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On the Occurrence of Hare Lice, *Haemodipsus* spp.
(Anoplura, Hoplopleuridae)
on Hares, *Lepus europaeus*, in The Netherlands

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Summary. In 1957 *Haemodipsus setoni* has been collected for the first time on *Lepus europaeus* in the Netherlands. Earlier *H. lyriocephalus* was the only known louse on the European hare.

During a three years' survey, the occurrence of both lice species was studied. On diseased hares an increasing infestation rate of *H. setoni* was found, while the infestation rate of *H. lyriocephalus* remained stable. The infestation of *H. setoni* on healthy hares was on a much lower level than in the case of the diseased hares. *H. lyriocephalus* seemed very rare on healthy hares.

No difference in infestation rate between the host sexes could be determined. Both sexes and juveniles of *H. setoni* and *H. lyriocephalus* seemed to be present during the whole year, but the infestation proved to be more severe in spring and summer.

Great numbers of lice occurred only on hares in a bad state of health. Mostly, infestation by lice was combined with other parasitic infestations with a more prolonged character. The relationship between the state of health, the time spent in cleaning the skin and infestation by lice is discussed.

Introduction

After Burmeister described *Haemodipsus lyriocephalus* in 1839 from a female specimen, this species was considered for a long time as "the" louse of the hare, *Lepus europaeus*. In 1934 Freund described the male. The full developmental cycle of *Haemodipsus lyriocephalus* was later published by Piechocki (1952-1953). Meanwhile, also *Lepus timidus* and *L. glacialis* had been found as hosts (Cooreman, 1952) but nevertheless *H. lyriocephalus* was always considered to be infrequent on these hares.

In 1965 the occurrence of *H. setoni* on *L. europaeus* in the Netherlands was mentioned for the first time (van den Broek, 1965). The first finding occurred on a dead hare (found in the Veluwe) with a mixed infestation of *H. lyriocephalus* and *H. setoni*. However, van den Broek since then found out that *H. setoni* already had been collected in the Netherlands in 1957, but the specimens had been erroneously recorded as *H. lyriocephalus*.

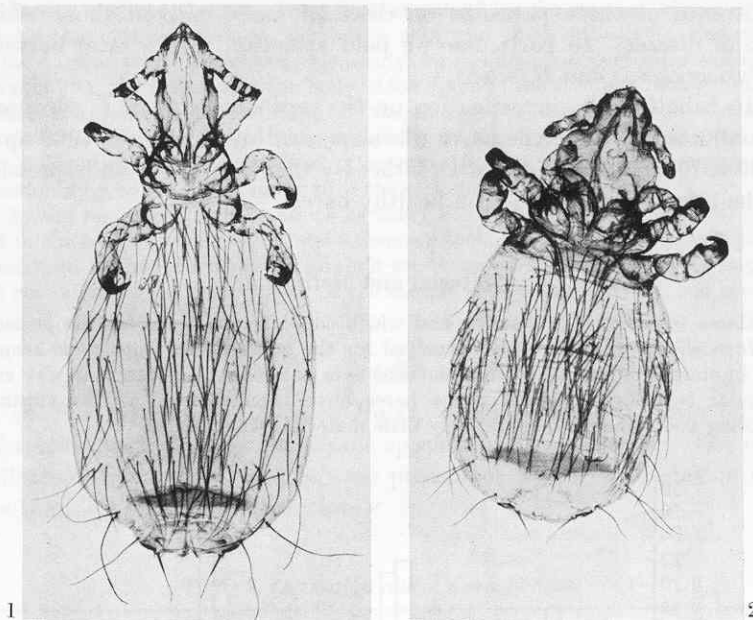


Fig. 1. *Haemodipsus lyriocephalus* Burm., female

Fig. 2. *Haemodipsus setoni* Ewing, female

H. setoni had been found earlier in North America on *L. californicus melanolis*, *L. arcticus*, and *Sylvilagus audubonii* (Beaucournu, 1968). In Great Britain it was found on *L. timidus scoticus* and *L. europaeus* (van den Broek, 1965); in France in 1960 and in Switzerland in 1966 on *L. europaeus* (Beaucournu, 1968). In Great Britain as well as in France and Switzerland mixed infestations of *H. setoni* and *H. lyriocephalus* occurred.

