THE BIOLOGY AND MANAGEMENT OF WILD RUMINANTS

CHAPTER FIFTEEN

THERMAL CHARACTERISTICS AND BASIC HEAT TRANSFER

by

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Published by

CornerBrook Press
Box 106
Lansing, N.Y. 14882

First printing, January 1982

Second printing, August 1982

Library of Congress Card Catalog Number 80-70984

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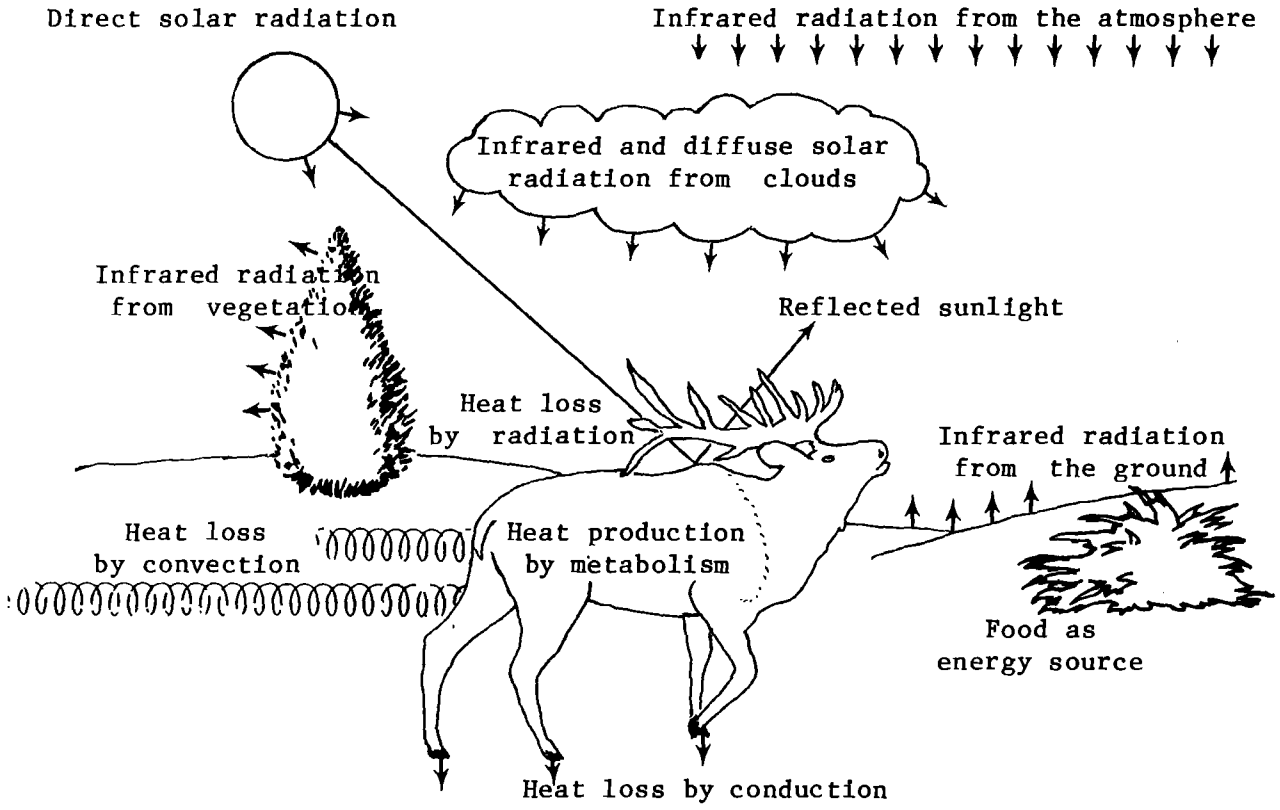
Thermal energy is transferred by radiation, conduction, convection, and evaporation. The physical processes are beyond the control of the animal, although the animal can change the amount of its surface participating in energy exchange by these different modes.

The sun's energy, especially the visible portion, is often thought of as energy input at the earth's surface. There must be a means to dissipate this energy from the earth's surface, however, or the energy content and the temperature of the earth would continue to rise. Overall, the radiation exchanged between the earth and space must be approximately equal in both directions, or else the earth would be heating up or cooling off. When the energy balance of the earth's surface was slightly negative, glaciation was extensive.

There have been many evaluations by field biologists and ecologists of the responses of different species to weather conditions, with the usual approach being a correlation analysis between weather data, such as temperature and wind velocity, and observed animal responses. This approach has resulted in some useful conclusions, but it does not provide an understanding of the four thermal exchange processes--radiation, convection, conduction, and evaporation--that every organism is involved in when subjected to atmospheric conditions.



It is possible to conceptualize the complex nature of homeothermy, but it is impossible to describe mathematically all of the dynamic thermal relationships between an animal and its environment. Recent research on the thermal balance of both plants and animals has provided an insight into the functional mechanisms used to maintain a thermal balance within certain physiological limits.

Thermal transfers between organism and environment always involve these thermal exchange processes, so an understanding of each is essential for an understanding of the effects of weather on an organism. Heat transfer is, in reality, incredibly complex and beyond analyses on a real-time basis. The basic principles are fairly simple, however, and may be understood by the use of selected situations that illustrate each of the four modes of heat transfer and interactions between them.

It is important to quantify basic heat transfer before attempting to interpret thermoregulatory behavior. Objective calculations are best made before subjective interpretations because they provide a framework within which alternatives may be chosen by animals in particular situations.

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