ECOLOGICAL OBSERVATIONS OF SOME COMMON FILTH FLIES IMPORTANT TO SANITATION FOUND AT TWO U.S. ARMY POSTS

by

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INTRODUCTION

History of the Study

Each U. S. Army post housing troops the size of a division or larger, is authorized to have a post entomologist who is an officer of the Medical Service Corps. One of the primary duties of this officer is to make frequent fly surveys of the post and recommend control measures to the post engineer, who is responsible for the actual control work.

Effective fly control to include good environmental sanitary practices, depends to a large extent on the knowledge of fly ecology, which includes their habits, abundance, and species variation. An insect survey of a military post is necessary to get this vital information.

The writer, who is an active member of the U. S. Army's Medical Service Corps, chose this study for a thesis because it is closely associated with his normal Army duties.

Locations of the Study

These observational studies of filth flies were made at Camp Stewart, Georgia during the summer and fall of 1952, and Fort Dix, New Jersey during the summer of 1953. The locations are important to this study as one Post is located in warm climate of the deep South, while the other Post is located in temperate climate of New Jersey.

Primary Objectives of the Study

The primary objectives of this study were: (1) To determine the fly abundance, (2) to determine the species composition of flies of the region, (3) to note the location, extent, kind, and prevalence of fly breeding places

and propagating media of the areas concerned, and (4) to compare the attractiveness of various fly attractants.

Purposes for Which the Study May Serve

It was thought that the results of this study may serve as follows: (1) they might provide data to guide future fly control operations in Army camps and show how to measure the effectiveness of those operations (if repeated) after control measures are employed; (2) they might show seasonal trends in relative abundance of the different species of flies for future epidemiological and entomological studies; (3) they might show the importance of knowing the genus or species of flies present since some insecticides are more effective against certain species than others, as the flight ranges of different species vary, thus affecting the limits of control zones; (4) the species of flies encountered sometimes give an indication of the fly breeding medium of a given area; (5) they may provide data to indicate where the principal adult fly densities and potential breeding areas are located, the prevalent species concerned, and the magnitude of the problem.

General Post Environmental Sanitary Conditions

Since several factors of fly ecology, particularly their habits, abundance, and breeding media depend on local sanitation, it is necessary to point out some local sanitary conditions at both Army Posts. Sanitary conditions at each post were rather typical for their respective areas. Both employed common or similiar basic sanitary practices in that each Post disposed of garbage and rubbish at nearby sanitary fills; garbage racks and cans were provided for retaining wastes at all eating establishments; garbage was disposed of daily; both maintained trailer camps, which are a constant

sanitary problem.

At Camp Stewart, Georgia, cattle grazed through out the entire Post. Uncorralled swine grazed in some areas of the Post. Both cattle and swine attracted flies by their mere presence and droppings. A few areas immediately surrounding the garbage racks displayed careless garbage disposal. Promiscuous fly breeding occurred in the small town of Hinesville, Georgia, which is only two miles from Camp Stewart. This distance is within flight range of flies. Fly breeding occurred in commercial wastes, insanitary privies, manure from domestic animals, and improper refuse handling. Certain floor drainage of few buildings used as troop mess halls allowed fly breeding. A hog farm three miles from Camp Stewart provided excellent breeding media.

At Fort Dix, New Jersey, there were no cattle or swine grazing on the Post, but indiscriminate droppings of domestic animals provided some fly breeding media around residential areas. Improper floor drainage of some buildings used as troop mess halls allowed some fly breeding. A dairy barn located three miles from Fort Dix provided excellent fly breeding media. Careless garbage disposal was displayed in some areas immediately surrounding garbage racks. The adjoining village of Wrightstown, N. J. provided a few minor fly breeding sources such as commercial wastes from cafeterias, beer halls, and night clubs which were numerous.

Both Posts operated permanent sewage disposal plants on the Post proper which attracted very few flies, but a temporary system of human excrement disposal was used in training and bivouac areas.

REVIEW OF LITERATURE

Certain species of flies are closely associated with improper sanitation, especially accumulations of filth, and for that reason are commonly known as "filth flies". "The rate of enteric infections or so-called filth borne diseases is parallel to the abundance of flies and poor sanitary practices in a given vicinity" (Pamphlet, Dept. of Preventive Medicine, Ft. Sam Houston, Texas. November 1950). "Filth flies" include those belonging to families Muscidae, Calliphoridae (blow flies), Sarcophagidae (flesh flies) and Anthomyiidae.

To show the importance of filth flies to Army personnel, the following information was extracted from a pamphlet, Dept. of Preventive Medicine, Ft. Sam Houston, Texas, the U. S. Army Medical Center, November 1950: During August 1942 in the State of Georgia, the Army had 16,000 soldiers in infantry training at a bivouac site (temporary out door living area). Within a few days of each other, 1557 men came down with bacillary dysentery, all due to a single organism (Shigella dysenteria Boydi). The bivouac site had poorly sanitated straddle trench latrines. Filth flies caught about these latrines and in the mess halls were positive for this organism.

During the U. S. Civil War, there were 186,000 deaths of soldiers from diseases, almost all of which were due to filth-borne diseases. In the Spanish-American War, total United States forces were 107,000 men. Of these, 3,000 died of filth-borne diseases while only 345 died as battle casualties. This tragedy drew such attention that a group of scientists under the direction of Dr. L. O. Howard, Chief of what is now Bureau of Entomology and Plant Quarantine, Washington, D. C. after extensive experiments, announced early in 1900 that house flies Musca domestica played an important role in the trans-

mission of enteric or filth-borne diseases among the troops.

Flies have been suspected of being active agents in the spread of human illnesses by authors and scientists since early times. Homer referred to flies and disease in the Odessey. These poems are possibly the oldest of any written record pertaining to flies and diseases. Aristotle in ancient Greece, and Pliny of the old Roman Empire both wrote extensively upon the subject of flies and their relationship to sanitation and men. The fourth plaque of Moses, Exodus VIII, 20-32, pertains to flies.

Flies are prolific breeders, and for that reason great numbers are encountered. Howard (1911a) stated that allowing an average of ten days for completion of each generation in the summer, a single gravid female fly laying 120 eggs on April 15, could theoretically, be responsible for the emergence of 5,598,720,000,000 adult flies on or before September 10. Devoe (1945) gives 325,923,200,000,000 as the possible number of summer descendants from a mated pair of flies.

Filth flies always constitute a problem to the health of a community. Watt and Lindsay (1941) showed clearly that, in Hidalgo County, Texas, the extent of infections, disease and deaths caused by the organisms of bacillary dysentery was materially reduced by fly control. Pathogenic organisms have been recovered from naturally infested flies of various species by Francis et al.(1948), Herms (1939), and Melnick et al.(1947). Extensive work by Bishopp (1915) and James (1947) indicated there were several species of filth flies causing myiasis in man and animals. Melnick et al.(1947) found the virus causing poliomyelitis present in flies. Scudder (1947) introduced a new technique for sampling the density of house fly populations. West (1951) stated that Musca domestica very seldom feeds in dead animals or rotted meats, but prefer practically any other material offering larval food, moisture,

and warmth. (Also, certain bacterial flora must be present in this media for larval maturation). It is encountered more often than all of the filth flies. Herms (1950, p. 329) stated that "the common house fly is by accident of habit and structure, an important and dangerous disease transmitting insect. In habit, the house fly is revoltingly filthy, feeding indiscriminately on excrement, vomit, and sputum, and is, on the other hand, especially attracted to the daintiest food of Man".

EQUIPMENT AND MATERIAL

An all-metal fly trap shaped as a "cone" was constructed as described by Coffey and Schoof (1949). The trap was durable, easy to transport and handle, and proved satisfactory for collecting flies. This trap is shown in Fig. 1.

