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A SURVEY OF THE FLY-PRODUCING SUBSTRATES
IN AN URBAN AREA

Thesis for the Degree of M. S.
MICHIGAN STATE UNIVERSITY
Malcolm McReynolds
1956

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A SURVEY OF THE FLY-PRODUCING
SUBSTRATES IN AN URBAN AREA

by

Malcolm McReynolds

AN ABSTRACT

Submitted in partial fulfillment of the requirements
for the degree of Master of Science
in Michigan State University

Department of Entomology
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1956

Approved

Roy Whitson

THESIS



MALCOLM McREYNOLDS

ABSTRACT

This study is a limited survey of fly-producing substrates in five socioeconomic areas in and near Lansing, Michigan, and of the species of flies produced. Four collections of adult flies were also made to obtain an estimate of the population.

The five socioeconomic areas arbitrarily chosen were "Upper Residential", "Middle Residential", "Lower Residential", "Business", and "River". With one exception, five blocks from each category were each surveyed twice during July and August, 1955. Samples of all substrates that contained larvae were collected and returned to the laboratory. Of the 198 positive samples collected, flies were reared and identified from 166.

Garbage in cans or in trash was found to be responsible for the majority of positive samples, with dog manure next in the numbers of positive substrate samples. "Green" sewage sludge represented the largest volume of a substrate in a semi-permanent location.

It seemed evident that the higher degree of sanitation, the fewer the opportunities for flies to find satisfactory breeding areas. This generally followed the socioeconomic levels. Exceptions were samples of dog manure that were prevalent in all the residential areas, and grass clippings which were more common in the High Residential locations.

Garbage appeared to represent the major substrate in the areas surveyed. Because of regular collection much of the garbage within cans had little opportunity to support larvae to maturity. Garbage cans in isolated locations, garbage thrown in tubs, barrels, etc., and an occasionally skipped route appeared to be more important as fly producers, especially in the Lower Residential areas.

Although trash areas did not usually appear to be responsible for large numbers of flies, a large number of positive samples were taken from garbage mixed with trash, particularly in the Business and Lower Residential areas.

The house fly, Musca domestica Linn., was more often taken from trash areas than from other locations and was rarely recovered from garbage in covered containers that were collected regularly. Late in the season "green" sewage sludge was found to be producing house flies in large quantities.

Phaenicia sericata (Meigen) appeared to be the predominant species breeding in garbage cans.

One collection of adult flies indicated a high population of blow flies. House flies entered the traps in extremely small numbers in comparison to the numbers observed during the survey.

The substrate survey was intended to be qualitative. However, with the possible exception of "green" sewage

MALCOLM McREYNOLDS

ABSTRACT

sludge, the amounts of semi-permanent substrates recorded seem to be less than would be necessary to produce the numbers of blow flies trapped or the house flies observed.

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CHAPTER I

INTRODUCTION

An increasing resistance to DDT and some related insecticides by certain of the filth-feeding flies has renewed interest in studying the basic methods of control. One of the first considerations in initiating a fly control program is to become familiar with the sources responsible for producing these pests.

West (1951) and Herms (1953) list many places where larvae of the filth-feeding flies have been found. Both emphasize the importance of sanitational control. Because the conditions that are responsible for the major sources of the fly population in a community may vary, a survey of the local habitats is often desirable.

This study is a limited survey of an urban community containing residential, business, and industrial areas. The main objectives were to determine the substrates that were supporting fly breeding in the areas selected and to identify the species involved. An added incentive to work on this problem was the author's specific interest in pest control service.

CHAPTER II

HISTORICAL REVIEW

Many workers, including Hewitt (1910), Howard (1911), and Hall (1947), have listed numerous substrates where the filth-feeding flies have been observed to develop.

Faine (1912) made a garbage-can survey of a tenement district in Boston. He found house flies and blow flies breeding in garbage cans, under garbage cans, and in garbage "houses". Blow flies and house flies comprised over 95 percent of the larvae collected.

Scudder (1949) suggested that flies are perhaps second only to man himself in the contaminative transfer of human disease. In the same paper he emphasized the need for cultural methods of controlling flies. He pointed out that sanitation and the general elimination of media suitable for fly breeding and feeding must be practiced even when using a chemical having the effectiveness of DDT when it was first released.

Quarterman, Baker, and Jensen (1949), in their study of fly-producing areas in the vicinity of Savannah, Georgia, found the city dump first in importance and the garbage can second. Sarcophaga spp. were the major group that was found breeding in dog feces.

Lindsay and McBrayer (1950) believed that fly breeding in garbage cans and at a dump area was virtually eliminated by accelerated collection and a sanitary land fill. They stated that larvae of Phaenicia spp. were capable of migrating from the garbage can to nearby soil when a twice-weekly collection was practiced. A three-times-per-week collection of garbage was practiced in their study in Georgia.

Haines (1953) made larval surveys of two Georgia towns of approximately 15,000 population. His results indicated that Musca domestica Linn. were breeding extensively in animal pen litter and to a lesser extent in garbage and fruits.

