THE CONSERVATION OF WATER IN SPARROWHAWK

ANTHONY COLLOCH LINNUS

by

ANTHONY STEENKAMP VALLIES IIICc. (Stellenbosch)

DEPARTMENT OF ZOOLOGY

THE UNIVERSITY OF ADELAIDE

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SUMMARY

(i) A study was made of water conservation in starving *T. molitor* adults and larvae that were kept at various combinations of temperature and humidity. Particular attention was paid to the way in which environmental humidity and temperature influence the internal condition of these insects and how these insects respond to changes in their internal condition.

(ii) The relationship between the length of life of starving *T. molitor* adults and atmospheric humidity and temperature has been defined.

(iii) Causes of death were found to be: desiccation in the lower humidity range, starvation in the intermediate range and "water-logging" of the tissues in the upper humidity range. Death as a result of desiccation occurred after the initial water content of the beetles had been reduced to a certain minimum. To be able to make this statement it was found necessary to show that some water, an amount increasing with humidity, is "bound" and thus unavailable to the insect. Water incorporated in eggs was found to constitute a form of "bound" water in starving virgin *T. molitor* females. Death as a result of "water-logging" of the tissues was found to occur when the wet/dry ratio has increased to a certain high level and that this condition occurs after the initial water content was reduced to below the level considered normal for newly emerged beetles. This suggested that the water content must be reduced in response to a reduction in dry matter content and at a certain minimum rate.
(iv) It was concluded that the malpighian tube rectal system acts as a water regulatory mechanism by excreting water with, or re-absorbing water from, the faeces.

(v) Evidence obtained, indicated that the rate of dry material consumption in starved *T. molitor* adults is independent of atmospheric humidity, suggesting that no additional energy is used to relieve internal conditions caused by either very low or very high humidities. To arrive at this conclusion it was necessary to (a) demonstrate a change in the rate of dry material consumption with time (b) to identify two populations within the experimental population. A change in the metabolic rate with time was found to be associated with egg maturation in females and possibly with sperm production in males. It is further associated with a change in the rate of reduction of the water content, but only in the lower humidity range.

Two populations within the experimental population were identified as females and males of the species. Differences in the response of the sexes to temperature and humidity were found to be in magnitude only and not in principle.

(vi) It was finally concluded that for maximum use of their energy resources starving *T. molitor* beetles have to exploit atmospheric humidity to either reduce excessive evaporation or to facilitate water loss.

(vii) The metabolic rate of starving *T. molitor* larvae in contrast to the adults decreased, at first independently of atmospheric humidity,
and then increases with time in all humidities. The increase in metabolic rate could be associated with either (a) the production of metabolic water which allow larvae to maintain an adequate ratio of water to dry material in very low humidities or (b) with the continuation of development in higher humidities.

(viii) The ability of T. molitor larvae to absorb water from unsaturated air was confirmed. In connection with this phenomenon, evidence is presented which indicates (a) that larvae need to be deprived of food to acquire the ability to absorb water from unsaturated air (b) that in larvae which were simultaneously deprived of food and desiccated a greater proportion absorbed water and at a lower relative humidity than larvae which were merely deprived of food (c) that water absorption stimulates metamorphosis in immature larvae, and also in larvae in which metamorphosis was prevented by desiccation.