The operating principle of this trap is simple. Flies are induced to enter the trap by means of an attractant, and after entering the trap, fly upward toward the light. Once they pass through the small opening at the top of the cone and into the cage, little chance is afforded for their escape.

All fly counts were recorded on improvised fly grill cards, and later transferred to a master chart as shown in results of this study. Grill cards are small cards where numerical figures can be easily inserted after such information as species of flies, date, hour of day, temperature, humidity, etc. A regular insect sweeping net was used to collect flies found in great abundance. These collections were used only to determine the species composition.

The publication, "Flies that Cause Myiasis in Man" and "Blow Flies of North America" by Maurice T. James and D. G. Hall respectively were used as keys to identify the flies collected.

Since success of fly trapping depended upon getting the flies to enter traps, the selection of attractants was important. The following attractants were used in this survey: fish heads, spoiled ham, decayed fruits, malt, dog feces, cow manure, human feces, chicken entrails, molasses and vinegar, and mixed garbage. The latter was used to attract all genera of flies because certain attractants were more attractive to one genus than to others.

Except for malt, all of the above attractants were commonly found on Army posts in garbage cans, sanitary dumps or fills, temporary field latrines, or were scattered throughout the post area or in a nearby town.

METHODS

The Survey

To accomplish the objectives of this study, a fly survey of Camp Stewart at Hinesville, Georgia, and Fort Dix in New Jersey, was undertaken. For practical purposes of this study, Hinesville is considered a part of Camp Stewart. This survey was conducted in accordance with procedures outlined by Coffey and Schoof (1949). Principle emphasis was placed on quantitative and qualitative studies of adult fly population densities, location, extent, kind, and prevalence of fly breeding media.

Types of Survey Stations Used

A casual observation was made to determine which unit areas at both Camp Stewart and Fort Dix and which city blocks in Hinesville exhibited the greatest fly breeding potential as determined by adult fly densities and/or fly breeding conditions. These areas and blocks were designated Fixed Block Stations. Occasionally a block selected as the fixed block station showed

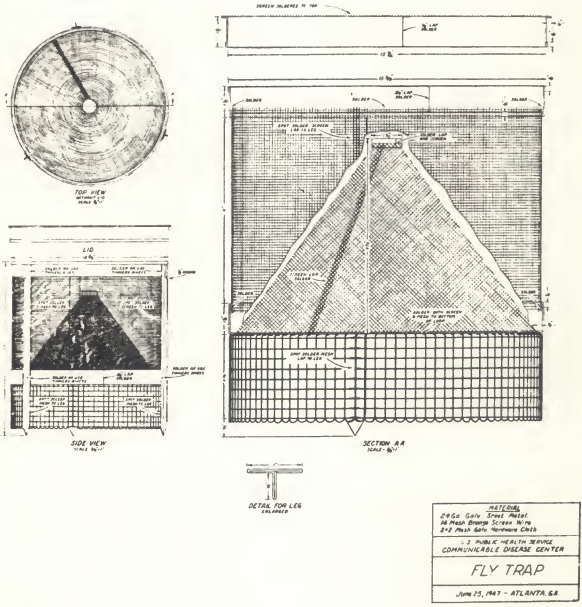

Fig. 1. Fly trap.

densities repeatedly lower than those of adjacent blocks or areas, thus the station was changed to another location.

Random block or area stations were set up on a systematic, randomized basis with different blocks or areas being studied each successive day for a period of one week per month until all units were covered. Figure 2, shows a typical arrangement of these stations as used for this study.

Several places exhibited an extremely high fly breeding potential as compared to other remaining blocks or areas. These are referred to as Dump Block Stations, and are not included in the general fly counts for this survey. They are treated separately because they were not typical of the town or Army Posts.

Collection Technique Used

Fly traps baited with various attractants were distributed to the various Fixed Block Stations twice each week and kept there for twenty four hour periods. Collected flies were killed by placing the cage portion of the trap in a tight fitting container and introducing chloroform. At Camp Stewart, Georgia, these collections were made twice each week from August 15, to September 30, 1952 and one week of each month during October and November. Collections were made at Fort Dix, New Jersey, three weeks during the months of July and of August, 1953. The operation of traps required about one man-hour per day for each trap. This included securing the bait, selection of a suitable site, transporting the traps, setting the traps, and killing the flies.

The traps were distributed to Random Block Stations daily for one week of each month (Fig.2). Fly collections were made at approximately 8:30 A.M., 12:30 P.M. and 6:30 P.M. on successive days. The operation of these traps

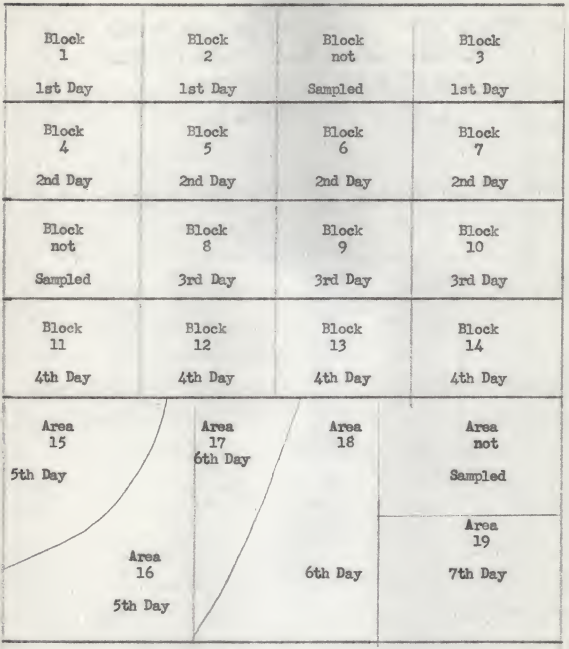

Fig. 2. Diagrammatic sketch of random block and area stations of an army post showing block and areas by numbers and the day collections were made.

required two man-hours per day for each trap.

A common insect net was used to collect flies at the Dump Block Stations. These collections were made twice per month. It was not necessary to use the fly traps here as flies literally covered the entire areas or stations, making it easy to collect with a net as many flies as were needed for study.

SURVEY FINDINGS AND DISCUSSION

The location of all stations and the ecological data which were observed are presented station by station. Generic composition of all flies collected from each station is shown in Tables 1 and 2.

The species of flies that were commonly encountered at Camp Stewart, Georgia and Fort Dix, New Jersey were as follows:

I. Calliphoridae
   Calliroga-macellaria and americana (only at Camp Stewart)
   Calliphora-vomitora and viridescens (only at Fort Dix)
   Ophyra-leucostoma and aenescens
   Phaenicia-pallescens, caeruleiviridis and sericata
   Phormia-regina

II. Sarcophagidae
   Sarcophaga-hoemorrhoidalis and helicis

III. Muscidae
   Fannia-canicularis and scalaris
   Musca-domestica
   Stomoxys-calcitrans

IV. Others
   Include Muscina assimilis (Camp Stewart), Muscina stabulans (Fort Dix), pomace flies, and few other flies whose identity was not certain.

Fixed Block Stations

Camp Stewart, Georgia

Camp Stewart's Old Waste Disposal Area. This was an old pond formerly used for disposal of human and miscellaneous wastes. It was located approximately one hundred yards from the Post swimming pool and about one mile from the troops billeting area. Floculation of sludge on the banks of this pond offered a good place for breeding and attracting flies. A considerable number of fly larvae were found in these accumulations. This pond was exposed to sun light throughout the day, and the number of adult flies collected varied at morning, noon, and early evening. The number of adults collected at 4:00 to 7:00 P.M. and 8:00 to 10:00 A.M. were double the number collected at noon. At one spot where there was a marked collection of sludge located on the pond's bank just above the water level, a few flies were noted to complete the cycle from egg to adult in six days. The average temperature during this time was 90-102 degrees Fahrenheit. In another collection of sludge located near the pond's banks, but within reach of the water level, a number of dead larvae were found probably the results of drowning or excess amount of moisture.