Schoof, Mail, and Savage (1954) illustrated the versatility of M. domestica by recovering this species from eleven of thirteen substrates. They found Sarcophaga spp. to be the primary species recovered from dog stools. In their studies of three cities they found Phaenicia spp. to occur more often in contained garbage, while M. domestica was more prevalent in scattered garbage.

Siverly and Schoof (1955), in a series of three papers based on larval surveys of Phoenix, Arizona, found M. domestica to infest nineteen of twenty-one substrates. Sarcophaga spp. were next in order, infesting thirteen of twenty-one substrates. Phaenicia sericata (Meigen) was

fourth, infesting ten of the twenty-one substrates. Sarcophaga spp. were recovered more frequently from excrement and Phaenicia spp. were taken more often from garbage. Chicken, horse, cow, and pig excrements gave high production potentials, whereas contained and scattered garbage were of less importance. In relating block environment to fly production, they observed that blocks with inadequate garbage collection, blocks with animal pens, and dump blocks had from two to thirty-seven times the potential for fly production that was present in other residential blocks where collection was adequate. They recommended fly breeding substrate surveys as a basic approach to the fly problem.

One of the methods used in determining the populations of adult flies has been the bait trap. Power and Melnick (1945) conducted surveys of New Haven, Connecticut, and found P. sericata represented 80 to 90 percent of all flies trapped. They had difficulty in luring M. domestica into the traps.

In comparing the numbers of flies collected in the vicinity of four garbage dumps in Michigan and New York, Savage and Schoof (1955) found P. sericata to represent 42 to 70 percent of the total adult collections.

In additional surveys conducted in the northeast portions of the U. S., Schoof and Savage (1955) found P.

sericata and Phormia spp. to be the predominant species collected. "Grid surveys" indicated M. domestica was more abundant than was illustrated by the collections. Phaenicia pallescens (Shannon) was not trapped at Grand Haven, Michigan, during 1949 and 1950, although it was present in 1948 at Muskegon. These two cities are approximately nine miles apart.

Recent workers have recorded new data on the dispersal habits of certain flies. Yates, Lindquist, and Butts (1952) recovered M. domestica at distances up to four miles from the release point. Their results also indicated that Phormia regina (Meigen) and Phaenicia spp. had the ability to disseminate to over four miles in forty-eight hours from the time of release.

Schoof, Siverly, and Jensen (1952) reported that M. domestica dispersed rapidly in numbers to attractive areas within one mile from the point of release. Flies were collected at stations five miles from the point of release, although the numbers beyond the two-mile range were not large. They pointed out that more flies were trapped at locations containing fly attractants than at random stations.

Additional confirmation on the ability of P. regina to disseminate considerable distances was made by Schoof and Mail (1953), when they recovered specimens ten miles from the release point.

The problem of overcoming the selectiveness introduced when bait traps are used in sampling an adult population of flies has been approached by standardizing a method for counting flies found on natural attractants. Scudder (1947) introduced a technique for sampling fly populations by the use of a standard wooden grill placed over natural attractants.

Later, in comparing the grill counts of adult flies with visual counts, Welch and Schoof (1953) found the visual fly density estimates by the same inspector to compare with the grill method by a 69 to 89 percent accuracy.

CHAPTER III

AREAS AND METHODS

A. Areas Involved

General Description. With three exceptions, all the blocks studied were within the city limits of Lansing, Michigan. The estimated population of Lansing on January 1, 1955, was 100,500 as listed by Hoffman (1955). Two rivers, the Grand and the Red Cedar, enter the city from the west and east respectively, join in the south part of town, and exit from the northwest corner.

Five socioeconomic areas were subjectively selected from within the city. The Ingham County Health Department aided in choosing these categories, which were based on the number of commercial establishments, general sanitation, and the proximity of the Grand River. The categories selected were "Upper Residential", "Middle Residential", "Lower Residential", "Business", and "River". In 1955, twice-weekly garbage collection began on June 20 in all residential areas within the city. The usual twice-weekly garbage collections were normally started on July 15 and conducted until October 15. Above-average temperatures in June were responsible for the earlier beginning date in 1955.



Upper Residential. These areas were characterized by having a high degree of sanitation, a large number of garbage disposal units and by being definitely separated from commercial enterprises.

Middle Residential. Sanitation in this grouping varied from good to fair. Most of the residents utilized covered cans for garbage disposal. Pets, such as dogs, were common; however, zoning regulations practically eliminated other livestock. As expected, this category seemed to be the grouping most frequently found within the city.

Lower Residential. Sanitation fluctuated from fair to poor. Garbage was more often scattered or placed in barrels, tubs, and other open containers. Dogs were probably more numerous than in the other four areas. In several instances chickens were housed in the back yard.

Business. Commercial establishments predominated with occasional living quarters present, usually on the second floor. Garbage collection in these areas usually consisted of making collections two or more times a week, depending upon the volume of garbage. Trash was removed by private contractors.