It is not clear as to how far *H. setoni* is a recent immigrant in Europe. In the opinion of Beaucournu (1968) the geographical distribution of *H. setoni* is probably much wider if it is accepted that all the findings of the rabbit louse, *H. ventricosus*, on hare species are erroneous records of *H. setoni*. For, according to Bouvier (1956) *H. ventricosus* is not transmissible to hares. It is Beaucournu's opinion too, that some new described lice of *L. tolai*, *L. zuluensis*, and *L. saxatilis* have to be considered as synonyms of *H. setoni*. If all this should be true, then *H. setoni* also should be present in Poland, Bulgaria, the European part of the U.S.S.R., the Asiatic Soviet Republics of Kazachstan and Jakutsk, and in the Transvaal.

However, it is noteworthy that both the first findings of *H. setoni* and the probably erroneously recorded findings of *H. ventricosus* on *L. europaeus* only date from the fifties.

In the course of our investigations on the mortality factors of *L. europaeus* in the Netherlands both *H. lyriocephalus* and *H. setoni* have been found regularly. This gave us the opportunity to study the

occurrence of these parasites on diseased hares and on those which died of diseases. In particular we paid attention to the ratio between *H. lyriocephalus* and *H. setoni*.

In behalf of our investigation on the reproductivity of *L. europaeus* a small number of female hares was shot monthly from June 1968 up to June 1970 in the province of Drenthe. By this we also got an impression of the infection rate of lice on healthy hares.

Material and Methods

Hares which died of diseases and which could be examined for the presence of *Haemodipsus* spp. have been received for the greater part from game-keepers and hunters. The spread of this material over the months of the year was very irregular (see Fig. 3). Most of the hares have been received in the autumn; in spring and summer comparatively little material was received.

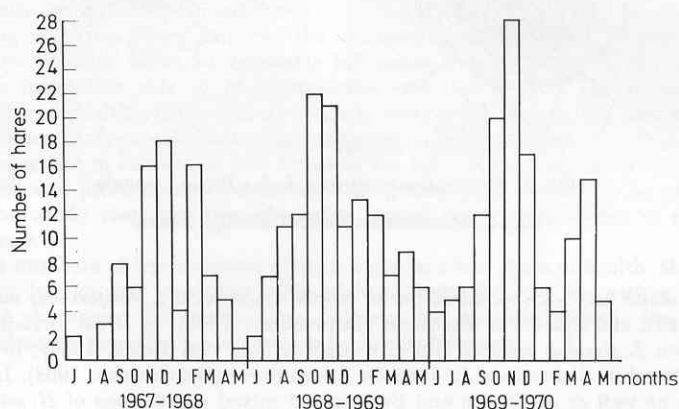


Fig. 3. Monthly on lice examined diseased hares from June 1967 up to May 1970

Generally, diseased hares were diagnosed as such and killed in the field by the game-keepers; in several cases those animals were caught by dogs. In this group we have also put hares shot during hunting but afterwards diagnosed as diseased and sent to our institute. Both the hares which died of diseases and the diseased ones shot by game-keepers or hunters are considered as diseased hares henceforth in this publication.

Dead young hares found in the field form an important part of the material from the month of June. Therefore, in handling the material a year has been taken from the beginning of June to the end of next May. The same has been done for the group of healthy hares from the province of Drenthe. This group includes only the hares shot in the field or killed by the traffic and showing no indications of bacterial infection or of important parasitological infestation by autopsy.

