
<i>Meoneura seducta</i>							
Collected	11 (7)	6 (5)	38 (10)	126 (2)	0	1 (1)	34 (2)
Reared	0	0	15 (3)	13 (4)	0	0	1 (1)
Total	11 (7)	6 (5)	53 (10)	139 (4)	0	1 (1)	35 (2)
<i>Microchrysa polita</i>							
Collected	1 (1)	4 (2)	0	0	0	0	0
Reared	85 (3)	32 (3)	0	0	0	0	0
Total	86 (4)	36 (3)	0	0	0	0	0
<i>Musca domestica</i>							
Collected	62 (8)	2 (1)	46 (5)	7 (3)	0	3 (1)	1 (1)
Reared	115 (2)	0	267 (2)	0	0	0	0
Total	177 (8)	2 (1)	313 (5)	7 (3)	0	3 (1)	1 (1)
<i>Muscina stabulans</i>							
Collected	2 (1)	0	4 (2)	8 (3)	0	6 (2)	5 (1)
Reared	6 (1)	0	4 (1)	44 (5)	0	0	0
Total	8 (2)	0	8 (2)	52 (5)	0	6 (2)	5 (1)
<i>Ophyra leucostoma</i>							
Collected	0	0	3 (2)	1 (1)	0	0	7 (2)
Reared	0	0	1 (1)	14 (2)	0	0	50 (3)
Total	0	0	4 (2)	15 (2)	0	0	57 (3)

Table 2.—Relative attractiveness of different dung types for 35 of the commoner species, expressed as number of flies secured and (in parentheses) number of collections in which a species was present. (Cont.)