River. Each block designated as a river area consistently bordered the Grand River. Commercial buildings and residential housing were also present. The city garbage disposal plant and a horse barn were incidental to this category.

B. Substrate Survey

The survey was conducted during the months of July and August, 1955. Weather information was obtained from the Daily Temperature, Degree Day and Precipitation Normals (1953) and the Local Climatological Data (1955), both published by the U. S. Department of Commerce, Weather Bureau. Average temperatures for the months of June, July, and August were 0.3, 6.7, and 6.4 degrees F. above the respective thirty-year averages. Precipitation records for these months also indicated a respective increase of 0.44, 1.71, and 1.40 inches over the thirty-year averages.

The survey began July 4 and continued through September 2. One block from each of the five categories was surveyed each week. Because the Low Residential block for the first week was determined as unsuitable for this survey, a total of twenty-four different blocks were surveyed during the first five weeks. The survey was then repeated over the same areas during the second five-week period.

Permission to conduct the survey was requested by contacting the occupants when practicable. It required from one-half to three hours to survey a block.

Notations of the type of substrate, approximate amount, probable source, location, survey date, and specific remarks were made in a field book. Because of the anticipated frequent occurrence of garbage containers, dog

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manure, and piled grass clippings or weeds, a notation was made whenever one of these substrates was found not to contain fly larvae as well as for the positive samples. Empty garbage cans and small or scattered amounts of grass clippings were not included.

C. Species-Substrate-Area Relationship

The principle equipment used to collect the substrates consisted of a garden trowel, a large long-handled spoon, and a sharpened circular spoon (seven-eighths inch in diameter). The latter was particularly useful for collecting various sizes of larvae from different areas of each substrate occurrence. This particular procedure was used in an attempt to obtain a better sample of the species present.

A sample of each positive substrate, together with larvae, was placed in a one-fourth pint glass bottle in which a one-half inch layer of sand had been previously added to provide a place for pupation. All bottles were marked according to the corresponding fieldbook entry. Substrates that contained no larvae or pupae were examined but no samples were collected.

A total of 198 positive samples were returned to the laboratory. Sixteen of these samples contained three or fewer larvae and pupae. Adult flies were reared from 166

samples. Rearing was performed in a constant-temperature room set for 80 degrees F. At one time the temperature of the rearing room rose above 95 degrees F., which may have been responsible for the loss of some larvae.

Twice-weekly inspections were made to remove adult flies and to maintain the moisture content of the media. Although most of the flies emerged within one week after they were collected, the samples were examined regularly for an additional month. All reared specimens were killed in a calcium cyanide bottle, pinned, and labeled.

Three labels were placed on each specimen. The first gave locality, date, and collector's name. The shape of the second label indicated the socioeconomic category, and its color represented the substrate. On the third label was the sample number that was placed on all specimens except those Sarcophaga spp. reared from dog manure.

Identification was completed during the fall and winter months. The Calliphoridae and most of the Muscidae were identified by the author and Mr. William Drew identified the anthomyiids.

D. Survey of Adult Flies

Size of population. In order to obtain a rough comparison of the fly populations present during the survey period, four collections for adult flies were conducted

from August 11 through August 31 in those blocks chosen for the substrate survey. As one block in the Lower Residential classification had previously been rejected, only three collections were made in this category.

Five bait-type traps measuring 18 x 13 x 11½ inches were used. A band of half-inch hardware screen was placed around the base of each trap to help prevent loss of bait.

After several unsuccessful attempts to make baits from those substrates found within the areas, a standard bait of fresh raw pork liver, sugar syrup, and milk was utilized throughout the nineteen collections. All traps were set on a twenty-four hour basis. Fresh bait was used with each setting. For comparative purposes, the volume of flies caught in each area and at each setting was recorded. To facilitate handling, the flies were chilled prior to making the volume measurement.

Species of flies. A sample of one hundred flies was saved from each collection. All were saved if less than one hundred were collected. Although the flies for the sample were picked at random, no attempt was made to determine the percentage of each species. These flies were identified as indicated in a previous section. Of the two labels placed on the specimens, one indicated the geographical location, date, and collector; the other indicated the socioeconomic category.

CHAPTER IV

PRESENTATION AND DISCUSSION OF RESULTS

A. Areas Involved

This survey is a limited study of selected locations and should not be considered as necessarily representative of other cities of similar size or, for that matter, as a complete cross section of the fly problem within the area. It is believed that the survey results gave a fair picture of the locations studied. However, some other areas that are excluded from this study may have a considerable influence on the problem. Dump areas, located mainly outside of the city limits, park and zoo areas, and rural communities adjacent to the city are locations that should be considered in the total problem.

B. Substrate Survey

Summary of all areas. All the substrates encountered were classified under the following twelve categories that are listed roughly in order of their importance by numbers of positive samples and the amount of substrate.

