

生物策略表

類別	生物策略 (Strategy)
生物策略 STRATEGY	熱點冷卻和加熱 (Hot spots cool and heat)
生物系統 LIVING SYSTEM	巴西犬吻蝠 <i>Tadarida brasiliensis</i> (Brazilian free-tailed bat)
功能類別 FUNCTIONS	#維持體內平衡 #保護免受溫度危害 #Maintain homeostasis #Protect from temperature
作用機制標題	由於動脈和靜脈的獨特排列創造了熱窗，巴西犬吻蝠的側翼有助於體溫調節 (The flanks of Brazilian free-tailed bats aid thermoregulation due to a unique arrangement of arteries and veins creating thermal windows.)
生物系統/作用機制 示意圖	
作用機制摘要說明 (SUMMARY OF FUNCTIONING MECHANISMS)	
文獻引用 (REFERENCES)	
<p>「巴西犬吻蝠 (Brazilian free-tailed bat, <i>Tadarida brasiliensis</i>) 在停歇於炎熱的洞窟內時、在溫暖的白天條件下飛行時、在涼爽的高海拔地區覓食時，都會面臨到熱逆境的挑戰。利用熱紅外線攝影機，在自由活動的巴西犬吻蝠的側翼處，我們確認了從腹面到延伸翼處的熱點 (hot spots)。這些熱點在鄰域 (syntopic) 的洞鼠耳蝠 (<i>Myotis velifer</i>) 中並不存在，</p>	

該物種在相對較短的距離內覓食，並且不會進行長距離的遷徙。

我們假設巴西犬吻蝠的熱點或「散熱器 (radiators)」可能為了遷移的適應，特別是在這種長距離、高飛行性的物種中。我們以透照法 (transillumination) 檢視了巴西犬吻蝠散熱器的脈管系統 (vasculature)，找出在翼的近端區域中垂直於身體位置的動脈和靜脈獨特排列的特性。我們假設這些散熱器利用溫暖血流使未隔熱的熱窗充血，讓蝙蝠在溫暖條件下飛行時得以散熱幫助維持熱平衡；但當它們在高海拔較冷的空氣中飛行時，則將血液分流並保存熱量。我們還檢視了翼手目 18 個科中的 15 科共 122 種物種的浸液標本 (fluid-preserved specimens)，並發現散熱器僅出現在犬吻蝠科 (Molossidae) 的種類，包括定居性和遷徙性的種和亞種。因此，散熱器似乎是一種獨特的性狀，在持續的擴散、覓食和長距離遷移過程中，可以促進能量和水分平衡。」 (Reichard et al. 2010: 358)

“The Brazilian free-tailed bat (*Tadarida brasiliensis*) experiences challenging thermal conditions while roosting in hot caves, flying during warm daylight conditions, and foraging at cool high altitudes. Using thermal infrared cameras, we identified hot spots along the flanks of free-ranging Brazilian free-tailed bats, ventral to the extended wings. These hot spots are absent in syntopic cave myotis (*Myotis velifer*), a species that forages over relatively short distances, and does not engage in long-distance migration.

We hypothesized that the hot spots, or ‘radiators’, on Brazilian free-tailed bats may be adaptations for migration, particularly in this long-distance, high-flying species. We examined the vasculature of radiators on Brazilian free-tailed bats with transillumination to characterize the unique arrangements of arteries and veins that are positioned perpendicular to the body in the proximal region of the wing. We hypothesized that these radiators aid in maintaining heat balance by flushing the uninsulated thermal window with warm blood, thereby dissipating heat while bats are flying under warm conditions, but shunting blood away and conserving heat when they are flying in cooler air at high altitudes. We also examined fluid-preserved specimens representing 122 species from 15 of 18 chiropteran families and radiators appeared present only in species in the family Molossidae, including both sedentary and migratory species and subspecies. Thus, the radiator appears to be a unique trait that may facilitate energy balance and water balance during sustained dispersal, foraging, and long-distance migration.” (Reichard et al. 2010: 358)

參考文獻清單與連結 (REFERENCE LIST)

Reichard, J. D., S. I. Prajapati, S. N. Austad, C. Keller, and T. H. Kunz. (2010). Thermal windows on Brazilian free-tailed bats facilitate thermoregulation during prolonged flight. *Integrative and Comparative Biology* 50: 358-370. (<https://doi.org/10.1093/icb/icq033>)

Reichard, J. D., S. R. Fellows, A. J. Frank, and T. H. Kunz. (2010). Thermoregulation during flight: body temperature and sensible heat transfer in free-ranging Brazilian free-tailed bats

(*Tadarida brasiliensis*). *Physiological and Biochemical Zoology* 83: 885-897.

(<https://www.journals.uchicago.edu/doi/full/10.1086/657253>)

延伸閱讀

生物系統延伸資訊連結 (LEARN MORE ABOUT THE LIVING SYSTEM/S)

https://en.wikipedia.org/wiki/Tadarida_brasiliensis

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<https://asknature.org/strategy/hot-spots-cool-and-heat/>