	Cow (54)*	Horse (32)*	Swine (19)*	Chicken (5)*	Sheep (7)*	Human (5)*	Mink (3)*
<i>Orthellia caesarion</i>							
Collected	65 (16)	17 (7)	4 (3)	0	10 (1)	0	0
Reared	14 (2)	0	0	0	0	0	0
Total	79 (16)	17 (7)	4 (3)	0	10 (1)	0	0
<i>Paregle cinerella</i>							
Collected	199 (15)	44 (9)	113 (10)	0	49 (3)	0	0
Reared	9 (4)	1 (1)	272 (6)	0	8 (3)	0	0
Total	208 (17)	45 (10)	385 (10)	0	57 (4)	0	0
<i>Phaenicia sericata</i>							
Collected	1 (1)	3 (2)	50 (8)	4 (1)	0	4 (1)	12 (2)
Reared	0	0	0	0	0	0	125 (2)
Total	1 (1)	3 (2)	50 (8)	4 (1)	0	4 (1)	137 (2)
<i>Phormia regina</i>							
Collected	5 (3)	1 (1)	14 (4)	0	0	19 (3)	16 (2)
Reared	0	0	0	0	0	0	0
Total	5 (3)	1 (1)	14 (4)	0	0	19 (3)	16 (2)
<i>Physiphora demandata</i>							
Collected	0	1 (1)	22 (2)	3 (1)	1 (1)	466 (2)	0
Reared	2 (1)	0	0	0	0	0	0
Total	2 (1)	1 (1)	22 (2)	3 (1)	1 (1)	466 (2)	0
<i>Psychoda pusilla</i>							
Collected	1 (1)	0	0	0	0	0	0
Reared	240 (8)	1 (1)	4 (1)	0	0	0	0
Total	241 (9)	1 (1)	4 (1)	0	0	0	0
<i>Ravinia lherminieri</i>							
Collected	58 (14)	26 (7)	31 (8)	0	18 (3)	152 (2)	0
Reared	104 (14)	42 (11)	194 (10)	0	19 (4)	71 (2)	0
Total	162 (20)	68 (13)	225 (11)	0	37 (4)	223 (2)	0
<i>Ravinia planifrons</i>							
Collected	12 (6)	2 (2)	2 (2)	0	1 (1)	0	0
Reared	7 (2)	0	0	0	2 (1)	0	0
Total	19 (7)	2 (2)	2 (2)	0	3 (2)	0	0
<i>Ravinia querula</i>							
Collected	28 (13)	4 (4)	1 (1)	0	4 (2)	19 (2)	0
Reared	82 (20)	5 (2)	0	0	0	0	0
Total	110 (24)	9 (6)	1 (1)	0	4 (2)	19 (2)	0
<i>Salitella scutellaris</i>							
Collected	238 (18)	2 (2)	0	0	0	0	0
Reared	112 (9)	147 (1)	0	0	0	0	0
Total	350 (20)	149 (3)	0	0	0	0	0
<i>Scatophaga furcata</i>							
Collected	19 (7)	26 (5)	2 (1)	0	0	0	0
Reared	2 (2)	0	8 (1)	0	0	0	0
Total	21 (8)	26 (5)	10 (1)	0	0	0	0
<i>Scatophaga stercoraria</i>							
Collected	157 (23)	52 (9)	1 (1)	0	0	0	0
Reared	283 (11)	0	21 (1)	0	0	0	0
Total	440 (27)	52 (9)	22 (1)	0	0	0	0
<i>Scatophaga carolinensis</i>							
Collected	87 (13)	30 (5)	3 (3)	0	0	0	0
Reared	13 (5)	0	0	0	0	0	0
Total	100 (16)	30 (5)	3 (3)	0	0	0	0
<i>Scatopse fuscipes</i>							
Collected	16 (4)	2 (2)	3 (2)	4 (2)	0	0	0
Reared	118 (16)	39 (5)	31 (5)	0	5 (1)	0	0
Total	134 (17)	41 (7)	34 (7)	4 (2)	5 (1)	0	0
<i>Sepsis biflexuosa</i>							
Collected	197 (24)	22 (7)	16 (3)	0	1 (1)	0	0
Reared	260 (15)	1 (1)	3 (1)	0	0	0	0
Total	457 (29)	23 (7)	19 (3)	0	1 (1)	0	0
<i>Sepsis neocynipsea</i>							
Collected	434 (28)	27 (10)	6 (4)	0	7 (2)	0	1 (1)
Reared	211 (17)	9 (1)	0	0	0	0	0
Total	645 (31)	36 (10)	6 (4)	0	7 (2)	0	1 (1)
<i>Sphaerocera subsultans</i>							
Collected	21 (12)	48 (7)	3 (2)	2 (1)	0	9 (1)	0
Reared	52 (3)	92 (6)	0	0	2 (1)	6 (1)	0
Total	73 (12)	140 (11)	3 (2)	2 (1)	2 (1)	15 (1)	0

* Total number of samples collected.

* Total number of collections adjusted for overlaps where these occurred between "collected" and "reared."

Table 3.—Percent occurrence of the commoner species in the entire fly population on several kinds of dung.