1. Garbage in containers
2. Dog manure
3. Under contained garbage
4. Garbage in trash

5. Partly digested sewage sludge
6. Scattered garbage
7. Soil soaked with dishwater
8. Garbage-soaked sawdust
9. Grass and grass clippings
10. Dead animals
11. Chicken manure
12. Miscellaneous

Table I combines these into six main categories. The caption, "Under contained garbage", refers to those larvae removed from under or around garbage cans. This classification was made in an attempt to determine if larvae were escaping from garbage cans prior to the routine collection. It does not mean that garbage was under the garbage can. Garbage, in various locations, produced the largest number of positive samples. Dog manure was second in the number of positive samples. Figure 1 gives the relative percentages of these positive samples.

Records of those positive substrates that appeared to have some permanence are summarized in Table II. Although the approximate amount of each substrate was recorded, the periodic collection of garbage and trash made some of the figures unreliable as a basis for estimating a fly potential.

TABLE I

TOTAL NUMBER OF POSITIVE SUBSTRATES COLLECTED FROM
VARIOUS LOCATIONS IN LANSING, MICHIGAN,
DURING JULY AND AUGUST, 1955

Socioeconomic Areas	Substrate							Total
	Garbage		Garbage in Trash	Scattered Garbage	Dog Manure	Grass Clippings	Miscel- laneous	
	In Cans	Under Cans*						
High Resi- dential	6	5	1	-	13	4	2	31
Middle Resi- dential	23	28	2	-	11	1	-	65
Low Resi- dential	8	1	10	5	10	-	5	39**
Business	19	6	15	1	-	1	1	43
River	6	3	4	-	4	-	3	20
Total	62	43	32	6	38	6	11	198

*Represents location of maggots, not the substrate.

