# The distribution of flies of the families galliphoridae and muscidae (diptera) in different habitats

Fraser, Andrew J. L.

# THE DISTRIBUTION OF FLIES OF THE FAMILIES CALLIPHORIDAE AND MUSCIDAE (DIPTERA) IN DIFFERENT HABITATS

by

ANDREW J. L. FRASER

B.Sc. (READING)

being

A dissertation submitted as part of the requirements for the degree of Master of Science (Advanced Course in Ecology)

in the

University of Durham

September, 1970.

# CONTENTS


| | | Page |
|---|---|---|
| I. | Introduction | 2 |
| II. | Methods and materials | 5 |
| II.1 | Bait trapping | 6 |
| II.2 | Bait | 7 |
| II.3 | Trapping area | 8 |
| II.4 | Aspect of trapping area | 12 |
| II.5 | Trap positions | 13 |
| II.6 | Trapping frequency | 17 |
| II.7 | Collection and laboratory methods | 18 |
| II.8 | Study animals and their habits | 20 |
| III. | Efficiency of trapping | 25 |
| IV. | Attraction effects | 30 |
| V. | The distribution of flies in different habitats | 35 |
| VI. | Seasonal changes in the species composition of the fly populations | 70 |
| VII. | The effects of climatic factors upon the catches of flies | 82 |
| VIII. | General discussion | 86 |
| IX. | Summary | 92 |
| X. | Acknowledgments | 94 |
| XI. | References | 96 |
| XII. | Appendix | 99 |

# I. INTRODUCTION

# INTRODUCTION

Relatively little work has been done on the habitat preferences of the Calliphoridae and particularly the Muscidae. In recent years Macloed and Donnelly (1956, 1957, 1958, 1962, 1963) in Britain and Nuorteva (1963) in Finland have published several papers on the ecology of the Calliphoridae. Nuorteva worked on the synanthrophy (= living in association with human settlements) of the blowflies in relation to polio epidemics. He suggested that the more synanthropic species are attracted to the sun and are therefore more likely to be found in open habitats. Macloed and Donnelly have dealt with many aspects of Calliphorine ecology. In their paper of 1957, they devoted a small section to the habitat preferences of the Calliphora Rob. Des. and Lucilia Rob. Des. species.

The great variability of the occurrence of flies in their broad distribution pattern has been shown in many papers. (Cragg and Hobart, 1955; Gilmour et al, 1946; Macloed and Donnelly, 1957). Nuorteva found that in different countries (Finland and Czechoslavakia), species have different food preferences. He suggested that the species may have different habitat preferences in widely separated areas of their geographical range.

Particular trap positions have been found to favour a particular, or several species, in terms of the number they catch (Macloed and Donnelly, 1962). They suggested that local soil conditions or microclimatic factors might be the cause though they could find none. On other occasions a single trap had a high catch of a species on only one trapping day. Such fleeting aggregations of flies they found difficult to explain though they cited immigration from other areas as a possible cause.

Flies are very active animals as all will know. There are even recorded cases of migration of Calliphora vicina Rob. Des. and C. vomitoria Meig. southward in autumn through the Pyrenees (Williams et al, 1956). This sort of activity will mean that considerable movement from one favourable habitat to another will occur even over very unfavourable terrain (Macloed and Donnelly, 1958: 1960). The crossing of unfavourable terrain has caused them to be found in areas where they would least be expected e.g. on a light-ship, twenty-two miles off the Belgian coast (Lempke, 1962). Thus it is quite normal to find them in habitats not usually associated with their distribution.

Why a particular habitat should be favourable while others are unfavourable, is difficult to ascertain. Macloed and Donnelly (1958) suggested that it was due to a complex of climatic, vegetational and nutritional stimuli which was attractive to one species, but might be repellant to another.

The objective of this dissertation is to discover a little more about the habitats that each species prefers. The practical work was done in conjunction with Miss S. Lewin who was studying the ageing of the Calliphorine species, throughout the trapping season, May 1st to July 15th. The changing species composition through this period is also studied and attempts are made to account for the fluctuating numbers of animals caught on the various trapping days.

The practical work was performed with twenty baited fly traps set in a study area in such a way that all the main types of habitat were included in the trapping programme. Details of the trapping area and trap sites are given in Section 2.

# II. METHODS AND MATERIALS

## II.1 BAIT TRAPPING

The method used to catch the flies was bait trapping. Norris (1965) concludes that this is the only generally successful method of studying the adult fly populations. The traps used to catch the flies are of a type first used by Cragg and Ramage (1945).

The trap is formed of a mosquito netting cylinder, 30 cms. in diameter and 54 cm. in height with a cone of netting near the lower end. This cone has a hole 2½ cms. across at its apex through which the flies enter the trap. The trap has a skirt 7 cms. deep attached to the base. The top of the cylinder has a drawstring around it allowing it to be closed. Six 30 cm. strings are sewn around the top and bottom to suspend the trap to a wire frame. This frame consists of three metal hoops 60 cms. high and 34 cms. across with the bottom 10 cms. of each hoop embedded in the ground. The cylinder is held to the frame so that the skirt is about 3 cms. above the ground. The trap is closed at the trap by the drawstring and the cone is pulled up by a string attached to its apex. The two ends of the draw-string and the tightener string are tied to the top of the frame. This maintains the position of the cone and prevents flies from escaping through the top. Figure I shows a diagram of a trap in position.

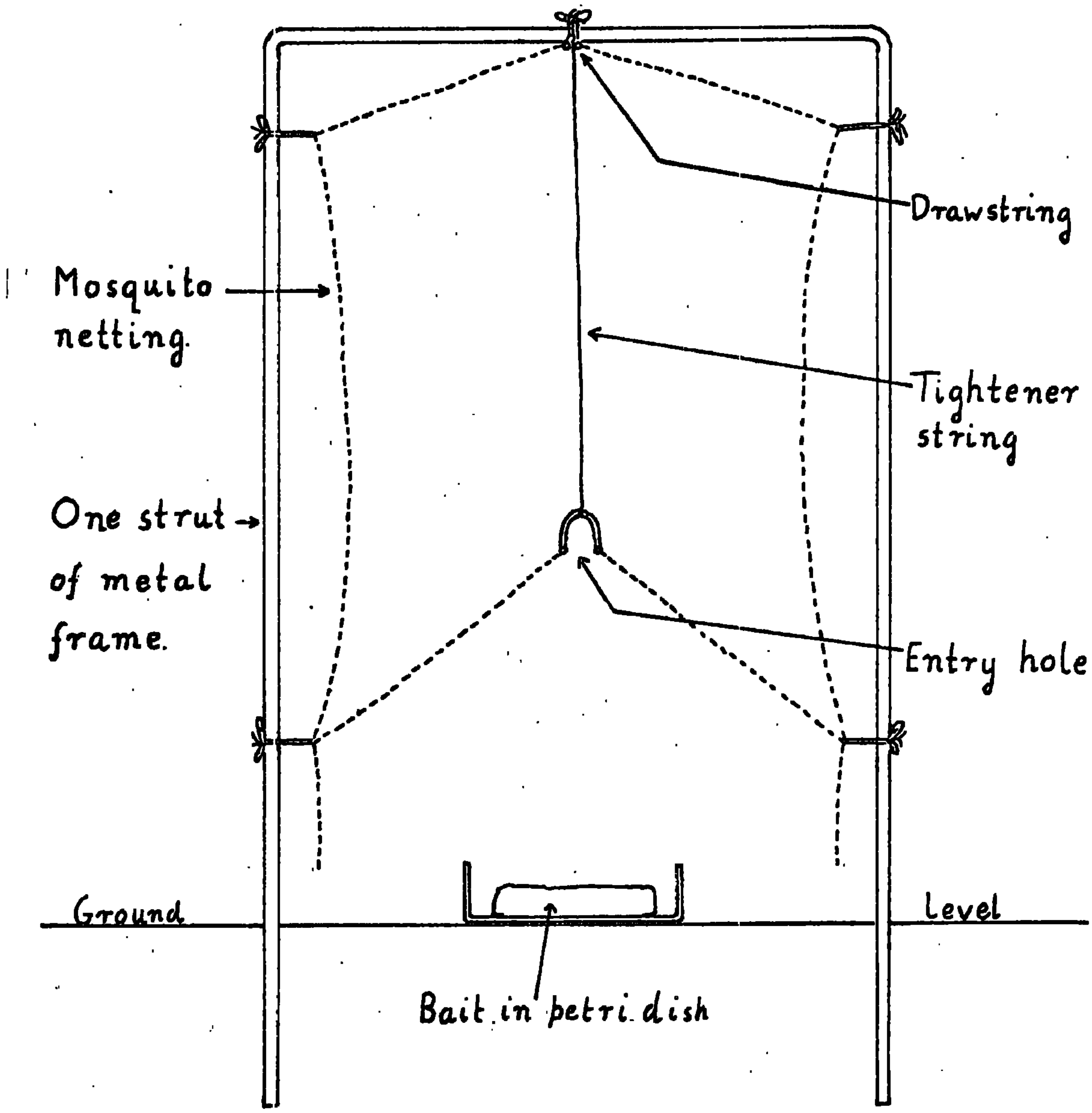



Fig 1 Sectional diagram of a bait trap.

## II.2 BAIT

The bait used at each trap was 35 grams of liver placed in a plastic dish under the trap. This liver was stored in a deep freeze until the day before the trapping, when it was taken out to thaw. It was used twice by the end of which time it was starting to get very high. Nuorteva (1959) showed that some species (e.g. Calliphora vomitoria) prefer whole carcasses, while others are not so specific in choice of baits. Gilmour et al (1946) concluded that liver was only half as attractive to Lucilia cuprina Wied on the second day of usage as on the first. This species, however, visits carrion soon after death and so this situation may have been expected. These two examples do show that the bait may have been more attractive to some species than to others, especially the dung feeding Muscidae.

## II.3 TRAPPING AREA

The area in which trapping took place is the Field Station of the Zoology Department of Durham University. Grid ref: NZ 274406.

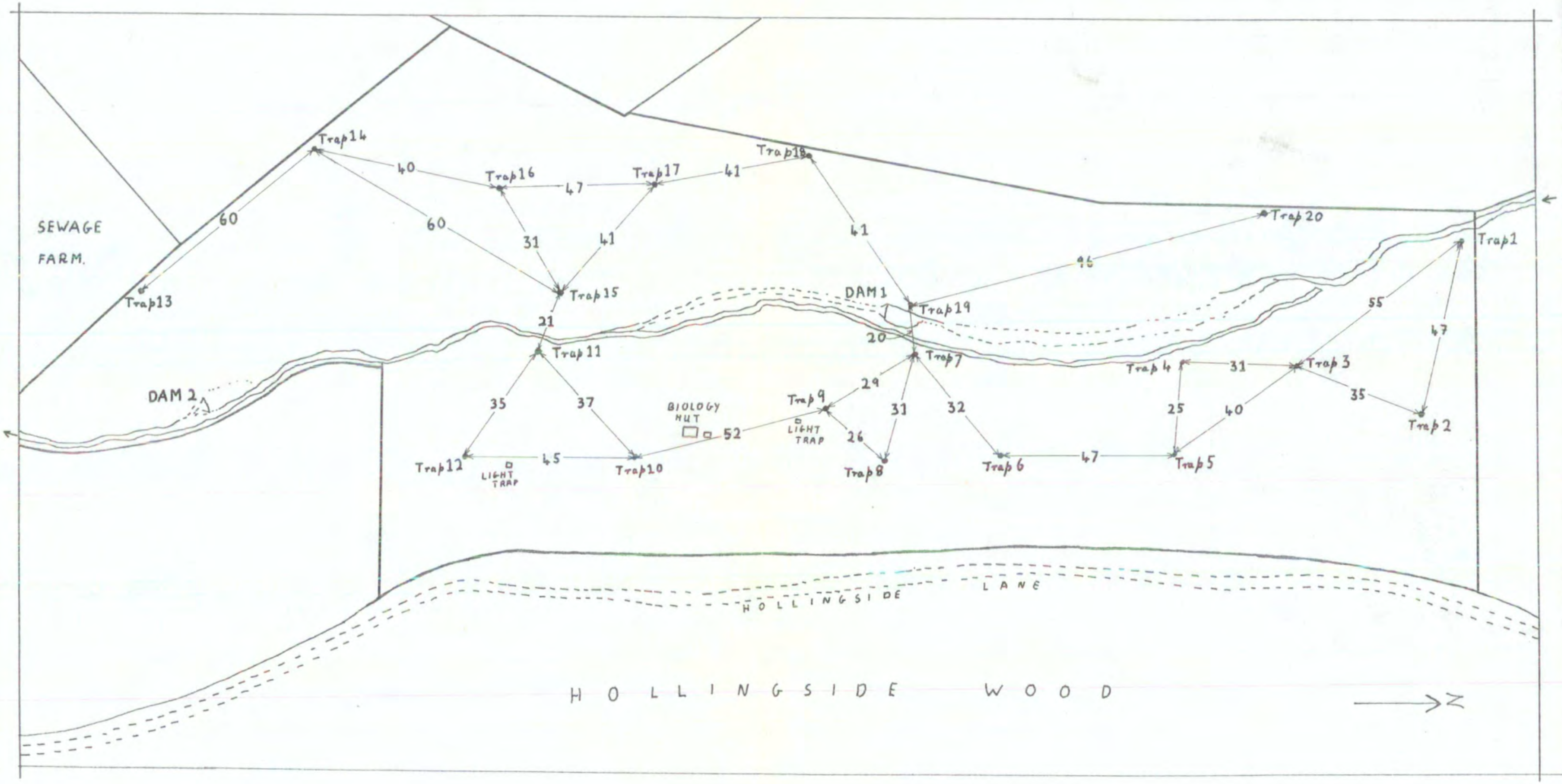
It is an area of approximately 3.8 hectares. It covers both sides of a small valley which has a stream, at its widest point 1½ metres wide, running south through it. For more detail see Fig.2 ( in which the numbers 1-20 indicate the fly trap positions).

The eastern side of the valley can be divided into two areas. The northern end has a very steep wooded side. The canopy is composed of oak (Quercus robur) and beech (Fagus sylvatica), but has a few silver birch (Betula verrucosa), larch (Larix decidua) and Scot's pine (Pinus sylvestris) in it. This wooded region has very little undergrowth, a few young silver birches being the only shrubs present. Above the wooded slope, the field station flattens off till it meets Hollingside Lane (see Fig.2). This flatter area is devoid of trees except for a few holly (Ilex aquifolium) and ash (Fraxinus excelsior) trees along the eastern hedge. It has a very large growth of brambles and hawthorn (Crataegus monogyna) scrub with a very rich herb layer. The southern end of this side of the valley has a narrow belt of trees along the stream. Above this there is more hawthorn/bramble scrub and only an oak and the biology hut cause a break in the vegetation.

The western side of the valley is rough open meadow with a few small trees of several species planted in it. The stream has been diverted near the top end of the reserve so that two small ponds could be formed behind dams. The upper one of these still has water in it, but the lower one has broken through the dam. This side of the valley has a much gentler slope than the eastern side.

The eastern side of the area has its boundary on Hollingside Lane with Hollingside Woods beyond. The other three sides are bounded by rough grazing pasture on which sheep and cattle have been grazing all summer. The south eastern corner has its boundary on a small sewage farm in the grounds of which sheep have been grazing. Fig.3 shows the vegetation of the Field Station.

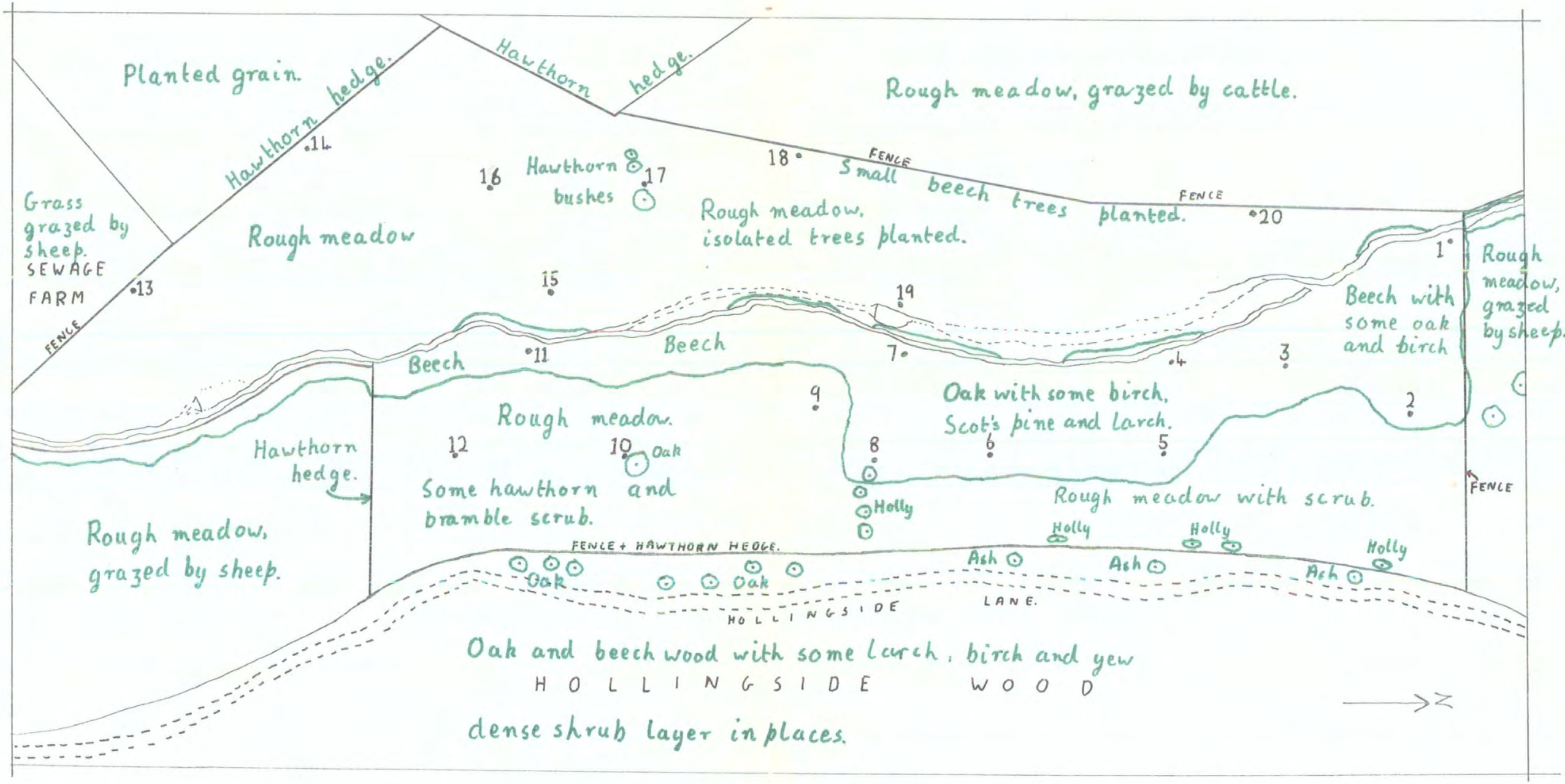
Fig. 2. DISTRIBUTION OF TRAPS ON FIELD STATION




Scale: Approx. 1": 1250"

All distances between traps is in metres. ——— Perimeter of Field Station.

Fig.3 VEGETATION MAP OF FIELD STATION




The numbers 1-20 show the trap positions.

## II.4 ASPECT OF TRAPPING AREA

The stream is a small tributary of the River Wear which it joins three-quarters of a mile south of the Field Station. The valley is in a small bowl of high ground well protected from all directions and with a rather small outlet valley to the Wear. It has a southern aspect, being protected a little more from the north than from the south. The north and east winds tend to have much less effect on the valley than the south and west ones. The Field Station is more prone to gusts of wind rather than a continuous breeze. The presence of high ground may cause considerable disturbance in the wind and thus account for this effect.

## II.5 TRAPPING POSITIONS

At the start of the work it was decided that twenty traps could be used. More traps could easily deplete the populations while fewer traps could make statistical work difficult. As it was many problems were encountered in the statistical analyses.

The positions for the traps were chosen so that they were fairly evenly spaced throughout the field station. However, due to the smaller area of the wood, in which nine traps were positioned, they are closer together in this habitat. The positions and spacing of the traps can be seen in Fig.2.

Trap 1. This was under a very large beech tree on litter completely bare of plants. It was four metres from the stream and the same distance from the northern boundary fence, beyond which was a rough meadow on which sheep were grazing.

Trap 2. This was partly overhung by a large beech on the upper slopes of the reserve. The trap was almost surrounded by oak and bramble scrub with large amounts of cocks foot grass (*Dactylis glomerata*).

Trap 3. This was situated under a beech half-way down the slope to the stream. There were a few small tussocks of grass, but no other vegetation.

Trap 4. The stream ran only two metres from this trap which was in a dense growth of Yorkshire fog (*Holcus lanatus*). There were a few isolated tussocks of soft rush (*Juncus effusus*) near the trap amongst some small silver birch trees. Some small trees on the other side of the stream overhung both the stream and the trap, shading it during most of the afternoon.

Trap 5. This trap was under two oak trees, one on either side of it. It was on a very steep part of the slope on a mat of grass which had a lot of dry oak litter under it.

Trap 6. One of the few Scot's pine trees formed a canopy over this trap. There was a considerable amount of pine litter under the tree which was on the slope of the reserve. The top of a large dead tree had fallen off and was lying close to the trap.

Trap 7. This trap was only two metres from the stream, with an oak on one side of the trap and a silver birch on the other. A large hawthorn bush on the far side of the stream shaded it during the afternoon. It was on a dense mat of grass with some wood horsetail (Equisetum sylvaticum) around the trap.

Trap 8. This trap was under a very dense holly bush and was continually being showered by debris from the bush. An oak tree was slightly downhill from the trap and shaded the trap all day. There were a few tufts of grass around the trap but no heavy growth occurred during the summer.

Trap 9. This was in the open meadow half-way up the slope of the valley. There were quite heavy growth of Dactylis and other grasses.

Trap 10. The solitary oak near the biology hut was five metres from this trap. It did not shade it, but may have had some effect on the fly catch. Very healthy growths of the creeping thistle (Cirsium arvense) occurred around the trap. They grew up during the trapping season and became exceedingly vicious as the time went by. Quite large patches of hawthorn/bramble scrub were only three metres from the trap.

Trap 11. This trap was on the narrow wooded fringe of the stream. It stood four metres from the stream and between two large beech trees which shaded it all day. It was on a mat of grass but there was little other flora near it.

Trap 12. The hawthorn/bramble scrub surrounded this trap on all sides. None of it was more than two metres high, but may have had considerable effects on the fly population. The grass surrounding the trap was mainly cocksfoot.

Trap 13. This trap was on the flat top of the reserve by the boundary fence with the sewage farm. The flora around it was quite varied but with cocksfoot forming the major component. Some small trees of uncertain parentage (possibly cultivated Pyrus or Malus) had been planted along this fence but were in rather poor condition.

Trap 14. This trap was also on the top of the reserve. It was surrounded by high cocksfoot grass with numerous creeping thistles amongst the grass. It was about seven metres from the top hawthorn hedge.

Trap 15. This trap was in the flat floor of the valley sixteen metres from the stream. There were several patches of soft rush and broad leaved dock (Rumex obtusifolius) around the trap. Between the stream and the trap was a narrow band of Salix bushes.

Trap 16. Very dense cocksfoot grass half-way up the slope of the valley surrounded the trap. In places, it was one and a half metres high and obliterated some small beech and pine trees planted near the trap.

Trap 17. Two quite large hawthorn bushes were on either side of the trap. The ground appeared to have been disturbed recently by the installation of an underground sewage pipe. The flora was accordingly more varied around this trap than elsewhere in the reserve.

Trap 18. A small hedge of beech had been planted along the western fence. The trap was placed between two of the small trees and the inevitable cocksfoot was well in evidence around it.

Trap 19. Dam 1 had a small pönd trapped behind it. Trap 19 was in a patch of Yorkshire fog three metres from the edge of the pond. Several alder trees (*Alnus glutinosus*) two metres high were near the trap but did not shade it from the sun.

Trap 20. Like trap 18, this was in the small beech hedge and was almost a duplicate though it was a bit nearer the stream.

## II.6 TRAPPING FREQUENCY

It was decided not to trap on a regular period basis as this would lead to trapping on days unfavourable to fly activity. In the first month trapping took place twice a week on days for which the weather forecast was good. After this, when there was a marked rise in the number of flies caught trapping was reduced to only once a week. At this time subsidiary trapping started on only eight points instead of the twenty normally used. These extra periods were alternated with the main trapping regime.

