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AN EXPERIMENTAL STUDY OF THE TOLERANCE OF HAPLOPHILUS SUBTERRANEUS (SHAW) AND HENIA VESUVIANA (NEWPORT) TO LOW HUMIDITY LEVELS.

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Field observations at a site in Newport, Isle of Wight (Grid ref. 40/498894) showed that the geophilomorph centipedes Haplophilus subterraneus (Shaw) and Henia vesuviana (Newport) were both present and abundant. The site is a south facing bank of clay, covered with scrub, nettles and various other vegetation. There is a high percentage of rubbish at the site, both on the ground surface and in the clay, providing a habitat similar to that of a rubbish dump.

Over a period of 27 months it was observed that although both of these large species were present, H. subterraneus was recorded at a higher frequency during the winter months whilst H. vesuviana was more abundant during the summer months. This indicated that there were factors acting on the two populations causing the seasonal variations. The seasonal variation in numbers of each species found in surface microsites is clearly seen in Fig. 1.

It was thought that this seasonal variation could be controlled by either soil humidity, ground temperature or both. Consequently, it was decided to experimentally test the two species' tolerance to low relative humidity at a constant temperature in order to determine whether this could be a controlling factor in the seasonal variation of the two species.

Method

Specimens were collected at different times of the year, from March 1986 to November 1986 from the Newport site.

37 specimens of H. subterraneus and 21 specimens of H. vesuviana were collected into mesh-topped petri dishes and were then kept for a period of 10-12 hours at a temperature of 19^{o}C $\pm$ 1^{o}C. The humidity level for this period was maintained at about 70% R.H.

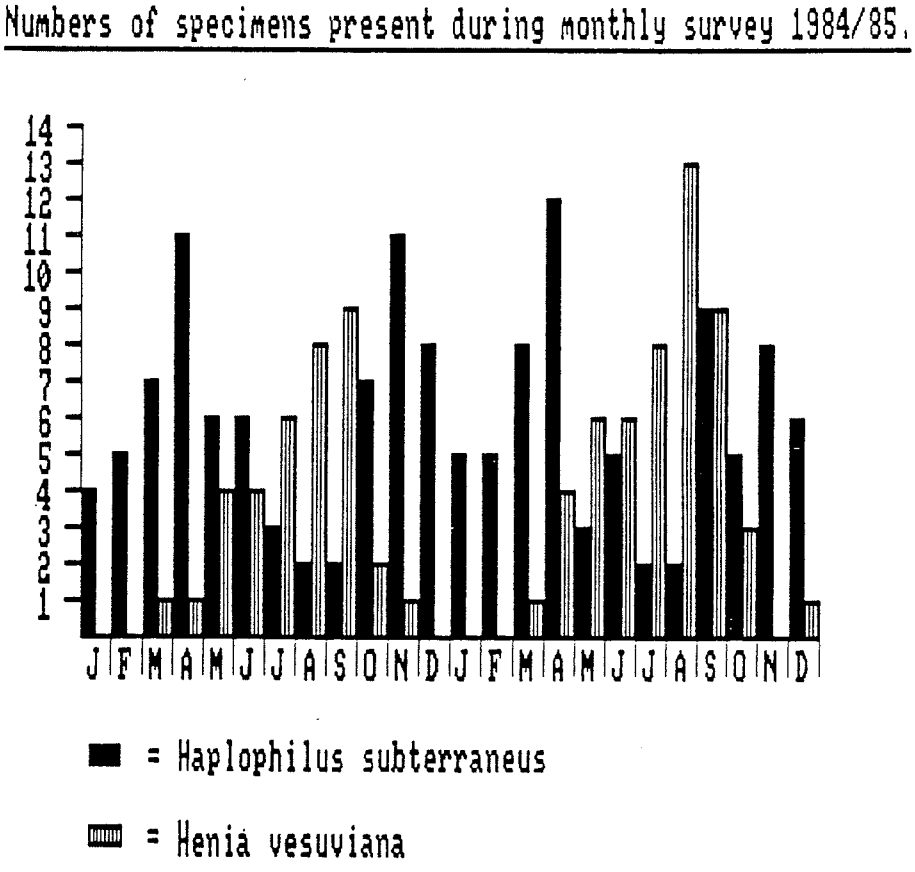

Fig. 1 Numbers of specimens of the two species present during monthly survey, 1984-5.

Each animal was then weighed on a Stanton 'Unimatic' balance in order to establish a 'start' weight and, once weighed, were placed in a humidity chamber with a R.H. of 40% at a temperature of 19°C ± 1°C.

For a period of eight hours, each was weighed hourly and the percentage of bodyweight lost calculated. The specimens were observed during the period in which they were retained in the humidity chamber and notes were made on their behaviour.

