

生物策略表

類別	生物策略 (Strategy)	
生物策略 STRATEGY	幼蟲在極度寒冷下生存 (Larvae survive extreme cold)	
生物系統 LIVING SYSTEM	紅扁甲 <i>Cucujus clavipes</i> (Red cucujid)	
功能類別 FUNCTIONS	#改變相性 #保護免受溫度危害 #Modify phase #Protect from temperature	
作用機制標題		
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>「在阿拉斯加的抗冷凍甲蟲紅扁甲幼蟲 <i>Cucujus clavipes puniceus</i> (鞘翅目：扁甲科)，其冬天的平均過冷卻點為-35°C至-42°C，記錄到最低過冷卻點的個體為-58°C。我們早前發現一些幼蟲在冷卻到-80°C時不會凍結，並且我們推測這些幼蟲會玻璃化 (vitrified)。在這裡，我們透過差別掃描量熱法提供的證據，紅扁甲幼蟲在小於-58°C的溫度下轉變為玻璃狀狀態，其避免凍結的能力極限並低至-150°C。這個新穎的發現玻璃化是昆蟲越冬的策略之一。在倒木的樹皮下越冬時，由於其微棲地的積雪少而缺乏隔熱層，紅扁甲幼蟲可能會處於大約-40°C (甚至更低) 的低溫環境…最後，我們提供了直接的證據顯示來自阿拉斯加懷斯曼的扁甲能夠在-100°C的溫度下生存。」(Sformo et al., 2010: 502)</p> <p>“Larvae of the freeze-avoiding beetle <i>Cucujus clavipes puniceus</i> (Coleoptera: Cucujidae) in Alaska have mean supercooling points in winter of -35 to -42°C, with the lowest supercooling point recorded for an individual of -58°C. We previously noted that some larvae did not freeze when cooled to -80°C, and we speculated that these larvae vitrified. Here we present evidence through differential scanning calorimetry that <i>C. c.puniceus</i> larvae transition into a glass-like state at temperatures <-58°C and can avoid freezing to at least -150°C. This novel</p>		

finding adds vitrification to the list of insect overwintering strategies. While overwintering beneath the bark of fallen trees, *C. c. puniceus* larvae may experience low ambient temperatures of around -40°C (and lower) when microhabitat is un-insulated because of low snow cover... Finally, we provide direct evidence that *Cucujus* from Wiseman, Alaska, survive temperatures to -100°C.” (Sformo et al. 2010:502)

參考文獻清單與連結 (REFERENCE LIST) Harvard 或 APA 格式

Bennett, V. A., T. Sformo, K. Walters, O. Toien, K. Jeannet, R. Hochstrasser, Q. Pan, A. S. Serianni, B. M. Barnes, and J. G. Duman. (2005). Comparative overwintering physiology of Alaska and Indiana populations of the beetle *Cucujus clavipes* (Fabricius): roles of antifreeze proteins, polyols, dehydration and diapause. *Journal of Experimental Biology* 208(23): 4467-4477. (<https://jeb.biologists.org/content/208/23/4467>)

Sformo, T., K. Walters, K. Jeannet, B. Wowk, G. M. Fahy, B. M. Barnes, and J. G. Duman. (2010). Deep supercooling, vitrification and limited survival to -100 C in the Alaskan beetle *Cucujus clavipes puniceus* (Coleoptera: Cucujidae) larvae. *Journal of Experimental Biology* 213(3): 502-509. (<https://jeb.biologists.org/content/213/3/502>)

延伸閱讀: Harvard 或 APA 格式

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

https://en.m.wikipedia.org/wiki/Cucujus_clavipes

撰寫/翻譯/編修者與日期

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AskNature 原文連結

<https://asknature.org/strategy/larvae-survive-extreme-cold/>