## II.7 COLLECTION AND LABORATORY METHODS

Before the trapping started the supporting hoops were placed in the positions chosen for the traps. They were left permanently in place until trapping had ended.

A trapping session was a twenty-four hour period from one night to the same time on the next night. Usually this was from about 7 p.m. to 7 p.m. The bait was placed directly under the entry hole of the trap. The trap was lowered until the skirt was 3 cms. off the ground. The vegetation grew very rapidly and it was necessary to keep the plants cropped to prevent them from interfering with the skirt.

On certain of the days when subsidiary trapping took place (1st, 3rd and 26th June and 4th July), some of the traps were collected at two hourly intervals. The traps on which two hour collections were made can be seen in Table 2. In each case the traps were taken in and newones installed as quickly as possible. The traps were always put out and collected in the same order to prevent differences in the times that each was out.

When the traps were collected the top of each trap was closed by tying the drawstrings. The entry hole was closed by fastening a plastic rose label, with the trap number written on it, around the cone just above the wire support. The traps were placed in a killing jar containing ethyl acetate. As Miss Lewin wished to dissect some of the animals it was necessary to use a chemical which did not damage the internal organs. Chemicals such as chloroform do some damage and so ethyl acetate was used which, though slower at killing the flies, did no harm to the ovaries. The dead flies were taken out of the traps and stored in labelled specimen tubes in a deep freeze. They could then be dissected without any deterioration of the organs. The flies were identified from the keys of the Royal Entomological Society of London Volume X Parts 4(a) Tachinidae and Calliphoridae and 4(b) Muscidae.

## II.8 STUDY ANIMALS AND THEIR HABITS

For full descriptions of the species see the Royal Entomological Society of London keys Vol.X parts 4(a) and 4(b).

Calliphoridae

All the Calliphoridae studied belong to the sub family Calliphorinae except the flesh flies *Sarcophaga* spp. Meigen which belong to the Sarcophaginae. The only way to identify most of the latter sub family, is by studying their genitalia (R.E.S.L. Vol X Pt. 4(a)) and as this proved too difficult they have been left as the genus *Sarcophaga*.

The females are viviparous, the young being laid as the first stage larvae. They can develop on almost any organic matter e.g. dung, carrion or decaying vegetable matter.

Calliphörinae

*Calliphora vicina* Robineau - Desvoidy

*C. vomitoria* Meigen

*C. loewi* Endertein

*Cynomyia mortuorum* Linnaeus

*Acrophaga subalpina* Ringdahl

*Phormia terrae-novae* Robineau - Desvoidy

All these species are different types of what is commonly called 'blowflies' though *Calliphora vicina* is the true blue-bottle. The larvae normally develop in carrion to which the female is attracted by smell (Krijgsman and Windred, 1933).

*Lucilia* spp. Robineau - Desvoidy

The most common species of this genus are *Lucilia sericata* Meigen, *L. richardsii* Collin and the *L. caesar* aggr., the latter composed of three species *L. caesar* Linnaeus, *L. illustris* Meigen and *L. ampullacea* Villeneuve. Many mistakes have been made in identifying these species (Macloed and Donnelly, 1958), particularly the females and therefore it was decided not to try to separate the Lucilia caesar aggr. Only three specimens of L. richardsii (one male and two females) and five specimens of L. sericata (one male and four females) were found out of a total of nearly 3,500 Lucilia flies in the whole trapping season. Therefore it was decided to group all the Lucilia species together.

Like the other Calliphoridae the larvae of these species are carrion feeders. However, L. sericata is the chief cause of myiasis of sheep in this country (Cragg, 1955). In areas of intense sheep breeding this species can be a great problem.

Some of the other Calliphorine flies have been found causing myiasis in sheep, but the cases are rather infrequent (Busvine, 1951).

Muscidae

| | |
|---|---|
| Dasyphora cyanella | Meigen |
| Polietes lardarius | Fabricius |
| Muscina pabulorum | Fallén |
| Muscina assimilis | Fallén |

The larvae of these species are all saprophytic, feeding on dung or vegetable matter though the two Muscina species have been recorded from the nests of Vespula vulgaris (R.E.S.L. Vol.X Pt. 4(b)).

The Phaonia genus Desvoidy has thirty-nine species, many of which have proved difficult to identify. Of this genus three species were identified, P. pallida Fabricius, P. populi Meigen and P. variegata Meigen. As these formed only a small part of the total number caught, the remainder of which could not be identified, the genus is left together.

The Mydaea genus Desvoidy has thirteen species which are also very difficult to distinguish. Four of these were identified:-

| | |
|---|---|
| Mydaea urbana | Meigen |
| M. scutellaris | Desvoidy |
| M. ancilla | Meigen |
| M. detrita | Zetterstedt |

Like the Phaonia genus they are grouped into the genus and not separated into species.

The larvae of these two genera are carnivarous, preying upon soil fauna and other fly larvae (Hammer, 1941).

Also found as occasionals were the following Muscid species:-

| | |
|---|---|
| Mesembrina meridiana | Linne |
| Polietes hirticrus | Meade |
| Polietes albolineatus | Fallen |
| Morellia simplex | Loew |
| Ophyra leucostoma | Wiedemann |
| Myospila meditabunda | Fabricius |
| Muscina stabulans | Fallen |
| Alloeostylus diaphanus | Wiedemann |
| Hydrotaea spp | Desvoidy |
| Limnophora spp | Desvoidy |
| Helina spp | Desvoidy |

No other animals caught in the traps were identified, only the Calliphoridae and the Muscidae being dealt with in this work.

To complete the development of the eggs in the ovaries the females of all the flies need a high protein feed (Macloed and Donnelly, 1957; Norris, 1965). Some take this feed from dung, usually the coprophagous species, and some from carcasses. However, none feed exclusively from one source and sometimes they will feed on nectar (Hammer, 1941). It is for this reason that the female flies are attracted to the bait. The male flies may feed on the meat, but they may also lie in wait to mate with any female flies that appear on the bait.

# III. EFFICIENCY OF TRAPPING

# EFFICIENCY OF TRAPPING

While trapping took place on the field, direct observations of the traps were made.

It was quickly noticed that some species were more cautious in their approach than were others. The *Sarcophaga* species seemed to be very timid, often being frightened away by the approach of other flies.

The *Calliphora* species immediately started to search for the bait. *Cynomyia* and the *Lucilia* species often sat on the trap or a convenient plant for a minute before starting to look for the bait. *Acrophaga* and the Muscidae were not observed at the traps and so their trap behaviour is unknown.

When searching, the fly felt around with its proboscis and few gave up the hunt before they found their way under the skirt. Once under trap, they walked straight to the meat and started to feed. Only a few of the flies laid eggs on the meat and unfortunately no record was kept of the batches found. On the days with the highest catches only about ten batches were laid per bait even when 200-300 flies had entered the trap.

The behaviour of the flies when they had finished feeding depended a lot on the species and on the time of day. Almost invariably they cleaned themselves thoroughly before moving from the bait. The *Lucilia* species normally took off and very rapidly found their way into the cylinder of the trap. Quite often the *Calliphora* species walked away from the meat before flying. In this way a small number escaped from the trap before flying off. If the trap had been badly set so that the skirt was lodged on an obstacle, far more flies escaped.

This was true especially in the evenings when the temperature dropped and the flies started to get sluggish. They flew less in these conditions tending to walk away from the liver. Sometimes they climbed grass stems, or the trap, and tried to fly, but normally they disappeared into the grass or litter. It is quite probable that they spent the night among the grass stems where they disappeared.

At the periods of maximum activity quite large numbers of flies were attracted to the bait. It was noticed that these occasionally 'took fright' in much the same way as do flocks of birds. No stimulus that could be seen caused this action. In normal circumstances the flies took off almost vertically and were likely to enter the trap, but in these fright flights, they took off much faster and at a lower angle. This meant that a large proportion of the flies escaped before they could enter the trap.

Some of the flies escaped from the trap through the entry hole and so it was decided to try to find out the escape rate of the flies from the trap. In this experiment, laboratory bred Calliphora vicina were marked with a spot of white paint on the dorsal surface of the thorax.

Thirty of the marked flies were released into each of four traps (Nos. 7, 8, 18, 19) on the 15th June and twenty-five flies into each of four traps (Nos. 4, 5, 14, 15) on the 19th June. They were put in early in the morning and then the traps were collected in the evening. The results can be seen in Table 1.

TABLE 1

Escape rate of marked flies from traps

| Date | Trap No. | No. introduced | No. remaining at end of day | % Escape | Average escape rate (%) |
|---|---|---|---|---|---|
| 15th June | 7<br>8<br>18<br>19 | 30<br>30<br>30<br>30 | 23<br>27<br>13<br>20 | 23.3<br>10.0<br>56.7<br>33.0 | 30.8 |
| 19th June | 4<br>5<br>14<br>15 | 25<br>25<br>25<br>25 | 22<br>17<br>11<br>11 | 12.0<br>32.0<br>56.0<br>56.0 | 39.0 |

Discussion

After the trapping on the 15th June it was thought that the flies might have been attracted to the bait from inside the trap. This would have caused them to do a more systematic search to find a way out. One fly was seen to escape through the hole, have a feed on the bait and then fly back into the trap. This suggests that some escapes may have occurred in this manner.

On the 18th of June and until the morning of the 19th the second group of flies had liver available for them to feed on. However, the higher escape rate on the second day suggests that if there was any such effect it was masked by some other factor.

When the flies were introduced into the traps, they were in an apparently stupified state after being carried in a small container for half an hour. In this condition they tended to crawl about rather than to fly. No direct observations were made on the flies immediately after their release into the traps but there is a strong possibility that some of the flies escaped by falling through the entry hole before they had recovered sufficiently to fly.

In the evening from 6 p.m. onwards, when the temperature started to drop, most of the flies flew to the top of the trap. There, they collected in bunches, like swarms of bees, around the tightener string. Some of these bunches fell off into the bottom of the trap. The fall of one such bunch through the entry hole could cause the loss of several flies and might account for the escape rate.

The final possibility is that during the flight in the trap some of the flies were certain to find the entry hole and then escape under the skirt.

Conclusions

Insufficient observations were made to ascertain which of these was the major cause of the escapes. It is postulated that the poor condition of the flies put into the trap is the major cause. Of the three possible reasons, this is the one which is not found on the normal trapping day. Therefore it is suggested that this high escape rate does not give a true picture of the rate in normal circumstances. Some flies will escape, but the percentage will probably be lower than obtained in this experiment.

# IV. ATTRACTION EFFECTS

## ATTRACTION EFFECTS

Cragg and Ramage (1945) discovered that flies in a trap could act as attractants to other flies. They set up a trap containing 150 live female Lucilia caesar aggr. and caught 34 more female L. caesar during the day without using any food bait and with only the female flies as attractants.

It was decided to test if the flies in this area reacted in the same way. Lucilia were not numerous enough to work with so Calliphora vomitoria and C. vicina were used. Flies were not released into the traps, as done by Cragg and Ramage, as escapes by laboratory bred flies from the traps could have ruined Miss Lewin's results if they had been recaptured.

Four baited traps were emptied every two hours (a total of five 2 hour periods) while four other traps were left out the whole day as controls. The premise was that if there was an attraction effect the traps left out the whole day should have a significantly higher catch at the end than those emptied every 2 hours. Each trap that was emptied two hourly had a paired trap as a control which was in a similar habitat. Thus on 1st June when trap 7 was emptied every 2 hours trap 4 acted as its control and on 3rd June trap 7 acted as the control and trap 4 was emptied.

The paired traps were as follows:-

| | | Set A. | Set B. |
|---|---|---|---|
| Low wood by stream | Traps | 4 | 7 |
| High wood on bank | Traps | 5 | 8 |
| Low meadow by stream | Traps | 15 | 19 |
| High meadow on bank | Traps | 14 | 18 |

The experiment was performed on four days (1st, 3rd and 26th June and 4th July) but, due to the very poor catches on the last two days, only the results from the first two could be used. The results for these two days can be seen in the tables in the Appendix. They are compared in Table 2.

TABLE 2

Comparison of catches in traps emptied at 2 hourly intervals (E) with those emptied at the end of the day (W)

| Date | Traps | E or W | Catch | Traps | E or W | Catch | % of total catch in E traps |
|---|---|---|---|---|---|---|---|
| | (a) *Calliphora vomitoria* | | | | | | |
| 1st June | Set B | E | 157 | Set A | W | 236 | 39.9 |
| 3rd June | Set A | E | 836 | Set B | W | 1,028 | 44.8 |
| Total | | | 993 | | | 1,264 | |
| 1st June | 7 only | E | 126 | 4 only | W | 234 | 35.0 |
| 3rd June | 4 only | E | 721 | 7 only | W | 876 | 45.1 |
| Total | | | 847 | | | 1,110 | |
| | (b) *Calliphora vicina* | | | | | | |
| 1st June | Set B | E | 78 | Set A | W | 46 | 62.9 |
| 3rd June | Set A | E | 103 | Set B | W | 149 | 40.9 |
| Total | | | 181 | | | 195 | |
| 1st June | 7 only | E | 34 | 4 only | W | 29 | 54.0 |
| 3rd June | 4 only | E | 46 | 7 only | W | 78 | 37.1 |
| Total | | | 80 | | | 107 | |

## Discussion

For *C. vomitoria* the combined totals for the E traps on both days are lower than the totals for the W traps. These results are significantly different at the 0.001 level (Chi square = 33). Traps 4 and 7 alone follow this trend almost exactly with a chi square of 35.5 which is also significant at the 0.001 level.

For C. vicina the results are not so clear cut. Neither the combined totals for the E and W traps nor the single trap numbers 4 and 7 are significantly different from a ratio of 1 : 1.

The results for C. vomitoria seem to support those obtained by Cragg and Ramage. There is a definite attraction of flies to an aggregation in a certain spot. Cragg and Ramage do not say if flies of different species to Lucilia caesar were attracted into their traps, so it is not known if an aggregation of one species will only attract that species or if it will attract others as well. No work seems to have been done on the actual stimulus, whether sight, sound or smell, which attracts the flies to each other. Judging by the way that flies find the bait, smell is a very important sense and it is probably this that brings the flies near each other, after which sight would be used.

It is possible that the attraction effects are higher than are shown by the results because some flies may have escaped from the traps (see Section IV). The traps with more animals in them, i.e. those out all day, will lose a high percentage than those taken in every two hours. This would counteract the attraction effects to some degree.

The lack of attraction shown by C. vicina may be due to a lack of reaction to stimuli. On the other hand the large numbers of C. vomitoria that were caught may have obliterated the smell of the fewC. vicina present. If it is the smell of C. vicina which would attract others of the same species, this could account for the lack of attraction.

The concentration of flies at one spot is of use in bringing the flies together to feed, mate and lay eggs. The combined attraction of the smell of a carcass and an aggregation of flies must be very appealing to a fly.

# V. THE DISTRIBUTION OF FLIES IN DIFFERENT HABITATS.

# THE DISTRIBUTION OF FLIES IN DIFFERENT HABITATS

The only results relevant to this subject are by Macloed and Donnelly,(1957: 1958) and a slight reference to it by Nuorteva (1963). No work at all could be found that referred to the distribution of the Muscidae.

The data for this work were obtained from the general trapping results. Only those species or genera of which at least ten specimens were caught are dealt with. Table III shows the total number of each species caught in each of the twenty traps. Each number is the combined total of fifteen trapping sessions. The separate trapping sessions from which these numbers were compounded can be seen in Tables 15-34 in the Appendix.

These numbers have been transposed onto the maps Figs.4-22. Where the specific or generic name at the top of the figure is followed by a date, then number at each trap position is the catch on that date alone. In other cases the numbers refer to the total catches in the eight special traps used in the six subsidiary trapping periods. These are shown by an 'S' following the heading name.

Where it seems meaningful, lines have been drawn enclosing traps whose catches all lie within certain ranges. It is realised that such 'contour' lines can be drawn in several different ways. The route taken for each line is the one that looks the most likely when all the traps in similar vegetation type have been taken into consideration.

In each map the red line shows the lower number contour and the purple line the higher one. The limits of the wooded area is shown in green.

For ease of description of the habitats it was decided to divide the traps up into four classes according to their positions:-

| | | |
|---|---|---|
| Low wood | Trap numbers | 1, 4, 7, 11 |
| High wood | Trap numbers | 2, 3, 5, 6, 8 |
| Low meadow | Trap numbers | 15, 19 |
| High meadow | Trap numbers | 9, 10, 12, 13, 14, 16, 17, 18, 20 |

It will be noted that the study area (see Section II(c)) formed a valley about 15 metres deep. The traps have been classes above into the 'high' and 'low' groups according to whether they were distributed at the bottom of the valley or at or near the top of the sloping sides.

It is not suggested that these classes are restricted to plant associations as in the phytosociological sense, but they indicate what may be different habitats as far as the flies are concerned.

<u>Calliphora vicina</u>

This fly has a fairly even distribution throughout the area. The contour lines show that the higher catches were obtained in the wood, but traps near to shade e.g. Traps 9, 10 and 19 also had reasonable catches. It appears to be tolerant of a wide range of conditions but prefers the more shaded parts. The occurrence all over the study area suggests that it is little affected by exposure to the wind.

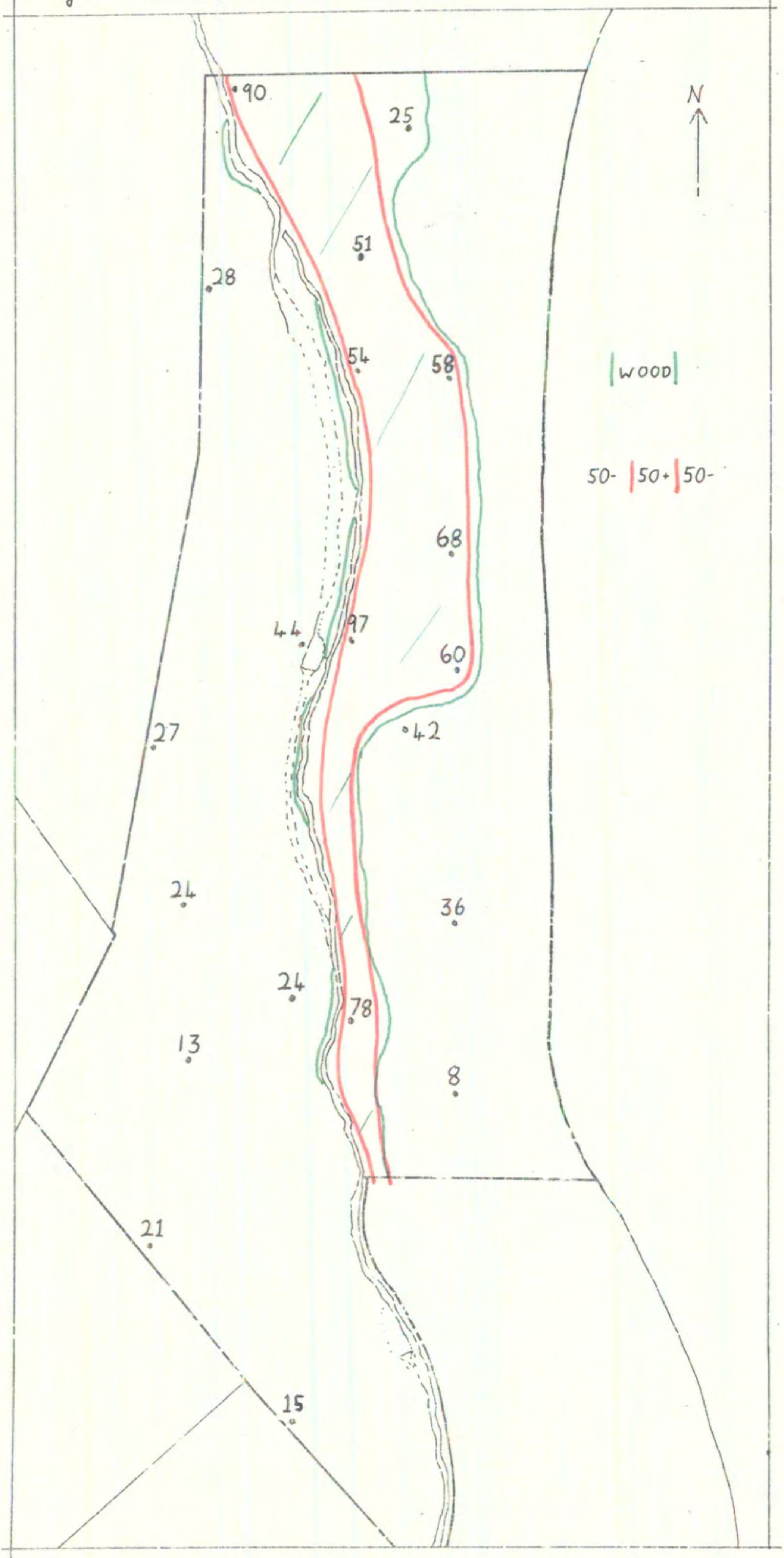
This is the same conclusion as that of Macloed and Donnelly (1958). Their catches of <u>C. vicina</u> were higher in taller vegetation, but good catches were obtained in exposed positions with little vegetation cover.

## Table 3

**Distribution of Calliphoridae and Muscidae in 20 traps in the study area**

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Calliphora vicina | 90 | 25 | 51 | 54 | 58 | 68 | 97 | 60 | 42 | 36 | 78 | 8 | 15 | 21 | 24 | 13 | 24 | 27 | 44 | 28 |
| Calliphora vomitoria | 461 | 13 | 10 | 448 | 28 | 34 | 741 | 9 | 18 | 100 | 259 | 10 | 127 | 1 | 14 | 0 | 17 | 4 | 13 | 5 |
| Lucilia spp. | 133 | 17 | 37 | 19 | 68 | 45 | 390 | 42 | 124 | 206 | 68 | 58 | 76 | 47 | 22 | 98 | 104 | 116 | 228 | 162 |
| Sarcophaga spp. | 4 | 16 | 3 | 2 | 4 | 5 | 7 | 4 | 28 | 13 | 14 | 11 | 8 | 11 | 11 | 4 | 3 | 9 | 21 | 5 |
| Cynomyia mortuorum | 1 | 2 | 0 | 0 | 3 | 3 | 1 | 2 | 0 | 1 | 0 | 4 | 0 | 10 | 2 | 15 | 4 | 13 | 9 | 9 |
| Acrophaga subalpina | 15 | 15 | 7 | 18 | 16 | 6 | 17 | 8 | 12 | 12 | 23 | 12 | 5 | 1 | 9 | 7 | 11 | 4 | 13 | 8 |
| Dasyphora cyanella | 1 | 0 | 0 | 3 | 1 | 0 | 7 | 1 | 3 | 16 | 4 | 1 | 0 | 1 | 5 | 2 | 2 | 2 | 7 | 0 |
| Polietes lardarius | 83 | 1 | 20 | 2 | 0 | 0 | 17 | 0 | 2 | 1 | 7 | 0 | 1 | 0 | 5 | 0 | 3 | 1 | 1 | 0 |
| Phaonia spp. | 25 | 3 | 14 | 34 | 21 | 11 | 49 | 14 | 7 | 3 | 30 | 1 | 8 | 2 | 8 | 0 | 5 | 6 | 9 | 7 |
| Muscina assimilis | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 4 | 0 | 0 | 0 | 4 | 0 |
| Muscina pabulorum | 2 | 0 | 0 | 0 | 4 | 1 | 5 | 0 | 4 | 9 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Mydaea spp. | 64 | 8 | 37 | 56 | 17 | 0 | 115 | 30 | 5 | 23 | 35 | 3 | 12 | 5 | 7 | 13 | 21 | 7 | 17 | 6 |

Fig. 4. CALLIPHORA VICINA



Calliphora vomitoria

As well as the map (Fig.5) for the combined trapping periods, there is a map for each of the trapping days 2nd June (Fig.6) and 5th June (Fig.7).

Fig.5 shows that *C. vomitoria* has a considerable preference for the shaded and sheltered area of the low wood. According to Macloed and Donnelly (1958) they are not deterred by a slope of $45^{\circ}$ and so it cannot be the slope in the wood that causes this preference. This small area is more shaded than the woody slopes and also is more protected from the wind. The more distant a trap is from these conditions, then the fewer flies does it catch e.g. traps 14, 16, 18, 20. Trap 10 is a trap that regularly had a high catch and yet it was in the open, never shaded and exposed to the winds. Such 'trap idiosyncrasy' was mentioned by Macloed and Donnelly (1956) and will be discussed in Section IX.

