

House Dust Mite Experiments



Experiments have been carried out in two major areas to answer the following questions

1. Do mites move in response to hygrothermal conditions within the mattress?

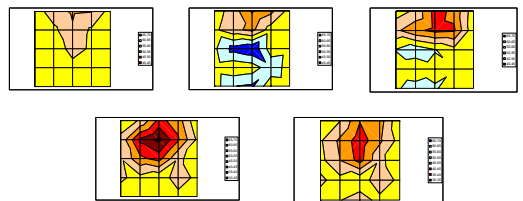
2. How many mites can you get in a mattress?

or

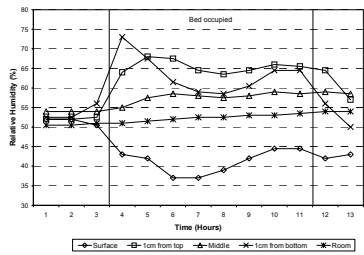
What is the Carrying Capacity of the mattress?

1. Do mites move in response to hygrothermal conditions within the mattress?

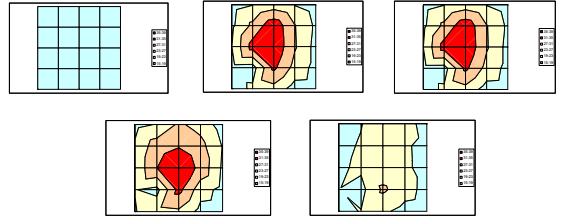
Horizontal variation of RH within a mattress



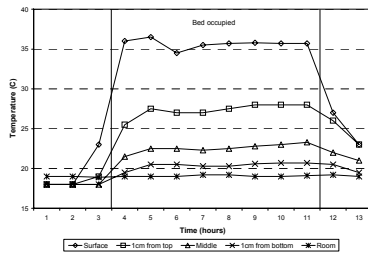
Vertical variation of RH within a mattress



Horizontal variation of temperature within a mattress



Vertical variation of RH within a mattress



How would mite movement affect the models predictions?

How would mite movement affect the models predictions

- Hygrothermal conditions within the mattress transient and heterogenous.

How would mite movement affect the models predictions

- Hygrothermal conditions within the mattress transient and heterogenous.
- As a result some areas of the mattress become more favourable to mites and others become less favourable.

How would mite movement affect the models predictions?

- Hygrothermal conditions within the mattress transient and heterogenous.
- As a result some areas of the mattress become more favourable to mites and others become less favourable.
- If mites can sense more favourable conditions and move into them they will increase their ability to survive and their reproductive rate.

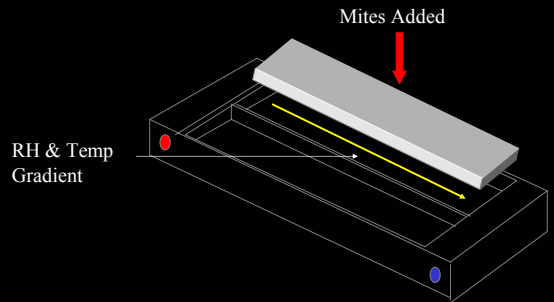
Mite movement

- Techniques such as heat extraction indicate that mites can detect and move in response to extremes of environmental conditions.
- How do they respond to conditions similar to those found within the mattress?

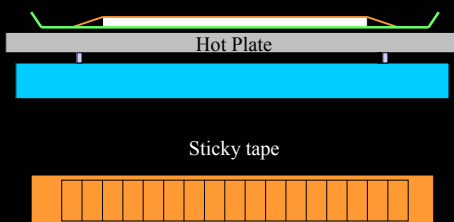
The mite movement box



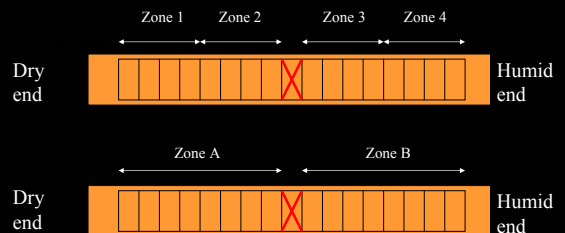
The addition of wadding



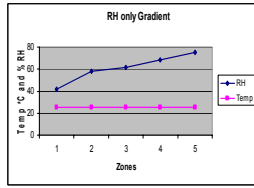
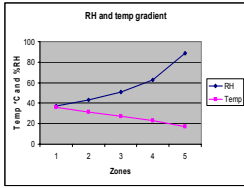
Mite extraction



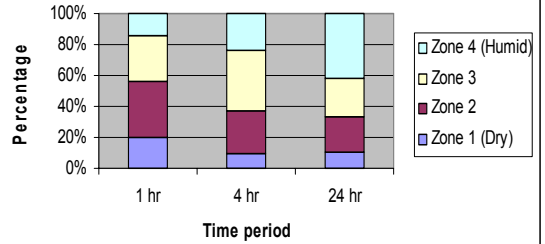
Analysis of results



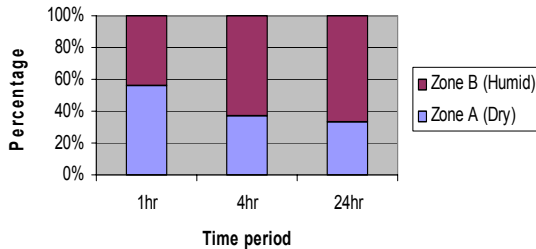
RH and temperature gradients within the experimental chamber