Species	Cow		Horse		Swine		Chicken		Sheep		Human		Mink	
	C*	R	C	R	C	R	C	R	C	R	C	R	C	R
<i>Calythea micropteryx</i>	2	—	1	—	3	—	—	—	1	—	—	—	—	—
<i>Copromyza equina</i>	—	—	3	1	—	—	—	—	—	—	—	—	—	—
<i>Copromyza marmorata</i>	3	—	28	3	6	—	—	—	1	—	—	—	—	—
<i>Fannia canicularis</i>	1	—	—	—	—	—	12	72	—	—	—	—	27	9
<i>Leptocera acutangula</i>	—	3	47	53	2	—	—	—	6	—	—	—	—	—
<i>Leptocera exiguella</i> A	1	2	—	—	—	36	4	5	—	—	13	—	19	—
<i>Leptocera exiguella</i> B	4	3	1	—	21	—	7	4	1	2	—	—	3	7
<i>Leptocera exiguella</i> C	6	4	1	—	—	—	—	—	2	—	—	—	—	—
<i>Leptocera ferruginata</i>	1	2	1	21	—	—	—	—	—	—	—	—	—	—
<i>Leptocera vagans</i>	7	—	1	—	7	1	4	—	—	—	—	—	2	—
<i>Meoneura seducta</i>	—	—	—	—	5	1	53	2	—	—	—	—	28	4
<i>Musca domestica</i>	3	4	—	—	6	19	3	—	—	—	—	—	—	—
<i>Muscina stabulans</i>	—	—	—	—	—	—	3	7	—	—	1	—	4	—
<i>Ophyra leucostoma</i>	—	—	—	—	—	—	—	2	—	—	—	—	6	16
<i>Orthellia caesarion</i>	3	—	—	—	—	—	—	—	9	—	—	—	—	—
<i>Paregle cinerella</i>	8	—	1	—	14	20	—	—	46	20	—	—	—	—
<i>Phaenicia sericata</i>	—	—	—	—	6	—	2	—	—	—	—	—	10	40
<i>Phormia regina</i>	—	—	—	—	2	—	—	—	—	—	3	—	13	—
<i>Physiphora demandata</i>	—	—	—	—	3	—	1	—	—	—	58	—	—	—
<i>Psychoda pusilla</i>	—	10	—	—	—	—	—	—	—	—	—	—	—	—
<i>Ravinia acerba</i>	—	—	—	—	—	—	—	—	—	—	6	—	—	—
<i>Ravinia lherminieri</i>	2	4	1	2	4	14	—	—	17	49	20	72	—	—
<i>Ravinia planifrons</i>	—	—	—	—	—	—	—	—	—	5	—	—	—	—
<i>Ravinia querula</i>	1	3	—	—	—	—	—	—	3	—	3	—	—	—
<i>Saltella scutellaris</i>	10	5	—	7	—	—	—	—	—	—	—	—	—	—
<i>Scatophaga stercoraria</i>	6	12	2	—	—	2	—	—	—	—	—	—	—	—
<i>Scatophora carolinensis</i>	4	—	1	—	—	—	—	—	—	—	—	—	—	—
<i>Scatopse fuscipes</i>	—	5	—	2	—	2	2	—	13	—	—	—	—	—
<i>Sepsis biflexuosa</i>	8	11	1	—	2	—	—	—	—	—	—	—	—	—
<i>Sepsis neocynipsea</i>	18	0	1	—	1	—	—	—	6	—	—	—	—	—
<i>Sphaerocera subsultans</i>	1	2	1	4	—	—	1	—	5	1	6	—	—	—
<i>Themira putris</i>	—	—	—	—	5	1	—	—	—	—	—	—	—	—
All others	11	21	9	7	13	4	8	8	8	6	14	3	7	9

*C = percent of total flies collected on dung; R = percent of total flies reared from dung.

Collected from cow, swine, and horse dung, but only large collection from horse dung (at Laird Park, Idaho); never reared; June-Aug.; areas I and IV.

Saltella scutellaris (Fallén). (Howard Smith.) Collected and reared in large numbers from cow and horse dung; prefers cow dung; Apr. 17-Aug. 17 (mostly June and July); widely distributed.

Sepsidimorpha secunda Melander and Spuler. (Howard Smith.) Collected several times (small numbers) from cow dung and twice from horse dung, never common; Apr. 21-Aug. 17, normally June, July; widely distributed.

Sepsis biflexuosa Strobl. (Howard Smith.) Commonly collected on and reared from cow pats (a sub-major influent), less common from horse and swine dung, collected once on sheep dung; adults attracted to cow pats for several days; Apr. 21-Oct. 22, mostly June-Aug.; common in all areas.

S. luteipes Melander and Spuler. (Howard Smith.) Collected and reared from cow dung; Wawawai and Blue Mountains; June only; probably an uncommon species in this area.

S. neocynipsea Melander and Spuler. (Howard Smith.) Very common on and in cow pats but is not so attracted to old pats as is *biflexuosa*; also collected on and reared from horse dung; collected on sheep, swine, and mink dung; Apr. 10-Oct. 22, mostly June-Aug.; widely distributed.

S. vicaria Walker. (Howard Smith.) Collected and reared from cow dung, never common; June only; areas I and IV.

Themira putris (L.). (Howard Smith.) Reared only from liquid swine manure (large numbers), collected also on cow dung; Pullman only; June-Aug.