The trapping on 2nd June shows a distribution almost identical with that for the compounded trapping. Only Trap13 shows a distinct deviation from the normal. On this one day it caught nearly six times as many flies as on the other fourteen days together. Such an odd catch is difficult to explain and will be discussed in Section IX.

The results for 5th June show a rather similar pattern to the normal. All the traps in the low wood, except trap 7, have lower catches than might have been expected. This was a day with rather little wind (only 2 knots) and might have increased the acceptability of the other traps. However, these do not show a significantly higher catch and so this may be a temporary trap idiosyncrasy.

Macloed and Donnelly (1957) had very anomalous results with this species, but concluded that it needed dense cover such as woods or deep field layer.

Fig. 5. CALLIPHORA VOMITORIA

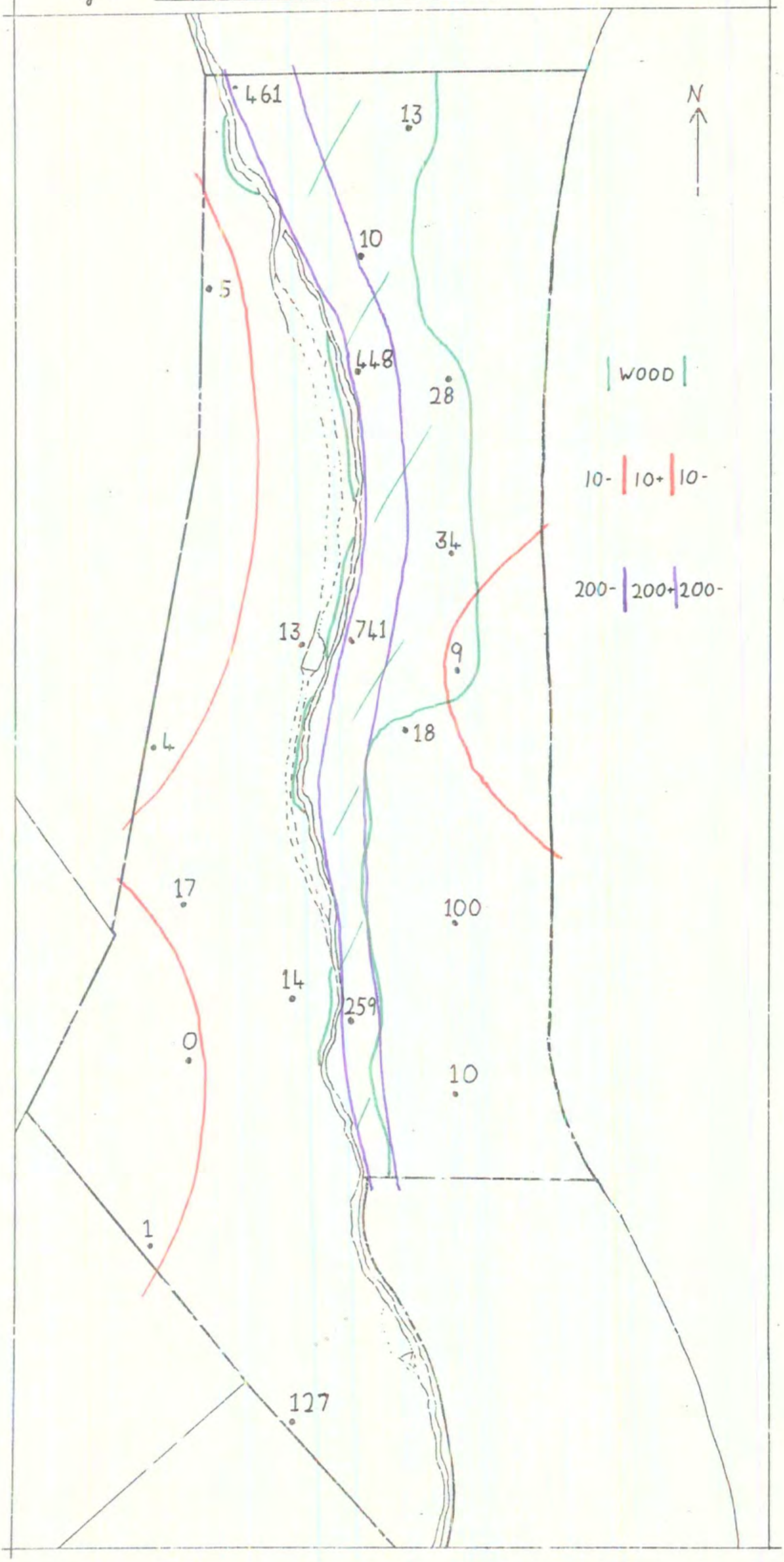


Fig. 6. CALLIPHORA VOMITORIA. (2nd. June)

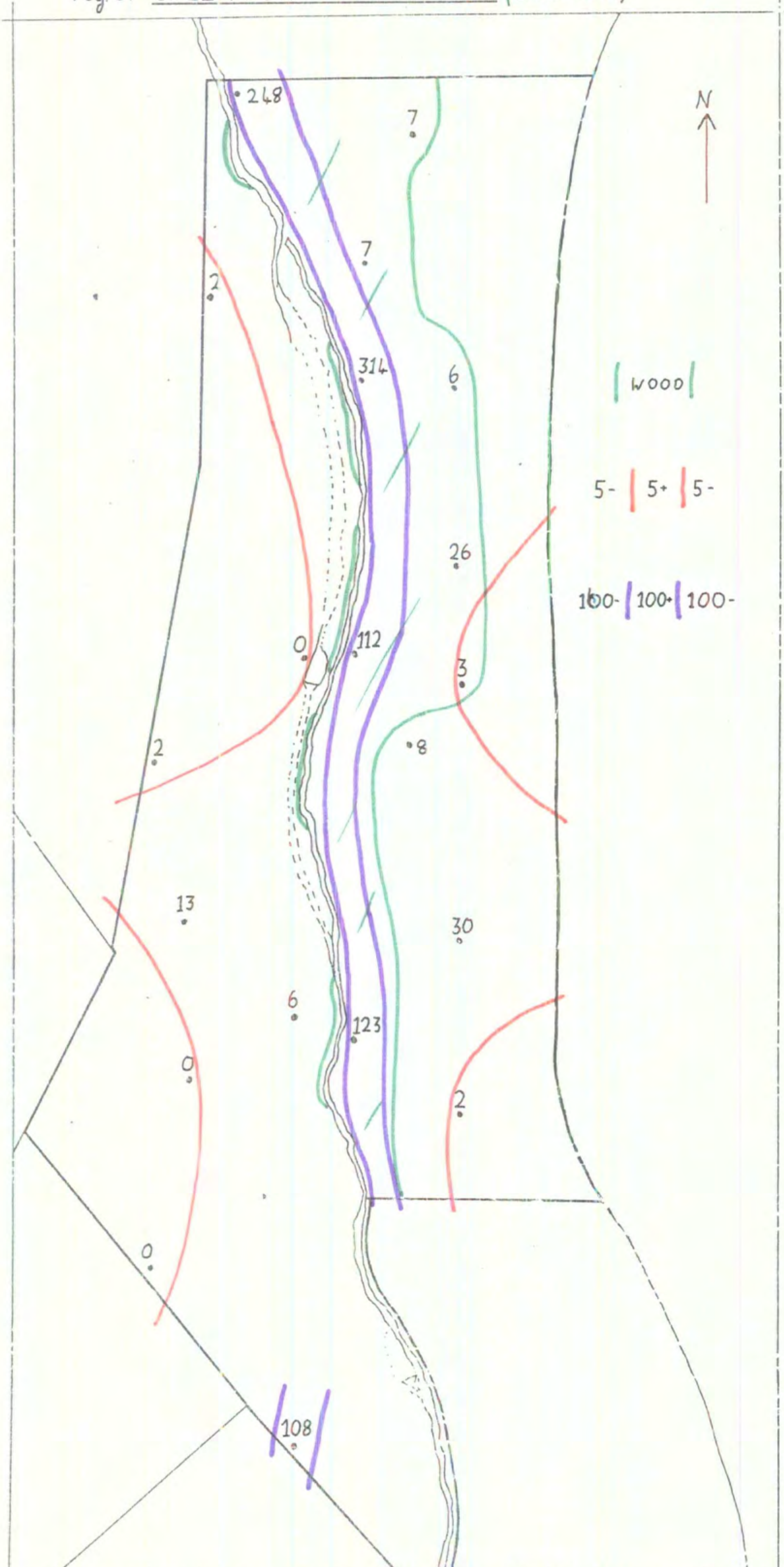


Fig 7 CALLIPHORA VOMITORIA (5th June)

<u>Sarcophaga</u> spp.

As far as could be seen from general looks, only two species of <u>Sarcophaga</u> were discovered though this may be entirely incorrect. Of one species only three specimens were obtained and so it is suggested that the distribution shown may be of only one species.

In Fig.8 it is difficult to see any definite trends though there may be a tendency to greater numbers in the open. Table 4 shows the totals caught in each of eight traps used for subsidiary trapping.

TABLE 4

Total numbers of Sarcophaga spp. caught in the eight traps shown during the six subsidiary trapping periods

| Habitat | Trap No. | Total of 6 trapping periods | Total of 21 trapping periods |
|---|---|---|---|
| Low wood | 4 | 9 | 11 |
| " " | 7 | 13 | 20 |
| Low meadow | 15 | 36 | 47 |
| " " | 19 | 17 | 38 |
| High wood | 5 | 10 | 14 |
| " " | 8 | 8 | 12 |
| High meadow | 14 | 14 | 25 |
| " " | 18 | 19 | 28 |

The combined totals of the 21 periods for these traps are shown in Fig.9. This clearly shows a preference for the open habitats, more in the lower sheltered meadow regions than in the higher meadow.

Fig. 8. SARCOPHAGA spp

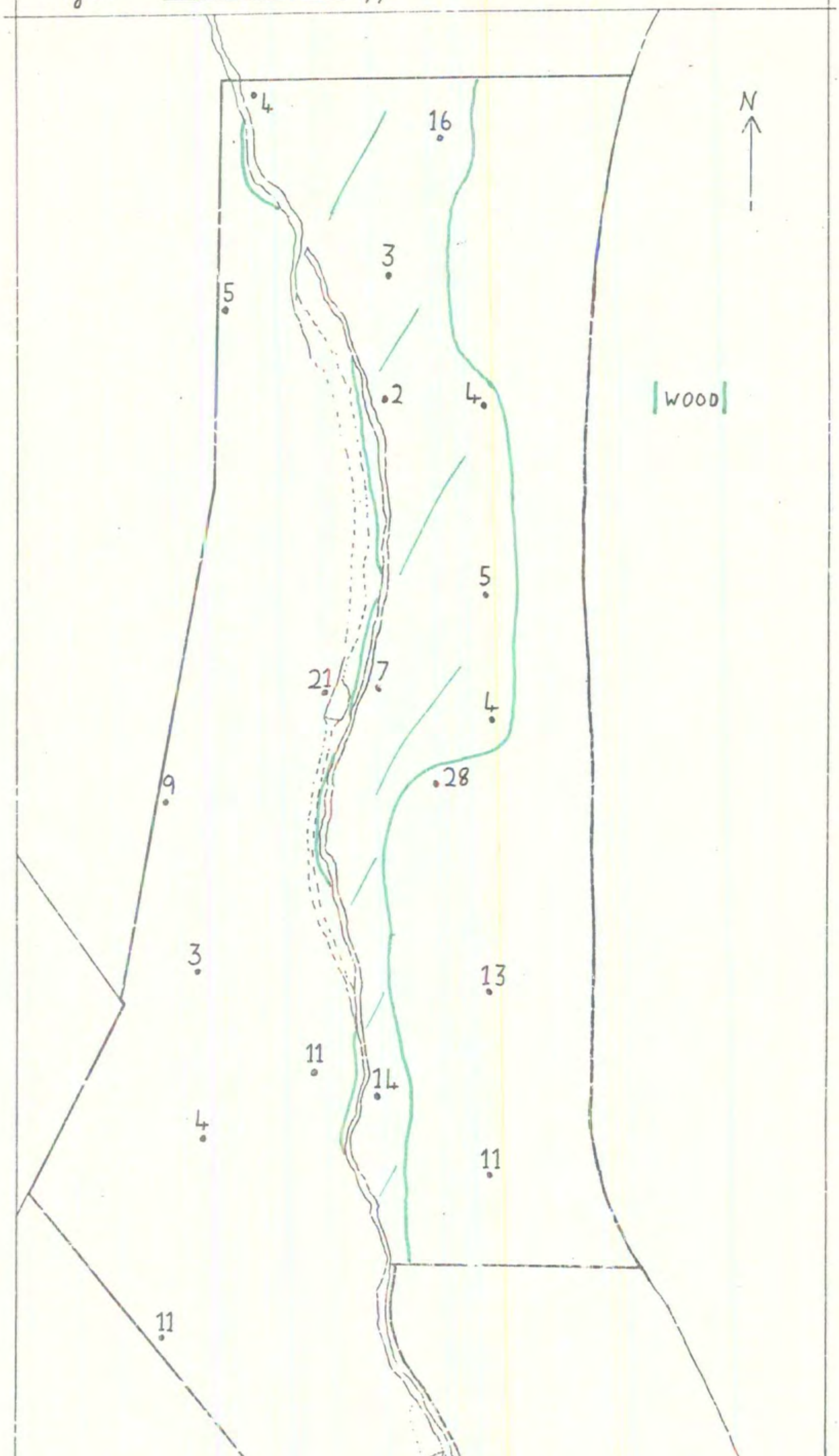
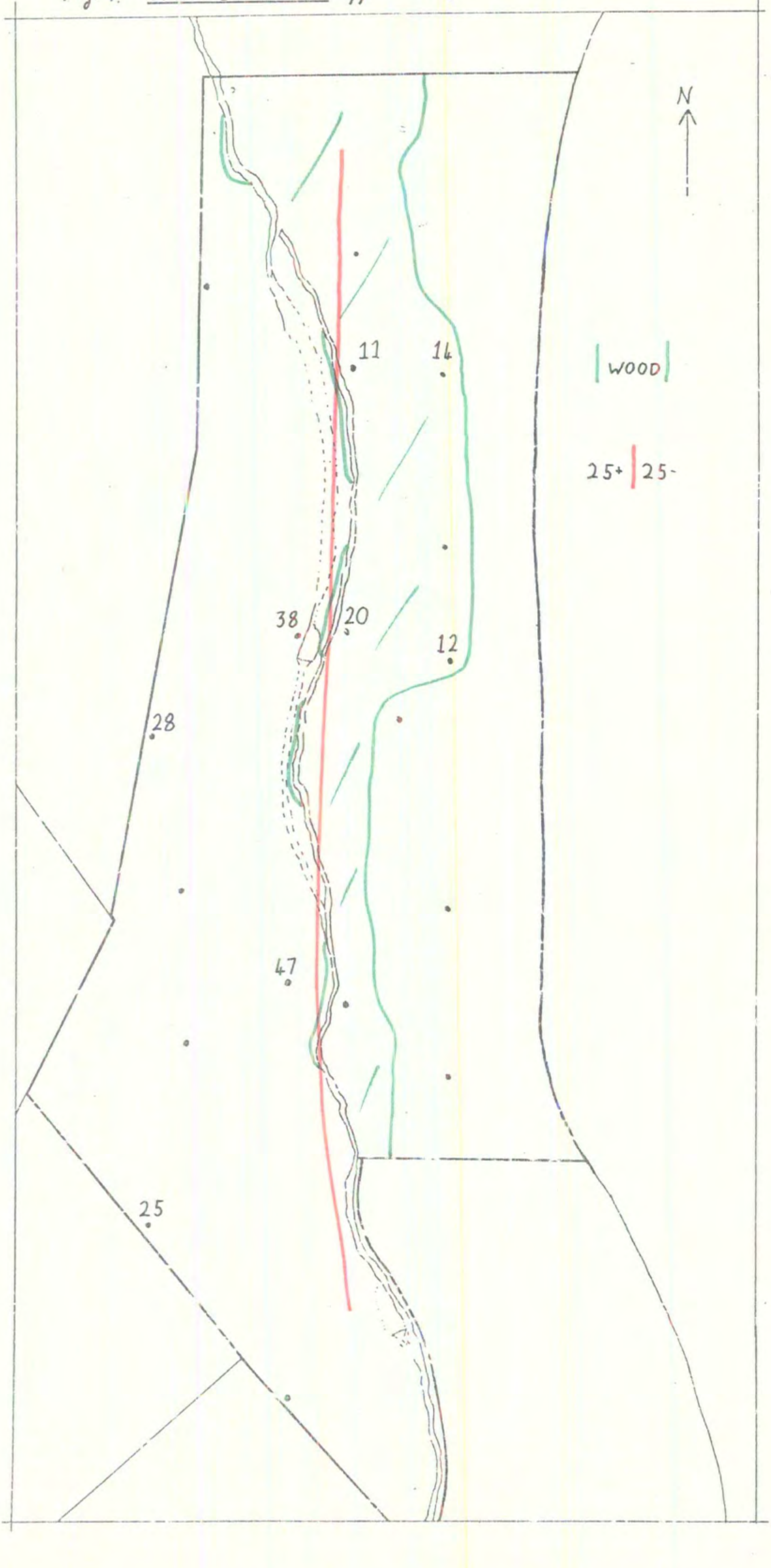


Fig. 9. SARCOPHAGA spp S





Lucilia species

From Fig.10 no particular habitat can be seen which is favoured by this genus. A wedge of high numbers is present into the trapping area from the fields to the west of the field station. This may suggest that it is the edge of a larger area of high density, but this is impossible to ascertain.

TABLE 5

TOTAL NUMBERS OF LUCILIA SPP. CAUGHT IN THE EIGHT TRAPS SHOWN DURING THE SIX SUBSIDIARY TRAPPING PERIODS

| Habitat | Trap No. | Total of 6 trapping periods | Total of 21 trapping periods |
|---|---|---|---|
| Low wood | 4 | 184 | 203 |
| " " | 7 | 308 | 698 |
| Low meadow | 15 | 213 | 235 |
| " " | 19 | 478 | 706 |
| High wood | 5 | 51 | 119 |
| " " | 8 | 87 | 129 |
| High meadow | 14 | 76 | 123 |
| " " | 18 | 103 | 219 |

The introduction of the six subsidiary trapping days (Table 5 and Fig.11) shows a slight preference for the valley floor. For some reason difficult to understand traps 7 and 19 have very high catches, much higher than the other six traps. This seems to be another case of trap idiosyncrasy for the conditions at these two traps are little different from those at traps 4 and 15.

Macloed and Donnelly (1957) thought that the Lucilia caesar aggr. preferred shaded haunts, but could occur out in the open where a high field layer was present. But in 1958 they changed their minds and said that this group preferred areas that were sheltered from the wind, but not shaded from the sun. These two opposing views suggest a wide tolerance of conditions, a state that would seem to be supported by these results.

Fig. 10. LUCILIA spp

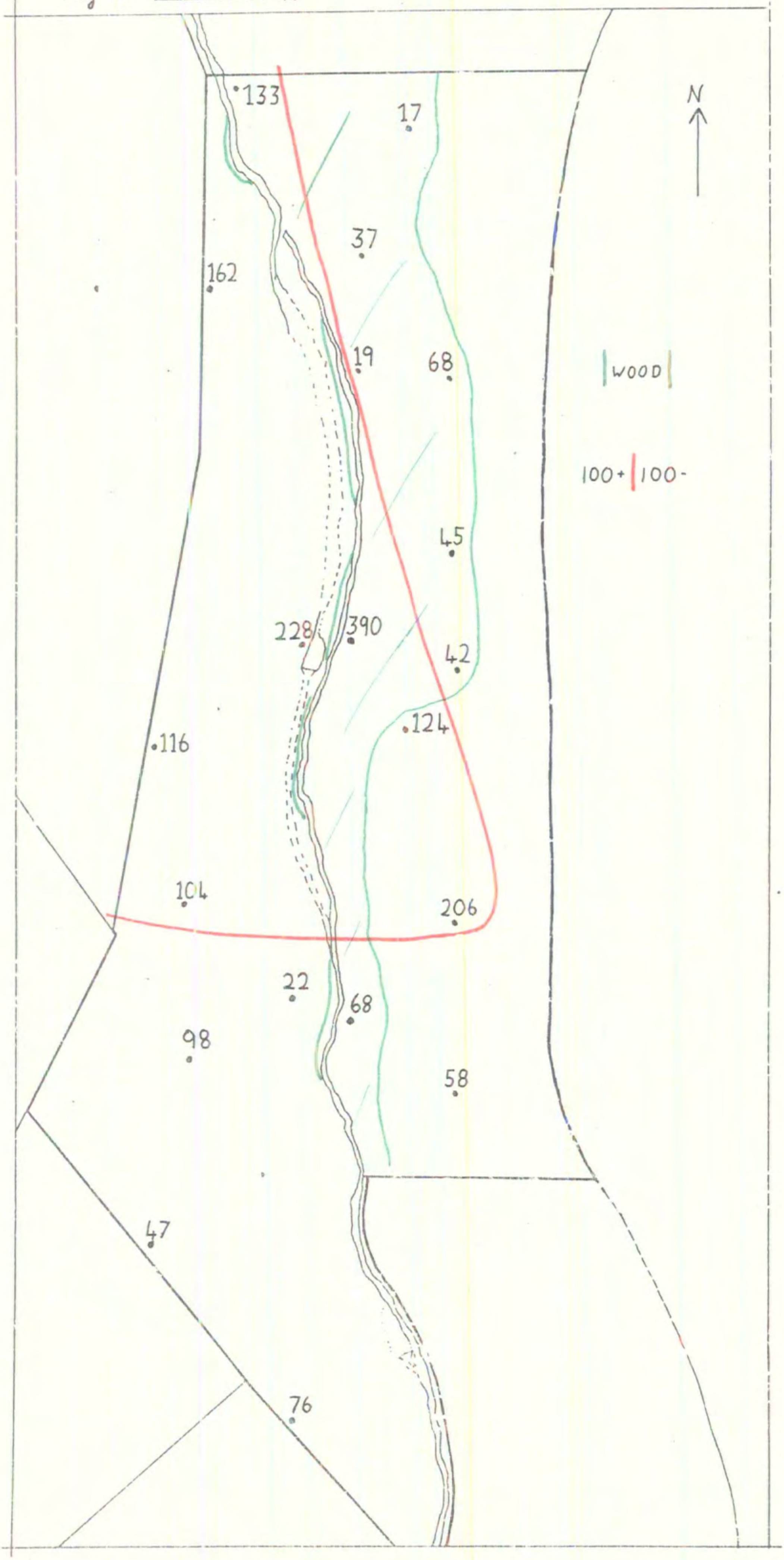
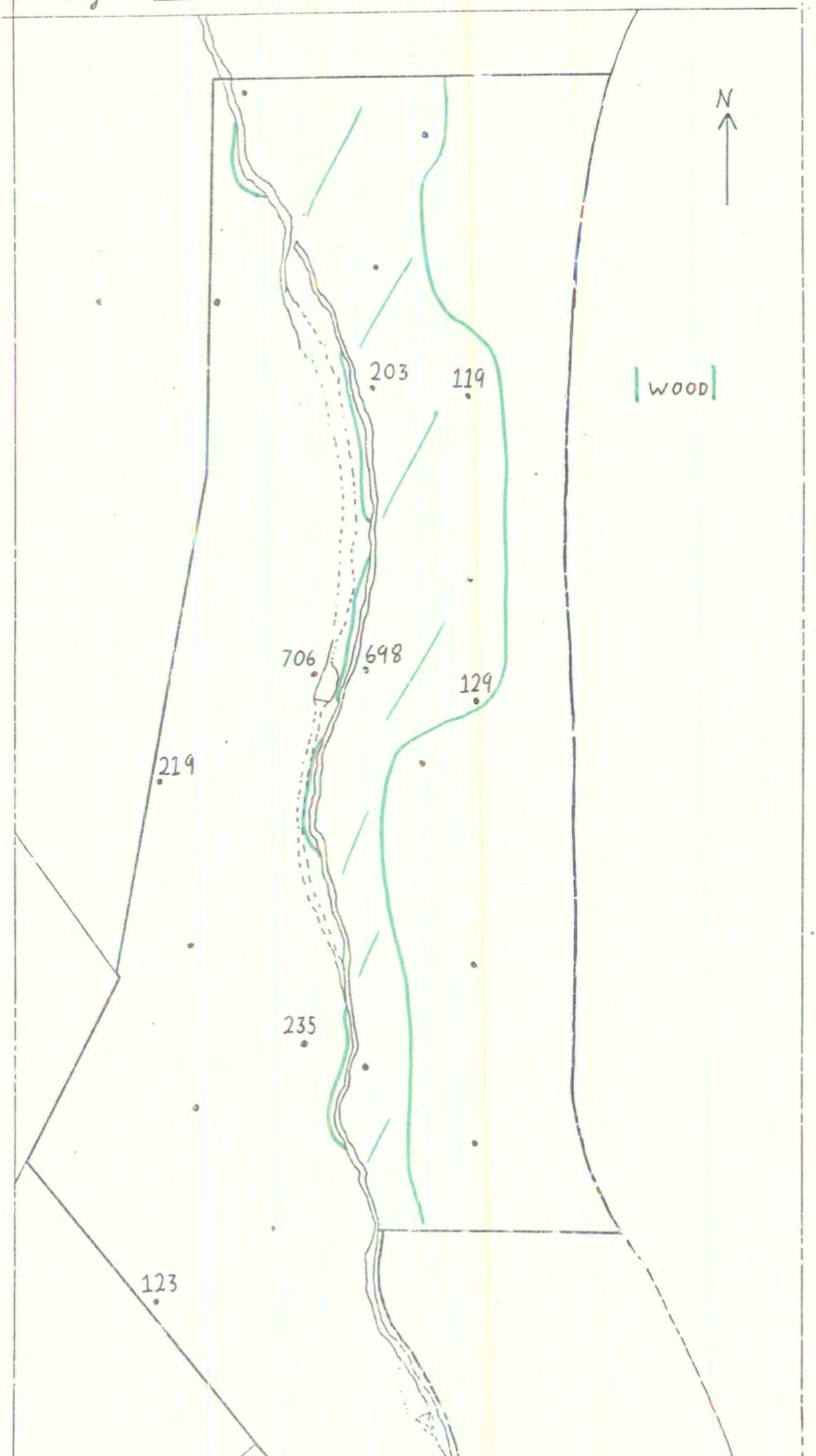


Fig. 11. LUCILIA spp S



As the population of Lucilia was almost entirely composed of the L. caesar aggr., it might be reasonable to assume that if this group could have been broken up into its component species, more definite distributions might have been obtained.