Adult Callitroga spp. and Sarcophaga spp. were the two most numerous species present (Table 1). An average of 58.0 and 17.1 flies respectively per trap day, were trapped in this area.

Camp Stewart's House Trailer Park. The adult fly population was high at this station because of the excellent breeding places. A leaking sewage pipe had polluted the soil of an area approximately 8 by 30 yards. Fly breeding in the soil was prolific. Numerous pupa were found in the dry soil where they had crawled from moist polluted soil just prior to pupation.

This area was exposed to the sun only about two hours each day. Isolated piles of dog dung were scattered throughout the trailer park's area, and while this media attracted adult Musca domestica and a few Sarcophagids, no fly breeding occurred. Several fly larvae were found in small individual piles of baby feces just outside trailer houses. It is believed that breeding in this medium was due to the milk diet of babies. Improperly stored garbage from the kitchen left on the ground around garbage cans exhibited fly breeding and attracted numerous Musca and Sarcophagids.

Adult Musca domestica and Callitroga spp. were the two most numerous species present (Table 1). An average of 125.6 and 16.0 flies respectively, per trap-day were trapped in this area.

Camp Stewart's Headquarters Mess Hall. Fly breeding was found under this building although no larval food could be seen by casual observation. The fact was, that grease, dirt, and tiny scraps of food accumulated on the kitchen floor were drained daily through to the ground when the kitchen was scrubbed with water. This was sufficient to support larval growth. The kitchen floor was made of ordinary lumber. Other mess halls with concrete kitchen floors and a planned drainage system permitted no fly breeding. A garbage rack and cans for garbage collection were located approximately ten yards from the mess hall. The ground area around this rack was covered with large size gravel about two inches deep to prevent a muddy and sloppy appearance resulting from rains or the washing of garbage cans. Small particles of garbage and greasy dish water spilled on this gravel, sifted its way to the bottom layer of gravel, then to the soil. When removing the layer of gravel, prolific fly breeding was found. Here, moisture, food, and protection from the hot sun were offered.

Adult Musca domestica and Callitroga spp. were the two most numerous

species present (Table 1). An average of 28.4 and 6.2 flies respectively per trap-day were trapped in this area.

Camp Stewart's "D" Rifle Range. This area was a large open place where cattle grazed throughout the summer and fall. Numbers of individual cow dung piles were scattered throughout the area. It was observed that during the months of August and September, these piles of cow dung attracted some adult flies in search of food, but no breeding was found, probably the result of the hot sun drying out the dung within 20-48 hours, and the high temperature recorded at 85-102 degrees. However, during the months of October and November when the temperature had dropped to 70-85 degrees, a few piles of dung produced some larvae. A thermometer placed in one day old cow dung registered an average of 95 degrees Farhenheit, ten degrees higher than outside temperature.

Adult Callitroga spp. and Sarcophaga spp. were the two most numerous species present (Table 1). An average of 18.0 and 7.0 flies respectively per trap-day were trapped in this area.

Camp Stewart's Air Strip and Bivouac Area. In this area, several carcasses of dead birds, opossum and rabbits were found containing numerous fly larvae. Only flies of the families Calliphoridae and Sarcophagidae were breeding in abundance. There were no Musca domestica. Fly larvae was found also in decayed human feces of an old, poorly covered deep pit latrine, formerly used by soldiers in bivouac.

Adult Callitroga spp. and Sarcophaga spp. were the two most numerous species present (Table 1). An average of 33.3 and 14.8 flies respectively per trap-day were trapped in this area.

Camp Stewart's N.C.O. Club. Numerous discarded beer cans piled in the rear of the N.C.O. building attracted large numbers of flies. A small amount

of beer left in the cans and/or spilled on the ground offered excellent fly food. Beer being a product of a fermenting process, it was more appetizing and preferred by flies. It was interesting to find only adult Musca domestica feeding here. Under this pile of beer cans, some larvae were found about one inch depth in the soil. Since flies only oviposit where larval food is present, the soil polluted with beer must have served as larval food.

Adult Musca domestica and Callitroga spp. were the two most numerous species present (Table 1). An average of 45.5 and 4.5 flies respectively per trap-day were trapped in this area.

Camp Stewart's Civilian Cafeteria. No breeding was found here, but garbage cans without tops located in rear of the building attracted an abundance of flies. Garbage containing "left over" foods, meat scraps, vegetables, oils etc. offered food and attractable odors for flies. Breeding did not occur as garbage was disposed of each day.

Adult Musca domestica and Callitroga spp. were the two most numerous species present (Table 1). An average of 32.1 and 5.5 flies respectively per trap-day were trapped in this area.

In Rear of the Town's Court House Building. In this location fly breeding existed in several piles of partially decayed industrial waste. Frequent rains supplied sufficient moisture for fly breeding.

Adult Musca domestica and Callitroga spp. respectively were the two most numerous species present in this area (Table 1).

Hinesville General Merchandise and Grocery Store. At the rear of this store, flies were abundant and breeding was fairly prolific. Several piles of discarded food were found to include cereals, bread and spoiled meats mixed with sawdust and wood shavings. These piles of fly breeding media

were located in constant sunlight. Several tests on several days with a hand thermometer registered 90-110 degrees Fahrenheit at a depth of 4 inches. The heat and sunlight showed no evidence of affecting larval growth. Musca domestica was the only species breeding.

Adult Musca domestica and Callitroga spp.respectively were the two most numerous species present in this area (Table 1).

Town's Bakery Shop. Behind this shop were open garbage cans filled with mixtures of bakery dough, flour, and various discarded sweets. Some of these material had been spilled on the ground around the garbage can for a good period of time and had polluted the soil. By probing a couple of inches into the damp soil, fly larvae were found. Some fly pupa were found in the dry soil.

Adult Musca domestica and Callitroga spp. respectively were the two most numerous species present in this area (Table 1).

Hinesville's North Side Negro Residential Section. This area was a substandard residential area. Housing and sanitation was poor. Several out-door privies were in use. Some houses had no garbage cans for disposal of waste. It was interesting to note that no fly breeding was found except in several out-door privies, yet flies were fairly abundant throughout the area. These conditions offered better attractability than breeding potential. Casual observation showed the flies to be primarily Musca domestica. Fly trap collections were also primarily Musca domestica.

Callitroga spp. ranked second in importance and Sarcophaga spp. was a close third (Table 1).

Main Street at Highway Leading to Camp Stewart. No breeding existed here, but an above average number of flies were attracted to horse manure droppings scattered at this intersection.

Adult Musca domestica was the only species collected in abundance.

Table 1. Generic breakdown showing the weekly trap-day averages of fixed block stations for all flies trapped from August 15, 1952 (1st trap-week) to November 30, 1952 (8th trap-week) at Camp Stewart, Georgia (including Hinesville).

Weeks	M. domestica	Phaenicia spp.	Sarcophaga spp.	Phormia spp.	Callitroga spp.	Fannia spp.	Ophyra	Other
			Camp Stewart's Old Waste Disposal Area					
1 (Aug.)	7	6	63	3	158	0	4	1
2	5	3	4	1	45	1	2	0
3 (Sept.)	6	14	56	12	196	0	6	0
4	11	0	1	0	1	0	0	1
5	3	0	2	2	6	0	0	0
6	11	5	6	10	37	0	1	0
7 (Oct.)	2	2	3	2	17	0	0	0
8 (Nov.)	0	0	0	0	0	0	0	0
			Camp Stewart's House Trailer Park					
1 (Aug.)	501	0	25	3	30	3	1	6
2	220	2	8	1	10	0	0	1
3 (Sept.)	92	7	33	2	62	0	3	1
4	128	0	3	0	1	2	0	1
5	28	1	4	1	10	0	1	0
6	18	5	5	2	10	0	0	1
7 (Oct.)	13	0	1	1	3	0	0	1
8 (Nov.)	2	0	0	0	0	0	0	0
			Camp Stewart's Headquarters Mess Hall					
1 (Aug.)	43	1	4	4	5	2	0	0
2	21	4	2	1	4	3	0	0
3 (Sept.)	31	3	3	1	9	0	1	1
4	48	1	1	0	1	1	0	0

Table 1. (con't.)

