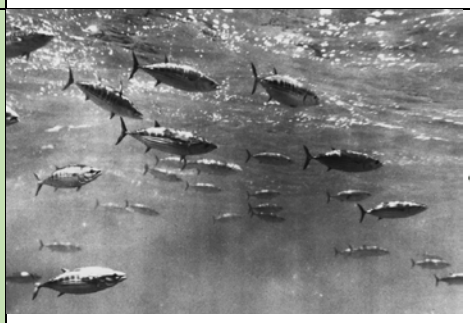
生物策略表

類別	生物策略 (Strategy)
生物策略 STRATEGY	在冷水中保持身體溫暖 (Bodies stay warm in cold water)
生物系統 LIVING SYSTEM	正鰹 *Katsuwonus pelamis* (Skipjack tuna)
功能類別 FUNCTIONS	#保護免受溫度危害 #Protect from temperature
作用機制標題	正鰹能夠在冷水中保持身體的溫暖是因為對流熱交換系統 (Bodies of skipjack tuna stay warmer because of countercurrent heat exchange system)
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)

「鮪魚 (tuna) 是非常特別的魚類，這篇文章探討的是讓他們如此特別的特徵之一：對流熱交換系統 (counter-current heat exchanger)。該結構的演化使鮪魚的體溫能夠遠高於周圍環境的水溫。例如，大型藍鰭鮪的肌肉溫度能夠比周圍的水溫還要高 20℃ (Carey et al. 1971)，小型正鰹 (small skipjack tuna) （2 公斤）的肌肉溫度則能夠比周圍水溫還要高 9℃ (Stevens & Fry, 1971)。其他魚類的體溫最多只能比周圍水溫還要高 2℃，因為代謝熱很快就從靜脈轉移到鰓附近的水中。為了維持大量的溫度額度，鮪魚必須在解剖學上有重大的構造改動，並在靜脈血和鰓之間建構溫度屏障。這篇文章描述了這種溫度屏障，也就是正鰹的對流熱交換機制。」(Stevens 1973: 145)

"Tunas are extraordinary fishes. This paper concerns one of the features that makes them extraordinary: the counter-current heat exchanger. The evolution of this device permits tuna to achieve body temperatures much greater than ambient water temperature. For example, the muscle temperature of large bluefin tuna can be as much as 20℃ above ambient water temperature (Carey et al. 1971) and the muscle temperature of small skipjack tuna (2 kg) can be as much as 9℃ above ambient (Stevens & Fry, 1971). The body temperature of other fishes is at most 2℃ above ambient (Stevens & Fry, 1970) because metabolic heat is efficiently transferred from the venous blood to surrounding water at the gills (Fig. 1). To maintain a large

temperature excess, tuna have had to make a tremendous anatomical investment and construct a thermal barrier between venous blood and the gills. The present paper describes this thermal barrier, the counter-current heat exchanger of skipjack tuna." (Stevens 1973: 145)

參考文獻清單與連結 (REFERENCE LIST)

Stevens, E. D., J. W. Kanwisher, and F.G. Carey. (2002). Muscle temperature in free-swimming giant Atlantic bluefin tuna (*Thunnus thynnus* L.). *Journal of Thermal Biology* 25: 419-423. (https://doi.org/10.1016/S0306-4565(00)00004-8)

Stevens, E. D., H. M. Lam, and J. Kendall. (1974). Vascular anatomy of the counter-current heat exchanger of skipjack tuna. *Journal of Experimental Biology* 61: 145-153. (https://jeb.biologists.org/content/61/1/145)

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/Skipjack_tuna

撰寫/翻譯/編修者與日期

柯雨彤翻譯 (2019/04/30)；譚國鎏編修 (2020/04/14)；許秋容編修 (2020/11/26)；施習德編修 (2020/12/15)

AskNature 原文連結

https://asknature.org/strategy/bodies-stay-warm-in-cold-water/