PIOPHILIDAE

Piophilha casei (L.). Reared from mink dung (10 specimens), Pullman; Aug. 10.

Piophilha sp. probably *affinis* Meigen. Collected on cow dung; Pullman, Sept. 30 and Oakesdale, June 13.

TRIXOSCELIDAE

Trixoscelis frontalis (Fallén). (M. T. James.) Collected several times from cow, horse, and swine dung; dung-frequenting significance not determined but this species is probably a scavenger; June-Aug.; areas I, III, IV.

CHAMAEMYIDAE

Leucopis sp. (M. T. James.) Reared once from liquid swine dung; larvae are recorded as aphid predators; collected at Pullman, Aug. 4.

AGROMYZIDAE

Cerodontha dorsalis (Loew). (Kenneth Frick.) Collected occasionally on cow and horse dung; Apr. 21-Oct. 22; taken in all areas.

Haplomyza minuta (Frost). (Kenneth Frick.) One specimen on cow dung; Endicott; July 12.

Phytobia sp. (Kenneth Frick.) One specimen on cow dung; Anatone; June 30.

MILICHIIDAE

"*Madiza*" *glabra* Fallén. (Curtis Sabrosky.) Collected and reared (moderate to large numbers) from chicken manure, collected also on cow dung and reared from swine dung; June-Aug.; Area I only; occasionally entered houses.

Meoneura seducta Collin. (Curtis Sabrosky.) Like the previous species, collected (58%) and reared (45%) in large numbers from chicken dung, also collected and reared in large to moderate numbers from swine dung and collected from mink (16%), cow, horse, human, and dog dung; prefers chicken and swine dung for breeding; May 19-Sept. 3; fairly widely distributed; occasionally entered houses.

Desmometopa sordida (Fallén). (Curtis Sabrosky.) One specimen on cow dung; Clarkston; Aug. 14.

Hemeromyia washingtona (Melander). (Curtis Sabrosky.) One specimen on cow dung; Troy, Idaho; June 8.

Leptomotopa latipes (Meigen). (Curtis Sabrosky.) One specimen on chicken dung; Pullman; Sept. 6.

CHILOROPIDAE

Lasiosina sp. (Curtis Sabrosky.) One specimen on horse dung; Laird Park, Idaho; July 21.

"*Madiza*" *neglecta* (Becker). (Curtis Sabrosky.) One specimen each on turkey dung (Wawawai, June 22) and horse dung; Blue Mountains; June 30.

Meromyza pratorum Meigen. (Curtis Sabrosky.) One specimen each on horse, cow, and swine dung; Pullman and Wawawai; June-Aug.

M. saltatrix (L.). (Curtis Sabrosky.) One specimen on swine dung; Pullman; Sept. 6.

Oscinella frit L. (Curtis Sabrosky.) Collected several times from cow and horse dung; normally associated with living plant material during at least part of its life cycle; June-Aug.; fairly widely distributed; occasionally entered houses.

O. incerta Becker. (Curtis Sabrosky.) Collected several times from cow and horse dung (numbers always small); June and July; areas I and IV.

O. nitidissima (Meigen). (Curtis Sabrosky.) Collected twice (12 specimens) from horse dung; June and July; area IV only.

Oscinella ? n. sp. (Curtis Sabrosky.) One specimen on swine dung; Pullman; July 18.

EPHYDRIDAE

Allotrichoma simplex (Loew). (M. T. James.) One specimen on horse dung; Clarkston; Aug. 14.

A. yosemite Cresson. (M. T. James.) One very large collection from horse dung; Laird Park; July 21; also 1 specimen on cow dung at same locality.

Athyroglossa (*Parathyroglossa*) *ordinata* Becker. (M. T. James.) One specimen on horse dung; Laird Park; July 21.

Coenia bisetosa Coquillett. (M. T. James.) One specimen on swine dung; Pullman; Aug. 4.

Gymnopa tibialis (Cresson). (M. T. James.) Collected on swine dung, mostly on semiliquid material; Pullman; Aug. and Sept.

Hydrellia griseola (Fallén). (M. T. James.) Two specimens on cow dung; Oakesdale; June 13.

