Onderstepoort Journal of Veterinary Science and Animal Industry, Volume 19, *Numbers* 1 *and* 2, *January and April,* 1944.

Printed in the Union of South Africa by the
Government Printer, Pretoria.

Sheep Blowfly Research VII.—Investigations in the Cape Winter-Rainfall Areas.

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THE investigations reported on in the first six articles of this series (*Onderstepoort J.*, Vol. 18, 1943) were carried out mainly in the summer-rainfall area, which constitutes the larger part of the Union. The winter-rainfall area comprises the south-western corner of the Cape Province and a strip of variable width along the southern coast extending about as far as Mossel Bay, to the east of which there is a further strip with a mixed rainfall. Sheep-farming is practised in the winter-rainfall area and blowflies are troublesome there as well as elsewhere. It was suspected that the climatic conditions of this region might affect the blowfly-sheep-carcase complex and produce a picture differing to some extent from that obtained in the summer-rainfall area. For this reason investigations were carried out for a year on a farm about three miles east of Bredasdorp, 15 miles from the sea and about 22 miles N.N.E. of Cape Agulhas.

The investigation was planned so as to give a fairly comprehensive picture of the blowfly problem in that area and comprised the following:—

1. Measurement of rainfall, temperature and humidity.
2. The collection and identification of maggots from struck sheep throughout the year.
3. The exposure of carcases of sheep and small animals and the identification of the flies which breed in them during the different seasons.
4. Continuous trapping of blowflies by means of ordinary meat bait.

1. CLIMATIC CONDITIONS.

The average rainfall over the last seven years prior to the experiment was 16·96 inches. The rains are usually soft and well distributed, so that the climate is moist in spite of the low rainfall, especially also because it is never very hot. The rainfall during the experimental period is given in Table 1, from which it can be seen that, although this is called a "winter-rainfall area" it rains at all times of the year.

The temperature and humidity were recorded continuously by a thermo-hygrograph, but unfortunately the records are not exact enough to warrant the publication of absolute figures from them. It can, however, be stated in

general that the temperature is moderate, and humidity relatively high, with no great daily or seasonal fluctuations. Cool, misty days occurred periodically as late as November. During December it was fairly warm, but the rains in January caused a drop in the temperature and thereafter it was cooler again. The winters are quite cool and the summers warm, but it is never very cold or hot. Also, while daily fluctuations of temperature and humidity occur, the mornings and the afternoons in summer and the midday period in winter are mild and provide ideal conditions for strike.

TABLE 1.

Rainfall (in inches) at the Site of Experiment.

1942.						1943.						TOTAL.
July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	April.	May.	June.	
0·65	1·21	1·01	0·41	0·25	2·90	3·09	0·82	1·80	1·53	0·00	1·82	15·49

2. SPECIES THAT STRIKE SHEEP.

Maggots were collected from struck sheep at Bredasdorp, Caledon and Stellenbosch. A total of 55 specimens with together over 5,000 maggots were examined. A larger number of specimens would have been desirable, but the collection had to be left mainly to farmers and they were not very enthusiastic. The specimens, however, represent all seasons of the year and are, therefore, a good indicator. In nine instances, i.e., two from Stellenbosch and seven from Bredasdorp, the maggots were bred to the fly stage and then identified: all were *Lucilia cuprina*. In the other cases the maggots were identified as *Lucilia* without exception and it is very probable that they were also *L. cuprina*.

3. CARCASE EXPERIMENTS.

(*a*) *Sheep carcases* were exposed as frequently as possible, using two large troughs and applying the technique described by Hepburn (1943a). Only eight experiments could be made on account of the slow development in the generally cool climate and because some time was required for the sand in the trough to dry after each experiment. The results are given in Table 2.

In no single instance did *L. cuprina* emerge from these carcases. Here is a marked difference from what had previously been found to occur in the summer-rainfall area. In the latter the winters are dry and cold, the *Chrysomyia* species are inactive and conditions are unfavourable for the occurrence of strike. Under these circumstances *L. cuprina* breeds in carcases until the other species become active in spring and conditions favour strike, when *L. cuprina* returns to the live sheep. In the winter-rainfall area, with its temperate and generally moist climate, conditions are favourable to strike throughout the year and *L. cuprina*, which is apparently more partial to the live animal than to the carcase, appears to be sufficiently attracted to sheep so that it is not drawn to carcases to any great extent. From the trapping records, however, it appears that *L. cuprina* does come to meat bait and it may, therefore, lay eggs in carcases, but its larvae are

apparently not able to compete with those of the *Chrysomyia* species. Some further evidence on this point seems to be provided by the breeding of *L. sericata* in large and small carcases and will be discussed later.