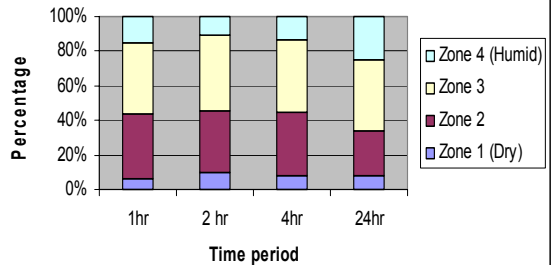
Mite movement along a temp and RH gradient for different periods of time



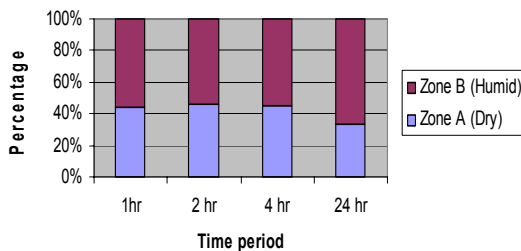
Mite movement between two zones along a temp and RH gradient for different periods of time



Mite movement along a RH gradient for different periods of time



Mite movement along an RH gradient for different periods of time



Conclusions

Mites move towards more humid conditions along a RH & temp gradient and an RH gradient albeit slowly.

This indicates that mites are able to sense both RH and temperature. The movement in response to RH and temperature appears to be more pronounced than RH alone, but this needs further investigation.

This movement will affect the model's predictions.

2. What is the carrying capacity (k) of the mattress?

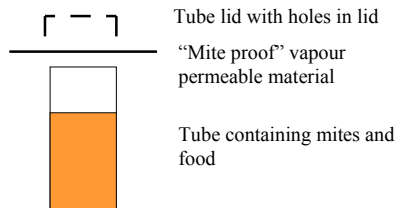
What is the carrying capacity (k) of the mattress?

Carrying Capacity is the maximum number of organisms which a particular habitat can normally support.

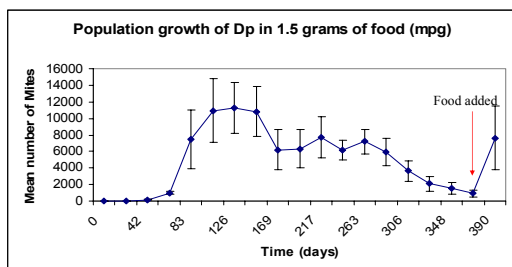
Why is carrying capacity (k) important?

- The mattress represents a large but finite environment.
- Even under beneficial conditions house dust mites would be unable to grow indefinitely.
- Knowing the carrying capacity allows us to set a maximum population for the model.

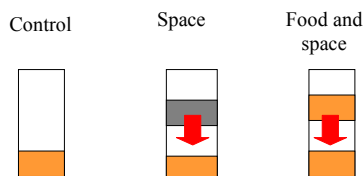
Long term carrying capacity experiments



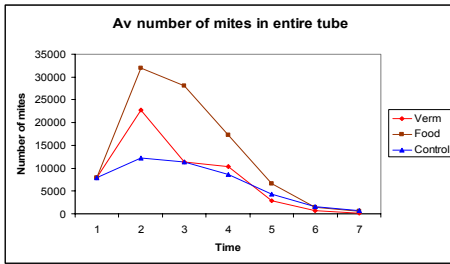
Long term carrying capacity experiment



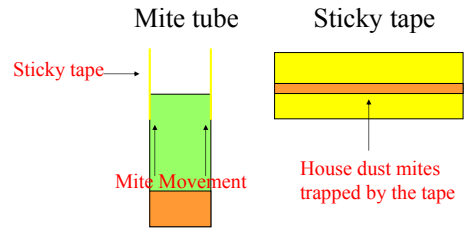
Is space or food the limiting factor ?



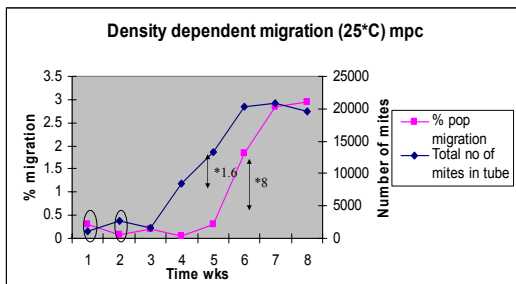
Is space or food the limiting factor?



Density dependent migration



Density dependent migration at 25°C



Conclusions

- Mite populations are unable to grow indefinitely.
- Carrying capacity is determined by the amount of food and space available.
- When carrying capacity is reached mites react by migrating, other behavioural changes are also likely to occur.
- Other factors may influence carrying capacity (more experiments required).
- **So how many mites can you get in a mattress?**

Back of envelope calculation

Humans can shed 1.5g of skin per day
 In bed for 8 out of 24hrs = 0.5 grams of skin per day
 Half of that removed by washing bed sheets, vacuuming etc
 = 0.25 grams of skin (food) per day.
 A 3 year old single mattress will therefore contain $0.25 \times 1095 = 275$ grams of skin

Assuming k is 12 000 mites per gram and the mattress has not been infested prior to this the maximum number of mites you will get in this particular bed is approximately

3 million Mites