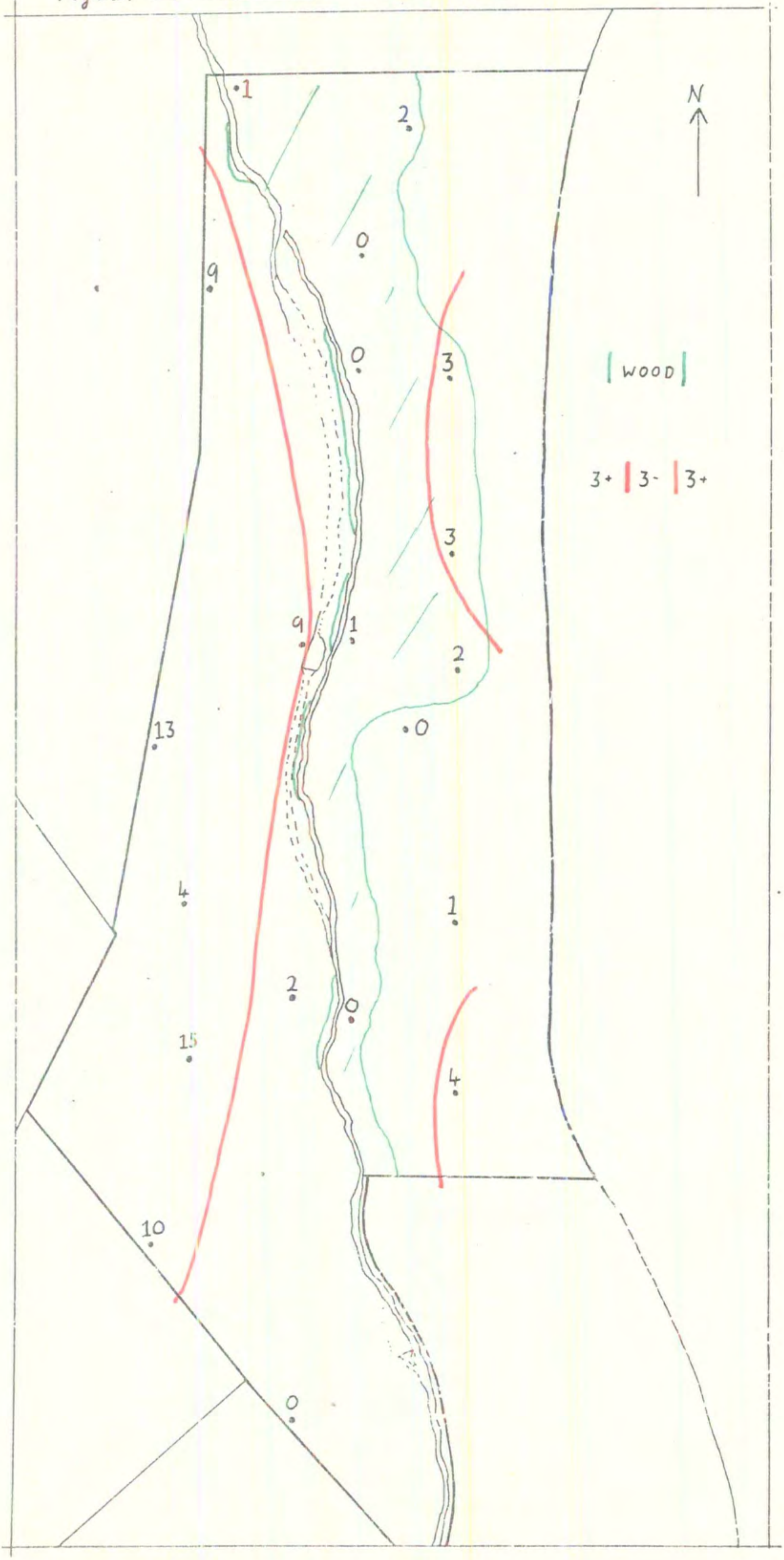
Cynomyia mortuorum

From these results it can be seen that Cynomyia prefers the more open areas. These are more exposed to the winds than the traps in the low wood which have both topographic and vegetational shelter. The exposed traps with rather low vegetation, e.g. traps 9, 13, 15 and 17, have fewer animals in them than those with lush plant growth around them. Thus it may be assumed that Cynomyia prefers exposed areas with a high field layer.

Macloed and Donnelly (1958) came to exactly the same conclusions that this species kept to exposed areas and avoided topographic shelter because this often contained vegetation which caused shading. This result agrees with the fact that Cynomyia occurs commonly on mountain slopes and moorland and is more abundant in northern and western Britain including the Hebrides. It is the most common blowfly on the notoriously exposed island of St. Kilda (Davies, personal communication).

Fig.12. CYNOMYIA MORTUORUM





Acrophaga subalpina

From Fig.13, it can be seen that this fly is fairly well distributed throughout the trapping area. There may be a preference for the wooded areas, particularly the low wood, but this is not too obvious. Fig.14 shows the total catch in only the eight special traps from 21 trapping periods. It is the whole valley floor rather than the low wood alone that is attractive. The higher numbers in the high wood than in the high meadow suggest that shading is of importance but less than the sheltering effect.

The only reference that can be found to this species is by Nuorteva (1963) where he deals with the synanthropy of the blowflies. He says that the more synanthropic species are more likely to be caught in the open and then goes on to give Acrophaga a strongly negative synanthropic index. This implies that Acrophaga is more likely to be found in wooded areas. This seems to endorse the results shown although it is dangerous to read too much into such scanty evidence.

Fig. 13 ACROPHAGA SUBALPINA

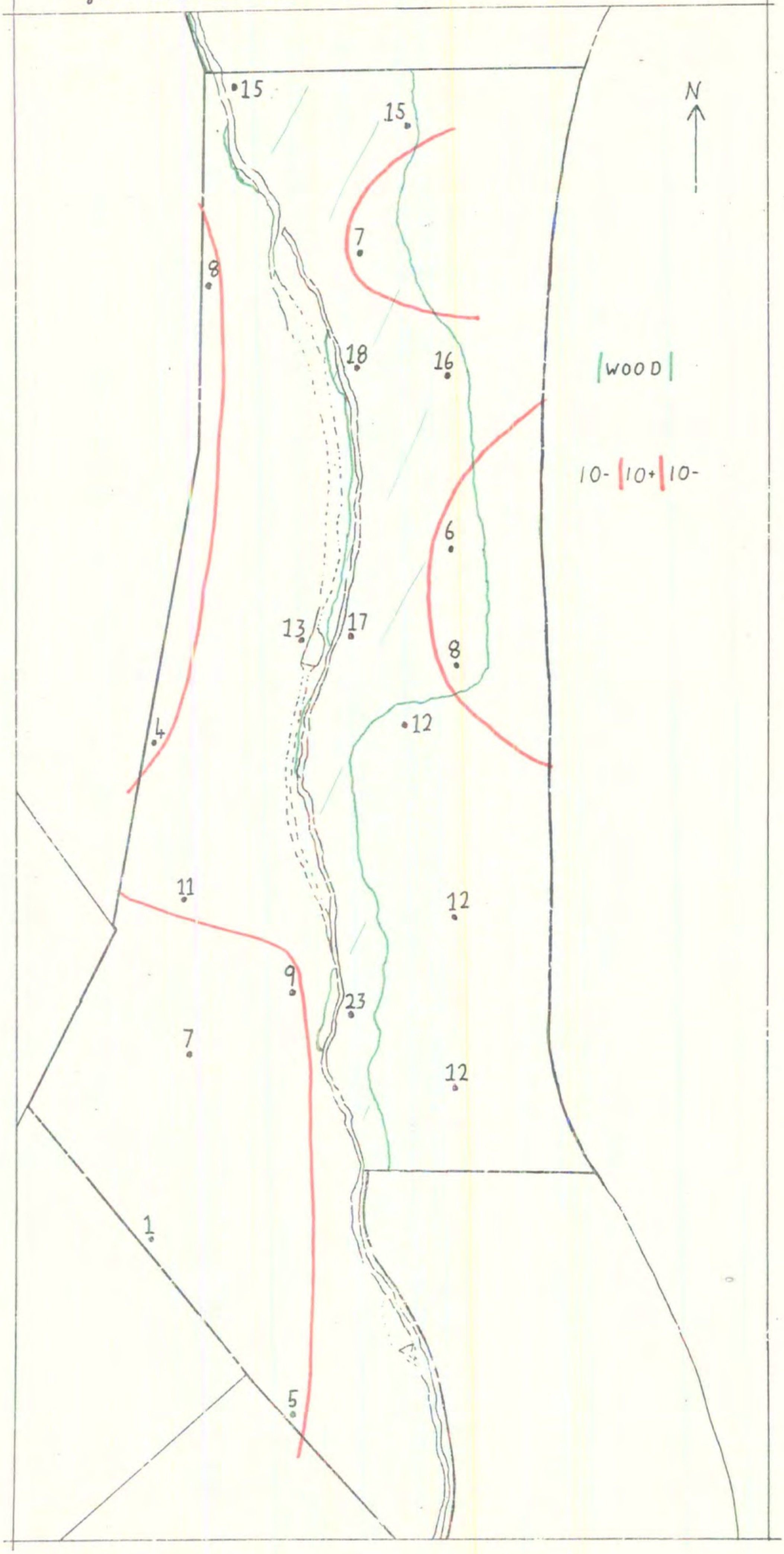
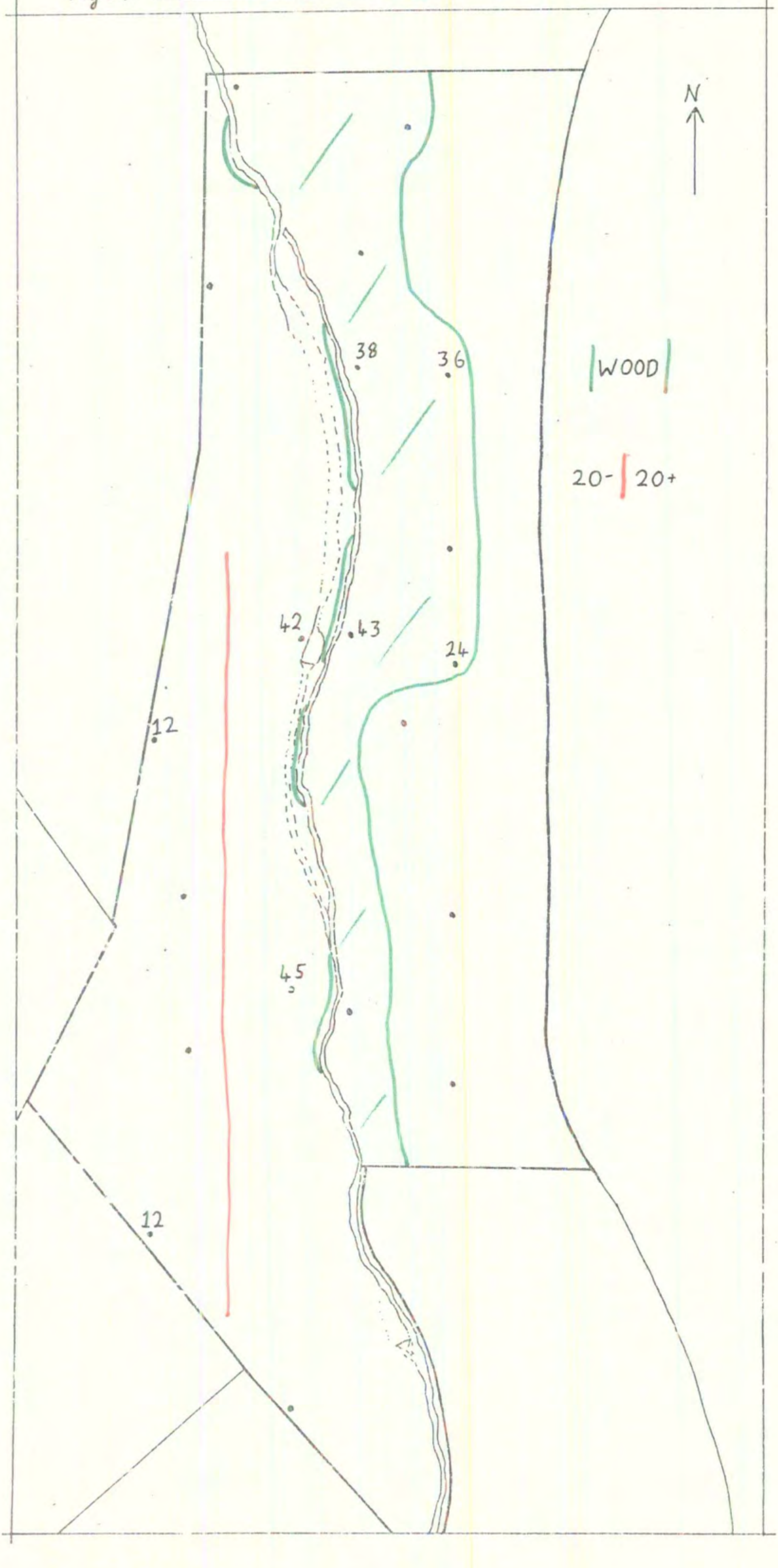


Fig. 14. ACROPHAGA SUBALPINA S



Dasyphora cyanella

A contour line has been drawn around several traps in the centre of the field station. These traps are in the lower more sheltered regions of the trapping area. The high number in trap 10 is almost entirely due to a large catch on 5th June (see Appendix Table 24), already described as a rather odd trapping day.

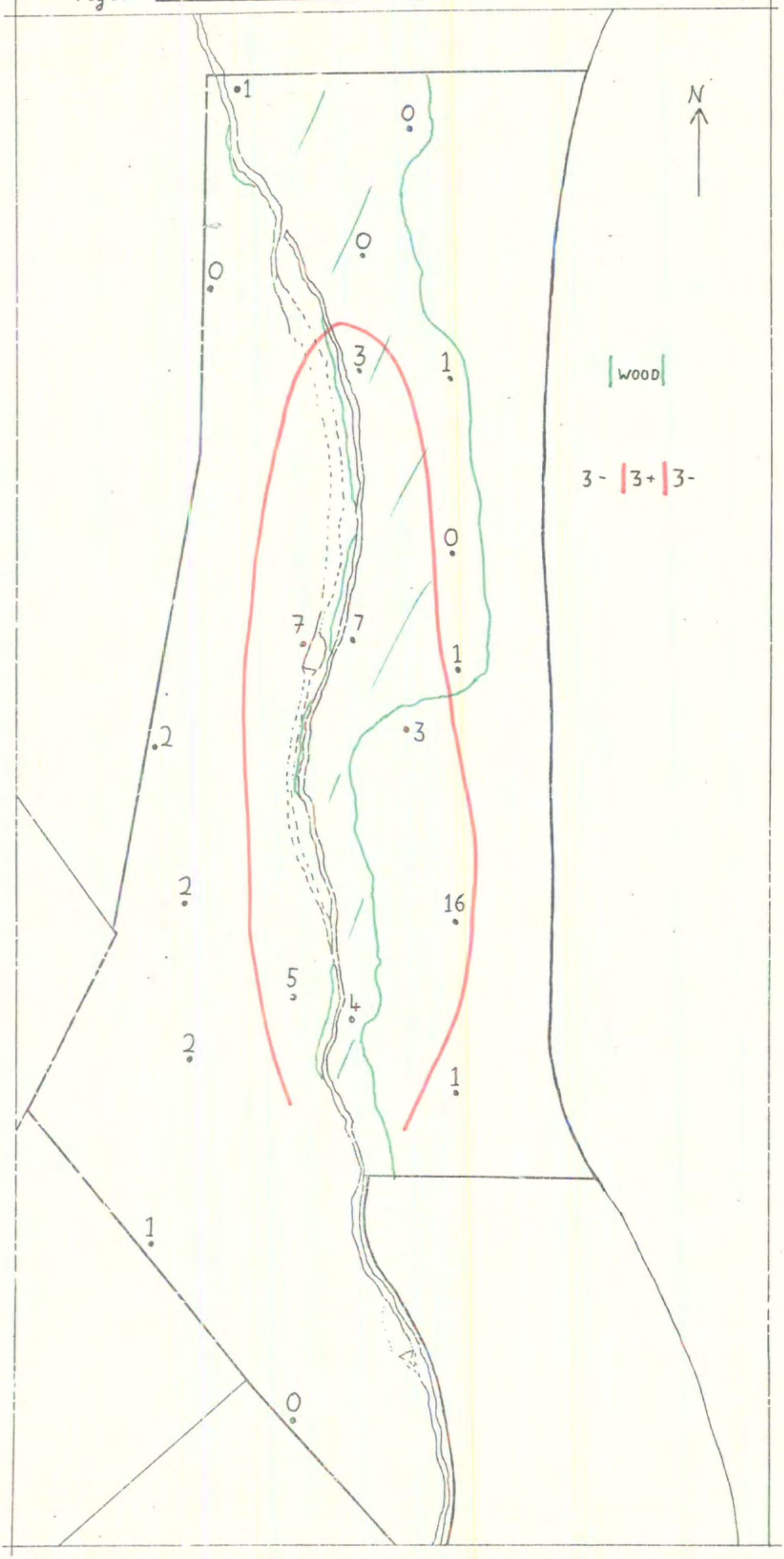
TABLE 6

TOTAL NUMBER OF DASYPHORA CYANELLA CAUGHT IN THE EIGHT TRAPS SHOWN DURING THE SIX SUBSIDIARY TRAPPING PERIODS

| Habitat | Trap No. | Total of 6 trapping periods | Total of 21 trapping periods |
|---|---|---|---|
| Low wood | 4 | 5 | 8 |
| " " | 7 | 22 | 29 |
| Low meadow | 15 | - | 5 |
| " " | 19 | 2 | 9 |
| High wood | 5 | - | 1 |
| " " | 8 | 1 | 2 |
| High meadow | 14 | 1 | 2 |
| " " | 18 | - | 2 |

These results in Table 6 show that it prefers the lower parts of the reserve where it is more sheltered.

Fig.15 DASYPHORA CYANELLA



Polietes lardarius

Fig.16 shows that this species appears to be confined more to the lower regions of the valley, especially the wood, where the traps are more shaded and sheltered.

The extremely high catch in trap 1 is due largely to two heavy trappings, one on 10th June (see Fig.17) and the other on 23rd June. This species is a dung fly, the adults being seen in large numbers on fresh cow pats. 10th June was the hottest day on which trapping occurred and it is very likely that the cattle which grazed the fields across the stream from trap 1 sheltered under some bushes just upstream from the field station. The dung they dropped there could have attracted the Polietes, some of which may have been diverted to trap 1.