**Two fewer blocks surveyed.

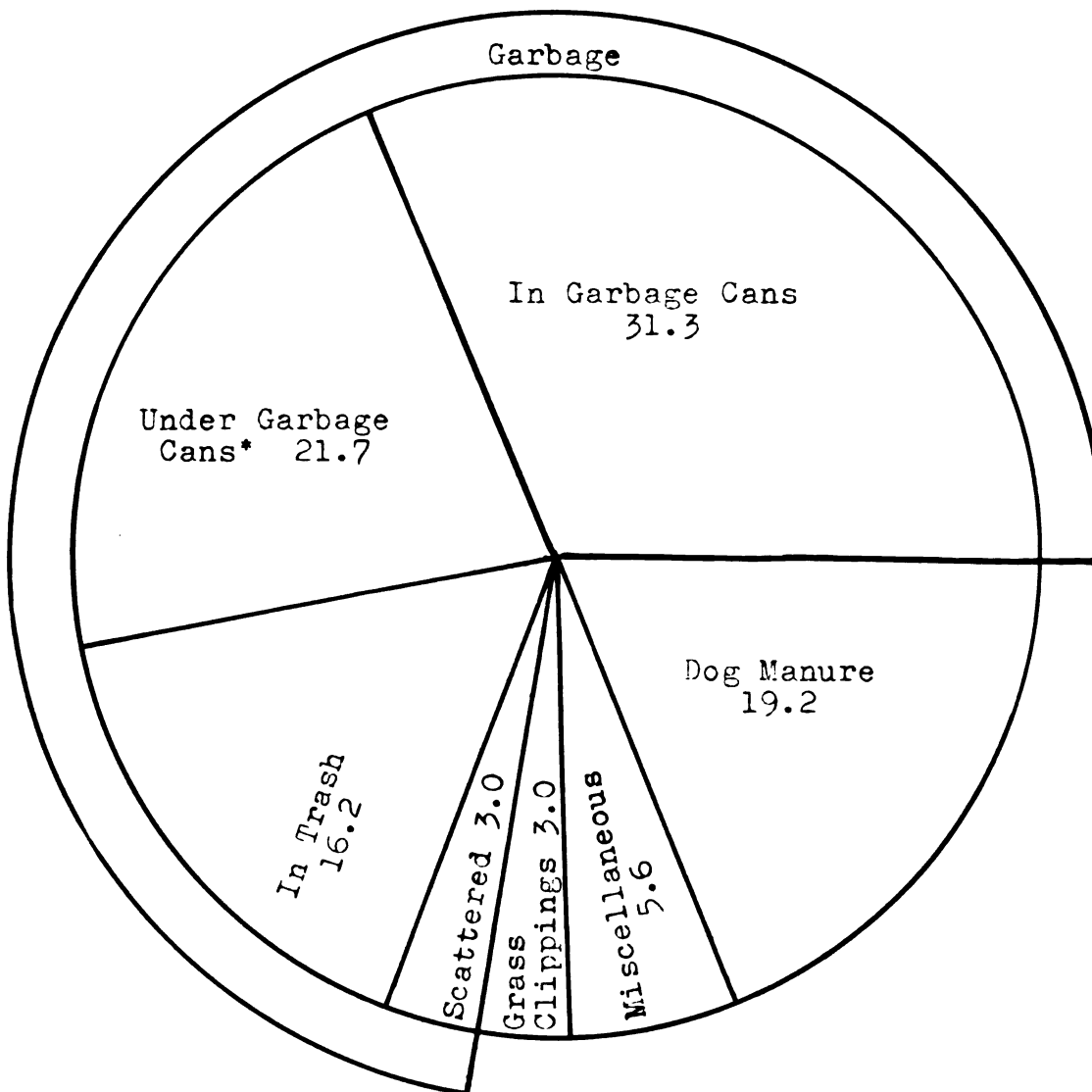


FIGURE 1

RELATIVE PERCENTAGES OF VARIOUS TYPES OF POSITIVE
FLY-PRODUCING SUBSTRATES. LANSING,
MICHIGAN, 1955

*"Under Garbage Cans" refers to the location of the
larvae, not the substrate.

TABLE II

ESTIMATED QUANTITIES (IN CUBIC FEET) OF VARIOUS SEMI-
 PERMANENT BREEDING SUBSTRATES OBSERVED IN THE SOCIOECONOMIC
 CATEGORIES SURVEYED IN LANSING, MICHIGAN,
 DURING JULY AND AUGUST, 1955

Sample Number	Location	Substrate	Estimated Amount
C97	Lower Residential	Garbage in trash	.2
212	Lower Residential	Garbage	2.7
214	Lower Residential	Scattered garbage	.2
215	Lower Residential	Dish water soil	2.7
25	River	Garbage	.2
C54	River	Garbage	.5
C82	River	Sawdust	8.0
203	River	Sewage sludge	190.0
C41	Business	Garbage	.2
C65	Business	Garbage	.1
C64	Business	Sawdust	.1
67	High Residential	Grass clippings	3.7
C67	High Residential	Grass clippings	5.0

High Residential. In comparison with the other residential categories in Tables I and II, this grouping had fewer fly-producing areas. Garbage disposal units were also more common. Dog manure was responsible for the largest number of positive samples. As shown in Table III, the number of samples of dog manure that did not contain fly larvae was also highest in this category. Although there were only four times when grass clippings yielded fly larvae, the fact that there were more piles of grass clippings in this category provided a slightly higher potential for this substrate.

Middle Residential. Garbage in cans was the major source of positive substrates. Routine garbage disposal was designed to destroy most of these infestations before they began to migrate from the cans. The number of positive samples collected from under or around the sites of garbage cans indicated some larvae were escaping before collection. Ten of the twenty-eight samples collected from these locations were taken from one block having a break in the routine collections. The remainder were scattered throughout the other blocks surveyed. Three ways of explaining their presence are:

1. They escaped from the cans prior to routine collection.

TABLE III

COMPARISON OF INCIDENCE OF POSITIVE AND NEGATIVE SAMPLES
OF THREE FLY-BREEDING SUBSTRATES SURVEYED AT LANSING,
MICHIGAN, DURING JULY AND AUGUST, 1955

Socioeconomic Areas	Substrate					
	Garbage in Containers		Dog Manure		Grass Clippings*	
	Pos.	Neg.	Pos.	Neg.	Pos.	Neg.
High Residential	6	39	13	23	4	8
Middle Residential	23	100	11	15	1	2
Low Residential**	8	28	10	21	-	-
Business	19	46	-	2	1	1
River	6	10	4	3	-	3
Total	62	223	38	64	6	14

*Includes only the piled grass and weeds that seemed capable of supporting fly larvae.

**Two fewer blocks were surveyed in this category.

2. Each block was occasionally missed during regular collections.
3. Larvae escaped from the cans before twice-weekly collections were begun.

Which of these occurred is beyond the scope of this study; however, observations indicate that the first is the least probable. As there was no constant pattern of larvae found under the garbage cans, it appeared that twice-weekly collections were adequate when all garbage was collected on this schedule.

Dog manure yielded almost as many positive samples as in the High Residential area, although the total number of occurrences was fewer.

Low Residential. The number of samples collected is misleading as there were two fewer blocks surveyed in this category than in the other four. The number of residences per block was also fewer and more samples were obtained from trash areas and scattered garbage. Garbage and trash were more often mixed and occasionally garbage was buried or fed to chickens. Although the number of samples was smaller, they frequently represented larger amounts of substrate. In a few instances garbage was found piled in locations where it would probably remain until decomposed. As shown in Table III the total number of samples of dog manure found was almost as high as the number found in the

High Residential category. Besides the two fewer blocks surveyed in the Low Residential category, tall weeds and trash areas made it more difficult to locate stools.

Business. Garbage in cans and near trash areas represented the majority of the samples in this group. Although some contained garbage from the commercial buildings was producing maggots, the waste material from living units in these blocks was responsible for breeding more flies. An accumulation of food materials, in the bottom of or under trash containers and around piles of trash, accounted for the relatively large number of samples collected from near commercial districts.