In the institute the hares have been examined for the presence of lice. Often the lice have their heads in the host's skin and it is difficult to find them in the thicker parts of the pelt. Generally we examined in particular the neck, the arm-pits, the groins, and the belly. After flaying, the skin was also examined inside, and sometimes the heads of the lice were visible through the skin. However, it is most likely that, especially in the case of slight infestations, lice might have been overlooked. Consequently the recorded percentages of infection may be somewhat lower than the real ones.

In the case of slight infestations as many lice as possible have been collected but in the case of more severe infestations we took samples from different places of the host. Without further verification it was accepted that this way of sampling did not influence the composition of the sample with respect to both lice species.

Results

a) *The Infestation of Diseased Hares.* Table 1 shows the data on the infestation with both *Haemodipsus* species on diseased hares. The data indicate only whether the lice were present or not; the infestation rate has been left out of consideration.

Table 1. *Infestation rate of diseased hares*

	June 1967 to May 1968 incl.	June 1968 to May 1969 incl.	June 1969 to May 1970 incl.
Number of hares examined for lice infestation	86 (100%)	133 (100%)	132 (100%)
Hares infested by <i>Haemodipsus lyriocephalus</i> ^a	7 (8%)	12 (9%)	11 (8%)
Hares infested by <i>Haemodipsus setoni</i> ^a	10 (12%)	21 (16%)	36 (27%)
Hares infested by both lice	6 (7%)	5 (4%)	5 (4%)
Total number of infested hares	11 (13%)	28 (21%)	39 (30%)

^a Combined infestations included.

It is noteworthy that *H. setoni* occurred more frequently than *H. lyriocephalus* in all three years of investigation. The infestation rate of *H. setoni* increased in the course of these years (12%, 16%, and 27%), while that of *H. lyriocephalus* remained practically the same (8%, 9%, and 8%).

b) *Mixed Infections of H. lyriocephalus and H. setoni.* Sixteen cases of mixed infestation by *H. lyriocephalus* and *H. setoni* could be found. In some cases the infestation was only slight (1-10 lice), in other cases it

was severe. In the cases of a severe infestation either *H. lyriocephalus* or *H. setoni* could be in the majority.

c) *The Infested Healthy Hares from the Province of Drenthe*. Table 2 summarizes the data on the infestation by both *Haemodipsus* species on healthy hares from Drenthe in the years 1968–1970. In this table too the data indicate only whether or not the lice were present.

Table 2. *Infestation rate of healthy hares from the province of Drenthe*

	June 1968 to May 1969 incl.	June 1969 to May 1970 incl.
Number of hares examined for lice infestation	77 (100%)	63 (100%)
Hares infested by <i>Haemodipsus lyriocephalus</i> ^a	1 (1%)	0
Hares infested by <i>Haemodipsus setoni</i> ^a	7 (9%)	7 (11%)
Hares infested by both lice	0	0
Total number of infested hares	8 (10%)	7 (11%)

^a Combined infestations included.

Table 2 shows that the infestation on the healthy hares from Drenthe was on a much lower level than in the case of the diseased hares (1968–1969: 10–21%, 1969–1970: 11–30%). In particular the low percentage of healthy hares infested by *H. lyriocephalus* is noteworthy: less than 1% for the whole material ($n = 134$). This may perhaps explain the fact that, although *H. lyriocephalus* is regularly to be found on diseased hares, it nevertheless is usually reported as to be found rarely.

d) *Infestation of Female and Male Hares*. In spring the male hares have more contact together than the females; consequently it should be possible that the infestation rate with lice might be different for both sexes.

The healthy hares from Drenthe, having been collected for the use of an investigation on the reproduction capacity, were nearly all females. Therefore it was impossible to examine any difference in infestation rate between the sexes. But in the case of diseased hares it was possible indeed. 331 diseased hares have been examined of which 176 were females and 155 were males. Only 36 females and 43 males proved to be infested by lice. From this material no difference in infestation rate between the sexes could be determined ($\chi^2 = 3.31$, $0.1 < p < 0.2$).

e) *The Infestation of Hares in the Different Seasons*. Table 3 summarizes the data on the infestation of diseased hares for the different seasons.