Fig.16 POLIETES LARDARIUS

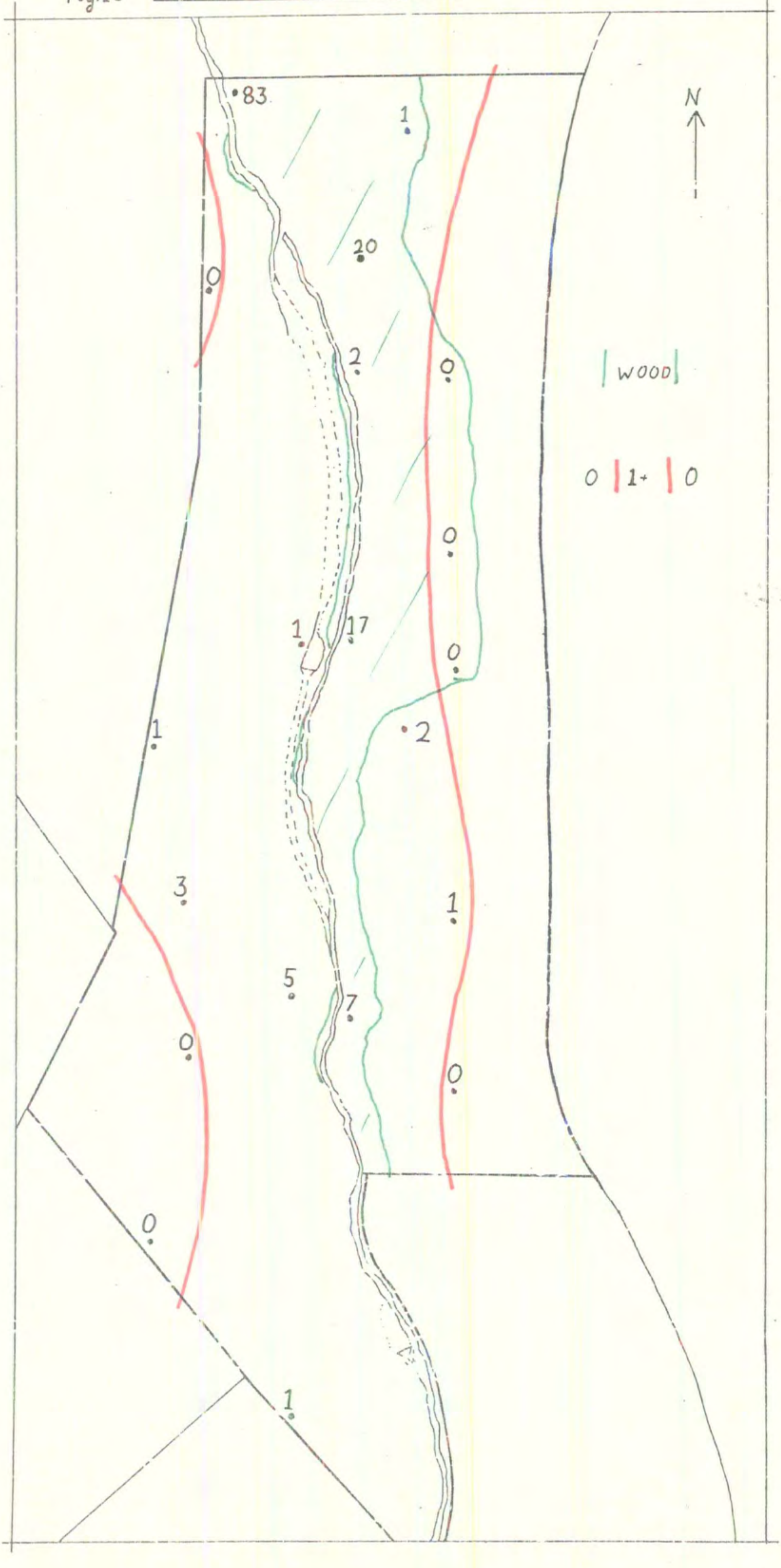
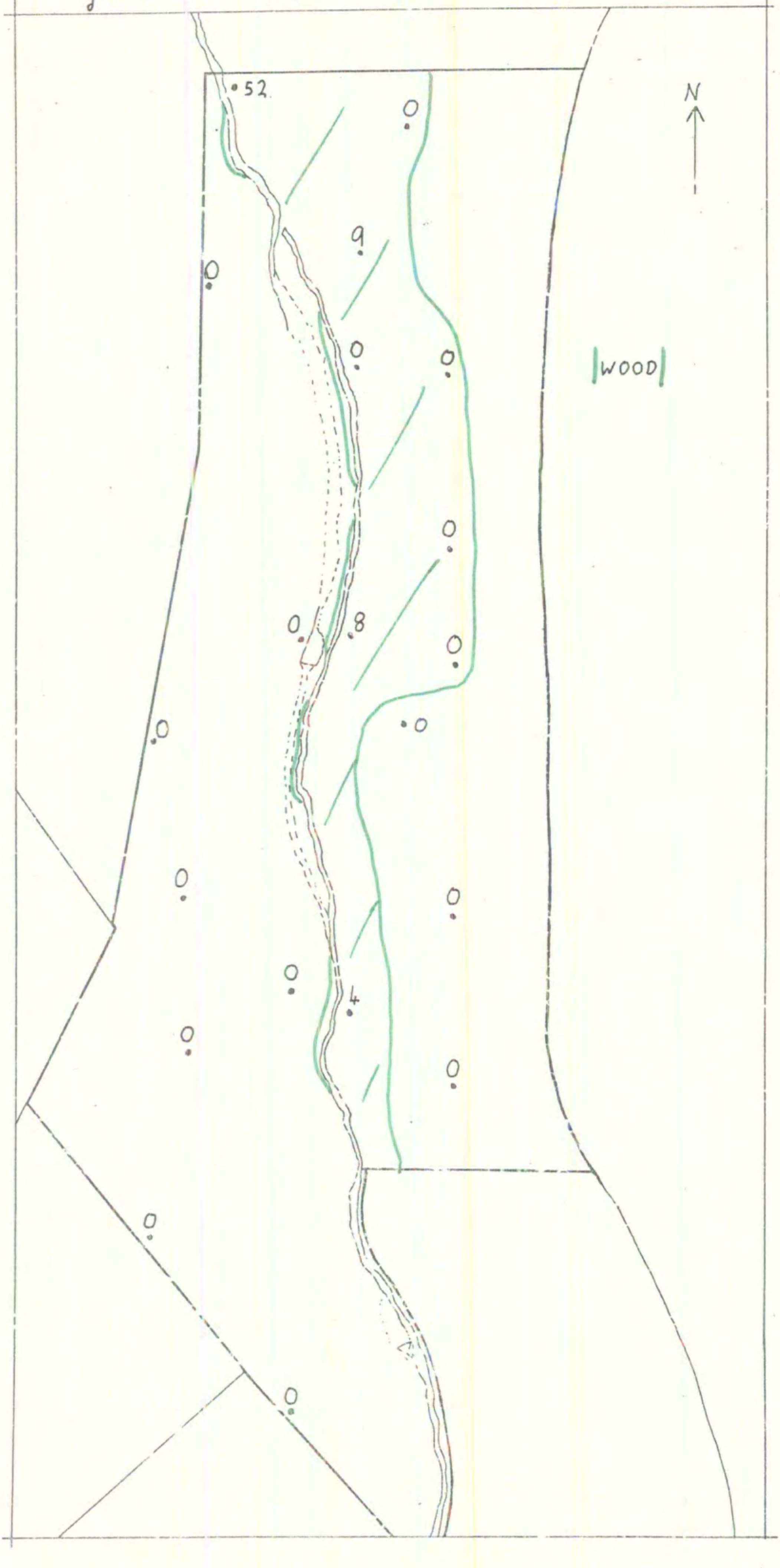


Fig. 17 POLIETES LARDARIUS (10th. June)



Muscina assimilis

Too few flies were caught to put great weight on any conclusions drawn from the results shown in Fig.18.

TABLE 7

TOTAL NUMBER OF MUSCINA ASSIMILIS CAUGHT IN THE EIGHT TRAPS SHOWN DURING THE SIX SUBSIDIARY TRAPPING PERIODS

| Habitat | Trap No. | Table of 6 trapping periods | Table of 21 trapping periods |
|---|---|---|---|
| Low wood | 4 | 4 | 4 |
| " " | 7 | 7 | 7 |
| Low meadow | 15 | 5 | 9 |
| " " | 19 | 7 | 11 |
| High wood | 5 | - | - |
| " " | 8 | - | - |
| High meadow | 14 | - | - |
| " " | 18 | - | - |

This extra evidence shows that M. assimilis can be found in the low wood and the low meadow traps (see Fig.19). This suggests that it is the shelter from the wind that they desire and possibly the attraction to an 'edge type' of environment.

Fig.18 MUSCINA ASSIMILIS

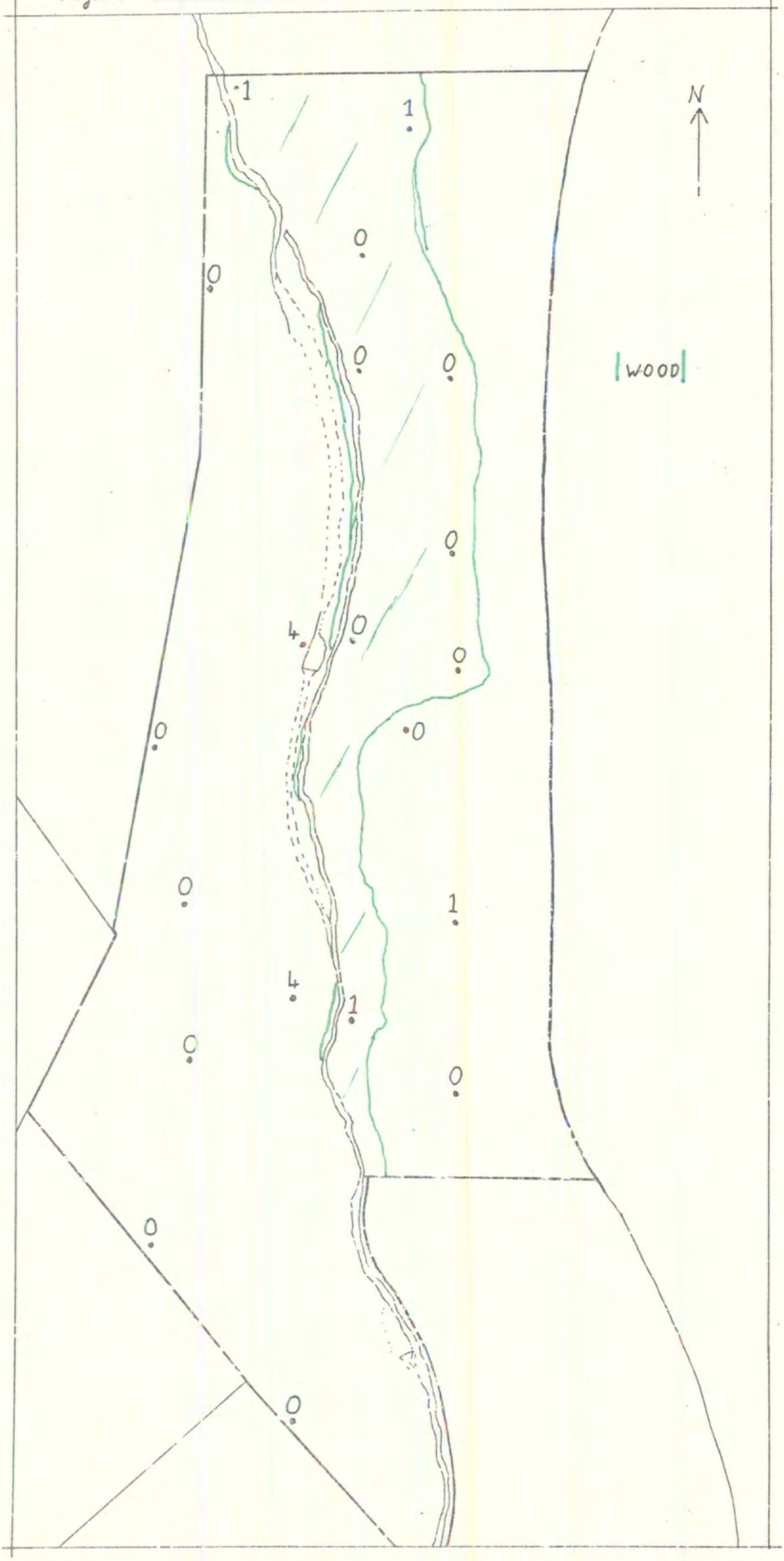
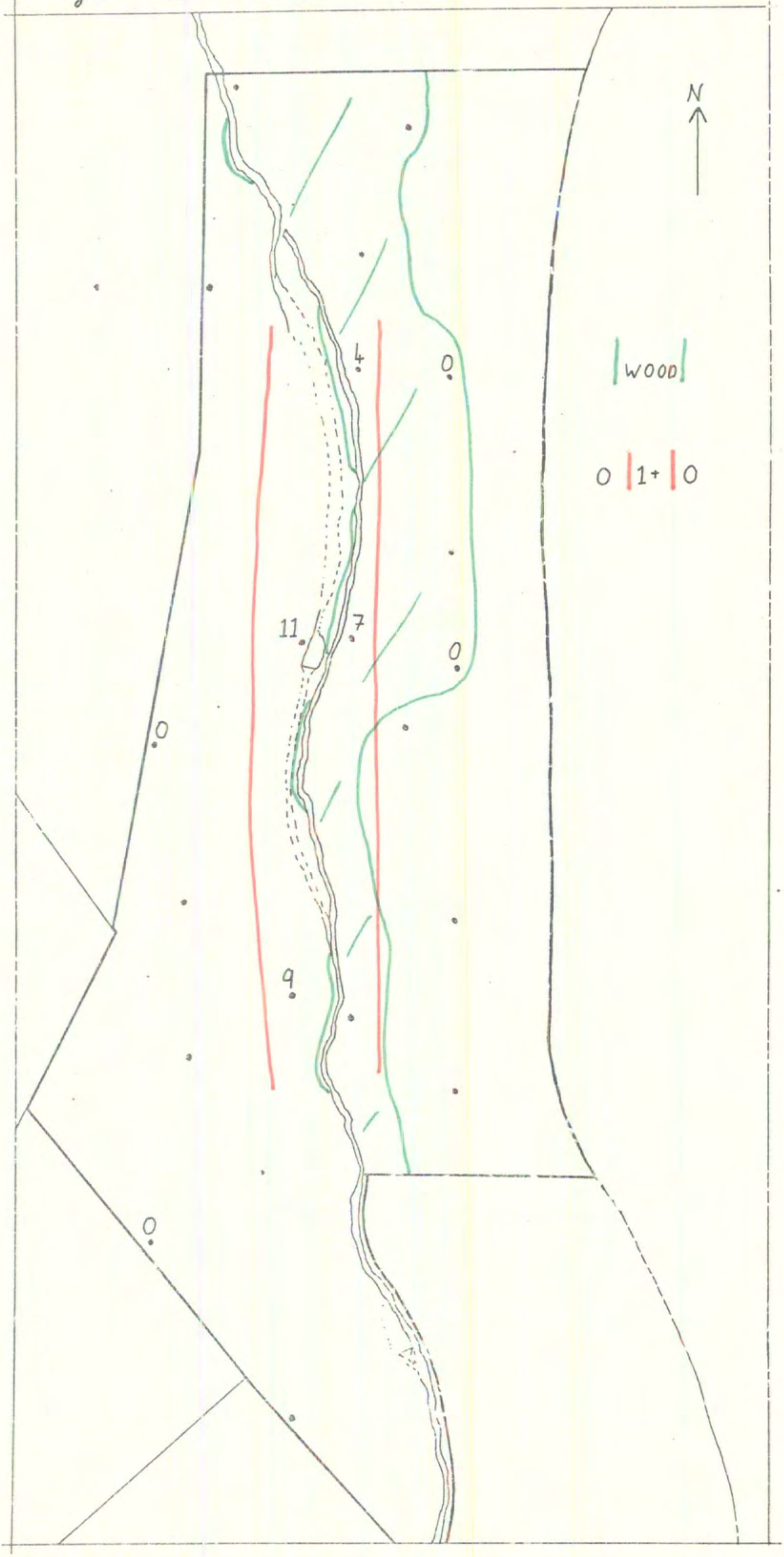


Fig. 19 MUSCINA ASSIMILIS S





Muscina pabulorum

There seems to be little consistancy in the distribution of this fly. The traps on the eastern side of the field station are more popular but the presence or absence of shade or shelter makes little difference.

TABLE 8

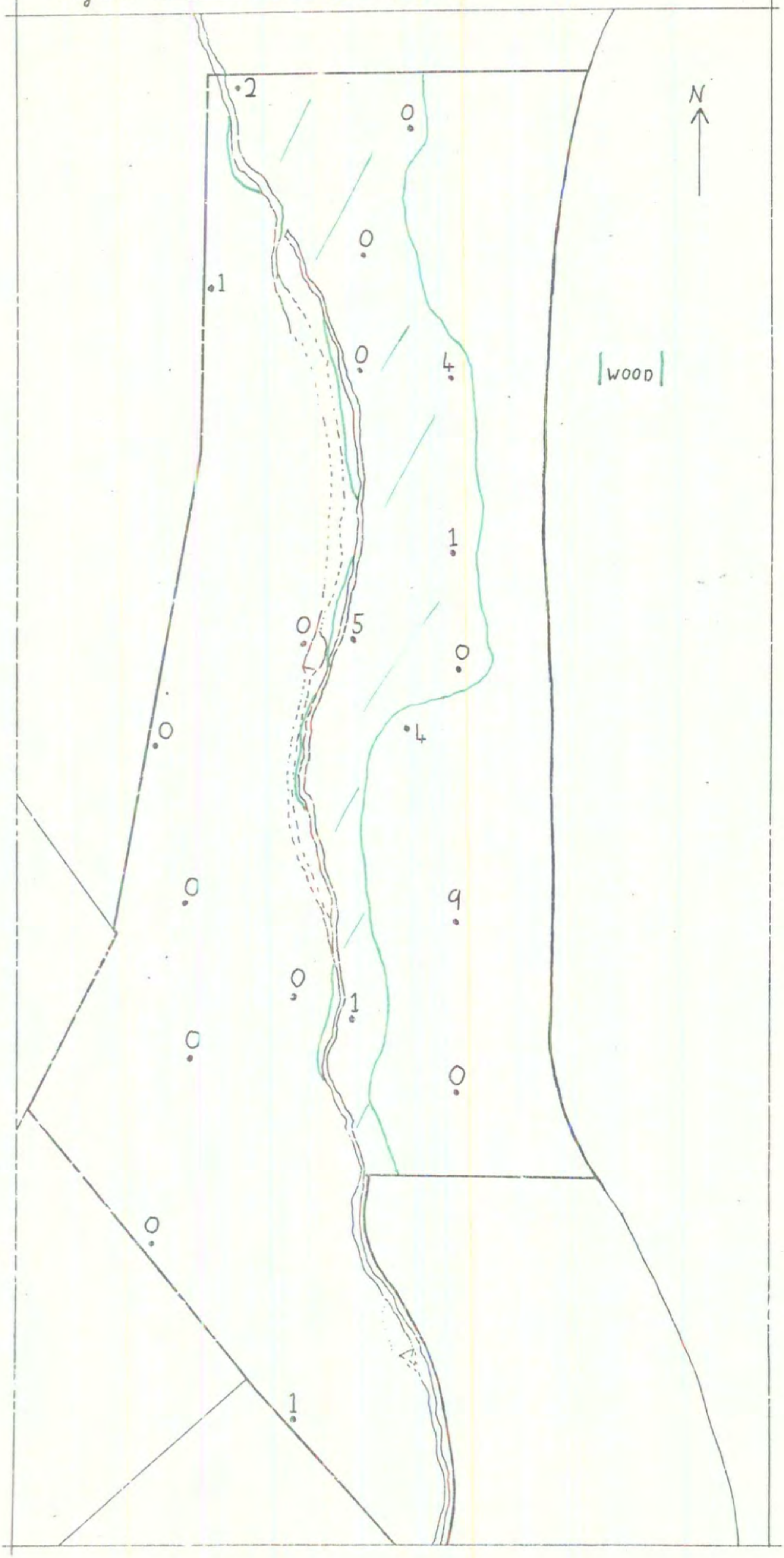
TOTAL NUMBERS OF MUSCINA PABULORUM CAUGHT IN THE EIGHT TRAPS SHOWN DURING THE SIX SUBSIDIARY TRAPPING PERIODS

| Habitat | Trap No. | Total of 6 trapping periods | Total of 21 trapping periods |
|---|---|---|---|
| Low wood | 4 | 9 | 9 |
| " " | 7 | 7 | 12 |
| Low meadow | 15 | 2 | 2 |
| " " | 19 | 4 | 4 |
| High wood | 5 | 2 | 6 |
| " " | 8 | - | - |
| High meadow | 14 | - | - |
| " " | 18 | - | - |

The appearance of flies in traps 4, 15 and 19 and the increase in numbers in trap 7 would suggest some possible preference for the lower regions, however the large numbers in the higher traps on the eastern side imply a tolerance of varied conditions.

Fig. 20. MUSCINA PABULORUM



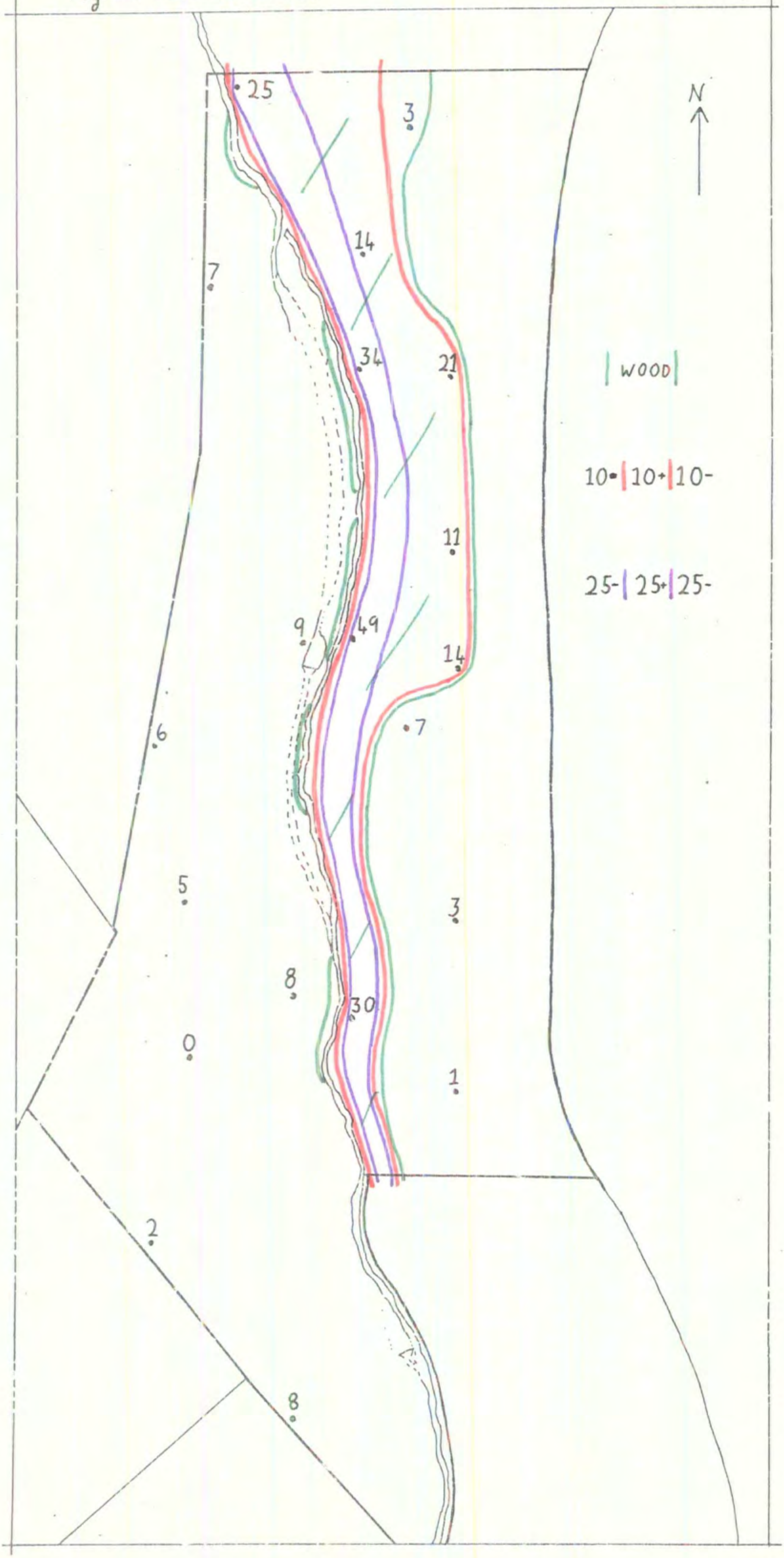


_Phaonia_ spp.

This genus has a distinct preference for the shaded wooded part of the study area with an increase in numbers towards the sheltered floor of the valley (see Fig.21). Trap 2 at which _Phaonia_ was rather rare is classed as high wood habitat. Its catch characteristics are sometimes more reminiscent of a high open trap than of the high wood type, (see _Calliphora vicina_ as well as _Phaonia_). This is probably not a trap idiosyncrasy, but a case of a true border line position between the two habitats.

Fig. 21. PHAONIA spp





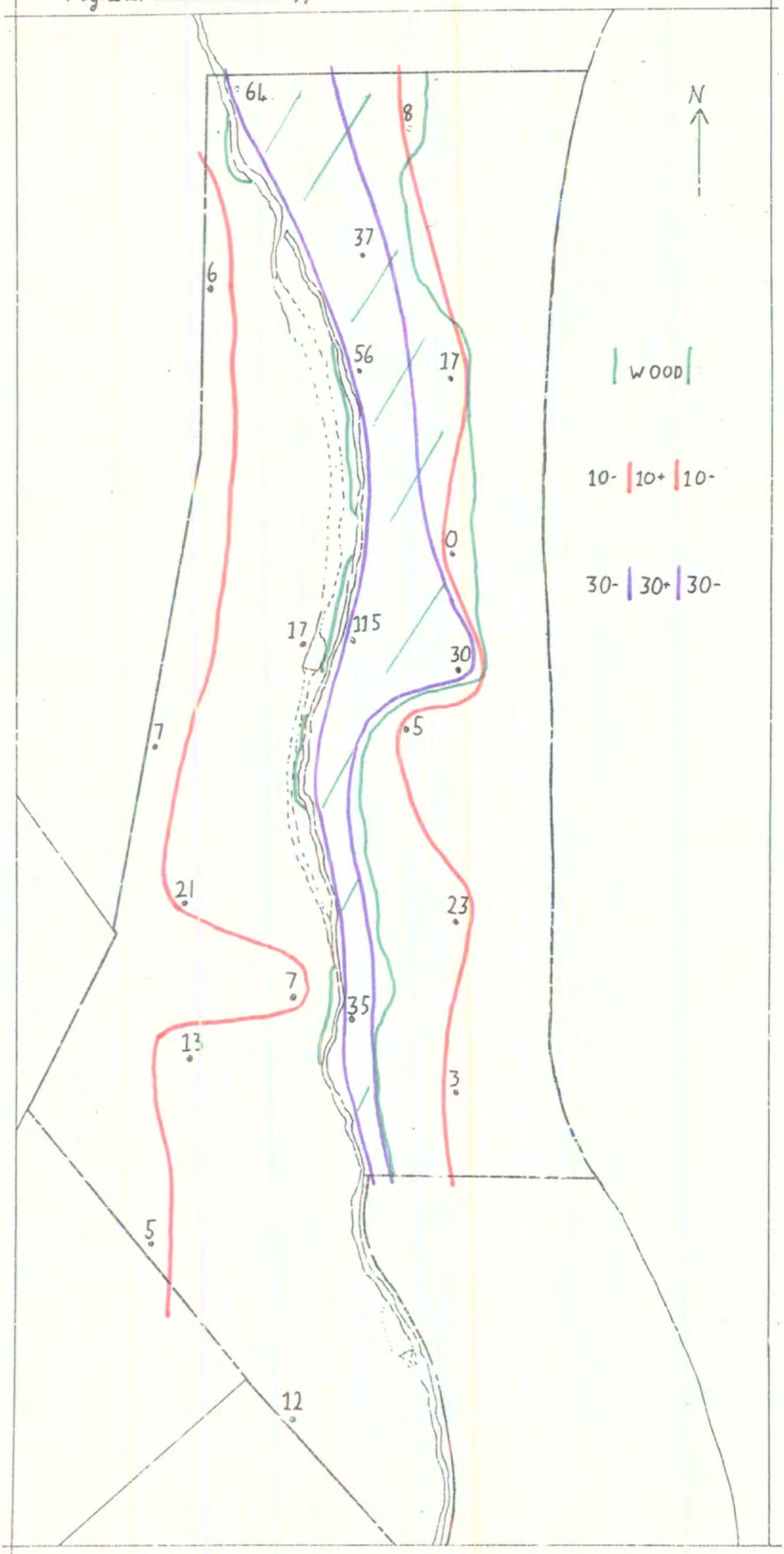
*Mydaea* spp.