TABLE 2.

Blowflies bred from Sheep Carcases.

Started.	Left Open.	*L. cupr.*	*L. seric.*	*C. chlor.*	*C. alb.*	*C. marg.*	*Cal croc.*
8/ 7/42.....	3 days	0	1,570 5·09%	25,056 81·35%	2,778 9·01%	1,334 4·33%	24 0·18%
8/ 7/42.....	10 days	0	396 0·66%	61,304 98·36%	129 0·21%	0	488 0·78%
25/ 8/42.....	3 days	0	0	63,305 91·28%	6,048 8·72%	0	0
25/ 8/42.....	7 days	0	0	59,780 82·76%	9,671 13·39%	2,776 3·84%	0
13/10/42.....	1 day	0	0	48,507 90·74%	4,949 9·26%	0	0
13/10/42.....	7 days	0	0	5,246 41·66%	6,820 54·16%	525 4·17%	0
17/11/42.....	1 day	0	0	8 0·78%	1,027 99·22%	0	0
17/11/42.....	7 days	0	0	0	1,567 69·64%	683 30·36%	0
22/12/42.....	1 day	0	42 1·46%	324 11·29%	2,454 85·51%	50 1·74%	0
22/12/42.....	7 days	0	0	16 0·07%	24,061 99·13%	185 0·80%	0
16/ 2/43.....	2 days	0	0	38 0·1%	4,076 12·2%	29,209 87·7%	0
16/ 2/43.....	7 days	0	0	236 1·5%	11,342 72·4%	4,091 26·1%	0
29/ 3/43.....	1 day	0	0	0	13,884 34·47%	26,395 65·53%	0
29/ 3/43.....	7 days	0	0	0	8,864 26·86%	24,128 73·14%	0
11/ 5/43.....	2 days	0	0	1,204 38·05%	594 18·77%	1,366 43·17%	0
11/ 5/43.....	7 days	0	0	0	972 21·95%	3,456 78·05%	0

EXPLANATION:

L. cupr. = *Lucilia cuprina;*
L. seric. = *Lucilia sericata;*
C. chlor. = *Chrysomyia chloropyga;*
C. alb. = *Chrysomyia albiceps;*
C. marg. = *Chrysomyia marginalis;*
Cal. croc. = *Calliphora croceipalpis.*

During the colder months, when *C. albiceps* and *C. marginalis* are fairly inactive, *C. chloropyga* breeds in these carcases in large numbers. When the other two species become active their competition is too strong for *C. chloropyga.* It is especially the larvae of *C. albiceps,* which can be observed to attack and kill large numbers of other larvae and particularly those of *C. chloropyga,* that make this competition so severe. The records show that from October onwards, fewer *C. chloropyga* bred from the 7-day carcases than from those closed after a short period (except in February) and this is very probably the result of such competition, especially because

C. albiceps is attracted better by the old than by the fresh carcase, as the records indicate. Although the larvae of *C. marginalis* are also attacked by those of *C. albiceps*, they are very vigorous and often escape and consequently these two species get on fairly well together. Still, the records appear to indicate that *C. marginalis* is more successful when *C. albiceps* larvae are not so frequent.

The low figures for November are due to the destruction of larvae and pupae by Dermestid beetles.

(*b*) *Carcases of Small Animals.*—During the year, 304 carcases of small animals were exposed, including birds of various sizes, mice, rats, polecats, hares, lizards, tortoises and frogs. These carcases were first weighed and then exposed on sand in suitable dishes or boxes until they were completely devoured by the maggots and the first flies were about to emerge. The sand was then placed in bottles, together with any larvae or pupae present in the remains of the carcase and protected against parasites. The remains of the carcase were weighed. The emerging flies were sorted and counted.