River. Although an occasional dead fish was found floating in the river or in the shallow waters at its edge, sixteen of the nineteen positive samples were taken from the usual waste products of the residential and commercial areas located in those blocks bordering the river.

A horse barn, incidental to this area, was examined twice during the survey. Numerous old pupal cases were present in one location where manure was loaded into a truck. However, this area was too dry to support larval development at the time it was surveyed. It was observed that the stable was attracting large numbers of flies, perhaps largely house flies.

Numerous larvae were recovered from the "green" sewage sludge during the second survey of the river area

adjacent to the garbage disposal plant. Although it is not known how long sludge was handled in this manner, the volume on September 2 was large, as shown in Table II.

C. Species-Substrate-Area Relationship

Substrates containing one species. Table IV compares the frequency of occurrence of the major species in the principal substrates. P. sericata was present in the samples collected more often than any other species. Six of the eight substrates listed in Table IV were infested by P. sericata.

Sarcophaga spp. were next in the total number of occurrences and were limited almost entirely to dog manure. Schoof, Mail, and Savage (1954) also found Sarcophaga spp. to be the main species found in dog stools. As a sample was usually from one stool, this may not have represented a large volume of substrate.

Both M. domestica and P. sericata seemed capable of developing in a relatively large number of substrates. M. domestica was in six of the eight substrates plus one miscellaneous sample. In comparison with the total numbers of occurrences of each, M. domestica seemed more versatile.

Garbage, in various locations, was utilized for larval development by all of the twelve species shown in Table II. Under the conditions found in the survey P. sericata

TABLE IV

FREQUENCY OF OCCURRENCE OF MAJOR SPECIES OF FLIES IN THE BREEDING SUBSTRATES
COLLECTED IN LANSING, MICHIGAN, IN JULY AND AUGUST, 1955

Species	Substrate						Total
	Garbage In Under Cans Cans*	Trash and Trash Areas	Scattered Garbage	Manure		Miscel- laneous	
				Dog	Chicken		
Calliphoridae							
<u>Lucilia illustris</u> (Meigen)	--	1	1	--	--	--	2
<u>Phaenicia sericata</u> (Meigen)	47	23	3	2	1	2	115
<u>Phormia regina</u> (Meigen)	5	1	--	--	--	--	6
<u>Protophormia</u> <u>terrae-novae</u> (R.D.)	3	--	--	--	--	--	3
Muscidae							
<u>Musca domestica</u> Linn.	4	9	2	--	--	2	22
<u>Muscina assimilis</u> (Fallén)	1	2	1	--	--	1	5
<u>Muscina stabulans</u> (Fallén)	1	2	--	--	--	1	4
<u>Ophyra leucostoma</u> (Weid.)	2	1	--	--	1	1	5
<u>Stomoxys calcitrans</u> (Linn.)	--	--	1	--	--	1	2
Sarcophagidae							
<u>Sarcophaga spp.</u>	--	--	--	31	--	--	31
Total	63	38	8	33	2	6	195

*Indicates location of larvae, not substrate.

appeared to be well-adapted for utilizing contained garbage as a breeding medium. M. domestica was found more often in garbage mixed with trash than as the primary infestation of garbage in covered containers. Of the four M. domestica infestations found in contained garbage, one can was without a lid, one was in garbage kept in an open tub, one was from a garbage can containing indications that it had not been emptied for several weeks, and the fourth was one specimen reared from material taken from a filled can. These results generally agree with those of Haines (1953) and Schoof, Mail and Savage (1954).

While infestations within garbage cans often contained large numbers of larvae, there were seldom more than twenty larvae and pupae found under any one can. It appeared that garbage collected regularly according to the twice-a-week schedule was not responsible for the production of large number of blow flies. Long holidays (July 4), routes missed because of inclement weather, and isolated garbage cans appeared to be important factors in an increased population of blow flies. Isolated garbage cans were those that were not collected twice-weekly because of their location. Second story porches and the lower cost residential dwellings within the River or Lower Residential categories were locations where garbage cans were found that had not been collected regularly. As indicated by

Table IV there were twenty-two samples containing M. domestica. However, except for the "green" sewage sludge these did not seem to explain satisfactorily the large numbers of house-flies that were observed during the survey.

Table V gives the minor species collected and the respective substrates.

Samples containing two or more species. As shown in Table VI, thirty-three samples or approximately twenty percent of the total positive samples contained two or more species. Trash areas produced more samples containing more than one species than were found in contained garbage, even though twice as many samples were taken from garbage cans. It seems that trash areas were responsible for producing more M. domestica than most of the other habitats.

Samples number 202 and number 214 are interesting in that they each contained six species. Although there was no evidence of additional food mixed with the grass and sand of sample number 202, food juices could have been present.