Napaea (*Callinapae*) *aldrichi* Sturtevant and Wheeler. (M. T. James.) One adult on cow dung; Oakesdale; June 13.

Phlygria debilis Loew. (M. T. James.) Collected several times (only as a single specimen each time) from cow and horse dung; Apr. 17-Oct. 22 (mostly spring and fall); areas I, III, IV.

Scatella spp. (M. T. James.) Collected and reared once from cow dung; June only; area I only.

Scatophila viridella Sturtevant and Wheeler. One specimen on cow dung; Oakesdale; June 13.

SPHAEROCERIDAE

Copromyza equina Fallén. Collected (91%) and reared (100%) from horse dung, also collected a few times on cow dung; Apr. 10-June 13 and Sept. 12-Oct. 22 (large numbers only in spring and fall); fairly widely distributed.

C. marmorata (Becker). Second most numerous fly on horse dung, also reared from it in large numbers; collected and reared several times from cow and swine dung, and collected once on sheep dung; Apr. 17-Oct. 22, mostly June-Aug.; wide-geographical distribution.

Leptocera (*Collinella*) *limosa* (Fallén). Collected and reared from cow dung in small numbers, collected also on horse dung (1 collection of 16 specimens); Apr. 17-Aug. 14; areas I, III, IV.

L. (Coprophila) acutangula (Zetterstedt). Most numerous species recorded; collected from horse (98%), swine, cow, and sheep dung, reared from horse (94%), cow, swine, and dog dung; prefers horse droppings, larvae coprophagous; collected Apr. 10-Oct. 7, commonest June-Sept.; widely distributed except in area II; seldom entered houses.

L. (Coprophila) exiguella Spuler Complex. A gradation of habits exists through the 3 species here recognized. Species A commonly reared from swine, chicken, mink, hamster, and human dung; also cow dung but breeds less than species B and C (and then more in manure piles). Species B common on and in cow, swine, chicken, and mink dung, less in horse and sheep dung, numbers and percentages intermediate between species A and C. Species C reared (98%) from cow dung, also attracted in moderate numbers to horse dung, rare on other types. All species from Apr. through Oct., species A most abundant Sept., species B Aug., species C July; species A nearly all from Pullman, species B most areas but large collections at Pullman, species C widely distributed.

L. (Coprophila) ferruginata (Stenhammer.) Reared once in very large numbers from horse dung (stable accumulations), collected and reared (1 large collection from manure pile) from cow dung, collected also on swine dung (rare); irregular in my collec-

tions, probably prefers manure piles of horse and/or cow dung; all collections from Pullman except 1 in Blue Mountains; Apr. 10-Aug. 18, mostly May, Aug.

L. (Coprophila) vagans (Haliday). Collected and reared from swine, cow, horse, and chicken dung (in that order of importance), collected also on mink dung; Apr. 10-Sept. 30, largest numbers June-Sept.; widely distributed.

L. (Elachiosoma) approximata Malloch. Collected occasionally from cow and horse dung and once from chicken manure; June 13-Sept. 6; all areas.

L. (Elachiosoma) ? n. sp. Collected on chicken and horse excrement; Pullman; June and July.

L. (Halidayini) spinnipennis (Haliday). Collected and reared from cow and horse dung (mostly reared from cow dung), found also on swine and chicken dung; Apr. 10-June 30 and Aug. 17-Sept. 30; areas I and IV.

L. (Leptocera) fontinalis (Fallén). Collected a few times on cow and horse dung; June and July; areas III and IV.

L. (Scotophilella) crassimana (Haliday). Collected and reared often from cow dung, once from sheep dung, collected also on horse (several times), swine, and dog dung; Apr. 14-June 30 and Sept. 5-Oct. 27; fairly widely distributed.

L. (Scotophilella) elegans Spuler. Collected and reared from cow, horse, and swine dung (mostly cow and horse), collected also on chicken dung; all from Pullman; Apr. 10-June 26 and Aug. 17-Sept. 6.