Weeks	M. domestica	Phaenicia spp.	Sarcophaga spp.	Phormia spp.	Callitroga spp.	Fannia spp.	Ophyra	Other
5	28	1	4	0	5	0	0	0
6	28	3	7	1	24	0	0	0
7 (Oct.)	21	0	1	1	0	0	1	0
8 (Nov.)	5	0	0	0	0	0	0	0
			Camp Stewart's "D" Range					
1 (Aug.)	15	10	25	3	47	4	3	2
2	7	4	5	3	25	0	1	0
3 (Sept.)	7	14	14	12	50	0	2	0
4	12	0	2	0	0	0	0	0
5	4	1	2	0	2	0	0	0
6	8	2	6	0	13	0	1	0
7 (Oct.)	1	0	1	7	4	0	1	0
8 (Nov.)	0	0	0	0	1	0	0	0
			Camp Stewart's Air Strip Bivouac Area					
1 (Aug.)	6	15	50	10	104	0	10	0
2	6	7	7	8	45	0	2	0
3 (Sept.)	6	18	42	3	44	0	12	0
4	10	1	2	0	7	0	0	0
5	3	0	5	1	8	0	1	0
6	10	2	10	2	52	0	1	0
7 (Oct.)	2	0	1	1	4	0	1	0
8 (Nov.)	0	0	0	0	0	0	0	0
			Camp Stewart's N.C.O. Club					
1 (Aug.)	116	0	6	0	5	1	0	2
2	38	0	2	3	3	1	0	1
3 (Sept.)	35	1	4	2	17	0	1	1
4	75	2	2	0	1	0	0	3
5	36	3	2	0	1	0	0	0

Table 1 (con't.)

Weeks	M. domestica	Phaenicia spp.	Sarcophaga spp.	Phormia spp.	Callitroga spp.	Fannia spp.	Ophyra	Other
6	45	2	7	1	5	0	1	0
7 (Oct.)	13	1	0	0	2	0	0	0
8 (Nov.)	4	0	0	0	0	0	0	0
			Camp Stewart's Civilian Cafeteria					
1 (Aug.)	46	4	4	3	4	1	0	5
2	35	3	1	2	4	1	0	0
3 (Sept.)	37	3	3	2	7	0	0	0
4	58	0	2	1	1	1	0	2
5	32	0	4	0	5	0	0	0
6	31	5	10	2	23	0	1	0
7 (Oct.)	11	0	0	0	0	0	0	0
8 (Nov.)	6	0	0	0	0	0	0	0
			Hinesville, Behind Court House Building					
1 (Aug.)	169	5	5	1	42	1	1	2
2	52	0	3	1	12	0	0	0
3 (Sept.)	36	5	7	1	46	0	0	1
4	73	0	0	0	2	0	0	1
5	15	0	2	0	0	1	0	0
6	27	1	0	0	7	0	0	0
7 (Oct.)	6	0	3	1	0	0	0	0
8 (Nov.)	0	0	0	0	0	0	0	0
			Hinesville's General Merchandise and Grocery Store					
1 (Aug.)	463	0	10	2	48	0	1	3
2	86	1	1	1	15	1	0	2
3 (Sept.)	49	10	8	4	35	0	2	0
4	100	0	4	0	1	2	0	3
5	50	1	0	0	2	0	0	0
6	45	3	2	0	11	0	0	0
7 (Oct.)	3	0	0	0	1	0	0	0
8 (Nov.)	0	0	0	0	0	0	0	0

Table 1. (concl.)

Weeks	M. domestica	Phaenicia spp.	Sarcophaga spp.	Phormia spp.	Calliphora spp.	Fannia spp.	Ophyra	Other
Hinesville's Bakery Shop								
1 (Aug.)	550	2	11	2	92	1	3	7
2	128	2	7	2	16	1	0	0
3 (Sept.)	69	3	12	2	71	0	0	0
4	135	0	3	0	0	2	0	1
5	53	1	4	0	1	0	0	2
6	47	1	7	1	15	0	1	1
7 (Oct.)	27	0	0	0	3	0	0	0
8 (Nov.)	10	0	0	0	0	0	0	0
Hinesville North Side Sub Standard Negro Housing Area								
1 (Aug.)	225	5	20	3	62	10	6	5
2	112	2	9	2	15	0	2	2
3 (Sept.)	111	7	18	5	73	1	0	2
4	216	0	3	0	1	1	0	4
5	80	0	6	0	4	1	0	3
6	98	5	5	4	63	0	2	1
7 (Oct.)	10	0	3	0	7	1	0	0
8 (Nov.)	5	0	0	0	0	0	0	0
Hinesville, Ct. Main Street and Camp Stewart Hi-Way								
1 (Aug.)	202	0	0	1	1	10	0	21
2	30	0	1	0	1	0	0	0
3 (Sept.)	16	1	1	1	4	0	0	0
4	32	0	1	0	0	1	0	0
5	12	0	0	0	1	1	0	0
6	18	0	4	1	10	0	1	0
7 (Oct.)	3	0	0	0	1	0	0	0
8 (Nov.)	0	0	0	0	0	0	0	0

Fort Dix, New Jersey

Mess Halls of Co. "C", Co. "I", Co. "G" and Co. "K". Ecological observations at all four of these company mess halls were practically the same. Little Musca domestica breeding was found under the gravel around the outdoor garbage racks and under the mess hall buildings when floors were improperly drained. There were no breeding of Calliphorids in the immediate vicinity. Phaenicia spp. and Musca domestica were the two most numerous species encountered. An average of 113.0 and 49.8 flies respectively per trap-day were trapped in these areas.

Fort Dix's House Trailer Park. Fly breeding was observed in scattered droppings of dog feces. Numerous adults were seen throughout the park. Musca domestica was the most numerous species encountered, followed by Phaenicia spp. An average of 118.0 and 52.0 flies respectively per trap-day were trapped in this area.

Fort Dix's Regimental Training Site. This area is located on the post, but about 3 miles from the troops billeting area. Numerous wild animals were present in the forest. Calliphorid breeding was observed in a dead carcass. Outdoor privy type latrines were used here, and attracted many flies. Breeding was present. Phaenicia spp. and Musca domestica were the two most numerous species encountered. An average of 163.6 and 31.5 flies respectively per trap-day were trapped in this area.

Table 2 shows the average trap-day collections from the six fixed stations at Fort Dix, New Jersey.

Table 2. Generic breakdown showing the weekly trap-day averages of fixed stations for all flies trapped from July 1, 1953 (1st trap-week) to August 30, 1953 (6th trap-week) at Fort Dix, New Jersey.

Weeks	M. domestica	Phaenicia spp.	Sarcophaga spp.	Calliphora spp.	Ophyra spp.	Others
			Mess Hall of Co. "C" 47th Infantry Regiment			
1 (July)	42	60	1	1	0	0
2	36	46	0	0	0	1
3	61	151	3	4	2	1
4 (Aug.)	75	204	5	5	3	2
5	88	246	7	5	3	4
6	102	250	16	10	5	6
			Mess Hall of Co. "I" 47th Infantry Regiment			
1 (July)	25	55	0	0	0	1
2	27	37	0	0	0	1
3	46	125	2	2	0	2
4 (Aug.)	53	137	3	3	1	0
5	87	192	4	3	3	3
6	89	226	7	5	5	4
			Mess Hall of Co. "G" 39th Infantry Regiment			
1 (July)	11	46	1	0	0	0
2	17	49	0	0	0	0
3	18	115	0	0	0	4
4 (Aug.)	42	161	7	1	0	5
5	46	181	6	3	0	7
6	65	225	11	5	2	7

Table 2. (concl.)

