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**OBSERVATIONS ON THE BIONOMICS OF THE SHEEP BODY  
LOUSE (*DAMALINIA OVIS*)**

By MARION T. SCOTT

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# OBSERVATIONS ON THE BIONOMICS OF THE SHEEP BODY LOUSE (*DAMALINIA OVIS*)

By MARION T. SCOTT\*

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## Summary

Experimental observations are recorded on the bionomics of *Damalinia ovis* on the sheep and *in vitro*.

The optimal conditions for *in-vitro* rearing of *D. ovis* are 36.5°C. and 70-90 per cent. relative humidity when a mixture of skin scurf and baker's yeast is used as food. Under these conditions the life cycle closely approximates the estimated life cycle on the sheep. The incubation period is 9-10 days; the three nymphal instars are completed in 7, 5, and 9 days respectively; the preoviposition period is approximately 3 days, making a cycle of 34 days from egg to egg. The lice and their eggs are very susceptible to changes in temperature.

The areas of heaviest infestation are along the mid-dorsal line and down the sides of the sheep. Individual sheep differ considerably in their susceptibility to artificial and to natural infestations. Sheep in poor condition tend to have the heaviest infestations, which are retained throughout the year. There is a pronounced seasonal fluctuation in populations of *D. ovis*, the heaviest infestation occurring in the period from June to September.

## I. INTRODUCTION

Little attention has been given to studies of the bionomics of Mallophaga which infest domestic animals. Lamson (1917), Craufurd-Benson (1941), and Matthyse (1946) have, however, investigated the bionomics of the cattle louse, *Damalinia bovis*. The work of Matthyse is of particular interest because he was able to rear the lice through two generations under artificial conditions. He fed them on cattle hair and brewer's yeast, and found that they thrived best at 95°F. and 70-84 per cent. relative humidity. The life cycle occupied 29 days under these conditions and closely approximated that on the host during the winter.

Some accounts of the life history of *D. ovis* are to be found in many publications, mainly of a semi-popular nature, but they differ considerably in detail and do not seem to be based on experimental evidence. The incubation period, as stated by different authors, ranges from 5 to 10 days and the nymphs are said to reach maturity 14-18 days later. High fecundity and ability to withstand adverse conditions are also attributed to *D. ovis* by many of these authors.

## II. THE LIFE CYCLE OF *D. OVIS* UNDER LABORATORY CONDITIONS

In these studies attempts were made to rear lice in the laboratory under controlled conditions of temperature and humidity.

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(a) *Methods*

Collections of *D. ovis* were made from the sheep by employing a water suction pump to which a small collecting bottle was attached. When large numbers of lice were required, a towel was held firmly for several minutes on the fleece of a heavily infested animal. The lice readily migrated on to the towel, from which they were removed by the suction pump. This method, however, was satisfactory only when the weather was warm and the fleece fairly short.

In the laboratory, the lice were kept in small celluloid boxes with felt bases, which rested on petri dishes supported on glass stands within glass watch boxes with vaseline-sealed lids. The watch boxes thus served as humidity chambers. The required relative humidity was maintained by standard concentrations of sulphuric acid (Wilson 1921).

(b) *Food Materials*

Various materials were tested as sources of food by maintaining adult lice, in the presence of the particular food on trial, at 37°C. and 70 per cent. relative humidity. The suitability of the food was determined by the period for which the lice survived. With greasy wool, the lice did not live longer than 5 days; on dried serum the survival period was 11 days; when scurf from the skins of living sheep was used, the lice survived for 20 days. This scurf was obtained by scraping the skin surface of an infested sheep with a scalpel and freeing the scrapings from eggs and lice under the microscope. The scurf probably consisted of a mixture of epithelial debris, wool wax, and suint. The addition of about an equal quantity of desiccated baker's yeast to the scurf did not increase the survival time, but reduced the mortality rate. This mixture was subsequently used for rearing lice in the laboratory.