Table 3. Infestation rate of diseased hares in the different seasons

	Summer (June, July, August)	Autumn (September, October, November)	Winter (December, January, February)	Spring (March, April, May)
Number of hares examined for lice infestation from June 1967 up to May 1970 incl.	40 (100%)	144 (100%)	102 (100%)	65 (100%)
Hares infested by <i>Haemodipsus lyriocephalus</i>	5 (13%)	8 (6%)	8 (8%)	9 (14%)
Hares infested by <i>Haemodipsus setoni</i>	8 (20%)	22 (15%)	13 (13%)	24 (37%)

Both the infestations by *H. lyriocephalus* and that by *H. setoni* proved to be much more severe in spring and summer than in autumn and winter.

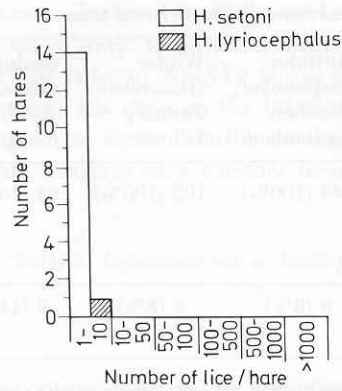
The data on the infestation of the healthy hares from Drenthe have been summarized in Table 4. No differentiation has been made between the two lice species as *H. lyriocephalus* was found in one case only.

From this table too it is clear that the infestation rate in spring and summer is more severe than in autumn and winter.

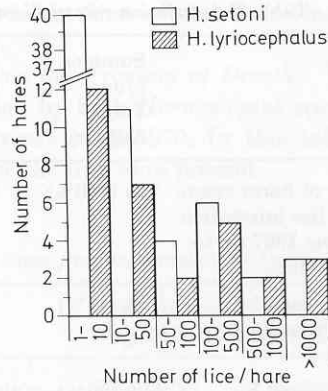
f) *The Occurrence of Female and Male Lice and Juveniles in the Course of the Year.* Table 5 shows in which months female and male specimens and juveniles of both lice species have been found. In this case all the

Table 4. Infestation rate of healthy hares from the province of Drenthe in the different seasons

	Summer (June, July, August)	Autumn (September, October, November)	Winter (December, January, February)	Spring (March, April, May)
Number of hares examined for lice infestation from June 1968 up to May 1970 incl.	43 (100%)	52 (100%)	26 (100%)	19 (100%)
Number of hares infested by <i>Haemodipsus lyriocephalus</i> and/or <i>H. setoni</i>	10 (23%)	1 (2%)	2 (7%)	2 (10%)



4



5

Fig. 4. Number of healthy hares at different infestation rates of both *Haemodipsus* species

Fig. 5. Number of diseased hares at different infestation rates of both *Haemodipsus* species

Table 5. Months in which males, females, and juveniles of *Haemodipsus lyriocephalus* and *H. setoni* have been found (×)

		January	February	March	April	May	June	July	August	September	October	November	December
<i>H. lyriocephalus</i>	♂♂	×	×	×	×	×	×			×		×	
	♀♀	×	×	×	×	×	×	×	×	×		×	
	⊙⊙	×	×	×	×	×	×	×		×		×	×
<i>H. setoni</i>	♂♂	×	×	×	×	×	×	×	×	×	×	×	×
	♀♀	×	×	×	×	×	×	×	×	×	×	×	×
	⊙⊙	×	×	×	×	×	×	×	×	×	×	×	×

findings of lice both on healthy and on diseased hares in the three years of investigation have been taken together.

