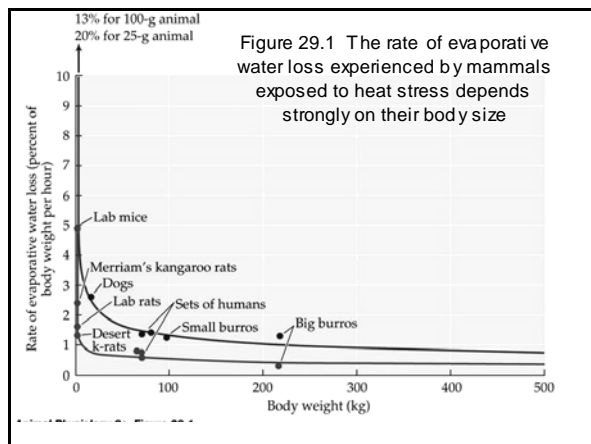


Chapter 29
Temperature Regulation in the Heat: Keeping Cool

1. Many animals evaporate water at a rate equal to their metabolic heat production
2. in a hot environment, more evaporation is needed to balance heat absorption
3. a human will die in one day in a hot desert without water

Keeping Cool: The Importance of Body Size

1. Rate of evaporation depends on body size & surface area
2. Smaller animals are at a disadvantage
 - A. high surface area to volume
 - B. structures with large SA
 - C. A small animal in a hot environment can die in 1 hour



1. Figure 29.2 Common wildebeests are drinking-water-dependent antelopes that seek shade
2. Figure 29.3 Grant's gazelles are drinking-water-independent antelopes noted for their indifference to sun or shade
3. Figure 29.7 The moisture content of "dry" grass varies with time of day or night
4. Figure 29.10 Oryxes in deserts often exist on dead, dry grasses and the leaves of water-stressed bushes and trees

Figure 29.6 Water budgets of wildebeests and oryxes

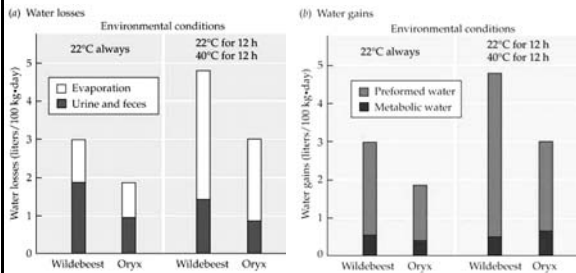


Figure 29.11 Average body-core temperatures of free-living Arabian oryxes over the 24-hour day

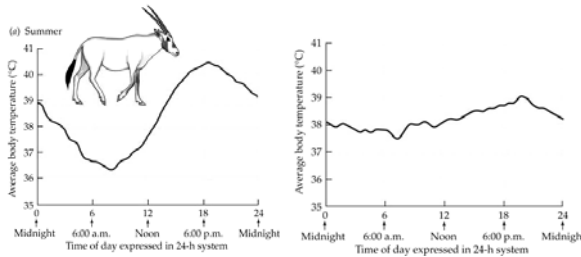


TABLE 29.2 Maximal urine concentrations and minimal fecal water concentrations in selected African mammals
All values are from dehydrated subjects.

| Species | Urine osmotic pressure (mosmol/kg H ₂ O) | Osmotic U/P ratio ^a | Fecal water content (g H ₂ O/100 g) |
|--|---|--------------------------------|--|
| African buffalo (<i>Syncerus caffer</i>) | 1120 | 4 | |
| Hereford cow (<i>Bos taurus</i>) | 1160 | 4 | 75 |
| Zebu cow (<i>Bos indicus</i>) | 1300 | 4 | |
| Somali donkey (<i>Equus asinus</i>) | 1680 | 5 | 61 |
| Common wildebeest (<i>Connochaetes taurinus</i>) | 1830 | 6 | |
| Thomson's gazelle (<i>Gazella thomsoni</i>) | 2640 | 7 | |
| Arabian oryx (<i>Oryx leucoryx</i>) | 2500 | 8 | 43 |
| Beisa oryx (<i>Oryx beisa</i>) | 3100 | 8 | |
| Grant's gazelle (<i>Gazella granti</i>) | 2790 | 8 | |
| Dromedary camel (<i>Camelus dromedarius</i>) | 3200 | 8 | 44 |
| Dik-dik (<i>Madoqua kiriki</i>) | 4760 | ~12 | 44 |

Advantages of being large in hot environment, e.g., camel

1. Camels do not carry water
2. Camels evaporate little water per unit body mass.
3. Camels use water to evaporate off heat.

Changes in Core Body Temperature

4. When unwatered, camel can tolerate increase in body temperature up to 41°C.
5. Oryxes undergo similar changes (HWA Fig 29.11)

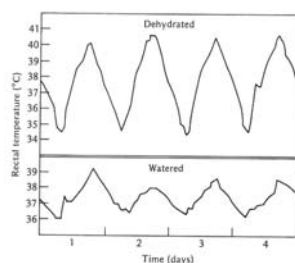


Figure 723 The daily temperature fluctuation in a well-watered camel is about 2 °C. When the camel is deprived of drinking water, the daily fluctuation may increase to as much as 7 °C. This has a great influence on the use of water for temperature regulation (see text). [Schmidt-Nielsen 1963]

Advantages of being large in hot environment,
e.g., camel.

1. High body temperature allows:
 - A. Water conservation
 - B. Reduces difference in external & internal temperatures
 - C. Less heat absorbed from environment.
slow conduction of heat into the body.

Advantages of being large in hot environment,
e.g., camel.

1. Thick fur
 - A.
2. Fat stored in hump
3. Can tolerate twice the water depletion as a human.
 - A.
 - B.
 - C.
4. Enormous capacity to rehydrate
 - A.
 - B.