Weeks	M. domestica	Phaenicia spp.	Sarcophaga spp.	Calliphora spp.	Ophyra spp.	Others
			Mess Hall of Co. "K" 364th Infantry Regiment			
1 (July)	7	11	1	0	0	0
2	40	12	0	0	0	1
3	50	28	0	0	0	0
4 (Aug.)	60	45	1	2	2	5
5	55	42	2	1	3	0
6	54	60	3	1	4	6
			Fort Dix's House Trailer Park			
1 (July)	75	46	4	0	0	1
2	51	51	5	0	0	4
3	95	37	5	1	0	1
4 (Aug.)	110	36	4	1	0	6
5	152	51	7	2	1	2
6	225	92	21	2	2	4
			Regimental Training Site			
1 (July)	20	65	5	2	2	0
2	9	47	1	0	1	0
3	30	125	12	5	4	0
4 (Aug.)	32	203	17	4	3	0
5	46	247	21	6	4	2
6	52	295	26	6	6	5

Random Block Stations

These stations were chosen at random all over the town of Hinesville and Camp Stewart, Georgia, and Fort Dix, New Jersey. The fly collections helped to evaluate the overall population density.

Camp Stewart, Georgia.

As shown in Table 3, Musca domestica was the most numerous species collected followed in order by Callitroga spp. and Sarcophaga spp.

The average trap day collection of Musca domestica (22.0) at Hinesville was higher than that at Camp Stewart (15.7). This could be attributed to better sanitary practices at Camp Stewart. The average trap day collections of Callitroga spp. (5.2) at Hinesville was also higher than Camp Stewart's (4.1).

Only Musca domestica was taken at Camp Stewart and Hinesville during the last trap week in November. All of the other species were no longer attracted to the traps. The highest population counts of a species were in August and September as shown in Table 3.

No outstanding breeding places were found in the immediate vicinity of Random Stations in contrast to Fixed Stations, indicating that the Random Stations counts were probably not greatly influenced by prolific breeding places nearby and therefore probably represented the overall fly density population as indicated by bait traps.

Fort Dix, New Jersey.

As shown in Table 4, Phaenicia spp. was the most numerous species collected, followed in order by Musca domestica and Sarcophaga spp.

The peak trap collection in August exceeded that in July. The average

Table 3. Generic breakdown showing the monthly trap-day averages of all combined random block stations from 15 August to 30 November, 1952 at Camp Stewart, Georgia. Collections were made 7 successive days of each month.

Month	*M. domestica*	*Phaenicia*	*Sarcophaga*	*Phormia* spp.	*Callitroga* spp.	*Fannia* spp.	*Ophyra* spp.	Others
				Camp Stewart, Ga.				
August	25	4	2	3	6	1	1	2
September	31	5	1	3	8	0	1	3
October	5	1	1	1	2	0	0	0
November	2	0	0	0	0	0	0	0
				Hinesville, Ga.				
August	35	4	3	1	9	1	1	3
September	28	3	1	0	10	0	1	4
October	20	4	1	0	2	0	0	0
November	5	0	0	0	0	0	0	0

Table 4. Generic breakdown showing the monthly trap-day average collections of all random stations from July 1, 1953 to August 31, 1953 at Fort Dix, New Jersey. Collections were made 7 successive days of each month.

Month	*M. domestica*	*Phaenicia* spp.	*Sarcophaga* spp.	*Calliphora* spp.	*Ophyra* spp.	Others
July	14	85	3	2	1	1
August	21	142	5	3	1	3

trap-day collections of Phaenicia spp. and other Calliphorids from random stations were nearly the same as those collected from fixed stations, in contrast to Musca domestica which was less than 50 per cent of those collected from fixed stations. There were no breeding places of Calliphorids within the immediate vicinity of either random or fixed stations. Musca domestica was found breeding in fixed stations only. These observations suggest that Calliphords will travel far from their breeding places if stimulated by the proper attractant.

Dump Block Stations

Hinesville's Open Garbage-Rubbish Dump. This dump is located approximately two miles from Hinesville and one and one-half miles from the cantonment area of Camp Stewart. Flies literally covered the entire dump. An average of about 12 flies per square inch were counted. Representative adult flies of all genera listed in Table 1, except Stomoxys, were present. Prolific breeding existed. All types of media for breeding and feeding were present.

The town dumps all its refuse at this place, and it is burned in a heap. Much remains unburned at the bottom and serves as an excellent breeding medium. The rat population at this dump is also heavy. It has long been known that most places that will attract rats will also attract flies.

An abundance of ants were noted carrying fly eggs to their nest. Birds were also seen darting or swooping down on this dump and picking up adult flies and larvae. While this took its toll, the fly population was not reduced to any appreciable extent.

A Horse and Mule Stable Located Three Miles From Camp Stewart. This stable is located about 3 miles from Camp Stewart. Piles of horse manure

about four feet in height were scattered around the stable, presumably to be used as soil fertilizer. However, numerous fly larvae and eggs were found. The larvae were usually found about four inches within the pile. Breeding appeared to have been a little more heavy in manure piles containing straw and alfalfa.

An insect catching net was used to sample the fly population. Only Musca and Stomoxys were present. As an index to measure the fly abundance, an average of 92 adult flies per square foot on walls of the barn was counted.

A Large Hog Farm. This farm was located about two and one-half miles from Camp Stewart. Garbage, kitchen liquid waste, and grains were used as food. Much was wasted or spilled on the ground, thus polluting the soil. Heavy breeding occurred here, and many flies were also attracted. The population was primarily Musca and Stomoxys. Collections were made by insect catching net.

As an index to measure the fly abundance, an average of 52 adult flies per square foot on the railing of the hog pen was counted.

Breeding also occurred in a pile of pig manure containing hay. No breeding deeper than four inches was noted.

Camp Stewart's Sanitary Fill. This sanitary fill was located on the reservation of Camp Stewart and was used to dump all non-edible garbage and refuse. Some edible garbage was dumped here also. The garbage and refuse were covered daily with heavy machinery, however, flies were attracted here in large numbers. Very little breeding existed.

Flies were collected by hand net to determine the species composition. Representative species of all listed in Table 2 were present, except Stomoxys.

Fort Dix's Sanitary Fill. Flies were attracted here in large numbers, but no breeding was observed.

Comparison of Attractants

Tables 5 and 6 show the total number of each genus trapped per each attractant at Camp Stewart, Georgia (including Hinesville) and Fort Dix, New Jersey. During the weeks in which the densities of Callitroga spp., Sarcophaga spp., and Phaenicia spp. rose or fell, as shown in Fig. 5, fish heads, chicken entrails and rotted ham were used as attractants. These attractants were most favored by the above three genera.

Fish heads attracted the greatest total number of all species of flies of all the attractants (Tables 5 and 6).

Musca domestica was the least choosy of all species about attractants as they were collected in great numbers from all of the attractants. However, they most favored the fish heads, cow manure, and human feces (Tables 5 and 6). Other than Musca domestica, few other species were attracted to molasses and malt (Table 2).

There were no Callitroga spp. collected from Fort Dix, New Jersey, but this species was the second most numerous collected in the warmer climate of Camp Stewart, Georgia. Likewise there were no Calliphora spp. collected from Camp Stewart, Georgia, but they were collected from Fort Dix, New Jersey, a more temperate climate.