Both sexes and juveniles of *H. setoni* could be found in all months and thus proved to be present during the whole year. *H. lyriocephalus* was found less and therefore the data on its occurrence in the different months are still limited. However, it seems most likely that also of this louse species the two sexes and the juveniles are present during the whole year.

g) *The Relation between the Infestation by Lice and the Host's State of Health.* From Tables 1 and 2 we have already seen that diseased

Table 6. Survey of endoparasites and pathogens on individual hares infested by great numbers of lice

Number of lice	1	2	3	4	5	6	7	8	9	10	11
10—50	×	×	●	●			○	×			
	×	×				▼	●	×			?)
	×						●				
	×	×			●		●	×			
	×				●		▼				
	×	×			○	○	○	×			
	×	×			▼	▼	○		×		
	×	×					●				
50—100	×	×									a)
	×		▼		○	○	●				b)
	×			▼	●		▼				
	×			●	■						
	×	×		▼	○	○	○	×			c)
	×	×		●	■	●	○	×			
100—500	×	×			■	●			×		
	×			▼	●		●				?)
	×	×			○	▼	●				
	×			■			○				
	×	×		●	▼		▼				
	×			○	▼	●	▼				
500—1000	×	×			■	○	○		×		
	×	×			○		○				
> 1000	×	×		▼	▼		○				
	×	×		▼	●		●			×	
	×	×			○	○	●				
	×			▼	○		●	×			
	×	×		○	○		●		×		

× present, ○ slight infestation, ● moderate infestation, ▼ severe infestation, ■ very severe infestation, ?) unknown infection, a) *Alcaligenes faecalis*, b) *Corynebacterium* from lung, c) gall-stones.

- 1 = *Haemodipsus setoni*
- 2 = *H. lyriocephalus*
- 3 = *Fasciola hepatica*
- 4 = *Graphidium strigosum*
- 5 = *Trichostrongylus retortaeformis*
- 6 = *Trichu leporisris*
- 7 = *Eimeria* spp.
- 8 = *Staphylococcus pyogenes*
- 9 = *Pasteurella pseudotuberculosis*
- 10 = *Yersinia enterocolitica*
- 11 = bronchopneumonia

hares and those died of diseases are more often infested by lice than healthy ones. Figs. 4 and 5 show for both groups, the healthy hares from Drenthe and the diseased hares, the frequency of the infestation rate. The quantities of lice have been roughly estimated, taking into account that in examining the hares on the presence of lice in general only a part of the parasites could be found.

Fig. 4 shows that a slight infestation of 1–10 lice also can be found on healthy hares but more severe infestations did not occur in this group. The latter, however, was the case with diseased hares (see Fig. 5), this group generally was in a bad state of health.

Murray (1961) has shown that the infestation by the louse *Polyplax serrata* on the mouse *Mus musculus* depends among other on the time spent by mice to clean their skin and on the effectiveness in doing this. It is likely that this also applies to the hares and that diseased hares in a bad state of health spend less time in cleaning their skin. This was illustrated by an observation made during an investigation on the day and night activity of hares. For that purpose 3 female and 3 male hares were observed on a wired pasture both by day and night (Noordam, in prep.). In the course of the observation period one female died from a haemolytic staphylomycose combined with a severe infestation by stomach worms (*Graphidium strigosum*) and intestinal worms (*Trichostrongylus retortaeformis*). It could be clearly observed that, during the last three months of its life, this diseased hare on an average spent much less time in cleaning its skin than the other hares as shown in Fig. 6.

We also found an infestation by 10–50 lice (*H. setoni*) on an otherwise healthy hare knocked down by traffic. Its left upper incisor had been grown out as so-called elephant's tooth so that the animal must have had difficulties in the cleaning of its skin.

h) Infestations by Haemodipsus spp. Combined with Other Parasites and Bacterial Infections. Table 6 shows that in our material a severe infestation by *Haemodipsus spp.* usually ran hand in hand with other parasitic infestations, sometimes also combined with infections by *Staphylococcus aureus*, *Pasteurella pseudotuberculosis*, and *Yersinia enterocolitica*, or with broncho-pneumonia. In one case lice have been found in combination with a bacterial infection only.