The humidity of the chamber was controlled using sulphuric acid at 48% concentrati giving a saturation deficit of 10.5 mm Hg at 19°C (40% R.H.).

Observations

Henia vesuviana

H. vesuviana, when placed into the controlled conditions, initially moved around the petri dishes for a short period (on average 23 minutes) before coiling itself into a 'ball'. This behaviour is described by Gaywood (1986) as a defensive mechanism and a resting stage but is also seen in females of this species when they form a coil around their eggs.

Generally H. vesuviana remains in the coiled position until after 4 hours when it spends increasing periods moving around the petri dish, alternating with periods of coiling. The effect of the increase in mobility is an increase in the loss of bodyweight.

Table 1. Henia vesuviana: Loss of Bodyweight at 40% and 70% relative humidity

Percentage loss of bodyweight at 40% R.H. at 19°C ± 1°C

Time	Min	Max	Mean
1 hr	1.5	2.9	2.3
2 hr	3.5	5.1	4.2
3 hr	4.2	5.7	5.2
4 hr	5.0	6.5	5.9
5 hr	5.5	10.9	8.2
6 hr	6.7	12.7	9.8
7 hr	8.7	13.6	11.5
8 hr	9.4	15.3	12.9

Percentage loss of bodyweight at 70% R.H. at 19°C ± 1°C

(Control specimens)

Time	Min	Max	Mean
1 hr	0.2	0.7	0.4
2 hr	0.5	0.9	0.65
3 hr	0.9	1.2	0.98
4 hr	1.0	1.7	1.31
5 hr	1.3	2.5	1.84
6 hr	1.7	3.3	2.41
7 hr	2.1	4.1	2.79
8 hr	2.4	5.0	3.32

Haplophilus subterraneus

H. subterraneus when placed in controlled conditions of 40% R.H. at 19°C ± 1°C initially remained quiescent for a short period (on average 38 minutes). During this period most specimens remained loosely coiled and never in the tight 'ball' of H. vesuviana. Generally the posterior end of the specimen was coiled and the anterior end was more or less extended.

Following the quiescent period, all specimens spent extended periods moving around the petri dishes and in all cases were very active. After five hours duration, one male specimen was walking backwards, dragging the anterior part of its body. At six and a half hours this specimen was dead. In the case of nine other specimens, after seven hours they were walking backwards dragging the anterior part of their bodies behind them. All nine of these specimens recovered at the termination of the experiment when they were laid on wet filter papers.

At all stages during the experiment H. subterraneus lost a higher percentage of bodyweight in the controlled conditions.

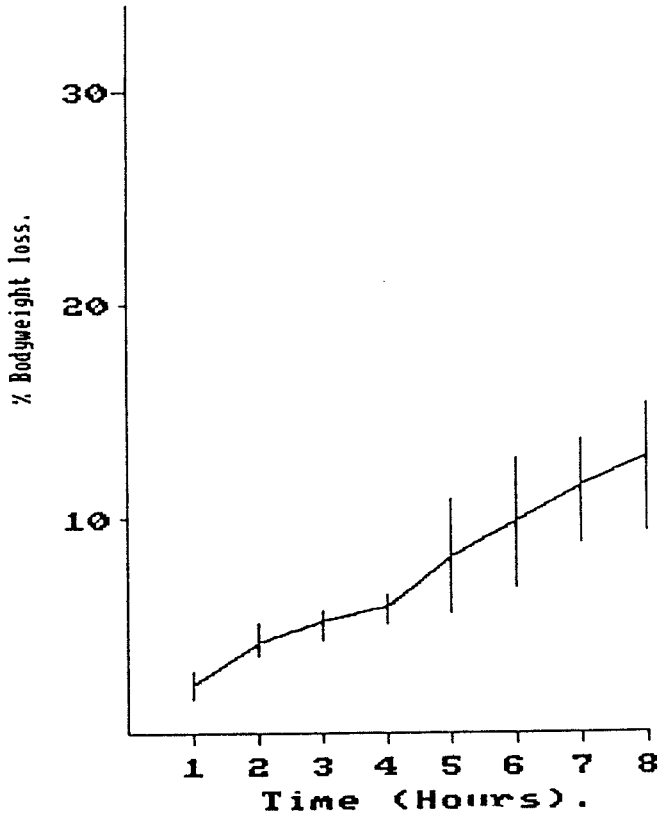

Fig. 2 Henia vesuviana: percentage loss of bodyweight at 40% R.H.