Representives of all other species listed in Tables 5 and 6 were found at both posts.

Comparative Densities

The following present the data necessary for a comparison of the fly densities.

The total average number of all flies collected each trap-day at Fixed Stations from August 15, 1952 to November 30, 1952 at Camp Stewart,

Table 5. Total number of each genus trapped per each attractant at Camp Stewart, Georgia (including Hinesville).

Species	Attractants*									
	A	F	B	I	H	J	G	E	C	D
M. domestica	3788	2141	647	1870	1004	922	1981	1155	1204	1760
Phaenicia spp.	206	15	86	6	181	79	18	3	48	0
Sarcophaga spp.	650	73	283	37	457	263	57	37	273	34
Phormia spp.	199	6	21	9	84	53	2	1	35	0
Calliltroga spp.	2660	6	929	7	1763	522	24	37	281	7
Fannia spp.	71	51	0	33	1	10	19	44	36	18
Ophyra spp.	82	27	19	13	39	26	9	30	43	14
Others	103	31	4	41	2	29	29	42	21	25

Legend: *A-Fish heads.
B-Rotted hams.
C-Decayed fruits.
D-Malt.
E-Dog feces.
F-Cow manure.
G-Human feces.
H-Chicken entrails.
I-Molasses and vinegar.
J-Mixed garbage.

Table 6. The total number of each genus trapped per each attractant at Fort Dix, New Jersey.

Species	Attractants*					
	A	B	C	D	E	F
M. domestica	900	95	140	705	159	99
Phaenicia spp.	1940	60	150	50	1254	550
Sarcophaga spp.	50	14	30	20	70	30
Calliphora spp.	21	9	5	5	25	20
Ophyra spp.	15	5	5	4	21	10
Others	29	4	6	10	25	15

*Legend: A-Fish head
B-Decayed fruit
C-Mixed garbage
D-Molasses and vinegar
E-Chicken entrails
F-Rotted ham

Georgia (including Hinesville) is shown in Fig. 3.

The total average number of all flies collected from Fixed Stations at Camp Stewart (proper) with those collected at Hinesville, Georgia is shown in Fig. 4.

The densities of the four most numerous genera collected from Fixed Stations at Camp Stewart (including Hinesville) is shown in Fig. 5.

The densities of the two highest genera collected at Camp Stewart (proper) with those of Hinesville, Georgia is shown in Fig. 6.

The densities of the three most numerous genera collected at Fort Dix, New Jersey is shown in Fig. 7.

The total average number of flies collected per trap-day at Camp Stewart, with those of Fort Dix, New Jersey is shown in Fig. 8.

Musca domestica was the most numerous species collected at Camp Stewart, (Fig. 6). Densities of Camp Stewart rose and fell almost identically to those of Hinesville (Fig. 6). The largest source of adult Musca domestica at Stewart and Hinesville probably originated from the same places, such as Hinesville's open garbage-rubbish dump, the hog farm, and the horse and mule stable, all located about equal distance from Camp Stewart and Hinesville (two miles.)

The densities of the 2nd, 3rd, and 4th most numerous genera (Callitroga spp., Sarcophaga spp., and Phaenicia spp.) at Camp Stewart rose and fell almost identically (Fig. 5). All three favored the same attractants (Table 5), which possibly accounts for this uniformity. Fish heads, chicken entrails and rotted ham were used as attractants during the weeks in which the densities rose.

The peak of the total fly populations at Camp Stewart and Fort Dix was probably during the month of August (Fig. 3 and Fig. 7), with a sudden decline in September and a gradual decline thereafter to November as indicated

at Camp Stewart. There were more flies trapped at Hinesville than Camp Stewart (Fig. 4).

Phaenicia spp. was by far the most numerous species collected at Fort Dix, followed in order by Musca domestica and Sarcophaga spp. (Fig. 7).

There were more Musca domestica collected at Camp Stewart than Fort Dix, and more Phaenicia spp. collected from Fort Dix than Camp Stewart (Fig. 5 and 7).

During the month of August, the average trap-day collection of flies was about the same at both posts (Fig. 8).

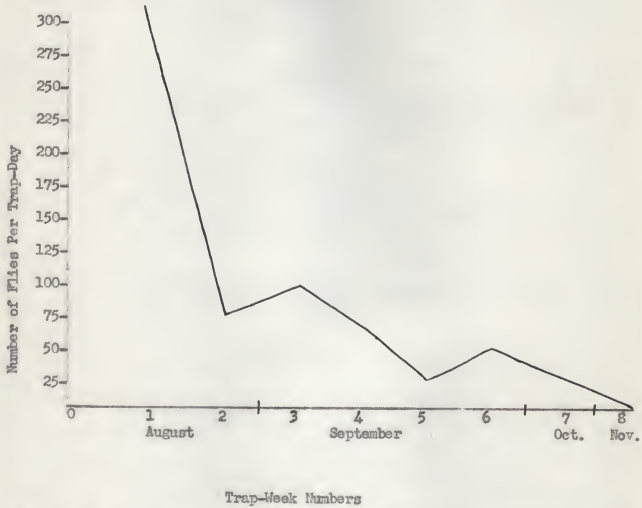

Fig. 3. Total average number of all flies collected per each trap-week at all fixed stations from August 15, 1952 (1st trap-week) to November 30, 1952 (8th trap-week) at Camp Stewart, Georgia (including Hinesville).

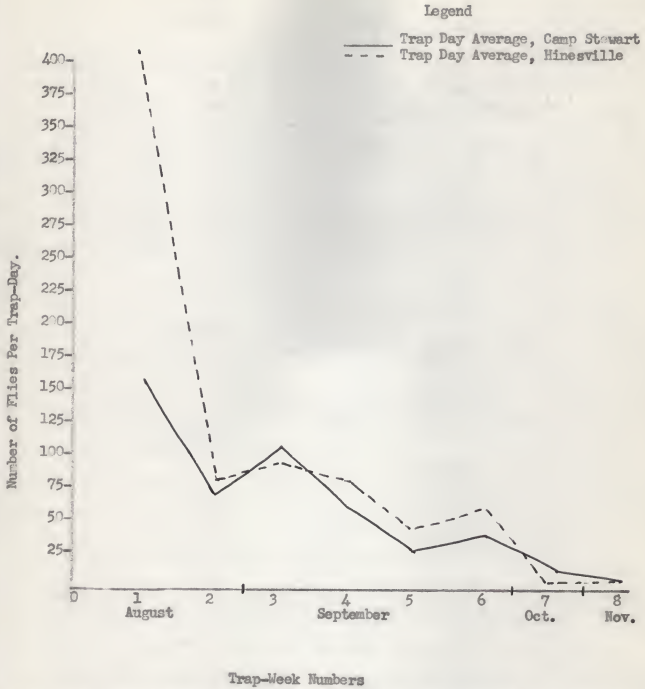

Fig. 4. A graphic summary of the total average number of all flies collected from fixed stations at Camp Stewart, Georgia (proper) for comparison with those collected at Hinesville, Georgia. Collections were made from August 15, 1952 (1st trap-week) to November 30, 1952 (8th trap-week).