(c) *The Egg*

In trials to determine the effect of different conditions of temperature and humidity upon the viability of the eggs and on their incubation period, eggs of unknown age were collected from sheep.

At 36.5°C. eggs hatched at relative humidities ranging from 50 to 90 per cent., and under these conditions the incubation period was estimated at 8-10 days. There appeared to be no significant difference which could be correlated with humidity, either in the duration of the incubation period or in the percentage hatch. To investigate the effect of temperature on hatching, batches of eggs were incubated at different temperatures and at a relative humidity of 70 per cent. Table 1 shows the number of eggs which hatched after various periods of incubation at temperatures of 30, 35, and 42°C.

It will be seen from this table that at temperatures of 30 and 42°C. only 30 per cent. of the eggs hatched. Furthermore, hatching was confined to the first six days of exposure. It seems evident that only those eggs

which were well advanced in their development when removed from the sheep were able to complete development and hatch at these temperatures. At 35°C., on the other hand, 80 per cent. of the eggs hatched.

These observations indicate that temperature has a much greater effect than humidity upon the viability of the egg. The optimal temperature is in the vicinity of 35-37°C.

TABLE 1  
THE EFFECT OF TEMPERATURE UPON THE EGGS OF *D. OVIS* AT  
70 PER CENT. R.H.

Days Incubated	Number Hatched at		
	30°C.	35°C.	42°C.
3	10	20	8
4	2	5	0
5	2	6	3
6	1	4	4
7	0	0	0
8	0	0	0
9	0	0	0
10	0	4	0
11	0	1	0
12	0	0	0
Number incubated	50	50	50
Percentage hatched	30	80	30

Eggs maintained at room temperature (18-20°C.) failed to hatch. To determine how long eggs would survive under these conditions, batches of 25 eggs were exposed for periods ranging from 1 to 7 days and were then incubated at 35°C. and 70 per cent. R.H. The results are given in Table 2.

No egg survived longer than five days, which strongly suggests that the eggs of *D. ovis* are highly susceptible to reduced temperatures.

TABLE 2  
VIABILITY OF EGGS OF *D. OVIS* AFTER EXPOSURE TO ROOM  
TEMPERATURE (18-20°C.)

Days at room temperature	0	1	2	3	4	5	6	7
Percentage hatched on subsequent incubation	90	79	62	25	8	5	0	0

(d) *Nymphal and Adult Development*

To determine the effect of temperature and humidity upon the development of the nymphs and adult lice, similar numbers of eggs were incubated and the newly-hatched nymphs were placed in cells where they were provided with skin scrapings and desiccated yeast and were kept at the desired temperature and humidity. This method of rearing lice was not ideal and the mortality rate was high, particularly among the newly-

emerged nymphs. On occasions, whole batches of nymphs died within a few days of emergence; other batches, however, completed their development into adults.

The effect of variations in temperature and humidity on the average time of development through each instar is shown in Table 3.

TABLE 3  
EFFECTS OF TEMPERATURE AND HUMIDITY ON NYMPHAL AND ADULT DEVELOPMENT OF  
D. OVIS

Temperature (°C.)	Relative Humidity (%)	Average Duration (days)				Survival to Adult Stage	Average Preoviposi- tion Period (days)
		1st Instar	2nd Instar	3rd Instar	Hatching to Adult		
35	30	All dead in 2-3 days					
	50	None reached 2nd instar					
	70	10	7	11	28	Poor	7
36.5	90	8	6	7	21	Poor	—
	30	All dead in 2-3 days					
	50	8	6	8	22	Good	4
39.5	70	8	6	8	22	Good	4
	90	9	5	8	22	Good	4
	30	All dead in 2-3 days					
	50	None reached 2nd instar					
	70	7	6	6	19	Moderate	—
	90	7	6	6	19	Moderate	—