D. Survey of Adult Flies

Size of population. Although observation indicated large numbers of flies were present, faulty equipment gave poor results on August 11 and cool weather greatly reduced fly activity on August 23 and 31. Temperatures on these

TABLE V
MINOR SPECIES RECOVERED FROM VARIOUS FLY-BREEDING
SUBSTRATES COLLECTED DURING A SURVEY
OF LANSING, MICHIGAN, IN 1955

Species	Substrates
Calliphoridae	
<u>Phaenicia caeruleiviridis</u> (Macq.)	Trash
Muscidae	
<u>Anthomyia</u> spp.	Dog Manure
<u>Fannia</u> spp.	Dog Manure, Trash
<u>Hydrotaea</u> spp.	Dog Manure, Trash
<u>Hylemya cilicrura</u> (Rond.)	Dog Manure, Trash
<u>Hylemya</u> spp.	Dog Manure
<u>Ophyra aenescens</u> (Wied.)	Garbage
Stratiomyiidae	
Undetermined sp.	Trash, Apple
Trupaneidae	
Undetermined sp.	Trash, Garbage

TABLE VI

SAMPLES OF FLY-BREEDING SUBSTRATES COLLECTED IN LANSING, MICHIGAN, IN 1955,
WHICH CONTAINED TWO OR MORE SPECIES

Substrate and Sample No.	Species		
	<u>Phaenicia sericata</u> (Meigen)	<u>Musca domestica</u> Linn.	Others
Contained Garbage			
9	x		<u>Phormia regina</u> (Meigen)
17	x		<u>Phormia regina</u> (Meigen)
29	x		<u>Phormia regina</u> (Meigen), <u>Erotophormia terrae-novae</u> (R.D.)
42			<u>Trupaneidae</u> undet.
91	x		<u>Erotophormia terrae-novae</u> (R.D.)
C19	x	x	<u>Ophyra leucostoma</u> (Wied.)
C48	x	x	<u>Ophyra leucostoma</u> (Wied.)
C65		x	<u>Ophyra leucostoma</u> (Wied.), <u>Trupaneidae</u> undet.
C97		x	<u>Phormia regina</u> (Meigen), <u>Ophyra aenescens</u> (Wied.)
218		x	<u>Anthomyia</u> spp.
Under			
Contained			
Garbage			
C31	x		<u>Lucilia illustris</u> (Meigen)
Trash			
Areas			
21	x		<u>Phormia regina</u> (Meigen)
C47	x	x	<u>Ophyra leucostoma</u> (Wied.)
C64		x	<u>Trupaneidae</u> undet.
200	x	x	<u>Muscina assimilis</u> (Fallén), <u>Muscina stabulans</u> (Fallén)
201	x	x	<u>Muscina assimilis</u> (Fallén), <u>Phaenicia caeruleviridis</u> (Macq.)

TABLE VI (continued)

Substrate and Sample No.	Species		
	<u>Phaenicia sericata</u> (Meigen)	<u>Musca domestica</u> Linn.	Others
Trash Areas (cont.)			
205			<u>Hydrotea</u> sp., Stratiomyidae undet.
211	x	x	
213	x	x	
215	x	x	<u>Hylemya cilicrura</u> (Rond.)
216	x	x	
217	x		<u>Anthomyia</u> sp.
Dog Manure			
13	x		<u>Sarcophaga</u> spp.
68			<u>Hylemya cilicrura</u> (Rond.), <u>Sarcophaga</u> sp., <u>Hylemya</u> sp.
084	x		<u>Sarcophaga</u> spp.
204			<u>Fannia</u> sp., <u>Sarcophaga</u> sp.
207			<u>Fannia</u> sp., <u>Sarcophaga</u> sp.
208			<u>Hylemya</u> sp., <u>Sarcophaga</u> sp.
209			<u>Fannia</u> sp., <u>Sarcophaga</u> sp.
Scattered Garbage			
C99	x	x	<u>Lucilia illustris</u> (Meigen), <u>Muscina assimilis</u> (Fallén),
214	x	x	<u>M. stabulans</u> (Fallén), <u>Stomoxys calcitrans</u> (Linn.)

TABLE VI (continued)

Substrate and Sample No.	Species		
	<u>Phaenicia</u> <u>sericata</u> (Meigen)	<u>Musca</u> <u>domestica</u> Linn.	Others
Grass Clippings 202		x	<u>Fannia</u> sp., <u>Hylemya</u> <u>cilicrura</u> (Rond.), <u>Muscina</u> <u>assimilis</u> (Fallén), <u>Stomoxys</u> <u>calcitrans</u> (Linn.)
Dead Animals C43	x	x	

last two dates were respectively 8.4 and 12.4 degrees F. below the average for August, 1955. The large numbers obtained on August 17, as shown in Table VII, seemed to be more representative of the actual situation.

Species of flies. No attempt was made to determine the percent of each species. Table VIII does show that P. sericata was present at each collection in all areas. There were only two collections in which P. regina was not represented. Table IX lists the minor species trapped and the respective collection dates.