L. (Scotophilella) gracilipennis Spuler. One specimen from chicken manure; Pullman; June 26.

L. (Scotophilella) mirabilis (Collin). Collected a few times on cow dung; all Pullman; May and July.

L. (Scotophilella) rara Spuler. One specimen on horse dung; Blue Mountains; June 30.

L. (Trachypella) ? n. sp. Two adults from chicken dung; Pullman; June 26.

Scatophora carolinensis Robineau-Desvoidy. Commonly attracted to cow (73%) and horse dung, occasionally to swine dung; reared only from cow dung; mostly Apr., June, Sept., Oct.; widely distributed.

Sphaerocera pusilla Fallén. Collected and reared several times from cow and horse dung (prefers cow dung?), taken also on swine dung; Apr. 10-Sept. 30; fairly widely distributed.

S. subsultans (L.). Collected and reared from horse, cow, human, and sheep dung, also collected on swine and chicken dung, prefers horse and then cow dung; season, Apr. 14-Oct. 22 but rare in July, Aug.; wide geographical distribution.

Sphaerocera sp. One specimen reared from horse dung; Blue Mountains; June 30.

SCATOMYZIDAE

Scatophaga furcata (Say). Collected and reared from cow and swine dung and commonly attracted to horse dung; not very common in this area; Apr. 10-June 2 and Oct. 7-27; fairly widely distributed.

S. stercoraria (L.). Very common on and in cow pats in spring and fall, attracted also to horse (often), swine, and dog dung; reared also from swine dung;

Apr. 10-June 30 and Sept. 5-Oct. 27; widely distributed.

MUSCIDAE sensu lato

Calythea micropteryx (Thomas). Collected (often) and reared from cow dung, also fairly common on horse and swine dung, rare on sheep dung; June 8-Sept. 12; widely distributed.

Paregle cinerella (Fallén). Collected commonly from swine, cow, horse, and sheep dung; reared from swine (94%), sheep, cow, and horse dung; larvae typically coprophagous; Apr. 10-Sept. 30 (mostly Apr., June, Sept.); widely distributed.

Paregle radicum (L.). (H. C. Hockett.) Reared largely from dog (also human) dung, collected on swine, horse, cow, and mink dung, rare on dung of herbivores; May 19-Sept. 12 (chiefly summer); widely distributed.

Hylemya sp. (H. C. Hockett.) One adult on dog feces; Pullman; Aug. 17.

Pegomya dissecta (Meigen). (H. C. Hockett.) Four specimens on horse dung; Wawawai; June 22.

Schoenomyza dorsalis Loew. (M. T. James.) Rare in my collections; on cow dung; Pullman and Blue Mountains; June only.

Fannia canicularis (L.). Collected from mink (47%), chicken (40%), swine, cow, dog, and human dung; reared from chicken (92%), mink (6%), swine, and cow dung; May 19-Sept. 6 (mostly summer); areas I and IV; common in houses.

F. leucosticta (Meigen). (J. C. Chillcott.) Rare in this area; reared from mink and swine dung (once each); Pullman; Aug., Sept.

F. manicata (Meigen). (J. C. Chillcott.) Collected and reared from chicken dung; Pullman; May 19; abundance in area or degree of dung preference unknown.

Musca domestica L. Commonly attracted to cow and swine dung, less common on chicken, human, mink, and horse dung; reared only from cow and swine manure piles; all collections from Pullman; season, Aug. 17-Oct. 27, with few exceptions; common in houses in fall.

Orthellia caesarion (Meigen). Collected (common) and reared from cow dung, collected also from horse, sheep and swine dung; normally associated with fresh cow pats; Apr. 10-Sept. 5 (mostly summer); widely distributed.

Graphomya maculata (Scopoli). (Bruce Eldridge.) One specimen on mink dung; Pullman; Aug. 10.

Morellia micans Macquart. (Bruce Eldridge.) One specimen on swine dung; Pullman; Aug. 17.

Hebecnema umbratica (Meigen). (M. T. James.) Collected a few times from cow dung; June only; areas I and IV.

Hydrotaea armipes (Fallén). (M. T. James.) Reared from cow and horse dung; larvae predaceous on coprophags; May 19-Sept. 5; areas I, III, IV.