The lice seem to be able to multiply strongly on gradually weakened hosts only. It is noteworthy indeed that great numbers of lice have not been found on hares with an acutely passing off coccidiosis but they did on hares with a slight coccidiosis infection where the progress of the disease apparently had a more prolonged character.

Haemodipsus species are said to be carriers of tularemia (Girard, 1950, cited by Beaucournu, 1968). How far diseases of hares are carried by lice is now subject of further investigations in the Netherlands.

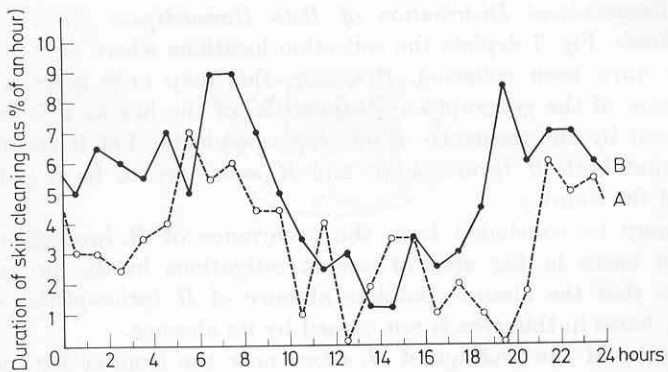


Fig. 6. Average % of time spent in cleaning the skin, calculated per hour. A by a diseased hare. B by 5 healthy hares (average). (Records from 5×24 hours in the course of the last three months of the diseased hare's life)

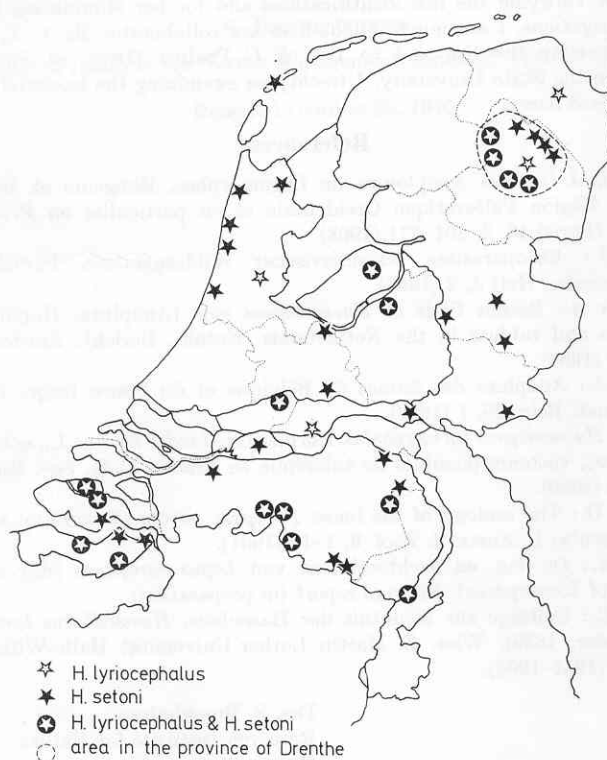


Fig. 7. Locations where the two *Haemodipsus* species have been collected in the Netherlands

i) *Geographical Distribution of Both Haemodipsus Species in the Netherlands.* Fig. 7 depicts the collection locations where hares infested by lice have been collected. However, this map only gives a rough impression of the geographical distribution of the lice as it is strongly influenced by the residence of our correspondents. Yet it seems most likely that both *H. lyriocephalus* and *H. setoni* are to be found in all parts of the country.

It may be concluded from the occurrence of *H. lyriocephalus* on diseased hares in the area of our investigations in the province of Drenthe that the almost complete absence of *H. lyriocephalus* on the healthy hares in this area is not caused by its absence.

In view of the findings of *H. setoni* near the frontier between the Netherlands and West Germany it may be accepted that this louse species also occurs in West Germany.

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