A Comparative Study of the Environmental Physiology of Peramelid Marsupials

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1. The peramelid marsupials studied can be categorised:

   Temperate species — body temperature about 36°C and basal metabolism of 50 kcal/$kg^{3/4}$ day.

   Tropical species — body temperature lower (35°) and basal metabolism unchanged (50 kcal/$kg^{3/4}$ day).

   Desert species — body temperature 35°C and basal metabolism reduced to 40 kcal/$kg^{3/4}$ day.

2. Body temperature of *Macrotis lagotis* remains at its normal level throughout the day and does not rise to a eutherian level when the animal is active.

3. The low metabolism of *Macrotis* is an adaptation common to some other desert mammals and it is speculated that this is due to a reduced thyroid hormone output superimposed on a low cellular metabolism, typical of marsupials in general.

4. The response to cold is similar in all bandicoots studied. All reach a maximal metabolism (4 times the basal level) at about 3°C. This is probably the lower limit at which bandicoots can maintain a constant body temperature. Like other marsupials so far investigated bandicoots have a high total body insulation at low temperatures. In *Macrotis* $\frac{2}{3}$ of this is solely tissue insulation compared to $\frac{1}{3}$ in a comparable eutherian.

5. The response to heat is quite different in all bandicoots studied. In all bandicoots cutaneous evaporation increases at higher temperatures, but this is not due to sweating. In *Isoodon* this insensible evaporation is less than that for sheep without sweat glands but still accounts for 20% of the total evaporation. The desert bandicoot, *Macrotis lagotis,* shows no active response to heat. Both temperate species (*Isoodon* and *Perameles*) respond to heat by increasing respiratory water loss (i.e. panting). In *Isoodon* panting accounts for about 40% of the total evaporation. *Perameles* loses more water via panting (72% of total evaporation) but this is done by very inefficient deeper panting. Salivation is an important method of evaporative heat loss in *Isoodon* and accounts for about 40% of the total evaporation. Salivation is nowhere near as important in *Perameles.*

6. All peramelid marsupials have an ad lib water turnover below that of eutherians with the desert *Macrotis* having the lowest (37% of the eutherian level). Minimal water requirements are further reduced and *Macrotis* still possesses the lowest turnover.

7. Partitioning of this minimum water requirements shows that in order to satisfy their water needs, the food in the wild would have to have a water content of at least 68%, 75% and 112% for *Macrotis, Isoodon* and *Perameles* respectively. In other words *P. nasuta,* unlike *M. lagotis* and *I. macrourus,* is dependent on free surface water in the wild.