Lice could not be reared at temperatures below 35°C. or above 39.5°C., irrespective of the humidity. At intermediate temperatures, relative humidities of 30 and 50 per cent. were definitely unfavourable, and only at 36.5°C. were lice reared to the adult stage at 50 per cent. R.H. Although many cultures were set up, only 4 and 5 adults were reared at relative humidities of 70 and 90 per cent. but, when the temperature was increased to 36.5°C., the numbers of adults obtained were 74 and 63 at these respective humidities. The life cycle, hatching to adult, was shortest at 39.5°C., namely 19 days, compared with 22 days at 36.5°C. However, the mortality was much higher than at 36.5°C., and at 70 per cent. R.H. 36 lice were reared, whereas 20 were reared at 90 per cent. R.H. It would appear, therefore, that the optimal conditions for development involve a temperature in the vicinity of 36.5°C. and relative humidity of 70-90 per cent. This conclusion is supported by the fact that whereas the pre-oviposition period at 35°C. was 7 days, at 36.5°C. it was only 4 days. At 39.5°C. lice failed to oviposit.

Observations made regularly throughout the year on groups of sheep kept under cover at the laboratory showed the skin temperature along the midline of the back to vary from 36.1 to 38.6°C. The optimal temperature for rearing lice in the laboratory, therefore, approximates very closely to the normal skin temperature of the host.

(e) *Oviposition Rate*

Under artificial conditions, females laid very poorly, one egg being deposited every 2 to 3 days. Matthyse (1946) gives the oviposition rate for *D. bovis* as 2 eggs every 3 days and the rate for *D. ovis* is probably similar when conditions are most favourable.

III. LIFE CYCLE ON THE SHEEP

Numerous attempts were made to rear lice on the sheep by enclosing them in small cages sealed to the skin, but the rapid growth of the wool lifted the cages within a few days and the lice escaped.

TABLE 4  
LIFE CYCLE OF *D. OVIS* ON SHEEP AND UNDER OPTIMAL CONDITIONS IN THE LABORATORY

	Time (days)	
	On Sheep	Laboratory at 36.5°C. and 70-90% R.H.
Incubation period	10	8-10
1st nymphal instar	7	8-9
2nd nymphal instar	5	5-6
3rd nymphal instar	9	8
Hatching to adult	21	22
Preoviposition period	3	4

The observations recorded here were made by releasing approximately 100 newly-hatched nymphs on louse-free sheep which were kept in isolation. Although the point of liberation was marked, lice could be found subsequently only after very tedious examination. Nevertheless, a sufficient number could usually be collected to determine the progress of their development. The number of adults which were found usually represented about 10 per cent. of the initial nymphal infestation. This disadvantage was overcome to some extent by repeating the experiment several times. Another disadvantage of this method was that only the minimal periods could be obtained for the duration of the various nymphal instars.

The number of days occupied in the several stages of the life cycle, as observed on the sheep and under optimal conditions in the laboratory, are shown in Table 4.

On the sheep the sexes are present in approximately equal numbers, in contrast to *D. bovis*, in which females vastly predominate and in which Matthysse (1946) considered parthenogenesis to be the normal method of reproduction.

#### IV. STUDIES ON *D. OVIS* POPULATIONS

The main difficulty encountered in studying population trends of *D. ovis* was to obtain a satisfactory method of assessing the degree to which a sheep was infested. Total counts were, of course, impossible, and sampling techniques such as were finally used were not very accurate, principally because the lice tended to move into the fleece as soon as it was opened, but also because they tended to congregate in colonies and, when the sheep were heavily infested, the numbers of lice at any point could not be accurately assessed. The method finally adopted was to open the fleece at 10 points along each of three lines on each side of the body, giving a total of 60 points at which the lice were counted. The lines chosen were as follows: a dorsal line about 2 in. from the midline of the back, a mid-side line, and a ventral line at the level of the head of the ulna. In this way a fairly satisfactory comparative estimate of light and medium infestations could be made. In heavy infestations, no actual count of the lice was possible owing to their number.