Like the other *Muscidae* this genus has a preference for the sheltered parts of the reserve (see Fig.22). The higher numbers are nearer the floor of the valley, especially in the shaded traps.

The numbers of three of the species in this genus (*M. urbana*, *M. ancilla* and *M. scutellaris*) appeared to be approximately equal, only *M. detrita* seemed to be rare. These three species might have had very different distributions and further work on this genus could improve the results. Time, however, did not permit separation of all the *Mydaea* catches into the component species.

Fig. 22. MYDAEA spp





# VI. SEASONAL CHANGES IN SPECIES COMPOSITION OF THE FLY POPULATIONS

## SEASONAL CHANGES IN SPECIES COMPOSITION OF THE FLY POPULATIONS

For two reasons, it was decided to split this section into two parts, the first to deal with the *Calliphoridae* and the second with the *Muscidae*. Firstly the flies are of two separate families and have very different habits so to try to treat them as a single population might lead to errors. Secondly, some work has been done on the *Calliphoridae* (Macloed and Donnelly, 1957; 1958) and it is useful to compare the two sets of results, a situation impossible if the *Muscidae* and *Calliphoridae* are combined.

### A. *Calliphoridae*

The period of trapping, 1st May-15th July comes in the early part of the normal yearly activity of the flies. Macloed and Donnelly (1957), trapping in 1953, caught their first Calliphorid, a *Calliphora vicina*, in mid March and they were still catching large numbers of the same species when they finished trapping in mid November. Thus to suggest that these results cover more than a small part of the season would be very presumptuous. The period they cover is when some flies had still not emerged and the population of others was developing.

The results were taken from the general trapping data on Tables 15-34 in the Appendix.

To show the population changes fully it was necessary to extract the results from as many days as possible. So as to include the subsidiary trapping days in the results, the data are taken from only the eight traps used on those days. Each figure in Table 10 represents the total of the eight traps on the day shown.

These figures from part A of Table 10 have been drawn out as graphs in Fig.23.

*Calliphora vicina*, *C. vomitoria* and *Cynomyia* appeared in the traps on 5th May. A practice trapping in late April caught no specimens of any species, so it is probable that the bulk of these three species emerged first at about this date. Macloed and Donnelly (1957) found the first mass emergence of *C. vicina* occurred in the last 10 days of April and in the first week of May *C. vomitoria* and *Cynomyia* appeared. *Calliphora vicina* and *Cynomyia* both maintained fairly stable populations after an initial high peak.

*C. vomitoria* had a rapid rise to a peak in early June but this tailed off rapidly towards the end of June and start of July. *C. vomitoria* has two peaks of high population in the year, the first in June and the second in late September. The peak found in early June in this experiment must be the first one mentioned above.

Thus for these three species the results agree with the conclusions drawn by other research workers.

The *Lucilia* and *Sarcophaga* species appeared at the same time on 21st May. Both rose to a peak on 3rd June, *Lucilia* at a much higher level than *Sarcophaga*. The numbers of *Lucilia* decreased with erratic fluctuations towards the end of the trapping period. *Sarcophaga* maintained a moderately stable population after the initial peak. On 3rd June *Acrophaga subalpina* appeared in quite large numbers, though still one of the minor species, and gradually decreased as the end of the trapping was approached.

Table 11 shows the percentages of the Calliphoridae caught on each trapping day. Before the population settled down, C. vicina was the major component, but when large numbers of flies started to be caught, C. vomitoria became the predominant species. During the last 10 days of May and the first week of June it maintained this position, but when its numbers declined the major role was taken over by both Lucilia and C. vicina. The numbers of these fluctuated, first one and then the other forming the highest percentage. Both Cynomyia and Sarcophaga were only minor constituents throughout the season, though Sarcophaga reached higher percentages on days with lower temperatures e.g. 16, 19 and 23rd June, by which it seemed to be less affected than the other species.

TABLE 9

Comparison of trapping results from Macloed and Donnelly (1957) with the present research

| Date | Total | Percentages | | | | | |
|---|---|---|---|---|---|---|---|
| | | Luc.* | C.vic. | C.vom. | Cyn. | Sarc | Acr. |
| May-mid June 1949-1952 | 9,804 | 25.5 | 74 | 1.8 | 0.5 | - | - |
| May-mid June 1970 | 6,535 | 25.8 | 11.2 | 58.5 | 1.0 | 2.0 | 1.5 |
| Mid June-end July 1949-1952 | 3,641 | 33.0 | 63 | 2.7 | 0.5 | - | - |
| Mid June-mid July 1970 | 1,346 | 56.4 | 19.8 | 4.8 | 2.6 | 5.1 | 11.3 |

*For the meaning of the abbreviations see Table 11.

A comparison between the results obtained in this work and those that Macloed and Donnelly found (1957) is shown in Table 9. In the first period, May-mid June, the only marked difference is between the two Calliphora species. These two species completely swapped places. Macloed and Donnelly found that C. vicina was dominant while in the present work C. vomitoria was dominant.

Four of the sites used by Macloed and Donnelly were in relatively open areas in which C. vicina occurs more regularly than C. vomitoria (see Section VI and Macloed and Donnelly, 1957). The fifth site was in a wood, admittedly of rather low canopy saplings, but even at this site, C. vicina was dominant.

If their catches had gone the same way as the ones in this wood, Macloed and Donnelly should have found that the woodland trap raised the percentage of C. vomitoria. However, the catches of C. vicina were still very dominant and so it might be assumed that the population of C. vomitoria was much lower at Crosby, Carlisle, their experimental area, than at Durham. The absolute numbers of C. vicina they caught at Crosby were larger than those in Durham. Therefore, it appears that the differences in percentages do show genuine differences in the population levels of the two species rather than differences in trapping habitats.

In the second period, mid June to mid July, the dominant fly was Lucilia. C. vicina had an increase in percentage due to a decrease in numbers of C. vomitoria rather than an increase of its own numbers. The percentages of Cynomyia and Sarcophaga also rose due to this phenomenon and Acrophaga started to form a considerable, though still minor, component of the population.

## TABLE 10

Total catches of Calliphorid and Muscid species and genera from eight traps

| | May | | | | | | | | June | | | | | | | | | | July | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 5 | 12 | 13 | 15 | 20 | 21 | 27 | 1 | 2 | 3 | 5 | 10 | 15 | 16 | 19 | 23 | 26 | 1 | 4 | 7 | 15 |
| A. Calliphoridae | | | | | | | | | | | | | | | | | | | | | | |
| Calliphora vomitoria | - | 10 | - | 2 | - | - | 40 | 97 | 393 | 443 | 2137 | 372 | 278 | 48 | 7 | 21 | 4 | 25 | - | 3 | 5 | - |
| Calliphora vicina | - | 13 | 4 | 7 | 1 | - | 6 | 31 | 124 | 45 | 285 | 99 | 63 | 55 | 28 | 54 | 15 | 67 | 9 | 32 | 50 | 11 |
| Lucilia spp. | - | - | - | - | - | - | 1 | 21 | 43 | 71 | 808 | 275 | 386 | 84 | 32 | 404 | 14 | 147 | 4 | 14 | 141 | 1 |
| Cynomyia mortuorum | - | 1 | - | 2 | - | - | - | 3 | 19 | 3 | 19 | 5 | 10 | 4 | 4 | 12 | 2 | 3 | 1 | 2 | 9 | 2 |
| Sarcophaga spp. | - | - | - | - | - | - | 1 | 10 | 32 | 14 | 56 | 7 | 3 | 4 | 11 | 12 | 10 | 18 | 3 | 4 | 9 | 1 |
| Acrophaga subalpina | - | - | - | - | - | - | - | - | - | - | 16 | 31 | 13 | 40 | 15 | 68 | 9 | 33 | 2 | 9 | 15 | 1 |
| B. Muscidae | | | | | | | | | | | | | | | | | | | | | | |
| Mydaea spp. | - | - | - | - | - | - | - | 6 | 3 | 14 | 45 | 50 | 108 | 34 | 17 | 107 | 19 | 41 | 7 | 10 | 28 | 5 |
| Phaonia spp. | - | - | - | - | 1 | - | 10 | 19 | 23 | 16 | 10 | 21 | 26 | 20 | 19 | 28 | 5 | 10 | 4 | 5 | 14 | 8 |
| Dasyphora cyanella | 1 | 3 | 3 | 3 | - | - | - | - | 8 | 4 | - | 26 | 7 | - | - | - | - | - | - | 1 | 1 | - |
| Muscina assimilis | - | 3 | - | - | - | - | - | - | - | - | 4 | - | - | - | 4 | 9 | - | 8 | 1 | 1 | 1 | - |
| Muscina pabulorum | - | - | - | - | - | - | - | - | - | - | 6 | - | 1 | 1 | 6 | 2 | - | 13 | 1 | 1 | 1 | - |
| Polietes lardarius | - | - | - | - | - | - | - | - | - | - | 1 | 3 | 8 | 12 | 5 | 6 | 2 | 3 | - | 2 | 5 | 2 |

TABLE 11

Changes in species populations of Calliphoridae throughout the trapping season

| Date | Total Calliphoridae caught | Percentages | | | | | |
|---|---|---|---|---|---|---|---|
| | | C.vom. | C.vic. | Luc.gr. | C.m. | Sarc. | A.s. |
| 1st May | - | - | - | - | - | - | - |
| 5th May | 24 | 42 | 54 | - | 4.1 | - | - |
| 12th May | 4 | - | 100 | - | - | - | - |
| 13th May | 11 | 18 | 64 | - | 18 | - | - |
| 15th May | 1 | - | 100 | - | - | - | - |
| 20th May | - | - | - | - | - | - | - |
| 21st May | 48 | 84 | 13 | 1.9 | - | 1.9 | - |
| 27th May | 162 | 60 | 19 | 13 | 1.6 | 6.2 | - |
| 1st June | 611 | 64 | 20 | 7.0 | 3.1 | 5.3 | - |
| 2nd June | 576 | 77 | 8 | 12 | 0.6 | 2.6 | - |
| 3rd June | 3,321 | 64 | 8.6 | 24 | 0.6 | 1.7 | 0.4 |
| 5th June | 789 | 47 | 13 | 35 | 0.6 | 0.9 | 3.8 |
| 10th June | 753 | 37 | 8.4 | 51 | 1.3 | 0.4 | 41.6 |
| 15th June | 235 | 20 | 23 | 36 | 1.7 | 1.7 | 17 |
| 16th June | 47 | 7.2 | 29 | 33 | 4.1 | 11.4 | 15 |
| 19th June | 571 | 3.7 | 4.5 | 71 | 2.1 | 2.1 | 12 |
| 23rd June | 54 | 7.4 | 28 | 26 | 3.7 | 19 | 17 |
| 26th June | 293 | 8.5 | 23 | 50 | 1.0 | 6.2 | 11 |
| 1st July | 19 | - | 47 | 21 | 5.3 | 16 | 10 |
| 4th July | 64 | 4.7 | 50 | 22 | 3.1 | 6.3 | 14 |
| 7th July | 229 | 2.2 | 22 | 62 | 3.9 | 3.9 | 6.4 |
| 15th July | 16 | - | 69 | 6.3 | 10.5 | 6.3 | 6.3 |

C.vic. - *Calliphora vicina*

C. vom. - *Calliphora vomitoria*

Luc. gr. - *Lucilia* group

C.m. - *Cynomyia mortuorum*

Sarc. - *Sarcophaga* spp.

A.s. - *Acrophaga subalpina*

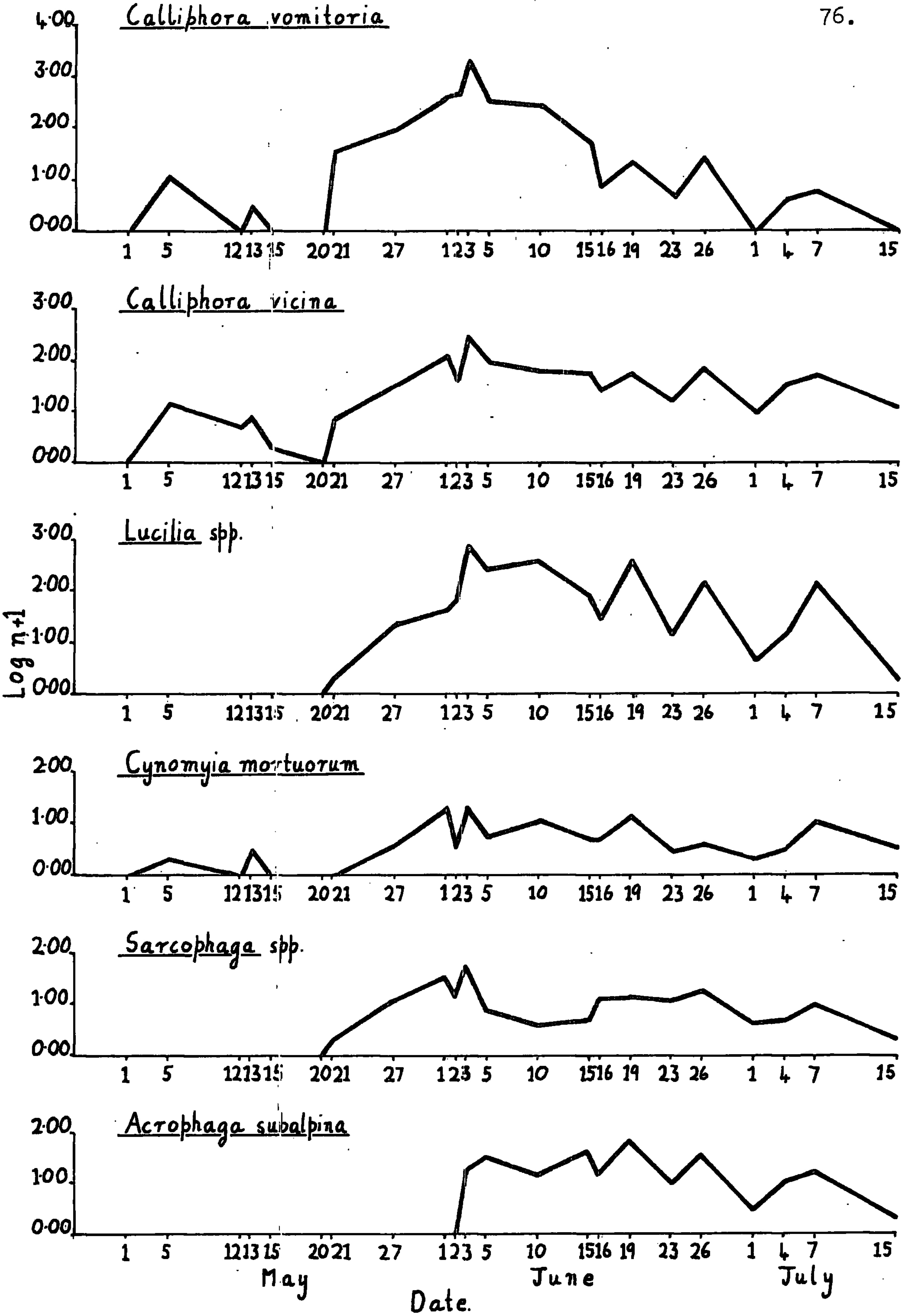



Fig. 23. Total numbers of the species of Calliphoridae caught in 8 bait traps on the dates shown.

B. Muscidae

Table 10(B) and Fig.24 show the abundance of the Muscid species.

At the start Dasyphora cyanella formed the major element of the population, though in rather small numbers. These numbers remained reasonably constant, except for a break when there was poor weather until 10th June. There was then a break of three weeks before it reappeared on 4th July. This may have been due to the death of the overwintering flies before the appearance of the new generation. This species was said to be rather uncommon, only being seen occasionally while feeding on dung (Muirhead Thomson, 1937). However, it was seen in very large numbers on dung in the fields surrounding the field station and also while sunning on trees through till mid June after which the numbers decreased.

The Mydaea and Phaonia genera formed the major components of the population. Phaonia appeared nearly a fortnight earlier and was, at first, the dominent genus. It was replaced by Mydaea at the start of July and this situation was maintained for 2 days (16th June and 15th July) until the end of trapping. Hammer (1941) said that M. urbana, one of the main constituent species of this genus, has its highest population in late August though a few had been seen earlier. Though the genus is not split up, it is thought that this species was quite common throughout the later part of the trapping season.

Except for an occurrence of Muscina assimilis in early May, the Muscina species had very similar populations throughout the trapping period. They were a minor part of the population even after they appeared in early June. As the larvae of these species are parasitic on wasps nests, they could only appear when the wasps nests had been formed for a time. The early record may have been of adults that had hibernated and then died before the next generation appeared.

*Polietes lardarius* appeared at the same time as the two *Muscina* species and maintained a steady, though low, population thereafter. Two peaks of maximum abundance have been found for this species (Hammer, 1941), one in June and the second in September. From the results no such early peak can be seen. However in the fields where there were dung pats left by cattle up to 50 *P. lardarius* were seen on each of many pats.

These flies were not caught in great numbers and any peak that may have been formed did not show up in the trapping.

TABLE 12

Changes in species proportions of Muscidae throughout trapping season

| Date | Total Muscidae caught | Myd. | Phao. | D.c. | M.a. | M.p. | P.l. |
|---|---|---|---|---|---|---|---|
| 1st May | 1 | - | - | 100 | - | - | - |
| 5th May | 4 | 32 | - | 50 | 5 | - | - |
| 12th May | 3 | - | - | 100 | - | - | - |
| 13th May | 3 | - | - | 100 | - | - | - |
| 15th May | 4 | - | 100 | - | - | - | - |
| 20th May | - | - | - | - | - | - | - |
| 21st May | 10 | - | 100 | - | - | - | - |
| 27th May | 25 | 32 | 68 | - | - | - | - |
| 1st June | 34 | 8.8 | 68 | 24 | - | - | - |
| 2nd June | 34 | 41 | 47 | 12 | - | - | - |
| 3rd June | 66 | 68 | 15 | - | 6.1 | 9.1 | 1.3 |
| 5th June | 100 | 50 | 21 | 26 | - | - | 3.0 |
| 10th June | 150 | 72 | 17 | 4.7 | - | 0.7 | 5.3 |
| 15th June | 67 | 51 | 30 | - | - | 1.5 | 18 |
| 16th June | 51 | 33 | 37 | - | 7.9 | 12 | 9.8 |
| 19th June | 152 | 70 | 18 | - | 5.9 | 1.3 | 3.9 |
| 23rd June | 26 | 73 | 19 | - | - | - | 7.6 |
| 26th June | 75 | 55 | 13 | - | 11 | 17 | 3.8 |
| 1st July | 13 | 54 | 31 | - | 7.7 | 7.7 | - |
| 4th July | 20 | 50 | 25 | 5.0 | 5.0 | 5.0 | 10 |
| 7th July | 50 | 56 | 28 | 2.0 | 2.0 | 2.0 | 10 |
| 15th July | 15 | 33 | 53 | - | - | - | - |

Myd. - *Mydaea* spp.

Phao. - *Phaonia* spp.

D.c. - *Dasyphora cyarella*

M.a. - *Muscina assimilis*

M.p. - *Muscina pabulorum*

P.l. - *Polietes lardarius*

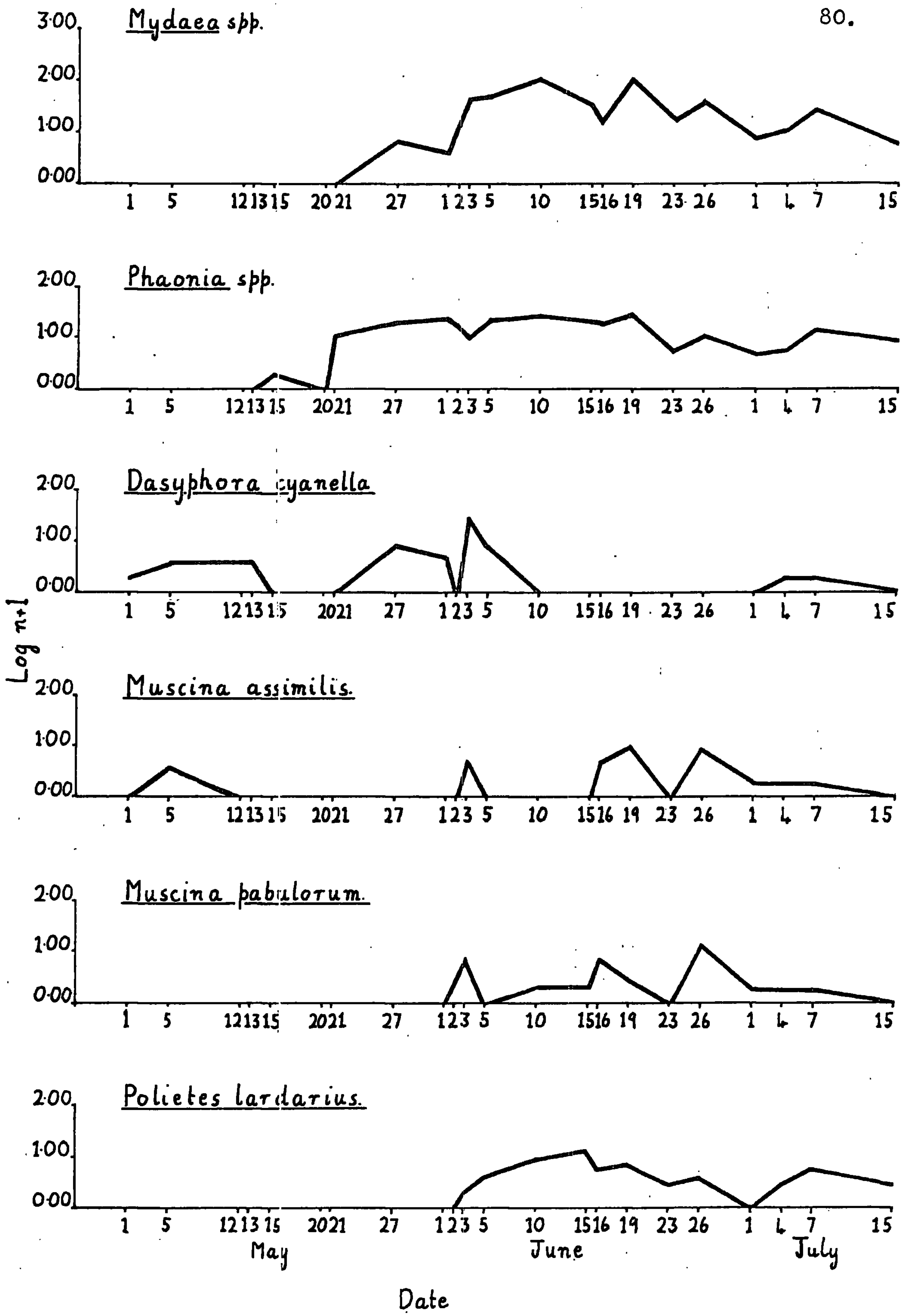



Fig. 24. Total numbers of the species of Muscidae caught in 8 bait traps on the dates shown.