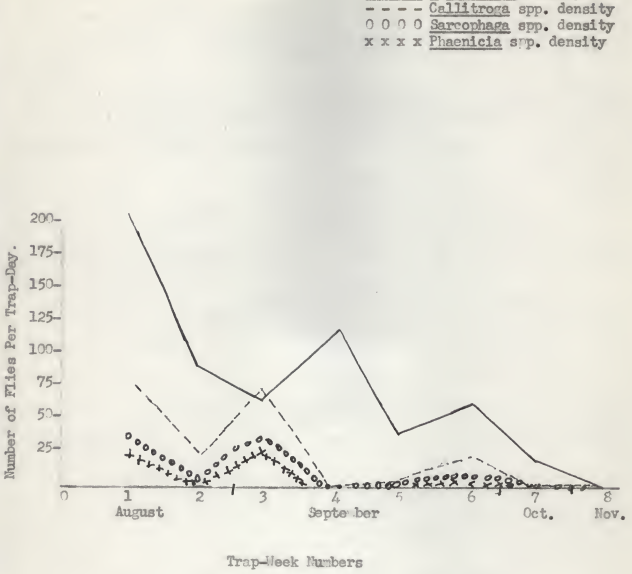

Fig. 5. A summary for comparing the densities of the four most numerous genera collected during trap-weeks 1 through 8 (August, September, October, and November) 1952, for all fixed stations at Camp Stewart, Georgia (including Hinesville).

*Trap-Weeks 1 thru 8 represents collection of flies for two weeks in August, four weeks in September, one week in October and one week in November.

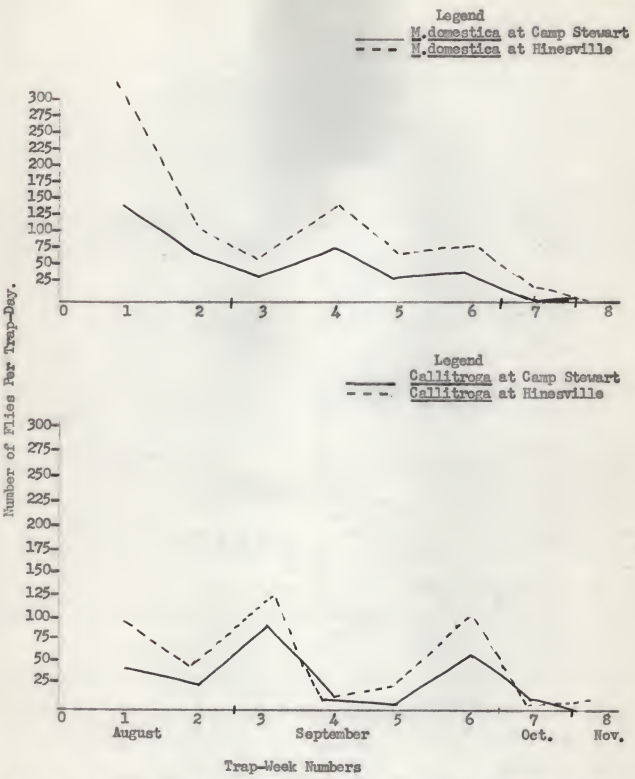

Fig. 6. A summary of the total number of the two highest fly densities collected at Camp Stewart, Georgia (proper) for comparison with those of Hinesville, Georgia. Collections were made from August 15,1952 (1st trap-week) to November 30, 1952 (8th trap-week).

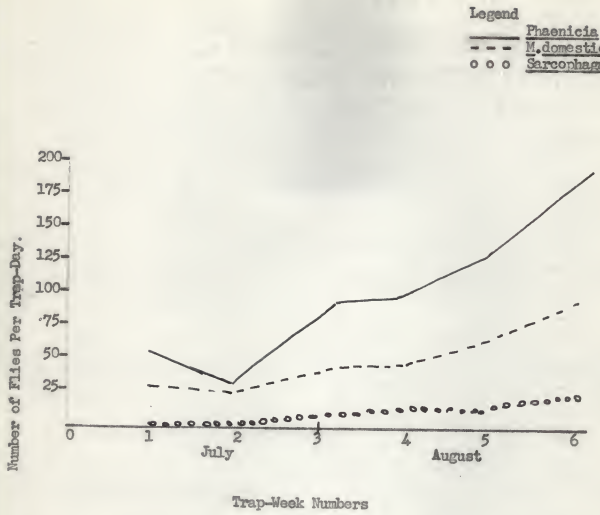

Fig. 7. A summary for comparing the densities of the three most numerous genera collected at Fort Dix, New Jersey during trap-weeks 1 through 6 (July and August 1953).

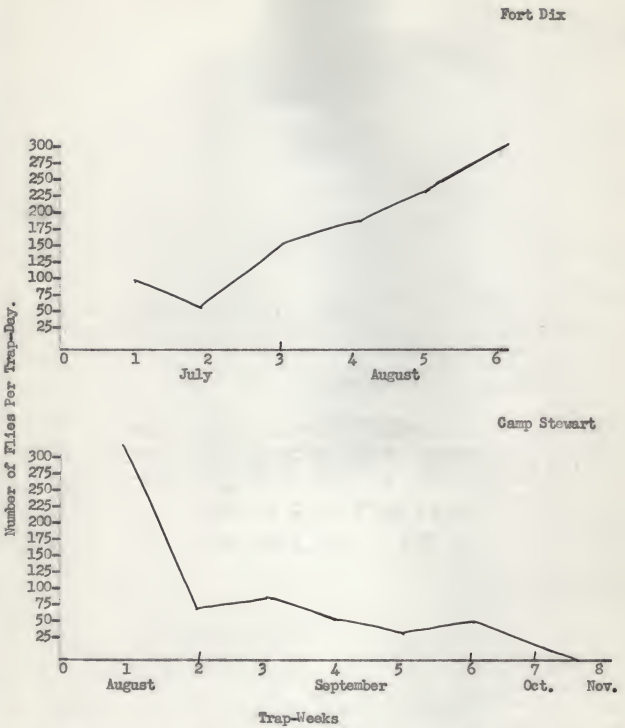

Fig. 8. A summary of the total trap-day averages of all flies trapped at Fort Dix, New Jersey (trap-week 1-6, July and August, 1953) for comparison with those trapped at Camp Stewart, Georgia (trap-week 1-8, August, September, October and November 1952).

CONCLUSIONS

The following conclusions may be drawn from this study:

1. There were more flies encountered in the fixed stations which exhibited many breeding places and media, than in the random stations with apparantly no breeding places.

2. Because fly breeding was found only in the fixed stations, and they were consistently more numerous even though the same attractants were used at both types of stations on the same days, it was concluded that adult flies (especially Musca domestica) tend to remain in the immediate vicinity of their breeding places.

3. The most abundant species at Camp Stewart was Musca domestica making up 59.5 per cent of the total fly population. The second, third and fourth most abundant genera in their order of rank were Callitroga spp., Sarcophaga spp., and Phaenicia spp. making up 22, 8 and 3 per cent of the total fly population respectively.

4. The most abundant genera at Fort Dix, New Jersey was Phaenicia spp., making up 61.2 per cent of the total fly population. The second and third most abundant genera in their order of rank were Musca domestica and Sarcophaga spp., making up 28 per cent and 3.2 per cent of the total fly population respectively.

5. The major fly problem as indicated by consistently higher counts, appeared to be at the fixed and dump block stations.

6. During the period studied, the peak of the fly population at both posts was during the month of August.

7. Musca domestica was encountered and was a problem at Camp Stewart up to the month of December.

8. There were no species of the genus Callitroga encountered at Fort Dix, but this genus ranked second at Camp Stewart.

9. Few Calliphora spp. were encountered at Fort Dix, and none were encountered at Camp Stewart, Georgia.

10. All flies encountered, except Musca domestica, were observed feeding and breeding on the same media.

11. The same media were found to attract the species of Calliphorids and Sarcophagids. They were generally carrion breeders.

12. Musca domestica required no specific attractant and was generally attracted to all media.

13. More flies were attracted to fish heads than any other attractants, which suggests that adult flies are attracted by distinctive odors.

14. The fly population is reduced to a slight extent by animal predators.

15. Isolated animal droppings are rarely suitable for fly breeding unless the climate is moist.

16. The Calliphorids and Sarcophagids will travel a long distance from their breeding places.

17. The manner in which animal manure is piled or spread will determine the amount, if any, of fly breeding.

18. The largest source of the adult fly population at both Army posts was not located on the posts, but was located in the nearby communities of which the Army has no control.

