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This presentation makes a synthesis of a long-term study upon the complex thermoregulatory plasticity in the king penguin while foraging at sea. Our goal was to understand how the great drops in body temperature are achieved, adjusted and regulated and how they may explain the ability of this species to prolong dives far beyond their theoretical aerobic limit. Even if the occurrence of a true hypothermia (i.e. drop of temperature in the body core) is clearly demonstrated in this penguin species, some contradictory results and unpublished observations lack a reasonable explanation. These contradictory results can be explained by:

- (1) different potential problems of sampling biological data ;
- (2) potential unknown adaptations (anatomical, physiological or behavioural).

After considering these explanations, a general view is emerging that may explain why such thermoregulatory plasticity is a key to the energetic strategy of this fascinating endothermic diver.