H. palaestrica (Meigen). (M. T. James.) One specimen on mink dung; Pullman; Aug. 10.

Muscina assimilis (Fallén). Reared from cow dung, collected also on dog and human excrement;

Apr. 21-Aug. 17; areas I and II; occasionally entered houses.

M. stabulans (Fallén). Collected and reared from poultry (chicken and turkey), swine, and cow dung, also collected on human, dog, and mink dung; larvae coprophagous (prefer poultry dung) as first 2 instars; facultatively zoophagous as third; season, May-Sept., mostly May, June; widely distributed; frequently found in houses.

Myiospila mediatubunda (F.). (Bruce Eldridge.) Collected on cow, sheep, horse, swine, and human dung, reared from cow and sheep dung; larvae obligate zoophagous; Apr. 17-Oct. 22 (all months); widely distributed.

Ophyra leucostoma (Wiedemann). Reared in large numbers from mink and chicken dung, occasionally in swine dung, a facultative carnivore; Pullman only; collected June, Aug., Sept.; breeds also in garbage.

Spilogona sp. (M. T. James.) Reared from cow and horse dung (mostly horse); June-July; areas I, III, IV.

Haematobia irritans (L.). Reared from cow pats; breeds only in fresh cow droppings; collected once on horse dung (accidental ?); Apr. 21-Sept. 3; areas I and II.

Stomoxys calcitrans (L.). (M. T. James.) Reared from cow and chicken dung (manure piles); rare in this area; Pullman only; June-Aug.

CALLIPHORIDAE

Eucalliphora lilaea (Walker). (M. T. James.) Attracted to human, swine, chicken, mink, dog, and horse dung (in small numbers); a common scavenger, particularly on carrion; June-Aug.; areas I and IV; entered dwellings.

Lucilia illustris (Meigen). (M. T. James.) Attracted to human excrement in moderate numbers, occasionally to swine and chicken dung; a common scavenger; Pullman; July-Sept.

Phaenicia sericata (Meigen). (M. T. James.) Reared in large numbers from mink dung, common on swine dung, attracted also to chicken, human, dog, turkey, horse, and cow dung; a very common scavenger; Apr. 28-Sept. 6, mostly summer; areas I and III; commonly entered houses.

Phormia regina (Meigen). (M. T. James.) Commonly attracted to human, mink, and swine dung, less commonly to cow, dog, horse, and poultry dung; May 19-Sept. 30, mainly summer months; areas I and III; entered houses.

Protophormia terraenovae (Robineau-Desvoidy). (M. T. James.) Reared once from cow dung, otherwise collected rarely on horse, swine, and chicken dung; all Pullman; collected May-Aug.

Bufolucilia thatuna (Shannon). (M. T. James.) One specimen each on swine and human excrement; Pullman; Aug.

Calliphora vicina Robineau-Desvoidy. (M. T. James.) One specimen each on chicken and cow dung; Pullman; May-July.

Pollenia rudis (F.). (M. T. James.) One adult on human excrement; Pullman; July 24.

SARCOPHAGIDAE

Taxigramma heteroneura (Meigen). (M. T. James.) Collected on human dung; Pullman; Aug.; probably of no dung-frequenting significance; may be parasitic under some circumstances.

Chaetoravinia latisetosa (Parker). (Verne Newhouse.) Reared on dog stools and collected (once) on human excrement; Pullman; July-Oct.

Ravinia acerba (Walker). (Verne Newhouse.) Reared from human and dog stools, collected also on swine dung; not common; Pullman; July-Aug.

R. lherminieri (Robineau-Desvoidy). (Verne Newhouse.) Collected and reared from cow, horse, swine, human, and sheep dung, usually in large numbers, attracted also to dog stools; a common scavenger and dung breeder; Apr. 28-Sept. 3, mostly July, Aug.; widely distributed.

R. planifrons (Aldrich). (Verne Newhouse.) Collected and reared from cow (several times) and sheep dung, attracted also to horse, swine, and dog dung; Apr. 21-Aug. 17, mostly summer; widely distributed.

