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## Temperature Relations and Underwater Endurance of the Smallest Homeothermic Diver

William A. Calder  
*Virginia Polytechnic Institute*

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Temperature Relations and Underwater Endurance of the  
Smallest Homeothermic Diver  
William A. Calder  
Virginia Polytechnic Institute  
Project Number 144

Metabolic intensity and thermal conductance are both inversely related to body weight in homeotherms. The 8-18 g. water shrew (Sorex palustris) dives year-round in cold mountain streams and is thus of considerable physiological interest, because of rapid oxygen consumption, unfavorable surface/volume ratio and light insulation.

Water shrews tolerated forced dives of 30-47.7 sec., swimming in a submerged cage. This endurance seems a greater metabolic feat than maximum dives of the muskrat, beaver, or seal, when metabolic intensity is taken into account.

Water conducts heat over 20 times as rapidly as does air, so heat loss of homeotherms in water has been assumed to be 20 times that in air. Cooling curve data from S. palustris and Peromyscus maniculatus suggest otherwise. Thermal conductances of fresh carcasses suspended in air were appropriate for body weight. Cooling in water was 4.3 to 5.5 times as rapid as in air, when the natural insulative air layer was trapped in the fur. After removing this air layer, conductance values were still only 10 times those in air. However, a 20 times change in one thermal resistance in the series from core outward cannot give a 20 times change for the entire series.

Rectal temperatures of the shrews decreased  $1.4(\pm 0.5 \text{ s.d.})^\circ\text{C}/30 \text{ sec.}$  during forced diving in  $10\text{-}12^\circ\text{C}$  water; this appears consistent with conductance data. Cooling from  $39.7$  to  $34^\circ\text{C}$  did not impair coordination noticeably during surface swimming. Thus, the diving endurance observed was probably limited by oxygen before cooling would be excessive.

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