##### (a) *Susceptibility of Individual Sheep*

The principal mode of transmission of lice is by direct contact. It was noticed, however, that some sheep, although closely confined with heavily infested animals, failed to become heavily infested themselves. There was no obvious reason for their relative immunity. Lambs readily became infested from their mothers and old sheep, and those in poor condition also tended to become heavily infested.

Two experiments were conducted concerning the effect of the host's plane of nutrition upon susceptibility to *D. ovis*, but the results were conflicting and no conclusions could be drawn. In one experiment, cross-bred sheep, each of which was artificially infested in the late winter with 10,000 lice, were kept on high and low planes of nutrition. The infestation declined in both groups during the summer months but, whereas it rose sharply among the poorly-fed sheep in the following winter, there was no appreciable rise among the well-fed sheep and they became completely free of lice in about 12 months. In the second experiment, however, in which Merino sheep with naturally-acquired light infestations were fed on rations with similar ingredients to those used in the first experiment, infestations increased rapidly in both groups, irrespective of the plane of nutrition.

##### (b) *Seasonal Fluctuations*

The results of counts on a group of sheep which were kept on a low plane of nutrition for some 20 months are shown in Figure 1. There

was a sharp decline in October or November in each year, followed by a period of minimum infestation from December to March. The populations began to increase again in April and May and reached maximum proportions in June to September.

General observations during the course of these studies indicated that marked fluctuations in body-lice infestations similar to those shown in Figure 1 are to be expected among infested sheep unless effective control measures are taken.

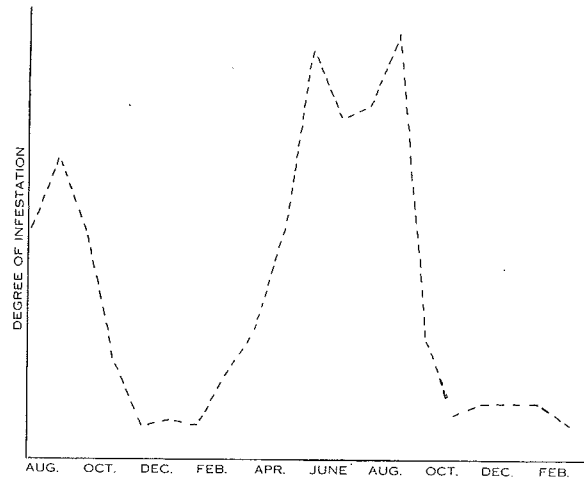


Fig. 1.—Seasonal fluctuations of *Damalinia ovis* populations on sheep.

(c) *Distribution of D. ovis on the Sheep*

These lice are not uniformly distributed over the body of the sheep. The favoured sites appear to be on the mid sides and the back. This was confirmed by actual counts, which were significantly higher along the back and mid-side regions than at the level of the axilla. Preference for these sites was observed irrespective of the degree of infestation. Nevertheless, some lice may be found anywhere on the body although on the belly of the sheep they may be found only singly and they do not appear to breed in that region. The underside of the neck is sometimes infested and lice in these sheltered positions may well serve as a source of reinfestation if the control methods adopted are not completely efficient.

## V. DISCUSSION

These studies have indicated that the life cycle of *Damalinia ovis* is somewhat longer than has been indicated by earlier writers.

When sheep are shorn, a very appreciable decline in the population of *D. ovis* occurs. This is brought about not only by the actual removal of lice and their eggs, but also by the unfavourable conditions to which



those remaining are exposed. These studies have shown that *D. ovis* survives only within fairly narrow limits of temperature. Furthermore, when lice were kept in wool at room temperature (18-20°C.) and a relative humidity of 50 per cent., few survived longer than 5 days and none beyond 10 days. It is not known whether those alive at 5 days or later were capable of reinfesting sheep. At 36.5°C. none survived in wool for longer than 5 days.

#### VI. ACKNOWLEDGMENT

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