It is not necessary to present the full records here; the following information will suffice:—

The frog carcases dried up and produced no blowflies. As had previously been noted, carcases up to about 500 gm. in weight react differently from carcases over that weight. In the smaller carcases *L. sericata* bred throughout the year and was accompanied by *Calliphora croceipalpis* during the colder months and *Sarcophaga* spp. during the warmer months. Only occassionally did a few *C. chloropyga* breed in these carcases and *C. albiceps* was also rarely bred from the larger ones, such as those of pigeons. During the period from 10.7.42 to 24.9.42 altogether 59 small carcases were exposed and four of these each produced a few *L. cuprina*, viz., two rats produced one and nine specimens, two birds one and four respectively. After that period no *L. cuprina* bred from small carcases.

The larger carcases, over 500 gm. in weight, such as cats, hares, hawks, pheasants, polecats and large snakes appear to form a transition between the smaller ones and the sheep carcase. They produce *L. sericata* as well as the species breeding in sheep carcases and show in general the same seasonal sequence of species as it occurs in sheep carcases. Tortoises form an exception in that they produce only those flies that breed in the small type of carcase, although they frequently weighed over 500 gm. In no case was *L. cuprina* obtained from the larger carcases and in general there was the same seasonal sequence of species and competition as noted in the sheep carcases—during the warmer months *C. albiceps* and *C. marginalis* preponderated while *L. sericata* and *C. chloropyga* decreased.

With the exception of tortoises, there was no difference in the flies bred by carcases of different species of small animals, as reported by Fuller (1934).

It appears then that *L. sericata* is mainly a small-carcase breeder and remains active as such throughout the year. During the colder season, when *C. albiceps* and *C. marginalis* are inactive, it is also able to breed in larger carcases, even in sheep, but in the latter it is unable to compete well against *C. chloropyga*, as indicated by the carcase test 8.7.42 (5·09 and 0·6 per cent. *L. sericata* against 81·35 and 98·36 per cent. *C. chloropyga*). From these results it seems permissible to conclude that the *Lucilia* species are not able to develop well in a carcase together with *Chrysomyia*

species. They seem, moreover, to prefer small to large carcases, as appears to be indicated by the fact that a few *L. cuprina* did breed from small carcases but not from the larger ones. Under the climatic condition of this particular area *L. cuprina* is continually attracted to live sheep and breeds on them, only occasionally also breeding in small carcases, and *L. sericata* is mainly restricted to small carcases since the *Chrysomyia* species claim the large ones.

4. Trapping of Blowflies.

The trap used was made of a 45-gallon oil drum of which the top and bottom were removed, the top closed with wire gauze and a gauze partition fixed inside across the middle. In the upper half eight 3-inch holes were made and each provided with a gauze cone through which the flies could enter. The trap was placed over a tin containing the bait. This type of trap is quite effective.

The bait used consisted of sheeps' intestines and was renewed weekly. The catches of the first three days and the next four days of each week were recorded separately, but owing to slow decomposition of the bait, there was little difference between the two groups of figures except that more flies were caught during the second period. The catches over the whole year are given in Table 3.

Table 3.

Blowflies Caught in Trap.

Month.	*L. cupr.*	*L. seric.*	*C. chlor.*	*C. alb.*	*C. marg.*	*Calliphora.*	*Sarcophaga.*
1942.							
July.....	68	57	623	292	1	2	12
August.....	13	29	633	38	0	7	5
September.....	307	1,992	3,367	137	1	115	33
October.....	1,302	2,810	3,955	159	0	166	249
November.....	331	783	1,839	479	0	4	163
December.....	526	427	1,082	4,568	98	0	302
1943.							
January.....	331	209	590	3,641	409	2	756
February.....	368	271	367	5,095	503	0	687
March.....	210	160	203	5,668	780	2	957
April.....	107	462	346	4,217	1,147	4	412
May.....	61	570	514	3,423	141	7	118
June.....	30	298	622	1,107	79	25	63
Total.....	3,654	8,068	14,141	28,824	3,159	334	3,757
Percentage....	6·28	13·87	24·31	49·54	5·43	0·57	—

The percentage figures do not include *Sarcophaga*.