# VII. THE EFFECTS OF CLIMATIC FACTORS UPON THE CATCHES OF FLIES

# THE EFFECTS OF CLIMATIC FACTORS UPON THE CATCHES OF FLIES

The graphs of the catches of the various species of flies (see Section VII Figs.23 and 24) show marked fluctuations. For the different species these fluctuations coincide throughout the whole trapping season. Changes in total numbers will occur, but not with such regularity and such agreement between species. It is unlikely that the changes could coincide so closely and so it was thought that some factor or group of factors must govern the catch levels. This factor(s) would control the activity of the flies and therefore their 'trapability' rather than changing the population numbers.

The most obvious of factors that is likely to effect the activity of flies is the weather. The meteorological data were obtained from the local observatory less than 1 mile from the study area and not, unfortunately, from the field station itself. However, they give a very good indication of the conditions present in the trapping area. These meteorological data, complete with the total Calliphoridae and Muscidae catch numbers are given in Table 14.

Correlation coefficient tests were made between the various climatic factors and the total catches. These are shown in Table 13.

TABLE 13

Correlation between climatic factors and fly catches

| Factor | Calliphoridae corr. coeff. | Probab- ility | Muscidae corr. coeff. | Probab- ility |
|---|---|---|---|---|
| Minimum temperature | -0.027 | Not sig. | + 0.282 | Not sig. |
| Maximum temperature | + 0.511 | <0.02 | + 0.665 | <0.001 |
| Wind speed | - 0.189 | Not sig. | - 0.395 | Not sig. |
| Hours sunshine | + 0.484 | <0.05 | + 0.442 | <0.05 |
| Relative humidity | - 0.212 | Not sig. | - 0.316 | Not sig. |

Conclusions

These results show that it is the maximum temperature and the hours of sunshine which are most closely correlated with the numbers of flies caught. The maximum temperature is so dependant upon the hours of sunshine that the two can hardly be separated.

Wind speed might have been expected to have some influence on the catches, but the correlation was not significant, though quite high for the Muscidae and lower for the Calliphoridae. In general the Calliphoridae are larger and stronger fliers than the Muscidae so this difference in correlation is not so surprising.

TABLE 14

Meteorological data and total catches of Calliphoridae and Muscidae

| Date | Wind speed (knots) | Relative humidity % | Maximum temperature (°C) | Minimum temperature (°C) | Rain (inches) | Sunshine (hours) | Total Calliphoridae | Total Muscidae |
|---|---|---|---|---|---|---|---|---|
| 1st May | 10 | 75 | 15 | 9 | 0.06 | 2.1 | 0 | 1 |
| 5th May | 10 | 97 | 22 | 7 | - | 11.7 | 24 | 3 |
| 12th May | 4 | 70 | 15 | 5 | Tr | 10.7 | 4 | 3 |
| 13th May | 8 | 79 | 14 | 5 | - | 8.9 | 11 | 3 |
| 15th May | 4 | 94 | 11 | 5 | - | 0.0 | 1 | 1 |
| 20th May | 16 | 74 | 13 | 7 | - | 1.4 | - | - |
| 21st May | 40 | 61 | 16 | 4 | 0.04 | 12.0 | 48 | 10 |
| 27th May | 4 | 73 | 22 | 9 | - | 12.0 | 162 | 25 |
| 1st June* | 10 | 57 | 18 | 9 | - | 11.6 | 611 | 34 |
| 2nd June | 18 | 62 | 21 | 7 | - | 7.3 | 576 | 34 |
| 3rd June* | 8 | 66 | 24 | 7 | - | 14.4 | 3,321 | 66 |
| 5th June | 2 | 77 | 20 | 8 | - | 9.4 | 789 | 100 |
| 10th June | 2 | 67 | 26 | 11 | - | 13.7 | 753 | 150 |
| 15th June * | 2 | 63 | 21 | 8 | - | 3.5 | 235 | 67 |
| 16th June | 10 | 76 | 17 | 11 | Tr | 8.1 | 97 | 51 |
| 19th June * | 6 | 74 | 21 | 11 | - | 9.9 | 571 | 152 |
| 23rd June | 12 | 84 | 18 | 13 | 0.12 | 4.9 | 54 | 26 |
| 26th June * | 8 | 55 | 20 | 11 | - | 6.5 | 293 | 75 |
| 1st July | 28 | 77 | 16 | 11 | - | 6.0 | 19 | 13 |
| 4th July * | 8 | 96 | 19 | 11 | - | 6.1 | 64 | 20 |
| 7th July | 2 | 68 | 24 | 13 | - | 9.8 | 229 | 50 |
| 15th July | 24 | 68 | 17 | 10 | Tr | 3.8 | 16 | 15 |

* Subsidiary trapping days.

# VIII. GENERAL DISCUSSION

## GENERAL DISCUSSION

In this paper attempts have been made to explain the distribution of the various species of fly caught in the bait trapping. Most of the conclusions agree quite closely with those drawn from other research work on the Calliphoridae. The species distribution can,to some degree,be seen to be associated with what can be classified as vegetation habitats. Several problems have been exposed which cannot, in this work at least, be answered by the use of results or statistics.

Why is it that the species appear to keep more to one particular habitat than to others? It would seem obvious that individuals of that species remain in the habitat because the conditions are more favourable in it than in another habitat. The use of this word 'condition' is rather dangerous. It may be better to say that in a favourable habitat there is a greater concentration of attractive stimuli than in other habitats. The most important of these stimuli appear to be the presence, or absence, of shade, shelter from the wind and food sources.

This brings to mind the maximum range of attraction to these stimuli. The trap idiosyncrasy (see Section VI) shown by some of the traps suggests that this range (insofar as a meat bait is concerned) is very short. In Fig.5 for C. vomitoria distribution,trap 19 caught only 13 flies in 15 trapping days while trap 7,20 metres away,caught 741 flies in the same period. This appears to show that if the flies kept to their habitats the attraction range to the bait at least must be very short e.g. only up to 10 or 15 metres. However, for a fly that relies upon the attraction to carcasses to survive this result would be almost laughable. This is supported by results from Macloed and Donnelly (unpublished,but mentioned in their 1962 paper) that there is some evidence for the attraction of blowflies to bait from a distance of 200 yds.

If this is so then these trap idiosyncrasies must be explained in some other way. It was mentioned in the introduction that blowflies are very active, indeed are almost continually on the move. Some cause might be associated with this activity.

The flies might have definite pathways of movement along which they fly and do not, or very seldom, stray outside these routes. These pathways follow the favourable habitats and where these end they fly to the next one over unfavourable terrain by the shortest possible route. If a trap was on one of the pathways over unfavourable habitats it would regularly get a high catch. This could cause some of the trap idiosyncrasies to be found in this, and other, work e.g. trap 10. However how do the flies 'know' that there is a suitable area on the other side?

Such pathways of flight have never been demonstrated experimentally, on the contrary Macloed and Donnelly (1958) have shown that flight appears to be aimless and at random. Flight, they found, is just as likely over unfavourable as over favourable terrain though it is usually a little faster. This means that the flies must have flown over the traps in the open areas of the field station. Then why were they not attracted to these traps to the same degree as to those in the wood?

Wardle (1927) made the suggestion that the failure to catch C. vomitoria in traps in the open was due to the faster desiccation of bait in these traps than in shaded ones.

C. vomitoria is less responsive to carrion odour than are other species and so needs the bait to be moist to be able to detect it. This can be disproved by reference to the first eight trapping days when halfway through the day the baits were moistened by spraying them with distilled water. The catches on these days did not have a higher number of C. vomitoria in the open traps than on the other days when the bait was not moistened. Thus some other explanation must be sought to account for this phenomenon.

Macloed and Donnelly (1958) concluded that an aimless flight could be interrupted at any time by attraction to some 'centre of action.' Thus the more centres of action i.e. attraction stimuli that there are, the more flies will have their flights interrupted. Thus the favourability of the habitat is selected by a population of flies rather than by an individual fly. This could explain how traps in a certain habitat could catch more flies, but I do not think it can explain so large a discrepancy as that shown in traps 7 and 19.

It has been suggested, very tentatively, that the differences between trap catches may be explained, partially at least, by the difference of sex ratios in the various habitats (Macloed and Donnelly, 1957). They found relatively more males of Calliphora and Lucilia species in wooded habitats than in open areas. Chi square tests were performed on the sex ratios in the different habitats in this work and no significant differences at all were found.

It is possible that in different habitats the flies need different threshold levels of stimulus to attract them to the bait. This trapability of flies may depend on their speed of flight. Over unfavourable terrain they fly faster and therefore will need more stimulus to cause them to interrupt their random flight. In the open there is just a single attraction stimulus, the bait, while in the wood there are several, the bait, shade, shelter and possibly a greater concentration of flies as well as others that have not been detected. Thus it will be a complex of attractions rather than a single one that causes the fly to stop in the wood traps rather than in the open traps.

The fleeting aggregations of flies mentioned in Section VI could be explained if pathways of flight occur. However, as these are very unlikely some other explanation is necessary. One possible cause for the sudden appearance of large numbers of Polietes lardarius in trap 1 was discussed. Other such aggregations like the one of C. vomitoria in trap 13 on 2nd June cannot be explained in this way. This large catch could be due to the sudden emergence of large numbers of flies from a nearby carcass. However, the dissection results for these flies (Lewin, 1970) shows that the age composition of this catch of flies appears to be the same as found in other traps. Also, these flies were not obviously teneral, a state that can be identified easily by the translucent nature of the cuticle which is usually still soft.

It is possible that a reduction in the threshold stimulus necessary to attract the flies to this trap occurred on this day alone. The cause of this reduction, if one exists, is not known and no attempt will be made to explain it, as this would involve going too deeply into the realms of the hypothesis. Such a reduction, but of a more permanent nature, could explain the consistently higher catches than would be expected, that were obtained in some traps.

From this discussion, it can be seen that there are many questions which cannot be answered satisfactorily in this work. Much more research needs to be performed before some of the question marks can be erased.

# IX. SUMMARY

## SUMMARY

Twenty liver baited traps were operated on fifteen days between 1st May and 15th July, 1970 and gave the following results:-

1. Large differences in catches of *Calliphora vomitoria* were shown between traps in open and shaded situations, these differences were less marked for the other species of flies.
2. The catches of *Calliphoridae* and *Muscidae* showed good correlations with the maximum temperature of the trapping day and also with the hours of sunshine.
3. Evidence that the presence of flies in a trap attracted *Calliphora vomitoria* to the trap was obtained.
4. Unexplainable large differences in catches between traps close together occurred.
5. Changes in the proportions of the species in the *Calliphoridae* and *Muscidae* populations through the trapping season were analysed.

# X. ACKNOWLEDGMENTS

ACKNOWLEDGMENTS

I wish to thank Dr. L. Davies for his continual help and encouragement.

Also:-

Miss S. Lewin who, in her role as fellow Dipterologist, has provided much help and light entertainment during the long hours in the laboratory.

The Zoology Department Technical Staff, especially Mr. J. Richardson, for answering many frantic requests for aid and equipment

Mrs. A. Robinson for typing this dissertation.

This research was undertaken while the author held a N.E.R.C. Advanced Course Studentship.

# XI. REFERENCES

# REFERENCES


Busvine, J. R. (1951) Insects and Hygiene. Methuen.

Clapham, A. R., Tuten, T. G., Warburg, E.F. Flora of the British Isles. Cambridge.

Cragg, J. B. (1955) The natural history of sheep blowflies in Britain. Ann. Appl. Biol. 42: 197-207.

Cragg, J. B. and Hobart, J. (1955) A study of a field population of the blowflies Lucilia ceasar (L.) and L. sericata (Mg.) Ann. Appl. Biol. 43: 645-663.

Cragg, J. B. and Ramage, G. R. (1945) Chemotropic studies on the blowflies Lucilia sericata (Mg.) and L. caesar (L) Parasitology 36: 168-175.

Davies, L. Personal communication.

Durham University Meteorological Observatory. Meteorological data for the period 1st May-15th July, 1970.

Gilmour, D., Waterhouse, D. F., Macintyre, G. A. (1946). An account of experiments to determine the natural population density of the sheep blowfly Lucilia cuprina (Wied.) Council. Sci. Ind. Res. Australia Bull. 195.

Hammer, O. (1941). Biological and Ecological Investigation on flies. Copenhagen.

Krijgsman, B. J. and Windred, G. L. (1933) Investigations of the buffalo fly Lyperosia exigua (de Meij) Pamph. Coun. Sci. Ind. Res. Australia 43.

Lempke, B. J. (1962) Insects captured on the light ship "Noord Hinder". Entomol. Ber. 22: 101-111.

Lewin, S. 1970. M.Sc. dissertation.

Macloed, J. and Donnelly, J. (1956a) Methods for the study of blowfly population 1 Bait trapping. Significante limits for comparative sampling. Ann. Appl. Biol. 44: 80-104.

Macloed, J. and Donnelly, J. (1956b) Methods for the study of blowfly populations. II. The use of laboratory bred material. Ann. Appl. Biol. 44: 643-648.

Macloed, J. and Donnelly, J. (1957) Some ecological relationships of natural populations of Calliphorine blowflies. J. An. Ecol. 26: 135-170.

Macloed, J. and Donnelly, J. (1958) The local distribution and dispersal paths of blowflies in hill country. J. An. Ecol. 27: 349-374.

Macloed, J. and Donnelly, J. (1960). Natural pastures and blowfly movement. J. An. Ecol. 29: 83-93.

Macloed, J. and Donnelly, J. (1962). Microgeographic aggregations in blowfly populations. J. An. Ecol. 31: 525-543.

Macloed, J. and Donnelly, J. (1963). Dispersal and interspersal of blowfly populations. J. An. Ecol. 32: 1-32.

Muirhead Thompson, R. C. (1937) Observations on the biology and larvae of the Anthomyidae. Parasitology 29: 273-335.

Norris, K. R. (1965) The bionomics of blowflies. Ann. Rev. Ent. 10: 67-68.

Norris, K. R. (1966) Daily patterns of flight activity of blowflies (Calliphoridae,Diptera) in the Canberra district as indicated by trap catches. Aust. J. Zool. 14. 835-853.

Nuorteva, P. (1959) Studies on the significance of flies on transmission of polio III. Comparison of blowfly fauna and activity of flies in relation to weather. Ann. Ent. Fenn. 25: 121-136.

Nuorteva, P. (1963) Synanthropy of blowflies in Finland. Ann. Ent. Fenn. 29: 1-49.

Royal Entomological Society of London Volume X. Parts 4(a) Tachinidae and Calliphoridae and 4(b) Muscidae.

Taylor, L. R. (1963) Analysis of the effect of temperature on insects in flight. J. An. Ecol. 32 99-117.

Wardle, R. A. (1927) The seasonal frequency of Calliphorine blowflies in Great Britain. J. Hyg. Camb. 26: 441-464.

Williams, C. B. et al (1956) Observations on the migration of insects in the Pyrenees in the autumn of 1953. Trans. Roy. Entomol. Soc. Lond. 108: 385-407.

# XII. APPENDIX

# APPENDIX

Each table shows the catch in a particular trap on all the trapping days. The subsidiary trapping days are shown by an asterisk above the date.

## TABLE 15

**Trap 1**

| Species | May | | | | | | | June | | | | | July | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1st | 5th | 12th | 13th | 15th | 21st | 27th | 2nd | 5th | 10th | 16th | 23rd | 1st | 7th | 15th |
| Calliphora vicina | - | 6 | - | - | - | - | - | 10 | 2 | 46 | 12 | 1 | 2 | 10 | 1 |
| Calliphora vomitoria | - | 2 | - | - | - | 5 | - | 248 | 8 | 184 | 10 | 2 | - | 2 | - |
| Lucilia sp. | - | - | - | - | - | - | - | 4 | 2 | 103 | 7 | 2 | 1 | 14 | - |
| Sarcophaga sp. | - | - | - | - | - | - | - | - | - | 3 | 1 | - | - | - | - |
| Cynomyea mortuorum | - | - | - | - | - | - | - | 1 | - | - | - | - | - | - | - |
| Acrophaga subalpina | - | - | - | - | - | - | - | - | - | 10 | - | 1 | - | 4 | - |
| Dasyphora cyanella | - | - | - | - | - | - | - | - | - | 1 | - | - | - | - | - |
| Polietes lardarius | - | - | - | - | - | - | - | 1 | 11 | 52 | 2 | 16 | - | 1 | - |
| Phaonia sp. | - | - | - | - | - | - | 2 | - | 1 | 15 | 2 | 2 | 2 | 1 | - |
| Muscina assimilis | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - |
| Muscina pabulorum | - | - | - | - | - | - | - | - | - | 1 | - | - | - | 1 | - |
| Hydaea sp. | - | - | - | - | - | - | - | 1 | 4 | 54 | - | 4 | - | 1 | - |

TABLE 16

Trap 2

| Species | May | | | | | | | June | | | | | July | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1st | 5th | 12th | 13th | 15th | 21st | 27th | 2nd | 5th | 10th | 16th | 23rd | 1st | 7th | 15th |
| Calliphora vicina | - | - | - | - | - | 2 | 2 | 6 | 5 | 1 | - | - | 3 | 5 | 1 |
| Calliphora vomitoria | - | - | - | - | - | 2 | - | 7 | 2 | 1 | - | - | - | - | - |
| Lucilia sp. | - | - | - | - | - | - | 1 | 2 | 7 | 3 | 2 | - | 2 | - | - |
| Sarcophaga sp. | - | - | - | - | - | - | 1 | 12 | - | - | - | 1 | 2 | - | - |
| Cynomyia mortuorum | - | 1 | - | - | - | - | - | - | - | - | - | - | - | 1 | - |
| Acrophaga subalpina | - | - | - | - | - | - | - | - | 2 | 3 | 3 | - | 1 | 6 | - |
| Dasyphora cyanella | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Polietes lardarius | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 |
| Phaonia sp. | - | - | - | - | - | - | 1 | - | 1 | - | - | - | - | 1 | - |
| Muscina assimilis | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - | - |
| Muscina pabulorum | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Hydaea sp. | - | - | - | - | - | - | - | - | 2 | - | 2 | 1 | - | - | 3 |

TABLE 17

Trap 3

| Species | May | | | | | | | June | | | | | July | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1st | 5th | 12th | 13th | 15th | 21st | 27th | 2nd | 5th | 10th | 16th | 23rd | 1st | 7th | 15th |
| Calliphora vicina | - | 2 | - | - | - | 1 | - | 4 | 10 | - | 13 | 3 | 2 | 16 | - |
| Calliphora vomitoria | - | - | - | - | - | - | - | 7 | 2 | - | 1 | - | - | - | - |
| Lucilia sp. | - | - | - | - | - | - | - | 16 | 2 | 12 | 2 | - | - | 5 | - |
| Sarcophaga sp. | - | - | - | - | - | - | - | 2 | - | 1 | - | - | - | - | - |
| Cynomyia mortuorum | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Acrophaga subalpina | - | - | - | - | - | - | - | - | 1 | - | - | - | 1 | 5 | - |
| Dasyphora cyanella | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Polietes lardarius | - | - | - | - | - | - | - | - | 2 | 9 | 9 | - | - | - | - |
| Phaonia sp. | - | - | - | - | - | - | - | - | 4 | 6 | 2 | - | - | 2 | - |
| Muscina assimilis | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Muscina pabulorum | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Hydaea sp. | - | - | - | - | - | θ | - | - | 6 | 30 | - | - | - | - | - |

TABLE 18

Trap 4

| Species | May | | | | | | | June | | | | | | | | | | July | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1st | 5th | 12th | 13th | 15th | 21st | 27th | 1st* | 2nd | 3rd* | 5th | 10th | 15th* | 16th | 19th* | 23rd | 26th* | 1st | 4th* | 7th | 15th |
| Calliphora vicina | - | 1 | 1 | 1 | - | 1 | 11 | 29 | 5 | 65 | 18 | 2 | 10 | 8 | 7 | - | 5 | 1 | - | 4 | 1 |
| Calliphora vomitoria | - | 3 | - | 1 | - | 16 | 46 | 234 | 314 | 945 | 56 | 6 | 34 | 4 | 10 | - | 16 | - | - | 2 | - |
| Lucilia sp. | - | - | - | - | - | - | - | 11 | 6 | 125 | 10 | - | 16 | - | 24 | - | 8 | - | - | 3 | - |
| Sarcophaga sp. | - | - | - | - | - | 1 | - | 6 | 1 | 1 | - | - | - | - | 2 | - | - | - | - | - | - |
| Cynomyia mortuorum | - | - | - | - | - | - | - | 3 | - | 1 | - | - | - | - | - | - | - | - | - | - | - |
| Acrophaga subalpina | - | - | - | - | - | - | - | - | - | 3 | 14 | - | 9 | 1 | 3 | - | 5 | - | - | 3 | - |
| Dasyphora cyanella | - | - | - | 1 | - | - | - | 3 | - | 2 | 2 | - | - | - | - | - | - | - | - | - | - |
| Polietes lardarius | 1 | - | - | - | - | - | - | - | - | - | - | - | 3 | 1 | 2 | - | 2 | - | - | - | - |
| Phaonia sp. | - | - | - | - | - | 2 | 5 | 7 | - | 3 | 6 | 9 | 4 | 9 | 4 | - | 2 | 1 | 1 | 2 | - |
| Muscina assimilis | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 2 | - | 2 | - | - | - | - |
| Muscina pabulorum | - | - | - | - | - | - | - | - | - | 1 | - | - | - | - | 1 | - | 7 | - | - | - | - |
| Mydaea sp. | - | - | - | - | - | - | 2 | 3 | 5 | 11 | 28 | 2 | 17 | 13 | 44 | 3 | 20 | - | - | 3 | - |

* Subsidiary trapping days.

TABLE 19

Trap 5

| Species | May | | | | | | | June | | | | | | | | | | July | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1st | 5th | 12th | 13th | 15th | 21st | 27th | 1st* | 2nd | 3rd* | 5th | 10th | 15th* | 16th | 19th* | 23rd | 26th* | 1st | 4th* | 7th | 15th |
| Calliphora vicina | - | 1 | 1 | - | - | - | - | 9 | 6 | 38 | 20 | 15 | 10 | 4 | 10 | 1 | 11 | 1 | 5 | 7 | 2 |
| Calliphora vomitoria | - | - | - | - | - | - | - | - | 6 | 64 | 13 | 8 | 5 | 1 | - | - | 1 | - | - | - | - |
| Lucilia sp. | - | - | - | - | - | - | - | - | 7 | 35 | 11 | 43 | 2 | 2 | 13 | - | 1 | - | - | 4 | 1 |
| Sarcophaga sp. | - | - | - | - | - | - | 1 | 2 | - | 7 | 1 | 2 | - | - | 1 | - | - | - | - | - | - |
| Cynomyea mortuorum | - | - | - | 1 | - | - | - | - | - | 3 | - | 2 | - | - | - | - | - | - | - | - | - |
| Acrophaga subalpina | - | - | - | - | - | - | - | - | - | 2 | 4 | 6 | 2 | 2 | 11 | - | 3 | - | 2 | 4 | - |
| Dasyphora cyanella | - | - | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Polietes lardarius | - | - | - | - | - | - | - | - | - | - | - | - | 1 | - | 1 | - | - | - | - | - | - |
| Phaonia sp. | - | - | - | - | - | - | 2 | 1 | 5 | 3 | 5 | 5 | 5 | 3 | 4 | - | 2 | - | 3 | 1 | - |
| Muscina assimilis | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Muscina pabulorum | - | - | - | - | - | - | - | - | - | 1 | - | 1 | - | 2 | 1 | - | - | - | - | 1 | - |
| Mydaea sp. | - | - | - | - | - | - | - | - | 1 | 1 | 3 | 12 | 4 | - | 7 | - | 2 | - | - | 1 | - |

* Subsidiary trapping days.