TABLE VII
VOLUME OF ADULT FLIES (CUBIC CENTIMETERS) RECOVERED
FROM TRAPS IN FIVE SOCIOECONOMIC AREAS IN
LANSING, MICHIGAN, IN AUGUST, 1955

Date Collected	Residential			Business	River
	High	Middle	Low		
Aug. 11	--*	220	--**	--*	20
Aug. 17	440	650	1300	650	200
Aug. 23	50	15	120	70	110
Aug. 31	30	240	130	--*	50

*Less than 10 cc.

**No collection.

TABLE VIII

DATES IN AUGUST, 1955, WHEN MAJOR SPECIES OF ADULT FLIES WERE TRAPPED
IN VARIOUS SOCIOECONOMIC AREAS IN LANSING, MICHIGAN

Species	Socioeconomic Location and Date																		
	Residential																		
	High			Middle			Low			Business			River						
	11	17	23	31	11	17	23	31	17	23	31	11	18	23	31	11	17	23	31
Calliphoridae																			
<u>Bufolucilia silvarium</u> (Meigen)	x		x	x		x		x		x				x				x	x
<u>Lucilia illustris</u> (Meigen)	x	x	x		x		x	x		x	x					x	x	x	x
<u>Phaenicia caeruleiviridis</u> (Macq.)		x	x	x		x		x		x						x			x
<u>Phaenicia sericata</u> (Meigen)	x	x	x	x	x	x	x	x		x	x	x	x	x	x	x	x	x	x
<u>Phormia regina</u> (Meigen)		x	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Muscidae																			
<u>Musca domestica</u> Linn.																x	x	x	x

TABLE IX

DATES IN AUGUST, 1955, THAT MINOR SPECIES OF FLIES
WERE COLLECTED AS ADULTS IN LANSING, MICHIGAN

Species	Dates Collected
Calliphoridae	
<u>Calliphora vicina</u> R. D.	23, 31
<u>Calliphora vomitoria</u> (Linn.)	11, 17
<u>Protophormia terrae-novae</u> (R.D.)	17, 31
<u>Cynomyopsis cadaverina</u> (R.D.)	17
Muscidae	
<u>Bigotomyia</u> spp.	11
<u>Hylemya cilicrura</u> (Rond.)	23, 31
<u>Hylemya</u> spp.	23
<u>Muscina assimilis</u> (Fallén)	23, 31
<u>Muscina stabulans</u> (Fallén)	23
<u>Myospila</u> spp.	23
<u>Ophyra leucostoma</u> (Wied.)	17, 23, 31

CHAPTER V

SUMMARY AND CONCLUSIONS

The basic purpose of the survey was to obtain information on the fly-breeding potentials of the residential, commercial, and river locations that were selected. Because of the ability of flies to move from one area to another any conclusions must take adjacent areas into consideration.

It seems evident that the higher the degree of sanitation, the fewer the opportunities for flies to find satisfactory breeding areas. This generally followed the socioeconomic levels. Exceptions were samples of dog manure that were prevalent in all the residential areas, and grass clippings which were more common in the High Residential locations.

Garbage, in some form, appeared to represent the major substrate in the areas surveyed. Because of regular garbage collection much of the garbage within garbage cans had little opportunity to support fly larvae to maturity. A possible exception is the period prior to twice-weekly garbage pickup. Otherwise, garbage cans that were in isolated locations, garbage thrown in tubs, barrels, etc., and an occasionally skipped route appeared to be more important as fly producers. Isolated garbage cans were found near

low cost housing in Business, Low Residential and River areas. The large number of samples taken from garbage in all areas shows the possible importance of such a suitable breeding medium if adequate garbage disposal were not practiced.

The number of larvae found under garbage cans indicated that some were escaping before pickup. This was sporadic as was shown by the large proportion of samples taken from one block where it was known that a regular collection had been skipped.

Poorer sanitational practices in the Lower Residential areas were responsible for garbage being placed in locations where it probably remained for more than one garbage collection. Since it was inadequately collected, the accumulation was capable of supporting a sizable number of larvae.

Although trash areas did not usually appear to be producing flies in volume, a comparatively large number of positive samples were taken from garbage mixed with trash. These were more common in the Business and Lower Residential areas and practically absent in the other residential locations.

The house fly, M. domestica, was more often taken from trash areas than from other locations and was rarely recovered from garbage in covered containers that were col-

lected regularly. Late in the season "green" sewage sludge was found to be producing house flies in large quantities.

P. sericata appeared to be the predominant species breeding in the garbage can. It would seem that the total number of samples taken from garbage cans was low enough to indicate the possibility of practical control of flies within garbage cans when twice-weekly garbage collection is practiced.

One collection of adult flies indicated a high population of flies. M. domestica entered the traps in extremely small numbers in comparison to the numbers observed during the survey. The lower volumes of adult flies from two collections correlate with the lower temperatures on the collection dates.

The results of the substrate survey were intended to be qualitative. However, with the possible exception of the "green" sewage sludge, the amounts of substrates recorded seem to be less than what would be expected necessary to produce the numbers of blow flies trapped or the house flies observed.

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