L. cuprina constitutes only 6·28 per cent. of the total, even though the bait decomposed slowly and should have been attractive to this species continually. The question arises what proportion of the blowfly population in the area concerned was constituted by *L. cuprina* and whether the trap caught a true sample of the flies present. All that can be said is that strikes

were occurring all the time, so that there were a sufficient number of *L. cuprina* for this eventuality, and that the other species were being caught in more or less the same proportions as they bred in the carcases during the different seasons.

In the area concerned few sheep carcases are left lying about, so that the chances for the *Chrysomia* species to breed are not many, while *L. cuprina* has probably far better chances on live sheep. Previous investigations have indicated that *C. marginalis* is not readily caught with meat bait (Hepburn, 1943 *b*). If, therefore, the trap catches 14,000 *C. chloropyga* and 28,000 *C. albiceps* as against only 3,600 *L. cuprina*, with bait attractive to the latter, it seems as if the catch is not a true sample. In any case it may probably be concluded that trapping with meat bait is not a very effective means of combating *L. cuprina*, which may be due to the fact that this fly is attracted better by susceptible sheep than by meat bait.

Discussion.

The investigation has produced a fairly complete picture of blowfly life in the area concerned and it shows up a distinct difference in the habits of the *Lucilia* and the *Chrysomyia* species. The latter are large-carcase breeders, with seasonal preferences exhibited by the different species. Of the former *L. sericata* is a small-carcase breeder, while *L. cuprina* is primarily attracted by live sheep when climatic conditions make them susceptible.

In this area as well as elsewhere an important question remains to be elucidated, viz., under what conditions does *C. chloropyga* strike sheep? Smit and du Plessis (1927) identified maggots collected from sheep all over the Union and state: "The maggots of *C. chloropyga* and *L. sericata* were the ones most commonly found—the two species being about equally abundant." Hepburn (1943 *b*) gives figures for maggots similarly collected all over the Union. The strikes caused by *C. chloropyga* alone were 6 per cent. of the total, in comparison to 55 per cent. caused by *L. cuprina* alone, while *C. chloropyga* was found in a further 29 per cent. of cases together with other species. Hepburn notes that the majority of the cases examined in Natal and the Transvaal were caused by *L. cuprina* and *C. chloropyga* in combination, and then states: "In general, the rainfall and humidity of the sheepfarming areas in the Eastern Transvaal and Natal is higher than that of the sheep areas in the Cape and Orange Free State. Whether this factor could be correlated with a higher incidence of *C. chloropyga* strike is one for investigation."

The results obtained at Bredasdorp appear strange on account of the fact that no cases of strike due to *C. chloropyga* were found, although this fly bred in carcases in very large numbers during the winter, and, therefore, a larger number of specimens from struck sheep would have been more satisfactory. However, it is questionable whether a high humidity favours strike by *C. chloropyga*, as tentatively suggested by Hepburn, for the humidity is usually high in the Bredasdorp area, where only *L. cuprina* appeared to cause strikes, and a further example is provided by the cases recorded by Hepburn from Dohne. This is in a high rainfall and high humidity area and maggots were collected from 56 cases of which 54 were caused by *L. cuprina*, the other two by *L. cuprina* and *C. chloropyga* combined.

Although strikes by *C. chloropyga* were not encountered during the present investigation, it would be desirable to destroy large carcases from about June to October in this area so as to control this fly, while during the rest of the year the carcases should be buried only about two days after death in order to encourage *C. marginalis*.

The regular and frequent treatment of strikes in order to kill all maggots should have a decided effect on the incidence of *L. cuprina* and, therefore, on the occurrence of myiasis.

Summary.

Investigations in the winter-rainfall area were carried out with the object of obtaining a complete picture of the blowfly-sheep-carcase complex.

The rainfall is well distributed over the whole year, the climate is mild and humidity is relatively high.

Under these conditions sheep are susceptible during all seasons so that *Lucilia cuprina* causes strikes and breeds almost exclusively on live sheep throughout the year. It did not breed in sheep carcases at any time and only a few *L. cuprina* were obtained from four small carcases in winter.

The sheep carcases produced mainly *Chrysomyia chloropyga* during the cooler months and *C. albiceps* and *C. marginalis* in summer. These flies were not found to strike sheep.

The questions of competition between *Lucilia* and *Chrysomyia* and of the conditions under which *C. chloropyga* causes strike are briefly discussed. The latter question merits further investigation.

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