19. Although flies are becoming more and more resistant to known insecticides, it is concluded that flies can be successfully controlled by diligently seeking their breeding places, the elimination of the same, and by good sanitary practices to include the elimination of neglected attractants.

SUMMARY

Some ecological facts of common filth flies important to sanitation were observed at Camp Stewart, Georgia (including the nearby town of Hinesville, Georgia) and Fort Dix, New Jersey during the months of August to December, 1952, and July and August, 1953 respectively. The principle emphasis was placed on quantitative and qualitative studies of adult fly population densities, and the locations, extent, kind and prevalence of fly breeding places.

To accomplish the objectives of this study, a fly survey of both Army posts was made. This survey was conducted in accordance with procedures outlined in "Methods of Surveying Fly Populations" by Clarence W. Marshall and "The Control of Domestic Flies" by J. H. Coffey and J. F. Schoof.

Fly traps baited with the following attractants were used to collect flies: Fish heads, rotted ham, decayed fruits, malt, dog feces, cow manure, human feces, chicken entrails, molasses and vinegar and mixed kitchen garbage. All of these attractants were common to Army posts.

The operation of fly traps required one man-hour per day for each trap. This work included the securing of baits, selection of suitable sites, transporting the traps, and killing the collected flies.

An insect net was used to collect flies from large breeding places, such as the city dump and animal stables.

An "open range" policy existed at Camp Stewart, Georgia, resulting in numerous cattle and swine grazing throughout the entire post and attracting flies by their mere presence. Their droppings also provided some fly breeding.

The open garbage-rubbish dump of Hinesville, Georgia, located only two miles from Camp Stewart, undoubtedly was one of the main sources of flies for the town and post.

The conclusions believed to be the most significant are as follows:

1. There were more flies encountered in the fixed stations which exhibited many breeding places and media, than in the random stations with apparently no breeding places.

2. Because fly breeding was found only in the fixed stations, and they were consistently more numerous even though the same attractants were used at both types of stations on the same days, it was concluded that adult flies (especially Musca domestica) tend to remain in the immediate vicinity of their breeding places.

3. The most abundant species at Camp Stewart was Musca domestica making up 59.5 per cent of the total fly population. The second, third and fourth most abundant genera in the order of rank were Callitroga spp., Sarcophaga spp., and Phaenicia spp. making up 22, 8 and 3 per cent of the total fly population respectively.

4. The most abundant genera at Fort Dix, New Jersey was Phaenicia spp., making up 61.2 per cent of the total fly population. The second and third most abundant genera in their order of rank were Musca domestica and Sarcophaga spp., making up 28 and 3.2 per cent of the total fly population respectively.

5. The major fly problem as indicated by consistently higher counts, appeared to be at the fixed and dump block stations.

6. During the period studied the peak of the fly population at both posts was during the month of August.

7. Musca domestica was encountered and was a problem at Camp Stewart up to the month of December.

8. There were no species of the genus Callitroga encountered at Fort Dix, but this genus ranked second at Camp Stewart.

9. Few Calliphora spp. were encountered at Fort Dix and none were encountered at Camp Stewart, Georgia.

10. All flies collected, except Musca domestica, were observed feeding and breeding on the same media.

11. The same media was found to attract the species of Calliphorids and Sarcophagids. They were generally carrion breeders.

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18. The largest source of the adult fly population at both Army posts was not located on the posts, but was located in the nearby communities of which the Army has no control.

19. Although flies are becoming more and more resistant to known insecticides, it is concluded that flies can be successfully controlled by diligently seeking their breeding places, the elimination of the same, and by good sanitary practices to include the elimination of neglected attractants.

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ECOLOGICAL OBSERVATIONS OF SOME COMMON FILTH FLIES IMPORTANT TO SANITATION FOUND AT TWO U.S. ARMY POSTS

by

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B.S., Prairie View University
Hempstead, Texas, 1939

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ABSTRACT

Some ecological facts of common filth flies important to sanitation were observed at Camp Stewart, Georgia (including the nearby town of Hinesville, Georgia) and Fort Dix, New Jersey during the months of August to December, 1952, and July and August, 1953 respectively. The principle emphasis was placed on quantitative and qualitative studies of adult fly populations, densities and the locations, extent, kind and prevalence of fly breeding places.

To accomplish the objectives of this study, a fly survey of both Army posts was made. This survey was conducted in accordance with procedures outlined in "Methods of Surveying Fly Populations" by Clarence W. Marshall and "The Control of Domestic Flies" by J. H. Coffey and J. F. Schoof.

Fly traps baited with the following attractants were used to collect flies: Fish heads, rotted ham, decayed fruits, malt, dog feces, cow manure, human feces, chicken entrails, molasses and vinegar and mixed kitchen garbage. All of these attractants were common to Army posts.

The operation of fly traps required one man-hour per day for each trap. This work included the securing of baits, selection of suitable sites, transporting the traps, and killing the collected flies.

An insect net was used to collect flies from large breeding places, such as the city dump and animal stables.

An "open range" policy existed at Camp Stewart, Georgia, resulting in numerous cattle and swine grazing throughout the entire post and attracting flies by their mere presence. Their droppings also provided some fly breeding.

The open garbage-rubbish dump of Hinesville, Georgia, located only two miles from Camp Stewart, undoubtedly was one of the main sources of flies for the town and post.

The conclusions believed to be the most significant are as follows:

1. There were more flies encountered in the fixed stations which exhibited many breeding places and media, than in the random stations with apparantly no breeding places.

2. Because fly breeding was found only in the fixed stations, and they were consistently more numerous even though the same attractants were used at both types of stations on the same days, it was concluded that adult flies (especially Musca domestica tend to remain in the immediate vicinity of their breeding places.

3. The most abundant species at Camp Stewart was Musca domestica making up 59.5 per cent of the total fly population. The second, third and fourth most abundant genera in the order of rank were Callitroga spp., Sarcophaga spp., and Phaenicia spp. making up 22, 8 and 3 per cent of the total fly population respectively.

4. The most abundant genera at Fort Dix, New Jersey was Phaenicia spp., making up 61.2 per cent of the total fly population. The second and third most abundant genera in their order of rank were Musca domestica and Sarcophaga spp., making up 28 and 3.2 per cent of the total fly population respectively.

5. The major fly problem as indicated by consistently higher counts, appeared to be at the fixed and dump block stations.

6. During the period studied the peak of the fly population at both posts was during the month of August.

7. Musca domestica was encountered and was a problem at Camp Stewart up to the month of December.

8. There were no species of the genus Callitroga encountered at Fort Dix, but this genus ranked second at Camp Stewart.

9. Few Calliphora spp. were encountered at Fort Dix, and none were encountered at Camp Stewart, Georgia.

10. All flies collected, except Musca domestica were observed feeding and breeding on the same media.

11. The same media was found to attract the species of Calliphorids and Sarcophagids. They were generally carrion breeders.

12. Musca domestica required no specific attractant and was generally attracted to all media.

13. More flies were attracted to fish heads than any other attractants, which suggest that adult flies are attracted by distinctive odors.

14. The fly population is reduced to a slight extent by animal predators.

15. Isolated animal droppings are rarely suitable for fly breeding unless the climate is moist.

16. The Calliphorids and Sarcophagids will travel a long distance from their breeding places.

17. The manner in which animal manure is piled or spread will determine the amount, if any, of fly breeding.

18. The largest source of the adult fly population at both Army posts was not located on the posts, but was located in the nearby communities of which the Army has no control.

19. Although flies are becoming more and more resistant to known insecticides, it is concluded that flies can be successfully controlled by diligently seeking their breeding places, the elimination of the same, and by good sanitary practices to include the elimination of neglected attractants.