R. querula (Walker). (Verne Newhouse.) Reared from cow (common) and horse dung, collected also on human (common), sheep, swine, and dog dung; similar to *lherminieri* in habits but less common; Apr. 28-Oct. 22, mostly June-Sept.; wide geographical distribution.

Sarcophaga bullata Parker. (Verne Newhouse.) Collected on human and swine dung; common scavenger; Pullman; July and Aug.

S. cooleyi Parker. (Verne Newhouse.) One specimen on human excrement; Pullman; July 24.

Blaesoxipha coloradensis (Aldrich). (Verne Newhouse.) One specimen on swine dung; Pullman; Aug. 17.

Helicobia rapax (Walker). (Verne Newhouse.) Collected on human (moderately large numbers), mink, and swine dung; Pullman; Aug.

Wohlfahrtia vigil opaca (Coquillett). (Verne Newhouse.) Collected on human and dog dung; Pullman; July-Aug.

TACHINIDAE

Hyalomipsis aldrichi (Townsend). (M. T. James.) One specimen on swine dung; Pullman; Sept. 6.

Lydella radialis Townsend. (M. T. James.) Three adults on cow dung; Pullman; July 30.

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Notes on the South American Species of *Vacusus*, with a New Species and Two New Synonyms (Coleoptera: Anthicidae)¹

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ABSTRACT

Vacusus martinsi is described from southern Brazil. New synonymy indicated is *V. holoxanthus* (Fairmaire and Germain, 1860) (= *V. jamaicanus* Werner, 1961), and *V. chilensis* (Solier, 1851) (= *Formicomus quadri-*

guttatus Philippi and Philippi, 1864). Additional distribution records are given for *V. apicicornis* (LaFerté), *holoxanthus* (Fairmaire and Germain), *parvus* (Pic), *vicinus* (LaFerté), and *vulgaris* Werner.

The purpose of this paper is to summarize much additional information on the species of *Vacusus* in South America that was not available at the time my previous paper was written (Werner 1961). That at least part of the species have extremely wide ranges was obvious before; more fit into this category now. In a few cases it seems certain that the type-locality is near the margin of the range and that the center of abundance is far from it. This is particularly true for the species described from the Buenos Aires region of Argentina, not only in *Vacusus* but in other genera of Anthicidae as well.

The additional records have been derived from my own collecting and from examination of specimens from many additional sources not accessible to me in 1961. The principal sources have been recorded under the following abbreviations: Alv., private collection of Moaçir Alvarenga, Rio de Janeiro, Brazil; B.A., Museo Nacional de Ciencias Naturales "Bernardino Rivadavia," Buenos Aires, Argentina; Bordón, private collection of Carlos Bordón, Caracas, Venezuela; D.Z., Departamento de Zoología, Ministerio da Agricultura, São Paulo, Brazil; La Plata, Museo de La Plata, La Plata, Argentina; and Lillo, Instituto Miguel Lillo, Tucumán, Argentina. I thank the curators or owners of these and the other collec-

tions cited for their generosity in making the material available for study, and for their hospitality when I visited them, often unannounced. Specimens collected by me are listed with F.W. as the collector.

The preferred habitat of the major part of the South American species seems to be dying or dead leaves, which probably support some fungus mycelium in all cases. In a dry region or season, this habitat may include such things as piles of grass cuttings, but in the damper areas and seasons the leaves hanging on recently killed small trees and shrubs are the preferred habitat. This is true for most other anthicid genera as well. Relatively few of the species fly to light at night, but those that do may be taken in large numbers.

Vacusus apicicornis (LaFerté) (Fig. 1)

Anthicus apicicornis LaFerté, 1848, 220-1.
Vacusus apicicornis: Werner, 1961, 804-5, Fig. 6 (see for synonymy).

A wide range in South America was indicated for this species by LaFerté's specimens, from the Province of Cumaná (now in Venezuela) and "Brazil." A rather discontinuous distribution is indicated in my 1961 paper: northeastern Argentina and the adjacent region of Brazil, and Trinidad and Colombia, with no records in between. A much more continuous distribution is indicated by the following records. Few

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