TABLE 20

Trap 6

| Species | May | | | | | | | June | | | | | July | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1st | 5th | 12th | 13th | 15th | 21st | 27th | 2nd | 5th | 10th | 16th | 23rd | 1st | 7th | 15th |
| Calliphora vicina | - | 7 | - | - | - | | 1 | 23 | 11 | 8 | 5 | 9 | - | 1 | 3 |
| Calliphora vomitoria | - | - | - | - | - | - | 1 | 26 | 2 | 5 | - | - | - | - | - |
| Lucilia sp. | - | - | - | - | - | - | - | 9 | 8 | 23 | 3 | - | - | 2 | - |
| Sarcophaga sp. | - | - | - | - | - | - | - | 5 | - | - | - | - | - | - | - |
| Cynomyia mortuorum | - | - | - | - | - | - | - | - | 1 | 1 | 1 | - | - | - | - |
| Acrophaga subalpina | - | - | - | - | - | - | - | - | 2 | 1 | 1 | 1 | - | - | 1 |
| Dasyphora cyanella | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Polietes lardarius | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Phaonia sp. | - | - | - | - | - | - | - | - | 1 | 3 | 5 | 1 | - | 1 | - |
| Muscina assimilis | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Muscina pabulorum | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 | - |
| Mydaea sp. | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |

## TABLE 21

Trap 7

| Species | May | | | | | | | June | | | | | | | | | | July | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1st | 5th | 12th | 13th | 15th | 21st | 27th | 1st* | 2nd | 3rd* | 5th | 10th | 15th* | 16th | 19th* | 23rd | 26th* | 1st | 4th* | 7th | 15th |
| Calliphora vicina | - | 3 | 1 | 2 | - | 3 | 1 | 34 | 10 | 78 | 25 | 30 | 19 | 7 | 17 | 4 | 16 | 2 | 9 | 9 | - |
| Calliphora vomitoria | - | 3 | - | - | - | 22 | 39 | 126 | 112 | 876 | 294 | 262 | 9 | 2 | 11 | 4 | 7 | - | 3 | 3 | - |
| Lucilia sp. | - | - | - | - | - | 1 | 9 | 11 | 35 | 180 | 123 | 197 | 10 | 7 | 92 | 3 | 10 | - | 5 | 15 | - |
| Sarcophaga sp. | - | - | - | - | - | - | 4 | 10 | 1 | 1 | - | - | - | - | 2 | - | - | - | - | 2 | - |
| Cynomyia mortuorum | - | 1 | - | - | - | - | - | 1 | - | 1 | - | 1 | - | - | - | - | - | - | - | - | - |
| Acrophaga subalpina | - | - | - | - | - | - | - | - | - | 4 | 7 | 1 | 1 | 2 | 12 | 3 | 4 | 1 | 5 | 3 | - |
| Dasyphora cyanella | - | - | - | - | - | - | 5 | - | - | 22 | 1 | - | - | - | - | - | - | - | - | 1 | - |
| Polietes lardarius | - | - | - | - | - | - | - | - | - | 1 | 2 | 8 | 7 | 4 | 3 | 2 | - | - | - | - | 1 |
| Phaonia sp. | - | - | - | - | - | 3 | 6 | 12 | 9 | 3 | 5 | 8 | 5 | 4 | 17 | 2 | 3 | 1 | 1 | 6 | 5 |
| Muscina assimilis | - | - | - | - | - | - | - | - | - | 1 | - | - | - | - | 4 | - | 2 | - | - | - | - |
| Muscina pabulorum | - | - | - | - | - | - | - | - | - | 2 | - | - | - | 4 | - | - | 4 | 1 | 1 | - | - |
| Mydaea sp. | - | - | - | - | - | - | 4 | - | 7 | 24 | 10 | 73 | 4 | 3 | 27 | 5 | 5 | 1 | 6 | 12 | - |

* Subsidiary trapping days.

## TABLE 22

Trap 8

| Species | May | | | | | | | June | | | | | | | | | | July | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1st | 5th | 12th | 13th | 15th | 21st | 27th | 1st* | 2nd | 3rd* | 5th | 10th | 15th* | 16th | 19th* | 23rd | 26th* | 1st | 4th* | 7th | 15th |
| Calliphora vicina | - | 4 | - | 1 | - | - | 9 | 26 | 12 | 43 | 14 | 9 | 9 | 1 | 3 | 3 | 15 | - | 7 | 7 | - |
| Calliphora vomitoria | - | 1 | - | - | - | - | 1 | 18 | 3 | 87 | 2 | 2 | - | - | - | - | 1 | - | - | - | - |
| Lucilia sp. | - | - | - | - | - | - | - | 4 | 6 | 59 | 7 | 24 | 3 | 2 | 3 | 1 | 18 | - | - | 2 | - |
| Sarcophaga sp. | - | - | - | - | - | - | - | 1 | 1 | 3 | - | - | - | - | - | 2 | 4 | - | - | 1 | - |
| Cynomyia mortuorum | - | - | - | - | - | - | - | - | 2 | 1 | - | - | - | - | - | - | - | - | - | - | - |
| Acrophaga subalpina | - | - | - | - | - | - | - | - | - | 4 | 1 | - | 2 | 1 | 3 | 2 | 6 | - | 1 | 4 | - |
| Dasyphora cyanella | - | - | - | - | - | - | - | - | - | 1 | - | - | - | - | - | - | - | - | - | - | - |
| Polietes lardarius | - | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - | 1 | - | 1 | - | - |
| Phaonia sp. | - | - | - | - | - | - | 1 | 2 | 1 | 1 | 2 | 4 | 5 | - | 2 | 3 | 2 | 1 | - | 1 | 1 |
| Muscina assimilis | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Muscina pabulorum | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Mydaea sp. | - | - | - | - | - | - | - | - | - | 5 | 5 | 18 | 6 | - | 8 | 6 | 3 | - | - | 1 | - |

* Subsidiary trapping days.

<u>TABLE 23</u>

<u>Trap 9</u>

| Species | May | | | | | | | June | | | | | July | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1st | 5th | 12th | 13th | 15th | 21st | 27th | 2nd | 5th | 10th | 16th | 23rd | 1st | 7th | 15th |
| Calliphora vicina | - | 1 | 1 | 2 | - | - | 1 | 15 | 7 | 4 | 2 | 3 | 3 | 1 | 2 |
| Calliphora vomitoria | - | - | - | - | - | 2 | - | 8 | 5 | 1 | 1 | - | - | 1 | - |
| Lucilia sp. | - | 1 | - | - | - | - | - | 11 | 38 | 66 | 2 | 2 | - | 4 | - |
| Sarcophaga sp. | - | - | - | - | - | - | - | 9 | 2 | - | 5 | 6 | 4 | 2 | - |
| Cynomyia mortuorum | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Acrophaga subalpina | - | - | - | - | - | - | - | - | 4 | 3 | 2 | 3 | - | - | - |
| Dasyphora cyanella | 1 | 1 | - | - | - | - | - | - | 1 | - | - | - | - | - | - |
| Polietes lardarius | 1 | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - |
| Phaonia sp. | - | - | - | - | - | - | - | 1 | 5 | - | - | 1 | - | - | - |
| Muscina assimilis | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Muscina pabulorum | - | - | - | - | - | - | - | - | - | - | - | 2 | 2 | - | - |
| Mydaea sp. | - | - | - | - | - | - | - | - | 2 | 1 | - | 1 | 1 | - | - |

TABLE 24

Trap 10

| Species | May | | | | | | | June | | | | | July | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1st | 5th | 12th | 13th | 15th | 21st | 27th | 2nd | 5th | 10th | 16th | 23rd | 1st | 7th | 15th |
| Calliphora vicina | - | 1 | 1 | 1 | - | - | 3 | 8 | 14 | 4 | - | - | - | 5 | - |
| Calliphora vomitoria | - | - | - | - | - | 2 | 18 | 30 | 48 | - | - | - | - | 2 | - |
| Lucilia sp. | - | - | - | - | - | - | 6 | 16 | 78 | 87 | 2 | - | - | 17 | - |
| Sarcophaga sp. | - | - | - | - | - | - | 4 | - | 1 | 3 | 1 | - | - | 4 | - |
| Cynomyia mortuorum | - | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Acrophaga subalpina | - | - | - | - | - | - | - | - | 4 | - | 2 | 2 | - | 4 | - |
| Dasyphora cyanella | - | - | - | - | - | - | 1 | - | 13 | - | - | - | - | 2 | - |
| Polietes lardarius | - | - | - | - | - | - | - | - | 1 | - | - | - | - | - | - |
| Phaonia sp. | - | - | - | - | - | - | - | - | 2 | - | 1 | - | - | - | - |
| Muscina assimilis | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 | - |
| Muscina pabulorum | - | - | - | - | - | - | - | - | - | - | - | - | - | 9 | - |
| Mydaea sp. | - | - | - | - | - | - | - | - | 9 | 5 | 2 | 1 | 1 | 4 | 1 |

TABLE 25

Trap 11

| Species | May | | | | | | | June | | | | | July | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1st | 5th | 12th | 13th | 15th | 21st | 27th | 2nd | 5th | 10th | 16th | 23rd | 1st | 7th | 15th |
| Calliphora vicina | - | 7 | - | - | - | 2 | 4 | 8 | 15 | 11 | 7 | 5 | 1 | 18 | - |
| Calliphora vomitoria | - | 7 | - | - | - | 8 | 35 | 123 | 25 | 52 | 1 | - | - | 8 | - |
| Lucilia sp. | - | - | - | - | - | - | 8 | 7 | 12 | 28 | - | 4 | - | 9 | - |
| Sarcophaga sp. | - | - | - | - | - | - | 4 | 5 | - | 1 | 1 | - | 1 | - | 2 |
| Cynomyia mortuorum | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Acrophaga subalpina | - | - | - | - | - | - | - | - | 2 | 11 | 2 | - | 1 | 7 | - |
| Dasyphora cyanella | - | 2 | - | - | - | - | 1 | - | - | - | - | - | - | 1 | - |
| Polietes lardarius | - | - | - | - | - | - | - | - | - | 4 | - | 2 | - | - | 1 |
| Phaonia sp. | - | 2 | - | - | - | - | 4 | 8 | 3 | 7 | - | 1 | 2 | 3 | - |
| Muscina assimilis | - | - | - | - | - | - | - | - | - | 1 | - | - | - | - | - |
| Muscina pabulorum | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - | - |
| Mydaea sp. | - | - | - | - | - | - | 3 | 1 | 2 | 14 | 1 | 4 | - | 5 | 5 |

## TABLE 26

Trap 12

| Species | May | | | | | | | June | | | | | July | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1st | 5th | 12th | 13th | 15th | 21st | 27th | 2nd | 5th | 10th | 16th | 23rd | 1st | 7th | 15th |
| Calliphora vicina | - | - | - | - | - | - | 1 | - | 3 | - | | - | 1 | 3 | - |
| Calliphora vomitoria | - | - | - | - | - | - | 1 | 2 | 7 | - | - | - | - | - | - |
| Lucilia sp. | - | - | - | - | - | - | 3 | 4 | 43 | 3 | 2 | - | - | 3 | - |
| Sarcophaga sp. | - | - | - | - | - | - | 2 | 3 | 2 | - | - | 2 | 2 | - | - |
| Cynomyia mortuorum | - | - | - | - | - | 1 | - | 2 | - | - | - | 1 | - | - | - |
| Acrophaga subalpina | - | - | - | - | - | - | - | - | 5 | 1 | 4 | - | - | 2 | - |
| Dasyphora cyanella | - | - | 1 | - | - | - | - | - | - | - | - | - | - | - | - |
| Polietes lardarius | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Phaonia sp. | - | - | - | - | - | - | - | - | 1 | - | - | - | - | - | - |
| Muscina assimilis | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Muscina pabulorum | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Mydaea sp. | - | - | - | - | - | - | - | - | - | - | - | 1 | 1 | 1 | - |

# TABLE 27

Trap 13

| Species | May | | | | | | | June | | | | | July | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1st | 5th | 12th | 13th | 15th | 21st | 27th | 2nd | 5th | 10th | 16th | 23rd | 1st | 7th | 15th |
| Calliphora vicina | - | - | - | - | - | - | 1 | - | 1 | 5 | 1 | 1 | - | 5 | 1 |
| Calliphora vomitoria | - | - | - | - | - | - | 1 | 108 | 3 | 15 | - | - | - | - | - |
| Lucilia sp. | - | - | - | - | - | - | - | 15 | 3 | 8 | 1 | - | 1 | 48 | - |
| Sarcophaga sp. | - | - | - | - | - | - | 1 | 2 | 1 | 1 | 1 | - | 1 | 1 | - |
| Cynomyia mortuorum | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Acrophaga subalpina | - | - | - | - | - | - | - | - | - | 3 | - | - | - | 2 | - |
| Dasyphora cyanella | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Polietes lardarius | - | - | - | - | - | - | - | 1 | - | - | - | - | - | - | - |
| Phaonia sp. | - | - | - | - | - | 7 | - | - | - | - | - | - | - | 1 | - |
| Muscina assimilis | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Muscina pabulorum | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 | - |
| Hydaea sp. | - | - | - | - | - | - | - | 2 | 1 | - | - | - | 4 | 3 | 2 |

## TABLE 28

Trap 14

| Species | May | | | | | | | June | | | | | | | | | | | July | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1st | 5th | 12th | 13th | 15th | 21st | 27th | 1st* | 2nd | 3rd* | 5th | 10th | 15th* | 16th | 19th* | 23rd | 26th* | 1st | 4th* | 7th | 15th |
| Calliphora vicina | - | - | - | - | - | - | - | 4 | 1 | 7 | 5 | - | 2 | 3 | 1 | 2 | 1 | - | 2 | 9 | 1 |
| Calliphora vomitoria | - | - | - | - | - | - | - | 1 | - | 5 | 1 | - | - | - | - | - | - | - | - | - | - |
| Lucilia sp. | - | - | - | - | - | - | - | 3 | 3 | 56 | 10 | 17 | 3 | 1 | 9 | 1 | 5 | 2 | - | 13 | - |
| Sarcophaga sp. | - | - | - | - | - | - | - | 3 | 1 | 7 | 1 | - | - | 4 | 2 | 3 | 2 | 1 | - | 1 | - |
| Cynomyia mortuorum | - | - | - | - | - | - | - | 4 | 1 | 3 | 1 | - | - | 1 | 1 | - | 1 | - | - | 6 | 1 |
| Acrophaga subalpina | - | - | - | - | - | - | - | - | - | - | - | 1 | 3 | - | 6 | - | 2 | - | - | - | - |
| Dasyphora cyanella | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - |
| Polietes lardarius | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Phaonia sp. | - | - | - | - | - | 1 | - | - | - | - | - | - | - | 1 | - | - | - | - | - | - | - |
| Muscina assimilis | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Muscina pabulorum | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Mydaea sp. | - | - | - | - | - | - | - | - | - | - | 1 | 2 | - | - | 3 | - | - | - | - | 1 | 1 |

* Subsidiary trapping days.

## TABLE 29

Trap 15

| Species | May | | | | | | | June | | | | | | | | | | July | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1st | 5th | 12th | 13th | 15th | 21st | 27th | 1st* | 2nd | 3rd* | 5th | 10th | 15th* | 16th | 19th* | 23rd | 26th* | 1st | 4th* | 7th | 15th |
| Calliphora vicina | - | 3 | - | 2 | - | - | - | 4 | 6 | 26 | 4 | 3 | 2 | - | 2 | - | 10 | 5 | 5 | - | 1 |
| Calliphora vomitoria | - | 2 | - | 1 | - | - | 4 | 1 | 6 | 95 | 1 | - | - | - | - | - | - | - | - | - | - |
| Lucilia sp. | - | - | - | - | - | - | 4 | 3 | - | 121 | 11 | 5 | 5 | - | 24 | 1 | 59 | 1 | 1 | - | - |
| Sarcophaga sp. | - | - | - | - | - | - | 1 | 3 | 3 | 16 | 4 | - | - | - | 5 | 1 | 10 | 1 | 2 | 1 | - |
| Cynomyia mortuorum | - | - | - | - | - | - | 1 | 4 | - | 4 | 1 | - | - | - | 1 | - | - | - | - | - | - |
| Acrophaga subalpina | - | - | - | - | - | - | - | - | - | 2 | 3 | 2 | 13 | 4 | 14 | - | 6 | - | 1 | - | - |
| Dasyphora cyanella | - | 3 | - | 1 | - | - | - | - | - | - | 1 | - | - | - | - | - | - | - | - | - | - |
| Polietes lardarius | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 4 | 1 |
| Phaonia sp. | - | - | - | - | - | - | 2 | - | 1 | - | 1 | - | 1 | 2 | 1 | - | 1 | - | - | - | 2 |
| Muscina assimilis | - | 2 | - | - | - | - | - | - | - | 1 | - | - | - | 1 | 3 | - | - | 1 | 1 | - | - |
| Muscina pabulorum | - | - | - | - | - | - | - | - | - | 2 | - | - | - | - | - | - | - | - | - | - | - |
| Mydaea sp. | - | - | - | - | - | - | - | - | 1 | 3 | - | 1 | 2 | - | 6 | - | 6 | 2 | - | 2 | 1 |

* Subsidiary trapping days.

# TABLE 30

Trap 16

| Species | May | | | | | | | June | | | | | July | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1st | 5th | 12th | 13th | 15th | 21st | 27th | 2nd | 5th | 10th | 16th | 23rd | 1st | 7th | 15th |
| Calliphora vicina | - | - | 1 | - | - | - | - | - | 4 | - | - | 2 | 2 | 3 | 1 |
| Calliphora vomitoria | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Lucilia sp. | - | - | - | - | - | - | - | 6 | 3 | 45 | 1 | 2 | 1 | 40 | - |
| Sarcophaga sp. | - | - | - | - | - | - | - | 2 | 1 | - | 1 | - | - | - | - |
| Cynomyia mortuorum | - | - | - | - | - | - | - | - | 4 | - | - | 5 | - | 4 | 2 |
| Acrophaga subalpina | - | - | - | - | - | - | - | - | - | - | 2 | 1 | 1 | 3 | - |
| Dasyphora cyanella | - | - | - | 1 | - | - | - | - | - | - | - | - | - | 1 | - |
| Polietes lardarius | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Phaonia sp. | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Muscina assimilis | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Muscina pabulorum | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Mydaea sp. | - | - | - | - | - | - | - | - | 1 | 1 | 1 | 3 | 2 | 3 | 2 |

# TABLE 31

Trap 17

| Species | May | | | | | | | June | | | | | July | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1st | 5th | 12th | 13th | 15th | 21st | 27th | 2nd | 5th | 10th | 16th | 23rd | 1st | 7th | 15th |
| Calliphora vicina | - | 1 | 1 | 1 | - | - | 3 | 4 | 1 | 3 | 4 | 2 | - | 3 | 1 |
| Calliphora vomitoria | - | - | - | - | - | 1 | 2 | 13 | 1 | - | - | - | - | - | - |
| Lucilia sp. | - | 1 | - | - | - | - | 1 | 3 | 21 | 72 | 4 | 1 | - | 1 | - |
| Sarcophaga sp. | - | - | - | - | - | - | - | - | 3 | - | - | - | - | - | - |
| Cynomyia mortuorum | - | - | - | - | - | 1 | - | - | - | - | - | 2 | - | 1 | - |
| Acrophaga subalpina | - | - | - | - | - | - | - | 2 | 2 | 6 | 1 | - | - | - | - |
| Dasyphora cyanella | - | - | 1 | - | - | - | - | - | - | - | - | - | - | 1 | - |
| Polietes lardarius | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 | 2 |
| Phaonia sp. | - | - | - | - | - | 1 | - | - | - | - | - | - | - | 2 | 2 |
| Muscina assimilis | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Muscina pabulorum | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Mydaea sp. | - | - | - | - | - | - | - | 1 | 4 | 1 | 3 | 2 | - | 4 | 6 |

## TABLE 32

Trap 18

| Species | May | | | | | | | June | | | | | | | | | | July | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1st | 5th | 12th | 13th | 15th | 21st | 27th | 1st* | 2nd | 3rd* | 5th | 10th | 15th* | 16th | 19th* | 23rd | 26th* | 1st | 4th* | 7th | 15th |
| Calliphora vicina | - | - | 1 | 1 | - | 2 | - | 8 | 5 | 6 | 2 | - | 3 | 1 | 4 | 1 | 2 | - | 2 | 5 | 4 |
| Calliphora vomitoria | - | - | - | - | - | 2 | - | 1 | 2 | 3 | - | - | - | - | - | - | - | - | - | - | - |
| Lucilia sp. | - | - | - | - | - | - | - | 4 | 5 | 30 | 8 | 14 | 17 | 14 | 45 | 1 | 5 | 1 | 2 | 87 | - |
| Sarcophaga sp. | - | - | - | - | - | - | - | 2 | 2 | 11 | - | - | 2 | 2 | - | 2 | 2 | - | 2 | 3 | - |
| Cynomyia mortuorum | - | - | - | - | - | - | - | 5 | - | 1 | 2 | 2 | 3 | 3 | 8 | 2 | 1 | 1 | 2 | 3 | - |
| Acrophaga subalpina | - | - | - | - | - | - | - | - | - | - | - | - | 2 | 2 | 5 | - | 1 | 1 | - | 1 | - |
| Dasyphora cyanella | - | - | 1 | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Polietes lardarius | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 | 1 | - |
| Phaonia sp. | - | - | - | - | 1 | 3 | - | - | - | - | - | - | - | - | - | - | - | - | - | 2 | - |
| Muscina assimilis | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Muscina pabulorum | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Mydaea sp. | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 3 | 1 | 5 | 2 | 3 | 3 | 1 |

* Subsidiary trapping days.

<u>TABLE 33</u>

<u>Trap 19</u>

| Species | May | | | | | | | June | | | | | | | | | | July | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1st | 5th | 12th | 13th | 15th | 21st | 27th | 1st* | 2nd | 3rd* | 5th | 10th | 15th* | 16th | 19th* | 23rd | 26th* | 1st | 4th* | 7th | 15th |
| Calliphora vicina | - | 1 | - | - | 1 | - | 8 | 10 | - | 22 | 11 | 4 | 7 | 4 | 10 | 4 | 7 | - | 2 | 9 | 2 |
| Calliphora vomitoria | - | 1 | - | - | - | - | 7 | 12 | - | 62 | 5 | - | - | - | - | - | - | - | - | - | - |
| Lucilia sp. | - | - | - | - | - | - | 8 | 7 | 9 | 202 | 95 | 86 | 28 | 6 | 194 | 7 | 41 | - | 6 | 17 | - |
| Sarcophaga sp. | - | - | - | - | - | - | 4 | 5 | 5 | 10 | 1 | 1 | 2 | 5 | - | 2 | - | 1 | - | 1 | 1 |
| Cynomyia mortuorum | - | - | - | 1 | - | - | 2 | 2 | - | 5 | 1 | 5 | 1 | - | 2 | - | 1 | - | - | - | 1 |
| Acrophaga subalpina | - | - | - | - | - | - | - | - | - | 1 | 2 | 3 | 8 | 3 | 14 | 4 | 6 | - | - | - | 1 |
| Dasyphora cyanella | - | - | 1 | - | - | - | 3 | 1 | - | 1 | 3 | - | - | - | - | - | - | - | - | - | - |
| Polietes lardarius | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - | - | - | - | - | - | - | - |
| Phaonia sp. | - | - | - | - | - | 1 | 3 | 1 | - | - | 2 | - | - | - | - | - | - | 1 | - | 2 | - |
| Muscina assimilis | - | 1 | - | - | - | - | - | - | - | 2 | - | - | - | 3 | - | - | 4 | - | - | 1 | - |
| Muscina pabulorum | - | - | - | - | - | - | - | 1 | - | - | - | - | 1 | - | - | - | 2 | - | - | - | - |
| Mydaea sp. | - | - | - | - | - | - | - | - | - | 1 | 3 | - | 1 | 1 | 9 | 4 | - | 2 | 1 | 5 | 2 |

* Subsidiary trapping days.

## TABLE 34

Trap 20

| Species | May | | | | | | | June | | | | | July | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1st | 5th | 12th | 13th | 15th | 21st | 27th | 2nd | 5th | 10th | 16th | 23rd | 1st | 7th | 15th |
| Calliphora vicina | 2 | - | - | - | - | - | - | 2 | 14 | 4 | 1 | 4 | - | - | 1 |
| Calliphora vomitoria | - | - | - | - | - | 1 | 1 | 2 | 1 | - | - | - | - | - | - |
| Lucilia sp. | - | - | - | - | - | - | 10 | 9 | 29 | 86 | 2 | 5 | - | 21 | - |
| Sarcophaga sp. | - | - | - | - | - | - | - | - | - | 1 | - | 1 | 1 | 2 | - |
| Cynomyia mortuorum | - | - | - | - | - | - | - | - | 3 | 5 | - | - | - | - | 1 |
| Acrophaga subalpina | - | - | - | - | - | - | - | - | 2 | 3 | 2 | - | 1 | - | - |
| Dasyphora cyanella | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Polietes lardarius | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Phaonia sp. | - | 1 | - | - | 1 | 1 | 1 | 1 | - | - | - | - | - | 1 | 1 |
| Muscina assimilis | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Muscina pabulorum | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 | - |
| Mydaea sp. | - | - | - | - | - | - | - | - | - | - | - | 1 | - | 5 | - |