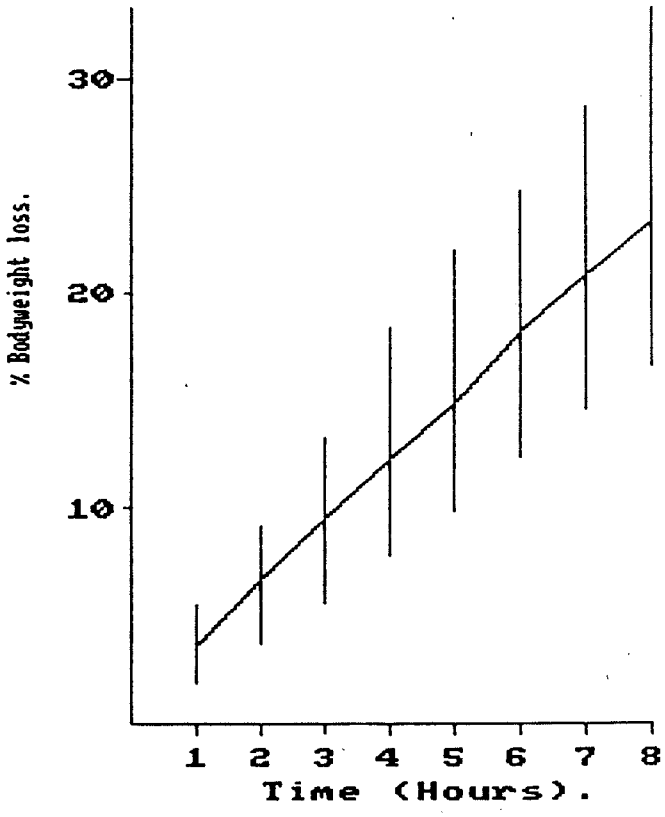

Fig. 3 Haplophilus subterraneus: percentage loss of bodyweight at 40% R.H.

Table 2. Haplophilus subterraneus: Loss of Bodyweight at 40% and 70% relative humidity

Percentage loss of bodyweight at 40% R.H. at 19°C ± 1°C

Time	Min	Max	Mean
1 hr	1.9	5.5	3.6
2 hr	3.6	9.1	6.7
3 hr	5.5	13.2	9.5
4 hr	7.7	18.4	12.3
5 hr	9.7	22.0	14.9
6 hr	12.3	24.7	18.2
7 hr	14.5	28.7	20.9
8 hr	16.5	33.9	23.4

Percentage loss of bodyweight at 70% R.H. at 19°C ± 1°C

(Control specimens)

Time	Min	Max	Mean
1 hr	0.35	0.81	0.51
2 hr	0.53	1.13	0.72
3 hr	0.8	1.37	1.07
4 hr	1.31	1.82	1.49
5 hr	1.85	2.31	2.08
6 hr	2.2	3.04	2.57
7 hr	2.98	3.87	3.49
8 hr	3.42	5.11	4.71

Discussion

In conditions of 70% R.H. at 19°C ± 1°C there is little difference between specimens of H. subterraneus and H. vesuviana in their loss of weight, although both species react differently. The control specimens of H. vesuviana tend to remain 'coiled' and inert, whilst the control specimens of H. subterraneus are generally more mobile and when inert do not display the fully 'coiled' stance of H. vesuviana.

However, when conditions of low humidity are imposed, the loss of weight by transpiration and respiration show a marked difference between the two species. At 40% R.H. 19°C ± 1°C, H. subterraneus loses water at a fairly constant rate, resulting in modified behaviour after about 5 hours. The behaviour shown (i.e. walking backwards, dragging the anterior part of the body) may indicate a serious loss of water from the anterior part of the body.

H. vesuviana exposed to the same conditions loses water at a slower rate possibly by remaining in its inert, coiled posture for long periods. After a period of about 4 hours there is increased activity in this species, probably triggered by the effect of water loss and the desire to find a site with a higher R.H. There is a lower rate of water loss in H. vesuviana and at no time during the experimental period did this species display the behaviour of H. subterraneus in walking backwards dragging the anterior end of the body.

Conclusion

H. vesuviana is better adapted to survive in a low relative humidity possibly due to its strategy of remaining in a quiescent, coiled state for long periods. Generally H. vesuviana is a less mobile species than is H. subterraneus.

Low relative humidity in the microsites at the Newport site would therefore suit H. vesuviana better than H. subterraneus. This would result in a higher population of H. vesuviana than H. subterraneus during the drier summer months, but does not explain the smaller winter population for this species. There are therefore other factors acting on the population of H. vesuviana resulting in the low winter population density.

References

Gaywood, M.J., 1986. The Defensive secretion of the Geophilomorph centipede Henia (Chaetechelyne) vesuviana Newport (in litt.)